APEX
ENVIRONMENTAL LLC

May 19, 2016

Mr. Craig Walkenspaw, District Engineer
Division of Materials and Waste Management
Ohio EPA Southeast District Office
2195 Front Street
Logan, Ohio 43138

Subject: Response to Ohio EPA Notice of Deficiencies (NOD #4) dated April 26, 2016
Contiguous Expansion PTI Application
Apex Sanitary Landfill, Jefferson County, Ohio

Dear Mr. Walkenspaw:

The Ohio EPA submitted a letter dated April 26, 2016 to Apex Environmental LLC (Apex) providing notice of deficiency (NOD) or comments to PTI Application No. 06-08448, as revised on December 31, 2015, for the proposed contiguous lateral and vertical expansion and AMDWR increase for the Apex Sanitary Landfill. The NOD contained deficiencies related to the general engineering, stability, and hydrogeologic sections of the PTI Application.

Apex is providing the response to the NOD and appropriate revisions to the PTI Application, including the Hydrogeologic Site Investigation Report (HSIR). The PTI Application narrative, calculations, and drawings have been revised in response to the Ohio EPA NOD. We are providing the following attachments:

- Attachment A – Response to Ohio EPA NOD #4 dated April 26, 2016;
- Attachment B – Revised PTI Application Narrative;
- Attachment C – Revised PTI Application Calculations;
- Attachment D – Revised PTI Application Drawings; and
- Attachment E – Revised HSIR Narrative and Tables.

The revised portions of the PTI Application are being submitted. The revisions to the narrative and calculations are indicated using strikeout for deleted text and underlined italics for new text. The header of revised calculation pages have been updated with revision dates. The revised drawings are indicated in the revision block of the specific drawing and in the revision column of the drawing list on the Title Sheet.

Apex is providing two copies of the Response to Ohio EPA NOD and revised portions of the PTI Application to the Ohio EPA and one copy to the Jefferson County General Health District. Apex is also providing two additional complete copies of the revised PTI Application which includes the HSIR.

Please contact me if you have further questions.

Sincerely,

Joe Tatarek, Vice President of Operations
Apex Environmental LLC

Enclosures

cc: Bruce Misselwitz, JCGHD
Anthony Rizzo – Apex Environmental LLC
Apex File – Contiguous Expansion PTI Application
Rick Buffalini, Civil & Environmental Consultants, Inc.

ATTACHMENT A

RESPONSE TO OHIO EPA NOD #4
DATED APRIL 26, 2016

ATTACHMENT A
RESPONSE TO OHIO EPA NOD #4 DATED APRIL 26, 2016
CONTIGUOUS EXPANSION PTI APPLICATION
APEX SANITARY LANDFILL
JEFFERSON COUNTY, OHIO

The Ohio EPA submitted a letter dated April 26, 2016 to Apex Environmental LLC (Apex) providing a notice of deficiency (NOD) or comments to PTI Application No. 06-08448, as revised December 31, 2015, for the proposed contiguous lateral and vertical expansion and AMDWR increase for the Apex Sanitary Landfill. The NOD contained deficiencies related to the general engineering, stability, and hydrogeologic sections of the PTI Application. Apex is providing the response to the NOD and appropriate revisions to the PTI Application, including the Hydrogeologic Site Investigation Report (HSIR).

General Engineering Review

Comment No. 1 – As necessary, please update Attachment 1A's Table of Effective and Pending Permits.

Response: The Table of Effective and Pending Permits has been updated.

Comment No. 2 – As noted on Page 5 of Attachment A1, please update the "Area Currently Filled" to be through Phase 6B-West-2's construction certification and the accumulated footprint of 95.7 acres.

Response: Attachment A1 has been revised to update the area currently filled through Phase 6B-West-2.

Comment No. 3 – As noted on Page 5 of Attachment A1, please update the "Volume Currently Filled" to be current through 12/31/2015 and the 2015 Annual Report's 15,222,944 cubic yards.

Response: Attachment A1 has been revised to update the volume currently filled to 15,222,944 cubic yards through 12/31/2015.

Comment No. 4 – As noted on Page 5 of Attachment 1A, please update the "Life Expectancy" using the AMDWR and the anticipated daily waste receipt as of 12/31/2015 or simply reference Section C5a (volume and anticipated life calculations). And please update Section 5Ca as necessary.

Response: The Volume and Anticipated Life Calculation included in Section (C)(5)(a) has been revised to update the remaining volume of airspace and the life expectancy. Attachment A1 references Section (C)(5)(a) for the life expectancy.

Comment No. 5 – The volume and anticipated life calculations shown in Section C5a are as of December 31, 2012. Please revise the volume and anticipated life calculations as of December 31, 2015.

Response: The Volume and Anticipated Life calculation included in Section (C)(5)(a) has been revised to update the remaining volume of airspace and the life expectancy.

Comment No. 6 – As noted on Page 6 of Attachment A1, the premature closure's "Total Closure Worst Case Estimate" is shown as $10,159,401 in 2013 dollars. Please update the closure estimate relative to 2016 dollars and the applicable worst case acreage. Related calculations are found in Section C5h.

Response: Attachment A1 and the final closure cost estimate in Section (C)(5)(h) have been revised to update the "Total Closure Worst Case Estimate" to 2016 dollars. In general, the values were increased to account for inflation since the last update in 2013. The cap system costs provided in the cost estimate are considered representative of 2016 costs. Additionally, the final closure cost estimate has been revised to reflect an increased anticipated open area in accordance with Comment No. 7.

Comment No. 7 – As noted on Page 6 of Attachment A1, the Expansion Permit Application's "Worst Case Acreage" is shown as 95 acres, which is reportedly "when Phase 12 is opened and large intermediate cover area." The current developed footprint is 95.7 acres through Phase 6B-West-2. The undeveloped balance of the original 117.5-acre unit includes Phases 6B-East, 7A and 7B. Phase 7B becomes a part of Phase 8's 23.3 acres within the expansion permit. The initial final cap installation isn't planned until after the expansion footprint is entered (Phase 8) and then at a proposed rate of one-acre of final closure for one-acre constructed in the expansion. Then final capping is to begin in the original unit within 12 months of Phase 8's initial construction certification.

If no final cap is installed prior to Phase 8's liner construction, then the worst case acreage must be inclusive of Phases 1 through 7A and the projected initial construction within Phase 8. Please update the worst case acreage from 95 acres to at least 117.5 acres and revise the premature closure's Total Closure Worst Case Estimate found in Section C5h.

Please update the worst case acreage for final closure or propose a final capping plan to reduce the acreage of the worst case.

Response: The final closure cost estimate in Section (C)(5)(h) has been revised based on a maximum anticipated open area of 141.2 acres, which occurs after construction of Phase 10. A table has been added to the final closure cost estimate calculating the maximum total open area as the landfill is being developed, assuming that final capping occurs within 12 months of construction of the lined area.

Comment No. 8 – As noted on Page 10 of Attachment 1A, the "Total Post-Closure Cost Estimate" is shown as $10,749,595 in 2013 dollars. Please update the post-closure estimate relative to 2016 dollars. Related calculations are found in Section C5i.

Prior to waste placement in Phase 8, the financial assurance for the premature closure and post closure care must meet all the requirements in the expansion permit. This reflects the fact that Phase 7B, as designed in the existing permit, will be redesigned and become part of Phase 8 in the expansion permit.

Response: Attachment A1 and the post-closure cost estimate in Section (C)(5)(i) have been revised to update the "Total Post-Closure Cost Estimate" to 2016 dollars. In general, the values were increased to account for inflation.

Comment No. 9 – On Page C1-3, the following is stated "E(3): All disclosure statements are current with Ohio EPA, with the last update submitted on January 31, 2013." Please revise this statement relative to Prophet Equity Group's purchase of the landfill and the most current disclosure statements.

Response: The statement on Page C1-3 has been revised relative to Prophet Equity Group's purchase of the landfill. The date of the last disclosure statement was July 22, 2015.

Comment No. 10 – As originally approved August 9, 2012 within an alteration of PTI No. 06-08438, the proposed rail unloading building is described within Section C8's narrative and its location is first shown on Plan Sheet 2C-2. The original conceptual design drawings (Plan Sheets 7O and 7P) were not included within the expansion permit application. Within the narrative, please reference the alteration and its plan sheets or incorporate the plan sheets into the expansion permit application directly.

Response: The drawings showing the proposed rail unloading building have been added as Drawings 7O and 7P of the contiguous expansion application. Additionally, Drawings 3A and 3B have been revised to reference the additional drawings. The Title Sheet has been revised to include the new drawings and to reflect the revision of additional drawings. Page C8-3 has been revised to reference the drawings.

Comment No. 11 – Section C8 does not discuss the prohibition of the direct acceptance of liquid and semisolid wastes (waste that can't pass the filter test). Section C8 does not discuss the acceptance of waste processed through Apex's solidification basins as authorized November 27, 2012. Please revise Section C8's narrative to specifically exclude the acceptance of liquid and semisolid wastes. Please include some acknowledgement of Apex's November 27, 2012 solidification authorization and that solid waste would be accepted after it is processed through the solidification basins. Apex should consider including the solidification authorization as an appendix within Section C9.

Response: Page C8-1 has been revised to state that direct acceptance and disposal of liquid and semisolid wastes at the working face is prohibited. The narrative states that these wastes may be accepted after solidification in the Solidification Basins. The authorization letter from the Ohio EPA regarding the Solidification Basins has been included as Appendix C8-B. We have also revised the table of contents to include the appendix.

Comment No. 12 – Within Appendix C9-D's (Final Closure/Post Closure Plan) Page 2, please remove the reference to Dave Mathews, District Manager.

Response: Page 2 of the Final Closure/Post Closure Plan has been revised to remove reference to an individual by name and just refers to the title.

Comment No. 13 – To complete the required four copies of the permit application, please provide two additional and identically complete copies of the revised application and a notarized statement that, to the best of the knowledge of the applicant, the detail engineering plans, specifications, and information in the permit application are true and accurate. It's all right to maintain the strikeout and italicized text throughout the expansion permit application's narrative.

Response: Two additional complete copies of the revised application are provided including the Hydrogeologic Site Investigation Report and drawings. Additionally, the Groundwater Detection Monitoring Program (GWDMP) was initially submitted as a stand-alone document. The GWDMP is now being included as Volume VI of the Application. The banner for Appendix C9-A has been revised to reference Volume VI. Two additional copies of the GWDMP are provided. We are providing binder covers for the HSIR and the GWDMP to incorporate these documents into the engineering portion of the application.

A new notarized statement has been provided and signed by the applicant and the engineer.

Comment No. 14 – Please provide two tab dividers for Appendix C8-A (Odor Management Plan) and Appendix C10-C (Table of Effective and Pending Permits). These were omitted within the December 31, 2015 submission.

Response: Tab dividers for Appendix C8-A (Odor Management Plan) and Appendix C10-C (Table of Effective and Pending Permits) are provided.

Stability and Settlement Reviews

The following comment was provided in entirety in an Interoffice Memo from the Ohio EPA dated February 26, 2016. NOD#4 provided a summary of this comment, which is presented below.

Comment No. 15 – As discussed recently, please submit seepage calculations verifying the liner system won't be damaged by seepage after the ground water collection pumps have been turned off or remove the notes indicating the pumping option and redesign the sump detail on Plan Sheet 7B to show gravity drainage through the underdrain conveyance pipe placed in a trench cut through the bedrock beneath the landfill's liner.

Response: A seepage calculation is provided that shows that the groundwater collection pumps will be used as a temporary control. The liner system won't be damaged by seepage after waste is placed and the groundwater collection pumps have been turned off. This calculation should be added after the Hydrostatic Uplift calculation in Section (C)(4)(a). As requested by the Ohio EPA in an email dated May 11, 2016, we have revised Drawing 4A and Section (C)(7) to require the underdrain sumps in Phases 11 and 12 to drain by gravity. The underdrain sumps in the other phases may drain by gravity or be pumped.

We have also revised the table of contents to include the seepage calculation.

Hydrogeological Review

The following comments were provided in entirety in an Interoffice Memo from the Ohio EPA dated November 22, 2013. NOD#4 provided a summary of these comments, which are presented below.

Comment No. 16 – As discussed recently, please propose initiating the proper abandonment of the main office's water supply well or demonstrate that a redrilled and cased well would be hydrogeologically isolated prior to waste placement at some distance greater than the 1,000 feet setback distance. Furthermore, Apex should implement a sampling program on the main office's water supply well that is tied to the landfill's development prior to waste placement at some distance greater than the 1,000 feet setback distance.

Response: Apex will properly abandon the existing water supply well at the main office prior to waste placement in Phase 10 within 1,000 feet of the water supply well. Apex will either install a well at least 1,000 feet downgradient or 500 feet upgradient of the limit of waste in accordance with OAC rule 3745-27-07(H)(3)(c)(ii), drill a new, deeper water well with casing installed to create a hydrogeologic barrier in accordance with OAC rule 3745-27-07(H)(3)(c)(iii), or install a potable water tank for the Apex office. Page C1-21 and C2-5 of the PTI Application and Drawing 6D – Phase 10 Development Plan have been revised accordingly.

Because the existing water supply well will be abandoned as described above, there is no need to sample the well. Furthermore, sampling the Apex water supply well is not appropriate because the well is not constructed to meet monitoring well standards in the Ohio EPA Technical Guidance Manual and the well does not monitor a discrete water bearing zone. Also, the well construction materials may impact water quality from the well. The water supply well is constructed with 70.5 feet of 8-inch inside diameter (I.D.) threaded steel surface casing and 235 feet of 4-inch I.D. polyvinyl chloride (PVC) casing with glued joints as indicated on the Well Log and Drilling Report No. 992542 in the PTI Application. The annulus between the borehole and the 4-inch I.D. PVC is open (not grouted or otherwise backfilled/sealed), thus, the well is supplied by all water-bearing zones from 70.5 feet to the borehole bottom at 245 feet below ground surface (bgs). Each water-bearing zone spanned by this well may demonstrate naturally occurring, but significant fluctuation in groundwater quality, and there is certainly mixing of groundwater from these zones in the well borehole. Groundwater quality fluctuations due to multiple water-bearing zones, mixing of groundwater in the well boring and potential organic compounds from glue used to connect the 4-inch PVC pipe may be misinterpreted as being related to a release from the landfill. Apex therefore requests Ohio EPA concurrence that the Apex water supply well should not be sampled.

Comment No. 17 – As discussed recently, please revisit the identified average yield of the regional aquifer to provide a more representative estimate. Please revise the private well log table and applicable narrative accordingly.

Response: The average yield of the regional aquifer has been re-evaluated using available private well logs located within one mile of the Apex facility. Table C3-2 in the PTI Application, Volume II, has been revised by denoting private well log data that, in our professional opinion, is not representative of sustained groundwater yields in the region and are no longer used in the regional aquifer average yield determination. The average yield of the regional aquifer has been reduced from 14.21 gallons per minute (gpm) to 9.0 gpm based on this re-evaluation. Table C3-9 in the PTI Application, Volume II, has also been revised to incorporate the re-evaluated regional aquifer average yield for evaluation of uppermost aquifer. There are no changes in the designation of the uppermost aquifer based on the re-evaluated regional aquifer average yield. In addition to Table C3-2 and Table C3-9, the Hydrogeologic Site Investigation Report narrative, pages C-4, C-26, C-27, C-28, C-30 and C-32 have been revised accordingly.

In addition to these revisions, we are providing the additional items for inclusion in your copies of the PTI Application.

- Revised covers to show revision date of May 2016. We are also providing binder covers to be inserted into the HSIR and the GWDMP volumes to incorporate them into the PTI Application.
- Revised table of contents to include Appendix C8-B and Volume VI. We are providing enough copies for each volume of the application.
- Revised Figure 1 for the Hydrostatic Uplift Analysis.
- Revised CQA plan Table 1 to include pinhole dispersion testing and the double hydrometer test.
- Replaced the Environmental Logistics Services logo with the Apex Environmental LLC logo on the Explosive Gas Monitoring Plan cover.

ATTACHMENT B

REVISED PTI APPLICATION NARRATIVE
Replace the existing narrative with that provided or insert new narrative as indicated.

Binder covers and spines
Inside Cover
Table of Contents
General Cover Sheet – page 4
Attachment A1 – pages 1, 2, 5, 6, 10
Appendix A to Attachment A1 – entire Table of Permits
Professional Engineer's Certification – ***Insert behind existing certifications***
Section (C)(1) – pages C1-3, C1-21
Section (C)(2) – page C2-5
Section (C)(7) – pages C7-7 and C7-13
Section (C)(8) – pages C8-1 through C8-5
Appendix C8-B – ***Insert behind Appendix C8-A***
Appendix C9-A, Groundwater Detection Monitoring Program – banner page
Appendix C9-B, Explosive Gas Monitoring Plan – Cover
Appendix C9-C, CQA/QC Plan – Cover Sheet and Table 1
Appendix C9-D, Final Closure/Post Closure Plan – page 2
Appendix C10-C – entire Table of Permits
Tab Dividers for Appendix C8-A, C8-B, and C10-C – ***Insert***
Volume VI, Appendix C9-A, Groundwater Detection Monitoring Program - ***Insert***
Appendix C9-A, Groundwater Detection Monitoring Program – signed certification

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ATTACHMENT C

REVISED PTI APPLICATION CALCULATIONS
Replace the existing calculation with the one provided or insert new calculation as indicated.

(C)(4)(a) Hydrostatic Uplift Analysis – Figure 1
(C)(4)(a) – Seepage Evaluation – ***Insert behind Hydrostatic Uplift Analysis***
(C)(5)(a) - Volume and Anticipated Life Calculation
(C)(5)(h) – Closure Cost Estimate
(C)(5)(i) – Post-Closure Cost Estimate

ATTACHMENT D

REVISED PTI APPLICATION DRAWINGS
(SUBMITTED AS A SEPARATE ROLLED PACKAGE)

Title Sheet, Drawings 3A, 3B, 4A, 6D, 7O, 7P

ATTACHMENT E
REVISED HSIR
Replace the existing information with that provided.

Binder Cover and Spines
Pages C-4, C-26, C-27, C-28, C-30, C-32
Tables C3-2, C3-9

APEX
ENVIRONMENTAL LLC

December 30, 2015

Mr. Craig Walkenspaw, District Engineer
Division of Materials and Waste Management
Ohio EPA Southeast District Office
2195 Front Street
Logan, Ohio 43138

RE: Response to Ohio EPA Notice of Deficiencies dated June 18, 2015
Contiguous Expansion PTI Application
Apex Sanitary Landfill, Jefferson County, Ohio

Dear Mr. Walkenspaw:

The Ohio EPA submitted an e-mail dated June 18, 2015 to Apex Environmental LLC (Apex) providing notice of deficiency (NOD) or comments to PTI Application No. 06-08448, as revised on July 22, 2013, for the proposed contiguous lateral and vertical expansion and AMDWR increase for the Apex Sanitary Landfill. The PTI Application narrative, calculations, and drawings have been revised in response to the Ohio EPA NOD. We are providing the following attachments:

- Attachment A – Response to Ohio EPA NOD dated June 22, 2015;
- Attachment B – Revised PTI Application Narrative;
- Attachment C – Revised PTI Application Calculations; and
- Attachment D – Revised PTI Application Drawings.

Only the revised portions of the PTI Application are being submitted. The revisions to the narrative and calculations are indicated using strikeout for deleted text and underline for new text. The header of revised calculation pages have been updated with revision dates. The revised drawings are indicated in the revision block of the specific drawing and in the revision column of the drawing list on the Title Sheet.

Apex is providing two copies of the Response to Ohio EPA NOD and revised portions of the PTI Application to the Ohio EPA and one copy to the Jefferson County General Health District. Apex will provide two additional complete copies of the revised PTI Application upon approval from Ohio EPA.

Please contact me if you have further questions.

Sincerely,

Joe Tatarek /rjb

Joe Tatarek, Vice President of Operations
Apex Environmental LLC

Enclosures

cc: Bruce Misselwitz, JCGHD
Anthony Rizzo – Apex Environmental LLC
Apex File – Contiguous Expansion PTI Application
Rick Buffalini, Civil & Environmental Consultants, Inc.

ATTACHMENT A

RESPONSE TO OHIO EPA NOD
DATED JUNE 18, 2015

ATTACHMENT A
RESPONSE TO OHIO EPA NOD DATED JUNE 18, 2015
CONTIGUOUS EXPANSION PTI APPLICATION
APEX SANITARY LANDFILL
JEFFERSON COUNTY, OHIO

The Ohio EPA submitted an e-mail dated June 18, 2015 to Apex Environmental, LLC (Apex) providing a notice of deficiency (NOD) or comments to PTI Application No. 06-08448, as revised July 22, 2013, for the proposed contiguous lateral and vertical expansion and AMDWR increase for the Apex Sanitary Landfill. The PTI Application narrative, calculations, and drawings have been revised in response to the Ohio EPA NOD.

In addition to the revisions made to the PTI Application to address the Ohio EPA NOD, the following revisions were made to the drawings and narrative in the Application:

- Replaced the Environmental Logistics Services logo with the Apex Environmental LLC logo on the binder covers and drawing title sheet.
- Updated the AEP power line location on Drawings 2A, 2B, 2C, 3A, 4A, 4H, 6E, 6F, and 6H. We did not revise the location on drawings that are not being revised for other reasons.
- Added the wetland conservation easement to Drawings 2A and 3A.
- Updated property information on Drawing 2B.
- Revised Drawing 3C to address the area of limestone in Phase 8 (Phase 7B of the permitted landfill) that is delineated as an area of potential high groundwater yield. This revision is in response to a letter from the Ohio EPA dated July 7, 2014 regarding the existing permitted landfill.
- Revised outlet location from Sedimentation Pond No. 1 on Drawings 4H and 7M.
- Revised the Sedimentation Pond No. 3 location on Drawings 4A, 4H, 6E, 6F, 6H, 7M, and revised elevations on Drawing 7N. We did not revise the location on drawings that are not being revised for other reasons.
- Revised required SDR of sideslope riser pipes on Drawing 7D and in narrative Section (C)(7).
- Revised the Table of Effective and Pending Permits based on the current status of each existing permit. Updated the status of the permits in Section II, Attachment A1, of the Solid Waste Facility Data Sheet and in narrative Section (C)(1).
- Revised the narrative regarding ownership in Section (C)(1).
- Revised narrative Section (C)(1) to include a statement that the AMDWR will not be increased until the contiguous expansion is entered.
- Revised narrative Section (C)(1) regarding the status of the DFFOs.
- Updated the personnel and equipment list in Section (C)(1) based on the current business plan.
- Revised narrative Section (C)(1) to address the area of limestone in Phase 8 that is delineated as an area of potential high groundwater yield.
- Revised narrative section (C)(8) to include the Odor Management Plan (OMP) which was approved as an alteration to the existing permit on July 20, 2015. The approval

letter and revised narrative have been included in new Appendix C8-A. For clarity, the previous narrative describing the OMP was deleted without tracking changes.

Comments from Ohio EPA

Comment No. 1 – Ohio EPA is considering the continued variance requested to site a sanitary landfill facility in a limestone quarry. No further clarification is requested.

Response: No response required.

Comment No. 2 – Ohio EPA is considering the variance request from siting criteria to continue the use of the main office's existing water supply well until the limits of waste placement are within 1,000 feet of the well. Apex would then decommission and replace the existing well with respect to the siting criteria. No further clarification is requested.

Response: No response required.

Comment No. 3 – What is the status of the following other auxiliary permits: NPDES; 401 permit; 404 water quality certification; isolated wetland permit, and air? Please update "Table of Effective and Pending Permits."

Response: The other auxiliary permit applications will be submitted in December 2015 in conjunction with this revision of the Solid Waste Permit Application.

Comment No. 4 – Plan Sheet 4A (Horizontal and Vertical Limits of Excavation) shows an underdrain located in Phases 11 and 12 with a slope less than 0.2%. This slope may not be sufficient to properly drain this area. We recommend having the drawings changed to show a minimum slope of 0.5% for the underdrain.

Response: Drawing 4A shows an underdrain geocomposite in Phases 11 and 12. If needed, the geocomposite will be installed to drain groundwater seepage to underdrain sumps at low points in each phase, which are at the leachate collection sump. In response to Comment No. 5 below, details for an underdrain sump have been added to Drawing 7B. Water collected in the underdrain sump will be pumped to discharge to the perimeter channel which flows to a proposed sedimentation pond or sloped to drain by gravity. The underdrain sump has also been included as an option for Phases 10 and 14. Drawings 2C, 3A, 4A, 6E, 6F, and 6H have been revised. Because of site condition, the slope of the underdrain in Phases 11 and 12 needs to be relatively flat. However, the conveyance pipe will be constructed in rock so settlement is not expected. In addition, the underdrain consists of a geocomposite with a geotextile and the underdrain sump is wrapped in a geotextile to reduce the potential for sediment to enter the underdrain pipe. In these conditions, the relatively flat slope of the underdrain conveyance pipe is considered adequate.

An underdrain pipe is also proposed to be installed in the valley to the south of Phases 11 and 12 to drain groundwater seepage beneath the proposed structural fill. As indicated on

Drawing 4A, an underdrain pipe is also proposed to drain groundwater seepage beneath the proposed structural fill to the south of Phase 13 and to the east of Phase 14.

Narrative in Section (C)(7) of the permit application has been revised to include a description of the underdrain sump.

Comment No. 5 – Plan Sheet 4A shows the possible installation of an underdrain geocomposite within Phase 10. No contingency was shown to include an underdrain pipe, which would be graded to drain out of the phase or to an underdrain sump and riser. Please revise Plan Sheet 4A to include an underdrain pipe or sump. As applicable, please include typical details on Plan Sheet 7B (Liner and Final Cover Systems Details).

Response: Drawing 4A shows an underdrain geocomposite in Phase 10. If needed, the geocomposite will be installed to drain groundwater seepage at the low point in the phase, which is beneath the leachate collection sump. An underdrain pipe in Phase 10 may be used to discharge the groundwater seepage by gravity into an existing underdrain system (SHAUDS No. 3) or an adjacent area. The location and outlet of the underdrain pipe in Phase 10 has been revised for clarity. A survey point has been added to Drawing 4A for the location of the tie-in.

Alternately, the geocomposite will be installed to drain groundwater seepage to an underdrain sump at the low point in Phase 10, which is at the leachate collection sump. A detail for an underdrain sump has been added to Drawing 7B. The underdrain sump will be pumped to discharge in the perimeter channel which flows to a proposed sedimentation pond. Drawings 2C, 3A, and 4A have been revised.

Narrative in Section (C)(7) of the permit application has been revised to include a description of the underdrain sump.

Comment No. 6 – Please revisit Detail D/7A (Liner Anchor Trench Detail) to show the Leachate Collection System's drainage layer material held back just short of the limits of waste placement and the crest of the liner system's side slope. As installed during recent construction events, please detail an "odor control soil plug" that runs from the held back drainage material to the liner system's anchor trench.

Response: Details D/7A (Liner Anchor Trench Detail) and B/7C (Liner/Final Cover System/Perimeter Road Configuration) have been revised to show a soil plug.

Comment No. 7 – Within Detail B/7A (Typical Final Cover System Detail), a 40-mil HDPE (High Density Polyethylene) flexible membrane liner is specified. Please provide some discussion why a HDPE was specified instead of the typical Liner Low Density Polyethylene (LLDPE) deployed in most final cover system's installation.

Response: The detail has been revised to include the option of LLDPE material. The CQA/QC Plan already includes options to use a 40-mil HDPE or LLDPE flexible membrane liner.

Comment No. 8 – Within the resubmission, the landfill's "Life Expectancy Using the Anticipated Daily Waste Receipt" was calculated at 27.3 years based on a projected 6,600 tons per day. Please revisit the anticipated life calculation in consideration of the landfill's redefined business model.

Response: Because it is difficult to predict the anticipated daily waste receipt over the life of the landfill, a varying anticipated daily waste receipt was used to calculate the anticipated site life. Additionally, Section II, Attachment A1, of the Solid Waste Facility Data Sheet has been revised to reference the revised calculation.

Comment No. 9 – Please update Appendix C1-E (Compliance Violation Summary) relative to any recent violations.

Response: The table in Appendix C1-E has been updated to reflect recent violations.

Comment No. 10 – In Section (C)(5)(e), the leachate storage tank calculation has been revised to include some 6,000 gallons per day of condensate from the landfill's proposed gas processing plant. Please clarify whether the condensate will be pretreated prior to its comingling with the leachate. And please inquire with Ohio EPA's Surface Water Division whether comingling the condensate and leachate will require a modification to the tank's pretreatment permit.

Response: Pretreatment of the condensate is not proposed because, according to the landfill gas project developer, the quality is expected to be similar to leachate. Please note that Apex does not have a pretreatment permit for the tank. Apex has an existing Indirect Discharge Permit to treat the leachate at the City of Steubenville Wastewater Treatment Plant (WWTP); however, Apex has not been discharging leachate there. If the landfill gas development project proceeds, and if Apex intends to resume discharging leachate at Steubenville WWTP, we will contact Ohio EPA Division of Surface Water to determine whether modification of the Indirect Discharge Permit is needed. Section (C)(7) has been revised to address this comment.

ATTACHMENT B

REVISED PTI APPLICATION NARRATIVE

Replace the existing narrative with that provided or insert new narrative.

Binder covers and spines
Inside Cover
Table of Contents
Attachment A1 – pages 1 and 5
Appendix A (to Attachment A1) – entire Table of Permits
Professional Engineer's Certification
Section (C)(1) – pages 2, 5, 6, 10, 11, 12, 13, 19, and 23
Appendix C1-E – entire Summary of Notice of Violations
Section (C)(7) – pages 5, 7, 13, 25, and 26
Section (C)(8) – replace page 5, remove OMP (pages 6 through 10) and associated figures and attachments
Appendix C8-A – Odor Management Plan (INSERT)
Appendix C10-C – entire Table of Permits

ATTACHMENT C

REVISED PTI APPLICATION CALCULATIONS

Replace the existing calculation with the one provided.

(C)(5)(a) Volume and Anticipated Life Calculation - calculation
(C)(5)(l) – Sedimentation Pond 3 Design Calculation

ATTACHMENT D

REVISED PTI APPLICATION DRAWINGS
(SUBMITTED AS A SEPARATE ROLLED PACKAGE)

Title Sheet, Drawings 2A, 2A-1, 2A-2, 2B-1, 2B-2, 2C-1, 2C-2, 3A, 3C, 4A, 4H, 6E, 6F, 6H, 7A, 7B, 7C, 7D, 7M, and 7N

ENVIRONMENTAL
LOGISTICS SERVICES
Apex Environmental, LLC

July 19, 2013

Mr. Craig Walkenspaw
District Engineer
Division of Materials and Waste Management
Ohio EPA Southeast District Office
2195 Front Street
Logan, Ohio 43138

RE: Response to Ohio EPA Notice of Deficiencies dated December 11, 2012
Contiguous Expansion PTI Application
Apex Sanitary Landfill
Jefferson County, Ohio

Dear Mr. Walkenspaw:

The Ohio EPA submitted a letter dated December 11, 2012 to Apex Environmental, LLC (Apex) providing Notice of Deficiency #2 to PTI Application No. 06-08448 for a proposed contiguous lateral and vertical expansion and AMDWR increase for the Apex Sanitary Landfill. The letter contained Attachment A - General Engineering review comments, Attachment B – Geotechnical Resource Group comments, and Attachment C – Hydrogeological review comments. The Ohio EPA provided the hydrogeologic review comments in a letter dated December 28, 2012

This response addresses the General Engineering review comments and the Geotechnical Resource Group comments. The responses regarding hydrogeology and related issues will be submitted under a separate cover.

The PTI Application narrative, calculations, and drawings have been revised in response to the Ohio EPA NOD. We are providing the following attachments:

- Attachment A – Response to Ohio EPA NOD dated December 11, 2012;
- Attachment B – Revised PTI Application Narrative;
- Attachment C – Revised PTI Application Calculations; and
- Attachment D – Revised PTI Application Drawings.

Only the revised portions of the PTI Application are being submitted. The revisions to the narrative and calculations are indicated using strikeout for deleted text and italics for new text. The header of revised calculation pages have been updated with revision dates. The revised drawings are indicated in the revision block of the specific drawing and in the revision column of the drawing list on the Title Sheet. Due to the number of drawings that are being revised, we are resubmitting the entire set.

Apex is providing two copies of the Response to Ohio EPA NOD and revised portions of the PTI Application to the Ohio EPA and one copy to the Jefferson County General Health District. Apex will provide two additional complete copies of the revised PTI Application upon approval from Ohio EPA.

Please contact me if you have further questions.

Best regards,

Dave Matthews, General Manager
Apex Environmental, LLC

Enclosures

cc: Bruce Misselwitz, JCGHD
Anthony Rizzo – Environmental Logistics Services, LLC
Apex file – Contiguous Expansion PTI Application
Rick Buffalini, Civil & Environmental Consultants

ATTACHMENT A

RESPONSE TO OHIO EPA NOD DATED DECEMBER 11, 2012

ATTACHMENT A
RESPONSE TO OHIO EPA NOD DATED DECEMBER 28, 2012
CONTIGUOUS EXPANSION PTI APPLICATION
APEX SANITARY LANDFILL
JEFFERSON COUNTY, OHIO

The Ohio EPA submitted a letter dated December 11, 2012 to Apex Environmental, LLC (Apex) providing Notice of Deficiency #2 to PTI Application No. 06-08448 for a proposed contiguous lateral and vertical expansion and AMDWR increase for the Apex Sanitary Landfill. The letter contained Attachment A - General Engineering review comments, Attachment B - Geotechnical Resource Group comments, and Attachment C – Hydrogeologic review comments. The Ohio EPA provided the hydrogeologic review comments in a letter dated December 28, 2012.

This response addresses the General Engineering review comments and the Geotechnical Resource Group comments. The deficiencies are repeated verbatim below and followed by the response in italicized text. The responses regarding hydrogeology and related issues are being submitted under a separate cover.

The PTI Application narrative, calculations, and drawings have been revised in response to the Ohio EPA NOD.

In addition to the revisions made to the PTI Application to address the Ohio EPA NODs, Apex has revised the phasing sequence of the proposed expansion to develop the site from the west to the east. As a result, the leachate collection layer and other associated drawings were revised to relocate the leachate sump to the first portion of the phase to be developed so that a temporary leachate sump could be avoided. The revised grading increased the proposed airspace by approximately 500,000 cubic yards to a total of approximately 61.1 million cubic yards. The revised grading plan required revisions to several calculations including airspace, soil balance, slope stability, settlement, and leachate management. The revised phasing and grading plan is depicted on Drawing 3A, Drawing 3C, Drawings 4A through 4E, and the Phase Development drawings.

In addition to the revisions made to the PTI Application to address the Ohio EPA NODs, the following revisions were made to the narrative and calculations in the Application:

- PTI Forms, Attachment A1. Appendix A was added which includes a table that lists all permits.
- The Leachate Storage Tank Calculation in Section (C)(5)(e) was revised to include the condensate from the proposed landfill gas processing plant.
- Section (C)(5)(k) was revised based on changes to the location of the proposed landfill gas management area location.
- The Surface Water Channel Calculation in Section (C)(5)(k) was revised to use grass lining instead of riprap lining where possible.
- Sections (C)(7) and (C)(8) were revised based on Alteration Requests for the current Vertical Expansion PTI Application that were approved by the Ohio EPA including 2012 Rail Area Improvements issued March 16, 2012 and the Rail Yard Expansion issued August 9, 2012.

- Section (C)(8), Odor Monitoring Plan was revised to be consistent with the PTI Alteration Request for the Vertical Expansion PTI Application submitted on June 13, 2013. The OMP is being resubmitted without tracking changes due to the extent of revisions.
- Section (C)(9), Explosive Gas Monitoring Plan was revised to discuss additional proposed enclosed structures at the facility.
- Section (C)(10) has been revised to refer to a list of permits that is presented in new Appendix (C)(10)-C.

In addition to the revisions made to the PTI Application to address the Ohio EPA NODs, the following revisions were also made to the drawings in the Application.

- All plan view drawings were revised with the 2013 topography.
- The relevant plan views have been revised to show the proposed landfill gas management area at the new location.
- Cross Section A-A on Drawing 5I changed with the proposed rail widening grading.
- A gas monitoring punch bar associated with the proposed gas management area has been added to Drawing 3B and the 6 series drawings.
- The solidification basin has been shown in the relocated location on Drawings 3A, 3B, and 6F, 6G, and 6H.
- Drawing 7B, Detail A, temporary cell divider berm configuration detail, was revised to show an extrusion weld on both sides.
- Drawing 7J, schematic of the landfill gas management area, was revised to be consistent with current design plans.
- The channel lining type was revised in the channel summary table on Drawing 7L.

Comments from Attachment A – General Engineering Review

Comment No. 1 - On Plan Sheets 2C-1 and 2C-2 (Man-Made Potential Explosive Gas Migration Pathways), please amend the drawings to include the sewer/water lines and other underground utilities associated with the proposed solidification facility, rail unloading building and the landfill gas processing facility.

Response: Drawings 2C-1 and 2C-2 have been revised to show underground utilities associated with solidification facility, proposed rail unloading area, and proposed gas processing facility.

Comment No. 2 - On Plan Sheet 2D-2 (Siting Criteria Summary), a comment is provided relative to OAC Rule 3745-27-07(H)(3)(C) and water supply wells. In particular, the comment states "None within 1,000-ft of waste placement, except the well at the landfill office which meets the criteria of rule OAC 3745-27-07(H)(3)(C)(i)."

Please fully explain how the main office well satisfies the criteria of OAC Rule 3745-27-07(H)(3)(C)(i) or alternately criteria (ii or iii).

Please reference Comment No. 21 and its alternate justification narrative on Page C1-19.

Response: As requested by the Ohio EPA, Apex has included a variance request in narrative Section (C)(2) requesting permission to use the existing water supply well until the waste limits are within 1,000 feet of the well. Prior to waste being placed within 1,000 feet of the water well, Apex will perform one of the following:

- Decommission the existing well and demonstrate that a new water supply well is separated from the limits of solid waste placement by a hydrogeologic barrier. Apex will install a new water well to be constructed with steel casing extending to the Connellsville/Morgantown UAS and a continuous annular cement seal from the bottom of the steel casing to the ground surface. Apex will obtain Ohio EPA approval before implementing this approach.
- Decommission the existing well and either reinstall the well 1,000 feet from the proposed limit of waste or install a cistern to provide water to the office.

Drawing 2D-2 and Sections (C)(1) and (C)(2) have been revised accordingly.

Comment No. 3 - On Plan Sheets 3A (Landfill Facilities/Utilities Location Plan), please amend the drawings to include all new utilities associated with the proposed solidification facility, rail unloading building and the landfill gas processing facility.

Response: Drawing 3A has been revised to show utilities associated with the solidification facility, proposed rail unloading area, and proposed landfill gas processing facility.

Comment No. 4 - On Plan Sheet 3B (Explosive Gas Control System Plan), please revise the drawing to merge the current GCCS as-built (Fall 2012) with the balance of the modeled system.

Response: Drawing 3B has been revised to show the February 19, 2013 as-built construction of the GCCS.

Comment No. 5 - On Plan Sheet 3B and subsequent drawings, please amend to incorporate the southern haul road from the rail yard (Constructed - Summer 2012).

Response: Drawing 3B and other applicable plan sheets have been revised to show the 2013 topography which includes the southern haul road from the rail yard.

Comment No. 6 - On Plan Sheet 3C (UAS Separation Isopach Map), please revise Note No. 4 to be reflective of Phase 6A-East's construction. And adjust the phasing limits to show Phases 6A and 6B. Please incorporate similar changes to subsequent drawings as necessary.

Response: Note 4 on Drawing 3C has been revised to remove mention of construction progress. The drawing has been revised to show Phase 6A, 6B, and 7A limits. Subsequent drawings have been revised in a similar manner. Additionally, page 1 of Section (C)(1) was revised to remove reference of the currently constructed cell.

Comment No. 7 - On Plan Sheets 4A (Horizontal and Vertical Limits of Excavation), please amend the drawing to include areas of excavation and fill associated with the proposed solidification facility, rail unloading building and the landfill gas processing facility. And please incorporate the as-built grading of the southern haul road from the rail yard.

Response: The location of the existing solidification basin does not appear on Drawing 4A. The excavation and fill associated with the proposed solidification basin location, rail unloading area, and landfill gas processing area have been added to Drawing 3A but are not shown on Drawing 4A because changes to the proposed grading plans would require revisions to all of the 4-series drawings.

Comment No. 8 - On Plan Sheet 4G (Top of Final Cover Grading Plan), the maximum elevation for the top of final cover is shown at 1577' msl which is 28' higher than Ohio's highest natural elevation which is at Campbell Hill near Bellefontaine, Ohio (1,549' msl). And the proposed maximum elevation is 189 feet higher than Jefferson County's highest natural elevation near Monroeville, Ohio at 1,388' msl.

When faced with a similar situation Cherokee Run Landfill elected to establish 1548' msl as their top of final cover.

In consideration of the proposed expansion, Ohio EPA requests that the expansion's top of final cover be reconfigured to be held less than 1549' msl.

Response: - The proposed design complies with all applicable regulations at the proposed height; therefore, Apex requests that the application be reviewed at the proposed elevation.

Comment No. 9 - On Plan Sheet 4H (Surface Water Management Plan), please add a reference to Detail A/7A (Sedimentation No. 1), B/7M (Sedimentation Pond No. 2) and B/7M (Sedimentation Pond No. 3).

Response: - The requested references have been added to Drawing 4H.

Comment No. 10 - Plan Sheet 7D (Leachate Management System Details), please revise Detail F/7D (Valve Vault) to show its correct position with respect to the sideslope riser pipe and pitless adapter.

As a suggestion, please note that the valve vault is a "confined space" and should be posted as such. The optional encasement of the in-line condensation sumps (Details A/7H and B/7H) should also be posted as confined spaces.

Response: Detail F on Drawing 7D has been revised to better represent the actual configuration of the vault and pitless adapter. Detail F on Drawing 7D and Details A and B on Drawing 7H have been annotated to require "Confined Space" signs outside these features.

Comment No. 11 - On Plan Sheet 7G (Gas Management System Details), please add a typical detail to show the configuration of a gas extraction well that utilizes a caisson to support an extended well.

Response: Apex has elected not to utilize a caisson-style gas well for future construction.

Comment No. 12 - According to Section II (Multimedia Information), a NPDES permit, a 401 permit, a 404 water quality certification, an isolated wetland permit, and an air permit are needed for the proposed expansion. At the time of the original submission, these applications weren't submitted yet.

What is the status of these or other applicable applications?

Response: The NPDES permit application, air permit application, and wetlands permit applications are expected to be submitted before the end of 2013.

Comment No. 13 - Please revisit Section III (Additional Information) #9 to correct the "Total Area Within the Limits of Waste Placement" which should be the sum of "Area Previously Approved" and "New Area Added by this Permit."

Response: Section III (9) has been revised as requested. In Section III (9), the area currently filled has been revised to include construction of Phase 6A-East.

Comment No. 14 - Please revisit Section III #10 to correct the "Total Volume" which should be the sum of "Volume Previously Approved" and "New Volume Proposed by this Permit."

Response: Section III (10) has been revised to include the volumes considering the revised base grades. Additionally, the total volume filled reflects the volume filled as of December 31, 2012.

Comment No 15 - Section IV (Cost Estimates) reports that the Total Closure Cost Estimate is $16,918,804 which actually appears to be based on some 183 acres as shown within Section (C)(5) [Closure Cost Estimate]. In contrast, Section IV declares 117 acres the "Worst Case Acreage" for when Phase 13 is just developed (please see Plan Sheet 6G).

Within Sections IV and (C)(5), please revise the Total Closure Cost Estimate with regards to the Worst Case Acreage only and without any discount for the installed gas collection and control systems. The proposed $92,453/ac appears to be low.

Response: The final closure cost estimate in Section (C)(5) of the application have been revised based on a maximum anticipated open area of 95 acres. The estimated final closure cost per acre has been increased to $106,942 to account for inflation since the original estimates were prepared. Attachment A1 of the permit application has been revised based on the recalculated closure cost estimate. The closure cost estimate in

Section (C)(5) and Attachment A1 have been revised based on increased costs in the final closure cost estimate.

Comment No. 16 - In recent years, Apex Environmental, LLC has progressively increased the facility's "worst case acreage." With the development of Phase 6A-East, the worst case acreage will be 87.3 acres. With the transition from the originally permitted 117.5-acre unit to the proposed expansion's 288.5-acre unit, beginning the closure of the original unit appears to be logical to limit the growing environmental liability.

In consideration of the proposed expansion, Ohio EPA requests the development of a systematic closure scheme for the originally permitted unit.

Response: Apex intends to cap a portion of the existing landfill unit equal to the lined area being constructed within the contiguous expansion area. The worst case open acreage will be limited to 95 acres. Capping will occur within 12 months of construction of the lined area. The Closure Plan in Section (C)(9) has been revised to include the proposed closure schedule.

Comment No. 17 - On Pages C1-5 & 6 [Information per OAC Rule 3745-27-07(A)(3)], please revise the compliance narrative to note the DFF&O of December 22, 2011 and revise Appendix C1-E as necessary.

Response: The narrative has been modified to include the December 22, 2011 DFFO and the June 3, 2013 DFFO which approved Apex's proposed actions to comply with the 2011 DFFO. The narrative was also revised to include the April 29, 2013 DFFO regarding payment of fees. Appendix C1-E has been modified to include the DFFO and all new entries up to present date.

Comment No. 18 - On Page C1-6 [Information per OAC Rule 3745-27-07(A)(5)], please update when the most recent disclosure statement was submitted as necessary.

Response: Pages C1-3 and C1-6 of Section (C)(1) have been updated with the date of the most recent disclosure statement submittal.

Comment No. 19 - On Page C1-12 [Information per OAC Rule 3745-27-07(E)(3)], please revise the compliance narrative as necessary.

Response: Page C1-12 of Section (C)(1) has been modified to reflect the items discussed in response to Comment 17.

*Comment No. 20 - On Page C1-19 [Information per OAC Rule 3745-27-07(H)(3)(C)], the narrative notes the following "The authorized fill area, the contiguous new unit and proposed vertical expansion are **not** located within 1,000 feet of a water supply well or developed spring." In contrast, the following sentence says "Apex uses and controls two water wells that are on the facility and used to support operations; only one is within 1,000 feet from the limits of waste."*

Actually, the proposed limits of waste placement will be some 220' from the well located at the main office.

Please revise the narrative to clarify that the proposed expansion is within 1,000 feet of one water supply well.

Response: The narrative on page C1-19 has been clarified.

Comment No. 21 - Reportedly, the water supply well adjacent to the main office is protected from the limits of waste placement by a "hydrogeologic barrier" as provided by OAC Rule 3745-27-07(H)(3)(C)(iii).

Please show that this well is actually isolated by a hydrogeologic barrier. Alternately, the well could be replaced with a cistern.

Response: The narrative on page C1-19 was revised as discussed in the response to Comment No. 2.

Comment No. 22 - On Page C1-21, please revise the facility compliance narrative to note the DFF&O of December 22, 2011.

Response: The paragraph on pages C1-21 and C1-22 has been modified to note the December 22, 2011, April 29, 2013, and June 3, 2013 DFFOs.

Comment No. 23 - Please revise and amend Appendix C1-E (Compliance Violations Summary) as necessary.

Response: Appendix C1-E has been modified to include the DFFO and all new entries up to present date.

Comment No. 24 - As available mid-December, 2012, please see Attachment C for further deficiencies as provided by the Southeast District Office's Division of Drinking and Ground Water (Joe Laughery).

Response: Responses to the Hydrogeologic Site Investigation Report are presented separately.

Comment No. 25 - Please see Attachment B for further deficiencies as provided by the Southeast District Office's Geotechnical Resource Group (Brian Queen).

Response: Responses to the Stability Analyses comments and geotechnical comments have been addressed and are presented with this submittal.

Comment No. 26 - As shown within Section (C)(5), please update the "remaining airspace of the existing unit", "anticipated life of facility" and other life estimates. As of December 29, 2010,

some 13.9 MCY of permitted airspace remained with a projected remaining life of 5.1 years. With the increased AMDWR alone (without additional airspace), the remaining life of the facility was estimated at 3.6 years.

Response: The remaining airspace estimates contained in Section (C)(5) have been updated to include 2012 airspace consumed. Attachment A1 has also been revised to include the 2012 airspace consumed.

Comment No. 27 - As found within Section (C)(5), please revise the reported "Total Cost of Post-Closure Per Acre" to be based on the total permitted 288.5 acres and not the actual surface area of the landfill.

Response: The total post closure cost estimate contained in Section (C)(5) has been revised to use the permitted 288.5 acre footprint area.

Comment No. 28 - Within Section (C)(8) [Operational Information], please revise the Odor Management Plan based the resolution of the December 22, 2011 DFF&Os.

Response: The revised Odor Management Plan was submitted to the Ohio EPA on June 13, 2013 as required by the June 3, 2013 DFFO. The revised plan is provided with this submittal. Please note that due to the large number of revisions, track changes was not used in the narrative to make review easier.

Comment No. 29 - Please submit two copies of the "final ground water detection monitoring program" so they may be placed within Appendix C9-A (Ground Water Detection Monitoring Program) of the first two copies of the permit application.

Response: Two copies of the revised Ground Water Detection Monitoring Program are included with the hydrogeologic responses.

Comment No. 30 - Within Appendix C9-B (Explosive Gas Monitoring Plan), please revisit the "Discussion of Latest Explosive Gas Investigation" as necessary.

Response: Page 7 of the Explosive Gas Monitoring Plan contained in Appendix C9-B has been revised to reflect the most recent monitoring event.

Comment No. 31 - Within Appendix C9-B, please revisit the "Description of the Proposed Monitoring System" to include the installation of permanent gas monitoring probes for "other structures" within 200 feet of the waste limits.

Response: Page 7 of the Explosive Gas Monitoring Plan contained in Section C9-B has been revised to include the installation of permanent gas probes to monitor occupied structures within 200 feet of the waste limits.

Comments from Attachment B – Geotechnical Resource Group Comments

Comment No. 1 - The hydrostatic uplift calculations determined that a factor of safety of 1.40 could not be met as the facility is currently designed. Calculations were also included that indicated a factor of safety above 1.40 could only be achieved once waste is placed in the facility. These calculations verify that the site's current design does not meet OAC 3745-27-08(C)(7)(a) which states.

> *"The factor of safety for hydrostatic uplift shall not be less than 1.40 at any location during the construction and operation of the facility."*

Since the weight of the liner system at the end of its construction is insufficient to achieve a factor of safety of 1.40 for hydrostatic uplift, the facility should be redesigned. Two possible designs are to raise the floor of the facility so it is not below the piezometric surface or to place a drainage layer beneath the liner to underdrain the liner system to prevent uplift pressure from developing in the areas of concern. It should also be noted that the current underdrain system is not providing drainage to all areas that show a piezometric surface above the liner.

> Response: The design has been revised to include a geocomposite drainage layer beneath the Recompacted Soil Liner in areas where the factor of safety for hydrostatic uplift is less than 1.40. The drainage layer will outlet into the proposed gravity underdrains. The extents of the proposed drainage layer are shown on Drawing 4A and the detail is shown on Drawing 7A.

Comment No. 2 – The unit weight of the Municipal solid waste was modeled as 90 pcf. This unit weight is higher than what is typically found in literature, and tended to make the factors of safety slightly higher than what would have been modeled with a lower unit weight. The consultant for the facility should provide a site specific explanation for the higher unit weight or change it to 75 pcf and revise the submittal appropriately.

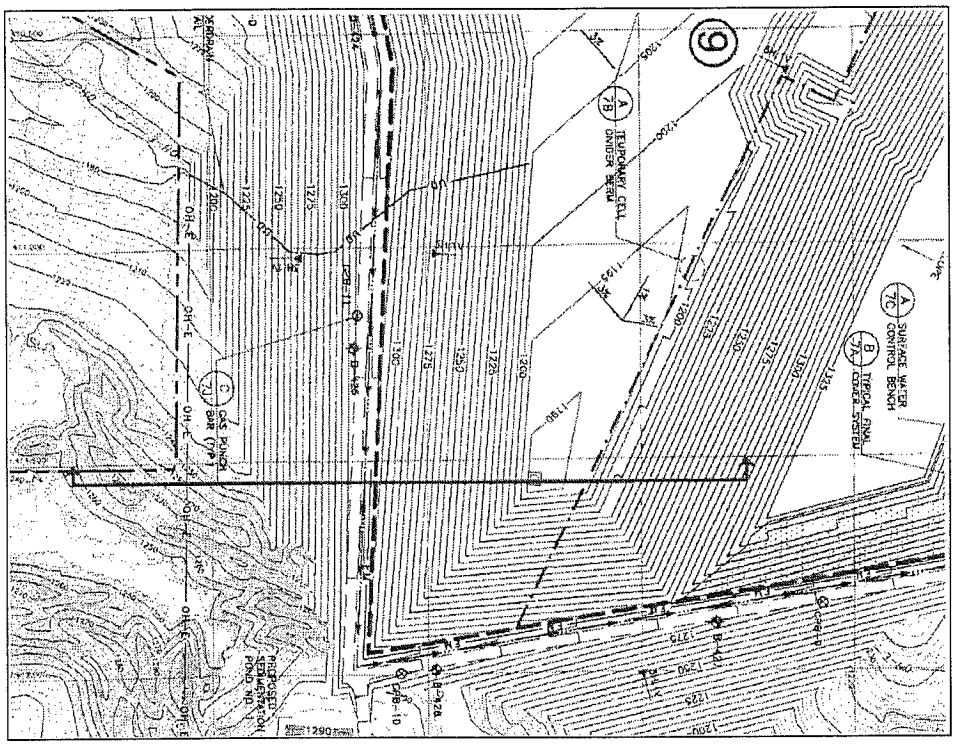
> Response: The slope stability, settlement, and hydrostatic uplift analyses and associated narratives have been revised to incorporate a MSW unit weight of 75 pcf.

Comment No. 3 – The back calculated internal shear strength determined necessary to maintain a factor of safety of 1.5 may not be achievable at the site. The 2005 interface shear strength data is lower than what is required by the back calculation. The consultant for the facility should evaluate if a redesign of the facility is necessary.

Material Interface	Normal Stress (psf)	PTI Peak Shear Strength (psf)	2005 Peak Shear Strength (psf)	PTI Post-Peak Shear Strength Peak Shear Strength (psf)	2005 Post-Peak Shear Strength (psf)
GCL vs GMX	150		76		60
GCL vs GMX	1000		356		277
GCL vs GMX	3000	1500	1144	875	711
GCL vs RSL	6000	2000	2023	1290	1029
GCL vs GMX	1350	4100	3233	2100	1188

Response: CEC reviewed the results of the interface shear strength testing performed for each phase of construction from 2005 to present. Based on these results, the shear strength envelope specified in the CQA Plan is achievable with the materials being used. The required minimum shear strength for the liner system has been revised based on the proposed revision to the phased development of the site. The critical slope stability cross section has been revised and results in lower required peak interface shear strengths. The global slope stability calculation narrative has been revised and includes two graphs that show a comparison of past shear strength data and the shear strength envelope used in this calculation.

Comment No. 4 – Weak saturated sandy clay mine spoil with SPT blow counts less than 4 were found I soil boring SB-20 at an elevation between 1238 and 1242. Soils with blow counts below 4 have been known to suffer undrained failures during excavation and loading. A cross section in a location similar to that shown in Figure 1 should be evaluated for interim undrained stability.



The undrained shear strength for this weak mine spoil may be best estimated from the consolidated undrained tests performed on samples of the material. Ohio EPA recommends using the following formula to determent the undrained strength ratio (S_u/σ'_v) of the soil:

$$\frac{S_u}{\sigma'_v} = \frac{{}^1/_2\,(\sigma_1 - \sigma_3)}{\sigma_3}$$

Or if σ_3 is inadvertently less than σ'_p then use

$$\frac{S_u}{\sigma'_v} = \frac{{}^1/_2\,(\sigma_1 - \sigma_3)}{\sigma'_p}$$

Where

S_u = *undrained shear strength*
σ'_v = *effective vertical stress and is = σ_3 for each load being tested*
σ_1 = *major principle stress*
σ_3 = *minor principle stress*
σ'_p = *preconsolidation stress*

The undrained stability of the cross section can either be evaluated using the undrained strength of the weak soil prior to loading/excavating or the weight of the structural fill being placed all at once can cause pore water pressure to be created. In the latter the undrained strength ratio can be entered as vertical stress ratios in Slide, and the weight of the structural fill will create the excess pore pressure. In the former the undrained strength can be estimated by multiplying the undrained strength ratio by the pre-excavation vertical stress to determine the cohesion value and setting the $\phi = 0$.

Response: Based on the proposed grading plan, the soft mine spoil material that was encountered in Test Boring SB-20 from Elevation 1238 to 1242 will be removed as part of the landfill construction. The proposed berm is approximately 80 to 90 feet from Test Boring SB-20 where mine spoil will remain in place at Elevation 1238 to 1242. Due to the high variability in the mine spoil over short distances, CEC does not believe that it is reasonable to assume that the soft material encountered in Test Boring SB-20 will extend 80 to 90 feet to the proposed berm where mine spoil will remain in place. Therefore, an additional slope stability cross section was not performed as discussed with the Ohio EPA. If soft material is encountered during excavation in this area or any area within the landfill footprint it will be removed and replaced with suitable fill or sampled and tested for shear strength in accordance with Section 3.0 of the CQA Plan.

Comment No. 5 – There is a 2H:1V slope associated with the proposed gas management area. The consultant should evaluate the stability of this slope.

Response: The proposed gas management area has been relocated to the north and is no longer adjacent to the contiguous expansion. The stability of the 2H:1V side slopes associated with the gas management area will not affect the stability of the contiguous expansion area.

Comment No. 6 – In the shallow saturated stability calculations, the consultant attempted to apply a factor of safety of 2.0 to the calculation by multiplying 2.0 times the peak 100 year 24 hour storm, which resulted in a 5.12 inches/hour rain event or 3.61E-03 cm/sec rain event. However, since the permeability of the vegetative soil was estimated at 4.2E-5 cm/sec the impingement rate used in the calculation defaulted to 4.2E-5 cm/sec for the permeability of the vegetative soil and thereby making the applied factor of safety irrelevant in the calculation. In order to properly apply a factor of safety in this calculation, one must apply it to the reduction factors. The consultant should revise the calculation appropriately.

Response: The factor of safety of 2.0 was applied to the reduction factors as requested.

Comment No. 7 – The design permeability of the vegetative cover soil is 4.20E-5 cm/sec. Some soils are not able to maintain this low of permeability after drought conditions. Please include the testing of the long term permeability of the vegetative soil in the quality assurance quality control plan. Please refer to Guidance Document 700 "Selecting Material for Cap Protection Layers".

Response: The permeability of the vegetative cover soils was incorrectly reported in the calculation narrative as 4.20E-5 cm/sec; however, the actual permeability used in the calculation was 1.00E-4 cm/sec. This is the same permeability that was used in the calculation performed for the approved Apex vertical expansion PTI Application and has been approved at other sites. Guidance Document 700 "Selecting Material for Cap Protection Layers" states that the permeability of vegetative cover soils will likely increase by 1 to 3 orders of magnitude due to years of root intrusion, freeze/thaw, and wet/dry cycles. Based on permeability test results performed for the contiguous

expansion, the average permeability of undisturbed site soils is 5.60E-6 cm/sec. This is approximately 2 orders of magnitude less than the permeability used in the calculation. CEC believes that the permeability of the vegetative cover soils once placed and compacted will be less than or equal to the undisturbed in-situ samples because the vegetative cover will be tracked in with dozers and the in-situ mine spoil was placed in an uncontrolled manner. Therefore, CEC believes that 1.00E-4 cm/sec is representative of the proposed vegetative cover soils long-term permeability. The calculation narrative was revised to state the permeability of 1.00E-4 cm/sec.

Comment No. 8 – The post settlement slope of the leachate collection pipe between points 1230 and 1229 is 0.20%. This is below the regulatory limit of 0.5%. The consultants should revise the design appropriately.

Response: The elevation of the leachate collection system in this area has been revised to maintain a post settlement slope of at least 0.5%. The grading change has been made to Drawings 4A through 4E.

Comment No. 9 – The structural fill area on the west side of phase 7 was not evaluated sufficiently for settlement. Please add the settlement points indicated in Figure 2 and evaluate them for settlement. When this evaluation is complete, the consultant will determine that the slopes in these area do not meet the regulation and the design will need to be revised in this area (see Table 2).

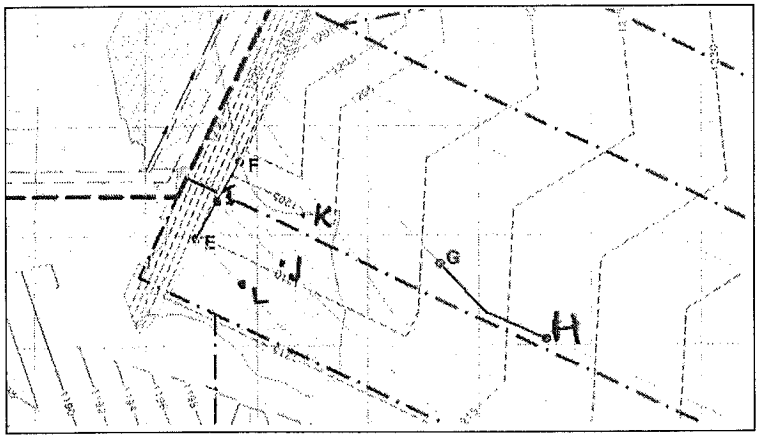


Figure 2

Post Settlement Slope and Strain Calculation – Existing Facility

Table 2

	Pipe		floor		Pipe
Point No.	I	J	K	L	E
Top of RSL El.	1207.1	1209.1	1205.6	1212	1210.3
Top of Waste El.	1265.7	1322	1318	1312	1271.2
Top of Existing Ground El.	1182	1174	1188	1180	1159.8
Top of Bedrock El.	1179.0	1171.0	1185.0	1177.0	1156.8
Top of Final Cover El.	1269.7	1326.0	1322.0	1316.0	1275.2
MSW Thickness (ft)	57.6	111.9	111.4	99.0	60.0
Shot Rock Thickness (ft)	22.1	32.1	14.6	29.0	47.4
Residual Soil Thickness (ft)	3.0	3.0	3.0	3.0	3.0
RSL					
Po (psf)	187.5	187.5	187.5	187.5	187.5
ΔP (psf)	5,987	10,874	10,829	9,713	6,201
S_c (ft)	0.012	0.076	0.076	0.064	0.016
Shot Rock					
Po (psf)	1,547	2,247	1,022	2,030	3,321
ΔP (psf)	7,721	13,308	12,038	11,930	9,709
S_c (ft)	1.730	3.084	1.474	2.689	3.864
Residual Soil					
Po (psf)	195	195	195	195	195
ΔP (psf)	9,268	15,555	13,060	13,960	13,030
S_c (ft)	0.184	0.241	0.222	0.229	0.221
Total S_c (ft)	1.926	3.401	1.771	2.982	4.101
Horizontal Dist. (ft)		210	120		150
Original Distance (ft)		210.010	120.051		150.010
Final Distance (ft)		210.001	120.015		150.027
Pre-settlement Slope (%)		-0.95%	2.92%		1.17%
Post-settlement Slope (%)		-0.25%	1.56%		1.91%
Strain (%)		-0.004%	-0.030%		0.011%
[1] Negative strain indicates tension.		Fail	Fail		Pass

Response: The settlement calculation has been revised to include the analysis of points in Figure 2. Based on the results of our revised calculation, the post settlement slopes in this area meet the minimum slopes required. The revised calculations are provided in Section (C)(4).

ATTACHMENT B

REVISED PTI APPLICATION NARRATIVE

Where indicated, insert the narrative. Otherwise, replace the existing narrative with that provided.

Binder covers and spines
Inside Cover
Table of Contents
Introduction, page I-1
Attachment A1 – pages 1,2,4-6,10 and insert Appendix A
Attachment B1a – pages 1-3
Professional Engineer's Certification
Section (C)(1) Narrative – all pages
Appendix C1-E – Replace summary and insert additional daily logs behind current
Section (C)(2) Narrative – all pages
Section (C)(3) Narrative – page C3-1
Section (C)(6) Narrative – page C6-4
Section (C)(7) Narrative – all pages
Section (C)(8) Narrative – all pages
Section (C)(9) Narrative – page C9-1
Appendix C9-B Explosive Gas Migration Monitoring Plan Application Form
Appendix C9-B – Explosive Gas Monitoring Plan – Cover, pages 2,3-5,7
Appendix C9-C – CQA/QC Plan – Cover, CQA/QC Plan Table of Contents
Page V-1, Table 6, Table 9
Appendix C9-D – Final Closure/Post Closure Plan – Cover, page 6
Section (C)(10) Narrative – page C10-2
Appendix C10-B – insert wetland information in front of current
Insert Appendix C10-C

ATTACHMENT C

REVISED PTI APPLICATION CALCULATIONS

Where indicated, remove or insert the calculation. Otherwise, replace the existing calculation with the one provided.

(C)(4)(a) – Hydrostatic Uplift Analysis and Attachments
(C)(4)(c)&(d) – Global Static and Seismic Slope Stability and Attachments
(C)(4)(c)&(d) – Final Cover Slope Stability
(C)(4)(e) – Settlement Analysis – Replace Calculation Narrative and Attachments A, B and C
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(C)(5)(c) - Leachate Accumulation from Two Slopes
(C)(5)(c) – Sump Infiltration Estimate
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(C)(5)(f) Leachate Collection Pipe Sizing
(C)(5)(f) – Leachate Pump and Force Main Design – Existing Forcemain
(C)(5)(f) – Leachate Pump and Force Main Design – Existing Forcemain with Phase 11 Sump - Insert
(C)(5)(f) – Leachate Pump and Force Main Design – Proposed Forcemain
(C)(5)(F) – Leachate Pump and Force Main Design – Proposed Phase 14 Forcemain - Insert
(C)(5)(h) – Final Closure Cost Estimate
(C)(5)(h) – Post-Closure Cost Estimate
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(C)(5)(k) – Culvert Sizing Calculation
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(C)(5)(l) – North Sedimentation Pond Design Calculation
(C)(5)(m) – Overall Soil Balance and Figure

ATTACHMENT D

REVISED PTI APPLICATION DRAWINGS
(SUBMITTED AS A SEPARATE ROLLED PACKAGE)

ENVIRONMENTAL
LOGISTICS SERVICES
Apex Environmental, LLC

October 27, 2011

Mr. Craig Walkenspaw
Ohio EPA Southeast District Office
Division of Materials and Waste Management
2195 Front Street
Logan, OH 43138

Dear Mr. Walkenspaw:

Subject: Contiguous Expansion Permit To Install Application
Apex Sanitary Landfill
Jefferson County, Ohio

Apex Environmental, LLC. (Apex) is submitting this Permit to Install (PTI) Application for a contiguous lateral and vertical expansion of the Apex Sanitary Landfill. This PTI Application also requests an increase in the Authorized Maximum Daily Waste Receipt (AMDWR). Civil & Environmental Consultants, Inc. (CEC) has prepared the PTI Application on behalf of Apex.

The PTI Application is formatted to comply with the requirements of the Ohio Administrative Code (OAC) 3745-27-06 effective July 1, 2004. Each sections of this PTI Application is presented in the order and format of the regulations. In accordance with OAC 3745-27-06(A)(4), Apex is providing two copies of the PTI Application to the Ohio EPA and one copy to the Jefferson County Health Department. Apex will provide two additional complete copies of the revised PTI Application upon request from the Ohio EPA. Also, attached is a check payable to "Treasurer-State of Ohio" for the required application fee of $400.00.

Additional, related documents include the Hydrogeologic Site Investigation Report by CEC (August 2011), and the Ground Water Detection Plan by CEC (October 2011) which were submitted separately to the Ohio EPA.

Please note that a separate PTI Application is also being submitted to the Division of Air Pollution Control and Division of Surface Water (NPDES permit) for the proposed expansion. Apex would be glad to meet with you to discuss this PTI Application. If you have any questions, please contact me at (704) 543-4389.

Sincerely,

Brendon Pantano
Vice President of Operations
Apex Environmental, LLC.

Enclosures

cc: Jefferson County Health Department (w/ enclosure)
Rick Buffalini, P.E., CEC (w/enclosure)

11877

APEX ENVIRONMENTAL, LLC
15 POLHEMUS LANE
BRIDGEWATER, NJ 08807

FIRST REPUBLIC BANK
SANTA ROSA, CA 95404

11-8166-3210

DATE	CHECK	AMOUNT
10/19/2011		**********400.00

PAY

TO THE ORDER OF

Four hundred and xx / 100 Dollars

Treasurer - State of Ohio
, OH
USA

AUTHORIZED SIGNATURE

AUTHORIZED SIGNATURE

Security features. Details on back.

⑈011877⑈ ⑆321081669⑆ 800006215900⑈

CONTIGUOUS EXPANSION
PERMIT TO INSTALL APPLICATION
APEX SANITARY LANDFILL
JEFFERSON COUNTY, OHIO

PREPARED FOR

Apex Environmental LLC
11 County Road 78
Amsterdam, Ohio 43903

PREPARED BY

Civil & Environmental Consultants, Inc.
333 Baldwin Road
Pittsburgh, Pennsylvania 15205

October 2011
Revised July 2013
Revised December 2015
Revised May 2016

CEC Project 091-867

Volume I of VI

Introduction through Section (C)(2)

CONTIGUOUS EXPANSION
PERMIT TO INSTALL APPLICATION
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JEFFERSON COUNTY, OHIO

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11 County Road 78
Amsterdam, Ohio 43903

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October 2011
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Revised May 2016

CEC Project 101-049

Volume II of VI

Section (C)(3)

CONTIGUOUS EXPANSION
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Revised May 2016

CEC Project 091-867

Volume III of VI

Section (C)(4)

CONTIGUOUS EXPANSION
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JEFFERSON COUNTY, OHIO

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Revised May 2016

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Volume IV of VI

Section (C)(5)

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11 County Road 78
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CEC Project 091-867

Volume V of VI

Section (C)(6) through Section (C)(10)

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JEFFERSON COUNTY, OHIO

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11 County Road 78
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Pittsburgh, Pennsylvania 15205

Revised May 2016

CEC Project 101-049

Volume VI of VI

Section (C)(9)(a) Groundwater Detection Monitoring Program

CONTIGUOUS EXPANSION
PERMIT TO INSTALL APPLICATION
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JEFFERSON COUNTY, OHIO

PREPARED FOR:

Apex Environmental LLC
11 County Road 78
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CEC Project 091-867

Volume III of VI

Section (C)(4)

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Volume IV of VI

Section (C)(5)

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CEC Project 091-867

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APEX
ENVIRONMENTAL LLC

CONTIGUOUS EXPANSION
PERMIT TO INSTALL APPLICATION
APEX SANITARY LANDFILL
JEFFERSON COUNTY, OHIO

CEC

May 2016
CEC Project
101-049

Volume VI of VI
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(C)(9)(a)

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PERMIT TO INSTALL APPLICATION
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CEC Project 091-867

Volume I of VI
Introduction through Section (C)(2)

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CEC Project 101-049

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CEC Project 091-867

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Section (C)(4)

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Volume V of VI
Section (C)(6) through Section (C)(10)

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Pittsburgh, PA 15205

May 2016

CEC Project 101-049

Volume VI of VI
Section (C)(9)(a) Groundwater Detection Monitoring Program

CONTIGUOUS EXPANSION PERMIT TO INSTALL APPLICATION
APEX SANITARY LANDFILL
JEFFERSON COUNTY, OHIO
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INTRODUCTION

Apex Environmental, LLC (Apex) owns and operates the Apex Sanitary Landfill located in Jefferson County, Ohio. The solid waste disposal facility has been in operation since 2005 and currently operates under Ohio EPA Permit to Install (PTI) No. 06-08438 issued December 31, 2009.

Apex is submitting this Permit to Install (PTI) Application for a contiguous lateral expansion to extend the horizontal limits of waste placement of the landfill. The contiguous expansion will also result in a vertical increase in elevation of waste placement. In addition, this PTI Application requests an increase in the Authorized Maximum Daily Waste Receipt (AMDWR) for the facility. Specifics regarding the expansion are summarized below:

	Currently Permitted	Requested Increase	New Permit Total
Limit of waste placement	117.5 acres	171 acres	288.5 acres
Airspace (approx.)	22.5 MCY (1)	~~60.6~~ *61.1* MCY	~~83.1~~ *83.6* MCY
AMDWR	7,500 tons/day	2,500 tons/day	10,000 tons/day

1) MCY means million cubic yards

The contiguous expansion impacts some wetlands, streams, and open bodies of water, many of which are remnants of the coal strip mining that has occurred over the years. Apex will restore and/or replace the wetlands and streams with features of equivalent or higher ecological value, which will increase the overall area of wetland and stream habitat. A separate permit application regarding the wetlands, streams, and water bodies will be submitted to the Ohio EPA and U.S. Army Corps of Engineers. Another separate application will be submitted to the Ohio EPA Division of Air Pollution Control.

Constructed environmental protection features of the expansion, such as liner system, cover system, gas management, and leachate management will be consistent with those currently permitted.

This PTI Application is formatted to comply with the requirements in Rule 3745-27-06(C) of the Ohio Administrative Code which requires a narrative to include the following:

- (C)(1) Summary of the Site Environs;
- (C)(2) Variances and Exemption Requests;
- (C)(3) Hydrogeologic Site Investigation Report;
- (C)(4) Stability Analysis;
- (C)(5) Calculations;
- (C)(6) Location Restriction Demonstrations;
- (C)(7) Construction Information;
- (C)(8) Operational Information;
- (C)(9) Plans; and
- (C)(10) Notifications and Certifications.

Drawings specified in Rule 3745-27-06(B)

- (B)(1) Title Sheet
- (B)(2) Publically Available Information
- (B)(3) Site Features
- (B)(4) Grading Plans
- (B)(5) Cross Sections
- (B)(6) Phased Development Plans
- (B)(7) Details

Each section of this PTI Application is presented in the order and format of the regulations. For convenience, each regulation is cited verbatim followed by narrative which provides the information required by that regulation. Because of references to other portions of the regulations within Rule 3745-27-06(C), the following additional rules are cited and addressed in this PTI Application:

- 3745-27-07
- 3745-27-08
- 3745-27-11
- 3745-27-14
- 3745-27-19
- 3745-27-20

The information contained in Rule 3745-27-06(A) is procedural information which is included within this PTI Application where appropriate.

Ohio Environmental Protection Agency
Lazarus Government Center
P.O. Box 1049
Columbus, Ohio 43216-1049

GENERAL COVER SHEET

For EPA Use Only

Application or ID Number _____

Core Place ID _____

Date Received _____

Check No. _____ Check ID No. _____

Check Date _____ Amount _____

Revenue ID No. _____

G DAPC
G DDAGW
G DHWM
G DSW
G DSIWM
G RTK
G DEFA
G TRI
G _____

Route to:

1. Facility Information

Legal Name	Apex Environmental, LLC
Alternate Name	Apex Sanitary Landfill
Street Address	11 County Road 78 - P.O. Box 157
City/State/Zip	Amsterdam, Ohio 43903
Location	Apex Sanitary Landfill is located east of Jefferson CR-78 and Harrison CR-51.
	It is approximately 1 mile north of SR-646.
County/Township	Jefferson and Harrison Counties, Springfield Township
Lat./Long./Point Description	~40°25'40" N
	~80°54'48" W

Facility Type: *(shaded areas indicate the attachment is under development)*

Y	Facility Type	Required Attachments	
X	Municipal Solid Waste Landfill	A1	B1a
	Industrial Solid Waste Landfill	A1	B1b
	Residual Solid Waste Landfill	A1	B1c
	Solid Waste Transfer Facility	A2	B2
	Scrap Tire Monofill	A3a	B3a
	Scrap Tire Monocell - Contiguous to MSW Landfill	A3b	B1a
	Scrap Tire Monocell - Contiguous to ISW Landfill	A3b	B1b
	Scrap Tire Monocell - Non-Contiguous to Landfill	A3b	B3a
	Scrap Tire Submergence Facility	A3a	B3b

	Class I Scrap Tire Storage Facility	A4	B4
	Class I Scrap Tire Recovery Facility	A4	B4
	Solid Waste Incinerator or Energy Recovery		
	Class I Solid Waste Composting Facility		
	Infectious Waste Treatment Facility		

2. Applicant Information

Applicant Name	Apex Environmental, LLC
Mailing Address	11 County Road 78
	P.O. Box 157
City/State/Zip	Amsterdam, Ohio 43903
Phone Number	740-543-4389
Email Address	
Billing Address	11 County Road 78
	P.O. Box 157
City/State/Zip	Amsterdam, Ohio 43903

3. Operator Information (if different from applicant)

Operator Name	Same
Mailing Address	
City/State/Zip	
Phone Number	

4. Land Owner Information (if different from applicant)

Land Owner Name	Same
Mailing Address	
City/State/Zip	
Phone Number	

5. Preparer Information (if different from applicant)

Preparer Name	Rick J. Buffalini, P.E.
Company	Civil & Environmental Consultants, Inc.
Mailing Address	333 Baldwin Road
City/State/Zip	Pittsburgh, PA 15205
Phone Number	412-429-2324
Email Address	rbuffalini@cecinc.com

duplicate page as necessary to add multiple land owners or preparers

Authorized Signature[1]: Under OAC rule 3745-27-02, this signature shall constitute personal affirmation that all statements or assertions of fact made in the application are true and complete, comply fully with applicable state requirements, and shall subject the signatory to liability under those state laws forbidding false or misleading statements.

Authorized Signature — Date: 10/20/11

Chief Operating Officer

Title

GENERAL ACKNOWLEDGMENT FORM

STATE OF New Jersey)
) ss.
COUNTY OF Somerset)

On this the 20 day of October, 2011 before me, _____, the undersigned Notary Public, personally appeared _____, proved to me on the basis of satisfactory evidence to be the person(s) whose name(s) was/were subscribed to the within instrument, and acknowledge that he/she/they executed it.

WITNESS my hand and official seal.

Lillian Cruz
Notary Public
New Jersey
My Commission Expires 11-23-2014

[1] Permit to install applications for municipal solid waste landfills, industrial solid waste landfills, residual waste landfills, and scrap tire monofills are not required to include the authorized signature until Ohio EPA requests it.

Under OAC 3745-27-02, the application for a permit to install shall be signed by either the owner or operator of the facility and shall be:

(a) in the case of a corporation, by a principal executive officer of at least the level of vice president, or his duly authorized representative, if such representative is responsible for the overall operation of the facility.

(b) in the case of a partnership, by a general partner.

(c) in the case of a limited liability company by a manager, member, or other duly authorized representative of the limited liability company, if such representative is responsible for the overall operation of the facility.

(d) in the case of sole proprietorship, by the owner.

(e) in the case of a municipal, state, federal or other governmental facility, by the principal executive officer, the ranking elected official, or other duly authorized employee.

Authorized Signature[1]: Under OAC rule 3745-27-02, this signature shall constitute personal affirmation that all statements or assertions of fact made in the application are true and complete, comply fully with applicable state requirements, and shall subject the signatory to liability under those state laws forbidding false or misleading statements.

5/19/16

Authorized Signature — Date

Vice President of Operations

Title

GENERAL ACKNOWLEDGMENT FORM

STATE OF OHIO)
) ss.
COUNTY OF JEFFERSON)

On this the 19th day of MAY, 2016 before me, CRAIG A. PETRELLA, the undersigned Notary Public, personally appeared JOE TATAREK, proved to me on the basis of satisfactory evidence to be the person(s) whose name(s) was/were subscribed to the within instrument, and acknowledge that he/she/they executed it.

WITNESS my hand and official seal.

CRAIG A. PETRELLA

NOTARY PUBLIC
STATE OF OHIO

My Commission Expires
October 10, 2018

[1] Permit to install applications for municipal solid waste landfills, industrial solid waste landfills, residual waste landfills, and scrap tire monofills are not required to include the authorized signature until Ohio EPA requests it.

Under OAC 3745-27-02, the application for a permit to install shall be signed by either the owner or operator of the facility and shall be:

(a) in the case of a corporation, by a principal executive officer of at least the level of vice president, or his duly authorized representative, if such representative is responsible for the overall operation of the facility.

(b) in the case of a partnership, by a general partner.

(c) in the case of a limited liability company by a manager, member, or other duly authorized representative of the limited liability company, if such representative is responsible for the overall operation of the facility.

(d) in the case of sole proprietorship, by the owner.

(e) in the case of a municipal, state, federal or other governmental facility, by the principal executive officer, the ranking elected official, or other duly authorized employee.

APPENDIX F

SOLID WASTE FACILITY DATA SHEET

Submittal Procedure

Submit four (4) copies of the Permit to Install application to the appropriate District office of the Ohio Environmental Protection Agency (Ohio EPA). Also, submit the application fee to the District office with the Permit to Install application.

Submit one copy of the Permit to Install application to the local Board of Health within seven (7) days after submitting the application to the Ohio EPA.

In accordance with the following applicable rule of the Ohio Administrative Code;

3745-27-06(A)(2) for municipal solid waste landfills
3745-29-06(A)(2) for industrial solid waste landfills
3745-30-05(A)(2) for residual solid waste landfills
3745-27-21(A)(2) for solid waste transfer facilities
3745-27-42(A)(1) for solid waste composting facilities
3745-27-50(A)(2) for solid waste incinerators

concurrent to submitting the Permit to Install application, the applicant must:

Submit a disclosure statement to the Office of the Attorney General as required in Rules 109:6-1-01 through 109:6-1-04 of the Ohio Administrative Code (OAC), and submit to the Division of Air Pollution Control and to the Division of Surface Water of the Ohio EPA, written notification of intent to site a municipal, industrial or residual solid waste facility and a written request for information pertaining to any regulatory requirements under Chapter 3704 or Chapter 6111 of the Ohio Revised Code (ORC).

Content/ Formatting Requirements

As of March 1, 1990, all Permit to Install applications must contain the information required by OAC Chapter 3745-27 for municipal solid waste landfill facilities, transfer facilities, composting facilities and incinerators; OAC Chapter 3745-29 for industrial solid waste landfill facilities, or; OAC Chapter 3745-30 for residual solid waste landfill facilities.

APPENDIX F

SOLID WASTE FACILITY DATA SHEET

GENERAL FACILITY INFORMATION

Name of Facility	**Apex Sanitary Landfill**				
Address	**11 County Road 78**				
City	**Amsterdam**	State	**Ohio**	ZIP	**43903**
County	**Jefferson and Harrison**	Township	**Springfield**		
Exact Location	**This site is located east of Jefferson County Road 78 and Harrison County Road 51 and approximately one mile north of State Road 646.**				

TYPE OF APPLICATION (Check all that apply)

[ ] New Facility [x] Modification (check below)

January 21, 1998
Original approval date

[X] Capacity Expansion
[X] Authorized Maximum Daily Waste Receipt change
[ ] Design Change
[ ] Other (specify) _____

APPLICANT INFORMATION

Name of Applicant	**Apex Environmental, LLC**				
Address	**11 County Road 78**				
City	**Amsterdam**	State	**Ohio**	ZIP	**43903**
Telephone	**(740) 543-4389**				

FACILITY OPERATOR INFORMATION

Name of Operator	**Apex Environmental, LLC**				
Address	**11 County Road 78**				
City	**Amsterdam**	State	**Ohio**	ZIP	**43903**
Telephone	**(740) 543-4389**				

Any prior solid waste facility operation experience ? YES or NO If yes, please explain.

YES, Apex Environmental, LLC constructed and has operated Apex Sanitary Landfill since 2005.

FACILITY LANDOWNER INFORMATION

Name of Landowner	**Apex Environmental, LLC**				
Address	**11 County Road 78**				
City	**Amsterdam**	State	**Ohio**	ZIP	**43903**
Telephone	**(740)-543-4389**				

FACILITY DESIGNER INFORMATION

Name of Designer	**Civil & Environmental Consultants, Inc.**				
Address	**333 Baldwin Road**				
City	**Pittsburgh**	State	**PA**	ZIP	**15205**
Telephone	**(412) 429-2324**				
Registered Engineer	**Rick J. Buffalini, P.E.**	Registered Surveyor	**Not Applicable**		
Other Registered person (please explain)					

Any prior solid waste facility design experience ? YES or NO If yes, please list projects.

YES, CEC has extensive experience with the design, permitting, construction and closure of solid waste landfills in Ohio and other states.

DIVISION OF SOLID AND INFECTIOUS
WASTE MANAGEMENT
Municipal, Industrial, and Residual Solid Waste Landfills

The information requested by this attachment is not required by rule, however it is useful to permit reviewers and the general public.

Multimedia Information, check all that apply:

Division of Surface Water

A Table of Effective and Pending Permits is presented in Appendix A.

Current NPDES Permit

Permit Number OIN00198*GD

Date Issued January 22, 2015

Leachate discharge to public sewer	Current		Proposed			
On-Site Leachate Treatment	Current		Proposed			
On-site Sanitary Treatment	Current	X	Proposed			
Waste Solidification	Current	*X*	Proposed			
Sedimentation Basin	Current	X	Proposed	X		
Holding Tank	Current	X	Proposed			
Stream Relocation	No		Yes	X		
Spillway Relocation	No	X	Yes			
New Outfall	No		Yes	X		
Headwater Removal	No	X	Yes			
401 Permit						
Required	No		Yes	X		
Submitted	No		Yes	X	Date	February 2016
Issued	No	X	Yes		Date	
404 Certification Required						
Required	No		Yes	X		
Submitted	No		Yes	X	Date	February 2016
Issued	No	X	Yes		Date	
Isolated Wetland Permit					Date	
Required	No		Yes	X		
Submitted	No		Yes	X	Date	February 2016
Issued	No	X	Yes		Date	

☐ Initial ☑ Revised May 2016
date

Division of Air Pollution Control

A Table of Effective and Pending Permits is presented in Appendix A.

Current DAPC Permit

Permit Number	06-07264	06-07467	P0103987
Date Issued	01/14/05	10/08/04	12/31/09

New/Revised DAPC permit application

Required	No		Yes	X		
Submitted	No		Yes	X	Date	12/30/2015
Issued	No	X	Yes		Date	
Active Gas Extraction	Current	X	Proposed	X		
Flare	Current	X	Proposed	X		
Rail Spur	Current	X	Proposed	*X*		
Additional Storage Piles	No	X	Yes			
Additional Haul Roads	No		Yes	X		
Waste Relocation	No	X	Yes			

Type of Daily Cover	soil
Dust Suppressant Used	water

Other Permits

A Table of Effective and Pending Permits is presented in Appendix A.

Permit	Local, State, or Federal Office	Date Applied for

Other Licenses

License	Local, State, or Federal Office	Date Applied for
Annual Operating License	Jefferson County General Health District	September each year

Other Plan Approvals

Plan	Local, State, or Federal Office	Date Applied for

Other Authorizations

Authorization	Local, State, or Federal Office	Date Applied for

☐ Initial ☑ Revised May 2016
date

Additional Information

1. Please indicate the reason for this application (check all that apply).

	New Facility		Design Modification
X	Lateral Expansion		Call-In, ORC 3734.05(A)(5)
X	Vertical Expansion		Operational Modification
X	AMDWR Change		Call-In, ORC 3734.05(A)(3) or (4)

2. If the facility is a residual waste landfill, please indicate the proposed classification of the landfill.

	Class I		Class II		Class III		Class IV

3. Please identify the licensing authority (Ohio EPA or local health department, if approved).

Licensing Authority: JEFFERSON COUNTY GENERAL HEALTH DISTRICT

4. Please state the name of the uppermost aquifer system below the limits of waste and the minimum distance between the uppermost aquifer system and the bottom of the liner system. (If there is more than one, then list all of them.)

Name of Aquifer System	Distance from liner to Aquifer System
Connellsville-Morgantown Association	> 15 feet

5. Please state the anticipated date and the location of the applicants meeting required by Ohio Revised Code 3734.05.

Location: John E. Gregg School, 212 Township Road 75A, Bergholz, Ohio 43908

Anticipated Date: November 30, 2011

Applicant's Meeting: Requirements and Ohio EPA Recommendations

The applicant is required to hold a public meeting no later than 35 days after submitting certain applications. See ORC 3734.05(A)(2)(d) for public meeting requirements.

At least 30 days before the public meeting, the applicant must publish notice of the meeting in all newspapers of general circulation published in the county. For information on newspapers of general circulation, contact Ohio EPA's Public Interest Center at (614) 644-2160.

The Agency recommends that the applicant contact each newspaper to ensure the legal notice is published in all newspapers in time to comply with the required deadlines.

No later than 5 days after the notice is published, the applicant must send a copy of the notice(s), with the date(s) published, by certified mail to the director of Ohio EPA.

The notice must also be sent by certified mail to the legislative authority and the chief executive officer of each municipal corporation, and the legislative authority of each township and each county in which the facility is or is proposed to be located.

No later than 30 days after the public meeting, the applicant must provide the director of Ohio EPA with a copy of the full meeting transcript; copies of any exhibits, displays or other materials presented at the meeting; and the original copy of any written comments submitted at the meeting.

The meeting shall include:
* description of the permit application process by an Ohio EPA employee,
* outline of the proposal in the permit application by the applicant,
* response by the applicant to comments and questions raised during the meeting, and
* an opportunity for citizens to submit written or oral comments regarding the application.

In addition, the Agency recommends that the applicant:
* arrange for any necessary audio/visual equipment,
* provide DSIWM's fact sheet regarding the permit to install process,
* prepare and provide fact sheets about the facility,
* provide registration sheets for a record of attendance and mailing list, and
* establish an information repository in a library near the facility.

Applicants are responsible for all costs of their public meeting except for Ohio EPA personnel costs.

6. Please list all variances and exemptions, pursuant to OAC 3745-27-03, requested in the permit application:

Variance/Exemption: OAC 3745-27-07(H)(2)(b): Siting of a sanitary landfill facility in a limestone quarry.

Variance/Exemption: *OAC 3745-27-07(H)(3)(c): Siting of a sanitary landfill facility one thousand feet from water supply well.*

Variance/Exemption: _____

7. Please list all alternatives, where allowed by rule, requested in the permit application:

Alternative: _____

Alternative: _____

Alternative: _____

Alternative: _____

8. Please state the acreage of the property where the facility will be located, and how much of this property is owned, leased, and not currently owned or leased, by the applicant.

1,285	Total Facility Area (acres)

1,285	Total Area Owned (acres)
	Total Area Leased (acres)
590	Total Other (acres) Explain: Facility Boundary

9. Please state the acreage of the facility within the limits of solid waste placement, and how many acres were previously approved, currently filled, and proposed to be filled as part of this application.

288.5	Total Area Within the Limits of Waste Placement (acres)

117.5	Area Previously Approved (acres)
95.7	Area Currently Filled (acres) **as of 12/31/16*
171	New Area Added (or Subtracted) by this Permit (acres)

10. Please state the volume of the landfill in cubic yards, and how much of this volume is previously approved, currently filled, and proposed as part of this application.

83,616,439	Total Volume (cubic yards)

22,523,618	Volume Previously Approved (cubic yards)
7,300,606	Volume Currently Filled (cubic yards)*as of *12/31/16*
61,092,821	New Volume Proposed by this Permit (cubic yards) This figure should be the same used to calculate the permit fee as per ORC 3745.11(Q)

11. Please state the authorized maximum daily waste receipt (AMDWR) requested for this facility and the anticipated daily waste receipt.

10,000	AMDWR (tons)	See C5a	Anticipated Daily Waste Receipt (tons)
7,500	Current AMDWR (tons), if any		

12. If the facility is a proposed new site, expansion, or AMDWR change, please state the life expectancy of the facility based on the total volume using the AMDWR and anticipated daily waste receipt if this application is approved.

17.9	Life Expectancy Using the AMDWR (years) **as of 12/31/16*
See C5a	Life Expectancy Using the Anticipated Daily Waste Receipt (years)

See Section (C)(5)(h) for detailed cost estimate.

Closure Cost Estimate.

$14,936,338	Total Closure Cost Estimate
141.2 acres	Worst Case Acreage

Description of when worst case occurs: See Drawing 6*D*. With Phase *10* opened and large intermediate cover area.

CY = Cubic Yards SF = Square Foot LF = Linear Foot EA = Each LS = Lump Sum

I	**Ground Water Monitoring Wells**			
	Item Description	Quantity	Unit Cost	Item Cost
a	Ground Water Monitoring Well Installation and Development (EA)		$	$
b	Ground Water Monitoring Well Repair and Replacement (EA)		$	$
c			$	$
Subtotal for Ground Water Monitoring Wells				$

II	**Fill and Grade (for premature closure)**			
	Item Description	Quantity	Unit Cost	Item Cost
a	Mobilization / Demobilization (LS)			$
b	Soil (CY**)		$	$
c	Excavation (CY)		$	$
d	Placement/ Spreading (CY)		$	$
e	Compaction (CY)		$	$
f	Transportation cost of materials (CY) (transport radius:_____)		$	$
g	Materials Testing (LS) (field and lab)			$
h	Surveying (LS)			$
i	QA/QC (LS)			$
j			$	$
Subtotal for Slope and Fill				$

** Note that the actual surface area may be significantly larger than the plan area depicted in the authorizing document. In addition, the volume of soil, once compacted, may be different than the volume excavated.

III	**Cap System Components**			
	Item Description**	Quantity	Unit Cost	Item Cost
a	Gas Collection Layer (CY or SF)		$	$
b	Sub-Base Layer (CY)		$	$
c	Engineered Barrier Layer (CY)		$	$
d	Geosynthetic Clay Liner (SF)		$	$
e	Flexible Membrane Liner (FML) (SF)		$	$
f	Drainage Layer (CY or SF)		$	$
g	Freeze Thaw Protection Layer (CY)		$	$
h	Vegetative Layer (CY)		$	$
i	Surface Water Control System (on the cap) (LS)			$
j	Mobilization/Demobilization for Earthwork (LS)			$
k	Mobilization/Demobilization for Geosynthetics (LS)			$
l	Temporary Erosion Control: Silt Fences (LF) Straw Bales (EA) Other Erosion Control		 $ $ $	 $ $ $
m			$	$
Subtotal Cap System Components				$

** Note that the actual surface area may be significantly larger than the plan area depicted in the authorizing document. In addition, the volume of soil once compacted, may be different than the volume excavated.

IV	**Permanent Surface Water Structures (outside limits of waste placement)**	
	Item Description	Item Cost
a	Surface Water Control Structures	$
b	Surface Water Conveyance Structures	$
c	Mobilization/Demobilization	$
d		$
Subtotal Permanent Surface Water Structures		$

V	**Explosive Gas Extraction and/or Control System**			
	Item Description	Quantity	Unit Cost	Item Cost
a	Extraction Well Installation, Repair, and Replacement (EA)		$	$
b	Collection System Installation, Repair, and Replacement (LF)		$	$
c	Flare System Installation, Repair, and Replacement (EA)		$	$
d	Establishment of Utilities and Supplemental Fuel System (LS)			$
e	Special Controls and Conveyance Structures		$	$
f	Mobilization/Demobilization (LS)			$
g	QA/QC & Certification (LS)			$
h			$	$
Subtotal Explosive Gas Extraction and/or Control System				$

VI	**Explosive Gas Monitoring System**	
	Item Description	Item Cost
a	Gas Monitoring Probe Installation, Repair, and Replacement	$
b	Alarm Installation and Replacement	$
c		$
Subtotal Explosive Gas Monitoring System		$

VII	**Access Control**			
	Item Description	Quantity	Unit Cost	Item Cost
a	Fencing (LF)		$	$
b	Gate (EA)		$	$
c	Sign (EA)		$	$
d			$	$
Subtotal Access Control				$

VIII	**Engineering** (QA/QC)			
	Item Description	Quantity	Unit Cost	Item Cost
a	Revisions to Closure Plan Report (LS)			$
b	Certified engineering designs and calculations for construction (LS)			$
c	Surveying (Acre)		$	$
d	Benchmark Installation (EA)		$	$
e	Benchmark Survey (EA)		$	$
f			$	$
Subtotal Engineering				$

IX	**Other Costs** List all other costs not included in other sections			
	Item Description	Quantity	Unit Cost	Item Cost
a	Environmental Monitoring (LS)			$
b	Utilities (LS)			$
c	Restoration of Borrow Areas (Acre)		$	$
d			$	$
Subtotal Site Specific Costs				$

Section IV – Cost Estimates **Attachment A1**

Post-Closure Care Cost Estimate.

See Section (C)(5)(i) for detailed cost estimate.

$11,587,721	Total Post-Closure Cost Estimate

CY = Cubic Yards SF = Square Foot LF = Linear Foot EA = Each LS = Lump Sum

I	**Inspection and Reporting**			
	Item Description	Annual Quantity	Unit Cost	Annual Cost
a	Ground Water Monitoring Report (EA)		$	$
b	Explosive Gas Monitoring Quarterly Report (EA)	4	$	$
c	Explosive Gas Monitoring Semi-Annual Report (EA)	2	$	$
d	Inspection (EA)	4	$	$
e	Inspection Summary (EA)	4	$	$
f	Annual Report (EA)	1	$	$
g	Other Reporting (Orders, Authorizing Documents) (EA)		$	$
h			$	$

Total Annual Cost	$
Total Annual Cost multiplied by years of post-closure care	$

	Item Description	Item Cost
i	Post-Closure Certification	$
Subtotal for Inspection and Reporting		$

II	**Ground Water Monitoring**	
	Item Description	Annual Cost
a	Trace Metals	$
b	Volatile and Semivolatile Organic Compounds	$
c	General Ground Water Quality Parameters	$
d	Alternate Parameter List (site specific)	$
e	Assessment Monitoring Parameters	$
f	Background Sampling (for new wells only)	$
g	Collection and Transportation of Samples	$
h		$
Subtotal for Ground Water Monitoring (total annual cost multiplied by years of post-closure care)		$

☐ Initial ☑ Revised May 2016
date

III	**Explosive Gas Migration Monitoring**			
	Item Description	Annual Quantity	Unit Cost	Annual Cost
a	Quarterly (Years 1-5) (per Sample Event)	4	$	$
b	Semi-Annual (Years 6-30) (per Sample Event)	2	$	$
c	Alternate Frequency (per Sample Event)		$	$
d			$	$
Total Annual Cost				$
Subtotal for Gas Monitoring (for all years of post-closure care)				$

IV	**Leachate Monitoring**	
	Item Description	Annual Cost
a	Annual Grab Sample 3745-27-14(A)(6)(b)	$
b	Cost of Testing for Special Constituents	$
c	Collection and Transportation of Samples	$
d		$
Subtotal for Leachate Monitoring (total annual cost multiplied by years of post-closure care)		$

V	**Surface Water Monitoring**	
	Item Description	Annual Cost
a	Sampling per NPDES Permit, Closure Plan, or Other Authorizing Document	$
b	Collection and Transportation of Samples	$
c		$
Subtotal Surface Water Monitoring (total annual cost multiplied by years of post-closure care)		$

VI	**Operation and Maintenance of Leachate Collection and Treatment System**			
	Item Description	Annual Quantity	Unit Cost	Annual Cost
a	Inspection & Flushing of Collection Pipes (LF)		$	$
b	Inspection & Cleaning of Sumps and Traps (EA)		$	$
c	Replacement of Sump pumps, piping, and instrumentation (EA)		$	$
d	Inspection & Cleaning of lift station(s), manhole(s), and conveyance structures (EA)		$	$
e	Replacement of conveyance structure pumps, piping, and instrumentation (EA)		$	$
f	Tanks (Spill containment repair, sealing, tank cleaning, and inspection) (EA)		$	$
g	Transportation Cost of Sludge Removal (CY) transportation radius:_____		$	$
h	Disposal Cost for Sludge Removal (CY) disposal site: _____		$	$
i	Characterization Cost of Sludge Removal (CY)		$	$
j	Off-site Disposal of Leachate (LS)			$
k	On-site Treatment and/or Pretreatment of Leachate (LS)			$
l			$	$
Subtotal Operation and Maintenance of Leachate Collection and Treatment Systems (total annual cost multiplied by years of post-closure care)				$

VII	**Operation and Maintenance of Ground Water Monitoring System**		
	Item Description	Unit Cost	Annual Average Cost
a	Routine Maintenance (inspection, cleaning, repairing) (LS)		$
b	Repair & Replacement of Monitoring Wells (LS)		$
c		$	$
Total Annual Cost			$
Total Annual Cost multiplied by years of post-closure care			$
	Item Description	Unit Cost	Item Cost
d	Abandonment at end of post-closure care period (number of wells: _____)	$	$
Subtotal for Operations and Maintenance of Ground Water Monitoring System			$

☑ Initial ☐ Revised _____ date

VIII	**Operation and Maintenance of Explosive Gas Extraction and/or Control System**		
	Item Description	Unit Cost	Annual Average Cost
a	Extraction Well Repair & Replacement (LS)		$
b	Collection System Repair & Replacement (LS)		$
c	Flare System Repair & Replacement (LS)		$
d	Air Emissions Monitoring [NSPS and OAC 3745-76] (number of years to be monitored:_____)	$	$
e	Special Control & Conveyance Structures (LS)		$
f		$	$
Total Annual Cost			$
Total Annual Cost multiplied by years of post-closure care			$
	Item Description	Unit Cost	Item Cost
g	Well Abandonment at end of post-closure care period (number of wells: _____)	$	$
h	System Abandonment at end of post-closure care period (LS)		$
Subtotal for Operation & Maintenance of Explosive Gas Extraction and/or Control System			$

IX	**Operation and Maintenance of Explosive Gas Monitoring System**		
	Item Description	Unit Cost	Annual Average Cost
a	Inspection, Repair & Replacement of Monitoring Probes (LS)		$
b	Inspection, Repair & Replacement of Monitoring Alarms (LS)		$
c			$
Total Annual Cost			$
Total Annual Cost multiplied by years of post-closure care			$
	Item Description	Unit Cost	Item Cost
d	Abandonment at end of post-closure care period (number of probes: _____)	$	$
Subtotal for Operations and Maintenance of Gas Monitoring System			$

Section IV – Cost Estimates **Attachment A1**

X	**Utilities for Operation**				
	Item Description	Supplier	Annual Quantity	Unit Cost	Annual Cost
a	Electricity			$	$
b	Natural Gas			$	$
c	Propane			$	$
d				$	$
Subtotal for Utilities for Operation (total annual cost multiplied by years of post-closure care)					$

XI	**Maintenance of Cover System**			
	Item Description	Annual Quantity	Unit Cost	Annual Cost
a	Mowing, fertilizing, removal of trees, mulching, and seeding (EA)		$	$
b	Cap Repair (leachate outbreak repair, erosion rill repair, differential settlement repair)		$	$
c	Maintain Grade & Erosion Repair Minimum based on annual erosion rate		$	$
d	Rodent Control (Acre)		$	$
e			$	$
Subtotal for Maintenance of Cover System (total annual cost multiplied by years of post-closure care)				$

XII	**Operation and Maintenance of Surface Water Management System**			
	Item Description	Annual Quantity	Unit Cost	Annual Cost
a	Inspection, Cleaning & Repair of Ditches (LF)		$	
b	Inspection, Cleaning & Repair of Conveyance Structure (EA)		$	
c	Inspection, Cleaning & Repair of Sedimentation Pond (EA)		$	
d	Inspection, Cleaning & Repair of Spillway/Outlet (EA)		$	
e			$	
Subtotal for Operation and Maintenance of Surface Water Management System (total annual cost multiplied by years of post-closure care)				$

☑ Initial ☐ Revised _____ date

XIII	**Operation and Maintenance of Access Control Structures**			
	Item Description	Annual Quantity	Unit Cost	Annual Cost
a	Inspection, Repair & Replacement of Fence (LF)		$	$
b	Inspection, Repair & Replacement of Gate (EA)		$	$
c	Inspection, Repair & Replacement of Sign (EA)		$	$
d	Maintenance of Roadways (LF)		$	$
e			$	$
Subtotal for Operation and Maintenance of Access Control Structures (total annual cost multiplied by years of post-closure care)				$

APPENDIX A

TABLE OF EFFECTIVE AND PENDING PERMITS

Table of Effective and Pending Permits
Updated May 2016
Apex Sanitary Landfill

Regulator	Description	Permit ID #	Issue Date
Water and Wastewater Permitting			
Ohio EPA	PTI, On-site Wastewater Treatment/Disposal System for Office Building	06-7901	10/13/05
Ohio EPA	PTI, On-site Wastewater Treatment/Disposal System for Rail Facility Breakroom/Scalehouse	06-8015	02/01/06
Jefferson County GHD	Private Water System Installation Permit for Scale House/Office	29-2005	01/20/06
Jefferson County GHD	Private Water System Installation Permit for Rail House	2005-0029	06/01/07
Ohio EPA	PTI, Installation of a Sedimentation Impoundment	870776	06/06/12
Ohio EPA	NPDES Permit Renewal	0IN00198*GD	01/22/15
Ohio EPA	NPDES Permit Renewal	0II00022*DD	01/23/15
Ohio EPA	Indirect Discharge Permit	0DP00050*BP	02/15/11
Ohio EPA	Indirect Discharge Permit	0DP00050*CP	Pending, submitted 09/01/15
Ohio EPA	NPDES Permit Modification for the Contiguous Expansion	0IN00198*HD	Pending, submitted 12/28/15
Dam Permitting			
ODNR	Dam Safety Engineering Program Class IV dam exemption from construction permit requirements	n/a	10/29/04
Solid Waste Permitting			
Ohio EPA	PTI, Vertical Expansion and AMDWR Increase	06-08438	12/31/09
Ohio EPA	PTI Alteration Request, Phase 5 Revisions	06-08438	10/27/10
Ohio EPA	PTI Alteration Request, 2011 Phasing Revisions	06-08438	06/14/11
Ohio EPA	PTI Alteration Request, 2011 Revision to Odor Management Plan	06-08438	08/05/11
Ohio EPA	PTI Alteration Request, 2012 Rail Area Improvements	06-08438	03/16/12
Ohio EPA	April 2012 GCCS As-built Alteration	06-08438	05/29/12
Ohio EPA	June 2012 GCCS As-built Alteration	06-08438	06/14/12
Ohio EPA	PTI Alteration Request, 2012 Rail Yard Expansion	06-08438	08/09/12

Regulator	Description	Permit ID #	Issue Date
Ohio EPA	Authorization to Construct and Operate a Solidification Basin	06-08438	11/27/12
Ohio EPA	PTI Alteration Request, 2012 Phase 6 Subdivision	06-08438	12/21/12
Ohio EPA	Fall 2012 GCCS As-Built Alteration	06-08438	02/28/13
Ohio EPA	Spring 2013 GCCS As-Built Alteration	06-08438	07/16/13
Ohio EPA	PTI Alteration Request, 2015 Phase 6 Phasing Revision	06-08438	01/21/15
Ohio EPA	Odor Management Plan Alteration	06-08438	07/20/15
Ohio EPA	PTI Modification, Contiguous Expansion and AMDWR Increase	06-08448	Pending, submitted 10/27/11
Air Permitting			
Ohio EPA	Final Permit to Install and Operate for Emissions Unit P001 (Caterpillar 330C Hydraulic Excavator diesel engine)	06-07264	1/15/2004 (Emissions Source Removed 11/30/2015)
Ohio EPA	Final Permit to Install and Operate for Emissions Unit F003 (Storage Piles)	06-07467	10/28/04
Ohio EPA	Environmentally Beneficial Determination for Installation of Temporary Flare		04/10/09
Ohio EPA	Final Permit to Install for Modifications of PTI 06-06987, 06-07467, 06-07264 for Emissions Sources F001 (Paved and Unpaved Roadways and Parking Areas), F002 (Refuse Disposal Activities), F004 (Rail Unloading Facility Unpaved Roadway), and F005 (Materials Handling Operations)	P0103987	12/31/09
Ohio EPA	Final Permit to Install for Emissions Unit F008 (Aggregate Processing Plant)	P0109402	02/13/12
Ohio EPA	Air Pollution Source Permit to Install Modification Application for Contiguous Expansion and AMDWR Increase	Pending	Pending, submitted 12/30/15
Wetlands Permitting			
Department of Army Corps of Engineers	Section 404 Clean Water Act permit for wetland and stream impacts	200400270	12/13/04
Ohio EPA	Section 401 Water Quality Certification and/or Isolated Wetland Permit	049815	11/23/04

Regulator	Description	Permit ID #	Issue Date
Ohio EPA	Modification of Section 401 Water Quality Certification and/or Isolated Wetland Permit to transfer to Apex	049815	12/17/04
Department of Army Corps of Engineers	Revised Mitigation Compliance Schedule and Permit Extension	200400270	10/09/09
Ohio EPA	401 Water Quality Certification and the Ohio Isolated Wetland Permit	124004	Pending, submitted 2/12/2016
Department of Army Corps of Engineers	Section 404 Clean Water Act permit for wetland and stream impacts	2004-270	Pending, submitted 2/12/2016
Limestone Mining Permitting			
ODNR	Limestone Mining Permit	IM1164	07/13/02

ATTACHMENT B1a
(MUNICIPAL SOLID WASTE LANDFILL)

INFORMATION TO BE SHOWN ON PLANS AND/OR SUBMITTED WITH PLANS

OAC 3745-27-06 PARAGRAPH	CONTENT	Plan Drawing No.	Section No.
DETAIL ENGINEERING PLAN COVER SHEET			
(B)(1)(a)	Name of the sanitary landfill facility	1	
(B)(1)(b)	Precise geographic location, boundaries, etc.	1	
(B)(1)(c)	Name and address of the applicant	1	
(B)(1)(d)	Name and address of the owner and of the operator	1	
(B)(1)(e)	Name and address of the person who prepared the plans	1	
(B)(1)(f)	Index of plan sheets	1	
PLAN DRAWINGS			
(B)(2)(b)(i)	All zoning classifications, property owners, political subdivisions	2B-1, 2B-2	
(B)(2)(b)(ii)	Potential gas migration pathways and sources	2C-1, 2C-2	
(B)(2)(b)(iii)	Limits of the regulatory floodplain	2B-1, 2B-2	
(B)(2)(b)(iv)	National park or recreation area, candidate areas for potential inclusion into the national park system, and any sate park or established state park purchase areas	2B-1, 2B-2	
(B)(2)(b)(v)	State nature preserves, state wildlife areas, national and state scenic rivers, any national wildlife refuge, special interest areas, research natural areas in the Wayne National Forest, outstanding resource waters, coldwater habitats, and exceptional warmwater habitats	2B-1, 2B-2	
(B)(2)(b)(vi)	Public and private water supply wells and their status (to be shown within 2,000' of waste placement)	2B-1, 2B-2	
(B)(2)(b)(vii)	Limits of wellhead protection areas etc.	2B-1, 2B-2	
(B)(2)(b)(viii)	Faults that have had displacement in Holocene time	2B-1, 2B-2	
(B)(2)(b)(ix)	Surface and underground mining (to be shown within 2,000' of the limits of solid waste placement)	2B-1, 2B-2	
(B)(2)(b)(x)	Limits of sole source aquifer	2B-1, 2B-2	
(B)(2)(c)	Limits of disturbance and the facility boundary	2B-1, 2B-2	
(B)(3)(b)	Location of existing and proposed pipes and conduits, etc.	3A	
(B)(3)(c)	Location of subsurface investigation sites	HSI	
(B)(3)(d)	Potentiometric maps of the uppermost aquifer system	HSI	
(B)(3)(e)	Location of ground water control structures	HSI	
(B)(3)(f)	Location of explosive gas control structures	3B	
(B)(3)(g)	Diagram of phases	3A	
(B)(3)(h)	Land set aside for leachate treatment/pretreatment	N/A	

OAC 3745-27-06 PARAGRAPH	CONTENT	Plan Drawing No.	Section No.
PLAN DRAWINGS (continued)			
(B)(4)(a)	Horizontal and vertical limits of excavation	4A	
(B)(4)(b)	Horizontal limits and elevations of soil liner	4B, 4C	
(B)(4)(c)	Elevations and layout of leachate management system	4D, 4E	
(B)(4)(d)	Horizontal limits and top and bottom elevations of solid waste placement	4D - 4F	
(B)(4)(e)	Horizontal limits and elevation of separatory liner (if required)	N/A	
(B)(4)(f)	Horizontal limits and top and bottom elevations of cap system and surface drainage	4F - 4H	
(B)(4)(g)	Grid system	4A – 4H	
CROSS SECTIONS			
(B)(5)(a)(i)	Existing topography	HSI	
(B)(5)(a)(ii)	Horizontal and vertical limits of excavation	HSI	
(B)(5)(a)(iii)	Horizontal limits and bottom elevations of any added geologic material	HSI	
(B)(5)(a)(iv)	Horizontal limits and bottom elevations of the recompacted soil liner	HSI	
(B)(5)(a)(v)	Geologic stratigraphy and significant zones of saturation	HSI	
(B)(5)(a)(vi)	Uppermost aquifer and saturated strata above aquifer	HSI	
(B)(5)(a)(vii)	Well logs of intercepted borings	HSI	
(B)(5)(a)(viii)	Any permanent ground water control structures	HSI	
(B)(5)(b)	Perimeter of the property showing explosive gas migration pathways	HSI	
(B)(5)(c)(i)	Existing topography	5H	
(B)(5)(c)(ii)	Limits of excavation	5I-5J	
(B)(5)(c)(iii)	Limits of waste placement	5I-5J	
(B)(5)(c)(iv)	Horizontal limits and top and bottom elevations of cap system	5I-5J	
(B)(5)(d)(i)	Limits of existing waste (if proposed vertical expansion)	5I-5J	
(B)(5)(d)(ii)	Approved and proposed limits of waste placement (if proposed vertical expansion)	5I-5J	
(B)(5)(d)(iii)	Separatory liner/LCS (if proposed vertical expansion)	N/A	
SYSTEMATIC DEVELOPMENT PLANS			
(B)(6)(a)	Monitoring wells to be installed for each phase	6A – 6I	
(B)(6)(b)	Extent of waste placement	6A – 6I	
(B)(6)(c)	Contours of previously filled phases	6A – 6I	
(B)(6)(d)	Limits of cover on previously filled phases	6A – 6I	
(B)(6)(e)	Contours of bottom limits of waste placement	6A – 6I	
(B)(6)(f)	Access roads	6A – 6I	
(B)(6)(g)	Surface water flow and points of concentration and measures to control	6A – 6I	

OAC 3745-27-06 PARAGRAPH	CONTENT	Plan Drawing No.	Section No.
DETAIL DRAWINGS			
(B)(7)(a)	Liner system, including interface between phases	7A – 7C	
(B)(7)(b)	Composite cap system	7A – 7C	
(B)(7)(c)	Relationship of composite cap system, leachate management system, soil liner, etc.	7A	
(B)(7)(d)(i)	Leachate collection layer	7D – 7F	
(B)(7)(d)(ii)	Collection pipes, bedding media, boots	7D – 7F	
(B)(7)(d)(iii)	Filter layer	7D – 7F	
(B)(7)(d)(iv)	Sumps	7D – 7F	
(B)(7)(d)(v)	Conveyance structures	7D – 7F	
(B)(7)(d)	Storage tanks	N/A	
(B)(7)(e)	Permanent ground water control structures, if any	HSI	
(B)(7)(f)	Ground water monitoring well and piezometer construction	HSI	
(B)(7)(g)	Explosive gas control system elements	7G-7J	
(B)(7)(h)	Separatory liner/LCS, if applicable	N/A	
(B)(7)(i)	Sedimentation pond, discharge structures, etc.	7M, 7N	
(B)(7)(j)	Other (e.g. structural fill, gas collection layer, interim liner, etc)	N/A	
NARRATIVE DESCRIPTION/INFORMATION (Summary)			
(C)(1)	Summary of the site environs, including discussion on compliance, waste placement limits, location restriction demonstrations, and operating criteria		(C)(1)
VARIANCE AND EXEMPTION REQUESTS			
(C)(2)	Any requests for variances and exemptions.		(C)(2)
SITE INVESTIGATION (Description of geology and hydrogeology)			
(C)(3)(b)(i)	Yield of regional aquifer		(C)(3)
(C)(3)(b)(ii)	Direction of flow in regional aquifer		(C)(3)
(C)(3)(b)(iii)	Recharge and discharge areas of regional aquifer		(C)(3)
(C)(3)(b)(iv)	Regional stratigraphy		(C)(3)
(C)(3)(b)(v)	Regional geomorphology		(C)(3)
(C)(3)(c)(i)	Letter from ODNR regarding mining in area		(C)(3)
(C)(3)(c)(ii)	Documentation of who owns the mineral rights		(C)(3)
(C)(3)(c)(iii)	Letter from ODNR regarding oil and gas wells in area		(C)(3)
(C)(3)(c)(iv)	Letter from COE regarding wetland delineation		(C)(3)

OAC 3745-27-06 PARAGRAPH	CONTENT	Plan Drawing No.	Section No.
SITE INVESTIGATION (Description of geology and hydrogeology, continued)			
(C)(3)(d)(i)(a)(i)	Textural classification of soil - USCS		(C)(3)
(C)(3)(d)(i)(a)(ii)	Rock type		(C)(3)
(C)(3)(d)(i)(a)(iii)	Color, moisture content, etc		(C)(3)
(C)(3)(d)(i)(a)(iv)	Hydraulic conductivity		(C)(3)
(C)(3)(d)(i)(b)	Thickness		(C)(3)
(C)(3)(d)(i)(c)	Lateral extent		(C)(3)
(C)(3)(d)(i)(d)	Depth and elevation		(C)(3)
(C)(3)(d)(i)(e)	Variations in texture etc.		(C)(3)
(C)(3)(d)(ii)	Local geomorphology		(C)(3)
(C)(3)(d)(iii)	Local structural geology		(C)(3)
(C)(3)(d)(iv)(a)	Temporal fluctuations in ground water levels and effects on flow		(C)(3)
(C)(3)(d)(iv)(b)	Interpretation of the ground water flow system		(C)(3)
(C)(3)(d)(iv)(c)	Characterization of recharge and discharge areas of the site		(C)(3)
(C)(3)(d)(iv)(d)	Yield of significant zones of saturation		(C)(3)
(C)(3)(d)(v)	Justification, if necessary, no 100 gpm aquifer is present		(C)(3)
(C)(3)(e)	Description and quantification of ground water quality		(C)(3)
SITE INVESTIGATION (Subsurface investigation information)			
(C)(3)(f)(i)(a)	Publically available well logs		(C)(3)
(C)(3)(f)(i)(b)	ODNR ground water resource maps		(C)(3)
(C)(3)(f)(i)(c)	Other publically available information used for (C)(3)(b) and (B)(2)		(C)(3)
(C)(3)(f)(ii)	Logs of subsurface investigation		(C)(3)
(C)(3)(f)(iii)	Construction diagrams of wells and piezometers		(C)(3)
(C)(3)(f)(iv)	Ground water data from uppermost aquifer and all significant zones of saturation above the uppermost aquifer		(C)(3)
(C)(3)(f)(v)	Logs of subsurface investigation		(C)(3)
(C)(3)(f)(vi)(a)	Grain size distribution		(C)(3)
(C)(3)(f)(vi)(b)	Atterberg limits		(C)(3)
(C)(3)(f)(vi)(c)	Specific gravity		(C)(3)
(C)(3)(f)(vi)(d)	Unit weight, in situ		(C)(3)
(C)(3)(f)(vi)(e)	Moisture content, in situ		(C)(3)
(C)(3)(f)(vi)(f)	Dry unit weight		(C)(3)
(C)(3)(f)(vi)(g)	Results ASTM D3080, ASTM D2850, ASTM D6467 for bearing capacity		(C)(3)
(C)(3)(f)(vi)(h)	Results ASTM D3080, ASTM D4767, ASTM D6467 for stability		(C)(3)
(C)(3)(f)(vi)(i)	Results ASTM D2850 for pore water pressure		(C)(3)

OAC 3745-27-06 PARAGRAPH	CONTENT	Plan Drawing No.	Section No.
SITE INVESTIGATION (Subsurface investigation information, continued)			
(C)(3)(f)(vi)(j)(i)	Coefficient of consolidation for settlement		(C)(3)
(C)(3)(f)(vi)(j)(ii)	Over consolidation ratio for settlement		(C)(3)
(C)(3)(f)(vi)(j)(iii)	Pre-construction pressure for settlement		(C)(3)
(C)(3)(f)(vi)(j)(iv)	Compression index for settlement		(C)(3)
(C)(3)(f)(vi)(j)(v)	Swelling index for settlement		(C)(3)
(C)(3)(f)(vi)(j)(vi)	In situ void ratio for settlement		(C)(3)
(C)(3)(f)(vi)(j)(vii)	Effective porosity for settlement		(C)(3)
(C)(3)(f)(vii)	Any other data		(C)(3)
SITE INVESTIGATION (Description of methodology)			
(C)(3)(g)(i)	Sampling methods used to characterize soil and rock		(C)(3)
(C)(3)(g)(ii)	Analytical methods used to characterize soil and rock		(C)(3)
(C)(3)(g)(iii)	Methodology and procedures used to define the uppermost aquifer etc.		(C)(3)
(C)(3)(g)(iv)	Methodology and procedures used to determine ground water quality		(C)(3)
(C)(3)(g)(iv)(a)	Detection of immiscible layers		(C)(3)
(C)(3)(g)(iv)(b)	Collection of ground water samples		(C)(3)
(C)(3)(g)(iv)(c)	Performance of field analysis		(C)(3)
(C)(3)(g)(iv)(d)	Decontamination of equipment		(C)(3)
(C)(3)(g)(iv)(e)	Analysis of ground water samples		(C)(3)
(C)(3)(g)(iv)(f)	Chain of custody control		(C)(3)
(C)(3)(g)(iv)(g)	Field and laboratory QA/QC		(C)(3)
STABILITY ANALYSIS			
(C)(4)(a)(i)	Findings of subsurface investigation for hydrostatic uplift		(C)(4)
(C)(4)(a)(ii)	Rationale used for hydrostatic uplift parameters		(C)(4)
(C)(4)(a)(iii)	Method used to calculate hydrostatic uplift		(C)(4)
(C)(4)(a)(iv)	Assessed failure modes and conditions		(C)(4)
(C)(4)(a)(v)	Rationale used for hydrostatic critical cross-section		(C)(4)
(C)(4)(a)(vi)	Temporal high phreatic and piezometric surfaces		(C)(4)
(C)(4)(a)(vii)	Profile view of critical area		(C)(4)
(C)(4)(a)(viii)	Hydrostatic uplift calculations		(C)(4)

OAC 3745-27-06 PARAGRAPH	CONTENT	Plan Drawing No.	Section No.
STABILITY ANALYSIS (continued)			
(C)(4)(b)(i)	Findings of subsurface investigation for bearing capacity		(C)(4)
(C)(4)(b)(ii)	Rationale used for bearing capacity parameters		(C)(4)
(C)(4)(b)(iii)	Method used to calculate bearing capacity		(C)(4)
(C)(4)(b)(iv)	Assessed failure modes and conditions		(C)(4)
(C)(4)(b)(v)	Profile view of critical area		(C)(4)
(C)(4)(b)(vi)	Plan view of critical cross-section		(C)(4)
(C)(4)(b)(vii)	Bearing capacity calculations		(C)(4)
(C)(4)(c)(i)	Findings of subsurface investigation for static stability		(C)(4)
(C)(4)(c)(ii)	Rationale used for static stability parameters		(C)(4)
(C)(4)(c)(iii)	Method used to calculate static stability		(C)(4)
(C)(4)(c)(iv)	Assessed failure modes and conditions		(C)(4)
(C)(4)(c)(v)	Rationale for choosing internal, interim, and final slopes cross-sections		(C)(4)
(C)(4)(c)(vi)	Profile view of critical cross-sections		(C)(4)
(C)(4)(c)(vii)	Plan view of critical cross-sections		(C)(4)
(C)(4)(c)(viii)	Summary of results		(C)(4)
(C)(4)(c)(ix)	Static stability calculations		(C)(4)
(C)(4)(d)(i)	Findings of subsurface investigation for seismic stability		(C)(4)
(C)(4)(d)(ii)	Rationale used for seismic stability parameters		(C)(4)
(C)(4)(d)(iii)	Method used to calculate seismic stability		(C)(4)
(C)(4)(d)(iv)	Assessed failure modes and conditions		(C)(4)
(C)(4)(d)(v)	Rationale for choosing internal, interim, and final slopes cross-sections		(C)(4)
(C)(4)(d)(vi)	Profile view of critical cross-sections		(C)(4)
(C)(4)(d)(vii)	Plan view of critical cross-sections		(C)(4)
(C)(4)(d)(viii)	Summary of results		(C)(4)
(C)(4)(d)(ix)	Seismic stability calculations		(C)(4)
(C)(4)(e)(i)	Findings of subsurface investigation for settlement		(C)(4)
(C)(4)(e)(ii)	Rationale used for settlement parameters		(C)(4)
(C)(4)(e)(iii)	Method used to calculate settlement		(C)(4)
(C)(4)(e)(iv)	Assessed failure modes and conditions		(C)(4)
(C)(4)(e)(v)	Summary of results		(C)(4)
(C)(4)(e)(vi)	Settlement calculations		(C)(4)

OAC 3745-27-06 PARAGRAPH	CONTENT	Plan Drawing No.	Section No.
STABILITY ANALYSIS (continued)			
(C)(4)(f)(i)	Findings of subsurface investigation for settlement of separatory liner		(C)(4)
(C)(4)(f)(ii)	Method used to calculate settlement of separatory liner		(C)(4)
(C)(4)(f)(iii)	Assessed failure modes and conditions		(C)(4)
(C)(4)(f)(iv)	Summary of results		(C)(4)
(C)(4)(f)(v)	Settlement calculations		(C)(4)
(C)(4)(g)	Analysis that the structural components will maintain their integrity		(C)(4)
(C)(4)(g)(i)	Regional stratigraphic or structural features of unstable areas		(C)(4)
(C)(4)(g)(ii)	Areas susceptible to liquefaction		(C)(4)
(C)(4)(g)(iii)	Areas susceptible to mass movement		(C)(4)
(C)(4)(g)(iv)	Areas impacted by natural and human induced activities		(C)(4)
(C)(4)(g)(v)	Presence of karst terrain		(C)(4)
(C)(4)(g)(vi)	Presence of underground mining		(C)(4)
(C)(4)(g)(vii)	Areas susceptible to coastal and river erosion		(C)(4)
CALCULATIONS			
(C)(5)(a)	Volume and life of the facility and each unit		(C)(5)
(C)(5)(b)	Liner thickness		(C)(5)
(C)(5)(c)	Leachate head and flow		(C)(5)
(C)(5)(d)	Amount of leachate to be recirculated and leachate head and flow		(C)(5)
(C)(5)(e)	Leachate storage tank size		(C)(5)
(C)(5)(f)	Pump size		(C)(5)
(C)(5)(g)	Pipe strength and pipe deflection		(C)(5)
(C)(5)(h)	Itemized closure costs - If not presented on PTI Attachment A		(C)(5)
(C)(5)(i)	Itemized post-closure care costs - If not presented on PTI Attachment A		(C)(5)
(C)(5)(j)	Soil erosion		(C)(5)
(C)(5)(k)	Surface water control structure size		(C)(5)
(C)(5)(l)	Sedimentation basin		(C)(5)
(C)(5)(m)	Other		(C)(5)

OAC 3745-27-06 PARAGRAPH	CONTENT	Plan Drawing No.	Section No.
LOCATION RESTRICTION DEMONSTRATIONS (from OAC 2745-27-20)			
(C)(6)	Airport safety		(C)(6)
(C)(6)	Regulatory floodplain		(C)(6)
(C)(6)	Holocene fault		(C)(6)
(C)(6)	Seismic impact zone		(C)(6)
(C)(6)	Unstable area		(C)(6)
CONSTRUCTION INFORMATION			
(C)(7)(a)	Installation of ground water monitoring program items		(C)(7)
(C)(7)(b)	Physical and chemical resistance of FML and LCS pipes		(C)(7)
(C)(7)(c)	Compaction equipment slope limitations		(C)(7)
OPERATIONAL INFORMATION			
(C)(8)(a)	Authorized maximum daily waste receipt		(C)(8)
(C)(8)(b)	Technique of waste receipt		(C)(8)
(C)(8)(c)	Type of waste received		(C)(8)
(C)(8)(d)	Type of equipment to be used for construction, operation, and maintenance		(C)(8)
PLANS			
(C)(9)(a)	Ground water detection plan		(C)(9)
(C)(9)(b)	Explosive gas monitoring plan		(C)(9)
(C)(9)(c)	QA/QC plan		(C)(9)
(C)(9)(d)	Final closure/post-closure care plan		(C)(9)
NOTIFICATIONS AND CERTIFICATION			
(C)(10)(a)(i)	Letter of intent to the government		(C)(10)
(C)(10)(a)(ii)	Letter of intent to the solid waste management district		(C)(10)
(C)(10)(a)(iii)	Letter of intent to the owner or lessee		(C)(10)
(C)(10)(a)(iv)	Letter of intent to the local zoning authority		(C)(10)
(C)(10)(a)(v)	Letter of intent to the airport administrator		(C)(10)
(C)(10)(a)(vi)	Letter of intent to the park system administrator		(C)(10)
(C)(10)(a)(vii)	Letter of intent to the conservancy district		(C)(10)
(C)(10)(b)	List of permits, licenses, plans approvals, authorizations that have been applied for - If not presented on PTI Attachment A		(C)(10)
(C)(10)(c)	Copy of wetland certification and 401/404 permit		(C)(10)
(C)(10)(d)	Proof of property ownership or lease agreement		NA

☑ Initial ☐ Revised_____ date

PROFESSIONAL ENGINEER'S CERTIFICATION

Lateral Expansion Permit to Install Application
Apex Sanitary Landfill
Apex Environmental, LLC.

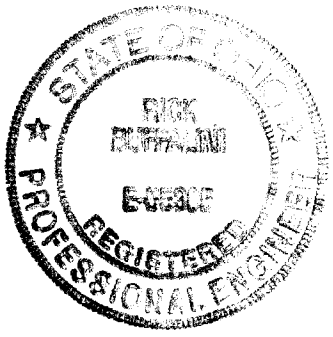
I, Rick J. Buffalini, being a Registered Professional Engineer in accordance with the Ohio Professional Engineer's Registration law, do hereby certify to the best of my knowledge, the detailed engineering plans, specifications, and information contained in the Permit to Install Application are true and accurate.

In accordance with OAC 3745-27-99, the following plan drawings, narrative and plans require certification by a licensed professional engineer:

- Plan drawings pursuant to OAC 3745-27-06(B)(3), (B)(4), (B)(5), (B)(6), and (B)(7); and
- Narrative information pursuant to OAC 37-27-06(C)(4), (C)(5), (C)(7), and (C)(9)(d).

SIGNATURE: _____

DATE: 10-24-11



Address: Civil & Environmental Consultants, Inc.
333 Baldwin Road
Pittsburgh, Pennsylvania 15205

Telephone: (412) 429-2324

PTI.EngNotarized-091-867

PROFESSIONAL ENGINEER'S CERTIFICATION

Contiguous Expansion Permit to Install Application
Apex Sanitary Landfill
Apex Environmental, LLC.

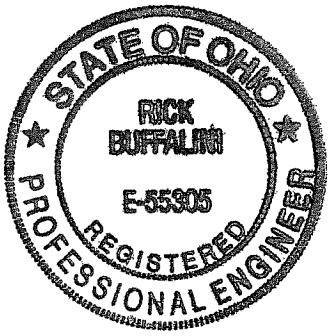
I, Rick J. Buffalini, being a Registered Professional Engineer in accordance with the Ohio Professional Engineer's Registration law, do hereby certify to the best of my knowledge, the detailed engineering plans, specifications, and information contained in the Permit to Install Application are true and accurate.

In accordance with OAC 3745-27-99, the following plan drawings, narrative and plans require certification by a licensed professional engineer:

- Plan drawings pursuant to OAC 3745-27-06(B)(3), (B)(4), (B)(5), (B)(6), and (B)(7); and
- Narrative information pursuant to OAC 37-27-06(C)(4), (C)(5), (C)(7), and (C)(9)(d).

SIGNATURE: _____

DATE: 7-18-13



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PROFESSIONAL ENGINEER'S CERTIFICATION

Contiguous Expansion Permit to Install Application
Apex Sanitary Landfill
Apex Environmental LLC

I, Rick J. Buffalini, being a Registered Professional Engineer in accordance with the Ohio Professional Engineer's Registration law, do hereby certify to the best of my knowledge, the detailed engineering plans, specifications, and information contained in the Permit to Install Application are true and accurate.

In accordance with OAC 3745-27-99, the following plan drawings, narrative and plans require certification by a licensed professional engineer:

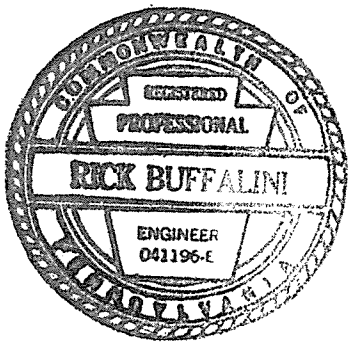
- Plan drawings pursuant to OAC 3745-27-06(B)(3), (B)(4), (B)(5), (B)(6), and (B)(7); and
- Narrative information pursuant to OAC 37-27-06(C)(4), (C)(5), (C)(7), and (C)(9)(d).

SIGNATURE: _____

DATE: 12-29-15

Address: Civil & Environmental Consultants, Inc.
333 Baldwin Road
Pittsburgh, Pennsylvania 15205

Telephone: (412) 429-2324



PROFESSIONAL ENGINEER'S CERTIFICATION

Contiguous Expansion Permit to Install Application
Apex Sanitary Landfill
Apex Environmental LLC

I, Rick J. Buffalini, being a Registered Professional Engineer in accordance with the Ohio Professional Engineer's Registration law, do hereby certify to the best of my knowledge, the detailed engineering plans, specifications, and information contained in the Permit to Install Application are true and accurate.

In accordance with OAC 3745-27-99, the following plan drawings, narrative and plans require certification by a licensed professional engineer:

- Plan drawings pursuant to OAC 3745-27-06(B)(3), (B)(4), (B)(5), (B)(6), and (B)(7); and
- Narrative information pursuant to OAC 37-27-06(C)(4), (C)(5), (C)(7), and (C)(9)(d).

SIGNATURE: _____

DATE: 5-18-16

Address: Civil & Environmental Consultants, Inc.
333 Baldwin Road
Pittsburgh, Pennsylvania 15205

Telephone: (412) 429-2324

(C)(1) SUMMARY OF SITE ENVIRONS

This section addresses the requirements of OAC 3745-27-06(C)(1) which also includes the requirements of OAC 3745-27-02 and OAC 3745-27-07.

(1) Summary of the site environs and a demonstration that the sanitary landfill facility will meet the criteria for permit approval by the Director specified in rules 3745-27-02 and 3745-27-07 of the Administrative Code. The demonstration shall include a discussion of the facility's compliance with any applicable authorizing document(s), the facility's limits of waste placement, the location restriction demonstration, and operational criteria.

C1.1 SUMMARY OF SITE ENVIRONS

Apex Environmental, LLC (Apex) owns, operates, and is the permittee of the Apex Sanitary Landfill. The limits of waste placement are located in Springfield Township, Jefferson County, Ohio. The facility boundary of the site extends into German Township, Harrison County including the entrance road. The site is located at 11 County Road 78, Amsterdam, Ohio and is east of Jefferson County Road 78 and Harrison County Road 51 and approximately 1 mile north of State Road 646. A location map showing the site is included on the Title Sheet of the drawing package. The land use surrounding the site consists of unreclaimed surface mine lands, agricultural use, and woodlands. There are no zoning requirements within the property.

Apex owns approximately 1,285 acres of property at this location. The currently permitted limits of waste placement encompasses 117.5 acres. The facility boundary includes the disposal area and rail unloading area. Drawing 2A presents the property boundary and facility boundary. A survey of the landfill property line prepared by Bair Goodie and Associates, Inc. is included in Appendix C1-D along with property deeds. Apex began accepting waste on November 28, 2005. ~~As of October 2011, waste has been placed in Phases 1 through 4 of the facility.~~

The Ohio EPA issued Permit to Install (PTI) No. 17-1194 dated January 21, 1998 to Apex Energy, Inc. for a new solid waste disposal facility. The PTI provided a permitted limit of waste placement of approximately 117.5 acres with an airspace of approximately 16 million cubic yards. On July 31, 2002, the Ohio EPA issued PTI No. 06-6219 for a vertical expansion of the

Apex Sanitary Landfill which provided a permitted capacity of approximately 17,542,000 cubic yards.

PTI 06-07409 was issued on October 28, 2004 for an AMDWR increase to 5,250 tons per day. On or about May 16, 2005, the site permits were transferred to Apex Environmental, LLC owned by Liberty Waste Services, LLC. Environmental Logistics Services LLC subsequently acquired Apex Environmental, LLC, the Apex Sanitary Landfill, and all site permits, on December 17, 2007. Then, on December 31, 2009, the Ohio EPA issued PTI No. 06-08438 for an additional vertical expansion (increasing permitted capacity to about 22,500,000 cubic yards) and received an increase in AMDWR to 7,500 tons per day. Ownership was transferred from Environmental Logistics Services LLC to PE-II Apex Environmental LLC, a company owned by the Prophet Equity Group. The ownership transfer closed on October 30, 2015. PE-II Apex Environmental LLC submitted applications for the transfer of applicable licenses and permits. After the ownership transfer, the purchaser PE-II Apex Environmental LLC changed its name to Apex Environmental LLC. The name change was accepted on November 4, 2015.

Apex is submitting this Permit to Install (PTI) Application for a contiguous expansion to the limits of waste placement and a corresponding increase in the vertical extent over the existing permitted areas.

This proposed expansion results in an airspace increase of approximately ~~60.6~~ *61.1* million cubic yards resulting in a total permitted airspace of approximately ~~83.1~~ *83.6* million cubic yards.

This application also proposes an increase in the Authorized Maximum Daily Waste Receipts (AMDWR) for the facility from the currently permitted 7,500 tons per day to 10,000 tons per day. The AMDWR will not be increased until the contiguous expansion is entered. The current AMDWR of 7,500 tons per day excludes construction and demolition debris accepted at the facility. The currently approved Air PTI allows Apex to accept 7,500 tons per day of solid waste and 2,000 tons per day for a total of 9,500 tons per day of material. The Air PTI Application submitted for the contiguous expansion and AMDWR increase proposes a total of 10,000 tons per day of material to be accepted.

C1.2 CONFORMANCE WITH CRITERIA FOR PERMIT APPROVAL

The authorized fill area and proposed lateral expansion of the Apex Sanitary Landfill meets the criteria for permit approval specified in Rules 3745-27-02 and 3745-27-07 of the Administrative Code. Each section of those rules is addressed to demonstrate compliance.

Information in Rule 3745-27-02

OAC 3745-27-02 is divided into paragraphs (A) through (L). Paragraph (E) is addressed here. Paragraphs (A) through (D) and (F) through (L) contain general information regarding Ohio EPA

policies and procedures regarding permit issuance and a response in not required here. OAC 3745-27-02(E) is addressed in the following sections.

(E) Permit application

(1) Each person proposing to establish or modify a solid waste facility or infectious waste treatment facility shall submit an application for a permit with accompanying detail plans and specifications to the director as he deems necessary in order to determine whether the criteria for approval have been met.

(E)(1): This application includes the information necessary to determine that the criteria for approval have been met.

(2) Each application for a permit to install shall be accompanied by a nonrefundable application fee established in Chapters 3734. and 3745. of the Revised Code.

(E)(2): The $400.00 application fee is included with this submittal.

(3) Every applicant for a permit, other than for a permit modification, shall file a disclosure statement, on a form developed by the attorney general, with the director of environmental protection and the attorney general at the same time the applicant files an application for a permit with the director.

(E)(3): All disclosure statements are current with the Ohio EPA, with the last update submitted on *July 22, 2015 regarding the change of ownership to Prophet Equity. The Ohio EPA approved the transfer of ownership in a letter dated February 17, 2016* ~~*January 31, 2013*~~ ~~September 30, 2011~~.

(4) The application for a permit to install shall be signed by either the owner or operator of the facility shall be:

(a) In the case of a corporation, by a principal executive officer of at least the level of vice president, or his duly authorized representative, if such representative is responsible for the overall operation of the facility.

(b) In the case of a partnership, by a general partner.

(c) In the case of a limited liability company by a manager, member, or other duly authorized representative of the limited liability company, if such representative is responsible for the overall operation of the facility.

(d) In the case of sole proprietorship, by the owner.

(e) In the case of a municipal, state, federal or other governmental facility, by the principal executive officer, the ranking elected official, or other duly authorized employee.

(E)(4): The application is signed by a duly authorized representative.

(5) The signatures on the application for a permit to install shall constitute personal affirmation that all statements or assertions of fact made in the application are true and complete, comply fully with applicable state requirements, and shall subject the signatory to liability under those state laws forbidding false or misleading statements.

(E)(5): The signature on the application includes the required statements.

(6) The applicant for a municipal solid waste landfill, industrial solid waste landfill, residual waste landfill or solid waste transfer facility, undergoing one or more of the following, shall also submit within thirty days of the public meeting on the application, as specified in division (A)(2)(d) of section 3734.05 of the Revised Code, a copy of the transcript of the public meeting on the application, copies of any exhibits, displays or other materials presented by the applicant at the meeting, and the original copy of any written comments submitted at the meeting.

(a) Establishing a new facility.
(b) Any increase of more than ten per cent in the total capacity of the existing facility.
(c) Any expansion of the limits of solid waste placement of the existing facility.
(d) Any increase in the depth of excavation at the existing facility.
(e) Any change in the technique of waste receipt or type of waste received at the existing facility that may endanger human health.

(E)(6): This application is for a contiguous lateral expansion that increases the total capacity of the existing facility by more than ten percent. Therefore, a public applicant's meeting is required and will be held by Apex. *The applicant's meeting was held on November 30, 2011 and Apex submitted the required documentation on December 20, 2011.* ~~After the meeting, Apex will submit all required documentation within the 30-day timeframe.~~

Information per Rule 3745-27-07

(A) General Criteria. The Director shall not approve any permit to install application for a sanitary landfill unless he determines all of the following:

(1) Establishment or modification and operation of the sanitary landfill facility will not violate Chapter 3704, 3734 or 6111 of the Revised Code.

(A)(1): Establishment and operation of the Apex Landfill Expansion will adhere to Chapters 3704, 3734 and 6111 of the Revised Code. Apex has Air Pollution Source PTI Application Nos. PTI No. 06-06987 (effective date December 10, 2002), 06-0746, (effective date October 28,

2004, and P0103987 (effective date December 31, 2009) for the existing landfill. Apex submitted an application for a Final Title V Chapter 3745-77 permit in November 2006. Apex will submit the required PTI Application to the Ohio EPA Division of Air Pollution Control (DAPC) related to the proposed lateral expansion and AMDWR increase in the near future. Apex will take the measures required by those permits to control air emissions including sweeping and watering roadways and parking areas, applying daily cover over waste, and installing a landfill gas collection and control system, as required by the New Source Performance Standards (NSPS).

Apex has National Pollutant Discharge Elimination System (NPDES) Permit No. 0IN00198*GD (effective March 1, 2015) ~~*ED (effective August 1, 2008)~~ for the existing landfill, and 0II00022*DD (effective March 1, 2015) ~~*CD (effective August 1, 2008)~~ for the mining ponds at the site. A permit modification which adds stormwater discharge points to the existing NPDES Permit will be submitted in the near future. Apex also has Indirect Discharge Permit No. 0DP00050*BP effective March 1, 2011 to discharge leachate at the City of Steubenville WWTP, and has an agreement to discharge leachate at the City of Alliance WWTP. An indirect discharge permit is not required for Apex to discharge leachate at the City of Alliance WWTP since the WWTP has an approved pretreatment program.

(2) The sanitary landfill facility will be capable of being constructed, operated, closed, and maintained during the post-closure care period in accordance with Chapter 3745-27 of the Administrative Code, and with the terms and conditions of the permit.

(A)(2): The proposed contiguous lateral expansion has been designed in accordance with OAC 3745-27 and with state of the practice design principles and materials for the construction, operation, closure, and maintenance of the facility through the post-closure care period.

(3) The applicant, and/or the person(s) listed as owner and operator if the owner and operator are not the applicant, who has been or is currently responsible for the management or operation of one or more solid waste facilities, has managed or operated such facility in substantive compliance with applicable provisions of Chapters 3704., 3734., 3714., and 6111. of the Revised Code, and any rules, permits or other authorizations issued thereunder, and has maintained substantial compliance with all applicable orders issue by the director, the environmental review appeals commission, or courts having jurisdiction in accordance with Chapter 3746-13 of the Administrative Code, in the course of such

previous or current management or operations. The director may take into consideration whether substantial compliance has been maintained with any applicable order from a board of health maintaining a program on the approved list and any other courts having jurisdiction.

(A)(3): Apex has operated the existing sanitary landfill from 2005 until present and is in substantial compliance with the applicable provisions of Chapter 3704, 3734, 3714, and 6111 of the Revised Code. Apex has operated the site in substantial compliance with the rules, permits, and other authorizations issued by the Ohio EPA. Apex has addressed and corrected any violation notices promptly and completely, and implements operational changes as necessary to maintain full compliance. *Director's Final Findings and Orders (DFFO) were submitted by the Ohio EPA on December 22, 2011. Additional DFFOs were submitted on June 3, 2013 that approved Apex's proposed actions to comply with the 2011 DFFO.* The DFFOs were terminated in a letter submitted by the Ohio EPA on December 11, 2015. *A DFFO was submitted by the Ohio EPA on April 29, 2013 regarding the payment of fees.* This DFFO was terminated upon completion of fee payment. A summary of the violations issued to the facility is provided in Appendix C1-E.

(4) The person listed as operator meets the requirements of division (L) of section 3734.02 of the Revised Code and rules adopted thereunder.

(A)(4): The persons who are responsible for the operation of the sanitary landfill will meet the requirements of Division (L) of Section 3734.02 of the Ohio Revised Code when that program is established.

(5) The applicant meets the requirements of sections 3734.40 to 3734.43 of the Revised Code and rules adopted thereunder.

(A)(5): Apex regularly files disclosure statements for the appropriate personnel with the Ohio Attorney General and has been approved to operate solid waste disposal facilities in the State of Ohio. ~~The most recent update was submitted on *January 31, 2013* September 30, 2011~~. A Change of Ownership Disclosure Statement was filed with the Ohio Attorney General Environmental Background Investigations Unit on July 22, 2015 ~~or about October 3, 2007, as supplemented~~.

(B) Discretionary criteria. The director may consider, when determining whether or not to approve a permit to install application for a sanitary landfill facility, the following:

(1) The impact the establishment or modification of the sanitary landfill facility may have on corrective measures that have been taken, are presently being taken, or are proposed to be taken at the facility or in the immediate area.

(B)(1): The facility is not conducting corrective measures for water quality impacts. Groundwater monitoring is currently limited to Detection Monitoring and there have been no unresolved assessment/groundwater quality issues.

(2) The technical ability of the owner or operator to adequately monitor the impact of the sanitary landfill facility on the environment.

(B)(2): Apex will continue to perform monitoring of ground water, surface water, and landfill gas as detailed in this PTI Application to determine if the landfill is adversely impacting the environment.

(C) Design criteria. The director shall not approve a permit to install application for any of the following unless he determines that the application conforms to the appropriate sections of rule 3745-27-08 of the Administrative Code as follows:

(1) Proposed new unit(s) of a new landfill or proposed new unit(s) contiguous or noncontiguous to an existing landfill shall comply with Paragraphs (B), (C), and (D) of rule 3745-27-08 of the Administrative Code.

(C)(1): The proposed new unit that results from the contiguous lateral expansion meets all requirements of 3745-27-08 (B), (C), and (D). Each requirement is specifically illustrated on the drawings and addressed in Section (C) (9)(c) of this application.

(2) A proposed vertical expansion, as defined in rule 3745-27-01 of the Administrative Code, shall do the following: (a) At a minimum, comply with paragraphs (B)(1)(a) and (B)(1)(e) to (B)(1)(h), paragraph (B)(2) as required, paragraph (B)(3) as relevant, paragraphs (C)(4) to (C)(7), and paragraphs (D)(1) to (D)(3) and (D)(18) to (D)(27) of rule 3745-27-08 of the Administrative Code if the expansion is above the authorized fill area(s) of the sanitary landfill facility. (b) At a minimum, comply with paragraphs (B), (C), and (D) of rule 3745-27-08 of the Administrative Code if the vertical expansion is below the authorized fill area(s) of the sanitary landfill facility.

(C)(2): The proposed contiguous lateral expansion results in a vertical increase over currently permitted areas. The resulting vertical increase will, at a minimum, comply with paragraphs (B)(1)(a) and (B)(1)(e) to (B)(1)(h), paragraph (B)(2) as required, paragraph (B)(3) as relevant, paragraphs (C)(4) to (C)(7), and paragraphs (D)(1) to (D)(3) and (D)(18) to (D)(27) of Rule 3745-27-08 of the Administrative Code. Each requirement in Rule 3745-27-08 is specifically addressed in Section (C)(7) - Construction Information, and Section (C)(9)(c) - Construction Quality Assurance/Quality Control Plan.

(3) Vertical Expansion Construction. For a permit application submitted after the effective date of this rule that includes a vertical expansion over an authorized fill area, the expansion area(s) must be constructed over either of the following:
(a) A separatory liner system constructed in accordance with rule 3745-27-08 of the Administrative Code. (b) An authorized fill area that is underlain by a composite liner or engineered liner previously approved by the director, and a leachate collection system.

(C)(3): The proposed vertical increase of the Apex Sanitary Landfill will be constructed over areas with a composite liner and leachate collection system. A separatory liner system is not required for this PTI Application.

(4) Applications for a sanitary landfill facility submitted in response to divisions (A)(3) and (A)(4) of section 3734.05 of the Revised Code shall comply with Paragraphs (B), (C), and (D) of rule 3745-27-08 of the Administrative Code, with the exception that filled areas of the sanitary landfill facility shall, at a minimum, meet the requirements of paragraphs (D)(1) to (D)(4), (D)(18) to (D)(23) and (D)(25) to (D)(27) of rule 3745-27-08 of the Administrative Code.

(C)(4): This PTI Application is not being submitted in response to Divisions (A)(3) and (A)(4) of Section 3734.05 of the Revised Code.

(5) Permit to install applications exclusively requesting a change in technique of waste receipt, or type of waste received, or type of equipment used need not comply with rule 3745-27-08 of the Administrative Code.

(C)(5): This PTI Application is not exclusively requesting a change in technique of waste receipt, or type of waste received, or type of equipment used.

(6) Applications exclusively requesting a change in the authorized maximum daily waste receipt (AMDWR) and submitted pursuant to paragraph (E) of this rule need not comply with rule 3745-27-08 of the Administrative Code.

(C)(6): This PTI Application is not exclusively for an increase in the authorized maximum daily waste receipt (AMDWR). Therefore, it addresses the information included in Rule 3745-27-08.

(7) Other modifications of a sanitary landfill facility, as that term is defined in Rule 3745-31-01 of the Administrative Code shall comply with the applicable sections of Rule 3745-27-08 of the Administrative Code.

(C)(7): This PTI Application is a modification and complies with the applicable sections of Rule 3745-27-08.

(D) [RESERVED].

(E) Additional criteria for authorized maximum daily waste receipt (AMDWR) increase applications. The director shall not approve a permit to install application for a permanent change in the authorized maximum daily waste receipt for the sanitary landfill facility unless the owner or operator demonstrates that the sanitary landfill facility can operate in compliance with all applicable solid waste regulations while receiving the requested maximum daily waste receipt. An adequate demonstration for a sanitary landfill facility includes, but is not limited to, the following:
(1) An explanation of the overall site design including construction timeframes and fill sequences for the sanitary landfill facility; and

(E)(1): Apex will generally construct the landfill in phases or sub-phases which include the construction of a composite liner/leachate collection system, waste placement, and construction of a composite final cover system. Construction activities of the phase will follow the general sequence below. This general sequence will proceed in each subsequent phase of construction:

- Install temporary and/or permanent drainage controls;
- Perform clearing and grubbing, as needed;
- Remove and stockpile topsoil, where present;
- Perform earthwork (excavation and structural fill placement) to achieve subgrade elevations;
- Install groundwater monitoring wells, as needed;
- Construct liner/leachate collection system;

- Submit the construction certification report to the Ohio EPA,
- Following Ohio EPA concurrence with the certification report, place the select waste layer;
- Complete filling to the permitted final waste grades as practicable in the current phase;
- Install intermediate cover or transitional cover;
- Expand the landfill gas collection and control system; and
- Install the final cover system in phases as warranted.

The construction time frames for each phase are contingent upon the proposed AMDWR and actual waste receipts. With the requested AMDWR of 10,000 tons per day, Apex will provide the resources necessary to construct the liner/leachate collection system to provide sufficient airspace. The AMDWR will not be increased until the contiguous expansion is entered.

The liner/leachate collection system consists of the following, from top to bottom:

- Geotextile filter, if required,
- Leachate collection/protective cover layer,
- Geotextile cushion,
- 60-mil high density polyethylene (HDPE) flexible membrane liner,
- Geosynthetic Clay Liner, and
- 3-feet thick recompacted soil liner.

See Section (C)(7) for more detailed information on the components of the liner/leachate collection system.

After waste placement has reached final grades, the final cover system will be constructed. The final cover system consists of the following from top to bottom:

- 30-inch thick cap protection layer;
- Geocomposite Drainage Layer

- 40-mil FML; and
- 18-inch thick recompacted soil barrier.

(2) Operational criteria such as the sanitary landfill facility's equipment availability, cover availability, and manpower; and

(E)(2): Apex Sanitary Landfill will employ an adequate number of personnel to operate and maintain the facility. Site personnel will be trained and knowledgeable of the appropriate operations plans, contingency plans, and health and safety plans. The proposed personnel and equipment ~~AMDWR~~ increase is based on unloading two unit trains per day (one per each shift), in addition to the waste to be received by roadway. The following table summarizes the current manpower, the anticipated increase and anticipated total manpower for the proposed AMDWR increase. The manpower allocations are the same for each shift.

PERSONNEL	CURRENT MANPOWER	ANTICIPATED INCREASE IN MANPOWER FOR AMDWR INCREASE	ANTICIPATED MANPOWER FOR AMDWR INCREASE
Equipment Operators	13	4	17
Landfill Operators	~~11~~ 12	~~3~~ 4	~~14~~ 16
Mechanics	6	0	6
Rail Operators	~~11~~ 0	~~2 (1 container handler, 1 dump truck operator)~~ 28	~~15~~ 28
Rail Laborers	~~6~~ 0	~~2 (laborers)~~ 8	8
~~Odor Control~~	~~5~~	~~2~~	~~5~~
Scale Clerk	~~2~~ 4	0	~~2~~ 4

The following table summarizes the current equipment, the anticipated increase, and total equipment for the AMDWR increase.

TYPE	CURRENT QUANTITY	ANTICIPATED INCREASE FOR AMDWR INCREASE	ANTICIPATED TOTAL FOR AMDWR INCREASE
WASTE PLACEMENT			
Waste Compactor	2	~~1~~ 0	~~3~~ 2
Bulldozer	2	1	3
Excavator	1	0	1
Loader/Backhoe	1	1	2
Tipper	1	0	1
Water Truck	~~2~~ 1	0	~~2~~ 1

TYPE	CURRENT QUANTITY	ANTICIPATED INCREASE FOR AMDWR INCREASE	ANTICIPATED TOTAL FOR AMDWR INCREASE
COVER OPERATIONS			
Articulating Dump ~~Truck~~	~~3~~ 2	~~0~~ 1	3
Excavator	1	0	1
Dozer	~~2~~ 1	0	~~2~~ 1
RAIL OPERATIONS			
Rail Car Mover ~~Handler~~	~~2~~ 0	~~0~~ 1	~~2~~ 1
Container Handler	~~3~~ 0	~~1~~ 2	4 2
Waste Transport Trucks	~~7~~ 0	~~1~~ 12	~~8~~ 12
Excavator	~~1~~ 0	~~0~~ 1	1
ODOR CONTROL (SEE SECTION (C)(8) FOR ODOR EQUIPMENT DETAILS)			
Agricultural Misting Unit ~~Sprayer~~	3	~~0~~ 3	~~3~~ 6
High Volume Misting Unit	~~1~~ 2	0	~~1~~ 2
~~Rail Yard High Pressure System~~	~~1~~	~~0~~	~~1~~
~~Perimeter Vapor System~~[1]	~~2~~	~~0~~	~~2~~
~~Water Truck~~	~~SEE ABOVE~~		

The above list presents typical equipment selections. Different equipment which performs a similar function may be substituted for those shown. The number and types of equipment may also vary depending upon the volume of waste receipts being accepted at any point in time. All equipment will be maintained by Apex Sanitary Landfill or through a service agreement with a vendor. Back-up equipment is available to the site from vendors ~~per pre-arranged agreements~~. This equipment or similar equipment will be used for future construction, operations, and maintenance. Additional equipment may be provided as necessary by contractors for construction.

Development of the Apex Sanitary Landfill will require soils for construction and operation of the facility. Cover soils are excavated from future phases of development. Sufficient soils to construct and operate the site are available from the excavation of the cells or adjacent borrow areas within the facility boundary.

(3) If applicable, the owner's or operator's previous compliance history throughout the life of the sanitary landfill facility and the daily logs for any period that the sanitary landfill facility was out of compliance.

(E)(3): Apex Sanitary Landfill has operated the site in substantial compliance with the applicable regulations and permits issued to the facility. *Director's Final Findings and Orders (DFFO) were submitted by the Ohio EPA on December 22, 2011. Additional DFFOs were submitted on June 3, 2013 that approved Apex's proposed actions to comply with the 2011 DFFO.* The DFFOs were terminated in a letter submitted by the Ohio EPA on December 11, 2015. *A DFFO was submitted by the Ohio EPA on April 29, 2013 regarding the payment of fees.* This DFFO was terminated upon completion of fee payment. A summary of the violations issued to the facility is provided in Appendix C1-E, including daily logs for the date of the violation only. Logs are not provided for every day because the ending period for some violations is not clear. Please note that daily logs are only provided for the periods that relate to operational violations.

Based on the operating history and the proposed increase in equipment, operators, and managers, Apex is expected to be able to operate the facility at the proposed AMDWR in compliance with the regulations.

(F) Applicability of location restriction demonstrations to proposed new unit(s)
(1) Proposed new unit(s). For a permit to install application for a proposed new unit(s), the director shall not approve the permit to install application for the proposed new unit(s), unless he determines that the owner or operator has demonstrated compliance with the location restriction demonstration requirements specified in rule 3745-27-20 of the Administrative Code.

(2) The director shall not approve a permit to install application submitted in accordance with divisions (A)(3) and (A)(4) of section 3734.05 of the Revised Code, unless he determines that the owner or operator has demonstrated that any unfilled areas of the sanitary landfill facility comply with the location restriction demonstration requirements specified in rule 3745-27-20 of the Administrative Code.

(F)(1): This PTI Application includes a new unit; therefore, the location restriction demonstrations have been examined, and demonstration of compliance is included in Section (C)(6) of this PTI Application.

(G) Applicability of siting criteria. For the purposes of this rule, an "authorized fill area" is an area within the limits of solid waste placement of a sanitary landfill facility which is

authorized, by a permit(s) to install, plan approval, operational report, or other authorizing document(s) to accept solid waste as of the date of submittal of the permit to install application for a new unit. The director shall not approve the permit to install application for a sanitary landfill facility unless he determines that the application meets the criteria specified in paragraph (H) of this rule, as follows:

(1) Call-in permits. A sanitary landfill facility for which the permit to install application, including any proposed new unit(s) and/or a proposed vertical expansion, is submitted in response to division (A)(3) or (A)(4) section 3734.05 of the Revised Code, shall meet all the criteria specified in paragraph (H) of this rule; however, the director may approve the application for one (or more) noncontiguous unit(s) which meet the criteria specified in paragraph (H) of this rule, even though other unit(s) do not meet the criteria specified in paragraph (H) of this rule.

(G)(1): This is not a call-in PTI Application.

(2) Operation Changes. A permit to install application that exclusively proposes a substantial change in technique of waste receipt, or type of waste received, or type of equipment used at the sanitary landfill facility need not comply with the criteria specified in paragraph (H) of this rule.

(G)(2): This is not a PTI Application exclusively proposing a substantial change in technique of waste receipt, type of waste received, or type of equipment used at the sanitary facility.

(3) AMDWR increase. A permit to install application which exclusively proposes a change in the authorized maximum daily waste receipt (AMDWR) limit for the sanitary landfill facility need not comply with the criteria specified in paragraph (H) of this rule.

(G)(3): This PTI Application is not exclusively for an increase in the AMDWR.

(4) Other modification permits. A permit to install application that incorporates a "modification" of the sanitary landfill facility as that term is defined in rule 3745-31-01 of the Administrative Code, and the modification does not incorporate a capacity increase or otherwise change the vertical or horizontal limits of waste placement, need not comply with the criteria specified in paragraph (H) of this rule.

(G)(4): This PTI Application is for a modification that proposes an increased capacity and horizontal and vertical limits of waste for the facility and complies with the criteria specified in paragraph (H) of this rule.

(5) Vertical expansion. For the purposes of this rule, a vertical expansion, as defined in rule 3745-27-01 of the Administrative Code, includes the proposed vertical expansion and all waste within the vertical projection above or below the proposed vertical expansion. When evaluating a proposed vertical expansion, the director shall apply the following criteria:
(a) All of the criteria specified in paragraph (H) of this rule, except for paragraph (H)(4) of this rule (general setbacks).

(G)(5)(a): The proposed vertical expansion complies with all of the criteria specified in paragraph (H) of this rule, except for (H)(4) which is not required or applicable.

(b) The criteria specified below apply to all areas of the authorized fill area that are contiguous to the proposed vertical expansion but which are not directly above or below the proposed vertical expansion: (i) Paragraph (H)(1) of this rule (location in national park, etc.); and (ii) Paragraph (H)(2) of this rule (ground water aquifer system protection).

(G)(5)(b): This PTI Application is for a contiguous expansion with a resulting vertical increase over the existing fill area. The portions above the authorized fill area that are contiguous to the proposed vertical expansion but which are not directly above or below the proposed vertical expansion meet the requirements of paragraph (H)(1) and (H)(2) of this rule.

(6) Proposed new unit(s). Proposed new unit(s) of a sanitary landfill facility shall meet all of the criteria specified in paragraph (H) of this rule; however, the director may approve the application for one (or more) noncontiguous proposed new unit(s) that meet the criteria specified in paragraph (H) of this rule, even though other proposed new unit(s) do not meet the criteria specified in paragraph (H) of this rule.

(G)(6): This PTI Application includes a new unit which meets all criteria of paragraph (H) of the rule.

(7) "Authorized fill area," that is contiguous or noncontiguous to a proposed new unit(s).
(a) Noncontiguous authorized fill area. When evaluating a proposed new unit(s), the criteria specified in paragraph (H) of this rule do not apply to an authorized fill area that is noncontiguous with the new unit(s) proposed in the permit to install application;
(b) Contiguous authorized fill area. When evaluating a permit to install application that includes a proposed contiguous new unit(s) without a vertical expansion above or below some or all of the authorized fill areas, the following apply:

(i) When evaluating a proposed new unit(s), the following criteria specified in paragraph (H) of this rule do not apply to authorized fill area contiguous with the new unit(s) proposed in the permit to install application:
(a) Paragraph (H)(3) of this rule (ground water setbacks).
(b) Paragraph (H)(4) of this rule (general setbacks).
(ii) When evaluating proposed new unit(s), the following criteria always apply to the authorized fill area contiguous to the new unit(s) in the permit to install application: (a) Paragraph (H)(1) of this rule (location in national park, etc.).
(b) Paragraph (H)(2) of this rule (ground water aquifer system protection).
(c) Contiguous new unit, authorized fill area, and vertical expansion. When evaluating a permit to install application that includes a proposed contiguous new unit(s) and also includes a vertical expansion above or below some or all of the authorized fill area, the following apply:
(i) Evaluate the vertical expansion component of the permit to install application in accordance with paragraph (G)(5) of this rule, and, if it meets the criteria specified in paragraph (G)(5) of this rule, then
(ii) Evaluate the proposed new unit(s) component of the permit to install application and the authorized fill area in accordance with paragraph (G)(6) of this rule.

(G)(7): This PTI Application is for a new unit. The entire new unit area meets all of the requirements of paragraph (G)(7)(c) of the rule.

(H) Siting criteria. (1) National parks, national recreation areas, and state parks. The limits of solid waste placement of the sanitary landfill facility are not located within one thousand feet of or within any of the following areas, in existence on the date of receipt of the permit to install application by Ohio EPA: (a) National park or recreation area;
(b) Candidate area for potential inclusion in the national park system;
(c) State park or established state park purchase area;
(d) Any property that lies within the boundaries of a national park or recreation area but that has not been acquired or is not administered by the secretary of the United States department of the interior. If the sanitary landfill facility is located within a park or recreation area and exclusively disposes of wastes generated within the park or recreation area, this paragraph shall not apply. The one-thousand-foot setback from the limits of solid waste placement does not apply if the applicant obtains a written authorization from the owner(s) and the designated authority of the areas designated in paragraph (H)(1) of this rule to locate the limits of solid waste placement within one thousand feet. Such authorizations must be effective prior to the issuance date of the permit.

(H)(1): The limits of solid waste placement for the authorized fill area, proposed contiguous new unit and vertical expansion are not located within 1,000 feet of, or within, a national park or recreation area, a candidate area for potential inclusion in the national park system, a state park or established state park purchase area, or any property that lies within the boundaries of a

national park or recreation area that has not been acquired or is not administered by the secretary of the United States Department of the Interior.

(2) Ground water aquifer system protection.
(a) Sand or gravel pit. The sanitary landfill facility is not located in a sand or gravel pit where the sand or gravel deposit has not been completely removed. For the purposes of this paragraph, a sand or gravel pit is an excavation resulting from a mining operation where the removal of sand or gravel is undertaken for use in another location or for commercial sale. This term does not include excavations of sand or gravel resulting from the construction of the sanitary landfill facility.

(H)(2)(a): Based on the review of available information on file at the Ohio Department of Natural Resources (ODNR), topographic maps, site investigations, and the general knowledge of historic land use at the property, the authorized fill area, and proposed contiguous new unit and vertical expansion are not located in a sand or gravel pit. As noted in this regulation, this does not include excavation of sand or gravel resulting from the construction of the landfill.

(b) Limestone or sandstone quarry. The sanitary landfill facility is not located in a limestone quarry or sandstone quarry. For the purposes of this paragraph, a limestone or sandstone quarry is an excavation resulting from a mining operation where limestone or sandstone is the principal material excavated for use in another location or for commercial sale. This term does not include excavations of limestone resulting from the construction of the sanitary landfill facility.

(H)(2)(b): Both coal and limestone have been previously mined on the property. OAC 3745-27-07(H)(2)(b) and Guidance Document No. 0693 titled "Siting Criteria" dated August 28, 2006 states a limestone or sandstone quarry "does not include excavations of limestone or sandstone resulting from the construction of the sanitary landfill facility." Guidance Document No. 0693 also states "If the limestone quarry has been filled in and reclaimed prior to the approval of the permit to install, there is no excavation (i.e., no quarry) and the criterion does not apply." Limestone will only be excavated as a result of landfill construction and is therefore not included in the siting criteria. Apex will not excavate below the permitted base grades to quarry the limestone. Though Apex believes that an exemption request is not required for the proposed expansion for the reasons cited, we have included an exemption request in Section (C)(2).

(c) Sole source aquifer. The sanitary landfill facility is not located above an aquifer declared by the federal government under the "Safe Drinking Water Act" to be a sole source aquifer prior to the date of receipt of the permit to install application by Ohio EPA.

(H)(2)(c): Based on information provided in Ohio EPA Guidance Document No. 0174, the authorized fill, the contiguous new unit and proposed vertical expansion are not located above an aquifer classified as a sole source aquifer by the federal government under the "Safe Drinking Water Act". No sole source aquifers are located in Jefferson or Harrison County Ohio. See Appendix C1-A for a figure depicting the limit of waste on a Drinking Water Source Protection Areas Map provided by Ohio EPA.

(d) One hundred gpm aquifer system. The sanitary landfill facility is not located above an unconsolidated aquifer system capable of sustaining a yield of one hundred gallons per minute for a twenty-four-hour period to an existing or future water supply well located within one thousand feet of the limits of solid waste placement of the sanitary landfill facility.

(H)(2)(d) The authorized fill area, the contiguous new unit and proposed vertical expansion are not above a 100 gpm aquifer system. The Hydrogeologic Investigation Report prepared by CEC dated August 31, 2011 provides aquifer testing results documenting the lack of a 100 gpm aquifer on the landfill facility.

(e) Isolation distance. The isolation distance between the uppermost aquifer system and the bottom of the recompacted soil liner of a sanitary landfill facility is not less than fifteen feet of in-situ or added geologic material constructed in accordance with rule 3745-27-08 of the Administrative Code.

(H)(2)(e): The isolation distance between the uppermost aquifer system (UAS) and the bottom of the recompacted soil liner (RSL) in the contiguous new unit and proposed vertical expansion will be greater than 15 feet of in-situ material. Refer to PTI Drawing 3C for an isopach representing the isolation distance between the UAS and the bottom of the RSL.

Note that an upper isolated high yield zone *(Pittsburgh Limestone UAS)* was encountered within the contiguous expansion footprint. This isolated zone will *essentially* be removed in its entirety (both vertically and horizontally) as indicated on Drawing 3C, therefore, separation from this

zone is not required. *Construction of the base grades for the contiguous expansion phases will result in nearly complete removal of the high yield zone, as shown on Hydrogeologic Drawing 3E-1- Area of Limestone/Shallow Bedrock Removal. Based on the interpolated contours of the base of limestone unit, there may be a small area (less than ¼ acre) of remaining limestone in Phase 10 of the expansion area. The estimated remaining limestone thickness in this area is a maximum of 5 feet. The surrounding limestone removal will dramatically alter recharge to this small area, which will no longer be considered an aquifer. Thus, the isolation distance requirement does not apply to this small area of remaining limestone.* Additionally, in response to an Ohio EPA letter dated July 7, 2014, Apex will remove the Pittsburgh Limestone in the western portion of Phase 8 where indicated on Drawing 3C. The extent of the Pittsburgh Limestone will be field determined by a qualified person. Alternately, Apex may submit a work plan to the Ohio EPA and implement a hydrogeologic investigation to classify the limestone an uppermost aquifer system or significant zone of saturation.

(3) Ground water setbacks.
(a) Five year time of travel. The limits of solid waste placement of the sanitary landfill facility and any temporary or permanent leachate ponds or lagoons are not located within the surface and subsurface areas of either of the following:
(i) Surrounding an existing or proposed public water supply well through which contaminants may move toward and may reach the public water supply well through underground geologic or man-made pathways within a period of five years. For the purposes of this paragraph, a proposed public water supply well is a well for which plans have been submitted to Ohio EPA for inclusion in a public water supply system on, or before, the date the permit to install application was received by Ohio EPA and for which a final denial has not been issued.
(ii) A well head protection area or a drinking water source protection area for a public water system using ground water. For purposes of this paragraph, a well head protection area includes areas near or surrounding a public water supply well or well field as delineated by the owner or operator of the public water supply well or well field and endorsed by Ohio EPA. For purposes of this paragraph, a drinking water source protection area for a public water system using ground water includes areas near or surrounding a public water supply well or well field as delineated by Ohio EPA. For the purposes of this paragraph, the prohibition against siting in a drinking water source protection area for a public water system using ground water shall not be effective until a map of the delineated area is sent by Ohio EPA and received by the owner or operator of the relevant public water supply well or well field.

(H)(3)(a): The authorized fill area, the contiguous new unit and proposed vertical expansion are not within the 5 year time of travel through underground pathways to an existing or proposed public water supply well or well head protection area. Refer to the Hydrogeologic Investigation Report prepared by CEC dated August 31, 2011, for a detailed discussion. The travel in the UAS is estimated at 91.5 feet in five years. The maximum distance of ground water flow in the

Bedrock SZS is 157.5 feet in five years. Both of these distances are within the facility boundary, Apex property boundary and will not reach a public water supplies.

(b) Underground mine. The sanitary landfill facility is not located within an area of potential subsidence due to an underground mine or within the angle of draw of an underground mine in existence on the date of receipt of the permit to install application by Ohio EPA unless the potential impact to the facility due to subsidence is minimized.

(H)(3)(b): The authorized fill area, the contiguous new unit and proposed vertical expansion are not located in an area of underground mines as evidenced from a review of historical records, onsite borings, and a search of ODNR records. During the excavation of Phase 4A, a previously undocumented underground drift mine was encountered. In most areas of the site, the Pittsburgh coal seam and Pittsburgh limestone are above the permitted base grades and therefore will be excavated out to achieve the permitted base grades. If an underground mine is discovered below the permitted base grades, the seam will be over-excavated and replaced with structural fill to achieve the permitted base grades.

(c) One thousand feet from water supply well. The limits of solid waste placement of the sanitary landfill facility are not located within one thousand feet of a water supply well or a developed spring in existence on the date the permit to install application was received by Ohio EPA, unless one or more of the following conditions are met:
(i) The water supply well or developed spring is controlled by the owner or operator of the sanitary landfill facility; and provided the following:
(a) The water supply well or developed spring is needed as a source of nonpotable water in order to meet the requirements of the approved permit.
(b) No other reasonable alternate water source is available.
(c) The water supply well or developed spring is constructed to prevent contamination of the ground water.
(ii) The water supply well or developed spring is at least five hundred feet hydrogeologically upgradient of the limits of solid waste placement of the sanitary landfill facility and the applicant demonstrates that the potential for migration of landfill gas to that well or developed spring is minimized.
(iii) The water supply well or developed spring is separated from the limits of solid waste placement of the sanitary landfill facility by a hydrogeologic barrier.
(iv) The water supply well or developed spring was constructed and is used solely for monitoring ground water quality. For the purposes of this paragraph, a developed spring is any spring that has been permanently modified by the addition of pipes or a collection basin to facilitate the collection and use of the spring water.

(H)(3)(c): The authorized fill area, the contiguous new unit and proposed vertical expansion are not located within 1,000 feet of a water supply well or developed spring *not owned by Apex*. Apex uses and controls two water wells that are on the facility and used to support operations; only one is within 1,000 feet from the limits of waste. *As requested by the Ohio EPA, Apex has included a variance request in Section (C)(2) requesting permission to use the existing water supply well until the waste limits are within 1,000 feet of the well, which occurs during waste placement in Phase 10. Prior to waste being placed within 1,000 feet of the water well in Phase 10, Apex will perform one of the following:*

- *Decommission the well and ~~D~~demonstrate that the new water supply well is separated from the limits of solid waste placement by a hydrogeologic barrier. This will require the installation of a new water well to be constructed with steel casing extending to the Connellsville/Morgantown UAS and a continuous annular cement seal from the bottom of the steel casing to the ground surface. Apex will obtain Ohio EPA approval before implementing.*
- *Decommission the well and either reinstall the well 1,000 feet hydrogeologically downgradient or 500 feet hydrogeologically upgradient from the proposed limit of waste or install a cistern (potable water tank) to provide water to the office.*

This is stated as a variance request in Section (C)(2). ~~This well meets the requirements of Rule 3745-27-07 (H)(3)(c)(iii), is and is controlled by Apex.~~ See Drawings 2B and 2D for the water supply wells at the facility.

(4) General setbacks.
(a) One thousand feet from natural areas. The limits of solid waste placement of the sanitary landfill facility are not located within one thousand feet of the following, that are in existence on the date of receipt of the permit to install application by Ohio EPA:
(i) Areas designated by the Ohio department of natural resources as either a state nature preserve including all lands dedicated under the Ohio natural areas law, a state wildlife area, or a state wild, scenic or recreational river.
(ii) Areas designated, owned, and managed by the Ohio (sic) historical society as a nature preserve.
(iii) Areas designated by the United States department of the interior as either a national wildlife refuge or a national wild, scenic or recreational river.
(iv) Areas designated by the United States forest service as either a special interest area or a research natural area in the Wayne national forest.
(v) Stream segments designated by Ohio EPA as either a state resource water, a coldwater habitat, or an exceptional warmwater habitat.
(b) Three hundred feet from property line. The limits of solid waste placement of the sanitary landfill facility are not located within three hundred feet of the sanitary landfill facility's property line.

(c) One thousand feet from domicile. The limits of solid waste placement of the sanitary landfill facility are not located within one thousand feet of a domicile, whose owner has not consented in writing to the location of the sanitary landfill facility, in existence on the date of receipt of the permit to install application by the Ohio EPA.
(d) Two hundred feet from surface waters. The limits of solid waste placement of the sanitary landfill facility are not located within two hundred feet of areas determined by Ohio EPA or the United States Army Corps of Engineers to be a stream, lake, or wetland.

(H)(4)(a): Based on review of USGS topographic quadrangles, Ohio EPA stream segment designations, and knowledge of the area, the proposed limits of waste placement are not located within 1,000 feet of:

- Areas designated by the Ohio Department of Natural Resources as either a state nature preserve, a state wildlife area, or a state scenic river.
- Areas designated, owned, and managed by the Ohio Historical Society as a nature preserve.
- Areas designated by the United States Department of the Interior as either a national wildlife refuge or a national scenic river.
- Areas designated by the United States Forest Service as either a special interest area or a research natural area in the Wayne National Forest.
- Stream segments designated by Ohio EPA as either a state resource water, a coldwater habitat, or an exceptional warmwater habitat.

(H)(4)(b) The proposed expansion has been designed to maintain a 300-feet minimum offset between the limits of waste placement and property lines not owned by Apex. The property offset criteria is presented on Drawing 2D-1 and 2D-2.

(H)(4)(c): The proposed expansion has been designed to maintain a 1,000-foot minimum offset between the limits of waste placement and all domiciles. The domicile offset criteria is presented on Drawing 2D-1 and 2D-2.

(H)(4)(d): The proposed expansion will impact wetlands, streams, and a pond at the facility. The delineated surface waters are presented on Drawing 2D-1 and 2D-2. CEC conducted a detailed field delineation of wetlands, streams, and ponds within the proposed construction limits of the proposed expansion. The field investigation identified 11 wetland areas within the proposed limit of disturbance ranging in size from 0.01-acre to 5.89 ~~0.0~~-acre with a total delineated area of 13.92 ~~23.22~~-acres. Additionally, 11 ~~6~~ streams totaling 4,301 ~~2,066~~ linear feet, and 11 open water mine pits ~~bodies~~ totaling 4.54 ~~5.8~~ acres were also identified within the proposed disturbed area. CEC submitted a Jurisdictional Waters Delineation Report dated October 2011 to the U.S. Army Corps of Engineers (COE). *The COE approved the Jurisdictional Delineation in a letter dated September 21, 2012.* A copy of the report *and COE letter are* ~~is~~ provided in Section (C)(10) of this PTI Application. Apex will provide the Ohio EPA with a copy of the Permit upon receipt by the Corps of Engineers.

C1.3 FACILITY COMPLIANCE

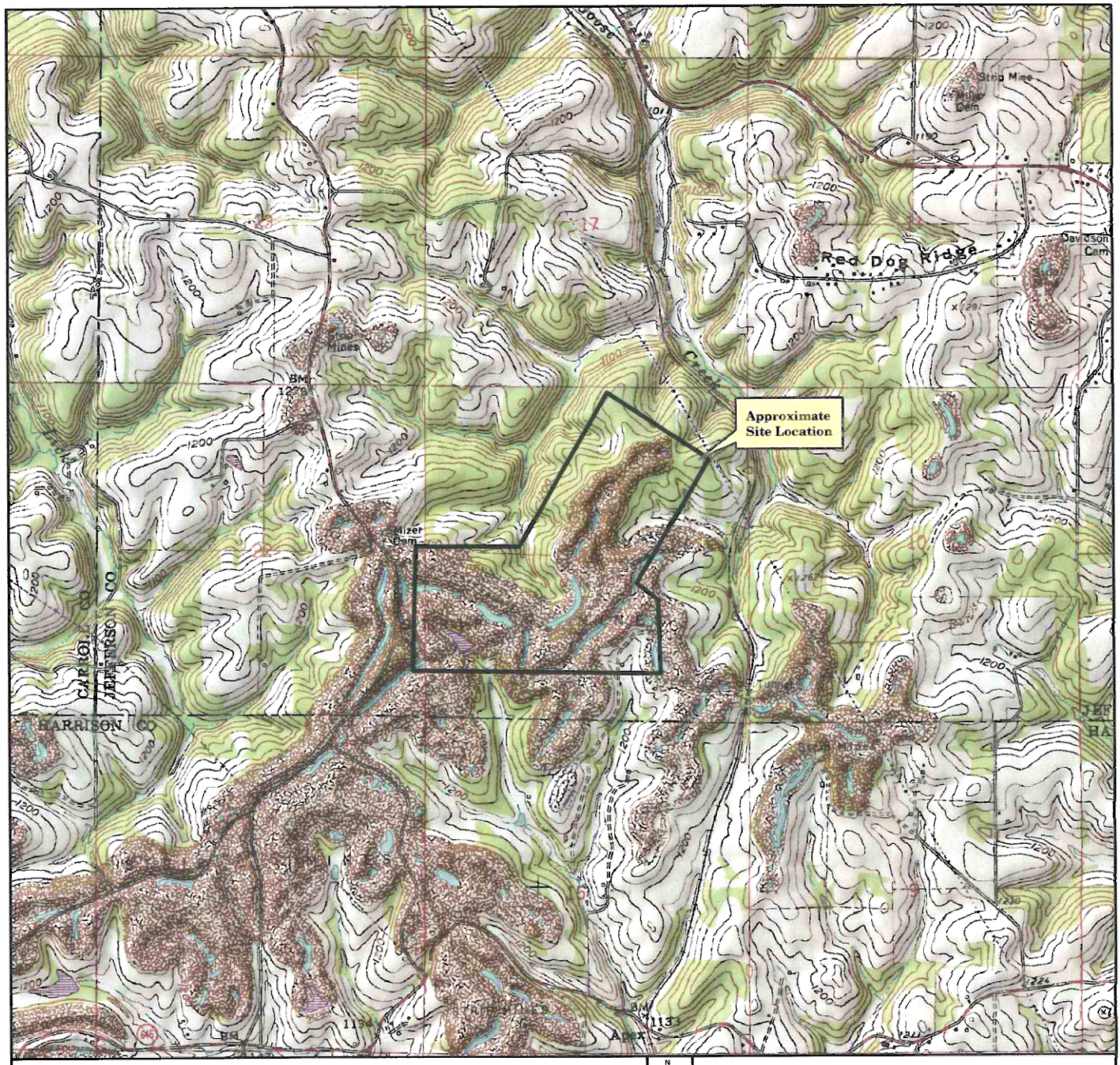
The Ohio EPA issued PTI No. 06-08438 on December 31, 2009 for the Apex Sanitary Landfill. Apex has operated the landfill since 2005. Apex has constructed and operated the site in accordance with the authorizing documents. The limits of waste placement have been in substantial compliance with the boundaries established in the PTI Application. The landfill meets the location restriction demonstration required by Rule 3745-27-20 and the necessary documentation was submitted into the Operating Record. Apex has constructed the engineered components in accordance with the requirements in the PTI Application and OAC 3745-27-08.

Apex has operated the site in substantial compliance with the operational requirements in Rule 3745-27-19. *Director's Final Findings and Orders (DFFO) were submitted by the Ohio EPA on December 22, 2011. Additional DFFOs were submitted on June 3, 2013 that approved Apex's proposed actions to comply with the 2011 DFFO.* The DFFOs were terminated in a letter submitted by the Ohio EPA on December 11, 2015. *A DFFO was submitted by the Ohio EPA on April 29, 2013 regarding the payment of fees.* This DFFO was terminated upon completion of fee payment. A summary of the violations issued to the facility is provided in Appendix C1-E.

The site conducts monitoring of its environmental control systems such as the explosive gas monitoring and ground water monitoring. Gas monitoring is conducted in accordance with the Explosive Gas Monitoring Plan. Ground water monitoring wells are located along the perimeter of the site and are monitored in accordance with the Ground Water Detection Monitoring Plan.

APPENDIX C1-A

DRINKING WATER SOURCE PROTECTION AREAS MAP



Public Water System Wells, Intakes and Drinking Water Source Protection Areas Near the Apex Landfill
Springfield Township, Jefferson County, Ohio

N

Scale 0 1,000 2,000 4,000 Feet
0 0.25 0.5 1 Mile

EXPLANATION

- Public Water System Intake
- Public Water System Well
- *Sole Source Aquifer*

Drinking Water Source Protection Areas - Ground Water

- Protection Area (Outer line = 5-year time-of-travel)
- Inner Management Zone (Inner line = 1-year time-of-travel)

Drinking Water Source Protection Areas - Surface Water

- Corridor Management Zone
- Emergency Management Zone
- Zone of Critical Concern (Ohio River systems only)
- Critical Assessment Zone (Lake Erie systems only)
- Potential Influence Zone (Lake Erie systems only)

Label text reflects system type as defined in Chapter 3745-81-01 of the Ohio Administrative Code as noted below.

Community Water System | Non-Transient, Non-Community Water System | *Transient, Non-Community Water System*

Base Maps:
Amsterdam 7.5 Minute Quadrangle Topographic Map, United States Geologic Survey

Site Location Provided by:
Matthew Barnett. P.G.
Civil & Environmental Consultants, Inc.

Ohio Environmental Protection Agency
Division of Drinking and Ground Waters

Map created on January 6. 2011

APPENDIX C1-B

TIME OF TRAVEL CALCULATIONS

TABLE C3-7
GROUNDWATER VELOCITY CALCUATIONS
APEX LANDFILL LATERAL EXPANSION

Civil & Environmental Consultants, Inc.

PROJECT	Apex Landfill Lateral Expansion	PROJECT NO.	101-049
	Groundwater Velocity Calculations	PAGE	1 OF 2
MADE BY	DWC	DATE	4-12-11
CHECKED BY	JMD	DATE	4-26-11

INTRODUCTION Calculate the Mean Groundwater Flow Rates

METHOD A derivation of Darcy's Equation.

CALCULATION

$$V = (K) \times (dh/dl)/n_e$$

Where: V = Mean Groundwater Flow Rate
K = Hydraulic Conductivity
dh/dl = Hydraulic Gradient
n_e = Effective Porosity

Connellsville/Morgantown UAS

K = 9.61×10^{-4} cm/sec (geometric mean of the K-testing)
dh/dl = 0.0064 ft/ft (average hydraulic gradient observed)
n_e = 0.35 (Sandstone - OEPA Technical Guidance Manual, 2006)

V = (9.61×10^{-4} cm/sec)(0.0064 ft/ft)/(0.35) = 1.76×10^{-5} cm/sec
= 5.77×10^{-7} ft / sec
= 0.05 ft/day
= 18.3 ft/year

Bellaire/Summerfield SZS

K = 3.50×10^{-5} cm/sec (geometric mean of the K-testing)
dh/dl = 0.039 ft/ft (average hydraulic gradient observed)
n_e = 0.06 (Shale - OEPA Technical Guidance Manual, 2006)

V = (3.50×10^{-5} cm/sec)(0.039 ft/ft)/(0.06) = 2.28×10^{-5} cm/sec
= 7.46×10^{-7} ft / sec
= 0.065 ft/day
= 23.5 ft/year

TABLE C3-7
GROUNDWATER VELOCITY CALCUATIONS
APEX LANDFILL LATERAL EXPANSION

Civil & Environmental Consultants, Inc.

PROJECT	Apex Landfill Lateral Expansion			PROJECT NO.	101-049
	Groundwater Velocity Calculations			PAGE	2 OF 2
MADE BY	DWC	DATE	4-12-11	CHECKED BY	JMD DATE 4-26-11

Limestone/Shallow Bedrock SZS and UAS

K = 7.61 x 10^{-4} cm/sec (geometric mean of the K-testing)
dh/dl = 0.012 ft/ft (average hydraulic gradient observed)
n_e = 0.30 (Limestone - OEPA Technical Guidance Manual, 2006)

V = (7.61x10^{-4} cm/sec)(0.012 ft/ft)/(0.30) = 3.04 x 10^{-5} cm/sec
= 9.97 x 10^{-6} ft / sec
= 0.086 ft/day
= 31.5 ft/year

Mine Spoil SZS

K = 3.67 x 10^{-4} cm/sec (geometric mean of the K-testing)
dh/dl = 0.013 ft/ft (average hydraulic gradient observed)
n_e = 0.32 (Sandy Clay - OEPA Technical Guidance Manual, 2006)

V = (3.67x10^{-4} cm/sec)(0.013 ft/ft)/(0.32) = 1.49 x 10^{-5} cm/sec
= 4.89 x 10^{-7} ft / sec
= 0.042 ft/day
= 15.4 ft/year

APPENDIX C1-C

WATER SUPPLY WELLS WITHIN 1 MILE OF FACILITY

January 5, 2011

Ms. Barb Lubberger
Ohio Environmental Protection Agency
Source Water Assessment and Protection Program
122 South Front Street
Columbus, Ohio 43215-1049

SUBJECT: Proposed PTI Application
Apex Landfill
Amsterdam, Ohio
CEC Project 101-049

Dear Ms. Lubberger:

Apex Environmental, LLC, is proposing to submit a Permit to Install (PTI) Application for the expansion of the Apex Landfill in Jefferson County, Ohio. The proposed expansion will add additional acreage to the existing landfill. The landfill is located in Springfield Township, Jefferson County, Ohio. A copy of a United States Geological Survey map segment for the site is attached.

We are requesting the Ohio Environmental Protection Agency, Division of Drinking and Ground Waters, Source Water Assessment and Protection Program provide information pertaining to any wellhead protection and/or source water protection areas within one mile of the property boundary identified in the attached figure.

We request a letter or an electronic mail transmitting the information in your files concerning any information as outlined above. Thank you for your assistance.

Sincerely,

CIVIL AND ENVIRONMENTAL CONSULTANTS, INC.

Matthew Barnett, P.G.
Project Manager

Attachment

REFERENCE:

U.S.G.S. 7.5 MINUTE TOPOGRAPHIC QUADRANGLE MAP
AMSTERDAM, OHIO; DATED 1976.

SCALE IN FEET

0 1500 3000

Civil & Environmental Consultants, Inc.
Columbus, OH
(614) 540-6633 • (888) 598-6808
Cincinnati, OH • Pittsburgh, PA • Indianapolis, IN • Nashville, TN

SITE LOCATION MAP
APEX ENVIRONMENTAL LLC.
JEFFERSON COUNTY, OHIO

DWN. BY: KMAC	SCALE:	DATE:	PROJECT NO.:	
CHKD. BY: DWC	1"=1500'	May 2006	042-021	Figure 1

Beaudoin, Michael

From: Internet WHP [whp@epa.state.oh.us]
Sent: Thursday, January 06, 2011 9:37 AM
To: Barnett, Matt
Subject: Re: Data Request
Attachments: mbarnett010611.PDF

Matt,

The attached map shows the location of the property indicated in your email in relation to surrounding public water system wells, intakes, drinking water source protection areas and Federally-designated sole source aquifers.

The Apex Landfill, located in Springfield Township, Jefferson County, Ohio, is not located within one mile of a public water system well, intake or drinking water source protection area.

This property is not located over a Federally-designated sole source aquifer.

Protection area boundaries are subject to change and additional protection areas may be determined in the future.

Feel free to contact me if you have any questions or need additional information.

Craig Smith
Ohio EPA
Division of Drinking and Ground Waters
Phone: (614) 644-2752
Fax: (614) 644-2909

>>> "Barnett, Matt" <mbarnett@cecinc.com> 1/5/2011 3:21 PM >>>
Please find attached the required information for a data request.
Please contact me with any questions. Thank you for your assistance.

Matthew Barnett, P.G.

Civil & Environmental Consultants, Inc.

8740 Orion Place, Suite 100 * Columbus, Ohio 43240

Toll-Free: 888-598-6808 * Direct: 614-310-2073 * Fax: 614-540-6638

Mobile: (614)214-6879 * http://www.cecinc.com

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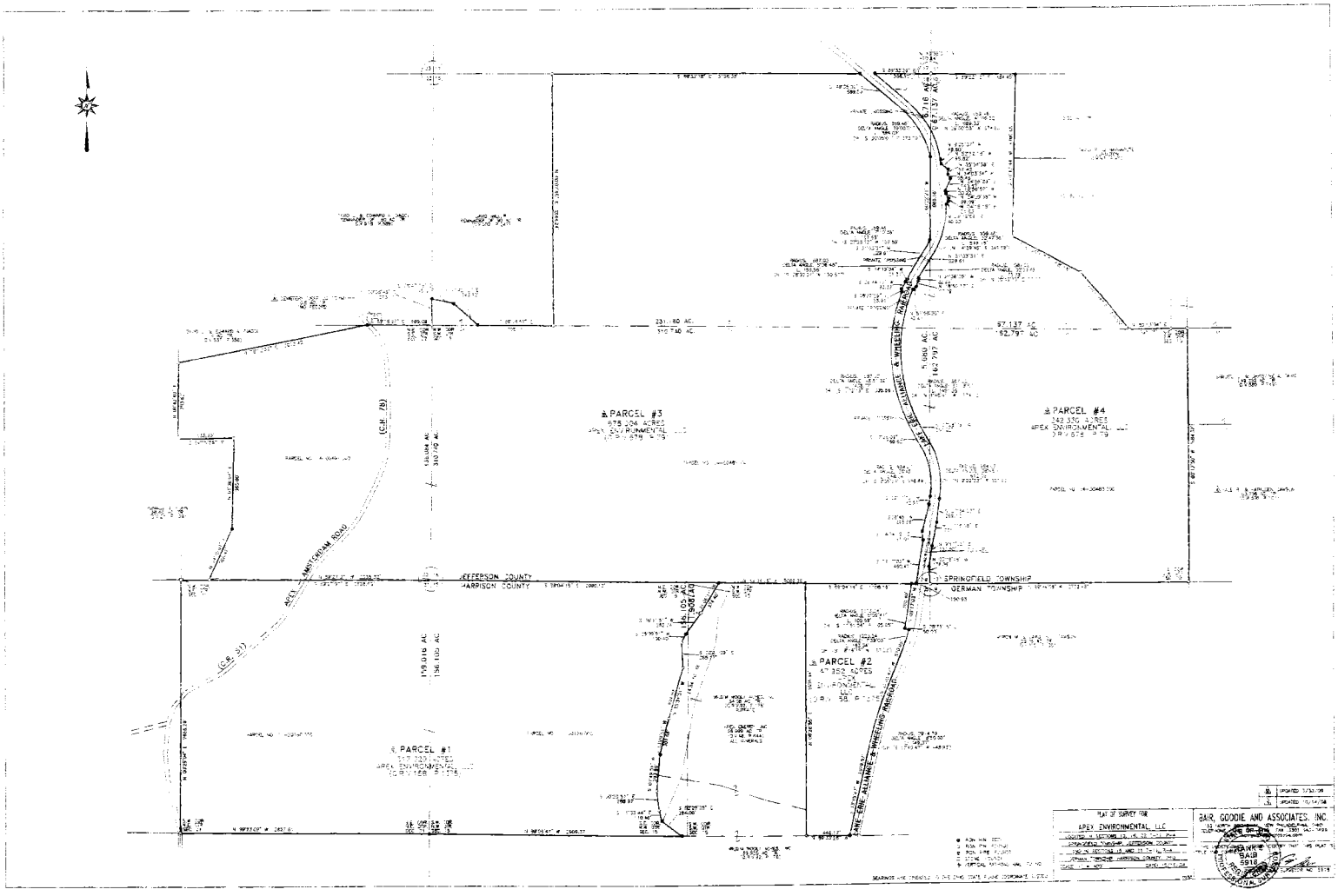
Ohio Environmental Protection Agency
Unless otherwise provided by law,
this communication and any response to it constitutes a public record.

APPENDIX C1-D

PROPERTY OWNERSHIP INFORMATION


PARCEL #3
PARCEL #4
PARCEL #2
PARCEL #1
JEFFERSON COUNTY
HARRISON COUNTY
SPRINGFIELD TOWNSHIP
GERMAN TOWNSHIP
APEX AMSTERDAM ROAD
(C.R. 78)
(C.R. 91)
APEX ENVIRONMENTAL, LLC
BAIR, GOODIE AND ASSOCIATES, INC.

Westin Deed

12-27-2004

193427

LIMITED WARRANTY DEED

(Ohio Statutory Form)

100

DEC 27 | 12 PM '04

OR VOL 678 PG 079

KNOW ALL MEN BY THESE PRESENTS, that **APEX ENERGY, INC.**, a corporation incorporated and existing under the laws of the State of Ohio ("Grantor"), for valuable consideration paid, grants with limited warranty covenants to **APEX ENVIRONMENTAL, LLC**, a Delaware limited liability company ("Grantee"), whose tax mailing address is Dominion Tower, Suite 3100, 625 Liberty Avenue, Pittsburgh, PA 15222, its successors and assigns, fee simple title to the following property:

Situated in the Township of Springfield, County of Jefferson and State of Ohio, and being more fully described on Exhibit A attached hereto and made a part hereof (the "Property"), together with all and singular the buildings, improvements, fixtures, ways, liberties, privileges, hereditaments, rights of way, easements and appurtenances whatsoever thereunder belonging, or in anywise appertaining, and the reversions, and remainders, rents, issues and profits thereof; and also all the estate, right, title, interest, property, claim and demand whatsoever, as well in law, as in equity, of the Grantor of, in or to the property described herein at Exhibit A and every part and parcel thereof, with the appurtenances.

Together with the Grantor's interest in all coal, coal seams, coal strata and other minerals located on or under the Property.

This conveyance is made subject to the restrictions, reservations and exceptions, rights of way, covenants and conditions set forth in prior deeds and other instruments in the chain of title from which it derives.

And the Grantor, does for itself, its successors and assigns, covenant with the Grantee, its successors and assigns that it warrants and will defend the premises to the Grantee and its successors and assigns, against the lawful claims and demands of all persons claiming through Grantor but against none other.

Prior Instrument Reference: OR Volume 35, page 684.

Permanent Tax Parcel Numbers:

Tract One: Tax Parcel Nos. 34-00489-000 and 34-00491-000
Tract Two: Tax Parcel No. 34-00483-000

TRANSFERRED
CONVEYANCE EXAMINED
AND SECT 319.202 R.C
COMPLIED WITH $3,680.50
DEC 27 2004
Patrick J. Marshall
Jefferson County Auditor
BY ED
NO. 1446

PI-1278645 v4

IN WITNESS WHEREOF, Grantor has executed this Limited Warranty Deed this 21st day of December, 2004.

APEX ENERGY, INC.,
an Ohio corporation

By: David Kvulock
Name: DAVID KVULOCK
Title: President

Commonwealth of Pennsylvania)
) ss:
County of Allegheny)

BEFORE ME, a Notary Public in and for said County and State personally appeared the above named David Kvulock, known to me personally to be the President of Apex Energy, Inc., an Ohio corporation, and who did acknowledge that he/she did sign the foregoing instrument on behalf of said company with due authorization, and as his/her free and voluntary act and deed in such capacity.

IN WITNESS WHEREOF, I have hereunto set my hand and official seal this 21st day of December, 2004.

Kathleen M. Murray
Notary Public

My Commission Expires:

Notarial Seal
Kathleen M. Murray, Notary Public
City of Pittsburgh, Allegheny County
My Commission Expires May 21, 2005
Member, Pennsylvania Association of Notaries

THIS INSTRUMENT PREPARED BY:

Frankovitch, Anetakis, Colantonio & Simon
337 Penco Road
Weirton, WV 26062
(304) 723-4400

EXHIBIT A

[See attached.]

Requested By: bjb 10/01/2007

Instrument 200400003691 OR Book 158 Page 1378

December 6, 2004

PARCEL #1

DESCRIPTION FOR APEX ENVIRONMENTAL, LLC
OF A 317.029 ACRE TRACT

Situated in the Township of German, County of Harrison and State of Ohio.

Being the remainder of a 306.94 acre tract (Parcel No. 11-00160.000) (as carried in the Auditor=s Records as a 160.544 acre tract) located in the Northeast Quarter of Section 21, Township 11, Range 4 and also being the remainder of a 302.12 acre tract (Parcel No. 11-00165.000) (as carried in the Auditor=s Records as a 157.066 acre tract) located in the Northwest and Northeast Quarters of Section 15, Township 11, Range 4 as conveyed to Apex Energy, Inc. by Warranty Deed as recorded in Deed Volume 235, Page 412 of the Harrison County Deed Records and being more fully described as follows:-

BEGINNING at a point at the northeast corner of said Section 21 being on the Jefferson and Harrison County line;

THENCE with the north line of Section 15, South 89 deg. 04 min. 18 sec. East, 2,990.13 feet to an iron pin (set) at the northwest corner of a 14.84 acre tract as conveyed to Wild=N Wooly Acres, Inc. (Official Record Volume 92, Page 176) and being a northeasterly corner of said 302.12 acre tract;

THENCE with the westerly lines of said 14.84 acre tract, the following nine (9) courses and with the easterly lines of said 302.12 acre tract, the following ten (10) courses:

1) THENCE South 31 deg. 06 min. 11 sec. West, 374.40 feet to an iron pin (found);

2) THENCE South 36 deg. 31 min. 51 sec. West, 262.74 feet to an iron pin (set);

3) THENCE South 25 deg. 00 min. 51 sec. West, 100.40 feet to an iron pin (found);

4) THENCE South 02 deg. 21 min. 09 sec. East, 265.17 feet to an iron pin (found);

5) THENCE South 15 deg. 31 min. 51 sec. West, 651.68 feet to an iron pin (found);

6) THENCE South 13 deg. 09 min. 51 sec. West, 301.66 feet to an iron pin (set);

Description for Apex Environmental, LLC
Of a 317.029 Acre Tract
Parcel #1
December 6, 2004
Page 2

7) THENCE South 01 deg. 49 min. 51 sec. West, 293.89 feet to an iron pin (found);

8) THENCE South 00 deg. 20 min. 51 sec. West, 288.97 feet to an iron pin (found);

9) THENCE South 11 deg. 33 min. 44 sec. East, 110.46 feet to an iron pin (set);

10) THENCE South 52 deg. 25 min. 25 sec. East, 264.00 feet to an iron pin (set) on the south line of the Northwest Quarter of Section 15;

THENCE North 89 deg. 06 min. 47 sec. West, 2,609.37 feet to an iron pin (set) at the southwest corner of said Northwest Quarter of Section 15;

THENCE with the south line of the Northeast Quarter of Section 21, North 89 deg. 23 min. 09 sec. West, 2,627.61 feet to an iron pin (found) at the southwest corner of the Northeast Quarter of Section 21 and being located in County Road 78;

THENCE with the west line of said Northeast Quarter of Section 21, North 00 deg. 29 min. 04 sec. East, 2,666.29 feet to a stone (found) at the northwest corner of said Northeast Quarter of Section 21 and being on the Jefferson and Harrison County line;

THENCE with said north line of Section 21 and county line, South 89 deg. 27 min. 07 sec. East, 2,628.69 feet to the PLACE OF BEGINNING, containing 317.029 acres, more or less, but subject to all legal highways, right-of-ways and easements.

The above described 317.029 acre tract comprises 159.016 acres in the Northeast Quarter of Section 21 and 156.105 acres in the Northwest Quarter of Section 15, and 1.908 acres in the Northeast Quarter of Section 15.

Bearings are oriented to the Ohio State Plane Coordinate System.

Iron pins indicated (set) are 5/8 inch iron bars with plastic cap stamped Bair & Goodie.

Plat and Description Prepared By
Frank E. Bair, Reg. Surveyor #5918

Requested By dec 06/21/2011

Instrument Book Page
200400003691 OR 158 1380

December 6, 2004

PARCEL #2

**DESCRIPTION FOR APEX ENVIRONMENTAL, LLC
OF A 47.952 ACRE TRACT**

Situated in the Township of German, County of Harrison and State of Ohio.

Being all of a 47.88 acre tract (Parcel No. 11-00161.000) located in the Northeast Quarter of Section 15, Township 11, Range 4 as conveyed to Apex Energy, Inc. by Warranty Deed as recorded in Deed Volume 235, Page 412 of the Harrison County Deed Records and being more fully described as follows:-

COMMENCING at an iron pin (found) at the northeast corner of said Section 15 being on the Jefferson and Harrison County line and on the east line of the Lake Erie, Alliance and Wheeling Railroad;

THENCE with the north line of Section 15 and with said county line, North 89 deg. 04 min. 18 sec. West, 190.93 feet to an iron pin (set) on the west line of said railroad and eing the northeast corner of said 47.88 acre tract and being the PLACE OF BEGINNING of the tract herein to be described;

THENCE from said beginning and leaving said section line and with the westerly lines of said railroad and the easterly lines of said 47.88 acre tract, the following seven (7) courses:

1) THENCE South 9 deg. 17 min. 03 sec. West, 368.40 feet to a point;

2) THENCE with a curve to the right, having a radius of 1,173.24 feet, a delta of 05 deg. 09 min. 41 sec., for an arc length of 105.69 feet to an iron pin (set) (chord bearing South 11 deg. 51 min. 54 sec. West, 105.65 feet);

3) THENCE South 75 deg. 33 min. 16 sec. East, 50.00 feet to an iron pin (set);

4) THENCE with a curve to the right, having a radius of 1,223.24 feet, a delta of 7 deg. 39 min. 03 sec., for an arc length of 163.34 feet to a point (chord bearing South 18 deg. 16 min. 15 sec. West, 163.22 feet);

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Description for Apex Environmental, LLC
Of a 47.952 Acre Tract
Parcel #2
December 6, 2004

5) THENCE South 22 deg. 05 min. 47 sec. West, 570.85 feet to a point;

6) THENCE with a curve to the left, having a radius of 2,914.79 feet, a delta of 08 deg. 50 min. 00 sec., for an arc length of 449.37 feet to a point (chord bearing South 17 deg. 40 min. 47 sec. West, 448.93 feet to a point);

7) THENCE South 13 deg. 15 min. 47 sec. West, 1,079.57 feet to an iron pin (set) on the south line of the Northeast Quarter of Section 15 and at the southeast corner of said 47.88 acre tract;

THENCE with the south line of the Northeast Quarter of Section 15 and 47.88 acre tract, North 89 deg. 33 min. 26 sec. West, 446.17 feet to an iron pipe (found) at the southwest corner of said 47.88 acre tract and a corner of a 59.925 acre tract as conveyed to Wild'N Wooly Acres, Inc. (Official Record Volume 92, Page 176);

THENCE with the westerly line of said 59.925 acre tract and a 54.08 acre tract as conveyed to Wild'N Wooly Acres, Inc. (Official Record Volume 92, Page 176), North 00 deg. 26 min. 55 sec. East, 2,656.44 feet to a vertical railroad rail (found) at the northwest corner of said 47.88 acre tract, northeast corner of said 54.08 acre tract and being on said north line of Section 15 and county line;

THENCE with said north line of Section 15 and with said county line, South 89 deg. 04 min. 18 sec. East, 1,108.16 feet to the PLACE OF BEGINNING, containing 47.952 acres, more or less, but subject to all legal highways, right-of-ways and easements.

Bearings are oriented to the Ohio State Plane Coordinate System.

Iron pins indicated (set) are 5/8 inch iron bars with plastic cap stamped Bair & Goodie.

Plat and Description Prepared By
Frank E. Bair, Reg. Surveyor #5918

December 6, 2004

PARCEL #3

DESCRIPTION FOR APEX ENVIRONMENTAL, LLC
OF A 678.004 ACRE TRACT

Situated in the Township of Springfield, County of Jefferson and State of Ohio.

Being part of a 554.78 acre tract (Parcel No. 34-00489.000) located in all Quarters of Section 16, Township 11, Range 4 and being all of a 135.83 acre tract (Parcel No. 34-00491.000) located in the Southeast Quarter of Section 22, Township 11, Range 4 as conveyed to Apex Energy, Inc. by Warranty Deed as recorded in Deed Volume 35, Page 684 of the Jefferson County Deed Records and being more fully described as follows:

BEGINNING at a point at the southeast corner of Southeast Quarter of Section 22;

THENCE from said beginning with the south line of Section 22, North 89 deg. 27 min. 07 sec. West, 2,335.32 feet to an iron pin (found) at the southwest corner of said 135.83 acre tract and the southeast corner of a 98.40 acre tract as conveyed to Ronald M. Kuhn (Deed Volume 21, Page 139);

THENCE with the west lines of said 135.83 acre tract and the east lines of said 98.40 acre tract, the following four (4) courses: North 24 deg. 25 min. 01 sec. East, 586.41 feet to an iron pin (set);

THENCE North 1 deg. 38 min. 57 sec. East, 965.00 feet to an iron pin (found);

THENCE South 89 deg. 25 min. 58 sec. West, 583.93 feet to an iron pin (found) on the west line of said Southeast Quarter of Section 22;

THENCE with said west line of the Southeast Quarter, North 00 deg. 42 min. 40 sec. East, 793.62 feet to an iron pin (found) at the southwest corner of a 9 acre tract as conveyed to David L. and Edward A. Ciacci (Deed Volume 537, Page 356);

THENCE with the north lines of said 135.83 acre tract and the south line of said 9 acre tract, North 79 deg. 12 min. 32 sec. East, 2,012.42 feet to an iron pin (set) on the north line of said Southeast Quarter and being located in Apex-Amsterdam Road (C.R. 78);

THENCE South 89 deg. 18 min. 57 sec. East, 669.09 feet to an iron pin (found) at the northeast corner of the Southeast Quarter of Section 22;

THENCE with the west line of Section 16 and the boundary lines of said 554.78 acre tract, the following five (5) courses:

1) THENCE North 00 deg. 08 min. 43 sec. East, 273.13 feet to an iron pin (set) at the southwest corner of a 80 acre tract as conveyed to David Miller (Deed Volume 602, Page 247);

2) THENCE with the southerly lines of said 80 acre tract, South 78 deg. 47 min. 06 sec. East, 245.00 feet to an iron pin (set);

3) THENCE South 47 deg. 42 min. 02 sec. East, 343.82 feet to an iron pin (set) on the north line of the Southwest Quarter of Section 16;

4) THENCE with said north line, South 89 deg. 18 min. 57 sec. East, 795.11 feet to an iron pin (found) at the southeast corner of said 80 acre tract;

5) THENCE with the east line of said 80 acre tract, North 00 deg. 07 min. 46 sec. East, 2,644.24 feet to an iron pin (found) on the north line of said Section 16;

THENCE with the north line of Section 16, South 89 deg. 33 min. 28 sec. East, 3,196.38 feet to an iron pin (set) on the west line of the Lake Erie Alliance and Wheeling Railroad;

THENCE with the west line of said railroad, the following sixteen (16) courses:

1) THENCE South 49 deg. 35 min. 01 sec. East, 589.53 feet to a point;

2) THENCE with a curve to the right, having a radius of 859.46 feet, a delta of 39 deg. 00 min. 01 sec., for an arc length of 585.02 feet to an iron pin (set) (chord bearing South 30 deg. 05 min. 01 sec. East, 573.79 feet) on the east line of Section 16;

3) THENCE with the east line of Section 16, South 00 deg. 22 min. 21 sec. West, 866.16 feet to an iron pin (set);

4) THENCE with a curve to the right, having a radius of 859.46 feet, a delta of 7 deg. 10 min. 38 sec., for an arc length of 107.66 feet to a point (chord bearing South 27 deg. 28 min. 12 sec. West, 107.59 feet);

5) THENCE South 31 deg. 03 min. 31 sec. West, 229.61 feet to a point;

6) THENCE with a curve to the left, having a radius of 1,687.02, a delta angle of 5 deg. 06 min. 48 sec., for an arc length of 150.56 feet to an iron pin (set) (chord bearing South 28 deg. 30 min. 07 sec. West, 150.51 feet to a point);

7) THENCE South 44 deg. 19 min. 04 sec. West, 21.81 feet to an iron pin (set);

8) THENCE South 26 deg. 44 min. 17 sec. West, 93.39 feet to an iron pin(set);

9) THENCE South 8 deg. 22 min. 29 sec. East, 23.91 feet to an iron pin (set);

10) THENCE with a curve to the left, having a radius of 1,687.02 feet, a delta angle of 48 deg. 51 min. 52 sec., for an arc length of 1,438.77 feet to a point (chord bearing South 3 deg. 02 min. 13 sec. East, 1,395.56 feet);

11) THENCE South 27 deg. 28 min. 09 sec. East, 260.62 feet to a point;

12) THENCE with a curve to the right, having a radius of 854.67 feet, a delta of 36 deg. 45 min. 11 sec., for an arc length of 548.24 feet to an iron pin (set) (chord bearing South 9 deg. 05 min. 34 sec. East, 538.89 feet);

13) THENCE South 9 deg. 17 min. 03 sec. West, 82.50 feet to an iron pin (set);

14) THENCE South 13 deg. 38 min. 45 sec. West, 295.86 feet to an iron pin (set);

15) THENCE South 4 deg. 54 min. 12 sec. East, 91.80 feet to an iron pin (set);

16) THENCE South 9 deg. 17 min. 03 sec. West, 460.47 feet to an iron pin (set) on the south line of Section 16;

THENCE with the south line of Section 16, North 89 deg. 04 min. 18 sec. West, 5,066.99 feet to the PLACE OF BEGINNING, containing 678.004 acres, more or less, but subject to all legal highways, right-of-ways and easements.

The above described 678.004 acre tract comprises 231.80 acres in the Northwest and Northeast Quarters of Section 16, 310.740 acres in the Southwest and Southeast Quarters of Section 16 and 136.084 acres in the Southeast Quarter of Section 22;

Bearings are oriented to the Ohio State Plane Coordinate System.

Iron pins indicated (set) are 5/8 inch iron bars with plastic cap stamped Bair & Goodie.

Plat and Description Prepared By
Frank E. Bair, Reg. Surveyor #5918

December 6, 2004

PARCEL #4

DESCRIPTION FOR APEX ENVIRONMENTAL, LLC
OF A 242.330 ACRE TRACT

Situated in the Township of Springfield, County of Jefferson and State of Ohio.

Being part of a 554.78 acre tract (Parcel No. 34-00489.000) located in the Southeast and Northeast Quarters of Section 16, Township 11, Range 4 and being all of a 233.23 acre tract (Parcel No. 34-00483.000) located in the Southwest and Northwest Quarters of Section 10, Township 11, Range 4 as conveyed to Apex Energy, Inc. by Warranty Deed as recorded in Deed Volume 35, Page 684 of the Jefferson County Deed Records and being more fully described as follows:

BEGINNING at an iron pin (found) at the southeast corner of the Southwest Quarter of Section 10 being on the Jefferson and Harrison County line and being the southeast corner of said 233.23 acre tract;

THENCE from said beginning with the south line of Section 10, North 89 deg. 44 min. 58 sec. West, 2,702.48 feet to an iron pin (found) at the southwest corner of Section 10 and being on the east line of the Lake Erie, Alliance and Wheeling Railroad;

OC #3

THENCE with the east line of said railroad, the following twenty-four (24) courses:

1) THENCE North 3 deg. 18 min. 48 sec. West, 178.36 feet to an iron pin (set);

2) THENCE North 9 deg. 17 min. 03 sec. East, 232.50 feet to an iron pin (set);

3) THENCE North 11 deg. 16 min. 06 sec. East, 231.14 feet to an iron pin (set);

4) THENCE North 7 deg. 34 min. 53 sec. East, 269.12 feet to an iron pin (set);

5) THENCE with a curve to the left, having a radius of 954.67 feet, a delta of 36 deg. 45 min. 11 sec., for an arc length of 612.39 feet to a point (chord bearing North 9 deg. 05 min. 32 sec. West, 601.93 feet);

6) THENCE North 27 deg. 28 min. 09 sec. West, 260.62 feet to a point;

7) THENCE with a curve to the right, having a radius of 1,587.02 feet, a delta of 51 deg. 18 min. 53 sec., for a an arc length of 1,421.35 feet to an iron pin (set) (chord bearing North 1 deg. 48 min. 41 sec. West, 1,374.32 feet);

8) THENCE North 51 deg. 58 min. 30 sec. East, 43.41 feet to an iron pin (set);

9) THENCE North 18 deg. 50 min. 37 sec. East, 67.79 feet to an iron pin (set);

10) THENCE North 1 deg. 36 min. 25 sec. West, 22.23 feet to an iron pin (set);

11) THENCE with a curve to the right, having a radius of 1,587.02 feet, a delta of 2 deg. 39 min. 49 sec., for an arc length of 73.78 feet to a point (chord bearing North 29 deg. 43 min. 39 sec. East, 73.77 feet);

12) THENCE North 31 deg. 03 min. 31 sec. East, 229.61 feet to a point;

13) THENCE with a curve to the left, having a radius of 959.46 feet, a delta of 32 deg. 47 min. 36 sec., for an arc length of 549.16 feet to an iron pin (set) (chord bearing North 14 deg. 39 min. 45 sec. East, 541.69 feet);

14) THENCE North 34 deg. 08 min. 58 sec. East, 40.03 feet to an iron pin (set);

15) THENCE North 4 deg. 15 min. 15 sec. West, 21.63 feet to an iron pin (set);

16) THENCE North 24 deg. 29 min. 35 sec. West, 69.09 feet to an iron pin (set);

17) THENCE North 16 deg. 56 min. 57 sec. West, 20.22 feet to an iron pin (set);

18) THENCE North 24 deg. 56 min. 23 sec. East, 143.67 feet to an iron pin (set);

19) THENCE North 34 deg. 03 min. 34 sec. West, 55.46 feet to an iron pin (set);

20) THENCE North 5 deg. 04 min. 38 sec. East, 51.42 feet to an iron pin (set);

21) THENCE North 52 deg. 12 min. 18 sec. West, 96.82 feet to an iron pin (set);

22) THENCE North 8 deg. 25 min. 07 sec. West, 48.60 feet to an iron pin (set);

OR VOL 678 PG 088

23) THENCE with a curve to the left having a radius of 959.46 feet, a delta of 41 deg. 09 min. 52 sec. for an arc length of 689.33 feet to a point (chord bearing North 29 deg. 00 min. 03 sec. West, 674.60 feet);

24) THENCE North 49 deg. 35 min. 01 sec. West, 470.24 feet to an iron pin (set) on the north line of Section 16;

THENCE with the north line of Section 16, South 89 deg. 33 min. 26 sec. East, 586.50 feet to an iron pin (found) at the northeast corner of Section 16;

THENCE with the north line of Section 10, South 89 deg. 22 min. 12 sec. East, 884.40 feet to an iron pin (set) at a northeasterly corner of said 233.23 acre tract and at the northwest corner of a 75.22 acre tract as conveyed to David R. and Margarete Johnston (Deed Volume 97, Page 471);

THENCE with the west line of a 75.22 acre tract and a 50.766 acre tract as conveyed to David R. and Margarete Johnston (Deed Volume 97, Page 471) and an easterly line of said 233.23 acre tract, South 1 deg. 17 min. 44 sec. West, 1,700.65 feet to an iron pin (found) at a westerly corner of said 50.766 acre tract and easterly corner of said 233.23 acre tract;

THENCE with the easterly lines of said 233.23 acre tract and the westerly lines of the 50.766 acre tract, the following three (3) courses:

1) THENCE South 62 deg. 25 min. 47 sec. East, 825.18 feet to an iron pin (found);

2) THENCE South 40 deg. 05 min. 38 sec. East, 789.55 feet to an iron pin (found) on the north line of the Southwest Quarter of Section 10;

3) THENCE with said north line of the Southwest Quarter of Section 10, North 89 deg. 13 min. 04 sec. East, 591.75 feet to an iron pin (found) at the northeast corner of the Southwest Quarter of Section 10;

THENCE with the east line of the Southwest Quarter, South 00 deg. 12 min. 50 sec. West, 2,684.32 feet to the PLACE OF BEGINNING, containing 242.330 acres, more or less, but subject to all legal highways, right-of-ways and easements.

The above described 242.330 acre tract comprises 162.797 acres in the Southwest Quarter

of Section 10, 67.137 acres in the Northwest Quarter of Section 10, 5.680 acres in the Southeast Quarter of Section 16 and 6.716 acres in the Northeast Quarter of Section 16;

Bearings are oriented to the Ohio State Plane Coordinate System;

Iron pins indicated (set) are 5/8 inch iron bars with plastic cap stamped Bair & Goodie.

Plat and Description Prepared By
Frank E. Bair, Reg. Surveyor #5918

Requested By: bjb 10/01/2007

Vesting Deed

"DEED CHECKED FOR GRAPHIC DESCRIPTION ONLY"
HARRISON CO. ENGR.
APPROVED ____ REJECTED ____
DATE 12-27-04 BY PZ

Instrument Book Page
200400003691 OR 158 1375

200400003691 CAP
Filed for Record in
HARRISON COUNTY, OHIO
TRACY L. BOYER
12-27-2004 At 03:42 pm.
LIMITED W D 68.00
OR Book 158 Page 1375 - 1381

This conveyance has been examined and the grantor has completed with section 319.202 of the revised code
Transfer Date 12-27-04 200400003691
Conveyance Fee $ 1459.60 TALON GROUP
Exempt ____ By EC 50 S MAIN ST 705
Transfer Fee $ 2.50 AKRON OH 44308
PATRICK J. MOORE, County Auditor

LIMITED WARRANTY DEED

(Ohio Statutory Form)

KNOW ALL MEN BY THESE PRESENTS, that **APEX ENERGY, INC.**, a corporation incorporated and existing under the laws of the State of Ohio ("Grantor"), for valuable consideration paid, grants with limited warranty covenants to **APEX ENVIRONMENTAL, LLC**, a Delaware limited liability company ("Grantee"), whose tax mailing address is Dominion Tower, Suite 3100, 625 Liberty Avenue, Pittsburgh, PA 15222, its successors and assigns, fee simple title to the following property:

Situated in the Township of German, County of Harrison and State of Ohio, and being more fully described on Exhibit A attached hereto and made a part hereof (the "Property"), together with all and singular the buildings, improvements, fixtures, ways, liberties, privileges, hereditaments, rights of way, easements and appurtenances whatsoever thereunder belonging, or in anywise appertaining, and the reversions, and remainders, rents, issues and profits thereof; and also all the estate, right, title, interest, property, claim and demand whatsoever, as well in law, as in equity, of the Grantor of, in or to the property described herein at Exhibit A and every part and parcel thereof, with the appurtenances.

Together with fee simple title to all coal, coal seams, coal strata and other minerals on or under the Property.

This conveyance is made subject to the restrictions, reservations and exceptions, rights of way, covenants and conditions set forth in prior deeds and other instruments of conveyance in the chain of title from which it derives.

And the Grantor, does for itself, its successors and assigns, covenant with the Grantee, its successors and assigns that it warrants and will defend the premises to the Grantee and its successors and assigns, against the lawful claims and demands of all persons claiming through Grantor but against none other.

Prior Instrument Reference: Volume 235, page 412.

Permanent Tax Parcel Numbers:
Tract One: Tax Parcel Nos. 11-00156.000 and 11-00160.000
Tract Two: Tax Parcel No. 11-00161.000
Coal Tax Parcel Nos. 11-00169.001 and 11-00170.001

Instrument Book Page
200400003691 OR 158 1376

IN WITNESS WHEREOF, Grantor has executed this Limited Warranty Deed this 21st day of December, 2004.

APEX ENERGY, INC.,
an Ohio corporation

By: David Krulock
Name: DAVID KRULOCK
Title: President

Commonwealth of Pennsylvania)
) ss:
County of Allegheny)

BEFORE ME, a Notary Public in and for said County and State personally appeared the above named David Krulock, known to me personally to be the President of Apex Energy, Inc., an Ohio corporation, and who did acknowledge that he/she did sign the foregoing instrument on behalf of said company with due authorization, and as his/her free and voluntary act and deed in such capacity.

IN WITNESS WHEREOF, I have hereunto set my hand and official seal this 21st day of December, 2004.

Kathleen M. Murray
Notary Public

My Commission Expires:

Notarial Seal
Kathleen M. Murray, Notary Public
City of Pittsburgh, Allegheny County
My Commission Expires May 21, 2005
Member, Pennsylvania Association of Notaries

THIS INSTRUMENT PREPARED BY:

Frankovitch, Anetakis, Colantonio & Simon
337 Penco Road
Weirton, WV 26062
(304) 723-4400

Instrument 200400003691 OR Book 158 Page 1377

EXHIBIT A

[See attached.]

APPENDIX C1-E

COMPLIANCE VIOLATIONS SUMMARY

- SUMMARY OF NOTICE OF VIOLATIONS
- DAILY LOGS (PROVIDED FOR OPERATIONAL VIOLATIONS ONLY)

Compliance Violations Summary
Apex Environmental, LLC
Apex Sanitary Landfill
Jefferson County, Ohio
Updated December 2015

No.	Date of Violation or Inspection	Date of Written Notice of Violation or Inspection Summary	Violation Reported (if applicable)	Apex Action	Apex Resolution Date	Regulatory Resolution
1	8/10/2005	8/18/2005 from Ohio EPA	Ohio EPA cites the facility for storage of shredded scrap tires	Submitted a letter to the Ohio EPA stating that the tire shred piles were adjusted in size and surveyed accordingly, to ensure compliance.	9/2/2005	n/a
2	7/13/2006	7/14/2006 from JCHD	JCHD cites violation for offsite odors	Apex installed a misting system	8/2006	Compliance Agreement on 10/17/2006
3	7/28/2006	8/4/2006 from Ohio EPA	Ohio EPA cites the facility for use of an uncertified GCL	Submitted a letter to the Ohio EPA with shear strength test results	8/10/2006	Follow-up Letter from Ohio EPA dated 8/14/2006
4	10/5/2006	10/18/2006 from Ohio EPA	Ohio EPA observes the use of tarps as an ADC beyond the trial period	Stopped using tarps as alternative daily cover	10/2006	n/a
5	5/24/2007	7/3/2007 from Ohio EPA	Ohio EPA observes violations for disposal of scrap tires, asbestos waste stored on-site, and violations relating to transitional cover and final cover	Submitted letter to Ohio EPA stating scrap tires were shipped to recycling facility and that transitional cover was installed	7/23/2007 & 12/14/2008	Follow-up letter dated 7/30/2007
6	11/27/2007	12/10/2007 from JCHD 2/1/2008 from Ohio EPA	Ohio EPA and JCHD observes violations for failure to apply intermediate cover	Submitted a letter to Ohio EPA stating that intermediate cover was being placed	2/15/2008	n/a
7	11/27/2007	2/1/2008 from Ohio EPA	Ohio EPA cites the facility for over height area in Phase 1B	Submitted Transitional Cover Documentation Report Addendum to Ohio EPA documenting relocated waste in over height area	6/13/2008	Follow-up Letter from Ohio EPA dated 8/8/2008
8	1/30/2008	1/30/2008 from JCHD	JCHD observes violation for blowing litter	Submitted letter to Ohio EPA contesting the violation	2/12/2008	Director's Final Findings and Orders dated 11/13/2008
9	4/18/2008	8/18/2008 from Ohio EPA	Apex accepts containerized liquid from Rapid Waste, Inc. for disposal	Submitted letter to Ohio EPA stating that staff will be retrained and revisions will be made to waste acceptance procedures	6/26/2008	Director's Final Findings and Orders dated 11/13/2008
10	4/24/2008	5/6/2008 from JCHD 5/22/2008 from Ohio EPA	JCHD and Ohio EPA observe violations for intermediate cover (flagging of solid waste and failure to control erosion) and leachate outbreaks	Rectified by grading and applying additional soil cover	5/2/2008	Letter of Abatement by the Health Department dated 5/6/2008
11	5/15/2008	5/15/2008 from Ohio EPA	Ohio EPA cites violation of NPDES permit	Submitted letter to Ohio EPA	5/31/2008	n/a
12	5/20/2008	6/20/2008 from Ohio EPA	Ohio EPA DAPC cites violation of NPDES	Submitted a letter to Ohio EPA	n/a	n/a
13	6/6/2008	7/3/2008 from JCHD	JCHD cites violation for offsite odors	Apex implemented additional odor controls. Apex has extensive odor control counter measures	6/6/2008	n/a

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14	6/17/2008	7/17/2008 from Ohio EPA	Apex accepts containerized liquid from Rapid Waste, Inc. for disposal. Ohio EPA observes material disposed at working face	Submitted a letter to Ohio EPA stating that staff will be re-trained and revisions will be made to waste acceptance procedures	8/7/2008	Director's Final Findings and Orders dated 11/13/2008
15	6/12/2008	6/27/2008 from Ohio EPA	Ohio EPA issues violation for deviations in record keeping	Submitted a letter to the Ohio EPA stating that records will be kept in accordance with the regulations	8/7/2008	n/a
16	3/10/2009	3/19/2009 from Ohio EPA	Ohio EPA issues violations for litter at trail unloading area and leachate outbreaks at the landfill area	E-mailed photos showing repairs made to the leachate outbreaks	3/13/2009	See 3/9/2009 letter confirming leachate outbreaks addressed
17	10/6/2009	10/28/2009 from JCHD	JCHD cites violation for failure to apply intermediate cover and observed leachate outbreak	Apex implemented immediate corrective action on 10/6/2009 including placing additional soil and repaired leachate outbreak	11/4/2009	E-mail correspondence sent to JCHD to express resolution on 11/4/2009
18	3/22/2010	4/5/2010 from Ohio EPA	Ohio EPA OAC 3745-27-19 (F) for improper daily cover	Apex implemented immediate corrective action	4/14/2010	Reference 4/14/2010 from JCHD stating violations noted on last visit had been corrected
19	5/3/2010	Letter dated 5/8/2010, should be 6/8/2010 from JCHD	JCHD cites violation for ponding water and observed leachate outbreaks	Apex implemented immediate corrective action. Apex placed additional soil, regraded affected areas, mulched exposed soils, and repaired leachate outbreaks	JCHD visit on 6/23/2010. Apex follow-up e-mail dated 6/24/2010 to JCHD	Follow-up letter dated 6/28/2010 stating that violations noted in 6/8/2010 letter are addressed
20	7/21/2010	7/28/2011 from MSHA	MSHA issues violations for improper fall protection and guarding	Apex implemented immediate corrective action. Apex installed proper rails/guards on equipment and landfill scale	7/28/2010	Follow up letter dated 7/28/2010
21	10/14/2010	11/2/2010 from Ohio EPA	Ohio EPA cites violation of OAC 3745-27-19 (F) for improper cover and flagging material	Apex was actively placing cover at the time of inspection. Continued activity and immediately addressed flagging and cover soil issue	By 10/16/2010	Follow up visit by Ohio EPA on 10/16/2010 and JCHD on 10/21/2010. Letter from JCHD dated 10/27/2010 stating violations noted on 10/14/2010 are addressed
22	11/5/2010	11/8/2010 from Ohio EPA, received 01/25/2010	Ohio EPA cites violation of OAC 3745-27-19 (G) for intermediate cover	Apex implemented corrective action to regrade area and placed soil that was staged nearby to address flagging and ensure minimum 12"	By 11/18/2011	Follow up visit by JCHD on 11/18/2010. Letter from JCHD dated 12/02/2010 stating violations noted on November 9 (sic) are addressed

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23	1/5/2011	1/20/2010 letter from Ohio EPA, received January	Ohio EPA cites violation of OAC 3745-27-19 (F) for improper cover and flagging material	Apex continued to place additional cover over areas of flagging noted by Ohio EPA. Addressed immediately	By 1/6/2011	Follow up visit by JCHD on January 13. Follow up visit by JCHD and Ohio EPA on 1/26/2011. Ohio EPA/JCHD stated that violation noted on 1/5/2011 was addressed (Verbal). Reference letter from JCHD dated 4/7/2011.
24	3/14/2011 and 3/15/2011	3/18/2011 letter from JCHD	JCHD cites for ponding leachate on Cell 5, litter, insufficient daily cover, inspection of sedimentation ponds, insufficient intermediate cover, leachate management, surface water management	Apex implemented corrective action plan to address all issues noted	4/4/2011 response letter to JCHD	Follow up visit by JCHD on 3/28/2011. Inspector was pleased with the overall progress. 4/7/2011 letter from JCHD stated all previous violations (except daily cover) had come into compliance as of 4/5/2011
25	4/5/2011	4/7/2011 letter from JCHD	JCHD cites violation of OAC 3745-27-19 (F)(1) stating the working face needed more daily cover	At the time of the inspection, cover was being placed and a third party earthwork contractor was assisting. Work completed immediately	4/25/2011 response letter to JCHD	Reference 8/23/2011 letter from JCHD stating no violations noted during July 25 and 26, August 9, 15, 19 and 22 inspections.
26	10/3/2011	10/4/2011 letter from JCHD	JCHD cites violation of OAC 3745-27-19 (J)(3) and OAC 3745-27-19 (K)(a),(b), & (c) for surface water, leachate, and odor	Work to grade top of inactive area was on-going at time of inspection as noted in JCHD letter to address both deficiencies. Addressed deficiencies within 24 hours. Additional soil placed and more regrading completed by 10/11/2011	10/3/2011 immediate response. 11/8/2011 response letter to JCHD	Director's Final Findings and Orders dated 12/22/2011
27	10/4/2011	10/14/2011 letter from Ohio EPA	Ohio EPA cites violation of NPDES permit for bypass of treatment and exceeding limits	The surface water runoff from Phase 5 accumulated at a low point and was pumped after allowing sediment to settle. Apex started to pump water from Phase 5 to the North Sedimentation Pond. Apex proposed to install a sediment basin and make other improvements in the rail unloading area	11/10/2011 response letter to Ohio EPA	Ohio EPA approval of PTI Application for Rail Area Improvements dated 6/6/2012 and Modificaiton of NPDES Permit dated 8/14/2012
28	10/6/2011	10/11/2011 letter from JCHD	JCHD cites violation of OAC 3745-27-19 (K)(a),(b), & (c) and OAC 3745-27-19 (B)(3) for leachate and odor	At the time of the inspection, Apex was actively addressing both alleged deficiencies. Subsequent to inspection, Apex action included additional rain flap inspection and repairs. Apex hired a contractor to install additional gas collection and control measures	Immediate and on-going actions. Provided JCHD with detailed schedule of GCCS installation on 10/18/2011. 10/20/2011 response letter to JCHD	Director's Final Findings and Orders dated 12/22/2011

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29	10/6/2011	10/20/2011 letter from Ohio EPA	Ohio EPA letter summarizing 10/06/2011 meeting. The Ohio EPA letter cited violation of OAC 3745-27-19(B)(1) & (B)(3), OAC 3745-27-19 (E)(1)(c), OAC 3745-27-19(E)(1)(c) and 3745-27-19(K) for leachate and odor	See response above	See response above. 11/8/2011 response letter to Ohio EPA	Director's Final Findings and Orders dated 12/22/2011
30	10/21/2011	10/25/2011 letter from JCHD	JCHD cites violation of OAC 3745-27-19(B)(1) for compliance and OAC 3745-27-19(K)(a)(b)(c) and 3745-27-19(B)(3) for leachate and odor	Apex is implementing measures of its Odor Control Plan as discussed in response letter to JCHD dated 10/20/2011	11/8/2011 response letter to JCHD	Director's Final Findings and Orders dated 12/22/2011
31	10/6/2011 and 10/14/2011	10/25/2011 letter from Ohio EPA	Ohio EPA letter regarding 10/6/2011 and 10/14/2011 inspections. Letter discussed 10/6/2011 meeting and cited violations of OAC 3745-27-19(B)(1), (B)(2), & (B)(3), OAC 3745-27-19(E)(10)(c) for compliance and odor	Apex is monitoring odor control activities in response to complaints as required in the Odor Management Plan. The evaluation is performed on-site. Apex is compiling information related to odor complaints. Apex is implementing measures of its Odor Control Plan as discussed in response letter to JCHD dated 10/20/2011	11/8/2011 response to Ohio EPA	Director's Final Findings and Orders dated 12/22/2011
32	10/28/2011	11/28/2011 letter from Ohio EPA	Ohio EPA notice of violation of ORC 6111.04 for migration of large amounts of suspended solids into "waters of the state" which violates NPDES permit	The same complaint as letter dated 10/14/2011 from Ohio EPA DSW. Apex proposed to install a sediment basin and make other improvements in the rail unloading area	Apex e-mail response dated 12/16/2011	Ohio EPA approval of PTI Application for Rail Area Improvements dated 6/6/2012 and Modificaiton of NPDES Permit dated 8/14/2012
33	12/7/2011	12/12/2011 letter from JCHD	JCHD cites violation of OAC 3745-27-19(K)(a)(b)(c), OAC 3745-27-19(B)(2)(3), ORC 3734.11, OAC 3745-27-19(C)(2)(A)(6), and OAC 3745-27-19(C)(7)(c) for odor, access, exposed waste, leachate	Apex repaired the leachate outbreak areas and documented the repairs on the same day that they were observed. Apex has made improvements to access roads and maintains the smallest practical unloading area and workface	12/30/2011 response letter to JCHD	Director's Final Findings and Orders dated 12/22/2011
34	12/7/2011	12/13/2011 letter from Ohio EPA	Ohio EPA cites violation of OAC 3745-27-19(B)(1) & (B)(3), OAC 3745-27-19(E)(2), OAC 3745-27-19, OAC 3745-27-19(7)(c)(c), and OAC 3745-27-19(K) for odors, access, exposed waste, leachate	See response above	1/3/2012 response letter to Ohio EPA	Director's Final Findings and Orders dated 12/22/2011
35	12/5/2011 through 12/11/2011	12/22/2011 letter from Ohio EPA	Ohio EPA cites violation of OAC 3745-27-19(B)(3), OAC 3745-27-19(B)(2), and ORC 3734.11 for odors	Installation of GCCS in accordance with Director's Final Findings and Orders	No written response necessary	Director's Final Findings and Orders dated 12/22/2011

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36	12/19/2011	12/21/2011 letter from Ohio EPA	Ohio EPA cites violations of OAC 3745-27-19(B)(3) & (B)(2), ORC 3734.11 (A) & (B) for odor	Installation of GCCS in accordance with Director's Final Findings and Orders	No written response necessary	Director's Final Findings and Orders dated 12/22/2011
37	n/a	12/22/2011 letter from Ohio EPA	Directors Final Findings and Orders for odor issues.	Installation of GCCS in accordance with Director's Final Findings and Orders	No written response necessary	n/a
38	1/9/2012 and 1/11/2012	1/12/2012 letter from Ohio EPA	Ohio EPA cites violations of OAB 3745-27-19(B)(3) & (B)(2), and ORC 3734.11 (A) & (B) for odor	Installation of GCCS in accordance with Director's Final Findings and Orders	1/26/2012 response letter to Ohio EPA	n/a
39	1/3/2012 through 1/6/2012	1/26/2012 letter from JCHD	JCHD cites violation of OAC 3745-27-19(B)(3)&(B)(2) and ORC 3734.11(A)&(B) for odor	Installation of GCCS in accordance with Director's Final Findings and Orders	2/14/2012 response letter to JCHD	n/a
40	1/15/2012 through 1/21/2012	1/26/2012 letter from JCHD	JCHD cites violation of OAC 3745-27-19(B)(3)&(B)(2) and ORC 3734.11(A)&(B) for odor	Installation of GCCS in accordance with Director's Final Findings and Orders	2/14/2012 response letter to JCHD	n/a
41	1/24/2012 and 1/25/2012	1/27/2012 letter from Ohio EPA	Ohio EPA cites violation of OAC 3745-27-19(B)(3)&(B)(2) and ORC 3734.11(A)&(B) for odor	Installation of GCCS in accordance with Director's Final Findings and Orders	2/10/2012 response letter to Ohio EPA	n/a
42	2/1/2012	3/6/2012 letter from Ohio EPA	Ohio EPA cites violation of OAC 3745-31-05(A)(3) for exceedance of emission limitations for sulfur dioxide (SO2)	Meetings with Ohio EPA, January 2012 and April 2012. Submitted Compliance Plan and Schedule	5/4/2012 response letter to Ohio EPA, Compliance Plan and Schedule	Pending
43	2/1/2012	2/7/2012 letter from Ohio EPA	Ohio EPA cites violation of OAC 3745-27-19(B)(3)&(B)(2) and ORC 3734.11(A)&(B) for odor	Installation of GCCS in accordance with Director's Final Findings and Orders	2/21/2012 response letter to Ohio EPA	n/a
44	2/1/2012	2/7/2012 letter from Ohio EPA	Ohio EPA cites violation of OAC 3745-27-19(G)(4) & (B)(2) and ORC 3734.11 for intermediate cover erosion	Any disruption of intermediate cover was promptly restored to provide the minimum required thickness of soil. Used "grade treatment" on intermediate cover and placed temporary straw mulch.	2/21/2012 response letter to Ohio EPA	3/13/2012 NOV letter from Ohio EPA states that much work has been occurred to re-grade and mulch portions of the slope. Some areas of intermediate cover remain exposed and unprotected
45	2/2/2012	2/3/2012 letter from JCHD	JCHD cites violation of OAC 3745-27-19(G)(4) for intermediate cover	See response above	2/21/2012 response letter to JCHD	Reference 5/18/2012 letter from JCHD
46	1/29/2012 through 2/4/2012	2/7/2012 letter from JCHD	JCHD cites violation of OAC Rule 3745-27-19(B)(3)&(B)(2) and ORC 3734.11 (A)&(B) for odor	Installation of GCCS in accordance with Director's Final Findings and Orders	2/23/2012 response letter to JCHD	Reference 5/18/2012 letter from JCHD

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47	2/9/2012	2/14/2012 letter from Ohio EPA	Ohio EPA cites violation of OAC Rule 3745-27-19(E)(1)(c), OAC Rule 3745-27-19(E)(11)(b), and ORC 3734.11 for North Sedimentation Pond engineering integrity and inspections. Ohio EPA cites continuing violation of 3745-27-19(G)(4) for intermediate cover. Without citation, the request to establish two-way passage of traffic was made.	The observations regarding the North Sedimentation Pond have been addressed. Any disruption of intermediate cover was promptly restored to provide the minimum required thickness of soil. The haul road was designed for one-way traffic.	2/28/2012 response letter to Ohio EPA	3/13/2012 NOV letter from Ohio EPA states that Apex has returned the North Sedimentation Pond to substantial compliance. Passage of two-way traffic will be clarified in Alteration Request dated March 7, 2012.
48	2/5/2012 through 2/9/2012	2/14/2012 letter from JCHD	JCHD cites violation of OAC Rule 3745-27-19(B)(3)&(B)(2) and ORC 3734.11 (A)&(B) for odor	Installation of GCCS in accordance with Director's Final Findings and Orders	3/1/2012 response letter to JCHD	Reference 5/18/2012 letter from JCHD
49	2/12/2012 through 2/18/2012	2/21/2012 letter from JCHD	JCHD cites violation of OAC Rule 3745-27-19(B)(3)&(B)(2) and ORC 3734.11 (A)&(B) for odor	Installation of GCCS in accordance with Director's Final Findings and Orders	3/8/2012 response letter to JCHD	Reference 5/18/2012 letter from JCHD
50	2/15/2012	2/22/2012 letter from JCHD	JCHD cites violation of OAC Rule 3745-27-19(B)(1) & (B)(3) for failure to control gas and/or odors from escaping through the transitional cover and escaping the boundaries of the facility	Apex is in compliance with the terms and conditions of the solid waste disposal license issued for the facility. There is no rule or requirement to "eliminate gas escaping through the transitional cover."	3/19/2012 response letter to JCHD	Reference 5/18/2012 letter from JCHD
51	2/19/2012 through 2/25/2012	2/28/2012 letter from JCHD	JCHD cites violation of OAC Rule 3745-27-19(B)(3)&(B)(2) and ORC 3734.11 (A)&(B) for odor	Installation of GCCS in accordance with Director's Final Findings and Orders	3/14/2012 response letter to JCHD	Reference 5/18/2012 letter from JCHD
52	Through 10/7/2011	3/8/2012 letter from Ohio EPA	Ohio EPA cites violation of OAC 3745-27-19(E)(8)(C), OAC 3745-27-19(B)(1), OAC 3745-27-19(B)(2), OAC 3745-27-19(L) for disposing of hazardous waste in a facility that is not licenced to accept hazardous waste	Benesch provided counsel for Apex and reached the following conclusions: there is no evidence or documentation (other than an e-mail from an employee at Service Specialties) that Apex has improperly accepted materials classified as hazardous wastes. Apex has conducted all operations in compliance with its license regarding acceptance of hazardous wastes, Apex conducts operations in compliance with its PCB/Hazardous Waste Detection and Prevention Plan and Waste Analysis Plan.	4/16/2012 response letter from Benesch to Ohio EPA.	n/a
53	3/7/2012	3/13/2012 letter from Ohio EPA	Ohio EPA cites violation of OAC 3745-27-19(B)(3)&(B)(2) and ORC 3734.11(A)&(B) for odor	Installation of GCCS in accordance with Director's Final Findings and Orders	3/27/2012 response to Ohio EPA	Reference 5/18/2012 letter from JCHD

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54	3/4/2012 through 3/10/2012	3/13/2012 letter from JCHD	JCHD cites violation of OAC 3745-27-19(B)(3)&(B)(2) and ORC 3734.11(A)&(B) for odor	Installation of GCCS in accordance with Director's Final Findings and Orders	3/29/2012 response letter to JCHD	n/a
55	October 2011 through January 2012	3/14/2012 letter from Ohio EPA	Ohio EPA cites violation of NPDES permit for exceeding limits and for testing frequency violations. The letter also mentions complaints about failing to maintain a berm to provide separation of leachate and non-contact stormwater.	Apex is continuing to implement erosion and sedimentation control measures to reduce sediment load into the North Sedimentation Pond. Apex reviewed sampling protocol and testing frequency with field personnel. Apex uses and will continue to use appropriate measures to separate leachate from stormwater runoff.	E-mail communication with Ohio EPA and 3/30/2012 response letter to Ohio EPA	Ohio EPA approval of PTI Application for Rail Area Improvements dated 6/6/2012 and Modificaiton of NPDES Permit dated 8/14/2012
56	5/2012	5/18/2012 letter from JCHD	Letter confirming full compliance based on inspection	None required, in compliance	No written response necessary	Apex in full compliance
57	April 2012 to August 2012	08/07/2012 letter from Ohio EPA, 8/17/2012 letter from Ohio EPA	Letters confirming full compliance with Odor Management Plan and confirming NO VIOLATIONS for odor since April 1, 2012.	None required, in compliance	No written response necessary	Apex in full compliance with OMP
58	8/3/2012 to 8/5/2012	9/13/2012 letter from Ohio EPA	Letter confirming full compliance with Odor Management Plan and confirming NO VIOLATIONS for odor cited during extended odor monitoring event	None required, in compliance	No written response necessary	Apex in full compliance with OMP
59	9/18/2012	10/01/2012 letter from Ohio EPA	Letter confirming compliance with Ohio Administrative Code (OAC) 3745-27-19. NO VIOLATION for failure to control odor was noted.	None required, in compliance	No written response necessary	Apex in full compliance
60	9/5/2012 and 9/19/2012 AND 10/3/2012	10/10/2012 letter from JCHD	Letter confirming compliance with odor control plan and that no violation were noted at the time of the inspections	None required, in compliance	No written response necessary	Apex in full compliance
61	9/24/2012	10/10/2012 letter from Ohio EPA, DAPC	Letter stating Apex in compliance with all applicable air pollution control regulations based on full Title V compliance inspection.	Apex provided supplemental info as requested by Ohio EPA during facility inspection	Apex provided supplemental information to Ohio EPA by September 27, 2012	Apex in full compliance

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62	10/3/2012	10/11/2012 letter from Ohio EPA	Letter confirming compliance with Ohio Administrative Code (OAC) 3745-27-19. NO VIOLATION for failure to control odor was noted.	None required, in compliance	No written response necessary	Apex in full compliance
63	10/18/2012	10/24/2012 letter from Ohio EPA	Letter confirming compliance with Ohio Administrative Code (OAC) 3745-27-19. NO VIOLATION for failure to control odor was noted.	None required, in compliance	No written response necessary	Apex in full compliance
64	N/A	12/21/2012 letter from Ohio EPA	Letter alleging violation of ORC 3734.57	Apex negotiated settlement with Ohio EPA	4/29/2013	Directors Final Findings and Orders dated 4/29/2013
65	N/A	2/5/2013 letter from Ohio EPA	Proposed Directors Final Findings and Orders to resolve Order No. 6 from 12/22/2011 DFFO	On-going discussions with Ohio EPA	6/3/2013	Director's Final Findings and Orders dated 6/3/2013
66	N/A	2/5/2013 letter from Ohio EPA	Proposed Directors Final Findings and Orders to resolve alleged violation of 3734.57	Apex negotiated settlement with Ohio EPA	4/29/2013	Directors Final Findings and Orders dated 4/29/2013
67	1/2/2013	2/26/2013 letter from JCHD	Letter confirming full compliance based on inspection	None required, in compliance	No written response necessary	Apex in full compliance
68	3/26/2013	4/1/2013 letter from Ohio EPA	Ohio EPA cites violation of OAC 3745-27-19 (K) for a leachate outbreak	Apex responded immediately and took action to divert the leachate. Apex excavated trenches within the waste to create a path for leachate flow.	4/15/2013 response letter to Ohio EPA.	Apex in full compliance
69	N/A	4/29/2013 letter from Ohio EPA	Directors Final Findings and Orders regarding the payment of fees.	Apex agreed to payment of fees required by DFFO.	No written response necessary	n/a
70	5/14/2013	5/20/2013 letter from Ohio EPA	Ohio EPA cites violation for disposing of leachate at working face.	Apex had a contractor on site cleaning the leachate collection sumps as well as the piping network. The Ohio EPA determined that leachate collected in the vacuum truck was disposed of at the working face.	n/a	n/a

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71	N/A	6/3/2013 letter from Ohio EPA	Directors Final Findings and Orders to resolve odor issues in December 2011 DFFO.	Apex has provided the Ohio EPA with a revised Odor Management Plan.	Apex submits revised OMP	OMP approved July 20, 2015
72	4/25/2013 to 5/29/2013	6/19/2013 letter from Ohio EPA	Ohio EPA cites violation of OAC 3745-27-19(B)(3) for odor	Apex's OCR Team also detected odors and followed the steps required in the OMP for when odors are detected. Documentation of the steps taken to abate odors was provided to Ohio EPA in a letter dated 5/29/2013.	7/8/2013 response letter to Ohio EPA	n/a
73	N/A	9/3/2013 letter from Ohio EPA	Letter documenting compliance inspection with Indirect Discharge permit No. 0DP00050*BP. Ohio EPA cites violation of permit requirements for sample collection and rainwater accumulation in secondary containment system.	n/a	n/a	n/a
74	7/30/2013 to 9/5/2013	9/20/2013 letter from Ohio EPA	Ohio EPA requesting surface scan figure with H2S information. Also requesting a description regarding intermediate and transitional cover materials in relation to requirements in OAC Rule 3745-27-08(D)(19) and 3745-27-19(G).	Apex provided the figure as requested. Apex uses mine spoil for intermediate and transitional cover. When necessary, Apex screens soil for a portion of the transitional cover to maximize compaction and minimize potential gas paths. Apex excavated test pits to confirm that the material used was suitable.	October 4, 2013 response letter to Ohio EPA	n/a
75	9/18/2013	10/7/2013 letter from Ohio EPA	Ohio EPA cites violation of OAC 3745-27-19(F) for failure to properly apply daily cover.	At the time of the inspection, Apex was placing the select waste layer over the leachate collection layer in the newly constructed Phase 6A West. The piles of waste observed were segregated from the select waste layer and placed adjacent to the new cell. The waste consisted of wood, metal, and non-odorous, non-putrescible type waste. Within 24 hours, the waste was relocated to Phase 6A East.	November 25, 2013 response letter to Ohio EPA	n/a
76	9/23/2013 to 9/25/2013	10/11/2013 letter from Ohio EPA	Ohio EPA cites violation of OAC 3745-27-19(B)(3) for odor	Ohio EPA accompanies Apex personnel during surface scan for methane on 9/26/2013. Hydrogen sulfide odors were detected. Ohio EPA requests conference within 30 days to discuss action taken to address recent odors as well as odor management plan.	Meeting with Ohio EPA on November 12, 2013 to discuss Odor Management Plan.	OMP approved July 20, 2015
77	12/2/2013 to 12/3/2013	12/5/2013 letter from JCHD	JCHD cites violation of OAC 3745-27-19(B)(1) for compliance; OAC 3745-27-19(K)(a)(b)(c) and 3745-27-19(B)(3) for leachate and odor; and OAC 3745-27-19(J)(3) for surface water management	Apex noted vague and contradictory language in the NOV regarding odors and compliance. The gas bubbling issue was addressed, even though it is not a violation of the cited leachate management regulation. The ponding water observed was due to third-party equipment travel and was fixed before the end of the day.	December 16, 2013 response letter to JCHD	n/a

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Jefferson County, Ohio
Updated December 2015

No.	Date of Violation or Inspection	Date of Written Notice of Violation or Inspection Summary	Violation Reported (if applicable)	Apex Action	Apex Resolution Date	Regulatory Resolution
78	12/19/2013	12/20/2013 letter from Ohio EPA	Ohio EPA cites violation of OAC 3745-27-19(B)(3) for odor. Also noted that odor control equipment was not in use during Ohio EPA's site visit due to mechanical failures. Requested application of 6 inches of screened soil as cover in areas where H2S reading were above 20 ppb or methane readings were above 250 ppm. Requested procedure to ensure that daily cover be promptly applied as planned daily contours are reached	Apex's OCR Team also detected odors and followed the steps required in the OMP for when odors are detected. Records show the HVMU was in operation the morning of the OEPA visit and when it did experience mechanical failure, the tote-based foggers were immediately relocated to the working face. Intermediate cover to be deployed as operationally possible. Documentation of the steps taken was provided to Ohio EPA in a letter dated 1/8/2014.	January 8, 2014 response letter to Ohio EPA	n/a
79	1/30/2014	2/10/2014 letter from Ohio EPA	Ohio EPA cites violation of OAC 3745-27-19(B)(3) for odor	Apex provided requested information regarding odor control, including photos documenting that additional intermediate cover was placed in problematic areas and results of a surface re-scan of problematic areas.	2/17/2014 response letter to Ohio EPA	n/a
80	12/17/2013	3/10/2014 and 4/2/2014 letters from Ohio EPA	Ohio EPA cites violation of OAC 3745-27-15 and 3745-27-16 for not increasing the Financial Assurance Document for 2013 inflation.	Apex renewed the bond for closure and post-closure care costs on December 17, 2013, but did not increase for inflation. Apex provided letter of credit for the amount not covered by the bond.	3/24/2014 and 4/14/2014 response letters to Ohio EPA, subsequent e-mails regarding letter of credit	Letter of Credit provided for ELS Acquisition LLC on May 2, 2014 by First Republic Bank
81	February 2014	3/4/2014 letter from Ohio EPA	Ohio EPA cites violation of OAC 3745-27-19(B)(3) for odor	Apex was addressing areas that were problematic in creating odors, causing disturbance to the intermediate cover. Apex provided results of a surface scan performed on 2/22/2014 which showed significant improvement of methane concentrations when compared to an event performed on 2/7/2014.	2/22/2014 e-mail response to Ohio EPA, prior to NOV letter	n/a
82	February 2014	4/9/2014 letters from Ohio EPA	Ohio EPA cites violations of conditions of NPDES Permit 0IN00198*FD and 0II00022*CD. Effluent limitations for Total Suspended Solids and Settleable Residue were exceeded.	Apex will implement controls as needed so that future discharges have lower concentrations of Total Suspended Solids and Settleable Residue.	e-mail responses to Ohio EPA on 3/14/2014 upon receipt of laboratory testing results, prior to NOV letter	n/a
83	March 2014	3/21/2014 letter from the Ohio EPA	Letter documenting odor inspection. Apex in compliance with OAC 3745-27-19(B)(3)	No action required by Apex.	n/a	n/a

Compliance Violations Summary
Apex Environmental, LLC
Apex Sanitary Landfill
Jefferson County, Ohio
Updated December 2015

No.	Date of Violation or Inspection	Date of Written Notice of Violation or Inspection Summary	Violation Reported (if applicable)	Apex Action	Apex Resolution Date	Regulatory Resolution
84	October 23, 2014	11/5/2014 letter from the JCHD	JCHD cites violation of OAC 3745-29-19 (E)(3) due to equipment breakdown and (E)(7)(c) due to large workface. JCHD cites violation of OAC 3745-27-K(1) for a leachate outbreak.	Equipment did breakdown, but was repaired as soon as practical. Apex was not creating off-site nuisances with the workface that was larger than typical. The leachate outbreak was contained and repaired.	December 17, 2014 response letter to JCHD	n/a
85	February 11, 2015	2/20/2015 letter from the Ohio EPA	Ohio EPA cites violation of PTI No. 06-6219 and OAC 3745-27-65(F) for improper tire shred storage. Ohio EPA cites violation of OAC 3745-27-19(E)(7)(c) for size of working face and OAC 3745-27-29(E)(3)(b) for inoperable equipment.	Apex had a survey performed so that the tire shreds could be stored in compliance with the PTI and OAC 3745-27-65(F). Apex had a larger working face because for safety issues due to weather conditions. Apex had the proper equipment available at the site. One compactor was down for maintenance but another was available for use.	March 10, 2015 response letter to Ohio EPA	n/a
86	April 7, 2015	4/9/2015 letter from the JCHD	JCHD cites violation of OAC 3745-27-19(F) for daily cover, OAC 3745-27-19(G)(2) for intermediate cover, and OAC 3745-27-19(E)(9) for litter.	Met with the JCHD to discuss the issue and requested that the NOV letter be rescinded.	n/a	n/a
87	April 8, 2015	4/9/2015 letter from the JCHD	JCHD cites violation of OAC 3745-27-19(B)(3) for odors.	Met with the JCHD to discuss the issue and requested that the letter be rescinded.	n/a	n/a
88	March / April 2015	12/2/2015 letter from Ohio EPA	Ohio EPA cites violations of the NPDES permit for Total Suspended Solids for Limestone Pond 003 in March and April 2015.	The samples were collected after significant rain events and/or snow melts. The NPDES permit states that total suspended solids (TSS) limits apply to discharge only during dry weather, and that TSS shall be monitored during both dry and wet weather conditions.	December 16, 2015 response to the Ohio EPA	n/a
89	N/A	12/11/2015 letter from Ohio EPA	Ohio EPA released Apex of the Director's Final Findings and Orders issued on December 22, 2011 and June 3, 2013.	No action required by Apex.	n/a	n/a

OhioEPA Municipal Solid Waste Landfill Facility Daily Log of Operations - Form 3

{Log Required by OAC 3745-27-19(E)(10)}

Facility Name: Apex Environmental Today's Date: 7/13/06

Facility Opened Today at (time): 12:00 Facility Closed Today at (time): 4:00

List Equipment in Operation at the Facility Today: 850, 836, 325, 345, IT62, Tipper

List Weather Conditions on this Day: Cloudy most of the day, Sunny late afternoon 88°s

The Facility Operator shall inspect the facility daily for compliance with the applicable regulations including but not limited to the following:

Place an (X) on the line next to all aspects of facility operations which have been inspected today.

3745-27-05 Prohibited Disposal Methods

X	(B)	No Open Burning

3745-27-19 Operation of a Facility

X	(E)(2)(a)	Maintain access roads
X	(b)	Limited access to facility
X	(c)	Signs posted
X	(d)	Exclusion of animals
X	(3)(a)	Adequate fire equipment
X	(b)	Operable and adequate equipment
X	(4)	Improper salvaging
X	(5)	Trained employees
X	(6)	Preparation for inclement weather
X	(7)(a)	Leachate treatment/disposal
	(b)	Phased operation
X	(c)	Confined unloading
X	(d)	Separation/control of flammable waste
X	(e)	Waste disposed at working face
X	(f)(I)	Compacting bulky items
X	(ii)	Minimizing dust generation
X	(8)(a)	NESHAP reg. asbestos disposal
	(b)	Acceptance of liquids
	(c)	Acceptance of hazardous waste
	(d)	Acceptance of PCBs
	(e)	Acceptance of infectious waste
	(f)	Acceptance of yard waste
	(g)	Acceptance of scrap tires
	(h)	Acceptance of low level rad. waste
	(I)	Acceptance of semi-solid material w/free liquid
X	(9)	Control of scattered litter
X	(10)	Keeping of daily logs
X	(11)(a)	Daily inspection of facility for ponding, erosion, leachate outbreaks (record any corrective actions below).
X	(12)	Copy of auth. docs available
X	(F)	Daily cover
	(3)	Alternate Daily Cover Used (describe in comment section below)
	(G)	Intermediate cover
	(H)	Final cover
X	(I)	Scales
X	(J)(1)	Surface water diversion
X	(2)	Design in operating record
X	(4)	Surface water monitoring
X	(K)(1)	Leachate control
	(2)	Lift station back-up pumps
	(3)	Collection pipe network (inspection)
	(4)	Temporary leachate storage
	(5)	Leachate treatment and disposal
	(6)	Leachate storage/disposal contingency plan
X	(7)	Surface water monitoring
X	(L)	PCB and hazardous waste prevention and detection program

3745-37-01 License

X	(A)	Valid license

rrective Actions Taken and Other Comments:

Signature of Person Completing Form — Jerrett Carroll, Print Name of Person Completing Form — 7/13/06, Date

fo... should be retained on file for three years for inspection by the local health department, Ohio EPA, or an authorized representative.
...re to provide accurate daily operations information may be considered a violation of Ohio Revised Code § 2921.13.

Leachate 13.5'

Log -Form 3 Sump 103.7'

Revised: August 1, 2005

OhioEPA Municipal Solid Waste Landfill Facility Daily Log of Operations - Form 3

{Log Required by OAC 3745-27-19(E)(10)}

Facility Name: Apex Environmental Today's Date: 8/4/06

Facility Opened Today at (time): 12:00 Facility Closed Today at (time): 4:00

List Equipment in Operation at the Facility Today: 850, 836, 325, ZT62, Tipper

List Weather Conditions on this Day: Rain last night Sunny today temp in the 80's

The Facility Operator shall inspect the facility daily for compliance with the applicable regulations including but not limited to the following:

Place an (X) on the line next to all aspects of facility operations which have been inspected today.

3745-27-05 Prohibited Disposal Methods

Y	(B)	No Open Burning

3745-27-19 Operation of a Facility

Y	(E)(2)(a)	Maintain access roads
X	(b)	Limited access to facility
X	(c)	Signs posted
X	(d)	Exclusion of animals
X	(3)(a)	Adequate fire equipment
X	(b)	Operable and adequate equipment
X	(4)	Improper salvaging
X	(5)	Trained employees
X	(6)	Preparation for inclement weather
	(7)(a)	Leachate treatment/disposal
X	(b)	Phased operation
X	(c)	Confined unloading
X	(d)	Separation/control of flammable waste
X	(e)	Waste disposed at working face
X	(f)(I)	Compacting bulky items
X	(ii)	Minimizing dust generation
	(8)(a)	NESHAP reg. asbestos disposal
	(b)	Acceptance of liquids
	(c)	Acceptance of hazardous waste
	(d)	Acceptance of PCBs
	(e)	Acceptance of infectious waste
	(f)	Acceptance of yard waste
	(g)	Acceptance of scrap tires
	(h)	Acceptance of low level rad. waste
	(I)	Acceptance of semi-solid material w/free liquid
X	(9)	Control of scattered litter
X	(10)	Keeping of daily logs
X	(11)(a)	Daily inspection of facility for ponding, erosion, leachate outbreaks (record any corrective actions below).
X	(12)	Copy of auth. docs available
X	(F)	Daily cover
	(3)	Alternate Daily Cover Used (describe in comment section below)
	(G)	Intermediate cover
	(H)	Final cover
X	(I)	Scales
X	(J)(1)	Surface water diversion
X	(2)	Design in operating record
X	(4)	Surface water monitoring
X	(K)(1)	Leachate control
	(2)	Lift station back-up pumps
	(3)	Collection pipe network (inspection)
	(4)	Temporary leachate storage
	(5)	Leachate treatment and disposal
	(6)	Leachate storage/disposal contingency plan
X	(7)	Surface water monitoring
X	(L)	PCB and hazardous waste prevention and detection program

3745-37-01 License

X	(A)	Valid license

Corrective Actions Taken and Other Comments:

watered roads, hauled leachate, Mister system

Gerald Carroll — *Signature of Person Completing Form*

Gerald Carroll — *Print Name of Person Completing Form*

8/4/06 — *Date*

This form should be retained on file for three years for inspection by the local health department, Ohio EPA, or an authorized representative. Failure to provide accurate daily operations information may be considered a violation of Ohio Revised Code § 2921.13.

Municipal Solid Waste Landfill Facility Daily Log of Operations - Form 3

{Log Required by OAC 3745-27-19(E)(10)}

Facility Name: APEX ENVIRONMENTAL Today's Date: 10-5-06

Facility Opened Today at (time): 12:00 Facility Closed Today at (time): 4:00

List Equipment in Operation at the Facility Today: 1050, 850, 836, 325, TIPPER, AUGER

List Weather Conditions on this Day: cloudy + cool

The Facility Operator shall inspect the facility daily for compliance with the applicable regulations including but not limited to the following:

Place an (X) on the line next to all aspects of facility operations which have been inspected today.

3745-27-05 Prohibited Disposal Methods

X	(B)	No Open Burning

3745-27-19 Operation of a Facility

X	(E)(2)(a)	Maintain access roads
X	(b)	Limited access to facility
X	(c)	Signs posted
X	(d)	Exclusion of animals
X	(3)(a)	Adequate fire equipment
X	(b)	Operable and adequate equipment
X	(4)	Improper salvaging
X	(5)	Trained employees
X	(6)	Preparation for inclement weather
	(7)(a)	Leachate treatment/disposal
	(b)	Phased operation
	(c)	Confined unloading
	(d)	Separation/control of flammable waste
	(e)	Waste disposed at working face
	(f)(I)	Compacting bulky items
	(ii)	Minimizing dust generation
	(8)(a)	NESHAP reg. asbestos disposal
	(b)	Acceptance of liquids
	(c)	Acceptance of hazardous waste
	(d)	Acceptance of PCBs
	(e)	Acceptance of infectious waste
	(f)	Acceptance of yard waste
	(g)	Acceptance of scrap tires
	(h)	Acceptance of low level rad. waste
	(I)	Acceptance of semi-solid material w/free liquid
X	(9)	Control of scattered litter
X	(10)	Keeping of daily logs
X	(11)(a)	Daily inspection of facility for ponding, erosion, leachate outbreaks (record any corrective actions below).
X	(12)	Copy of auth. docs available
X	(F)	Daily cover
	(3)	Alternate Daily Cover Used (describe in comment section below)
	(G)	Intermediate cover
	(H)	Final cover
X	(I)	Scales
X	(J)(1)	Surface water diversion
X	(2)	Design in operating record
X	(4)	Surface water monitoring
X	(K)(1)	Leachate control
	(2)	Lift station back-up pumps
	(3)	Collection pipe network (inspection)
	(4)	Temporary leachate storage
	(5)	Leachate treatment and disposal
	(6)	Leachate storage/disposal contingency plan
X	(7)	Surface water monitoring
X	(L)	PCB and hazardous waste prevention and detection program

3745-37-01 License

X	(A)	Valid license

Corrective Actions Taken and Other Comments:

PICKED LITTER, HAULED COVER, GRADED ROADS, WATERED ROADS
SPRAYED HAULING OUT LEACHATE.

Rob Carpenter — ROB CARPENTER — 10-5-06

Signature of Person Completing Form — Print Name of Person Completing Form — Date

Form should be retained on file for three years for inspection by the local health department, Ohio EPA, or an authorized representative. Failure to provide accurate daily operations information may be considered a violation of Ohio Revised Code § 2921.13.

LEACHATE - 4'-9"

SUMP - 15.3"

Page 1 of 1 - Form 3 Revised: August 1, 2005

Municipal Solid Waste Landfill Facility Daily Log of Operations - Form 3

{Log Required by OAC 3745-27-19(E)(10)}

Facility Name: Apex Environmental Today's Date: 5-17-07

Facility Opened Today at (time): 12:00 Facility Closed Today at (time): 4:00

List Equipment in Operation at the Facility Today: 1050, 850, 836, 325, 6, Ayan, TIPPER, ET

List Weather Conditions on this Day: Cloudy

The Facility Operator shall inspect the facility daily for compliance with the applicable regulations including but not limited to the following:

Place an (X) on the line next to all aspects of facility operations which have been inspected today.

3745-27-05 Prohibited Disposal Methods

X (B) No Open Burning

3745-27-19 Operation of a Facility

X (E)(2)(a) Maintain access roads
X (b) Limited access to facility
X (c) Signs posted
X (d) Exclusion of animals
X (3)(a) Adequate fire equipment
X (b) Operable and adequate equipment
(4) Improper salvaging
(5) Trained employees
X (6) Preparation for inclement weather
(7)(a) Leachate treatment/disposal
(b) Phased operation
(c) Confined unloading
(d) Separation/control of flammable waste
(e) Waste disposed at working face
(f)(I) Compacting bulky items
(ii) Minimizing dust generation
(8)(a) NESHAP reg. asbestos disposal
(b) Acceptance of liquids
(c) Acceptance of hazardous waste
(d) Acceptance of PCBs
(e) Acceptance of infectious waste
(f) Acceptance of yard waste
(g) Acceptance of scrap tires
(h) Acceptance of low level rad. waste
(I) Acceptance of semi-solid material w/free liquid

X (9) Control of scattered litter
X (10) Keeping of daily logs
X (11)(a) Daily inspection of facility for ponding, erosion, leachate outbreaks (record any corrective actions below).
X (12) Copy of auth. docs available
X (F) Daily cover
(3) Alternate Daily Cover Used (describe in comment section below)
(G) Intermediate cover
(H) Final cover
X (I) Scales
X (J)(1) Surface water diversion
X (2) Design in operating record
X (4) Surface water monitoring
X (K)(1) Leachate control
(2) Lift station back-up pumps
(3) Collection pipe network (inspection)
(4) Temporary leachate storage
(5) Leachate treatment and disposal
(6) Leachate storage/disposal contingency plan
X (7) Surface water monitoring
X (L) PCB and hazardous waste prevention and detection program

3745-37-01 License

Y (A) Valid license

Corrective Actions Taken and Other Comments:

Picked Litter, Loaded Tires, Sumped Hauling Leachate

R Carpenter RAB CARPENTER 5-17-07

Person Completing Form *Print Name of Person Completing Form* *Date*

This should be retained on file for three years for inspection by the local health department, Ohio EPA, or an authorized representative. Failure to provide accurate daily operations information may be considered a violation of Ohio Revised Code § 2921.13.

Leachate - 6' Sumps - 1 - 15.4

1 - 19.8

Form 3 Revised: August 1, 2005

Municipal Solid Waste Landfill Facility Daily Log of Operations - Form 3

{Log Required by OAC 3745-27-19(E)(10)}

cility Name: APEX ENVIRONMENTAL Today's Date: 11-27-07

.lity Opened Today at (time): 24 HRS Facility Closed Today at (time): _____

List Equipment in Operation at the Facility Today: 1050, 850, 836, 325, 300, 6, 7, HAUL TRUCK

List Weather Conditions on this Day: cloudy - Temps in 40's

The Facility Operator shall inspect the facility daily for compliance with the applicable regulations including but not limited to the following:

Place an (X) on the line next to all aspects of facility operations which have been inspected today.

3745-27-05 Prohibited Disposal Methods

X	(B)	No Open Burning

3745-27-19 Operation of a Facility

X	(E)(2)(a)	Maintain access roads
X	(b)	Limited access to facility
X	(c)	Signs posted
X	(d)	Exclusion of animals
X	(3)(a)	Adequate fire equipment
X	(b)	Operable and adequate equipment
X	(4)	Improper salvaging
X	(5)	Trained employees
X	(6)	Preparation for inclement weather
	(7)(a)	Leachate treatment/disposal
	(b)	Phased operation
X	(c)	Confined unloading
X	(d)	Separation/control of flammable waste
X	(e)	Waste disposed at working face
X	(f)(I)	Compacting bulky items
X	(ii)	Minimizing dust generation
	(8)(a)	NESHAP reg. asbestos disposal
	(b)	Acceptance of liquids
	(c)	Acceptance of hazardous waste
	(d)	Acceptance of PCBs
	(e)	Acceptance of infectious waste
	(f)	Acceptance of yard waste
	(g)	Acceptance of scrap tires
	(h)	Acceptance of low level rad. waste
	(I)	Acceptance of semi-solid material w/free liquid
X	(9)	Control of scattered litter
X	(10)	Keeping of daily logs
X	(11)(a)	Daily inspection of facility for ponding, erosion, leachate outbreaks (record any corrective actions below).
X	(12)	Copy of auth. docs available
X	(F)	Daily cover
	(3)	Alternate Daily Cover Used (describe in comment section below)
	(G)	Intermediate cover
	(H)	Final cover
X	(I)	Scales
X	(J)(1)	Surface water diversion
X	(2)	Design in operating record
X	(4)	Surface water monitoring
X	(K)(1)	Leachate control
	(2)	Lift station back-up pumps
	(3)	Collection pipe network (inspection)
	(4)	Temporary leachate storage
	(5)	Leachate treatment and disposal
	(6)	Leachate storage/disposal contingency plan
X	(7)	Surface water monitoring
X	(L)	PCB and hazardous waste prevention and detection program

3745-37-01 License

X	(A)	Valid license

Corrective Actions Taken and Other Comments:

Picked Litter, Hauled Cover, Synagro Hauling Leachate.

Rob Carpenter — *Signature of Person Completing Form*

Rob Carpenter — *Print Name of Person Completing Form*

11-27-07 — *Date*

This form should be retained on file for three years for inspection by the local health department, Ohio EPA, or an authorized representative.
to provide accurate daily operations information may be considered a violation of Ohio Revised Code § 2921.13.

LEACHATE - 17'

SUMPS - 1 - 32.6

3 - 23.6

Revised: August 1, 2005

Municipal Solid Waste Landfill Facility Daily Log of Operations - Form 3

{Log Required by OAC 3745-27-19(E)(10)}

Facility Name: Apex Environmental Today's Date: 1-30-08

Facility Opened Today at (time): 24HR Facility Closed Today at (time):

List Equipment in Operation at the Facility Today: 1050, 850, 836, 325, 300, 6, 7, Tipper, RT.

List Weather Conditions on this Day: Cold. Windy. Temps in 20's

The Facility Operator shall inspect the facility daily for compliance with the applicable regulations including but not limited to the following:

Place an (X) on the line next to all aspects of facility operations which have been inspected today.

3745-27-05 Prohibited Disposal Methods

X	(B)	No Open Burning

3745-27-19 Operation of a Facility

X	(E)(2)(a)	Maintain access roads
X	(b)	Limited access to facility
X	(c)	Signs posted
X	(d)	Exclusion of animals
X	(3)(a)	Adequate fire equipment
X	(b)	Operable and adequate equipment
X	(4)	Improper salvaging
X	(5)	Trained employees
X	(6)	Preparation for inclement weather
X	(7)(a)	Leachate treatment/disposal
X	(b)	Phased operation
X	(c)	Confined unloading
X	(d)	Separation/control of flammable waste
X	(e)	Waste disposed at working face
X	(f)(I)	Compacting bulky items
X	(ii)	Minimizing dust generation
—	(8)(a)	NESHAP reg. asbestos disposal
—	(b)	Acceptance of liquids
—	(c)	Acceptance of hazardous waste
—	(d)	Acceptance of PCBs
—	(e)	Acceptance of infectious waste
—	(f)	Acceptance of yard waste
—	(g)	Acceptance of scrap tires
—	(h)	Acceptance of low level rad. waste
—	(I)	Acceptance of semi-solid material w/free liquid
X	(9)	Control of scattered litter
X	(10)	Keeping of daily logs
X	(11)(a)	Daily inspection of facility for ponding, erosion, leachate outbreaks (record any corrective actions below).
X	(12)	Copy of auth. docs available
X	(F)	Daily cover
—	(3)	Alternate Daily Cover Used (describe in comment section below)
—	(G)	Intermediate cover
—	(H)	Final cover
X	(I)	Scales
X	(J)(1)	Surface water diversion
X	(2)	Design in operating record
X	(4)	Surface water monitoring
X	(K)(1)	Leachate control
—	(2)	Lift station back-up pumps
—	(3)	Collection pipe network (inspection)
—	(4)	Temporary leachate storage
—	(5)	Leachate treatment and disposal
—	(6)	Leachate storage/disposal contingency plan
X	(7)	Surface water monitoring
X	(L)	PCB and hazardous waste prevention and detection program

3745-37-01 License

X	(A)	Valid license

Corrective Actions Taken and Other Comments:

Picking Litter, Securing Trash fences, Hauling Cover, Synagro Hauling Leachate.

Rob Carpenter — *Signature of Person Completing Form*

ROB CARPENTER — *Print Name of Person Completing Form*

1-30-08 — *Date*

Form should be retained on file for three years for inspection by the local health department, Ohio EPA, or an authorized representative. Failure to provide accurate daily operations information may be considered a violation of Ohio Revised Code § 2921.13.

Leachate - 10' 3" Sumps 1 - 21.6

3 - 19.1

Municipal Solid Waste Landfill Facility Daily Log of Operations - Form 3

(Log Required by OAC 3745-27-19(E)(16))

Facility Name: Apex Environmental Today's Date: 4-18-08

Facility Opened Today at (time): 24 HR Facility Closed Today at (time): _____

List Equipment in Operation at the Facility Today: 1050, 850, 836, 345, 325, 300, 155, 6, 7, Allan, Tipper, TT.

List Weather Conditions on this Day: Sunny Temps in 70's

The Facility Operator shall inspect the facility daily for compliance with the applicable regulations including but not limited to the following:

Place an (X) on the line next to all aspects of facility operations which have been inspected today.

3745-27-05 Prohibited Disposal Methods

X	(B)	No Open Burning

3745-27-19 Operation of a Facility

X	(E)(2)(a)	Maintain access roads
X	(b)	Limited access to facility
X	(c)	Signs posted
X	(d)	Exclusion of animals
X	(3)(a)	Adequate fire equipment
X	(b)	Operable and adequate equipment
X	(4)	Improper salvaging
X	(5)	Trained employees
X	(6)	Preparation for inclement weather
X	(7)(a)	Leachate treatment/disposal
X	(b)	Phased operation
X	(c)	Confined unloading
X	(d)	Separation/control of flammable waste
X	(e)	Waste disposed at working face
X	(f)(I)	Compacting bulky items
X	(ii)	Minimizing dust generation
X	(8)(a)	NESHAP reg. asbestos disposal
X	(b)	Acceptance of liquids
X	(c)	Acceptance of hazardous waste
X	(d)	Acceptance of PCBs
X	(e)	Acceptance of infectious waste
X	(f)	Acceptance of yard waste
X	(g)	Acceptance of scrap tires
X	(h)	Acceptance of low level rad. waste
X	(I)	Acceptance of semi-solid material w/free liquid
X	(9)	Control of scattered litter
X	(10)	Keeping of daily logs
X	(11)(a)	Daily inspection of facility for ponding, erosion, leachate outbreaks (record any corrective actions below).
X	(12)	Copy of auth. docs available
X	(F)	Daily cover
X	(3)	Alternate Daily Cover Used (describe in comment section below)
X	(G)	Intermediate cover
X	(H)	Final cover
X	(I)	Scales
X	(J)(1)	Surface water diversion
X	(2)	Design in operating record
X	(4)	Surface water monitoring
X	(K)(1)	Leachate control
X	(2)	Lift station back-up pumps
X	(3)	Collection pipe network (inspection)
X	(4)	Temporary leachate storage
X	(5)	Leachate treatment and disposal
X	(6)	Leachate storage/disposal contingency plan
X	(7)	Surface water monitoring
X	(L)	PCB and hazardous waste prevention and detection program

3745-37-01 License

X	(A)	Valid license

rective Actions Taken and Other Comments:

Picked Litter Synagro Hauling Leachate Hauled Cover
Fixing Leachate out Breaks

Rob Carpenter
gnature of Person Completing Form

ROB CARPENTER
Print Name of Person Completing Form

4-18-08
Date

uld be retained on file for three years for inspection by the local health department, Ohio EPA, or an authorized representative.
ic ide accurate daily operations information may be considered a violation of Ohio Revised Code § 2921.13.

Leachate - 2'-6" Sumps 1 · 20.1

3 - 19.6

g-Form 3

Revised: August 1, 2005

Municipal Solid Waste Landfill Facility Daily Log of Operations - Form 3

(Log Required by OAC 3745-27-19(E)(10))

Facility Name: Apex Environmental Today's Date: 4-24-08

Facility Opened Today at (time): 24 HR Facility Closed Today at (time): _____

List Equipment in Operation at the Facility Today: 1050, 850, 836, 345, 325, 300, 155, 6, 7, Alon, Tipper, ZT

List Weather Conditions on this Day: Sunny Temps in 70's

The Facility Operator shall inspect the facility daily for compliance with the applicable regulations including but not limited to the following:

Place an (X) on the line next to all aspects of facility operations which have been inspected today.

3745-27-05 Prohibited Disposal Methods

X	(B)	No Open Burning

3745-27-19 Operation of a Facility

X	(E)(2)(a)	Maintain access roads
X	(b)	Limited access to facility
X	(c)	Signs posted
X	(d)	Exclusion of animals
X	(3)(a)	Adequate fire equipment
X	(b)	Operable and adequate equipment
X	(4)	Improper salvaging
X	(5)	Trained employees
	(6)	Preparation for inclement weather
X	(7)(a)	Leachate treatment/disposal
X	(b)	Phased operation
X	(c)	Confined unloading
	(d)	Separation/control of flammable waste
	(e)	Waste disposed at working face
	(f)(I)	Compacting bulky items
	(ii)	Minimizing dust generation
	(8)(a)	NESHAP reg. asbestos disposal
	(b)	Acceptance of liquids
	(c)	Acceptance of hazardous waste
	(d)	Acceptance of PCBs
	(e)	Acceptance of infectious waste
	(f)	Acceptance of yard waste
	(g)	Acceptance of scrap tires
	(h)	Acceptance of low level rad. waste
	(I)	Acceptance of semi-solid material w/free liquid
X	(9)	Control of scattered litter
X	(10)	Keeping of daily logs
X	(11)(a)	Daily inspection of facility for ponding, erosion, leachate outbreaks (record any corrective actions below).
X	(12)	Copy of auth. docs available
X	(F)	Daily cover
	(3)	Alternate Daily Cover Used (describe in comment section below)
	(G)	Intermediate cover
	(H)	Final cover
X	(I)	Scales
X	(J)(1)	Surface water diversion
X	(2)	Design in operating record
X	(4)	Surface water monitoring
X	(K)(1)	Leachate control
	(2)	Lift station back-up pumps
	(3)	Collection pipe network (inspection)
	(4)	Temporary leachate storage
	(5)	Leachate treatment and disposal
	(6)	Leachate storage/disposal contingency plan
X	(7)	Surface water monitoring
X	(L)	PCB and hazardous waste prevention and detection program

3745-37-01 License

X	(A)	Valid license

Corrective Actions Taken and Other Comments:

Picked Litter Hauled Cover, Synagro Hauled Leachate, Watering Roads working West Slop (Getting to Grade)

Rob Carpenter — *Signature of Person Completing Form*

Rob Carpenter — *Print Name of Person Completing Form*

4-24-08 — *Date*

...uld be retained on file for three years for inspection by the local health department, Ohio EPA, or an authorized representative. ... to ...vide accurate daily operations information may be considered a violation of Ohio Revised Code § 2921.13.

Leachate - 4' 3"

Sumps 1 - 20.5

3 - 17.8

Municipal Solid Waste Landfill Facility Daily Log of Operations - Form 3

(Log Required by OAC 3745-27-19(E)(1)(b))

Facility Name: Apex Environmental Today's Date: 6-6-08

Facility Opened Today at (time): 24HR Facility Closed Today at (time): _____

List Equipment in Operation at the Facility Today: 105, 850, 836, 345, 325, 320, 1555, 1550 6, 7, Ayon, Tipper, Tr.

List Weather Conditions on this Day: Clear - Temps in 80's

The Facility Operator shall inspect the facility daily for compliance with the applicable regulations including but not limited to the following:

Place an (X) on the line next to all aspects of facility operations which have been inspected today.

3745-27-05 Prohibited Disposal Methods

- X (B) No Open Burning

3745-27-19 Operation of a Facility

- X (E)(2)(a) Maintain access roads
- X (b) Limited access to facility
- X (c) Signs posted
- X (d) Exclusion of animals
- X (3)(a) Adequate fire equipment
- X (b) Operable and adequate equipment
- X (4) Improper salvaging
- X (5) Trained employees
- X (6) Preparation for inclement weather
- X (7)(a) Leachate treatment/disposal
- X (b) Phased operation
- X (c) Confined unloading
- X (d) Separation/control of flammable waste
- X (e) Waste disposed at working face
- X (f)(I) Compacting bulky items
- X (ii) Minimizing dust generation
- X (8)(a) NESHAP reg. asbestos disposal
- X (b) Acceptance of liquids
- X (c) Acceptance of hazardous waste
- X (d) Acceptance of PCBs
- X (e) Acceptance of infectious waste
- X (f) Acceptance of yard waste
- X (g) Acceptance of scrap tires
- X (h) Acceptance of low level rad. waste
- X (I) Acceptance of semi-solid material w/free liquid
- X (9) Control of scattered litter
- X (10) Keeping of daily logs
- X (11)(a) Daily inspection of facility for ponding, erosion, leachate outbreaks (record any corrective actions below).
- X (12) Copy of auth. docs available
- X (F) Daily cover
- (3) Alternate Daily Cover Used (describe in comment section below)
- (G) Intermediate cover
- (H) Final cover
- X (I) Scales
- X (J)(1) Surface water diversion
- X (2) Design in operating record
- X (4) Surface water monitoring
- X (K)(1) Leachate control
- (2) Lift station back-up pumps
- (3) Collection pipe network (inspection)
- (4) Temporary leachate storage
- (5) Leachate treatment and disposal
- (6) Leachate storage/disposal contingency plan
- X (7) Surface water monitoring
- Y (L) PCB and hazardous waste prevention and detection program

3745-37-01 License

- X (A) Valid license

Corrective Actions Taken and Other Comments:

Picked Litter, Water Roads.

R.J Carpenter
Signature of Person Completing Form

RoB CARPENTER
Print Name of Person Completing Form

6-6-08
Date

Form should be retained on file for three years for inspection by the local health department, Ohio EPA, or an authorized representative. Failure to provide accurate daily operations information may be considered a violation of Ohio Revised Code § 2921.13.

Leachate 4" 7"

Sumps - 1 - 17.8

3 - 19.7

Form 3

Revised: August 1, 2005

Municipal Solid Waste Landfill Facility Daily Log of Operations - Form 3

(Log Required by Ohio Revised Code 3734.02(E)(2))

Facility Name: Apex Environmental Today's Date: 6-11-08

Facility Opened Today at (time): 24 HR Facility Closed Today at (time): _____

List Equipment in Operation at the Facility Today: 1050, 850, 836, 325, 300, 1555, 1550, 345, 6, 7, Mixer, Tipper, 111

Last Weather Conditions on this Day: Sunny- Temps in 80's

The Facility Operator shall inspect the facility daily for compliance with the applicable regulations including but not limited to the following:

Place an (X) on the line next to all aspects of facility operations which have been inspected today.

3745-27-05 Prohibited Disposal Methods

- X (B) No Open Burning

3745-27-19 Operation of a Facility

- X (E)(2)(a) Maintain access roads
- X (b) Limited access to facility
- X (c) Signs posted
- X (d) Exclusion of animals
- X (3)(a) Adequate fire equipment
- X (b) Operable and adequate equipment
- X (4) Improper salvaging
- X (5) Trained employees
- X (6) Preparation for inclement weather
- X (7)(a) Leachate treatment/disposal
- X (b) Phased operation
- X (c) Confined unloading
- X (d) Separation/control of flammable waste
- X (e) Waste disposed at working face
- X (f)(i) Compacting bulky items
- X (ii) Minimizing dust generation
- X (8)(a) NESHAP reg. asbestos disposal
- X (b) Acceptance of liquids
- X (c) Acceptance of hazardous waste
- X (d) Acceptance of PCBs
- X (e) Acceptance of infectious waste
- X (f) Acceptance of yard waste
- X (g) Acceptance of scrap tires
- X (h) Acceptance of low level rad. waste
- X (I) Acceptance of semi-solid material w/free liquid
- X (9) Control of scattered litter
- X (10) Keeping of daily logs
- X (11)(a) Daily inspection of facility for ponding, erosion, leachate outbreaks (record any corrective actions below).
- X (12) Copy of auth. docs available
- X (F) Daily cover
- X (3) Alternate Daily Cover Used (describe in comment section below)
- — (G) Intermediate cover
- — (H) Final cover
- X (I) Scales
- X (J)(1) Surface water diversion
- X (2) Design in operating record
- X (4) Surface water monitoring
- X (K)(1) Leachate control
- — (2) Lift station back-up pumps
- — (3) Collection pipe network (inspection)
- — (4) Temporary leachate storage
- — (5) Leachate treatment and disposal
- — (6) Leachate storage/disposal contingency plan
- X (7) Surface water monitoring
- X (L) PCB and hazardous waste prevention and detection program

3745-37-01 License

- X (A) Valid license

Corrective Actions Taken and Other Comments:

Picked LITTER, Hauled Cover, WATER ROADS, MIXED BATCH OF CONCOVER TO SPRAY IF NEEDED, SYMBRO Hauling leachate

Rob Carpenter
Signature of Person Completing Form

ROB CARPENTER
Print Name of Person Completing Form

6-11-08
Date

This should be retained on file for three years for inspection by the local health department, Ohio EPA, or an authorized representative. Provide accurate daily operations information may be considered a violation of Ohio Revised Code § 2921.13.

LEACHATE - 12'6" Sumps 1-17.3

Form 3

3 30.5

Revised: August 1, 2005

Municipal Solid Waste Landfill Facility Daily Log of Operations - Form 3

{Log Required by OAC 3745-27-19(E)(10)}

ity Name: Apex Environmental Today's Date: 3-10-09

Facility Opened Today at (time): 24hr Facility Closed Today at (time): _____

List Equipment in Operation at the Facility Today: 300 325 345 835 AIson Tipper 155S 155V IT

List Weather Conditions on this Day: Cloudy 48°

The Facility Operator shall inspect the facility daily for compliance with the applicable regulations including but not limited to the following:

Place an (X) on the line next to all aspects of facility operations which have been inspected today.

3745-27-05 Prohibited Disposal Methods

X	(B)	No Open Burning

3745-27-19 Operation of a Facility

X	(E)(2)(a)	Maintain access roads
X	(b)	Limited access to facility
X	(c)	Signs posted
X	(d)	Exclusion of animals
X	(3)(a)	Adequate fire equipment
X	(b)	Operable and adequate equipment
X	(4)	Improper salvaging
X	(5)	Trained employees
X	(6)	Preparation for inclement weather
	(7)(a)	Leachate treatment/disposal
	(b)	Phased operation
X	(c)	Confined unloading
X	(d)	Separation/control of flammable waste
X	(e)	Waste disposed at working face
X	(f)(I)	Compacting bulky items
X	(ii)	Minimizing dust generation
	(8)(a)	NESHAP reg. asbestos disposal
	(b)	Acceptance of liquids
	(c)	Acceptance of hazardous waste
	(d)	Acceptance of PCBs
	(e)	Acceptance of infectious waste
	(f)	Acceptance of yard waste
	(g)	Acceptance of scrap tires
	(h)	Acceptance of low level rad. waste
	(I)	Acceptance of semi-solid material w/free liquid
X	(9)	Control of scattered litter
X	(10)	Keeping of daily logs
X	(11)(a)	Daily inspection of facility for ponding, erosion, leachate outbreaks (record any corrective actions below).
X	(12)	Copy of auth. docs available
X	(F)	Daily cover
	(3)	Alternate Daily Cover Used (describe in comment section below)
	(G)	Intermediate cover
	(H)	Final cover
X	(I)	Scales
X	(J)(1)	Surface water diversion
X	(2)	Design in operating record
X	(4)	Surface water monitoring
X	(K)(1)	Leachate control
	(2)	Lift station back-up pumps
	(3)	Collection pipe network (inspection)
	(4)	Temporary leachate storage
	(5)	Leachate treatment and disposal
	(6)	Leachate storage/disposal contingency plan
X	(7)	Surface water monitoring
X	(L)	PCB and hazardous waste prevention and detection program

3745-37-01 License

X	(A)	Valid license

Corrective Actions Taken and Other Comments:

Haul cover pick litter fix Ditch radhill Leachate out Break north/west slopes

Signature of Person Completing Form — Kevin Morrison, Print Name of Person Completing Form — 3-10-09, Date

This form should be retained on file for three years for inspection by the local health department, Ohio EPA, or an authorized representative. Failure to provide accurate daily operations information may be considered a violation of Ohio Revised Code § 2921.13.

leachate - Sump 1 - 17.1
10'3"
3-24.6

Municipal Solid Waste Landfill Facility Daily Log of Operations - Form 3

(Log Required by OAC 3745-27-19(E)(10))

Facility Name: Apex Environmental Today's Date: 10-6-09

Facility Opened Today at (time): 24 hrs Facility Closed Today at (time):

List Equipment in Operation at the Facility Today: 6, 7, 300, 325, 836, Cat 735, 345, 155 (U Blade), 1, Skidsteer

List Weather Conditions on this Day: 60's and clear

RECEIVED OCT 07 2009

The Facility Operator shall inspect the facility daily for compliance with the applicable regulations including but not limited to the following:

Place an (X) on the line next to all aspects of facility operations which have been inspected today.

BY: [signature]

3745-27-05 Prohibited Disposal Methods

- X (B) No Open Burning

3745-27-19 Operation of a Facility

- X (E)(2)(a) Maintain access roads
- X (b) Limited access to facility
- X (c) Signs posted
- X (d) Exclusion of animals
- X (3)(a) Adequate fire equipment
- X (b) Operable and adequate equipment
- X (4) Improper salvaging
- X (5) Trained employees
- X (6) Preparation for inclement weather
- X (7)(a) Leachate treatment/disposal
- X (b) Phased operation
- X (c) Confined unloading
- X (d) Separation/control of flammable waste
- X (e) Waste disposed at working face
- X (f)(i) Compacting bulky items
- X (ii) Minimizing dust generation
- X (8)(a) NESHAP reg. asbestos disposal
- X (b) Acceptance of liquids
- X (c) Acceptance of hazardous waste
- X (d) Acceptance of PCBs
- X (e) Acceptance of infectious waste
- X (f) Acceptance of yard waste
- X (g) Acceptance of scrap tires
- X (h) Acceptance of low level rad. waste
- X (i) Acceptance of semi-solid material w/free liquid
- X (9) Control of scattered litter
- X (10) Keeping of daily logs
- X (11)(a) Daily inspection of facility for ponding, erosion, leachate outbreaks (record any corrective actions below).
- X (12) Copy of auth. docs available
- X (F) Daily cover
- X (3) Alternate Daily Cover Used (describe in comment section below)
- X (G) Intermediate cover
- X (H) Final cover
- X (I) Scales
- X (J)(1) Surface water diversion
- X (2) Design in operating record
- X (4) Surface water monitoring
- X (K)(1) Leachate control
- X (2) Lift station back-up pumps
- X (3) Collection pipe network (inspection)
- X (4) Temporary leachate storage
- X (5) Leachate treatment and disposal
- X (6) Leachate storage/disposal contingency plan
- X (7) Surface water monitoring
- X (L) PCB and hazardous waste prevention and detection program

3745-37-01 License

- X (A) Valid license

Corrective Actions Taken and Other Comments:

Picked Litter, Found 2 LEACHATE OUTBREAKS ON NORTH SLOPE NOTified Supervisor @ 7:00 AM, will fix SOON AS POSSIBLE.
Synagro hauled leachate, WATER ROADS

Signature of Person Completing Form | *Print Name of Person Completing Form* | *Date*

This form should be retained on file for three years for inspection by the local health department, Ohio EPA, or an authorized representative. Failure to provide accurate daily operations information may be considered a violation of Ohio Revised Code § 2921.13.

Dump 1 = 22.1 Leachate = 1'8"

Dump 3 = 25.2

Municipal Solid Waste Landfill Facility Daily Log of Operations - Form 3

(Log Required by OAC 3745-27-19(E)(10))

Facility Name: Apex Environmental Today's Date: 3-22-10

Facility Opened Today at (time): 24hr Facility Closed Today at (time): _____

List Equipment in Operation at the Facility Today: 1550, 6, 7, 850, 836, 300, 325 Alson, IT, Tipper

List Weather Conditions on this Day: Rain then Clearing up 60°

The Facility Operator shall inspect the facility daily for compliance with the applicable regulations including but not limited to the following:

Place an (X) on the line next to all aspects of facility operations which have been inspected today.

3745-27-05 Prohibited Disposal Methods

- X (B) No Open Burning

3745-27-19 Operation of a Facility

- X (D)(2)(a) Maintain access roads
- X (b) Limited access to facility
- X (c) Signs posted
- X (d) Exclusion of animals
- X (3)(a) Adequate fire equipment
- X (b) Operable and adequate equipment
- X (4) Improper salvaging
- X (5) Trained employees
- X (6) Preparation for inclement weather
- X (7)(a) Leachate treatment/disposal
- X (b) Phased operation
- X (c) Confined unloading
- X (d) Separation/control of flammable waste
- X (e) Waste disposed at working face
- X (I)(I) Compacting bulky items
- X (ii) Minimizing dust generation
- — (8)(a) NESHAP reg. asbestos disposal
- — (b) Acceptance of liquids
- — (c) Acceptance of hazardous waste
- — (d) Acceptance of PCBs
- — (e) Acceptance of infectious waste
- — (f) Acceptance of yard waste
- — (g) Acceptance of scrap tires
- — (h) Acceptance of low level rad. waste
- — (I) Acceptance of semi-solid material w/free liquid
- X (9) Control of scattered litter
- X (10) Keeping of daily logs
- X (11)(a) Daily inspection of facility for ponding, erosion, leachate outbreaks (record any corrective actions below).
- X (12) Copy of auth. docs available
- X (F) Daily cover
- — (3) Alternate Daily Cover Used (describe in comment section below)
- — (G) Intermediate cover
- — (H) Final cover
- X (I) Scales
- X (J)(1) Surface water diversion
- X (2) Design in operating record
- X (4) Surface water monitoring
- X (K)(1) Leachate control
- — (2) Lift station back-up pumps
- — (3) Collection pipe network (inspection)
- — (4) Temporary leachate storage
- — (5) Leachate treatment and disposal
- — (6) Leachate storage/disposal contingency plan
- X (7) Surface water monitoring
- X (L) PCB and hazardous waste prevention and detection program

3745-37-01 License

- X (A) Valid license

Corrective Actions Taken and Other Comments:

Picked litter, Hauled Cover,

Jason Garrett — Signature of Person Completing Form

Jason Garrett — Print Name of Person Completing Form

3-22-10 — Date

This form should be retained on file for three years for inspection by the local health department, Ohio EPA, or an authorized representative. Failure to provide accurate daily operations information may be considered a violation of Ohio Revised Code § 2921.13.

leachate 10'

Sump 1 - 18.2

Sump 3 - 16.7

Sump 4 - 21.1

Municipal Solid Waste Landfill Facility Daily Log of Operations - Form 3

(Log Required by OAC 3745-27-19(E)(10))

Facility Name: APEX Environmental Today's Date: 5-3-10

Facility Opened Today at (time): 24HR Facility Closed Today at (time): ——

List Equipment in Operation at the Facility Today: 7, 6, 325, 300, Material Handler Tipper, Jacos, 850

List Weather Conditions on this Day: Rain till 10:00, Cloudy, Then Sun Came out 12:00

The Facility Operator shall inspect the facility daily for compliance with the applicable regulations including but not limited to the following:

Place an (X) on the line next to all aspects of facility operations which have been inspected today.

3745-27-05 Prohibited Disposal Methods

X	(B)	No Open Burning

3745-27-19 Operation of a Facility

X	(E)(2)(a)	Maintain access roads
X	(b)	Limited access to facility
X	(c)	Signs posted
X	(d)	Exclusion of animals
X	(3)(a)	Adequate fire equipment
X	(b)	Operable and adequate equipment
X	(4)	Improper salvaging
X	(5)	Trained employees
X	(6)	Preparation for inclement weather
X	(7)(a)	Leachate treatment/disposal
X	(b)	Phased operation
X	(c)	Confined unloading
X	(d)	Separation/control of flammable waste
X	(e)	Waste disposed at working face
X	(f)(i)	Compacting bulky items
X	(ii)	Minimizing dust generation
—	(8)(a)	NESHAP reg. asbestos disposal
—	(b)	Acceptance of liquids
—	(c)	Acceptance of hazardous waste
—	(d)	Acceptance of PCBs
—	(e)	Acceptance of infectious waste
—	(f)	Acceptance of yard waste
—	(g)	Acceptance of scrap tires
—	(h)	Acceptance of low level rad. waste
—	(i)	Acceptance of semi-solid material w/free liquid
X	(9)	Control of scattered litter
X	(10)	Keeping of daily logs
X	(11)(a)	Daily inspection of facility for ponding, erosion, leachate outbreaks (record any corrective actions below).
X	(12)	Copy of auth. docs available
X	(F)	Daily cover
X	(3)	Alternate Daily Cover Used (describe in comment section below)
X	(G)	Intermediate cover
X	(H)	Final cover
X	(I)	Scales
X	(J)(1)	Surface water diversion
X	(2)	Design in operating record
X	(4)	Surface water monitoring
X	(K)(1)	Leachate control
—	(2)	Lift station back-up pumps
—	(3)	Collection pipe network (inspection)
—	(4)	Temporary leachate storage
—	(5)	Leachate treatment and disposal
—	(6)	Leachate storage/disposal contingency plan
X	(7)	Surface water monitoring
X	(L)	PCB and hazardous waste prevention and detection program

3745-37-01 License

X	(A)	Valid license

Corrective Actions Taken and Other Comments:

Clearing mud till 11:30 AM Sun Came out may have to water Some parts of roads

Todd Brammer — *Signature of Person Completing Form*

TODD BRAMMER — *Print Name of Person Completing Form*

5-3-10 — *Date*

This form should be retained on file for three years for inspection by the local health department, Ohio EPA, or an authorized representative. Failure to provide accurate daily operations information may be considered a violation of Ohio Revised Code § 2921.13.

Leachate - 2.9

1 - 20.3
3 - 21.2
4 - 19.4

Municipal Solid Waste Landfill Facility Daily Log of Operations - Form 3

(Log Required by OAC 3745-27-19(E)(10))

Facility Name: Apex Environmental Today's Date: 10-19-10

Facility Opened Today at (time): 24hr Facility Closed Today at (time): _____

List Equipment in Operation at the Facility Today: 850, 6, 7, 155U, 8, 325, 345, 400 Tipper, I-t, 836, Handler

List Weather Conditions on this Day: Cloudy Temps in 50's

The Facility Operator shall inspect the facility daily for compliance with the applicable regulations including but not limited to the following:

Place an (X) on the line next to all aspects of facility operations which have been inspected today.

3745-27-05 Prohibited Disposal Methods

- X (B) No Open Burning

3745-27-19 Operation of a Facility

- X (E)(2)(a) Maintain access roads
- X (b) Limited access to facility
- X (c) Signs posted
- X (d) Exclusion of animals
- X (3)(a) Adequate fire equipment
- X (b) Operable and adequate equipment
- X (4) Improper salvaging
- X (5) Trained employees
- X (6) Preparation for inclement weather
- X (7)(a) Leachate treatment/disposal
- X (b) Phased operation
- X (c) Confined unloading
- X (d) Separation/control of flammable waste
- X (e) Waste disposed at working face
- X (f)(i) Compacting bulky items
- X (ii) Minimizing dust generation
- (8)(a) NESHAP reg. asbestos disposal
- (b) Acceptance of liquids
- (c) Acceptance of hazardous waste
- (d) Acceptance of PCBs
- (e) Acceptance of infectious waste
- (f) Acceptance of yard waste
- (g) Acceptance of scrap tires
- (h) Acceptance of low level rad. waste
- (i) Acceptance of semi-solid material w/free liquid
- X (9) Control of scattered litter
- X (10) Keeping of daily logs
- X (11)(a) Daily inspection of facility for ponding, erosion, leachate outbreaks (record any corrective actions below).
- X (12) Copy of auth. docs available
- X (F) Daily cover
- (3) Alternate Daily Cover Used (describe in comment section below)
- (G) Intermediate cover
- (H) Final cover
- X (I) Scales
- X (J)(1) Surface water diversion
- X (2) Design in operating record
- X (4) Surface water monitoring
- X (K)(1) Leachate control
- (2) Lift station back-up pumps
- (3) Collection pipe network (inspection)
- (4) Temporary leachate storage
- (5) Leachate treatment and disposal
- (6) Leachate storage/disposal contingency plan
- X (7) Surface water monitoring
- X (L) PCB and hazardous waste prevention and detection program

3745-37-01 License

- X (A) Valid license

Corrective Actions Taken and Other Comments:

Picked litter, Hauled Cover, Synagro hauling leachate

Jason Garrett — *Signature of Person Completing Form*

Jason Garrett — *Print Name of Person Completing Form*

10-14-10 — *Date*

This form should be retained on file for three years for inspection by the local health department, Ohio EPA, or an authorized representative. Failure to provide accurate daily operations information may be considered a violation of Ohio Revised Code § 2921.13.

leachate - 6'

Sump1 - 20.1

Sump3 - 20.1

Sump4 - 16.9

450935

OhioEPA Municipal Solid Waste Landfill Facility Daily Log of Operations - Form 3

(Log Required by OAC 3745-27-19(E)(10))

Facility Name: Apex Environmental Today's Date: 11-5-10

Facility Opened Today at (time): 24hr Facility Closed Today at (time): _____

List Equipment in Operation at the Facility Today: 1550, 7, 328, 836, FT, Tipper

List Weather Conditions on this Day: rain Temps in 30's

The Facility Operator shall inspect the facility daily for compliance with the applicable regulations including but not limited to the following:

Place an (X) on the line next to all aspects of facility operations which have been inspected today.

3745-27-05 Prohibited Disposal Methods

- X (B) No Open Burning

3745-27-19 Operation of a Facility

- X (E)(2)(a) Maintain access roads
- X (b) Limited access to facility
- X (c) Signs posted
- X (d) Exclusion of animals
- X (3)(a) Adequate fire equipment
- X (b) Operable and adequate equipment
- X (4) Improper salvaging
- X (5) Trained employees
- X (6) Preparation for inclement weather
- X (7)(a) Leachate treatment/disposal
- X (b) Phased operation
- X (c) Confined unloading
- X (d) Separation/control of flammable waste
- X (e) Waste disposed at working face
- X (f)(i) Compacting bulky items
- X (ii) Minimizing dust generation
- — (8)(a) NESHAP reg. asbestos disposal
- — (b) Acceptance of liquids
- — (c) Acceptance of hazardous waste
- — (d) Acceptance of PCBs
- — (e) Acceptance of infectious waste
- — (f) Acceptance of yard waste
- — (g) Acceptance of scrap tires
- — (h) Acceptance of low level rad. waste
- — (I) Acceptance of semi-solid material w/free liquid
- X (9) Control of scattered litter
- X (10) Keeping of daily logs
- X (11)(a) Daily inspection of facility for ponding, erosion, leachate outbreaks (record any corrective actions below).
- X (12) Copy of auth. does available
- X (F) Daily cover
- — (3) Alternate Daily Cover Used (describe in comment section below)
- — (G) Intermediate cover
- — (H) Final cover
- X (I) Scales
- X (J)(1) Surface water diversion
- X (2) Design in operating record
- X (4) Surface water monitoring
- X (K)(1) Leachate control
- — (2) Lift station back-up pumps
- — (3) Collection pipe network (inspection)
- — (4) Temporary leachate storage
- — (5) Leachate treatment and disposal
- — (6) Leachate storage/disposal contingency plan
- X (7) Surface water monitoring
- X (L) PCB and hazardous waste prevention and detection program

3745-37-01 License

- X (A) Valid license

Corrective Actions Taken and Other Comments:

picked litter, graveled cell hills

Jason Garrett — *Signature of Person Completing Form*

Jason Garrett — *Print Name of Person Completing Form*

11-5-10 — *Date*

This form should be retained on file for three years for inspection by the local health department, Ohio EPA, or an authorized representative. Failure to provide accurate daily operations information may be considered a violation of Ohio Revised Code § 2921.13.

Sump 1 25.3
Sump 3 21.8
Sump 4 22.9

Bleachate 5.7

Municipal Solid Waste Landfill Facility Daily Log of Operations - Form 3

(Log Required by OAC 3745-27-19(E)(10))

Facility Name: Apex Environmental Today's Date: 1-5-11

Facility Opened Today at (time): 24hr Facility Closed Today at (time): _____

List Equipment in Operation at the Facility Today: 836, Aljon, Lt, Handler, 325, 328 Tipper

List Weather Conditions on this Day: Cloudy Temps in 30s

The Facility Operator shall inspect the facility daily for compliance with the applicable regulations including but not limited to the following:

Place an (X) on the line next to all aspects of facility operations which have been inspected today.

3745-27-05 Prohibited Disposal Methods

X	(B)	No Open Burning

3745-27-19 Operation of a Facility

X	(E)(2)(a)	Maintain access roads
X	(b)	Limited access to facility
X	(c)	Signs posted
X	(d)	Exclusion of animals
X	(3)(a)	Adequate fire equipment
X	(b)	Operable and adequate equipment
X	(4)	Improper salvaging
X	(5)	Trained employees
X	(6)	Preparation for inclement weather
X	(7)(a)	Leachate treatment/disposal
X	(b)	Phased operation
X	(c)	Confined unloading
X	(d)	Separation/control of flammable waste
X	(e)	Waste disposed at working face
X	(f)(I)	Compacting bulky items
X	(ii)	Minimizing dust generation
	(8)(a)	NESHAP reg. asbestos disposal
	(b)	Acceptance of liquids
	(c)	Acceptance of hazardous waste
	(d)	Acceptance of PCBs
	(e)	Acceptance of infectious waste
	(f)	Acceptance of yard waste
	(g)	Acceptance of scrap tires
	(h)	Acceptance of low level rad. waste
	(I)	Acceptance of semi-solid material w/free liquid
X	(9)	Control of scattered litter
X	(10)	Keeping of daily logs
X	(11)(a)	Daily inspection of facility for ponding, erosion, leachate outbreaks (record any corrective actions below).
X	(12)	Copy of auth. does available
X	(F)	Daily cover
	(3)	Alternate Daily Cover Used (describe in comment section below)
	(G)	Intermediate cover
	(H)	Final cover
X	(I)	Scales
X	(J)(1)	Surface water diversion
X	(2)	Design in operating record
X	(4)	Surface water monitoring
X	(K)(1)	Leachate control
	(2)	Lift station back-up pumps
	(3)	Collection pipe network (inspection)
	(4)	Temporary leachate storage
	(5)	Leachate treatment and disposal
	(6)	Leachate storage/disposal contingency plan
X	(7)	Surface water monitoring
X	(L)	PCB and hazardous waste prevention and detection program

3745-37-01 License

X	(A)	Valid license

Corrective Actions Taken and Other Comments:

Picked litter, Hauled cover

Jason Garrett 1-5-11

Signature of Person Completing Form *Print Name of Person Completing Form* *Date*

This form should be retained on file for three years for inspection by the local health department, Ohio EPA, or an authorized representative. Failure to provide accurate daily operations information may be considered a violation of Ohio Revised Code § 2921.13.

Sump1 14.6
Sump3 20.1
Sump4 23.0

Municipal Solid Waste Landfill Facility Daily Log of Operations - Form 3

(Log Required by OAC 3745-27-19(E)(10))

Facility Name: Apex Environmental Today's Date: 4-5-11

Facility Opened Today at (time): 24 Facility Closed Today at (time): _____

List Equipment in Operation at the Facility Today: 836, Material handler, 328, 325, 155, Tipper, D7R, D6T, 307

List Weather Conditions on this Day: Snow morning cloudy PM

The Facility Operator shall inspect the facility daily for compliance with the applicable regulations including but not limited to the following:

Place an (X) on the line next to all aspects of facility operations which have been inspected today.

3745-27-05 Prohibited Disposal Methods

- X (B) No Open Burning

3745-27-19 Operation of a Facility

- X (E)(2)(a) Maintain access roads
- X (b) Limited access to facility
- X (c) Signs posted
- X (d) Exclusion of animals
- X (3)(a) Adequate fire equipment
- X (b) Operable and adequate equipment
- X (4) Improper salvaging
- X (5) Trained employees
- X (6) Preparation for inclement weather
- X (7)(a) Leachate treatment/disposal
- X (b) Phased operation
- X (c) Confined unloading
- X (d) Separation/control of flammable waste
- X (e) Waste disposed at working face
- X (f)(I) Compacting bulky items
- (ii) Minimizing dust generation
- (8)(a) NESHAP reg. asbestos disposal
- (b) Acceptance of liquids
- (c) Acceptance of hazardous waste
- (d) Acceptance of PCBs
- (e) Acceptance of infectious waste
- (f) Acceptance of yard waste
- (g) Acceptance of scrap tires
- (h) Acceptance of low level rad. waste
- (I) Acceptance of semi-solid material w/free liquid
- X (9) Control of scattered litter
- X (10) Keeping of daily logs
- X (11)(a) Daily inspection of facility for ponding, erosion, leachate outbreaks (record any corrective actions below).
- X (12) Copy of auth. docs available
- X (F) Daily cover
- (3) Alternate Daily Cover Used (describe in comment section below)
- (G) Intermediate cover
- (H) Final cover
- X (I) Scales
- X (J)(1) Surface water diversion
- X (2) Design in operating record
- X (4) Surface water monitoring
- X (K)(1) Leachate control
- (2) Lift station back-up pumps
- (3) Collection pipe network (inspection)
- (4) Temporary leachate storage
- X (5) Leachate treatment and disposal
- X (6) Leachate storage/disposal contingency plan
- X (7) Surface water monitoring
- X (L) PCB and hazardous waste prevention and detection program

3745-37-01 License

- X (A) Valid license

Corrective Actions Taken and Other Comments:

Building up ramps to speed, hauling cover

David R Bardnell — *Signature of Person Completing Form*

Daniel L Bardnell — *Print Name of Person Completing Form*

4-5-11 — *Date*

This form should be retained on file for three years for inspection by the local health department, Ohio EPA, or an authorized representative. Failure to provide accurate daily operations information may be considered a violation of Ohio Revised Code § 2921.13.

Leachate Tank 17'8"

Sumps 3 24.1 on
1 75.4 off
4 44.1 on

Revised: August 1, 2005

Municipal Solid Waste Landfill Facility Daily Log of Operations - Form 3

(Log Required by OAC 3745-27-19(E)(10))

Facility Name: Apex Environmental Today's Date: 10-3-11

Facility Opened Today at (time): 2P MR Facility Closed Today at (time): _____

List Equipment in Operation at the Facility Today: Tipper, ET, Ajax, 836, 345, 325, 6, 7, 155

List Weather Conditions on this Day: Rain - Temps in 50's

The Facility Operator shall inspect the facility daily for compliance with the applicable regulations including but not limited to the following:

Place an (X) on the line next to all aspects of facility operations which have been inspected today.

3745-27-05 Prohibited Disposal Methods

X	(B)	No Open Burning

3745-27-19 Operation of a Facility

X	(E)(2)(a)	Maintain access roads
X	(b)	Limited access to facility
X	(c)	Signs posted
X	(d)	Exclusion of animals
X	(3)(a)	Adequate fire equipment
X	(b)	Operable and adequate equipment
X	(4)	Improper salvaging
X	(5)	Trained employees
X	(6)	Preparation for inclement weather
X	(7)(a)	Leachate treatment/disposal
X	(b)	Phased operation
X	(c)	Confined unloading
X	(d)	Separation/control of flammable waste
X	(e)	Waste disposed at working face
X	(f)(I)	Compacting bulky items
X	(ii)	Minimizing dust generation
	(8)(a)	NESHAP reg. asbestos disposal
	(b)	Acceptance of liquids
	(c)	Acceptance of hazardous waste
	(d)	Acceptance of PCBs
	(e)	Acceptance of infectious waste
	(f)	Acceptance of yard waste
	(g)	Acceptance of scrap tires
	(h)	Acceptance of low level rad. waste
	(I)	Acceptance of semi-solid material w/free liquid
X	(9)	Control of scattered litter
X	(10)	Keeping of daily logs
X	(11)(a)	Daily inspection of facility for ponding, erosion, leachate outbreaks (record any corrective actions below).
X	(12)	Copy of auth. does available
X	(F)	Daily cover
	(3)	Alternate Daily Cover Used (describe in comment section below)
	(G)	Intermediate cover
	(H)	Final cover
X	(I)	Scales
X	(J)(1)	Surface water diversion
X	(2)	Design in operating record
X	(4)	Surface water monitoring
X	(K)(1)	Leachate control
	(2)	Lift station back-up pumps
	(3)	Collection pipe network (inspection)
	(4)	Temporary leachate storage
X	(5)	Leachate treatment and disposal
X	(6)	Leachate storage/disposal contingency plan
X	(7)	Surface water monitoring
X	(L)	PCB and hazardous waste prevention and detection program

3745-37-01 License

X	(A)	Valid license

Corrective Actions Taken and Other Comments:

Hauled Cover, Synagro Hauled Leachate, Graded Roads
Small Ponding on Top From Rain, outBreak South West Slop, Erosion Cuts West Slop

Rob Carpenter — Signature of Person Completing Form

Rob Carpenter — Print Name of Person Completing Form

10-3-11 — Date

This form should be retained on file for three years for inspection by the local health department, Ohio EPA, or an authorized representative. Failure to provide accurate daily operations information may be considered a violation of Ohio Revised Code § 2921.13.

Leachate - 13'-10"

Sumps - 1 - 21.4
3 - 30.5
4 - 23.1

Revised: August 1, 2005

OhioEPA Municipal Solid Waste Landfill Facility Daily Log of Operations - Form 3

(Log Required by OAC 3745-27-19(E)(10))

Facility Name: Apex Environmental Today's Date: 10-03-11

Facility Opened Today at (time): _____ Facility Closed Today at (time): 6:30 pm

List Equipment in Operation at the Facility Today: Tipper IT, Algon, Komatsu

List Weather Conditions on this Day: Rain Slight to drizzle

The Facility Operator shall inspect the facility daily for compliance with the applicable regulations including but not limited to the following:

Place an (X) on the line next to all aspects of facility operations which have been inspected today.

3745-27-05 Prohibited Disposal Methods

___	(B)	No Open Burning

3745-27-19 Operation of a Facility

X	(E)(2)(a)	Maintain access roads
X	(b)	Limited access to facility
X	(c)	Signs posted
X	(d)	Exclusion of animals
X	(3)(a)	Adequate fire equipment
X	(b)	Operable and adequate equipment
X	(4)	Improper salvaging
X	(5)	Trained employees
X	(6)	Preparation for inclement weather
X	(7)(a)	Leachate treatment/disposal
X	(b)	Phased operation
X	(c)	Confined unloading
X	(d)	Separation/control of flammable waste
X	(e)	Waste disposed at working face
X	(f)(i)	Compacting bulky items
X	(ii)	Minimizing dust generation
	(8)(a)	NESHAP reg. asbestos disposal
	(b)	Acceptance of liquids
	(c)	Acceptance of hazardous waste
	(d)	Acceptance of PCBs
	(e)	Acceptance of infectious waste
	(f)	Acceptance of yard waste
	(g)	Acceptance of scrap tires
	(h)	Acceptance of low level rad. waste
	(i)	Acceptance of semi-solid material w/free liquid
X	(9)	Control of scattered litter
X	(10)	Keeping of daily logs
X	(11)(a)	Daily inspection of facility for ponding, erosion, leachate outbreaks (record any corrective actions below).
X	(12)	Copy of auth. does available
X	(F)	Daily cover
	(3)	Alternate Daily Cover Used (describe in comment section below)
	(G)	Intermediate cover
	(H)	Final cover
X	(I)	Scales
X	(J)(1)	Surface water diversion
X	(2)	Design in operating record
X	(4)	Surface water monitoring
X	(K)(1)	Leachate control
	(2)	Lift station back-up pumps
	(3)	Collection pipe network (inspection)
	(4)	Temporary leachate storage
X	(5)	Leachate treatment and disposal
X	(6)	Leachate storage/disposal contingency plan
X	(7)	Surface water monitoring
X	(L)	PCB and hazardous waste prevention and detection program

3745-37-01 License

X	(A)	Valid license

Corrective Actions Taken and Other Comments:

Signature of Person Completing Form — Dwane. E. Sims Sr. (Print Name of Person Completing Form) — 10-03-11 (Date)

This form should be retained on file for three years for inspection by the local health department, Ohio EPA, or an authorized representative. Failure to provide accurate daily operations information may be considered a violation of Ohio Revised Code § 2921.13.

Municipal Solid Waste Landfill Facility Daily Log of Operations - Form 3

(Log Required by OAC 3745-27-19(E)(10))

Facility Name: APEX ENVIRONMENTAL Today's Date: 10-6-11

Facility Opened Today at (time): 24HR Facility Closed Today at (time): _____

List Equipment in Operation at the Facility Today: TIPPER, ET, ALJON, 836, 345, 325 6, 7, 155

List Weather Conditions on this Day: CLEAR, TEMPS IN 70'S

The Facility Operator shall inspect the facility daily for compliance with the applicable regulations including but not limited to the following:

Place an (X) on the line next to all aspects of facility operations which have been inspected today.

3745-27-05 Prohibited Disposal Methods

X	(B)	No Open Burning

3745-27-19 Operation of a Facility

X	(E)(2)(a)	Maintain access roads
X	(b)	Limited access to facility
X	(c)	Signs posted
X	(d)	Exclusion of animals
X	(3)(a)	Adequate fire equipment
X	(b)	Operable and adequate equipment
X	(4)	Improper salvaging
X	(5)	Trained employees
X	(6)	Preparation for inclement weather
X	(7)(a)	Leachate treatment/disposal
X	(b)	Phased operation
X	(c)	Confined unloading
X	(d)	Separation/control of flammable waste
X	(e)	Waste disposed at working face
X	(f)(i)	Compacting bulky items
X	(ii)	Minimizing dust generation
	(8)(a)	NESHAP reg. asbestos disposal
	(b)	Acceptance of liquids
	(c)	Acceptance of hazardous waste
	(d)	Acceptance of PCBs
	(e)	Acceptance of infectious waste
	(f)	Acceptance of yard waste
	(g)	Acceptance of scrap tires
	(h)	Acceptance of low level rad. waste
	(i)	Acceptance of semi-solid material w/free liquid
X	(9)	Control of scattered litter
X	(10)	Keeping of daily logs
X	(11)(a)	Daily inspection of facility for ponding, erosion, leachate outbreaks (record any corrective actions below).
X	(12)	Copy of auth. docs available
X	(F)	Daily cover
	(3)	Alternate Daily Cover Used (describe in comment section below)
	(G)	Intermediate cover
	(H)	Final cover
X	(I)	Scales
X	(J)(1)	Surface water diversion
X	(2)	Design in operating record
X	(4)	Surface water monitoring
X	(K)(1)	Leachate control
	(2)	Lift station back-up pumps
	(3)	Collection pipe network (inspection)
	(4)	Temporary leachate storage
X	(5)	Leachate treatment and disposal
X	(6)	Leachate storage/disposal contingency plan
X	(7)	Surface water monitoring
X	(L)	PCB and hazardous waste prevention and detection program

3745-37-01 License

X	(A)	Valid license

Corrective Actions Taken and Other Comments:

PICKED LITTER, HAULED COVER, WATER ROADS, GRADED ROADS LEACHATE BREAKOUT ON SOUTHWEST SLOP & SOUTH SLOP TOP. FLAGGING ON NORTH EAST SLOP - NOTIFIED SUPERVISOR, SUPERVISOR HAD AREAS REPAIRED

Rob Carpenter — *Signature of Person Completing Form*

ROB CARPENTER — *Print Name of Person Completing Form*

10-6-11 — *Date*

This form should be retained on file for three years for inspection by the local health department, Ohio EPA, or an authorized representative. Failure to provide accurate daily operations information may be considered a violation of Ohio Revised Code § 2921.13.

LEACHATE - 11'3"

SUMPS - 1 - 16.5

3 - 40.3

4 - 20.1

Municipal Solid Waste Landfill Facility Daily Log of Operations - Form 3

(Log Required by OAC 3745-27-19(E)(10))

Facility Name: Apex Environmental Today's Date: 10-14-11

Facility Opened Today at (time): 24 hrs Facility Closed Today at (time): _____

List Equipment in Operation at the Facility Today: Tipper, FT, DB, D7, D6, 155, 328, 325, 836

List Weather Conditions on this Day: Rain Showers AM high 50's, Rain Showers PM

The Facility Operator shall inspect the facility daily for compliance with the applicable regulations including but not limited to the following:

Place an (X) on the line next to all aspects of facility operations which have been inspected today.

3745-27-05 Prohibited Disposal Methods

X	(B)	No Open Burning

3745-27-19 Operation of a Facility

X	(E)(2)(a)	Maintain access roads
X	(b)	Limited access to facility
X	(c)	Signs posted
X	(d)	Exclusion of animals
X	(3)(a)	Adequate fire equipment
X	(b)	Operable and adequate equipment
X	(4)	Improper salvaging
X	(5)	Trained employees
X	(6)	Preparation for inclement weather
X	(7)(a)	Leachate treatment/disposal
X	(b)	Phased operation
X	(c)	Confined unloading
X	(d)	Separation/control of flammable waste
X	(e)	Waste disposed at working face
X	(f)(i)	Compacting bulky items
X	(ii)	Minimizing dust generation
—	(8)(a)	NESHAP reg. asbestos disposal
—	(b)	Acceptance of liquids
—	(c)	Acceptance of hazardous waste
—	(d)	Acceptance of PCBs
—	(e)	Acceptance of infectious waste
—	(f)	Acceptance of yard waste
—	(g)	Acceptance of scrap tires
—	(h)	Acceptance of low level rad. waste
—	(i)	Acceptance of semi-solid material w/free liquid
X	(9)	Control of scattered litter
X	(10)	Keeping of daily logs
X	(11)(a)	Daily inspection of facility for ponding, erosion, leachate outbreaks (record any corrective actions below).
X	(12)	Copy of auth. docs available
X	(F)	Daily cover
—	(3)	Alternate Daily Cover Used (describe in comment section below)
—	(G)	Intermediate cover
—	(H)	Final cover
X	(I)	Scales
X	(J)(1)	Surface water diversion
X	(2)	Design in operating record
X	(4)	Surface water monitoring
X	(K)(1)	Leachate control
—	(2)	Lift station back-up pumps
—	(3)	Collection pipe network (inspection)
—	(4)	Temporary leachate storage
X	(5)	Leachate treatment and disposal
X	(6)	Leachate storage/disposal contingency plan
X	(7)	Surface water monitoring
X	(L)	PCB and hazardous waste prevention and detection program

3745-37-01 License

X	(A)	Valid license

Corrective Actions Taken and Other Comments:

hauling cover, Rail & dozd the roads, grading road to cell

Daniel L Bushnell — *Signature of Person Completing Form*

Daniel L Bushnell — *Print Name of Person Completing Form*

10-14-11 — *Date*

This form should be retained on file for three years for inspection by the local health department, Ohio EPA, or an authorized representative. Failure to provide accurate daily operations information may be considered a violation of Ohio Revised Code § 2921.13.

Leachate Tank 14' 6"

Sumps 3-23.6
1-23.9
4-16.14

Municipal Solid Waste Landfill Facility Daily Log of Operations - Form 3

(Log Required by OAC 3745-27-19(E)(10))

Facility Name: APEX ENVIRONMENTAL Today's Date: 10-21-11

Facility Opened Today at (time): 2 PM Facility Closed Today at (time): _____

List Equipment in Operation at the Facility Today: TIPPER, FT, 836, 345, 325, 6, 7, 153

List Weather Conditions on this Day: cloudy light RAIN - Temps in 40's

The Facility Operator shall inspect the facility daily for compliance with the applicable regulations including but not limited to the following:

Place an (X) on the line next to all aspects of facility operations which have been inspected today.

3745-27-05 Prohibited Disposal Methods

X	(B)	No Open Burning

3745-27-19 Operation of a Facility

X	(E)(2)(a)	Maintain access roads
X	(b)	Limited access to facility
X	(c)	Signs posted
X	(d)	Exclusion of animals
X	(3)(a)	Adequate fire equipment
X	(b)	Operable and adequate equipment
X	(4)	Improper salvaging
X	(5)	Trained employees
X	(6)	Preparation for inclement weather
X	(7)(a)	Leachate treatment/disposal
X	(b)	Phased operation
X	(c)	Confined unloading
X	(d)	Separation/control of flammable waste
X	(e)	Waste disposed at working face
X	(f)(i)	Compacting bulky items
X	(ii)	Minimizing dust generation
	(8)(a)	NESHAP reg. asbestos disposal
	(b)	Acceptance of liquids
	(c)	Acceptance of hazardous waste
	(d)	Acceptance of PCBs
	(e)	Acceptance of infectious waste
	(f)	Acceptance of yard waste
	(g)	Acceptance of scrap tires
	(h)	Acceptance of low level rad. waste
	(i)	Acceptance of semi-solid material w/free liquid
X	(9)	Control of scattered litter
X	(10)	Keeping of daily logs
X	(11)(a)	Daily inspection of facility for ponding, erosion, leachate outbreaks (record any corrective actions below).
X	(12)	Copy of auth. does available
X	(F)	Daily cover
	(3)	Alternate Daily Cover Used (describe in comment section below)
	(G)	Intermediate cover
	(H)	Final cover
X	(I)	Scales
X	(J)(1)	Surface water diversion
X	(2)	Design in operating record
X	(4)	Surface water monitoring
X	(K)(1)	Leachate control
	(2)	Lift station back-up pumps
	(3)	Collection pipe network (inspection)
	(4)	Temporary leachate storage
X	(5)	Leachate treatment and disposal
X	(6)	Leachate storage/disposal contingency plan
X	(7)	Surface water monitoring
X	(L)	PCB and hazardous waste prevention and detection program

3745-37-01 License

X	(A)	Valid license

Corrective Actions Taken and Other Comments:

Picked LITTER, Hauled Cover, SWAGRO Hauled LEACHATE, Grading Roads Graveling Hills, GAS Bubbles on North Slop + West Slop, slight Ponding on East Supervisors notified. STARTING To Repair Today

Rob Carpenter — Signature of Person Completing Form

ROB CARPENTER — Print Name of Person Completing Form

10-21-11 — Date

This form should be retained on file for three years for inspection by the local health department, Ohio EPA, or an authorized representative. Failure to provide accurate daily operations information may be considered a violation of Ohio Revised Code § 2921.13.

LEACHATE - 14' 6"

Sumps - 1 - 20.5
3 - 36.6
4 - 22.2

Municipal Solid Waste Landfill Facility Daily Log of Operations - Form 3

(Log Required by OAC 3745-27-19(E)(10))

Facility Name: APEX ENVIRONMENTAL Today's Date: 10-28-11

Facility Opened Today at (time): 24HR Facility Closed Today at (time): _____

List Equipment in Operation at the Facility Today: TIMBER JT, 836, 345, 166, 325, 6, 7 Grader

List Weather Conditions on this Day: PARTLY cloudy Temps in 50's

The Facility Operator shall inspect the facility daily for compliance with the applicable regulations including but not limited to the following:

Place an (X) on the line next to all aspects of facility operations which have been inspected today.

3745-27-05 Prohibited Disposal Methods

X	(B)	No Open Burning

3745-27-19 Operation of a Facility

X	(E)(2)(a)	Maintain access roads
X	(b)	Limited access to facility
X	(c)	Signs posted
X	(d)	Exclusion of animals
X	(3)(a)	Adequate fire equipment
X	(b)	Operable and adequate equipment
X	(4)	Improper salvaging
X	(5)	Trained employees
X	(6)	Preparation for inclement weather
X	(7)(a)	Leachate treatment/disposal
X	(b)	Phased operation
X	(c)	Confined unloading
X	(d)	Separation/control of flammable waste
X	(e)	Waste disposed at working face
X	(f)(i)	Compacting bulky items
X	(ii)	Minimizing dust generation
	(8)(a)	NESHAP reg. asbestos disposal
	(b)	Acceptance of liquids
	(c)	Acceptance of hazardous waste
	(d)	Acceptance of PCBs
	(e)	Acceptance of infectious waste
	(f)	Acceptance of yard waste
	(g)	Acceptance of scrap tires
	(h)	Acceptance of low level rad. waste
	(i)	Acceptance of semi-solid material w/free liquid
X	(9)	Control of scattered litter
X	(10)	Keeping of daily logs
X	(11)(a)	Daily inspection of facility for ponding, erosion, leachate outbreaks (record any corrective actions below).
X	(12)	Copy of auth. does available
X	(F)	Daily cover
	(3)	Alternate Daily Cover Used (describe in comment section below)
	(G)	Intermediate cover
	(H)	Final cover
X	(I)	Scales
X	(J)(1)	Surface water diversion
X	(2)	Design in operating record
X	(4)	Surface water monitoring
X	(K)(1)	Leachate control
	(2)	Lift station back-up pumps
	(3)	Collection pipe network (inspection)
	(4)	Temporary leachate storage
X	(5)	Leachate treatment and disposal
X	(6)	Leachate storage/disposal contingency plan
X	(7)	Surface water monitoring
X	(L)	PCB and hazardous waste prevention and detection program

3745-37-01 License

X	(A)	Valid license

Corrective Actions Taken and Other Comments:

Hauled cover, Hauled Leachate, Graded Roads, Drilling Holes for new GAS wells on EAST Slop- GAS & LEACHATE out Break low on EAST Slop Foreman Notified - (Repaired)

RB Carpenter — Signature of Person Completing Form

RB CARPENTER — Print Name of Person Completing Form

10-28-11 — Date

This form should be retained on file for three years for inspection by the local health department, Ohio EPA, or an authorized representative. Failure to provide accurate daily operations information may be considered a violation of Ohio Revised Code § 2921.13.

LEACHATE - 16.5"

Sumps - 1 - 19.8

3 - 41.3

4 - 20.8

Revised: August 1, 2005

OhioEPA **Municipal Solid Waste Landfill Facility Daily Log of Operations - Form 3**
(Log Required by OAC 3745-27-19(E)(10))

Facility Name: APEX ENVIRONMENTAL Today's Date: 12-5-11
Facility Opened Today at (time): 24 HR Facility Closed Today at (time):
List Equipment in Operation at the Facility Today: Tipper, ET, 155V, 165S, Allen, 3X5, 3D, 6, 7, 8
List Weather Conditions on this Day: Cloudy and off Rain

The Facility Operator shall inspect the facility daily for compliance with the applicable regulations including but not limited to the following:

Place an (X) on the line next to all aspects of facility operations which have been inspected today.

3745-27-05 Prohibited Disposal Methods

Mark	Item	Description
X	(B)	No Open Burning

3745-27-19 Operation of a Facility

Mark	Item	Description
X	(E)(2)(a)	Maintain access roads
X	(b)	Limited access to facility
X	(c)	Signs posted
X	(d)	Exclusion of animals
X	(3)(a)	Adequate fire equipment
X	(b)	Operable and adequate equipment
X	(4)	Improper salvaging
X	(5)	Trained employees
X	(6)	Preparation for inclement weather
X	(7)(a)	Leachate treatment/disposal
X	(b)	Phased operation
X	(c)	Confined unloading
X	(d)	Separation/control of flammable waste
X	(e)	Waste disposed at working face
X	(f)(i)	Compacting bulky items
X	(ii)	Minimizing dust generation
	(8)(a)	NESHAP reg. asbestos disposal
	(b)	Acceptance of liquids
	(c)	Acceptance of hazardous waste
	(d)	Acceptance of PCBs
	(e)	Acceptance of infectious waste
	(f)	Acceptance of yard waste
	(g)	Acceptance of scrap tires
	(h)	Acceptance of low level rad. waste
	(i)	Acceptance of semi-solid material w/free liquid
X	(9)	Control of scattered litter
X	(10)	Keeping of daily logs
X	(11)(a)	Daily inspection of facility for ponding, erosion, leachate outbreaks (record any corrective actions below).
X	(12)	Copy of auth. docs available
X	(F)	Daily cover
	(3)	Alternate Daily Cover Used (describe in comment section below)
	(G)	Intermediate cover
	(H)	Final cover
X	(I)	Scales
X	(J)(1)	Surface water diversion
X	(2)	Design in operating record
X	(4)	Surface water monitoring
X	(K)(1)	Leachate control
	(2)	Lift station back-up pumps
	(3)	Collection pipe network (inspection)
	(4)	Temporary leachate storage
X	(5)	Leachate treatment and disposal
X	(6)	Leachate storage/disposal contingency plan
X	(7)	Surface water monitoring
X	(L)	PCB and hazardous waste prevention and detection program

3745-37-01 License

Mark	Item	Description
X	(A)	Valid license

Corrective Actions Taken and Other Comments:
Hauled cover, Hauled Leachate, Grading & Graveling Roads

[signature] — Signature of Person Completing Form
ROB CARPENTER — Print Name of Person Completing Form
12-5-11 — Date

This form should be retained on file for three years for inspection by the local health department, Ohio EPA, or an authorized representative. Failure to provide accurate daily operations information may be considered a violation of Ohio Revised Code § 2921.13.

LEACHATE - 3'-10"   Sumps 1 - 23.4
3 - 14.2
4 - 19.0

OhioEPA Municipal Solid Waste Landfill Facility Daily Log of Operations - Form 3

(Log Required by OAC 3745-27-19(E)(10))

Facility Name: Apex Environmental Today's Date: 12-6-11

Facility Opened Today at (time): 24 HR Facility Closed Today at (time): _____

List Equipment in Operation at the Facility Today: Tipper, ET, Dozer, 836, 345, 328, 6, 7 8, 153

List Weather Conditions on this Day: Cloudy - Temps in 40's

The Facility Operator shall inspect the facility daily for compliance with the applicable regulations including but not limited to the following:

Place an (X) on the line next to all aspects of facility operations which have been inspected today.

3745-27-05 Prohibited Disposal Methods

- X (B) No Open Burning

3745-27-19 Operation of a Facility

- X (E)(2)(a) Maintain access roads
- X (b) Limited access to facility
- X (c) Signs posted
- X (d) Exclusion of animals
- X (3)(a) Adequate fire equipment
- X (b) Operable and adequate equipment
- X (4) Improper salvaging
- X (5) Trained employees
- X (6) Preparation for inclement weather
- X (7)(a) Leachate treatment/disposal
- X (b) Phased operation
- X (c) Confined unloading
- X (d) Separation/control of flammable waste
- X (e) Waste disposed at working face
- X (J)(i) Compacting bulky items
- X (ii) Minimizing dust generation
- (8)(a) NESHAP reg. asbestos disposal
- (b) Acceptance of liquids
- (c) Acceptance of hazardous waste
- (d) Acceptance of PCBs
- (e) Acceptance of infectious waste
- (f) Acceptance of yard waste
- (g) Acceptance of scrap tires
- (h) Acceptance of low level rad. waste
- (I) Acceptance of semi-solid material w/free liquid
- X (9) Control of scattered litter
- X (10) Keeping of daily logs
- X (11)(a) Daily inspection of facility for ponding, erosion, leachate outbreaks (record any corrective actions below).
- X (12) Copy of auth. does available
- X (F) Daily cover
- (3) Alternate Daily Cover Used (describe in comment section below)
- (G) Intermediate cover
- (H) Final cover
- X (I) Scales
- X (J)(1) Surface water diversion
- X (2) Design in operating record
- X (4) Surface water monitoring
- X (K)(1) Leachate control
- (2) Lift station back-up pumps
- (3) Collection pipe network (inspection)
- (4) Temporary leachate storage
- X (5) Leachate treatment and disposal
- X (6) Leachate storage/disposal contingency plan
- X (7) Surface water monitoring
- X (L) PCB and hazardous waste prevention and detection program

3745-37-01 License

- X (A) Valid license

Corrective Actions Taken and Other Comments:

Hauled Cover, Hauled Leachate, Grading & Grading Roads, Installing New Gas Lines, Surface Scanning 5b/25, Repairing Rails at North end of Rail

RB Carpenter — *Signature of Person Completing Form*

ROB CARPENTER — *Print Name of Person Completing Form*

12-6-11 — *Date*

This form should be retained on file for three years for inspection by the local health department, Ohio EPA, or an authorized representative. Failure to provide accurate daily operations information may be considered a violation of Ohio Revised Code § 2921.13.

Leachate - 2 | 5 11

Sumps - 1 - 23.2
3 - 16.3
4 - 21.4

Municipal Solid Waste Landfill Facility Daily Log of Operations - Form 3

(Log Required by OAC 3745-27-19(E)(10))

Facility Name: APEX ENVIRONMENTAL Today's Date: 12-7-11

Facility Opened Today at (time): 24th Facility Closed Today at (time): _____

List Equipment in Operation at the Facility Today: TIPPER, IT, AJAX, 856, 345, 325, 6, 7 & 155

List Weather Conditions on this Day: out of Rain Temps in 40's

The Facility Operator shall inspect the facility daily for compliance with the applicable regulations including but not limited to the following:

Place an (X) on the line next to all aspects of facility operations which have been inspected today.

3745-27-05 Prohibited Disposal Methods

X (B) No Open Burning

3745-27-19 Operation of a Facility

X (E)(2)(a) Maintain access roads
X (b) Limited access to facility
X (c) Signs posted
X (d) Exclusion of animals
X (3)(a) Adequate fire equipment
X (b) Operable and adequate equipment
X (4) Improper salvaging
X (5) Trained employees
X (6) Preparation for inclement weather
X (7)(a) Leachate treatment/disposal
X (b) Phased operation
X (c) Confined unloading
X (d) Separation/control of flammable waste
X (e) Waste disposed at working face
X (i)(I) Compacting bulky items
X (ii) Minimizing dust generation
(8)(a) NESHAP reg. asbestos disposal
(b) Acceptance of liquids
(c) Acceptance of hazardous waste
(d) Acceptance of PCBs
(e) Acceptance of infectious waste
(f) Acceptance of yard waste
(g) Acceptance of scrap tires
(h) Acceptance of low level rad. waste
(I) Acceptance of semi-solid material w/free liquid
X (9) Control of scattered litter
X (10) Keeping of daily logs
X (11)(a) Daily inspection of facility for ponding, erosion, leachate outbreaks (record any corrective actions below).
X (12) Copy of auth. does available
X (F) Daily cover
(3) Alternate Daily Cover Used (describe in comment section below)
(G) Intermediate cover
(H) Final cover
X (I) Scales
X (J)(1) Surface water diversion
X (2) Design in operating record
X (4) Surface water monitoring
X (K)(1) Leachate control
(2) Lift station back-up pumps
(3) Collection pipe network (inspection)
(4) Temporary leachate storage
X (5) Leachate treatment and disposal
X (6) Leachate storage/disposal contingency plan
X (7) Surface water monitoring
X (L) PCB and hazardous waste prevention and detection program

3745-37-01 License

X (A) Valid license

Corrective Actions Taken and Other Comments:

Hauled Cover, Hauled Leachate, Grading & Graveling Hills, Installing Lines for New Gas System

RJ Carpenter — *Signature of Person Completing Form*

RJ Carpenter — *Print Name of Person Completing Form*

12-7-11 — *Date*

This form should be retained on file for three years for inspection by the local health department, Ohio EPA, or an authorized representative. Failure to provide accurate daily operations information may be considered a violation of Ohio Revised Code § 2921.13.

LEACHATE - 2.8"

Sumps 1 - 18.9

3 -

4 - 23.3

Revised: August 1, 2005

Municipal Solid Waste Landfill Facility Daily Log of Operations - Form 3

(Log Required by OAC 3745-27-19(E)(10))

Facility Name: Apex Environmental Today's Date: 12-8-11

Facility Opened Today at (time): 24 hr Facility Closed Today at (time): _____

List Equipment in Operation at the Facility Today: Tipper, ET, Aljon, 345, 325, 6, 7, 155 U

List Weather Conditions on this Day: Clear - Temps in Low 40's

The Facility Operator shall inspect the facility daily for compliance with the applicable regulations including but not limited to the following:

Place an (X) on the line next to all aspects of facility operations which have been inspected today.

3745-27-05 Prohibited Disposal Methods

X	(B)	No Open Burning

3745-27-19 Operation of a Facility

X	(E)(2)(a)	Maintain access roads
X	(b)	Limited access to facility
X	(c)	Signs posted
X	(d)	Exclusion of animals
X	(3)(a)	Adequate fire equipment
X	(b)	Operable and adequate equipment
X	(4)	Improper salvaging
X	(5)	Trained employees
X	(6)	Preparation for inclement weather
X	(7)(a)	Leachate treatment/disposal
X	(b)	Phased operation
X	(c)	Confined unloading
X	(d)	Separation/control of flammable waste
X	(e)	Waste disposed at working face
X	(I)(i)	Compacting bulky items
X	(ii)	Minimizing dust generation
	(8)(a)	NESHAP reg. asbestos disposal
	(b)	Acceptance of liquids
	(c)	Acceptance of hazardous waste
	(d)	Acceptance of PCBs
	(e)	Acceptance of infectious waste
	(f)	Acceptance of yard waste
	(g)	Acceptance of scrap tires
	(h)	Acceptance of low level rad. waste
	(i)	Acceptance of semi-solid material w/free liquid
X	(9)	Control of scattered litter
X	(10)	Keeping of daily logs
X	(11)(a)	Daily inspection of facility for ponding, erosion, leachate outbreaks (record any corrective actions below).
X	(12)	Copy of auth. does available
X	(F)	Daily cover
X	(3)	Alternate Daily Cover Used (describe in comment section below)
	(G)	Intermediate cover
	(H)	Final cover
X	(I)	Scales
X	(J)(1)	Surface water diversion
X	(2)	Design in operating record
X	(4)	Surface water monitoring
X	(K)(1)	Leachate control
	(2)	Lift station back-up pumps
	(3)	Collection pipe network (inspection)
	(4)	Temporary leachate storage
X	(5)	Leachate treatment and disposal
X	(6)	Leachate storage/disposal contingency plan
X	(7)	Surface water monitoring
X	(L)	PCB and hazardous waste prevention and detection program

3745-37-01 License

X	(A)	Valid license

Corrective Actions Taken and Other Comments:

Hauled Cover, Added Cover Dirt To East Slope, working on New Gas Lines on West Slope

Signature of Person Completing Form — Rob Carpenter — Print Name of Person Completing Form — 12-8-11 — Date

This form should be retained on file for three years for inspection by the local health department, Ohio EPA, or an authorized representative. Failure to provide accurate daily operations information may be considered a violation of Ohio Revised Code § 2921.13.

Leachate - 1'-10"

Sumps 1- 20.1

3- 13.6

4- 23.1

OhioEPA Municipal Solid Waste Landfill Facility Daily Log of Operations - Form 3

(Log Required by OAC 3745-27-19(E)(10))

Facility Name: APEX Environmental Today's Date: 12-9-11

Facility Opened Today at (time): 2nd Facility Closed Today at (time): _____

List Equipment in Operation at the Facility Today: Tipper, ET, AJ 80, 836, 345, 325 6, 7, 8, 154

List Weather Conditions on this Day: Clear - Temps in 40's

The Facility Operator shall inspect the facility daily for compliance with the applicable regulations including but not limited to the following:

Place an (X) on the line next to all aspects of facility operations which have been inspected today.

3745-27-05 Prohibited Disposal Methods

X (B) No Open Burning

3745-27-19 Operation of a Facility

X (E)(2)(a) Maintain access roads
X (b) Limited access to facility
X (c) Signs posted
X (d) Exclusion of animals
X (3)(a) Adequate fire equipment
X (b) Operable and adequate equipment
X (4) Improper salvaging
X (5) Trained employees
X (6) Preparation for inclement weather
X (7)(a) Leachate treatment/disposal
— (b) Phased operation
X (c) Confined unloading
X (d) Separation/control of flammable waste
X (e) Waste disposed at working face
X (f)(i) Compacting bulky items
X (ii) Minimizing dust generation
X (8)(a) NESHAP reg. asbestos disposal
— (b) Acceptance of liquids
— (c) Acceptance of hazardous waste
— (d) Acceptance of PCBs
— (e) Acceptance of infectious waste
— (f) Acceptance of yard waste
— (g) Acceptance of scrap tires
— (h) Acceptance of low level rad. waste
— (I) Acceptance of semi-solid material w/free liquid
X (9) Control of scattered litter
X (10) Keeping of daily logs
X (11)(a) Daily inspection of facility for ponding, erosion, leachate outbreaks (record any corrective actions below).
X (12) Copy of auth. does available
X (F) Daily cover
— (3) Alternate Daily Cover Used (describe in comment section below)
— (G) Intermediate cover
— (H) Final cover
X (I) Scales
X (J)(1) Surface water diversion
X (2) Design in operating record
X (4) Surface water monitoring
X (K)(1) Leachate control
— (2) Lift station back-up pumps
— (3) Collection pipe network (inspection)
— (4) Temporary leachate storage
X (5) Leachate treatment and disposal
X (6) Leachate storage/disposal contingency plan
X (7) Surface water monitoring
X (L) PCB and hazardous waste prevention and detection program

3745-37-01 License

X (A) Valid license

Corrective Actions Taken and Other Comments:

Picked Litter, Hauled Cover, installing new gas line on East Slope

R.B. Carpenter — *Signature of Person Completing Form*

R.B. Carpenter — *Print Name of Person Completing Form*

12-9-11 — *Date*

This form should be retained on file for three years for inspection by the local health department, Ohio EPA, or an authorized representative. Failure to provide accurate daily operations information may be considered a violation of Ohio Revised Code § 2921.13.

Leachate - 2'-2"

Sumps 1 - 23.6
3 - -16
4 - 2.01

Revised August 1, 2005

Municipal Solid Waste Landfill Facility Daily Log of Operations - Form 3

(Log Required by OAC 3745-27-19(E)(10))

Facility Name: Apex Environmental LLC Today's Date: 12-10-11

Facility Opened Today at (time): 24 hrs Facility Closed Today at (time): _____

List Equipment in Operation at the Facility Today: 155, 328, 836, 135, Tipper, Material handler, T.T, D6T, D7R

List Weather Conditions on this Day: Low 20's am clear cold to Low 30's pm

The Facility Operator shall inspect the facility daily for compliance with the applicable regulations including but not limited to the following:

Place an (X) on the line next to all aspects of facility operations which have been inspected today.

3745-27-05 Prohibited Disposal Methods

X (B) No Open Burning

3745-27-19 Operation of a Facility

X (E)(2)(a) Maintain access roads
X (b) Limited access to facility
X (c) Signs posted
X (d) Exclusion of animals
X (3)(a) Adequate fire equipment
X (b) Operable and adequate equipment
X (4) Improper salvaging
X (5) Trained employees
X (6) Preparation for inclement weather
X (7)(a) Leachate treatment/disposal
X (b) Phased operation
X (c) Confined unloading
X (d) Separation/control of flammable waste
X (e) Waste disposed at working face
X (i)(I) Compacting bulky items
X (ii) Minimizing dust generation
— (8)(a) NESHAP reg. asbestos disposal
— (b) Acceptance of liquids
— (c) Acceptance of hazardous waste
— (d) Acceptance of PCBs
— (e) Acceptance of infectious waste
— (f) Acceptance of yard waste
— (g) Acceptance of scrap tires
— (h) Acceptance of low level rad. waste
— (I) Acceptance of semi-solid material w/free liquid
X (9) Control of scattered litter
X (10) Keeping of daily logs
X (11)(a) Daily inspection of facility for ponding, erosion, leachate outbreaks (record any corrective actions below).
X (12) Copy of auth. does available
X (F) Daily cover
— (3) Alternate Daily Cover Used (describe in comment section below)
— (G) Intermediate cover
— (H) Final cover
X (I) Scales
X (J)(1) Surface water diversion
X (2) Design in operating record
X (4) Surface water monitoring
X (K)(1) Leachate control
— (2) Lift station back-up pumps
— (3) Collection pipe network (inspection)
— (4) Temporary leachate storage
X (5) Leachate treatment and disposal
X (6) Leachate storage/disposal contingency plan
X (7) Surface water monitoring
X (L) PCB and hazardous waste prevention and detection program

3745-37-01 License

X (A) Valid license

Corrective Actions Taken and Other Comments:

Rail and over the roads running, hauling cover, covering

Daniel L Bedquell Daniel L Bedquell 12-10-11

Signature of Person Completing Form *Print Name of Person Completing Form* *Date*

This form should be retained on file for three years for inspection by the local health department, Ohio EPA, or an authorized representative. Failure to provide accurate daily operations information may be considered a violation of Ohio Revised Code § 2921.13.

Leachate 2' 3" TANK

Sumps 3 - 24.5
1 - 23.8
4 - 21.6

Ohio EPA Municipal Solid Waste Landfill Facility Daily Log of Operations - Form 3

(Log Required by OAC 3745-27-19(E)(7)(i))

Facility Name: Apex Environmental Today's Date: 12-11-11

Facility Opened Today at (time): 24 hrs Facility Closed Today at (time): _____

List Equipment in Operation at the Facility Today: D6T, Tipper, 155, 320, IT, Material handler 328

List Weather Conditions on this Day: Mid Town rain

The Facility Operator shall inspect the facility daily for compliance with the applicable regulations including but not limited to the following:

Place an (X) on the line next to all aspects of facility operations which have been inspected today.

3745-27-05 Prohibited Disposal Methods

X (B) No Open Burning

3745-27-19 Operation of a Facility

X (E)(2)(a) Maintain access roads
X (b) Limited access to facility
X (c) Signs posted
X (d) Exclusion of animals
X (3)(a) Adequate fire equipment
X (b) Operable and adequate equipment
X (4) Improper salvaging
X (5) Trained employees
X (6) Preparation for inclement weather
X (7)(a) Leachate treatment/disposal
X (b) Phased operation
X (c) Confined unloading
X (d) Separation/control of flammable waste
X (e) Waste disposed at working face
X (f)(i) Compacting bulky items
X (ii) Minimizing dust generation
X (8)(a) NESHAP reg. asbestos disposal
X (b) Acceptance of liquids
X (c) Acceptance of hazardous waste
X (d) Acceptance of PCBs
X (e) Acceptance of infectious waste
X (f) Acceptance of yard waste
X (g) Acceptance of scrap tires
X (h) Acceptance of low level rad. waste
X (i) Acceptance of semi-solid material w/free liquid
X (9) Control of scattered litter
X (10) Keeping of daily logs
X (11)(a) Daily inspection of facility for ponding, erosion, leachate outbreaks (record any corrective actions below).
X (12) Copy of auth. does available
X (F) Daily cover
X (3) Alternate Daily Cover Used (describe in comment section below)
X (G) Intermediate cover
X (H) Final cover
X (I) Scales
X (J)(1) Surface water diversion
X (2) Design in operating record
X (4) Surface water monitoring
X (K)(1) Leachate control
X (2) Lift station back-up pumps
X (3) Collection pipe network (inspection)
X (4) Temporary leachate storage
X (5) Leachate treatment and disposal
X (6) Leachate storage/disposal contingency plan
X (7) Surface water monitoring
X (L) PCB and hazardous waste prevention and detection program

3745-37-01 License

X (A) Valid license

Corrective Actions Taken and Other Comments:

Rail and over threads running, hauling cover, covering, working on roads.

Daniel L Bradwell — *Signature of Person Completing Form*

Daniel L Bradwell — *Print Name of Person Completing Form*

12-11-11 — *Date*

This form should be retained on file for three years for inspection by the local health department, Ohio EPA, or an authorized representative. Failure to provide accurate daily operations information may be considered a violation of Ohio Revised Code § 2921.13.

Leachate Tank 2' 6"

Sumps 3 - 13.8 turned off
1 - 19.1
4 - 21.8

Revised: August 1, 2005

Municipal Solid Waste Landfill Facility Daily Log of Operations - Form 3

(Log Required by OAC 3745-27-19(E)(10))

Facility Name: Alex Environmental Today's Date: 12-19-11

Facility Opened Today at (time): 24th Facility Closed Today at (time): _____

List Equipment in Operation at the Facility Today: Tipper, D7, Allow, 155, 345, 325 6, 7

List Weather Conditions on this Day: Cloudy Temps in 40's

The Facility Operator shall inspect the facility daily for compliance with the applicable regulations including but not limited to the following:

Place an (X) on the line next to all aspects of facility operations which have been inspected today.

3745-27-05 Prohibited Disposal Methods

- X (B) No Open Burning

3745-27-19 Operation of a Facility

- X (E)(3)(a) ~~Maintain access roads~~
- X (b) Limited access to facility
- X (c) Signs posted
- X (d) Exclusion of animals
- X (3)(a) Adequate fire equipment
- X (b) Operable and adequate equipment
- X (4) ~~Improper salvaging~~
- X (5) Trained employees
- X (6) Preparation for inclement weather
- X (7)(a) Leachate treatment/disposal
- X (b) Phased operation
- X (c) Confined unloading
- X (d) Separation/control of flammable waste
- X (e) Waste disposed at working face
- X (I)(i) Compacting bulky items
- X (ii) Minimizing dust generation
- X (8)(a) NESHAP reg. asbestos disposal
- — (b) Acceptance of liquids
- — (c) Acceptance of hazardous waste
- — (d) Acceptance of PCBs
- — (e) Acceptance of infectious waste
- — (f) Acceptance of yard waste
- — (g) Acceptance of scrap tires
- — (h) Acceptance of low level rad. waste
- — (i) Acceptance of semi-solid material w/free liquid
- X (9) Control of scattered litter
- X (10) Keeping of daily logs
- X (11)(a) Daily inspection of facility for ponding, erosion, leachate outbreaks (record any corrective actions below)
- X (12) Copy of auth. does available
- X (F) Daily cover
- — (3) Alternate Daily Cover Used (describe in comment section below)
- — (G) Intermediate cover
- — (H) Final cover
- X (I) Scales
- X (J)(1) Surface water diversion
- X (2) Design in operating record
- X (4) Surface water monitoring
- X (K)(1) Leachate control
- — (2) Lift station back-up pumps
- — (3) Collection pipe network (inspection)
- — (4) Temporary leachate storage
- X (5) Leachate treatment and disposal
- X (6) Leachate storage/disposal contingency plan
- X (7) Surface water monitoring
- X (L) PCB and hazardous waste prevention and detection program

3745-37-01 License

- X (A) Valid license

Corrective Actions Taken and Other Comments:

Hauled Cover, Hauled Leachate, Reg. Installing new Gas Lines Grading Roads

Rob Carpenter ROB CARPENTER 12-19-11

Signature of Person Completing Form *Print Name of Person Completing Form* *Date*

This form should be retained on file for three years for inspection by the local health department, Ohio EPA, or an authorized representative. Failure to provide accurate daily operations information may be considered a violation of Ohio Revised Code § 2921.13.

Leachate - 11-2' Sumps - 1 - 18.5

3 - 56.0

4 - 23.1

Municipal Solid Waste Landfill Facility Daily Log of Operations - Form 3

(Log Required by OAC 3745-27-19(E)(10))

Facility Name: APEX ENVIRONMENTAL Today's Date: 1-3-12

Facility Opened Today at (time): 7 AM Facility Closed Today at (time): _____

List Equipment in Operation at the Facility Today: TIPPER, IT, MAT. HANDLER, 836, 845, 153, 6, 7, 328

List Weather Conditions on this Day: Cloudy - Light Snow - Temps in 20's

The Facility Operator shall inspect the facility daily for compliance with the applicable regulations including but not limited to the following:

Place an (X) on the line next to all aspects of facility operations which have been inspected today.

3745-27-05 Prohibited Disposal Methods

X (B) No Open Burning

3745-27-19 Operation of a Facility

X (E)(2)(a) Maintain access roads
X (b) Limited access to facility
X (c) Signs posted
X (d) Exclusion of animals
X (3)(a) Adequate fire equipment
X (b) Operable and adequate equipment
X (4) Improper salvaging
X (5) Trained employees
X (6) Preparation for inclement weather
X (7)(a) Leachate treatment/disposal
X (b) Phased operation
X (c) Confined unloading
X (d) Separation/control of flammable waste
X (e) Waste disposed at working face
X (f)(i) Compacting bulky items
X (ii) Minimizing dust generation
X (8)(a) NESHAP reg. asbestos disposal
— (b) Acceptance of liquids
— (c) Acceptance of hazardous waste
— (d) Acceptance of PCBs
— (e) Acceptance of infectious waste
— (f) Acceptance of yard waste
— (g) Acceptance of scrap tires
— (h) Acceptance of low level rad. waste
— (i) Acceptance of semi-solid material w/free liquid
X (9) Control of scattered litter
X (10) Keeping of daily logs
X (11)(a) Daily inspection of facility for ponding, erosion, leachate outbreaks (record any corrective actions below).
X (12) Copy of auth. docs available
X (F) Daily cover
— (3) Alternate Daily Cover Used (describe in comment section below)
— (G) Intermediate cover
— (H) Final cover
X (I) Scales
X (J)(1) Surface water diversion
X (2) Design in operating record
X (4) Surface water monitoring
X (K)(1) Leachate control
— (2) Lift station back-up pumps
— (3) Collection pipe network (inspection)
— (4) Temporary leachate storage
X (5) Leachate treatment and disposal
X (6) Leachate storage/disposal contingency plan
X (7) Surface water monitoring
X (L) PCB and hazardous waste prevention and detection program

3745-37-01 License

X (A) Valid license

Corrective Actions Taken and Other Comments:

HAULED COVER, HAULED LEACHATE. A.E.G. INSTALLING NEW GAS LINES
3 LEACHATE OUT BREAKS ON WEST SLOPE - (SCHEDULED EQUIPMENT NOW TO FIX)

Rob Carpenter — *Signature of Person Completing Form*

ROB CARPENTER — *Print Name of Person Completing Form*

1-3-12 — *Date*

This form should be retained on file for three years for inspection by the local health department, Ohio EPA, or an authorized representative. Failure to provide accurate daily operations information may be considered a violation of Ohio Revised Code § 2921.13.

LEACHATE - 11'-1"

SUMPS 1 - 23.0
3 - 17.1
4 - 18.5

Municipal Solid Waste Landfill Facility Daily Log of Operations - Form 3

(Log Required by OAC 3745-27-19(E)(10))

Facility Name: APEX ENVIRONMENTAL Today's Date: 1-4-12

Facility Opened Today at (time): 24 HR Facility Closed Today at (time): _____

List Equipment in Operation at the Facility Today: TIPPER, ET, MAT. HANDLER, 836, 345, 320 6, 7, 155

List Weather Conditions on this Day: CLEAR. TEMPS IN 20'S

The Facility Operator shall inspect the facility daily for compliance with the applicable regulations including but not limited to the following:

Place an (X) on the line next to all aspects of facility operations which have been inspected today.

3745-27-05 Prohibited Disposal Methods

X	(B)	No Open Burning

3745-27-19 Operation of a Facility

X	(E)(2)(a)	Maintain access roads
X	(b)	Limited access to facility
X	(c)	Signs posted
X	(d)	Exclusion of animals
X	(3)(a)	Adequate fire equipment
X	(b)	Operable and adequate equipment
X	(4)	Improper salvaging
X	(5)	Trained employees
X	(6)	Preparation for inclement weather
X	(7)(a)	Leachate treatment/disposal
X	(b)	Phased operation
X	(c)	Confined unloading
X	(d)	Separation/control of flammable waste
X	(e)	Waste disposed at working face
X	(f)(i)	Compacting bulky items
X	(ii)	Minimizing dust generation
	(8)(a)	NESHAP reg. asbestos disposal
	(b)	Acceptance of liquids
	(c)	Acceptance of hazardous waste
	(d)	Acceptance of PCBs
	(e)	Acceptance of infectious waste
	(f)	Acceptance of yard waste
	(g)	Acceptance of scrap tires
	(h)	Acceptance of low level rad. waste
	(I)	Acceptance of semi-solid material w/free liquid
X	(9)	Control of scattered litter
X	(10)	Keeping of daily logs
X	(11)(a)	Daily inspection of facility for ponding, erosion, leachate outbreaks (record any corrective actions below).
X	(12)	Copy of auth. docs available
X	(F)	Daily cover
	(3)	Alternate Daily Cover Used (describe in comment section below)
	(G)	Intermediate cover
	(H)	Final cover
X	(I)	Scales
X	(J)(1)	Surface water diversion
X	(2)	Design in operating record
X	(4)	Surface water monitoring
X	(K)(1)	Leachate control
	(2)	Lift station back-up pumps
	(3)	Collection pipe network (inspection)
	(4)	Temporary leachate storage
X	(5)	Leachate treatment and disposal
X	(6)	Leachate storage/disposal contingency plan
X	(7)	Surface water monitoring
X	(L)	PCB and hazardous waste prevention and detection program

3745-37-01 License

X	(A)	Valid license

Corrective Actions Taken and Other Comments:

PICKED LITTER, HAULED COVER, HAULED LEACHATE, REPAIRING LEACHATE OUT BREAKS ON WEST SLOPE. AEG INSTALLING NEW GAS WELLS ON SOUTH SLOPE.

Rob Carpenter
Signature of Person Completing Form

ROB CARPENTER
Print Name of Person Completing Form

1-4-12
Date

This form should be retained on file for three years for inspection by the local health department, Ohio EPA, or an authorized representative. Failure to provide accurate daily operations information may be considered a violation of Ohio Revised Code § 2921.13.

LEACHATE - 101

SUMPS 1 - 19.6
3 - 172
4 - 22.4

Revised: August 1, 2005

OhioEPA Municipal Solid Waste Landfill Facility Daily Log of Operations - Form 3

(Log Required by OAC 3745-27-19(E)(10))

Facility Name: APEX ENVIRONMENTAL Today's Date: 1-5-12

Facility Opened Today at (time): 24 HR Facility Closed Today at (time): _____

List Equipment in Operation at the Facility Today: TIPPER, IT, MAT. HANDLER, 155, 6, 7, MISC 345, 325

List Weather Conditions on this Day: CLEAR - TEMPS IN LOW 30'S

The Facility Operator shall inspect the facility daily for compliance with the applicable regulations including but not limited to the following:

Place an (X) on the line next to all aspects of facility operations which have been inspected today.

3745-27-05 Prohibited Disposal Methods

X	(B)	No Open Burning

3745-27-19 Operation of a Facility

X	(E)(2)(a)	Maintain access roads
X	(b)	Limited access to facility
X	(c)	Signs posted
X	(d)	Exclusion of animals
X	(3)(a)	Adequate fire equipment
X	(b)	Operable and adequate equipment
X	(4)	Improper salvaging
X	(5)	Trained employees
X	(6)	Preparation for inclement weather
X	(7)(a)	Leachate treatment/disposal
X	(b)	Phased operation
X	(c)	Confined unloading
X	(d)	Separation/control of flammable waste
X	(e)	Waste disposed at working face
X	(f)(i)	Compacting bulky items
X	(ii)	Minimizing dust generation
	(8)(a)	NESHAP reg. asbestos disposal
	(b)	Acceptance of liquids
	(c)	Acceptance of hazardous waste
	(d)	Acceptance of PCBs
	(e)	Acceptance of infectious waste
	(f)	Acceptance of yard waste
	(g)	Acceptance of scrap tires
	(h)	Acceptance of low level rad. waste
	(i)	Acceptance of semi-solid material w/free liquid
X	(9)	Control of scattered litter
X	(10)	Keeping of daily logs
X	(11)(a)	Daily inspection of facility for ponding, erosion, leachate outbreaks (record any corrective actions below).
X	(12)	Copy of auth. docs available
X	(F)	Daily cover
	(3)	Alternate Daily Cover Used (describe in comment section below)
	(G)	Intermediate cover
	(H)	Final cover
X	(I)	Scales
X	(J)(1)	Surface water diversion
X	(2)	Design in operating record
X	(4)	Surface water monitoring
X	(K)(1)	Leachate control
	(2)	Lift station back-up pumps
	(3)	Collection pipe network (inspection)
	(4)	Temporary leachate storage
X	(5)	Leachate treatment and disposal
X	(6)	Leachate storage/disposal contingency plan
X	(7)	Surface water monitoring
X	(L)	PCB and hazardous waste prevention and detection program

3745-37-01 License

X	(A)	Valid license

Corrective Actions Taken and Other Comments:

HAULED COVER, HAULED LEACHATE, A.E.G. INSTALLING NEW GAS LINES ON SOUTH SLOPE SPRAYING GCL COVER ON EAST SLOPE

Rob Carpenter — *Signature of Person Completing Form*

ROB CARPENTER — *Print Name of Person Completing Form*

1-5-12 — *Date*

This form should be retained on file for three years for inspection by the local health department, Ohio EPA, or an authorized representative. Failure to provide accurate daily operations information may be considered a violation of Ohio Revised Code § 2921.13.

LEACHATE - 5'.8" AT 10:30 AM

SUMPS 1 - 23.6
3 - 17.2
4 - 22.3

OhioEPA Municipal Solid Waste Landfill Facility Daily Log of Operations - Form 3

(Log Required by OAC 3745-27-19(E)(10))

Facility Name: APEX ENVIRONMENTAL Today's Date: 1-6-12

Facility Opened Today at (time): 24HR Facility Closed Today at (time): _____

List Equipment in Operation at the Facility Today: TIPPER, FT, MAT HANDLER.

List Weather Conditions on this Day: Cloudy - Temps - 40's

The Facility Operator shall inspect the facility daily for compliance with the applicable regulations including but not limited to the following:

Place an (X) on the line next to all aspects of facility operations which have been inspected today.

3745-27-05 Prohibited Disposal Methods

X	(B)	No Open Burning

3745-27-19 Operation of a Facility

X	(E)(2)(a)	Maintain access roads
X	(b)	Limited access to facility
X	(c)	Signs posted
X	(d)	Exclusion of animals
X	(3)(a)	Adequate fire equipment
X	(b)	Operable and adequate equipment
X	(4)	Improper salvaging
X	(5)	Trained employees
X	(6)	Preparation for inclement weather
X	(7)(a)	Leachate treatment/disposal
X	(b)	Phased operation
X	(c)	Confined unloading
X	(d)	Separation/control of flammable waste
X	(e)	Waste disposed at working face
X	(f)(i)	Compacting bulky items
X	(ii)	Minimizing dust generation
	(8)(a)	NESHAP reg. asbestos disposal
	(b)	Acceptance of liquids
	(c)	Acceptance of hazardous waste
	(d)	Acceptance of PCBs
	(e)	Acceptance of infectious waste
	(f)	Acceptance of yard waste
	(g)	Acceptance of scrap tires
	(h)	Acceptance of low level rad. waste
	(i)	Acceptance of semi-solid material w/free liquid
X	(9)	Control of scattered litter
X	(10)	Keeping of daily logs
X	(11)(a)	Daily inspection of facility for ponding, erosion, leachate outbreaks (record any corrective actions below).
X	(12)	Copy of auth. does available
X	(F)	Daily cover
	(3)	Alternate Daily Cover Used (describe in comment section below)
	(G)	Intermediate cover
	(H)	Final cover
X	(I)	Scales
X	(J)(1)	Surface water diversion
X	(2)	Design in operating record
X	(4)	Surface water monitoring
X	(K)(1)	Leachate control
	(2)	Lift station back-up pumps
	(3)	Collection pipe network (inspection)
	(4)	Temporary leachate storage
X	(5)	Leachate treatment and disposal
X	(6)	Leachate storage/disposal contingency plan
X	(7)	Surface water monitoring
X	(L)	PCB and hazardous waste prevention and detection program

3745-37-01 License

X	(A)	Valid license

Corrective Actions Taken and Other Comments:

HAULED COVER, HAULED LEACHATE, MEC INSTALLING NEW GAS LINES

Rob Carpenter — *Signature of Person Completing Form*

R.B CARPENTER — *Print Name of Person Completing Form*

1-6-12 — *Date*

This form should be retained on file for three years for inspection by the local health department, Ohio EPA, or an authorized representative. Failure to provide accurate daily operations information may be considered a violation of Ohio Revised Code § 2921.13.

LEACHATE - 4'-3"

SUMPS- 1 - 22.6
3 - 17.2
4 - 20.6

Revised: August 1, 2005

OhioEPA Municipal Solid Waste Landfill Facility Daily Log of Operations - Form 3

(Log Required by OAC 3745-27-19(E)(10))

Facility Name: Apex Environmental Today's Date: 1-9-12

Facility Opened Today at (time): 24 HR Facility Closed Today at (time): _____

List Equipment in Operation at the Facility Today: Tipper, D7, mat. Handler 6, 7, 155, 3x6 Allan 348

List Weather Conditions on this Day: clear Temps in 40's

The Facility Operator shall inspect the facility daily for compliance with the applicable regulations including but not limited to the following:

Place an (X) on the line next to all aspects of facility operations which have been inspected today.

3745-27-05 Prohibited Disposal Methods

X	(B)	No Open Burning

3745-27-19 Operation of a Facility

X	(E)(2)(a)	Maintain access roads
X	(b)	Limited access to facility
X	(c)	Signs posted
X	(d)	Exclusion of animals
X	(3)(a)	Adequate fire equipment
X	(b)	Operable and adequate equipment
X	(4)	Improper salvaging
X	(5)	Trained employees
X	(6)	Preparation for inclement weather
X	(7)(a)	Leachate treatment/disposal
X	(b)	Phased operation
X	(c)	Confined unloading
X	(d)	Separation/control of flammable waste
X	(e)	Waste disposed at working face
X	(I)(I)	Compacting bulky items
X	(ii)	Minimizing dust generation
	(8)(a)	NESHAP reg. asbestos disposal
	(b)	Acceptance of liquids
	(c)	Acceptance of hazardous waste
	(d)	Acceptance of PCBs
	(e)	Acceptance of infectious waste
	(f)	Acceptance of yard waste
	(g)	Acceptance of scrap tires
	(h)	Acceptance of low level rad. waste
	(I)	Acceptance of semi-solid material w/free liquid
X	(9)	Control of scattered litter
X	(10)	Keeping of daily logs
X	(11)(a)	Daily inspection of facility for ponding, erosion, leachate outbreaks (record any corrective actions below).
X	(12)	Copy of auth. docs available
X	(F)	Daily cover
	(3)	Alternate Daily Cover Used (describe in comment section below)
	(G)	Intermediate cover
	(H)	Final cover
X	(I)	Scales
X	(J)(1)	Surface water diversion
X	(2)	Design in operating record
X	(4)	Surface water monitoring
X	(K)(1)	Leachate control
	(2)	Lift station back-up pumps
	(3)	Collection pipe network (inspection)
	(4)	Temporary leachate storage
X	(5)	Leachate treatment and disposal
X	(6)	Leachate storage/disposal contingency plan
X	(7)	Surface water monitoring
X	(L)	PCB and hazardous waste prevention and detection program

3745-37-01 License

X	(A)	Valid license

Corrective Actions Taken and Other Comments:

Picked Litter, Hauled cover, Hauled Leachate, water Roads. A.E.G. installing new gas lines, walked slopes checking outbreaks found 1 marked on map, notified Supervisor, will fix ASAP.

Rob Carpenter — *Signature of Person Completing Form*

Rob Carpenter — *Print Name of Person Completing Form*

1-9-12 — *Date*

This form should be retained on file for three years for inspection by the local health department, Ohio EPA, or an authorized representative. Failure to provide accurate daily operations information may be considered a violation of Ohio Revised Code § 2921.13.

Leachate - 2'4" AT 12:05

Sumps - 1 - 23.6
3 - 17.3
4 - 19.4

Revised: August 1, 2005

Municipal Solid Waste Landfill Facility Daily Log of Operations - Form 3

(Log Required by OAC 3745-27-19(E)(10))

Facility Name: Apex Environmental Today's Date: 1-11-12

Facility Opened Today at (time): 24 HR Facility Closed Today at (time):

~~List Equipment in Operation at the Facility Today:~~ Trapper, JD, 992 LC, 345

List Weather Conditions on this Day: Rain - Temps in 30's

The Facility Operator shall inspect the facility daily for compliance with the applicable regulations including but not limited to the following:

Place an (X) on the line next to all aspects of facility operations which have been inspected today.

3745-27-05 Prohibited Disposal Methods

X (B) No Open Burning

3745-27-19 Operation of a Facility

X (E)(2)(a) Maintain access roads
X (b) Limited access to facility
X (c) Signs posted
X (d) Exclusion of animals
X (3)(a) Adequate fire equipment
X (b) Operable and adequate equipment
X (4) Improper salvaging
X (5) Trained employees
X (6) Preparation for inclement weather
X (7)(a) Leachate treatment/disposal
X (b) Phased operation
X (c) Confined unloading
X (d) Separation/control of flammable waste
X (e) Waste disposed at working face
X (f)(i) Compacting bulky items
X (ii) Minimizing dust generation
X (8)(a) NESHAP reg. asbestos disposal
— (b) Acceptance of liquids
— (c) Acceptance of hazardous waste
— (d) Acceptance of PCBs
— (e) Acceptance of infectious waste
— (f) Acceptance of yard waste
— (g) Acceptance of scrap tires
— (h) Acceptance of low level rad. waste
— (i) Acceptance of semi-solid material w/free liquid
X (9) Control of scattered litter
X (10) Keeping of daily logs
X (11)(a) Daily inspection of facility for ponding, erosion, leachate outbreaks (record any corrective actions below).
X (12) Copy of auth. docs available
X (F) Daily cover
— (3) Alternate Daily Cover Used (describe in comment section below)
— (G) Intermediate cover
— (H) Final cover
X (I) Scales
X (J)(1) Surface water diversion
X (2) Design in operating record
X (4) Surface water monitoring
X (K)(1) Leachate control
— (2) Lift station back-up pumps
— (3) Collection pipe network (inspection)
— (4) Temporary leachate storage
X (5) Leachate treatment and disposal
X (6) Leachate storage/disposal contingency plan
X (7) Surface water monitoring
X (L) PCB and hazardous waste prevention and detection program

3745-37-01 License

X (A) Valid license

Corrective Actions Taken and Other Comments:

Picked Litter, Hauled Cover, Hauled Leachate, A.E.G working on New Gas Lines

Bob Carpenter — *Signature of Person Completing Form*

Bob Carpenter — *Print Name of Person Completing Form*

1-11-12 — *Date*

This form should be retained on file for three years for inspection by the local health department, Ohio EPA, or an authorized representative. Failure to provide accurate daily operations information may be considered a violation of Ohio Revised Code § 2921.13.

Leachate - 1:6"
7:00 AM

Sumps - 1 - 19.7
3 - 17.2
4 - 22.8

Revised: August 1, 2005

OhioEPA Municipal Solid Waste Landfill Facility Daily Log of Operations - Form 3

(Log Required by OAC 3745-27-19(E)(10))

Facility Name: ACE Environmental Today's Date: 1-15-12

Facility Opened Today at (time): 2ish AM Facility Closed Today at (time): _____

List Equipment in Operation at the Facility Today: Tipper, ET, 345, Misc, Mat. Handler 6, 7, 322, 155

List Weather Conditions on this Day: Cold. Temps in 20's

The Facility Operator shall inspect the facility daily for compliance with the applicable regulations including but not limited to the following:

Place an (X) on the line next to all aspects of facility operations which have been inspected today.

3745-27-05 Prohibited Disposal Methods

X	(B)	No Open Burning

3745-27-19 Operation of a Facility

X	(E)(2)(a)	Maintain access roads
X	(b)	Limited access to facility
X	(c)	Signs posted
X	(d)	Exclusion of animals
X	(3)(a)	Adequate fire equipment
X	(b)	Operable and adequate equipment
X	(4)	Improper salvaging
X	(5)	Trained employees
X	(6)	Preparation for inclement weather
X	(7)(a)	Leachate treatment/disposal
X	(b)	Phased operation
X	(c)	Confined unloading
X	(d)	Separation/control of flammable waste
X	(e)	Waste disposed at working face
X	(i)(I)	Compacting bulky items
X	(ii)	Minimizing dust generation
	(8)(a)	NESHAP reg. asbestos disposal
	(b)	Acceptance of liquids
	(c)	Acceptance of hazardous waste
	(d)	Acceptance of PCBs
	(e)	Acceptance of infectious waste
	(f)	Acceptance of yard waste
	(g)	Acceptance of scrap tires
	(h)	Acceptance of low level rad. waste
	(I)	Acceptance of semi-solid material w/free liquid
X	(9)	Control of scattered litter
X	(10)	Keeping of daily logs
X	(11)(a)	Daily inspection of facility for ponding, erosion, leachate outbreaks (record any corrective actions below).
X	(12)	Copy of auth. docs available
X	(F)	Daily cover
X	(3)	Alternate Daily Cover Used (describe in comment section below)
X	(G)	Intermediate cover
	(H)	Final cover
X	(I)	Scales
X	(J)(1)	Surface water diversion
X	(2)	Design in operating record
X	(4)	Surface water monitoring
X	(K)(1)	Leachate control
	(2)	Lift station back-up pumps
	(3)	Collection pipe network (inspection)
	(4)	Temporary leachate storage
X	(5)	Leachate treatment and disposal
X	(6)	Leachate storage/disposal contingency plan
X	(7)	Surface water monitoring
X	(L)	PCB and hazardous waste prevention and detection program

3745-37-01 License

X	(A)	Valid license

Corrective Actions Taken and Other Comments:

Haulro Cover, Graded Roads

R. Carpenter — *Signature of Person Completing Form*

Rob Carpenter — *Print Name of Person Completing Form*

1-15-12 — *Date*

This form should be retained on file for three years for inspection by the local health department, Ohio EPA, or an authorized representative. Failure to provide accurate daily operations information may be considered a violation of Ohio Revised Code § 2921.13.

Leachate - 3'

Scraps 1 - 19.6
3 - 17.1
4 - 23.3

OhioEPA Municipal Solid Waste Landfill Facility Daily Log of Operations - Form 3

(Log Required by OAC 3745-27-19(E)(10))

Facility Name: APEX ENVIRONMENTAL Today's Date: 1-16-12

Facility Opened Today at (time): 24 HR Facility Closed Today at (time): _____

List Equipment in Operation at the Facility Today: TIPPER, FT, MAT. HANDLER, 345, ALSO 820, 6, 7, 154

List Weather Conditions on this Day: CLOUDY - TEMPS IN 30'S

The Facility Operator shall inspect the facility daily for compliance with the applicable regulations including but not limited to the following:

Place an (X) on the line next to all aspects of facility operations which have been inspected today.

3745-27-05 Prohibited Disposal Methods

X (B) No Open Burning

3745-27-19 Operation of a Facility

X (E)(2)(a) Maintain access roads
X (b) Limited access to facility
X (c) Signs posted
X (d) Exclusion of animals
X (3)(a) Adequate fire equipment
X (b) Operable and adequate equipment
X (4) Improper salvaging
X (5) Trained employees
X (6) Preparation for inclement weather
X (7)(a) Leachate treatment/disposal
X (b) Phased operation
X (c) Confined unloading
X (d) Separation/control of flammable waste
X (e) Waste disposed at working face
X (f)(i) Compacting bulky items
X (ii) Minimizing dust generation
(8)(a) NESHAP reg. asbestos disposal
(b) Acceptance of liquids
(c) Acceptance of hazardous waste
(d) Acceptance of PCBs
(e) Acceptance of infectious waste
(f) Acceptance of yard waste
(g) Acceptance of scrap tires
(h) Acceptance of low level rad. waste
(i) Acceptance of semi-solid material w/free liquid
X (9) Control of scattered litter
X (10) Keeping of daily logs
X (11)(a) Daily inspection of facility for ponding, erosion, leachate outbreaks (record any corrective actions below).
X (12) Copy of auth. docs available
X (F) Daily cover
(3) Alternate Daily Cover Used (describe in comment section below)
(G) Intermediate cover
(H) Final cover
X (I) Scales
X (J)(1) Surface water diversion
X (2) Design in operating record
X (4) Surface water monitoring
X (K)(1) Leachate control
(2) Lift station back-up pumps
(3) Collection pipe network (inspection)
(4) Temporary leachate storage
X (5) Leachate treatment and disposal
X (6) Leachate storage/disposal contingency plan
X (7) Surface water monitoring
X (L) PCB and hazardous waste prevention and detection program

3745-37-01 License

X (A) Valid license

Corrective Actions Taken and Other Comments:

PICKED LITTER, HAULED COVER, DUMPING IN NEW CELL (SEE COVER)

RL Carpenter — *Signature of Person Completing Form*

ROB CARPENTER — *Print Name of Person Completing Form*

1-16-12 — *Date*

This form should be retained on file for three years for inspection by the local health department, Ohio EPA, or an authorized representative. Failure to provide accurate daily operations information may be considered a violation of Ohio Revised Code § 2921.13.

LEACHATE - APPROX 5'

SUMPS - 1-20.1

3-172.

4-22.1

(ICE BUILDING UPON CABLE, PULLING DOWN)

Municipal Solid Waste Landfill Facility Daily Log of Operations - Form 3

(Log Required by OAC 3745-27-19(E)(10))

Facility Name: APEX ENVIRONMENTAL Today's Date: 1-17-12

Facility Opened Today at (time): 24 HR Facility Closed Today at (time):

List Equipment in Operation at the Facility Today: TIPPER, FT, MAT. HANDLER, 348 ALSO, 320, 6, 7, 153

List Weather Conditions on this Day: RAIN- TEMPS IN 40'S

The Facility Operator shall inspect the facility daily for compliance with the applicable regulations including but not limited to the following:

Place an (X) on the line next to all aspects of facility operations which have been inspected today.

3745-27-05 Prohibited Disposal Methods

- X (B) No Open Burning

3745-27-19 Operation of a Facility

- X (E)(2)(a) Maintain access roads
- X (b) Limited access to facility
- X (c) Signs posted
- X (d) Exclusion of animals
- X (3)(a) Adequate fire equipment
- X (b) Operable and adequate equipment
- X (4) Improper salvaging
- X (5) Trained employees
- X (6) Preparation for inclement weather
- X (7)(a) Leachate treatment/disposal
- X (b) Phased operation
- X (c) Confined unloading
- X (d) Separation/control of flammable waste
- X (e) Waste disposed at working face
- X (f)(i) Compacting bulky items
- X (ii) Minimizing dust generation
- (8)(a) NESHAP reg. asbestos disposal
- (b) Acceptance of liquids
- (c) Acceptance of hazardous waste
- (d) Acceptance of PCBs
- (e) Acceptance of infectious waste
- (f) Acceptance of yard waste
- (g) Acceptance of scrap tires
- (h) Acceptance of low level rad. waste
- (i) Acceptance of semi-solid material w/free liquid
- X (9) Control of scattered litter
- X (10) Keeping of daily logs
- X (11)(a) Daily inspection of facility for ponding, erosion, leachate outbreaks (record any corrective actions below).
- X (12) Copy of auth. does available
- X (F) Daily cover
- (3) Alternate Daily Cover Used (describe in comment section below)
- (G) Intermediate cover
- (H) Final cover
- X (I) Scales
- X (J)(1) Surface water diversion
- X (2) Design in operating record
- X (4) Surface water monitoring
- X (K)(1) Leachate control
- (2) Lift station back-up pumps
- (3) Collection pipe network (inspection)
- (4) Temporary leachate storage
- X (5) Leachate treatment and disposal
- X (6) Leachate storage/disposal contingency plan
- X (7) Surface water monitoring
- X (L) PCB and hazardous waste prevention and detection program

3745-37-01 License

- X (A) Valid license

Corrective Actions Taken and Other Comments:

HAULED COVER, HAULED LEACHATE, GRADED ROADS

R. Carpenter — *Signature of Person Completing Form*

ROB CARPENTER — *Print Name of Person Completing Form*

1-17-12 — *Date*

This form should be retained on file for three years for inspection by the local health department, Ohio EPA, or an authorized representative. Failure to provide accurate daily operations information may be considered a violation of Ohio Revised Code § 2921.13.

LEACHATE - 4'

SUMPS 1 - 20.6
3 - 17.2
4 - 18.6

Revised: August 1, 2005

Municipal Solid Waste Landfill Facility Daily Log of Operations - Form 3

(Log Required by OAC 3745-27-19(E)(10))

Facility Name: ARCH ENVIRONMENTAL Today's Date: 1-18-12

Facility Opened Today at (time): 24HR Facility Closed Today at (time): _____

List Equipment in Operation at the Facility Today: TIPPER, ET, MAT HANDLER, 836, 345, 328, 6, 7, 155

List Weather Conditions on this Day: Cold - Temps in 20's

The Facility Operator shall inspect the facility daily for compliance with the applicable regulations including but not limited to the following:

Place an (X) on the line next to all aspects of facility operations which have been inspected today.

3745-27-05 Prohibited Disposal Methods

X	(B)	No Open Burning

3745-27-19 Operation of a Facility

X	(E)(2)(a)	Maintain access roads
X	(b)	Limited access to facility
X	(c)	Signs posted
X	(d)	Exclusion of animals
X	(3)(a)	Adequate fire equipment
X	(b)	Operable and adequate equipment
X	(4)	Improper salvaging
X	(5)	Trained employees
X	(6)	Preparation for inclement weather
X	(7)(a)	Leachate treatment/disposal
X	(b)	Phased operation
X	(c)	Confined unloading
X	(d)	Separation/control of flammable waste
X	(e)	Waste disposed at working face
X	(f)(I)	Compacting bulky items
X	(ii)	Minimizing dust generation
	(8)(a)	NESHAP reg. asbestos disposal
	(b)	Acceptance of liquids
	(c)	Acceptance of hazardous waste
	(d)	Acceptance of PCBs
	(e)	Acceptance of infectious waste
	(f)	Acceptance of yard waste
	(g)	Acceptance of scrap tires
	(h)	Acceptance of low level rad. waste
	(I)	Acceptance of semi-solid material w/free liquid
X	(9)	Control of scattered litter
X	(10)	Keeping of daily logs
X	(11)(a)	Daily inspection of facility for ponding, erosion, leachate outbreaks (record any corrective actions below).
X	(12)	Copy of auth. does available
X	(F)	Daily cover
	(3)	Alternate Daily Cover Used (describe in comment section below)
	(G)	Intermediate cover
	(H)	Final cover
X	(I)	Scales
X	(J)(1)	Surface water diversion
X	(2)	Design in operating record
X	(4)	Surface water monitoring
X	(K)(1)	Leachate control
	(2)	Lift station back-up pumps
	(3)	Collection pipe network (inspection)
	(4)	Temporary leachate storage
X	(5)	Leachate treatment and disposal
X	(6)	Leachate storage/disposal contingency plan
X	(7)	Surface water monitoring
X	(L)	PCB and hazardous waste prevention and detection program

3745-37-01 License

X	(A)	Valid license

Corrective Actions Taken and Other Comments:

Picked Litter, Hauled Cover, Hauled Leachate, Repairing Perimeter System Lines, Are working on New Gas Lines

Rob Carpenter — *Signature of Person Completing Form*

ROB CARPENTER — *Print Name of Person Completing Form*

1-18-12 — *Date*

This form should be retained on file for three years for inspection by the local health department, Ohio EPA, or an authorized representative. Failure to provide accurate daily operations information may be considered a violation of Ohio Revised Code § 2921.13.

LEACHATE - 3'-10" @ 10:30 AM

Sumps 1 - 20.7
3 - [redacted]171
4 - 14.7

Revised: August 1, 2005

Municipal Solid Waste Landfill Facility Daily Log of Operations - Form 3

(Log Required by OAC 3745-27-19(E)(10))

Facility Name: APEX ENVIRONMENTAL Today's Date: 1-19-12

Facility Opened Today at (time): 24th Facility Closed Today at (time): _____

List Equipment in Operation at the Facility Today: TIPPER, IT, MAT HANDLER, 345, MAJOR 6, 7, 155

List Weather Conditions on this Day: SNOW - TEMPS in 20's

The Facility Operator shall inspect the facility daily for compliance with the applicable regulations including but not limited to the following:

Place an (X) on the line next to all aspects of facility operations which have been inspected today.

3745-27-05 Prohibited Disposal Methods

- X (B) No Open Burning

3745-27-19 Operation of a Facility

- X (E)(2)(a) Maintain access roads
- X (b) Limited access to facility
- X (c) Signs posted
- X (d) Exclusion of animals
- X (3)(a) Adequate fire equipment
- X (b) Operable and adequate equipment
- X (4) Improper salvaging
- X (5) Trained employees
- X (6) Preparation for inclement weather
- X (7)(a) Leachate treatment/disposal
- X (b) Phased operation
- X (c) Confined unloading
- X (d) Separation/control of flammable waste
- X (e) Waste disposed at working face
- X (I)(1) Compacting bulky items
- X (ii) Minimizing dust generation
- X (8)(a) NESHAP reg. asbestos disposal
- — (b) Acceptance of liquids
- — (c) Acceptance of hazardous waste
- — (d) Acceptance of PCBs
- — (e) Acceptance of infectious waste
- — (f) Acceptance of yard waste
- — (g) Acceptance of scrap tires
- — (h) Acceptance of low level rad. waste
- — (I) Acceptance of semi-solid material w/free liquid
- X (9) Control of scattered litter
- X (10) Keeping of daily logs
- X (11)(a) Daily inspection of facility for ponding, erosion, leachate outbreaks (record any corrective actions below).
- X (12) Copy of auth. docs available
- X (F) Daily cover
- — (3) Alternate Daily Cover Used (describe in comment section below)
- — (G) Intermediate cover
- — (H) Final cover
- X (I) Scales
- X (J)(1) Surface water diversion
- X (2) Design in operating record
- X (4) Surface water monitoring
- X (K)(1) Leachate control
- — (2) Lift station back-up pumps
- — (3) Collection pipe network (inspection)
- — (4) Temporary leachate storage
- X (5) Leachate treatment and disposal
- X (6) Leachate storage/disposal contingency plan
- X (7) Surface water monitoring
- X (L) PCB and hazardous waste prevention and detection program

3745-37-01 License

- X (A) Valid license

Corrective Actions Taken and Other Comments:

PICKED LITTER, HAULED COVER, HAULED LEACHATE, REG DRILLING & INSTALLING GAS LINES, INSTALLED NEW FILTER SOCKS ON PERIMETER.

Rob Carpenter — *Signature of Person Completing Form*

R.B CARPENTER — *Print Name of Person Completing Form*

1-19-12 — *Date*

This form should be retained on file for three years for inspection by the local health department, Ohio EPA, or an authorized representative. Failure to provide accurate daily operations information may be considered a violation of Ohio Revised Code § 2921.13.

LEACHATE - 3'-1" @ 8:20 AM

SUMPS 1 - 20.6
3 - 170
4 - 19.5

Revised: August 1, 2005

OhioEPA Municipal Solid Waste Landfill Facility Daily Log of Operations - Form 3

(Log Required by OAC 3745-27-19(E)(10))

Facility Name: APEX ENVIRONMENTAL Today's Date: 1-20-12

Facility Opened Today at (time): 24 HR Facility Closed Today at (time): _____

List Equipment in Operation at the Facility Today: TIPPER, IT, MAT. HANDLER, 836, 345, 320 6, 7, 155

List Weather Conditions on this Day: CLEAR - TEMPS IN 20'S

The Facility Operator shall inspect the facility daily for compliance with the applicable regulations including but not limited to the following:

Place an (X) on the line next to all aspects of facility operations which have been inspected today.

3745-27-05 Prohibited Disposal Methods

- X (B) No Open Burning

3745-27-19 Operation of a Facility

- X (E)(2)(a) Maintain access roads
- X (b) Limited access to facility
- X (c) Signs posted
- X (d) Exclusion of animals
- X (3)(a) Adequate fire equipment
- X (b) Operable and adequate equipment
- X (4) Improper salvaging
- X (5) Trained employees
- X (6) Preparation for inclement weather
- X (7)(a) Leachate treatment/disposal
- X (b) Phased operation
- X (c) Confined unloading
- X (d) Separation/control of flammable waste
- X (e) Waste disposed at working face
- X (I)(i) Compacting bulky items
- X (ii) Minimizing dust generation
- (8)(a) NESHAP reg. asbestos disposal
- (b) Acceptance of liquids
- (c) Acceptance of hazardous waste
- (d) Acceptance of PCBs
- (e) Acceptance of infectious waste
- (f) Acceptance of yard waste
- (g) Acceptance of scrap tires
- (h) Acceptance of low level rad. waste
- (I) Acceptance of semi-solid material w/free liquid
- X (9) Control of scattered litter
- X (10) Keeping of daily logs
- X (11)(a) Daily inspection of facility for ponding, erosion, leachate outbreaks (record any corrective actions below).
- X (12) Copy of auth. docs available
- X (F) Daily cover
- (3) Alternate Daily Cover Used (describe in comment section below)
- (G) Intermediate cover
- (H) Final cover
- X (I) Scales
- X (J)(1) Surface water diversion
- X (2) Design in operating record
- X (4) Surface water monitoring
- X (K)(1) Leachate control
- (2) Lift station back-up pumps
- (3) Collection pipe network (inspection)
- (4) Temporary leachate storage
- N (5) Leachate treatment and disposal
- X (6) Leachate storage/disposal contingency plan
- X (7) Surface water monitoring
- X (L) PCB and hazardous waste prevention and detection program

3745-37-01 License

- X (A) Valid license

Corrective Actions Taken and Other Comments:

PICKED LITTER, HAULED COVER, GRADED ROADS. AEG INSTALLING NEW GAS LINES

Signature of Person Completing Form — Print Name of Person Completing Form: BOB CARPENTER — Date: 1-20-12

This form should be retained on file for three years for inspection by the local health department, Ohio EPA, or an authorized representative. Failure to provide accurate daily operations information may be considered a violation of Ohio Revised Code § 2921.13.

LEACHATE - APPROX 3'

SUMPS - 1 - 22.0
3 - 17.1
4 - 24.1

MSW Log -Form 3 (FLOAT CABLE [redacted] HOOK UP. PUTTING DOWN)

Revised: August 1, 2005

OhioEPA Municipal Solid Waste Landfill Facility Daily Log of Operations - Form 3

(Log Required by OAC 3745-27-19(E)(10))

Facility Name: APex Environmental Logistics Today's Date: 1-21-12

Facility Opened Today at (time): 24hr-5 Facility Closed Today at (time): _____

List Equipment in Operation at the Facility Today: D7, D155, trackhoes, graders, Loaders, and rail trucks

List Weather Conditions on this Day: 20°F with 9mph winds and aprox 6 inch snow

The Facility Operator shall inspect the facility daily for compliance with the applicable regulations including but not limited to the following:

Place an (X) on the line next to all aspects of facility operations which have been inspected today.

3745-27-05 Prohibited Disposal Methods

X	(B)	No Open Burning

3745-27-19 Operation of a Facility

X	(E)(2)(a)	Maintain access roads
X	(b)	Limited access to facility
X	(c)	Signs posted
X	(d)	Exclusion of animals
X	(3)(a)	Adequate fire equipment
X	(b)	Operable and adequate equipment
X	(4)	Improper salvaging
X	(5)	Trained employees
X	(6)	Preparation for inclement weather
X	(7)(a)	Leachate treatment/disposal
X	(b)	Phased operation
X	(c)	Confined unloading
X	(d)	Separation/control of flammable waste
X	(e)	Waste disposed at working face
X	(I)(I)	Compacting bulky items
	(ii)	Minimizing dust generation
	(8)(a)	NESHAP reg. asbestos disposal
	(b)	Acceptance of liquids
	(c)	Acceptance of hazardous waste
	(d)	Acceptance of PCBs
	(e)	Acceptance of infectious waste
	(f)	Acceptance of yard waste
	(g)	Acceptance of scrap tires
	(h)	Acceptance of low level rad. waste
	(I)	Acceptance of semi-solid material w/free liquid
X	(9)	Control of scattered litter
X	(10)	Keeping of daily logs
X	(11)(a)	Daily inspection of facility for ponding, erosion, leachate outbreaks (record any corrective actions below).
X	(12)	Copy of auth. docs available
X	(F)	Daily cover
	(3)	Alternate Daily Cover Used (describe in comment section below)
	(G)	Intermediate cover
	(H)	Final cover
X	(I)	Scales
X	(J)(1)	Surface water diversion
X	(2)	Design in operating record
X	(4)	Surface water monitoring
X	(K)(1)	Leachate control
	(2)	Lift station back-up pumps
	(3)	Collection pipe network (inspection)
	(4)	Temporary leachate storage
X	(5)	Leachate treatment and disposal
X	(6)	Leachate storage/disposal contingency plan
X	(7)	Surface water monitoring
X	(L)	PCB and hazardous waste prevention and detection program

3745-37-01 License

X	(A)	Valid license

Corrective Actions Taken and Other Comments:

Rail and over the roads, hauling stone for roads, grading roads

Signature of Person Completing Form *Print Name of Person Completing Form* *Date*

This form should be retained on file for three years for inspection by the local health department, Ohio EPA, or an authorized representative. Failure to provide accurate daily operations information may be considered a violation of Ohio Revised Code § 2921.13.

Leachate tank - 6'Ft

Sumps - 4 - 24.5
1 - 22.4
3 - 168.2

Revised: August 1, 2005

Ohio EPA Municipal Solid Waste Landfill Facility Daily Log of Operations - Form 3

(Log Required by OAC 3745-27-19(E)(10))

Facility Name: Apex Environmental Today's Date: 1-24-12

Facility Opened Today at (time): 7AM Facility Closed Today at (time): _____

List Equipment in Operation at the Facility Today: Tipper, FT, Mat. Handler 345, G7 155, 328

List Weather Conditions on this Day: Cloudy; Temps in 30's

The Facility Operator shall inspect the facility daily for compliance with the applicable regulations including but not limited to the following:

Place an (X) on the line next to all aspects of facility operations which have been inspected today.

3745-27-05 Prohibited Disposal Methods

- X (B) No Open Burning

3745-27-19 Operation of a Facility

- X (E)(2)(a) Maintain access roads
- X (b) Limited access to facility
- X (c) Signs posted
- X (d) Exclusion of animals
- X (3)(a) Adequate fire equipment
- X (b) Operable and adequate equipment
- X (4) Improper salvaging
- X (5) Trained employees
- X (6) Preparation for inclement weather
- X (7)(a) Leachate treatment/disposal
- X (b) Phased operation
- X (c) Confined unloading
- X (d) Separation/control of flammable waste
- X (e) Waste disposed at working face
- X (f)(i) Compacting bulky items
- X (ii) Minimizing dust generation
- (8)(a) NESHAP reg. asbestos disposal
- (b) Acceptance of liquids
- (c) Acceptance of hazardous waste
- (d) Acceptance of PCBs
- (e) Acceptance of infectious waste
- (f) Acceptance of yard waste
- (g) Acceptance of scrap tires
- (h) Acceptance of low level rad. waste
- (i) Acceptance of semi-solid material w/free liquid
- X (9) Control of scattered litter
- X (10) Keeping of daily logs
- X (11)(a) Daily inspection of facility for ponding, erosion, leachate outbreaks (record any corrective actions below).
- X (12) Copy of auth. does available
- X (F) Daily cover
- (3) Alternate Daily Cover Used (describe in comment section below)
- (G) Intermediate cover
- (H) Final cover
- X (I) Scales
- X (J)(1) Surface water diversion
- X (2) Design in operating record
- X (4) Surface water monitoring
- X (K)(1) Leachate control
- (2) Lift station back-up pumps
- (3) Collection pipe network (inspection)
- (4) Temporary leachate storage
- X (5) Leachate treatment and disposal
- X (6) Leachate storage/disposal contingency plan
- X (7) Surface water monitoring
- X (L) PCB and hazardous waste prevention and detection program

3745-37-01 License

- X (A) Valid license

Corrective Actions Taken and Other Comments:

Picked Litter Hauled Cover, Grading Roads, AEG working on New Gas wells & lines, Sampled 001 Pond Discharge (Monthly, Quarterly)

Rob Carpenter — Signature of Person Completing Form

ROB CARPENTER — Print Name of Person Completing Form

1-24-12. — Date

This form should be retained on file for three years for inspection by the local health department, Ohio EPA, or an authorized representative. Failure to provide accurate daily operations information may be considered a violation of Ohio Revised Code § 2921.13.

LEACHATE — 6'-6" @ 8:00AM

Sumps 1 - 20.9
3 - 34.1
4 - 83.6

Revised: August 1, 2005

Municipal Solid Waste Landfill Facility Daily Log of Operations - Form 3

[Log Required by OAC 3745-27-19(E)(10)]

Facility Name: APEX ENVIRONMENTAL Today's Date: 1-25-12

Facility Opened Today at (time): 24 HR Facility Closed Today at (time): _____

List Equipment in Operation at the Facility Today: TIPPER ET, MAT HANDLER, 345, 328, 6, 2 155

List Weather Conditions on this Day: CLOUDY TEMPS IN 30'S

The Facility Operator shall inspect the facility daily for compliance with the applicable regulations including but not limited to the following:

Place an (X) on the line next to all aspects of facility operations which have been inspected today.

3745-27-05 Prohibited Disposal Methods

X	(B)	No Open Burning

3745-27-19 Operation of a Facility

X	(E)(2)(a)	Maintain access roads
X	(b)	Limited access to facility
X	(c)	Signs posted
X	(d)	Exclusion of animals
X	(3)(a)	Adequate fire equipment
X	(b)	Operable and adequate equipment
X	(4)	Improper salvaging
X	(5)	Trained employees
X	(6)	Preparation for inclement weather
X	(7)(a)	Leachate treatment/disposal
X	(b)	Phased operation
X	(c)	Confined unloading
X	(d)	Separation/control of flammable waste
X	(e)	Waste disposed at working face
X	(f)(i)	Compacting bulky items
X	(ii)	Minimizing dust generation
/	(8)(a)	NESHAP reg. asbestos disposal
	(b)	Acceptance of liquids
	(c)	Acceptance of hazardous waste
	(d)	Acceptance of PCBs
	(e)	Acceptance of infectious waste
	(f)	Acceptance of yard waste
	(g)	Acceptance of scrap tires
	(h)	Acceptance of low level rad. waste
	(i)	Acceptance of semi-solid material w/free liquid
X	(9)	Control of scattered litter
X	(10)	Keeping of daily logs
X	(11)(a)	Daily inspection of facility for ponding, erosion, leachate outbreaks (record any corrective actions below).
X	(12)	Copy of auth. docs available
X	(F)	Daily cover
	(3)	Alternate Daily Cover Used (describe in comment section below)
	(G)	Intermediate cover
	(H)	Final cover
X	(I)	Scales
X	(J)(1)	Surface water diversion
X	(2)	Design in operating record
X	(4)	Surface water monitoring
X	(K)(1)	Leachate control
	(2)	Lift station back-up pumps
	(3)	Collection pipe network (inspection)
	(4)	Temporary leachate storage
X	(5)	Leachate treatment and disposal
X	(6)	Leachate storage/disposal contingency plan
X	(7)	Surface water monitoring
X	(L)	PCB and hazardous waste prevention and detection program

3745-37-01 License

X	(A)	Valid license

Corrective Actions Taken and Other Comments:

PICKED LITTER, HAULED COVER, HAULED LEACHATE, GRADING ROADS, ABG, INSTALLING WELLS + GAS LINES, WALKED SLOPS INSPECTING OUTBREAKS (MARKED ON MAPS + REPORTED TO SUPERVISORS — OUTBREAKS REPAIRED

Rob Carpenter — *Signature of Person Completing Form*

ROB CARPENTER — *Print Name of Person Completing Form*

1-25-12 — *Date*

This form should be retained on file for three years for inspection by the local health department, Ohio EPA, or an authorized representative. Failure to provide accurate daily operations information may be considered a violation of Ohio Revised Code § 2921.13.

LEACHATE 6' @ 8:15 AM

SUMPS 1 - 14.6
3 - 34.0
4 - 24.0

Revised: August 1, 2005

Municipal Solid Waste Landfill Facility Daily Log of Operations - Form 3

(Log Required by OAC 3745-27-19(E)(10))

Facility Name: Apex Environmental Today's Date: 1-29-17

Facility Opened Today at (time): 24hrs Facility Closed Today at (time): _____

List Equipment in Operation at the Facility Today: D7, D155, D6, Jcb rental, cat rental-mtl, trackhoes, Rock trucks, rail trucks

List Weather Conditions on this Day: _____

The Facility Operator shall inspect the facility daily for compliance with the applicable regulations including but not limited to the following:

Place an (X) on the line next to all aspects of facility operations which have been inspected today.

3745-27-05 Prohibited Disposal Methods

X	(B)	No Open Burning

3745-27-19 Operation of a Facility

X	(E)(2)(a)	Maintain access roads
X	(b)	Limited access to facility
X	(c)	Signs posted
X	(d)	Exclusion of animals
X	(3)(a)	Adequate fire equipment
X	(b)	Operable and adequate equipment
X	(4)	Improper salvaging
X	(5)	Trained employees
X	(6)	Preparation for inclement weather
X	(7)(a)	Leachate treatment/disposal
X	(b)	Phased operation
X	(c)	Confined unloading
X	(d)	Separation/control of flammable waste
X	(e)	Waste disposed at working face
X	(f)(J)	Compacting bulky items
X	(ii)	Minimizing dust generation
	(8)(a)	NESHAP reg. asbestos disposal
	(b)	Acceptance of liquids
	(c)	Acceptance of hazardous waste
	(d)	Acceptance of PCBs
	(e)	Acceptance of infectious waste
	(f)	Acceptance of yard waste
	(g)	Acceptance of scrap tires
	(h)	Acceptance of low level rad. waste
	(I)	Acceptance of semi-solid material w/free liquid
X	(9)	Control of scattered liter
X	(10)	Keeping of daily logs
X	(11)(a)	Daily inspection of facility for ponding, erosion, leachate outbreaks (record any corrective actions below).
X	(12)	Copy of auth. does available
X	(F)	Daily cover
	(3)	Alternate Daily Cover Used (describe in comment section below)
	(G)	Intermediate cover
	(H)	Final cover
X	(I)	Scales
X	(J)(1)	Surface water diversion
X	(2)	Design in operating record
X	(4)	Surface water monitoring
X	(K)(1)	Leachate control
	(2)	Lift station back-up pumps
	(3)	Collection pipe network (inspection)
	(4)	Temporary leachate storage
X	(5)	Leachate treatment and disposal
X	(6)	Leachate storage/disposal contingency plan
X	(7)	Surface water monitoring
X	(L)	PCB and hazardous waste prevention and detection program

3745-37-01 License

X	(A)	Valid license

Corrective Actions Taken and Other Comments:

Rain and over the roads, hauling cover

Signature of Person Completing Form *Print Name of Person Completing Form* *Date*

This form should be retained on file for three years for inspection by the local health department, Ohio EPA, or an authorized representative. Failure to provide accurate daily operations information may be considered a violation of Ohio Revised Code § 2921.13.

Leachate tank- 7.6'

SUMPS 4-76.7
1-14.3
3-140.4

Revised: August 1, 2005

Municipal Solid Waste Landfill Facility Daily Log of Operations - Form 3

(Log Required by OAC 3745-27-19(E)(10))

Facility Name: Apex Environmental Today's Date: 1-30-12

Facility Opened Today at (time): 24 hr Facility Closed Today at (time):

List Equipment in Operation at the Facility Today: Tipper, ET, MAT. Handler, 345, Allson 105, 6, 7, 32D

List Weather Conditions on this Day: Cloudy - Temp: in 30

The Facility Operator shall inspect the facility daily for compliance with the applicable regulations including but not limited to the following:

Place an (X) on the line next to all aspects of facility operations which have been inspected today.

3745-27-05 Prohibited Disposal Methods

X	(B)	No Open Burning

3745-27-19 Operation of a Facility

X	(E)(2)(a)	Maintain access roads
X	(b)	Limited access to facility
X	(c)	Signs posted
X	(d)	Exclusion of animals
X	(3)(a)	Adequate fire equipment
X	(b)	Operable and adequate equipment
X	(4)	Improper salvaging
X	(5)	Trained employees
X	(6)	Preparation for inclement weather
X	(7)(a)	Leachate treatment/disposal
X	(b)	Phased operation
X	(c)	Confined unloading
X	(d)	Separation/control of flammable waste
X	(e)	Waste disposed at working face
X	(f)(i)	Compacting bulky items
X	(ii)	Minimizing dust generation
	(8)(a)	NESHAP reg. asbestos disposal
	(b)	Acceptance of liquids
	(c)	Acceptance of hazardous waste
	(d)	Acceptance of PCBs
	(e)	Acceptance of infectious waste
	(f)	Acceptance of yard waste
	(g)	Acceptance of scrap tires
	(h)	Acceptance of low level rad. waste
	(i)	Acceptance of semi-solid material w/free liquid
X	(9)	Control of scattered litter
X	(10)	Keeping of daily logs
X	(11)(a)	Daily inspection of facility for ponding, erosion, leachate outbreaks (record any corrective actions below).
X	(12)	Copy of auth. does available
X	(F)	Daily cover
	(3)	Alternate Daily Cover Used (describe in comment section below)
	(G)	Intermediate cover
	(H)	Final cover
X	(I)	Scales
X	(J)(1)	Surface water diversion
X	(2)	Design in operating record
X	(4)	Surface water monitoring
X	(K)(1)	Leachate control
	(2)	Lift station back-up pumps
	(3)	Collection pipe network (inspection)
	(4)	Temporary leachate storage
X	(5)	Leachate treatment and disposal
X	(6)	Leachate storage/disposal contingency plan
X	(7)	Surface water monitoring
X	(L)	PCB and hazardous waste prevention and detection program

3745-37-01 License

X	(A)	Valid license

Corrective Actions Taken and Other Comments:

Picked Litter, Hauled Cover, Hauled Leachate, Graded Roads
AEC installing new Gas Lines & wells

Rob Carpenter — Signature of Person Completing Form

RB Carpenter — Print Name of Person Completing Form

1-30-12 — Date

This form should be retained on file for three years for inspection by the local health department, Ohio EPA, or an authorized representative. Failure to provide accurate daily operations information may be considered a violation of Ohio Revised Code § 2921.13.

Leachate: 8:10 AM 8'-7" 4:05 PM 7'-8"

Sumps 1 - 17.4
3 - 145.4
4 - 73.1

Revised: August 1, 2005

Municipal Solid Waste Landfill Facility Daily Log of Operations - Form 3

(Log Required by OAC 3745-27-19(E)(10))

Facility Name: APEX ENVIRONMENTAL Today's Date: 1-31-12

Facility Opened Today at (time): 24th Facility Closed Today at (time): _____

List Equipment in Operation at the Facility Today: TIPPER, ZT, MAT. HANDLER, 155, 6, 7, 345 836

List Weather Conditions on this Day: CLEAR - TEMPS IN 50

The Facility Operator shall inspect the facility daily for compliance with the applicable regulations including but not limited to the following:

Place an (X) on the line next to all aspects of facility operations which have been inspected today.

3745-27-05 Prohibited Disposal Methods

X (B) No Open Burning

3745-27-19 Operation of a Facility

X (E)(2)(a) Maintain access roads
X (b) Limited access to facility
X (c) Signs posted
X (d) Exclusion of animals
X (3)(a) Adequate fire equipment
X (b) Operable and adequate equipment
X (4) Improper salvaging
X (5) Trained employees
X (6) Preparation for inclement weather
X (7)(a) Leachate treatment/disposal
X (b) Phased operation
X (c) Confined unloading
X (d) Separation/control of flammable waste
X (e) Waste disposed at working face
X (f)(i) Compacting bulky items
X (ii) Minimizing dust generation
(8)(a) NESHAP reg. asbestos disposal
(b) Acceptance of liquids
(c) Acceptance of hazardous waste
(d) Acceptance of PCBs
(e) Acceptance of infectious waste
(f) Acceptance of yard waste
(g) Acceptance of scrap tires
(h) Acceptance of low level rad. waste
(I) Acceptance of semi-solid material w/free liquid

X (9) Control of scattered litter
X (10) Keeping of daily logs
X (11)(a) Daily inspection of facility for ponding, erosion, leachate outbreaks (record any corrective actions below).
X (12) Copy of auth. docs available
X (F) Daily cover
(3) Alternate Daily Cover Used (describe in comment section below)
(G) Intermediate cover
(H) Final cover
X (I) Scales
X (J)(1) Surface water diversion
X (2) Design in operating record
X (4) Surface water monitoring
X (K)(1) Leachate control
(2) Lift station back-up pumps
(3) Collection pipe network (inspection)
(4) Temporary leachate storage
X (5) Leachate treatment and disposal
X (6) Leachate storage/disposal contingency plan
X (7) Surface water monitoring
X (L) PCB and hazardous waste prevention and detection program

3745-37-01 License

X (A) Valid license

Corrective Actions Taken and Other Comments:

PICKED LITTER, HAULED COVER, HAULED LEACHATE, AEG, INSTALLING GAS LINES, LEACHATE OUTBREAKS ON EAST SLOP. MARKED ON MAP NOTIFIED SUPERVISOR

R.J. Carpenter — *Signature of Person Completing Form*

R.B CARPENTER — *Print Name of Person Completing Form*

1-31-12 — *Date*

This form should be retained on file for three years for inspection by the local health department, Ohio EPA, or an authorized representative. Failure to provide accurate daily operations information may be considered a violation of Ohio Revised Code § 2921.13.

LEACHATE - 8' @ 9:00 AM 6 @ 4:45 PM

Sumps 1 - 23.3
3 - 149.8
4 - 66.3

Municipal Solid Waste Landfill Facility Daily Log of Operations - Form 3

(Log Required by OAC 3745-27-19(E)(10))

Facility Name: Apex Environmental Today's Date: 2-1-12

Facility Opened Today at (time): 24 HR Facility Closed Today at (time):

List Equipment in Operation at the Facility Today: TiPAR, ET, 836, Allow, 6, 7, 155, 345, 328

List Weather Conditions on this Day: Cloudy Temps in 40's

The Facility Operator shall inspect the facility daily for compliance with the applicable regulations including but not limited to the following:

Place an (X) on the line next to all aspects of facility operations which have been inspected today.

3745-27-05 Prohibited Disposal Methods

X	(B)	No Open Burning

3745-27-19 Operation of a Facility

X	(E)(2)(a)	Maintain access roads
X	(b)	Limited access to facility
X	(c)	Signs posted
X	(d)	Exclusion of animals
X	(3)(a)	Adequate fire equipment
X	(b)	Operable and adequate equipment
X	(4)	Improper salvaging
X	(5)	Trained employees
X	(6)	Preparation for inclement weather
X	(7)(a)	Leachate treatment/disposal
X	(b)	Phased operation
X	(c)	Confined unloading
X	(d)	Separation/control of flammable waste
X	(e)	Waste disposed at working face
X	(f)(i)	Compacting bulky items
X	(ii)	Minimizing dust generation
	(8)(a)	NESHAP reg. asbestos disposal
	(b)	Acceptance of liquids
	(c)	Acceptance of hazardous waste
	(d)	Acceptance of PCBs
	(e)	Acceptance of infectious waste
	(f)	Acceptance of yard waste
	(g)	Acceptance of scrap tires
	(h)	Acceptance of low level rad. waste
	(I)	Acceptance of semi-solid material w/free liquid
X	(9)	Control of scattered litter
X	(10)	Keeping of daily logs
X	(11)(a)	Daily inspection of facility for ponding, erosion, leachate outbreaks (record any corrective actions below).
X	(12)	Copy of auth. does available
X	(F)	Daily cover
	(3)	Alternate Daily Cover Used (describe in comment section below)
	(G)	Intermediate cover
	(H)	Final cover
X	(I)	Scales
X	(J)(1)	Surface water diversion
X	(2)	Design in operating record
X	(4)	Surface water monitoring
X	(K)(1)	Leachate control
	(2)	Lift station back-up pumps
	(3)	Collection pipe network (inspection)
	(4)	Temporary leachate storage
X	(5)	Leachate treatment and disposal
X	(6)	Leachate storage/disposal contingency plan
X	(7)	Surface water monitoring
X	(L)	PCB and hazardous waste prevention and detection program

3745-37-01 License

X	(A)	Valid license

Corrective Actions Taken and Other Comments:

Picked Litter, Hauled Cover, Hauled Leachate, Grading Roads, AEG installing gas lines, Repaired Leachate out Breaks on East Slop.

Rob Carpenter
Signature of Person Completing Form

ROB CARPENTER
Print Name of Person Completing Form

2-1-12
Date

This form should be retained on file for three years for inspection by the local health department, Ohio EPA, or an authorized representative. Failure to provide accurate daily operations information may be considered a violation of Ohio Revised Code § 2921.13.

LEACHATE - 6.3 @ 9:00 AM

Sumps 1 - 17.6
3 - 148.8
4 - 51.6

Revised: August 1, 2005

Municipal Solid Waste Landfill Facility Daily Log of Operations - Form 3

(Log Required by OAC 3745-27-19(E)(10))

Facility Name: Apex Environmental Today's Date: 2-2-12

Facility Opened Today at (time): 24hr Facility Closed Today at (time):

List Equipment in Operation at the Facility Today: Tipper, IT, mat. Handler, 836, Alson, 345, 320, 6, 7, 155

List Weather Conditions on this Day: Cloudy - Temps in 40's

The Facility Operator shall inspect the facility daily for compliance with the applicable regulations including but not limited to the following:

Place an (X) on the line next to all aspects of facility operations which have been inspected today.

3745-27-05 Prohibited Disposal Methods

- X (B) No Open Burning

3745-27-19 Operation of a Facility

- X (E)(2)(a) Maintain access roads
- X (b) Limited access to facility
- X (c) Signs posted
- X (d) Exclusion of animals
- X (3)(a) Adequate fire equipment
- X (b) Operable and adequate equipment
- X (4) Improper salvaging
- X (5) Trained employees
- X (6) Preparation for inclement weather
- X (7)(a) Leachate treatment/disposal
- X (b) Phased operation
- X (c) Confined unloading
- X (d) Separation/control of flammable waste
- X (e) Waste disposed at working face
- X (f)(i) Compacting bulky items
- X (ii) Minimizing dust generation
- (8)(a) NESHAP reg. asbestos disposal
- (b) Acceptance of liquids
- (c) Acceptance of hazardous waste
- (d) Acceptance of PCBs
- (e) Acceptance of infectious waste
- (f) Acceptance of yard waste
- (g) Acceptance of scrap tires
- (h) Acceptance of low level rad. waste
- (I) Acceptance of semi-solid material w/free liquid
- X (9) Control of scattered litter
- X (10) Keeping of daily logs
- X (11)(a) Daily inspection of facility for ponding, erosion, leachate outbreaks (record any corrective actions below).
- X (12) Copy of auth. docs available
- X (F) Daily cover
- (3) Alternate Daily Cover Used (describe in comment section below)
- (G) Intermediate cover
- (H) Final cover
- X (I) Scales
- X (J)(1) Surface water diversion
- X (2) Design in operating record
- X (4) Surface water monitoring
- X (K)(1) Leachate control
- (2) Lift station back-up pumps
- (3) Collection pipe network (inspection)
- (4) Temporary leachate storage
- X (5) Leachate treatment and disposal
- X (6) Leachate storage/disposal contingency plan
- X (7) Surface water monitoring
- X (L) PCB and hazardous waste prevention and detection program

3745-37-01 License

- X (A) Valid license

Corrective Actions Taken and Other Comments:

Picked Litter, Hauled Cover, Hauled Leachate, Grading Roads, AEG, Installing new gas lines & new flare, Cleaning mud from North Road Edges.

Rob Carpenter — Signature of Person Completing Form

ROB CARPENTER — Print Name of Person Completing Form

2-2-12 — Date

This form should be retained on file for three years for inspection by the local health department, Ohio EPA, or an authorized representative. Failure to provide accurate daily operations information may be considered a violation of Ohio Revised Code § 2921.13.

LEACHATE - 5' @ 8:30 AM; 3'-6" @ 4:45 PM

Sumps 1 - 20.3 @ 9:00 AM; 3 - 148.8; 4 - 36.4

Sumps 1 - 20.7 @ 5:00 PM; 3 - 148.8; 4 - 48.6

Revised: August 2006

Ohio EPA Municipal Solid Waste Landfill Facility Daily Log of Operations - Form 3

(Log Required by OAC 3745-27-19(E)(10))

Facility Name: APEX ENVIRONMENTAL Today's Date: 2-3-12

Facility Opened Today at (time): 24 HR Facility Closed Today at (time): _____

List Equipment in Operation at the Facility Today: TIPPER, IT, MAT HANDLER 155, C, 7 345 BX, Allow 328

List Weather Conditions on this Day: Clear - Temps in 40's

The Facility Operator shall inspect the facility daily for compliance with the applicable regulations including but not limited to the following:

Place an (X) on the line next to all aspects of facility operations which have been inspected today.

3745-27-05 Prohibited Disposal Methods

X	(B)	No Open Burning

3745-27-19 Operation of a Facility

X	(E)(2)(a)	Maintain access roads
X	(b)	Limited access to facility
X	(c)	Signs posted
X	(d)	Exclusion of animals
X	(3)(a)	Adequate fire equipment
X	(b)	Operable and adequate equipment
X	(4)	Improper salvaging
X	(5)	Trained employees
X	(6)	Preparation for inclement weather
X	(7)(a)	Leachate treatment/disposal
X	(b)	Phased operation
X	(c)	Confined unloading
X	(d)	Separation/control of flammable waste
X	(e)	Waste disposed at working face
X	(f)(I)	Compacting bulky items
X	(ii)	Minimizing dust generation
	(8)(a)	NESHAP reg. asbestos disposal
	(b)	Acceptance of liquids
	(c)	Acceptance of hazardous waste
	(d)	Acceptance of PCBs
	(e)	Acceptance of infectious waste
	(f)	Acceptance of yard waste
	(g)	Acceptance of scrap tires
	(h)	Acceptance of low level rad. waste
	(i)	Acceptance of semi-solid material w/free liquid
X	(9)	Control of scattered litter
X	(10)	Keeping of daily logs
X	(11)(a)	Daily inspection of facility for ponding, erosion, leachate outbreaks (record any corrective actions below).
X	(12)	Copy of auth. does available
X	(F)	Daily cover
	(3)	Alternate Daily Cover Used (describe in comment section below)
	(G)	Intermediate cover
	(H)	Final cover
X	(I)	Scales
X	(J)(1)	Surface water diversion
X	(2)	Design in operating record
X	(4)	Surface water monitoring
X	(K)(1)	Leachate control
	(2)	Lift station back-up pumps
	(3)	Collection pipe network (inspection)
	(4)	Temporary leachate storage
X	(5)	Leachate treatment and disposal
X	(6)	Leachate storage/disposal contingency plan
X	(7)	Surface water monitoring
X	(L)	PCB and hazardous waste prevention and detection program

3745-37-01 License

X	(A)	Valid license

Corrective Actions Taken and Other Comments:

Picking LITTER, Hauling Cover AEG installing NEW GAS LINES Seeding EAST slope

Signature of Person Completing Form — ROB CARPENTER Print Name of Person Completing Form — 2-3-12 Date

This form should be retained on file for three years for inspection by the local health department, Ohio EPA, or an authorized representative. Failure to provide accurate daily operations information may be considered a violation of Ohio Revised Code § 2921.13.

LEACHATE - 3'4"

@ 8:00 AM

Sumps - 1 - 16.8

3 - 148.8

4 - 15.8

Revised: August 1, 2005

OhioEPA Municipal Solid Waste Landfill Facility Daily Log of Operations - Form 3

(Log Required by OAC 3745-27-19(E)(10))

Facility Name: Apex Environmental Today's Date: 2-4-12

Facility Opened Today at (time): 24hrs Facility Closed Today at (time): _____

List Equipment in Operation at the Facility Today: _____

List Weather Conditions on this Day: RAIN TO SNOW Lows 30's

The Facility Operator shall inspect the facility daily for compliance with the applicable regulations including but not limited to the following:

Place an (X) on the line next to all aspects of facility operations which have been inspected today.

3745-27-05 Prohibited Disposal Methods

X	(B)	No Open Burning

3745-27-19 Operation of a Facility

X	(E)(2)(a)	Maintain access roads
X	(b)	Limited access to facility
X	(c)	Signs posted
X	(d)	Exclusion of animals
X	(3)(a)	Adequate fire equipment
X	(b)	Operable and adequate equipment
X	(4)	Improper salvaging
X	(5)	Trained employees
X	(6)	Preparation for inclement weather
X	(7)(a)	Leachate treatment/disposal
X	(b)	Phased operation
X	(c)	Confined unloading
X	(d)	Separation/control of flammable waste
X	(e)	Waste disposed at working face
X	(f)(i)	Compacting bulky items
X	(ii)	Minimizing dust generation
	(8)(a)	NESHAP reg. asbestos disposal
	(b)	Acceptance of liquids
	(c)	Acceptance of hazardous waste
	(d)	Acceptance of PCBs
	(e)	Acceptance of infectious waste
	(f)	Acceptance of yard waste
	(g)	Acceptance of scrap tires
	(h)	Acceptance of low level rad. waste
	(i)	Acceptance of semi-solid material w/free liquid
X	(9)	Control of scattered litter
X	(10)	Keeping of daily logs
X	(11)(a)	Daily inspection of facility for ponding, erosion, leachate outbreaks (record any corrective actions below).
X	(12)	Copy of auth. docs available
X	(F)	Daily cover
	(3)	Alternate Daily Cover Used (describe in comment section below)
	(G)	Intermediate cover
	(H)	Final cover
X	(I)	Scales
X	(J)(1)	Surface water diversion
X	(2)	Design in operating record
X	(4)	Surface water monitoring
X	(K)(1)	Leachate control
	(2)	Lift station back-up pumps
	(3)	Collection pipe network (inspection)
	(4)	Temporary leachate storage
X	(5)	Leachate treatment and disposal
X	(6)	Leachate storage/disposal contingency plan
X	(7)	Surface water monitoring
X	(L)	PCB and hazardous waste prevention and detection program

3745-37-01 License

X	(A)	Valid license

Corrective Actions Taken and Other Comments:

Hauling cover covering, over the roads running, rail running Seeding on East Slope, working on sump #3

David L Bradnell — *Signature of Person Completing Form*

Daniel L Bradnell — *Print Name of Person Completing Form*

2-4-12 — *Date*

This form should be retained on file for three years for inspection by the local health department, Ohio EPA, or an authorized representative. Failure to provide accurate daily operations information may be considered a violation of Ohio Revised Code § 2921.13.

Leachate Tank

3' 5"

Sumps:

4 - 22.2

1 - 21.8

3 - 15.07

OhioEPA **Municipal Solid Waste Landfill Facility Daily Log of Operations - Form 3**
(Log Required by OAC 3745-27-19(E)(10))

Facility Name: Apex Environmental Today's Date: 2-5-12
Facility Opened Today at (time): 24hrs Facility Closed Today at (time):
List Equipment in Operation at the Facility Today: 2-IT's, material handler, D6R, D7R, 165, 328 Austons
List Weather Conditions on this Day: low 30's AM to clear, sunny 40's

The Facility Operator shall inspect the facility daily for compliance with the applicable regulations including but not limited to the following:

Place an (X) on the line next to all aspects of facility operations which have been inspected today.

3745-27-05 Prohibited Disposal Methods

X (B) No Open Burning

3745-27-19 Operation of a Facility

X (E)(2)(a) Maintain access roads
X (b) Limited access to facility
X (c) Signs posted
X (d) Exclusion of animals
X (3)(a) Adequate fire equipment
X (b) Operable and adequate equipment
X (4) Improper salvaging
X (5) Trained employees
X (6) Preparation for inclement weather
X (7)(a) Leachate treatment/disposal
X (b) Phased operation
X (c) Confined unloading
X (d) Separation/control of flammable waste
X (e) Waste disposed at working face
X (f)(i) Compacting bulky items
X (ii) Minimizing dust generation
— (8)(a) NESHAP reg. asbestos disposal
— (b) Acceptance of liquids
— (c) Acceptance of hazardous waste
— (d) Acceptance of PCBs
— (e) Acceptance of infectious waste
— (f) Acceptance of yard waste
— (g) Acceptance of scrap tires
— (h) Acceptance of low level rad. waste
— (i) Acceptance of semi-solid material w/free liquid

X (9) Control of scattered litter
X (10) Keeping of daily logs
X (11)(a) Daily inspection of facility for ponding, erosion, leachate outbreaks (record any corrective actions below).
X (12) Copy of auth. docs available
X (F) Daily cover
— (3) Alternate Daily Cover Used (describe in comment section below)
— (G) Intermediate cover
— (H) Final cover
X (I) Scales
X (J)(1) Surface water diversion
X (2) Design in operating record
X (4) Surface water monitoring
X (K)(1) Leachate control
— (2) Lift station back-up pumps
— (3) Collection pipe network (inspection)
— (4) Temporary leachate storage
X (5) Leachate treatment and disposal
X (6) Leachate storage/disposal contingency plan
X (7) Surface water monitoring
X (L) PCB and hazardous waste prevention and detection program

3745-37-01 License

X (A) Valid license

Corrective Actions Taken and Other Comments:
Rail only running, hauling, cover, covering work on access ramp

Daniel L Bardnell — *Signature of Person Completing Form*
Daniel L Bardnell — *Print Name of Person Completing Form*
2-5-12 — *Date*

This form should be retained on file for three years for inspection by the local health department, Ohio EPA, or an authorized representative. Failure to provide accurate daily operations information may be considered a violation of Ohio Revised Code § 2921.13.

Leachate Tank
3' 10"

Sumps 3 - 148.6 off (working on)
1 - 20.6
4 - 21.8

Municipal Solid Waste Landfill Facility Daily Log of Operations - Form 3

[Log Required by OAC 3745-27-19(E)(10)]

Facility Name: APEX ENVIRONMENTAL Today's Date: 2-6-12

Facility Opened Today at (time): 8AM Facility Closed Today at (time): _____

List Equipment in Operation at the Facility Today: TIPPER, ST, MAT. HANDLER, 836, AUGER, 6, 2, 345, 155, 329

List Weather Conditions on this Day: CLEAR - TEMPS IN 40'S

The Facility Operator shall inspect the facility daily for compliance with the applicable regulations including but not limited to the following:

Place an (X) on the line next to all aspects of facility operations which have been inspected today.

3745-27-05 Prohibited Disposal Methods

X	(B)	No Open Burning

3745-27-19 Operation of a Facility

X	(E)(2)(a)	Maintain access roads
X	(b)	Limited access to facility
X	(c)	Signs posted
X	(d)	Exclusion of animals
X	(3)(a)	Adequate fire equipment
X	(b)	Operable and adequate equipment
X	(4)	Improper salvaging
X	(5)	Trained employees
X	(6)	Preparation for inclement weather
X	(7)(a)	Leachate treatment/disposal
X	(b)	Phased operation
X	(c)	Confined unloading
X	(d)	Separation/control of flammable waste
X	(e)	Waste disposed at working face
X	(f)(i)	Compacting bulky items
X	(ii)	Minimizing dust generation
—	(8)(a)	NESHAP reg. asbestos disposal
—	(b)	Acceptance of liquids
—	(c)	Acceptance of hazardous waste
—	(d)	Acceptance of PCBs
—	(e)	Acceptance of infectious waste
—	(f)	Acceptance of yard waste
—	(g)	Acceptance of scrap tires
—	(h)	Acceptance of low level rad. waste
—	(i)	Acceptance of semi-solid material w/free liquid
X	(9)	Control of scattered litter
X	(10)	Keeping of daily logs
X	(11)(a)	Daily inspection of facility for ponding, erosion, leachate outbreaks (record any corrective actions below).
X	(12)	Copy of auth. does available
X	(F)	Daily cover
—	(3)	Alternate Daily Cover Used (describe in comment section below)
—	(G)	Intermediate cover
—	(H)	Final cover
X	(I)	Scales
X	(J)(1)	Surface water diversion
X	(2)	Design in operating record
X	(4)	Surface water monitoring
X	(K)(1)	Leachate control
—	(2)	Lift station back-up pumps
—	(3)	Collection pipe network (inspection)
—	(4)	Temporary leachate storage
X	(5)	Leachate treatment and disposal
X	(6)	Leachate storage/disposal contingency plan
X	(7)	Surface water monitoring
X	(L)	PCB and hazardous waste prevention and detection program

3745-37-01 License

X	(A)	Valid license

Corrective Actions Taken and Other Comments:

Picked litter, Hauled Cover, Hauled Leachate, Repaired Litter Fences, Got Liquid Levels on West Slope Wells.

R L Carpenter
Signature of Person Completing Form

ROB CARPENTER
Print Name of Person Completing Form

2-6-12
Date

This form should be retained on file for three years for inspection by the local health department, Ohio EPA, or an authorized representative. Failure to provide accurate daily operations information may be considered a violation of Ohio Revised Code § 2921.13.

LEACHATE - 4' @ 8:15 AM 3'3" @ 4:45 PM Sumps 1 - 20.3, 3 - 148.8, 4 - 23.3

Revised: August 1, 2005

Municipal Solid Waste Landfill Facility Daily Log of Operations - Form 3

(Log Required by OAC 3745-27-19(E)(10))

Facility Name: APEX ENVIRONMENTAL Today's Date: 2-7-12

Facility Opened Today at (time): 24HR Facility Closed Today at (time):

List Equipment in Operation at the Facility Today: TIPPER, IT, MAT. HANDLER, 836, AI/DOZ C, 7, 155, 345, 328

List Weather Conditions on this Day: CLEAR - TEMPS IN 40'S

The Facility Operator shall inspect the facility daily for compliance with the applicable regulations including but not limited to the following:

Place an (X) on the line next to all aspects of facility operations which have been inspected today.

3745-27-05 Prohibited Disposal Methods

X	(B)	No Open Burning

3745-27-19 Operation of a Facility

X	(E)(2)(a)	Maintain access roads
X	(b)	Limited access to facility
X	(c)	Signs posted
X	(d)	Exclusion of animals
X	(3)(a)	Adequate fire equipment
X	(b)	Operable and adequate equipment
X	(4)	Improper salvaging
X	(5)	Trained employees
X	(6)	Preparation for inclement weather
X	(7)(a)	Leachate treatment/disposal
X	(b)	Phased operation
X	(c)	Confined unloading
X	(d)	Separation/control of flammable waste
X	(e)	Waste disposed at working face
X	(i)(I)	Compacting bulky items
X	(ii)	Minimizing dust generation
	(8)(a)	NESHAP reg. asbestos disposal
	(b)	Acceptance of liquids
	(c)	Acceptance of hazardous waste
	(d)	Acceptance of PCBs
	(e)	Acceptance of infectious waste
	(f)	Acceptance of yard waste
	(g)	Acceptance of scrap tires
	(h)	Acceptance of low level rad. waste
	(I)	Acceptance of semi-solid material w/free liquid
X	(9)	Control of scattered litter
X	(10)	Keeping of daily logs
X	(11)(a)	Daily inspection of facility for ponding, erosion, leachate outbreaks (record any corrective actions below).
X	(12)	Copy of auth. does available
X	(F)	Daily cover
	(3)	Alternate Daily Cover Used (describe in comment section below)
	(G)	Intermediate cover
	(H)	Final cover
X	(I)	Scales
X	(J)(1)	Surface water diversion
X	(2)	Design in operating record
X	(4)	Surface water monitoring
X	(K)(1)	Leachate control
	(2)	Lift station back-up pumps
	(3)	Collection pipe network (inspection)
	(4)	Temporary leachate storage
X	(5)	Leachate treatment and disposal
X	(6)	Leachate storage/disposal contingency plan
X	(7)	Surface water monitoring
X	(L)	PCB and hazardous waste prevention and detection program

3745-37-01 License

X	(A)	Valid license

Corrective Actions Taken and Other Comments:

HAULED COVER, HAULED LEACHATE, GRADING ROADS

Rob Carpenter
Signature of Person Completing Form

ROB CARPENTER
Print Name of Person Completing Form

2-7-12
Date

This form should be retained on file for three years for inspection by the local health department, Ohio EPA, or an authorized representative. Failure to provide accurate daily operations information may be considered a violation of Ohio Revised Code § 2921.13.

LEACHATE - 3:15 @ 8:00AM

SUMPS 1 - 21.2
3 - 147.9
4 - 21.6

Revised: August 1, 2005

Municipal Solid Waste Landfill Facility Daily Log of Operations - Form 3

(Log Required by OAC 3745-27-19(E)(10))

Facility Name: APEX ENVIRONMENTAL Today's Date: 2-8-12

Facility Opened Today at (time): 24 HR Facility Closed Today at (time): _____

List Equipment in Operation at the Facility Today: TIPPER, IT, MAT. HANDLER, 836, ALJON 6, 7, 155, 345, 320

List Weather Conditions on this Day: SNOW - TEMPS IN 30'S

The Facility Operator shall inspect the facility daily for compliance with the applicable regulations including but not limited to the following:

Place an (X) on the line next to all aspects of facility operations which have been inspected today.

3745-27-05 Prohibited Disposal Methods

X	(B)	No Open Burning

3745-27-19 Operation of a Facility

X	(E)(2)(a)	Maintain access roads
X	(b)	Limited access to facility
X	(c)	Signs posted
X	(d)	Exclusion of animals
X	(3)(a)	Adequate fire equipment
X	(b)	Operable and adequate equipment
X	(4)	Improper salvaging
X	(5)	Trained employees
X	(6)	Preparation for inclement weather
X	(7)(a)	Leachate treatment/disposal
X	(b)	Phased operation
X	(c)	Confined unloading
X	(d)	Separation/control of flammable waste
X	(e)	Waste disposed at working face
X	(f)(i)	Compacting bulky items
X	(ii)	Minimizing dust generation
	(8)(a)	NESHAP reg. asbestos disposal
	(b)	Acceptance of liquids
	(c)	Acceptance of hazardous waste
	(d)	Acceptance of PCBs
	(e)	Acceptance of infectious waste
	(f)	Acceptance of yard waste
	(g)	Acceptance of scrap tires
	(h)	Acceptance of low level rad. waste
	(I)	Acceptance of semi-solid material w/free liquid
X	(9)	Control of scattered litter
X	(10)	Keeping of daily logs
X	(11)(a)	Daily inspection of facility for ponding, erosion, leachate outbreaks (record any corrective actions below).
X	(12)	Copy of auth. does available
X	(F)	Daily cover
	(3)	Alternate Daily Cover Used (describe in comment section below)
	(G)	Intermediate cover
	(H)	Final cover
X	(I)	Scales
X	(J)(1)	Surface water diversion
X	(2)	Design in operating record
X	(4)	Surface water monitoring
X	(K)(1)	Leachate control
	(2)	Lift station back-up pumps
	(3)	Collection pipe network (inspection)
	(4)	Temporary leachate storage
X	(5)	Leachate treatment and disposal
X	(6)	Leachate storage/disposal contingency plan
X	(7)	Surface water monitoring
X	(L)	PCB and hazardous waste prevention and detection program

3745-37-01 License

X	(A)	Valid license

Corrective Actions Taken and Other Comments:

PICK LITTER, HAULED COVER, GRADING ROADS, CLEANING DITCHES

Rob Carpenter
Signature of Person Completing Form

ROB CARPENTER
Print Name of Person Completing Form

2-8-12
Date

This form should be retained on file for three years for inspection by the local health department, Ohio EPA, or an authorized representative. Failure to provide accurate daily operations information may be considered a violation of Ohio Revised Code § 2921.13.

LEACHATE - 3'-16" @ 7:00 AM 3'-5" @ 4:00 PM

SUMPS - 1 - 22.9
3 - 19.2
4 - 21.1

Revised: August 1, 2005

Municipal Solid Waste Landfill Facility Daily Log of Operations - Form 3

(Log Required by OAC 3745-27-19(E)(10))

Facility Name: APEX ENVIRONMENTAL Today's Date: 2-9-12

Facility Opened Today at (time): 24 HR Facility Closed Today at (time): _____

List Equipment in Operation at the Facility Today: TIPPER, IT, MAT. HANDLER, 836, AIJAN 345, 6, 7, 328, 155

List Weather Conditions on this Day: CLEAR- TEMPS IN 30'S

The Facility Operator shall inspect the facility daily for compliance with the applicable regulations including but not limited to the following:

Place an (X) on the line next to all aspects of facility operations which have been inspected today.

3745-27-05 Prohibited Disposal Methods

X	(B)	No Open Burning

3745-27-19 Operation of a Facility

X	(E)(2)(a)	Maintain access roads
X	(b)	Limited access to facility
X	(c)	Signs posted
X	(d)	Exclusion of animals
X	(3)(a)	Adequate fire equipment
X	(b)	Operable and adequate equipment
X	(4)	Improper salvaging
X	(5)	Trained employees
X	(6)	Preparation for inclement weather
X	(7)(a)	Leachate treatment/disposal
X	(b)	Phased operation
X	(c)	Confined unloading
X	(d)	Separation/control of flammable waste
X	(e)	Waste disposed at working face
X	(f)(i)	Compacting bulky items
X	(ii)	Minimizing dust generation
	(8)(a)	NESHAP reg. asbestos disposal
	(b)	Acceptance of liquids
	(c)	Acceptance of hazardous waste
	(d)	Acceptance of PCBs
	(e)	Acceptance of infectious waste
	(f)	Acceptance of yard waste
	(g)	Acceptance of scrap tires
	(h)	Acceptance of low level rad. waste
	(i)	Acceptance of semi-solid material w/free liquid
X	(9)	Control of scattered litter
X	(10)	Keeping of daily logs
X	(11)(a)	Daily inspection of facility for ponding, erosion, leachate outbreaks (record any corrective actions below).
X	(12)	Copy of auth. does available
X	(F)	Daily cover
	(3)	Alternate Daily Cover Used (describe in comment section below)
	(G)	Intermediate cover
	(H)	Final cover
X	(I)	Scales
X	(J)(1)	Surface water diversion
X	(2)	Design in operating record
X	(4)	Surface water monitoring
X	(K)(1)	Leachate control
	(2)	Lift station back-up pumps
	(3)	Collection pipe network (inspection)
	(4)	Temporary leachate storage
X	(5)	Leachate treatment and disposal
X	(6)	Leachate storage/disposal contingency plan
X	(7)	Surface water monitoring
X	(L)	PCB and hazardous waste prevention and detection program

3745-37-01 License

X	(A)	Valid license

Corrective Actions Taken and Other Comments:

HAULED COVER, HAULED LEACHATE, GRADING ROADS, PUT SCALER AROUND #3 SUMP, CLEANING DITCHES

Rob Carpenter — *Signature of Person Completing Form*

ROB CARPENTER — *Print Name of Person Completing Form*

2-9-12 — *Date*

This form should be retained on file for three years for inspection by the local health department, Ohio EPA, or an authorized representative. Failure to provide accurate daily operations information may be considered a violation of Ohio Revised Code § 2921.13.

LEACHATE - 3'11"
@
8:10 AM

SUMPS. 1 - 16.0
3 - 78.7
4 - 23.4

Revised: August 1, 2005

Municipal Solid Waste Landfill Facility Daily Log of Operations - Form 3

(Log Required by OAC 3745-27-19(E)(10))

Facility Name: Apex Environmental Today's Date: 2-12-12

Facility Opened Today at (time): 24 hrs Facility Closed Today at (time): _____

List Equipment in Operation at the Facility Today: D6T, 155, 325, IT, Material handler, D7R, PC270

List Weather Conditions on this Day: Snow Showers windy 19° am

The Facility Operator shall inspect the facility daily for compliance with the applicable regulations including but not limited to the following:

Place an (X) on the line next to all aspects of facility operations which have been inspected today.

3745-27-05 Prohibited Disposal Methods

X	(B)	No Open Burning

3745-27-19 Operation of a Facility

X	(E)(2)(a)	Maintain access roads
X	(b)	Limited access to facility
X	(c)	Signs posted
X	(d)	Exclusion of animals
X	(3)(a)	Adequate fire equipment
X	(b)	Operable and adequate equipment
X	(4)	Improper salvaging
X	(5)	Trained employees
X	(6)	Preparation for inclement weather
X	(7)(a)	Leachate treatment/disposal
X	(b)	Phased operation
X	(c)	Confined unloading
X	(d)	Separation/control of flammable waste
X	(e)	Waste disposed at working face
X	(f)(i)	Compacting bulky items
X	(ii)	Minimizing dust generation
—	(8)(a)	NESHAP reg. asbestos disposal
—	(b)	Acceptance of liquids
—	(c)	Acceptance of hazardous waste
—	(d)	Acceptance of PCBs
—	(e)	Acceptance of infectious waste
—	(f)	Acceptance of yard waste
—	(g)	Acceptance of scrap tires
—	(h)	Acceptance of low level rad. waste
—	(i)	Acceptance of semi-solid material w/free liquid
X	(9)	Control of scattered litter
X	(10)	Keeping of daily logs
X	(11)(a)	Daily inspection of facility for ponding, erosion, leachate outbreaks (record any corrective actions below).
X	(12)	Copy of auth. docs available
X	(F)	Daily cover
—	(3)	Alternate Daily Cover Used (describe in comment section below)
—	(G)	Intermediate cover
—	(H)	Final cover
X	(I)	Scales
X	(J)(1)	Surface water diversion
X	(2)	Design in operating record
X	(4)	Surface water monitoring
X	(K)(1)	Leachate control
—	(2)	Lift station back-up pumps
—	(3)	Collection pipe network (inspection)
—	(4)	Temporary leachate storage
X	(5)	Leachate treatment and disposal
X	(6)	Leachate storage/disposal contingency plan
X	(7)	Surface water monitoring
X	(L)	PCB and hazardous waste prevention and detection program

3745-37-01 License

X	(A)	Valid license

Corrective Actions Taken and Other Comments:

Rail only running, hauling cover, covering

Daniel L Bradwell — *Signature of Person Completing Form*

Daniel L Bradwell — *Print Name of Person Completing Form*

2-12-12 — *Date*

This form should be retained on file for three years for inspection by the local health department, Ohio EPA, or an authorized representative. Failure to provide accurate daily operations information may be considered a violation of Ohio Revised Code § 2921.13.

Leachate Tank 3' 6"

Sumps- 3-122.0
1- 21.2
4- 19.9

Revised: August 1, 2005

Municipal Solid Waste Landfill Facility Daily Log of Operations - Form 3

(Log Required by OAC 3745-27-19(E)(10))

Facility Name: APEX ENVIRONMENTAL Today's Date: 2-13-12

Facility Opened Today at (time): 7AM Facility Closed Today at (time): _____

List Equipment in Operation at the Facility Today: TIPPER, IT, MAT. HANDLER, 836 A John, 155, 348, 6, 7

List Weather Conditions on this Day: clear. cold. Temps in 20's

The Facility Operator shall inspect the facility daily for compliance with the applicable regulations including but not limited to the following:

Place an (X) on the line next to all aspects of facility operations which have been inspected today.

3745-27-05 Prohibited Disposal Methods

X	(B)	No Open Burning

3745-27-19 Operation of a Facility

X	(E)(2)(a)	Maintain access roads
X	(b)	Limited access to facility
X	(c)	Signs posted
X	(d)	Exclusion of animals
X	(3)(a)	Adequate fire equipment
X	(b)	Operable and adequate equipment
X	(4)	Improper salvaging
X	(5)	Trained employees
X	(6)	Preparation for inclement weather
X	(7)(a)	Leachate treatment/disposal
X	(b)	Phased operation
X	(c)	Confined unloading
X	(d)	Separation/control of flammable waste
X	(e)	Waste disposed at working face
X	(f)(i)	Compacting bulky items
X	(ii)	Minimizing dust generation
	(8)(a)	NESHAP reg. asbestos disposal
	(b)	Acceptance of liquids
	(c)	Acceptance of hazardous waste
	(d)	Acceptance of PCBs
	(e)	Acceptance of infectious waste
	(f)	Acceptance of yard waste
	(g)	Acceptance of scrap tires
	(h)	Acceptance of low level rad. waste
	(i)	Acceptance of semi-solid material w/free liquid
X	(9)	Control of scattered litter
X	(10)	Keeping of daily logs
X	(11)(a)	Daily inspection of facility for ponding, erosion, leachate outbreaks (record any corrective actions below).
X	(12)	Copy of auth. docs available
X	(F)	Daily cover
	(3)	Alternate Daily Cover Used (describe in comment section below)
	(G)	Intermediate cover
	(H)	Final cover
X	(I)	Scales
X	(J)(1)	Surface water diversion
X	(2)	Design in operating record
X	(4)	Surface water monitoring
X	(K)(1)	Leachate control
	(2)	Lift station back-up pumps
	(3)	Collection pipe network (inspection)
	(4)	Temporary leachate storage
X	(5)	Leachate treatment and disposal
X	(6)	Leachate storage/disposal contingency plan
X	(7)	Surface water monitoring
X	(L)	PCB and hazardous waste prevention and detection program

3745-37-01 License

X	(A)	Valid license

Corrective Actions Taken and Other Comments:

Hauled cover, AEG installing new gas lines

Rob Carpenter — *Signature of Person Completing Form*

ROB CARPENTER — *Print Name of Person Completing Form*

2-13-12 — *Date*

This form should be retained on file for three years for inspection by the local health department, Ohio EPA, or an authorized representative. Failure to provide accurate daily operations information may be considered a violation of Ohio Revised Code § 2921.13.

LEACHATE - 0

CABLE FROZE UP.

Sumps 1 - 22.8
3 - 52.1
4 - 22.8

Municipal Solid Waste Landfill Facility Daily Log of Operations - Form 3

(Log Required by OAC 3745-27-19(E)(10))

Facility Name: APEX ENVIRONMENTAL Today's Date: 2-14-12.

Facility Opened Today at (time): 24HR Facility Closed Today at (time): _____

List Equipment in Operation at the Facility Today: TIPPER, IT, MAT. HANDLER, 836 ARJOW 345, 22, 6, 7, IT5

List Weather Conditions on this Day: LIGHT SNOW. TEMPS IN 30'S

The Facility Operator shall inspect the facility daily for compliance with the applicable regulations including but not limited to the following:

Place an (X) on the line next to all aspects of facility operations which have been inspected today.

3745-27-05 Prohibited Disposal Methods

X	(B)	No Open Burning

3745-27-19 Operation of a Facility

X	(E)(2)(a)	Maintain access roads
X	(b)	Limited access to facility
X	(c)	Signs posted
X	(d)	Exclusion of animals
X	(3)(a)	Adequate fire equipment
X	(b)	Operable and adequate equipment
X	(4)	Improper salvaging
X	(5)	Trained employees
X	(6)	Preparation for inclement weather
X	(7)(a)	Leachate treatment/disposal
X	(b)	Phased operation
X	(c)	Confined unloading
X	(d)	Separation/control of flammable waste
X	(e)	Waste disposed at working face
X	(f)(i)	Compacting bulky items
X	(ii)	Minimizing dust generation
	(8)(a)	NESHAP reg. asbestos disposal
	(b)	Acceptance of liquids
	(c)	Acceptance of hazardous waste
	(d)	Acceptance of PCBs
	(e)	Acceptance of infectious waste
	(f)	Acceptance of yard waste
	(g)	Acceptance of scrap tires
	(h)	Acceptance of low level rad. waste
	(i)	Acceptance of semi-solid material w/free liquid
X	(9)	Control of scattered litter
X	(10)	Keeping of daily logs
X	(11)(a)	Daily inspection of facility for ponding, erosion, leachate outbreaks (record any corrective actions below).
X	(12)	Copy of auth. does available
X	(F)	Daily cover
	(3)	Alternate Daily Cover Used (describe in comment section below)
	(G)	Intermediate cover
	(H)	Final cover
X	(I)	Scales
X	(J)(1)	Surface water diversion
X	(2)	Design in operating record
X	(4)	Surface water monitoring
X	(K)(1)	Leachate control
	(2)	Lift station back-up pumps
	(3)	Collection pipe network (inspection)
	(4)	Temporary leachate storage
X	(5)	Leachate treatment and disposal
X	(6)	Leachate storage/disposal contingency plan
X	(7)	Surface water monitoring
X	(L)	PCB and hazardous waste prevention and detection program

3745-37-01 License

X	(A)	Valid license

Corrective Actions Taken and Other Comments:

PICKED LITTER, HAULED COVER, HAULED LEACHATE, MEG. INSTALLING NEW GAS LINES ON WEST SLOPE

R/ Carpenter — *Signature of Person Completing Form*

ROB CARPENTER — *Print Name of Person Completing Form*

2-14-12 — *Date*

This form should be retained on file for three years for inspection by the local health department, Ohio EPA, or an authorized representative. Failure to provide accurate daily operations information may be considered a violation of Ohio Revised Code § 2921.13.

LEACHATE- 4'-10" @ 11:00 AM

SUMPS 1 - 22.7
3 - 20.5
4 - 22.2

Revised: August 1, 2005

OhioEPA Municipal Solid Waste Landfill Facility Daily Log of Operations - Form 3

(Log Required by OAC 3745-27-19(E)(10))

Facility Name: Apex Environmental Today's Date: 2-15-12

Facility Opened Today at (time): 24 Facility Closed Today at (time): _____

List Equipment in Operation at the Facility Today: A450N, 328, D7, 155, A450N, ET, Tipper material handler

List Weather Conditions on this Day: Low 30's am to 40 pm clear

The Facility Operator shall inspect the facility daily for compliance with the applicable regulations including but not limited to the following:

Place an (X) on the line next to all aspects of facility operations which have been inspected today.

3745-27-05 Prohibited Disposal Methods

X (B) No Open Burning

3745-27-19 Operation of a Facility

X (E)(2)(a) Maintain access roads
X (b) Limited access to facility
X (c) Signs posted
X (d) Exclusion of animals
X (3)(a) Adequate fire equipment
X (b) Operable and adequate equipment
X (4) Improper salvaging
X (5) Trained employees
X (6) Preparation for inclement weather
X (7)(a) Leachate treatment/disposal
X (b) Phased operation
X (c) Confined unloading
X (d) Separation/control of flammable waste
X (e) Waste disposed at working face
X (f)(I) Compacting bulky items
X (ii) Minimizing dust generation
— (8)(a) NESHAP reg. asbestos disposal
— (b) Acceptance of liquids
— (c) Acceptance of hazardous waste
— (d) Acceptance of PCBs
— (e) Acceptance of infectious waste
— (f) Acceptance of yard waste
— (g) Acceptance of scrap tires
— (h) Acceptance of low level rad. waste
— (I) Acceptance of semi-solid material w/free liquid
X (9) Control of scattered litter
X (10) Keeping of daily logs
X (11)(a) Daily inspection of facility for ponding, erosion, leachate outbreaks (record any corrective actions below).
X (12) Copy of auth. docs available
X (F) Daily cover
— (3) Alternate Daily Cover Used (describe in comment section below)
— (G) Intermediate cover
— (H) Final cover
X (I) Scales
X (J)(1) Surface water diversion
X (2) Design in operating record
X (4) Surface water monitoring
X (K)(1) Leachate control
— (2) Lift station back-up pumps
— (3) Collection pipe network (inspection)
— (4) Temporary leachate storage
X (5) Leachate treatment and disposal
X (6) Leachate storage/disposal contingency plan
X (7) Surface water monitoring
X (L) PCB and hazardous waste prevention and detection program

3745-37-01 License

X (A) Valid license

Corrective Actions Taken and Other Comments:

found several gas bubbles, Relayed to Tony to Dave, Rail and over the roads running, hauling cover, Installing gas Lines, covering by Ryan

Daniel L Beaver — Signature of Person Completing Form

Daniel L Beaver — Print Name of Person Completing Form

2/15/12 — Date

This form should be retained on file for three years for inspection by the local health department, Ohio EPA, or an authorized representative. Failure to provide accurate daily operations information may be considered a violation of Ohio Revised Code § 2921.13.

Leachate Tank 4' 7"

Sumps 3-1060
1-23.2
4-21.6

Municipal Solid Waste Landfill Facility Daily Log of Operations - Form 3

(Log Required by OAC 3745-27-19(E)(10))

Facility Name: Apex Environmental Today's Date: 7-16-12

Facility Opened Today at (time): 24hrs Facility Closed Today at (time): _____

List Equipment in Operation at the Facility Today: D6, D7, D8, Loader, Excavator, Tipper, rail trucks, grader, Rock trucks

List Weather Conditions on this Day: Rainy, Mid 40s Mild winds around 5mph

The Facility Operator shall inspect the facility daily for compliance with the applicable regulations including but not limited to the following:

Place an (X) on the line next to all aspects of facility operations which have been inspected today.

3745-27-05 Prohibited Disposal Methods

X	(B)	No Open Burning

3745-27-19 Operation of a Facility

X	(E)(2)(a)	Maintain access roads
X	(b)	Limited access to facility
X	(c)	Signs posted
X	(d)	Exclusion of animals
X	(3)(a)	Adequate fire equipment
X	(b)	Operable and adequate equipment
X	(4)	Improper salvaging
X	(5)	Trained employees
X	(6)	Preparation for inclement weather
X	(7)(a)	Leachate treatment/disposal
X	(b)	Phased operation
X	(c)	Confined unloading
X	(d)	Separation/control of flammable waste
X	(e)	Waste disposed at working face
X	(i)(I)	Compacting bulky items
	(ii)	Minimizing dust generation
	(8)(a)	NESHAP reg. asbestos disposal
	(b)	Acceptance of liquids
	(c)	Acceptance of hazardous waste
	(d)	Acceptance of PCBs
	(e)	Acceptance of infectious waste
	(f)	Acceptance of yard waste
	(g)	Acceptance of scrap tires
	(h)	Acceptance of low level rad. waste
	(I)	Acceptance of semi-solid material w/free liquid
X	(9)	Control of scattered litter
X	(10)	Keeping of daily logs
X	(11)(a)	Daily inspection of facility for ponding, erosion, leachate outbreaks (record any corrective actions below).
X	(12)	Copy of auth. docs available
X	(F)	Daily cover
	(3)	Alternate Daily Cover Used (describe in comment section below)
	(G)	Intermediate cover
	(H)	Final cover
X	(I)	Scales
X	(J)(1)	Surface water diversion
X	(2)	Design in operating record
X	(4)	Surface water monitoring
X	(K)(1)	Leachate control
	(2)	Lift station back-up pumps
	(3)	Collection pipe network (inspection)
	(4)	Temporary leachate storage
X	(5)	Leachate treatment and disposal
X	(6)	Leachate storage/disposal contingency plan
X	(7)	Surface water monitoring
X	(L)	PCB and hazardous waste prevention and detection program

3745-37-01 License

X	(A)	Valid license

Corrective Actions Taken and Other Comments:

rail and over the rock, grading roads, hauling rock and dirt

Signature of Person Completing Form *Print Name of Person Completing Form* *Date*

This form should be retained on file for three years for inspection by the local health department, Ohio EPA, or an authorized representative. Failure to provide accurate daily operations information may be considered a violation of Ohio Revised Code § 2921.13.

Leachate tank 4' 10"

Sumps 4 - 22.6
1 - 22.6
3 - 91.5

Municipal Solid Waste Landfill Facility Daily Log of Operations - Form 3

(Log Required by OAC 3745-27-19(E)(10))

Facility Name: Apex Environmental Today's Date: 2-17-12

Facility Opened Today at (time): 24hrs Facility Closed Today at (time): _____

List Equipment in Operation at the Facility Today: Tipper, 155, Material Handler, 328, Alison D7R, D6T, D7R

List Weather Conditions on this Day: Low 30's am to mid 30's low 40's pm cloudy

The Facility Operator shall inspect the facility daily for compliance with the applicable regulations including but not limited to the following:

Place an (X) on the line next to all aspects of facility operations which have been inspected today.

3745-27-05 Prohibited Disposal Methods

X	(B)	No Open Burning

3745-27-19 Operation of a Facility

X	(E)(2)(a)	Maintain access roads
X	(b)	Limited access to facility
X	(c)	Signs posted
X	(d)	Exclusion of animals
X	(3)(a)	Adequate fire equipment
X	(b)	Operable and adequate equipment
X	(4)	Improper salvaging
X	(5)	Trained employees
X	(6)	Preparation for inclement weather
X	(7)(a)	Leachate treatment/disposal
X	(b)	Phased operation
X	(c)	Confined unloading
X	(d)	Separation/control of flammable waste
X	(e)	Waste disposed at working face
X	(I)(i)	Compacting bulky items
X	(ii)	Minimizing dust generation
—	(8)(a)	NESHAP reg. asbestos disposal
—	(b)	Acceptance of liquids
—	(c)	Acceptance of hazardous waste
—	(d)	Acceptance of PCBs
—	(e)	Acceptance of infectious waste
—	(f)	Acceptance of yard waste
—	(g)	Acceptance of scrap tires
—	(h)	Acceptance of low level rad. waste
—	(i)	Acceptance of semi-solid material w/free liquid
X	(9)	Control of scattered litter
X	(10)	Keeping of daily logs
X	(11)(a)	Daily inspection of facility for ponding, erosion, leachate outbreaks (record any corrective actions below).
X	(12)	Copy of auth. docs available
X	(F)	Daily cover
—	(3)	Alternate Daily Cover Used (describe in comment section below)
—	(G)	Intermediate cover
—	(H)	Final cover
X	(I)	Scales
X	(J)(1)	Surface water diversion
X	(2)	Design in operating record
X	(4)	Surface water monitoring
X	(K)(1)	Leachate control
—	(2)	Lift station back-up pumps
—	(3)	Collection pipe network (inspection)
—	(4)	Temporary leachate storage
X	(5)	Leachate treatment and disposal
X	(6)	Leachate storage/disposal contingency plan
X	(7)	Surface water monitoring
X	(L)	PCB and hazardous waste prevention and detection program

3745-37-01 License

X	(A)	Valid license

Corrective Actions Taken and Other Comments:

Pull and cover the roads running, hauling cover, drilling and installing gas lines, Tough #2 mp. cap has been repaired by Ryan - need pictures. hauling leachate.

Daniel L Bradwell Daniel L Bradwell 2-17-12

Signature of Person Completing Form *Print Name of Person Completing Form* *Date*

This form should be retained on file for three years for inspection by the local health department, Ohio EPA, or an authorized representative. Failure to provide accurate daily operations information may be considered a violation of Ohio Revised Code § 2921.13.

Leachate Tank 3'11"

Sumps 3. 108.1
1 21.9
4 20.4

Municipal Solid Waste Landfill Facility Daily Log of Operations - Form 3

(Log Required by OAC 3745-27-19(E)(10))

Facility Name: APex Environmental Today's Date: 2-18-17

Facility Opened Today at (time): 24hrs Facility Closed Today at (time): _____

List Equipment in Operation at the Facility Today: D6, D7, D8, Loader, taylog Forklift, Cat rental, water truck, rail trucks, Rock truck, excavators, compactor

List Weather Conditions on this Day: Sunny, 15-20 mph winds to the NE and E at 36°F

The Facility Operator shall inspect the facility daily for compliance with the applicable regulations including but not limited to the following:

Place an (X) on the line next to all aspects of facility operations which have been inspected today.

3745-27-05 Prohibited Disposal Methods

X	(B)	No Open Burning

3745-27-19 Operation of a Facility

X	(E)(2)(a)	Maintain access roads
X	(b)	Limited access to facility
X	(c)	Signs posted
X	(d)	Exclusion of animals
X	(3)(a)	Adequate fire equipment
X	(b)	Operable and adequate equipment
X	(4)	Improper salvaging
X	(5)	Trained employees
X	(6)	Preparation for inclement weather
X	(7)(a)	Leachate treatment/disposal
X	(b)	Phased operation
X	(c)	Confined unloading
X	(d)	Separation/control of flammable waste
X	(e)	Waste disposed at working face
X	(I)(1)	Compacting bulky items
X	(ii)	Minimizing dust generation
	(8)(a)	NESHAP reg. asbestos disposal
	(b)	Acceptance of liquids
	(c)	Acceptance of hazardous waste
	(d)	Acceptance of PCBs
	(e)	Acceptance of infectious waste
	(f)	Acceptance of yard waste
	(g)	Acceptance of scrap tires
	(h)	Acceptance of low level rad. waste
	(i)	Acceptance of semi-solid material w/free liquid
X	(9)	Control of scattered litter
X	(10)	Keeping of daily logs
X	(11)(a)	Daily inspection of facility for ponding, erosion, leachate outbreaks (record any corrective actions below).
X	(12)	Copy of auth. docs available
X	(F)	Daily cover
	(3)	Alternate Daily Cover Used (describe in comment section below)
	(G)	Intermediate cover
	(H)	Final cover
X	(I)	Scales
X	(J)(1)	Surface water diversion
X	(2)	Design in operating record
X	(4)	Surface water monitoring
X	(K)(1)	Leachate control
	(2)	Lift station back-up pumps
	(3)	Collection pipe network (inspection)
	(4)	Temporary leachate storage
X	(5)	Leachate treatment and disposal
X	(6)	Leachate storage/disposal contingency plan
X	(7)	Surface water monitoring
X	(L)	PCB and hazardous waste prevention and detection program

3745-37-01 License

X	(A)	Valid license

Corrective Actions Taken and Other Comments:

Mail and over the roads, digging trenches for pipes, Dozing Down ruts, Compacting and Dozing trash

Signature of Person Completing Form *Print Name of Person Completing Form* *Date*

This form should be retained on file for three years for inspection by the local health department, Ohio EPA, or an authorized representative. Failure to provide accurate daily operations information may be considered a violation of Ohio Revised Code § 2921.13.

Leachate tank - 3'10"

Sumps 4 - 20.7

1 - 20.1

3 - 1109

Municipal Solid Waste Landfill Facility Daily Log of Operations - Form 3

(Log Required by OAC 3745-27-19(E)(10))

Facility Name: Apex Environmental Today's Date: 2-19-12

Facility Opened Today at (time): 24 hrs Facility Closed Today at (time): _____

List Equipment in Operation at the Facility Today: D6T, 155, Alton, IT, Material handler D7R, 328, 325

List Weather Conditions on this Day: 20's AM TO clear and 30's PM

The Facility Operator shall inspect the facility daily for compliance with the applicable regulations including but not limited to the following:

Place an (X) on the line next to all aspects of facility operations which have been inspected today.

3745-27-05 Prohibited Disposal Methods

- X (B) No Open Burning

3745-27-19 Operation of a Facility

- X (E)(2)(a) Maintain access roads
- X (b) Limited access to facility
- X (c) Signs posted
- X (d) Exclusion of animals
- X (3)(a) Adequate fire equipment
- X (b) Operable and adequate equipment
- X (4) Improper salvaging
- X (5) Trained employees
- X (6) Preparation for inclement weather
- X (7)(a) Leachate treatment/disposal
- X (b) Phased operation
- X (c) Confined unloading
- X (d) Separation/control of flammable waste
- X (e) Waste disposed at working face
- X (i)(I) Compacting bulky items
- X (ii) Minimizing dust generation
- — (8)(a) NESHAP reg. asbestos disposal
- — (b) Acceptance of liquids
- — (c) Acceptance of hazardous waste
- — (d) Acceptance of PCBs
- — (e) Acceptance of infectious waste
- — (f) Acceptance of yard waste
- — (g) Acceptance of scrap tires
- — (h) Acceptance of low level rad. waste
- — (I) Acceptance of semi-solid material w/free liquid
- X (9) Control of scattered litter
- X (10) Keeping of daily logs
- X (11)(a) Daily inspection of facility for ponding, erosion, leachate outbreaks (record any corrective actions below).
- X (12) Copy of auth. docs available
- X (F) Daily cover
- — (3) Alternate Daily Cover Used (describe in comment section below)
- — (G) Intermediate cover
- — (H) Final cover
- X (I) Scales
- X (J)(1) Surface water diversion
- X (2) Design in operating record
- X (4) Surface water monitoring
- X (K)(1) Leachate control
- — (2) Lift station back-up pumps
- — (3) Collection pipe network (inspection)
- — (4) Temporary leachate storage
- X (5) Leachate treatment and disposal
- X (6) Leachate storage/disposal contingency plan
- X (7) Surface water monitoring
- X (L) PCB and hazardous waste prevention and detection program

3745-37-01 License

- X (A) Valid license

Corrective Actions Taken and Other Comments:

Rail only running, drilling gas walls, working on gas lines worked on Sump, pumps pulled and cleaned. hauling cover, covering

Daniel L Brodnax Daniel L Brodnax 2-19-12

Signature of Person Completing Form *Print Name of Person Completing Form* *Date*

This form should be retained on file for three years for inspection by the local health department, Ohio EPA, or an authorized representative. Failure to provide accurate daily operations information may be considered a violation of Ohio Revised Code § 2921.13.

Leachate Tank

4' 5"

Sumps - 3 - 113.2

1-21.0

4-24.1

OhioEPA Municipal Solid Waste Landfill Facility Daily Log of Operations - Form 3

(Log Required by OAC 3745-27-19(E)(10))

Facility Name: Apex Environmental Today's Date: 2-20-12

Facility Opened Today at (time): 24 hrs Facility Closed Today at (time): _____

List Equipment in Operation at the Facility Today: _____

List Weather Conditions on this Day: M.d 20's AM To 40's PM Sunny & Clear

The Facility Operator shall inspect the facility daily for compliance with the applicable regulations including but not limited to the following:

Place an (X) on the line next to all aspects of facility operations which have been inspected today.

3745-27-05 Prohibited Disposal Methods

X (B) No Open Burning

3745-27-19 Operation of a Facility

X (E)(2)(a) Maintain access roads
X (b) Limited access to facility
X (c) Signs posted
X (d) Exclusion of animals
X (3)(a) Adequate fire equipment
X (b) Operable and adequate equipment
X (4) Improper salvaging
X (5) Trained employees
X (6) Preparation for inclement weather
X (7)(a) Leachate treatment/disposal
X (b) Phased operation
X (c) Confined unloading
X (d) Separation/control of flammable waste
X (e) Waste disposed at working face
X (I)(I) Compacting bulky items
X (ii) Minimizing dust generation
— (8)(a) NESHAP reg. asbestos disposal
— (b) Acceptance of liquids
— (c) Acceptance of hazardous waste
— (d) Acceptance of PCBs
— (e) Acceptance of infectious waste
— (f) Acceptance of yard waste
— (g) Acceptance of scrap tires
— (h) Acceptance of low level rad. waste
— (I) Acceptance of semi-solid material w/free liquid
X (9) Control of scattered litter
X (10) Keeping of daily logs
X (11)(a) Daily inspection of facility for ponding, erosion, leachate outbreaks (record any corrective actions below).
X (12) Copy of auth. does available
X (F) Daily cover
— (3) Alternate Daily Cover Used (describe in comment section below)
— (G) Intermediate cover
— (H) Final cover
X (I) Scales
X (J)(1) Surface water diversion
X (2) Design in operating record
X (4) Surface water monitoring
X (K)(1) Leachate control
— (2) Lift station back-up pumps
— (3) Collection pipe network (inspection)
— (4) Temporary leachate storage
X (5) Leachate treatment and disposal
X (6) Leachate storage/disposal contingency plan
X (7) Surface water monitoring
X (L) PCB and hazardous waste prevention and detection program

3745-37-01 License

X (A) Valid license

Corrective Actions Taken and Other Comments:

Roll over the roads running, hauling cover, covering, drilling gas wells, installing gas lines, watering roads.

Daniel R Bendwell
Signature of Person Completing Form

Daniel C Bendwell
Print Name of Person Completing Form

2-20-12
Date

This form should be retained on file for three years for inspection by the local health department, Ohio EPA, or an authorized representative. Failure to provide accurate daily operations information may be considered a violation of Ohio Revised Code § 2921.13.

Leachate Tank 6'4"

Sumps 3 - 82
1 - 19.1
4 - 22.2

Revised: August 1, 2005

OhioEPA Municipal Solid Waste Landfill Facility Daily Log of Operations - Form 3

(Log Required by OAC 3745-27-19(E)(10))

Facility Name: Apex Environmental Today's Date: 2-21-12

Facility Opened Today at (time): 24hrs. Facility Closed Today at (time): _____

List Equipment in Operation at the Facility Today: 16G, Tipper, 325, D7R, IT, DGR

List Weather Conditions on this Day: high 20's am to snow and rain shower pm mid 40's

The Facility Operator shall inspect the facility daily for compliance with the applicable regulations including but not limited to the following:

Place an (X) on the line next to all aspects of facility operations which have been inspected today.

3745-27-05 Prohibited Disposal Methods

X	(B)	No Open Burning

3745-27-19 Operation of a Facility

X	(E)(2)(a)	Maintain access roads
X	(b)	Limited access to facility
X	(c)	Signs posted
X	(d)	Exclusion of animals
X	(3)(a)	Adequate fire equipment
X	(b)	Operable and adequate equipment
X	(4)	Improper salvaging
X	(5)	Trained employees
X	(6)	Preparation for inclement weather
X	(7)(a)	Leachate treatment/disposal
X	(b)	Phased operation
X	(c)	Confined unloading
X	(d)	Separation/control of flammable waste
X	(e)	Waste disposed at working face
X	(I)(I)	Compacting bulky items
X	(ii)	Minimizing dust generation
	(8)(a)	NESHAP reg. asbestos disposal
	(b)	Acceptance of liquids
	(c)	Acceptance of hazardous waste
	(d)	Acceptance of PCBs
	(e)	Acceptance of infectious waste
	(f)	Acceptance of yard waste
	(g)	Acceptance of scrap tires
	(h)	Acceptance of low level rad. waste
	(I)	Acceptance of semi-solid material w/free liquid
X	(9)	Control of scattered litter
X	(10)	Keeping of daily logs
X	(11)(a)	Daily inspection of facility for ponding, erosion, leachate outbreaks (record any corrective actions below).
X	(12)	Copy of auth. does available
X	(F)	Daily cover
	(3)	Alternate Daily Cover Used (describe in comment section below)
	(G)	Intermediate cover
	(H)	Final cover
X	(I)	Scales
X	(J)(1)	Surface water diversion
X	(2)	Design in operating record
X	(4)	Surface water monitoring
X	(K)(1)	Leachate control
	(2)	Lift station back-up pumps
	(3)	Collection pipe network (inspection)
	(4)	Temporary leachate storage
X	(5)	Leachate treatment and disposal
X	(6)	Leachate storage/disposal contingency plan
X	(7)	Surface water monitoring
X	(L)	PCB and hazardous waste prevention and detection program

3745-37-01 License

X	(A)	Valid license

Corrective Actions Taken and Other Comments:

Rail tower the roads, hauling cover, covering, drilling and installing gas pipe grading roads, watering roads

Daniel P Beadwell Daniel L Beadwell 2-21-12

Signature of Person Completing Form *Print Name of Person Completing Form* *Date*

This form should be retained on file for three years for inspection by the local health department, Ohio EPA, or an authorized representative. Failure to provide accurate daily operations information may be considered a violation of Ohio Revised Code § 2921.13.

Leachate Tank
7' 11"

Sumps 3-52.1
1-19.6
4 23.7

Revised: August 1, 2005

Municipal Solid Waste Landfill Facility Daily Log of Operations - Form 3

(Log Required by OAC 3745-27-19(E)(10))

Facility Name: Apex Environmental Today's Date: 2-22-12

Facility Opened Today at (time): 24 hrs. Facility Closed Today at (time): _____

List Equipment in Operation at the Facility Today: 155, ALJON, 328, D6T D7R Tipper IT Material handler

List Weather Conditions on this Day: 30's AM sunny clear breezy 40 high pm

The Facility Operator shall inspect the facility daily for compliance with the applicable regulations including but not limited to the following:

Place an (X) on the line next to all aspects of facility operations which have been inspected today.

3745-27-05 Prohibited Disposal Methods

X	(B)	No Open Burning

3745-27-19 Operation of a Facility

X	(E)(2)(a)	Maintain access roads
X	(b)	Limited access to facility
X	(c)	Signs posted
X	(d)	Exclusion of animals
X	(3)(a)	Adequate fire equipment
X	(b)	Operable and adequate equipment
X	(4)	Improper salvaging
X	(5)	Trained employees
X	(6)	Preparation for inclement weather
X	(7)(a)	Leachate treatment/disposal
X	(b)	Phased operation
X	(c)	Confined unloading
X	(d)	Separation/control of flammable waste
X	(e)	Waste disposed at working face
X	(I)(i)	Compacting bulky items
X	(ii)	Minimizing dust generation
	(8)(a)	NESHAP reg. asbestos disposal
	(b)	Acceptance of liquids
	(c)	Acceptance of hazardous waste
	(d)	Acceptance of PCBs
	(e)	Acceptance of infectious waste
	(f)	Acceptance of yard waste
	(g)	Acceptance of scrap tires
	(h)	Acceptance of low level rad. waste
	(I)	Acceptance of semi-solid material w/free liquid
X	(9)	Control of scattered litter
X	(10)	Keeping of daily logs
X	(11)(a)	Daily inspection of facility for ponding, erosion, leachate outbreaks (record any corrective actions below).
X	(12)	Copy of auth. docs available
X	(F)	Daily cover
	(3)	Alternate Daily Cover Used (describe in comment section below)
	(G)	Intermediate cover
	(H)	Final cover
X	(I)	Scales
X	(J)(1)	Surface water diversion
X	(2)	Design in operating record
X	(4)	Surface water monitoring
X	(K)(1)	Leachate control
	(2)	Lift station back-up pumps
	(3)	Collection pipe network (inspection)
	(4)	Temporary leachate storage
X	(5)	Leachate treatment and disposal
X	(6)	Leachate storage/disposal contingency plan
X	(7)	Surface water monitoring
X	(L)	PCB and hazardous waste prevention and detection program

3745-37-01 License

X	(A)	Valid license

Corrective Actions Taken and Other Comments:

rail over the roads running, hauling cover, covering, drilling, gas wells, laying gas lines, putting cover on

Daniel L Bradwell — *Signature of Person Completing Form*

Daniel L Bradwell — *Print Name of Person Completing Form*

2-22-12 — *Date*

This form should be retained on file for three years for inspection by the local health department, Ohio EPA, or an authorized representative. Failure to provide accurate daily operations information may be considered a violation of Ohio Revised Code § 2921.13.

MSW Log -Form 3

Leachate Tank 8' 1"

Sumps 3 - 13
1 - 21.1
4 - 22.0

Revised: August 1, 2005

Municipal Solid Waste Landfill Facility Daily Log of Operations - Form 3

(Log Required by OAC 3745-27-19(E)(10))

Facility Name: APEX ENVIRONMENTAL Today's Date: 2-23-12

Facility Opened Today at (time): 24 HR Facility Closed Today at (time):

List Equipment in Operation at the Facility Today: TIPPER, FT, MAT. HANDLER, 345, 528, 6, 2, 153, ALLAN, 836

List Weather Conditions on this Day: CLEAR · TEMPS IN 40'S

The Facility Operator shall inspect the facility daily for compliance with the applicable regulations including but not limited to the following:

Place an (X) on the line next to all aspects of facility operations which have been inspected today.

3745-27-05 Prohibited Disposal Methods

- X (B) No Open Burning

3745-27-19 Operation of a Facility

- X (E)(2)(a) Maintain access roads
- X (b) Limited access to facility
- X (c) Signs posted
- X (d) Exclusion of animals
- X (3)(a) Adequate fire equipment
- X (b) Operable and adequate equipment
- X (4) Improper salvaging
- X (5) Trained employees
- X (6) Preparation for inclement weather
- X (7)(a) Leachate treatment/disposal
- X (b) Phased operation
- X (c) Confined unloading
- X (d) Separation/control of flammable waste
- X (e) Waste disposed at working face
- X (i)(i) Compacting bulky items
- X (ii) Minimizing dust generation
- (8)(a) NESHAP reg. asbestos disposal
- (b) Acceptance of liquids
- (c) Acceptance of hazardous waste
- (d) Acceptance of PCBs
- (e) Acceptance of infectious waste
- (f) Acceptance of yard waste
- (g) Acceptance of scrap tires
- (h) Acceptance of low level rad. waste
- (i) Acceptance of semi-solid material w/free liquid
- X (9) Control of scattered litter
- X (10) Keeping of daily logs
- X (11)(a) Daily inspection of facility for ponding, erosion, leachate outbreaks (record any corrective actions below).
- X (12) Copy of auth. does available
- X (F) Daily cover
- (3) Alternate Daily Cover Used (describe in comment section below)
- (G) Intermediate cover
- (H) Final cover
- X (I) Scales
- X (J)(1) Surface water diversion
- X (2) Design in operating record
- X (4) Surface water monitoring
- X (K)(1) Leachate control
- (2) Lift station back-up pumps
- (3) Collection pipe network (inspection)
- (4) Temporary leachate storage
- X (5) Leachate treatment and disposal
- X (6) Leachate storage/disposal contingency plan
- X (7) Surface water monitoring
- X (L) PCB and hazardous waste prevention and detection program

3745-37-01 License

- X (A) Valid license

Corrective Actions Taken and Other Comments:

PICKED LITTER, HAULED COVER, HAULED LEACHATE AFTER INSTALLING GAS LINES + WELLS, BUILDING NEW LEACHATE LOADOUT PAD, GRADING ROADS

Signature of Person Completing Form — ROB CARPENTER, Print Name of Person Completing Form — 2-23-12, Date

This form should be retained on file for three years for inspection by the local health department, Ohio EPA, or an authorized representative. Failure to provide accurate daily operations information may be considered a violation of Ohio Revised Code § 2921.13.

LEACHATE - 8'-5

SUMPS 3 - 47.9

10 - 23.7

7 - 22.6

Municipal Solid Waste Landfill Facility Daily Log of Operations - Form 3

[Log Required by OAC 3745-27-19(E)(10)]

Facility Name: APEX ENVIRONMENTAL Today's Date: 2-24-12

Facility Opened Today at (time): 24 HR Facility Closed Today at (time): _____

List Equipment in Operation at the Facility Today: TIPPER, D7, MATL HANDLER, 836, AJAX, 945 329, 6, 7, 155

List Weather Conditions on this Day: Cloudy, Temps in 40's

The Facility Operator shall inspect the facility daily for compliance with the applicable regulations including but not limited to the following:

Place an (X) on the line next to all aspects of facility operations which have been inspected today.

3745-27-05 Prohibited Disposal Methods

- X (B) No Open Burning

3745-27-19 Operation of a Facility

- X (E)(2)(a) Maintain access roads
- X (b) Limited access to facility
- X (c) Signs posted
- X (d) Exclusion of animals
- X (3)(a) Adequate fire equipment
- X (b) Operable and adequate equipment
- X (4) Improper salvaging
- X (5) Trained employees
- X (6) Preparation for inclement weather
- X (7)(a) Leachate treatment/disposal
- X (b) Phased operation
- X (c) Confined unloading
- X (d) Separation/control of flammable waste
- X (e) Waste disposed at working face
- X (f)(i) Compacting bulky items
- X (ii) Minimizing dust generation
- (8)(a) NESHAP reg. asbestos disposal
- (b) Acceptance of liquids
- (c) Acceptance of hazardous waste
- (d) Acceptance of PCBs
- (e) Acceptance of infectious waste
- (f) Acceptance of yard waste
- (g) Acceptance of scrap tires
- (h) Acceptance of low level rad. waste
- (I) Acceptance of semi-solid materiel w/free liquid
- X (9) Control of scattered litter
- X (10) Keeping of daily logs
- X (11)(a) Daily inspection of facility for ponding, erosion, leachate outbreaks (record any corrective actions below).
- X (12) Copy of auth. does available
- X (F) Daily cover
- (3) Alternate Daily Cover Used (describe in comment section below)
- (G) Intermediate cover
- (H) Final cover
- X (I) Scales
- X (J)(1) Surface water diversion
- X (2) Design in operating record
- X (4) Surface water monitoring
- X (K)(1) Leachate control
- (2) Lift station back-up pumps
- (3) Collection pipe network (inspection)
- (4) Temporary leachate storage
- X (5) Leachate treatment and disposal
- X (6) Leachate storage/disposal contingency plan
- X (7) Surface water monitoring
- X (L) PCB and hazardous waste prevention and detection program

3745-37-01 License

- X (A) Valid license

Corrective Actions Taken and Other Comments:

PICKED LITTER, HAULED COVER, HAULED LEACHATE, REG. DRILLING & INSTALLING WELLS + LINES

Leachate 8.5" Sumps 1- 20.6, 3- 42.0, 4- 23.3

Signature of Person Completing Form

R.B CARPENTER
Print Name of Person Completing Form

2-24-12
Date

This form should be retained on file for three years for inspection by the local health department, Ohio EPA, or an authorized representative. Failure to provide accurate daily operations information may be considered a violation of Ohio Revised Code § 2921.13.

Municipal Solid Waste Landfill Facility Daily Log of Operations - Form 3

(Log Required by OAC 3745-27-19(E)(10))

Facility Name: Apex Environmental Today's Date: 2-25-12

Facility Opened Today at (time): 24 hr Facility Closed Today at (time):

List Equipment in Operation at the Facility Today: Tipper, D7, mat Hanklet, Allow, 836 345, 325, 6, 7, 155

List Weather Conditions on this Day: Snow. Temps in 30's

The Facility Operator shall inspect the facility daily for compliance with the applicable regulations including but not limited to the following:

Place an (X) on the line next to all aspects of facility operations which have been inspected today.

3745-27-05 Prohibited Disposal Methods

- X (B) No Open Burning

3745-27-19 Operation of a Facility

- X (E)(2)(a) Maintain access roads
- X (b) Limited access to facility
- X (c) Signs posted
- X (d) Exclusion of animals
- X (3)(a) Adequate fire equipment
- X (b) Operable and adequate equipment
- X (4) Improper salvaging
- X (5) Trained employees
- X (6) Preparation for inclement weather
- X (7)(a) Leachate treatment/disposal
- X (b) Phased operation
- X (c) Confined unloading
- X (d) Separation/control of flammable waste
- X (e) Waste disposed at working face
- X (f)(i) Compacting bulky items
- X (ii) Minimizing dust generation
- (8)(a) NESHAP reg. asbestos disposal
- (b) Acceptance of liquids
- (c) Acceptance of hazardous waste
- (d) Acceptance of PCBs
- (e) Acceptance of infectious waste
- (f) Acceptance of yard waste
- (g) Acceptance of scrap tires
- (h) Acceptance of low level rad. waste
- (I) Acceptance of semi-solid material w/free liquid
- X (9) Control of scattered litter
- X (10) Keeping of daily logs
- X (11)(a) Daily inspection of facility for ponding, erosion, leachate outbreaks (record any corrective actions below).
- X (12) Copy of auth. does available
- X (F) Daily cover
- (3) Alternate Daily Cover Used (describe in comment section below)
- (G) Intermediate cover
- (H) Final cover
- X (I) Scales
- X (J)(1) Surface water diversion
- X (2) Design in operating record
- X (4) Surface water monitoring
- X (K)(1) Leachate control
- (2) Lift station back-up pumps
- (3) Collection pipe network (inspection)
- (4) Temporary leachate storage
- X (5) Leachate treatment and disposal
- X (6) Leachate storage/disposal contingency plan
- X (7) Surface water monitoring
- X (L) PCB and hazardous waste prevention and detection program

3745-37-01 License

- X (A) Valid license

Corrective Actions Taken and Other Comments:

Picked litter, Hauled cover, Grading & Graveling Roads

R L Carpenter
Signature of Person Completing Form

Rob Carpenter
Print Name of Person Completing Form

2-25-12
Date

This form should be retained on file for three years for inspection by the local health department, Ohio EPA, or an authorized representative. Failure to provide accurate daily operations information may be considered a violation of Ohio Revised Code § 2921.13.

Leachate. 8'

Sumps 1 - 22.2
3 - 14.7
4 - 23.9

Revised: August 1, 2005

Municipal Solid Waste Landfill Facility Daily Log of Operations - Form 3

(Log Required by OAC 3745-27-19(E)(10))

Facility Name: Apex Environmental Today's Date: 3-4-12

Facility Opened Today at (time): 24hr Facility Closed Today at (time): _____

List Equipment in Operation at the Facility Today: IT, Material handler, 836, ADT, D6T LGP, D7R, 320

List Weather Conditions on this Day: High 20's am to Low 30's pm snow showers

The Facility Operator shall inspect the facility daily for compliance with the applicable regulations including but not limited to the following:

Place an (X) on the line next to all aspects of facility operations which have been inspected today.

3745-27-05 Prohibited Disposal Methods

X	(B)	No Open Burning

3745-27-19 Operation of a Facility

X	(E)(2)(a)	Maintain access roads
X	(b)	Limited access to facility
X	(c)	Signs posted
X	(d)	Exclusion of animals
X	(3)(a)	Adequate fire equipment
X	(b)	Operable and adequate equipment
X	(4)	Improper salvaging
X	(5)	Trained employees
X	(6)	Preparation for inclement weather
X	(7)(a)	Leachate treatment/disposal
X	(b)	Phased operation
X	(c)	Confined unloading
X	(d)	Separation/control of flammable waste
X	(e)	Waste disposed at working face
X	(f)(i)	Compacting bulky items
X	(ii)	Minimizing dust generation
	(8)(a)	NESHAP reg. asbestos disposal
	(b)	Acceptance of liquids
	(c)	Acceptance of hazardous waste
	(d)	Acceptance of PCBs
	(e)	Acceptance of infectious waste
	(f)	Acceptance of yard waste
	(g)	Acceptance of scrap tires
	(h)	Acceptance of low level rad. waste
	(i)	Acceptance of semi-solid material w/free liquid
X	(9)	Control of scattered litter
X	(10)	Keeping of daily logs
X	(11)(a)	Daily inspection of facility for ponding, erosion, leachate outbreaks (record any corrective actions below).
X	(12)	Copy of auth. docs available
X	(F)	Daily cover
	(3)	Alternate Daily Cover Used (describe in comment section below)
	(G)	Intermediate cover
	(H)	Final cover
X	(I)	Scales
X	(J)(1)	Surface water diversion
X	(2)	Design in operating record
X	(4)	Surface water monitoring
X	(K)(1)	Leachate control
	(2)	Lift station back-up pumps
	(3)	Collection pipe network (inspection)
	(4)	Temporary leachate storage
X	(5)	Leachate treatment and disposal
X	(6)	Leachate storage/disposal contingency plan
X	(7)	Surface water monitoring
X	(L)	PCB and hazardous waste prevention and detection program

3745-37-01 License

X	(A)	Valid license

Corrective Actions Taken and Other Comments:

Road only running, hauling cover, paper picking, covering seeding on slopes

Daniel L Brannen 3-4-12

Signature of Person Completing Form *Print Name of Person Completing Form* *Date*

This form should be retained on file for three years for inspection by the local health department, Ohio EPA, or an authorized representative. Failure to provide accurate daily operations information may be considered a violation of Ohio Revised Code § 2921.13.

Leachate Tank 13' 11"

Sump 3-36.7 1-20.4 4-22.0

MSW Log-Form 3 Revised: August 1, 2005

Municipal Solid Waste Landfill Facility Daily Log of Operations - Form 3

(Log Required by OAC 3745-27-09(E)(10))

Facility Name: Apex Environmental Today's Date: 3-5-12

Facility Opened Today at (time): 24 hr Facility Closed Today at (time): _____

List Equipment in Operation at the Facility Today: D6 - D7R - JT - 836 - 155 - Handler

List Weather Conditions on this Day: Mid 20s to Mid 30s Sun and clouds

The Facility Operator shall inspect the facility daily for compliance with the applicable regulations including but not limited to the following:

Place an (X) on the line next to all aspects of facility operations which have been inspected today.

3745-27-05 Prohibited Disposal Methods

X (B) No Open Burning

3745-27-19 Operation of a Facility

X (E)(2)(a) Maintain access roads
X (b) Limited access to facility
X (c) Signs posted
X (d) Exclusion of animals
X (3)(a) Adequate fire equipment
X (b) Operable and adequate equipment
X (4) Improper salvaging
X (5) Trained employees
X (6) Preparation for inclement weather
X (7)(a) Leachate treatment/disposal
(b) Phased operation
X (c) Confined unloading
X (d) Separation/control of flammable waste
X (e) Waste disposed at working face
X (I)(i) Compacting bulky items
X (ii) Minimizing dust generation
X (8)(a) NESHAP reg. asbestos disposal
X (b) Acceptance of liquids
X (c) Acceptance of hazardous waste
X (d) Acceptance of PCBs
X (e) Acceptance of infectious waste
X (f) Acceptance of yard waste
X (g) Acceptance of scrap tires
X (h) Acceptance of low level rad. waste
X (I) Acceptance of semi-solid material w/free liquid
X (9) Control of scattered litter
X (10) Keeping of daily logs
X (11)(a) Daily inspection of facility for ponding, erosion, leachate outbreaks (record any corrective actions below).
X (12) Copy of authorizations available
X (F) Daily cover
(3) Alternate Daily Cover Used (describe in comment section below)
(G) Intermediate cover
(H) Final cover
X (I) Scales
X (J)(1) Surface water diversion
X (2) Design/operating record
X (4) Surface water monitoring
X (K)(1) Leachate control
(2) Lift station back-up pumps
(3) Collection pipe network (inspection)
(4) Temporary leachate storage
X (5) Leachate treatment and disposal
X (6) Leachate storage/disposal contingency plan
X (7) Surface water monitoring
X (L) PCB and hazardous waste prevention and detection program

3745-37-01 License

X (A) Valid license

Corrective Actions Taken and Other Comments:

Rail and over the road Geo const. hauling cover and covering

Donald Shannon — Signature of Person Completing Form

RONALD SHANNON — Print Name of Person Completing Form

3-5-12 — Date

This form should be retained on file for three years for inspection by the local health department, Ohio EPA, or an authorized representative. Failure to provide accurate daily operations information may be considered a violation of Ohio Revised Code § 2921.13.

Leachate Tank
15 FT 2"

Sump
4 = 17.5"
1 = 21.0
3 = 32.5

Revised: August 1, 2005

OhioEPA Municipal Solid Waste Landfill Facility Daily Log of Operations - Form 3

(Log Required by OAC 3745-27-19(E)(10))

Facility Name: Apex Environmental Today's Date: 3-6-12

Facility Opened Today at (time): 24 Facility Closed Today at (time): _____

List Equipment in Operation at the Facili Today: Tipper, 816 - D6T - Mat. Handler 836 - D7R - 155 - 325

List Weather Conditions on this Day: 23 Temp - Clear

The Facility Operator shall inspect the facility daily for compliance with the applicable regulations including but not limited to the following:

Place an (X) on the line next to all aspects of facility operation which have been inspected today.

3745-27-05 Prohibited Disposal Methods

X (B) No Open Burning

3745-27-19 Operation of a Facility

X (E)(2)(a) Maintain access roads
X (b) Limited access to facility
X (c) Signs posted
X (d) Exclusion of animals
X (3)(a) Adequate fire equipment
X (b) Operable and adequate equipment
X (4) Improper salvaging
X (5) Trained employees
X (6) Preparation for inclement weather
X (7)(a) Leachate treatment/disposal
X (b) Phased operation
X (c) Confined unloading
X (d) Separation/control of flammable waste
X (e) Waste disposed at working face
X (f)(i) Compacting bulky items
X (ii) Minimizing dust generation
— (8)(a) NESHAP reg. asbestos disposal
— (b) Acceptance of liquids
— (c) Acceptance of hazardous waste
— (d) Acceptance of PCBs
— (e) Acceptance of infectious waste
— (f) Acceptance of yard waste
— (g) Acceptance of scrap tires
— (h) Acceptance of low level rad. waste
— (i) Acceptance of semi-solid material w/free liquid
X (9) Control of scattered litter
X (10) Keeping of daily logs
X (11)(a) Daily inspection of facility for ponding, erosion, leachate outbreaks (record any corrective actions below).
X (12) Copy of auth. does available
X (F) Daily cover
— (3) Alternate Daily Cover Used (describe in comment section below)
— (G) Intermediate cover
— (H) Final cover
X (I) Scales
X (J)(1) Surface water diversion
X (2) Design in operating record
X (4) Surface water monitoring
X (K)(1) Leachate control
— (2) Lift station back-up pumps
— (3) Collection pipe network (inspection)
— (4) Temporary leachate storage
X (5) Leachate treatment and disposal
X (6) Leachate storage/disposal contingency plan
X (7) Surface water monitoring
X (L) PCB and hazardous waste prevention and detection program

3745-37-01 License

X (A) Valid license

Corrective Actions Taken and Other Comments:

Picking litter, Scraping roads, rail over the road - Covering - gas cond. Hauling cover.

Donald Shannon — Signature of Person Completing Form

DONALD SHANNON — Print Name of Person Completing Form

3-6-12 — Date

This form should be retained on file for three years for inspection by the local health department, Ohio EPA, or an authorized representative. Failure to provide accurate daily operations information may be considered a violation of Ohio Revised Code § 2921.13.

Leachate — 14' 2"

Sumps 1-19,7
3-48,1
4-24,3

Revised, August 1, 2005

Municipal Solid Waste Landfill Facility Daily Log of Operations - Form 3

(Log Required by OAC 3745-27-19(E)(10))

Facility Name: APEX Environmental Today's Date: 3-7-12

Facility Opened Today at (time): 24 hr Facility Closed Today at (time): _____

List Equipment in Operation at the Facility Today: Tipper, Alyon, IT, D7, 155, 325

List Weather Conditions on this Day: clear and hi of 55

The Facility Operator shall inspect the facility daily for compliance with the applicable regulations including but not limited to the following:

Place an (X) on the line next to all aspects of facility operations which have been inspected today.

3745-27-05 Prohibited Disposal Methods

X	(B)	No Open Burning

3745-27-19 Operation of a Facility

X	(E)(2)(a)	Maintain access roads
X	(b)	Limited access to facility
X	(c)	Signs posted
X	(d)	Exclusion of animals
X	(3)(a)	Adequate fire equipment
X	(b)	Operable and adequate equipment
X	(4)	Improper salvaging
X	(5)	Trained employees
X	(6)	Preparation for inclement weather
X	(7)(a)	Leachate treatment/disposal
X	(b)	Phased operation
X	(c)	Confined unloading
X	(d)	Separation/control of flammable waste
X	(e)	Waste disposed at working face
X	(f)(i)	Compacting bulky items
X	(ii)	Minimizing dust generation
	(8)(a)	NESHAP reg. asbestos disposal
	(b)	Acceptance of liquids
	(c)	Acceptance of hazardous waste
	(d)	Acceptance of PCBs
	(e)	Acceptance of infectious waste
	(f)	Acceptance of yard waste
	(g)	Acceptance of scrap tires
	(h)	Acceptance of low level rad. waste
	(i)	Acceptance of semi-solid material w/free liquid
X	(9)	Control of scattered litter
X	(10)	Keeping of daily logs
X	(11)(a)	Daily inspection of facility for ponding, erosion, leachate outbreaks (record any corrective actions below).
X	(12)	Copy of auth. does available
X	(F)	Daily cover
	(3)	Alternate Daily Cover Used (describe in comment section below)
	(G)	Intermediate cover
	(H)	Final cover
X	(I)	Scales
X	(J)(1)	Surface water diversion
X	(2)	Design in operating record
X	(4)	Surface water monitoring
X	(K)(1)	Leachate control
	(2)	Lift station back-up pumps
	(3)	Collection pipe network (inspection)
	(4)	Temporary leachate storage
X	(5)	Leachate treatment and disposal
X	(6)	Leachate storage/disposal contingency plan
X	(7)	Surface water monitoring
X	(L)	PCB and hazardous waste prevention and detection program

3745-37-01 License

X	(A)	Valid license

Corrective Actions Taken and Other Comments:

Picking litter, over the road, rail Hauling cover, Gas line work

Donald S. Mosser — *Signature of Person Completing Form*

Donald S. Mosser — *Print Name of Person Completing Form*

3-7-12 — *Date*

This form should be retained on file for three years for inspection by the local health department, Ohio EPA, or an authorized representative. Failure to provide accurate daily operations information may be considered a violation of Ohio Revised Code § 2921.13.

Sump 1 33.4 Leachate 13'6"
3 19.2
4 22.8

OhioEPA Municipal Solid Waste Landfill Facility Daily Log of Operations - Form 3

(Log Required by OAC 3745-27-19(E)(10))

Facility Name: Apex Environmental Today's Date: 3-8-12

Facility Opened Today at (time): 24 hr Facility Closed Today at (time): ____

List Equipment in Operation at the Facility Today: tipper, IT, mit badger, 836, 545, 326 D6, D7, 155

List Weather Conditions on this Day: rain and windy hi of 50

The Facility Operator shall inspect the facility daily for compliance with the applicable regulations including but not limited to the following:

Place an (X) on the line next to all aspects of facility operations which have been inspected today.

3745-27-05 Prohibited Disposal Methods

X (B) No Open Burning

3745-27-19 Operation of a Facility

X (E)(2)(a) Maintain access roads
X (b) Limited access to facility
X (c) Signs posted
X (d) Exclusion of animals
X (3)(a) Adequate fire equipment
X (b) Operable and adequate equipment
X (4) Improper salvaging
X (5) Trained employees
X (6) Preparation for inclement weather
X (7)(a) Leachate treatment/disposal
| (b) Phased operation
X (c) Confined unloading
X (d) Separation/control of flammable waste
X (e) Waste disposed at working face
X (f)(i) Compacting bulky items
X (ii) Minimizing dust generation
| (8)(a) NESHAP reg. asbestos disposal
| (b) Acceptance of liquids
| (c) Acceptance of hazardous waste
| (d) Acceptance of PCBs
| (e) Acceptance of infectious waste
| (f) Acceptance of yard waste
| (g) Acceptance of scrap tires
| (h) Acceptance of low level rad. waste
| (i) Acceptance of semi-solid material w/free liquid
X (9) Control of scattered litter
X (10) Keeping of daily logs
X (11)(a) Daily inspection of facility for ponding, erosion, leachate outbreaks (record any corrective actions below).
X (12) Copy of auth. docs available
X (F) Daily cover
| (3) Alternate Daily Cover Used (describe in comment section below)
| (G) Intermediate cover
| (H) Final cover
X (I) Scales
X (J)(1) Surface water diversion
X (2) Design in operating record
X (4) Surface water monitoring
X (K)(1) Leachate control
| (2) Lift station back-up pumps
| (3) Collection pipe network (inspection)
| (4) Temporary leachate storage
X (5) Leachate treatment and disposal
X (6) Leachate storage/disposal contingency plan
X (7) Surface water monitoring
X (L) PCB and hazardous waste prevention and detection program

3745-37-01 License

X (A) Valid license

Corrective Actions Taken and Other Comments:

Donald Masser — *Signature of Person Completing Form*

Donald Masser — *Print Name of Person Completing Form*

3-8-12 — *Date*

This form should be retained on file for three years for inspection by the local health department, Ohio EPA, or an authorized representative. Failure to provide accurate daily operations information may be considered a violation of Ohio Revised Code § 2921.13.

Sump 1 49.6
317.5
421.9

Leachate 12'6"

Municipal Solid Waste Landfill Facility Daily Log of Operations - Form 3

(Log Required by OAC 3745-27-19(E)(10))

Facility Name: Apex Environmental Today's Date: 3-9-12

Facility Opened Today at (time): 24 hr Facility Closed Today at (time): _____

List Equipment in Operation at the Facility Today: Tipper, AL Gear, 325, IT, D7 155

List Weather Conditions on this Day: Windy hi in the 40's

The Facility Operator shall inspect the facility daily for compliance with the applicable regulations including but not limited to the following:

Place an (X) on the line next to all aspects of facility operations which have been inspected today.

3745-27-05 Prohibited Disposal Methods

X	(B)	No Open Burning

3745-27-19 Operation of a Facility

X	(E)(2)(a)	Maintain access roads
X	(b)	Limited access to facility
X	(c)	Signs posted
X	(d)	Exclusion of animals
X	(3)(a)	Adequate fire equipment
X	(b)	Operable and adequate equipment
X	(4)	Improper salvaging
X	(5)	Trained employees
X	(6)	Preparation for inclement weather
X	(7)(a)	Leachate treatment/disposal
X	(b)	Phased operation
X	(c)	Confined unloading
X	(d)	Separation/control of flammable waste
X	(e)	Waste disposed at working face
X	(f)(i)	Compacting bulky items
X	(ii)	Minimizing dust generation
	(8)(a)	NESHAP reg. asbestos disposal
	(b)	Acceptance of liquids
	(c)	Acceptance of hazardous waste
	(d)	Acceptance of PCBs
	(e)	Acceptance of infectious waste
	(f)	Acceptance of yard waste
	(g)	Acceptance of scrap tires
	(h)	Acceptance of low level rad. waste
	(i)	Acceptance of semi-solid material w/free liquid
X	(9)	Control of scattered liner
X	(10)	Keeping of daily logs
X	(11)(a)	Daily inspection of facility for ponding, erosion, leachate outbreaks (record any corrective actions below).
X	(12)	Copy of auth. does available
X	(F)	Daily cover
	(3)	Alternate Daily Cover Used (describe in comment section below)
	(G)	Intermediate cover
	(H)	Final cover
X	(I)	Scales
X	(J)(1)	Surface water diversion
X	(2)	Design in operating record
X	(4)	Surface water monitoring
X	(K)(1)	Leachate control
	(2)	Lift station back-up pumps
	(3)	Collection pipe network (inspection)
	(4)	Temporary leachate storage
X	(5)	Leachate treatment and disposal
X	(6)	Leachate storage/disposal contingency plan
X	(7)	Surface water monitoring
X	(L)	PCB and hazardous waste prevention and detection program

3745-37-01 License

X	(A)	Valid license

Corrective Actions Taken and Other Comments:

Picking Litter, Scraping Road, Hauling cover rail used over the road

Donald S. Mosser — *Signature of Person Completing Form*

Donald S. Mosser — *Print Name of Person Completing Form*

3-9-12 — *Date*

This form should be retained on file for three years for inspection by the local health department, Ohio EPA, or an authorized representative. Failure to provide accurate daily operations information may be considered a violation of Ohio Revised Code § 2921.13.

MSW Log - Form 3

Sump
125.1
344.5
423.8

Leachate
12'6"

Revised: August 1, 2005

Permit 001 003 004 002 – No Discharge
500 tank @ Lonewalk Rd – No Discharge

OhioEPA

Municipal Solid Waste Landfill Facility Daily Log of Operations - Form 3

(Log Required by OAC 3745-27-19(E)(10))

Facility Name: Apex Landfill Today's Date: 3/10/2012

Facility Opened Today at (time): ______ Facility Closed Today at (time): ______

List Equipment in Operation at the Facility Today: 450 Exc – 2 Volvo and 6 trucks tipper 2 Dozers

List Weather Conditions on this Day: Sunny, Low 40's –

The Facility Operator shall inspect the facility daily for compliance with the applicable regulations including but not limited to the following:

Place an (X) on the line next to all aspects of facility operations which have been inspected today.

3745-27-05 Prohibited Disposal Methods

- X (B) No Open Burning

3745-27-19 Operation of a Facility

- ✓ (E)(2)(a) Maintain access roads
- ✓ (b) Limited access to facility
- ✓ (c) Signs posted
- ✓ (d) Exclusion of animals
- ✓ (3)(a) Adequate fire equipment
- ✓ (b) Operable and adequate equipment
- ✓ (4) Improper salvaging
- ✓ (5) Trained employees
- ✓ (6) Preparation for inclement weather
- ___ (7)(a) Leachate treatment/disposal
- ✓ (b) Phased operation
- ✓ (c) Confined unloading
- ___ (d) Separation/control of flammable waste
- ✓ (e) Waste disposed at working face
- ✓ (f)(i) Compacting bulky items
- ___ (ii) Minimizing dust generation
- N/A (8)(a) NESHAP reg. asbestos disposal
- ✓ (b) Acceptance of liquids
- ✓ (c) Acceptance of hazardous waste
- ✓ (d) Acceptance of PCBs
- ✓ (e) Acceptance of infectious waste
- ✓ (f) Acceptance of yard waste
- ✓ (g) Acceptance of scrap tires
- ✓ (h) Acceptance of low level rad. waste
- ✓ (i) Acceptance of semi-solid material w/free liquid

- ✓ (9) Control of scattered litter
- ✓ (10) Keeping of daily logs
- ✓ (11)(a) Daily inspection of facility for ponding, erosion, leachate outbreaks (record any corrective actions below).
- ✓ (12) Copy of auth. docs available
- ✓ (F) Daily cover
- N/A (3) Alternate Daily Cover Used (describe in comment section below)
- ✓ (G) Intermediate cover
- N/A (H) Final cover
- ✓ (I) Scales
- ✓ (J)(1) Surface water diversion
- ✓ (2) Design in operating record
- N/A (4) Surface water monitoring
- ___ (K)(1) Leachate control
- ___ (2) Lift station back-up pumps
- N/A (3) Collection pipe network (inspection)
- N/A (4) Temporary leachate storage
- ✓ (5) Leachate treatment and disposal
- ✓ (6) Leachate storage/disposal contingency plan
- ✓ (7) Surface water monitoring
- ✓ (L) PCB and hazardous waste prevention and detection program

3745-37-01 License

- ✓ (A) Valid license

Corrective Actions Taken and Other Comments:

Paper picker working perimeter – Seeding/mulching South Slope above ramp, and NE corner Walker Hill – no outbreaks – Good cover – working on letdown – East side / Trenching for 12" jumper on GCCS – West side

______ Signature of Person Completing Form ______ Print Name of Person Completing Form ______ Date

This form should be retained on file for three years for inspection by the local health department, Ohio EPA, or an authorized representative. Failure to provide accurate daily operations information may be considered a violation of Ohio Revised Code § 2921.13.

Tank Level @ 14.1 @ 10:40

Sump 3 23.7
Sump 1 16.1
Sump 4 22.6

OhioEPA Municipal Solid Waste Landfill Facility Daily Log of Operations - Form 3

(Log Required by OAC 3745-27-19(E)(10))

Facility Name: APEX ENVIRONMENTAL Today's Date: 5-18-12

Facility Opened Today at (time): 24 HR Facility Closed Today at (time): _____

List Equipment in Operation at the Facility Today: TIPPER, IT, MAT. HANDLER, 6, 7, 154, 345, 329, 836

List Weather Conditions on this Day: CLEAR - TEMPS IN 70'S

The Facility Operator shall inspect the facility daily for compliance with the applicable regulations including but not limited to the following:

Place an (X) on the line next to all aspects of facility operations which have been inspected today.

3745-27-05 Prohibited Disposal Methods

X	(B)	No Open Burning

3745-27-19 Operation of a Facility

X	(E)(2)(a)	Maintain access roads
X	(b)	Limited access to facility
X	(c)	Signs posted
X	(d)	Exclusion of animals
X	(3)(a)	Adequate fire equipment
X	(b)	Operable and adequate equipment
X	(4)	Improper salvaging
X	(5)	Trained employees
X	(6)	Preparation for inclement weather
X	(7)(a)	Leachate treatment/disposal
X	(b)	Phased operation
X	(c)	Confined unloading
X	(d)	Separation/control of flammable waste
X	(e)	Waste disposed at working face
X	(f)(i)	Compacting bulky items
X	(ii)	Minimizing dust generation
DNI	(8)(a)	NESHAP reg. asbestos disposal
DNI	(b)	Acceptance of liquids
DNI	(c)	Acceptance of hazardous waste
DNI	(d)	Acceptance of PCBs
DNI	(e)	Acceptance of Infectious waste
DNI	(f)	Acceptance of yard waste
DNI	(g)	Acceptance of scrap tires
DNI	(h)	Acceptance of low level rad. waste
DNI	(i)	Acceptance of semi-solid material w/free liquid
X	(9)	Control of scattered litter
X	(10)	Keeping of daily logs
X	(11)(a)	Daily inspection of facility for ponding, erosion, leachate outbreaks (record any corrective actions below).
X	(12)	Copy of auth. does available
X	(F)	Daily cover
N/A	(3)	Alternate Daily Cover Used (describe in comment section below)
DNI	(G)	Intermediate cover
DNI	(H)	Final cover
X	(I)	Scales
X	(J)(1)	Surface water diversion
X	(2)	Design in operating record
X	(4)	Surface water monitoring
X	(K)(1)	Leachate control
DNI	(2)	Lift station back-up pumps
DNI	(3)	Collection pipe network (inspection)
X	(4)	Temporary leachate storage
X	(5)	Leachate treatment and disposal
X	(6)	Leachate storage/disposal contingency plan
X	(7)	Surface water monitoring
X	(L)	PCB and hazardous waste prevention and detection program

3745-37-01 License

X	(A)	Valid license

Corrective Actions Taken and Other Comments:

PICKED LITTER, HAULED COVER, WATER ROADS

Rob Carpenter — *Signature of Person Completing Form*

ROB CARPENTER — *Print Name of Person Completing Form*

5-18-12 — *Date*

This form should be retained on file for three years for inspection by the local health department, Ohio EPA, or an authorized representative. Failure to provide accurate daily operations information may be considered a violation of Ohio Revised Code § 2921.13.

LEACHATE - 3-8" SUMPS 1 - 50.6
3 - 23.3
4 - 24.3

Revised: August 1, 2005

Municipal Solid Waste Landfill Facility Daily Log of Operations - Form 3

(Log Required by OAC 3745-27-19(E)(10))

Facility Name: APEX ENVIRONMENTAL Today's Date: 8-3-12

Facility Opened Today at (time): 24 HR Facility Closed Today at (time): _____

List Equipment in Operation at the Facility Today: TIPPER, IT, MAT. HANDLER, 6, 7, 155 AIRAN, 348, 72P

List Weather Conditions on this Day: CLEAR - Temps in 90's

The Facility Operator shall inspect the facility daily for compliance with the applicable regulations including but not limited to the following:

Place an (X) on the line next to all aspects of facility operations which have been inspected today.

3745-27-05 Prohibited Disposal Methods

X	(B)	No Open Burning

3745-27-19 Operation of a Facility

X	(E)(2)(a)	Maintain access roads
X	(b)	Limited access to facility
X	(c)	Signs posted
X	(d)	Exclusion of animals
X	(3)(a)	Adequate fire equipment
X	(b)	Operable and adequate equipment
X	(4)	Improper salvaging
X	(5)	Trained employees
X	(6)	Preparation for inclement weather
X	(7)(a)	Leachate treatment/disposal
X	(b)	Phased operation
X	(c)	Confined unloading
X	(d)	Separation/control of flammable waste
X	(e)	Waste disposed at working face
X	(f)(i)	Compacting bulky items
X	(ii)	Minimizing dust generation
ONI	(8)(a)	NESHAP reg. asbestos disposal
ONI	(b)	Acceptance of liquids
ONI	(c)	Acceptance of hazardous waste
ONI	(d)	Acceptance of PCBs
ONI	(e)	Acceptance of infectious waste
ONI	(f)	Acceptance of yard waste
ONI	(g)	Acceptance of scrap tires
ONI	(h)	Acceptance of low level rad. waste
ONI	(i)	Acceptance of semi-solid material w/free liquid
X	(9)	Control of scattered litter
X	(10)	Keeping of daily logs
X	(11)(a)	Daily inspection of facility for ponding, erosion, leachate outbreaks (record any corrective actions below).
X	(12)	Copy of auth. does available
X	(F)	Daily cover
N/A	(3)	Alternate Daily Cover Used (describe in comment section below)
X	(G)	Intermediate cover
X	(H)	Final cover
X	(I)	Scales
X	(J)(1)	Surface water diversion
X	(2)	Design in operating record
X	(4)	Surface water monitoring
X	(K)(1)	Leachate control
X	(2)	Lift station back-up pumps
ONI	(3)	Collection pipe network (inspection)
X	(4)	Temporary leachate storage
X	(5)	Leachate treatment and disposal
X	(6)	Leachate storage/disposal contingency plan
X	(7)	Surface water monitoring
X	(L)	PCB and hazardous waste prevention and detection program

3745-37-01 License

X	(A)	Valid license

Corrective Actions Taken and Other Comments:

PICKED LITTER, HAULED CAKED WATER ROADS, SYNAGRO HAULED LEACHATE.

Rob Carpenter / J. PANCOAST — *Signature of Person Completing Form*

ROB CARPENTER / JOHN PANCOAST — *Print Name of Person Completing Form*

8-3-12 — *Date*

This form should be retained on file for three years for inspection by the local health department, Ohio EPA, or an authorized representative. Failure to provide accurate daily operations information may be considered a violation of Ohio Revised Code § 2921.13.

LEACHATE - 7-7"

SUMPS 1 - 12.1
3 - 17.8
4 - 22.6

Municipal Solid Waste Landfill Facility Daily Log of Operations - Form 3

(Log Required by OAC 3745-27-19(E)(10))

Facility Name: APEX ENVIRONMENTAL Today's Date: 8-4-12

Facility Opened Today at (time): 24 HR Facility Closed Today at (time): _____

List Equipment in Operation at the Facility Today: TIPPER, FT, MAT. HANDLER, AJAX 6, 7, 155

List Weather Conditions on this Day: CLEAR

The Facility Operator shall inspect the facility daily for compliance with the applicable regulations including but not limited to the following:

Place an (X) on the line next to all aspects of facility operations which have been inspected today.

3745-27-05 Prohibited Disposal Methods

X	(B)	No Open Burning

3745-27-19 Operation of a Facility

X	(E)(2)(a)	Maintain access roads
X	(b)	Limited access to facility
X	(c)	Signs posted
X	(d)	Exclusion of animals
X	(3)(a)	Adequate fire equipment
X	(b)	Operable and adequate equipment
X	(4)	Improper salvaging
X	(5)	Trained employees
X	(6)	Preparation for inclement weather
X	(7)(a)	Leachate treatment/disposal
X	(b)	Phased operation
X	(c)	Confined unloading
X	(d)	Separation/control of flammable waste
X	(e)	Waste disposed at working face
X	(f)(i)	Compacting bulky items
X	(ii)	Minimizing dust generation
DNI	(8)(a)	NESHAP reg. asbestos disposal
DNI	(b)	Acceptance of liquids
DNI	(c)	Acceptance of hazardous waste
DNI	(d)	Acceptance of PCBs
DNI	(e)	Acceptance of infectious waste
DNI	(f)	Acceptance of yard waste
DNI	(g)	Acceptance of scrap tires
DNI	(h)	Acceptance of low level rad. waste
DNI	(I)	Acceptance of semi-solid material w/free liquid
X	(9)	Control of scattered litter
X	(10)	Keeping of daily logs
X	(11)(a)	Daily inspection of facility for ponding, erosion, leachate outbreaks (record any corrective actions below).
X	(12)	Copy of auth. docs available
X	(F)	Daily cover
N/A	(3)	Alternate Daily Cover Used (describe in comment section below)
X	(G)	Intermediate cover
X	(H)	Final cover
X	(I)	Scales
X	(J)(1)	Surface water diversion
X	(2)	Design in operating record
X	(4)	Surface water monitoring
X	(K)(1)	Leachate control
X	(2)	Lift station back-up pumps
DNI	(3)	Collection pipe network (inspection)
X	(4)	Temporary leachate storage
X	(5)	Leachate treatment and disposal
X	(6)	Leachate storage/disposal contingency plan
X	(7)	Surface water monitoring
X	(L)	PCB and hazardous waste prevention and detection program

3745-37-01 License

X	(A)	Valid license

Corrective Actions Taken and Other Comments:

Picked Paper - Hauled cover

Rob Carpenter — *Signature of Person Completing Form*

ROB CARPENTER — *Print Name of Person Completing Form*

8-4-12 — *Date*

This form should be retained on file for three years for inspection by the local health department, Ohio EPA, or an authorized representative. Failure to provide accurate daily operations information may be considered a violation of Ohio Revised Code § 2921.13.

LEACHATE - 7-11

SUMPS 1 - 18.6
3 - 40.1
4 - 18.1

Revised August 1, 2005

OhioEPA Municipal Solid Waste Landfill Facility Daily Log of Operations - Form 3

(Log Required by OAC 3745-27-19(E)(10))

Facility Name: APEX ENVIRONMENTAL Today's Date: 8-5-12

Facility Opened Today at (time): 24 HRS Facility Closed Today at (time): _____

List Equipment in Operation at the Facility Today: ALSOT, D6, D8, D7, 155, 328 DUT TRUCKS

List Weather Conditions on this Day: RAIN OVERCAST 82°

The Facility Operator shall inspect the facility daily for compliance with the applicable regulations including but not limited to the following:

Place an (X) on the line next to all aspects of facility operations which have been inspected today.

3745-27-05 Prohibited Disposal Methods

X (B) No Open Burning

3745-27-19 Operation of a Facility

X (E)(2)(a) Maintain access roads
X (b) Limited access to facility
X (c) Signs posted
X (d) Exclusion of animals
X (3)(a) Adequate fire equipment
X (b) Operable and adequate equipment
X (4) Improper salvaging
X (5) Trained employees
X (6) Preparation for inclement weather
X (7)(a) Leachate treatment/disposal
X (b) Phased operation
X (c) Confined unloading
X (d) Separation/control of flammable waste
X (e) Waste disposed at working face
X (f)(i) Compacting bulky items
X (ii) Minimizing dust generation
DUE (8)(a) NESHAP reg. asbestos disposal
DUE (b) Acceptance of liquids
DUE (c) Acceptance of hazardous waste
DUE (d) Acceptance of PCBs
DUE (e) Acceptance of infectious waste
DUE (f) Acceptance of yard waste
DUE (g) Acceptance of scrap tires
DUE (h) Acceptance of low level rad. waste
DUE (i) Acceptance of semi-solid material w/free liquid
X (9) Control of scattered litter
X (10) Keeping of daily logs
X (11)(a) Daily inspection of facility for ponding, erosion, leachate outbreaks (record any corrective actions below).
X (12) Copy of auth. docs available
X (F) Daily cover
X (3) Alternate Daily Cover Used (describe in comment section below)
X (G) Intermediate cover
X (H) Final cover
X (I) Scales
X (J)(1) Surface water diversion
X (2) Design in operating record
X (4) Surface water monitoring
X (K)(1) Leachate control
X (2) Lift station back-up pumps
DUE (3) Collection pipe network (inspection)
X (4) Temporary leachate storage
X (5) Leachate treatment and disposal
X (6) Leachate storage/disposal contingency plan
X (7) Surface water monitoring
X (L) PCB and hazardous waste prevention and detection program

3745-37-01 License

X (A) Valid license

Corrective Actions Taken and Other Comments:

_____

_____

_____

Dave Kennedy — *Signature of Person Completing Form*

Dave Kennedy — *Print Name of Person Completing Form*

8-5-12 — *Date*

This form should be retained on file for three years for inspection by the local health department, Ohio EPA, or an authorized representative. Failure to provide accurate daily operations information may be considered a violation of Ohio Revised Code § 2921.13.

Ohio EPA Municipal Solid Waste Landfill Facility Daily Log of Operations - Form 3

(Log Required by OAC 3745-27-19(E)(10))

Facility Name: Apex Environmental Today's Date: 8-7-12

Facility Opened Today at (time): 24 HR Facility Closed Today at (time): _____

List Equipment in Operation at the Facility Today: Tipper, ET, MAT Handler, Rijon 836 G, 7, 155, 320

List Weather Conditions on this Day: Clear - Temps in 80's

The Facility Operator shall inspect the facility daily for compliance with the applicable regulations including but not limited to the following:

Place an (X) on the line next to all aspects of facility operations which have been inspected today.

3745-27-05 Prohibited Disposal Methods

X	(B)	No Open Burning

3745-27-19 Operation of a Facility

X	(E)(2)(a)	Maintain access roads
X	(b)	Limited access to facility
X	(c)	Signs posted
X	(d)	Exclusion of animals
X	(3)(a)	Adequate fire equipment
X	(b)	Operable and adequate equipment
X	(4)	Improper salvaging
X	(5)	Trained employees
X	(6)	Preparation for inclement weather
X	(7)(a)	Leachate treatment/disposal
X	(b)	Phased operation
X	(c)	Confined unloading
X	(d)	Separation/control of flammable waste
X	(e)	Waste disposed at working face
X	(f)(i)	Compacting bulky items
X	(ii)	Minimizing dust generation
DNI	(8)(a)	NESHAP reg. asbestos disposal
DNI	(b)	Acceptance of liquids
DNI	(c)	Acceptance of hazardous waste
DNI	(d)	Acceptance of PCBs
DNI	(e)	Acceptance of infectious waste
DNI	(f)	Acceptance of yard waste
DNI	(g)	Acceptance of scrap tires
DNI	(h)	Acceptance of low level rad. waste
DNI	(i)	Acceptance of semi-solid material w/free liquid
X	(9)	Control of scattered litter
X	(10)	Keeping of daily logs
X	(11)(a)	Daily inspection of facility for ponding, erosion, leachate outbreaks (record any corrective actions below).
X	(12)	Copy of auth. docs available
X	(F)	Daily cover
N/A	(3)	Alternate Daily Cover Used (describe in comment section below)
X	(G)	Intermediate cover
X	(H)	Final cover
X	(I)	Scales
X	(J)(1)	Surface water diversion
X	(2)	Design in operating record
X	(4)	Surface water monitoring
X	(K)(1)	Leachate control
X	(2)	Lift station back-up pumps
DNI	(3)	Collection pipe network (inspection)
X	(4)	Temporary leachate storage
X	(5)	Leachate treatment and disposal
X	(6)	Leachate storage/disposal contingency plan
X	(7)	Surface water monitoring
X	(L)	PCB and hazardous waste prevention and detection program

3745-37-01 License

X	(A)	Valid license

Corrective Actions Taken and Other Comments:

Picked Litter, Hauled Cover Water, Roads, Synagro Hauling Leachate. Covered gas seeps on each side of drainage channel on 2nd tier of east slope.

Rob Carpenter / John Pancar — Rob Carpenter / John Pancar — 8-7-12

Signature of Person Completing Form — *Print Name of Person Completing Form* — *Date*

This form should be retained on file for three years for inspection by the local health department, Ohio EPA, or an authorized representative. Failure to provide accurate daily operations information may be considered a violation of Ohio Revised Code § 2921.13.

Leachate - 8'-11" @ 9:30 AM

Sumps 1 - 17.4
3 - 21.3
4 - 22.2

OhioEPA Municipal Solid Waste Landfill Facility Daily Log of Operations - Form 3

(Log Required by OAC 3745-27-19(E)(10))

Facility Name: Apex Environmental Today's Date: 8-17-12

Facility Opened Today at (time): 24hrs Facility Closed Today at (time): 2

List Equipment in Operation at the Facility Today: tipper, LT, MA Thandler Alston 155, 6, 7, 328

List Weather Conditions on this Day: Off and on Rain Temp 70°

The Facility Operator shall inspect the facility daily for compliance with the applicable regulations including but not limited to the following:

Place an (X) on the line next to all aspects of facility operations which have been inspected today.

3745-27-05 Prohibited Disposal Methods

— (B) No Open Burning

3745-27-19 Operation of a Facility

X (E)(2)(a) Maintain access roads
X (b) Limited access to facility
X (c) Signs posted
X (d) Exclusion of animals
X (3)(a) Adequate fire equipment
X (b) Operable and adequate equipment
X (4) Improper salvaging
X (5) Trained employees
X (6) Preparation for inclement weather
X (7)(a) Leachate treatment/disposal
X (b) Phased operation
X (c) Confined unloading
X (d) Separation/control of flammable waste
X (e) Waste disposed at working face
X (f)(i) Compacting bulky items
X (ii) Minimizing dust generation
X (8)(a) NESHAP reg. asbestos disposal
DNI (b) Acceptance of liquids
DNI (c) Acceptance of hazardous waste
DNI (d) Acceptance of PCBs
DNI (e) Acceptance of infectious waste
DNI (f) Acceptance of yard waste
DNI (g) Acceptance of scrap tires
DNI (h) Acceptance of low level rad. waste
DNI (i) Acceptance of semi-solid material w/free liquid
X (9) Control of scattered litter
X (10) Keeping of daily logs
X (11)(a) Daily inspection of facility for ponding, erosion, leachate outbreaks (record any corrective actions below).
X (12) Copy of auth. does available
X QP (F) Daily cover
N/A (3) Alternate Daily Cover Used (describe in comment section below)
X QP (G) Intermediate cover
X QP (H) Final cover
X (I) Scales
X (J)(1) Surface water diversion
X (2) Design in operating record
X (4) Surface water monitoring
X (K)(1) Leachate control
X (2) Lift station back-up pumps
DNI (3) Collection pipe network (inspection)
X (4) Temporary leachate storage
X (5) Leachate treatment and disposal
X (6) Leachate storage/disposal contingency plan
X (7) Surface water monitoring
X (L) PCB and hazardous waste prevention and detection program

3745-37-01 License

X (A) Valid license

Corrective Actions Taken and Other Comments:

Picked litter hauled cover, watered Roads, Hauled leach Ate covered LEACHATE DOWN SLOPE of GW-61.

James J Applegarth James J Applegarth 8-17-12

Signature of Person Completing Form *Print Name of Person Completing Form* *Date*

JOHN PANCOST

This form should be retained on file for three years for inspection by the local health department, Ohio EPA, or an authorized representative. Failure to provide accurate daily operations information may be considered a violation of Ohio Revised Code § 2921.13.

Leach Ate 9'11 AT 11AM SumPS 1-19.6 4-21.3 3-19.3

Municipal Solid Waste Landfill Facility Daily Log of Operations - Form 3

(Log Required by OAC 3745-27-19(E)(10))

Facility Name: APEX ENVIRONMENTAL Today's Date: 9-5-12

Facility Opened Today at (time): 24HR Facility Closed Today at (time): _____

List Equipment in Operation at the Facility Today: TIPPER, IT MATERIAL HANDLER, 155 ASW, 6, 7.

List Weather Conditions on this Day: CLEAR, TEMPS IN 80's

The Facility Operator shall inspect the facility daily for compliance with the applicable regulations including but not limited to the following:

Place an (X) on the line next to all aspects of facility operations which have been inspected today.

3745-27-05 Prohibited Disposal Methods

X	(B)	No Open Burning

3745-27-19 Operation of a Facility

X	(E)(2)(a)	Maintain access roads
X	(b)	Limited access to facility
X	(c)	Signs posted
X	(d)	Exclusion of animals
X	(3)(a)	Adequate fire equipment
X	(b)	Operable and adequate equipment
X	(4)	Improper salvaging
X	(5)	Trained employees
X	(6)	Preparation for inclement weather
X	(7)(a)	Leachate treatment/disposal
X	(b)	Phased operation
X	(c)	Confined unloading
X	(d)	Separation/control of flammable waste
X	(e)	Waste disposed at working face
X	(f)(I)	Compacting bulky items
X	(ii)	Minimizing dust generation
DNI	(8)(a)	NESHAP reg. asbestos disposal
DNI	(b)	Acceptance of liquids
DNI	(c)	Acceptance of hazardous waste
DNI	(d)	Acceptance of PCBs
DNI	(e)	Acceptance of infectious waste
DNI	(f)	Acceptance of yard waste
DNI	(g)	Acceptance of scrap tires
DNI	(h)	Acceptance of low level rad. waste
DNI	(I)	Acceptance of semi-solid material w/free liquid
X	(9)	Control of scattered litter
X	(10)	Keeping of daily logs
X	(11)(a)	Daily inspection of facility for ponding, erosion, leachate outbreaks (record any corrective actions below).
X	(12)	Copy of auth. does available
X	(F)	Daily cover
N/A	(3)	Alternate Daily Cover Used (describe in comment section below)
X	(G)	Intermediate cover
X	(H)	Final cover
X	(I)	Scales
X	(J)(1)	Surface water diversion
X	(2)	Design in operating record
X	(4)	Surface water monitoring
X	(K)(1)	Leachate control
X	(2)	Lift station back-up pumps
DNI	(3)	Collection pipe network (inspection)
X	(4)	Temporary leachate storage
X	(5)	Leachate treatment and disposal
X	(6)	Leachate storage/disposal contingency plan
X	(7)	Surface water monitoring
X	(L)	PCB and hazardous waste prevention and detection program

3745-37-01 License

X	(A)	Valid license

Corrective Actions Taken and Other Comments:

PICKED LITTER, HAULED COVER, HAULED LEACHATE. WATER ROAD.

R L Carpenter — *Signature of Person Completing Form*

ROB CARPENTER — *Print Name of Person Completing Form*

9-5-12 — *Date*

This form should be retained on file for three years for inspection by the local health department, Ohio EPA, or an authorized representative. Failure to provide accurate daily operations information may be considered a violation of Ohio Revised Code § 2921.13.

LEACHATE - 10'3" @ 2:30

SUMPS 1 - 12.5
3 - 33.3
4 - 23.3

Revised: August 1, 2005

Municipal Solid Waste Landfill Facility Daily Log of Operations - Form 3

(Log Required by OAC 3745-27-19(E)(10))

Facility Name: APEX ENVIRONMENTAL Today's Date: 9-18-12

Facility Opened Today at (time): 24HR Facility Closed Today at (time): _____

List Equipment in Operation at the Facility Today: TIPPER, EX. MAT. HANDLER 836, 155 6, 7, 345

List Weather Conditions on this Day: RAIN · TEMPS IN 70'S

The Facility Operator shall inspect the facility daily for compliance with the applicable regulations including but not limited to the following:

Place an (X) on the line next to all aspects of facility operations which have been inspected today.

3745-27-05 Prohibited Disposal Methods

X	(B)	No Open Burning

3745-27-19 Operation of a Facility

X	(E)(2)(a)	Maintain access roads
X	(b)	Limited access to facility
X	(c)	Signs posted
X	(d)	Exclusion of animals
X	(3)(a)	Adequate fire equipment
X	(b)	Operable and adequate equipment
X	(4)	Improper salvaging
X	(5)	Trained employees
X	(6)	Preparation for inclement weather
X	(7)(a)	Leachate treatment/disposal
X	(b)	Phased operation
X	(c)	Confined unloading
X	(d)	Separation/control of flammable waste
X	(e)	Waste disposed at working face
X	(f)(i)	Compacting bulky items
X	(ii)	Minimizing dust generation
DNI	(8)(a)	NESHAP reg. asbestos disposal
DNI	(b)	Acceptance of liquids
DNI	(c)	Acceptance of hazardous waste
DNI	(d)	Acceptance of PCBs
DNI	(e)	Acceptance of infectious waste
DNI	(f)	Acceptance of yard waste
DNI	(g)	Acceptance of scrap tires
DNI	(h)	Acceptance of low level rad. waste
DNI	(i)	Acceptance of semi-solid material w/free liquid
X	(9)	Control of scattered litter
X	(10)	Keeping of daily logs
X	(11)(a)	Daily inspection of facility for ponding, erosion, leachate outbreaks (record any corrective actions below).
X	(12)	Copy of auth. does available
X	(F)	Daily cover
N/A	(3)	Alternate Daily Cover Used (describe in comment section below)
X	(G)	Intermediate cover
X	(H)	Final cover
X	(I)	Scales
X	(J)(1)	Surface water diversion
X	(2)	Design in operating record
X	(4)	Surface water monitoring
X	(K)(1)	Leachate control
DNI	(2)	Lift station back-up pumps
X	(3)	Collection pipe network (inspection)
X	(4)	Temporary leachate storage
X	(5)	Leachate treatment and disposal
X	(6)	Leachate storage/disposal contingency plan
X	(7)	Surface water monitoring
X	(L)	PCB and hazardous waste prevention and detection program

3745-37-01 License

X	(A)	Valid license

Corrective Actions Taken and Other Comments:

PICKED LITTER, HAULED COVER, HAULED LEACHATE, GRADED ROADS - #1 SUMP WIRED UP & RUNNING

Rob Carpenter — *Signature of Person Completing Form*

ROB CARPENTER — *Print Name of Person Completing Form*

9-18-12 — *Date*

This form should be retained on file for three years for inspection by the local health department, Ohio EPA, or an authorized representative. Failure to provide accurate daily operations information may be considered a violation of Ohio Revised Code § 2921.13.

LEACHATE - 12.7"

8:15 AM

SUMPS 1 - 44.3 - ON

3 - 33.3

4 - 18.6

Municipal Solid Waste Landfill Facility Daily Log of Operations - Form 3

(Log Required by OAC 3745-27-19(E)(10))

Facility Name: Apex Environmental Today's Date: 9-19-12

Facility Opened Today at (time): 24 HR Facility Closed Today at (time): _____

List Equipment in Operation at the Facility Today: Tipper, IT, Mat. Handler, 836, 153, 6, 7, 328.

List Weather Conditions on this Day: Clear, wet, Temps in 80's

The Facility Operator shall inspect the facility daily for compliance with the applicable regulations including but not limited to the following:

Place an (X) on the line next to all aspects of facility operations which have been inspected today.

3745-27-05 Prohibited Disposal Methods

X	(B)	No Open Burning

3745-27-19 Operation of a Facility

X	(E)(2)(a)	Maintain access roads
X	(b)	Limited access to facility
X	(c)	Signs posted
X	(d)	Exclusion of animals
X	(3)(a)	Adequate fire equipment
X	(b)	Operable and adequate equipment
X	(4)	Improper salvaging
X	(5)	Trained employees
X	(6)	Preparation for inclement weather
X	(7)(a)	Leachate treatment/disposal
X	(b)	Phased operation
X	(c)	Confined unloading
X	(d)	Separation/control of flammable waste
X	(e)	Waste disposed at working face
X	(I)(I)	Compacting bulky items
X	(ii)	Minimizing dust generation
DNI	(8)(a)	NESHAP reg. asbestos disposal
DNI	(b)	Acceptance of liquids
DNI	(c)	Acceptance of hazardous waste
DNI	(d)	Acceptance of PCBs
DNI	(e)	Acceptance of infectious waste
DNI	(f)	Acceptance of yard waste
DNI	(g)	Acceptance of scrap tires
DNI	(h)	Acceptance of low level rad. waste
DNI	(I)	Acceptance of semi-solid material w/free liquid
X	(9)	Control of scattered litter
X	(10)	Keeping of daily logs
X	(11)(a)	Daily inspection of facility for ponding, erosion, leachate outbreaks (record any corrective actions below).
X	(12)	Copy of auth. docs available
X N/A	(F)	Daily cover
N/A	(3)	Alternate Daily Cover Used (describe in comment section below)
X N/A	(G)	Intermediate cover
X N/A	(H)	Final cover
X	(I)	Scales
X	(J)(1)	Surface water diversion
X	(2)	Design in operating record
X	(4)	Surface water monitoring
X	(K)(1)	Leachate control
X	(2)	Lift station back-up pumps
DNI	(3)	Collection pipe network (inspection)
X	(4)	Temporary leachate storage
X	(5)	Leachate treatment and disposal
X	(6)	Leachate storage/disposal contingency plan
X	(7)	Surface water monitoring
X	(L)	PCB and hazardous waste prevention and detection program

3745-37-01 License

X	(A)	Valid license

Corrective Actions Taken and Other Comments:

Picked Litter, Hauled Cover, Hauled Leachate, Covered Leachate on East Side down slope of GW-61

Signature of Person Completing Form

RB Carpenter / John Parrott — Print Name of Person Completing Form

9-19-12 — Date

This form should be retained on file for three years for inspection by the local health department, Ohio EPA, or an authorized representative. Failure to provide accurate daily operations information may be considered a violation of Ohio Revised Code § 2921.13.

Leachate - 11-6" @ 10:45 AM

Sumps 1 - 38.2
3 - 31.3
4 - 16.5

Revised: August 1, 2005

Municipal Solid Waste Landfill Facility Daily Log of Operations - Form 3

(Log Required by OAC 3745-27-19(E)(10))

Facility Name: Apex Environmental Today's Date: 9-14-12

Facility Opened Today at (time): 24 HR Facility Closed Today at (time): _____

List Equipment in Operation at the Facility Today: Tipper, ET Allad, 155, 6, 7, 32A

List Weather Conditions on this Day: Clear · Temps in 70's

The Facility Operator shall inspect the facility daily for compliance with the applicable regulations including but not limited to the following:

Place an (X) on the line next to all aspects of facility operations which have been inspected today.

3745-27-05 Prohibited Disposal Methods

X	(B)	No Open Burning

3745-27-19 Operation of a Facility

X	(E)(2)(a)	Maintain access roads
X	(b)	Limited access to facility
X	(c)	Signs posted
X	(d)	Exclusion of animals
X	(3)(a)	Adequate fire equipment
X	(b)	Operable and adequate equipment
X	(4)	Improper salvaging
X	(5)	Trained employees
X	(6)	Preparation for inclement weather
X	(7)(a)	Leachate treatment/disposal
X	(b)	Phased operation
X	(c)	Confined unloading
X	(d)	Separation/control of flammable waste
X	(e)	Waste disposed at working face
X	(f)(i)	Compacting bulky items
X	(ii)	Minimizing dust generation
DNI	(8)(a)	NESHAP reg. asbestos disposal
DNI	(b)	Acceptance of liquids
DNI	(c)	Acceptance of hazardous waste
DNI	(d)	Acceptance of PCBs
DNI	(e)	Acceptance of infectious waste
DNI	(f)	Acceptance of yard waste
DNI	(g)	Acceptance of scrap tires
DNI	(h)	Acceptance of low level rad. waste
DNI	(i)	Acceptance of semi-solid material w/free liquid
X	(9)	Control of scattered litter
X	(10)	Keeping of daily logs
X	(11)(a)	Daily inspection of facility for ponding, erosion, leachate outbreaks (record any corrective actions below).
X	(12)	Copy of auth. does available
X	(F)	Daily cover
W/A	(3)	Alternate Daily Cover Used (describe in comment section below)
X	(G)	Intermediate cover
X	(H)	Final cover
X	(I)	Scales
X	(J)(1)	Surface water diversion
X	(2)	Design in operating record
X	(4)	Surface water monitoring
X	(K)(1)	Leachate control
X	(2)	Lift station back-up pumps
DNI	(3)	Collection pipe network (inspection)
X	(4)	Temporary leachate storage
X	(5)	Leachate treatment and disposal
X	(6)	Leachate storage/disposal contingency plan
X	(7)	Surface water monitoring
X	(L)	PCB and hazardous waste prevention and detection program

3745-37-01 License

X	(A)	Valid license

Corrective Actions Taken and Other Comments:

Picked Litter, Hauled Cover Water Roads, Hauled Leachate ~~Hauled~~ dug up Leachate right of GW-61, Filled with stone and covered w/ BSL. Covered gas leaks on surface on West side.

Rob Carpenter / Rob Carpenter / Apex / 9-14-12

Signature of Person Completing Form — Print Name of Person Completing Form — Date

This form should be retained on file for three years for inspection by the local health department, Ohio EPA, or an authorized representative. Failure to provide accurate daily operations information may be considered a violation of Ohio Revised Code § 2921.13.

Leachate - 11'6"

Sumps 1 - 174.8

3 - 36.9

4 - 18.6

@ 8:30 AM

Municipal Solid Waste Landfill Facility Daily Log of Operations - Form 3

(Log Required by OAC 3745-27-19(E)(10))

Facility Name: Apex Environmental Today's Date: 10-3-12

Facility Opened Today at (time): 24 hr Facility Closed Today at (time): _____

List Equipment in Operation at the Facility Today: Tipper, IT, Mat. Handler 135, Alson 6, 7 325

List Weather Conditions on this Day: Cloudy - Temps in 20's

The Facility Operator shall inspect the facility daily for compliance with the applicable regulations including but not limited to the following:

Place an (X) on the line next to all aspects of facility operations which have been inspected today.

3745-27-05 Prohibited Disposal Methods

X	(B)	No Open Burning

3745-27-19 Operation of a Facility

X	(E)(2)(a)	Maintain access roads
X	(b)	Limited access to facility
X	(c)	Signs posted
X	(d)	Exclusion of animals
X	(3)(a)	Adequate fire equipment
X	(b)	Operable and adequate equipment
X	(4)	Improper salvaging
X	(5)	Trained employees
X	(6)	Preparation for inclement weather
X	(7)(a)	Leachate treatment/disposal
X	(b)	Phased operation
X	(c)	Confined unloading
X	(d)	Separation/control of flammable waste
X	(e)	Waste disposed at working face
X	(f)(i)	Compacting bulky items
X	(ii)	Minimizing dust generation
DNI	(8)(a)	NESHAP reg. asbestos disposal
DNI	(b)	Acceptance of liquids
DNI	(c)	Acceptance of hazardous waste
DNI	(d)	Acceptance of PCBs
DNI	(e)	Acceptance of infectious waste
DNI	(f)	Acceptance of yard waste
DNI	(g)	Acceptance of scrap tires
DNI	(h)	Acceptance of low level rad. waste
DNI	(i)	Acceptance of semi-solid material w/free liquid
X	(9)	Control of scattered litter
X	(10)	Keeping of daily logs
X	(11)(a)	Daily inspection of facility for ponding, erosion, leachate outbreaks (record any corrective actions below).
X	(12)	Copy of auth. does available
X	(F)	Daily cover
N/A	(3)	Alternate Daily Cover Used (describe in comment section below)
X	(G)	Intermediate cover
X	(H)	Final cover
X	(I)	Scales
X	(J)(1)	Surface water diversion
X	(2)	Design in operating record
X	(4)	Surface water monitoring
X	(K)(1)	Leachate control
X	(2)	Lift station back-up pumps
DNI	(3)	Collection pipe network (inspection)
X	(4)	Temporary leachate storage
X	(5)	Leachate treatment and disposal
X	(6)	Leachate storage/disposal contingency plan
X	(7)	Surface water monitoring
X	(L)	PCB and hazardous waste prevention and detection program

3745-37-01 License

X	(A)	Valid license

Corrective Actions Taken and Other Comments:

Picked Litter, Hauled Cover, Hauler Leachate Covered Leachate on the North Slope. Covered Leachate along access road going to work face.

R L Carpenter — Signature of Person Completing Form

ROB CARPENTER — Print Name of Person Completing Form

10-3-12 — Date

This form should be retained on file for three years for inspection by the local health department, Ohio EPA, or an authorized representative. Failure to provide accurate daily operations information may be considered a violation of Ohio Revised Code § 2921.13.

Leachate - C

OhioEPA Municipal Solid Waste Landfill Facility Daily Log of Operations - Form 3

(Log Required by OAC 3745-27-19(E)(10))

Facility Name: APEX ENVIRONMENTAL Today's Date: 10-18-12

Facility Opened Today at (time): 24 HR Facility Closed Today at (time): _____

List Equipment in Operation at the Facility Today: TIPPER, IT. MAT-HANDLER 836 155, 6, 7, 325

List Weather Conditions on this Day: Cloudy. RAIN

The Facility Operator shall inspect the facility daily for compliance with the applicable regulations including but not limited to the following:

Place an (X) on the line next to all aspects of facility operations which have been inspected today.

3745-27-05 Prohibited Disposal Methods

X	(B)	No Open Burning

3745-27-19 Operation of a Facility

X	(E)(2)(a)	Maintain access roads
X	(b)	Limited access to facility
X	(c)	Signs posted
X	(d)	Exclusion of animals
X	(3)(a)	Adequate fire equipment
X	(b)	Operable and adequate equipment
X	(4)	Improper salvaging
X	(5)	Trained employees
X	(6)	Preparation for inclement weather
X	(7)(a)	Leachate treatment/disposal
X	(b)	Phased operation
X	(c)	Confined unloading
X	(d)	Separation/control of flammable waste
X	(e)	Waste disposed at working face
X	(I)(I)	Compacting bulky items
X	(ii)	Minimizing dust generation
DNI	(8)(a)	NESHAP reg. asbestos disposal
DNI	(b)	Acceptance of liquids
DNI	(c)	Acceptance of hazardous waste
DNI	(d)	Acceptance of PCBs
DNI	(e)	Acceptance of infectious waste
DNI	(f)	Acceptance of yard waste
DNI	(g)	Acceptance of scrap tires
DNI	(h)	Acceptance of low level rad. waste
DNI	(I)	Acceptance of semi-solid material w/free liquid
X	(9)	Control of scattered litter
X	(10)	Keeping of daily logs
X	(11)(a)	Daily inspection of facility for ponding, erosion, leachate outbreaks (record any corrective actions below).
X	(12)	Copy of auth. does available
X	(F)	Daily cover
N/A	(3)	Alternate Daily Cover Used (describe in comment section below)
X	(G)	Intermediate cover
X	(H)	Final cover
X	(I)	Scales
X	(J)(1)	Surface water diversion
X	(2)	Design in operating record
X	(4)	Surface water monitoring
X	(K)(1)	Leachate control
X	(2)	Lift station back-up pumps
DNI	(3)	Collection pipe network (inspection)
X	(4)	Temporary leachate storage
X	(5)	Leachate treatment and disposal
X	(6)	Leachate storage/disposal contingency plan
X	(7)	Surface water monitoring
X	(L)	PCB and hazardous waste prevention and detection program

3745-37-01 License

X	(A)	Valid license

Corrective Actions Taken and Other Comments:

PICKED LITTER HAULED COVER COVERED LEACHATE ON EAST SLOPE OF NEW CELL. COVERED LEACHATE ON EAST SLOPE BELOW GW-02

Rob Carpenter — Signature of Person Completing Form

ROB CARPENTER — Print Name of Person Completing Form

10-18-12 — Date

This form should be retained on file for three years for inspection by the local health department, Ohio EPA, or an authorized representative. Failure to provide accurate daily operations information may be considered a violation of Ohio Revised Code § 2921.13.

Municipal Solid Waste Landfill Facility Daily Log of Operations - Form 3

(Log Required by OAC 3745-27-19(E)(10))

Facility Name: APEX ENVIRONMENTAL Today's Date: 12-21-12

Facility Opened Today at (time): 7AM Facility Closed Today at (time): _____

List Equipment in Operation at the Facility Today: TRPR, ET, 836, 385, 455, 6, 7.

List Weather Conditions on this Day: SNOW - TEMPS IN 30'S

The Facility Operator shall inspect the facility daily for compliance with the applicable regulations including but not limited to the following:

Place an (X) on the line next to all aspects of facility operations which have been inspected today.

3745-27-05 Prohibited Disposal Methods

X	(B)	No Open Burning

3745-27-19 Operation of a Facility

X	(E)(2)(a)	Maintain access roads
X	(b)	Limited access to facility
X	(c)	Signs posted
X	(d)	Exclusion of animals
X	(3)(a)	Adequate fire equipment
X	(b)	Operable and adequate equipment
X	(4)	Improper salvaging
X	(5)	Trained employees
X	(6)	Preparation for inclement weather
X	(7)(a)	Leachate treatment/disposal
X	(b)	Phased operation
X	(c)	Confined unloading
X	(d)	Separation/control of flammable waste
X	(e)	Waste disposed at working face
X	(f)(I)	Compacting bulky items
X	(ii)	Minimizing dust generation
DNI	(8)(a)	NESHAP reg. asbestos disposal
DNI	(b)	Acceptance of liquids
DNI	(c)	Acceptance of hazardous waste
DNI	(d)	Acceptance of PCBs
DNI	(e)	Acceptance of infectious waste
DNI	(f)	Acceptance of yard waste
DNI	(g)	Acceptance of scrap tires
DNI	(h)	Acceptance of low level rad. waste
DNI	(I)	Acceptsnce of semi-solid material w/free liquid
X	(9)	Control of scattered litter
X	(10)	Keeping of daily logs
X JP	(11)(a)	Daily inspection of facility for ponding, erosion, leachate outbreaks (record any corrective actions below).
X	(12)	Copy of auth. does available
X JP	(F)	Daily cover
N/A	(3)	Alternate Daily Cover Used (describe in comment section below)
X JP	(G)	Intermediate cover
X JP	(H)	Final cover
X	(I)	Scales
X	(J)(1)	Surface water diversion
X	(2)	Design in operating record
X	(4)	Surface water monitoring
X	(K)(1)	Leachate control
X	(2)	Lift station back-up pumps
DNI	(3)	Collection pipe network (inspection)
X	(4)	Temporary leachate storage
X	(5)	Leachate treatment and disposal
X	(6)	Leachate storage/disposal contingency plan
X	(7)	Surface water monitoring
X	(L)	PCB and hazardous waste prevention and detection program

3745-37-01 License

X	(A)	Valid license

Corrective Actions Taken and Other Comments:

PICKED LITTER HAULED COVER HAULED LEACHATE GRADED + GRAVEL ROADS' COVERED LEACHATE DOWN SLOPE OF GW-61

R Carpenter/Rpmont — *Signature of Person Completing Form*

R.B CARPENTER/RPMONT — *Print Name of Person Completing Form*

12-21-12 — *Date*

This form should be retained on file for three years for inspection by the local health department, Ohio EPA, or an authorized representative. Failure to provide accurate daily operations information may be considered a violation of Ohio Revised Code § 2921.13.

Municipal Solid Waste Landfill Facility Daily Log of Operations - Form 3

(Log Required by OAC 3745-27-19(E)(10))

Facility Name: Apex Environmental Today's Date: 1-2-13

Facility Opened Today at (time): 2x #1 Facility Closed Today at (time):

List Equipment in Operation at the Facility Today: T. Apex, Ft. Mat. Handler, 155, 6, 7 325

List Weather Conditions on this Day: cloudy - Temps in 20's

The Facility Operator shall inspect the facility daily for compliance with the applicable regulations including but not limited to the following:

Place an (X) on the line next to all aspects of facility operations which have been inspected today.

3745-27-05 Prohibited Disposal Methods

X	(B)	No Open Burning

3745-27-19 Operation of a Facility

X	(E)(2)(a)	Maintain access roads
X	(b)	Limited access to facility
X	(c)	Signs posted
X	(d)	Exclusion of animals
X	(3)(a)	Adequate fire equipment
X	(b)	Operable and adequate equipment
X	(4)	Improper salvaging
X	(5)	Trained employees
X	(6)	Preparation for inclement weather
X	(7)(a)	Leachate treatment/disposal
X	(b)	Phased operation
X	(c)	Confined unloading
X	(d)	Separation/control of flammable waste
X	(e)	Waste disposed at working face
X	(f)(i)	Compacting bulky items
X	(ii)	Minimizing dust generation
DNI	(8)(a)	NESHAP reg. asbestos disposal
DNI	(b)	Acceptance of liquids
DNI	(c)	Acceptance of hazardous waste
DNI	(d)	Acceptance of PCBs
DNI	(e)	Acceptance of infectious waste
DNI	(f)	Acceptance of yard waste
DNI	(g)	Acceptance of scrap tires
DNI	(h)	Acceptance of low level rad. waste
DNI	(i)	Acceptance of semi-solid material w/free liquid
X	(9)	Control of scattered litter
X	(10)	Keeping of daily logs
X JP	(11)(a)	Daily inspection of facility for ponding, erosion, leachate outbreaks (record any corrective actions below).
X JP	(12)	Copy of auth. docs available
X JP	(F)	Daily cover
N/A	(3)	Alternate Daily Cover Used (describe in comment section below)
X JP	(G)	Intermediate cover
X JP	(H)	Final cover
X	(I)	Scales
X	(J)(1)	Surface water diversion
X	(2)	Design in operating record
X	(4)	Surface water monitoring
X	(K)(1)	Leachate control
X	(2)	Lift station back-up pumps
DNI	(3)	Collection pipe network (inspection)
X	(4)	Temporary leachate storage
X	(5)	Leachate treatment and disposal
X	(6)	Leachate storage/disposal contingency plan
X	(7)	Surface water monitoring
X	(L)	PCB and hazardous waste prevention and detection program

3745-37-01 License

___	(A)	Valid license

Corrective Actions Taken and Other Comments:

Picked Litter, Hauled Cover, Hauled Leachate, Graded Roads

Rob Carpenter / J. Pancost — *Signature of Person Completing Form*

Rob Carpenter / J. Pancost — *Print Name of Person Completing Form*

1-2-13 — *Date*

This form should be retained on file for three years for inspection by the local health department, Ohio EPA, or an authorized representative. Failure to provide accurate daily operations information may be considered a violation of Ohio Revised Code § 2921.13.

Municipal Solid Waste Landfill Facility Daily Log of Operations - Form 3

(Log Required by OAC 3745-27-19(E)(10))

Facility Name: APEX ENVIRONMENTAL Today's Date: 2-5-13

Facility Opened Today at (time): 24 HR Facility Closed Today at (time): _____

List Equipment in Operation at the Facility Today: TIPPER, DT, MATL HANDLER, 155, 836, 6, 7, 325

List Weather Conditions on this Day: Cloudy - Temps in 20's

The Facility Operator shall inspect the facility daily for compliance with the applicable regulations including but not limited to the following:

Place an (X) on the line next to all aspects of facility operations which have been inspected today.

3745-27-05 Prohibited Disposal Methods

X	(B)	No Open Burning

3745-27-19 Operation of a Facility

X	(E)(2)(a)	Maintain access roads
X	(b)	Limited access to facility
X	(c)	Signs posted
X	(d)	Exclusion of animals
X	(3)(a)	Adequate fire equipment
X	(b)	Operable and adequate equipment
X	(4)	Improper salvaging
X	(5)	Trained employees
X	(6)	Preparation for inclement weather
X	(7)(a)	Leachate treatment/disposal
X	(b)	Phased operation
X	(c)	Confined unloading
X	(d)	Separation/control of flammable waste
X	(e)	Waste disposed at working face
X	(f)(i)	Compacting bulky items
X	(ii)	Minimizing dust generation
DNI	(8)(a)	NESHAP reg. asbestos disposal
DNI	(b)	Acceptance of liquids
DNI	(c)	Acceptance of hazardous waste
DNI	(d)	Acceptance of PCBs
DNI	(e)	Acceptance of infectious waste
DNI	(f)	Acceptance of yard waste
DNI	(g)	Acceptance of scrap tires
DNI	(h)	Acceptance of low level rad. waste
DNI	(i)	Acceptance of semi-solid material w/free liquid
X	(9)	Control of scattered litter
X	(10)	Keeping of daily logs
X GP	(11)(a)	Daily inspection of facility for ponding, erosion, leachate outbreaks (record any corrective actions below).
X	(12)	Copy of auth. does available
X GP	(F)	Daily cover
N/A	(3)	Alternate Daily Cover Used (describe in comment section below)
X GP	(G)	Intermediate cover
X GP	(H)	Final cover
X	(I)	Scales
X	(J)(1)	Surface water diversion
X	(2)	Design in operating record
X	(4)	Surface water monitoring
X	(K)(1)	Leachate control
X	(2)	Lift station back-up pumps
DNI	(3)	Collection pipe network (inspection)
X	(4)	Temporary leachate storage
X	(5)	Leachate treatment and disposal
X	(6)	Leachate storage/disposal contingency plan
X	(7)	Surface water monitoring
X	(L)	PCB and hazardous waste prevention and detection program

3745-37-01 License

X	(A)	Valid license

Corrective Actions Taken and Other Comments:

PICKED LITTER HAULED COUCH HAULED LEACHATE, A.E.E working on gas GENSET ON EAST SLOPE

Signature of Person Completing Form

JOHN PANCOAST
BOB CARPENTER
Print Name of Person Completing Form

2-5-13
Date

This form should be retained on file for three years for inspection by the local health department, Ohio EPA, or an authorized representative. Failure to provide accurate daily operations information may be considered a violation of Ohio Revised Code § 2921.13.

Municipal Solid Waste Landfill Facility Daily Log of Operations - Form 3

(Log Required by OAC 3745-27-19(E)(10))

Facility Name: Apex Environmental Today's Date: 3-26-13

Facility Opened Today at (time): 24 HR Facility Closed Today at (time):

List Equipment in Operation at the Facility Today: Tipper, IT, MAT. Handler, 836 360, 6, 8,

List Weather Conditions on this Day: cloudy - Temps in 40's

The Facility Operator shall inspect the facility daily for compliance with the applicable regulations including but not limited to the following:

Place an (X) on the line next to all aspects of facility operations which have been inspected today.

3745-27-05 Prohibited Disposal Methods

- X (B) No Open Burning

3745-27-19 Operation of a Facility

- X (E)(2)(a) Maintain access roads
- X (b) Limited access to facility
- X (c) Signs posted
- X (d) Exclusion of animals
- X (3)(a) Adequate fire equipment
- X (b) Operable and adequate equipment
- X (4) Improper salvaging
- X (5) Trained employees
- X (6) Preparation for inclement weather
- X (7)(a) Leachate treatment/disposal
- X (b) Phased operation
- X (c) Confined unloading
- X (d) Separation/control of flammable waste
- X (e) Waste disposed at working face
- X (f)(i) Compacting bulky items
- X (ii) Minimizing dust generation
- DNI (8)(a) NESHAP reg. asbestos disposal
- DNI (b) Acceptance of liquids
- DNI (c) Acceptance of hazardous waste
- DNI (d) Acceptance of PCBs
- DNI (e) Acceptance of infectious waste
- DNI (f) Acceptance of yard waste
- DNI (g) Acceptance of scrap tires
- DNI (h) Acceptance of low level rad. waste
- DNI (I) Acceptance of semi-solid material w/free liquid
- X (9) Control of scattered litter
- X (10) Keeping of daily logs
- X (11)(a) Daily inspection of facility for ponding, erosion, leachate outbreaks (record any corrective actions below).
- X (12) Copy of auth. does available
- X AP (F) Daily cover
- N/A (3) Alternate Daily Cover Used (describe in comment section below)
- X AP (G) Intermediate cover
- X AP (H) Final cover
- X (I) Scales
- X (J)(1) Surface water diversion
- X (2) Design in operating record
- X (4) Surface water monitoring
- X (K)(1) Leachate control
- X (2) Lift station back-up pumps
- DNI (3) Collection pipe network (inspection)
- X (4) Temporary leachate storage
- X (5) Leachate treatment and disposal
- X (6) Leachate storage/disposal contingency plan
- X (7) Surface water monitoring
- X (L) PCB and hazardous waste prevention and detection program

3745-37-01 License

- X (A) Valid license

Corrective Actions Taken and Other Comments:

Picked Litter, Hauled Cover, Hauled Leachate. Dug up Leachate outbreak down slope of GW-65R, just above 2nd bench

Rob Carpenter JOHN PAUCOST ROB CARPENTER 3-26-13

Signature of Person Completing Form *Print Name of Person Completing Form* *Date*

This form should be retained on file for three years for inspection by the local health department, Ohio EPA, or an authorized representative. Failure to provide accurate daily operations information may be considered a violation of Ohio Revised Code § 2921.13.

(C)(2) VARIANCE AND EXEMPTION REQUESTS

Variance and Exemption Requests

Any variance or exemption requests from the requirements in rule 3745-27-07, 3745-27-08, 3745-27-09, 3745-27-10, 3745-27-11, 3745-27-12, 3745-27-13, 3745-27-14, 3745-27-15, 3745-27-16, 3745-27-10, 0r 3745-27-20 of the Administrative Code.

EXEMPTION REQUEST – FACILITY IN LIMESTONE OR SANDSTONE QUARRY

Apex Environmental, LLC (Apex) is submitting this exemption request from the requirements of OAC 3745-27-07(H)(2)(b) which specifies that "the sanitary landfill facility is not located in a limestone quarry or sandstone quarry. For the purposes of this paragraph, a limestone or sandstone quarry is an excavation resulting from a mining operation where limestone or sandstone is principal material excavated for use in another location or for commercial sale. This term does not include excavation of limestone resulting from the construction of the sanitary landfill facility."

Apex believes that an exemption request is not required for the proposed expansion because of the following reasons:

1. Any limestone excavation will result solely from the construction of the landfill. Apex will not excavate below the permitted excavation grades to mine the limestone nor will limestone be excavated beyond the landfill limits of waste. Therefore, as stated in the regulations, the excavation is not a limestone quarry.
2. Regarding past limestone mining, guidance document No. 0693 titled "Siting Criteria" dated August 28, 2006 state "If the limestone quarry has been filled in and reclaimed prior to the approval of a the permit to install, there is no excavation (i.e. no quarry) and the criterion does not apply." The previous limestone mine has been filled in and reclaimed so this criterion does not apply.

OAC 3745-27-03 states, "Exemptions pursuant to division (G) of section 3734.02 of the revised code, the director may, by order, exempt any person generating, collecting, storing, treating, disposing of, or transporting solid wastes, including scrap tires, from any requirement of chapter 3734 of the revise code, or any rules adopted thereunder if granting the exemption is unlikely to adversely affect the public health or safety or the environment. For the purposes of this rule, an exemption is defined as "A discretionary action of the director that relieves an applicant from a requirement of chapter 3734 of the revises code or any rule adapted thereunder."

ORC 3734.02(G) states, "The director, by order, may exempt any person generating, collecting, storing, treating, disposing of, or transporting solid wastes or hazardous waste, or processing solid wastes that consist of scrap tires, in such quantities or under such circumstances that, in the determination of the director, are unlikely to adversely affect the public health or safety or the environment from any requirement to obtain a registration certificate, permit, or license or comply with the manifest system or other requirements of this chapter. Such an exemption shall be consistent with and equivalent to any regulations adopted by the administrator of the United States Environmental Protection Agency under the "Resource Conservation and Recovery Act of 1976," 90 Stat.2806, 42 U.S.C.A. 6921, as amended, except as otherwise provided in this chapter."

The basis for the exemption request is that the siting of the proposed lateral expansion at the Apex Sanitary Landfill will not adversely affect public health, safety, or the environment.

BASIS FOR EXEMPTION REQUEST

As part of the landfill construction, Apex will remove limestone where it is encountered above the permitted base grades of the liner system. Apex will not excavate below the permitted base grades to mine the limestone.

A limestone quarry may be unsuitable for a sanitary landfill if the quarry is an open pit excavation where all of the limestone and overburden is removed from the quarry leaving a deep, open pit. This type of quarry is left with deep highwalls that will accumulate ground water and surface water at the site. This water can make it difficult to isolate the waste and liner system from the ground water aquifer. In addition, the typical quarry leaves a highwall which provides stability concerns related to landfill construction and leachate migration through the highwall.

The past and proposed future excavation of limestone at the Apex Sanitary Landfill is not an open pit excavation leaving an incised depression without a discharge to surface waters. The limestone, which is approximately 5 feet thick may be excavated as a surface mine. This site was also previously mined for coal. The limestone seam is immediately below the previously mined coal seam. Where the limestone excavation is performed as part of the landfill construction, any mine spoil will be removed, the limestone excavated, and the rock below the limestone excavated to achieve design base grades of the landfill. There are no depressions to accumulate ground water or highwalls that may provide a path for leachate migration or stability concerns left in place as a result of the limestone excavation.

In addition, the landfill is designed to comply with all of the other ground water protections and setback siting criteria in OAC 3745-27-07(H)(2) and (3). Most importantly, the landfill is designed to provide at least 15 feet of separation between the base of recompacted soil liner and the top of the uppermost aquifer system. Finally, the ground water monitoring system at the facility is able to detect a potential release from the facility.

Therefore, any concerns associated with siting a landfill in a limestone quarry are not present at this facility. Based on the above, the proposed contiguous expansion PTI application will be protective of public health, safety, and the environment.

VARIANCE REQUEST – FACILITY WITHIN ONE THOUSAND FEET OF WATER SUPPLY WELL

Apex Environmental, LLC (Apex) is submitting this variance request from the requirements of OAC 3745-27-07(H)(3)(c) which specifies that "the limits of solid waste placement of the sanitary landfill facility are not located within one thousand feet of a water supply well or a developed spring in existence on the date the permit to install application was received by Ohio EPA..."

OAC 3745-27-03 states, "The director shall grant a variance only if the applicant demonstrates to the director's satisfaction that construction, operation, closure activities and/or post-closure activities of the solid waste facility in the manner approved by the variance and any terms or conditions imposed as part of the variance will not create a nuisance or a hazard to public health or safety or the environment and is unlikely to result in a violation of any other requirements of chapters 3704., 3714., 3734. and 6111. of the Revised Code and any rules adopted thereunder." "For the purposes of this rule, a variance is defined as an action of the director that alters or changes a requirement of a rule adopted under chapter 3734. of the Revised Code."

OAC 3734.02 states, "The director shall grant a variance only if the applicant demonstrates to the director's satisfaction that construction and operation of the solid waste facility in the manner allowed by the variance and any terms or conditions imposed as part of the variance will not create a nuisance or a hazard to the public health or safety or the environment.

The basis for the variance request is that the siting of the proposed lateral expansion at the Apex Sanitary Landfill will not adversely affect public health, safety, or the environment."

BASIS FOR VARIANCE REQUEST

The water well supply is for the main office, which is within 1,000 feet of the proposed limits of waste placement in the southwestern portion of the lateral expansion area. Apex is requesting Ohio EPA approval to use the water well during the operation of the landfill. The water well is

controlled by Apex and is not used as a drinking water source. The well is used to provide water to the office sinks and toilets. This variance only requests the use of the well until the actual limits of waste are within 1,000 feet of the well, which occurs during waste placement in Phase 10. Prior to placing waste within 1,000 feet of the well in Phase 10, Apex will ~~either~~ decommission the well and ~~or~~ submit a demonstration to the Ohio EPA that a new well with casing installed to create a hydrogeologic barrier can be separated by the limits of waste by a hydrogeologic barrier in accordance with OAC rule 3745-27-07(H)(3)(c)(iii)~~.~~, install a well at least 1,000 feet downgradient or 500 feet upgradient of the limit of waste in accordance with OAC rule 3745-27-07(H)(3)(c)(ii), or install a potable water tank for the Apex office.

Based on the above, the proposed contiguous expansion PTI application will be protective of public health, safety, and the environment.

(C)(4) STABILITY ANALYSIS

(C)(4) The following analyses establishing the stability of the sanitary landfill facility and the subsurface. The analyses shall provide sufficient information to allow Ohio EPA to sufficiently characterize the facility geology to allow for the evaluation of the proposed design of the sanitary landfill facility.

This section presents landfill stability analysis required by OAC 3745-27-06(C)(4). Where appropriate, the calculations include references, assumptions and site-specific data.

The following analyses are provided:

(a) hydrostatic uplift analysis,
(b) bearing capacity analysis,
(c) static stability analysis,
(d) seismic stability analysis,
(e) settlement analysis of the composite liner system,
(f) settlement analysis of the separatory liner (if necessary), and
(g) unstable areas analysis.

DISCUSSION

This document summarizes the subsurface investigation and laboratory testing in accordance with OAC 3745-27-06(C)(3)(f)(v) to use in the geotechnical analyses. OAC 3745-27-06(C)(3)(f)(v) requires information for the geotechnical analyses to be collected from unconsolidated stratigraphic units susceptible to stability or settlement failure to 50 feet below proposed excavation depths. Conclusions based on the information obtained from the subsurface investigation, laboratory testing results, and site research are presented herein.

2010 SUBSURFACE INVESTIGATION

General

The area of the existing on-site mine spoil material to remain in place (only within the footprint of the perimeter berm) is approximately 121 acres. In accordance with 3745-27-06(C)(3)(f)(v) at least one subsurface investigatory site (test boring or test pit) per every four acres was performed considering the 2010 investigation and previous investigations at the site A boring/test pit location plan is presented as Drawing 3D in the HSIR, and indicates both the 2010 and prior investigation sites. A discussion of investigations conducted prior to 2010 is included later in this document

Piezometers

Twenty-six piezometers were installed as part of the hydrogeologic investigation at the site to monitor and evaluate groundwater at the site. Test boring numbers containing a 'P' indicate that a piezometer was installed at that location. Piezometers were installed using the hollow stem auger (HSA) method, air rotary drilling methods, and conventional bedrock coring techniques. Nine piezometers were installed to monitor groundwater with in the unconsolidated materials at the site and the remaining seventeen piezometers were installed to monitor groundwater within the bedrock at the site. For more detailed information refer to the Hydrogeologic Site Investigation Report which is in Section (C)(3) of this PTI application.

Test Borings

Thirty-four test borings were drilled for the site specific geotechnical field investigation. The borings were logged in the field by a qualified representative of CEC. The test borings were drilled using hollow stem augers (HSA), generally in conjunction with standard penetration tests (SPTs). The drilling was performed by Test Boring Services, Inc. (TBS) from August 2 through 30, 2010 under the direct supervision CEC.

Test boring numbers beginning with 'SB' indicate a soil boring advanced by HSA with split spoon sampling to split spoon or auger refusal. CEC defines split spoon refusal as the depth at which 50 blows or more are required to drive the sampling spoon 6 inches or less. Test boring numbers beginning with 'RB' indicate a test boring advanced by HSA to the top of bedrock or to auger refusal without performing SPTs. At the time of the investigation it was assumed that all of the mine spoil at the RB locations would be removed, therefore undisturbed samples were not collected. Instead, the cuttings from the RB borings were used for logging and bulk samples were collected at various locations and depths for remolded laboratory testing. An additional intent of conducting the 'RB' borings was to better define the top of rock surface for design purposes.

Split spoon sampling was conducted in accordance with ASTM D-1586 and at 2-foot centers (continuously) using a 2-inch outer diameter (OD) split-spoon sampler that is 24 inches in length. Blow counts were recorded for every 6 inches that the split-spoon sampler was advanced on the test boring logs. The first increment is considered a seating of the sampler. The sum of the blows for the second and third increments is the "N" value. The "N" value is considered to be an indication of the relative density of coarse-grained soils (sand and gravel) or the consistency of fine-grained (silt and clay) soils.

To confirm field identification techniques, some samples were selected for laboratory classification testing. Split spoon samples were placed in sealed glass jars and bulk samples were collected (and placed in sealed bags) at various depths within the mine spoil and residual soil. Selected bulk and split spoon samples were delivered to Geotechnical Testing Services, Inc. (GTS), an AASHTO accredited independent laboratory. Tests on these samples included grain size analysis, Atterberg limits (plasticity), standard Proctor, remolded consolidated-undrained (CU) triaxial, remolded one-dimensional consolidation, specific gravity, and in-situ moisture content.

Relatively undisturbed Shelby tube samples were collected from test borings during drilling/test pit excavation within the mine spoil and residual soil. These samples were taken at depths and locations where relatively soft, cohesive material was encountered as indicated by the SPTs or visual observation. Where low sample recovery or Shelby tube refusal occurred, a second Shelby tube was collected, if possible, either directly below the failed sample interval or in an adjacent boring at approximately the same depth. Laboratory tests on selected Shelby tubes included grain size analysis and classification, Atterberg limits (plasticity), CU triaxial, one-dimensional consolidation, hydraulic conductivity, specific gravity, in-situ unit weight, and in-situ moisture content.

Test Pits

Fourteen test pits were excavated, where accessible, between September 20 and September 23, 2010 by TBS under the direct supervision of CEC throughout the site. The test pits were generally focused in areas that were unlikely to have significant thicknesses of mine spoil based on a review of historic topographic maps, in an effort to characterize the thickness and properties of the residual soils that may remain in place beneath the perimeter berm. The test pits were advanced to bedrock or to the excavator's limit of reach. The test pits ranged in depth from 3 to 19 feet below the ground surface (bgs). Undisturbed samples were collected at depths and locations using Shelby tubes and disturbed bulk samples within the unconsolidated material of either residual soil or mine spoil. The Shelby tubes were pushed using an adapter that holds the tube and was attached to the excavator bucket.

Rock Core

Several borings were advanced into bedrock and obtained continuous HQ-size (approximately 2.5-inch diameter) rock core samples for visual description and to estimate the engineering characteristics of the bedrock. The length of rock core recovered was measured and compared to the length of the core run to determine the rock core recovery percentage. The percentage of rock core equal to or longer than 4 inches was also measured and is called the Rock Quality Designation (RQD). The rock core recovery and RQD are an

indication of bedrock hardness, brokenness, and weathering. They also provide a qualitative indication of the capacity of the bedrock to support loads and difficulty of excavation. Rock core samples were visually examined and described in the field.

Data Obtained

Based on the field logs and historic information, subsurface stratigraphic profiles were developed for the site. Mine spoil was generally encountered directly beneath the ground surface, which overlies residual soil and bedrock. However, mine spoil was not encountered in all areas of the site. Residual soil was encountered at the ground surface where mine spoil did not exist. Based on the subsurface investigation, the mine spoil and residual soil are generally considered to be compressible/unconsolidated layers.

The mine spoil was generally sampled in a moist condition and consisted of various material types ranging from clay to gravel. The fine-grained mine spoil encountered had consistencies ranging from very soft to very stiff. The coarse-grained mine spoil encountered had relative densities ranging from loose to very dense.

The residual soil, as expected, was less variable than the mine spoil generally consisting of clay with varying amounts of sand and rock fragments or decomposed bedrock. The fine-grained residual soil encountered had consistencies ranging from medium stiff to hard. The coarse-grained residual soil encountered had relative densities ranging from medium dense to very dense.

Fat clay was encountered at the site in the southern portion of the expansion beneath the proposed perimeter berm. This material was identified is highly plastic and generally highly compressible with relatively low shear strength. Fat clay was encountered in the mine spoil and residual soil at the site. It was encountered in the mine spoil in Test Borings SB-12 from 16 to 18 feet and SB-14 from 26.5 to 27 feet and was encountered in the residual soil at Test Boring RB-8 from 23 to 27 feet and SB-16 from 0.5 to 2.5 feet.

The Pittsburgh coal seam was previously mined at the surface and beneath portions of the site. One mine void was encountered during this investigation in Test Boring SB-6 at a depth of 46 to 49.5 feet bgs (El. 1232.3 to 1228.8) and in a previous investigation from approximately 55 to 56 feet bgs (El. 1227.3 to 1226.3) in Test Boring B-12. Theses void elevations and locations correlate with that of the previously mined Pittsburgh Coal Seam. Both of these test borings area located in the southwest corner of the proposed expansion floor. In-tact coal was encountered in Test Borings SB-10 from 52 to 54 feet bgs (El. 1247.8 to 1245.8) and nearby Test Boring B-401 from 52 to 54.2 feet bgs, which was performed during a previous site investigation. An elevated uppermost aquifer system (UAS) was encountered at the site as shown on Drawing 3F in the HSIR. This elevated UAS is located in the central portion of the proposed expansion floor and is approximately 70 to 80 feet higher in elevation than the surrounding UAS at the site. Refer to the Hydrogeologic Investigation Summary presented in this PTI for more information. The proposed expansion was designed with the intent that the mine spoil, remaining coal, mine voids, and elevated UAS will be removed during excavations to reach the proposed grades.

Unsuitable material, to be removed, exists in the area on the north side of the expansion and to the west of the existing permitted area. Refer to Drawing 3D in the HSIR and Drawing 4A in this application for the

exact location. In addition to mine spoil in the area shown on Drawing 4A excavated material from the construction of Phase 1 was wasted here including trees, boulders, etc.

PREVIOUS SUBSURFACE INVESTIGATIONS

Previous subsurface investigations were performed for the existing landfill. These test boring and test pit logs support the subsurface profile identified in the current investigation. Refer to section (C)(3) of this application for test boring and test pit logs and locations.

LABORATORY TESTING

OAC 3745-27-06(C)(3)(f)(vi) requires laboratory analyses to be performed on representative samples of all unconsolidated stratigraphic units under the facility down to a minimum of 50 feet below the proposed depths of excavation. Geotechnical laboratory testing was performed classify the samples and to provide shear strength, consolidation, and hydraulic conductivity properties for the samples collected. The following tests were performed on a representative amount of disturbed samples. Tests were performed on at least 3 undisturbed samples from each critical layer and each compressible layer:

1. Grain Size (ASTM D422) / Hydrometer (ASTM D422) / Atterberg Limits (ASTM D4318) / Moisture Content (ASTM D2216) / Specific Gravity (ASTM D854): To classify the materials and to correlate the tested samples with published data and with other materials at the site.
2. In-situ Unit Weight (ASTM D2937): To determine unit weights for use in the calculations.
3. CU Triaxial Shear Testing (ASTM D4767): To determine the total and effective stress strength parameters for use in the stability analysis.
4. One Dimensional Consolidation Properties (ASTM D2435): To determine parameters for use in the settlement analysis.
5. Hydraulic Conductivity Testing (ASTM D5084): To determine the average vertical permeability for use in the liner thickness calculations.

CEC selected samples to be tested for the stability and settlement analysis and for the hydrogeologic site investigation report. Classification testing was performed on disturbed and undisturbed samples so that correlations of compressibility, shear strength, and permeability could be made between samples. A summary of laboratory testing results is included in Attachment A.

Soil Classification

The Unified Soil Classification System (USCS) designations (presented in the following table) for the unconsolidated material are based on the laboratory testing results and the field visual descriptions of the soil samples, as reported on the drilling logs presented in the HSIR. The unconsolidated materials can generally be divided as shown in the following table.

Soil Origin	USCS Designation
Mine Spoil	CH, CL, MH, GC, SC
Residual Soil	CH, CL, SC

Moisture Density Relationships

Six standard Proctor moisture density relationship tests (ASTM D 698) were performed (three residual and three mine spoil samples) to determine the optimum moisture content and maximum dry density of the on-site materials. The results are summarized in the following table.

Soil Origin	Boring/ Test Pit	Sample Depth (ft)	Sample No.	USCS Symbol	In-situ Moisture Content (%)	Optimum Moisture Content (%)	Maximum Dry Density (pcf)
Residual	RB-8	23-27	B-1	CH	35.6	18.4	94.1
	Average				***35.6***	***18.4***	***94.1***
Mine Spoil	RB-1	14-19	B-1	CL	22.5	17.1	103.1
	RB-3	20-24	B-1	CL	12.9	13.9	111.5
	RB-4	19-24	B-1	CL	27.4	21.1	98.4
	SB-1	58-66	B-1	CL	12.9	14.2	113.1
	SB-14	16-20	B-1	CL	24.9	20.3	102.4
	Average				***20.1***	***17.3***	***105.7***

These results were used in preparing the remolded triaxial shear and one-dimensional consolidation samples that were tested as a part of this investigation and will be used for construction purposes. As shown in the previous table, the in-situ moisture contents are typically higher that the optimum moisture contents for the samples tested. This suggests that some drying or advance stockpiling measures for the on-site soils may be necessary to achieve proper compaction during construction.

Twenty-two (22) bulk density (ASTM D 2937) tests were performed (seven residual and fifteen mine spoil samples) to determine the in-situ wet and dry densities of the on-site materials. The results are summarized in the following table. These results were used in the Section (C)(4) PTI such as slope stability and settlement.

Origin	Boring/Test Pit Number	Sample Depth	Sample Number	USCS Symbol	Moisture Content (%)	In-Situ Wet Density (pcf)	In-Situ Dry Density (pcf)
					ASTM D 2216	ASTM D 2937	
Mine Spoil	SB-3	11.5 - 13.5	ST-1	CL	10.5	141.4	128.0
	SB-4	28 - 30	ST-1	CL	9.1	121.6	111.4
	SB-6	9 - 10	ST-2	GC	9.5	130.7	119.3

Origin	Boring/Test Pit Number	Sample Depth	Sample Number	USCS Symbol	Moisture Content (%)	In-Situ Wet Density (pcf)	In-Situ Dry Density (pcf)
	SB-8	2 - 4	ST-1	CL	15.4	130.8	113.4
	SB-12-1	16 - 18	ST-1	CL	21.9	123.0	103.6
	SB-14	10 - 12	ST-1	CL	21.6	125.9	103.5
	SB-14	25 - 25.5	ST-2	MH	38.1	87.1	52.8
	SB-14	26.5 - 27	ST-2	CH	65.0	106.1	76.8
	SB-16	1 - 3	ST-1	CL	20.9	126.1	104.3
	SB-17	16 - 18	ST-1	SC	16.4	114.8	98.6
	SB-17	18 - 20	ST-2	SC	10.1	125.7	114.2
	SB-18	10 - 12	ST-1	CL	17.9	132.3	112.2
	SB-18	22 - 24	ST-3	GC	15.4	126.1	109.2
	SB-19	11 - 13	ST-1	CL	16.1	128.6	110.8
	SB-20	16 - 18, 17 - 19	ST-1, ST-2	GC	20.3	138.5	115.2
	Average				***20.5***	***123.9***	***104.9***
Residual	SB-16	0.5 - 2.5	ST-1	CH	21.9	118.4	97.1
	SB-21	9 - 11	ST-1	CL	13.4	137.2	121.0
	TPE-17	12 - 14	ST-1	CL	14.9	138.0	120.1
	TPE-18	12 - 14	ST-1	CL	22.4	128.1	104.6
	TPE-18	18 - 19.7	ST-2	SC	11.9	137.1	122.5
	TPE-19	2 - 4	ST-1	CL	14.6	140.2	122.3
	TPE-21	2 - 4	ST-1	CL	21.8	133.3	109.5
	Average				***17.2***	***133.2***	***113.9***

Shear Strength

In accordance with OAC 3745-27-06(C)(3)(f)(vi) undisturbed shear strength testing was conducted at ten percent or more of the geotechnical sampling locations where a critical layer was encountered. To determine if any critical layers exist, the location of Shelby tube samples was chosen based on the results of the SPTs, material field identification, the sample location, and likelihood of sample recovery. Once a potential critical layer was identified, a Shelby tube sample was collected from that zone between split-spoon sample intervals or in an adjacent auger boring. Each end of the Shelby tube soil sample was sealed with wax, capped and taped. The samples were stored and handled per ASTM sample handling recommendations.

Five undisturbed CU triaxial tests with pore pressure readings (two mine spoil and three residual soil samples) were performed. Samples for testing were selected by listing them based on their consistency (N-value) reported on the logs, the material description/classification, and the location/elevation of the test boring from

which they were sampled. Generally the samples with the lowest consistency were chosen for testing while maintaining a representative selection regarding elevation and plan location.

The following table presents a summary of the total and effective stress values (and associated sample information) obtained from CU triaxial (ASTM D 4767) or direct shear (ASTM D 3080) strength testing.

Sample Condition	Soil Origin	Boring/ Test Pit Number	USCS Symbol	Effective Stress		Total Stress	
				Cohesion (psf)	Angle of Friction (degrees)	Cohesion (psf)	Angle of Friction (degrees)
Undisturbed	Mine Spoil	SB-3	CL	1,094[(1)]	29.3[(1)]	--	--
		SB-4	CL	14[(1)]	29.1[(1)]	--	--
		SB-12-1	CL	0	34.8	29	23.1
		SB-14	MH	158[(1)]	34.1[(1)]	--	--
		SB-14	CH	274[(1)]	23.8[(1)]	--	--
		SB-20	GC	259	27.7	274	14.3
		Average		***299.8***	***29.8***	***152***	***19***
	Residual	SB-8	CL	173[(1)]	32.2[(1)]	--	--
		SB-16	CL	187	26.3	518	15.0
		SB-16	CH	734[(1)]	20.9[(1)]	--	--
		TPE-17	CL	720	28.4	1,195	12.7
		TPE-19	CL	230	32.6	202	21.4
		Average		***408.8***	***28.1***	***683***	***16***
Remolded	Mine Spoil	RB-1	CL	158	29.3	173	14.6
		SB-1	CL	173	25.7	317	13.8
		SB-14	CL	274	26.2	302	13.1
	Residual	RB-8	CH	144	26.6	58	15.8
		Average		***187.3***	***27***	***212.5***	***14.3***

[(1)] Values were determined from direct shear test results

One-dimensional Consolidation

One-dimensional consolidation tests were performed on six undisturbed (four mine spoil and two residual samples) and two remolded residual samples obtained during this investigation. These samples were chosen based on their consistencies reported on the logs (blow counts), the depth and location at which the samples were taken, and the type/origin of the sample. A representative selection of strengths, depths, and locations were chosen for final testing. The following table summarizes this testing.

Sample Condition	Soil Origin	Test Boring/Pit	Sample Depth (ft)	USCS Classification
Remolded	Mine Spoil	RB-3	20-24	CL
		RB-4	19-24	CL
Undisturbed	Mine Spoil	SB-6	9-10	GC
		SB-16	0.5-2.5	CH
		SB-17	16-18	SC
		SB-18	10-12	SC
	Residual	SB-21	9-11	CL
		TPE-18	12-14	CL

Hydraulic Conductivity

The following table presents a summary of the hydraulic conductivity test results for samples obtained during the subsurface investigation.

Soil Origin	Test Boring/Pit	Sample Depth (ft)	Sample Number	USCS Symbol	Average Hydraulic Conductivity (cm/sec)
Mine Spoil	SB-4	28 - 30	ST-1	CL	2.00E-07
	SB-6	9 - 10	ST-2	GC	7.40E-08
	SB-8	2 - 4	ST-1	CL	3.70E-05
	SB-14	10 - 12	ST-1	CL	1.70E-07
	SB-17	18 - 20	ST-2	SC	7.10E-08
	SB-18	22 - 24	ST-3	GC	7.00E-07
	SB-19	11 - 13	ST-1	CL	2.70E-06
	Average				***5.85E-06***
Residual	TPE-18	18 - 19.7	ST-2	SC	5.70E-06
	TPE-21	2 - 4	ST-1	CL	3.80E-06
	Average				***4.75E-06***

These results demonstrate that the materials at the site that were tested have low permeability values.

CRITICAL LAYERS

In accordance with OAC 3745-27-06(C)(3)(f)(vi), CU triaxial compression test, mechanical sieve tests, Atterberg limits, moisture contents, etc. were performed on samples obtained from each potentially critical layer susceptible to static and seismic slope stability failure.

A critical layer is any unconsolidated stratigraphic unit susceptible to stability or settlement failure up to 50 feet below the proposed depths of excavation. Two potential critical layers were identified beneath the site based on the 2010 and previous subsurface investigations: (1) mine spoil and (2) residual soil. Laboratory test results confirmed that these two units are generally compressible and consist of lean clay, fat clay, clayey gravel, clayey sand, and elastic silt, which are materials that are generally subject to long-term consolidation.

The fat clay in Test Boring SB-12 was identified early during the 2010 investigation so an additional test boring adjacent to SB-12 identified as SB-12-1 was performed. A Shelby tube was obtained from SB-12-1 from the same elevation where the fat clay was identified in SB-12. The sample from SB-12-1 classified as sandy lean clay with an effective angle of friction of 34.8 degrees and a total stress angle of friction of 23.1 degrees. These results are significantly higher than typical fat clay results and laboratory results obtained from other fat clays on site. This reinforces the matrix-like concept discussed herein of the mine spoil and its highly variable structure with discontinuous layers.

Based on the test borings, it is likely that a continuous layer of fat clay exists in the residual soil at the base of the Pittsburgh Coal Seam. Clay is often encountered at the base of coal seams and is commonly referred to as "underclay". This layer was evaluated in Cross Section 1 in the Global Slope Stability Analysis.

SEISMICITY

Based on the Peak Acceleration (%g) with 2% Probability of Exceedance in 50 Years, published by the U.S.G.S in June of 1996, the peak acceleration for the site is estimated to be approximately 6% of gravity (0.06g).

UNSTABLE AREAS

The proposed landfill expansion is not in an unstable area based on the following factors listed in DSIWM Procedural and Technical Considerations for the Unstable Areas Location Restriction Demonstration, dated June 12, 2004, which was performed for the previously permitted vertical expansion at the site.

- On-site or local soil type and hydraulic conditions;
- On-site or local geologic or geomorphic features;
- On-site or local human made features (surface and subsurface);
- On-site or local events (surface and subsurface).

Surface geomorphology does not suggest the presence of Karst features at or in the vicinity of the site. The surface topography does not indicate that areas susceptible to mass movements of earth materials are present.

CONCLUSIONS

CEC reviewed the geotechnical/hydrogeologic information for the site to determine if any critical layers were immediately identifiable. CEC reviewed all the subsurface data available for the site as part of the site investigation, including the thickness of the soil layers, sample descriptions, soil classification, and standard penetration numbers. Based on the subsurface investigations and laboratory test results, the mine spoil is

variable but the variations typically occur over small distances allowing the reasonable establishment of average overall strength parameters that represent the material as a whole. Therefore, the mine spoil could be modeled as one unit with average test results used for engineering properties. The residual soil encountered was less variable, but can also modeled as one unit with average engineering properties.

Due to the low elevation of the UAS at the site, the engineering design of the contiguous expansion allowed the base grades to be such that all mine spoil will be removed within the floor area of the landfill. In addition, these base grades and removal of the mine spoil allow the expansion to achieve very close to a soil balance for the life of the facility. As a result, the floor will be founded on an excavated competent rock surface which will result in negligible settlement and differential settlement, even with the increased waste thickness that results from the contiguous lateral expansion. Refer to the post settlement slope and stain analysis (C)(4)(e) for the calculations for maximum settlement effects on the expansion floor area.

At the perimeter of the contiguous lateral expansion, the 3H:1V berm excavation rises out of the competent bedrock and through mine spoil. An evaluation has been made of the differential settlement that could occur on the portions of liner system that are founded on 3H:1V mine spoil slopes. These calculations show that a maximum estimated strain of 0.085% will occur, which is well below the strain that could damage the liner system. Refer to the post settlement slope and stain analysis (C)(4)(e) for these calculations. Therefore, CEC concludes that the mine spoil may remain in-place beneath the proposed perimeter berm with one local exception.

Drawing 4A of this application shows an area where waste material from previous construction was placed as a stockpile. This material should be removed beneath the proposed floor and perimeter berm to elevations that match or are lower than those shown in the 2000 topographic mapping that was performed. This material is not suitable to be left in place due to the presence of large amounts of organic material (trees, etc.) and large boulders that was placed over the existing the mine spoil after 2000.

Although there are no undocumented underground mines in the lateral contiguous expansion area, two borings encountered an unrecoverable fissile coal seam or a void at the estimated coal seam elevation. CEC recommends exploring the condition of the coal seam encountered in the area of SB-6 and B-12 during construction, and also proposes a general condition that, if any coal seam voids are encountered at on the 3H:1V perimeter slopes, the coal seam shall be removed until it is certain that all voids have been removed, or to the limits of waste disposal, whichever comes first.

ATTACHMENT A

LABORATORY TESTING SUMMARY TABLE

LABORATORY TEST RESULTS SUMMARY
APEX LANDFILL CONTIGUOUS EXPANSION
APEX ENVIRONMENTAL, LLC

Boring/Test Pit Number	Sample Depth (ft)	Sample Number	Moisture Content (%)	Specific Gravity	Atterberg Limits		USDA Classification				USCS Classification[2]			USCS Symbol	USCS Description	In-Situ Wet Density (pcf)	In-Situ Dry Density (pcf)	Optimum Moisture Content (%)	Maximum Dry Density (pcf)	Effective Stress		Total Stress		Effective Stress		Unconfined Compressive Strength (psf)	Average Hydraulic Conductivity (cm/sec)	Initial Void Ratio, e_o	Compression Index, C_c	Average Recompression Index, C_r	Apparent Preconsolidation Pressure, P_c (psf)	Average Coefficient of Consolidation, C_v (in^2/min)
					Liquid Limit (%)	Plastic Limit (%)	Gravel (%)	Sand (%)	Silt (%)	Clay (%)	% Passing 2" Sieve (%)	% Passing 3/4" Sieve (%)	% Passing No. 200 Sieve (%)							Cohesion (psf)	Angle of Friction (degrees)	Cohesion (psf)	Angle of Friction (degrees)	Cohesion (psf)	Angle of Friction (degrees)							
			ASTM D 2216	ASTM D 854	ASTM D 4318		ASTM D 422									ASTM D 2937		ASTM D 698		ASTM D 4767				ASTM D 3080		ASTM D 2166	ASTM D 5084	ASTM D 2435			
RB-1	14 - 19	B-1	22.5	--	43	18	3.60	17.40	48.00	31.00	100.00	99.70	84.50	CL	Lean Clay With Sand	--	--	17.1	103.1	158	29.3	173	14.6	--	--	--	--	--	--	--	--
RB-3	20 - 24	B-1	12.9	2.69	37	14	10.10	26.00	36.20	27.70	100.00	99.10	68.00	CL	Sandy Lean Clay	--	--	13.9	111.5	--	--	--	--	--	--	--	--	0.5831	0.172	0.030	2,400	0.017
RB-4	19 - 24	B-1	27.4	2.56	45	19	6.30	18.40	37.50	37.80	100.00	99.80	79.30	CL	Lean Clay With Sand	--	--	21.1	98.4	--	--	--	--	--	--	--	--	0.7135	0.179	0.034	1,200	0.006
RB-8	23 - 27	B-1	35.6	--	56	24	3.40	10.70	41.80	44.20	100.00	99.30	90.20	CH	Fat Clay	--	--	18.4	94.1	144	26.6	58	15.8	--	--	--	--	--	--	--	--
SB-1	26 - 28	SS-13	6.2	--	33	20	5.10	19.20	55.10	20.60	100.00	100.00	82.00	CL	Lean Clay With Sand	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
SB-1	58 - 66	B-1	12.9	--	40	18	21.20	19.80	32.70	26.30	100.00	98.70	62.90	CL	Sandy Lean Clay	--	--	14.2	113.1	173	25.7	317	13.8	--	--	--	--	--	--	--	--
SB-2	22 - 24	SS-12	12.6	--	33	19	45.70	15.40	28.00	10.90	100.00	86.70	41.40	GC	Clayey Gravel With Sand	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
SB-3	11.5 - 13.5	ST-1	10.5	--	38	18	0.00	9.80	74.10	16.10	100.00	100.00	97.60	CL	Lean Clay	141.4	128.0	--	--	--	--	--	--	1,094	29.3	--	--	--	--	--	--
SB-4	28 - 30	ST-1	9.1	--	37	19	11.40	25.70	39.50	23.40	100.00	96.80	66.10	CL	Sandy Lean Clay	121.6	111.4	--	--	--	--	--	--	14	29.1	--	2.00E-07	--	--	--	--
SB-5	6 - 8	SS-4	12.3	--	37	19	54.10	24.50	16.10	5.20	100.00	71.40	25.10	GC	Clayey Gravel With Sand	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
SB-6	8 - 9	ST-1	8.2	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
SB-6	9 - 10	ST-2	9.5	2.72	34	19	44.90	25.10	21.70	8.30	100.00	85.20	32.60	GC	Clayey Gravel With Sand	130.7	119.3	--	--	--	--	--	--	--	--	--	7.40E-08	0.6339	0.158	0.019	NC	0.089
SB-6	30 - 32	SS-15	14.7	--	37	19	25.60	31.30	26.20	16.80	100.00	100.00	45.40	SC	Clayey Sand	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
SB-8	2 - 4	ST-1	15.4	--	35	21	5.20	27.00	51.90	15.80	100.00	100.00	74.10	CL	Lean Clay With Sand	130.8	113.4	--	--	--	--	--	--	173	32.2	--	3.70E-05	--	--	--	--
SB-8	6 - 8	SS-3	10.6	--	30	19	18.70	32.10	35.20	14.00	100.00	92.50	53.70	CL	Sandy Lean Clay	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
SB-9	0 - 2	SS-1	14.7	--	46	22	12.70	20.00	39.80	27.50	100.00	100.00	70.00	CL	Lean Clay With Sand	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
SB-11	14 - 16	SS-8	13.4	--	40	21	9.40	26.30	42.00	22.30	100.00	100.00	70.30	CL	Lean Clay With Sand	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
SB-12	16 - 18	SS-9	23.6	--	50	25	0.00	(1)	(1)	(1)	100.00	100.00	79.10	CH	Fat Clay With Sand	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
SB-12-1	16 - 18	ST-1	21.9	--	43	22	10.20	29.10	37.00	23.60	100.00	100.00	63.80	CL	Sandy Lean Clay	123.0	103.6	--	--	0	34.8	29	23.1	--	--	--	--	--	--	--	--
SB-14	10 - 12	ST-1	21.6	--	48	22	14.40	28.50	38.70	18.40	100.00	93.80	60.80	CL	Sandy Lean Clay	125.9	103.5	--	--	--	--	--	--	--	--	--	1.70E-07	--	--	--	--
SB-14	16 - 20	B-1	24.9	--	46	19	6.70	15.40	40.6	37.4	100.00	99.80	81.50	CL	Lean Clay With Sand	--	--	20.3	102.4	274	26.2	302	13.1	--	--	--	--	--	--	--	--
SB-14	25 - 25.5	ST-2	38.1	--	81	48	0.00	37.40	36.20	26.50	100.00	100.00	72.50	MH	Elastic Silt With Sand	87.1	52.8	--	--	--	--	--	--	158	34.1	238	--	--	--	--	--
SB-14	26.5 - 27	ST-2	65.0	--	54	23	0.00	4.50	46.70	48.80	100.00	100.00	96.90	CH	Fat Clay	106.1	76.8	--	--	--	--	--	--	274	23.8	--	--	--	--	--	--
SB-15	4 - 6	SS-3	13.6	--	36	11	10.50	26.70	27.50	35.30	100.00	100.00	65.20	CL	Sandy Lean Clay	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
SB-16	1 - 3	ST-1	20.9	--	42	20	0.00	20.30	41.30	38.50	100.00	100.00	82.70	CL	Lean Clay With Sand	126.1	104.3	--	--	187	26.3	518	15.0	--	--	--	--	0.6837	0.157	0.042	3,600	0.007
SB-16	0.5 - 2.5	ST-1	21.9	2.70	60	26	0.00	4.70	40.50	54.90	100.00	100.00	98.00	CH	Fat Clay	118.4	97.1	--	--	--	--	--	--	734	20.9	--	--	--	--	--	--
SB-17	6 - 8	SS-4	13.9	--	38	10	13.60	(1)	(1)	(1)	100.00	100.00	54.70	CL	Sandy Lean Clay	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
SB-17	16 - 18	ST-1	16.4	2.70	40	21	34.90	21.10	28.10	16.00	100.00	85.50	46.10	SC	Clayey Sand	114.8	98.6	--	--	--	--	--	--	--	--	--	--	0.5933	0.147	0.020	2,400	0.058
SB-17	18 - 20	ST-2	10.1	--	37	18	25.90	27.50	31.20	15.30	100.00	93.90	49.80	SC	Clayey Sand With Gravel	125.7	114.2	--	--	--	--	--	--	--	--	--	7.10E-08	--	--	--	--
SB-18	10 - 12	ST-1	17.9	2.71	42	21	21.30	23.40	34.40	21.00	100.00	97.10	57.60	CL	Sandy Lean Clay With Gravel	132.3	112.2	--	--	--	--	--	--	--	--	--	--	0.6913	0.153	0.030	1,400	0.024
SB-18	22 - 24	ST-3	15.4	--	39	22	31.00	23.60	32.70	12.70	100.00	85.90	47.90	GC	Clayey Gravel With Sand	126.1	109.2	--	--	--	--	--	--	--	--	--	7.00E-07	--	--	--	--
SB-18	28 - 30	SS-11	17.3	--	41	20	41.70	(1)	(1)	(1)	100.00	100.00	38.20	GC	Clayey Gravel With Sand	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
SB-19	11 - 13	ST-1	16.1	--	41	19	8.80	23.40	41.0	26.8	100.00	100.00	70.60	CL	Lean Clay With Sand	128.6	110.8	--	--	--	--	--	--	--	--	--	2.70E-06	--	--	--	--
SB-20	16 - 18, 17 - 19	ST-1, ST-2	20.3	--	35	17	48.20	21.60	18.30	11.90	82.30	76.20	31.50	GC	Clayey Gravel With Sand	138.5	115.2	--	--	259	27.7	274	14.3	--	--	--	--	--	--	--	--
SB-21	9 - 11	ST-1	13.4	2.77	42	20	17.70	14.60	42.60	25.10	100.00	98.50	74.20	CL	Lean Clay With Gravel	137.2	121.0	--	--	--	--	--	--	--	--	--	--	0.4449	0.120	0.027	8,200	0.062
TPE-17	12 - 14	ST-1	14.9	--	32	17	12.20	35.00	38.90	14.00	100.00	98.50	58.10	CL	Sandy Lean Clay	138.0	120.1	--	--	720	28.4	1195	12.7	--	--	--	--	--	--	--	--
TPE-18	12 - 14	ST-1	22.4	2.77	42	20	11.80	22.30	41.50	24.30	100.00	99.00	69.10	CL	Sandy Lean Clay	128.1	104.6	--	--	--	--	--	--	--	--	--	--	--	--	--	--
TPE-18	18 - 19.7	ST-2	11.9	--	32	19	24.50	37.80	30.10	7.60	100.00	100.00	44.40	SC	Clayey Sand With Gravel	137.1	122.5	--	--	--	--	--	--	--	--	--	5.70E-06	0.6846	0.147	0.026	5,800	0.013
TPE-19	2 - 4	ST-1	14.6	--	41	23	7.10	21.10	51.00	20.70	100.00	100.00	75.90	CL	Lean Clay With Sand	140.2	122.3	--	--	230	32.6	202	21.4	--	--	--	--	--	--	--	--
TPE-21	2 - 4	ST-1	21.8	--	44	23	0.40	53.30	39.40	6.80	100.00	100.00	53.20	CL	Sandy Lean Clay	133.3	109.5	--	--	--	--	--	--	--	--	--	3.80E-06	--	--	--	--
HIGHEST VALUE			65.0	2.77	81	48	54.10	53.30	74.10	54.90	100.00	100.00	98.00	--	--	141.4	128.0	21.1	113.1	720	34.8	1195	23.1	1094	34.1	--	3.70E-05	0.7135	0.179	0.042	8,200	0.089
LOWEST VALUE			6.2	2.56	30	10	0.00	4.50	16.10	5.20	82.30	71.40	25.10	--	--	87.1	52.8	13.9	94.1	0	25.7	29	12.7	14	20.9	--	7.10E-08	0.4449	0.120	0.019	1,200	0.006
AVERAGE			18.2	2.70	42	20	15.85	23.33	37.88	23.15	99.55	96.34	64.49	--	--	126.9	107.7	17.5	103.8	238	28.6	341	16.0	408	28.2	--	5.60E-06	0.6285	0.154	0.028	3,571	0.034

Notes:

(1) Hydrometer was unable to be performed due to lack of material

(2) USDA grain size analysis was corrected for 100% Passing a 3-inch sieve.

HYDROSTATIC UPLIFT ANALYSIS

(a) The hydrostatic uplift analysis shall include the following:

- **(i) The scope, extent, and findings of the subsurface investigation conducted in accordance with paragraph (C)(3) of this rule, as it pertains to hydrostatic uplift.**
- **(ii) A narrative description of the rationale used for the selection of the analysis input parameters.**
- **(iii) A description of the method used to calculate hydraulic uplift.**
- **(iv) A description of the assessed failure modes and conditions.**
- **(v) A narrative description of the rationale used for the selection of the critical cross section that, at a minimum, shall consider the worst case intersection of the highest phreatic or piezometric surface with the maximum excavation depth.**
- **(vi) A plan drawing showing the temporal high phreatic and piezometric surfaces (prepared in compliance with paragraph (B)(3)(d) of this rule) and the horizontal and vertical limits of excavation (prepared in compliance with paragraph (B)(4)(a) of this rule).**
- **(vii) A profile view of the critical area that fully depicts the analysis input model including the following:**
  - **(a) The material boundaries.**
  - **(*b*) The applicable dimensions, including but not limited to the depth of excavation, and depth to the temporal high phreatic and piezometric surfaces.**
  - **(*c*) The material types.**
  - **(*d*) The in situ unit weights and saturated unit weights.**
- **(viii) The actual calculations and/or computer output.**

Civil & Environmental Consultants, Inc.

SUBJECT	(C)(4)(a) Hydrostatic Uplift Analysis					PROJECT NO.	091-867.0015
PROJECT	Apex Environmental, LLC					PAGE 1	OF 3
Apex Sanitary Landfill Contiguous Expansion							
MADE BY	JMN	DATE	October 2011	CHECKED BY	MRB	DATE	10/21/11
MADE BY	JMN	DATE	July 2013	CHECKED BY	AMR	DATE	07-19-2013

OBJECTIVE

The objective of this analysis is to determine if there is potential for hydrostatic uplift of the proposed liner system and if so, what is the factor of safety (FS) against hydrostatic uplift. This analysis is in accordance with OAC Sections 3745-27-06(C)(4)(a) and 3745-27-08 (C)(7)(a).

DISCUSSION

Based on the Hydrogeologic Site Investigation Report (HSIR) ~~dated August 2011~~ prepared by Civil & Environmental Consultants, Inc. (CEC), there ~~upper~~ *are* two piezometric heads (potentiometric surfaces) associated with bedrock units that will be left in-place beneath the proposed expansion footprint, *which* are the Bellaire/Summersfield (SZS) and Connelsville/Morgantown (UAS). The SZS unit is generally directly beneath the proposed base of RSL. ~~The UAS is beneath the SZS and beneath base of RSL at depths ranging from approximately 25 to 50 feet.~~

The mine spoil and limestone aquifers will be removed beneath the floor of the propose expansion. The potentiometric surface associated with the UAS only reaches the proposed excavation grades in limited areas ~~and does not rise more than 5 feet above the base of RSL~~. *and is lower in elevation than the potentiometric surface associated with the SZS.* The potentiometric surface associated with the SZS ~~does~~ *rises* above the excavation grades in some areas and up to approximately ~~25 feet~~ *24 feet.* This is shown by the isopach contours comparing these two surfaces on Figure 1 in Attachment A. Therefore, the surface associated with the SZS was evaluated for hydrostatic uplift.

METHODOLOGY

This calculation analyzes the potential for hydrostatic uplift at the base of the proposed RSL. The uplift potential of the RSL is characterized as a FS consisting of a ratio of stabilizing to uplifting forces. As stated in the GeoRG Manual, "a conservative evaluation of the resistance created by a soil layer against hydrostatic uplift can be accomplished by calculating a maximum uplift force based on a maximum piezometric head and comparing it with the normal stress created by the overlying soil layers."

The stabilizing force is the summation of thicknesses of the soil layers, that overlie the base of the RSL, times their unit weights. The driving force, potentially producing uplift on the liner system, is the height of the potentiometric surface above the base of the RSL times the unit weight of water (62.4 pcf).

A calculation was performed to determine the maximum allowable height of the potentiometric surface above the base of the RSL that would result in a factor of safety equal to or less than 1.40. The following calculation was performed in accordance with the methodologies presented in the Ohio EPA, Geotechnical Resource Group "Geotechnical and Stability Analyses for Ohio Waste Containment Facilities" manual (GeoRG Manual), dated September 14, 2004.

$$FS = \frac{\sum(\gamma_{overlying\ soil} \times H_{overlying\ soil})}{\gamma_{water} \times H_p}$$

Where: $\gamma_{overlying\ soil}$ = unit weight of overlying soil component (pcf);
$H_{overlying\ soil}$ = thickness of overlying soil component (ft);
γ_{water} = unit weight of groundwater = 62.4 pcf; and
H_p = height of potentiometric surface above the base of the RSL (ft).

Table 1: Summary of overlying soil thicknesses and unit weights

Soil Component	Unit Weight (pcf)	Thickness (ft)
Leachate Collection Layer	115	1
RSL	125	3

$$FS = \frac{(3\text{ft} \times 125\text{pcf}) + (1\text{ft} \times 115\text{pcf})}{62.4\text{pcf} \times H_p} \geq 1.4 \rightarrow H_p \leq \frac{490\text{psf}}{1.4 \times 62.4\text{pcf}} = 5.61\text{ft}$$

This shows that if the height of the potentiometric surface is above the base of the RSL by more than 5.61 feet and no MSW has been placed in that area, the FS against hydrostatic uplift is less than 1.40. By creating an isopach between the potentiometric surface and the base of RSL using AutoCAD, these areas were identified and are shown on Figure 1 in Attachment A.

The GeoRG Manual, states that a justification for a reduction in allowable factor of safety is if "the area can be excavated, constructed, and buried by sufficient waste or fill material during the same construction season so that failure of the engineered components will be prevented." Therefore, in each phase with factors of safety less than 1.40, the height of MSW required to be placed to reach a factor of safety of 1.40 was determined at the location of the maximum potentiometric surface height above the base of the RSL. The following equation was used for this calculation.

$$H_{MSW} = \frac{1.40 \times 62.4\text{ pcf} \times H_W - 3\text{ft} \times 125\text{pcf} - 1\text{ft} \times 115\text{pcf}}{\sout{90}\ 75\text{ pcf}}$$

Where: H_{MSW} = Minimum height of MSW required to be placed to reach a factor of safety of 1.40 (ft)
H_W = Maximum height of potentiometric head above the base of RSL per Phase (ft) – varies

CONCLUSIONS

As shown by the above calculation, the height of the potentiometric head above the liner system must be less than or equal to 5.61 feet to achieve a factor of safety against hydrostatic uplift greater than or equal to 1.40. As shown on Figure 1 in Attachment A, the potentiometric surface rises above the base of RSL in some areas.

A permanent underdrain system that will drain by gravity is proposed to be installed in the locations shown on Figure 1 and Drawing 4A. As shown the system is proposed to be installed to the sumps of the phases that have a factor of safety against hydrostatic uplift less than 1.40. The intent of this system is to collect and convey any seepage beneath the RSL and relieve any hydrostatic pressure that may build beneath the RSL. The underdrain system is to be installed as-needed, if groundwater is encountered during construction.

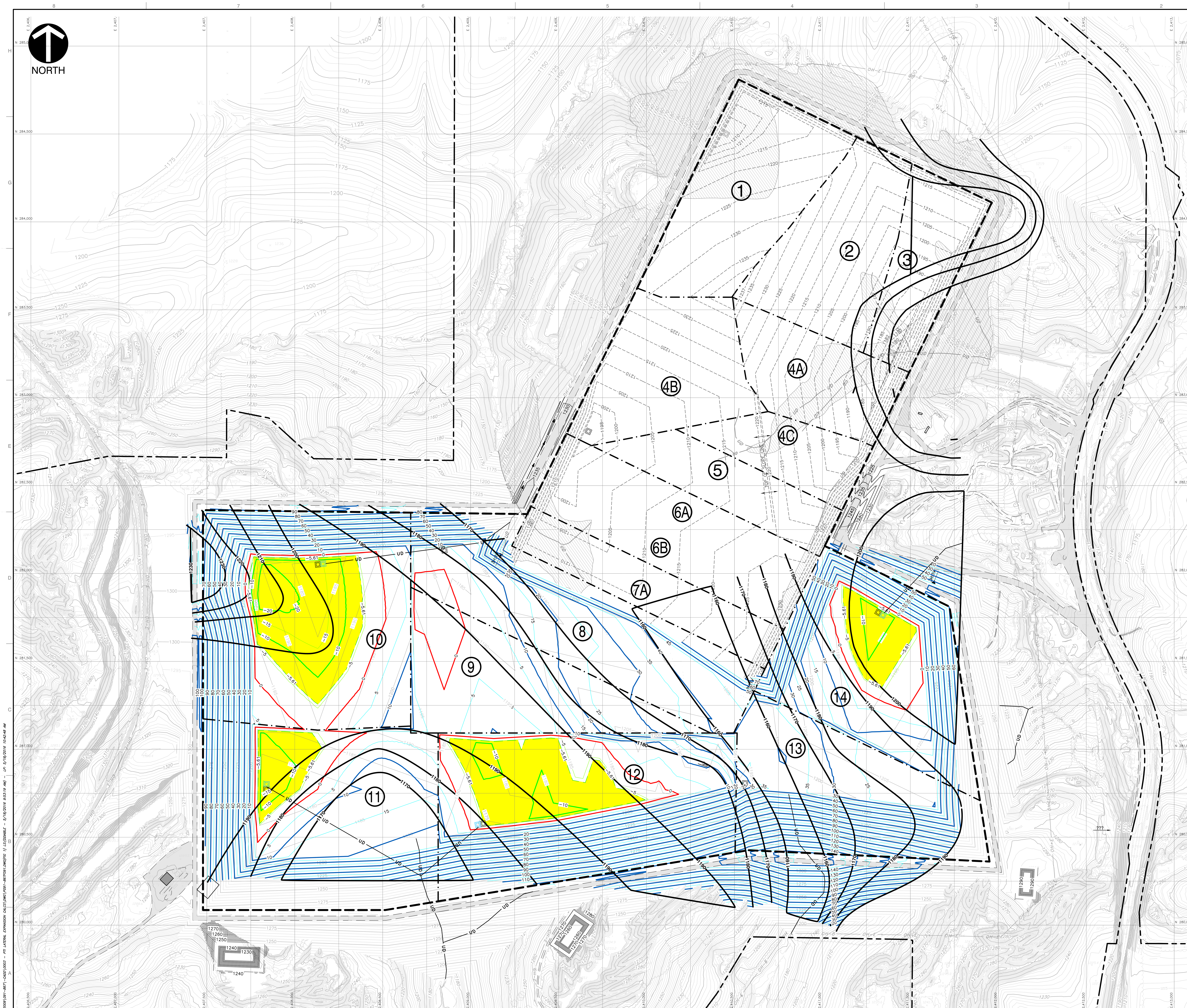
The following table summarizes the results for each phase regarding waste heights required for a factor of safety against hydrostatic uplift of 1.40. The heights of waste range from ~~3~~ *10* to ~~20~~ *22* feet in Phases 12/14 and ~~12~~ *10*, respectively.

Phase No.	Height of Waste (ft)
~~8~~ *10*	~~14~~ *22*
~~10~~ *11*	~~3~~ *11*
12	~~20~~ *10*
~~13~~ *14*	~~12~~ *10*

Waste heights exceeding 15 feet are typically placed in one construction season at MSW landfills. The underdrain system will only be required until the waste heights presented in the previous table are reached in the areas shown on Figure 1 with factors of safety less than 1.40. Therefore, the proposed expansion area will exceed the minimum factor of safety of 1.40 against hydrostatic uplift forces in accordance with OAC Section 3745-27-06(C)(4)(a).

ATTACHMENT A

FIGURE 1



REVISION RECORD

NO	DATE	DESCRIPTION
1	7/2013	RESPONSE TO OHIO EPA NOD DATED 12/28/12 AND REVISED PHASING.
2	5/2016	REVISED IN RESPONSE TO OHIO EPA NOD DATED 4/26/2016.

SUBMITTAL RECORD

NO	DATE	DESCRIPTION

LEGEND

- 1220 — EXISTING GROUND CONTOUR (SEE REFERENCE)
- PROPERTY LINE
- LIMIT OF SOLID WASTE PLACEMENT
- PHASE LIMIT
- 8 — PHASE DESIGNATION
- PERIMETER ROAD
- 1220 — PERMITTED BASE OF RECOMPACTED SOIL LINER CONTOUR
- 1220 — PROPOSED BASE OF RECOMPACTED SOIL LINER CONTOUR
- 1160 — BELLAIRE/SUMMERFIELD POTENTIOMETRIC SURFACE
- 10 — DEPTH OF POTENTIOMETRIC SURFACE BELOW BASE OF RSL
- -10 — HEIGHT OF POTENTIOMETRIC SURFACE ABOVE BASE OF RSL
- 0 — LOCATION WHERE POTENTIOMETRIC SURFACE AND BASE OF RSL ARE AT THE SAME ELEVATION
- UD — EXISTING UNDERDRAIN SYSTEM
- UD — PROPOSED UNDERDRAIN SYSTEM
- AREA WHERE HYDROSTATIC UPLIFT FACTOR OF SAFETY IS LESS THAN 1.4 (AREA WHERE GEOCOMPOSITE UNDERDRAIN WILL BE PLACED BENEATH LINER SYSTEM, ALSO SHOWN ON DRAWING 4A)
- LEACHATE SUMP
- AREA OF STRUCTURAL FILL

REFERENCE

1. EXISTING TOPOGRAPHY PREPARED BY KEDDAL AERIAL MAPPING; DATE OF PHOTOGRAPHY: 1/18/13. ADDITIONAL MAPPING WAS PREPARED BY KEDDAL AERIAL MAPPING FROM AERIAL PHOTOGRAPHY DATED 1/6/12 AND 1/5/11 AND BY M.A.N. MAPPING FROM AERIAL PHOTOGRAPHY DATED 12/14/00.
2. POTENTIOMETRIC SURFACE TAKEN FROM DRAWING 3M OF THE HYDROGEOLOGIC SITE INVESTIGATION REPORT BY CEC, DATED AUGUST 2011.

SCALE IN FEET
0 200 400

*HAND SIGNATURE ON FILE

Authorized Use:

- ☐ Survey
- ☐ Design Dev.
- ☑ Permitting
- ☐ Bidding
- ☐ Construction
- ☐ -

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PERMIT TO INSTALL APPLICATION
LATERAL EXPANSION
APEX SANITARY LANDFILL
JEFFERSON COUNTY, OHIO

DRAWN BY: MJI	CHECKED BY: JMN	APPROVED BY: RJB *
DATE: 7/18/13	DWG SCALE: 1"=200'	PROJECT NO: 091-867

HYDROSTATIC UPLIFT CALCULATION

FIGURE NO.: 1

ATTACHMENT B

CALCULATION TABLE

HYDROSTATIC UPLIFT ANALYSIS
APEX LANDFILL CONTIGUOUS EXPANSION

Material	Density (pcf)	Thickness (ft)
Protective Cover	115	1
RSL	125	3
Waste	75	Unknown
Water	62.4	Varies

Phase No.	Max. Height of Potentiometric Surface Above Base of RSL, H_W (ft)	Height of Waste Required, H_{MSW} (ft)	Calculated Factor of Safety	Target Factor of Safety
10	24	22	1.43	1.40
11	15	11	1.40	1.40
12	14	10	1.42	1.40
14	14	10	1.42	1.40

SEEPAGE EVALUATION

OBJECTIVE

Though not required by Ohio Administrative Code Regulations, the potential for groundwater seepage and seepage damage in the proposed contiguous expansion area is being evaluated as requested by the Ohio EPA in comments in an Interoffice Memo dated February 26, 2016.

DISCUSSION

There is a proposed underdrain in Phases 10, 11, 12, and 14 of the proposed expansion. The groundwater will be conveyed to groundwater sumps at low points. The most recent revision of the PTI Application, submitted on December 30, 2015, included the option to pump or gravity drain the groundwater sumps. The Ohio EPA comments state that seepage needs to be evaluated to verify that the liner system won't be damaged after the pumps in the groundwater sumps have been turned off. This calculation is being performed to demonstrate that pumping of the groundwater is a temporary control. The pumps in the groundwater sumps can be turned off after waste placement occurs, and the liner system will not be damaged.

Ohio EPA has issued a draft of Chapter 7 of the ***Geotechnical and Stability Analyses for Ohio Waste Containment Facilities*** (GeoRG) Policy Manual (draft Chapter 7). Though not required by Ohio Administrative Code Regulations, the potential for groundwater seepage and seepage damage in the proposed contiguous expansion area is being evaluated.

As stated in the draft, seepage damage can be classified into three broad categories, which include:

- Uplift;
- Heaving; and
- Piping or Internal Erosion.

Based on the Hydrogeologic Site Investigation Report (HSIR) prepared by Civil & Environmental Consultants, Inc. (CEC), there are two piezometric heads (potentiometric surfaces) associated with bedrock units that will be left in-place beneath the proposed expansion footprint, which are the Bellaire/Summersfield (SZS) and Connellsville/Morgantown (UAS). The potentiometric surface associated with the UAS only reaches the proposed base grades in limited areas and is lower in elevation than the potentiometric surface associated with the SZS. The potentiometric surface associated with the SZS is above the proposed landfill base grades in some areas. The Bellaire/Summersfield SZS potentiometric surface was therefore critical for the hydrostatic uplift evaluation, and is also critical for the seepage evaluation. The Bellaire/Summersfield SZS unit is generally directly beneath the proposed base of RSL.

The hydrostatic uplift calculation was previously prepared and submitted in PTI Application Section (C)(4)(a) to compare the downward stabilizing forces of soils and wastes and the uplift force on the base of RSL from the Bellaire/Summersfield potentiometric surface. Figure 1 in the hydrostatic uplift

calculation shows the elevation of the Bellaire/Summersfield SZS potentiometric surface in comparison to the base of RSL. As shown in the figure, the potentiometric surface is above the base of RSL in some areas, located in Phases 10, 11, 12, and 14 of the proposed expansion. Below is a summary table of the maximum height of the potentiometric surface above the base of RSL, as determined in the hydrostatic uplift calculation.

Phase No.	Max. Height of Potentiometric Surface Above Base of RSL, Hp (ft)
10	24
11	15
12	14
14	14

CEC prepared calculations to show areas where waste placement is needed to obtain the required factor of safety for hydrostatic uplift. The following table summarizes the minimum waste thicknesses needed to achieve the required factor of safety against uplift at the critical location in each phase. A geocomposite underdrain is proposed in these locations.

Phase No.	Minimum Thickness of Waste Required from Uplift Calculation (ft)
10	22
11	11
12	9.5
14	9.5

As noted in draft Chapter 7, heaving is typically analyzed by comparing the seepage forces exerted by the groundwater with the unit weight of overburden counteracting materials. The hydrostatic uplift calculation evaluates these conditions; therefore a separate analysis for heaving is not being submitted.

This seepage evaluation is being included as a supplement to the hydrostatic uplift calculation as requested by the Ohio EPA. For this evaluation, piping and internal erosion due to seepage were considered. As discussed in the Geotechnical Summary, which is included in Section (C)(4) of the PTI Application, all mine spoil will be removed within the floor area of the landfill by excavating to the proposed base grades. As a result, the grades of the base of recompacted soil liner (RSL) on the floor of the landfill will be founded on bedrock. There is no anticipated damage from seepage in the underlying bedrock due to piping and internal erosion. This seepage evaluation was therefore limited to the RSL.

METHODOLOGY

Consistent with the hydrostatic uplift calculation, the Bellaire/Summersfield SZS potentiometric surface was considered during this seepage evaluation. This is because the Bellaire/Summersfield potentiometric surface is higher than the Connellsville/Morgantown UAS. For the seepage evaluation, the critical gradient in the RSL will be compared with the actual gradient through the RSL to determine if there is the potential for piping and internal erosion of the RSL. Additionally, based on soil properties for RSL, the potential for internal erosion will be evaluated by calculating the erosion rate index of the RSL.

Seepage Evaluation

For the seepage evaluation, the critical gradient in the RSL will be compared with the actual gradient through the RSL to determine if there is the potential for loss of soil stability in the RSL layer. As presented in draft Chapter 7 and consistent with methodology presented in ***The Principles of Geotechnical Engineering*** by Braja M. Das (Das), a loss of soil stability can occur when there is zero effective stress in the soil, or when the critical hydraulic gradient is exceeded. As presented in Das, the loss of soil stability can result in boiling of soils or a quick condition, which leads to piping and internal erosion in granular soils. The piping and internal erosion soil failures are not as common in cohesive soils. The loss of soil stability is being evaluated in this calculation for RSL, which is a cohesive soil.

Calculation of Critical Hydraulic Gradient

The equations for the critical hydraulic gradient that are presented in draft Chapter 7 account for excavation situations for which no overburden is present. However, this is a temporary condition since waste will eventually be placed and will create overburden pressure. The overburden pressure changes the effective stress in the soil and therefore changes the critical hydraulic gradient. This is demonstrated by the equations below, which use methodology presented in Das. Corresponding pages from Das and a diagram depicting a typical section at Apex are included in Attachment A. Draft Chapter 7 is included in Attachment B.

The basic equation for effective stress in soil material is as follows:

$$Effective\ stress = Total\ stress - Pore\ water\ pressure$$

The total stress in the RSL material at depth z assuming that waste placement has occurred can be represented as follows:

$$\sigma_{total} = (\gamma_{MSW} * h_{MSW}) + (\gamma_{PC} * h_{PC}) + (\gamma_{RSL} * z)$$

Where:
σ_{total} = Total stress at a point of depth z in the RSL material

γ_{MSW} = Unit weight of MSW = 75 pcf
h_{MSW} = Placed height of MSW (varies by location)
γ_{PC} = Unit weight of protective cover = 115 pcf
h_{PC} = Depth of protective cover = 1 foot
γ_{RSL} = Saturated unit weight of RSL = 125 pcf
z = Depth at which the stress is being evaluated within the RSL material measured from the top of RSL (can range from 0 to 3 feet)

For purposes of this calculation, the RSL material is conservatively assumed to be completely saturated (i.e., the water level in the soil material is at the bottom of the overlying geomembrane). Therefore the pore water pressure at a depth z in the RSL material can be calculated as follows:

$$\mu = (H_{water} + z + iz)\gamma_w$$

Where:
μ = Pore water pressure at a point of depth z in the RSL material
H_{water} = Height of water above the soil (0 since the water level is restricted by the overlying geomembrane)
z = Depth within RSL material (can range from 0 to 3 feet)
i = hydraulic gradient in the RSL
γ_w = Unit weight of water = 62.4 pcf

Effective stress can be represented as the difference between the total stress and the pore water pressure, or:

$$\sigma_{eff} = \sigma_{total} - \mu$$

The effective stress in the RSL material assuming that waste placement has occurred can be represented as follows:

$$\sigma_{eff} = \big((\gamma_{MSW} * h_{MSW}) + (\gamma_{PC} * h_{PC}) + (\gamma_{RSL} * z)\big) - \big((z + iz)\gamma_w\big)$$

The critical gradient is reached when there is zero effective stress in the soil. The equation presented above for effective stress was therefore set equal to zero, and revised equations for the critical gradient, i_{cr}, were derived considering the overburden material.

$$0 = \big((\gamma_{MSW} * h_{MSW}) + (\gamma_{PC} * h_{PC}) + (\gamma_{RSL} * z)\big) - \big((z + i_{cr}z)\gamma_w\big)$$

This equation can be solved for critical hydraulic gradient, as shown by the steps below.

$$\big((z + i_{cr}z)\gamma_w\big) = \big((\gamma_{MSW} * h_{MSW}) + (\gamma_{PC} * h_{PC}) + (\gamma_{RSL} * z)\big)$$

$$z\gamma_w + i_{cr}z\gamma_w = (\gamma_{MSW} * h_{MSW}) + (\gamma_{PC} * h_{PC}) + (\gamma_{RSL} * z)$$

$$i_{cr}z\gamma_w = (\gamma_{MSW} * h_{MSW}) + (\gamma_{PC} * h_{PC}) + (\gamma_{RSL} * z) - z\gamma_w$$

$$i_{cr} = \frac{(\gamma_{MSW} * h_{MSW}) + (\gamma_{PC} * h_{PC}) + (\gamma_{RSL} * z) - z\gamma_w}{z\gamma_w}$$

$$i_{cr} = \frac{(\gamma_{MSW} * h_{MSW}) + (\gamma_{PC} * h_{PC})}{z\gamma_w} + \frac{\gamma_{RSL} - \gamma_w}{\gamma_w}$$

Note that the second term of the equation matches the calculation for critical gradient without the presence of overburden (as described in draft Chapter 7) while the first term accounts for the effect of overburden material. When there is no overburden present, the first term equals zero and the equation reduces to the calculation presented in draft Chapter 7. When present, the overburden provides additional downward vertical stress to counteract the effects from upward seepage.

Note that z reflects the depth that the calculation is performed at in the RSL. As z increases in the above formula, the critical gradient decreases. Therefore, the maximum z value of 3 feet has been conservatively used when calculating the critical hydraulic gradient. Also, when calculating the critical hydraulic gradient, it was assumed that waste was placed to the minimum thickness required based on the hydrostatic uplift calculation.

Calculation of Actual Hydraulic Gradient

As noted in draft Chapter 7, the actual hydraulic gradient through a soil can be calculated using the following equation:

$$i_{actual} = \frac{\Delta h}{\Delta L}$$

Where:
Δh = head loss between two points
ΔL = apparent flow distance at which the gradient is being measured

For zones of saturation, the following equation is presented for the actual gradient.

$$i_{actual} = \frac{top\ of\ potentiometric\ surface\ elev. - top\ of\ clay\ liner\ elev.}{top\ of\ clay\ liner\ elev. - top\ of\ water\ bearing\ unit\ elev.}$$

Below is a summary table of the maximum height of the potentiometric surface above the base of RSL, as determined in the hydrostatic uplift calculation. Note that for the uplift calculation, the driving force was

calculated as the difference between the potentiometric surface and the base of RSL, so that heaving of the RSL could be evaluated. This calculation is evaluating seepage through the RSL, so the head was calculated as the difference between the potentiometric surface and the top of RSL. The flow length was calculated through the RSL.

Phase No.	Max. Height of Potentiometric Surface Above Top of RSL, hp (ft)
10	21
11	12
12	11
14	11

The Bellaire/Summersfield SZS unit is directly beneath the proposed base of RSL at the critical locations. Therefore, the top of the water bearing unit elevation was conservatively assumed to be at the base of RSL material in all locations, and the apparent flow distance or denominator of the above equation was calculated as 3 feet in each location.

Calculation of Factor of Safety for Seepage

Based on the above equations, a critical and actual hydraulic gradient was calculated for each of the critical locations, where the potentiometric surface reached the maximum height above the RSL, as identified in the hydrostatic uplift calculation. The factor of safety against seepage damage is the ratio of the critical hydraulic gradient to the actual hydraulic gradient:

$$FS = {}^{i_{cr}}/_{i_{actual}}$$

Where:
FS = Factor of safety against seepage
i_{cr} = critical hydraulic gradient
i_{actual} = actual hydraulic gradient

The results are presented in the table below and the calculation spreadsheet is presented in Attachment C.

Phase No.	Max. Height of Potentiometric Surface Above Top of RSL, hp (ft)	Critical Gradient, i_{cr}	Minimum Thickness of Waste from Uplift calculation, h_{MSW} (ft)	Actual Gradient, i_{actual}	Factor of Safety	Target Factor of Safety
10	21	10.4	22.0	7.0	1.49	1.10
11	12	6.0	11.0	4.0	1.51	1.10
12	11	5.4	9.5	3.7	1.48	1.10
14	11	5.4	9.5	3.7	1.48	1.10

As can be seen in the table above, when waste is placed to the minimum required thickness, the factor of safety for seepage exceeds the target factor of safety. This shows that the RSL soil will retain stability, and damage due to seepage is not anticipated.

Installation of Underdrain for Uplift and Seepage

As stated in the hydrostatic uplift calculation, a geocomposite underdrain system will be installed if groundwater is encountered during construction. The underdrain geocomposite is proposed in areas where waste placement is needed to obtain the required factor of safety for uplift. The intent of the underdrain geocomposite is to collect and convey any seepage beneath the RSL. The underdrain system will also include pipe trenches with perforated or solid pipe, bedded in a minimum of 18 inches of coarse aggregate and wrapped with geotextile fabric. The groundwater will be conveyed to sumps, and either pumped or gravity drained.

If water is pumped from the underdrain system, the pumping will continue until the minimum required waste thickness is placed. This will prevent damage due to uplift and seepage during construction and initial waste placement. Since the pumping is only needed until certain depths of waste are placed, this is considered a temporary groundwater control.

The underdrain system is to be installed as-needed if groundwater is encountered during construction.

Details for the underdrain system are provided on Drawing 7B of the PTI Application Drawings.

Potential for Internal Erosion of RSL

As stated above, the base grades/base of RSL on the floor of the landfill will be founded on bedrock. As presented in draft Chapter 7 and consistent with the methodology from a document entitled, ***Investigation of Rate of Erosion of Soils in Embankment Dams***, Chi Fai Wan and Robin Fell, Journal of Geotechnical and Geo-environmental Engineering, April 2004 (Wan), the potential for internal erosion in fine-grained soils can be estimated using the Erosion Rate Index. The Erosion Rate Index is based on soil properties, including the soil gradation, amounts of fines and clay, Atterberg limits, in situ water and density, and construction specifications.

Calculation of Erosion Rate Index

The following table presents qualitative terms for erosion rate indexes, $I_{EROSION}$.

Erosion rate index	Description
<2	Extremely rapid
2-3	Very rapid
3-4	Moderately rapid
4-5	Moderately slow
5-6	Very slow
>6	Extremely slow

The following equation for fine-grained soils was utilized to estimate the erosion rate index:

$$I_{EROSION} = 0.153\gamma d - 0.042RD + 0.10\omega + 0.0097\Delta\omega r - 0.0056Fines + 0.042Clay - 0.09LL + 0.11Ip + 0.44P - 10.20$$

Where: $I_{EROSION}$ = predicted erosion rate index, which has values in the range of 0 to 6, with soils that erode rapidly having a lower $I_{EROSION}$ than soils that erode slowly.
γ_d = dry density of the soil, pcf
RD = relative density of the soil (γ_d/ γ_{dmax} = percentage compaction in percent)
γ_{dmax} = maximum dry density of the soil, pcf
ω = water content, %
$\Delta\omega_r$ = water content ratio in percent, equal to (ω – OMC)/OMC*100%, where OMC is the optimum water content in %
Fines = fines content of the soil passing No. 200 sieve, %
Clay = mass fraction finer than 0.005 mm, %
LL = liquid limit, %

I_p = plasticity index, %
P = pinhole test classification expressed as an ordinal number

Dispersiveness Category	Pinhole Test Classification Value	Description
D1	1	Dispersive Clays that fail rapidly under 2-in. head
D2	2	
ND4	3	Slightly to moderately dispersive clays that erode slowly under 2-in. or 7-in. head.
ND3	4	
ND2	5	Nondispersive clay with very slight to no colloidal erosion under 15-in. or 40-in. head.
ND1	6	

1. Dispersiveness category based on ASTM D4647, Method A & Method C, which is included in proposed Chapter 7 of the GEORG Manual.

To estimate the erosion rate index of the RSL, input values were determined based on laboratory test results from on-site soils that were used as RSL during construction events. This includes laboratory test results obtained during construction of test pads and during RSL soil stockpile prequalification. Test pads are required to model the equipment, soil, and construction techniques of the recompacted soil liner (RSL) and show that the required permeability for RSL will be achieved using the construction techniques. The soils for Test Pad Nos. 3 and 4 are representative of the soils used as RSL. Recently, RSL Stockpile Nos. 25 through 30 were prequalified prior to construction. The soils in Stockpile Nos. 25 through 30 are consistent with the soils used for Test Pad Nos. 3 and 4.

For this evaluation, the laboratory test results for Test Pad Nos. 3 and 4 and for Stockpile Nos. 25 through 30 were used to obtain the input values. Attachment D includes summary tables with the average test results for each test pad and stockpile. The on-site soils from these test pads and stockpiles are considered representative of the material that is anticipated for future RSL.

	Averages from Test Pads	**Averages from RSL Soils Prequalification (SP 25 through SP 30)**
γ_{dmax} (see Note 1)	121.2	117.1
γ_{d}/γ_{dmax} (see Note 1)	95%	95%
ω (see Note 1)	11.7	13.1
$\Delta\omega_r$ (see Note 2)	0%	0%
Fines	55.9	58.4
Clay (see Note 3)	18.9	23.1
LL	35	37
I_p	17	18
Pinhole Dispersion Test Classification Value	4 (see Note 5)	4 (see Note 5)

1. The CQA Plan allows for 95% of the Standard Proctor or 90% of the Modified Proctor. As the percent compaction is subtracted in the formula, the higher percentage was used for conservatism.
2. The in-situ moisture content of the soil is assumed to equal the optimum moisture content.
3. The clay content reported is the % passing the 0.002 mm sieve, which is conservative.
4. Percentage of fines and clay were estimated based on the data from Test Pad Nos. 3 and 4 and RSL Soils Prequalification for Stockpile Nos. 25 through 30.
5. The pinhole dispersion test classification value is assumed based on CEC's testing experience of similar materials. The representative test results are presented in Attachment E. A conservative value was used in comparison to the representative test results.

$I_{EROSION}$ for the averages from RSL Soils Prequalification and for the Test Pad Construction is calculated as follows:

Test Pad Construction

$$I_{EROSION} = 0.153\gamma d - 0.042RD + 0.10\omega + 0.0097\Delta\omega r - 0.0056Fines + 0.042Clay - 0.09LL + 0.11Ip + 0.44P - 10.20$$

$I_{EROSION}$ = (0.153*121.2) – (0.042*95) + (0.10*11.7) + (0.0097*0) – (0.0056*55.9) + (0.042*18.9) – (0.09*35) + (0.11*17) + (0.44*4) – 10.20 = 6.5

RSL Soils Prequalification

$$I_{EROSION} = 0.153\gamma d - 0.042RD + 0.10\omega + 0.0097\Delta\omega r - 0.0056Fines + 0.042Clay - 0.09LL + 0.11Ip + 0.44P - 10.20$$

$I_{EROSION}$ = (0.153*117.1) – (0.042*95) + (0.10*13.1) + (0.0097*0) – (0.0056*58.4) + (0.042*23.1) – (0.09*37) + (0.11*18) + (0.44*4) – 10.20 = 6.1

The erosion rate index calculated for representative RSL materials ranges from 6.5 to 6.1 and averages 6.3, which indicates that the RSL will erode extremely slowly.

CONCLUSIONS

- A geocomposite underdrain system will be installed if groundwater is encountered during construction. The underdrain geocomposite is proposed in areas where waste placement is needed to obtain the required factor of safety for seepage. The intent of the underdrain geocomposite is to collect and convey any seepage beneath the RSL. The underdrain system will also include pipe trenches with perforated or solid pipe, bedded in a minimum of 18 inches of

coarse aggregate and wrapped with geotextile fabric. The groundwater will be conveyed to sumps, and either pumped or gravity drained.

- In areas where the underdrain is installed, groundwater will be pumped until waste is placed to the minimum required thickness to meet the required factor of safety for seepage. The following table summarizes the minimum waste thicknesses needed to achieve the required factor of safety at the critical location in each phase.

Phase No.	Minimum Thickness of Waste Required from Uplift Calculation (ft)
10	22
11	11
12	9.5
14	9.5

- If water is pumped from the underdrain system, the pumping will continue until the minimum required waste thickness is placed. This will prevent damage due to seepage during construction. Since the pumping is only needed until certain depths of waste are placed, this is considered a temporary groundwater control.
- The potential for internal erosion in fine-grained soils can be estimated using the Erosion Rate Index. The erosion rate index calculated for representative RSL materials ranges from 6.5 to 6.1 and averages 6.3, which indicates that the RSL will erode extremely slowly.

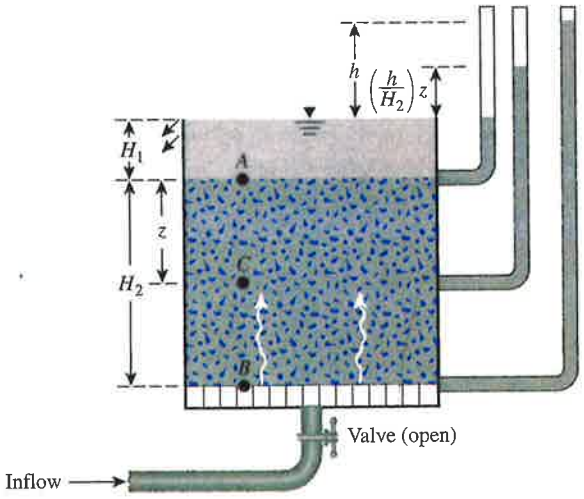
ATTACHMENT A

PAGES FROM DAS AND DIAGRAM

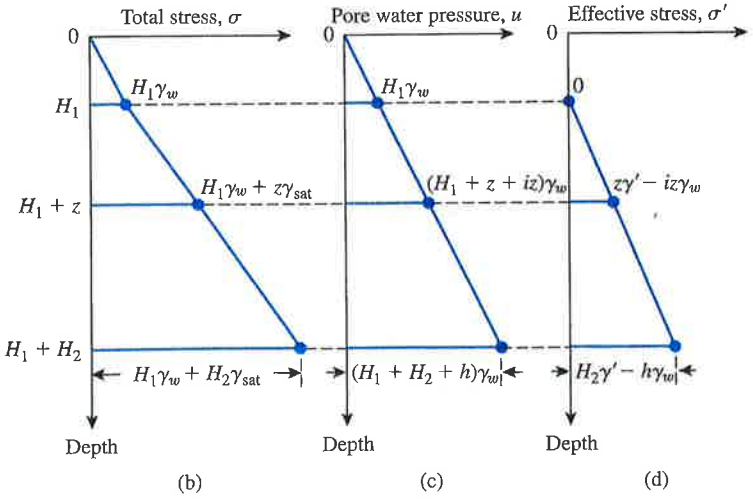
9.2 Stresses in Saturated Soil with Upward Seepage

If water is seeping, the effective stress at any point in a soil mass will differ from that in the static case. It will increase or decrease, depending on the direction of seepage.

Figure 9.4a shows a layer of granular soil in a tank where upward seepage is caused by adding water through the valve at the bottom of the tank. The rate of water supply is kept constant. The loss of head caused by upward seepage between the levels of A and B is h. Keeping in mind that the total stress at any point in the soil mass is due solely to the



(a)



(b) (c) (d)

Figure 9.4 (a) Layer of soil in a tank with upward seepage. Variation of (b) total stress; (c) pore water pressure; and (d) effective stress with depth for a soil layer with upward seepage

weight of soil and water above it, we find that the effective stress calculations at points A and B are as follows:

At A,

- Total stress: $\sigma_A = H_1\gamma_w$
- Pore water pressure: $u_A = H_1\gamma_w$
- Effective stress: $\sigma'_A = \sigma_A - u_A = 0$

At B,

- Total stress: $\sigma_B = H_1\gamma_w + H_2\gamma_{sat}$
- Pore water pressure: $u_B = (H_1 + H_2 + h)\gamma_w$
- Effective stress: $\sigma'_B = \sigma_B - u_B$
  $= H_2(\gamma_{sat} - \gamma_w) - h\gamma_w$
  $= H_2\gamma' - h\gamma_w$

Similarly, the effective stress at a point C located at a depth z below the top of the soil surface can be calculated as follows:

At C,

- Total stress: $\sigma_C = H_1\gamma_w + z\gamma_{sat}$
- Pore water pressure: $u_C = \left(H_1 + z + \frac{h}{H_2}z\right)\gamma_w$
- Effective stress: $\sigma'_C = \sigma_C - u_C$
  $= z(\gamma_{sat} - \gamma_w) - \frac{h}{H_2}z\gamma_w$
  $= z\gamma' - \frac{h}{H_2}z\gamma_w$

Note that h/H_2 is the hydraulic gradient i caused by the flow, and therefore,

$$\sigma'_C = z\gamma' - iz\gamma_w \tag{9.7}$$

The variations of total stress, pore water pressure, and effective stress with depth are plotted in Figures 9.4b through 9.4d, respectively. A comparison of Figures 9.2d and 9.3d shows that the effective stress at a point located at a depth z measured from the surface of a soil layer is reduced by an amount $iz\gamma_w$ because of upward seepage of water. If the rate of seepage and thereby the hydraulic gradient gradually are increased, a limiting condition will be reached, at which point

$$\sigma'_C = z\gamma' - i_{cr}z\gamma_w = 0 \tag{9.8}$$

where i_{cr} = critical hydraulic gradient (for zero effective stress).

Under such a situation, soil stability is lost. This situation generally is referred to as *boiling,* or a *quick condition.*

From Eq. (9.8),

$$i_{cr} = \frac{\gamma'}{\gamma_w} \tag{9.9}$$

For most soils, the value of i_{cr} varies from 0.9 to 1.1, with an average of 1.

Civil & Environmental Consultants, Inc.

PROJECT (C)(4)(a) Seepage Evaluation PROJECT NO. 154-006

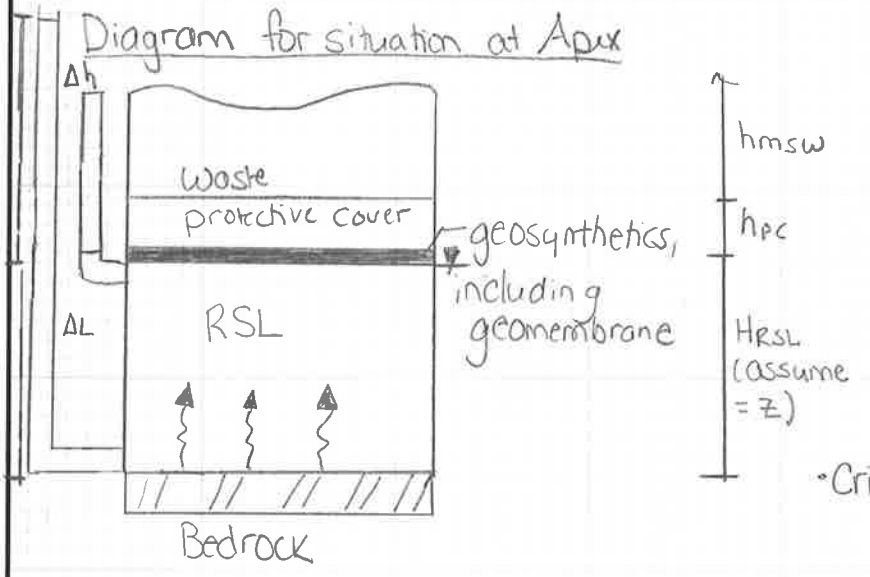
Apex Environmental LLC PAGE ____ OF ____

Apex Sanitary Landfill Contiguous Expansion

PREPARED BY ____ DATE ____ CHECKED BY ____ DATE ____

Seepage Evaluation- Calculation of Critical Hydraulic Gradient

Diagram for situation at Apex



•Critical point for hydraulic gradient

Effective stress = Total stress - Pore water pressure ($\sigma_{EFF} = \sigma_{TOTAL} - u$)

$$\sigma_{TOTAL} = (\gamma_{msw} * h_{msw}) + (\gamma_{PC} * h_{PC}) + (\gamma_{RSL} * Z)$$

$$u = (Z + iZ)\gamma_w$$

$$\sigma_{EFF} = (\gamma_{msw} * h_{msw}) + (\gamma_{PC} * h_{PC}) + (\gamma_{RSL} * Z) - [(Z + iZ)\gamma_w]$$

The critical gradient is reached when $\sigma_{EFF} = 0$.

ATTACHMENT B

DRAFT CHAPTER 7 FROM THE GEORG POLICY MANUAL

National Waste & Recycling Association

Collect. Recycle. Innovate.

June 19, 2015

Ms. Annette De Havilland
Division of Materials and Waste Management
Ohio Environmental Protection
PO Box 1049
Columbus, Ohio 43216 -1049

Re: Comments to Ohio EPA's Proposed Chapter 7 Update to the GEORG Policy Manual

Dear Ms. Braun:

The members of the Ohio Chapter of the National Waste & Recycling Association (NWRA) have received and reviewed the Ohio EPA's proposed updates to Chapter 7 - Hydrostatic Uplift Analysis in the Policy (DSIWM-27-08-660) on the *Geotechnical and Stability Analyses for Ohio Waste Containment Facilities* (aka GEORG Manual). As you may recall our members own and/or operate 25 solid waste landfills within the state of Ohio and well over 550 landfills nationally. Our members have been designing, constructing, and certifying landfill liners systems for over 25 years to satisfy both the Federal subtitle D requirements and state regulations

We appreciate Ohio EPA providing the opportunity to the regulated community to review and comment on the proposed updates to Chapter 7 of the GEORG Manual, and we support the Agency's desire to better educate our regulators through investigation "to evaluate the risks to our landfill's liner system and the potential vulnerability of these engineered components to hydrostatic uplift and/or subsurface seepage. We share the Agency concerns on this topic, and have been addressing these mechanisms for over 25 years at our disposal facilities in Ohio and in other states. These mechanisms have been adequately addressed historically by understanding the hydrogeological conditions at each disposal facility as required in Ohio Administrative Code (OAC) 3745-27-06 (solid waste permit applications) and the existing requirements for the construction of the engineered components outlined in OAC 3745-27-08. Hydrostatic uplift as required in the existing OAC rules requires a factor of safety of 1.4. Seepage on the other hand does not have specific regulatory requirements related to the engineering design of the liner components, and therefore is more difficult to relate back to specific regulatory requirements.

Both of these hydrogeologic and geotechnical engineering mechanisms are not new ones, and we believe that that both are already being managed through effective engineering design to prevent hydrostatic uplift and /or to effectively manage the seepage under and around the disposal facility's structural fill, added geologic material, and/or liner systems or other engineered structures at solid waste disposal facilities. The responsible professional engineer for each landfill's permitting and/or liner installation certification and /or other engineered component installation project has an obligation to

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have and maintain the expertise with these topics to provide these services in accordance with the Professional Engineers code of ethics.

In addition, the construction quality assurance/control process documents that the design and technical specification and quality control plans are being followed during construction. These quality control mechanisms are the final step in confirming that the engineered components have been installed in accordance with the professional engineer's design, the regulatory requirements and any requirements contained in the Ohio EPA approved solid waste permit application. These quality control practices include reviewing the installation of underdrain systems which have been employed for over 25 years to protect the various landfill components from both hydrostatic uplift and seepage. These methods have been effective and utilized by the Industry.

We further recognize as indicated in the reference bibliography provided with the Ohio EPA revised Chapter 7, that this is not a new issue. Engineering books and technical papers have been written on this and related topics dating back to the 1950's.

With respect to the actual updated language of Chapter 7, we appreciate Ohio EPA's attempts to provide a more advanced introductory basis for hydrostatic uplift, heave, and seepage; however, respectfully, this draft write-up can be considered ineffective and inadequate to train Ohio EPA scientists and engineers that have neither the engineering training nor experience to better understand these topics.

Geotechnical engineers have written entire chapters of engineering books and/or a multitude of technical papers on each of these three topics, and Ohio EPA is attempting to summarize them in less than 28 pages. The updated Chapter 7 language does not reference the regulatory requirements that they attempt to assist an untrained regulator in understanding the engineering theorems and corresponding assumptions. The examples provided do not provide the necessary insights as to where this data emulates from the regulatory requirements and the landfill's Ohio EPA approved Subsurface Investigation Report and/or the stability analyses can be found. The Chapter 7 write-up can be better organized to relate regualtory requirements to providing the necessary inputs to utilize the theorums.

The paragraph on "heaving" pertains more to bearing capacity than to hydrostatic uplift and/or seepage. Heaving in certain soils can be attritributed to a situation where unloading or a substantial reduction in overburden stress on a certain soil layer can cause an increase in pore pressure (aka cause subsurface water migration into this soil layer). Typically, this water migration is not significant in the midwest (except in underconsolidated and some normally consolidated soils) since our soils are not as suspectable as some soils located west of the Mississippi River. We would suggest that the heaving topic could be more correctly related to the GEORG manual section related to bearing capacity, but it would need to have an enhanced explanation to assist Ohio EPA scientists unfamilar with this topic.

Lastly, landfill engineers have been adequately addresssing the uplift potential and seepage issues for over 2 5 years by installing underdrain systems. We would disagree with the Ohio EPA's position provided in the third paragraph of the Introduction of Chapter 7 that a properly designed underdrain system used to reduce the buildup of pore water pressure may prevent damage associated with hydrostatic uplift but cannot be employed to reduce the seepage potential and associated damage. These systems are highly effective and have provided adequate protection to the subsurafce engineered components of our solid waste facilities. It was somewhat surprising in the updated Chapter 7 language

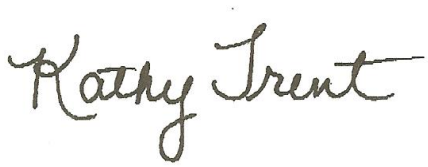
that minimal references to the installation and use of underdrain systems were made.

We are appreciative of the effort and commitment of Ohio EPA to research the state of the practice on these topics and to maintain stringent and technically proficient reference documents that are protective of the environment.

NSWMA is supportive of providing more reference documents to Ohio EPA revirewers; however, they can not become a replacement to engineers or scientists with applicable engineering training and geotechincal experience. As such, we respectively request the Agency continue to clarify and simplify the proposed Chapter 7 lanaguage and /or provide training seminars rather than seek additional policy language to address these types of engineering mechnisms.

We would be happy to meet with you and any other agency personnel at your convenience to discuss our comments. Please feel free to contact us at 513-490-4490 or 513-720-1369 should you have any questions or wish additional information.

Sincerely,
NATIONAL WASTE & RECYCLING ASSOCIATION



Kathy Trent — Chapter Chairperson

Bruce O. Schmucker, P.E. — Chapter Vice-Chairperson

Attachments: Ohio EPA updated Chapter 7 to GEORG Manual

cc: Peggy Macenas – NWRA

Chapter 7
SEEPAGE AND HYDROSTATIC UPLIFT ANALYSES

Introduction

This chapter provides information to use when evaluating the seepage and hydrostatic uplift potential at a waste containment facility in Ohio. Both of these forces can cause significant damage to the landfill foundation layers, engineered components, and structures at a waste containment facility.

Seepage and hydrostatic uplift may undermine the foundation of engineered components and those ancillary structures that usually have small basal foot prints when the ground water level (phreatic or potentiometric) rises above the bottom elevation of the engineering component or structure. This condition may lead to pressure build up beneath the engineered component or structure that can simply lift the engineering component or damage the foundation soils under the structure.

Hydrostatic uplift is a floatation condition that is caused by the displaced volume of the rising water table. This condition can be easily corrected by counteracting and equalizing the hydrostatic uplift force by building heavier structures, anchoring, or by placing overburden material. A properly designed filter accompanied by an increase in the vertical stress from the constructed liner or emplaced waste may prevent damage associated with hydrostatic uplift or reduce the likelihood of soil boils from forming by keeping the sand particles in their original positions. However, it should be noted that such measures will have no measurable impact on the reduction of pore water pressure buildup within the soil and hence cannot be employed to reduce the seepage potential and associated damage.

Seepage is the flow of water through soils caused by the difference in head. This difference in head is a measure of the energy lost in overcoming the resistance provided by the soils and other underground obstructions. Seepage damage can be classified into three broad categories.

1. Uplift
2. Heaving
3. Piping or internal erosion.

Uplift Concept and Analysis

Water percolation through a soil layer affects hydrostatic uplift force. As a result, considering seepage may theoretically be a more accurate approach. The shear resistance of the soil could also be theoretically taken into account. However, for practical purposes, a conservative evaluation of the resistance created by a soil layer against hydrostatic uplift can be accomplished by calculating a maximum uplift force based on a maximum measured piezometric head and comparing it to the normal stress created by the overlying soil layers. This is especially true when checking an interface between a subbase and a clay (or plastic) liner, where any significant seepage through the liner material is not anticipated nor wanted.

When selecting the scenarios for analysis of the hydrostatic uplift or seepage potential, it must be ensured that the worst-case interactions of the excavation and of the construction grades with the phreatic and piezometric surfaces are selected. Temporal changes in phreatic and piezometric surfaces must be taken into account. The highest temporal phreatic and piezometric surfaces must be used in the analyses. Using average depth of excavation or average elevation for the phreatic and piezometric surfaces **is not acceptable** (see Figure 7-3). The goal of the analyses is to identify all areas within the facility where liners or other structures will be constructed that have a factor of safety less than 1.4 for hydrostatic uplift or 1.1 for seepage potential.

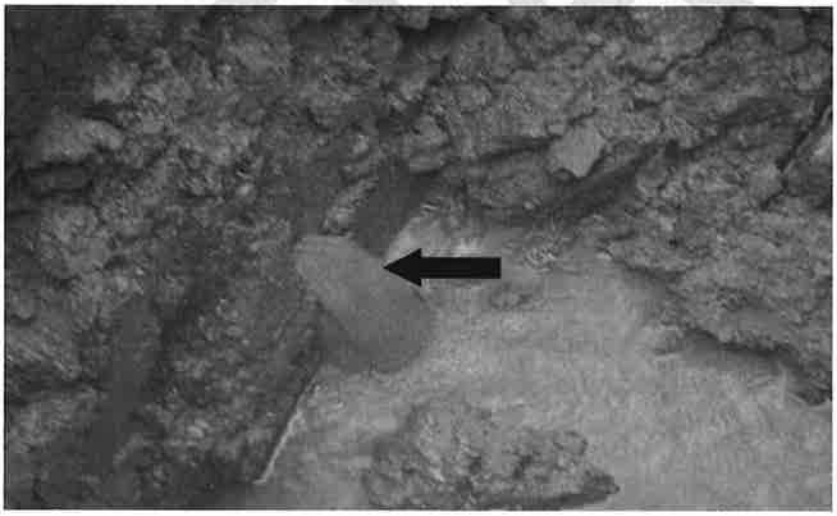


Figure 7-1 Example of Piping through the excavation Wall

Figure 7-1 is an example of piping through the wall of excavation caused by high hydrostatic pressures at an Ohio landfill creating flow through more than 20 feet of heavy in situ clay materials causing flooding of the excavation.

Figure 7-2 illustrates a situation where a clay liner (or another soil layer) is constructed above a saturated layer. The piezometric head (H_P) is applying upward pressure on the liner.

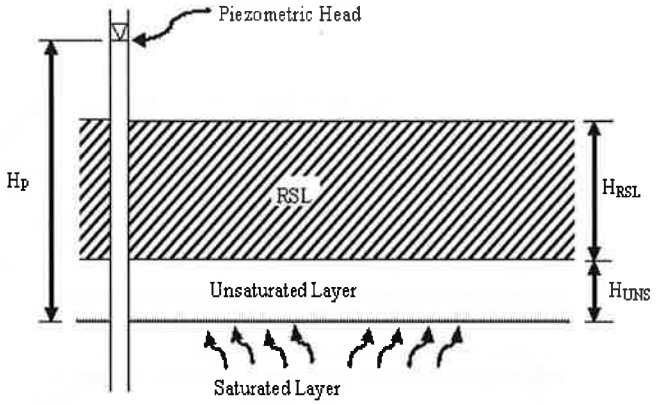


Figure 7-2 Example of uplift pressure acting below the Liner System

Factor of safety is commonly calculated as a ratio between a resisting (available or stabilizing) force and a driving (attacking or destabilizing) force. The factor of safety against hydrostatic uplift for the condition described in Figure 7-2 can be expressed as:

Equation 7-1

$$FS_{Uplift} = \frac{Resisting\ Force}{Driving\ Force} = \frac{\gamma_{RSL} H_{RSL} + \gamma_{UNS} H_{UNS}}{\gamma_w H_P}$$

Where,

γ_{RSL} = field density of clay liner, pcf

γ_w = density of water, pcf

γ_{UNS} = field density of unsaturated foundation soil, pcf

H_{RSL} = thickness of recompacted soil liner, ft

H_{UNS} = thickness of unsaturated foundation soil, ft

H_P = piezometric level above the unsaturated foundation soil (head), ft

An unstable condition caused by hydrostatic uplift may develop when the hydrostatic uplift force acting along the line of saturation overcomes the downward stabilizing force created by the weight of the soil layer(s) above the line of saturation. If an area acted upon by the hydrostatic force is sufficiently great, excess water pressure may cause overlying soil to rise, creating a failure known as "heave." Although heave can take place in any soil, it will most likely occur at an interface between a relatively impervious layer (such as a clay liner) and a saturated, relatively pervious base.

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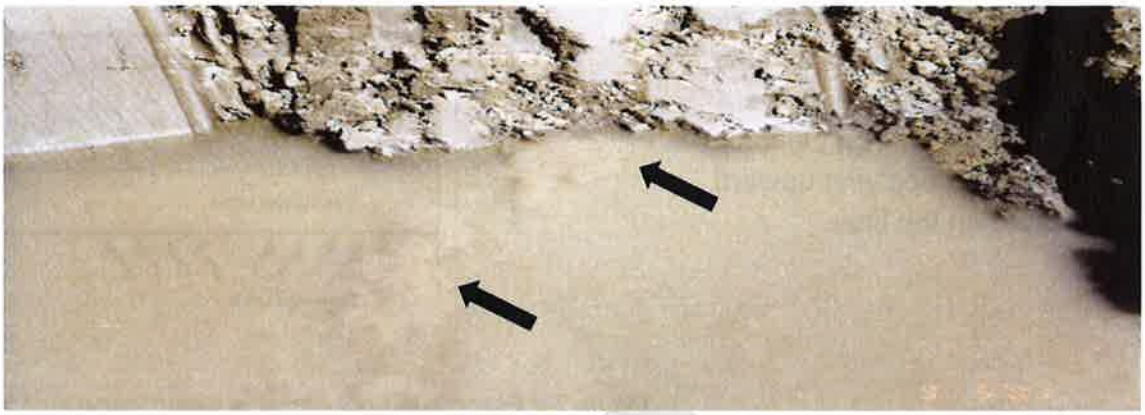


Figure 7-3 Example of Seepage through the Foundation

Figure 7-3 is another example of high hydrostatic pressures at an Ohio landfill causing flow through more than 20 feet of heavy in situ clay materials resulting in flooding of the excavation. The upward flow or seepage water is evidenced by a cloudy disturbance in the flooded excavation.

Heaving Concept and Analysis

Heaving occurs when the effective stress in the soil approaches zero. At this point there will not be any surface contact between the soil particles, leading to the formation of surface cracking or more severe soil breaking at or below the surface. Heaving typically is analyzed by comparing the seepage force exerted by the groundwater with the effective or buoyant unit weight of the overburden counteracting materials.

Heaving may also occur at the bottom of excavations due to bearing capacity failure. The factor of safety against heaving may be obtained from the modified Terzaghi's bearing capacity theory as presented below.

Equation 7-2

$$FS = \frac{11c}{\gamma H}$$

Where,

$c =$ soil cohesion (Φ = 0 concept), psf

$H =$ depth of excavation, ft

$\gamma =$ bulk unit weight of soil, pcf

Note that a value less than a constant of eleven will need to be used for trenches with small widths.

Piping or Internal Erosion Concept and Analysis

Piping or internal erosion, on the other hand, usually occurs when the drag or seepage forces, due to the water movement, exceed the cohesive resisting forces between the soil particles. This phenomenon will ultimately lead to the formation of soil erosion channels called soil pipes. Once soil piping starts, the flow in the soil pipe will continue to increase due to the decreased resistance to the flow or friction loss, and the increase in the velocity head, ultimately resulting in a collapse or other structural damage. Soil piping has been experienced at a number of excavation sites in Ohio. At those sites, higher seepage pressures or hydraulic gradients had caused the soil near the surface to form hairline cracks and soil boils. The internal erosion process continued to worsen with time and apparently progresses in a backward fashion until a number of soil pipes were formed between the surface and the source of the groundwater pressure, undermining the integrity of the foundation soil and liner system, and providing a direct conduit between the bottom of the landfill and the aquifer system.

This chapter discusses three methods (analytical method, flow net method, and finite element analysis method) to determine the seepage potential at a site.

Analytical Method

In order to evaluate if internal erosion or soil piping will be experienced during excavation and if soil boils will form, the internal and exit hydraulic gradient should be compared with the critical hydraulic gradient using the following equation:

Equation 7-3

$$i_{cr} = \frac{\gamma'}{\gamma_w} = \frac{G_s - 1}{e + 1}$$

Where,

i_{cr} = critical hydraulic gradient, unitless

γ' = submerged unit weight, pcf

γ_w = unit weight of water, pcf

G_S = soil specific gravity, unitless

e = soil void ratio, percent

The rate of total head loss or energy dissipation through the soil matrix is defined as the hydraulic gradient, i.

Equation 7-4: for zones of saturation

$$i_{actual} = \frac{\Delta h}{\Delta L} = \frac{top\ of\ potentiometric\ surface\ elev. - top\ of\ clay\ liner\ elev.}{top\ of\ clay\ liner\ elev. - top\ of\ waer\ baring\ unit\ elev.}$$

Equation 7-5: for upper most aquifers

$$i_{actual} = \frac{\Delta h}{\Delta L} = \frac{top\ of\ potentiometric\ surface\ elev. - bottom\ of\ excavation\ elev.}{bottom\ of\ excavation\ elev. - top\ of\ waer\ baring\ unit\ elev.}$$

Where,

Δh = head loss between two points, ft

ΔL = apparent flow distance at which the hydraulic gradient is being measured, ft

The head loss increases linearly with increasing velocity when the flow is in the laminar and transition phases. The relationship becomes nonlinear in the turbulent phase. Once the turbulent phase is reached, even if the velocity is reduced, the flow will remain turbulent in part of the transition zone until the laminar zone is reached again. This explains why once the seepage damage begins, it will not be stopped or reduced without engineering intervention.

When considering the effect of the hydraulic gradient, the effective vertical stress may be defined by:

Equation 7-6

$$\sigma'_V = \sigma_V - iu$$

As the hydraulic gradient increases, σ_V approaches iu and σ'_V approaches zero. At this point, the gradient approaches the critical gradient, i_{cr}, which can be demonstrate to be equal to $i_{cr} = \frac{\sigma_V}{u} = \frac{\gamma'}{\gamma_w}$.

The internal and exit hydraulic gradients can be calculated using a finite element or a flow net method. The answer obtained from these methods should be compared to the critical hydraulic gradient, i_{cr}, calculated using the above formulas.

As long the internal and exit hydraulic gradients are less than the critical gradient, i_{cr}, the seepage is expected to be in accordance with the principle of Darcy's law and the permeability of the soil should remain constant. This suggests that there will be minimal

disturbance to the soil structures and that internal erosion will not occur. However, when the hydraulic internal or exit gradient exceeds the critical gradient, i_{cr}, the hydraulic conductivity of the soil is expected to increase, ultimately resulting in a loss of strength of the foundation soils, leading to the formation of soil piping tunnels and soil boils on the surface. This condition, when it occurs in cohesionless soil, is termed as a quick condition. Simple testing and visual inspection of the flow coming from the sand boils can shed a very important light on the severity of the soil piping condition. If fine materials are being carried along with the flow from the sand boils, this may be an indication that a severe piping condition is developing. In this situation, immediate action will need to be implemented to remedy the cause of the problem.

The tractive stress concept may also be used to determine the magnitude of the critical gradient. Khilar et al. reported the critical gradient necessary to cause soil piping to be:

Equation 7-7

$$i_{cr} = \frac{\tau_{cr}}{2.878\gamma_w}\left(\frac{n_o}{K_o}\right)^{0.5}$$

Where,

τ_{cr} = critical tractive stress (dynes/cm^2) = 0.001 (S_v+ α_u) tan (30 + 1.73 PI) (Dunn, 1959; Abt et al., 1996; Philip et al. 2006).

S_v = the saturated shear strength, N/m^2, lb/ft^2

α_u = unit conversion constant, 8630 N/m^2, 180 lb/ft^2

PI = Plasticity Index from the Atterberg limits

n_o = initial porosity, percent

K_o = initial hydraulic conductivity (cm/sec) (One order of magnitude less than the lab permeability)

Philip's recommends using "unconfined compressive test (ASTM D211-66-76) to determine the saturated shear strength, S_v.

Flow Net Method

Seepage problems can also be estimated through the use of the continuity equation which will result in a special form of equation that is called the "Laplace Equation." In three dimensions, the equation will take the following form:

Equation 7-8

$$\frac{\delta^2 h}{\delta x^2} + \frac{\delta^2 h}{\delta y^2} + \frac{\delta^2 h}{\delta z^2} = 0$$

Graphical representation of this equation will yield ellipses for the flow lines and hyperbolas for the equipotential lines. The two families of curves will intersect at 90 degree angles to form a pattern of peculiar square figures. Using Darcy's Law the following form of equation can be easily used to determine the amount of seepage per unit time per unit distance from the groundwater to an excavation or from an elevated ground reservoir or sedimentation pond through the embankment.

Equation 7-9

$$q = K h_L \frac{N_f}{N_d}$$

Where,

$q =$ seepage flow rate, cfs

$k =$ soil hydraulic conductivity, ft^2/sec

$h_L =$ total head loss, ft

$N_f =$ total number of flow channels in the flow net, unitless

$N_d =$ total number of equipotential drop lines in the flow net, unitless

Finite Element Analysis Method (FEM)

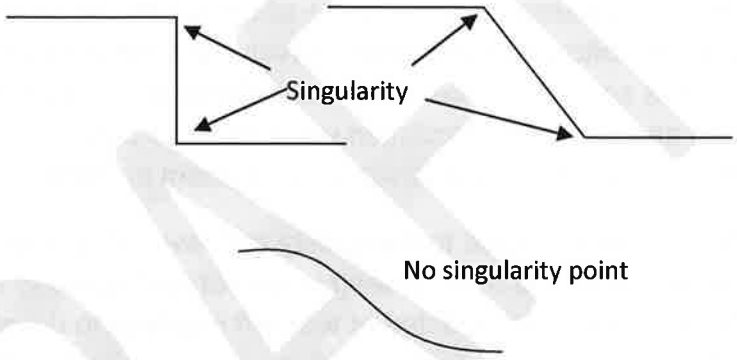
Finite element models are available to perform seepage analysis for saturated or unsaturated steady and unsteady state flow conditions. The basic steps involved in most finite element programs are:

(1) Selection of the cross section that is intended to be modeled. The section geometry will need to be entered into the finite element program.

(2) The cross section is discretized by dividing it into smaller sections or elements. This option is usually automatic in most finite element programs. Some finite element programs may allow you to select the type of element to be used in the finite element analysis. The materials' hydraulic conductivity and initial fluid head or potential will need to be specified. The boundary conditions will need to be defined accurately otherwise the results may be questionable. The finite element

programs that deal with seepage analysis contain flow, potential, gradient, and velocity relationships that will allow you to solve for these unknown at each node established by the discretizing step using element stiffness matrices and equations. The programs will assemble the stiffness matrices; account for the known boundary conditions and solve for the unknowns.

It should be noted that FEM programs are used to solve the partial differential flow equation which is undefined at points of singularity. It is meaningless to compute the gradients at points of singularity. Therefore, unless the surface has sharp and abrupt changes, attempts must be modeled surfaces as they are encountered in the field (i.e., transition between the floor and side slope should be modeled as a curve instead sharp angle).



Calculation of Seepage Factor of Safety

The calculation for factor of safety concerning seepage is calculated as follows:

$$FS = \frac{i_{critical}}{i_{actual}}$$

Soil Gradation and Piping Damage

Formation of soil piping is very favorable in a permeable sandy/gravelly formation. Soil formation is considered to be prone to piping damage when the following conditions are met:

1. There is more than 10% by weight of particles finer than 0.25 mm; and
2. There is a lack of particles with a grain size in the range of 0.5 to 2 mm; and
3. The coefficient of uniformity is greater than 20; and
4. The coefficient of curvature is greater than 3.

When two soils with similar grain size distribution curves are being compared, the soil with the higher friction angle will tend to exhibit a higher critical gradient and therefore, will be less prone to piping damage.

It is recommended that a seepage analysis be performed if the potentiometric head on the bottom of excavation exceeds 5% of the thickness/distance of the soil between the source of groundwater pressure and the bottom of excavation. Soil piping will very likely occur if the head on the bottom of excavation exceed 20% of the soil thickness/distance between the source of groundwater pressure and the bottom of excavation.

The potentiometric or phreatic heads in the saturated soil foundation layer can be measured with the aid of piezometers, water levels in borings, or other techniques, and compared to the thickness/distance of the soil between the source of groundwater pressure and the bottom of excavation to evaluate if the 20% criterion has been exceeded. If this screening criterion is not satisfied (i.e., exceeding the 20% criterion), a more detailed and accurate calculation using facility's own specific values must be included with any request to construct a liner system or install an engineered structure.

Special attention must be paid to the quality and level of compaction of the backfill material that will be placed around seep collars or underground conduits. If the backfill material placed is poorly compacted or was left exposed to develop cracks, a seepage pathway potential will be very likely to occur. Again, once this phenomenon occurs, seepage velocity will increase leading to even eroding more impervious and well compacted material such as recompacted soil liner system.

Determination of Total Head and the Concept of Seepage Forces

Flow of water through soils is governed by the total head. Bernoulli's Equation defines the total head for steady state of non-viscous incompressible fluids as follow:

Total Head = Pressure Head (piezometric) + Elevation Head (Potential) +Velocity Head

Or in a mathematical form: $$\text{Total Head (feet)} = \frac{P}{\gamma_w} + Z + \frac{V^2}{2g}$$

The elevation head or potential head is the distance between an arbitrarily selected datum and the point in question. Elevation head can be negative if the point in question falls below the datum line. Bernoulli's equation can be used to determine the gradient and the pore water pressure at a point.

Water seeping through the soil imparts energy to soil grains in the form of friction. The seepage force can be represented by:

Equation 7-10

$$F = 62.4 i V = 62.4 A \Delta h$$

Where,

$F =$ seepage force

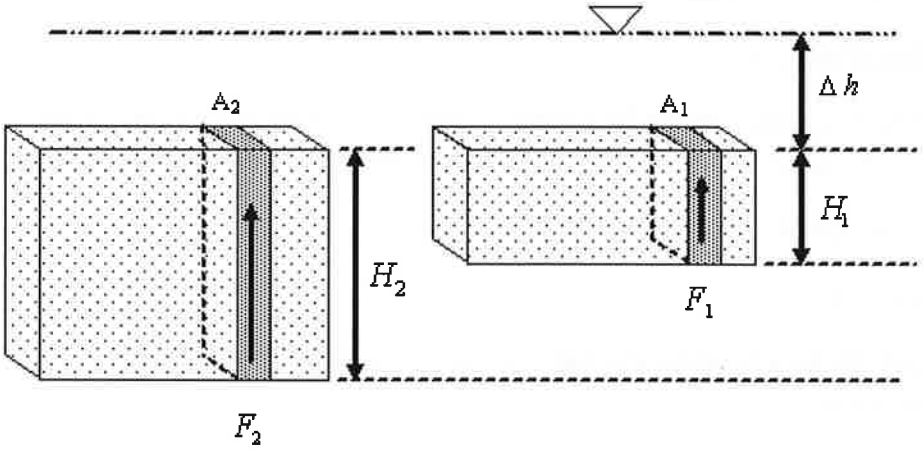
$i =$ average hydraulic gradient

$V =$ volume of which the hydraulic gradient is acting upon

$\Delta h =$ head loss between two points

A = Area

For a given area and energy loss, the seepage force is constant regardless of the distance over which it travels. To illustrate this concept, the following review is provided.



$$F_1 = 62.4 i_1 V_1$$

$$i_1 = \frac{\Delta h}{H_1}$$

$$V_1 = A_1 H_1$$

$$\therefore F_1 = 62.4 \frac{\Delta h}{H_1} A_1 H_1 = 62.4 \Delta h A_1$$

$$Assume\ A_1 = A_2 = A$$

$$F_1 = 62.4 \Delta h A$$

Similarly,

$$F_2 = 62.4\, i_2\, V_2$$

$$i_2 = \frac{\Delta h}{H_2}$$

$$V_2 = A_2\, H_2$$

$$\therefore F_2 = 62.4 \frac{\Delta h}{H_2} A_2\, H_2 = 62.4\, \Delta h\, A_2$$

$$Assume\ A_1 = A_2 = A$$

$$F_2 = 62.4\, \Delta h\, A$$

This will conclude that $\overrightarrow{F_1} = \overrightarrow{F_2}$

This demonstrates that the seepage force will not be reduced by the thickness of the layer it travels through.

Minimum Factors of Safety

The following factors of safety should be used, unless superseded by rule, when demonstrating that a facility will resist the hydrostatic uplift and seepage potential.

Hydrostatic Uplift Analysis: FS > 1.4

Seepage Analysis: FS> 1.1

The use of a higher factor of safety against hydrostatic uplift or seepage potential may be warranted whenever:

1. A failure would have a catastrophic effect upon human health or the environment, uncertainty exists regarding the accuracy, consistency, or validity of data, and no opportunity exists to conduct additional testing to improve or verify the quality of the data. Designers may want to consider increasing the required factor of safety if repairing a facility after a failure would create a hardship for the responsible parties or the waste disposal customers.

2. Large uncertainty exists about the effects that changes to the site conditions over time may have on the phreatic or piezometric surfaces, and no engineered controls can be implemented that will significantly reduce the uncertainty.

3. The soil is classified to have moderately rapid to extremely rapid erosion rate.

A facility must be designed to prevent failures due to hydrostatic uplift. A factor of safety against hydrostatic uplift and seepage potential lower than 1.4 and 1.1, respectively; is not considered a sound engineering practice in most circumstances. This is due to the uncertainties in calculating a factor of safety against hydrostatic uplift and seepage potential, and any failure of the waste containment facility due to hydrostatic uplift or seepage potential is likely to increase the potential for harm to human health and the environment. If a facility has a factor of safety against hydrostatic uplift less than 1.4, it may be necessary to lower the groundwater table to an acceptable level until enough stabilizing material is placed above the liner system to result in a factor of safety greater than 1.4. However, if it is determined that the factor of safety against seepage potential is less than 1.1, mitigation to reduce the uplift or seepage pressures, redesigning the facility to achieve the required factor of safety, or using another site not at risk of a failure due to seepage potential will be necessary.

The factors of safety specified in this policy are based on the assumptions contained in this policy. Those assumptions include, but are not limited to, the use of conservative, site-specific, higher quality data; proper selection of worst-case geometry; and the use of calculation methods that are demonstrated to be valid and appropriate for the facility. If different assumptions are used, these factors of safety may not be appropriately protective of human health and the environment. For instance, using the average depth of excavation (double-dot dashed line in Figure 7-4) and the average elevation of the piezometric surface (large dashed line) result in the conclusion that hydrostatic uplift will not occur, which is not appropriate. Note that the temporal high piezometric surface (small dashed line) does intersect the liner system (hashed area) creating the potential for hydrostatic uplift that must be analyzed. The factors of safety specified in this policy are based on the assumption that the soil will poses a moderately slow to extremely slow erosion rate $I_{erosion}$ greater than 5.0.

The erosion characteristic of a soil can be described by a parameter called the erosion rate index. The erosion index rate measures the rate of erosion and the critical shear stress of the soil when erosion is expected to begin. The rate of erosion appears to be dependent on the soil gradation, amounts of fines and clay, Atterberg limits, in situ water and density, construction specifications, and to a certain degrees on the soil mineralogy and its cementations property.

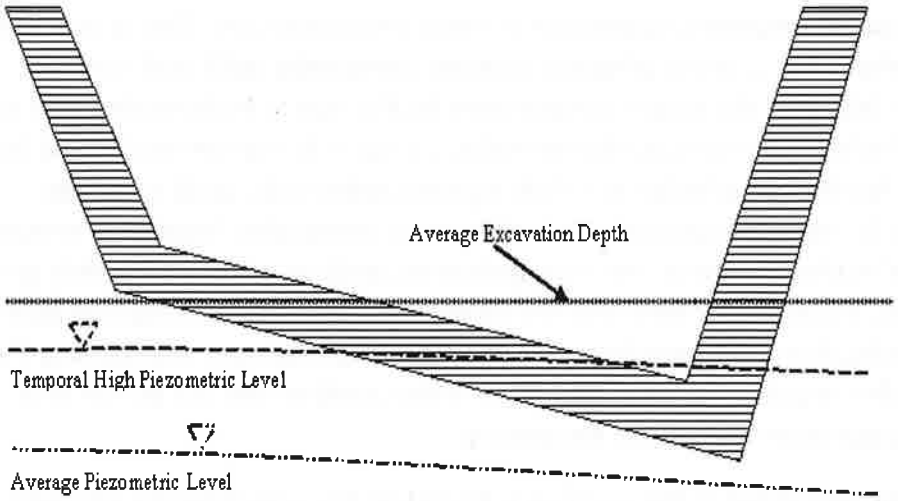


Figure 7-4 illustration of relationship between pressure heads and bottom of excavation

The erosion rate index for plastic soils may be estimated using the following equation developed by Wan and Fell, 2004:

Equation 7-12

$$I_{erosion} = 0.153\gamma_d - 0.042RD + 0.1\omega + 0097\Delta\omega_r - 0.056F - 0.09LL + 0.11I_p + 0.44P - 10$$

Where,

$I_{erosion}$ = erosion rate index

γ_d = soil dry density, lb/ft^3

RD = relative density of the soil, % (use 95 for undisturbed foundation soil)

ω = water content, %

$\Delta\omega$ = water content ratio, $\% = \dfrac{\omega - \text{OMC}}{\text{OMC}} \times 100$

OMC = optimum water content, %

F = percent of fines in the soil, %

Clay* = percent of clay (0.002mm) in the soil, %

LL = liquid limit, %

I_P = plasticity index, %

P = pinhole test classification value

*Wan and Fell define it to be percent passing 0.005mm

The following table provides guidance for selecting the pinhole test classification value.

Dispersiveness Category	Pinhole Test Classification Value	Description
D1	1	Dispersive clays that fail rapidly under 2-in head
D2	2	
ND4	3	Slightly to moderately dispersive clays that erode slowly under 2-in or 7-in head
ND3	4	
ND2	5	Nondispersive clay with very slight to no colloidal erosion under 15-in or 40 in head
ND1	6	

The dispersiveness category is based on ASTM D 4647, Methods A&C.

Qualitative terms for representing the erosion rate index were suggested as follows:

Erosion Rate Index ($I_{erosion}$)	Description
<2	Extremely rapid
2 – 3	Very rapid
3 – 4	Moderately rapid
4 – 5	Moderately slow
5 – 6	Very slow
>6	Extremely slow

The responsible party should ensure that the design and specifications in all authorizing documents and the QA/QC plan clearly require that the assumptions and specifications used in the hydrostatic uplift and seepage analyses for the facility will be followed and confirmed during and before construction, operations, and closure.

From time to time, changes to the facility design may be needed that will alter the assumptions and specifications used in the hydrostatic uplift or seepage analyses. If this

occurs, a request to change the facility design is required to be submitted for Ohio EPA approval in accordance with applicable rules. The request to change the facility design must include a new hydrostatic uplift and seepage analyses that uses assumptions and specifications appropriate for the change request.

REPORTING

This section describes the information that should be submitted to demonstrate that a facility is not susceptible to hydrostatic uplift and seepage damage. Ohio EPA recommends that the following information be included in its own separate section of a geotechnical and stability analyses report that will be submitted for Ohio EPA review:

1. A narrative and tabular summary of the results of the hydrostatic uplift and seepage analyses,
2. A summary and discussion of the results of the subsurface investigation that apply to the hydrostatic uplift and seepage analysis and how they were used in the analyses,
3. A summary of the worst-case scenarios used to analyze the hydrostatic uplift and seepage potential at the facility,
4. Isopach maps comparing the excavation and construction grades, depicting the temporal high phreatic and piezometric surfaces and showing the limits of the waste containment unit(s),
5. Drawings showing the cross sections analyzed. The cross sections should include:
    a. The engineered components and excavation limits of the facility,
    b. The soil stratigraphy and their properties such as thickness, porosity, hydraulic conductivity and degree of saturation, and
    c. The locations of the temporal high phreatic and piezometric surfaces.
6. The detailed hydrostatic uplift and seepage calculations, and
7. Any figures, drawings, or references relied upon during the analysis marked to show how they relate to the facility.
8. All electronic files and relevant information.

Figure 7-5 Hydrostatic pressure can cause in situ materials to fracture and allow the passage of the underlying ground water into an excavation, causing flooding of the excavation and weakening the in situ materials. The two delta formations in the above picture are obvious evidence of flow through the in situ materials, which at this Ohio landfill are over 20 feet thick.

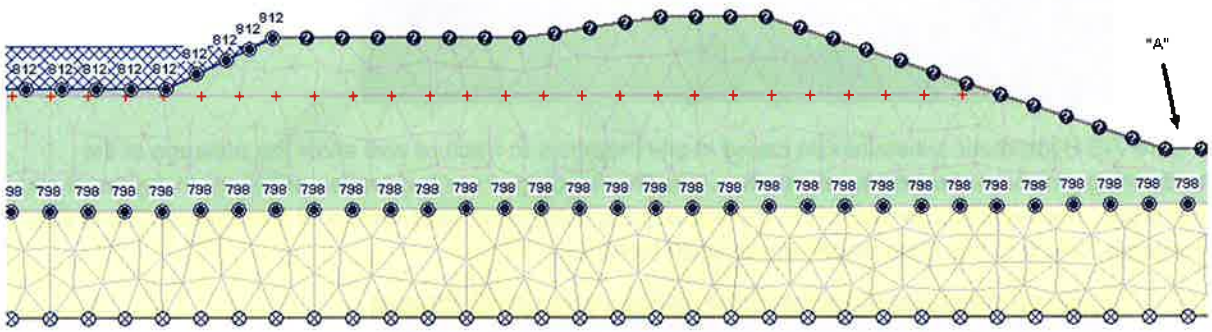
Figure 7-6 Hydrostatic pressures are causing ground water to pipe into an excavation of an Ohio landfill. This may have been caused by fracturing of the in situ materials, piping, or from an improperly abandoned boring.

Any drawings or cross sections referred to in this policy that are already present in another part of the geotechnical and stability analyses report can be referenced rather than duplicated in each section. It is helpful if the responsible party ensures the referenced items are easy to locate and marked to show the appropriate information.

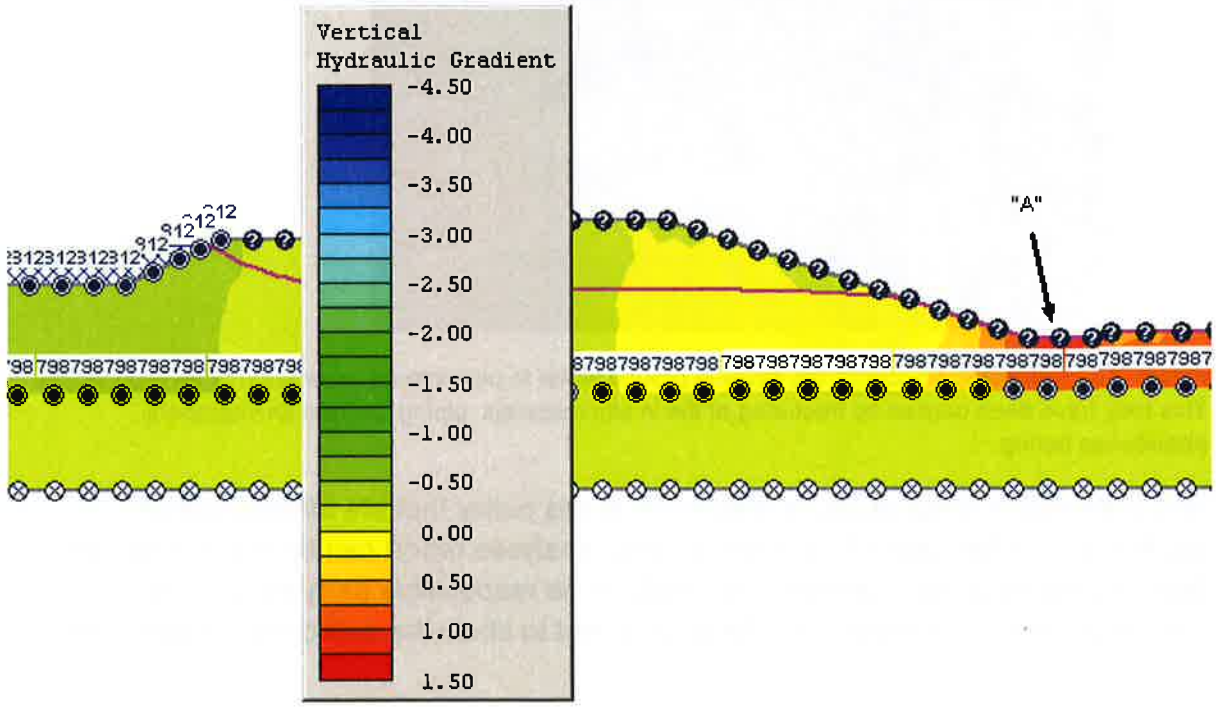
Seepage Analysis using FEM and Traditional Methods - Example Calculation

To assess the seepage potential, the gradient due to upward seepage force at the base of excavation will need to be evaluated at least on a 100 ft by 100 ft grid and at the toe of the side slopes. For illustrative purpose, the seepage potential is evaluated at point "A" where the following information is available.

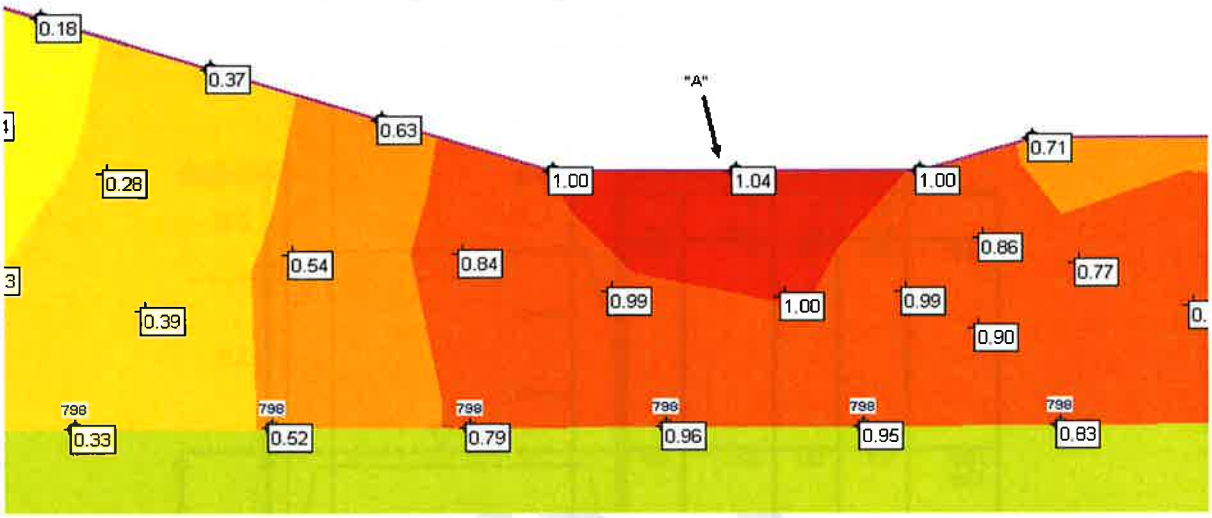
The specific gravity of the foundation soil = 2.75, void ration = 0.5, saturated unit weight of the soil = 139.2 pcf, and the geometry and hydrostatic conditions are shown in the figure below.



The results of the vertical hydraulic gradients can be determined using a finite element program. The following is the results obtained using "Slide" program.



Enlarging the view near the area of concern at point "A" for this example, the following is obtained.



Therefore, the expected exit vertical gradient at point "A" is 1.04.

Performing the same problem using the Equation 7-4, one can obtain the actual gradient at point "A":

$$i_{act} = \frac{\Delta h}{\Delta L} = \frac{potentiometric\ surface\ elev - water\ table\ elev}{subgrade\ surface\ elev - top\ of\ UAS\ elev} = \frac{798 - 782.5}{782.5 - 766.5} = 0.97$$

This compares well with the results obtained from the finite element program of 1.04.

The critical gradient is the smaller of:

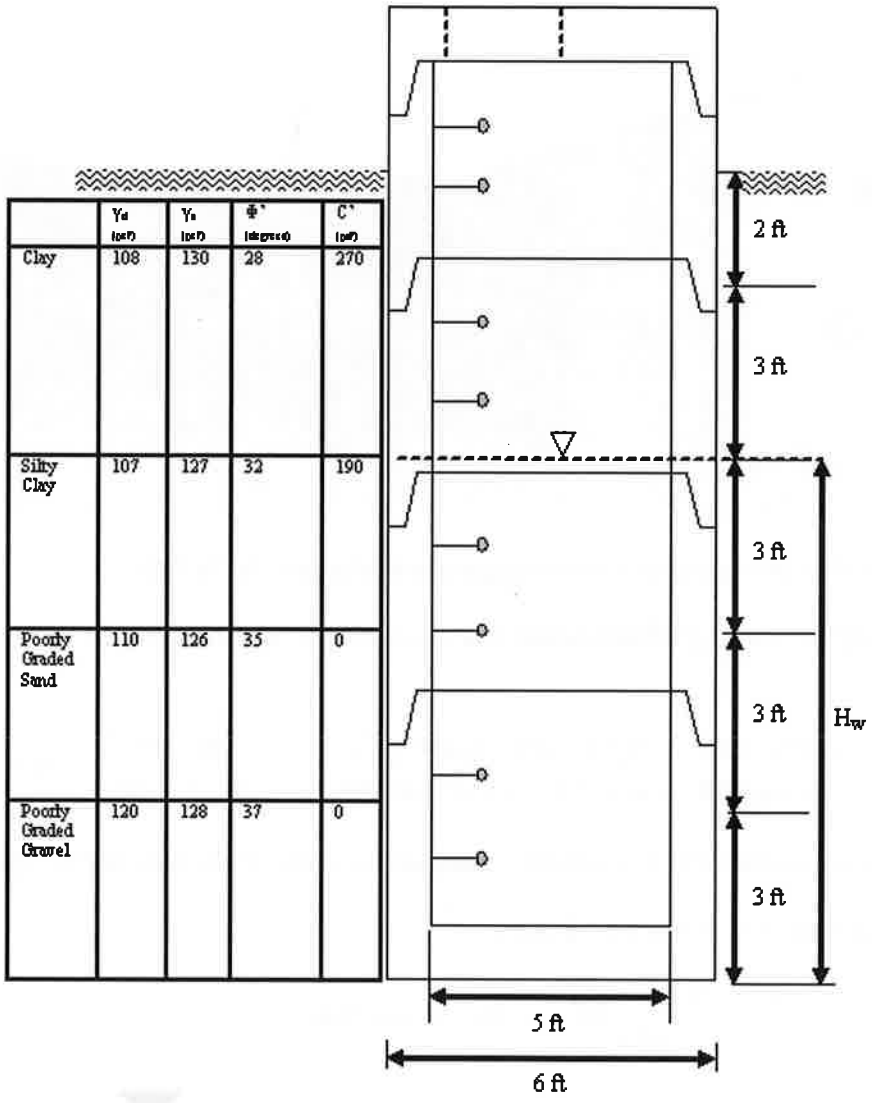
$$i_{cr} = \frac{\gamma'}{\gamma_w} = \frac{\gamma_{sat} - \gamma_w}{\gamma_w} = \frac{135.2 - 62.4}{62.4} = 1.16 \quad \leftarrow \text{controls}$$

$$i_{cr} = \frac{G_S - 1}{e + 1} = \frac{2.75 - 1}{0.5 + 1} = 1.17$$

Hydrostatic Uplift of a Pump Station - Example Calculation

Find the factor of safety for the pumping station against uplifting.

Assume the pumping station walls are coated with an impermeable epoxy coating layer.



	γ_d (pcf)	γ_s (pcf)	Φ' (degrees)	C' (psf)
Clay	108	130	28	270
Silty Clay	107	127	32	190
Poorly Graded Sand	110	126	35	0
Poorly Graded Gravel	120	128	37	0

$$FS_{Uplift} = \frac{Pullout\ Resistance}{Uplift\ Pressure}$$

$$FS_{Uplift} = \frac{Wall\ Friction + Weight\ of\ Soil\ above\ Extended\ Base + Deadmen\ Resistance + Structure\ Weight}{Uplift\ Pressure}$$

In this case, we do not have an extended base or deadmen, therefore,

$$FS_{Uplift} = \frac{Wall\ Friction + Structure\ Weight}{Uplift\ Pressure}$$

$$Uplift\ Pressure = \gamma_w A_o H_w$$

$$Uplift\ Pressure = \gamma_w A_o H_w$$

$$Uplift\ Pressure = (62.4\ pcf)\left(\frac{\pi(6\ ft)^2}{4}\right)(9\ ft) = 15{,}871\ lbs$$

$$Wall\ Friction = K_o\ \gamma_b \frac{H}{2} A_o \tan\phi' + A_o\ C_S$$

$$Weight\ of\ Soil\ above\ Extended\ Base = (A_o - A_i) H\ \gamma_b$$

Where,

$K_o = at\ rest\ pressure coefficien\ t = 1 - \sin\phi'$
$\gamma_b = bouyant\ soil\ weight = \gamma_{sat} - \gamma_w$
$A_o = ouside\ area\ of\ manhole\ shaft$
$A_i = inside\ area\ of\ manhole\ shaft$
$C_S = saturated\ cohesion$

Therefore, the wall friction along the different layers ➔

$$Wall\ friction = friction\ along\ gravel + friction\ along\ sand + friction\ along\ silty\ clay + friction\ along\ clay$$

$$Friction\ along\ gravel = K_o\ \gamma_b \frac{H}{2} A_o \tan\phi' + A_o\ C_S$$

$$= (1 - \sin\phi')(\gamma_{sat} - \gamma_w)\frac{H}{2}(2\pi r H)\tan\phi' + A_o\ C_S$$

$$= (1 - \sin 37)(128 - 62.4)\frac{3}{2}(2\pi(3)(3))\tan 37 + A_o(0)$$

$$= 1{,}670\ \text{lbs}$$

$$\textit{Friction along sand} = (1-\sin 35)(126-62.4)\frac{3}{2}(2\,PI(3)(3))\tan 35 + A_o(0) = 1{,}611\,\text{lbs}$$

$$\textit{Friction along silty clay} = (1-\sin 32)(127-62.4)\frac{3}{2}(2\,PI(3)(3))\tan 32 = 1{,}610\,\text{lbs}$$

$$\textit{Friction along clay} = (1-\sin 28)(130-62.4)\frac{3}{2}(2\,PI(3)(3))\tan 28 + \left(1-\sin 28)(108)\left(\frac{2}{2}\right)((2\,PI(3)(2))\tan 28\right)$$

$$= 2{,}766\,\text{lbs}$$

$$\textit{Weight of the Structure} = (A_o - A_i)H\gamma_{concrete}$$

$$= \left(\frac{\pi D_o^2}{4} - \frac{\pi D_i^2}{4}\right)H\gamma_{concrete}$$

$$= \frac{\pi}{4}(D_o^2 - D_i^2)H\gamma_{concrete}$$

$$= \frac{\pi}{4}((6\,ft)^2 - (5\,ft)^2)(19\,ft)(150\,pcf)$$

$$= 24{,}622\,\text{lbs}$$

$$\therefore \quad FS = \frac{1{,}670 + 1{,}611 + 1{,}610 + 2{,}766 + 24{,}622}{15{,}871} = 2.0$$

Factor of safety not considering wall friction is:

$$FS = \frac{24{,}622}{15{,}871} = 1.6$$

DRAFT

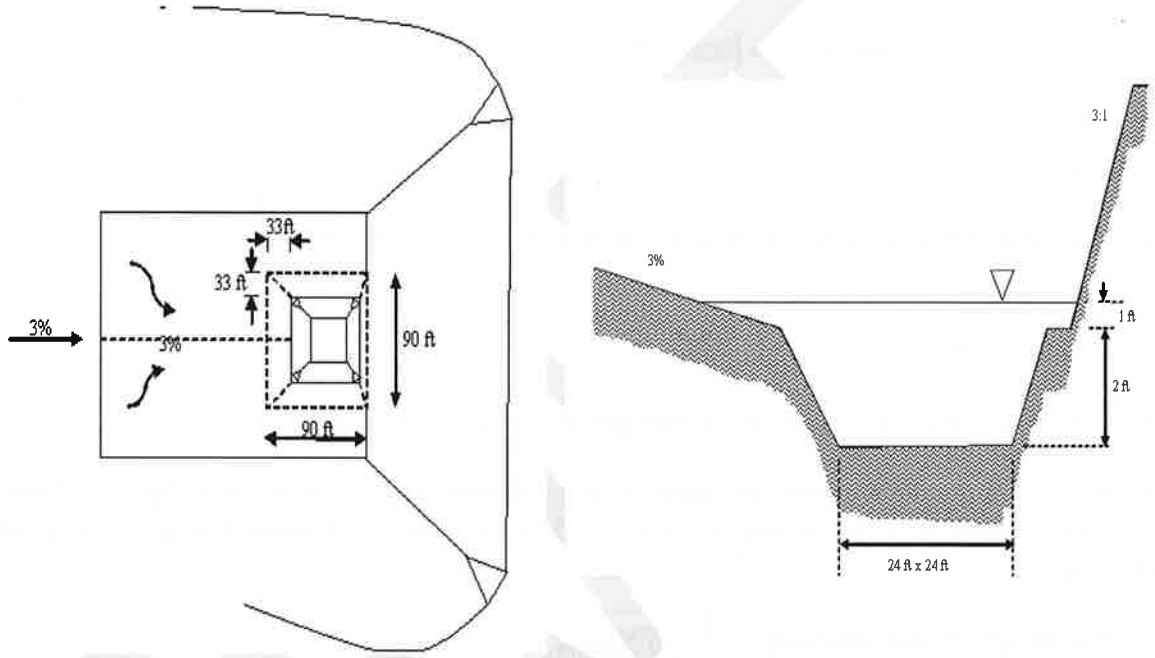
Hydrostatic Uplift at the Sump - Example Calculation

Given a sump with dimensions of 24 ft x 24 ft x 2 ft deep.

Floor and flow line slopes = 3% .

Piezometeric head level is determined to be 1 ft above the sump rim.

Foundation soil has $\Phi = 22^{o}$ and c= 100 psf.



Since we know the piezometric head is 1 ft above the sump rim, this will mean it will extend a distance equal to 33 ft from the rim if the floor slope is 3%.

The volume of the area delineated by the piezometric line intersecting the sump area is the volume of the sump + volume of 3 full spectrum + the volume of a small spectrum between the sump and the 3:1 side slope.

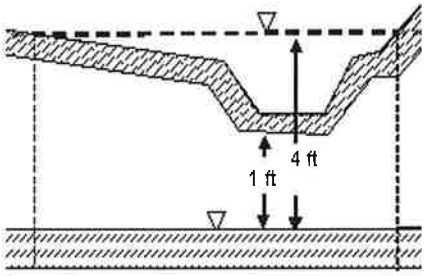
Assume the volume of the small spectrum is equal to zero.

Volume of the sump = 24 ft x 24 ft x 2 ft = 1,152 ft^3

$$Volume\ of\ the\ 3\ spectrum = \left[\frac{[(24\text{ft}\times 1\text{ft})+(90\text{ft}\times 1\text{ft})](33\text{ft})}{2}\right](3)$$
$$= 5{,}643\text{ft}^3$$

Total volume of the area subjected to uplifting = 5,643 + 1,152 = 6,795 ft^3

This will result in an uplift force = 6,795 ft^3 x 62.4 pcf = 424,008 lbs



$$Volume\ of\ dry\ soil\ resisting\ uplift = [90\text{ft}\times 90\text{ft}\times 4\text{ft}] - 6{,}795\text{ft}^3$$
$$= 25{,}605\text{ft}^3$$

Assume γ_{soil} = 120 pcf

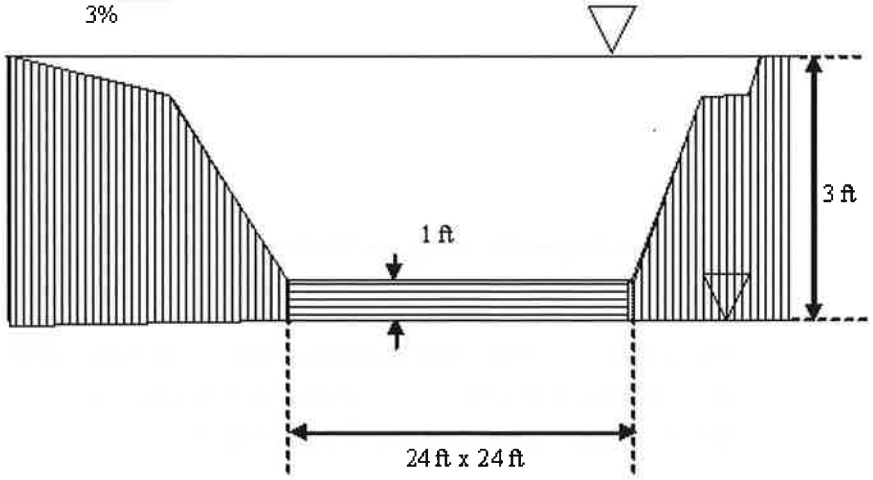
Weight of soil in this wedge = 120 pcf x 25,605 ft^3 = 3,072,600 lbs

$$\therefore\quad F.S = \frac{3{,}072{,}600}{424{,}008} = 7.2$$

Note that this is without considering the soil shear resistance to uplift.

However, if we redo the same analysis for the situation shown in the next figure where the phreatic head is only 1 ft below the bottom of the sump and using the same analysis as before.

Now the weight of soil resisting uplift is equal to 69,120 lbs resulting is a factor of safety of approximately 0.96.



Now considering the foundation soil shear resistance properties:

$$\tau = c + \sigma\tan\phi$$
$$\sigma = 120\text{pcf}\times 1\text{ft} = 120\text{psf}$$
$$\tau = 100 + 120\tan 22^o = 148\text{psf}$$

The area resisting uplift below the sump = 24 ft x 1 ft x 4 sides = 96 ft^2

The corresponding uplift pressure at the bottom of the sump = (24 ft x 24 ft x 2 ft)(62.4 pcf) = 71,885 lbs.

The resisting force contributed by the soil shear strength = 96 ft^2 x 148 psf = 14,208 lbs

Therefore,

$$FS = \frac{69{,}120 + 14{,}208}{71{,}885} = 1.16$$

Ohio EPA does not recommend relying on the soil cohesion or friction properties to calculate the resisting force for the uplift pressure due to the uncertainty associated with the soil fracturing.

DRAFT

Estimation of the Soil Erosion Rate – Example Calculation

An embankment was constructed to the following specifications:

Average field density = γ_d = 120 pcf

Average moisture content = MC = 12%

Find the predicted erosion rate index for an embankment that was constructed from soils that have the following properties:

Maximum dry density = MDD = 130 pcf

Optimum moisture content = OMC = 10%

% passing the No. 200 sieve = F = 65%

% passing the No. 200 sieve = Clay = 35%

Liquid limit = LL = 28%

Plastic limit = PL = 15%

Pinhole test classification = P = 3

$$I_{erosion} = 0.153\gamma_d - 0.042RD + 0.1\omega + 0.0097\Delta\omega_r - 0.0056F + 0.042Clay - 0.09LL + 0.11I_P + 0.44P - 10.2$$

Where,

$$RD = \frac{\gamma_d}{MDD} \times 100 = \frac{120}{130} \times 100 = 92.3\%$$

$$\Delta\omega_r = \frac{\omega - OMC}{OMC} \times 100 = \frac{12 - 10}{10} \times 100 = 20\%$$

$$I_P = LL - PL = 28 - 15 = 13\%$$

Substituting,

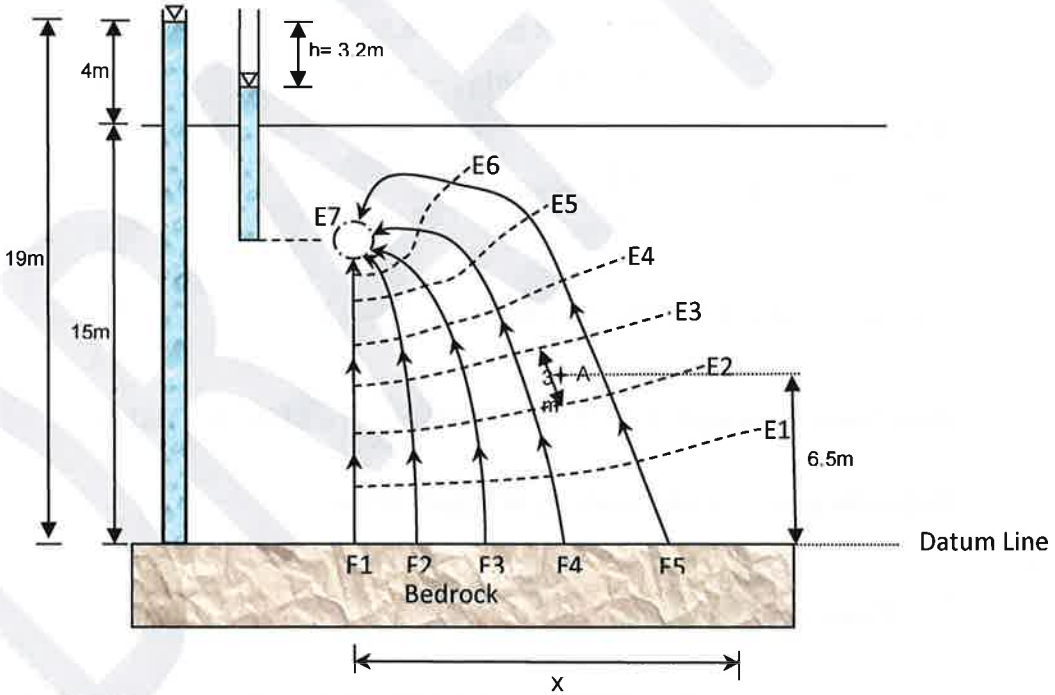
$$I_{erosion} = 0.153(120) - 0.042(92.3) + 0.1(12) + 0.0097(20) - 0.0056(65) + 0.042(35) - 0.09(28) + 0.11(13) + 0.44(3) - 10.2$$
$$I_{erosion} = 7.0$$

This is greater than 5 ➔ the soil is not prone to erosion, and therefore the normal factors of safety applied for seepage will likely be appropriate.

Use of Flow net - Example Calculation

Note: This example is included as an illustration on how to use the flow net method and not as an acceptable method to deal with seepage problems from groundwater to the bottom of waste containment cells.

Determine the spacing required in the till layer for the underdrain collection pipe if it is used to intercept groundwater flowing to the surface. Also, determine the pore water pressure, gradient and velocity at point "A". The permeability of the till layer is 1 x 10^{-5} cm/sec.



The discharge from the bedrock aquifer to the perforated collection pipe can be found using the following formula:

$$q = K h_L \frac{N_f}{N_d}$$

Where,

$h_L = 3.2\text{m}, \quad N_L = 5\,(\text{F1 through F5}), \quad N_d = 7\,(\text{E1 to E7})$

Therefore,

$$q = (1.0\times10^{-7}\,\text{m/sec})(3.2m)(5/7) = 2.29\times10^{-7}\,\text{m}^2/\text{sec} = 5.2\,\text{gal/day per 1 meter of pipe length}$$

The total discharge to each pipe will be twice the amount calculated above due to symmetry, and hence the total discharge is approximately 10.4 gal/day per meter length.

The approximate length of the aquifer that will discharge to the perforated pipe will be 2X ("X" can be scaled off the scale drawing). In this case "X" was determined to be 13m. Therefore the perforated pipe should be spaced at 26m on centers

The pore water pressure at point "A" is:

$$\begin{aligned}\text{Pressure Head at A} &= (\text{Total Head - Elevation Head})_{@A}\\ &= (19\text{m} - \text{N}_\text{d}\times\Delta h)_{@A} - 6.5\text{m}\\ &= (19\text{m} - 2.5\times\Delta h)_{@A} - 6.5\text{m}\end{aligned}$$

Where

$$\Delta h = \frac{\text{Total Head Loss}}{\text{N}_\text{d}} = \frac{3.2}{7} = 0.46$$

$\therefore$

$$\text{Pressure Head at A} = (19\text{m} - 2.5\times0.46) - 6.5\text{m} = 11.4\text{m}$$

$\therefore$

$$\text{Pore Water Pressure at A} = (11.4\text{m})(9.81\,\text{m}/\text{sec}^2) = 112\text{KPa} = 16.2\text{psi}$$

Hydraulic gradient and velocity at point "A"are:

$$i_A = \frac{\Delta h}{\text{Distance of flow travel}} = \frac{0.46}{3} = 0.153$$

$$V_A = K\times i_A = (10^{-5}\,\text{cm/sec})(0.153) = 1.5\times10^{-6}\,\text{cm/sec}$$

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ATTACHMENT C

SEEPAGE CALCULATION SPREADSHEETS

Seepage Calculation
Apex Environmental LLC
Apex Sanitary Landfill Contiguous Expansion
CEC Project 154-006.0012

Material	Density (pcf)	Thickness (ft)
Protective Cover	115	1
RSL	125	3
Waste	75	Varies
Water	62.4	Varies

Phase No.	Max. Height of Potentiometric Surface Above Top of RSL, hp (ft)	Critical Gradient	Height of Waste from Uplift calculation, h_{MSW} (ft)	Actual Gradient	Factor of Safety	Target Factor of Safety
10	21	10.4	22.0	7.0	1.49	1.10
11	12	6.0	11.0	4.0	1.51	1.10
12	11	5.4	9.5	3.7	1.48	1.10
14	11	5.4	9.5	3.7	1.48	1.10

ATTACHMENT D

LABORATORY TEST RESULT SUMMARY TABLES FOR EROSION RATE INDEX CALCULATION

Table 1 - Summary of Test Pad Soils Data
Erosion Rate Index Calculation
Apex Environmental LLC
Apex Sanitary Landfill Contiguous Expansion
CEC Project 154-006.0012

		TP3	TP4	Average
Modified Proctor	*OMC (%)*	9.6	8.0	**8.8**
	MDD (pcf)	126.0	133.4	**129.7**
Standard Proctor	*OMC (%)*	12.6	10.9	**11.7**
	MDD (pcf)	116.9	125.4	**121.2**
Atterberg Limits	*Liquid Limit*	36	35	**35**
	Plasticity Index	16	18	**17**
USDA Soils Classification	*% Gravel*	29.1	33.2	**31.2**
	% Sand	12.6	19.5	**16.1**
	% Silt	36.7	31.0	**33.9**
	% Clay	21.6	16.2	**18.9**
USCS Soils Classification	*% Pass 2"*	100.0	100.0	**100.0**
	% Pass 3/4"	94.3	94.1	**94.2**
	% Pass No. 200	61.4	50.4	**55.9**
	% Less than 0.002 mm	21.6	16.2	**18.9**

Table 2 - Summary of Recent RSL Soils Testing
Erosion Rate Index
Apex Environmental LLC
Apex Sanitary Landfill Contiguous Expansion
CEC Project 154-006.0012

		SP 25	SP 26	SP 27	SP 28	SP 29	SP 30	Average
Modified Proctor	*OMC (%)*	10.8	9.2	10.4	8.7	10.6	10.5	**10.0**
	MDD (pcf)	124.7	127.6	125.4	128.8	123.9	125.1	**125.9**
Standard Proctor	*OMC (%)*	13.5	12.8	13.2	12.1	13.5	13.3	**13.1**
	MDD (pcf)	116.7	118.5	116.3	118.5	115.5	117.4	**117.1**
Atterberg Limits	*Liquid Limit*	39	34	36	36	40	38	**37**
	Plasticity Index	19	15	18	19	20	19	**18**
USDA Soils Classification	*% Gravel*	25.8	28.1	25.7	36.8	26.8	24.9	**28.0**
	% Sand	13.2	14.3	17.1	17.2	15.1	14.9	**15.3**
	% Silt	34.4	36.8	34.8	26.8	32.9	35.9	**33.6**
	% Clay	26.6	20.8	22.4	19.2	25.2	24.3	**23.1**
USCS Soils Classification	*% Pass 2"*	100.0	100.0	100.0	100.0	100.0	100.0	**100.0**
	% Pass 3/4"	93.7	97.2	98.5	93.1	96.1	97.3	**96.0**
	% Pass No. 200	62.5	60.4	59.1	47.0	59.8	61.7	**58.4**
	% Less than 0.002 mm	26.6	20.8	22.4	19.2	25.2	24.3	**23.1**

ATTACHMENT E

PINHOLE DISPERSION TEST RESULTS

TABLE 1
POTENTIAL FOR PIPING FAILURE - SEEPAGE EVALUATION
FRANKLIN COUNTY SANITARY LANDFILL

LABORATORY RESULTS												
SAMPLE ID	*MOISTURE DENSITY RELATIONSHIP*		*ATTERBERG LIMITS*		*GRAIN SIZE DISTRIBUTION*			*PINHOLE DISPERSION*				
	ONE-POINT STANDARD PROCTOR		*LIQUID LIMIT (%)*	*PLASTICITY INDEX (%)*	*% PASSING 2" SIEVE (%)*	*% PASSING 3/4" SIEVE (%)*	*% PASSING No. 200 SIEVE (%)*	*TURBIDITY AT 2" HEAD*	*TURBIDITY AT 7" OF HEAD*	*TURBIDITY AT 15" OF HEAD*	*TURBIDITY AT 40" OF HEAD*	*CLASSIFICATION*
	MOISTURE CONTENT (%)	*DRY DENSITY (PCF)*										
SA-1 (L-1)	14.0	115.9	24	7	100	100	63.4	CLEAR	CLEAR	CLEAR	CLEAR	ND-1 (NON-DISPERSIVE)
SA-2 (L-2)	9.2	130.5	NP	NP	100	94.3	41.5	--- NOT TESTED ---				
SA-3 (L-3)	11.7	121.9	21	6	100	95.7	58.5	CLEAR	CLEAR	CLEAR	CLEAR	ND-1 (NON-DISPERSIVE)
TEST PAD 1 AND 2 RESULTS												
MINIMUM	9.4	125.1	20	6	97.8	93.5	49.0					
MAXIMUM	11.6	129.2	24	10	100.0	99.5	62.0					
AVERAGE	10.4	127.4	22	8	98.7	95.7	55.2					

Note that the moisture content and dry densities for Test Pad 1 and 2, represent the optimum moisture contents and maximum dry densities respectively.

COMPACTION TEST REPORT

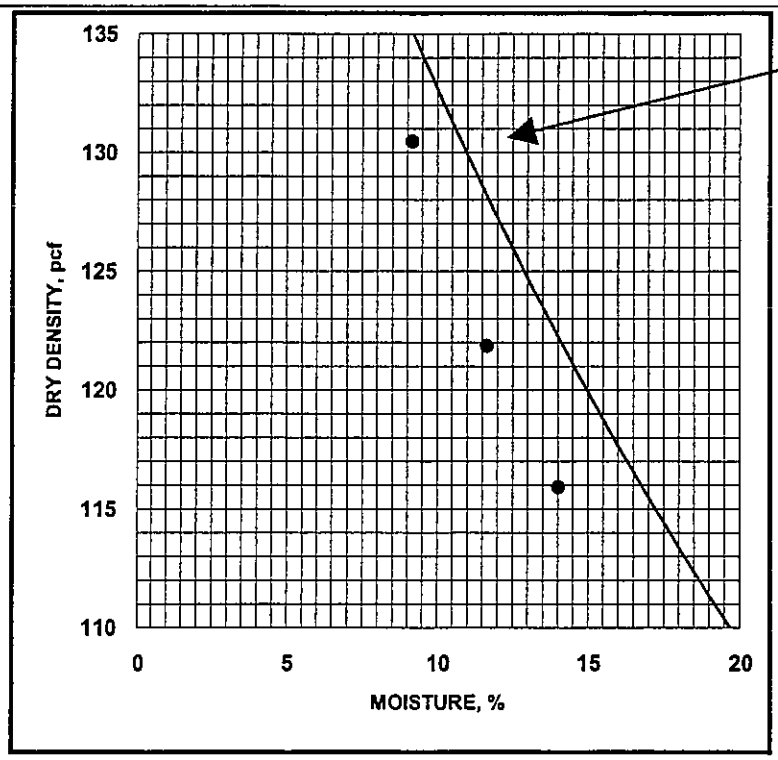
JLT

CLIENT : CEC
PROJECT : SWACO FCSL
MATERIAL : Three Bucket Samples

JOB NO 08LS1806.01
DATE 01/02/09
Tested By RL
Calc 'd By JBJr.

	ASTM	Mold	Hammer	Drop	Layers	Rock Cor.	Technique	Calibration
METHOD	D698-A	4"	5.5 lbs	12"	3/25	No	Auto Hammer	03-02-089

	S-1 at 4 to 5 ft		S-2 at 18 to 19 feet		S-3 at 10 to 11 feet			
MOLD+WETSOIL, g	6150		6305		6209			
MOLD, gr	4150		4150		4150			
WET SOIL, gr	2000		2155		2059			
WET DENSITY, pcf	132.16		142.40		136.06			
Tare ID	P45		P48		W-8			
WET + TARE, gr	2227.8		2353.9		2190.3			
DRY + TARE, gr	1976.4		2172.7		1981.9			
TARE, gr	181.2		192.8		192.8			
DRY SOIL, gr	1795.2		1979.9		1789.1			
WATER, gr	251.4		181.2		208.4			
MOISTURE	0.140		0.092		0.116			
MOISTURE, %	**14.00**		**9.15**		**11.65**			
DRY DENSITY, pcf	**115.92**		**130.46**		**121.86**			



Zero Air Voids
SG = 2.70

As-Received Moisture Content
_____ %

Maximum Dry Density
_____ pcf

Optimum Moisture Content
_____ %

96% of Max. Density
_____ pcf

90% of Max. Density
_____ pcf

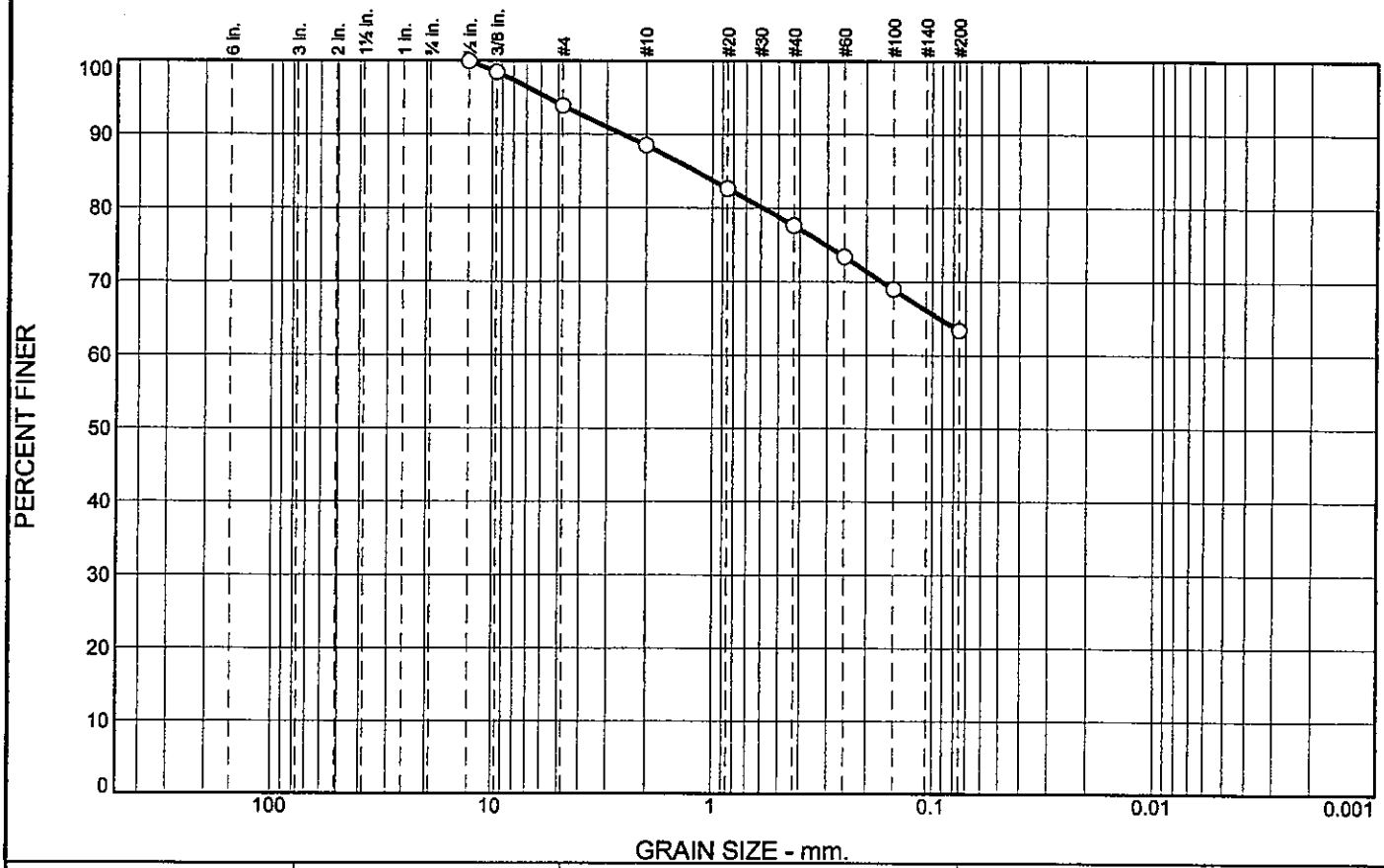
Atterberg Limits		
LL	NR	%
PL	NR	%
PI	NR	%

Classification : _____

JLT *Laboratories, Inc.*

FIGURE - 1-Point Tests

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	6.1	5.4	10.8	14.3	63.4	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
.50	100.0		
.375	98.5		
#4	93.9		
#10	88.5		
#20	82.6		
#40	77.7		
#60	73.4		
#100	69.0		
#200	63.4		

* (no specification provided)

Material Description

Bulk

Atterberg Limits

PL= 17 LL= 24 PI= 7

Coefficients

D_{90}= 2.5377 D_{85}= 1.1891 D_{60}=
D_{50}= D_{30}= D_{15}=
D_{10}= C_u= C_c=

Classification

USCS= AASHTO=

Remarks

As-Rec'd M/C = 14.0%

Location: SWACO FCSL
Sample Number: SA1 **Depth:** 4-5 **Date:** 03/19/2009

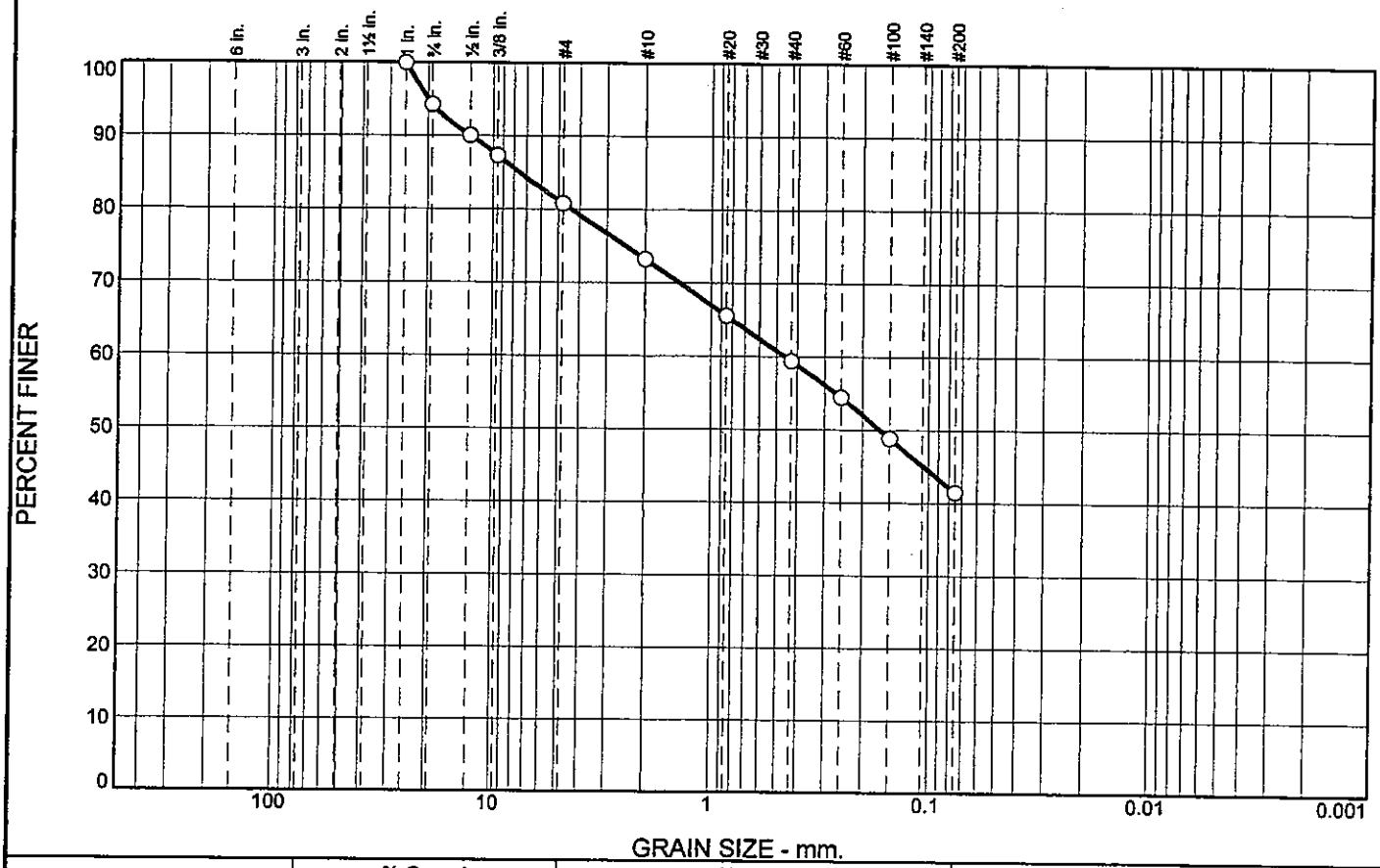
JLT Laboratories, Inc.

Canonsburg, PA

Client: CEC, Inc.
Project: Franklin County Landfill
SWACO FCSL
Project No: 09LS1865.01 **Figure**

Tested By: RL **Checked By:** JB

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	5.7	13.5	7.6	13.8	17.9	41.5	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
1.0	100.0		
.75	94.3		
.50	90.0		
.375	87.3		
#4	80.8		
#10	73.2		
#20	65.6		
#40	59.4		
#60	54.4		
#100	48.9		
#200	41.5		

* (no specification provided)

Material Description

Bulk

Atterberg Limits

PL= NP LL= NP PI= NP

Coefficients

D_{90}= 12.6426 D_{85}= 7.5229 D_{60}= 0.4552
D_{50}= 0.1660 D_{30}= D_{15}=
D_{10}= C_u= C_c=

Classification

USCS= AASHTO=

Remarks

As-Rec'd M/C = 9.2%

Location: SWACO FCSL
Sample Number: L2 **Depth:** 18-19 **Date:** 03/19/2009

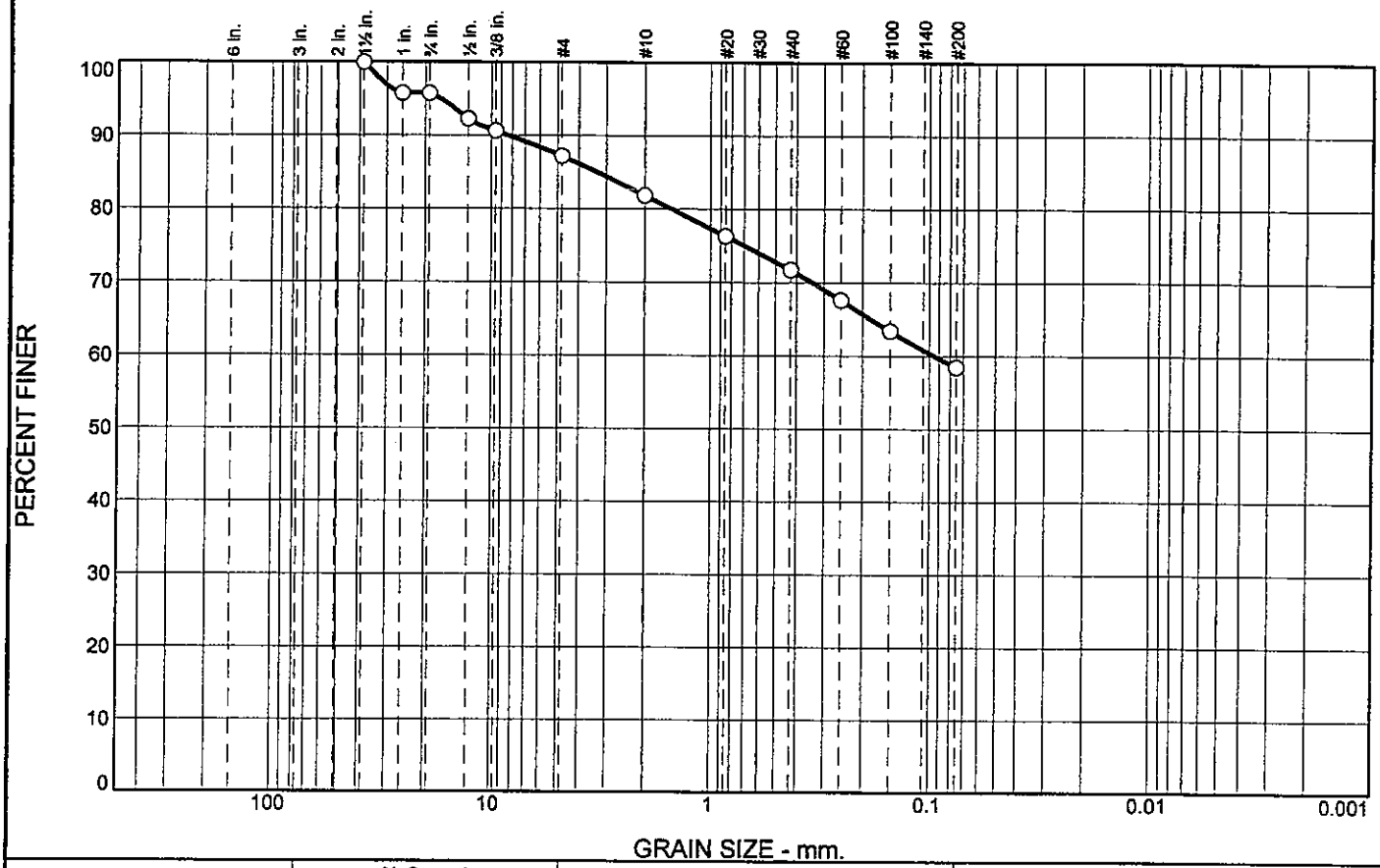
JLT Laboratories, Inc.

Canonsburg, PA

Client: CEC, Inc.
Project: Franklin County Landfill
SWACO FCSL
Project No: 09LS1865.01 **Figure**

Tested By: RL **Checked By:** JB

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	4.3	8.5	5.4	10.1	13.2	58.5	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
1.5	100.0		
1.0	95.7		
.75	95.7		
.50	92.2		
.375	90.6		
#4	87.2		
#10	81.8		
#20	76.3		
#40	71.7		
#60	67.6		
#100	63.4		
#200	58.5		

* (no specification provided)

Material Description

Bulk

Atterberg Limits

PL= 15 LL= 21 PI= 6

Coefficients

D_{90}= 8.3081 D_{85}= 3.2960 D_{60}= 0.0936
D_{50}= D_{30}= D_{15}=
D_{10}= C_u= C_c=

Classification

USCS= AASHTO=

Remarks

As-Rec'd M/C = 11.3%

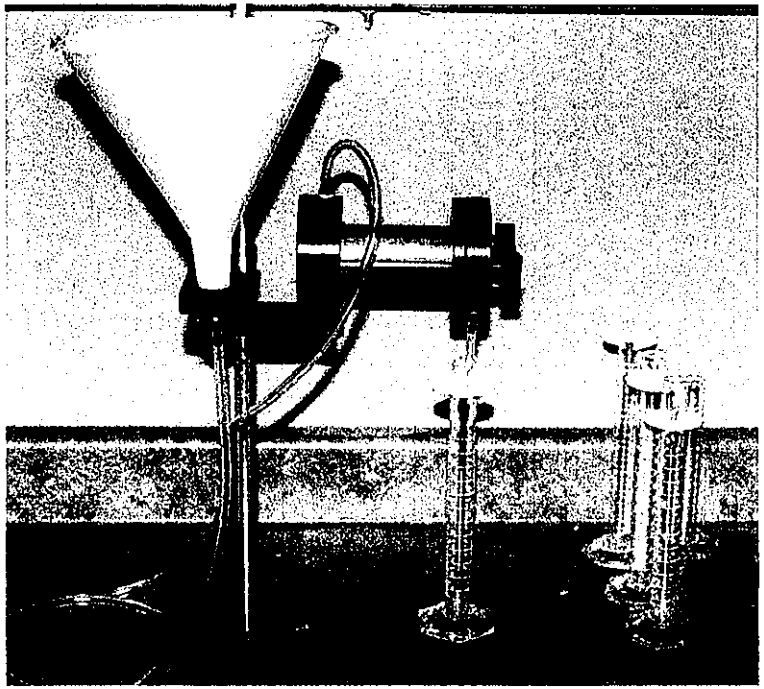
Location: SWACO FCSL
Sample Number: L3 **Depth:** 10-11 **Date:** 03/19/2009

JLT Laboratories, Inc.

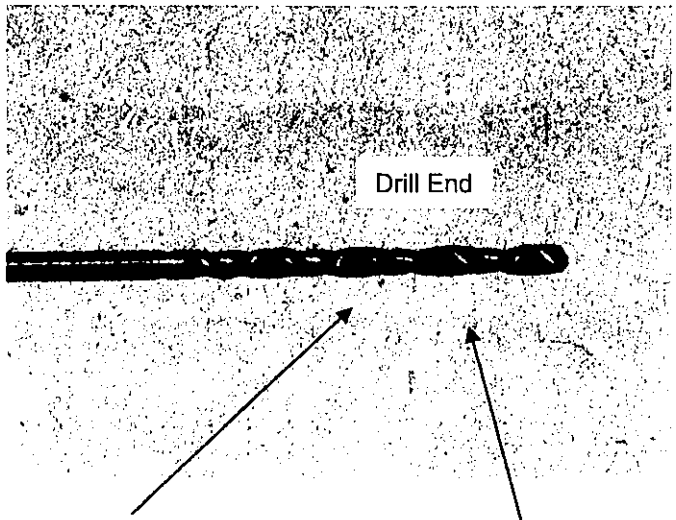
Canonsburg, PA

Client: CEC, Inc.
Project: Franklin County Landfill
SWACO FCSL
Project No: 09LS1865.01 **Figure**

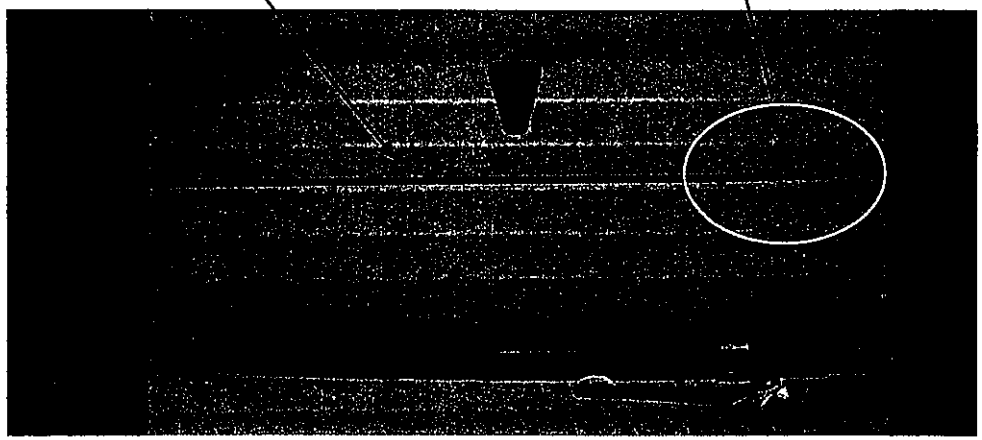
Tested By: RL **Checked By:** JB



Pinhole Test Unit



1 mm Rod



JLT *Laboratories, Inc.*

PINHOLE DISPERSION TEST

ASTM D-4647

JLT

Client : CEC
Project : Franklin County Landfill SWACO FCSL
Material : Sample SA-1 (L-1)
Material Description : Light Brown Sandy Clayey SILT Classification : CL-ML

Date : March 25, 2009
Job No. : 09LS1865.01
Perf'd By : MLB
Chk'd By : JBJr

Material Processing: Air dried and processed over No 10 sieve
Minus No 10 material used for the test

Liquid Limit : 24
Plastic Limit : 17

Compaction Criteria Requirements

Dry Density :	116.0	pcf
Moisture :	15.0	%
Moist Density :	133.4	pcf

Curing of Sample

Once fabricated, the sample cured in the test unit with the 1mm rod overnight prior to testing

Actual Sample per the Standard

Length :	1.50	in
Diameter :	1.365	in
Volume :	0.0012703	cu ft
Moist Weight :	77.0	gr
Moist Density :	133.5	pcf
Moisture Content :	15.0	%
Dry Density :	116.1	pcf

Test Results Using Test Method A

Head	Elps'd Time	Flow Q	Flow Rate	Turbidity						Remarks
in	min	cc	cc/min	Very Dark	Dark	Mod Dark	Silty Dark	Barely Vis	Clear	
2	0.75	25	33.3						X	
	0.90	25	27.8						X	
	1.03	25	24.3						X	
	1.07	25	23.4						X	
	1.08	25	23.1						X	
	4.11	100	24.3						X	
	4.25	100	23.5						X	
7	2.30	100	43.5						X	
	2.27	100	44.1						X	
	2.30	100	43.5						X	
	2.28	100	43.9						X	
15	1.18	100	84.7						X	
	1.19	100	84.0						X	
	1.17	100	85.5						X	
	1.18	100	84.7						X	
40	0.70	100	142.9						X	
	0.70	100	142.9						X	
	0.70	100	142.9						X	
	0.70	100	142.9						X	
	0.70	100	142.9						X	

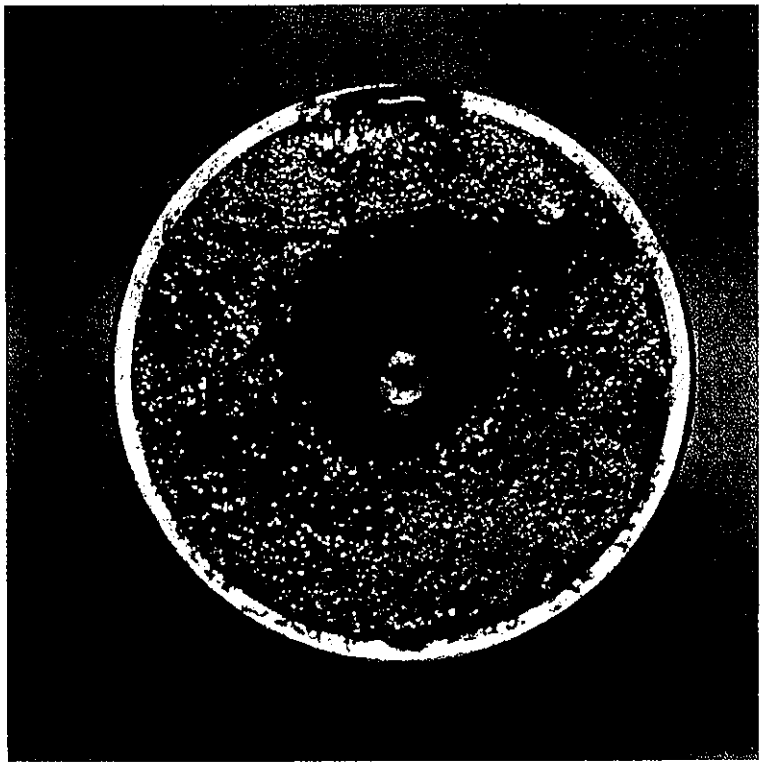
Total Flow : 1625 cc

Comments

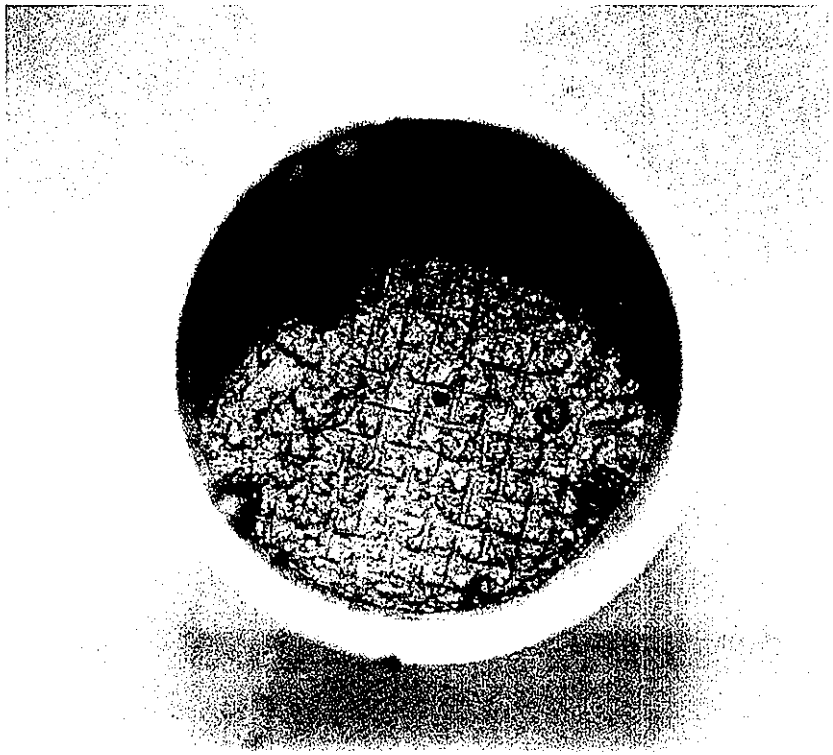
1. Dealred water used for the test
2. See attached photos of the sample and effluent water
3. See the attached property data sheet

CLASSIFICATION : Non-Dispersive
ND1

JLT *Laboratories, Inc.*



Inflow Side



Outflow Side

JLT *Laboratories, Inc.*

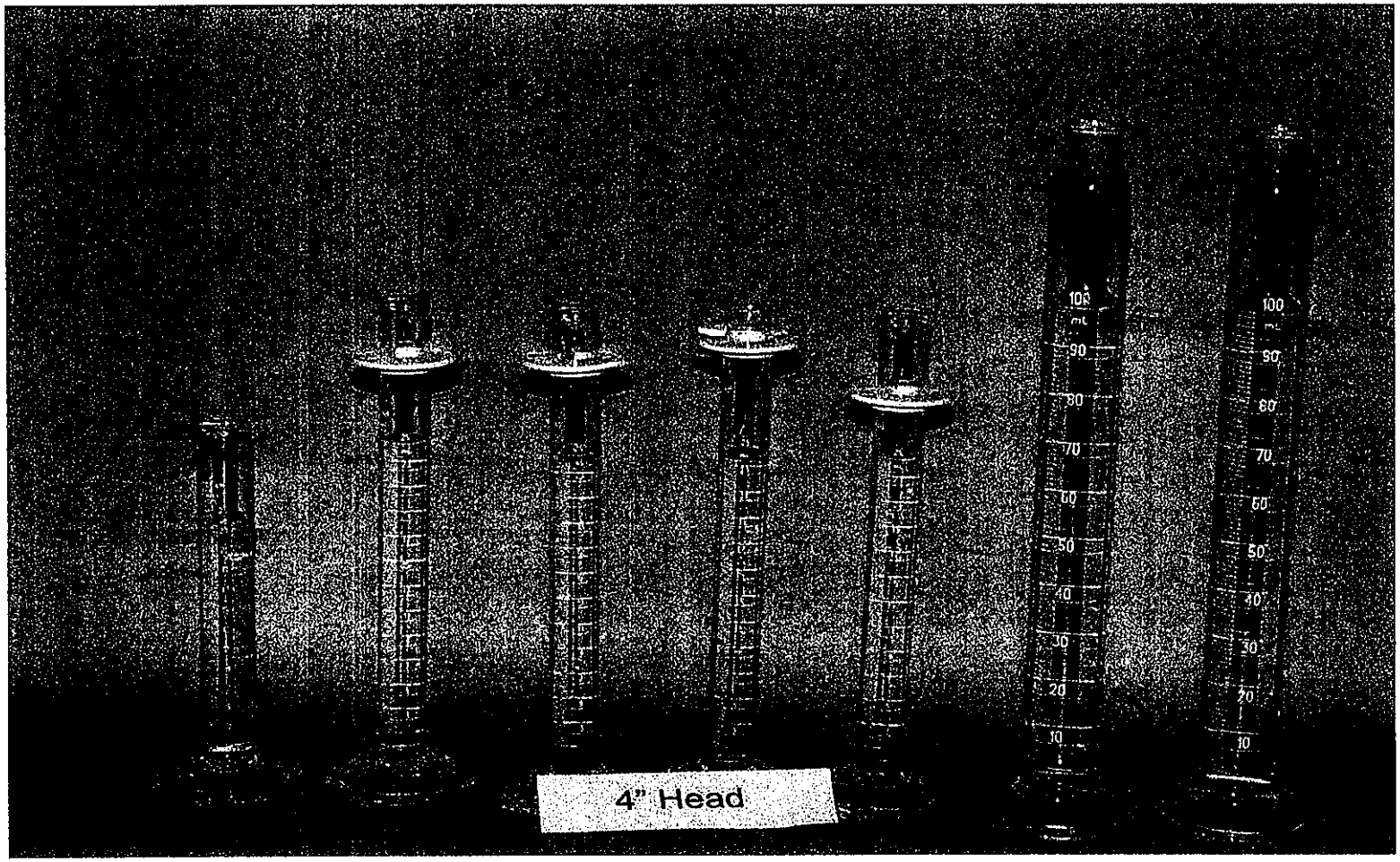
Sample SA-1 (L-1)

No Change in Hole Diameter After the Test

Cross Section After Test

JLT *Laboratories, Inc.*

Sample SA-1 (L-1)



Water Clear throughout the test

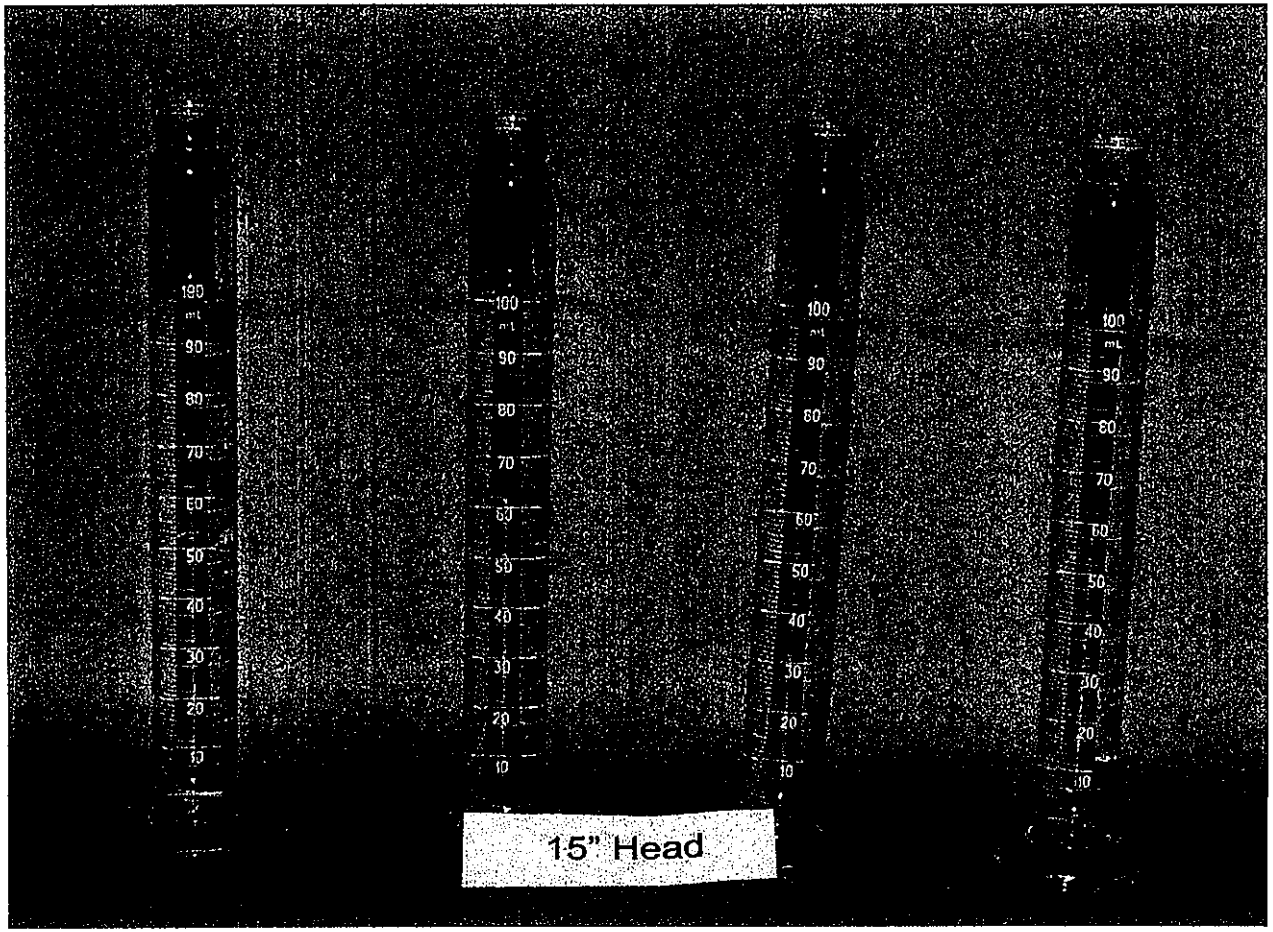
JLT *Laboratories, Inc.*

Sample SA-1 (L-1)

Water Clear throughout the test

Sample SA-1 (L-1)

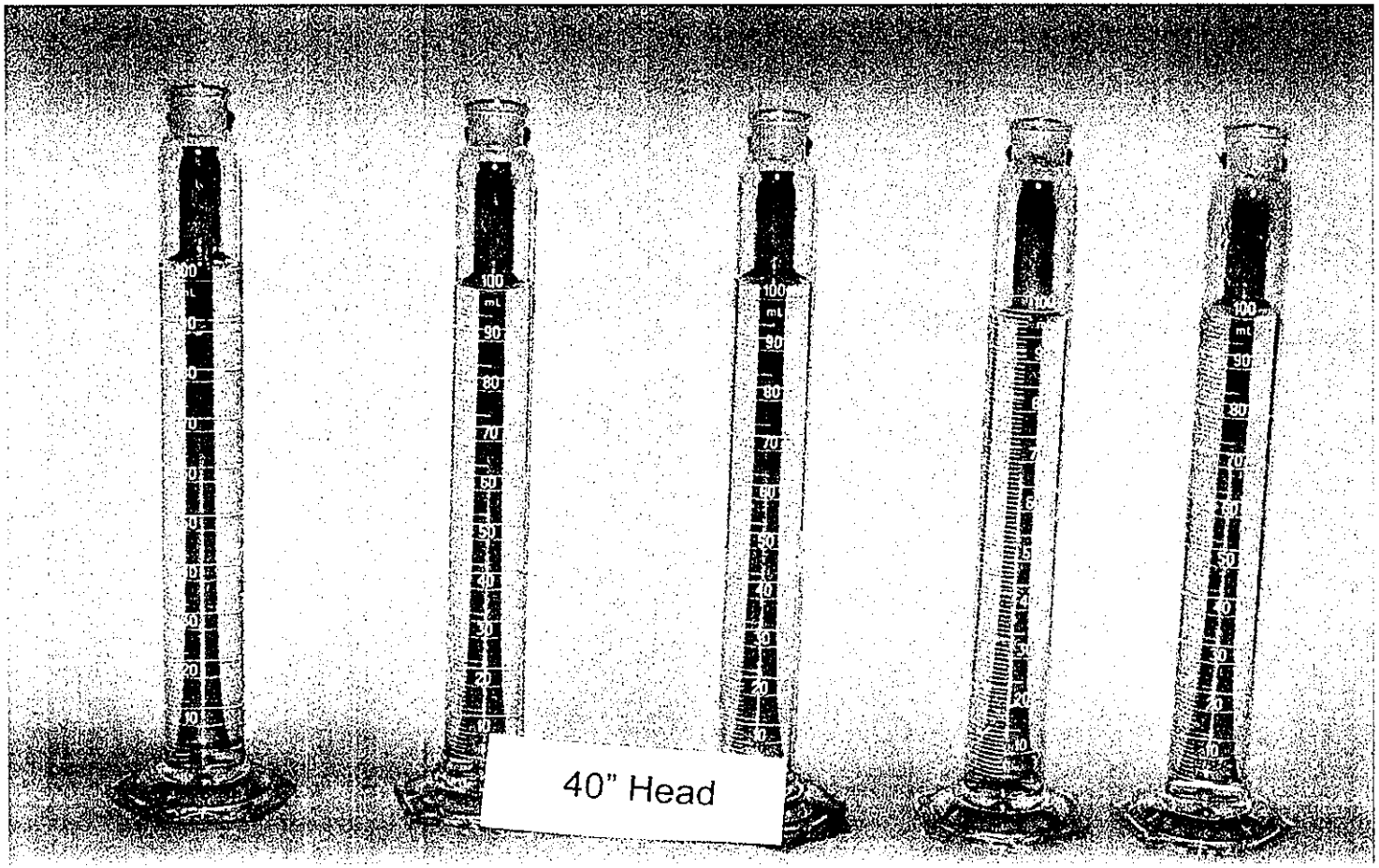
JLT *Laboratories, Inc.*



Water Clear throughout the test

JLT *Laboratories, Inc.*

Sample SA-1 (L-1)



Water Clear throughout the test

JLT *Laboratories, Inc.*

Sample SA-1 (L-1)

PINHOLE DISPERSION TEST

ASTM D-4647

JLT

Client : CEC
Project : Franklin County Landfill SWACO FCSL
Material : Sample SA-3 (L-3)
Material Description : Light Brown Sandy Clayey SILT Classification : CL-ML

Date : March 27, 2009
Job No. : 09LS1865.01
Perf'd By : MLB
Chk'd By : JBJr

Material Processing: Air dried and processed over No 10 sieve
Minus No 10 material used for the test

Liquid Limit : 21
Plastic Limit : 15

Compaction Criteria Requirements

Dry Density :	118.0	pcf
Moisture :	14.0	%
Moist Density :	134.52	pcf

Curing of Sample

Once fabricated, the sample cured in the test unit with the 1mm rod overnight prior to testing

Actual Sample per the Standard

Length :	1.50	in
Diameter :	1.365	in
Volume :	0.0012703	cu ft
Moist Weight :	77.6	gr
Moist Density :	134.6	pcf
Moisture Content :	14.0	%
Dry Density :	118.0	pcf

Test Results Using Test Method A

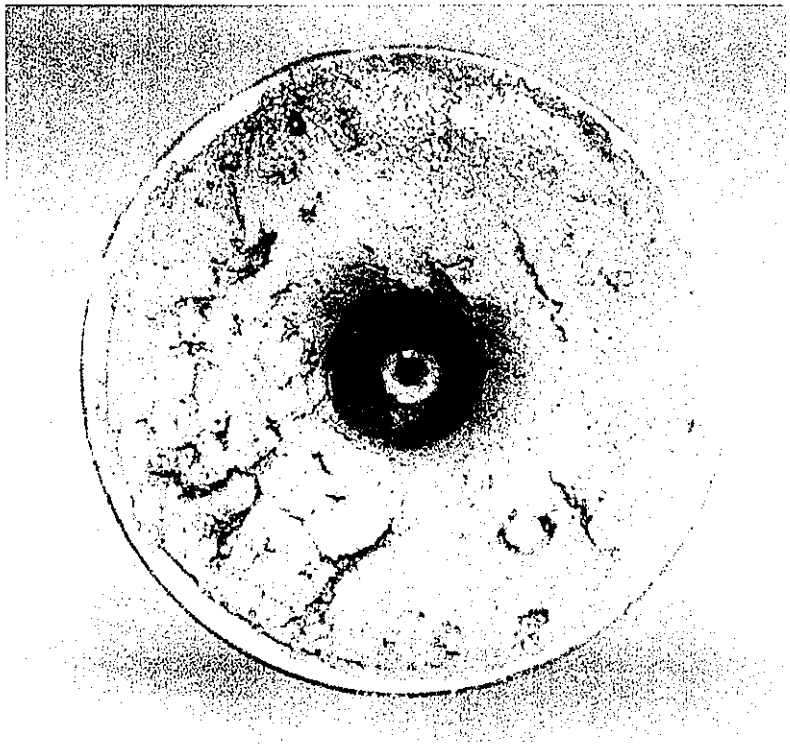
Head	Elps'd Time	Flow Q	Flow Rate	Turbidity						Remarks
In	min	cc	cc/min	Very Dark	Dark	Mod Dark	Silty Dark	Barely Vis	Clear	
2	1.35	25	18.5						X	
	0.92	25	27.2						X	
	1.05	25	23.8						X	
	1.02	25	24.5						X	
	1.03	25	24.3						X	
	3.90	100	25.6						X	
	3.92	100	25.5						X	
7	2.17	100	46.1						X	
	2.13	100	46.9						X	
	2.14	100	46.7						X	
	2.23	100	44.8						X	
	2.27	100	44.1						X	
15	1.52	100	65.8						X	
	1.48	100	67.6						X	
	1.46	100	68.5						X	
	1.46	100	68.5						X	
	1.46	100	68.5						X	
40	0.83	100	120.5						X	
	Flow	25	N/A						X	
	0.85	100	117.6						X	
	Flow	25	N/A						X	
	0.82	100	122.0						X	
	Flow	20	N/A						X	
	0.83	100	120.5						X	
	0.82	100	122.0						X	

Total Flow : 1895 cc

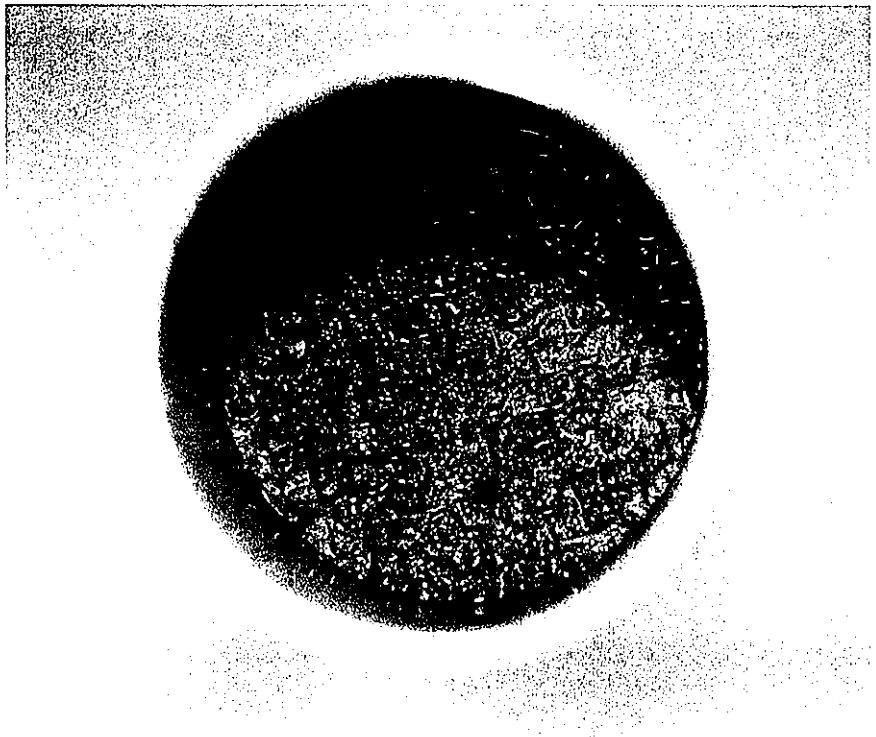
Comments

1. Dealred water used for the test
2. See attached photos of the sample and effluent water
3. See the attached property data sheet

CLASSIFICATION : Non-Dispersive
ND1



Inflow Side

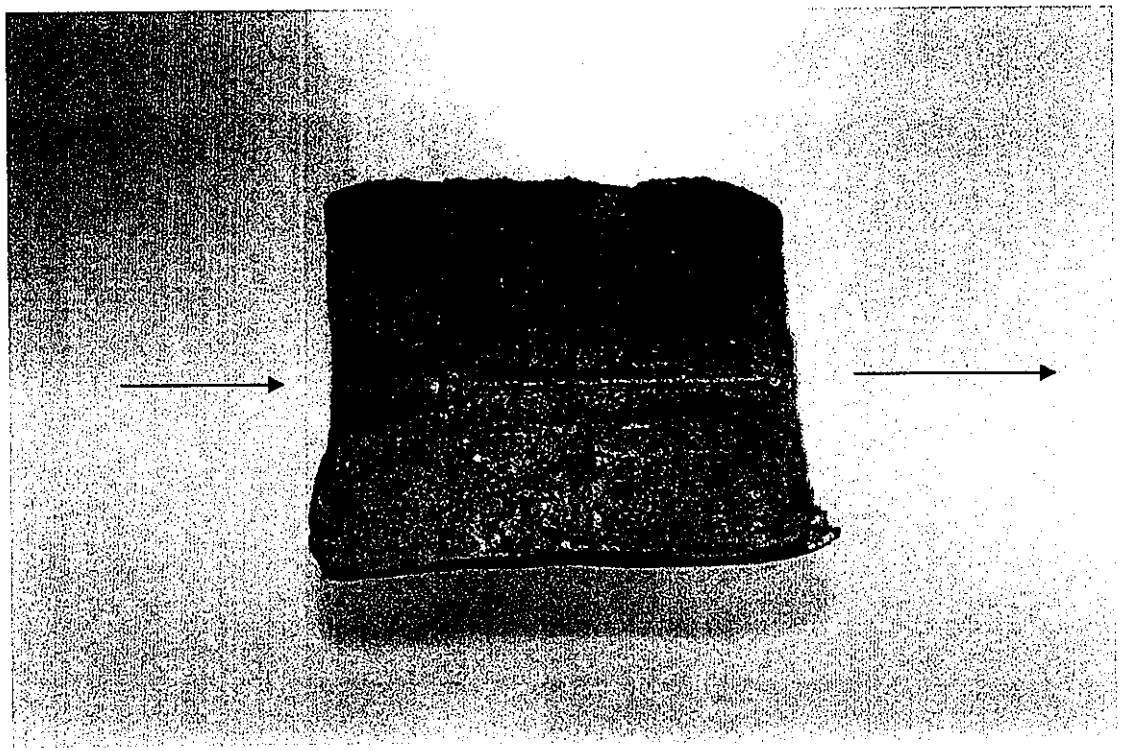


Outflow Side

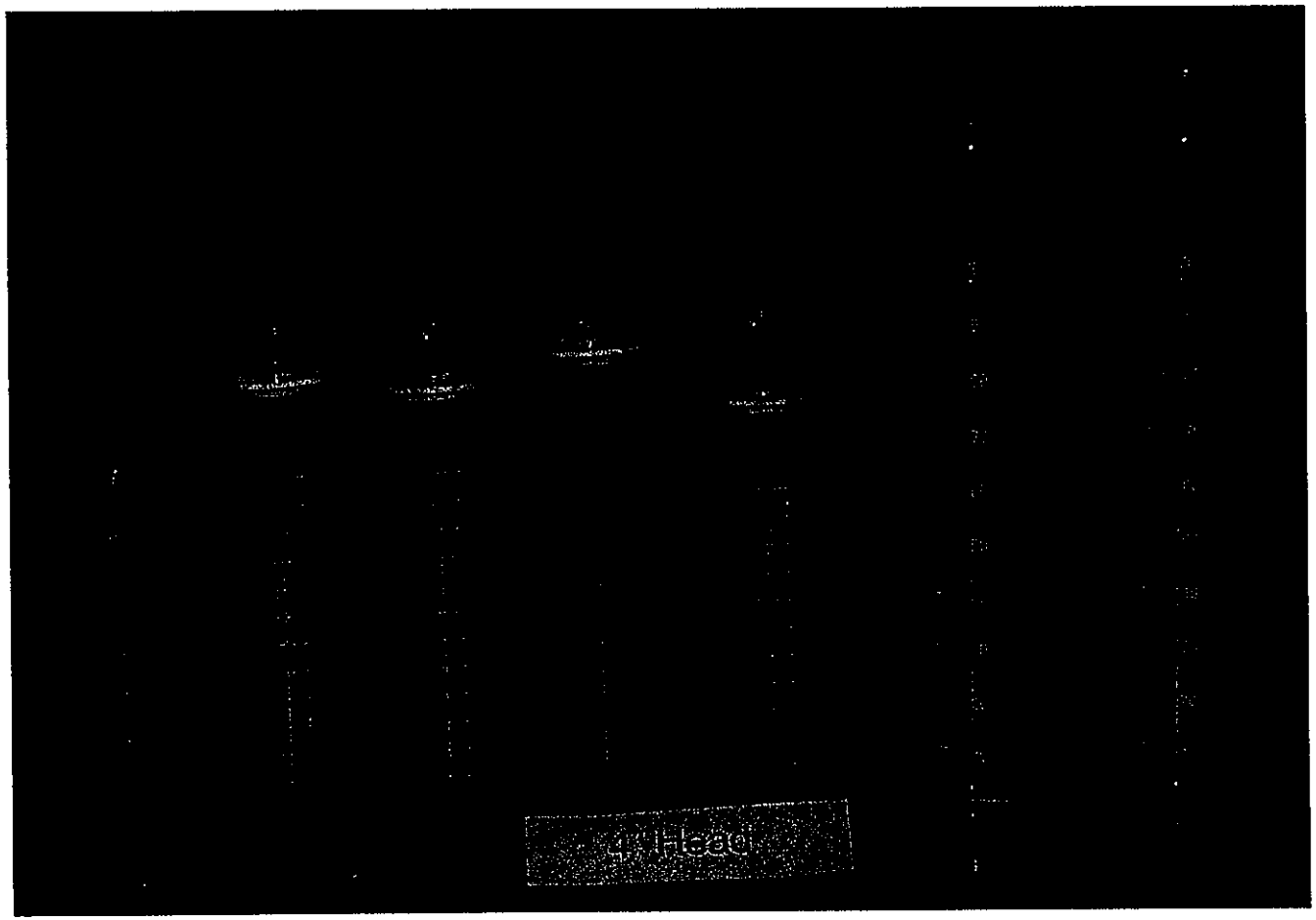
JLT *Laboratories, Inc.*

Sample SA-3 (L-3)

No Change in Hole Diameter After the Test



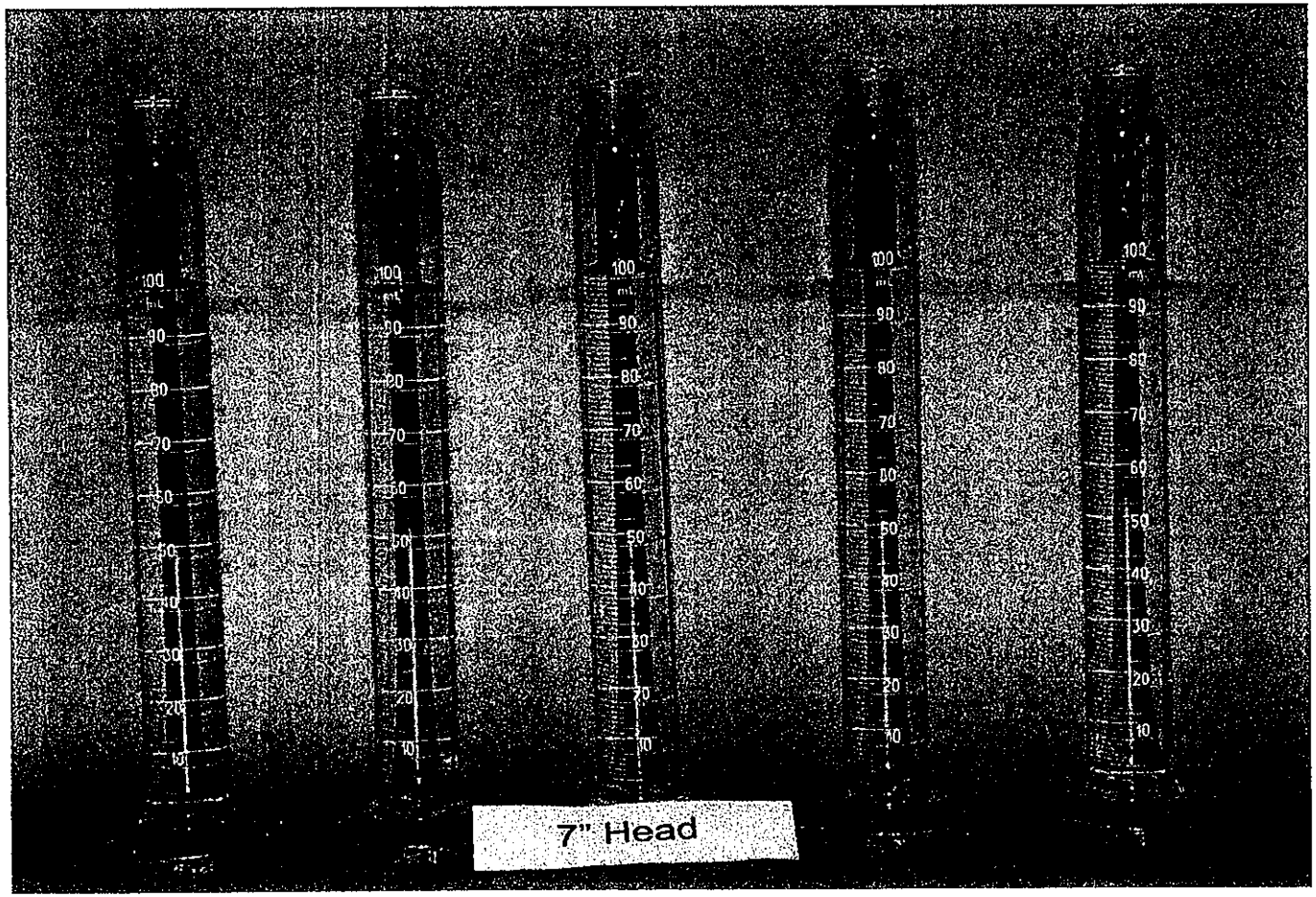
Cross Section After Test



Water Clear throughout the test

JLT *Laboratories, Inc.*

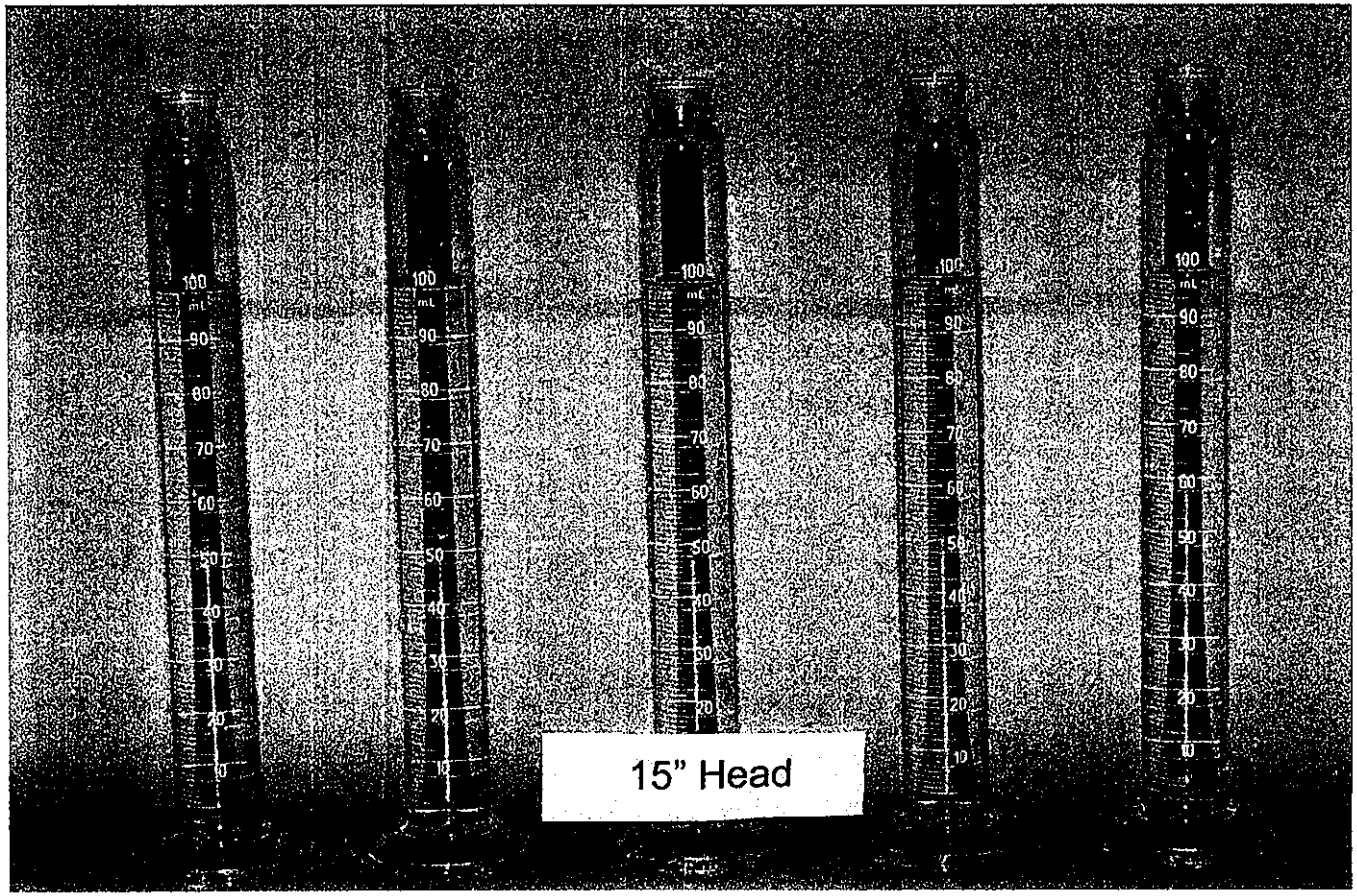
Sample SA-3 (L-3)



Water Clear throughout the test

JLT *Laboratories, Inc.*

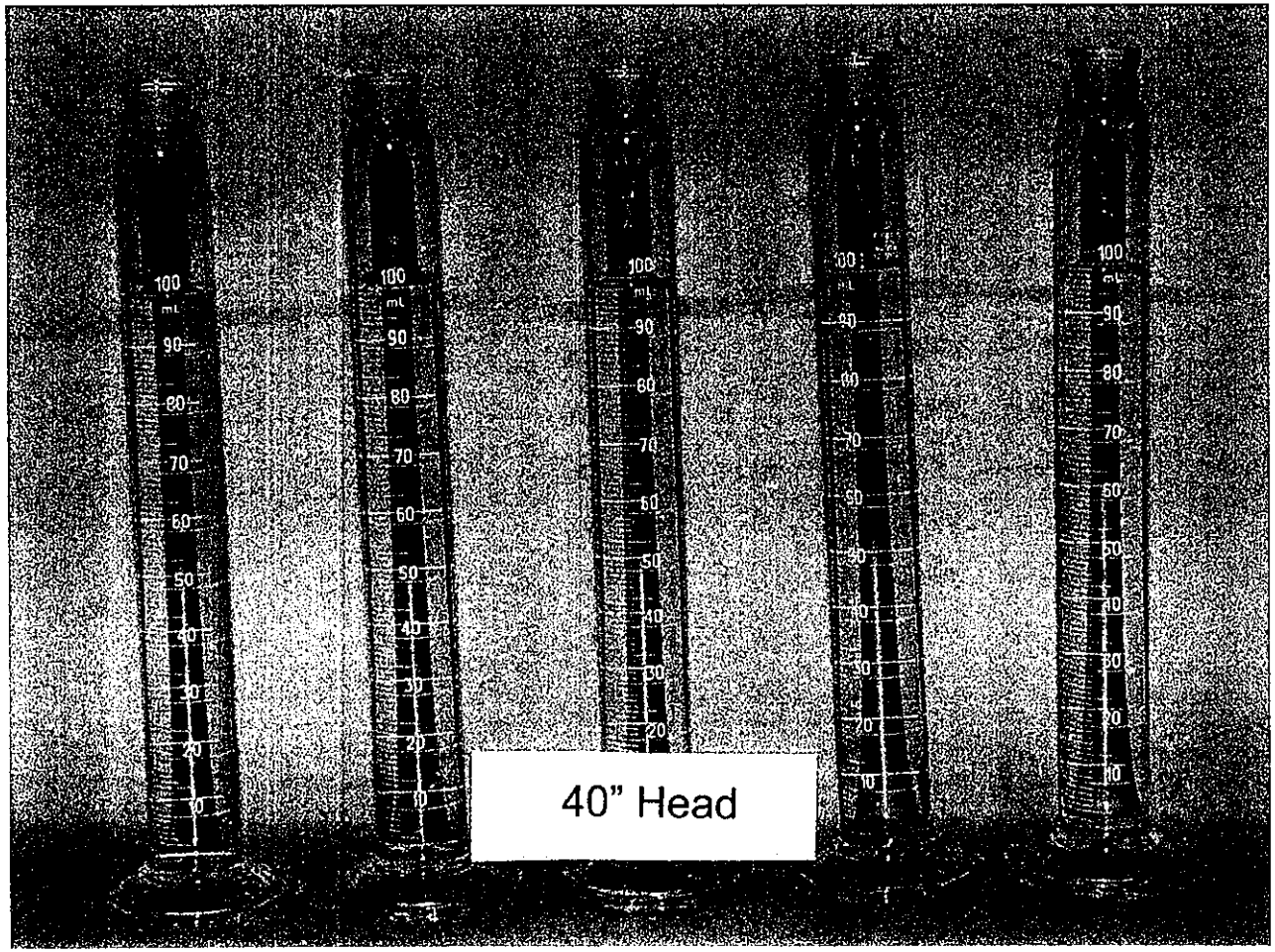
Sample SA-3 (L-3)



Water Clear throughout the test

JLT *Laboratories, Inc.*

Sample SA-3 (L-3)



Water Clear throughout the test

JLT *Laboratories, Inc.*

Sample SA-3 (L-3)

BEARING CAPACITY ANALYSIS

(b) The bearing capacity analysis for any vertical sump risers on the composite liner system shall include the following:

- **(i) The scope, extent, and findings of the subsurface investigation conducted in accordance with paragraph (C)(3) of this rule, as it pertains to bearing capacity.**
- **(ii) A narrative description of the rationale used for the selection of the analysis input parameters.**
- **(iii) A description of the method used to calculate bearing capacity.**
- **(iv) A description of the assessed failure modes and conditions.**
- **(v) A profile view of the critical cross section that fully depicts the analysis input model including the following:**
  - ***(a)*** **The material boundaries.**
  - ***(b)*** **The temporal high piezometric surface.**
  - ***(c)*** **The material types.**
  - ***(d)*** **The in situ unit weights and saturated unit weights.**
- **(vi) The plan view of the critical cross section including northings and eastings for the endpoints of the section.**
- **(vii) The actual calculations and/or computer output.**

(C)(4)(b) No vertical sump risers are designed for the proposed contiguous expansion.

STABILITY ANALYSIS

(c) The static stability analysis shall include the following:

(i) The scope, extent, and findings of the subsurface investigation conducted in accordance with paragraph (C)(3) of this rule, and earthen materials testing program as it pertains to static stability.

(ii) A narrative description of the rationale used for the selection of the analysis input parameters.

(iii) A description of the method used to calculate static stability.

(iv) An assessment of failure modes and conditions that at a minimum should include the following:

(*a*) Deep-seated translational and rotational failure mechanisms of internal slopes, interim slopes and final slopes for drained conditions and, as applicable, undrained conditions.

(*b*) Shallow translational and rotational failure mechanisms of internal slopes and final slopes for saturated conditions and drained conditions.

(v) For each of the failure modes and conditions assessed, provide a narrative description of the rationale used for the selection of the critical cross sections for the internal slopes, interim slopes, and final slopes.

(vi) A profile view of the critical cross sections that fully depicts the analysis input model including the following:

(*a*) The material boundaries.

(*b*) The temporal high phreatic and piezometric surfaces.

(*c*) The material types.

(*d*) The in situ unit weights and, where applicable, the in situ saturated unit weights.

(*e*) The material shear strengths.

(vii) The plan view of the critical cross sections that includes the northings and eastings for the endpoints of the sections.

(viii) A summary of the results using two dimensional limit equilibrium methods or other methods acceptable to the director for each of the critical cross sections.

(ix) The actual calculations and/or computer output.

(d) The seismic stability analysis shall include the following:

(i) The scope, extent, and findings of the subsurface investigation conducted in accordance with paragraph (C)(3) of this rule, and earthen materials testing program as it pertains to seismic stability.

(ii) A narrative description of the rationale used for the selection of the analysis input parameters.

(iii) A description of the method used to calculate the seismic stability.

(iv) An assessment of failure modes and conditions that, at a minimum, should include the following:

(*a*) Deep-seated translational and rotational failure mechanisms of final slopes for drained conditions.

(*b*) Deep-seated translational and rotational failure mechanisms of internal slopes and interim slopes for drained conditions, if required by the Director.

(*c*) Shallow translational and rotational failure mechanisms of final slopes for drained conditions.

(*d*) Liquefaction failure mechanisms of internal slopes, interim slopes, and final slopes.

(v) For each of the failure modes and conditions, provide a narrative description of the rationale used for the selection of the critical cross sections for the internal slopes, interim slopes, and final slopes.

(vi) The profile views of the critical cross sections that fully depict the analysis input model including the following:

(*a*) The material boundaries.

(*b*) The temporal high phreatic and piezometric surfaces.

(*c*) The material types.

(*d*) The in situ unit weights and, where applicable, the in situ saturated unit weights.

(*e*) The material shear strengths.

(vii) The plan views of the critical cross sections that include the northings and eastings for the endpoints of the sections.

(viii) A summary of the results using two or three dimensional limit equilibrium methods or other methods acceptable to the Director for each of the critical cross sections.

(ix) The actual calculations and/or computer output.

OBJECTIVE

This analysis was performed in accordance with OAC 3745-27-06(C)(4)(c)&(d) to verify that the proposed grades in the landfill expansion yield a slope stability factor of safety (FS) of at least 1.50 for static conditions and 1.00 for seismic conditions in accordance with OAC 3745-27-08(C)(7)(c)&(d).

SUBSURFACE INVESTIGATION

The area of the existing on-site mine spoil material to remain in place (only within the footprint of the perimeter berm) is approximately 121 acres. In accordance with 3745-27-06(C)(3)(f)(v) at least one subsurface investigatory site (test boring or test pit) per every four acres was performed considering the 2010 investigation and previous investigations at the site. A boring/test pit location plan is presented as Drawing 3D in the HSIR. Refer to the Geotechnical Summary for more information regarding the subsurface investigation.

METHODOLOGY

Slope stability software Slide Version 6.0 was used to calculate the minimum slope stability factors of safety. The program uses 2D limit equilibrium methods to determine the minimum factor of safety. Spencer's Method was used to calculate all factors of safety.

To evaluate the stability of the proposed expansion, critical cross sections were analyzed considering final and interim waste grades. The final grades of landfill were evaluated with one cross section (Cross Section A-A) and three cross sections were evaluated based on interim waste grades (Cross Sections B-B, C-C, and D-D) from Phases ~~9~~ *7A*, ~~11~~ *8*, and ~~13~~ *12*. The locations of these cross sections are shown on Figures 1 through ~~4~~ *3* in Attachment A.

The following deep-seated analyses were performed on all cross sections yielding 8 factors of safety per cross section.

1. Static – drained – rotational and translational failure surfaces
2. Static– undrained – rotational and translational failure surfaces
3. Seismic– drained – rotational and translational failure surfaces
4. Seismic– undrained – rotational and translational failure surfaces

The following Attachments are included with this analysis.

1. Attachment A – Figures
2. Attachment B – Cross Section A-A Slide Slope Stability Software Analysis Output Data
3. Attachment C – Cross Section B-B Slide Slope Stability Software Analysis Output Data
4. Attachment D – Cross Section C-C Slide Slope Stability Software Analysis Output Data
5. Attachment E – Cross Section D-D Slide Slope Stability Software Analysis Output Data

CROSS SECTIONS

The final and interim waste grades were reviewed for selection of the critical cross sections to be analyzed for slope stability. After review of the sections it was apparent that the interim sections are more critical and will control the stability analysis. This is due to the internal 3H:1V floor slopes, thick interim waste slopes, and interim waste grades steeper than the final waste grades. Therefore, one critical section was chosen to evaluate the final waste grades and three cross sections were chosen to analyze the interim waste grades.

Cross Section A-A

The final waste slopes were evaluated with Cross Section A-A, which is oriented north-south along the southern portion of the perimeter berm. A-A is located through the tallest proposed outer berm slope and nearly the highest waste peak. Based on the shear strength laboratory testing summary in the Geotechnical Summary, the mine spoil and remolded samples are comparable in shear strength. The shear strength values that were used for the structural fill are likely the same values that would be used *for* mine spoil. Therefore, the two main controlling factors in selecting the most critical cross section for final waste slopes ~~was~~ *were* the height of waste and height of outer berm slope and not the berm material.

Cross Sections B-B ~~and D-D~~ *C-C*

These sections were analyzed due to the presence of the internal floor slope in Phase 8. Some resistance is lost beyond the toe of the waste slope due to the internal slope along Cross Section B-B. Cross Section C-C was analyzed using the post-peak (residual) interface shear strengths on the 3H:1V slope.

~~These sections represent the Phase 9 and Phase 11 interim waste slopes. They are critical because of the relatively short distance between the toe of the 3H:1V internal slope (which require the use of post-peak shear strengths to be modeled within the baseliner system) and the toe of the interim waste slope. The waste mass located between the toe of the internal slope and the toe of the interim slope acts as a buttress. If the distance between the toe of the internal slope and the toe of the interim slope is too short, this buttress is reduced and the slope stability factor of safety decreases.~~

Cross Section ~~C-C~~*D-D*

This section was analyzed because it passes through the tallest interim waste slope and represents Phase 12 interim waste grades. ~~This is the section that passes through the highest waste peak and represents Phase 13 interim waste grades. The floor slope at the toe of this section is sloping away from the interim slope providing no buttressing affect, though there is a short internal 3H:1V slope at the toe of the interim slope.~~

MATERIAL PROPERTIES

Conservative material properties were used in this analysis, which were based on published data and site specific laboratory test results. The material properties were used to develop shear strength parameters for the Construction Quality Assurance (CQA) Plan. All proposed interfaces will be required to meet the minimum calculated contact interface shear strength, which will be included with other minimum shear strength parameters specified within the CQA Plan.

The following table summarizes the soil, bedrock, and waste properties used in the stability analysis. The RSL was the only material that was modeled in an undrained condition.

Material Type	Unit Weight (pcf)	Drained Condition		Undrained Condition	
		Angle of Friction (degrees)	Cohesion (psf)	Angle of Friction (degrees)	Cohesion (psf)
MSW	~~90~~ *75*	33	400	--	--
Protective Cover	115	30	0	--	--
RSL	125	27	0	213	14
Structural Fill	125	27	0	--	--
Bedrock	130	~~35~~ *32*	10,000	--	--

Municipal Solid Waste (MSW)

The shear strength properties of MSW were obtained from published information The properties are conservative when compared to the maximum recommendation in Chapter 8 of the Geotechnical and Stability Analyses for Ohio Waste Containment Facilities manual published by the Ohio EPA Geotechnical Resource Group, dated June 20, 2002 (GeoRG Manual).

Placed Earthen Materials

Structural fill, final cover soils, RSL, and protective cover are earthen materials that will be placed to construct the landfill. Recompacted on-site clayey till will be used for the RSL and final cover soils; aggregate or tire shreds are proposed for use as protective cover (this analysis assumes aggregate). Since shallow stability of the final cover system is not being analyzed here, the entire final cover system was modeled as one soil unit, which was 4 feet thick. Structural fill is required in some areas to construct the exterior berm and will likely consit of excavated on-site soils. The shear strength values used in the analysis are conservative compared to the NAVFAC Design Manual 7.2, 1986, which lists the following properties for compacted materials.

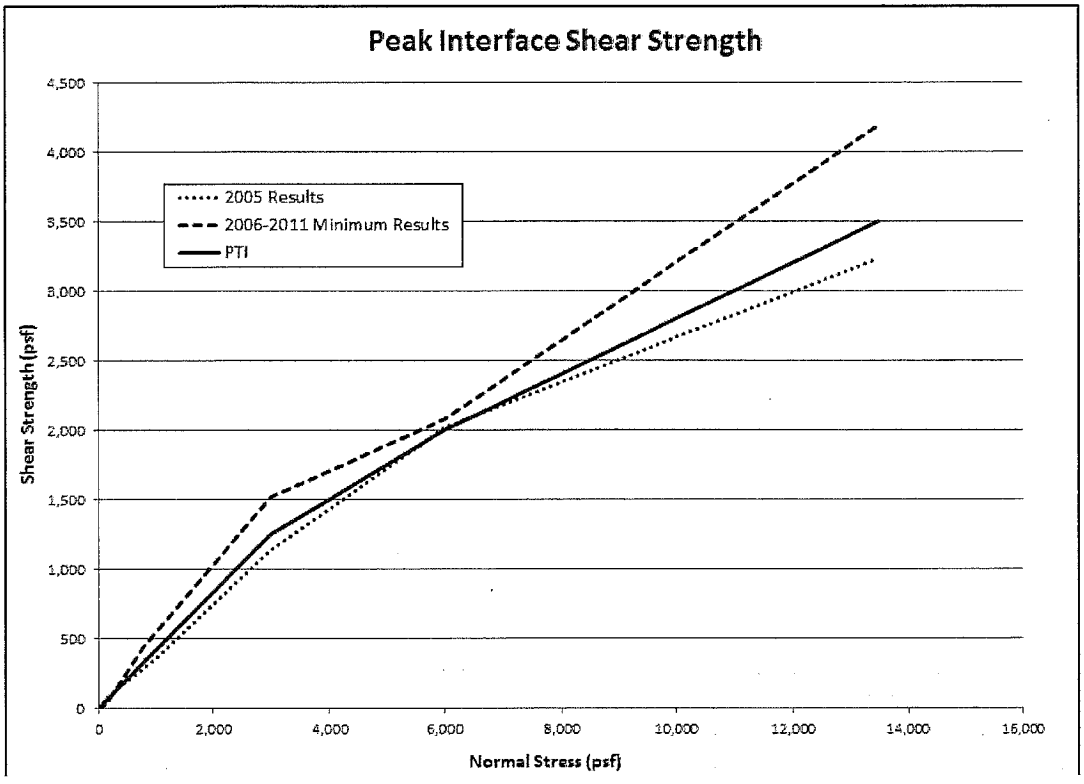
USCS Group	Soil Type	As Compacted Cohesion (psf)	Friction Angle (degees)
CL	Lean Clay	1,800	28
SM	Silty Sand	0	34
SP	Poorly Graded Sand	0	37
SW	Well Graded Sand	0	38

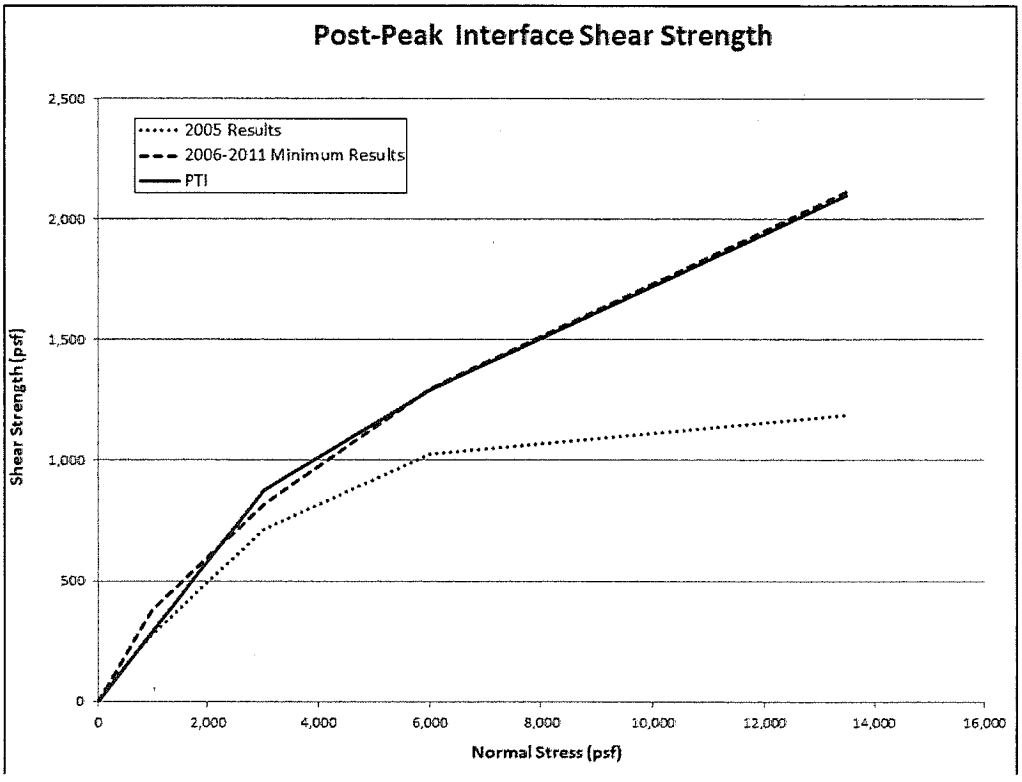
WATER SURFACES

A phreatic surface was input within the stability analyses and assigned to the protective cover to represent a 1-foot leachate head above the baseliner system. Failure surfaces entering the bedrock beneath the site are not critical, so the potentiometric surfaces associated with the SZS and UAS were not utilized in this analysis.

BASELINER SYSTEM

The liner system consists of from top to bottom: (1) protective cover, (2) geocomposite, (3) textured geomembrane, (4) GCL, and (5) RSL. The geosynthetics were modeled as a 6-inch thick material in Slide, between the RSL and protective cover, with shear strength properties representative of the most critical interface. The following charts were developed from previous testing at the site and were the basis for determining a reasonable shear strength envelope for peak and post-peak conditions.





These values produced acceptable factors of safety for all scenarios. The following table summarizes the values used in this analysis and referred to as PTI shear strengths. These values are also included in Table 9 of the CQA/QC plan.

Normal Stress (psf)	PTI Peak Shear Strength (psf)	PTI Post-Peak Shear Strength (psf)
3,000	~~1,500~~ *1,250*	875
6,000	2,000	1,290
13,500	~~4,100~~ *3,500*	2,100

SEISMIC COEFFICIENT

A shear wave accelerating through the landfill will produce horizontal and vertical accelerations producing a slope stability FS that is less than a corresponding slope stability FS governed by static conditions. The shear wave acceleration is modeled within the stability analysis by inputting a seismic coefficient that is some fraction of gravity. The peak acceleration for the site is estimated to be 0.06 g based on the following figure, "Peak Acceleration (%g) with 2% Probability of Exceedance in 50 Years

(site: NEHRP B-C boundary)", published by the U.S.G.S in June of 1996 and copied into the GeoRG Manual.

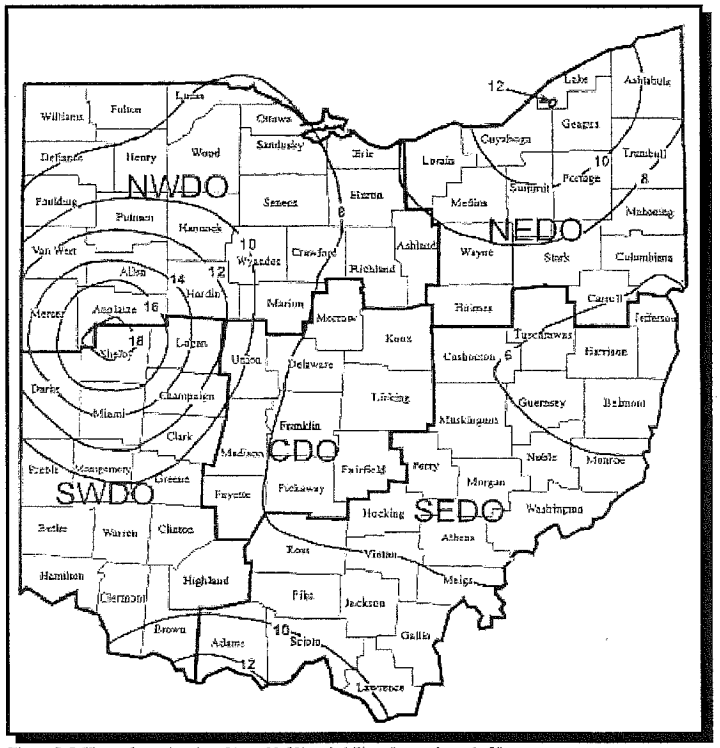


Figure 9-6 The peak acceleration (%g) with 2% probability of exceedance in 50 years. U.S. Geological Survey (June 1996) National Seismic Hazard Mapping Project. "Peak Acceleration (%g) with 2% Probability of Exceedance in 50 Years (site: NEHRP B-C boundary)."

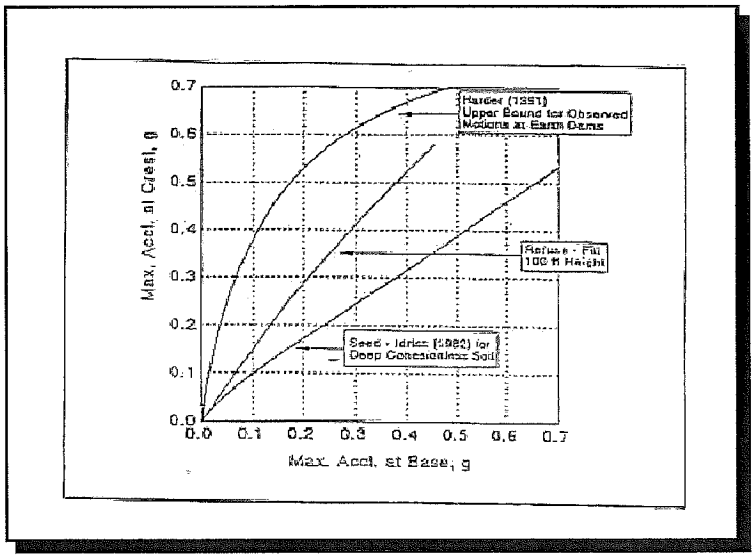


Figure 8-11 Approximate relationship between maximum accelerations at the base and crest for various ground conditions. Singh and Sun,1995, Figure 3.

The previous figure shows the relationship between maximum horizontal seismic acceleration at the base and crest of 100 feet of refuse. Based on this figure, the maximum horizontal seismic acceleration at the crest of the landfill can be expected to be 0.10g, which was used in this analysis.

CONCLUSIONS

Factors of safety were calculated for each cross section analyzed. The minimum FS calculated for the static analysis was 1.50, which meets the required minimum of 1.50. The minimum FS calculated for the seismic analysis was 1.03, which exceeds the required minimum of 1.00. All calculated factors of safety meet the requirements of OAC 3745-27-08(C)(7). Output files from the analyses are included in Attachments B through E. The following table summarizes the results.

Cross Section	Seismicity	Loading Condition	Failure Type	Minimum Calculated FS	Target FS
A-A	Static	Drained	Rotational	~~1.53~~ *1.53*	1.50
			Translational	~~2.45~~ *2.39*	
		Undrained	Rotational	~~1.53~~ *1.53*	
			Translational	~~2.09~~ *2.36*	
	Seismic	Drained	Rotational	~~1.14~~ *1.14*	1.00
			Translational	~~1.68~~ *1.59*	
		Undrained	Rotational	~~1.14~~ *1.14*	
			Translational	~~1.42~~ *1.59*	
B-B	Static	Drained	Rotational	~~2.88~~ *2.28*	1.50
			Translational	~~1.85~~ *1.77*	
		Undrained	Rotational	~~2.62~~ *2.14*	

Cross Section	Seismicity	Loading Condition	Failure Type	Minimum Calculated FS	Target FS
			Translational	~~1.69~~ *1.68*	
	Seismic	Drained	Rotational	~~1.99~~ *1.70*	1.00
			Translational	~~1.24~~ *1.60*	
		Undrained	Rotational	~~1.92~~ *1.52*	
			Translational	~~1.16~~ *1.19*	
C-C	Static	Drained	Rotational	~~2.21~~ *2.28*	1.50
			Translational	~~1.71~~ *1.62*	
		Undrained	Rotational	~~2.10~~ *2.02*	
			Translational	~~1.56~~ *1.50*	
	Seismic	Drained	Rotational	~~1.65~~ *1.71*	1.00
			Translational	~~1.24~~ *1.20*	
		Undrained	Rotational	~~1.57~~ *1.52*	
			Translational	~~1.12~~ *1.21*	
D-D	Static	Drained	Rotational	~~2.38~~ *2.37*	1.50
			Translational	~~1.80~~ *1.73*	
		Undrained	Rotational	~~2.21~~ *2.23*	
			Translational	~~1.70~~ *1.68*	
	Seismic	Drained	Rotational	~~1.77~~ *1.74*	1.00
			Translational	~~2.02~~ *1.23*	
		Undrained	Rotational	~~1.64~~ *1.65*	
			Translational	~~1.16~~ *1.18*	

ATTACHMENT A

FIGURES

NORTH

LEGEND

- 1220 — EXISTING GROUND CONTOUR
- PROPERTY LINE
- LIMIT OF SOLID WASTE PLACEMENT
- PHASE LIMIT
- (8) PHASE DESIGNATION
- ACCESS ROAD
- 1450 — PROPOSED CONTOUR
- FM — EXISTING FORCEMAIN
- PROPOSED SURFACE WATER CHANNEL

REFERENCE

EXISTING TOPOGRAPHY PREPARED BY KEDDAL AERIAL MAPPING; DATE OF PHOTOGRAPHY: 1/18/13. ADDITIONAL MAPPING WAS PREPARED BY KEDDAL AERIAL MAPPING FROM AERIAL PHOTOGRAPHY DATED 1/6/12 AND 1/5/11 AND BY M.A.N. MAPPING FROM AERIAL PHOTOGRAPHY DATED 12/14/00.

SCALE IN FEET

0 500 1000

*HAND SIGNATURE ON FILE

Civil & Environmental Consultants, Inc.
333 Baldwin Road - Pittsburgh, PA 15205
412-429-2324 · 800-365-2324
www.cecinc.com

APEX ENVIRONMENTAL, LLC.
PTI APPLICATION - CONTIGUOUS EXPANSION
APEX SANITARY LANDFILL
JEFFERSON COUNTY, OHIO

CROSS SECTION B-B
LOCATION PLAN

DRAWN BY:	JAS	CHECKED BY:	JMN	APPROVED BY:	*RJB	FIGURE NO.:	1
DATE:	07/15/13	DWG SCALE:	1"=500'	PROJECT NO:	091-867.0016		

P:\2009\091-867\0002 - PTI LATERAL EXPANSION\DWG\P091-867F061.DWG[SECTION B-B']LS:(MAPA - 7/17/2013) - LP: 7/17/2013 11:52:47 AM

NORTH

LEGEND

- 1220 — EXISTING GROUND CONTOUR
- PROPERTY LINE
- LIMIT OF SOLID WASTE PLACEMENT
- PHASE LIMIT
- (9) PHASE DESIGNATION
- ACCESS ROAD
- 1450 — PROPOSED CONTOUR
- FM — EXISTING FORCEMAIN
- PROPOSED SURFACE WATER CHANNEL

REFERENCE

EXISTING TOPOGRAPHY PREPARED BY KEDDAL AERIAL MAPPING; DATE OF PHOTOGRAPHY: 1/18/13. ADDITIONAL MAPPING WAS PREPARED BY KEDDAL AERIAL MAPPING FROM AERIAL PHOTOGRAPHY DATED 1/6/12 AND 1/5/11 AND BY M.A.N. MAPPING FROM AERIAL PHOTOGRAPHY DATED 12/14/00.

SCALE IN FEET

0 500 1000

* HAND SIGNATURE ON FILE

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APEX ENVIRONMENTAL, LLC.
PTI APPLICATION - CONTIGUOUS EXPANSION
APEX SANITARY LANDFILL
JEFFERSON COUNTY, OHIO

CROSS SECTION C-C
LOCATION PLAN

DRAWN BY:	JAS	CHECKED BY:	JMN	APPROVED BY:	*RJB
DATE:	07/15/13	DWG SCALE:	1"=500'	PROJECT NO:	091-867.0016

FIGURE NO.: 2

P:\2009\091-867\0002 - PTI LATERAL EXPANSION\DWG\P091-867F062.DWG]SECTION C-C'LS:(MIAPI - 7/17/2013) - LP: 7/17/2013 11:56:14 AM

LEGEND

- 1220 — EXISTING GROUND CONTOUR
- PROPERTY LINE
- LIMIT OF SOLID WASTE PLACEMENT
- PHASE LIMIT
- (13) PHASE DESIGNATION
- ACCESS ROAD
- 1450 — PROPOSED CONTOUR
- FM — EXISTING FORCEMAIN
- PROPOSED SURFACE WATER CHANNEL

REFERENCE

EXISTING TOPOGRAPHY PREPARED BY KEDDAL AERIAL MAPPING; DATE OF PHOTOGRAPHY: 1/18/13. ADDITIONAL MAPPING WAS PREPARED BY KEDDAL AERIAL MAPPING FROM AERIAL PHOTOGRAPHY DATED 1/6/12 AND 1/5/11 AND BY M.A.N. MAPPING FROM AERIAL PHOTOGRAPHY DATED 12/14/00.

SCALE IN FEET

0 500 1000

* HAND SIGNATURE ON FILE

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APEX ENVIRONMENTAL, LLC.
PTI APPLICATION - CONTIGUOUS EXPANSION
APEX SANITARY LANDFILL
JEFFERSON COUNTY, OHIO
CROSS SECTIONS A-A AND D-D
LOCATION PLAN

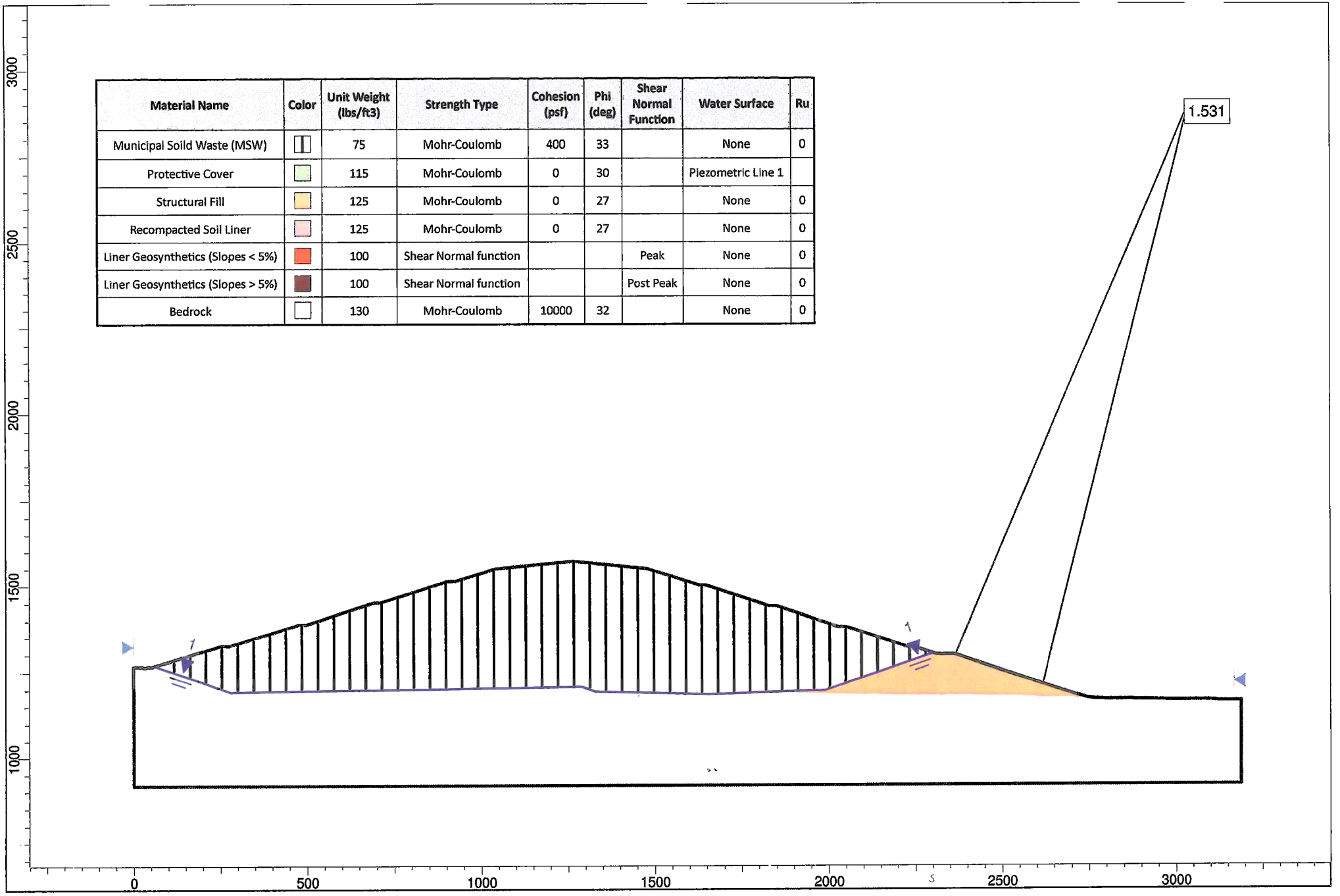
DRAWN BY:	JAS	CHECKED BY:	JMN	APPROVED BY:	*RJB	FIGURE NO.:	3
DATE:	07/15/13	DWG SCALE:	1"=500'	PROJECT NO:	091-867.0016		

P:\2009\091-867\0002 - PTI LATERAL EXPANSION\DWG\P091-867F066.DWG[SECTIONS A-A - D-D]L PALUCCI - 7/17/2013 - LP: 7/17/2013 12:06:56 PM

ATTACHMENT B

CROSS SECTION A-A SLIDE OUTPUT

Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)	Shear Normal Function	Water Surface	Ru
Municipal Soild Waste (MSW)		75	Mohr-Coulomb	400	33		None	0
Protective Cover		115	Mohr-Coulomb	0	30		Piezometric Line 1	
Structural Fill		125	Mohr-Coulomb	0	27		None	0
Recompacted Soil Liner		125	Mohr-Coulomb	0	27		None	0
Liner Geosynthetics (Slopes < 5%)		100	Shear Normal function			Peak	None	0
Liner Geosynthetics (Slopes > 5%)		100	Shear Normal function			Post Peak	None	0
Bedrock		130	Mohr-Coulomb	10000	32		None	0



A-A -- static -- rotational -- drained-Rev1.slim

Slide Analysis Information

Project Summary

File Name A-A -- static -- rotational -- drained-Rev1.slim
Slide Modeler Version: 6.017

General Settings

Units of Measurement: Imperial Units
Time Units: days
Permeability Units: feet/second
Failure Direction: Left to Right
Data Output: Standard
Maximum Material Properties: 20
Maximum Support Properties: 20

Analysis Options

Analysis Methods Used

Spencer

Number of slices: 25
Tolerance: 0.005
Maximum number of iterations 50
Check malpha < 0.2: Yes
Initial trial value of FS: 1
Steffensen Iteration: Yes

Groundwater Analysis

Groundwater Method: Water Surfaces
Pore Fluid Unit Weight: 62.4 lbs/ft3
Advanced Groundwater Method: None

Random Numbers

Pseudo-random Seed: 10116
Random Number Generation Method Park and Miller v.3

Surface Options

Surface Type: Circular
Search Method: Auto Refine Search
Divisions along slope: 20
Circles per division: 10
Number of iterations: 10
Divisions to use in next iteration: 50%
Composite Surfaces: Disabled
Minimum Elevation: 0
Minimum Depth: 5

Material Properties

Property	Municipal Soild Waste (MSW)	Protective Cover	Structural Fill	Recompacted Soil Liner	Liner Geosynthetics (Slopes	Liner Geosynthetics (Slopes >5%)	Bedrock
Color							
Strength Type	Mohr-Coulomb	Mohr-Coulomb	Mohr-Coulomb	Mohr-Coulomb	Shear Normal function	Shear Normal function	Mohr-Coulomb
Unit Weight [lbs/ft3]	75	115	125	125	100	100	130
Cohesion [psf]	400	0	0	0			10000
Friction Angle [deg]	33	30	27	27			32

Water Surface	None	Piezometric Line 1	None	None	None	None	None
Hu Value		1					
Ru Value	0		0	0	0	0	0

Shear Normal Functions

Name. Peak

Normal (psf)	Shear (psf)
0	0
3000	1250
6000	2000
13500	3500

Name: Post Peak

Normal (psf)	Shear (psf)
0	0
3000	875
6000	1290
13500	2100

Global Minimums

Method: spencer

FS: 1.530960
Center: 3039.080, 2901.363
Radius: 1738.868
Left Slip Surface Endpoint: 2365.410, 1298.294
Right Slip Surface Endpoint: 2616.176, 1214.706
Resisting Moment=9.29892e+007 lb-ft
Driving Moment=6.07393e+007 lb-ft
Resisting Horizontal Force=50756.6 lb
Driving Horizontal Force=33153.6 lb
Total Slice Area=885.22 ft2

Valid / Invalid Surfaces

Method: spencer

Number of Valid Surfaces: 8822
Number of Invalid Surfaces: 0

Slice Data

Global Minimum Query (spencer) - Safety Factor: 1.53096

Slice Number	Width [ft]	Weight [lbs]	Base Material	Base Cohesion [psf]	Base Friction Angle [degrees]	Shear Stress [psf]	Shear Strength [psf]	Base Normal Stress [psf]	Pore Pressure [psf]	Effective Normal Stress [psf]
1	10.0306	523.4	Structural Fill	0	27	15.1751	23.2324	45.5962	0	45.5962
2	10.0306	1524.26	Structural Fill	0	27	44.3068	67.832	133.128	0	133.128
3	10.0306	2433.6	Structural Fill	0	27	70.9202	108.576	213.092	0	213.092
4	10.0306	3252.11	Structural Fill	0	27	95.0142	145.463	285.487	0	285.487
5	10.0306	3980.46	Structural Fill	0	27	116.588	178.491	350.309	0	350.309
6	10.0306	4619.3	Structural Fill	0	27	135.64	207.66	407.556	0	407.556
7	10.0306	5169.27	Structural Fill	0	27	152.17	232.966	457.221	0	457.221
8	10.0306	5630.99	Structural Fill	0	27	166.175	254.408	499.303	0	499.303
9	10.0306	6005.06	Structural Fill	0	27	177.655	271.982	533.794	0	533.794
10	10.0306	6292.05	Structural Fill	0	27	186.605	285.685	560.688	0	560.688
11	10.0306	6492.55	Structural Fill	0	27	193.025	295.514	579.98	0	579.98
12	10.0306	6607.09	Structural Fill	0	27	196.913	301.466	591.66	0	591.66
13	10.0306	6636.21	Structural Fill	0	27	198.264	303.534	595.72	0	595.72
14	10.0306	6580.45	Structural Fill	0	27	197.076	301.716	592.151	0	592.151
15	10.0306	6440.3	Structural Fill	0	27	193.347	296.007	580.946	0	580.946
16	10.0306	6216.25	Structural Fill	0	27	187.072	286.4	562.092	0	562.092
17	10.0306	5908.8	Structural Fill	0	27	178.248	272.891	535.579	0	535.579
18	10.0306	5518.4	Structural Fill	0	27	166.87	255.472	501.393	0	501.393

19	10.0306	5045.51	Structural Fill	0	27	152.936	234.139	459.524	0	459.524
20	10.0306	4490.56	Structural Fill	0	27	136.44	208.884	409.958	0	409.958
21	10.0306	3853.99	Structural Fill	0	27	117.377	179.699	352.68	0	352.68
22	10.0306	3136.2	Structural Fill	0	27	95.7425	146.578	287.676	0	287.676
23	10.0306	2337.6	Structural Fill	0	27	71.5316	109.512	214.929	0	214.929
24	10.0306	1458.57	Structural Fill	0	27	44.7382	68.4924	134.424	0	134.424
25	10.0306	499.5	Structural Fill	0	27	15.3974	23.5728	46.2641	0	46.2641

Interslice Data

Global Minimum Query (spencer) - Safety Factor: 1.53096

Slice Number	X coordinate [ft]	Y coordinate - Bottom [ft]	Interslice Normal Force [lbs]	Interslice Shear Force [lbs]	Interslice Force Angle [degrees]
1	2365.41	1298.29	0	0	0
2	2375.44	1294.12	38.2635	2.59825	3.88466
3	2385.47	1290.01	140.227	9.522	3.88466
4	2395.5	1285.98	287.942	19.5524	3.88465
5	2405.53	1282.02	465.235	31.5914	3.88466
6	2415.56	1278.13	657.688	44.6597	3.88465
7	2425.59	1274.31	852.601	57.895	3.88465
8	2435.62	1270.56	1038.97	70.5504	3.88466
9	2445.66	1266.89	1207.47	81.9924	3.88467
10	2455.69	1263.28	1350.43	91.6994	3.88464
11	2465.72	1259.74	1461.77	99.2602	3.88466
12	2475.75	1256.27	1537.07	104.373	3.88464
13	2485.78	1252.87	1573.45	106.843	3.88463
14	2495.81	1249.54	1569.62	106.584	3.88467
15	2505.84	1246.28	1525.85	103.611	3.88464
16	2515.87	1243.08	1443.92	98.0482	3.88466
17	2525.9	1239.95	1327.16	90.1193	3.88464
18	2535.93	1236.88	1180.37	80.1518	3.88465

19	2545.96	1233.88	1009.87	68.5745	3.88467
20	2555.99	1230.95	823.462	55.9164	3.88465
21	2566.02	1228.08	630.4	42.8067	3.88465
22	2576.05	1225.28	441.41	29.9735	3.88465
23	2586.08	1222.54	268.667	18.2436	3.88466
24	2596.11	1219.86	125.788	8.54152	3.88465
25	2606.14	1217.25	27.825	1.88943	3.88465
26	2616.18	1214.71	0	0	0

List Of Coordinates

Piezoline

X	Y
58.875	1268.87
217.897	1215.87
221.196	1214.77
280.957	1194.86
288.976	1194.97
290.76	1194.99
292.958	1195.02
303.498	1195.17
381.498	1196.23
655.075	1199.98
666.771	1200.14
668.918	1200.17
689.348	1200.45
689.605	1200.45
692.302	1200.49
696.539	1200.55
696.715	1200.55
878.471	1203.04

881.029	1203.08
888.34	1203.18
891.752	1203.22
1014.52	1204.91
1025.6	1205.06
1063.9	1205.58
1198.58	1207.43
1289.37	1208.67
1299.55	1205.32
1310.55	1201.71
1316.69	1199.69
1327.63	1196.09
1572.64	1189.55
1650.41	1187.47
1733.72	1189.92
1770.71	1191.01
1786.62	1191.47
1948.28	1196.22
1991.12	1198.29
2073.13	1225.58
2076.26	1226.63
2218.38	1273.92
2302.22	1301.82

External Boundary

X	Y
0	1267.39
-7.11e-014	917.395
3187.88	917.395
3187.88	1164.49
3168.8	1164.58
3123.89	1164.57

3101.01	1166.89
3094.63	1166.74
3066.83	1166.62
3032.96	1166.11
2982.45	1166.23
2928.57	1167.68
2860.3	1168.43
2801.49	1168.98
2766.09	1170.38
2759.08	1171.66
2740.21	1173.36
2478.3	1260.67
2360.43	1299.95
2335.42	1299.96
2329.42	1297.97
2326.42	1297.97
2320.41	1299.97
2310.92	1299.97
2309.34	1299.44
2304.59	1301.03
2303.8	1301.29
2302.22	1301.82
2246.98	1320.23
2226.89	1320.29
2060.24	1375.84
2046.89	1380.29
2028.5	1380.34
1848.06	1439.92
1846.81	1440.34
1826.73	1440.4
1646.63	1500.4
1626.6	1500.47
1478	1550

1262.76	1571.52
1039.03	1550
924.851	1513.38
924.106	1513.15
902.693	1512.92
709.533	1450.97
688.122	1450.75
494.964	1388.8
473.556	1388.58
381.867	1359.18
274.39	1326.76
250.638	1326.3
68.9007	1272.09
61.0978	1269.59
58.875	1268.87
57.2632	1268.36
56.4573	1268.1
51.6219	1266.55
50.0236	1267.08
40.4339	1267.14
34.3688	1265.18
31.3363	1265.2
25.2712	1267.24
6.39138	1267.35

Material Boundary

X	Y
56.4573	1268.1
217.423	1214.45
220.722	1213.35
280.724	1193.35
288.997	1193.47

290.781	1193.49
292.978	1193.52
303.518	1193.67
381.518	1194.73
655.096	1198.48
666.791	1198.64
668.939	1198.67
689.369	1198.95
689.626	1198.95
692.323	1198.99
696.56	1199.05
696.736	1199.05
878.492	1201.54
881.049	1201.58
888.361	1201.68
891.772	1201.72
1014.54	1203.41
1025.62	1203.56
1063.92	1204.08
1198.6	1205.93
1289.14	1207.17
1299.08	1203.9
1310.08	1200.28
1316.22	1198.26
1327.37	1194.59
1572.6	1188.05
1650.41	1185.97
1733.77	1188.42
1770.76	1189.51
1786.67	1189.97
1948.34	1194.72
1991.4	1196.8

2073.6	1224.16
2076.73	1225.2
2218.85	1272.5
2304.59	1301.03

Material Boundary

X	Y
57.2632	1268.36
217.581	1214.92
220.88	1213.83
280.802	1193.85
288.99	1193.97
290.774	1193.99
292.971	1194.02
303.511	1194.17
381.511	1195.23
655.089	1198.98
666.784	1199.14
668.932	1199.17
689.362	1199.45
689.619	1199.45
692.316	1199.49
696.553	1199.55
696.729	1199.55
878.485	1202.04
881.042	1202.08
888.354	1202.18
891.766	1202.22
1014.54	1203.91
1025.61	1204.06
1063.91	1204.58
1198.59	1206.43

1289.22	1207.67
1299.24	1204.37
1310.24	1200.76
1316.38	1198.74
1327.46	1195.09
1572.62	1188.55
1650.41	1186.47
1733.75	1188.92
1770.74	1190.01
1786.65	1190.47
1948.32	1195.22
1991.3	1197.3
2073.45	1224.63
2076.58	1225.68
2218.7	1272.97
2303.8	1301.29

Material Boundary

X	Y
58.875	1268.87
217.897	1215.87
221.196	1214.77
280.957	1194.86
288.976	1194.97
290.76	1194.99
292.958	1195.02
303.498	1195.17
381.498	1196.23
655.075	1199.98
666.771	1200.14
668.918	1200.17
689.348	1200.45

689.605	1200.45
692.302	1200.49
696.539	1200.55
696.715	1200.55
878.471	1203.04
881.029	1203.08
888.34	1203.18
891.752	1203.22
1014.52	1204.91
1025.6	1205.06
1063.9	1205.58
1198.58	1207.43
1289.37	1208.67
1299.55	1205.32
1310.55	1201.71
1316.69	1199.69
1327.63	1196.09
1572.64	1189.55
1650.41	1187.47
1733.72	1189.92
1770.71	1191.01
1786.62	1191.47
1948.28	1196.22
1991.12	1198.29
2073.13	1225.58
2076.26	1226.63
2218.38	1273.92
2302.22	1301.82

Material Boundary

X	Y
280.724	1193.35

280.802	1193.85

Material Boundary

X	Y
1991.3	1197.3
1991.4	1196.8

Material Boundary

X	Y
2759.08	1171.66
2762.03	1171.04
2766.09	1170.38

Material Boundary

X	Y
51.6219	1266.55
216.475	1211.6
280.257	1190.35
293.019	1190.52
381.559	1191.73
696.601	1196.05
891.814	1198.72
1198.64	1202.93
1288.68	1204.16
1326.85	1191.61
1572.52	1185.05
1650.41	1182.97
1733.85	1185.42
1786.75	1186.98
1896.93	1190.21

1926.95	1191.09
1948.45	1191.72
1991.95	1193.83
2309.34	1299.44

Material Boundary

X	Y
1926.95	1191.09
1951.22	1190.38
1973.97	1189.82
2012.05	1188.88
2055.85	1187.74
2088.42	1186.82
2107.13	1186.38
2134.57	1186.3
2141.85	1186
2180.21	1184.65
2183.8	1184.53
2186.21	1184.48
2203.48	1184.36
2230.83	1183.88
2237.4	1183.72
2244.36	1183.34
2245.84	1183.08
2247.12	1183
2252.2	1182.67
2255.23	1182.75
2261.98	1182.66
2265.14	1183.12
2273.56	1182.86
2289.56	1182.71
2311.23	1182.34

2331.85	1180.87
2347.09	1181.82
2361.52	1181.55
2383.63	1181.96
2388.07	1181.81
2411.52	1181.02
2412.26	1181.01
2419.26	1180.37
2459.51	1179.71
2480.58	1180.2
2517.61	1179.69
2522.5	1179.23
2548.83	1178.3
2561.21	1177.6
2593.62	1176.94
2605.16	1176.61
2614.44	1176.26
2627.39	1175.68
2634.86	1175.5
2667.89	1174.86
2694.82	1174.33
2705.07	1174.28
2728.95	1173.71
2735.21	1173.88
2740.21	1173.36

Material Boundary

X	Y
1896.93	1190.21
1899.05	1190.19
1915.52	1190.05
1996.36	1187.92

2023.88	1187.2
2058.68	1186.31
2079.59	1185.79
2087.13	1185.61
2098.51	1185.36
2109.56	1185.16
2130.6	1185.06
2150.3	1184.85
2163.01	1184.63
2179.69	1184.1
2189.31	1183
2247.12	1183

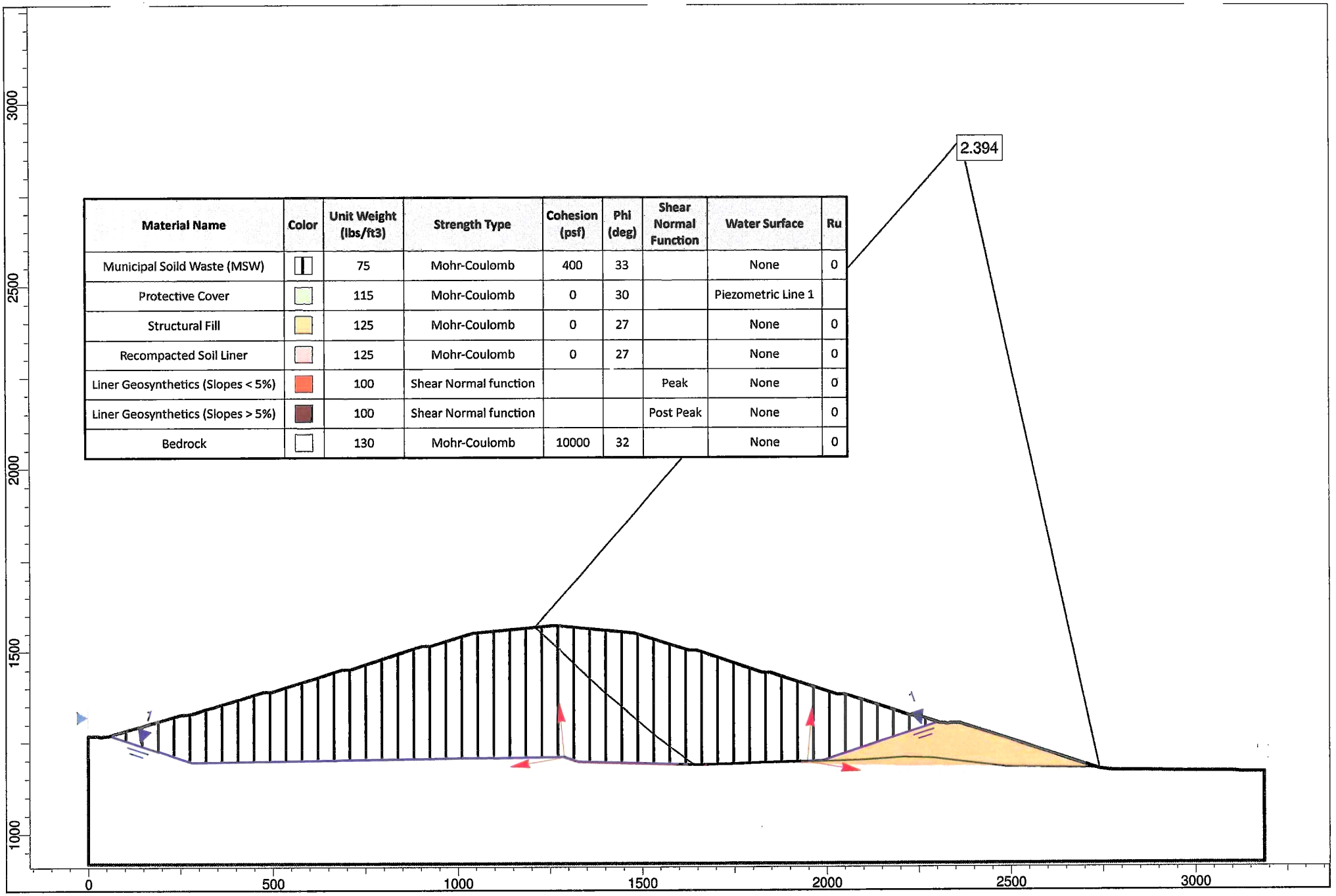
Material Boundary

X	Y
1289.14	1207.17
1289.22	1207.67

Material Boundary

X	Y
1327.37	1194.59
1327.46	1195.09

Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)	Shear Normal Function	Water Surface	Ru
Municipal Soild Waste (MSW)		75	Mohr-Coulomb	400	33		None	0
Protective Cover		115	Mohr-Coulomb	0	30		Piezometric Line 1	
Structural Fill		125	Mohr-Coulomb	0	27		None	0
Recompacted Soil Liner		125	Mohr-Coulomb	0	27		None	0
Liner Geosynthetics (Slopes < 5%)		100	Shear Normal function			Peak	None	0
Liner Geosynthetics (Slopes > 5%)		100	Shear Normal function			Post Peak	None	0
Bedrock		130	Mohr-Coulomb	10000	32		None	0



A-A -- static -- translational -- drained-Rev1.slim

Slide Analysis Information

Project Summary

File Name: A-A -- static -- translational -- drained-Rev1.slim
Slide Modeler Version: 6.017

General Settings

Units of Measurement: Imperial Units
Time Units: days
Permeability Units: feet/second
Failure Direction: Left to Right
Data Output: Standard
Maximum Material Properties: 20
Maximum Support Properties: 20

Analysis Options

Analysis Methods Used

Spencer

Number of slices: 25
Tolerance: 0.005
Maximum number of iterations: 50
Check malpha < 0.2: Yes
Initial trial value of FS: 1
Steffensen Iteration: Yes

Groundwater Analysis

Groundwater Method: Water Surfaces
Pore Fluid Unit Weight: 62.4 lbs/ft3

Advanced Groundwater Method: None

Random Numbers

Pseudo-random Seed: 10116
Random Number Generation Method: Park and Miller v.3

Surface Options

Surface Type: Non-Circular Block Search
Number of Surfaces: 5000
Pseudo-Random Surfaces: Enabled
Convex Surfaces Only: Disabled
Left Projection Angle (Start Angle): 95
Left Projection Angle (End Angle): 190
Right Projection Angle (Start Angle): -10
Right Projection Angle (End Angle): 85
Minimum Elevation: Not Defined
Minimum Depth: Not Defined

Material Properties

Property	Municipal Soild Waste (MSW)	Protective Cover	Structural Fill	Recompacted Soil Liner	Liner Geosynthetics (Slopes	Liner Geosynthetics (Slopes > 5%)	Bedrock
Color							
Strength Type	Mohr-Coulomb	Mohr-Coulomb	Mohr-Coulomb	Mohr-Coulomb	Shear Normal function	Shear Normal function	Mohr-Coulomb
Unit Weight [lbs/ft3]	75	115	125	125	100	100	130
Cohesion [psf]	400	0	0	0			10000
Friction Angle [deg]	33	30	27	27			32
Water Surface	None	Piezometric Line 1	None	None	None	None	None
Hu Value		1					

Ru Value	0	0	0	0	0	0

Shear Normal Functions

Name: Peak

Normal (psf)	Shear (psf)
0	0
3000	1250
6000	2000
13500	3500

Name: Post Peak

Normal (psf)	Shear (psf)
0	0
3000	875
6000	1290
13500	2100

Global Minimums

Method: spencer

FS: 2.394230
Axis Location: 2367.852, 2900.609
Left Slip Surface Endpoint: 1209.461, 1566.396
Right Slip Surface Endpoint: 2740.188, 1173.368
Resisting Moment=1.65112e+010 lb-ft
Driving Moment=6.89622e+009 lb-ft
Resisting Horizontal Force=8.60931e+006 lb
Driving Horizontal Force=3.59585e+006 lb
Total Slice Area=239352 ft2

Global Minimum Coordinates

Method: spencer

X	Y
1209.46	1566.4
1335.74	1445.82
1401.29	1384.84
1538.48	1263.94
1639.84	1186.22
1741.54	1188.65
1920.93	1194.35
2100.35	1200.06
2209.63	1206.23
2289.16	1203.79
2488.32	1180.23
2707.24	1176.77
2740.19	1173.37

Valid / Invalid Surfaces

Method: spencer

Number of Valid Surfaces: 2199
Number of Invalid Surfaces: 2802

Error Codes:

Error Code -107 reported for 979 surfaces
Error Code -108 reported for 1394 surfaces
Error Code -111 reported for 99 surfaces
Error Code -112 reported for 329 surfaces
Error Code -116 reported for 1 surface

Error Codes

The following errors were encountered during the computation:

-107 = Total driving moment or total driving force is negative. This will occur if the wrong failure direction is specified, or if high external or anchor loads are applied against the failure direction.

-108 = Total driving moment or total driving force < 0.1. This is to limit the calculation of extremely high safety factors if the driving force is very small (0.1 is an arbitrary number).
-111 = safety factor equation did not converge
-112 = The coefficient M-Alpha = cos(alpha)(1+tan(alpha)tan(phi)/F) < 0.2 for the final iteration of the safety factor calculation. This screens out some slip surfaces which may not be valid in the context of the analysis, in particular, deep seated slip surfaces with many high negative base angle slices in the passive zone.
-116 = Not enough slices to analyze the surface Increase the number of slices in the job control in the modeler.

Slice Data

Global Minimum Query (spencer) - Safety Factor: 2.39423

Slice Number	Width [ft]	Weight [lbs]	Base Material	Base Cohesion [psf]	Base Friction Angle [degrees]	Shear Stress [psf]	Shear Strength [psf]	Base Normal Stress [psf]	Pore Pressure [psf]	Effective Normal Stress [psf]
1	63.1405	156415	Municipal Soild Waste (MSW)	400	33	622.004	1489.22	1677.24	0	1677.24
2	63.1405	432906	Municipal Soild Waste (MSW)	400	33	1468.68	3516.36	4798.78	0	4798.78
3	65.5515	715904	Municipal Soild Waste (MSW)	400	33	2273.15	5442.44	7764.68	0	7764.68
4	68.5948	1.027e+006	Municipal Soild Waste (MSW)	400	33	3114.68	7457.26	10867.2	0	10867.2
5	68.5948	1.27068e+006	Municipal Soild Waste (MSW)	400	33	3819.37	9144.44	13465.2	0	13465.2
6	99.2845	2.14173e+006	Municipal Soild Waste (MSW)	400	33	4606.53	11029.1	16367.4	0	16367.4
7	1.35161	31769.5	Protective Cover	0	30	4368.29	10458.7	18146.3	31.2111	18115.1
8	0.717594	16928.7	Liner Geosynthetics (Slopes < 5%)	800	11.31	1952.81	4675.48	19377.4	0	19377.4
9	11.1251	262316	Liner Geosynthetics (Slopes < 5%)	800	11.31	2360.12	5650.67	24253.4	0	24253.4
10	90.574	2.01696e+006	Liner Geosynthetics (Slopes < 5%)	800	11.31	2247.92	5382.04	22910.2	0	22910.2
11	89.6968	1.77913e+006	Liner Geosynthetics (Slopes < 5%)	800	11.31	2043.83	4893.41	20467.1	0	20467.1
12	89.6968	1.60039e+006	Liner Geosynthetics (Slopes < 5%)	800	11.31	1872.76	4483.83	18419.1	0	18419.1
13	27.4669	447191	Liner Geosynthetics (Slopes < 5%)	800	11.31	1738.75	4162.96	16814.8	0	16814.8
14	30.2294	468655	Liner Geosynthetics (Slopes < 5%)	800	11.31	1671.97	4003.09	16015.5	0	16015.5
15	22.5738	334849	Recompacted Soil Liner	0	27	3352.01	8025.48	15750.9	0	15750.9
16	99.155	1.42081e+006	Structural Fill	0	27	3238.05	7752.63	15215.3	0	15215.3
17	109.272	1.4253e+006	Structural Fill	0	27	2980.65	7136.37	14005.9	0	14005.9
18	79.5367	982093	Structural Fill	0	27	2714.11	6498.21	12753.4	0	12753.4
19	99.5802	1.25536e+006	Structural Fill	0	27	2668.7	6389.48	12540.1	0	12540.1
20	99.5802	1.09291e+006	Structural Fill	0	27	2323.36	5562.65	10917.4	0	10917.4
21	72.9707	597548	Structural Fill	0	27	1811.75	4337.75	8513.3	0	8513.3
22	72.9707	386186	Structural Fill	0	27	1170.91	2803.42	5502.02	0	5502.02

23	72.9707	174825	Structural Fill	0	27	530.062	1269.09	2490.73	0	2490.73
24	28.3212	15303.9	Structural Fill	0	27	115.121	275.625	540.944	0	540.944
25	4.63157	308.417	Structural Fill	0	27	14.1864	33.9656	66.6613	0	66.6613

Interslice Data

Global Minimum Query (spencer) - Safety Factor: 2.39423

Slice Number	X coordinate [ft]	Y coordinate - Bottom [ft]	Interslice Normal Force [lbs]	Interslice Shear Force [lbs]	Interslice Force Angle [degrees]
1	1209.46	1566.4	0	0	0
2	1272.6	1506.11	61841.3	13014.4	11.8844
3	1335.74	1445.82	258408	54381.6	11.8844
4	1401.29	1384.84	582919	122674	11.8843
5	1469.89	1324.39	1.02617e+006	215957	11.8844
6	1538.48	1263.94	1.57814e+006	332117	11.8844
7	1637.77	1187.81	2.36688e+006	498106	11.8844
8	1639.12	1186.77	2.37978e+006	500822	11.8844
9	1639.84	1186.22	2.38904e+006	502771	11.8844
10	1650.96	1186.49	2.35636e+006	495892	11.8844
11	1741.54	1188.65	2.10331e+006	442638	11.8844
12	1831.23	1191.5	1.8616e+006	391770	11.8844
13	1920.93	1194.35	1.64108e+006	345362	11.8844
14	1948.4	1195.23	1.57863e+006	332221	11.8844
15	1978.63	1196.19	1.5127e+006	318345	11.8844
16	2001.2	1196.9	1.42573e+006	300042	11.8844
17	2100.35	1200.06	1.05669e+006	222379	11.8844
18	2209.63	1206.23	644506	135635	11.8844
19	2289.16	1203.79	459714	96746.1	11.8844
20	2388.74	1192.01	341740	71918.7	11.8844
21	2488.32	1180.23	239033	50304.2	11.8844
22	2561.29	1179.07	116630	24544.7	11.8844
23	2634.26	1177.92	37523.1	7896.68	11.8844
24	2707.24	1176.77	1711.68	360.22	11.8844

25	2735.56	1173.85	33.8139	7.11607	11.8844
26	2740.19	1173.37	0	0	0

List Of Coordinates

Piezoline

X	Y
58.875	1268.87
217.897	1215.87
221.196	1214.77
280.957	1194.86
288.976	1194.97
290.76	1194.99
292.958	1195.02
303.498	1195.17
381.498	1196.23
655.075	1199.98
666.771	1200.14
668.918	1200.17
689.348	1200.45
689.605	1200.45
692.302	1200.49
696.539	1200.55
696.715	1200.55
878.471	1203.04
881.029	1203.08
888.34	1203.18
891.752	1203.22
1014.52	1204.91
1025.6	1205.06
1063.9	1205.58
1198.58	1207.43
1289.37	1208.67

1299.55	1205.32
1310.55	1201.71
1316.69	1199.69
1327.63	1196.09
1572.64	1189.55
1650.41	1187.47
1733.72	1189.92
1770.71	1191.01
1786.62	1191.47
1948.28	1196.22
1991.12	1198.29
2073.13	1225.58
2076.26	1226.63
2218.38	1273.92
2302.22	1301.82

Block Search Polyline

X	Y
1289.18	1207.44
1327.42	1194.88
1572.61	1188.31
1650.41	1186.21
1733.77	1188.65
1770.74	1189.76
1786.66	1190.21
1948.31	1195.01

External Boundary

X	Y
0	1267.39
-7.11e-014	917.395
3187.88	917.395

3187.88	1164.49
3168.8	1164.58
3123.89	1164.57
3101.01	1166.89
3094.63	1166.74
3066.83	1166.62
3032.96	1166.11
2982.45	1166.23
2928.57	1167.68
2860.3	1168.43
2801.49	1168.98
2766.09	1170.38
2759.08	1171.66
2740.21	1173.36
2478.3	1260.67
2360.43	1299.95
2335.42	1299.96
2329.42	1297.97
2326.42	1297.97
2320.41	1299.97
2310.92	1299.97
2309.34	1299.44
2304.59	1301.03
2303.8	1301.29
2302.22	1301.82
2246.98	1320.23
2226.89	1320.29
2060.24	1375.84
2046.89	1380.29
2028.5	1380.34
1848.06	1439.92
1846.81	1440.34
1826.73	1440.4
1646.63	1500.4

1626.6	1500.47
1478	1550
1262.76	1571.52
1039.03	1550
924.851	1513.38
924.106	1513.15
902.693	1512.92
709.533	1450.97
688.122	1450.75
494.964	1388.8
473.556	1388.58
381.867	1359.18
274.39	1326.76
250.638	1326.3
68.9007	1272.09
61.0978	1269.59
58.875	1268.87
57.2632	1268.36
56.4573	1268.1
51.6219	1266.55
50.0236	1267.08
40.4339	1267.14
34.3688	1265.18
31.3363	1265.2
25.2712	1267.24
6.39138	1267.35

Material Boundary

X	Y
56.4573	1268.1
217.423	1214.45
220.722	1213.35
280.724	1193.35

288.997	1193.47
290.781	1193.49
292.978	1193.52
303.518	1193.67
381.518	1194.73
655.096	1198.48
666.791	1198.64
668.939	1198.67
689.369	1198.95
689.626	1198.95
692.323	1198.99
696.56	1199.05
696.736	1199.05
878.492	1201.54
881.049	1201.58
888.361	1201.68
891.772	1201.72
1014.54	1203.41
1025.62	1203.56
1063.92	1204.08
1198.6	1205.93
1289.14	1207.17
1299.08	1203.9
1310.08	1200.28
1316.22	1198.26
1327.37	1194.59
1572.6	1188.05
1650.41	1185.97
1733.77	1188.42
1770.76	1189.51
1786.67	1189.97
1948.34	1194.72
1991.4	1196.8
2073.6	1224.16

2076.73	1225.2
2218.85	1272.5
2304.59	1301.03

Material Boundary

X	Y
57.2632	1268.36
217.581	1214.92
220.88	1213.83
280.802	1193.85
288.99	1193.97
290.774	1193.99
292.971	1194.02
303.511	1194.17
381.511	1195.23
655.089	1198.98
666.784	1199.14
668.932	1199.17
689.362	1199.45
689.619	1199.45
692.316	1199.49
696.553	1199.55
696.729	1199.55
878.485	1202.04
881.042	1202.08
888.354	1202.18
891.766	1202.22
1014.54	1203.91
1025.61	1204.06
1063.91	1204.58
1198.59	1206.43
1289.22	1207.67
1299.24	1204.37

1310.24	1200.76
1316.38	1198.74
1327.46	1195.09
1572.62	1188.55
1650.41	1186.47
1733.75	1188.92
1770.74	1190.01
1786.65	1190.47
1948.32	1195.22
1991.3	1197.3
2073.45	1224.63
2076.58	1225.68
2218.7	1272.97
2303.8	1301.29

Material Boundary

X	Y
58.875	1268.87
217.897	1215.87
221.196	1214.77
280.957	1194.86
288.976	1194.97
290.76	1194.99
292.958	1195.02
303.498	1195.17
381.498	1196.23
655.075	1199.98
666.771	1200.14
668.918	1200.17
689.348	1200.45
689.605	1200.45
692.302	1200.49
696.539	1200.55

696.715	1200.55
878.471	1203.04
881.029	1203.08
888.34	1203.18
891.752	1203.22
1014.52	1204.91
1025.6	1205.06
1063.9	1205.58
1198.58	1207.43
1289.37	1208.67
1299.55	1205.32
1310.55	1201.71
1316.69	1199.69
1327.63	1196.09
1572.64	1189.55
1650.41	1187.47
1733.72	1189.92
1770.71	1191.01
1786.62	1191.47
1948.28	1196.22
1991.12	1198.29
2073.13	1225.58
2076.26	1226.63
2218.38	1273.92
2302.22	1301.82

Material Boundary

X	Y
280.724	1193.35
280.802	1193.85

Material Boundary

X	Y
1991.3	1197.3
1991.4	1196.8

Material Boundary

X	Y
2759.08	1171.66
2762.03	1171.04
2766.09	1170.38

Material Boundary

X	Y
51.6219	1266.55
216.475	1211.6
280.257	1190.35
293.019	1190.52
381.559	1191.73
696.601	1196.05
891.814	1198.72
1198.64	1202.93
1288.68	1204.16
1326.85	1191.61
1572.52	1185.05
1650.41	1182.97
1733.85	1185.42
1786.75	1186.98
1896.93	1190.21
1926.95	1191.09
1948.45	1191.72
1991.95	1193.83
2309.34	1299.44

Material Boundary

X	Y
1926.95	1191.09
1951.22	1190.38
1973.97	1189.82
2012.05	1188.88
2055.85	1187.74
2088.42	1186.82
2107.13	1186.38
2134.57	1186.3
2141.85	1186
2180.21	1184.65
2183.8	1184.53
2186.21	1184.48
2203.48	1184.36
2230.83	1183.88
2237.4	1183.72
2244.36	1183.34
2245.84	1183.08
2247.12	1183
2252.2	1182.67
2255.23	1182.75
2261.98	1182.66
2265.14	1183.12
2273.56	1182.86
2289.56	1182.71
2311.23	1182.34
2331.85	1180.87
2347.09	1181.82
2361.52	1181.55
2383.63	1181.96
2388.07	1181.81
2411.52	1181.02
2412.26	1181.01

2419.26	1180.37
2459.51	1179.71
2480.58	1180.2
2517.61	1179.69
2522.5	1179.23
2548.83	1178.3
2561.21	1177.6
2593.62	1176.94
2605.16	1176.61
2614.44	1176.26
2627.39	1175.68
2634.86	1175.5
2667.89	1174.86
2694.82	1174.33
2705.07	1174.28
2728.95	1173.71
2735.21	1173.88
2740.21	1173.36

Material Boundary

X	Y
1896.93	1190.21
1899.05	1190.19
1915.52	1190.05
1996.36	1187.92
2023.88	1187.2
2058.68	1186.31
2079.59	1185.79
2087.13	1185.61
2098.51	1185.36
2109.56	1185.16
2130.6	1185.06
2150.3	1184.85

2163.01	1184.63
2179.69	1184.1
2189.31	1183
2247.12	1183

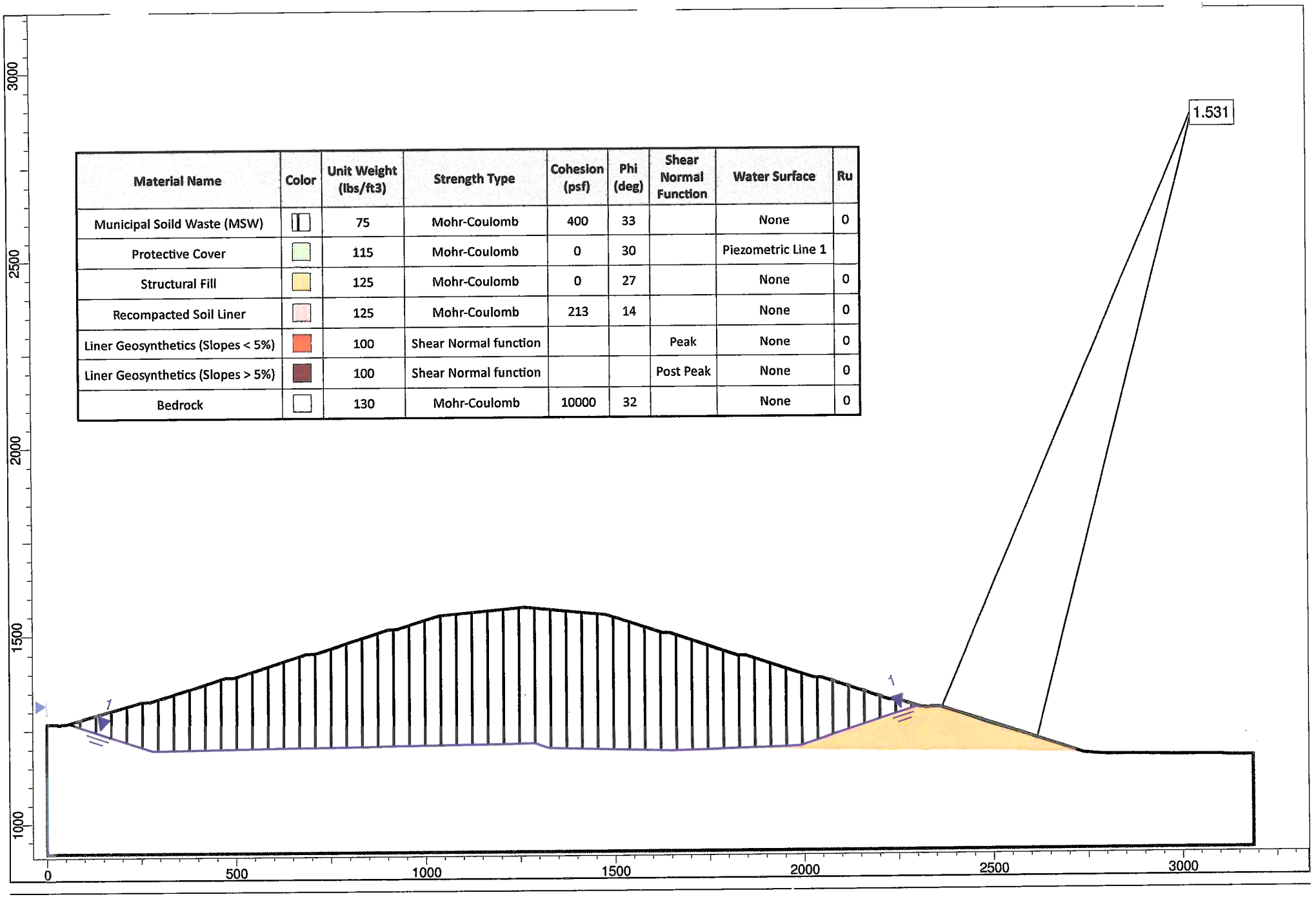
Material Boundary

X	Y
1289.14	1207.17
1289.22	1207.67

Material Boundary

X	Y
1327.37	1194.59
1327.46	1195.09

Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)	Shear Normal Function	Water Surface	Ru
Municipal Soild Waste (MSW)		75	Mohr-Coulomb	400	33		None	0
Protective Cover		115	Mohr-Coulomb	0	30		Piezometric Line 1	
Structural Fill		125	Mohr-Coulomb	0	27		None	0
Recompacted Soil Liner		125	Mohr-Coulomb	213	14		None	0
Liner Geosynthetics (Slopes < 5%)		100	Shear Normal function			Peak	None	0
Liner Geosynthetics (Slopes > 5%)		100	Shear Normal function			Post Peak	None	0
Bedrock		130	Mohr-Coulomb	10000	32		None	0



A-A -- static -- rotational -- undrained-Rev1.slim

Slide Analysis Information

Project Summary

File Name: A-A -- static -- rotational -- undrained-Rev1.slim
Slide Modeler Version: 6.023

General Settings

Units of Measurement: Imperial Units
Time Units: days
Permeability Units: feet/second
Failure Direction: Left to Right
Data Output: Standard
Maximum Material Properties: 20
Maximum Support Properties: 20

Analysis Options

Analysis Methods Used

Spencer

Number of slices: 25
Tolerance: 0.005
Maximum number of iterations: 50
Check malpha < 0.2: Yes
Initial trial value of FS: 1
Steffensen Iteration: Yes

Groundwater Analysis

Groundwater Method: Water Surfaces
Pore Fluid Unit Weight: 62.4 lbs/ft3

Advanced Groundwater Method: None

Random Numbers

Pseudo-random Seed: 10116
Random Number Generation Method: Park and Miller v.3

Surface Options

Surface Type: Circular
Search Method: Auto Refine Search
Divisions along slope: 20
Circles per division: 10
Number of iterations: 10
Divisions to use in next iteration: 50%
Composite Surfaces: Disabled
Minimum Elevation: 0
Minimum Depth: 5

Material Properties

Property	Municipal Soild Waste (MSW)	Protective Cover	Structural Fill	Recompacted Soil Liner	Liner Geosynthetics (Slopes	Liner Geosynthetics (Slopes > 5%)	Bedrock
Color							
Strength Type	Mohr-Coulomb	Mohr-Coulomb	Mohr-Coulomb	Mohr-Coulomb	Shear Normal function	Shear Normal function	Mohr-Coulomb
Unit Weight [lbs/ft3]	75	115	125	125	100	100	130
Cohesion [psf]	400	0	0	213			10000
Friction Angle [deg]	33	30	27	14			32
Water Surface	None	Piezometric Line 1	None	None	None	None	None
Hu Value		1					
Ru Value	0		0	0	0	0	0

Shear Normal Functions

Name. Peak

Normal (psf)	Shear (psf)
0	0
3000	1250
6000	2000
13500	3500

Name. Post Peak

Normal (psf)	Shear (psf)
0	0
3000	875
6000	1290
13500	2100

Global Minimums

Method: spencer

FS: 1.530960
Center: 3039.080, 2901.363
Radius: 1738.868
Left Slip Surface Endpoint: 2365.410, 1298.294
Right Slip Surface Endpoint: 2616.176, 1214.706
Resisting Moment=9.29892e+007 lb-ft
Driving Moment=6.07393e+007 lb-ft
Resisting Horizontal Force=50756.6 lb
Driving Horizontal Force=33153.6 lb
Total Slice Area=885.22 ft2

Valid / Invalid Surfaces

Method: spencer

Number of Valid Surfaces: 8821
Number of Invalid Surfaces. 0

Slice Data

Global Minimum Query (spencer) - Safety Factor: 1.53096

Slice Number	Width [ft]	Weight [lbs]	Base Material	Base Cohesion [psf]	Base Friction Angle [degrees]	Shear Stress [psf]	Shear Strength [psf]	Base Normal Stress [psf]	Pore Pressure [psf]	Effective Normal Stress [psf]
1	10.0306	523.4	Structural Fill	0	27	15.1751	23.2324	45.5962	0	45.5962
2	10.0306	1524.26	Structural Fill	0	27	44.3068	67.832	133.128	0	133.128
3	10.0306	2433.6	Structural Fill	0	27	70.9202	108.576	213.092	0	213.092
4	10.0306	3252.11	Structural Fill	0	27	95.0142	145.463	285.487	0	285.487
5	10.0306	3980.46	Structural Fill	0	27	116.588	178.491	350.309	0	350.309
6	10.0306	4619.3	Structural Fill	0	27	135.64	207.66	407.556	0	407.556
7	10.0306	5169.27	Structural Fill	0	27	152.17	232.966	457.221	0	457.221
8	10.0306	5630.99	Structural Fill	0	27	166.175	254.408	499.303	0	499.303
9	10.0306	6005.06	Structural Fill	0	27	177.655	271.982	533.794	0	533.794
10	10.0306	6292.05	Structural Fill	0	27	186.605	285.685	560.688	0	560.688
11	10.0306	6492.55	Structural Fill	0	27	193.025	295.514	579.98	0	579.98
12	10.0306	6607.09	Structural Fill	0	27	196.913	301.466	591.66	0	591.66
13	10.0306	6636.21	Structural Fill	0	27	198.264	303.534	595.72	0	595.72
14	10.0306	6580.45	Structural Fill	0	27	197.076	301.716	592.151	0	592.151
15	10.0306	6440.3	Structural Fill	0	27	193.347	296.007	580.946	0	580.946
16	10.0306	6216.25	Structural Fill	0	27	187.072	286.4	562.092	0	562.092
17	10.0306	5908.8	Structural Fill	0	27	178.248	272.891	535.579	0	535.579
18	10.0306	5518.4	Structural Fill	0	27	166.87	255.472	501.393	0	501.393
19	10.0306	5045.51	Structural Fill	0	27	152.936	234.139	459.524	0	459.524
20	10.0306	4490.56	Structural Fill	0	27	136.44	208.884	409.958	0	409.958
21	10.0306	3853.99	Structural Fill	0	27	117.377	179.699	352.68	0	352.68
22	10.0306	3136.2	Structural Fill	0	27	95.7425	146.578	287.676	0	287.676
23	10.0306	2337.6	Structural Fill	0	27	71.5316	109.512	214.929	0	214.929
24	10.0306	1458.57	Structural Fill	0	27	44.7382	68.4924	134.424	0	134.424
25	10.0306	499.5	Structural Fill	0	27	15.3974	23.5728	46.2641	0	46.2641

Interslice Data

Global Minimum Query (spencer) - Safety Factor: 1.53096

Slice Number	X coordinate [ft]	Y coordinate - Bottom [ft]	Interslice Normal Force [lbs]	Interslice Shear Force [lbs]	Interslice Force Angle [degrees]
1	2365.41	1298.29	0	0	0
2	2375.44	1294.12	38.2635	2.59825	3.88466
3	2385.47	1290.01	140.227	9.522	3.88466
4	2395.5	1285.98	287.942	19.5524	3.88465
5	2405.53	1282.02	465.235	31.5914	3.88466
6	2415.56	1278.13	657.688	44.6597	3.88465
7	2425.59	1274.31	852.601	57.895	3.88465
8	2435.62	1270.56	1038.97	70.5504	3.88466
9	2445.66	1266.89	1207.47	81.9924	3.88467
10	2455.69	1263.28	1350.43	91.6994	3.88464
11	2465.72	1259.74	1461.77	99.2602	3.88466
12	2475.75	1256.27	1537.07	104.373	3.88464
13	2485.78	1252.87	1573.45	106.843	3.88463
14	2495.81	1249.54	1569.62	106.584	3.88467
15	2505.84	1246.28	1525.85	103.611	3.88464
16	2515.87	1243.08	1443.92	98.0482	3.88466
17	2525.9	1239.95	1327.16	90.1193	3.88464
18	2535.93	1236.88	1180.37	80.1518	3.88465
19	2545.96	1233.88	1009.87	68.5745	3.88467
20	2555.99	1230.95	823.462	55.9164	3.88465
21	2566.02	1228.08	630.4	42.8067	3.88465
22	2576.05	1225.28	441.41	29.9735	3.88465
23	2586.08	1222.54	268.667	18.2436	3.88466
24	2596.11	1219.86	125.788	8.54152	3.88465
25	2606.14	1217.25	27.825	1.88943	3.88465
26	2616.18	1214.71	0	0	0

List Of Coordinates

Piezoline

X	Y
58.875	1268.87
217.897	1215.87
221.196	1214.77
280.957	1194.86
288.976	1194.97
290.76	1194.99
292.958	1195.02
303.498	1195.17
381.498	1196.23
655.075	1199.98
666.771	1200.14
668.918	1200.17
689.348	1200.45
689.605	1200.45
692.302	1200.49
696.539	1200.55
696.715	1200.55
878.471	1203.04
881.029	1203.08
888.34	1203.18
891.752	1203.22
1014.52	1204.91
1025.6	1205.06
1063.9	1205.58
1198.58	1207.43
1289.37	1208.67
1299.55	1205.32
1310.55	1201.71
1316.69	1199.69

1327.63	1196.09
1572.64	1189.55
1650.41	1187.47
1733.72	1189.92
1770.71	1191.01
1786.62	1191.47
1948.28	1196.22
1991.12	1198.29
2073.13	1225.58
2076.26	1226.63
2218.38	1273.92
2302.22	1301.82

External Boundary

X	Y
0	1267.39
-7.11e-014	917.395
3187.88	917.395
3187.88	1164.49
3168.8	1164.58
3123.89	1164.57
3101.01	1166.89
3094.63	1166.74
3066.83	1166.62
3032.96	1166.11
2982.45	1166.23
2928.57	1167.68
2860.3	1168.43
2801.49	1168.98
2766.09	1170.38
2759.08	1171.66
2740.21	1173.36
2478.3	1260.67

2360.43	1299.95
2335.42	1299.96
2329.42	1297.97
2326.42	1297.97
2320.41	1299.97
2310.92	1299.97
2309.34	1299.44
2304.59	1301.03
2303.8	1301.29
2302.22	1301.82
2246.98	1320.23
2226.89	1320.29
2060.24	1375.84
2046.89	1380.29
2028.5	1380.34
1848.06	1439.92
1846.81	1440.34
1826.73	1440.4
1646.63	1500.4
1626.6	1500.47
1478	1550
1262.76	1571.52
1039.03	1550
924.851	1513.38
924.106	1513.15
902.693	1512.92
709.533	1450.97
688.122	1450.75
494.964	1388.8
473.556	1388.58
381.867	1359.18
274.39	1326.76
250.638	1326.3
68.9007	1272.09

61.0978	1269.59
58.875	1268.87
57.2632	1268.36
56.4573	1268.1
51.6219	1266.55
50.0236	1267.08
40.4339	1267.14
34.3688	1265.18
31.3363	1265.2
25.2712	1267.24
6.39138	1267.35

Material Boundary

X	Y
56.4573	1268.1
217.423	1214.45
220.722	1213.35
280.724	1193.35
288.997	1193.47
290.781	1193.49
292.978	1193.52
303.518	1193.67
381.518	1194.73
655.096	1198.48
666.791	1198.64
668.939	1198.67
689.369	1198.95
689.626	1198.95
692.323	1198.99
696.56	1199.05
696.736	1199.05
878.492	1201.54
881.049	1201.58

888.361	1201.68
891.772	1201.72
1014.54	1203.41
1025.62	1203.56
1063.92	1204.08
1198.6	1205.93
1289.14	1207.17
1299.08	1203.9
1310.08	1200.28
1316.22	1198.26
1327.37	1194.59
1572.6	1188.05
1650.41	1185.97
1733.77	1188.42
1770.76	1189.51
1786.67	1189.97
1948.34	1194.72
1991.4	1196.8
2073.6	1224.16
2076.73	1225.2
2218.85	1272.5
2304.59	1301.03

Material Boundary

X	Y
57.2632	1268.36
217.581	1214.92
220.88	1213.83
280.802	1193.85
288.99	1193.97
290.774	1193.99
292.971	1194.02
303.511	1194.17

381.511	1195.23
655.089	1198.98
666.784	1199.14
668.932	1199.17
689.362	1199.45
689.619	1199.45
692.316	1199.49
696.553	1199.55
696.729	1199.55
878.485	1202.04
881.042	1202.08
888.354	1202.18
891.766	1202.22
1014.54	1203.91
1025.61	1204.06
1063.91	1204.58
1198.59	1206.43
1289.22	1207.67
1299.24	1204.37
1310.24	1200.76
1316.38	1198.74
1327.46	1195.09
1572.62	1188.55
1650.41	1186.47
1733.75	1188.92
1770.74	1190.01
1786.65	1190.47
1948.32	1195.22
1991.3	1197.3
2073.45	1224.63
2076.58	1225.68
2218.7	1272.97
2303.8	1301.29

Material Boundary

X	Y
58.875	1268.87
217.897	1215.87
221.196	1214.77
280.957	1194.86
288.976	1194.97
290.76	1194.99
292.958	1195.02
303.498	1195.17
381.498	1196.23
655.075	1199.98
666.771	1200.14
668.918	1200.17
689.348	1200.45
689.605	1200.45
692.302	1200.49
696.539	1200.55
696.715	1200.55
878.471	1203.04
881.029	1203.08
888.34	1203.18
891.752	1203.22
1014.52	1204.91
1025.6	1205.06
1063.9	1205.58
1198.58	1207.43
1289.37	1208.67
1299.55	1205.32
1310.55	1201.71
1316.69	1199.69
1327.63	1196.09
1572.64	1189.55
1650.41	1187.47

1733.72	1189.92
1770.71	1191.01
1786.62	1191.47
1948.28	1196.22
1991.12	1198.29
2073.13	1225.58
2076.26	1226.63
2218.38	1273.92
2302.22	1301.82

Material Boundary

X	Y
280.724	1193.35
280.802	1193.85

Material Boundary

X	Y
1991.3	1197.3
1991.4	1196.8

Material Boundary

X	Y
2759.08	1171.66
2762.03	1171.04
2766.09	1170.38

Material Boundary

X	Y
51.6219	1266.55
216.475	1211.6
280.257	1190.35

293.019	1190.52
381.559	1191.73
696.601	1196.05
891.814	1198.72
1198.64	1202.93
1288.68	1204.16
1326.85	1191.61
1572.52	1185.05
1650.41	1182.97
1733.85	1185.42
1786.75	1186.98
1896.93	1190.21
1926.95	1191.09
1948.45	1191.72
1991.95	1193.83
2309.34	1299.44

Material Boundary

X	Y
1926.95	1191.09
1951.22	1190.38
1973.97	1189.82
2012.05	1188.88
2055.85	1187.74
2088.42	1186.82
2107.13	1186.38
2134.57	1186.3
2141.85	1186
2180.21	1184.65
2183.8	1184.53
2186.21	1184.48
2203.48	1184.36
2230.83	1183.88

2237.4	1183.72
2244.36	1183.34
2245.84	1183.08
2247.12	1183
2252.2	1182.67
2255.23	1182.75
2261.98	1182.66
2265.14	1183.12
2273.56	1182.86
2289.56	1182.71
2311.23	1182.34
2331.85	1180.87
2347.09	1181.82
2361.52	1181.55
2383.63	1181.96
2388.07	1181.81
2411.52	1181.02
2412.26	1181.01
2419.26	1180.37
2459.51	1179.71
2480.58	1180.2
2517.61	1179.69
2522.5	1179.23
2548.83	1178.3
2561.21	1177.6
2593.62	1176.94
2605.16	1176.61
2614.44	1176.26
2627.39	1175.68
2634.86	1175.5
2667.89	1174.86
2694.82	1174.33
2705.07	1174.28
2728.95	1173.71

2735.21	1173.88
2740.21	1173.36

Material Boundary

X	Y
1896.93	1190.21
1899.05	1190.19
1915.52	1190.05
1996.36	1187.92
2023.88	1187.2
2058.68	1186.31
2079.59	1185.79
2087.13	1185.61
2098.51	1185.36
2109.56	1185.16
2130.6	1185.06
2150.3	1184.85
2163.01	1184.63
2179.69	1184.1
2189.31	1183
2247.12	1183

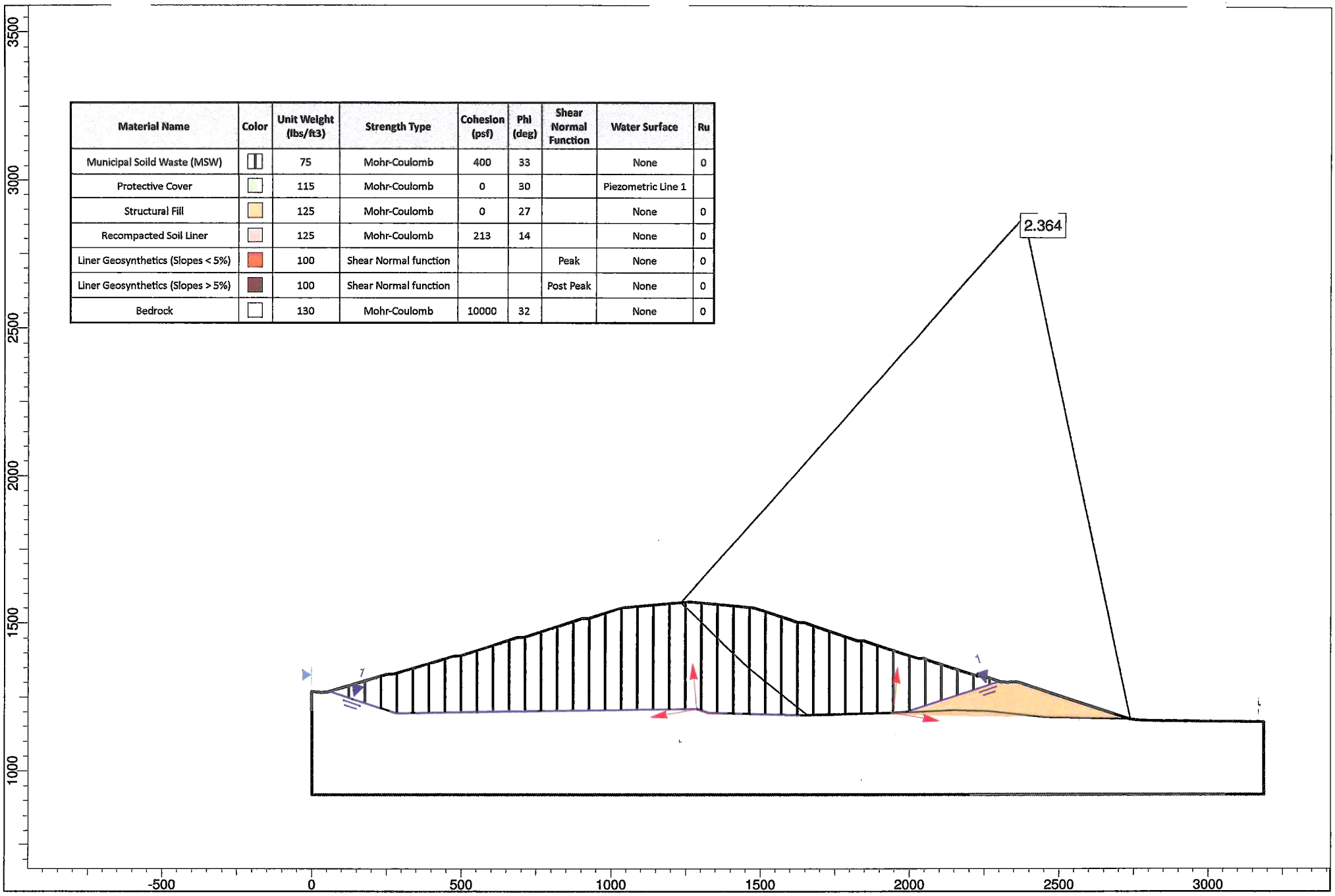
Material Boundary

X	Y
1289.14	1207.17
1289.22	1207.67

Material Boundary

X	Y
1327.37	1194.59
1327.46	1195.09

Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)	Shear Normal Function	Water Surface	Ru
Municipal Soild Waste (MSW)		75	Mohr-Coulomb	400	33		None	0
Protective Cover		115	Mohr-Coulomb	0	30		Piezometric Line 1	
Structural Fill		125	Mohr-Coulomb	0	27		None	0
Recompacted Soil Liner		125	Mohr-Coulomb	213	14		None	0
Liner Geosynthetics (Slopes < 5%)		100	Shear Normal function			Peak	None	0
Liner Geosynthetics (Slopes > 5%)		100	Shear Normal function			Post Peak	None	0
Bedrock		130	Mohr-Coulomb	10000	32		None	0



A-A -- static -- translational -- undrained-Rev1.slim

Slide Analysis Information

Project Summary

File Name A-A -- static -- translational -- undrained-Rev1.slim
Slide Modeler Version: 6.017

General Settings

Units of Measurement: Imperial Units
Time Units: days
Permeability Units: feet/second
Failure Direction: Left to Right
Data Output: Standard
Maximum Material Properties: 20
Maximum Support Properties: 20

Analysis Options

Analysis Methods Used

Spencer

Number of slices: 25
Tolerance: 0.005
Maximum number of iterations: 50
Check malpha < 0.2: Yes
Initial trial value of FS: 1
Steffensen iteration: Yes

Groundwater Analysis

Groundwater Method: Water Surfaces
Pore Fluid Unit Weight: 62.4 lbs/ft3

Advanced Groundwater Method: None

Random Numbers

Pseudo-random Seed: 10116
Random Number Generation Method: Park and Miller v.3

Surface Options

Surface Type: Non-Circular Block Search
Number of Surfaces: 5000
Pseudo-Random Surfaces Enabled
Convex Surfaces Only: Disabled
Left Projection Angle (Start Angle): 95
Left Projection Angle (End Angle): 190
Right Projection Angle (Start Angle): -10
Right Projection Angle (End Angle): 85
Minimum Elevation: Not Defined
Minimum Depth: Not Defined

Material Properties

Property	Municipal Soild Waste (MSW)	Protective Cover	Structural Fill	Recompacted Soil Liner	Liner Geosynthetics (Slopes	Liner Geosynthetics (Slopes > 5%)	Bedrock
Color							
Strength Type	Mohr-Coulomb	Mohr-Coulomb	Mohr-Coulomb	Mohr-Coulomb	Shear Normal function	Shear Normal function	Mohr-Coulomb
Unit Weight [lbs/ft3]	75	115	125	125	100	100	130
Cohesion [psf]	400	0	0	213			10000
Friction Angle [deg]	33	30	27	14			32
Water Surface	None	Piezometric Line 1	None	None	None	None	None
Hu Value		1					

Ru Value	0	0	0	0	0	0

Shear Normal Functions

Name: Peak

Normal (psf)	Shear (psf)
0	0
3000	1250
6000	2000
13500	3500

Name: Post Peak

Normal (psf)	Shear (psf)
0	0
3000	875
6000	1290
13500	2100

Global Minimums

Method: spencer

FS: 2.364110
Axis Location: 2382.183, 2877.690
Left Slip Surface Endpoint: 1233.523, 1568.711
Right Slip Surface Endpoint: 2740.170, 1173.374
Resisting Moment=1.5784e+010 lb-ft
Driving Moment=6.67651e+009 lb-ft
Resisting Horizontal Force=8.32664e+006 lb
Driving Horizontal Force=3.5221e+006 lb
Total Slice Area=231302 ft2

Global Minimum Coordinates

Method: spencer

X	Y
1233.52	1568.71
1461.71	1347.21
1659.21	1186.73
1761.84	1189.24
1938.56	1194.75
2147.36	1204.83
2265.08	1202.09
2454.62	1181.04
2721.36	1175.3
2740.17	1173.37

Valid / Invalid Surfaces

Method: spencer

Number of Valid Surfaces: 2204
Number of Invalid Surfaces: 2797

Error Codes:

Error Code -107 reported for 979 surfaces
Error Code -108 reported for 1389 surfaces
Error Code -111 reported for 99 surfaces
Error Code -112 reported for 329 surfaces
Error Code -116 reported for 1 surface

Error Codes

The following errors were encountered during the computation:

-107 = Total driving moment or total driving force is negative. This will occur if the wrong failure direction is specified, or if high external or anchor loads are applied against the failure direction.
-108 = Total driving moment or total driving force < 0.1. This is to limit the calculation of extremely high safety factors if the driving force is very small (0.1 is an arbitrary number).
-111 = safety factor equation did not converge
-112 = The coefficient M-Alpha = cos(alpha)(1+tan(alpha)tan(phi)/F) < 0.2 for the final iteration of the safety factor calculation. This screens out some slip surfaces which

may not be valid in the context of the analysis, in particular, deep seated slip surfaces with many high negative base angle slices in the passive zone.
-116 = Not enough slices to analyze the surface Increase the number of slices in the job control in the modeler.

Slice Data

Global Minimum Query (spencer) - Safety Factor: 2.36411

Slice Number	Width [ft]	Weight [lbs]	Base Material	Base Cohesion [psf]	Base Friction Angle [degrees]	Shear Stress [psf]	Shear Strength [psf]	Base Normal Stress [psf]	Pore Pressure [psf]	Effective Normal Stress [psf]
1	76.0638	215342	Municipal Soild Waste (MSW)	400	33	693.568	1639.67	1908.92	0	1908.92
2	76.0638	599442	Municipal Soild Waste (MSW)	400	33	1673.13	3955.46	5474.93	0	5474.93
3	76.0638	977251	Municipal Soild Waste (MSW)	400	33	2636.65	6233.33	8982.53	0	8982.53
4	65.4372	1.09652e+006	Municipal Soild Waste (MSW)	400	33	3586.88	8479.79	12441.8	0	12441.8
5	65.4372	1.25274e+006	Municipal Soild Waste (MSW)	400	33	4076.77	9637.94	14225.1	0	14225.1
6	65.4372	1.41726e+006	Municipal Soild Waste (MSW)	400	33	4592.64	10857.5	16103.2	0	16103.2
7	1.18475	27496.8	Protective Cover	0	30	4285.67	10131.8	17579.8	31.1211	17548.7
8	102.632	2.24561e+006	Liner Geosynthetics (Slopes < 5%)	800	11.31	2244.86	5307.1	22535.5	0	22535.5
9	88.3608	1.71215e+006	Liner Geosynthetics (Slopes < 5%)	800	11.31	2031.22	4802.02	20010.1	0	20010.1
10	88.3608	1.53665e+006	Liner Geosynthetics (Slopes < 5%)	800	11.31	1858.44	4393.56	17967.8	0	17967.8
11	10.3552	166116	Liner Geosynthetics (Slopes < 5%)	800	11.31	1749.04	4134.93	16674.6	0	16674.6
12	42.3863	648127	Liner Geosynthetics (Slopes < 5%)	800	11.31	1683.39	3979.71	15898.6	0	15898.6
13	1.84361	27049	Liner Geosynthetics (Slopes > 5%)	642	6.16405	960.501	2270.73	15080.8	0	15080.8
14	11.1143	161974	Recompacted Soil Liner	213	14	1690.56	3996.66	15175.4	0	15175.4
15	71.5507	1.01797e+006	Structural Fill	0	27	3286.73	7770.18	15249.9	0	15249.9
16	71.5507	959578	Structural Fill	0	27	3098.18	7324.45	14375	0	14375
17	58.8588	749615	Structural Fill	0	27	2848.09	6733.19	13214.6	0	13214.6
18	58.8588	744771	Structural Fill	0	27	2829.69	6689.69	13129.3	0	13129.3
19	94.771	1.23357e+006	Structural Fill	0	27	2801.13	6622.18	12996.8	0	12996.8
20	94.771	1.16154e+006	Structural Fill	0	27	2637.57	6235.5	12237.8	0	12237.8
21	63.0433	612222	Structural Fill	0	27	2173.45	5138.27	10084.4	0	10084.4
22	101.845	661762	Structural Fill	0	27	1454.26	3438.02	6747.5	0	6747.5
23	101.845	257481	Structural Fill	0	27	565.828	1337.68	2625.34	0	2625.34
24	14.4475	4836.01	Structural Fill	0	27	72.3071	170.942	335.492	0	335.492
25	4.36523	275.189	Structural Fill	0	27	13.6179	32.1943	63.1849	0	63.1849

Interslice Data

Global Minimum Query (spencer) - Safety Factor: 2.36411

Slice Number	X coordinate [ft]	Y coordinate - Bottom [ft]	Interslice Normal Force [lbs]	Interslice Shear Force [lbs]	Interslice Force Angle [degrees]
1	1233.52	1568.71	0	0	0
2	1309.59	1494.88	88186.5	18934	12.1177
3	1385.65	1421.04	365153	78399.9	12.1177
4	1461.71	1347.21	827809	177734	12.1177
5	1527.15	1294.04	1.25464e+006	269377	12.1177
6	1592.59	1240.87	1.74425e+006	374496	12.1176
7	1658.03	1187.7	2.29995e+006	493808	12.1177
8	1659.21	1186.73	2.31179e+006	496351	12.1177
9	1761.84	1189.24	2.02484e+006	434741	12.1177
10	1850.2	1192	1.79026e+006	384376	12.1177
11	1938.56	1194.75	1.57658e+006	338497	12.1176
12	1948.92	1195.25	1.55013e+006	332818	12.1176
13	1991.31	1197.3	1.44623e+006	310510	12.1176
14	1993.15	1197.39	1.44311e+006	309842	12.1177
15	2004.26	1197.92	1.41618e+006	304059	12.1176
16	2075.81	1201.38	1.12831e+006	242253	12.1177
17	2147.36	1204.83	856957	183992	12.1177
18	2206.22	1203.46	707475	151898	12.1177
19	2265.08	1202.09	558958	120010	12.1176
20	2359.85	1191.56	430278	92382.5	12.1177
21	2454.62	1181.04	309113	66367.8	12.1177
22	2517.67	1179.68	185773	39886.2	12.1177
23	2619.51	1177.49	52452.9	11261.8	12.1176
24	2721.36	1175.3	580.207	124.573	12.1177
25	2735.8	1173.82	31.2386	6.70706	12.1177
26	2740.17	1173.37	0	0	0

List Of Coordinates

Piezoline

X	Y
58.875	1268.87
217.897	1215.87
221.196	1214.77
280.957	1194.86
288.976	1194.97
290.76	1194.99
292.958	1195.02
303.498	1195.17
381.498	1196.23
655.075	1199.98
666.771	1200.14
668.918	1200.17
689.348	1200.45
689.605	1200.45
692.302	1200.49
696.539	1200.55
696.715	1200.55
878.471	1203.04
881.029	1203.08
888.34	1203.18
891.752	1203.22
1014.52	1204.91
1025.6	1205.06
1063.9	1205.58
1198.58	1207.43
1289.37	1208.67
1299.55	1205.32
1310.55	1201.71
1316.69	1199.69

1327.63	1196.09
1572.64	1189.55
1650.41	1187.47
1733.72	1189.92
1770.71	1191.01
1786.62	1191.47
1948.28	1196.22
1991.12	1198.29
2073.13	1225.58
2076.26	1226.63
2218.38	1273.92
2302.22	1301.82

Block Search Polyline

X	Y
1289.18	1207.4
1327.42	1194.84
1572.62	1188.3
1650.41	1186.21
1733.78	1188.67
1770.77	1189.76
1786.66	1190.23
1948.33	1195

External Boundary

X	Y
0	1267.39
-7.11e-014	917.395
3187.88	917.395
3187.88	1164.49
3168.8	1164.58
3123.89	1164.57

3101.01	1166.89
3094.63	1166.74
3066.83	1166.62
3032.96	1166.11
2982.45	1166.23
2928.57	1167.68
2860.3	1168.43
2801.49	1168.98
2766.09	1170.38
2759.08	1171.66
2740.21	1173.36
2478.3	1260.67
2360.43	1299.95
2335.42	1299.96
2329.42	1297.97
2326.42	1297.97
2320.41	1299.97
2310.92	1299.97
2309.34	1299.44
2304.59	1301.03
2303.8	1301.29
2302.22	1301.82
2246.98	1320.23
2226.89	1320.29
2060.24	1375.84
2046.89	1380.29
2028.5	1380.34
1848.06	1439.92
1846.81	1440.34
1826.73	1440.4
1646.63	1500.4
1626.6	1500.47
1478	1550
1262.76	1571.52

1039.03	1550
924.851	1513.38
924.106	1513.15
902.693	1512.92
709.533	1450.97
688.122	1450.75
494.964	1388.8
473.556	1388.58
381.867	1359.18
274.39	1326.76
250.638	1326.3
68.9007	1272.09
61.0978	1269.59
58.875	1268.87
57.2632	1268.36
56.4573	1268.1
51.6219	1266.55
50.0236	1267.08
40.4339	1267.14
34.3688	1265.18
31.3363	1265.2
25.2712	1267.24
6.39138	1267.35

Material Boundary

X	Y
56.4573	1268.1
217.423	1214.45
220.722	1213.35
280.724	1193.35
288.997	1193.47
290.781	1193.49
292.978	1193.52

303.518	1193.67
381.518	1194.73
655.096	1198.48
666.791	1198.64
668.939	1198.67
689.369	1198.95
689.626	1198.95
692.323	1198.99
696.56	1199.05
696.736	1199.05
878.492	1201.54
881.049	1201.58
888.361	1201.68
891.772	1201.72
1014.54	1203.41
1025.62	1203.56
1063.92	1204.08
1198.6	1205.93
1289.14	1207.17
1299.08	1203.9
1310.08	1200.28
1316.22	1198.26
1327.37	1194.59
1572.6	1188.05
1650.41	1185.97
1733.77	1188.42
1770.76	1189.51
1786.67	1189.97
1948.34	1194.72
1991.4	1196.8
2073.6	1224.16
2076.73	1225.2
2218.85	1272.5
2304.59	1301.03

Material Boundary

X	Y
57.2632	1268.36
217.581	1214.92
220.88	1213.83
280.802	1193.85
288.99	1193.97
290.774	1193.99
292.971	1194.02
303.511	1194.17
381.511	1195.23
655.089	1198.98
666.784	1199.14
668.932	1199.17
689.362	1199.45
689.619	1199.45
692.316	1199.49
696.553	1199.55
696.729	1199.55
878.485	1202.04
881.042	1202.08
888.354	1202.18
891.766	1202.22
1014.54	1203.91
1025.61	1204.06
1063.91	1204.58
1198.59	1206.43
1289.22	1207.67
1299.24	1204.37
1310.24	1200.76
1316.38	1198.74
1327.46	1195.09

1572.62	1188.55
1650.41	1186.47
1733.75	1188.92
1770.74	1190.01
1786.65	1190.47
1948.32	1195.22
1991.3	1197.3
2073.45	1224.63
2076.58	1225.68
2218.7	1272.97
2303.8	1301.29

Material Boundary

X	Y
58.875	1268.87
217.897	1215.87
221.196	1214.77
280.957	1194.86
288.976	1194.97
290.76	1194.99
292.958	1195.02
303.498	1195.17
381.498	1196.23
655.075	1199.98
666.771	1200.14
668.918	1200.17
689.348	1200.45
689.605	1200.45
692.302	1200.49
696.539	1200.55
696.715	1200.55
878.471	1203.04
881.029	1203.08

888.34	1203.18
891.752	1203.22
1014.52	1204.91
1025.6	1205.06
1063.9	1205.58
1198.58	1207.43
1289.37	1208.67
1299.55	1205.32
1310.55	1201.71
1316.69	1199.69
1327.63	1196.09
1572.64	1189.55
1650.41	1187.47
1733.72	1189.92
1770.71	1191.01
1786.62	1191.47
1948.28	1196.22
1991.12	1198.29
2073.13	1225.58
2076.26	1226.63
2218.38	1273.92
2302.22	1301.82

Material Boundary

X	Y
280.724	1193.35
280.802	1193.85

Material Boundary

X	Y
1991.3	1197.3
1991.4	1196.8

Material Boundary

X	Y
2759.08	1171.66
2762.03	1171.04
2766.09	1170.38

Material Boundary

X	Y
51.6219	1266.55
216.475	1211.6
280.257	1190.35
293.019	1190.52
381.559	1191.73
696.601	1196.05
891.814	1198.72
1198.64	1202.93
1288.68	1204.16
1326.85	1191.61
1572.52	1185.05
1650.41	1182.97
1733.85	1185.42
1786.75	1186.98
1896.93	1190.21
1926.95	1191.09
1948.45	1191.72
1991.95	1193.83
2309.34	1299.44

Material Boundary

X	Y
1926.95	1191.09

1951.22	1190.38
1973.97	1189.82
2012.05	1188.88
2055.85	1187.74
2088.42	1186.82
2107.13	1186.38
2134.57	1186.3
2141.85	1186
2180.21	1184.65
2183.8	1184.53
2186.21	1184.48
2203.48	1184.36
2230.83	1183.88
2237.4	1183.72
2244.36	1183.34
2245.84	1183.08
2247.12	1183
2252.2	1182.67
2255.23	1182.75
2261.98	1182.66
2265.14	1183.12
2273.56	1182.86
2289.56	1182.71
2311.23	1182.34
2331.85	1180.87
2347.09	1181.82
2361.52	1181.55
2383.63	1181.96
2388.07	1181.81
2411.52	1181.02
2412.26	1181.01
2419.26	1180.37
2459.51	1179.71
2480.58	1180.2

2517.61	1179.69
2522.5	1179.23
2548.83	1178.3
2561.21	1177.6
2593.62	1176.94
2605.16	1176.61
2614.44	1176.26
2627.39	1175.68
2634.86	1175.5
2667.89	1174.86
2694.82	1174.33
2705.07	1174.28
2728.95	1173.71
2735.21	1173.88
2740.21	1173.36

Material Boundary

X	Y
1896.93	1190.21
1899.05	1190.19
1915.52	1190.05
1996.36	1187.92
2023.88	1187.2
2058.68	1186.31
2079.59	1185.79
2087.13	1185.61
2098.51	1185.36
2109.56	1185.16
2130.6	1185.06
2150.3	1184.85
2163.01	1184.63
2179.69	1184.1
2189.31	1183

2247.12	1183

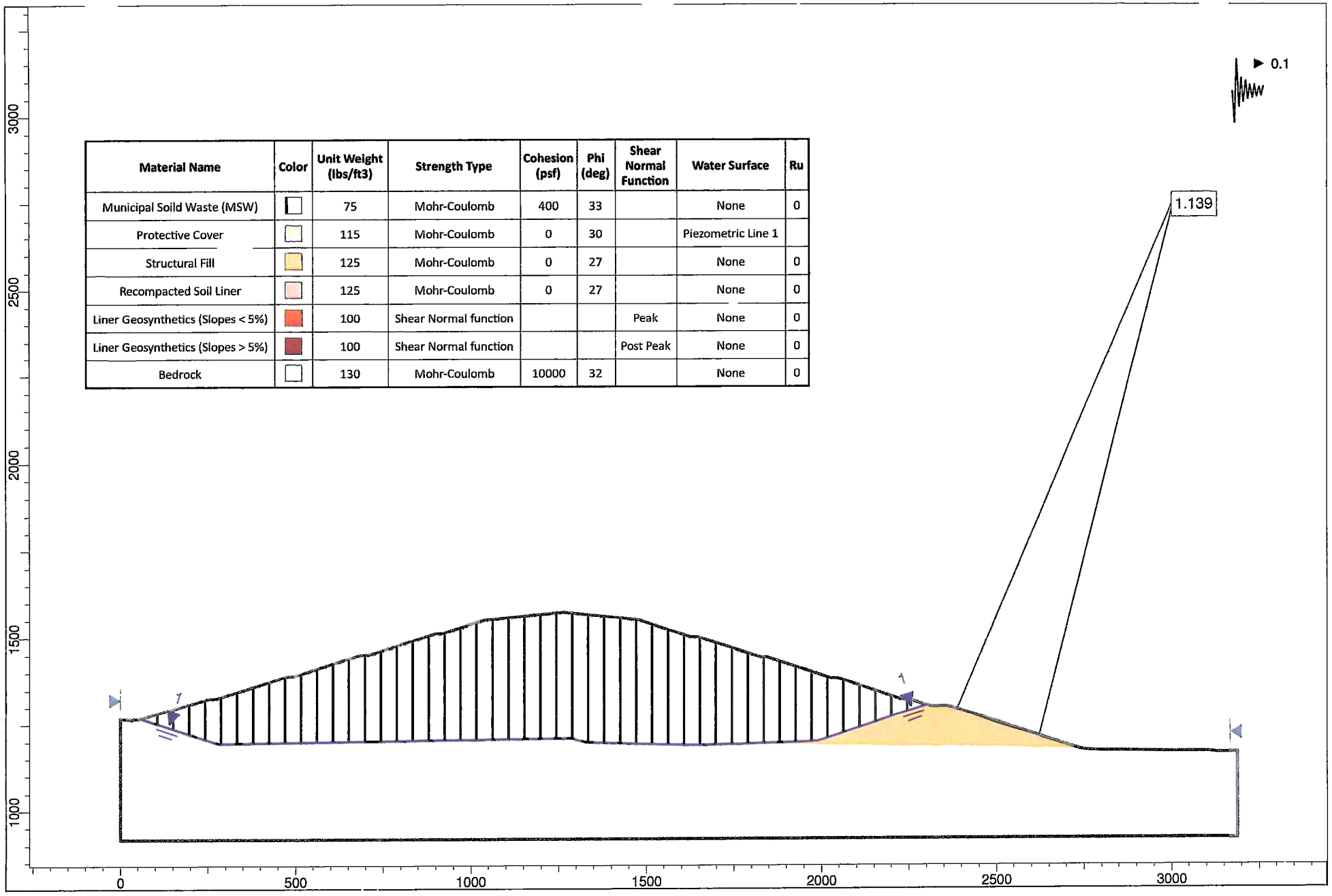
Material Boundary

X	Y
1289.14	1207.17
1289.22	1207.67

Material Boundary

X	Y
1327.37	1194.59
1327.46	1195.09

Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)	Shear Normal Function	Water Surface	Ru
Municipal Soild Waste (MSW)		75	Mohr-Coulomb	400	33		None	0
Protective Cover		115	Mohr-Coulomb	0	30		Piezometric Line 1	
Structural Fill		125	Mohr-Coulomb	0	27		None	0
Recompacted Soil Liner		125	Mohr-Coulomb	0	27		None	0
Liner Geosynthetics (Slopes < 5%)		100	Shear Normal function			Peak	None	0
Liner Geosynthetics (Slopes > 5%)		100	Shear Normal function			Post Peak	None	0
Bedrock		130	Mohr-Coulomb	10000	32		None	0



A-A -- seismic -- rotational -- drained-Rev1.slim

Slide Analysis Information

Project Summary

File Name: A-A -- seismic -- rotational -- drained-Rev1.slim
Slide Modeler Version: 6.023

General Settings

Units of Measurement: Imperial Units
Time Units: days
Permeability Units: feet/second
Failure Direction: Left to Right
Data Output: Standard
Maximum Material Properties: 20
Maximum Support Properties: 20

Analysis Options

Analysis Methods Used

Spencer

Number of slices: 25
Tolerance: 0.005
Maximum number of iterations: 50
Check malpha < 0.2: Yes
Initial trial value of FS: 1
Steffensen Iteration: Yes

Groundwater Analysis

Groundwater Method: Water Surfaces
Pore Fluid Unit Weight: 62.4 lbs/ft3
Advanced Groundwater Method: None

Random Numbers

Pseudo-random Seed: 10116
Random Number Generation Method: Park and Miller v.3

Surface Options

Surface Type: Circular
Search Method: Auto Refine Search
Divisions along slope: 20
Circles per division: 10
Number of iterations: 10
Divisions to use in next iteration: 50%
Composite Surfaces: Disabled
Minimum Elevation: 0
Minimum Depth: 5

Loading

Seismic Load Coefficient (Horizontal): 0.1

Material Properties

Property	Municipal Soild Waste (MSW)	Protective Cover	Structural Fill	Recompacted Soil Liner	Liner Geosynthetics (Slopes	Liner Geosynthetics (Slopes >5%)	Bedrock
Color							
Strength Type	Mohr-Coulomb	Mohr-Coulomb	Mohr-Coulomb	Mohr-Coulomb	Shear Normal function	Shear Normal function	Mohr-Coulomb

Unit Weight [lbs/ft3]	75	115	125	125	100	100	130
Cohesion [psf]	400	0	0	0			10000
Friction Angle [deg]	33	30	27	27			32
Water Surface	None	Piezometric Line 1	None	None	None	None	None
Hu Value		1					
Ru Value	0		0	0	0	0	0

Shear Normal Functions

Name. Peak

Normal (psf)	Shear (psf)
0	0
3000	1250
6000	2000
13500	3500

Name. Post Peak

Normal (psf)	Shear (psf)
0	0
3000	875
6000	1290
13500	2100

Global Minimums

Method: spencer

FS: 1.138570
Center: 3011.581, 2770.118
Radius: 1605.396
Left Slip Surface Endpoint: 2388.165, 1290.709

Right Slip Surface Endpoint: 2622.669, 1212.541
Resisting Moment=7.35227e+007 lb-ft
Driving Moment=6.45748e+007 lb-ft
Resisting Horizontal Force=43470 lb
Driving Horizontal Force=38179.6 lb
Total Slice Area=784.159 ft2

Valid / Invalid Surfaces

Method: spencer

Number of Valid Surfaces: 10865
Number of Invalid Surfaces: 0

Slice Data

Global Minimum Query (spencer) - Safety Factor: 1.13857

Slice Number	Width [ft]	Weight [lbs]	Base Material	Base Cohesion [psf]	Base Friction Angle [degrees]	Shear Stress [psf]	Shear Strength [psf]	Base Normal Stress [psf]	Pore Pressure [psf]	Effective Normal Stress [psf]
1	9.38017	463.801	Structural Fill	0	27	18.4844	21.0458	41.3048	0	41.3048
2	9.38017	1350.67	Structural Fill	0	27	54.0203	61.5059	120.712	0	120.712
3	9.38017	2156.38	Structural Fill	0	27	86.5488	98.5419	193.399	0	193.399
4	9.38017	2881.56	Structural Fill	0	27	116.06	132.143	259.345	0	259.345
5	9.38017	3526.8	Structural Fill	0	27	142.545	162.297	318.526	0	318.526
6	9.38017	4092.71	Structural Fill	0	27	165.993	188.995	370.922	0	370.922
7	9.38017	4579.85	Structural Fill	0	27	186.393	212.222	416.51	0	416.51
8	9.38017	4988.77	Structural Fill	0	27	203.737	231.969	455.264	0	455.264
9	9.38017	5320.02	Structural Fill	0	27	218.012	248.222	487.162	0	487.162
10	9.38017	5574.11	Structural Fill	0	27	229.207	260.968	512.179	0	512.179
11	9.38017	5751.57	Structural Fill	0	27	237.311	270.195	530.289	0	530.289
12	9.38017	5852.87	Structural Fill	0	27	242.313	275.89	541.465	0	541.465
13	9.38017	5878.52	Structural Fill	0	27	244.2	278.039	545.682	0	545.682

14	9.38017	5828.97	Structural Fill	0	27	242.961	276.628	542.912	0	542.912
15	9.38017	5704.68	Structural Fill	0	27	238.582	271.642	533.128	0	533.128
16	9.38017	5506.1	Structural Fill	0	27	231.05	263.067	516.298	0	516.298
17	9.38017	5233.64	Structural Fill	0	27	220.354	250.889	492.396	0	492.396
18	9.38017	4887.74	Structural Fill	0	27	206.478	235.09	461.391	0	461.391
19	9.38017	4468.79	Structural Fill	0	27	189.41	215.657	423.251	0	423.251
20	9.38017	3977.19	Structural Fill	0	27	169.135	192.572	377.943	0	377.943
21	9.38017	3413.32	Structural Fill	0	27	145.637	165.818	325.438	0	325.438
22	9.38017	2777.54	Structural Fill	0	27	118.904	135.38	265.698	0	265.698
23	9.38017	2070.23	Structural Fill	0	27	88.9168	101.238	198.691	0	198.691
24	9.38017	1291.72	Structural Fill	0	27	55.6631	63.3763	124.383	0	124.383
25	9.38017	442.354	Structural Fill	0	27	18.3154	20.8534	40.9272	0	40.9272

Interslice Data

Global Minimum Query (spencer) - Safety Factor 1.13857

Slice Number	X coordinate [ft]	Y coordinate - Bottom [ft]	Interslice Normal Force [lbs]	Interslice Shear Force [lbs]	Interslice Force Angle [degrees]
1	2388.17	1290.71	0	0	0
2	2397.55	1286.79	34.7379	3.99986	6.56834
3	2406.93	1282.94	127.393	14.6685	6.56832
4	2416.31	1279.16	261.747	30.1386	6.56834
5	2425.69	1275.45	423.157	48.724	6.56834
6	2435.07	1271.81	598.537	68.9179	6.56833
7	2444.45	1268.23	776.335	89.3902	6.56833
8	2453.83	1264.73	946.516	108.986	6.56836
9	2463.21	1261.28	1100.55	126.722	6.56835
10	2472.59	1257.91	1231.38	141.786	6.56834
11	2481.97	1254.6	1333.44	153.537	6.56831
12	2491.35	1251.35	1402.59	161.5	6.56835
13	2500.73	1248.17	1436.16	165.365	6.56833

14	2510.11	1245.05	1432.89	164.989	6.56835
15	2519.49	1242	1392.96	160.391	6.56834
16	2528.87	1239.01	1317.95	151.754	6.56834
17	2538.25	1236.09	1210.83	139.42	6.56835
18	2547.63	1233.22	1075.98	123.893	6.56836
19	2557.01	1230.42	919.174	105.837	6.56832
20	2566.39	1227.68	747.539	86.0746	6.56834
21	2575.77	1225.01	569.597	65.5856	6.56833
22	2585.15	1222.39	395.235	45.5089	6.56833
23	2594.53	1219.84	235.707	27.1403	6.56835
24	2603.91	1217.35	103.633	11.9327	6.56833
25	2613.29	1214.91	12.9928	1.49605	6.56837
26	2622.67	1212.54	0	0	0

List Of Coordinates

Piezoline

X	Y
58.875	1268.87
217.897	1215.87
221.196	1214.77
280.957	1194.86
288.976	1194.97
290.76	1194.99
292.958	1195.02
303.498	1195.17
381.498	1196.23
655.075	1199.98
666.771	1200.14
668.918	1200.17
689.348	1200.45

689.605	1200.45
692.302	1200.49
696.539	1200.55
696.715	1200.55
878.471	1203.04
881.029	1203.08
888.34	1203.18
891.752	1203.22
1014.52	1204.91
1025.6	1205.06
1063.9	1205.58
1198.58	1207.43
1289.37	1208.67
1299.55	1205.32
1310.55	1201.71
1316.69	1199.69
1327.63	1196.09
1572.64	1189.55
1650.41	1187.47
1733.72	1189.92
1770.71	1191.01
1786.62	1191.47
1948.28	1196.22
1991.12	1198.29
2073.13	1225.58
2076.26	1226.63
2218.38	1273.92
2302.22	1301.82

External Boundary

X	Y
0	1267.39

-7.11e-014	917.395
3187.88	917.395
3187.88	1164.49
3168.8	1164.58
3123.89	1164.57
3101.01	1166.89
3094.63	1166.74
3066.83	1166.62
3032.96	1166.11
2982.45	1166.23
2928.57	1167.68
2860.3	1168.43
2801.49	1168.98
2766.09	1170.38
2759.08	1171.66
2740.21	1173.36
2478.3	1260.67
2360.43	1299.95
2335.42	1299.96
2329.42	1297.97
2326.42	1297.97
2320.41	1299.97
2310.92	1299.97
2309.34	1299.44
2304.59	1301.03
2303.8	1301.29
2302.22	1301.82
2246.98	1320.23
2226.89	1320.29
2060.24	1375.84
2046.89	1380.29
2028.5	1380.34
1848.06	1439.92

1846.81	1440.34
1826.73	1440.4
1646.63	1500.4
1626.6	1500.47
1478	1550
1262.76	1571.52
1039.03	1550
924.851	1513.38
924.106	1513.15
902.693	1512.92
709.533	1450.97
688.122	1450.75
494.964	1388.8
473.556	1388.58
381.867	1359.18
274.39	1326.76
250.638	1326.3
68.9007	1272.09
61.0978	1269.59
58.875	1268.87
57.2632	1268.36
56.4573	1268.1
51.6219	1266.55
50.0236	1267.08
40.4339	1267.14
34.3688	1265.18
31.3363	1265.2
25.2712	1267.24
6.39138	1267.35

Material Boundary

X	Y

56.4573	1268.1
217.423	1214.45
220.722	1213.35
280.724	1193.35
288.997	1193.47
290.781	1193.49
292.978	1193.52
303.518	1193.67
381.518	1194.73
655.096	1198.48
666.791	1198.64
668.939	1198.67
689.369	1198.95
689.626	1198.95
692.323	1198.99
696.56	1199.05
696.736	1199.05
878.492	1201.54
881.049	1201.58
888.361	1201.68
891.772	1201.72
1014.54	1203.41
1025.62	1203.56
1063.92	1204.08
1198.6	1205.93
1289.14	1207.17
1299.08	1203.9
1310.08	1200.28
1316.22	1198.26
1327.37	1194.59
1572.6	1188.05
1650.41	1185.97

1733.77	1188.42
1770.76	1189.51
1786.67	1189.97
1948.34	1194.72
1991.4	1196.8
2073.6	1224.16
2076.73	1225.2
2218.85	1272.5
2304.59	1301.03

Material Boundary

X	Y
57.2632	1268.36
217.581	1214.92
220.88	1213.83
280.802	1193.85
288.99	1193.97
290.774	1193.99
292.971	1194.02
303.511	1194.17
381.511	1195.23
655.089	1198.98
666.784	1199.14
668.932	1199.17
689.362	1199.45
689.619	1199.45
692.316	1199.49
696.553	1199.55
696.729	1199.55
878.485	1202.04
881.042	1202.08
888.354	1202.18

891.766	1202.22
1014.54	1203.91
1025.61	1204.06
1063.91	1204.58
1198.59	1206.43
1289.22	1207.67
1299.24	1204.37
1310.24	1200.76
1316.38	1198.74
1327.46	1195.09
1572.62	1188.55
1650.41	1186.47
1733.75	1188.92
1770.74	1190.01
1786.65	1190.47
1948.32	1195.22
1991.3	1197.3
2073.45	1224.63
2076.58	1225.68
2218.7	1272.97
2303.8	1301.29

Material Boundary

X	Y
58.875	1268.87
217.897	1215.87
221.196	1214.77
280.957	1194.86
288.976	1194.97
290.76	1194.99
292.958	1195.02
303.498	1195.17

381.498	1196.23
655.075	1199.98
666.771	1200.14
668.918	1200.17
689.348	1200.45
689.605	1200.45
692.302	1200.49
696.539	1200.55
696.715	1200.55
878.471	1203.04
881.029	1203.08
888.34	1203.18
891.752	1203.22
1014.52	1204.91
1025.6	1205.06
1063.9	1205.58
1198.58	1207.43
1289.37	1208.67
1299.55	1205.32
1310.55	1201.71
1316.69	1199.69
1327.63	1196.09
1572.64	1189.55
1650.41	1187.47
1733.72	1189.92
1770.71	1191.01
1786.62	1191.47
1948.28	1196.22
1991.12	1198.29
2073.13	1225.58
2076.26	1226.63
2218.38	1273.92
2302.22	1301.82

Material Boundary

X	Y
280.724	1193.35
280.802	1193.85

Material Boundary

X	Y
1991.3	1197.3
1991.4	1196.8

Material Boundary

X	Y
2759.08	1171.66
2762.03	1171.04
2766.09	1170.38

Material Boundary

X	Y
51.6219	1266.55
216.475	1211.6
280.257	1190.35
293.019	1190.52
381.559	1191.73
696.601	1196.05
891.814	1198.72
1198.64	1202.93
1288.68	1204.16
1326.85	1191.61

1572.52	1185.05
1650.41	1182.97
1733.85	1185.42
1786.75	1186.98
1896.93	1190.21
1926.95	1191.09
1948.45	1191.72
1991.95	1193.83
2309.34	1299.44

Material Boundary

X	Y
1926.95	1191.09
1951.22	1190.38
1973.97	1189.82
2012.05	1188.88
2055.85	1187.74
2088.42	1186.82
2107.13	1186.38
2134.57	1186.3
2141.85	1186
2180.21	1184.65
2183.8	1184.53
2186.21	1184.48
2203.48	1184.36
2230.83	1183.88
2237.4	1183.72
2244.36	1183.34
2245.84	1183.08
2247.12	1183
2252.2	1182.67
2255.23	1182.75

2261.98	1182.66
2265.14	1183.12
2273.56	1182.86
2289.56	1182.71
2311.23	1182.34
2331.85	1180.87
2347.09	1181.82
2361.52	1181.55
2383.63	1181.96
2388.07	1181.81
2411.52	1181.02
2412.26	1181.01
2419.26	1180.37
2459.51	1179.71
2480.58	1180.2
2517.61	1179.69
2522.5	1179.23
2548.83	1178.3
2561.21	1177.6
2593.62	1176.94
2605.16	1176.61
2614.44	1176.26
2627.39	1175.68
2634.86	1175.5
2667.89	1174.86
2694.82	1174.33
2705.07	1174.28
2728.95	1173.71
2735.21	1173.88
2740.21	1173.36

Material Boundary

X	Y
1896.93	1190.21
1899.05	1190.19
1915.52	1190.05
1996.36	1187.92
2023.88	1187.2
2058.68	1186.31
2079.59	1185.79
2087.13	1185.61
2098.51	1185.36
2109.56	1185.16
2130.6	1185.06
2150.3	1184.85
2163.01	1184.63
2179.69	1184.1
2189.31	1183
2247.12	1183

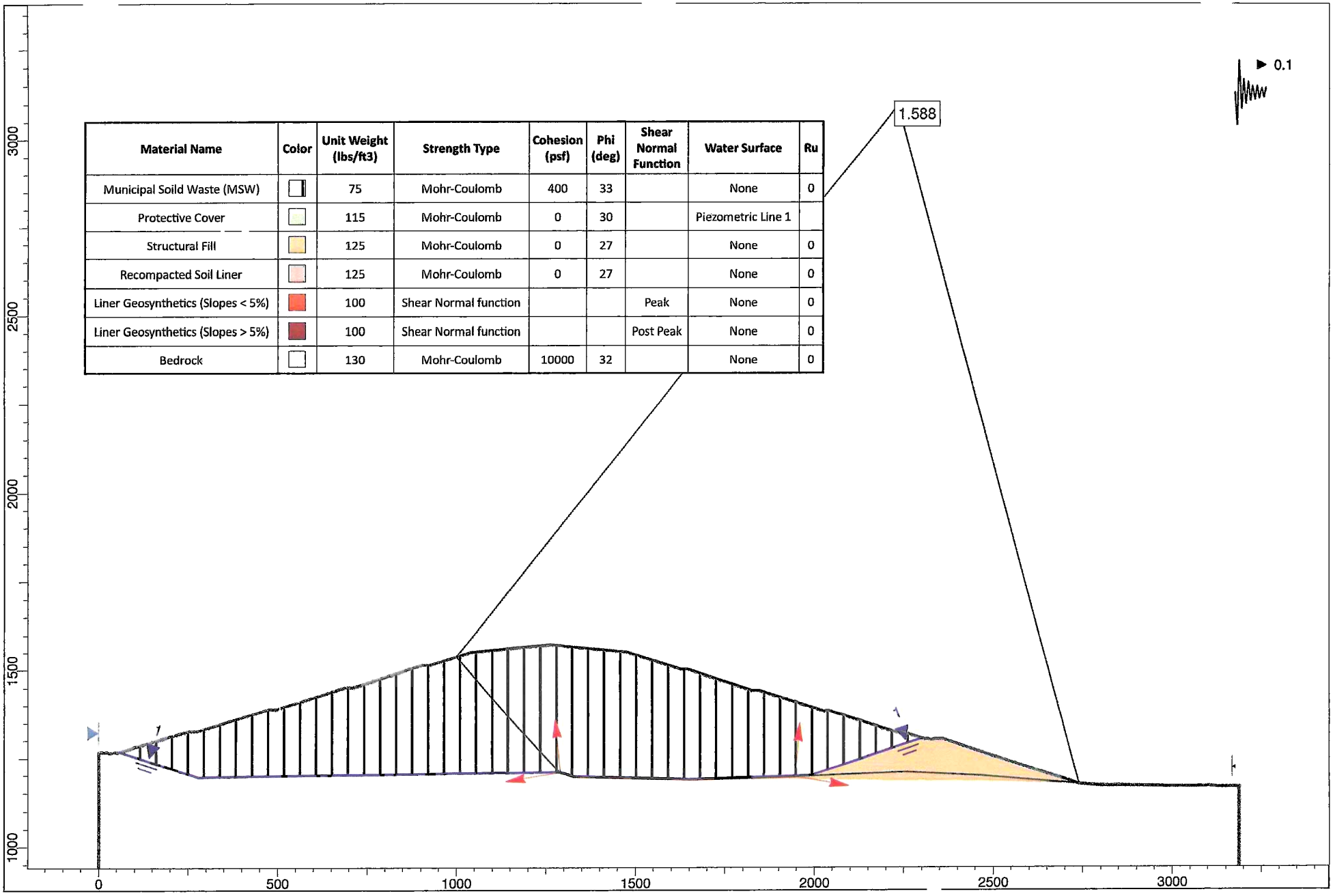
Material Boundary

X	Y
1289.14	1207.17
1289.22	1207.67

Material Boundary

X	Y
1327.37	1194.59
1327.46	1195.09

Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)	Shear Normal Function	Water Surface	Ru
Municipal Soild Waste (MSW)		75	Mohr-Coulomb	400	33		None	0
Protective Cover		115	Mohr-Coulomb	0	30		Piezometric Line 1	
Structural Fill		125	Mohr-Coulomb	0	27		None	0
Recompacted Soil Liner		125	Mohr-Coulomb	0	27		None	0
Liner Geosynthetics (Slopes < 5%)		100	Shear Normal function			Peak	None	0
Liner Geosynthetics (Slopes > 5%)		100	Shear Normal function			Post Peak	None	0
Bedrock		130	Mohr-Coulomb	10000	32		None	0



A-A -- seismic -- translational -- drained-Rev1.slim

Slide Analysis Information

Project Summary

File Name: A-A -- seismic -- translational -- drained-Rev1.slim
Slide Modeler Version: 6.023

General Settings

Units of Measurement: Imperial Units
Time Units: days
Permeability Units: feet/second
Failure Direction: Left to Right
Data Output: Standard
Maximum Material Properties: 20
Maximum Support Properties: 20

Analysis Options

Analysis Methods Used

Spencer

Number of slices: 25
Tolerance: 0.005
Maximum number of iterations: 50
Check malpha < 0.2: Yes
Initial trial value of FS: 1
Steffensen Iteration: Yes

Groundwater Analysis

Groundwater Method: Water Surfaces
Pore Fluid Unit Weight: 62.4 lbs/ft3
Advanced Groundwater Method: None

Random Numbers

Pseudo-random Seed: 10116
Random Number Generation Method: Park and Miller v.3

Surface Options

Surface Type: Non-Circular Block Search
Number of Surfaces: 5000
Pseudo-Random Surfaces: Enabled
Convex Surfaces Only: Disabled
Left Projection Angle (Start Angle): 95
Left Projection Angle (End Angle): 190
Right Projection Angle (Start Angle): -10
Right Projection Angle (End Angle): 85
Minimum Elevation: Not Defined
Minimum Depth: Not Defined

Loading

Seismic Load Coefficient (Horizontal): 0.1

Material Properties

Property	Municipal Soild Waste (MSW)	Protective Cover	Structural Fill	Recompacted Soil Liner	Liner Geosynthetics (Slopes	Liner Geosynthetics (Slopes >5%)	Bedrock
Color							

Strength Type	Mohr-Coulomb	Mohr-Coulomb	Mohr-Coulomb	Mohr-Coulomb	Shear Normal function	Shear Normal function	Mohr-Coulomb
Unit Weight [lbs/ft3]	75	115	125	125	100	100	130
Cohesion [psf]	400	0	0	0			10000
Friction Angle [deg]	33	30	27	27			32
Water Surface	None	Piezometric Line 1	None	None	None	None	None
Hu Value		1					
Ru Value	0		0	0	0	0	0

Shear Normal Functions

Name: Peak

Normal (psf)	Shear (psf)
0	0
3000	1250
6000	2000
13500	3500

Name: Post Peak

Normal (psf)	Shear (psf)
0	0
3000	875
6000	1290
13500	2100

Global Minimums

Method: spencer

FS: 1.588260
Axis Location: 2234.001, 3095.248
Left Slip Surface Endpoint: 1000.095, 1537.514

Right Slip Surface Endpoint: 2739.844, 1173.483
Resisting Moment=1.91654e+010 lb-ft
Driving Moment=1.20669e+010 lb-ft
Resisting Horizontal Force=9.16096e+006 lb
Driving Horizontal Force=5.76791e+006 lb
Total Slice Area=336726 ft2

Global Minimum Coordinates

Method: spencer

X	Y
1000.1	1537.51
1133.64	1378.95
1288.45	1207.43
1328.19	1194.87
1563.39	1188.29
1650.55	1185.98
1749.27	1188.88
1937.81	1194.84
2104.02	1200.93
2257.34	1207.03
2466.04	1197.12
2739.84	1173.48

Valid / Invalid Surfaces

Method: spencer

Number of Valid Surfaces: 2593
Number of Invalid Surfaces: 2408

Error Codes:

Error Code -107 reported for 347 surfaces
Error Code -108 reported for 1397 surfaces
Error Code -111 reported for 95 surfaces
Error Code -112 reported for 568 surfaces
Error Code -116 reported for 1 surface

Error Codes

The following errors were encountered during the computation.

-107 = Total driving moment or total driving force is negative. This will occur if the wrong failure direction is specified, or if high external or anchor loads are applied against the failure direction.
-108 = Total driving moment or total driving force < 0.1. This is to limit the calculation of extremely high safety factors if the driving force is very small (0.1 is an arbitrary number).
-111 = safety factor equation did not converge
-112 = The coefficient M-Alpha = cos(alpha)(1+tan(alpha)tan(phi)/F) < 0.2 for the final iteration of the safety factor calculation. This screens out some slip surfaces which may not be valid in the context of the analysis, in particular, deep seated slip surfaces with many high negative base angle slices in the passive zone.
-116 = Not enough slices to analyze the surface increase the number of slices in the job control in the modeler.

Slice Data

Global Minimum Query (spencer) - Safety Factor: 1.58826

Slice Number	Width [ft]	Weight [lbs]	Base Material	Base Cohesion [psf]	Base Friction Angle [degrees]	Shear Stress [psf]	Shear Strength [psf]	Base Normal Stress [psf]	Pore Pressure [psf]	Effective Normal Stress [psf]
1	66.7738	245620	Municipal Soild Waste (MSW)	400	33	1053.37	1673.03	1960.3	0	1960.3
2	66.7738	687602	Municipal Soild Waste (MSW)	400	33	2593.67	4119.43	5727.42	0	5727.42
3	76.8563	1.30517e+006	Municipal Soild Waste (MSW)	400	33	4284.01	6804.12	9861.46	0	9861.46
4	76.8563	1.83419e+006	Municipal Soild Waste (MSW)	400	33	5939.13	9432.88	13909.4	0	13909.4
5	1.09584	29694.4	Protective Cover	0	30	5915.47	9395.31	16311.5	38.3495	16273.2
6	39.7347	1.09208e+006	Liner Geosynthetics (Slopes > 5%)	642	6.16405	2066.03	3281.39	24438.7	0	24438.7
7	78.4004	2.16328e+006	Liner Geosynthetics (Slopes < 5%)	800	11.31	3980.37	6321.86	27609.3	0	27609.3
8	78.4004	2.12984e+006	Liner Geosynthetics (Slopes < 5%)	800	11.31	3926.88	6236.91	27184.5	0	27184.5
9	78.4004	2.03389e+006	Liner Geosynthetics (Slopes < 5%)	800	11.31	3773.41	5993.15	25965.7	0	25965.7

10	87.1649	2.10261e+006	Liner Geosynthetics (Slopes < 5%)	800	11.31	3547.02	5633.59	24167.9	0	24167.9
11	0.705603	16600.3	Liner Geosynthetics (Slopes < 5%)	800	11.31	3547.64	5634.58	24172.9	0	24172.9
12	98.0096	2.17429e+006	Liner Geosynthetics (Slopes < 5%)	800	11.31	3375.2	5360.7	22803.5	0	22803.5
13	94.2737	1.84748e+006	Liner Geosynthetics (Slopes < 5%)	800	11.31	3045.35	4836.81	20184.1	0	20184.1
14	94.2737	1.64799e+006	Liner Geosynthetics (Slopes < 5%)	800	11.31	2773.18	4404.53	18022.6	0	18022.6
15	10.7502	172555	Liner Geosynthetics (Slopes < 5%)	800	11.31	2594.2	4120.26	16601.3	0	16601.3
16	42.832	656168	Liner Geosynthetics (Slopes < 5%)	800	11.31	2499.87	3970.44	15852.2	0	15852.2
17	10.678	154580	Recompacted Soil Liner	0	27	5089.73	8083.82	15865.4	0	15865.4
18	101.947	1.45232e+006	Structural Fill	0	27	5008.63	7955	15612.6	0	15612.6
19	76.6565	1.01457e+006	Structural Fill	0	27	4663.14	7406.28	14535.6	0	14535.6
20	76.6565	946394	Structural Fill	0	27	4349.81	6908.63	13558.9	0	13558.9
21	104.352	1.26056e+006	Structural Fill	0	27	4016.3	6378.93	12519.3	0	12519.3
22	104.352	1.07675e+006	Structural Fill	0	27	3430.65	5448.76	10693.8	0	10693.8
23	91.2682	642988	Structural Fill	0	27	2285	3629.17	7122.66	0	7122.66
24	91.2682	385793	Structural Fill	0	27	1371	2177.5	4273.59	0	4273.59
25	91.2682	128598	Structural Fill	0	27	457	725.835	1424.53	0	1424.53

Interslice Data

Global Minimum Query (spencer) - Safety Factor: 1.58826

Slice Number	X coordinate [ft]	Y coordinate - Bottom [ft]	Interslice Normal Force [lbs]	Interslice Shear Force [lbs]	Interslice Force Angle [degrees]
1	1000.1	1537.51	0	0	0
2	1066.87	1458.23	109642	31209.3	15.8889
3	1133.64	1378.95	459296	130738	15.8889
4	1210.5	1293.8	1.1003e+006	313197	15.8888
5	1287.36	1208.64	2.01169e+006	572623	15.8889
6	1288.45	1207.43	2.02798e+006	577260	15.8889
7	1328.19	1194.87	2.36197e+006	672331	15.8889
8	1406.59	1192.68	2.32676e+006	662308	15.8889
9	1484.99	1190.49	2.29147e+006	652262	15.8889

10	1563.39	1188.29	2.25594e+006	642150	15.8889
11	1650.55	1185.98	2.21306e+006	629943	15.8889
12	1651.26	1186	2.21172e+006	629561	15.8889
13	1749.27	1188.88	2.0327e+006	578604	15.8889
14	1843.54	1191.86	1.87017e+006	532339	15.8889
15	1937.81	1194.84	1.71979e+006	489534	15.8889
16	1948.57	1195.23	1.70261e+006	484645	15.8889
17	1991.4	1196.8	1.63626e+006	465758	15.8889
18	2002.08	1197.2	1.59116e+006	452920	15.8889
19	2104.02	1200.93	1.16741e+006	332302	15.8889
20	2180.68	1203.98	867119	246824	15.8889
21	2257.34	1207.03	587002	167089	15.8889
22	2361.69	1202.07	355976	101328	15.8889
23	2466.04	1197.12	158638	45155.9	15.8889
24	2557.31	1189.24	70505.7	20069.3	15.8889
25	2648.58	1181.36	17626.4	5017.33	15.8889
26	2739.84	1173.48	0	0	0

List Of Coordinates

Piezoline

X	Y
58.875	1268.87
217.897	1215.87
221.196	1214.77
280.957	1194.86
288.976	1194.97
290.76	1194.99
292.958	1195.02
303.498	1195.17
381.498	1196.23

655.075	1199.98
666.771	1200.14
668.918	1200.17
689.348	1200.45
689.605	1200.45
692.302	1200.49
696.539	1200.55
696.715	1200.55
878.471	1203.04
881.029	1203.08
888.34	1203.18
891.752	1203.22
1014.52	1204.91
1025.6	1205.06
1063.9	1205.58
1198.58	1207.43
1289.37	1208.67
1299.55	1205.32
1310.55	1201.71
1316.69	1199.69
1327.63	1196.09
1572.64	1189.55
1650.41	1187.47
1733.72	1189.92
1770.71	1191.01
1786.62	1191.47
1948.28	1196.22
1991.12	1198.29
2073.13	1225.58
2076.26	1226.63
2218.38	1273.92
2302.22	1301.82

Block Search Polyline

X	Y
1289.18	1207.42
1327.42	1194.84
1572.6	1188.31
1650.4	1186.2
1733.75	1188.66
1770.74	1189.73
1786.65	1190.2
1948.32	1194.96

External Boundary

X	Y
0	1267.39
-7.11e-014	917.395
3187.88	917.395
3187.88	1164.49
3168.8	1164.58
3123.89	1164.57
3101.01	1166.89
3094.63	1166.74
3066.83	1166.62
3032.96	1166.11
2982.45	1166.23
2928.57	1167.68
2860.3	1168.43
2801.49	1168.98
2766.09	1170.38
2759.08	1171.66
2740.21	1173.36
2478.3	1260.67

2360.43	1299.95
2335.42	1299.96
2329.42	1297.97
2326.42	1297.97
2320.41	1299.97
2310.92	1299.97
2309.34	1299.44
2304.59	1301.03
2303.8	1301.29
2302.22	1301.82
2246.98	1320.23
2226.89	1320.29
2060.24	1375.84
2046.89	1380.29
2028.5	1380.34
1848.06	1439.92
1846.81	1440.34
1826.73	1440.4
1646.63	1500.4
1626.6	1500.47
1478	1550
1262.76	1571.52
1039.03	1550
924.851	1513.38
924.106	1513.15
902.693	1512.92
709.533	1450.97
688.122	1450.75
494.964	1388.8
473.556	1388.58
381.867	1359.18
274.39	1326.76
250.638	1326.3

68.9007	1272.09
61.0978	1269.59
58.875	1268.87
57.2632	1268.36
56.4573	1268.1
51.6219	1266.55
50.0236	1267.08
40.4339	1267.14
34.3688	1265.18
31.3363	1265.2
25.2712	1267.24
6.39138	1267.35

Material Boundary

X	Y
56.4573	1268.1
217.423	1214.45
220.722	1213.35
280.724	1193.35
288.997	1193.47
290.781	1193.49
292.978	1193.52
303.518	1193.67
381.518	1194.73
655.096	1198.48
666.791	1198.64
668.939	1198.67
689.369	1198.95
689.626	1198.95
692.323	1198.99
696.56	1199.05

696.736	1199.05
878.492	1201.54
881.049	1201.58
888.361	1201.68
891.772	1201.72
1014.54	1203.41
1025.62	1203.56
1063.92	1204.08
1198.6	1205.93
1289.14	1207.17
1299.08	1203.9
1310.08	1200.28
1316.22	1198.26
1327.37	1194.59
1572.6	1188.05
1650.41	1185.97
1733.77	1188.42
1770.76	1189.51
1786.67	1189.97
1948.34	1194.72
1991.4	1196.8
2073.6	1224.16
2076.73	1225.2
2218.85	1272.5
2304.59	1301.03

Material Boundary

X	Y
57.2632	1268.36
217.581	1214.92
220.88	1213.83
280.802	1193.85

288.99	1193.97
290.774	1193.99
292.971	1194.02
303.511	1194.17
381.511	1195.23
655.089	1198.98
666.784	1199.14
668.932	1199.17
689.362	1199.45
689.619	1199.45
692.316	1199.49
696.553	1199.55
696.729	1199.55
878.485	1202.04
881.042	1202.08
888.354	1202.18
891.766	1202.22
1014.54	1203.91
1025.61	1204.06
1063.91	1204.58
1198.59	1206.43
1289.22	1207.67
1299.24	1204.37
1310.24	1200.76
1316.38	1198.74
1327.46	1195.09
1572.62	1188.55
1650.41	1186.47
1733.75	1188.92
1770.74	1190.01
1786.65	1190.47
1948.32	1195.22
1991.3	1197.3

2073.45	1224.63
2076.58	1225.68
2218.7	1272.97
2303.8	1301.29

Material Boundary

X	Y
58.875	1268.87
217.897	1215.87
221.196	1214.77
280.957	1194.86
288.976	1194.97
290.76	1194.99
292.958	1195.02
303.498	1195.17
381.498	1196.23
655.075	1199.98
666.771	1200.14
668.918	1200.17
689.348	1200.45
689.605	1200.45
692.302	1200.49
696.539	1200.55
696.715	1200.55
878.471	1203.04
881.029	1203.08
888.34	1203.18
891.752	1203.22
1014.52	1204.91
1025.6	1205.06
1063.9	1205.58
1198.58	1207.43

1289.37	1208.67
1299.55	1205.32
1310.55	1201.71
1316.69	1199.69
1327.63	1196.09
1572.64	1189.55
1650.41	1187.47
1733.72	1189.92
1770.71	1191.01
1786.62	1191.47
1948.28	1196.22
1991.12	1198.29
2073.13	1225.58
2076.26	1226.63
2218.38	1273.92
2302.22	1301.82

Material Boundary

X	Y
280.724	1193.35
280.802	1193.85

Material Boundary

X	Y
1991.3	1197.3
1991.4	1196.8

Material Boundary

X	Y
2759.08	1171.66

2762.03	1171.04
2766.09	1170.38

Material Boundary

X	Y
51.6219	1266.55
216.475	1211.6
280.257	1190.35
293.019	1190.52
381.559	1191.73
696.601	1196.05
891.814	1198.72
1198.64	1202.93
1288.68	1204.16
1326.85	1191.61
1572.52	1185.05
1650.41	1182.97
1733.85	1185.42
1786.75	1186.98
1896.93	1190.21
1926.95	1191.09
1948.45	1191.72
1991.95	1193.83
2309.34	1299.44

Material Boundary

X	Y
1926.95	1191.09
1951.22	1190.38
1973.97	1189.82
2012.05	1188.88

2055.85	1187.74
2088.42	1186.82
2107.13	1186.38
2134.57	1186.3
2141.85	1186
2180.21	1184.65
2183.8	1184.53
2186.21	1184.48
2203.48	1184.36
2230.83	1183.88
2237.4	1183.72
2244.36	1183.34
2245.84	1183.08
2247.12	1183
2252.2	1182.67
2255.23	1182.75
2261.98	1182.66
2265.14	1183.12
2273.56	1182.86
2289.56	1182.71
2311.23	1182.34
2331.85	1180.87
2347.09	1181.82
2361.52	1181.55
2383.63	1181.96
2388.07	1181.81
2411.52	1181.02
2412.26	1181.01
2419.26	1180.37
2459.51	1179.71
2480.58	1180.2
2517.61	1179.69

2522.5	1179.23
2548.83	1178.3
2561.21	1177.6
2593.62	1176.94
2605.16	1176.61
2614.44	1176.26
2627.39	1175.68
2634.86	1175.5
2667.89	1174.86
2694.82	1174.33
2705.07	1174.28
2728.95	1173.71
2735.21	1173.88
2740.21	1173.36

Material Boundary

X	Y
1896.93	1190.21
1899.05	1190.19
1915.52	1190.05
1996.36	1187.92
2023.88	1187.2
2058.68	1186.31
2079.59	1185.79
2087.13	1185.61
2098.51	1185.36
2109.56	1185.16
2130.6	1185.06
2150.3	1184.85
2163.01	1184.63
2179.69	1184.1
2189.31	1183

2247.12	1183

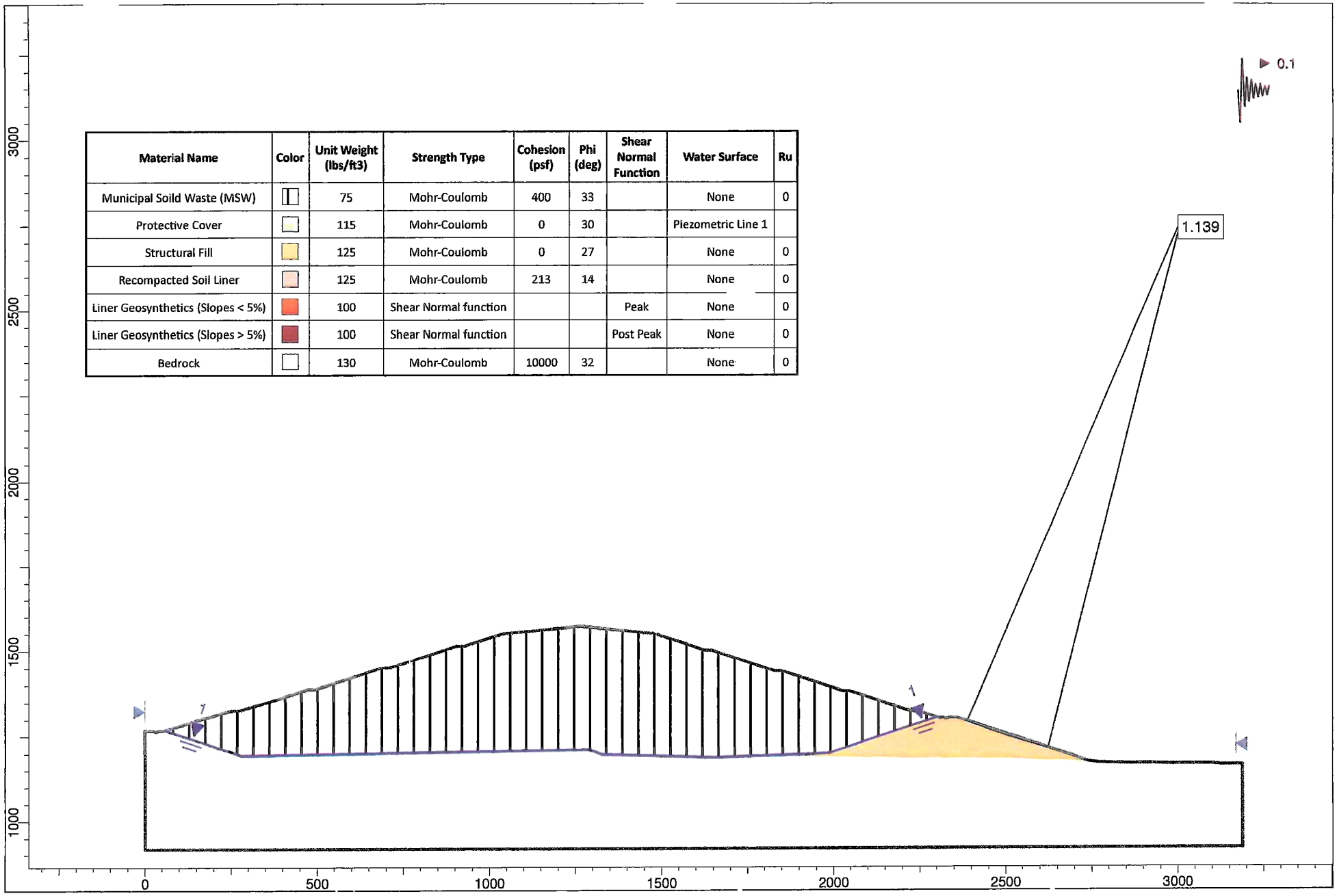
Material Boundary

X	Y
1289.14	1207.17
1289.22	1207.67

Material Boundary

X	Y
1327.37	1194.59
1327.46	1195.09

Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)	Shear Normal Function	Water Surface	Ru
Municipal Soild Waste (MSW)		75	Mohr-Coulomb	400	33		None	0
Protective Cover		115	Mohr-Coulomb	0	30		Piezometric Line 1	
Structural Fill		125	Mohr-Coulomb	0	27		None	0
Recompacted Soil Liner		125	Mohr-Coulomb	213	14		None	0
Liner Geosynthetics (Slopes < 5%)		100	Shear Normal function			Peak	None	0
Liner Geosynthetics (Slopes > 5%)		100	Shear Normal function			Post Peak	None	0
Bedrock		130	Mohr-Coulomb	10000	32		None	0



A-A -- seismic -- rotational -- undrained-Rev1.slim

Slide Analysis Information

Project Summary

File Name: A-A -- seismic -- rotational -- undrained-Rev1.slim
Slide Modeler Version: 6.023

General Settings

Units of Measurement: Imperial Units
Time Units: days
Permeability Units: feet/second
Failure Direction: Left to Right
Data Output: Standard
Maximum Material Properties: 20
Maximum Support Properties: 20

Analysis Options

Analysis Methods Used

Spencer

Number of slices: 25
Tolerance: 0.005
Maximum number of iterations: 50
Check malpha < 0.2: Yes
Initial trial value of FS: 1
Steffensen Iteration: Yes

Groundwater Analysis

Groundwater Method: Water Surfaces
Pore Fluid Unit Weight: 62.4 lbs/ft3
Advanced Groundwater Method: None

Random Numbers

Pseudo-random Seed: 10116
Random Number Generation Method: Park and Miller v.3

Surface Options

Surface Type: Circular
Search Method: Auto Refine Search
Divisions along slope: 20
Circles per division: 10
Number of iterations: 10
Divisions to use in next iteration: 50%
Composite Surfaces: Disabled
Minimum Elevation: 0
Minimum Depth: 5

Loading

Seismic Load Coefficient (Horizontal) 0.1

Material Properties

Property	Municipal Soild Waste (MSW)	Protective Cover	Structural Fill	Recompacted Soil Liner	Liner Geosynthetics (Slopes	Liner Geosynthetics (Slopes >5%)	Bedrock
Color							
Strength Type	Mohr-Coulomb	Mohr-Coulomb	Mohr-Coulomb	Mohr-Coulomb	Shear Normal function	Shear Normal function	Mohr-Coulomb

Unit Weight [lbs/ft3]	75	115	125	125	100	100	130
Cohesion [psf]	400	0	0	213			10000
Friction Angle [deg]	33	30	27	14			32
Water Surface	None	Piezometric Line 1	None	None	None	None	None
Hu Value		1					
Ru Value	0		0	0	0	0	0

Shear Normal Functions

Name: Peak

Normal (psf)	Shear (psf)
0	0
3000	1250
6000	2000
13500	3500

Name: Post Peak

Normal (psf)	Shear (psf)
0	0
3000	875
6000	1290
13500	2100

Global Minimums

Method: spencer

FS: 1.138570
Center: 3011.581, 2770.118
Radius: 1605.396
Left Slip Surface Endpoint: 2388.165, 1290.709

Right Slip Surface Endpoint: 2622.669, 1212.541
Resisting Moment=7.35227e+007 lb-ft
Driving Moment=6.45748e+007 lb-ft
Resisting Horizontal Force=43470 lb
Driving Horizontal Force=38179.6 lb
Total Slice Area=784.159 ft2

Valid / Invalid Surfaces

Method: spencer

Number of Valid Surfaces: 10865
Number of Invalid Surfaces: 0

Slice Data

Global Minimum Query (spencer) - Safety Factor: 1.13857

Slice Number	Width [ft]	Weight [lbs]	Base Material	Base Cohesion [psf]	Base Friction Angle [degrees]	Shear Stress [psf]	Shear Strength [psf]	Base Normal Stress [psf]	Pore Pressure [psf]	Effective Normal Stress [psf]
1	9.38017	463.801	Structural Fill	0	27	18.4844	21.0458	41.3048	0	41.3048
2	9.38017	1350.67	Structural Fill	0	27	54.0203	61.5059	120.712	0	120.712
3	9.38017	2156.38	Structural Fill	0	27	86.5488	98.5419	193.399	0	193.399
4	9.38017	2881.56	Structural Fill	0	27	116.06	132.143	259.345	0	259.345
5	9.38017	3526.8	Structural Fill	0	27	142.545	162.297	318.526	0	318.526
6	9.38017	4092.71	Structural Fill	0	27	165.993	188.995	370.922	0	370.922
7	9.38017	4579.85	Structural Fill	0	27	186.393	212.222	416.51	0	416.51
8	9.38017	4988.77	Structural Fill	0	27	203.737	231.969	455.264	0	455.264
9	9.38017	5320.02	Structural Fill	0	27	218.012	248.222	487.162	0	487.162
10	9.38017	5574.11	Structural Fill	0	27	229.207	260.968	512.179	0	512.179
11	9.38017	5751.57	Structural Fill	0	27	237.311	270.195	530.289	0	530.289
12	9.38017	5852.87	Structural Fill	0	27	242.313	275.89	541.465	0	541.465
13	9.38017	5878.52	Structural Fill	0	27	244.2	278.039	545.682	0	545.682

14	9.38017	5828.97	Structural Fill	0	27	242.961	276.628	542.912	0	542.912
15	9.38017	5704.68	Structural Fill	0	27	238.582	271.642	533.128	0	533.128
16	9.38017	5506.1	Structural Fill	0	27	231.05	263.067	516.298	0	516.298
17	9.38017	5233.64	Structural Fill	0	27	220.354	250.889	492.396	0	492.396
18	9.38017	4887.74	Structural Fill	0	27	206.478	235.09	461.391	0	461.391
19	9.38017	4468.79	Structural Fill	0	27	189.41	215.657	423.251	0	423.251
20	9.38017	3977.19	Structural Fill	0	27	169.135	192.572	377.943	0	377.943
21	9.38017	3413.32	Structural Fill	0	27	145.637	165.818	325.438	0	325.438
22	9.38017	2777.54	Structural Fill	0	27	118.904	135.38	265.698	0	265.698
23	9.38017	2070.23	Structural Fill	0	27	88.9168	101.238	198.691	0	198.691
24	9.38017	1291.72	Structural Fill	0	27	55.6631	63.3763	124.383	0	124.383
25	9.38017	442.354	Structural Fill	0	27	18.3154	20.8534	40.9272	0	40.9272

Interslice Data

Global Minimum Query (spencer) - Safety Factor: 1.13857

Slice Number	X coordinate [ft]	Y coordinate - Bottom [ft]	Interslice Normal Force [lbs]	Interslice Shear Force [lbs]	Interslice Force Angle [degrees]
1	2388.17	1290.71	0	0	0
2	2397.55	1286.79	34.7379	3.99986	6.56834
3	2406.93	1282.94	127.393	14.6685	6.56832
4	2416.31	1279.16	261.747	30.1386	6.56834
5	2425.69	1275.45	423.157	48.724	6.56834
6	2435.07	1271.81	598.537	68.9179	6.56833
7	2444.45	1268.23	776.335	89.3902	6.56833
8	2453.83	1264.73	946.516	108.986	6.56836
9	2463.21	1261.28	1100.55	126.722	6.56835
10	2472.59	1257.91	1231.38	141.786	6.56834
11	2481.97	1254.6	1333.44	153.537	6.56831
12	2491.35	1251.35	1402.59	161.5	6.56835
13	2500.73	1248.17	1436.16	165.365	6.56833

14	2510.11	1245.05	1432.89	164.989	6.56835
15	2519.49	1242	1392.96	160.391	6.56834
16	2528.87	1239.01	1317.95	151.754	6.56834
17	2538.25	1236.09	1210.83	139.42	6.56835
18	2547.63	1233.22	1075.98	123.893	6.56836
19	2557.01	1230.42	919.174	105.837	6.56832
20	2566.39	1227.68	747.539	86.0746	6.56834
21	2575.77	1225.01	569.597	65.5856	6.56833
22	2585.15	1222.39	395.235	45.5089	6.56833
23	2594.53	1219.84	235.707	27.1403	6.56835
24	2603.91	1217.35	103.633	11.9327	6.56833
25	2613.29	1214.91	12.9928	1.49605	6.56837
26	2622.67	1212.54	0	0	0

List Of Coordinates

Piezoline

X	Y
58.875	1268.87
217.897	1215.87
221.196	1214.77
280.957	1194.86
288.976	1194.97
290.76	1194.99
292.958	1195.02
303.498	1195.17
381.498	1196.23
655.075	1199.98
666.771	1200.14
668.918	1200.17
689.348	1200.45

689.605	1200.45
692.302	1200.49
696.539	1200.55
696.715	1200.55
878.471	1203.04
881.029	1203.08
888.34	1203.18
891.752	1203.22
1014.52	1204.91
1025.6	1205.06
1063.9	1205.58
1198.58	1207.43
1289.37	1208.67
1299.55	1205.32
1310.55	1201.71
1316.69	1199.69
1327.63	1196.09
1572.64	1189.55
1650.41	1187.47
1733.72	1189.92
1770.71	1191.01
1786.62	1191.47
1948.28	1196.22
1991.12	1198.29
2073.13	1225.58
2076.26	1226.63
2218.38	1273.92
2302.22	1301.82

External Boundary

X	Y
0	1267.39

-7.11e-014	917.395
3187.88	917.395
3187.88	1164.49
3168.8	1164.58
3123.89	1164.57
3101.01	1166.89
3094.63	1166.74
3066.83	1166.62
3032.96	1166.11
2982.45	1166.23
2928.57	1167.68
2860.3	1168.43
2801.49	1168.98
2766.09	1170.38
2759.08	1171.66
2740.21	1173.36
2478.3	1260.67
2360.43	1299.95
2335.42	1299.96
2329.42	1297.97
2326.42	1297.97
2320.41	1299.97
2310.92	1299.97
2309.34	1299.44
2304.59	1301.03
2303.8	1301.29
2302.22	1301.82
2246.98	1320.23
2226.89	1320.29
2060.24	1375.84
2046.89	1380.29
2028.5	1380.34
1848.06	1439.92

1846.81	1440.34
1826.73	1440.4
1646.63	1500.4
1626.6	1500.47
1478	1550
1262.76	1571.52
1039.03	1550
924.851	1513.38
924.106	1513.15
902.693	1512.92
709.533	1450.97
688.122	1450.75
494.964	1388.8
473.556	1388.58
381.867	1359.18
274.39	1326.76
250.638	1326.3
68.9007	1272.09
61.0978	1269.59
58.875	1268.87
57.2632	1268.36
56.4573	1268.1
51.6219	1266.55
50.0236	1267.08
40.4339	1267.14
34.3688	1265.18
31.3363	1265.2
25.2712	1267.24
6.39138	1267.35

Material Boundary

X	Y

56.4573	1268.1
217.423	1214.45
220.722	1213.35
280.724	1193.35
288.997	1193.47
290.781	1193.49
292.978	1193.52
303.518	1193.67
381.518	1194.73
655.096	1198.48
666.791	1198.64
668.939	1198.67
689.369	1198.95
689.626	1198.95
692.323	1198.99
696.56	1199.05
696.736	1199.05
878.492	1201.54
881.049	1201.58
888.361	1201.68
891.772	1201.72
1014.54	1203.41
1025.62	1203.56
1063.92	1204.08
1198.6	1205.93
1289.14	1207.17
1299.08	1203.9
1310.08	1200.28
1316.22	1198.26
1327.37	1194.59
1572.6	1188.05
1650.41	1185.97

1733.77	1188.42
1770.76	1189.51
1786.67	1189.97
1948.34	1194.72
1991.4	1196.8
2073.6	1224.16
2076.73	1225.2
2218.85	1272.5
2304.59	1301.03

Material Boundary

X	Y
57.2632	1268.36
217.581	1214.92
220.88	1213.83
280.802	1193.85
288.99	1193.97
290.774	1193.99
292.971	1194.02
303.511	1194.17
381.511	1195.23
655.089	1198.98
666.784	1199.14
668.932	1199.17
689.362	1199.45
689.619	1199.45
692.316	1199.49
696.553	1199.55
696.729	1199.55
878.485	1202.04
881.042	1202.08
888.354	1202.18

891.766	1202.22
1014.54	1203.91
1025.61	1204.06
1063.91	1204.58
1198.59	1206.43
1289.22	1207.67
1299.24	1204.37
1310.24	1200.76
1316.38	1198.74
1327.46	1195.09
1572.62	1188.55
1650.41	1186.47
1733.75	1188.92
1770.74	1190.01
1786.65	1190.47
1948.32	1195.22
1991.3	1197.3
2073.45	1224.63
2076.58	1225.68
2218.7	1272.97
2303.8	1301.29

Material Boundary

X	Y
58.875	1268.87
217.897	1215.87
221.196	1214.77
280.957	1194.86
288.976	1194.97
290.76	1194.99
292.958	1195.02
303.498	1195.17

381.498	1196.23
655.075	1199.98
666.771	1200.14
668.918	1200.17
689.348	1200.45
689.605	1200.45
692.302	1200.49
696.539	1200.55
696.715	1200.55
878.471	1203.04
881.029	1203.08
888.34	1203.18
891.752	1203.22
1014.52	1204.91
1025.6	1205.06
1063.9	1205.58
1198.58	1207.43
1289.37	1208.67
1299.55	1205.32
1310.55	1201.71
1316.69	1199.69
1327.63	1196.09
1572.64	1189.55
1650.41	1187.47
1733.72	1189.92
1770.71	1191.01
1786.62	1191.47
1948.28	1196.22
1991.12	1198.29
2073.13	1225.58
2076.26	1226.63
2218.38	1273.92
2302.22	1301.82

Material Boundary

X	Y
280.724	1193.35
280.802	1193.85

Material Boundary

X	Y
1991.3	1197.3
1991.4	1196.8

Material Boundary

X	Y
2759.08	1171.66
2762.03	1171.04
2766.09	1170.38

Material Boundary

X	Y
51.6219	1266.55
216.475	1211.6
280.257	1190.35
293.019	1190.52
381.559	1191.73
696.601	1196.05
891.814	1198.72
1198.64	1202.93
1288.68	1204.16
1326.85	1191.61

1572.52	1185.05
1650.41	1182.97
1733.85	1185.42
1786.75	1186.98
1896.93	1190.21
1926.95	1191.09
1948.45	1191.72
1991.95	1193.83
2309.34	1299.44

Material Boundary

X	Y
1926.95	1191.09
1951.22	1190.38
1973.97	1189.82
2012.05	1188.88
2055.85	1187.74
2088.42	1186.82
2107.13	1186.38
2134.57	1186.3
2141.85	1186
2180.21	1184.65
2183.8	1184.53
2186.21	1184.48
2203.48	1184.36
2230.83	1183.88
2237.4	1183.72
2244.36	1183.34
2245.84	1183.08
2247.12	1183
2252.2	1182.67
2255.23	1182.75

2261.98	1182.66
2265.14	1183.12
2273.56	1182.86
2289.56	1182.71
2311.23	1182.34
2331.85	1180.87
2347.09	1181.82
2361.52	1181.55
2383.63	1181.96
2388.07	1181.81
2411.52	1181.02
2412.26	1181.01
2419.26	1180.37
2459.51	1179.71
2480.58	1180.2
2517.61	1179.69
2522.5	1179.23
2548.83	1178.3
2561.21	1177.6
2593.62	1176.94
2605.16	1176.61
2614.44	1176.26
2627.39	1175.68
2634.86	1175.5
2667.89	1174.86
2694.82	1174.33
2705.07	1174.28
2728.95	1173.71
2735.21	1173.88
2740.21	1173.36

Material Boundary

X	Y
1896.93	1190.21
1899.05	1190.19
1915.52	1190.05
1996.36	1187.92
2023.88	1187.2
2058.68	1186.31
2079.59	1185.79
2087.13	1185.61
2098.51	1185.36
2109.56	1185.16
2130.6	1185.06
2150.3	1184.85
2163.01	1184.63
2179.69	1184.1
2189.31	1183
2247.12	1183

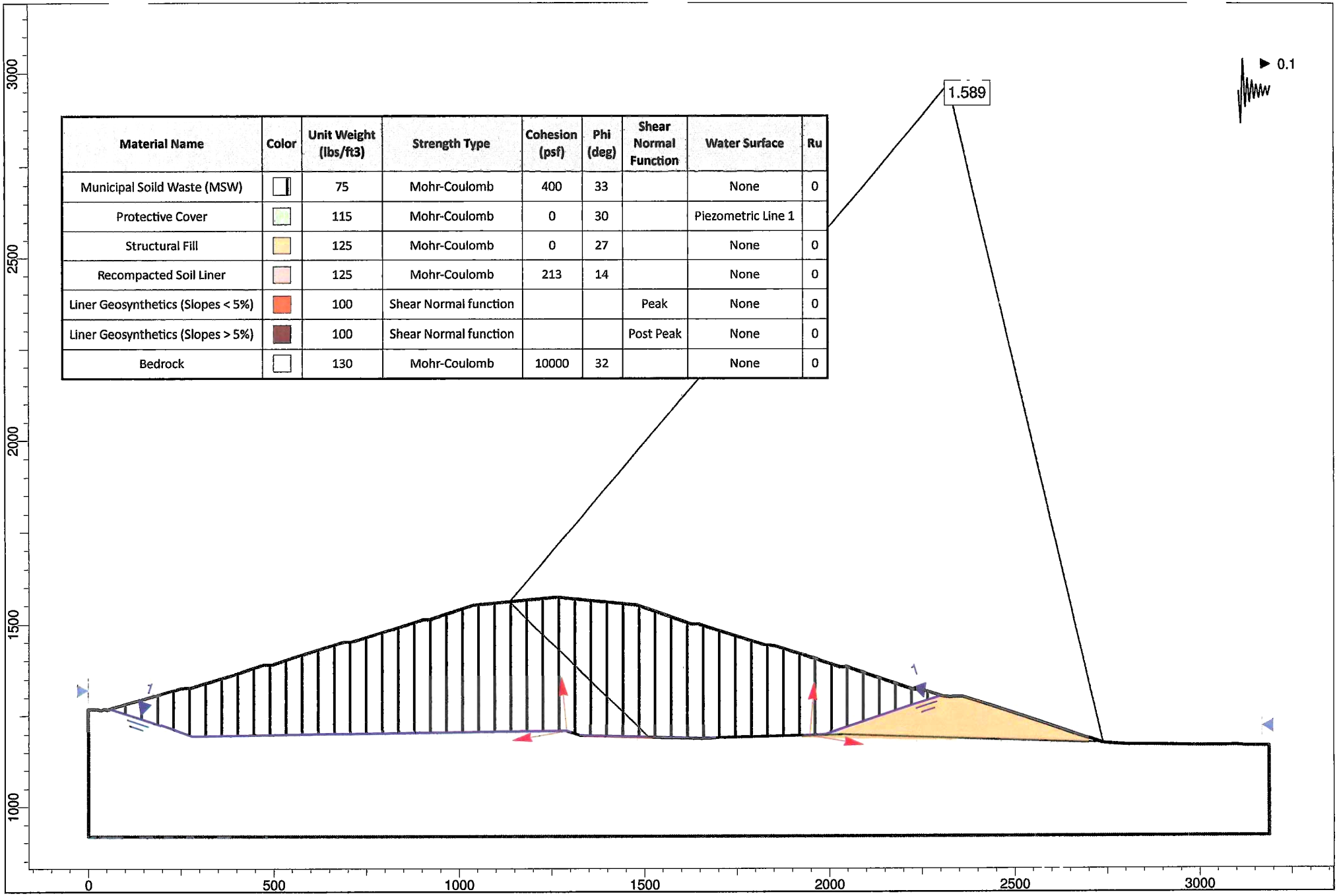
Material Boundary

X	Y
1289.14	1207.17
1289.22	1207.67

Material Boundary

X	Y
1327.37	1194.59
1327.46	1195.09

Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)	Shear Normal Function	Water Surface	Ru
Municipal Soild Waste (MSW)		75	Mohr-Coulomb	400	33		None	0
Protective Cover		115	Mohr-Coulomb	0	30		Piezometric Line 1	
Structural Fill		125	Mohr-Coulomb	0	27		None	0
Recompacted Soil Liner		125	Mohr-Coulomb	213	14		None	0
Liner Geosynthetics (Slopes < 5%)		100	Shear Normal function			Peak	None	0
Liner Geosynthetics (Slopes > 5%)		100	Shear Normal function			Post Peak	None	0
Bedrock		130	Mohr-Coulomb	10000	32		None	0



A-A -- seismic -- translational -- undrained-Rev1.slim

Slide Analysis Information

Project Summary

File Name: A-A -- seismic -- translational -- undrained-Rev1.slim
Slide Modeler Version: 6.023

General Settings

Units of Measurement: Imperial Units
Time Units: days
Permeability Units: feet/second
Failure Direction: Left to Right
Data Output: Standard
Maximum Material Properties: 20
Maximum Support Properties: 20

Analysis Options

Analysis Methods Used

Spencer

Number of slices: 25
Tolerance: 0.005
Maximum number of iterations: 50
Check malpha < 0.2: Yes
Initial trial value of FS: 1
Steffensen Iteration: Yes

Groundwater Analysis

Groundwater Method: Water Surfaces
Pore Fluid Unit Weight: 62.4 lbs/ft3

Advanced Groundwater Method: None

Random Numbers

Pseudo-random Seed: 10116
Random Number Generation Method: Park and Miller v.3

Surface Options

Surface Type: Non-Circular Block Search
Number of Surfaces: 5000
Pseudo-Random Surfaces: Enabled
Convex Surfaces Only: Disabled
Left Projection Angle (Start Angle): 95
Left Projection Angle (End Angle): 190
Right Projection Angle (Start Angle): -10
Right Projection Angle (End Angle): 85
Minimum Elevation: Not Defined
Minimum Depth: Not Defined

Loading

Seismic Load Coefficient (Horizontal): 0.1

Material Properties

Property	Municipal Soild Waste (MSW)	Protective Cover	Structural Fill	Recompacted Soil Liner	Liner Geosynthetics (Slopes	Liner Geosynthetics (Slopes > 5%)	Bedrock
Color							
Strength Type	Mohr-Coulomb	Mohr-Coulomb	Mohr-Coulomb	Mohr-Coulomb	Shear Normal function	Shear Normal function	Mohr-Coulomb
Unit Weight [lbs/ft3]	75	115	125	125	100	100	130
Cohesion [psf]	400	0	0	213			10000

Friction Angle [deg]	33	30	27	14			32
Water Surface	None	Piezometric Line 1	None	None	None	None	None
Hu Value		1					
Ru Value	0		0	0	0	0	0

Shear Normal Functions

Name: Peak

Normal (psf)	Shear (psf)
0	0
3000	1250
6000	2000
13500	3500

Name: Post Peak

Normal (psf)	Shear (psf)
0	0
3000	875
6000	1290
13500	2100

Global Minimums

Method: spencer

FS. 1.589150
Axis Location: 2322.772, 2970.266
Left Slip Surface Endpoint: 1135.346, 1559.266
Right Slip Surface Endpoint: 2739.116, 1173.725
Resisting Moment=1.7517e+010 lb-ft
Driving Moment=1.10229e+010 lb-ft
Resisting Horizontal Force=8.85321e+006 lb
Driving Horizontal Force=5.57102e+006 lb
Total Slice Area=277796 ft2

Global Minimum Coordinates

Method: spencer

X	Y
1135.35	1559.27
1512.05	1190.17
1563.61	1188.29
1651.15	1185.99
1744.7	1188.74
1770.16	1189.49
2038.44	1198.12
2739.12	1173.73

Valid / Invalid Surfaces

Method: spencer

Number of Valid Surfaces: 2598
Number of Invalid Surfaces: 2403

Error Codes:

Error Code -107 reported for 347 surfaces
Error Code -108 reported for 1400 surfaces
Error Code -111 reported for 87 surfaces
Error Code -112 reported for 568 surfaces
Error Code -116 reported for 1 surface

Error Codes

The following errors were encountered during the computation:

-107 = Total driving moment or total driving force is negative. This will occur if the wrong failure direction is specified, or if high external or anchor loads are applied against the failure direction.
-108 = Total driving moment or total driving force < 0.1. This is to limit the calculation of extremely high safety factors if the driving force is very small (0.1 is an arbitrary

number).
-111 = safety factor equation did not converge
-112 = The coefficient M-Alpha = cos(alpha)(1+tan(alpha)tan(phi)/F) < 0.2 for the final iteration of the safety factor calculation. This screens out some slip surfaces which may not be valid in the context of the analysis, in particular, deep seated slip surfaces with many high negative base angle slices in the passive zone.
-116 = Not enough slices to analyze the surface Increase the number of slices in the job control in the modeler.

Slice Data

Global Minimum Query (spencer) - Safety Factor: 1.58915

Slice Number	Width [ft]	Weight [lbs]	Base Material	Base Cohesion [psf]	Base Friction Angle [degrees]	Shear Stress [psf]	Shear Strength [psf]	Base Normal Stress [psf]	Pore Pressure [psf]	Effective Normal Stress [psf]
1	75.1312	227767	Municipal Soild Waste (MSW)	400	33	968.48	1539.06	1753.99	0	1753.99
2	75.1312	679461	Municipal Soild Waste (MSW)	400	33	2476.22	3935.09	5443.57	0	5443.57
3	75.1312	1.07205e+006	Municipal Soild Waste (MSW)	400	33	3786.66	6017.57	8650.3	0	8650.3
4	75.1312	1.44452e+006	Municipal Soild Waste (MSW)	400	33	5029.96	7993.36	11692.8	0	11692.8
5	75.1312	1.80746e+006	Municipal Soild Waste (MSW)	400	33	6241.45	9918.6	14657.4	0	14657.4
6	1.04294	27252.7	Protective Cover	0	30	5930.5	9424.45	16354.6	31.0144	16323.6
7	51.5659	1.32051e+006	Liner Geosynthetics (Slopes < 5%)	800	11.31	3718.03	5908.5	25542.5	0	25542.5
8	87.5413	2.11099e+006	Liner Geosynthetics (Slopes < 5%)	800	11.31	3546.24	5635.51	24177.5	0	24177.5
9	93.5521	2.07929e+006	Liner Geosynthetics (Slopes < 5%)	800	11.31	3385.22	5379.62	22898.1	0	22898.1
10	3.72836	78017.8	Liner Geosynthetics (Slopes < 5%)	800	11.31	3218.05	5113.96	21569.8	0	21569.8
11	21.7294	447176	Liner Geosynthetics (Slopes < 5%)	800	11.31	3173.51	5043.19	21215.9	0	21215.9
12	89.1249	1.70991e+006	Liner Geosynthetics (Slopes < 5%)	800	11.31	2997.53	4763.53	19817.6	0	19817.6
13	89.1249	1.52594e+006	Liner Geosynthetics (Slopes < 5%)	800	11.31	2731.66	4341.02	17705.1	0	17705.1
14	30.9394	479337	Liner Geosynthetics (Slopes < 5%)	800	11.31	2521.9	4007.68	16038.4	0	16038.4
15	21.9154	324840	Recompacted Soil Liner	213	14	2548.92	4050.61	15391.8	0	15391.8
16	37.1754	537204	Structural Fill	0	27	5103.1	8109.59	15916	0	15916
17	87.1343	1.26005e+006	Structural Fill	0	27	4872.03	7742.39	15195.3	0	15195.3
18	87.1343	1.2305e+006	Structural Fill	0	27	4757.77	7560.81	14838.9	0	14838.9
19	87.1343	1.23139e+006	Structural Fill	0	27	4761.21	7566.28	14849.7	0	14849.7
20	87.1343	1.20895e+006	Structural Fill	0	27	4674.45	7428.41	14579.1	0	14579.1
21	87.1343	1.00327e+006	Structural Fill	0	27	3879.17	6164.59	12098.7	0	12098.7
22	87.1343	719963	Structural Fill	0	27	2783.77	4423.83	8682.25	0	8682.25
23	87.1343	436659	Structural Fill	0	27	1688.36	2683.06	5265.8	0	5265.8

24	87.1343	153356	Structural Fill	0	27	592.957	942.298	1849.37	0	1849.37
25	3.59974	241.761	Structural Fill	0	27	22.627	35.9577	70.571	0	70.571

Interslice Data

Global Minimum Query (spencer) - Safety Factor: 1.58915

Slice Number	X coordinate [ft]	Y coordinate - Bottom [ft]	Interslice Normal Force [lbs]	Interslice Shear Force [lbs]	Interslice Force Angle [degrees]
1	1135.35	1559.27	0	0	0
2	1210.48	1485.65	79133.3	24693.4	17.3304
3	1285.61	1412.04	361763	112888	17.3305
4	1360.74	1338.42	821259	256273	17.3305
5	1435.87	1264.81	1.44856e+006	452021	17.3305
6	1511	1191.19	2.23937e+006	698792	17.3305
7	1512.05	1190.17	2.25262e+006	702928	17.3305
8	1563.61	1188.29	2.24105e+006	699316	17.3304
9	1651.15	1185.99	2.19719e+006	685628	17.3304
10	1744.7	1188.74	2.02552e+006	632059	17.3304
11	1748.43	1188.85	2.01895e+006	630010	17.3304
12	1770.16	1189.49	1.98113e+006	618208	17.3304
13	1859.29	1192.36	1.82814e+006	570468	17.3304
14	1948.41	1195.23	1.6865e+006	526271	17.3305
15	1979.35	1196.22	1.64045e+006	511899	17.3304
16	2001.27	1196.93	1.60622e+006	501217	17.3304
17	2038.44	1198.12	1.45119e+006	452842	17.3305
18	2125.58	1195.09	1.19878e+006	374077	17.3304
19	2212.71	1192.05	952286	297159	17.3304
20	2299.85	1189.02	705614	220186	17.3305
21	2386.98	1185.99	463438	144615	17.3304
22	2474.11	1182.95	262463	81901.2	17.3305
23	2561.25	1179.92	118240	36896.7	17.3305
24	2648.38	1176.88	30768.7	9601.31	17.3304
25	2735.52	1173.85	48.4294	15.1123	17.3304

26	2739.12	1173.73	0	0	0

List Of Coordinates

Piezoline

X	Y
58.875	1268.87
217.897	1215.87
221.196	1214.77
280.957	1194.86
288.976	1194.97
290.76	1194.99
292.958	1195.02
303.498	1195.17
381.498	1196.23
655.075	1199.98
666.771	1200.14
668.918	1200.17
689.348	1200.45
689.605	1200.45
692.302	1200.49
696.539	1200.55
696.715	1200.55
878.471	1203.04
881.029	1203.08
888.34	1203.18
891.752	1203.22
1014.52	1204.91
1025.6	1205.06
1063.9	1205.58
1198.58	1207.43
1289.37	1208.67
1299.55	1205.32

1310.55	1201.71
1316.69	1199.69
1327.63	1196.09
1572.64	1189.55
1650.41	1187.47
1733.72	1189.92
1770.71	1191.01
1786.62	1191.47
1948.28	1196.22
1991.12	1198.29
2073.13	1225.58
2076.26	1226.63
2218.38	1273.92
2302.22	1301.82

Block Search Polyline

X	Y
1289.18	1207.41
1327.41	1194.83
1572.61	1188.29
1650.39	1186.19
1733.74	1188.65
1786.66	1190.23
1948.31	1194.97

External Boundary

X	Y
0	1267.39
-7.11e-014	917.395
3187.88	917.395
3187.88	1164.49
3168.8	1164.58

3123.89	1164.57
3101.01	1166.89
3094.63	1166.74
3066.83	1166.62
3032.96	1166.11
2982.45	1166.23
2928.57	1167.68
2860.3	1168.43
2801.49	1168.98
2766.09	1170.38
2759.08	1171.66
2740.21	1173.36
2478.3	1260.67
2360.43	1299.95
2335.42	1299.96
2329.42	1297.97
2326.42	1297.97
2320.41	1299.97
2310.92	1299.97
2309.34	1299.44
2304.59	1301.03
2303.8	1301.29
2302.22	1301.82
2246.98	1320.23
2226.89	1320.29
2060.24	1375.84
2046.89	1380.29
2028.5	1380.34
1848.06	1439.92
1846.81	1440.34
1826.73	1440.4
1646.63	1500.4
1626.6	1500.47
1478	1550

1262.76	1571.52
1039.03	1550
924.851	1513.38
924.106	1513.15
902.693	1512.92
709.533	1450.97
688.122	1450.75
494.964	1388.8
473.556	1388.58
381.867	1359.18
274.39	1326.76
250.638	1326.3
68.9007	1272.09
61.0978	1269.59
58.875	1268.87
57.2632	1268.36
56.4573	1268.1
51.6219	1266.55
50.0236	1267.08
40.4339	1267.14
34.3688	1265.18
31.3363	1265.2
25.2712	1267.24
6.39138	1267.35

Material Boundary

X	Y
56.4573	1268.1
217.423	1214.45
220.722	1213.35
280.724	1193.35
288.997	1193.47
290.781	1193.49

292.978	1193.52
303.518	1193.67
381.518	1194.73
655.096	1198.48
666.791	1198.64
668.939	1198.67
689.369	1198.95
689.626	1198.95
692.323	1198.99
696.56	1199.05
696.736	1199.05
878.492	1201.54
881.049	1201.58
888.361	1201.68
891.772	1201.72
1014.54	1203.41
1025.62	1203.56
1063.92	1204.08
1198.6	1205.93
1289.14	1207.17
1299.08	1203.9
1310.08	1200.28
1316.22	1198.26
1327.37	1194.59
1572.6	1188.05
1650.41	1185.97
1733.77	1188.42
1770.76	1189.51
1786.67	1189.97
1948.34	1194.72
1991.4	1196.8
2073.6	1224.16
2076.73	1225.2
2218.85	1272.5

2304.59	1301.03

Material Boundary

X	Y
57.2632	1268.36
217.581	1214.92
220.88	1213.83
280.802	1193.85
288.99	1193.97
290.774	1193.99
292.971	1194.02
303.511	1194.17
381.511	1195.23
655.089	1198.98
666.784	1199.14
668.932	1199.17
689.362	1199.45
689.619	1199.45
692.316	1199.49
696.553	1199.55
696.729	1199.55
878.485	1202.04
881.042	1202.08
888.354	1202.18
891.766	1202.22
1014.54	1203.91
1025.61	1204.06
1063.91	1204.58
1198.59	1206.43
1289.22	1207.67
1299.24	1204.37
1310.24	1200.76
1316.38	1198.74

1327.46	1195.09
1572.62	1188.55
1650.41	1186.47
1733.75	1188.92
1770.74	1190.01
1786.65	1190.47
1948.32	1195.22
1991.3	1197.3
2073.45	1224.63
2076.58	1225.68
2218.7	1272.97
2303.8	1301.29

Material Boundary

X	Y
58.875	1268.87
217.897	1215.87
221.196	1214.77
280.957	1194.86
288.976	1194.97
290.76	1194.99
292.958	1195.02
303.498	1195.17
381.498	1196.23
655.075	1199.98
666.771	1200.14
668.918	1200.17
689.348	1200.45
689.605	1200.45
692.302	1200.49
696.539	1200.55
696.715	1200.55
878.471	1203.04

881.029	1203.08
888.34	1203.18
891.752	1203.22
1014.52	1204.91
1025.6	1205.06
1063.9	1205.58
1198.58	1207.43
1289.37	1208.67
1299.55	1205.32
1310.55	1201.71
1316.69	1199.69
1327.63	1196.09
1572.64	1189.55
1650.41	1187.47
1733.72	1189.92
1770.71	1191.01
1786.62	1191.47
1948.28	1196.22
1991.12	1198.29
2073.13	1225.58
2076.26	1226.63
2218.38	1273.92
2302.22	1301.82

Material Boundary

X	Y
280.724	1193.35
280.802	1193.85

Material Boundary

X	Y
1991.3	1197.3

1991.4	1196.8

Material Boundary

X	Y
2759.08	1171.66
2762.03	1171.04
2766.09	1170.38

Material Boundary

X	Y
51.6219	1266.55
216.475	1211.6
280.257	1190.35
293.019	1190.52
381.559	1191.73
696.601	1196.05
891.814	1198.72
1198.64	1202.93
1288.68	1204.16
1326.85	1191.61
1572.52	1185.05
1650.41	1182.97
1733.85	1185.42
1786.75	1186.98
1896.93	1190.21
1926.95	1191.09
1948.45	1191.72
1991.95	1193.83
2309.34	1299.44

Material Boundary

X	Y

1926.95	1191.09
1951.22	1190.38
1973.97	1189.82
2012.05	1188.88
2055.85	1187.74
2088.42	1186.82
2107.13	1186.38
2134.57	1186.3
2141.85	1186
2180.21	1184.65
2183.8	1184.53
2186.21	1184.48
2203.48	1184.36
2230.83	1183.88
2237.4	1183.72
2244.36	1183.34
2245.84	1183.08
2247.12	1183
2252.2	1182.67
2255.23	1182.75
2261.98	1182.66
2265.14	1183.12
2273.56	1182.86
2289.56	1182.71
2311.23	1182.34
2331.85	1180.87
2347.09	1181.82
2361.52	1181.55
2383.63	1181.96
2388.07	1181.81
2411.52	1181.02
2412.26	1181.01
2419.26	1180.37
2459.51	1179.71

2480.58	1180.2
2517.61	1179.69
2522.5	1179.23
2548.83	1178.3
2561.21	1177.6
2593.62	1176.94
2605.16	1176.61
2614.44	1176.26
2627.39	1175.68
2634.86	1175.5
2667.89	1174.86
2694.82	1174.33
2705.07	1174.28
2728.95	1173.71
2735.21	1173.88
2740.21	1173.36

Material Boundary

X	Y
1896.93	1190.21
1899.05	1190.19
1915.52	1190.05
1996.36	1187.92
2023.88	1187.2
2058.68	1186.31
2079.59	1185.79
2087.13	1185.61
2098.51	1185.36
2109.56	1185.16
2130.6	1185.06
2150.3	1184.85
2163.01	1184.63
2179.69	1184.1

2189.31	1183
2247.12	1183

Material Boundary

X	Y
1289.14	1207.17
1289.22	1207.67

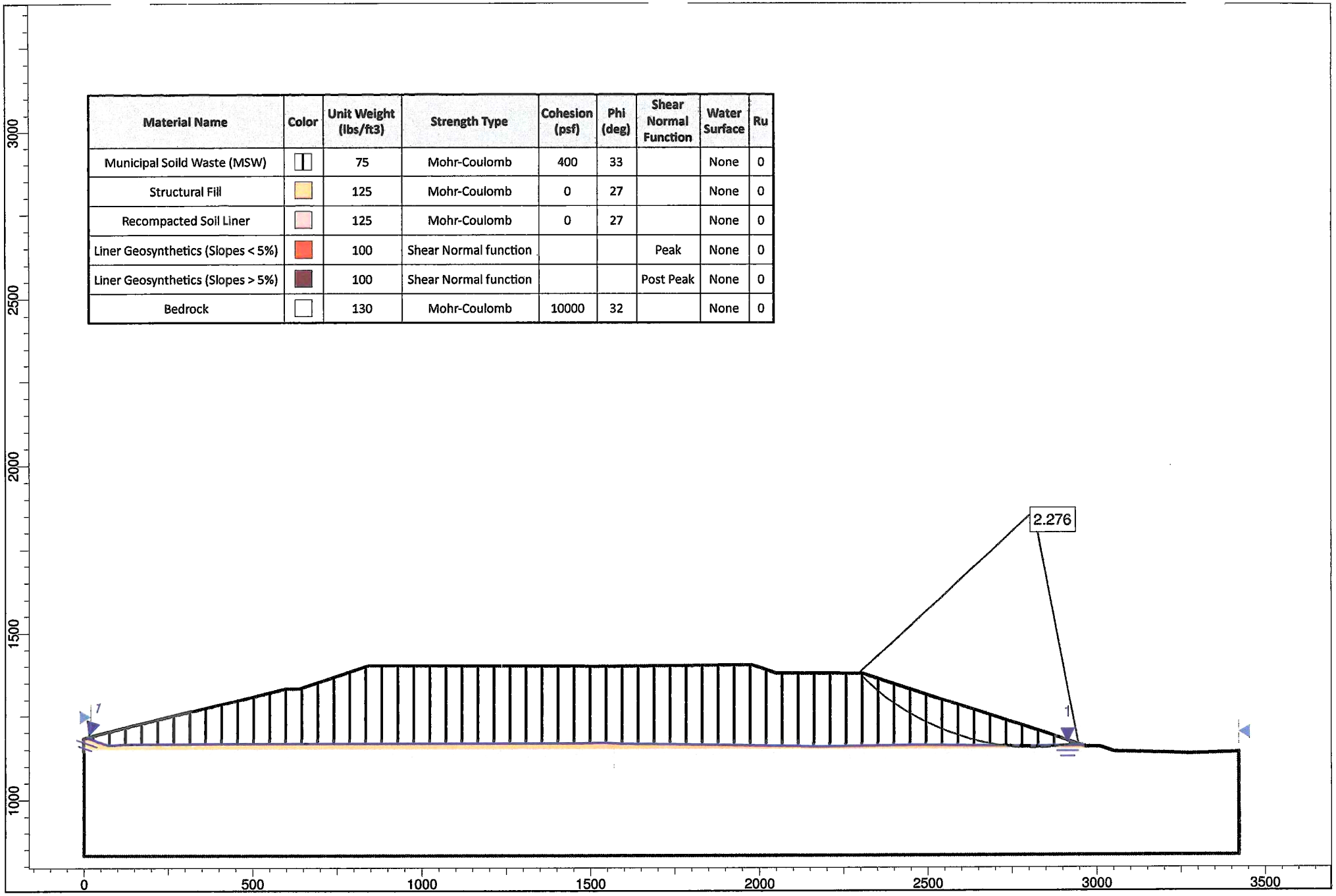
Material Boundary

X	Y
1327.37	1194.59
1327.46	1195.09

ATTACHMENT C

CROSS SECTION B-B SLIDE OUTPUT

Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)	Shear Normal Function	Water Surface	Ru
Municipal Soild Waste (MSW)		75	Mohr-Coulomb	400	33		None	0
Structural Fill		125	Mohr-Coulomb	0	27		None	0
Recompacted Soil Liner		125	Mohr-Coulomb	0	27		None	0
Liner Geosynthetics (Slopes < 5%)		100	Shear Normal function			Peak	None	0
Liner Geosynthetics (Slopes > 5%)		100	Shear Normal function			Post Peak	None	0
Bedrock		130	Mohr-Coulomb	10000	32		None	0



B-B -- static -- rotational -- drained - Rev1.slim

Slide Analysis Information

Project Summary

File Name: B-B -- static -- rotational -- drained - Rev1.slim
Slide Modeler Version: 6.023

General Settings

Units of Measurement: Imperial Units
Time Units: days
Permeability Units: feet/second
Failure Direction: Left to Right
Data Output: Standard
Maximum Material Properties: 20
Maximum Support Properties: 20

Analysis Options

Analysis Methods Used

Spencer

Number of slices: 25
Tolerance: 0.005
Maximum number of iterations: 50
Check malpha < 0.2: Yes
Initial trial value of FS: 1
Steffensen Iteration: Yes

Groundwater Analysis

Groundwater Method: Water Surfaces
Pore Fluid Unit Weight: 62.4 lbs/ft3

Advanced Groundwater Method: None

Random Numbers

Pseudo-random Seed: 10116
Random Number Generation Method: Park and Miller v.3

Surface Options

Surface Type: Circular
Search Method: Auto Refine Search
Divisions along slope: 20
Circles per division: 10
Number of iterations: 10
Divisions to use in next iteration: 50%
Composite Surfaces: Disabled
Minimum Elevation: 0
Minimum Depth: 5

Material Properties

Property	Municipal Soild Waste (MSW)	Structural Fill	Recompacted Soil Liner	Liner Geosynthetics (Slopes	Liner Geosynthetics (Slopes > 5%)	Bedrock
Color						
Strength Type	Mohr-Coulomb	Mohr-Coulomb	Mohr-Coulomb	Shear Normal function	Shear Normal function	Mohr-Coulomb
Unit Weight [lbs/ft3]	75	125	125	100	100	130
Cohesion [psf]	400	0	0			10000
Friction Angle [deg]	33	27	27			32
Water Surface	None	None	None	None	None	None
Ru Value	0	0	0	0	0	0

Shear Normal Functions

Name: Peak

Normal (psf)	Shear (psf)
0	0
3000	1250
6000	2000
13500	3500

Name: Post Peak

Normal (psf)	Shear (psf)
0	0
3000	875
6000	1290
13500	2100

Global Minimums

Method: spencer

FS: 2.275510
Center: 2814.814, 1862.134
Radius: 712.126
Left Slip Surface Endpoint: 2295.149, 1375.234
Right Slip Surface Endpoint: 2946.417, 1162.274
Resisting Moment=1.47613e+009 lb-ft
Driving Moment=6.48704e+008 lb-ft
Resisting Horizontal Force=1.91946e+006 lb
Driving Horizontal Force=843530 lb
Total Slice Area=41688 ft2

Valid / Invalid Surfaces

Method: spencer

Number of Valid Surfaces: 11741
Number of Invalid Surfaces: 0

Slice Data

Global Minimum Query (spencer) - Safety Factor: 2.27551

Slice Number	Width [ft]	Weight [lbs]	Base Material	Base Cohesion [psf]	Base Friction Angle [degrees]	Shear Stress [psf]	Shear Strength [psf]	Base Normal Stress [psf]	Pore Pressure [psf]	Effective Normal Stress [psf]
1	29.4557	28319.7	Municipal Soild Waste (MSW)	400	33	334.449	761.041	555.956	0	555.956
2	29.4557	70088.2	Municipal Soild Waste (MSW)	400	33	625.767	1423.94	1576.72	0	1576.72
3	29.4557	103814	Municipal Soild Waste (MSW)	400	33	882.176	2007.4	2475.18	0	2475.18
4	29.4557	131815	Municipal Soild Waste (MSW)	400	33	1113.08	2532.82	3284.26	0	3284.26
5	29.4557	154742	Municipal Soild Waste (MSW)	400	33	1318.53	3000.32	4004.15	0	4004.15
6	29.4557	173095	Municipal Soild Waste (MSW)	400	33	1498.56	3409.98	4634.97	0	4634.97
7	29.4557	187269	Municipal Soild Waste (MSW)	400	33	1653.12	3761.68	5176.52	0	5176.52
8	29.4557	197580	Municipal Soild Waste (MSW)	400	33	1782.06	4055.09	5628.33	0	5628.33
9	29.4557	204282	Municipal Soild Waste (MSW)	400	33	1885.13	4289.63	5989.52	0	5989.52
10	29.4557	207584	Municipal Soild Waste (MSW)	400	33	1961.95	4464.44	6258.68	0	6258.68
11	29.4557	207656	Municipal Soild Waste (MSW)	400	33	2012	4578.32	6434.04	0	6434.04
12	29.4557	204635	Municipal Soild Waste (MSW)	400	33	2034.6	4629.75	6513.25	0	6513.25
13	29.4557	198635	Municipal Soild Waste (MSW)	400	33	2028.91	4616.81	6493.34	0	6493.34
14	29.4557	189746	Municipal Soild Waste (MSW)	400	33	1993.9	4537.14	6370.62	0	6370.62
15	7.2766	45413.9	Recompacted Soil Liner	0	27	1384.98	3151.53	6185.22	0	6185.22
16	3.86514	23939.7	Liner Geosynthetics (Slopes < 5%)	800	11.31	886.201	2016.56	6082.78	0	6082.78
17	28.221	169831	Recompacted Soil Liner	0	27	1357.85	3089.79	6064.06	0	6064.06
18	33.5691	187594	Structural Fill	0	27	1291.48	2938.77	5767.67	0	5767.67
19	33.5691	165762	Structural Fill	0	27	1171.68	2666.16	5232.65	0	5232.65
20	33.5691	137680	Structural Fill	0	27	999.728	2274.89	4464.73	0	4464.73
21	33.5691	103555	Structural Fill	0	27	773.005	1758.98	3452.19	0	3452.19
22	28.4499	56210.4	Recompacted Soil Liner	0	27	508.321	1156.69	2270.12	0	2270.12
23	3.88595	5245.59	Liner Geosynthetics (Slopes < 5%)	0	22.6199	282.135	642	1540.8	0	1540.8
24	7.31164	8183.45	Recompacted Soil Liner	0	27	293.496	667.853	1310.73	0	1310.73
25	25.6013	12330.4	Municipal Soild Waste (MSW)	400	33	374.15	851.383	695.07	0	695.07

Interslice Data

Global Minimum Query (spencer) - Safety Factor: 2.27551

Slice Number	X coordinate [ft]	Y coordinate - Bottom [ft]	Interslice Normal Force [lbs]	Interslice Shear Force [lbs]	Interslice Force Angle [degrees]
1	2295.15	1375.23	0	0	0
2	2324.6	1345.59	6635.19	2062.78	17.2697
3	2354.06	1319.15	29898.1	9294.85	17.2696
4	2383.52	1295.47	62539.3	19442.5	17.2697
5	2412.97	1274.22	99578.9	30957.5	17.2696
6	2442.43	1255.13	137183	42648.2	17.2697
7	2471.88	1238.02	172393	53594.5	17.2697
8	2501.34	1222.72	202940	63090.9	17.2697
9	2530.79	1209.1	227121	70608.3	17.2696
10	2560.25	1197.06	243712	75766.4	17.2697
11	2589.71	1186.52	251913	78315.9	17.2697
12	2619.16	1177.41	251302	78125.9	17.2697
13	2648.62	1169.67	241814	75176.3	17.2697
14	2678.07	1163.26	223730	69554.1	17.2696
15	2707.53	1158.14	197673	61453.5	17.2697
16	2714.81	1157.07	194222	60380.7	17.2697
17	2718.67	1156.53	194068	60332.7	17.2697
18	2746.89	1153.25	175620	54597.5	17.2696
19	2780.46	1150.84	146234	45462	17.2697
20	2814.03	1150.01	111261	34589.3	17.2696
21	2847.6	1150.76	74350.7	23114.5	17.2697
22	2881.17	1153.11	40327.9	12537.3	17.2696
23	2909.62	1156.35	18517.9	5756.91	17.2696
24	2913.5	1156.88	16601.1	5161.02	17.2696
25	2920.82	1157.94	13064.5	4061.57	17.2697
26	2946.42	1162.27	0	0	0

List Of Coordinates

Piezoline

X	Y
8.36236	1184.11
19.9687	1180.24
34.8152	1175.29
42.7472	1172.38
49.8178	1170.29
58.565	1167.38
64.9216	1165.26
71.5832	1163.26
87.4587	1163.65
103.395	1164.15
149.393	1165.24
157.08	1165.24
246.129	1165.22
251.452	1165.22
340.252	1165.21
345.834	1165.21
434.385	1165.2
440.226	1165.2
528.527	1165.18
534.628	1165.18
622.68	1165.17
629.041	1165.17
716.843	1165.16
723.463	1165.15
811.017	1165.14
817.896	1165.14
905.2	1165.13
912.34	1165.13
999.394	1165.12
1006.79	1165.11
1093.6	1165.1
1101.26	1165.1

1187.81	1165.09
1195.73	1165.09
1282.04	1165.07
1290.21	1165.07
1376.27	1165.06
1384.71	1165.06
1390.24	1165.06
1470.47	1165.05
1518.68	1166.67
1534.49	1167.2
1545.72	1166.68
1571.62	1165.5
1592.19	1164.55
1734.26	1162.68
1900.02	1160.5
2040.78	1158.65
2186.18	1156.73
2464.16	1160.48
2464.75	1160.49
2468.11	1160.45
2817.68	1157.07
2871.82	1157.53
2958.49	1158.26

External Boundary

X	Y
0	831.999
3422.62	831.999
3422.62	1139.03
3409.35	1138.65
3320.41	1136.04
3274.61	1134.7
3203.54	1136.61

3051.13	1140.71
3022.35	1150.12
3009.9	1154.19
2971.69	1153.87
2962.89	1156.8
2961.42	1157.28
2958.49	1158.26
2306.07	1375.16
2050.12	1377
1992.97	1396
1977.93	1401
1571.11	1398.35
854.366	1400.48
843.931	1400.26
637.348	1331.54
596.847	1331.48
21.1232	1187.65
14.5324	1186
10.4122	1184.63
8.36236	1184.11
6.56235	1183.66
5.66234	1183.43
0.262295	1182.07
0	1182
0	1150

Material Boundary

X	Y
2921.25	1150
2938.56	1150
2965.22	1150
2966.66	1150
2970.05	1150

2970.76	1150
2982.06	1150
3010.89	1150
3022.35	1150.12

Material Boundary

X	Y
8.36236	1184.11
13.5602	1182.38
13.5672	1182.38
13.5972	1182.37
19.8808	1180.27
19.9687	1180.24
28.5649	1177.38
34.8152	1175.29
34.9515	1175.25
42.7472	1172.38
49.8178	1170.29
49.9969	1170.23
58.565	1167.38
64.8136	1165.3
64.9216	1165.26
65.105	1165.2
71.5832	1163.26
87.4587	1163.65
103.395	1164.15
149.393	1165.24
157.08	1165.24
246.129	1165.22
251.452	1165.22
340.252	1165.21
345.834	1165.21
434.385	1165.2

440.226	1165.2
528.527	1165.18
534.628	1165.18
622.68	1165.17
629.041	1165.17
716.843	1165.16
723.463	1165.15
811.017	1165.14
817.896	1165.14
905.2	1165.13
912.34	1165.13
999.394	1165.12
1006.79	1165.11
1093.6	1165.1
1101.26	1165.1
1187.81	1165.09
1195.73	1165.09
1282.04	1165.07
1290.21	1165.07
1376.27	1165.06
1384.71	1165.06
1390.24	1165.06
1470.47	1165.05
1518.68	1166.67
1534.49	1167.2
1545.72	1166.68
1571.62	1165.5
1592.19	1164.55
1734.26	1162.68
1900.02	1160.5
2040.78	1158.65
2186.18	1156.73
2464.16	1160.48
2464.75	1160.49

2468.11	1160.45
2817.68	1157.07
2871.82	1157.53
2958.49	1158.26

Material Boundary

X	Y
6.56235	1183.66
13.2441	1181.43
13.2505	1181.43
13.2803	1181.42
19.5644	1179.32
19.653	1179.29
28.249	1176.43
34.4988	1174.34
34.6207	1174.3
42.4328	1171.43
49.518	1169.34
49.6807	1169.29
58.2487	1166.43
64.4978	1164.35
64.6	1164.31
64.7979	1164.25
71.4489	1162.25
87.4868	1162.66
103.423	1163.15
149.405	1164.24
157.08	1164.24
246.129	1164.22
251.451	1164.22
340.252	1164.21
345.833	1164.21
434.384	1164.2

440.226	1164.2
528.527	1164.18
534.628	1164.18
622.68	1164.17
629.041	1164.17
716.843	1164.16
723.463	1164.15
811.017	1164.14
817.896	1164.14
905.2	1164.13
912.34	1164.13
999.394	1164.12
1006.79	1164.11
1093.6	1164.1
1101.26	1164.1
1187.81	1164.09
1195.73	1164.09
1282.04	1164.07
1290.21	1164.07
1376.27	1164.06
1384.71	1164.06
1390.24	1164.06
1470.48	1164.05
1518.71	1165.67
1534.49	1166.2
1545.67	1165.68
1571.58	1164.5
1592.16	1163.55
1734.25	1161.68
1900.01	1159.5
2040.77	1157.65
2186.18	1155.73
2464.18	1159.48
2464.76	1159.49

2468.1	1159.45
2817.68	1156.07
2871.83	1156.53
2961.42	1157.28

Material Boundary

X	Y
5.66234	1183.43
13.086	1180.95
13.0922	1180.95
13.1219	1180.94
19.4061	1178.85
19.4951	1178.82
28.0911	1175.95
34.3405	1173.87
34.4552	1173.83
42.2755	1170.96
49.368	1168.86
49.5226	1168.81
58.0905	1165.95
64.3399	1163.87
64.4392	1163.84
64.6444	1163.77
71.3818	1161.75
87.5009	1162.16
103.436	1162.65
149.41	1163.74
157.08	1163.74
246.129	1163.72
251.451	1163.72
340.252	1163.71
345.833	1163.71
434.384	1163.7

440.225	1163.7
528.527	1163.68
534.628	1163.68
622.68	1163.67
629.04	1163.67
716.843	1163.66
723.463	1163.65
811.017	1163.64
817.896	1163.64
905.2	1163.63
912.339	1163.63
999.394	1163.62
1006.79	1163.61
1093.6	1163.6
1101.26	1163.6
1187.81	1163.59
1195.73	1163.59
1282.04	1163.57
1290.21	1163.57
1376.27	1163.56
1384.71	1163.56
1390.24	1163.56
1470.49	1163.55
1518.73	1165.17
1534.48	1165.69
1545.65	1165.18
1571.56	1164
1592.15	1163.05
1734.24	1161.18
1900	1159
2040.76	1157.15
2186.18	1155.23
2464.18	1158.98
2464.76	1158.99

2468.1	1158.95
2817.68	1155.57
2871.83	1156.03
2962.89	1156.8

Material Boundary

X	Y
0	1150
2921.25	1150

Material Boundary

X	Y
0.262295	1182.07
12.1377	1178.11
12.1416	1178.11
12.1714	1178.1
18.4567	1176
18.548	1175.97
27.1436	1173.11
33.3911	1171.02
33.4626	1171
41.2864	1168.13
41.3322	1168.11
41.3737	1168.1
48.4686	1166
48.5741	1165.96
57.1416	1163.11
63.3923	1161.03
63.4745	1161
63.7232	1160.91
70.9791	1158.74
87.5852	1159.16

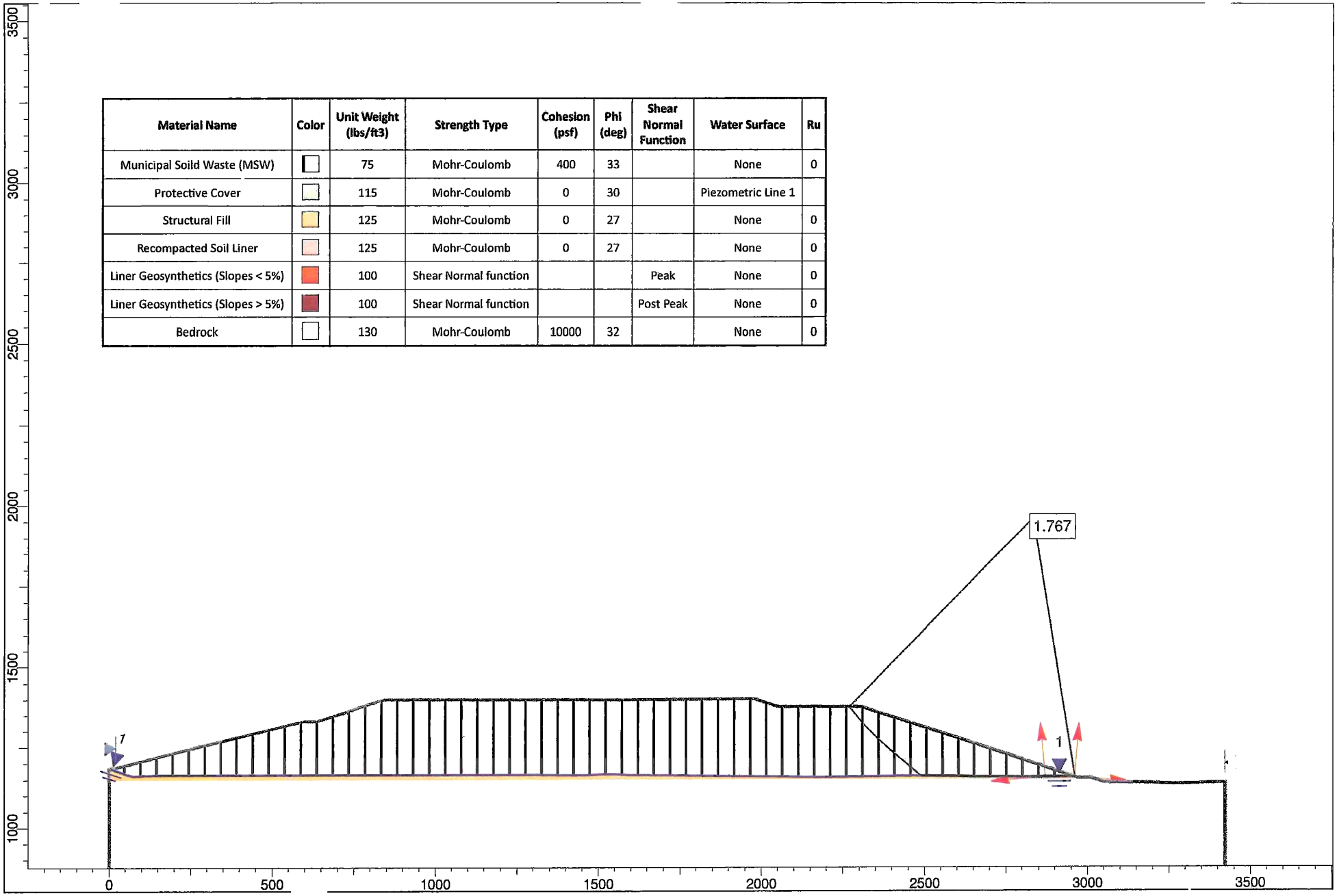
103.518	1159.65
149.446	1160.74
157.079	1160.74
246.129	1160.72
251.451	1160.72
340.251	1160.71
345.833	1160.71
434.384	1160.7
440.225	1160.7
528.527	1160.68
534.627	1160.68
622.68	1160.67
629.04	1160.67
716.843	1160.66
723.463	1160.65
811.016	1160.64
817.896	1160.64
905.2	1160.63
912.339	1160.63
999.393	1160.62
1006.79	1160.61
1093.6	1160.6
1101.26	1160.6
1187.81	1160.59
1195.73	1160.59
1282.04	1160.57
1290.21	1160.57
1376.27	1160.56
1384.71	1160.56
1390.24	1160.56
1470.52	1160.55
1470.54	1160.55
1518.83	1162.17
1534.47	1162.69

1545.51	1162.19
1571.42	1161
1592.06	1160.05
1734.2	1158.18
1899.96	1156
2040.72	1154.15
2186.19	1152.23
2464.22	1155.98
2464.76	1155.99
2468.07	1155.95
2817.68	1152.57
2871.86	1153.03
2971.69	1153.87

Material Boundary

X	Y
71.3818	1161.75
71.4489	1162.25

Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)	Shear Normal Function	Water Surface	Ru
Municipal Soild Waste (MSW)		75	Mohr-Coulomb	400	33		None	0
Protective Cover		115	Mohr-Coulomb	0	30		Piezometric Line 1	
Structural Fill		125	Mohr-Coulomb	0	27		None	0
Recompacted Soil Liner		125	Mohr-Coulomb	0	27		None	0
Liner Geosynthetics (Slopes < 5%)		100	Shear Normal function			Peak	None	0
Liner Geosynthetics (Slopes > 5%)		100	Shear Normal function			Post Peak	None	0
Bedrock		130	Mohr-Coulomb	10000	32		None	0



B-B -- static -- translational -- drained - Rev1.slim

Slide Analysis Information

Project Summary

File Name: B-B -- static -- translational -- drained - Rev1.slim
Slide Modeler Version: 6.023

General Settings

Units of Measurement: Imperial Units
Time Units: days
Permeability Units: feet/second
Failure Direction: Left to Right
Data Output: Standard
Maximum Material Properties: 20
Maximum Support Properties: 20

Analysis Options

Analysis Methods Used

Spencer

Number of slices: 25
Tolerance: 0.005
Maximum number of iterations: 50
Check malpha < 0.2: Yes
Initial trial value of FS: 1
Steffensen Iteration: Yes

Groundwater Analysis

Groundwater Method: Water Surfaces
Pore Fluid Unit Weight: 62.4 lbs/ft3

Advanced Groundwater Method: None

Random Numbers

Pseudo-random Seed: 10116
Random Number Generation Method: Park and Miller v.3

Surface Options

Surface Type: Non-Circular Block Search
Number of Surfaces: 7000
Pseudo-Random Surfaces: Enabled
Convex Surfaces Only: Disabled
Left Projection Angle (Start Angle): 95
Left Projection Angle (End Angle): 185
Right Projection Angle (Start Angle): -5
Right Projection Angle (End Angle): 85
Minimum Elevation: Not Defined
Minimum Depth: Not Defined

Material Properties

Property	Municipal Soild Waste (MSW)	Protective Cover	Structural Fill	Recompacted Soil Liner	Liner Geosynthetics (Slopes	Liner Geosynthetics (Slopes > 5%)	Bedrock
Color							
Strength Type	Mohr-Coulomb	Mohr-Coulomb	Mohr-Coulomb	Mohr-Coulomb	Shear Normal function	Shear Normal function	Mohr-Coulomb
Unit Weight [lbs/ft3]	75	115	125	125	100	100	130
Cohesion [psf]	400	0	0	0			10000
Friction Angle [deg]	33	30	27	27			32
Water Surface	None	Piezometric Line 1	None	None	None	None	None
Hu Value		1					

Ru Value	0	0	0	0	0	0

Shear Normal Functions

Name: Peak

Normal (psf)	Shear (psf)
0	0
3000	1250
6000	2000
13500	3500

Name: Post Peak

Normal (psf)	Shear (psf)
0	0
3000	875
6000	1290
13500	2100

Global Minimums

Method: spencer

FS: 1.766940
Axis Location: 2835.028, 1959.073
Left Slip Surface Endpoint: 2269.925, 1375.416
Right Slip Surface Endpoint: 2962.892, 1156.797
Resisting Moment=1.549e+009 lb-ft
Driving Moment=8.76659e+008 lb-ft
Resisting Horizontal Force=1.63624e+006 lb
Driving Horizontal Force=926035 lb
Total Slice Area=57113.7 ft2

Global Minimum Coordinates

Method: spencer

X	Y
2269.93	1375.42
2315.07	1319.07
2361.08	1271.8
2420.03	1218.4
2490.82	1159.24
2567.62	1157.99
2642.4	1157.27
2735.6	1156.36
2817.66	1155.57
2962.89	1156.8

Valid / Invalid Surfaces

Method: spencer

Number of Valid Surfaces: 3633
Number of Invalid Surfaces: 3368

Error Codes:

Error Code -106 reported for 66 surfaces
Error Code -107 reported for 37 surfaces
Error Code -108 reported for 1681 surfaces
Error Code -110 reported for 465 surfaces
Error Code -111 reported for 429 surfaces
Error Code -112 reported for 690 surfaces

Error Codes

The following errors were encountered during the computation:

-106 = Average slice width is less than 0.0001 * (maximum horizontal extent of soil region). This limitation is imposed to avoid numerical errors which may result from too many slices, or too small a slip region.
-107 = Total driving moment or total driving force is negative. This will occur if the wrong failure direction is specified, or if high external or anchor loads are applied against the failure direction.
-108 = Total driving moment or total driving force < 0.1. This is to limit the calculation of extremely high safety factors if the driving force is very small (0.1 is an arbitrary

number).
-110 = The water table or a piezoline does not span the slip region for a given slip surface, when Water Surfaces is specified as the method of pore pressure calculation. If this error occurs, check that the water table or piezoline(s) span the appropriate soil cells.
-111 = safety factor equation did not converge
-112 = The coefficient M-Alpha = cos(alpha)(1+tan(alpha)tan(phi)/F) < 0.2 for the final iteration of the safety factor calculation. This screens out some slip surfaces which may not be valid in the context of the analysis, in particular, deep seated slip surfaces with many high negative base angle slices in the passive zone.

Slice Data

Global Minimum Query (spencer) - Safety Factor: 1.76694

Slice Number	Width [ft]	Weight [lbs]	Base Material	Base Cohesion [psf]	Base Friction Angle [degrees]	Shear Stress [psf]	Shear Strength [psf]	Base Normal Stress [psf]	Pore Pressure [psf]	Effective Normal Stress [psf]
1	22.5744	23712.6	Municipal Soild Waste (MSW)	400	33	405.171	715.912	486.463	0	486.463
2	22.5744	70148.6	Municipal Soild Waste (MSW)	400	33	846.56	1495.82	1687.41	0	1687.41
3	23.0019	105385	Municipal Soild Waste (MSW)	400	33	1260.98	2228.07	2814.99	0	2814.99
4	23.0019	132967	Municipal Soild Waste (MSW)	400	33	1542.02	2724.66	3579.67	0	3579.67
5	29.4756	206742	Municipal Soild Waste (MSW)	400	33	1924	3399.59	4618.96	0	4618.96
6	29.4756	244103	Municipal Soild Waste (MSW)	400	33	2237.01	3952.67	5470.63	0	5470.63
7	34.7934	333039	Municipal Soild Waste (MSW)	400	33	2634.03	4654.17	6550.84	0	6550.84
8	34.7934	378731	Municipal Soild Waste (MSW)	400	33	2968.68	5245.48	7461.38	0	7461.38
9	1.20851	14000	Protective Cover	0	30	2656.86	4694.52	8162.27	31.1452	8131.13
10	25.6002	289943	Liner Geosynthetics (Slopes < 5%)	800	11.31	1783.5	3151.33	11756.7	0	11756.7
11	25.6002	274507	Liner Geosynthetics (Slopes < 5%)	800	11.31	1713.41	3027.49	11137.4	0	11137.4
12	25.6002	259070	Liner Geosynthetics (Slopes < 5%)	800	11.31	1643.32	2903.65	10518.3	0	10518.3
13	46.0038	426067	Liner Geosynthetics (Slopes < 5%)	800	11.31	1546.86	2733.2	9666.02	0	9666.02
14	28.7687	240406	Liner Geosynthetics (Slopes < 5%)	800	11.31	1441.38	2546.83	8734.19	0	8734.19
15	0.817157	6535.97	Liner Geosynthetics (Slopes < 5%)	800	11.31	1399.65	2473.09	8365.44	0	8365.44
16	30.7967	234542	Liner Geosynthetics (Slopes < 5%)	800	11.31	1355.05	2394.29	7971.48	0	7971.48
17	30.7967	211583	Liner Geosynthetics (Slopes < 5%)	800	11.31	1268.17	2240.78	7203.9	0	7203.9
18	30.7967	188624	Liner Geosynthetics (Slopes < 5%)	800	11.31	1181.29	2087.26	6436.32	0	6436.32
19	27.3511	148270	Liner Geosynthetics (Slopes < 5%)	500	14.0363	1090.77	1927.33	5709.3	0	5709.3
20	27.3511	130161	Liner Geosynthetics (Slopes < 5%)	500	14.0363	993.526	1755.5	5021.98	0	5021.98
21	27.3511	112052	Liner Geosynthetics (Slopes < 5%)	500	14.0363	896.278	1583.67	4334.69	0	4334.69
22	38.4638	125931	Liner Geosynthetics (Slopes < 5%)	500	14.0363	780.213	1378.59	3514.35	0	3514.35

23	38.4638	88105.4	Liner Geosynthetics (Slopes < 5%)	2.27374e-013	22.6199	582.368	1029.01	2469.63	0	2469.63
24	34.1531	46527	Liner Geosynthetics (Slopes < 5%)	0	22.6199	346.356	611.991	1468.78	0	1468.78
25	34.1531	16578.2	Liner Geosynthetics (Slopes < 5%)	2.84217e-014	22.6199	123.412	218.061	523.345	0	523.345

Interslice Data

Global Minimum Query (spencer) - Safety Factor: 1.76694

Slice Number	X coordinate [ft]	Y coordinate - Bottom [ft]	Interslice Normal Force [lbs]	Interslice Shear Force [lbs]	Interslice Force Angle [degrees]
1	2269.93	1375.42	0	0	0
2	2292.5	1347.24	4559.02	1315.8	16.0989
3	2315.07	1319.07	32989.4	9521.21	16.0989
4	2338.08	1295.43	70517.1	20352.2	16.0989
5	2361.08	1271.8	119653	34533.7	16.099
6	2390.55	1245.1	186266	53759	16.0989
7	2420.03	1218.4	266391	76884.3	16.0989
8	2454.82	1189.32	365221	105408	16.0989
9	2489.62	1160.25	478884	138213	16.0989
10	2490.82	1159.24	483916	139665	16.0989
11	2516.42	1158.82	443139	127896	16.0989
12	2542.02	1158.41	403899	116571	16.0989
13	2567.62	1157.99	366196	105689	16.0988
14	2613.63	1157.54	299340	86393.7	16.0989
15	2642.4	1157.27	260306	75127.9	16.0989
16	2643.21	1157.26	259228	74816.9	16.0989
17	2674.01	1156.96	219874	63458.9	16.0989
18	2704.81	1156.66	182968	52807.1	16.0989
19	2735.6	1156.36	148508	42861.4	16.0988
20	2762.96	1156.1	120185	34687.2	16.0989
21	2790.31	1155.83	94340.7	27228.1	16.0989
22	2817.66	1155.57	70974	20484.1	16.0989
23	2856.12	1155.89	39821.8	11493.1	16.0988
24	2894.59	1156.22	16618.9	4796.47	16.099

25	2928.74	1156.51	4365.92	1260.07	16.0989
26	2962.89	1156.8	0	0	0

List Of Coordinates

Piezoline

X	Y
8.36236	1184.11
13.5602	1182.38
19.9687	1180.24
28.5649	1177.38
34.8152	1175.29
42.7472	1172.38
49.9969	1170.23
58.565	1167.38
65.105	1165.2
71.5832	1163.26
87.4587	1163.65
103.395	1164.15
149.393	1165.24
157.08	1165.24
246.129	1165.22
251.452	1165.22
340.252	1165.21
345.834	1165.21
434.385	1165.2
440.226	1165.2
528.527	1165.18
534.628	1165.18
622.68	1165.17
629.041	1165.17
716.843	1165.16
723.463	1165.15

811.017	1165.14
817.896	1165.14
905.2	1165.13
912.34	1165.13
999.394	1165.12
1006.79	1165.11
1093.6	1165.1
1101.26	1165.1
1187.81	1165.09
1195.73	1165.09
1282.04	1165.07
1290.21	1165.07
1376.27	1165.06
1384.71	1165.06
1390.24	1165.06
1470.47	1165.05
1518.68	1166.67
1534.49	1167.2
1545.72	1166.68
1571.62	1165.5
1592.19	1164.55
1734.26	1162.68
1900.02	1160.5
2040.78	1158.65
2186.18	1156.73
2464.16	1160.48
2464.75	1160.49
2468.11	1160.45
2817.68	1157.07
2871.82	1157.53
2958.49	1158.26

Block Search Polyline

X	Y
2961.42	1157.03
2871.83	1156.28

External Boundary

X	Y
0	831.999
3422.62	831.999
3422.62	1139.03
3409.35	1138.65
3320.41	1136.04
3274.61	1134.7
3203.54	1136.61
3051.13	1140.71
3022.35	1150.12
3009.9	1154.19
2971.69	1153.87
2962.89	1156.8
2961.42	1157.28
2958.49	1158.26
2306.07	1375.16
2050.12	1377
1992.97	1396
1977.93	1401
1571.11	1398.35
854.366	1400.48
843.931	1400.26
637.348	1331.54
596.847	1331.48
21.1232	1187.65
14.5324	1186
10.4122	1184.63
8.36236	1184.11

6.56235	1183.66
5.66234	1183.43
0.262295	1182.07
0	1182
0	1150

Material Boundary

X	Y
2921.25	1150
2938.56	1150
2965.22	1150
2966.66	1150
2970.05	1150
2970.76	1150
2982.06	1150
3010.89	1150
3022.35	1150.12

Material Boundary

X	Y
8.36236	1184.11
13.5602	1182.38
13.5672	1182.38
13.5972	1182.37
19.8808	1180.27
19.9687	1180.24
28.5649	1177.38
34.8152	1175.29
34.9515	1175.25
42.7472	1172.38
49.8178	1170.29
49.9969	1170.23

58.565	1167.38
64.8136	1165.3
64.9216	1165.26
65.105	1165.2
71.5832	1163.26
87.4587	1163.65
103.395	1164.15
149.393	1165.24
157.08	1165.24
246.129	1165.22
251.452	1165.22
340.252	1165.21
345.834	1165.21
434.385	1165.2
440.226	1165.2
528.527	1165.18
534.628	1165.18
622.68	1165.17
629.041	1165.17
716.843	1165.16
723.463	1165.15
811.017	1165.14
817.896	1165.14
905.2	1165.13
912.34	1165.13
999.394	1165.12
1006.79	1165.11
1093.6	1165.1
1101.26	1165.1
1187.81	1165.09
1195.73	1165.09
1282.04	1165.07
1290.21	1165.07
1376.27	1165.06

1384.71	1165.06
1390.24	1165.06
1470.47	1165.05
1518.68	1166.67
1534.49	1167.2
1545.72	1166.68
1571.62	1165.5
1592.19	1164.55
1734.26	1162.68
1900.02	1160.5
2040.78	1158.65
2186.18	1156.73
2464.16	1160.48
2464.75	1160.49
2468.11	1160.45
2817.68	1157.07
2871.82	1157.53
2958.49	1158.26

Material Boundary

X	Y
6.56235	1183.66
13.2441	1181.43
13.2505	1181.43
13.2803	1181.42
19.5644	1179.32
19.653	1179.29
28.249	1176.43
34.4988	1174.34
34.6207	1174.3
42.4328	1171.43
49.518	1169.34
49.6807	1169.29

58.2487	1166.43
64.4978	1164.35
64.6	1164.31
64.7979	1164.25
71.4489	1162.25
87.4868	1162.66
103.423	1163.15
149.405	1164.24
157.08	1164.24
246.129	1164.22
251.451	1164.22
340.252	1164.21
345.833	1164.21
434.384	1164.2
440.226	1164.2
528.527	1164.18
534.628	1164.18
622.68	1164.17
629.041	1164.17
716.843	1164.16
723.463	1164.15
811.017	1164.14
817.896	1164.14
905.2	1164.13
912.34	1164.13
999.394	1164.12
1006.79	1164.11
1093.6	1164.1
1101.26	1164.1
1187.81	1164.09
1195.73	1164.09
1282.04	1164.07
1290.21	1164.07
1376.27	1164.06

1384.71	1164.06
1390.24	1164.06
1470.48	1164.05
1518.71	1165.67
1534.49	1166.2
1545.67	1165.68
1571.58	1164.5
1592.16	1163.55
1734.25	1161.68
1900.01	1159.5
2040.77	1157.65
2186.18	1155.73
2464.18	1159.48
2464.76	1159.49
2468.1	1159.45
2817.68	1156.07
2871.83	1156.53
2961.42	1157.28

Material Boundary

X	Y
5.66234	1183.43
13.086	1180.95
13.0922	1180.95
13.1219	1180.94
19.4061	1178.85
19.4951	1178.82
28.0911	1175.95
34.3405	1173.87
34.4552	1173.83
42.2755	1170.96
49.368	1168.86
49.5226	1168.81

58.0905	1165.95
64.3399	1163.87
64.4392	1163.84
64.6444	1163.77
71.3818	1161.75
87.5009	1162.16
103.436	1162.65
149.41	1163.74
157.08	1163.74
246.129	1163.72
251.451	1163.72
340.252	1163.71
345.833	1163.71
434.384	1163.7
440.225	1163.7
528.527	1163.68
534.628	1163.68
622.68	1163.67
629.04	1163.67
716.843	1163.66
723.463	1163.65
811.017	1163.64
817.896	1163.64
905.2	1163.63
912.339	1163.63
999.394	1163.62
1006.79	1163.61
1093.6	1163.6
1101.26	1163.6
1187.81	1163.59
1195.73	1163.59
1282.04	1163.57
1290.21	1163.57
1376.27	1163.56

1384.71	1163.56
1390.24	1163.56
1470.49	1163.55
1518.73	1165.17
1534.48	1165.69
1545.65	1165.18
1571.56	1164
1592.15	1163.05
1734.24	1161.18
1900	1159
2040.76	1157.15
2186.18	1155.23
2464.18	1158.98
2464.76	1158.99
2468.1	1158.95
2817.68	1155.57
2871.83	1156.03
2962.89	1156.8

Material Boundary

X	Y
0	1150
2921.25	1150

Material Boundary

X	Y
0.262295	1182.07
12.1377	1178.11
12.1416	1178.11
12.1714	1178.1
18.4567	1176
18.548	1175.97

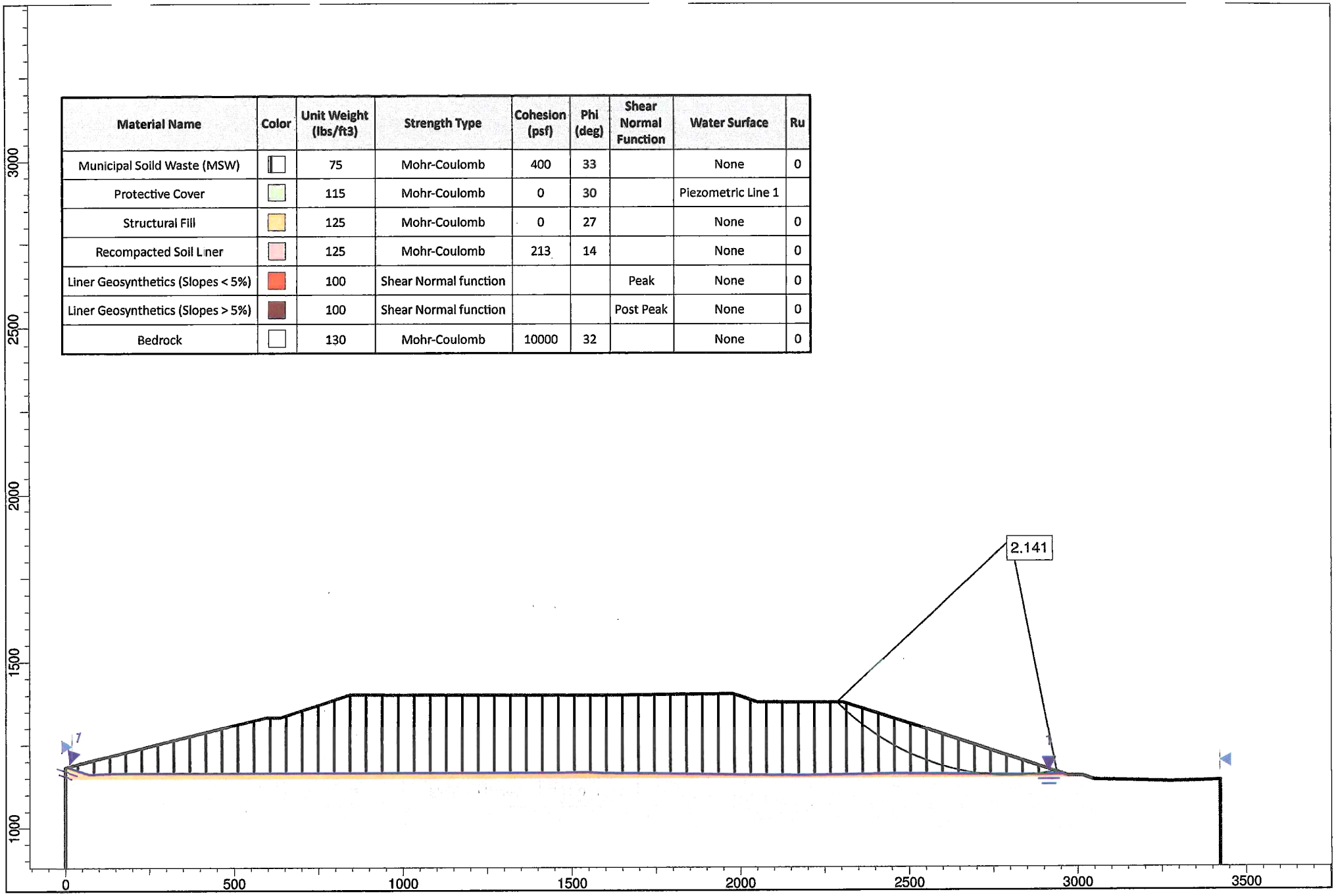
27.1436	1173.11
33.3911	1171.02
33.4626	1171
41.2864	1168.13
41.3322	1168.11
41.3737	1168.1
48.4686	1166
48.5741	1165.96
57.1416	1163.11
63.3923	1161.03
63.4745	1161
63.7232	1160.91
70.9791	1158.74
87.5852	1159.16
103.518	1159.65
149.446	1160.74
157.079	1160.74
246.129	1160.72
251.451	1160.72
340.251	1160.71
345.833	1160.71
434.384	1160.7
440.225	1160.7
528.527	1160.68
534.627	1160.68
622.68	1160.67
629.04	1160.67
716.843	1160.66
723.463	1160.65
811.016	1160.64
817.896	1160.64
905.2	1160.63
912.339	1160.63
999.393	1160.62

1006.79	1160.61
1093.6	1160.6
1101.26	1160.6
1187.81	1160.59
1195.73	1160.59
1282.04	1160.57
1290.21	1160.57
1376.27	1160.56
1384.71	1160.56
1390.24	1160.56
1470.52	1160.55
1470.54	1160.55
1518.83	1162.17
1534.47	1162.69
1545.51	1162.19
1571.42	1161
1592.06	1160.05
1734.2	1158.18
1899.96	1156
2040.72	1154.15
2186.19	1152.23
2464.22	1155.98
2464.76	1155.99
2468.07	1155.95
2817.68	1152.57
2871.86	1153.03
2971.69	1153.87

Material Boundary

X	Y
71.3818	1161.75
71.4489	1162.25

Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)	Shear Normal Function	Water Surface	Ru
Municipal Soild Waste (MSW)		75	Mohr-Coulomb	400	33		None	0
Protective Cover		115	Mohr-Coulomb	0	30		Piezometric Line 1	
Structural Fill		125	Mohr-Coulomb	0	27		None	0
Recompacted Soil Liner		125	Mohr-Coulomb	213	14		None	0
Liner Geosynthetics (Slopes < 5%)		100	Shear Normal function			Peak	None	0
Liner Geosynthetics (Slopes > 5%)		100	Shear Normal function			Post Peak	None	0
Bedrock		130	Mohr-Coulomb	10000	32		None	0



B-B -- static -- rotational -- undrained - Rev1.slim

Slide Analysis Information

Project Summary

File Name: B-B -- static -- rotational -- undrained - Rev1.slim
Slide Modeler Version: 6.023

General Settings

Units of Measurement: Imperial Units
Time Units: days
Permeability Units: feet/second
Failure Direction: Left to Right
Data Output: Standard
Maximum Material Properties: 20
Maximum Support Properties: 20

Analysis Options

Analysis Methods Used

Spencer

Number of slices: 25
Tolerance: 0.005
Maximum number of iterations: 50
Check malpha < 0.2: Yes
Initial trial value of FS: 1
Steffensen Iteration: Yes

Groundwater Analysis

Groundwater Method: Water Surfaces
Pore Fluid Unit Weight: 62.4 lbs/ft3

Advanced Groundwater Method: None

Random Numbers

Pseudo-random Seed: 10116
Random Number Generation Method: Park and Miller v.3

Surface Options

Surface Type: Circular
Search Method: Auto Refine Search
Divisions along slope: 20
Circles per division: 10
Number of iterations: 10
Divisions to use in next iteration: 50%
Composite Surfaces: Disabled
Minimum Elevation: 0
Minimum Depth: 5

Material Properties

Property	Municipal Soild Waste (MSW)	Protective Cover	Structural Fill	Recompacted Soil Liner	Liner Geosynthetics (Slopes	Liner Geosynthetics (Slopes > 5%)	Bedrock
Color							
Strength Type	Mohr-Coulomb	Mohr-Coulomb	Mohr-Coulomb	Mohr-Coulomb	Shear Normal function	Shear Normal function	Mohr-Coulomb
Unit Weight [lbs/ft3]	75	115	125	125	100	100	130
Cohesion [psf]	400	0	0	213			10000
Friction Angle [deg]	33	30	27	14			32
Water Surface	None	Piezometric Line 1	None	None	None	None	None
Hu Value		1					
Ru Value	0		0	0	0	0	0

Shear Normal Functions

Name: Peak

Normal (psf)	Shear (psf)
0	0
3000	1250
6000	2000
13500	3500

Name: Post Peak

Normal (psf)	Shear (psf)
0	0
3000	875
6000	1290
13500	2100

Global Minimums

Method: spencer

FS: 2.141200
Center: 2802.653, 1860.843
Radius: 708.433
Left Slip Surface Endpoint: 2286.785, 1375.295
Right Slip Surface Endpoint: 2937.264, 1165.317
Resisting Moment=1.40226e+009 lb-ft
Driving Moment=6.54893e+008 lb-ft
Resisting Horizontal Force=1.8244e+006 lb
Driving Horizontal Force=852045 lb
Total Slice Area=42460.2 ft2

Valid / Invalid Surfaces

Method: spencer

Number of Valid Surfaces: 11759
Number of Invalid Surfaces: 0

Slice Data

Global Minimum Query (spencer) - Safety Factor: 2.1412

Slice Number	Width [ft]	Weight [lbs]	Base Material	Base Cohesion [psf]	Base Friction Angle [degrees]	Shear Stress [psf]	Shear Strength [psf]	Base Normal Stress [psf]	Pore Pressure [psf]	Effective Normal Stress [psf]
1	30.4579	33005	Municipal Soild Waste (MSW)	400	33	377.315	807.907	628.121	0	628.121
2	30.4579	80078.2	Municipal Soild Waste (MSW)	400	33	713.553	1527.86	1736.75	0	1736.75
3	30.4579	115395	Municipal Soild Waste (MSW)	400	33	991.804	2123.65	2654.18	0	2654.18
4	30.4579	144456	Municipal Soild Waste (MSW)	400	33	1241.72	2658.77	3478.19	0	3478.19
5	30.4579	167983	Municipal Soild Waste (MSW)	400	33	1463.26	3133.13	4208.66	0	4208.66
6	30.4579	186528	Municipal Soild Waste (MSW)	400	33	1656.34	3546.55	4845.25	0	4845.25
7	30.4579	200524	Municipal Soild Waste (MSW)	400	33	1820.78	3898.65	5387.44	0	5387.44
8	30.4579	210316	Municipal Soild Waste (MSW)	400	33	1956.29	4188.81	5834.25	0	5834.25
9	30.4579	216179	Municipal Soild Waste (MSW)	400	33	2062.46	4416.13	6184.29	0	6184.29
10	30.4579	218337	Municipal Soild Waste (MSW)	400	33	2138.67	4579.33	6435.6	0	6435.6
11	30.4579	216971	Municipal Soild Waste (MSW)	400	33	2184.19	4676.79	6585.68	0	6585.68
12	30.4579	212229	Municipal Soild Waste (MSW)	400	33	2198.04	4706.44	6631.35	0	6631.35
13	30.4579	204227	Municipal Soild Waste (MSW)	400	33	2179.02	4665.71	6568.63	0	6568.63
14	30.4579	193057	Municipal Soild Waste (MSW)	400	33	2125.67	4551.49	6392.72	0	6392.72
15	8.99998	54702.5	Protective Cover	0	30	1654.51	3542.64	6167.23	31.2015	6136.03
16	4.94718	29642.3	Liner Geosynthetics (Slopes < 5%)	500	14.0363	931.039	1993.54	5974.14	0	5974.14
17	23.3915	135480	Recompacted Soil Liner	213	14	774.991	1659.41	5801.2	0	5801.2
18	23.3915	126621	Recompacted Soil Liner	213	14	740.622	1585.82	5506.09	0	5506.09
19	43.7564	204332	Recompacted Soil Liner	213	14	665.356	1424.66	4859.71	0	4859.71
20	28.3391	105414	Recompacted Soil Liner	213	14	562.135	1203.64	3973.25	0	3973.25
21	28.3391	79567.6	Recompacted Soil Liner	213	14	456.829	978.162	3068.89	0	3068.89
22	5.15562	11471.9	Liner Geosynthetics (Slopes < 5%)	0	22.6199	489.356	1047.81	2514.75	0	2514.75
23	9.3125	18230.8	Protective Cover	0	30	613.105	1312.78	2305	31.2011	2273.8
24	24.2181	32741.6	Municipal Soild Waste (MSW)	400	33	718.882	1539.27	1754.33	0	1754.33
25	24.2181	11174	Municipal Soild Waste (MSW)	400	33	396.782	849.589	692.307	0	692.307

Interslice Data

Global Minimum Query (spencer) - Safety Factor: 2.1412

Slice Number	X coordinate [ft]	Y coordinate - Bottom [ft]	Interslice Normal Force [lbs]	Interslice Shear Force [lbs]	Interslice Force Angle [degrees]
1	2286.78	1375.29	0	0	0
2	2317.24	1344.85	7638.93	2426.59	17.623
3	2347.7	1317.8	32885	10446.3	17.6231
4	2378.16	1293.67	66727.5	21196.7	17.623
5	2408.62	1272.11	103942	33018.3	17.623
6	2439.07	1252.82	140543	44645.1	17.623
7	2469.53	1235.62	173487	55110.1	17.623
8	2499.99	1220.32	200477	63683.6	17.623
9	2530.45	1206.79	219827	69830.5	17.623
10	2560.91	1194.93	230379	73182.3	17.623
11	2591.36	1184.65	231434	73517.5	17.623
12	2621.82	1175.88	222722	70750.1	17.623
13	2652.28	1168.55	204375	64922.1	17.6231
14	2682.74	1162.63	176926	56202.4	17.623
15	2713.19	1158.08	141310	44888.6	17.623
16	2722.19	1156.99	133131	42290.4	17.623
17	2727.14	1156.45	131800	41867.7	17.623
18	2750.53	1154.33	125955	40011	17.623
19	2773.93	1152.99	116001	36848.8	17.6229
20	2817.68	1152.57	88956.8	28258.1	17.623
21	2846.02	1153.74	68387.8	21724.1	17.623
22	2874.36	1156.05	48359.1	15361.8	17.623
23	2879.52	1156.59	44470.2	14126.4	17.623
24	2888.83	1157.67	36276.6	11523.6	17.6229
25	2913.05	1161.06	12921.4	4104.62	17.623
26	2937.26	1165.32	0	0	0

List Of Coordinates

Piezoline

X	Y
8.36236	1184.11
13.5972	1182.37
19.9687	1180.24
28.5649	1177.38
34.9515	1175.25
42.7472	1172.38
49.9969	1170.23
58.565	1167.38
65.105	1165.2
71.5832	1163.26
87.4587	1163.65
103.395	1164.15
149.393	1165.24
157.08	1165.24
246.129	1165.22
251.452	1165.22
340.252	1165.21
345.834	1165.21
434.385	1165.2
440.226	1165.2
528.527	1165.18
534.628	1165.18
622.68	1165.17
629.041	1165.17
716.843	1165.16
723.463	1165.15
811.017	1165.14
817.896	1165.14
905.2	1165.13

912.34	1165.13
999.394	1165.12
1006.79	1165.11
1093.6	1165.1
1101.26	1165.1
1187.81	1165.09
1195.73	1165.09
1282.04	1165.07
1290.21	1165.07
1376.27	1165.06
1384.71	1165.06
1390.24	1165.06
1470.81	1165.06
1518.68	1166.67
1534.49	1167.2
1545.72	1166.68
1571.62	1165.5
1592.19	1164.55
1734.26	1162.68
1900.02	1160.5
2040.78	1158.65
2186.18	1156.73
2464.16	1160.48
2464.75	1160.49
2468.11	1160.45
2817.68	1157.07
2871.82	1157.53
2958.49	1158.26

External Boundary

X	Y
0	831.999
3422.62	831.999

3422.62	1139.03
3409.35	1138.65
3320.41	1136.04
3274.61	1134.7
3203.54	1136.61
3051.13	1140.71
3022.35	1150.12
3009.9	1154.19
2971.69	1153.87
2962.89	1156.8
2961.42	1157.28
2958.49	1158.26
2306.07	1375.16
2050.12	1377
1992.97	1396
1977.93	1401
1571.11	1398.35
854.366	1400.48
843.931	1400.26
637.348	1331.54
596.847	1331.48
21.1232	1187.65
14.5324	1186
10.4122	1184.63
8.36236	1184.11
6.56235	1183.66
5.66234	1183.43
0.262295	1182.07
0	1182
0	1150

Material Boundary

X	Y

2921.25	1150
2938.56	1150
2965.22	1150
2966.66	1150
2970.05	1150
2970.76	1150
2982.06	1150
3010.89	1150
3022.35	1150.12

Material Boundary

X	Y
8.36236	1184.11
13.5602	1182.38
13.5672	1182.38
13.5972	1182.37
19.8808	1180.27
19.9687	1180.24
28.5649	1177.38
34.8152	1175.29
34.9515	1175.25
42.7472	1172.38
49.8178	1170.29
49.9969	1170.23
58.565	1167.38
64.8136	1165.3
64.9216	1165.26
65.105	1165.2
71.5832	1163.26
87.4587	1163.65
103.395	1164.15
149.393	1165.24
157.08	1165.24

246.129	1165.22
251.452	1165.22
340.252	1165.21
345.834	1165.21
434.385	1165.2
440.226	1165.2
528.527	1165.18
534.628	1165.18
622.68	1165.17
629.041	1165.17
716.843	1165.16
723.463	1165.15
811.017	1165.14
817.896	1165.14
905.2	1165.13
912.34	1165.13
999.394	1165.12
1006.79	1165.11
1093.6	1165.1
1101.26	1165.1
1187.81	1165.09
1195.73	1165.09
1282.04	1165.07
1290.21	1165.07
1376.27	1165.06
1384.71	1165.06
1390.24	1165.06
1470.47	1165.05
1518.68	1166.67
1534.49	1167.2
1545.72	1166.68
1571.62	1165.5
1592.19	1164.55
1734.26	1162.68

1900.02	1160.5
2040.78	1158.65
2186.18	1156.73
2464.16	1160.48
2464.75	1160.49
2468.11	1160.45
2817.68	1157.07
2871.82	1157.53
2958.49	1158.26

Material Boundary

X	Y
6.56235	1183.66
13.2441	1181.43
13.2505	1181.43
13.2803	1181.42
19.5644	1179.32
19.653	1179.29
28.249	1176.43
34.4988	1174.34
34.6207	1174.3
42.4328	1171.43
49.518	1169.34
49.6807	1169.29
58.2487	1166.43
64.4978	1164.35
64.6	1164.31
64.7979	1164.25
71.4489	1162.25
87.4868	1162.66
103.423	1163.15
149.405	1164.24
157.08	1164.24

246.129	1164.22
251.451	1164.22
340.252	1164.21
345.833	1164.21
434.384	1164.2
440.226	1164.2
528.527	1164.18
534.628	1164.18
622.68	1164.17
629.041	1164.17
716.843	1164.16
723.463	1164.15
811.017	1164.14
817.896	1164.14
905.2	1164.13
912.34	1164.13
999.394	1164.12
1006.79	1164.11
1093.6	1164.1
1101.26	1164.1
1187.81	1164.09
1195.73	1164.09
1282.04	1164.07
1290.21	1164.07
1376.27	1164.06
1384.71	1164.06
1390.24	1164.06
1470.48	1164.05
1518.71	1165.67
1534.49	1166.2
1545.67	1165.68
1571.58	1164.5
1592.16	1163.55
1734.25	1161.68

1900.01	1159.5
2040.77	1157.65
2186.18	1155.73
2464.18	1159.48
2464.76	1159.49
2468.1	1159.45
2817.68	1156.07
2871.83	1156.53
2961.42	1157.28

Material Boundary

X	Y
5.66234	1183.43
13.086	1180.95
13.0922	1180.95
13.1219	1180.94
19.4061	1178.85
19.4951	1178.82
28.0911	1175.95
34.3405	1173.87
34.4552	1173.83
42.2755	1170.96
49.368	1168.86
49.5226	1168.81
58.0905	1165.95
64.3399	1163.87
64.4392	1163.84
64.6444	1163.77
71.3818	1161.75
87.5009	1162.16
103.436	1162.65
149.41	1163.74
157.08	1163.74

246.129	1163.72
251.451	1163.72
340.252	1163.71
345.833	1163.71
434.384	1163.7
440.225	1163.7
528.527	1163.68
534.628	1163.68
622.68	1163.67
629.04	1163.67
716.843	1163.66
723.463	1163.65
811.017	1163.64
817.896	1163.64
905.2	1163.63
912.339	1163.63
999.394	1163.62
1006.79	1163.61
1093.6	1163.6
1101.26	1163.6
1187.81	1163.59
1195.73	1163.59
1282.04	1163.57
1290.21	1163.57
1376.27	1163.56
1384.71	1163.56
1390.24	1163.56
1470.49	1163.55
1518.73	1165.17
1534.48	1165.69
1545.65	1165.18
1571.56	1164
1592.15	1163.05
1734.24	1161.18

1900	1159
2040.76	1157.15
2186.18	1155.23
2464.18	1158.98
2464.76	1158.99
2468.1	1158.95
2817.68	1155.57
2871.83	1156.03
2962.89	1156.8

Material Boundary

X	Y
0	1150
2921.25	1150

Material Boundary

X	Y
0.262295	1182.07
12.1377	1178.11
12.1416	1178.11
12.1714	1178.1
18.4567	1176
18.548	1175.97
27.1436	1173.11
33.3911	1171.02
33.4626	1171
41.2864	1168.13
41.3322	1168.11
41.3737	1168.1
48.4686	1166
48.5741	1165.96
57.1416	1163.11

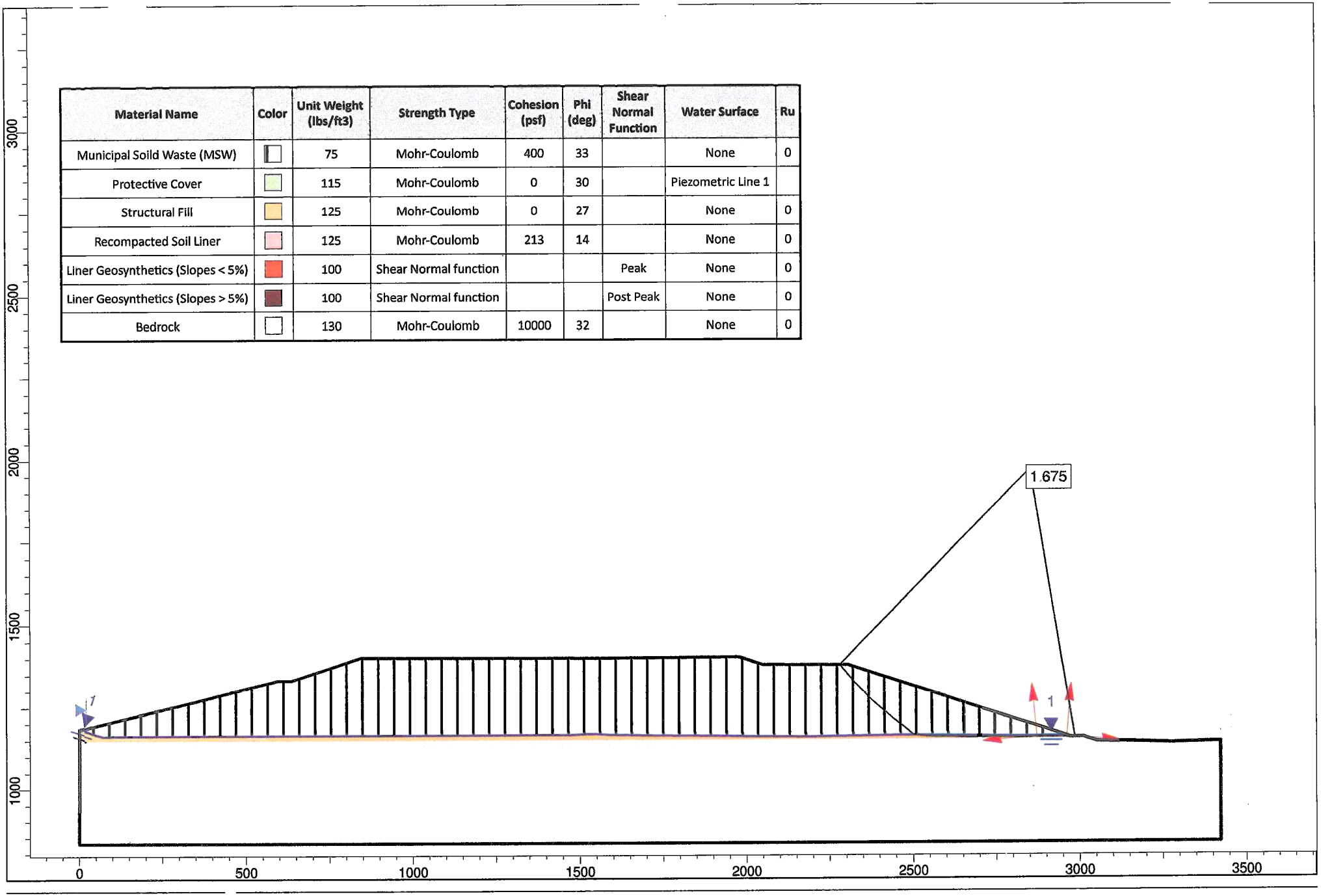
63.3923	1161.03
63.4745	1161
63.7232	1160.91
70.9791	1158.74
87.5852	1159.16
103.518	1159.65
149.446	1160.74
157.079	1160.74
246.129	1160.72
251.451	1160.72
340.251	1160.71
345.833	1160.71
434.384	1160.7
440.225	1160.7
528.527	1160.68
534.627	1160.68
622.68	1160.67
629.04	1160.67
716.843	1160.66
723.463	1160.65
811.016	1160.64
817.896	1160.64
905.2	1160.63
912.339	1160.63
999.393	1160.62
1006.79	1160.61
1093.6	1160.6
1101.26	1160.6
1187.81	1160.59
1195.73	1160.59
1282.04	1160.57
1290.21	1160.57
1376.27	1160.56
1384.71	1160.56

1390.24	1160.56
1470.52	1160.55
1470.54	1160.55
1518.83	1162.17
1534.47	1162.69
1545.51	1162.19
1571.42	1161
1592.06	1160.05
1734.2	1158.18
1899.96	1156
2040.72	1154.15
2186.19	1152.23
2464.22	1155.98
2464.76	1155.99
2468.07	1155.95
2817.68	1152.57
2871.86	1153.03
2971.69	1153.87

Material Boundary

X	Y
71.3818	1161.75
71.4489	1162.25

Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)	Shear Normal Function	Water Surface	Ru
Municipal Soild Waste (MSW)		75	Mohr-Coulomb	400	33		None	0
Protective Cover		115	Mohr-Coulomb	0	30		Piezometric Line 1	
Structural Fill		125	Mohr-Coulomb	0	27		None	0
Recompacted Soil Liner		125	Mohr-Coulomb	213	14		None	0
Liner Geosynthetics (Slopes < 5%)		100	Shear Normal function			Peak	None	0
Liner Geosynthetics (Slopes > 5%)		100	Shear Normal function			Post Peak	None	0
Bedrock		130	Mohr-Coulomb	10000	32		None	0



B-B -- static -- translational -- undrained - Rev1.slim

Slide Analysis Information

Project Summary

File Name: B-B -- static -- translational -- undrained - Rev1.slim
Slide Modeler Version: 6.023

General Settings

Units of Measurement: Imperial Units
Time Units: days
Permeability Units: feet/second
Failure Direction: Left to Right
Data Output: Standard
Maximum Material Properties: 20
Maximum Support Properties: 20

Analysis Options

Analysis Methods Used

Spencer

Number of slices: 25
Tolerance: 0.005
Maximum number of iterations: 50
Check malpha < 0.2: Yes
Initial trial value of FS: 1
Steffensen Iteration: Yes

Groundwater Analysis

Groundwater Method: Water Surfaces
Pore Fluid Unit Weight: 62.4 lbs/ft3

Advanced Groundwater Method: None

Random Numbers

Pseudo-random Seed: 10116
Random Number Generation Method: Park and Miller v.3

Surface Options

Surface Type: Non-Circular Block Search
Number of Surfaces: 7000
Pseudo-Random Surfaces: Enabled
Convex Surfaces Only: Disabled
Left Projection Angle (Start Angle): 95
Left Projection Angle (End Angle): 185
Right Projection Angle (Start Angle): -5
Right Projection Angle (End Angle): 85
Minimum Elevation: Not Defined
Minimum Depth: Not Defined

Material Properties

Property	Municipal Soild Waste (MSW)	Protective Cover	Structural Fill	Recompacted Soil Liner	Liner Geosynthetics (Slopes	Liner Geosynthetics (Slopes > 5%)	Bedrock
Color							
Strength Type	Mohr-Coulomb	Mohr-Coulomb	Mohr-Coulomb	Mohr-Coulomb	Shear Normal function	Shear Normal function	Mohr-Coulomb
Unit Weight [lbs/ft3]	75	115	125	125	100	100	130
Cohesion [psf]	400	0	0	213			10000
Friction Angle [deg]	33	30	27	14			32
Water Surface	None	Piezometric Line 1	None	None	None	None	None
Hu Value		1					

Ru Value	0	0	0	0	0	0

Shear Normal Functions

Name: Peak

Normal (psf)	Shear (psf)
0	0
3000	1250
6000	2000
13500	3500

Name: Post Peak

Normal (psf)	Shear (psf)
0	0
3000	875
6000	1290
13500	2100

Global Minimums

Method: spencer

FS: 1.674820
Axis Location: 2854.314, 1967.966
Left Slip Surface Endpoint: 2281.306, 1375.334
Right Slip Surface Endpoint: 2984.615, 1153.981
Resisting Moment=1.47364e+009 lb-ft
Driving Moment=8.7988e+008 lb-ft
Resisting Horizontal Force=1.52681e+006 lb
Driving Horizontal Force=911623 lb
Total Slice Area=55764.1 ft2

Global Minimum Coordinates

Method: spencer

X	Y
2281.31	1375.33
2326.28	1319.73
2377.25	1268.74
2444.67	1208.05
2502.26	1159.14
2531.76	1156.71
2568.34	1154.99
2604.76	1154.67
2673.8	1153.98
2742.84	1153.29
2802.74	1152.73
2870.64	1153.16
2938.54	1153.59
2984.61	1153.98

Valid / Invalid Surfaces

Method: spencer

Number of Valid Surfaces: 3658
Number of Invalid Surfaces: 3343

Error Codes:

Error Code -106 reported for 66 surfaces
Error Code -107 reported for 37 surfaces
Error Code -108 reported for 1658 surfaces
Error Code -110 reported for 465 surfaces
Error Code -111 reported for 426 surfaces
Error Code -112 reported for 691 surfaces

Error Codes

The following errors were encountered during the computation:

-106 = Average slice width is less than 0.0001 * (maximum horizontal extent of soil region). This limitation is imposed to avoid numerical errors which may result from too many slices, or too small a slip region.
-107 = Total driving moment or total driving force is negative. This will occur if the wrong failure direction is specified, or if high external or anchor loads are applied against the failure direction.
-108 = Total driving moment or total driving force < 0.1. This is to limit the calculation of extremely high safety factors if the driving force is very small (0.1 is an arbitrary number).
-110 = The water table or a piezoline does not span the slip region for a given slip surface, when Water Surfaces is specified as the method of pore pressure calculation. If this error occurs, check that the water table or piezoline(s) span the appropriate soil cells.
-111 = safety factor equation did not converge
-112 = The coefficient M-Alpha = cos(alpha)(1+tan(alpha)tan(phi)/F) < 0.2 for the final iteration of the safety factor calculation. This screens out some slip surfaces which may not be valid in the context of the analysis, in particular, deep seated slip surfaces with many high negative base angle slices in the passive zone.

Slice Data

Global Minimum Query (spencer) - Safety Factor: 1.67482

Slice Number	Width [ft]	Weight [lbs]	Base Material	Base Cohesion [psf]	Base Friction Angle [degrees]	Shear Stress [psf]	Shear Strength [psf]	Base Normal Stress [psf]	Pore Pressure [psf]	Effective Normal Stress [psf]
1	22.4868	23307.2	Municipal Soild Waste (MSW)	400	33	420.942	705.002	469.664	0	469.664
2	22.4868	64939.1	Municipal Soild Waste (MSW)	400	33	836.896	1401.65	1542.4	0	1542.4
3	25.4827	109352	Municipal Soild Waste (MSW)	400	33	1259.46	2109.37	2632.19	0	2632.19
4	25.4827	141885	Municipal Soild Waste (MSW)	400	33	1575.6	2638.84	3447.49	0	3447.49
5	33.7109	233412	Municipal Soild Waste (MSW)	400	33	1993.52	3338.79	4525.32	0	4525.32
6	33.7109	281799	Municipal Soild Waste (MSW)	400	33	2365.09	3961.1	5483.61	0	5483.61
7	28.2144	271526	Municipal Soild Waste (MSW)	400	33	2753.6	4611.78	6485.57	0	6485.57
8	28.2144	302377	Municipal Soild Waste (MSW)	400	33	3043.34	5097.05	7232.82	0	7232.82
9	1.16687	13192.7	Protective Cover	0	30	2698.87	4520.12	7859.64	30.5632	7829.08
10	7.1575	80793.6	Liner Geosynthetics (Slopes < 5%)	800	11.31	1838.73	3079.54	11397.7	0	11397.7
11	22.3351	246993	Recompacted Soil Liner	213	14	1789.08	2996.39	11163.6	0	11163.6
12	36.5852	385342	Recompacted Soil Liner	213	14	1735.96	2907.42	10806.7	0	10806.7
13	36.4191	354463	Recompacted Soil Liner	213	14	1641.05	2748.46	10169.2	0	10169.2
14	34.52	306287	Recompacted Soil Liner	213	14	1507	2523.95	9268.7	0	9268.7
15	34.52	277479	Recompacted Soil Liner	213	14	1377.74	2307.46	8400.44	0	8400.44
16	23.0133	168982	Recompacted Soil Liner	213	14	1270.02	2127.06	7676.88	0	7676.88
17	23.0133	156178	Recompacted Soil Liner	213	14	1183.85	1982.73	7098.02	0	7098.02
18	23.0133	143375	Recompacted Soil Liner	213	14	1097.68	1838.41	6519.17	0	6519.17

19	29.952	167399	Recompacted Soil Liner	213	14	998.579	1672.44	5853.48	0	5853.48
20	29.952	145653	Recompacted Soil Liner	213	14	886.101	1484.06	5097.94	0	5097.94
21	33.9495	137827	Recompacted Soil Liner	213	14	766.596	1283.91	4295.18	0	4295.18
22	33.9495	108562	Recompacted Soil Liner	213	14	632.079	1058.62	3391.59	0	3391.59
23	33.9495	79398.1	Recompacted Soil Liner	213	14	498.025	834.102	2491.11	0	2491.11
24	33.9495	50234.2	Recompacted Soil Liner	213	14	363.972	609.587	1590.62	0	1590.62
25	46.0738	19515	Structural Fill	0	27	142.132	238.046	467.19	0	467.19

Interslice Data

Global Minimum Query (spencer) - Safety Factor: 1.67482

Slice Number	X coordinate [ft]	Y coordinate - Bottom [ft]	Interslice Normal Force [lbs]	Interslice Shear Force [lbs]	Interslice Force Angle [degrees]
1	2281.31	1375.33	0	0	0
2	2303.79	1347.53	3591.71	1043.16	16.1952
3	2326.28	1319.73	27653.8	8031.65	16.1952
4	2351.76	1294.24	62664.4	18200	16.1952
5	2377.25	1268.74	110405	32065.5	16.1952
6	2410.96	1238.4	180523	52430.5	16.1952
7	2444.67	1208.05	267195	77603.2	16.1952
8	2472.88	1184.09	344893	100169	16.1951
9	2501.1	1160.13	432320	125561	16.1952
10	2502.26	1159.14	436959	126909	16.1952
11	2509.42	1158.55	430520	125039	16.1953
12	2531.76	1156.71	411106	119400	16.1952
13	2568.34	1154.99	366266	106377	16.1952
14	2604.76	1154.67	309752	89963	16.1952
15	2639.28	1154.32	260910	75777.8	16.1952
16	2673.8	1153.98	216233	62802	16.1952
17	2696.81	1153.75	188762	54823.3	16.1952
18	2719.83	1153.52	163141	47382.1	16.1952
19	2742.84	1153.29	139371	40478.5	16.1953
20	2772.79	1153.01	111114	32271.6	16.1952

21	2802.74	1152.73	86012.9	24981.2	16.1952
22	2836.69	1152.94	59062.7	17153.9	16.1952
23	2870.64	1153.16	36873.8	10709.5	16.1952
24	2904.59	1153.38	19429.9	5643.13	16.1952
25	2938.54	1153.59	6730.81	1954.87	16.1952
26	2984.61	1153.98	0	0	0

List Of Coordinates

Piezoline

X	Y
8.36236	1184.11
13.5972	1182.37
19.9687	1180.24
28.5649	1177.38
34.9515	1175.25
42.7472	1172.38
49.9969	1170.23
58.565	1167.38
64.8136	1165.3
71.5832	1163.26
87.4587	1163.65
103.395	1164.15
149.393	1165.24
157.08	1165.24
246.129	1165.22
251.452	1165.22
340.252	1165.21
345.834	1165.21
434.385	1165.2
440.226	1165.2
528.527	1165.18
534.628	1165.18

622.68	1165.17
629.041	1165.17
716.843	1165.16
723.463	1165.15
811.017	1165.14
817.896	1165.14
905.2	1165.13
912.34	1165.13
999.394	1165.12
1006.79	1165.11
1093.6	1165.1
1101.26	1165.1
1187.81	1165.09
1195.73	1165.09
1282.04	1165.07
1290.21	1165.07
1376.27	1165.06
1384.71	1165.06
1390.24	1165.06
1470.47	1165.05
1518.68	1166.67
1534.49	1167.2
1545.72	1166.68
1571.62	1165.5
1592.19	1164.55
1734.26	1162.68
1900.02	1160.5
2040.78	1158.65
2186.18	1156.73
2464.16	1160.48
2468.11	1160.45
2817.68	1157.07
2871.82	1157.53
2958.49	1158.26

Block Search Polyline

X	Y
2961.42	1157.03
2871.83	1156.28

External Boundary

X	Y
0	831.999
3422.62	831.999
3422.62	1139.03
3409.35	1138.65
3320.41	1136.04
3274.61	1134.7
3203.54	1136.61
3051.13	1140.71
3022.35	1150.12
3009.9	1154.19
2971.69	1153.87
2962.89	1156.8
2961.42	1157.28
2958.49	1158.26
2306.07	1375.16
2050.12	1377
1992.97	1396
1977.93	1401
1571.11	1398.35
854.366	1400.48
843.931	1400.26
637.348	1331.54
596.847	1331.48
21.1232	1187.65

14.5324	1186
10.4122	1184.63
8.36236	1184.11
6.56235	1183.66
5.66234	1183.43
0.262295	1182.07
0	1182
0	1150

Material Boundary

X	Y
2921.25	1150
2938.56	1150
2965.22	1150
2966.66	1150
2970.05	1150
2970.76	1150
2982.06	1150
3010.89	1150
3022.35	1150.12

Material Boundary

X	Y
8.36236	1184.11
13.5602	1182.38
13.5672	1182.38
13.5972	1182.37
19.8808	1180.27
19.9687	1180.24
28.5649	1177.38
34.8152	1175.29
34.9515	1175.25

42.7472	1172.38
49.8178	1170.29
49.9969	1170.23
58.565	1167.38
64.8136	1165.3
64.9216	1165.26
65.105	1165.2
71.5832	1163.26
87.4587	1163.65
103.395	1164.15
149.393	1165.24
157.08	1165.24
246.129	1165.22
251.452	1165.22
340.252	1165.21
345.834	1165.21
434.385	1165.2
440.226	1165.2
528.527	1165.18
534.628	1165.18
622.68	1165.17
629.041	1165.17
716.843	1165.16
723.463	1165.15
811.017	1165.14
817.896	1165.14
905.2	1165.13
912.34	1165.13
999.394	1165.12
1006.79	1165.11
1093.6	1165.1
1101.26	1165.1
1187.81	1165.09
1195.73	1165.09

1282.04	1165.07
1290.21	1165.07
1376.27	1165.06
1384.71	1165.06
1390.24	1165.06
1470.47	1165.05
1518.68	1166.67
1534.49	1167.2
1545.72	1166.68
1571.62	1165.5
1592.19	1164.55
1734.26	1162.68
1900.02	1160.5
2040.78	1158.65
2186.18	1156.73
2464.16	1160.48
2464.75	1160.49
2468.11	1160.45
2817.68	1157.07
2871.82	1157.53
2958.49	1158.26

Material Boundary

X	Y
6.56235	1183.66
13.2441	1181.43
13.2505	1181.43
13.2803	1181.42
19.5644	1179.32
19.653	1179.29
28.249	1176.43
34.4988	1174.34
34.6207	1174.3

42.4328	1171.43
49.518	1169.34
49.6807	1169.29
58.2487	1166.43
64.4978	1164.35
64.6	1164.31
64.7979	1164.25
71.4489	1162.25
87.4868	1162.66
103.423	1163.15
149.405	1164.24
157.08	1164.24
246.129	1164.22
251.451	1164.22
340.252	1164.21
345.833	1164.21
434.384	1164.2
440.226	1164.2
528.527	1164.18
534.628	1164.18
622.68	1164.17
629.041	1164.17
716.843	1164.16
723.463	1164.15
811.017	1164.14
817.896	1164.14
905.2	1164.13
912.34	1164.13
999.394	1164.12
1006.79	1164.11
1093.6	1164.1
1101.26	1164.1
1187.81	1164.09
1195.73	1164.09

1282.04	1164.07
1290.21	1164.07
1376.27	1164.06
1384.71	1164.06
1390.24	1164.06
1470.48	1164.05
1518.71	1165.67
1534.49	1166.2
1545.67	1165.68
1571.58	1164.5
1592.16	1163.55
1734.25	1161.68
1900.01	1159.5
2040.77	1157.65
2186.18	1155.73
2464.18	1159.48
2464.76	1159.49
2468.1	1159.45
2817.68	1156.07
2871.83	1156.53
2961.42	1157.28

Material Boundary

X	Y
5.66234	1183.43
13.086	1180.95
13.0922	1180.95
13.1219	1180.94
19.4061	1178.85
19.4951	1178.82
28.0911	1175.95
34.3405	1173.87
34.4552	1173.83

42.2755	1170.96
49.368	1168.86
49.5226	1168.81
58.0905	1165.95
64.3399	1163.87
64.4392	1163.84
64.6444	1163.77
71.3818	1161.75
87.5009	1162.16
103.436	1162.65
149.41	1163.74
157.08	1163.74
246.129	1163.72
251.451	1163.72
340.252	1163.71
345.833	1163.71
434.384	1163.7
440.225	1163.7
528.527	1163.68
534.628	1163.68
622.68	1163.67
629.04	1163.67
716.843	1163.66
723.463	1163.65
811.017	1163.64
817.896	1163.64
905.2	1163.63
912.339	1163.63
999.394	1163.62
1006.79	1163.61
1093.6	1163.6
1101.26	1163.6
1187.81	1163.59
1195.73	1163.59

1282.04	1163.57
1290.21	1163.57
1376.27	1163.56
1384.71	1163.56
1390.24	1163.56
1470.49	1163.55
1518.73	1165.17
1534.48	1165.69
1545.65	1165.18
1571.56	1164
1592.15	1163.05
1734.24	1161.18
1900	1159
2040.76	1157.15
2186.18	1155.23
2464.18	1158.98
2464.76	1158.99
2468.1	1158.95
2817.68	1155.57
2871.83	1156.03
2962.89	1156.8

Material Boundary

X	Y
0	1150
2921.25	1150

Material Boundary

X	Y
0.262295	1182.07
12.1377	1178.11
12.1416	1178.11

12.1714	1178.1
18.4567	1176
18.548	1175.97
27.1436	1173.11
33.3911	1171.02
33.4626	1171
41.2864	1168.13
41.3322	1168.11
41.3737	1168.1
48.4686	1166
48.5741	1165.96
57.1416	1163.11
63.3923	1161.03
63.4745	1161
63.7232	1160.91
70.9791	1158.74
87.5852	1159.16
103.518	1159.65
149.446	1160.74
157.079	1160.74
246.129	1160.72
251.451	1160.72
340.251	1160.71
345.833	1160.71
434.384	1160.7
440.225	1160.7
528.527	1160.68
534.627	1160.68
622.68	1160.67
629.04	1160.67
716.843	1160.66
723.463	1160.65
811.016	1160.64
817.896	1160.64

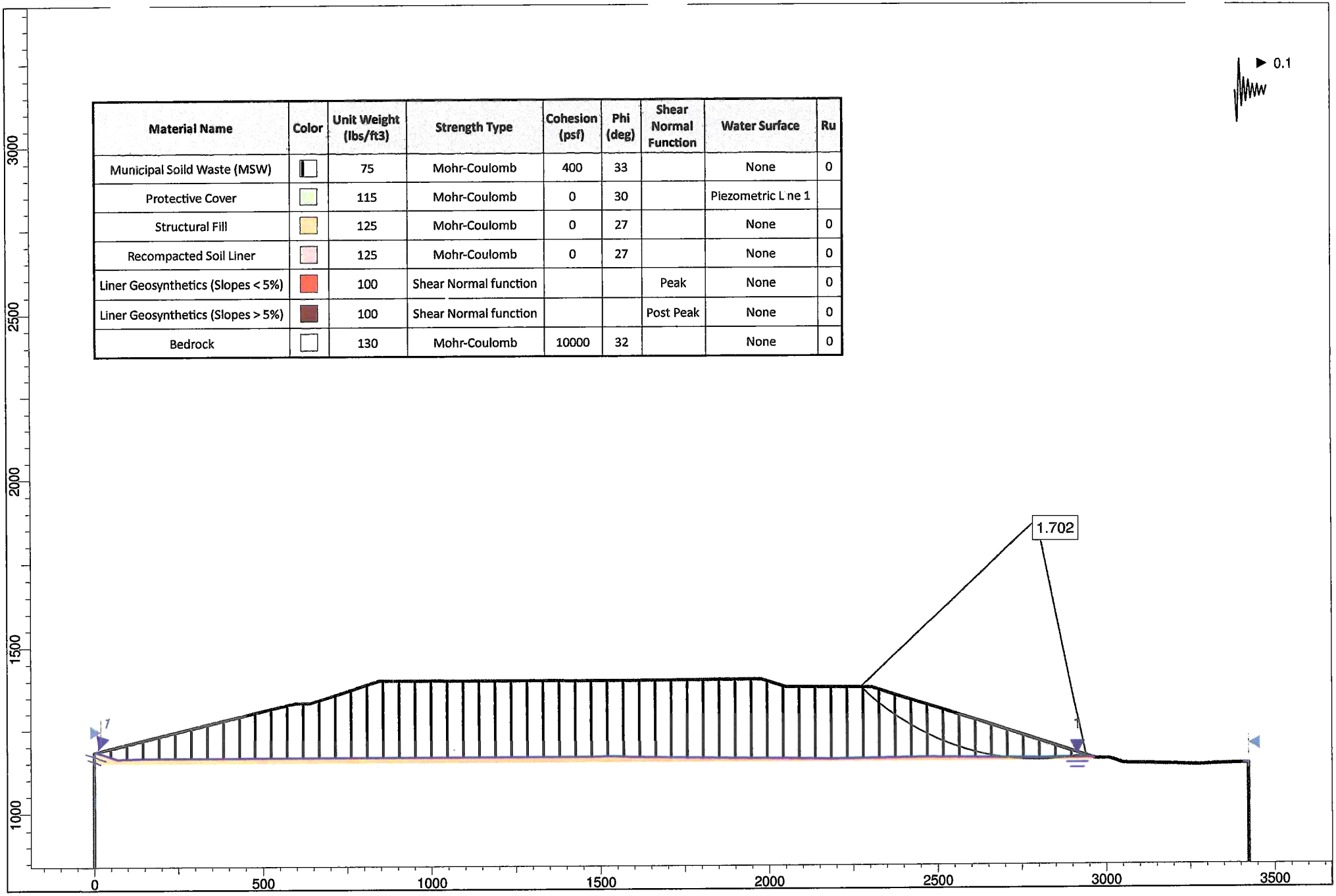
905.2	1160.63
912.339	1160.63
999.393	1160.62
1006.79	1160.61
1093.6	1160.6
1101.26	1160.6
1187.81	1160.59
1195.73	1160.59
1282.04	1160.57
1290.21	1160.57
1376.27	1160.56
1384.71	1160.56
1390.24	1160.56
1470.52	1160.55
1470.54	1160.55
1518.83	1162.17
1534.47	1162.69
1545.51	1162.19
1571.42	1161
1592.06	1160.05
1734.2	1158.18
1899.96	1156
2040.72	1154.15
2186.19	1152.23
2464.22	1155.98
2464.76	1155.99
2468.07	1155.95
2817.68	1152.57
2871.86	1153.03
2971.69	1153.87

Material Boundary

X	Y

71.3818	1161.75
71.4489	1162.25

Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)	Shear Normal Function	Water Surface	Ru
Municipal Soild Waste (MSW)		75	Mohr-Coulomb	400	33		None	0
Protective Cover		115	Mohr-Coulomb	0	30		Piezometric Line 1	
Structural Fill		125	Mohr-Coulomb	0	27		None	0
Recompacted Soil Liner		125	Mohr-Coulomb	0	27		None	0
Liner Geosynthetics (Slopes < 5%)		100	Shear Normal function			Peak	None	0
Liner Geosynthetics (Slopes > 5%)		100	Shear Normal function			Post Peak	None	0
Bedrock		130	Mohr-Coulomb	10000	32		None	0



B-B -- seismic -- rotational -- drained - Rev1.slim

Slide Analysis Information

Project Summary

File Name: B-B -- seismic -- rotational -- drained - Rev1.slim
Slide Modeler Version: 6.023

General Settings

Units of Measurement: Imperial Units
Time Units: days
Permeability Units: feet/second
Failure Direction: Left to Right
Data Output: Standard
Maximum Material Properties: 20
Maximum Support Properties: 20

Analysis Options

Analysis Methods Used

Spencer

Number of slices: 25
Tolerance: 0.005
Maximum number of iterations: 50
Check malpha < 0.2: Yes
Initial trial value of FS: 1
Steffensen Iteration: Yes

Groundwater Analysis

Groundwater Method: Water Surfaces
Pore Fluid Unit Weight: 62.4 lbs/ft3

Advanced Groundwater Method: None

Random Numbers

Pseudo-random Seed: 10116
Random Number Generation Method: Park and Miller v.3

Surface Options

Surface Type: Circular
Search Method: Auto Refine Search
Divisions along slope: 20
Circles per division: 10
Number of iterations: 10
Divisions to use in next iteration: 50%
Composite Surfaces: Disabled
Minimum Elevation: 0
Minimum Depth: 5

Loading

Seismic Load Coefficient (Horizontal): 0.1

Material Properties

Property	Municipal Solid Waste (MSW)	Protective Cover	Structural Fill	Recompacted Soil Liner	Liner Geosynthetics (Slopes	Liner Geosynthetics (Slopes > 5%)	Bedrock
Color							
Strength Type	Mohr-Coulomb	Mohr-Coulomb	Mohr-Coulomb	Mohr-Coulomb	Shear Normal function	Shear Normal function	Mohr-Coulomb
Unit Weight [lbs/ft3]	75	115	125	125	100	100	130
Cohesion [psf]	400	0	0	0			10000
Friction Angle							

[deg]						
Water Surface	None	Piezometric Line 1	None	None	None	None	None
Hu Value		1					
Ru Value	0		0	0	0	0	0

Shear Normal Functions

Name: Peak

Normal (psf)	Shear (psf)
0	0
3000	1250
6000	2000
13500	3500

Name: Post Peak

Normal (psf)	Shear (psf)
0	0
3000	875
6000	1290
13500	2100

Global Minimums

Method: spencer

FS: 1.701630
Center: 2796.822, 1872.477
Radius: 722.466
Left Slip Surface Endpoint: 2272.543, 1375.397
Right Slip Surface Endpoint: 2940.124, 1164.366
Resisting Moment=1.60356e+009 lb-ft
Driving Moment=9.42364e+008 lb-ft
Resisting Horizontal Force=2.0616e+006 lb
Driving Horizontal Force=1.21154e+006 lb
Total Slice Area=46151.9 ft2

Valid / Invalid Surfaces

Method: spencer

Number of Valid Surfaces: 12514
Number of Invalid Surfaces. 0

Slice Data

Global Minimum Query (spencer) - Safety Factor: 1.70163

Slice Number	Width [ft]	Weight [lbs]	Base Material	Base Cohesion [psf]	Base Friction Angle [degrees]	Shear Stress [psf]	Shear Strength [psf]	Base Normal Stress [psf]	Pore Pressure [psf]	Effective Normal Stress [psf]
1	29.64	32554.8	Municipal Soild Waste (MSW)	400	33	448.012	762.351	557.971	0	557.971
2	29.64	86068.2	Municipal Soild Waste (MSW)	400	33	890.029	1514.5	1716.18	0	1716.18
3	29.64	119895	Municipal Soild Waste (MSW)	400	33	1208.86	2057.04	2551.61	0	2551.61
4	29.64	147848	Municipal Soild Waste (MSW)	400	33	1501.24	2554.56	3317.72	0	3317.72
5	29.64	170743	Municipal Soild Waste (MSW)	400	33	1767.92	3008.34	4016.48	0	4016.48
6	29.64	189072	Municipal Soild Waste (MSW)	400	33	2008.14	3417.11	4645.93	0	4645.93
7	29.64	203224	Municipal Soild Waste (MSW)	400	33	2221.09	3779.48	5203.94	0	5203.94
8	29.64	213509	Municipal Soild Waste (MSW)	400	33	2405.86	4093.89	5688.08	0	5688.08
9	29.64	220179	Municipal Soild Waste (MSW)	400	33	2561.37	4358.51	6095.57	0	6095.57
10	29.64	223439	Municipal Soild Waste (MSW)	400	33	2686.39	4571.24	6423.13	0	6423.13
11	29.64	223458	Municipal Soild Waste (MSW)	400	33	2779.46	4729.61	6667.01	0	6667.01
12	29.64	220373	Municipal Soild Waste (MSW)	400	33	2838.88	4830.73	6822.73	0	6822.73
13	29.64	214296	Municipal Soild Waste (MSW)	400	33	2862.69	4871.24	6885.11	0	6885.11
14	29.64	205317	Municipal Soild Waste (MSW)	400	33	2848.55	4847.17	6848.02	0	6848.02
15	7.23523	48630.6	Protective Cover	0	30	2244.52	3819.34	6646.49	31.2015	6615.29
16	3.83703	25592.4	Liner Geosynthetics (Slopes < 5%)	800	11.31	1216.67	2070.33	6351.65	0	6351.65
17	27.8078	180733	Recompacted Soil Liner	0	27	1947.16	3313.34	6502.79	0	6502.79
18	33.8641	205797	Structural Fill	0	27	1882.87	3203.95	6288.1	0	6288.1
19	33.8641	183923	Structural Fill	0	27	1747.31	2973.28	5835.4	0	5835.4
20	33.8641	155361	Structural Fill	0	27	1534.19	2610.62	5123.63	0	5123.63

21	33.8641	120807	Structural Fill	0	27	1241.64	2112.82	4146.65	0	4146.65
22	29.2706	71697.2	Recompacted Soil Liner	0	27	886.215	1508.01	2959.64	0	2959.64
23	3.96841	7190.9	Liner Geosynthetics (Slopes < 5%)	1.13687e-013	22.6199	527.384	897.413	2153.79	0	2153.79
24	7.45539	11805.6	Protective Cover	0	30	673.848	1146.64	2017.23	31.2011	1986.03
25	37.5905	26890	Municipal Soild Waste (MSW)	400	33	694.123	1181.14	1202.85	0	1202.85

Interslice Data

Global Minimum Query (spencer) - Safety Factor: 1.70163

Slice Number	X coordinate [ft]	Y coordinate - Bottom [ft]	Interslice Normal Force [lbs]	Interslice Shear Force [lbs]	Interslice Force Angle [degrees]
1	2272.54	1375.4	0	0	0
2	2302.18	1345.89	6413.75	2783.3	23.4588
3	2331.82	1319.55	33810.7	14672.5	23.4589
4	2361.46	1295.92	70191.4	30460.2	23.4589
5	2391.1	1274.69	110828	48095	23.459
6	2420.74	1255.61	152030	65975	23.4589
7	2450.38	1238.49	190849	82820.9	23.4589
8	2480.02	1223.17	224936	97613.1	23.4589
9	2509.66	1209.53	252442	109550	23.459
10	2539.3	1197.47	271953	118017	23.459
11	2568.94	1186.89	282447	122570	23.4588
12	2598.58	1177.74	283263	122925	23.4589
13	2628.22	1169.96	274095	118946	23.4589
14	2657.86	1163.5	254986	110654	23.459
15	2687.5	1158.33	226344	98224	23.4589
16	2694.74	1157.26	222050	96360.6	23.4589
17	2698.57	1156.72	223344	96922.3	23.4589
18	2726.38	1153.45	208432	90451.1	23.4589
19	2760.25	1150.94	180952	78525.8	23.4589
20	2794.11	1150.02	145441	63115.5	23.4589
21	2827.98	1150.68	105511	45787.7	23.459
22	2861.84	1152.94	66098.4	28684	23.4589

23	2891.11	1156.19	37669	16346.8	23.4589
24	2895.08	1156.72	35142.1	15250.3	23.459
25	2902.53	1157.79	29145.3	12647.9	23.4589
26	2940.12	1164.37	0	0	0

List Of Coordinates

Piezoline

X	Y
8.36236	1184.11
13.5972	1182.37
19.8808	1180.27
28.5649	1177.38
34.9515	1175.25
42.7472	1172.38
49.9969	1170.23
64.8136	1165.3
71.5832	1163.26
87.4587	1163.65
103.395	1164.15
149.393	1165.24
157.08	1165.24
246.129	1165.22
251.452	1165.22
340.252	1165.21
345.834	1165.21
434.385	1165.2
440.226	1165.2
528.527	1165.18
534.628	1165.18
622.68	1165.17
629.041	1165.17
716.843	1165.16

723.463	1165.15
811.017	1165.14
817.896	1165.14
905.2	1165.13
912.34	1165.13
999.394	1165.12
1006.79	1165.11
1093.6	1165.1
1101.26	1165.1
1187.81	1165.09
1195.73	1165.09
1282.04	1165.07
1290.21	1165.07
1376.27	1165.06
1384.71	1165.06
1390.24	1165.06
1470.47	1165.05
1518.68	1166.67
1534.49	1167.2
1545.72	1166.68
1571.62	1165.5
1592.19	1164.55
1734.26	1162.68
1900.02	1160.5
2040.78	1158.65
2186.18	1156.73
2464.16	1160.48
2464.75	1160.49
2468.11	1160.45
2817.68	1157.07
2870.49	1157.52
2871.82	1157.53
2958.49	1158.26

External Boundary

X	Y
0	831.999
3422.62	831.999
3422.62	1139.03
3409.35	1138.65
3320.41	1136.04
3274.61	1134.7
3203.54	1136.61
3051.13	1140.71
3022.35	1150.12
3009.9	1154.19
2971.69	1153.87
2962.89	1156.8
2961.42	1157.28
2958.49	1158.26
2306.07	1375.16
2050.12	1377
1992.97	1396
1977.93	1401
1571.11	1398.35
854.366	1400.48
843.931	1400.26
637.348	1331.54
596.847	1331.48
21.1232	1187.65
14.5324	1186
10.4122	1184.63
8.36236	1184.11
6.56235	1183.66
5.66234	1183.43
0.262295	1182.07
0	1182
0	1150

Material Boundary

X	Y
2921.25	1150
2938.56	1150
2965.22	1150
2966.66	1150
2970.05	1150
2970.76	1150
2982.06	1150
3010.89	1150
3022.35	1150.12

Material Boundary

X	Y
8.36236	1184.11
13.5602	1182.38
13.5672	1182.38
13.5972	1182.37
19.8808	1180.27
19.9687	1180.24
28.5649	1177.38
34.8152	1175.29
34.9515	1175.25
42.7472	1172.38
49.8178	1170.29
49.9969	1170.23
58.565	1167.38
64.8136	1165.3
64.9216	1165.26
65.105	1165.2
71.5832	1163.26

87.4587	1163.65
103.395	1164.15
149.393	1165.24
157.08	1165.24
246.129	1165.22
251.452	1165.22
340.252	1165.21
345.834	1165.21
434.385	1165.2
440.226	1165.2
528.527	1165.18
534.628	1165.18
622.68	1165.17
629.041	1165.17
716.843	1165.16
723.463	1165.15
811.017	1165.14
817.896	1165.14
905.2	1165.13
912.34	1165.13
999.394	1165.12
1006.79	1165.11
1093.6	1165.1
1101.26	1165.1
1187.81	1165.09
1195.73	1165.09
1282.04	1165.07
1290.21	1165.07
1376.27	1165.06
1384.71	1165.06
1390.24	1165.06
1470.47	1165.05
1518.68	1166.67
1534.49	1167.2

1545.72	1166.68
1571.62	1165.5
1592.19	1164.55
1734.26	1162.68
1900.02	1160.5
2040.78	1158.65
2186.18	1156.73
2464.16	1160.48
2464.75	1160.49
2468.11	1160.45
2817.68	1157.07
2871.82	1157.53
2958.49	1158.26

Material Boundary

X	Y
6.56235	1183.66
13.2441	1181.43
13.2505	1181.43
13.2803	1181.42
19.5644	1179.32
19.653	1179.29
28.249	1176.43
34.4988	1174.34
34.6207	1174.3
42.4328	1171.43
49.518	1169.34
49.6807	1169.29
58.2487	1166.43
64.4978	1164.35
64.6	1164.31
64.7979	1164.25
71.4489	1162.25

87.4868	1162.66
103.423	1163.15
149.405	1164.24
157.08	1164.24
246.129	1164.22
251.451	1164.22
340.252	1164.21
345.833	1164.21
434.384	1164.2
440.226	1164.2
528.527	1164.18
534.628	1164.18
622.68	1164.17
629.041	1164.17
716.843	1164.16
723.463	1164.15
811.017	1164.14
817.896	1164.14
905.2	1164.13
912.34	1164.13
999.394	1164.12
1006.79	1164.11
1093.6	1164.1
1101.26	1164.1
1187.81	1164.09
1195.73	1164.09
1282.04	1164.07
1290.21	1164.07
1376.27	1164.06
1384.71	1164.06
1390.24	1164.06
1470.48	1164.05
1518.71	1165.67
1534.49	1166.2

1545.67	1165.68
1571.58	1164.5
1592.16	1163.55
1734.25	1161.68
1900.01	1159.5
2040.77	1157.65
2186.18	1155.73
2464.18	1159.48
2464.76	1159.49
2468.1	1159.45
2817.68	1156.07
2871.83	1156.53
2961.42	1157.28

Material Boundary

X	Y
5.66234	1183.43
13.086	1180.95
13.0922	1180.95
13.1219	1180.94
19.4061	1178.85
19.4951	1178.82
28.0911	1175.95
34.3405	1173.87
34.4552	1173.83
42.2755	1170.96
49.368	1168.86
49.5226	1168.81
58.0905	1165.95
64.3399	1163.87
64.4392	1163.84
64.6444	1163.77
71.3818	1161.75

87.5009	1162.16
103.436	1162.65
149.41	1163.74
157.08	1163.74
246.129	1163.72
251.451	1163.72
340.252	1163.71
345.833	1163.71
434.384	1163.7
440.225	1163.7
528.527	1163.68
534.628	1163.68
622.68	1163.67
629.04	1163.67
716.843	1163.66
723.463	1163.65
811.017	1163.64
817.896	1163.64
905.2	1163.63
912.339	1163.63
999.394	1163.62
1006.79	1163.61
1093.6	1163.6
1101.26	1163.6
1187.81	1163.59
1195.73	1163.59
1282.04	1163.57
1290.21	1163.57
1376.27	1163.56
1384.71	1163.56
1390.24	1163.56
1470.49	1163.55
1518.73	1165.17
1534.48	1165.69

1545.65	1165.18
1571.56	1164
1592.15	1163.05
1734.24	1161.18
1900	1159
2040.76	1157.15
2186.18	1155.23
2464.18	1158.98
2464.76	1158.99
2468.1	1158.95
2817.68	1155.57
2871.83	1156.03
2962.89	1156.8

Material Boundary

X	Y
0	1150
2921.25	1150

Material Boundary

X	Y
0.262295	1182.07
12.1377	1178.11
12.1416	1178.11
12.1714	1178.1
18.4567	1176
18.548	1175.97
27.1436	1173.11
33.3911	1171.02
33.4626	1171
41.2864	1168.13
41.3322	1168.11

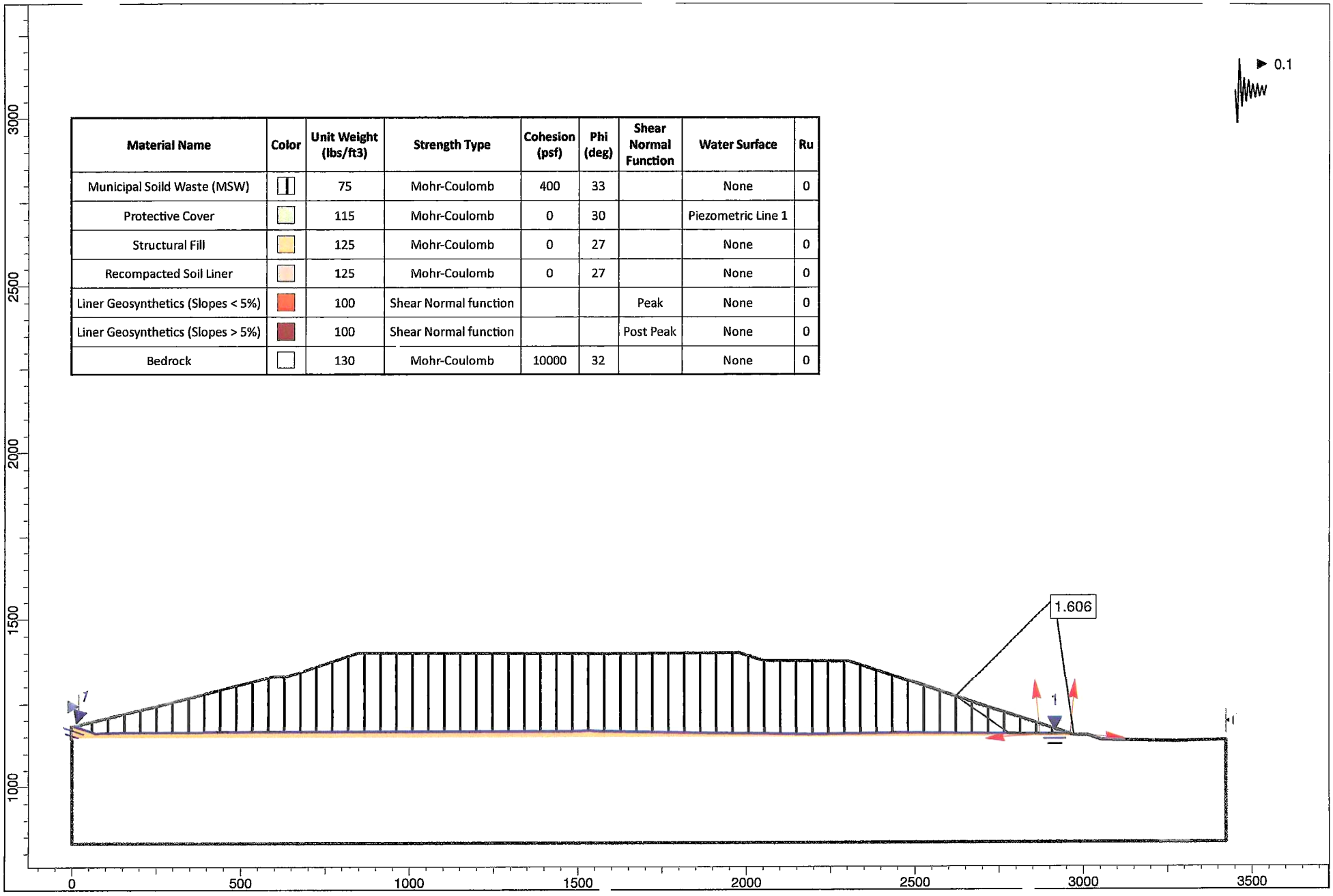
41.3737	1168.1
48.4686	1166
48.5741	1165.96
57.1416	1163.11
63.3923	1161.03
63.4745	1161
63.7232	1160.91
70.9791	1158.74
87.5852	1159.16
103.518	1159.65
149.446	1160.74
157.079	1160.74
246.129	1160.72
251.451	1160.72
340.251	1160.71
345.833	1160.71
434.384	1160.7
440.225	1160.7
528.527	1160.68
534.627	1160.68
622.68	1160.67
629.04	1160.67
716.843	1160.66
723.463	1160.65
811.016	1160.64
817.896	1160.64
905.2	1160.63
912.339	1160.63
999.393	1160.62
1006.79	1160.61
1093.6	1160.6
1101.26	1160.6
1187.81	1160.59
1195.73	1160.59

1282.04	1160.57
1290.21	1160.57
1376.27	1160.56
1384.71	1160.56
1390.24	1160.56
1470.52	1160.55
1470.54	1160.55
1518.83	1162.17
1534.47	1162.69
1545.51	1162.19
1571.42	1161
1592.06	1160.05
1734.2	1158.18
1899.96	1156
2040.72	1154.15
2186.19	1152.23
2464.22	1155.98
2464.76	1155.99
2468.07	1155.95
2817.68	1152.57
2871.86	1153.03
2971.69	1153.87

Material Boundary

X	Y
71.3818	1161.75
71.4489	1162.25

Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)	Shear Normal Function	Water Surface	Ru
Municipal Soild Waste (MSW)		75	Mohr-Coulomb	400	33		None	0
Protective Cover		115	Mohr-Coulomb	0	30		Piezometric Line 1	
Structural Fill		125	Mohr-Coulomb	0	27		None	0
Recompacted Soil Liner		125	Mohr-Coulomb	0	27		None	0
Liner Geosynthetics (Slopes < 5%)		100	Shear Normal function			Peak	None	0
Liner Geosynthetics (Slopes > 5%)		100	Shear Normal function			Post Peak	None	0
Bedrock		130	Mohr-Coulomb	10000	32		None	0



B-B -- seismic -- translational -- drained - Rev1.slim

Slide Analysis Information

Project Summary

File Name: B-B -- seismic -- translational -- drained - Rev1.slim
Slide Modeler Version: 6.023

General Settings

Units of Measurement: Imperial Units
Time Units: days
Permeability Units: feet/second
Failure Direction: Left to Right
Data Output: Standard
Maximum Material Properties: 20
Maximum Support Properties: 20

Analysis Options

Analysis Methods Used

Spencer

Number of slices: 25
Tolerance: 0.005
Maximum number of iterations: 50
Check malpha < 0.2: Yes
Initial trial value of FS: 1
Steffensen Iteration: Yes

Groundwater Analysis

Groundwater Method: Water Surfaces
Pore Fluid Unit Weight: 62.4 lbs/ft3

Advanced Groundwater Method: None

Random Numbers

Pseudo-random Seed: 10116
Random Number Generation Method: Park and Miller v.3

Surface Options

Surface Type: Non-Circular Block Search
Number of Surfaces: 7000
Pseudo-Random Surfaces: Enabled
Convex Surfaces Only: Disabled
Left Projection Angle (Start Angle): 95
Left Projection Angle (End Angle): 185
Right Projection Angle (Start Angle): -5
Right Projection Angle (End Angle): 85
Minimum Elevation: Not Defined
Minimum Depth: Not Defined

Loading

Seismic Load Coefficient (Horizontal): 0.1

Material Properties

Property	Municipal Soild Waste (MSW)	Protective Cover	Structural Fill	Recompacted Soil Liner	Liner Geosynthetics (Slopes	Liner Geosynthetics (Slopes > 5%)	Bedrock
Color							
Strength Type	Mohr-Coulomb	Mohr-Coulomb	Mohr-Coulomb	Mohr-Coulomb	Shear Normal function	Shear Normal function	Mohr-Coulomb
Unit Weight [lbs/ft3]	75	115	125	125	100	100	130
Cohesion [psf]	400	0	0	0			10000

Friction Angle [deg]	33	30	27	27			32
Water Surface	None	Piezometric Line 1	None	None	None	None	None
Hu Value		1					
Ru Value	0		0	0	0	0	0

Shear Normal Functions

Name. Peak

Normal (psf)	Shear (psf)
0	0
3000	1250
6000	2000
13500	3500

Name. Post Peak

Normal (psf)	Shear (psf)
0	0
3000	875
6000	1290
13500	2100

Global Minimums

Method: spencer

FS: 1.605530
Axis Location: 2913.228, 1560.798
Left Slip Surface Endpoint: 2622.764, 1269.871
Right Slip Surface Endpoint: 2971.691, 1153.871
Resisting Moment=1.8057e+008 lb-ft
Driving Moment=1.12468e+008 lb-ft
Resisting Horizontal Force=396384 lb
Driving Horizontal Force=246887 lb
Total Slice Area=10430.5 ft2

Global Minimum Coordinates

Method: spencer

X	Y
2622.76	1269.87
2781.83	1155.91
2938.78	1156.59
2971.69	1153.87

Valid / Invalid Surfaces

Method: spencer

Number of Valid Surfaces: 2930
Number of Invalid Surfaces: 4071

Error Codes:

Error Code -106 reported for 66 surfaces
Error Code -108 reported for 1589 surfaces
Error Code -110 reported for 465 surfaces
Error Code -111 reported for 1117 surfaces
Error Code -112 reported for 834 surfaces

Error Codes

The following errors were encountered during the computation:

-106 = Average slice width is less than 0.0001 * (maximum horizontal extent of soil region). This limitation is imposed to avoid numerical errors which may result from too many slices, or too small a slip region.
-108 = Total driving moment or total driving force < 0.1. This is to limit the calculation of extremely high safety factors if the driving force is very small (0.1 is an arbitrary number).
-110 = The water table or a piezoline does not span the slip region for a given slip surface, when Water Surfaces is specified as the method of pore pressure calculation. If this error occurs, check that the water table or piezoline(s) span the appropriate soil cells.
-111 = safety factor equation did not converge
-112 = The coefficient M-Alpha = cos(alpha)(1+tan(alpha)tan(phi)/F) < 0.2 for the final iteration of the safety factor calculation. This screens out some slip surfaces which

may not be valid in the context of the analysis, in particular, deep seated slip surfaces with many high negative base angle slices in the passive zone.

Slice Data

Global Minimum Query (spencer) - Safety Factor: 1.60553

Slice Number	Width [ft]	Weight [lbs]	Base Material	Base Cohesion [psf]	Base Friction Angle [degrees]	Shear Stress [psf]	Shear Strength [psf]	Base Normal Stress [psf]	Pore Pressure [psf]	Effective Normal Stress [psf]
1	15.6944	3546.44	Municipal Soild Waste (MSW)	400	33	292.516	469.643	107.241	0	107.241
2	15.6944	10639.3	Municipal Soild Waste (MSW)	400	33	413.785	664.344	407.054	0	407.054
3	15.6944	17732.2	Municipal Soild Waste (MSW)	400	33	535.054	859.045	706.868	0	706.868
4	15.6944	24825.1	Municipal Soild Waste (MSW)	400	33	656.323	1053.75	1006.68	0	1006.68
5	15.6944	31918	Municipal Soild Waste (MSW)	400	33	777.592	1248.45	1306.49	0	1306.49
6	15.6944	39010.9	Municipal Soild Waste (MSW)	400	33	898.862	1443.15	1606.31	0	1606.31
7	15.6944	46103.8	Municipal Soild Waste (MSW)	400	33	1020.13	1637.85	1906.12	0	1906.12
8	15.6944	53196.6	Municipal Soild Waste (MSW)	400	33	1141.4	1832.55	2205.93	0	2205.93
9	15.6944	60289.5	Municipal Soild Waste (MSW)	400	33	1262.67	2027.25	2505.74	0	2505.74
10	15.6944	67382.4	Municipal Soild Waste (MSW)	400	33	1383.94	2221.95	2805.56	0	2805.56
11	1.41507	6452.35	Protective Cover	0	30	1085.67	1743.07	3050.28	31.2015	3019.08
12	0.710299	3279.19	Liner Geosynthetics (Slopes < 5%)	500	14.0363	800.861	1285.81	3143.23	0	3143.23
13	14.2676	63497.4	Liner Geosynthetics (Slopes < 5%)	500	14.0363	1051	1687.42	4749.69	0	4749.69
14	14.2676	58284.6	Liner Geosynthetics (Slopes < 5%)	500	14.0363	992.333	1593.22	4372.89	0	4372.89
15	14.2676	53082.7	Liner Geosynthetics (Slopes < 5%)	500	14.0363	933.787	1499.22	3996.89	0	3996.89
16	14.2676	47950	Liner Geosynthetics (Slopes < 5%)	500	14.0363	876.019	1406.47	3625.89	0	3625.89
17	14.2676	42829.5	Liner Geosynthetics (Slopes < 5%)	500	14.0363	818.386	1313.94	3255.77	0	3255.77
18	14.2676	37709	Liner Geosynthetics (Slopes < 5%)	0	22.6199	747.211	1199.67	2879.22	0	2879.22
19	14.2676	32588.5	Liner Geosynthetics (Slopes < 5%)	0	22.6199	645.749	1036.77	2488.25	0	2488.25
20	14.2676	27467.9	Liner Geosynthetics (Slopes < 5%)	1.13687e-013	22.6199	544.284	873.864	2097.27	0	2097.27
21	14.2676	22347.4	Liner Geosynthetics (Slopes < 5%)	0	22.6199	442.82	710.96	1706.3	0	1706.3
22	14.2676	17226.9	Liner Geosynthetics (Slopes < 5%)	0	22.6199	341.355	548.056	1315.34	0	1315.34
23	14.2676	12106.4	Liner Geosynthetics (Slopes < 5%)	0	22.6199	239.89	385.151	924.363	0	924.363
24	16.4568	9091.45	Recompacted Soil Liner	0	27	182.426	292.89	574.829	0	574.829
25	16.4568	4003.61	Recompacted Soil Liner	0	27	80.3348	128.98	253.139	0	253.139

Interslice Data

Global Minimum Query (spencer) - Safety Factor: 1.60553

Slice Number	X coordinate [ft]	Y coordinate - Bottom [ft]	Interslice Normal Force [lbs]	Interslice Shear Force [lbs]	Interslice Force Angle [degrees]
1	2622.76	1269.87	0	0	0
2	2638.46	1258.63	-3030.47	-1425.51	25.1919
3	2654.15	1247.38	-3883.98	-1827	25.192
4	2669.85	1236.14	-2560.53	-1204.46	25.192
5	2685.54	1224.9	939.874	442.11	25.192
6	2701.24	1213.65	6617.24	3112.7	25.1919
7	2716.93	1202.41	14471.6	6807.32	25.1919
8	2732.63	1191.17	24502.8	11526	25.1921
9	2748.32	1179.92	36711.1	17268.6	25.1919
10	2764.01	1168.68	51096.3	24035.3	25.1919
11	2779.71	1157.44	67658.5	31826.1	25.192
12	2781.12	1156.42	69859.6	32861.5	25.192
13	2781.83	1155.91	71218.1	33500.5	25.192
14	2796.1	1155.98	62279.7	29295.9	25.1919
15	2810.37	1156.04	53680.3	25250.8	25.1919
16	2824.64	1156.1	45419.3	21364.9	25.1919
17	2838.9	1156.16	37492	17636	25.192
18	2853.17	1156.22	29897.9	14063.7	25.1919
19	2867.44	1156.28	22830.3	10739.2	25.1919
20	2881.71	1156.35	16722.5	7866.13	25.1919
21	2895.97	1156.41	11574.3	5444.48	25.192
22	2910.24	1156.47	7385.89	3474.27	25.192
23	2924.51	1156.53	4157.16	1955.5	25.192
24	2938.78	1156.59	1888.15	888.17	25.1919
25	2955.23	1155.23	577.271	271.544	25.1919
26	2971.69	1153.87	0	0	0

List Of Coordinates

Piezoline

X	Y
8.36236	1184.11
13.5602	1182.38
19.9687	1180.24
28.5649	1177.38
34.8152	1175.29
42.7472	1172.38
49.8178	1170.29
58.565	1167.38
65.105	1165.2
71.5832	1163.26
87.4587	1163.65
103.395	1164.15
149.393	1165.24
157.08	1165.24
246.129	1165.22
251.452	1165.22
340.252	1165.21
345.834	1165.21
434.385	1165.2
440.226	1165.2
528.527	1165.18
534.628	1165.18
622.68	1165.17
629.041	1165.17
716.843	1165.16
723.463	1165.15
811.017	1165.14
817.896	1165.14
906.193	1165.14

912.34	1165.13
999.394	1165.12
1006.79	1165.11
1093.6	1165.1
1101.26	1165.1
1187.81	1165.09
1195.73	1165.09
1282.04	1165.07
1290.21	1165.07
1376.27	1165.06
1384.71	1165.06
1390.24	1165.06
1470.47	1165.05
1518.68	1166.67
1534.49	1167.2
1545.72	1166.68
1571.62	1165.5
1592.19	1164.55
1734.26	1162.68
1900.02	1160.5
2040.78	1158.65
2186.18	1156.73
2464.16	1160.48
2468.11	1160.45
2817.68	1157.07
2871.82	1157.53
2958.49	1158.26

Block Search Polyline

X	Y
2961.42	1157.03
2871.83	1156.28

External Boundary

X	Y
0	831.999
3422.62	831.999
3422.62	1139.03
3409.35	1138.65
3320.41	1136.04
3274.61	1134.7
3203.54	1136.61
3051.13	1140.71
3022.35	1150.12
3009.9	1154.19
2971.69	1153.87
2962.89	1156.8
2961.42	1157.28
2958.49	1158.26
2306.07	1375.16
2050.12	1377
1992.97	1396
1977.93	1401
1571.11	1398.35
854.366	1400.48
843.931	1400.26
637.348	1331.54
596.847	1331.48
21.1232	1187.65
14.5324	1186
10.4122	1184.63
8.36236	1184.11
6.56235	1183.66
5.66234	1183.43
0.262295	1182.07
0	1182
0	1150

Material Boundary

X	Y
2921.25	1150
2938.56	1150
2965.22	1150
2966.66	1150
2970.05	1150
2970.76	1150
2982.06	1150
3010.89	1150
3022.35	1150.12

Material Boundary

X	Y
8.36236	1184.11
13.5602	1182.38
13.5672	1182.38
13.5972	1182.37
19.8808	1180.27
19.9687	1180.24
28.5649	1177.38
34.8152	1175.29
34.9515	1175.25
42.7472	1172.38
49.8178	1170.29
49.9969	1170.23
58.565	1167.38
64.8136	1165.3
64.9216	1165.26
65.105	1165.2
71.5832	1163.26

87.4587	1163.65
103.395	1164.15
149.393	1165.24
157.08	1165.24
246.129	1165.22
251.452	1165.22
340.252	1165.21
345.834	1165.21
434.385	1165.2
440.226	1165.2
528.527	1165.18
534.628	1165.18
622.68	1165.17
629.041	1165.17
716.843	1165.16
723.463	1165.15
811.017	1165.14
817.896	1165.14
905.2	1165.13
912.34	1165.13
999.394	1165.12
1006.79	1165.11
1093.6	1165.1
1101.26	1165.1
1187.81	1165.09
1195.73	1165.09
1282.04	1165.07
1290.21	1165.07
1376.27	1165.06
1384.71	1165.06
1390.24	1165.06
1470.47	1165.05
1518.68	1166.67
1534.49	1167.2

1545.72	1166.68
1571.62	1165.5
1592.19	1164.55
1734.26	1162.68
1900.02	1160.5
2040.78	1158.65
2186.18	1156.73
2464.16	1160.48
2464.75	1160.49
2468.11	1160.45
2817.68	1157.07
2871.82	1157.53
2958.49	1158.26

Material Boundary

X	Y
6.56235	1183.66
13.2441	1181.43
13.2505	1181.43
13.2803	1181.42
19.5644	1179.32
19.653	1179.29
28.249	1176.43
34.4988	1174.34
34.6207	1174.3
42.4328	1171.43
49.518	1169.34
49.6807	1169.29
58.2487	1166.43
64.4978	1164.35
64.6	1164.31
64.7979	1164.25
71.4489	1162.25

87.4868	1162.66
103.423	1163.15
149.405	1164.24
157.08	1164.24
246.129	1164.22
251.451	1164.22
340.252	1164.21
345.833	1164.21
434.384	1164.2
440.226	1164.2
528.527	1164.18
534.628	1164.18
622.68	1164.17
629.041	1164.17
716.843	1164.16
723.463	1164.15
811.017	1164.14
817.896	1164.14
905.2	1164.13
912.34	1164.13
999.394	1164.12
1006.79	1164.11
1093.6	1164.1
1101.26	1164.1
1187.81	1164.09
1195.73	1164.09
1282.04	1164.07
1290.21	1164.07
1376.27	1164.06
1384.71	1164.06
1390.24	1164.06
1470.48	1164.05
1518.71	1165.67
1534.49	1166.2

1545.67	1165.68
1571.58	1164.5
1592.16	1163.55
1734.25	1161.68
1900.01	1159.5
2040.77	1157.65
2186.18	1155.73
2464.18	1159.48
2464.76	1159.49
2468.1	1159.45
2817.68	1156.07
2871.83	1156.53
2961.42	1157.28

Material Boundary

X	Y
5.66234	1183.43
13.086	1180.95
13.0922	1180.95
13.1219	1180.94
19.4061	1178.85
19.4951	1178.82
28.0911	1175.95
34.3405	1173.87
34.4552	1173.83
42.2755	1170.96
49.368	1168.86
49.5226	1168.81
58.0905	1165.95
64.3399	1163.87
64.4392	1163.84
64.6444	1163.77
71.3818	1161.75

87.5009	1162.16
103.436	1162.65
149.41	1163.74
157.08	1163.74
246.129	1163.72
251.451	1163.72
340.252	1163.71
345.833	1163.71
434.384	1163.7
440.225	1163.7
528.527	1163.68
534.628	1163.68
622.68	1163.67
629.04	1163.67
716.843	1163.66
723.463	1163.65
811.017	1163.64
817.896	1163.64
905.2	1163.63
912.339	1163.63
999.394	1163.62
1006.79	1163.61
1093.6	1163.6
1101.26	1163.6
1187.81	1163.59
1195.73	1163.59
1282.04	1163.57
1290.21	1163.57
1376.27	1163.56
1384.71	1163.56
1390.24	1163.56
1470.49	1163.55
1518.73	1165.17
1534.48	1165.69

1545.65	1165.18
1571.56	1164
1592.15	1163.05
1734.24	1161.18
1900	1159
2040.76	1157.15
2186.18	1155.23
2464.18	1158.98
2464.76	1158.99
2468.1	1158.95
2817.68	1155.57
2871.83	1156.03
2962.89	1156.8

Material Boundary

X	Y
0	1150
2921.25	1150

Material Boundary

X	Y
0.262295	1182.07
12.1377	1178.11
12.1416	1178.11
12.1714	1178.1
18.4567	1176
18.548	1175.97
27.1436	1173.11
33.3911	1171.02
33.4626	1171
41.2864	1168.13
41.3322	1168.11

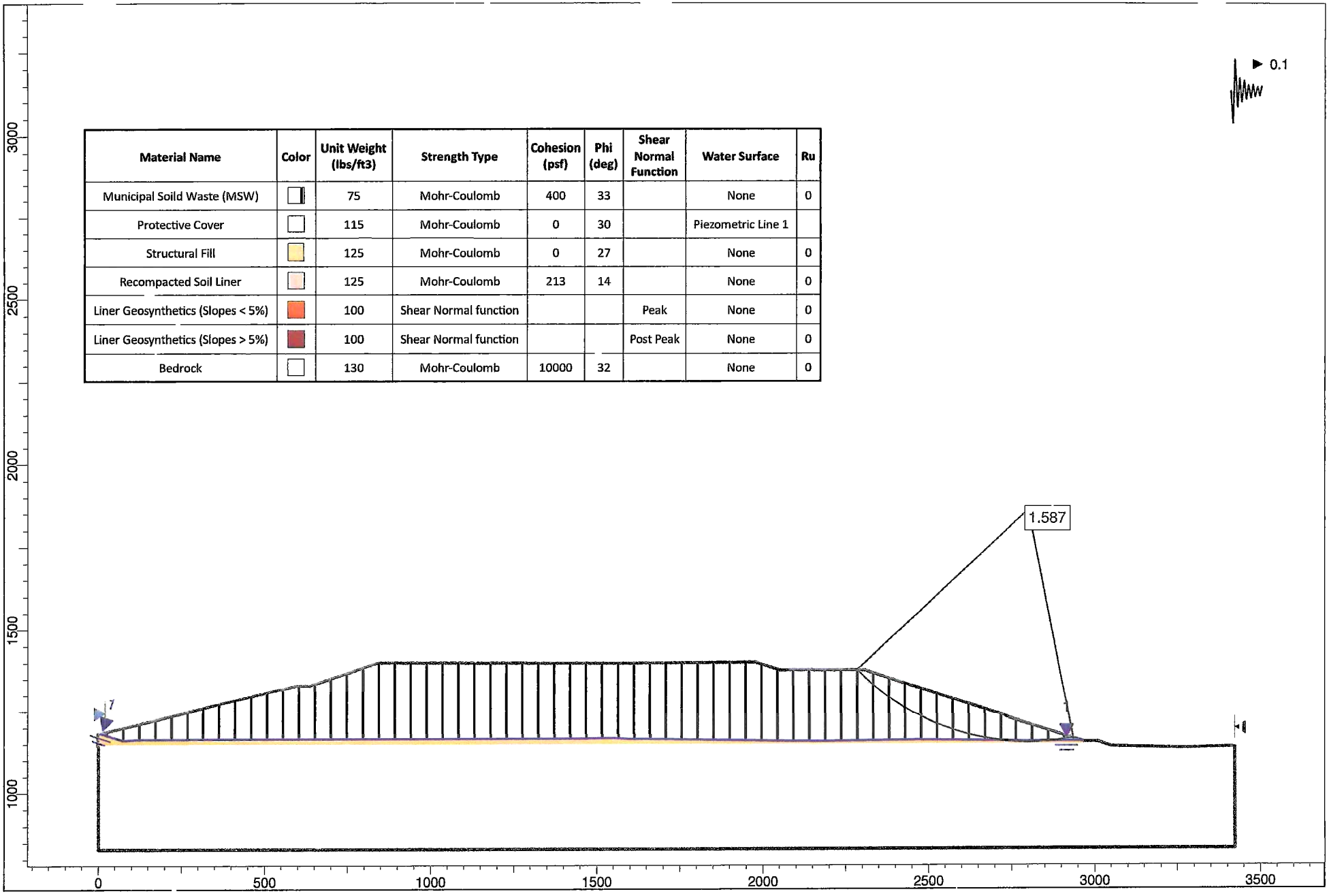
41.3737	1168.1
48.4686	1166
48.5741	1165.96
57.1416	1163.11
63.3923	1161.03
63.4745	1161
63.7232	1160.91
70.9791	1158.74
87.5852	1159.16
103.518	1159.65
149.446	1160.74
157.079	1160.74
246.129	1160.72
251.451	1160.72
340.251	1160.71
345.833	1160.71
434.384	1160.7
440.225	1160.7
528.527	1160.68
534.627	1160.68
622.68	1160.67
629.04	1160.67
716.843	1160.66
723.463	1160.65
811.016	1160.64
817.896	1160.64
905.2	1160.63
912.339	1160.63
999.393	1160.62
1006.79	1160.61
1093.6	1160.6
1101.26	1160.6
1187.81	1160.59
1195.73	1160.59

1282.04	1160.57
1290.21	1160.57
1376.27	1160.56
1384.71	1160.56
1390.24	1160.56
1470.52	1160.55
1470.54	1160.55
1518.83	1162.17
1534.47	1162.69
1545.51	1162.19
1571.42	1161
1592.06	1160.05
1734.2	1158.18
1899.96	1156
2040.72	1154.15
2186.19	1152.23
2464.22	1155.98
2464.76	1155.99
2468.07	1155.95
2817.68	1152.57
2871.86	1153.03
2971.69	1153.87

Material Boundary

X	Y
71.3818	1161.75
71.4489	1162.25

Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)	Shear Normal Function	Water Surface	Ru
Municipal Soild Waste (MSW)		75	Mohr-Coulomb	400	33		None	0
Protective Cover		115	Mohr-Coulomb	0	30		Piezometric Line 1	
Structural Fill		125	Mohr-Coulomb	0	27		None	0
Recompacted Soil Liner		125	Mohr-Coulomb	213	14		None	0
Liner Geosynthetics (Slopes < 5%)		100	Shear Normal function			Peak	None	0
Liner Geosynthetics (Slopes > 5%)		100	Shear Normal function			Post Peak	None	0
Bedrock		130	Mohr-Coulomb	10000	32		None	0



B-B -- seismic -- rotational -- undrained - Rev1.slim

Slide Analysis Information

Project Summary

File Name: B-B -- seismic -- rotational -- undrained - Rev1.slim
Slide Modeler Version: 6.023

General Settings

Units of Measurement: Imperial Units
Time Units: days
Permeability Units: feet/second
Failure Direction: Left to Right
Data Output: Standard
Maximum Material Properties: 20
Maximum Support Properties: 20

Analysis Options

Analysis Methods Used

Spencer

Number of slices: 25
Tolerance: 0.005
Maximum number of iterations: 50
Check malpha < 0.2: Yes
Initial trial value of FS: 1
Steffensen Iteration: Yes

Groundwater Analysis

Groundwater Method: Water Surfaces
Pore Fluid Unit Weight: 62.4 lbs/ft3

Advanced Groundwater Method: None

Random Numbers

Pseudo-random Seed: 10116
Random Number Generation Method: Park and Miller v.3

Surface Options

Surface Type: Circular
Search Method: Auto Refine Search
Divisions along slope: 20
Circles per division: 10
Number of iterations: 10
Divisions to use in next iteration: 50%
Composite Surfaces: Disabled
Minimum Elevation: 0
Minimum Depth: 5

Loading

Seismic Load Coefficient (Horizontal): 0.1

Material Properties

Property	Municipal Soild Waste (MSW)	Protective Cover	Structural Fill	Recompacted Soil Liner	Liner Geosynthetics (Slopes	Liner Geosynthetics (Slopes > 5%)	Bedrock
Color							
Strength Type	Mohr-Coulomb	Mohr-Coulomb	Mohr-Coulomb	Mohr-Coulomb	Shear Normal function	Shear Normal function	Mohr-Coulomb
Unit Weight [lbs/ft3]	75	115	125	125	100	100	130
Cohesion [psf]	400	0	0	213			10000
Friction Angle							

[deg]						
Water Surface	None	Piezometric Line 1	None	None	None	None
Hu Value		1				
Ru Value	0	0	0	0	0	0

Shear Normal Functions

Name. Peak

Normal (psf)	Shear (psf)
0	0
3000	1250
6000	2000
13500	3500

Name. Post Peak

Normal (psf)	Shear (psf)
0	0
3000	875
6000	1290
13500	2100

Global Minimums

Method: spencer

FS: 1.587270
Center: 2800.106, 1862.265
Radius: 709.842
Left Slip Surface Endpoint: 2283.620, 1375.318
Right Slip Surface Endpoint: 2936.349, 1165.621
Resisting Moment=1.37652e+009 lb-ft
Driving Moment=8.67226e+008 lb-ft
Resisting Horizontal Force=1.79717e+006 lb
Driving Horizontal Force=1.13224e+006 lb
Total Slice Area=43073.9 ft2

Valid / Invalid Surfaces

Method: spencer

Number of Valid Surfaces: 12688
Number of Invalid Surfaces: 0

Slice Data

Global Minimum Query (spencer) - Safety Factor. 1.58727

Slice Number	Width [ft]	Weight [lbs]	Base Material	Base Cohesion [psf]	Base Friction Angle [degrees]	Shear Stress [psf]	Shear Strength [psf]	Base Normal Stress [psf]	Pore Pressure [psf]	Effective Normal Stress [psf]
1	30.4881	33753.5	Municipal Soild Waste (MSW)	400	33	477.094	757.277	550.158	0	550.158
2	30.4881	82424.6	Municipal Soild Waste (MSW)	400	33	896.029	1422.24	1574.11	0	1574.11
3	30.4881	117734	Municipal Soild Waste (MSW)	400	33	1240.98	1969.77	2417.24	0	2417.24
4	30.4881	146792	Municipal Soild Waste (MSW)	400	33	1558.37	2473.55	3192.99	0	3192.99
5	30.4881	170316	Municipal Soild Waste (MSW)	400	33	1847.13	2931.9	3898.77	0	3898.77
6	30.4881	188858	Municipal Soild Waste (MSW)	400	33	2106.2	3343.11	4531.99	0	4531.99
7	30.4881	202850	Municipal Soild Waste (MSW)	400	33	2334.41	3705.34	5089.79	0	5089.79
8	30.4881	212635	Municipal Soild Waste (MSW)	400	33	2530.47	4016.54	5568.98	0	5568.98
9	30.4881	218489	Municipal Soild Waste (MSW)	400	33	2692.89	4274.35	5965.99	0	5965.99
10	30.4881	220635	Municipal Soild Waste (MSW)	400	33	2819.96	4476.03	6276.52	0	6276.52
11	30.4881	219255	Municipal Soild Waste (MSW)	400	33	2909.64	4618.39	6495.75	0	6495.75
12	30.4881	214494	Municipal Soild Waste (MSW)	400	33	2959.6	4697.68	6617.84	0	6617.84
13	30.4881	206471	Municipal Soild Waste (MSW)	400	33	2967.04	4709.49	6636.03	0	6636.03
14	30.4881	195279	Municipal Soild Waste (MSW)	400	33	2928.67	4648.59	6542.26	0	6542.26
15	8.99684	55280.8	Protective Cover	0	30	2267.23	3598.7	6264.33	31.2015	6233.13
16	4.9441	29952.5	Liner Geosynthetics (Slopes < 5%)	500	14.0363	1246.51	1978.55	5914.21	0	5914.21
17	23.2885	136455	Recompacted Soil Liner	213	14	1035.07	1642.93	5735.14	0	5735.14
18	23.2885	127693	Recompacted Soil Liner	213	14	995.71	1580.46	5484.59	0	5484.59
19	44.5316	210720	Recompacted Soil Liner	213	14	902.587	1432.65	4891.73	0	4891.73
20	28.0071	105732	Recompacted Soil Liner	213	14	770.946	1223.7	4053.71	0	4053.71

21	28.0071	80492.7	Recompacted Soil Liner	213	14	635.46	1008.65	3191.16	0	3191.16
22	5.18833	11919.6	Liner Geosynthetics (Slopes < 5%)	2.27374e-013	22.6199	709.092	1125.52	2701.24	0	2701.24
23	9.3626	18995.5	Protective Cover	0	30	922.66	1464.51	2567.8	31.2011	2536.6
24	25.1405	35350	Municipal Soild Waste (MSW)	400	33	1107.95	1758.62	2092.08	0	2092.08
25	25.1405	12073.9	Municipal Soild Waste (MSW)	400	33	628.553	997.684	920.351	0	920.351

Interslice Data

Global Minimum Query (spencer) - Safety Factor: 1.58727

Slice Number	X coordinate [ft]	Y coordinate - Bottom [ft]	Interslice Normal Force [lbs]	Interslice Shear Force [lbs]	Interslice Force Angle [degrees]
1	2283.62	1375.32	0	0	0
2	2314.11	1344.89	5543.93	2438.05	23.7384
3	2344.6	1317.85	28970	12740.1	23.7384
4	2375.08	1293.73	61141.7	26888.3	23.7385
5	2405.57	1272.16	97075.8	42691	23.7384
6	2436.06	1252.88	132856	58426.2	23.7385
7	2466.55	1235.68	165390	72733.5	23.7384
8	2497.04	1220.37	192246	84543.9	23.7384
9	2527.52	1206.85	211550	93033.1	23.7384
10	2558.01	1194.98	221913	97590.8	23.7385
11	2588.5	1184.7	222392	97801.3	23.7384
12	2618.99	1175.92	212460	93433.4	23.7384
13	2649.48	1168.59	192005	84437.8	23.7384
14	2679.96	1162.66	161336	70950.6	23.7384
15	2710.45	1158.11	121211	53304.8	23.7384
16	2719.45	1157.02	113112	49743	23.7383
17	2724.39	1156.47	113172	49769.8	23.7385
18	2747.68	1154.36	114772	50473.2	23.7384
19	2770.97	1153.02	111658	49104	23.7385
20	2815.5	1152.59	94568	41588.1	23.7384
21	2843.51	1153.75	78800.1	34653.9	23.7384
22	2871.52	1156.02	61764.2	27162	23.7384

23	2876.7	1156.57	57800.9	25419.1	23.7385
24	2886.07	1157.65	48274.1	21229.5	23.7385
25	2911.21	1161.17	16527.2	7268.18	23.7385
26	2936.35	1165.62	0	0	0

List Of Coordinates

Piezoline

X	Y
8.36236	1184.11
13.5972	1182.37
19.9687	1180.24
28.5649	1177.38
34.9515	1175.25
42.7472	1172.38
49.9969	1170.23
58.565	1167.38
65.105	1165.2
71.5832	1163.26
87.4587	1163.65
103.395	1164.15
149.393	1165.24
157.08	1165.24
246.129	1165.22
251.452	1165.22
340.252	1165.21
345.834	1165.21
434.385	1165.2
440.226	1165.2
528.527	1165.18
534.628	1165.18
622.68	1165.17
629.041	1165.17

716.843	1165.16
723.463	1165.15
811.017	1165.14
817.896	1165.14
905.2	1165.13
912.34	1165.13
999.394	1165.12
1006.79	1165.11
1093.6	1165.1
1101.26	1165.1
1187.81	1165.09
1195.73	1165.09
1282.04	1165.07
1290.21	1165.07
1376.27	1165.06
1384.71	1165.06
1390.24	1165.06
1470.47	1165.05
1518.68	1166.67
1534.49	1167.2
1545.72	1166.68
1571.62	1165.5
1592.19	1164.55
1734.26	1162.68
1900.02	1160.5
2040.78	1158.65
2186.18	1156.73
2464.16	1160.48
2468.11	1160.45
2817.68	1157.07
2871.82	1157.53
2958.49	1158.26

External Boundary

X	Y
0	831.999
3422.62	831.999
3422.62	1139.03
3409.35	1138.65
3320.41	1136.04
3274.61	1134.7
3203.54	1136.61
3051.13	1140.71
3022.35	1150.12
3009.9	1154.19
2971.69	1153.87
2962.89	1156.8
2961.42	1157.28
2958.49	1158.26
2306.07	1375.16
2050.12	1377
1992.97	1396
1977.93	1401
1571.11	1398.35
854.366	1400.48
843.931	1400.26
637.348	1331.54
596.847	1331.48
21.1232	1187.65
14.5324	1186
10.4122	1184.63
8.36236	1184.11
6.56235	1183.66
5.66234	1183.43
0.262295	1182.07
0	1182
0	1150

Material Boundary

X	Y
2921.25	1150
2938.56	1150
2965.22	1150
2966.66	1150
2970.05	1150
2970.76	1150
2982.06	1150
3010.89	1150
3022.35	1150.12

Materiai Boundary

X	Y
8.36236	1184.11
13.5602	1182.38
13.5672	1182.38
13.5972	1182.37
19.8808	1180.27
19.9687	1180.24
28.5649	1177.38
34.8152	1175.29
34.9515	1175.25
42.7472	1172.38
49.8178	1170.29
49.9969	1170.23
58.565	1167.38
64.8136	1165.3
64.9216	1165.26
65.105	1165.2
71.5832	1163.26
87.4587	1163.65

103.395	1164.15
149.393	1165.24
157.08	1165.24
246.129	1165.22
251.452	1165.22
340.252	1165.21
345.834	1165.21
434.385	1165.2
440.226	1165.2
528.527	1165.18
534.628	1165.18
622.68	1165.17
629.041	1165.17
716.843	1165.16
723.463	1165.15
811.017	1165.14
817.896	1165.14
905.2	1165.13
912.34	1165.13
999.394	1165.12
1006.79	1165.11
1093.6	1165.1
1101.26	1165.1
1187.81	1165.09
1195.73	1165.09
1282.04	1165.07
1290.21	1165.07
1376.27	1165.06
1384.71	1165.06
1390.24	1165.06
1470.47	1165.05
1518.68	1166.67
1534.49	1167.2
1545.72	1166.68

1571.62	1165.5
1592.19	1164.55
1734.26	1162.68
1900.02	1160.5
2040.78	1158.65
2186.18	1156.73
2464.16	1160.48
2464.75	1160.49
2468.11	1160.45
2817.68	1157.07
2871.82	1157.53
2958.49	1158.26

Material Boundary

X	Y
6.56235	1183.66
13.2441	1181.43
13.2505	1181.43
13.2803	1181.42
19.5644	1179.32
19.653	1179.29
28.249	1176.43
34.4988	1174.34
34.6207	1174.3
42.4328	1171.43
49.518	1169.34
49.6807	1169.29
58.2487	1166.43
64.4978	1164.35
64.6	1164.31
64.7979	1164.25
71.4489	1162.25
87.4868	1162.66

103.423	1163.15
149.405	1164.24
157.08	1164.24
246.129	1164.22
251.451	1164.22
340.252	1164.21
345.833	1164.21
434.384	1164.2
440.226	1164.2
528.527	1164.18
534.628	1164.18
622.68	1164.17
629.041	1164.17
716.843	1164.16
723.463	1164.15
811.017	1164.14
817.896	1164.14
905.2	1164.13
912.34	1164.13
999.394	1164.12
1006.79	1164.11
1093.6	1164.1
1101.26	1164.1
1187.81	1164.09
1195.73	1164.09
1282.04	1164.07
1290.21	1164.07
1376.27	1164.06
1384.71	1164.06
1390.24	1164.06
1470.48	1164.05
1518.71	1165.67
1534.49	1166.2
1545.67	1165.68

1571.58	1164.5
1592.16	1163.55
1734.25	1161.68
1900.01	1159.5
2040.77	1157.65
2186.18	1155.73
2464.18	1159.48
2464.76	1159.49
2468.1	1159.45
2817.68	1156.07
2871.83	1156.53
2961.42	1157.28

Material Boundary

X	Y
5.66234	1183.43
13.086	1180.95
13.0922	1180.95
13.1219	1180.94
19.4061	1178.85
19.4951	1178.82
28.0911	1175.95
34.3405	1173.87
34.4552	1173.83
42.2755	1170.96
49.368	1168.86
49.5226	1168.81
58.0905	1165.95
64.3399	1163.87
64.4392	1163.84
64.6444	1163.77
71.3818	1161.75
87.5009	1162.16

103.436	1162.65
149.41	1163.74
157.08	1163.74
246.129	1163.72
251.451	1163.72
340.252	1163.71
345.833	1163.71
434.384	1163.7
440.225	1163.7
528.527	1163.68
534.628	1163.68
622.68	1163.67
629.04	1163.67
716.843	1163.66
723.463	1163.65
811.017	1163.64
817.896	1163.64
905.2	1163.63
912.339	1163.63
999.394	1163.62
1006.79	1163.61
1093.6	1163.6
1101.26	1163.6
1187.81	1163.59
1195.73	1163.59
1282.04	1163.57
1290.21	1163.57
1376.27	1163.56
1384.71	1163.56
1390.24	1163.56
1470.49	1163.55
1518.73	1165.17
1534.48	1165.69
1545.65	1165.18

1571.56	1164
1592.15	1163.05
1734.24	1161.18
1900	1159
2040.76	1157.15
2186.18	1155.23
2464.18	1158.98
2464.76	1158.99
2468.1	1158.95
2817.68	1155.57
2871.83	1156.03
2962.89	1156.8

Material Boundary

X	Y
0	1150
2921.25	1150

Material Boundary

X	Y
0.262295	1182.07
12.1377	1178.11
12.1416	1178.11
12.1714	1178.1
18.4567	1176
18.548	1175.97
27.1436	1173.11
33.3911	1171.02
33.4626	1171
41.2864	1168.13
41.3322	1168.11
41.3737	1168.1

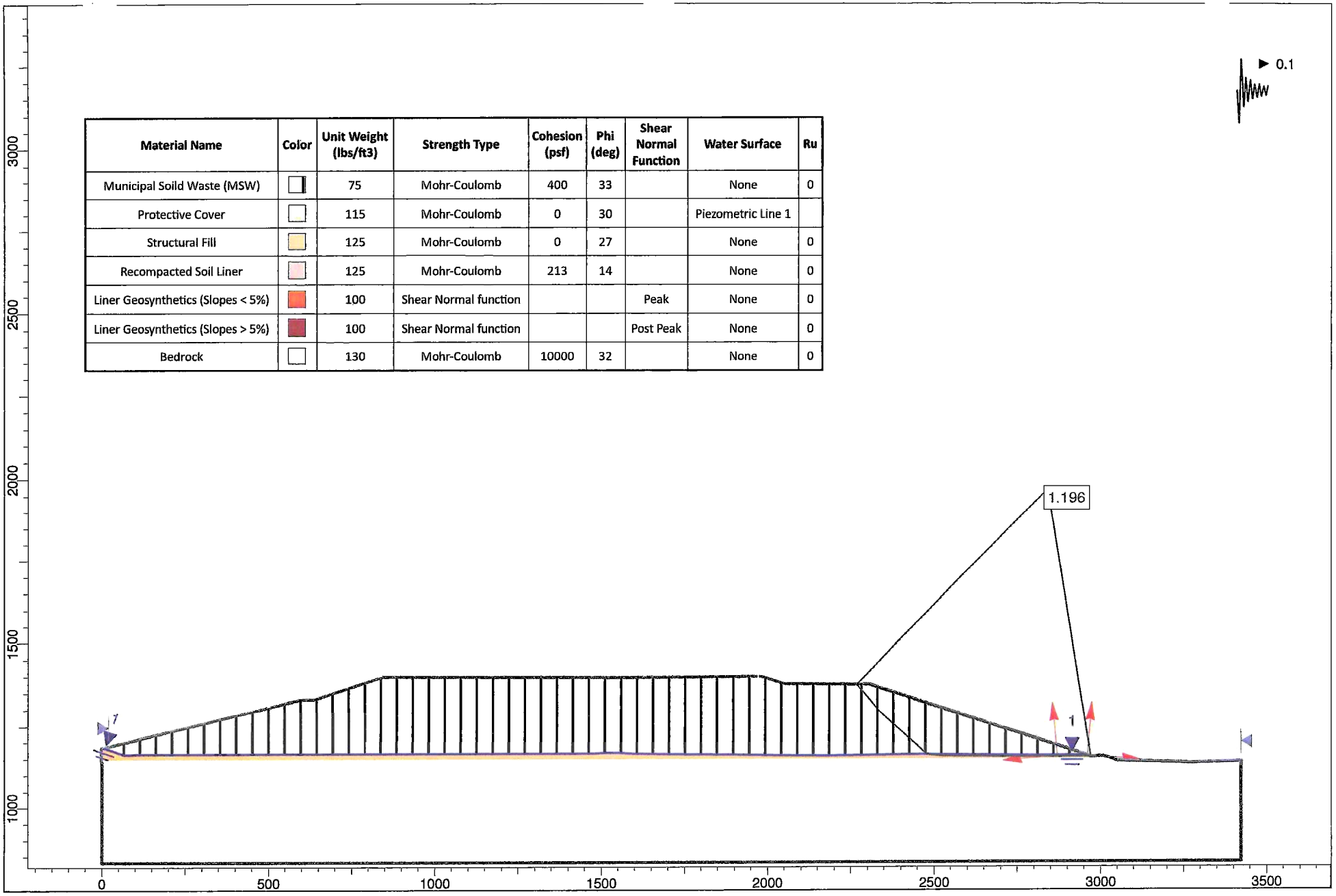
48.4686	1166
48.5741	1165.96
57.1416	1163.11
63.3923	1161.03
63.4745	1161
63.7232	1160.91
70.9791	1158.74
87.5852	1159.16
103.518	1159.65
149.446	1160.74
157.079	1160.74
246.129	1160.72
251.451	1160.72
340.251	1160.71
345.833	1160.71
434.384	1160.7
440.225	1160.7
528.527	1160.68
534.627	1160.68
622.68	1160.67
629.04	1160.67
716.843	1160.66
723.463	1160.65
811.016	1160.64
817.896	1160.64
905.2	1160.63
912.339	1160.63
999.393	1160.62
1006.79	1160.61
1093.6	1160.6
1101.26	1160.6
1187.81	1160.59
1195.73	1160.59
1282.04	1160.57

1290.21	1160.57
1376.27	1160.56
1384.71	1160.56
1390.24	1160.56
1470.52	1160.55
1470.54	1160.55
1518.83	1162.17
1534.47	1162.69
1545.51	1162.19
1571.42	1161
1592.06	1160.05
1734.2	1158.18
1899.96	1156
2040.72	1154.15
2186.19	1152.23
2464.22	1155.98
2464.76	1155.99
2468.07	1155.95
2817.68	1152.57
2871.86	1153.03
2971.69	1153.87

Material Boundary

X	Y
71.3818	1161.75
71.4489	1162.25

Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)	Shear Normal Function	Water Surface	Ru
Municipal Soild Waste (MSW)		75	Mohr-Coulomb	400	33		None	0
Protective Cover		115	Mohr-Coulomb	0	30		Piezometric Line 1	
Structural Fill		125	Mohr-Coulomb	0	27		None	0
Recompacted Soil Liner		125	Mohr-Coulomb	213	14		None	0
Liner Geosynthetics (Slopes < 5%)		100	Shear Normal function			Peak	None	0
Liner Geosynthetics (Slopes > 5%)		100	Shear Normal function			Post Peak	None	0
Bedrock		130	Mohr-Coulomb	10000	32		None	0



B-B -- seismic -- translational -- undrained - Rev1.slim

Slide Analysis Information

Project Summary

File Name: B-B -- seismic -- translational -- undrained - Rev1.slim
Slide Modeler Version: 6.023

General Settings

Units of Measurement: Imperial Units
Time Units: days
Permeability Units: feet/second
Failure Direction: Left to Right
Data Output: Standard
Maximum Material Properties: 20
Maximum Support Properties: 20

Analysis Options

Analysis Methods Used

Spencer

Number of slices: 25
Tolerance: 0.005
Maximum number of iterations: 50
Check malpha < 0.2: Yes
Initial trial value of FS: 1
Steffensen Iteration: Yes

Groundwater Analysis

Groundwater Method: Water Surfaces
Pore Fluid Unit Weight: 62.4 lbs/ft3

Advanced Groundwater Method: None

Random Numbers

Pseudo-random Seed: 10116
Random Number Generation Method: Park and Miller v.3

Surface Options

Surface Type: Non-Circular Block Search
Number of Surfaces: 7000
Pseudo-Random Surfaces: Enabled
Convex Surfaces Only: Disabled
Left Projection Angle (Start Angle): 95
Left Projection Angle (End Angle): 185
Right Projection Angle (Start Angle): -5
Right Projection Angle (End Angle): 85
Minimum Elevation: Not Defined
Minimum Depth: Not Defined

Loading

Seismic Load Coefficient (Horizontal): 0.1

Material Properties

Property	Municipal Soild Waste (MSW)	Protective Cover	Structural Fill	Recompacted Soil Liner	Liner Geosynthetics (Slopes	Liner Geosynthetics (Slopes > 5%)	Bedrock
Color							
Strength Type	Mohr-Coulomb	Mohr-Coulomb	Mohr-Coulomb	Mohr-Coulomb	Shear Normal function	Shear Normal function	Mohr-Coulomb
Unit Weight [lbs/ft3]	75	115	125	125	100	100	130
Cohesion [psf]	400	0	0	213			10000

Friction Angle [deg]	33	30	27	14			32
Water Surface	None	Piezometric Line 1	None	None	None	None	None
Hu Value		1					
Ru Value	0		0	0	0	0	0

Shear Normal Functions

Name: Peak

Normal (psf)	Shear (psf)
0	0
3000	1250
6000	2000
13500	3500

Name. Post Peak

Normal (psf)	Shear (psf)
0	0
3000	875
6000	1290
13500	2100

Global Minimums

Method: spencer

FS: 1.195510
Axis Location: 2841.690, 1967.760
Left Slip Surface Endpoint: 2268.580, 1375.426
Right Slip Surface Endpoint: 2971.691, 1153.871
Resisting Moment=1.42896e+009 lb-ft
Driving Moment=1.19527e+009 lb-ft
Resisting Horizontal Force=1.49874e+006 lb
Driving Horizontal Force=1.25364e+006 lb
Total Slice Area=59099.3 ft2

Global Minimum Coordinates

Method: spencer

X	Y
2268.58	1375.43
2335.37	1294.89
2479.36	1159.37
2527.81	1155.38
2751.35	1153.21
2971.69	1153.87

Valid / Invalid Surfaces

Method: spencer

Number of Valid Surfaces: 2950
Number of Invalid Surfaces. 4051

Error Codes:

Error Code -106 reported for 66 surfaces
Error Code -108 reported for 1573 surfaces
Error Code -110 reported for 465 surfaces
Error Code -111 reported for 1114 surfaces
Error Code -112 reported for 833 surfaces

Error Codes

The following errors were encountered during the computation:

-106 = Average slice width is less than 0.0001 * (maximum horizontal extent of soil region). This limitation is imposed to avoid numerical errors which may result from too many slices, or too small a slip region.
-108 = Total driving moment or total driving force < 0.1. This is to limit the calculation of extremely high safety factors if the driving force is very small (0.1 is an arbitrary number).
-110 = The water table or a piezoline does not span the slip region for a given slip surface, when Water Surfaces is specified as the method of pore pressure calculation. If

this error occurs, check that the water table or piezoline(s) span the appropriate soil cells.
-111 = safety factor equation did not converge
-112 = The coefficient M-Alpha = cos(alpha)(1+tan(alpha)tan(phi)/F) < 0.2 for the final iteration of the safety factor calculation. This screens out some slip surfaces which may not be valid in the context of the analysis, in particular, deep seated slip surfaces with many high negative base angle slices in the passive zone.

Slice Data

Global Minimum Query (spencer) - Safety Factor: 1.19551

Slice Number	Width [ft]	Weight [lbs]	Base Material	Base Cohesion [psf]	Base Friction Angle [degrees]	Shear Stress [psf]	Shear Strength [psf]	Base Normal Stress [psf]	Pore Pressure [psf]	Effective Normal Stress [psf]
1	33.3937	50124.5	Municipal Soild Waste (MSW)	400	33	660.994	790.225	600.895	0	600.895
2	33.3937	139904	Municipal Soild Waste (MSW)	400	33	1364.92	1631.77	1896.76	0	1896.76
3	28.5882	169871	Municipal Soild Waste (MSW)	400	33	2089.3	2497.78	3230.31	0	3230.31
4	28.5882	207185	Municipal Soild Waste (MSW)	400	33	2485.5	2971.44	3959.67	0	3959.67
5	28.5882	244499	Municipal Soild Waste (MSW)	400	33	2881.7	3445.1	4689.03	0	4689.03
6	28.5882	281813	Municipal Soild Waste (MSW)	400	33	3277.9	3918.76	5418.42	0	5418.42
7	28.5882	319127	Municipal Soild Waste (MSW)	400	33	3674.1	4392.42	6147.78	0	6147.78
8	1.05164	12471.4	Protective Cover	0	30	3240.4	3873.93	6740.42	30.5638	6709.85
9	7.16241	84819.4	Liner Geosynthetics (Slopes < 5%)	800	11.31	2653.49	3172.27	11861.3	0	11861.3
10	41.2856	473522	Recompacted Soil Liner	213	14	2574.36	3077.67	11489.6	0	11489.6
11	31.8906	343501	Recompacted Soil Liner	213	14	2557.14	3057.09	11407	0	11407
12	31.8906	318882	Recompacted Soil Liner	213	14	2388.03	2854.91	10596.1	0	10596.1
13	31.8906	294263	Recompacted Soil Liner	213	14	2218.91	2652.73	9785.25	0	9785.25
14	31.8906	269644	Recompacted Soil Liner	213	14	2049.8	2450.56	8974.36	0	8974.36
15	31.8906	245025	Recompacted Soil Liner	213	14	1880.69	2248.38	8163.47	0	8163.47
16	31.8906	220406	Recompacted Soil Liner	213	14	1711.57	2046.2	7352.55	0	7352.55
17	31.8906	195787	Recompacted Soil Liner	213	14	1542.45	1844.02	6541.66	0	6541.66
18	0.304508	1750.82	Recompacted Soil Liner	213	14	1457.09	1741.97	6132.36	0	6132.36
19	31.4778	168093	Recompacted Soil Liner	213	14	1379.49	1649.19	5760.25	0	5760.25
20	31.4778	142537	Recompacted Soil Liner	213	14	1199.9	1434.49	4899.14	0	4899.14
21	31.4778	117338	Recompacted Soil Liner	213	14	1022.83	1222.8	4050.1	0	4050.1
22	31.4778	92675.7	Recompacted Soil Liner	213	14	849.516	1015.61	3219.08	0	3219.08
23	31.4778	68018.2	Recompacted Soil Liner	213	14	676.242	808.454	2388.24	0	2388.24

24	31.4778	43360.7	Recompacted Soil Liner	213	14	502.968	601.303	1557.4	0	1557.4
25	31.4778	17454.6	Recompacted Soil Liner	213	14	320.919	383.662	684.488	0	684.488

Interslice Data

Global Minimum Query (spencer) - Safety Factor: 1.19551

Slice Number	X coordinate [ft]	Y coordinate - Bottom [ft]	Interslice Normal Force [lbs]	Interslice Shear Force [lbs]	Interslice Force Angle [degrees]
1	2268.58	1375.43	0	0	0
2	2301.97	1335.16	7136.16	3441.75	25.7479
3	2335.37	1294.89	51925.4	25043.5	25.7479
4	2363.96	1267.98	96100.9	46349.1	25.7478
5	2392.54	1241.08	152306	73456.8	25.7479
6	2421.13	1214.17	220542	106367	25.7479
7	2449.72	1187.26	300807	145078	25.7478
8	2478.31	1160.36	393103	189592	25.7478
9	2479.36	1159.37	397614	191768	25.7479
10	2486.52	1158.78	394086	190066	25.7478
11	2527.81	1155.38	374217	180483	25.7478
12	2559.7	1155.07	330540	159418	25.7478
13	2591.59	1154.76	289545	139647	25.7479
14	2623.48	1154.45	251230	121168	25.748
15	2655.37	1154.14	215597	103982	25.7479
16	2687.26	1153.83	182644	88088.4	25.7478
17	2719.15	1153.52	152372	73488.4	25.7478
18	2751.04	1153.21	124781	60181.2	25.7478
19	2751.35	1153.21	124530	60060.4	25.7479
20	2782.82	1153.31	97373.1	46962.7	25.7478
21	2814.3	1153.4	73394.8	35398.1	25.7479
22	2845.78	1153.49	52550.5	25344.9	25.7478
23	2877.26	1153.59	34773.8	16771.3	25.7479
24	2908.74	1153.68	20063.9	9676.76	25.7479
25	2940.21	1153.78	8420.88	4061.36	25.7478

26	2971.69	1153.87	0	0	0

List Of Coordinates

Piezoline

X	Y
8.36236	1184.11
13.5972	1182.37
19.9687	1180.24
28.5649	1177.38
34.8152	1175.29
42.7472	1172.38
49.8178	1170.29
58.565	1167.38
64.8136	1165.3
71.5832	1163.26
87.4587	1163.65
103.395	1164.15
149.393	1165.24
157.08	1165.24
246.129	1165.22
251.452	1165.22
340.252	1165.21
345.834	1165.21
434.385	1165.2
440.226	1165.2
528.527	1165.18
534.628	1165.18
622.68	1165.17
629.041	1165.17
716.843	1165.16
723.463	1165.15
811.017	1165.14

817.896	1165.14
905.2	1165.13
912.34	1165.13
999.394	1165.12
1006.79	1165.11
1093.6	1165.1
1101.26	1165.1
1187.81	1165.09
1195.73	1165.09
1282.04	1165.07
1290.21	1165.07
1376.27	1165.06
1384.71	1165.06
1390.24	1165.06
1470.47	1165.05
1518.68	1166.67
1534.49	1167.2
1545.72	1166.68
1571.62	1165.5
1592.19	1164.55
1734.26	1162.68
1900.02	1160.5
2040.78	1158.65
2186.18	1156.73
2464.16	1160.48
2464.75	1160.49
2468.11	1160.45
2817.68	1157.07
2871.82	1157.53
2958.49	1158.26

Block Search Polyline

X	Y

2961.42	1157.03
2871.83	1156.28

External Boundary

X	Y
0	831.999
3422.62	831.999
3422.62	1139.03
3409.35	1138.65
3320.41	1136.04
3274.61	1134.7
3203.54	1136.61
3051.13	1140.71
3022.35	1150.12
3009.9	1154.19
2971.69	1153.87
2962.89	1156.8
2961.42	1157.28
2958.49	1158.26
2306.07	1375.16
2050.12	1377
1992.97	1396
1977.93	1401
1571.11	1398.35
854.366	1400.48
843.931	1400.26
637.348	1331.54
596.847	1331.48
21.1232	1187.65
14.5324	1186
10.4122	1184.63
8.36236	1184.11
6.56235	1183.66

5.66234	1183.43
0.262295	1182.07
0	1182
0	1150

Material Boundary

X	Y
2921.25	1150
2938.56	1150
2965.22	1150
2966.66	1150
2970.05	1150
2970.76	1150
2982.06	1150
3010.89	1150
3022.35	1150.12

Material Boundary

X	Y
8.36236	1184.11
13.5602	1182.38
13.5672	1182.38
13.5972	1182.37
19.8808	1180.27
19.9687	1180.24
28.5649	1177.38
34.8152	1175.29
34.9515	1175.25
42.7472	1172.38
49.8178	1170.29
49.9969	1170.23
58.565	1167.38

64.8136	1165.3
64.9216	1165.26
65.105	1165.2
71.5832	1163.26
87.4587	1163.65
103.395	1164.15
149.393	1165.24
157.08	1165.24
246.129	1165.22
251.452	1165.22
340.252	1165.21
345.834	1165.21
434.385	1165.2
440.226	1165.2
528.527	1165.18
534.628	1165.18
622.68	1165.17
629.041	1165.17
716.843	1165.16
723.463	1165.15
811.017	1165.14
817.896	1165.14
905.2	1165.13
912.34	1165.13
999.394	1165.12
1006.79	1165.11
1093.6	1165.1
1101.26	1165.1
1187.81	1165.09
1195.73	1165.09
1282.04	1165.07
1290.21	1165.07
1376.27	1165.06
1384.71	1165.06

1390.24	1165.06
1470.47	1165.05
1518.68	1166.67
1534.49	1167.2
1545.72	1166.68
1571.62	1165.5
1592.19	1164.55
1734.26	1162.68
1900.02	1160.5
2040.78	1158.65
2186.18	1156.73
2464.16	1160.48
2464.75	1160.49
2468.11	1160.45
2817.68	1157.07
2871.82	1157.53
2958.49	1158.26

Material Boundary

X	Y
6.56235	1183.66
13.2441	1181.43
13.2505	1181.43
13.2803	1181.42
19.5644	1179.32
19.653	1179.29
28.249	1176.43
34.4988	1174.34
34.6207	1174.3
42.4328	1171.43
49.518	1169.34
49.6807	1169.29
58.2487	1166.43

64.4978	1164.35
64.6	1164.31
64.7979	1164.25
71.4489	1162.25
87.4868	1162.66
103.423	1163.15
149.405	1164.24
157.08	1164.24
246.129	1164.22
251.451	1164.22
340.252	1164.21
345.833	1164.21
434.384	1164.2
440.226	1164.2
528.527	1164.18
534.628	1164.18
622.68	1164.17
629.041	1164.17
716.843	1164.16
723.463	1164.15
811.017	1164.14
817.896	1164.14
905.2	1164.13
912.34	1164.13
999.394	1164.12
1006.79	1164.11
1093.6	1164.1
1101.26	1164.1
1187.81	1164.09
1195.73	1164.09
1282.04	1164.07
1290.21	1164.07
1376.27	1164.06
1384.71	1164.06

1390.24	1164.06
1470.48	1164.05
1518.71	1165.67
1534.49	1166.2
1545.67	1165.68
1571.58	1164.5
1592.16	1163.55
1734.25	1161.68
1900.01	1159.5
2040.77	1157.65
2186.18	1155.73
2464.18	1159.48
2464.76	1159.49
2468.1	1159.45
2817.68	1156.07
2871.83	1156.53
2961.42	1157.28

Material Boundary

X	Y
5.66234	1183.43
13.086	1180.95
13.0922	1180.95
13.1219	1180.94
19.4061	1178.85
19.4951	1178.82
28.0911	1175.95
34.3405	1173.87
34.4552	1173.83
42.2755	1170.96
49.368	1168.86
49.5226	1168.81
58.0905	1165.95

64.3399	1163.87
64.4392	1163.84
64.6444	1163.77
71.3818	1161.75
87.5009	1162.16
103.436	1162.65
149.41	1163.74
157.08	1163.74
246.129	1163.72
251.451	1163.72
340.252	1163.71
345.833	1163.71
434.384	1163.7
440.225	1163.7
528.527	1163.68
534.628	1163.68
622.68	1163.67
629.04	1163.67
716.843	1163.66
723.463	1163.65
811.017	1163.64
817.896	1163.64
905.2	1163.63
912.339	1163.63
999.394	1163.62
1006.79	1163.61
1093.6	1163.6
1101.26	1163.6
1187.81	1163.59
1195.73	1163.59
1282.04	1163.57
1290.21	1163.57
1376.27	1163.56
1384.71	1163.56

1390.24	1163.56
1470.49	1163.55
1518.73	1165.17
1534.48	1165.69
1545.65	1165.18
1571.56	1164
1592.15	1163.05
1734.24	1161.18
1900	1159
2040.76	1157.15
2186.18	1155.23
2464.18	1158.98
2464.76	1158.99
2468.1	1158.95
2817.68	1155.57
2871.83	1156.03
2962.89	1156.8

Material Boundary

X	Y
0	1150
2921.25	1150

Material Boundary

X	Y
0.262295	1182.07
12.1377	1178.11
12.1416	1178.11
12.1714	1178.1
18.4567	1176
18.548	1175.97
27.1436	1173.11

33.3911	1171.02
33.4626	1171
41.2864	1168.13
41.3322	1168.11
41.3737	1168.1
48.4686	1166
48.5741	1165.96
57.1416	1163.11
63.3923	1161.03
63.4745	1161
63.7232	1160.91
70.9791	1158.74
87.5852	1159.16
103.518	1159.65
149.446	1160.74
157.079	1160.74
246.129	1160.72
251.451	1160.72
340.251	1160.71
345.833	1160.71
434.384	1160.7
440.225	1160.7
528.527	1160.68
534.627	1160.68
622.68	1160.67
629.04	1160.67
716.843	1160.66
723.463	1160.65
811.016	1160.64
817.896	1160.64
905.2	1160.63
912.339	1160.63
999.393	1160.62
1006.79	1160.61

1093.6	1160.6
1101.26	1160.6
1187.81	1160.59
1195.73	1160.59
1282.04	1160.57
1290.21	1160.57
1376.27	1160.56
1384.71	1160.56
1390.24	1160.56
1470.52	1160.55
1470.54	1160.55
1518.83	1162.17
1534.47	1162.69
1545.51	1162.19
1571.42	1161
1592.06	1160.05
1734.2	1158.18
1899.96	1156
2040.72	1154.15
2186.19	1152.23
2464.22	1155.98
2464.76	1155.99
2468.07	1155.95
2817.68	1152.57
2871.86	1153.03
2971.69	1153.87

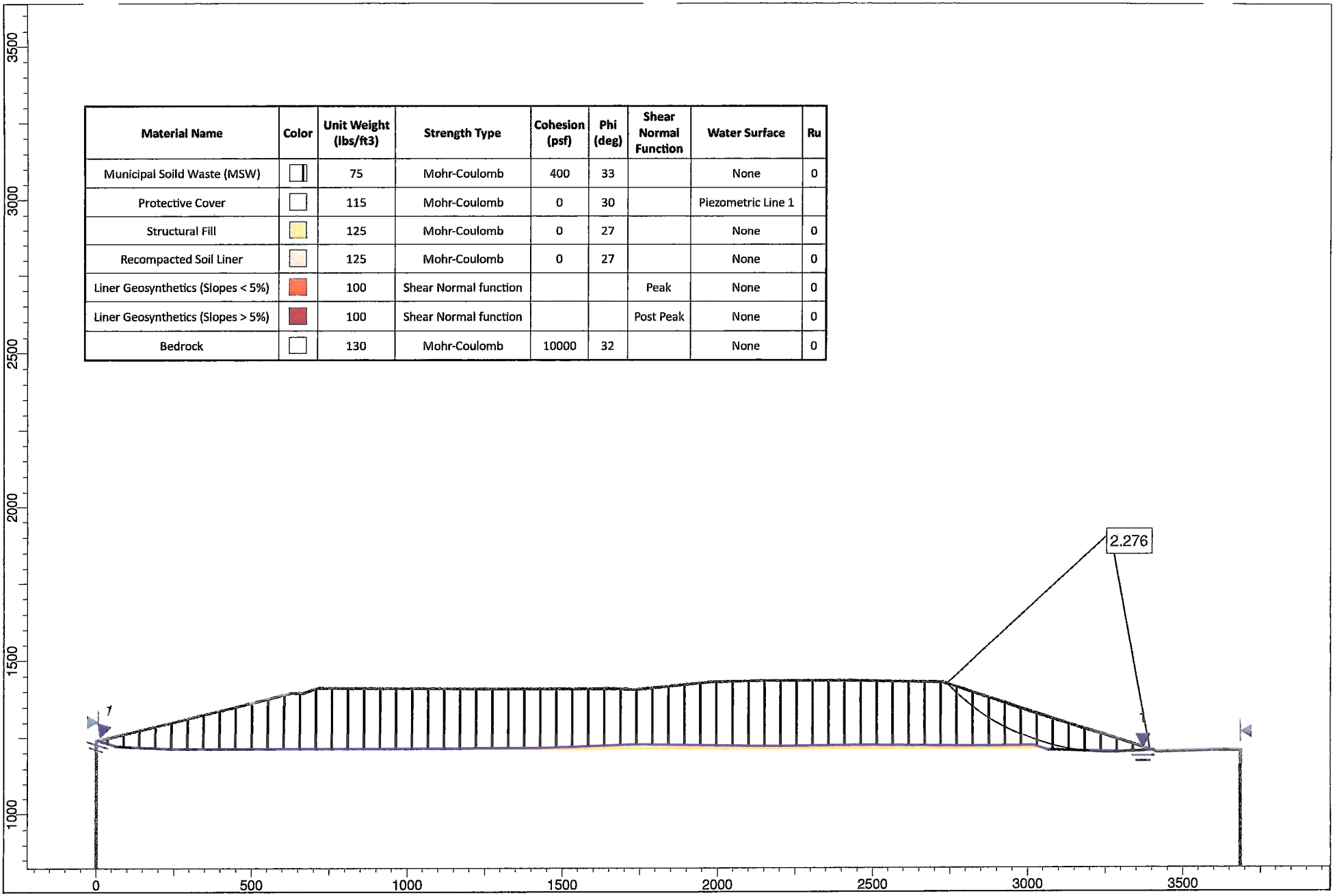
Material Boundary

X	Y
71.3818	1161.75
71.4489	1162.25

ATTACHMENT D

CROSS SECTION C-C SLIDE OUTPUT

Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)	Shear Normal Function	Water Surface	Ru
Municipal Soild Waste (MSW)		75	Mohr-Coulomb	400	33		None	0
Protective Cover		115	Mohr-Coulomb	0	30		Piezometric Line 1	
Structural Fill		125	Mohr-Coulomb	0	27		None	0
Recompacted Soil Liner		125	Mohr-Coulomb	0	27		None	0
Liner Geosynthetics (Slopes < 5%)		100	Shear Normal function			Peak	None	0
Liner Geosynthetics (Slopes > 5%)		100	Shear Normal function			Post Peak	None	0
Bedrock		130	Mohr-Coulomb	10000	32		None	0



Slide Analysis Information

SLIDE - An Interactive Slope Stability Program

Project Summary

File Name: C-C -- static -- rotational -- drained-rev1.slim
Slide Modeler Version: 6.023
Project Title: SLIDE - An Interactive Slope Stability Program
Date Created: 10/19/2011, 7:30:21 AM

General Settings

Units of Measurement: Imperial Units
Time Units: days
Permeability Units: feet/second
Failure Direction: Left to Right
Data Output: Standard
Maximum Material Properties: 20
Maximum Support Properties: 20

Analysis Options

Analysis Methods Used

Spencer

Number of slices: 25
Tolerance: 0.005
Maximum number of iterations. 50
Check malpha < 0.2 Yes
Initial trial value of FS: 1
Steffensen Iteration: Yes

Groundwater Analysis

Groundwater Method: Water Surfaces
Pore Fluid Unit Weight. 62.4 lbs/ft3
Advanced Groundwater Method: None

Random Numbers

Pseudo-random Seed: 10116
Random Number Generation Method: Park and Miller v.3

Surface Options

Surface Type: Circular
Search Method: Auto Refine Search
Divisions along slope: 20
Circles per division: 10
Number of iterations: 10
Divisions to use in next iteration: 50%
Composite Surfaces: Disabled
Minimum Elevation: Not Defined
Minimum Depth: 4

Material Properties

Property	Municipal Solid Waste (MSW)	Protective Cover	Structural Fill	Recompacted Soil Liner	Liner Geosynthetics (Slopes	Liner Geosynthetics (Slopes > 5%)	Bedrock
Color							
Strength Type	Mohr-Coulomb	Mohr-Coulomb	Mohr-Coulomb	Mohr-Coulomb	Shear Normal function	Shear Normal function	Mohr-Coulomb
Unit Weight [lbs/ft3]	75	115	125	125	100	100	130
Cohesion [psf]	400	0	0	0			10000
Friction Angle							

[deg]						
Water Surface	None	Piezometric Line 1	None	None	None	None
Hu Value		1				
Ru Value	0		0	0	0	0	0

Shear Normal Functions

Name: Peak

Normal (psf)	Shear (psf)
0	0
3000	1250
6000	2000
13500	3500

Name: Post Peak

Normal (psf)	Shear (psf)
0	0
3000	875
6000	1290
13500	2100

Global Minimums

Method: spencer

FS: 2.276450
Center: 3266.616, 1914.478
Radius: 718.941
Left Slip Surface Endpoint: 2740.295, 1424.721
Right Slip Surface Endpoint: 3393.819, 1206.879
Resisting Moment=1.46725e+009 lb-ft
Driving Moment=6.44532e+008 lb-ft
Resisting Horizontal Force=1.88988e+006 lb
Driving Horizontal Force=830189 lb
Total Slice Area=40786.9 ft2

Valid / Invalid Surfaces

Method: spencer

Number of Valid Surfaces: 12661
Number of Invalid Surfaces: 0

Slice Data

Global Minimum Query (spencer) - Safety Factor: 2.27645

Slice Number	Width [ft]	Weight [lbs]	Base Material	Base Cohesion [psf]	Base Friction Angle [degrees]	Shear Stress [psf]	Shear Strength [psf]	Base Normal Stress [psf]	Pore Pressure [psf]	Effective Normal Stress [psf]
1	30.3114	23383.7	Municipal Soild Waste (MSW)	400	33	297.831	677.997	428.077	0	428.077
2	30.3114	66303.3	Municipal Soild Waste (MSW)	400	33	586.838	1335.91	1441.17	0	1441.17
3	30.3114	102078	Municipal Soild Waste (MSW)	400	33	849.151	1933.05	2360.69	0	2360.69
4	30.3114	131666	Municipal Soild Waste (MSW)	400	33	1084.78	2469.45	3186.68	0	3186.68
5	30.3114	155782	Municipal Soild Waste (MSW)	400	33	1293.78	2945.22	3919.29	0	3919.29
6	30.3114	174974	Municipal Soild Waste (MSW)	400	33	1476.15	3360.38	4558.57	0	4558.57
7	30.3114	189674	Municipal Soild Waste (MSW)	400	33	1631.83	3714.78	5104.3	0	5104.3
8	30.3114	200224	Municipal Soild Waste (MSW)	400	33	1760.64	4008.02	5555.86	0	5555.86
9	30.3114	206901	Municipal Soild Waste (MSW)	400	33	1862.3	4239.44	5912.21	0	5912.21
10	30.3114	209929	Municipal Soild Waste (MSW)	400	33	1936.37	4408.04	6171.84	0	6171.84
11	30.3114	209490	Municipal Soild Waste (MSW)	400	33	1982.24	4512.48	6332.68	0	6332.68
12	30.3114	205733	Municipal Soild Waste (MSW)	400	33	1999.19	4551.06	6392.08	0	6392.08
13	30.3114	198777	Municipal Soild Waste (MSW)	400	33	1986.26	4521.62	6346.75	0	6346.75
14	30.3114	188718	Municipal Soild Waste (MSW)	400	33	1942.29	4421.52	6192.61	0	6192.61
15	9.13177	54676.4	Protective Cover	0	30	1513.08	3444.46	5997.18	31.2115	5965.97
16	5.03003	29714.6	Liner Geosynthetics (Slopes < 5%)	500	14.0363	860.577	1959.06	5836.26	0	5836.26
17	24.4639	139784	Recompacted Soil Liner	0	27	1296.07	2950.43	5790.53	0	5790.53
18	24.4639	130629	Recompacted Soil Liner	0	27	1234.23	2809.66	5514.25	0	5514.25
19	38.6821	181114	Recompacted Soil Liner	0	27	1109.21	2525.06	4955.7	0	4955.7
20	25.1479	97574	Recompacted Soil Liner	0	27	942.788	2146.21	4212.18	0	4212.18

21	25.1479	79246.4	Recompacted Soil Liner	0	27	781.489	1779.02	3491.53	0	3491.53
22	25.1479	58830.5	Recompacted Soil Liner	0	27	592.4	1348.57	2646.72	0	2646.72
23	6.21157	11158	Liner Geosynthetics (Slopes < 5%)	0	22.6199	369.783	841.793	2020.31	0	2020.31
24	10.8033	16016.3	Protective Cover	0	30	431.761	982.882	1733.61	31.2132	1702.4
25	34.9351	22326.5	Municipal Soild Waste (MSW)	400	33	425.998	969.764	877.36	0	877.36

Interslice Data

Global Minimum Query (spencer) - Safety Factor: 2.27645

Slice Number	X coordinate [ft]	Y coordinate - Bottom [ft]	Interslice Normal Force [lbs]	Interslice Shear Force [lbs]	Interslice Force Angle [degrees]
1	2740.29	1424.72	0	0	0
2	2770.61	1394.05	4108.43	1282.35	17.3345
3	2800.92	1366.75	25660	8009.17	17.3345
4	2831.23	1342.36	57511.8	17951	17.3346
5	2861.54	1320.52	94267.3	29423.3	17.3345
6	2891.85	1300.94	131795	41136.7	17.3345
7	2922.16	1283.42	166922	52100.8	17.3345
8	2952.47	1267.8	197232	61561.4	17.3345
9	2982.79	1253.94	220927	68957.1	17.3345
10	3013.1	1241.72	236730	73889.8	17.3345
11	3043.41	1231.06	243828	76105.1	17.3345
12	3073.72	1221.9	241820	75478.3	17.3345
13	3104.03	1214.16	230699	72007.3	17.3345
14	3134.34	1207.81	210839	65808.5	17.3345
15	3164.65	1202.8	182994	57117.4	17.3346
16	3173.79	1201.56	176672	55144.1	17.3346
17	3178.82	1200.92	176063	54953.9	17.3345
18	3203.28	1198.33	159347	49736.5	17.3346
19	3227.74	1196.59	138783	43317.9	17.3345
20	3266.43	1195.54	101109	31558.9	17.3346
21	3291.57	1195.97	75587	23592.7	17.3345
22	3316.72	1197.29	51353.3	16028.7	17.3345

23	3341.87	1199.49	30637.1	9562.66	17.3345
24	3348.08	1200.17	26965.4	8416.6	17.3345
25	3358.88	1201.48	20023.5	6249.88	17.3346
26	3393.82	1206.88	0	0	0

List Of Coordinates

Piezoline

X	Y
6.28913	1241.49
11.7811	1239.66
12.9533	1239.27
14.5365	1238.74
21.6471	1236.38
27.5697	1234.4
28.0365	1234.25
28.6061	1234.04
35.8423	1231.38
42.2702	1229.48
42.9166	1229.29
43.6938	1229.04
51.6734	1226.38
57.3963	1224.47
58.0083	1224.27
58.8558	1223.99
62.5178	1222.77
66.1855	1221.54
87.4233	1219.67
89.4228	1219.49
92.4618	1219.39
193.54	1215.4
222.478	1213.76
250.788	1212.15

270.993	1212.17
299.704	1212.21
343.95	1212.26
395.033	1212.33
448.569	1212.4
490.059	1212.45
545.787	1212.52
584.784	1212.57
642.688	1212.64
679.208	1212.69
739.275	1212.76
773.333	1212.81
835.549	1212.89
867.16	1212.93
931.51	1213.01
960.692	1213.05
1027.16	1213.13
1053.93	1213.16
1122.51	1213.25
1146.87	1213.28
1217.54	1213.37
1239.52	1213.4
1312.27	1213.49
1331.88	1213.52
1343.62	1213.53
1406.61	1213.61
1456.34	1215.34
1489.31	1216.48
1550.64	1218.6
1564.55	1219.09
1576.41	1219.5
1616.77	1220.9
1725.68	1224.67
1734.85	1224.99

1751.25	1224.77
1880.37	1223.01
2053.39	1220.65
2065.64	1220.48
2110.92	1219.86
2137.66	1219.5
2161.21	1219.18
2186.36	1218.84
2237.41	1219.5
2327.98	1220.68
2476	1222.6
2780.56	1219.5
2813.43	1219.16
2818.74	1219.21
2832.46	1219.32
2832.68	1219.32
2834.63	1219.33
2835.13	1219.34
2855.69	1219.5
2900.94	1219.86
3019.32	1220.8
3032.17	1216.55
3052.28	1209.89
3065.57	1205.5
3072.2	1205.32
3145.39	1203.33
3179.6	1202.4
3179.93	1202.39
3180.3	1202.38
3187.48	1202.18
3201.76	1201.8
3229.15	1201.05
3268.94	1199.97
3288.57	1199.43

3338.87	1200.9
3405.9	1202.85

External Boundary

X	Y
1842.37	800
3684.75	800
3684.75	1001.58
3684.75	1203.16
3614.87	1204.43
3418.32	1198.71
3410.04	1201.47
3408.66	1201.93
3405.9	1202.85
3328.75	1228.57
2967.02	1349.15
2726.17	1429.43
2580.1	1432.71
2434.02	1436
2141.34	1436
1978.72	1431.45
1739.67	1407.24
1732.46	1407.44
1669.36	1409.1
1234.23	1409.91
711.358	1411.68
664.71	1396.15
624.341	1395.99
452.918	1353.15
356.179	1328.98
6.28913	1241.49
4.48248	1241.04
3.57634	1240.81

0	1239.93
4.08e-014	1238.85
0	800

Material Boundary

X	Y
3.57634	1240.81
7.22137	1239.6
11.3065	1238.24
12.4789	1237.85
14.0631	1237.32
14.1692	1237.28
21.1739	1234.95
27.0952	1232.98
27.5407	1232.83
28.0893	1232.63
33.2583	1230.73
35.371	1229.96
41.8454	1228.05
42.4671	1227.86
43.2199	1227.61
51.1995	1224.95
56.9228	1223.05
57.5346	1222.85
58.3816	1222.56
60.979	1221.7
65.8782	1220.07
87.2914	1218.18
89.3304	1218
92.4057	1217.89
193.468	1213.9
250.747	1210.65
270.995	1210.67

299.705	1210.71
343.952	1210.76
395.035	1210.83
448.571	1210.9
490.061	1210.95
545.789	1211.02
584.786	1211.07
642.69	1211.14
679.21	1211.19
739.277	1211.26
773.335	1211.31
835.55	1211.39
867.162	1211.43
931.512	1211.51
960.693	1211.55
1027.16	1211.63
1053.93	1211.66
1122.51	1211.75
1146.87	1211.78
1217.54	1211.87
1239.52	1211.9
1312.27	1211.99
1331.88	1212.02
1343.62	1212.03
1406.65	1212.11
1406.67	1212.11
1456.39	1213.84
1489.37	1214.98
1538.79	1216.69
1550.7	1217.1
1564.6	1217.59
1576.46	1218
1616.82	1219.4
1725.73	1223.18

1734.86	1223.49
1751.23	1223.27
1947.06	1220.6
2053.37	1219.15
2065.62	1218.98
2110.9	1218.36
2137.64	1218
2161.19	1217.68
2186.36	1217.34
2237.43	1218
2306.53	1218.9
2476	1221.1
2780.54	1218
2813.43	1217.66
2818.75	1217.71
2832.47	1217.82
2832.49	1217.82
2832.7	1217.82
2834.65	1217.83
2835.14	1217.84
2855.7	1218
2900.95	1218.36
3019.09	1219.3
3023.56	1217.82
3031.7	1215.12
3045.96	1210.4
3065.31	1204
3072.16	1203.82
3145.35	1201.83
3179.56	1200.9
3179.89	1200.89
3180.26	1200.88
3187.43	1200.68
3201.72	1200.3

3229.11	1199.55
3268.9	1198.47
3288.57	1197.93
3338.92	1199.4
3381.34	1200.64
3410.04	1201.47

Material Boundary

X	Y
4.48248	1241.04
11.4647	1238.71
12.637	1238.32
14.2209	1237.79
21.3316	1235.43
27.2534	1233.45
27.706	1233.3
28.2616	1233.1
35.5281	1230.43
41.987	1228.53
42.617	1228.34
43.3779	1228.09
51.2743	1225.46
51.3575	1225.43
57.0806	1223.52
57.6925	1223.32
58.5397	1223.04
62.2581	1221.8
65.9806	1220.56
87.3353	1218.67
89.3612	1218.49
92.4244	1218.39
193.492	1214.4
250.76	1211.15

270.995	1211.17
299.705	1211.21
343.951	1211.26
395.034	1211.33
448.57	1211.4
490.06	1211.45
545.788	1211.52
584.785	1211.57
642.69	1211.64
679.209	1211.69
739.276	1211.76
773.334	1211.81
835.55	1211.89
867.162	1211.93
931.512	1212.01
960.693	1212.05
1027.16	1212.13
1053.93	1212.16
1122.51	1212.25
1146.87	1212.28
1217.54	1212.37
1239.52	1212.4
1312.27	1212.49
1331.88	1212.52
1343.62	1212.53
1406.64	1212.61
1406.65	1212.61
1456.37	1214.34
1489.35	1215.48
1550.68	1217.6
1564.58	1218.09
1576.44	1218.5
1616.81	1219.9
1642.74	1220.8

1725.72	1223.67
1734.86	1223.99
1751.24	1223.77
1921.84	1221.44
2053.37	1219.65
2065.63	1219.48
2110.91	1218.86
2137.65	1218.5
2161.2	1218.18
2186.36	1217.84
2237.42	1218.5
2393.42	1220.53
2476	1221.6
2780.55	1218.5
2813.43	1218.16
2818.75	1218.21
2832.47	1218.32
2832.49	1218.32
2832.69	1218.32
2834.64	1218.33
2835.14	1218.34
2855.7	1218.5
2900.95	1218.86
3019.16	1219.8
3031.85	1215.6
3065.39	1204.5
3072.17	1204.32
3145.36	1202.33
3179.57	1201.4
3179.9	1201.39
3180.27	1201.38
3187.45	1201.18
3201.73	1200.8
3229.12	1200.05

3268.91	1198.97
3288.57	1198.43
3338.9	1199.9
3374.63	1200.94
3408.66	1201.93

Material Boundary

X	Y
6.28913	1241.49
11.7811	1239.66
12.9533	1239.27
14.5365	1238.74
21.6471	1236.38
27.5697	1234.4
28.0365	1234.25
28.6061	1234.04
35.8423	1231.38
42.2702	1229.48
42.9166	1229.29
43.6938	1229.04
51.6734	1226.38
57.3963	1224.47
58.0083	1224.27
58.8558	1223.99
62.5178	1222.77
66.1855	1221.54
87.4233	1219.67
89.4228	1219.49
92.4618	1219.39
193.54	1215.4
222.478	1213.76
250.788	1212.15
270.993	1212.17

299.704	1212.21
343.95	1212.26
395.033	1212.33
448.569	1212.4
490.059	1212.45
545.787	1212.52
584.784	1212.57
642.688	1212.64
679.208	1212.69
739.275	1212.76
773.333	1212.81
835.549	1212.89
867.16	1212.93
931.51	1213.01
960.692	1213.05
1027.16	1213.13
1053.93	1213.16
1122.51	1213.25
1146.87	1213.28
1217.54	1213.37
1239.52	1213.4
1312.27	1213.49
1331.88	1213.52
1343.62	1213.53
1406.61	1213.61
1456.34	1215.34
1489.31	1216.48
1550.64	1218.6
1564.55	1219.09
1576.41	1219.5
1616.77	1220.9
1725.68	1224.67
1734.85	1224.99
1751.25	1224.77

1880.37	1223.01
2053.39	1220.65
2065.64	1220.48
2110.92	1219.86
2137.66	1219.5
2161.21	1219.18
2186.36	1218.84
2237.41	1219.5
2327.98	1220.68
2476	1222.6
2780.56	1219.5
2813.43	1219.16
2818.74	1219.21
2832.46	1219.32
2832.48	1219.32
2832.68	1219.32
2834.63	1219.33
2835.13	1219.34
2855.69	1219.5
2900.94	1219.86
3019.32	1220.8
3032.17	1216.55
3052.28	1209.89
3065.57	1205.5
3072.2	1205.32
3145.39	1203.33
3179.6	1202.4
3179.93	1202.39
3180.3	1202.38
3187.48	1202.18
3201.76	1201.8
3229.15	1201.05
3268.94	1199.97
3288.57	1199.43

3338.87	1200.9
3405.9	1202.85

Material Boundary

X	Y
4.08e-014	1238.85
34.4284	1227.11
65.2636	1217.11
81.2266	1215.8
92.2935	1214.89
133.788	1213.25
193.324	1210.91
221.882	1209.28
250.644	1207.65
565.291	1208.05
804.446	1208.35
993.933	1208.59
1122.51	1208.75
1146.88	1208.78
1375.18	1209.07
1405.98	1209.07
1489.47	1211.98
1616.93	1216.4
1698.14	1219.22
1730.36	1220.34
1902.26	1218.21
2129.7	1215.11
2137.6	1215
2186.36	1214.34
2476.01	1218.1
2779.83	1215.01
2780.51	1215
2878.35	1215.18

3018.61	1216.29
3039.13	1209.51
3048.27	1206.48
3064.78	1201.02
3167.41	1198.23
3288.58	1194.93
3391.71	1197.94
3418.32	1198.71

Material Boundary

X	Y
1405.98	1209.07
2095.19	1209
2871.02	1209
3039.13	1209.51

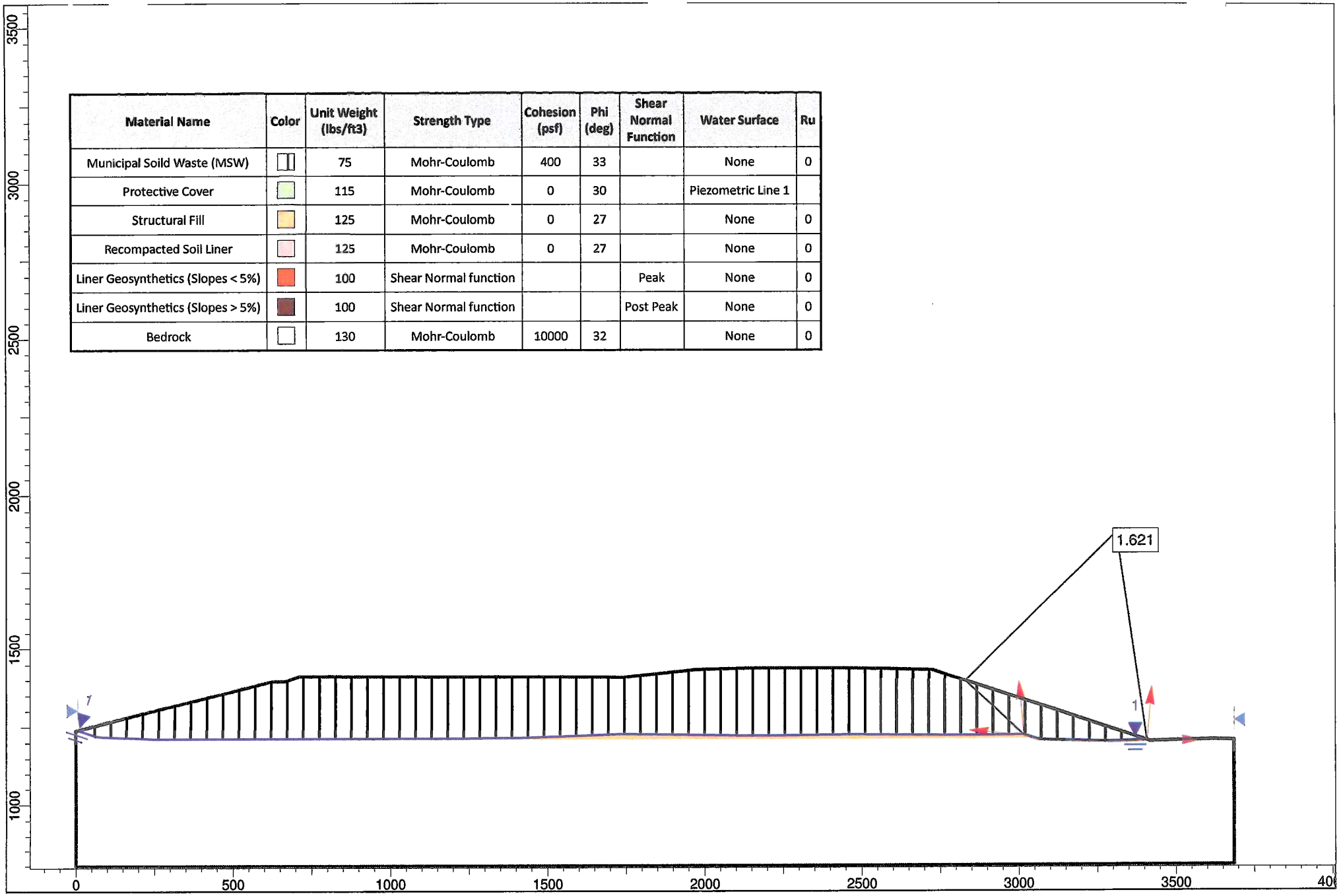
Material Boundary

X	Y
3019.09	1219.3
3019.16	1219.8

Material Boundary

X	Y
3065.31	1204
3065.39	1204.5

Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)	Shear Normal Function	Water Surface	Ru
Municipal Soild Waste (MSW)		75	Mohr-Coulomb	400	33		None	0
Protective Cover		115	Mohr-Coulomb	0	30		Piezometric Line 1	
Structural Fill		125	Mohr-Coulomb	0	27		None	0
Recompacted Soil Liner		125	Mohr-Coulomb	0	27		None	0
Liner Geosynthetics (Slopes < 5%)		100	Shear Normal function			Peak	None	0
Liner Geosynthetics (Slopes > 5%)		100	Shear Normal function			Post Peak	None	0
Bedrock		130	Mohr-Coulomb	10000	32		None	0



Slide Analysis Information

SLIDE - An Interactive Slope Stability Program

Project Summary

File Name: C-C -- static -- translational --drained-rev1.slim
Slide Modeler Version: 6.023
Project Title: SLIDE - An Interactive Slope Stability Program
Date Created: 10/19/2011, 7:30:21 AM

General Settings

Units of Measurement: Imperial Units
Time Units: days
Permeability Units: feet/second
Failure Direction: Left to Right
Data Output: Standard
Maximum Material Properties: 20
Maximum Support Properties: 20

Analysis Options

Analysis Methods Used

Spencer

Number of slices: 25
Tolerance: 0.005
Maximum number of iterations: 50
Check malpha < 0.2: Yes
Initial trial value of FS: 1
Steffensen Iteration: Yes

Groundwater Analysis

Groundwater Method: Water Surfaces
Pore Fluid Unit Weight: 62.4 lbs/ft3
Advanced Groundwater Method: None

Random Numbers

Pseudo-random Seed: 10116
Random Number Generation Method: Park and Miller v.3

Surface Options

Surface Type: Non-Circular Block Search
Number of Surfaces: 5000
Pseudo-Random Surfaces: Enabled
Convex Surfaces Only: Disabled
Left Projection Angle (Start Angle): 175
Left Projection Angle (End Angle): 95
Right Projection Angle (Start Angle): 0
Right Projection Angle (End Angle): 85
Minimum Elevation: Not Defined
Minimum Depth: Not Defined

Material Properties

Property	Municipal Soild Waste (MSW)	Protective Cover	Structural Fill	Recompacted Soil Liner	Liner Geosynthetics (Slopes	Liner Geosynthetics (Slopes > 5%)	Bedrock
Color							
Strength Type	Mohr-Coulomb	Mohr-Coulomb	Mohr-Coulomb	Mohr-Coulomb	Shear Normal function	Shear Normal function	Mohr-Coulomb
Unit Weight [lbs/ft3]	75	115	125	125	100	100	130
Cohesion [psf]	400	0	0	0			10000

Friction Angle [deg]	33	30	27	27			32
Water Surface	None	Piezometric Line 1	None	None	None	None	None
Hu Value		1					
Ru Value	0		0	0	0	0	0

Shear Normal Functions

Name: Peak

Normal (psf)	Shear (psf)
0	0
3000	1250
6000	2000
13500	3500

Name. Post Peak

Normal (psf)	Shear (psf)
0	0
3000	875
6000	1290
13500	2100

Global Minimums

Method: spencer

FS: 1.620960
Axis Location: 3312.166, 1875.592
Left Slip Surface Endpoint: 2831.044, 1394.471
Right Slip Surface Endpoint: 3408.390, 1202.023
Resisting Moment=7.90303e+008 lb-ft
Driving Moment=4.87552e+008 lb-ft
Resisting Horizontal Force=1.00824e+006 lb
Driving Horizontal Force=622004 lb
Total Slice Area=35964.7 ft2

Global Minimum Coordinates

Method: spencer

X	Y
2831.04	1394.47
3017.33	1219.86
3065.63	1204.43
3093.4	1203.24
3135.16	1202.11
3171.21	1201.13
3183.59	1200.79
3193.11	1200.53
3221.17	1199.77
3259.66	1198.72
3283.17	1198.08
3336.25	1199.32
3399.26	1201.57
3408.39	1202.02

Valid / Invalid Surfaces

Method: spencer

Number of Valid Surfaces: 3063
Number of Invalid Surfaces: 1938

Error Codes:

Error Code -106 reported for 6 surfaces
Error Code -107 reported for 86 surfaces
Error Code -108 reported for 823 surfaces
Error Code -110 reported for 83 surfaces
Error Code -111 reported for 99 surfaces
Error Code -112 reported for 841 surfaces

Error Codes

The following errors were encountered during the computation:

-106 = Average slice width is less than 0.0001 * (maximum horizontal extent of soil region). This limitation is imposed to avoid numerical errors which may result from too many slices, or too small a slip region.
-107 = Total driving moment or total driving force is negative. This will occur if the wrong failure direction is specified, or if high external or anchor loads are applied against the failure direction.
-108 = Total driving moment or total driving force < 0.1. This is to limit the calculation of extremely high safety factors if the driving force is very small (0.1 is an arbitrary number).
-110 = The water table or a piezoline does not span the slip region for a given slip surface, when Water Surfaces is specified as the method of pore pressure calculation. If this error occurs, check that the water table or piezoline(s) span the appropriate soil cells.
-111 = safety factor equation did not converge
-112 = The coefficient M-Alpha = cos(alpha)(1+tan(alpha)tan(phi)/F) < 0.2 for the final iteration of the safety factor calculation. This screens out some slip surfaces which may not be valid in the context of the analysis, in particular, deep seated slip surfaces with many high negative base angle slices in the passive zone.

Slice Data

Global Minimum Query (spencer) - Safety Factor: 1.62096

Slice Number	Width [ft]	Weight [lbs]	Base Material	Base Cohesion [psf]	Base Friction Angle [degrees]	Shear Stress [psf]	Shear Strength [psf]	Base Normal Stress [psf]	Pore Pressure [psf]	Effective Normal Stress [psf]
1	26.4721	15873.2	Municipal Soild Waste (MSW)	400	33	360.91	585.02	284.906	0	284.906
2	26.4721	47619.5	Municipal Soild Waste (MSW)	400	33	678.998	1100.63	1078.87	0	1078.87
3	26.4721	79365.8	Municipal Soild Waste (MSW)	400	33	997.088	1616.24	1872.84	0	1872.84
4	26.4721	111112	Municipal Soild Waste (MSW)	400	33	1315.17	2131.84	2666.8	0	2666.8
5	26.4721	142859	Municipal Soild Waste (MSW)	400	33	1633.26	2647.45	3460.77	0	3460.77
6	26.4721	174605	Municipal Soild Waste (MSW)	400	33	1951.35	3163.06	4254.73	0	4254.73
7	26.4721	206351	Municipal Soild Waste (MSW)	400	33	2269.43	3678.66	5048.7	0	5048.7
8	0.97794	8249.23	Protective Cover	0	30	2021.55	3276.85	5704.51	28.8425	5675.67
9	1.75832	14916.3	Liner Geosynthetics (Slopes < 5%)	800	11.31	1451.17	2352.29	7761.43	0	7761.43
10	23.2738	197291	Liner Geosynthetics (Slopes > 5%)	642	6.16405	915.042	1483.25	7789.32	0	7789.32
11	23.2738	196571	Liner Geosynthetics (Slopes > 5%)	642	6.16405	913.142	1480.17	7760.79	0	7760.79
12	27.77	225856	Liner Geosynthetics (Slopes < 5%)	800	11.31	1525.18	2472.25	8361.23	0	8361.23
13	41.7531	307159	Liner Geosynthetics (Slopes < 5%)	800	11.31	1434.46	2325.21	7626.04	0	7626.04

14	36.0506	232990	Liner Geosynthetics (Slopes < 5%)	800	11.31	1321.94	2142.81	6714.07	0	6714.07
15	12.3877	73171.4	Liner Geosynthetics (Slopes < 5%)	800	11.31	1251.51	2028.65	6143.24	0	6143.24
16	9.51681	53824.5	Liner Geosynthetics (Slopes < 5%)	500	14.0363	1216.6	1972.06	5888.26	0	5888.26
17	28.0568	146579	Liner Geosynthetics (Slopes < 5%)	500	14.0363	1148.17	1861.13	5444.52	0	5444.52
18	38.4942	171639	Liner Geosynthetics (Slopes < 5%)	500	14.0363	1026.73	1664.29	4657.16	0	4657.16
19	23.5097	88126.7	Liner Geosynthetics (Slopes < 5%)	500	14.0363	914.052	1481.64	3926.56	0	3926.56
20	26.5417	82774.9	Liner Geosynthetics (Slopes < 5%)	500	14.0363	827.566	1341.45	3365.81	0	3365.81
21	26.5417	64008.9	Liner Geosynthetics (Slopes < 5%)	2.27374e-013	22.6199	671.257	1088.08	2611.39	0	2611.39
22	31.5024	51029.8	Liner Geosynthetics (Slopes < 5%)	1.13687e-013	22.6199	453.969	735.865	1766.08	0	1766.08
23	31.5024	23393.8	Liner Geosynthetics (Slopes < 5%)	5.68434e-014	22.6199	208.115	337.346	809.63	0	809.63
24	4.15804	1011.64	Liner Geosynthetics (Slopes < 5%)	0	22.6199	68.6926	111.348	267.237	0	267.237
25	4.97193	498.803	Protective Cover	0	30	16.878	27.3585	106.712	59.3256	47.3864

Interslice Data

Global Minimum Query (spencer) - Safety Factor: 1.62096

Slice Number	X coordinate [ft]	Y coordinate - Bottom [ft]	Interslice Normal Force [lbs]	Interslice Shear Force [lbs]	Interslice Force Angle [degrees]
1	2831.04	1394.47	0	0	0
2	2857.52	1369.66	-2484.4	-624.447	14.1089
3	2883.99	1344.84	6312.14	1586.54	14.1089
4	2910.46	1320.03	26389.6	6632.97	14.1089
5	2936.93	1295.22	57748	14514.8	14.1089
6	2963.4	1270.4	100387	25232.1	14.1089
7	2989.88	1245.59	154308	38784.9	14.1089
8	3016.35	1220.77	219509	55173.1	14.1089
9	3017.33	1219.86	222761	55990.5	14.1089
10	3019.09	1219.3	224569	56444.8	14.1089
11	3042.36	1211.86	261176	65646.1	14.1089
12	3065.63	1204.43	297616	74805.1	14.1089
13	3093.4	1203.24	265197	66656.7	14.1089
14	3135.16	1202.11	213957	53777.5	14.1089
15	3171.21	1201.13	172819	43437.7	14.1089

16	3183.59	1200.79	159442	40075.3	14.1089
17	3193.11	1200.53	149386	37547.8	14.1089
18	3221.17	1199.77	121325	30494.8	14.1089
19	3259.66	1198.72	86676.4	21785.9	14.1089
20	3283.17	1198.08	67698.5	17015.9	14.1089
21	3309.71	1198.7	43645.1	10970.1	14.1089
22	3336.25	1199.32	24208.6	6084.78	14.1089
23	3367.76	1200.45	7918.23	1990.23	14.1089
24	3399.26	1201.57	450.164	113.148	14.1089
25	3403.42	1201.78	109.97	27.6408	14.1089
26	3408.39	1202.02	0	0	0

List Of Coordinates

Piezoline

X	Y
6.28913	1241.49
11.4859	1239.76
12.9533	1239.27
14.5365	1238.74
21.6471	1236.38
27.5697	1234.4
28.0365	1234.25
28.6061	1234.04
35.8423	1231.38
42.2702	1229.48
42.9166	1229.29
43.6938	1229.04
51.6734	1226.38
57.3963	1224.47
58.8558	1223.99
62.5178	1222.77
66.1855	1221.54

87.4233	1219.67
89.4228	1219.49
92.4618	1219.39
193.54	1215.4
222.478	1213.76
250.788	1212.15
270.993	1212.17
299.704	1212.21
343.95	1212.26
395.033	1212.33
448.569	1212.4
490.059	1212.45
545.787	1212.52
584.784	1212.57
642.688	1212.64
679.208	1212.69
739.275	1212.76
773.333	1212.81
835.549	1212.89
867.16	1212.93
931.51	1213.01
960.692	1213.05
1027.16	1213.13
1053.93	1213.16
1122.51	1213.25
1146.87	1213.28
1217.54	1213.37
1239.52	1213.4
1312.27	1213.49
1331.88	1213.52
1343.62	1213.53
1406.61	1213.61
1456.34	1215.34
1489.31	1216.48

1550.64	1218.6
1564.55	1219.09
1576.41	1219.5
1616.77	1220.9
1725.68	1224.67
1734.85	1224.99
1751.25	1224.77
1880.37	1223.01
2053.39	1220.65
2065.64	1220.48
2110.92	1219.86
2137.66	1219.5
2161.21	1219.18
2186.36	1218.84
2237.41	1219.5
2327.98	1220.68
2476	1222.6
2780.56	1219.5
2813.43	1219.16
2818.74	1219.21
2832.48	1219.32
2832.68	1219.32
2834.63	1219.33
2835.13	1219.34
2855.69	1219.5
2900.94	1219.86
3019.32	1220.8
3032.17	1216.55
3052.28	1209.89
3065.57	1205.5
3072.2	1205.32
3145.39	1203.33
3179.6	1202.4
3179.93	1202.39

3180.3	1202.38
3187.48	1202.18
3201.76	1201.8
3229.15	1201.05
3268.94	1199.97
3288.57	1199.43
3338.87	1200.9
3405.9	1202.85

Block Search Polyline

X	Y
3019.13	1219.56
3065.35	1204.26
3072.16	1204.05
3145.36	1202.07
3179.57	1201.14
3180.27	1201.14
3187.45	1200.93
3201.72	1200.53
3229.11	1199.79
3268.91	1198.72
3288.57	1198.18
3338.91	1199.66
3409.36	1201.7

External Boundary

X	Y
1842.37	800
3684.75	800
3684.75	1001.58
3684.75	1203.16
3614.87	1204.43

3418.32	1198.71
3410.04	1201.47
3408.66	1201.93
3405.9	1202.85
3328.75	1228.57
2967.02	1349.15
2726.17	1429.43
2580.1	1432.71
2434.02	1436
2141.34	1436
1978.72	1431.45
1739.67	1407.24
1732.46	1407.44
1669.36	1409.1
1234.23	1409.91
711.358	1411.68
664.71	1396.15
624.341	1395.99
452.918	1353.15
356.179	1328.98
6.28913	1241.49
4.48248	1241.04
3.57634	1240.81
0	1239.93
4.08e-014	1238.85
0	800

Material Boundary

X	Y
3.57634	1240.81
7.22137	1239.6
11.3065	1238.24
12.4789	1237.85

14.0631	1237.32
14.1692	1237.28
21.1739	1234.95
27.0952	1232.98
27.5407	1232.83
28.0893	1232.63
33.2583	1230.73
35.371	1229.96
41.8454	1228.05
42.4671	1227.86
43.2199	1227.61
51.1995	1224.95
56.9228	1223.05
57.5346	1222.85
58.3816	1222.56
60.979	1221.7
65.8782	1220.07
87.2914	1218.18
89.3304	1218
92.4057	1217.89
193.468	1213.9
250.747	1210.65
270.995	1210.67
299.705	1210.71
343.952	1210.76
395.035	1210.83
448.571	1210.9
490.061	1210.95
545.789	1211.02
584.786	1211.07
642.69	1211.14
679.21	1211.19
739.277	1211.26
773.335	1211.31

835.55	1211.39
867.162	1211.43
931.512	1211.51
960.693	1211.55
1027.16	1211.63
1053.93	1211.66
1122.51	1211.75
1146.87	1211.78
1217.54	1211.87
1239.52	1211.9
1312.27	1211.99
1331.88	1212.02
1343.62	1212.03
1406.65	1212.11
1406.67	1212.11
1456.39	1213.84
1489.37	1214.98
1538.79	1216.69
1550.7	1217.1
1564.6	1217.59
1576.46	1218
1616.82	1219.4
1725.73	1223.18
1734.86	1223.49
1751.23	1223.27
1947.06	1220.6
2053.37	1219.15
2065.62	1218.98
2110.9	1218.36
2137.64	1218
2161.19	1217.68
2186.36	1217.34
2237.43	1218
2306.53	1218.9

2476	1221.1
2780.54	1218
2813.43	1217.66
2818.75	1217.71
2832.47	1217.82
2832.49	1217.82
2832.7	1217.82
2834.65	1217.83
2835.14	1217.84
2855.7	1218
2900.95	1218.36
3019.09	1219.3
3023.56	1217.82
3031.7	1215.12
3045.96	1210.4
3065.31	1204
3072.16	1203.82
3145.35	1201.83
3179.56	1200.9
3179.89	1200.89
3180.26	1200.88
3187.43	1200.68
3201.72	1200.3
3229.11	1199.55
3268.9	1198.47
3288.57	1197.93
3338.92	1199.4
3381.34	1200.64
3410.04	1201.47

Material Boundary

X	Y
4.48248	1241.04

11.4647	1238.71
12.637	1238.32
14.2209	1237.79
21.3316	1235.43
27.2534	1233.45
27.706	1233.3
28.2616	1233.1
35.5281	1230.43
41.987	1228.53
42.617	1228.34
43.3779	1228.09
51.2743	1225.46
51.3575	1225.43
57.0806	1223.52
57.6925	1223.32
58.5397	1223.04
62.2581	1221.8
65.9806	1220.56
87.3353	1218.67
89.3612	1218.49
92.4244	1218.39
193.492	1214.4
250.76	1211.15
270.995	1211.17
299.705	1211.21
343.951	1211.26
395.034	1211.33
448.57	1211.4
490.06	1211.45
545.788	1211.52
584.785	1211.57
642.69	1211.64
679.209	1211.69
739.276	1211.76

773.334	1211.81
835.55	1211.89
867.162	1211.93
931.512	1212.01
960.693	1212.05
1027.16	1212.13
1053.93	1212.16
1122.51	1212.25
1146.87	1212.28
1217.54	1212.37
1239.52	1212.4
1312.27	1212.49
1331.88	1212.52
1343.62	1212.53
1406.64	1212.61
1406.65	1212.61
1456.37	1214.34
1489.35	1215.48
1550.68	1217.6
1564.58	1218.09
1576.44	1218.5
1616.81	1219.9
1642.74	1220.8
1725.72	1223.67
1734.86	1223.99
1751.24	1223.77
1921.84	1221.44
2053.37	1219.65
2065.63	1219.48
2110.91	1218.86
2137.65	1218.5
2161.2	1218.18
2186.36	1217.84
2237.42	1218.5

2393.42	1220.53
2476	1221.6
2780.55	1218.5
2813.43	1218.16
2818.75	1218.21
2832.47	1218.32
2832.49	1218.32
2832.69	1218.32
2834.64	1218.33
2835.14	1218.34
2855.7	1218.5
2900.95	1218.86
3019.16	1219.8
3031.85	1215.6
3065.39	1204.5
3072.17	1204.32
3145.36	1202.33
3179.57	1201.4
3179.9	1201.39
3180.27	1201.38
3187.45	1201.18
3201.73	1200.8
3229.12	1200.05
3268.91	1198.97
3288.57	1198.43
3338.9	1199.9
3374.63	1200.94
3408.66	1201.93

Material Boundary

X	Y
6.28913	1241.49
11.7811	1239.66

12.9533	1239.27
14.5365	1238.74
21.6471	1236.38
27.5697	1234.4
28.0365	1234.25
28.6061	1234.04
35.8423	1231.38
42.2702	1229.48
42.9166	1229.29
43.6938	1229.04
51.6734	1226.38
57.3963	1224.47
58.0083	1224.27
58.8558	1223.99
62.5178	1222.77
66.1855	1221.54
87.4233	1219.67
89.4228	1219.49
92.4618	1219.39
193.54	1215.4
222.478	1213.76
250.788	1212.15
270.993	1212.17
299.704	1212.21
343.95	1212.26
395.033	1212.33
448.569	1212.4
490.059	1212.45
545.787	1212.52
584.784	1212.57
642.688	1212.64
679.208	1212.69
739.275	1212.76
773.333	1212.81

835.549	1212.89
867.16	1212.93
931.51	1213.01
960.692	1213.05
1027.16	1213.13
1053.93	1213.16
1122.51	1213.25
1146.87	1213.28
1217.54	1213.37
1239.52	1213.4
1312.27	1213.49
1331.88	1213.52
1343.62	1213.53
1406.61	1213.61
1456.34	1215.34
1489.31	1216.48
1550.64	1218.6
1564.55	1219.09
1576.41	1219.5
1616.77	1220.9
1725.68	1224.67
1734.85	1224.99
1751.25	1224.77
1880.37	1223.01
2053.39	1220.65
2065.64	1220.48
2110.92	1219.86
2137.66	1219.5
2161.21	1219.18
2186.36	1218.84
2237.41	1219.5
2327.98	1220.68
2476	1222.6
2780.56	1219.5

2813.43	1219.16
2818.74	1219.21
2832.46	1219.32
2832.48	1219.32
2832.68	1219.32
2834.63	1219.33
2835.13	1219.34
2855.69	1219.5
2900.94	1219.86
3019.32	1220.8
3032.17	1216.55
3052.28	1209.89
3065.57	1205.5
3072.2	1205.32
3145.39	1203.33
3179.6	1202.4
3179.93	1202.39
3180.3	1202.38
3187.48	1202.18
3201.76	1201.8
3229.15	1201.05
3268.94	1199.97
3288.57	1199.43
3338.87	1200.9
3405.9	1202.85

Material Boundary

X	Y
4.08e-014	1238.85
34.4284	1227.11
65.2636	1217.11
81.2266	1215.8
92.2935	1214.89

133.788	1213.25
193.324	1210.91
221.882	1209.28
250.644	1207.65
565.291	1208.05
804.446	1208.35
993.933	1208.59
1122.51	1208.75
1146.88	1208.78
1375.18	1209.07
1405.98	1209.07
1489.47	1211.98
1616.93	1216.4
1698.14	1219.22
1730.36	1220.34
1902.26	1218.21
2129.7	1215.11
2137.6	1215
2186.36	1214.34
2476.01	1218.1
2779.83	1215.01
2780.51	1215
2878.35	1215.18
3018.61	1216.29
3039.13	1209.51
3048.27	1206.48
3064.78	1201.02
3167.41	1198.23
3288.58	1194.93
3391.71	1197.94
3418.32	1198.71

Material Boundary

X	Y
1405.98	1209.07
2095.19	1209
2871.02	1209
3039.13	1209.51

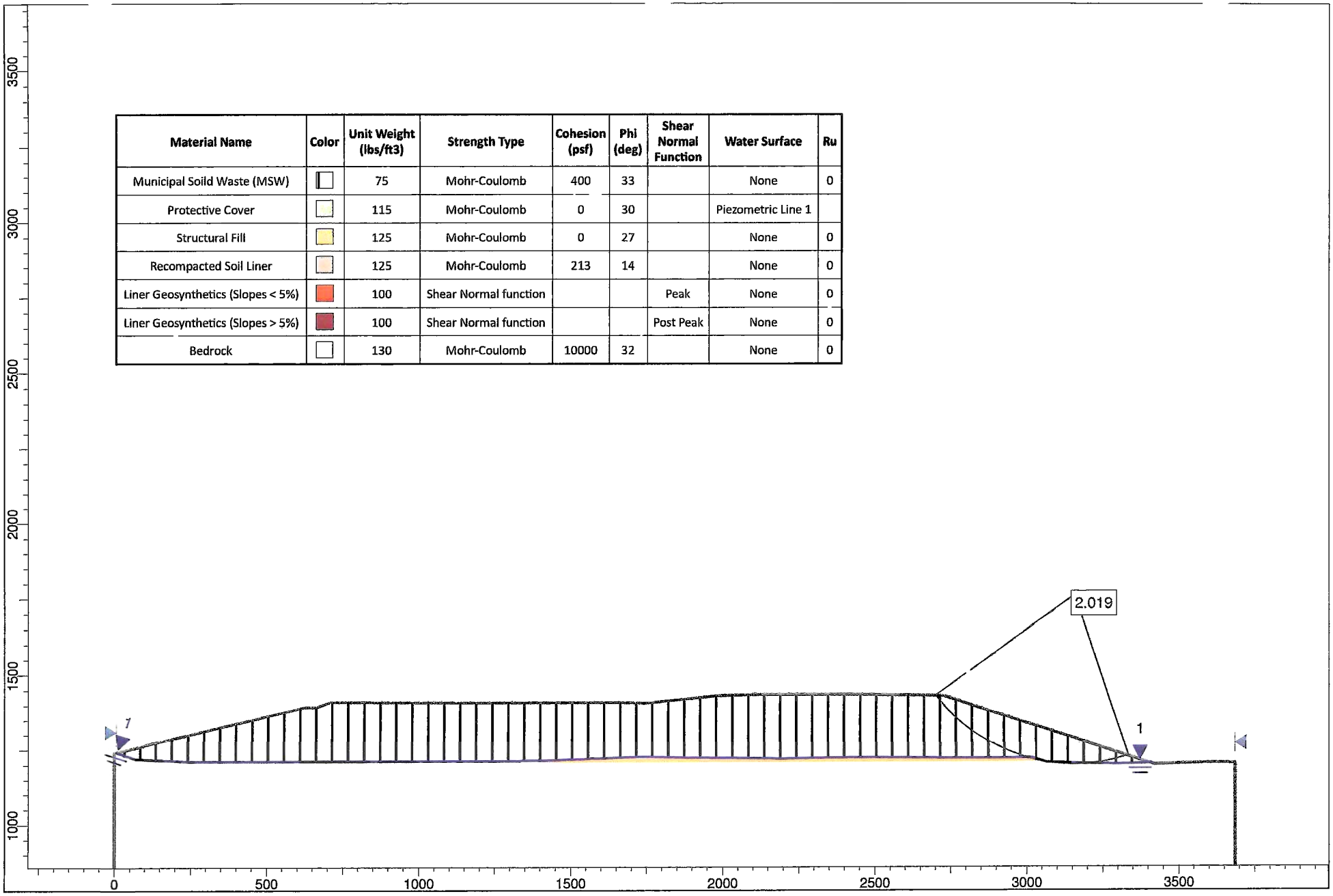
Material Boundary

X	Y
3019.09	1219.3
3019.16	1219.8

Material Boundary

X	Y
3065.31	1204
3065.39	1204.5

Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)	Shear Normal Function	Water Surface	Ru
Municipal Soild Waste (MSW)		75	Mohr-Coulomb	400	33		None	0
Protective Cover		115	Mohr-Coulomb	0	30		Piezometric Line 1	
Structural Fill		125	Mohr-Coulomb	0	27		None	0
Recompacted Soil Liner		125	Mohr-Coulomb	213	14		None	0
Liner Geosynthetics (Slopes < 5%)		100	Shear Normal function			Peak	None	0
Liner Geosynthetics (Slopes > 5%)		100	Shear Normal function			Post Peak	None	0
Bedrock		130	Mohr-Coulomb	10000	32		None	0



Slide Analysis Information

SLIDE - An Interactive Slope Stability Program

Project Summary

File Name: C-C -- static -- rotational -- undrained-rev1.slim
Slide Modeler Version: 6.023
Project Title: SLIDE - An Interactive Slope Stability Program
Date Created: 10/19/2011, 7:30:21 AM

General Settings

Units of Measurement: Imperial Units
Time Units: days
Permeability Units: feet/second
Failure Direction: Left to Right
Data Output: Standard
Maximum Material Properties: 20
Maximum Support Properties: 20

Analysis Options

Analysis Methods Used

Spencer

Number of slices: 25
Tolerance: 0.005
Maximum number of iterations 50
Check malpha < 0.2: Yes
Initial trial value of FS: 1
Steffensen Iteration: Yes

Groundwater Analysis

Groundwater Method: Water Surfaces
Pore Fluid Unit Weight 62.4 lbs/ft3
Advanced Groundwater Method: None

Random Numbers

Pseudo-random Seed: 10116
Random Number Generation Method: Park and Miller v.3

Surface Options

Surface Type: Circular
Search Method: Auto Refine Search
Divisions along slope: 20
Circles per division: 10
Number of iterations: 10
Divisions to use in next iteration: 50%
Composite Surfaces: Disabled
Minimum Elevation: Not Defined
Minimum Depth: 4

Material Properties

Property	Municipal Soild Waste (MSW)	Protective Cover	Structural Fill	Recompacted Soil Liner	Liner Geosynthetics (Slopes	Liner Geosynthetics (Slopes > 5%)	Bedrock
Color							
Strength Type	Mohr-Coulomb	Mohr-Coulomb	Mohr-Coulomb	Mohr-Coulomb	Shear Normal function	Shear Normal function	Mohr-Coulomb
Unit Weight [lbs/ft3]	75	115	125	125	100	100	130
Cohesion [psf]	400	0	0	213			10000
Friction Angle							

[deg]							
Water Surface	None	Piezometric Line 1	None	None	None	None	None
Hu Value		1					
Ru Value	0		0	0	0	0	0

Shear Normal Functions

Name. Peak

Normal (psf)	Shear (psf)
0	0
3000	1250
6000	2000
13500	3500

Name. Post Peak

Normal (psf)	Shear (psf)
0	0
3000	875
6000	1290
13500	2100

Global Minimums

Method: spencer

FS: 2.019220
Center: 3157.089, 1762.696
Radius: 564.621
Left Slip Surface Endpoint 2700.901, 1429.997
Right Slip Surface Endpoint. 3334.471, 1226.662
Resisting Moment=1.21704e+009 lb-ft
Driving Moment=6.02729e+008 lb-ft
Resisting Horizontal Force=1.95044e+006 lb
Driving Horizontal Force=965933 lb
Total Slice Area=51264.2 ft2

Valid / Invalid Surfaces

Method: spencer

Number of Valid Surfaces: 14049
Number of Invalid Surfaces: 0

Slice Data

Global Minimum Query (spencer) - Safety Factor: 2.01922

Slice Number	Width [ft]	Weight [lbs]	Base Material	Base Cohesion [psf]	Base Friction Angle [degrees]	Shear Stress [psf]	Shear Strength [psf]	Base Normal Stress [psf]	Pore Pressure [psf]	Effective Normal Stress [psf]
1	42.5962	77503.6	Municipal Soild Waste (MSW)	400	33	521.5	1053.02	1005.57	0	1005.57
2	42.5962	188027	Municipal Soild Waste (MSW)	400	33	1126.65	2274.96	2887.18	0	2887.18
3	42.5962	262350	Municipal Soild Waste (MSW)	400	33	1611.91	3254.81	4396.02	0	4396.02
4	42.5962	314931	Municipal Soild Waste (MSW)	400	33	2015.12	4068.97	5649.72	0	5649.72
5	42.5962	349857	Municipal Soild Waste (MSW)	400	33	2338.68	4722.3	6655.75	0	6655.75
6	42.5962	369728	Municipal Soild Waste (MSW)	400	33	2583.73	5217.12	7417.72	0	7417.72
7	42.5962	376287	Municipal Soild Waste (MSW)	400	33	2750.07	5552.99	7934.91	0	7934.91
8	3.37775	29896.8	Protective Cover	0	30	2327.98	4700.71	8173.07	31.201	8141.87
9	1.71834	15238.9	Liner Geosynthetics (Slopes < 5%)	800	11.31	1211.54	2446.37	8231.86	0	8231.86
10	10.7608	95997.7	Recompacted Soil Liner	213	14	1132.89	2287.55	8320.56	0	8320.56
11	14.6789	131434	Structural Fill	0	27	2130.8	4302.55	8444.21	0	8444.21
12	25.6109	222444	Recompacted Soil Liner	213	14	1129.84	2281.4	8295.92	0	8295.92
13	3.49578	29570.8	Liner Geosynthetics (Slopes > 5%)	642	6.16405	753.128	1520.73	8136.4	0	8136.4
14	6.58345	55111.1	Protective Cover	0	30	2340.37	4725.72	8218.05	32.8631	8185.19
15	0.592046	4917.67	Municipal Soild Waste (MSW)	400	33	2845.65	5746	8232.12	0	8232.12
16	7.73252	63957.4	Protective Cover	0	30	2330.77	4706.34	8182.84	31.2115	8151.63
17	4.22396	34706.1	Liner Geosynthetics (Slopes < 5%)	800	11.31	1193.38	2409.69	8048.46	0	8048.46
18	36.9935	294312	Recompacted Soil Liner	213	14	1080.75	2182.28	7898.34	0	7898.34
19	53.8389	382280	Recompacted Soil Liner	213	14	1005.07	2029.46	7285.44	0	7285.44
20	37.1565	218045	Recompacted Soil Liner	213	14	875.066	1766.95	6232.54	0	6232.54

21	4.25113	22022.7	Liner Geosynthetics (Slopes < 5%)	500	14.0363	946.98	1912.16	5648.66	0	5648.66
22	7.78687	38620.6	Protective Cover	0	30	1620.21	3271.56	5697.71	31.2115	5666.5
23	38.8651	160033	Municipal Soild Waste (MSW)	400	33	1819.28	3673.53	5040.79	0	5040.79
24	38.8651	101906	Municipal Soild Waste (MSW)	400	33	1301.94	2628.9	3432.22	0	3432.22
25	38.8651	35397.4	Municipal Soild Waste (MSW)	400	33	636.006	1284.24	1361.61	0	1361.61

Interslice Data

Global Minimum Query (spencer) - Safety Factor: 2.01922

Slice Number	X coordinate [ft]	Y coordinate - Bottom [ft]	Interslice Normal Force [lbs]	Interslice Shear Force [lbs]	Interslice Force Angle [degrees]
1	2700.9	1430	0	0	0
2	2743.5	1378.33	29687.2	7780.14	14.6853
3	2786.09	1337.07	100704	26391.5	14.6853
4	2828.69	1303.4	179870	47138.6	14.6853
5	2871.29	1275.75	250033	65526.4	14.6853
6	2913.88	1253.14	300677	78798.7	14.6853
7	2956.48	1234.92	325535	85313.1	14.6853
8	2999.07	1220.64	321406	84231.2	14.6853
9	3002.45	1219.66	321478	84250	14.6853
10	3004.17	1219.18	323395	84752.4	14.6853
11	3014.93	1216.26	335414	87902.2	14.6853
12	3029.61	1212.65	334541	87673.3	14.6853
13	3055.22	1207.34	349616	91624	14.6853
14	3058.72	1206.71	352101	92275.4	14.6853
15	3065.3	1205.59	345899	90649.9	14.6853
16	3065.89	1205.49	345010	90417.1	14.6853
17	3073.62	1204.28	336849	88278.4	14.6853
18	3077.85	1203.66	336746	88251.3	14.6853
19	3114.84	1199.66	328303	86038.5	14.6853
20	3168.68	1198.19	284722	74617.2	14.6853
21	3205.84	1200.18	239729	62825.8	14.6853
22	3210.09	1200.57	233521	61198.9	14.6853

23	3217.88	1201.36	216380	56706.7	14.6853
24	3256.74	1206.94	117363	30757.3	14.6852
25	3295.61	1215.33	37838.5	9916.37	14.6853
26	3334.47	1226.66	0	0	0

List Of Coordinates

Piezoline

X	Y
6.28913	1241.49
11.7811	1239.66
12.9533	1239.27
14.5365	1238.74
21.6471	1236.38
27.5697	1234.4
28.0365	1234.25
28.6061	1234.04
35.8423	1231.38
42.2702	1229.48
42.9166	1229.29
43.6938	1229.04
51.6734	1226.38
57.3963	1224.47
58.0083	1224.27
58.8558	1223.99
62.5178	1222.77
66.1855	1221.54
87.4233	1219.67
89.4228	1219.49
92.4618	1219.39
193.54	1215.4
222.478	1213.76
250.788	1212.15

270.993	1212.17
299.704	1212.21
343.95	1212.26
395.033	1212.33
448.569	1212.4
490.059	1212.45
545.787	1212.52
584.784	1212.57
642.688	1212.64
679.208	1212.69
739.275	1212.76
773.333	1212.81
835.549	1212.89
867.16	1212.93
931.51	1213.01
960.692	1213.05
1027.16	1213.13
1053.93	1213.16
1122.51	1213.25
1146.87	1213.28
1217.54	1213.37
1239.52	1213.4
1312.27	1213.49
1331.88	1213.52
1343.62	1213.53
1406.61	1213.61
1456.34	1215.34
1489.31	1216.48
1550.64	1218.6
1564.55	1219.09
1576.41	1219.5
1616.77	1220.9
1725.68	1224.67
1734.85	1224.99

1751.25	1224.77
1880.37	1223.01
2053.39	1220.65
2065.64	1220.48
2110.92	1219.86
2137.66	1219.5
2161.21	1219.18
2186.36	1218.84
2237.41	1219.5
2327.98	1220.68
2476	1222.6
2780.56	1219.5
2813.43	1219.16
2818.74	1219.21
2832.46	1219.32
2832.68	1219.32
2834.63	1219.33
2835.13	1219.34
2855.69	1219.5
2900.94	1219.86
3019.32	1220.8
3032.17	1216.55
3052.28	1209.89
3065.57	1205.5
3072.2	1205.32
3145.39	1203.33
3179.6	1202.4
3179.93	1202.39
3180.3	1202.38
3187.48	1202.18
3201.76	1201.8
3229.15	1201.05
3268.94	1199.97
3288.57	1199.43

3338.87	1200.9
3405.9	1202.85

External Boundary

X	Y
1842.37	800
3684.75	800
3684.75	1001.58
3684.75	1203.16
3614.87	1204.43
3418.32	1198.71
3410.04	1201.47
3408.66	1201.93
3405.9	1202.85
3328.75	1228.57
2967.02	1349.15
2726.17	1429.43
2580.1	1432.71
2434.02	1436
2141.34	1436
1978.72	1431.45
1739.67	1407.24
1732.46	1407.44
1669.36	1409.1
1234.23	1409.91
711.358	1411.68
664.71	1396.15
624.341	1395.99
452.918	1353.15
356.179	1328.98
6.28913	1241.49
4.48248	1241.04
3.57634	1240.81

0	1239.93
4.08e-014	1238.85
0	800

Material Boundary

X	Y
3.57634	1240.81
7.22137	1239.6
11.3065	1238.24
12.4789	1237.85
14.0631	1237.32
14.1692	1237.28
21.1739	1234.95
27.0952	1232.98
27.5407	1232.83
28.0893	1232.63
33.2583	1230.73
35.371	1229.96
41.8454	1228.05
42.4671	1227.86
43.2199	1227.61
51.1995	1224.95
56.9228	1223.05
57.5346	1222.85
58.3816	1222.56
60.979	1221.7
65.8782	1220.07
87.2914	1218.18
89.3304	1218
92.4057	1217.89
193.468	1213.9
250.747	1210.65
270.995	1210.67

299.705	1210.71
343.952	1210.76
395.035	1210.83
448.571	1210.9
490.061	1210.95
545.789	1211.02
584.786	1211.07
642.69	1211.14
679.21	1211.19
739.277	1211.26
773.335	1211.31
835.55	1211.39
867.162	1211.43
931.512	1211.51
960.693	1211.55
1027.16	1211.63
1053.93	1211.66
1122.51	1211.75
1146.87	1211.78
1217.54	1211.87
1239.52	1211.9
1312.27	1211.99
1331.88	1212.02
1343.62	1212.03
1406.65	1212.11
1406.67	1212.11
1456.39	1213.84
1489.37	1214.98
1538.79	1216.69
1550.7	1217.1
1564.6	1217.59
1576.46	1218
1616.82	1219.4
1725.73	1223.18

1734.86	1223.49
1751.23	1223.27
1947.06	1220.6
2053.37	1219.15
2065.62	1218.98
2110.9	1218.36
2137.64	1218
2161.19	1217.68
2186.36	1217.34
2237.43	1218
2306.53	1218.9
2476	1221.1
2780.54	1218
2813.43	1217.66
2818.75	1217.71
2832.47	1217.82
2832.49	1217.82
2832.7	1217.82
2834.65	1217.83
2835.14	1217.84
2855.7	1218
2900.95	1218.36
3019.09	1219.3
3023.56	1217.82
3031.7	1215.12
3045.96	1210.4
3065.31	1204
3072.16	1203.82
3145.35	1201.83
3179.56	1200.9
3179.89	1200.89
3180.26	1200.88
3187.43	1200.68
3201.72	1200.3

3229.11	1199.55
3268.9	1198.47
3288.57	1197.93
3338.92	1199.4
3381.34	1200.64
3410.04	1201.47

Materia. Boundary

X	Y
4.48248	1241.04
11.4647	1238.71
12.637	1238.32
14.2209	1237.79
21.3316	1235.43
27.2534	1233.45
27.706	1233.3
28.2616	1233.1
35.5281	1230.43
41.987	1228.53
42.617	1228.34
43.3779	1228.09
51.2743	1225.46
51.3575	1225.43
57.0806	1223.52
57.6925	1223.32
58.5397	1223.04
62.2581	1221.8
65.9806	1220.56
87.3353	1218.67
89.3612	1218.49
92.4244	1218.39
193.492	1214.4
250.76	1211.15

270.995	1211.17
299.705	1211.21
343.951	1211.26
395.034	1211.33
448.57	1211.4
490.06	1211.45
545.788	1211.52
584.785	1211.57
642.69	1211.64
679.209	1211.69
739.276	1211.76
773.334	1211.81
835.55	1211.89
867.162	1211.93
931.512	1212.01
960.693	1212.05
1027.16	1212.13
1053.93	1212.16
1122.51	1212.25
1146.87	1212.28
1217.54	1212.37
1239.52	1212.4
1312.27	1212.49
1331.88	1212.52
1343.62	1212.53
1406.64	1212.61
1406.65	1212.61
1456.37	1214.34
1489.35	1215.48
1550.68	1217.6
1564.58	1218.09
1576.44	1218.5
1616.81	1219.9
1642.74	1220.8

1725.72	1223.67
1734.86	1223.99
1751.24	1223.77
1921.84	1221.44
2053.37	1219.65
2065.63	1219.48
2110.91	1218.86
2137.65	1218.5
2161.2	1218.18
2186.36	1217.84
2237.42	1218.5
2393.42	1220.53
2476	1221.6
2780.55	1218.5
2813.43	1218.16
2818.75	1218.21
2832.47	1218.32
2832.49	1218.32
2832.69	1218.32
2834.64	1218.33
2835.14	1218.34
2855.7	1218.5
2900.95	1218.86
3019.16	1219.8
3031.85	1215.6
3065.39	1204.5
3072.17	1204.32
3145.36	1202.33
3179.57	1201.4
3179.9	1201.39
3180.27	1201.38
3187.45	1201.18
3201.73	1200.8
3229.12	1200.05

3268.91	1198.97
3288.57	1198.43
3338.9	1199.9
3374.63	1200.94
3408.66	1201.93

Material Boundary

X	Y
6.28913	1241.49
11.7811	1239.66
12.9533	1239.27
14.5365	1238.74
21.6471	1236.38
27.5697	1234.4
28.0365	1234.25
28.6061	1234.04
35.8423	1231.38
42.2702	1229.48
42.9166	1229.29
43.6938	1229.04
51.6734	1226.38
57.3963	1224.47
58.0083	1224.27
58.8558	1223.99
62.5178	1222.77
66.1855	1221.54
87.4233	1219.67
89.4228	1219.49
92.4618	1219.39
193.54	1215.4
222.478	1213.76
250.788	1212.15
270.993	1212.17

299.704	1212.21
343.95	1212.26
395.033	1212.33
448.569	1212.4
490.059	1212.45
545.787	1212.52
584.784	1212.57
642.688	1212.64
679.208	1212.69
739.275	1212.76
773.333	1212.81
835.549	1212.89
867.16	1212.93
931.51	1213.01
960.692	1213.05
1027.16	1213.13
1053.93	1213.16
1122.51	1213.25
1146.87	1213.28
1217.54	1213.37
1239.52	1213.4
1312.27	1213.49
1331.88	1213.52
1343.62	1213.53
1406.61	1213.61
1456.34	1215.34
1489.31	1216.48
1550.64	1218.6
1564.55	1219.09
1576.41	1219.5
1616.77	1220.9
1725.68	1224.67
1734.85	1224.99
1751.25	1224.77

1880.37	1223.01
2053.39	1220.65
2065.64	1220.48
2110.92	1219.86
2137.66	1219.5
2161.21	1219.18
2186.36	1218.84
2237.41	1219.5
2327.98	1220.68
2476	1222.6
2780.56	1219.5
2813.43	1219.16
2818.74	1219.21
2832.46	1219.32
2832.48	1219.32
2832.68	1219.32
2834.63	1219.33
2835.13	1219.34
2855.69	1219.5
2900.94	1219.86
3019.32	1220.8
3032.17	1216.55
3052.28	1209.89
3065.57	1205.5
3072.2	1205.32
3145.39	1203.33
3179.6	1202.4
3179.93	1202.39
3180.3	1202.38
3187.48	1202.18
3201.76	1201.8
3229.15	1201.05
3268.94	1199.97
3288.57	1199.43

3338.87	1200.9
3405.9	1202.85

Material Boundary

X	Y
4.08e-014	1238.85
34.4284	1227.11
65.2636	1217.11
81.2266	1215.8
92.2935	1214.89
133.788	1213.25
193.324	1210.91
221.882	1209.28
250.644	1207.65
565.291	1208.05
804.446	1208.35
993.933	1208.59
1122.51	1208.75
1146.88	1208.78
1375.18	1209.07
1405.98	1209.07
1489.47	1211.98
1616.93	1216.4
1698.14	1219.22
1730.36	1220.34
1902.26	1218.21
2129.7	1215.11
2137.6	1215
2186.36	1214.34
2476.01	1218.1
2779.83	1215.01
2780.51	1215
2878.35	1215.18

3018.61	1216.29
3039.13	1209.51
3048.27	1206.48
3064.78	1201.02
3167.41	1198.23
3288.58	1194.93
3391.71	1197.94
3418.32	1198.71

Material Boundary

X	Y
1405.98	1209.07
2095.19	1209
2871.02	1209
3039.13	1209.51

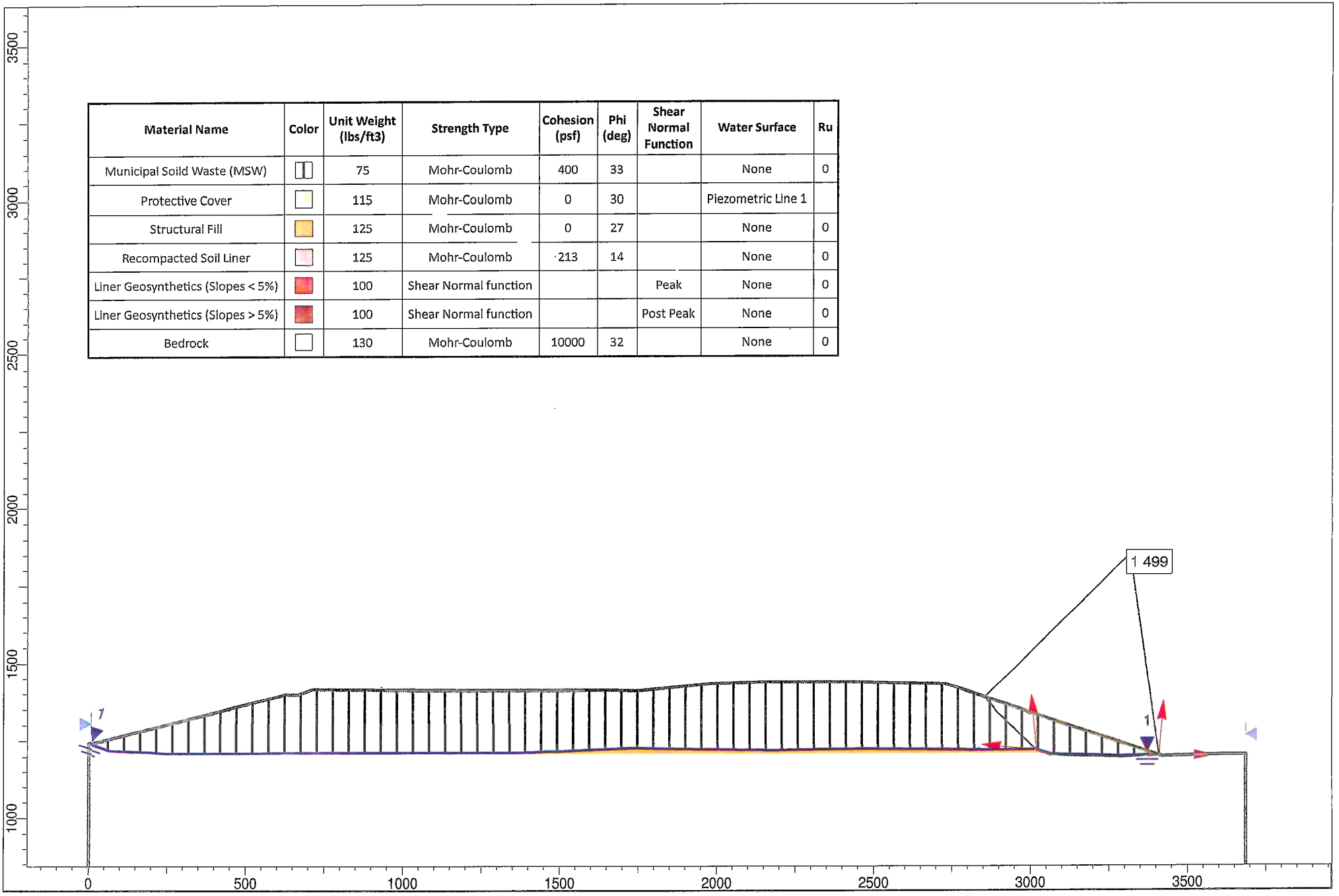
Material Boundary

X	Y
3019.09	1219.3
3019.16	1219.8

Material Boundary

X	Y
3065.31	1204
3065.39	1204.5

Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)	Shear Normal Function	Water Surface	Ru
Municipal Soild Waste (MSW)		75	Mohr-Coulomb	400	33		None	0
Protective Cover		115	Mohr-Coulomb	0	30		Piezometric Line 1	
Structural Fill		125	Mohr-Coulomb	0	27		None	0
Recompacted Soil Liner		125	Mohr-Coulomb	213	14		None	0
Liner Geosynthetics (Slopes < 5%)		100	Shear Normal function			Peak	None	0
Liner Geosynthetics (Slopes > 5%)		100	Shear Normal function			Post Peak	None	0
Bedrock		130	Mohr-Coulomb	10000	32		None	0



Slide Analysis Information

SLIDE - An Interactive Slope Stability Program

Project Summary

File Name: C-C -- static -- translational -- undrained-rev1.slim
Slide Modeler Version: 6.023
Project Title: SLIDE - An Interactive Slope Stability Program
Date Created: 10/19/2011, 7:30:21 AM

General Settings

Units of Measurement: Imperial Units
Time Units: days
Permeability Units: feet/second
Failure Direction: Left to Right
Data Output: Standard
Maximum Material Properties: 20
Maximum Support Properties: 20

Analysis Options

Analysis Methods Used

Spencer

Number of slices: 25
Tolerance: 0.005
Maximum number of iterations: 50
Check malpha < 0.2: Yes
Initial trial value of FS: 1
Steffensen Iteration: Yes

Groundwater Analysis

Groundwater Method: Water Surfaces
Pore Fluid Unit Weight: 62.4 lbs/ft3
Advanced Groundwater Method: None

Random Numbers

Pseudo-random Seed: 10116
Random Number Generation Method: Park and Miller v.3

Surface Options

Surface Type: Non-Circular Block Search
Number of Surfaces: 5000
Pseudo-Random Surfaces: Enabled
Convex Surfaces Only: Disabled
Left Projection Angle (Start Angle): 175
Left Projection Angle (End Angle): 95
Right Projection Angle (Start Angle): 0
Right Projection Angle (End Angle): 85
Minimum Elevation: Not Defined
Minimum Depth: Not Defined

Material Properties

Property	Municipal Soild Waste (MSW)	Protective Cover	Structural Fill	Recompacted Soil Liner	Liner Geosynthetics (Slopes	Liner Geosynthetics (Slopes > 5%)	Bedrock
Color							
Strength Type	Mohr-Coulomb	Mohr-Coulomb	Mohr-Coulomb	Mohr-Coulomb	Shear Normal function	Shear Normal function	Mohr-Coulomb
Unit Weight [lbs/ft3]	75	115	125	125	100	100	130
Cohesion [psf]	400	0	0	213			10000

Friction Angle [deg]	33	30	27	14			32
Water Surface	None	Piezometric Line 1	None	None	None	None	None
Hu Value		1					
Ru Value	0		0	0	0	0	0

Shear Normal Functions

Name Peak

Normal (psf)	Shear (psf)
0	0
3000	1250
6000	2000
13500	3500

Name. Post Peak

Normal (psf)	Shear (psf)
0	0
3000	875
6000	1290
13500	2100

Global Minimums

Method: spencer

FS. 1.499450
Axis Location: 3316.248, 1848.513
Left Slip Surface Endpoint: 2854.416, 1386.681
Right Slip Surface Endpoint: 3408.615, 1201.948
Resisting Moment=7.02266e+008 lb-ft
Driving Moment=4.68351e+008 lb-ft
Resisting Horizontal Force=915913 lb
Driving Horizontal Force=610835 lb
Total Slice Area=36035.2 ft2

Global Minimum Coordinates

Method: spencer

X	Y
2854.42	1386.68
2892.46	1340.79
3017.38	1219.86
3065.76	1203.92
3111.13	1200.18
3149.18	1198.72
3187.21	1197.69
3254.19	1195.87
3288.48	1194.94
3342.5	1196.5
3380.13	1201.02
3408.61	1201.95

Valid / Invalid Surfaces

Method: spencer

Number of Valid Surfaces 3061
Number of Invalid Surfaces: 1940

Error Codes:

Error Code -106 reported for 6 surfaces
Error Code -107 reported for 86 surfaces
Error Code -108 reported for 825 surfaces
Error Code -110 reported for 85 surfaces
Error Code -111 reported for 95 surfaces
Error Code -112 reported for 843 surfaces

Error Codes

The following errors were encountered during the computation:

-106 = Average slice width is less than 0.0001 * (maximum horizontal extent of soil region). This limitation is imposed to avoid numerical errors which may result from too many slices, or too small a slip region.
-107 = Total driving moment or total driving force is negative. This will occur if the wrong failure direction is specified, or if high external or anchor loads are applied against the failure direction.
-108 = Total driving moment or total driving force < 0.1. This is to limit the calculation of extremely high safety factors if the driving force is very small (0.1 is an arbitrary number).
-110 = The water table or a piezoline does not span the slip region for a given slip surface, when Water Surfaces is specified as the method of pore pressure calculation. If this error occurs, check that the water table or piezoline(s) span the appropriate soil cells.
-111 = safety factor equation did not converge
-112 = The coefficient M-Alpha = cos(alpha)(1+tan(alpha)tan(phi)/F) < 0.2 for the final iteration of the safety factor calculation. This screens out some slip surfaces which may not be valid in the context of the analysis, in particular, deep seated slip surfaces with many high negative base angle slices in the passive zone.

Slice Data

Global Minimum Query (spencer) - Safety Factor: 1.49945

Slice Number	Width [ft]	Weight [lbs]	Base Material	Base Cohesion [psf]	Base Friction Angle [degrees]	Shear Stress [psf]	Shear Strength [psf]	Base Normal Stress [psf]	Pore Pressure [psf]	Effective Normal Stress [psf]
1	19.0209	11844.1	Municipal Soild Waste (MSW)	400	33	359.456	538.986	214.019	0	214.019
2	19.0209	35532.2	Municipal Soild Waste (MSW)	400	33	674.333	1011.13	941.057	0	941.057
3	24.7947	76390.9	Municipal Soild Waste (MSW)	400	33	1073.28	1609.33	1862.21	0	1862.21
4	24.7947	105658	Municipal Soild Waste (MSW)	400	33	1402.87	2103.53	2623.21	0	2623.21
5	24.7947	134925	Municipal Soild Waste (MSW)	400	33	1732.46	2597.73	3384.2	0	3384.2
6	24.7947	164191	Municipal Soild Waste (MSW)	400	33	2062.04	3091.93	4145.2	0	4145.2
7	24.7947	193458	Municipal Soild Waste (MSW)	400	33	2391.63	3586.13	4906.2	0	4906.2
8	0.948024	7995.3	Protective Cover	0	30	2132.4	3197.42	5566.97	28.8686	5538.1
9	1.70442	14458	Liner Geosynthetics (Slopes < 5%)	800	11.31	1564.07	2345.24	7726.17	0	7726.17
10	0.393118	3338.16	Liner Geosynthetics (Slopes > 5%)	642	6.16405	988.415	1482.08	7778.5	0	7778.5
11	23.1423	196442	Liner Geosynthetics (Slopes > 5%)	642	6.16405	988.21	1481.77	7775.67	0	7775.67
12	23.1423	196259	Liner Geosynthetics (Slopes > 5%)	642	6.16405	987.687	1480.99	7768.4	0	7768.4
13	22.6869	188233	Recompacted Soil Liner	213	14	1535.15	2301.88	8378.02	0	8378.02
14	22.6869	179977	Recompacted Soil Liner	213	14	1474.22	2210.52	8011.61	0	8011.61
15	38.0411	279249	Recompacted Soil Liner	213	14	1399.24	2098.09	7560.68	0	7560.68

16	38.0388	247006	Recompacted Soil Liner	213	14	1260.24	1889.67	6724.75	0	6724.75
17	33.4865	189947	Recompacted Soil Liner	213	14	1119.5	1678.64	5878.35	0	5878.35
18	33.4865	164200	Recompacted Soil Liner	213	14	987.736	1481.06	5085.91	0	5085.91
19	34.2953	141478	Recompacted Soil Liner	213	14	854.373	1281.09	4283.88	0	4283.88
20	27.0096	90870.5	Recompacted Soil Liner	213	14	739.619	1109.02	3593.75	0	3593.75
21	27.0096	71048.3	Recompacted Soil Liner	213	14	610.766	915.813	2818.83	0	2818.83
22	32.9635	53665.1	Recompacted Soil Liner	213	14	449.223	673.587	1847.31	0	1847.31
23	4.66228	4232.93	Liner Geosynthetics (Slopes < 5%)	0	22.6199	290.466	435.539	1045.29	0	1045.29
24	23.0576	11670.2	Liner Geosynthetics (Slopes < 5%)	2.84217e-014	22.6199	153.786	230.594	553.424	0	553.424
25	5.42911	566.31	Protective Cover	0	30	18.6869	28.0201	110.401	61.8686	48.5321

Interslice Data

Global Minimum Query (spencer) - Safety Factor: 1.49945

Slice Number	X coordinate [ft]	Y coordinate - Bottom [ft]	Interslice Normal Force [lbs]	Interslice Shear Force [lbs]	Interslice Force Angle [degrees]
1	2854.42	1386.68	0	0	0
2	2873.44	1363.74	-1926.44	-474.601	13.8399
3	2892.46	1340.79	6839.93	1685.09	13.8398
4	2917.25	1316.79	24926.9	6141.01	13.8398
5	2942.05	1292.78	53108.2	13083.8	13.8399
6	2966.84	1268.78	91383.8	22513.4	13.8398
7	2991.64	1244.78	139754	34429.9	13.8398
8	3016.43	1220.77	198218	48833.2	13.8398
9	3017.38	1219.86	201306	49593.9	13.8398
10	3019.08	1219.3	202976	50005.4	13.8398
11	3019.48	1219.17	203595	50157.8	13.8398
12	3042.62	1211.55	239980	59121.8	13.8399
13	3065.76	1203.92	276323	68075.3	13.8399
14	3088.45	1202.05	257188	63361.1	13.8398
15	3111.13	1200.18	238748	58818.3	13.8399
16	3149.18	1198.72	196520	48414.8	13.8398
17	3187.21	1197.69	155531	38316.9	13.8399

18	3220.7	1196.78	123395	30399.7	13.8398
19	3254.19	1195.87	94949.1	23391.8	13.8399
20	3288.48	1194.94	69642.3	17157.2	13.8399
21	3315.49	1195.72	46848.6	11541.7	13.8399
22	3342.5	1196.5	28142.6	6933.24	13.8398
23	3375.47	1200.46	6020.02	1483.1	13.8399
24	3380.13	1201.02	4080.39	1005.25	13.8399
25	3403.19	1201.77	120.88	29.7802	13.8399
26	3408.61	1201.95	0	0	0

List Of Coordinates

Piezoline

X	Y
6.28913	1241.49
11.4859	1239.76
12.9533	1239.27
14.5365	1238.74
21.6471	1236.38
27.5697	1234.4
28.0365	1234.25
28.6061	1234.04
35.8423	1231.38
42.2702	1229.48
42.9166	1229.29
43.6938	1229.04
51.6734	1226.38
57.3963	1224.47
58.8558	1223.99
62.5178	1222.77
66.1855	1221.54
87.4233	1219.67
89.4228	1219.49

92.4618	1219.39
193.54	1215.4
222.478	1213.76
250.788	1212.15
270.993	1212.17
299.704	1212.21
343.95	1212.26
395.033	1212.33
448.569	1212.4
490.059	1212.45
545.787	1212.52
584.784	1212.57
642.688	1212.64
679.208	1212.69
739.275	1212.76
773.333	1212.81
835.549	1212.89
867.16	1212.93
931.51	1213.01
960.692	1213.05
1027.16	1213.13
1053.93	1213.16
1122.51	1213.25
1146.87	1213.28
1217.54	1213.37
1239.52	1213.4
1312.27	1213.49
1331.88	1213.52
1343.62	1213.53
1406.61	1213.61
1456.34	1215.34
1489.31	1216.48
1550.64	1218.6
1564.55	1219.09

1576.41	1219.5
1616.77	1220.9
1725.68	1224.67
1734.85	1224.99
1751.25	1224.77
1880.37	1223.01
2053.39	1220.65
2065.64	1220.48
2110.92	1219.86
2137.66	1219.5
2161.21	1219.18
2186.36	1218.84
2237.41	1219.5
2327.98	1220.68
2476	1222.6
2780.56	1219.5
2813.43	1219.16
2818.74	1219.21
2832.48	1219.32
2832.68	1219.32
2834.63	1219.33
2835.13	1219.34
2855.69	1219.5
2900.94	1219.86
3019.32	1220.8
3032.17	1216.55
3052.28	1209.89
3065.57	1205.5
3072.2	1205.32
3145.39	1203.33
3179.6	1202.4
3179.93	1202.39
3180.3	1202.38
3187.48	1202.18

3201.76	1201.8
3229.15	1201.05
3268.94	1199.97
3288.57	1199.43
3338.87	1200.9
3405.9	1202.85

Block Search Polyline

X	Y
3019.13	1219.59
3065.35	1204.24
3072.17	1204.05
3145.35	1202.07
3179.55	1201.13
3180.27	1201.13
3187.46	1200.94
3201.73	1200.53
3229.11	1199.79
3268.92	1198.7
3288.59	1198.19
3338.93	1199.66
3409.3	1201.72

External Boundary

X	Y
1842.37	800
3684.75	800
3684.75	1001.58
3684.75	1203.16
3614.87	1204.43
3418.32	1198.71
3410.04	1201.47

3408.66	1201.93
3405.9	1202.85
3328.75	1228.57
2967.02	1349.15
2726.17	1429.43
2580.1	1432.71
2434.02	1436
2141.34	1436
1978.72	1431.45
1739.67	1407.24
1732.46	1407.44
1669.36	1409.1
1234.23	1409.91
711.358	1411.68
664.71	1396.15
624.341	1395.99
452.918	1353.15
356.179	1328.98
6.28913	1241.49
4.48248	1241.04
3.57634	1240.81
0	1239.93
4.08e-014	1238.85
0	800

Material Boundary

X	Y
3.57634	1240.81
7.22137	1239.6
11.3065	1238.24
12.4789	1237.85
14.0631	1237.32
14.1692	1237.28

21.1739	1234.95
27.0952	1232.98
27.5407	1232.83
28.0893	1232.63
33.2583	1230.73
35.371	1229.96
41.8454	1228.05
42.4671	1227.86
43.2199	1227.61
51.1995	1224.95
56.9228	1223.05
57.5346	1222.85
58.3816	1222.56
60.979	1221.7
65.8782	1220.07
87.2914	1218.18
89.3304	1218
92.4057	1217.89
193.468	1213.9
250.747	1210.65
270.995	1210.67
299.705	1210.71
343.952	1210.76
395.035	1210.83
448.571	1210.9
490.061	1210.95
545.789	1211.02
584.786	1211.07
642.69	1211.14
679.21	1211.19
739.277	1211.26
773.335	1211.31
835.55	1211.39
867.162	1211.43

931.512	1211.51
960.693	1211.55
1027.16	1211.63
1053.93	1211.66
1122.51	1211.75
1146.87	1211.78
1217.54	1211.87
1239.52	1211.9
1312.27	1211.99
1331.88	1212.02
1343.62	1212.03
1406.65	1212.11
1406.67	1212.11
1456.39	1213.84
1489.37	1214.98
1538.79	1216.69
1550.7	1217.1
1564.6	1217.59
1576.46	1218
1616.82	1219.4
1725.73	1223.18
1734.86	1223.49
1751.23	1223.27
1947.06	1220.6
2053.37	1219.15
2065.62	1218.98
2110.9	1218.36
2137.64	1218
2161.19	1217.68
2186.36	1217.34
2237.43	1218
2306.53	1218.9
2476	1221.1
2780.54	1218

2813.43	1217.66
2818.75	1217.71
2832.47	1217.82
2832.49	1217.82
2832.7	1217.82
2834.65	1217.83
2835.14	1217.84
2855.7	1218
2900.95	1218.36
3019.09	1219.3
3023.56	1217.82
3031.7	1215.12
3045.96	1210.4
3065.31	1204
3072.16	1203.82
3145.35	1201.83
3179.56	1200.9
3179.89	1200.89
3180.26	1200.88
3187.43	1200.68
3201.72	1200.3
3229.11	1199.55
3268.9	1198.47
3288.57	1197.93
3338.92	1199.4
3381.34	1200.64
3410.04	1201.47

Material Boundary

X	Y
4.48248	1241.04
11.4647	1238.71
12.637	1238.32

14.2209	1237.79
21.3316	1235.43
27.2534	1233.45
27.706	1233.3
28.2616	1233.1
35.5281	1230.43
41.987	1228.53
42.617	1228.34
43.3779	1228.09
51.2743	1225.46
51.3575	1225.43
57.0806	1223.52
57.6925	1223.32
58.5397	1223.04
62.2581	1221.8
65.9806	1220.56
87.3353	1218.67
89.3612	1218.49
92.4244	1218.39
193.492	1214.4
250.76	1211.15
270.995	1211.17
299.705	1211.21
343.951	1211.26
395.034	1211.33
448.57	1211.4
490.06	1211.45
545.788	1211.52
584.785	1211.57
642.69	1211.64
679.209	1211.69
739.276	1211.76
773.334	1211.81
835.55	1211.89

867.162	1211.93
931.512	1212.01
960.693	1212.05
1027.16	1212.13
1053.93	1212.16
1122.51	1212.25
1146.87	1212.28
1217.54	1212.37
1239.52	1212.4
1312.27	1212.49
1331.88	1212.52
1343.62	1212.53
1406.64	1212.61
1406.65	1212.61
1456.37	1214.34
1489.35	1215.48
1550.68	1217.6
1564.58	1218.09
1576.44	1218.5
1616.81	1219.9
1642.74	1220.8
1725.72	1223.67
1734.86	1223.99
1751.24	1223.77
1921.84	1221.44
2053.37	1219.65
2065.63	1219.48
2110.91	1218.86
2137.65	1218.5
2161.2	1218.18
2186.36	1217.84
2237.42	1218.5
2393.42	1220.53
2476	1221.6

2780.55	1218.5
2813.43	1218.16
2818.75	1218.21
2832.47	1218.32
2832.49	1218.32
2832.69	1218.32
2834.64	1218.33
2835.14	1218.34
2855.7	1218.5
2900.95	1218.86
3019.16	1219.8
3031.85	1215.6
3065.39	1204.5
3072.17	1204.32
3145.36	1202.33
3179.57	1201.4
3179.9	1201.39
3180.27	1201.38
3187.45	1201.18
3201.73	1200.8
3229.12	1200.05
3268.91	1198.97
3288.57	1198.43
3338.9	1199.9
3374.63	1200.94
3408.66	1201.93

Material Boundary

X	Y
6.28913	1241.49
11.7811	1239.66
12.9533	1239.27
14.5365	1238.74

21.6471	1236.38
27.5697	1234.4
28.0365	1234.25
28.6061	1234.04
35.8423	1231.38
42.2702	1229.48
42.9166	1229.29
43.6938	1229.04
51.6734	1226.38
57.3963	1224.47
58.0083	1224.27
58.8558	1223.99
62.5178	1222.77
66.1855	1221.54
87.4233	1219.67
89.4228	1219.49
92.4618	1219.39
193.54	1215.4
222.478	1213.76
250.788	1212.15
270.993	1212.17
299.704	1212.21
343.95	1212.26
395.033	1212.33
448.569	1212.4
490.059	1212.45
545.787	1212.52
584.784	1212.57
642.688	1212.64
679.208	1212.69
739.275	1212.76
773.333	1212.81
835.549	1212.89
867.16	1212.93

931.51	1213.01
960.692	1213.05
1027.16	1213.13
1053.93	1213.16
1122.51	1213.25
1146.87	1213.28
1217.54	1213.37
1239.52	1213.4
1312.27	1213.49
1331.88	1213.52
1343.62	1213.53
1406.61	1213.61
1456.34	1215.34
1489.31	1216.48
1550.64	1218.6
1564.55	1219.09
1576.41	1219.5
1616.77	1220.9
1725.68	1224.67
1734.85	1224.99
1751.25	1224.77
1880.37	1223.01
2053.39	1220.65
2065.64	1220.48
2110.92	1219.86
2137.66	1219.5
2161.21	1219.18
2186.36	1218.84
2237.41	1219.5
2327.98	1220.68
2476	1222.6
2780.56	1219.5
2813.43	1219.16
2818.74	1219.21

2832.46	1219.32
2832.48	1219.32
2832.68	1219.32
2834.63	1219.33
2835.13	1219.34
2855.69	1219.5
2900.94	1219.86
3019.32	1220.8
3032.17	1216.55
3052.28	1209.89
3065.57	1205.5
3072.2	1205.32
3145.39	1203.33
3179.6	1202.4
3179.93	1202.39
3180.3	1202.38
3187.48	1202.18
3201.76	1201.8
3229.15	1201.05
3268.94	1199.97
3288.57	1199.43
3338.87	1200.9
3405.9	1202.85

Material Boundary

X	Y
4.08e-014	1238.85
34.4284	1227.11
65.2636	1217.11
81.2266	1215.8
92.2935	1214.89
133.788	1213.25
193.324	1210.91

221.882	1209.28
250.644	1207.65
565.291	1208.05
804.446	1208.35
993.933	1208.59
1122.51	1208.75
1146.88	1208.78
1375.18	1209.07
1405.98	1209.07
1489.47	1211.98
1616.93	1216.4
1698.14	1219.22
1730.36	1220.34
1902.26	1218.21
2129.7	1215.11
2137.6	1215
2186.36	1214.34
2476.01	1218.1
2779.83	1215.01
2780.51	1215
2878.35	1215.18
3018.61	1216.29
3039.13	1209.51
3048.27	1206.48
3064.78	1201.02
3167.41	1198.23
3288.58	1194.93
3391.71	1197.94
3418.32	1198.71

Material Boundary

X	Y
1405.98	1209.07

2095.19	1209
2871.02	1209
3039.13	1209.51

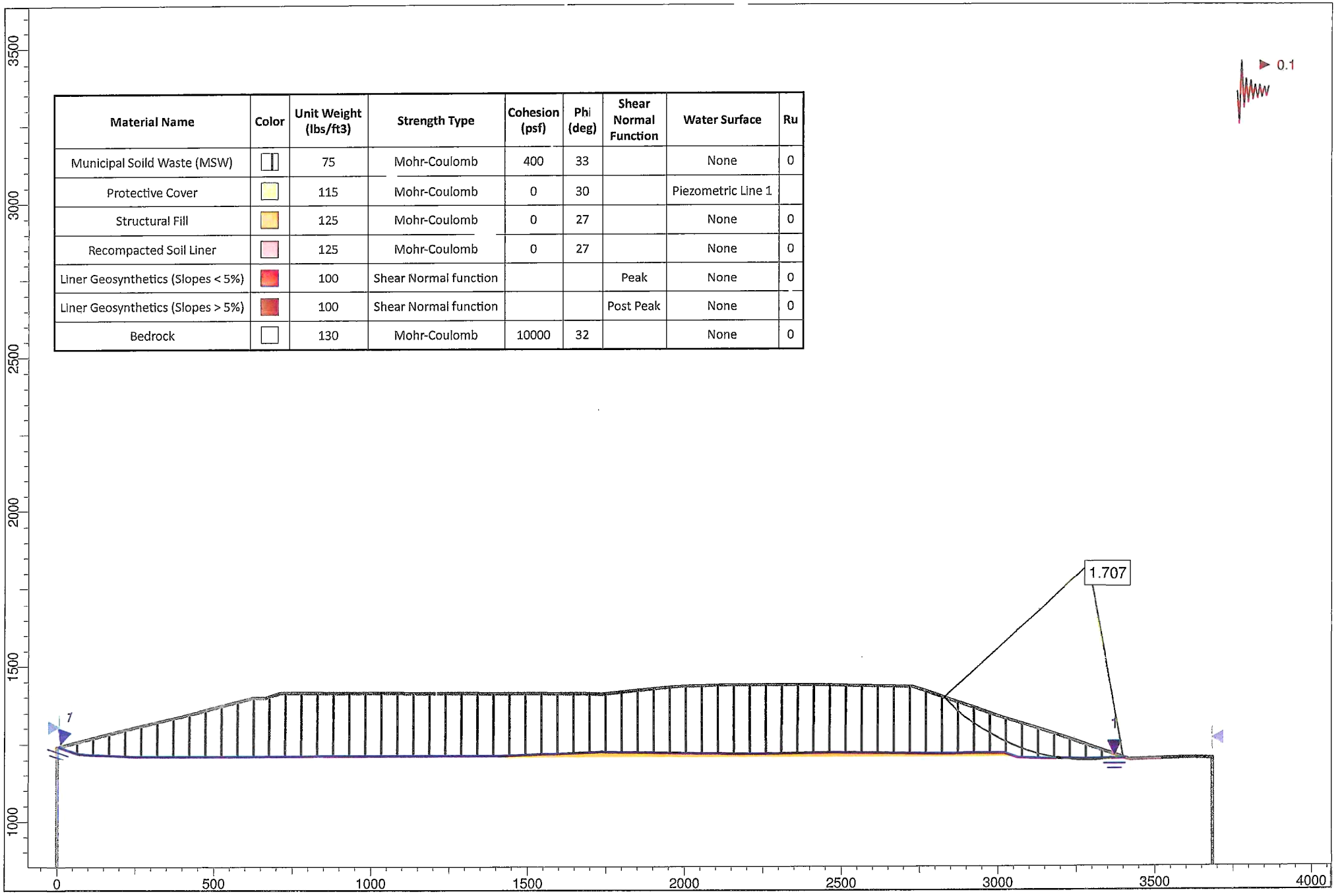
Material Boundary

X	Y
3019.09	1219.3
3019.16	1219.8

Material Boundary

X	Y
3065.31	1204
3065.39	1204.5

Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)	Shear Normal Function	Water Surface	Ru
Municipal Soild Waste (MSW)		75	Mohr-Coulomb	400	33		None	0
Protective Cover		115	Mohr-Coulomb	0	30		Piezometric Line 1	
Structural Fill		125	Mohr-Coulomb	0	27		None	0
Recompacted Soil Liner		125	Mohr-Coulomb	0	27		None	0
Liner Geosynthetics (Slopes < 5%)		100	Shear Normal function			Peak	None	0
Liner Geosynthetics (Slopes > 5%)		100	Shear Normal function			Post Peak	None	0
Bedrock		130	Mohr-Coulomb	10000	32		None	0



Slide Analysis Information

SLIDE - An Interactive Slope Stability Program

Project Summary

File Name: C-C -- seismic -- rotational -- drained-rev1.slim
Slide Modeler Version: 6.023
Project Title: SLIDE - An Interactive Slope Stability Program
Date Created: 10/19/2011, 7:30:21 AM

General Settings

Units of Measurement: Imperial Units
Time Units: days
Permeability Units: feet/second
Failure Direction: Left to Right
Data Output: Standard
Maximum Material Properties: 20
Maximum Support Properties: 20

Analysis Options

Analysis Methods Used

Spencer

Number of slices: 25
Tolerance: 0.005
Maximum number of iterations: 50
Check malpha < 0.2: Yes
Initial trial value of FS: 1
Steffensen Iteration: Yes

Groundwater Analysis

Groundwater Method: Water Surfaces
Pore Fluid Unit Weight: 62.4 lbs/ft3
Advanced Groundwater Method: None

Random Numbers

Pseudo-random Seed: 10116
Random Number Generation Method: Park and Miller v.3

Surface Options

Surface Type: Circular
Search Method: Auto Refine Search
Divisions along slope: 20
Circles per division: 10
Number of iterations: 10
Divisions to use in next iteration: 50%
Composite Surfaces: Disabled
Minimum Elevation: Not Defined
Minimum Depth: 4

Loading

Seismic Load Coefficient (Horizontal): 0.1

Material Properties

Property	Municipal Soild Waste (MSW)	Protective Cover	Structural Fill	Recompacted Soil Liner	Liner Geosynthetics (Slopes	Liner Geosynthetics (Slopes > 5%)	Bedrock
Color							

Strength Type	Mohr-Coulomb	Mohr-Coulomb	Mohr-Coulomb	Mohr-Coulomb	Shear Normal function	Shear Normal function	Mohr-Coulomb
Unit Weight [lbs/ft3]	75	115	125	125	100	100	130
Cohesion [psf]	400	0	0	0			10000
Friction Angle [deg]	33	30	27	27			32
Water Surface	None	Piezometric Line 1	None	None	None	None	None
Hu Value		1					
Ru Value	0		0	0	0	0	0

Shear Normal Functions

Name: Peak

Normal (psf)	Shear (psf)
0	0
3000	1250
6000	2000
13500	3500

Name: Post Peak

Normal (psf)	Shear (psf)
0	0
3000	875
6000	1290
13500	2100

Global Minimums

Method: spencer

FS: 1.707390
Center: 3288.712, 1822.964
Radius: 627.994
Left Slip Surface Endpoint: 2828.971, 1395.162
Right Slip Surface Endpoint: 3399.824, 1204.878

Resisting Moment=9.55862e+008 lb-ft
Driving Moment=5.59839e+008 lb-ft
Resisting Horizontal Force=1.4129e+006 lb
Driving Horizontal Force=827519 lb
Total Slice Area=31112.7 ft2

Valid / Invalid Surfaces

Method: spencer

Number of Valid Surfaces: 15097
Number of Invalid Surfaces: 0

Slice Data

Global Minimum Query (spencer) - Safety Factor: 1.70739

Slice Number	Width [ft]	Weight [lbs]	Base Material	Base Cohesion [psf]	Base Friction Angle [degrees]	Shear Stress [psf]	Shear Strength [psf]	Base Normal Stress [psf]	Pore Pressure [psf]	Effective Normal Stress [psf]
1	28.1703	20085.1	Municipal Soild Waste (MSW)	400	33	359.552	613.895	329.368	0	329.368
2	28.1703	56754.9	Municipal Soild Waste (MSW)	400	33	678.751	1158.89	1168.59	0	1168.59
3	28.1703	86947.3	Municipal Soild Waste (MSW)	400	33	972.859	1661.05	1941.84	0	1941.84
4	28.1703	111566	Municipal Soild Waste (MSW)	400	33	1240.99	2118.85	2646.8	0	2646.8
5	28.1703	131276	Municipal Soild Waste (MSW)	400	33	1482.31	2530.88	3281.28	0	3281.28
6	28.1703	146583	Municipal Soild Waste (MSW)	400	33	1695.93	2895.62	3842.91	0	3842.91
7	28.1703	157879	Municipal Soild Waste (MSW)	400	33	1880.87	3211.38	4329.16	0	4329.16
8	28.1703	165472	Municipal Soild Waste (MSW)	400	33	2035.98	3476.22	4736.97	0	4736.97
9	28.1703	169608	Municipal Soild Waste (MSW)	400	33	2159.95	3687.87	5062.87	0	5062.87
10	28.1703	170486	Municipal Soild Waste (MSW)	400	33	2251.17	3843.63	5302.73	0	5302.73
11	28.1703	168263	Municipal Soild Waste (MSW)	400	33	2307.8	3940.32	5451.6	0	5451.6
12	28.1703	163066	Municipal Soild Waste (MSW)	400	33	2327.63	3974.17	5503.75	0	5503.75
13	28.1703	154997	Municipal Soild Waste (MSW)	400	33	2308.03	3940.7	5452.18	0	5452.18
14	8.59743	45502.7	Protective Cover	0	30	1764.44	3012.58	5249.15	31.2115	5217.94
15	4.7444	24775.1	Liner Geosynthetics (Slopes < 5%)	500	14.0363	1027.3	1754	5016.03	0	5016.03
16	23.7879	119930	Recompacted Soil Liner	0	27	1514.22	2585.36	5074.04	0	5074.04

17	23.7879	111397	Recompacted Soil Liner	0	27	1449.07	2474.13	4855.78	0	4855.78
18	31.0944	128049	Recompacted Soil Liner	0	27	1319.76	2253.35	4422.44	0	4422.44
19	2.63811	9832.82	Recompacted Soil Liner	0	27	1221.06	2084.82	4091.69	0	4091.69
20	34.2947	110741	Recompacted Soil Liner	0	27	1084.12	1851.02	3632.84	0	3632.84
21	23.1886	55215.7	Recompacted Soil Liner	0	27	831.444	1419.6	2786.12	0	2786.12
22	23.1886	36251.2	Recompacted Soil Liner	0	27	564.088	963.118	1890.22	0	1890.22
23	4.71428	4894.34	Liner Geosynthetics (Slopes < 5%)	0	22.6199	301.157	514.193	1234.06	0	1234.06
24	8.55169	6630.54	Protective Cover	0	30	322.906	551.327	986.139	31.2132	954.926
25	16.0502	4827.82	Municipal Soild Waste (MSW)	400	33	477.069	814.542	638.34	0	638.34

Interslice Data

Global Minimum Query (spencer) - Safety Factor 1.70739

Slice Number	X coordinate [ft]	Y coordinate - Bottom [ft]	Interslice Normal Force [lbs]	Interslice Shear Force [lbs]	Interslice Force Angle [degrees]
1	2828.97	1395.16	0	0	0
2	2857.14	1366.76	1221.32	530.571	23.4813
3	2885.31	1341.67	17069.9	7415.55	23.4812
4	2913.48	1319.4	41569.7	18058.8	23.4812
5	2941.65	1299.58	70162	30480	23.4812
6	2969.82	1281.96	99309.4	43142.3	23.4812
7	2997.99	1266.31	126251	54846.4	23.4813
8	3026.16	1252.49	148846	64662.1	23.4812
9	3054.33	1240.35	165468	71883.3	23.4813
10	3082.5	1229.79	174944	75999.7	23.4812
11	3110.67	1220.74	176507	76678.7	23.4812
12	3138.84	1213.11	169781	73756.7	23.4812
13	3167.01	1206.87	154773	67237.1	23.4813
14	3195.19	1201.97	131889	57295.5	23.4812
15	3203.78	1200.74	127727	55487.6	23.4813
16	3208.53	1200.11	128480	55814.7	23.4812
17	3232.32	1197.51	117611	51092.8	23.4812
18	3256.1	1195.82	102441	44502.9	23.4813

19	3287.2	1194.97	77892.3	33838.2	23.4812
20	3289.84	1194.97	75653.3	32865.6	23.4813
21	3324.13	1195.97	45870	19927	23.4813
22	3347.32	1197.71	27234.6	11831.4	23.4813
23	3370.51	1200.32	12830.2	5573.73	23.4812
24	3375.22	1200.96	11111.3	4826.99	23.4812
25	3383.77	1202.21	7777.1	3378.55	23.4812
26	3399.82	1204.88	0	0	0

List Of Coordinates

Piezoline

X	Y
6.28913	1241.49
11.4859	1239.76
12.9533	1239.27
14.5365	1238.74
21.6471	1236.38
27.5697	1234.4
28.0365	1234.25
28.6061	1234.04
35.8423	1231.38
42.2702	1229.48
42.9166	1229.29
43.6938	1229.04
51.6734	1226.38
57.3963	1224.47
58.8558	1223.99
62.5178	1222.77
66.1855	1221.54
87.4233	1219.67
89.4228	1219.49
92.4618	1219.39

193.54	1215.4
222.478	1213.76
250.788	1212.15
270.993	1212.17
299.704	1212.21
343.95	1212.26
395.033	1212.33
448.569	1212.4
490.059	1212.45
545.787	1212.52
584.784	1212.57
642.688	1212.64
679.208	1212.69
739.275	1212.76
773.333	1212.81
835.549	1212.89
867.16	1212.93
931.51	1213.01
960.692	1213.05
1027.16	1213.13
1053.93	1213.16
1122.51	1213.25
1146.87	1213.28
1217.54	1213.37
1239.52	1213.4
1312.27	1213.49
1331.88	1213.52
1343.62	1213.53
1406.61	1213.61
1456.34	1215.34
1489.31	1216.48
1550.64	1218.6
1564.55	1219.09
1576.41	1219.5

1616.77	1220.9
1725.68	1224.67
1734.85	1224.99
1751.25	1224.77
1880.37	1223.01
2053.39	1220.65
2065.64	1220.48
2110.92	1219.86
2137.66	1219.5
2161.21	1219.18
2186.36	1218.84
2237.41	1219.5
2327.98	1220.68
2476	1222.6
2780.56	1219.5
2813.43	1219.16
2818.74	1219.21
2832.48	1219.32
2832.68	1219.32
2834.63	1219.33
2835.13	1219.34
2855.69	1219.5
2900.94	1219.86
3019.32	1220.8
3032.17	1216.55
3052.28	1209.89
3065.57	1205.5
3072.2	1205.32
3145.39	1203.33
3179.6	1202.4
3179.93	1202.39
3180.3	1202.38
3187.48	1202.18
3201.76	1201.8

3229.15	1201.05
3268.94	1199.97
3288.57	1199.43
3338.87	1200.9
3405.9	1202.85

External Boundary

X	Y
1842.37	800
3684.75	800
3684.75	1001.58
3684.75	1203.16
3614.87	1204.43
3418.32	1198.71
3410.04	1201.47
3408.66	1201.93
3405.9	1202.85
3328.75	1228.57
2967.02	1349.15
2726.17	1429.43
2580.1	1432.71
2434.02	1436
2141.34	1436
1978.72	1431.45
1739.67	1407.24
1732.46	1407.44
1669.36	1409.1
1234.23	1409.91
711.358	1411.68
664.71	1396.15
624.341	1395.99
452.918	1353.15
356.179	1328.98

6.28913	1241.49
4.48248	1241.04
3.57634	1240.81
0	1239.93
4.08e-014	1238.85
0	800

Material Boundary

X	Y
3.57634	1240.81
7.22137	1239.6
11.3065	1238.24
12.4789	1237.85
14.0631	1237.32
14.1692	1237.28
21.1739	1234.95
27.0952	1232.98
27.5407	1232.83
28.0893	1232.63
33.2583	1230.73
35.371	1229.96
41.8454	1228.05
42.4671	1227.86
43.2199	1227.61
51.1995	1224.95
56.9228	1223.05
57.5346	1222.85
58.3816	1222.56
60.979	1221.7
65.8782	1220.07
87.2914	1218.18
89.3304	1218
92.4057	1217.89

193.468	1213.9
250.747	1210.65
270.995	1210.67
299.705	1210.71
343.952	1210.76
395.035	1210.83
448.571	1210.9
490.061	1210.95
545.789	1211.02
584.786	1211.07
642.69	1211.14
679.21	1211.19
739.277	1211.26
773.335	1211.31
835.55	1211.39
867.162	1211.43
931.512	1211.51
960.693	1211.55
1027.16	1211.63
1053.93	1211.66
1122.51	1211.75
1146.87	1211.78
1217.54	1211.87
1239.52	1211.9
1312.27	1211.99
1331.88	1212.02
1343.62	1212.03
1406.65	1212.11
1406.67	1212.11
1456.39	1213.84
1489.37	1214.98
1538.79	1216.69
1550.7	1217.1
1564.6	1217.59

1576.46	1218
1616.82	1219.4
1725.73	1223.18
1734.86	1223.49
1751.23	1223.27
1947.06	1220.6
2053.37	1219.15
2065.62	1218.98
2110.9	1218.36
2137.64	1218
2161.19	1217.68
2186.36	1217.34
2237.43	1218
2306.53	1218.9
2476	1221.1
2780.54	1218
2813.43	1217.66
2818.75	1217.71
2832.47	1217.82
2832.49	1217.82
2832.7	1217.82
2834.65	1217.83
2835.14	1217.84
2855.7	1218
2900.95	1218.36
3019.09	1219.3
3023.56	1217.82
3031.7	1215.12
3045.96	1210.4
3065.31	1204
3072.16	1203.82
3145.35	1201.83
3179.56	1200.9
3179.89	1200.89

3180.26	1200.88
3187.43	1200.68
3201.72	1200.3
3229.11	1199.55
3268.9	1198.47
3288.57	1197.93
3338.92	1199.4
3381.34	1200.64
3410.04	1201.47

Material Boundary

X	Y
4.48248	1241.04
11.4647	1238.71
12.637	1238.32
14.2209	1237.79
21.3316	1235.43
27.2534	1233.45
27.706	1233.3
28.2616	1233.1
35.5281	1230.43
41.987	1228.53
42.617	1228.34
43.3779	1228.09
51.2743	1225.46
51.3575	1225.43
57.0806	1223.52
57.6925	1223.32
58.5397	1223.04
62.2581	1221.8
65.9806	1220.56
87.3353	1218.67
89.3612	1218.49

92.4244	1218.39
193.492	1214.4
250.76	1211.15
270.995	1211.17
299.705	1211.21
343.951	1211.26
395.034	1211.33
448.57	1211.4
490.06	1211.45
545.788	1211.52
584.785	1211.57
642.69	1211.64
679.209	1211.69
739.276	1211.76
773.334	1211.81
835.55	1211.89
867.162	1211.93
931.512	1212.01
960.693	1212.05
1027.16	1212.13
1053.93	1212.16
1122.51	1212.25
1146.87	1212.28
1217.54	1212.37
1239.52	1212.4
1312.27	1212.49
1331.88	1212.52
1343.62	1212.53
1406.64	1212.61
1406.65	1212.61
1456.37	1214.34
1489.35	1215.48
1550.68	1217.6
1564.58	1218.09

1576.44	1218.5
1616.81	1219.9
1642.74	1220.8
1725.72	1223.67
1734.86	1223.99
1751.24	1223.77
1921.84	1221.44
2053.37	1219.65
2065.63	1219.48
2110.91	1218.86
2137.65	1218.5
2161.2	1218.18
2186.36	1217.84
2237.42	1218.5
2393.42	1220.53
2476	1221.6
2780.55	1218.5
2813.43	1218.16
2818.75	1218.21
2832.47	1218.32
2832.49	1218.32
2832.69	1218.32
2834.64	1218.33
2835.14	1218.34
2855.7	1218.5
2900.95	1218.86
3019.16	1219.8
3031.85	1215.6
3065.39	1204.5
3072.17	1204.32
3145.36	1202.33
3179.57	1201.4
3179.9	1201.39
3180.27	1201.38

3187.45	1201.18
3201.73	1200.8
3229.12	1200.05
3268.91	1198.97
3288.57	1198.43
3338.9	1199.9
3374.63	1200.94
3408.66	1201.93

Material Boundary

X	Y
6.28913	1241.49
11.7811	1239.66
12.9533	1239.27
14.5365	1238.74
21.6471	1236.38
27.5697	1234.4
28.0365	1234.25
28.6061	1234.04
35.8423	1231.38
42.2702	1229.48
42.9166	1229.29
43.6938	1229.04
51.6734	1226.38
57.3963	1224.47
58.0083	1224.27
58.8558	1223.99
62.5178	1222.77
66.1855	1221.54
87.4233	1219.67
89.4228	1219.49
92.4618	1219.39
193.54	1215.4

222.478	1213.76
250.788	1212.15
270.993	1212.17
299.704	1212.21
343.95	1212.26
395.033	1212.33
448.569	1212.4
490.059	1212.45
545.787	1212.52
584.784	1212.57
642.688	1212.64
679.208	1212.69
739.275	1212.76
773.333	1212.81
835.549	1212.89
867.16	1212.93
931.51	1213.01
960.692	1213.05
1027.16	1213.13
1053.93	1213.16
1122.51	1213.25
1146.87	1213.28
1217.54	1213.37
1239.52	1213.4
1312.27	1213.49
1331.88	1213.52
1343.62	1213.53
1406.61	1213.61
1456.34	1215.34
1489.31	1216.48
1550.64	1218.6
1564.55	1219.09
1576.41	1219.5
1616.77	1220.9

1725.68	1224.67
1734.85	1224.99
1751.25	1224.77
1880.37	1223.01
2053.39	1220.65
2065.64	1220.48
2110.92	1219.86
2137.66	1219.5
2161.21	1219.18
2186.36	1218.84
2237.41	1219.5
2327.98	1220.68
2476	1222.6
2780.56	1219.5
2813.43	1219.16
2818.74	1219.21
2832.46	1219.32
2832.48	1219.32
2832.68	1219.32
2834.63	1219.33
2835.13	1219.34
2855.69	1219.5
2900.94	1219.86
3019.32	1220.8
3032.17	1216.55
3052.28	1209.89
3065.57	1205.5
3072.2	1205.32
3145.39	1203.33
3179.6	1202.4
3179.93	1202.39
3180.3	1202.38
3187.48	1202.18
3201.76	1201.8

3229.15	1201.05
3268.94	1199.97
3288.57	1199.43
3338.87	1200.9
3405.9	1202.85

Material Boundary

X	Y
4.08e-014	1238.85
34.4284	1227.11
65.2636	1217.11
81.2266	1215.8
92.2935	1214.89
133.788	1213.25
193.324	1210.91
221.882	1209.28
250.644	1207.65
565.291	1208.05
804.446	1208.35
993.933	1208.59
1122.51	1208.75
1146.88	1208.78
1375.18	1209.07
1405.98	1209.07
1489.47	1211.98
1616.93	1216.4
1698.14	1219.22
1730.36	1220.34
1902.26	1218.21
2129.7	1215.11
2137.6	1215
2186.36	1214.34
2476.01	1218.1

2779.83	1215.01
2780.51	1215
2878.35	1215.18
3018.61	1216.29
3039.13	1209.51
3048.27	1206.48
3064.78	1201.02
3167.41	1198.23
3288.58	1194.93
3391.71	1197.94
3418.32	1198.71

Material Boundary

X	Y
1405.98	1209.07
2095.19	1209
2871.02	1209
3039.13	1209.51

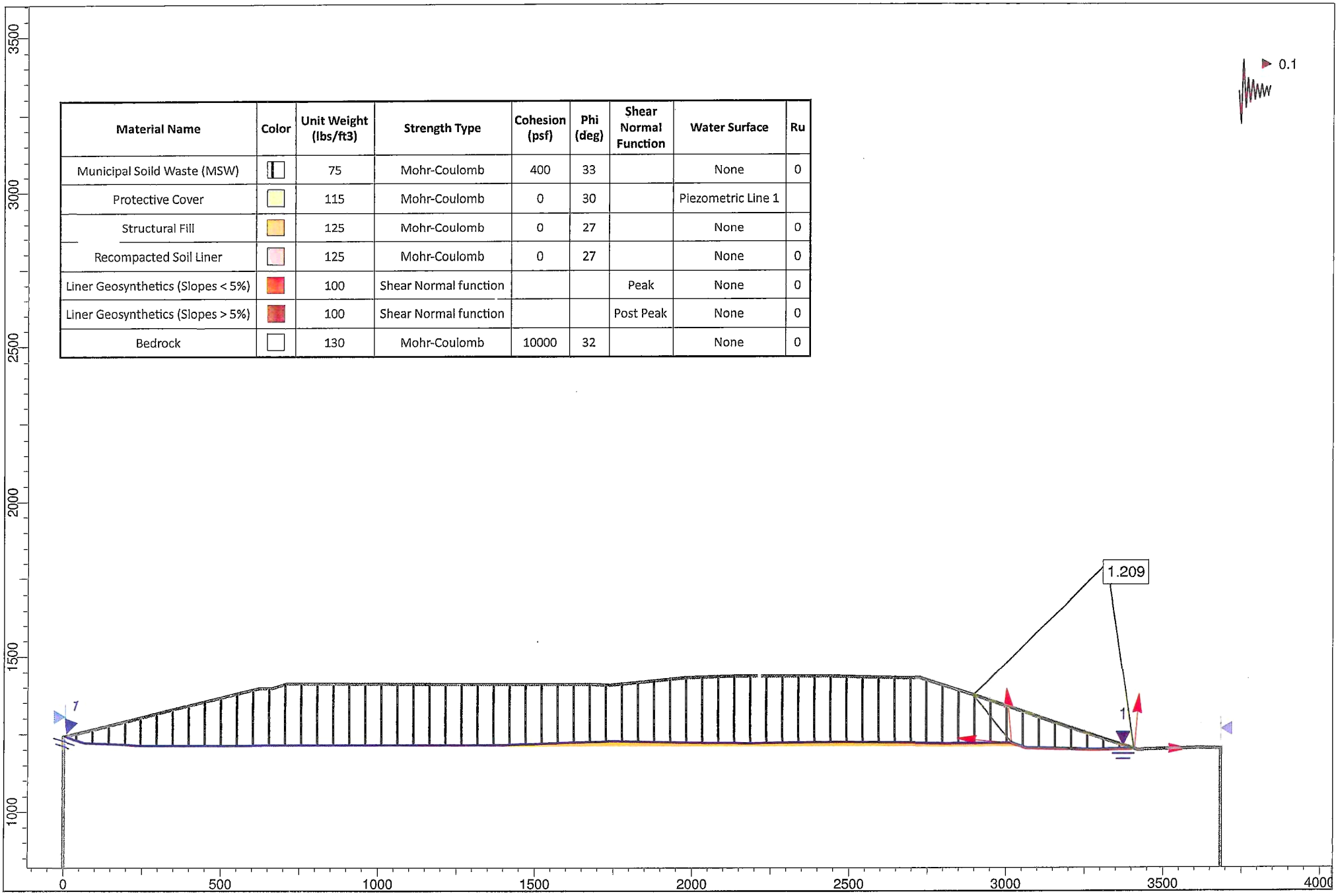
Material Boundary

X	Y
3019.09	1219.3
3019.16	1219.8

Material Boundary

X	Y
3065.31	1204
3065.39	1204.5

Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)	Shear Normal Function	Water Surface	Ru
Municipal Soild Waste (MSW)		75	Mohr-Coulomb	400	33		None	0
Protective Cover		115	Mohr-Coulomb	0	30		Piezometric Line 1	
Structural Fill		125	Mohr-Coulomb	0	27		None	0
Recompacted Soil Liner		125	Mohr-Coulomb	0	27		None	0
Liner Geosynthetics (Slopes < 5%)		100	Shear Normal function			Peak	None	0
Liner Geosynthetics (Slopes > 5%)		100	Shear Normal function			Post Peak	None	0
Bedrock		130	Mohr-Coulomb	10000	32		None	0



Slide Analysis Information

SLIDE - An Interactive Slope Stability Program

Project Summary

File Name: C-C -- seismic -- translational --drained-rev1.slim
Slide Modeler Version: 6.023
Project Title: SLIDE - An Interactive Slope Stability Program
Date Created: 10/19/2011, 7:30:21 AM

General Settings

Units of Measurement: Imperial Units
Time Units: days
Permeability Units: feet/second
Failure Direction: Left to Right
Data Output: Standard
Maximum Material Properties: 20
Maximum Support Properties: 20

Analysis Options

Analysis Methods Used

Spencer

Number of slices: 25
Tolerance: 0.005
Maximum number of iterations: 50
Check malpha < 0.2: Yes
Initial trial value of FS: 1
Steffensen Iteration: Yes

Groundwater Analysis

Groundwater Method: Water Surfaces
Pore Fluid Unit Weight: 62.4 lbs/ft3
Advanced Groundwater Method: None

Random Numbers

Pseudo-random Seed: 10116
Random Number Generation Method: Park and Miller v.3

Surface Options

Surface Type: Non-Circular Block Search
Number of Surfaces: 5000
Pseudo-Random Surfaces: Enabled
Convex Surfaces Only: Disabled
Left Projection Angle (Start Angle): 175
Left Projection Angle (End Angle): 95
Right Projection Angle (Start Angle): 0
Right Projection Angle (End Angle): 85
Minimum Elevation: Not Defined
Minimum Depth: Not Defined

Loading

Seismic Load Coefficient (Horizontal): 0.1

Material Properties

Property	Municipal Soild Waste (MSW)	Protective Cover	Structural Fill	Recompacted Soil Liner	Liner Geosynthetics (Slopes	Liner Geosynthetics (Slopes > 5%)	Bedrock
Color							

Strength Type	Mohr-Coulomb	Mohr-Coulomb	Mohr-Coulomb	Mohr-Coulomb	Shear Normal function	Shear Normal function	Mohr-Coulomb
Unit Weight [lbs/ft3]	75	115	125	125	100	100	130
Cohesion [psf]	400	0	0	0			10000
Friction Angle [deg]	33	30	27	27			32
Water Surface	None	Piezometric Line 1	None	None	None	None	None
Hu Value		1					
Ru Value	0		0	0	0	0	0

Shear Normal Functions

Name. Peak

Normal (psf)	Shear (psf)
0	0
3000	1250
6000	2000
13500	3500

Name. Post Peak

Normal (psf)	Shear (psf)
0	0
3000	875
6000	1290
13500	2100

Global Minimums

Method: spencer

FS: 1.208980
Axis Location: 3321.368, 1796.628
Left Slip Surface Endpoint: 2897.169, 1372.429
Right Slip Surface Endpoint: 3406.208, 1202.750

Resisting Moment=5.62191e+008 lb-ft
Driving Moment=4.65012e+008 lb-ft
Resisting Horizontal Force=811840 lb
Driving Horizontal Force=671507 lb
Total Slice Area=32022.5 ft2

Global Minimum Coordinates

Method: spencer

X	Y
2897.17	1372.43
3019.98	1219.27
3065.35	1204.26
3072.16	1204.05
3145.36	1202.07
3179.57	1201.14
3180.27	1201.14
3187.45	1200.93
3201.72	1200.53
3229.11	1199.79
3268.91	1198.72
3288.57	1198.18
3338.91	1199.66
3405.17	1201.58
3406.21	1202.75

Valid / Invalid Surfaces

Method: spencer

Number of Valid Surfaces: 2808
Number of Invalid Surfaces: 2193

Error Codes:

Error Code -106 reported for 6 surfaces
Error Code -108 reported for 831 surfaces
Error Code -110 reported for 83 surfaces
Error Code -111 reported for 218 surfaces
Error Code -112 reported for 1055 surfaces

Error Codes

The following errors were encountered during the computation:

-106 = Average slice width is less than 0.0001 * (maximum horizontal extent of soil region). This limitation is imposed to avoid numerical errors which may result from too many slices, or too small a slip region.
-108 = Total driving moment or total driving force < 0.1. This is to limit the calculation of extremely high safety factors if the driving force is very small (0.1 is an arbitrary number).
-110 = The water table or a piezoline does not span the slip region for a given slip surface, when Water Surfaces is specified as the method of pore pressure calculation. If this error occurs, check that the water table or piezoline(s) span the appropriate soil cells.
-111 = safety factor equation did not converge
-112 = The coefficient M-Alpha = cos(alpha)(1+tan(alpha)tan(phi)/F) < 0.2 for the final iteration of the safety factor calculation. This screens out some slip surfaces which may not be valid in the context of the analysis, in particular, deep seated slip surfaces with many high negative base angle slices in the passive zone.

Slice Data

Global Minimum Query (spencer) - Safety Factor. 1.20898

Slice Number	Width [ft]	Weight [lbs]	Base Material	Base Cohesion [psf]	Base Friction Angle [degrees]	Shear Stress [psf]	Shear Strength [psf]	Base Normal Stress [psf]	Pore Pressure [psf]	Effective Normal Stress [psf]
1	30.3977	31662.8	Municipal Soild Waste (MSW)	400	33	527.031	637.17	365.211	0	365.211
2	30.3977	94988.5	Municipal Soild Waste (MSW)	400	33	1069.1	1292.51	1374.35	0	1374.35
3	30.3977	158314	Municipal Soild Waste (MSW)	400	33	1611.16	1947.86	2383.49	0	2383.49
4	30.3977	221640	Municipal Soild Waste (MSW)	400	33	2153.22	2603.2	3392.64	0	3392.64
5	0.942248	7903.43	Protective Cover	0	30	1980.54	2394.43	4184.17	36.8957	4147.28
6	0.275475	2328.39	Liner Geosynthetics (Slopes > 5%)	460	7.87594	967.986	1170.28	5134.52	0	5134.52
7	22.6862	191990	Liner Geosynthetics (Slopes > 5%)	642	6.16405	1171.96	1416.88	7174.85	0	7174.85
8	22.6862	191900	Liner Geosynthetics (Slopes > 5%)	642	6.16405	1171.67	1416.52	7171.5	0	7171.5
9	6.80958	57046.1	Liner Geosynthetics (Slopes < 5%)	800	11.31	2110.62	2551.7	8758.51	0	8758.51
10	24.4	195686	Liner Geosynthetics (Slopes < 5%)	800	11.31	2053.84	2483.05	8415.22	0	8415.22

11	24.4	182013	Liner Geosynthetics (Slopes < 5%)	800	11.31	1959.91	2369.49	7847.48	0	7847.48
12	24.4	168339	Liner Geosynthetics (Slopes < 5%)	800	11.31	1865.99	2255.94	7279.7	0	7279.7
13	34.206	212965	Liner Geosynthetics (Slopes < 5%)	800	11.31	1753.25	2119.64	6598.22	0	6598.22
14	0.708	4123.3	Liner Geosynthetics (Slopes < 5%)	800	11.31	1707.02	2063.75	6318.73	0	6318.73
15	7.18	41162.9	Liner Geosynthetics (Slopes < 5%)	800	11.31	1669.07	2017.87	6089.33	0	6089.33
16	14.267	78299.7	Liner Geosynthetics (Slopes < 5%)	500	14.0363	1621.69	1960.59	5842.35	0	5842.35
17	27.389	137229	Liner Geosynthetics (Slopes < 5%)	500	14.0363	1520.94	1838.78	5355.1	0	5355.1
18	39.795	168662	Liner Geosynthetics (Slopes < 5%)	500	14.0363	1356.15	1639.56	4558.21	0	4558.21
19	19.667	69929.9	Liner Geosynthetics (Slopes < 5%)	500	14.0363	1210	1462.86	3851.45	0	3851.45
20	25.1705	75209	Liner Geosynthetics (Slopes < 5%)	500	14.0363	1122.11	1356.61	3426.43	0	3426.43
21	25.1705	57970	Liner Geosynthetics (Slopes < 5%)	2.27374e-013	22.6199	917.749	1109.54	2662.89	0	2662.89
22	33.1306	50044.6	Liner Geosynthetics (Slopes < 5%)	1.13687e-013	22.6199	601.715	727.461	1745.91	0	1745.91
23	33.1306	20218.8	Liner Geosynthetics (Slopes < 5%)	0	22.6199	243.102	293.906	705.373	0	705.373
24	0.228433	32.9883	Liner Geosynthetics (Slopes < 5%)	0	22.6199	262.365	317.194	761.267	0	761.267
25	0.804856	52.8844	Protective Cover	0	30	379.929	459.326	830.224	34.6478	795.577

Interslice Data

Global Minimum Query (spencer) - Safety Factor. 1.20898

Slice Number	X coordinate [ft]	Y coordinate - Bottom [ft]	Interslice Normal Force [lbs]	Interslice Shear Force [lbs]	Interslice Force Angle [degrees]
1	2897.17	1372.43	0	0	0
2	2927.57	1334.52	1056.01	465.977	23.81
3	2957.96	1296.61	30290.1	13365.8	23.8099
4	2988.36	1258.7	87702.3	38699.6	23.81
5	3018.76	1220.79	173293	76467.2	23.8099
6	3019.7	1219.62	177141	78165.4	23.81
7	3019.98	1219.27	178872	78929.4	23.81
8	3042.66	1211.77	225463	99487.9	23.81
9	3065.35	1204.26	272026	120034	23.8099
10	3072.16	1204.05	265213	117028	23.81
11	3096.56	1203.39	240444	106098	23.8099
12	3120.96	1202.73	216214	95406.6	23.81

13	3145.36	1202.07	192523	84952.8	23.81
14	3179.57	1201.14	160189	70685.4	23.8101
15	3180.27	1201.14	159398	70336.2	23.81
16	3187.45	1200.93	152846	67445	23.81
17	3201.72	1200.53	139989	61771.5	23.8099
18	3229.11	1199.79	116177	51264.4	23.81
19	3268.91	1198.72	84186.9	37148.4	23.81
20	3288.57	1198.18	69579.1	30702.6	23.81
21	3313.74	1198.92	46437.6	20491.1	23.81
22	3338.91	1199.66	27259.6	12028.6	23.81
23	3372.04	1200.62	10732.5	4735.84	23.81
24	3405.17	1201.58	4055.33	1789.46	23.81
25	3405.4	1201.84	3801.51	1677.46	23.81
26	3406.21	1202.75	0	0	0

List Of Coordinates

Piezoline

X	Y
6.28913	1241.49
11.4859	1239.76
12.9533	1239.27
14.5365	1238.74
21.6471	1236.38
27.5697	1234.4
28.0365	1234.25
28.6061	1234.04
35.8423	1231.38
42.2702	1229.48
42.9166	1229.29
43.6938	1229.04
51.6734	1226.38
57.3963	1224.47

58.8558	1223.99
62.5178	1222.77
66.1855	1221.54
87.4233	1219.67
89.4228	1219.49
92.4618	1219.39
193.54	1215.4
222.478	1213.76
250.788	1212.15
270.993	1212.17
299.704	1212.21
343.95	1212.26
395.033	1212.33
448.569	1212.4
490.059	1212.45
545.787	1212.52
584.784	1212.57
642.688	1212.64
679.208	1212.69
739.275	1212.76
773.333	1212.81
835.549	1212.89
867.16	1212.93
931.51	1213.01
960.692	1213.05
1027.16	1213.13
1053.93	1213.16
1122.51	1213.25
1146.87	1213.28
1217.54	1213.37
1239.52	1213.4
1312.27	1213.49
1331.88	1213.52
1343.62	1213.53

1406.61	1213.61
1456.34	1215.34
1489.31	1216.48
1550.64	1218.6
1564.55	1219.09
1576.41	1219.5
1616.77	1220.9
1725.68	1224.67
1734.85	1224.99
1751.25	1224.77
1880.37	1223.01
2053.39	1220.65
2065.64	1220.48
2110.92	1219.86
2137.66	1219.5
2161.21	1219.18
2186.36	1218.84
2237.41	1219.5
2327.98	1220.68
2476	1222.6
2780.56	1219.5
2813.43	1219.16
2818.74	1219.21
2832.48	1219.32
2832.68	1219.32
2834.63	1219.33
2835.13	1219.34
2855.69	1219.5
2900.94	1219.86
3019.32	1220.8
3032.17	1216.55
3052.28	1209.89
3065.57	1205.5
3072.2	1205.32

3145.39	1203.33
3179.6	1202.4
3179.93	1202.39
3180.3	1202.38
3187.48	1202.18
3201.76	1201.8
3229.15	1201.05
3268.94	1199.97
3288.57	1199.43
3338.87	1200.9
3405.9	1202.85

Block Search Polyline

X	Y
3019.13	1219.56
3065.35	1204.26
3072.16	1204.05
3145.36	1202.07
3179.57	1201.14
3180.27	1201.14
3187.45	1200.93
3201.72	1200.53
3229.11	1199.79
3268.91	1198.72
3288.57	1198.18
3338.91	1199.66
3409.36	1201.7

External Boundary

X	Y
1842.37	800
3684.75	800

3684.75	1001.58
3684.75	1203.16
3614.87	1204.43
3418.32	1198.71
3410.04	1201.47
3408.66	1201.93
3405.9	1202.85
3328.75	1228.57
2967.02	1349.15
2726.17	1429.43
2580.1	1432.71
2434.02	1436
2141.34	1436
1978.72	1431.45
1739.67	1407.24
1732.46	1407.44
1669.36	1409.1
1234.23	1409.91
711.358	1411.68
664.71	1396.15
624.341	1395.99
452.918	1353.15
356.179	1328.98
6.28913	1241.49
4.48248	1241.04
3.57634	1240.81
0	1239.93
4.08e-014	1238.85
0	800

Material Boundary

X	Y
3.57634	1240.81

7.22137	1239.6
11.3065	1238.24
12.4789	1237.85
14.0631	1237.32
14.1692	1237.28
21.1739	1234.95
27.0952	1232.98
27.5407	1232.83
28.0893	1232.63
33.2583	1230.73
35.371	1229.96
41.8454	1228.05
42.4671	1227.86
43.2199	1227.61
51.1995	1224.95
56.9228	1223.05
57.5346	1222.85
58.3816	1222.56
60.979	1221.7
65.8782	1220.07
87.2914	1218.18
89.3304	1218
92.4057	1217.89
193.468	1213.9
250.747	1210.65
270.995	1210.67
299.705	1210.71
343.952	1210.76
395.035	1210.83
448.571	1210.9
490.061	1210.95
545.789	1211.02
584.786	1211.07
642.69	1211.14

679.21	1211.19
739.277	1211.26
773.335	1211.31
835.55	1211.39
867.162	1211.43
931.512	1211.51
960.693	1211.55
1027.16	1211.63
1053.93	1211.66
1122.51	1211.75
1146.87	1211.78
1217.54	1211.87
1239.52	1211.9
1312.27	1211.99
1331.88	1212.02
1343.62	1212.03
1406.65	1212.11
1406.67	1212.11
1456.39	1213.84
1489.37	1214.98
1538.79	1216.69
1550.7	1217.1
1564.6	1217.59
1576.46	1218
1616.82	1219.4
1725.73	1223.18
1734.86	1223.49
1751.23	1223.27
1947.06	1220.6
2053.37	1219.15
2065.62	1218.98
2110.9	1218.36
2137.64	1218
2161.19	1217.68

2186.36	1217.34
2237.43	1218
2306.53	1218.9
2476	1221.1
2780.54	1218
2813.43	1217.66
2818.75	1217.71
2832.47	1217.82
2832.49	1217.82
2832.7	1217.82
2834.65	1217.83
2835.14	1217.84
2855.7	1218
2900.95	1218.36
3019.09	1219.3
3023.56	1217.82
3031.7	1215.12
3045.96	1210.4
3065.31	1204
3072.16	1203.82
3145.35	1201.83
3179.56	1200.9
3179.89	1200.89
3180.26	1200.88
3187.43	1200.68
3201.72	1200.3
3229.11	1199.55
3268.9	1198.47
3288.57	1197.93
3338.92	1199.4
3381.34	1200.64
3410.04	1201.47

Material Boundary

X	Y
4.48248	1241.04
11.4647	1238.71
12.637	1238.32
14.2209	1237.79
21.3316	1235.43
27.2534	1233.45
27.706	1233.3
28.2616	1233.1
35.5281	1230.43
41.987	1228.53
42.617	1228.34
43.3779	1228.09
51.2743	1225.46
51.3575	1225.43
57.0806	1223.52
57.6925	1223.32
58.5397	1223.04
62.2581	1221.8
65.9806	1220.56
87.3353	1218.67
89.3612	1218.49
92.4244	1218.39
193.492	1214.4
250.76	1211.15
270.995	1211.17
299.705	1211.21
343.951	1211.26
395.034	1211.33
448.57	1211.4
490.06	1211.45
545.788	1211.52
584.785	1211.57
642.69	1211.64

679.209	1211.69
739.276	1211.76
773.334	1211.81
835.55	1211.89
867.162	1211.93
931.512	1212.01
960.693	1212.05
1027.16	1212.13
1053.93	1212.16
1122.51	1212.25
1146.87	1212.28
1217.54	1212.37
1239.52	1212.4
1312.27	1212.49
1331.88	1212.52
1343.62	1212.53
1406.64	1212.61
1406.65	1212.61
1456.37	1214.34
1489.35	1215.48
1550.68	1217.6
1564.58	1218.09
1576.44	1218.5
1616.81	1219.9
1642.74	1220.8
1725.72	1223.67
1734.86	1223.99
1751.24	1223.77
1921.84	1221.44
2053.37	1219.65
2065.63	1219.48
2110.91	1218.86
2137.65	1218.5
2161.2	1218.18

2186.36	1217.84
2237.42	1218.5
2393.42	1220.53
2476	1221.6
2780.55	1218.5
2813.43	1218.16
2818.75	1218.21
2832.47	1218.32
2832.49	1218.32
2832.69	1218.32
2834.64	1218.33
2835.14	1218.34
2855.7	1218.5
2900.95	1218.86
3019.16	1219.8
3031.85	1215.6
3065.39	1204.5
3072.17	1204.32
3145.36	1202.33
3179.57	1201.4
3179.9	1201.39
3180.27	1201.38
3187.45	1201.18
3201.73	1200.8
3229.12	1200.05
3268.91	1198.97
3288.57	1198.43
3338.9	1199.9
3374.63	1200.94
3408.66	1201.93

Material Boundary

X	Y

6.28913	1241.49
11.7811	1239.66
12.9533	1239.27
14.5365	1238.74
21.6471	1236.38
27.5697	1234.4
28.0365	1234.25
28.6061	1234.04
35.8423	1231.38
42.2702	1229.48
42.9166	1229.29
43.6938	1229.04
51.6734	1226.38
57.3963	1224.47
58.0083	1224.27
58.8558	1223.99
62.5178	1222.77
66.1855	1221.54
87.4233	1219.67
89.4228	1219.49
92.4618	1219.39
193.54	1215.4
222.478	1213.76
250.788	1212.15
270.993	1212.17
299.704	1212.21
343.95	1212.26
395.033	1212.33
448.569	1212.4
490.059	1212.45
545.787	1212.52
584.784	1212.57
642.688	1212.64
679.208	1212.69

739.275	1212.76
773.333	1212.81
835.549	1212.89
867.16	1212.93
931.51	1213.01
960.692	1213.05
1027.16	1213.13
1053.93	1213.16
1122.51	1213.25
1146.87	1213.28
1217.54	1213.37
1239.52	1213.4
1312.27	1213.49
1331.88	1213.52
1343.62	1213.53
1406.61	1213.61
1456.34	1215.34
1489.31	1216.48
1550.64	1218.6
1564.55	1219.09
1576.41	1219.5
1616.77	1220.9
1725.68	1224.67
1734.85	1224.99
1751.25	1224.77
1880.37	1223.01
2053.39	1220.65
2065.64	1220.48
2110.92	1219.86
2137.66	1219.5
2161.21	1219.18
2186.36	1218.84
2237.41	1219.5
2327.98	1220.68

2476	1222.6
2780.56	1219.5
2813.43	1219.16
2818.74	1219.21
2832.46	1219.32
2832.48	1219.32
2832.68	1219.32
2834.63	1219.33
2835.13	1219.34
2855.69	1219.5
2900.94	1219.86
3019.32	1220.8
3032.17	1216.55
3052.28	1209.89
3065.57	1205.5
3072.2	1205.32
3145.39	1203.33
3179.6	1202.4
3179.93	1202.39
3180.3	1202.38
3187.48	1202.18
3201.76	1201.8
3229.15	1201.05
3268.94	1199.97
3288.57	1199.43
3338.87	1200.9
3405.9	1202.85

Material Boundary

X	Y
4.08e-014	1238.85
34.4284	1227.11
65.2636	1217.11

81.2266	1215.8
92.2935	1214.89
133.788	1213.25
193.324	1210.91
221.882	1209.28
250.644	1207.65
565.291	1208.05
804.446	1208.35
993.933	1208.59
1122.51	1208.75
1146.88	1208.78
1375.18	1209.07
1405.98	1209.07
1489.47	1211.98
1616.93	1216.4
1698.14	1219.22
1730.36	1220.34
1902.26	1218.21
2129.7	1215.11
2137.6	1215
2186.36	1214.34
2476.01	1218.1
2779.83	1215.01
2780.51	1215
2878.35	1215.18
3018.61	1216.29
3039.13	1209.51
3048.27	1206.48
3064.78	1201.02
3167.41	1198.23
3288.58	1194.93
3391.71	1197.94
3418.32	1198.71

Material Boundary

X	Y
1405.98	1209.07
2095.19	1209
2871.02	1209
3039.13	1209.51

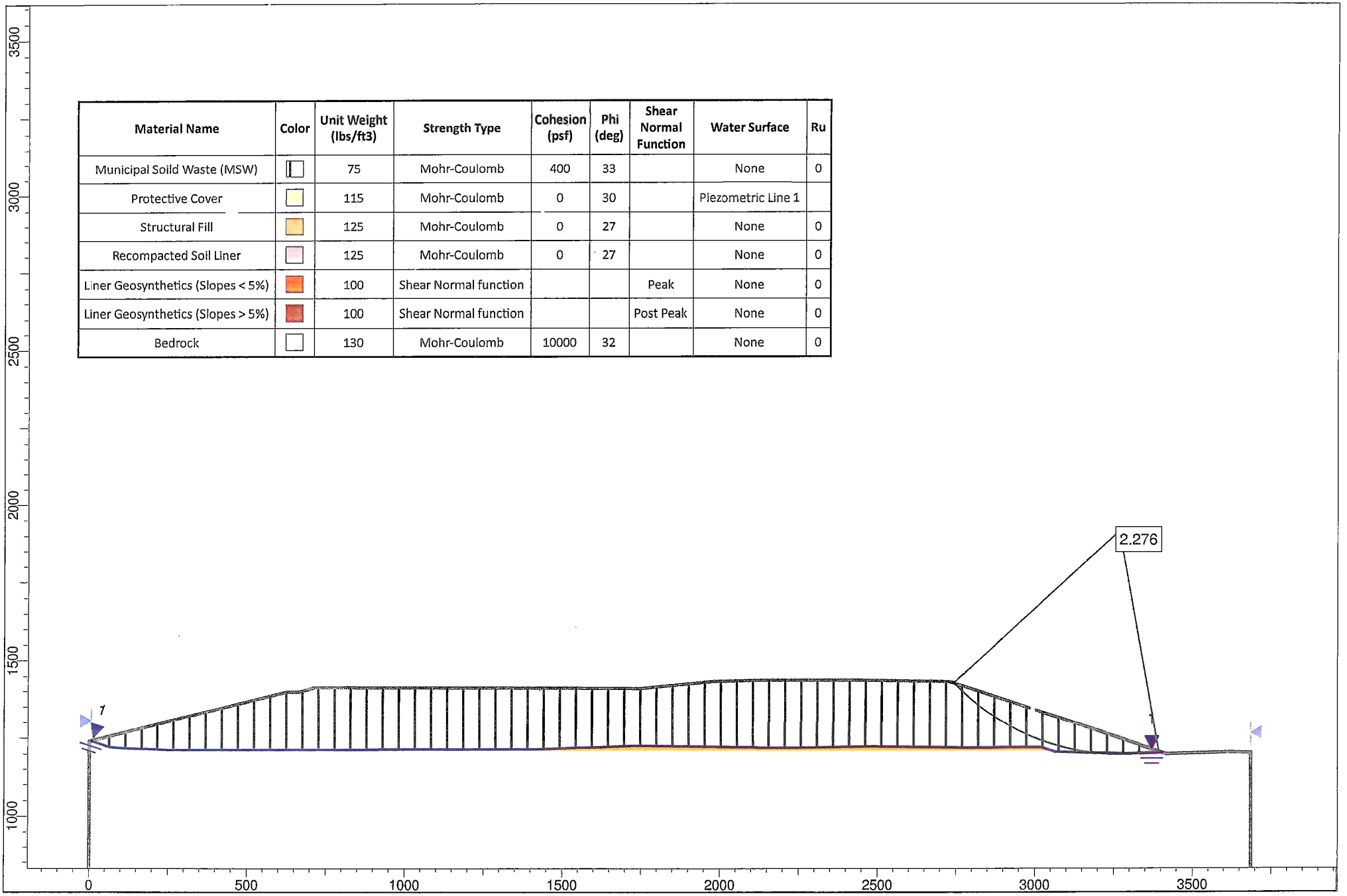
Material Boundary

X	Y
3019.09	1219.3
3019.16	1219.8

Material Boundary

X	Y
3065.31	1204
3065.39	1204.5

Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)	Shear Normal Function	Water Surface	Ru
Municipal Soild Waste (MSW)		75	Mohr-Coulomb	400	33		None	0
Protective Cover		115	Mohr-Coulomb	0	30		Piezometric Line 1	
Structural Fill		125	Mohr-Coulomb	0	27		None	0
Recompacted Soil Liner		125	Mohr-Coulomb	0	27		None	0
Liner Geosynthetics (Slopes < 5%)		100	Shear Normal function			Peak	None	0
Liner Geosynthetics (Slopes > 5%)		100	Shear Normal function			Post Peak	None	0
Bedrock		130	Mohr-Coulomb	10000	32		None	0



Slide Analysis Information

SLIDE - An Interactive Slope Stability Program

Project Summary

File Name: C-C -- static -- rotational -- drained-rev1.slim
Slide Modeler Version: 6.023
Project Title: SLIDE - An Interactive Slope Stability Program
Date Created: 10/19/2011, 7:30:21 AM

General Settings

Units of Measurement: Imperial Units
Time Units: days
Permeability Units: feet/second
Failure Direction: Left to Right
Data Output: Standard
Maximum Material Properties: 20
Maximum Support Properties: 20

Analysis Options

Analysis Methods Used

Spencer

Number of slices: 25
Tolerance: 0.005
Maximum number of iterations: 50
Check malpha < 0.2: Yes
Initial trial value of FS: 1
Steffensen Iteration: Yes

Groundwater Analysis

Groundwater Method: Water Surfaces
Pore Fluid Unit Weight: 62.4 lbs/ft3
Advanced Groundwater Method: None

Random Numbers

Pseudo-random Seed: 10116
Random Number Generation Method: Park and Miller v.3

Surface Options

Surface Type: Circular
Search Method: Auto Refine Search
Divisions along slope: 20
Circles per division: 10
Number of iterations: 10
Divisions to use in next iteration: 50%
Composite Surfaces: Disabled
Minimum Elevation: Not Defined
Minimum Depth: 4

Material Properties

Property	Municipal Soild Waste (MSW)	Protective Cover	Structural Fill	Recompacted Soil Liner	Liner Geosynthetics (Slopes	Liner Geosynthetics (Slopes > 5%)	Bedrock
Color							
Strength Type	Mohr-Coulomb	Mohr-Coulomb	Mohr-Coulomb	Mohr-Coulomb	Shear Normal function	Shear Normal function	Mohr-Coulomb
Unit Weight [lbs/ft3]	75	115	125	125	100	100	130
Cohesion [psf]	400	0	0	0			10000
Friction Angle							

[deg]						
Water Surface	None	Piezometric Line 1	None	None	None	None
Hu Value		1				
Ru Value	0		0	0	0	0

Shear Normal Functions

Name: Peak

Normal (psf)	Shear (psf)
0	0
3000	1250
6000	2000
13500	3500

Name. Post Peak

Normal (psf)	Shear (psf)
0	0
3000	875
6000	1290
13500	2100

Global Minimums

Method: spencer

FS: 2.276450
Center: 3266.616, 1914.478
Radius: 718.941
Left Slip Surface Endpoint: 2740.295, 1424.721
Right Slip Surface Endpoint: 3393.819, 1206.879
Resisting Moment=1.46725e+009 lb-ft
Driving Moment=6.44532e+008 lb-ft
Resisting Horizontal Force=1.88988e+006 lb
Driving Horizontal Force=830189 lb
Total Slice Area=40786.9 ft2

Valid / Invalid Surfaces

Method: spencer

Number of Valid Surfaces: 12661
Number of Invalid Surfaces: 0

Slice Data

Global Minimum Query (spencer) - Safety Factor: 2.27645

Slice Number	Width [ft]	Weight [lbs]	Base Material	Base Cohesion [psf]	Base Friction Angle [degrees]	Shear Stress [psf]	Shear Strength [psf]	Base Normal Stress [psf]	Pore Pressure [psf]	Effective Normal Stress [psf]
1	30.3114	23383.7	Municipal Soild Waste (MSW)	400	33	297.831	677.997	428.077	0	428.077
2	30.3114	66303.3	Municipal Soild Waste (MSW)	400	33	586.838	1335.91	1441.17	0	1441.17
3	30.3114	102078	Municipal Soild Waste (MSW)	400	33	849.151	1933.05	2360.69	0	2360.69
4	30.3114	131666	Municipal Soild Waste (MSW)	400	33	1084.78	2469.45	3186.68	0	3186.68
5	30.3114	155782	Municipal Soild Waste (MSW)	400	33	1293.78	2945.22	3919.29	0	3919.29
6	30.3114	174974	Municipal Soild Waste (MSW)	400	33	1476.15	3360.38	4558.57	0	4558.57
7	30.3114	189674	Municipal Soild Waste (MSW)	400	33	1631.83	3714.78	5104.3	0	5104.3
8	30.3114	200224	Municipal Soild Waste (MSW)	400	33	1760.64	4008.02	5555.86	0	5555.86
9	30.3114	206901	Municipal Soild Waste (MSW)	400	33	1862.3	4239.44	5912.21	0	5912.21
10	30.3114	209929	Municipal Soild Waste (MSW)	400	33	1936.37	4408.04	6171.84	0	6171.84
11	30.3114	209490	Municipal Soild Waste (MSW)	400	33	1982.24	4512.48	6332.68	0	6332.68
12	30.3114	205733	Municipal Soild Waste (MSW)	400	33	1999.19	4551.06	6392.08	0	6392.08
13	30.3114	198777	Municipal Soild Waste (MSW)	400	33	1986.26	4521.62	6346.75	0	6346.75
14	30.3114	188718	Municipal Soild Waste (MSW)	400	33	1942.29	4421.52	6192.61	0	6192.61
15	9.13177	54676.4	Protective Cover	0	30	1513.08	3444.46	5997.18	31.2115	5965.97
16	5.03003	29714.6	Liner Geosynthetics (Slopes < 5%)	500	14.0363	860.577	1959.06	5836.26	0	5836.26
17	24.4639	139784	Recompacted Soil Liner	0	27	1296.07	2950.43	5790.53	0	5790.53
18	24.4639	130629	Recompacted Soil Liner	0	27	1234.23	2809.66	5514.25	0	5514.25
19	38.6821	181114	Recompacted Soil Liner	0	27	1109.21	2525.06	4955.7	0	4955.7
20	25.1479	97574	Recompacted Soil Liner	0	27	942.788	2146.21	4212.18	0	4212.18

21	25.1479	79246.4	Recompacted Soil Liner	0	27	781.489	1779.02	3491.53	0	3491.53
22	25.1479	58830.5	Recompacted Soil Liner	0	27	592.4	1348.57	2646.72	0	2646.72
23	6.21157	11158	Liner Geosynthetics (Slopes < 5%)	0	22.6199	369.783	841.793	2020.31	0	2020.31
24	10.8033	16016.3	Protective Cover	0	30	431.761	982.882	1733.61	31.2132	1702.4
25	34.9351	22326.5	Municipal Soild Waste (MSW)	400	33	425.998	969.764	877.36	0	877.36

Interslice Data

Global Minimum Query (spencer) - Safety Factor: 2.27645

Slice Number	X coordinate [ft]	Y coordinate - Bottom [ft]	Interslice Normal Force [lbs]	Interslice Shear Force [lbs]	Interslice Force Angle [degrees]
1	2740.29	1424.72	0	0	0
2	2770.61	1394.05	4108.43	1282.35	17.3345
3	2800.92	1366.75	25660	8009.17	17.3345
4	2831.23	1342.36	57511.8	17951	17.3346
5	2861.54	1320.52	94267.3	29423.3	17.3345
6	2891.85	1300.94	131795	41136.7	17.3345
7	2922.16	1283.42	166922	52100.8	17.3345
8	2952.47	1267.8	197232	61561.4	17.3345
9	2982.79	1253.94	220927	68957.1	17.3345
10	3013.1	1241.72	236730	73889.8	17.3345
11	3043.41	1231.06	243828	76105.1	17.3345
12	3073.72	1221.9	241820	75478.3	17.3345
13	3104.03	1214.16	230699	72007.3	17.3345
14	3134.34	1207.81	210839	65808.5	17.3345
15	3164.65	1202.8	182994	57117.4	17.3346
16	3173.79	1201.56	176672	55144.1	17.3346
17	3178.82	1200.92	176063	54953.9	17.3345
18	3203.28	1198.33	159347	49736.5	17.3346
19	3227.74	1196.59	138783	43317.9	17.3345
20	3266.43	1195.54	101109	31558.9	17.3346
21	3291.57	1195.97	75587	23592.7	17.3345
22	3316.72	1197.29	51353.3	16028.7	17.3345

23	3341.87	1199.49	30637.1	9562.66	17.3345
24	3348.08	1200.17	26965.4	8416.6	17.3345
25	3358.88	1201.48	20023.5	6249.88	17.3346
26	3393.82	1206.88	0	0	0

List Of Coordinates

Piezoline

X	Y
6.28913	1241.49
11.7811	1239.66
12.9533	1239.27
14.5365	1238.74
21.6471	1236.38
27.5697	1234.4
28.0365	1234.25
28.6061	1234.04
35.8423	1231.38
42.2702	1229.48
42.9166	1229.29
43.6938	1229.04
51.6734	1226.38
57.3963	1224.47
58.0083	1224.27
58.8558	1223.99
62.5178	1222.77
66.1855	1221.54
87.4233	1219.67
89.4228	1219.49
92.4618	1219.39
193.54	1215.4
222.478	1213.76
250.788	1212.15

270.993	1212.17
299.704	1212.21
343.95	1212.26
395.033	1212.33
448.569	1212.4
490.059	1212.45
545.787	1212.52
584.784	1212.57
642.688	1212.64
679.208	1212.69
739.275	1212.76
773.333	1212.81
835.549	1212.89
867.16	1212.93
931.51	1213.01
960.692	1213.05
1027.16	1213.13
1053.93	1213.16
1122.51	1213.25
1146.87	1213.28
1217.54	1213.37
1239.52	1213.4
1312.27	1213.49
1331.88	1213.52
1343.62	1213.53
1406.61	1213.61
1456.34	1215.34
1489.31	1216.48
1550.64	1218.6
1564.55	1219.09
1576.41	1219.5
1616.77	1220.9
1725.68	1224.67
1734.85	1224.99

1751.25	1224.77
1880.37	1223.01
2053.39	1220.65
2065.64	1220.48
2110.92	1219.86
2137.66	1219.5
2161.21	1219.18
2186.36	1218.84
2237.41	1219.5
2327.98	1220.68
2476	1222.6
2780.56	1219.5
2813.43	1219.16
2818.74	1219.21
2832.46	1219.32
2832.68	1219.32
2834.63	1219.33
2835.13	1219.34
2855.69	1219.5
2900.94	1219.86
3019.32	1220.8
3032.17	1216.55
3052.28	1209.89
3065.57	1205.5
3072.2	1205.32
3145.39	1203.33
3179.6	1202.4
3179.93	1202.39
3180.3	1202.38
3187.48	1202.18
3201.76	1201.8
3229.15	1201.05
3268.94	1199.97
3288.57	1199.43

3338.87	1200.9
3405.9	1202.85

External Boundary

X	Y
1842.37	800
3684.75	800
3684.75	1001.58
3684.75	1203.16
3614.87	1204.43
3418.32	1198.71
3410.04	1201.47
3408.66	1201.93
3405.9	1202.85
3328.75	1228.57
2967.02	1349.15
2726.17	1429.43
2580.1	1432.71
2434.02	1436
2141.34	1436
1978.72	1431.45
1739.67	1407.24
1732.46	1407.44
1669.36	1409.1
1234.23	1409.91
711.358	1411.68
664.71	1396.15
624.341	1395.99
452.918	1353.15
356.179	1328.98
6.28913	1241.49
4.48248	1241.04
3.57634	1240.81

0	1239.93
4.08e-014	1238.85
0	800

Material Boundary

X	Y
3.57634	1240.81
7.22137	1239.6
11.3065	1238.24
12.4789	1237.85
14.0631	1237.32
14.1692	1237.28
21.1739	1234.95
27.0952	1232.98
27.5407	1232.83
28.0893	1232.63
33.2583	1230.73
35.371	1229.96
41.8454	1228.05
42.4671	1227.86
43.2199	1227.61
51.1995	1224.95
56.9228	1223.05
57.5346	1222.85
58.3816	1222.56
60.979	1221.7
65.8782	1220.07
87.2914	1218.18
89.3304	1218
92.4057	1217.89
193.468	1213.9
250.747	1210.65
270.995	1210.67

299.705	1210.71
343.952	1210.76
395.035	1210.83
448.571	1210.9
490.061	1210.95
545.789	1211.02
584.786	1211.07
642.69	1211.14
679.21	1211.19
739.277	1211.26
773.335	1211.31
835.55	1211.39
867.162	1211.43
931.512	1211.51
960.693	1211.55
1027.16	1211.63
1053.93	1211.66
1122.51	1211.75
1146.87	1211.78
1217.54	1211.87
1239.52	1211.9
1312.27	1211.99
1331.88	1212.02
1343.62	1212.03
1406.65	1212.11
1406.67	1212.11
1456.39	1213.84
1489.37	1214.98
1538.79	1216.69
1550.7	1217.1
1564.6	1217.59
1576.46	1218
1616.82	1219.4
1725.73	1223.18

1734.86	1223.49
1751.23	1223.27
1947.06	1220.6
2053.37	1219.15
2065.62	1218.98
2110.9	1218.36
2137.64	1218
2161.19	1217.68
2186.36	1217.34
2237.43	1218
2306.53	1218.9
2476	1221.1
2780.54	1218
2813.43	1217.66
2818.75	1217.71
2832.47	1217.82
2832.49	1217.82
2832.7	1217.82
2834.65	1217.83
2835.14	1217.84
2855.7	1218
2900.95	1218.36
3019.09	1219.3
3023.56	1217.82
3031.7	1215.12
3045.96	1210.4
3065.31	1204
3072.16	1203.82
3145.35	1201.83
3179.56	1200.9
3179.89	1200.89
3180.26	1200.88
3187.43	1200.68
3201.72	1200.3

3229.11	1199.55
3268.9	1198.47
3288.57	1197.93
3338.92	1199.4
3381.34	1200.64
3410.04	1201.47

Material Boundary

X	Y
4.48248	1241.04
11.4647	1238.71
12.637	1238.32
14.2209	1237.79
21.3316	1235.43
27.2534	1233.45
27.706	1233.3
28.2616	1233.1
35.5281	1230.43
41.987	1228.53
42.617	1228.34
43.3779	1228.09
51.2743	1225.46
51.3575	1225.43
57.0806	1223.52
57.6925	1223.32
58.5397	1223.04
62.2581	1221.8
65.9806	1220.56
87.3353	1218.67
89.3612	1218.49
92.4244	1218.39
193.492	1214.4
250.76	1211.15

270.995	1211.17
299.705	1211.21
343.951	1211.26
395.034	1211.33
448.57	1211.4
490.06	1211.45
545.788	1211.52
584.785	1211.57
642.69	1211.64
679.209	1211.69
739.276	1211.76
773.334	1211.81
835.55	1211.89
867.162	1211.93
931.512	1212.01
960.693	1212.05
1027.16	1212.13
1053.93	1212.16
1122.51	1212.25
1146.87	1212.28
1217.54	1212.37
1239.52	1212.4
1312.27	1212.49
1331.88	1212.52
1343.62	1212.53
1406.64	1212.61
1406.65	1212.61
1456.37	1214.34
1489.35	1215.48
1550.68	1217.6
1564.58	1218.09
1576.44	1218.5
1616.81	1219.9
1642.74	1220.8

1725.72	1223.67
1734.86	1223.99
1751.24	1223.77
1921.84	1221.44
2053.37	1219.65
2065.63	1219.48
2110.91	1218.86
2137.65	1218.5
2161.2	1218.18
2186.36	1217.84
2237.42	1218.5
2393.42	1220.53
2476	1221.6
2780.55	1218.5
2813.43	1218.16
2818.75	1218.21
2832.47	1218.32
2832.49	1218.32
2832.69	1218.32
2834.64	1218.33
2835.14	1218.34
2855.7	1218.5
2900.95	1218.86
3019.16	1219.8
3031.85	1215.6
3065.39	1204.5
3072.17	1204.32
3145.36	1202.33
3179.57	1201.4
3179.9	1201.39
3180.27	1201.38
3187.45	1201.18
3201.73	1200.8
3229.12	1200.05

3268.91	1198.97
3288.57	1198.43
3338.9	1199.9
3374.63	1200.94
3408.66	1201.93

Material Boundary

X	Y
6.28913	1241.49
11.7811	1239.66
12.9533	1239.27
14.5365	1238.74
21.6471	1236.38
27.5697	1234.4
28.0365	1234.25
28.6061	1234.04
35.8423	1231.38
42.2702	1229.48
42.9166	1229.29
43.6938	1229.04
51.6734	1226.38
57.3963	1224.47
58.0083	1224.27
58.8558	1223.99
62.5178	1222.77
66.1855	1221.54
87.4233	1219.67
89.4228	1219.49
92.4618	1219.39
193.54	1215.4
222.478	1213.76
250.788	1212.15
270.993	1212.17

299.704	1212.21
343.95	1212.26
395.033	1212.33
448.569	1212.4
490.059	1212.45
545.787	1212.52
584.784	1212.57
642.688	1212.64
679.208	1212.69
739.275	1212.76
773.333	1212.81
835.549	1212.89
867.16	1212.93
931.51	1213.01
960.692	1213.05
1027.16	1213.13
1053.93	1213.16
1122.51	1213.25
1146.87	1213.28
1217.54	1213.37
1239.52	1213.4
1312.27	1213.49
1331.88	1213.52
1343.62	1213.53
1406.61	1213.61
1456.34	1215.34
1489.31	1216.48
1550.64	1218.6
1564.55	1219.09
1576.41	1219.5
1616.77	1220.9
1725.68	1224.67
1734.85	1224.99
1751.25	1224.77

1880.37	1223.01
2053.39	1220.65
2065.64	1220.48
2110.92	1219.86
2137.66	1219.5
2161.21	1219.18
2186.36	1218.84
2237.41	1219.5
2327.98	1220.68
2476	1222.6
2780.56	1219.5
2813.43	1219.16
2818.74	1219.21
2832.46	1219.32
2832.48	1219.32
2832.68	1219.32
2834.63	1219.33
2835.13	1219.34
2855.69	1219.5
2900.94	1219.86
3019.32	1220.8
3032.17	1216.55
3052.28	1209.89
3065.57	1205.5
3072.2	1205.32
3145.39	1203.33
3179.6	1202.4
3179.93	1202.39
3180.3	1202.38
3187.48	1202.18
3201.76	1201.8
3229.15	1201.05
3268.94	1199.97
3288.57	1199.43

3338.87	1200.9
3405.9	1202.85

Material Boundary

X	Y
4.08e-014	1238.85
34.4284	1227.11
65.2636	1217.11
81.2266	1215.8
92.2935	1214.89
133.788	1213.25
193.324	1210.91
221.882	1209.28
250.644	1207.65
565.291	1208.05
804.446	1208.35
993.933	1208.59
1122.51	1208.75
1146.88	1208.78
1375.18	1209.07
1405.98	1209.07
1489.47	1211.98
1616.93	1216.4
1698.14	1219.22
1730.36	1220.34
1902.26	1218.21
2129.7	1215.11
2137.6	1215
2186.36	1214.34
2476.01	1218.1
2779.83	1215.01
2780.51	1215
2878.35	1215.18

3018.61	1216.29
3039.13	1209.51
3048.27	1206.48
3064.78	1201.02
3167.41	1198.23
3288.58	1194.93
3391.71	1197.94
3418.32	1198.71

Material Boundary

X	Y
1405.98	1209.07
2095.19	1209
2871.02	1209
3039.13	1209.51

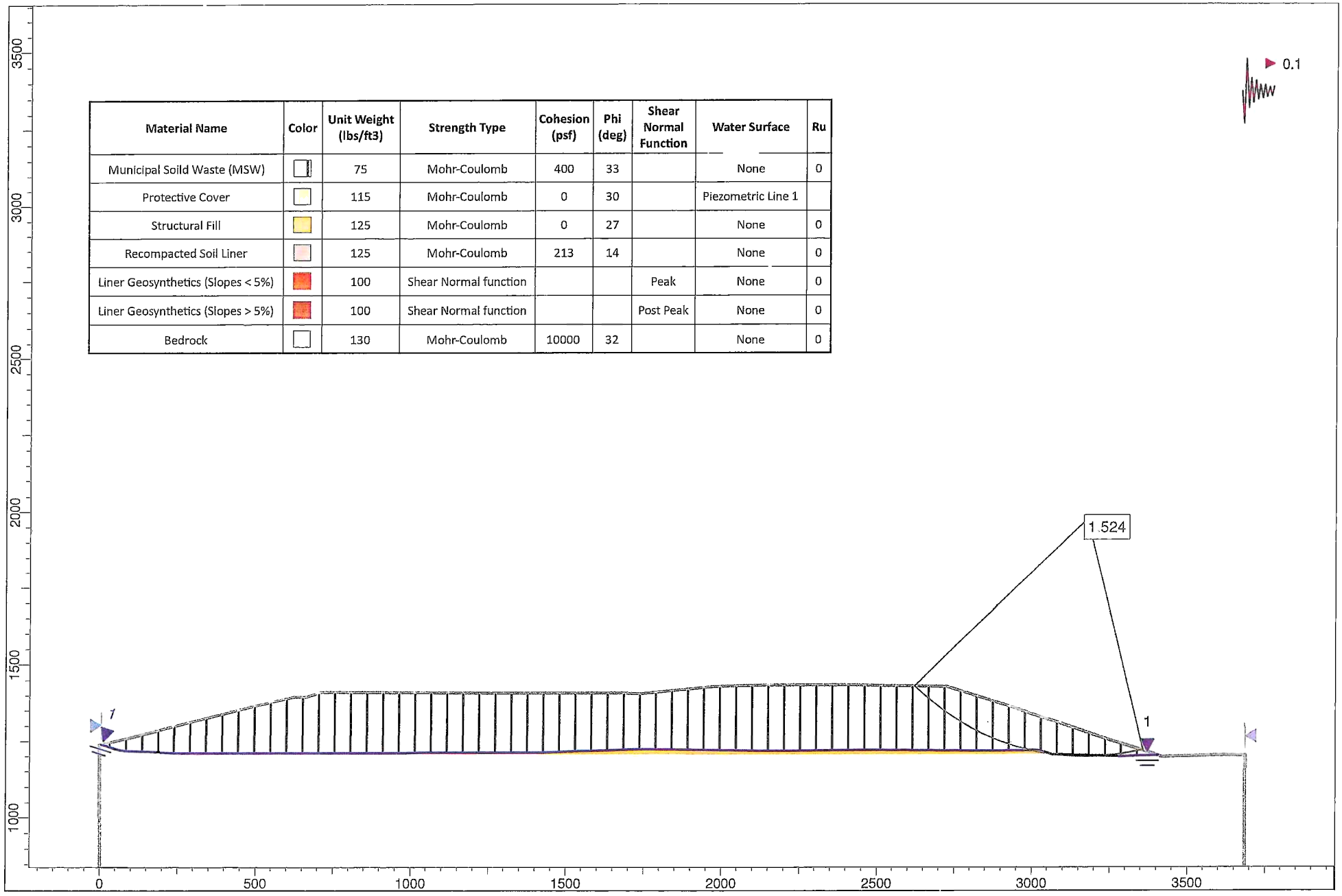
Material Boundary

X	Y
3019.09	1219.3
3019.16	1219.8

Material Boundary

X	Y
3065.31	1204
3065.39	1204.5

Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)	Shear Normal Function	Water Surface	Ru
Municipal Soild Waste (MSW)		75	Mohr-Coulomb	400	33		None	0
Protective Cover		115	Mohr-Coulomb	0	30		Piezometric Line 1	
Structural Fill		125	Mohr-Coulomb	0	27		None	0
Recompacted Soil Liner		125	Mohr-Coulomb	213	14		None	0
Liner Geosynthetics (Slopes < 5%)		100	Shear Normal function			Peak	None	0
Liner Geosynthetics (Slopes > 5%)		100	Shear Normal function			Post Peak	None	0
Bedrock		130	Mohr-Coulomb	10000	32		None	0



Slide Analysis Information

SLIDE - An Interactive Slope Stability Program

Project Summary

File Name: C-C – seismic – rotational -- undrained-rev1.slim
Slide Modeler Version: 6.023
Project Title: SLIDE - An Interactive Slope Stability Program
Date Created: 10/19/2011, 7:30:21 AM

General Settings

Units of Measurement: Imperial Units
Time Units: days
Permeability Units: feet/second
Failure Direction: Left to Right
Data Output: Standard
Maximum Material Properties: 20
Maximum Support Properties: 20

Analysis Options

Analysis Methods Used

Spencer

Number of slices: 25
Tolerance: 0.005
Maximum number of iterations: 50
Check malpha < 0.2: Yes
Initial trial value of FS: 1
Steffensen Iteration: Yes

Groundwater Analysis

Groundwater Method: Water Surfaces
Pore Fluid Unit Weight: 62.4 lbs/ft3
Advanced Groundwater Method: None

Random Numbers

Pseudo-random Seed: 10116
Random Number Generation Method: Park and Miller v.3

Surface Options

Surface Type: Circular
Search Method: Auto Refine Search
Divisions along slope: 20
Circles per division: 10
Number of iterations: 10
Divisions to use in next iteration: 50%
Composite Surfaces: Disabled
Minimum Elevation: Not Defined
Minimum Depth: 4

Loading

Seismic Load Coefficient (Horizontal): 0.1

Material Properties

Property	Municipal Soild Waste (MSW)	Protective Cover	Structural Fill	Recompacted Soil Liner	Liner Geosynthetics (Slopes	Liner Geosynthetics (Slopes > 5%)	Bedrock
Color							

Strength Type	Mohr-Coulomb	Mohr-Coulomb	Mohr-Coulomb	Mohr-Coulomb	Shear Normal function	Shear Normal function	Mohr-Coulomb
Unit Weight [lbs/ft3]	75	115	125	125	100	100	130
Cohesion [psf]	400	0	0	213			10000
Friction Angle [deg]	33	30	27	14			32
Water Surface	None	Piezometric Line 1	None	None	None	None	None
Hu Value		1					
Ru Value	0		0	0	0	0	0

Shear Normal Functions

Name. Peak

Normal (psf)	Shear (psf)
0	0
3000	1250
6000	2000
13500	3500

Name. Post Peak

Normal (psf)	Shear (psf)
0	0
3000	875
6000	1290
13500	2100

Global Minimums

Method: spencer

FS: 1.524430
Center: 3177.375, 1975.194
Radius: 777.657
Left Slip Surface Endpoint: 2621.080, 1431.792
Right Slip Surface Endpoint: 3358.026, 1218.811

Resisting Moment=2.00478e+009 lb-ft
Driving Moment=1.3151e+009 lb-ft
Resisting Horizontal Force=2.38359e+006 lb
Driving Horizontal Force=1.56359e+006 lb
Total Slice Area=62543 ft2

Valid / Invalid Surfaces

Method: spencer

Number of Valid Surfaces: 14579
Number of Invalid Surfaces: 0

Slice Data

Global Minimum Query (spencer) - Safety Factor: 1.52443

Slice Number	Width [ft]	Weight [lbs]	Base Material	Base Cohesion [psf]	Base Friction Angle [degrees]	Shear Stress [psf]	Shear Strength [psf]	Base Normal Stress [psf]	Pore Pressure [psf]	Effective Normal Stress [psf]
1	46.0582	73275.8	Municipal Soild Waste (MSW)	400	33	627.921	957.222	858.047	0	858.047
2	46.0582	208783	Municipal Soild Waste (MSW)	400	33	1468.77	2239.04	2831.87	0	2831.87
3	46.0582	311320	Municipal Soild Waste (MSW)	400	33	2209.81	3368.7	4571.4	0	4571.4
4	46.0582	362060	Municipal Soild Waste (MSW)	400	33	2681.99	4088.5	5679.79	0	5679.79
5	46.0582	395970	Municipal Soild Waste (MSW)	400	33	3073.86	4685.88	6599.68	0	6599.68
6	46.0582	416591	Municipal Soild Waste (MSW)	400	33	3394.67	5174.93	7352.74	0	7352.74
7	46.0582	425090	Municipal Soild Waste (MSW)	400	33	3640.62	5549.87	7930.1	0	7930.1
8	46.0582	422337	Municipal Soild Waste (MSW)	400	33	3806.97	5803.46	8320.61	0	8320.61
9	3.93609	35770.6	Protective Cover	0	30	3164.99	4824.8	8388.01	31.201	8356.81
10	2.00084	18196.4	Liner Geosynthetics (Slopes < 5%)	800	11.31	1597.84	2435.79	8178.98	0	8178.98
11	12.505	114059	Recompacted Soil Liner	213	14	1485.78	2264.96	8230.01	0	8230.01
12	28.3152	256926	Structural Fill	0	27	2866.85	4370.31	8577.23	0	8577.23
13	19.7876	171852	Recompacted Soil Liner	213	14	1466.21	2235.13	8110.3	0	8110.3
14	3.01038	25464.5	Liner Geosynthetics (Slopes > 5%)	642	6.16405	977.902	1490.74	7858.73	0	7858.73
15	5.82497	48761.8	Protective Cover	0	30	3143.77	4792.46	8333.64	32.8631	8300.78
16	1.6543	13728	Municipal Soild Waste (MSW)	400	33	3875.47	5907.89	8481.41	0	8481.41

17	9.03047	74415.9	Protective Cover	0	30	3126.09	4765.5	8285.29	31.2115	8254.08
18	4.92491	40201.3	Liner Geosynthetics (Slopes < 5%)	800	11.31	1554.87	2370.29	7851.43	0	7851.43
19	42.5624	333270	Recompacted Soil Liner	213	14	1388.89	2117.26	7637.58	0	7637.58
20	66.3251	448858	Recompacted Soil Liner	213	14	1268.1	1933.13	6899.07	0	6899.07
21	42.7253	227646	Recompacted Soil Liner	213	14	1071.29	1633.11	5695.75	0	5695.75
22	4.95209	22622.5	Liner Geosynthetics (Slopes < 5%)	500	14.0363	1164.16	1774.68	5098.72	0	5098.72
23	9.08483	39288.2	Protective Cover	0	30	1999.41	3047.96	5310.44	31.2115	5279.23
24	55.9204	178979	Municipal Soild Waste (MSW)	400	33	2156.04	3286.73	4445.18	0	4445.18
25	55.9204	62587	Municipal Soild Waste (MSW)	400	33	1060.44	1616.57	1873.35	0	1873.35

Interslice Data

Global Minimum Query (spencer) - Safety Factor: 1.52443

Slice Number	X coordinate [ft]	Y coordinate - Bottom [ft]	Interslice Normal Force [lbs]	Interslice Shear Force [lbs]	Interslice Force Angle [degrees]
1	2621.08	1431.79	0	0	0
2	2667.14	1388.33	15667.5	6419.13	22.2794
3	2713.2	1351.26	73792.3	30233.5	22.2794
4	2759.25	1319.51	148211	60723.6	22.2794
5	2805.31	1292.32	215187	88164.2	22.2794
6	2851.37	1269.17	265832	108914	22.2794
7	2897.43	1249.67	294319	120586	22.2795
8	2943.49	1233.54	296886	121637	22.2794
9	2989.55	1220.56	271601	111278	22.2795
10	2993.48	1219.59	270834	110963	22.2793
11	2995.48	1219.11	273413	112020	22.2794
12	3007.99	1216.21	290081	118849	22.2794
13	3036.3	1210.44	283995	116356	22.2795
14	3056.09	1207.05	299604	122751	22.2794
15	3059.1	1206.58	302891	124098	22.2795
16	3064.93	1205.71	296717	121568	22.2794
17	3066.58	1205.47	293707	120335	22.2795
18	3075.61	1204.22	283211	116035	22.2795

19	3080.54	1203.59	284544	116581	22.2795
20	3123.1	1199.43	290441	118997	22.2795
21	3189.42	1197.63	263570	107987	22.2794
22	3232.15	1199.47	230046	94252.1	22.2794
23	3237.1	1199.83	224673	92050.8	22.2794
24	3246.18	1200.59	206417	84571.3	22.2794
25	3302.11	1207.61	72424.3	29673	22.2794
26	3358.03	1218.81	0	0	0

List Of Coordinates

Piezoline

X	Y
6.28913	1241.49
11.4859	1239.76
12.9533	1239.27
14.5365	1238.74
21.6471	1236.38
27.5697	1234.4
28.0365	1234.25
28.6061	1234.04
35.8423	1231.38
42.2702	1229.48
42.9166	1229.29
43.6938	1229.04
51.6734	1226.38
57.3963	1224.47
58.8558	1223.99
62.5178	1222.77
66.1855	1221.54
87.4233	1219.67
89.4228	1219.49
92.4618	1219.39

193.54	1215.4
222.478	1213.76
250.788	1212.15
270.993	1212.17
299.704	1212.21
343.95	1212.26
395.033	1212.33
448.569	1212.4
490.059	1212.45
545.787	1212.52
584.784	1212.57
642.688	1212.64
679.208	1212.69
739.275	1212.76
773.333	1212.81
835.549	1212.89
867.16	1212.93
931.51	1213.01
960.692	1213.05
1027.16	1213.13
1053.93	1213.16
1122.51	1213.25
1146.87	1213.28
1217.54	1213.37
1239.52	1213.4
1312.27	1213.49
1331.88	1213.52
1343.62	1213.53
1406.61	1213.61
1456.34	1215.34
1489.31	1216.48
1550.64	1218.6
1564.55	1219.09
1576.41	1219.5

1616.77	1220.9
1725.68	1224.67
1734.85	1224.99
1751.25	1224.77
1880.37	1223.01
2053.39	1220.65
2065.64	1220.48
2110.92	1219.86
2137.66	1219.5
2161.21	1219.18
2186.36	1218.84
2237.41	1219.5
2327.98	1220.68
2476	1222.6
2780.56	1219.5
2813.43	1219.16
2818.74	1219.21
2832.48	1219.32
2832.68	1219.32
2834.63	1219.33
2835.13	1219.34
2855.69	1219.5
2900.94	1219.86
3019.32	1220.8
3032.17	1216.55
3052.28	1209.89
3065.57	1205.5
3072.2	1205.32
3145.39	1203.33
3179.6	1202.4
3179.93	1202.39
3180.3	1202.38
3187.48	1202.18
3201.76	1201.8

3229.15	1201.05
3268.94	1199.97
3288.57	1199.43
3338.87	1200.9
3405.9	1202.85

External Boundary

X	Y
1842.37	800
3684.75	800
3684.75	1001.58
3684.75	1203.16
3614.87	1204.43
3418.32	1198.71
3410.04	1201.47
3408.66	1201.93
3405.9	1202.85
3328.75	1228.57
2967.02	1349.15
2726.17	1429.43
2580.1	1432.71
2434.02	1436
2141.34	1436
1978.72	1431.45
1739.67	1407.24
1732.46	1407.44
1669.36	1409.1
1234.23	1409.91
711.358	1411.68
664.71	1396.15
624.341	1395.99
452.918	1353.15
356.179	1328.98

6.28913	1241.49
4.48248	1241.04
3.57634	1240.81
0	1239.93
4.08e-014	1238.85
0	800

Material Boundary

X	Y
3.57634	1240.81
7.22137	1239.6
11.3065	1238.24
12.4789	1237.85
14.0631	1237.32
14.1692	1237.28
21.1739	1234.95
27.0952	1232.98
27.5407	1232.83
28.0893	1232.63
33.2583	1230.73
35.371	1229.96
41.8454	1228.05
42.4671	1227.86
43.2199	1227.61
51.1995	1224.95
56.9228	1223.05
57.5346	1222.85
58.3816	1222.56
60.979	1221.7
65.8782	1220.07
87.2914	1218.18
89.3304	1218
92.4057	1217.89

193.468	1213.9
250.747	1210.65
270.995	1210.67
299.705	1210.71
343.952	1210.76
395.035	1210.83
448.571	1210.9
490.061	1210.95
545.789	1211.02
584.786	1211.07
642.69	1211.14
679.21	1211.19
739.277	1211.26
773.335	1211.31
835.55	1211.39
867.162	1211.43
931.512	1211.51
960.693	1211.55
1027.16	1211.63
1053.93	1211.66
1122.51	1211.75
1146.87	1211.78
1217.54	1211.87
1239.52	1211.9
1312.27	1211.99
1331.88	1212.02
1343.62	1212.03
1406.65	1212.11
1406.67	1212.11
1456.39	1213.84
1489.37	1214.98
1538.79	1216.69
1550.7	1217.1
1564.6	1217.59

1576.46	1218
1616.82	1219.4
1725.73	1223.18
1734.86	1223.49
1751.23	1223.27
1947.06	1220.6
2053.37	1219.15
2065.62	1218.98
2110.9	1218.36
2137.64	1218
2161.19	1217.68
2186.36	1217.34
2237.43	1218
2306.53	1218.9
2476	1221.1
2780.54	1218
2813.43	1217.66
2818.75	1217.71
2832.47	1217.82
2832.49	1217.82
2832.7	1217.82
2834.65	1217.83
2835.14	1217.84
2855.7	1218
2900.95	1218.36
3019.09	1219.3
3023.56	1217.82
3031.7	1215.12
3045.96	1210.4
3065.31	1204
3072.16	1203.82
3145.35	1201.83
3179.56	1200.9
3179.89	1200.89

3180.26	1200.88
3187.43	1200.68
3201.72	1200.3
3229.11	1199.55
3268.9	1198.47
3288.57	1197.93
3338.92	1199.4
3381.34	1200.64
3410.04	1201.47

Material Boundary

X	Y
4.48248	1241.04
11.4647	1238.71
12.637	1238.32
14.2209	1237.79
21.3316	1235.43
27.2534	1233.45
27.706	1233.3
28.2616	1233.1
35.5281	1230.43
41.987	1228.53
42.617	1228.34
43.3779	1228.09
51.2743	1225.46
51.3575	1225.43
57.0806	1223.52
57.6925	1223.32
58.5397	1223.04
62.2581	1221.8
65.9806	1220.56
87.3353	1218.67
89.3612	1218.49

92.4244	1218.39
193.492	1214.4
250.76	1211.15
270.995	1211.17
299.705	1211.21
343.951	1211.26
395.034	1211.33
448.57	1211.4
490.06	1211.45
545.788	1211.52
584.785	1211.57
642.69	1211.64
679.209	1211.69
739.276	1211.76
773.334	1211.81
835.55	1211.89
867.162	1211.93
931.512	1212.01
960.693	1212.05
1027.16	1212.13
1053.93	1212.16
1122.51	1212.25
1146.87	1212.28
1217.54	1212.37
1239.52	1212.4
1312.27	1212.49
1331.88	1212.52
1343.62	1212.53
1406.64	1212.61
1406.65	1212.61
1456.37	1214.34
1489.35	1215.48
1550.68	1217.6
1564.58	1218.09

1576.44	1218.5
1616.81	1219.9
1642.74	1220.8
1725.72	1223.67
1734.86	1223.99
1751.24	1223.77
1921.84	1221.44
2053.37	1219.65
2065.63	1219.48
2110.91	1218.86
2137.65	1218.5
2161.2	1218.18
2186.36	1217.84
2237.42	1218.5
2393.42	1220.53
2476	1221.6
2780.55	1218.5
2813.43	1218.16
2818.75	1218.21
2832.47	1218.32
2832.49	1218.32
2832.69	1218.32
2834.64	1218.33
2835.14	1218.34
2855.7	1218.5
2900.95	1218.86
3019.16	1219.8
3031.85	1215.6
3065.39	1204.5
3072.17	1204.32
3145.36	1202.33
3179.57	1201.4
3179.9	1201.39
3180.27	1201.38

3187.45	1201.18
3201.73	1200.8
3229.12	1200.05
3268.91	1198.97
3288.57	1198.43
3338.9	1199.9
3374.63	1200.94
3408.66	1201.93

Material Boundary

X	Y
6.28913	1241.49
11.7811	1239.66
12.9533	1239.27
14.5365	1238.74
21.6471	1236.38
27.5697	1234.4
28.0365	1234.25
28.6061	1234.04
35.8423	1231.38
42.2702	1229.48
42.9166	1229.29
43.6938	1229.04
51.6734	1226.38
57.3963	1224.47
58.0083	1224.27
58.8558	1223.99
62.5178	1222.77
66.1855	1221.54
87.4233	1219.67
89.4228	1219.49
92.4618	1219.39
193.54	1215.4

222.478	1213.76
250.788	1212.15
270.993	1212.17
299.704	1212.21
343.95	1212.26
395.033	1212.33
448.569	1212.4
490.059	1212.45
545.787	1212.52
584.784	1212.57
642.688	1212.64
679.208	1212.69
739.275	1212.76
773.333	1212.81
835.549	1212.89
867.16	1212.93
931.51	1213.01
960.692	1213.05
1027.16	1213.13
1053.93	1213.16
1122.51	1213.25
1146.87	1213.28
1217.54	1213.37
1239.52	1213.4
1312.27	1213.49
1331.88	1213.52
1343.62	1213.53
1406.61	1213.61
1456.34	1215.34
1489.31	1216.48
1550.64	1218.6
1564.55	1219.09
1576.41	1219.5
1616.77	1220.9

1725.68	1224.67
1734.85	1224.99
1751.25	1224.77
1880.37	1223.01
2053.39	1220.65
2065.64	1220.48
2110.92	1219.86
2137.66	1219.5
2161.21	1219.18
2186.36	1218.84
2237.41	1219.5
2327.98	1220.68
2476	1222.6
2780.56	1219.5
2813.43	1219.16
2818.74	1219.21
2832.46	1219.32
2832.48	1219.32
2832.68	1219.32
2834.63	1219.33
2835.13	1219.34
2855.69	1219.5
2900.94	1219.86
3019.32	1220.8
3032.17	1216.55
3052.28	1209.89
3065.57	1205.5
3072.2	1205.32
3145.39	1203.33
3179.6	1202.4
3179.93	1202.39
3180.3	1202.38
3187.48	1202.18
3201.76	1201.8

3229.15	1201.05
3268.94	1199.97
3288.57	1199.43
3338.87	1200.9
3405.9	1202.85

Material Boundary

X	Y
4.08e-014	1238.85
34.4284	1227.11
65.2636	1217.11
81.2266	1215.8
92.2935	1214.89
133.788	1213.25
193.324	1210.91
221.882	1209.28
250.644	1207.65
565.291	1208.05
804.446	1208.35
993.933	1208.59
1122.51	1208.75
1146.88	1208.78
1375.18	1209.07
1405.98	1209.07
1489.47	1211.98
1616.93	1216.4
1698.14	1219.22
1730.36	1220.34
1902.26	1218.21
2129.7	1215.11
2137.6	1215
2186.36	1214.34
2476.01	1218.1

2779.83	1215.01
2780.51	1215
2878.35	1215.18
3018.61	1216.29
3039.13	1209.51
3048.27	1206.48
3064.78	1201.02
3167.41	1198.23
3288.58	1194.93
3391.71	1197.94
3418.32	1198.71

Material Boundary

X	Y
1405.98	1209.07
2095.19	1209
2871.02	1209
3039.13	1209.51

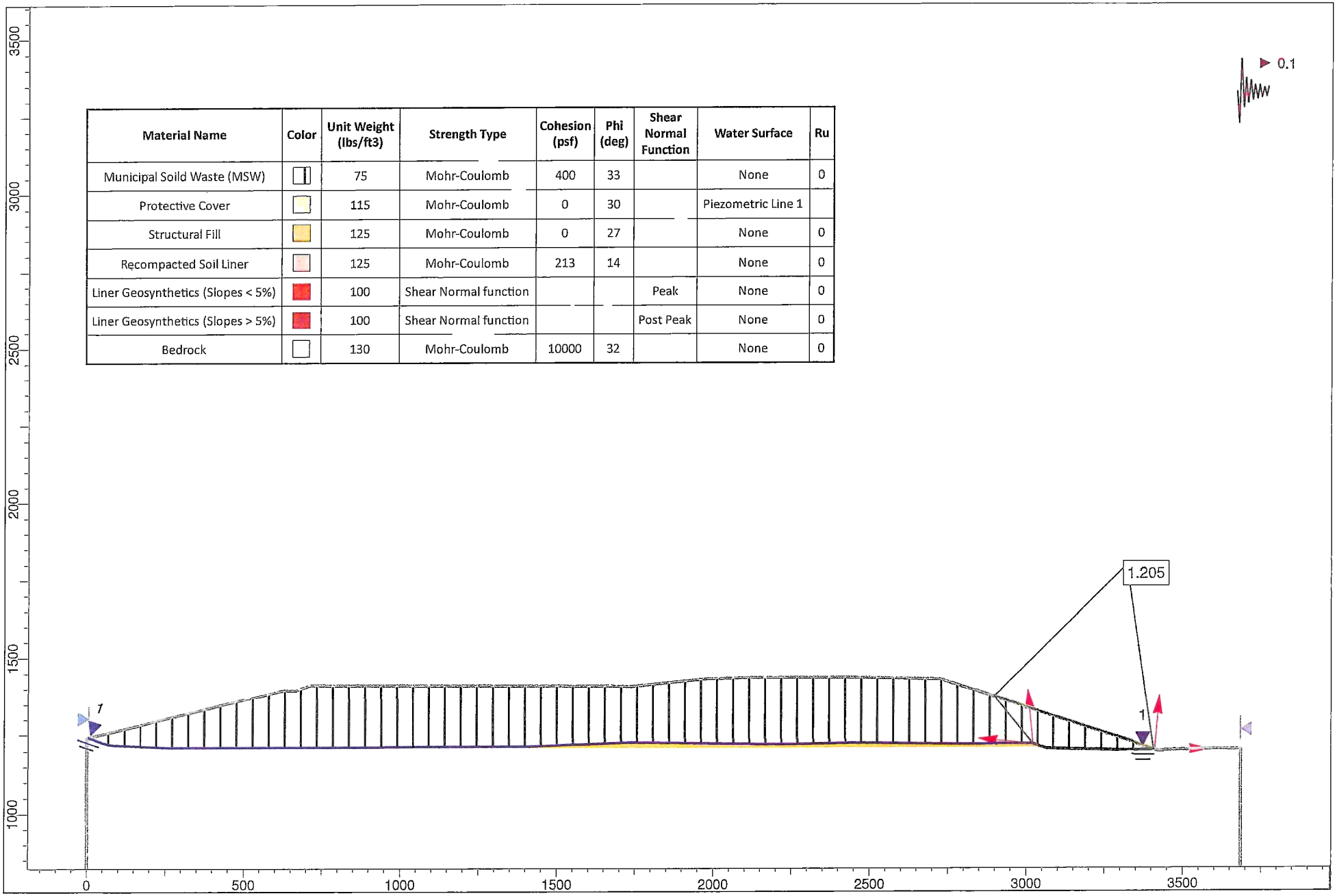
Material Boundary

X	Y
3019.09	1219.3
3019.16	1219.8

Material Boundary

X	Y
3065.31	1204
3065.39	1204.5

Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)	Shear Normal Function	Water Surface	Ru
Municipal Soild Waste (MSW)		75	Mohr-Coulomb	400	33		None	0
Protective Cover		115	Mohr-Coulomb	0	30		Piezometric Line 1	
Structural Fill		125	Mohr-Coulomb	0	27		None	0
Recompacted Soil Liner		125	Mohr-Coulomb	213	14		None	0
Liner Geosynthetics (Slopes < 5%)		100	Shear Normal function			Peak	None	0
Liner Geosynthetics (Slopes > 5%)		100	Shear Normal function			Post Peak	None	0
Bedrock		130	Mohr-Coulomb	10000	32		None	0



Slide Analysis Information

SLIDE - An Interactive Slope Stability Program

Project Summary

File Name: C-C -- seismic -- translational -- undrained-rev1.slim
Slide Modeler Version: 6.023
Project Title: SLIDE - An Interactive Slope Stability Program
Date Created: 10/19/2011, 7:30:21 AM

General Settings

Units of Measurement: Imperial Units
Time Units: days
Permeability Units: feet/second
Failure Direction: Left to Right
Data Output: Standard
Maximum Material Properties: 20
Maximum Support Properties: 20

Analysis Options

Analysis Methods Used

Spencer

Number of slices: 25
Tolerance: 0.005
Maximum number of iterations: 50
Check malpha < 0.2: Yes
Initial trial value of FS: 1
Steffensen Iteration: Yes

Groundwater Analysis

Groundwater Method: Water Surfaces
Pore Fluid Unit Weight: 62.4 lbs/ft3
Advanced Groundwater Method: None

Random Numbers

Pseudo-random Seed: 10116
Random Number Generation Method: Park and Miller v.3

Surface Options

Surface Type: Non-Circular Block Search
Number of Surfaces: 5000
Pseudo-Random Surfaces: Enabled
Convex Surfaces Only: Disabled
Left Projection Angle (Start Angle): 175
Left Projection Angle (End Angle): 95
Right Projection Angle (Start Angle): 0
Right Projection Angle (End Angle): 85
Minimum Elevation: Not Defined
Minimum Depth: Not Defined

Loading

Seismic Load Coefficient (Horizontal): 0.1

Material Properties

Property	Municipal Soild Waste (MSW)	Protective Cover	Structural Fill	Recompacted Soil Liner	Liner Geosynthetics (Slopes	Liner Geosynthetics (Slopes > 5%)	Bedrock
Color							

Strength Type	Mohr-Coulomb	Mohr-Coulomb	Mohr-Coulomb	Mohr-Coulomb	Shear Normal function	Shear Normal function	Mohr-Coulomb
Unit Weight [lbs/ft3]	75	115	125	125	100	100	130
Cohesion [psf]	400	0	0	213			10000
Friction Angle [deg]	33	30	27	14			32
Water Surface	None	Piezometric Line 1	None	None	None	None	None
Hu Value		1					
Ru Value	0		0	0	0	0	0

Shear Normal Functions

Name. Peak

Normal (psf)	Shear (psf)
0	0
3000	1250
6000	2000
13500	3500

Name Post Peak

Normal (psf)	Shear (psf)
0	0
3000	875
6000	1290
13500	2100

Global Minimums

Method: spencer

FS: 1.204810
Axis Location: 3321.323, 1796.523
Left Slip Surface Endpoint: 2897.215, 1372.414
Right Slip Surface Endpoint: 3406.145, 1202.771

Resisting Moment=5.61456e+008 lb-ft
Driving Moment=4.66011e+008 lb-ft
Resisting Horizontal Force=811548 lb
Driving Horizontal Force=673589 lb
Total Slice Area=32016.4 ft2

Global Minimum Coordinates

Method: spencer

X	Y
2897.21	1372.41
3019.98	1219.31
3065.35	1204.24
3072.17	1204.05
3145.35	1202.07
3179.55	1201.13
3180.27	1201.13
3187.46	1200.94
3201.73	1200.53
3229.11	1199.79
3268.92	1198.7
3288.59	1198.19
3338.93	1199.66
3405.11	1201.6
3406.14	1202.77

Valid / Invalid Surfaces

Method: spencer

Number of Valid Surfaces: 2797
Number of Invalid Surfaces: 2204

Error Codes:

Error Code -106 reported for 6 surfaces
Error Code -108 reported for 830 surfaces
Error Code -110 reported for 85 surfaces
Error Code -111 reported for 227 surfaces
Error Code -112 reported for 1056 surfaces

Error Codes

The following errors were encountered during the computation:

-106 = Average slice width is less than 0.0001 * (maximum horizontal extent of soil region). This limitation is imposed to avoid numerical errors which may result from too many slices, or too small a slip region.
-108 = Total driving moment or total driving force < 0.1. This is to limit the calculation of extremely high safety factors if the driving force is very small (0.1 is an arbitrary number).
-110 = The water table or a piezoline does not span the slip region for a given slip surface, when Water Surfaces is specified as the method of pore pressure calculation. If this error occurs, check that the water table or piezoline(s) span the appropriate soil cells.
-111 = safety factor equation did not converge
-112 = The coefficient M-Alpha = cos(alpha)(1+tan(alpha)tan(phi)/F) < 0.2 for the final iteration of the safety factor calculation. This screens out some slip surfaces which may not be valid in the context of the analysis, in particular, deep seated slip surfaces with many high negative base angle slices in the passive zone.

Slice Data

Global Minimum Query (spencer) - Safety Factor: 1.20481

Slice Number	Width [ft]	Weight [lbs]	Base Material	Base Cohesion [psf]	Base Friction Angle [degrees]	Shear Stress [psf]	Shear Strength [psf]	Base Normal Stress [psf]	Pore Pressure [psf]	Effective Normal Stress [psf]
1	30.3946	31656.4	Municipal Soild Waste (MSW)	400	33	528.774	637.072	365.059	0	365.059
2	30.3946	94969.3	Municipal Soild Waste (MSW)	400	33	1076.71	1297.23	1381.61	0	1381.61
3	30.3946	158282	Municipal Soild Waste (MSW)	400	33	1624.65	1957.39	2398.16	0	2398.16
4	30.3946	221595	Municipal Soild Waste (MSW)	400	33	2172.58	2617.55	3414.72	0	3414.72
5	0.954428	8005.25	Protective Cover	0	30	2003.01	2413.25	4217.25	37.3726	4179.87
6	0.235547	1990.48	Liner Geosynthetics (Slopes > 5%)	460	7.87594	973.641	1173.05	5154.58	0	5154.58
7	22.6823	191904	Liner Geosynthetics (Slopes > 5%)	642	6.16405	1178.55	1419.93	7203.01	0	7203.01
8	22.6823	191874	Liner Geosynthetics (Slopes > 5%)	642	6.16405	1178.45	1419.8	7201.88	0	7201.88
9	6.82228	57157.2	Liner Geosynthetics (Slopes < 5%)	800	11.31	2117.57	2551.27	8756.37	0	8756.37
10	24.3933	195627	Liner Geosynthetics (Slopes < 5%)	800	11.31	2058.06	2479.57	8397.82	0	8397.82

11	24.3933	181958	Liner Geosynthetics (Slopes < 5%)	800	11.31	1963.86	2366.08	7830.42	0	7830.42
12	24.3933	168289	Liner Geosynthetics (Slopes < 5%)	800	11.31	1869.66	2252.59	7262.97	0	7262.97
13	34.203	212967	Liner Geosynthetics (Slopes < 5%)	800	11.31	1756.36	2116.08	6580.4	0	6580.4
14	0.716	4170.78	Liner Geosynthetics (Slopes < 5%)	800	11.31	1709.8	2059.98	6299.92	0	6299.92
15	7.19	41222	Liner Geosynthetics (Slopes < 5%)	800	11.31	1673.82	2016.64	6083.21	0	6083.21
16	14.269	78309.9	Liner Geosynthetics (Slopes < 5%)	500	14.0363	1623.2	1955.65	5822.6	0	5822.6
17	27.379	137198	Liner Geosynthetics (Slopes < 5%)	500	14.0363	1523.09	1835.03	5340.11	0	5340.11
18	39.817	168805	Liner Geosynthetics (Slopes < 5%)	500	14.0363	1357.89	1636	4543.98	0	4543.98
19	19.67	69938.1	Liner Geosynthetics (Slopes < 5%)	500	14.0363	1212.47	1460.8	3843.19	0	3843.19
20	25.1685	75162.6	Liner Geosynthetics (Slopes < 5%)	500	14.0363	1121.94	1351.73	3406.91	0	3406.91
21	25.1685	57936.2	Liner Geosynthetics (Slopes < 5%)	2.27374e-013	22.6199	915.132	1102.56	2646.14	0	2646.14
22	33.0899	49955.9	Liner Geosynthetics (Slopes < 5%)	1.13687e-013	22.6199	600.207	723.135	1735.52	0	1735.52
23	33.0899	20174.2	Liner Geosynthetics (Slopes < 5%)	0	22.6199	242.388	292.031	700.874	0	700.874
24	0.208467	30.2906	Liner Geosynthetics (Slopes < 5%)	0	22.6199	254.198	306.26	735.023	0	735.023
25	0.825431	55.061	Protective Cover	0	30	359.886	433.594	784.944	33.9377	751.006

Interslice Data

Global Minimum Query (spencer) - Safety Factor: 1.20481

Slice Number	X coordinate [ft]	Y coordinate - Bottom [ft]	Interslice Normal Force [lbs]	Interslice Shear Force [lbs]	Interslice Force Angle [degrees]
1	2897.21	1372.41	0	0	0
2	2927.61	1334.51	989.516	417.796	22.8906
3	2958	1296.6	30249	12771.8	22.8906
4	2988.4	1258.7	87778.4	37062	22.8906
5	3018.79	1220.79	173578	73288.4	22.8905
6	3019.75	1219.6	177493	74941.5	22.8906
7	3019.98	1219.31	178978	75568.4	22.8905
8	3042.67	1211.78	225796	95336	22.8905
9	3065.35	1204.24	272605	115100	22.8906
10	3072.17	1204.05	265586	112136	22.8905
11	3096.56	1203.39	240676	101619	22.8906
12	3120.96	1202.73	216313	91332.1	22.8905

13	3145.35	1202.07	192498	81276.8	22.8905
14	3179.55	1201.13	160111	67602.5	22.8906
15	3180.27	1201.13	159308	67263.5	22.8906
16	3187.46	1200.94	152613	64436.8	22.8906
17	3201.73	1200.53	139783	59019.5	22.8906
18	3229.11	1199.79	115899	48935.3	22.8906
19	3268.92	1198.7	83843.1	35400.4	22.8905
20	3288.59	1198.19	69037.7	29149.2	22.8905
21	3313.76	1198.92	45912.6	19385.3	22.8905
22	3338.93	1199.66	26810.8	11320.1	22.8905
23	3372.02	1200.63	10336.3	4364.22	22.8906
24	3405.11	1201.6	3683.25	1555.15	22.8906
25	3405.32	1201.83	3459.51	1460.68	22.8905
26	3406.14	1202.77	0	0	0

List Of Coordinates

Piezoline

X	Y
6.28913	1241.49
11.4859	1239.76
12.9533	1239.27
14.5365	1238.74
21.6471	1236.38
27.5697	1234.4
28.0365	1234.25
28.6061	1234.04
35.8423	1231.38
42.2702	1229.48
42.9166	1229.29
43.6938	1229.04
51.6734	1226.38
57.3963	1224.47

58.8558	1223.99
62.5178	1222.77
66.1855	1221.54
87.4233	1219.67
89.4228	1219.49
92.4618	1219.39
193.54	1215.4
222.478	1213.76
250.788	1212.15
270.993	1212.17
299.704	1212.21
343.95	1212.26
395.033	1212.33
448.569	1212.4
490.059	1212.45
545.787	1212.52
584.784	1212.57
642.688	1212.64
679.208	1212.69
739.275	1212.76
773.333	1212.81
835.549	1212.89
867.16	1212.93
931.51	1213.01
960.692	1213.05
1027.16	1213.13
1053.93	1213.16
1122.51	1213.25
1146.87	1213.28
1217.54	1213.37
1239.52	1213.4
1312.27	1213.49
1331.88	1213.52
1343.62	1213.53

1406.61	1213.61
1456.34	1215.34
1489.31	1216.48
1550.64	1218.6
1564.55	1219.09
1576.41	1219.5
1616.77	1220.9
1725.68	1224.67
1734.85	1224.99
1751.25	1224.77
1880.37	1223.01
2053.39	1220.65
2065.64	1220.48
2110.92	1219.86
2137.66	1219.5
2161.21	1219.18
2186.36	1218.84
2237.41	1219.5
2327.98	1220.68
2476	1222.6
2780.56	1219.5
2813.43	1219.16
2818.74	1219.21
2832.48	1219.32
2832.68	1219.32
2834.63	1219.33
2835.13	1219.34
2855.69	1219.5
2900.94	1219.86
3019.32	1220.8
3032.17	1216.55
3052.28	1209.89
3065.57	1205.5
3072.2	1205.32

3145.39	1203.33
3179.6	1202.4
3179.93	1202.39
3180.3	1202.38
3187.48	1202.18
3201.76	1201.8
3229.15	1201.05
3268.94	1199.97
3288.57	1199.43
3338.87	1200.9
3405.9	1202.85

Block Search Polyline

X	Y
3019.13	1219.59
3065.35	1204.24
3072.17	1204.05
3145.35	1202.07
3179.55	1201.13
3180.27	1201.13
3187.46	1200.94
3201.73	1200.53
3229.11	1199.79
3268.92	1198.7
3288.59	1198.19
3338.93	1199.66
3409.3	1201.72

External Boundary

X	Y
1842.37	800
3684.75	800

3684.75	1001.58
3684.75	1203.16
3614.87	1204.43
3418.32	1198.71
3410.04	1201.47
3408.66	1201.93
3405.9	1202.85
3328.75	1228.57
2967.02	1349.15
2726.17	1429.43
2580.1	1432.71
2434.02	1436
2141.34	1436
1978.72	1431.45
1739.67	1407.24
1732.46	1407.44
1669.36	1409.1
1234.23	1409.91
711.358	1411.68
664.71	1396.15
624.341	1395.99
452.918	1353.15
356.179	1328.98
6.28913	1241.49
4.48248	1241.04
3.57634	1240.81
0	1239.93
4.08e-014	1238.85
0	800

Material Boundary

X	Y
3.57634	1240.81

7.22137	1239.6
11.3065	1238.24
12.4789	1237.85
14.0631	1237.32
14.1692	1237.28
21.1739	1234.95
27.0952	1232.98
27.5407	1232.83
28.0893	1232.63
33.2583	1230.73
35.371	1229.96
41.8454	1228.05
42.4671	1227.86
43.2199	1227.61
51.1995	1224.95
56.9228	1223.05
57.5346	1222.85
58.3816	1222.56
60.979	1221.7
65.8782	1220.07
87.2914	1218.18
89.3304	1218
92.4057	1217.89
193.468	1213.9
250.747	1210.65
270.995	1210.67
299.705	1210.71
343.952	1210.76
395.035	1210.83
448.571	1210.9
490.061	1210.95
545.789	1211.02
584.786	1211.07
642.69	1211.14

679.21	1211.19
739.277	1211.26
773.335	1211.31
835.55	1211.39
867.162	1211.43
931.512	1211.51
960.693	1211.55
1027.16	1211.63
1053.93	1211.66
1122.51	1211.75
1146.87	1211.78
1217.54	1211.87
1239.52	1211.9
1312.27	1211.99
1331.88	1212.02
1343.62	1212.03
1406.65	1212.11
1406.67	1212.11
1456.39	1213.84
1489.37	1214.98
1538.79	1216.69
1550.7	1217.1
1564.6	1217.59
1576.46	1218
1616.82	1219.4
1725.73	1223.18
1734.86	1223.49
1751.23	1223.27
1947.06	1220.6
2053.37	1219.15
2065.62	1218.98
2110.9	1218.36
2137.64	1218
2161.19	1217.68

2186.36	1217.34
2237.43	1218
2306.53	1218.9
2476	1221.1
2780.54	1218
2813.43	1217.66
2818.75	1217.71
2832.47	1217.82
2832.49	1217.82
2832.7	1217.82
2834.65	1217.83
2835.14	1217.84
2855.7	1218
2900.95	1218.36
3019.09	1219.3
3023.56	1217.82
3031.7	1215.12
3045.96	1210.4
3065.31	1204
3072.16	1203.82
3145.35	1201.83
3179.56	1200.9
3179.89	1200.89
3180.26	1200.88
3187.43	1200.68
3201.72	1200.3
3229.11	1199.55
3268.9	1198.47
3288.57	1197.93
3338.92	1199.4
3381.34	1200.64
3410.04	1201.47

Material Boundary

X	Y
4.48248	1241.04
11.4647	1238.71
12.637	1238.32
14.2209	1237.79
21.3316	1235.43
27.2534	1233.45
27.706	1233.3
28.2616	1233.1
35.5281	1230.43
41.987	1228.53
42.617	1228.34
43.3779	1228.09
51.2743	1225.46
51.3575	1225.43
57.0806	1223.52
57.6925	1223.32
58.5397	1223.04
62.2581	1221.8
65.9806	1220.56
87.3353	1218.67
89.3612	1218.49
92.4244	1218.39
193.492	1214.4
250.76	1211.15
270.995	1211.17
299.705	1211.21
343.951	1211.26
395.034	1211.33
448.57	1211.4
490.06	1211.45
545.788	1211.52
584.785	1211.57
642.69	1211.64

679.209	1211.69
739.276	1211.76
773.334	1211.81
835.55	1211.89
867.162	1211.93
931.512	1212.01
960.693	1212.05
1027.16	1212.13
1053.93	1212.16
1122.51	1212.25
1146.87	1212.28
1217.54	1212.37
1239.52	1212.4
1312.27	1212.49
1331.88	1212.52
1343.62	1212.53
1406.64	1212.61
1406.65	1212.61
1456.37	1214.34
1489.35	1215.48
1550.68	1217.6
1564.58	1218.09
1576.44	1218.5
1616.81	1219.9
1642.74	1220.8
1725.72	1223.67
1734.86	1223.99
1751.24	1223.77
1921.84	1221.44
2053.37	1219.65
2065.63	1219.48
2110.91	1218.86
2137.65	1218.5
2161.2	1218.18

2186.36	1217.84
2237.42	1218.5
2393.42	1220.53
2476	1221.6
2780.55	1218.5
2813.43	1218.16
2818.75	1218.21
2832.47	1218.32
2832.49	1218.32
2832.69	1218.32
2834.64	1218.33
2835.14	1218.34
2855.7	1218.5
2900.95	1218.86
3019.16	1219.8
3031.85	1215.6
3065.39	1204.5
3072.17	1204.32
3145.36	1202.33
3179.57	1201.4
3179.9	1201.39
3180.27	1201.38
3187.45	1201.18
3201.73	1200.8
3229.12	1200.05
3268.91	1198.97
3288.57	1198.43
3338.9	1199.9
3374.63	1200.94
3408.66	1201.93

Material Boundary

X	Y

6.28913	1241.49
11.7811	1239.66
12.9533	1239.27
14.5365	1238.74
21.6471	1236.38
27.5697	1234.4
28.0365	1234.25
28.6061	1234.04
35.8423	1231.38
42.2702	1229.48
42.9166	1229.29
43.6938	1229.04
51.6734	1226.38
57.3963	1224.47
58.0083	1224.27
58.8558	1223.99
62.5178	1222.77
66.1855	1221.54
87.4233	1219.67
89.4228	1219.49
92.4618	1219.39
193.54	1215.4
222.478	1213.76
250.788	1212.15
270.993	1212.17
299.704	1212.21
343.95	1212.26
395.033	1212.33
448.569	1212.4
490.059	1212.45
545.787	1212.52
584.784	1212.57
642.688	1212.64
679.208	1212.69

739.275	1212.76
773.333	1212.81
835.549	1212.89
867.16	1212.93
931.51	1213.01
960.692	1213.05
1027.16	1213.13
1053.93	1213.16
1122.51	1213.25
1146.87	1213.28
1217.54	1213.37
1239.52	1213.4
1312.27	1213.49
1331.88	1213.52
1343.62	1213.53
1406.61	1213.61
1456.34	1215.34
1489.31	1216.48
1550.64	1218.6
1564.55	1219.09
1576.41	1219.5
1616.77	1220.9
1725.68	1224.67
1734.85	1224.99
1751.25	1224.77
1880.37	1223.01
2053.39	1220.65
2065.64	1220.48
2110.92	1219.86
2137.66	1219.5
2161.21	1219.18
2186.36	1218.84
2237.41	1219.5
2327.98	1220.68

2476	1222.6
2780.56	1219.5
2813.43	1219.16
2818.74	1219.21
2832.46	1219.32
2832.48	1219.32
2832.68	1219.32
2834.63	1219.33
2835.13	1219.34
2855.69	1219.5
2900.94	1219.86
3019.32	1220.8
3032.17	1216.55
3052.28	1209.89
3065.57	1205.5
3072.2	1205.32
3145.39	1203.33
3179.6	1202.4
3179.93	1202.39
3180.3	1202.38
3187.48	1202.18
3201.76	1201.8
3229.15	1201.05
3268.94	1199.97
3288.57	1199.43
3338.87	1200.9
3405.9	1202.85

Material Boundary

X	Y
4.08e-014	1238.85
34.4284	1227.11
65.2636	1217.11

81.2266	1215.8
92.2935	1214.89
133.788	1213.25
193.324	1210.91
221.882	1209.28
250.644	1207.65
565.291	1208.05
804.446	1208.35
993.933	1208.59
1122.51	1208.75
1146.88	1208.78
1375.18	1209.07
1405.98	1209.07
1489.47	1211.98
1616.93	1216.4
1698.14	1219.22
1730.36	1220.34
1902.26	1218.21
2129.7	1215.11
2137.6	1215
2186.36	1214.34
2476.01	1218.1
2779.83	1215.01
2780.51	1215
2878.35	1215.18
3018.61	1216.29
3039.13	1209.51
3048.27	1206.48
3064.78	1201.02
3167.41	1198.23
3288.58	1194.93
3391.71	1197.94
3418.32	1198.71

Material Boundary

X	Y
1405.98	1209.07
2095.19	1209
2871.02	1209
3039.13	1209.51

Material Boundary

X	Y
3019.09	1219.3
3019.16	1219.8

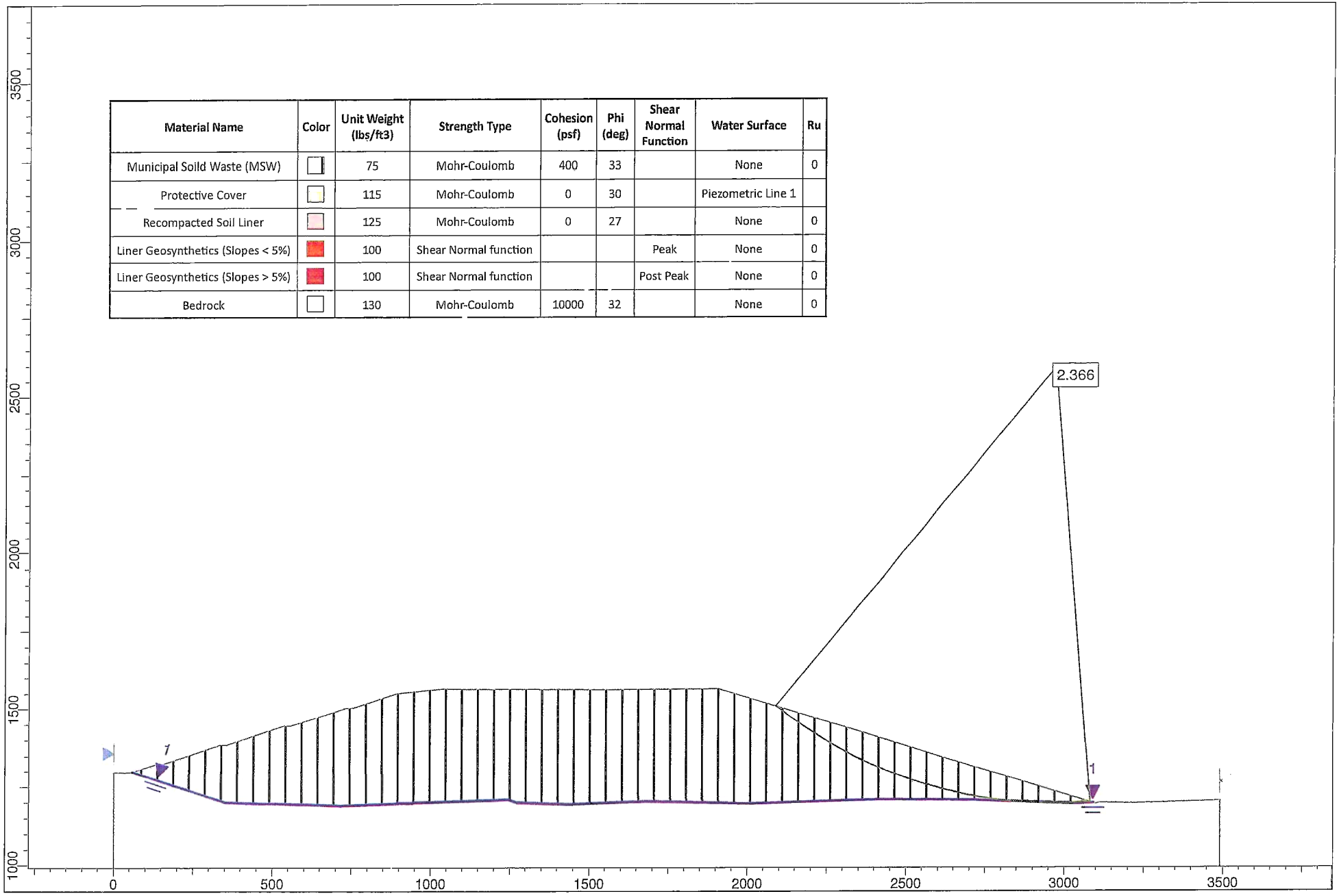
Material Boundary

X	Y
3065.31	1204
3065.39	1204.5

ATTACHMENT E

CROSS SECTION D-D SLIDE OUTPUT

Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)	Shear Normal Function	Water Surface	Ru
Municipal Soild Waste (MSW)		75	Mohr-Coulomb	400	33		None	0
Protective Cover		115	Mohr-Coulomb	0	30		Piezometric Line 1	
Recompacted Soil Liner		125	Mohr-Coulomb	0	27		None	0
Liner Geosynthetics (Slopes < 5%)		100	Shear Normal function			Peak	None	0
Liner Geosynthetics (Slopes > 5%)		100	Shear Normal function			Post Peak	None	0
Bedrock		130	Mohr-Coulomb	10000	32		None	0



D-D -- static -- rotational -- drained -Rev1.slim

Slide Analysis Information

Project Summary

File Name: D-D -- static -- rotational -- drained -Rev1.slim
Slide Modeler Version: 6.023

General Settings

Units of Measurement: Imperial Units
Time Units: days
Permeability Units: feet/second
Failure Direction: Left to Right
Data Output: Standard
Maximum Material Properties: 20
Maximum Support Properties: 20

Analysis Options

Analysis Methods Used

Spencer

Number of slices: 25
Tolerance: 0.005
Maximum number of iterations: 50
Check malpha < 0.2: Yes
Initial trial value of FS: 1
Steffensen Iteration: Yes

Groundwater Analysis

Groundwater Method: Water Surfaces
Pore Fluid Unit Weight: 62.4 lbs/ft3

Advanced Groundwater Method: None

Random Numbers

Pseudo-random Seed: 10116
Random Number Generation Method: Park and Miller v.3

Surface Options

Surface Type: Circular
Search Method: Auto Refine Search
Divisions along slope: 20
Circles per division: 10
Number of iterations: 10
Divisions to use in next iteration: 50%
Composite Surfaces: Disabled
Minimum Elevation: 0
Minimum Depth: 5

Material Properties

Property	Municipal Soild Waste (MSW)	Protective Cover	Recompacted Soil Liner	Liner Geosynthetics (Slopes	Liner Geosynthetics (Slopes > 5%)	Bedrock
Color						
Strength Type	Mohr-Coulomb	Mohr-Coulomb	Mohr-Coulomb	Shear Normal function	Shear Normal function	Mohr-Coulomb
Unit Weight [lbs/ft3]	75	115	125	100	100	130
Cohesion [psf]	400	0	0			10000
Friction Angle [deg]	33	30	27			32
Water Surface	None	Piezometric Line 1	None	None	None	None
Hu Value		1				
Ru Value	0		0	0	0	0

Shear Normal Functions

Name: Peak

Normal (psf)	Shear (psf)
0	0
3000	1250
6000	2000
13500	3500

Name: Post Peak

Normal (psf)	Shear (psf)
0	0
3000	875
6000	1290
13500	2100

Global Minimums

Method: spencer

FS: 2.366300
Center 2971.243, 2594.149
Radius: 1398.928
Left Slip Surface Endpoint: 2088.628, 1508.796
Right Slip Surface Endpoint: 3080.874, 1199.523
Resisting Moment=4.93159e+009 lb-ft
Driving Moment=2.08409e+009 lb-ft
Resisting Horizontal Force=3.31908e+006 lb
Driving Horizontal Force=1.40265e+006 lb
Total Slice Area=69721.9 ft2

Valid / Invalid Surfaces

Method: spencer

Number of Valid Surfaces: 10848
Number of Invalid Surfaces: 0

Slice Data

Global Minimum Query (spencer) - Safety Factor: 2.3663

Slice Number	Width [ft]	Weight [lbs]	Base Material	Base Cohesion [psf]	Base Friction Angle [degrees]	Shear Stress [psf]	Shear Strength [psf]	Base Normal Stress [psf]	Pore Pressure [psf]	Effective Normal Stress [psf]
1	45.3854	36142.5	Municipal Soild Waste (MSW)	400	33	312.771	740.11	523.723	0	523.723
2	45.3854	103546	Municipal Soild Waste (MSW)	400	33	625.774	1480.77	1664.23	0	1664.23
3	45.3854	161589	Municipal Soild Waste (MSW)	400	33	910.426	2154.34	2701.46	0	2701.46
4	45.3854	211007	Municipal Soild Waste (MSW)	400	33	1166.57	2760.45	3634.78	0	3634.78
5	45.3854	252406	Municipal Soild Waste (MSW)	400	33	1394.03	3298.69	4463.6	0	4463.6
6	45.3854	286296	Municipal Soild Waste (MSW)	400	33	1592.6	3768.56	5187.12	0	5187.12
7	45.3854	313105	Municipal Soild Waste (MSW)	400	33	1762	4169.43	5804.42	0	5804.42
8	45.3854	333197	Municipal Soild Waste (MSW)	400	33	1901.94	4500.55	6314.28	0	6314.28
9	45.3854	346881	Municipal Soild Waste (MSW)	400	33	2011.98	4760.94	6715.26	0	6715.26
10	45.3854	354422	Municipal Soild Waste (MSW)	400	33	2091.65	4949.47	7005.56	0	7005.56
11	45.3854	356045	Municipal Soild Waste (MSW)	400	33	2140.37	5064.75	7183.07	0	7183.07
12	45.3854	351943	Municipal Soild Waste (MSW)	400	33	2157.44	5105.15	7245.3	0	7245.3
13	45.3854	342278	Municipal Soild Waste (MSW)	400	33	2142.07	5068.78	7189.3	0	7189.3
14	45.3854	327189	Municipal Soild Waste (MSW)	400	33	2093.32	4953.43	7011.66	0	7011.66
15	45.3854	306790	Municipal Soild Waste (MSW)	400	33	2010.12	4756.54	6708.47	0	6708.47
16	45.3854	281175	Municipal Soild Waste (MSW)	400	33	1891.21	4475.18	6275.23	0	6275.23
17	14.5843	84483.2	Protective Cover	0	30	1426.7	3376	5878.63	31.2233	5847.41
18	8.29692	46803.1	Liner Geosynthetics (Slopes < 5%)	500	14.0363	806.728	1908.96	5635.83	0	5635.83
19	39.8368	210336	Recompacted Soil Liner	0	27	1163.18	2752.43	5401.95	0	5401.95
20	39.8368	183501	Recompacted Soil Liner	0	27	1030.33	2438.07	4784.97	0	4784.97
21	39.8368	150989	Recompacted Soil Liner	0	27	860.901	2037.15	3998.14	0	3998.14
22	39.8368	112821	Recompacted Soil Liner	0	27	653.349	1546.02	3034.23	0	3034.23
23	8.33551	18398	Liner Geosynthetics (Slopes < 5%)	0	22.6199	414.75	981.424	2355.42	0	2355.42
24	14.6614	27697.4	Protective Cover	0	30	497.663	1177.62	2070.92	31.2233	2039.7
25	60.854	51161.5	Municipal Soild Waste (MSW)	400	33	450.173	1065.24	1024.39	0	1024.39

Interslice Data

Global Minimum Query (spencer) - Safety Factor: 2.3663

Slice Number	X coordinate [ft]	Y coordinate - Bottom [ft]	Interslice Normal Force [lbs]	Interslice Shear Force [lbs]	Interslice Force Angle [degrees]
1	2088.63	1508.8	0	0	0
2	2134.01	1473.41	4336.82	1303.21	16.7255
3	2179.4	1440.9	30050	9030.02	16.7255
4	2224.78	1411.02	69460.4	20872.8	16.7255
5	2270.17	1383.57	116280	34942.2	16.7256
6	2315.56	1358.4	165373	49694.7	16.7256
7	2360.94	1335.37	212578	63879.8	16.7256
8	2406.33	1314.36	254575	76499.7	16.7255
9	2451.71	1295.27	288783	86779.3	16.7255
10	2497.1	1278.02	313291	94144	16.7255
11	2542.48	1262.55	326797	98202.4	16.7255
12	2587.87	1248.78	328570	98735.4	16.7255
13	2633.25	1236.67	318427	95687.3	16.7255
14	2678.64	1226.16	296714	89162.4	16.7255
15	2724.02	1217.24	264302	79422.8	16.7255
16	2769.41	1209.86	222598	66890.8	16.7255
17	2814.79	1204	173553	52152.8	16.7256
18	2829.38	1202.43	161942	48663.6	16.7255
19	2837.68	1201.61	159875	48042.5	16.7255
20	2877.51	1198.36	131086	39391.2	16.7255
21	2917.35	1196.26	100118	30085.5	16.7255
22	2957.19	1195.29	69696.2	20943.7	16.7255
23	2997.02	1195.46	43165.4	12971.2	16.7255
24	3005.36	1195.64	39288.2	11806.1	16.7255
25	3020.02	1196.07	31092.7	9343.34	16.7255
26	3080.87	1199.52	0	0	0

List Of Coordinates

Piezoline

X	Y
57.6579	1300.17
213.704	1248.26
218.596	1246.63
218.978	1246.5
219.04	1246.48
219.113	1246.46
238.099	1240.14
299.49	1219.72
307.146	1217.17
308.357	1216.77
320.36	1212.78
322.67	1212.01
324.604	1211.37
351.432	1202.44
353.182	1202.39
353.579	1202.38
355.218	1202.34
365.46	1202.06
386.794	1201.48
478.224	1198.99
490.273	1198.67
495.222	1198.53
517.792	1197.92
598.571	1195.72
611.496	1195.37
714.939	1192.55
746.619	1193.48
903.613	1198.05
913.376	1198.33
938.805	1199.07
949.56	1199.38

1002.6	1200.93
1009.37	1201.13
1112.4	1204.12
1205.97	1206.85
1235.69	1207.71
1246.06	1208.02
1266.27	1201.33
1271.08	1199.74
1389.7	1196.52
1390.01	1196.51
1393.38	1196.42
1436.2	1195.25
1620.63	1200.62
1693.49	1202.74
1826.84	1200.44
2007.96	1197.32
2352.27	1207.25
2420.6	1209.22
2709.42	1208.07
2732.82	1207.16
2737.79	1206.97
2738.83	1206.93
2743.02	1206.77
2771.27	1205.68
2905.12	1200.51
2906.85	1200.44
2958.91	1198.43
2979.82	1197.62
2990.68	1197.2
3033.19	1195.56
3036.23	1195.45
3038.35	1195.36
3088.28	1196.72
3089.73	1196.76

External Boundary

X	Y
0	1298.65
-5.68e-014	948.648
3490.88	948.648
3490.88	1204.12
3211.07	1196.22
3109.13	1198.96
3096.28	1194.71
3092.19	1195.99
3091.37	1196.25
3089.73	1196.76
1908.19	1565.04
1552.15	1562.07
1281.64	1563.33
1126.08	1564.05
1037.88	1564.46
891.692	1550
754.538	1504.01
734.523	1504.03
555.126	1444.72
535.112	1444.74
355.714	1385.43
339.684	1385.45
335.7	1385.45
156.302	1326.14
136.288	1326.17
57.6579	1300.17
56.069	1299.64
55.2745	1299.38
51.3023	1298.07
49.7139	1298.6

40.1835	1298.61
34.156	1296.61
31.1422	1296.62
25.1147	1298.62

Material Boundary

X	Y
55.2745	1299.38
213.23	1246.84
218.122	1245.21
218.505	1245.08
218.567	1245.06
218.64	1245.04
237.625	1238.72
299.016	1218.3
306.672	1215.75
307.883	1215.35
319.886	1211.36
322.197	1210.59
324.13	1209.94
351.169	1200.95
353.141	1200.89
353.538	1200.88
355.177	1200.84
365.42	1200.56
386.753	1199.98
478.183	1197.49
490.232	1197.17
495.181	1197.03
517.751	1196.42
598.53	1194.22
611.455	1193.87
714.94	1191.05

746.663	1191.98
903.657	1196.55
913.419	1196.83
938.849	1197.57
949.603	1197.88
1002.64	1199.43
1009.42	1199.63
1112.44	1202.62
1206.01	1205.35
1235.73	1206.21
1245.84	1206.51
1265.8	1199.91
1270.82	1198.25
1389.66	1195.02
1389.97	1195.01
1393.34	1194.92
1436.2	1193.75
1620.67	1199.12
1693.5	1201.24
1826.82	1198.94
2007.97	1195.82
2352.32	1205.75
2420.61	1207.72
2709.39	1206.57
2732.76	1205.66
2737.73	1205.47
2738.77	1205.43
2742.96	1205.27
2771.22	1204.18
2905.06	1199.01
2906.79	1198.94
2958.85	1196.93
2979.76	1196.13
2990.63	1195.71

3033.13	1194.06
3036.18	1193.95
3038.34	1193.86
3088.32	1195.22
3090.01	1195.27
3092.19	1195.99

Material Boundary

X	Y
56.069	1299.64
213.388	1247.31
218.28	1245.68
218.663	1245.56
218.725	1245.53
218.798	1245.51
237.783	1239.19
299.174	1218.77
306.83	1216.23
308.041	1215.82
320.044	1211.83
322.354	1211.06
324.288	1210.42
351.257	1201.45
353.155	1201.39
353.552	1201.38
355.191	1201.34
365.433	1201.06
386.766	1200.48
478.197	1197.99
490.246	1197.67
495.194	1197.53
517.764	1196.92
598.544	1194.72

611.469	1194.37
714.94	1191.55
746.648	1192.48
903.642	1197.05
913.405	1197.33
938.834	1198.07
949.589	1198.38
1002.63	1199.93
1009.4	1200.13
1112.43	1203.12
1206	1205.85
1235.72	1206.71
1245.92	1207.01
1265.96	1200.38
1270.9	1198.75
1389.67	1195.52
1389.99	1195.51
1393.36	1195.42
1436.2	1194.25
1620.66	1199.62
1693.5	1201.74
1826.82	1199.44
2007.97	1196.32
2352.3	1206.25
2420.61	1208.22
2709.4	1207.07
2732.78	1206.16
2737.75	1205.97
2738.79	1205.93
2742.98	1205.77
2771.24	1204.68
2905.08	1199.51
2906.81	1199.44
2958.87	1197.43

2979.78	1196.62
2990.65	1196.21
3033.15	1194.56
3036.2	1194.45
3038.34	1194.36
3088.3	1195.72
3089.92	1195.77
3091.37	1196.25

Material Boundary

X	Y
57.6579	1300.17
213.704	1248.26
218.596	1246.63
218.978	1246.5
219.04	1246.48
219.113	1246.46
238.099	1240.14
299.49	1219.72
307.146	1217.17
308.357	1216.77
320.36	1212.78
322.67	1212.01
324.604	1211.37
351.432	1202.44
353.182	1202.39
353.579	1202.38
355.218	1202.34
365.46	1202.06
386.794	1201.48
478.224	1198.99
490.273	1198.67
495.222	1198.53

517.792	1197.92
598.571	1195.72
611.496	1195.37
714.939	1192.55
746.619	1193.48
903.613	1198.05
913.376	1198.33
938.805	1199.07
949.56	1199.38
1002.6	1200.93
1009.37	1201.13
1112.4	1204.12
1205.97	1206.85
1235.69	1207.71
1246.06	1208.02
1266.27	1201.33
1271.08	1199.74
1389.7	1196.52
1390.01	1196.51
1393.38	1196.42
1436.2	1195.25
1620.63	1200.62
1693.49	1202.74
1826.84	1200.44
2007.96	1197.32
2352.27	1207.25
2420.6	1209.22
2709.42	1208.07
2732.82	1207.16
2737.79	1206.97
2738.83	1206.93
2743.02	1206.77
2771.27	1205.68
2905.12	1200.51

2906.85	1200.44
2958.91	1198.43
2979.82	1197.62
2990.68	1197.2
3033.19	1195.56
3036.23	1195.45
3038.35	1195.36
3088.28	1196.72
3089.73	1196.76

Material Boundary

X	Y
51.3023	1298.07
212.441	1244.46
217.333	1242.84
217.716	1242.71
217.778	1242.69
217.851	1242.66
236.836	1236.35
298.227	1215.93
305.883	1213.38
307.094	1212.98
319.097	1208.98
321.407	1208.21
323.341	1207.57
350.731	1198.46
353.073	1198.4
353.47	1198.38
355.109	1198.34
365.352	1198.06
386.685	1197.48
478.115	1194.99
490.164	1194.67

495.113	1194.53
517.683	1193.92
598.462	1191.72
611.387	1191.37
714.943	1188.55
746.736	1189.48
903.73	1194.05
913.492	1194.33
938.922	1195.07
949.676	1195.39
1002.72	1196.93
1009.49	1197.13
1112.52	1200.13
1206.09	1202.85
1235.81	1203.72
1245.47	1204
1265.02	1197.53
1270.38	1195.76
1389.59	1192.52
1389.9	1192.51
1393.27	1192.42
1436.2	1191.25
1620.75	1196.62
1693.52	1198.74
1826.77	1196.44
2007.99	1193.32
2352.39	1203.25
2420.65	1205.22
2709.34	1204.07
2732.66	1203.17
2737.64	1202.97
2738.68	1202.93
2742.86	1202.77
2771.12	1201.68

2904.97	1196.51
2906.69	1196.44
2958.76	1194.43
2979.66	1193.63
2990.53	1193.21
3033.03	1191.57
3036.08	1191.45
3038.33	1191.36
3088.39	1192.72
3090.24	1192.77
3090.43	1192.78
3090.44	1192.78
3096.28	1194.71

Material Boundary

X	Y
350.731	1198.46
351.169	1200.95
351.257	1201.45
351.432	1202.44

Material Boundary

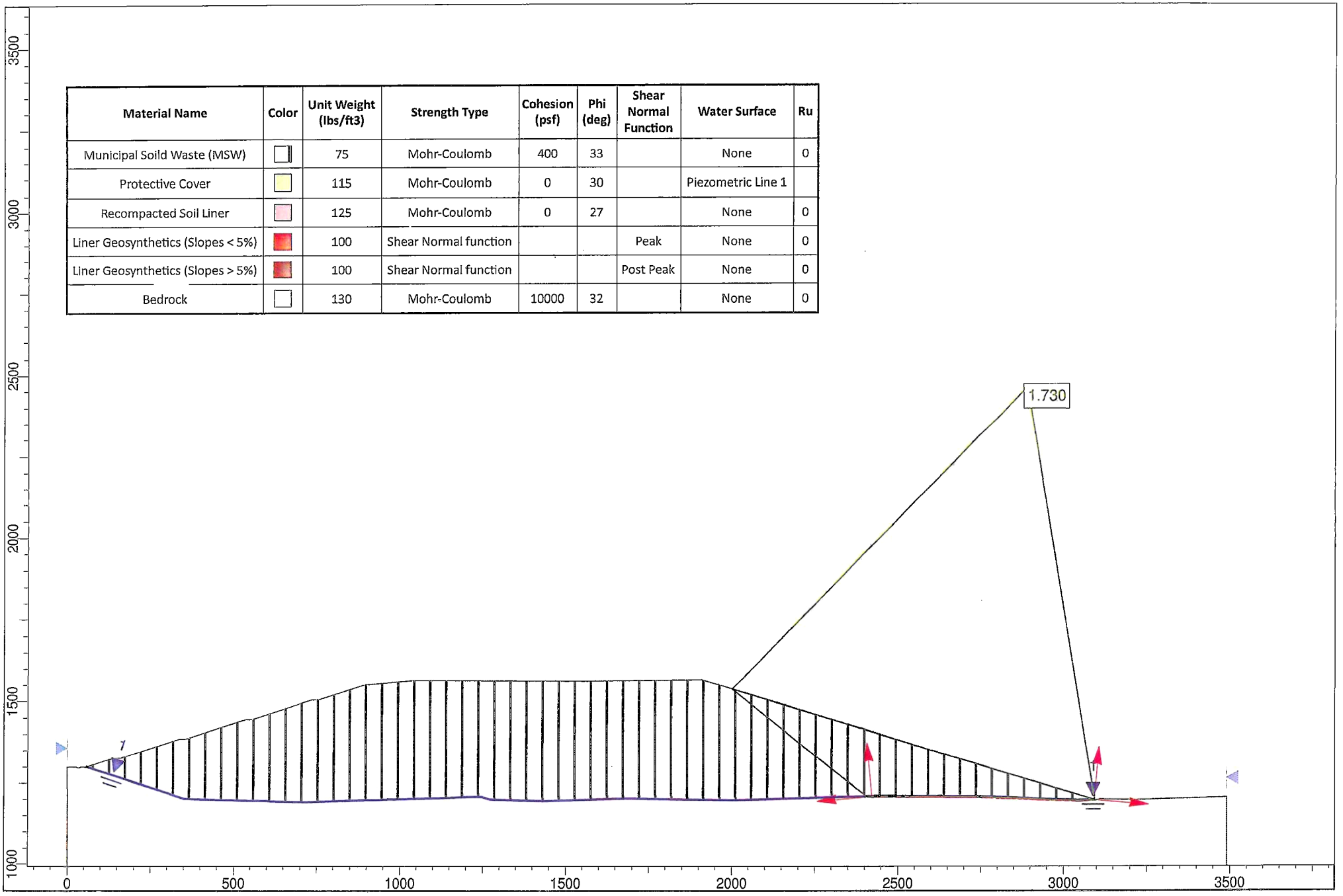
X	Y
1245.47	1204
1245.84	1206.51
1245.92	1207.01
1246.06	1208.02

Material Boundary

X	Y
1270.38	1195.76
1270.82	1198.25

1270.9	1198.75
1271.08	1199.74

Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)	Shear Normal Function	Water Surface	Ru
Municipal Soild Waste (MSW)		75	Mohr-Coulomb	400	33		None	0
Protective Cover		115	Mohr-Coulomb	0	30		Piezometric Line 1	
Recompacted Soil Liner		125	Mohr-Coulomb	0	27		None	0
Liner Geosynthetics (Slopes < 5%)		100	Shear Normal function			Peak	None	0
Liner Geosynthetics (Slopes > 5%)		100	Shear Normal function			Post Peak	None	0
Bedrock		130	Mohr-Coulomb	10000	32		None	0



D-D -- static -- translational -- drained -Rev1.slim

Slide Analysis Information

Project Summary

File Name: D-D -- static -- translational -- drained -Rev1.slim
Slide Modeler Version: 6.023

General Settings

Units of Measurement: Imperial Units
Time Units: days
Permeability Units: feet/second
Failure Direction: Left to Right
Data Output: Standard
Maximum Material Properties: 20
Maximum Support Properties: 20

Analysis Options

Analysis Methods Used

Spencer

Number of slices: 25
Tolerance: 0.005
Maximum number of iterations: 50
Check malpha < 0.2: Yes
Initial trial value of FS: 1
Steffensen Iteration: Yes

Groundwater Analysis

Groundwater Method: Water Surfaces
Pore Fluid Unit Weight: 62.4 lbs/ft3

Advanced Groundwater Method: None

Random Numbers

Pseudo-random Seed: 10116
Random Number Generation Method: Park and Miller v.3

Surface Options

Surface Type: Non-Circular Block Search
Number of Surfaces: 7000
Pseudo-Random Surfaces: Enabled
Convex Surfaces Only: Disabled
Left Projection Angle (Start Angle): 95
Left Projection Angle (End Angle): 185
Right Projection Angle (Start Angle): -5
Right Projection Angle (End Angle): 85
Minimum Elevation: Not Defined
Minimum Depth: Not Defined

Material Properties

Property	Municipal Soild Waste (MSW)	Protective Cover	Recompacted Soil Liner	Liner Geosynthetics (Slopes	Liner Geosynthetics (Slopes > 5%)	Bedrock
Color						
Strength Type	Mohr-Coulomb	Mohr-Coulomb	Mohr-Coulomb	Shear Normal function	Shear Normal function	Mohr-Coulomb
Unit Weight [lbs/ft3]	75	115	125	100	100	130
Cohesion [psf]	400	0	0			10000
Friction Angle [deg]	33	30	27			32
Water Surface	None	Piezometric Line 1	None	None	None	None
Hu Value		1				
Ru Value	0		0	0	0	0

Shear Normal Functions

Name: Peak

Normal (psf)	Shear (psf)
0	0
3000	1250
6000	2000
13500	3500

Name: Post Peak

Normal (psf)	Shear (psf)
0	0
3000	875
6000	1290
13500	2100

Global Minimums

Method: spencer

FS: 1.730060
Axis Location: 2888.090, 2460.188
Left Slip Surface Endpoint: 1999.877, 1536.459
Right Slip Surface Endpoint: 3094.145, 1195.380
Resisting Moment=4.49797e+009 lb-ft
Driving Moment=2.5999e+009 lb-ft
Resisting Horizontal Force=3.10535e+006 lb
Driving Horizontal Force=1.79494e+006 lb
Total Slice Area=109880 ft2

Global Minimum Coordinates

Method: spencer

X	Y
1999.88	1536.46
2404.88	1207.78

2708.24	1206.61
2727.19	1205.89
2733.09	1205.65
2763.07	1204.49
2899.07	1199.24
2912.08	1198.74
2953.24	1197.15
2970.52	1196.58
2983.43	1195.98
3029.98	1194.19
3030.42	1194.18
3071.83	1194.78
3094.14	1195.38

Valid / Invalid Surfaces

Method: spencer

Number of Valid Surfaces: 4467
Number of Invalid Surfaces: 2534

Error Codes:

Error Code -106 reported for 2 surfaces
Error Code -107 reported for 67 surfaces
Error Code -108 reported for 1040 surfaces
Error Code -110 reported for 19 surfaces
Error Code -111 reported for 88 surfaces
Error Code -112 reported for 1318 surfaces

Error Codes

The following errors were encountered during the computation:

-106 = Average slice width is less than 0.0001 * (maximum horizontal extent of soil region). This limitation is imposed to avoid numerical errors which may result from too many slices, or too small a slip region.
-107 = Total driving moment or total driving force is negative. This will occur if the wrong failure direction is specified, or if high external or anchor loads are applied against

the failure direction.
-108 = Total driving moment or total driving force < 0.1. This is to limit the calculation of extremely high safety factors if the driving force is very small (0.1 is an arbitrary number).
-110 = The water table or a piezoline does not span the slip region for a given slip surface, when Water Surfaces is specified as the method of pore pressure calculation. If this error occurs, check that the water table or piezoline(s) span the appropriate soil cells.
-111 = safety factor equation did not converge
-112 = The coefficient M-Alpha = cos(alpha)(1+tan(alpha)tan(phi)/F) < 0.2 for the final iteration of the safety factor calculation. This screens out some slip surfaces which may not be valid in the context of the analysis, in particular, deep seated slip surfaces with many high negative base angle slices in the passive zone.

Slice Data

Global Minimum Query (spencer) - Safety Factor: 1.73006

Slice Number	Width [ft]	Weight [lbs]	Base Material	Base Cohesion [psf]	Base Friction Angle [degrees]	Shear Stress [psf]	Shear Strength [psf]	Base Normal Stress [psf]	Pore Pressure [psf]	Effective Normal Stress [psf]
1	67.3052	84911.9	Municipal Soild Waste (MSW)	400	33	530.597	917.964	797.594	0	797.594
2	67.3052	254736	Municipal Soild Waste (MSW)	400	33	1193.16	2064.24	2562.71	0	2562.71
3	67.3052	424560	Municipal Soild Waste (MSW)	400	33	1855.73	3210.52	4327.83	0	4327.83
4	67.3052	594383	Municipal Soild Waste (MSW)	400	33	2518.29	4356.8	6092.94	0	6092.94
5	67.3052	764207	Municipal Soild Waste (MSW)	400	33	3180.86	5503.08	7858.05	0	7858.05
6	67.3052	934031	Municipal Soild Waste (MSW)	400	33	3843.43	6649.36	9623.16	0	9623.16
7	1.17341	17813.3	Protective Cover	0	30	3590.13	6211.14	10788.8	30.7665	10758
8	75.8391	1.08896e+006	Liner Geosynthetics (Slopes < 5%)	800	11.31	2191.97	3792.24	14961.2	0	14961.2
9	75.8391	956253	Liner Geosynthetics (Slopes < 5%)	800	11.31	1983.1	3430.88	13154.4	0	13154.4
10	75.8391	823447	Liner Geosynthetics (Slopes < 5%)	800	11.31	1774.07	3069.24	11346.2	0	11346.2
11	75.8391	690640	Liner Geosynthetics (Slopes < 5%)	800	11.31	1565.04	2707.61	9538.04	0	9538.04
12	18.9499	152309	Liner Geosynthetics (Slopes < 5%)	800	11.31	1421.93	2460.02	8300.08	0	8300.08
13	5.90325	45944.9	Liner Geosynthetics (Slopes < 5%)	800	11.31	1390.89	2406.33	8031.67	0	8031.67
14	29.9785	222323	Liner Geosynthetics (Slopes < 5%)	800	11.31	1348.55	2333.07	7665.35	0	7665.35
15	64.3223	414903	Liner Geosynthetics (Slopes < 5%)	800	11.31	1234.91	2136.46	6682.32	0	6682.32
16	71.6809	362539	Liner Geosynthetics (Slopes < 5%)	500	14.0363	1049	1814.83	5259.31	0	5259.31
17	13.008	54216.1	Liner Geosynthetics (Slopes < 5%)	500	14.0363	917.147	1586.72	4346.89	0	4346.89
18	41.1645	149663	Liner Geosynthetics (Slopes < 5%)	500	14.0363	838.313	1450.33	3801.32	0	3801.32
19	17.2778	52392.8	Liner Geosynthetics (Slopes < 5%)	500	14.0363	750.303	1298.07	3192.27	0	3192.27
20	12.9053	35145.2	Liner Geosynthetics (Slopes < 5%)	2.27374e-013	22.6199	686.485	1187.66	2850.38	0	2850.38

21	46.5481	98651.4	Liner Geosynthetics (Slopes < 5%)	1.13687e-013	22.6199	536.491	928.162	2227.59	0	2227.59
22	0.43929	719.424	Liner Geosynthetics (Slopes < 5%)	1.13687e-013	22.6199	419.591	725.917	1742.2	0	1742.2
23	41.412	46418.5	Liner Geosynthetics (Slopes < 5%)	1.13687e-013	22.6199	292.347	505.778	1213.87	0	1213.87
24	18.1671	7067.29	Liner Geosynthetics (Slopes < 5%)	0	22.6199	102.183	176.782	424.276	0	424.276
25	4.15043	261.084	Recompacted Soil Liner	0	27	20.5829	35.6096	69.8878	0	69.8878

Interslice Data

Global Minimum Query (spencer) - Safety Factor: 1.73006

Slice Number	X coordinate [ft]	Y coordinate - Bottom [ft]	Interslice Normal Force [lbs]	Interslice Shear Force [lbs]	Interslice Force Angle [degrees]
1	1999.88	1536.46	0	0	0
2	2067.18	1481.84	7853.33	2247.96	15.9734
3	2134.49	1427.22	67524.5	19328.4	15.9734
4	2201.79	1372.6	179014	51241.5	15.9734
5	2269.1	1317.98	342321	97987	15.9734
6	2336.4	1263.35	557445	159565	15.9734
7	2403.71	1208.73	824388	235976	15.9734
8	2404.88	1207.78	830449	237711	15.9734
9	2480.72	1207.49	668595	191381	15.9734
10	2556.56	1207.2	522052	149434	15.9734
11	2632.4	1206.9	390831	111873	15.9734
12	2708.24	1206.61	274935	78698.2	15.9734
13	2727.19	1205.89	253969	72697	15.9734
14	2733.09	1205.65	247679	70896.4	15.9734
15	2763.07	1204.49	216121	61863.2	15.9734
16	2827.39	1202.01	153287	43877.3	15.9734
17	2899.07	1199.24	92651.4	26520.8	15.9734
18	2912.08	1198.74	82906.7	23731.5	15.9734
19	2953.24	1197.15	54439.1	15582.8	15.9734
20	2970.52	1196.58	43293.9	12392.6	15.9734
21	2983.43	1195.98	36134.6	10343.3	15.9734
22	3029.98	1194.19	15164.6	4340.77	15.9734

23	3030.42	1194.18	14993.3	4291.73	15.9734
24	3071.83	1194.78	2156.74	617.352	15.9734
25	3089.99	1195.27	93.2238	26.6847	15.9734
26	3094.14	1195.38	0	0	0

List Of Coordinates

Piezoline

X	Y
57.6579	1300.17
213.704	1248.26
218.596	1246.63
218.978	1246.5
219.04	1246.48
219.113	1246.46
238.099	1240.14
299.49	1219.72
307.146	1217.17
308.357	1216.77
320.36	1212.78
322.67	1212.01
324.604	1211.37
351.432	1202.44
353.182	1202.39
353.579	1202.38
355.218	1202.34
365.46	1202.06
386.794	1201.48
478.224	1198.99
490.273	1198.67
495.222	1198.53
517.792	1197.92
598.571	1195.72

611.496	1195.37
714.939	1192.55
746.619	1193.48
903.613	1198.05
913.376	1198.33
938.805	1199.07
949.56	1199.38
1002.6	1200.93
1009.37	1201.13
1112.4	1204.12
1205.97	1206.85
1235.69	1207.71
1246.06	1208.02
1266.27	1201.33
1271.08	1199.74
1389.7	1196.52
1390.01	1196.51
1393.38	1196.42
1436.2	1195.25
1620.63	1200.62
1693.49	1202.74
1826.84	1200.44
2007.96	1197.32
2352.27	1207.25
2420.6	1209.22
2709.42	1208.07
2732.82	1207.16
2737.79	1206.97
2738.83	1206.93
2743.02	1206.77
2771.27	1205.68
2905.12	1200.51
2906.85	1200.44
2958.91	1198.43

2979.82	1197.62
2990.68	1197.2
3033.19	1195.56
3036.23	1195.45
3038.35	1195.36
3088.28	1196.72
3089.73	1196.76

Block Search Polyline

X	Y
3091.71	1196.14
3089.99	1195.53
3038.36	1194.1
3036.25	1194.19
2990.65	1195.94
2979.78	1196.38
2958.88	1197.17
2906.82	1199.19
2905.09	1199.25
2771.33	1204.45
2739.04	1205.65
2733.13	1205.92
2709.41	1206.82
2420.62	1207.96

External Boundary

X	Y
0	1298.65
-5.68e-014	948.648
3490.88	948.648
3490.88	1204.12
3211.07	1196.22

3109.13	1198.96
3096.28	1194.71
3092.19	1195.99
3091.37	1196.25
3089.73	1196.76
1908.19	1565.04
1552.15	1562.07
1281.64	1563.33
1126.08	1564.05
1037.88	1564.46
891.692	1550
754.538	1504.01
734.523	1504.03
555.126	1444.72
535.112	1444.74
355.714	1385.43
339.684	1385.45
335.7	1385.45
156.302	1326.14
136.288	1326.17
57.6579	1300.17
56.069	1299.64
55.2745	1299.38
51.3023	1298.07
49.7139	1298.6
40.1835	1298.61
34.156	1296.61
31.1422	1296.62
25.1147	1298.62

Material Boundary

X	Y
55.2745	1299.38

213.23	1246.84
218.122	1245.21
218.505	1245.08
218.567	1245.06
218.64	1245.04
237.625	1238.72
299.016	1218.3
306.672	1215.75
307.883	1215.35
319.886	1211.36
322.197	1210.59
324.13	1209.94
351.169	1200.95
353.141	1200.89
353.538	1200.88
355.177	1200.84
365.42	1200.56
386.753	1199.98
478.183	1197.49
490.232	1197.17
495.181	1197.03
517.751	1196.42
598.53	1194.22
611.455	1193.87
714.94	1191.05
746.663	1191.98
903.657	1196.55
913.419	1196.83
938.849	1197.57
949.603	1197.88
1002.64	1199.43
1009.42	1199.63
1112.44	1202.62
1206.01	1205.35

1235.73	1206.21
1245.84	1206.51
1265.8	1199.91
1270.82	1198.25
1389.66	1195.02
1389.97	1195.01
1393.34	1194.92
1436.2	1193.75
1620.67	1199.12
1693.5	1201.24
1826.82	1198.94
2007.97	1195.82
2352.32	1205.75
2420.61	1207.72
2709.39	1206.57
2732.76	1205.66
2737.73	1205.47
2738.77	1205.43
2742.96	1205.27
2771.22	1204.18
2905.06	1199.01
2906.79	1198.94
2958.85	1196.93
2979.76	1196.13
2990.63	1195.71
3033.13	1194.06
3036.18	1193.95
3038.34	1193.86
3088.32	1195.22
3090.01	1195.27
3092.19	1195.99

Material Boundary

X	Y
56.069	1299.64
213.388	1247.31
218.28	1245.68
218.663	1245.56
218.725	1245.53
218.798	1245.51
237.783	1239.19
299.174	1218.77
306.83	1216.23
308.041	1215.82
320.044	1211.83
322.354	1211.06
324.288	1210.42
351.257	1201.45
353.155	1201.39
353.552	1201.38
355.191	1201.34
365.433	1201.06
386.766	1200.48
478.197	1197.99
490.246	1197.67
495.194	1197.53
517.764	1196.92
598.544	1194.72
611.469	1194.37
714.94	1191.55
746.648	1192.48
903.642	1197.05
913.405	1197.33
938.834	1198.07
949.589	1198.38
1002.63	1199.93
1009.4	1200.13

1112.43	1203.12
1206	1205.85
1235.72	1206.71
1245.92	1207.01
1265.96	1200.38
1270.9	1198.75
1389.67	1195.52
1389.99	1195.51
1393.36	1195.42
1436.2	1194.25
1620.66	1199.62
1693.5	1201.74
1826.82	1199.44
2007.97	1196.32
2352.3	1206.25
2420.61	1208.22
2709.4	1207.07
2732.78	1206.16
2737.75	1205.97
2738.79	1205.93
2742.98	1205.77
2771.24	1204.68
2905.08	1199.51
2906.81	1199.44
2958.87	1197.43
2979.78	1196.62
2990.65	1196.21
3033.15	1194.56
3036.2	1194.45
3038.34	1194.36
3088.3	1195.72
3089.92	1195.77
3091.37	1196.25

Material Boundary

X	Y
57.6579	1300.17
213.704	1248.26
218.596	1246.63
218.978	1246.5
219.04	1246.48
219.113	1246.46
238.099	1240.14
299.49	1219.72
307.146	1217.17
308.357	1216.77
320.36	1212.78
322.67	1212.01
324.604	1211.37
351.432	1202.44
353.182	1202.39
353.579	1202.38
355.218	1202.34
365.46	1202.06
386.794	1201.48
478.224	1198.99
490.273	1198.67
495.222	1198.53
517.792	1197.92
598.571	1195.72
611.496	1195.37
714.939	1192.55
746.619	1193.48
903.613	1198.05
913.376	1198.33
938.805	1199.07
949.56	1199.38
1002.6	1200.93

1009.37	1201.13
1112.4	1204.12
1205.97	1206.85
1235.69	1207.71
1246.06	1208.02
1266.27	1201.33
1271.08	1199.74
1389.7	1196.52
1390.01	1196.51
1393.38	1196.42
1436.2	1195.25
1620.63	1200.62
1693.49	1202.74
1826.84	1200.44
2007.96	1197.32
2352.27	1207.25
2420.6	1209.22
2709.42	1208.07
2732.82	1207.16
2737.79	1206.97
2738.83	1206.93
2743.02	1206.77
2771.27	1205.68
2905.12	1200.51
2906.85	1200.44
2958.91	1198.43
2979.82	1197.62
2990.68	1197.2
3033.19	1195.56
3036.23	1195.45
3038.35	1195.36
3088.28	1196.72
3089.73	1196.76

Material Boundary

X	Y
51.3023	1298.07
212.441	1244.46
217.333	1242.84
217.716	1242.71
217.778	1242.69
217.851	1242.66
236.836	1236.35
298.227	1215.93
305.883	1213.38
307.094	1212.98
319.097	1208.98
321.407	1208.21
323.341	1207.57
350.731	1198.46
353.073	1198.4
353.47	1198.38
355.109	1198.34
365.352	1198.06
386.685	1197.48
478.115	1194.99
490.164	1194.67
495.113	1194.53
517.683	1193.92
598.462	1191.72
611.387	1191.37
714.943	1188.55
746.736	1189.48
903.73	1194.05
913.492	1194.33
938.922	1195.07
949.676	1195.39
1002.72	1196.93

1009.49	1197.13
1112.52	1200.13
1206.09	1202.85
1235.81	1203.72
1245.47	1204
1265.02	1197.53
1270.38	1195.76
1389.59	1192.52
1389.9	1192.51
1393.27	1192.42
1436.2	1191.25
1620.75	1196.62
1693.52	1198.74
1826.77	1196.44
2007.99	1193.32
2352.39	1203.25
2420.65	1205.22
2709.34	1204.07
2732.66	1203.17
2737.64	1202.97
2738.68	1202.93
2742.86	1202.77
2771.12	1201.68
2904.97	1196.51
2906.69	1196.44
2958.76	1194.43
2979.66	1193.63
2990.53	1193.21
3033.03	1191.57
3036.08	1191.45
3038.33	1191.36
3088.39	1192.72
3090.24	1192.77
3090.43	1192.78

3090.44	1192.78
3096.28	1194.71

Material Boundary

X	Y
350.731	1198.46
351.169	1200.95
351.257	1201.45
351.432	1202.44

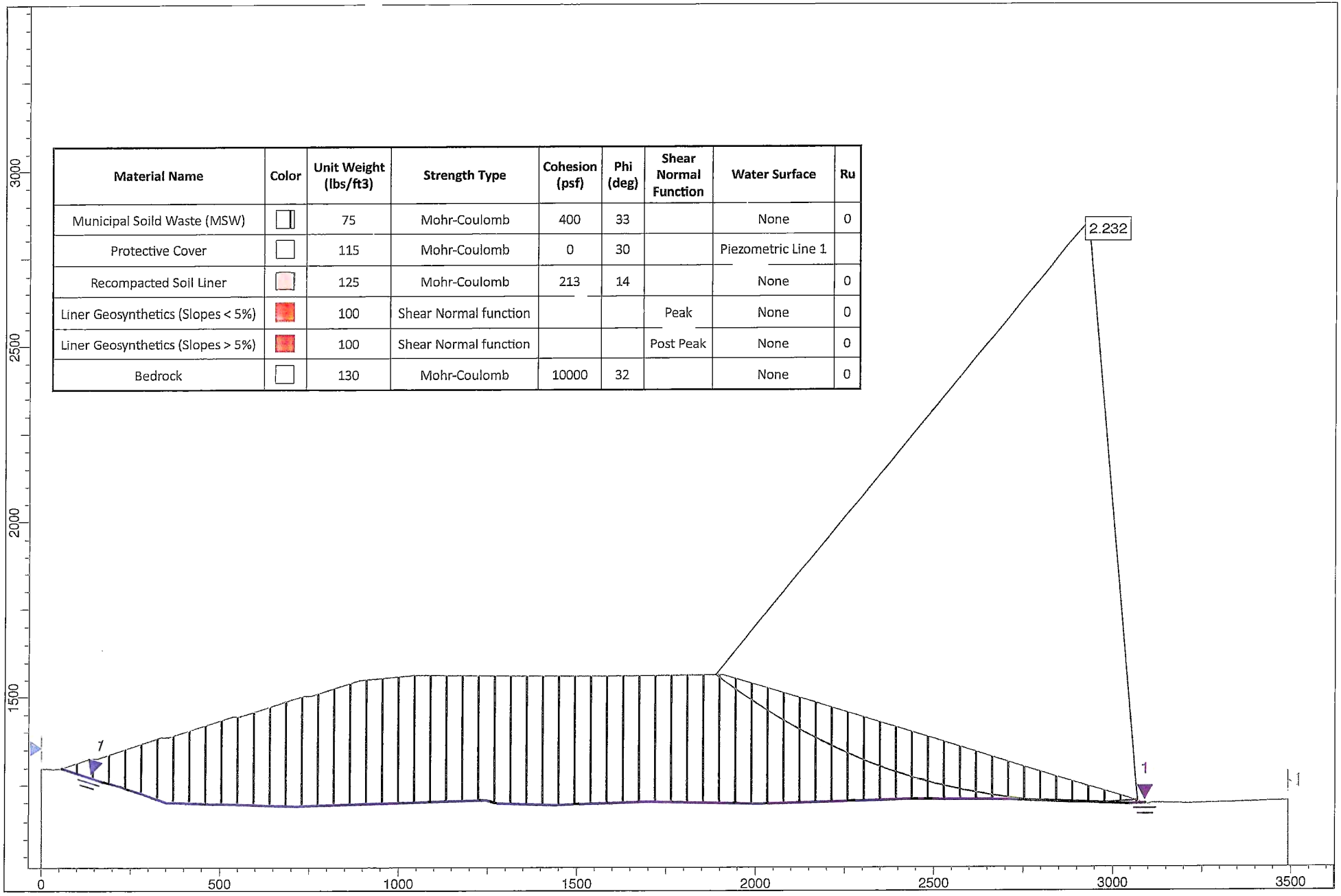
Material Boundary

X	Y
1245.47	1204
1245.84	1206.51
1245.92	1207.01
1246.06	1208.02

Material Boundary

X	Y
1270.38	1195.76
1270.82	1198.25
1270.9	1198.75
1271.08	1199.74

Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)	Shear Normal Function	Water Surface	Ru
Municipal Soild Waste (MSW)		75	Mohr-Coulomb	400	33		None	0
Protective Cover		115	Mohr-Coulomb	0	30		Piezometric Line 1	
Recompacted Soil Liner		125	Mohr-Coulomb	213	14		None	0
Liner Geosynthetics (Slopes < 5%)		100	Shear Normal function			Peak	None	0
Liner Geosynthetics (Slopes > 5%)		100	Shear Normal function			Post Peak	None	0
Bedrock		130	Mohr-Coulomb	10000	32		None	0



D-D -- static -- rotational -- undrained -Rev1.slim

Slide Analysis Information

Project Summary

File Name: D-D -- static -- rotational -- undrained -Rev1.slim
Slide Modeler Version: 6.023

General Settings

Units of Measurement: Imperial Units
Time Units: days
Permeability Units: feet/second
Failure Direction: Left to Right
Data Output: Standard
Maximum Material Properties: 20
Maximum Support Properties: 20

Analysis Options

Analysis Methods Used

Spencer

Number of slices: 25
Tolerance: 0.005
Maximum number of iterations: 50
Check malpha < 0.2: Yes
Initial trial value of FS: 1
Steffensen Iteration: Yes

Groundwater Analysis

Groundwater Method: Water Surfaces
Pore Fluid Unit Weight: 62.4 lbs/ft3

Advanced Groundwater Method: None

Random Numbers

Pseudo-random Seed: 10116
Random Number Generation Method: Park and Miller v.3

Surface Options

Surface Type: Circular
Search Method: Auto Refine Search
Divisions along slope: 20
Circles per division: 10
Number of iterations: 10
Divisions to use in next iteration: 50%
Composite Surfaces: Disabled
Minimum Elevation: 0
Minimum Depth: 5

Material Properties

Property	Municipal Soild Waste (MSW)	Protective Cover	Recompacted Soil Liner	Liner Geosynthetics (Slopes	Liner Geosynthetics (Slopes > 5%)	Bedrock
Color						
Strength Type	Mohr-Coulomb	Mohr-Coulomb	Mohr-Coulomb	Shear Normal function	Shear Normal function	Mohr-Coulomb
Unit Weight [lbs/ft3]	75	115	125	100	100	130
Cohesion [psf]	400	0	213			10000
Friction Angle [deg]	33	30	14			32
Water Surface	None	Piezometric Line 1	None	None	None	None
Hu Value		1				
Ru Value	0		0	0	0	0

Shear Normal Functions

Name: Peak

Normal (psf)	Shear (psf)
0	0
3000	1250
6000	2000
13500	3500

Name. Post Peak

Normal (psf)	Shear (psf)
0	0
3000	875
6000	1290
13500	2100

Global Minimums

Method: spencer

FS: 2.231900
Center: 2929.750, 2855.162
Radius: 1658.370
Left Slip Surface Endpoint: 1887.955, 1564.869
Right Slip Surface Endpoint 3070.453, 1202.772
Resisting Moment=8.1136e+009 lb-ft
Driving Moment=3.63529e+009 lb-ft
Resisting Horizontal Force=4.5972e+006 lb
Driving Horizontal Force=2.05977e+006 lb
Total Slice Area=102883 ft2

Valid / Invalid Surfaces

Method: spencer

Number of Valid Surfaces: 12919
Number of Invalid Surfaces: 0

Slice Data

Global Minimum Query (spencer) - Safety Factor: 2.2319

Slice Number	Width [ft]	Weight [lbs]	Base Material	Base Cohesion [psf]	Base Friction Angle [degrees]	Shear Stress [psf]	Shear Strength [psf]	Base Normal Stress [psf]	Pore Pressure [psf]	Effective Normal Stress [psf]
1	53.9343	71707.5	Municipal Soild Waste (MSW)	400	33	443.096	988.945	906.896	0	906.896
2	53.9343	170622	Municipal Soild Waste (MSW)	400	33	852.323	1902.3	2313.34	0	2313.34
3	53.9343	251473	Municipal Soild Waste (MSW)	400	33	1207.38	2694.76	3533.62	0	3533.62
4	53.9343	320195	Municipal Soild Waste (MSW)	400	33	1527.26	3408.7	4633	0	4633
5	53.9343	377639	Municipal Soild Waste (MSW)	400	33	1811.64	4043.39	5610.33	0	5610.33
6	53.9343	424514	Municipal Soild Waste (MSW)	400	33	2060.12	4597.99	6464.35	0	6464.35
7	53.9343	461419	Municipal Soild Waste (MSW)	400	33	2272.31	5071.56	7193.56	0	7193.56
8	53.9343	488861	Municipal Soild Waste (MSW)	400	33	2447.66	5462.93	7796.23	0	7796.23
9	53.9343	507273	Municipal Soild Waste (MSW)	400	33	2585.59	5770.77	8270.25	0	8270.25
10	53.9343	517024	Municipal Soild Waste (MSW)	400	33	2685.36	5993.46	8613.17	0	8613.17
11	53.9343	518428	Municipal Soild Waste (MSW)	400	33	2746.15	6129.13	8822.07	0	8822.07
12	53.9343	511755	Municipal Soild Waste (MSW)	400	33	2766.97	6175.6	8893.64	0	8893.64
13	53.9343	497230	Municipal Soild Waste (MSW)	400	33	2746.69	6130.33	8823.95	0	8823.95
14	53.9343	475047	Municipal Soild Waste (MSW)	400	33	2684	5990.43	8608.52	0	8608.52
15	53.9343	445363	Municipal Soild Waste (MSW)	400	33	2577.42	5752.54	8242.19	0	8242.19
16	53.9343	408309	Municipal Soild Waste (MSW)	400	33	2425.21	5412.83	7719.07	0	7719.07
17	15.36	108954	Protective Cover	0	30	1866.01	4164.74	7244.77	31.2233	7213.54
18	8.6567	59990.7	Liner Geosynthetics (Slopes < 5%)	800	11.31	979.591	2186.35	6931.77	0	6931.77
19	60.6226	387050	Recompacted Soil Liner	213	14	813.213	1815.01	6425.31	0	6425.31
20	60.6226	320199	Recompacted Soil Liner	213	14	699.458	1561.12	5407.02	0	5407.02
21	60.6226	236502	Recompacted Soil Liner	213	14	549.881	1227.28	4068.05	0	4068.05
22	8.69529	26325.3	Liner Geosynthetics (Slopes < 5%)	500	14.0363	586.883	1309.86	3239.45	0	3239.45
23	15.4372	41647.2	Protective Cover	0	30	761.961	1700.62	2976.79	31.2233	2945.56
24	44.7663	84359.8	Municipal Soild Waste (MSW)	400	33	820.274	1830.77	2203.2	0	2203.2
25	44.7663	28799.7	Municipal Soild Waste (MSW)	400	33	422.447	942.86	835.93	0	835.93

Interslice Data

Global Minimum Query (spencer) - Safety Factor: 2.2319

Slice Number	X coordinate [ft]	Y coordinate - Bottom [ft]	Interslice Normal Force [lbs]	Interslice Shear Force [lbs]	Interslice Force Angle [degrees]
1	1887.96	1564.87	0	0	0
2	1941.89	1523.12	13967.7	4335.55	17.2443
3	1995.82	1484.77	56740.1	17612	17.2442
4	2049.76	1449.53	116174	36060	17.2442
5	2103.69	1417.17	183744	57033.7	17.2442
6	2157.63	1387.5	252498	78374.9	17.2442
7	2211.56	1360.37	316818	98339.5	17.2442
8	2265.5	1335.64	372240	115543	17.2443
9	2319.43	1313.18	415328	128917	17.2442
10	2373.36	1292.91	443567	137682	17.2442
11	2427.3	1274.74	455297	141323	17.2442
12	2481.23	1258.6	449660	139573	17.2442
13	2535.17	1244.42	426565	132405	17.2442
14	2589.1	1232.16	386677	120024	17.2443
15	2643.04	1221.76	331413	102870	17.2442
16	2696.97	1213.21	262954	81620.4	17.2442
17	2750.9	1206.46	184273	57197.9	17.2442
18	2766.26	1204.87	167168	51888.5	17.2442
19	2774.92	1204.04	164476	51053	17.2442
20	2835.54	1199.47	144528	44861.1	17.2442
21	2896.17	1197.13	114780	35627.3	17.2442
22	2956.79	1197.01	81942	25434.6	17.2442
23	2965.48	1197.18	76307.3	23685.6	17.2442
24	2980.92	1197.58	63344.2	19661.9	17.2442
25	3025.69	1199.57	22256.4	6908.33	17.2442
26	3070.45	1202.77	0	0	0

List Of Coordinates

Piezoline

X	Y
57.6579	1300.17
213.704	1248.26
218.596	1246.63
218.978	1246.5
219.04	1246.48
219.113	1246.46
238.099	1240.14
299.49	1219.72
307.146	1217.17
308.357	1216.77
320.36	1212.78
322.67	1212.01
324.604	1211.37
351.432	1202.44
353.182	1202.39
353.579	1202.38
355.218	1202.34
365.46	1202.06
386.794	1201.48
478.224	1198.99
490.273	1198.67
495.222	1198.53
517.792	1197.92
598.571	1195.72
611.496	1195.37
714.939	1192.55
746.619	1193.48
903.613	1198.05
913.376	1198.33
938.805	1199.07
949.56	1199.38

1002.6	1200.93
1009.37	1201.13
1112.4	1204.12
1205.97	1206.85
1235.69	1207.71
1246.06	1208.02
1266.27	1201.33
1271.08	1199.74
1389.7	1196.52
1390.01	1196.51
1393.38	1196.42
1436.2	1195.25
1620.63	1200.62
1693.49	1202.74
1826.84	1200.44
2007.96	1197.32
2352.27	1207.25
2420.6	1209.22
2709.42	1208.07
2732.82	1207.16
2737.79	1206.97
2738.83	1206.93
2743.02	1206.77
2771.27	1205.68
2905.12	1200.51
2906.85	1200.44
2958.91	1198.43
2979.82	1197.62
2990.68	1197.2
3033.19	1195.56
3036.23	1195.45
3038.35	1195.36
3088.28	1196.72
3089.73	1196.76

External Boundary

X	Y
0	1298.65
-5.68e-014	948.648
3490.88	948.648
3490.88	1204.12
3211.07	1196.22
3109.13	1198.96
3096.28	1194.71
3092.19	1195.99
3091.37	1196.25
3089.73	1196.76
1908.19	1565.04
1552.15	1562.07
1281.64	1563.33
1126.08	1564.05
1037.88	1564.46
891.692	1550
754.538	1504.01
734.523	1504.03
555.126	1444.72
535.112	1444.74
355.714	1385.43
339.684	1385.45
335.7	1385.45
156.302	1326.14
136.288	1326.17
57.6579	1300.17
56.069	1299.64
55.2745	1299.38
51.3023	1298.07
49.7139	1298.6

40.1835	1298.61
34.156	1296.61
31.1422	1296.62
25.1147	1298.62

Material Boundary

X	Y
55.2745	1299.38
213.23	1246.84
218.122	1245.21
218.505	1245.08
218.567	1245.06
218.64	1245.04
237.625	1238.72
299.016	1218.3
306.672	1215.75
307.883	1215.35
319.886	1211.36
322.197	1210.59
324.13	1209.94
351.169	1200.95
353.141	1200.89
353.538	1200.88
355.177	1200.84
365.42	1200.56
386.753	1199.98
478.183	1197.49
490.232	1197.17
495.181	1197.03
517.751	1196.42
598.53	1194.22
611.455	1193.87
714.94	1191.05

746.663	1191.98
903.657	1196.55
913.419	1196.83
938.849	1197.57
949.603	1197.88
1002.64	1199.43
1009.42	1199.63
1112.44	1202.62
1206.01	1205.35
1235.73	1206.21
1245.84	1206.51
1265.8	1199.91
1270.82	1198.25
1389.66	1195.02
1389.97	1195.01
1393.34	1194.92
1436.2	1193.75
1620.67	1199.12
1693.5	1201.24
1826.82	1198.94
2007.97	1195.82
2352.32	1205.75
2420.61	1207.72
2709.39	1206.57
2732.76	1205.66
2737.73	1205.47
2738.77	1205.43
2742.96	1205.27
2771.22	1204.18
2905.06	1199.01
2906.79	1198.94
2958.85	1196.93
2979.76	1196.13
2990.63	1195.71

3033.13	1194.06
3036.18	1193.95
3038.34	1193.86
3088.32	1195.22
3090.01	1195.27
3092.19	1195.99

Material Boundary

X	Y
56.069	1299.64
213.388	1247.31
218.28	1245.68
218.663	1245.56
218.725	1245.53
218.798	1245.51
237.783	1239.19
299.174	1218.77
306.83	1216.23
308.041	1215.82
320.044	1211.83
322.354	1211.06
324.288	1210.42
351.257	1201.45
353.155	1201.39
353.552	1201.38
355.191	1201.34
365.433	1201.06
386.766	1200.48
478.197	1197.99
490.246	1197.67
495.194	1197.53
517.764	1196.92
598.544	1194.72

611.469	1194.37
714.94	1191.55
746.648	1192.48
903.642	1197.05
913.405	1197.33
938.834	1198.07
949.589	1198.38
1002.63	1199.93
1009.4	1200.13
1112.43	1203.12
1206	1205.85
1235.72	1206.71
1245.92	1207.01
1265.96	1200.38
1270.9	1198.75
1389.67	1195.52
1389.99	1195.51
1393.36	1195.42
1436.2	1194.25
1620.66	1199.62
1693.5	1201.74
1826.82	1199.44
2007.97	1196.32
2352.3	1206.25
2420.61	1208.22
2709.4	1207.07
2732.78	1206.16
2737.75	1205.97
2738.79	1205.93
2742.98	1205.77
2771.24	1204.68
2905.08	1199.51
2906.81	1199.44
2958.87	1197.43

2979.78	1196.62
2990.65	1196.21
3033.15	1194.56
3036.2	1194.45
3038.34	1194.36
3088.3	1195.72
3089.92	1195.77
3091.37	1196.25

Material Boundary

X	Y
57.6579	1300.17
213.704	1248.26
218.596	1246.63
218.978	1246.5
219.04	1246.48
219.113	1246.46
238.099	1240.14
299.49	1219.72
307.146	1217.17
308.357	1216.77
320.36	1212.78
322.67	1212.01
324.604	1211.37
351.432	1202.44
353.182	1202.39
353.579	1202.38
355.218	1202.34
365.46	1202.06
386.794	1201.48
478.224	1198.99
490.273	1198.67
495.222	1198.53

517.792	1197.92
598.571	1195.72
611.496	1195.37
714.939	1192.55
746.619	1193.48
903.613	1198.05
913.376	1198.33
938.805	1199.07
949.56	1199.38
1002.6	1200.93
1009.37	1201.13
1112.4	1204.12
1205.97	1206.85
1235.69	1207.71
1246.06	1208.02
1266.27	1201.33
1271.08	1199.74
1389.7	1196.52
1390.01	1196.51
1393.38	1196.42
1436.2	1195.25
1620.63	1200.62
1693.49	1202.74
1826.84	1200.44
2007.96	1197.32
2352.27	1207.25
2420.6	1209.22
2709.42	1208.07
2732.82	1207.16
2737.79	1206.97
2738.83	1206.93
2743.02	1206.77
2771.27	1205.68
2905.12	1200.51

2906.85	1200.44
2958.91	1198.43
2979.82	1197.62
2990.68	1197.2
3033.19	1195.56
3036.23	1195.45
3038.35	1195.36
3088.28	1196.72
3089.73	1196.76

Material Boundary

X	Y
51.3023	1298.07
212.441	1244.46
217.333	1242.84
217.716	1242.71
217.778	1242.69
217.851	1242.66
236.836	1236.35
298.227	1215.93
305.883	1213.38
307.094	1212.98
319.097	1208.98
321.407	1208.21
323.341	1207.57
350.731	1198.46
353.073	1198.4
353.47	1198.38
355.109	1198.34
365.352	1198.06
386.685	1197.48
478.115	1194.99
490.164	1194.67

495.113	1194.53
517.683	1193.92
598.462	1191.72
611.387	1191.37
714.943	1188.55
746.736	1189.48
903.73	1194.05
913.492	1194.33
938.922	1195.07
949.676	1195.39
1002.72	1196.93
1009.49	1197.13
1112.52	1200.13
1206.09	1202.85
1235.81	1203.72
1245.47	1204
1265.02	1197.53
1270.38	1195.76
1389.59	1192.52
1389.9	1192.51
1393.27	1192.42
1436.2	1191.25
1620.75	1196.62
1693.52	1198.74
1826.77	1196.44
2007.99	1193.32
2352.39	1203.25
2420.65	1205.22
2709.34	1204.07
2732.66	1203.17
2737.64	1202.97
2738.68	1202.93
2742.86	1202.77
2771.12	1201.68

2904.97	1196.51
2906.69	1196.44
2958.76	1194.43
2979.66	1193.63
2990.53	1193.21
3033.03	1191.57
3036.08	1191.45
3038.33	1191.36
3088.39	1192.72
3090.24	1192.77
3090.43	1192.78
3090.44	1192.78
3096.28	1194.71

Material Boundary

X	Y
350.731	1198.46
351.169	1200.95
351.257	1201.45
351.432	1202.44

Material Boundary

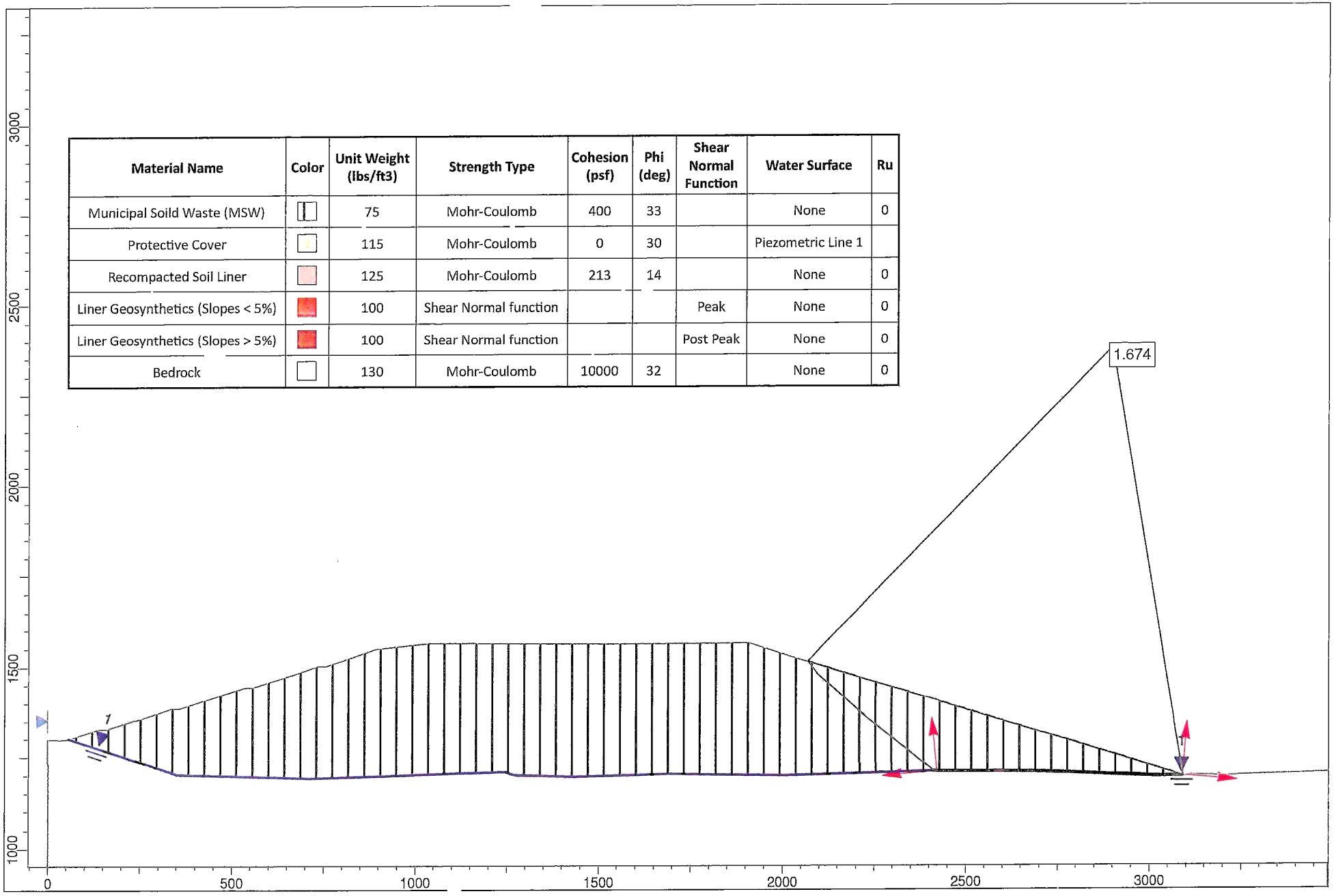
X	Y
1245.47	1204
1245.84	1206.51
1245.92	1207.01
1246.06	1208.02

Material Boundary

X	Y
1270.38	1195.76
1270.82	1198.25

1270.9	1198.75
1271.08	1199.74

Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)	Shear Normal Function	Water Surface	Ru
Municipal Soild Waste (MSW)		75	Mohr-Coulomb	400	33		None	0
Protective Cover		115	Mohr-Coulomb	0	30		Piezometric Line 1	
Recompacted Soil Liner		125	Mohr-Coulomb	213	14		None	0
Liner Geosynthetics (Slopes < 5%)		100	Shear Normal function			Peak	None	0
Liner Geosynthetics (Slopes > 5%)		100	Shear Normal function			Post Peak	None	0
Bedrock		130	Mohr-Coulomb	10000	32		None	0



D-D -- static -- translational -- undrained -Rev1.slim

Slide Analysis Information

Project Summary

File Name. D-D – static – translational -- undrained -Rev1.slim
Slide Modeler Version. 6.023

General Settings

Units of Measurement: Imperial Units
Time Units: days
Permeability Units: feet/second
Failure Direction: Left to Right
Data Output: Standard
Maximum Material Properties: 20
Maximum Support Properties: 20

Analysis Options

Analysis Methods Used

Spencer

Number of slices: 25
Tolerance: 0.005
Maximum number of iterations: 50
Check malpha < 0.2: Yes
Initial trial value of FS: 1
Steffensen Iteration: Yes

Groundwater Analysis

Groundwater Method: Water Surfaces
Pore Fluid Unit Weight 62.4 lbs/ft3

Advanced Groundwater Method: None

Random Numbers

Pseudo-random Seed: 10116
Random Number Generation Method: Park and Miller v.3

Surface Options

Surface Type: Non-Circular Block Search
Number of Surfaces: 7000
Pseudo-Random Surfaces: Enabled
Convex Surfaces Only: Disabled
Left Projection Angle (Start Angle): 95
Left Projection Angle (End Angle) 185
Right Projection Angle (Start Angle): -5
Right Projection Angle (End Angle): 85
Minimum Elevation: Not Defined
Minimum Depth: Not Defined

Material Properties

Property	Municipal Soild Waste (MSW)	Protective Cover	Recompacted Soil Liner	Liner Geosynthetics (Slopes	Liner Geosynthetics (Slopes > 5%)	Bedrock
Color						
Strength Type	Mohr-Coulomb	Mohr-Coulomb	Mohr-Coulomb	Shear Normal function	Shear Normal function	Mohr-Coulomb
Unit Weight [lbs/ft3]	75	115	125	100	100	130
Cohesion [psf]	400	0	213			10000
Friction Angle [deg]	33	30	14			32
Water Surface	None	Piezometric Line 1	None	None	None	None
Hu Value		1				
Ru Value	0		0	0	0	0

Shear Normal Functions

Name: Peak

Normal (psf)	Shear (psf)
0	0
3000	1250
6000	2000
13500	3500

Name: Post Peak

Normal (psf)	Shear (psf)
0	0
3000	875
6000	1290
13500	2100

Global Minimums

Method: spencer

FS: 1.674310
Axis Location: 2899.603, 2379.192
Left Slip Surface Endpoint: 2068.660, 1515.020
Right Slip Surface Endpoint: 3092.375, 1195.934
Resisting Moment=3.89503e+009 lb-ft
Driving Moment=2.32635e+009 lb-ft
Resisting Horizontal Force=2.83221e+006 lb
Driving Horizontal Force=1.69157e+006 lb
Total Slice Area=105285 ft2

Global Minimum Coordinates

Method: spencer

X	Y
2068.66	1515.02
2096.42	1479.15

2223.18	1365.16
2315.87	1287.95
2414.46	1208.06
2440.85	1207.69
2606.89	1206.96
2780.73	1202.04
2855.99	1198.4
2899.7	1196.72
3026.46	1191.82
3054.8	1194.34
3092.38	1195.93

Valid / Invalid Surfaces

Method: spencer

Number of Valid Surfaces: 4466
Number of Invalid Surfaces: 2535

Error Codes:

Error Code -106 reported for 2 surfaces
Error Code -107 reported for 67 surfaces
Error Code -108 reported for 1043 surfaces
Error Code -110 reported for 18 surfaces
Error Code -111 reported for 90 surfaces
Error Code -112 reported for 1315 surfaces

Error Codes

The following errors were encountered during the computation:

-106 = Average slice width is less than 0.0001 * (maximum horizontal extent of soil region). This limitation is imposed to avoid numerical errors which may result from too many slices, or too small a slip region.
-107 = Total driving moment or total driving force is negative. This will occur if the wrong failure direction is specified, or if high external or anchor loads are applied against the failure direction.
-108 = Total driving moment or total driving force < 0.1. This is to limit the calculation of extremely high safety factors if the driving force is very small (0.1 is an arbitrary

number).
-110 = The water table or a piezoline does not span the slip region for a given slip surface, when Water Surfaces is specified as the method of pore pressure calculation. If this error occurs, check that the water table or piezoline(s) span the appropriate soil cells.
-111 = safety factor equation did not converge
-112 = The coefficient M-Alpha = cos(alpha)(1+tan(alpha)tan(phi)/F) < 0.2 for the final iteration of the safety factor calculation. This screens out some slip surfaces which may not be valid in the context of the analysis, in particular, deep seated slip surfaces with many high negative base angle slices in the passive zone.

Slice Data

Global Minimum Query (spencer) - Safety Factor: 1.67431

Slice Number	Width [ft]	Weight [lbs]	Base Material	Base Cohesion [psf]	Base Friction Angle [degrees]	Shear Stress [psf]	Shear Strength [psf]	Base Normal Stress [psf]	Pore Pressure [psf]	Effective Normal Stress [psf]
1	27.7597	28334.2	Municipal Soild Waste (MSW)	400	33	410.61	687.489	442.694	0	442.694
2	42.2543	125596	Municipal Soild Waste (MSW)	400	33	970.591	1625.07	1886.43	0	1886.43
3	42.2543	204272	Municipal Soild Waste (MSW)	400	33	1452.38	2431.74	3128.62	0	3128.62
4	42.2543	282948	Municipal Soild Waste (MSW)	400	33	1934.18	3238.42	4370.79	0	4370.79
5	46.3437	395467	Municipal Soild Waste (MSW)	400	33	2481.1	4154.13	5780.85	0	5780.85
6	46.3437	479446	Municipal Soild Waste (MSW)	400	33	2964.54	4963.56	7027.26	0	7027.26
7	48.7098	592419	Municipal Soild Waste (MSW)	400	33	3485.32	5835.5	8369.94	0	8369.94
8	48.7098	681143	Municipal Soild Waste (MSW)	400	33	3976.5	6657.89	9636.3	0	9636.3
9	1.17125	17493.7	Protective Cover	0	30	3627.74	6073.96	10551.1	30.6638	10520.4
10	26.3924	387734	Liner Geosynthetics (Slopes < 5%)	800	11.31	2301.97	3854.21	15271	0	15271
11	63.3806	866444	Liner Geosynthetics (Slopes < 5%)	800	11.31	2184.07	3656.81	14284	0	14284
12	63.3806	773892	Liner Geosynthetics (Slopes < 5%)	800	11.31	2003.63	3354.7	12773.5	0	12773.5
13	39.278	433152	Recompacted Soil Liner	213	14	1846.77	3092.07	11547.3	0	11547.3
14	51.367	516794	Recompacted Soil Liner	213	14	1678.88	2810.96	10419.8	0	10419.8
15	51.367	463916	Recompacted Soil Liner	213	14	1520.64	2546.02	9357.25	0	9357.25
16	71.1047	550514	Recompacted Soil Liner	213	14	1322.49	2214.26	8026.61	0	8026.61
17	75.2567	469864	Recompacted Soil Liner	213	14	1082.95	1813.19	6417.99	0	6417.99
18	43.7111	221664	Recompacted Soil Liner	213	14	908.01	1520.29	5243.25	0	5243.25
19	63.3815	251908	Recompacted Soil Liner	213	14	740.239	1239.39	4116.6	0	4116.6
20	63.3815	169633	Recompacted Soil Liner	213	14	541.64	906.873	2782.97	0	2782.97
21	27.9284	42845.7	Recompacted Soil Liner	213	14	384.257	643.365	1726.1	0	1726.1
22	0.409487	432.801	Liner Geosynthetics (Slopes < 5%)	5.68434e-014	22.6199	299.321	501.156	1202.77	0	1202.77

23	30.9788	19610.5	Liner Geosynthetics (Slopes < 5%)	0	22.6199	174.296	291.826	700.382	0	700.382
24	4.35953	680.485	Protective Cover	0	30	38.1823	63.929	171.066	60.3376	110.728
25	2.23697	96.7611	Liner Geosynthetics (Slopes < 5%)	0	22.6199	11.9097	19.9406	47.8577	0	47.8577

Interslice Data

Global Minimum Query (spencer) - Safety Factor 1.67431

Slice Number	X coordinate [ft]	Y coordinate - Bottom [ft]	Interslice Normal Force [lbs]	Interslice Shear Force [lbs]	Interslice Force Angle [degrees]
1	2068.66	1515.02	0	0	0
2	2096.42	1479.15	4481.45	1316.16	16.367
3	2138.67	1441.15	35147.9	10322.6	16.367
4	2180.93	1403.16	92654.6	27211.8	16.367
5	2223.18	1365.16	177001	51983.6	16.367
6	2269.53	1326.55	285194	83758.8	16.367
7	2315.87	1287.95	419102	123086	16.367
8	2364.58	1248.48	579682	170247	16.367
9	2413.29	1209.01	766319	225061	16.367
10	2414.46	1208.06	772084	226754	16.367
11	2440.85	1207.69	717040	210588	16.367
12	2504.23	1207.41	582572	171096	16.367
13	2567.61	1207.13	459121	134839	16.367
14	2606.89	1206.96	388567	114118	16.367
15	2658.26	1205.51	317470	93237.8	16.367
16	2709.63	1204.05	252956	74290.7	16.367
17	2780.73	1202.04	175066	51415.2	16.367
18	2855.99	1198.4	116928	34340.8	16.3671
19	2899.7	1196.72	86090.4	25283.9	16.367
20	2963.08	1194.27	49248.2	14463.7	16.367
21	3026.46	1191.82	21729.4	6381.71	16.367
22	3054.39	1194.3	6717.97	1973	16.367
23	3054.8	1194.34	6551.67	1924.16	16.367
24	3085.78	1195.65	229.371	67.364	16.367

25	3090.14	1195.84	31.195	9.16169	16.367
26	3092.38	1195.93	0	0	0

List Of Coordinates

Piezoline

X	Y
57.6579	1300.17
213.704	1248.26
218.596	1246.63
218.978	1246.5
219.04	1246.48
219.113	1246.46
238.099	1240.14
299.49	1219.72
307.146	1217.17
308.357	1216.77
320.36	1212.78
322.67	1212.01
324.604	1211.37
351.432	1202.44
353.182	1202.39
353.579	1202.38
355.218	1202.34
365.46	1202.06
386.794	1201.48
478.224	1198.99
490.273	1198.67
495.222	1198.53
517.792	1197.92
598.571	1195.72
611.496	1195.37
714.939	1192.55

746.619	1193.48
903.613	1198.05
913.376	1198.33
938.805	1199.07
949.56	1199.38
1002.6	1200.93
1009.37	1201.13
1112.4	1204.12
1205.97	1206.85
1235.69	1207.71
1246.06	1208.02
1266.27	1201.33
1271.08	1199.74
1389.7	1196.52
1390.01	1196.51
1393.38	1196.42
1436.2	1195.25
1620.63	1200.62
1693.49	1202.74
1826.84	1200.44
2007.96	1197.32
2352.27	1207.25
2420.6	1209.22
2709.42	1208.07
2732.82	1207.16
2737.79	1206.97
2738.83	1206.93
2743.02	1206.77
2771.27	1205.68
2905.12	1200.51
2906.85	1200.44
2958.91	1198.43
2979.82	1197.62
2990.68	1197.2

3033.19	1195.56
3036.23	1195.45
3038.35	1195.36
3088.28	1196.72
3089.73	1196.76

Block Search Polyline

X	Y
3091.73	1196.14
3090	1195.54
3038.39	1194.12
2990.68	1195.94
2979.8	1196.35
2958.97	1197.17
2906.87	1199.2
2771.27	1204.41
2743.01	1205.52
2709.46	1206.81
2420.61	1207.96

External Boundary

X	Y
0	1298.65
-5.68e-014	948.648
3490.88	948.648
3490.88	1204.12
3211.07	1196.22
3109.13	1198.96
3096.28	1194.71
3092.19	1195.99
3091.37	1196.25
3089.73	1196.76

1908.19	1565.04
1552.15	1562.07
1281.64	1563.33
1126.08	1564.05
1037.88	1564.46
891.692	1550
754.538	1504.01
734.523	1504.03
555.126	1444.72
535.112	1444.74
355.714	1385.43
339.684	1385.45
335.7	1385.45
156.302	1326.14
136.288	1326.17
57.6579	1300.17
56.069	1299.64
55.2745	1299.38
51.3023	1298.07
49.7139	1298.6
40.1835	1298.61
34.156	1296.61
31.1422	1296.62
25.1147	1298.62

Material Boundary

X	Y
55.2745	1299.38
213.23	1246.84
218.122	1245.21
218.505	1245.08
218.567	1245.06
218.64	1245.04

237.625	1238.72
299.016	1218.3
306.672	1215.75
307.883	1215.35
319.886	1211.36
322.197	1210.59
324.13	1209.94
351.169	1200.95
353.141	1200.89
353.538	1200.88
355.177	1200.84
365.42	1200.56
386.753	1199.98
478.183	1197.49
490.232	1197.17
495.181	1197.03
517.751	1196.42
598.53	1194.22
611.455	1193.87
714.94	1191.05
746.663	1191.98
903.657	1196.55
913.419	1196.83
938.849	1197.57
949.603	1197.88
1002.64	1199.43
1009.42	1199.63
1112.44	1202.62
1206.01	1205.35
1235.73	1206.21
1245.84	1206.51
1265.8	1199.91
1270.82	1198.25
1389.66	1195.02

1389.97	1195.01
1393.34	1194.92
1436.2	1193.75
1620.67	1199.12
1693.5	1201.24
1826.82	1198.94
2007.97	1195.82
2352.32	1205.75
2420.61	1207.72
2709.39	1206.57
2732.76	1205.66
2737.73	1205.47
2738.77	1205.43
2742.96	1205.27
2771.22	1204.18
2905.06	1199.01
2906.79	1198.94
2958.85	1196.93
2979.76	1196.13
2990.63	1195.71
3033.13	1194.06
3036.18	1193.95
3038.34	1193.86
3088.32	1195.22
3090.01	1195.27
3092.19	1195.99

Material Boundary

X	Y
56.069	1299.64
213.388	1247.31
218.28	1245.68
218.663	1245.56

218.725	1245.53
218.798	1245.51
237.783	1239.19
299.174	1218.77
306.83	1216.23
308.041	1215.82
320.044	1211.83
322.354	1211.06
324.288	1210.42
351.257	1201.45
353.155	1201.39
353.552	1201.38
355.191	1201.34
365.433	1201.06
386.766	1200.48
478.197	1197.99
490.246	1197.67
495.194	1197.53
517.764	1196.92
598.544	1194.72
611.469	1194.37
714.94	1191.55
746.648	1192.48
903.642	1197.05
913.405	1197.33
938.834	1198.07
949.589	1198.38
1002.63	1199.93
1009.4	1200.13
1112.43	1203.12
1206	1205.85
1235.72	1206.71
1245.92	1207.01
1265.96	1200.38

1270.9	1198.75
1389.67	1195.52
1389.99	1195.51
1393.36	1195.42
1436.2	1194.25
1620.66	1199.62
1693.5	1201.74
1826.82	1199.44
2007.97	1196.32
2352.3	1206.25
2420.61	1208.22
2709.4	1207.07
2732.78	1206.16
2737.75	1205.97
2738.79	1205.93
2742.98	1205.77
2771.24	1204.68
2905.08	1199.51
2906.81	1199.44
2958.87	1197.43
2979.78	1196.62
2990.65	1196.21
3033.15	1194.56
3036.2	1194.45
3038.34	1194.36
3088.3	1195.72
3089.92	1195.77
3091.37	1196.25

Material Boundary

X	Y
57.6579	1300.17
213.704	1248.26

218.596	1246.63
218.978	1246.5
219.04	1246.48
219.113	1246.46
238.099	1240.14
299.49	1219.72
307.146	1217.17
308.357	1216.77
320.36	1212.78
322.67	1212.01
324.604	1211.37
351.432	1202.44
353.182	1202.39
353.579	1202.38
355.218	1202.34
365.46	1202.06
386.794	1201.48
478.224	1198.99
490.273	1198.67
495.222	1198.53
517.792	1197.92
598.571	1195.72
611.496	1195.37
714.939	1192.55
746.619	1193.48
903.613	1198.05
913.376	1198.33
938.805	1199.07
949.56	1199.38
1002.6	1200.93
1009.37	1201.13
1112.4	1204.12
1205.97	1206.85
1235.69	1207.71

1246.06	1208.02
1266.27	1201.33
1271.08	1199.74
1389.7	1196.52
1390.01	1196.51
1393.38	1196.42
1436.2	1195.25
1620.63	1200.62
1693.49	1202.74
1826.84	1200.44
2007.96	1197.32
2352.27	1207.25
2420.6	1209.22
2709.42	1208.07
2732.82	1207.16
2737.79	1206.97
2738.83	1206.93
2743.02	1206.77
2771.27	1205.68
2905.12	1200.51
2906.85	1200.44
2958.91	1198.43
2979.82	1197.62
2990.68	1197.2
3033.19	1195.56
3036.23	1195.45
3038.35	1195.36
3088.28	1196.72
3089.73	1196.76

Material Boundary

X	Y
51.3023	1298.07

212.441	1244.46
217.333	1242.84
217.716	1242.71
217.778	1242.69
217.851	1242.66
236.836	1236.35
298.227	1215.93
305.883	1213.38
307.094	1212.98
319.097	1208.98
321.407	1208.21
323.341	1207.57
350.731	1198.46
353.073	1198.4
353.47	1198.38
355.109	1198.34
365.352	1198.06
386.685	1197.48
478.115	1194.99
490.164	1194.67
495.113	1194.53
517.683	1193.92
598.462	1191.72
611.387	1191.37
714.943	1188.55
746.736	1189.48
903.73	1194.05
913.492	1194.33
938.922	1195.07
949.676	1195.39
1002.72	1196.93
1009.49	1197.13
1112.52	1200.13
1206.09	1202.85

1235.81	1203.72
1245.47	1204
1265.02	1197.53
1270.38	1195.76
1389.59	1192.52
1389.9	1192.51
1393.27	1192.42
1436.2	1191.25
1620.75	1196.62
1693.52	1198.74
1826.77	1196.44
2007.99	1193.32
2352.39	1203.25
2420.65	1205.22
2709.34	1204.07
2732.66	1203.17
2737.64	1202.97
2738.68	1202.93
2742.86	1202.77
2771.12	1201.68
2904.97	1196.51
2906.69	1196.44
2958.76	1194.43
2979.66	1193.63
2990.53	1193.21
3033.03	1191.57
3036.08	1191.45
3038.33	1191.36
3088.39	1192.72
3090.24	1192.77
3090.43	1192.78
3090.44	1192.78
3096.28	1194.71

Material Boundary

X	Y
350.731	1198.46
351.169	1200.95
351.257	1201.45
351.432	1202.44

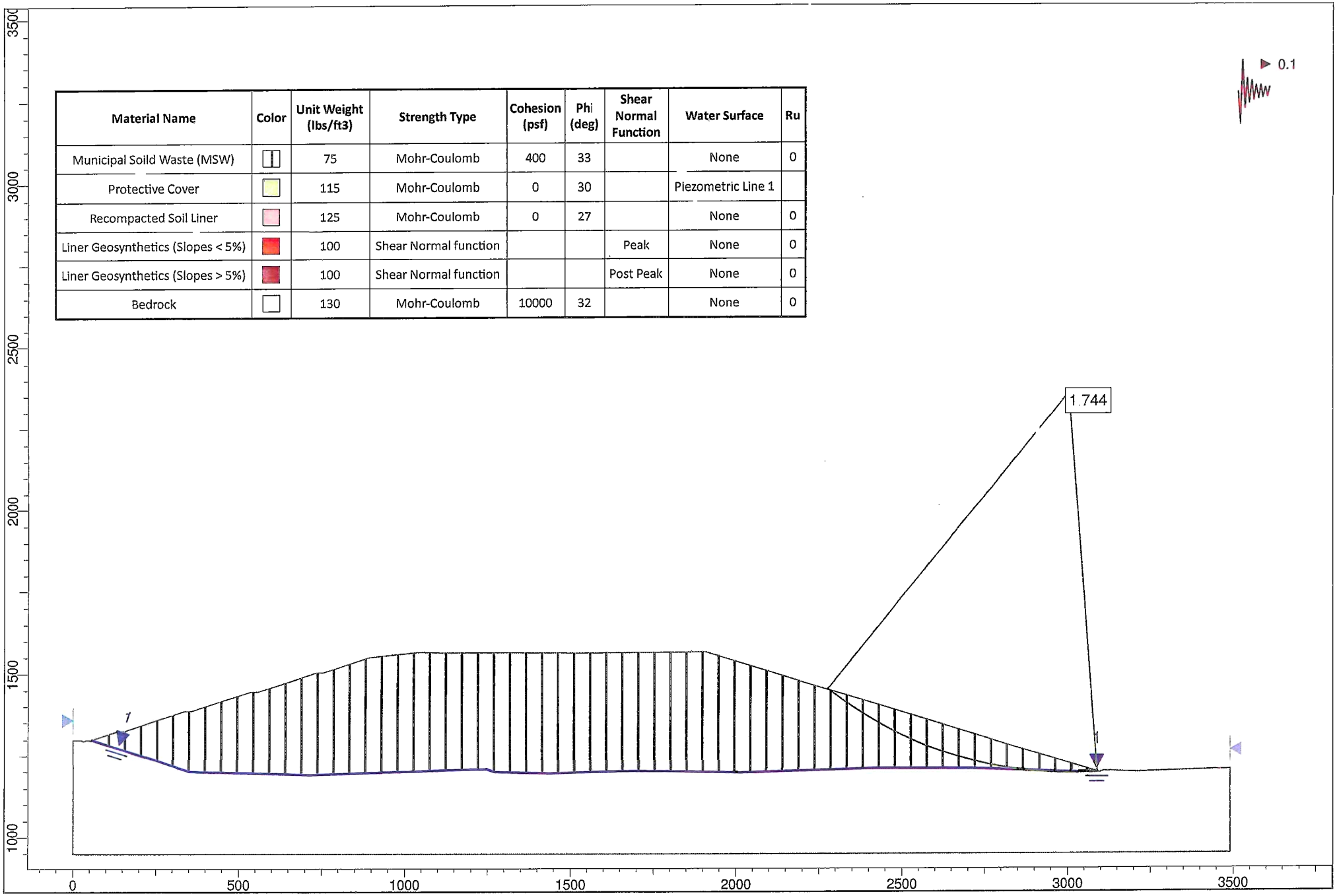
Material Boundary

X	Y
1245.47	1204
1245.84	1206.51
1245.92	1207.01
1246.06	1208.02

Material Boundary

X	Y
1270.38	1195.76
1270.82	1198.25
1270.9	1198.75
1271.08	1199.74

Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)	Shear Normal Function	Water Surface	Ru
Municipal Soild Waste (MSW)		75	Mohr-Coulomb	400	33		None	0
Protective Cover		115	Mohr-Coulomb	0	30		Piezometric Line 1	
Recompacted Soil Liner		125	Mohr-Coulomb	0	27		None	0
Liner Geosynthetics (Slopes < 5%)		100	Shear Normal function			Peak	None	0
Liner Geosynthetics (Slopes > 5%)		100	Shear Normal function			Post Peak	None	0
Bedrock		130	Mohr-Coulomb	10000	32		None	0



D-D -- seismic -- rotational -- drained -Rev1.slim

Slide Analysis Information

Project Summary

File Name: D-D – seismic -- rotational – drained -Rev1.slim
Slide Modeler Version 6.023

General Settings

Units of Measurement: Imperial Units
Time Units: days
Permeability Units: feet/second
Failure Direction: Left to Right
Data Output: Standard
Maximum Material Properties: 20
Maximum Support Properties: 20

Analysis Options

Analysis Methods Used

Spencer

Number of slices: 25
Tolerance: 0.005
Maximum number of iterations: 50
Check malpha < 0.2: Yes
Initial trial value of FS: 1
Steffensen Iteration: Yes

Groundwater Analysis

Groundwater Method: Water Surfaces
Pore Fluid Unit Weight: 62.4 lbs/ft3

Advanced Groundwater Method: None

Random Numbers

Pseudo-random Seed: 10116
Random Number Generation Method: Park and Miller v.3

Surface Options

Surface Type: Circular
Search Method: Auto Refine Search
Divisions along slope: 20
Circles per division: 10
Number of iterations: 10
Divisions to use in next iteration: 50%
Composite Surfaces: Disabled
Minimum Elevation: 0
Minimum Depth: 5

Loading

Seismic Load Coefficient (Horizontal): 0.1

Material Properties

Property	Municipal Soild Waste (MSW)	Protective Cover	Recompacted Soil Liner	Liner Geosynthetics (Slopes	Liner Geosynthetics (Slopes > 5%)	Bedrock
Color						
Strength Type	Mohr-Coulomb	Mohr-Coulomb	Mohr-Coulomb	Shear Normal function	Shear Normal function	Mohr-Coulomb
Unit Weight [lbs/ft3]	75	115	125	100	100	130
Cohesion [psf]	400	0	0			10000
Friction Angle [deg]	33	30	27			32
Water Surface	None	Piezometric Line 1	None	None	None	None

Hu Value		1			
Ru Value	0	0	0	0	0

Shear Normal Functions

Name. Peak

Normal (psf)	Shear (psf)
0	0
3000	1250
6000	2000
13500	3500

Name. Post Peak

Normal (psf)	Shear (psf)
0	0
3000	875
6000	1290
13500	2100

Global Minimums

Method: spencer

FS: 1.743600
Center: 3004.527, 2356.490
Radius: 1162.955
Left Slip Surface Endpoint: 2275.212, 1450.640
Right Slip Surface Endpoint: 3089.997, 1196.679
Resisting Moment=2.6631e+009 lb-ft
Driving Moment=1.52736e+009 lb-ft
Resisting Horizontal Force=2.16201e+006 lb
Driving Horizontal Force=1.23997e+006 lb
Total Slice Area=46398.1 ft2

Valid / Invalid Surfaces

Method: spencer

Number of Valid Surfaces: 11599
Number of Invalid Surfaces: 0

Slice Data

Global Minimum Query (spencer) - Safety Factor: 1.7436

Slice Number	Width [ft]	Weight [lbs]	Base Material	Base Cohesion [psf]	Base Friction Angle [degrees]	Shear Stress [psf]	Shear Strength [psf]	Base Normal Stress [psf]	Pore Pressure [psf]	Effective Normal Stress [psf]
1	34.6061	20787	Municipal Soild Waste (MSW)	400	33	355.329	619.552	338.08	0	338.08
2	34.6061	59766.8	Municipal Soild Waste (MSW)	400	33	649.594	1132.63	1128.15	0	1128.15
3	34.6061	93754.9	Municipal Soild Waste (MSW)	400	33	923.004	1609.35	1862.24	0	1862.24
4	34.6061	123113	Municipal Soild Waste (MSW)	400	33	1174.96	2048.66	2538.72	0	2538.72
5	34.6061	148146	Municipal Soild Waste (MSW)	400	33	1404.87	2449.53	3156	0	3156
6	34.6061	169110	Municipal Soild Waste (MSW)	400	33	1612.12	2810.89	3712.45	0	3712.45
7	34.6061	186227	Municipal Soild Waste (MSW)	400	33	1796.06	3131.61	4206.31	0	4206.31
8	34.6061	199685	Municipal Soild Waste (MSW)	400	33	1956.02	3410.51	4635.77	0	4635.77
9	34.6061	209647	Municipal Soild Waste (MSW)	400	33	2091.24	3646.28	4998.84	0	4998.84
10	34.6061	216254	Municipal Soild Waste (MSW)	400	33	2200.91	3837.5	5293.28	0	5293.28
11	34.6061	219627	Municipal Soild Waste (MSW)	400	33	2284.12	3982.6	5516.71	0	5516.71
12	34.6061	219872	Municipal Soild Waste (MSW)	400	33	2339.9	4079.85	5666.48	0	5666.48
13	34.6061	217080	Municipal Soild Waste (MSW)	400	33	2367.13	4127.32	5739.56	0	5739.56
14	34.6061	211329	Municipal Soild Waste (MSW)	400	33	2364.58	4122.88	5732.74	0	5732.74
15	34.6061	202685	Municipal Soild Waste (MSW)	400	33	2330.88	4064.12	5642.25	0	5642.25
16	34.6061	191206	Municipal Soild Waste (MSW)	400	33	2264.5	3948.39	5464.03	0	5464.03
17	34.6061	176938	Municipal Soild Waste (MSW)	400	33	2163.72	3772.67	5193.45	0	5193.45
18	12.8468	61828.2	Protective Cover	0	30	1595.04	2781.12	4848.27	31.2233	4817.05
19	7.24158	33960.1	Liner Geosynthetics (Slopes < 5%)	500	14.0363	943.519	1645.12	4580.48	0	4580.48
20	38.0725	166301	Recompacted Soil Liner	0	27	1298.58	2264.2	4443.73	0	4443.73
21	38.0725	142565	Recompacted Soil Liner	0	27	1140.81	1989.12	3903.86	0	3903.86
22	38.0725	112867	Recompacted Soil Liner	0	27	925.895	1614.39	3168.42	0	3168.42
23	38.0725	77229.1	Recompacted Soil Liner	0	27	649.782	1132.96	2223.56	0	2223.56

24	28.3163	32303.3	Liner Geosynthetics (Slopes < 5%)	0	22.6199	297.647	518.977	1245.54	0	1245.54
25	25.7874	9894.33	Protective Cover	0	30	136.496	237.995	446.216	33.9957	412.22

Interslice Data

Global Minimum Query (spencer) - Safety Factor 1.7436

Slice Number	X coordinate [ft]	Y coordinate - Bottom [ft]	Interslice Normal Force [lbs]	Interslice Shear Force [lbs]	Interslice Force Angle [degrees]
1	2275.21	1450.64	0	0	0
2	2309.82	1423.84	-1160.08	-468.764	22.0026
3	2344.42	1399.03	10313.1	4167.28	22.0025
4	2379.03	1376.07	30489	12319.9	22.0025
5	2413.64	1354.83	56041.6	22645.2	22.0026
6	2448.24	1335.21	84157.5	34006.2	22.0026
7	2482.85	1317.11	112466	45445.1	22.0026
8	2517.45	1300.45	138988	56162.1	22.0026
9	2552.06	1285.16	162095	65498.8	22.0025
10	2586.67	1271.2	180477	72926.7	22.0025
11	2621.27	1258.5	193126	78037.8	22.0025
12	2655.88	1247.03	199315	80538.8	22.0025
13	2690.48	1236.74	198594	80247.3	22.0025
14	2725.09	1227.61	190779	77089.5	22.0025
15	2759.7	1219.6	175958	71100.9	22.0026
16	2794.3	1212.69	154495	62427.9	22.0025
17	2828.91	1206.87	127035	51331.9	22.0025
18	2863.52	1202.12	94523.6	38194.9	22.0025
19	2876.36	1200.62	87465.2	35342.7	22.0025
20	2883.6	1199.84	87599.1	35396.8	22.0025
21	2921.68	1196.49	69653.6	28145.5	22.0026
22	2959.75	1194.4	48630.7	19650.6	22.0026
23	2997.82	1193.55	27325.4	11041.6	22.0026
24	3035.89	1193.96	9403.13	3799.6	22.0026
25	3064.21	1195.07	2820.48	1139.69	22.0025

26	3090	1196.68	0	0	0

List Of Coordinates

Piezoline

X	Y
57.6579	1300.17
213.704	1248.26
218.596	1246.63
218.978	1246.5
219.04	1246.48
219.113	1246.46
238.099	1240.14
299.49	1219.72
307.146	1217.17
308.357	1216.77
320.36	1212.78
322.67	1212.01
324.604	1211.37
351.432	1202.44
353.182	1202.39
353.579	1202.38
355.218	1202.34
365.46	1202.06
386.794	1201.48
478.224	1198.99
490.273	1198.67
495.222	1198.53
517.792	1197.92
598.571	1195.72
611.496	1195.37
714.939	1192.55
746.619	1193.48

903.613	1198.05
913.376	1198.33
938.805	1199.07
949.56	1199.38
1002.6	1200.93
1009.37	1201.13
1112.4	1204.12
1205.97	1206.85
1235.69	1207.71
1246.06	1208.02
1266.27	1201.33
1271.08	1199.74
1389.7	1196.52
1390.01	1196.51
1393.38	1196.42
1436.2	1195.25
1620.63	1200.62
1693.49	1202.74
1826.84	1200.44
2007.96	1197.32
2352.27	1207.25
2420.6	1209.22
2709.42	1208.07
2732.82	1207.16
2737.79	1206.97
2738.83	1206.93
2743.02	1206.77
2771.27	1205.68
2905.12	1200.51
2906.85	1200.44
2958.91	1198.43
2979.82	1197.62
2990.68	1197.2
3033.19	1195.56

3036.23	1195.45
3038.35	1195.36
3088.28	1196.72
3089.73	1196.76

External Boundary

X	Y
0	1298.65
-5.68e-014	948.648
3490.88	948.648
3490.88	1204.12
3211.07	1196.22
3109.13	1198.96
3096.28	1194.71
3092.19	1195.99
3091.37	1196.25
3089.73	1196.76
1908.19	1565.04
1552.15	1562.07
1281.64	1563.33
1126.08	1564.05
1037.88	1564.46
891.692	1550
754.538	1504.01
734.523	1504.03
555.126	1444.72
535.112	1444.74
355.714	1385.43
339.684	1385.45
335.7	1385.45
156.302	1326.14
136.288	1326.17
57.6579	1300.17

56.069	1299.64
55.2745	1299.38
51.3023	1298.07
49.7139	1298.6
40.1835	1298.61
34.156	1296.61
31.1422	1296.62
25.1147	1298.62

Material Boundary

X	Y
55.2745	1299.38
213.23	1246.84
218.122	1245.21
218.505	1245.08
218.567	1245.06
218.64	1245.04
237.625	1238.72
299.016	1218.3
306.672	1215.75
307.883	1215.35
319.886	1211.36
322.197	1210.59
324.13	1209.94
351.169	1200.95
353.141	1200.89
353.538	1200.88
355.177	1200.84
365.42	1200.56
386.753	1199.98
478.183	1197.49
490.232	1197.17
495.181	1197.03

517.751	1196.42
598.53	1194.22
611.455	1193.87
714.94	1191.05
746.663	1191.98
903.657	1196.55
913.419	1196.83
938.849	1197.57
949.603	1197.88
1002.64	1199.43
1009.42	1199.63
1112.44	1202.62
1206.01	1205.35
1235.73	1206.21
1245.84	1206.51
1265.8	1199.91
1270.82	1198.25
1389.66	1195.02
1389.97	1195.01
1393.34	1194.92
1436.2	1193.75
1620.67	1199.12
1693.5	1201.24
1826.82	1198.94
2007.97	1195.82
2352.32	1205.75
2420.61	1207.72
2709.39	1206.57
2732.76	1205.66
2737.73	1205.47
2738.77	1205.43
2742.96	1205.27
2771.22	1204.18
2905.06	1199.01

2906.79	1198.94
2958.85	1196.93
2979.76	1196.13
2990.63	1195.71
3033.13	1194.06
3036.18	1193.95
3038.34	1193.86
3088.32	1195.22
3090.01	1195.27
3092.19	1195.99

Material Boundary

X	Y
56.069	1299.64
213.388	1247.31
218.28	1245.68
218.663	1245.56
218.725	1245.53
218.798	1245.51
237.783	1239.19
299.174	1218.77
306.83	1216.23
308.041	1215.82
320.044	1211.83
322.354	1211.06
324.288	1210.42
351.257	1201.45
353.155	1201.39
353.552	1201.38
355.191	1201.34
365.433	1201.06
386.766	1200.48
478.197	1197.99

490.246	1197.67
495.194	1197.53
517.764	1196.92
598.544	1194.72
611.469	1194.37
714.94	1191.55
746.648	1192.48
903.642	1197.05
913.405	1197.33
938.834	1198.07
949.589	1198.38
1002.63	1199.93
1009.4	1200.13
1112.43	1203.12
1206	1205.85
1235.72	1206.71
1245.92	1207.01
1265.96	1200.38
1270.9	1198.75
1389.67	1195.52
1389.99	1195.51
1393.36	1195.42
1436.2	1194.25
1620.66	1199.62
1693.5	1201.74
1826.82	1199.44
2007.97	1196.32
2352.3	1206.25
2420.61	1208.22
2709.4	1207.07
2732.78	1206.16
2737.75	1205.97
2738.79	1205.93
2742.98	1205.77

2771.24	1204.68
2905.08	1199.51
2906.81	1199.44
2958.87	1197.43
2979.78	1196.62
2990.65	1196.21
3033.15	1194.56
3036.2	1194.45
3038.34	1194.36
3088.3	1195.72
3089.92	1195.77
3091.37	1196.25

Material Boundary

X	Y
57.6579	1300.17
213.704	1248.26
218.596	1246.63
218.978	1246.5
219.04	1246.48
219.113	1246.46
238.099	1240.14
299.49	1219.72
307.146	1217.17
308.357	1216.77
320.36	1212.78
322.67	1212.01
324.604	1211.37
351.432	1202.44
353.182	1202.39
353.579	1202.38
355.218	1202.34
365.46	1202.06

386.794	1201.48
478.224	1198.99
490.273	1198.67
495.222	1198.53
517.792	1197.92
598.571	1195.72
611.496	1195.37
714.939	1192.55
746.619	1193.48
903.613	1198.05
913.376	1198.33
938.805	1199.07
949.56	1199.38
1002.6	1200.93
1009.37	1201.13
1112.4	1204.12
1205.97	1206.85
1235.69	1207.71
1246.06	1208.02
1266.27	1201.33
1271.08	1199.74
1389.7	1196.52
1390.01	1196.51
1393.38	1196.42
1436.2	1195.25
1620.63	1200.62
1693.49	1202.74
1826.84	1200.44
2007.96	1197.32
2352.27	1207.25
2420.6	1209.22
2709.42	1208.07
2732.82	1207.16
2737.79	1206.97

2738.83	1206.93
2743.02	1206.77
2771.27	1205.68
2905.12	1200.51
2906.85	1200.44
2958.91	1198.43
2979.82	1197.62
2990.68	1197.2
3033.19	1195.56
3036.23	1195.45
3038.35	1195.36
3088.28	1196.72
3089.73	1196.76

Material Boundary

X	Y
51.3023	1298.07
212.441	1244.46
217.333	1242.84
217.716	1242.71
217.778	1242.69
217.851	1242.66
236.836	1236.35
298.227	1215.93
305.883	1213.38
307.094	1212.98
319.097	1208.98
321.407	1208.21
323.341	1207.57
350.731	1198.46
353.073	1198.4
353.47	1198.38
355.109	1198.34

365.352	1198.06
386.685	1197.48
478.115	1194.99
490.164	1194.67
495.113	1194.53
517.683	1193.92
598.462	1191.72
611.387	1191.37
714.943	1188.55
746.736	1189.48
903.73	1194.05
913.492	1194.33
938.922	1195.07
949.676	1195.39
1002.72	1196.93
1009.49	1197.13
1112.52	1200.13
1206.09	1202.85
1235.81	1203.72
1245.47	1204
1265.02	1197.53
1270.38	1195.76
1389.59	1192.52
1389.9	1192.51
1393.27	1192.42
1436.2	1191.25
1620.75	1196.62
1693.52	1198.74
1826.77	1196.44
2007.99	1193.32
2352.39	1203.25
2420.65	1205.22
2709.34	1204.07
2732.66	1203.17

2737.64	1202.97
2738.68	1202.93
2742.86	1202.77
2771.12	1201.68
2904.97	1196.51
2906.69	1196.44
2958.76	1194.43
2979.66	1193.63
2990.53	1193.21
3033.03	1191.57
3036.08	1191.45
3038.33	1191.36
3088.39	1192.72
3090.24	1192.77
3090.43	1192.78
3090.44	1192.78
3096.28	1194.71

Material Boundary

X	Y
350.731	1198.46
351.169	1200.95
351.257	1201.45
351.432	1202.44

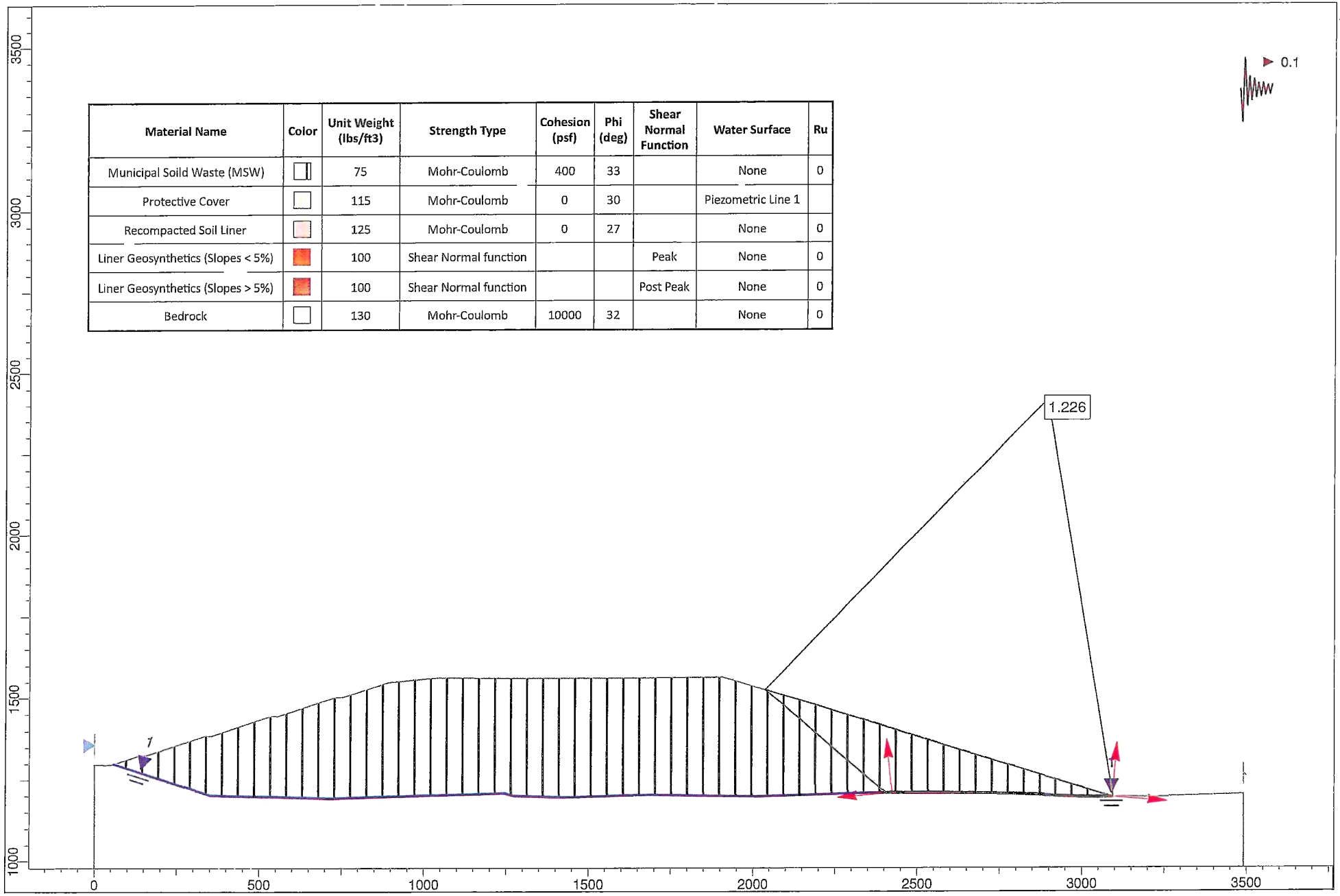
Material Boundary

X	Y
1245.47	1204
1245.84	1206.51
1245.92	1207.01
1246.06	1208.02

Material Boundary

X	Y
1270.38	1195.76
1270.82	1198.25
1270.9	1198.75
1271.08	1199.74

Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)	Shear Normal Function	Water Surface	Ru
Municipal Soild Waste (MSW)		75	Mohr-Coulomb	400	33		None	0
Protective Cover		115	Mohr-Coulomb	0	30		Piezometric Line 1	
Recompacted Soil Liner		125	Mohr-Coulomb	0	27		None	0
Liner Geosynthetics (Slopes < 5%)		100	Shear Normal function			Peak	None	0
Liner Geosynthetics (Slopes > 5%)		100	Shear Normal function			Post Peak	None	0
Bedrock		130	Mohr-Coulomb	10000	32		None	0



D-D -- seismic -- translational -- drained -Rev1.slim

Slide Analysis Information

Project Summary

File Name: D-D -- seismic -- translational -- drained -Rev1.slim
Slide Modeler Version: 6.023

General Settings

Units of Measurement: Imperial Units
Time Units: days
Permeability Units: feet/second
Failure Direction: Left to Right
Data Output: Standard
Maximum Material Properties: 20
Maximum Support Properties: 20

Analysis Options

Analysis Methods Used

Spencer

Number of slices: 25
Tolerance: 0.005
Maximum number of iterations: 50
Check malpha < 0.2: Yes
Initial trial value of FS: 1
Steffensen Iteration: Yes

Groundwater Analysis

Groundwater Method: Water Surfaces
Pore Fluid Unit Weight: 62.4 lbs/ft3

Advanced Groundwater Method: None

Random Numbers

Pseudo-random Seed: 10116
Random Number Generation Method: Park and Miller v.3

Surface Options

Surface Type: Non-Circular Block Search
Number of Surfaces: 7000
Pseudo-Random Surfaces: Enabled
Convex Surfaces Only: Disabled
Left Projection Angle (Start Angle): 95
Left Projection Angle (End Angle): 185
Right Projection Angle (Start Angle): -5
Right Projection Angle (End Angle): 85
Minimum Elevation: Not Defined
Minimum Depth: Not Defined

Loading

Seismic Load Coefficient (Horizontal): 0.1

Material Properties

Property	Municipal Soild Waste (MSW)	Protective Cover	Recompacted Soil Liner	Liner Geosynthetics (Slopes	Liner Geosynthetics (Slopes > 5%)	Bedrock
Color						
Strength Type	Mohr-Coulomb	Mohr-Coulomb	Mohr-Coulomb	Shear Normal function	Shear Normal function	Mohr-Coulomb
Unit Weight [lbs/ft3]	75	115	125	100	100	130
Cohesion [psf]	400	0	0			10000
Friction Angle [deg]	33	30	27			32
Water Surface	None	Piezometric Line 1	None	None	None	None

Hu Value		1			
Ru Value	0	0	0	0	0

Shear Normal Functions

Name: Peak

Normal (psf)	Shear (psf)
0	0
3000	1250
6000	2000
13500	3500

Name Post Peak

Normal (psf)	Shear (psf)
0	0
3000	875
6000	1290
13500	2100

Global Minimums

Method: spencer

FS: 1.225800
Axis Location: 2894.973, 2417.922
Left Slip Surface Endpoint: 2036.441, 1525.062
Right Slip Surface Endpoint: 3094.141, 1195.381
Resisting Moment=3.89153e+009 lb-ft
Driving Moment=3.17469e+009 lb-ft
Resisting Horizontal Force=2.79096e+006 lb
Driving Horizontal Force=2.27685e+006 lb
Total Slice Area=106205 ft2

Global Minimum Coordinates

Method: spencer

X	Y
2036.44	1525.06
2404.63	1207.77
2703.56	1206.79
2734.33	1205.62
2737.06	1205.5
2773.4	1204.09
2900.89	1199.17
2962.28	1196.8
2975.19	1196.45
3037.7	1193.89
3073.8	1194.83
3094.14	1195.38

Valid / Invalid Surfaces

Method: spencer

Number of Valid Surfaces: 3993
Number of Invalid Surfaces: 3008

Error Codes:

Error Code -106 reported for 2 surfaces
Error Code -108 reported for 1019 surfaces
Error Code -110 reported for 18 surfaces
Error Code -111 reported for 320 surfaces
Error Code -112 reported for 1649 surfaces

Error Codes

The following errors were encountered during the computation:

-106 = Average slice width is less than 0.0001 * (maximum horizontal extent of soil region). This limitation is imposed to avoid numerical errors which may result from too many slices, or too small a slip region.

-108 = Total driving moment or total driving force < 0.1. This is to limit the calculation of extremely high safety factors if the driving force is very small (0.1 is an arbitrary number).
-110 = The water table or a piezoline does not span the slip region for a given slip surface, when Water Surfaces is specified as the method of pore pressure calculation. If this error occurs, check that the water table or piezoline(s) span the appropriate soil cells.
-111 = safety factor equation did not converge
-112 = The coefficient M-Alpha = cos(alpha)(1+tan(alpha)tan(phi)/F) < 0.2 for the final iteration of the safety factor calculation. This screens out some slip surfaces which may not be valid in the context of the analysis, in particular, deep seated slip surfaces with many high negative base angle slices in the passive zone.

Slice Data

Global Minimum Query (spencer) - Safety Factor. 1.2258

Slice Number	Width [ft]	Weight [lbs]	Base Material	Base Cohesion [psf]	Base Friction Angle [degrees]	Shear Stress [psf]	Shear Strength [psf]	Base Normal Stress [psf]	Pore Pressure [psf]	Effective Normal Stress [psf]
1	45.8848	43429.9	Municipal Soild Waste (MSW)	400	33	580.674	711.79	480.115	0	480.115
2	45.8848	130290	Municipal Soild Waste (MSW)	400	33	1173.23	1438.15	1598.61	0	1598.61
3	45.8848	217149	Municipal Soild Waste (MSW)	400	33	1765.79	2164.51	2717.11	0	2717.11
4	45.8848	304009	Municipal Soild Waste (MSW)	400	33	2358.35	2890.87	3835.6	0	3835.6
5	45.8848	390869	Municipal Soild Waste (MSW)	400	33	2950.91	3617.23	4954.1	0	4954.1
6	45.8848	477728	Municipal Soild Waste (MSW)	400	33	3543.47	4343.59	6072.61	0	6072.61
7	45.8848	564588	Municipal Soild Waste (MSW)	400	33	4136.03	5069.95	7191.1	0	7191.1
8	45.8848	651448	Municipal Soild Waste (MSW)	400	33	4728.59	5796.31	8309.6	0	8309.6
9	1.10804	16827.3	Protective Cover	0	30	4274.64	5239.85	9106.48	30.7887	9075.69
10	49.8228	730588	Liner Geosynthetics (Slopes < 5%)	800	11.31	3170.39	3886.26	15431.3	0	15431.3
11	49.8228	673235	Liner Geosynthetics (Slopes < 5%)	800	11.31	2976.96	3649.16	14245.8	0	14245.8
12	49.8228	615778	Liner Geosynthetics (Slopes < 5%)	800	11.31	2783.18	3411.62	13058.1	0	13058.1
13	49.8228	558321	Liner Geosynthetics (Slopes < 5%)	800	11.31	2589.4	3174.09	11870.4	0	11870.4
14	49.8228	500863	Liner Geosynthetics (Slopes < 5%)	800	11.31	2395.62	2936.55	10682.8	0	10682.8
15	49.8228	443406	Liner Geosynthetics (Slopes < 5%)	800	11.31	2201.84	2699.02	9495.08	0	9495.08
16	30.7662	246486	Liner Geosynthetics (Slopes < 5%)	800	11.31	2016.25	2471.52	8357.58	0	8357.58
17	2.73382	20965.2	Liner Geosynthetics (Slopes < 5%)	800	11.31	1953.43	2394.52	7972.59	0	7972.59
18	36.3321	264121	Liner Geosynthetics (Slopes < 5%)	800	11.31	1893.85	2321.48	7607.41	0	7607.41
19	59.2518	372742	Liner Geosynthetics (Slopes < 5%)	800	11.31	1733.28	2124.65	6623.24	0	6623.24
20	68.2439	340209	Liner Geosynthetics (Slopes < 5%)	500	14.0363	1488.27	1824.32	5297.29	0	5297.29
21	61.3853	224532	Liner Geosynthetics (Slopes < 5%)	500	14.0363	1210.87	1484.29	3937.16	0	3937.16

22	12.912	37308.7	Liner Geosynthetics (Slopes < 5%)	500	14.0363	1056.83	1295.46	3181.85	0	3181.85
23	62.5117	132347	Liner Geosynthetics (Slopes < 5%)	1.13687e-013	22.6199	785.297	962.617	2310.28	0	2310.28
24	36.0983	37066.4	Liner Geosynthetics (Slopes < 5%)	0	22.6199	406.154	497.864	1194.87	0	1194.87
25	20.342	6236.11	Liner Geosynthetics (Slopes < 5%)	2.84217e-014	22.6199	121.4	148.812	357.15	0	357.15

Interslice Data

Global Minimum Query (spencer) - Safety Factor. 1.2258

Slice Number	X coordinate [ft]	Y coordinate - Bottom [ft]	Interslice Normal Force [lbs]	Interslice Shear Force [lbs]	Interslice Force Angle [degrees]
1	2036.44	1525.06	0	0	0
2	2082.33	1485.52	-3316.61	-1560.95	25.2038
3	2128.21	1445.98	19090.5	8984.86	25.2038
4	2174.1	1406.44	67221.4	31637.4	25.2038
5	2219.98	1366.9	141076	66396.7	25.2038
6	2265.87	1327.35	240654	113263	25.2039
7	2311.75	1287.81	365956	172236	25.2039
8	2357.63	1248.27	516982	243315	25.2038
9	2403.52	1208.73	693732	326502	25.2038
10	2404.63	1207.77	699373	329157	25.2038
11	2454.45	1207.61	617012	290394	25.2038
12	2504.27	1207.44	538357	253375	25.2038
13	2554.1	1207.28	463416	218104	25.2037
14	2603.92	1207.12	392188	184582	25.2039
15	2653.74	1206.95	324675	152807	25.2038
16	2703.56	1206.79	260874	122779	25.2038
17	2734.33	1205.62	233252	109779	25.2038
18	2737.06	1205.5	230981	108710	25.2038
19	2773.4	1204.09	199260	93780.9	25.2038
20	2832.65	1201.81	148987	70120	25.2038
21	2900.89	1199.17	95399.8	44899.5	25.2038
22	2962.28	1196.8	52857.6	24877.2	25.2038
23	2975.19	1196.45	44052.7	20733.2	25.2038

24	3037.7	1193.89	14122	6646.47	25.2039
25	3073.8	1194.83	2043.65	961.835	25.2038
26	3094.14	1195.38	0	0	0

List Of Coordinates

Piezoline

X	Y
57.6579	1300.17
213.704	1248.26
218.596	1246.63
218.978	1246.5
219.04	1246.48
219.113	1246.46
238.099	1240.14
299.49	1219.72
307.146	1217.17
308.357	1216.77
320.36	1212.78
322.67	1212.01
324.604	1211.37
351.432	1202.44
353.182	1202.39
353.579	1202.38
355.218	1202.34
365.46	1202.06
386.794	1201.48
478.224	1198.99
490.273	1198.67
495.222	1198.53
517.792	1197.92
598.571	1195.72
611.496	1195.37

714.939	1192.55
746.619	1193.48
903.613	1198.05
913.376	1198.33
938.805	1199.07
949.56	1199.38
1002.6	1200.93
1009.37	1201.13
1112.4	1204.12
1205.97	1206.85
1235.69	1207.71
1246.06	1208.02
1266.27	1201.33
1271.08	1199.74
1389.7	1196.52
1390.01	1196.51
1393.38	1196.42
1436.2	1195.25
1620.63	1200.62
1693.49	1202.74
1826.84	1200.44
2007.96	1197.32
2352.27	1207.25
2420.6	1209.22
2709.42	1208.07
2732.82	1207.16
2737.79	1206.97
2738.83	1206.93
2743.02	1206.77
2771.27	1205.68
2905.12	1200.51
2906.85	1200.44
2958.91	1198.43
2979.82	1197.62

2990.68	1197.2
3033.19	1195.56
3036.23	1195.45
3038.35	1195.36
3088.28	1196.72
3089.73	1196.76

Block Search Polyline

X	Y
3091.76	1196.13
3090.03	1195.52
3038.38	1194.11
2990.93	1195.95
2958.96	1197.18
2906.87	1199.18
2771.25	1204.41
2743.01	1205.5
2738.83	1205.67
2709.42	1206.81
2420.61	1207.97

External Boundary

X	Y
0	1298.65
-5.68e-014	948.648
3490.88	948.648
3490.88	1204.12
3211.07	1196.22
3109.13	1198.96
3096.28	1194.71
3092.19	1195.99
3091.37	1196.25

3089.73	1196.76
1908.19	1565.04
1552.15	1562.07
1281.64	1563.33
1126.08	1564.05
1037.88	1564.46
891.692	1550
754.538	1504.01
734.523	1504.03
555.126	1444.72
535.112	1444.74
355.714	1385.43
339.684	1385.45
335.7	1385.45
156.302	1326.14
136.288	1326.17
57.6579	1300.17
56.069	1299.64
55.2745	1299.38
51.3023	1298.07
49.7139	1298.6
40.1835	1298.61
34.156	1296.61
31.1422	1296.62
25.1147	1298.62

Material Boundary

X	Y
55.2745	1299.38
213.23	1246.84
218.122	1245.21
218.505	1245.08
218.567	1245.06

218.64	1245.04
237.625	1238.72
299.016	1218.3
306.672	1215.75
307.883	1215.35
319.886	1211.36
322.197	1210.59
324.13	1209.94
351.169	1200.95
353.141	1200.89
353.538	1200.88
355.177	1200.84
365.42	1200.56
386.753	1199.98
478.183	1197.49
490.232	1197.17
495.181	1197.03
517.751	1196.42
598.53	1194.22
611.455	1193.87
714.94	1191.05
746.663	1191.98
903.657	1196.55
913.419	1196.83
938.849	1197.57
949.603	1197.88
1002.64	1199.43
1009.42	1199.63
1112.44	1202.62
1206.01	1205.35
1235.73	1206.21
1245.84	1206.51
1265.8	1199.91
1270.82	1198.25

1389.66	1195.02
1389.97	1195.01
1393.34	1194.92
1436.2	1193.75
1620.67	1199.12
1693.5	1201.24
1826.82	1198.94
2007.97	1195.82
2352.32	1205.75
2420.61	1207.72
2709.39	1206.57
2732.76	1205.66
2737.73	1205.47
2738.77	1205.43
2742.96	1205.27
2771.22	1204.18
2905.06	1199.01
2906.79	1198.94
2958.85	1196.93
2979.76	1196.13
2990.63	1195.71
3033.13	1194.06
3036.18	1193.95
3038.34	1193.86
3088.32	1195.22
3090.01	1195.27
3092.19	1195.99

Material Boundary

X	Y
56.069	1299.64
213.388	1247.31
218.28	1245.68

218.663	1245.56
218.725	1245.53
218.798	1245.51
237.783	1239.19
299.174	1218.77
306.83	1216.23
308.041	1215.82
320.044	1211.83
322.354	1211.06
324.288	1210.42
351.257	1201.45
353.155	1201.39
353.552	1201.38
355.191	1201.34
365.433	1201.06
386.766	1200.48
478.197	1197.99
490.246	1197.67
495.194	1197.53
517.764	1196.92
598.544	1194.72
611.469	1194.37
714.94	1191.55
746.648	1192.48
903.642	1197.05
913.405	1197.33
938.834	1198.07
949.589	1198.38
1002.63	1199.93
1009.4	1200.13
1112.43	1203.12
1206	1205.85
1235.72	1206.71
1245.92	1207.01

1265.96	1200.38
1270.9	1198.75
1389.67	1195.52
1389.99	1195.51
1393.36	1195.42
1436.2	1194.25
1620.66	1199.62
1693.5	1201.74
1826.82	1199.44
2007.97	1196.32
2352.3	1206.25
2420.61	1208.22
2709.4	1207.07
2732.78	1206.16
2737.75	1205.97
2738.79	1205.93
2742.98	1205.77
2771.24	1204.68
2905.08	1199.51
2906.81	1199.44
2958.87	1197.43
2979.78	1196.62
2990.65	1196.21
3033.15	1194.56
3036.2	1194.45
3038.34	1194.36
3088.3	1195.72
3089.92	1195.77
3091.37	1196.25

Material Boundary

X	Y
57.6579	1300.17

213.704	1248.26
218.596	1246.63
218.978	1246.5
219.04	1246.48
219.113	1246.46
238.099	1240.14
299.49	1219.72
307.146	1217.17
308.357	1216.77
320.36	1212.78
322.67	1212.01
324.604	1211.37
351.432	1202.44
353.182	1202.39
353.579	1202.38
355.218	1202.34
365.46	1202.06
386.794	1201.48
478.224	1198.99
490.273	1198.67
495.222	1198.53
517.792	1197.92
598.571	1195.72
611.496	1195.37
714.939	1192.55
746.619	1193.48
903.613	1198.05
913.376	1198.33
938.805	1199.07
949.56	1199.38
1002.6	1200.93
1009.37	1201.13
1112.4	1204.12
1205.97	1206.85

1235.69	1207.71
1246.06	1208.02
1266.27	1201.33
1271.08	1199.74
1389.7	1196.52
1390.01	1196.51
1393.38	1196.42
1436.2	1195.25
1620.63	1200.62
1693.49	1202.74
1826.84	1200.44
2007.96	1197.32
2352.27	1207.25
2420.6	1209.22
2709.42	1208.07
2732.82	1207.16
2737.79	1206.97
2738.83	1206.93
2743.02	1206.77
2771.27	1205.68
2905.12	1200.51
2906.85	1200.44
2958.91	1198.43
2979.82	1197.62
2990.68	1197.2
3033.19	1195.56
3036.23	1195.45
3038.35	1195.36
3088.28	1196.72
3089.73	1196.76

Material Boundary

X	Y

51.3023	1298.07
212.441	1244.46
217.333	1242.84
217.716	1242.71
217.778	1242.69
217.851	1242.66
236.836	1236.35
298.227	1215.93
305.883	1213.38
307.094	1212.98
319.097	1208.98
321.407	1208.21
323.341	1207.57
350.731	1198.46
353.073	1198.4
353.47	1198.38
355.109	1198.34
365.352	1198.06
386.685	1197.48
478.115	1194.99
490.164	1194.67
495.113	1194.53
517.683	1193.92
598.462	1191.72
611.387	1191.37
714.943	1188.55
746.736	1189.48
903.73	1194.05
913.492	1194.33
938.922	1195.07
949.676	1195.39
1002.72	1196.93
1009.49	1197.13
1112.52	1200.13

1206.09	1202.85
1235.81	1203.72
1245.47	1204
1265.02	1197.53
1270.38	1195.76
1389.59	1192.52
1389.9	1192.51
1393.27	1192.42
1436.2	1191.25
1620.75	1196.62
1693.52	1198.74
1826.77	1196.44
2007.99	1193.32
2352.39	1203.25
2420.65	1205.22
2709.34	1204.07
2732.66	1203.17
2737.64	1202.97
2738.68	1202.93
2742.86	1202.77
2771.12	1201.68
2904.97	1196.51
2906.69	1196.44
2958.76	1194.43
2979.66	1193.63
2990.53	1193.21
3033.03	1191.57
3036.08	1191.45
3038.33	1191.36
3088.39	1192.72
3090.24	1192.77
3090.43	1192.78
3090.44	1192.78
3096.28	1194.71

Material Boundary

X	Y
350.731	1198.46
351.169	1200.95
351.257	1201.45
351.432	1202.44

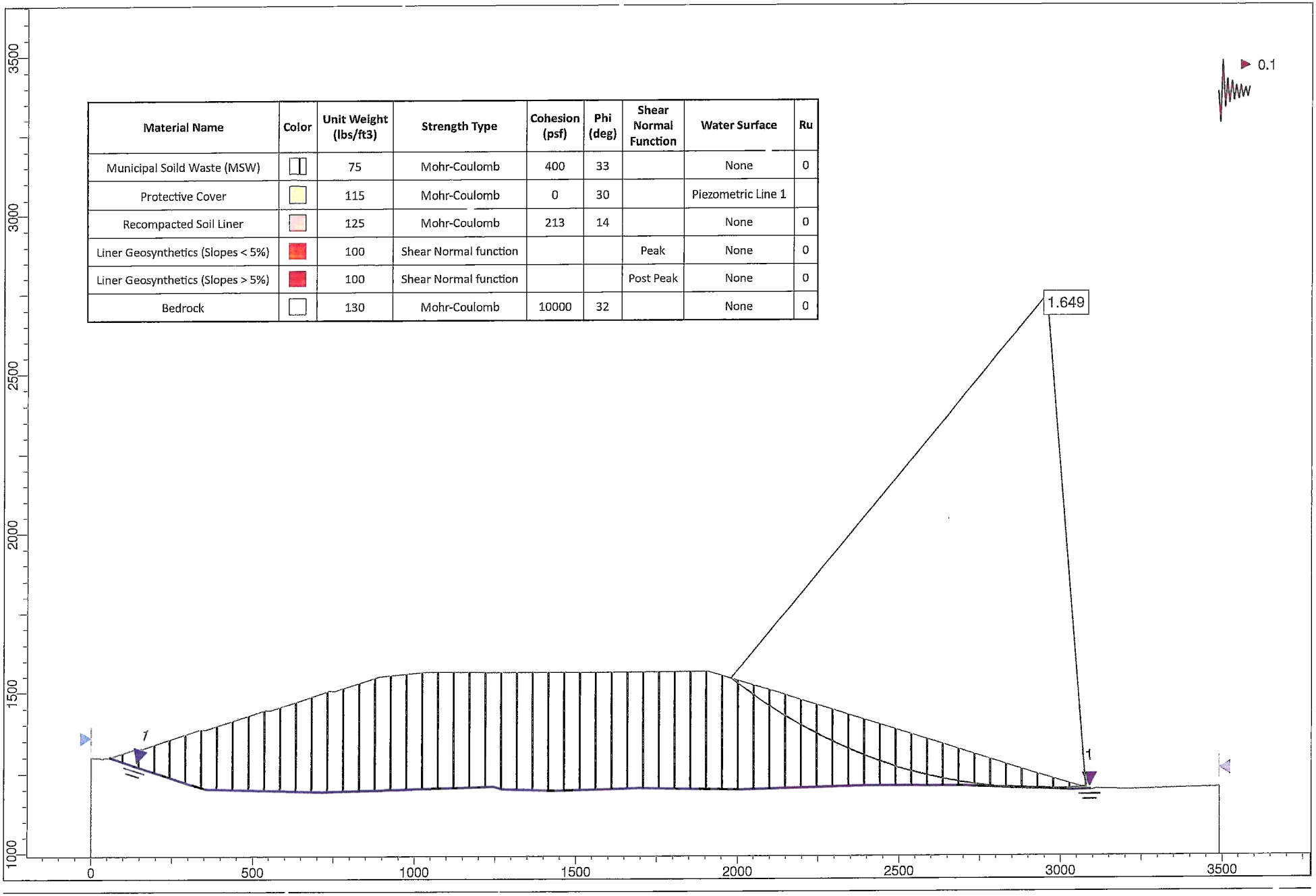
Material Boundary

X	Y
1245.47	1204
1245.84	1206.51
1245.92	1207.01
1246.06	1208.02

Material Boundary

X	Y
1270.38	1195.76
1270.82	1198.25
1270.9	1198.75
1271.08	1199.74

Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)	Shear Normal Function	Water Surface	Ru
Municipal Soild Waste (MSW)		75	Mohr-Coulomb	400	33		None	0
Protective Cover		115	Mohr-Coulomb	0	30		Piezometric Line 1	
Recompacted Soil Liner		125	Mohr-Coulomb	213	14		None	0
Liner Geosynthetics (Slopes < 5%)		100	Shear Normal function			Peak	None	0
Liner Geosynthetics (Slopes > 5%)		100	Shear Normal function			Post Peak	None	0
Bedrock		130	Mohr-Coulomb	10000	32		None	0



D-D -- seismic -- rotational -- undrained -Rev1 slim

Slide Analysis Information

Project Summary

File Name: D-D -- seismic -- rotational -- undrained -Rev1.slim
Slide Modeler Version: 6.023

General Settings

Units of Measurement: Imperial Units
Time Units: days
Permeability Units: feet/second
Failure Direction: Left to Right
Data Output: Standard
Maximum Material Properties: 20
Maximum Support Properties: 20

Analysis Options

Analysis Methods Used

Spencer

Number of slices: 25
Tolerance: 0.005
Maximum number of iterations: 50
Check malpha < 0.2: Yes
Initial trial value of FS: 1
Steffensen Iteration: Yes

Groundwater Analysis

Groundwater Method: Water Surfaces
Pore Fluid Unit Weight: 62.4 lbs/ft3

Advanced Groundwater Method: None

Random Numbers

Pseudo-random Seed: 10116
Random Number Generation Method: Park and Miller v.3

Surface Options

Surface Type: Circular
Search Method: Auto Refine Search
Divisions along slope: 20
Circles per division: 10
Number of iterations: 10
Divisions to use in next iteration: 50%
Composite Surfaces: Disabled
Minimum Elevation: 0
Minimum Depth: 5

Loading

Seismic Load Coefficient (Horizontal): 0.1

Material Properties

Property	Municipal Soild Waste (MSW)	Protective Cover	Recompacted Soil Liner	Liner Geosynthetics (Slopes	Liner Geosynthetics (Slopes > 5%)	Bedrock
Color						
Strength Type	Mohr-Coulomb	Mohr-Coulomb	Mohr-Coulomb	Shear Normal function	Shear Normal function	Mohr-Coulomb
Unit Weight [lbs/ft3]	75	115	125	100	100	130
Cohesion [psf]	400	0	213			10000
Friction Angle [deg]	33	30	14			32
Water Surface	None	Piezometric Line 1	None	None	None	None

Hu Value		1			
Ru Value	0	0	0	0	0

Shear Normal Functions

Name: Peak

Normal (psf)	Shear (psf)
0	0
3000	1250
6000	2000
13500	3500

Name. Post Peak

Normal (psf)	Shear (psf)
0	0
3000	875
6000	1290
13500	2100

Global Minimums

Method: spencer

FS: 1.649420
Center: 2956.111, 2744.542
Radius: 1548.724
Left Slip Surface Endpoint: 1978.987, 1542.970
Right Slip Surface Endpoint 3077.482, 1200.581
Resisting Moment=6.1657e+009 lb-ft
Driving Moment=3.73811e+009 lb-ft
Resisting Horizontal Force=3.75379e+006 lb
Driving Horizontal Force=2.27583e+006 lb
Total Slice Area=85453 ft2

Valid / Invalid Surfaces

D-D -- seismic -- rotational -- undrained -Rev1.slim

Method: spencer

Number of Valid Surfaces: 12238
Number of Invalid Surfaces: 0

Slice Data

Global Minimum Query (spencer) - Safety Factor: 1.64942

Slice Number	Width [ft]	Weight [lbs]	Base Material	Base Cohesion [psf]	Base Friction Angle [degrees]	Shear Stress [psf]	Shear Strength [psf]	Base Normal Stress [psf]	Pore Pressure [psf]	Effective Normal Stress [psf]
1	47.537	39799.4	Municipal Soild Waste (MSW)	400	33	433.626	715.231	485.413	0	485.413
2	47.537	114308	Municipal Soild Waste (MSW)	400	33	860.072	1418.62	1568.54	0	1568.54
3	47.537	179036	Municipal Soild Waste (MSW)	400	33	1256.85	2073.07	2576.31	0	2576.31
4	47.537	234720	Municipal Soild Waste (MSW)	400	33	1622.9	2676.85	3506.04	0	3506.04
5	47.537	281973	Municipal Soild Waste (MSW)	400	33	1957.19	3228.23	4355.1	0	4355.1
6	47.537	321314	Municipal Soild Waste (MSW)	400	33	2258.65	3725.47	5120.78	0	5120.78
7	47.537	353184	Municipal Soild Waste (MSW)	400	33	2526.17	4166.72	5800.24	0	5800.24
8	47.537	377957	Municipal Soild Waste (MSW)	400	33	2758.55	4550.01	6390.45	0	6390.45
9	47.537	395957	Municipal Soild Waste (MSW)	400	33	2954.51	4873.22	6888.15	0	6888.15
10	47.537	407462	Municipal Soild Waste (MSW)	400	33	3112.62	5134.01	7289.75	0	7289.75
11	47.537	412709	Municipal Soild Waste (MSW)	400	33	3231.34	5329.84	7591.28	0	7591.28
12	47.537	411906	Municipal Soild Waste (MSW)	400	33	3308.95	5457.85	7788.41	0	7788.41
13	47.537	405228	Municipal Soild Waste (MSW)	400	33	3343.55	5514.91	7876.27	0	7876.27
14	47.537	392827	Municipal Soild Waste (MSW)	400	33	3332.99	5497.5	7849.46	0	7849.46
15	47.537	374831	Municipal Soild Waste (MSW)	400	33	3274.89	5401.67	7701.88	0	7701.88
16	47.537	351347	Municipal Soild Waste (MSW)	400	33	3166.57	5223	7426.76	0	7426.76
17	47.537	322464	Municipal Soild Waste (MSW)	400	33	3005	4956.5	7016.4	0	7016.4
18	15.1182	96063.8	Protective Cover	0	30	2270.74	3745.41	6518.46	31.2233	6487.23
19	8.56346	53044.1	Liner Geosynthetics (Slopes < 5%)	800	11.31	1222.4	2016.25	6081.23	0	6081.23
20	57.0965	324248	Recompacted Soil Liner	213	14	975.458	1608.94	5598.79	0	5598.79
21	57.0965	265011	Recompacted Soil Liner	213	14	838.289	1382.69	4691.37	0	4691.37
22	57.0965	190704	Recompacted Soil Liner	213	14	653.999	1078.72	3472.2	0	3472.2
23	8.60204	21594.3	Liner Geosynthetics (Slopes < 5%)	2.27374e-013	22.6199	689.879	1137.9	2730.96	0	2730.96

24	15.1954	33188.3	Protective Cover	0	30	866.25	1428.81	2506	31.2233	2474.77
25	71.598	70558.5	Municipal Soild Waste (MSW)	400	33	771.68	1272.82	1344.03	0	1344.03

Interslice Data

Global Minimum Query (spencer) - Safety Factor: 1.64942

Slice Number	X coordinate [ft]	Y coordinate - Bottom [ft]	Interslice Normal Force [lbs]	Interslice Shear Force [lbs]	Interslice Force Angle [degrees]
1	1978.99	1542.97	0	0	0
2	2026.52	1505.83	1388.66	589.454	23.0001
3	2074.06	1471.54	25699.8	10909	23.0002
4	2121.6	1439.88	65391.8	27757.2	23
5	2169.13	1410.67	114111	48437.3	23
6	2216.67	1383.74	166507	70678.2	23.0001
7	2264.21	1358.97	218097	92576.7	23
8	2311.75	1336.23	265159	112553	22.9999
9	2359.28	1315.44	304659	129320	23
10	2406.82	1296.5	334191	141856	23
11	2454.36	1279.35	351941	149390	23
12	2501.89	1263.92	356655	151391	23
13	2549.43	1250.17	347628	147560	23.0001
14	2596.97	1238.03	324700	137827	23
15	2644.5	1227.49	288261	122360	23.0001
16	2692.04	1218.5	239269	101564	23.0001
17	2739.58	1211.03	179276	76098.4	23.0001
18	2787.12	1205.07	110466	46890.1	23
19	2802.23	1203.48	96058.7	40774.6	23.0001
20	2810.8	1202.65	95945.1	40726.4	23.0001
21	2867.89	1198.33	96828.6	41101.4	23
22	2924.99	1196.13	85778.1	36410.8	23.0001
23	2982.09	1196.04	67822.9	28789.2	23.0001
24	2990.69	1196.2	63586.5	26990.9	23
25	3005.88	1196.62	52700	22369.9	23.0001

26	3077.48	1200.58	0	0	0

List Of Coordinates

Piezoline

X	Y
57.6579	1300.17
213.704	1248.26
218.596	1246.63
218.978	1246.5
219.04	1246.48
219.113	1246.46
238.099	1240.14
299.49	1219.72
307.146	1217.17
308.357	1216.77
320.36	1212.78
322.67	1212.01
324.604	1211.37
351.432	1202.44
353.182	1202.39
353.579	1202.38
355.218	1202.34
365.46	1202.06
386.794	1201.48
478.224	1198.99
490.273	1198.67
495.222	1198.53
517.792	1197.92
598.571	1195.72
611.496	1195.37
714.939	1192.55
746.619	1193.48

903.613	1198.05
913.376	1198.33
938.805	1199.07
949.56	1199.38
1002.6	1200.93
1009.37	1201.13
1112.4	1204.12
1205.97	1206.85
1235.69	1207.71
1246.06	1208.02
1266.27	1201.33
1271.08	1199.74
1389.7	1196.52
1390.01	1196.51
1393.38	1196.42
1436.2	1195.25
1620.63	1200.62
1693.49	1202.74
1826.84	1200.44
2007.96	1197.32
2352.27	1207.25
2420.6	1209.22
2709.42	1208.07
2732.82	1207.16
2737.79	1206.97
2738.83	1206.93
2743.02	1206.77
2771.27	1205.68
2905.12	1200.51
2906.85	1200.44
2958.91	1198.43
2979.82	1197.62
2990.68	1197.2
3033.19	1195.56

3036.23	1195.45
3038.35	1195.36
3088.28	1196.72
3089.73	1196.76

External Boundary

X	Y
0	1298.65
-5.68e-014	948.648
3490.88	948.648
3490.88	1204.12
3211.07	1196.22
3109.13	1198.96
3096.28	1194.71
3092.19	1195.99
3091.37	1196.25
3089.73	1196.76
1908.19	1565.04
1552.15	1562.07
1281.64	1563.33
1126.08	1564.05
1037.88	1564.46
891.692	1550
754.538	1504.01
734.523	1504.03
555.126	1444.72
535.112	1444.74
355.714	1385.43
339.684	1385.45
335.7	1385.45
156.302	1326.14
136.288	1326.17
57.6579	1300.17

56.069	1299.64
55.2745	1299.38
51.3023	1298.07
49.7139	1298.6
40.1835	1298.61
34.156	1296.61
31.1422	1296.62
25.1147	1298.62

Material Boundary

X	Y
55.2745	1299.38
213.23	1246.84
218.122	1245.21
218.505	1245.08
218.567	1245.06
218.64	1245.04
237.625	1238.72
299.016	1218.3
306.672	1215.75
307.883	1215.35
319.886	1211.36
322.197	1210.59
324.13	1209.94
351.169	1200.95
353.141	1200.89
353.538	1200.88
355.177	1200.84
365.42	1200.56
386.753	1199.98
478.183	1197.49
490.232	1197.17
495.181	1197.03

517.751	1196.42
598.53	1194.22
611.455	1193.87
714.94	1191.05
746.663	1191.98
903.657	1196.55
913.419	1196.83
938.849	1197.57
949.603	1197.88
1002.64	1199.43
1009.42	1199.63
1112.44	1202.62
1206.01	1205.35
1235.73	1206.21
1245.84	1206.51
1265.8	1199.91
1270.82	1198.25
1389.66	1195.02
1389.97	1195.01
1393.34	1194.92
1436.2	1193.75
1620.67	1199.12
1693.5	1201.24
1826.82	1198.94
2007.97	1195.82
2352.32	1205.75
2420.61	1207.72
2709.39	1206.57
2732.76	1205.66
2737.73	1205.47
2738.77	1205.43
2742.96	1205.27
2771.22	1204.18
2905.06	1199.01

2906.79	1198.94
2958.85	1196.93
2979.76	1196.13
2990.63	1195.71
3033.13	1194.06
3036.18	1193.95
3038.34	1193.86
3088.32	1195.22
3090.01	1195.27
3092.19	1195.99

Material Boundary

X	Y
56.069	1299.64
213.388	1247.31
218.28	1245.68
218.663	1245.56
218.725	1245.53
218.798	1245.51
237.783	1239.19
299.174	1218.77
306.83	1216.23
308.041	1215.82
320.044	1211.83
322.354	1211.06
324.288	1210.42
351.257	1201.45
353.155	1201.39
353.552	1201.38
355.191	1201.34
365.433	1201.06
386.766	1200.48
478.197	1197.99

490.246	1197.67
495.194	1197.53
517.764	1196.92
598.544	1194.72
611.469	1194.37
714.94	1191.55
746.648	1192.48
903.642	1197.05
913.405	1197.33
938.834	1198.07
949.589	1198.38
1002.63	1199.93
1009.4	1200.13
1112.43	1203.12
1206	1205.85
1235.72	1206.71
1245.92	1207.01
1265.96	1200.38
1270.9	1198.75
1389.67	1195.52
1389.99	1195.51
1393.36	1195.42
1436.2	1194.25
1620.66	1199.62
1693.5	1201.74
1826.82	1199.44
2007.97	1196.32
2352.3	1206.25
2420.61	1208.22
2709.4	1207.07
2732.78	1206.16
2737.75	1205.97
2738.79	1205.93
2742.98	1205.77

2771.24	1204.68
2905.08	1199.51
2906.81	1199.44
2958.87	1197.43
2979.78	1196.62
2990.65	1196.21
3033.15	1194.56
3036.2	1194.45
3038.34	1194.36
3088.3	1195.72
3089.92	1195.77
3091.37	1196.25

Material Boundary

X	Y
57.6579	1300.17
213.704	1248.26
218.596	1246.63
218.978	1246.5
219.04	1246.48
219.113	1246.46
238.099	1240.14
299.49	1219.72
307.146	1217.17
308.357	1216.77
320.36	1212.78
322.67	1212.01
324.604	1211.37
351.432	1202.44
353.182	1202.39
353.579	1202.38
355.218	1202.34
365.46	1202.06

386.794	1201.48
478.224	1198.99
490.273	1198.67
495.222	1198.53
517.792	1197.92
598.571	1195.72
611.496	1195.37
714.939	1192.55
746.619	1193.48
903.613	1198.05
913.376	1198.33
938.805	1199.07
949.56	1199.38
1002.6	1200.93
1009.37	1201.13
1112.4	1204.12
1205.97	1206.85
1235.69	1207.71
1246.06	1208.02
1266.27	1201.33
1271.08	1199.74
1389.7	1196.52
1390.01	1196.51
1393.38	1196.42
1436.2	1195.25
1620.63	1200.62
1693.49	1202.74
1826.84	1200.44
2007.96	1197.32
2352.27	1207.25
2420.6	1209.22
2709.42	1208.07
2732.82	1207.16
2737.79	1206.97

2738.83	1206.93
2743.02	1206.77
2771.27	1205.68
2905.12	1200.51
2906.85	1200.44
2958.91	1198.43
2979.82	1197.62
2990.68	1197.2
3033.19	1195.56
3036.23	1195.45
3038.35	1195.36
3088.28	1196.72
3089.73	1196.76

Material Boundary

X	Y
51.3023	1298.07
212.441	1244.46
217.333	1242.84
217.716	1242.71
217.778	1242.69
217.851	1242.66
236.836	1236.35
298.227	1215.93
305.883	1213.38
307.094	1212.98
319.097	1208.98
321.407	1208.21
323.341	1207.57
350.731	1198.46
353.073	1198.4
353.47	1198.38
355.109	1198.34

365.352	1198.06
386.685	1197.48
478.115	1194.99
490.164	1194.67
495.113	1194.53
517.683	1193.92
598.462	1191.72
611.387	1191.37
714.943	1188.55
746.736	1189.48
903.73	1194.05
913.492	1194.33
938.922	1195.07
949.676	1195.39
1002.72	1196.93
1009.49	1197.13
1112.52	1200.13
1206.09	1202.85
1235.81	1203.72
1245.47	1204
1265.02	1197.53
1270.38	1195.76
1389.59	1192.52
1389.9	1192.51
1393.27	1192.42
1436.2	1191.25
1620.75	1196.62
1693.52	1198.74
1826.77	1196.44
2007.99	1193.32
2352.39	1203.25
2420.65	1205.22
2709.34	1204.07
2732.66	1203.17

2737.64	1202.97
2738.68	1202.93
2742.86	1202.77
2771.12	1201.68
2904.97	1196.51
2906.69	1196.44
2958.76	1194.43
2979.66	1193.63
2990.53	1193.21
3033.03	1191.57
3036.08	1191.45
3038.33	1191.36
3088.39	1192.72
3090.24	1192.77
3090.43	1192.78
3090.44	1192.78
3096.28	1194.71

Material Boundary

X	Y
350.731	1198.46
351.169	1200.95
351.257	1201.45
351.432	1202.44

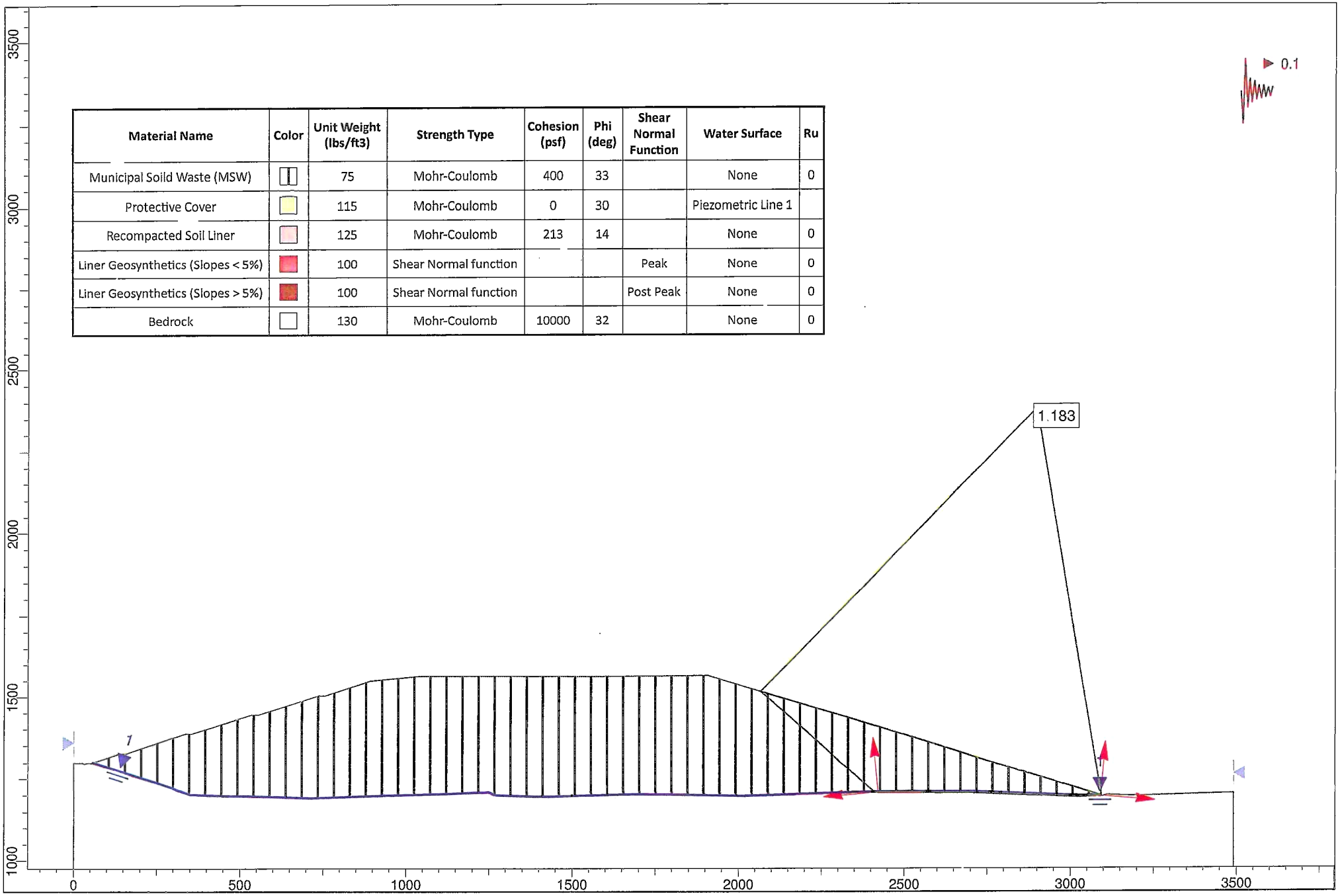
Material Boundary

X	Y
1245.47	1204
1245.84	1206.51
1245.92	1207.01
1246.06	1208.02

Material Boundary

X	Y
1270.38	1195.76
1270.82	1198.25
1270.9	1198.75
1271.08	1199.74

Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)	Shear Normal Function	Water Surface	Ru
Municipal Soild Waste (MSW)		75	Mohr-Coulomb	400	33		None	0
Protective Cover		115	Mohr-Coulomb	0	30		Piezometric Line 1	
Recompacted Soil Liner		125	Mohr-Coulomb	213	14		None	0
Liner Geosynthetics (Slopes < 5%)		100	Shear Normal function			Peak	None	0
Liner Geosynthetics (Slopes > 5%)		100	Shear Normal function			Post Peak	None	0
Bedrock		130	Mohr-Coulomb	10000	32		None	0



D-D -- seismic -- translational -- undrained -Rev1.slim

Slide Analysis Information

Project Summary

File Name: D-D -- seismic -- translational -- undrained -Rev1.slim
Slide Modeler Version: 6.023

General Settings

Units of Measurement: Imperial Units
Time Units: days
Permeability Units: feet/second
Failure Direction: Left to Right
Data Output: Standard
Maximum Material Properties: 20
Maximum Support Properties: 20

Analysis Options

Analysis Methods Used

Spencer

Number of slices: 25
Tolerance: 0.005
Maximum number of iterations: 50
Check malpha < 0.2: Yes
Initial trial value of FS: 1
Steffensen Iteration: Yes

Groundwater Analysis

Groundwater Method: Water Surfaces
Pore Fluid Unit Weight: 62.4 lbs/ft3

Advanced Groundwater Method: None

Random Numbers

Pseudo-random Seed: 10116
Random Number Generation Method: Park and Miller v.3

Surface Options

Surface Type: Non-Circular Block Search
Number of Surfaces: 7000
Pseudo-Random Surfaces: Enabled
Convex Surfaces Only: Disabled
Left Projection Angle (Start Angle): 95
Left Projection Angle (End Angle): 185
Right Projection Angle (Start Angle): -5
Right Projection Angle (End Angle): 85
Minimum Elevation: Not Defined
Minimum Depth: Not Defined

Loading

Seismic Load Coefficient (Horizontal): 0.1

Material Properties

Property	Municipal Soild Waste (MSW)	Protective Cover	Recompacted Soil Liner	Liner Geosynthetics (Slopes	Liner Geosynthetics (Slopes > 5%)	Bedrock
Color						
Strength Type	Mohr-Coulomb	Mohr-Coulomb	Mohr-Coulomb	Shear Normal function	Shear Normal function	Mohr-Coulomb
Unit Weight [lbs/ft3]	75	115	125	100	100	130
Cohesion [psf]	400	0	213			10000
Friction Angle [deg]	33	30	14			32
Water Surface	None	Piezometric Line 1	None	None	None	None

Hu Value		1			
Ru Value	0	0	0	0	0

Shear Normal Functions

Name. Peak

Normal (psf)	Shear (psf)
0	0
3000	1250
6000	2000
13500	3500

Name: Post Peak

Normal (psf)	Shear (psf)
0	0
3000	875
6000	1290
13500	2100

Global Minimums

Method: spencer

FS: 1.182630
Axis Location. 2899.195, 2381.693
Left Slip Surface Endpoint: 2066.496, 1515.695
Right Slip Surface Endpoint. 3092.374, 1195.935
Resisting Moment=3.52246e+009 lb-ft
Driving Moment=2.97849e+009 lb-ft
Resisting Horizontal Force=2.5886e+006 lb
Driving Horizontal Force=2.18885e+006 lb
Total Slice Area=103604 ft2

Global Minimum Coordinates

Method: spencer

X	Y
2066.5	1515.69
2409.06	1207.9
2543.97	1207.23
2601.2	1204.5
2696.37	1204.45
2739.24	1203.17
2788.98	1200.99
2877.28	1197.59
2886.94	1197.21
2937.93	1195.3
3024.5	1191.9
3059.6	1194.46
3092.37	1195.93

Valid / Invalid Surfaces

Method: spencer

Number of Valid Surfaces: 3996
Number of Invalid Surfaces: 3005

Error Codes:

Error Code -106 reported for 2 surfaces
Error Code -108 reported for 1018 surfaces
Error Code -110 reported for 19 surfaces
Error Code -111 reported for 316 surfaces
Error Code -112 reported for 1650 surfaces

Error Codes

The following errors were encountered during the computation:

-106 = Average slice width is less than 0.0001 * (maximum horizontal extent of soil region). This limitation is imposed to avoid numerical errors which may result from too

many slices, or too small a slip region.
-108 = Total driving moment or total driving force < 0.1. This is to limit the calculation of extremely high safety factors if the driving force is very small (0.1 is an arbitrary number).
-110 = The water table or a piezoline does not span the slip region for a given slip surface, when Water Surfaces is specified as the method of pore pressure calculation. If this error occurs, check that the water table or piezoline(s) span the appropriate soil cells.
-111 = safety factor equation did not converge
-112 = The coefficient M-Alpha = cos(alpha)(1+tan(alpha)tan(phi)/F) < 0.2 for the final iteration of the safety factor calculation. This screens out some slip surfaces which may not be valid in the context of the analysis, in particular, deep seated slip surfaces with many high negative base angle slices in the passive zone.

Slice Data

Global Minimum Query (spencer) - Safety Factor: 1.18263

Slice Number	Width [ft]	Weight [lbs]	Base Material	Base Cohesion [psf]	Base Friction Angle [degrees]	Shear Stress [psf]	Shear Strength [psf]	Base Normal Stress [psf]	Pore Pressure [psf]	Effective Normal Stress [psf]
1	56.9172	71286.7	Municipal Soild Waste (MSW)	400	33	685.537	810.737	632.479	0	632.479
2	56.9172	213860	Municipal Soild Waste (MSW)	400	33	1467.56	1735.58	2056.62	0	2056.62
3	56.9172	356434	Municipal Soild Waste (MSW)	400	33	2249.59	2660.43	3480.77	0	3480.77
4	56.9172	499007	Municipal Soild Waste (MSW)	400	33	3031.62	3585.28	4904.9	0	4904.9
5	56.9172	641580	Municipal Soild Waste (MSW)	400	33	3813.64	4510.13	6329.04	0	6329.04
6	56.9172	784154	Municipal Soild Waste (MSW)	400	33	4595.67	5434.98	7753.19	0	7753.19
7	1.06384	16034.9	Protective Cover	0	30	4231.08	5003.8	8697.61	30.7797	8666.83
8	67.1842	964285	Liner Geosynthetics (Slopes < 5%)	800	11.31	3249.58	3843.05	15215.3	0	15215.3
9	67.1842	860631	Liner Geosynthetics (Slopes < 5%)	800	11.31	2979.7	3523.88	13619.4	0	13619.4
10	0.540009	6497.38	Liner Geosynthetics (Slopes < 5%)	800	11.31	2843.59	3362.92	12814.6	0	12814.6
11	57.2279	659368	Recompacted Soil Liner	213	14	2685.16	3175.55	11882.1	0	11882.1
12	95.1751	942113	Recompacted Soil Liner	213	14	2418.46	2860.14	10617.1	0	10617.1
13	13.2717	114774	Recompacted Soil Liner	213	14	2092.09	2474.17	9069.09	0	9069.09
14	29.5971	242597	Recompacted Soil Liner	213	14	1993.33	2357.37	8600.62	0	8600.62
15	49.7366	367268	Recompacted Soil Liner	213	14	1797.31	2125.55	7670.8	0	7670.8
16	88.299	528579	Recompacted Soil Liner	213	14	1500.4	1774.42	6262.49	0	6262.49
17	9.66455	48159.4	Recompacted Soil Liner	213	14	1281.2	1515.19	5222.78	0	5222.78
18	50.9887	222257	Recompacted Soil Liner	213	14	1147.56	1357.14	4588.92	0	4588.92
19	86.567	255400	Recompacted Soil Liner	213	14	840.121	993.552	3130.62	0	3130.62
20	34.6859	51713	Recompacted Soil Liner	213	14	561.044	663.507	1806.88	0	1806.88

21	0.410361	383.847	Liner Geosynthetics (Slopes < 5%)	5.68434e-014	22.6199	412.137	487.405	1169.77	0	1169.77
22	27.0691	15190.1	Liner Geosynthetics (Slopes < 5%)	0	22.6199	239.644	283.41	680.181	0	680.181
23	3.45644	502.34	Protective Cover	0	30	54.336	64.2594	171.806	60.5054	111.301
24	1.84316	95.5671	Liner Geosynthetics (Slopes < 5%)	0	22.6199	22.1423	26.1862	62.847	0	62.847
25	0.410352	3.35171	Recompacted Soil Liner	213	14	206.277	243.95	124.132	0	124.132

Interslice Data

Global Minimum Query (spencer) - Safety Factor: 1.18263

Slice Number	X coordinate [ft]	Y coordinate - Bottom [ft]	Interslice Normal Force [lbs]	Interslice Shear Force [lbs]	Interslice Force Angle [degrees]
1	2066.5	1515.69	0	0	0
2	2123.41	1464.56	454.553	229.781	26.817
3	2180.33	1413.42	43485.6	21982.4	26.817
4	2237.25	1362.28	129093	65258	26.8171
5	2294.16	1311.14	257277	130056	26.817
6	2351.08	1260	428038	216378	26.8171
7	2408	1208.86	641375	324222	26.8171
8	2409.06	1207.9	646791	326960	26.8171
9	2476.25	1207.57	530013	267927	26.8171
10	2543.43	1207.23	420466	212550	26.8171
11	2543.97	1207.23	419615	212120	26.8171
12	2601.2	1204.5	364322	184168	26.817
13	2696.37	1204.45	228852	115687	26.8171
14	2709.65	1204.05	216158	109270	26.817
15	2739.24	1203.17	189021	95552.3	26.8171
16	2788.98	1200.99	153078	77382.5	26.8171
17	2877.28	1197.59	94737	47890.6	26.8171
18	2886.94	1197.21	89179.8	45081.3	26.8171
19	2937.93	1195.3	61650.7	31165.1	26.8171
20	3024.5	1191.9	25118.1	12697.5	26.8171
21	3059.18	1194.43	6249.29	3159.08	26.8171
22	3059.6	1194.46	6083.47	3075.26	26.8171

23	3086.66	1195.68	287.355	145.261	26.8171
24	3090.12	1195.83	123.068	62.212	26.817
25	3091.96	1195.92	86.602	43.7782	26.8171
26	3092.37	1195.93	0	0	0

List Of Coordinates

Piezoline

X	Y
57.6579	1300.17
213.704	1248.26
218.596	1246.63
218.978	1246.5
219.04	1246.48
219.113	1246.46
238.099	1240.14
299.49	1219.72
307.146	1217.17
308.357	1216.77
320.36	1212.78
322.67	1212.01
324.604	1211.37
351.432	1202.44
353.182	1202.39
353.579	1202.38
355.218	1202.34
365.46	1202.06
386.794	1201.48
478.224	1198.99
490.273	1198.67
495.222	1198.53
517.792	1197.92
598.571	1195.72

611.496	1195.37
714.939	1192.55
746.619	1193.48
903.613	1198.05
913.376	1198.33
938.805	1199.07
949.56	1199.38
1002.6	1200.93
1009.37	1201.13
1112.4	1204.12
1205.97	1206.85
1235.69	1207.71
1246.06	1208.02
1266.27	1201.33
1271.08	1199.74
1389.7	1196.52
1390.01	1196.51
1393.38	1196.42
1436.2	1195.25
1620.63	1200.62
1693.49	1202.74
1826.84	1200.44
2007.96	1197.32
2352.27	1207.25
2420.6	1209.22
2709.42	1208.07
2732.82	1207.16
2737.79	1206.97
2738.83	1206.93
2743.02	1206.77
2771.27	1205.68
2905.12	1200.51
2906.85	1200.44
2958.91	1198.43

2979.82	1197.62
2990.68	1197.2
3033.19	1195.56
3036.23	1195.45
3038.35	1195.36
3088.28	1196.72
3089.73	1196.76

Block Search Polyline

X	Y
3091.74	1196.13
3090	1195.53
3038.38	1194.12
2998.53	1195.63
2961.53	1197.1
2906.86	1199.19
2771.28	1204.42
2743.03	1205.5
2738.86	1205.66
2732.82	1205.9
2709.42	1206.81
2420.61	1207.96

External Boundary

X	Y
0	1298.65
-5.68e-014	948.648
3490.88	948.648
3490.88	1204.12
3211.07	1196.22
3109.13	1198.96
3096.28	1194.71

3092.19	1195.99
3091.37	1196.25
3089.73	1196.76
1908.19	1565.04
1552.15	1562.07
1281.64	1563.33
1126.08	1564.05
1037.88	1564.46
891.692	1550
754.538	1504.01
734.523	1504.03
555.126	1444.72
535.112	1444.74
355.714	1385.43
339.684	1385.45
335.7	1385.45
156.302	1326.14
136.288	1326.17
57.6579	1300.17
56.069	1299.64
55.2745	1299.38
51.3023	1298.07
49.7139	1298.6
40.1835	1298.61
34.156	1296.61
31.1422	1296.62
25.1147	1298.62

Material Boundary

X	Y
55.2745	1299.38
213.23	1246.84
218.122	1245.21

218.505	1245.08
218.567	1245.06
218.64	1245.04
237.625	1238.72
299.016	1218.3
306.672	1215.75
307.883	1215.35
319.886	1211.36
322.197	1210.59
324.13	1209.94
351.169	1200.95
353.141	1200.89
353.538	1200.88
355.177	1200.84
365.42	1200.56
386.753	1199.98
478.183	1197.49
490.232	1197.17
495.181	1197.03
517 751	1196.42
598.53	1194.22
611.455	1193.87
714.94	1191.05
746.663	1191.98
903.657	1196.55
913.419	1196.83
938.849	1197.57
949.603	1197.88
1002.64	1199.43
1009.42	1199.63
1112.44	1202.62
1206.01	1205.35
1235.73	1206.21
1245.84	1206.51

1265.8	1199.91
1270.82	1198.25
1389.66	1195.02
1389.97	1195.01
1393.34	1194.92
1436.2	1193.75
1620.67	1199.12
1693.5	1201.24
1826.82	1198.94
2007.97	1195.82
2352.32	1205.75
2420.61	1207.72
2709.39	1206.57
2732.76	1205.66
2737.73	1205.47
2738.77	1205.43
2742.96	1205.27
2771.22	1204.18
2905.06	1199.01
2906.79	1198.94
2958.85	1196.93
2979.76	1196.13
2990.63	1195.71
3033.13	1194.06
3036.18	1193.95
3038.34	1193.86
3088.32	1195.22
3090.01	1195.27
3092.19	1195.99

Material Boundary

X	Y
56.069	1299.64

213.388	1247.31
218.28	1245.68
218.663	1245.56
218.725	1245.53
218.798	1245.51
237.783	1239.19
299.174	1218.77
306.83	1216.23
308.041	1215.82
320.044	1211.83
322.354	1211.06
324.288	1210.42
351.257	1201.45
353.155	1201.39
353.552	1201.38
355.191	1201.34
365.433	1201.06
386.766	1200.48
478.197	1197.99
490.246	1197.67
495.194	1197.53
517.764	1196.92
598.544	1194.72
611.469	1194.37
714.94	1191.55
746.648	1192.48
903.642	1197.05
913.405	1197.33
938.834	1198.07
949.589	1198.38
1002.63	1199.93
1009.4	1200.13
1112.43	1203.12
1206	1205.85

1235.72	1206.71
1245.92	1207.01
1265.96	1200.38
1270.9	1198.75
1389.67	1195.52
1389.99	1195.51
1393.36	1195.42
1436.2	1194.25
1620.66	1199.62
1693.5	1201.74
1826.82	1199.44
2007.97	1196.32
2352.3	1206.25
2420.61	1208.22
2709.4	1207.07
2732.78	1206.16
2737.75	1205.97
2738.79	1205.93
2742.98	1205.77
2771.24	1204.68
2905.08	1199.51
2906.81	1199.44
2958.87	1197.43
2979.78	1196.62
2990.65	1196.21
3033.15	1194.56
3036.2	1194.45
3038.34	1194.36
3088.3	1195.72
3089.92	1195.77
3091.37	1196.25

Material Boundary

X	Y
57.6579	1300.17
213.704	1248.26
218.596	1246.63
218.978	1246.5
219.04	1246.48
219.113	1246.46
238.099	1240.14
299.49	1219.72
307.146	1217.17
308.357	1216.77
320.36	1212.78
322.67	1212.01
324.604	1211.37
351.432	1202.44
353.182	1202.39
353.579	1202.38
355.218	1202.34
365.46	1202.06
386.794	1201.48
478.224	1198.99
490.273	1198.67
495.222	1198.53
517.792	1197.92
598.571	1195.72
611.496	1195.37
714.939	1192.55
746.619	1193.48
903.613	1198.05
913.376	1198.33
938.805	1199.07
949.56	1199.38
1002.6	1200.93
1009.37	1201.13

1112.4	1204.12
1205.97	1206.85
1235.69	1207.71
1246.06	1208.02
1266.27	1201.33
1271.08	1199.74
1389.7	1196.52
1390.01	1196.51
1393.38	1196.42
1436.2	1195.25
1620.63	1200.62
1693.49	1202.74
1826.84	1200.44
2007.96	1197.32
2352.27	1207.25
2420.6	1209.22
2709.42	1208.07
2732.82	1207.16
2737.79	1206.97
2738.83	1206.93
2743.02	1206.77
2771.27	1205.68
2905.12	1200.51
2906.85	1200.44
2958.91	1198.43
2979.82	1197.62
2990.68	1197.2
3033.19	1195.56
3036.23	1195.45
3038.35	1195.36
3088.28	1196.72
3089.73	1196.76

Material Boundary

X	Y
51.3023	1298.07
212.441	1244.46
217.333	1242.84
217.716	1242.71
217.778	1242.69
217.851	1242.66
236.836	1236.35
298.227	1215.93
305.883	1213.38
307.094	1212.98
319.097	1208.98
321.407	1208.21
323.341	1207.57
350.731	1198.46
353.073	1198.4
353.47	1198.38
355.109	1198.34
365.352	1198.06
386.685	1197.48
478.115	1194.99
490.164	1194.67
495.113	1194.53
517.683	1193.92
598.462	1191.72
611.387	1191.37
714.943	1188.55
746.736	1189.48
903.73	1194.05
913.492	1194.33
938.922	1195.07
949.676	1195.39
1002.72	1196.93
1009.49	1197.13

1112.52	1200.13
1206.09	1202.85
1235.81	1203.72
1245.47	1204
1265.02	1197.53
1270.38	1195.76
1389.59	1192.52
1389.9	1192.51
1393.27	1192.42
1436.2	1191.25
1620.75	1196.62
1693.52	1198.74
1826.77	1196.44
2007.99	1193.32
2352.39	1203.25
2420.65	1205.22
2709.34	1204.07
2732.66	1203.17
2737.64	1202.97
2738.68	1202.93
2742.86	1202.77
2771.12	1201.68
2904.97	1196.51
2906.69	1196.44
2958.76	1194.43
2979.66	1193.63
2990.53	1193.21
3033.03	1191.57
3036.08	1191.45
3038.33	1191.36
3088.39	1192.72
3090.24	1192.77
3090.43	1192.78
3090.44	1192.78

3096.28	1194.71

Material Boundary

X	Y
350.731	1198.46
351.169	1200.95
351.257	1201.45
351.432	1202.44

Material Boundary

X	Y
1245.47	1204
1245.84	1206.51
1245.92	1207.01
1246.06	1208.02

Material Boundary

X	Y
1270.38	1195.76
1270.82	1198.25
1270.9	1198.75
1271.08	1199.74

OBJECTIVE

The objective of this analysis is to determine the shear strength that will provide an unsaturated veneer slope stability FS $\geq$1.50 with respect to the protective cover layer failing along the cell baseliner 3:1 (H:V) sideslopes. The calculation will also consider the presence of equipment placing and spreading protective cover material across the sideslope.

Spreadsheet and slope stability software methods were utilized to complete the analyses. The table below presents the scenarios evaluated and the required factors of safety:

Translational or Rotational	Static or Seismic	Saturated or Unsaturated	OAC Rule 3745-27-08	Minimum Factor of Safety	Method of Calculation
Translational	Static	Unsaturated	(C)(7)(c)(ii)	1.50	Spreadsheet
Rotational	Static	Unsaturated	(C)(7)(c)(ii)	1.50	Software

METHODOLOGY

Multiple reference methods were utilized within this analysis and are described below.

"Cover Soil Slope Stability Involving Geosynthetic Interfaces", (GRI REPORT #18), by Te-Yang Soong and Robert M. Koerner, December 9, 1996, Geosynthetic Research Institute (GRI), Drexel University.

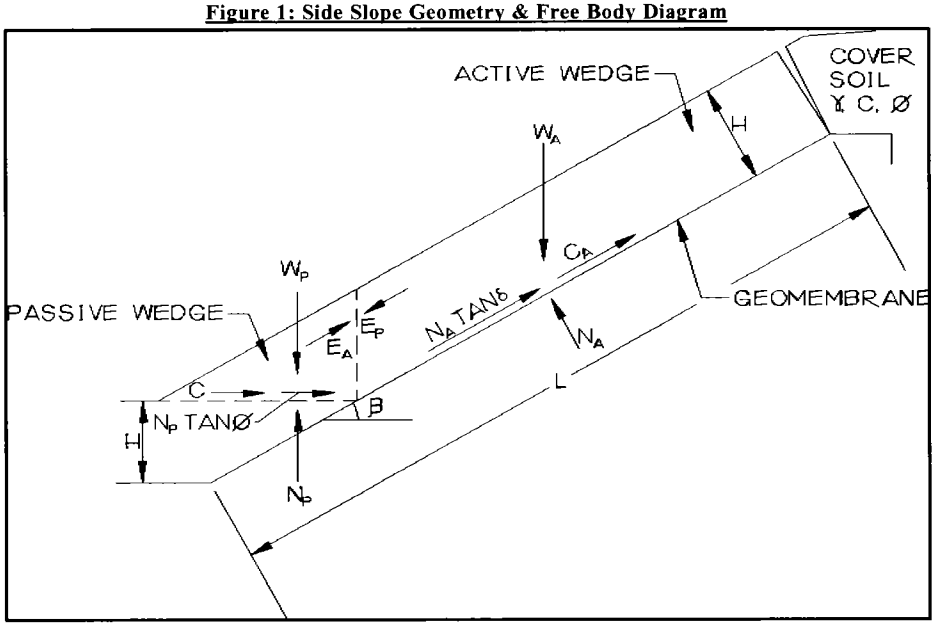
This reference was utilized to compute the factors of safety for the static drained translational analyses. It considers the presence of equipment on top of the cover layer and provides a FS based on the most critical interface shear strength of baseliner components. The spreadsheet calculates a FS by dividing the cover material along the sideslope into active and passive blocks. Then interwedge force equations are set equal to each other and are arranged in the form of a quadratic equation that can be solved to calculate a FS.

Slide version 6 is a computer software program utilized in the preparation of the shallow rotational analysis for the static drained case. The program uses limit equilibrium techniques to determine a FS for each given input cross-section and corresponding data file. Slide will calculate FS for both rotational and translational failure surfaces within a cross-section in terms of both static and seismic conditions based upon slope geometry, phreatic surfaces and the shear strength parameters of materials and the most critical contact interface within the proposed baseliner system. The software utilizes a CAD based graphical interface and was used calculate the factor of safety using Spencer's Method.

This calculation analyzes the greatest difference between perimeter berm height and cell floor corresponding to a longest length of 3:1 (H:V) sideslope of approximately 350 feet. Figure 1 illustrates

the proposed geometry of the baseliner sideslope and the freebody of the forces acting along the sideslope.

Figure 1: Side Slope Geometry & Free Body Diagram



Slope Dimensions	
Maximum Length of Baseliner Sideslope (along the length of the geomembrane)	350 feet
Baseliner Sideslope Orientation	3H:1V or 18.43 degrees

This veneer slope stability FS calculation is prepared proposing the following assumptions:

- The presence of equipment along the 3:1 (H:V) protective cover sideslope is analyzed within GRI Report #18.
- The shear strength component of adhesion developed between geosynthetic material layers is ignored.
- Tensile strength of the geosynthetic materials contributing to the veneer slope stability FS is ignored.
- The protective cover material provides a buttress at the toe of the slope, i.e. the passive soil wedge.
- The anticipated granular nature of the proposed protective cover material suggests that cohesive strength does not exist, therefore only the internal angle of friction will be utilized.
- Weights of the geosynthetic components are negligible compared to the weight of protective cover material and therefore are not considered in the calculations.
- All calculations will utilize a 1-foot unit width of sideslope.

PROPOSED BASELINER

The baseliner system design option along the landfill cell sideslope is outlined below, from top to bottom:

- Geotextile Filter Layer (if needed)
- Leachate Collection/Protective Cover (1-foot of aggregate or 2-feet of tire shreds, modeled as 1-foot of aggregate);
- Geotextile Cushion Layer;
- Geocomposite leachate collection layer;
- 60-mil HDPE Flexible Membrane Liner (FML);
- Geosynthetic Clay Liner (GCL);
- 3-foot thick Recompacted Soil Liner (RSL);
- Structural fill where required; and
- Existing subgrade soils or bedrock.

MATERIAL PARAMETERS

Protective Cover

Unit weight: $\gamma = 115$ pcf;
Cohesion: c = 0 psf; and

Internal angle of friction: $\Phi_i = 30$ degrees, a conservative value based upon NAVAC Design Manual 7.2, 1986, which lists the following friction angles for sands:

USCS GROUP	SOIL TYPE	FRICTION ANGLE
SM	Silty Sand	34
SP	Poorly Graded Sand	37
SW	Well Graded Sand	38

Recompacted Soil Liner (RSL)

g': Unit weight = 125 pcf
c': Cohesion = 0 psf
ϕ': Friction angle = 27 degrees.

Structural Fill

γ': Unit weight = 125 pcf
c': Cohesion = 0 psf
ϕ': Friction angle = 27 degrees.

Required Shear Strength

The calculations were used to determine the shear strength parameters (contact interface friction angle, $\phi_{\text{interface friction}}$) that results in acceptable factors of safety. The input variables of baseliner side slope length, cover, and LGP equipment will be held constant within the spreadsheet while the contact interface friction angle, $\phi_{\text{interface friction}}$, is varied until a FS of $\geq$1.50 is achieved. Cohesion was ignored.

All proposed interfaces are required to meet the minimum calculated contact interface shear strength which is included with other minimum shear strength parameters specified within the Construction Quality Assurance (CQA) Plan.

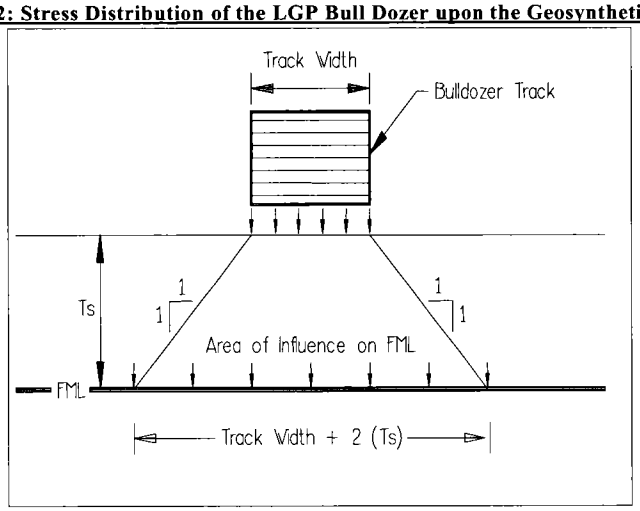
VARIABLES DEFINED

W_A = Total weight of the active wedge;
W_P = Total weight of the passive wedge;
N_A = Effective force normal to the failure plane of the active wedge;
N_P = Effective force normal to the failure plane of the passive wedge;
γ = Unit weight of the protective cover soil;
h = Thickness of the protective cover soil;
L = Length of slope measured along the geomembrane;
β = Soil slope angle beneath the geomembrane;
ϕ = Internal angle of friction within the protective cover soil;
δ = Interface friction angle between the most critical geosynthetic interface;
C_a = Adhesive force between the components lying along the most critical geosynthetic interface of the active wedge;
c_a = The adhesion developed between the components lying along the most critical geosynthetic interface of the active wedge;
C = Cohesive force along the failure plane of the passive wedge;
c = cohesion of the protective cover soil;
E_A = Interwedge force acting on the active wedge from the passive wedge;
E_P = Interwedge force acting on the passive wedge from the active wedge and
FS = Factor of safety against protective cover soil sliding down the slope.

CALCULATIONS

It is proposed that a Low Ground Pressure (LGP) bulldozer will be used to place protective cover material across the sideslope. The pressure exerted upon the top of the geosynthetic layers by a bulldozer is modeled as illustrated in Figure 2 thus the bulldozer will not operate over the geosynthetic layers until the 12-inch thick protective cover material layer is placed.

Figure 2: Stress Distribution of the LGP Bull Dozer upon the Geosynthetic Layers



The following typical LGP Bulldozer equipment specifications are used within the GRI Report #18.

- 2 tracks
- Track length = 10.25 feet
- Track width = 2.75 feet
- Operating weight = 42,500 lbs
- One Track Contact area = 28.2 ft^2
- One Track Contact pressure = 21,250 lbs / 28.2 ft^2 = 753.5 psf

Subsequently, the forces are resolved below to produce a veneer slope stability FS. The equations are shown on pages 13 and 14 of GRI Report #18 and for ease of calculations are incorporated into a spreadsheet to produce a FS corresponding to a given set of input parameters. A copy of the spreadsheet calculations displaying the results is included in Attachment A. GRI Report # 18 utilizes an influence factor which is a function of the ratio of the bulldozer track width to the thickness of the cover soil to account for the dissipation of surface forces through the cover soil to the geosynthetic interface. As shown on the GRI Report # 18 calculation provided in Attachement A, a bulldozer track width of 2.75-feet and a cover soil thickness of 1 or 2 feet corresponds to an influence factor of 0.97. Since the GRI Report # 18 calculation applies pressures over a smaller area of influence to the underlying geosynthetics

than would be applied by using the typical stress distribution as shown in Figure 3 above, the GRI Report # 18 calculation represents a conservative approach for dissipation of forces through the cover soil to the underlying geomembrane.

Static Drained Translational Analyses

An analysis was completed using a spreadsheet (excel) recommended by GRI to determine the stability of the baseliner considering translational failures. Input values used in the analysis were described in the previous sections of the report. Refer to Attachment A "Spreadsheet Based Translational Failure Analysis" for translational stability results.

Static Drained Rotational Analyses

As stated above, this analysis was completed using the software package Slide. The input values utilized in the Slide analyses are the same as the values utilized in the spreadsheet calculations with the exception that the RSL, structural fill, and in-situ layers are only modeled in the rotational analyses. In Slide, the "auto-refine search" feature was enabled to locate the worst case factor of safety over the entire slope. Output files from this analysis are included in Attachment B.

CONCLUSIONS

The following table presents a summary of the calculated factors of safety for the analyses performed. As shown, all calculated factors of safety meet the requirements of OAC 3745-27-08(C)(7).

Translational or Rotational	Static or Seismic	Drained or Undrained	OAC Rule 3745-27-08	Calculated Factor of Safety	Required Factor of Safety	Method of Calculation
Translational	Static	Drained	(C)(7)(c)(ii)	1.51	1.50	Spreadsheet
Rotational	Static	Drained	(C)(7)(c)(ii)	1.54	1.50	Software

The analyses indicate that a contact interface shear strength friction angle of 26.6 degrees results in acceptable factors of safety. This value is specified as a shear stress of **401 psf** in the CQA/QC Plan as the requirement for baseliner interface shear strength under low normal loads.

This peak shear strength value was determined as follows:

$\tau = C_a + \sigma_n \tan \phi$

Where: $C_a = 0$ psf

σ_n = 800 psf (conservative for equipment loading and protective cover material)
ϕ = 26.6°
τ = 401 psf

Any combination of C_a and ϕ yielding a $\tau \geq 401$ psf under a normal load of 800 psf will be considered acceptable.

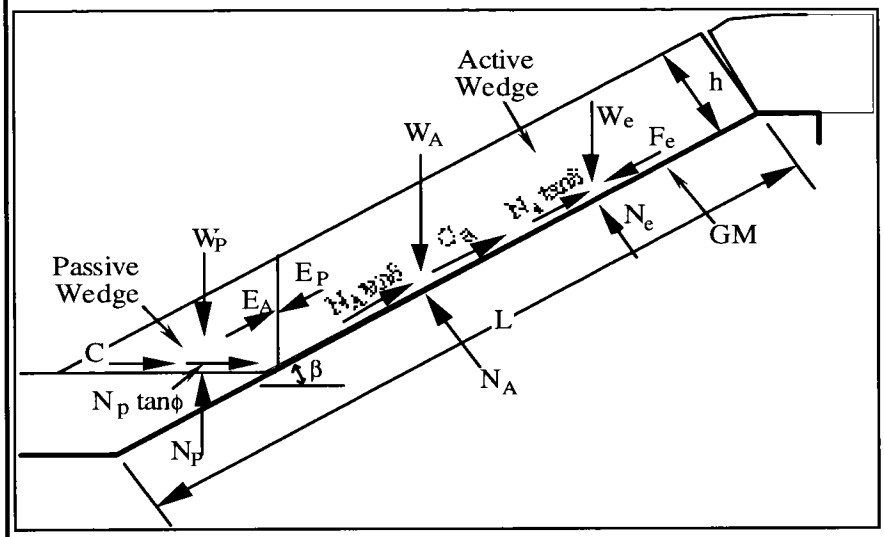
ATTACHMENT A

Spreadsheet Based Translational Failure Analysis

COVER PLACEMENT WITH THE INCORPORATION OF EQUIPMENT LOADS

Placement of the Cover Material Layer

across the sideslopes with the incorporation of Equipment Loads



Calculation of FS

Active Wedge:

Wa= 42167.2 lb

Na= 40003.3 lb

Passive Wedge:

Wp= 191.7 lb

$$FS = \frac{-b + \sqrt{b^2 - 4ac}}{2a}$$

a= 14897.6

b= -25358

c= 4307.1

FS= 1.511

thickness of protective cover soil = h =	1.00	ft			
pro. cov. mat. slope angle beneath the geomembrane = β =	18.43	°	*= 0.32*	*(rad.)*	
finished protective cover material slope angle = ω =	18.43	°	*= 0.32*	*(rad.)*	
length of slope measured along the geomembrane = L =	370.0	ft			
unit weight of the protective cover soil = γ =	115.0	lb/ft^3			
friction angle of the protective cover soil = ϕ =	30.0	°	*= 0.52*	*(rad.)*	
cohesion of the protective cover soil = c =	0.0	lb/ft^2		*C= 0*	*lb*
critical interface friction angle = δ =	26.60	°	*= 0.46*	*(rad.)*	
adhesion = ca =	0.0	lb/ft^2		*Ca= 0*	*lb*

thickness of the protective cover soil = h =	1.00	ft	*b/h= 3.0*
equipment ground pressure (= wt. of equipment/(2wb)) = q =	753.5	lb/ft^2	*We=qwl= 7491.7*
length of each equipment track = w =	10.3	ft	*Ne=Wecosβ= 7107.2*
width of each equipment track = b =	3.0	ft	*Fe=We(a/g)= 0.0*
influence factor* at geomembrane interface = I =	0.97		
acceleration/deceleration of the bulldozer = a =	0.00	g	

*Influence Factor Default Values

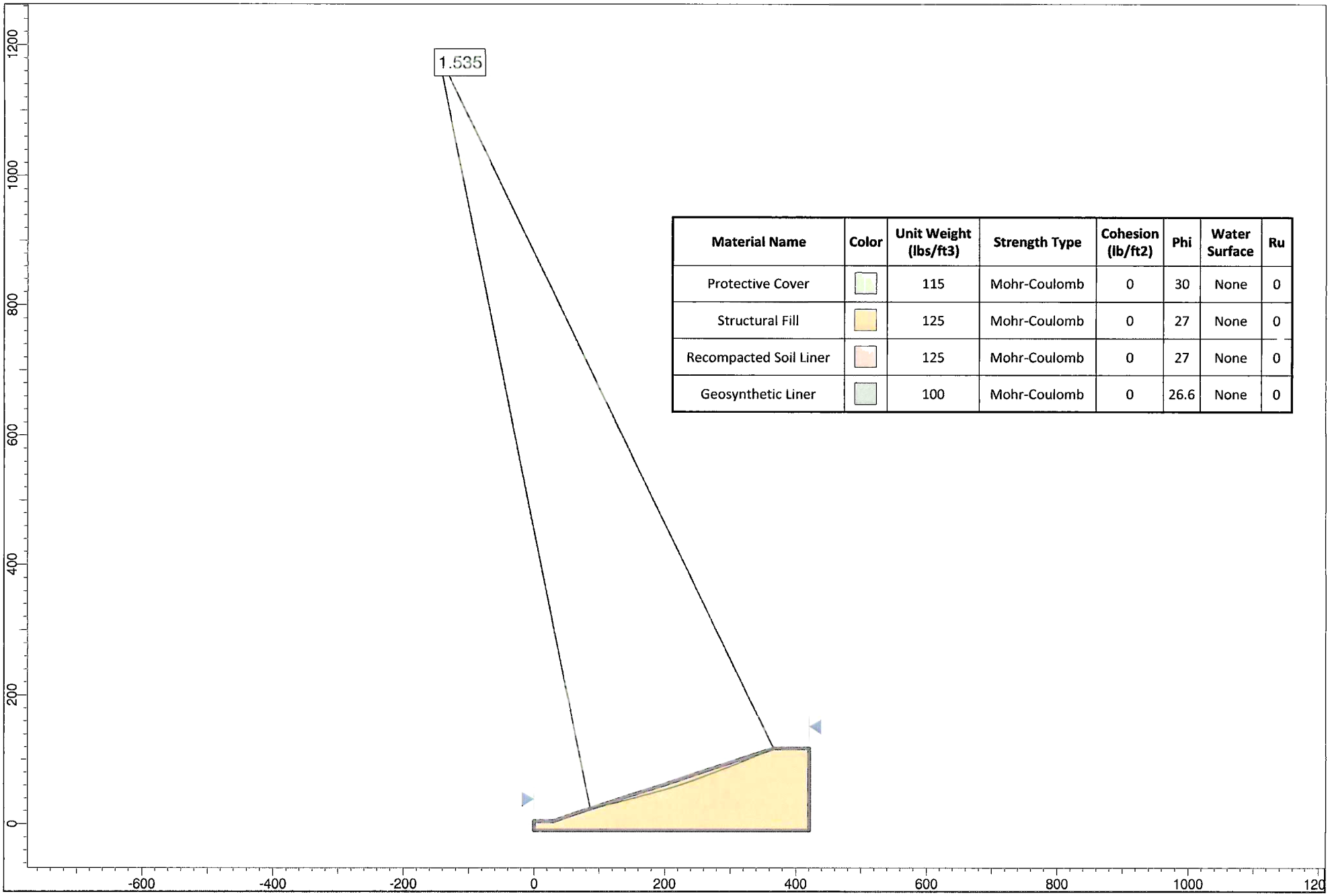
Cover Soil Thickness	Equipment Track Width		
	Very Wide	Wide	Standard
[2] 300 mm	1.00	0.97	0.94
300-1000 mm	0.97	0.92	0.70
[3] 1000 mm	0.95	0.75	0.30

Note: Denotes an automatically calculated cell

Denotes input values

ATTACHMENT B

Software Based Rotational Failure Analysis



Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (lb/ft2)	Phi	Water Surface	Ru
Protective Cover		115	Mohr-Coulomb	0	30	None	0
Structural Fill		125	Mohr-Coulomb	0	27	None	0
Recompacted Soil Liner		125	Mohr-Coulomb	0	27	None	0
Geosynthetic Liner		100	Mohr-Coulomb	0	26.6	None	0

Baseliner -- static -- rotational -- drained.slim

Slide Analysis Information

Project Summary

File Name: Baseliner -- static -- rotational -- drained.slim
Slide Modeler Version: 6.012

General Settings

Units of Measurement: Imperial Units
Time Units: days
Permeability Units: feet/second
Failure Direction: Right to Left
Data Output: Standard
Maximum Material Properties: 20
Maximum Support Properties: 20

Analysis Options

Analysis Methods Used

Spencer

Number of slices: 25
Tolerance: 0.005
Maximum number of iterations: 50
Check malpha < 0.2: Yes
Initial trial value of FS: 1
Steffensen Iteration: Yes

Groundwater Analysis

Groundwater Method: Water Surfaces
Pore Fluid Unit Weight: 62.4 lbs/ft3
Advanced Groundwater Method: None

Random Numbers

Pseudo-random Seed: 10116
Random Number Generation Method: Park and Miller v.3

Surface Options

Surface Type: Circular
Search Method: Auto Refine Search

Divisions along slope: 20
Circles per division: 10
Number of iterations: 10
Divisions to use in next iteration: 50%
Composite Surfaces: Disabled
Minimum Elevation: 0
Minimum Depth: 2

Material Properties

Property	Protective Cover	Structural Fill	Recompacted Soil Liner	Baseliner
Color				
Strength Type	Mohr-Coulomb	Mohr-Coulomb	Mohr-Coulomb	Mohr-Coulomb
Unit Weight [lbs/ft3]	115	125	125	100
Cohesion [psf]	0	0	0	0
Friction Angle [deg]	30	27	27	26.6
Water Surface	None	None	None	None
Ru Value	0	0	0	0

Global Minimums

Method: spencer

FS: 1.534920
Center: -147.594, 1188.057
Radius: 1188.047
Left Slip Surface Endpoint: 85.859, 23.173
Right Slip Surface Endpoint: 366.411, 116.957
Resisting Moment=1.27523e+008 lb-ft
Driving Moment=8.30814e+007 lb-ft
Resisting Horizontal Force=101708 lb
Driving Horizontal Force=66262.6 lb

Valid / Invalid Surfaces

Method: spencer

Number of Valid Surfaces: 8465
Number of Invalid Surfaces: 0

Slice Data

Global Minimum Query (spencer) - Safety Factor: 1.53492

Slice Number	Width [ft]	Weight [lbs]	Base Material	Base Cohesion [psf]	Base Friction Angle [degrees]	Shear Stress [psf]	Shear Strength [psf]	Base Normal Stress [psf]	Pore Pressure [psf]	Effective Normal Stress [psf]

1	7.66578	440.782	Protective Cover	0	30	21.0793	32.3551	56.0406	0	56.0406
2	3.99275	558.984	Baseliner	0	26.6	44.204	67.8496	135.493	0	135.493
3	13.4819	3557.76	Recompacted Soil Liner	0	27	84.4181	129.575	254.305	0	254.305
4	13.4819	6085.62	Recompacted Soil Liner	0	27	143.348	220.028	431.829	0	431.829
5	12.1184	7401.95	Structural Fill	0	27	192.626	295.666	580.278	0	580.278
6	12.1184	9015.68	Structural Fill	0	27	233.075	357.751	702.127	0	702.127
7	12.1184	10424	Structural Fill	0	27	267.699	410.897	806.435	0	806.435
8	12.1184	11625.3	Structural Fill	0	27	296.563	455.201	893.383	0	893.383
9	12.1184	12617.8	Structural Fill	0	27	319.729	490.758	963.164	0	963.164
10	12.1184	13399.6	Structural Fill	0	27	337.255	517.66	1015.96	0	1015.96
11	12.1184	13968.7	Structural Fill	0	27	349.201	535.996	1051.95	0	1051.95
12	12.1184	14323.1	Structural Fill	0	27	355.623	545.853	1071.29	0	1071.29
13	12.1184	14460.6	Structural Fill	0	27	356.576	547.316	1074.17	0	1074.17
14	12.1184	14378.8	Structural Fill	0	27	352.114	540.467	1060.72	0	1060.72
15	12.1184	14075.5	Structural Fill	0	27	342.289	525.386	1031.13	0	1031.13
16	12.1184	13547.9	Structural Fill	0	27	327.152	502.152	985.53	0	985.53
17	12.1184	12793.6	Structural Fill	0	27	306.754	470.843	924.079	0	924.079
18	12.1184	11809.6	Structural Fill	0	27	281.143	431.532	846.927	0	846.927
19	12.1184	10593	Structural Fill	0	27	250.368	384.295	754.221	0	754.221
20	12.1184	9140.8	Structural Fill	0	27	214.476	329.204	646.099	0	646.099
21	12.1184	7449.66	Structural Fill	0	27	173.515	266.331	522.704	0	522.704
22	12.5798	5683.08	Recompacted Soil Liner	0	27	126.55	194.244	381.227	0	381.227
23	12.5798	3324.36	Recompacted Soil Liner	0	27	73.4507	112.741	221.267	0	221.267
24	3.69206	516.888	Baseliner	0	26.6	38.074	58.4405	116.703	0	116.703
25	7.06441	406.204	Protective Cover	0	30	19.3015	29.6263	51.3143	0	51.3143

Interslice Data

Global Minimum Query (spencer) - Safety Factor: 1.53492

Slice Number	X coordinate [ft]	Y coordinate - Bottom [ft]	Interslice Normal Force [lbs]	Interslice Shear Force [lbs]	Interslice Force Angle [degrees]
1	85.8593	23.173	0	0	0
2	93.525	24.7355	74.5327	23.0132	17.1589
3	97.5178	25.5702	138.487	42.7602	17.159
4	111	28.4948	536.472	165.645	17.159
5	124.482	31.5838	1141.22	352.372	17.159
6	136.6	34.502	1789.56	552.557	17.159
7	148.718	37.5553	2479.23	765.503	17.1589
8	160.837	40.7446	3161.57	976.189	17.159
9	172.955	44.0712	3794.87	1171.73	17.159
10	185.074	47.5363	4344.28	1341.37	17.159

11	197.192	51.141	4781.85	1476.48	17.159
12	209.311	54.8869	5086.54	1570.56	17.159
13	221.429	58.7752	5244.22	1619.24	17.1589
14	233.547	62.8074	5247.7	1620.32	17.159
15	245.666	66.9851	5096.82	1573.73	17.159
16	257.784	71.31	4798.44	1481.6	17.159
17	269.903	75.7837	4366.58	1348.26	17.159
18	282.021	80.408	3822.44	1180.24	17.1589
19	294.139	85.1849	3194.53	986.367	17.159
20	306.258	90.1163	2518.82	777.727	17.1589
21	318.376	95.2043	1838.78	567.753	17.1589
22	330.495	100.451	1205.6	372.249	17.1589
23	343.075	106.068	661.225	204.165	17.159
24	355.654	111.862	306.246	94.5587	17.159
25	359.346	113.596	244.875	75.6092	17.1589
26	366.411	116.957	0	0	0

List Of Coordinates

External Boundary

X	Y
380	117
371.026	117
369.53	117
366.538	117
30	4.5
0	4.5
0	3.5
0	3
0	0
0	-10
210	-10
420	-10
420	117

Material Boundary

X	Y
0	0
30	0
380	117

Material Boundary

X	Y

0	3
30	3
371.026	117

Material Boundary

X	Y
0	3.5
30	3.5
369.53	117

OBJECTIVE

The objective of this analysis is to determine (1) the minimum required shear strength of the final cover system components and (2) the required geocomposite drainage layer transmissivity.

COVER MATERIAL PARAMETERS

The final cover system was analyzed for shallow translational and rotational failure surfaces under static unsaturated, static saturated, and seismic unsaturated conditions using a spreadsheet and Slide version 6.0 (Slide). This analysis was performed to determine the material/interface shear strength for the final cover system that will yield factors of safety (FS) equal to or greater than 1.50 for static unsaturated conditions, 1.10 for static saturated conditions, and 1.00 for seismic unsaturated conditions in accordance with OAC 3745-27-08(C)(7)(c)&(d). The proposed final cover system consists of 3H:1V final side slopes with benches. The benches will be constructed with a maximum vertical spacing of 60 feet based on the top of waste grades. The proposed components of the final cover system are outlined below from top to bottom:

- 2.5-foot thick Vegetative/Frost Protection Layer;
- Double-sided Drainage Geocomposite;
- 40-mil textured Geomembrane;
- 1.5-foot thick Recompacted Soil Barrier (RSB); and
- 12-inch thick Intermediate Cover Layer.

The final cover system was analyzed using the following material properties for the slope stability analysis:

Vegetative Soil Cover Parameters
Unit weight of the vegetative cover layer material: $\gamma_t = 125$ pcf
Cohesion: c = 0 psf
Internal Friction Angle: $\phi = 27$ degrees
Permeability: k = ~~4.20~~ *1.00* x $10^{-5\ -4}$ cm/sec
Thickness = 2.5 feet.

The analysis assumes that on-site soil will be used as newly-compacted fill for the vegetative soil with a fair grass cover. Based on testing of soils at the site, CEC assumed that soil with a USCS classification of CL will be used. Based on Figure 1, this results in an SCS curve number of 80, which is used in the analysis.

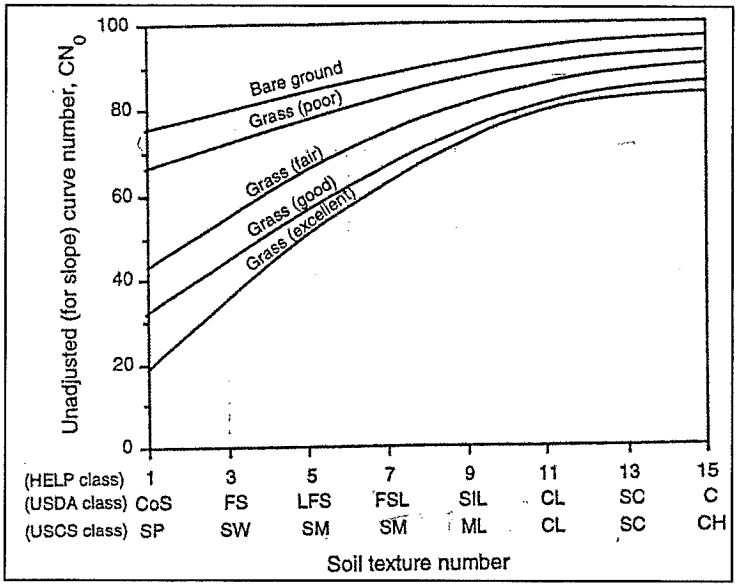


Figure 1: Figure A-3 of GRI Report #19

Geosynthetics

Unit weight of the geosynthetic material: γ_t = 100 pcf
Cohesion: c' = 0 psf
Internal Friction Angle: ϕ' = 26.6 degrees
Thickness = 0.5 feet

Recompacted Soil Barrier (RSB)

Unit weight of the barrier soil material: γ_t = 125 pcf
Cohesion: c' = 0 psf
Internal Friction Angle: ϕ' = 27 degrees
Thickness = 1.5 feet

Intermediate Cover

Unit weight of the barrier soil material: γ_t = 125 pcf
Cohesion: c' = 0 psf
Internal Friction Angle: ϕ' = 27 degrees
Thickness = 1.0 feet

Municipal Solid Waste (MSW)

Unit weight of the solid waste material: γ_t = ~~90~~ *75* pcf
Cohesion: c' = 400 psf
Internal Friction Angle: ϕ' = 33.0 degrees
Thickness = varies

The shear strength properties of MSW are conservative when compared to the maximum recommendation in Chapter 8 of the *Geotechnical and Stability Analyses for Ohio Waste Containment Facilities* manual published by the Ohio EPA Geotechnical Resource Group, dated September, 14, 2004 (GeoRG Manual).

SEISMIC COEFFICIENT

The shear wave acceleration is modeled within the stability analysis by inputting a coefficient, (Cs) that is some fraction of gravity (g). According to the USGS website, based on the 2008 data for Peak Acceleration (%g) with 2% Probability of Exceedance in 50 Years, the peak horizontal ground acceleration for the site is 0.06g. Figure 8-11 in the GeoRG Manual shows that horizontal ground acceleration may increase as it reaches the surface at waste heights of 100 feet. When plotting 0.06g on Figure 8-11, the maximum horizontal ground acceleration at waste heights of 100 feet can be expected to be 0.10g.

SPREADSHEET CALCULATIONS

The spreadsheet-based calculations are described in more detail below.

Static and Seismic Unsaturated Translational Analysis

Figure 2 below illustrates the free-body diagram used to perform the calculations.

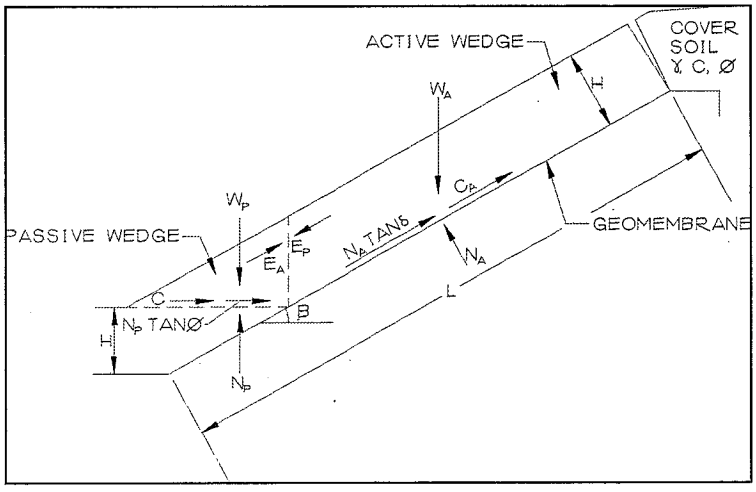


Figure 2: Sideslope geometry and free-body diagram

The GRI Report #18 and #19 veneer slope stability calculations are prepared proposing the following assumptions:

- The presence of equipment along the 3H:1V cover sideslope is analyzed within GRI Report #18.
- The shear strength component of adhesion developed between geosynthetic material layers is ignored.
- Tensile strength of the geosynthetic materials contributing to the veneer slope stability FS is ignored.
- The cover material provides a buttress at the toe of the slope, i.e. the passive soil wedge.
- Weights of the geosynthetic components are negligible compared to the weight of cover material and therefore are not considered in the calculations.
- The effect of seepage forces on the veneer stability of the final cover material layer, generated by a storm event, is evaluated in GRI Report # 19
- Cohesion within the final cover soil is ignored (conservative).
- All calculations will utilize a 1-foot unit width of sideslope.

A Low Ground Pressure (LGP) bulldozer will likely be used to place cover soil on the sideslope. The presence of equipment was only modeled in the static analysis. The typical pressure distribution for a LGP dozer operating on top of a cover soil layer placed over underlying geosynthetic layers is modeled as illustrated in Figure 3, where TS is the thickness of the soil layer over the geosynthetics. The vegetative cover material will be placed in lifts with a minimum thickness of 1.25 feet (2 lifts). Therefore, the bulldozer will not operate over the geosynthetic layers until least 1.25 feet of vegetative cover material is in place. The spreadsheet analysis was modeled assuming these two scenarios: (1) after the first 1.25-foot thick lift was placed and (2) after the second 1.25-foot thick lift was placed (2.5 feet total).

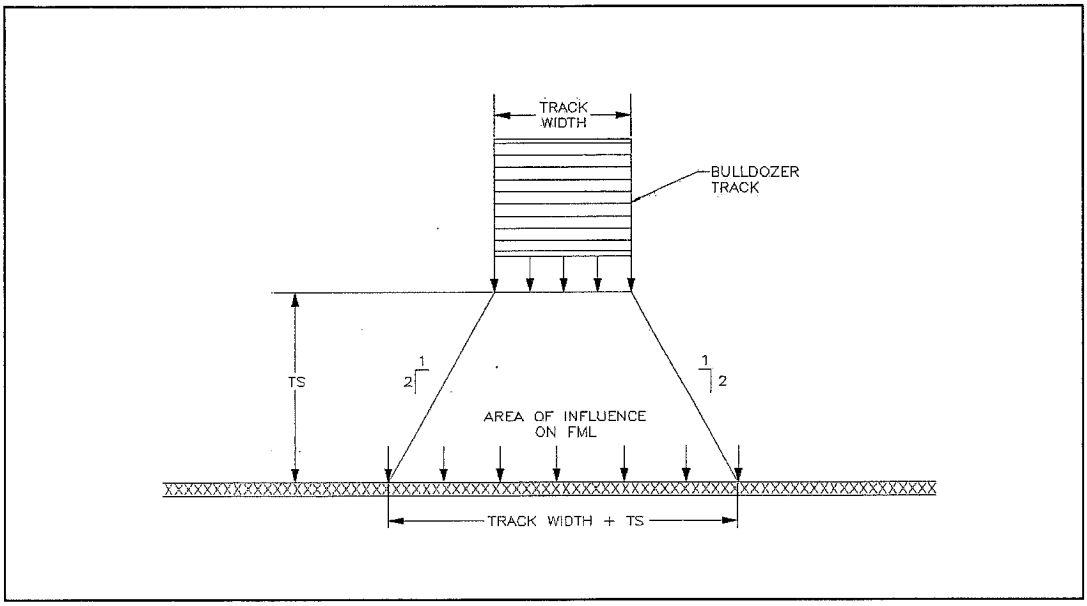


Figure 3: Typical Stress Distribution of an LGP Bull Dozer upon the Geosynthetic Layers

The following typical LGP Bulldozer equipment specifications are used within the GRI Report #18.

- 2 tracks
- Track length = 10.25 feet
- Track width = 2.75 feet
- Operating weight = 42,500 lbs
- One Track Contact area = 28.2 ft^2
- One Track Contact pressure = 21,250 lbs / 28.2 ft^2 = 753.5 psf

Subsequently, the forces are resolved below to produce a veneer slope stability FS. The equations are shown on pages 13 and 14 of GRI Report #18, and for ease of calculations are incorporated into a spreadsheet to produce a FS corresponding to a given set of input parameters. A copy of the spreadsheet calculations displaying the results is included in Attachment A. GRI Report # 18 utilizes an influence factor which is a function of the ratio of the bulldozer track width to the thickness of the cover soil to account for the dissipation of surface forces through the cover soil to the geosynthetic interface. As shown on the GRI Report # 18 calculation provided in Attachement A, a bulldozer track width of 2.75-feet and a cover soil thickness of 1.25-feet or 2.5 feet corresponds to an influence factor of 0.97. Since the GRI Report # 18 calculation applies pressures over a smaller area of influence to the underlying geosynthetics than would be applied by using the typical stress distribution as shown in Figure 3 above, the GRI Report # 18 calculation represents a conservative approach for dissipation of forces through the cover soil to the underlying geomembrane.

Static Saturated Translational Analysis

The effect of seepage forces acting on the veneer stability of the final cover material layer, generated by a storm event, is evaluated using the methodologies outlined in GRI Report # 19. This calculation method is used to determine the head within the final cover system as well as determining the required transmissivity of the final cover geocomposite. The transmissivity of the geocomposite used in the design will be calculated assuming the 100 year, 1-hour storm event ~~with a factor of safety of 2.0 applied to the rainfall intensity for conservatism~~.

An important input parameter within the GRI Report #19 spreadsheet calculation that impacts slope stability is the "runoff coefficient" (RC). The RC estimates the amount of precipitation that drains off the final cover sideslope as surface water runoff, thereby not infiltrating, saturating and reducing the shear strength of the final cover material.

Calculating the RC (as a function of time) consists of determining a Soil Conservation Service (SCS) curve number using the proposed length and orientation of the final cover sideslope and the magnitude of a given storm event. Subsequent equations are then used to determine "potential retention" and "accumulated precipitation" values, which are then input into an equation to calculate a RC. Appendix A presents the analysis used to calculate the RC.

GRI Report #19 includes a spreadsheet calculation that considers the affects of rainfall and drainage layer capacity parameters for a given slope stability condition. The GRI Report #19 spreadsheet is a modified version of the slope stability spreadsheet calculation presented within GRI Report #18. The following rainfall and drainage layer data was input into the GRI Report #19 spreadsheet calculation:

- The peak 100-year, 1-hour storm event corresponds to a rainfall amount of 2.56 inches/hour. ~~Applying a factor of safety of 2.0 to the rainfall intensity results in a rainfall amount of 5.12 inches/hour~~;
- A vegetative cover material permeability of $k_{c.s.}$ = ~~4.20~~ *1.00* x 10^{-5} ~~$^{-4}$~~ cm/sec;
- A vegetative cover material thickness of $h_{c.s.}$ = 1.25 feet for 1 lift or 2.5 for final conditions;
- A geocomposite thickness of h_d = 300 mils = 7.62 mm; and
- A long term geocomposite transmissivity of θ_{lt} = ~~2.45~~ *1.77* x 10^{-4} m^2/sec = θ_{100}.

In this analysis, the permeability of the drainage layer (K_d) is a function of the required transmissivity and thickness of the geocomposite using the following equation:

$K_d = \theta_{lt} / h_d$

Where h_d equals the thickness of the geocomposite

Therefore, the permeability of the geocomposite equals:

K_d = (~~2.54~~ *1.7724* x 10^{-4} m^2/sec) / [7.62 mm /(1000 mm/m)] = ~~0.0321~~ 0.02326 m/sec = ~~3.21~~ 2.326 cm/sec

The GRI Report #18 and #19 calculation spreadsheets are provided in Attachment A.

Geocomposite Transmissivity Calculation

To account for the reduction in transmissivity over the long term, the geocomposite required transmissivity will be increased using reduction factors based on *GRI Standard – GC8, "Determination of the Allowable Flow Rate of a Drainage Geocomposite"*, to develop the transmissivity specification at the time of installation. The Reduction factors for the flow capacity of geocomposites having a geonet core used in landfill cover drainage layer applications are listed below.

$\theta_{ult} = \theta_{lt} * FS_D * (RF_{IN} * RF_{CR} * RF_{CC} * RF_{BC})$

Where: FS_D = *Overall factor of safety for drainage (2.0);*
RF_{IN} = Reduction Factor for geotextile intrusion (1.0 to 1.2);
RF_{CR} = Reduction Factor for creep deformation (1.2 to 1.4);
RF_{CC} = Reduction Factor for chemical clogging (1.0 to 1.2); and
RF_{BC} = Reduction Factor for biological clogging (1.2 to 3.5).

Since the laboratory testing will be performed using site-specific boundary conditions, the reduction factor for intrusion of the geotextile into the geonet will be ignored (RF_{IN} =1.0).

Reduction factors for creep deformation, RF_{CR} = 1.4, biological clogging, RF_{BC} = 2.7, and chemical clogging RF_{CC} =1.1 were utilized. The resulting ultimate transmissivity (θ_{ult}) is calculated as shown below.

$$\theta_{ult} = \sout{2.45}\ 1.77 * 10^{-4}\ m^2/sec \times 2 \times (1.0 * 1.4 * 1.1 * 2.7) = \sout{1.02}\ 1.47 * 10^{-3}\ m^2/sec$$

SOFTWARE CALCULATIONS

Translational and rotational analyses were completed using Slide. The input values utilized in the Slide analyses are the same as the values utilized in the spreadsheet calculations. For the saturated analyses, a head of 0.1 meters (0.33 feet) was assumed, which is conservative since the maximum head above the liner ($\sout{h_{avh}}\ h_{avg}$) determined in the GRI Report #19 calculation spreadsheet was $\sout{0.01}\ 0.16$ meters *for both the 1.25 feet and 2.5 feet of final cover soil.* For the translational saturated analysis, the software was permitted to search for the most critical failure surface within the final cover soils and geosynthetics.

A summary of these calculations are provided in the following conclusions section of this document. Output files from the software analyses are included in Attachment B.

CONCLUSIONS

The following tables present a summary of the calculated factors of safety for the various analyses performed for the final cover system. As shown, all calculated factors of safety meet the requirements of OAC 3745-27-08(C)(7). The spreadsheet outputs for the translational analyses are provided in Attachment A, and the software outputs for the translational and rotational analyses are provided in Attachment B.

Translational or Rotational	Static or Seismic	Unsaturated or Saturated	OAC Rule 3745-27-08	Vegetative Cover Thickness	Calculated Factor of Safety	Required Factor of Safety
Translational	Static	Unsaturated	(C)(7)(c)(ii)	1.25	1.52	1.50
	Seismic		(C)(7)(d)(ii)		1.14	1.00
	Static	Saturated	(C)(7)(f)(ii)		$\sout{1.51}\ 22$	1.10
	Static	Unsaturated	(C)(7)(c)(ii)	2.5	1.54	1.50
	Seismic		(C)(7)(d)(ii)		1.15	1.00
	Static	Saturated	(C)(7)(f)(ii)		$\sout{1.54}\ 39$	1.10
Rotational	Static	Unsaturated	(C)(7)(c)(ii)		1.55	1.50
	Seismic		(C)(7)(d)(ii)		1.16	1.00
	Static	Saturated	(C)(7)(f)(ii)		1.55	1.10

Shear Strength Requirements

The analyses indicate that the soil material used to construct the final cover layer over the 3H:1V slopes which exhibits an internal shear strength of **~~408~~ *560* psf** results in acceptable factors of safety. This value is specified in the CQA/QC Plan as the requirement for final cover system RSB and vegetative cover soil soil peak shear strength under a normal load of ~~800~~ *1100* psf. The normal load of ~~800~~ *1100* psf is a conservative value that is used to account for maximum loading on the geosynthetics due to overlying soils and equipment loads.

This peak shear strength value was determined using the following equation:

$\tau = c + \sigma_n \tan \phi$

Where: c = 0 psf (as utilized in saturated software analyses)
σ_n = ~~800~~ *1100* psf (based on cover soil thickness and equipment loads)
ϕ = 27

Any combination of c and ϕ yielding a $\tau \geq$ ~~408~~ *560* psf under a normal load of ~~800~~ *1100* psf will be considered acceptable.

Interface Shear Strength Requirements

The analyses indicate that the soil/geosynthetics and geosynthetics/geosynthetics interfaces for the materials used to construct the final cover system over the 3H:1V slopes which exhibits an interface shear strength of **~~401~~ *551* psf,** results in acceptable factors of safety. This value is specified in the CQA/QC Plan as the requirement for the final cover system soil/geosynthetics and geosynthetics/geosynthetics interface peak shear strength under low normal loads.

This peak shear strength value was determined using the following equation:

$\tau = c + \sigma_n \tan \phi$

Where: c = 0 psf
σ_n = ~~800~~ *1100* psf
ϕ = 26.6° (as described above)

Any combination of c and ϕ yielding a $\tau \geq$ ~~401~~ *551* psf under a normal load of ~~800~~ *1100* psf will be considered acceptable.

Geocomposite Requirements

The result of the geocomposite transmissivity calculation indicates that a geonet thickness of **300 mil** and a transmissivity of ~~**1.02**~~ ***1.47*** **x10^{-3} m^2/sec** are required to obtain an acceptable FS. These values are specified in the CQA/QC Plan. To accurately model field conditions, the selected geocomposite shall be tested with a normal load of ~~800~~ *1100* psf, which is a conservative estimate based on the anticipated loading on the geosynthetics due to overlying soils and equipment loads. Testing shall also be performed using a hydraulic gradient of 0.316 ft/ft with the site specific boundary conditions of the final cover system.

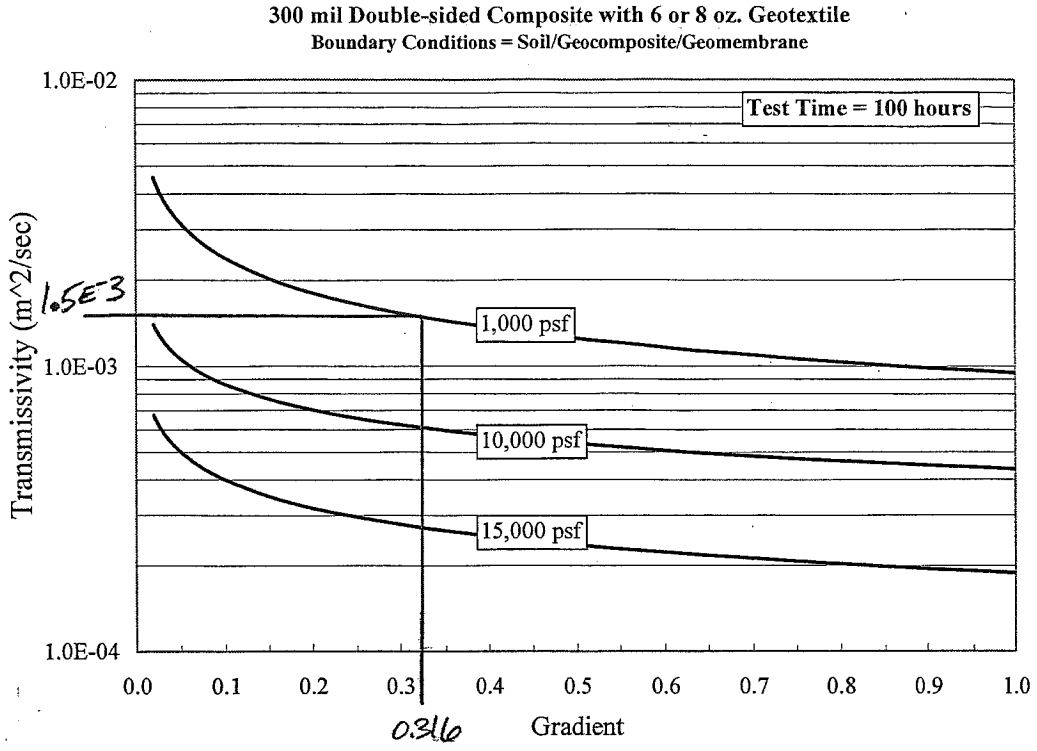


Figure A-9. Performance Transmissivity of a 300 mil GSE FabriNet UF geocomposite under Soil.

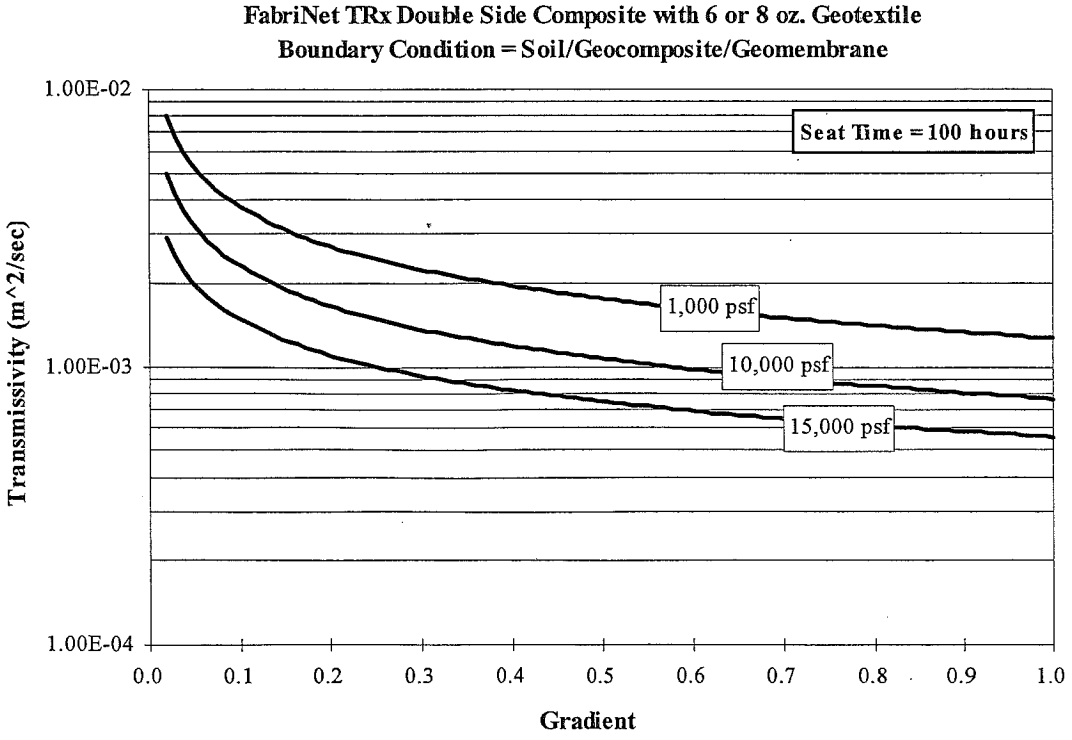


Figure A-10. Performance Transmissivity of GSE FabriNet TRx geocomposite under Soil.

ATTACHMENT A

Spreadsheet Based Translational Failure Surface Calculations

APEX SANITARY LANDFILL CONTIGUOUS EXPANSION
SHALLOW SLOPE STABILITY ANALYSIS
INPUT TABLE

Denotes an input value
Denotes an automatically calculated cell

INPUT VALUES							
thickness of cover soil at the top of the slope = hc =	1.25	ft	=	0.381	meters =	381	mm
thickness of cover soil at the bottom of the slope = D =	1.25	ft					
drainage layer thickness = t =	300	mil	=	0.762	cm =	7.62	mm
slope beneath the geomembrane (xH:1V) =	3.00	H:1V					
slope angle beneath the geomembrane = b =	18.43	degrees					
finished slope angle = w =	18.43	degrees		(for uniform cover soil thickness w = b)			
length of slope measured along the geomembrane = L =	194.0	ft	=	59.1312	meters		
length of slope between drainage outlets = L =	194.0	ft	=	59.1312	meters		
moist unit weight of cover soil = γ_t =	125.00	pcf	=	19.64	kN/m^3		
saturated unit weight = γ_{sat} =	140.00	pcf	=	21.99	kN/m^3		
friction angle of the cover soil = f =	27.0	degrees					
cohesion of the cover soil = c =	0.0	lb/ft^2					
minimum interface friction angle = d =	26.6	degrees					
minimum interface adhesion = ca =	0.0	lb/ft^2					
Unadjusted Curve Number	80						
STORM EVENT _____ YEAR	100	Year					
STORM EVENT _____ HOUR	1	Hour					
STORM EVENT RAINFALL	2.56	Inches	=	65.02	mm/hour		
Permeability of cover material = q_h =	1.00E-04	cm/sec					
Permeability of drainage layer = k_d =	2.326	cm/sec					
Long Term Design Transmissivity = q =	1.7724E-04	m^2/sec					
Overall FS for drainage = FS_D =	2						
Reduction Factor for geotextile intrusion = RF_{IN} =	1						
Reduction Factor for creep deformation = RF_{CR} =	1.4						
Reduction Factor for chemical clogging = RF_{CC} =	1.1						
Reduction Factor for biological clogging = RF_{BC} =	2.7						
equipment ground pressure (= wt. of equipment/(2wb)) = q =	753.5	lb/ft^2					
length of each equipment track = w =	10.25	ft					
width of each equipment track = b =	2.75	ft					
influence factor* at geomembrane interface = I =	0.97	See Table -->					
acceleration/deceleration of the bulldozer = a =	0.00	g					
seismic coefficient = Cs =	0.100	g					

*Influence Factor Default Values

Cover Soil Thickness	Equipment Track Width		
	Very Wide	Wide	Standard
[2] 300 mm	1.00	0.97	0.94
300-1000 mm	0.97	0.92	0.70
[3] 1000 mm	0.95	0.75	0.30

OUTPUT SUMMARY

Ultimate Geocomposite Transmissivity Specification =	1.47E-03	m^2/sec

Slope Stability Factor of Safety Summary

Method	FS	Required FS
Static - Translational - Unsaturated	1.52	1.50
Seismic - Translational - Unsaturated	1.14	1.00
Static - Translational - Saturated	1.22	1.10

The adjusted SCS Curve Number is calculated as:

$CN = 100 - (100-CN_0) * (L^2 / S)^{CN_0^{-0.81}}$

Where:

CN_0	SCS curve number (unadjusted for slope), from Figure A-3 of GRI Report #19 Appendix
L	Standardized Dimensionless Length = L divided by 152 meters
S	Standardized Dimensionless Inclination = s / 0.04 (where s is defined as the vertical rise over the horizontal distance expressed as a ratio)

Input Variables 300

CN_0 =	**80**					
Slope Length =	**194**	feet or	59.12831	meters		
S =	**3.00**	on 1	0.333	percent,	which yields	8.333
Storm Event						
100	year	**1**	hour	storm		
2.560	inches/hour or	65.024	millimeters/hour			

Calculated Variables

$CN_0^{-0.81}$ =	0.02874
L^2 / S =	0.0182
100 - CN_0 =	20

The adjusted SCS Curve Number is equal to:

CN = **82.2**

The Potential Retention, (PR) in millimeters is calculated by:

2.325

PR = (25400 / CN) - 254

PR = **55** millimeters

The Runoff Coefficient, RC(t), as a function of time is determined by:

$$RC(t) = \frac{[P(t) - 0.2 * PR]^2}{P(t) * [P(t) + 0.8*PR]}$$

Where:

P(t) = Accumulated Precipitation, mm

P(t) = I * t

Where: P(t) = I*t

I = Rainfall Intensity, mm per hour

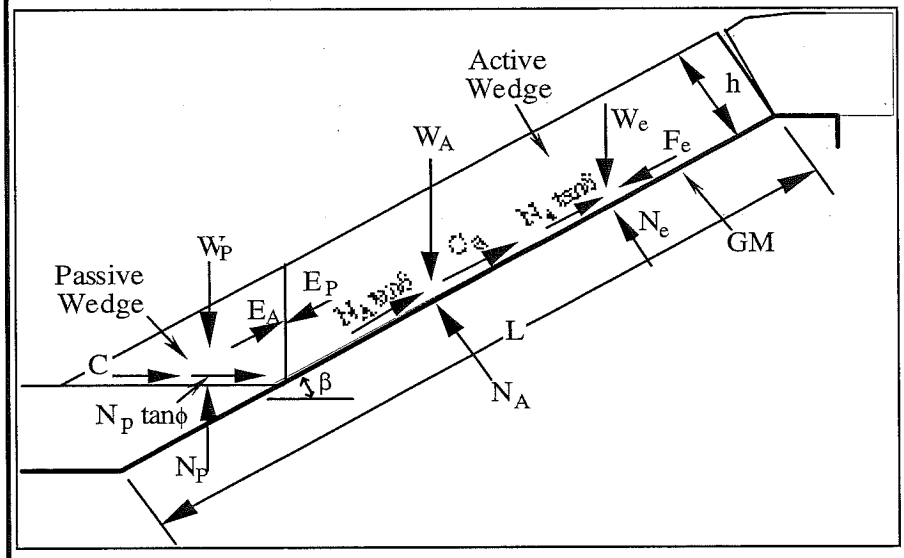
t = time, hours

P(t) = 65.024 millimeters

RC(t) = 0.412

COVER PLACEMENT WITH THE INCORPORATION OF EQUIPMENT LOADS

Placement of the Cover Material Layer
across the sideslopes with the incorporation of Equipment Loads



Calculation of FS

Active Wedge:

Wa= 29662.3 *lb*

Na= 28140.1 *lb*

Passive Wedge:

Wp= 325.5 *lb*

$$FS = \frac{-b + \sqrt{b^2 - 4ac}}{2a}$$

a= 11146.2

b= -18804

c= 2844.0

FS= 1.519

thickness of cover soil = h =	1.25	ft			
cov. mat. slope angle beneath the geomembrane = b =	18.43	°	= 0.32	(rad.)	
finished cover material slope angle = w =	18.43	2.325	= 0.32	(rad.)	
length of slope measured along the geomembrane = L =	194.0	ft			
unit weight of the cover soil = g =	125.0	lb/ft^3			
friction angle of the cover soil = f =	27.0	°	= 0.47	(rad.)	
cohesion of thecover soil = c =	0.0	lb/ft^2		C= 0	lb
critical interface friction angle = d =	26.60	°	= 0.46	(rad.)	
adhesion = ca =	0.0	lb/ft^2		Ca= 0	lb

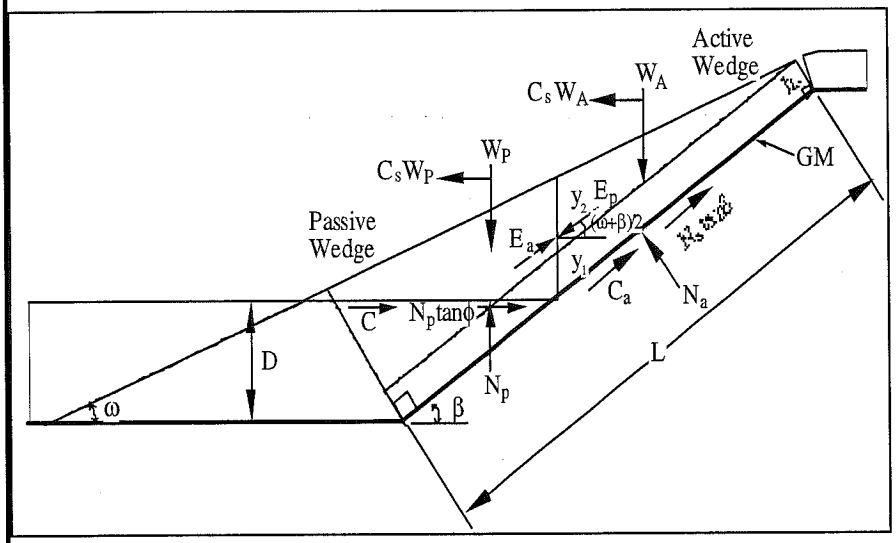
thickness of the cover soil = h =	1.25	ft	b/h=	2.2
equipment ground pressure (= wt. of equipment/(2wb)) = q =	753.5	lb/ft^2	We=qwI=	7491.7
length of each equipment track = w =	10.3	ft	Ne=Wecosb=	7107.2
width of each equipment track = b =	2.8	ft	Fe=We(a/g)=	0.0
influence factor* at geomembrane interface = I =	0.97			
acceleration/deceleration of the bulldozer = a =	0.00	g		

*Influence Factor Default Values

Cover Soil Thickness	Equipment Track Width		
	Very Wide	Wide	Standard
[2] 300 mm	1.00	0.97	0.94
300-1000 mm	0.97	0.92	0.70
[3] 1000 mm	0.95	0.75	0.30

Note:
- Denotes an automatically calculated cell
- Denotes input values

UNIFORMED AND/OR TAPERED COVER SOIL WITH CONSIDERATION OF SEISMIC FORCES



Calculation of FS

Active Wedge:

Wa=	*29662.3*	*lb*
Na=	*28140.1*	*lb*
Ca=	*0.0*	*lb*

Passive Wedge:

Wp=	*325.5*	*lb*
C=	*0.0*	*lb*

$$FS = \frac{-b + \sqrt{b^2 - 4ac}}{2a}$$

a=	*11286.9*
b=	*-14751*
c=	*2154.0*

FS= 1.139

(Note: for uniform cover soil thickness the input value of w = b)

thickness of cover soil at top (crest) of the slope = hc =	1.25	ft			
thickness of cover soil along the bottom of the site = D =	1.25	ft			
soil slope angle beneath the geomembrane = b =	18.43	°	=	*0.32*	*(rad.)*
finished cover soil slope angle = w =	18.43	2.325	=	*0.32*	*(rad.)*
length of slope measured along the geomembrane = L =	194.0	ft			

y2=	*0.00*	*(ft)*
y1=	*1.32*	*(ft)*
(w+b)/2=	*0.322*	*(rad.)*
(=	*18.4*	*°)*

unit weight of the cover soil = g =	125.0	lb/ft^3			
friction angle of the cover soil = f =	27.0	°	=	*0.47*	*(rad.)*
cohesion of the cover soil = c =	0.0	lb/ft^2			
critical interface friction angle = d =	26.6	°	=	*0.46*	*(rad.)*
adhesion between cover soil and geocomposite = ca =	0.0	lb/ft^2			

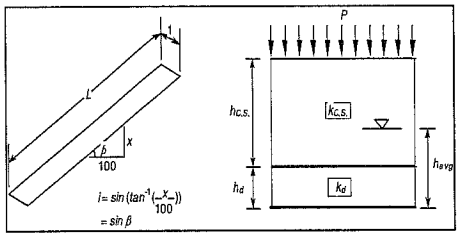
seismic coefficient = Cs = 0.10000 g

Note:

Denotes an automatically calculated cell

Denotes input values

Calculation of DLC and PSR



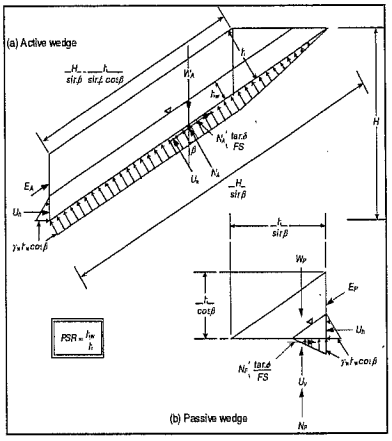
L =	59.13	m	i =	0.3162	
b =	18.43	°	$L(\cos b)$ =	56.10	m
			x =	18.70	m
$h_{C.S.}$ =	381.00	mm	$h_{C.S.}$ =	0.4	m
h_d or t_{GS} =	7.62	mm	h_d or t_{GS} =	0.00762	m
			$h_{C.S.} + h_d$ =	0.39	m
$k_{C.S.}$ =	1.00E-04	cm/s	$k_{C.S.}$ =	1.0E-06	m/s
k_d or k_{GS} =	2.326	cm/s	k_d or k_{GS} =	2.3E-02	m/s
P =	65.02	mm/hr	$P(RC)$ =	26.8	mm/hr
RC =	0.412		Actual runoff =	61.42	mm/hr
	2.325		$PERC$ =	3.60	mm/hr
			$FLUX_{actual}$ =	0.202	m^3/hr
			$FLUX_{allow}$ =	0.202	m^3/hr
			q =	5.6E-05	m^3/sec
			h_{avg} =	0.160	m

DLC	0.999
PSR	0.41218

DLC = 0.9991

PSR = 0.412

* Note: If there is only only one soil above the geomembrane treat it as the drainage layer.



thickness of cover soil = h = 0.39 m

length of slope measured along the geomembrane = L = 59 m

soil slope angle beneath the geomembrane = b = 18.4 ° = 0.32 (rad.)

vertical height of the slope measured from the toe = H = 18.7 m

parallel submergence ratio = PSR = 0.41

depth of the water surface measured from the geomembrane = h_w = 0.160 m

dry unit weight of the cover soil = g_{dry} = 19.6 kN/m³

saturated unit weight of the cover soil = $g_{sat'd}$ = 22.0 kN/m³

unit weight of water = g_w = 9.81 kN/m³

friction angle of the cover soil = f = 27.0 ° = 0.47 (rad.)

Minimum interface friction angle = d = 26.6 ° = 0.46 (rad.)

Calculation of FS

Active Wedge:

W_A = 468.5002 kN

U_n = 87.75098 kN

U_h = 0.125852 kN

N_A = 356.6675 kN

Passive Wedge:

W_P = 5.043311 kN

U_V = 0.377556 kN

$FS = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$

where a = 140.6

b = -195.6

c = 28.8

FS= 1.22

Note: numbers in boxes are input values

numbers in Italics are calculated values

Constructed by Te-Yang Soong

APEX SANITARY LANDFILL CONTIGUOUS EXPANSION
SHALLOW SLOPE STABILITY ANALYSIS
INPUT TABLE

Denotes an input value
Denotes an automatically calculated cell

INPUT VALUES						
thickness of cover soil at the top of the slope = hc =	2.50	ft	=	0.762	meters =	762 mm
thickness of cover soil at the bottom of the slope = D =	2.50	ft				
drainage layer thickness = t =	300	mil	=	0.762	cm =	7.62 mm
slope beneath the geomembrane (xH:1V) =	3.00	H:1V				
slope angle beneath the geomembrane = b =	18.43	degrees				
finished slope angle = w =	18.43	degrees		(for uniform cover soil thickness w = b)		
length of slope measured along the geomembrane = L =	194.0	ft	=	59.1312	meters	
length of slope between drainage outlets = L =	194.0	ft	=	59.1312	meters	
moist unit weight of cover soil = γ_t =	125.00	pcf	=	19.64	kN/m^3	
saturated unit weight = γ_{sat} =	140.00	pcf	=	21.99	kN/m^3	
friction angle of the cover soil = f =	27.0	degrees				
cohesion of the cover soil = c =	0.0	lb/ft^2				
minimum interface friction angle = d =	26.6	degrees				
minimum interface adhesion = ca =	0.0	lb/ft^2				
Unadjusted Curve Number	80					
STORM EVENT _____ YEAR	100	Year				
STORM EVENT _____ HOUR	1	Hour				
STORM EVENT RAINFALL	2.56	Inches	=	65.02	mm/hour	
Permeability of cover material = q_h =	1.00E-04	cm/sec				
Permeability of drainage layer = k_d =	2.326	cm/sec				
Long Term Design Transmissivity = q =	1.7724E-04	m^2/sec				
Overall FS for drainage = FS_D =	2					
Reduction Factor for geotextile intrusion = RF_{IN} =	1					
Reduction Factor for creep deformation = RF_{CR} =	1.4					
Reduction Factor for chemical clogging = RF_{CC} =	1.1					
Reduction Factor for biological clogging = RF_{BC} =	2.7					
equipment ground pressure (= wt. of equipment/(2wb)) = q =	753.5	lb/ft^2				
length of each equipment track = w =	10.25	ft				
width of each equipment track = b =	2.75	ft				
influence factor* at geomembrane interface = I =	0.97	See Table -->				
acceleration/deceleration of the bulldozer = a =	0.00	g				
seismic coefficient = Cs =	0.100	g				

*Influence Factor Default Values

Cover Soil Thickness	Equipment Track Width		
	Very Wide	Wide	Standard
[2]300 mm	1.00	0.97	0.94
300-1000 mm	0.97	0.92	0.70
[3] 1000 mm	0.95	0.75	0.30

OUTPUT SUMMARY

Ultimate Geocomposite Transmissivity Specification = 1.47E-03 **m^2/sec**

Slope Stability Factor of Safety Summary

Method	FS	Required FS
Static - Translational - Unsaturated	1.54	1.50
Seismic - Translational - Unsaturated	1.15	1.00
Static - Translational - Saturated	1.39	1.10

The adjusted SCS Curve Number is calculated as:

$CN = 100 - (100-CN_0) * (L^2 / S)^{CN_0^{-0.81}}$

Where:

CN_0	SCS curve number (unadjusted for slope), from Figure A-3 of GRI Report #19 Appendix
L	Standardized Dimensionless Length = L divided by 152 meters
S	Standardized Dimensionless Inclination = s / 0.04 (where s is defined as the vertical rise over the horizontal distance expressed as a ratio)

Input Variables

CN_0 =	**80**					
Slope Length =	**194**	feet or	59.12831	meters		
S =	**3.00**	on 1	0.333	percent,	which yields	8.333
Storm Event						
100	year	1	hour	storm		
2.560	inches/hour or	65.024	millimeters/hour			

Calculated Variables

$CN_0^{-0.81}$ =	0.02874
L^2 / S =	0.0182
100 - CN_0 =	20

The adjusted SCS Curve Number is equal to:

CN = **82.2**

The Potential Retention, (PR) in millimeters is calculated by:

PR = (25400 / CN) - 254

PR = **55** millimeters

The Runoff Coefficient, RC(t), as a function of time is determined by:

$$RC(t) = \frac{[P(t) - 0.2 * PR]^2}{P(t) * [P(t) + 0.8*PR]}$$

Where:

P(t) = Accumulated Precipitation, mm

P(t) = I * t

Where: P(t) = I*t

I = Rainfall Intensity, mm per hour

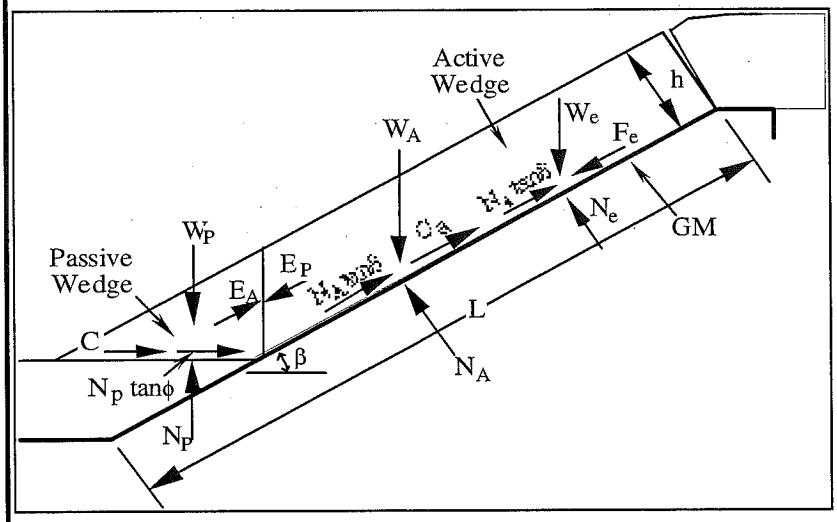
t = time, hours

P(t) = 65.024 millimeters

RC(t) = 0.412

COVER PLACEMENT WITH THE INCORPORATION OF EQUIPMENT LOADS

Placement of the Cover Material Layer
across the sideslopes with the incorporation of Equipment Loads



65

Calculation of FS

Active Wedge:

Wa= *58024.3 lb*
Na= *55046.7 lb*

Passive Wedge:

Wp= *1302.1 lb*

$$FS = \frac{-b + \sqrt{b^2 - 4ac}}{2a}$$

a= *19654.8*
b= *-33529*
c= *5014.9*

FS= 1.540

thickness of cover soil = h =	2.50	ft			
cov. mat. slope angle beneath the geomembrane = b =	18.43	0.001	= *0.32*	*(rad.)*	
finished cover material slope angle = w =	18.43	7.87	= *0.32*	*(rad.)*	
length of slope measured along the geomembrane = L =	194.0	0			
unit weight of the cover soil = g =	125.0	lb/ft^3			
friction angle of the cover soil = f =	27.0	°	= *0.47*	*(rad.)*	
cohesion of thecover soil = c =	0.0	lb/ft^2		*C= 0*	*lb*
critical interface friction angle = d =	26.60	°	= *0.46*	*(rad.)*	
adhesion = ca =	0.0	lb/ft^2		*Ca= 0*	*lb*

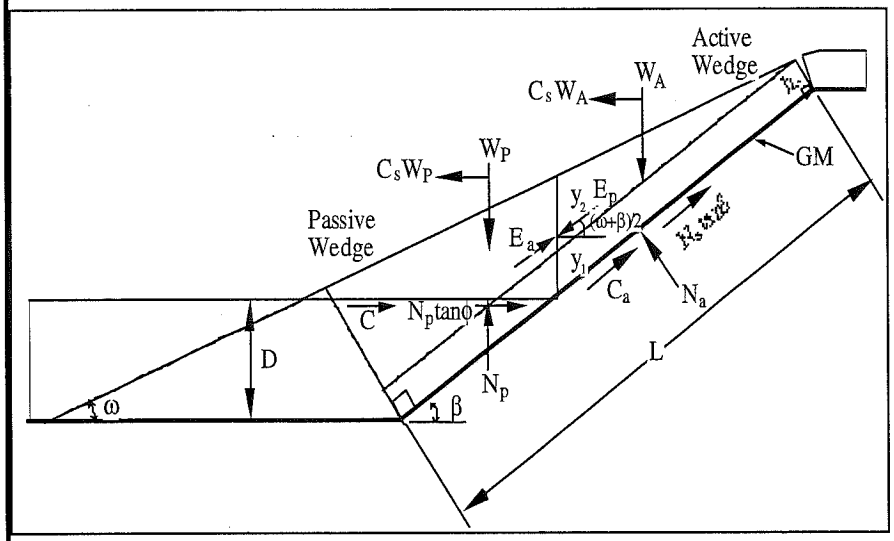
thickness of the cover soil = h =	2.50	ft	*b/h=*	*1.1*
equipment ground pressure (= wt. of equipment/(2wb)) = q =	753.5	lb/ft^2	*We=qwI=*	*7491.7*
length of each equipment track = w =	10.3	ft	*Ne=Wecosb=*	*7107.2*
width of each equipment track = b =	2.8	ft	*Fe=We(a/g)=*	*0.0*
influence factor* at geomembrane interface = I =	0.97			
acceleration/deceleration of the bulldozer = a =	0.00	g		

*Influence Factor Default Values

Cover Soil Thickness	Equipment Track Width		
	Very Wide	Wide	Standard
[2] 300 mm	1.00	0.97	0.94
300-1000 mm	0.97	0.92	0.70
[3] 1000 mm	0.95	0.75	0.30

Note: Denotes an automatically calculated cell
Denotes input values

UNIFORMED AND/OR TAPERED COVER SOIL WITH CONSIDERATION OF SEISMIC FORCES



65

Calculation of FS

Active Wedge:

Wa=	*58024.3*	*lb*
Na=	*55046.7*	*lb*
Ca=	*0.0*	*lb*

Passive Wedge:

Wp=	*1302.1*	*lb*
C=	*0.0*	*lb*

$$FS = \frac{-b + \sqrt{b^2 - 4ac}}{2a}$$

a=	*22142.2*
b=	*-29178*
c=	*4213.6*

FS= 1.153

(Note: for uniform cover soil thickness the input value of w = b)

thickness of cover soil at top (crest) of the slope = hc =	2.50	ft		
thickness of cover soil along the bottom of the site = D =	2.50	ft		
soil slope angle beneath the geomembrane = b =	18.43	0.001	= *0.32*	*(rad.)*
finished cover soil slope angle = w =	18.43	7.87	= *0.32*	*(rad.)*
length of slope measured along the geomembrane = L =	194.0	0		

y2=	*0.00*	*(ft)*
y1=	*2.64*	*(ft)*
(w+b)/2=	*0.322*	*(rad.)*
(=	*18.4*	*°)*

unit weight of the cover soil = g =	125.0	lb/ft^3		
friction angle of the cover soil = f =	27.0	°	= *0.47*	*(rad.)*
cohesion of the cover soil = c =	0.0	lb/ft^2		
critical interface friction angle = d =	26.6	°	= *0.46*	*(rad.)*
adhesion between cover soil and geocomposite = ca =	0.0	lb/ft^2		

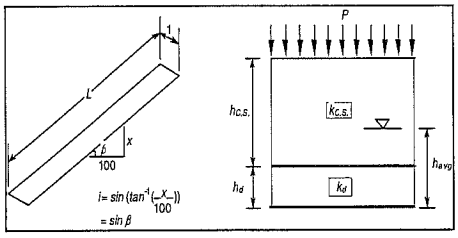
seismic coefficient = Cs = 0.10000 g

Note: Denotes an automatically calculated cell

Denotes input values

numbers in Italics are calculated values

Calculation of DLC and PSR



L =	59.13	m	i =	0.3162	
b =	18.43	°	$L(\cos b)$ =	56.10	m
			x =	18.70	m
$h_{c.s.}$ =	762.00	mm	$h_{c.s.}$ =	0.8	m
h_d or t_{GS} =	7.62	mm	h_d or t_{GS} =	0.00762	m
			$h_{c.s.} + h_d$ =	0.77	m
$k_{c.s.}$ =	1.00E-04	cm/s	$k_{c.s.}$ =	1.0E-06	m/s
k_d or k_{GS} =	2.326	cm/s	k_d or k_{GS} =	2.3E-02	m/s
P =	65.02	mm/hr	$P(RC)$ =	26.8	mm/hr
RC =	0.412		Actual runoff =	61.42	mm/hr
			PERC =	3.60	mm/hr
			$FLUX_{actual}$ =	0.202	m^2/hr
			$FLUX_{allow}$ =	0.202	m^2/hr

DLC	0.999
PSR	0.20813

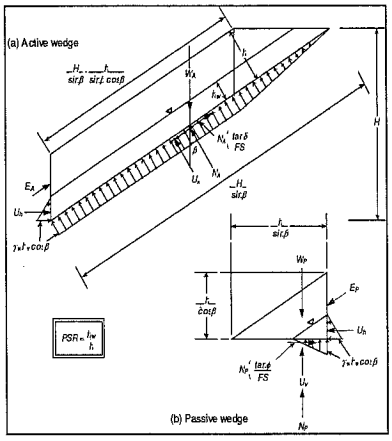
DLC = 0.9991

* Note: If there is only only one soil above the geomembrane treat it as the drainage layer.

q = 5.6E-05 m^3/sec

h_{avg} = 0.160 m

PSR = 0.208



thickness of cover soil = h = 0.77 m

length of slope measured along the geomembrane = L = 59 m

soil slope angle beneath the geomembrane = b = 18.4 ° = 0.32 (rad.)

vertical height of the slope measured from the toe = H = 18.7 m

parallel submergence ratio = PSR = 0.21

depth of the water surface measured from the geomembrane = h_w = 0.160 m

dry unit weight of the cover soil = g_{dry} =	19.6	kN/m³	
saturated unit weight of the cover soil = $g_{sat'd}$ =	22.0	kN/m³	
unit weight of water = g_w =	9.81	kN/m³	
friction angle of the cover soil = f =	27.0	° = 0.47	(rad.)
Minimum interface friction angle = d =	26.6	° = 0.46	(rad.)

Calculation of FS

Active Wedge:

W_A =	896.4359	kN
U_n =	87.75098	kN
U_h =	0.125852	kN
N_A =	762.6431	kN

Passive Wedge:

W_P =	19.4852	kN
U_V =	0.377556	kN

$$FS = \frac{-b + \sqrt{b^2 - 4ac}}{2a}$$

where a = 268.9

b = -417.5

c = 61.5

FS= 1.39

Note: numbers in boxes are input values

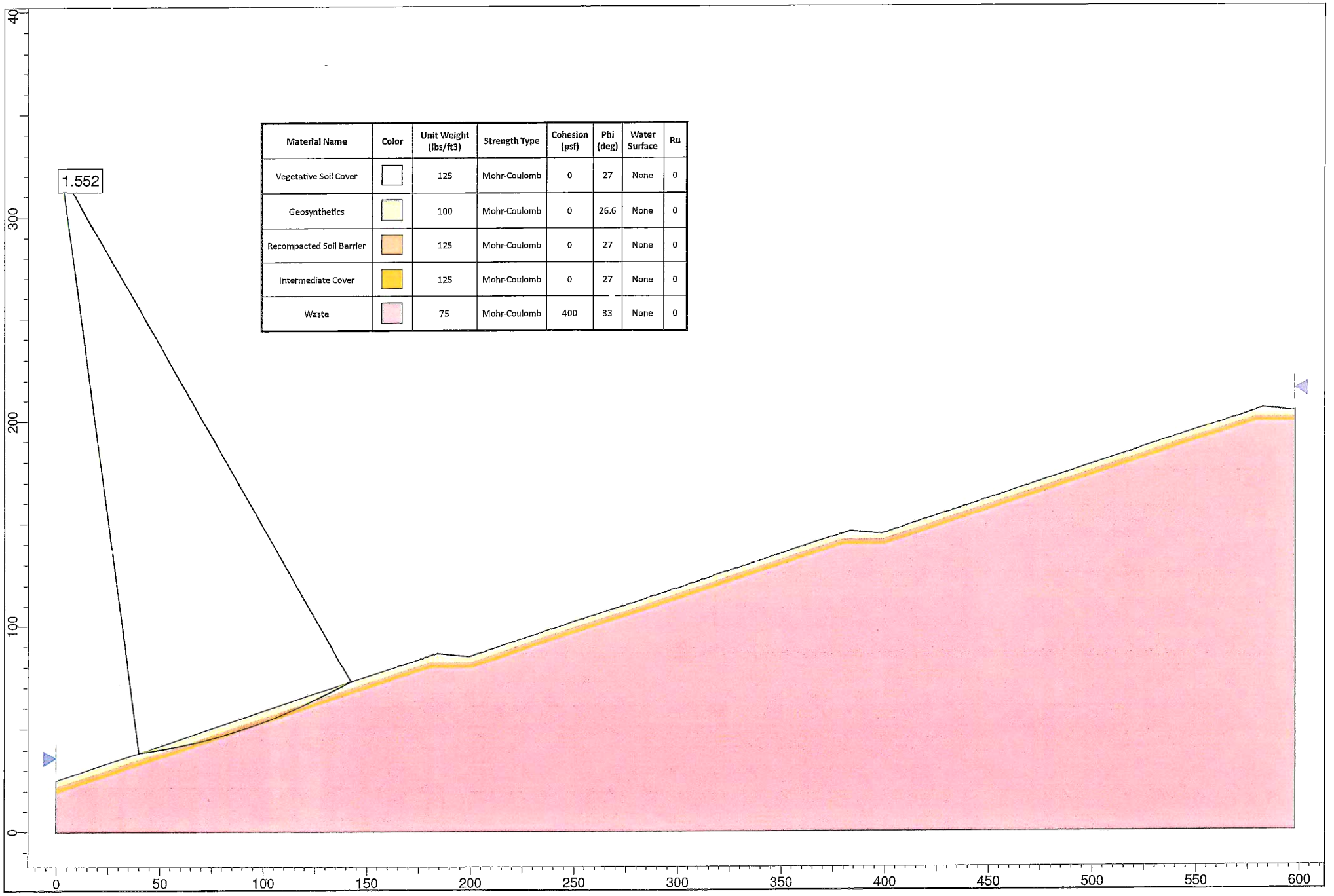
numbers in Italics are calculated values

Constructed by Te-Yang Soong

ATTACHMENT B

Software Rotational Failure Surface Calculations

Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)	Water Surface	Ru
Vegetative Soil Cover		125	Mohr-Coulomb	0	27	None	0
Geosynthetics		100	Mohr-Coulomb	0	26.6	None	0
Recompacted Soil Barrier		125	Mohr-Coulomb	0	27	None	0
Intermediate Cover		125	Mohr-Coulomb	0	27	None	0
Waste		75	Mohr-Coulomb	400	33	None	0



Slide Analysis Information

SLIDE - An Interactive Slope Stability Program

Project Summary

File Name: final cover -- static -- rotational -- unsaturated.slim
Slide Modeler Version: 6.02
Project Title: SLIDE - An Interactive Slope Stability Program
Date Created: 9/14/2011, 3:39:23 PM

General Settings

Units of Measurement: Imperial Units
Time Units: days
Permeability Units: feet/second
Failure Direction: Right to Left
Data Output: Standard
Maximum Material Properties: 20
Maximum Support Properties: 20

Analysis Options

Analysis Methods Used

Bishop simplified

Number of slices: 25
Tolerance: 0.005
Maximum number of iterations: 50
Check malpha < 0.2: Yes
Initial trial value of FS: 1
Steffensen Iteration: Yes

Groundwater Analysis

Groundwater Method: Water Surfaces
Pore Fluid Unit Weight: 62.4 lbs/ft3
Advanced Groundwater Method: None

Random Numbers

Pseudo-random Seed: 10116
Random Number Generation Method: Park and Miller v.3

Surface Options

Surface Type: Circular
Search Method: Slope Search
Number of Surfaces: 5000
Upper Angle: Not Defined
Lower Angle: Not Defined
Composite Surfaces: Disabled
Reverse Curvature: Create Tension Crack
Minimum Elevation: Not Defined
Minimum Depth: 5

Material Properties

Property	Vegetative Soil Cover	Geosynthetics	Recompacted Soil Barrier	Intermediate Cover	Waste
Color					
Strength Type	Mohr-Coulomb	Mohr-Coulomb	Mohr-Coulomb	Mohr-Coulomb	Mohr-Coulomb
Unit Weight [lbs/ft3]	125	100	125	125	75
Cohesion [psf]	0	0	0	0	400
Friction Angle [deg]	27	26.6	27	27	33
Water Surface	None	None	None	None	None
Ru Value	0	0	0	0	0

Global Minimums

Method: bishop simplified

FS: 1.552230
Center: 2.289, 322.092
Radius: 286.242
Left Slip Surface Endpoint: 40.060, 38.353
Right Slip Surface Endpoint: 142.316, 72.438
Resisting Moment=6.26419e+006 lb-ft
Driving Moment=4.03561e+006 lb-ft
Total Slice Area=367.909 ft2

Valid / Invalid Surfaces

Method: bishop simplified

Number of Valid Surfaces: 4445
Number of Invalid Surfaces: 555

Error Codes:

Error Code -103 reported for 555 surfaces

Error Codes

The following errors were encountered during the computation:

-103 = Two surface / slope intersections, but one or more surface / nonslope external polygon intersections lie between

them. This usually occurs when the slip surface extends past the bottom of the soil region, but may also occur on a benched slope model with two sets of Slope Limits.

Slice Data

Global Minimum Query (bishop simplified) - Safety Factor 1.55223

Slice Number	Width [ft]	Weight [lbs]	Base Material	Base Cohesion [psf]	Base Friction Angle [degrees]	Shear Stress [psf]	Shear Strength [psf]	Base Normal Stress [psf]	Pore Pressure [psf]	Effective Normal Stress [psf]
1	3.81955	176.299	Vegetative Soil Cover	0	27	14.4873	22.4876	44.1344	0	44.1344
2	3.81955	516.335	Vegetative Soil Cover	0	27	42.2473	65.5776	128.703	0	128.703
3	3.81955	831.165	Vegetative Soil Cover	0	27	67.7148	105.109	206.287	0	206.287
4	3.81955	1120.63	Vegetative Soil Cover	0	27	90.9028	141.102	276.929	0	276.929
5	3.82921	1363.11	Geosynthetics	0	26.6	108.039	167.702	334.893	0	334.893
6	3.90569	1610.86	Recompacted Soil Barrier	0	27	126.675	196.628	385.904	0	385.904
7	3.90569	1832.05	Recompacted Soil Barrier	0	27	143.426	222.63	436.938	0	436.938
8	3.90569	2025.23	Recompacted Soil Barrier	0	27	157.839	245.002	480.843	0	480.843
9	3.90569	2190.11	Recompacted Soil Barrier	0	27	169.921	263.756	517.649	0	517.649
10	4.45346	2661.13	Intermediate Cover	0	27	180.19	279.696	548.935	0	548.935
11	4.45346	2795.43	Intermediate Cover	0	27	188.297	292.281	573.634	0	573.634
12	4.45346	2886.26	Intermediate Cover	0	27	193.394	300.192	589.16	0	589.16
13	4.45346	2932.98	Intermediate Cover	0	27	195.482	303.433	595.521	0	595.521
14	4.45346	2934.92	Intermediate Cover	0	27	194.562	302.005	592.718	0	592.718
15	4.45346	2891.32	Intermediate Cover	0	27	190.632	295.905	580.747	0	580.747
16	4.45346	2801.39	Intermediate Cover	0	27	183.689	285.127	559.594	0	559.594
17	4.45346	2664.27	Intermediate Cover	0	27	173.726	269.662	529.242	0	529.242
18	3.66854	2058.79	Recompacted Soil Barrier	0	27	162.129	251.662	493.914	0	493.914
19	3.66854	1905.73	Recompacted Soil Barrier	0	27	149.369	231.855	455.043	0	455.043
20	3.66854	1724.78	Recompacted Soil Barrier	0	27	134.541	208.839	409.869	0	409.869
			Recompacted Soil							

Slice Number	Width [ft]	Weight [lbs]	Base Material	Base Cohesion [psf]	Base Friction Angle [degrees]	Shear Stress [psf]	Shear Strength [psf]	Base Normal Stress [psf]	Pore Pressure [psf]	Effective Normal Stress [psf]
			Barrier							
22	3.51301	1251.51	Geosynthetics	0	26.6	99.4614	154.387	308.303	0	308.303
23	4.57019	1286.37	Vegetative Soil Cover	0	27	79.331	123.14	241.675	0	241.675
24	4.57019	813.996	Vegetative Soil Cover	0	27	49.8814	77.4274	151.96	0	151.96
25	4.57019	281.496	Vegetative Soil Cover	0	27	17.1382	26.6024	52.2101	0	52.2101

Interslice Data

Global Minimum Query (bishop simplified) - Safety Factor 1.55223

Slice Number	X coordinate [ft]	Y coordinate - Bottom [ft]	Interslice Normal Force [lbs]	Interslice Shear Force [lbs]	Interslice Force Angle [degrees]
1	40.06	38.3533	0	0	0
2	43.8795	38.8879	31.5944	0	0
3	47.6991	39.4752	116.956	0	0
4	51.5186	40.1154	242.849	0	0
5	55.3382	40.809	397.089	0	0
6	59.1674	41.5582	558.808	0	0
7	63.073	42.3785	735.733	0	0
8	66.9787	43.2559	911.1	0	0
9	70.8844	44.1909	1076.37	0	0
10	74.7901	45.1842	1224.13	0	0
11	79.2436	46.3886	1363.36	0	0
12	83.697	47.6706	1464.36	0	0
13	88.1505	49.0313	1521.77	0	0
14	92.604	50.4717	1532.26	0	0
15	97.0574	51.9933	1494.63	0	0
16	101.511	53.5973	1409.86	0	0
17	105.964	55.2853	1281.19	0	0
18	110.418	57.0589	1114.22	0	0
19	114.086	58.5854	953.503	0	0
20	117.755	60.1721	778.011	0	0
21	121.423	61.8202	594.785	0	0
22	125.092	63.5309	412.164	0	0
23	128.605	65.2288	237.189	0	0
24	133.175	67.5272	43.3428	0	0
25	137.745	69.9294	-94.3099	0	0
26	142.316	72.4382	0	0	0

List Of Coordinates

External Boundary

X	Y

597.804	0
597.804	198.82
597.804	199.82
597.804	201.32
597.804	201.82
597.804	204.256
582.419	205.794
398.594	144.525
383.209	146.064
199.385	84.7945
184	86.333
0	25
0	22.3648
0	21.8378
0	20.2566
0	19.2025
0	0

Material Boundary

X	Y
0	19.2025
180.487	79.3588
200.487	79.3588
379.696	139.089
399.696	139.089
578.906	198.82
597.804	198.82

Material Boundary

X	Y
0	20.2566
180.325	80.3588
200.325	80.3588
379.534	140.089
399.534	140.089
578.743	199.82
597.804	199.82

Material Boundary

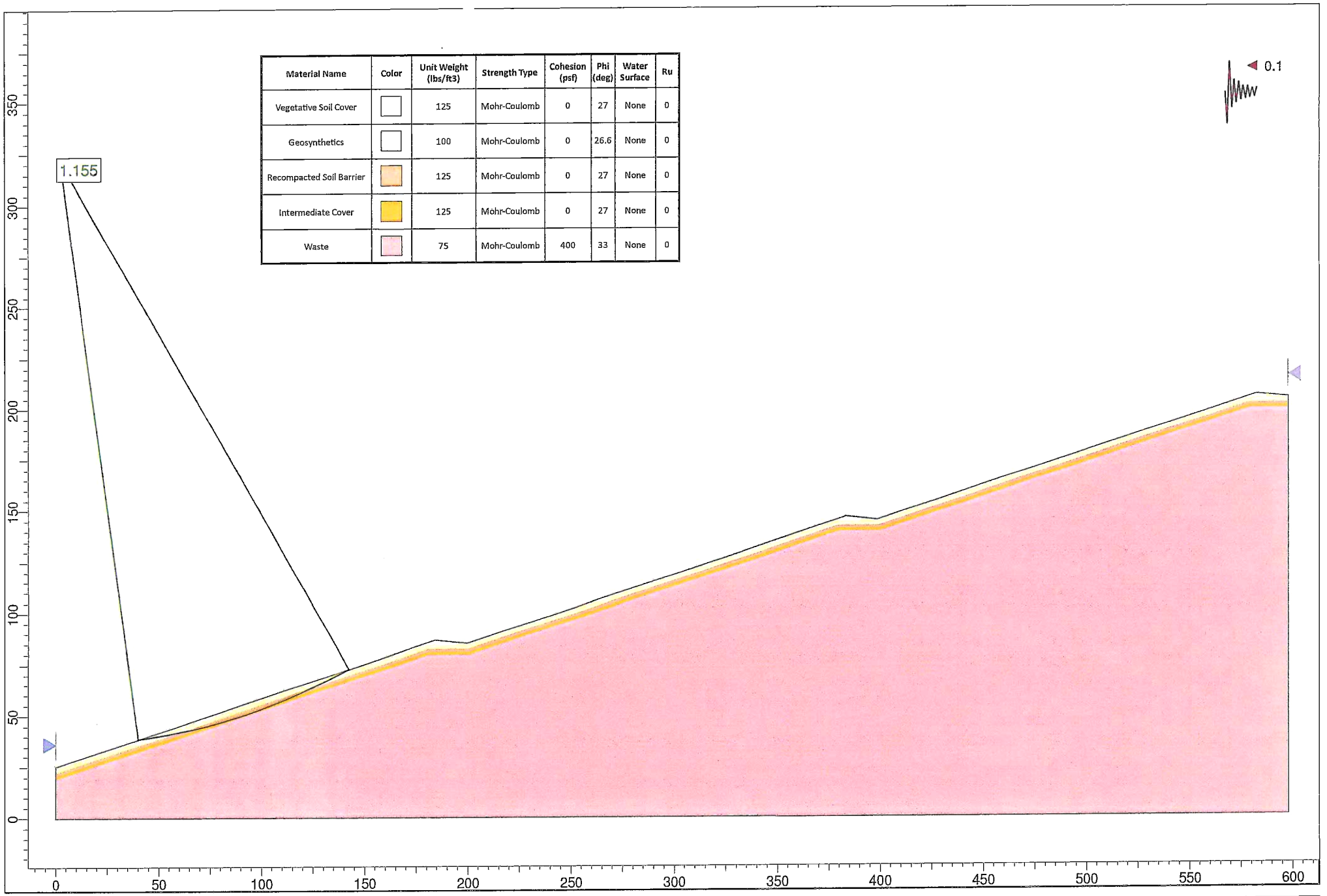
X	Y
0	21.8378
180.081	81.8588
200.081	81.8588
379.291	141.589

399.291	141.589
578.5	201.32
597.804	201.32

Material Boundary

X	Y
0	22.3648
180	82.3588
200	82.3588
379.209	142.089
399.209	142.089
578.419	201.82
597.804	201.82

Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)	Water Surface	Ru
Vegetative Soil Cover		125	Mohr-Coulomb	0	27	None	0
Geosynthetics		100	Mohr-Coulomb	0	26.6	None	0
Recompacted Soil Barrier		125	Mohr-Coulomb	0	27	None	0
Intermediate Cover		125	Mohr-Coulomb	0	27	None	0
Waste		75	Mohr-Coulomb	400	33	None	0



Slide Analysis Information

SLIDE - An Interactive Slope Stability Program

Project Summary

File Name: final cover -- seismic -- rotational -- unsaturated.slim
Slide Modeler Version: 6.02
Project Title: SLIDE - An Interactive Slope Stability Program
Date Created: 9/14/2011, 3:39:23 PM

General Settings

Units of Measurement: Imperial Units
Time Units: days
Permeability Units: feet/second
Failure Direction: Right to Left
Data Output: Standard
Maximum Material Properties: 20
Maximum Support Properties: 20

Analysis Options

Analysis Methods Used

Bishop simplified

Number of slices: 25
Tolerance: 0.005
Maximum number of iterations: 50
Check malpha < 0.2: Yes
Initial trial value of FS: 1
Steffensen Iteration: Yes

Groundwater Analysis

Groundwater Method: Water Surfaces
Pore Fluid Unit Weight: 62.4 lbs/ft3
Advanced Groundwater Method: None

Random Numbers

Pseudo-random Seed: 10116
Random Number Generation Method: Park and Miller v.3

Surface Options

Surface Type: Circular
Search Method: Slope Search
Number of Surfaces: 5000
Upper Angle: Not Defined
Lower Angle: Not Defined
Composite Surfaces: Disabled
Reverse Curvature: Create Tension Crack
Minimum Elevation: Not Defined
Minimum Depth: 5

Loading

Seismic Load Coefficient (Horizontal): 0.1

Material Properties

Property	Vegetative Soil Cover	Geosynthetics	Recompacted Soil Barrier	Intermediate Cover	Waste
Color					
Strength Type	Mohr-Coulomb	Mohr-Coulomb	Mohr-Coulomb	Mohr-Coulomb	Mohr-Coulomb
Unit Weight [lbs/ft3]	125	100	125	125	75
Cohesion [psf]	0	0	0	0	400
Friction Angle [deg]	27	26.6	27	27	33
Water Surface	None	None	None	None	None
Ru Value	0	0	0	0	0

Global Minimums

Method: bishop simplified

FS: 1.154970
Center: 2.289, 322.092
Radius: 286.242
Left Slip Surface Endpoint: 40.060, 38.353
Right Slip Surface Endpoint: 142.316, 72.438
Resisting Moment=6.05939e+006 lb-ft
Driving Moment=5.24635e+006 lb-ft
Total Slice Area=367.909 ft2

Valid / Invalid Surfaces

Method: bishop simplified

Number of Valid Surfaces: 4445
Number of Invalid Surfaces: 555

Error Codes:

Error Code -103 reported for 555 surfaces

Error Codes

The following errors were encountered during the computation:

-103 = Two surface / slope intersections, but one or more surface / nonslope external polygon intersections lie between them. This usually occurs when the slip surface extends past the bottom of the soil region, but may also occur on a benched slope model with two sets of Slope Limits.

Slice Data

Global Minimum Query (bishop simplified) - Safety Factor: 1.15497

Slice Number	Width [ft]	Weight [lbs]	Base Material	Base Cohesion [psf]	Base Friction Angle [degrees]	Shear Stress [psf]	Shear Strength [psf]	Base Normal Stress [psf]	Pore Pressure [psf]	Effective Normal Stress [psf]
1	3.81955	176.299	Vegetative Soil Cover	0	27	19.1787	22.1508	43.4735	0	43.4735
2	3.81955	516.335	Vegetative Soil Cover	0	27	55.8498	64.5048	126.598	0	126.598
3	3.81955	831.165	Vegetative Soil Cover	0	27	89.3919	103.245	202.629	0	202.629
4	3.81955	1120.63	Vegetative Soil Cover	0	27	119.836	138.407	271.641	0	271.641
5	3.82921	1363.11	Geosynthetics	0	26.6	142.276	164.325	328.15	0	328.15
6	3.90569	1610.86	Recompacted Soil Barrier	0	27	166.527	192.334	377.477	0	377.477
7	3.90569	1832.05	Recompacted Soil Barrier	0	27	188.283	217.461	426.79	0	426.79
8	3.90569	2025.23	Recompacted Soil Barrier	0	27	206.91	238.975	469.016	0	469.016
9	3.90569	2190.11	Recompacted Soil Barrier	0	27	222.433	256.904	504.203	0	504.203
10	4.45346	2661.13	Intermediate Cover	0	27	235.52	272.018	533.866	0	533.866
11	4.45346	2795.43	Intermediate Cover	0	27	245.72	283.799	556.987	0	556.987
12	4.45346	2886.26	Intermediate Cover	0	27	251.963	291.01	571.139	0	571.139
13	4.45346	2932.98	Intermediate Cover	0	27	254.271	293.675	576.369	0	576.369
14	4.45346	2934.92	Intermediate Cover	0	27	252.662	291.817	572.723	0	572.723
15	4.45346	2891.32	Intermediate Cover	0	27	247.154	285.456	560.24	0	560.24
16	4.45346	2801.39	Intermediate Cover	0	27	237.761	274.607	538.947	0	538.947
17	4.45346	2664.27	Intermediate Cover	0	27	224.494	259.284	508.873	0	508.873
18	3.66854	2058.79	Recompacted Soil Barrier	0	27	209.192	241.61	474.185	0	474.185
			Recompacted Soil							

			Barrier							
20	3.66854	1724.78	Recompacted Soil Barrier	0	27	173.114	199.942	392.409	0	392.409
21	3.66854	1515.42	Recompacted Soil Barrier	0	27	151.153	174.577	342.625	0	342.625
22	3.51301	1251.51	Geosynthetics	0	26.6	127.707	147.498	294.547	0	294.547
23	4.57019	1286.37	Vegetative Soil Cover	0	27	101.632	117.382	230.375	0	230.375
24	4.57019	813.996	Vegetative Soil Cover	0	27	63.7886	73.6739	144.593	0	144.593
25	4.57019	281.496	Vegetative Soil Cover	0	27	21.8764	25.2666	49.5884	0	49.5884

Interslice Data

Global Minimum Query (bishop simplified) - Safety Factor. 1.15497

Slice Number	X coordinate [ft]	Y coordinate - Bottom [ft]	Interslice Normal Force [lbs]	Interslice Shear Force [lbs]	Interslice Force Angle [degrees]
1	40.06	38.3533	0	0	0
2	43.8795	38.8879	32.356	0	0
3	47.6991	39.4752	119.623	0	0
4	51.5186	40.1154	248.096	0	0
5	55.3382	40.809	405.201	0	0
6	59.1674	41.5582	567.653	0	0
7	63.073	42.3785	747.124	0	0
8	66.9787	43.2559	924.591	0	0
9	70.8844	44.1909	1091.38	0	0
10	74.7901	45.1842	1240.02	0	0
11	79.2436	46.3886	1379.43	0	0
12	83.697	47.6706	1479.77	0	0
13	88.1505	49.0313	1535.76	0	0
14	92.604	50.4717	1544.23	0	0
15	97.0574	51.9933	1504.16	0	0
16	101.511	53.5973	1416.7	0	0
17	105.964	55.2853	1285.33	0	0
18	110.418	57.0589	1115.82	0	0
19	114.086	58.5854	953.277	0	0
20	117.755	60.1721	776.281	0	0
21	121.423	61.8202	591.93	0	0
22	125.092	63.5309	408.591	0	0
23	128.605	65.2288	231.808	0	0
24	133.175	67.5272	38.0041	0	0
25	137.745	69.9294	-99.2999	0	0
26	142.316	72.4382	0	0	0

List Of Coordinates

External Boundary

X	Y
597.804	0
597.804	198.82
597.804	199.82
597.804	201.32
597.804	201.82
597.804	204.256
582.419	205.794
398.594	144.525
383.209	146.064
199.385	84.7945
184	86.333
0	25
0	22.3648
0	21.8378
0	20.2566
0	19.2025
0	0

Material Boundary

X	Y
0	19.2025
180.487	79.3588
200.487	79.3588
379.696	139.089
399.696	139.089
578.906	198.82
597.804	198.82

Material Boundary

X	Y
0	20.2566
180.325	80.3588
200.325	80.3588
379.534	140.089
399.534	140.089
578.743	199.82
597.804	199.82

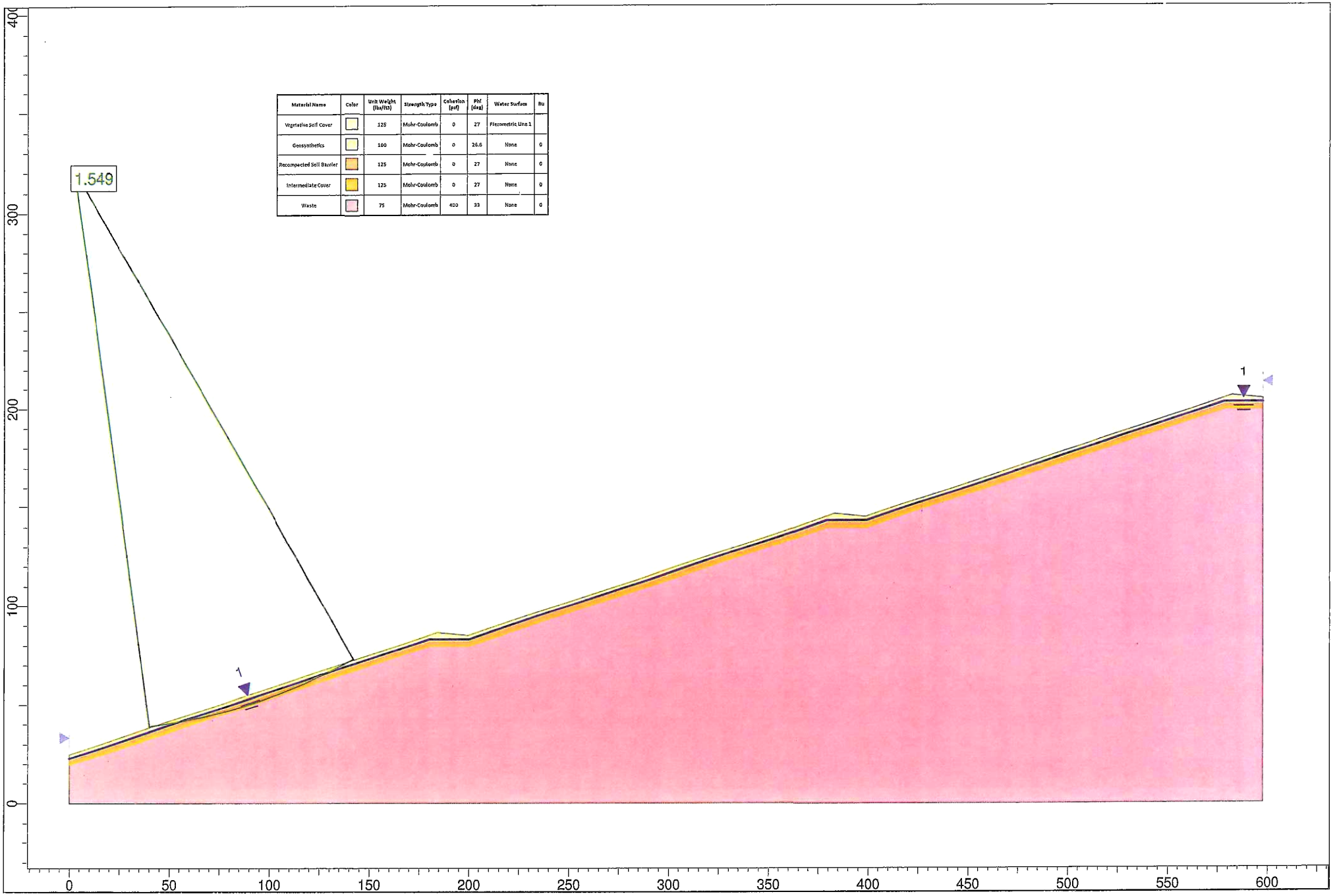
Material Boundary

X	Y
0	21.8378

180.081	81.8588
200.081	81.8588
379.291	141.589
399.291	141.589
578.5	201.32
597.804	201.32

Material Boundary

X	Y
0	22.3648
180	82.3588
200	82.3588
379.209	142.089
399.209	142.089
578.419	201.82
597.804	201.82


Material Name | Color | Unit Weight (lbs/ft3) | Strength Type | Cohesion (psf) | Phi (deg) | Water Surface | Ru
Vegetative Soil Cover | 125 | Mohr-Coulomb | 0 | 27 | Piezometric Line 1 |
Geosynthetics | 100 | Mohr-Coulomb | 0 | 26.6 | None | 0
Recompacted Soil Barrier | 125 | Mohr-Coulomb | 0 | 27 | None | 0
Intermediate Cover | 125 | Mohr-Coulomb | 0 | 27 | None | 0
Waste | 75 | Mohr-Coulomb | 400 | 33 | None | 0
1.549
1
1
0
100
200
300
400
0
50
100
150
200
250
300
350
400
450
500
550
600

Slide Analysis Information

SLIDE - An Interactive Slope Stability Program

Project Summary

File Name: final cover -- static -- rotational -- saturated.slim
Slide Modeler Version: 6.023
Project Title: SLIDE - An Interactive Slope Stability Program
Date Created: 9/14/2011, 3:39:23 PM

General Settings

Units of Measurement: Imperial Units
Time Units: days
Permeability Units: feet/second
Failure Direction: Right to Left
Data Output: Standard
Maximum Material Properties: 20
Maximum Support Properties: 20

Analysis Options

Analysis Methods Used

Bishop simplified

Number of slices: 25
Tolerance: 0.005
Maximum number of iterations: 50
Check malpha < 0.2: Yes
Initial trial value of FS: 1
Steffensen Iteration: Yes

Groundwater Analysis

Groundwater Method: Water Surfaces
Pore Fluid Unit Weight: 62.4 lbs/ft3
Advanced Groundwater Method: None

Random Numbers

Pseudo-random Seed: 10116
Random Number Generation Method: Park and Miller v.3

Surface Options

Surface Type: Circular
Search Method: Slope Search
Number of Surfaces: 5000
Upper Angle: Not Defined
Lower Angle: Not Defined
Composite Surfaces: Disabled
Reverse Curvature: Create Tension Crack
Minimum Elevation: Not Defined
Minimum Depth: 5

Material Properties

Property	Vegetative Soil Cover	Geosynthetics	Recompacted Soil Barrier	Intermediate Cover	Waste
Color					
Strength Type	Mohr-Coulomb	Mohr-Coulomb	Mohr-Coulomb	Mohr-Coulomb	Mohr-Coulomb
Unit Weight [lbs/ft3]	125	100	125	125	75
Cohesion [psf]	0	0	0	0	400
Friction Angle [deg]	27	26.6	27	27	33
Water Surface	Piezometric Line 1	None	None	None	None
Hu Value	1				

Ru Value	0	0	0	0

Global Minimums

Method: bishop simplified

FS: 1.548670
Center: 2.289, 322.092
Radius: 286.242
Left Slip Surface Endpoint: 40.060, 38.353
Right Slip Surface Endpoint: 142.316, 72.438
Resisting Moment=6.24981e+006 lb-ft
Driving Moment=4.03561e+006 lb-ft
Total Slice Area=367.909 ft2

Valid / Invalid Surfaces

Method: bishop simplified

Number of Valid Surfaces: 4445
Number of Invalid Surfaces: 555

Error Codes:

Error Code -103 reported for 555 surfaces

Error Codes

The following errors were encountered during the computation:

-103 = Two surface / slope intersections, but one or more surface / nonslope external polygon intersections lie between them. This usually occurs when the slip surface extends past the bottom of the soil region, but may also occur on a benched slope model with two sets of Slope Limits.

Slice Data

Global Minimum Query (bishop simplified) - Safety Factor: 1.54867

Slice Number	Width [ft]	Weight [lbs]	Base Material	Base Cohesion [psf]	Base Friction Angle [degrees]	Shear Stress [psf]	Shear Strength [psf]	Base Normal Stress [psf]	Pore Pressure [psf]	Effective Normal Stress [psf]
1	3.81955	176.299	Vegetative Soil Cover	0	27	14.5191	22.4853	44.13	0	44.13
2	3.81955	516.335	Vegetative Soil Cover	0	27	42.3397	65.5703	128.689	0	128.689
3	3.81955	831.165	Vegetative Soil Cover	0	27	67.8621	105.096	206.262	0	206.262
4	3.81955	1120.63	Vegetative Soil Cover	0	27	86.6421	134.18	277.699	14.3565	263.343
5	3.82921	1363.11	Geosynthetics	0	26.6	108.273	167.679	334.847	0	334.847
6	3.90569	1610.86	Recompacted Soil Barrier	0	27	126.947	196.599	385.846	0	385.846
7	3.90569	1832.05	Recompacted Soil Barrier	0	27	143.733	222.595	436.868	0	436.868
8	3.90569	2025.23	Recompacted Soil Barrier	0	27	158.175	244.961	480.763	0	480.763
9	3.90569	2190.11	Recompacted Soil Barrier	0	27	170.28	263.708	517.557	0	517.557
10	4.45346	2661.13	Intermediate Cover	0	27	180.57	279.643	548.831	0	548.831
11	4.45346	2795.43	Intermediate Cover	0	27	188.693	292.223	573.52	0	573.52
12	4.45346	2886.26	Intermediate Cover	0	27	193.798	300.129	589.036	0	589.036
13	4.45346	2932.98	Intermediate Cover	0	27	195.888	303.366	595.388	0	595.388
14	4.45346	2934.92	Intermediate Cover	0	27	194.963	301.934	592.58	0	592.58
15	4.45346	2891.32	Intermediate Cover	0	27	191.023	295.832	580.603	0	580.603
16	4.45346	2801.39	Intermediate Cover	0	27	184.064	285.054	559.449	0	559.449
17	4.45346	2664.27	Intermediate Cover	0	27	174.078	269.59	529.1	0	529.1
18	3.66854	2058.79	Recompacted Soil Barrier	0	27	162.457	251.592	493.778	0	493.778
19	3.66854	1905.73	Recompacted Soil Barrier	0	27	149.669	231.788	454.91	0	454.91
20	3.66854	1724.78	Recompacted Soil Barrier	0	27	134.81	208.776	409.747	0	409.747
21	3.66854	1515.42	Recompacted Soil Barrier	0	27	117.871	182.544	358.263	0	358.263
22	3.51301	1251.51	Geosynthetics	0	26.6	99.6591	154.339	308.208	0	308.208
23	4.57019	1286.37	Vegetative Soil Cover	0	27	77.1572	119.491	242.766	8.25235	234.514
24	4.57019	813.996	Vegetative Soil Cover	0	27	49.979	77.401	151.908	0	151.908
25	4.57019	281.496	Vegetative Soil Cover	0	27	17.1714	26.5929	52.1917	0	52.1917

Interslice Data

Global Minimum Query (bishop simplified) - Safety Factor: 1.54867

Slice	X coordinate	Y coordinate - Bottom	Interslice Normal Force	Interslice Shear Force	Interslice Force Angle

	[ft]	[ft]	[lbs]	[lbs]	[degrees]
1	40.06	38.3533	0	0	0
2	43.8795	38.8879	31.7194	0	0
3	47.6991	39.4752	117.445	0	0
4	51.5186	40.1154	243.923	0	0
5	55.3382	40.809	381.404	0	0
6	59.1674	41.5582	544.059	0	0
7	63.073	42.3785	722.103	0	0
8	66.9787	43.2559	898.74	0	0
9	70.8844	44.1909	1065.41	0	0
10	74.7901	45.1842	1214.69	0	0
11	79.2436	46.3886	1355.74	0	0
12	83.697	47.6706	1458.67	0	0
13	88.1505	49.0313	1518.06	0	0
14	92.604	50.4717	1530.56	0	0
15	97.0574	51.9933	1494.95	0	0
16	101.511	53.5973	1412.17	0	0
17	105.964	55.2853	1285.43	0	0
18	110.418	57.0589	1120.29	0	0
19	114.086	58.5854	960.996	0	0
20	117.755	60.1721	786.824	0	0
21	121.423	61.8202	604.796	0	0
22	125.092	63.5309	423.231	0	0
23	128.605	65.2288	249.12	0	0
24	133.175	67.5272	42.8669	0	0
25	137.745	69.9294	-94.2108	0	0
26	142.316	72.4382	0	0	0

List Of Coordinates

Piezoline

X	Y
0	22.8846

180	82.8785
200	82.8785
379.209	142.609
399.209	142.609
578.418	202.34
597.804	202.34

External Boundary

X	Y
597.804	0
597.804	198.82
597.804	199.82
597.804	201.32
597.804	201.82
597.804	202.34
597.804	204.256
582.419	205.794
398.594	144.525
383.209	146.064
199.385	84.7945
184	86.333
0	25
0	22.8846
0	22.3648
0	21.8378
0	20.2566
0	19.2025
0	0

Material Boundary

X	Y
0	19.2025

180.487	79.3588
200.487	79.3588
379.696	139.089
399.696	139.089
578.906	198.82
597.804	198.82

Material Boundary

X	Y
0	20.2566
180.325	80.3588
200.325	80.3588
379.534	140.089
399.534	140.089
578.743	199.82
597.804	199.82

Material Boundary

X	Y
0	21.8378
180.081	81.8588
200.081	81.8588
379.291	141.589
399.291	141.589
578.5	201.32
597.804	201.32

Material Boundary

X	Y
0	22.3648
180	82.3588
200	82.3588

379.209	142.089
399.209	142.089
578.419	201.82
597.804	201.82

COMPOSITE LINER SYSTEM SETTLEMENT ANALYSES

(e) The settlement analyses of the composite liner system shall include the following:

- **(i) The scope, extent, and findings of the subsurface investigation conducted in accordance with paragraph (C)(3) of this rule, and earthen materials testing program as it pertains to settlement.**
- **(ii) A narrative description of the rationale used for the selection of the analysis input parameters.**
- **(iii) A description of the method used to calculate the settlement.**
- **(iv) A description of the assessed failure modes and conditions.**
- **(v) A summary of the results.**
- **(vi) The actual calculations of settlement and/or computer output.**

OBJECTIVE

The objective of this calculation was to determine the post-settlement slopes of the baseliner system for the proposed expansion. CEC estimated the amount of settlement that may occur within the recompacted soil liner (RSL), the underlying structural fill, and residual soil (if present) located beneath the proposed landfill. The analysis was performed in accordance with OAC 3745-27-08(C)(1) and (C)(3). These regulations require the composite liner system to have a minimum slope of 2.0 percent in all areas, except along flow lines augmented by leachate collection pipes, where a 0.5 percent slope is required after, accounting for 100% of primary and secondary consolidation settlement.

PERMITTED FACILITY

Post settlement slopes and stain on the FML and leachate collection pipes were evaluated and approved by the Ohio EPA as part of the vertical expansion permit application for Apex Landfill. However, the proposed contiguous expansion will result in additional MSW being placed over portions of the permitted facility in Phases 5, 6, and 7. Therefore, the permitted facility was reevaluated (in the affected area) for post settlement slope and strain at the worst-case floor and leachate collection pipe locations. These locations are shown on Figure ~~2~~ *1* in Attachment A. Point elevations for the top of waste, top of RSL, and existing ground surface were taken from the drawings included in this report. The top of bedrock information was taken from recently drilled borings in this area. This boring information is included in Attachment C.

The worst-case floor location was evaluated in the southwestern corner of the permitted facility, spanning from Phase 6 to Phase 7 and the boundary of proposed MSW. Up to approximately 50 feet of structural fill consisting of shot rock will be placed beneath the facility in this area. Remolded consolidation tests were performed on two samples of the shot rock material for the vertical expansion permit. The shot rock material is compressible and breaks down to a soil-like consistency in the field due to the blasting and handling. The worst-case floor segment will span from this point of maximum fill to a point where no structural fill will be placed. The worst-case post settlement slope for the leachate collection pipes is shown on Figure ~~2~~ *1* in Attachment A. ~~This segment spans from the proposed peak elevation of MSW to the boundary of proposed additional MSW.~~

PROPOSED EXPANSION

The post settlement slopes and strains were calculated at the most critical pipe and floor segments in each phase (Phases 8 and 9 were combined). The critical segments were determined based on the differential height of waste, distance between points, and thickness of compressible layers. ~~Settlement calculations were made at multiple locations on the proposed expansion floor to estimate the differential settlement that may occur along the proposed expansion floor and leachate collection pipes.~~ Calculations were performed to estimate the average settlements based on the values obtained from the multiple laboratory tests. Calculations are included on the spreadsheets presented in Attachment B. The

locations of settlement calculation points and the most critical pipe and floor slope locations for the expansion are presented on Figure ~~2~~ *1* in Attachment A.

The proposed expansion floor will be excavated into bedrock in all areas except one, which is located at the toe of the perimeter berm in the south portion of Phase ~~13~~ *11*, as shown on Figures ~~1 and 2~~. Therefore, the compressible layer beneath the expansion consists of 3 feet of RSL in all areas except the one fill area.

As shown on the settlement calculation spreadsheet presented in Attachment B, one compressible layer was analyzed at each calculation point. This layer consists of structural fill *(for Phase 11 only)* and three feet of RSL. Elevations at each calculation point for the existing ground surface (before excavation), top of waste, base of RSL, and top of bedrock were generated using AutoCAD and are shown on the attached spreadsheet in Attachments B. Once the total settlement was calculated for each point, ~~settlement contours were generated using AutoCAD~~ *the post settlement slope and strain was calculated for each segment.* ~~These contours were subtracted from the proposed top of RSL to create RSL post settlement contours as shown on Figure 2 in Attachment A. These contours were used to locate the critical segments.~~

EVALUATION OF PARAMETERS

Attachment D contains consolidation test results used in this analysis. These results are summarized in the following sections.

Unit Weight, Compression Index, Recompression Index, Preconsolidation Pressure, and Initial Void Ratio

These parameters were taken from the lab data presented in Attachment D and averaged by material type and origin (mine spoil, residual, or shot rock). The following table summarizes this data.

Origin	Boring/ Test Pit Number	Sample Depth (ft)	Sample Number	Compression Index, C_c	Recompression Index, C_r	Preconsolidation Pressure (psf)	Initial Void Ratio (e_o)	Unit Weight (pcf)
Remolded Samples[1]								
Mine Spoil	RB-3	20 - 24	B-1	0.172	0.057	2,400	0.5831	125
Residual	RB-4	19 - 24	B-1	0.179	0.068	1,200	0.7135	125
	Average			**0.176**	**0.063**	**1,800**	**0.6483**	**125**
Shot Rock	SR-2	--	--	0.112	0.009	8,200	0.3213	140
	SR-6	--	--	0.115	0.007	6,000	0.3672	140
	Average			**0.114**	**0.008**	**7,100**	**0.3443**	**140**
Undisturbed Samples								

Residual	SB-21	9 - 11	ST-1	0.120	0.050	8,200	0.4449	135
	TPE-18	12 - 14	ST-1	0.147	0.051	5,800	0.6846	125
	Average			**0.134**	**0.051**	**7,000**	**0.5648**	**130**

(1)The average values of the remolded samples were used for the RSL, final cover, and structural fill parameters in the analysis.

The following table summarizes the unit weights used in the analysis for MSW and protective cover based on published data and CEC's experience with similar materials.

Material Type	Unit Weight, γ (pcf)
PC	115
MSW	~~90~~ 75

Secondary Compression Index (C_α)

The secondary compression index was obtained from the laboratory data for each sample at each loading increment. This data is summarized in the following table. The average value for the remolded samples of 0.004 was used for the RSL and structural fill parameters in the analysis. The average value of 0.003 was used for the residual soil in the analysis.

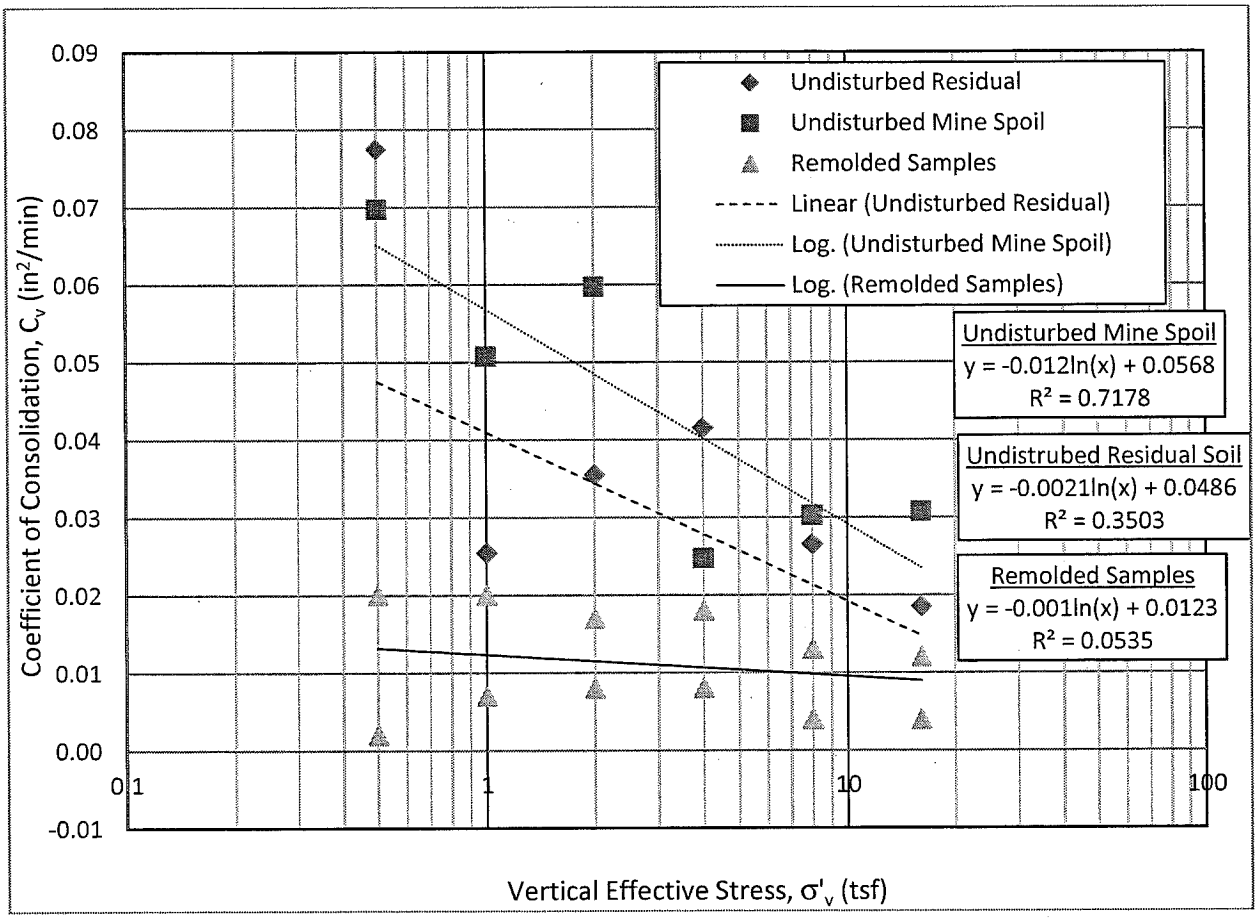
Secondary Compression Index C_α								
Load Increment	Remolded(1)		Undisturbed					
	Mine Spoil	Residual	Mine Spoil				Residual	
	RB-3	RB-4	SB-6	SB-16	SB-17	SB-18	SB-21	TPE-18
0.25-0.5	1.0E-04	1.4E-03	3.6E-03	3.8E-04	4.8E-04	1.7E-03	1.3E-04	1.4E-03
0.5-1	1.8E-03	4.7E-03	3.4E-03	1.8E-03	1.5E-03	2.4E-03	9.9E-04	3.0E-03
1-2	4.5E-03	2.8E-03	2.8E-03	3.1E-03	2.4E-03	2.3E-03	1.1E-03	2.5E-03
2-4	4.0E-03	8.6E-03	3.3E-03	4.4E-03	3.9E-03	4.9E-03	1.6E-03	5.2E-03
4-8	5.0E-03	4.3E-03	3.1E-03	4.4E-03	2.7E-03	3.5E-03	2.3E-03	3.5E-03
8-16	3.9E-03	8.5E-03	3.2E-03	1.0E-02	5.0E-03	5.9E-03	1.7E-03	7.8E-03
Average	0.00321	0.00503	0.00324	0.00400	0.00267	0.00343	0.00130	0.00390
	0.004		0.003				0.003	
			0.003					

Coefficient of Consolidation (C_v)

The coefficient of consolidation was obtained from the laboratory data for each sample at each loading increment. This data is summarized in the following table.

Coefficient of Consolidation (in^2/min)								
	Remolded		Undisturbed					
	Mine Spoil	Residual	Mine Spoil				Residual	
Load Increment	RB-3	RB-4	SB-6	SB-16	SB-17	SB-18	SB-21	TPE-18
0.5	0.020	0.002	0.219	0.005	0.029	0.026	0.134	0.021
1	0.020	0.007	0.03	0.01	0.136	0.027	0.04	0.011
2	0.017	0.008	0.109	0.009	0.091	0.03	0.056	0.015
4	0.018	0.008	0.035	0.008	0.032	0.024	0.066	0.017
8	0.013	0.004	0.066	0.004	0.032	0.019	0.046	0.007
16	0.012	0.004	0.072	0.003	0.029	0.019	0.032	0.005
Average	0.017	0.006	0.089	0.007	0.058	0.024	0.062	0.013

Once this data was summarized, the following graph was created to show the relationship of coefficient of consolidation to log of vertical effective stress (σ'_v). A trendline was fit to each data set and the equations of these lines (displayed on the graph) were used in the analysis to determine the coefficient of consolidation as a function of vertical effective stress.

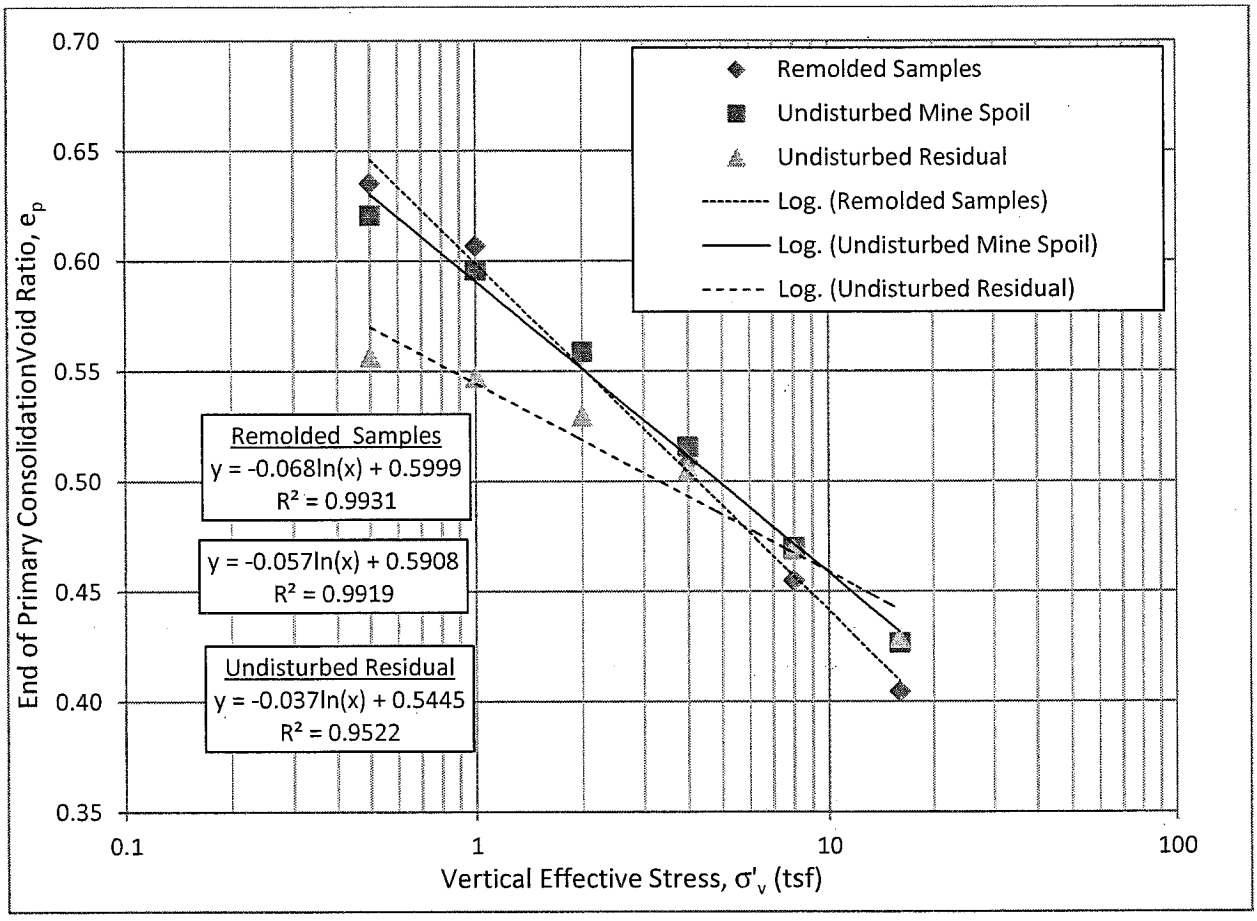

Undisturbed Residual
Undisturbed Mine Spoil
Remolded Samples
Linear (Undisturbed Residual)
Log. (Undisturbed Mine Spoil)
Log. (Remolded Samples)
Undisturbed Mine Spoil
y = -0.012ln(x) + 0.0568
R² = 0.7178
Undistrubed Residual Soil
y = -0.0021ln(x) + 0.0486
R² = 0.3503
Remolded Samples
y = -0.001ln(x) + 0.0123
R² = 0.0535
Coefficient of Consolidation, Cv (in²/min)
0.09
0.08
0.07
0.06
0.05
0.04
0.03
0.02
0.01
0.00
-0.01
0.1
1
10
100
Vertical Effective Stress, σ'v (tsf)

End of Primary Consolidation Void Ratio (e_p)

The void ratio at the end of primary consolidation was obtained from the laboratory data for each sample at each loading increment. This data is summarized in the following table.

Void Ratio at the End of Primary Consolidation, e_p								
Load Increment	Remolded		Undisturbed					
	Mine Spoil	Residual	Mine Spoil				Residual	
	RB-3	RB-4	SB-6	SB-16	SB-17	SB-18	SB-21	TPE-18
0.25-0.5	0.5792	0.6912	0.5409	0.6808	0.5903	0.6708	0.4390	0.6738
0.5-1	0.5641	0.6494	0.4914	0.6718	0.5798	0.6400	0.4311	0.6631
1-2	0.5217	0.5937	0.4464	0.6456	0.5480	0.5946	0.4169	0.6424
2-4	0.4740	0.5429	0.4006	0.6092	0.5027	0.5497	0.3967	0.6132
4-8	0.4239	0.4856	0.3576	0.5630	0.4568	0.5018	0.3667	0.5710
8-16	0.3744	0.4349	0.3177	0.5163	0.4163	0.4564	0.3305	0.5268
Average	0.4896	0.5663	0.4258	0.6145	0.5157	0.5689	0.3968	0.6151
	0.5279		0.5312				0.5059	

Once this data was summarized, the following graph was created to show the relationship of void ratio at the end of primary consolidation to log of vertical effective stress (σ'_v). A trendline was fit to each data set and the equations of these lines (displayed on the graph) were used in the analysis to determine the void ratio at end of primary consolidation as a function of vertical effective stress.



CALCULATING PRIMARY SETTLEMENT

~~A total of 232 points (1000 through 1231) were selected over the proposed phases for calculation of settlement.~~ Primary consolidation settlement was calculated using the following equations.

If $p_o \geq p_c$ then the material is normally consolidated and the following equation is used.

$$S_c = \frac{C_c H}{1 + e_o} \times log\left(\frac{p_o + \Delta p}{p_o}\right)$$

If $\Delta p + p_o < p_c$ then the material is overconsolidated and the following equation is used.

$$S_c = \frac{C_r H}{1 + e_o} \times log\left(\frac{p_o + \Delta p}{p_o}\right)$$

If $p_o + \Delta p > p_c$ then the material is overconsolidated prior to loading and normally consolidated subsequent to loading and the following equation is used.

$$S_c = \frac{C_r H}{1+e_o} \times log\left(\frac{p_c}{p_o}\right) + \frac{C_c H}{1+e_o} \times log\left(\frac{p_o + \Delta p}{p_c}\right)$$

Where: S_c = primary consolidation settlement, (ft);
C_c = compression index;
C_r = recompression index;
e_o = initial void ratio;
H = thickness of the compressible layer, (ft);
p_c = preconsolidation pressure (psf);
p_o = initial effective vertical pressure (psf); and
Δp = change in vertical effective pressure (psf).

The spreadsheet was programmed to determine which of these equations to use based on an average preconsolidation pressure and the current and proposed loading at each point.

CALCULATING SECONDARY SETTLEMENT

Secondary settlement was estimated by using the following equation.

$$S_s = \frac{C_\alpha}{1+e_p} \times H \times \log\frac{T_s}{T_p}$$

Where:

S_s = secondary settlement (ft)
T_s = time over which secondary compression is to be calculated (years)
T_P = time to complete primary consolidation in the consolidating layer (years)
C_α = secondary compression index of the compressible layer;
H = thickness of the layer to be evaluated (ft)
e_p = void ratio at the time of complete primary consolidation

T_P was estimated by using the following equation.

$$T_P = \frac{T_v \times H_t^{\,2}}{C_v}$$

Where:

T_v = a dimensionless time factor associated with the time it takes for primary settlement to be completed
C_v = coefficient of consolidation (determined using the Square-Root-of-Time method)
H_t = maximum length of drainage in the consolidating layer so that H_t is the full thickness of the consolidating layer if it is drained on one side (top or bottom) and H_t is one-half of the thickness of the consolidating layer if it is drained on both sides (top and bottom) (ft)
**This calculation assumes double drainage*

Given Variables:

T_s = 100 years+T_P
T_v = Time factor = 4.58 based on 99.999% consolidation
C_v = from laboratory data.

Once the secondary settlement was calculated it was added to the average primary settlements to determine total settlement at each point.

POST SETTLEMENT SLOPES

Post settlement slopes were calculated by dividing the difference in total post settlement vertical elevations of two locations by the horizontal distance separating the two points. The calculations for post settlement floor and pipe slopes are presented in Attachment C. The floor and pipe section locations analyzed are shown on Figure ~~2~~ *1* in Attachment A.

STRAIN CALCULATION

Possible effects of differential settlement within the proposed expansion and existing landfill also include increased tensile strain upon the FML and leachate collection pipes. The strain on each segment evaluated will be compared to the allowable tensile strain of the FML and leachate collection pipes. Strain is defined by the following equation.

$$\varepsilon = \frac{\Delta l}{l_o}$$

Where: Δl = the change in length between two points (ft)
l_o = the original length between the same two points (ft)

The maximum strain calculations are presented in Attachment C and summarized in the following section. The strain at yield for the HDPE FML is reported to be 12% based on GRI Test Method GM 13.

The Plexco/Spirolite Engineering Manual Vol. 2 by the Chevron Chemical Company, 1998, states that the allowable pipe strain for HDPE gravity piping is 4.2%.

CONCLUSIONS

Floor Post Settlement Slopes

The most critical post settlement floor and pipe slopes were analyzed for the existing and proposed units. The settlement analysis demonstrates that the liner system maintains positive drainage and that the worst-case post settlement floor slope is 2.99% for the proposed unit and ~~2.71%~~ *2.92%* for the existing unit. Therefore, both the units are in compliance with OAC 3745-27-08(C)(1)(c), and the minimum slopes of the composite liner system are greater than 2% after settlement. The calculation also shows that positive drainage is maintained along the floor in the existing unit after accounting for settlement in accordance with OAC 3745-27-08(C)(1)(d).

Pipe Post Settlement Slopes

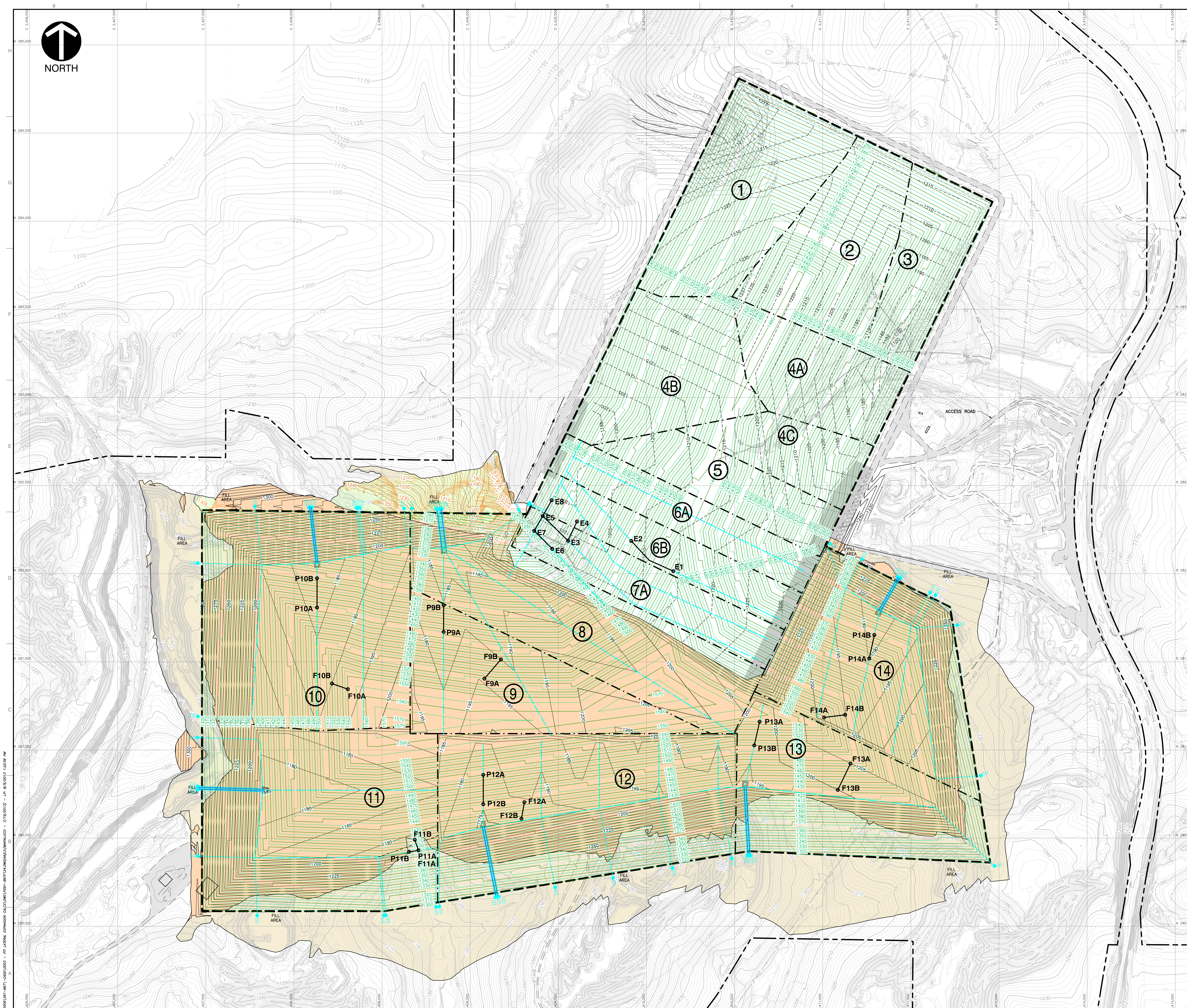
The settlement analysis demonstrates that the permitted leachate collection pipes maintain positive drainage and that the worst-case post settlement pipe slope is 0.54% for the proposed unit and 0.63% for the existing unit. Therefore, both units are in compliance with OAC 3745-27-08(C)(3)(d) and the minimum slopes of permanent leachate collection pipes are greater than the required 0.5% after accounting for primary and secondary post settlement.

Strain

Based on this calculation, the maximum strain experienced by the leachate collection pipes is 0.003% and 0.002% in the existing and proposed facilities, respectively. Based on this calculation, the maximum strain experienced by the FML is 0.015% and 0.028% in the existing and proposed facilities, respectively. All of these values are within the allowable limits of the manufacturer's specifications for HDPE pipe and FML.

ATTACHMENT A

Figures



REVISION RECORD

NO	DATE	DESCRIPTION
1	7/2013	RESPONSE TO OHIO EPA NOD DATED 12/28/12 AND REVISED PHASING

SUBMITTAL RECORD

NO	DATE	DESCRIPTION

LEGEND

- 1220 — EXISTING GROUND CONTOUR (SEE REFERENCE)
- PROPERTY LINE
- LIMIT OF SOLID WASTE PLACEMENT
- PHASE LIMIT
- 8 — PHASE DESIGNATION
- ACCESS ROAD
- 1220 — PERMITTED BASE OF EXCAVATION CONTOUR
- 1220 — PROPOSED BASE OF EXCAVATION CONTOUR
- 1450 — TOP OF WASTE CONTOUR
- UD — EXISTING UNDERDRAIN SYSTEM
- CO — PROPOSED LEACHATE COLLECTION CLEANOUT
- PROPOSED LEACHATE COLLECTION PIPE
- LEACHATE SUMP AND SIDESLOPE RISER
- AREA OF EXCAVATION
- AREA OF STRUCTURAL FILL
- APPROXIMATE LOCATION OF EXCESS SOIL STOCKPILE OVER EXCAVATION

NOTES

1. DESIGN GRADES SHOWN WITHIN THE LIMITS OF WASTE REPRESENT THE PROPOSED BASE OF EXCAVATION/TOP OF STRUCTURAL FILL.
2. MINE SPOIL AND OTHER UNSUITABLE SOILS WILL BE OVER EXCAVATED BENEATH THE STRUCTURAL COMPONENTS OF THE EXISTING UNIT IN ACCORDANCE WITH PERMIT NO. 06-08438 APPROVED 12/31/09. IN THE SHADED AREA, THE LIMIT OF EXCAVATION WILL BE FIELD DETERMINED TO REMOVE ALL MINE SPOIL 30 FEET BEYOND THE LIMITS OF WASTE. GRADES SHOWN HERE MAY VARY.
3. ANY UNDERGROUND MINE VOIDS, IF PRESENT WITHIN THE LANDFILL ANGLE OF DRAW, WILL BE OVEREXCAVATED BEYOND THESE GRADES.
4. CONTOURS IN EXCESS SOIL STOCKPILE OVEREXCAVATION AREA SHOWN IN RED ARE THE JANUARY 5, 2011 TOPOGRAPHY AND THE LIMIT OF EXCAVATION GRADES, REPRESENTING THE GRADES THAT WILL BE OVEREXCAVATED.

REFERENCE

1. EXISTING TOPOGRAPHY PREPARED BY KEDDAL AERIAL MAPPING; DATE OF PHOTOGRAPHY: 1/18/13. ADDITIONAL MAPPING WAS PREPARED BY KEDDAL AERIAL MAPPING FROM AERIAL PHOTOGRAPHY DATED 1/6/12 AND 1/5/11 AND BY M.A.N. MAPPING FROM AERIAL PHOTOGRAPHY DATED 12/14/00.
2. TOPOGRAPHIC MAPPING IN FILL AREAS OF EXISTING UNIT PREPARED BY KEDDAL AERIAL MAPPING DATED 12/18/07 AND 3/7/06.
3. EXISTING CONTOURS OF EXCESS SOIL STOCKPILE OVEREXCAVATION AREA WERE DEVELOPED BY M.A.N. MAPPING DATED 12/14/00.

SCALE IN FEET
0 200 400

*HAND SIGNATURE ON FILE

Authorized Use:
☐ Survey ☑ Permitting ☐ Construction
☐ Design Dev. ☐ Bidding ☐ -

Civil & Environmental Consultants, Inc.
333 Baldwin Road - Pittsburgh, PA 15205
Ph: 412.429.2324 · 800.365.2324 · Fax: 412.429.2114
www.cecinc.com

APEX ENVIRONMENTAL, LLC.
PERMIT TO INSTALL APPLICATION
CONTIGUOUS EXPANSION
APEX SANITARY LANDFILL
JEFFERSON COUNTY, OHIO

DRAWN BY: MJI	CHECKED BY: JMN	APPROVED BY: RJB *
DATE: 7/18/13	DWG SCALE: 1"=200'	PROJECT NO: 091-867

POST - SETTLEMENT
SLOPE CALCULATION
OF LEACHATE COLLECTION SYSTEM

FIGURE NO.: 1

ATTACHMENT B

Settlement Calculation Spreadsheets

Apex Sanitary Landfill Contiguous Expansion
Settlement Calculation -- Proposed Facility

	POINT ID:	F-9A	F-9B	P-9A	P-9B	F-10A	F-10B	P-10A	P-10B	F-11A	F-11B	P-11A	P-11B	F-12A	F-12B	P-12A	P-12B	F-13A
	UNITS																	
Existing Ground Surface										1189	1191	1189	1193					
Top of Bedrock		1229	1226	1227	1223	1228	1229	1239	1240	1188	1190	1188	1189	1223	1219	1222	1216	1218
Top of Excavation or Structural Fill El.		1194	1190	1187	1185	1193	1190	1183	1182	1194	1191	1194	1193	1179	1177	1177	1175	1205
Top of Waste El.		1525	1486	1455	1405	1550	1520	1450	1395	1392	1413	1392	1391	1455	1425	1510	1455	1475
Top of RSL El. (3ft Thick)		1197	1193	1190	1188	1196	1193	1186	1185	1197	1194	1197	1196	1182	1180	1180	1178	1208
Top Final Cover El. (4ft Thick)		1529	1490	1459	1409	1554	1524	1454	1399	1396	1417	1396	1395	1459	1429	1514	1459	1479
Top Protective Cover El. (1ft Thick)		1198	1194	1191	1189	1197	1194	1187	1186	1198	1195	1198	1197	1183	1181	1181	1179	1209
Bottom of RSL El.		1194	1190	1187	1185	1193	1190	1183	1182	1194	1191	1194	1193	1179	1177	1177	1175	1205
Thickness of compressible layer (Includes RSL and Structural Fill)	ft	3	3	3	3	3	3	3	3	9	4	9	7	3	3	3	3	3
PRIMARY SETTLEMENT																		
Vertical effective stress after excavation and before loading, σ'_o	psf	188	188	188	188	188	188	188	188	550	278	550	455	188	188	188	188	188
Vertical effective stress after loading, σ'_v	psf	25303	22686	20625	16989	27287	25253	20504	16504	15728	17219	15728	15621	21173	19136	25481	21480	20756
Change in Vertical effective stress, $\Delta\sigma'_v$	psf	25116	22499	20438	16802	27099	25065	20317	16317	15178	16941	15178	15167	20985	18948	25293	21293	20568
TOTAL PRIMARY SETTLEMENT	ft	0.48	0.46	0.45	0.42	0.49	0.48	0.45	0.42	1.05	0.60	1.05	0.89	0.45	0.44	0.48	0.46	0.45
SECONDARY SETTLEMENT																		
t_s[1] Equals 100 years + t_p	yr	101.16	101.14	101.13	101.11	101.17	101.16	101.13	101.11	109.50	102.44	109.50	106.48	101.14	101.12	101.16	101.14	101.13
T_v[2] From Table	in^2/min	4.58	4.58	4.58	4.58	4.58	4.58	4.58	4.58	4.58	4.58	4.58	4.58	4.58	4.58	4.58	4.58	4.58
C_v From Lab Data Graph	ft^2/yr	35.63	36.03	36.38	37.09	35.36	35.64	36.40	37.19	37.37	37.04	37.37	37.39	36.28	36.65	35.61	36.23	36.36
C_α From Lab Data		0.0041	0.0041	0.0041	0.0041	0.0041	0.0041	0.0041	0.0041	0.0041	0.0041	0.0041	0.0041	0.0041	0.0041	0.0041	0.0041	0.0041
t_p (Assuming one way drainage)	yr	1.16	1.14	1.13	1.11	1.17	1.16	1.13	1.11	9.50	2.44	9.50	6.48	1.14	1.12	1.16	1.14	1.13
Void Ratio (e_p) From Lab Data Graph		0.427	0.435	0.441	0.454	0.422	0.427	0.442	0.456	0.460	0.454	0.460	0.460	0.439	0.446	0.427	0.438	0.441
TOTAL SECONDARY SETTLEMENT	ft	0.017	0.017	0.017	0.017	0.017	0.017	0.017	0.017	0.026	0.020	0.026	0.025	0.017	0.017	0.017	0.017	0.017
ESTIMATED TOTAL SETTLEMENT	**ft**	**0.50**	**0.48**	**0.47**	**0.44**	**0.51**	**0.49**	**0.47**	**0.44**	**1.08**	**0.62**	**1.08**	**0.92**	**0.47**	**0.46**	**0.50**	**0.47**	**0.47**
	POINT ID:	**F-9A**	**F-9B**	**P-9A**	**P-9B**	**F-10A**	**F-10B**	**P-10A**	**P-10B**	**F-11A**	**F-11B**	**P-11A**	**P-11B**	**F-12A**	**F-12B**	**P-12A**	**P-12B**	**F-13A**

[1] T_s given as 100 years plus the time to complete primary consolidation

[2] T_v given assuming 99.999% Consolidation

[3] Shaded boxes denote input values. Unshaded boxes indicate calculated values.

Apex Sanitary Landfill Contiguous Expansion
Settlement Calculation -- Proposed Facility

	POINT ID:	F-13B	P-13A	P-13B	F-14A	F-14B	P-14A	P-14B
	UNITS							
Existing Ground Surface								
Top of Bedrock		1210	1214	1215	1216	1222	1229	1228
Top of Excavation or Structural Fill El.		1200	1197	1196	1199	1195	1190	1188
Top of Waste El.		1425	1545	1500	1520	1480	1400	1355
Top of RSL El. (3ft Thick)		1203	1200	1199	1202	1198	1193	1191
Top Final Cover El. (4ft Thick)		1429	1549	1504	1524	1484	1404	1359
Top Protective Cover El. (1ft Thick)		1204	1201	1200	1203	1199	1194	1192
Bottom of RSL El.		1200	1197	1196	1199	1195	1190	1188
Thickness of compressible layer (Includes RSL and Structural Fill)	ft	3	3	3	3	3	3	3
PRIMARY SETTLEMENT								
Vertical effective stress after excavation and before loading, σ'_o	psf	188	188	188	188	188	188	188
Vertical effective stress after loading, σ'_v	psf	17378	26572	23300	24597	21868	16263	12990
Change in Vertical effective stress, $\Delta\sigma'_v$	psf	17190	26384	23113	24409	21681	16075	12803
TOTAL PRIMARY SETTLEMENT	ft	0.43	0.49	0.47	0.47	0.46	0.42	0.39
SECONDARY SETTLEMENT								
t_s [1] Equals 100 years + t_p	yr	101.11	101.16	101.15	101.15	101.14	101.11	101.08
Tv[2] From Table	in^2/min	4.58	4.58	4.58	4.58	4.58	4.58	4.58
C_v From Lab Data Graph	ft^2/yr	37.00	35.45	35.93	35.74	36.16	37.25	38.07
C_α From Lab Data		0.0041	0.0041	0.0041	0.0041	0.0041	0.0041	0.0041
t_p (Assuming one way drainage)	yr	1.11	1.16	1.15	1.15	1.14	1.11	1.08
Void Ratio (e_p) From Lab Data Graph		0.453	0.424	0.433	0.429	0.437	0.457	0.473
TOTAL SECONDARY SETTLEMENT	ft	0.017	0.017	0.017	0.017	0.017	0.017	0.017
ESTIMATED TOTAL SETTLEMENT	**ft**	**0.44**	**0.50**	**0.48**	**0.49**	**0.47**	**0.43**	**0.40**
	POINT ID:	**F-13B**	**P-13A**	**P-13B**	**F-14A**	**F-14B**	**P-14A**	**P-14B**

[1] T_s given as 100 years plus the time to complete primary consolidation

[2] T_v given assuming 99.999% Consolidation

[3] Shaded boxes denote input values. Unshaded boxes indicate calculated values.

ATTACHMENT C

Post-Settlement Slope and Strain Analysis

Apex Sanitary Landfill Contiguous Expansion
Post Settlement Slope and Strain Calculation -- Proposed Facility

	Phases 8 & 9				Phase 10				Phase 11			
	Floor		Pipe		Floor		Pipe		Floor		Pipe	
Point No	A	B	A	B	A	B	A	B	A	B	A	B
Top of RSL El. Before Settlement	1197.3	1193.0	1189.7	1188.2	1195.9	1193.0	1186.3	1184.6	1196.7	1194.0	1196.7	1196.2
Top of RSL El. After Settlement	1196.8	1192.5	1189.2	1187.7	1195.4	1192.5	1185.8	1184.2	1195.6	1193.4	1195.6	1195.3
Horizontal Dist. (ft)	144.1		151.5		96.0		166.7		63.8		54.4	
Total Settlement (ft)	0.50	0.48	0.47	0.44	0.51	0.49	0.47	0.44	1.08	0.62	1.08	0.92
Original Distance (ft)	144.116		151.532		96.024		166.684		63.904		54.390	
Final Distance (ft)	144.115		151.532		96.024		166.684		63.887		54.389	
Pre-settlement Slope (%)	3.00%		1.00%		3.00%		1.00%		4.20%		0.85%	
Post-settlement Slope (%)	2.99%	Pass	0.98%	Pass	2.99%	Pass	0.98%	Pass	3.48%	Pass	0.54%	Pass
Strain (%)	0.00030%	Pass	0.00020%	Pass	0.00030%	Pass	0.00020%	Pass	0.02760%	Pass	0.00210%	Pass

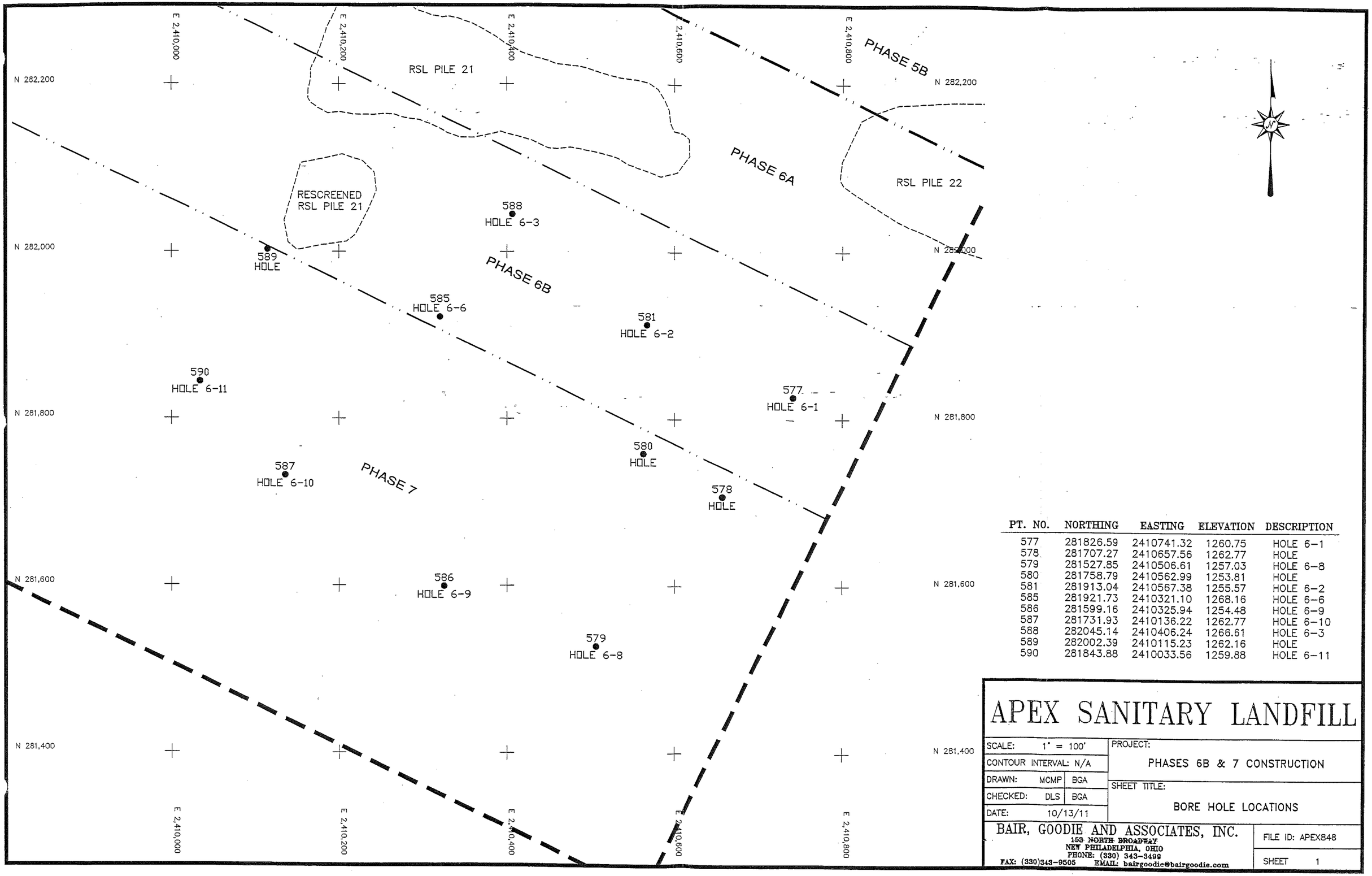
	Phase 12				Phase 13				Phase 14			
	Floor		Pipe		Floor		Pipe		Floor		Pipe	
Point No	A	B	A	B	A	B	A	B	A	B	A	B
Top of RSL El. Before Settlement	1182.4	1179.6	1180.0	1178.3	1208.0	1203.0	1200.4	1199.0	1201.7	1198.1	1192.9	1191.5
Top of RSL El. After Settlement	1181.9	1179.1	1179.5	1177.8	1207.5	1202.6	1199.9	1198.5	1201.3	1197.6	1192.4	1191.1
Horizontal Dist. (ft)	94.6		166.5		165.3		137.9		120.7		136.9	
Total Settlement (ft)	0.47	0.46	0.50	0.47	0.47	0.44	0.50	0.48	0.49	0.47	0.43	0.40
Original Distance (ft)	94.603		166.509		165.393		137.918		120.787		136.878	
Final Distance (ft)	94.602		166.508		165.392		137.918		120.787		136.878	
Pre-settlement Slope (%)	3.00%		1.00%		3.00%		1.00%		3.00%		1.00%	
Post-settlement Slope (%)	2.99%	Pass	0.99%	Pass	2.99%	Pass	0.99%	Pass	2.99%	Pass	0.98%	Pass
Strain (%)	0.00040%	Pass	0.00010%	Pass	0.00040%	Pass	0.00010%	Pass	0.00040%	Pass	0.00020%	Pass

(1) Negative strain indicates tension.

Apex Sanitary Landfill Contiguous Expansion
Post Settlement Slope and Strain Calculation -- Existing Facility

	Floor Segments				Pipe Segments					
Point No.	**E7**	**E8**	**E3**	**E4**	**E2**	**E1**	**E3**	**E5**	**E6**	**E7**
Top of RSL El.	1210.3	1203.9	1209.2	1205.3	1217.5	1211.5	1209.2	1207.2	1212.0	1210.3
Top of Waste El.	1271.2	1265.7	1322.1	1320.1	1506.0	1416.0	1322.1	1264.8	1312.0	1271.2
Pre-existing Ground El.	1159.8	1200.7	1174.5	1198.7	1265.0	1250.0	1174.5	1179.0	1180.0	1159.8
Top of Bedrock El.	1149.8	1190.7	1164.5	1188.7	1230.0	1230.0	1164.5	1169.0	1170.0	1149.8
Top of Final Cover El.	1275.2	1269.7	1326.1	1324.1	1510.0	1420.0	1326.1	1268.8	1316.0	1275.2
MSW Thickness (ft)	60.0	60.8	111.9	113.8	287.5	203.5	111.9	56.6	99.0	59.9
Shot Rock Thickness (ft)	47.4	0.1	31.69	3.64	0.0	0.0	31.7	25.15	29	47.5
Residual Soil Thickness (ft)	10.0	10.0	10.0	10.0	0.0	0.0	10.0	10.0	10.0	10.0
RSL										
Po (psf)	187.5	187.5	187.5	187.5	187.5	187.5	187.5	187.5	187.5	187.5
ΔP (psf)	5,114	5,176	9,004	9,151	22,178	15,878	9,004	4,861	8,040	5,108
S_c (ft)	0.262	0.263	0.338	0.340	0.461	0.415	0.338	0.255	0.323	0.261
Shot Rock										
Po (psf)	3,321	10	2,218	255	0	0	2,218	1,761	2,030	3,325
ΔP (psf)	5,489	5,551	9,379	9,526	0	0	9,379	5,236	8,415	5,483
S_c (ft)	0.466	0.002	0.663	0.073	0	0	0.663	0.087	0.502	0.466
Residual Soil										
Po (psf)	650	650	650	650	0	0	650	650	650	650
ΔP (psf)	12,130	5,572	13,816	10,035	0	0	13,816	8,757	12,475	12,133
S_c (ft)	0.400	0.317	0.414	0.380	0	0	0.414	0.366	0.403	0.400
Total S_c (ft)	1.128	0.582	1.415	0.794	0.461	0.415	1.415	0.708	1.228	1.128
Horizontal Dist. (ft)	200		120		300		210		150	
Original Length (ft)	200.102		120.062		300.060		210.010		150.010	
Final Length (ft)	200.085		120.044		300.059		210.004		150.009	
Pre-settlement Slope	3.19%		3.23%		2.00%		0.97%		1.13%	
Post-settlement Slope	2.92%	Pass	2.71%	Pass	1.98%	Pass	0.63%	Pass	1.07%	Pass
Strain	-0.008%	Pass	-0.015%	Pass	0.000%	Pass	-0.003%	Pass	-0.001%	Pass

(1) Negative strain indicates tension.



PT. NO.	NORTHING	EASTING	ELEVATION	DESCRIPTION
577	281826.59	2410741.32	1260.75	HOLE 6-1
578	281707.27	2410657.56	1262.77	HOLE
579	281527.85	2410506.61	1257.03	HOLE 6-8
580	281758.79	2410562.99	1253.81	HOLE
581	281913.04	2410567.38	1255.57	HOLE 6-2
585	281921.73	2410321.10	1268.16	HOLE 6-6
586	281599.16	2410325.94	1254.48	HOLE 6-9
587	281731.93	2410136.22	1262.77	HOLE 6-10
588	282045.14	2410406.24	1266.61	HOLE 6-3
589	282002.39	2410115.23	1262.16	HOLE
590	281843.88	2410033.56	1259.88	HOLE 6-11

APEX SANITARY LANDFILL

SCALE: 1" = 100'		PROJECT: PHASES 6B & 7 CONSTRUCTION
CONTOUR INTERVAL: N/A		
DRAWN: MCMP	BGA	SHEET TITLE: BORE HOLE LOCATIONS
CHECKED: DLS	BGA	
DATE: 10/13/11		

BAIR, GOODIE AND ASSOCIATES, INC.
153 NORTH BROADWAY
NEW PHILADELPHIA, OHIO
PHONE: (330) 343-3499
FAX: (330)343-9505 EMAIL: bairgoodie@bairgoodie.com

FILE ID: APEX848

SHEET 1

NON NEWCOMB

PAGE 1.

[redacted] 9:30 to 4:30 10-4 - 11

Hole 6-1 0' - 18' BACK FILL Ground: 1261
577 18' - 22' GRAY SANDSTONE Rock: 1243
Total 22' ft

Hole 6-2 Ground: 1256
581 0'-27' BACK FILL Rock: 1229
27'- 30' GRAY SANDSTONE
Total 30 ft

Hole 6-3 0'- 37' BACK FILL Ground: 1267
586 37' - 40' GRAY SANDSTONE Rock: 1230
Total 40 ft

Hole 6-4 Ground: 1263
578 0 - 26 BACK FILL Rock: 1237
26 - 28 BROWN SANDY SHALE
28 - 30 COAL
Total 30 ft

Hole 6-5 Ground: 1254
580 0-25 BACK FILL Rock: 1229
25-30 GRAY SANDSTONE
Total 30 ft

OVER

Hole 6-6

Ground: 1268
Rock: 1233

585
0'-35' BACK FILL
35'-39' GRAY SHALE
39'-41' GRAY SANDSTONE
Total 41' ft

Hole 6-7

Ground: 1262
Rock: 1235

589
0'-37' BACK FILL
37'-38' GRAY SHALE
38'-40' GRAY SANDSTONE
Total 40 ft

Hole 6-8

Ground: 1257
Rock: 1236

579
0'-21' BACK FILL
21'-23' GRAY SHALE
23'-28' COAL
28'-30' GRAY CLAY
30'-31' GRAY SANDSTONE
Total 31 ft

Hole 6-9

Ground: 1254
Rock: 1226

586
0'-28' BACK FILL
28'-30' COAL
30'-32' GRAY CLAY
32'-33' GRAY SANDSTONE
Total 33' ft

NON NEWCOME

10 - 4 -11

Hole 6-10

587

0'-23'	BACK FILL	Ground: 1263
23 - ~~43~~	GRAY SHALE	Rock: 1240
~~43~~ - 45	COAL	
45 - ~~47~~	GRAY CLAY	
47 - 49	GRAY SHALE	

Total 49 ft

Hole 6-11

590

Ground: 1260
Rock: 1215

0 - 45'	BACK FILL	
45' ~~45~~ - 48	COAL	
48' - 49'	GRAY SHALE	

Total 49'

ATTACHMENT D

Laboratory Data Used in Settlement Calculation

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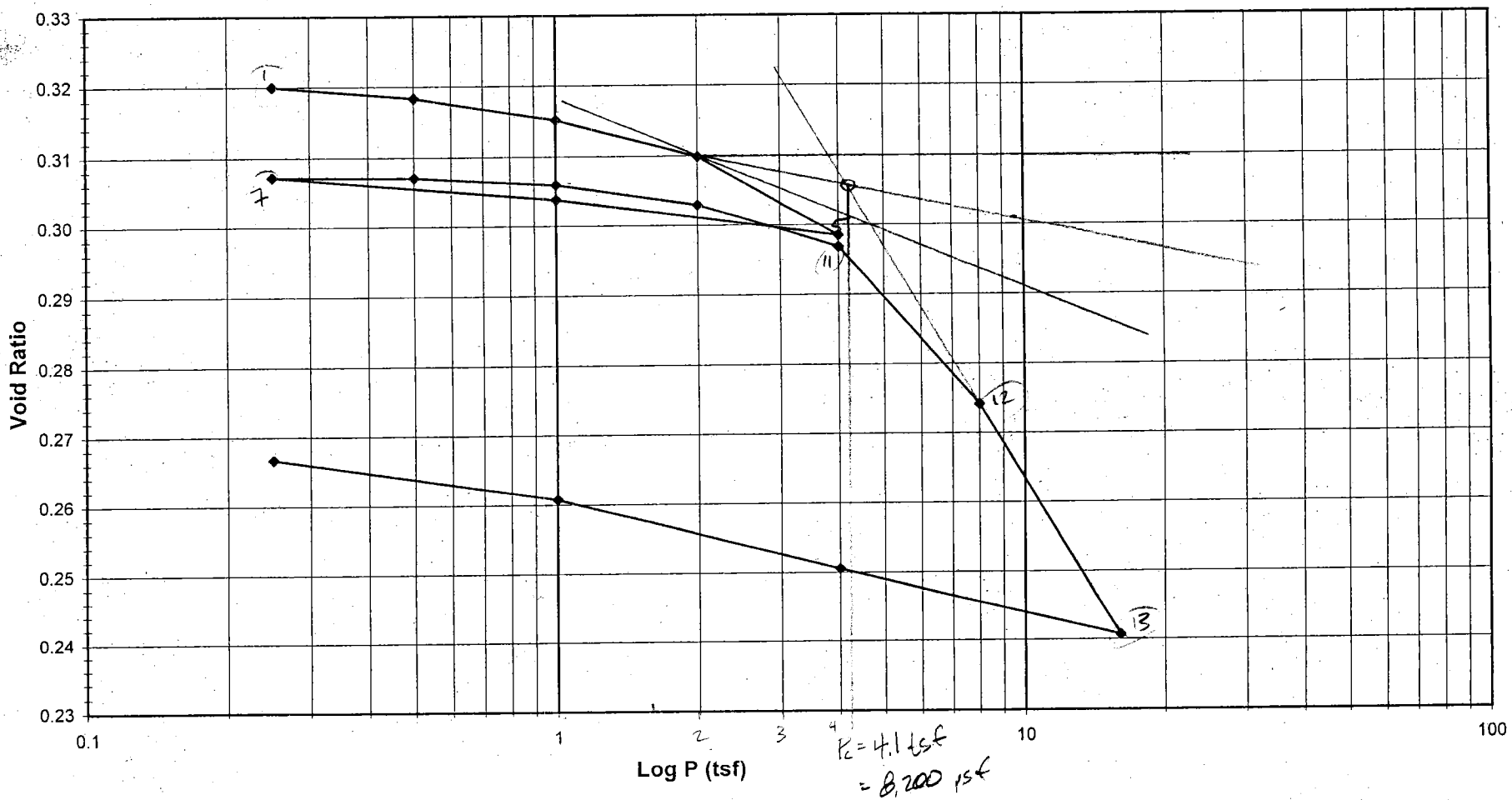
ONE DIMENSIONAL CONSOLIDATION

ASTM D 2435-04 / AASHTO T216-03 (SOP-S24)

Client	CEC	Boring No.	NA
Client Reference	APEX SANITARY L.F. 072-002	Depth (ft)	NA
Project No.	2008-026-33	Sample No.	SR-2
Lab ID	2008-026-33-06	Visual Description	GRAY CLAY (-#4 MATERIAL)

Sample Conditions: UNDISTURBED, INUNDATED AND DOUBLE DRAINED



Tested By TM *Date* 10/21/08 *Approved By* RJO *Date* 11-3-08

DCN: CT-S24F Date: 12/12/05 Revision: 5

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ONE DIMENSIONAL CONSOLIDATION

ASTM D 2435-04 / AASHTO T216-03 (SOP-S24)

Client	CEC	Boring No.	NA
Client Reference	APEX SANITARY L.F. 072-002	Depth (ft)	NA
Project No.	2008-026-33	Sample No.	SR-2
Lab ID	2008-026-33-06	Visual Description	GRAY CLAY *(-#4 MATERIAL)*

Sample Conditions: UNDISTURBED, INUNDATED AND DOUBLE DRAINED
Consolidometer No. 4
1 Division = 0.0001 (in)

$C_c = \frac{e_{12} - e_{13}}{\log \frac{P_{12}}{P_{13}}} = \frac{0.27421 - 0.24064}{\log(8/16)} = 0.112$

$C_r = \frac{e_4 - e_{11}}{\log \frac{P_4}{P_{11}}} = \frac{0.30718 - 0.29683}{\log(0.25/4)} = 0.0086$

Sample Properties	Initial	Final
Water Content		
Tare Number	1186	1208
Wt. Tare & WS (gm)	158.69	137.75
Wt. Tare & DS (gm)	147.53	125.46
Wt. Water (gm)	11.16	12.29
Wt. Tare (gm)	6.84	6.68
Wt. DS (gm)	140.69	118.78
Water Content (%)	7.93	10.35
Sample Parameters		
Sample Diameter (in)	2.5	2.5
Sample Height (in)	0.750	0.719
Sample Volume (cc)	60.33	57.84
Wt. Wet Sample + Ring (gm)	209.71	212.69
Wt. of Ring (gm)	76.65	76.65
Wt. of Wet Sample (gm)	133.06	136.04
Wet Density (pcf)	137.63	146.77
Wet Density (g/cc)	2.21	2.35
Water Content (%)	7.93	10.35
Wt. of Dry Sample (gm)	123.28	123.28
Dry Density (pcf)	127.51	133.01
Dry Density (g/cc)	2.04	2.13
Void Ratio	0.3213	0.2667
Saturation (%)	66.66	104.76
Specific Gravity	2.70	*Assumed*

Test Data Summary

	Applied Pressure (tsf)	Final Dial Reading (div)	Machine Deflection (div)	Corrected Reading (div)	Height of Sample (mm)	Volume (cc)	Dry Density (g/cc)	Void Ratio
0	Seating	0	0	0	19.050	60.330	2.04345	**0.32130**
1	0.25	14.3	6.6	7.7	19.030	60.268	2.04555	**0.31994**
2	0.5	28.7	11.7	17.0	19.007	60.193	2.04809	**0.31830**
3	1	53.3	18.5	34.8	18.962	60.050	2.05297	**0.31517**
4	2	93.3	28.5	64.8	18.885	59.809	2.06126	**0.30988**
5	4	171.0	41.2	129.8	18.720	59.286	2.07944	**0.29843**
6	1	130.0	30.8	99.2	18.798	59.532	2.07084	**0.30382**
7	0.25	94.7	14.6	80.1	18.847	59.686	2.06551	**0.30718**
8	0.5	98.4	17.5	80.9	18.845	59.679	2.06573	**0.30704**
9	1	108.9	21.6	87.3	18.828	59.628	2.06751	**0.30592**
10	2	133.4	29.4	104.0	18.786	59.493	2.07218	**0.30297**
11	4	180.5	41.6	138.9	18.697	59.213	2.08201	**0.29683**
12	8	320.6	53.3	267.3	18.371	58.180	2.11897	**0.27421**
13	16	521.5	63.7	457.8	17.887	56.647	2.17629	**0.24064**
14	4	453.1	51.3	401.8	18.029	57.098	2.15912	**0.25051**
15	1	380.4	36.7	343.7	18.177	57.565	2.14159	**0.26075**
16	0.25	329.8	19.7	310.1	18.262	57.835	2.13158	**0.26666**

NOTE: 0.75 TSF WAS APPLIED TO STOP SWELL.
THIS IS NOT INCLUDED IN THE LOADING INCREMENTS.

Tested By TM *Date* 10/21/08 *Input Checked By* GU *Date* 11-3-08

DCN: CT-S24F Date: 12/12/05 Revision: 5

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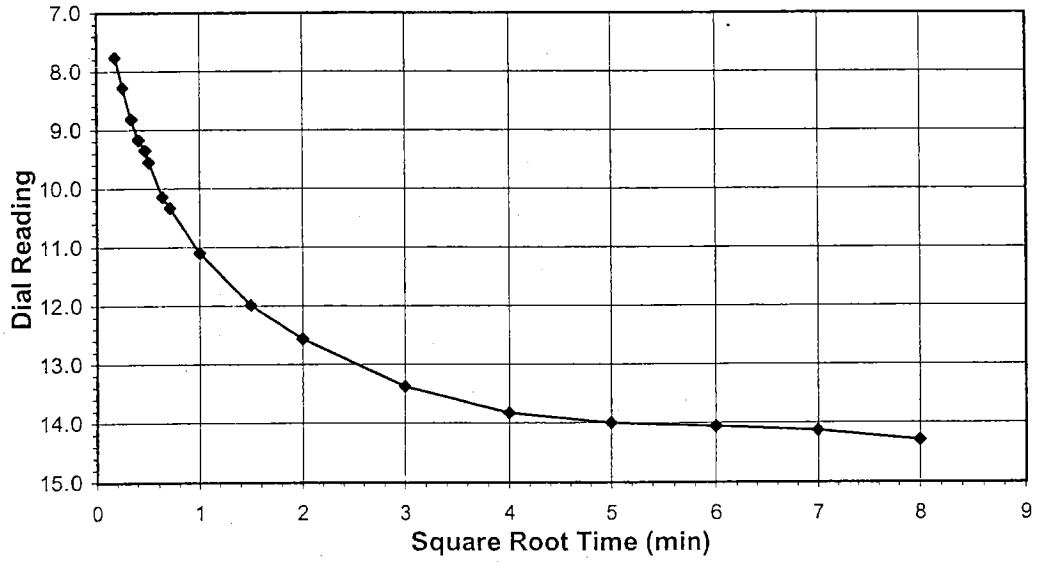
ONE DIMENSIONAL CONSOLIDATION

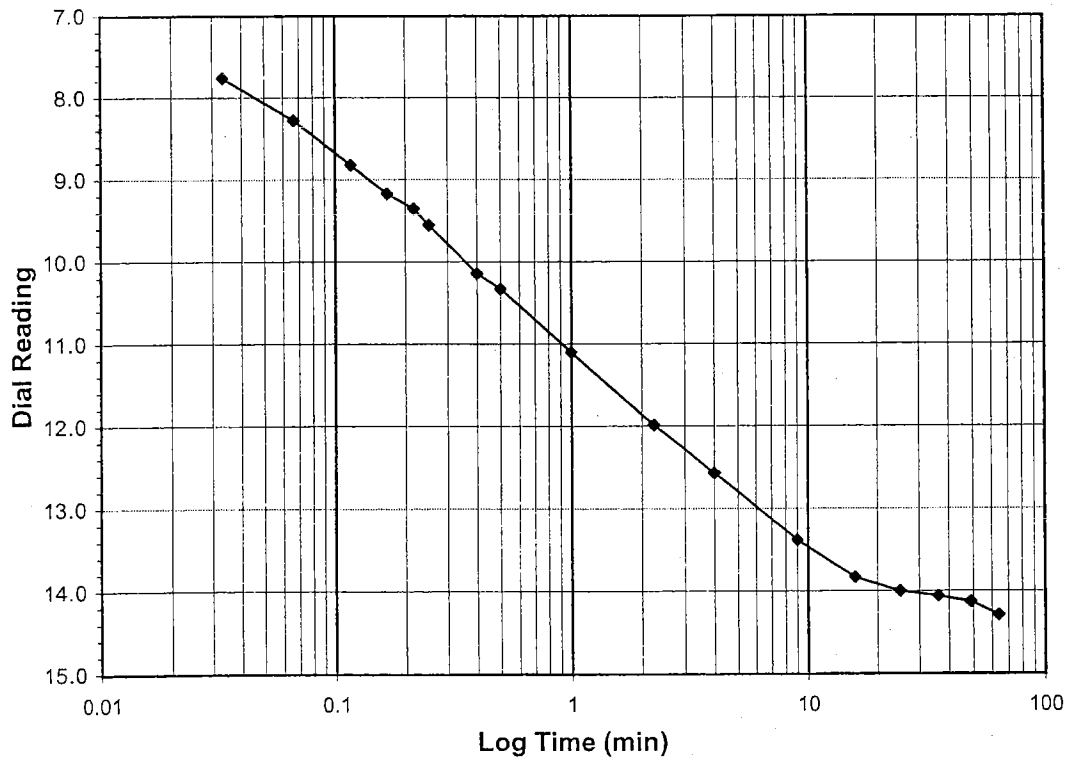
ASTM D 2435-04 / AASHTO T216-03 (SOP-S24)

Client	CEC	Boring No.	NA
Client Project	APEX SANITARY L.F. 072-002	Depth (ft)	NA
Project No.	2008-026-33	Sample No.	SR-2
Lab ID	2008-026-33-06	Visual Description	GRAY CLAY *(-#4 MATERIAL)*

Sample Conditions: REMOLDED, INUNDATED AND DOUBLE DRAINED

NOTE: 0.75 TSF WAS APPLIED TO STOP SWELL.
THIS IS NOT INCLUDED IN THE LOADING INCREMENTS.





Test Load	**(tsf)**	**0-0.25**
Final Reading	**(div)**	**14.3**
Consolidometer No.		4
1 Division	(in)	0.0001
Start Date		10/21/08
Start Time		15:04:22

Elapsed Time (min)	Dial Reading (div)
Initial	**0.0**
0.03	7.8
0.07	8.3
0.12	8.8
0.17	9.2
0.22	9.4
0.25	9.6
0.40	10.1
0.50	10.3
1.00	11.1
2.25	12.0
4.00	12.6
9.00	13.4
16.00	13.8
25.00	14.0
36.02	14.1
49.00	14.1
64.00	14.3

Tested By TM *Date* 10/21/08 *Checked By* GU *Date* 11-3-08

DCN: CT-24E Date: 3/2/98 Revision: 2

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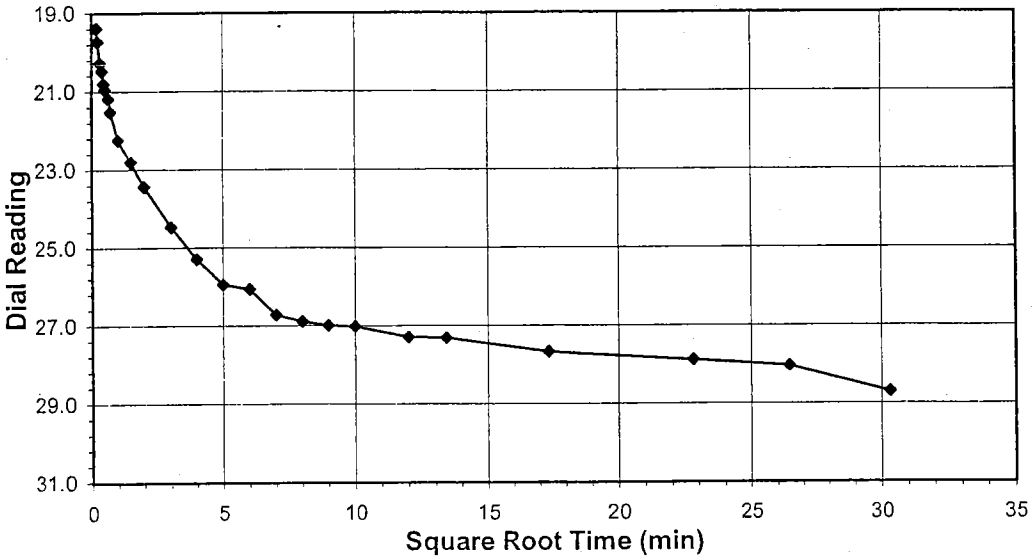
ONE DIMENSIONAL CONSOLIDATION

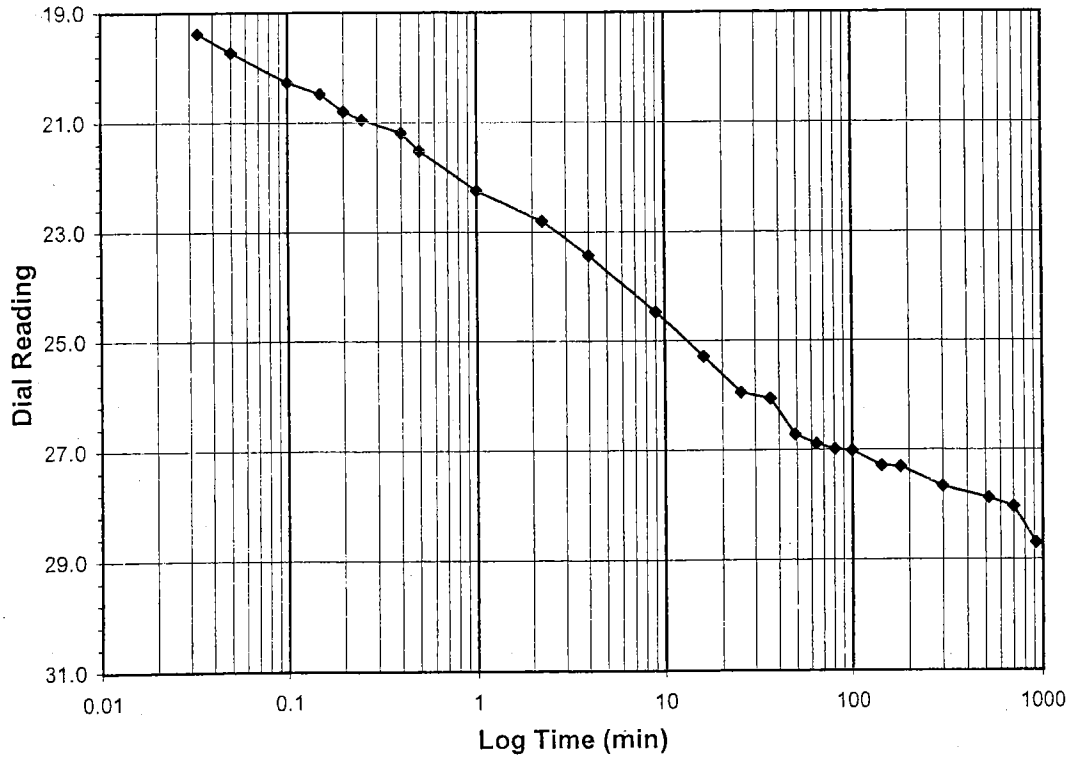
ASTM D 2435-04 / AASHTO T216-03 (SOP-S24)

Client	CEC	Boring No.	NA
Client Project	APEX SANITARY L.F. 072-002	Depth (ft)	NA
Project No.	2008-026-33	Sample No.	SR-2
Lab ID	2008-026-33-06	Visual Description	GRAY CLAY *(-#4 MATERIAL)*

Sample Conditions: REMOLDED, INUNDATED AND DOUBLE DRAINED

NOTE: 0.75 TSF WAS APPLIED TO STOP SWELL.
THIS IS NOT INCLUDED IN THE LOADING INCREMENTS.





Test Load	**(tsf)**	**0.25-0.5**
Final Reading	**(div)**	**28.7**
Consolidometer No.		4
1 Division	(in)	0.0001
Start Date		10/21/08
Start Time		16:14:26

Elapsed Time (min)	Dial Reading (div)
Initial	**14.3**
0.03	19.4
0.05	19.7
0.10	20.3
0.15	20.5
0.20	20.8
0.25	21.0
0.40	21.2
0.50	21.5
1.00	22.2
2.25	22.8
4.00	23.4
9.00	24.5
16.00	25.3
25.00	26.0
36.00	26.1
49.00	26.7
64.00	26.9
81.00	27.0
100.00	27.0
144.00	27.3
180.00	27.3
300.00	27.7
520.00	27.9
700.00	28.0
920.00	28.7

Tested By TM *Date* 10/21/08 *Checked By* GU *Date* 11-3-08

DCN: CT-24E Date: 3/2/98 Revision: 2

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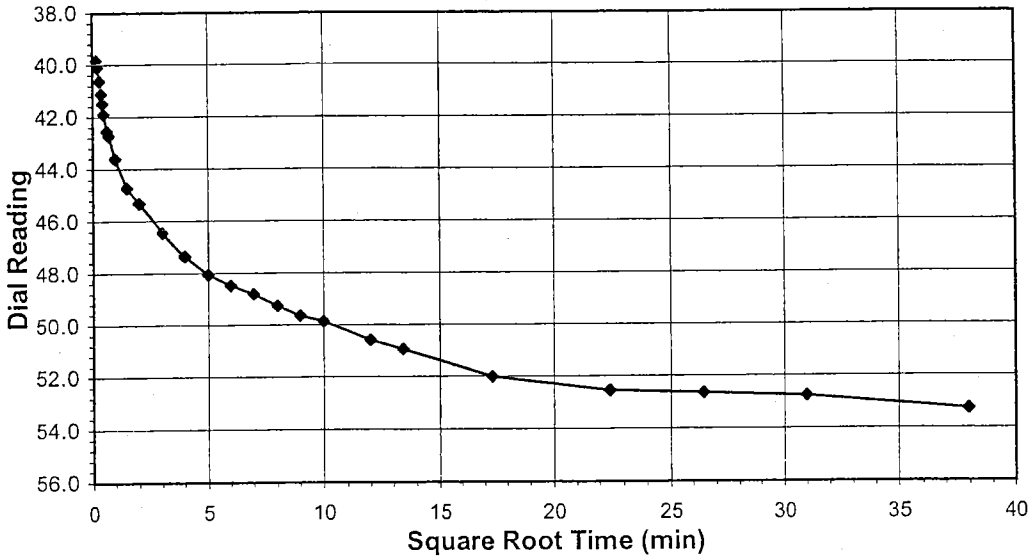
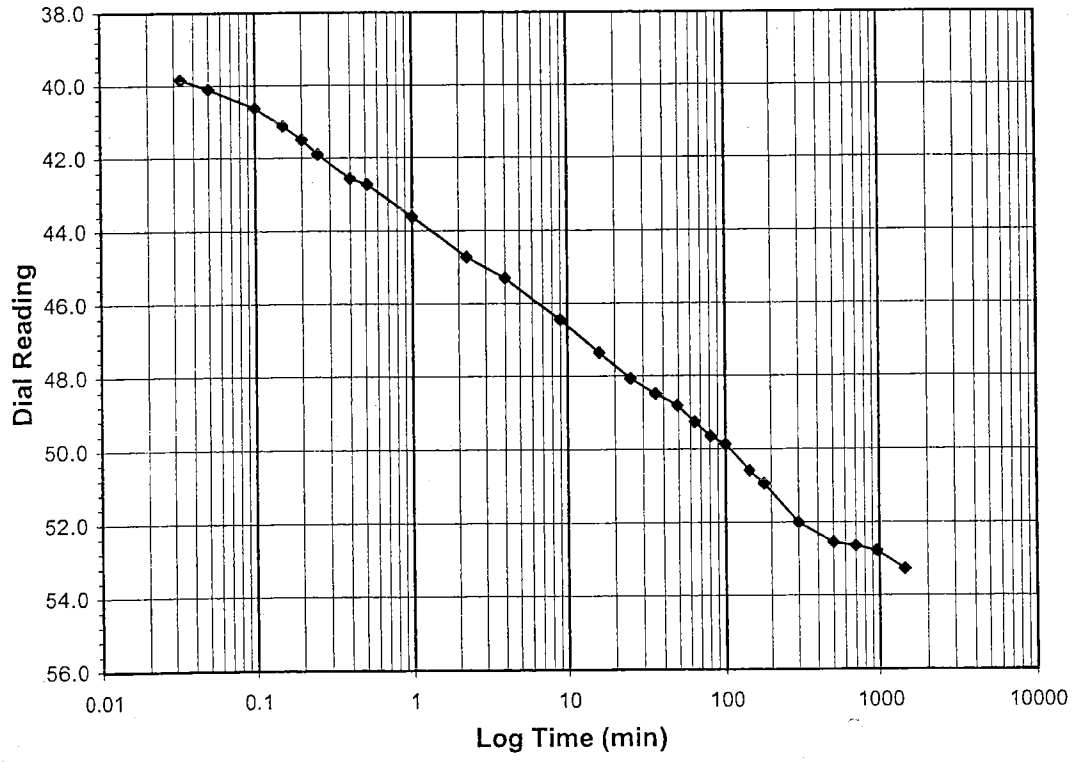
ASTM D 2435-04 / AASHTO T216-03 (SOP-S24)

Client	CEC	Boring No.	NA
Client Project	APEX SANITARY L.F. 072-002	Depth (ft)	NA
Project No.	2008-026-33	Sample No.	SR-2
Lab ID	2008-026-33-06	Visual Description	GRAY CLAY *(-#4 MATERIAL)*

Sample Conditions: REMOLDED, INUNDATED AND DOUBLE DRAINED

NOTE: 0.75 TSF WAS APPLIED TO STOP SWELL.
THIS IS NOT INCLUDED IN THE LOADING INCREMENTS.





Test Load	**(tsf)**	**0.5-1.0**
Final Reading	**(div)**	**53.3**
Consolidometer No.		4
1 Division	(in)	0.0001
Start Date		10/22/08
Start Time		7:31:33

Elapsed Time (min)	Dial Reading (div)
Initial	**28.7**
0.03	39.8
0.05	40.1
0.10	40.6
0.15	41.1
0.20	41.5
0.25	41.9
0.40	42.6
0.52	42.7
1.00	43.6
2.25	44.7
4.00	45.3
9.00	46.5
16.00	47.4
25.00	48.1
36.00	48.5
49.00	48.8
64.00	49.3
81.00	49.7
100.00	49.9
144.00	50.6
180.00	50.9
300.00	52.0
502.88	52.6
700.00	52.7
960.00	52.8
1440.00	53.3

Tested By TM *Date* 10/22/08 *Checked By* GU *Date* 11-3-08

DCN: CT-24E Date: 3/2/98 Revision: 2

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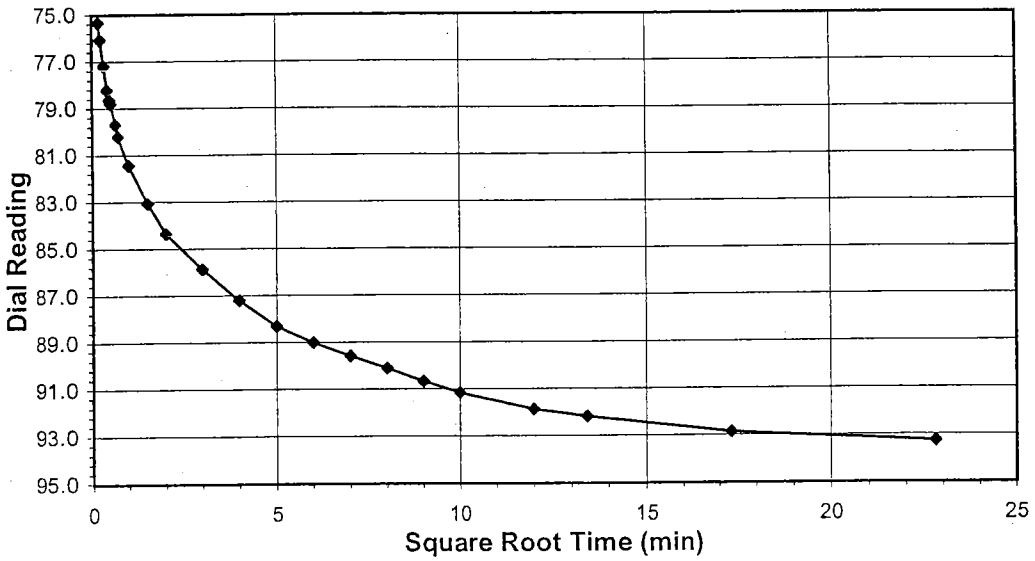
ONE DIMENSIONAL CONSOLIDATION

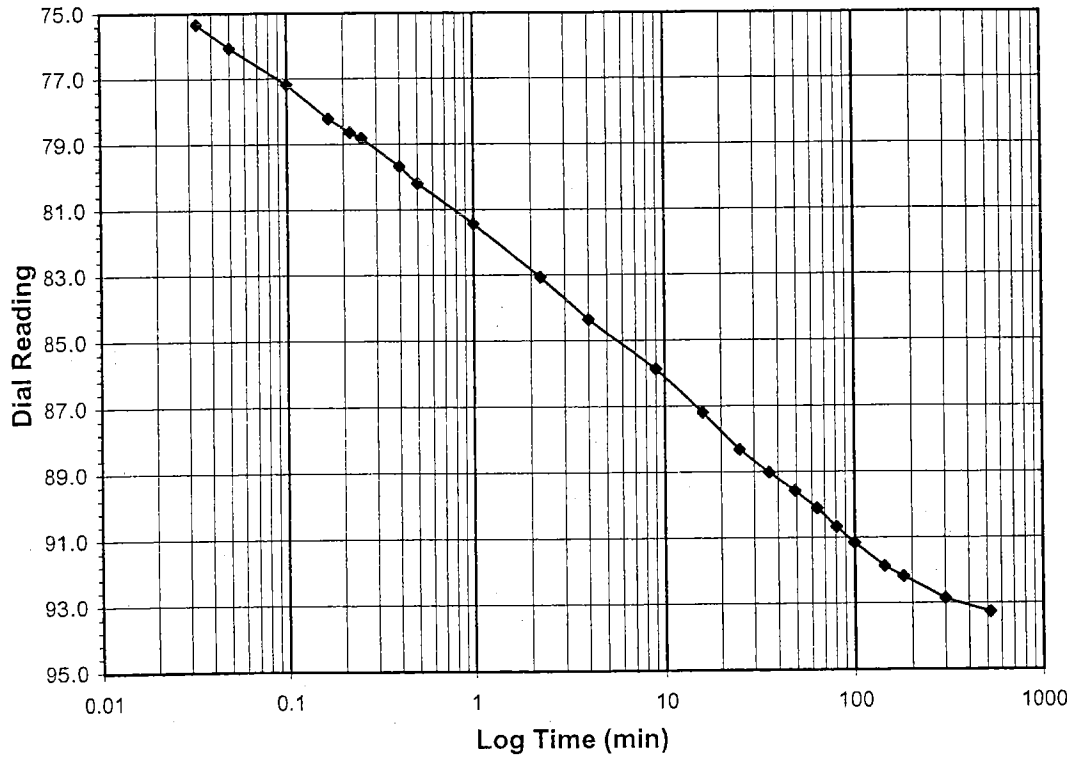
ASTM D 2435-04 / AASHTO T216-03 (SOP-S24)

Client	CEC	Boring No.	NA
Client Project	APEX SANITARY L.F. 072-002	Depth (ft)	NA
Project No.	2008-026-33	Sample No.	SR-2
Lab ID	2008-026-33-06	Visual Description	GRAY CLAY *(-#4 MATERIAL)*

Sample Conditions: REMOLDED, INUNDATED AND DOUBLE DRAINED

NOTE: 0.75 TSF WAS APPLIED TO STOP SWELL.
THIS IS NOT INCLUDED IN THE LOADING INCREMENTS.





Test Load	**(tsf)**	**1.0-2.0**
Final Reading	**(div)**	**93.3**
Consolidometer No.		4
1 Division	(in)	0.0001
Start Date		10/23/08
Start Time		7:38:02

Elapsed Time (min)	Dial Reading (div)
Initial	**53.3**
0.03	75.3
0.05	76.1
0.10	77.2
0.17	78.2
0.22	78.7
0.25	78.8
0.40	79.7
0.50	80.2
1.00	81.4
2.25	83.1
4.00	84.4
9.00	85.9
16.00	87.2
25.00	88.3
36.00	89.0
49.00	89.6
64.00	90.1
81.00	90.7
100.00	91.2
144.02	91.9
180.00	92.2
300.00	92.9
519.90	93.3

Tested By TM *Date* 10/23/08 *Checked By* GU *Date* 11-3-08

DCN: CT-24E Date: 3/2/98 Revision: 2

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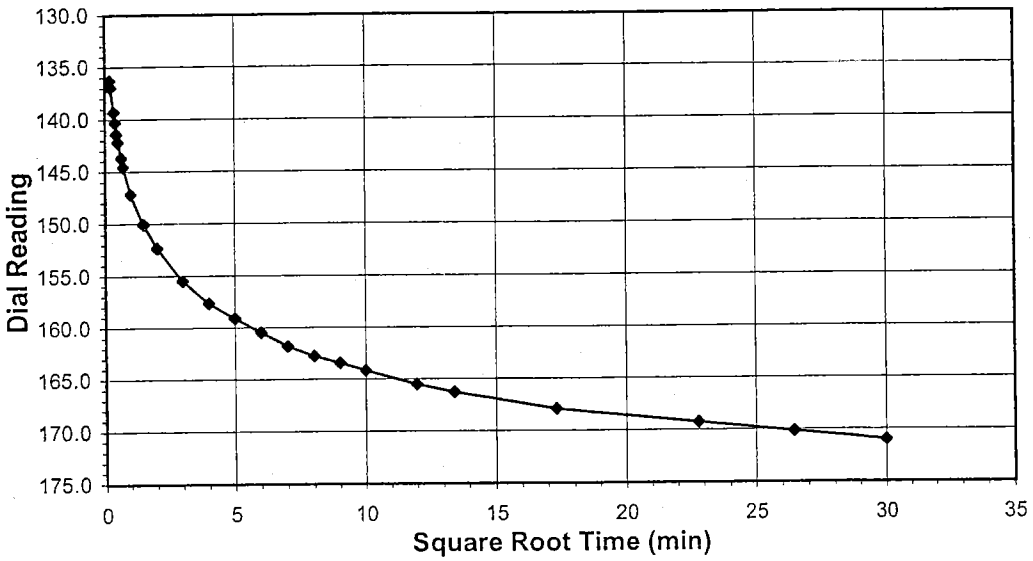
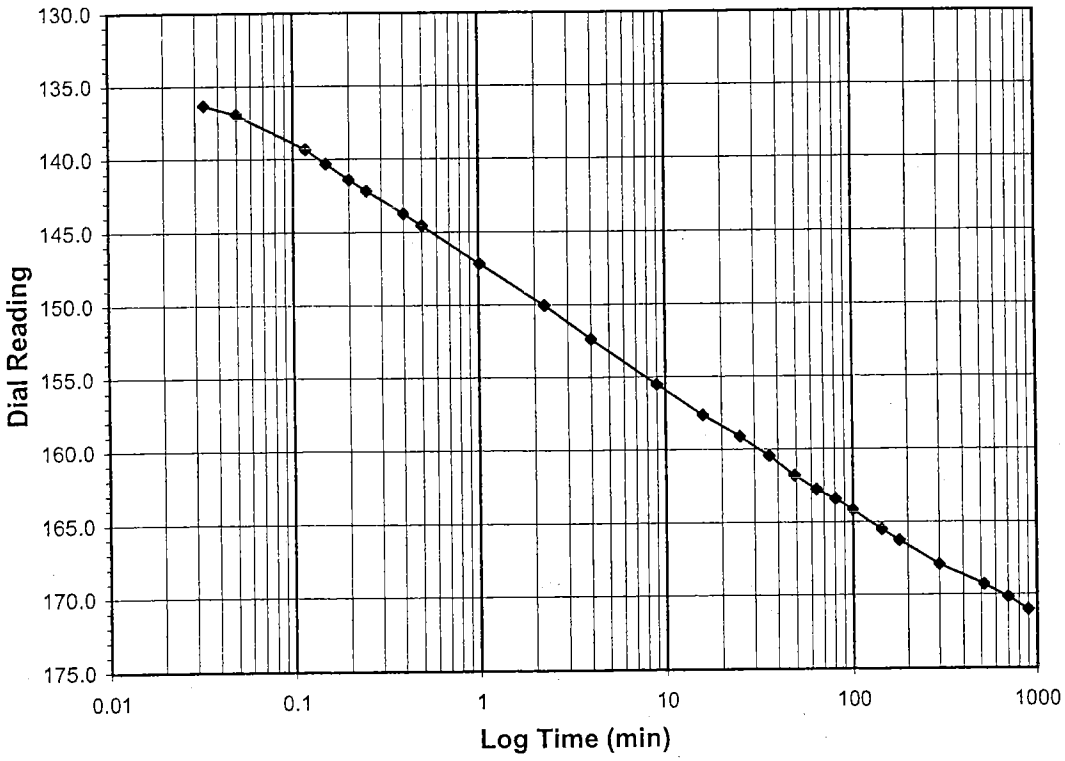
ASTM D 2435-04 / AASHTO T216-03 (SOP-S24)

Client	CEC	Boring No.	NA
Client Project	APEX SANITARY L.F. 072-002	Depth (ft)	NA
Project No.	2008-026-33	Sample No.	SR-2
Lab ID	2008-026-33-06	Visual Description	GRAY CLAY *(-#4 MATERIAL)*

Sample Conditions: REMOLDED, INUNDATED AND DOUBLE DRAINED

NOTE: 0.75 TSF WAS APPLIED TO STOP SWELL. THIS IS NOT INCLUDED IN THE LOADING INCREMENTS.





Test Load	**(tsf)**	**2.0-4.0**
Final Reading	**(div)**	**171.0**
Consolidometer No.		4
1 Division	(in)	0.0001
Start Date		10/23/08
Start Time		16:26:13

Elapsed Time (min)	Dial Reading (div)
Initial	**93.3**
0.03	136.3
0.05	137.0
0.12	139.3
0.15	140.3
0.20	141.4
0.25	142.2
0.40	143.7
0.50	144.6
1.02	147.2
2.25	150.1
4.00	152.4
9.00	155.5
16.00	157.6
25.00	159.1
36.02	160.5
49.02	161.8
64.00	162.8
81.00	163.4
100.00	164.2
144.00	165.5
180.00	166.3
300.00	167.9
520.02	169.3
700.00	170.2
900.00	171.0

Tested By TM *Date* 10/23/08 *Checked By* GU *Date* 11-3-08

DCN: CT-24E Date: 3/2/98 Revision: 2

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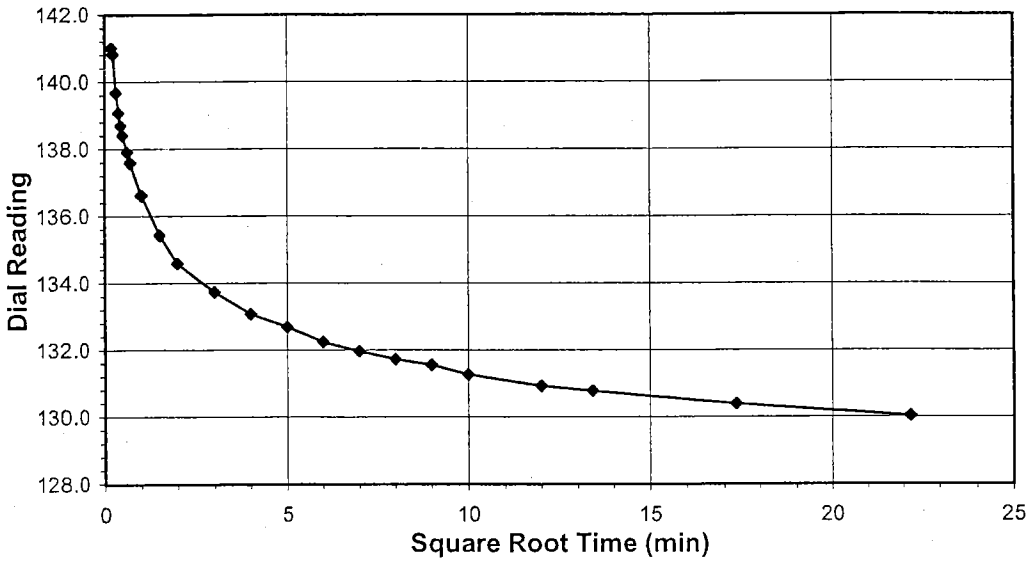
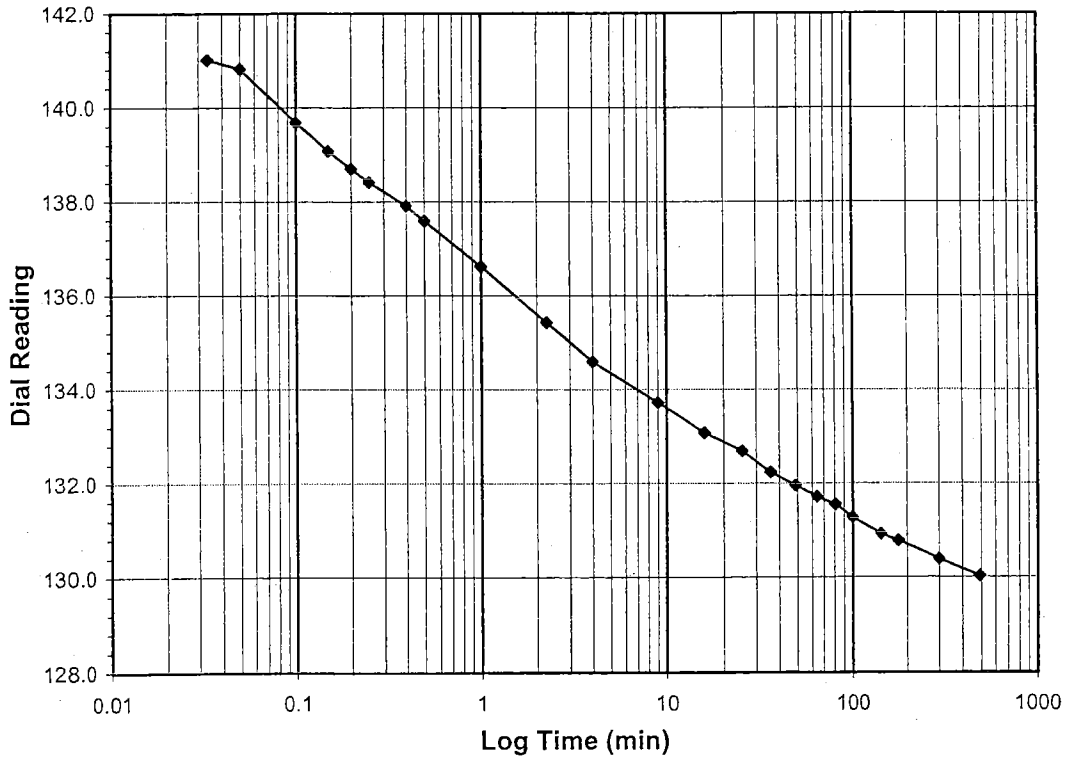
ASTM D 2435-04 / AASHTO T216-03 (SOP-S24)

Client	CEC	Boring No.	NA
Client Project	APEX SANITARY L.F. 072-002	Depth (ft)	NA
Project No.	2008-026-33	Sample No.	SR-2
Lab ID	2008-026-33-06	Visual Description	GRAY CLAY *(-#4 MATERIAL)*

Sample Conditions: REMOLDED, INUNDATED AND DOUBLE DRAINED

NOTE: 0.75 TSF WAS APPLIED TO STOP SWELL.
THIS IS NOT INCLUDED IN THE LOADING INCREMENTS.





Test Load	**(tsf)**	**4.0-1.0**
Final Reading	**(div)**	**130.0**
Consolidometer No.		4
1 Division	(in)	0.0001
Start Date		10/24/08
Start Time		7:23:03

Elapsed Time (min)	Dial Reading (div)
Initial	**171.0**
0.03	141.0
0.05	140.8
0.10	139.7
0.15	139.1
0.20	138.7
0.25	138.4
0.40	137.9
0.50	137.6
1.00	136.6
2.25	135.4
4.00	134.6
9.00	133.7
16.00	133.1
25.00	132.7
36.00	132.2
49.00	132.0
64.00	131.7
81.00	131.6
100.00	131.3
144.00	130.9
180.00	130.8
300.00	130.4
492.45	130.0

Tested By TM *Date* 10/24/08 *Checked By* GU *Date* 11-3-08

DCN: CT-24E Date: 3/2/98 Revision: 2

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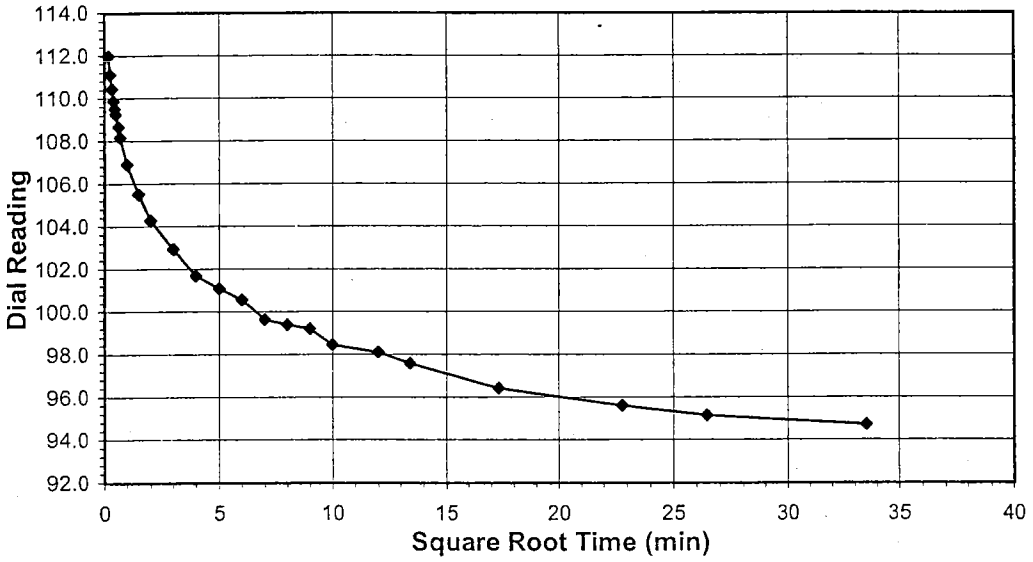
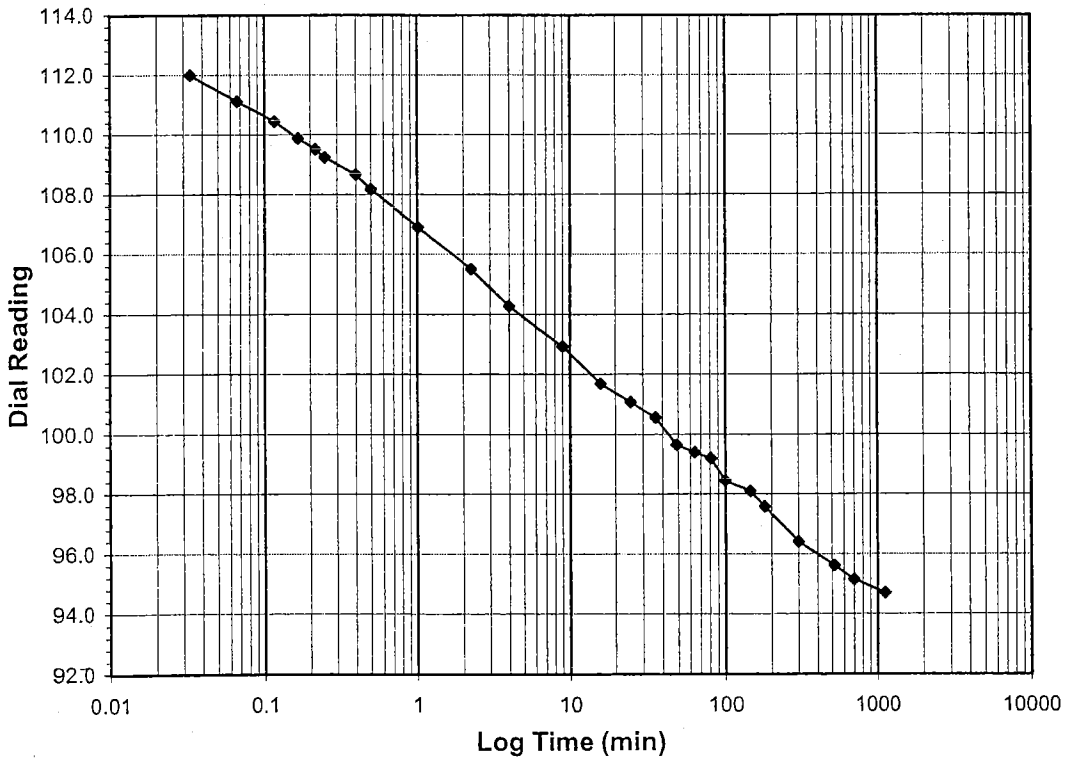
ASTM D 2435-04 / AASHTO T216-03 (SOP-S24)

Client	CEC	Boring No.	NA
Client Project	APEX SANITARY L.F. 072-002	Depth (ft)	NA
Project No.	2008-026-33	Sample No.	SR-2
Lab ID	2008-026-33-06	Visual Description	GRAY CLAY *(-#4 MATERIAL)*

Sample Conditions: REMOLDED, INUNDATED AND DOUBLE DRAINED

NOTE: 0.75 TSF WAS APPLIED TO STOP SWELL.
THIS IS NOT INCLUDED IN THE LOADING INCREMENTS.





Test Load	**(tsf)**	**1.0-0.25**
Final Reading	**(div)**	**94.7**
Consolidometer No.		4
1 Division	(in)	0.0001
Start Date		10/24/08
Start Time		15:38:58

Elapsed Time (min)	Dial Reading (div)
Initial	**130.0**
0.03	112.0
0.07	111.1
0.12	110.4
0.17	109.9
0.22	109.5
0.25	109.2
0.40	108.7
0.50	108.2
1.02	106.9
2.25	105.5
4.00	104.3
9.00	102.9
16.00	101.7
25.00	101.1
36.00	100.6
49.00	99.6
64.00	99.4
81.00	99.2
100.00	98.5
144.00	98.1
180.00	97.6
300.00	96.4
520.00	95.6
700.00	95.2
1124.27	94.7

Tested By TM *Date* 10/24/08 *Checked By* GU *Date* 11-3-08

DCN: CT-24E Date: 3/2/98 Revision: 2

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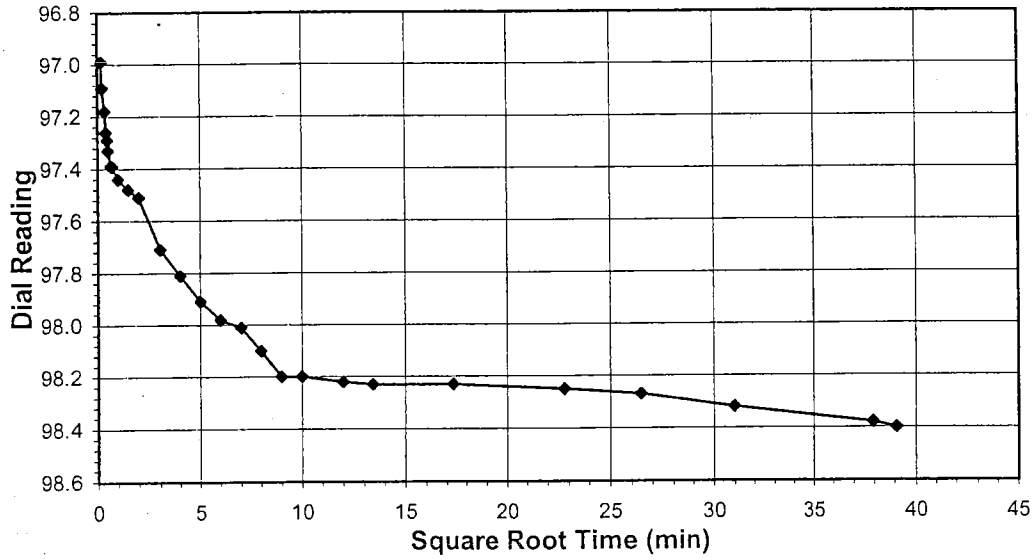
ONE DIMENSIONAL CONSOLIDATION

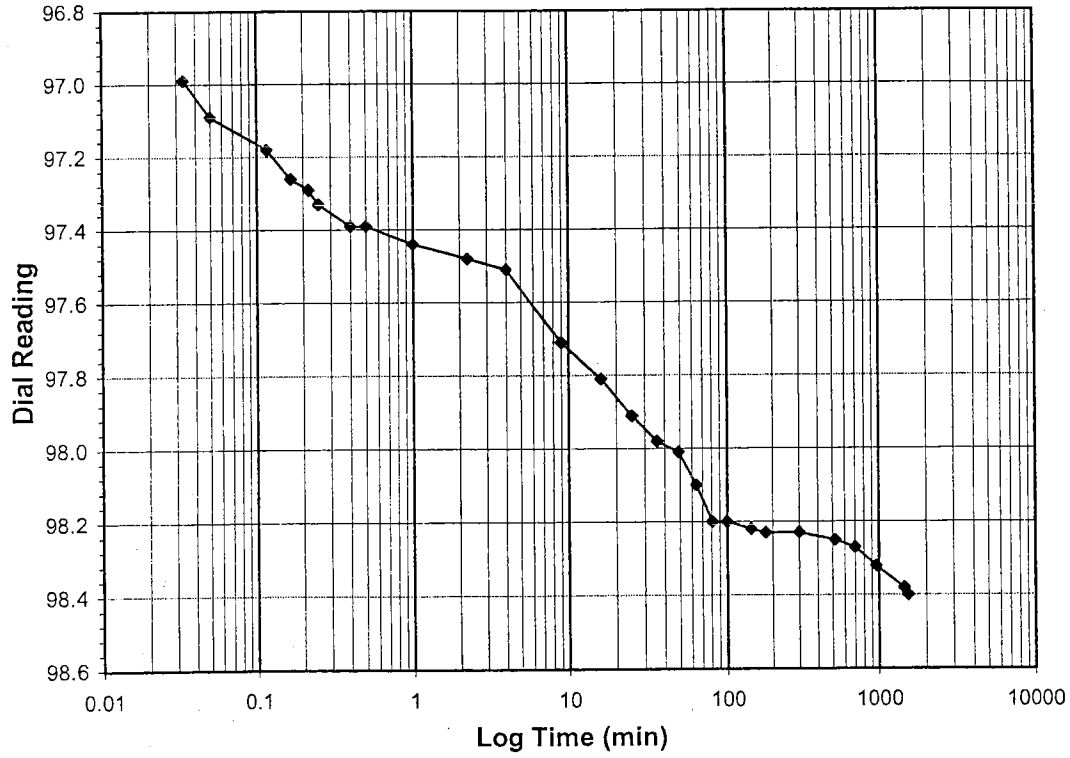
ASTM D 2435-04 / AASHTO T216-03 (SOP-S24)

Client	CEC	Boring No.	NA
Client Project	APEX SANITARY L.F. 072-002	Depth (ft)	NA
Project No.	2008-026-33	Sample No.	SR-2
Lab ID	2008-026-33-06	Visual Description	GRAY CLAY *(-#4 MATERIAL)*

Sample Conditions: REMOLDED, INUNDATED AND DOUBLE DRAINED

NOTE: 0.75 TSF WAS APPLIED TO STOP SWELL.
THIS IS NOT INCLUDED IN THE LOADING INCREMENTS.





Test Load	**(tsf)**	**0.25-0.5**
Final Reading	**(div)**	**98.4**
Consolidometer No.		4
1 Division	(in)	0.0001
Start Date		10/25/08
Start Time		10:25:48

Elapsed Time (min)	Dial Reading (div)
Initial	**94.7**
0.03	97.0
0.05	97.1
0.12	97.2
0.17	97.3
0.22	97.3
0.25	97.3
0.40	97.4
0.50	97.4
1.00	97.4
2.25	97.5
4.00	97.5
9.00	97.7
16.00	97.8
25.00	97.9
36.00	98.0
49.00	98.0
64.00	98.1
81.00	98.2
100.00	98.2
144.00	98.2
180.00	98.2
300.00	98.2
520.00	98.3
700.00	98.3
960.00	98.3
1440.00	98.4
1528.95	98.4

Tested By TM *Date* 10/25/08 *Checked By* CJ *Date* 11-3-08

DCN: CT-24E Date: 3/2/98 Revision: 2

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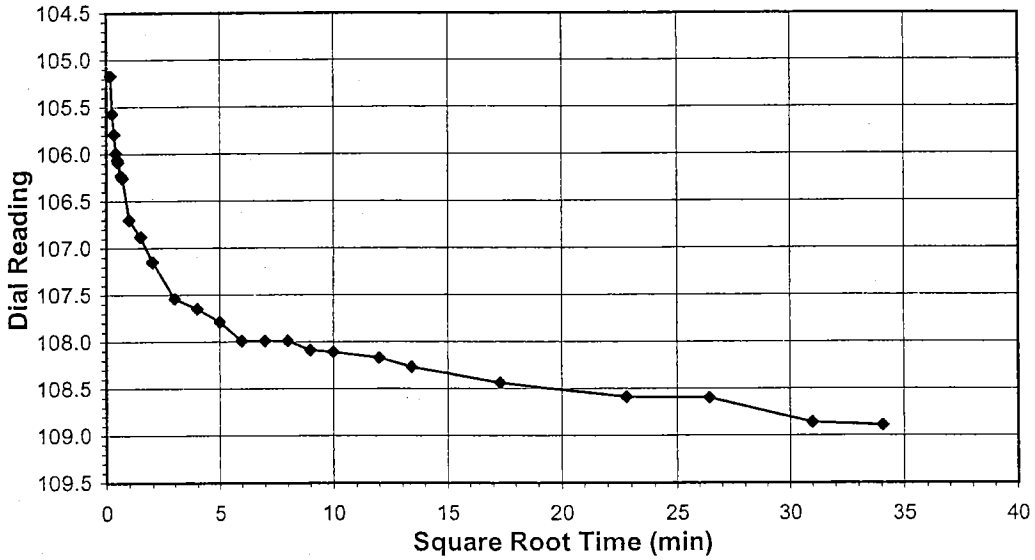
ONE DIMENSIONAL CONSOLIDATION

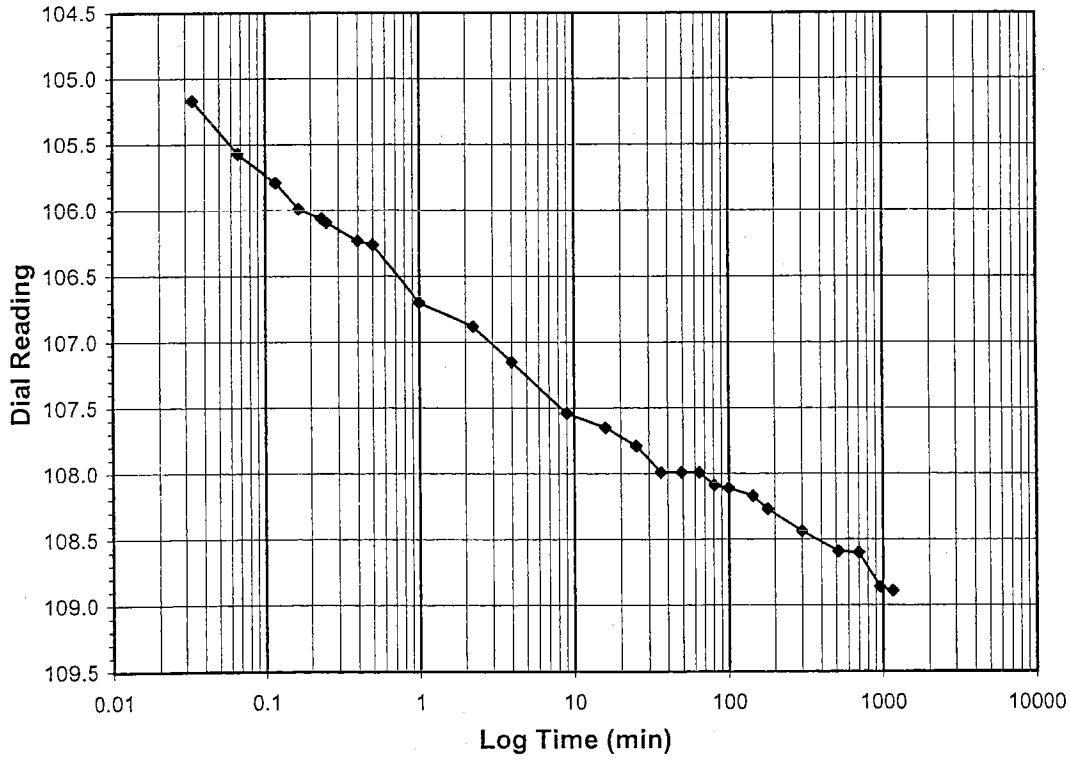
ASTM D 2435-04 / AASHTO T216-03 (SOP-S24)

Client	CEC	Boring No.	NA
Client Project	APEX SANITARY L.F. 072-002	Depth (ft)	NA
Project No.	2008-026-33	Sample No.	SR-2
Lab ID	2008-026-33-06	Visual Description	GRAY CLAY *(-#4 MATERIAL)*

Sample Conditions: REMOLDED, INUNDATED AND DOUBLE DRAINED

NOTE: 0.75 TSF WAS APPLIED TO STOP SWELL.
THIS IS NOT INCLUDED IN THE LOADING INCREMENTS.





Test Load (tsf)	**0.5-1.0**
Final Reading (div)	**108.9**
Consolidometer No.	4
1 Division (in)	0.0001
Start Date	10/26/08
Start Time	11:56:26

Elapsed Time (min)	Dial Reading (div)
Initial	**98.4**
0.03	105.2
0.07	105.6
0.12	105.8
0.17	106.0
0.23	106.1
0.25	106.1
0.40	106.2
0.50	106.3
1.00	106.7
2.25	106.9
4.00	107.2
9.02	107.5
16.00	107.7
25.00	107.8
36.00	108.0
49.00	108.0
64.00	108.0
81.00	108.1
100.02	108.1
144.00	108.2
180.00	108.3
300.00	108.4
520.00	108.6
700.00	108.6
960.00	108.9
1160.00	108.9

Tested By TM *Date* 10/26/08 *Checked By* GU *Date* 11-3-08

DCN: CT-24E Date: 3/2/98 Revision: 2

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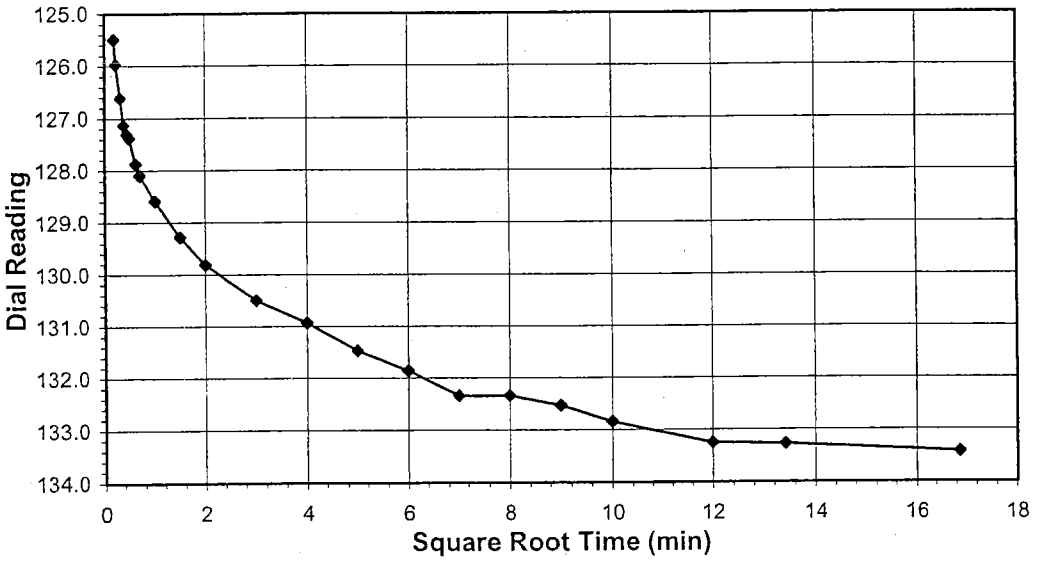
ONE DIMENSIONAL CONSOLIDATION

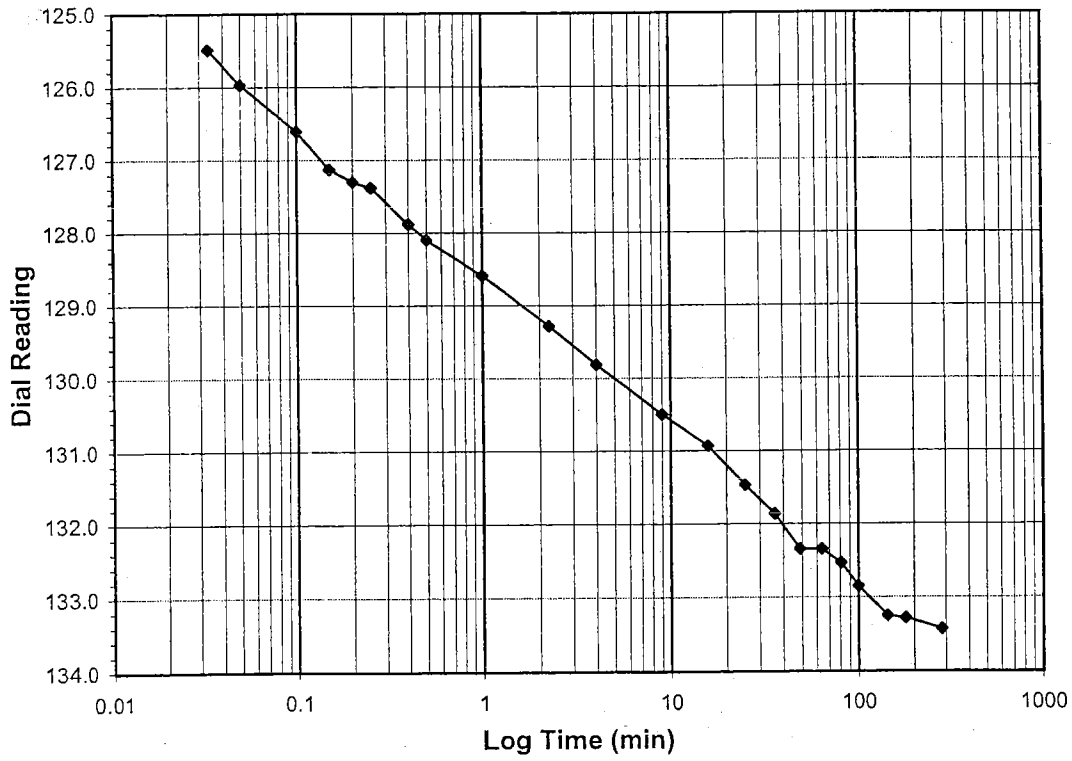
ASTM D 2435-04 / AASHTO T216-03 (SOP-S24)

Client	CEC	Boring No.	NA
Client Project	APEX SANITARY L.F. 072-002	Depth (ft)	NA
Project No.	2008-026-33	Sample No.	SR-2
Lab ID	2008-026-33-06	Visual Description	GRAY CLAY *(-#4 MATERIAL)*

Sample Conditions: REMOLDED, INUNDATED AND DOUBLE DRAINED

NOTE: 0.75 TSF WAS APPLIED TO STOP SWELL.
THIS IS NOT INCLUDED IN THE LOADING INCREMENTS.





Test Load (tsf)	**1.0-2.0**
Final Reading (div)	**133.4**
Consolidometer No.	4
1 Division (in)	0.0001
Start Date	10/27/08
Start Time	7:21:45

Elapsed Time (min)	Dial Reading (div)
Initial	**108.9**
0.03	125.5
0.05	126.0
0.10	126.6
0.15	127.1
0.20	127.3
0.25	127.4
0.40	127.9
0.50	128.1
1.00	128.6
2.25	129.3
4.00	129.8
9.00	130.5
16.00	130.9
25.00	131.5
36.00	131.9
49.00	132.3
64.00	132.3
81.02	132.5
100.00	132.9
144.00	133.3
180.00	133.3
284.95	133.4

Tested By TM *Date* 10/27/08 *Checked By* CJ *Date* 11-3-08

DCN: CT-24E Date: 3/2/98 Revision: 2

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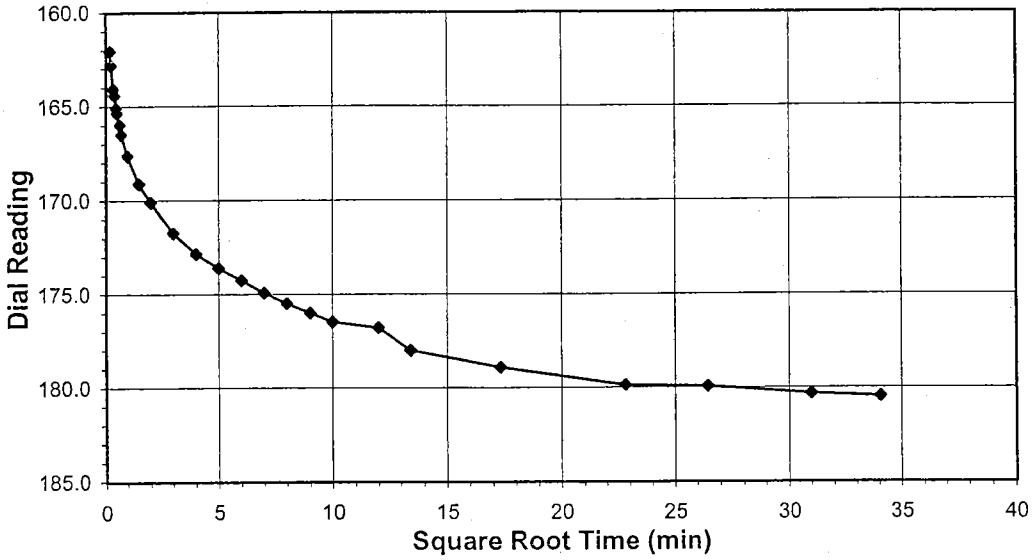
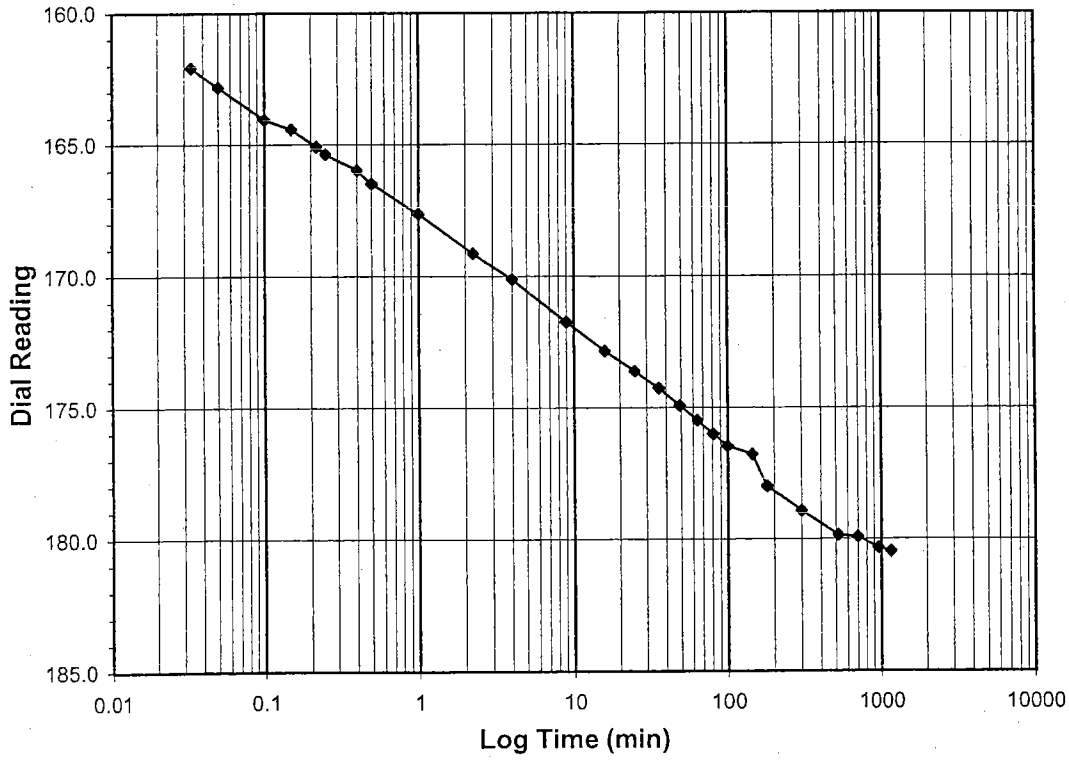
ASTM D 2435-04 / AASHTO T216-03 (SOP-S24)

Client	CEC	Boring No.	NA
Client Project	APEX SANITARY L.F. 072-002	Depth (ft)	NA
Project No.	2008-026-33	Sample No.	SR-2
Lab ID	2008-026-33-06	Visual Description	GRAY CLAY *(-#4 MATERIAL)*

Sample Conditions: REMOLDED, INUNDATED AND DOUBLE DRAINED

NOTE: 0.75 TSF WAS APPLIED TO STOP SWELL.
THIS IS NOT INCLUDED IN THE LOADING INCREMENTS.





Test Load (tsf)	**2.0-4.0**
Final Reading (div)	**180.5**
Consolidometer No.	4
1 Division (in)	0.0001
Start Date	10/27/08
Start Time	12:08:23

Elapsed Time (min)	Dial Reading (div)
Initial	**133.4**
0.03	162.1
0.05	162.8
0.10	164.1
0.15	164.4
0.22	165.1
0.25	165.4
0.40	166.0
0.50	166.5
1.00	167.6
2.25	169.1
4.00	170.1
9.00	171.7
16.00	172.8
25.00	173.6
36.00	174.3
49.00	174.9
64.00	175.5
81.00	176.0
100.00	176.5
144.00	176.8
180.00	178.0
300.00	178.9
520.00	179.9
700.00	179.9
960.00	180.3
1160.00	180.5

Tested By TM *Date* 10/27/08 *Checked By* GU *Date* 11-3-08

DCN: CT-24E Date: 3/2/98 Revision: 2

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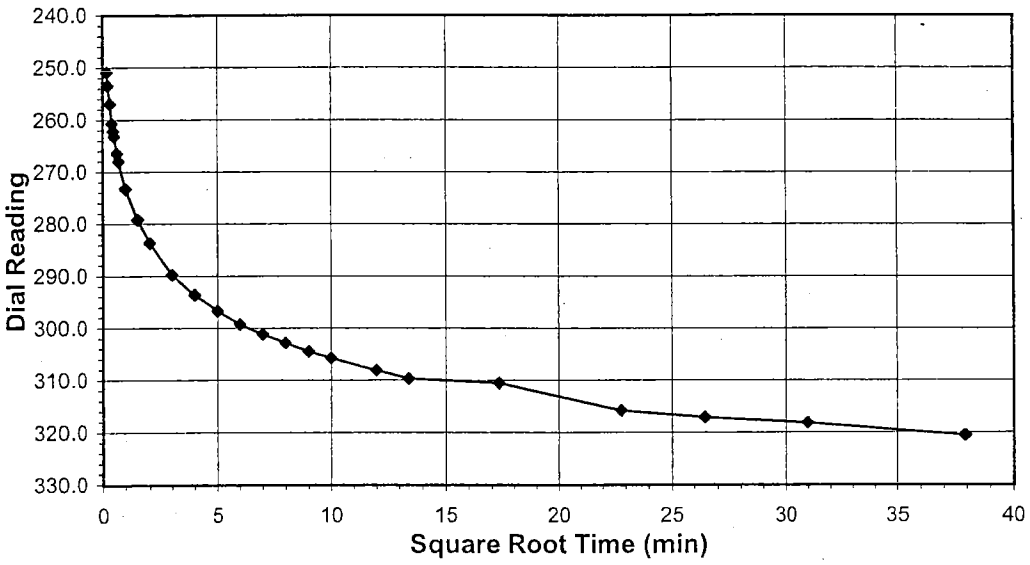
ONE DIMENSIONAL CONSOLIDATION

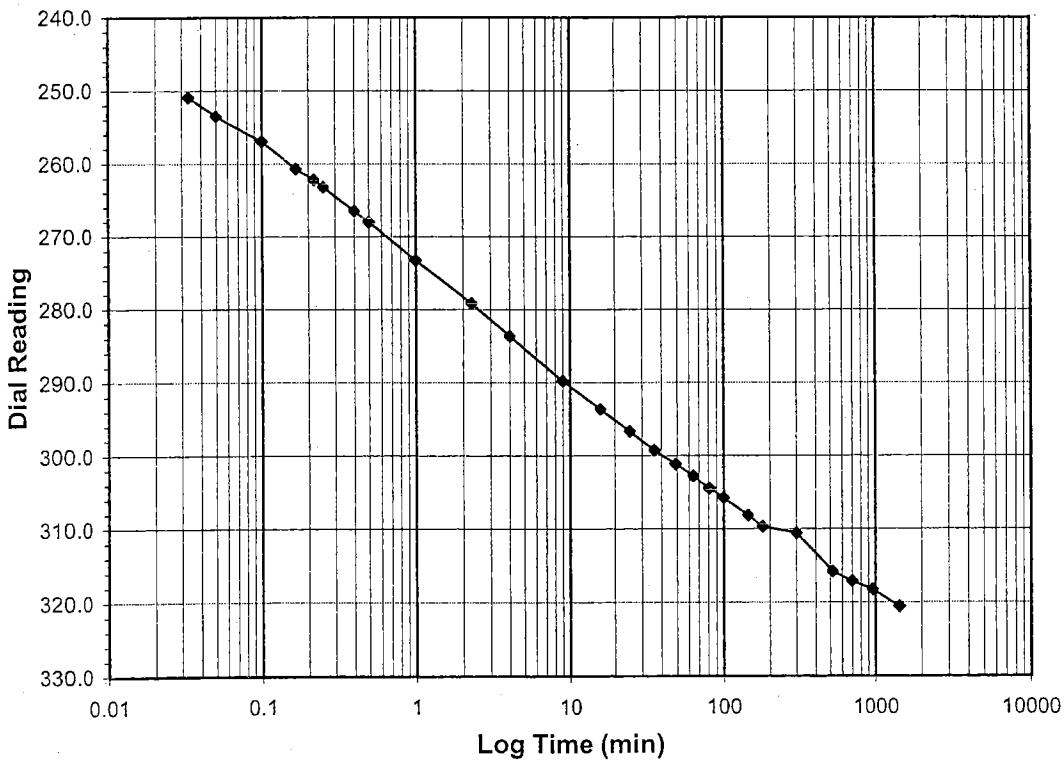
ASTM D 2435-04 / AASHTO T216-03 (SOP-S24)

Client	CEC	Boring No.	NA
Client Project	APEX SANITARY L.F. 072-002	Depth (ft)	NA
Project No.	2008-026-33	Sample No.	SR-2
Lab ID	2008-026-33-06	Visual Description	GRAY CLAY *(-#4 MATERIAL)*

Sample Conditions: REMOLDED, INUNDATED AND DOUBLE DRAINED

NOTE: 0.75 TSF WAS APPLIED TO STOP SWELL.
THIS IS NOT INCLUDED IN THE LOADING INCREMENTS.





Test Load	**(tsf)**	**4.0-8.0**
Final Reading	**(div)**	**320.6**
Consolidometer No.		4
1 Division	(in)	0.0001
Start Date		10/28/08
Start Time		7:31:40

Elapsed Time (min)	Dial Reading (div)
Initial	**180.5**
0.03	250.9
0.05	253.5
0.10	257.0
0.17	260.7
0.22	262.2
0.25	263.2
0.40	266.4
0.50	268.0
1.00	273.3
2.27	279.2
4.00	283.7
9.00	289.8
16.00	293.6
25.00	296.7
36.00	299.3
49.00	301.2
64.00	302.8
81.00	304.5
100.00	305.7
144.00	308.1
180.02	309.7
300.00	310.6
520.00	315.8
700.00	317.1
960.00	318.2
1440.00	320.6

Tested By TM *Date* 10/28/08 *Checked By* GU *Date* 11-3-08

DCN: CT-24E Date: 3/2/98 Revision: 2

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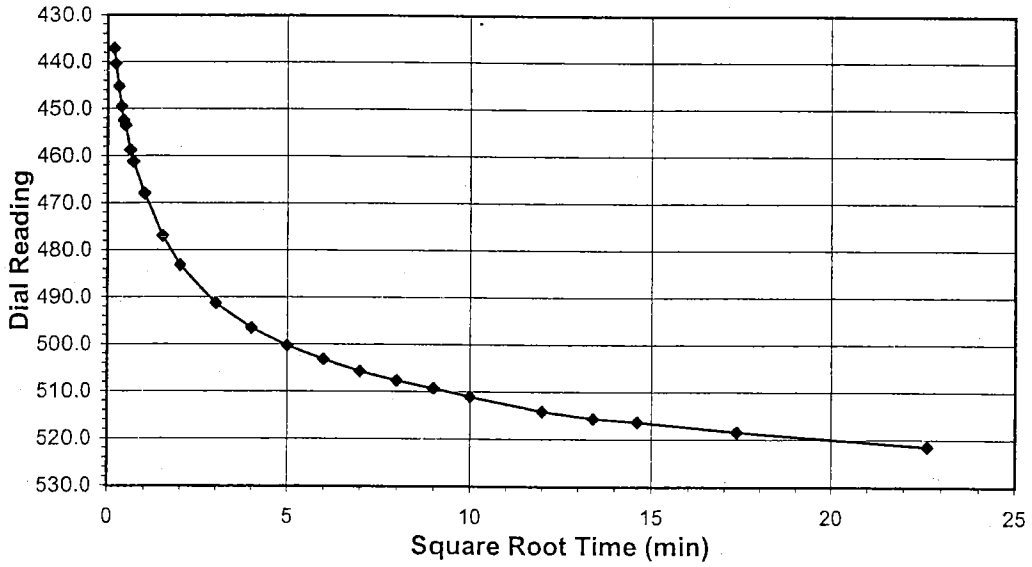
ONE DIMENSIONAL CONSOLIDATION

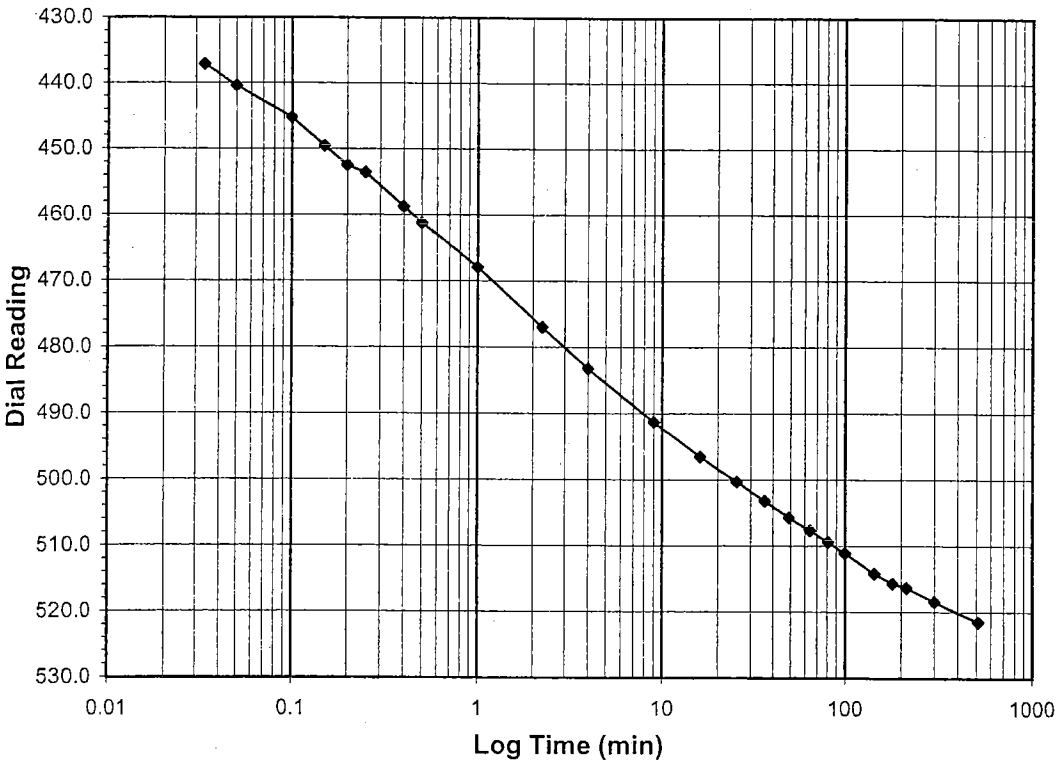
ASTM D 2435-04 / AASHTO T216-03 (SOP-S24)

Client	CEC	Boring No.	NA
Client Project	APEX SANITARY L.F. 072-002	Depth (ft)	NA
Project No.	2008-026-33	Sample No.	SR-2
Lab ID	2008-026-33-06	Visual Description	GRAY CLAY *(-#4 MATERIAL)*

Sample Conditions: REMOLDED, INUNDATED AND DOUBLE DRAINED

NOTE: 0.75 TSF WAS APPLIED TO STOP SWELL.
THIS IS NOT INCLUDED IN THE LOADING INCREMENTS.





Test Load (tsf)	**8.0-16.0**
Final Reading (div)	**521.5**
Consolidometer No.	4
1 Division (in)	0.0001
Start Date	10/29/08
Start Time	7:51:30

Elapsed Time (min)	Dial Reading (div)
Initial	**320.6**
0.03	437.2
0.05	440.4
0.10	445.2
0.15	449.5
0.20	452.5
0.25	453.6
0.40	458.8
0.50	461.2
1.00	467.9
2.25	477.0
4.00	483.2
9.00	491.3
16.02	496.5
25.00	500.3
36.00	503.2
49.00	505.7
64.00	507.7
81.00	509.4
100.00	511.1
144.00	514.2
180.00	515.7
213.60	516.3
300.00	518.5
511.97	521.5

Tested By TM *Date* 10/29/08 *Checked By* GU *Date* 11-3-08

DCN: CT-24E Date: 3/2/98 Revision: 2

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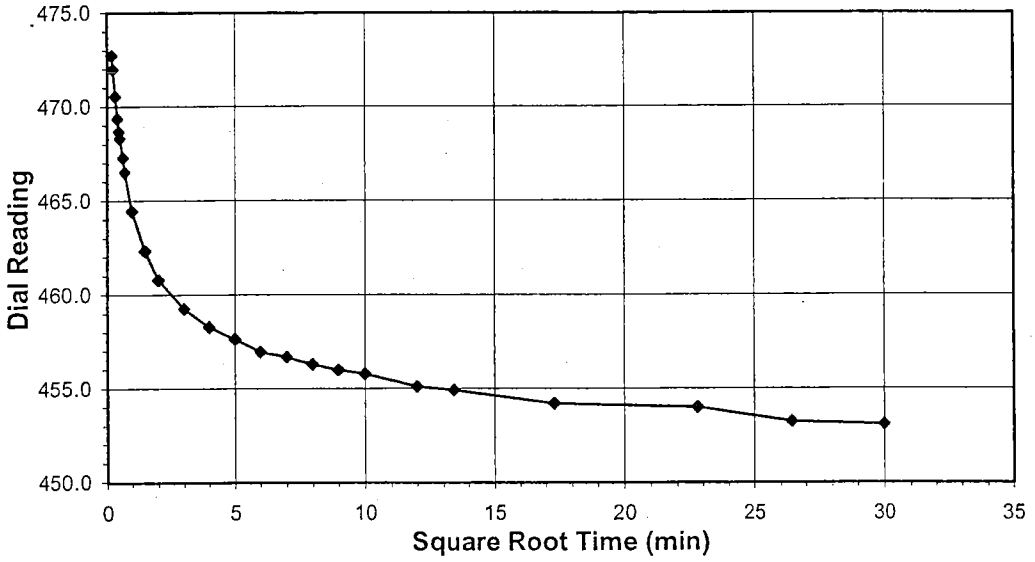
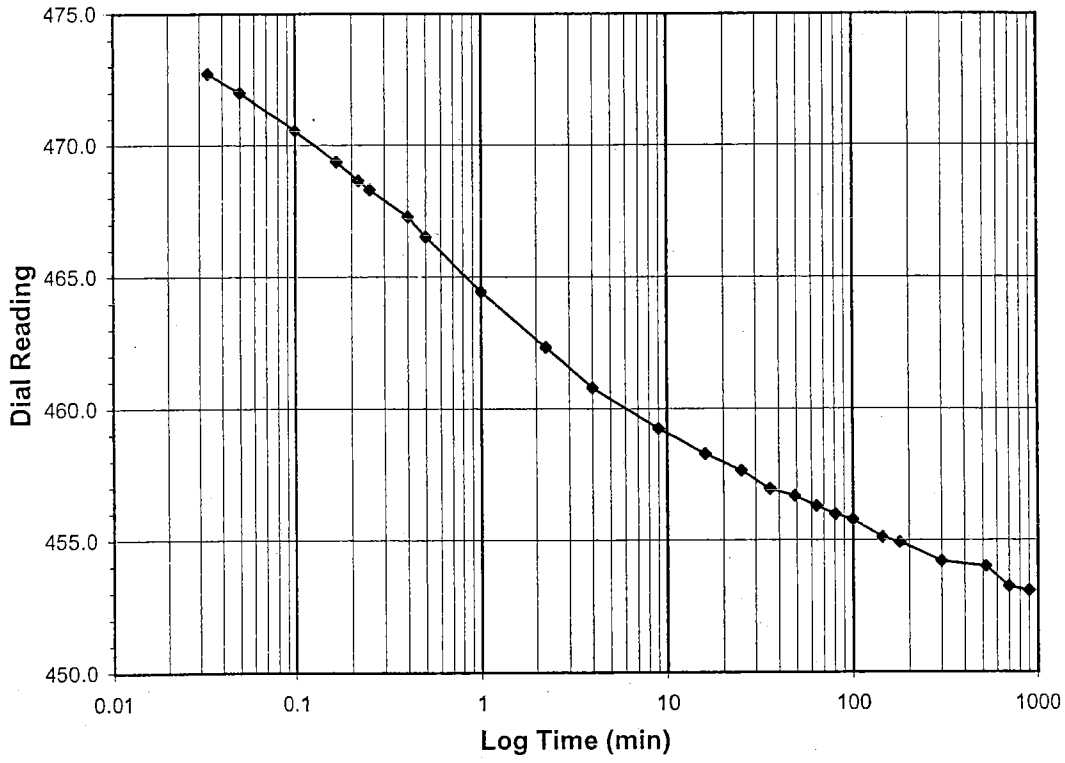
ASTM D 2435-04 / AASHTO T216-03 (SOP-S24)

Client	CEC	Boring No.	NA
Client Project	APEX SANITARY L.F. 072-002	Depth (ft)	NA
Project No.	2008-026-33	Sample No.	SR-2
Lab ID	2008-026-33-06	Visual Description	GRAY CLAY *(-#4 MATERIAL)*

Sample Conditions: REMOLDED, INUNDATED AND DOUBLE DRAINED

NOTE: 0.75 TSF WAS APPLIED TO STOP SWELL.
THIS IS NOT INCLUDED IN THE LOADING INCREMENTS.





Test Load (tsf)	**16.0-4.0**
Final Reading (div)	**453.1**
Consolidometer No.	4
1 Division (in)	0.0001
Start Date	10/29/08
Start Time	16:25:56

Elapsed Time (min)	Dial Reading (div)
Initial	**521.5**
0.03	472.7
0.05	472.0
0.10	470.6
0.17	469.4
0.22	468.7
0.25	468.3
0.40	467.3
0.50	466.5
1.00	464.4
2.25	462.3
4.00	460.8
9.00	459.3
16.00	458.3
25.00	457.6
36.00	457.0
49.00	456.7
64.00	456.3
81.00	456.0
100.00	455.8
144.00	455.1
180.00	454.9
300.02	454.2
520.00	454.0
700.00	453.2
900.00	453.1

Tested By TM *Date* 10/29/08 *Checked By* GU *Date* 11-3-08

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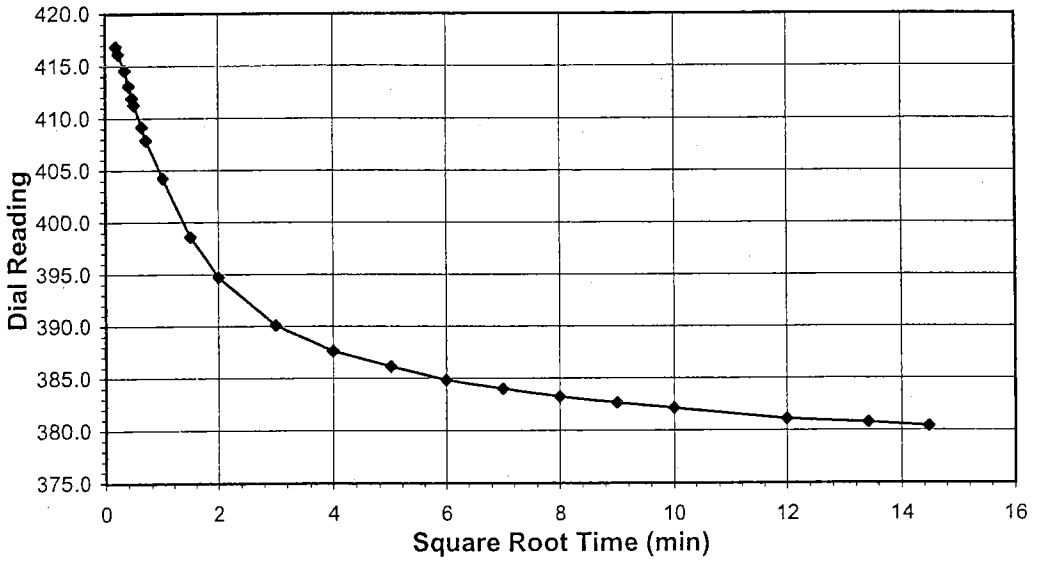
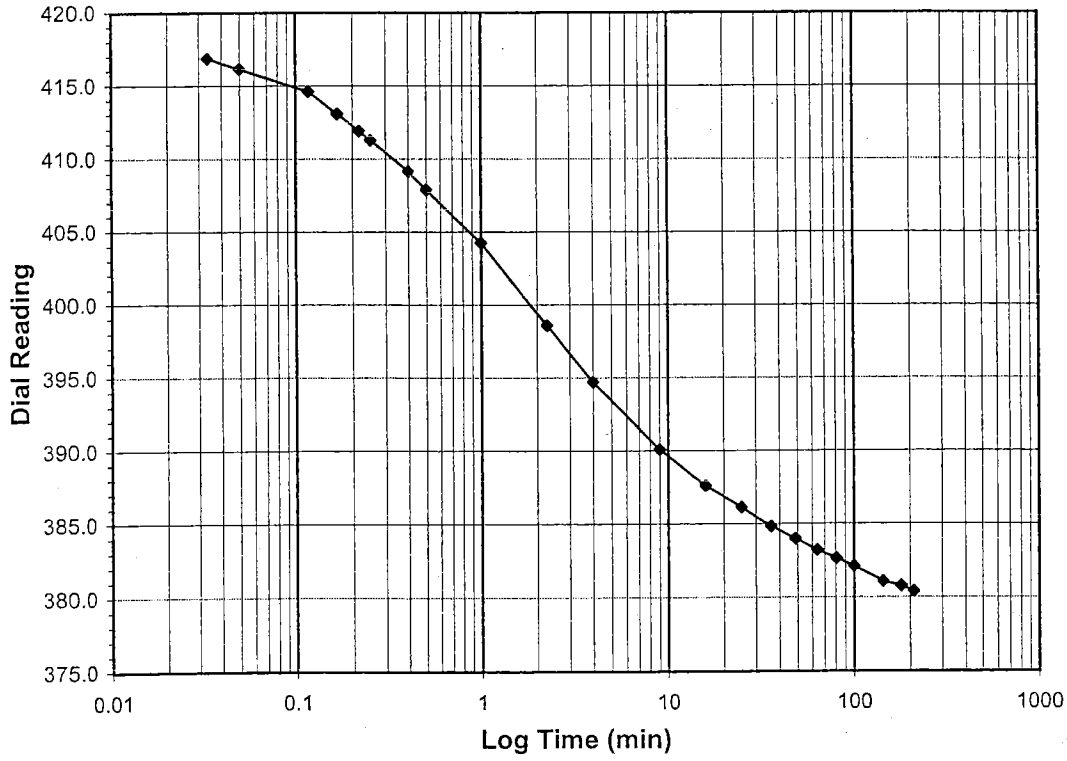
ASTM D 2435-04 / AASHTO T216-03 (SOP-S24)

Client	CEC	Boring No.	NA
Client Project	APEX SANITARY L.F. 072-002	Depth (ft)	NA
Project No.	2008-026-33	Sample No.	SR-2
Lab ID	2008-026-33-06	Visual Description	GRAY CLAY *(-#4 MATERIAL)*

Sample Conditions: REMOLDED, INUNDATED AND DOUBLE DRAINED

NOTE: 0.75 TSF WAS APPLIED TO STOP SWELL.
THIS IS NOT INCLUDED IN THE LOADING INCREMENTS.





Test Load	**(tsf)**	**4.0-1.0**
Final Reading	**(div)**	**380.4**
Consolidometer No.		4
1 Division	(in)	0.0001
Start Date		10/30/08
Start Time		7:24:49

Elapsed Time (min)	Dial Reading (div)
Initial	**453.1**
0.03	416.9
0.05	416.2
0.12	414.6
0.17	413.1
0.22	411.9
0.25	411.3
0.40	409.2
0.50	407.9
1.00	404.3
2.25	398.6
4.00	394.7
9.00	390.1
16.00	387.6
25.00	386.1
36.00	384.8
49.00	384.0
64.00	383.2
81.00	382.7
100.00	382.1
144.00	381.1
180.00	380.8
209.80	380.4

Tested By TM *Date* 10/30/08 *Checked By* GU *Date* 11-3-08

DCN: CT-24E Date: 3/2/98 Revision: 2

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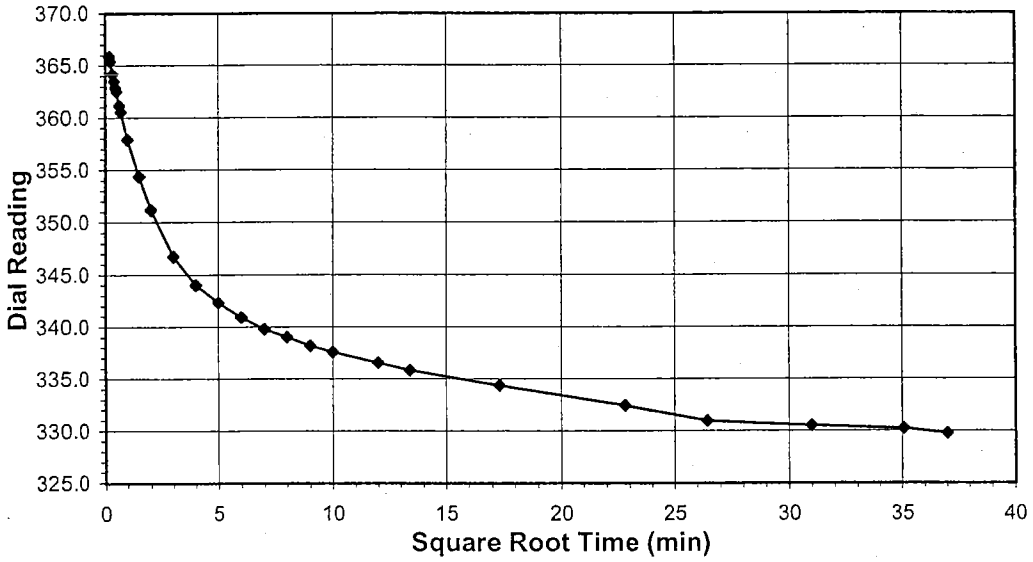
ONE DIMENSIONAL CONSOLIDATION

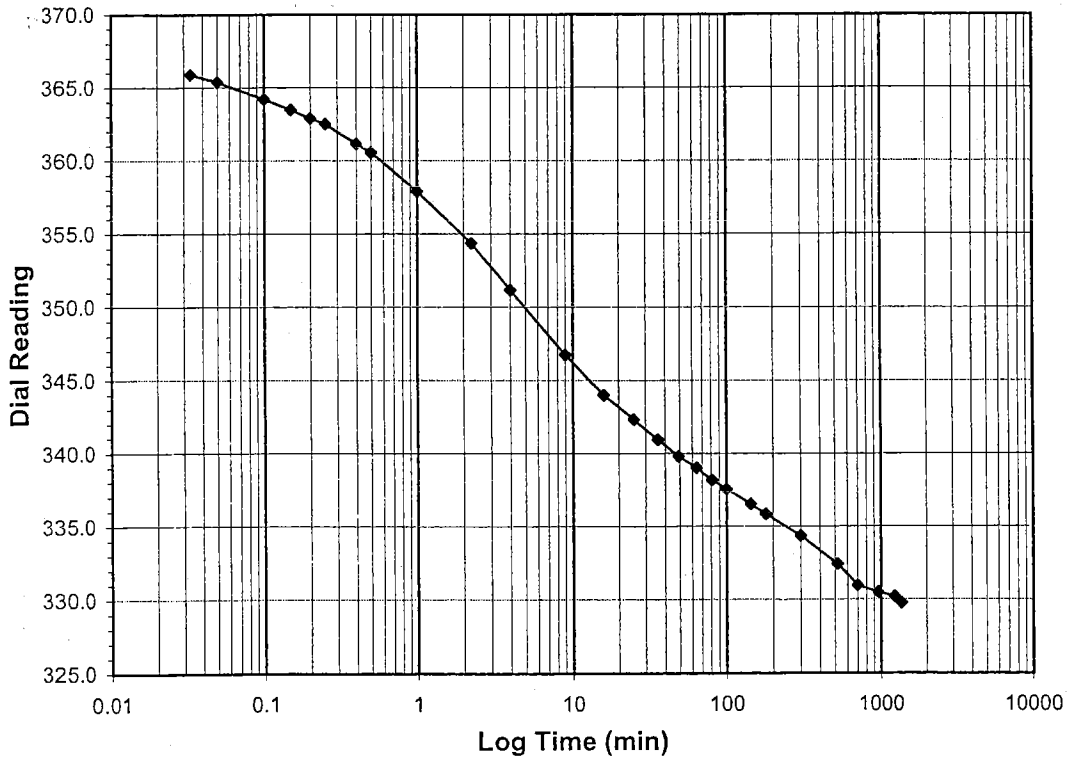
ASTM D 2435-04 / AASHTO T216-03 (SOP-S24)

Client	CEC	Boring No.	NA
Client Project	APEX SANITARY L.F. 072-002	Depth (ft)	NA
Project No.	2008-026-33	Sample No.	SR-2
Lab ID	2008-026-33-06	Visual Description	GRAY CLAY *(-#4 MATERIAL)*

Sample Conditions: REMOLDED, INUNDATED AND DOUBLE DRAINED

NOTE: 0.75 TSF WAS APPLIED TO STOP SWELL.
THIS IS NOT INCLUDED IN THE LOADING INCREMENTS.





Test Load	**(tsf)**	**1.0-0.25**
Final Reading	**(div)**	**329.8**
Consolidometer No.		4
1 Division	(in)	0.0001
Start Date		10/30/08
Start Time		10:55:54

Elapsed Time (min)	Dial Reading (div)
Initial	**380.4**
0.03	365.9
0.05	365.4
0.10	364.2
0.15	363.5
0.20	362.9
0.25	362.5
0.40	361.1
0.50	360.6
1.00	357.9
2.25	354.4
4.00	351.2
9.00	346.7
16.00	344.0
25.00	342.3
36.00	340.9
49.00	339.8
64.00	339.0
81.00	338.2
100.00	337.6
144.00	336.5
180.00	335.9
300.00	334.4
520.00	332.4
700.00	331.0
960.00	330.5
1230.00	330.2
1371.00	329.8

Tested By TM *Date* 10/30/08 *Checked By* GU *Date* 11-3-08

DCN: CT-24E Date: 3/2/98 Revision: 2

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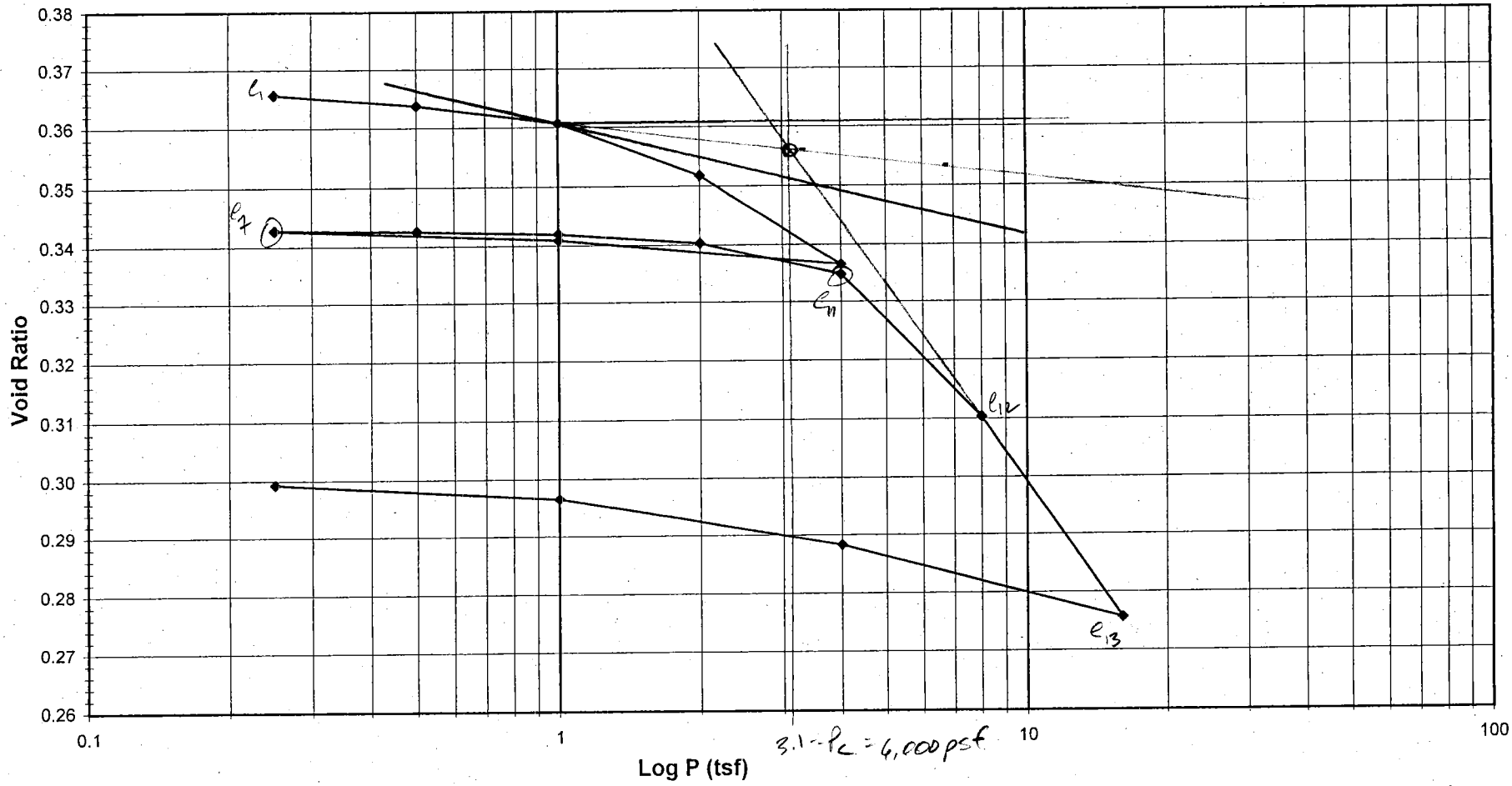
ONE DIMENSIONAL CONSOLIDATION

ASTM D 2435-04 / AASHTO T216-03 (SOP-S24)

Client	CIVIL & ENVIRONMENTAL CONSULTANTS	Boring No.	NA
Client Reference	APEX SANITARY L.F. 072-002	Depth (ft)	NA
Project No.	2008-026-41	Sample No.	SR-6
Lab ID	2008-026-41-01	Visual Description	GRAY CLAY (-#4 MATERIAL)

Sample Conditions: REMOLDED, INUNDATED AND DOUBLE DRAINED



Tested By TM *Date* 12/11/08 *Approved By* DB *Date* 12/23/08

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ONE DIMENSIONAL CONSOLIDATION

ASTM D 2435-04 / AASHTO T216-03 (SOP-S24)

Client	CIVIL & ENVIRONMENTAL CONSULTANTS
Client Reference	APEX SANITARY L.F. 072-002
Project No.	2008-026-41
Lab ID	2008-026-41-01

Boring No.	NA
Depth (ft)	NA
Sample No.	SR-6
Visual Description	GRAY CLAY (-#4 MATERIAL)

Sample Conditions: REMOLDED, INUNDATED AND DOUBLE DRAINED
Consolidometer No. 4
1 Division = 0.0001 (in)

$C_R = \frac{e_7 - e_{11}}{\log \frac{P_7}{P_{11}}} = 0.007$ $e_o = 0.36720$

$C_C = \frac{e_{12} - e_{13}}{\log \frac{P_{12}}{P_{13}}} = 0.115$ $P_c = 6,000$ psf

Sample Properties	Initial	Final
Water Content		
Tare Number	1226	1209
Wt. Tare & WS (gm)	216.22	140.12
Wt. Tare & DS (gm)	199.94	126.06
Wt. Water (gm)	16.28	14.06
Wt. Tare (gm)	6.71	6.65
Wt. DS (gm)	193.23	119.41
Water Content (%)	8.43	11.77
Sample Parameters		
Sample Diameter (in)	2.5	2.5
Sample Height (in)	0.750	0.713
Sample Volume (cc)	60.33	57.33
Wt. Wet Sample + Ring (gm)	205.89	209.88
Wt. of Ring (gm)	76.71	76.71
Wt. of Wet Sample (gm)	129.18	133.17
Wet Density (pcf)	133.61	144.94
Wet Density (g/cc)	2.14	2.32
Water Content (%)	8.43	11.77
Wt. of Dry Sample (gm)	119.14	119.14
Dry Density (pcf)	123.23	129.67
Dry Density (g/cc)	1.97	2.08
Void Ratio	0.3672	0.2993
Saturation (%)	61.95	106.23
Specific Gravity	2.70	*Assumed*

Test Data Summary

	Applied Pressure (tsf)	Final Dial Reading (div)	Machine Deflection (div)	Corrected Reading (div)	Height of Sample (mm)	Volume (cc)	Dry Density (g/cc)	Void Ratio
P_0	Seating	0	0	0	19.050	60.330	1.97484	**0.36720** e_o
P_1	0.25	15.2	6.6	8.6	19.028	60.261	1.97711	**0.36563** e_1
	0.5	30.7	11.7	19.0	19.002	60.177	1.97986	**0.36373**
	1	54.5	18.5	36.0	18.959	60.040	1.98437	**0.36063**
	2	113.3	28.5	84.8	18.835	59.648	1.99743	**0.35174**
	4	209.7	41.2	168.5	18.622	58.974	2.02023	**0.33648**
	1	174.9	30.8	144.1	18.684	59.171	2.01353	**0.34093**
P_7	0.25	148.7	14.6	134.1	18.709	59.251	2.01080	**0.34275** e_7
	0.5	152.7	17.5	135.2	18.707	59.242	2.01110	**0.34255**
	1	160.3	21.6	138.7	18.698	59.214	2.01205	**0.34191**
	2	177.0	29.4	147.6	18.675	59.143	2.01449	**0.34029**
	4	219.6	41.6	178.0	18.598	58.898	2.02285	**0.33475**
P_{12}	8	365.4	53.3	312.1	18.257	57.819	2.06059	**0.31030** e_{12}
P_{13}	16	565.7	63.7	502.0	17.775	56.292	2.11651	**0.27569** e_{13}
	4	484.4	51.3	433.1	17.950	56.846	2.09587	**0.28825**
	1	424.5	36.7	387.8	18.065	57.210	2.08252	**0.29650**
	0.25	392.3	19.7	372.6	18.104	57.333	2.07808	**0.29927**

NOTE: 1.5 TSF WAS APPLIED TO STOP SWELL.
THIS IS NOT INCLUDED IN THE LOADING INCREMENTS.

Tested By TM *Date* 12/11/08 *Input Checked By* DB *Date* 12/23/08

DCN: CT-S24F Date: 12/12/05 Revision: 5

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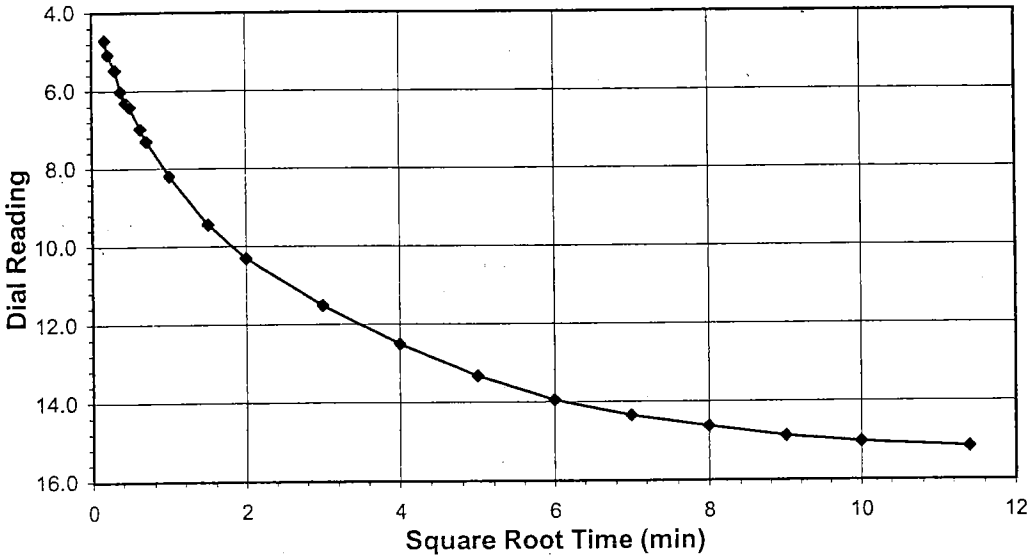
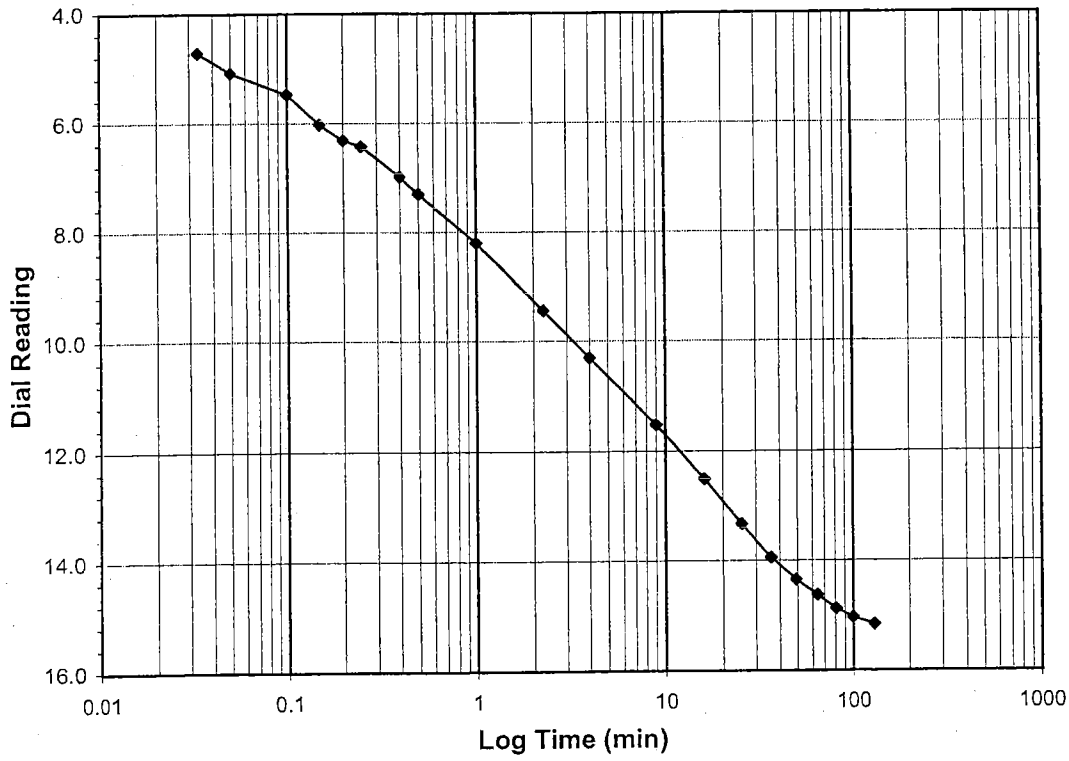
ASTM D 2435-04 / AASHTO T216-03 (SOP-S24)

Client	CIVIL & ENVIRONMENTAL CONSULTANTS	Boring No.	NA
Client Project	APEX SANITARY L.F. 072-002	Depth (ft)	NA
Project No.	2008-026-41	Sample No.	SR-6
Lab ID	2008-026-41-01	Visual Description	GRAY CLAY (-#4 MATERIAL)

Sample Conditions: REMOLDED, INUNDATED AND DOUBLE DRAINED

NOTE: 1.5 TSF WAS APPLIED TO STOP SWELL. THIS IS NOT INCLUDED IN THE LOADING INCREMENTS.





Test Load	**(tsf)**	**0-0.25**
Final Reading	**(div)**	**15.2**
Consolidometer No.		4
1 Division	(in)	0.0001
Start Date		12/11/08
Start Time		13:06:43

Elapsed Time (min)	Dial Reading (div)
Initial	**0.0**
0.03	4.7
0.05	5.1
0.10	5.5
0.15	6.0
0.20	6.3
0.25	6.4
0.40	7.0
0.50	7.3
1.00	8.2
2.25	9.4
4.00	10.3
9.00	11.5
16.00	12.5
25.00	13.3
36.00	14.0
49.00	14.4
64.00	14.6
81.00	14.9
100.00	15.0
130.00	15.2

Tested By TM *Date* 12/11/08 *Checked By* DB *Date* 12/23/08

DCN: CT-24E Date: 3/2/98 Revision: 2

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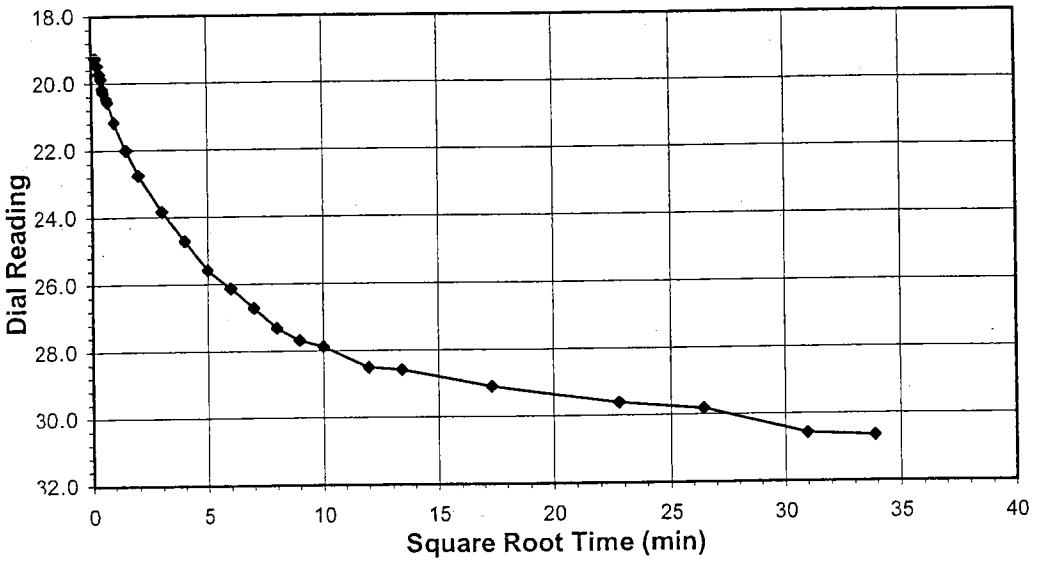
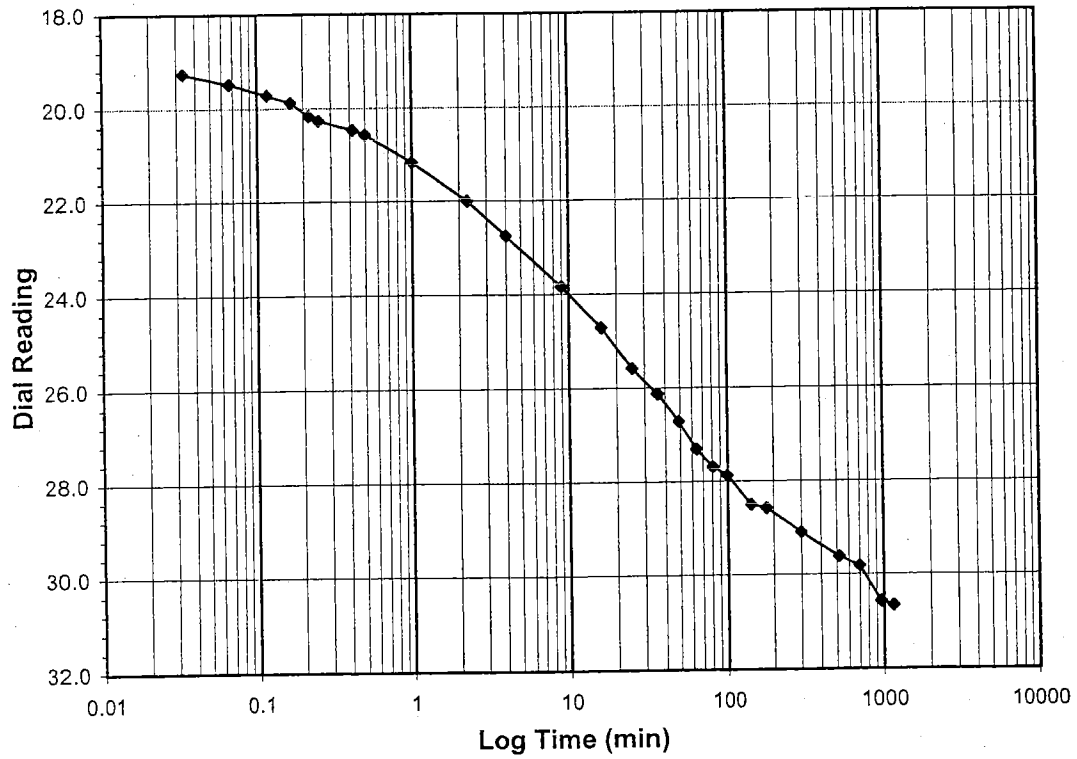
ASTM D 2435-04 / AASHTO T216-03 (SOP-S24)

Client	CIVIL & ENVIRONMENTAL CONSULTANTS	Boring No.	NA
Client Project	APEX SANITARY L.F. 072-002	Depth (ft)	NA
Project No.	2008-026-41	Sample No.	SR-6
Lab ID	2008-026-41-01	Visual Description	GRAY CLAY (-#4 MATERIAL)

Sample Conditions: REMOLDED, INUNDATED AND DOUBLE DRAINED

NOTE: 1.5 TSF WAS APPLIED TO STOP SWELL. THIS IS NOT INCLUDED IN THE LOADING INCREMENTS.





Test Load	**(tsf)**	**0.25-0.5**
Final Reading	**(div)**	**30.7**
Consolidometer No.		4
1 Division	(in)	0.0001
Start Date		12/11/08
Start Time		15:20:57

Elapsed Time (min)	Dial Reading (div)
Initial	**15.2**
0.03	19.3
0.07	19.5
0.12	19.7
0.17	19.9
0.22	20.2
0.25	20.3
0.42	20.5
0.50	20.6
1.00	21.2
2.25	22.0
4.00	22.8
9.00	23.8
16.00	24.7
25.00	25.6
36.02	26.1
49.00	26.7
64.00	27.3
81.00	27.7
100.00	27.9
144.00	28.5
180.00	28.6
300.00	29.1
520.00	29.6
700.00	29.8
960.00	30.6
1148.58	30.7

Tested By TM *Date* 12/11/08 *Checked By* DB *Date* 12/23/08

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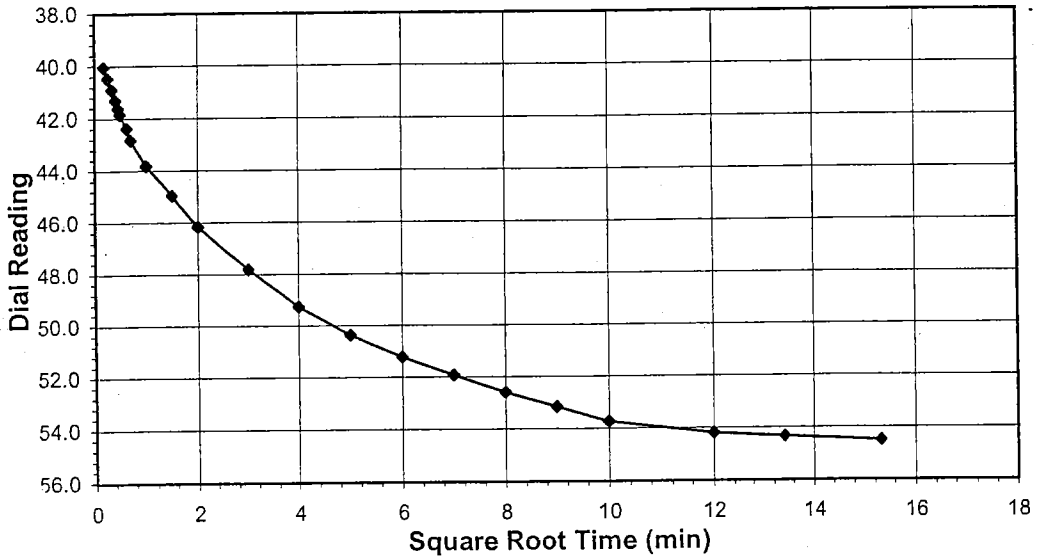
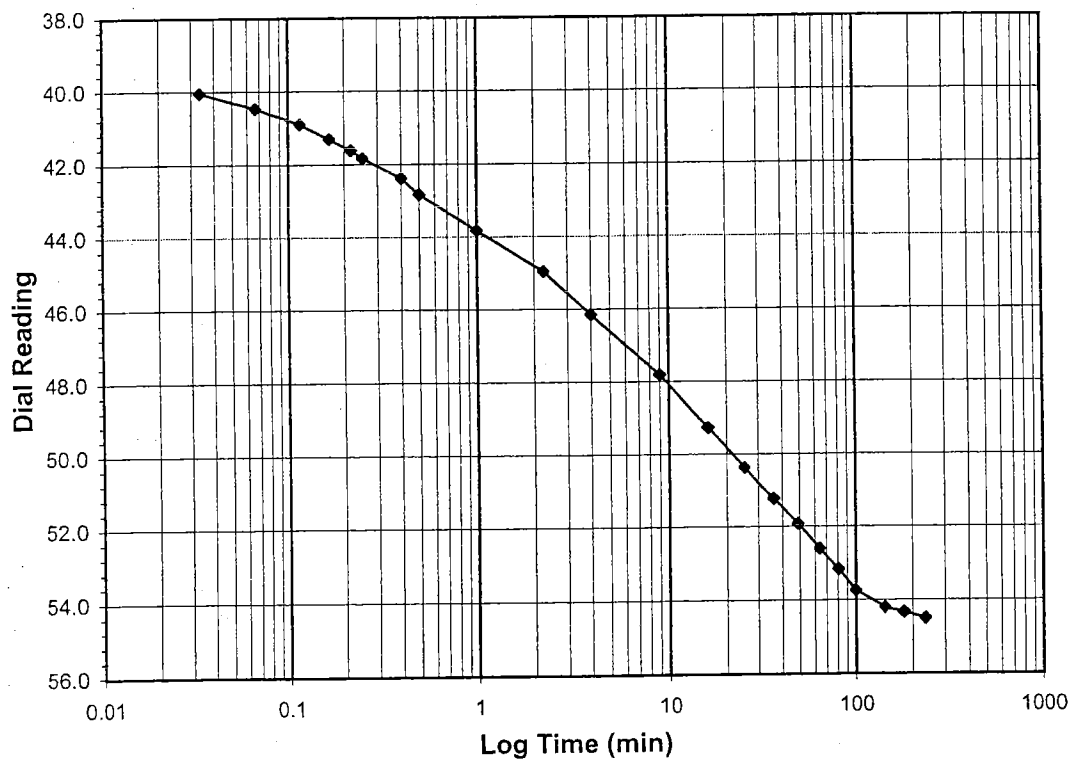
ASTM D 2435-04 / AASHTO T216-03 (SOP-S24)

Client	CIVIL & ENVIRONMENTAL CONSULTANTS	Boring No.	NA
Client Project	APEX SANITARY L.F. 072-002	Depth (ft)	NA
Project No.	2008-026-41	Sample No.	SR-6
Lab ID	2008-026-41-01	Visual Description	GRAY CLAY (-#4 MATERIAL)

Sample Conditions: REMOLDED, INUNDATED AND DOUBLE DRAINED

NOTE: 1.5 TSF WAS APPLIED TO STOP SWELL. THIS IS NOT INCLUDED IN THE LOADING INCREMENTS.





Test Load	**(tsf)**	**0.5-1.0**
Final Reading	**(div)**	**54.5**
Consolidometer No.		4
1 Division	(in)	0.0001
Start Date		12/12/08
Start Time		10:32:13

Elapsed Time (min)	Dial Reading (div)
Initial	**30.7**
0.03	40.1
0.07	40.5
0.12	40.9
0.17	41.3
0.22	41.6
0.25	41.8
0.40	42.4
0.50	42.8
1.00	43.8
2.25	45.0
4.00	46.2
9.00	47.8
16.00	49.3
25.02	50.4
36.00	51.2
49.00	51.9
64.00	52.6
81.00	53.2
100.00	53.7
144.00	54.2
180.00	54.3
235.03	54.5

Tested By TM *Date* 12/12/08 *Checked By* DJ *Date* 12/23/08

DCN: CT-24E Date: 3/2/98 Revision: 2

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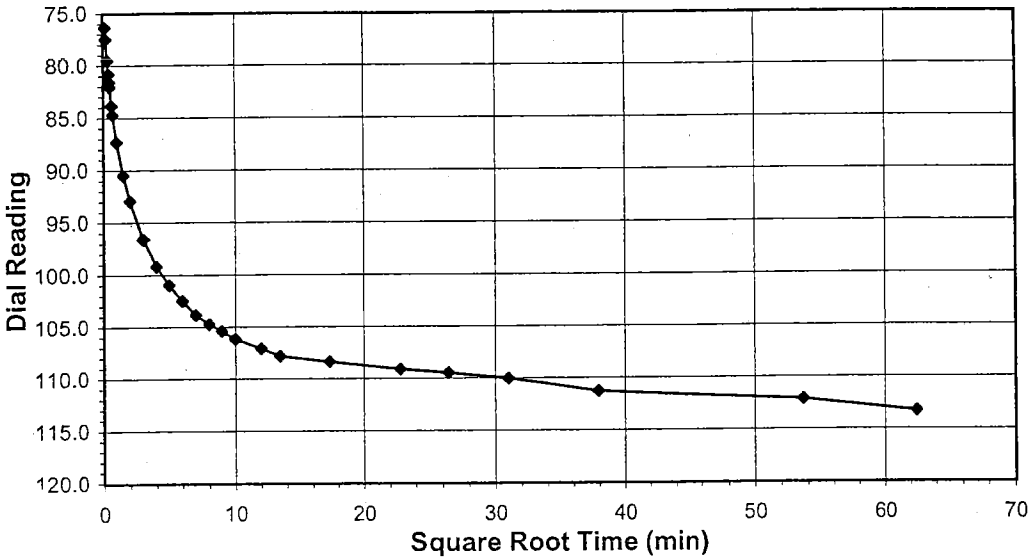
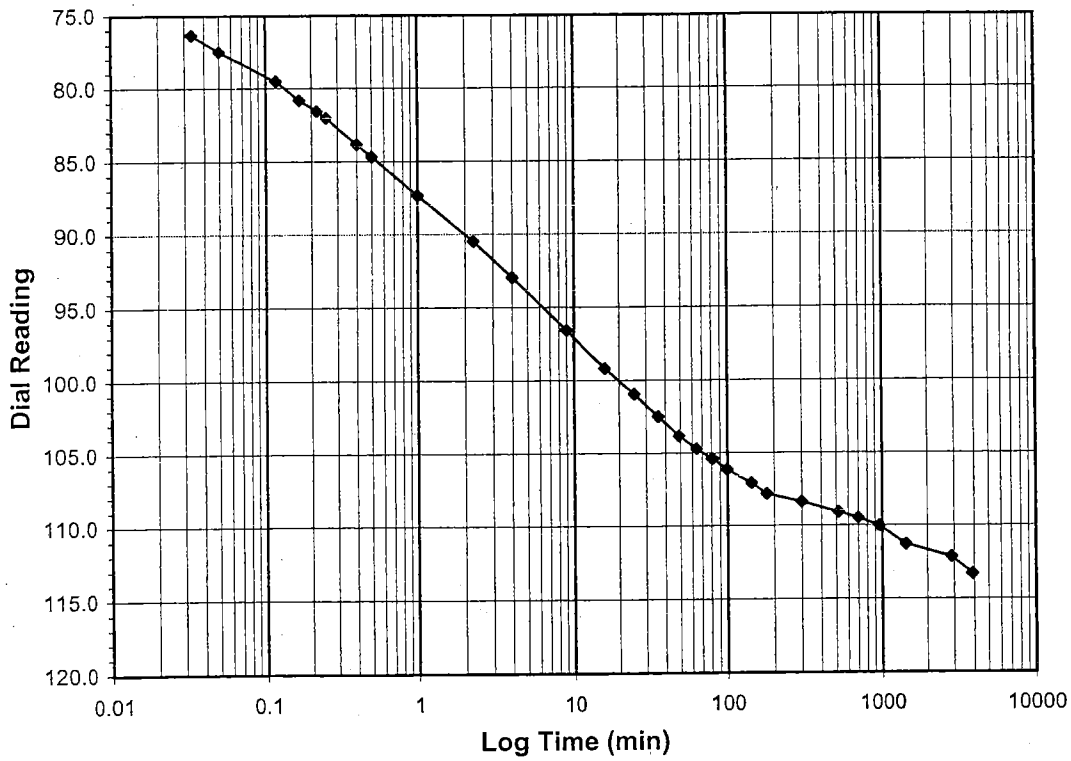
ASTM D 2435-04 / AASHTO T216-03 (SOP-S24)

Client	CIVIL & ENVIRONMENTAL CONSULTANTS	Boring No.	NA
Client Project	APEX SANITARY L.F. 072-002	Depth (ft)	NA
Project No.	2008-026-41	Sample No.	SR-6
Lab ID	2008-026-41-01	Visual Description	GRAY CLAY (-#4 MATERIAL)

Sample Conditions: REMOLDED, INUNDATED AND DOUBLE DRAINED

NOTE: 1.5 TSF WAS APPLIED TO STOP SWELL. THIS IS NOT INCLUDED IN THE LOADING INCREMENTS.





Test Load	**(tsf)**	**1.0-2.0**
Final Reading	**(div)**	**113.3**
Consolidometer No.		4
1 Division	(in)	0.0001
Start Date		12/12/08
Start Time		14:39:32

Elapsed Time (min)	Dial Reading (div)
Initial	**54.5**
0.03	76.4
0.05	77.5
0.12	79.5
0.17	80.8
0.22	81.6
0.25	82.0
0.40	83.9
0.50	84.7
1.00	87.4
2.25	90.5
4.00	93.0
9.00	96.6
16.00	99.2
25.00	101.0
36.00	102.5
49.00	103.8
64.00	104.7
81.00	105.4
100.00	106.2
144.00	107.1
180.00	107.8
300.00	108.4
520.00	109.1
700.00	109.5
960.00	110.0
1440.00	111.3
2880.00	112.1
3900.00	113.3

Tested By TM *Date* 12/12/08 *Checked By* DB *Date* 12/23/08

DCN: CT-24E Date: 3/2/98 Revision: 2

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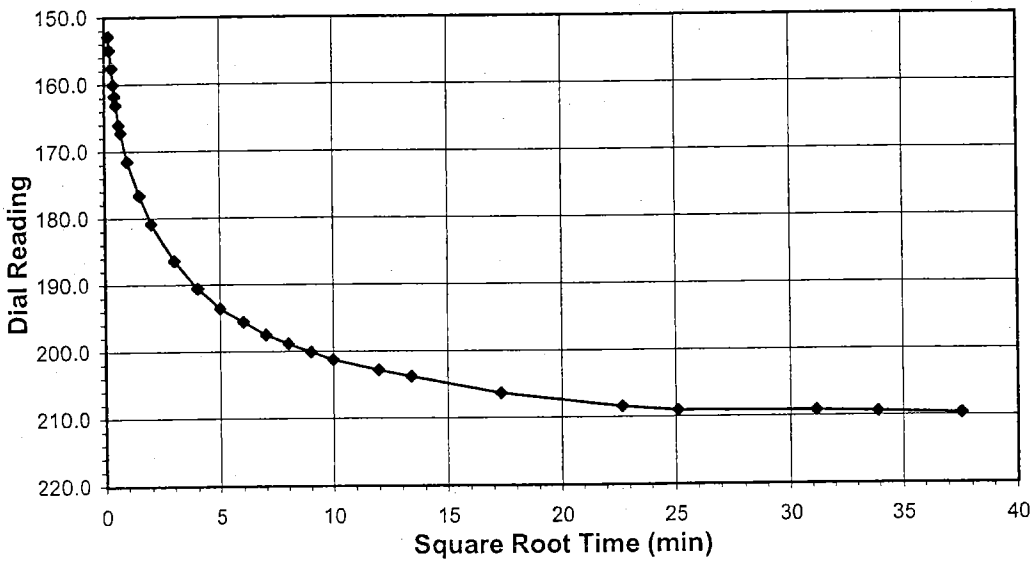
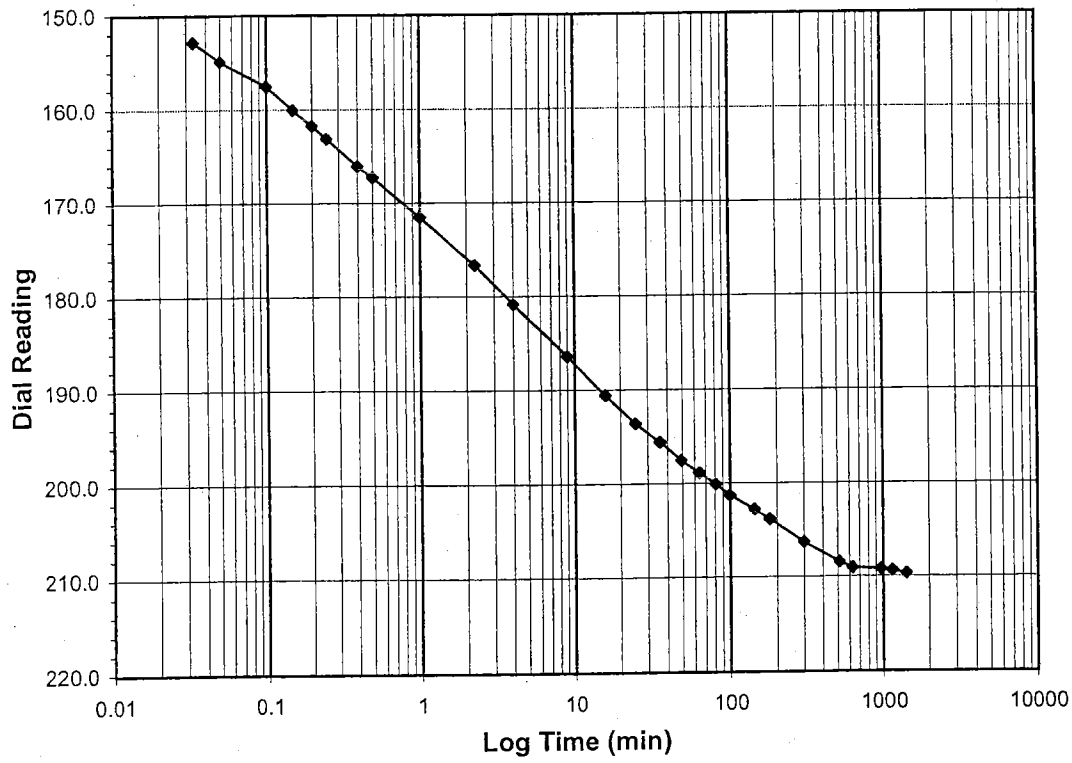
ASTM D 2435-04 / AASHTO T216-03 (SOP-S24)

Client	CIVIL & ENVIRONMENTAL CONSULTANTS	Boring No.	NA
Client Project	APEX SANITARY L.F. 072-002	Depth (ft)	NA
Project No.	2008-026-41	Sample No.	SR-6
Lab ID	2008-026-41-01	Visual Description	GRAY CLAY (-#4 MATERIAL)

Sample Conditions: REMOLDED, INUNDATED AND DOUBLE DRAINED

NOTE: 1.5 TSF WAS APPLIED TO STOP SWELL. THIS IS NOT INCLUDED IN THE LOADING INCREMENTS.





Test Load	**(tsf)**	**2.0-4.0**
Final Reading	**(div)**	**209.7**
Consolidometer No.		4
1 Division	(in)	0.0001
Start Date		12/15/08
Start Time		7:41:39

Elapsed Time (min)	Dial Reading (div)
Initial	**113.3**
0.03	152.8
0.05	154.9
0.10	157.6
0.15	160.1
0.20	161.7
0.25	163.1
0.40	166.1
0.50	167.2
1.00	171.5
2.25	176.6
4.00	180.9
9.00	186.4
16.00	190.6
25.00	193.6
36.00	195.6
49.00	197.5
64.00	198.9
81.00	200.1
100.00	201.3
144.00	202.8
180.00	203.8
300.00	206.3
514.90	208.4
630.90	209.1
970.90	209.2
1150.92	209.4
1410.90	209.7

Tested By TM *Date* 12/15/08 *Checked By* DB *Date* 12/23/08

DCN: CT-24E Date: 3/2/98 Revision: 2

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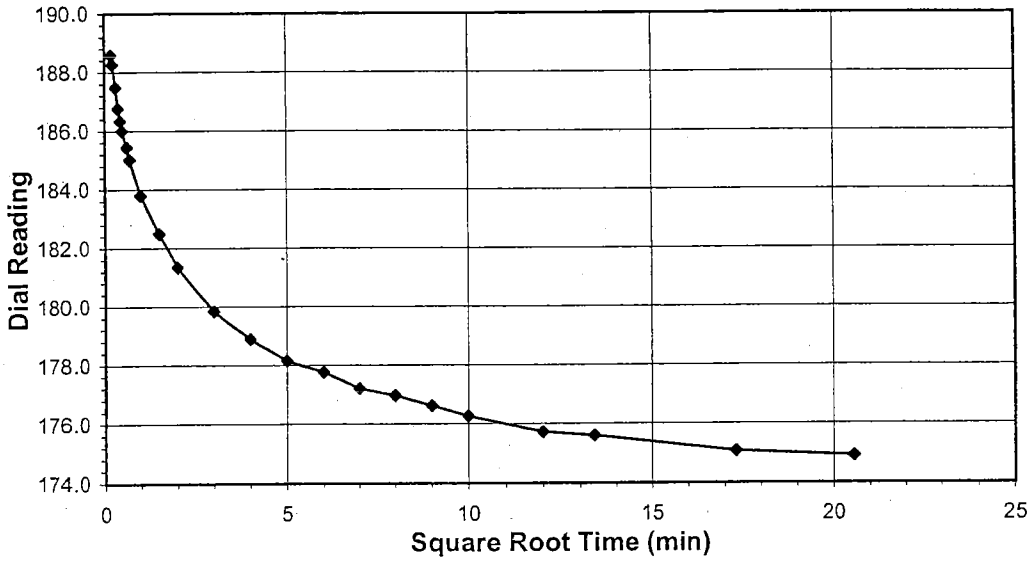
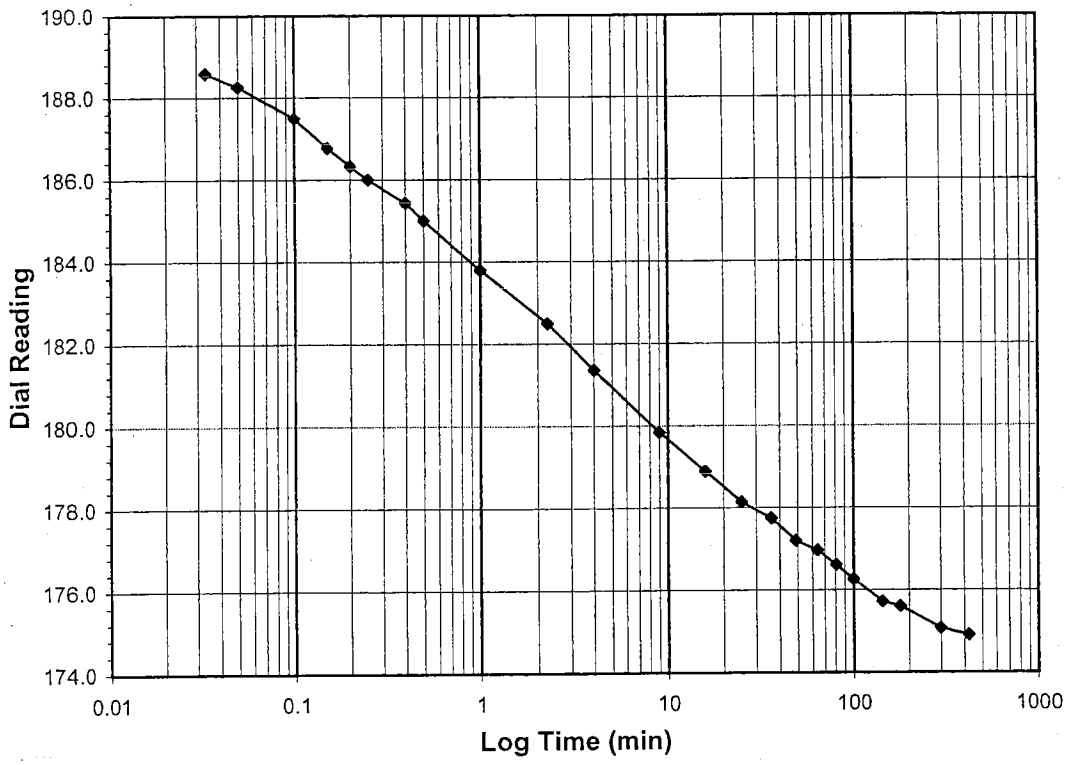
ASTM D 2435-04 / AASHTO T216-03 (SOP-S24)

Client	CIVIL & ENVIRONMENTAL CONSULTANTS	Boring No.	NA
Client Project	APEX SANITARY L.F. 072-002	Depth (ft)	NA
Project No.	2008-026-41	Sample No.	SR-6
Lab ID	2008-026-41-01	Visual Description	GRAY CLAY (-#4 MATERIAL)

Sample Conditions: REMOLDED, INUNDATED AND DOUBLE DRAINED

NOTE: 1.5 TSF WAS APPLIED TO STOP SWELL.
THIS IS NOT INCLUDED IN THE LOADING INCREMENTS.





Test Load	**(tsf)**	**4.0-1.0**
Final Reading	**(div)**	**174.9**
Consolidometer No.		4
1 Division	(in)	0.0001
Start Date		12/16/08
Start Time		7:44:31

Elapsed Time (min)	Dial Reading (div)
Initial	**209.7**
0.03	188.6
0.05	188.3
0.10	187.5
0.15	186.8
0.20	186.3
0.25	186.0
0.40	185.4
0.50	185.0
1.00	183.8
2.25	182.5
4.00	181.4
9.00	179.8
16.00	178.9
25.00	178.2
36.00	177.8
49.00	177.2
64.00	177.0
81.00	176.6
100.00	176.3
144.00	175.7
180.00	175.6
300.00	175.1
422.87	174.9

Tested By TM *Date* 12/16/08 *Checked By* DB *Date* 12/23/08

DCN: CT-24E Date: 3/2/98 Revision: 2

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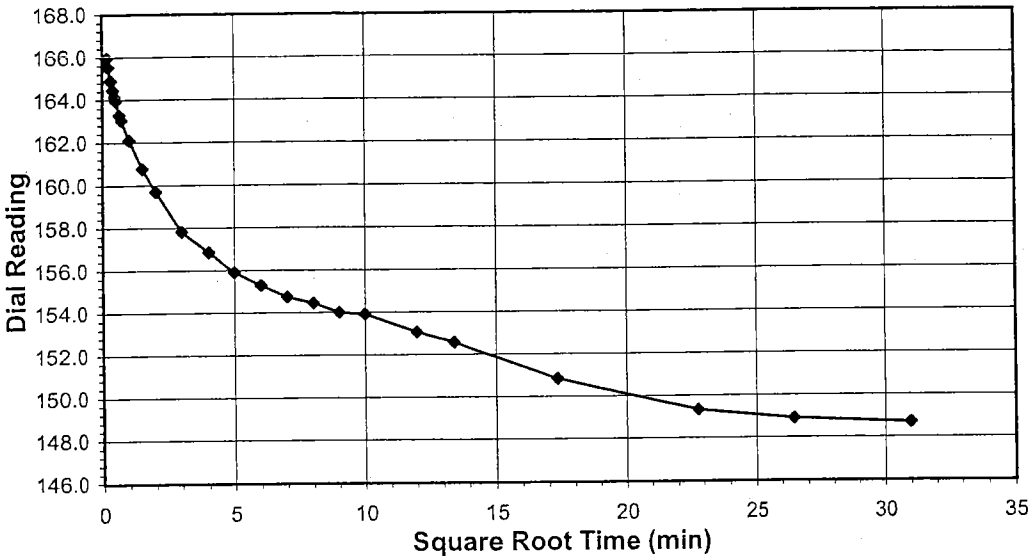
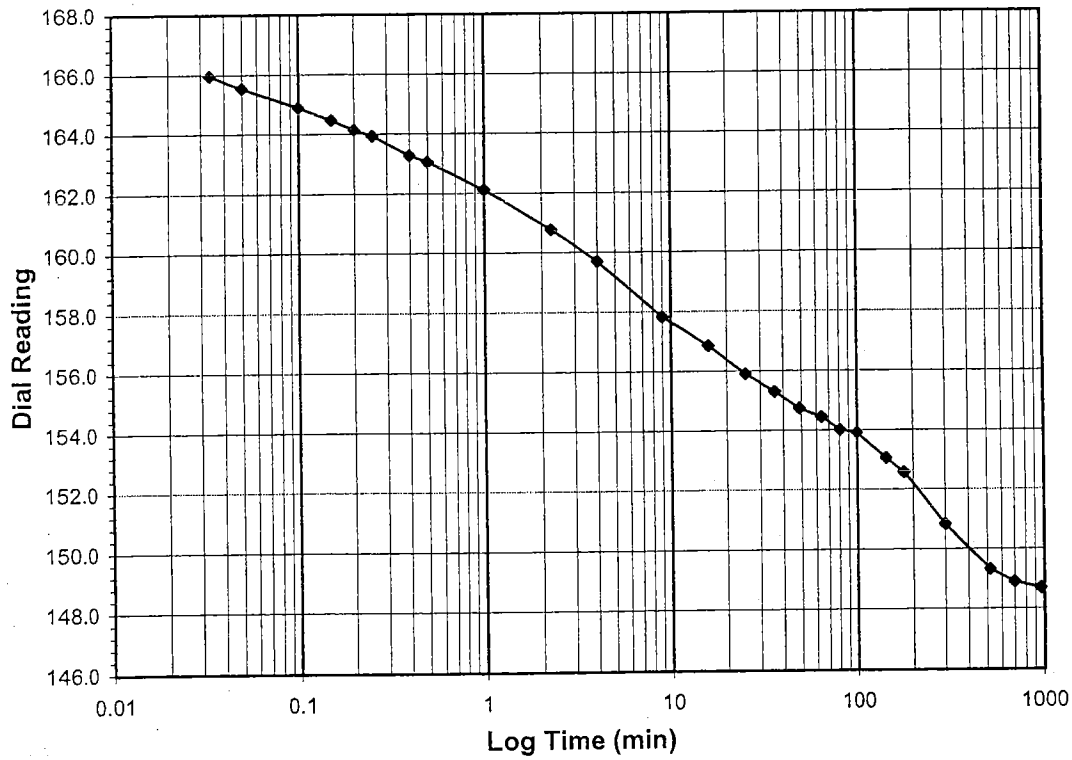
ASTM D 2435-04 / AASHTO T216-03 (SOP-S24)

Client	CIVIL & ENVIRONMENTAL CONSULTANTS	Boring No.	NA
Client Project	APEX SANITARY L.F. 072-002	Depth (ft)	NA
Project No.	2008-026-41	Sample No.	SR-6
Lab ID	2008-026-41-01	Visual Description	GRAY CLAY (-#4 MATERIAL)

Sample Conditions: REMOLDED, INUNDATED AND DOUBLE DRAINED

NOTE: 1.5 TSF WAS APPLIED TO STOP SWELL. THIS IS NOT INCLUDED IN THE LOADING INCREMENTS.





Test Load (tsf)	**1.0-0.25**
Final Reading (div)	**148.7**
Consolidometer No.	4
1 Division (in)	0.0001
Start Date	12/16/08
Start Time	14:56:13

Elapsed Time (min)	Dial Reading (div)
Initial	**174.9**
0.03	166.0
0.05	165.5
0.10	164.9
0.15	164.5
0.20	164.1
0.25	163.9
0.40	163.3
0.50	163.1
1.00	162.1
2.25	160.8
4.00	159.7
9.00	157.8
16.00	156.9
25.00	155.9
36.00	155.3
49.00	154.7
64.00	154.5
81.02	154.0
100.00	153.9
144.00	153.1
180.00	152.6
300.00	150.8
520.00	149.3
700.00	148.9
960.00	148.7

Tested By TM *Date* 12/16/08 *Checked By* DB *Date* 12/23/08

DCN: CT-24E Date: 3/2/98 Revision: 2

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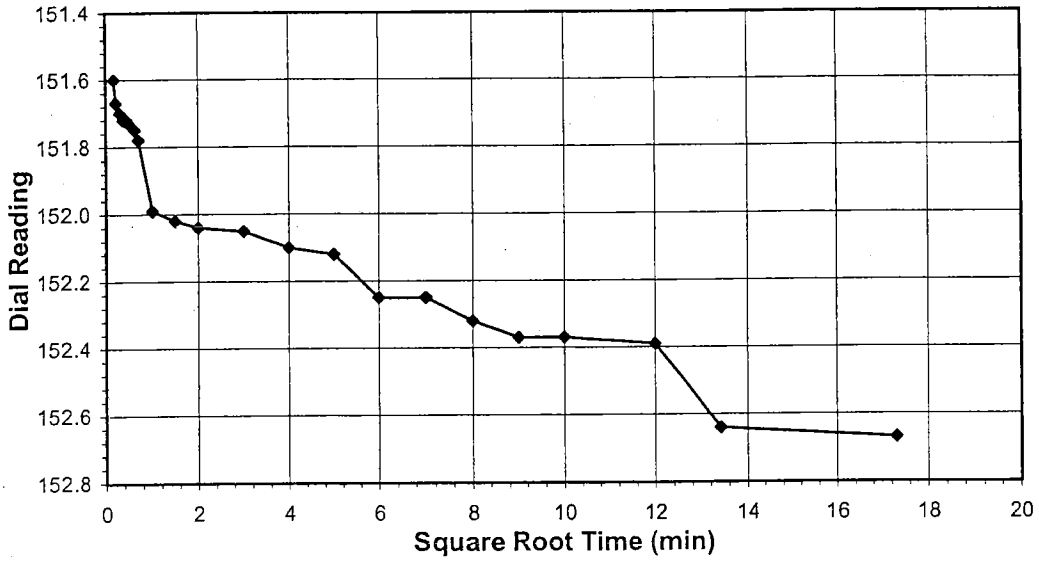
ONE DIMENSIONAL CONSOLIDATION

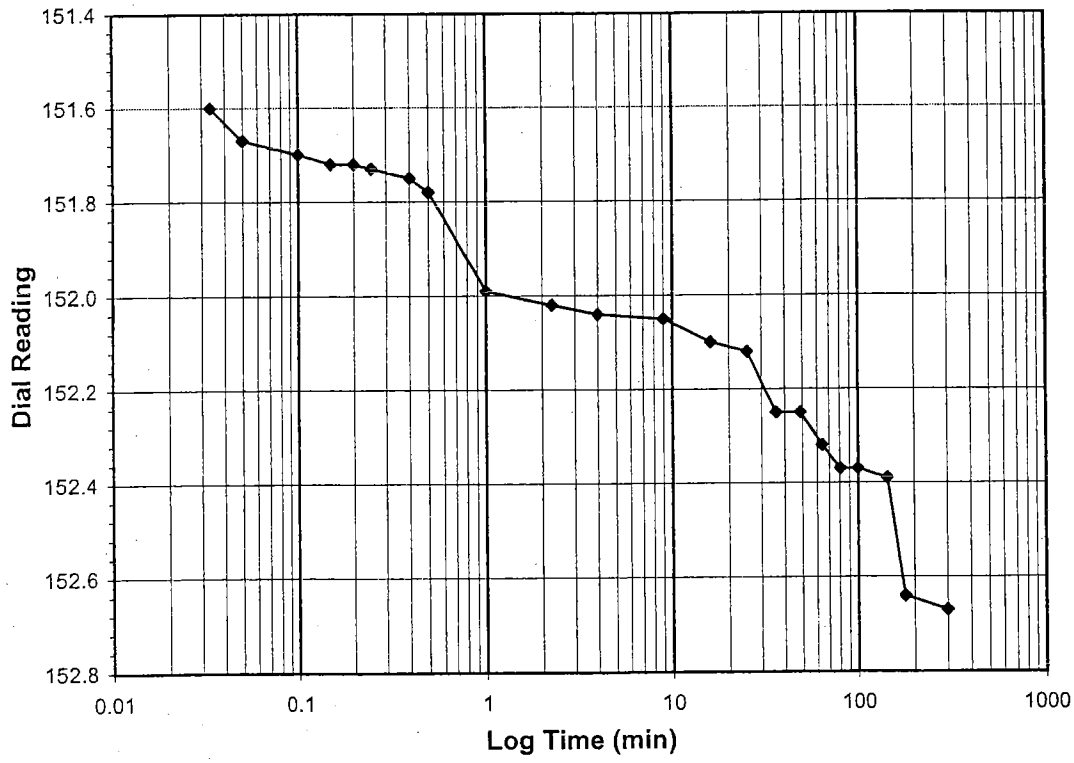
ASTM D 2435-04 / AASHTO T216-03 (SOP-S24)

Client	CIVIL & ENVIRONMENTAL CONSULTANTS	Boring No.	NA
Client Project	APEX SANITARY L.F. 072-002	Depth (ft)	NA
Project No.	2008-026-41	Sample No.	SR-6
Lab ID	2008-026-41-01	Visual Description	GRAY CLAY (-#4 MATERIAL)

Sample Conditions: REMOLDED, INUNDATED AND DOUBLE DRAINED

NOTE: 1.5 TSF WAS APPLIED TO STOP SWELL. THIS IS NOT INCLUDED IN THE LOADING INCREMENTS.





Test Load	**(tsf)**	**0.25-0.5**
Final Reading	**(div)**	**152.7**
Consolidometer No.		4
1 Division	(in)	0.0001
Start Date		12/17/08
Start Time		7:30:59

Elapsed Time (min)	Dial Reading (div)
Initial	**148.7**
0.03	151.6
0.05	151.7
0.10	151.7
0.15	151.7
0.20	151.7
0.25	151.7
0.40	151.8
0.50	151.8
1.00	152.0
2.25	152.0
4.00	152.0
9.00	152.1
16.00	152.1
25.00	152.1
36.00	152.3
49.00	152.3
64.00	152.3
81.00	152.4
100.00	152.4
144.00	152.4
180.00	152.6
300.00	152.7

Tested By TM *Date* 12/17/08 *Checked By* DB *Date* 12/23/08

DCN: CT-24E Date: 3/2/98 Revision: 2

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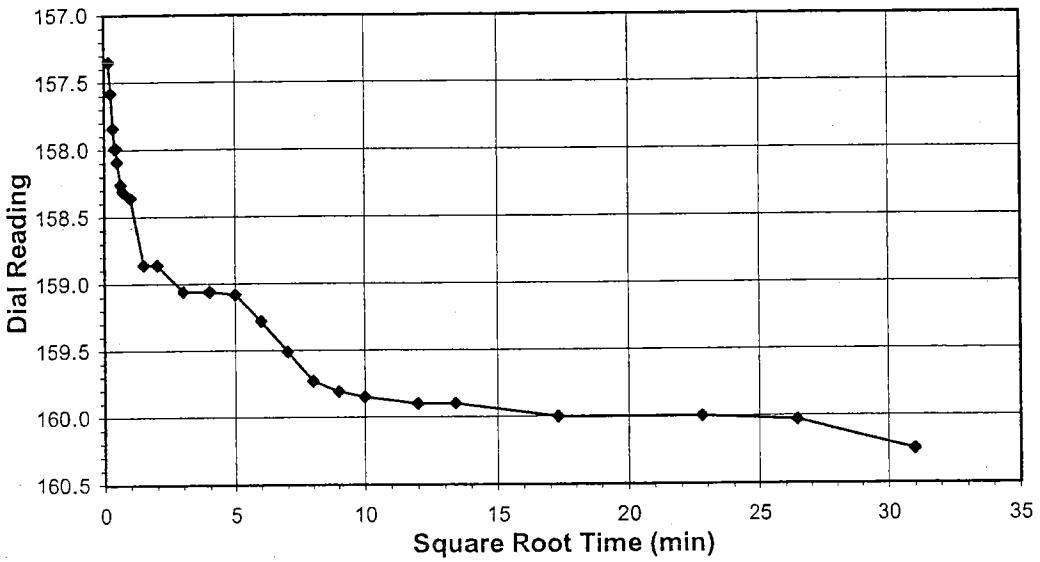
ONE DIMENSIONAL CONSOLIDATION

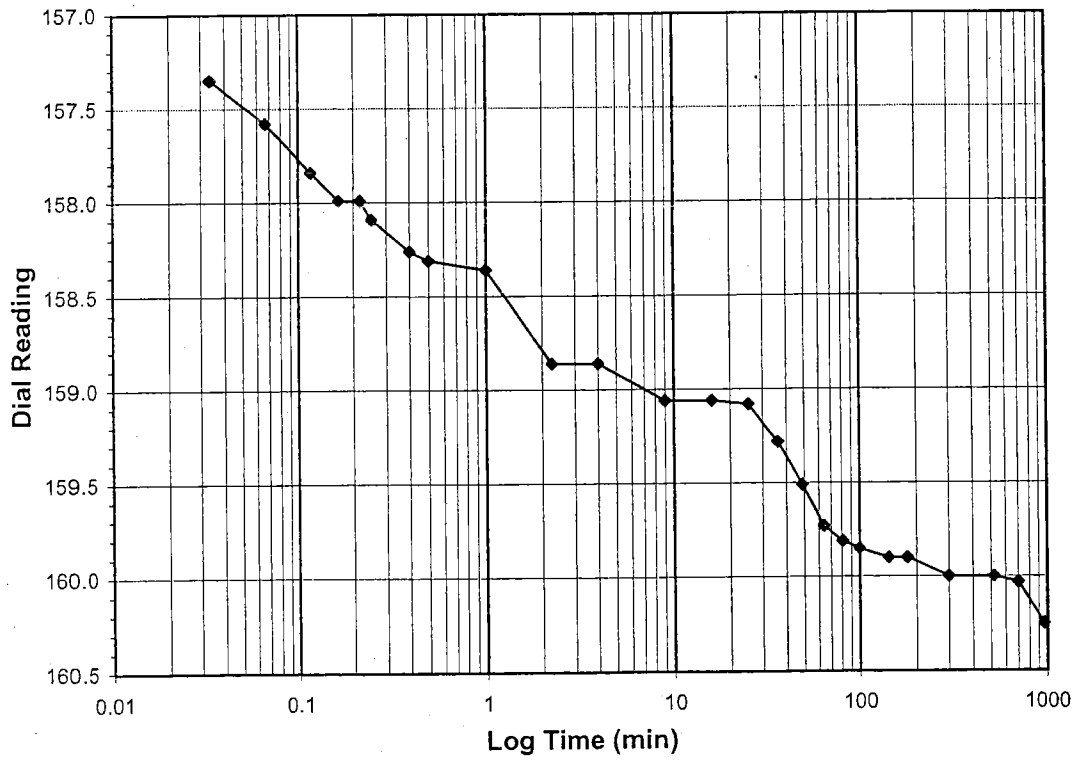
ASTM D 2435-04 / AASHTO T216-03 (SOP-S24)

Client	CIVIL & ENVIRONMENTAL CONSULTANTS	Boring No.	NA
Client Project	APEX SANITARY L.F. 072-002	Depth (ft)	NA
Project No.	2008-026-41	Sample No.	SR-6
Lab ID	2008-026-41-01	Visual Description	GRAY CLAY (-#4 MATERIAL)

Sample Conditions: REMOLDED, INUNDATED AND DOUBLE DRAINED

NOTE: 1.5 TSF WAS APPLIED TO STOP SWELL. THIS IS NOT INCLUDED IN THE LOADING INCREMENTS.





Test Load	**(tsf)**	**0.5-1.0**
Final Reading	**(div)**	**160.3**
Consolidometer No.		4
1 Division	(in)	0.0001
Start Date		12/17/08
Start Time		12:48:31

Elapsed Time (min)	Dial Reading (div)
Initial	**152.7**
0.03	157.4
0.07	157.6
0.12	157.8
0.17	158.0
0.22	158.0
0.25	158.1
0.40	158.3
0.50	158.3
1.00	158.4
2.25	158.9
4.00	158.9
9.00	159.1
16.00	159.1
25.00	159.1
36.00	159.3
49.00	159.5
64.00	159.7
81.00	159.8
100.00	159.9
144.00	159.9
180.00	159.9
300.00	160.0
520.00	160.0
700.00	160.0
960.00	160.3

Tested By TM *Date* 12/17/08 *Checked By* DB *Date* 2/23/08

DCN: CT-24E Date: 3/2/98 Revision: 2

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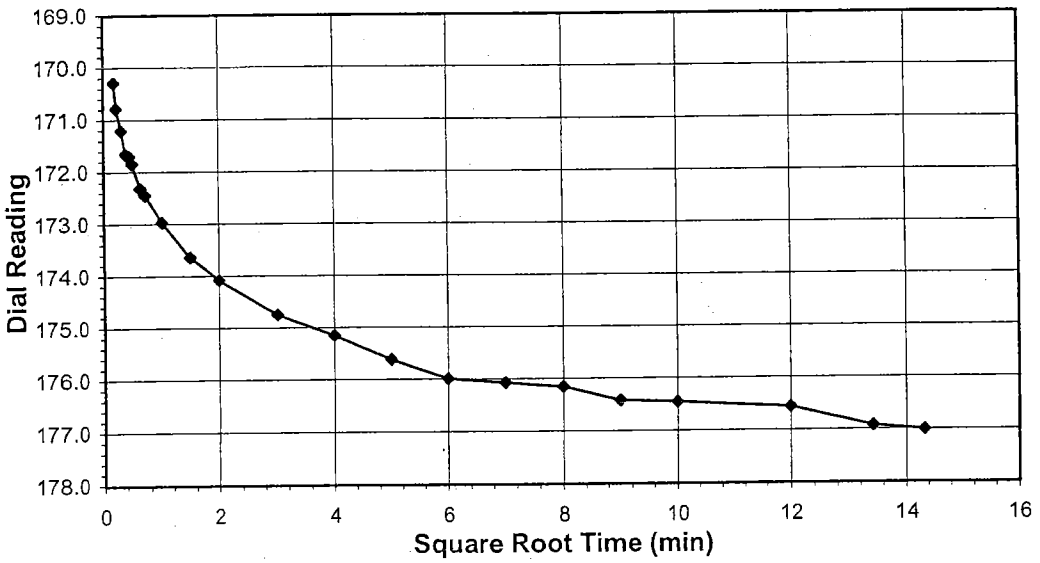
ONE DIMENSIONAL CONSOLIDATION

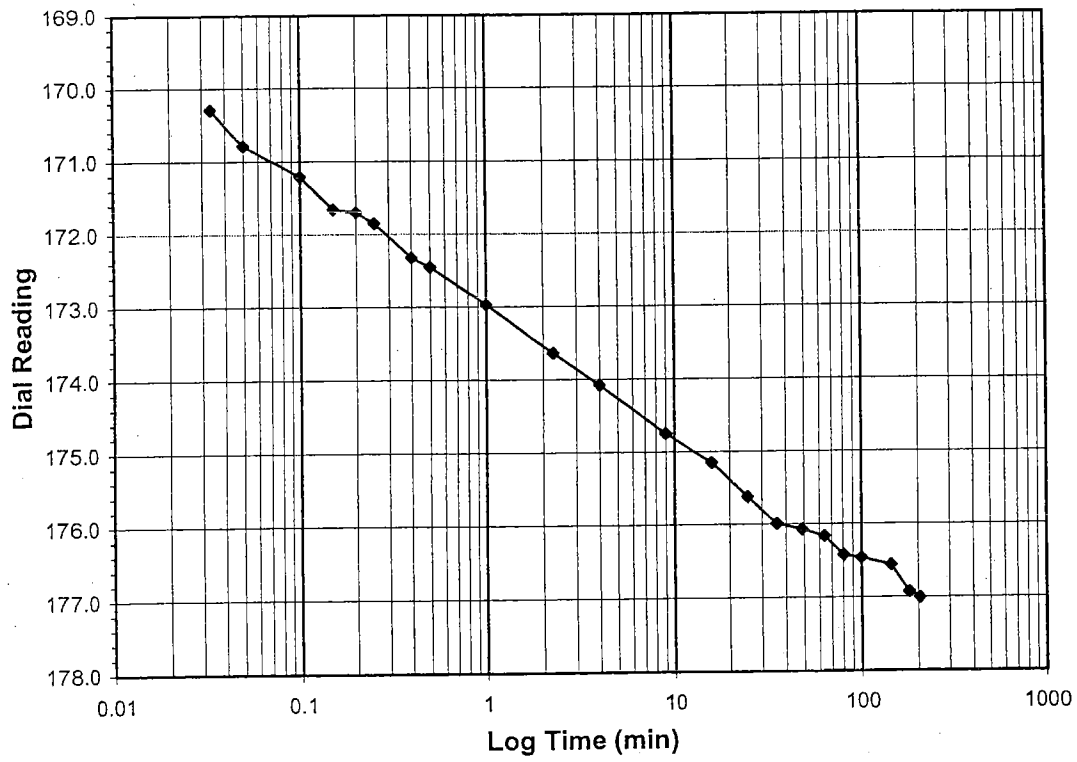
ASTM D 2435-04 / AASHTO T216-03 (SOP-S24)

Client	CIVIL & ENVIRONMENTAL CONSULTANTS	Boring No.	NA
Client Project	APEX SANITARY L.F. 072-002	Depth (ft)	NA
Project No.	2008-026-41	Sample No.	SR-6
Lab ID	2008-026-41-01	Visual Description	GRAY CLAY (-#4 MATERIAL)

Sample Conditions: REMOLDED, INUNDATED AND DOUBLE DRAINED

NOTE: 1.5 TSF WAS APPLIED TO STOP SWELL. THIS IS NOT INCLUDED IN THE LOADING INCREMENTS.





Test Load	**(tsf)**	**1.0-2.0**
Final Reading	**(div)**	**177.0**
Consolidometer No.		4
1 Division	(in)	0.0001
Start Date		12/18/08
Start Time		7:42:48

Elapsed Time (min)	Dial Reading (div)
Initial	**160.3**
0.03	170.3
0.05	170.8
0.10	171.2
0.15	171.7
0.20	171.7
0.25	171.9
0.40	172.3
0.50	172.5
1.00	173.0
2.25	173.6
4.00	174.1
9.00	174.8
16.00	175.2
25.00	175.6
36.00	176.0
49.00	176.1
64.00	176.2
81.00	176.4
100.00	176.5
144.00	176.6
180.00	176.9
205.20	177.0

Tested By TM *Date* 12/18/08 *Checked By* DB *Date* 12/23/08

DCN: CT-24E Date: 3/2/98 Revision: 2

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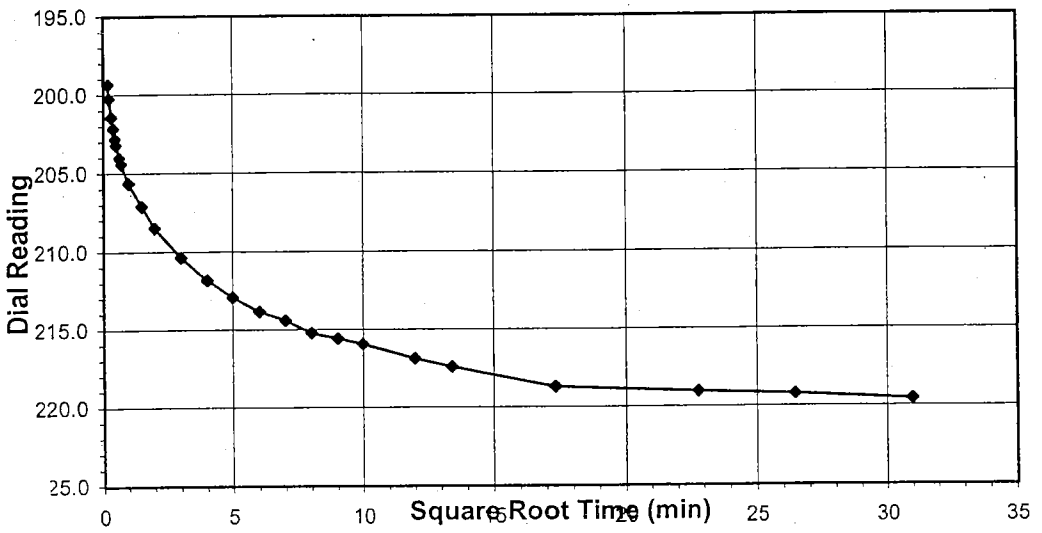
ONE DIMENSIONAL CONSOLIDATION

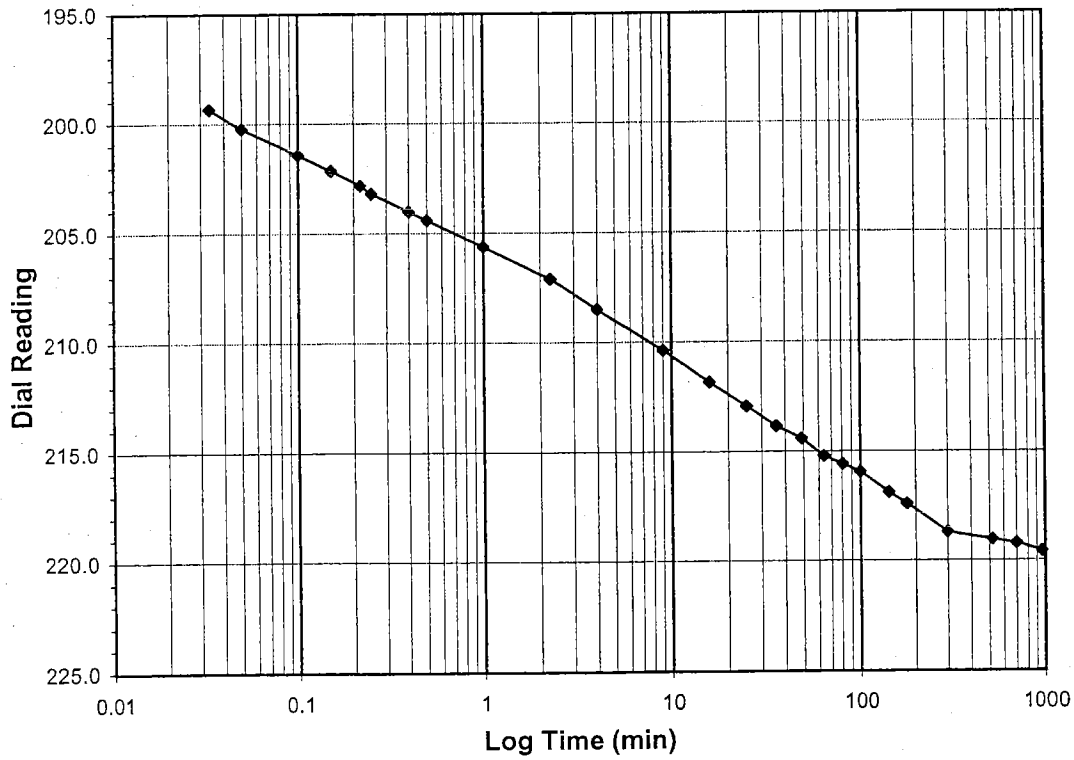
ASTM D 2435-04 / AASHTO T216-03 (SOP-S24)

Client	CIVIL & ENVIRONMENTAL CONSULTANTS	Boring No.	NA
Client Project	APEX SANITARY L.F. 072-002	Depth (ft)	NA
Project No.	2008-026-41	Sample No.	SR-6
Lab ID	2008-026-41-01	Visual Description	GRAY CLAY (-#4 MATERIAL)

Sample Conditions: REMOLDED, INUNDATED AND DOUBLE DRAINED

NOTE: 1.5 TSF WAS APPLIED TO STOP SWELL. THIS IS NOT INCLUDED IN THE LOADING INCREMENTS.





Test Load (tsf)	**2.0-4.0**
Final Reading (div)	**219.6**
Consolidometer No.	4
1 Division (in)	0.0001
Start Date	12/18/08
Start Time	11:17:12

Elapsed Time (min)	Dial Reading (div)
Initial	**177.0**
0.03	199.3
0.05	200.2
0.10	201.4
0.15	202.2
0.22	202.8
0.25	203.2
0.40	204.0
0.50	204.4
1.00	205.6
2.25	207.1
4.00	208.5
9.00	210.4
16.00	211.8
25.00	212.9
36.00	213.8
49.00	214.4
64.00	215.2
81.00	215.6
100.00	216.0
144.00	216.9
180.00	217.4
300.00	218.7
520.00	219.1
700.00	219.2
960.00	219.6

Tested By TM *Date* 12/18/08 *Checked By* DB *Date* 12/23/08

DCN: CT-24E Date: 3/2/98 Revision: 2

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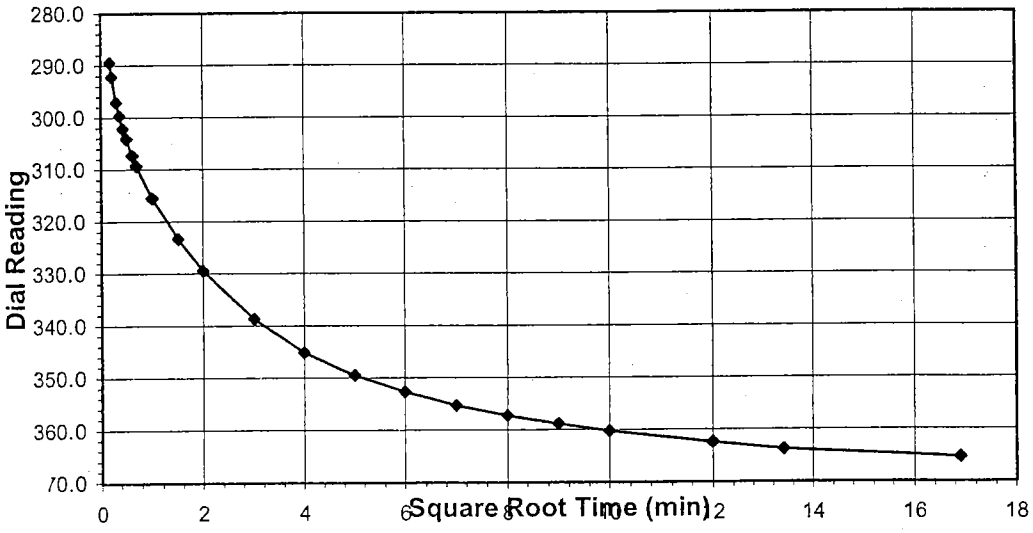
ONE DIMENSIONAL CONSOLIDATION

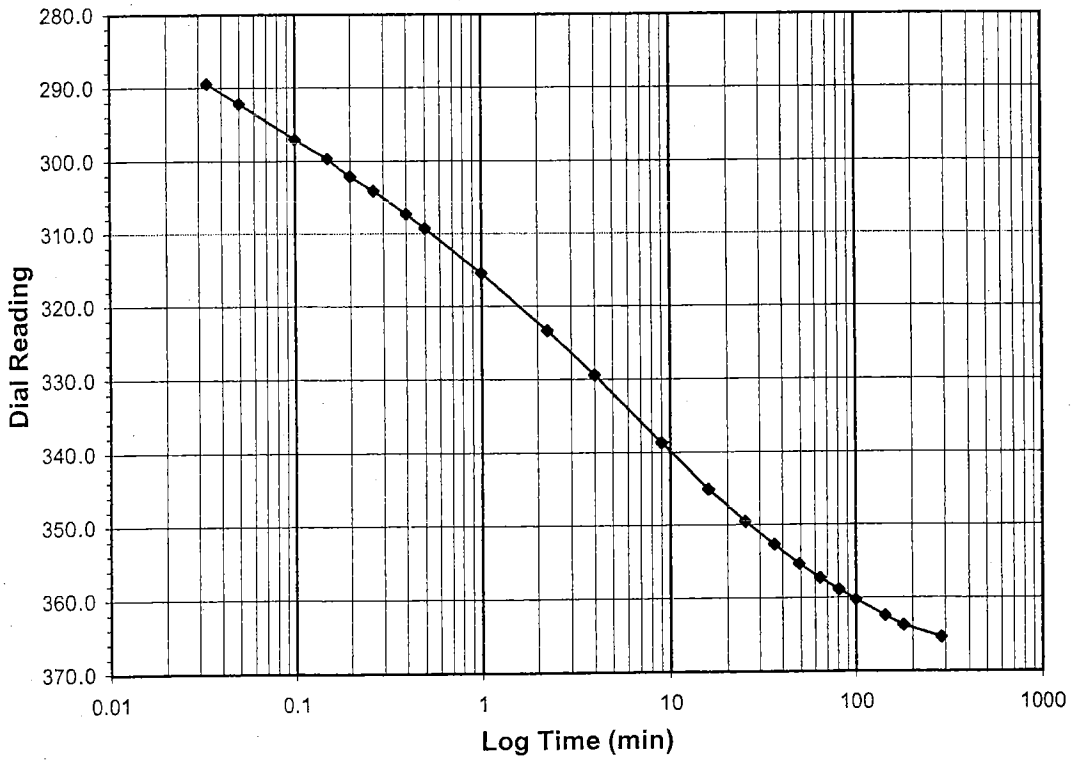
ASTM D 2435-04 / AASHTO T216-03 (SOP-S24)

Client	CIVIL & ENVIRONMENTAL CONSULTANTS	Boring No.	NA
Client Project	APEX SANITARY L.F. 072-002	Depth (ft)	NA
Project No.	2008-026-41	Sample No.	SR-6
Lab ID	2008-026-41-01	Visual Description	GRAY CLAY (-#4 MATERIAL)

Sample Conditions: REMOLDED, INUNDATED AND DOUBLE DRAINED

NOTE: 1.5 TSF WAS APPLIED TO STOP SWELL. THIS IS NOT INCLUDED IN THE LOADING INCREMENTS.





Test Load	**(tsf)**	**4.0-8.0**
Final Reading	**(div)**	**365.4**
Consolidometer No.		4
1 Division	(in)	0.0001
Start Date		12/19/08
Start Time		7:45:49

Elapsed Time (min)	Dial Reading (div)
Initial	**219.6**
0.03	289.5
0.05	292.2
0.10	297.1
0.15	299.7
0.20	302.1
0.27	304.1
0.40	307.3
0.50	309.3
1.00	315.5
2.25	323.3
4.00	329.4
9.02	338.7
16.02	345.2
25.00	349.5
36.00	352.7
49.02	355.3
64.00	357.3
81.00	358.9
100.00	360.3
144.00	362.5
180.00	363.8
285.82	365.4

Tested By TM *Date* 12/19/08 *Checked By* DB *Date* 12/23/08

DCN: CT-24E Date: 3/2/98 Revision: 2

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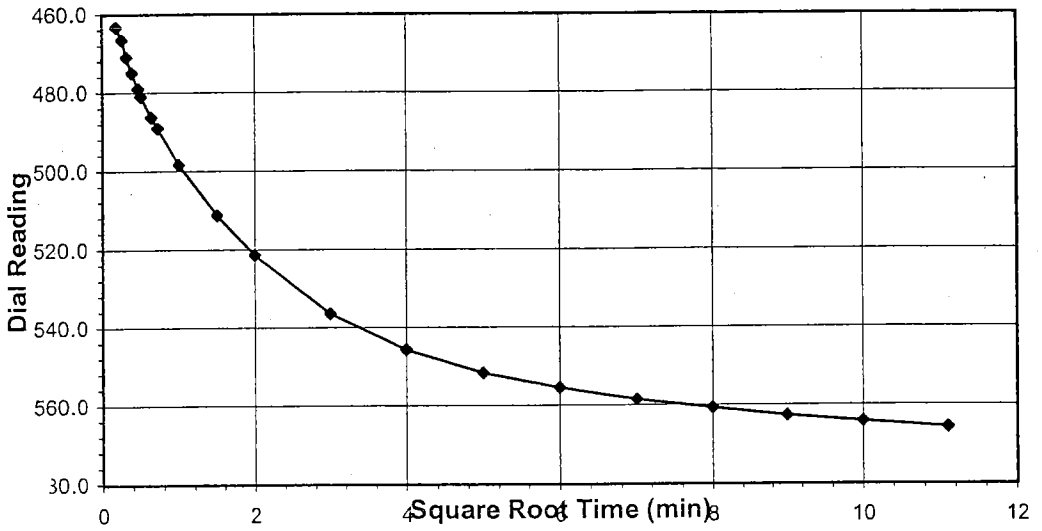
ONE DIMENSIONAL CONSOLIDATION

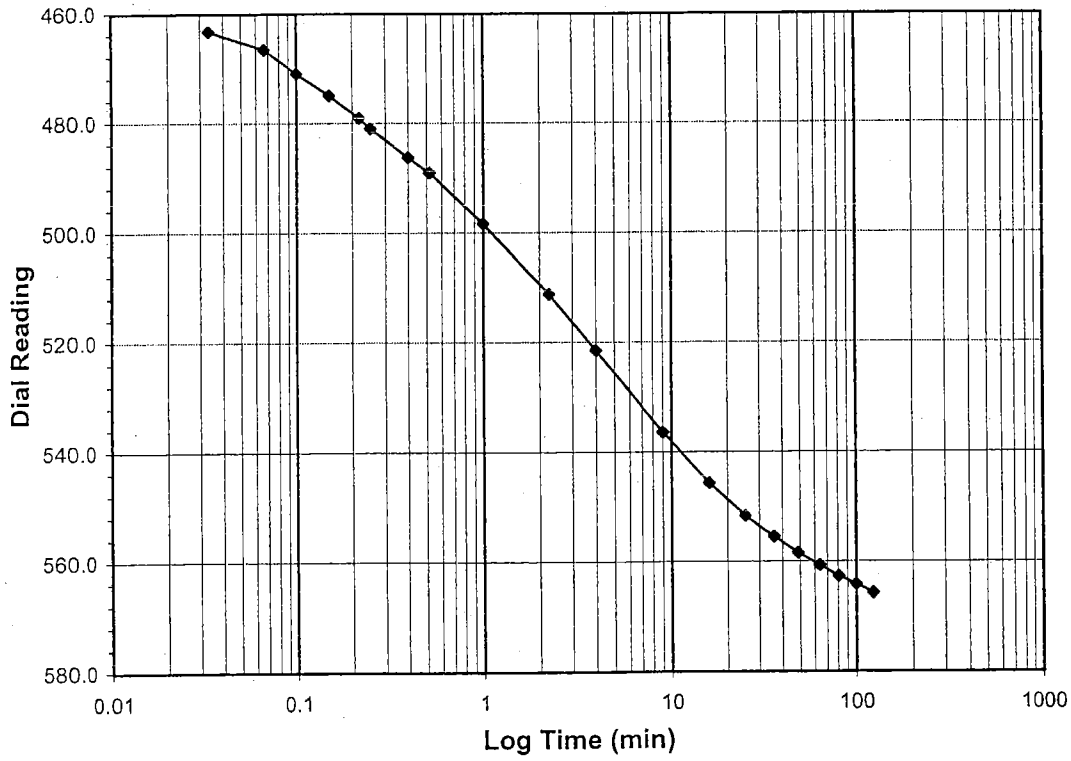
ASTM D 2435-04 / AASHTO T216-03 (SOP-S24)

Client	CIVIL & ENVIRONMENTAL CONSULTANTS	Boring No.	NA
Client Project	APEX SANITARY L.F. 072-002	Depth (ft)	NA
Project No.	2008-026-41	Sample No.	SR-6
Lab ID	2008-026-41-01	Visual Description	GRAY CLAY (-#4 MATERIAL)

Sample Conditions: REMOLDED, INUNDATED AND DOUBLE DRAINED

NOTE: 1.5 TSF WAS APPLIED TO STOP SWELL. THIS IS NOT INCLUDED IN THE LOADING INCREMENTS.





Test Load	**(tsf)**	**8.0-16.0**
Final Reading	**(div)**	**565.7**
Consolidometer No.		4
1 Division	(in)	0.0001
Start Date		12/19/08
Start Time		12:34:04

Elapsed Time (min)	Dial Reading (div)
Initial	**365.4**
0.03	463.2
0.07	466.5
0.10	471.0
0.15	474.9
0.22	479.0
0.25	481.0
0.40	486.3
0.52	489.0
1.00	498.3
2.25	511.2
4.00	521.4
9.00	536.5
16.00	545.8
25.00	551.7
36.00	555.5
49.00	558.5
64.00	560.7
81.00	562.7
100.00	564.2
123.45	565.7

Tested By TM *Date* 12/19/08 *Checked By* DB *Date* 12/23/08

DCN: CT-24E Date: 3/2/98 Revision: 2

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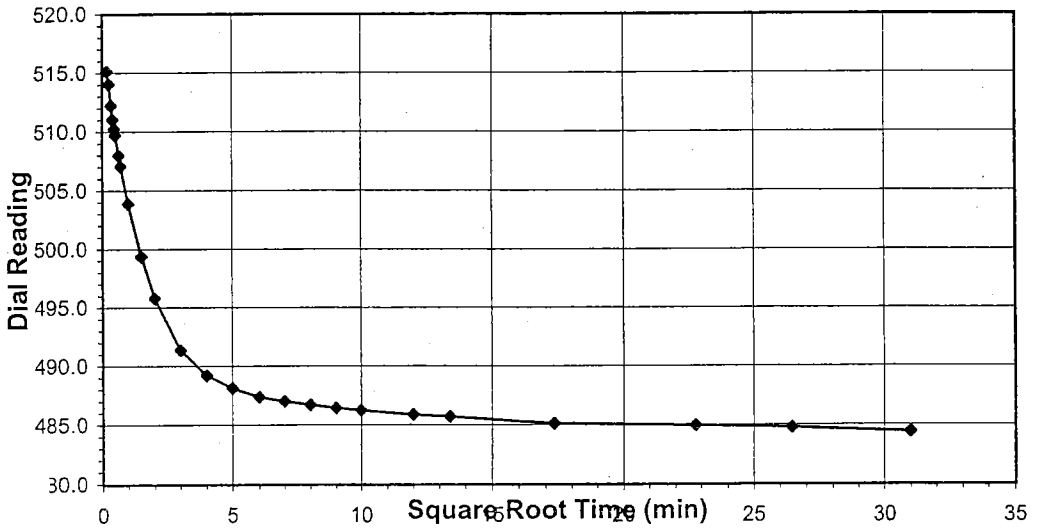
ONE DIMENSIONAL CONSOLIDATION

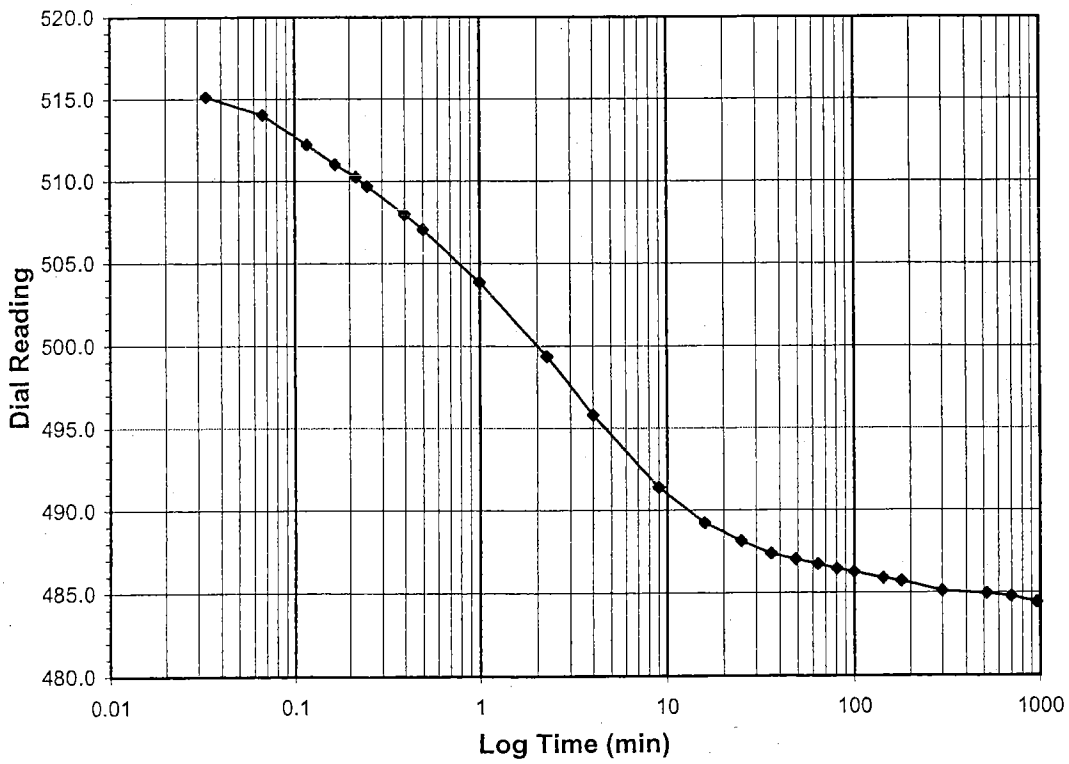
ASTM D 2435-04 / AASHTO T216-03 (SOP-S24)

Client	CIVIL & ENVIRONMENTAL CONSULTANTS	Boring No.	NA
Client Project	APEX SANITARY L.F. 072-002	Depth (ft)	NA
Project No.	2008-026-41	Sample No.	SR-6
Lab ID	2008-026-41-01	Visual Description	GRAY CLAY (-#4 MATERIAL)

Sample Conditions: REMOLDED, INUNDATED AND DOUBLE DRAINED

NOTE: 1.5 TSF WAS APPLIED TO STOP SWELL. THIS IS NOT INCLUDED IN THE LOADING INCREMENTS.





Test Load (tsf)	**16.0-4.0**
Final Reading (div)	**484.4**
Consolidometer No.	4
1 Division (in)	0.0001
Start Date	12/19/08
Start Time	14:39:35

Elapsed Time (min)	Dial Reading (div)
Initial	**565.7**
0.03	515.1
0.07	514.0
0.12	512.2
0.17	511.0
0.22	510.3
0.25	509.7
0.40	508.0
0.50	507.1
1.00	503.9
2.25	499.4
4.00	495.8
9.00	491.4
16.00	489.2
25.00	488.1
36.00	487.4
49.00	487.0
64.00	486.7
81.00	486.5
100.00	486.3
144.00	485.9
180.00	485.7
300.00	485.1
520.00	484.9
700.02	484.8
960.00	484.4

Tested By TM *Date* 12/19/08 *Checked By* DB *Date* 12/23/08

DCN: CT-24E Date: 3/2/98 Revision: 2

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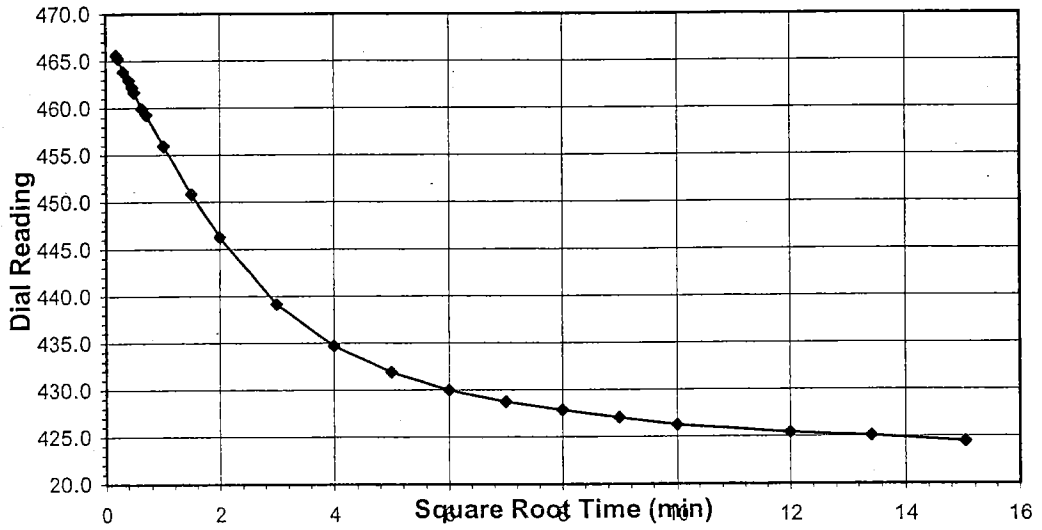
ONE DIMENSIONAL CONSOLIDATION

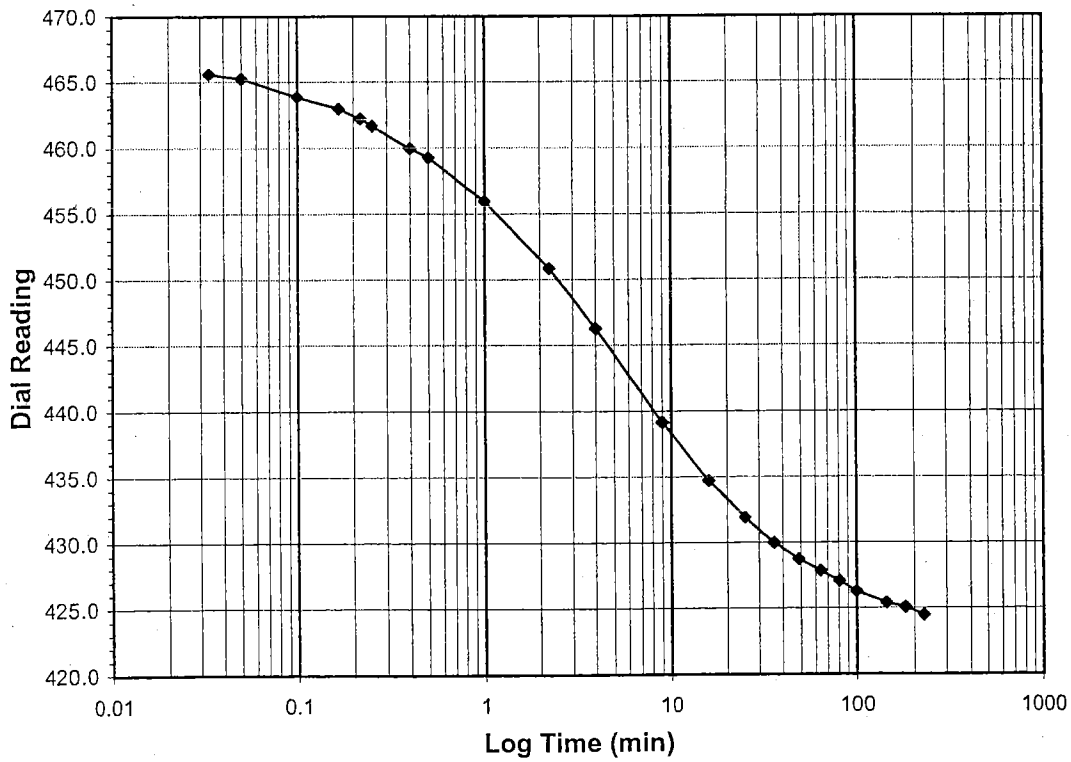
ASTM D 2435-04 / AASHTO T216-03 (SOP-S24)

Client	CIVIL & ENVIRONMENTAL CONSULTANTS	Boring No.	NA
Client Project	APEX SANITARY L.F. 072-002	Depth (ft)	NA
Project No.	2008-026-41	Sample No.	SR-6
Lab ID	2008-026-41-01	Visual Description	GRAY CLAY (-#4 MATERIAL)

Sample Conditions: REMOLDED, INUNDATED AND DOUBLE DRAINED

NOTE: 1.5 TSF WAS APPLIED TO STOP SWELL. THIS IS NOT INCLUDED IN THE LOADING INCREMENTS.





Test Load (tsf)	**4.0-1.0**
Final Reading (div)	**424.5**
Consolidometer No.	4
1 Division (in)	0.0001
Start Date	12/22/08
Start Time	7:50:35

Elapsed Time (min)	Dial Reading (div)
Initial	**484.4**
0.03	465.6
0.05	465.3
0.10	463.9
0.17	463.0
0.22	462.2
0.25	461.7
0.40	460.0
0.50	459.3
1.00	456.0
2.25	450.9
4.00	446.3
9.00	439.1
16.00	434.7
25.00	431.9
36.00	430.0
49.00	428.7
64.00	427.9
81.00	427.1
100.00	426.2
144.00	425.4
180.02	425.1
226.15	424.5

Tested By TM *Date* 12/22/08 *Checked By* DB *Date* 12/23/08

DCN: CT-24E Date: 3/2/98 Revision: 2

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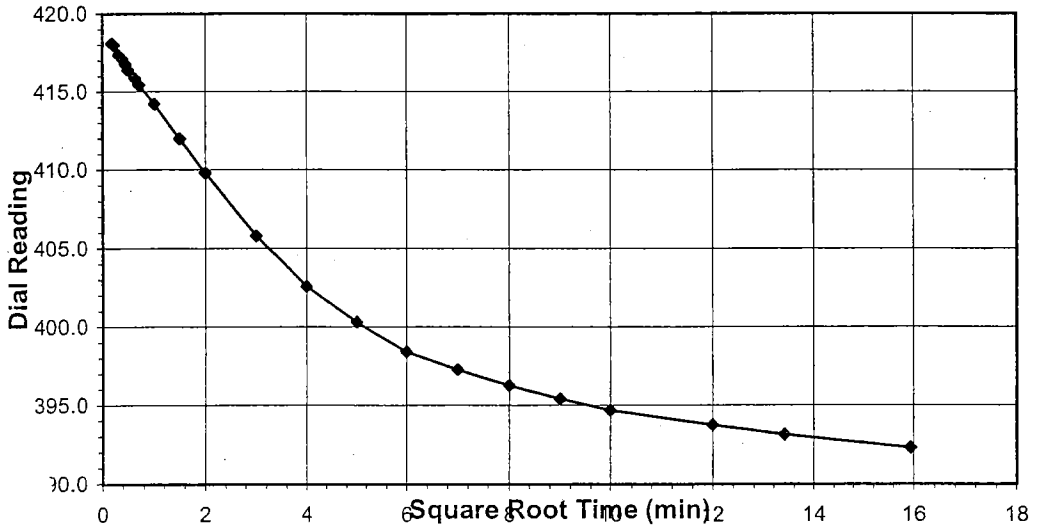
ONE DIMENSIONAL CONSOLIDATION

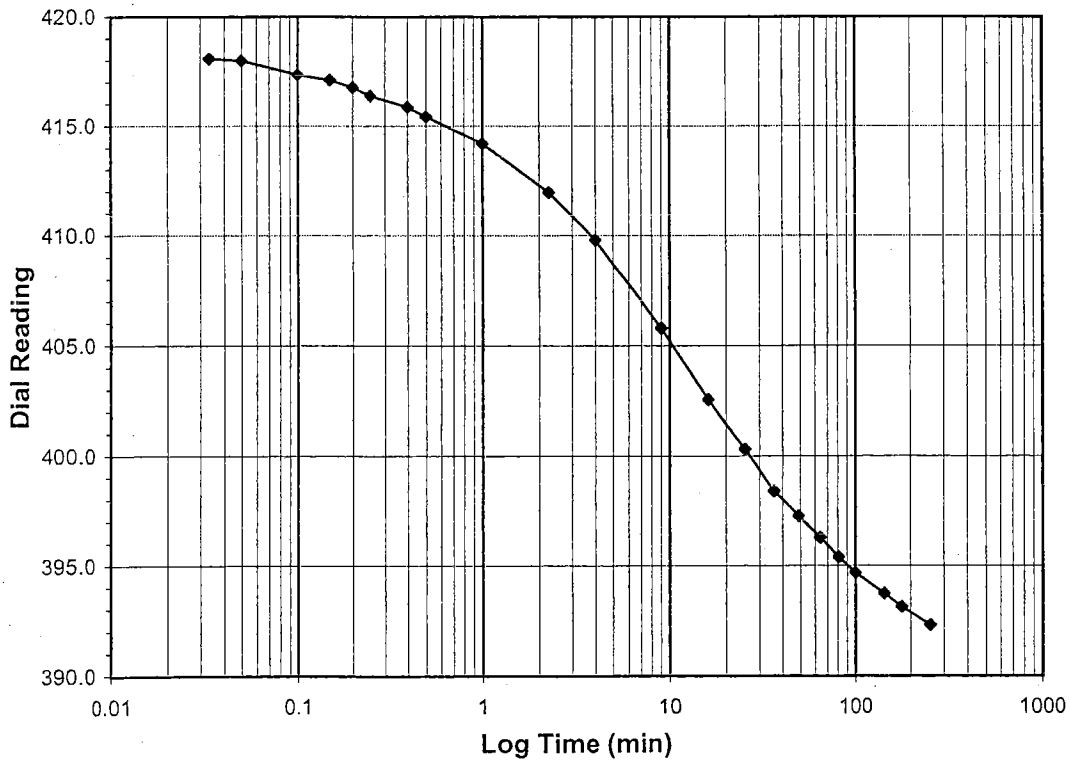
ASTM D 2435-04 / AASHTO T216-03 (SOP-S24)

Client	CIVIL & ENVIRONMENTAL CONSULTANTS	Boring No.	NA
Client Project	APEX SANITARY L.F. 072-002	Depth (ft)	NA
Project No.	2008-026-41	Sample No.	SR-6
Lab ID	2008-026-41-01	Visual Description	GRAY CLAY (-#4 MATERIAL)

Sample Conditions: REMOLDED, INUNDATED AND DOUBLE DRAINED

NOTE: 1.5 TSF WAS APPLIED TO STOP SWELL. THIS IS NOT INCLUDED IN THE LOADING INCREMENTS.





Test Load	**(tsf)**	**1.0-0.25**
Final Reading	**(div)**	**392.3**
Consolidometer No.		4
1 Division	(in)	0.0001
Start Date		12/22/08
Start Time		11:44:02

Elapsed Time (min)	Dial Reading (div)
Initial	**424.5**
0.03	418.1
0.05	418.0
0.10	417.3
0.15	417.1
0.20	416.8
0.25	416.4
0.40	415.9
0.50	415.4
1.00	414.2
2.25	412.0
4.00	409.8
9.00	405.8
16.00	402.6
25.00	400.3
36.00	398.4
49.00	397.3
64.00	396.3
81.00	395.4
100.02	394.7
144.00	393.7
180.00	393.1
254.37	392.3

Tested By TM *Date* 12/22/08 *Checked By* DB *Date* 12/23/08

DCN: CT-24E Date: 3/2/98 Revision: 2

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ONE-DIMENSIONAL CONSOLIDATION PROPERTIES OF SOILS
ASTM D 2435

Client	Civil & Environmental Consultant	Boring	SB-21
Client Project	091-867 Apex Landfill Expansion	Depth	9'-11'
Project No.	30598	Sample	ST-1
		Lab Sample No.	30598011

Visual Description: LIGHT OLIVE BROWN LEAN CLAY WITH GRAVEL
Sample Conditions: Undisturbed, Inundated, and Double Drained
Machine Deflection Correction: Applied

SAMPLE PROPERTIES		
	Initial	Final
Tare Number	A42	Z12
Wt. Tare & WS, gm	125.9	295.85
Wt. Tare & DS, gm	112.18	275.69
Wt. Tare, gm	9.49	123.26
Water Content, %	13.4%	13.2%
Sample Diameter, in	2.5	2.5
Sample Height, in	1.004	0.9224
Sample Volume, in^3	4.9290	4.5279
Wt. WS + Ring, gm	289.21	287.23
Wt. of Ring, gm	113.68	113.68
Wt. of WS, gm	175.53	173.55
Wet Density, pcf	135.61	145.95
Wet Density, g/cc	2.173	2.339
Water Content, %	13.4%	13.2%
Wt. of DS, gm	154.84	153.28
Dry Density, pcf	119.62	128.90
Dry Density, g/cc	1.917	2.066
Void Ratio, e	0.4449	0.3409
Saturation, %	83.2%	
Specific Gravity	2.77	Measured
Height of Solids, in	0.6949	0.6949

TEST DATA SUMMARY

Applied Pressure tsf	Load Duration min	Final Height in	Vertical Strain %	Dry Density g/cc	Void Ratio e	a_v ft^2/ton	Incremental C_c	Incremental C_r
Seating	NA	1.0041	0.00	1.9170	0.4449	NA	NA	NA
0.25	24	1.0018	0.23%	1.9215	0.4416	1.35E-02	NA	NA
0.5	190	0.9998	0.43%	1.9253	0.4388	1.12E-02	0.009	NA
1	60	0.9940	1.01%	1.9365	0.4304	1.67E-02	0.028	NA
2	758	0.9837	2.04%	1.9569	0.4155	1.49E-02	0.049	NA
4	190	0.9698	3.42%	1.9849	0.3955	1.00E-02	0.066	NA
1	120	0.9795	2.45%	1.9653	0.4095	4.65E-03	NA	NA
0.25	190	0.9899	1.42%	1.9446	0.4244	2.00E-02	NA	NA
0.5	758	0.9886	1.54%	1.9471	0.4226	7.20E-03	NA	0.006
1	240	0.9852	1.89%	1.9539	0.4177	9.93E-03	NA	0.016
2	95	0.9781	2.59%	1.9681	0.4075	1.02E-02	NA	0.034
4	95	0.9676	3.64%	1.9895	0.3923	7.55E-03	NA	0.050
8	955	0.9475	5.64%	2.0315	0.3635	7.21E-03	0.096	NA
16	240	0.9224	8.14%	2.0868	0.3274	4.51E-03	0.120	NA

C_r 0.037

Note: The calculations performed and the parameters presented herein are for preliminary purposes only. GTS only accepts responsibility for the raw data obtained from the consolidation tests. This data may be interpreted differently by others. It is the responsibility of the user to determine the appropriateness and accuracy of the computed values.

Input Validation | Reviewed By: | Date Tested: 12/8/2010 |

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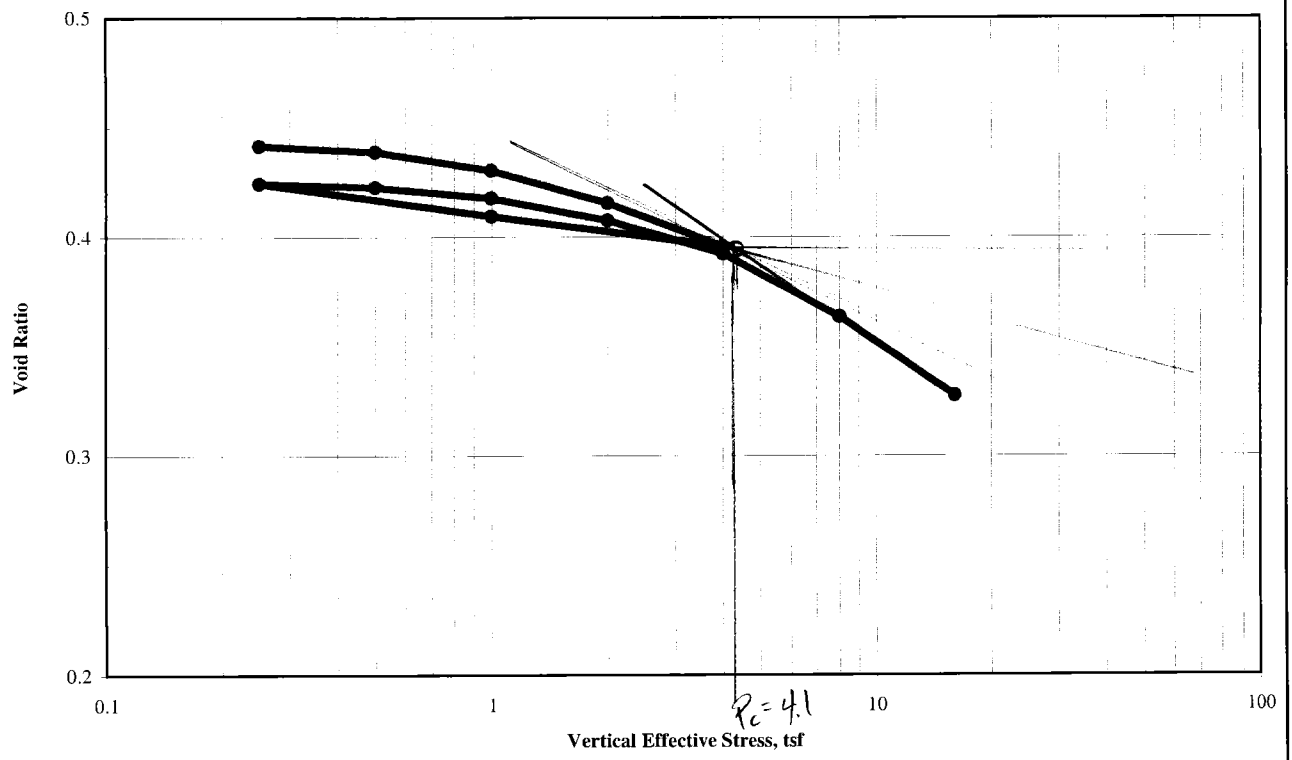
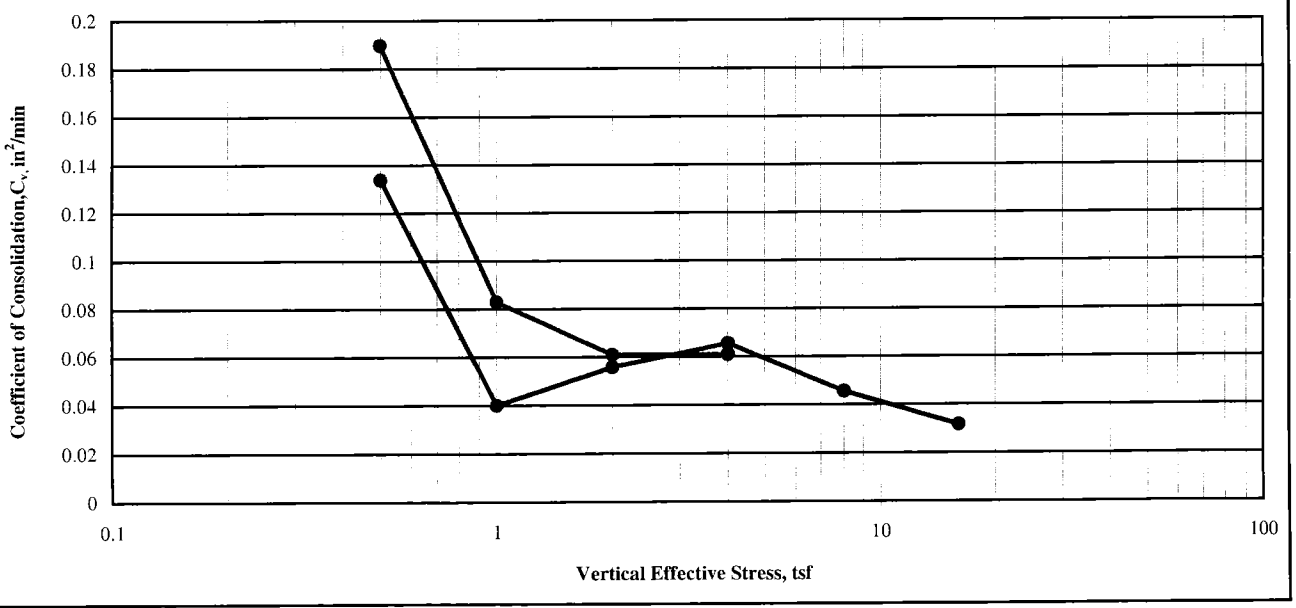
ONE-DIMENSIONAL CONSOLIDATION PROPERTIES OF SOILS
ASTM D 2435

Client	Civil & Environmental Consultants, Inc.	Boring	SB-21
Client Project	091-867 Apex Landfill Expansion	Depth	9'-11'
Project No.	30598	Sample	ST-1
		Lab Sample No.	30598011
Visual Description	LIGHT OLIVE BROWN LEAN CLAY WITH GRAVEL		
Sample Conditions	Undisturbed, Inundated, and Double Drained		
Machine Deflection Correction:	Applied		

Void Ratio (Final Height) vs Vertical Effective Consolidation Stress



Coeffieicent of Consolidation (log. method) vs. Vertical Effective Consolidation Stress



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ONE-DIMENSIONAL CONSOLIDATION PROPERTIES OF SOILS
ASTM D 2435

Client	Civil & Environmental Consultant	Boring	SB-21	**Test Load, tsf**	**0-0.25**
Client Project	091-867 Apex Landfill Expansion	Depth	9'-11'		Load 1 of 13
Project No.	30598	Sample	ST-1		
		Lab ID#	30598011		

Visual Description: LIGHT OLIVE BROWN LEAN CLAY WITH GRAVEL
Test Conditions: Undisturbed, Inundated, and Double Drained

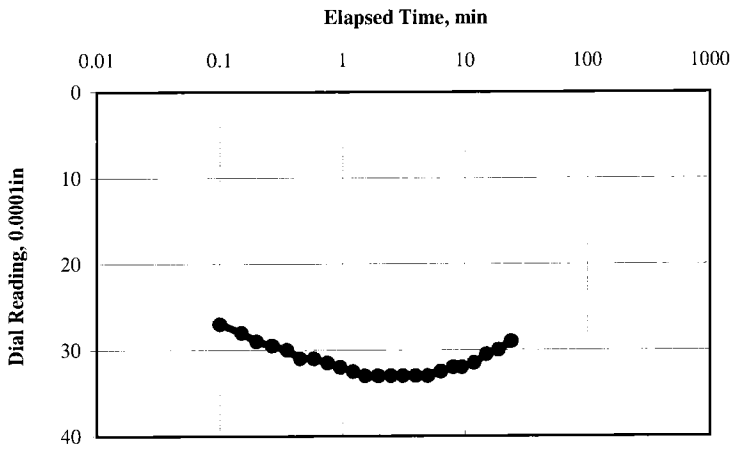
Time Vs. Dial Reading

Elapsed Time (min)	Sqrt Time ($min^{1/2}$)	Dial Reading (0.0001in)	Sample Height (in)	Void Ratio
0	0	0	1.0041	0.4449
Corrections*		-5.5	-0.00055	-0.0008
Adjusted Sample Height & Void Ratio				
0.10	0.32	27.0	1.0020	0.4418
0.15	0.39	28.0	1.0019	0.4417
0.20	0.45	29.0	1.0018	0.4416
0.27	0.52	29.5	1.0017	0.4415
0.35	0.59	30.0	1.0017	0.4414
0.45	0.67	31.0	1.0016	0.4413
0.58	0.76	31.0	1.0016	0.4413
0.75	0.87	31.5	1.0015	0.4412
0.95	0.97	32.0	1.0015	0.4411
1.22	1.10	32.5	1.0014	0.4411
1.53	1.24	33.0	1.0014	0.4410
1.95	1.40	33.0	1.0014	0.4410
2.47	1.57	33.0	1.0014	0.4410
3.12	1.77	33.0	1.0014	0.4410
3.95	1.99	33.0	1.0014	0.4410
4.98	2.23	33.0	1.0014	0.4410
6.30	2.51	32.5	1.0014	0.4411
7.95	2.82	32.0	1.0015	0.4411
9.40	3.07	32.0	1.0015	0.4411
11.85	3.44	31.5	1.0015	0.4412
14.95	3.87	30.5	1.0016	0.4413
18.85	4.34	30.0	1.0017	0.4414
23.77	4.88	29.0	1.0018	0.4416

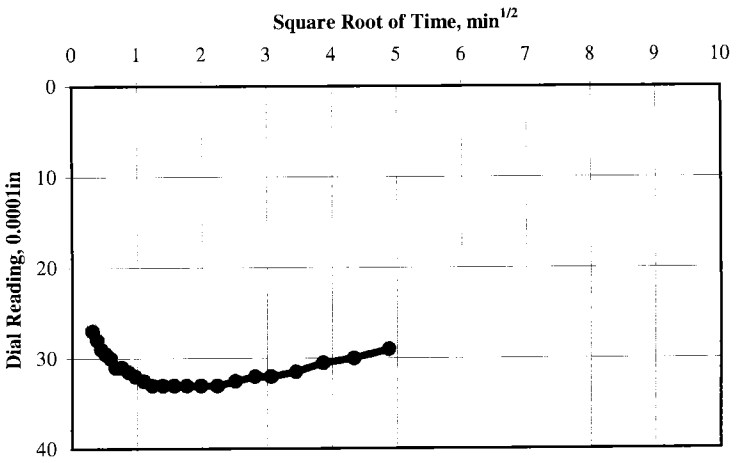
Machine Deflection

Applied Deflection Correction to Sample Height, 0.0001in: -5.5
**Correction is applied to all dial readings.*

Log of Elapsed Time vs. Dial Reading



Square Root of Elapsed Time vs. Dial Reading



Sqrt. of Elapsed Time vs Dial Reading

Log of Elapsed Time vs Dial Reading

Specimen Swelled

Load Summary

Initial Sample Height, in	1.0041
Initial Sample Void Ratio	0.4449
Final Sample Height, in	1.0018
Final Sample Void Ratio	0.4416
Incremental Strain, %	0.23%
Loading Duration, min	23.766667

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ONE-DIMENSIONAL CONSOLIDATION PROPERTIES OF SOILS
ASTM D 2435

Client	Civil & Environmental Consultant	Boring	SB-21	**Test Load, tsf 0.25-0.5**
Client Project	091-867 Apex Landfill Expansion	Depth	9'-11'	Load 2 of 13
Project No.	30598	Sample	ST-1	
		Lab ID#	30598011	
Visual Description	LIGHT OLIVE BROWN LEAN CLAY WITH GRAVEL			
Test Conditions:	Undisturbed, Inundated, and Double Drained			

Time Vs. Dial Reading

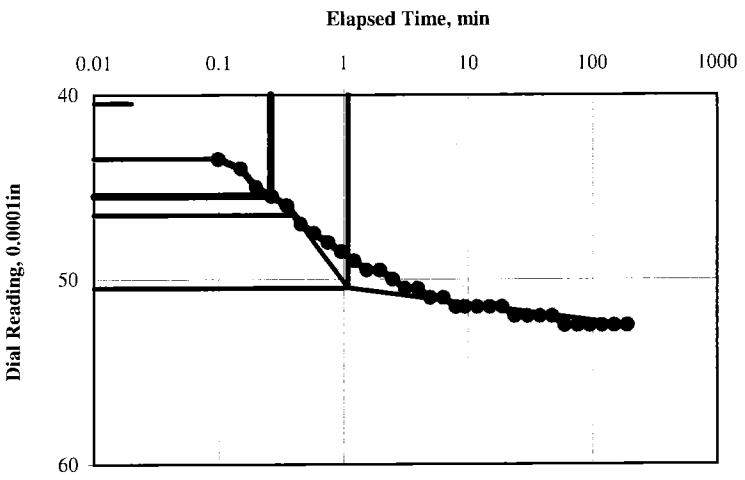
Elapsed Time (min)	Sqrt Time ($min^{1/2}$)	Dial Reading (0.0001in)	Sample Height (in)	Void Ratio
0	0	29.0	1.0018	0.4416
Corrections*		-4	-0.0004	-0.0006
Adjusted Sample Height & Void Ratio				
0.10	0.32	43.5	1.0007	0.4400
0.15	0.39	44.0	1.0007	0.4400
0.20	0.45	45.0	1.0006	0.4398
0.27	0.52	45.5	1.0005	0.4398
0.35	0.59	46.0	1.0005	0.4397
0.45	0.67	47.0	1.0004	0.4395
0.58	0.76	47.5	1.0003	0.4395
0.75	0.87	48.0	1.0003	0.4394
0.95	0.97	48.5	1.0002	0.4393
1.22	1.10	49.0	1.0002	0.4393
1.53	1.24	49.5	1.0001	0.4392
1.95	1.40	49.5	1.0001	0.4392
2.47	1.57	50.0	1.0001	0.4391
3.12	1.77	50.5	1.0000	0.4390
3.95	1.99	50.5	1.0000	0.4390
4.98	2.23	51.0	1.0000	0.4390
6.30	2.51	51.0	1.0000	0.4390
7.95	2.82	51.5	0.9999	0.4389
9.40	3.07	51.5	0.9999	0.4389
11.85	3.44	51.5	0.9999	0.4389
14.95	3.87	51.5	0.9999	0.4389
18.85	4.34	51.5	0.9999	0.4389
23.77	4.88	52.0	0.9999	0.4388
29.95	5.47	52.0	0.9999	0.4388
37.75	6.14	52.0	0.9999	0.4388
47.57	6.90	52.0	0.9999	0.4388
59.95	7.74	52.5	0.9998	0.4388
75.95	8.71	52.5	0.9998	0.4388
94.95	9.74	52.5	0.9998	0.4388
119.95	10.95	52.5	0.9998	0.4388
150.95	12.29	52.5	0.9998	0.4388
189.95	13.78	52.5	0.9998	0.4388

Machine Deflection

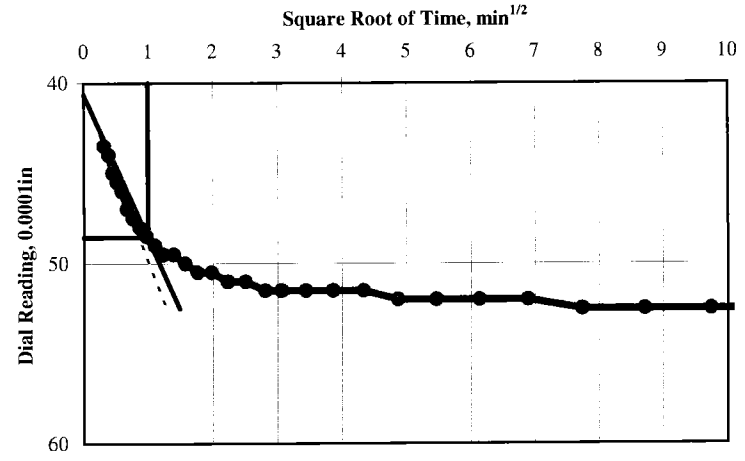
Applied Deflection Correction to Sample Height, 0.0001in -4

**Correction is applied to all dial readings.*

Log of Elapsed Time vs. Dial Reading



Square Root of Elapsed Time vs. Dial Reading



Sqrt. of Elapsed Time vs Dial Reading		Log of Elapsed Time vs Dial Reading		Load Summary	
T0 = 0 min.	D0 = 40.6 div.	T0 = 0 min.	D0 = 40.5 div.		
T90 = 0.98 min	D90 = 48.6 div.	T50 = 0.26 min.	D50 = 45.5 div.	Initial Sample Height, in	1.0018
T100 = NA min	D100 = 49.4 div.	T100 = 1.08 min.	D100 = 50.5 div.	Initial Sample Void Ratio	0.4416
Height at: D90 = 1.0002, D100 = 1.0001		Height at: D50 = 1.0005, D100 = 1		Final Sample Height, in	0.9998
Average Sample Height, in	1.0008	Average Sample Height, in	1.0008	Final Sample Void Ratio	0.4388
Average Drainage Height, in	0.5004	Average Drainage Height, in	0.5004	Incremental Strain, %	0.19%
T (Time Factor for T90)	0.848	T (Time Factor for T50)	0.197	Loading Duration, min	189.95
Coef. of Consol., C_v, in^2/min	0.217	Coef. of Consol., C_v, in^2/min	0.190		

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ONE-DIMENSIONAL CONSOLIDATION PROPERTIES OF SOILS
ASTM D 2435

Client	Civil & Environmental Consultant	Boring	SB-21	**Test Load, tsf**	**0.5-1**
Client Project	091-867 Apex Landfill Expansion	Depth	9'-11'		Load 3 of 13
Project No.	30598	Sample	ST-1		
		Lab ID#	30598011		

Visual Description: LIGHT OLIVE BROWN LEAN CLAY WITH GRAVEL
Test Conditions: Undisturbed, Inundated, and Double Drained

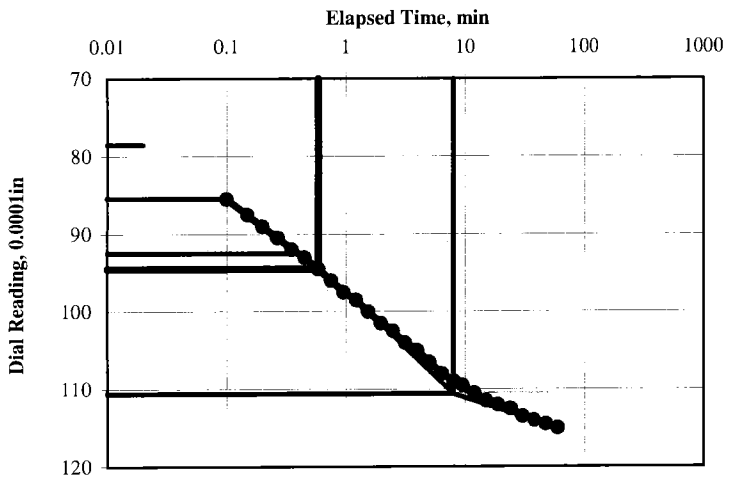
Time Vs. Dial Reading

Elapsed Time (min)	Sqrt Time ($min^{1/2}$)	Dial Reading (0.0001in)	Sample Height (in)	Void Ratio
0	0	52.5	0.9998	0.4388
Corrections*		-4.5	-0.00045	-0.0006
Adjusted Sample Height & Void Ratio				
0.10	0.32	85.5	0.9970	0.4346
0.15	0.39	87.5	0.9968	0.4344
0.20	0.45	89.0	0.9966	0.4341
0.27	0.52	90.5	0.9965	0.4339
0.35	0.59	92.0	0.9963	0.4337
0.45	0.67	93.0	0.9962	0.4336
0.58	0.76	94.5	0.9961	0.4334
0.75	0.87	96.0	0.9959	0.4331
0.95	0.97	97.5	0.9958	0.4329
1.22	1.10	98.5	0.9957	0.4328
1.53	1.24	100.0	0.9955	0.4326
1.95	1.40	101.5	0.9954	0.4323
2.47	1.57	102.5	0.9953	0.4322
3.12	1.77	104.0	0.9951	0.4320
3.95	1.99	105.0	0.9950	0.4318
4.98	2.23	106.5	0.9949	0.4316
6.30	2.51	108.0	0.9947	0.4314
7.95	2.82	109.0	0.9946	0.4313
9.40	3.07	109.5	0.9946	0.4312
11.85	3.44	110.5	0.9945	0.4311
14.95	3.87	111.5	0.9944	0.4309
18.85	4.34	112.0	0.9943	0.4308
23.77	4.88	112.5	0.9943	0.4308
29.95	5.47	113.5	0.9942	0.4306
37.75	6.14	114.0	0.9941	0.4305
47.57	6.90	114.5	0.9941	0.4305
59.95	7.74	115.0	0.9940	0.4304

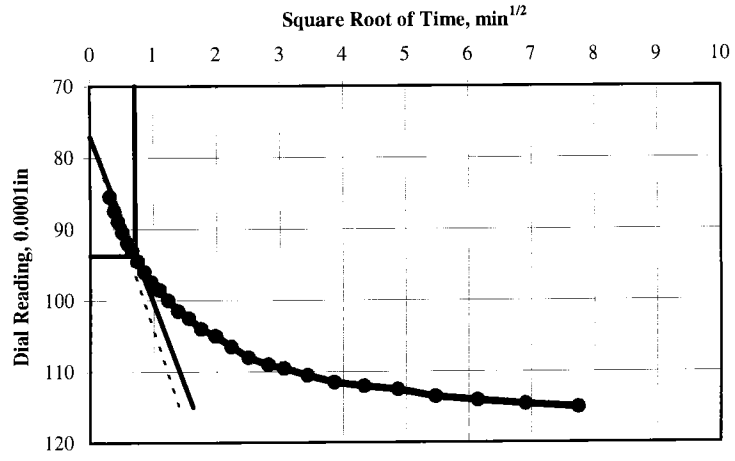
Machine Deflection

Applied Deflection Correction to Sample Height, 0.0001in: -4.5
**Correction is applied to all dial readings.*

Log of Elapsed Time vs. Dial Reading



Square Root of Elapsed Time vs. Dial Reading



Sqrt. of Elapsed Time vs Dial Reading		Log of Elapsed Time vs Dial Reading		Load Summary	
T0 = 0 min.	D0 = 77.1 div.	T0 = 0 min.	D0 = 78.5 div.		
T90 = 0.518 min	D90 = 93.7 div.	T50 = 0.59 min.	D50 = 94.5 div.	Initial Sample Height, in	0.9998
T100 = NA min	D100 = 95.6 div.	T100 = 7.88 min.	D100 = 110.6 div.	Initial Sample Void Ratio	0.4388
Height at: D90 = 0.9962, D100 = 0.996		Height at: D50 = 0.9961, D100 = 0.9945		Final Sample Height, in	0.9940
Average Sample Height, in	0.9969	Average Sample Height, in	0.9969	Final Sample Void Ratio	0.4304
Average Drainage Height, in	0.4985	Average Drainage Height, in	0.4985	Incremental Strain, %	0.58%
T (Time Factor for T90)	0.848	T (Time Factor for T50)	0.197	Loading Duration, min	59.95
Coef. of Consol., C_v, in^2/min	0.411	Coef. of Consol., C_v, in^2/min	0.083		

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ONE-DIMENSIONAL CONSOLIDATION PROPERTIES OF SOILS
ASTM D 2435

Client	Civil & Environmental Consultant	Boring	SB-21	**Test Load, tsf**	**1-2**
Client Project	091-867 Apex Landfill Expansion	Depth	9'-11'		Load 4 of 13
Project No.	30598	Sample	ST-1		
		Lab ID#	30598011		

Visual Description: LIGHT OLIVE BROWN LEAN CLAY WITH GRAVEL
Test Conditions: Undisturbed, Inundated, and Double Drained

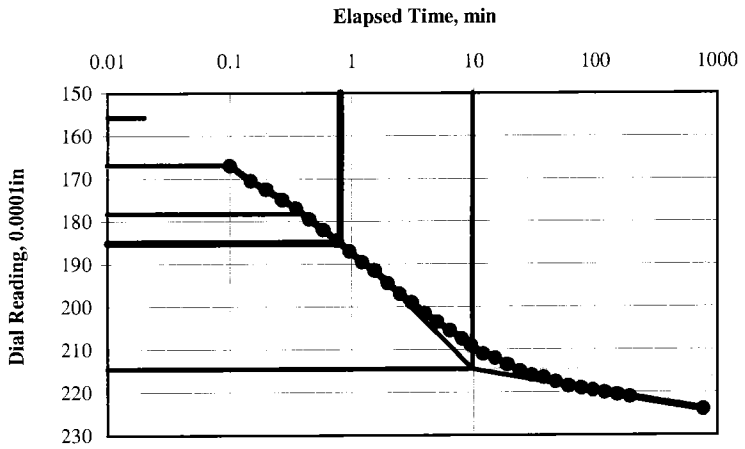
Time Vs. Dial Reading

Elapsed Time (min)	Sqrt Time ($min^{1/2}$)	Dial Reading (0.0001in)	Sample Height (in)	Void Ratio
0	0	115.0	0.9940	0.4304
Corrections*		-5.5	-0.00055	-0.0008
Adjusted Sample Height & Void Ratio				
0.10	0.32	167.0	0.9894	0.4237
0.15	0.39	170.5	0.9890	0.4232
0.20	0.45	172.5	0.9888	0.4229
0.27	0.52	175.0	0.9886	0.4226
0.35	0.59	177.0	0.9884	0.4223
0.45	0.67	179.5	0.9881	0.4219
0.58	0.76	182.0	0.9879	0.4216
0.75	0.87	184.5	0.9876	0.4212
0.95	0.97	187.0	0.9874	0.4208
1.22	1.10	189.5	0.9871	0.4205
1.53	1.24	191.5	0.9869	0.4202
1.95	1.40	194.5	0.9866	0.4198
2.47	1.57	197.0	0.9864	0.4194
3.12	1.77	199.0	0.9862	0.4191
3.95	1.99	201.5	0.9859	0.4187
4.98	2.23	203.5	0.9857	0.4185
6.30	2.51	205.5	0.9855	0.4182
7.95	2.82	207.5	0.9853	0.4179
9.40	3.07	209.0	0.9852	0.4177
11.85	3.44	211.0	0.9850	0.4174
14.95	3.87	212.0	0.9849	0.4172
18.85	4.34	213.5	0.9847	0.4170
23.77	4.88	215.0	0.9846	0.4168
29.95	5.47	216.0	0.9845	0.4167
37.75	6.14	216.5	0.9844	0.4166
47.57	6.90	217.5	0.9843	0.4164
59.95	7.74	218.5	0.9842	0.4163
75.95	8.71	219.0	0.9842	0.4162
94.95	9.74	219.5	0.9841	0.4162
119.95	10.95	220.0	0.9841	0.4161
150.95	12.29	220.5	0.9840	0.4160
189.95	13.78	221.0	0.9840	0.4159
757.95	27.53	224.0	0.9837	0.4155

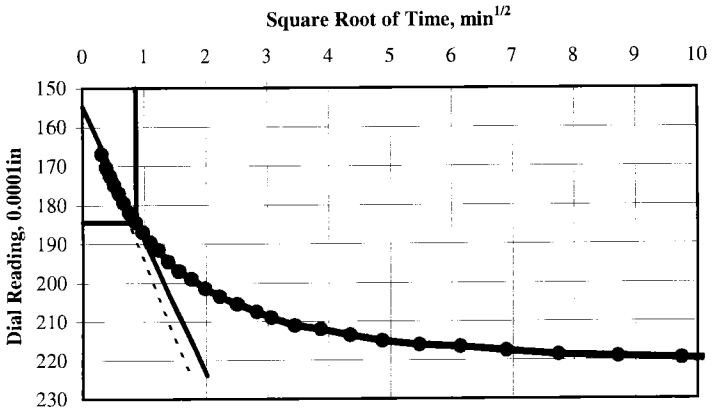
Machine Deflection

Applied Deflection Correction to Sample Height, 0.0001in: -5.5
**Correction is applied to all dial readings.*

Log of Elapsed Time vs. Dial Reading



Square Root of Elapsed Time vs. Dial Reading



Sqrt. of Elapsed Time vs Dial Reading		Log of Elapsed Time vs Dial Reading		Load Summary	
T0 = 0 min.	D0 = 154.8 div.	T0 = 0 min.	D0 = 155.7 div.		
T90 = 0.74 min	D90 = 184.5 div.	T50 = 0.79 min.	D50 = 185.1 div.	Initial Sample Height, in	0.9940
T100 = NA min	D100 = 187.8 div.	T100 = 9.73 min.	D100 = 214.6 div.	Initial Sample Void Ratio	0.4304
Height at: D90 = 0.9876, D100 = 0.9873		Height at: D50 = 0.9876, D100 = 0.9846		Final Sample Height, in	0.9837
Average Sample Height, in	0.9889	Average Sample Height, in	0.9889	Final Sample Void Ratio	0.4155
Average Drainage Height, in	0.4944	Average Drainage Height, in	0.4944	Incremental Strain, %	1.04%
T (Time Factor for T90)	0.848	T (Time Factor for T50)	0.197	Loading Duration, min	757.95
Coef. of Consol., C_v, in^2/min	0.277	Coef. of Consol., C_v, in^2/min	0.061		

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ONE-DIMENSIONAL CONSOLIDATION PROPERTIES OF SOILS
ASTM D 2435

Client	Civil & Environmental Consultant	Boring	SB-21	**Test Load, tsf**	**2-4**
Client Project	091-867 Apex Landfill Expansion	Depth	9'-11'		Load 5 of 13
Project No.	30598	Sample	ST-1		
		Lab ID#	30598011		

Visual Description: LIGHT OLIVE BROWN LEAN CLAY WITH GRAVEL
Test Conditions: Undisturbed, Inundated, and Double Drained

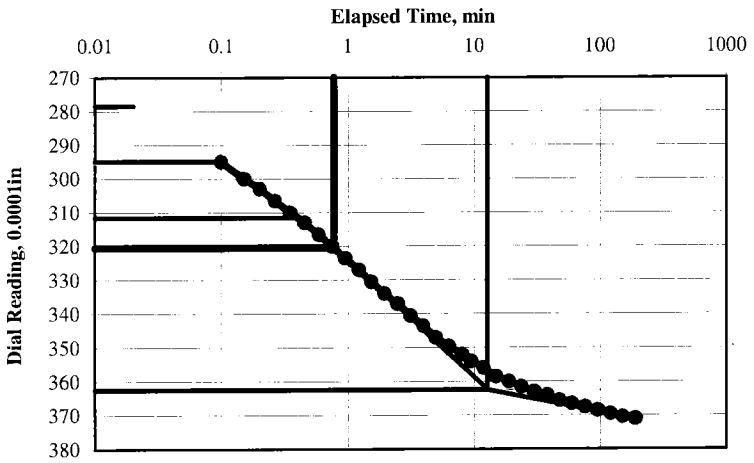
Time Vs. Dial Reading

Elapsed Time (min)	Sqrt Time ($min^{1/2}$)	Dial Reading (0.0001in)	Sample Height (in)	Void Ratio
0	0	224.0	0.9837	0.4155
Corrections*		-8	-0.0008	-0.0012
Adjusted Sample Height & Void Ratio				
0.10	0.32	295.0	0.9774	0.4064
0.15	0.39	300.0	0.9769	0.4057
0.20	0.45	303.0	0.9766	0.4053
0.27	0.52	306.5	0.9762	0.4048
0.35	0.59	310.0	0.9759	0.4043
0.45	0.67	313.0	0.9756	0.4039
0.58	0.76	316.5	0.9752	0.4034
0.75	0.87	320.0	0.9749	0.4028
0.95	0.97	323.5	0.9745	0.4023
1.22	1.10	327.0	0.9742	0.4018
1.53	1.24	330.5	0.9738	0.4013
1.95	1.40	334.0	0.9735	0.4008
2.47	1.57	337.0	0.9732	0.4004
3.12	1.77	340.5	0.9728	0.3999
3.95	1.99	343.5	0.9725	0.3995
4.98	2.23	347.0	0.9722	0.3990
6.30	2.51	349.5	0.9719	0.3986
7.95	2.82	352.0	0.9717	0.3982
9.40	3.07	354.0	0.9715	0.3980
11.85	3.44	356.0	0.9713	0.3977
14.95	3.87	358.5	0.9710	0.3973
18.85	4.34	360.0	0.9709	0.3971
23.77	4.88	361.5	0.9707	0.3969
29.95	5.47	363.0	0.9706	0.3967
37.75	6.14	364.0	0.9705	0.3965
47.57	6.90	365.5	0.9703	0.3963
59.95	7.74	366.5	0.9702	0.3962
75.95	8.71	367.5	0.9701	0.3960
94.95	9.74	368.5	0.9700	0.3959
119.95	10.95	369.5	0.9699	0.3957
150.95	12.29	370.5	0.9698	0.3956
189.95	13.78	371.0	0.9698	0.3955

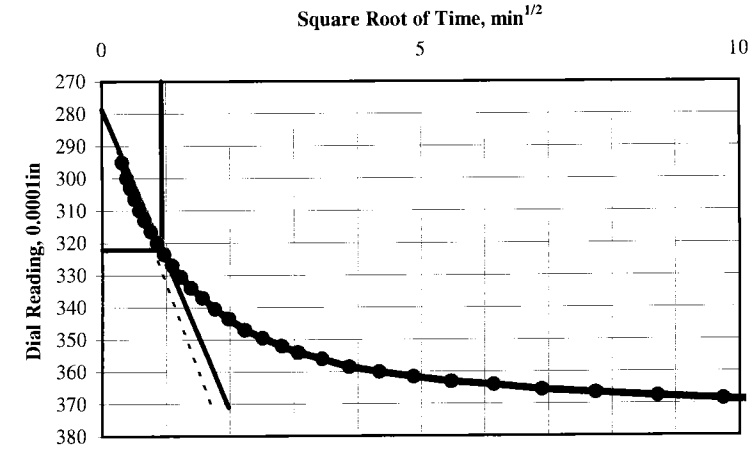
Machine Deflection

Applied Deflection Correction to Sample Height, 0.0001in: -8
**Correction is applied to all dial readings.*

Log of Elapsed Time vs. Dial Reading



Square Root of Elapsed Time vs. Dial Reading



Sqrt. of Elapsed Time vs Dial Reading		Log of Elapsed Time vs Dial Reading		Load Summary	
T0 = 0 min.	D0 = 278.7 div.	T0 = 0 min.	D0 = 278.4 div.		
T90 = 0.865 min	D90 = 322.1 div.	T50 = 0.77 min.	D50 = 320.4 div.	Initial Sample Height, in	0.9837
T100 = NA min	D100 = 326.9 div.	T100 = 12.7 min.	D100 = 362.5 div.	Initial Sample Void Ratio	0.4155
Height at: D90 = 0.9747, D100 = 0.9742		Height at: D50 = 0.9748, D100 = 0.9706		Final Sample Height, in	0.9698
Average Sample Height, in	0.9767	Average Sample Height, in	0.9767	Final Sample Void Ratio	0.3955
Average Drainage Height, in	0.4884	Average Drainage Height, in	0.4884	Incremental Strain, %	1.41%
T (Time Factor for T90)	0.848	T (Time Factor for T50)	0.197	Loading Duration, min	189.95
Coef. of Consol., C_v, in^2/min	0.233	Coef. of Consol., C_v, in^2/min	0.061		

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ONE-DIMENSIONAL CONSOLIDATION PROPERTIES OF SOILS
ASTM D 2435

Client	Civil & Environmental Consultant	Boring	SB-21	**Test Load, tsf**	**4-1**
Client Project	091-867 Apex Landfill Expansion	Depth	9'-11'		Load 6 of 13
Project No.	30598	Sample	ST-1		
		Lab ID#	30598011		
Visual Description	LIGHT OLIVE BROWN LEAN CLAY WITH GRAVEL				
Test Conditions:	Undisturbed, Inundated, and Double Drained				

Time Vs. Dial Reading

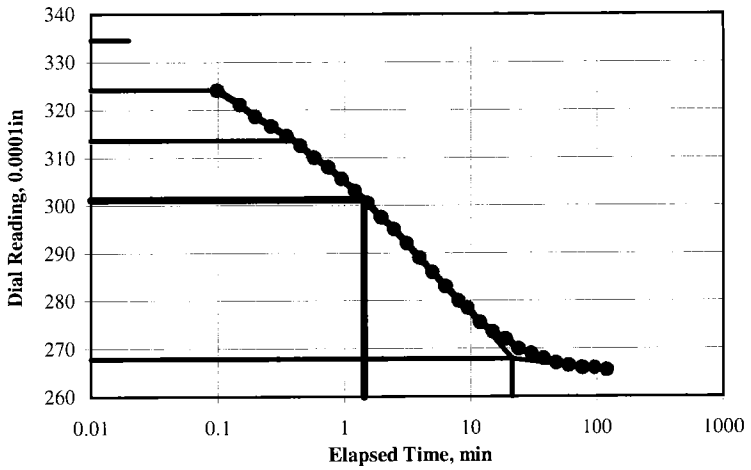
Elapsed Time (min)	Sqrt Time ($min^{1/2}$)	Dial Reading (0.0001in)	Sample Height (in)	Void Ratio
0	0	371.0	0.9698	0.3955
Corrections*		8.5	0.00085	0.00122
Adjusted Sample Height & Void Ratio				
0.10	0.32	324.0	0.9736	0.4010
0.15	0.39	321.0	0.9739	0.4015
0.20	0.45	318.5	0.9742	0.4018
0.27	0.52	316.5	0.9744	0.4021
0.35	0.59	314.5	0.9746	0.4024
0.45	0.67	312.5	0.9748	0.4027
0.58	0.76	310.0	0.9750	0.4031
0.75	0.87	308.0	0.9752	0.4034
0.95	0.97	305.5	0.9755	0.4037
1.22	1.10	303.0	0.9757	0.4041
1.53	1.24	300.5	0.9760	0.4044
1.95	1.40	297.5	0.9763	0.4049
2.47	1.57	295.0	0.9765	0.4052
3.12	1.77	292.0	0.9768	0.4057
3.95	1.99	289.0	0.9771	0.4061
4.98	2.23	286.0	0.9774	0.4065
6.30	2.51	283.0	0.9777	0.4069
7.95	2.82	280.0	0.9780	0.4074
9.40	3.07	278.5	0.9782	0.4076
11.85	3.44	275.5	0.9785	0.4080
14.95	3.87	273.5	0.9787	0.4083
18.85	4.34	272.0	0.9788	0.4085
23.77	4.88	270.0	0.9790	0.4088
29.95	5.47	269.0	0.9791	0.4090
37.75	6.14	268.0	0.9792	0.4091
47.57	6.90	267.0	0.9793	0.4093
59.95	7.74	266.5	0.9794	0.4093
75.95	8.71	266.0	0.9794	0.4094
94.95	9.74	266.0	0.9794	0.4094
119.95	10.95	265.5	0.9795	0.4095

Machine Deflection

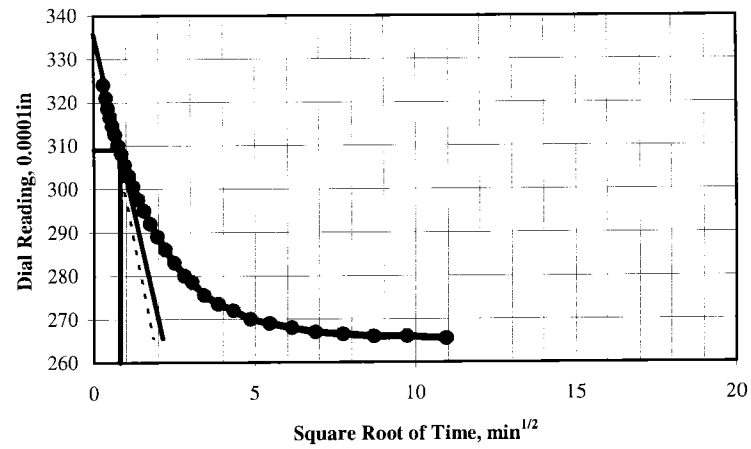
Applied Deflection Correction to Sample Height, 0.0001in 8.5

**Correction is applied to all dial readings.*

Log of Elapsed Time vs. Dial Reading



Square Root of Elapsed Time vs. Dial Reading



Sqrt. of Elapsed Time vs Dial Reading		Log of Elapsed Time vs Dial Reading		Load Summary	
T0 = 0 min.	D0 = 335.8 div.	T0 = 0 min.	D0 = 334.6 div.		
T90 = 0.656 min	D90 = 309.1 div.	T50 = 1.43 min.	D50 = 301.2 div.	Initial Sample Height, in	0.9698
T100 = NA min	D100 = 306.1 div.	T100 = 21.35 min.	D100 = 267.9 div.	Initial Sample Void Ratio	0.3955
Height at: D90 = 0.9751, D100 = 0.9754		Height at: D50 = 0.9759, D100 = 0.9792		Final Sample Height, in	0.9795
Average Sample Height, in	0.9746	Average Sample Height, in	0.9746	Final Sample Void Ratio	0.4095
Average Drainage Height, in	0.4873	Average Drainage Height, in	0.4873	Incremental Strain, %	-1.00%
T (Time Factor for T90)	0.848	T (Time Factor for T50)	0.197	Loading Duration, min	119.95
Coef. of Consol., C_v, in^2/min	0.306	Coef. of Consol., C_v, in^2/min	0.033		

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ONE-DIMENSIONAL CONSOLIDATION PROPERTIES OF SOILS
ASTM D 2435

Client	Civil & Environmental Consultant	Boring	SB-21	**Test Load, tsf**	**1-0.25**
Client Project	091-867 Apex Landfill Expansion	Depth	9'-11'		Load 7 of 13
Project No.	30598	Sample	ST-1		
		Lab ID#	30598011		
Visual Description	LIGHT OLIVE BROWN LEAN CLAY WITH GRAVEL				
Test Conditions:	Undisturbed, Inundated, and Double Drained				

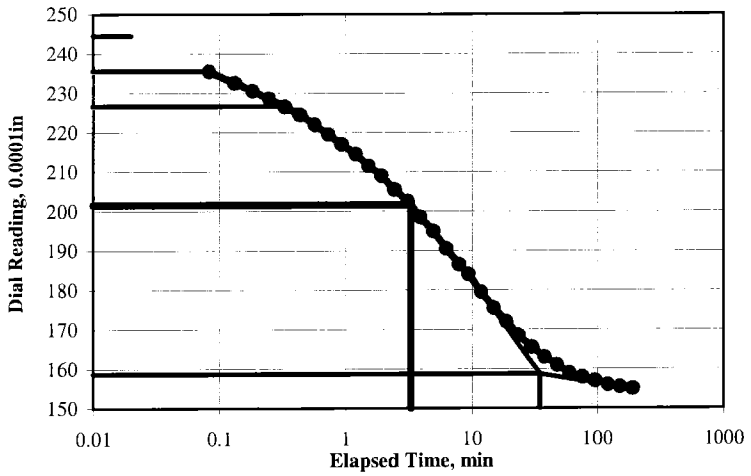
Time Vs. Dial Reading				
Elapsed Time (min)	**Sqrt Time ($min^{1/2}$)**	**Dial Reading (0.0001in)**	**Sample Height (in)**	**Void Ratio**
0	0	265.5	0.9795	0.4095
Corrections*		6.5	0.00065	0.00094
Adjusted Sample Height & Void Ratio				
0.08	0.29	235.5	0.9818	0.4128
0.13	0.37	232.5	0.9821	0.4133
0.18	0.43	230.5	0.9823	0.4136
0.25	0.50	228.5	0.9825	0.4139
0.33	0.58	226.5	0.9827	0.4141
0.43	0.66	224.5	0.9829	0.4144
0.57	0.75	222.0	0.9832	0.4148
0.73	0.86	219.5	0.9834	0.4152
0.93	0.97	217.0	0.9837	0.4155
1.20	1.10	214.5	0.9839	0.4159
1.52	1.23	211.5	0.9842	0.4163
1.93	1.39	209.0	0.9845	0.4167
2.45	1.57	205.5	0.9848	0.4172
3.10	1.76	202.5	0.9851	0.4176
3.93	1.98	198.5	0.9855	0.4182
4.97	2.23	195.0	0.9859	0.4187
6.28	2.51	190.5	0.9863	0.4193
7.93	2.82	186.5	0.9867	0.4199
9.38	3.06	184.0	0.9870	0.4203
11.83	3.44	179.5	0.9874	0.4209
14.93	3.86	175.5	0.9878	0.4215
18.83	4.34	172.0	0.9882	0.4220
23.75	4.87	168.5	0.9885	0.4225
29.93	5.47	165.5	0.9888	0.4229
37.73	6.14	163.0	0.9891	0.4233
47.55	6.90	161.0	0.9893	0.4236
59.93	7.74	159.0	0.9895	0.4239
75.93	8.71	158.0	0.9896	0.4240
94.93	9.74	157.0	0.9897	0.4241
119.93	10.95	156.0	0.9898	0.4243
150.93	12.29	155.5	0.9898	0.4244
189.93	13.78	155.0	0.9899	0.4244

Machine Deflection

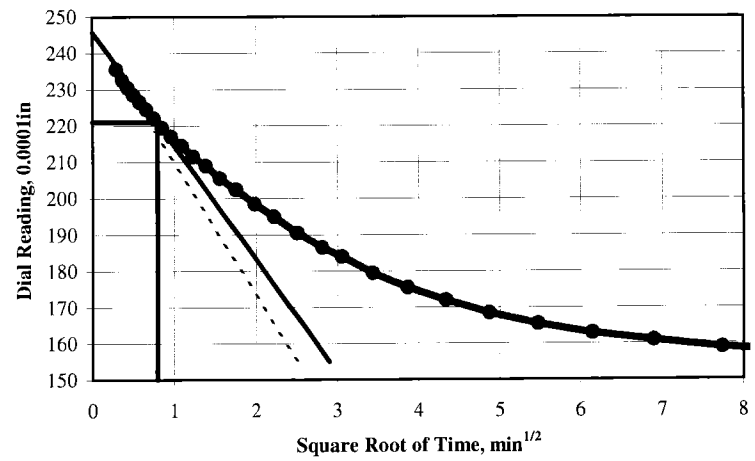
Applied Deflection Correction to Sample Height, 0.0001in 6.5

**Correction is applied to all dial readings.*

Log of Elapsed Time vs. Dial Reading



Square Root of Elapsed Time vs. Dial Reading



Sqrt. of Elapsed Time vs Dial Reading			
T0 = 0 min.	D0 = 245.8 div.		
T90 = 0.624 min	D90 = 221.1 div.		
T100 = NA min	D100 = 218.4 div.		
Height at: D90 = 0.9833, D100 = 0.9835			
Average Sample Height, in	0.9847		
Average Drainage Height, in	0.4923		
T (Time Factor for T90)	0.848		
Coef. of Consol., C_v, in^2/min	0.330		

Log of Elapsed Time vs Dial Reading			
T0 = 0 min.	D0 = 244.5 div.		
T50 = 3.27 min.	D50 = 201.6 div.		
T100 = 34.57 min.	D100 = 158.7 div.		
Height at: D50 = 0.9852, D100 = 0.9895			
Average Sample Height, in	0.9847		
Average Drainage Height, in	0.4923		
T (Time Factor for T50)	0.197		
Coef. of Consol., C_v, in^2/min	0.015		

Load Summary	
Initial Sample Height, in	0.9795
Initial Sample Void Ratio	0.4095
Final Sample Height, in	0.9899
Final Sample Void Ratio	0.4244
Incremental Strain, %	-1.06%
Loading Duration, min	189.93333

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ONE-DIMENSIONAL CONSOLIDATION PROPERTIES OF SOILS
ASTM D 2435

Client	Civil & Environmental Consultant	Boring	SB-21	**Test Load, tsf 0.25-0.5**
Client Project	091-867 Apex Landfill Expansion	Depth	9'-11'	Load 8 of 13
Project No.	30598	Sample	ST-1	
		Lab ID#	30598011	

Visual Description: LIGHT OLIVE BROWN LEAN CLAY WITH GRAVEL
Test Conditions: Undisturbed, Inundated, and Double Drained

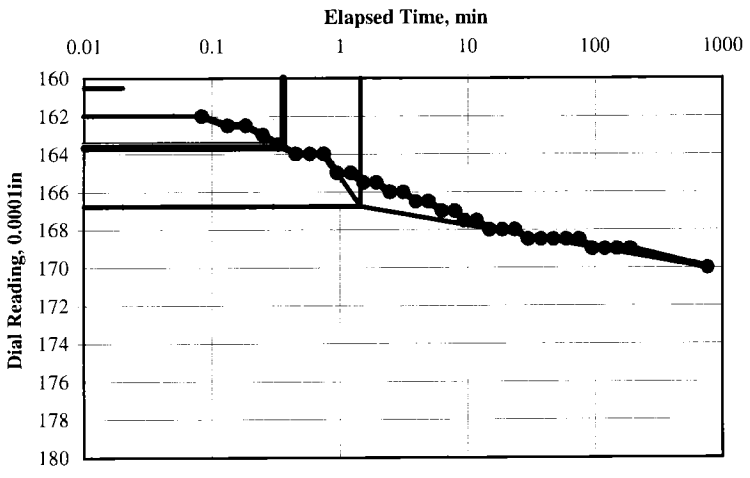
Time Vs. Dial Reading

Elapsed Time (min)	Sqrt Time ($min^{1/2}$)	Dial Reading (0.0001in)	Sample Height (in)	Void Ratio
0	0	155.0	0.9899	0.4244
Corrections*		-2.5	-0.00025	-0.0004
Adjusted Sample Height & Void Ratio				
0.08	0.29	162.0	0.9894	0.4238
0.13	0.37	162.5	0.9894	0.4237
0.18	0.43	162.5	0.9894	0.4237
0.25	0.50	163.0	0.9893	0.4236
0.33	0.58	163.5	0.9893	0.4236
0.45	0.67	164.0	0.9892	0.4235
0.58	0.76	164.0	0.9892	0.4235
0.75	0.87	164.0	0.9892	0.4235
0.95	0.97	165.0	0.9891	0.4234
1.22	1.10	165.0	0.9891	0.4234
1.53	1.24	165.5	0.9891	0.4233
1.95	1.40	165.5	0.9891	0.4233
2.47	1.57	166.0	0.9890	0.4232
3.13	1.77	166.0	0.9890	0.4232
3.95	1.99	166.5	0.9890	0.4231
4.98	2.23	166.5	0.9890	0.4231
6.30	2.51	167.0	0.9889	0.4231
7.95	2.82	167.0	0.9889	0.4231
9.40	3.07	167.5	0.9889	0.4230
11.85	3.44	167.5	0.9889	0.4230
14.95	3.87	168.0	0.9888	0.4229
18.85	4.34	168.0	0.9888	0.4229
23.77	4.88	168.0	0.9888	0.4229
29.95	5.47	168.5	0.9888	0.4228
37.75	6.14	168.5	0.9888	0.4228
47.57	6.90	168.5	0.9888	0.4228
59.95	7.74	168.5	0.9888	0.4228
75.95	8.71	168.5	0.9888	0.4228
94.95	9.74	169.0	0.9887	0.4228
119.95	10.95	169.0	0.9887	0.4228
150.95	12.29	169.0	0.9887	0.4228
189.95	13.78	169.0	0.9887	0.4228
757.95	27.53	170.0	0.9886	0.4226

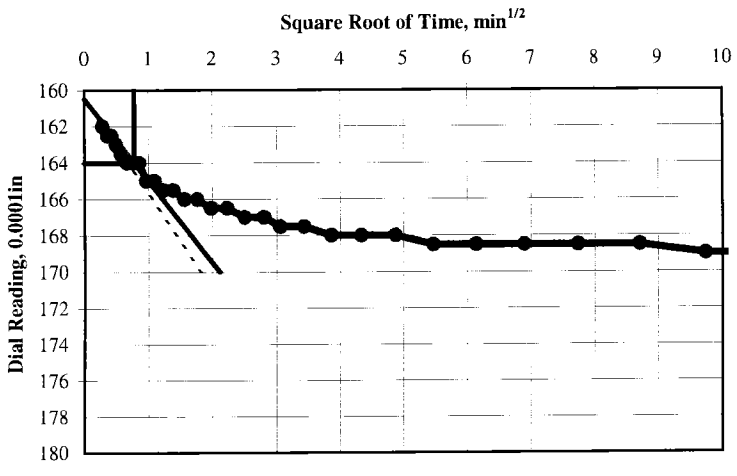
Machine Deflection

Applied Deflection Correction to Sample Height, 0.0001in: -2.5
**Correction is applied to all dial readings.*

Log of Elapsed Time vs. Dial Reading



Square Root of Elapsed Time vs. Dial Reading



Sqrt. of Elapsed Time vs Dial Reading

T0 = 0 min.	D0 = 160.5 div.
T90 = 0.608 min	D90 = 164 div.
T100 = NA min	D100 = 164.4 div.
Height at: D90 = 0.9892, D100 = 0.9892	
Average Sample Height, in	0.9893
Average Drainage Height, in	0.4946
T (Time Factor for T90)	0.848
Coef. of Consol., C_v, in^2/min	0.339

Log of Elapsed Time vs Dial Reading

T0 = 0 min.	D0 = 160.5 div.
T50 = 0.36 min.	D50 = 163.6 div.
T100 = 1.44 min.	D100 = 166.8 div.
Height at: D50 = 0.9893, D100 = 0.9889	
Average Sample Height, in	0.9893
Average Drainage Height, in	0.4946
T (Time Factor for T50)	0.197
Coef. of Consol., C_v, in^2/min	0.134

Load Summary

Initial Sample Height, in	0.9899
Initial Sample Void Ratio	0.4244
Final Sample Height, in	0.9886
Final Sample Void Ratio	0.4226
Incremental Strain, %	0.13%
Loading Duration, min	757.95

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ONE-DIMENSIONAL CONSOLIDATION PROPERTIES OF SOILS
ASTM D 2435

Client	Civil & Environmental Consultant	Boring	SB-21	**Test Load, tsf**	**0.5-1**
Client Project	091-867 Apex Landfill Expansion	Depth	9'-11'		Load 9 of 13
Project No.	30598	Sample	ST-1		
		Lab ID#	30598011		
Visual Description	LIGHT OLIVE BROWN LEAN CLAY WITH GRAVEL				
Test Conditions:	Undisturbed, Inundated, and Double Drained				

Time Vs. Dial Reading

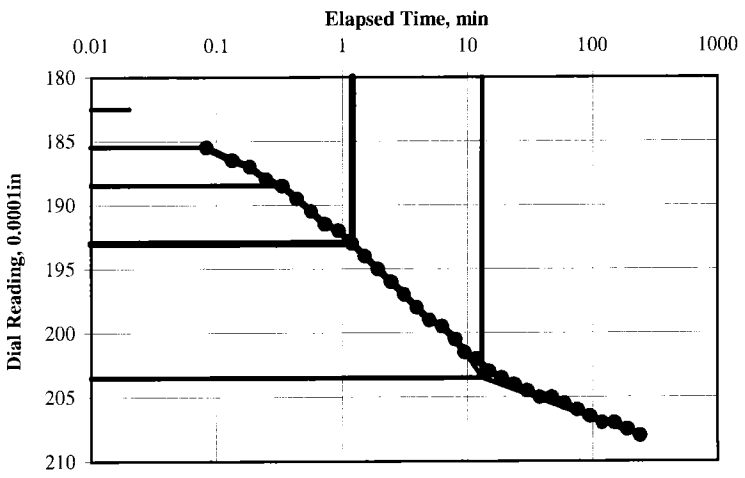
Elapsed Time (min)	Sqrt Time ($min^{1/2}$)	Dial Reading (0.0001in)	Sample Height (in)	Void Ratio
0	0	170.0	0.9886	0.4226
Corrections*		-3.5	-0.00035	-0.0005
Adjusted Sample Height & Void Ratio				
0.08	0.29	185.5	0.9874	0.4209
0.13	0.37	186.5	0.9873	0.4208
0.18	0.43	187.0	0.9873	0.4207
0.25	0.50	188.0	0.9872	0.4205
0.33	0.58	188.5	0.9871	0.4205
0.43	0.66	189.5	0.9870	0.4203
0.57	0.75	190.5	0.9869	0.4202
0.73	0.86	191.5	0.9868	0.4200
0.93	0.97	192.0	0.9868	0.4200
1.20	1.10	193.0	0.9867	0.4198
1.52	1.23	194.0	0.9866	0.4197
1.93	1.39	195.0	0.9865	0.4195
2.45	1.57	196.0	0.9864	0.4194
3.10	1.76	197.0	0.9863	0.4193
3.93	1.98	198.0	0.9862	0.4191
4.97	2.23	199.0	0.9861	0.4190
6.28	2.51	199.5	0.9860	0.4189
7.93	2.82	200.5	0.9859	0.4187
9.38	3.06	201.5	0.9858	0.4186
11.83	3.44	202.0	0.9858	0.4185
14.93	3.86	203.0	0.9857	0.4184
18.83	4.34	203.5	0.9856	0.4183
23.75	4.87	204.0	0.9856	0.4182
29.93	5.47	204.5	0.9855	0.4182
37.73	6.14	205.0	0.9855	0.4181
47.55	6.90	205.0	0.9855	0.4181
59.93	7.74	205.5	0.9854	0.4180
75.93	8.71	206.0	0.9854	0.4180
94.93	9.74	206.5	0.9853	0.4179
119.93	10.95	207.0	0.9853	0.4178
150.93	12.29	207.0	0.9853	0.4178
189.93	13.78	207.5	0.9852	0.4177
239.93	15.49	208.0	0.9852	0.4177

Machine Deflection

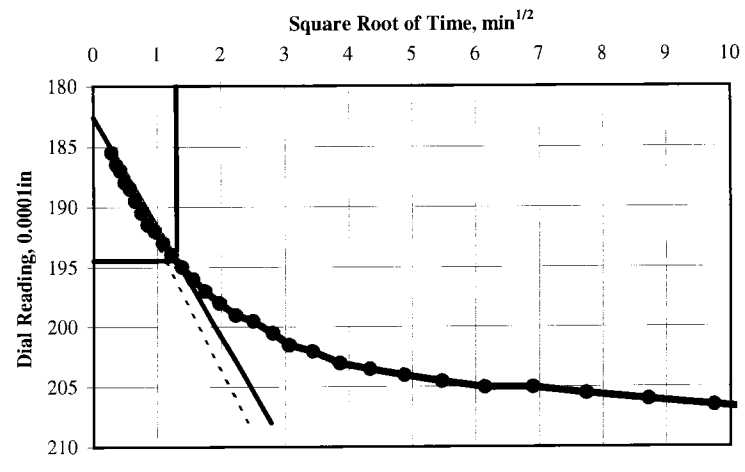
Applied Deflection Correction to Sample Height, 0.0001in -3.5

**Correction is applied to all dial readings.*

Log of Elapsed Time vs. Dial Reading



Square Root of Elapsed Time vs. Dial Reading



Sqrt. of Elapsed Time vs Dial Reading		Log of Elapsed Time vs Dial Reading		Load Summary	
T0 = 0 min.	D0 = 182.6 div.	T0 = 0 min.	D0 = 182.5 div.		
T90 = 1.69 min	D90 = 194.5 div.	T50 = 1.2 min.	D50 = 193 div.	Initial Sample Height, in	0.9886
T100 = NA min	D100 = 195.8 div.	T100 = 13.14 min.	D100 = 203.5 div.	Initial Sample Void Ratio	0.4226
Height at: D90 = 0.9865, D100 = 0.9864		Height at: D50 = 0.9867, D100 = 0.9856		Final Sample Height, in	0.9852
Average Sample Height, in	0.9869	Average Sample Height, in	0.9869	Final Sample Void Ratio	0.4177
Average Drainage Height, in	0.4935	Average Drainage Height, in	0.4935	Incremental Strain, %	0.35%
T (Time Factor for T90)	0.848	T (Time Factor for T50)	0.197	Loading Duration, min	239.93333
Coef. of Consol., C_v, in^2/min	0.121	Coef. of Consol., C_v, in^2/min	0.040		

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ONE-DIMENSIONAL CONSOLIDATION PROPERTIES OF SOILS
ASTM D 2435

Client	Civil & Environmental Consultant	Boring	SB-21	**Test Load, tsf**	**1-2**
Client Project	091-867 Apex Landfill Expansion	Depth	9'-11'		Load 10 of 13
Project No.	30598	Sample	ST-1		
		Lab ID#	30598011		

Visual Description: LIGHT OLIVE BROWN LEAN CLAY WITH GRAVEL
Test Conditions: Undisturbed, Inundated, and Double Drained

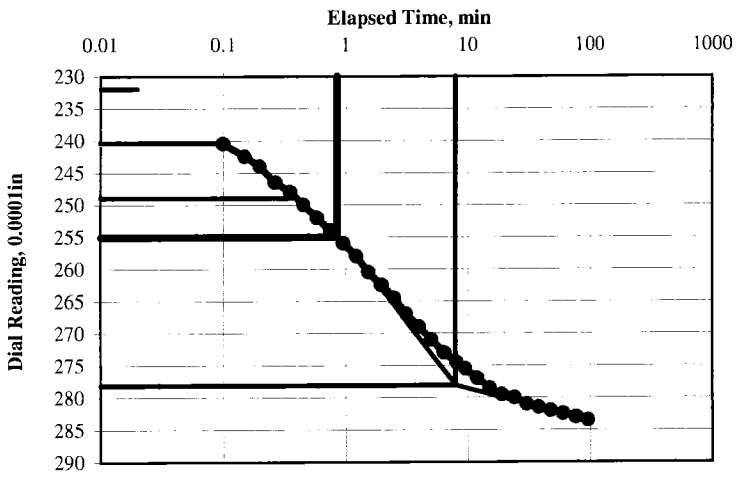
Time Vs. Dial Reading

Elapsed Time (min)	Sqrt Time ($min^{1/2}$)	Dial Reading (0.0001in)	Sample Height (in)	Void Ratio
0	0	208.0	0.9852	0.4177
Corrections*		-4.5	-0.00045	-0.0006
Adjusted Sample Height & Void Ratio				
0.10	0.32	240.5	0.9824	0.4136
0.15	0.39	242.5	0.9822	0.4134
0.20	0.45	244.0	0.9820	0.4131
0.27	0.52	246.5	0.9818	0.4128
0.35	0.59	248.0	0.9816	0.4126
0.45	0.67	250.0	0.9814	0.4123
0.58	0.76	252.0	0.9812	0.4120
0.75	0.87	254.0	0.9810	0.4117
0.95	0.97	256.0	0.9808	0.4114
1.22	1.10	258.0	0.9806	0.4111
1.53	1.24	260.5	0.9804	0.4108
1.95	1.40	262.5	0.9802	0.4105
2.47	1.57	264.5	0.9800	0.4102
3.12	1.77	267.0	0.9797	0.4098
3.95	1.99	269.0	0.9795	0.4095
4.98	2.23	271.0	0.9793	0.4093
6.30	2.51	273.0	0.9791	0.4090
7.95	2.82	274.5	0.9790	0.4087
9.40	3.07	275.5	0.9789	0.4086
11.85	3.44	277.0	0.9787	0.4084
14.95	3.87	278.5	0.9786	0.4082
18.85	4.34	279.5	0.9785	0.4080
23.77	4.88	280.0	0.9784	0.4080
29.95	5.47	281.0	0.9783	0.4078
37.75	6.14	281.5	0.9783	0.4077
47.57	6.90	282.0	0.9782	0.4077
59.95	7.74	282.5	0.9782	0.4076
75.95	8.71	283.0	0.9781	0.4075
94.95	9.74	283.5	0.9781	0.4075

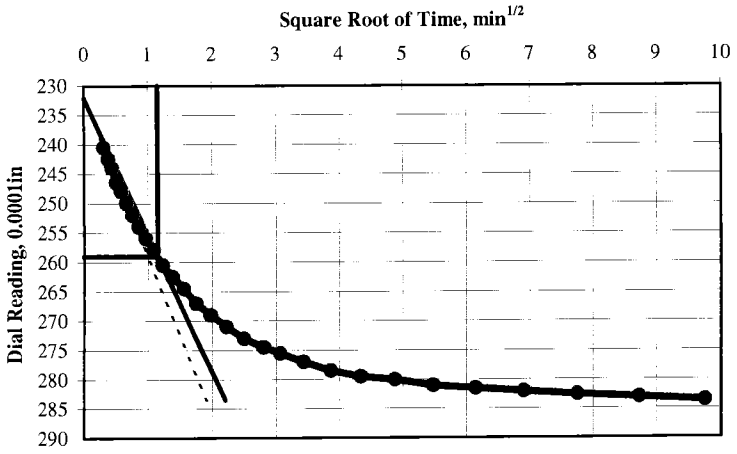
Machine Deflection

Applied Deflection Correction to Sample Height, 0.0001in: -4.5
**Correction is applied to all dial readings.*

Log of Elapsed Time vs. Dial Reading



Square Root of Elapsed Time vs. Dial Reading



Sqrt. of Elapsed Time vs Dial Reading			Log of Elapsed Time vs Dial Reading			Load Summary	
T0 = 0 min.	D0 = 232.1 div.		T0 = 0 min.	D0 = 231.9 div.			
T90 = 1.346 min	D90 = 259 div.		T50 = 0.85 min.	D50 = 255 div.		Initial Sample Height, in	0.9852
T100 = NA min	D100 = 262 div.		T100 = 7.8 min.	D100 = 278.1 div.		Initial Sample Void Ratio	0.4177
Height at: D90 = 0.9805, D100 = 0.9802			Height at: D50 = 0.9809, D100 = 0.9786			Final Sample Height, in	0.9781
Average Sample Height, in		0.9816	Average Sample Height, in		0.9816	Final Sample Void Ratio	0.4075
Average Drainage Height, in		0.4908	Average Drainage Height, in		0.4908	Incremental Strain, %	0.72%
T (Time Factor for T90)		0.848	T (Time Factor for T50)		0.197	Loading Duration, min	94.95
Coef. of Consol., C_v, in^2/min		0.152	Coef. of Consol., C_v, in^2/min		0.056		

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ONE-DIMENSIONAL CONSOLIDATION PROPERTIES OF SOILS
ASTM D 2435

Client	Civil & Environmental Consultant	Boring	SB-21	**Test Load, tsf**	**2-4**
Client Project	091-867 Apex Landfill Expansion	Depth	9'-11'		Load 11 of 13
Project No.	30598	Sample	ST-1		
		Lab ID#	30598011		

Visual Description: LIGHT OLIVE BROWN LEAN CLAY WITH GRAVEL
Test Conditions: Undisturbed, Inundated, and Double Drained

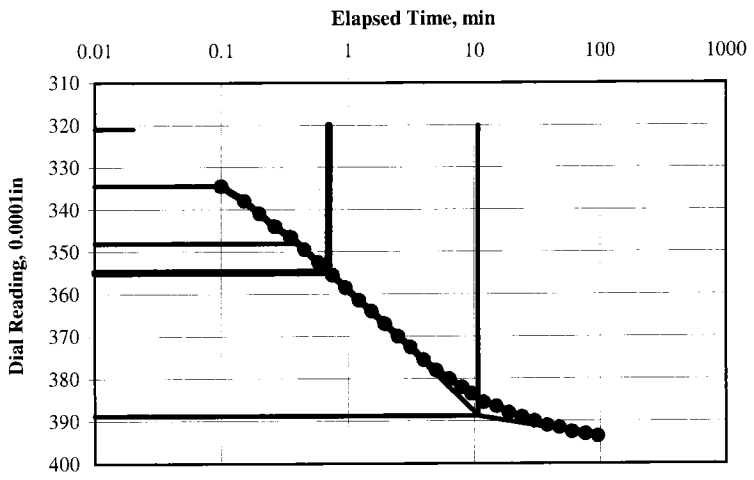
Time Vs. Dial Reading

Elapsed Time (min)	Sqrt Time ($min^{1/2}$)	Dial Reading (0.0001in)	Sample Height (in)	Void Ratio
0	0	283.5	0.9781	0.4075
Corrections*		-5	-0.0005	-0.0007
Adjusted Sample Height & Void Ratio				
0.10	0.32	334.5	0.9735	0.4008
0.15	0.39	338.0	0.9731	0.4003
0.20	0.45	341.0	0.9728	0.3999
0.27	0.52	344.0	0.9725	0.3995
0.35	0.59	346.5	0.9723	0.3991
0.45	0.67	349.5	0.9720	0.3987
0.58	0.76	352.5	0.9717	0.3982
0.75	0.87	355.5	0.9714	0.3978
0.95	0.97	358.5	0.9711	0.3974
1.22	1.10	361.5	0.9708	0.3969
1.53	1.24	364.0	0.9705	0.3966
1.95	1.40	367.0	0.9702	0.3962
2.47	1.57	370.0	0.9699	0.3957
3.12	1.77	372.5	0.9697	0.3954
3.95	1.99	375.5	0.9694	0.3949
4.98	2.23	378.0	0.9691	0.3946
6.30	2.51	380.0	0.9689	0.3943
7.95	2.82	382.0	0.9687	0.3940
9.40	3.07	383.5	0.9686	0.3938
11.85	3.44	385.5	0.9684	0.3935
14.95	3.87	386.5	0.9683	0.3934
18.85	4.34	388.0	0.9681	0.3931
23.77	4.88	389.0	0.9680	0.3930
29.95	5.47	390.0	0.9679	0.3928
37.75	6.14	391.0	0.9678	0.3927
47.57	6.90	391.5	0.9678	0.3926
59.95	7.74	392.5	0.9677	0.3925
75.95	8.71	393.0	0.9676	0.3924
94.95	9.74	393.5	0.9676	0.3923

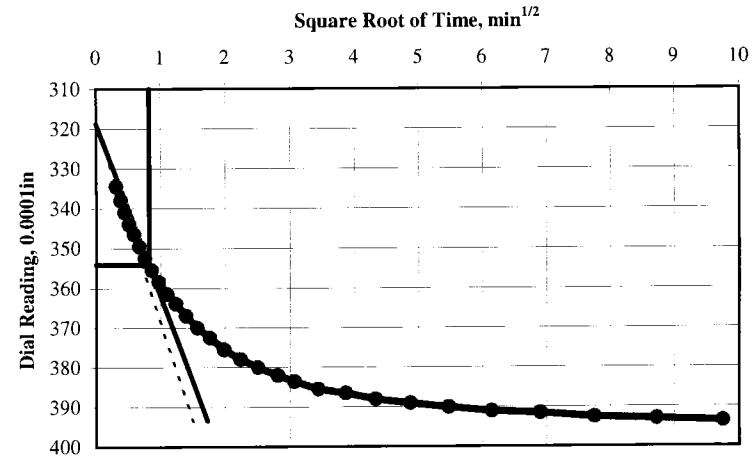
Machine Deflection

Applied Deflection Correction to Sample Height, 0.0001in: -5
**Correction is applied to all dial readings.*

Log of Elapsed Time vs. Dial Reading



Square Root of Elapsed Time vs. Dial Reading



Sqrt. of Elapsed Time vs Dial Reading

T0 = 0 min.	D0 = 318.8 div.
T90 = 0.672 min	D90 = 354.1 div.
T100 = NA min	D100 = 358 div.
Height at: D90 = 0.9715, D100 = 0.9711	
Average Sample Height, in	0.9728
Average Drainage Height, in	0.4864
T (Time Factor for T90)	0.848
Coef. of Consol., C_v, in^2/min	0.300

Log of Elapsed Time vs Dial Reading

T0 = 0 min.	D0 = 320.9 div.
T50 = 0.71 min.	D50 = 354.8 div.
T100 = 10.7 min.	D100 = 388.7 div.
Height at: D50 = 0.9714, D100 = 0.9681	
Average Sample Height, in	0.9728
Average Drainage Height, in	0.4864
T (Time Factor for T50)	0.197
Coef. of Consol., C_v, in^2/min	0.066

Load Summary

Initial Sample Height, in	0.9781
Initial Sample Void Ratio	0.4075
Final Sample Height, in	0.9676
Final Sample Void Ratio	0.3923
Incremental Strain, %	1.07%
Loading Duration, min	94.95

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ONE-DIMENSIONAL CONSOLIDATION PROPERTIES OF SOILS
ASTM D 2435

Client	Civil & Environmental Consultant	Boring	SB-21	**Test Load, tsf**	**4-8**
Client Project	091-867 Apex Landfill Expansion	Depth	9'-11'		Load 12 of 13
Project No.	30598	Sample	ST-1		
		Lab ID#	30598011		

Visual Description: LIGHT OLIVE BROWN LEAN CLAY WITH GRAVEL
Test Conditions: Undisturbed, Inundated, and Double Drained

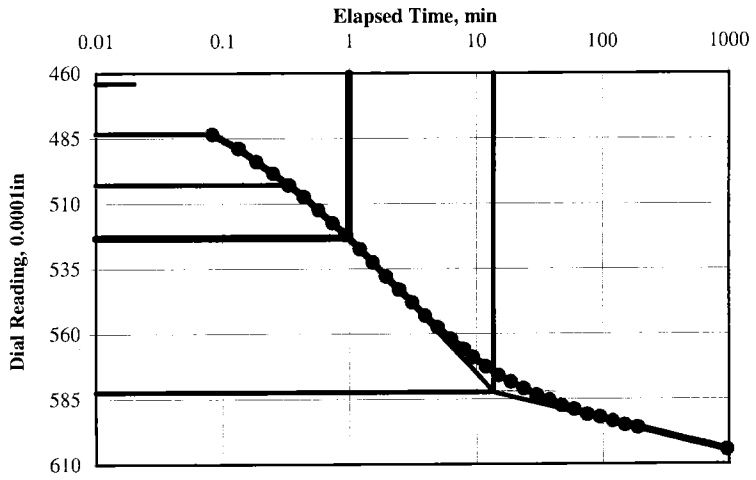
Time Vs. Dial Reading

Elapsed Time (min)	Sqrt Time ($min^{1/2}$)	Dial Reading (0.0001in)	Sample Height (in)	Void Ratio
0	0	393.5	0.9676	0.3923
Corrections*		-10.5	-0.00105	-0.0015
Adjusted Sample Height & Void Ratio				
0.08	0.29	483.5	0.9596	0.3809
0.13	0.37	489.0	0.9591	0.3801
0.18	0.43	494.0	0.9586	0.3794
0.25	0.50	498.5	0.9581	0.3787
0.33	0.58	503.0	0.9577	0.3781
0.43	0.66	507.5	0.9572	0.3774
0.57	0.75	512.5	0.9567	0.3767
0.73	0.86	517.5	0.9562	0.3760
0.93	0.97	522.0	0.9558	0.3754
1.20	1.10	527.5	0.9552	0.3746
1.52	1.23	532.5	0.9547	0.3739
1.93	1.39	538.0	0.9542	0.3731
2.45	1.57	543.0	0.9537	0.3723
3.10	1.76	548.0	0.9532	0.3716
3.93	1.98	553.0	0.9527	0.3709
4.97	2.23	557.5	0.9522	0.3703
6.28	2.51	562.0	0.9518	0.3696
7.93	2.82	566.0	0.9514	0.3690
9.38	3.06	569.0	0.9511	0.3686
11.83	3.44	572.5	0.9507	0.3681
14.93	3.86	576.0	0.9504	0.3676
18.83	4.34	578.5	0.9501	0.3672
23.75	4.87	581.0	0.9499	0.3669
29.93	5.47	583.5	0.9496	0.3665
37.73	6.14	585.5	0.9494	0.3662
47.55	6.90	587.5	0.9492	0.3659
59.93	7.74	589.0	0.9491	0.3657
75.93	8.71	591.0	0.9489	0.3654
94.93	9.74	592.0	0.9488	0.3653
119.93	10.95	593.5	0.9486	0.3651
150.93	12.29	595.0	0.9485	0.3649
189.93	13.78	596.0	0.9484	0.3647
954.93	30.90	604.5	0.9475	0.3635

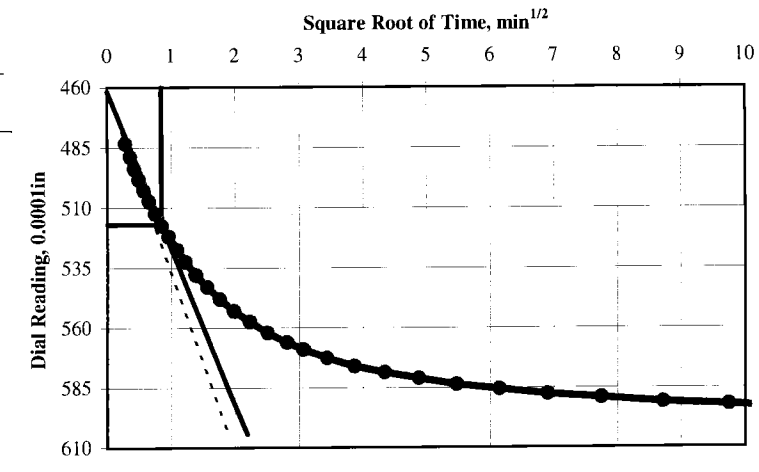
Machine Deflection

Applied Deflection Correction to Sample Height, 0.0001in: -10.5
**Correction is applied to all dial readings.*

Log of Elapsed Time vs. Dial Reading



Square Root of Elapsed Time vs. Dial Reading



Sqrt. of Elapsed Time vs Dial Reading		Log of Elapsed Time vs Dial Reading		Load Summary	
T0 = 0 min.	D0 = 461.7 div.	T0 = 0 min.	D0 = 464 div.		
T90 = 0.723 min	D90 = 517 div.	T50 = 0.99 min.	D50 = 523.2 div.	Initial Sample Height, in	0.9676
T100 = NA min	D100 = 523.1 div.	T100 = 13.77 min.	D100 = 582.5 div.	Initial Sample Void Ratio	0.3923
Height at: D90 = 0.9563, D100 = 0.9557		Height at: D50 = 0.9557, D100 = 0.9497		Final Sample Height, in	0.9475
Average Sample Height, in	0.9576	Average Sample Height, in	0.9576	Final Sample Void Ratio	0.3635
Average Drainage Height, in	0.4788	Average Drainage Height, in	0.4788	Incremental Strain, %	2.07%
T (Time Factor for T90)	0.848	T (Time Factor for T50)	0.197	Loading Duration, min	954.93333
Coef. of Consol., C_v, in^2/min	0.272	Coef. of Consol., C_v, in^2/min	0.046		

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ONE-DIMENSIONAL CONSOLIDATION PROPERTIES OF SOILS
ASTM D 2435

Client	Civil & Environmental Consultant	Boring	SB-21	**Test Load, tsf**	**8-16**
Client Project	091-867 Apex Landfill Expansion	Depth	9'-11'		Load 13 of 13
Project No.	30598	Sample	ST-1		
		Lab ID#	30598011		

Visual Description: LIGHT OLIVE BROWN LEAN CLAY WITH GRAVEL
Test Conditions: Undisturbed, Inundated, and Double Drained

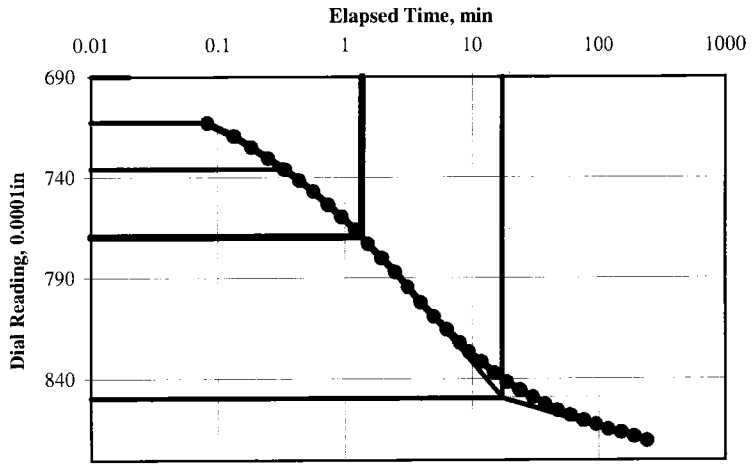
Time Vs. Dial Reading

Elapsed Time (min)	Sqrt Time ($min^{1/2}$)	Dial Reading (0.0001in)	Sample Height (in)	Void Ratio
0	0	604.5	0.9475	0.3635
Corrections*		-15	-0.0015	-0.0022
Adjusted Sample Height & Void Ratio				
0.08	0.29	713.0	0.9382	0.3500
0.13	0.37	719.5	0.9375	0.3491
0.18	0.43	725.0	0.9370	0.3483
0.25	0.50	730.5	0.9364	0.3475
0.33	0.58	736.0	0.9359	0.3467
0.43	0.66	741.5	0.9353	0.3459
0.57	0.75	747.0	0.9348	0.3451
0.73	0.86	753.5	0.9341	0.3442
0.93	0.97	759.5	0.9335	0.3433
1.20	1.10	766.0	0.9329	0.3424
1.52	1.23	773.0	0.9322	0.3414
1.93	1.39	780.0	0.9315	0.3404
2.45	1.57	787.0	0.9308	0.3394
3.10	1.76	794.5	0.9300	0.3383
3.93	1.98	802.0	0.9293	0.3372
4.97	2.23	809.0	0.9286	0.3362
6.28	2.51	815.5	0.9279	0.3353
7.93	2.82	822.0	0.9273	0.3344
9.38	3.06	826.5	0.9268	0.3337
11.83	3.44	831.5	0.9263	0.3330
14.93	3.86	837.0	0.9258	0.3322
18.83	4.34	841.5	0.9253	0.3315
23.75	4.87	845.5	0.9249	0.3310
29.93	5.47	849.0	0.9246	0.3305
37.73	6.14	852.5	0.9242	0.3300
47.55	6.90	855.5	0.9239	0.3295
59.93	7.74	858.0	0.9237	0.3292
75.93	8.71	860.5	0.9234	0.3288
94.93	9.74	862.5	0.9232	0.3285
119.93	10.95	865.0	0.9230	0.3282
150.93	12.29	866.5	0.9228	0.3279
189.93	13.78	868.5	0.9226	0.3277
239.93	15.49	870.5	0.9224	0.3274

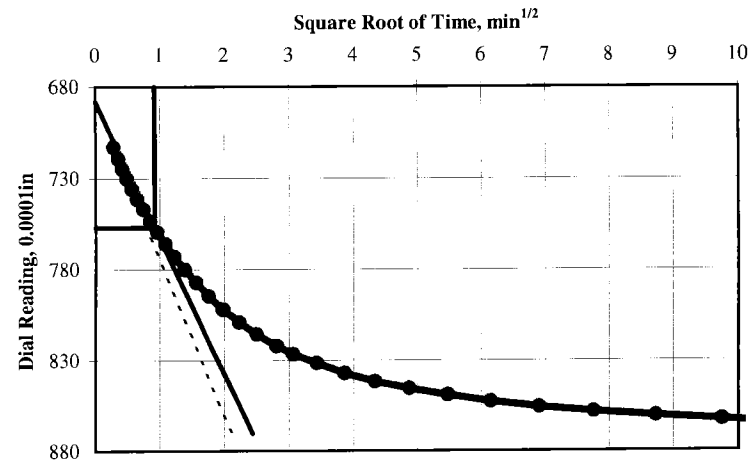
Machine Deflection

Applied Deflection Correction to Sample Height, 0.0001in: -15
**Correction is applied to all dial readings.*

Log of Elapsed Time vs. Dial Reading



Square Root of Elapsed Time vs. Dial Reading



Sqrt. of Elapsed Time vs Dial Reading		Log of Elapsed Time vs Dial Reading		Load Summary	
T0 = 0 min.	D0 = 688.2 div.	T0 = 0 min.	D0 = 690 div.		
T90 = 0.846 min	D90 = 757.1 div.	T50 = 1.36 min.	D50 = 769.7 div.	Initial Sample Height, in	0.9475
T100 = NA min	D100 = 764.7 div.	T100 = 17.34 min.	D100 = 849.4 div.	Initial Sample Void Ratio	0.3635
Height at: D90 = 0.9338, D100 = 0.933		Height at: D50 = 0.9325, D100 = 0.9245		Final Sample Height, in	0.9224
Average Sample Height, in	0.9350	Average Sample Height, in	0.9350	Final Sample Void Ratio	0.3274
Average Drainage Height, in	0.4675	Average Drainage Height, in	0.4675	Incremental Strain, %	2.65%
T (Time Factor for T90)	0.848	T (Time Factor for T50)	0.197	Loading Duration, min	239.93333
Coef. of Consol., C_v, in^2/min	0.218	Coef. of Consol., C_v, in^2/min	0.032		

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ONE-DIMENSIONAL CONSOLIDATION PROPERTIES OF SOILS
ASTM D 2435

Client	Civil & Environmental Consultant	Boring	SB-18
Client Project	091-867 Apex Landfill Expansion	Depth	10'-12'
Project No.	30598	Sample	ST-1
		Lab Sample No.	30598010

Visual Description: Dark Grayish Brown Sandy Clay with Gravel
Sample Conditions: Undisturbed, Inundated, and Double Drained
Machine Deflection Correction: Applied

SAMPLE PROPERTIES		
	Initial	Final
Tare Number	A12	A9
Wt. Tare & WS, gm	121.92	161.44
Wt. Tare & DS, gm	104.87	138.68
Wt. Tare, gm	9.53	9.8
Water Content, %	17.9%	17.7%
Sample Diameter, in	2.5	2.5
Sample Height, in	1.017	0.8731
Sample Volume, in^3	4.9922	4.2856
Wt. WS + Ring, gm	268.2	265.74
Wt. of Ring, gm	113.68	113.68
Wt. of WS, gm	154.52	152.06
Wet Density, pcf	117.86	135.11
Wet Density, g/cc	1.889	2.165
Water Content, %	17.9%	17.7%
Wt. of DS, gm	131.08	129.24
Dry Density, pcf	99.98	114.83
Dry Density, g/cc	1.602	1.840
Void Ratio, e	0.6913	0.4726
Saturation, %	70.1%	
Specific Gravity	2.71	Measured
Height of Solids, in	0.6013	0.6013

TEST DATA SUMMARY

Applied Pressure tsf	Load Duration min	Final Height in	Vertical Strain %	Dry Density g/cc	Void Ratio e	a_v ft^2/ton	Incremental C_c	Incremental C_r
Seating	NA	1.0170	0.00	1.6023	0.6913	NA	NA	NA
0.25	240	1.0136	0.34%	1.6077	0.6856	2.30E-02	NA	NA
0.5	955	1.0031	1.37%	1.6246	0.6681	6.98E-02	0.058	NA
1	302	0.9846	3.19%	1.6551	0.6374	6.15E-02	0.102	NA
2	1,514	0.9569	5.91%	1.7029	0.5914	4.60E-02	0.153	NA
4	151	0.9299	8.56%	1.7524	0.5465	2.25E-02	0.149	NA
1	151	0.9364	7.93%	1.7403	0.5572	3.58E-03	NA	NA
0.25	120	0.9469	6.90%	1.7210	0.5747	2.33E-02	NA	NA
0.5	955	0.9458	7.00%	1.7229	0.5729	6.98E-03	NA	0.006
1	95	0.9427	7.31%	1.7286	0.5678	1.03E-02	NA	0.017
2	190	0.9362	7.95%	1.7407	0.5569	1.09E-02	NA	0.036
4	151	0.9252	9.03%	1.7614	0.5386	9.15E-03	NA	0.061
8	758	0.9007	11.44%	1.8093	0.4978	1.02E-02	0.135	NA
16	190	0.8731	14.15%	1.8665	0.4519	5.74E-03	0.152	NA

C_r = 0.03

Note: The calculations performed and the parameters presented herein are for preliminary purposes only. GTS only accepts responsibility for the raw data obtained from the consolidation tests. This data may be interpreted differently by others. It is the responsibility of the user to determine the appropriateness and accuracy of the computed values.

Input Validation | Reviewed By: | Date Tested: 12/3/2010 |

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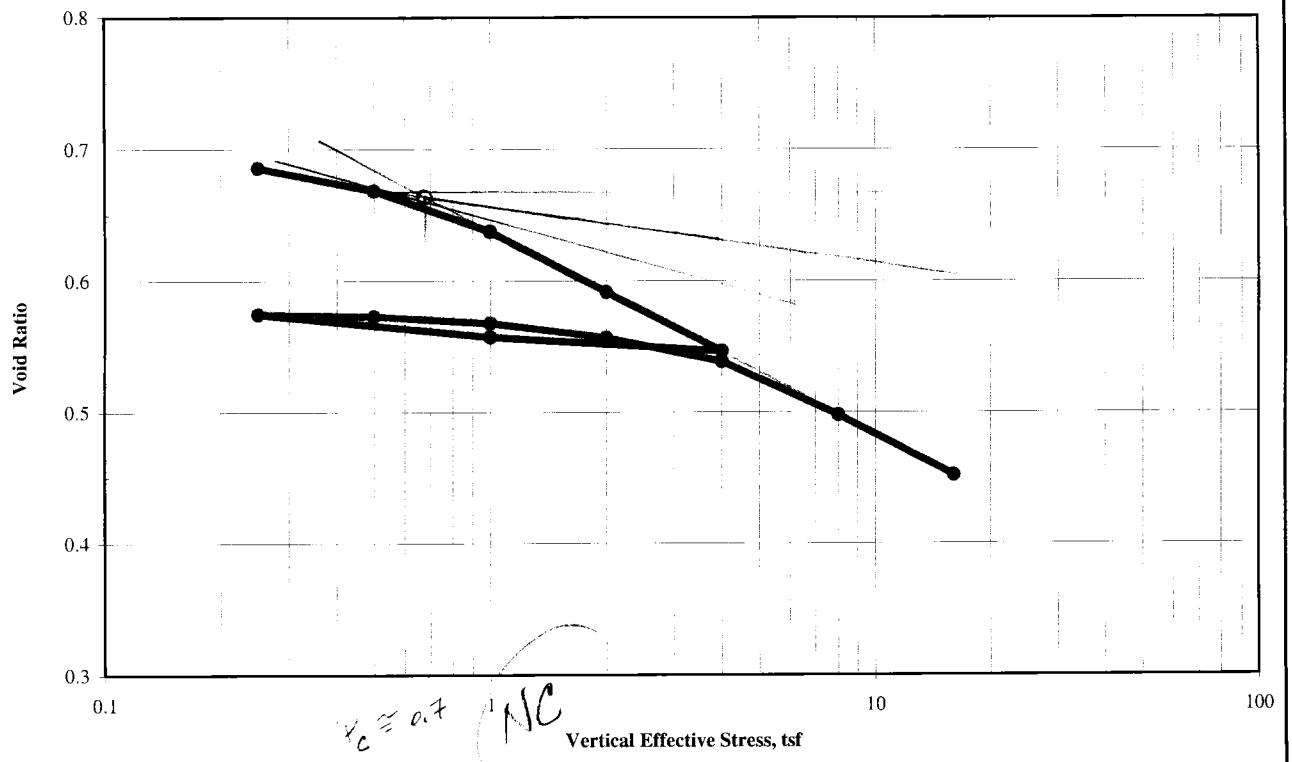
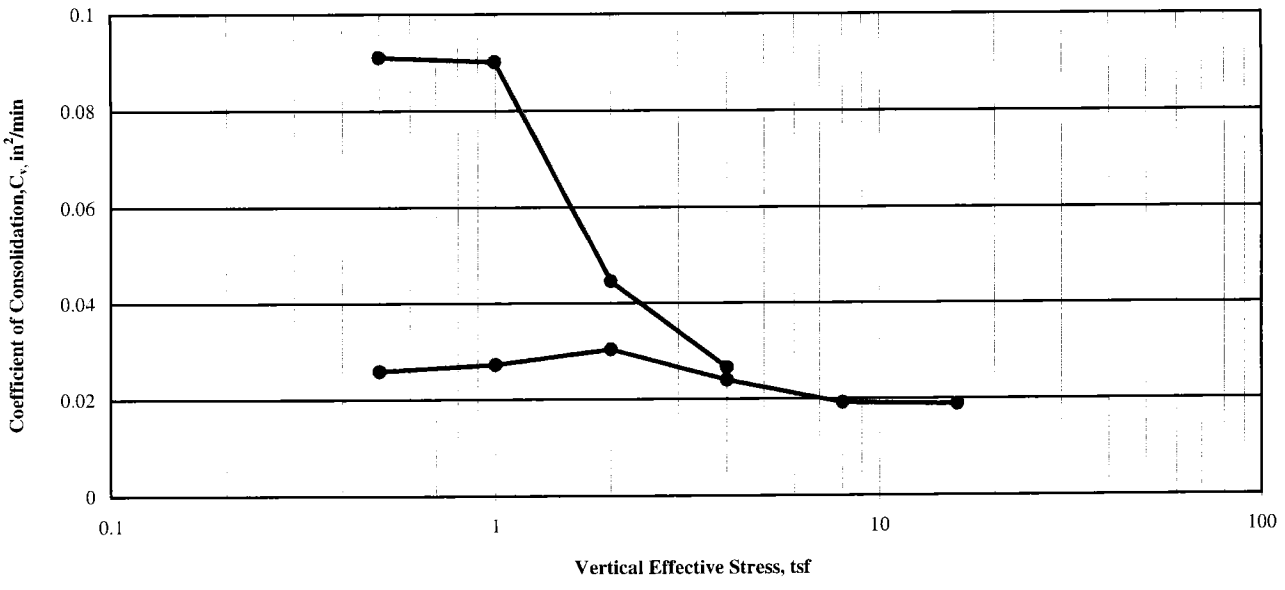
ONE-DIMENSIONAL CONSOLIDATION PROPERTIES OF SOILS
ASTM D 2435

Client	Civil & Environmental Consultants, Inc.	Boring	SB-18
Client Project	091-867 Apex Landfill Expansion	Depth	10'-12'
Project No.	30598	Sample	ST-1
		Lab Sample No.	30598010
Visual Description	Dark Grayish Brown Sandy Clay with Gravel		
Sample Conditions	Undisturbed, Inundated, and Double Drained		
Machine Deflection Correction:	Applied		

Void Ratio (Final Height) vs Vertical Effective Consolidation Stress



Coeffieicent of Consolidation (log. method) vs. Vertical Effective Consolidation Stress



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ONE-DIMENSIONAL CONSOLIDATION PROPERTIES OF SOILS
ASTM D 2435

Client	Civil & Environmental Consultant	Boring	SB-18	**Test Load, tsf**	**0-0.25**
Client Project	091-867 Apex Landfill Expansion	Depth	10'-12'		Load 1 of 13
Project No.	30598	Sample	ST-1		
		Lab ID#	30598010		
Visual Description	Dark Grayish Brown Sandy Clay with Gravel				
Test Conditions:	Undisturbed, Inundated, and Double Drained				

Time Vs. Dial Reading

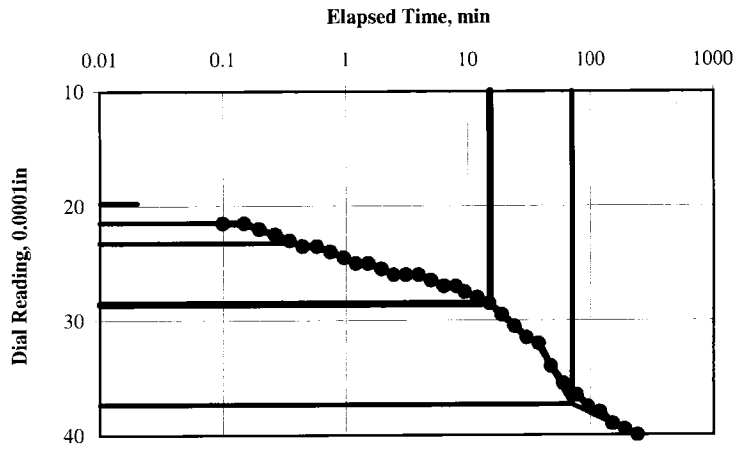
Elapsed Time (min)	Sqrt Time ($min^{1/2}$)	Dial Reading (0.0001in)	Sample Height (in)	Void Ratio
0	0	0	1.0170	0.6913
Corrections*		-5.5	-0.00055	-0.0009
Adjusted Sample Height & Void Ratio				
0.10	0.32	21.5	1.0154	0.6887
0.15	0.39	21.5	1.0154	0.6887
0.20	0.45	22.0	1.0154	0.6886
0.27	0.52	22.5	1.0153	0.6885
0.35	0.59	23.0	1.0153	0.6884
0.45	0.67	23.5	1.0152	0.6883
0.58	0.76	23.5	1.0152	0.6883
0.75	0.87	24.0	1.0152	0.6883
0.97	0.98	24.5	1.0151	0.6882
1.22	1.10	25.0	1.0151	0.6881
1.53	1.24	25.0	1.0151	0.6881
1.95	1.40	25.5	1.0150	0.6880
2.47	1.57	26.0	1.0150	0.6879
3.12	1.77	26.0	1.0150	0.6879
3.95	1.99	26.0	1.0150	0.6879
4.98	2.23	26.5	1.0149	0.6878
6.30	2.51	27.0	1.0149	0.6878
7.95	2.82	27.0	1.0149	0.6878
9.40	3.07	27.5	1.0148	0.6877
11.85	3.44	28.0	1.0148	0.6876
14.95	3.87	28.5	1.0147	0.6875
18.85	4.34	29.5	1.0146	0.6873
23.77	4.88	30.5	1.0145	0.6872
29.95	5.47	31.5	1.0144	0.6870
37.75	6.14	32.0	1.0144	0.6869
47.57	6.90	34.0	1.0142	0.6866
59.95	7.74	35.5	1.0140	0.6863
75.95	8.71	36.5	1.0139	0.6862
94.95	9.74	37.5	1.0138	0.6860
119.95	10.95	38.0	1.0138	0.6859
150.95	12.29	39.0	1.0137	0.6858
189.95	13.78	39.5	1.0136	0.6857
239.95	15.49	40.0	1.0136	0.6856

Machine Deflection

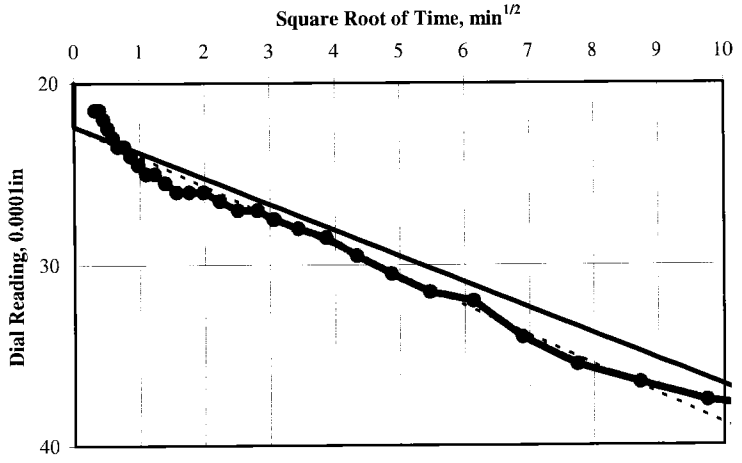
Applied Deflection Correction to Sample Height, 0.0001in -5.5

**Correction is applied to all dial readings.*

Log of Elapsed Time vs. Dial Reading



Square Root of Elapsed Time vs. Dial Reading



Sqrt. of Elapsed Time vs Dial Reading

T0 = 0 min.	D0 = 22.4 div.
T90 = 0 min	D90 = 22.4 div.
T100 = NA min	D100 = 22.4 div.
Height at: D90 = 1.0153, D100 = 1.0153	
Average Sample Height, in	1.0153
Average Drainage Height, in	0.5076
T (Time Factor for T90)	0.848
Coef. of Consol., C_v, in^2/min	#DIV/0!

Log of Elapsed Time vs Dial Reading

T0 = 0 min.	D0 = 19.7 div.
T50 = 15.09 min.	D50 = 28.5 div.
T100 = 70 min.	D100 = 37.3 div.
Height at: D50 = 1.0147, D100 = 1.0138	
Average Sample Height, in	1.0153
Average Drainage Height, in	0.5076
T (Time Factor for T50)	0.197
Coef. of Consol., C_v, in^2/min	0.003

Load Summary

Initial Sample Height, in	1.0170
Initial Sample Void Ratio	0.6913
Final Sample Height, in	1.0136
Final Sample Void Ratio	0.6856
Incremental Strain, %	0.34%
Loading Duration, min	239.95

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ONE-DIMENSIONAL CONSOLIDATION PROPERTIES OF SOILS
ASTM D 2435

Client	Civil & Environmental Consultant	Boring	SB-18	**Test Load, tsf 0.25-0.5**
Client Project	091-867 Apex Landfill Expansion	Depth	10'-12'	Load 2 of 13
Project No.	30598	Sample	ST-1	
		Lab ID#	30598010	
Visual Description	Dark Grayish Brown Sandy Clay with Gravel			
Test Conditions:	Undisturbed, Inundated, and Double Drained			

Time Vs. Dial Reading

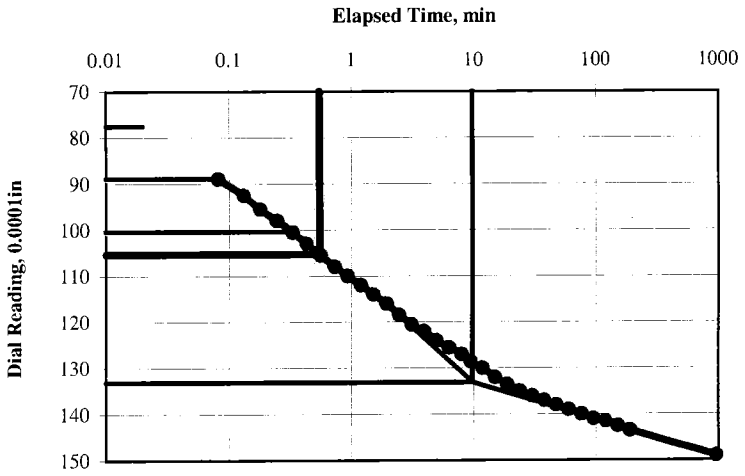
Elapsed Time (min)	Sqrt Time ($min^{1/2}$)	Dial Reading (0.0001in)	Sample Height (in)	Void Ratio
0	0	40.0	1.0136	0.6856
Corrections*		-4	-0.0004	-0.0007
Adjusted Sample Height & Void Ratio				
0.08	0.29	89.0	1.0091	0.6781
0.13	0.37	92.5	1.0087	0.6775
0.18	0.43	95.5	1.0084	0.6770
0.25	0.50	98.0	1.0082	0.6766
0.33	0.58	100.5	1.0079	0.6762
0.43	0.66	103.0	1.0077	0.6758
0.57	0.75	105.5	1.0074	0.6754
0.73	0.86	108.0	1.0072	0.6750
0.93	0.97	110.0	1.0070	0.6746
1.20	1.10	112.0	1.0068	0.6743
1.52	1.23	114.0	1.0066	0.6740
1.93	1.39	116.0	1.0064	0.6736
2.45	1.57	118.5	1.0061	0.6732
3.10	1.76	120.5	1.0059	0.6729
3.93	1.98	122.0	1.0058	0.6726
4.97	2.23	124.0	1.0056	0.6723
6.28	2.51	125.5	1.0054	0.6720
7.93	2.82	127.0	1.0053	0.6718
9.38	3.06	128.5	1.0051	0.6715
11.83	3.44	130.0	1.0050	0.6713
14.93	3.86	132.0	1.0048	0.6710
18.83	4.34	133.5	1.0046	0.6707
23.75	4.87	135.0	1.0045	0.6705
29.93	5.47	136.0	1.0044	0.6703
37.73	6.14	137.0	1.0043	0.6701
47.55	6.90	138.0	1.0042	0.6700
59.93	7.74	139.0	1.0041	0.6698
75.93	8.71	140.0	1.0040	0.6696
94.93	9.74	141.0	1.0039	0.6695
119.93	10.95	141.5	1.0038	0.6694
150.93	12.29	142.5	1.0037	0.6692
189.93	13.78	143.5	1.0036	0.6690
954.93	30.90	149.0	1.0031	0.6681

Machine Deflection

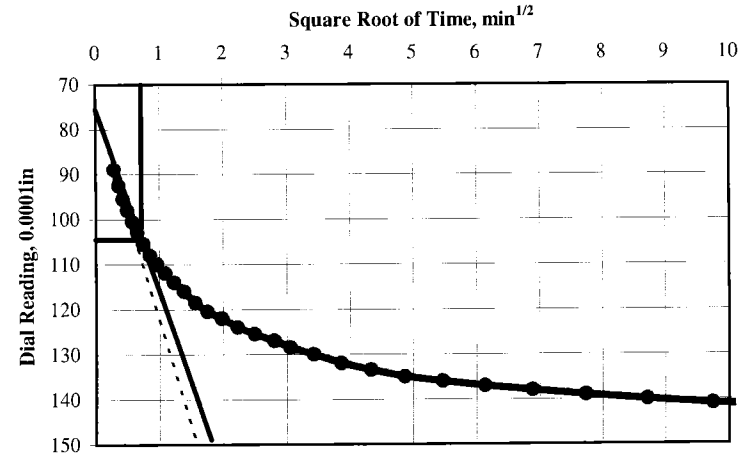
Applied Deflection Correction to Sample Height, 0.0001in -4

**Correction is applied to all dial readings.*

Log of Elapsed Time vs. Dial Reading



Square Root of Elapsed Time vs. Dial Reading



Sqrt. of Elapsed Time vs Dial Reading		Log of Elapsed Time vs Dial Reading		Load Summary	
T0 = 0 min.	D0 = 75.5 div.	T0 = 0 min.	D0 = 77.5 div.		
T90 = 0.518 min	D90 = 104.5 div.	T50 = 0.55 min.	D50 = 105.3 div.	Initial Sample Height, in	1.0136
T100 = NA min	D100 = 107.7 div.	T100 = 9.72 min.	D100 = 133.1 div.	Initial Sample Void Ratio	0.6856
Height at: D90 = 1.0075, D100 = 1.0072		Height at: D50 = 1.0074, D100 = 1.0046		Final Sample Height, in	1.0031
Average Sample Height, in	1.0083	Average Sample Height, in	1.0083	Final Sample Void Ratio	0.6681
Average Drainage Height, in	0.5042	Average Drainage Height, in	0.5042	Incremental Strain, %	1.04%
T (Time Factor for T90)	0.848	T (Time Factor for T50)	0.197	Loading Duration, min	954.93333
Coef. of Consol., C_v, in^2/min	0.421	Coef. of Consol., C_v, in^2/min	0.091		

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ONE-DIMENSIONAL CONSOLIDATION PROPERTIES OF SOILS
ASTM D 2435

Client	Civil & Environmental Consultant	Boring	SB-18	**Test Load, tsf**	**0.5-1**
Client Project	091-867 Apex Landfill Expansion	Depth	10'-12'		Load 3 of 13
Project No.	30598	Sample	ST-1		
		Lab ID#	30598010		
Visual Description	Dark Grayish Brown Sandy Clay with Gravel				
Test Conditions:	Undisturbed, Inundated, and Double Drained				

Time Vs. Dial Reading

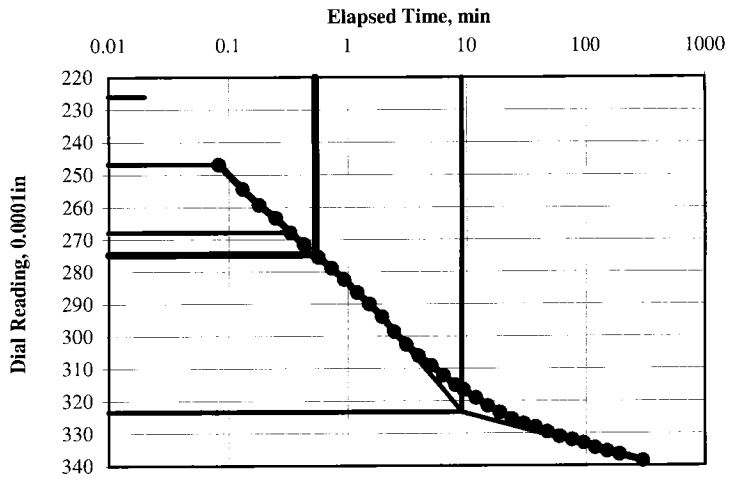
Elapsed Time (min)	Sqrt Time ($min^{1/2}$)	Dial Reading (0.0001in)	Sample Height (in)	Void Ratio
0	0	149.0	1.0031	0.6681
Corrections*		-4.5	-0.00045	-0.0007
Adjusted Sample Height & Void Ratio				
0.08	0.29	247.0	0.9937	0.6526
0.13	0.37	254.5	0.9930	0.6513
0.18	0.43	259.5	0.9925	0.6505
0.25	0.50	263.5	0.9921	0.6498
0.33	0.58	268.0	0.9916	0.6491
0.43	0.66	271.5	0.9913	0.6485
0.57	0.75	275.5	0.9909	0.6478
0.73	0.86	279.0	0.9905	0.6473
0.93	0.97	282.5	0.9902	0.6467
1.20	1.10	286.5	0.9898	0.6460
1.52	1.23	290.0	0.9894	0.6454
1.93	1.39	294.0	0.9890	0.6448
2.45	1.57	298.5	0.9886	0.6440
3.10	1.76	302.5	0.9882	0.6434
3.93	1.98	306.0	0.9878	0.6428
4.97	2.23	309.0	0.9875	0.6423
6.28	2.51	312.0	0.9872	0.6418
7.93	2.82	315.0	0.9869	0.6413
9.38	3.06	316.5	0.9868	0.6410
11.83	3.44	319.0	0.9865	0.6406
14.93	3.86	321.5	0.9863	0.6402
18.83	4.34	323.5	0.9861	0.6399
23.75	4.87	325.5	0.9859	0.6395
29.93	5.47	327.0	0.9857	0.6393
37.73	6.14	328.0	0.9856	0.6391
47.55	6.90	329.5	0.9855	0.6389
59.93	7.74	331.0	0.9853	0.6386
75.93	8.71	332.0	0.9852	0.6384
94.93	9.74	333.0	0.9851	0.6383
119.93	10.95	334.5	0.9850	0.6380
150.93	12.29	335.5	0.9849	0.6379
189.93	13.78	336.5	0.9848	0.6377
301.93	17.38	338.5	0.9846	0.6374

Machine Deflection

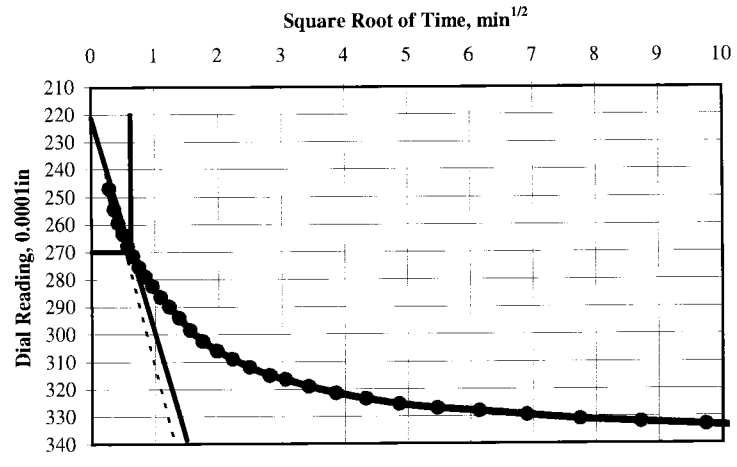
Applied Deflection Correction to Sample Height, 0.0001in -4.5

**Correction is applied to all dial readings.*

Log of Elapsed Time vs. Dial Reading



Square Root of Elapsed Time vs. Dial Reading



Sqrt. of Elapsed Time vs Dial Reading		Log of Elapsed Time vs Dial Reading		Load Summary	
T0 = 0 min.	D0 = 221.2 div.	T0 = 0 min.	D0 = 226 div.		
T90 = 0.384 min	D90 = 270 div.	T50 = 0.54 min.	D50 = 274.7 div.	Initial Sample Height, in	1.0031
T100 = NA min	D100 = 275.4 div.	T100 = 9.05 min.	D100 = 323.3 div.	Initial Sample Void Ratio	0.6681
Height at: D90 = 0.9914, D100 = 0.9909		Height at: D50 = 0.9909, D100 = 0.9861		Final Sample Height, in	0.9846
Average Sample Height, in	0.9938	Average Sample Height, in	0.9938	Final Sample Void Ratio	0.6374
Average Drainage Height, in	0.4969	Average Drainage Height, in	0.4969	Incremental Strain, %	1.84%
T (Time Factor for T90)	0.848	T (Time Factor for T50)	0.197	Loading Duration, min	301.93333
Coef. of Consol., C_v, in^2/min	0.538	Coef. of Consol., C_v, in^2/min	0.090		

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ONE-DIMENSIONAL CONSOLIDATION PROPERTIES OF SOILS
ASTM D 2435

Client	Civil & Environmental Consultant	Boring	SB-18	**Test Load, tsf**	**1-2**
Client Project	091-867 Apex Landfill Expansion	Depth	10'-12'		Load 4 of 13
Project No.	30598	Sample	ST-1		
		Lab ID#	30598010		
Visual Description	Dark Grayish Brown Sandy Clay with Gravel				
Test Conditions:	Undisturbed, Inundated, and Double Drained				

Time Vs. Dial Reading

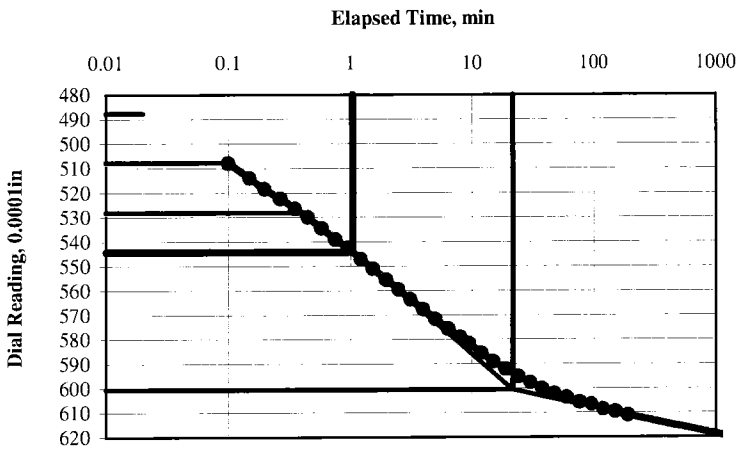
Elapsed Time (min)	Sqrt Time ($min^{1/2}$)	Dial Reading (0.0001in)	Sample Height (in)	Void Ratio
0	0	338.5	0.9846	0.6374
Corrections*		-5.5	-0.00055	-0.0009
Adjusted Sample Height & Void Ratio				
0.10	0.32	508.0	0.9682	0.6101
0.15	0.39	514.0	0.9676	0.6091
0.20	0.45	518.5	0.9671	0.6083
0.27	0.52	522.5	0.9667	0.6077
0.35	0.59	526.5	0.9663	0.6070
0.45	0.67	530.0	0.9660	0.6064
0.58	0.76	534.5	0.9655	0.6057
0.75	0.87	539.0	0.9651	0.6049
0.95	0.97	542.5	0.9647	0.6044
1.22	1.10	547.0	0.9643	0.6036
1.53	1.24	551.0	0.9639	0.6029
1.95	1.40	555.5	0.9634	0.6022
2.47	1.57	559.5	0.9630	0.6015
3.12	1.77	563.5	0.9626	0.6009
3.95	1.99	567.5	0.9622	0.6002
4.98	2.23	571.5	0.9618	0.5995
6.30	2.51	575.5	0.9614	0.5989
7.95	2.82	579.0	0.9611	0.5983
9.40	3.07	581.5	0.9608	0.5979
11.85	3.44	585.5	0.9604	0.5972
14.95	3.87	589.0	0.9601	0.5966
18.85	4.34	592.0	0.9598	0.5961
23.77	4.88	595.0	0.9595	0.5956
29.95	5.47	597.5	0.9592	0.5952
37.75	6.14	600.0	0.9590	0.5948
47.57	6.90	602.0	0.9588	0.5945
59.95	7.74	603.5	0.9586	0.5942
75.95	8.71	605.5	0.9584	0.5939
94.95	9.74	606.5	0.9583	0.5937
119.95	10.95	608.5	0.9581	0.5934
150.95	12.29	609.5	0.9580	0.5932
189.95	13.78	611.0	0.9579	0.5930
1513.95	38.91	620.5	0.9569	0.5914

Machine Deflection

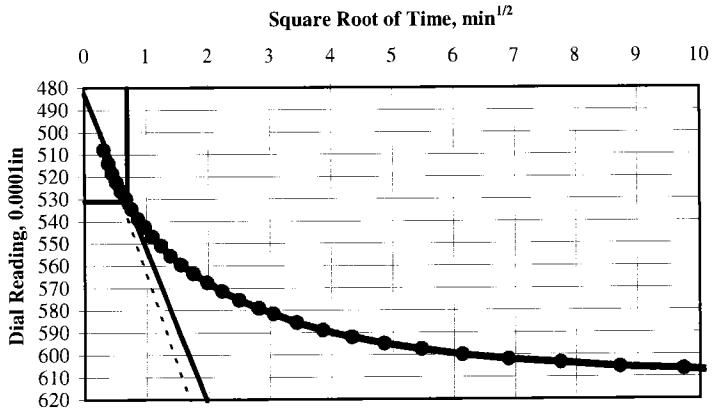
Applied Deflection Correction to Sample Height, 0.0001in -5.5

**Correction is applied to all dial readings.*

Log of Elapsed Time vs. Dial Reading



Square Root of Elapsed Time vs. Dial Reading



Sqrt. of Elapsed Time vs Dial Reading		Log of Elapsed Time vs Dial Reading		Load Summary	
T0 = 0 min.	D0 = 482.7 div.	T0 = 0 min.	D0 = 487.6 div.		
T90 = 0.476 min	D90 = 531 div.	T50 = 1.04 min.	D50 = 544.1 div.	Initial Sample Height, in	0.9846
T100 = NA min	D100 = 536.4 div.	T100 = 21.68 min.	D100 = 600.6 div.	Initial Sample Void Ratio	0.6374
Height at: D90 = 0.9659, D100 = 0.9653		Height at: D50 = 0.9645, D100 = 0.9589		Final Sample Height, in	0.9569
Average Sample Height, in	0.9707	Average Sample Height, in	0.9707	Final Sample Void Ratio	0.5914
Average Drainage Height, in	0.4854	Average Drainage Height, in	0.4854	Incremental Strain, %	2.81%
T (Time Factor for T90)	0.848	T (Time Factor for T50)	0.197	Loading Duration, min	1513.95
Coef. of Consol., C_v, in^2/min	0.417	Coef. of Consol., C_v, in^2/min	0.045		

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ONE-DIMENSIONAL CONSOLIDATION PROPERTIES OF SOILS
ASTM D 2435

Client	Civil & Environmental Consultant	Boring	SB-18	**Test Load, tsf**	**2-4**
Client Project	091-867 Apex Landfill Expansion	Depth	10'-12'		Load 5 of 13
Project No.	30598	Sample	ST-1		
		Lab ID#	30598010		

Visual Description: Dark Grayish Brown Sandy Clay with Gravel
Test Conditions: Undisturbed, Inundated, and Double Drained

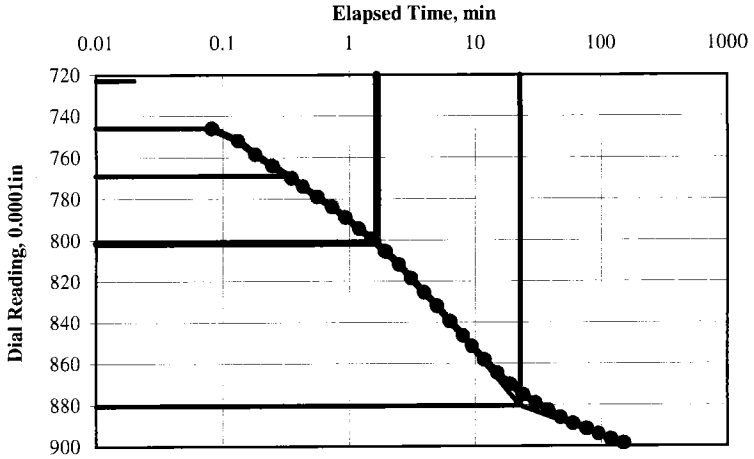
Time Vs. Dial Reading

Elapsed Time (min)	Sqrt Time ($min^{1/2}$)	Dial Reading (0.0001in)	Sample Height (in)	Void Ratio
0	0	620.5	0.9569	0.5914
Corrections*		-8	-0.0008	-0.0013
Adjusted Sample Height & Void Ratio				
0.08	0.29	746.0	0.9452	0.5718
0.13	0.37	752.0	0.9446	0.5708
0.18	0.43	758.5	0.9439	0.5698
0.25	0.50	764.0	0.9434	0.5688
0.35	0.59	770.0	0.9428	0.5679
0.43	0.66	774.0	0.9424	0.5672
0.57	0.75	779.0	0.9419	0.5664
0.73	0.86	784.0	0.9414	0.5655
0.93	0.97	789.0	0.9409	0.5647
1.20	1.10	794.5	0.9403	0.5638
1.52	1.23	799.5	0.9398	0.5629
1.93	1.39	805.5	0.9392	0.5619
2.47	1.57	812.0	0.9386	0.5609
3.12	1.77	818.5	0.9379	0.5598
3.95	1.99	825.5	0.9372	0.5586
4.98	2.23	832.0	0.9366	0.5575
6.30	2.51	839.5	0.9358	0.5563
7.95	2.82	846.5	0.9351	0.5551
9.40	3.07	851.5	0.9346	0.5543
11.85	3.44	858.0	0.9340	0.5532
14.95	3.87	864.5	0.9333	0.5521
18.85	4.34	870.0	0.9328	0.5512
23.77	4.88	875.0	0.9323	0.5504
29.95	5.47	879.0	0.9319	0.5497
37.75	6.14	882.5	0.9315	0.5491
47.57	6.90	886.0	0.9312	0.5486
59.95	7.74	889.0	0.9309	0.5481
75.95	8.71	891.5	0.9306	0.5476
94.95	9.74	894.0	0.9304	0.5472
119.95	10.95	896.5	0.9301	0.5468
150.95	12.29	898.5	0.9299	0.5465

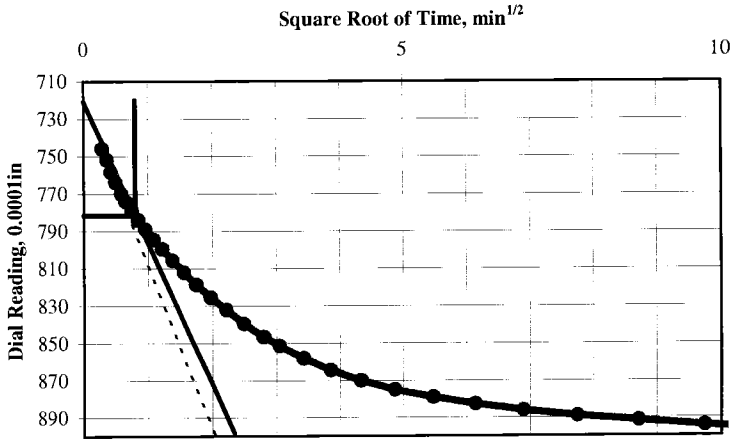
Machine Deflection

Applied Deflection Correction to Sample Height, 0.0001in: -8
**Correction is applied to all dial readings.*

Log of Elapsed Time vs. Dial Reading



Square Root of Elapsed Time vs. Dial Reading



Sqrt. of Elapsed Time vs Dial Reading

T0 = 0 min.	D0 = 720.9 div.
T90 = 0.656 min	D90 = 781.5 div.
T100 = NA min	D100 = 788.3 div.
Height at: D90 = 0.9416, D100 = 0.9409	
Average Sample Height, in	0.9434
Average Drainage Height, in	0.4717
T (Time Factor for T90)	0.848
Coef. of Consol., C_v, in^2/min	0.291

Log of Elapsed Time vs Dial Reading

T0 = 0 min.	D0 = 722.9 div.
T50 = 1.65 min.	D50 = 801.6 div.
T100 = 22.57 min.	D100 = 880.3 div.
Height at: D50 = 0.9396, D100 = 0.9317	
Average Sample Height, in	0.9434
Average Drainage Height, in	0.4717
T (Time Factor for T50)	0.197
Coef. of Consol., C_v, in^2/min	0.027

Load Summary

Initial Sample Height, in	0.9569
Initial Sample Void Ratio	0.5914
Final Sample Height, in	0.9299
Final Sample Void Ratio	0.5465
Incremental Strain, %	2.82%
Loading Duration, min	150.95

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ONE-DIMENSIONAL CONSOLIDATION PROPERTIES OF SOILS
ASTM D 2435

Client	Civil & Environmental Consultant	Boring	SB-18	**Test Load, tsf**	**4-1**
Client Project	091-867 Apex Landfill Expansion	Depth	10'-12'		Load 6 of 13
Project No.	30598	Sample	ST-1		
		Lab ID#	30598010		
Visual Description	Dark Grayish Brown Sandy Clay with Gravel				
Test Conditions:	Undisturbed, Inundated, and Double Drained				

Time Vs. Dial Reading

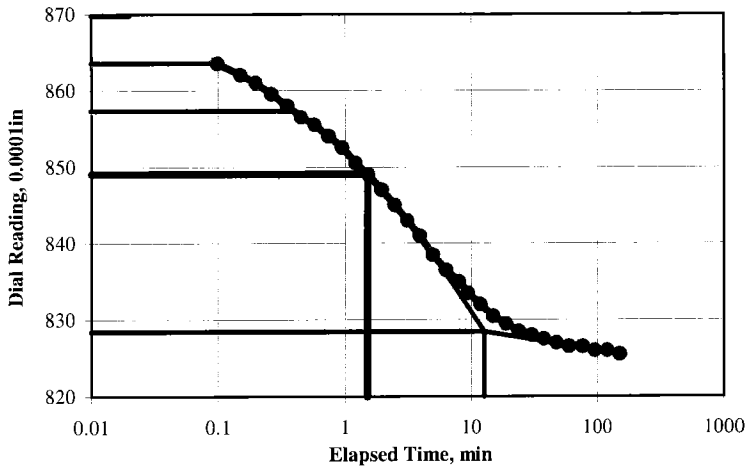
Elapsed Time (min)	Sqrt Time ($min^{1/2}$)	Dial Reading (0.0001in)	Sample Height (in)	Void Ratio
0	0	898.5	0.9299	0.5465
Corrections*		8.5	0.00085	0.00141
Adjusted Sample Height & Void Ratio				
0.10	0.32	863.5	0.9326	0.5509
0.15	0.39	862.0	0.9327	0.5511
0.20	0.45	861.0	0.9328	0.5513
0.27	0.52	859.5	0.9330	0.5516
0.35	0.59	858.0	0.9331	0.5518
0.45	0.67	856.5	0.9333	0.5521
0.58	0.76	855.5	0.9334	0.5522
0.75	0.87	854.0	0.9335	0.5525
0.95	0.97	852.5	0.9337	0.5527
1.22	1.10	850.5	0.9339	0.5530
1.53	1.24	849.0	0.9340	0.5533
1.95	1.40	847.0	0.9342	0.5536
2.47	1.57	845.0	0.9344	0.5540
3.12	1.77	843.0	0.9346	0.5543
3.95	1.99	841.0	0.9348	0.5546
4.98	2.23	838.5	0.9351	0.5550
6.30	2.51	836.5	0.9353	0.5554
7.95	2.82	835.0	0.9354	0.5556
9.40	3.07	833.5	0.9356	0.5559
11.85	3.44	832.0	0.9357	0.5561
14.95	3.87	830.5	0.9359	0.5564
18.85	4.34	829.5	0.9360	0.5565
23.77	4.88	828.5	0.9361	0.5567
29.95	5.47	828.0	0.9361	0.5568
37.75	6.14	827.5	0.9362	0.5569
47.57	6.90	827.0	0.9362	0.5570
59.95	7.74	826.5	0.9363	0.5570
75.95	8.71	826.5	0.9363	0.5570
94.95	9.74	826.0	0.9363	0.5571
119.95	10.95	826.0	0.9363	0.5571
150.95	12.29	825.5	0.9364	0.5572

Machine Deflection

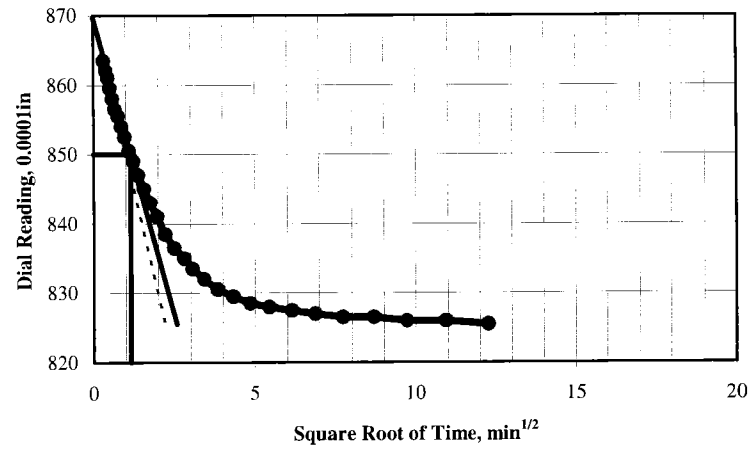
Applied Deflection Correction to Sample Height, 0.0001in 8.5

**Correction is applied to all dial readings.*

Log of Elapsed Time vs. Dial Reading



Square Root of Elapsed Time vs. Dial Reading



Sqrt. of Elapsed Time vs Dial Reading		Log of Elapsed Time vs Dial Reading		Load Summary	
T0 = 0 min.	D0 = 869.7 div.	T0 = 0 min.	D0 = 869.8 div.		
T90 = 1.323 min	D90 = 850 div.	T50 = 1.51 min.	D50 = 849.1 div.	Initial Sample Height, in	0.9299
T100 = NA min	D100 = 847.8 div.	T100 = 12.72 min.	D100 = 828.4 div.	Initial Sample Void Ratio	0.5465
Height at: D90 = 0.9339, D100 = 0.9341		Height at: D50 = 0.934, D100 = 0.9361		Final Sample Height, in	0.9364
Average Sample Height, in	0.9331	Average Sample Height, in	0.9331	Final Sample Void Ratio	0.5572
Average Drainage Height, in	0.4666	Average Drainage Height, in	0.4666	Incremental Strain, %	-0.69%
T (Time Factor for T90)	0.848	T (Time Factor for T50)	0.197	Loading Duration, min	150.95
Coef. of Consol., C_v, in^2/min	0.140	Coef. of Consol., C_v, in^2/min	0.028		

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ONE-DIMENSIONAL CONSOLIDATION PROPERTIES OF SOILS
ASTM D 2435

Client	Civil & Environmental Consultant	Boring	SB-18	**Test Load, tsf**	**1-0.25**
Client Project	091-867 Apex Landfill Expansion	Depth	10'-12'		Load 7 of 13
Project No.	30598	Sample	ST-1		
		Lab ID#	30598010		
Visual Description	Dark Grayish Brown Sandy Clay with Gravel				
Test Conditions:	Undisturbed, Inundated, and Double Drained				

Time Vs. Dial Reading

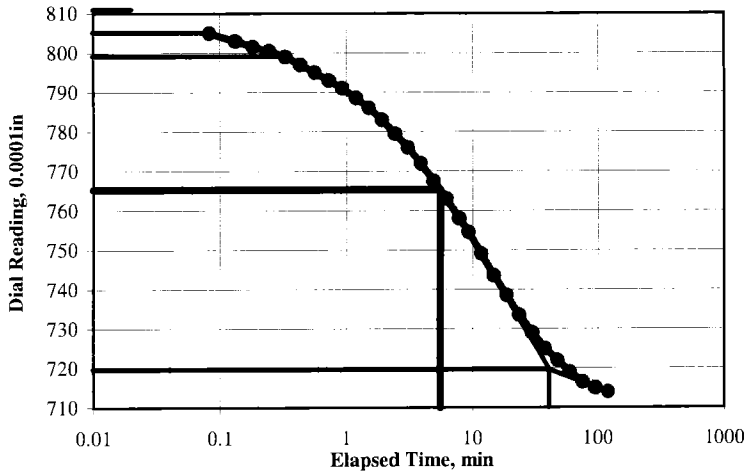
Elapsed Time (min)	Sqrt Time ($min^{1/2}$)	Dial Reading (0.0001in)	Sample Height (in)	Void Ratio
0	0	825.5	0.9364	0.5572
Corrections*		6.5	0.00065	0.00108
Adjusted Sample Height & Void Ratio				
0.08	0.29	805.0	0.9378	0.5595
0.13	0.37	803.0	0.9380	0.5599
0.18	0.43	801.5	0.9381	0.5601
0.25	0.50	800.5	0.9382	0.5603
0.33	0.58	799.0	0.9384	0.5605
0.43	0.66	797.0	0.9386	0.5609
0.57	0.75	795.0	0.9388	0.5612
0.73	0.86	793.0	0.9390	0.5615
0.93	0.97	791.0	0.9392	0.5619
1.20	1.10	788.5	0.9394	0.5623
1.52	1.23	786.0	0.9397	0.5627
1.93	1.39	783.0	0.9400	0.5632
2.45	1.57	779.5	0.9403	0.5638
3.10	1.76	776.0	0.9407	0.5644
3.93	1.98	772.0	0.9411	0.5650
4.97	2.23	767.5	0.9415	0.5658
6.28	2.51	763.0	0.9420	0.5665
7.93	2.82	758.0	0.9425	0.5674
9.38	3.06	754.5	0.9428	0.5679
11.83	3.44	749.0	0.9434	0.5688
14.93	3.86	743.5	0.9439	0.5698
18.83	4.34	738.5	0.9444	0.5706
23.75	4.87	733.5	0.9449	0.5714
29.93	5.47	729.0	0.9454	0.5722
37.73	6.14	725.0	0.9458	0.5728
47.55	6.90	722.0	0.9461	0.5733
59.93	7.74	719.0	0.9464	0.5738
75.93	8.71	716.5	0.9466	0.5743
94.93	9.74	715.0	0.9468	0.5745
119.93	10.95	714.0	0.9469	0.5747

Machine Deflection

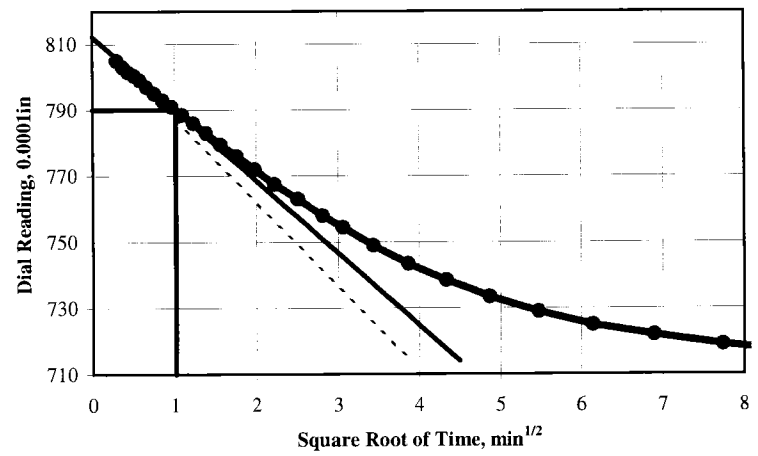
Applied Deflection Correction to Sample Height, 0.0001in 6.5

**Correction is applied to all dial readings.*

Log of Elapsed Time vs. Dial Reading



Square Root of Elapsed Time vs. Dial Reading



Sqrt. of Elapsed Time vs Dial Reading

T0 = 0 min.	D0 = 812.2 div.
T90 = 1.02 min	D90 = 790.1 div.
T100 = NA min	D100 = 787.6 div.
Height at: D90 = 0.9392, D100 = 0.9395	
Average Sample Height, in	0.9416
Average Drainage Height, in	0.4708
T (Time Factor for T90)	0.848
Coef. of Consol., C_v, in^2/min	0.183

Log of Elapsed Time vs Dial Reading

T0 = 0 min.	D0 = 811 div.
T50 = 5.56 min.	D50 = 765.3 div.
T100 = 40.77 min.	D100 = 719.7 div.
Height at: D50 = 0.9417, D100 = 0.9463	
Average Sample Height, in	0.9416
Average Drainage Height, in	0.4708
T (Time Factor for T50)	0.197
Coef. of Consol., C_v, in^2/min	0.008

Load Summary

Initial Sample Height, in	0.9364
Initial Sample Void Ratio	0.5572
Final Sample Height, in	0.9469
Final Sample Void Ratio	0.5747
Incremental Strain, %	-1.12%
Loading Duration, min	119.93333

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ONE-DIMENSIONAL CONSOLIDATION PROPERTIES OF SOILS
ASTM D 2435

Client	Civil & Environmental Consultant	Boring	SB-18	**Test Load, tsf 0.25-0.5**
Client Project	091-867 Apex Landfill Expansion	Depth	10'-12'	Load 8 of 13
Project No.	30598	Sample	ST-1	
		Lab ID#	30598010	
Visual Description	Dark Grayish Brown Sandy Clay with Gravel			
Test Conditions:	Undisturbed, Inundated, and Double Drained			

Time Vs. Dial Reading

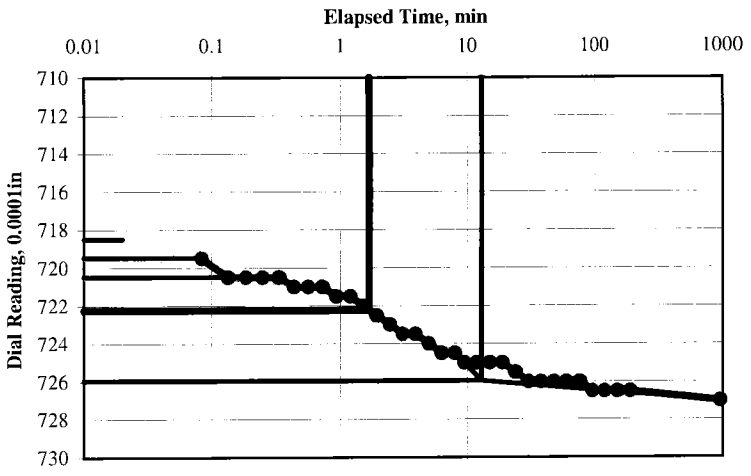
Elapsed Time (min)	Sqrt Time ($min^{1/2}$)	Dial Reading (0.0001in)	Sample Height (in)	Void Ratio
0	0	714.0	0.9469	0.5747
Corrections*		-2.5	-0.00025	-0.0004
Adjusted Sample Height & Void Ratio				
0.08	0.29	719.5	0.9466	0.5742
0.13	0.37	720.5	0.9465	0.5740
0.18	0.43	720.5	0.9465	0.5740
0.25	0.50	720.5	0.9465	0.5740
0.33	0.58	720.5	0.9465	0.5740
0.43	0.66	721.0	0.9464	0.5739
0.57	0.75	721.0	0.9464	0.5739
0.73	0.86	721.0	0.9464	0.5739
0.93	0.97	721.5	0.9464	0.5738
1.20	1.10	721.5	0.9464	0.5738
1.52	1.23	722.0	0.9463	0.5738
1.93	1.39	722.5	0.9463	0.5737
2.45	1.57	723.0	0.9462	0.5736
3.10	1.76	723.5	0.9462	0.5735
3.93	1.98	723.5	0.9462	0.5735
4.97	2.23	724.0	0.9461	0.5734
6.28	2.51	724.5	0.9461	0.5733
7.93	2.82	724.5	0.9461	0.5733
9.38	3.06	725.0	0.9460	0.5733
11.83	3.44	725.0	0.9460	0.5733
14.93	3.86	725.0	0.9460	0.5733
18.83	4.34	725.0	0.9460	0.5733
23.75	4.87	725.5	0.9460	0.5732
29.93	5.47	726.0	0.9459	0.5731
37.73	6.14	726.0	0.9459	0.5731
47.55	6.90	726.0	0.9459	0.5731
59.93	7.74	726.0	0.9459	0.5731
75.93	8.71	726.0	0.9459	0.5731
94.93	9.74	726.5	0.9459	0.5730
119.93	10.95	726.5	0.9459	0.5730
150.93	12.29	726.5	0.9459	0.5730
189.93	13.78	726.5	0.9459	0.5730
954.93	30.90	727.0	0.9458	0.5729

Machine Deflection

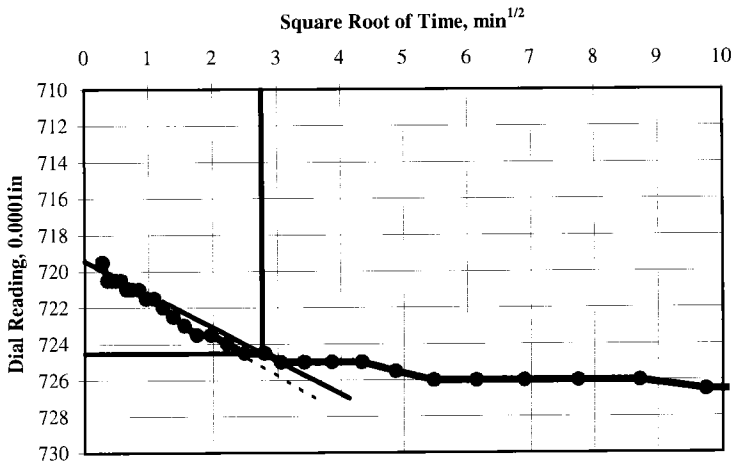
Applied Deflection Correction to Sample Height, 0.0001in -2.5

**Correction is applied to all dial readings.*

Log of Elapsed Time vs. Dial Reading



Square Root of Elapsed Time vs. Dial Reading



Sqrt. of Elapsed Time vs Dial Reading

T0 = 0 min.	D0 = 719.4 div.
T90 = 7.673 min	D90 = 724.5 div.
T100 = NA min	D100 = 725.1 div.
Height at: D90 = 0.9461, D100 = 0.946	
Average Sample Height, in	0.9463
Average Drainage Height, in	0.4732
T (Time Factor for T90)	0.848
Coef. of Consol., C_v, in^2/min	0.025

Log of Elapsed Time vs Dial Reading

T0 = 0 min.	D0 = 718.5 div.
T50 = 1.7 min.	D50 = 722.2 div.
T100 = 12.95 min.	D100 = 726 div.
Height at: D50 = 0.9463, D100 = 0.9459	
Average Sample Height, in	0.9463
Average Drainage Height, in	0.4732
T (Time Factor for T50)	0.197
Coef. of Consol., C_v, in^2/min	0.026

Load Summary

Initial Sample Height, in	0.9469
Initial Sample Void Ratio	0.5747
Final Sample Height, in	0.9458
Final Sample Void Ratio	0.5729
Incremental Strain, %	0.11%
Loading Duration, min	954.93333

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ONE-DIMENSIONAL CONSOLIDATION PROPERTIES OF SOILS
ASTM D 2435

Client	Civil & Environmental Consultant	Boring	SB-18	**Test Load, tsf**	**0.5-1**
Client Project	091-867 Apex Landfill Expansion	Depth	10'-12'		Load 9 of 13
Project No.	30598	Sample	ST-1		
		Lab ID#	30598010		
Visual Description	Dark Grayish Brown Sandy Clay with Gravel				
Test Conditions:	Undisturbed, Inundated, and Double Drained				

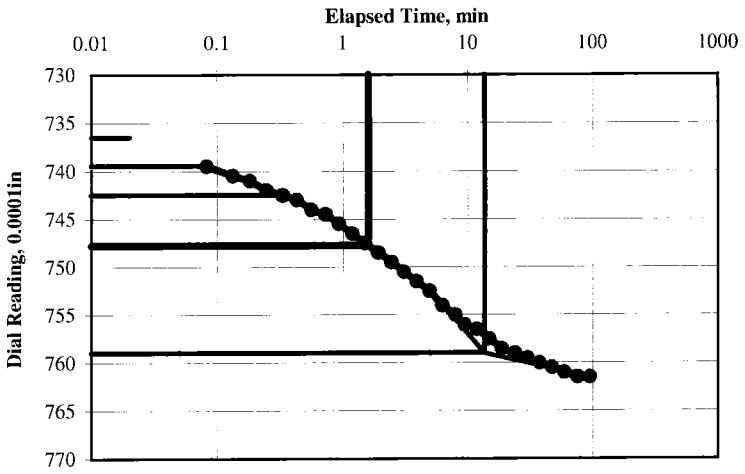
Time Vs. Dial Reading				
Elapsed Time (min)	**Sqrt Time ($min^{1/2}$)**	**Dial Reading (0.0001in)**	**Sample Height (in)**	**Void Ratio**
0	0	727.0	0.9458	0.5729
Corrections*		-3.5	-0.00035	-0.0006
Adjusted Sample Height & Void Ratio				
0.08	0.29	739.5	0.9449	0.5714
0.13	0.37	740.5	0.9448	0.5713
0.18	0.43	741.0	0.9448	0.5712
0.25	0.50	742.0	0.9447	0.5710
0.33	0.58	742.5	0.9446	0.5709
0.43	0.66	743.0	0.9446	0.5708
0.57	0.75	744.0	0.9445	0.5707
0.73	0.86	744.5	0.9444	0.5706
0.93	0.97	745.5	0.9443	0.5704
1.20	1.10	746.5	0.9442	0.5703
1.52	1.23	747.5	0.9441	0.5701
1.93	1.39	748.5	0.9440	0.5699
2.45	1.57	749.5	0.9439	0.5698
3.10	1.76	750.5	0.9438	0.5696
3.93	1.98	751.5	0.9437	0.5694
4.97	2.23	752.5	0.9436	0.5693
6.28	2.51	754.0	0.9435	0.5690
7.93	2.82	755.0	0.9434	0.5688
9.38	3.06	756.0	0.9433	0.5687
11.83	3.44	756.5	0.9432	0.5686
14.93	3.86	757.5	0.9431	0.5684
18.83	4.34	758.5	0.9430	0.5683
23.75	4.87	759.0	0.9430	0.5682
29.93	5.47	759.5	0.9429	0.5681
37.73	6.14	760.0	0.9429	0.5680
47.55	6.90	760.5	0.9428	0.5679
59.93	7.74	761.0	0.9428	0.5679
75.93	8.71	761.5	0.9427	0.5678
94.93	9.74	761.5	0.9427	0.5678

Machine Deflection

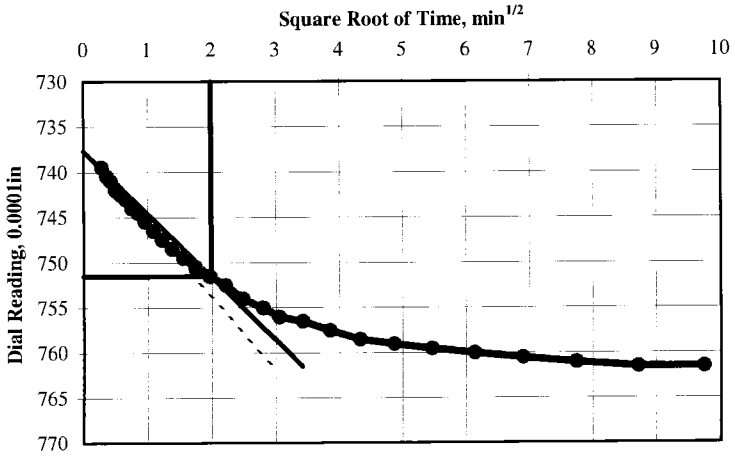
Applied Deflection Correction to Sample Height, 0.0001in -3.5

**Correction is applied to all dial readings.*

Log of Elapsed Time vs. Dial Reading



Square Root of Elapsed Time vs. Dial Reading



Sqrt. of Elapsed Time vs Dial Reading			Log of Elapsed Time vs Dial Reading			Load Summary	
T0 = 0 min.	D0 = 737.7 div.		T0 = 0 min.	D0 = 736.5 div.			
T90 = 3.96 min	D90 = 751.5 div.		T50 = 1.61 min.	D50 = 747.7 div.		Initial Sample Height, in	0.9458
T100 = NA min	D100 = 753.1 div.		T100 = 13.74 min.	D100 = 759 div.		Initial Sample Void Ratio	0.5729
Height at: D90 = 0.9437, D100 = 0.9435			Height at: D50 = 0.9441, D100 = 0.943			Final Sample Height, in	0.9427
Average Sample Height, in		0.9443	Average Sample Height, in		0.9443	Final Sample Void Ratio	0.5678
Average Drainage Height, in		0.4721	Average Drainage Height, in		0.4721	Incremental Strain, %	0.33%
T (Time Factor for T90)		0.848	T (Time Factor for T50)		0.197	Loading Duration, min	94.933333
Coef. of Consol., C_v, in^2/min		0.048	Coef. of Consol., C_v, in^2/min		0.027		

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ONE-DIMENSIONAL CONSOLIDATION PROPERTIES OF SOILS
ASTM D 2435

Client	Civil & Environmental Consultant	Boring	SB-18	**Test Load, tsf**	**1-2**
Client Project	091-867 Apex Landfill Expansion	Depth	10'-12'		Load 10 of 13
Project No.	30598	Sample	ST-1		
		Lab ID#	30598010		
Visual Description	Dark Grayish Brown Sandy Clay with Gravel				
Test Conditions:	Undisturbed, Inundated, and Double Drained				

Time Vs. Dial Reading

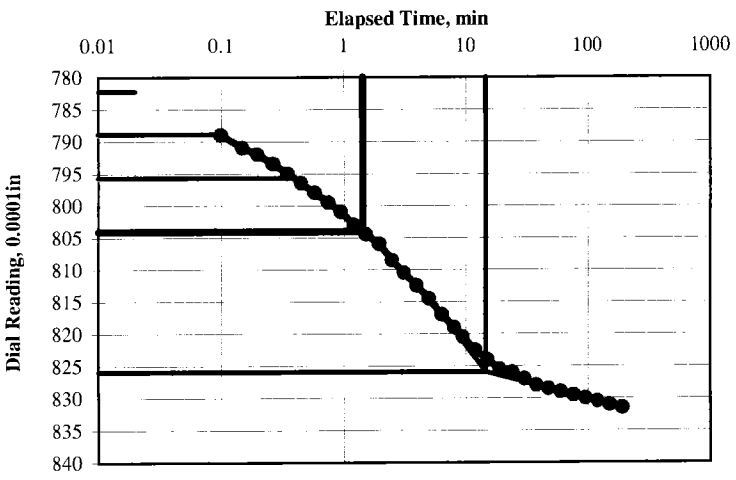
Elapsed Time (min)	Sqrt Time ($min^{1/2}$)	Dial Reading (0.0001in)	Sample Height (in)	Void Ratio
0	0	761.5	0.9427	0.5678
Corrections*		-4.5	-0.00045	-0.0007
Adjusted Sample Height & Void Ratio				
0.10	0.32	789.0	0.9404	0.5639
0.15	0.39	791.0	0.9402	0.5636
0.20	0.45	792.0	0.9401	0.5634
0.27	0.52	793.5	0.9400	0.5632
0.35	0.59	795.0	0.9398	0.5629
0.45	0.67	796.5	0.9397	0.5627
0.58	0.76	798.0	0.9395	0.5624
0.75	0.87	799.5	0.9394	0.5622
0.95	0.97	801.0	0.9392	0.5619
1.22	1.10	803.0	0.9390	0.5616
1.53	1.24	804.5	0.9389	0.5614
1.95	1.40	806.0	0.9387	0.5611
2.47	1.57	808.5	0.9385	0.5607
3.12	1.77	810.5	0.9383	0.5604
3.95	1.99	812.5	0.9381	0.5600
4.98	2.23	814.5	0.9379	0.5597
6.30	2.51	817.0	0.9376	0.5593
7.95	2.82	819.0	0.9374	0.5590
9.40	3.07	820.5	0.9373	0.5587
11.85	3.44	822.5	0.9371	0.5584
14.95	3.87	824.0	0.9369	0.5581
18.85	4.34	825.5	0.9368	0.5579
23.77	4.88	826.0	0.9367	0.5578
29.95	5.47	827.0	0.9366	0.5576
37.75	6.14	828.0	0.9365	0.5575
47.57	6.90	828.5	0.9365	0.5574
59.95	7.74	829.0	0.9364	0.5573
75.95	8.71	829.5	0.9364	0.5572
94.95	9.74	830.0	0.9363	0.5571
119.95	10.95	830.5	0.9363	0.5570
150.95	12.29	831.0	0.9362	0.5570
189.95	13.78	831.5	0.9362	0.5569

Machine Deflection

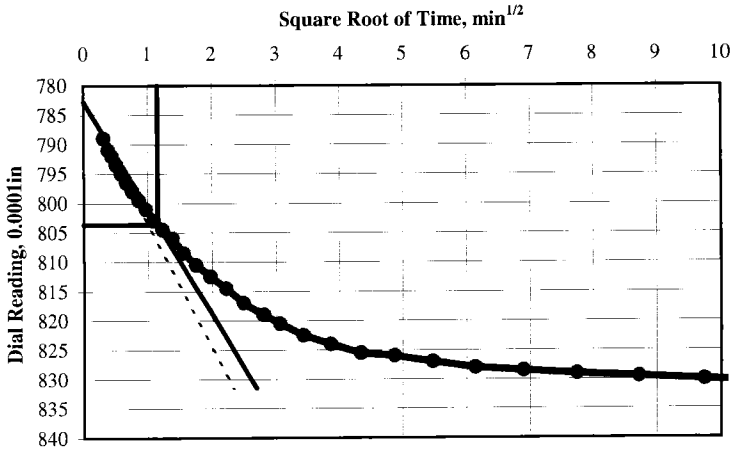
Applied Deflection Correction to Sample Height, 0.0001in -4.5

**Correction is applied to all dial readings.*

Log of Elapsed Time vs. Dial Reading



Square Root of Elapsed Time vs. Dial Reading



Sqrt. of Elapsed Time vs Dial Reading

T0 = 0 min.	D0 = 782.7 div.
T90 = 1.346 min	D90 = 803.6 div.
T100 = NA min	D100 = 806 div.
Height at: D90 = 0.9389, D100 = 0.9387	
Average Sample Height, in	0.9394
Average Drainage Height, in	0.4697
T (Time Factor for T90)	0.848
Coef. of Consol., C_v, in^2/min	0.139

Log of Elapsed Time vs Dial Reading

T0 = 0 min.	D0 = 782.2 div.
T50 = 1.43 min.	D50 = 804.1 div.
T100 = 14.57 min.	D100 = 825.9 div.
Height at: D50 = 0.9389, D100 = 0.9367	
Average Sample Height, in	0.9394
Average Drainage Height, in	0.4697
T (Time Factor for T50)	0.197
Coef. of Consol., C_v, in^2/min	0.030

Load Summary

Initial Sample Height, in	0.9427
Initial Sample Void Ratio	0.5678
Final Sample Height, in	0.9362
Final Sample Void Ratio	0.5569
Incremental Strain, %	0.69%
Loading Duration, min	189.95

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ONE-DIMENSIONAL CONSOLIDATION PROPERTIES OF SOILS
ASTM D 2435

Client	Civil & Environmental Consultant	Boring	SB-18	**Test Load, tsf**	**2-4**
Client Project	091-867 Apex Landfill Expansion	Depth	10'-12'		Load 11 of 13
Project No.	30598	Sample	ST-1		
		Lab ID#	30598010		
Visual Description	Dark Grayish Brown Sandy Clay with Gravel				
Test Conditions:	Undisturbed, Inundated, and Double Drained				

Time Vs. Dial Reading

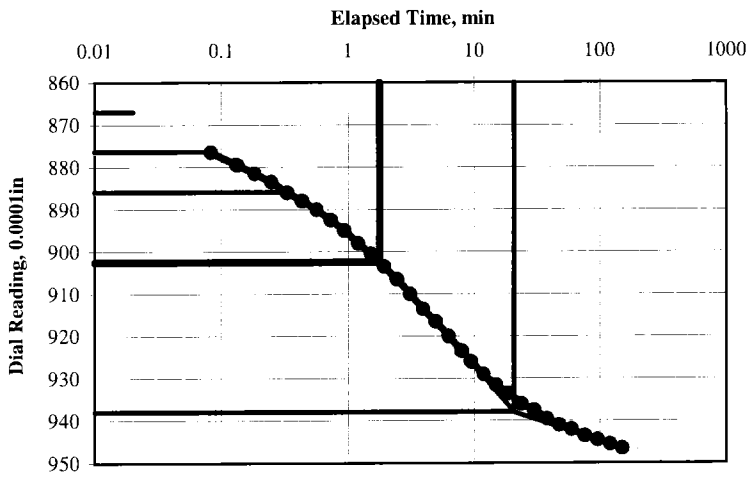
Elapsed Time (min)	Sqrt Time ($min^{1/2}$)	Dial Reading (0.0001in)	Sample Height (in)	Void Ratio
0	0	831.5	0.9362	0.5569
Corrections*		-5	-0.0005	-0.0008
Adjusted Sample Height & Void Ratio				
0.08	0.29	876.5	0.9322	0.5502
0.13	0.37	879.5	0.9319	0.5497
0.18	0.43	881.5	0.9317	0.5494
0.25	0.50	883.5	0.9315	0.5491
0.33	0.58	886.0	0.9312	0.5486
0.43	0.66	888.0	0.9310	0.5483
0.57	0.75	890.0	0.9308	0.5480
0.73	0.86	892.5	0.9306	0.5476
0.93	0.97	895.0	0.9303	0.5471
1.20	1.10	898.0	0.9300	0.5466
1.52	1.23	900.5	0.9298	0.5462
1.93	1.39	903.5	0.9295	0.5457
2.45	1.57	906.5	0.9292	0.5452
3.10	1.76	910.0	0.9288	0.5447
3.93	1.98	913.5	0.9285	0.5441
4.97	2.23	916.5	0.9282	0.5436
6.28	2.51	920.0	0.9278	0.5430
7.93	2.82	923.5	0.9275	0.5424
9.38	3.06	926.0	0.9272	0.5420
11.83	3.44	929.0	0.9269	0.5415
14.93	3.86	931.5	0.9267	0.5411
18.83	4.34	933.5	0.9265	0.5407
23.75	4.87	936.0	0.9262	0.5403
29.93	5.47	937.5	0.9261	0.5401
37.73	6.14	939.5	0.9259	0.5397
47.55	6.90	941.0	0.9257	0.5395
59.93	7.74	942.0	0.9256	0.5393
75.93	8.71	943.5	0.9255	0.5391
94.93	9.74	944.5	0.9254	0.5389
119.93	10.95	945.5	0.9253	0.5387
150.93	12.29	946.5	0.9252	0.5386

Machine Deflection

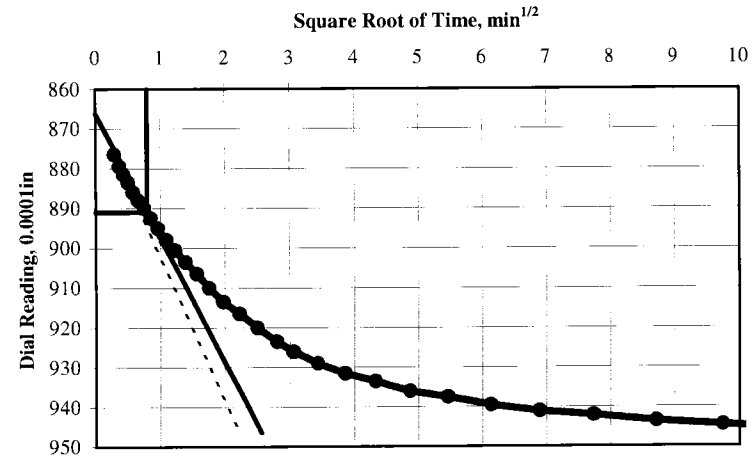
Applied Deflection Correction to Sample Height, 0.0001in -5

**Correction is applied to all dial readings.*

Log of Elapsed Time vs. Dial Reading



Square Root of Elapsed Time vs. Dial Reading



Sqrt. of Elapsed Time vs Dial Reading		Log of Elapsed Time vs Dial Reading		Load Summary	
T0 = 0 min.	D0 = 866.2 div.	T0 = 0 min.	D0 = 867 div.		
T90 = 0.624 min	D90 = 890.9 div.	T50 = 1.78 min.	D50 = 902.5 div.	Initial Sample Height, in	0.9362
T100 = NA min	D100 = 893.6 div.	T100 = 20.75 min.	D100 = 937.9 div.	Initial Sample Void Ratio	0.5569
Height at: D90 = 0.9307, D100 = 0.9304		Height at: D50 = 0.9296, D100 = 0.926		Final Sample Height, in	0.9252
Average Sample Height, in	0.9307	Average Sample Height, in	0.9307	Final Sample Void Ratio	0.5386
Average Drainage Height, in	0.4653	Average Drainage Height, in	0.4653	Incremental Strain, %	1.18%
T (Time Factor for T90)	0.848	T (Time Factor for T50)	0.197	Loading Duration, min	150.93333
Coef. of Consol., C_v, in^2/min	0.294	Coef. of Consol., C_v, in^2/min	0.024		

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ONE-DIMENSIONAL CONSOLIDATION PROPERTIES OF SOILS
ASTM D 2435

Client	Civil & Environmental Consultant	Boring	SB-18	**Test Load, tsf**	**4-8**
Client Project	091-867 Apex Landfill Expansion	Depth	10'-12'		Load 12 of 13
Project No.	30598	Sample	ST-1		
		Lab ID#	30598010		

Visual Description: Dark Grayish Brown Sandy Clay with Gravel
Test Conditions: Undisturbed, Inundated, and Double Drained

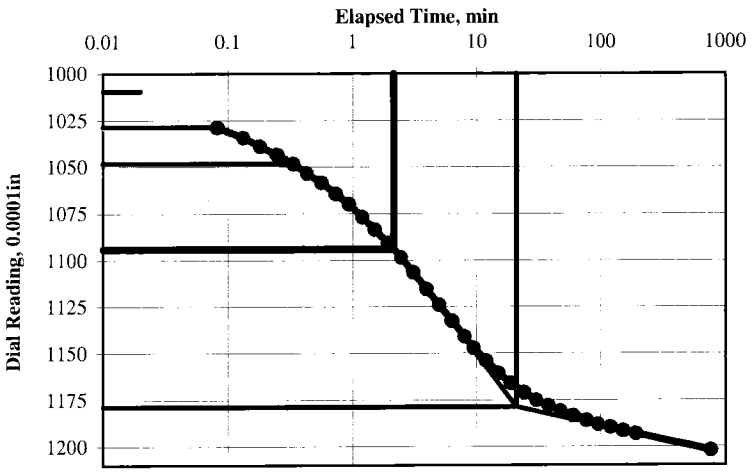
Time Vs. Dial Reading

Elapsed Time (min)	Sqrt Time ($min^{1/2}$)	Dial Reading (0.0001in)	Sample Height (in)	Void Ratio
0	0	946.5	0.9252	0.5386
Corrections*		-10.5	-0.00105	-0.0017
Adjusted Sample Height & Void Ratio				
0.08	0.29	1029.0	0.9180	0.5266
0.13	0.37	1034.5	0.9174	0.5257
0.18	0.43	1039.0	0.9170	0.5249
0.25	0.50	1043.5	0.9165	0.5242
0.33	0.58	1048.5	0.9160	0.5234
0.43	0.66	1053.5	0.9155	0.5225
0.57	0.75	1058.5	0.9150	0.5217
0.73	0.86	1064.5	0.9144	0.5207
0.93	0.97	1070.0	0.9139	0.5198
1.20	1.10	1077.0	0.9132	0.5186
1.52	1.23	1083.5	0.9125	0.5175
1.93	1.39	1091.0	0.9118	0.5163
2.45	1.57	1098.5	0.9110	0.5150
3.10	1.76	1106.5	0.9102	0.5137
3.93	1.98	1115.5	0.9093	0.5122
4.97	2.23	1124.0	0.9085	0.5108
6.28	2.51	1132.5	0.9076	0.5094
7.93	2.82	1141.0	0.9068	0.5080
9.38	3.06	1147.0	0.9062	0.5070
11.83	3.44	1154.0	0.9055	0.5058
14.93	3.86	1160.5	0.9048	0.5047
18.83	4.34	1166.0	0.9043	0.5038
23.75	4.87	1171.0	0.9038	0.5030
29.93	5.47	1175.0	0.9034	0.5023
37.73	6.14	1178.0	0.9031	0.5018
47.55	6.90	1181.0	0.9028	0.5013
59.93	7.74	1183.5	0.9025	0.5009
75.93	8.71	1186.0	0.9023	0.5005
94.93	9.74	1188.0	0.9021	0.5002
119.93	10.95	1189.5	0.9019	0.4999
150.93	12.29	1191.5	0.9017	0.4996
189.93	13.78	1193.0	0.9016	0.4993
757.93	27.53	1202.0	0.9007	0.4978

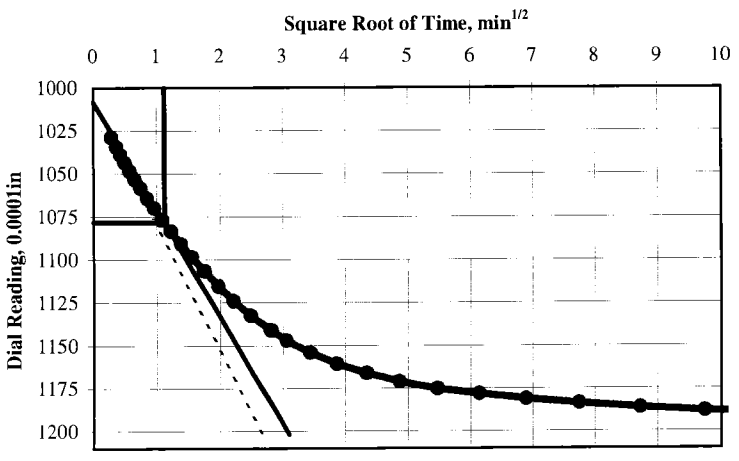
Machine Deflection

Applied Deflection Correction to Sample Height, 0.0001in: -10.5
**Correction is applied to all dial readings.*

Log of Elapsed Time vs. Dial Reading



Square Root of Elapsed Time vs. Dial Reading



Sqrt. of Elapsed Time vs Dial Reading		Log of Elapsed Time vs Dial Reading		Load Summary	
T0 = 0 min.	D0 = 1008.3 div.	T0 = 0 min.	D0 = 1009.5 div.		
T90 = 1.254 min	D90 = 1078.3 div.	T50 = 2.13 min.	D50 = 1094.1 div.	Initial Sample Height, in	0.9252
T100 = NA min	D100 = 1086.1 div.	T100 = 20.9 min.	D100 = 1178.6 div.	Initial Sample Void Ratio	0.5386
Height at: D90 = 0.913, D100 = 0.9122		Height at: D50 = 0.9114, D100 = 0.903		Final Sample Height, in	0.9007
Average Sample Height, in	0.9129	Average Sample Height, in	0.9129	Final Sample Void Ratio	0.4978
Average Drainage Height, in	0.4565	Average Drainage Height, in	0.4565	Incremental Strain, %	2.65%
T (Time Factor for T90)	0.848	T (Time Factor for T50)	0.197	Loading Duration, min	757.93333
Coef. of Consol., C_v, in^2/min	0.140	Coef. of Consol., C_v, in^2/min	0.019		

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ONE-DIMENSIONAL CONSOLIDATION PROPERTIES OF SOILS
ASTM D 2435

Client	Civil & Environmental Consultant	Boring	SB-18	**Test Load, tsf**	**8-16**
Client Project	091-867 Apex Landfill Expansion	Depth	10'-12'		Load 13 of 13
Project No.	30598	Sample	ST-1		
		Lab ID#	30598010		
Visual Description	Dark Grayish Brown Sandy Clay with Gravel				
Test Conditions:	Undisturbed, Inundated, and Double Drained				

Time Vs. Dial Reading

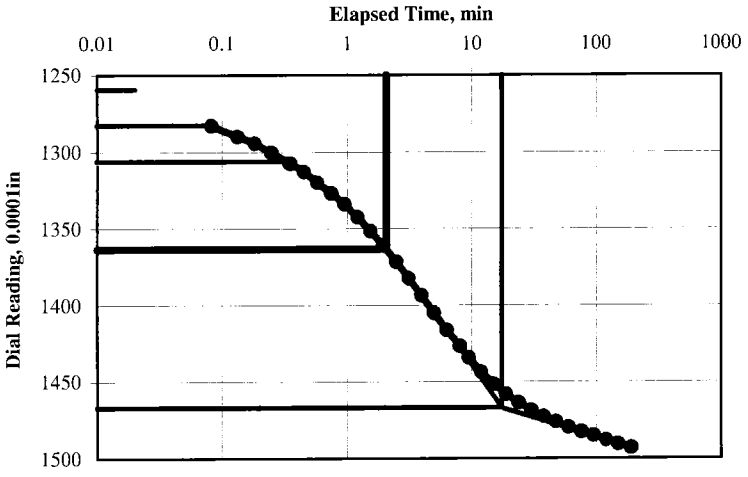
Elapsed Time (min)	Sqrt Time ($min^{1/2}$)	Dial Reading (0.0001in)	Sample Height (in)	Void Ratio
0	0	1202.0	0.9007	0.4978
Corrections*		-15	-0.0015	-0.0025
Adjusted Sample Height & Void Ratio				
0.08	0.29	1283.0	0.8941	0.4869
0.13	0.37	1290.0	0.8934	0.4857
0.18	0.43	1294.5	0.8929	0.4849
0.25	0.50	1300.5	0.8923	0.4839
0.35	0.59	1307.5	0.8916	0.4828
0.45	0.67	1313.0	0.8911	0.4819
0.58	0.76	1320.0	0.8904	0.4807
0.75	0.87	1327.0	0.8897	0.4795
0.95	0.97	1334.0	0.8890	0.4784
1.22	1.10	1342.5	0.8881	0.4770
1.55	1.24	1351.5	0.8872	0.4755
1.95	1.40	1361.0	0.8863	0.4739
2.47	1.57	1371.5	0.8852	0.4721
3.12	1.77	1382.5	0.8841	0.4703
3.95	1.99	1393.5	0.8830	0.4685
4.98	2.23	1405.0	0.8819	0.4666
6.30	2.51	1416.0	0.8808	0.4647
7.95	2.82	1426.5	0.8797	0.4630
9.40	3.07	1434.0	0.8790	0.4617
11.85	3.44	1443.5	0.8780	0.4602
14.95	3.87	1451.5	0.8772	0.4588
→ 18.85	4.34	1458.0	0.8766	0.4578
23.77	4.88	1463.5	0.8760	0.4568
29.95	5.47	1468.5	0.8755	0.4560
37.75	6.14	1472.5	0.8751	0.4553
47.57	6.90	1476.0	0.8748	0.4548
59.95	7.74	1479.5	0.8744	0.4542
75.95	8.71	1482.5	0.8741	0.4537
94.95	9.74	1485.0	0.8739	0.4533
119.95	10.95	1488.0	0.8736	0.4528
150.95	12.29	1490.5	0.8733	0.4524
→ 189.95	13.78	1493.0	0.8731	0.4519

Machine Deflection

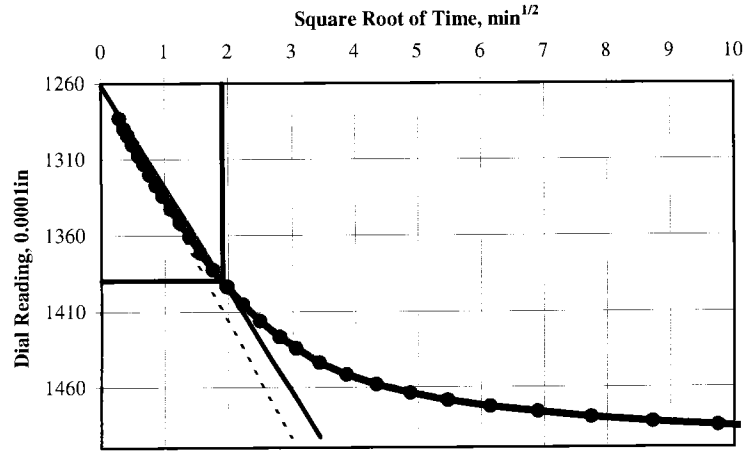
Applied Deflection Correction to Sample Height, 0.0001in: -15

**Correction is applied to all dial readings.*

Log of Elapsed Time vs. Dial Reading



Square Root of Elapsed Time vs. Dial Reading



Sqrt. of Elapsed Time vs Dial Reading			Log of Elapsed Time vs Dial Reading			Load Summary	
T0 = 0 min.	D0 = 1261.4 div.		T0 = 0 min.	D0 = 1259.5 div.			
T90 = 3.648 min	D90 = 1389.8 div.		T50 = 2.05 min.	D50 = 1363.3 div.		Initial Sample Height, in	0.9007
T100 = NA min	D100 = 1404.1 div.		T100 = 17.46 min.	D100 = 1467 div.		Initial Sample Void Ratio	0.4978
Height at: D90 = 0.8834, D100 = 0.8819			Height at: D50 = 0.886, D100 = 0.8757			Final Sample Height, in	0.8731
Average Sample Height, in		0.8869	Average Sample Height, in		0.8869	Final Sample Void Ratio	0.4519
Average Drainage Height, in		0.4434	Average Drainage Height, in		0.4434	Incremental Strain, %	3.06%
T (Time Factor for T90)		0.848	T (Time Factor for T50)		0.197	Loading Duration, min	189.95
Coef. of Consol., C_v, in^2/min		0.046	Coef. of Consol., C_v, in^2/min		0.019		

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ONE-DIMENSIONAL CONSOLIDATION PROPERTIES OF SOILS
ASTM D 2435

Client	Civil & Environmental Consultant	Boring	SB-17
Client Project	091-867 Apex Landfill Expansion	Depth	16'-18'
Project No.	30598	Sample	ST-1
		Lab Sample No.	30598009

Visual Description: Gray Clayey Sand
Sample Conditions: Undisturbed, Inundated, and Double Drained
Machine Deflection Correction: Applied

SAMPLE PROPERTIES		
	Initial	Final
Tare Number	A45	A33
Wt. Tare & WS, gm	114.76	168.62
Wt. Tare & DS, gm	99.5	147.41
Wt. Tare, gm	9.08	9.74
Water Content, %	16.9%	15.4%
Sample Diameter, in	2.5	2.5
Sample Height, in	1.007	0.8918
Sample Volume, in^3	4.9413	4.3778
Wt. WS + Ring, gm	271.29	270.71
Wt. of Ring, gm	110.92	110.92
Wt. of WS, gm	160.37	159.79
Wet Density, pcf	123.59	138.99
Wet Density, g/cc	1.981	2.227
Water Content, %	16.9%	15.4%
Wt. of DS, gm	137.21	138.46
Dry Density, pcf	105.74	120.43
Dry Density, g/cc	1.695	1.930
Void Ratio, e	0.5933	0.3989
Saturation, %	76.8%	
Specific Gravity	2.7	Measured
Height of Solids, in	0.6318	0.6318

TEST DATA SUMMARY

Applied Pressure tsf	Load Duration min	Final Height in	Vertical Strain %	Dry Density g/cc	Void Ratio e	a_v ft^2/ton	Incremental C_c	Incremental C_r
Seating	NA	1.0066	0.00	1.6946	0.5933	NA	NA	NA
0.25	120	1.0065	0.01%	1.6947	0.5932	6.66E-04	NA	NA
0.5	478	1.0041	0.25%	1.6988	0.5894	1.53E-02	0.013	NA
1	302	0.9966	1.00%	1.7116	0.5775	2.38E-02	0.040	NA
2	1,514	0.9755	3.09%	1.7486	0.5441	3.33E-02	0.111	NA
4	151	0.9475	5.87%	1.8002	0.4998	2.22E-02	0.147	NA
1	151	0.9513	5.50%	1.7931	0.5058	1.98E-03	NA	NA
0.25	120	0.9580	4.83%	1.7805	0.5164	1.42E-02	NA	NA
0.5	95	0.9572	4.91%	1.7820	0.5151	5.07E-03	NA	0.004
1	95	0.9554	5.09%	1.7855	0.5122	5.83E-03	NA	0.010
2	190	0.9512	5.50%	1.7932	0.5057	6.56E-03	NA	0.022
4	151	0.9427	6.35%	1.8094	0.4922	6.71E-03	NA	0.045
8	758	0.9181	8.79%	1.8579	0.4532	9.75E-03	0.130	NA
16	190	0.8918	11.40%	1.9127	0.4116	5.20E-03	0.138	NA

$A_{v_c} = 0.020$

Note: The calculations performed and the parameters presented herein are for preliminary purposes only. GTS only accepts responsibility for the raw data obtained from the consolidation tests. This data may be interpreted differently by others. It is the responsibility of the user to determine the appropriateness and accuracy of the computed values.

Input Validation | Reviewed By: | Date Tested: 12/3/2010 |

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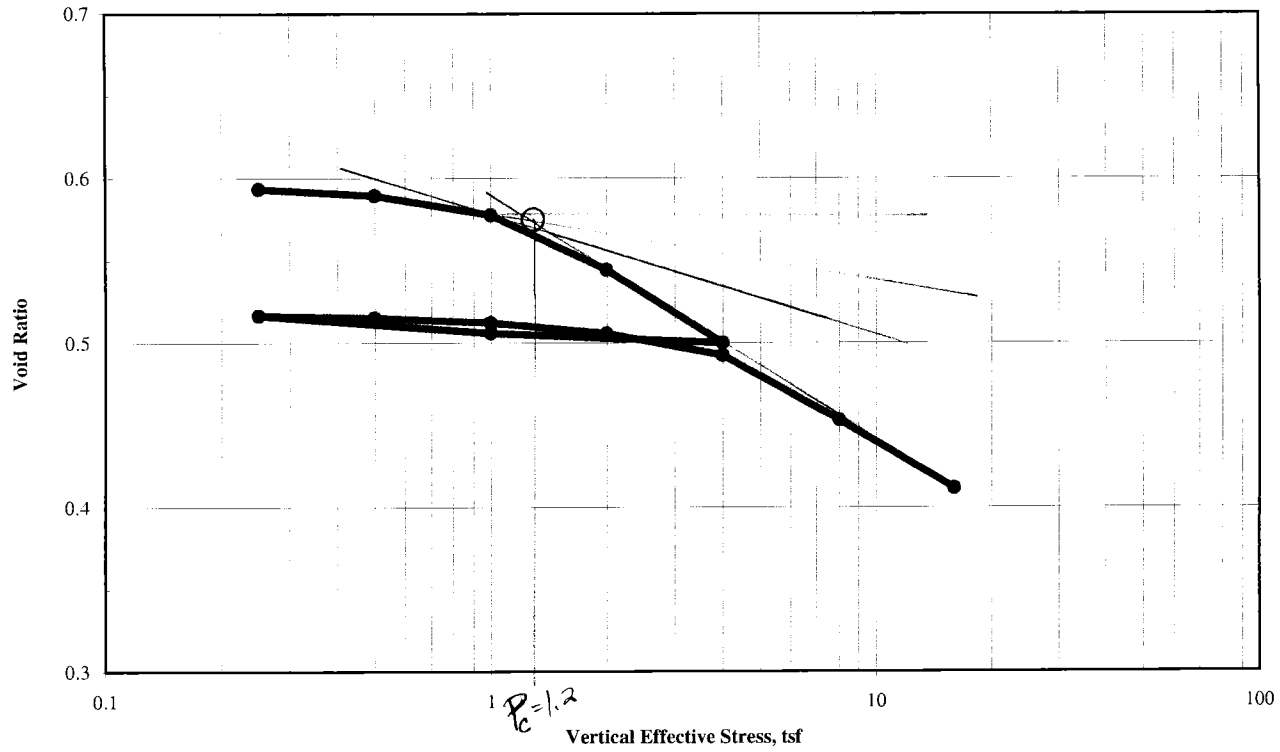
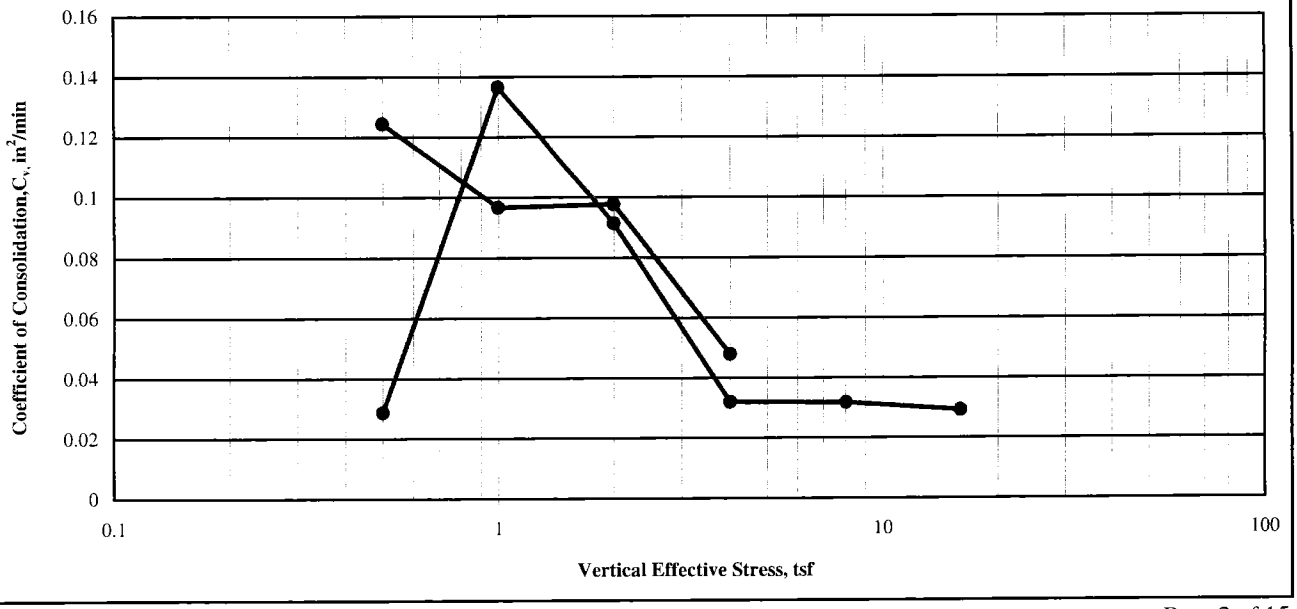
ONE-DIMENSIONAL CONSOLIDATION PROPERTIES OF SOILS
ASTM D 2435

Client	Civil & Environmental Consultants, Inc.	Boring	SB-17
Client Project	091-867 Apex Landfill Expansion	Depth	16'-18'
Project No.	30598	Sample	ST-1
		Lab Sample No.	30598009
Visual Description	Gray Clayey Sand		
Sample Conditions	Undisturbed, Inundated, and Double Drained		
Machine Deflection Correction:	Applied		

Void Ratio (Final Height) vs Vertical Effective Consolidation Stress



Coeffieicent of Consolidation (log. method) vs. Vertical Effective Consolidation Stress



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ONE-DIMENSIONAL CONSOLIDATION PROPERTIES OF SOILS
ASTM D 2435

Client	Civil & Environmental Consultant	Boring	SB-17	**Test Load, tsf**	**0-0.25**
Client Project	091-867 Apex Landfill Expansion	Depth	16'-18'		Load 1 of 13
Project No.	30598	Sample	ST-1		
		Lab ID#	30598009		

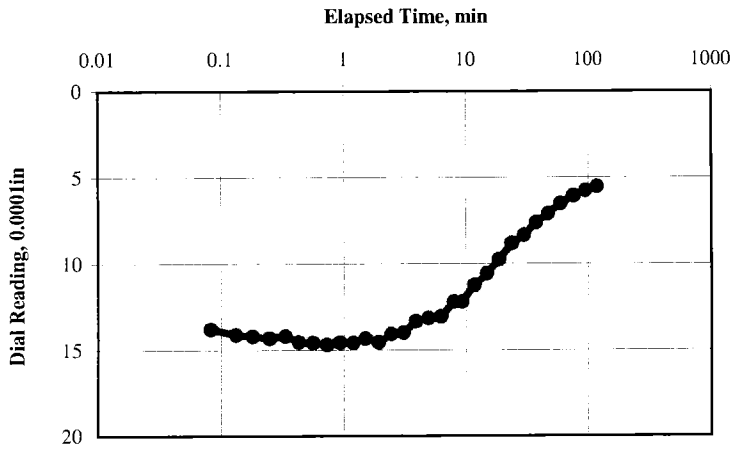
Visual Description: Gray Clayey Sand
Test Conditions: Undisturbed, Inundated, and Double Drained

Time Vs. Dial Reading				
Elapsed Time (min)	**Sqrt Time ($min^{1/2}$)**	**Dial Reading (0.0001in)**	**Sample Height (in)**	**Void Ratio**
0	0	0	1.0066	0.5933
Corrections*		-4.5	-0.00045	-0.0007
Adjusted Sample Height & Void Ratio				
0.08	0.29	13.8	1.0057	0.5919
0.13	0.37	14.1	1.0057	0.5918
0.18	0.43	14.2	1.0057	0.5918
0.25	0.50	14.3	1.0056	0.5918
0.33	0.58	14.2	1.0057	0.5918
0.43	0.66	14.5	1.0056	0.5917
0.57	0.75	14.6	1.0056	0.5917
0.73	0.86	14.7	1.0056	0.5917
0.93	0.97	14.6	1.0056	0.5917
1.20	1.10	14.6	1.0056	0.5917
1.52	1.23	14.3	1.0056	0.5918
1.93	1.39	14.5	1.0056	0.5917
2.45	1.57	14.1	1.0057	0.5918
3.10	1.76	14.0	1.0057	0.5918
3.93	1.98	13.3	1.0057	0.5919
4.97	2.23	13.1	1.0058	0.5920
6.28	2.51	13.1	1.0058	0.5920
7.93	2.82	12.2	1.0059	0.5921
9.38	3.06	12.2	1.0059	0.5921
11.83	3.44	11.3	1.0059	0.5923
14.93	3.86	10.6	1.0060	0.5924
18.83	4.34	9.8	1.0061	0.5925
23.75	4.87	8.8	1.0062	0.5926
29.93	5.47	8.4	1.0062	0.5927
37.73	6.14	7.7	1.0063	0.5928
47.55	6.90	7.1	1.0064	0.5929
59.93	7.74	6.5	1.0064	0.5930
75.93	8.71	6.1	1.0065	0.5931
94.93	9.74	5.8	1.0065	0.5931
119.93	10.95	5.6	1.0065	0.5932

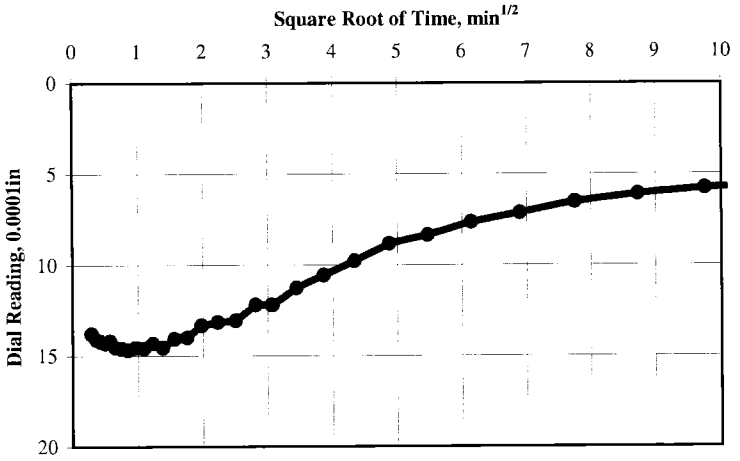
Machine Deflection

Applied Deflection Correction to Sample Height, 0.0001in: -4.5
**Correction is applied to all dial readings.*

Log of Elapsed Time vs. Dial Reading



Square Root of Elapsed Time vs. Dial Reading



Sqrt. of Elapsed Time vs Dial Reading | **Log of Elapsed Time vs Dial Reading**

Specimen Swelled

Load Summary

Initial Sample Height, in	1.0066
Initial Sample Void Ratio	0.5933
Final Sample Height, in	1.0065
Final Sample Void Ratio	0.5932
Incremental Strain, %	0.01%
Loading Duration, min	119.93333

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ONE-DIMENSIONAL CONSOLIDATION PROPERTIES OF SOILS
ASTM D 2435

Client	Civil & Environmental Consultant	Boring	SB-17	**Test Load, tsf 0.25-0.5**
Client Project	091-867 Apex Landfill Expansion	Depth	16'-18'	Load 2 of 13
Project No.	30598	Sample	ST-1	
		Lab ID#	30598009	

Visual Description: Gray Clayey Sand
Test Conditions: Undisturbed, Inundated, and Double Drained

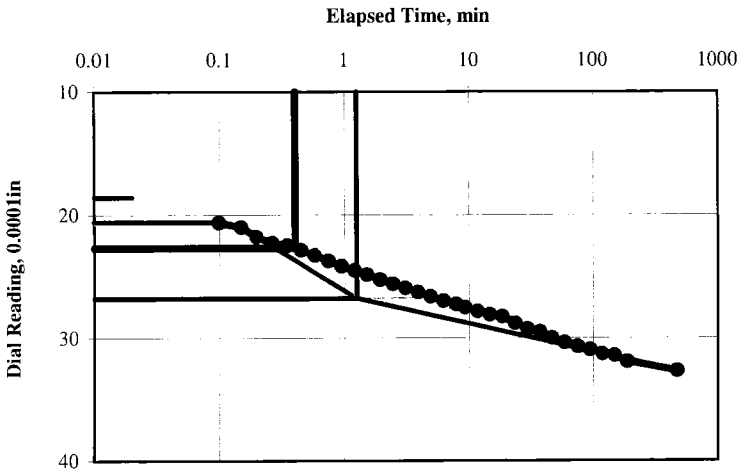
Time Vs. Dial Reading

Elapsed Time (min)	Sqrt Time ($min^{1/2}$)	Dial Reading (0.0001in)	Sample Height (in)	Void Ratio
0	0	5.6	1.0065	0.5932
Corrections*		-3	-0.0003	-0.0005
Adjusted Sample Height & Void Ratio				
0.10	0.32	20.6	1.0053	0.5913
0.15	0.39	21.0	1.0053	0.5912
0.20	0.45	21.8	1.0052	0.5911
0.27	0.52	22.3	1.0051	0.5910
0.35	0.59	22.5	1.0051	0.5910
0.45	0.67	22.8	1.0051	0.5909
0.58	0.76	23.3	1.0050	0.5908
0.75	0.87	23.7	1.0050	0.5908
0.95	0.97	24.2	1.0050	0.5907
1.22	1.10	24.5	1.0049	0.5906
1.53	1.24	24.8	1.0049	0.5906
1.95	1.40	25.3	1.0048	0.5905
2.47	1.57	25.6	1.0048	0.5905
3.12	1.77	25.9	1.0048	0.5904
3.95	1.99	26.3	1.0047	0.5904
4.98	2.23	26.6	1.0047	0.5903
6.30	2.51	27.0	1.0047	0.5903
7.95	2.82	27.2	1.0047	0.5902
9.40	3.07	27.5	1.0046	0.5902
11.85	3.44	27.8	1.0046	0.5901
14.95	3.87	28.1	1.0046	0.5901
18.85	4.34	28.3	1.0045	0.5901
23.77	4.88	28.8	1.0045	0.5900
29.95	5.47	29.3	1.0044	0.5899
37.75	6.14	29.5	1.0044	0.5899
47.57	6.90	30.0	1.0044	0.5898
59.95	7.74	30.4	1.0043	0.5897
75.95	8.71	30.7	1.0043	0.5897
94.95	9.74	31.0	1.0043	0.5896
119.95	10.95	31.3	1.0042	0.5896
150.95	12.29	31.4	1.0042	0.5895
189.95	13.78	31.9	1.0042	0.5895
477.95	21.86	32.7	1.0041	0.5894

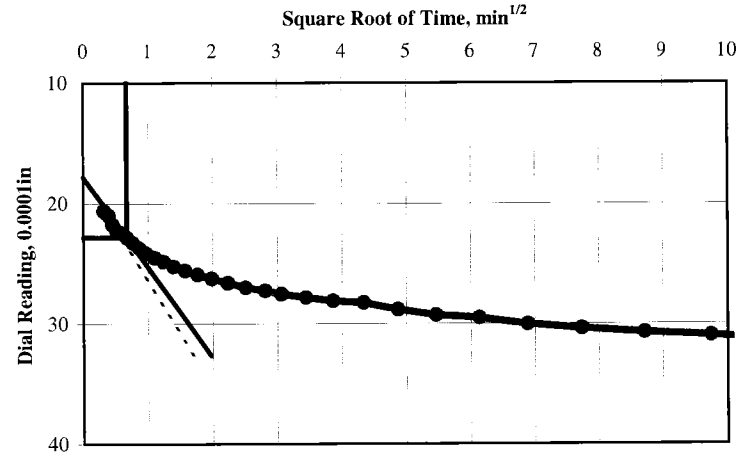
Machine Deflection

Applied Deflection Correction to Sample Height, 0.0001in: -3
**Correction is applied to all dial readings.*

Log of Elapsed Time vs. Dial Reading



Square Root of Elapsed Time vs. Dial Reading



Sqrt. of Elapsed Time vs Dial Reading		Log of Elapsed Time vs Dial Reading		Load Summary	
T0 = 0 min.	D0 = 17.8 div.	T0 = 0 min.	D0 = 18.6 div.		
T90 = 0.436 min	D90 = 22.8 div.	T50 = 0.4 min.	D50 = 22.7 div.	Initial Sample Height, in	1.0065
T100 = NA min	D100 = 23.4 div.	T100 = 1.25 min.	D100 = 26.8 div.	Initial Sample Void Ratio	0.5932
Height at: D90 = 1.0051, D100 = 1.005		Height at: D50 = 1.0051, D100 = 1.0047		Final Sample Height, in	1.0041
Average Sample Height, in	1.0053	Average Sample Height, in	1.0053	Final Sample Void Ratio	0.5894
Average Drainage Height, in	0.5027	Average Drainage Height, in	0.5027	Incremental Strain, %	0.24%
T (Time Factor for T90)	0.848	T (Time Factor for T50)	0.197	Loading Duration, min	477.95
Coef. of Consol., C_v, in^2/min	0.486	Coef. of Consol., C_v, in^2/min	0.124		

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ONE-DIMENSIONAL CONSOLIDATION PROPERTIES OF SOILS
ASTM D 2435

Client	Civil & Environmental Consultant	Boring	SB-17	**Test Load, tsf**	**0.5-1**
Client Project	091-867 Apex Landfill Expansion	Depth	16'-18'		Load 3 of 13
Project No.	30598	Sample	ST-1		
		Lab ID#	30598009		

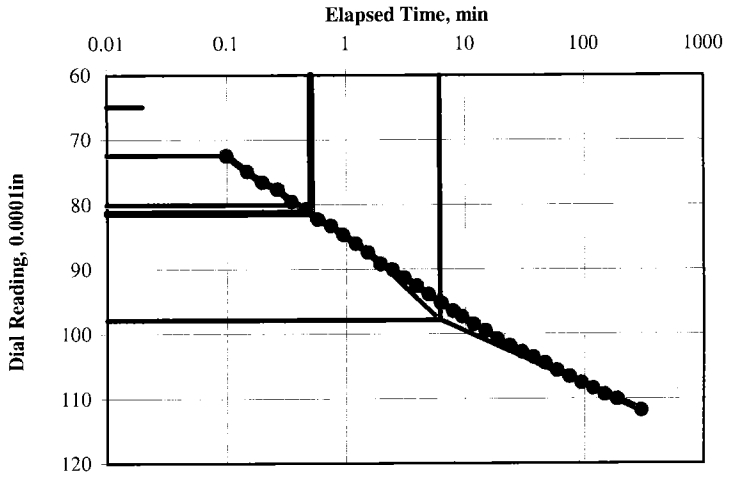
Visual Description: Gray Clayey Sand
Test Conditions: Undisturbed, Inundated, and Double Drained

Time Vs. Dial Reading				
Elapsed Time (min)	**Sqrt Time ($min^{1/2}$)**	**Dial Reading (0.0001in)**	**Sample Height (in)**	**Void Ratio**
0	0	32.7	1.0041	0.5894
Corrections*		-4	-0.0004	-0.0006
Adjusted Sample Height & Void Ratio				
0.10	0.32	72.5	1.0005	0.5837
0.15	0.39	75.0	1.0003	0.5833
0.20	0.45	76.6	1.0001	0.5830
0.27	0.52	77.7	1.0000	0.5829
0.35	0.59	79.6	0.9998	0.5826
0.47	0.68	80.8	0.9997	0.5824
0.58	0.76	82.3	0.9995	0.5821
0.75	0.87	83.4	0.9994	0.5820
0.95	0.97	84.7	0.9993	0.5817
1.22	1.10	86.1	0.9992	0.5815
1.53	1.24	87.4	0.9990	0.5813
1.95	1.40	89.2	0.9989	0.5810
2.47	1.57	90.1	0.9988	0.5809
3.12	1.77	91.4	0.9986	0.5807
3.95	1.99	92.6	0.9985	0.5805
4.98	2.23	93.9	0.9984	0.5803
6.30	2.51	95.2	0.9983	0.5801
7.95	2.82	96.4	0.9981	0.5799
9.40	3.07	97.3	0.9980	0.5798
11.85	3.44	98.5	0.9979	0.5796
14.95	3.87	99.5	0.9978	0.5794
18.85	4.34	100.8	0.9977	0.5792
23.77	4.88	101.9	0.9976	0.5790
29.95	5.47	102.8	0.9975	0.5789
37.75	6.14	103.6	0.9974	0.5788
47.57	6.90	104.5	0.9973	0.5786
59.95	7.74	105.6	0.9972	0.5784
75.95	8.71	106.6	0.9971	0.5783
94.95	9.74	107.5	0.9970	0.5781
119.95	10.95	108.4	0.9969	0.5780
150.95	12.29	109.4	0.9968	0.5778
189.95	13.78	110.1	0.9968	0.5777
301.95	17.38	111.8	0.9966	0.5775

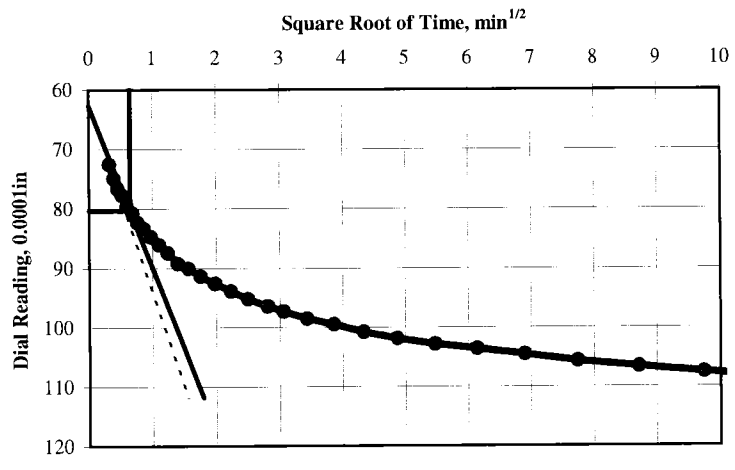
Machine Deflection

Applied Deflection Correction to Sample Height, 0.0001in: -4
**Correction is applied to all dial readings.*

Log of Elapsed Time vs. Dial Reading



Square Root of Elapsed Time vs. Dial Reading



Sqrt. of Elapsed Time vs Dial Reading		Log of Elapsed Time vs Dial Reading		Load Summary	
T0 = 0 min.	D0 = 62.7 div.	T0 = 0 min.	D0 = 64.9 div.		
T90 = 0.423 min	D90 = 80.3 div.	T50 = 0.51 min.	D50 = 81.4 div.	Initial Sample Height, in	1.0041
T100 = NA min	D100 = 82.3 div.	T100 = 6.13 min.	D100 = 97.8 div.	Initial Sample Void Ratio	0.5894
Height at: D90 = 0.9997, D100 = 0.9995		Height at: D50 = 0.9996, D100 = 0.998		Final Sample Height, in	0.9966
Average Sample Height, in	1.0004	Average Sample Height, in	1.0004	Final Sample Void Ratio	0.5775
Average Drainage Height, in	0.5002	Average Drainage Height, in	0.5002	Incremental Strain, %	0.75%
T (Time Factor for T90)	0.848	T (Time Factor for T50)	0.197	Loading Duration, min	301.95
Coef. of Consol., C_v, in^2/min	0.507	Coef. of Consol., C_v, in^2/min	0.097		

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ONE-DIMENSIONAL CONSOLIDATION PROPERTIES OF SOILS
ASTM D 2435

Client	Civil & Environmental Consultant	Boring	SB-17	**Test Load, tsf**	**1-2**
Client Project	091-867 Apex Landfill Expansion	Depth	16'-18'		Load 4 of 13
Project No.	30598	Sample	ST-1		
		Lab ID#	30598009		

Visual Description: Gray Clayey Sand
Test Conditions: Undisturbed, Inundated, and Double Drained

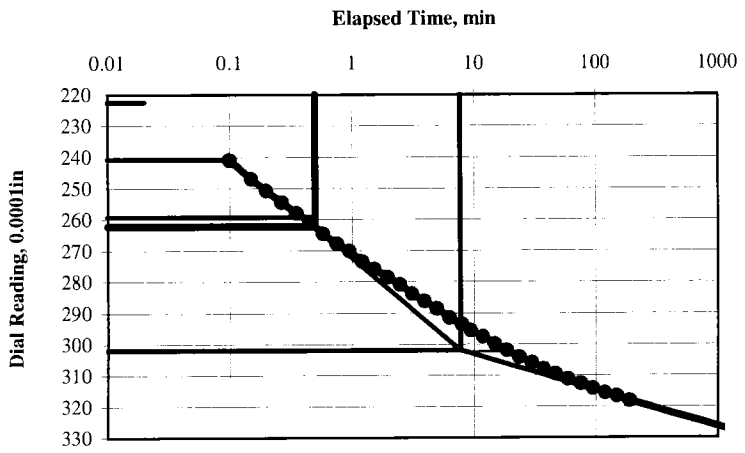
Time Vs. Dial Reading

Elapsed Time (min)	Sqrt Time ($min^{1/2}$)	Dial Reading (0.0001in)	Sample Height (in)	Void Ratio
0	0	111.8	0.9966	0.5775
Corrections*		-6	-0.0006	-0.0009
Adjusted Sample Height & Void Ratio				
0.10	0.32	241.0	0.9843	0.5580
0.15	0.39	247.0	0.9837	0.5570
0.20	0.45	250.8	0.9833	0.5564
0.27	0.52	254.5	0.9829	0.5558
0.35	0.59	258.0	0.9826	0.5553
0.45	0.67	260.8	0.9823	0.5548
0.58	0.76	264.6	0.9819	0.5542
0.75	0.87	267.7	0.9816	0.5537
0.95	0.97	270.2	0.9814	0.5533
1.22	1.10	273.5	0.9810	0.5528
1.53	1.24	276.0	0.9808	0.5524
1.95	1.40	278.5	0.9805	0.5520
2.47	1.57	280.9	0.9803	0.5516
3.12	1.77	283.8	0.9800	0.5512
3.95	1.99	286.2	0.9798	0.5508
4.98	2.23	288.6	0.9795	0.5504
6.30	2.51	291.5	0.9792	0.5500
7.95	2.82	293.6	0.9790	0.5496
9.40	3.07	295.6	0.9788	0.5493
11.85	3.44	297.6	0.9786	0.5490
14.95	3.87	299.9	0.9784	0.5486
18.85	4.34	302.0	0.9782	0.5483
23.77	4.88	304.1	0.9780	0.5480
29.95	5.47	305.9	0.9778	0.5477
37.75	6.14	307.9	0.9776	0.5474
47.57	6.90	309.4	0.9774	0.5471
59.95	7.74	311.1	0.9773	0.5469
75.95	8.71	312.7	0.9771	0.5466
94.95	9.74	314.2	0.9770	0.5464
119.95	10.95	315.6	0.9768	0.5462
150.95	12.29	316.7	0.9767	0.5460
189.95	13.78	318.2	0.9766	0.5457
1513.95	38.91	328.4	0.9755	0.5441

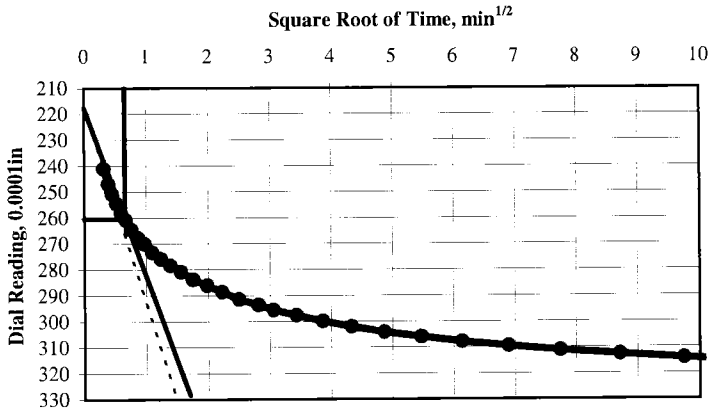
Machine Deflection

Applied Deflection Correction to Sample Height, 0.0001in: -6
**Correction is applied to all dial readings.*

Log of Elapsed Time vs. Dial Reading



Square Root of Elapsed Time vs. Dial Reading



Sqrt. of Elapsed Time vs Dial Reading		Log of Elapsed Time vs Dial Reading		Load Summary	
T0 = 0 min.	D0 = 217.6 div.	T0 = 0 min.	D0 = 222.5 div.		
T90 = 0.436 min	D90 = 260.4 div.	T50 = 0.49 min.	D50 = 262.2 div.	Initial Sample Height, in	0.9966
T100 = NA min	D100 = 265.2 div.	T100 = 7.68 min.	D100 = 301.9 div.	Initial Sample Void Ratio	0.5775
Height at: D90 = 0.9823, D100 = 0.9819		Height at: D50 = 0.9822, D100 = 0.9782		Final Sample Height, in	0.9755
Average Sample Height, in	0.9861	Average Sample Height, in	0.9861	Final Sample Void Ratio	0.5441
Average Drainage Height, in	0.4930	Average Drainage Height, in	0.4930	Incremental Strain, %	2.11%
T (Time Factor for T90)	0.848	T (Time Factor for T50)	0.197	Loading Duration, min	1513.95
Coef. of Consol., C_v, in^2/min	0.474	Coef. of Consol., C_v, in^2/min	0.098		

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ONE-DIMENSIONAL CONSOLIDATION PROPERTIES OF SOILS
ASTM D 2435

Client	Civil & Environmental Consultant	Boring	SB-17	**Test Load, tsf**	**2-4**
Client Project	091-867 Apex Landfill Expansion	Depth	16'-18'		Load 5 of 13
Project No.	30598	Sample	ST-1		
		Lab ID#	30598009		

Visual Description: Gray Clayey Sand
Test Conditions: Undisturbed, Inundated, and Double Drained

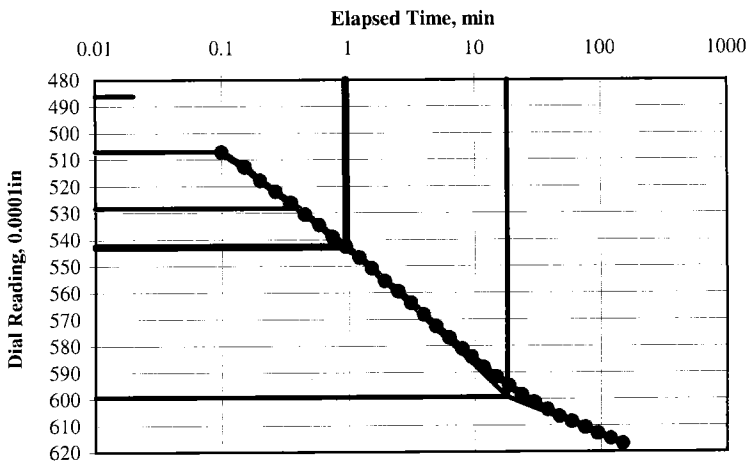
Time Vs. Dial Reading

Elapsed Time (min)	Sqrt Time ($min^{1/2}$)	Dial Reading (0.0001in)	Sample Height (in)	Void Ratio
0	0	328.4	0.9755	0.5441
Corrections*		-8.5	-0.00085	-0.0013
Adjusted Sample Height & Void Ratio				
0.10	0.32	507.4	0.9585	0.5171
0.15	0.39	512.9	0.9579	0.5163
0.20	0.45	517.9	0.9574	0.5155
0.27	0.52	522.0	0.9570	0.5148
0.35	0.59	526.2	0.9566	0.5142
0.45	0.67	530.7	0.9562	0.5135
0.58	0.76	534.6	0.9558	0.5128
0.75	0.87	539.1	0.9553	0.5121
0.95	0.97	542.7	0.9550	0.5116
1.22	1.10	546.9	0.9545	0.5109
1.53	1.24	551.0	0.9541	0.5102
1.95	1.40	555.7	0.9537	0.5095
2.47	1.57	559.5	0.9533	0.5089
3.12	1.77	563.8	0.9528	0.5082
3.95	1.99	568.3	0.9524	0.5075
4.98	2.23	572.6	0.9520	0.5068
6.30	2.51	577.0	0.9515	0.5061
7.95	2.82	581.1	0.9511	0.5055
9.40	3.07	584.1	0.9508	0.5050
11.85	3.44	588.2	0.9504	0.5044
14.95	3.87	591.6	0.9501	0.5038
18.85	4.34	595.1	0.9497	0.5033
23.77	4.88	598.4	0.9494	0.5027
29.95	5.47	601.2	0.9491	0.5023
37.75	6.14	604.0	0.9488	0.5018
47.57	6.90	606.6	0.9486	0.5014
59.95	7.74	608.6	0.9484	0.5011
75.95	8.71	610.7	0.9482	0.5008
94.95	9.74	613.0	0.9479	0.5004
119.95	10.95	614.9	0.9477	0.5001
150.95	12.29	616.9	0.9475	0.4998

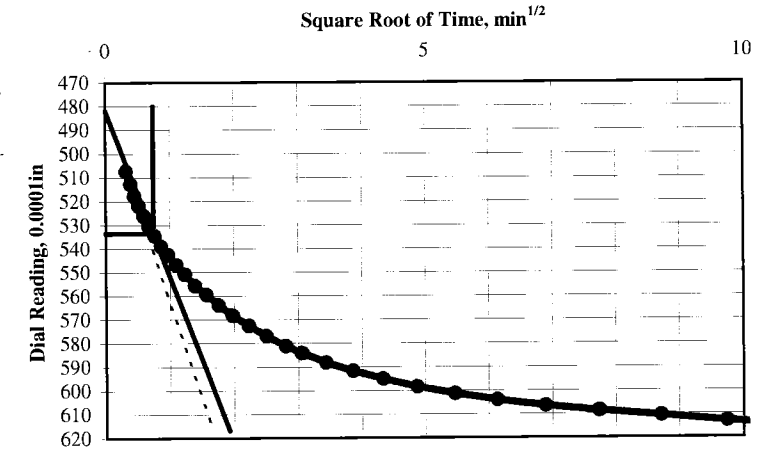
Machine Deflection

Applied Deflection Correction to Sample Height, 0.0001in: -8.5
**Correction is applied to all dial readings.*

Log of Elapsed Time vs. Dial Reading



Square Root of Elapsed Time vs. Dial Reading



Sqrt. of Elapsed Time vs Dial Reading

T0 = 0 min.	D0 = 481.8 div.
T90 = 0.548 min	D90 = 533.6 div.
T100 = NA min	D100 = 539.3 div.
Height at: D90 = 0.9559, D100 = 0.9553	
Average Sample Height, in	0.9615
Average Drainage Height, in	0.4808
T (Time Factor for T90)	0.848
Coef. of Consol., C_v, in^2/min	0.359

Log of Elapsed Time vs Dial Reading

T0 = 0 min.	D0 = 486.1 div.
T50 = 0.95 min.	D50 = 542.7 div.
T100 = 18.15 min.	D100 = 599.2 div.
Height at: D50 = 0.955, D100 = 0.9493	
Average Sample Height, in	0.9615
Average Drainage Height, in	0.4808
T (Time Factor for T50)	0.197
Coef. of Consol., C_v, in^2/min	0.048

Load Summary

Initial Sample Height, in	0.9755
Initial Sample Void Ratio	0.5441
Final Sample Height, in	0.9475
Final Sample Void Ratio	0.4998
Incremental Strain, %	2.87%
Loading Duration, min	150.95

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ONE-DIMENSIONAL CONSOLIDATION PROPERTIES OF SOILS
ASTM D 2435

Client	Civil & Environmental Consultant	Boring	SB-17	**Test Load, tsf**	**4-1**
Client Project	091-867 Apex Landfill Expansion	Depth	16'-18'		Load 6 of 13
Project No.	30598	Sample	ST-1		
		Lab ID#	30598009		

Visual Description: Gray Clayey Sand
Test Conditions: Undisturbed, Inundated, and Double Drained

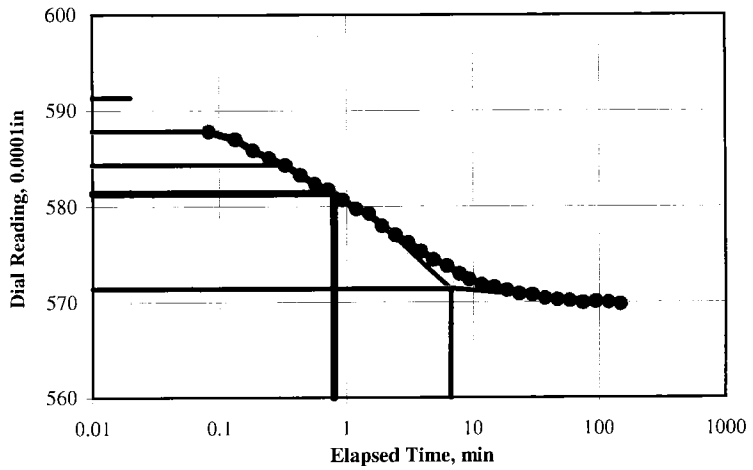
Time Vs. Dial Reading

Elapsed Time (min)	Sqrt Time ($min^{1/2}$)	Dial Reading (0.0001in)	Sample Height (in)	Void Ratio
0	0	616.9	0.9475	0.4998
Corrections*		9.5	0.00095	0.0015
Adjusted Sample Height & Void Ratio				
0.08	0.29	587.8	0.9495	0.5029
0.13	0.37	587.0	0.9496	0.5030
0.18	0.43	585.8	0.9497	0.5032
0.25	0.50	585.0	0.9498	0.5033
0.33	0.58	584.3	0.9498	0.5035
0.43	0.66	583.2	0.9500	0.5036
0.57	0.75	582.3	0.9500	0.5038
0.73	0.86	581.7	0.9501	0.5039
0.93	0.97	580.7	0.9502	0.5040
1.20	1.10	579.7	0.9503	0.5042
1.52	1.23	579.3	0.9503	0.5043
1.93	1.39	578.0	0.9505	0.5045
2.45	1.57	577.0	0.9506	0.5046
3.10	1.76	576.2	0.9507	0.5047
3.93	1.98	575.3	0.9507	0.5049
4.97	2.23	574.4	0.9508	0.5050
6.28	2.51	573.8	0.9509	0.5051
7.93	2.82	573.0	0.9510	0.5053
9.38	3.06	572.4	0.9510	0.5053
11.83	3.44	571.8	0.9511	0.5054
14.93	3.86	571.6	0.9511	0.5055
18.83	4.34	571.3	0.9511	0.5055
23.75	4.87	570.9	0.9512	0.5056
29.93	5.47	570.8	0.9512	0.5056
37.73	6.14	570.4	0.9512	0.5057
47.55	6.90	570.3	0.9512	0.5057
59.93	7.74	570.2	0.9513	0.5057
75.93	8.71	569.9	0.9513	0.5057
94.93	9.74	570.1	0.9513	0.5057
119.93	10.95	570.0	0.9513	0.5057
150.93	12.29	569.8	0.9513	0.5058

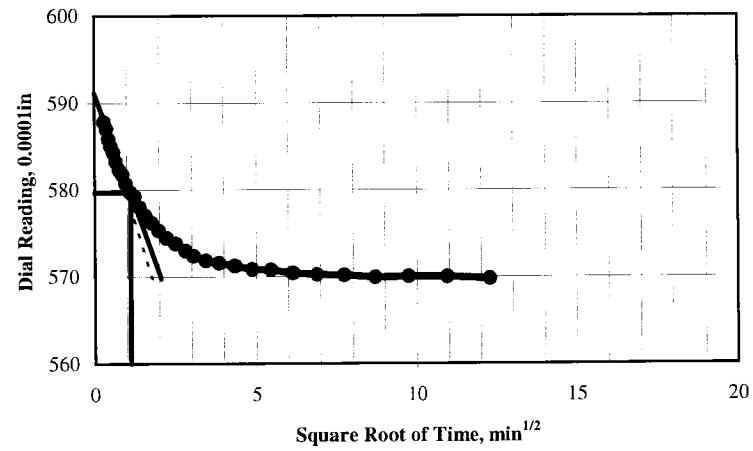
Machine Deflection

Applied Deflection Correction to Sample Height, 0.0001in: 9.5
**Correction is applied to all dial readings.*

Log of Elapsed Time vs. Dial Reading



Square Root of Elapsed Time vs. Dial Reading



Sqrt. of Elapsed Time vs Dial Reading		Log of Elapsed Time vs Dial Reading		Load Summary	
T0 = 0 min.	D0 = 591.1 div.	T0 = 0 min.	D0 = 591.3 div.		
T90 = 1.232 min	D90 = 579.7 div.	T50 = 0.8 min.	D50 = 581.4 div.	Initial Sample Height, in	0.9475
T100 = NA min	D100 = 578.4 div.	T100 = 6.71 min.	D100 = 571.4 div.	Initial Sample Void Ratio	0.4998
Height at: D90 = 0.9503, D100 = 0.9504		Height at: D50 = 0.9501, D100 = 0.9511		Final Sample Height, in	0.9513
Average Sample Height, in	0.9494	Average Sample Height, in	0.9494	Final Sample Void Ratio	0.5058
Average Drainage Height, in	0.4747	Average Drainage Height, in	0.4747	Incremental Strain, %	-0.40%
T (Time Factor for T90)	0.848	T (Time Factor for T50)	0.197	Loading Duration, min	150.93333
Coef. of Consol., C_v, in^2/min	0.156	Coef. of Consol., C_v, in^2/min	0.055		

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ONE-DIMENSIONAL CONSOLIDATION PROPERTIES OF SOILS
ASTM D 2435

Client	Civil & Environmental Consultant	Boring	SB-17	**Test Load, tsf**	**1-0.25**
Client Project	091-867 Apex Landfill Expansion	Depth	16'-18'		Load 7 of 13
Project No.	30598	Sample	ST-1		
		Lab ID#	30598009		

Visual Description: Gray Clayey Sand
Test Conditions: Undisturbed, Inundated, and Double Drained

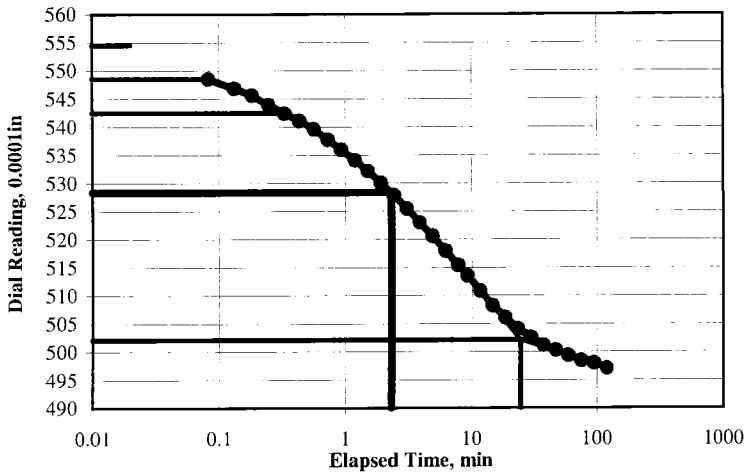
Time Vs. Dial Reading

Elapsed Time (min)	Sqrt Time ($min^{1/2}$)	Dial Reading (0.0001in)	Sample Height (in)	Void Ratio
0	0	569.8	0.9513	0.5058
Corrections*		5.5	0.00055	0.00087
Adjusted Sample Height & Void Ratio				
0.08	0.29	548.5	0.9529	0.5083
0.13	0.37	546.8	0.9530	0.5085
0.18	0.43	545.6	0.9532	0.5087
0.25	0.50	543.9	0.9533	0.5090
0.33	0.58	542.4	0.9535	0.5092
0.43	0.66	541.0	0.9536	0.5094
0.57	0.75	539.6	0.9538	0.5097
0.73	0.86	537.7	0.9540	0.5100
0.93	0.97	535.9	0.9541	0.5103
1.20	1.10	534.1	0.9543	0.5105
1.52	1.23	532.1	0.9545	0.5108
1.93	1.39	530.0	0.9547	0.5112
2.45	1.57	527.8	0.9549	0.5115
3.10	1.76	525.4	0.9552	0.5119
3.93	1.98	522.9	0.9554	0.5123
4.97	2.23	520.5	0.9557	0.5127
6.28	2.51	517.9	0.9559	0.5131
7.93	2.82	515.4	0.9562	0.5135
9.38	3.06	513.5	0.9564	0.5138
11.83	3.44	510.8	0.9566	0.5142
14.93	3.86	508.2	0.9569	0.5146
18.83	4.34	506.0	0.9571	0.5150
23.75	4.87	504.1	0.9573	0.5153
29.93	5.47	502.5	0.9575	0.5155
37.73	6.14	501.1	0.9576	0.5158
47.55	6.90	500.3	0.9577	0.5159
59.93	7.74	499.4	0.9578	0.5160
75.93	8.71	498.4	0.9579	0.5162
94.93	9.74	498.0	0.9579	0.5163
119.93	10.95	497.0	0.9580	0.5164

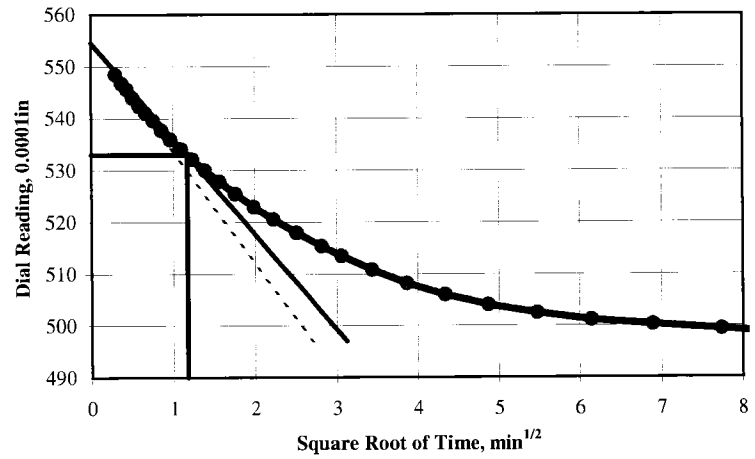
Machine Deflection

Applied Deflection Correction to Sample Height, 0.0001in 5.5
**Correction is applied to all dial readings.*

Log of Elapsed Time vs. Dial Reading



Square Root of Elapsed Time vs. Dial Reading



Sqrt. of Elapsed Time vs Dial Reading		Log of Elapsed Time vs Dial Reading		Load Summary	
T0 = 0 min.	D0 = 554.6 div.	T0 = 0 min.	D0 = 554.6 div.		
T90 = 1.369 min	D90 = 533 div.	T50 = 2.31 min.	D50 = 528.3 div.	Initial Sample Height, in	0.9513
T100 = NA min	D100 = 530.6 div.	T100 = 24.82 min.	D100 = 502.1 div.	Initial Sample Void Ratio	0.5058
Height at: D90 = 0.9544, D100 = 0.9547		Height at: D50 = 0.9549, D100 = 0.9575		Final Sample Height, in	0.9580
Average Sample Height, in	0.9547	Average Sample Height, in	0.9547	Final Sample Void Ratio	0.5164
Average Drainage Height, in	0.4773	Average Drainage Height, in	0.4773	Incremental Strain, %	-0.71%
T (Time Factor for T90)	0.848	T (Time Factor for T50)	0.197	Loading Duration, min	119.93333
Coef. of Consol., C_v, in^2/min	0.141	Coef. of Consol., C_v, in^2/min	0.019		

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ONE-DIMENSIONAL CONSOLIDATION PROPERTIES OF SOILS
ASTM D 2435

Client	Civil & Environmental Consultant	Boring	SB-17	**Test Load, tsf**	**0.25-0.5**
Client Project	091-867 Apex Landfill Expansion	Depth	16'-18'		Load 8 of 13
Project No.	30598	Sample	ST-1		
		Lab ID#	30598009		

Visual Description: Gray Clayey Sand
Test Conditions: Undisturbed, Inundated, and Double Drained

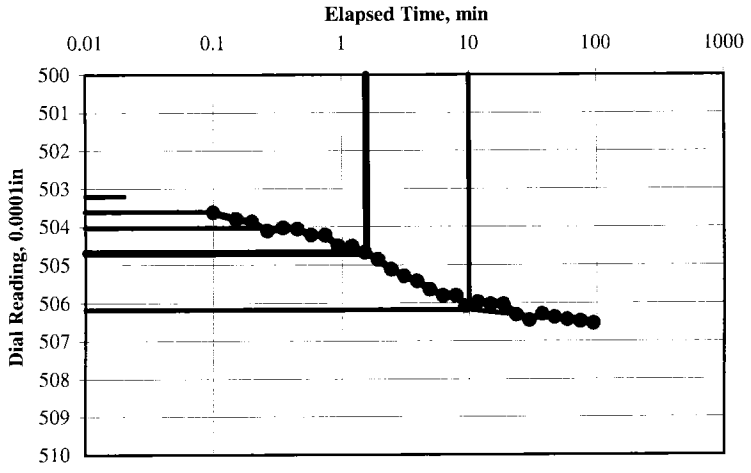
Time Vs. Dial Reading

Elapsed Time (min)	Sqrt Time ($min^{1/2}$)	Dial Reading (0.0001in)	Sample Height (in)	Void Ratio
0	0	497.0	0.9580	0.5164
Corrections*		-1.5	-0.00015	-0.0002
Adjusted Sample Height & Void Ratio				
0.10	0.32	503.6	0.9575	0.5156
0.15	0.39	503.8	0.9575	0.5156
0.20	0.45	503.9	0.9575	0.5156
0.27	0.52	504.1	0.9575	0.5155
0.35	0.59	504.0	0.9575	0.5155
0.45	0.67	504.1	0.9575	0.5155
0.58	0.76	504.2	0.9575	0.5155
0.75	0.87	504.2	0.9575	0.5155
0.95	0.97	504.5	0.9574	0.5155
1.22	1.10	504.5	0.9574	0.5155
1.53	1.24	504.7	0.9574	0.5154
1.95	1.40	504.9	0.9574	0.5154
2.47	1.57	505.1	0.9574	0.5154
3.12	1.77	505.3	0.9573	0.5153
3.95	1.99	505.4	0.9573	0.5153
4.98	2.23	505.6	0.9573	0.5153
6.30	2.51	505.8	0.9573	0.5153
7.95	2.82	505.8	0.9573	0.5153
9.40	3.07	506.1	0.9573	0.5152
11.85	3.44	506.0	0.9573	0.5152
14.95	3.87	506.0	0.9573	0.5152
18.85	4.34	506.0	0.9573	0.5152
23.77	4.88	506.3	0.9572	0.5152
29.95	5.47	506.5	0.9572	0.5152
37.75	6.14	506.3	0.9572	0.5152
47.57	6.90	506.4	0.9572	0.5152
59.95	7.74	506.4	0.9572	0.5152
75.95	8.71	506.5	0.9572	0.5151
94.95	9.74	506.5	0.9572	0.5151

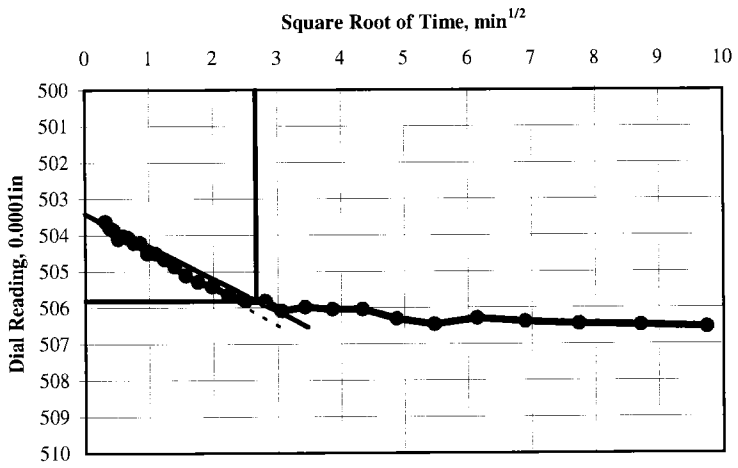
Machine Deflection

Applied Deflection Correction to Sample Height, 0.0001in: -1.5
**Correction is applied to all dial readings.*

Log of Elapsed Time vs. Dial Reading



Square Root of Elapsed Time vs. Dial Reading



Sqrt. of Elapsed Time vs Dial Reading

T0 = 0 min.	D0 = 503.4 div.		
T90 = 7.129 min	D90 = 505.8 div.		
T100 = NA min	D100 = 506.1 div.		
Height at: D90 = 0.9573, D100 = 0.9573			
Average Sample Height, in	0.9576		
Average Drainage Height, in	0.4788		
T (Time Factor for T90)	0.848		
Coef. of Consol., C_v, in^2/min	0.027		

Log of Elapsed Time vs Dial Reading

T0 = 0 min.	D0 = 503.2 div.		
T50 = 1.57 min.	D50 = 504.7 div.		
T100 = 9.94 min.	D100 = 506.2 div.		
Height at: D50 = 0.9574, D100 = 0.9573			
Average Sample Height, in	0.9576		
Average Drainage Height, in	0.4788		
T (Time Factor for T50)	0.197		
Coef. of Consol., C_v, in^2/min	0.029		

Load Summary

Initial Sample Height, in	0.9580
Initial Sample Void Ratio	0.5164
Final Sample Height, in	0.9572
Final Sample Void Ratio	0.5151
Incremental Strain, %	0.08%
Loading Duration, min	94.95

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ONE-DIMENSIONAL CONSOLIDATION PROPERTIES OF SOILS
ASTM D 2435

Client	Civil & Environmental Consultant	Boring	SB-17	**Test Load, tsf**	**0.5-1**
Client Project	091-867 Apex Landfill Expansion	Depth	16'-18'		Load 9 of 13
Project No.	30598	Sample	ST-1		
		Lab ID#	30598009		

Visual Description: Gray Clayey Sand
Test Conditions: Undisturbed, Inundated, and Double Drained

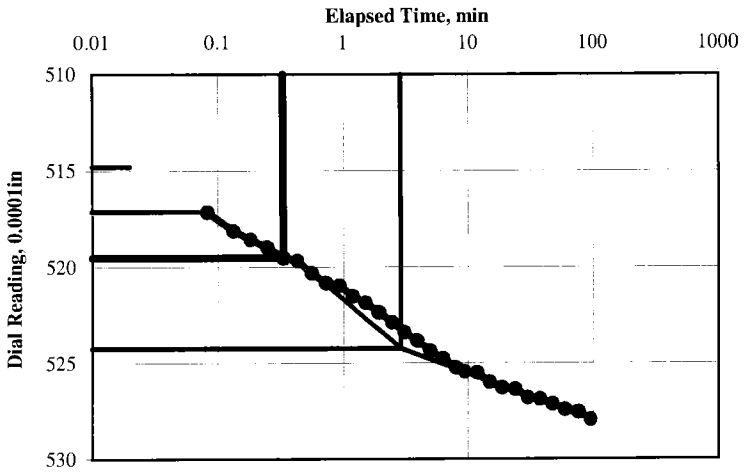
Time Vs. Dial Reading

Elapsed Time (min)	Sqrt Time ($min^{1/2}$)	Dial Reading (0.0001in)	Sample Height (in)	Void Ratio
0	0	506.5	0.9572	0.5151
Corrections*		-3	-0.0003	-0.0005
Adjusted Sample Height & Void Ratio				
0.08	0.29	517.2	0.9565	0.5139
0.13	0.37	518.1	0.9564	0.5138
0.18	0.43	518.6	0.9563	0.5137
0.25	0.50	519.0	0.9563	0.5136
0.33	0.58	519.6	0.9562	0.5136
0.43	0.66	519.7	0.9562	0.5135
0.57	0.75	520.3	0.9561	0.5134
0.73	0.86	520.8	0.9561	0.5133
0.93	0.97	521.0	0.9561	0.5133
1.20	1.10	521.5	0.9560	0.5132
1.52	1.23	521.9	0.9560	0.5132
1.93	1.39	522.4	0.9559	0.5131
2.45	1.57	522.9	0.9559	0.5130
3.10	1.76	523.4	0.9558	0.5129
3.93	1.98	523.8	0.9558	0.5129
4.97	2.23	524.4	0.9557	0.5128
6.28	2.51	524.8	0.9557	0.5127
7.93	2.82	525.2	0.9557	0.5127
9.38	3.06	525.5	0.9556	0.5126
11.83	3.44	525.5	0.9556	0.5126
14.93	3.86	526.0	0.9556	0.5125
18.83	4.34	526.3	0.9555	0.5125
23.75	4.87	526.4	0.9555	0.5125
29.93	5.47	526.8	0.9555	0.5124
37.73	6.14	526.9	0.9555	0.5124
47.55	6.90	527.1	0.9555	0.5124
59.93	7.74	527.4	0.9554	0.5123
75.93	8.71	527.6	0.9554	0.5123
94.93	9.74	528.0	0.9554	0.5122

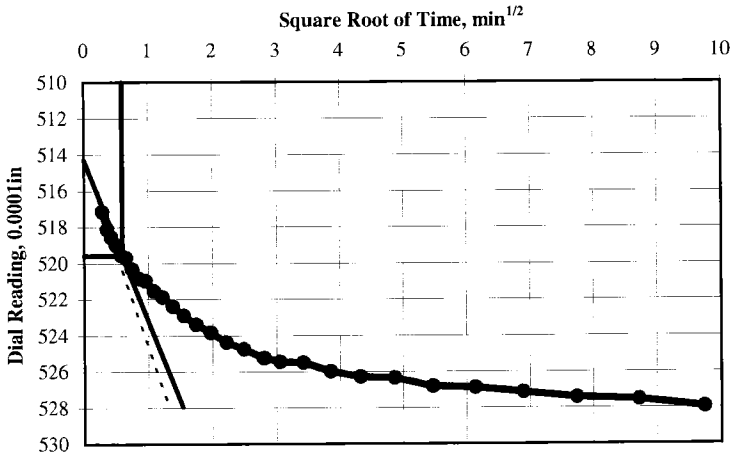
Machine Deflection

Applied Deflection Correction to Sample Height, 0.0001in: -3
**Correction is applied to all dial readings.*

Log of Elapsed Time vs. Dial Reading



Square Root of Elapsed Time vs. Dial Reading



Sqrt. of Elapsed Time vs Dial Reading		Log of Elapsed Time vs Dial Reading		Load Summary	
T0 = 0 min.	D0 = 514.3 div.	T0 = 0 min.	D0 = 514.8 div.		
T90 = 0.36 min	D90 = 519.6 div.	T50 = 0.33 min.	D50 = 519.5 div.	Initial Sample Height, in	0.9572
T100 = NA min	D100 = 520.2 div.	T100 = 2.87 min.	D100 = 524.2 div.	Initial Sample Void Ratio	0.5151
Height at: D90 = 0.9562, D100 = 0.9562		Height at: D50 = 0.9562, D100 = 0.9558		Final Sample Height, in	0.9554
Average Sample Height, in	0.9563	Average Sample Height, in	0.9563	Final Sample Void Ratio	0.5122
Average Drainage Height, in	0.4782	Average Drainage Height, in	0.4782	Incremental Strain, %	0.19%
T (Time Factor for T90)	0.848	T (Time Factor for T50)	0.197	Loading Duration, min	94.933333
Coef. of Consol., C_v, in^2/min	0.543	Coef. of Consol., C_v, in^2/min	0.136		

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ONE-DIMENSIONAL CONSOLIDATION PROPERTIES OF SOILS
ASTM D 2435

Client	Civil & Environmental Consultant	Boring	SB-17	**Test Load, tsf**	**1-2**
Client Project	091-867 Apex Landfill Expansion	Depth	16'-18'		Load 10 of 13
Project No.	30598	Sample	ST-1		
		Lab ID#	30598009		

Visual Description: Gray Clayey Sand
Test Conditions: Undisturbed, Inundated, and Double Drained

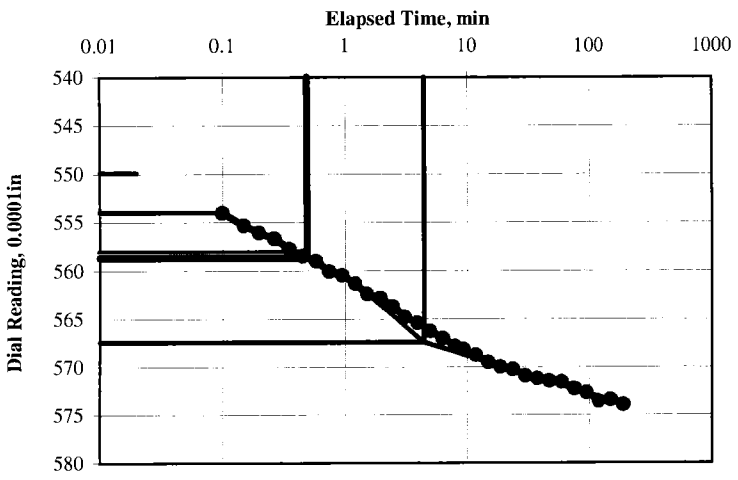
Time Vs. Dial Reading

Elapsed Time (min)	Sqrt Time ($min^{1/2}$)	Dial Reading (0.0001in)	Sample Height (in)	Void Ratio
0	0	528.0	0.9554	0.5122
Corrections*		-4.5	-0.00045	-0.0007
Adjusted Sample Height & Void Ratio				
0.10	0.32	554.0	0.9532	0.5088
0.15	0.39	555.3	0.9531	0.5086
0.20	0.45	556.1	0.9530	0.5085
0.27	0.52	556.7	0.9530	0.5084
0.35	0.59	557.8	0.9528	0.5082
0.45	0.67	558.5	0.9528	0.5081
0.58	0.76	559.0	0.9527	0.5080
0.75	0.87	560.1	0.9526	0.5078
0.95	0.97	560.5	0.9526	0.5078
1.22	1.10	561.4	0.9525	0.5076
1.53	1.24	562.4	0.9524	0.5075
1.95	1.40	562.9	0.9523	0.5074
2.47	1.57	563.7	0.9523	0.5073
3.12	1.77	564.8	0.9521	0.5071
3.95	1.99	565.4	0.9521	0.5070
4.98	2.23	566.3	0.9520	0.5069
6.30	2.51	567.0	0.9519	0.5068
7.95	2.82	567.8	0.9518	0.5066
9.40	3.07	568.2	0.9518	0.5066
11.85	3.44	568.7	0.9518	0.5065
14.95	3.87	569.5	0.9517	0.5064
18.85	4.34	570.0	0.9516	0.5063
23.77	4.88	570.2	0.9516	0.5062
29.95	5.47	570.9	0.9515	0.5061
37.75	6.14	571.2	0.9515	0.5061
47.57	6.90	571.4	0.9515	0.5061
59.95	7.74	571.6	0.9515	0.5060
75.95	8.71	572.3	0.9514	0.5059
94.95	9.74	572.7	0.9514	0.5059
119.95	10.95	573.5	0.9513	0.5057
150.95	12.29	573.4	0.9513	0.5057
189.95	13.78	573.9	0.9512	0.5057

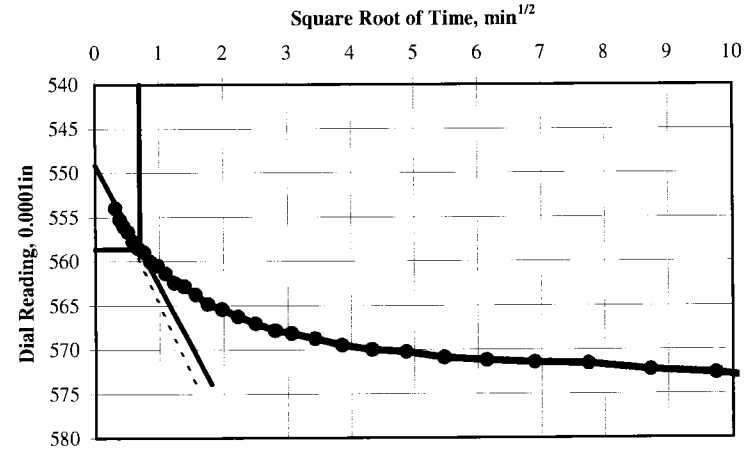
Machine Deflection

Applied Deflection Correction to Sample Height, 0.0001in: -4.5
**Correction is applied to all dial readings.*

Log of Elapsed Time vs. Dial Reading



Square Root of Elapsed Time vs. Dial Reading



Sqrt. of Elapsed Time vs Dial Reading

T0 = 0 min.	D0 = 549.1 div.
T90 = 0.49 min	D90 = 558.6 div.
T100 = NA min	D100 = 559.7 div.
Height at: D90 = 0.9528, D100 = 0.9527	
Average Sample Height, in	0.9533
Average Drainage Height, in	0.4767
T (Time Factor for T90)	0.848
Coef. of Consol., C_v, in^2/min	0.395

Log of Elapsed Time vs Dial Reading

T0 = 0 min.	D0 = 549.9 div.
T50 = 0.49 min.	D50 = 558.7 div.
T100 = 4.45 min.	D100 = 567.4 div.
Height at: D50 = 0.9528, D100 = 0.9519	
Average Sample Height, in	0.9533
Average Drainage Height, in	0.4767
T (Time Factor for T50)	0.197
Coef. of Consol., C_v, in^2/min	0.091

Load Summary

Initial Sample Height, in	0.9554
Initial Sample Void Ratio	0.5122
Final Sample Height, in	0.9512
Final Sample Void Ratio	0.5057
Incremental Strain, %	0.43%
Loading Duration, min	189.95

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ONE-DIMENSIONAL CONSOLIDATION PROPERTIES OF SOILS
ASTM D 2435

Client	Civil & Environmental Consultant	Boring	SB-17	**Test Load, tsf**	**2-4**
Client Project	091-867 Apex Landfill Expansion	Depth	16'-18'		Load 11 of 13
Project No.	30598	Sample	ST-1		
		Lab ID#	30598009		

Visual Description: Gray Clayey Sand
Test Conditions: Undisturbed, Inundated, and Double Drained

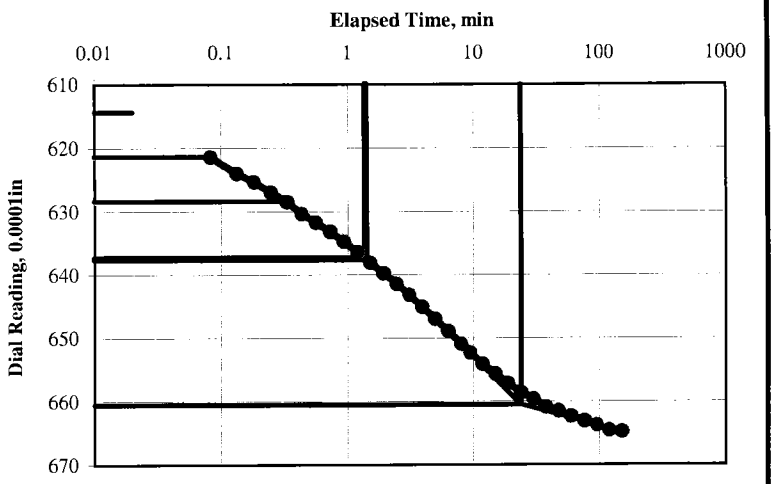
Time Vs. Dial Reading

Elapsed Time (min)	Sqrt Time ($min^{1/2}$)	Dial Reading (0.0001in)	Sample Height (in)	Void Ratio
0	0	573.9	0.9512	0.5057
Corrections*		-6	-0.0006	-0.0009
Adjusted Sample Height & Void Ratio				
0.08	0.29	621.4	0.9471	0.4991
0.13	0.37	624.1	0.9468	0.4987
0.18	0.43	625.4	0.9467	0.4985
0.25	0.50	627.0	0.9465	0.4982
0.33	0.58	628.5	0.9464	0.4980
0.43	0.66	630.4	0.9462	0.4977
0.57	0.75	631.7	0.9461	0.4975
0.73	0.86	633.2	0.9459	0.4972
0.93	0.97	634.8	0.9457	0.4970
1.20	1.10	636.4	0.9456	0.4967
1.52	1.23	638.1	0.9454	0.4965
1.93	1.39	639.7	0.9453	0.4962
2.45	1.57	641.5	0.9451	0.4959
3.10	1.76	643.2	0.9449	0.4956
3.93	1.98	645.1	0.9447	0.4953
4.97	2.23	647.0	0.9445	0.4950
6.28	2.51	648.9	0.9443	0.4947
7.93	2.82	651.0	0.9441	0.4944
9.38	3.06	652.3	0.9440	0.4942
11.83	3.44	654.1	0.9438	0.4939
14.93	3.86	655.7	0.9437	0.4937
18.83	4.34	657.1	0.9435	0.4934
23.75	4.87	658.6	0.9434	0.4932
29.93	5.47	659.6	0.9433	0.4930
37.73	6.14	660.9	0.9431	0.4928
47.55	6.90	661.5	0.9431	0.4927
59.93	7.74	662.3	0.9430	0.4926
75.93	8.71	663.1	0.9429	0.4925
94.93	9.74	663.8	0.9428	0.4924
119.93	10.95	664.6	0.9428	0.4923
150.93	12.29	664.8	0.9427	0.4922

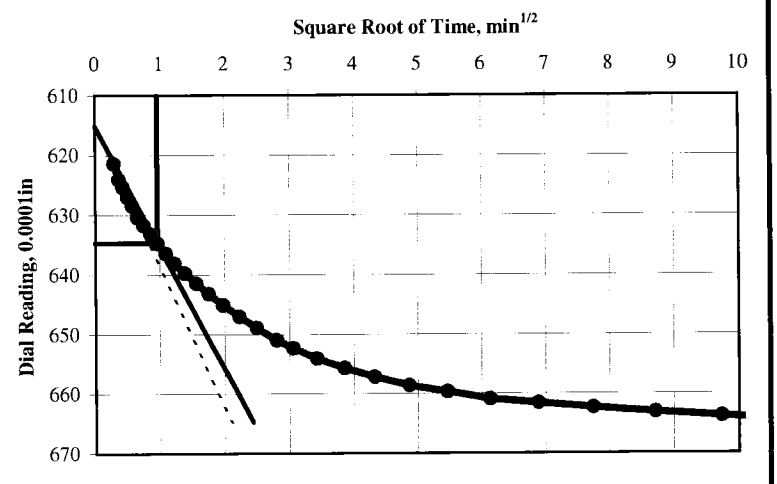
Machine Deflection

Applied Deflection Correction to Sample Height, 0.0001in: -6
**Correction is applied to all dial readings.*

Log of Elapsed Time vs. Dial Reading



Square Root of Elapsed Time vs. Dial Reading



Sqrt. of Elapsed Time vs Dial Reading		Log of Elapsed Time vs Dial Reading		Load Summary	
T0 = 0 min.	D0 = 615.1 div.	T0 = 0 min.	D0 = 614.4 div.		
T90 = 0.922 min	D90 = 634.7 div.	T50 = 1.38 min.	D50 = 637.4 div.	Initial Sample Height, in	0.9512
T100 = NA min	D100 = 636.8 div.	T100 = 23.65 min.	D100 = 660.5 div.	Initial Sample Void Ratio	0.5057
Height at: D90 = 0.9458, D100 = 0.9455		Height at: D50 = 0.9455, D100 = 0.9432		Final Sample Height, in	0.9427
Average Sample Height, in	0.9470	Average Sample Height, in	0.9470	Final Sample Void Ratio	0.4922
Average Drainage Height, in	0.4735	Average Drainage Height, in	0.4735	Incremental Strain, %	0.89%
T (Time Factor for T90)	0.848	T (Time Factor for T50)	0.197	Loading Duration, min	150.93333
Coef. of Consol., C_v, in^2/min	0.206	Coef. of Consol., C_v, in^2/min	0.032		

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ONE-DIMENSIONAL CONSOLIDATION PROPERTIES OF SOILS
ASTM D 2435

Client	Civil & Environmental Consultant	Boring	SB-17	**Test Load, tsf**	**4-8**
Client Project	091-867 Apex Landfill Expansion	Depth	16'-18'		Load 12 of 13
Project No.	30598	Sample	ST-1		
		Lab ID#	30598009		

Visual Description: Gray Clayey Sand
Test Conditions: Undisturbed, Inundated, and Double Drained

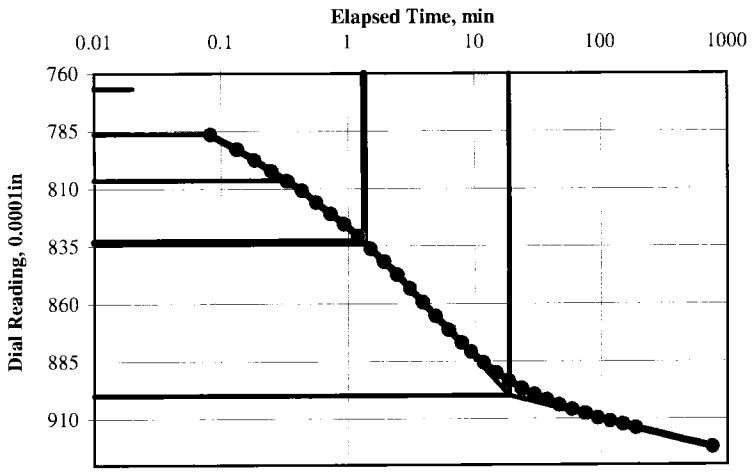
Time Vs. Dial Reading

Elapsed Time (min)	Sqrt Time ($min^{1/2}$)	Dial Reading (0.0001in)	Sample Height (in)	Void Ratio
0	0	664.8	0.9427	0.4922
Corrections*		-11	-0.0011	-0.0017
Adjusted Sample Height & Void Ratio				
0.08	0.29	786.6	0.9317	0.4747
0.13	0.37	793.0	0.9310	0.4737
0.18	0.43	797.6	0.9306	0.4730
0.25	0.50	802.3	0.9301	0.4722
0.33	0.58	806.7	0.9297	0.4715
0.43	0.66	810.8	0.9292	0.4709
0.57	0.75	816.0	0.9287	0.4700
0.73	0.86	821.0	0.9282	0.4692
0.93	0.97	825.4	0.9278	0.4685
1.20	1.10	830.6	0.9273	0.4677
1.52	1.23	836.1	0.9267	0.4669
1.93	1.39	841.7	0.9262	0.4660
2.45	1.57	847.4	0.9256	0.4651
3.10	1.76	853.3	0.9250	0.4641
3.93	1.98	859.3	0.9244	0.4632
4.97	2.23	865.3	0.9238	0.4622
6.28	2.51	871.3	0.9232	0.4613
7.93	2.82	876.9	0.9226	0.4604
9.38	3.06	880.8	0.9222	0.4598
11.83	3.44	885.5	0.9218	0.4590
14.93	3.86	889.8	0.9213	0.4584
18.83	4.34	893.4	0.9210	0.4578
23.75	4.87	896.6	0.9207	0.4573
29.93	5.47	899.3	0.9204	0.4568
37.73	6.14	901.6	0.9202	0.4565
47.55	6.90	903.8	0.9199	0.4561
59.93	7.74	905.9	0.9197	0.4558
75.93	8.71	907.6	0.9196	0.4555
94.93	9.74	909.6	0.9194	0.4552
119.93	10.95	911.0	0.9192	0.4550
150.93	12.29	912.2	0.9191	0.4548
189.93	13.78	913.9	0.9189	0.4545
757.93	27.53	922.1	0.9181	0.4532

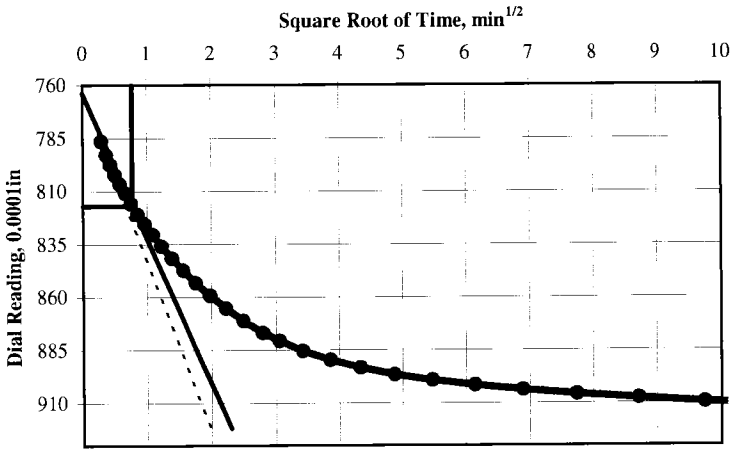
Machine Deflection

Applied Deflection Correction to Sample Height, 0.0001in: -11
**Correction is applied to all dial readings.*

Log of Elapsed Time vs. Dial Reading



Square Root of Elapsed Time vs. Dial Reading



Sqrt. of Elapsed Time vs Dial Reading		Log of Elapsed Time vs Dial Reading		Load Summary	
T0 = 0 min.	D0 = 763.9 div.	T0 = 0 min.	D0 = 766.5 div.		
T90 = 0.593 min	D90 = 817 div.	T50 = 1.34 min.	D50 = 833.2 div.	Initial Sample Height, in	0.9427
T100 = NA min	D100 = 822.9 div.	T100 = 19.06 min.	D100 = 899.9 div.	Initial Sample Void Ratio	0.4922
Height at: D90 = 0.9286, D100 = 0.928		Height at: D50 = 0.927, D100 = 0.9203		Final Sample Height, in	0.9181
Average Sample Height, in	0.9304	Average Sample Height, in	0.9304	Final Sample Void Ratio	0.4532
Average Drainage Height, in	0.4652	Average Drainage Height, in	0.4652	Incremental Strain, %	2.61%
T (Time Factor for T90)	0.848	T (Time Factor for T50)	0.197	Loading Duration, min	757.93333
Coef. of Consol., C_v, in^2/min	0.307	Coef. of Consol., C_v, in^2/min	0.032		

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ONE-DIMENSIONAL CONSOLIDATION PROPERTIES OF SOILS
ASTM D 2435

Client	Civil & Environmental Consultant	Boring	SB-17	**Test Load, tsf**	**8-16**
Client Project	091-867 Apex Landfill Expansion	Depth	16'-18'		Load 13 of 13
Project No.	30598	Sample	ST-1		
		Lab ID#	30598009		

Visual Description: Gray Clayey Sand
Test Conditions: Undisturbed, Inundated, and Double Drained

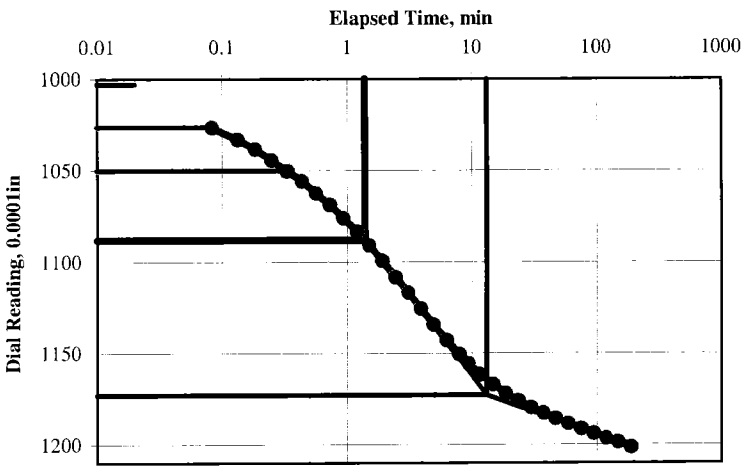
Time Vs. Dial Reading

Elapsed Time (min)	Sqrt Time ($min^{1/2}$)	Dial Reading (0.0001in)	Sample Height (in)	Void Ratio
0	0	922.1	0.9181	0.4532
Corrections*		-16.5	-0.00165	-0.0026
Adjusted Sample Height & Void Ratio				
0.08	0.29	1026.8	0.9093	0.4393
0.13	0.37	1033.4	0.9086	0.4382
0.18	0.43	1038.5	0.9081	0.4374
0.25	0.50	1044.7	0.9075	0.4365
0.33	0.58	1050.6	0.9069	0.4355
0.43	0.66	1056.0	0.9064	0.4347
0.57	0.75	1062.6	0.9057	0.4336
0.73	0.86	1069.0	0.9051	0.4326
0.93	0.97	1076.2	0.9044	0.4315
1.20	1.10	1083.4	0.9036	0.4303
1.52	1.23	1091.0	0.9029	0.4291
1.93	1.39	1099.4	0.9020	0.4278
2.45	1.57	1108.5	0.9011	0.4263
3.10	1.76	1116.9	0.9003	0.4250
3.93	1.98	1125.7	0.8994	0.4236
4.97	2.23	1134.4	0.8985	0.4222
6.28	2.51	1142.8	0.8977	0.4209
7.93	2.82	1150.5	0.8969	0.4197
9.38	3.06	1155.6	0.8964	0.4189
11.83	3.44	1161.7	0.8958	0.4179
14.93	3.86	1167.0	0.8953	0.4171
18.83	4.34	1171.9	0.8948	0.4163
23.75	4.87	1176.0	0.8944	0.4157
29.93	5.47	1179.7	0.8940	0.4151
37.73	6.14	1182.7	0.8937	0.4146
47.55	6.90	1185.8	0.8934	0.4141
59.93	7.74	1188.4	0.8931	0.4137
75.93	8.71	1191.4	0.8928	0.4132
94.93	9.74	1193.9	0.8926	0.4128
119.93	10.95	1196.5	0.8923	0.4124
150.93	12.29	1198.6	0.8921	0.4121
189.93	13.78	1201.4	0.8918	0.4116

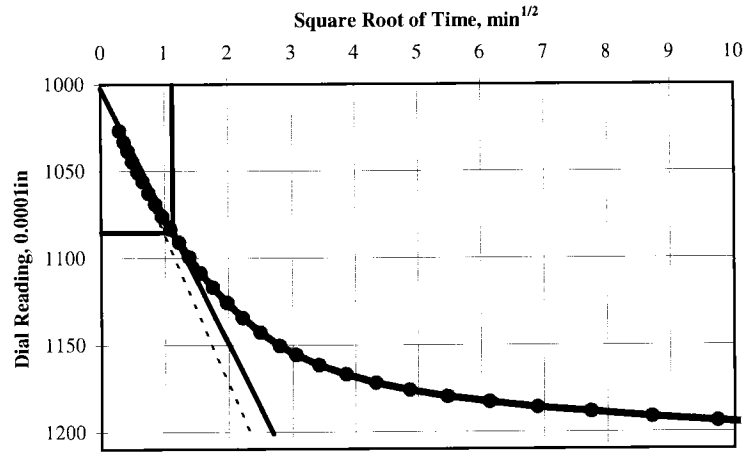
Machine Deflection

Applied Deflection Correction to Sample Height, 0.0001in: -16.5
**Correction is applied to all dial readings.*

Log of Elapsed Time vs. Dial Reading



Square Root of Elapsed Time vs. Dial Reading



Sqrt. of Elapsed Time vs Dial Reading		Log of Elapsed Time vs Dial Reading		Load Summary	
T0 = 0 min.	D0 = 1002.5 div.	T0 = 0 min.	D0 = 1003 div.		
T90 = 1.277 min	D90 = 1085.4 div.	T50 = 1.38 min.	D50 = 1088 div.	Initial Sample Height, in	0.9181
T100 = NA min	D100 = 1094.6 div.	T100 = 13.24 min.	D100 = 1173 div.	Initial Sample Void Ratio	0.4532
Height at: D90 = 0.9034, D100 = 0.9025		Height at: D50 = 0.9032, D100 = 0.8947		Final Sample Height, in	0.8918
Average Sample Height, in	0.9050	Average Sample Height, in	0.9050	Final Sample Void Ratio	0.4116
Average Drainage Height, in	0.4525	Average Drainage Height, in	0.4525	Incremental Strain, %	2.86%
T (Time Factor for T90)	0.848	T (Time Factor for T50)	0.197	Loading Duration, min	189.93333
Coef. of Consol., C_v, in^2/min	0.136	Coef. of Consol., C_v, in^2/min	0.029		

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ONE-DIMENSIONAL CONSOLIDATION PROPERTIES OF SOILS
ASTM D 2435

Client	Civil & Environmental Consultant	Boring	RB-3
Client Project	091-867 Apex Landfill Expansion	Depth	20'-24'
Project No.	30598	Sample	B-1
		Lab Sample No.	30598026

Visual Description: Dark Gray Sandy Clay
Sample Conditions: Remolded, Inundated, and Double Drained
Machine Deflection Correction: Applied

SAMPLE PROPERTIES		
	Initial	Final
Tare Number	Z12	F5
Wt. Tare & WS, gm	165.91	281.06
Wt. Tare & DS, gm	160.21	259.36
Wt. Tare, gm	123.26	123.16
Water Content, %	15.4%	15.9%
Sample Diameter, in	2.5	2.5
Sample Height, in	1.004	0.8687
Sample Volume, in^3	4.9271	4.2642
Wt. WS + Ring, gm	270.45	270.19
Wt. of Ring, gm	112.09	112.09
Wt. of WS, gm	158.36	158.10
Wet Density, pcf	122.39	141.18
Wet Density, g/cc	1.961	2.263
Water Content, %	15.4%	15.9%
Wt. of DS, gm	137.20	136.37
Dry Density, pcf	106.03	121.78
Dry Density, g/cc	1.699	1.952
Void Ratio, e	0.5831	0.3784
Saturation, %	71.2%	
Specific Gravity	2.69	Measured
Height of Solids, in	0.6340	0.6340

TEST DATA SUMMARY

Applied Pressure tsf	Load Duration min	Final Height in	Vertical Strain %	Dry Density g/cc	Void Ratio e	a_v ft^2/ton	Incremental C_c	Incremental C_r
Seating	NA	1.0038	0.00	1.6992	0.5831	NA	NA	NA
0.25	3	1.0028	0.09%	1.7008	0.5816	5.99E-03	NA	NA
0.5	12	1.0013	0.25%	1.7034	0.5792	9.78E-03	0.008	NA
1	758	0.9914	1.24%	1.7205	0.5635	3.12E-02	0.052	NA
2	380	0.9637	3.99%	1.7698	0.5199	4.36E-02	0.145	NA
4	151	0.9335	7.00%	1.8272	0.4722	2.39E-02	0.158	NA
1	758	0.9405	6.30%	1.8135	0.4833	3.71E-03	NA	NA
0.25	302	0.9521	5.15%	1.7914	0.5016	2.44E-02	NA	NA
0.5	240	0.9508	5.28%	1.7939	0.4995	8.52E-03	NA	0.007
1	95	0.9468	5.68%	1.8015	0.4932	1.26E-02	NA	0.021
2	758	0.9400	6.36%	1.8145	0.4825	1.07E-02	NA	0.036
4	302	0.9291	7.44%	1.8357	0.4654	8.56E-03	NA	0.057
8	95	0.9016	10.18%	1.8918	0.4219	1.09E-02	0.144	NA
16	955	0.8687	13.45%	1.9634	0.3701	6.48E-03	0.172	NA
							for	0.050

Note: The calculations performed and the parameters presented herein are for preliminary purposes only. GTS only accepts responsibility for the raw data obtained from the consolidation tests. This data may be interpreted differently by others. It is the responsibility of the user to determine the appropriateness and accuracy of the computed values.

Input Validation | Reviewed By: | Date Tested: 12/20/2010

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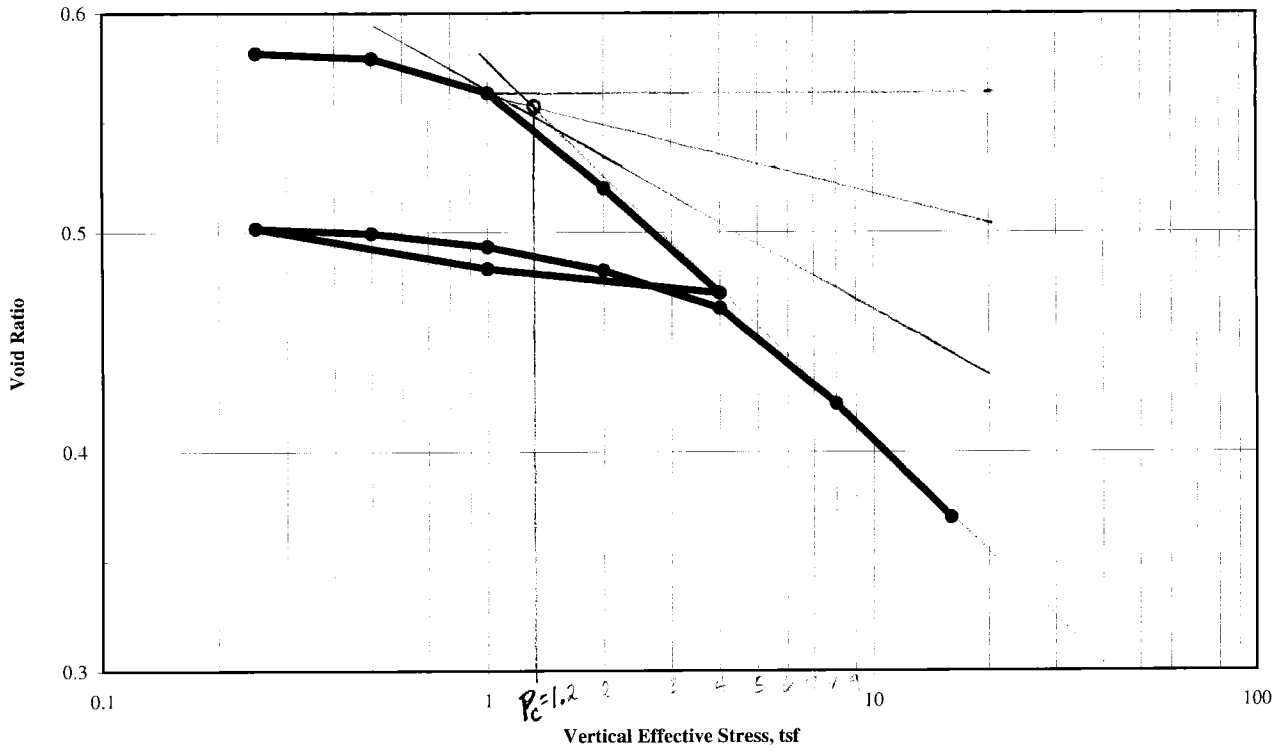
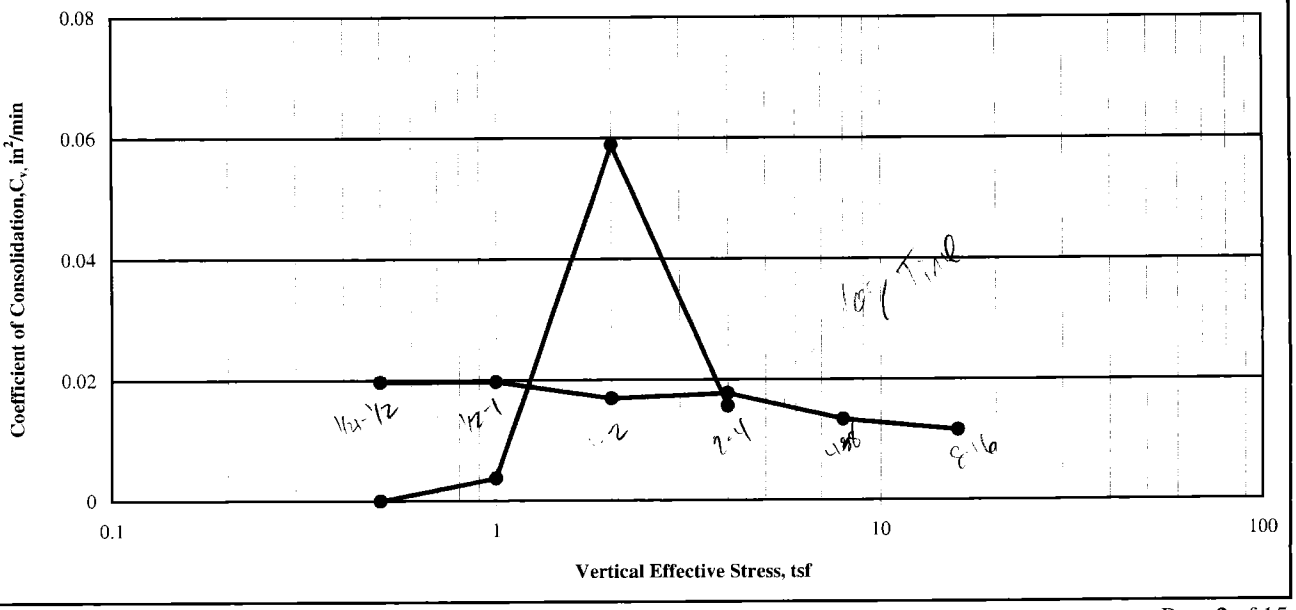
ONE-DIMENSIONAL CONSOLIDATION PROPERTIES OF SOILS
ASTM D 2435

Client	Civil & Environmental Consultants, Inc.	Boring	RB-3
Client Project	091-867 Apex Landfill Expansion	Depth	20'-24'
Project No.	30598	Sample	B-1
		Lab Sample No.	30598026
Visual Description	Dark Gray Sandy Clay		
Sample Conditions	Remolded, Inundated, and Double Drained		
Machine Deflection Correction:	Applied		

Void Ratio (Final Height) vs Vertical Effective Consolidation Stress



Coeffieicent of Consolidation (log. method) vs. Vertical Effective Consolidation Stress



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ONE-DIMENSIONAL CONSOLIDATION PROPERTIES OF SOILS
ASTM D 2435

Client	Civil & Environmental Consultant	Boring	RB-3	**Test Load, tsf**	**0-0.25**
Client Project	091-867 Apex Landfill Expansion	Depth	20'-24'		Load 1 of 13
Project No.	30598	Sample	B-1		
		Lab ID#	30598026		

Visual Description: Dark Gray Sandy Clay
Test Conditions: Remolded, Inundated, and Double Drained

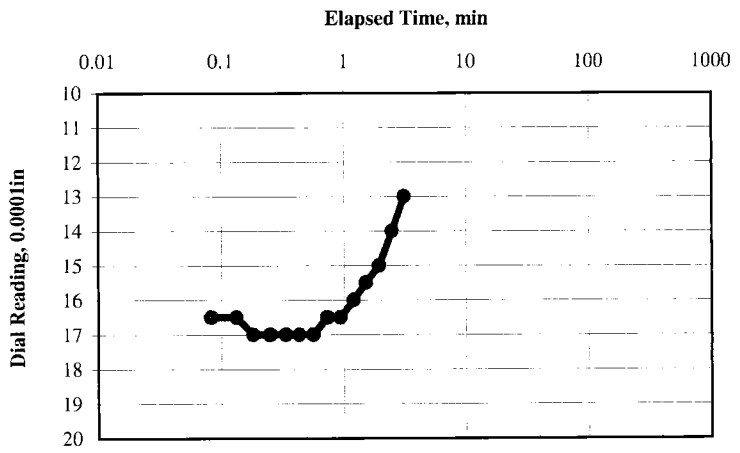
Time Vs. Dial Reading

Elapsed Time (min)	Sqrt Time ($min^{1/2}$)	Dial Reading (0.0001in)	Sample Height (in)	Void Ratio
0	0	0	1.0038	0.5831
Corrections*		-3.5	-0.00035	-0.0006
Adjusted Sample Height & Void Ratio				
0.08	0.29	16.5	1.0025	0.5810
0.13	0.37	16.5	1.0025	0.5810
0.18	0.43	17.0	1.0024	0.5810
0.25	0.50	17.0	1.0024	0.5810
0.33	0.58	17.0	1.0024	0.5810
0.43	0.66	17.0	1.0024	0.5810
0.57	0.75	17.0	1.0024	0.5810
0.73	0.86	16.5	1.0025	0.5810
0.93	0.97	16.5	1.0025	0.5810
1.20	1.10	16.0	1.0025	0.5811
1.52	1.23	15.5	1.0026	0.5812
1.93	1.39	15.0	1.0026	0.5813
2.45	1.57	14.0	1.0027	0.5814
3.10	1.76	13.0	1.0028	0.5816

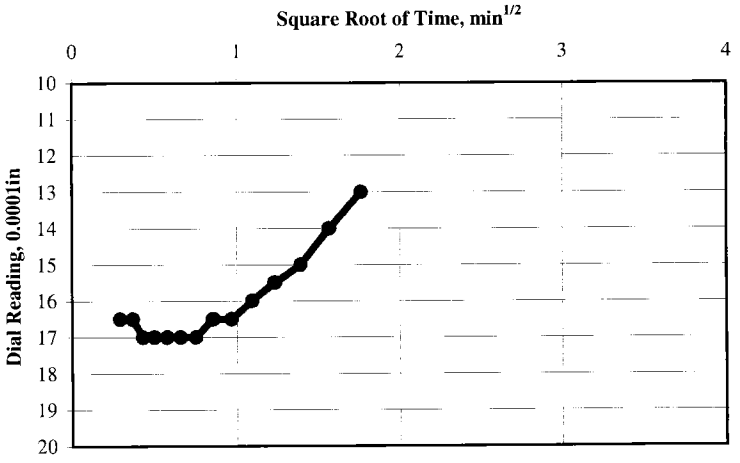
Machine Deflection

Applied Deflection Correction to Sample Height, 0.0001in: -3.5
**Correction is applied to all dial readings.*

Log of Elapsed Time vs. Dial Reading



Square Root of Elapsed Time vs. Dial Reading



Sqrt. of Elapsed Time vs Dial Reading | **Log of Elapsed Time vs Dial Reading**

Specimen Swelled

Load Summary

Initial Sample Height, in	1.0038
Initial Sample Void Ratio	0.5831
Final Sample Height, in	1.0028
Final Sample Void Ratio	0.5816
Incremental Strain, %	0.09%
Loading Duration, min	3.1

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ONE-DIMENSIONAL CONSOLIDATION PROPERTIES OF SOILS
ASTM D 2435

Client	Civil & Environmental Consultant	Boring	RB-3	**Test Load, tsf**	**0.25-0.5**
Client Project	091-867 Apex Landfill Expansion	Depth	20'-24'		Load 2 of 13
Project No.	30598	Sample	B-1		
		Lab ID#	30598026		

Visual Description: Dark Gray Sandy Clay
Test Conditions: Remolded, Inundated, and Double Drained

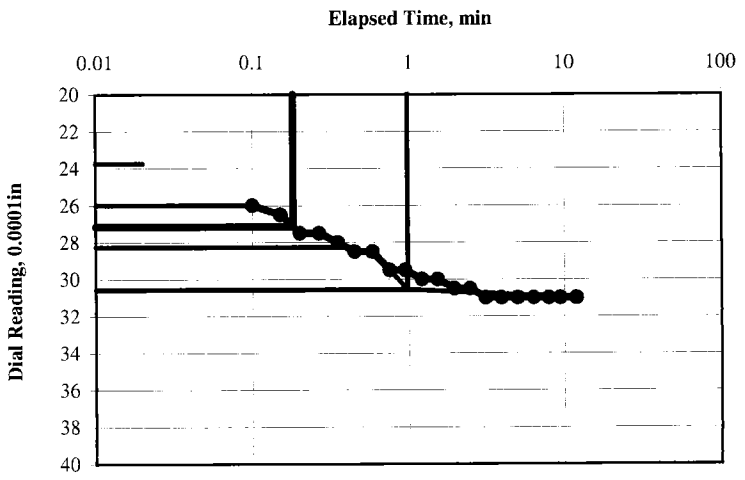
Time Vs. Dial Reading

Elapsed Time (min)	Sqrt Time ($min^{1/2}$)	Dial Reading (0.0001in)	Sample Height (in)	Void Ratio
0	0	13.0	1.0028	0.5816
Corrections*		-2.5	-0.00025	-0.0004
Adjusted Sample Height & Void Ratio				
0.10	0.32	26.0	1.0018	0.5799
0.15	0.39	26.5	1.0017	0.5799
0.20	0.45	27.5	1.0016	0.5797
0.27	0.52	27.5	1.0016	0.5797
0.35	0.59	28.0	1.0016	0.5796
0.45	0.67	28.5	1.0015	0.5796
0.58	0.76	28.5	1.0015	0.5796
0.75	0.87	29.5	1.0014	0.5794
0.95	0.97	29.5	1.0014	0.5794
1.22	1.10	30.0	1.0014	0.5793
1.53	1.24	30.0	1.0014	0.5793
1.95	1.40	30.5	1.0013	0.5792
2.47	1.57	30.5	1.0013	0.5792
3.12	1.77	31.0	1.0013	0.5792
3.95	1.99	31.0	1.0013	0.5792
4.98	2.23	31.0	1.0013	0.5792
6.30	2.51	31.0	1.0013	0.5792
7.95	2.82	31.0	1.0013	0.5792
9.40	3.07	31.0	1.0013	0.5792
11.85	3.44	31.0	1.0013	0.5792

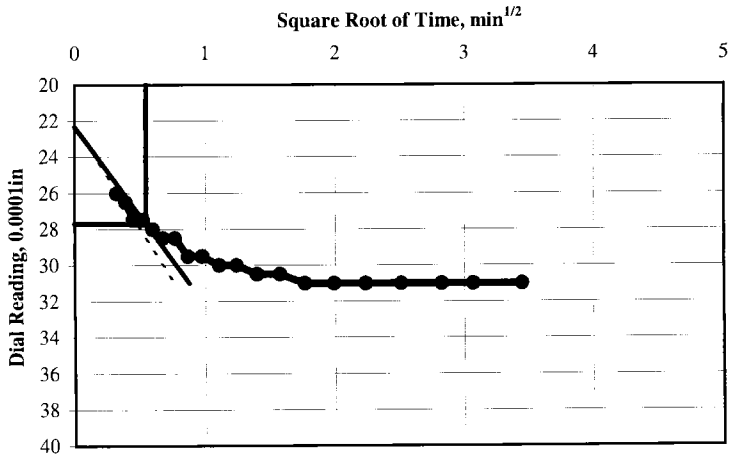
Machine Deflection

Applied Deflection Correction to Sample Height, 0.0001in: -2.5
**Correction is applied to all dial readings.*

Log of Elapsed Time vs. Dial Reading



Square Root of Elapsed Time vs. Dial Reading



Sqrt. of Elapsed Time vs Dial Reading		Log of Elapsed Time vs Dial Reading		Load Summary	
T0 = 0 min.	D0 = 22.3 div.	T0 = 0 min.	D0 = 23.7 div.		
T90 = 0.303 min	D90 = 27.7 div.	T50 = 0.18 min.	D50 = 27.1 div.	Initial Sample Height, in	1.0028
T100 = NA min	D100 = 28.3 div.	T100 = 0.98 min.	D100 = 30.6 div.	Initial Sample Void Ratio	0.5816
Height at: D90 = 1.0016, D100 = 1.0015		Height at: D50 = 1.0016, D100 = 1.0013		Final Sample Height, in	1.0013
Average Sample Height, in	1.0020	Average Sample Height, in	1.0020	Final Sample Void Ratio	0.5792
Average Drainage Height, in	0.5010	Average Drainage Height, in	0.5010	Incremental Strain, %	0.15%
T (Time Factor for T90)	0.848	T (Time Factor for T50)	0.197	Loading Duration, min	11.85
Coef. of Consol., C_v, in^2/min	0.716	Coef. of Consol., C_v, in^2/min	0.275		

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ONE-DIMENSIONAL CONSOLIDATION PROPERTIES OF SOILS
ASTM D 2435

Client	Civil & Environmental Consultant	Boring	RB-3	**Test Load, tsf**	**0.5-1**
Client Project	091-867 Apex Landfill Expansion	Depth	20'-24'		Load 3 of 13
Project No.	30598	Sample	B-1		
		Lab ID#	30598026		

Visual Description: Dark Gray Sandy Clay
Test Conditions: Remolded, Inundated, and Double Drained

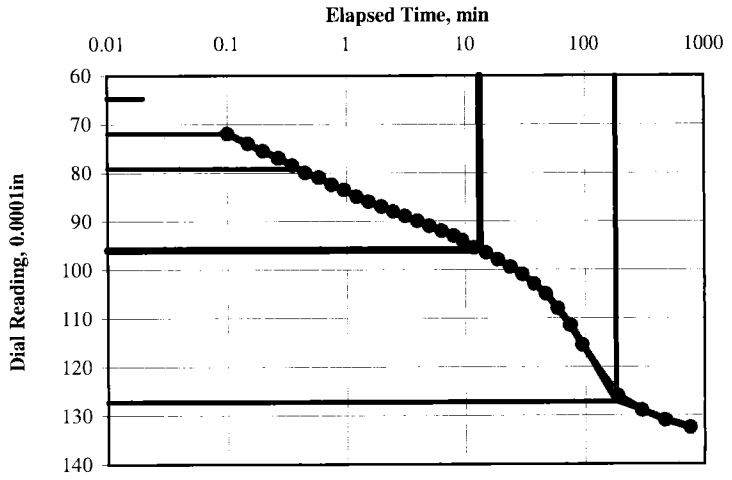
Time Vs. Dial Reading

Elapsed Time (min)	Sqrt Time ($min^{1/2}$)	Dial Reading (0.0001in)	Sample Height (in)	Void Ratio
0	0	31.0	1.0013	0.5792
Corrections*		-2.5	-0.00025	-0.0004
Adjusted Sample Height & Void Ratio				
0.10	0.32	72.0	0.9974	0.5731
0.15	0.39	74.0	0.9972	0.5728
0.20	0.45	75.5	0.9971	0.5725
0.27	0.52	77.0	0.9969	0.5723
0.35	0.59	78.5	0.9968	0.5721
0.45	0.67	80.0	0.9966	0.5718
0.58	0.76	81.0	0.9965	0.5717
0.75	0.87	82.5	0.9964	0.5714
0.95	0.97	83.5	0.9963	0.5713
1.22	1.10	85.0	0.9961	0.5710
1.53	1.24	86.0	0.9960	0.5709
1.95	1.40	87.0	0.9959	0.5707
2.47	1.57	88.0	0.9958	0.5706
3.12	1.77	89.0	0.9957	0.5704
3.95	1.99	90.0	0.9956	0.5702
4.98	2.23	91.0	0.9955	0.5701
6.30	2.51	92.0	0.9954	0.5699
7.95	2.82	93.0	0.9953	0.5698
9.40	3.07	94.0	0.9952	0.5696
11.85	3.44	95.5	0.9951	0.5694
14.95	3.87	96.5	0.9950	0.5692
18.85	4.34	98.0	0.9948	0.5690
23.77	4.88	99.5	0.9947	0.5687
29.95	5.47	101.0	0.9945	0.5685
37.75	6.14	103.0	0.9943	0.5682
47.57	6.90	105.0	0.9941	0.5679
59.95	7.74	108.0	0.9938	0.5674
75.95	8.71	111.5	0.9935	0.5669
94.95	9.74	115.5	0.9931	0.5662
189.95	13.78	126.0	0.9920	0.5646
301.95	17.38	129.0	0.9917	0.5641
477.95	21.86	131.0	0.9915	0.5638
757.95	27.53	132.5	0.9914	0.5635

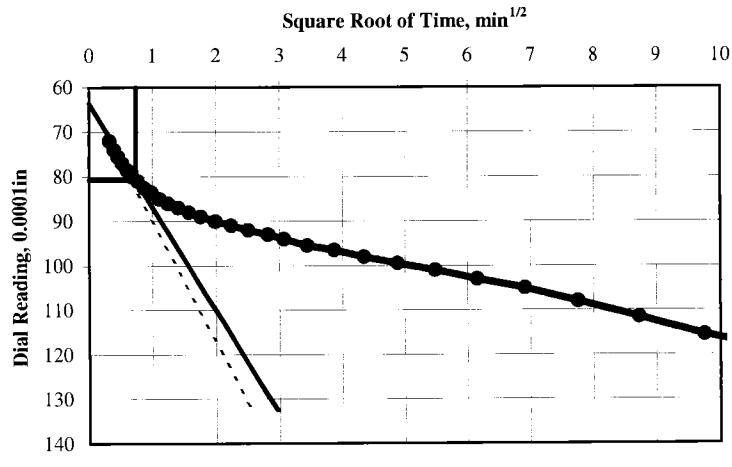
Machine Deflection

Applied Deflection Correction to Sample Height, 0.0001in: -2.5
**Correction is applied to all dial readings.*

Log of Elapsed Time vs. Dial Reading



Square Root of Elapsed Time vs. Dial Reading



Sqrt. of Elapsed Time vs Dial Reading		Log of Elapsed Time vs Dial Reading		Load Summary	
T0 = 0 min.	D0 = 63.6 div.	T0 = 0 min.	D0 = 64.7 div.		
T90 = 0.548 min	D90 = 80.7 div.	T50 = 13.16 min.	D50 = 96 div.	Initial Sample Height, in	1.0013
T100 = NA min	D100 = 82.6 div.	T100 = 182.46 min.	D100 = 127.2 div.	Initial Sample Void Ratio	0.5792
Height at: D90 = 0.9965, D100 = 0.9963		Height at: D50 = 0.995, D100 = 0.9919		Final Sample Height, in	0.9914
Average Sample Height, in	0.9963	Average Sample Height, in	0.9963	Final Sample Void Ratio	0.5635
Average Drainage Height, in	0.4982	Average Drainage Height, in	0.4982	Incremental Strain, %	0.99%
T (Time Factor for T90)	0.848	T (Time Factor for T50)	0.197	Loading Duration, min	757.95
Coef. of Consol., C_v, in^2/min	0.388	Coef. of Consol., C_v, in^2/min	0.004		

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ONE-DIMENSIONAL CONSOLIDATION PROPERTIES OF SOILS
ASTM D 2435

Client	Civil & Environmental Consultant	Boring	RB-3	**Test Load, tsf**	**1-2**
Client Project	091-867 Apex Landfill Expansion	Depth	20'-24'		Load 4 of 13
Project No.	30598	Sample	B-1		
		Lab ID#	30598026		

Visual Description: Dark Gray Sandy Clay
Test Conditions: Remolded, Inundated, and Double Drained

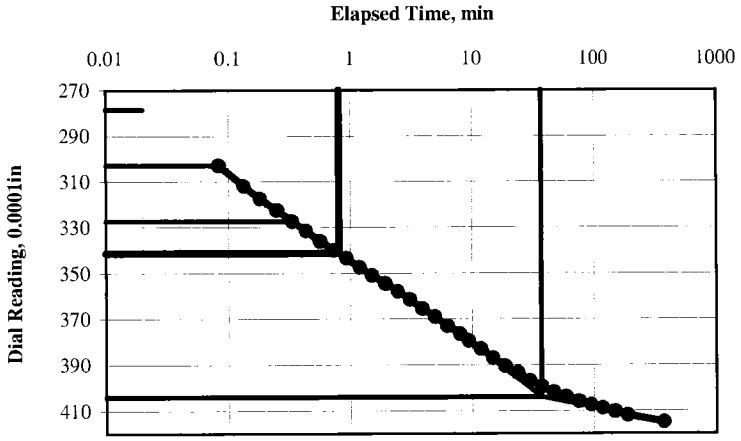
Time Vs. Dial Reading

Elapsed Time (min)	Sqrt Time ($min^{1/2}$)	Dial Reading (0.0001in)	Sample Height (in)	Void Ratio
0	0	132.5	0.9914	0.5635
Corrections*		-6	-0.0006	-0.0009
Adjusted Sample Height & Void Ratio				
0.08	0.29	303.0	0.9749	0.5376
0.13	0.37	312.0	0.9740	0.5362
0.18	0.43	317.5	0.9735	0.5353
0.25	0.50	322.5	0.9730	0.5345
0.33	0.58	327.5	0.9725	0.5337
0.43	0.66	331.5	0.9721	0.5331
0.57	0.75	336.0	0.9716	0.5324
0.73	0.86	340.0	0.9712	0.5318
0.93	0.97	343.5	0.9709	0.5312
1.20	1.10	347.5	0.9705	0.5306
1.52	1.23	351.0	0.9701	0.5300
1.93	1.39	354.5	0.9698	0.5295
2.45	1.57	358.0	0.9694	0.5289
3.10	1.76	361.5	0.9691	0.5284
3.93	1.98	365.5	0.9687	0.5277
4.97	2.23	369.0	0.9683	0.5272
6.28	2.51	373.0	0.9679	0.5266
7.93	2.82	376.5	0.9676	0.5260
9.38	3.06	379.5	0.9673	0.5255
11.83	3.44	383.0	0.9669	0.5250
14.93	3.86	387.0	0.9665	0.5243
18.83	4.34	390.5	0.9662	0.5238
23.75	4.87	393.5	0.9659	0.5233
29.93	5.47	397.0	0.9655	0.5228
37.73	6.14	399.5	0.9653	0.5224
47.55	6.90	402.0	0.9650	0.5220
59.93	7.74	404.0	0.9648	0.5217
75.93	8.71	406.0	0.9646	0.5214
94.93	9.74	407.5	0.9645	0.5211
119.93	10.95	409.0	0.9643	0.5209
150.93	12.29	410.5	0.9642	0.5206
189.93	13.78	412.0	0.9640	0.5204
379.93	19.49	415.0	0.9637	0.5199

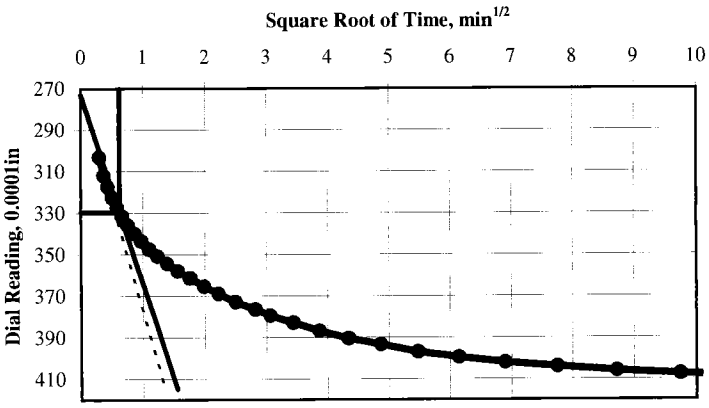
Machine Deflection

Applied Deflection Correction to Sample Height, 0.0001in: -6
**Correction is applied to all dial readings.*

Log of Elapsed Time vs. Dial Reading



Square Root of Elapsed Time vs. Dial Reading



Sqrt. of Elapsed Time vs Dial Reading		Log of Elapsed Time vs Dial Reading		Load Summary	
T0 = 0 min.	D0 = 273.2 div.	T0 = 0 min.	D0 = 278.5 div.		
T90 = 0.384 min	D90 = 329.8 div.	T50 = 0.8 min.	D50 = 341.2 div.	Initial Sample Height, in	0.9914
T100 = NA min	D100 = 336.1 div.	T100 = 36.95 min.	D100 = 404 div.	Initial Sample Void Ratio	0.5635
Height at: D90 = 0.9722, D100 = 0.9716		Height at: D50 = 0.9711, D100 = 0.9648		Final Sample Height, in	0.9637
Average Sample Height, in	0.9775	Average Sample Height, in	0.9775	Final Sample Void Ratio	0.5199
Average Drainage Height, in	0.4888	Average Drainage Height, in	0.4888	Incremental Strain, %	2.79%
T (Time Factor for T90)	0.848	T (Time Factor for T50)	0.197	Loading Duration, min	379.93333
Coef. of Consol., C_v, in^2/min	0.521	Coef. of Consol., C_v, in^2/min	0.059		

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ONE-DIMENSIONAL CONSOLIDATION PROPERTIES OF SOILS
ASTM D 2435

Client	Civil & Environmental Consultant	Boring	RB-3	**Test Load, tsf**	**2-4**
Client Project	091-867 Apex Landfill Expansion	Depth	20'-24'		Load 5 of 13
Project No.	30598	Sample	B-1		
		Lab ID#	30598026		

Visual Description: Dark Gray Sandy Clay
Test Conditions: Remolded, Inundated, and Double Drained

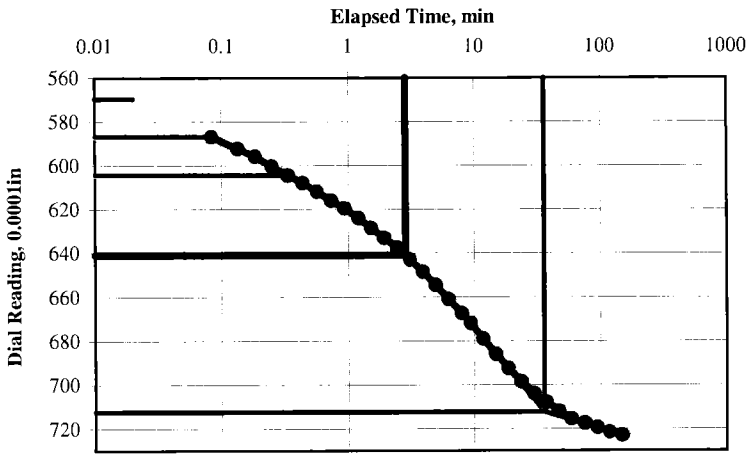
Time Vs. Dial Reading

Elapsed Time (min)	Sqrt Time ($min^{1/2}$)	Dial Reading (0.0001in)	Sample Height (in)	Void Ratio
0	0	415.0	0.9637	0.5199
Corrections*		-5.5	-0.00055	-0.0009
Adjusted Sample Height & Void Ratio				
0.08	0.29	587.0	0.9471	0.4937
0.13	0.37	592.5	0.9465	0.4928
0.18	0.43	596.0	0.9462	0.4923
0.25	0.50	600.5	0.9457	0.4915
0.33	0.58	604.5	0.9453	0.4909
0.43	0.66	608.0	0.9450	0.4904
0.57	0.75	612.0	0.9446	0.4897
0.73	0.86	616.0	0.9442	0.4891
0.93	0.97	619.5	0.9438	0.4885
1.20	1.10	624.0	0.9434	0.4878
1.52	1.23	628.5	0.9429	0.4871
1.93	1.39	633.0	0.9425	0.4864
2.45	1.57	637.5	0.9420	0.4857
3.10	1.76	643.0	0.9415	0.4848
3.93	1.98	648.5	0.9409	0.4840
4.97	2.23	654.5	0.9403	0.4830
6.28	2.51	661.0	0.9397	0.4820
7.93	2.82	667.5	0.9390	0.4810
9.38	3.06	672.0	0.9386	0.4803
11.83	3.44	679.0	0.9379	0.4792
14.93	3.86	686.0	0.9372	0.4781
18.83	4.34	692.5	0.9365	0.4770
23.75	4.87	698.5	0.9359	0.4761
29.93	5.47	704.0	0.9354	0.4752
37.73	6.14	708.0	0.9350	0.4746
47.55	6.90	712.0	0.9346	0.4740
59.93	7.74	715.5	0.9342	0.4734
75.93	8.71	717.5	0.9340	0.4731
94.93	9.74	719.5	0.9338	0.4728
119.93	10.95	721.5	0.9336	0.4725
150.93	12.29	723.0	0.9335	0.4722

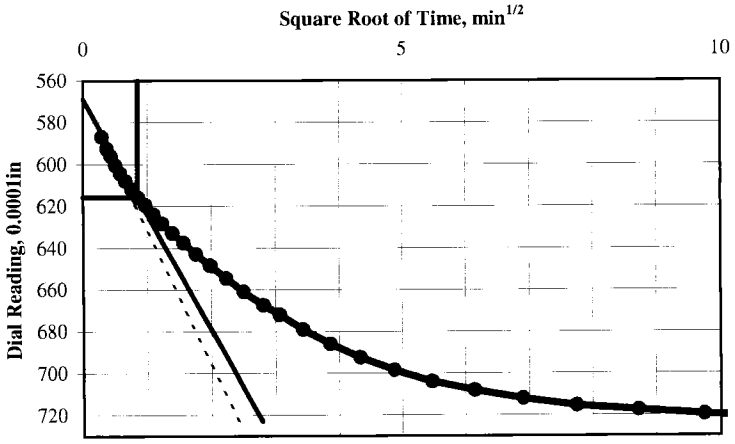
Machine Deflection

Applied Deflection Correction to Sample Height, 0.0001in: -5.5
**Correction is applied to all dial readings.*

Log of Elapsed Time vs. Dial Reading



Square Root of Elapsed Time vs. Dial Reading



Sqrt. of Elapsed Time vs Dial Reading

T0 = 0 min.	D0 = 569 div.
T90 = 0.723 min	D90 = 615.8 div.
T100 = NA min	D100 = 621 div.
Height at: D90 = 0.9442, D100 = 0.9436	
Average Sample Height, in	0.9486
Average Drainage Height, in	0.4743
T (Time Factor for T90)	0.848
Coef. of Consol., C_v, in^2/min	0.263

Log of Elapsed Time vs Dial Reading

T0 = 0 min.	D0 = 569.5 div.
T50 = 2.84 min.	D50 = 640.9 div.
T100 = 35.71 min.	D100 = 712.3 div.
Height at: D50 = 0.9417, D100 = 0.9345	
Average Sample Height, in	0.9486
Average Drainage Height, in	0.4743
T (Time Factor for T50)	0.197
Coef. of Consol., C_v, in^2/min	0.016

Load Summary

Initial Sample Height, in	0.9637
Initial Sample Void Ratio	0.5199
Final Sample Height, in	0.9335
Final Sample Void Ratio	0.4722
Incremental Strain, %	3.14%
Loading Duration, min	150.93333

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ONE-DIMENSIONAL CONSOLIDATION PROPERTIES OF SOILS
ASTM D 2435

Client	Civil & Environmental Consultant	Boring	RB-3	**Test Load, tsf**	**4-1**
Client Project	091-867 Apex Landfill Expansion	Depth	20'-24'		Load 6 of 13
Project No.	30598	Sample	B-1		
		Lab ID#	30598026		

Visual Description: Dark Gray Sandy Clay
Test Conditions: Remolded, Inundated, and Double Drained

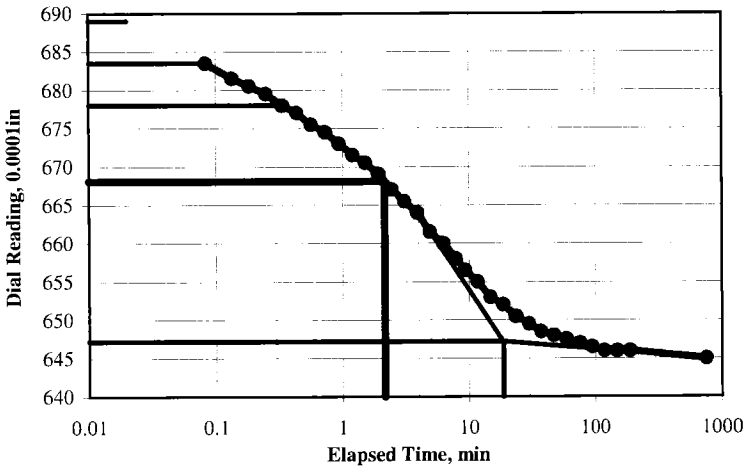
Time Vs. Dial Reading

Elapsed Time (min)	Sqrt Time ($min^{1/2}$)	Dial Reading (0.0001in)	Sample Height (in)	Void Ratio
0	0	723.0	0.9335	0.4722
Corrections*		7.5	0.00075	0.00118
Adjusted Sample Height & Void Ratio				
0.08	0.29	683.5	0.9367	0.4773
0.13	0.37	681.5	0.9369	0.4776
0.18	0.43	680.5	0.9370	0.4777
0.25	0.50	679.5	0.9371	0.4779
0.33	0.58	678.0	0.9372	0.4781
0.43	0.66	677.0	0.9373	0.4783
0.57	0.75	675.5	0.9375	0.4785
0.73	0.86	674.5	0.9376	0.4787
0.93	0.97	673.0	0.9377	0.4789
1.20	1.10	671.5	0.9379	0.4792
1.52	1.23	670.5	0.9380	0.4793
1.93	1.39	669.0	0.9381	0.4796
2.45	1.57	667.0	0.9383	0.4799
3.10	1.76	665.5	0.9385	0.4801
3.93	1.98	664.0	0.9386	0.4803
4.97	2.23	661.5	0.9389	0.4807
6.28	2.51	660.0	0.9390	0.4810
7.93	2.82	658.0	0.9392	0.4813
9.38	3.06	656.5	0.9394	0.4815
11.83	3.44	655.0	0.9395	0.4818
14.93	3.86	653.0	0.9397	0.4821
18.83	4.34	652.0	0.9398	0.4822
23.75	4.87	650.5	0.9400	0.4825
29.93	5.47	649.5	0.9401	0.4826
37.73	6.14	648.5	0.9402	0.4828
47.55	6.90	648.0	0.9402	0.4829
59.93	7.74	647.5	0.9403	0.4829
75.93	8.71	647.0	0.9403	0.4830
94.93	9.74	646.5	0.9404	0.4831
119.93	10.95	646.0	0.9404	0.4832
150.93	12.29	646.0	0.9404	0.4832
189.93	13.78	646.0	0.9404	0.4832
757.93	27.53	645.0	0.9405	0.4833

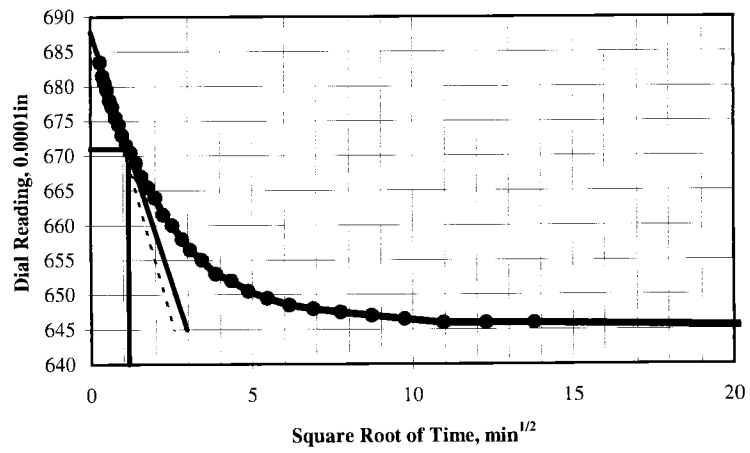
Machine Deflection

Applied Deflection Correction to Sample Height, 0.0001in: 7.5
**Correction is applied to all dial readings.*

Log of Elapsed Time vs. Dial Reading



Square Root of Elapsed Time vs. Dial Reading



Sqrt. of Elapsed Time vs Dial Reading		Log of Elapsed Time vs Dial Reading		Load Summary	
T0 = 0 min.	D0 = 687.8 div.	T0 = 0 min.	D0 = 689 div.		
T90 = 1.346 min	D90 = 671 div.	T50 = 2.15 min.	D50 = 668.1 div.	Initial Sample Height, in	0.9335
T100 = NA min	D100 = 669.1 div.	T100 = 18.84 min.	D100 = 647.2 div.	Initial Sample Void Ratio	0.4722
Height at: D90 = 0.9379, D100 = 0.9381		Height at: D50 = 0.9382, D100 = 0.9403		Final Sample Height, in	0.9405
Average Sample Height, in	0.9370	Average Sample Height, in	0.9370	Final Sample Void Ratio	0.4833
Average Drainage Height, in	0.4685	Average Drainage Height, in	0.4685	Incremental Strain, %	-0.76%
T (Time Factor for T90)	0.848	T (Time Factor for T50)	0.197	Loading Duration, min	757.93333
Coef. of Consol., C_v, in^2/min	0.137	Coef. of Consol., C_v, in^2/min	0.020		

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ONE-DIMENSIONAL CONSOLIDATION PROPERTIES OF SOILS
ASTM D 2435

Client	Civil & Environmental Consultant	Boring	RB-3	**Test Load, tsf**	**1-0.25**
Client Project	091-867 Apex Landfill Expansion	Depth	20'-24'		Load 7 of 13
Project No.	30598	Sample	B-1		
		Lab ID#	30598026		

Visual Description: Dark Gray Sandy Clay
Test Conditions: Remolded, Inundated, and Double Drained

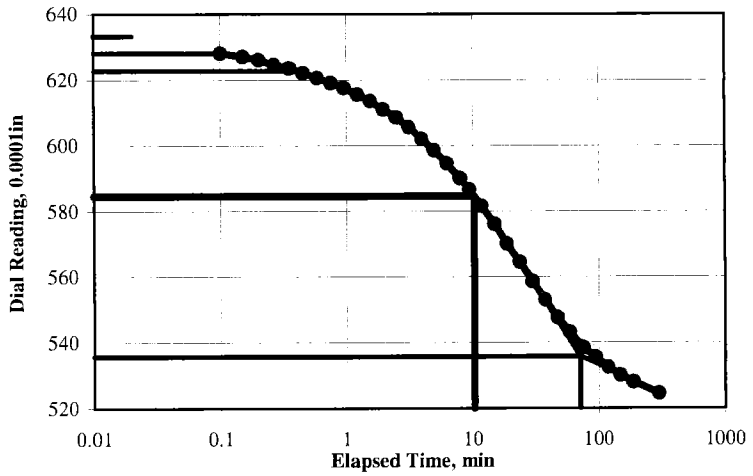
Time Vs. Dial Reading

Elapsed Time (min)	Sqrt Time ($min^{1/2}$)	Dial Reading (0.0001in)	Sample Height (in)	Void Ratio
0	0	645.0	0.9405	0.4833
Corrections*		4.5	0.00045	0.00071
Adjusted Sample Height & Void Ratio				
0.10	0.32	628.0	0.9418	0.4853
0.15	0.39	627.0	0.9419	0.4855
0.20	0.45	626.0	0.9420	0.4856
0.27	0.52	624.5	0.9421	0.4859
0.35	0.59	623.5	0.9422	0.4860
0.45	0.67	622.0	0.9424	0.4863
0.58	0.76	620.5	0.9425	0.4865
0.75	0.87	619.0	0.9427	0.4867
0.95	0.97	617.5	0.9428	0.4870
1.22	1.10	615.5	0.9430	0.4873
1.53	1.24	613.5	0.9432	0.4876
1.95	1.40	611.0	0.9435	0.4880
2.47	1.57	608.5	0.9437	0.4884
3.12	1.77	605.5	0.9440	0.4889
3.95	1.99	602.0	0.9444	0.4894
4.98	2.23	598.5	0.9447	0.4900
6.30	2.51	594.5	0.9451	0.4906
7.95	2.82	590.0	0.9456	0.4913
9.40	3.07	586.5	0.9459	0.4919
11.85	3.44	581.5	0.9464	0.4926
14.95	3.87	576.0	0.9470	0.4935
18.85	4.34	570.0	0.9476	0.4945
23.77	4.88	564.5	0.9481	0.4953
29.95	5.47	558.5	0.9487	0.4963
37.75	6.14	553.0	0.9493	0.4971
47.57	6.90	547.5	0.9498	0.4980
59.95	7.74	543.0	0.9503	0.4987
75.95	8.71	538.5	0.9507	0.4994
94.95	9.74	535.5	0.9510	0.4999
119.95	10.95	532.5	0.9513	0.5004
150.95	12.29	530.0	0.9516	0.5008
189.95	13.78	528.0	0.9518	0.5011
301.95	17.38	524.5	0.9521	0.5016

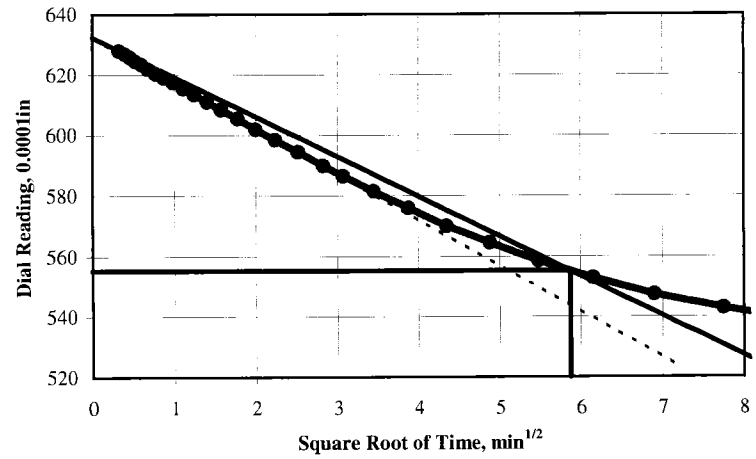
Machine Deflection

Applied Deflection Correction to Sample Height, 0.0001in: 4.5
**Correction is applied to all dial readings.*

Log of Elapsed Time vs. Dial Reading



Square Root of Elapsed Time vs. Dial Reading



Sqrt. of Elapsed Time vs Dial Reading			Log of Elapsed Time vs Dial Reading			Load Summary	
T0 = 0 min.	D0 = 632.3 div.		T0 = 0 min.	D0 = 633.3 div.			
T90 = 34.457 min	D90 = 555.2 div.		T50 = 10.31 min.	D50 = 584.5 div.		Initial Sample Height, in	0.9405
T100 = NA min	D100 = 546.7 div.		T100 = 72.04 min.	D100 = 535.7 div.		Initial Sample Void Ratio	0.4833
Height at: D90 = 0.949, D100 = 0.9499			Height at: D50 = 0.9461, D100 = 0.951			Final Sample Height, in	0.9521
Average Sample Height, in		0.9463	Average Sample Height, in		0.9463	Final Sample Void Ratio	0.5016
Average Drainage Height, in		0.4732	Average Drainage Height, in		0.4732	Incremental Strain, %	-1.23%
T (Time Factor for T90)		0.848	T (Time Factor for T50)		0.197	Loading Duration, min	301.95
Coef. of Consol., C_v, in^2/min		0.006	Coef. of Consol., C_v, in^2/min		0.004		

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ONE-DIMENSIONAL CONSOLIDATION PROPERTIES OF SOILS
ASTM D 2435

Client	Civil & Environmental Consultant	Boring	RB-3	**Test Load, tsf**	**0.25-0.5**
Client Project	091-867 Apex Landfill Expansion	Depth	20'-24'		Load 8 of 13
Project No.	30598	Sample	B-1		
		Lab ID#	30598026		

Visual Description: Dark Gray Sandy Clay
Test Conditions: Remolded, Inundated, and Double Drained

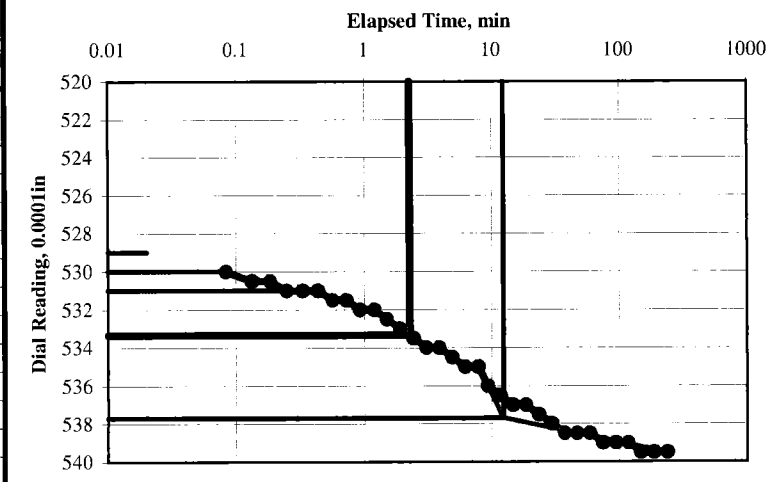
Time Vs. Dial Reading

Elapsed Time (min)	Sqrt Time ($min^{1/2}$)	Dial Reading (0.0001in)	Sample Height (in)	Void Ratio
0	0	524.5	0.9521	0.5016
Corrections*		-1.5	-0.00015	-0.0002
Adjusted Sample Height & Void Ratio				
0.08	0.29	530.0	0.9517	0.5010
0.13	0.37	530.5	0.9517	0.5009
0.18	0.43	530.5	0.9517	0.5009
0.25	0.50	531.0	0.9516	0.5008
0.33	0.58	531.0	0.9516	0.5008
0.43	0.66	531.0	0.9516	0.5008
0.57	0.75	531.5	0.9516	0.5008
0.73	0.86	531.5	0.9516	0.5008
0.93	0.97	532.0	0.9515	0.5007
1.20	1.10	532.0	0.9515	0.5007
1.52	1.23	532.5	0.9515	0.5006
1.93	1.39	533.0	0.9514	0.5005
2.45	1.57	533.5	0.9514	0.5005
3.10	1.76	534.0	0.9513	0.5004
3.93	1.98	534.0	0.9513	0.5004
4.97	2.23	534.5	0.9513	0.5003
6.28	2.51	535.0	0.9512	0.5002
7.93	2.82	535.0	0.9512	0.5002
9.38	3.06	536.0	0.9511	0.5001
11.83	3.44	536.5	0.9511	0.5000
14.93	3.86	537.0	0.9510	0.4999
18.83	4.34	537.0	0.9510	0.4999
23.75	4.87	537.5	0.9510	0.4998
29.93	5.47	538.0	0.9509	0.4997
37.73	6.14	538.5	0.9509	0.4997
47.55	6.90	538.5	0.9509	0.4997
59.93	7.74	538.5	0.9509	0.4997
75.93	8.71	539.0	0.9508	0.4996
94.93	9.74	539.0	0.9508	0.4996
119.93	10.95	539.0	0.9508	0.4996
150.93	12.29	539.5	0.9508	0.4995
189.93	13.78	539.5	0.9508	0.4995
239.93	15.49	539.5	0.9508	0.4995

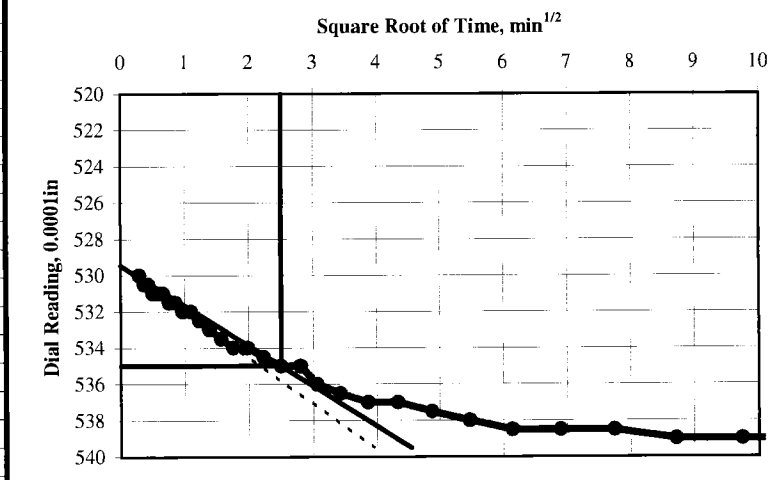
Machine Deflection

Applied Deflection Correction to Sample Height, 0.0001in: -1.5
**Correction is applied to all dial readings.*

Log of Elapsed Time vs. Dial Reading



Square Root of Elapsed Time vs. Dial Reading



Sqrt. of Elapsed Time vs Dial Reading

T0 = 0 min.	D0 = 529.5 div.		
T90 = 6.3 min	D90 = 535 div.		
T100 = NA min	D100 = 535.6 div.		
Height at: D90 = 0.9512, D100 = 0.9511			
Average Sample Height, in	0.9514		
Average Drainage Height, in	0.4757		
T (Time Factor for T90)	0.848		
Coef. of Consol., C_v, in^2/min	0.030		

Log of Elapsed Time vs Dial Reading

T0 = 0 min.	D0 = 529 div.		
T50 = 2.27 min.	D50 = 533.3 div.		
T100 = 12.44 min.	D100 = 537.7 div.		
Height at: D50 = 0.9514, D100 = 0.9509			
Average Sample Height, in	0.9514		
Average Drainage Height, in	0.4757		
T (Time Factor for T50)	0.197		
Coef. of Consol., C_v, in^2/min	0.020		

Load Summary

Initial Sample Height, in	0.9521
Initial Sample Void Ratio	0.5016
Final Sample Height, in	0.9508
Final Sample Void Ratio	0.4995
Incremental Strain, %	0.14%
Loading Duration, min	239.93333

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ONE-DIMENSIONAL CONSOLIDATION PROPERTIES OF SOILS
ASTM D 2435

Client	Civil & Environmental Consultant	Boring	RB-3	**Test Load, tsf**	**0.5-1**
Client Project	091-867 Apex Landfill Expansion	Depth	20'-24'		Load 9 of 13
Project No.	30598	Sample	B-1		
		Lab ID#	30598026		

Visual Description: Dark Gray Sandy Clay
Test Conditions: Remolded, Inundated, and Double Drained

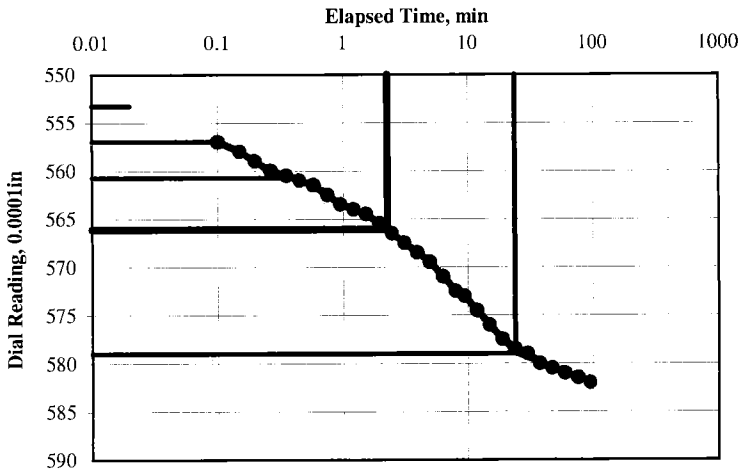
Time Vs. Dial Reading

Elapsed Time (min)	Sqrt Time ($min^{1/2}$)	Dial Reading (0.0001in)	Sample Height (in)	Void Ratio
0	0	539.5	0.9508	0.4995
Corrections*		-2.5	-0.00025	-0.0004
Adjusted Sample Height & Void Ratio				
0.10	0.32	557.0	0.9493	0.4971
0.15	0.39	558.0	0.9492	0.4970
0.20	0.45	559.0	0.9491	0.4968
0.27	0.52	560.0	0.9490	0.4967
0.35	0.59	560.5	0.9489	0.4966
0.45	0.67	561.0	0.9489	0.4965
0.58	0.76	561.5	0.9488	0.4964
0.75	0.87	562.5	0.9487	0.4963
0.95	0.97	563.5	0.9486	0.4961
1.22	1.10	564.0	0.9486	0.4960
1.53	1.24	564.5	0.9485	0.4960
1.95	1.40	565.5	0.9484	0.4958
2.47	1.57	566.5	0.9483	0.4956
3.12	1.77	567.5	0.9482	0.4955
3.95	1.99	568.5	0.9481	0.4953
4.98	2.23	569.5	0.9480	0.4952
6.30	2.51	571.0	0.9479	0.4949
7.95	2.82	572.5	0.9477	0.4947
9.40	3.07	573.0	0.9477	0.4946
11.85	3.44	574.5	0.9475	0.4944
14.95	3.87	576.0	0.9474	0.4941
18.85	4.34	577.5	0.9472	0.4939
23.77	4.88	578.5	0.9471	0.4938
29.95	5.47	579.0	0.9471	0.4937
37.75	6.14	580.0	0.9470	0.4935
47.57	6.90	580.5	0.9469	0.4934
59.95	7.74	581.0	0.9469	0.4934
75.95	8.71	581.5	0.9468	0.4933
94.95	9.74	582.0	0.9468	0.4932

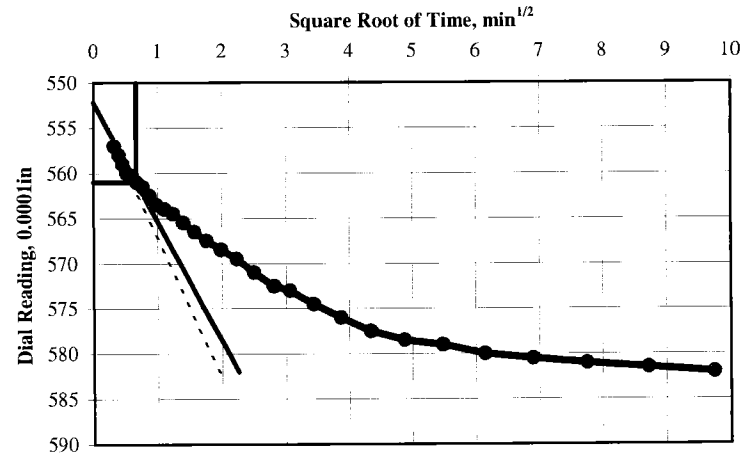
Machine Deflection

Applied Deflection Correction to Sample Height, 0.0001in: -2.5
**Correction is applied to all dial readings.*

Log of Elapsed Time vs. Dial Reading



Square Root of Elapsed Time vs. Dial Reading



Sqrt. of Elapsed Time vs Dial Reading		Log of Elapsed Time vs Dial Reading		Load Summary	
T0 = 0 min.	D0 = 552.2 div.	T0 = 0 min.	D0 = 553.2 div.		
T90 = 0.449 min	D90 = 561 div.	T50 = 2.25 min.	D50 = 566.1 div.	Initial Sample Height, in	0.9508
T100 = NA min	D100 = 562 div.	T100 = 23.69 min.	D100 = 579 div.	Initial Sample Void Ratio	0.4995
Height at: D90 = 0.9489, D100 = 0.9488		Height at: D50 = 0.9483, D100 = 0.9471		Final Sample Height, in	0.9468
Average Sample Height, in	0.9488	Average Sample Height, in	0.9488	Final Sample Void Ratio	0.4932
Average Drainage Height, in	0.4744	Average Drainage Height, in	0.4744	Incremental Strain, %	0.42%
T (Time Factor for T90)	0.848	T (Time Factor for T50)	0.197	Loading Duration, min	94.95
Coef. of Consol., C_v, in^2/min	0.428	Coef. of Consol., C_v, in^2/min	0.020		

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ONE-DIMENSIONAL CONSOLIDATION PROPERTIES OF SOILS
ASTM D 2435

Client	Civil & Environmental Consultant	Boring	RB-3	**Test Load, tsf**	**1-2**
Client Project	091-867 Apex Landfill Expansion	Depth	20'-24'		Load 10 of 13
Project No.	30598	Sample	B-1		
		Lab ID#	30598026		

Visual Description: Dark Gray Sandy Clay
Test Conditions: Remolded, Inundated, and Double Drained

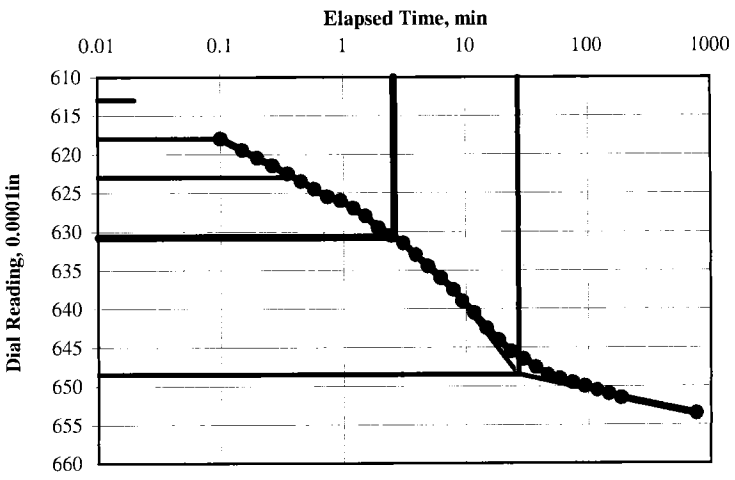
Time Vs. Dial Reading

Elapsed Time (min)	Sqrt Time ($min^{1/2}$)	Dial Reading (0.0001in)	Sample Height (in)	Void Ratio
0	0	582.0	0.9468	0.4932
Corrections*		-3.5	-0.00035	-0.0006
Adjusted Sample Height & Void Ratio				
0.10	0.32	618.0	0.9435	0.4881
0.15	0.39	619.5	0.9434	0.4878
0.20	0.45	620.5	0.9433	0.4877
0.27	0.52	621.5	0.9432	0.4875
0.35	0.59	622.5	0.9431	0.4874
0.45	0.67	623.5	0.9430	0.4872
0.58	0.76	624.5	0.9429	0.4870
0.75	0.87	625.5	0.9428	0.4869
0.95	0.97	626.0	0.9427	0.4868
1.22	1.10	627.0	0.9426	0.4867
1.53	1.24	628.0	0.9425	0.4865
1.95	1.40	629.5	0.9424	0.4863
2.47	1.57	630.5	0.9423	0.4861
3.12	1.77	631.5	0.9422	0.4859
3.95	1.99	633.0	0.9420	0.4857
4.98	2.23	634.5	0.9419	0.4855
6.30	2.51	636.0	0.9417	0.4852
7.95	2.82	637.5	0.9416	0.4850
9.40	3.07	639.0	0.9414	0.4848
11.85	3.44	640.5	0.9413	0.4845
14.95	3.87	642.5	0.9411	0.4842
18.85	4.34	644.0	0.9409	0.4840
23.77	4.88	645.5	0.9408	0.4837
29.95	5.47	646.5	0.9407	0.4836
37.75	6.14	647.5	0.9406	0.4834
47.57	6.90	648.5	0.9405	0.4833
59.95	7.74	649.0	0.9404	0.4832
75.95	8.71	649.5	0.9404	0.4831
94.95	9.74	650.0	0.9403	0.4830
119.95	10.95	650.5	0.9403	0.4829
150.95	12.29	651.0	0.9402	0.4829
189.95	13.78	651.5	0.9402	0.4828
757.95	27.53	653.5	0.9400	0.4825

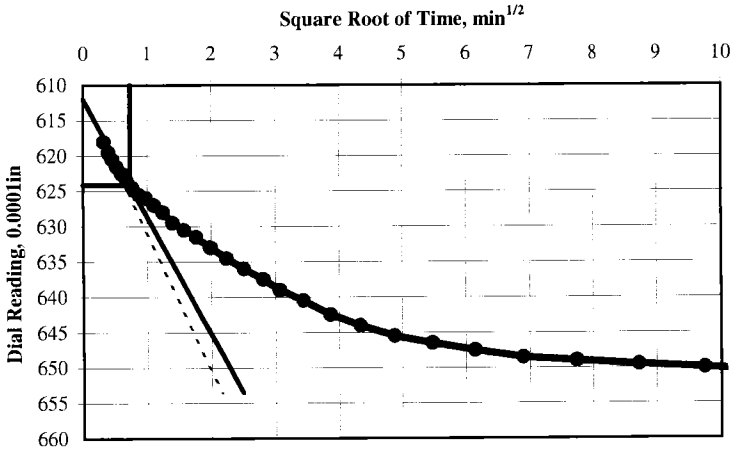
Machine Deflection

Applied Deflection Correction to Sample Height, 0.0001in: -3.5
**Correction is applied to all dial readings.*

Log of Elapsed Time vs. Dial Reading



Square Root of Elapsed Time vs. Dial Reading



Sqrt. of Elapsed Time vs Dial Reading

T0 = 0 min.	D0 = 612 div.
T90 = 0.533 min	D90 = 624.1 div.
T100 = NA min	D100 = 625.5 div.
Height at: D90 = 0.9429, D100 = 0.9428	
Average Sample Height, in	0.9434
Average Drainage Height, in	0.4717
T (Time Factor for T90)	0.848
Coef. of Consol., C_v, in^2/min	0.355

Log of Elapsed Time vs Dial Reading

T0 = 0 min.	D0 = 613 div.
T50 = 2.6 min.	D50 = 630.7 div.
T100 = 27.07 min.	D100 = 648.5 div.
Height at: D50 = 0.9422, D100 = 0.9405	
Average Sample Height, in	0.9434
Average Drainage Height, in	0.4717
T (Time Factor for T50)	0.197
Coef. of Consol., C_v, in^2/min	0.017

Load Summary

Initial Sample Height, in	0.9468
Initial Sample Void Ratio	0.4932
Final Sample Height, in	0.9400
Final Sample Void Ratio	0.4825
Incremental Strain, %	0.72%
Loading Duration, min	757.95

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ONE-DIMENSIONAL CONSOLIDATION PROPERTIES OF SOILS
ASTM D 2435

Client	Civil & Environmental Consultant	Boring	RB-3	**Test Load, tsf**	**2-4**
Client Project	091-867 Apex Landfill Expansion	Depth	20'-24'		Load 11 of 13
Project No.	30598	Sample	B-1		
		Lab ID#	30598026		
Visual Description	Dark Gray Sandy Clay				
Test Conditions:	Remolded, Inundated, and Double Drained				

Time Vs. Dial Reading

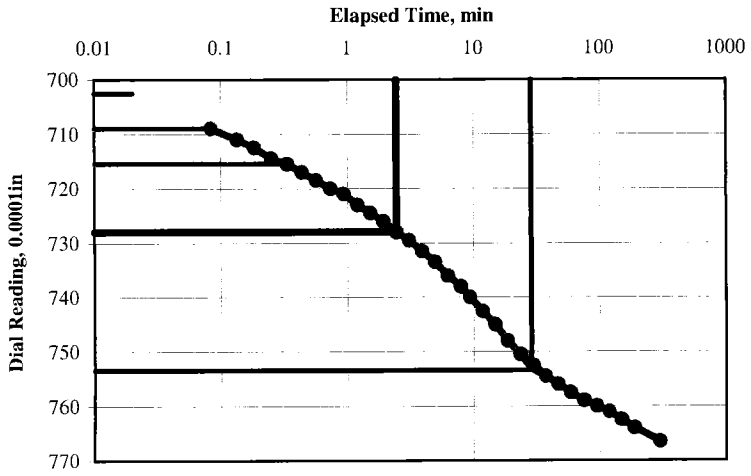
Elapsed Time (min)	Sqrt Time ($min^{1/2}$)	Dial Reading (0.0001in)	Sample Height (in)	Void Ratio
0	0	653.5	0.9400	0.4825
Corrections*		-4.5	-0.00045	-0.0007
Adjusted Sample Height & Void Ratio				
0.08	0.29	709.0	0.9349	0.4744
0.13	0.37	711.0	0.9347	0.4741
0.18	0.43	712.5	0.9345	0.4739
0.25	0.50	714.5	0.9343	0.4736
0.33	0.58	715.5	0.9342	0.4734
0.43	0.66	717.0	0.9341	0.4732
0.57	0.75	718.5	0.9339	0.4729
0.73	0.86	720.0	0.9338	0.4727
0.93	0.97	721.0	0.9337	0.4725
1.20	1.10	723.0	0.9335	0.4722
1.52	1.23	724.5	0.9333	0.4720
1.93	1.39	726.0	0.9332	0.4717
2.45	1.57	728.0	0.9330	0.4714
3.10	1.76	729.5	0.9328	0.4712
3.93	1.98	731.5	0.9326	0.4709
4.97	2.23	733.5	0.9324	0.4706
6.28	2.51	736.0	0.9322	0.4702
7.93	2.82	738.0	0.9320	0.4699
9.38	3.06	740.0	0.9318	0.4695
11.83	3.44	742.5	0.9315	0.4691
14.93	3.86	745.0	0.9313	0.4688
18.83	4.34	748.0	0.9310	0.4683
23.75	4.87	750.5	0.9307	0.4679
29.93	5.47	752.5	0.9305	0.4676
37.73	6.14	754.5	0.9303	0.4673
47.55	6.90	756.0	0.9302	0.4670
59.93	7.74	757.5	0.9300	0.4668
75.93	8.71	759.0	0.9299	0.4665
94.93	9.74	760.0	0.9298	0.4664
119.93	10.95	761.0	0.9297	0.4662
150.93	12.29	762.5	0.9295	0.4660
189.93	13.78	764.0	0.9294	0.4658
301.93	17.38	766.5	0.9291	0.4654

Machine Deflection

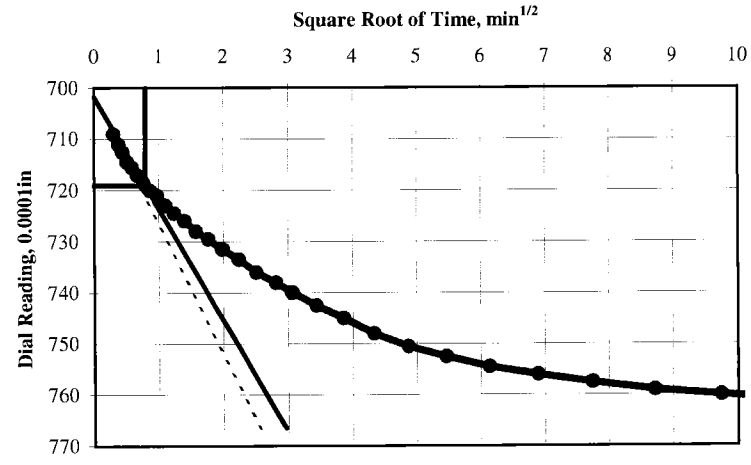
Applied Deflection Correction to Sample Height, 0.0001in -4.5

**Correction is applied to all dial readings.*

Log of Elapsed Time vs. Dial Reading



Square Root of Elapsed Time vs. Dial Reading



Sqrt. of Elapsed Time vs Dial Reading		Log of Elapsed Time vs Dial Reading		Load Summary	
T0 = 0 min.	D0 = 701.8 div.	T0 = 0 min.	D0 = 702.5 div.		
T90 = 0.624 min	D90 = 719.1 div.	T50 = 2.43 min.	D50 = 727.9 div.	Initial Sample Height, in	0.9400
T100 = NA min	D100 = 721 div.	T100 = 28.53 min.	D100 = 753.4 div.	Initial Sample Void Ratio	0.4825
Height at: D90 = 0.9338, D100 = 0.9337		Height at: D50 = 0.933, D100 = 0.9304		Final Sample Height, in	0.9291
Average Sample Height, in	0.9345	Average Sample Height, in	0.9345	Final Sample Void Ratio	0.4654
Average Drainage Height, in	0.4673	Average Drainage Height, in	0.4673	Incremental Strain, %	1.15%
T (Time Factor for T90)	0.848	T (Time Factor for T50)	0.197	Loading Duration, min	301.93333
Coef. of Consol., C_v, in^2/min	0.296	Coef. of Consol., C_v, in^2/min	0.018		

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ONE-DIMENSIONAL CONSOLIDATION PROPERTIES OF SOILS
ASTM D 2435

Client	Civil & Environmental Consultant	Boring	RB-3	**Test Load, tsf**	**4-8**
Client Project	091-867 Apex Landfill Expansion	Depth	20'-24'		Load 12 of 13
Project No.	30598	Sample	B-1		
		Lab ID#	30598026		

Visual Description: Dark Gray Sandy Clay
Test Conditions: Remolded, Inundated, and Double Drained

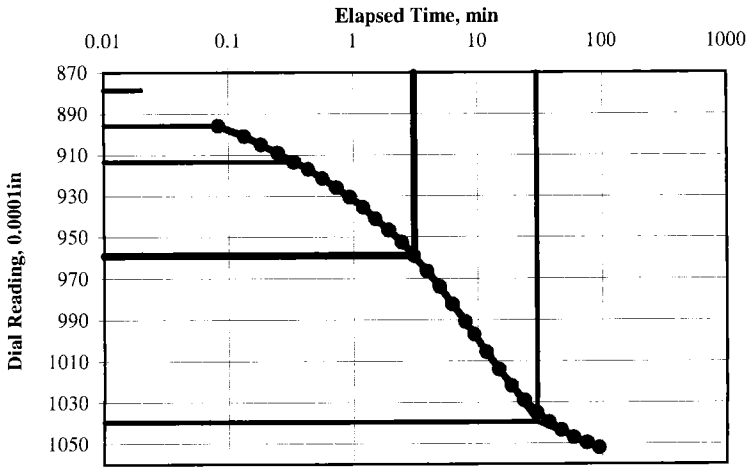
Time Vs. Dial Reading

Elapsed Time (min)	Sqrt Time ($min^{1/2}$)	Dial Reading (0.0001in)	Sample Height (in)	Void Ratio
0	0	766.5	0.9291	0.4654
Corrections*		-10	-0.001	-0.0016
Adjusted Sample Height & Void Ratio				
0.08	0.29	896.0	0.9172	0.4465
0.13	0.37	901.0	0.9167	0.4457
0.18	0.43	905.0	0.9163	0.4451
0.25	0.50	909.0	0.9159	0.4445
0.33	0.58	913.5	0.9154	0.4438
0.43	0.66	917.0	0.9151	0.4432
0.57	0.75	921.5	0.9146	0.4425
0.73	0.86	926.0	0.9142	0.4418
0.93	0.97	930.5	0.9137	0.4411
1.20	1.10	935.5	0.9132	0.4403
1.52	1.23	941.0	0.9127	0.4394
1.93	1.39	946.5	0.9121	0.4385
2.45	1.57	952.5	0.9115	0.4376
3.10	1.76	959.0	0.9109	0.4366
3.93	1.98	966.5	0.9101	0.4354
4.97	2.23	974.0	0.9094	0.4342
6.28	2.51	982.5	0.9085	0.4329
7.93	2.82	991.0	0.9077	0.4315
9.38	3.06	997.0	0.9071	0.4306
11.83	3.44	1005.5	0.9062	0.4292
14.93	3.86	1014.0	0.9054	0.4279
18.83	4.34	1022.0	0.9046	0.4266
23.75	4.87	1029.0	0.9039	0.4255
29.93	5.47	1035.0	0.9033	0.4246
37.73	6.14	1039.5	0.9028	0.4239
47.55	6.90	1043.5	0.9024	0.4233
59.93	7.74	1047.0	0.9021	0.4227
75.93	8.71	1049.5	0.9018	0.4223
94.93	9.74	1052.0	0.9016	0.4219

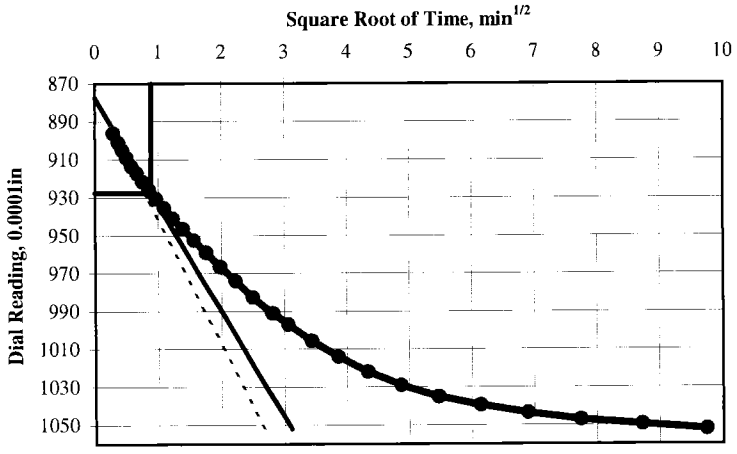
Machine Deflection

Applied Deflection Correction to Sample Height, 0.0001in: -10
**Correction is applied to all dial readings.*

Log of Elapsed Time vs. Dial Reading



Square Root of Elapsed Time vs. Dial Reading



Sqrt. of Elapsed Time vs Dial Reading

T0 = 0 min.	D0 = 877.4 div.
T90 = 0.792 min	D90 = 927.5 div.
T100 = NA min	D100 = 933.1 div.
Height at: D90 = 0.914, D100 = 0.9134	
Average Sample Height, in	0.9153
Average Drainage Height, in	0.4577
T (Time Factor for T90)	0.848
Coef. of Consol., C_v, in^2/min	0.223

Log of Elapsed Time vs Dial Reading

T0 = 0 min.	D0 = 878.5 div.
T50 = 3.09 min.	D50 = 958.9 div.
T100 = 29.8 min.	D100 = 1039.3 div.
Height at: D50 = 0.9109, D100 = 0.9028	
Average Sample Height, in	0.9153
Average Drainage Height, in	0.4577
T (Time Factor for T50)	0.197
Coef. of Consol., C_v, in^2/min	0.013

Load Summary

Initial Sample Height, in	0.9291
Initial Sample Void Ratio	0.4654
Final Sample Height, in	0.9016
Final Sample Void Ratio	0.4219
Incremental Strain, %	2.97%
Loading Duration, min	94.933333

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ONE-DIMENSIONAL CONSOLIDATION PROPERTIES OF SOILS
ASTM D 2435

Client	Civil & Environmental Consultant	Boring	RB-3	**Test Load, tsf**	**8-16**
Client Project	091-867 Apex Landfill Expansion	Depth	20'-24'		Load 13 of 13
Project No.	30598	Sample	B-1		
		Lab ID#	30598026		

Visual Description: Dark Gray Sandy Clay
Test Conditions: Remolded, Inundated, and Double Drained

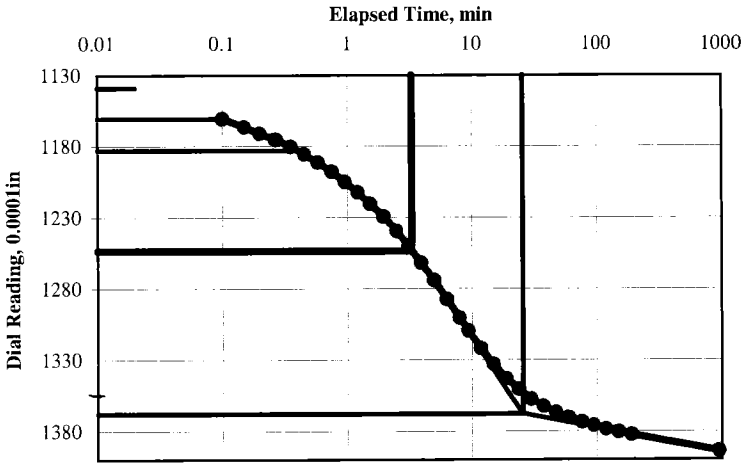
Time Vs. Dial Reading

Elapsed Time (min)	Sqrt Time ($min^{1/2}$)	Dial Reading (0.0001in)	Sample Height (in)	Void Ratio
0	0	1052.0	0.9016	0.4219
Corrections*		-13.5	-0.00135	-0.0021
Adjusted Sample Height & Void Ratio				
0.10	0.32	1161.0	0.8920	0.4068
0.15	0.39	1166.5	0.8915	0.4060
0.20	0.45	1171.0	0.8910	0.4053
0.27	0.52	1175.5	0.8906	0.4046
0.35	0.59	1180.5	0.8901	0.4038
0.45	0.67	1185.5	0.8896	0.4030
0.58	0.76	1191.5	0.8890	0.4020
0.75	0.87	1198.0	0.8883	0.4010
0.95	0.97	1205.0	0.8876	0.3999
1.22	1.10	1212.5	0.8869	0.3987
1.53	1.24	1220.5	0.8861	0.3975
1.95	1.40	1229.5	0.8852	0.3960
2.47	1.57	1239.5	0.8842	0.3945
3.12	1.77	1250.0	0.8831	0.3928
3.95	1.99	1262.0	0.8819	0.3909
4.98	2.23	1274.0	0.8807	0.3890
6.30	2.51	1287.5	0.8794	0.3869
7.95	2.82	1300.5	0.8781	0.3848
9.40	3.07	1309.5	0.8772	0.3834
11.85	3.44	1322.0	0.8759	0.3815
14.95	3.87	1333.0	0.8748	0.3797
18.85	4.34	1343.0	0.8738	0.3781
23.77	4.88	1350.5	0.8731	0.3770
29.95	5.47	1357.5	0.8724	0.3759
37.75	6.14	1362.5	0.8719	0.3751
47.57	6.90	1367.0	0.8714	0.3744
59.95	7.74	1370.5	0.8711	0.3738
75.95	8.71	1373.5	0.8708	0.3733
94.95	9.74	1376.0	0.8705	0.3729
119.95	10.95	1378.5	0.8703	0.3725
150.95	12.29	1380.5	0.8701	0.3722
189.95	13.78	1382.5	0.8699	0.3719
954.95	30.90	1394.0	0.8687	0.3701

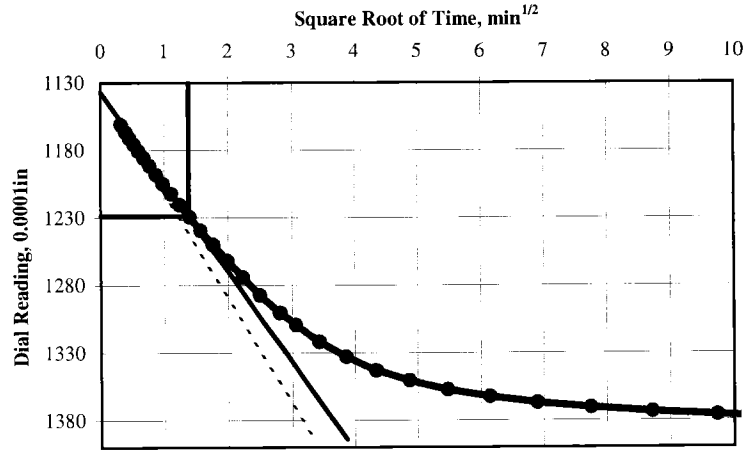
Machine Deflection

Applied Deflection Correction to Sample Height, 0.0001in: -13.5
**Correction is applied to all dial readings.*

Log of Elapsed Time vs. Dial Reading



Square Root of Elapsed Time vs. Dial Reading



Sqrt. of Elapsed Time vs Dial Reading			Log of Elapsed Time vs Dial Reading			Load Summary	
T0 = 0 min.	D0 = 1136.9 div.		T0 = 0 min.	D0 = 1138.8 div.			
T90 = 1.904 min	D90 = 1228.8 div.		T50 = 3.33 min.	D50 = 1253.3 div.		Initial Sample Height, in	0.9016
T100 = NA min	D100 = 1239 div.		T100 = 25.38 min.	D100 = 1367.7 div.		Initial Sample Void Ratio	0.4219
Height at: D90 = 0.8852, D100 = 0.8842			Height at: D50 = 0.8828, D100 = 0.8713			Final Sample Height, in	0.8687
Average Sample Height, in		0.8851	Average Sample Height, in		0.8851	Final Sample Void Ratio	0.3701
Average Drainage Height, in		0.4426	Average Drainage Height, in		0.4426	Incremental Strain, %	3.64%
T (Time Factor for T90)		0.848	T (Time Factor for T50)		0.197	Loading Duration, min	954.95
Coef. of Consol., C_v, in^2/min		0.087	Coef. of Consol., C_v, in^2/min		0.012		

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ONE-DIMENSIONAL CONSOLIDATION PROPERTIES OF SOILS
ASTM D 2435

Client	Civil & Environmental Consultant	Boring	TPE-18
Client Project	091-867 Apex Landfill Expansion	Depth	12'-14'
Project No.	30598	Sample	ST-1
		Lab Sample No.	30598012

Visual Description: Yellowish Brown Sandy Lean Clay
Sample Conditions: Undisturbed, Inundated, and Double Drained
Machine Deflection Correction: Applied

SAMPLE PROPERTIES			*TEST DATA SUMMARY*								
	Initial	Final	**Applied**	**Load**	**Final**	**Vertical**	**Dry**	**Void**	**a_v**	**Incremental**	
Tare Number	Z13	Z7	**Pressure**	**Duration**	**Height**	**Strain**	**Density**	**Ratio**		**C_c**	**C_r**
Wt. Tare & WS, gm	241.96	279.74	**tsf**	**min**	**in**	**%**	**g/cc**	**e**	**ft^2/ton**		
Wt. Tare & DS, gm	220.12	253.3	Seating	NA	1.0040	0.00	1.6443	0.6846	NA	NA	NA
Wt. Tare, gm	122.82	123.07	0.25	24	1.0013	0.27%	1.6488	0.6800	1.85E-02	NA	NA
Water Content, %	22.4%	20.3%	0.5	190	0.9970	0.70%	1.6558	0.6729	2.85E-02	0.024	NA
			1	60	0.9903	1.37%	1.6671	0.6616	2.27E-02	0.038	NA
Sample Diameter, in	2.5	2.5	2	302	0.9782	2.57%	1.6877	0.6413	2.03E-02	0.067	NA
Sample Height, in	1.004	0.9083	4	151	0.9602	4.37%	1.7194	0.6111	1.51E-02	0.100	NA
Sample Volume, in^3	4.9284	4.4584	1	120	0.9674	3.65%	1.7066	0.6232	4.03E-03	NA	NA
Wt. WS + Ring, gm	276.25	271.01	0.25	240	0.9757	2.82%	1.6920	0.6371	1.86E-02	NA	NA
Wt. of Ring, gm	113.65	113.65	0.5	302	0.9747	2.92%	1.6937	0.6355	6.38E-03	NA	0.005
Wt. of WS, gm	162.6	157.36	1	758	0.9718	3.21%	1.6987	0.6306	9.73E-03	NA	0.016
Wet Density, pcf	125.63	134.40	2	240	0.9664	3.75%	1.7082	0.6216	9.06E-03	NA	0.030
Wet Density, g/cc	2.013	2.154	4	151	0.9573	4.66%	1.7246	0.6062	7.68E-03	NA	0.051
Water Content, %	22.4%	20.3%	8	955	0.9347	6.90%	1.7662	0.5684	9.46E-03	0.126	NA
Wt. of DS, gm	132.79	130.80	16	190	0.9083	9.54%	1.8176	0.5240	5.55E-03	0.147	NA
Dry Density, pcf	102.60	111.72									
Dry Density, g/cc	1.644	1.790									
Void Ratio, e	0.6846	0.5472									
Saturation, %	90.8%		*Note: The calculations performed and the parameters presented herein are for preliminary purposes only. GTS only accepts responsibility for the raw data obtained from the consolidation tests. This data may be interpreted differently by others. It is the responsibility of the user to determine the appropriateness and accuracy of the computed values.*								
Specific Gravity	2.77	Measured									
Height of Solids, in	0.5960	0.5960									

Input Validation | Reviewed By: | Date Tested: 12/13/2010 |

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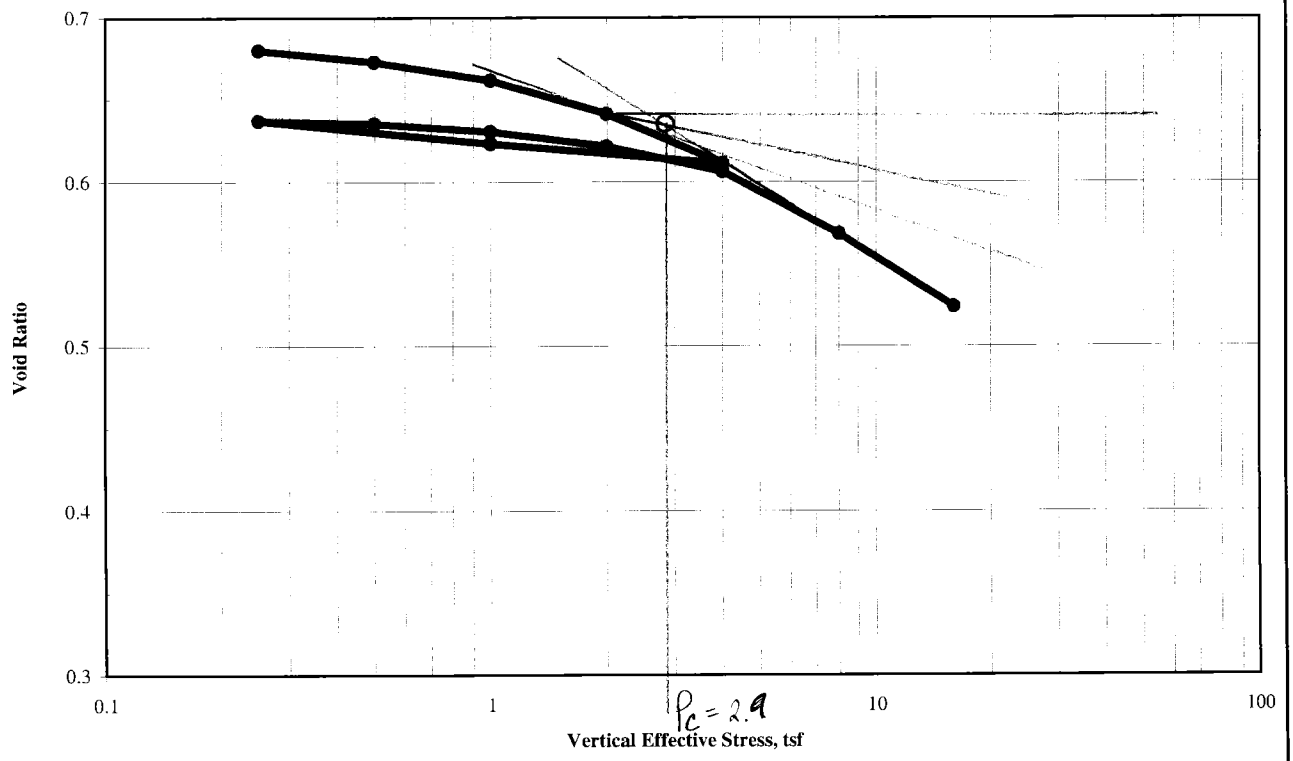
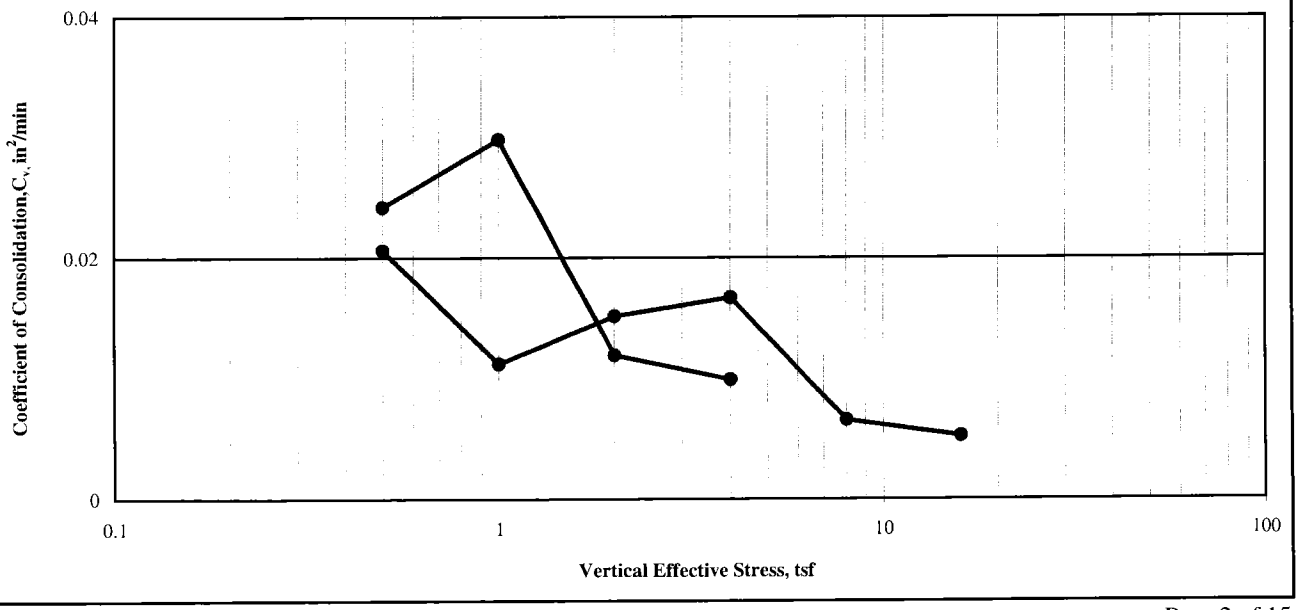
ONE-DIMENSIONAL CONSOLIDATION PROPERTIES OF SOILS
ASTM D 2435

Client	Civil & Environmental Consultants, Inc.	Boring	TPE-18
Client Project	091-867 Apex Landfill Expansion	Depth	12'-14'
Project No.	30598	Sample	ST-1
		Lab Sample No.	30598012
Visual Description	Yellowish Brown Sandy Lean Clay		
Sample Conditions	Undisturbed, Inundated, and Double Drained		
Machine Deflection Correction:	Applied		

Void Ratio (Final Height) vs Vertical Effective Consolidation Stress



Coeffieicent of Consolidation (log. method) vs. Vertical Effective Consolidation Stress



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ONE-DIMENSIONAL CONSOLIDATION PROPERTIES OF SOILS
ASTM D 2435

Client	Civil & Environmental Consultant	Boring	TPE-18	**Test Load, tsf**	**0-0.25**
Client Project	091-867 Apex Landfill Expansion	Depth	12'-14'		Load 1 of 13
Project No.	30598	Sample	ST-1		
		Lab ID#	30598012		
Visual Description	Yellowish Brown Sandy Lean Clay				
Test Conditions:	Undisturbed, Inundated, and Double Drained				

Time Vs. Dial Reading

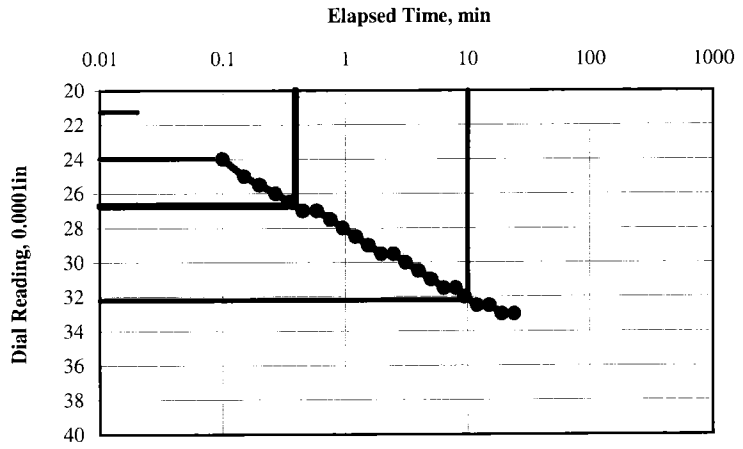
Elapsed Time (min)	Sqrt Time ($min^{1/2}$)	Dial Reading (0.0001in)	Sample Height (in)	Void Ratio
0	0	0	1.0040	0.6846
Corrections*		-5.5	-0.00055	-0.0009
Adjusted Sample Height & Void Ratio				
0.10	0.32	24.0	1.0022	0.6815
0.15	0.39	25.0	1.0021	0.6814
0.20	0.45	25.5	1.0020	0.6813
0.27	0.52	26.0	1.0020	0.6812
0.35	0.59	26.5	1.0019	0.6811
0.45	0.67	27.0	1.0019	0.6810
0.58	0.76	27.0	1.0019	0.6810
0.75	0.87	27.5	1.0018	0.6810
0.95	0.97	28.0	1.0018	0.6809
1.22	1.10	28.5	1.0017	0.6808
1.53	1.24	29.0	1.0017	0.6807
1.95	1.40	29.5	1.0016	0.6806
2.47	1.57	29.5	1.0016	0.6806
3.12	1.77	30.0	1.0016	0.6805
3.95	1.99	30.5	1.0015	0.6805
4.98	2.23	31.0	1.0015	0.6804
6.30	2.51	31.5	1.0014	0.6803
7.95	2.82	31.5	1.0014	0.6803
9.40	3.07	32.0	1.0014	0.6802
→ 11.85	3.44	32.5	1.0013	0.6801
14.95	3.87	32.5	1.0013	0.6801
18.85	4.34	33.0	1.0013	0.6800
→ 23.77	4.88	33.0	1.0013	0.6800

Machine Deflection

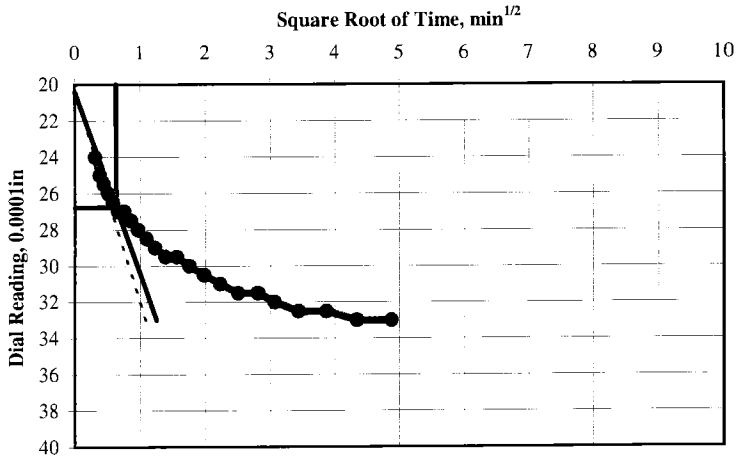
Applied Deflection Correction to Sample Height, 0.0001in: -5.5

**Correction is applied to all dial readings.*

Log of Elapsed Time vs. Dial Reading



Square Root of Elapsed Time vs. Dial Reading



Sqrt. of Elapsed Time vs Dial Reading

T0 = 0 min.	D0 = 20.4 div.		
T90 = 0.397 min	D90 = 26.8 div.		
T100 = NA min	D100 = 27.5 div.		
Height at: D90 = 1.0019, D100 = 1.0018			
Average Sample Height, in	1.0026		
Average Drainage Height, in	0.5013		
T (Time Factor for T90)	0.848		
Coef. of Consol., C_v, in^2/min	0.530		

Log of Elapsed Time vs Dial Reading

T0 = 0 min.	D0 = 21.2 div.		
T50 = 0.39 min.	D50 = 26.7 div.		
T100 = 10.02 min.	D100 = 32.2 div.		
Height at: D50 = 1.0019, D100 = 1.0013			
Average Sample Height, in	1.0026		
Average Drainage Height, in	0.5013		
T (Time Factor for T50)	0.197		
Coef. of Consol., C_v, in^2/min	0.127		

Load Summary

Initial Sample Height, in	1.0040
Initial Sample Void Ratio	0.6846
Final Sample Height, in	1.0013
Final Sample Void Ratio	0.6800
Incremental Strain, %	0.27%
Loading Duration, min	23.766667

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ONE-DIMENSIONAL CONSOLIDATION PROPERTIES OF SOILS
ASTM D 2435

Client	Civil & Environmental Consultant	Boring	TPE-18	**Test Load, tsf 0.25-0.5**
Client Project	091-867 Apex Landfill Expansion	Depth	12'-14'	Load 2 of 13
Project No.	30598	Sample	ST-1	
		Lab ID#	30598012	
Visual Description	Yellowish Brown Sandy Lean Clay			
Test Conditions:	Undisturbed, Inundated, and Double Drained			

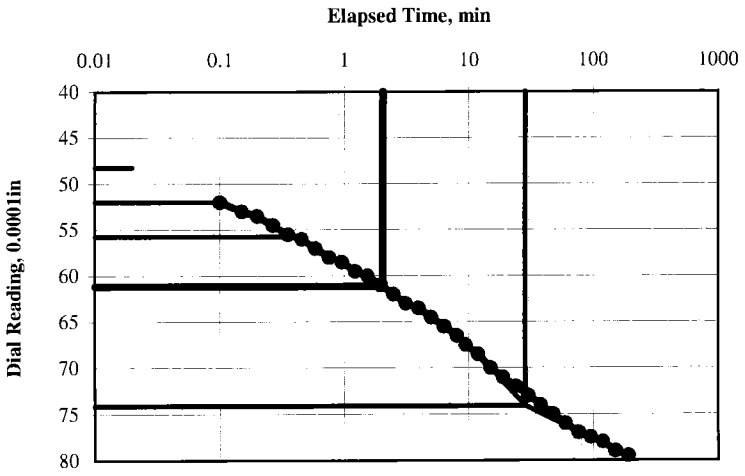
Time Vs. Dial Reading				
Elapsed Time (min)	**Sqrt Time ($min^{1/2}$)**	**Dial Reading (0.0001in)**	**Sample Height (in)**	**Void Ratio**
0	0	33.0	1.0013	0.6800
Corrections*		-4	-0.0004	-0.0007
Adjusted Sample Height & Void Ratio				
0.10	0.32	52.0	0.9998	0.6775
0.15	0.39	53.0	0.9997	0.6773
0.20	0.45	53.5	0.9996	0.6773
0.27	0.52	54.5	0.9995	0.6771
0.35	0.59	55.5	0.9994	0.6769
0.45	0.67	56.0	0.9994	0.6768
0.58	0.76	57.0	0.9993	0.6767
0.75	0.87	58.0	0.9992	0.6765
0.95	0.97	58.5	0.9991	0.6764
1.22	1.10	59.5	0.9990	0.6763
1.53	1.24	60.0	0.9990	0.6762
1.95	1.40	61.0	0.9989	0.6760
2.47	1.57	62.0	0.9988	0.6758
3.12	1.77	63.0	0.9987	0.6757
3.95	1.99	63.5	0.9986	0.6756
4.98	2.23	64.5	0.9985	0.6754
6.30	2.51	65.5	0.9984	0.6752
7.95	2.82	66.5	0.9983	0.6751
9.40	3.07	67.5	0.9982	0.6749
11.85	3.44	68.5	0.9981	0.6747
14.95	3.87	70.0	0.9980	0.6745
18.85	4.34	71.0	0.9979	0.6743
23.77	4.88	72.0	0.9978	0.6742
29.95	5.47	73.0	0.9977	0.6740
37.75	6.14	74.0	0.9976	0.6738
47.57	6.90	75.0	0.9975	0.6737
59.95	7.74	76.0	0.9974	0.6735
75.95	8.71	77.0	0.9973	0.6733
94.95	9.74	77.5	0.9972	0.6732
119.95	10.95	78.0	0.9972	0.6732
150.95	12.29	79.0	0.9971	0.6730
189.95	13.78	79.5	0.9970	0.6729

Machine Deflection

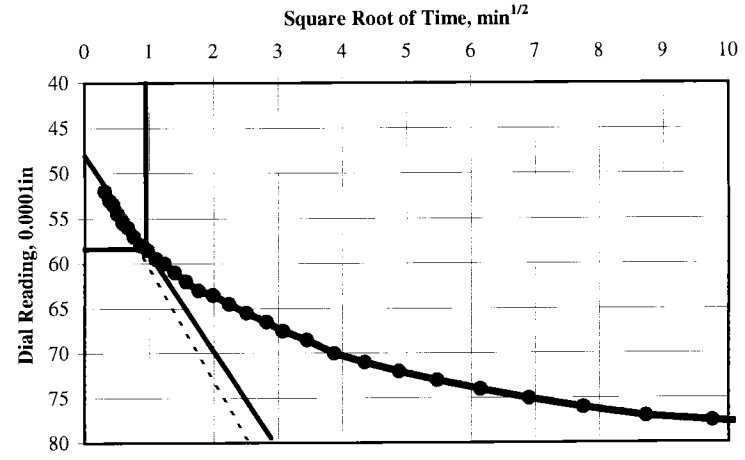
Applied Deflection Correction to Sample Height, 0.0001in -4

**Correction is applied to all dial readings.*

Log of Elapsed Time vs. Dial Reading



Square Root of Elapsed Time vs. Dial Reading



Sqrt. of Elapsed Time vs Dial Reading			Log of Elapsed Time vs Dial Reading			Load Summary	
T0 = 0 min.	D0 = 48 div.		T0 = 0 min.	D0 = 48.2 div.			
T90 = 0.903 min	D90 = 58.4 div.		T50 = 2.03 min.	D50 = 61.2 div.		Initial Sample Height, in	1.0013
T100 = NA min	D100 = 59.5 div.		T100 = 28.26 min.	D100 = 74.1 div.		Initial Sample Void Ratio	0.6800
Height at: D90 = 0.9991, D100 = 0.999			Height at: D50 = 0.9988, D100 = 0.9975			Final Sample Height, in	0.9970
Average Sample Height, in		0.9991	Average Sample Height, in		0.9991	Final Sample Void Ratio	0.6729
Average Drainage Height, in		0.4996	Average Drainage Height, in		0.4996	Incremental Strain, %	0.42%
T (Time Factor for T90)		0.848	T (Time Factor for T50)		0.197	Loading Duration, min	189.95
Coef. of Consol., C_v, in^2/min		0.235	Coef. of Consol., C_v, in^2/min		0.024		

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ONE-DIMENSIONAL CONSOLIDATION PROPERTIES OF SOILS
ASTM D 2435

Client	Civil & Environmental Consultant	Boring	TPE-18	**Test Load, tsf**	**0.5-1**
Client Project	091-867 Apex Landfill Expansion	Depth	12'-14'		Load 3 of 13
Project No.	30598	Sample	ST-1		
		Lab ID#	30598012		

Visual Description: Yellowish Brown Sandy Lean Clay
Test Conditions: Undisturbed, Inundated, and Double Drained

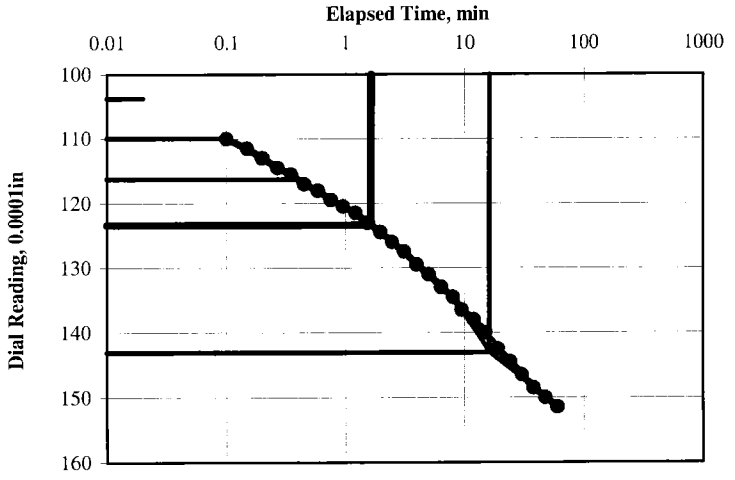
Time Vs. Dial Reading

Elapsed Time (min)	Sqrt Time ($min^{1/2}$)	Dial Reading (0.0001in)	Sample Height (in)	Void Ratio
0	0	79.5	0.9970	0.6729
Corrections*		-4.5	-0.00045	-0.0008
Adjusted Sample Height & Void Ratio				
0.10	0.32	110.0	0.9944	0.6685
0.15	0.39	111.5	0.9943	0.6683
0.20	0.45	113.0	0.9941	0.6680
0.27	0.52	114.5	0.9940	0.6678
0.35	0.59	115.5	0.9939	0.6676
0.45	0.67	117.0	0.9937	0.6674
0.58	0.76	118.0	0.9936	0.6672
0.75	0.87	119.5	0.9935	0.6669
0.95	0.97	120.5	0.9934	0.6668
1.22	1.10	121.5	0.9933	0.6666
1.53	1.24	123.0	0.9931	0.6664
1.95	1.40	124.5	0.9930	0.6661
2.47	1.57	126.0	0.9928	0.6659
3.12	1.77	127.5	0.9927	0.6656
3.95	1.99	129.5	0.9925	0.6653
4.98	2.23	131.0	0.9923	0.6650
6.30	2.51	133.0	0.9921	0.6647
7.95	2.82	134.5	0.9920	0.6644
9.40	3.07	136.5	0.9918	0.6641
11.85	3.44	138.0	0.9916	0.6638
14.95	3.87	140.0	0.9914	0.6635
→ 18.85	4.34	142.5	0.9912	0.6631
23.77	4.88	144.5	0.9910	0.6627
29.95	5.47	146.5	0.9908	0.6624
37.75	6.14	148.5	0.9906	0.6621
47.57	6.90	150.0	0.9904	0.6618
→ 59.95	7.74	151.5	0.9903	0.6616

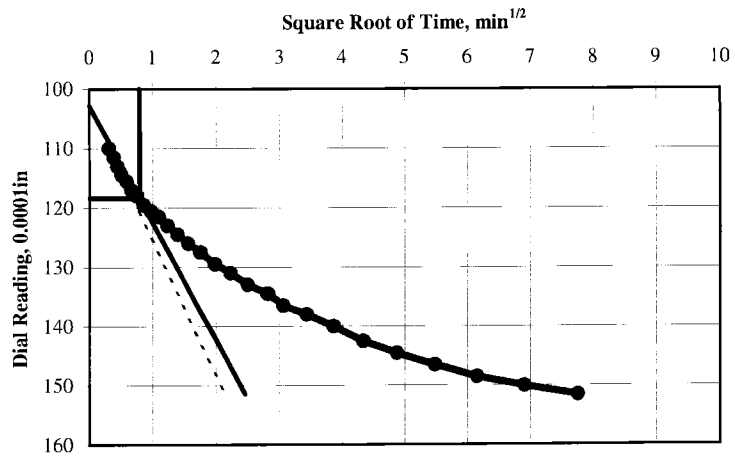
Machine Deflection

Applied Deflection Correction to Sample Height, 0.0001in: -4.5
**Correction is applied to all dial readings.*

Log of Elapsed Time vs. Dial Reading



Square Root of Elapsed Time vs. Dial Reading



Sqrt. of Elapsed Time vs Dial Reading		Log of Elapsed Time vs Dial Reading		Load Summary	
T0 = 0 min.	D0 = 102.8 div.	T0 = 0 min.	D0 = 103.7 div.		
T90 = 0.624 min	D90 = 118.4 div.	T50 = 1.63 min.	D50 = 123.4 div.	Initial Sample Height, in	0.9970
T100 = NA min	D100 = 120.1 div.	T100 = 16.25 min.	D100 = 143 div.	Initial Sample Void Ratio	0.6729
Height at: D90 = 0.9936, D100 = 0.9934		Height at: D50 = 0.9931, D100 = 0.9911		Final Sample Height, in	0.9903
Average Sample Height, in	0.9936	Average Sample Height, in	0.9936	Final Sample Void Ratio	0.6616
Average Drainage Height, in	0.4968	Average Drainage Height, in	0.4968	Incremental Strain, %	0.68%
T (Time Factor for T90)	0.848	T (Time Factor for T50)	0.197	Loading Duration, min	59.95
Coef. of Consol., C_v, in^2/min	0.335	Coef. of Consol., C_v, in^2/min	0.030		

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ONE-DIMENSIONAL CONSOLIDATION PROPERTIES OF SOILS
ASTM D 2435

Client	Civil & Environmental Consultant	Boring	TPE-18	**Test Load, tsf**	**1-2**
Client Project	091-867 Apex Landfill Expansion	Depth	12'-14'		Load 4 of 13
Project No.	30598	Sample	ST-1		
		Lab ID#	30598012		

Visual Description: Yellowish Brown Sandy Lean Clay
Test Conditions: Undisturbed, Inundated, and Double Drained

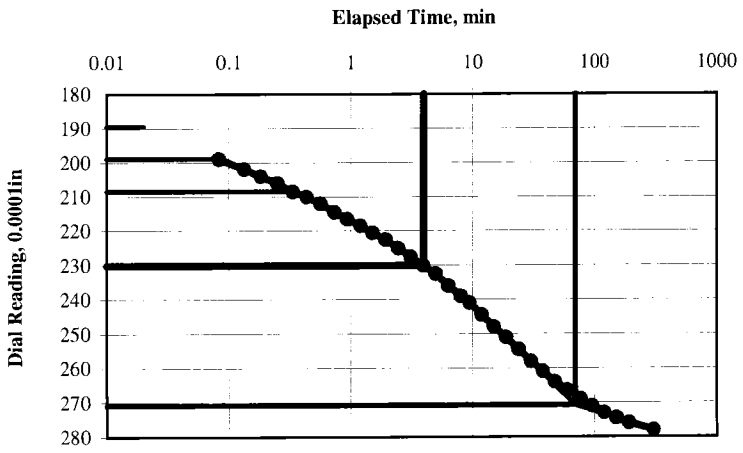
Time Vs. Dial Reading

Elapsed Time (min)	Sqrt Time ($min^{1/2}$)	Dial Reading (0.0001in)	Sample Height (in)	Void Ratio
0	0	151.5	0.9903	0.6616
Corrections*		-5.5	-0.00055	-0.0009
Adjusted Sample Height & Void Ratio				
0.08	0.29	199.0	0.9861	0.6545
0.13	0.37	202.0	0.9858	0.6540
0.18	0.43	204.0	0.9856	0.6537
0.25	0.50	206.0	0.9854	0.6534
0.33	0.58	208.5	0.9851	0.6529
0.43	0.66	210.0	0.9850	0.6527
0.57	0.75	212.0	0.9848	0.6523
0.73	0.86	214.5	0.9845	0.6519
0.93	0.97	216.5	0.9843	0.6516
1.20	1.10	218.5	0.9841	0.6513
1.52	1.23	220.5	0.9839	0.6509
1.93	1.39	222.5	0.9837	0.6506
2.45	1.57	225.0	0.9835	0.6502
3.10	1.76	227.5	0.9832	0.6497
3.93	1.98	230.0	0.9830	0.6493
4.97	2.23	232.5	0.9827	0.6489
6.28	2.51	236.0	0.9824	0.6483
7.93	2.82	239.0	0.9821	0.6478
9.38	3.06	241.0	0.9819	0.6475
11.83	3.44	244.5	0.9815	0.6469
14.93	3.86	248.0	0.9812	0.6463
18.83	4.34	251.0	0.9809	0.6458
23.75	4.87	254.5	0.9805	0.6452
29.93	5.47	258.0	0.9802	0.6446
37.73	6.14	261.0	0.9799	0.6441
47.55	6.90	264.0	0.9796	0.6436
59.93	7.74	266.5	0.9793	0.6432
75.93	8.71	269.0	0.9791	0.6428
94.93	9.74	271.0	0.9789	0.6424
119.93	10.95	273.0	0.9787	0.6421
150.93	12.29	274.5	0.9785	0.6419
189.93	13.78	276.0	0.9784	0.6416
301.93	17.38	278.0	0.9782	0.6413

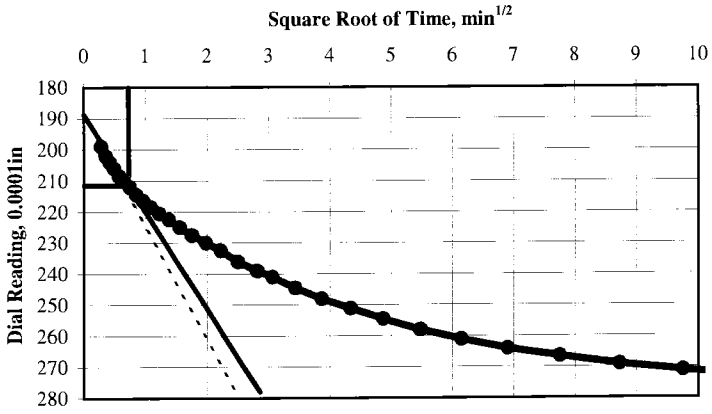
Machine Deflection

Applied Deflection Correction to Sample Height, 0.0001in: -5.5
**Correction is applied to all dial readings.*

Log of Elapsed Time vs. Dial Reading



Square Root of Elapsed Time vs. Dial Reading



Sqrt. of Elapsed Time vs Dial Reading		Log of Elapsed Time vs Dial Reading		Load Summary	
T0 = 0 min.	D0 = 188.7 div.	T0 = 0 min.	D0 = 189.5 div.		
T90 = 0.533 min	D90 = 211.5 div.	T50 = 4 min.	D50 = 230.2 div.	Initial Sample Height, in	0.9903
T100 = NA min	D100 = 214 div.	T100 = 69.99 min.	D100 = 270.8 div.	Initial Sample Void Ratio	0.6616
Height at: D90 = 0.9848, D100 = 0.9845		Height at: D50 = 0.9829, D100 = 0.9789		Final Sample Height, in	0.9782
Average Sample Height, in	0.9842	Average Sample Height, in	0.9842	Final Sample Void Ratio	0.6413
Average Drainage Height, in	0.4921	Average Drainage Height, in	0.4921	Incremental Strain, %	1.22%
T (Time Factor for T90)	0.848	T (Time Factor for T50)	0.197	Loading Duration, min	301.93333
Coef. of Consol., C_v, in^2/min	0.386	Coef. of Consol., C_v, in^2/min	0.012		

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ONE-DIMENSIONAL CONSOLIDATION PROPERTIES OF SOILS
ASTM D 2435

Client	Civil & Environmental Consultant	Boring	TPE-18	**Test Load, tsf**	**2-4**
Client Project	091-867 Apex Landfill Expansion	Depth	12'-14'		Load 5 of 13
Project No.	30598	Sample	ST-1		
		Lab ID#	30598012		
Visual Description	Yellowish Brown Sandy Lean Clay				
Test Conditions:	Undisturbed, Inundated, and Double Drained				

Time Vs. Dial Reading

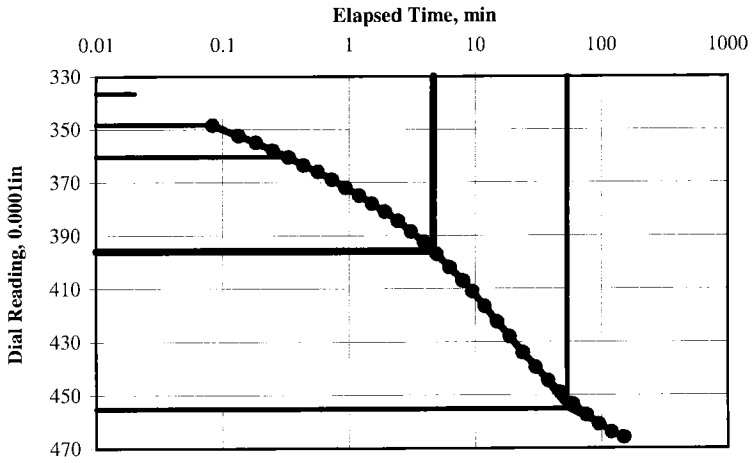
Elapsed Time (min)	Sqrt Time ($min^{1/2}$)	Dial Reading (0.0001in)	Sample Height (in)	Void Ratio
0	0	278.0	0.9782	0.6413
Corrections*		-8	-0.0008	-0.0013
Adjusted Sample Height & Void Ratio				
0.08	0.29	348.5	0.9719	0.6308
0.13	0.37	352.5	0.9715	0.6301
0.18	0.43	355.0	0.9713	0.6297
0.25	0.50	358.0	0.9710	0.6292
0.33	0.58	360.5	0.9707	0.6288
0.43	0.66	363.5	0.9704	0.6283
0.57	0.75	366.0	0.9702	0.6278
0.73	0.86	369.0	0.9699	0.6273
0.93	0.97	372.0	0.9696	0.6268
1.20	1.10	375.0	0.9693	0.6263
1.52	1.23	378.0	0.9690	0.6258
1.93	1.39	381.0	0.9687	0.6253
2.45	1.57	384.5	0.9683	0.6247
3.10	1.76	388.5	0.9679	0.6241
3.93	1.98	392.5	0.9675	0.6234
4.97	2.23	397.0	0.9671	0.6226
6.28	2.51	402.0	0.9666	0.6218
7.93	2.82	407.0	0.9661	0.6210
9.38	3.06	411.0	0.9657	0.6203
11.83	3.44	416.5	0.9651	0.6194
14.93	3.86	422.5	0.9645	0.6184
18.83	4.34	428.0	0.9640	0.6174
23.75	4.87	434.0	0.9634	0.6164
29.93	5.47	439.5	0.9628	0.6155
37.73	6.14	444.5	0.9623	0.6147
47.55	6.90	449.0	0.9619	0.6139
→ 59.93	7.74	453.5	0.9614	0.6132
75.93	8.71	457.5	0.9610	0.6125
94.93	9.74	461.0	0.9607	0.6119
119.93	10.95	464.0	0.9604	0.6114
→ 150.93	12.29	466.0	0.9602	0.6111

Machine Deflection

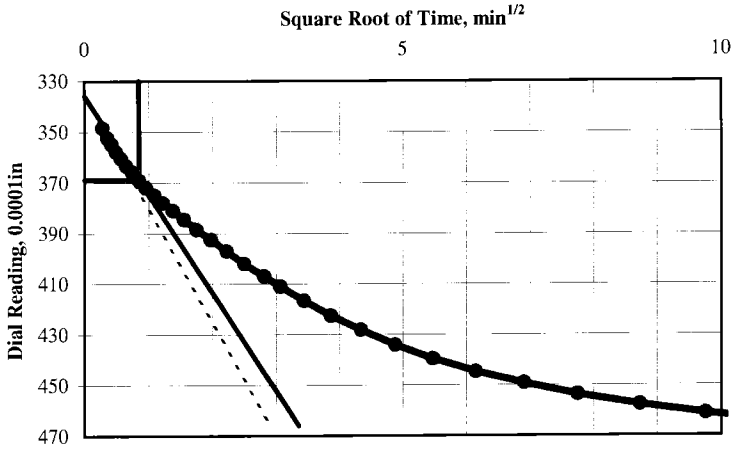
Applied Deflection Correction to Sample Height, 0.0001in: -8

**Correction is applied to all dial readings.*

Log of Elapsed Time vs. Dial Reading



Square Root of Elapsed Time vs. Dial Reading



Sqrt. of Elapsed Time vs Dial Reading		Log of Elapsed Time vs Dial Reading		Load Summary	
T0 = 0 min.	D0 = 335.9 div.	T0 = 0 min.	D0 = 336.5 div.		
T90 = 0.723 min	D90 = 368.8 div.	T50 = 4.68 min.	D50 = 395.9 div.	Initial Sample Height, in	0.9782
T100 = NA min	D100 = 372.5 div.	T100 = 53.97 min.	D100 = 455.2 div.	Initial Sample Void Ratio	0.6413
Height at: D90 = 0.9699, D100 = 0.9695		Height at: D50 = 0.9672, D100 = 0.9612		Final Sample Height, in	0.9602
Average Sample Height, in	0.9692	Average Sample Height, in	0.9692	Final Sample Void Ratio	0.6111
Average Drainage Height, in	0.4846	Average Drainage Height, in	0.4846	Incremental Strain, %	1.84%
T (Time Factor for T90)	0.848	T (Time Factor for T50)	0.197	Loading Duration, min	150.93333
Coef. of Consol., C_v, in^2/min	0.275	Coef. of Consol., C_v, in^2/min	0.010		

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ONE-DIMENSIONAL CONSOLIDATION PROPERTIES OF SOILS
ASTM D 2435

Client	Civil & Environmental Consultant	Boring	TPE-18	**Test Load, tsf**	**4-1**
Client Project	091-867 Apex Landfill Expansion	Depth	12'-14'		Load 6 of 13
Project No.	30598	Sample	ST-1		
		Lab ID#	30598012		
Visual Description	Yellowish Brown Sandy Lean Clay				
Test Conditions:	Undisturbed, Inundated, and Double Drained				

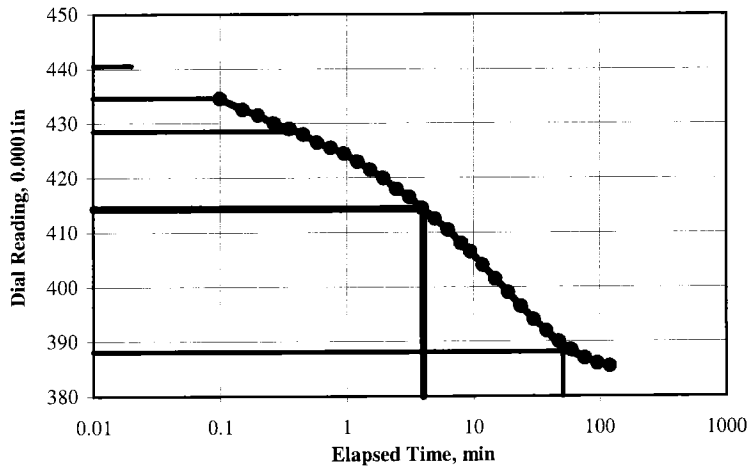
Time Vs. Dial Reading				
Elapsed Time (min)	**Sqrt Time ($min^{1/2}$)**	**Dial Reading (0.0001in)**	**Sample Height (in)**	**Void Ratio**
0	0	466.0	0.9602	0.6111
Corrections*		8.5	0.00085	0.00143
Adjusted Sample Height & Void Ratio				
0.10	0.32	434.5	0.9625	0.6149
0.15	0.39	432.5	0.9627	0.6153
0.20	0.45	431.5	0.9628	0.6154
0.27	0.52	430.0	0.9629	0.6157
0.35	0.59	429.0	0.9630	0.6159
0.45	0.67	428.0	0.9631	0.6160
0.58	0.76	426.5	0.9633	0.6163
0.75	0.87	425.5	0.9634	0.6164
0.95	0.97	424.5	0.9635	0.6166
1.22	1.10	423.0	0.9636	0.6169
1.53	1.24	421.5	0.9638	0.6171
1.95	1.40	420.0	0.9639	0.6174
2.47	1.57	418.0	0.9641	0.6177
3.12	1.77	416.5	0.9643	0.6179
3.95	1.99	414.5	0.9645	0.6183
4.98	2.23	412.5	0.9647	0.6186
6.30	2.51	410.5	0.9649	0.6190
7.95	2.82	408.0	0.9651	0.6194
9.40	3.07	406.5	0.9653	0.6196
11.85	3.44	404.0	0.9655	0.6200
14.95	3.87	401.5	0.9658	0.6205
18.85	4.34	399.0	0.9660	0.6209
23.77	4.88	396.5	0.9663	0.6213
29.95	5.47	394.0	0.9665	0.6217
37.75	6.14	392.0	0.9667	0.6221
47.57	6.90	390.0	0.9669	0.6224
59.95	7.74	388.5	0.9671	0.6226
75.95	8.71	387.0	0.9672	0.6229
94.95	9.74	386.0	0.9673	0.6231
119.95	10.95	385.5	0.9674	0.6232

Machine Deflection

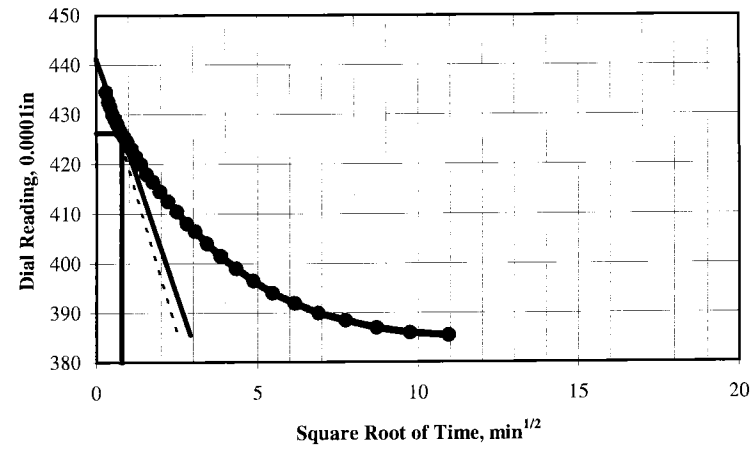
Applied Deflection Correction to Sample Height, 0.0001in 8.5

**Correction is applied to all dial readings.*

Log of Elapsed Time vs. Dial Reading



Square Root of Elapsed Time vs. Dial Reading



Sqrt. of Elapsed Time vs Dial Reading		Log of Elapsed Time vs Dial Reading		Load Summary	
T0 = 0 min.	D0 = 441.3 div.	T0 = 0 min.	D0 = 440.5 div.		
T90 = 0.608 min	D90 = 426.3 div.	T50 = 4.04 min.	D50 = 414.3 div.	Initial Sample Height, in	0.9602
T100 = NA min	D100 = 424.6 div.	T100 = 51.73 min.	D100 = 388.1 div.	Initial Sample Void Ratio	0.6111
Height at: D90 = 0.9633, D100 = 0.9634		Height at: D50 = 0.9645, D100 = 0.9671		Final Sample Height, in	0.9674
Average Sample Height, in	0.9638	Average Sample Height, in	0.9638	Final Sample Void Ratio	0.6232
Average Drainage Height, in	0.4819	Average Drainage Height, in	0.4819	Incremental Strain, %	-0.75%
T (Time Factor for T90)	0.848	T (Time Factor for T50)	0.197	Loading Duration, min	119.95
Coef. of Consol., C_v, in^2/min	0.321	Coef. of Consol., C_v, in^2/min	0.011		

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ONE-DIMENSIONAL CONSOLIDATION PROPERTIES OF SOILS
ASTM D 2435

Client	Civil & Environmental Consultant	Boring	TPE-18	**Test Load, tsf**	**1-0.25**
Client Project	091-867 Apex Landfill Expansion	Depth	12'-14'		Load 7 of 13
Project No.	30598	Sample	ST-1		
		Lab ID#	30598012		
Visual Description	Yellowish Brown Sandy Lean Clay				
Test Conditions:	Undisturbed, Inundated, and Double Drained				

Time Vs. Dial Reading

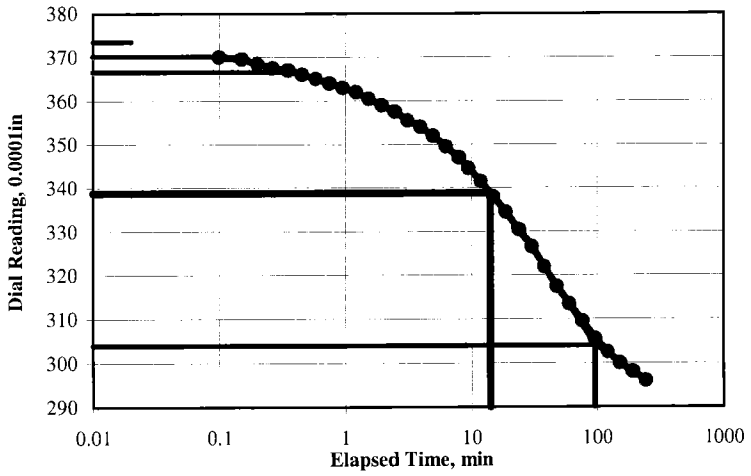
Elapsed Time (min)	Sqrt Time ($min^{1/2}$)	Dial Reading (0.0001in)	Sample Height (in)	Void Ratio
0	0	385.5	0.9674	0.6232
Corrections*		6.5	0.00065	0.00109
Adjusted Sample Height & Void Ratio				
0.10	0.32	370.0	0.9683	0.6247
0.15	0.39	369.5	0.9683	0.6247
0.20	0.45	368.5	0.9684	0.6249
0.27	0.52	367.5	0.9685	0.6251
0.35	0.59	367.0	0.9686	0.6252
0.45	0.67	366.0	0.9687	0.6253
0.58	0.76	365.0	0.9688	0.6255
0.75	0.87	364.0	0.9689	0.6257
0.95	0.97	363.0	0.9690	0.6258
1.22	1.10	362.0	0.9691	0.6260
1.53	1.24	360.5	0.9692	0.6263
1.95	1.40	359.0	0.9694	0.6265
2.47	1.57	357.5	0.9695	0.6268
3.12	1.77	355.5	0.9697	0.6271
3.95	1.99	354.0	0.9699	0.6273
4.98	2.23	352.0	0.9701	0.6277
6.30	2.51	349.5	0.9703	0.6281
7.95	2.82	347.0	0.9706	0.6285
9.40	3.07	344.5	0.9708	0.6289
11.85	3.44	341.5	0.9711	0.6294
14.95	3.87	338.0	0.9715	0.6300
18.85	4.34	334.5	0.9718	0.6306
23.77	4.88	330.5	0.9722	0.6313
29.95	5.47	326.5	0.9726	0.6320
37.75	6.14	322.0	0.9731	0.6327
47.57	6.90	317.5	0.9735	0.6335
59.95	7.74	313.5	0.9739	0.6341
75.95	8.71	309.5	0.9743	0.6348
94.95	9.74	305.5	0.9747	0.6355
119.95	10.95	302.5	0.9750	0.6360
150.95	12.29	300.0	0.9753	0.6364
189.95	13.78	298.0	0.9755	0.6367
239.95	15.49	296.0	0.9757	0.6371

Machine Deflection

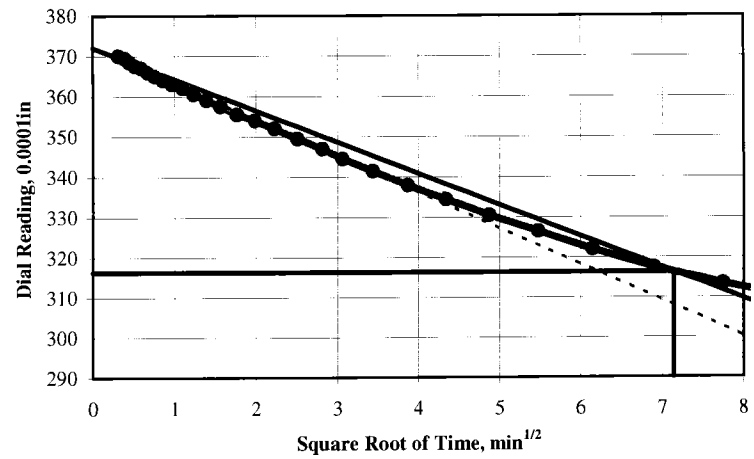
Applied Deflection Correction to Sample Height, 0.0001in 6.5

**Correction is applied to all dial readings.*

Log of Elapsed Time vs. Dial Reading



Square Root of Elapsed Time vs. Dial Reading



Sqrt. of Elapsed Time vs Dial Reading

T0 = 0 min.	D0 = 372.1 div.
T90 = 50.98 min	D90 = 316.3 div.
T100 = NA min	D100 = 310.1 div.
Height at: D90 = 0.9736, D100 = 0.9742	
Average Sample Height, in	0.9715
Average Drainage Height, in	0.4858
T (Time Factor for T90)	0.848
Coef. of Consol., C_v, in^2/min	0.004

Log of Elapsed Time vs Dial Reading

T0 = 0 min.	D0 = 373.5 div.
T50 = 14.23 min.	D50 = 338.7 div.
T100 = 95.4 min.	D100 = 304 div.
Height at: D50 = 0.9714, D100 = 0.9749	
Average Sample Height, in	0.9715
Average Drainage Height, in	0.4858
T (Time Factor for T50)	0.197
Coef. of Consol., C_v, in^2/min	0.003

Load Summary

Initial Sample Height, in	0.9674
Initial Sample Void Ratio	0.6232
Final Sample Height, in	0.9757
Final Sample Void Ratio	0.6371
Incremental Strain, %	-0.86%
Loading Duration, min	239.95

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ONE-DIMENSIONAL CONSOLIDATION PROPERTIES OF SOILS
ASTM D 2435

Client	Civil & Environmental Consultant	Boring	TPE-18	**Test Load, tsf**	**0.25-0.5**
Client Project	091-867 Apex Landfill Expansion	Depth	12'-14'		Load 8 of 13
Project No.	30598	Sample	ST-1		
		Lab ID#	30598012		

Visual Description: Yellowish Brown Sandy Lean Clay
Test Conditions: Undisturbed, Inundated, and Double Drained

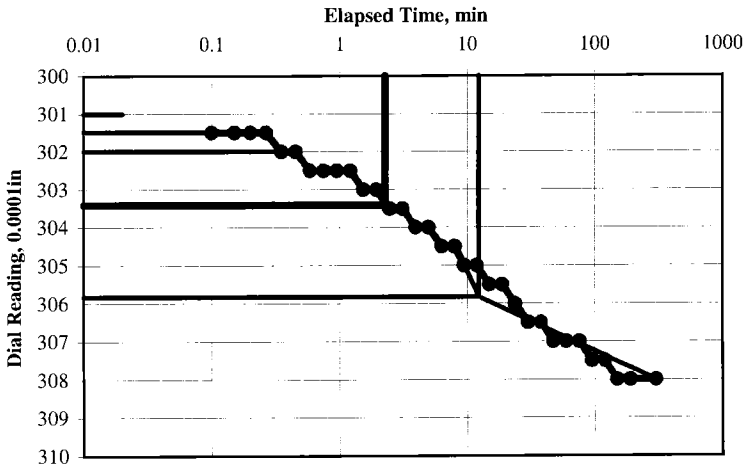
Time Vs. Dial Reading

Elapsed Time (min)	Sqrt Time ($min^{1/2}$)	Dial Reading (0.0001in)	Sample Height (in)	Void Ratio
0	0	296.0	0.9757	0.6371
Corrections*		-2.5	-0.00025	-0.0004
Adjusted Sample Height & Void Ratio				
0.10	0.32	301.5	0.9754	0.6366
0.15	0.39	301.5	0.9754	0.6366
0.20	0.45	301.5	0.9754	0.6366
0.27	0.52	301.5	0.9754	0.6366
0.35	0.59	302.0	0.9753	0.6365
0.45	0.67	302.0	0.9753	0.6365
0.58	0.76	302.5	0.9753	0.6364
0.75	0.87	302.5	0.9753	0.6364
0.95	0.97	302.5	0.9753	0.6364
1.22	1.10	302.5	0.9753	0.6364
1.53	1.24	303.0	0.9752	0.6363
1.95	1.40	303.0	0.9752	0.6363
2.47	1.57	303.5	0.9752	0.6362
3.12	1.77	303.5	0.9752	0.6362
3.95	1.99	304.0	0.9751	0.6362
4.98	2.23	304.0	0.9751	0.6362
6.30	2.51	304.5	0.9751	0.6361
7.95	2.82	304.5	0.9751	0.6361
9.40	3.07	305.0	0.9750	0.6360
11.85	3.44	305.0	0.9750	0.6360
14.95	3.87	305.5	0.9750	0.6359
18.85	4.34	305.5	0.9750	0.6359
23.77	4.88	306.0	0.9749	0.6358
29.95	5.47	306.5	0.9749	0.6357
37.75	6.14	306.5	0.9749	0.6357
47.57	6.90	307.0	0.9748	0.6357
59.95	7.74	307.0	0.9748	0.6357
75.95	8.71	307.0	0.9748	0.6357
94.95	9.74	307.5	0.9748	0.6356
119.95	10.95	307.5	0.9748	0.6356
150.95	12.29	308.0	0.9747	0.6355
189.95	13.78	308.0	0.9747	0.6355
301.95	17.38	308.0	0.9747	0.6355

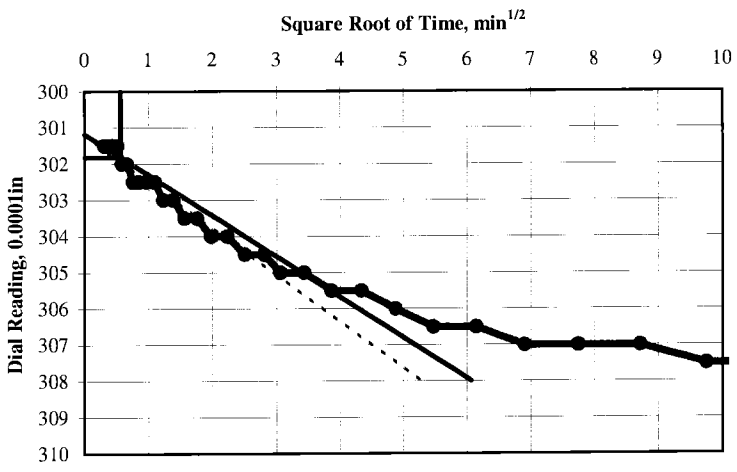
Machine Deflection

Applied Deflection Correction to Sample Height, 0.0001in: -2.5
**Correction is applied to all dial readings.*

Log of Elapsed Time vs. Dial Reading



Square Root of Elapsed Time vs. Dial Reading



Sqrt. of Elapsed Time vs Dial Reading

T0 = 0 min.	D0 = 301.2 div.		
T90 = 0.314 min	D90 = 301.8 div.		
T100 = NA min	D100 = 301.9 div.		
Height at: D90 = 0.9753, D100 = 0.9753			
Average Sample Height, in	0.9752		
Average Drainage Height, in	0.4876		
T (Time Factor for T90)	0.848		
Coef. of Consol., C_v, in^2/min	0.636		

Log of Elapsed Time vs Dial Reading

T0 = 0 min.	D0 = 301 div.		
T50 = 2.27 min.	D50 = 303.4 div.		
T100 = 12.38 min.	D100 = 305.8 div.		
Height at: D50 = 0.9752, D100 = 0.9749			
Average Sample Height, in	0.9752		
Average Drainage Height, in	0.4876		
T (Time Factor for T50)	0.197		
Coef. of Consol., C_v, in^2/min	0.021		

Load Summary

Initial Sample Height, in	0.9757
Initial Sample Void Ratio	0.6371
Final Sample Height, in	0.9747
Final Sample Void Ratio	0.6355
Incremental Strain, %	0.10%
Loading Duration, min	301.95

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ONE-DIMENSIONAL CONSOLIDATION PROPERTIES OF SOILS
ASTM D 2435

Client	Civil & Environmental Consultant	Boring	TPE-18	**Test Load, tsf**	**0.5-1**
Client Project	091-867 Apex Landfill Expansion	Depth	12'-14'		Load 9 of 13
Project No.	30598	Sample	ST-1		
		Lab ID#	30598012		

Visual Description: Yellowish Brown Sandy Lean Clay
Test Conditions: Undisturbed, Inundated, and Double Drained

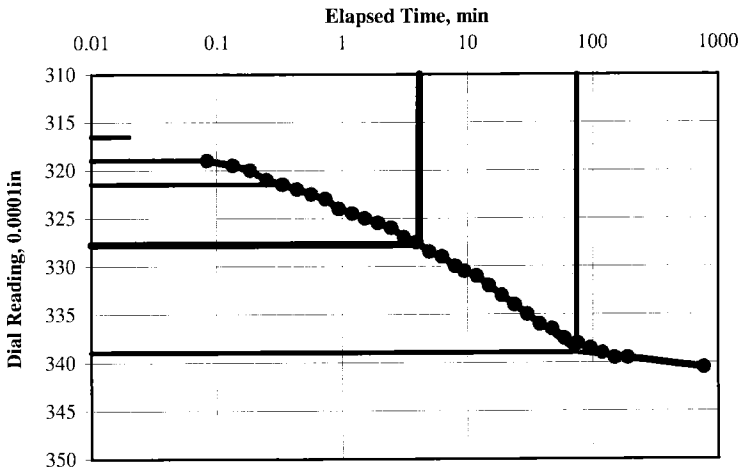
Time Vs. Dial Reading

Elapsed Time (min)	Sqrt Time ($min^{1/2}$)	Dial Reading (0.0001in)	Sample Height (in)	Void Ratio
0	0	308.0	0.9747	0.6355
Corrections*		-3.5	-0.00035	-0.0006
Adjusted Sample Height & Void Ratio				
0.08	0.29	319.0	0.9740	0.6342
0.13	0.37	319.5	0.9739	0.6341
0.18	0.43	320.0	0.9739	0.6341
0.25	0.50	321.0	0.9738	0.6339
0.33	0.58	321.5	0.9737	0.6338
0.43	0.66	322.0	0.9737	0.6337
0.57	0.75	322.5	0.9736	0.6336
0.73	0.86	323.0	0.9736	0.6336
0.93	0.97	324.0	0.9735	0.6334
1.20	1.10	324.5	0.9734	0.6333
1.52	1.23	325.0	0.9734	0.6332
1.93	1.39	325.5	0.9733	0.6331
2.45	1.57	326.0	0.9733	0.6330
3.10	1.76	327.0	0.9732	0.6329
3.93	1.98	327.5	0.9731	0.6328
4.97	2.23	328.5	0.9730	0.6326
6.28	2.51	329.0	0.9730	0.6325
7.93	2.82	330.0	0.9729	0.6324
9.38	3.06	330.5	0.9728	0.6323
11.83	3.44	331.0	0.9728	0.6322
14.93	3.86	332.0	0.9727	0.6320
18.83	4.34	333.0	0.9726	0.6319
23.75	4.87	334.0	0.9725	0.6317
29.93	5.47	335.0	0.9724	0.6315
37.73	6.14	336.0	0.9723	0.6314
47.55	6.90	336.5	0.9722	0.6313
59.93	7.74	337.5	0.9721	0.6311
75.93	8.71	338.0	0.9721	0.6310
94.93	9.74	338.5	0.9720	0.6310
119.93	10.95	339.0	0.9720	0.6309
150.93	12.29	339.5	0.9719	0.6308
189.93	13.78	339.5	0.9719	0.6308
757.93	27.53	340.5	0.9718	0.6306

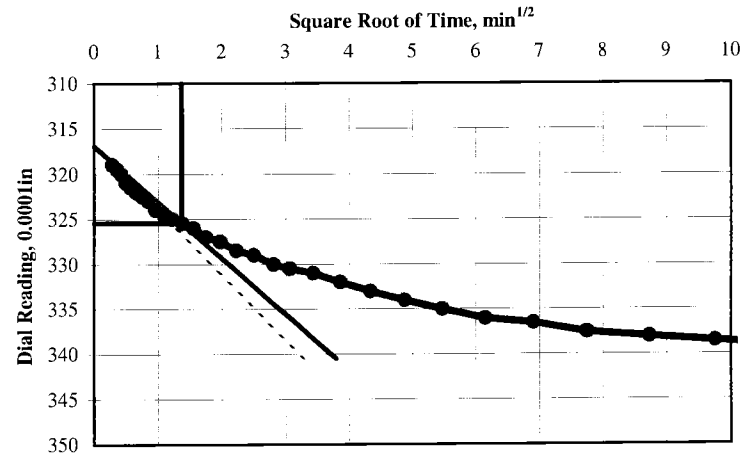
Machine Deflection

Applied Deflection Correction to Sample Height, 0.0001in: -3.5
**Correction is applied to all dial readings.*

Log of Elapsed Time vs. Dial Reading



Square Root of Elapsed Time vs. Dial Reading



Sqrt. of Elapsed Time vs Dial Reading

T0 = 0 min.	D0 = 316.9 div.
T90 = 1.877 min	D90 = 325.4 div.
T100 = NA min	D100 = 326.4 div.
Height at: D90 = 0.9733, D100 = 0.9732	
Average Sample Height, in	0.9733
Average Drainage Height, in	0.4866
T (Time Factor for T90)	0.848
Coef. of Consol., C_v, in^2/min	0.107

Log of Elapsed Time vs Dial Reading

T0 = 0 min.	D0 = 316.5 div.
T50 = 4.16 min.	D50 = 327.7 div.
T100 = 75.05 min.	D100 = 339 div.
Height at: D50 = 0.9731, D100 = 0.972	
Average Sample Height, in	0.9733
Average Drainage Height, in	0.4866
T (Time Factor for T50)	0.197
Coef. of Consol., C_v, in^2/min	0.011

Load Summary

Initial Sample Height, in	0.9747
Initial Sample Void Ratio	0.6355
Final Sample Height, in	0.9718
Final Sample Void Ratio	0.6306
Incremental Strain, %	0.30%
Loading Duration, min	757.93333

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ONE-DIMENSIONAL CONSOLIDATION PROPERTIES OF SOILS
ASTM D 2435

Client	Civil & Environmental Consultant	Boring	TPE-18	**Test Load, tsf**	**1-2**
Client Project	091-867 Apex Landfill Expansion	Depth	12'-14'		Load 10 of 13
Project No.	30598	Sample	ST-1		
		Lab ID#	30598012		

Visual Description: Yellowish Brown Sandy Lean Clay
Test Conditions: Undisturbed, Inundated, and Double Drained

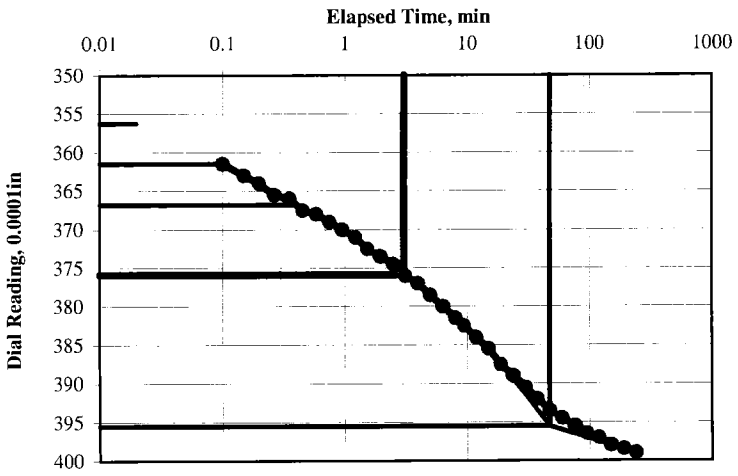
Time Vs. Dial Reading

Elapsed Time (min)	Sqrt Time ($min^{1/2}$)	Dial Reading (0.0001in)	Sample Height (in)	Void Ratio
0	0	340.5	0.9718	0.6306
Corrections*		-4.5	-0.00045	-0.0008
Adjusted Sample Height & Void Ratio				
0.10	0.32	361.5	0.9702	0.6278
0.15	0.39	363.0	0.9700	0.6276
0.20	0.45	364.0	0.9699	0.6274
0.27	0.52	365.5	0.9698	0.6272
0.35	0.59	366.0	0.9697	0.6271
0.45	0.67	367.5	0.9696	0.6268
0.58	0.76	368.0	0.9695	0.6268
0.75	0.87	369.0	0.9694	0.6266
0.95	0.97	370.0	0.9693	0.6264
1.22	1.10	371.0	0.9692	0.6263
1.53	1.24	372.5	0.9691	0.6260
1.95	1.40	373.5	0.9690	0.6258
2.47	1.57	374.5	0.9689	0.6257
3.12	1.77	376.0	0.9687	0.6254
3.95	1.99	377.0	0.9686	0.6252
4.98	2.23	378.5	0.9685	0.6250
6.30	2.51	380.0	0.9683	0.6247
7.95	2.82	381.5	0.9682	0.6245
9.40	3.07	382.5	0.9681	0.6243
11.85	3.44	384.0	0.9679	0.6241
14.95	3.87	385.5	0.9678	0.6238
18.85	4.34	387.5	0.9676	0.6235
23.77	4.88	389.0	0.9674	0.6232
29.95	5.47	390.5	0.9673	0.6230
37.75	6.14	392.0	0.9671	0.6227
47.57	6.90	393.5	0.9670	0.6225
59.95	7.74	394.5	0.9669	0.6223
75.95	8.71	395.5	0.9668	0.6221
94.95	9.74	396.5	0.9667	0.6220
119.95	10.95	397.0	0.9666	0.6219
150.95	12.29	398.0	0.9665	0.6217
189.95	13.78	398.5	0.9665	0.6216
239.95	15.49	399.0	0.9664	0.6216

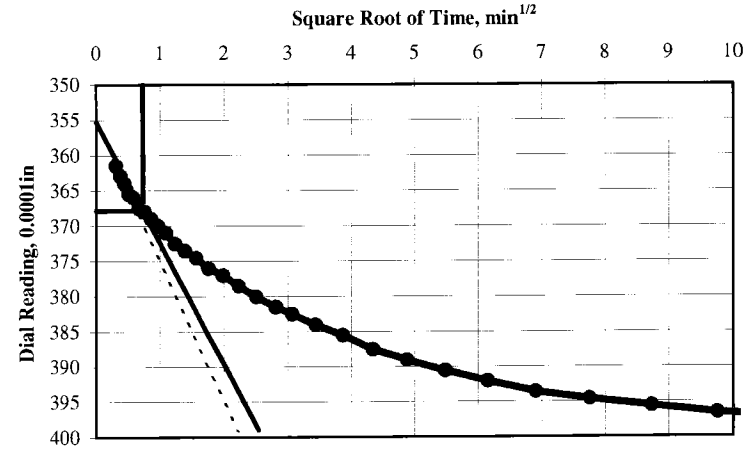
Machine Deflection

Applied Deflection Correction to Sample Height, 0.0001in: -4.5
**Correction is applied to all dial readings.*

Log of Elapsed Time vs. Dial Reading



Square Root of Elapsed Time vs. Dial Reading



Sqrt. of Elapsed Time vs Dial Reading		Log of Elapsed Time vs Dial Reading		Load Summary	
T0 = 0 min.	D0 = 355.3 div.	T0 = 0 min.	D0 = 356.2 div.		
T90 = 0.533 min	D90 = 367.8 div.	T50 = 3.05 min.	D50 = 375.9 div.	Initial Sample Height, in	0.9718
T100 = NA min	D100 = 369.2 div.	T100 = 47.74 min.	D100 = 395.5 div.	Initial Sample Void Ratio	0.6306
Height at: D90 = 0.9695, D100 = 0.9694		Height at: D50 = 0.9687, D100 = 0.9668		Final Sample Height, in	0.9664
Average Sample Height, in	0.9691	Average Sample Height, in	0.9691	Final Sample Void Ratio	0.6216
Average Drainage Height, in	0.4846	Average Drainage Height, in	0.4846	Incremental Strain, %	0.56%
T (Time Factor for T90)	0.848	T (Time Factor for T50)	0.197	Loading Duration, min	239.95
Coef. of Consol., C_v, in^2/min	0.372	Coef. of Consol., C_v, in^2/min	0.015		

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ONE-DIMENSIONAL CONSOLIDATION PROPERTIES OF SOILS
ASTM D 2435

Client	Civil & Environmental Consultant	Boring	TPE-18	**Test Load, tsf**	**2-4**
Client Project	091-867 Apex Landfill Expansion	Depth	12'-14'		Load 11 of 13
Project No.	30598	Sample	ST-1		
		Lab ID#	30598012		

Visual Description: Yellowish Brown Sandy Lean Clay
Test Conditions: Undisturbed, Inundated, and Double Drained

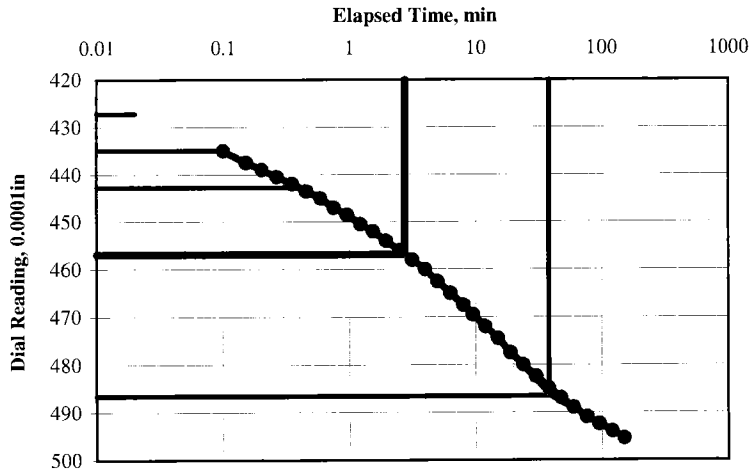
Time Vs. Dial Reading

Elapsed Time (min)	Sqrt Time ($min^{1/2}$)	Dial Reading (0.0001in)	Sample Height (in)	Void Ratio
0	0	399.0	0.9664	0.6216
Corrections*		-5	-0.0005	-0.0008
Adjusted Sample Height & Void Ratio				
0.10	0.32	435.0	0.9633	0.6164
0.15	0.39	437.5	0.9631	0.6159
0.20	0.45	439.0	0.9629	0.6157
0.27	0.52	440.5	0.9628	0.6154
0.35	0.59	442.0	0.9626	0.6152
0.45	0.67	443.5	0.9625	0.6149
0.58	0.76	445.0	0.9623	0.6147
0.75	0.87	447.0	0.9621	0.6143
0.95	0.97	448.5	0.9620	0.6141
1.22	1.10	450.5	0.9618	0.6138
1.53	1.24	452.0	0.9616	0.6135
1.95	1.40	454.0	0.9614	0.6132
2.47	1.57	456.0	0.9612	0.6128
3.12	1.77	458.0	0.9610	0.6125
3.95	1.99	460.0	0.9608	0.6122
4.98	2.23	462.5	0.9606	0.6117
6.30	2.51	465.0	0.9603	0.6113
7.95	2.82	467.5	0.9601	0.6109
9.40	3.07	469.5	0.9599	0.6106
11.85	3.44	472.0	0.9596	0.6101
14.95	3.87	474.5	0.9594	0.6097
18.85	4.34	477.5	0.9591	0.6092
23.77	4.88	480.0	0.9588	0.6088
29.95	5.47	482.5	0.9586	0.6084
37.75	6.14	485.0	0.9583	0.6080
47.57	6.90	487.0	0.9581	0.6076
59.95	7.74	489.0	0.9579	0.6073
75.95	8.71	491.0	0.9577	0.6070
94.95	9.74	492.5	0.9576	0.6067
119.95	10.95	494.0	0.9574	0.6065
150.95	12.29	495.5	0.9573	0.6062

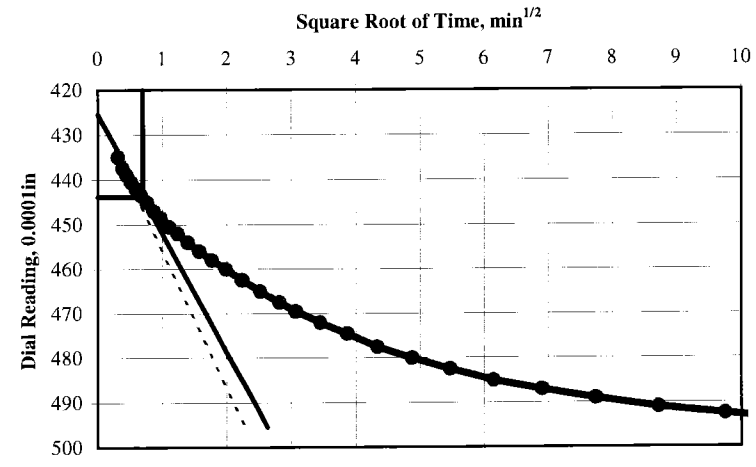
Machine Deflection

Applied Deflection Correction to Sample Height, 0.0001in: -5
**Correction is applied to all dial readings.*

Log of Elapsed Time vs. Dial Reading



Square Root of Elapsed Time vs. Dial Reading



Sqrt. of Elapsed Time vs Dial Reading

T0 = 0 min.	D0 = 425.4 div.		
T90 = 0.476 min	D90 = 443.8 div.		
T100 = NA min	D100 = 445.9 div.		
Height at: D90 = 0.9624, D100 = 0.9622			
Average Sample Height, in	0.9618		
Average Drainage Height, in	0.4809		
T (Time Factor for T90)	0.848		
Coef. of Consol., C_v, in^2/min	0.412		

Log of Elapsed Time vs Dial Reading

T0 = 0 min.	D0 = 427.2 div.		
T50 = 2.73 min.	D50 = 456.9 div.		
T100 = 37.94 min.	D100 = 486.6 div.		
Height at: D50 = 0.9611, D100 = 0.9581			
Average Sample Height, in	0.9618		
Average Drainage Height, in	0.4809		
T (Time Factor for T50)	0.197		
Coef. of Consol., C_v, in^2/min	0.017		

Load Summary

Initial Sample Height, in	0.9664
Initial Sample Void Ratio	0.6216
Final Sample Height, in	0.9573
Final Sample Void Ratio	0.6062
Incremental Strain, %	0.95%
Loading Duration, min	150.95

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ONE-DIMENSIONAL CONSOLIDATION PROPERTIES OF SOILS
ASTM D 2435

Client	Civil & Environmental Consultant	Boring	TPE-18	**Test Load, tsf**	**4-8**
Client Project	091-867 Apex Landfill Expansion	Depth	12'-14'		Load 12 of 13
Project No.	30598	Sample	ST-1		
		Lab ID#	30598012		
Visual Description	Yellowish Brown Sandy Lean Clay				
Test Conditions:	Undisturbed, Inundated, and Double Drained				

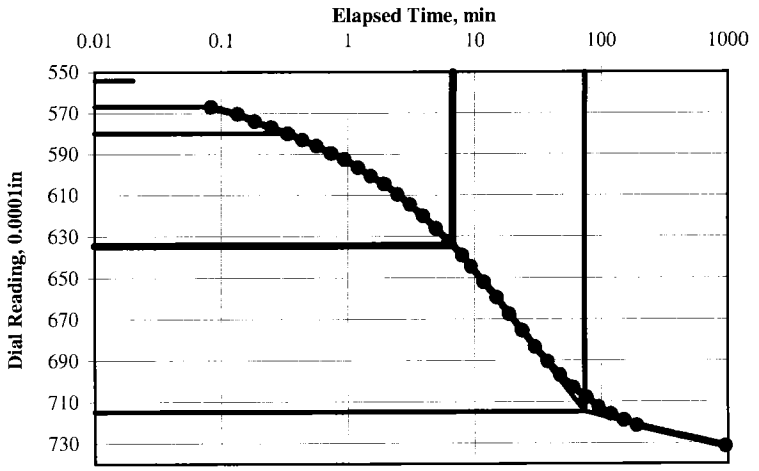
Time Vs. Dial Reading				
Elapsed Time (min)	**Sqrt Time ($min^{1/2}$)**	**Dial Reading (0.0001in)**	**Sample Height (in)**	**Void Ratio**
0	0	495.5	0.9573	0.6062
Corrections*		-10.5	-0.00105	-0.0018
Adjusted Sample Height & Void Ratio				
0.08	0.29	567.0	0.9512	0.5960
0.13	0.37	570.5	0.9508	0.5954
0.18	0.43	574.0	0.9505	0.5948
0.25	0.50	577.0	0.9502	0.5943
0.33	0.58	580.0	0.9499	0.5938
0.43	0.66	583.0	0.9496	0.5933
0.57	0.75	586.0	0.9493	0.5928
0.73	0.86	589.5	0.9489	0.5922
0.93	0.97	592.5	0.9486	0.5917
1.20	1.10	596.5	0.9482	0.5910
1.52	1.23	600.5	0.9478	0.5903
1.93	1.39	604.5	0.9474	0.5897
2.45	1.57	609.5	0.9469	0.5888
3.10	1.76	614.5	0.9464	0.5880
3.93	1.98	620.0	0.9459	0.5871
4.97	2.23	626.0	0.9453	0.5861
6.28	2.51	632.5	0.9446	0.5850
7.93	2.82	639.0	0.9440	0.5839
9.38	3.06	644.5	0.9434	0.5830
11.83	3.44	652.0	0.9427	0.5817
14.93	3.86	659.5	0.9419	0.5804
18.83	4.34	667.5	0.9411	0.5791
23.75	4.87	675.5	0.9403	0.5778
29.93	5.47	683.5	0.9395	0.5764
37.73	6.14	690.5	0.9388	0.5752
47.55	6.90	697.0	0.9382	0.5742
59.93	7.74	703.0	0.9376	0.5731
--> 75.93	8.71	708.0	0.9371	0.5723
94.93	9.74	712.5	0.9366	0.5716
119.93	10.95	716.0	0.9363	0.5710
150.93	12.29	719.0	0.9360	0.5705
189.93	13.78	721.5	0.9357	0.5700
> 954.93	30.90	731.5	0.9347	0.5684

Machine Deflection

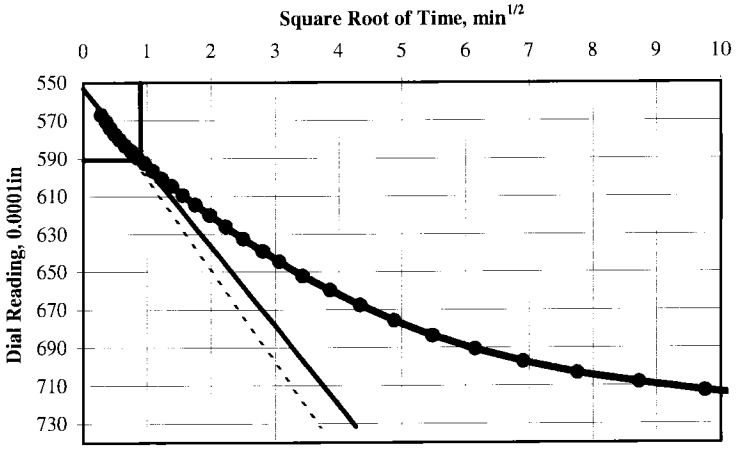
Applied Deflection Correction to Sample Height, 0.0001in -10.5

**Correction is applied to all dial readings.*

Log of Elapsed Time vs. Dial Reading



Square Root of Elapsed Time vs. Dial Reading



Sqrt. of Elapsed Time vs Dial Reading			
T0 = 0 min.	D0 = 553.1 div.		
T90 = 0.81 min	D90 = 590.7 div.		
T100 = NA min	D100 = 594.8 div.		
Height at: D90 = 0.9488, D100 = 0.9484			
Average Sample Height, in	0.9460		
Average Drainage Height, in	0.4730		
T (Time Factor for T90)	0.848		
Coef. of Consol., C_v, in^2/min	0.235		

Log of Elapsed Time vs Dial Reading			
T0 = 0 min.	D0 = 554 div.		
T50 = 6.72 min.	D50 = 634.4 div.		
T100 = 73.99 min.	D100 = 714.8 div.		
Height at: D50 = 0.9444, D100 = 0.9364			
Average Sample Height, in	0.9460		
Average Drainage Height, in	0.4730		
T (Time Factor for T50)	0.197		
Coef. of Consol., C_v, in^2/min	0.007		

Load Summary	
Initial Sample Height, in	0.9573
Initial Sample Void Ratio	0.6062
Final Sample Height, in	0.9347
Final Sample Void Ratio	0.5684
Incremental Strain, %	2.36%
Loading Duration, min	954.93333

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ONE-DIMENSIONAL CONSOLIDATION PROPERTIES OF SOILS
ASTM D 2435

Client	Civil & Environmental Consultant	Boring	TPE-18	**Test Load, tsf**	**8-16**
Client Project	091-867 Apex Landfill Expansion	Depth	12'-14'		Load 13 of 13
Project No.	30598	Sample	ST-1		
		Lab ID#	30598012		
Visual Description	Yellowish Brown Sandy Lean Clay				
Test Conditions:	Undisturbed, Inundated, and Double Drained				

Time Vs. Dial Reading

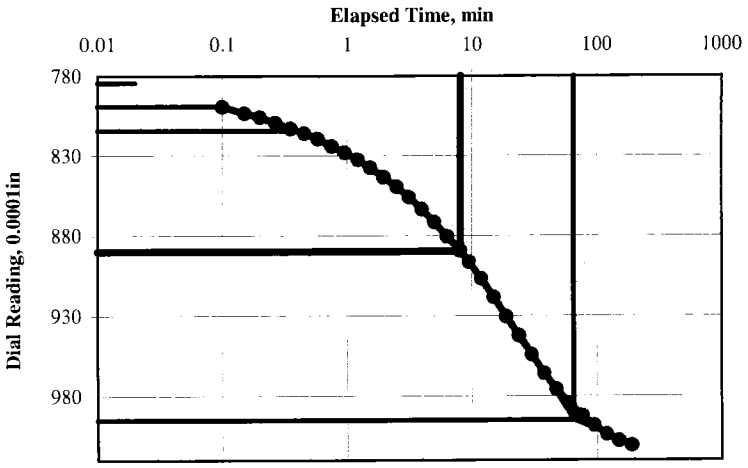
Elapsed Time (min)	Sqrt Time ($min^{1/2}$)	Dial Reading (0.0001in)	Sample Height (in)	Void Ratio
0	0	731.5	0.9347	0.5684
Corrections*		-15	-0.0015	-0.0025
Adjusted Sample Height & Void Ratio				
0.10	0.32	799.5	0.9294	0.5595
0.15	0.39	803.5	0.9290	0.5588
0.20	0.45	806.0	0.9288	0.5584
0.27	0.52	809.5	0.9284	0.5578
0.35	0.59	813.0	0.9281	0.5572
0.45	0.67	816.0	0.9278	0.5567
0.58	0.76	819.5	0.9274	0.5561
0.75	0.87	824.0	0.9270	0.5554
0.95	0.97	828.0	0.9266	0.5547
1.22	1.10	832.5	0.9261	0.5539
1.53	1.24	837.5	0.9256	0.5531
1.95	1.40	843.5	0.9250	0.5521
2.47	1.57	849.5	0.9244	0.5511
3.12	1.77	856.0	0.9238	0.5500
3.95	1.99	863.5	0.9230	0.5487
4.98	2.23	871.5	0.9222	0.5474
6.30	2.51	880.5	0.9213	0.5459
7.95	2.82	889.5	0.9204	0.5444
9.40	3.07	896.5	0.9197	0.5432
11.85	3.44	907.0	0.9187	0.5414
14.95	3.87	918.5	0.9175	0.5395
18.85	4.34	930.5	0.9163	0.5375
23.77	4.88	942.5	0.9151	0.5355
29.95	5.47	954.5	0.9139	0.5335
37.75	6.14	966.0	0.9128	0.5315
47.57	6.90	976.0	0.9118	0.5299
59.95	7.74	985.0	0.9109	0.5283
75.95	8.71	992.5	0.9101	0.5271
94.95	9.74	998.5	0.9095	0.5261
119.95	10.95	1004.0	0.9090	0.5252
150.95	12.29	1008.0	0.9086	0.5245
189.95	13.78	1011.0	0.9083	0.5240

Machine Deflection

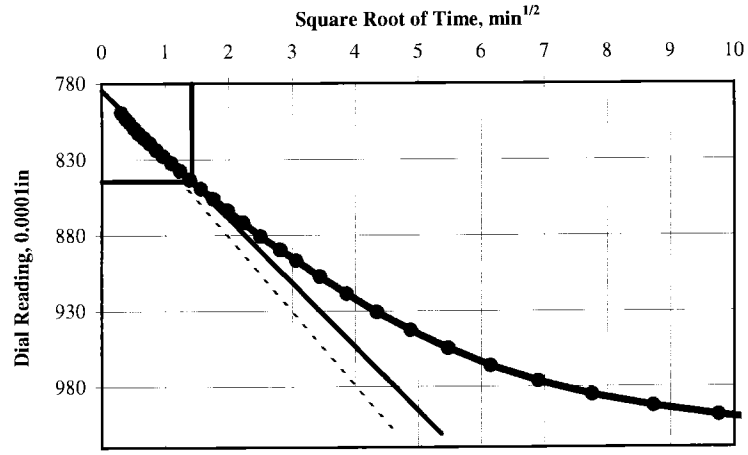
Applied Deflection Correction to Sample Height, 0.0001in: -15

**Correction is applied to all dial readings.*

Log of Elapsed Time vs. Dial Reading



Square Root of Elapsed Time vs. Dial Reading



Sqrt. of Elapsed Time vs Dial Reading		Log of Elapsed Time vs Dial Reading		Load Summary	
T0 = 0 min.	D0 = 784.4 div.	T0 = 0 min.	D0 = 784.4 div.		
T90 = 2.016 min	D90 = 844.3 div.	T50 = 8 min.	D50 = 889.7 div.	Initial Sample Height, in	0.9347
T100 = NA min	D100 = 850.9 div.	T100 = 65.47 min.	D100 = 995.1 div.	Initial Sample Void Ratio	0.5684
Height at: D90 = 0.9249, D100 = 0.9243		Height at: D50 = 0.9204, D100 = 0.9098		Final Sample Height, in	0.9083
Average Sample Height, in	0.9215	Average Sample Height, in	0.9215	Final Sample Void Ratio	0.5240
Average Drainage Height, in	0.4607	Average Drainage Height, in	0.4607	Incremental Strain, %	2.83%
T (Time Factor for T90)	0.848	T (Time Factor for T50)	0.197	Loading Duration, min	189.95
Coef. of Consol., C_v, in^2/min	0.089	Coef. of Consol., C_v, in^2/min	0.005		

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ONE-DIMENSIONAL CONSOLIDATION PROPERTIES OF SOILS
ASTM D 2435

Client	Civil & Environmental Consultant	Boring	SB-6
Client Project	091-867 Apex Landfill Expansion	Depth	9'-10'
Project No.	30598	Sample	ST-2
		Lab Sample No.	30598014

Visual Description: Grayish Brown Clayey Gravel with Sand
Sample Conditions: Undisturbed, Inundated, and Double Drained
Machine Deflection Correction: Applied

SAMPLE PROPERTIES			*TEST DATA SUMMARY*								
	Initial	Final	**Applied**	**Load**	**Final**	**Vertical**	**Dry**	**Void**	a_v	**Incremental**	
Tare Number	A12	B12	**Pressure**	**Duration**	**Height**	**Strain**	**Density**	**Ratio**		C_c	C_r
Wt. Tare & WS, gm	257.57	234.9	**tsf**	**min**	**in**	**%**	**g/cc**	**e**	**ft^2/ton**		
Wt. Tare & DS, gm	235.97	217.89	Seating	NA	1.0063	0.00	1.6647	0.6339	NA	NA	NA
Wt. Tare, gm	9.53	85.04	0.25	76	0.9739	3.21%	1.7200	0.5814	2.10E-01	NA	NA
Water Content, %	9.5%	12.8%	0.5	120	0.9459	6.00%	1.7710	0.5358	1.82E-01	0.151	NA
			1	60	0.9169	8.88%	1.8270	0.4888	9.42E-02	0.156	NA
Sample Diameter, in	2.5	2.5	2	758	0.8875	11.80%	1.8874	0.4411	4.76E-02	0.158	NA
Sample Height, in	1.006	0.8095	4	190	0.8607	14.46%	1.9462	0.3976	2.18E-02	0.145	NA
Sample Volume, in^3	4.9394	3.9735	1	120	0.8642	14.11%	1.9383	0.4033	1.90E-03	NA	NA
Wt. WS + Ring, gm	258.52	261.02	0.25	190	0.8704	13.50%	1.9246	0.4133	1.33E-02	NA	NA
Wt. of Ring, gm	110.92	110.92	0.5	38	0.8698	13.56%	1.9258	0.4124	3.56E-03	NA	0.003
Wt. of WS, gm	147.6	150.10	1	1,514	0.8677	13.77%	1.9305	0.4089	6.88E-03	NA	0.011
Wet Density, pcf	113.79	143.84	2	955	0.8641	14.13%	1.9386	0.4031	5.88E-03	NA	0.020
Wet Density, g/cc	1.824	2.305	4	190	0.8567	14.86%	1.9554	0.3910	6.01E-03	NA	0.040
Water Content, %	9.5%	12.8%	8	120	0.8341	17.10%	2.0082	0.3545	9.14E-03	0.122	NA
Wt. of DS, gm	134.75	133.06	16	120	0.8095	19.56%	2.0694	0.3144	5.01E-03	0.133	NA
Dry Density, pcf	103.88	127.52									
Dry Density, g/cc	1.665	2.044								$A_{v_2} = 0.019$	
Void Ratio, e	0.6339	0.3310									
Saturation, %	40.9%		*Note: The calculations performed and the parameters presented herein are for preliminary purposes only. GTS only accepts responsibility for the raw data obtained from the consolidation tests. This data may be interpreted differently by others. It is the responsibility of the user to determine the appropriateness and accuracy of the computed values.*								
Specific Gravity	2.72	Measured									
Height of Solids, in	0.6159	0.6159									

Input Validation | Reviewed By: | Date Tested: 12/18/2010 |

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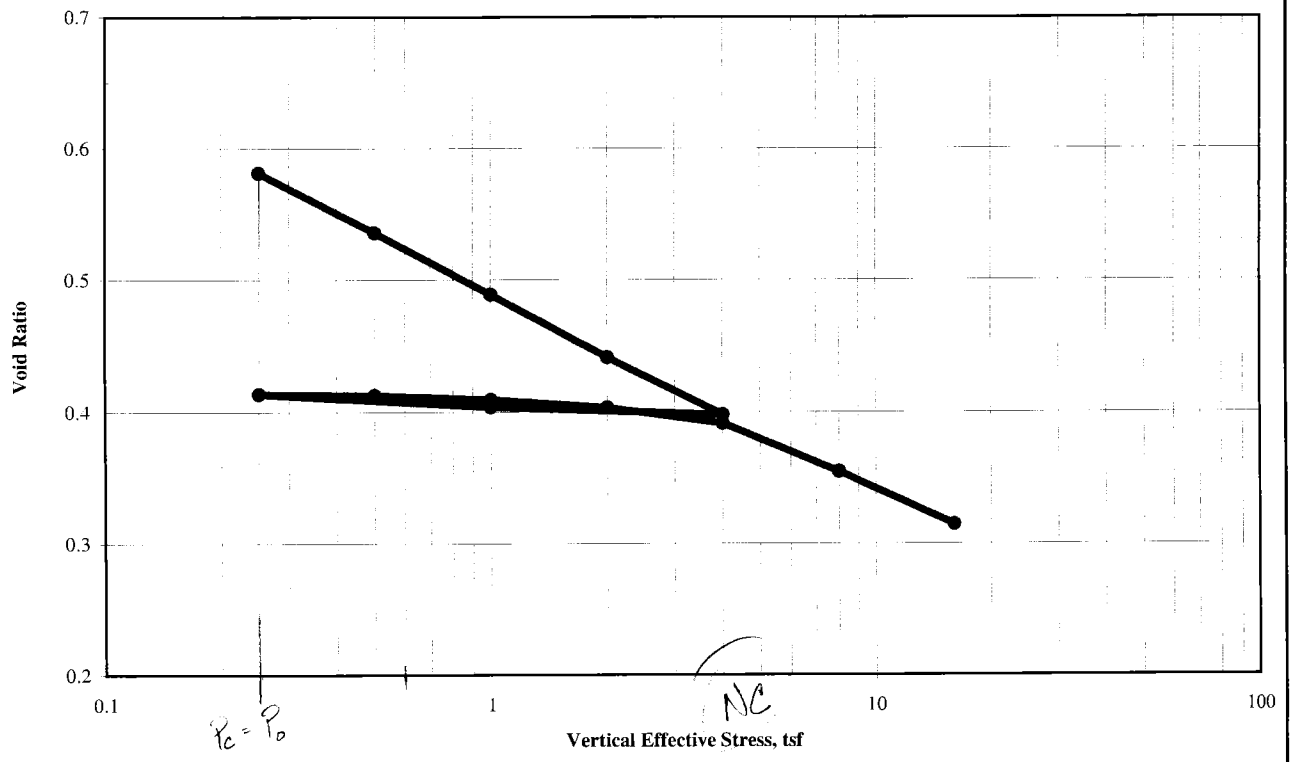
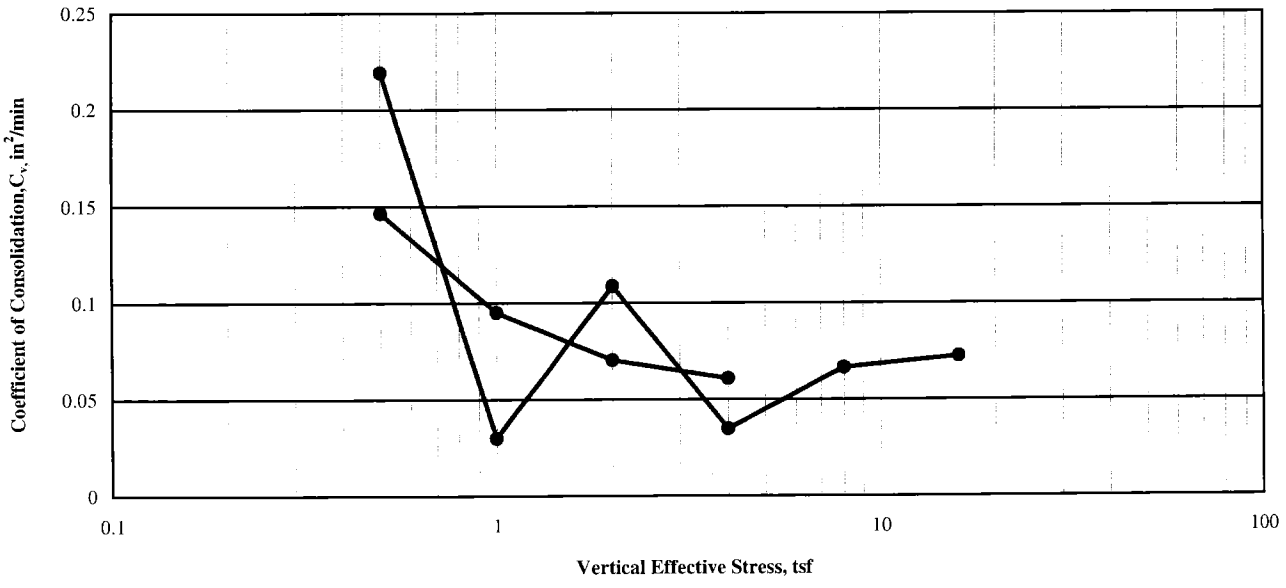
ONE-DIMENSIONAL CONSOLIDATION PROPERTIES OF SOILS
ASTM D 2435

Client	Civil & Environmental Consultants, Inc.	Boring	SB-6
Client Project	091-867 Apex Landfill Expansion	Depth	9'-10'
Project No.	30598	Sample	ST-2
		Lab Sample No.	30598014
Visual Description	Grayish Brown Clayey Gravel with Sand		
Sample Conditions	Undisturbed, Inundated, and Double Drained		
Machine Deflection Correction:	Applied		

Void Ratio (Final Height) vs Vertical Effective Consolidation Stress



Coeffieicent of Consolidation (log. method) vs. Vertical Effective Consolidation Stress



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ONE-DIMENSIONAL CONSOLIDATION PROPERTIES OF SOILS
ASTM D 2435

Client	Civil & Environmental Consultant	Boring	SB-6	**Test Load, tsf**	**0-0.25**
Client Project	091-867 Apex Landfill Expansion	Depth	9'-10'		Load 1 of 13
Project No.	30598	Sample	ST-2		
		Lab ID#	30598014		
Visual Description	Grayish Brown Clayey Gravel with Sand				
Test Conditions:	Undisturbed, Inundated, and Double Drained				

Time Vs. Dial Reading

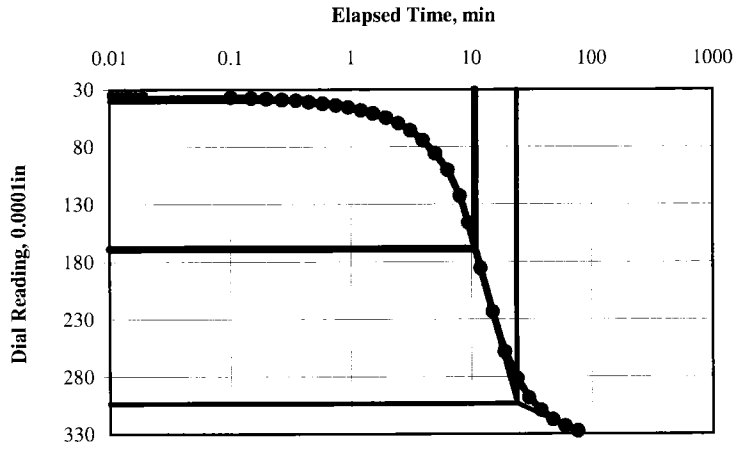
Elapsed Time (min)	Sqrt Time ($min^{1/2}$)	Dial Reading (0.0001in)	Sample Height (in)	Void Ratio
0	0	0	1.0063	0.6339
Corrections*		-4.5	-0.00045	-0.0007
Adjusted Sample Height & Void Ratio				
0.10	0.32	37.1	1.0030	0.6286
0.15	0.39	37.8	1.0029	0.6285
0.20	0.45	38.4	1.0029	0.6284
0.27	0.52	39.1	1.0028	0.6283
0.35	0.59	39.6	1.0027	0.6282
0.45	0.67	41.0	1.0026	0.6280
0.58	0.76	42.4	1.0025	0.6278
0.75	0.87	43.9	1.0023	0.6275
0.95	0.97	45.5	1.0022	0.6273
1.22	1.10	48.2	1.0019	0.6268
1.53	1.24	50.8	1.0016	0.6264
1.95	1.40	54.7	1.0012	0.6258
2.47	1.57	59.6	1.0007	0.6250
3.12	1.77	65.7	1.0001	0.6240
3.95	1.99	74.1	0.9993	0.6226
4.98	2.23	85.8	0.9981	0.6207
6.30	2.51	100.2	0.9967	0.6184
7.95	2.82	122.8	0.9944	0.6147
9.40	3.07	146.2	0.9921	0.6109
11.85	3.44	185.6	0.9881	0.6045
14.95	3.87	223.6	0.9843	0.5983
18.85	4.34	258.3	0.9809	0.5927
23.77	4.88	281.8	0.9785	0.5889
29.95	5.47	298.6	0.9768	0.5862
37.75	6.14	309.4	0.9758	0.5844
47.57	6.90	317.8	0.9749	0.5830
59.95	7.74	323.2	0.9744	0.5822
75.95	8.71	327.7	0.9739	0.5814

Machine Deflection

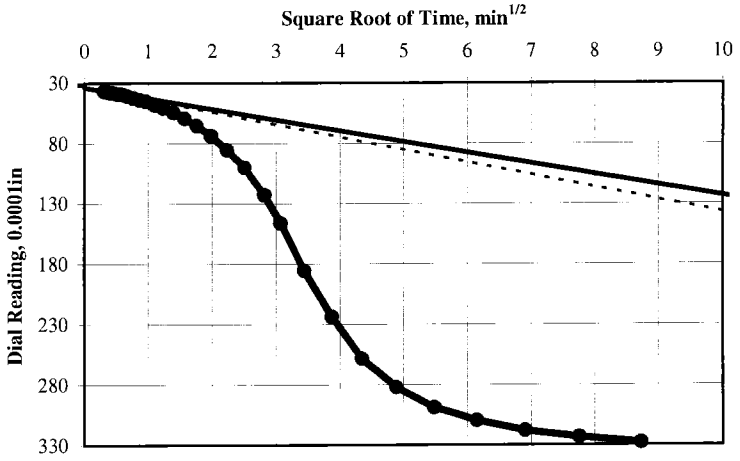
Applied Deflection Correction to Sample Height, 0.0001in -4.5

**Correction is applied to all dial readings.*

Log of Elapsed Time vs. Dial Reading



Square Root of Elapsed Time vs. Dial Reading



Sqrt. of Elapsed Time vs Dial Reading		Log of Elapsed Time vs Dial Reading		Load Summary	
T0 = 0 min.	D0 = 33.8 div.	T0 = 0 min.	D0 = 33.8 div.		
T90 = 0.063 min	D90 = 31.5 div.	T50 = 10.73 min.	D50 = 168.7 div.	Initial Sample Height, in	1.0063
T100 = NA min	D100 = 31.3 div.	T100 = 23.72 min.	D100 = 303.5 div.	Initial Sample Void Ratio	0.6339
Height at: D90 = 1.0036, D100 = 1.0036		Height at: D50 = 0.9898, D100 = 0.9764		Final Sample Height, in	0.9739
Average Sample Height, in	0.9901	Average Sample Height, in	0.9901	Final Sample Void Ratio	0.5814
Average Drainage Height, in	0.4950	Average Drainage Height, in	0.4950	Incremental Strain, %	3.21%
T (Time Factor for T90)	0.848	T (Time Factor for T50)	0.197	Loading Duration, min	75.95
Coef. of Consol., C_v, in^2/min	3.265	Coef. of Consol., C_v, in^2/min	0.004		

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ONE-DIMENSIONAL CONSOLIDATION PROPERTIES OF SOILS
ASTM D 2435

Client	Civil & Environmental Consultant	Boring	SB-6	**Test Load, tsf 0.25-0.5**
Client Project	091-867 Apex Landfill Expansion	Depth	9'-10'	Load 2 of 13
Project No.	30598	Sample	ST-2	
		Lab ID#	30598014	
Visual Description	Grayish Brown Clayey Gravel with Sand			
Test Conditions:	Undisturbed, Inundated, and Double Drained			

Time Vs. Dial Reading

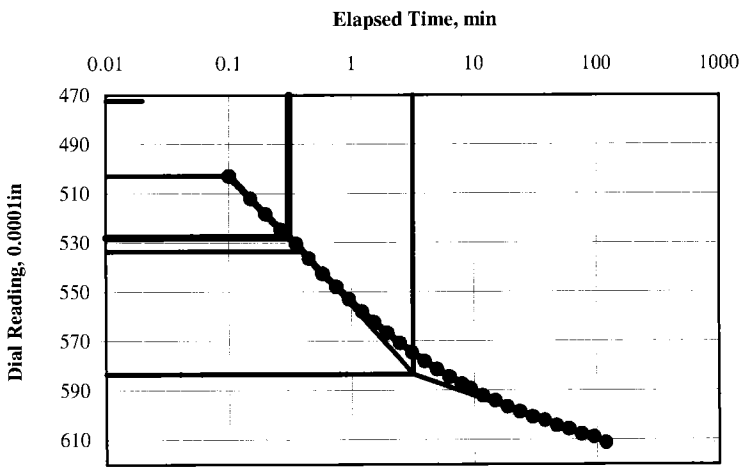
	Elapsed Time (min)	Sqrt Time ($min^{1/2}$)	Dial Reading (0.0001in)	Sample Height (in)	Void Ratio
	0	0	327.7	0.9739	0.5814
	Corrections*		-3	-0.0003	-0.0005
	Adjusted Sample Height & Void Ratio				
	0.10	0.32	502.9	0.9567	0.5535
	0.15	0.39	511.9	0.9558	0.5520
	0.20	0.45	518.3	0.9552	0.5510
	0.27	0.52	524.7	0.9545	0.5499
	0.35	0.59	530.4	0.9540	0.5490
	0.45	0.67	536.4	0.9534	0.5480
	0.58	0.76	542.6	0.9527	0.5470
	0.75	0.87	548.0	0.9522	0.5462
	0.95	0.97	553.0	0.9517	0.5453
	1.22	1.10	558.1	0.9512	0.5445
	1.53	1.24	562.3	0.9508	0.5438
	1.95	1.40	566.7	0.9503	0.5431
	2.47	1.57	570.8	0.9499	0.5424
	3.12	1.77	574.6	0.9495	0.5418
→	3.95	1.99	578.3	0.9492	0.5412
	4.98	2.23	581.5	0.9488	0.5407
	6.30	2.51	584.6	0.9485	0.5402
	7.95	2.82	587.5	0.9483	0.5397
	9.40	3.07	589.4	0.9481	0.5394
	11.85	3.44	592.2	0.9478	0.5390
	14.95	3.87	594.3	0.9476	0.5386
	18.85	4.34	596.8	0.9473	0.5382
	23.77	4.88	598.7	0.9471	0.5379
	29.95	5.47	600.9	0.9469	0.5376
	37.75	6.14	602.3	0.9468	0.5373
	47.57	6.90	604.4	0.9466	0.5370
	59.95	7.74	605.7	0.9464	0.5368
	75.95	8.71	607.8	0.9462	0.5364
	94.95	9.74	609.0	0.9461	0.5362
→	119.95	10.95	611.4	0.9459	0.5358

Machine Deflection

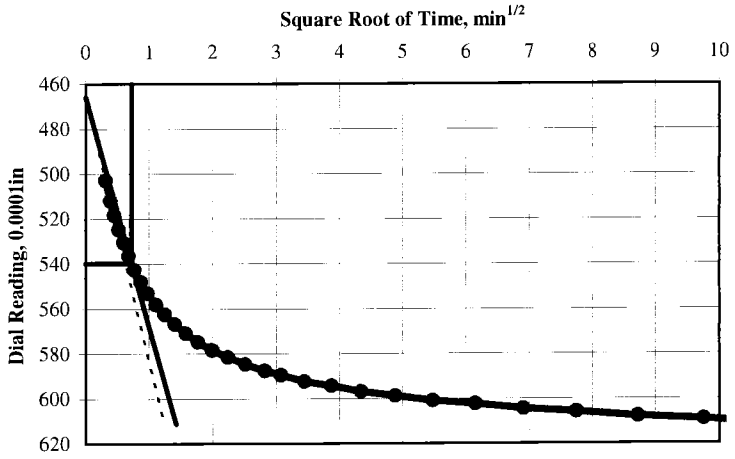
Applied Deflection Correction to Sample Height, 0.0001in: -3

**Correction is applied to all dial readings.*

Log of Elapsed Time vs. Dial Reading



Square Root of Elapsed Time vs. Dial Reading



Sqrt. of Elapsed Time vs Dial Reading		Log of Elapsed Time vs Dial Reading		Load Summary	
T0 = 0 min.	D0 = 465.9 div.	T0 = 0 min.	D0 = 472.2 div.		
T90 = 0.518 min	D90 = 539.8 div.	T50 = 0.31 min.	D50 = 527.9 div.	Initial Sample Height, in	0.9739
T100 = NA min	D100 = 548.1 div.	T100 = 3.21 min.	D100 = 583.6 div.	Initial Sample Void Ratio	0.5814
Height at: D90 = 0.953, D100 = 0.9522		Height at: D50 = 0.9542, D100 = 0.9486		Final Sample Height, in	0.9459
Average Sample Height, in	0.9599	Average Sample Height, in	0.9599	Final Sample Void Ratio	0.5358
Average Drainage Height, in	0.4799	Average Drainage Height, in	0.4799	Incremental Strain, %	2.88%
T (Time Factor for T90)	0.848	T (Time Factor for T50)	0.197	Loading Duration, min	119.95
Coef. of Consol., C_v, in^2/min	0.374	Coef. of Consol., C_v, in^2/min	0.146		

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ONE-DIMENSIONAL CONSOLIDATION PROPERTIES OF SOILS
ASTM D 2435

Client	Civil & Environmental Consultant	Boring	SB-6	**Test Load, tsf**	**0.5-1**
Client Project	091-867 Apex Landfill Expansion	Depth	9'-10'		Load 3 of 13
Project No.	30598	Sample	ST-2		
		Lab ID#	30598014		
Visual Description	Grayish Brown Clayey Gravel with Sand				
Test Conditions:	Undisturbed, Inundated, and Double Drained				

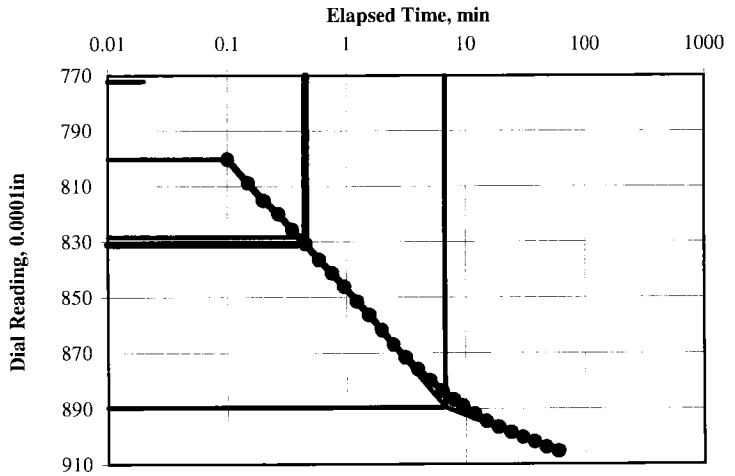
Time Vs. Dial Reading				
Elapsed Time (min)	**Sqrt Time ($min^{1/2}$)**	**Dial Reading (0.0001in)**	**Sample Height (in)**	**Void Ratio**
0	0	611.4	0.9459	0.5358
Corrections*		-4	-0.0004	-0.0006
Adjusted Sample Height & Void Ratio				
0.10	0.32	800.3	0.9274	0.5058
0.15	0.39	808.8	0.9265	0.5044
0.20	0.45	815.1	0.9259	0.5034
0.27	0.52	820.1	0.9254	0.5026
0.35	0.59	825.7	0.9248	0.5017
0.45	0.67	830.8	0.9243	0.5009
0.58	0.76	836.6	0.9237	0.4999
0.75	0.87	841.3	0.9233	0.4992
0.95	0.97	846.2	0.9228	0.4984
1.22	1.10	851.5	0.9222	0.4975
1.53	1.24	856.5	0.9218	0.4967
1.95	1.40	861.9	0.9212	0.4958
2.47	1.57	867.1	0.9207	0.4950
3.12	1.77	871.7	0.9202	0.4942
3.95	1.99	876.0	0.9198	0.4935
4.98	2.23	880.0	0.9194	0.4929
6.30	2.51	883.8	0.9190	0.4923
7.95	2.82	887.0	0.9187	0.4918
9.40	3.07	889.1	0.9185	0.4914
11.85	3.44	892.0	0.9182	0.4909
14.95	3.87	894.7	0.9179	0.4905
18.85	4.34	896.8	0.9177	0.4902
23.77	4.88	898.7	0.9175	0.4898
29.95	5.47	900.4	0.9174	0.4896
37.75	6.14	902.0	0.9172	0.4893
47.57	6.90	904.0	0.9170	0.4890
59.95	7.74	905.4	0.9169	0.4888

Machine Deflection

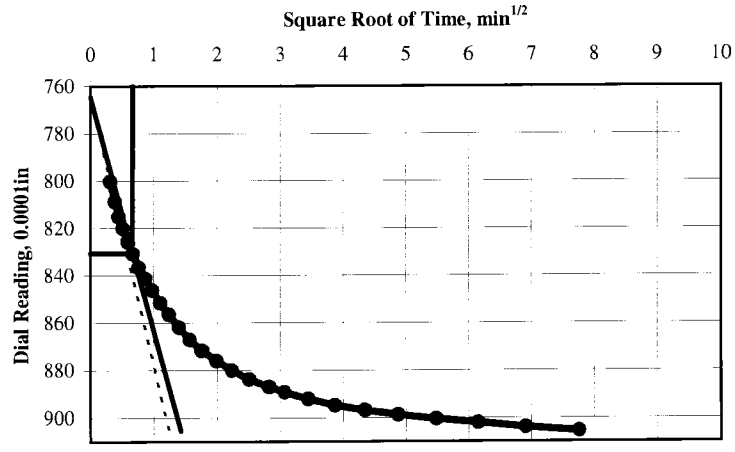
Applied Deflection Correction to Sample Height, 0.0001in: -4

**Correction is applied to all dial readings.*

Log of Elapsed Time vs. Dial Reading



Square Root of Elapsed Time vs. Dial Reading



Sqrt. of Elapsed Time vs Dial Reading			Log of Elapsed Time vs Dial Reading			Load Summary	
T0 = 0 min.	D0 = 764.5 div.		T0 = 0 min.	D0 = 772.2 div.			
T90 = 0.449 min	D90 = 830.7 div.		T50 = 0.45 min.	D50 = 830.9 div.		Initial Sample Height, in	0.9459
T100 = NA min	D100 = 838.1 div.		T100 = 6.63 min.	D100 = 889.6 div.		Initial Sample Void Ratio	0.5358
Height at: D90 = 0.9243, D100 = 0.9236			Height at: D50 = 0.9243, D100 = 0.9184			Final Sample Height, in	0.9169
Average Sample Height, in		0.9314	Average Sample Height, in		0.9314	Final Sample Void Ratio	0.4888
Average Drainage Height, in		0.4657	Average Drainage Height, in		0.4657	Incremental Strain, %	3.07%
T (Time Factor for T90)		0.848	T (Time Factor for T50)		0.197	Loading Duration, min	59.95
Coef. of Consol., C_v, in^2/min		0.409	Coef. of Consol., C_v, in^2/min		0.095		

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ONE-DIMENSIONAL CONSOLIDATION PROPERTIES OF SOILS
ASTM D 2435

Client	Civil & Environmental Consultant	Boring	SB-6	**Test Load, tsf**	**1-2**
Client Project	091-867 Apex Landfill Expansion	Depth	9'-10'		Load 4 of 13
Project No.	30598	Sample	ST-2		
		Lab ID#	30598014		
Visual Description	Grayish Brown Clayey Gravel with Sand				
Test Conditions:	Undisturbed, Inundated, and Double Drained				

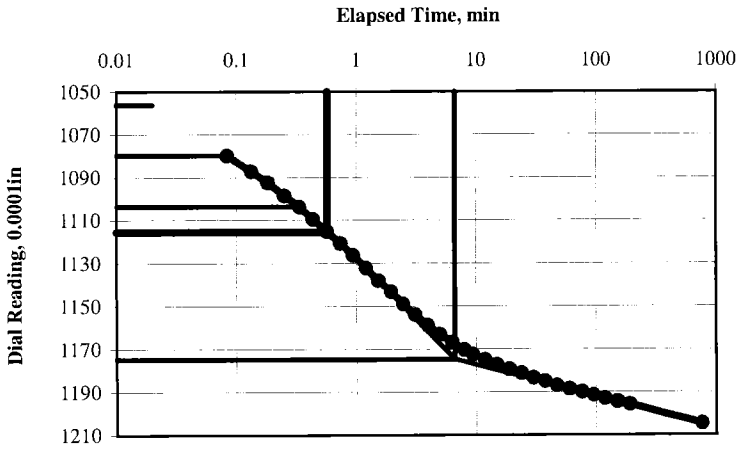
Time Vs. Dial Reading				
Elapsed Time (min)	**Sqrt Time ($min^{1/2}$)**	**Dial Reading (0.0001in)**	**Sample Height (in)**	**Void Ratio**
0	0	905.4	0.9169	0.4888
Corrections*		-6	-0.0006	-0.001
Adjusted Sample Height & Void Ratio				
0.08	0.29	1079.9	0.9000	0.4614
0.13	0.37	1087.2	0.8993	0.4602
0.18	0.43	1092.3	0.8988	0.4594
0.25	0.50	1098.5	0.8981	0.4584
0.33	0.58	1103.7	0.8976	0.4575
0.43	0.66	1109.3	0.8971	0.4566
0.57	0.75	1115.2	0.8965	0.4557
0.73	0.86	1120.7	0.8959	0.4548
0.93	0.97	1126.3	0.8954	0.4539
1.20	1.10	1132.3	0.8948	0.4529
1.52	1.23	1138.1	0.8942	0.4520
1.93	1.39	1143.3	0.8937	0.4511
2.45	1.57	1149.1	0.8931	0.4502
3.10	1.76	1154.1	0.8926	0.4494
3.93	1.98	1158.9	0.8921	0.4486
4.97	2.23	1163.2	0.8917	0.4479
6.28	2.51	1166.9	0.8913	0.4473
→ 7.93	2.82	1170.4	0.8910	0.4467
9.38	3.06	1172.6	0.8907	0.4464
11.83	3.44	1175.0	0.8905	0.4460
14.93	3.86	1177.3	0.8903	0.4456
18.83	4.34	1179.5	0.8901	0.4452
23.75	4.87	1181.3	0.8899	0.4449
29.93	5.47	1183.4	0.8897	0.4446
37.73	6.14	1185.1	0.8895	0.4443
47.55	6.90	1187.1	0.8893	0.4440
59.93	7.74	1188.7	0.8891	0.4437
75.93	8.71	1190.1	0.8890	0.4435
94.93	9.74	1191.5	0.8888	0.4433
119.93	10.95	1193.0	0.8887	0.4430
150.93	12.29	1194.4	0.8886	0.4428
189.93	13.78	1195.8	0.8884	0.4426
→ 757.93	27.53	1204.7	0.8875	0.4411

Machine Deflection

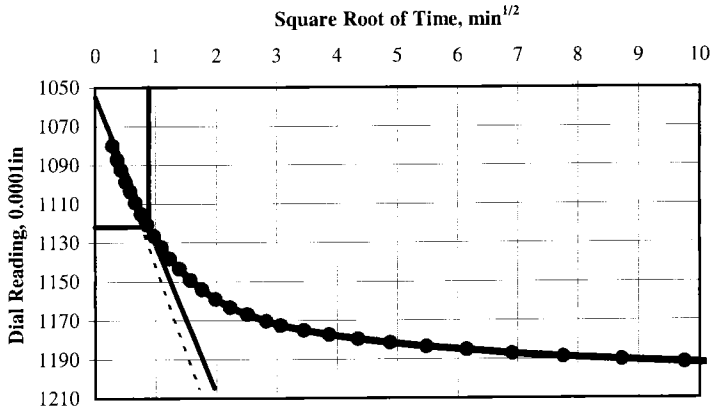
Applied Deflection Correction to Sample Height, 0.0001in -6

**Correction is applied to all dial readings.*

Log of Elapsed Time vs. Dial Reading



Square Root of Elapsed Time vs. Dial Reading



Sqrt. of Elapsed Time vs Dial Reading			Log of Elapsed Time vs Dial Reading			Load Summary	
T0 = 0 min.	D0 = 1054.8 div.		T0 = 0 min.	D0 = 1056.1 div.			
T90 = 0.774 min	D90 = 1122 div.		T50 = 0.57 min.	D50 = 1115.4 div.		Initial Sample Height, in	0.9169
T100 = NA min	D100 = 1129.4 div.		T100 = 6.6 min.	D100 = 1174.7 div.		Initial Sample Void Ratio	0.4888
Height at: D90 = 0.8958, D100 = 0.8951			Height at: D50 = 0.8965, D100 = 0.8905			Final Sample Height, in	0.8875
Average Sample Height, in		0.9022	Average Sample Height, in		0.9022	Final Sample Void Ratio	0.4411
Average Drainage Height, in		0.4511	Average Drainage Height, in		0.4511	Incremental Strain, %	3.20%
T (Time Factor for T90)		0.848	T (Time Factor for T50)		0.197	Loading Duration, min	757.93333
Coef. of Consol., C_v, in^2/min		0.222	Coef. of Consol., C_v, in^2/min		0.070		

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ONE-DIMENSIONAL CONSOLIDATION PROPERTIES OF SOILS
ASTM D 2435

Client	Civil & Environmental Consultant	Boring	SB-6	**Test Load, tsf**	**2-4**
Client Project	091-867 Apex Landfill Expansion	Depth	9'-10'		Load 5 of 13
Project No.	30598	Sample	ST-2		
		Lab ID#	30598014		
Visual Description	Grayish Brown Clayey Gravel with Sand				
Test Conditions:	Undisturbed, Inundated, and Double Drained				

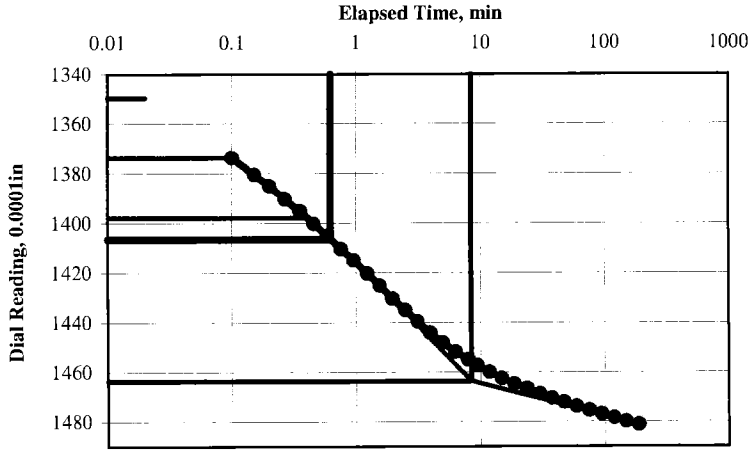
Time Vs. Dial Reading				
Elapsed Time (min)	**Sqrt Time ($min^{1/2}$)**	**Dial Reading (0.0001in)**	**Sample Height (in)**	**Void Ratio**
0	0	1204.7	0.8875	0.4411
Corrections*		-8.5	-0.00085	-0.0014
Adjusted Sample Height & Void Ratio				
0.10	0.32	1373.8	0.8715	0.4151
0.15	0.39	1380.5	0.8708	0.4140
0.20	0.45	1385.1	0.8703	0.4132
0.27	0.52	1390.3	0.8698	0.4124
0.35	0.59	1395.1	0.8693	0.4116
0.45	0.67	1400.3	0.8688	0.4108
0.58	0.76	1405.2	0.8683	0.4100
0.75	0.87	1410.5	0.8678	0.4091
0.95	0.97	1415.0	0.8673	0.4084
1.22	1.10	1420.3	0.8668	0.4075
1.53	1.24	1425.1	0.8663	0.4067
1.95	1.40	1430.6	0.8658	0.4058
2.47	1.57	1435.1	0.8653	0.4051
3.12	1.77	1439.7	0.8649	0.4044
3.95	1.99	1444.3	0.8644	0.4036
4.98	2.23	1448.2	0.8640	0.4030
6.30	2.51	1451.9	0.8637	0.4024
7.95	2.82	1455.1	0.8633	0.4019
→ 9.40	3.07	1457.3	0.8631	0.4015
11.85	3.44	1460.0	0.8629	0.4011
14.95	3.87	1462.6	0.8626	0.4006
18.85	4.34	1464.8	0.8624	0.4003
23.77	4.88	1466.7	0.8622	0.4000
29.95	5.47	1468.8	0.8620	0.3996
37.75	6.14	1470.6	0.8618	0.3993
47.57	6.90	1472.1	0.8616	0.3991
59.95	7.74	1473.8	0.8615	0.3988
75.95	8.71	1475.5	0.8613	0.3986
94.95	9.74	1477.0	0.8611	0.3983
119.95	10.95	1478.5	0.8610	0.3981
150.95	12.29	1480.0	0.8609	0.3978
→ 189.95	13.78	1481.1	0.8607	0.3976

Machine Deflection

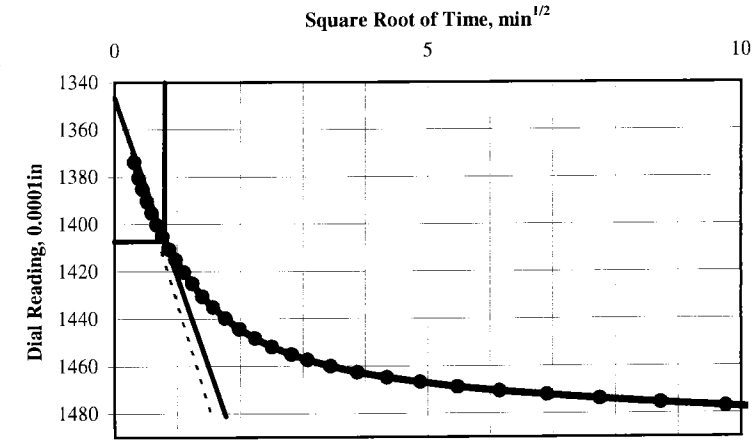
Applied Deflection Correction to Sample Height, 0.0001in -8.5

**Correction is applied to all dial readings.*

Log of Elapsed Time vs. Dial Reading



Square Root of Elapsed Time vs. Dial Reading



Sqrt. of Elapsed Time vs Dial Reading			
T0 = 0 min.	D0 = 1346.4 div.		
T90 = 0.64 min	D90 = 1407.3 div.		
T100 = NA min	D100 = 1414 div.		
Height at: D90 = 0.8681, D100 = 0.8674			
Average Sample Height, in	0.8741		
Average Drainage Height, in	0.4371		
T (Time Factor for T90)	0.848		
Coef. of Consol., C_v, in^2/min	0.251		

Log of Elapsed Time vs Dial Reading			
T0 = 0 min.	D0 = 1349.6 div.		
T50 = 0.62 min.	D50 = 1406.6 div.		
T100 = 8.42 min.	D100 = 1463.6 div.		
Height at: D50 = 0.8682, D100 = 0.8625			
Average Sample Height, in	0.8741		
Average Drainage Height, in	0.4371		
T (Time Factor for T50)	0.197		
Coef. of Consol., C_v, in^2/min	0.061		

Load Summary	
Initial Sample Height, in	0.8875
Initial Sample Void Ratio	0.4411
Final Sample Height, in	0.8607
Final Sample Void Ratio	0.3976
Incremental Strain, %	3.02%
Loading Duration, min	189.95

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ONE-DIMENSIONAL CONSOLIDATION PROPERTIES OF SOILS
ASTM D 2435

Client	Civil & Environmental Consultant	Boring	SB-6	**Test Load, tsf**	**4-1**
Client Project	091-867 Apex Landfill Expansion	Depth	9'-10'		Load 6 of 13
Project No.	30598	Sample	ST-2		
		Lab ID#	30598014		
Visual Description	Grayish Brown Clayey Gravel with Sand				
Test Conditions:	Undisturbed, Inundated, and Double Drained				

Time Vs. Dial Reading

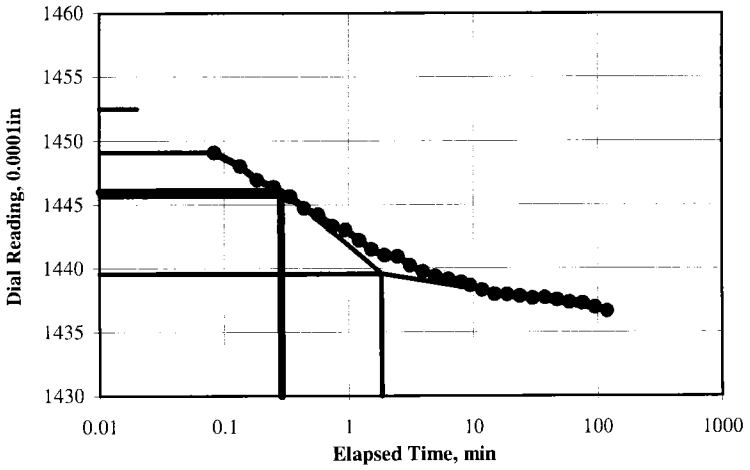
Elapsed Time (min)	Sqrt Time ($min^{1/2}$)	Dial Reading (0.0001in)	Sample Height (in)	Void Ratio
0	0	1481.1	0.8607	0.3976
Corrections*		9.5	0.00095	0.00154
Adjusted Sample Height & Void Ratio				
0.08	0.29	1449.1	0.8630	0.4013
0.13	0.37	1448.0	0.8631	0.4015
0.18	0.43	1446.9	0.8632	0.4016
0.25	0.50	1446.4	0.8633	0.4017
0.33	0.58	1445.6	0.8633	0.4019
0.43	0.66	1444.7	0.8634	0.4020
0.57	0.75	1444.2	0.8635	0.4021
0.73	0.86	1443.3	0.8636	0.4022
0.93	0.97	1443.0	0.8636	0.4023
1.20	1.10	1442.2	0.8637	0.4024
1.52	1.23	1441.5	0.8638	0.4025
1.93	1.39	1441.0	0.8638	0.4026
2.45	1.57	1440.9	0.8638	0.4026
3.10	1.76	1440.2	0.8639	0.4027
3.93	1.98	1439.8	0.8639	0.4028
4.97	2.23	1439.4	0.8640	0.4029
6.28	2.51	1439.1	0.8640	0.4029
7.93	2.82	1438.9	0.8640	0.4029
9.38	3.06	1438.6	0.8640	0.4030
11.83	3.44	1438.3	0.8641	0.4030
14.93	3.86	1438.0	0.8641	0.4031
18.83	4.34	1437.9	0.8641	0.4031
23.75	4.87	1437.8	0.8641	0.4031
29.93	5.47	1437.6	0.8641	0.4031
37.73	6.14	1437.7	0.8641	0.4031
47.55	6.90	1437.5	0.8641	0.4032
59.93	7.74	1437.3	0.8642	0.4032
75.93	8.71	1437.3	0.8642	0.4032
94.93	9.74	1436.9	0.8642	0.4033
119.93	10.95	1436.6	0.8642	0.4033

Machine Deflection

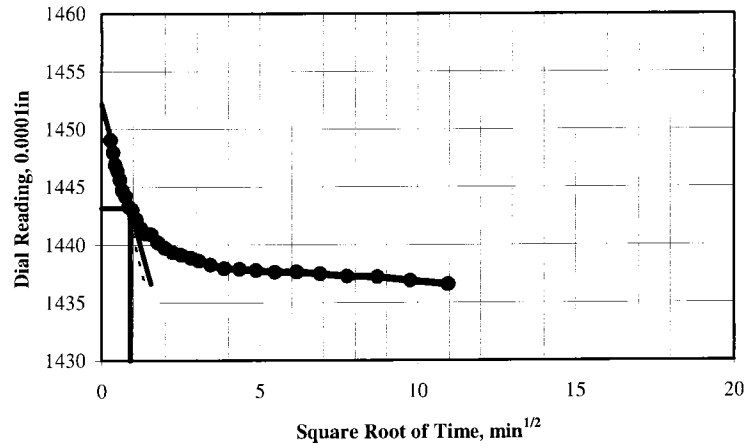
Applied Deflection Correction to Sample Height, 0.0001in 9.5

**Correction is applied to all dial readings.*

Log of Elapsed Time vs. Dial Reading



Square Root of Elapsed Time vs. Dial Reading



Sqrt. of Elapsed Time vs Dial Reading

T0 = 0 min.	D0 = 1452.2 div.		
T90 = 0.81 min	D90 = 1443.2 div.		
T100 = NA min	D100 = 1442.2 div.		
Height at: D90 = 0.8636, D100 = 0.8637			
Average Sample Height, in	0.8625		
Average Drainage Height, in	0.4312		
T (Time Factor for T90)	0.848		
Coef. of Consol., C_v, in^2/min	0.195		

Log of Elapsed Time vs Dial Reading

T0 = 0 min.	D0 = 1452.5 div.		
T50 = 0.29 min.	D50 = 1446 div.		
T100 = 1.84 min.	D100 = 1439.6 div.		
Height at: D50 = 0.8633, D100 = 0.8639			
Average Sample Height, in	0.8625		
Average Drainage Height, in	0.4312		
T (Time Factor for T50)	0.197		
Coef. of Consol., C_v, in^2/min	0.126		

Load Summary

Initial Sample Height, in	0.8607
Initial Sample Void Ratio	0.3976
Final Sample Height, in	0.8642
Final Sample Void Ratio	0.4033
Incremental Strain, %	-0.41%
Loading Duration, min	119.93333

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ONE-DIMENSIONAL CONSOLIDATION PROPERTIES OF SOILS
ASTM D 2435

Client	Civil & Environmental Consultant	Boring	SB-6	**Test Load, tsf**	**1-0.25**
Client Project	091-867 Apex Landfill Expansion	Depth	9'-10'		Load 7 of 13
Project No.	30598	Sample	ST-2		
		Lab ID#	30598014		
Visual Description	Grayish Brown Clayey Gravel with Sand				
Test Conditions:	Undisturbed, Inundated, and Double Drained				

Time Vs. Dial Reading

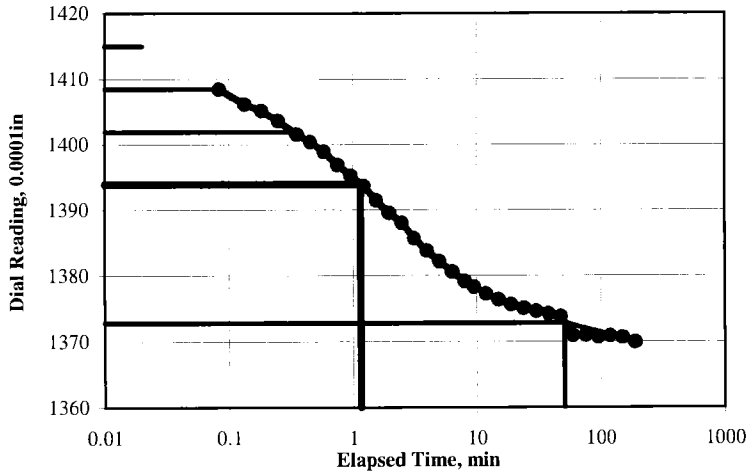
Elapsed Time (min)	Sqrt Time ($min^{1/2}$)	Dial Reading (0.0001in)	Sample Height (in)	Void Ratio
0	0	1436.6	0.8642	0.4033
Corrections*		5.5	0.00055	0.00089
Adjusted Sample Height & Void Ratio				
0.08	0.29	1408.4	0.8665	0.4070
0.13	0.37	1406.1	0.8667	0.4074
0.18	0.43	1405.2	0.8668	0.4075
0.25	0.50	1403.6	0.8670	0.4078
0.35	0.59	1401.6	0.8672	0.4081
0.45	0.67	1400.4	0.8673	0.4083
0.58	0.76	1398.9	0.8675	0.4086
0.75	0.87	1396.8	0.8677	0.4089
0.95	0.97	1395.2	0.8678	0.4091
1.22	1.10	1393.6	0.8680	0.4094
1.53	1.24	1391.5	0.8682	0.4098
1.95	1.40	1389.5	0.8684	0.4101
2.47	1.57	1388.0	0.8685	0.4103
3.12	1.77	1385.7	0.8688	0.4107
3.95	1.99	1383.8	0.8690	0.4110
4.98	2.23	1382.1	0.8691	0.4113
6.30	2.51	1380.6	0.8693	0.4115
7.95	2.82	1379.1	0.8694	0.4118
9.40	3.07	1378.3	0.8695	0.4119
11.85	3.44	1377.2	0.8696	0.4121
14.95	3.87	1376.4	0.8697	0.4122
18.85	4.34	1375.6	0.8698	0.4123
23.77	4.88	1375.0	0.8698	0.4124
29.95	5.47	1374.6	0.8699	0.4125
37.75	6.14	1374.2	0.8699	0.4126
47.57	6.90	1373.8	0.8700	0.4126
59.95	7.74	1370.9	0.8703	0.4131
75.95	8.71	1370.9	0.8703	0.4131
94.95	9.74	1370.6	0.8703	0.4131
119.95	10.95	1370.8	0.8703	0.4131
150.95	12.29	1370.6	0.8703	0.4131
189.95	13.78	1369.9	0.8704	0.4133

Machine Deflection

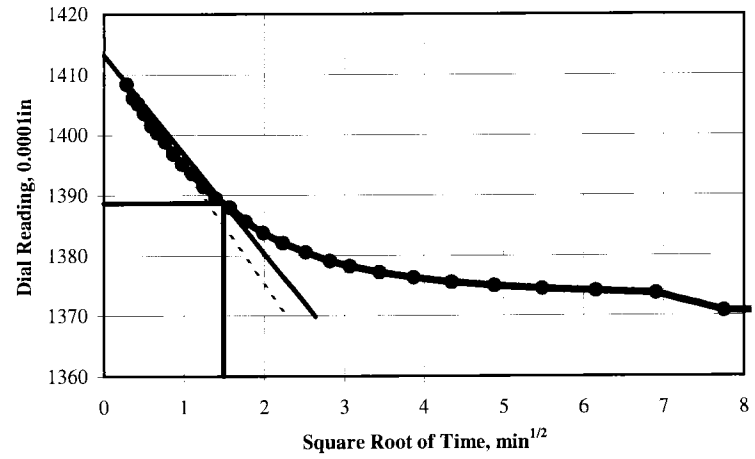
Applied Deflection Correction to Sample Height, 0.0001in 5.5

**Correction is applied to all dial readings.*

Log of Elapsed Time vs. Dial Reading



Square Root of Elapsed Time vs. Dial Reading



Sqrt. of Elapsed Time vs Dial Reading		Log of Elapsed Time vs Dial Reading		Load Summary	
T0 = 0 min.	D0 = 1413.2 div.	T0 = 0 min.	D0 = 1415 div.		
T90 = 2.25 min	D90 = 1388.7 div.	T50 = 1.16 min.	D50 = 1393.9 div.	Initial Sample Height, in	0.8642
T100 = NA min	D100 = 1385.9 div.	T100 = 51.21 min.	D100 = 1372.9 div.	Initial Sample Void Ratio	0.4033
Height at: D90 = 0.8685, D100 = 0.8688		Height at: D50 = 0.868, D100 = 0.8701		Final Sample Height, in	0.8704
Average Sample Height, in	0.8673	Average Sample Height, in	0.8673	Final Sample Void Ratio	0.4133
Average Drainage Height, in	0.4337	Average Drainage Height, in	0.4337	Incremental Strain, %	-0.71%
T (Time Factor for T90)	0.848	T (Time Factor for T50)	0.197	Loading Duration, min	189.95
Coef. of Consol., C_v, in^2/min	0.071	Coef. of Consol., C_v, in^2/min	0.032		

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ONE-DIMENSIONAL CONSOLIDATION PROPERTIES OF SOILS
ASTM D 2435

Client	Civil & Environmental Consultant	Boring	SB-6	**Test Load, tsf**	**0.25-0.5**
Client Project	091-867 Apex Landfill Expansion	Depth	9'-10'		Load 8 of 13
Project No.	30598	Sample	ST-2		
		Lab ID#	30598014		
Visual Description	Grayish Brown Clayey Gravel with Sand				
Test Conditions:	Undisturbed, Inundated, and Double Drained				

Time Vs. Dial Reading

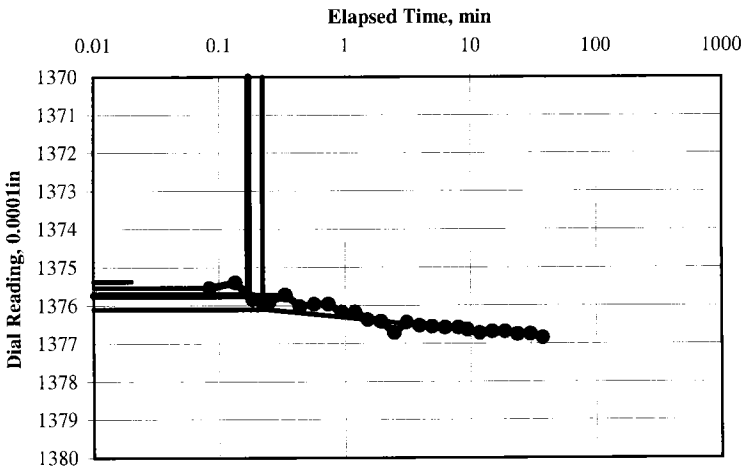
Elapsed Time (min)	Sqrt Time ($min^{1/2}$)	Dial Reading (0.0001in)	Sample Height (in)	Void Ratio
0	0	1369.9	0.8704	0.4133
Corrections*		-1.5	-0.00015	-0.0002
Adjusted Sample Height & Void Ratio				
0.08	0.29	1375.5	0.8699	0.4126
0.13	0.37	1375.4	0.8700	0.4126
0.18	0.43	1375.8	0.8699	0.4125
0.25	0.50	1375.9	0.8699	0.4125
0.33	0.58	1375.7	0.8699	0.4126
0.43	0.66	1376.0	0.8699	0.4125
0.57	0.75	1376.0	0.8699	0.4125
0.73	0.86	1376.0	0.8699	0.4125
0.93	0.97	1376.2	0.8699	0.4125
1.20	1.10	1376.2	0.8699	0.4125
1.52	1.23	1376.4	0.8699	0.4124
1.93	1.39	1376.4	0.8699	0.4124
2.45	1.57	1376.7	0.8698	0.4124
3.10	1.76	1376.4	0.8699	0.4124
3.93	1.98	1376.5	0.8698	0.4124
4.97	2.23	1376.6	0.8698	0.4124
6.28	2.51	1376.6	0.8698	0.4124
7.93	2.82	1376.6	0.8698	0.4124
9.38	3.06	1376.6	0.8698	0.4124
11.83	3.44	1376.7	0.8698	0.4124
14.93	3.86	1376.7	0.8698	0.4124
18.83	4.34	1376.7	0.8698	0.4124
23.75	4.87	1376.8	0.8698	0.4124
29.93	5.47	1376.8	0.8698	0.4124
37.73	6.14	1376.9	0.8698	0.4124

Machine Deflection

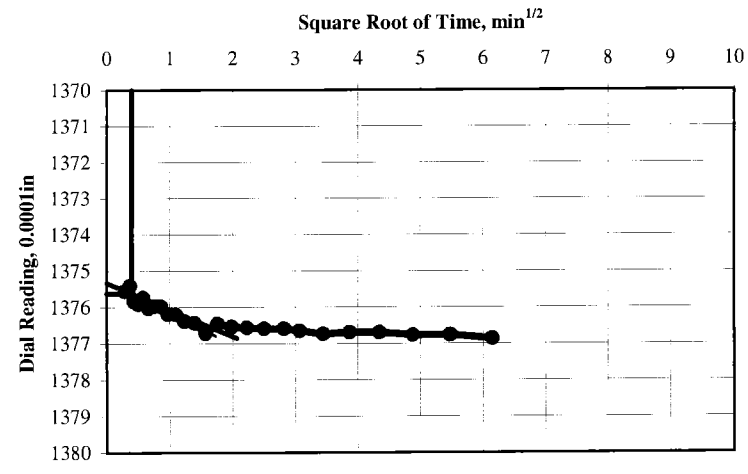
Applied Deflection Correction to Sample Height, 0.0001in -1.5

**Correction is applied to all dial readings.*

Log of Elapsed Time vs. Dial Reading



Square Root of Elapsed Time vs. Dial Reading



Sqrt. of Elapsed Time vs Dial Reading

T0 = 0 min.	D0 = 1375.3 div.		
T90 = 0.16 min	D90 = 1375.6 div.		
T100 = NA min	D100 = 1375.7 div.		
Height at: D90 = 0.8699, D100 = 0.8699			
Average Sample Height, in	0.8701		
Average Drainage Height, in	0.4350		
T (Time Factor for T90)	0.848		
Coef. of Consol., C_v, in^2/min	1.023		

Log of Elapsed Time vs Dial Reading

T0 = 0 min.	D0 = 1375.4 div.		
T50 = 0.17 min.	D50 = 1375.7 div.		
T100 = 0.22 min.	D100 = 1376.1 div.		
Height at: D50 = 0.8699, D100 = 0.8699			
Average Sample Height, in	0.8701		
Average Drainage Height, in	0.4350		
T (Time Factor for T50)	0.197		
Coef. of Consol., C_v, in^2/min	0.219		

Load Summary

Initial Sample Height, in	0.8704
Initial Sample Void Ratio	0.4133
Final Sample Height, in	0.8698
Final Sample Void Ratio	0.4124
Incremental Strain, %	0.06%
Loading Duration, min	37.733333

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ONE-DIMENSIONAL CONSOLIDATION PROPERTIES OF SOILS
ASTM D 2435

Client	Civil & Environmental Consultant	Boring	SB-6	**Test Load, tsf**	**0.5-1**
Client Project	091-867 Apex Landfill Expansion	Depth	9'-10'		Load 9 of 13
Project No.	30598	Sample	ST-2		
		Lab ID#	30598014		
Visual Description	Grayish Brown Clayey Gravel with Sand				
Test Conditions:	Undisturbed, Inundated, and Double Drained				

Time Vs. Dial Reading

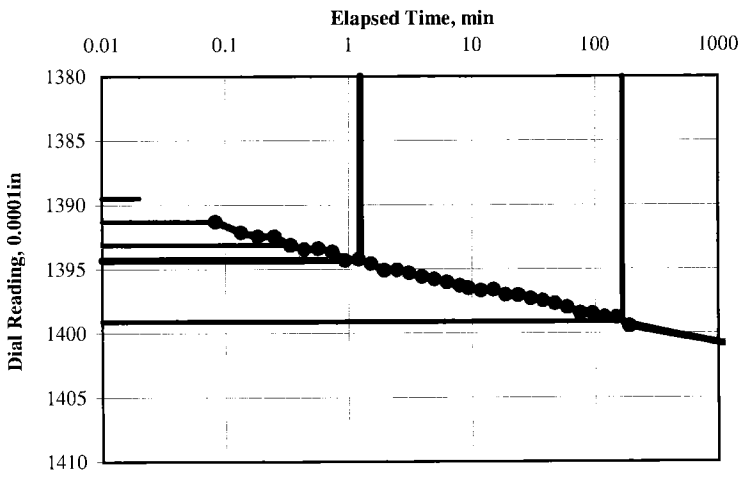
Elapsed Time (min)	Sqrt Time ($min^{1/2}$)	Dial Reading (0.0001in)	Sample Height (in)	Void Ratio
0	0	1376.9	0.8698	0.4124
Corrections*		-3	-0.0003	-0.0005
Adjusted Sample Height & Void Ratio				
0.08	0.29	1391.3	0.8687	0.4105
0.13	0.37	1392.2	0.8686	0.4104
0.18	0.43	1392.5	0.8686	0.4103
0.25	0.50	1392.5	0.8686	0.4103
0.33	0.58	1393.1	0.8685	0.4102
0.43	0.66	1393.5	0.8685	0.4102
0.57	0.75	1393.4	0.8685	0.4102
0.73	0.86	1393.7	0.8684	0.4101
0.93	0.97	1394.3	0.8684	0.4100
1.20	1.10	1394.3	0.8684	0.4100
1.52	1.23	1394.6	0.8683	0.4100
1.93	1.39	1395.1	0.8683	0.4099
2.45	1.57	1395.1	0.8683	0.4099
3.10	1.76	1395.3	0.8683	0.4099
3.93	1.98	1395.6	0.8682	0.4098
4.97	2.23	1395.8	0.8682	0.4098
6.28	2.51	1396.1	0.8682	0.4097
7.93	2.82	1396.3	0.8682	0.4097
9.38	3.06	1396.5	0.8681	0.4097
11.83	3.44	1396.7	0.8681	0.4096
14.93	3.86	1396.6	0.8681	0.4096
18.83	4.34	1397.0	0.8681	0.4096
23.75	4.87	1397.1	0.8681	0.4096
29.93	5.47	1397.3	0.8681	0.4095
37.73	6.14	1397.5	0.8681	0.4095
47.55	6.90	1397.7	0.8680	0.4095
59.93	7.74	1398.0	0.8680	0.4094
75.93	8.71	1398.5	0.8680	0.4094
94.93	9.74	1398.5	0.8680	0.4093
119.93	10.95	1398.7	0.8679	0.4093
150.93	12.29	1398.8	0.8679	0.4093
189.93	13.78	1399.5	0.8679	0.4092
1513.93	38.91	1401.0	0.8677	0.4089

Machine Deflection

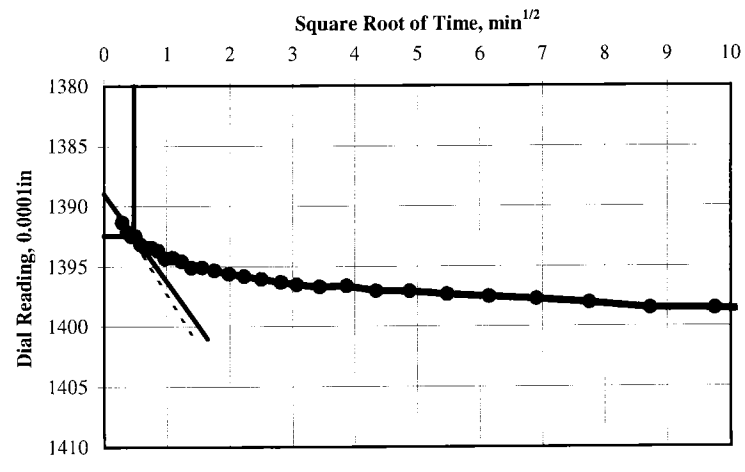
Applied Deflection Correction to Sample Height, 0.0001in -3

**Correction is applied to all dial readings.*

Log of Elapsed Time vs. Dial Reading



Square Root of Elapsed Time vs. Dial Reading



Sqrt. of Elapsed Time vs Dial Reading			Log of Elapsed Time vs Dial Reading			Load Summary	
T0 = 0 min.	D0 = 1389 div.		T0 = 0 min.	D0 = 1389.5 div.			
T90 = 0.23 min	D90 = 1392.5 div.		T50 = 1.25 min.	D50 = 1394.3 div.		Initial Sample Height, in	0.8698
T100 = NA min	D100 = 1392.9 div.		T100 = 168.3 min.	D100 = 1399.1 div.		Initial Sample Void Ratio	0.4124
Height at: D90 = 0.8686, D100 = 0.8685			Height at: D50 = 0.8684, D100 = 0.8679			Final Sample Height, in	0.8677
Average Sample Height, in		0.8688	Average Sample Height, in		0.8688	Final Sample Void Ratio	0.4089
Average Drainage Height, in		0.4344	Average Drainage Height, in		0.4344	Incremental Strain, %	0.24%
T (Time Factor for T90)		0.848	T (Time Factor for T50)		0.197	Loading Duration, min	1513.9333
Coef. of Consol., C_v, in^2/min		0.692	Coef. of Consol., C_v, in^2/min		0.030		

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ONE-DIMENSIONAL CONSOLIDATION PROPERTIES OF SOILS
ASTM D 2435

Client	Civil & Environmental Consultant	Boring	SB-6	**Test Load, tsf**	**1-2**
Client Project	091-867 Apex Landfill Expansion	Depth	9'-10'		Load 10 of 13
Project No.	30598	Sample	ST-2		
		Lab ID#	30598014		
Visual Description	Grayish Brown Clayey Gravel with Sand				
Test Conditions:	Undisturbed, Inundated, and Double Drained				

Time Vs. Dial Reading

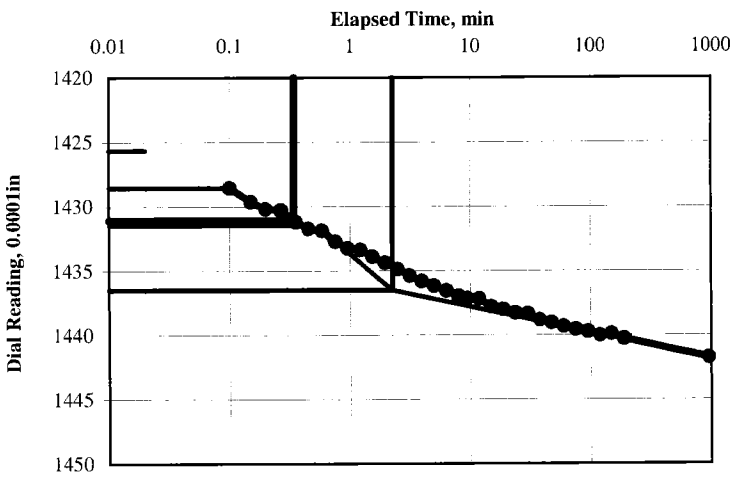
Elapsed Time (min)	Sqrt Time ($min^{1/2}$)	Dial Reading (0.0001in)	Sample Height (in)	Void Ratio
0	0	1401.0	0.8677	0.4089
Corrections*		-4.5	-0.00045	-0.0007
Adjusted Sample Height & Void Ratio				
0.10	0.32	1428.6	0.8654	0.4052
0.15	0.39	1429.6	0.8653	0.4050
0.20	0.45	1430.2	0.8652	0.4049
0.27	0.52	1430.3	0.8652	0.4049
0.35	0.59	1431.2	0.8651	0.4048
0.45	0.67	1431.7	0.8651	0.4047
0.58	0.76	1431.9	0.8651	0.4047
0.75	0.87	1432.7	0.8650	0.4045
0.95	0.97	1433.3	0.8649	0.4044
1.22	1.10	1433.4	0.8649	0.4044
1.53	1.24	1433.9	0.8649	0.4043
1.95	1.40	1434.4	0.8648	0.4042
2.47	1.57	1434.9	0.8648	0.4042
3.12	1.77	1435.4	0.8647	0.4041
3.95	1.99	1435.8	0.8647	0.4040
4.98	2.23	1436.2	0.8646	0.4040
6.30	2.51	1436.5	0.8646	0.4039
7.95	2.82	1437.0	0.8646	0.4038
9.40	3.07	1437.1	0.8645	0.4038
11.85	3.44	1437.2	0.8645	0.4038
14.95	3.87	1437.8	0.8645	0.4037
18.85	4.34	1438.0	0.8644	0.4037
23.77	4.88	1438.3	0.8644	0.4036
29.95	5.47	1438.4	0.8644	0.4036
37.75	6.14	1438.8	0.8644	0.4035
47.57	6.90	1439.0	0.8643	0.4035
59.95	7.74	1439.3	0.8643	0.4034
75.95	8.71	1439.6	0.8643	0.4034
94.95	9.74	1439.7	0.8643	0.4034
119.95	10.95	1440.0	0.8642	0.4033
150.95	12.29	1439.9	0.8643	0.4034
189.95	13.78	1440.3	0.8642	0.4033
954.95	30.90	1441.7	0.8641	0.4031

Machine Deflection

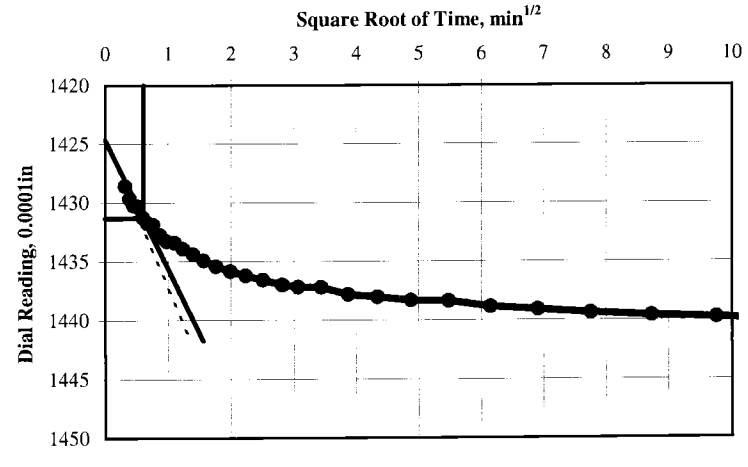
Applied Deflection Correction to Sample Height, 0.0001in -4.5

**Correction is applied to all dial readings.*

Log of Elapsed Time vs. Dial Reading



Square Root of Elapsed Time vs. Dial Reading



Sqrt. of Elapsed Time vs Dial Reading

T0 = 0 min.	D0 = 1424.7 div.
T90 = 0.372 min	D90 = 1431.3 div.
T100 = NA min	D100 = 1432.1 div.
Height at: D90 = 0.8651, D100 = 0.865	
Average Sample Height, in	0.8659
Average Drainage Height, in	0.4329
T (Time Factor for T90)	0.848
Coef. of Consol., C_v, in^2/min	0.426

Log of Elapsed Time vs Dial Reading

T0 = 0 min.	D0 = 1425.7 div.
T50 = 0.34 min.	D50 = 1431.1 div.
T100 = 2.23 min.	D100 = 1436.5 div.
Height at: D50 = 0.8651, D100 = 0.8646	
Average Sample Height, in	0.8659
Average Drainage Height, in	0.4329
T (Time Factor for T50)	0.197
Coef. of Consol., C_v, in^2/min	0.109

Load Summary

Initial Sample Height, in	0.8677
Initial Sample Void Ratio	0.4089
Final Sample Height, in	0.8641
Final Sample Void Ratio	0.4031
Incremental Strain, %	0.42%
Loading Duration, min	954.95

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ONE-DIMENSIONAL CONSOLIDATION PROPERTIES OF SOILS
ASTM D 2435

Client	Civil & Environmental Consultant	Boring	SB-6	**Test Load, tsf**	**2-4**
Client Project	091-867 Apex Landfill Expansion	Depth	9'-10'		Load 11 of 13
Project No.	30598	Sample	ST-2		
		Lab ID#	30598014		
Visual Description	Grayish Brown Clayey Gravel with Sand				
Test Conditions:	Undisturbed, Inundated, and Double Drained				

Time Vs. Dial Reading

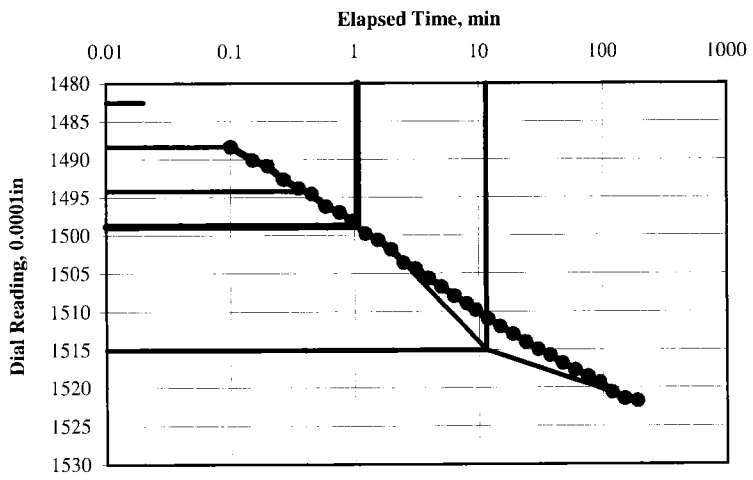
Elapsed Time (min)	Sqrt Time ($min^{1/2}$)	Dial Reading (0.0001in)	Sample Height (in)	Void Ratio
0	0	1441.7	0.8641	0.4031
Corrections*		-6	-0.0006	-0.001
Adjusted Sample Height & Void Ratio				
0.10	0.32	1488.4	0.8600	0.3965
0.15	0.39	1490.1	0.8598	0.3962
0.20	0.45	1490.9	0.8598	0.3961
0.27	0.52	1492.7	0.8596	0.3958
0.35	0.59	1493.8	0.8595	0.3956
0.45	0.67	1494.5	0.8594	0.3955
0.58	0.76	1496.2	0.8592	0.3952
0.75	0.87	1496.9	0.8592	0.3951
0.95	0.97	1498.1	0.8590	0.3949
1.22	1.10	1499.8	0.8589	0.3946
1.53	1.24	1500.6	0.8588	0.3945
1.95	1.40	1501.9	0.8587	0.3943
2.47	1.57	1503.6	0.8585	0.3940
3.12	1.77	1504.4	0.8584	0.3939
3.95	1.99	1505.6	0.8583	0.3937
4.98	2.23	1506.8	0.8582	0.3935
6.30	2.51	1508.0	0.8581	0.3933
7.95	2.82	1509.0	0.8579	0.3931
9.40	3.07	1509.9	0.8579	0.3930
11.85	3.44	1511.0	0.8577	0.3928
14.95	3.87	1512.0	0.8576	0.3926
18.85	4.34	1513.0	0.8575	0.3925
23.77	4.88	1514.0	0.8574	0.3923
29.95	5.47	1515.0	0.8574	0.3921
37.75	6.14	1515.8	0.8573	0.3920
47.57	6.90	1516.8	0.8572	0.3918
59.95	7.74	1517.7	0.8571	0.3917
75.95	8.71	1518.6	0.8570	0.3916
94.95	9.74	1519.3	0.8569	0.3914
119.95	10.95	1520.6	0.8568	0.3912
150.95	12.29	1521.5	0.8567	0.3911
189.95	13.78	1521.8	0.8567	0.3910

Machine Deflection

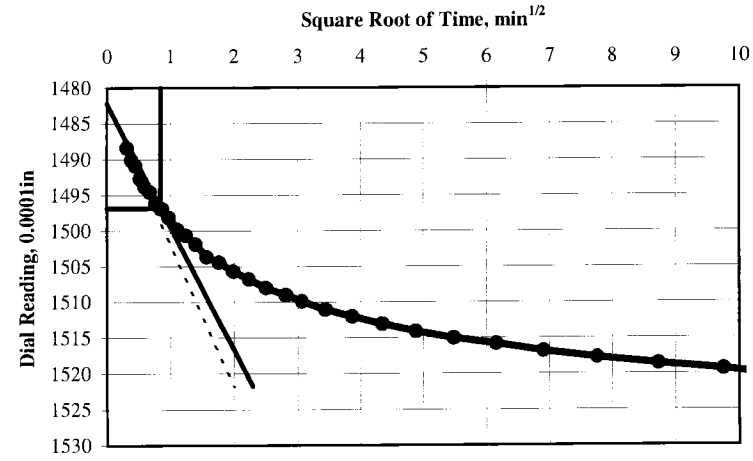
Applied Deflection Correction to Sample Height, 0.0001in -6

**Correction is applied to all dial readings.*

Log of Elapsed Time vs. Dial Reading



Square Root of Elapsed Time vs. Dial Reading



Sqrt. of Elapsed Time vs Dial Reading

T0 = 0 min.	D0 = 1482.2 div.		
T90 = 0.723 min	D90 = 1496.8 div.		
T100 = NA min	D100 = 1498.4 div.		
Height at: D90 = 0.8592, D100 = 0.859			
Average Sample Height, in	0.8604		
Average Drainage Height, in	0.4302		
T (Time Factor for T90)	0.848		
Coef. of Consol., C_v, in^2/min	0.218		

Log of Elapsed Time vs Dial Reading

T0 = 0 min.	D0 = 1482.5 div.		
T50 = 1.05 min.	D50 = 1498.8 div.		
T100 = 11.47 min.	D100 = 1515.1 div.		
Height at: D50 = 0.859, D100 = 0.8573			
Average Sample Height, in	0.8604		
Average Drainage Height, in	0.4302		
T (Time Factor for T50)	0.197		
Coef. of Consol., C_v, in^2/min	0.035		

Load Summary

Initial Sample Height, in	0.8641
Initial Sample Void Ratio	0.4031
Final Sample Height, in	0.8567
Final Sample Void Ratio	0.3910
Incremental Strain, %	0.86%
Loading Duration, min	189.95

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ONE-DIMENSIONAL CONSOLIDATION PROPERTIES OF SOILS
ASTM D 2435

Client	Civil & Environmental Consultant	Boring	SB-6	**Test Load, tsf**	**4-8**
Client Project	091-867 Apex Landfill Expansion	Depth	9'-10'		Load 12 of 13
Project No.	30598	Sample	ST-2		
		Lab ID#	30598014		
Visual Description	Grayish Brown Clayey Gravel with Sand				
Test Conditions:	Undisturbed, Inundated, and Double Drained				

Time Vs. Dial Reading

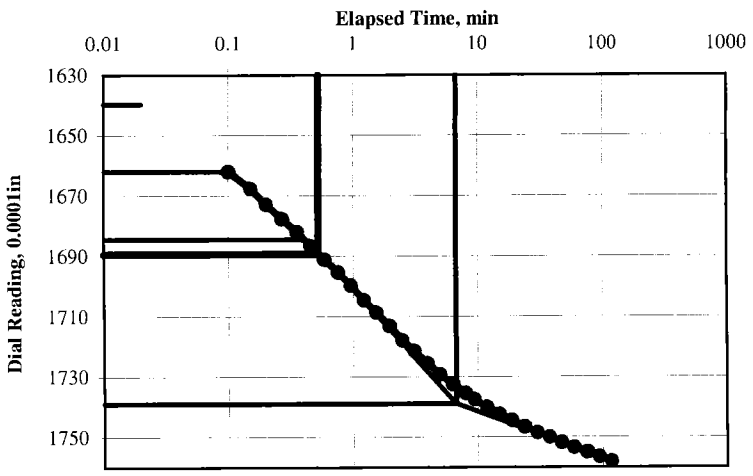
Elapsed Time (min)	Sqrt Time ($min^{1/2}$)	Dial Reading (0.0001in)	Sample Height (in)	Void Ratio
0	0	1521.8	0.8567	0.3910
Corrections*		-11	-0.0011	-0.0018
Adjusted Sample Height & Void Ratio				
0.10	0.32	1662.1	0.8437	0.3700
0.15	0.39	1667.6	0.8432	0.3691
0.20	0.45	1672.8	0.8427	0.3683
0.27	0.52	1677.6	0.8422	0.3675
0.35	0.59	1682.0	0.8417	0.3668
0.45	0.67	1686.6	0.8413	0.3661
0.58	0.76	1691.1	0.8408	0.3653
0.75	0.87	1695.4	0.8404	0.3646
0.95	0.97	1699.8	0.8400	0.3639
1.22	1.10	1704.7	0.8395	0.3631
1.53	1.24	1708.8	0.8391	0.3625
1.95	1.40	1713.2	0.8386	0.3617
2.47	1.57	1718.0	0.8382	0.3610
3.12	1.77	1721.6	0.8378	0.3604
3.95	1.99	1725.6	0.8374	0.3597
4.98	2.23	1729.2	0.8370	0.3591
6.30	2.51	1732.6	0.8367	0.3586
7.95	2.82	1735.5	0.8364	0.3581
9.40	3.07	1737.6	0.8362	0.3578
11.85	3.44	1740.1	0.8359	0.3574
14.95	3.87	1742.4	0.8357	0.3570
18.85	4.34	1744.5	0.8355	0.3566
23.77	4.88	1746.6	0.8353	0.3563
29.95	5.47	1748.5	0.8351	0.3560
37.75	6.14	1750.0	0.8349	0.3558
47.57	6.90	1751.8	0.8348	0.3555
59.95	7.74	1753.5	0.8346	0.3552
75.95	8.71	1755.0	0.8345	0.3550
94.95	9.74	1756.5	0.8343	0.3547
119.95	10.95	1758.0	0.8341	0.3545

Machine Deflection

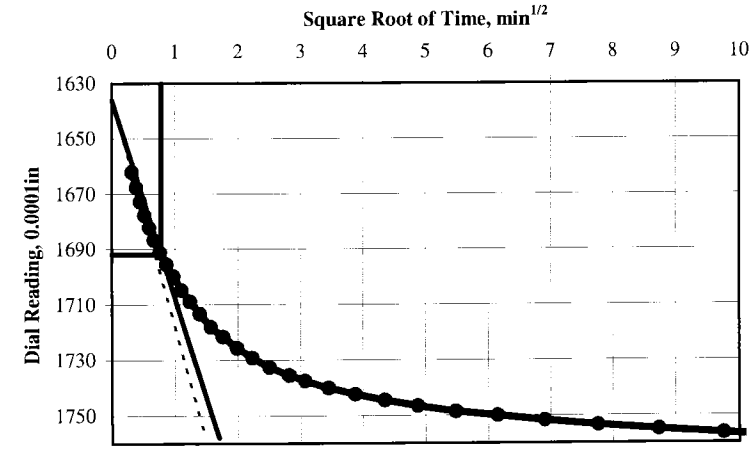
Applied Deflection Correction to Sample Height, 0.0001in -11

**Correction is applied to all dial readings.*

Log of Elapsed Time vs. Dial Reading



Square Root of Elapsed Time vs. Dial Reading



Sqrt. of Elapsed Time vs Dial Reading

T0 = 0 min.	D0 = 1636 div.		
T90 = 0.608 min	D90 = 1692 div.		
T100 = NA min	D100 = 1698.2 div.		
Height at: D90 = 0.8408, D100 = 0.8401			
Average Sample Height, in		0.8454	
Average Drainage Height, in		0.4227	
T (Time Factor for T90)		0.848	
Coef. of Consol., C_v, in^2/min		0.246	

Log of Elapsed Time vs Dial Reading

T0 = 0 min.	D0 = 1639.7 div.		
T50 = 0.53 min.	D50 = 1689.3 div.		
T100 = 6.68 min.	D100 = 1738.9 div.		
Height at: D50 = 0.841, D100 = 0.8361			
Average Sample Height, in		0.8454	
Average Drainage Height, in		0.4227	
T (Time Factor for T50)		0.197	
Coef. of Consol., C_v, in^2/min		0.066	

Load Summary

Initial Sample Height, in	0.8567
Initial Sample Void Ratio	0.3910
Final Sample Height, in	0.8341
Final Sample Void Ratio	0.3545
Incremental Strain, %	2.63%
Loading Duration, min	119.95

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ONE-DIMENSIONAL CONSOLIDATION PROPERTIES OF SOILS
ASTM D 2435

Client	Civil & Environmental Consultant	Boring	SB-6	**Test Load, tsf**	**8-16**
Client Project	091-867 Apex Landfill Expansion	Depth	9'-10'		Load 13 of 13
Project No.	30598	Sample	ST-2		
		Lab ID#	30598014		
Visual Description	Grayish Brown Clayey Gravel with Sand				
Test Conditions:	Undisturbed, Inundated, and Double Drained				

Time Vs. Dial Reading

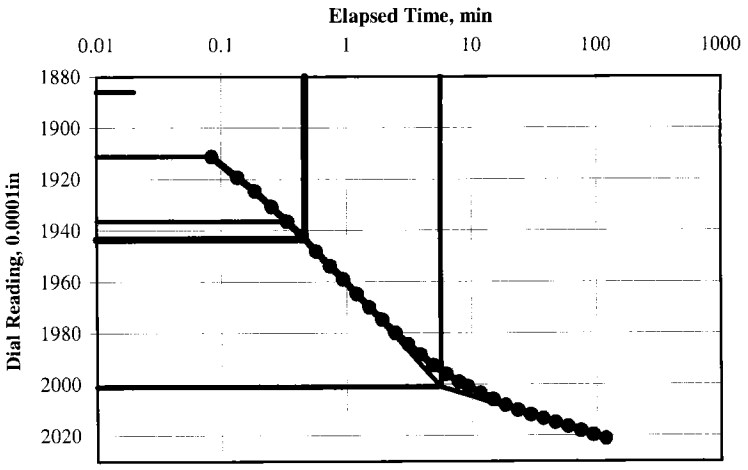
Elapsed Time (min)	Sqrt Time ($min^{1/2}$)	Dial Reading (0.0001in)	Sample Height (in)	Void Ratio
0	0	1758.0	0.8341	0.3545
Corrections*		-16.5	-0.00165	-0.0027
Adjusted Sample Height & Void Ratio				
0.08	0.29	1911.3	0.8205	0.3323
0.13	0.37	1919.4	0.8197	0.3309
0.18	0.43	1924.8	0.8191	0.3301
0.25	0.50	1930.9	0.8185	0.3291
0.33	0.58	1936.6	0.8179	0.3281
0.43	0.66	1942.2	0.8174	0.3272
0.57	0.75	1948.3	0.8168	0.3262
0.73	0.86	1954.0	0.8162	0.3253
0.93	0.97	1959.2	0.8157	0.3245
1.20	1.10	1965.0	0.8151	0.3235
1.52	1.23	1970.2	0.8146	0.3227
1.93	1.39	1975.0	0.8141	0.3219
2.45	1.57	1980.2	0.8136	0.3211
3.10	1.76	1984.6	0.8131	0.3203
3.93	1.98	1988.5	0.8128	0.3197
4.97	2.23	1992.7	0.8123	0.3190
→ 6.28	2.51	1996.1	0.8120	0.3185
7.93	2.82	1999.2	0.8117	0.3180
9.38	3.06	2001.1	0.8115	0.3177
11.83	3.44	2003.5	0.8112	0.3173
14.93	3.86	2006.0	0.8110	0.3169
18.83	4.34	2008.2	0.8108	0.3165
23.75	4.87	2010.2	0.8106	0.3162
29.93	5.47	2012.0	0.8104	0.3159
37.73	6.14	2013.4	0.8103	0.3157
47.55	6.90	2014.9	0.8101	0.3154
59.93	7.74	2016.5	0.8100	0.3152
75.93	8.71	2018.2	0.8098	0.3149
94.93	9.74	2019.8	0.8096	0.3146
→ 119.93	10.95	2021.3	0.8095	0.3144

Machine Deflection

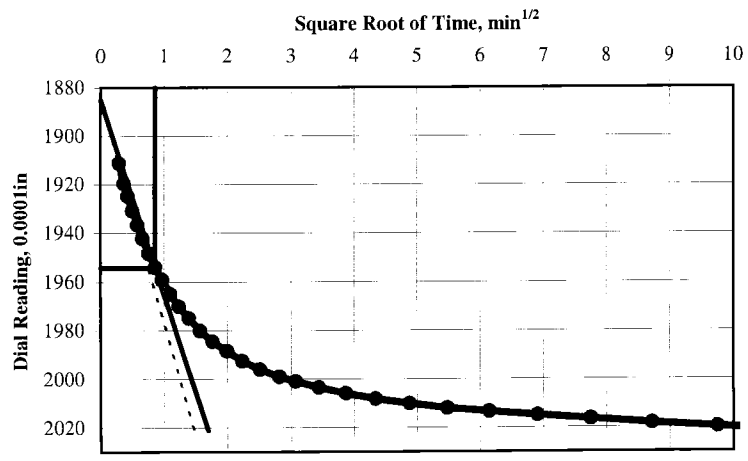
Applied Deflection Correction to Sample Height, 0.0001in -16.5

**Correction is applied to all dial readings.*

Log of Elapsed Time vs. Dial Reading



Square Root of Elapsed Time vs. Dial Reading



Sqrt. of Elapsed Time vs Dial Reading			Log of Elapsed Time vs Dial Reading			Load Summary	
T0 = 0 min.	D0 = 1885.1 div.		T0 = 0 min.	D0 = 1886 div.			
T90 = 0.74 min	D90 = 1954.3 div.		T50 = 0.46 min.	D50 = 1943.5 div.		Initial Sample Height, in	0.8341
T100 = NA min	D100 = 1962 div.		T100 = 5.69 min.	D100 = 2001 div.		Initial Sample Void Ratio	0.3545
Height at: D90 = 0.8162, D100 = 0.8154			Height at: D50 = 0.8173, D100 = 0.8115			Final Sample Height, in	0.8095
Average Sample Height, in		0.8218	Average Sample Height, in		0.8218	Final Sample Void Ratio	0.3144
Average Drainage Height, in		0.4109	Average Drainage Height, in		0.4109	Incremental Strain, %	2.96%
T (Time Factor for T90)		0.848	T (Time Factor for T50)		0.197	Loading Duration, min	119.93333
Coef. of Consol., C_v, in^2/min		0.192	Coef. of Consol., C_v, in^2/min		0.072		

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ONE-DIMENSIONAL CONSOLIDATION PROPERTIES OF SOILS
ASTM D 2435

Client	Civil & Environmental Consultant	Boring	RB-4
Client Project	091-867 Apex Landfill Expansion	Depth	19'-24'
Project No.	30598	Sample	B-1
		Lab Sample No.	30598027

Visual Description: Olive Brown Lean Clay with Sand
Sample Conditions: Remolded, Inundated, and Double Drained
Machine Deflection Correction: Applied

SAMPLE PROPERTIES		
	Initial	Final
Tare Number	Z13	F5
Wt. Tare & WS, gm	174.68	266.37
Wt. Tare & DS, gm	164.74	244.32
Wt. Tare, gm	122.8	123.16
Water Content, %	23.7%	18.2%
Sample Diameter, in	2.5	2.5
Sample Height, in	1.008	0.8416
Sample Volume, in^3	4.9468	4.1313
Wt. WS + Ring, gm	260.73	254.34
Wt. of Ring, gm	110.92	110.92
Wt. of WS, gm	149.81	143.42
Wet Density, pcf	115.32	132.19
Wet Density, g/cc	1.848	2.118
Water Content, %	23.7%	18.2%
Wt. of DS, gm	121.11	121.34
Dry Density, pcf	93.22	111.84
Dry Density, g/cc	1.494	1.792
Void Ratio, e	0.7135	0.4283
Saturation, %	85.0%	
Specific Gravity	2.56	Measured
Height of Solids, in	0.5881	0.5881

TEST DATA SUMMARY

Applied Pressure tsf	Load Duration min	Final Height in	Vertical Strain %	Dry Density g/cc	Void Ratio e	a_v ft^2/ton	Incremental C_c	Incremental C_r
Seating	NA	1.0078	0.00	1.4940	0.7135	NA	NA	NA
0.25	60	1.0044	0.34%	1.4990	0.7078	2.31E-02	NA	NA
0.5	758	0.9938	1.39%	1.5150	0.6898	7.21E-02	0.060	NA
1	380	0.9676	3.98%	1.5559	0.6454	8.88E-02	0.148	NA
2	955	0.9360	7.12%	1.6085	0.5916	5.38E-02	0.179	NA
4	240	0.9050	10.20%	1.6636	0.5388	2.64E-02	0.175	NA
1	302	0.9121	9.49%	1.6506	0.5510	4.05E-03	NA	NA
0.25	955	0.9248	8.23%	1.6279	0.5726	2.88E-02	NA	NA
0.5	380	0.9237	8.34%	1.6299	0.5707	7.55E-03	NA	0.006
1	955	0.9201	8.70%	1.6363	0.5645	1.23E-02	NA	0.020
2	190	0.9131	9.39%	1.6488	0.5526	1.19E-02	NA	0.040
4	190	0.9011	10.58%	1.6708	0.5322	1.02E-02	NA	0.068
8	955	0.8717	13.50%	1.7272	0.4822	1.25E-02	0.166	NA
16	240	0.8416	16.49%	1.7889	0.4311	6.39E-03	0.170	NA

Avg = 0.0339

Note: The calculations performed and the parameters presented herein are for preliminary purposes only. GTS only accepts responsibility for the raw data obtained from the consolidation tests. This data may be interpreted differently by others. It is the responsibility of the user to determine the appropriateness and accuracy of the computed values.

Input Validation | Reviewed By: | Date Tested: 12/20/2010 |

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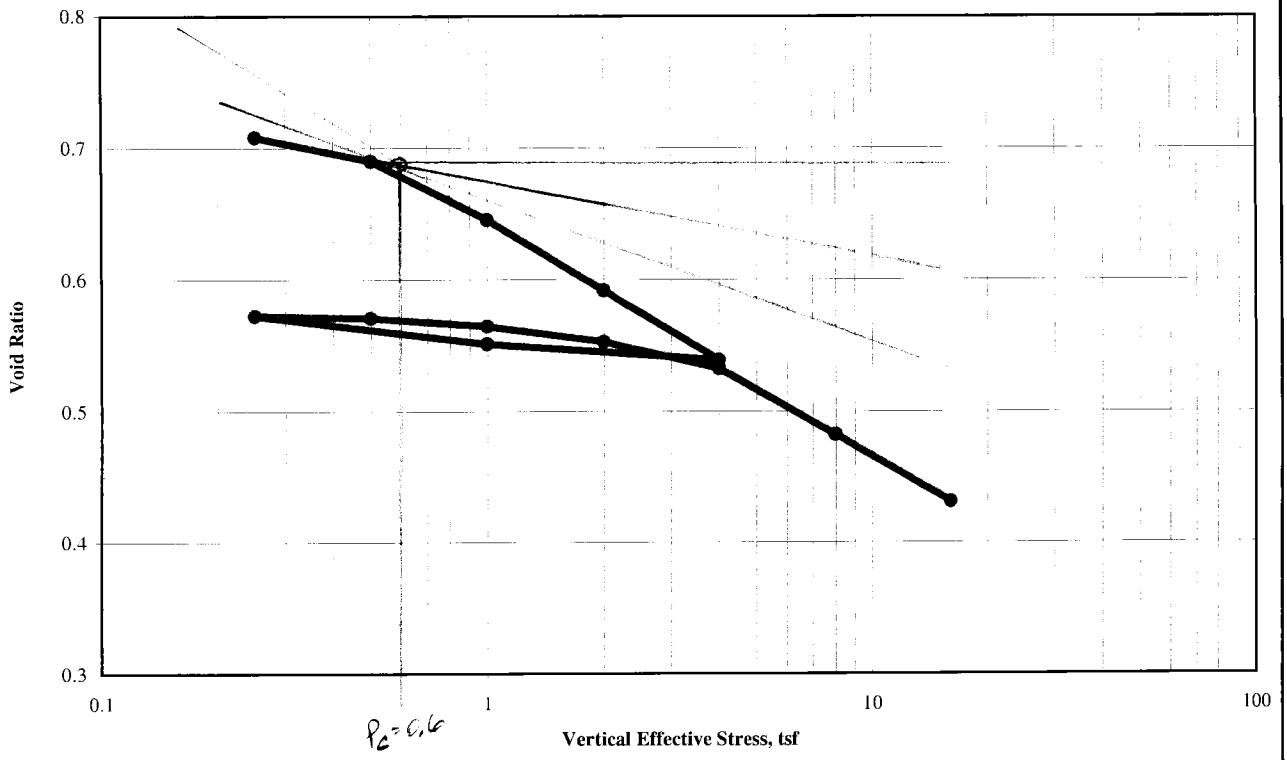
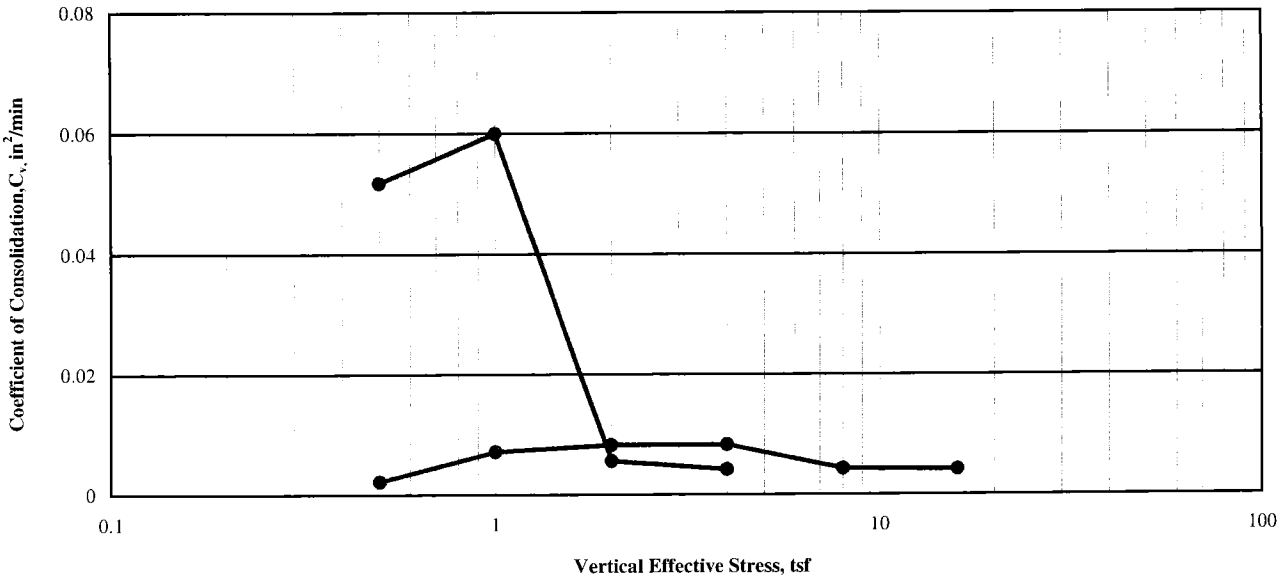
ONE-DIMENSIONAL CONSOLIDATION PROPERTIES OF SOILS
ASTM D 2435

Client	Civil & Environmental Consultants, Inc.	Boring	RB-4
Client Project	091-867 Apex Landfill Expansion	Depth	19'-24'
Project No.	30598	Sample	B-1
		Lab Sample No.	30598027
Visual Description	Olive Brown Lean Clay with Sand		
Sample Conditions	Remolded, Inundated, and Double Drained		
Machine Deflection Correction:	Applied		

Void Ratio (Final Height) vs Vertical Effective Consolidation Stress



Coeffieicent of Consolidation (log. method) vs. Vertical Effective Consolidation Stress



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ONE-DIMENSIONAL CONSOLIDATION PROPERTIES OF SOILS
ASTM D 2435

Client	Civil & Environmental Consultant	Boring	RB-4	**Test Load, tsf**	**0-0.25**
Client Project	091-867 Apex Landfill Expansion	Depth	19'-24'		Load 1 of 13
Project No.	30598	Sample	B-1		
		Lab ID#	30598027		
Visual Description	Olive Brown Lean Clay with Sand				
Test Conditions:	Remolded, Inundated, and Double Drained				

Time Vs. Dial Reading

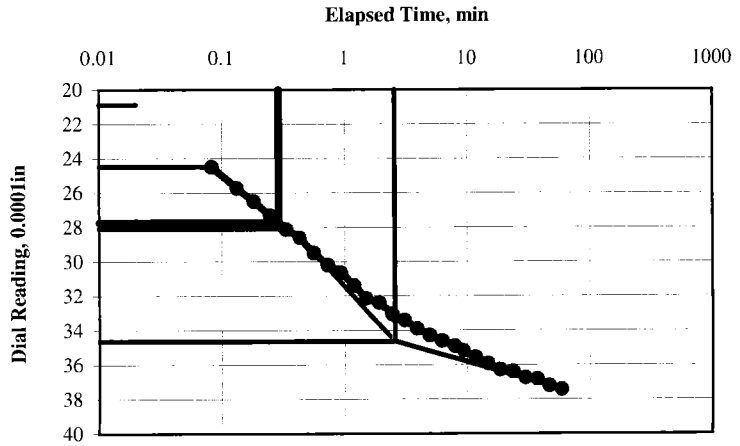
Elapsed Time (min)	Sqrt Time ($min^{1/2}$)	Dial Reading (0.0001in)	Sample Height (in)	Void Ratio
0	0	0	1.0078	0.7135
Corrections*		-3.5	-0.00035	-0.0006
Adjusted Sample Height & Void Ratio				
0.08	0.29	24.5	1.0056	0.7100
0.13	0.37	25.7	1.0055	0.7098
0.18	0.43	26.5	1.0054	0.7096
0.25	0.50	27.3	1.0054	0.7095
0.33	0.58	28.1	1.0053	0.7094
0.43	0.66	28.6	1.0052	0.7093
0.57	0.75	29.5	1.0051	0.7091
0.73	0.86	30.2	1.0051	0.7090
0.93	0.97	30.6	1.0050	0.7089
1.20	1.10	31.4	1.0050	0.7088
1.52	1.23	32.1	1.0049	0.7087
1.93	1.39	32.4	1.0049	0.7086
2.45	1.57	33.1	1.0048	0.7085
3.10	1.76	33.4	1.0048	0.7085
3.93	1.98	33.9	1.0047	0.7084
4.97	2.23	34.3	1.0047	0.7083
6.28	2.51	34.6	1.0046	0.7083
7.93	2.82	34.9	1.0046	0.7082
9.38	3.06	35.2	1.0046	0.7082
11.83	3.44	35.6	1.0045	0.7081
14.93	3.86	35.9	1.0045	0.7080
18.83	4.34	36.3	1.0045	0.7080
23.75	4.87	36.4	1.0045	0.7079
29.93	5.47	36.8	1.0044	0.7079
37.73	6.14	36.8	1.0044	0.7079
47.55	6.90	37.2	1.0044	0.7078
59.93	7.74	37.4	1.0044	0.7078

Machine Deflection

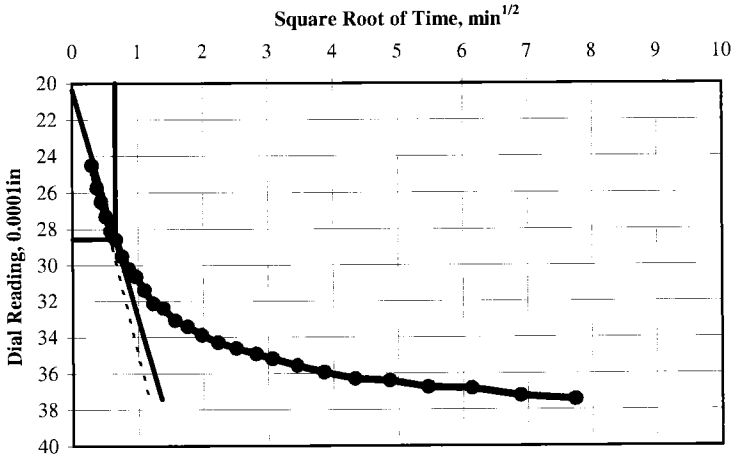
Applied Deflection Correction to Sample Height, 0.0001in -3.5

**Correction is applied to all dial readings.*

Log of Elapsed Time vs. Dial Reading



Square Root of Elapsed Time vs. Dial Reading



Sqrt. of Elapsed Time vs Dial Reading

T0 = 0 min.	D0 = 20.4 div.		
T90 = 0.423 min	D90 = 28.6 div.		
T100 = NA min	D100 = 29.5 div.		
Height at: D90 = 1.0052, D100 = 1.0052			
Average Sample Height, in	1.0061		
Average Drainage Height, in	0.5030		
T (Time Factor for T90)	0.848		
Coef. of Consol., C_v, in^2/min	0.506		

Log of Elapsed Time vs Dial Reading

T0 = 0 min.	D0 = 20.9 div.		
T50 = 0.29 min.	D50 = 27.7 div.		
T100 = 2.56 min.	D100 = 34.6 div.		
Height at: D50 = 1.0053, D100 = 1.0046			
Average Sample Height, in	1.0061		
Average Drainage Height, in	0.5030		
T (Time Factor for T50)	0.197		
Coef. of Consol., C_v, in^2/min	0.172		

Load Summary

Initial Sample Height, in	1.0078
Initial Sample Void Ratio	0.7135
Final Sample Height, in	1.0044
Final Sample Void Ratio	0.7078
Incremental Strain, %	0.34%
Loading Duration, min	59.933333

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ONE-DIMENSIONAL CONSOLIDATION PROPERTIES OF SOILS
ASTM D 2435

Client	Civil & Environmental Consultant	Boring	RB-4	**Test Load, tsf**	**0.25-0.5**
Client Project	091-867 Apex Landfill Expansion	Depth	19'-24'		Load 2 of 13
Project No.	30598	Sample	B-1		
		Lab ID#	30598027		
Visual Description	Olive Brown Lean Clay with Sand				
Test Conditions:	Remolded, Inundated, and Double Drained				

Time Vs. Dial Reading

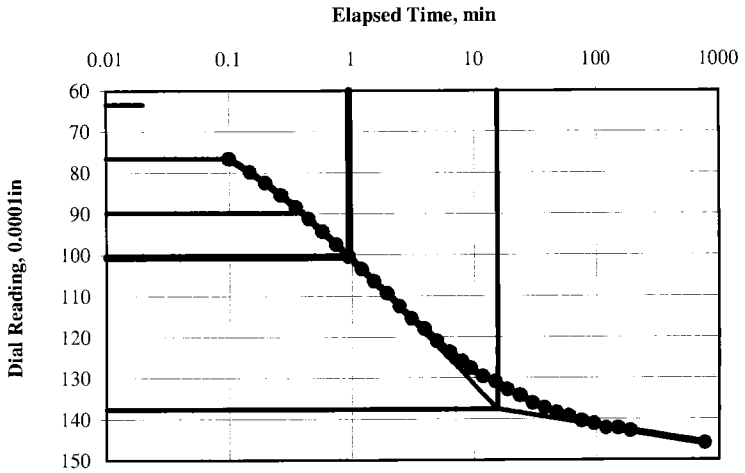
Elapsed Time (min)	Sqrt Time ($min^{1/2}$)	Dial Reading (0.0001in)	Sample Height (in)	Void Ratio
0	0	37.4	1.0044	0.7078
Corrections*		-2.5	-0.00025	-0.0004
Adjusted Sample Height & Void Ratio				
0.10	0.32	76.7	1.0007	0.7015
0.15	0.39	79.9	1.0004	0.7010
0.20	0.45	82.5	1.0001	0.7005
0.27	0.52	85.5	0.9998	0.7000
0.35	0.59	88.4	0.9995	0.6995
0.45	0.67	91.3	0.9992	0.6990
0.58	0.76	94.3	0.9989	0.6985
0.75	0.87	97.5	0.9986	0.6980
0.95	0.97	100.4	0.9983	0.6975
1.22	1.10	103.5	0.9980	0.6970
1.53	1.24	106.4	0.9977	0.6965
1.95	1.40	109.4	0.9974	0.6960
2.47	1.57	112.6	0.9971	0.6954
3.12	1.77	115.5	0.9968	0.6949
3.95	1.99	118.0	0.9966	0.6945
4.98	2.23	121.0	0.9963	0.6940
6.30	2.51	123.7	0.9960	0.6935
7.95	2.82	125.9	0.9958	0.6932
9.40	3.07	127.6	0.9956	0.6929
11.85	3.44	129.6	0.9954	0.6925
14.95	3.87	130.9	0.9953	0.6923
→ 18.85	4.34	132.8	0.9951	0.6920
23.77	4.88	134.2	0.9949	0.6917
29.95	5.47	136.1	0.9947	0.6914
37.75	6.14	137.2	0.9946	0.6912
47.57	6.90	138.5	0.9945	0.6910
59.95	7.74	139.3	0.9944	0.6909
75.95	8.71	140.5	0.9943	0.6907
94.95	9.74	141.2	0.9942	0.6906
119.95	10.95	142.2	0.9941	0.6904
150.95	12.29	142.2	0.9941	0.6904
189.95	13.78	142.9	0.9941	0.6903
→ 757.95	27.53	145.9	0.9938	0.6898

Machine Deflection

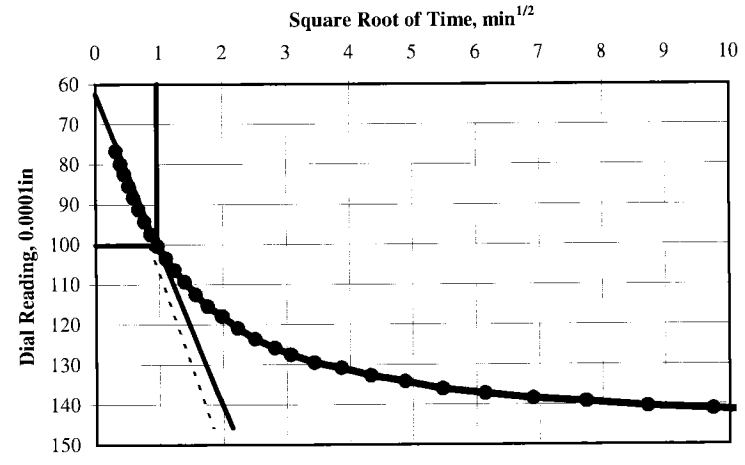
Applied Deflection Correction to Sample Height, 0.0001in: -2.5

**Correction is applied to all dial readings.*

Log of Elapsed Time vs. Dial Reading



Square Root of Elapsed Time vs. Dial Reading



Sqrt. of Elapsed Time vs Dial Reading			Log of Elapsed Time vs Dial Reading			Load Summary	
T0 = 0 min.	D0 = 62.5 div.		T0 = 0 min.	D0 = 63.4 div.			
T90 = 0.941 min	D90 = 100.3 div.		T50 = 0.95 min.	D50 = 100.5 div.		Initial Sample Height, in	1.0044
T100 = NA min	D100 = 104.5 div.		T100 = 15.52 min.	D100 = 137.6 div.		Initial Sample Void Ratio	0.7078
Height at: D90 = 0.9983, D100 = 0.9979			Height at: D50 = 0.9983, D100 = 0.9946			Final Sample Height, in	0.9938
Average Sample Height, in		0.9991	Average Sample Height, in		0.9991	Final Sample Void Ratio	0.6898
Average Drainage Height, in		0.4995	Average Drainage Height, in		0.4995	Incremental Strain, %	1.05%
T (Time Factor for T90)		0.848	T (Time Factor for T50)		0.197	Loading Duration, min	757.95
Coef. of Consol., C_v, in^2/min		0.225	Coef. of Consol., C_v, in^2/min		0.052		

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ONE-DIMENSIONAL CONSOLIDATION PROPERTIES OF SOILS
ASTM D 2435

Client	Civil & Environmental Consultant	Boring	RB-4	**Test Load, tsf**	**0.5-1**
Client Project	091-867 Apex Landfill Expansion	Depth	19'-24'		Load 3 of 13
Project No.	30598	Sample	B-1		
		Lab ID#	30598027		
Visual Description	Olive Brown Lean Clay with Sand				
Test Conditions:	Remolded, Inundated, and Double Drained				

Time Vs. Dial Reading

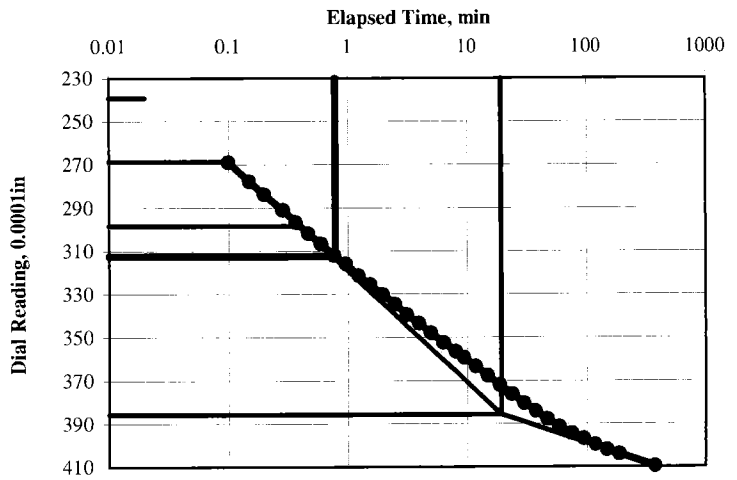
Elapsed Time (min)	Sqrt Time ($min^{1/2}$)	Dial Reading (0.0001in)	Sample Height (in)	Void Ratio
0	0	145.9	0.9938	0.6898
Corrections*		-2.5	-0.00025	-0.0004
Adjusted Sample Height & Void Ratio				
0.10	0.32	268.9	0.9817	0.6693
0.15	0.39	277.8	0.9808	0.6677
0.20	0.45	283.8	0.9802	0.6667
0.28	0.53	291.0	0.9795	0.6655
0.37	0.61	296.8	0.9789	0.6645
0.47	0.68	301.9	0.9784	0.6637
0.60	0.77	306.7	0.9779	0.6628
0.77	0.88	312.0	0.9774	0.6619
0.97	0.98	316.0	0.9770	0.6613
1.23	1.11	321.4	0.9765	0.6603
1.55	1.24	325.6	0.9760	0.6596
1.97	1.40	330.3	0.9756	0.6588
2.48	1.58	334.7	0.9751	0.6581
3.13	1.77	339.5	0.9747	0.6573
3.97	1.99	343.5	0.9743	0.6566
5.00	2.24	348.0	0.9738	0.6558
6.32	2.51	352.4	0.9734	0.6551
7.97	2.82	356.5	0.9729	0.6544
9.42	3.07	359.3	0.9727	0.6539
11.87	3.44	363.3	0.9723	0.6532
14.97	3.87	367.6	0.9718	0.6525
18.87	4.34	372.0	0.9714	0.6517
→ 23.78	4.88	376.2	0.9710	0.6510
29.97	5.47	380.5	0.9705	0.6503
37.77	6.15	384.1	0.9702	0.6497
47.58	6.90	387.8	0.9698	0.6490
59.97	7.74	391.3	0.9695	0.6485
75.97	8.72	394.4	0.9692	0.6479
94.97	9.75	396.9	0.9689	0.6475
119.97	10.95	399.6	0.9686	0.6470
150.97	12.29	402.0	0.9684	0.6466
189.97	13.78	404.0	0.9682	0.6463
→ 379.97	19.49	409.5	0.9676	0.6454

Machine Deflection

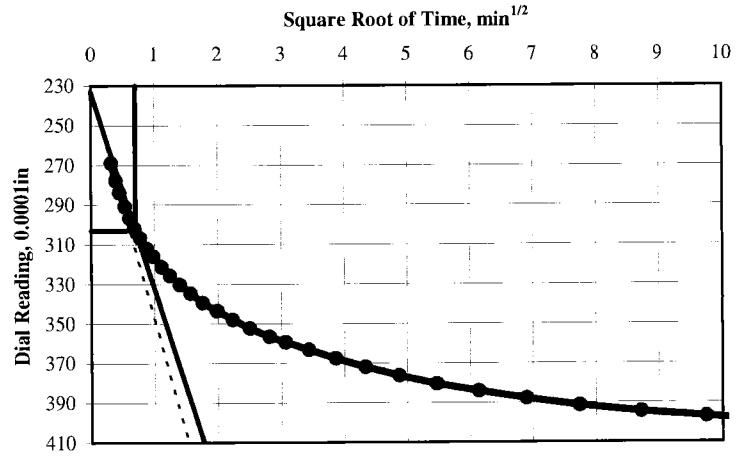
Applied Deflection Correction to Sample Height, 0.0001in -2.5

**Correction is applied to all dial readings.*

Log of Elapsed Time vs. Dial Reading



Square Root of Elapsed Time vs. Dial Reading



Sqrt. of Elapsed Time vs Dial Reading			Log of Elapsed Time vs Dial Reading			Load Summary	
T0 = 0 min.	D0 = 233.1 div.		T0 = 0 min.	D0 = 239.2 div.			
T90 = 0.49 min	D90 = 303 div.		T50 = 0.79 min.	D50 = 312.4 div.		Initial Sample Height, in	0.9938
T100 = NA min	D100 = 310.7 div.		T100 = 19.41 min.	D100 = 385.6 div.		Initial Sample Void Ratio	0.6898
Height at: D90 = 0.9783, D100 = 0.9775			Height at: D50 = 0.9774, D100 = 0.97			Final Sample Height, in	0.9676
Average Sample Height, in		0.9807	Average Sample Height, in		0.9807	Final Sample Void Ratio	0.6454
Average Drainage Height, in		0.4904	Average Drainage Height, in		0.4904	Incremental Strain, %	2.63%
T (Time Factor for T90)		0.848	T (Time Factor for T50)		0.197	Loading Duration, min	379.96667
Coef. of Consol., C_v, in^2/min		0.411	Coef. of Consol., C_v, in^2/min		0.060		

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ONE-DIMENSIONAL CONSOLIDATION PROPERTIES OF SOILS
ASTM D 2435

Client	Civil & Environmental Consultant	Boring	RB-4	**Test Load, tsf**	**1-2**
Client Project	091-867 Apex Landfill Expansion	Depth	19'-24'		Load 4 of 13
Project No.	30598	Sample	B-1		
		Lab ID#	30598027		
Visual Description	Olive Brown Lean Clay with Sand				
Test Conditions:	Remolded, Inundated, and Double Drained				

Time Vs. Dial Reading

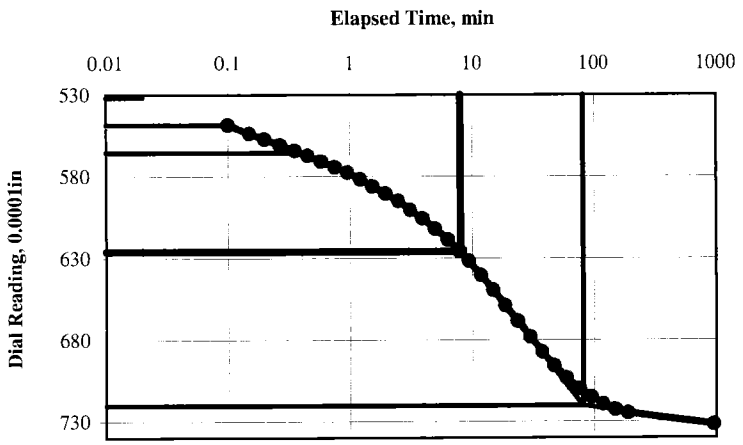
Elapsed Time (min)	Sqrt Time ($min^{1/2}$)	Dial Reading (0.0001in)	Sample Height (in)	Void Ratio
0	0	409.5	0.9676	0.6454
Corrections*		-6	-0.0006	-0.001
Adjusted Sample Height & Void Ratio				
0.10	0.32	548.7	0.9543	0.6227
0.15	0.39	553.9	0.9538	0.6218
0.20	0.45	557.3	0.9535	0.6213
0.27	0.52	560.9	0.9531	0.6206
0.35	0.59	564.2	0.9528	0.6201
0.45	0.67	567.3	0.9525	0.6195
0.58	0.76	570.9	0.9521	0.6189
0.75	0.87	574.4	0.9518	0.6183
0.95	0.97	577.7	0.9514	0.6178
1.22	1.10	581.8	0.9510	0.6171
1.53	1.24	586.1	0.9506	0.6164
1.95	1.40	590.4	0.9502	0.6156
2.47	1.57	595.1	0.9497	0.6148
3.12	1.77	600.4	0.9492	0.6139
3.95	1.99	605.7	0.9486	0.6130
4.98	2.23	611.9	0.9480	0.6120
6.30	2.51	618.5	0.9474	0.6108
7.95	2.82	626.0	0.9466	0.6096
9.40	3.07	631.7	0.9460	0.6086
11.85	3.44	640.3	0.9452	0.6071
14.95	3.87	649.4	0.9443	0.6056
18.85	4.34	658.9	0.9433	0.6040
23.77	4.88	668.3	0.9424	0.6024
29.95	5.47	678.1	0.9414	0.6007
37.75	6.14	687.2	0.9405	0.5992
47.57	6.90	695.7	0.9396	0.5977
59.95	7.74	703.3	0.9389	0.5964
75.95	8.71	709.9	0.9382	0.5953
→ 94.95	9.74	714.9	0.9377	0.5944
119.95	10.95	719.3	0.9373	0.5937
150.95	12.29	722.7	0.9369	0.5931
189.95	13.78	724.7	0.9367	0.5928
→ 954.95	30.90	731.7	0.9360	0.5916

Machine Deflection

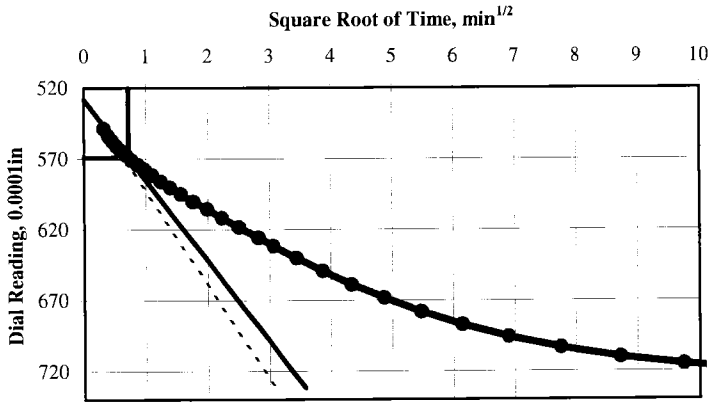
Applied Deflection Correction to Sample Height, 0.0001in: -6

**Correction is applied to all dial readings.*

Log of Elapsed Time vs. Dial Reading



Square Root of Elapsed Time vs. Dial Reading



Sqrt. of Elapsed Time vs Dial Reading		Log of Elapsed Time vs Dial Reading		Load Summary	
T0 = 0 min.	D0 = 528.2 div.	T0 = 0 min.	D0 = 531.6 div.		
T90 = 0.518 min	D90 = 569.2 div.	T50 = 7.94 min.	D50 = 625.9 div.	Initial Sample Height, in	0.9676
T100 = NA min	D100 = 573.8 div.	T100 = 80.83 min.	D100 = 720.2 div.	Initial Sample Void Ratio	0.6454
Height at: D90 = 0.9523, D100 = 0.9518		Height at: D50 = 0.9466, D100 = 0.9372		Final Sample Height, in	0.9360
Average Sample Height, in	0.9518	Average Sample Height, in	0.9518	Final Sample Void Ratio	0.5916
Average Drainage Height, in	0.4759	Average Drainage Height, in	0.4759	Incremental Strain, %	3.27%
T (Time Factor for T90)	0.848	T (Time Factor for T50)	0.197	Loading Duration, min	954.95
Coef. of Consol., C_v, in^2/min	0.370	Coef. of Consol., C_v, in^2/min	0.006		

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ONE-DIMENSIONAL CONSOLIDATION PROPERTIES OF SOILS
ASTM D 2435

Client	Civil & Environmental Consultant	Boring	RB-4	**Test Load, tsf**	**2-4**
Client Project	091-867 Apex Landfill Expansion	Depth	19'-24'		Load 5 of 13
Project No.	30598	Sample	B-1		
		Lab ID#	30598027		
Visual Description	Olive Brown Lean Clay with Sand				
Test Conditions:	Remolded, Inundated, and Double Drained				

Time Vs. Dial Reading

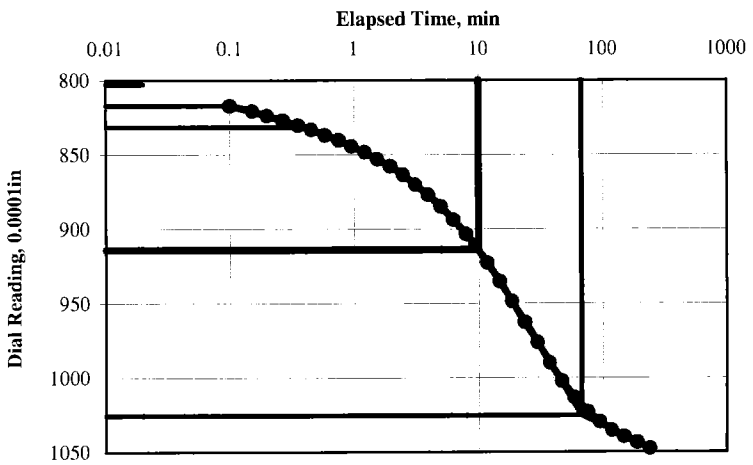
Elapsed Time (min)	Sqrt Time ($min^{1/2}$)	Dial Reading (0.0001in)	Sample Height (in)	Void Ratio
0	0	731.7	0.9360	0.5916
Corrections*		-5.5	-0.00055	-0.0009
Adjusted Sample Height & Void Ratio				
0.10	0.32	817.3	0.9280	0.5780
0.15	0.39	820.9	0.9277	0.5774
0.20	0.45	824.1	0.9273	0.5768
0.27	0.52	827.2	0.9270	0.5763
0.35	0.59	830.3	0.9267	0.5758
0.45	0.67	833.2	0.9264	0.5753
0.58	0.76	836.9	0.9261	0.5746
0.75	0.87	840.3	0.9257	0.5741
0.95	0.97	844.3	0.9253	0.5734
1.22	1.10	848.4	0.9249	0.5727
1.53	1.24	853.1	0.9244	0.5719
1.95	1.40	857.9	0.9240	0.5711
2.47	1.57	863.6	0.9234	0.5701
3.12	1.77	870.2	0.9227	0.5690
3.95	1.99	877.1	0.9220	0.5678
4.98	2.23	884.9	0.9213	0.5665
6.30	2.51	893.7	0.9204	0.5650
7.95	2.82	903.6	0.9194	0.5633
9.40	3.07	911.2	0.9186	0.5620
11.85	3.44	922.7	0.9175	0.5600
14.95	3.87	935.3	0.9162	0.5579
18.85	4.34	948.7	0.9149	0.5556
23.77	4.88	962.6	0.9135	0.5533
29.95	5.47	976.3	0.9121	0.5509
37.75	6.14	989.9	0.9108	0.5486
47.57	6.90	1002.3	0.9095	0.5465
59.95	7.74	1013.2	0.9084	0.5447
→ 75.95	8.71	1022.7	0.9075	0.5431
94.95	9.74	1029.5	0.9068	0.5419
119.95	10.95	1035.3	0.9062	0.5409
150.95	12.29	1039.4	0.9058	0.5402
189.95	13.78	1043.5	0.9054	0.5395
→ 239.95	15.49	1047.5	0.9050	0.5388

Machine Deflection

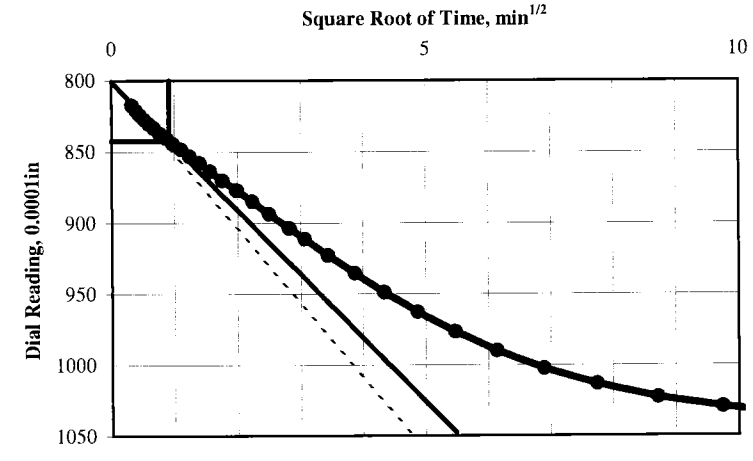
Applied Deflection Correction to Sample Height, 0.0001in -5.5

**Correction is applied to all dial readings.*

Log of Elapsed Time vs. Dial Reading



Square Root of Elapsed Time vs. Dial Reading



Sqrt. of Elapsed Time vs Dial Reading		Log of Elapsed Time vs Dial Reading		Load Summary	
T0 = 0 min.	D0 = 800.9 div.	T0 = 0 min.	D0 = 802.8 div.		
T90 = 0.846 min	D90 = 842.3 div.	T50 = 9.97 min.	D50 = 914.1 div.	Initial Sample Height, in	0.9360
T100 = NA min	D100 = 846.9 div.	T100 = 68.11 min.	D100 = 1025.5 div.	Initial Sample Void Ratio	0.5916
Height at: D90 = 0.9255, D100 = 0.9251		Height at: D50 = 0.9183, D100 = 0.9072		Final Sample Height, in	0.9050
Average Sample Height, in	0.9205	Average Sample Height, in	0.9205	Final Sample Void Ratio	0.5388
Average Drainage Height, in	0.4603	Average Drainage Height, in	0.4603	Incremental Strain, %	3.32%
T (Time Factor for T90)	0.848	T (Time Factor for T50)	0.197	Loading Duration, min	239.95
Coef. of Consol., C_v, in^2/min	0.212	Coef. of Consol., C_v, in^2/min	0.004		

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ONE-DIMENSIONAL CONSOLIDATION PROPERTIES OF SOILS
ASTM D 2435

Client	Civil & Environmental Consultant	Boring	RB-4	**Test Load, tsf**	**4-1**
Client Project	091-867 Apex Landfill Expansion	Depth	19'-24'		Load 6 of 13
Project No.	30598	Sample	B-1		
		Lab ID#	30598027		
Visual Description	Olive Brown Lean Clay with Sand				
Test Conditions:	Remolded, Inundated, and Double Drained				

Time Vs. Dial Reading

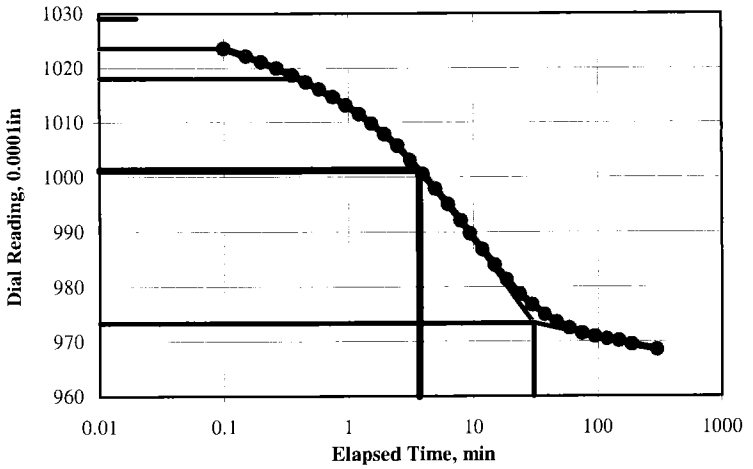
Elapsed Time (min)	Sqrt Time ($min^{1/2}$)	Dial Reading (0.0001in)	Sample Height (in)	Void Ratio
0	0	1047.5	0.9050	0.5388
Corrections*		7.5	0.00075	0.00128
Adjusted Sample Height & Void Ratio				
0.10	0.32	1023.5	0.9066	0.5416
0.15	0.39	1022.1	0.9068	0.5419
0.20	0.45	1021.1	0.9069	0.5421
0.27	0.52	1019.9	0.9070	0.5422
0.35	0.59	1018.6	0.9071	0.5425
0.45	0.67	1017.4	0.9073	0.5427
0.58	0.76	1016.0	0.9074	0.5429
0.75	0.87	1014.6	0.9075	0.5431
0.95	0.97	1013.1	0.9077	0.5434
1.22	1.10	1011.5	0.9079	0.5437
1.53	1.24	1009.8	0.9080	0.5440
1.95	1.40	1007.8	0.9082	0.5443
2.47	1.57	1005.7	0.9084	0.5447
3.12	1.77	1003.1	0.9087	0.5451
3.95	1.99	1000.5	0.9089	0.5455
4.98	2.23	997.9	0.9092	0.5460
6.30	2.51	995.1	0.9095	0.5465
7.95	2.82	992.0	0.9098	0.5470
9.40	3.07	989.7	0.9100	0.5474
11.85	3.44	986.8	0.9103	0.5479
14.95	3.87	983.9	0.9106	0.5484
18.85	4.34	981.2	0.9109	0.5488
23.77	4.88	978.6	0.9111	0.5493
29.95	5.47	976.6	0.9113	0.5496
37.75	6.14	974.9	0.9115	0.5499
47.57	6.90	973.5	0.9116	0.5501
59.95	7.74	972.4	0.9118	0.5503
75.95	8.71	971.5	0.9118	0.5505
94.95	9.74	970.9	0.9119	0.5506
119.95	10.95	970.5	0.9120	0.5507
150.95	12.29	970.1	0.9120	0.5507
189.95	13.78	969.5	0.9121	0.5508
301.95	17.38	968.5	0.9121	0.5510

Machine Deflection

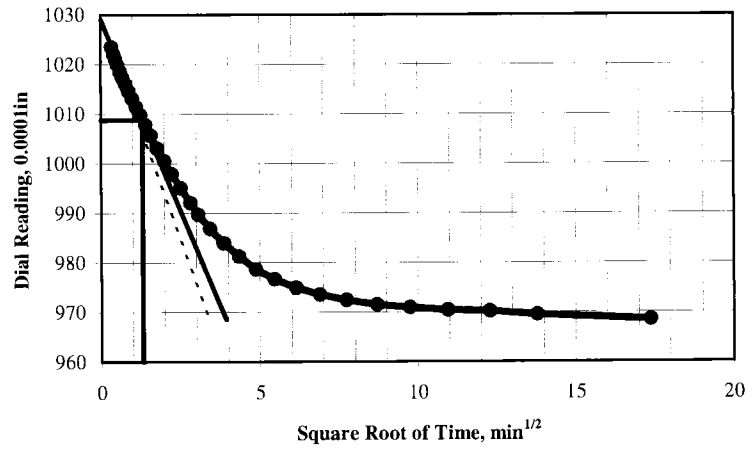
Applied Deflection Correction to Sample Height, 0.0001in 7.5

**Correction is applied to all dial readings.*

Log of Elapsed Time vs. Dial Reading



Square Root of Elapsed Time vs. Dial Reading



Sqrt. of Elapsed Time vs Dial Reading		Log of Elapsed Time vs Dial Reading		Load Summary	
T0 = 0 min.	D0 = 1029 div.	T0 = 0 min.	D0 = 1029.1 div.		
T90 = 1.716 min	D90 = 1008.8 div.	T50 = 3.71 min.	D50 = 1001.2 div.	Initial Sample Height, in	0.9050
T100 = NA min	D100 = 1006.6 div.	T100 = 30.47 min.	D100 = 973.4 div.	Initial Sample Void Ratio	0.5388
Height at: D90 = 0.9081, D100 = 0.9083		Height at: D50 = 0.9089, D100 = 0.9117		Final Sample Height, in	0.9121
Average Sample Height, in	0.9086	Average Sample Height, in	0.9086	Final Sample Void Ratio	0.5510
Average Drainage Height, in	0.4543	Average Drainage Height, in	0.4543	Incremental Strain, %	-0.79%
T (Time Factor for T90)	0.848	T (Time Factor for T50)	0.197	Loading Duration, min	301.95
Coef. of Consol., C_v, in^2/min	0.102	Coef. of Consol., C_v, in^2/min	0.011		

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ONE-DIMENSIONAL CONSOLIDATION PROPERTIES OF SOILS
ASTM D 2435

Client	Civil & Environmental Consultant	Boring	RB-4	**Test Load, tsf**	**1-0.25**
Client Project	091-867 Apex Landfill Expansion	Depth	19'-24'		Load 7 of 13
Project No.	30598	Sample	B-1		
		Lab ID#	30598027		
Visual Description	Olive Brown Lean Clay with Sand				
Test Conditions:	Remolded, Inundated, and Double Drained				

Time Vs. Dial Reading

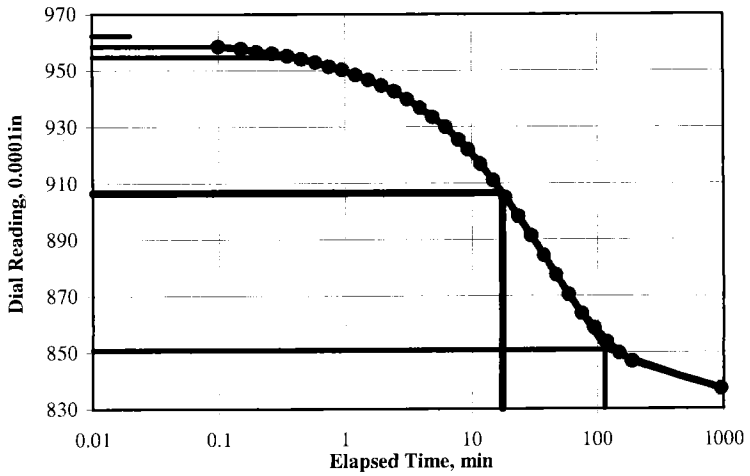
Elapsed Time (min)	Sqrt Time ($min^{1/2}$)	Dial Reading (0.0001in)	Sample Height (in)	Void Ratio
0	0	968.5	0.9121	0.5510
Corrections*		4.5	0.00045	0.00077
Adjusted Sample Height & Void Ratio				
0.10	0.32	958.4	0.9127	0.5519
0.15	0.39	957.7	0.9128	0.5521
0.20	0.45	956.6	0.9129	0.5523
0.27	0.52	956.0	0.9129	0.5523
0.35	0.59	955.1	0.9130	0.5525
0.45	0.67	954.1	0.9131	0.5527
0.58	0.76	952.9	0.9133	0.5529
0.75	0.87	951.3	0.9134	0.5531
0.95	0.97	950.2	0.9135	0.5533
1.22	1.10	948.3	0.9137	0.5536
1.53	1.24	946.6	0.9139	0.5539
1.95	1.40	944.6	0.9141	0.5543
2.47	1.57	942.6	0.9143	0.5546
3.12	1.77	939.7	0.9146	0.5551
3.95	1.99	936.7	0.9149	0.5556
4.98	2.23	933.4	0.9152	0.5562
6.30	2.51	929.8	0.9156	0.5568
7.95	2.82	925.4	0.9160	0.5576
9.40	3.07	921.9	0.9164	0.5581
11.85	3.44	916.7	0.9169	0.5590
14.95	3.87	910.9	0.9175	0.5600
18.85	4.34	904.9	0.9181	0.5610
23.77	4.88	898.2	0.9187	0.5622
29.95	5.47	891.3	0.9194	0.5633
37.75	6.14	884.4	0.9201	0.5645
47.57	6.90	877.4	0.9208	0.5657
59.95	7.74	870.5	0.9215	0.5669
75.95	8.71	863.8	0.9222	0.5680
94.95	9.74	858.6	0.9227	0.5689
119.95	10.95	853.7	0.9232	0.5697
150.95	12.29	849.8	0.9236	0.5704
189.95	13.78	846.9	0.9239	0.5709
954.95	30.90	837.1	0.9248	0.5726

Machine Deflection

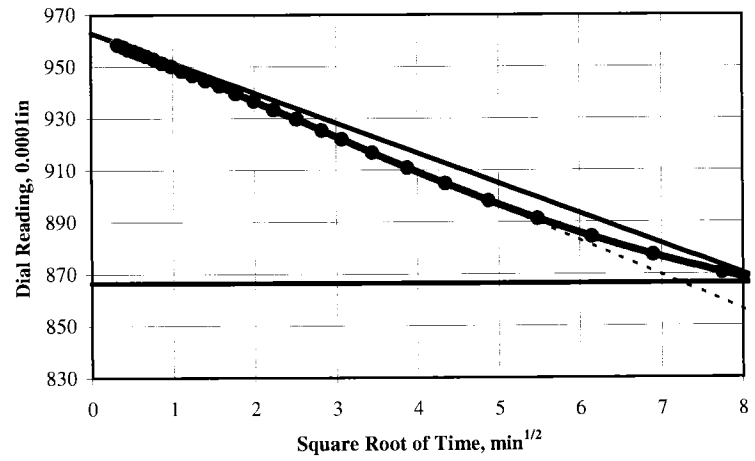
Applied Deflection Correction to Sample Height, 0.0001in 4.5

**Correction is applied to all dial readings.*

Log of Elapsed Time vs. Dial Reading



Square Root of Elapsed Time vs. Dial Reading



Sqrt. of Elapsed Time vs Dial Reading		Log of Elapsed Time vs Dial Reading		Load Summary	
T0 = 0 min.	D0 = 963 div.	T0 = 0 min.	D0 = 962.3 div.		
T90 = 69.056 min	D90 = 866.6 div.	T50 = 17.62 min.	D50 = 906.7 div.	Initial Sample Height, in	0.9121
T100 = NA min	D100 = 855.9 div.	T100 = 113.9 min.	D100 = 851 div.	Initial Sample Void Ratio	0.5510
Height at: D90 = 0.9219, D100 = 0.923		Height at: D50 = 0.9179, D100 = 0.9235		Final Sample Height, in	0.9248
Average Sample Height, in	0.9185	Average Sample Height, in	0.9185	Final Sample Void Ratio	0.5726
Average Drainage Height, in	0.4592	Average Drainage Height, in	0.4592	Incremental Strain, %	-1.39%
T (Time Factor for T90)	0.848	T (Time Factor for T50)	0.197	Loading Duration, min	954.95
Coef. of Consol., C_v, in^2/min	0.003	Coef. of Consol., C_v, in^2/min	0.002		

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ONE-DIMENSIONAL CONSOLIDATION PROPERTIES OF SOILS
ASTM D 2435

Client	Civil & Environmental Consultant	Boring	RB-4	**Test Load, tsf**	**0.25-0.5**
Client Project	091-867 Apex Landfill Expansion	Depth	19'-24'		Load 8 of 13
Project No.	30598	Sample	B-1		
		Lab ID#	30598027		
Visual Description	Olive Brown Lean Clay with Sand				
Test Conditions:	Remolded, Inundated, and Double Drained				

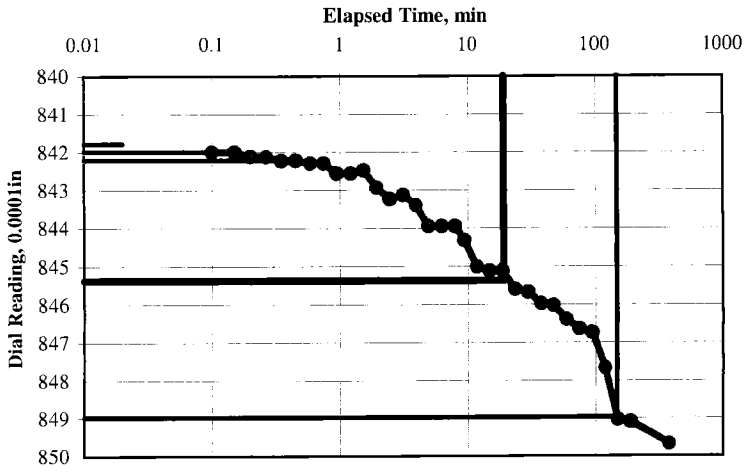
Time Vs. Dial Reading				
Elapsed Time (min)	**Sqrt Time ($min^{1/2}$)**	**Dial Reading (0.0001in)**	**Sample Height (in)**	**Void Ratio**
0	0	837.1	0.9248	0.5726
Corrections*		-1.5	-0.00015	-0.0003
Adjusted Sample Height & Void Ratio				
0.10	0.32	842.0	0.9245	0.5720
0.15	0.39	842.0	0.9245	0.5720
0.20	0.45	842.1	0.9245	0.5720
0.27	0.52	842.1	0.9245	0.5720
0.35	0.59	842.2	0.9245	0.5719
0.45	0.67	842.2	0.9245	0.5719
0.58	0.76	842.3	0.9245	0.5719
0.75	0.87	842.3	0.9245	0.5719
0.95	0.97	842.6	0.9244	0.5719
1.22	1.10	842.6	0.9244	0.5719
1.53	1.24	842.5	0.9245	0.5719
1.95	1.40	842.9	0.9244	0.5718
2.47	1.57	843.2	0.9244	0.5718
3.12	1.77	843.1	0.9244	0.5718
3.95	1.99	843.4	0.9244	0.5717
4.98	2.23	843.9	0.9243	0.5717
6.30	2.51	843.9	0.9243	0.5717
7.95	2.82	843.9	0.9243	0.5717
9.40	3.07	844.3	0.9243	0.5716
11.85	3.44	845.0	0.9242	0.5715
14.95	3.87	845.1	0.9242	0.5715
18.85	4.34	845.1	0.9242	0.5715
23.77	4.88	845.6	0.9241	0.5714
29.95	5.47	845.7	0.9241	0.5714
37.75	6.14	846.0	0.9241	0.5713
47.57	6.90	846.0	0.9241	0.5713
59.95	7.74	846.4	0.9241	0.5712
75.95	8.71	846.6	0.9240	0.5712
94.95	9.74	846.7	0.9240	0.5712
119.95	10.95	847.7	0.9239	0.5710
150.95	12.29	849.0	0.9238	0.5708
189.95	13.78	849.1	0.9238	0.5708
379.95	19.49	849.7	0.9237	0.5707

Machine Deflection

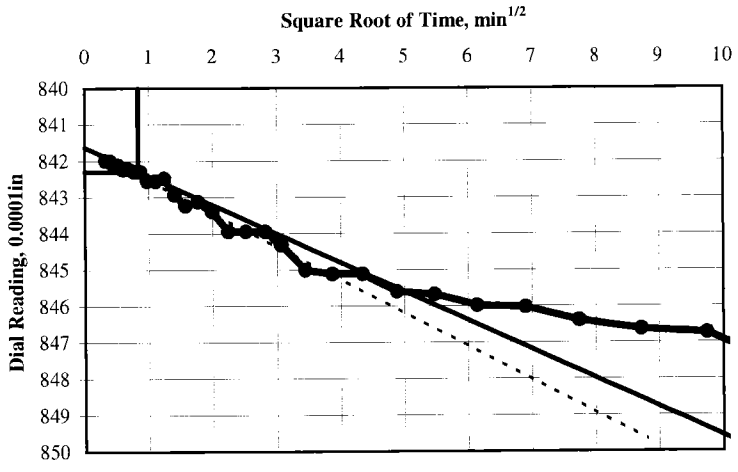
Applied Deflection Correction to Sample Height, 0.0001in -1.5

**Correction is applied to all dial readings.*

Log of Elapsed Time vs. Dial Reading



Square Root of Elapsed Time vs. Dial Reading



Sqrt. of Elapsed Time vs Dial Reading			
T0 = 0 min.	D0 = 841.6 div.		
T90 = 0.706 min	D90 = 842.3 div.		
T100 = NA min	D100 = 842.4 div.		
Height at: D90 = 0.9245, D100 = 0.9245			
Average Sample Height, in	0.9243		
Average Drainage Height, in	0.4621		
T (Time Factor for T90)	0.848		
Coef. of Consol., C_v, in^2/min	0.258		

Log of Elapsed Time vs Dial Reading			
T0 = 0 min.	D0 = 841.8 div.		
T50 = 19.12 min.	D50 = 845.4 div.		
T100 = 149.6 min.	D100 = 849 div.		
Height at: D50 = 0.9242, D100 = 0.9238			
Average Sample Height, in	0.9243		
Average Drainage Height, in	0.4621		
T (Time Factor for T50)	0.197		
Coef. of Consol., C_v, in^2/min	0.002		

Load Summary	
Initial Sample Height, in	0.9248
Initial Sample Void Ratio	0.5726
Final Sample Height, in	0.9237
Final Sample Void Ratio	0.5707
Incremental Strain, %	0.12%
Loading Duration, min	379.95

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ONE-DIMENSIONAL CONSOLIDATION PROPERTIES OF SOILS
ASTM D 2435

Client	Civil & Environmental Consultant	Boring	RB-4	**Test Load, tsf**	**0.5-1**
Client Project	091-867 Apex Landfill Expansion	Depth	19'-24'		Load 9 of 13
Project No.	30598	Sample	B-1		
		Lab ID#	30598027		
Visual Description	Olive Brown Lean Clay with Sand				
Test Conditions:	Remolded, Inundated, and Double Drained				

Time Vs. Dial Reading

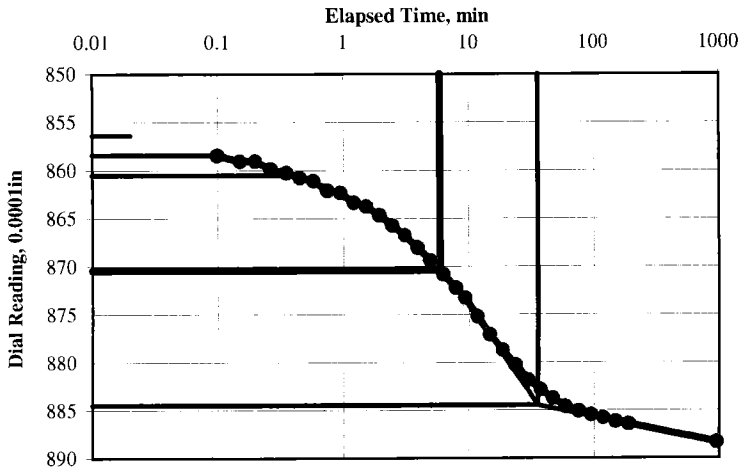
Elapsed Time (min)	Sqrt Time ($min^{1/2}$)	Dial Reading (0.0001in)	Sample Height (in)	Void Ratio
0	0	849.7	0.9237	0.5707
Corrections*		-2.5	-0.00025	-0.0004
Adjusted Sample Height & Void Ratio				
0.10	0.32	858.5	0.9231	0.5696
0.15	0.39	859.1	0.9230	0.5695
0.20	0.45	859.1	0.9230	0.5695
0.27	0.52	859.9	0.9230	0.5694
0.35	0.59	860.3	0.9229	0.5693
0.45	0.67	860.8	0.9229	0.5692
0.58	0.76	861.1	0.9228	0.5692
0.75	0.87	862.1	0.9227	0.5690
0.95	0.97	862.3	0.9227	0.5690
1.22	1.10	863.4	0.9226	0.5688
1.53	1.24	863.8	0.9226	0.5687
1.95	1.40	864.7	0.9225	0.5686
2.47	1.57	865.7	0.9224	0.5684
3.12	1.77	866.8	0.9223	0.5682
3.95	1.99	868.0	0.9221	0.5680
4.98	2.23	869.4	0.9220	0.5678
6.30	2.51	870.8	0.9219	0.5675
7.95	2.82	872.2	0.9217	0.5673
9.40	3.07	873.3	0.9216	0.5671
11.85	3.44	875.2	0.9214	0.5668
14.95	3.87	877.1	0.9212	0.5664
18.85	4.34	878.7	0.9211	0.5662
23.77	4.88	880.2	0.9209	0.5659
29.95	5.47	881.9	0.9208	0.5656
37.75	6.14	882.8	0.9207	0.5655
47.57	6.90	883.7	0.9206	0.5653
59.95	7.74	884.6	0.9205	0.5652
75.95	8.71	885.1	0.9204	0.5651
94.95	9.74	885.5	0.9204	0.5650
119.95	10.95	885.8	0.9204	0.5650
150.95	12.29	886.2	0.9203	0.5649
189.95	13.78	886.4	0.9203	0.5649
954.95	30.90	888.3	0.9201	0.5645

Machine Deflection

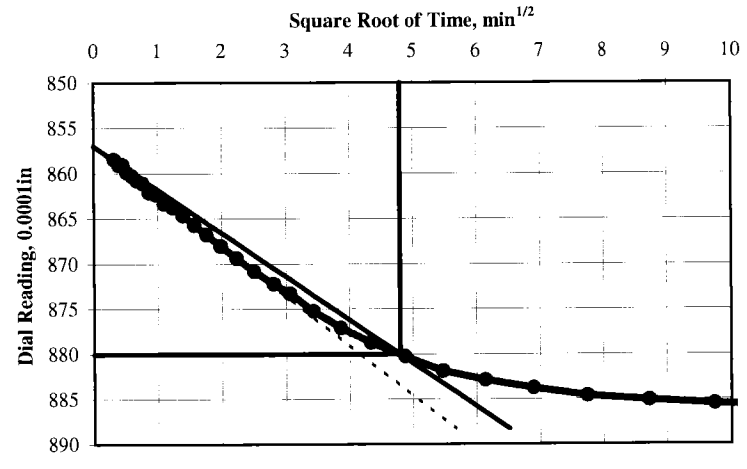
Applied Deflection Correction to Sample Height, 0.0001in -2.5

**Correction is applied to all dial readings.*

Log of Elapsed Time vs. Dial Reading



Square Root of Elapsed Time vs. Dial Reading



Sqrt. of Elapsed Time vs Dial Reading			Log of Elapsed Time vs Dial Reading			Load Summary	
T0 = 0 min.	D0 = 857 div.		T0 = 0 min.	D0 = 856.4 div.			
T90 = 22.944 min	D90 = 880 div.		T50 = 5.88 min.	D50 = 870.4 div.		Initial Sample Height, in	0.9237
T100 = NA min	D100 = 882.5 div.		T100 = 35.7 min.	D100 = 884.5 div.		Initial Sample Void Ratio	0.5707
Height at: D90 = 0.921, D100 = 0.9207			Height at: D50 = 0.9219, D100 = 0.9205			Final Sample Height, in	0.9201
Average Sample Height, in		0.9219	Average Sample Height, in		0.9219	Final Sample Void Ratio	0.5645
Average Drainage Height, in		0.4610	Average Drainage Height, in		0.4610	Incremental Strain, %	0.39%
T (Time Factor for T90)		0.848	T (Time Factor for T50)		0.197	Loading Duration, min	954.95
Coef. of Consol., C_v, in^2/min		0.008	Coef. of Consol., C_v, in^2/min		0.007		

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ONE-DIMENSIONAL CONSOLIDATION PROPERTIES OF SOILS
ASTM D 2435

Client	Civil & Environmental Consultant	Boring	RB-4	**Test Load, tsf**	**1-2**
Client Project	091-867 Apex Landfill Expansion	Depth	19'-24'		Load 10 of 13
Project No.	30598	Sample	B-1		
		Lab ID#	30598027		
Visual Description	Olive Brown Lean Clay with Sand				
Test Conditions:	Remolded, Inundated, and Double Drained				

Time Vs. Dial Reading

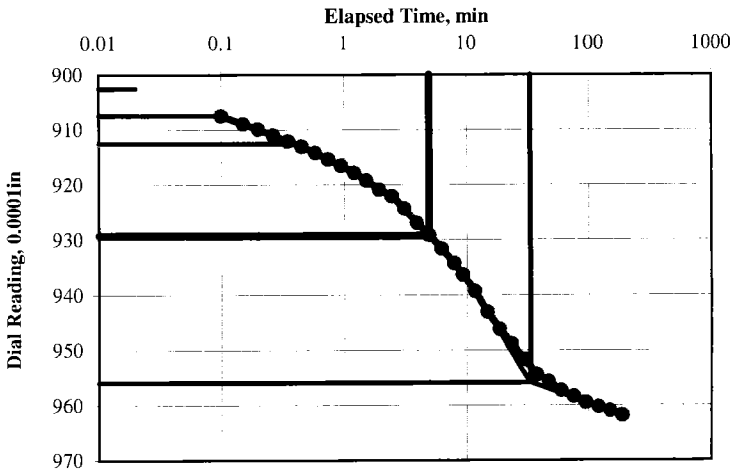
Elapsed Time (min)	Sqrt Time ($min^{1/2}$)	Dial Reading (0.0001in)	Sample Height (in)	Void Ratio
0	0	888.3	0.9201	0.5645
Corrections*		-3.5	-0.00035	-0.0006
Adjusted Sample Height & Void Ratio				
0.10	0.32	907.6	0.9185	0.5619
0.15	0.39	909.0	0.9184	0.5616
0.20	0.45	909.9	0.9183	0.5615
0.27	0.52	911.1	0.9182	0.5613
0.35	0.59	912.1	0.9181	0.5611
0.45	0.67	913.1	0.9180	0.5609
0.58	0.76	914.2	0.9179	0.5607
0.75	0.87	915.4	0.9178	0.5605
0.95	0.97	916.6	0.9176	0.5603
1.22	1.10	917.8	0.9175	0.5601
1.53	1.24	919.3	0.9174	0.5599
1.95	1.40	920.9	0.9172	0.5596
2.47	1.57	922.1	0.9171	0.5594
3.12	1.77	924.4	0.9169	0.5590
3.95	1.99	927.0	0.9166	0.5586
4.98	2.23	929.2	0.9164	0.5582
6.30	2.51	931.6	0.9161	0.5578
7.95	2.82	934.3	0.9159	0.5573
9.40	3.07	936.4	0.9157	0.5570
11.85	3.44	939.4	0.9154	0.5564
14.95	3.87	943.1	0.9150	0.5558
18.85	4.34	946.2	0.9147	0.5553
23.77	4.88	948.9	0.9144	0.5548
29.95	5.47	951.7	0.9141	0.5543
37.75	6.14	954.5	0.9139	0.5539
47.57	6.90	955.7	0.9137	0.5537
59.95	7.74	957.3	0.9136	0.5534
75.95	8.71	958.4	0.9135	0.5532
94.95	9.74	959.5	0.9134	0.5530
119.95	10.95	960.3	0.9133	0.5529
150.95	12.29	961.0	0.9132	0.5528
189.95	13.78	961.8	0.9131	0.5526

Machine Deflection

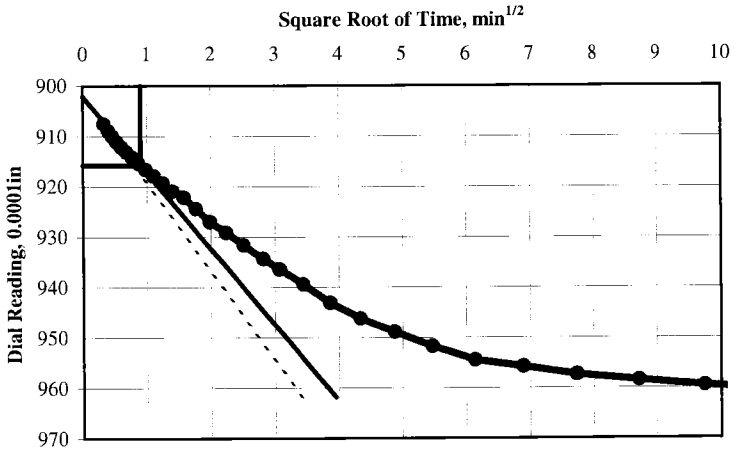
Applied Deflection Correction to Sample Height, 0.0001in -3.5

**Correction is applied to all dial readings.*

Log of Elapsed Time vs. Dial Reading



Square Root of Elapsed Time vs. Dial Reading



Sqrt. of Elapsed Time vs Dial Reading		Log of Elapsed Time vs Dial Reading		Load Summary	
T0 = 0 min.	D0 = 902.1 div.	T0 = 0 min.	D0 = 902.5 div.		
T90 = 0.81 min	D90 = 915.8 div.	T50 = 5 min.	D50 = 929.2 div.	Initial Sample Height, in	0.9201
T100 = NA min	D100 = 917.3 div.	T100 = 33.27 min.	D100 = 955.9 div.	Initial Sample Void Ratio	0.5645
Height at: D90 = 0.9177, D100 = 0.9176		Height at: D50 = 0.9164, D100 = 0.9137		Final Sample Height, in	0.9131
Average Sample Height, in	0.9166	Average Sample Height, in	0.9166	Final Sample Void Ratio	0.5526
Average Drainage Height, in	0.4583	Average Drainage Height, in	0.4583	Incremental Strain, %	0.76%
T (Time Factor for T90)	0.848	T (Time Factor for T50)	0.197	Loading Duration, min	189.95
Coef. of Consol., C_v, in^2/min	0.219	Coef. of Consol., C_v, in^2/min	0.008		

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ONE-DIMENSIONAL CONSOLIDATION PROPERTIES OF SOILS
ASTM D 2435

Client	Civil & Environmental Consultant	Boring	RB-4	**Test Load, tsf**	**2-4**
Client Project	091-867 Apex Landfill Expansion	Depth	19'-24'		Load 11 of 13
Project No.	30598	Sample	B-1		
		Lab ID#	30598027		
Visual Description	Olive Brown Lean Clay with Sand				
Test Conditions:	Remolded, Inundated, and Double Drained				

Time Vs. Dial Reading

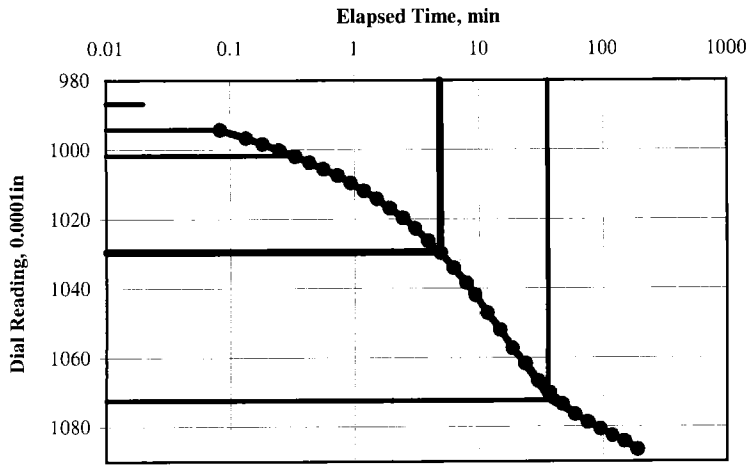
Elapsed Time (min)	Sqrt Time ($min^{1/2}$)	Dial Reading (0.0001in)	Sample Height (in)	Void Ratio
0	0	961.8	0.9131	0.5526
Corrections*		-4.5	-0.00045	-0.0008
Adjusted Sample Height & Void Ratio				
0.08	0.29	994.3	0.9103	0.5479
0.13	0.37	996.7	0.9101	0.5475
0.18	0.43	998.4	0.9099	0.5472
0.25	0.50	1000.2	0.9097	0.5469
0.33	0.58	1001.9	0.9096	0.5466
0.43	0.66	1003.7	0.9094	0.5463
0.57	0.75	1005.6	0.9092	0.5460
0.73	0.86	1007.5	0.9090	0.5456
0.93	0.97	1009.6	0.9088	0.5453
1.20	1.10	1011.9	0.9086	0.5449
1.52	1.23	1014.2	0.9083	0.5445
1.93	1.39	1016.9	0.9081	0.5440
2.45	1.57	1019.7	0.9078	0.5436
3.10	1.76	1022.8	0.9075	0.5430
3.93	1.98	1026.3	0.9071	0.5424
4.97	2.23	1029.8	0.9068	0.5418
6.28	2.51	1034.1	0.9063	0.5411
7.93	2.82	1038.5	0.9059	0.5404
9.38	3.06	1042.0	0.9056	0.5398
11.83	3.44	1047.1	0.9050	0.5389
14.93	3.86	1052.0	0.9046	0.5381
18.83	4.34	1057.3	0.9040	0.5372
23.75	4.87	1061.7	0.9036	0.5364
29.93	5.47	1066.8	0.9031	0.5356
37.73	6.14	1070.1	0.9027	0.5350
47.55	6.90	1073.4	0.9024	0.5344
59.93	7.74	1076.4	0.9021	0.5339
75.93	8.71	1078.6	0.9019	0.5335
94.93	9.74	1080.6	0.9017	0.5332
119.93	10.95	1082.5	0.9015	0.5329
150.93	12.29	1084.2	0.9013	0.5326
189.93	13.78	1086.5	0.9011	0.5322

Machine Deflection

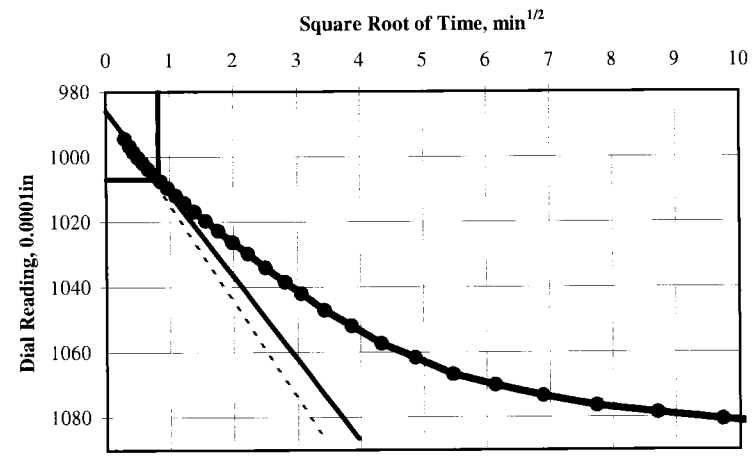
Applied Deflection Correction to Sample Height, 0.0001in -4.5

**Correction is applied to all dial readings.*

Log of Elapsed Time vs. Dial Reading



Square Root of Elapsed Time vs. Dial Reading



Sqrt. of Elapsed Time vs Dial Reading

T0 = 0 min.	D0 = 986 div.
T90 = 0.689 min	D90 = 1007 div.
T100 = NA min	D100 = 1009.3 div.
Height at: D90 = 0.9091, D100 = 0.9088	
Average Sample Height, in	0.9071
Average Drainage Height, in	0.4536
T (Time Factor for T90)	0.848
Coef. of Consol., C_v, in^2/min	0.254

Log of Elapsed Time vs Dial Reading

T0 = 0 min.	D0 = 986.7 div.
T50 = 4.88 min.	D50 = 1029.5 div.
T100 = 36.09 min.	D100 = 1072.3 div.
Height at: D50 = 0.9068, D100 = 0.9025	
Average Sample Height, in	0.9071
Average Drainage Height, in	0.4536
T (Time Factor for T50)	0.197
Coef. of Consol., C_v, in^2/min	0.008

Load Summary

Initial Sample Height, in	0.9131
Initial Sample Void Ratio	0.5526
Final Sample Height, in	0.9011
Final Sample Void Ratio	0.5322
Incremental Strain, %	1.32%
Loading Duration, min	189.93333

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ONE-DIMENSIONAL CONSOLIDATION PROPERTIES OF SOILS
ASTM D 2435

Client	Civil & Environmental Consultant	Boring	RB-4	**Test Load, tsf**	**4-8**
Client Project	091-867 Apex Landfill Expansion	Depth	19'-24'		Load 12 of 13
Project No.	30598	Sample	B-1		
		Lab ID#	30598027		
Visual Description	Olive Brown Lean Clay with Sand				
Test Conditions:	Remolded, Inundated, and Double Drained				

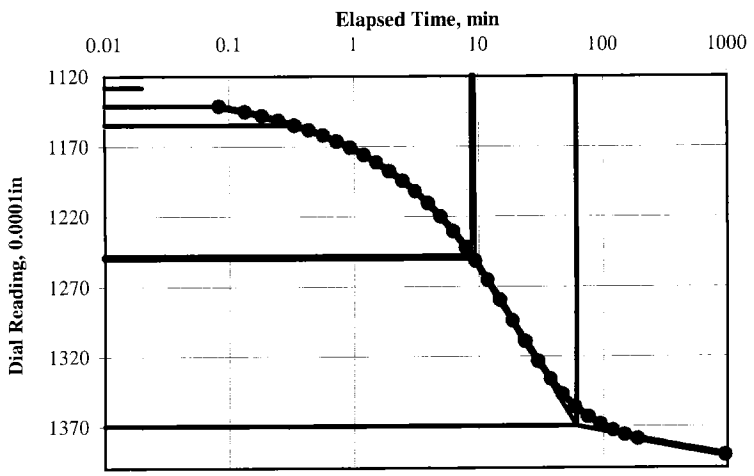
Time Vs. Dial Reading				
Elapsed Time (min)	**Sqrt Time ($min^{1/2}$)**	**Dial Reading (0.0001in)**	**Sample Height (in)**	**Void Ratio**
0	0	1086.5	0.9011	0.5322
Corrections*		-10	-0.001	-0.0017
Adjusted Sample Height & Void Ratio				
0.08	0.29	1141.6	0.8966	0.5245
0.13	0.37	1145.5	0.8962	0.5239
0.18	0.43	1148.4	0.8959	0.5234
0.25	0.50	1151.7	0.8956	0.5228
0.33	0.58	1155.1	0.8952	0.5222
0.43	0.66	1158.5	0.8949	0.5217
0.57	0.75	1162.3	0.8945	0.5210
0.73	0.86	1166.6	0.8941	0.5203
0.93	0.97	1171.0	0.8936	0.5195
1.20	1.10	1176.2	0.8931	0.5186
1.52	1.23	1181.6	0.8926	0.5177
1.93	1.39	1187.9	0.8920	0.5167
2.45	1.57	1194.7	0.8913	0.5155
3.10	1.76	1202.3	0.8905	0.5142
3.93	1.98	1210.7	0.8897	0.5128
4.97	2.23	1220.1	0.8887	0.5112
6.28	2.51	1230.8	0.8877	0.5094
7.93	2.82	1242.5	0.8865	0.5074
9.38	3.06	1251.8	0.8856	0.5058
11.83	3.44	1265.4	0.8842	0.5035
14.93	3.86	1279.8	0.8828	0.5010
18.83	4.34	1294.6	0.8813	0.4985
23.75	4.87	1309.2	0.8798	0.4960
29.93	5.47	1323.5	0.8784	0.4936
37.73	6.14	1336.1	0.8771	0.4914
47.55	6.90	1347.1	0.8760	0.4896
59.93	7.74	1356.1	0.8751	0.4881
→ 75.93	8.71	1363.1	0.8744	0.4869
94.93	9.74	1368.4	0.8739	0.4860
119.93	10.95	1372.7	0.8735	0.4852
150.93	12.29	1376.1	0.8731	0.4847
189.93	13.78	1378.8	0.8729	0.4842
→ 954.93	30.90	1390.5	0.8717	0.4822

Machine Deflection

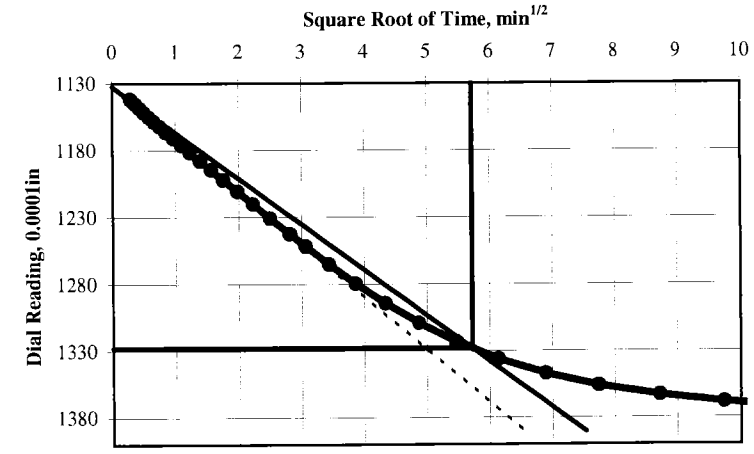
Applied Deflection Correction to Sample Height, 0.0001in: -10

**Correction is applied to all dial readings.*

Log of Elapsed Time vs. Dial Reading



Square Root of Elapsed Time vs. Dial Reading



Sqrt. of Elapsed Time vs Dial Reading			Log of Elapsed Time vs Dial Reading			Load Summary	
T0 = 0 min.	D0 = 1132.2 div.		T0 = 0 min.	D0 = 1128.1 div.			
T90 = 32.604 min	D90 = 1328 div.		T50 = 8.91 min.	D50 = 1248.9 div.		Initial Sample Height, in	0.9011
T100 = NA min	D100 = 1349.8 div.		T100 = 61.53 min.	D100 = 1369.7 div.		Initial Sample Void Ratio	0.5322
Height at: D90 = 0.878, D100 = 0.8758			Height at: D50 = 0.8859, D100 = 0.8738			Final Sample Height, in	0.8717
Average Sample Height, in		0.8864	Average Sample Height, in		0.8864	Final Sample Void Ratio	0.4822
Average Drainage Height, in		0.4432	Average Drainage Height, in		0.4432	Incremental Strain, %	3.26%
T (Time Factor for T90)		0.848	T (Time Factor for T50)		0.197	Loading Duration, min	954.93333
Coef. of Consol., C_v, in^2/min		0.005	Coef. of Consol., C_v, in^2/min		0.004		

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ONE-DIMENSIONAL CONSOLIDATION PROPERTIES OF SOILS
ASTM D 2435

Client	Civil & Environmental Consultant	Boring	RB-4	**Test Load, tsf**	**8-16**
Client Project	091-867 Apex Landfill Expansion	Depth	19'-24'		Load 13 of 13
Project No.	30598	Sample	B-1		
		Lab ID#	30598027		
Visual Description	Olive Brown Lean Clay with Sand				
Test Conditions:	Remolded, Inundated, and Double Drained				

Time Vs. Dial Reading

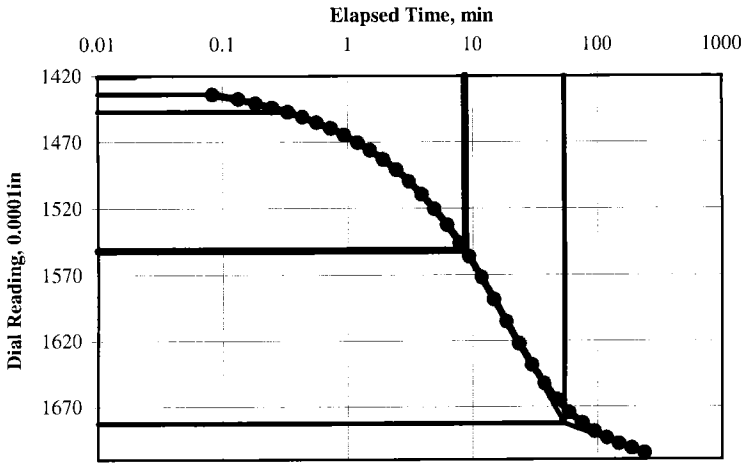
Elapsed Time (min)	Sqrt Time ($min^{1/2}$)	Dial Reading (0.0001in)	Sample Height (in)	Void Ratio
0	0	1390.5	0.8717	0.4822
Corrections*		-13.5	-0.00135	-0.0023
Adjusted Sample Height & Void Ratio				
0.08	0.29	1434.2	0.8687	0.4771
0.13	0.37	1437.7	0.8683	0.4765
0.18	0.43	1440.9	0.8680	0.4759
0.25	0.50	1444.1	0.8677	0.4754
0.33	0.58	1447.5	0.8673	0.4748
0.43	0.66	1451.1	0.8670	0.4742
0.57	0.75	1455.3	0.8666	0.4735
0.73	0.86	1459.8	0.8661	0.4727
0.93	0.97	1464.7	0.8656	0.4719
1.20	1.10	1470.3	0.8651	0.4709
1.52	1.23	1476.2	0.8645	0.4699
1.93	1.39	1483.2	0.8638	0.4687
2.45	1.57	1490.9	0.8630	0.4674
3.10	1.76	1499.6	0.8621	0.4659
3.93	1.98	1509.4	0.8612	0.4643
4.97	2.23	1520.3	0.8601	0.4624
6.28	2.51	1532.5	0.8589	0.4604
7.93	2.82	1546.1	0.8575	0.4580
9.38	3.06	1556.5	0.8565	0.4563
11.83	3.44	1571.9	0.8549	0.4537
14.93	3.86	1588.6	0.8532	0.4508
18.83	4.34	1605.4	0.8516	0.4480
23.75	4.87	1622.2	0.8499	0.4451
29.93	5.47	1638.2	0.8483	0.4424
37.73	6.14	1652.5	0.8469	0.4400
47.55	6.90	1664.4	0.8457	0.4379
→ 59.93	7.74	1674.4	0.8447	0.4362
75.93	8.71	1682.4	0.8439	0.4349
94.93	9.74	1688.6	0.8432	0.4338
119.93	10.95	1693.5	0.8428	0.4330
150.93	12.29	1697.9	0.8423	0.4322
189.93	13.78	1701.4	0.8420	0.4316
→ 239.93	15.49	1704.8	0.8416	0.4311

Machine Deflection

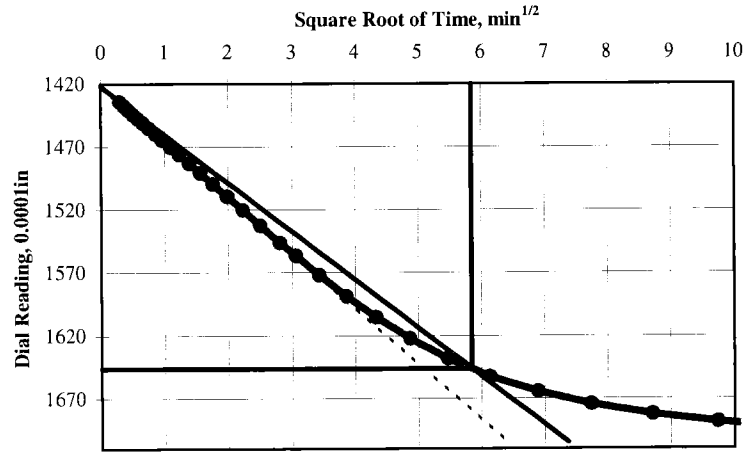
Applied Deflection Correction to Sample Height, 0.0001in: -13.5

**Correction is applied to all dial readings.*

Log of Elapsed Time vs. Dial Reading



Square Root of Elapsed Time vs. Dial Reading



Sqrt. of Elapsed Time vs Dial Reading			Log of Elapsed Time vs Dial Reading			Load Summary	
T0 = 0 min.	D0 = 1421.9 div.		T0 = 0 min.	D0 = 1420.8 div.			
T90 = 34.106 min	D90 = 1646.1 div.		T50 = 8.69 min.	D50 = 1551.7 div.		Initial Sample Height, in	0.8717
T100 = NA min	D100 = 1671 div.		T100 = 54.72 min.	D100 = 1682.6 div.		Initial Sample Void Ratio	0.4822
Height at: D90 = 0.8475, D100 = 0.845			Height at: D50 = 0.8569, D100 = 0.8438			Final Sample Height, in	0.8416
Average Sample Height, in		0.8567	Average Sample Height, in		0.8567	Final Sample Void Ratio	0.4311
Average Drainage Height, in		0.4283	Average Drainage Height, in		0.4283	Incremental Strain, %	3.45%
T (Time Factor for T90)		0.848	T (Time Factor for T50)		0.197	Loading Duration, min	239.93333
Coef. of Consol., C_v, in^2/min		0.005	Coef. of Consol., C_v, in^2/min		0.004		

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ONE-DIMENSIONAL CONSOLIDATION PROPERTIES OF SOILS
ASTM D 2435

Client	Civil & Environmental Consultant	Boring	SB-16
Client Project	091-867 Apex Landfill Expansion	Depth	0.5'-2.5'
Project No.	30598	Sample	ST-1
		Lab Sample No.	30598008

Visual Description: Light Olive Brown Fat Clay
Sample Conditions: Undisturbed, Inundated, and Double Drained
Machine Deflection Correction: Applied

SAMPLE PROPERTIES		
	Initial	Final
Tare Number	A23	Z13
Wt. Tare & WS, gm	98.22	277.35
Wt. Tare & DS, gm	81.05	251.7
Wt. Tare, gm	9.45	122.82
Water Content, %	24.0%	19.9%
Sample Diameter, in	2.5	2.5
Sample Height, in	1.004	0.9011
Sample Volume, in^3	4.9265	4.4234
Wt. WS + Ring, gm	272.59	267.73
Wt. of Ring, gm	112.08	112.08
Wt. of WS, gm	160.51	155.65
Wet Density, pcf	124.06	133.99
Wet Density, g/cc	1.988	2.147
Water Content, %	24.0%	19.9%
Wt. of DS, gm	129.46	129.81
Dry Density, pcf	100.07	111.75
Dry Density, g/cc	1.604	1.791
Void Ratio, e	0.6837	0.5076
Saturation, %	94.7%	
Specific Gravity	2.7	Measured
Height of Solids, in	0.5961	0.5961

TEST DATA SUMMARY

Applied Pressure tsf	Load Duration min	Final Height in	Vertical Strain %	Dry Density g/cc	Void Ratio e	a_v ft^2/ton	Incremental C_c	Incremental C_r
Seating	NA	1.0036	0.00	1.6036	0.6837	NA	NA	NA
0.25	120	1.0036	0.00%	1.6036	0.6837	0.00E+00	NA	NA
0.5	380	1.0018	0.18%	1.6066	0.6806	1.24E-02	0.010	NA
1	955	0.9946	0.90%	1.6182	0.6685	2.42E-02	0.040	NA
2	1,514	0.9792	2.44%	1.6437	0.6427	2.58E-02	0.086	NA
4	1,203	0.9573	4.62%	1.6813	0.6059	1.84E-02	0.122	NA
1	380	0.9685	3.50%	1.6618	0.6247	6.26E-03	NA	NA
0.25	955	0.9846	1.90%	1.6347	0.6517	3.60E-02	NA	NA
0.5	955	0.9830	2.05%	1.6372	0.6491	1.04E-02	NA	0.009
1	1,203	0.9778	2.57%	1.6460	0.6404	1.74E-02	NA	0.029
2	955	0.9682	3.53%	1.6623	0.6243	1.61E-02	NA	0.053
4	380	0.9544	4.90%	1.6863	0.6011	1.16E-02	NA	0.077
8	955	0.9293	7.40%	1.7318	0.5590	1.05E-02	0.140	NA
16	302	0.9011	10.21%	1.7860	0.5117	5.91E-03	0.157	NA

Avg. = 0.042

Note: The calculations performed and the parameters presented herein are for preliminary purposes only. GTS only accepts responsibility for the raw data obtained from the consolidation tests. This data may be interpreted differently by others. It is the responsibility of the user to determine the appropriateness and accuracy of the computed values.

Input Validation | Reviewed By: | Date Tested: 12/3/2010 |

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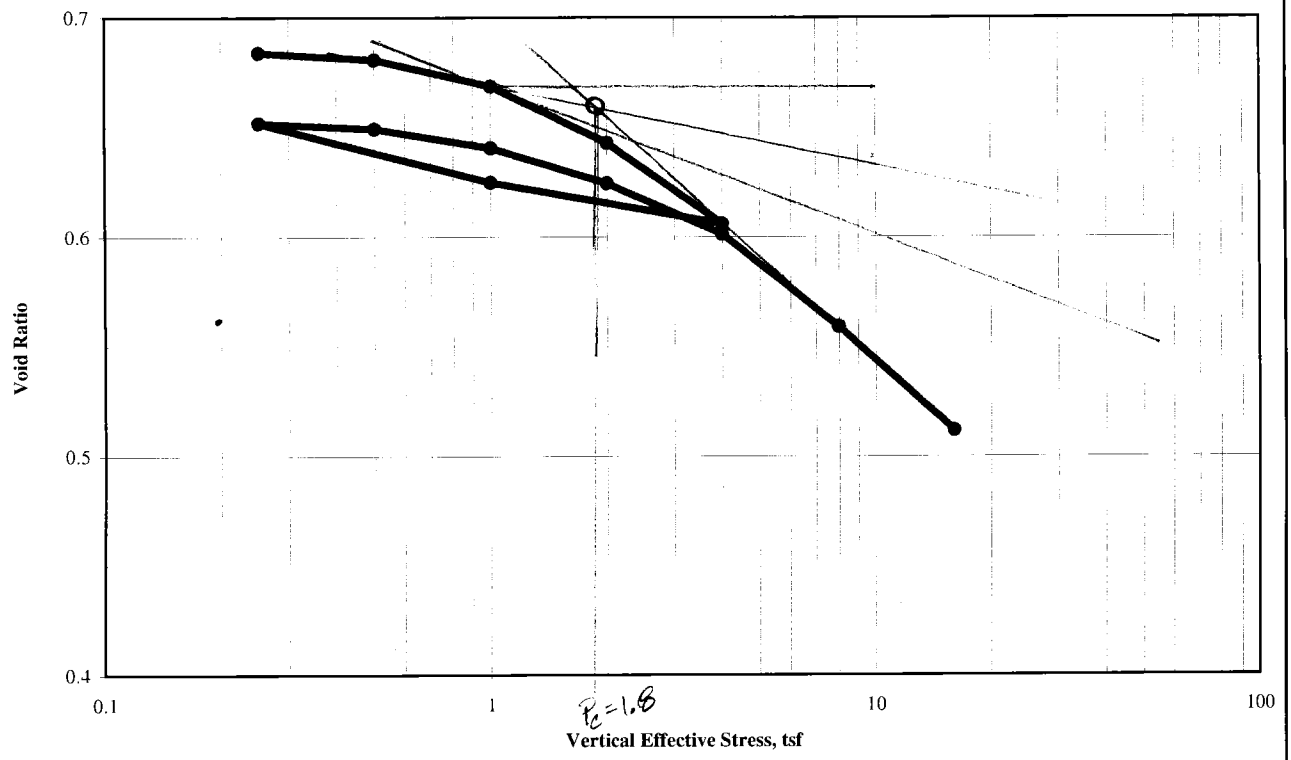
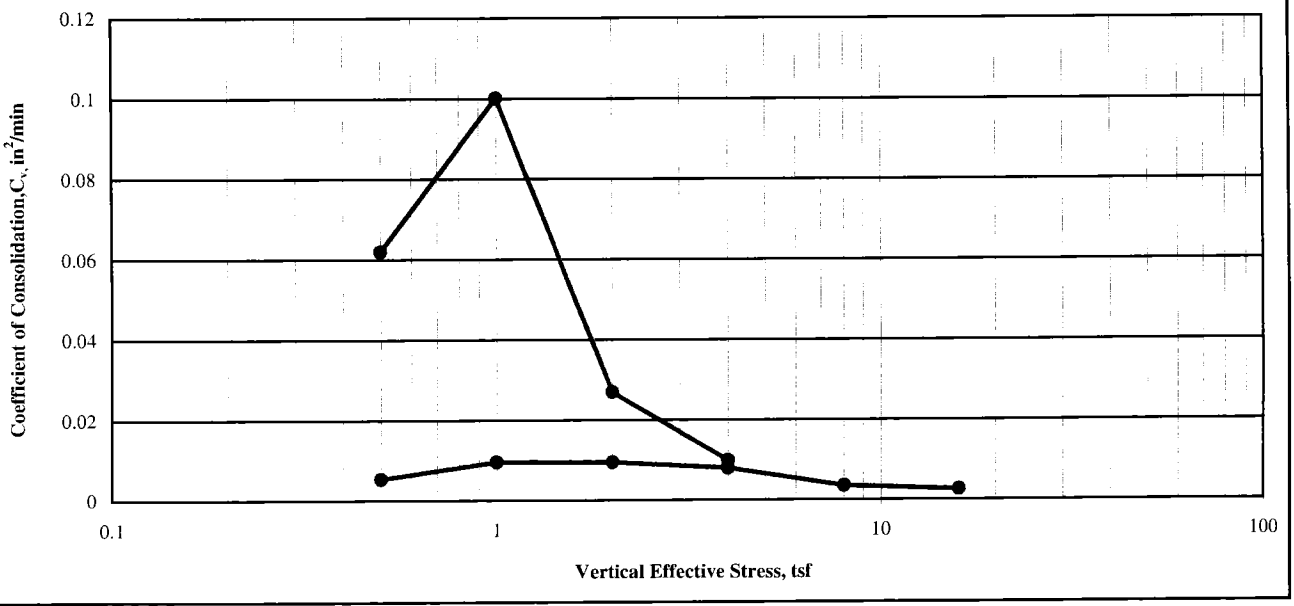
ONE-DIMENSIONAL CONSOLIDATION PROPERTIES OF SOILS
ASTM D 2435

Client	Civil & Environmental Consultants, Inc.	Boring	SB-16
Client Project	091-867 Apex Landfill Expansion	Depth	0.5'-2.5'
Project No.	30598	Sample	ST-1
		Lab Sample No.	30598008
Visual Description	Light Olive Brown Fat Clay		
Sample Conditions	Undisturbed, Inundated, and Double Drained		
Machine Deflection Correction:	Applied		

Void Ratio (Final Height) vs Vertical Effective Consolidation Stress



Coeffieicent of Consolidation (log. method) vs. Vertical Effective Consolidation Stress



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ONE-DIMENSIONAL CONSOLIDATION PROPERTIES OF SOILS
ASTM D 2435

Client	Civil & Environmental Consultant	Boring	SB-16	**Test Load, tsf**	**0-0.25**
Client Project	091-867 Apex Landfill Expansion	Depth	0.5'-2.5'		Load 1 of 13
Project No.	30598	Sample	ST-1		
		Lab ID#	30598008		

Visual Description: Light Olive Brown Fat Clay
Test Conditions: Undisturbed, Inundated, and Double Drained

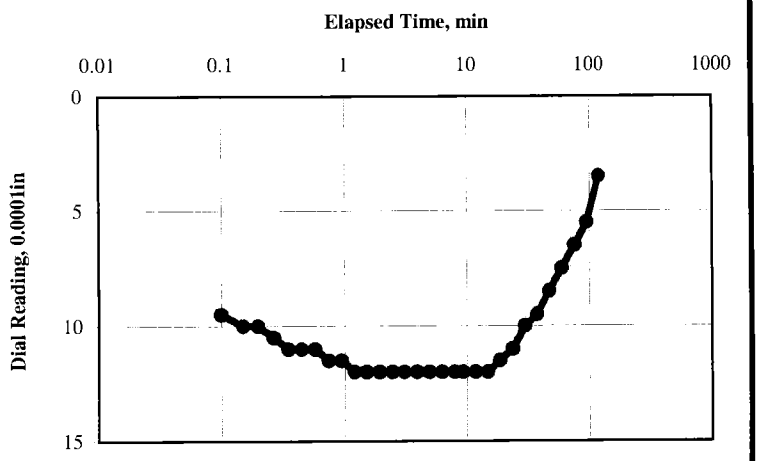
Time Vs. Dial Reading

Elapsed Time (min)	Sqrt Time ($min^{1/2}$)	Dial Reading (0.0001in)	Sample Height (in)	Void Ratio
0	0	0	1.0036	0.6837
Corrections*		-3.5	-0.00035	-0.0006
Adjusted Sample Height & Void Ratio				
0.10	0.32	9.5	1.0030	0.6827
0.15	0.39	10.0	1.0030	0.6826
0.20	0.45	10.0	1.0030	0.6826
0.27	0.52	10.5	1.0029	0.6825
0.35	0.59	11.0	1.0029	0.6824
0.45	0.67	11.0	1.0029	0.6824
0.58	0.76	11.0	1.0029	0.6824
0.75	0.87	11.5	1.0028	0.6823
0.95	0.97	11.5	1.0028	0.6823
1.22	1.10	12.0	1.0028	0.6822
1.53	1.24	12.0	1.0028	0.6822
1.95	1.40	12.0	1.0028	0.6822
2.47	1.57	12.0	1.0028	0.6822
3.12	1.77	12.0	1.0028	0.6822
3.95	1.99	12.0	1.0028	0.6822
4.98	2.23	12.0	1.0028	0.6822
6.30	2.51	12.0	1.0028	0.6822
7.97	2.82	12.0	1.0028	0.6822
9.40	3.07	12.0	1.0028	0.6822
11.85	3.44	12.0	1.0028	0.6822
14.95	3.87	12.0	1.0028	0.6822
18.85	4.34	11.5	1.0028	0.6823
23.77	4.88	11.0	1.0029	0.6824
29.95	5.47	10.0	1.0030	0.6826
37.75	6.14	9.5	1.0030	0.6827
47.57	6.90	8.5	1.0031	0.6828
59.95	7.74	7.5	1.0032	0.6830
75.95	8.71	6.5	1.0033	0.6832
94.95	9.74	5.5	1.0034	0.6833
119.95	10.95	3.5	1.0036	0.6837

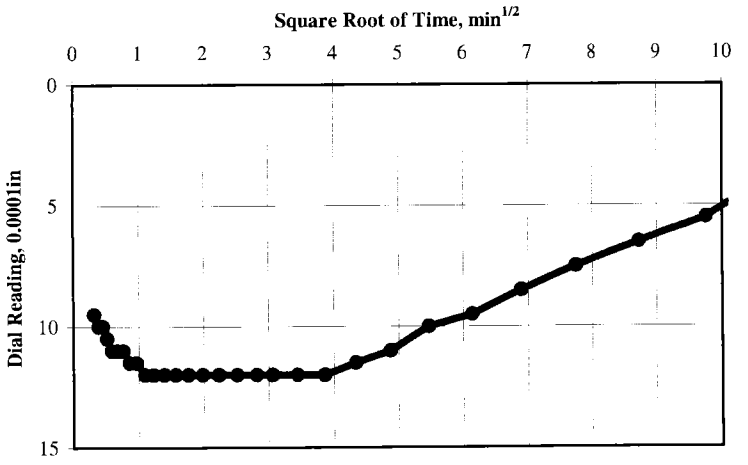
Machine Deflection

Applied Deflection Correction to Sample Height, 0.0001in: -3.5
**Correction is applied to all dial readings.*

Log of Elapsed Time vs. Dial Reading



Square Root of Elapsed Time vs. Dial Reading



Sqrt. of Elapsed Time vs Dial Reading

Specimen Swelled

Log of Elapsed Time vs Dial Reading

Load Summary

Initial Sample Height, in	1.0036
Initial Sample Void Ratio	0.6837
Final Sample Height, in	1.0036
Final Sample Void Ratio	0.6837
Incremental Strain, %	0.00%
Loading Duration, min	119.95

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ONE-DIMENSIONAL CONSOLIDATION PROPERTIES OF SOILS
ASTM D 2435

Client	Civil & Environmental Consultant	Boring	SB-16	**Test Load, tsf**	**0.25-0.5**
Client Project	091-867 Apex Landfill Expansion	Depth	0.5'-2.5'		Load 2 of 13
Project No.	30598	Sample	ST-1		
		Lab ID#	30598008		

Visual Description: Light Olive Brown Fat Clay
Test Conditions: Undisturbed, Inundated, and Double Drained

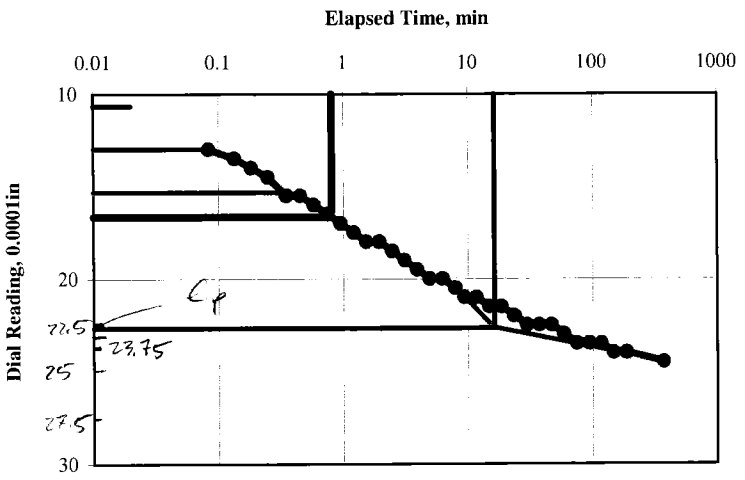
Time Vs. Dial Reading

Elapsed Time (min)	Sqrt Time ($min^{1/2}$)	Dial Reading (0.0001in)	Sample Height (in)	Void Ratio
0	0	3.5	1.0036	0.6837
Corrections*		-2.5	-0.00025	-0.0004
Adjusted Sample Height & Void Ratio				
0.08	0.29	13.0	1.0029	0.6825
0.13	0.37	13.5	1.0029	0.6824
0.18	0.43	14.0	1.0028	0.6823
0.25	0.50	14.5	1.0028	0.6822
0.35	0.59	15.5	1.0027	0.6821
0.45	0.67	15.5	1.0027	0.6821
0.58	0.76	16.0	1.0026	0.6820
0.75	0.87	16.5	1.0026	0.6819
0.95	0.97	17.0	1.0025	0.6818
1.22	1.10	17.5	1.0025	0.6817
1.53	1.24	18.0	1.0024	0.6817
1.95	1.40	18.0	1.0024	0.6817
2.47	1.57	18.5	1.0024	0.6816
3.12	1.77	19.0	1.0023	0.6815
3.95	1.99	19.5	1.0023	0.6814
4.98	2.23	20.0	1.0022	0.6813
6.30	2.51	20.0	1.0022	0.6813
7.95	2.82	20.5	1.0022	0.6812
9.40	3.07	21.0	1.0021	0.6812
11.85	3.44	21.0	1.0021	0.6812
14.95	3.87	21.5	1.0021	0.6811
18.85	4.34	21.5	1.0021	0.6811
23.77	4.88	22.0	1.0020	0.6810
29.95	5.47	22.5	1.0020	0.6809
37.75	6.14	22.5	1.0020	0.6809
47.57	6.90	22.5	1.0020	0.6809
59.95	7.74	23.0	1.0019	0.6808
75.95	8.71	23.5	1.0019	0.6807
94.95	9.74	23.5	1.0019	0.6807
119.95	10.95	23.5	1.0019	0.6807
150.95	12.29	24.0	1.0018	0.6807
189.95	13.78	24.0	1.0018	0.6807
379.95	19.49	24.5	1.0018	0.6806

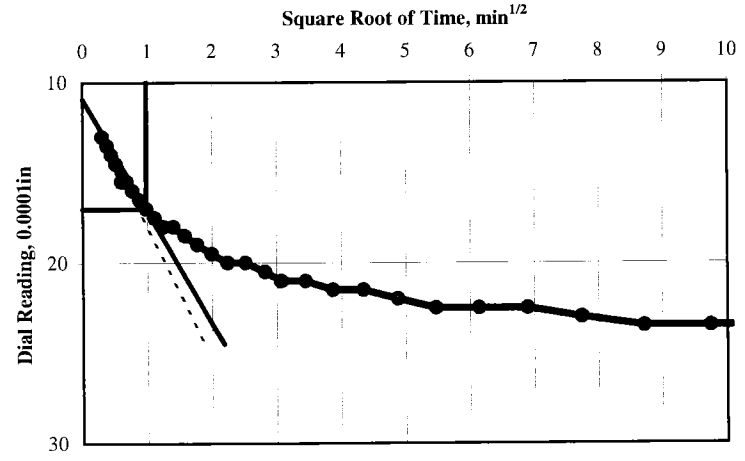
Machine Deflection

Applied Deflection Correction to Sample Height, 0.0001in: -2.5
**Correction is applied to all dial readings.*

Log of Elapsed Time vs. Dial Reading



Square Root of Elapsed Time vs. Dial Reading



Sqrt. of Elapsed Time vs Dial Reading		Log of Elapsed Time vs Dial Reading		Load Summary	
T0 = 0 min.	D0 = 10.9 div.	T0 = 0 min.	D0 = 10.6 div.		
T90 = 0.96 min	D90 = 17 div.	T50 = 0.8 min.	D50 = 16.6 div.	Initial Sample Height, in	1.0036
T100 = NA min	D100 = 17.7 div.	T100 = 16.31 min.	D100 = 22.6 div.	Initial Sample Void Ratio	0.6837
Height at: D90 = 1.0025, D100 = 1.0025		Height at: D50 = 1.0026, D100 = 1.002		Final Sample Height, in	1.0018
Average Sample Height, in	1.0027	Average Sample Height, in	1.0027	Final Sample Void Ratio	0.6806
Average Drainage Height, in	0.5014	Average Drainage Height, in	0.5014	Incremental Strain, %	0.18%
T (Time Factor for T90)	0.848	T (Time Factor for T50)	0.197	Loading Duration, min	379.95
Coef. of Consol., C_v, in^2/min	0.222	Coef. of Consol., C_v, in^2/min	0.062		

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ONE-DIMENSIONAL CONSOLIDATION PROPERTIES OF SOILS
ASTM D 2435

Client	Civil & Environmental Consultant	Boring	SB-16	**Test Load, tsf**	**0.5-1**
Client Project	091-867 Apex Landfill Expansion	Depth	0.5'-2.5'		Load 3 of 13
Project No.	30598	Sample	ST-1		
		Lab ID#	30598008		

Visual Description: Light Olive Brown Fat Clay
Test Conditions: Undisturbed, Inundated, and Double Drained

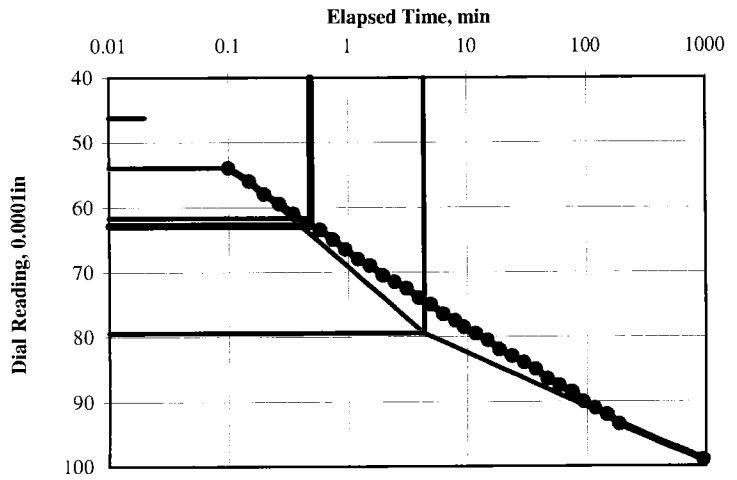
Time Vs. Dial Reading

Elapsed Time (min)	Sqrt Time ($min^{1/2}$)	Dial Reading (0.0001in)	Sample Height (in)	Void Ratio
0	0	24.5	1.0018	0.6806
Corrections*		-2.5	-0.00025	-0.0004
Adjusted Sample Height & Void Ratio				
0.10	0.32	54.0	0.9991	0.6760
0.15	0.39	56.0	0.9989	0.6757
0.20	0.45	58.0	0.9987	0.6754
0.27	0.52	59.5	0.9985	0.6751
0.35	0.59	61.0	0.9984	0.6749
0.45	0.67	62.5	0.9982	0.6746
0.58	0.76	63.5	0.9981	0.6744
0.75	0.87	65.0	0.9980	0.6742
0.95	0.97	66.5	0.9978	0.6739
1.22	1.10	68.0	0.9977	0.6737
1.53	1.24	69.0	0.9976	0.6735
1.95	1.40	70.5	0.9974	0.6733
2.47	1.57	71.5	0.9973	0.6731
3.12	1.77	72.5	0.9972	0.6729
3.95	1.99	74.0	0.9971	0.6727
4.98	2.23	75.0	0.9970	0.6725
6.30	2.51	76.5	0.9968	0.6723
7.95	2.82	77.5	0.9967	0.6721
9.40	3.07	78.5	0.9966	0.6719
11.85	3.44	79.5	0.9965	0.6718
14.95	3.87	80.5	0.9964	0.6716
18.85	4.34	82.0	0.9963	0.6713
23.77	4.88	83.0	0.9962	0.6712
29.95	5.47	84.0	0.9961	0.6710
37.75	6.14	85.0	0.9960	0.6708
47.57	6.90	86.5	0.9958	0.6706
59.95	7.74	87.5	0.9957	0.6704
75.95	8.71	88.5	0.9956	0.6703
94.95	9.74	90.0	0.9955	0.6700
119.95	10.95	91.0	0.9954	0.6698
150.95	12.29	92.0	0.9953	0.6697
189.95	13.78	93.5	0.9951	0.6694
954.95	30.90	99.0	0.9946	0.6685

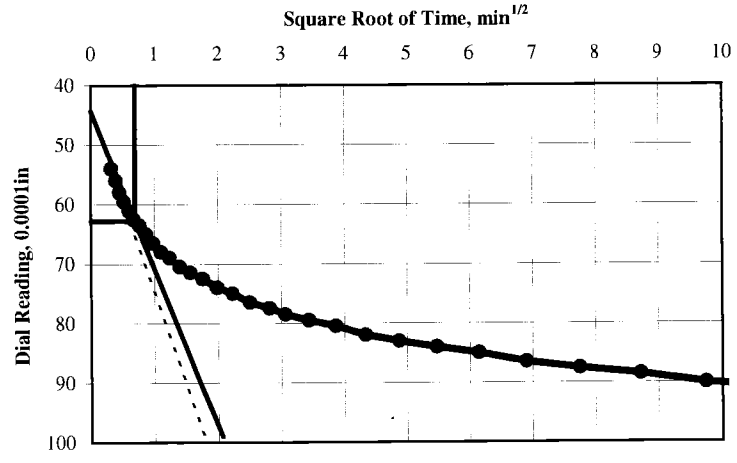
Machine Deflection

Applied Deflection Correction to Sample Height, 0.0001in: -2.5
**Correction is applied to all dial readings.*

Log of Elapsed Time vs. Dial Reading



Square Root of Elapsed Time vs. Dial Reading



Sqrt. of Elapsed Time vs Dial Reading		Log of Elapsed Time vs Dial Reading		Load Summary	
T0 = 0 min.	D0 = 44.3 div.	T0 = 0 min.	D0 = 46.2 div.		
T90 = 0.49 min	D90 = 62.8 div.	T50 = 0.49 min.	D50 = 62.8 div.	Initial Sample Height, in	1.0018
T100 = NA min	D100 = 64.8 div.	T100 = 4.34 min.	D100 = 79.4 div.	Initial Sample Void Ratio	0.6806
Height at: D90 = 0.9982, D100 = 0.998		Height at: D50 = 0.9982, D100 = 0.9965		Final Sample Height, in	0.9946
Average Sample Height, in	0.9982	Average Sample Height, in	0.9982	Final Sample Void Ratio	0.6685
Average Drainage Height, in	0.4991	Average Drainage Height, in	0.4991	Incremental Strain, %	0.72%
T (Time Factor for T90)	0.848	T (Time Factor for T50)	0.197	Loading Duration, min	954.95
Coef. of Consol., C_v, in^2/min	0.435	Coef. of Consol., C_v, in^2/min	0.100		

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ONE-DIMENSIONAL CONSOLIDATION PROPERTIES OF SOILS
ASTM D 2435

Client	Civil & Environmental Consultant	Boring	SB-16	**Test Load, tsf**	**1-2**
Client Project	091-867 Apex Landfill Expansion	Depth	0.5'-2.5'		Load 4 of 13
Project No.	30598	Sample	ST-1		
		Lab ID#	30598008		

Visual Description: Light Olive Brown Fat Clay
Test Conditions: Undisturbed, Inundated, and Double Drained

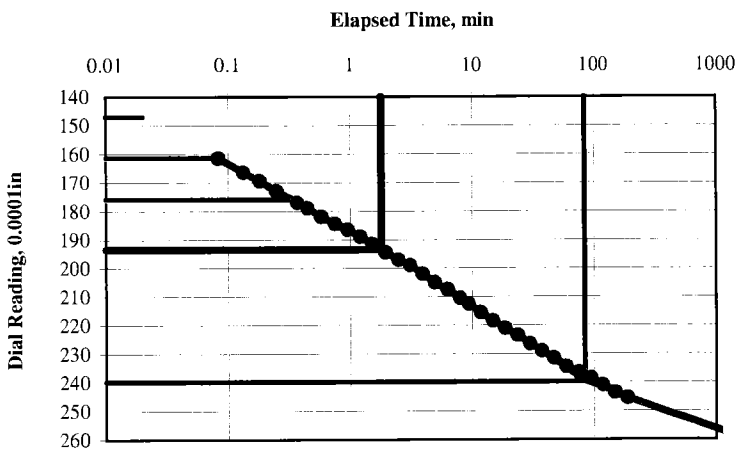
Time Vs. Dial Reading

Elapsed Time (min)	Sqrt Time ($min^{1/2}$)	Dial Reading (0.0001in)	Sample Height (in)	Void Ratio
0	0	99.0	0.9946	0.6685
Corrections*		-6	-0.0006	-0.001
Adjusted Sample Height & Void Ratio				
0.08	0.29	161.5	0.9889	0.6590
0.13	0.37	166.5	0.9884	0.6582
0.18	0.43	169.5	0.9881	0.6577
0.25	0.50	173.0	0.9878	0.6571
0.37	0.61	177.0	0.9874	0.6564
0.45	0.67	179.0	0.9872	0.6561
0.58	0.76	182.0	0.9869	0.6556
0.75	0.87	184.5	0.9866	0.6552
0.95	0.97	186.5	0.9864	0.6548
1.22	1.10	189.0	0.9862	0.6544
1.53	1.24	191.5	0.9859	0.6540
1.95	1.40	194.5	0.9856	0.6535
2.48	1.58	197.0	0.9854	0.6531
3.12	1.77	199.0	0.9852	0.6527
3.95	1.99	202.0	0.9849	0.6522
4.98	2.23	205.0	0.9846	0.6517
6.30	2.51	207.5	0.9843	0.6513
7.95	2.82	210.5	0.9840	0.6508
9.40	3.07	212.5	0.9838	0.6505
11.85	3.44	215.5	0.9835	0.6500
14.95	3.87	218.5	0.9832	0.6494
18.85	4.34	221.0	0.9830	0.6490
23.77	4.88	223.5	0.9827	0.6486
29.95	5.47	226.5	0.9824	0.6481
37.75	6.14	229.0	0.9822	0.6477
47.57	6.90	231.5	0.9819	0.6473
59.95	7.74	234.5	0.9816	0.6468
75.95	8.71	236.5	0.9814	0.6464
94.95	9.74	238.5	0.9812	0.6461
119.95	10.95	241.0	0.9810	0.6457
150.95	12.29	243.5	0.9807	0.6453
189.95	13.78	245.5	0.9805	0.6449
1513.95	38.91	259.0	0.9792	0.6427

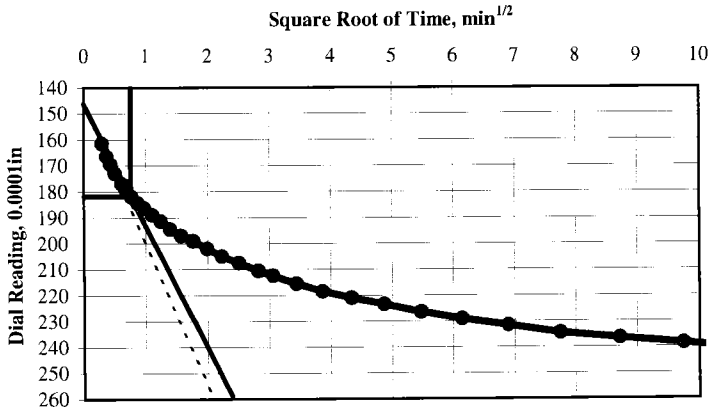
Machine Deflection

Applied Deflection Correction to Sample Height, 0.0001in: -6
**Correction is applied to all dial readings.*

Log of Elapsed Time vs. Dial Reading



Square Root of Elapsed Time vs. Dial Reading



Sqrt. of Elapsed Time vs Dial Reading		Log of Elapsed Time vs Dial Reading		Load Summary	
T0 = 0 min.	D0 = 146.3 div.	T0 = 0 min.	D0 = 147 div.		
T90 = 0.578 min	D90 = 181.8 div.	T50 = 1.78 min.	D50 = 193.4 div.	Initial Sample Height, in	0.9946
T100 = NA min	D100 = 185.7 div.	T100 = 83.42 min.	D100 = 239.8 div.	Initial Sample Void Ratio	0.6685
Height at: D90 = 0.9869, D100 = 0.9865		Height at: D50 = 0.9857, D100 = 0.9811		Final Sample Height, in	0.9792
Average Sample Height, in	0.9869	Average Sample Height, in	0.9869	Final Sample Void Ratio	0.6427
Average Drainage Height, in	0.4934	Average Drainage Height, in	0.4934	Incremental Strain, %	1.55%
T (Time Factor for T90)	0.848	T (Time Factor for T50)	0.197	Loading Duration, min	1513.95
Coef. of Consol., C_v, in^2/min	0.361	Coef. of Consol., C_v, in^2/min	0.027		

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ONE-DIMENSIONAL CONSOLIDATION PROPERTIES OF SOILS
ASTM D 2435

Client	Civil & Environmental Consultant	Boring	SB-16	**Test Load, tsf**	**2-4**
Client Project	091-867 Apex Landfill Expansion	Depth	0.5'-2.5'		Load 5 of 13
Project No.	30598	Sample	ST-1		
		Lab ID#	30598008		

Visual Description: Light Olive Brown Fat Clay
Test Conditions: Undisturbed, Inundated, and Double Drained

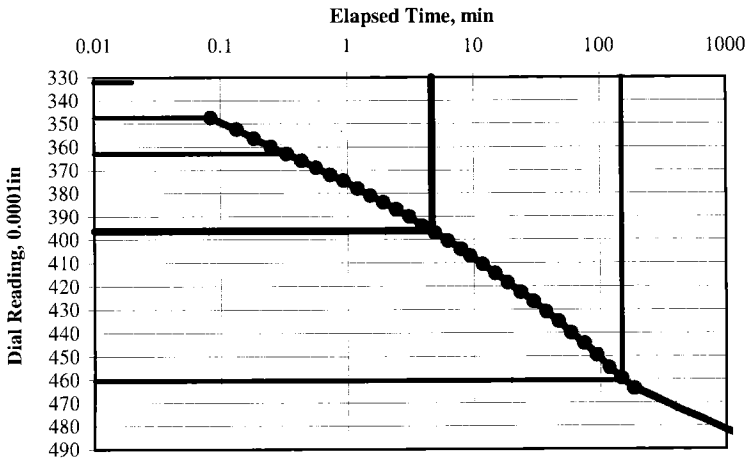
Time Vs. Dial Reading

Elapsed Time (min)	Sqrt Time ($min^{1/2}$)	Dial Reading (0.0001in)	Sample Height (in)	Void Ratio
0	0	259.0	0.9792	0.6427
Corrections*		-5.5	-0.00055	-0.0009
Adjusted Sample Height & Void Ratio				
0.08	0.29	347.5	0.9709	0.6287
0.13	0.37	352.5	0.9704	0.6279
0.18	0.43	356.5	0.9700	0.6272
0.25	0.50	360.0	0.9696	0.6266
0.33	0.58	363.0	0.9693	0.6261
0.43	0.66	366.0	0.9690	0.6256
0.57	0.75	369.0	0.9687	0.6251
0.73	0.86	372.0	0.9684	0.6246
0.93	0.97	374.5	0.9682	0.6242
1.20	1.10	378.0	0.9678	0.6236
1.52	1.23	381.0	0.9675	0.6231
1.93	1.39	384.0	0.9672	0.6226
2.45	1.57	387.0	0.9669	0.6221
3.10	1.76	390.0	0.9666	0.6216
3.93	1.98	394.0	0.9662	0.6209
4.97	2.23	397.0	0.9659	0.6204
6.28	2.51	400.5	0.9656	0.6198
7.93	2.82	404.0	0.9652	0.6193
9.38	3.06	407.0	0.9649	0.6187
11.83	3.44	410.5	0.9646	0.6182
14.93	3.86	414.5	0.9642	0.6175
18.83	4.34	418.5	0.9638	0.6168
23.75	4.87	422.5	0.9634	0.6161
29.93	5.47	426.5	0.9630	0.6155
37.73	6.14	431.0	0.9625	0.6147
47.55	6.90	435.0	0.9621	0.6141
59.93	7.74	440.0	0.9616	0.6132
75.93	8.71	444.5	0.9612	0.6125
94.93	9.74	449.5	0.9607	0.6116
119.93	10.95	455.0	0.9601	0.6107
→ 150.93	12.29	459.5	0.9597	0.6099
189.93	13.78	464.0	0.9592	0.6092
--> 1202.93	34.68	483.5	0.9573	0.6059

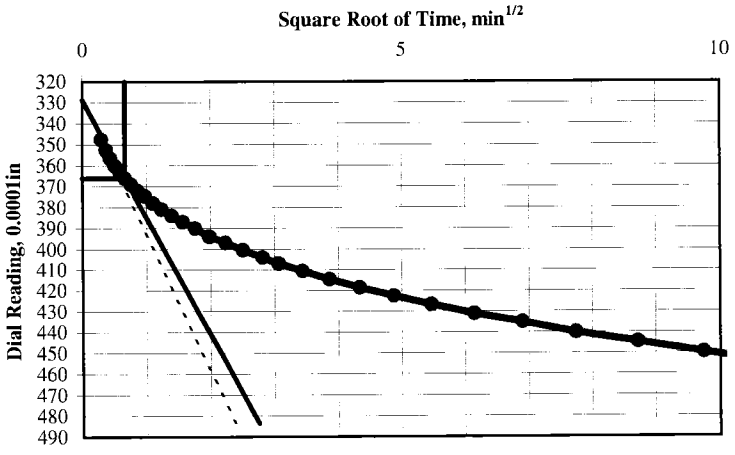
Machine Deflection

Applied Deflection Correction to Sample Height, 0.0001in: -5.5
**Correction is applied to all dial readings.*

Log of Elapsed Time vs. Dial Reading



Square Root of Elapsed Time vs. Dial Reading



Sqrt. of Elapsed Time vs Dial Reading		Log of Elapsed Time vs Dial Reading		Load Summary	
T0 = 0 min.	D0 = 328.9 div.	T0 = 0 min.	D0 = 332 div.		
T90 = 0.449 min	D90 = 366.2 div.	T50 = 4.67 min.	D50 = 396.2 div.	Initial Sample Height, in	0.9792
T100 = NA min	D100 = 370.4 div.	T100 = 150.93 min.	D100 = 460.4 div.	Initial Sample Void Ratio	0.6427
Height at: D90 = 0.969, D100 = 0.9686		Height at: D50 = 0.966, D100 = 0.9596		Final Sample Height, in	0.9573
Average Sample Height, in	0.9682	Average Sample Height, in	0.9682	Final Sample Void Ratio	0.6059
Average Drainage Height, in	0.4841	Average Drainage Height, in	0.4841	Incremental Strain, %	2.24%
T (Time Factor for T90)	0.848	T (Time Factor for T50)	0.197	Loading Duration, min	1202.9333
Coef. of Consol., C_v, in^2/min	0.449	Coef. of Consol., C_v, in^2/min	0.010		

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ONE-DIMENSIONAL CONSOLIDATION PROPERTIES OF SOILS
ASTM D 2435

Client	Civil & Environmental Consultant	Boring	SB-16	**Test Load, tsf**	**4-1**
Client Project	091-867 Apex Landfill Expansion	Depth	0.5'-2.5'		Load 6 of 13
Project No.	30598	Sample	ST-1		
		Lab ID#	30598008		

Visual Description: Light Olive Brown Fat Clay
Test Conditions: Undisturbed, Inundated, and Double Drained

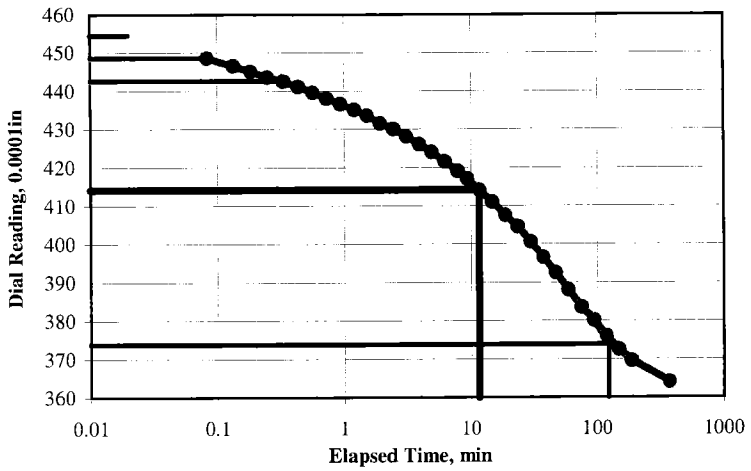
Time Vs. Dial Reading

Elapsed Time (min)	Sqrt Time ($min^{1/2}$)	Dial Reading (0.0001in)	Sample Height (in)	Void Ratio
0	0	483.5	0.9573	0.6059
Corrections*		7.5	0.00075	0.00126
Adjusted Sample Height & Void Ratio				
0.08	0.29	448.5	0.9600	0.6105
0.13	0.37	446.5	0.9602	0.6109
0.18	0.43	445.0	0.9604	0.6111
0.25	0.50	443.5	0.9605	0.6114
0.33	0.58	442.5	0.9606	0.6115
0.43	0.66	441.0	0.9608	0.6118
0.57	0.75	439.5	0.9609	0.6120
0.73	0.86	438.0	0.9611	0.6123
0.93	0.97	436.5	0.9612	0.6125
1.20	1.10	435.0	0.9614	0.6128
1.52	1.23	433.5	0.9615	0.6130
1.93	1.39	431.5	0.9617	0.6134
2.45	1.57	430.0	0.9619	0.6136
3.10	1.76	428.0	0.9621	0.6140
3.93	1.98	426.0	0.9623	0.6143
4.97	2.23	424.0	0.9625	0.6146
6.28	2.51	421.5	0.9627	0.6151
7.93	2.82	419.0	0.9630	0.6155
9.38	3.06	417.0	0.9632	0.6158
11.83	3.44	414.0	0.9635	0.6163
14.93	3.86	411.0	0.9638	0.6168
18.83	4.34	407.5	0.9641	0.6174
23.75	4.87	404.5	0.9644	0.6179
29.93	5.47	400.5	0.9648	0.6186
37.73	6.14	396.5	0.9652	0.6193
47.55	6.90	392.5	0.9656	0.6199
59.93	7.74	388.0	0.9661	0.6207
75.93	8.71	383.5	0.9665	0.6214
94.93	9.74	380.0	0.9669	0.6220
119.93	10.95	376.0	0.9673	0.6227
150.93	12.29	372.5	0.9676	0.6233
189.93	13.78	369.5	0.9679	0.6238
379.93	19.49	364.0	0.9685	0.6247

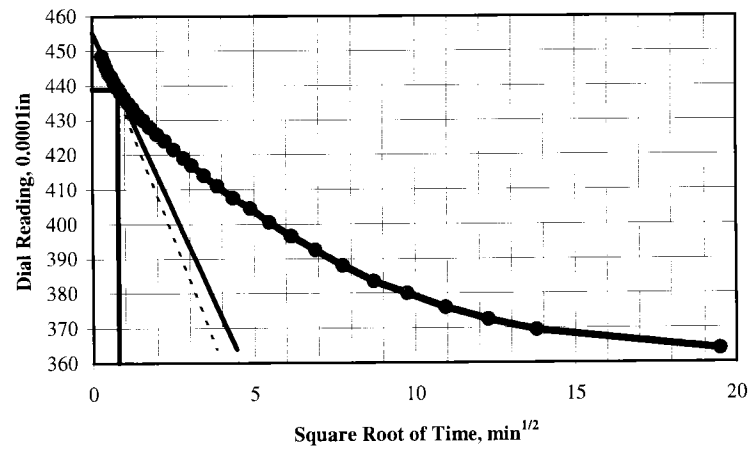
Machine Deflection

Applied Deflection Correction to Sample Height, 0.0001in 7.5
**Correction is applied to all dial readings.*

Log of Elapsed Time vs. Dial Reading



Square Root of Elapsed Time vs. Dial Reading



Sqrt. of Elapsed Time vs Dial Reading		Log of Elapsed Time vs Dial Reading		Load Summary	
T0 = 0 min.	D0 = 455.2 div.	T0 = 0 min.	D0 = 454.5 div.		
T90 = 0.624 min	D90 = 438.9 div.	T50 = 11.69 min.	D50 = 414.2 div.	Initial Sample Height, in	0.9573
T100 = NA min	D100 = 437.1 div.	T100 = 124.25 min.	D100 = 373.8 div.	Initial Sample Void Ratio	0.6059
Height at: D90 = 0.961, D100 = 0.9612		Height at: D50 = 0.9635, D100 = 0.9675		Final Sample Height, in	0.9685
Average Sample Height, in	0.9629	Average Sample Height, in	0.9629	Final Sample Void Ratio	0.6247
Average Drainage Height, in	0.4814	Average Drainage Height, in	0.4814	Incremental Strain, %	-1.17%
T (Time Factor for T90)	0.848	T (Time Factor for T50)	0.197	Loading Duration, min	379.93333
Coef. of Consol., C_v, in^2/min	0.314	Coef. of Consol., C_v, in^2/min	0.004		

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ONE-DIMENSIONAL CONSOLIDATION PROPERTIES OF SOILS
ASTM D 2435

Client	Civil & Environmental Consultant	Boring	SB-16	**Test Load, tsf**	**1-0.25**
Client Project	091-867 Apex Landfill Expansion	Depth	0.5'-2.5'		Load 7 of 13
Project No.	30598	Sample	ST-1		
		Lab ID#	30598008		

Visual Description: Light Olive Brown Fat Clay
Test Conditions: Undisturbed, Inundated, and Double Drained

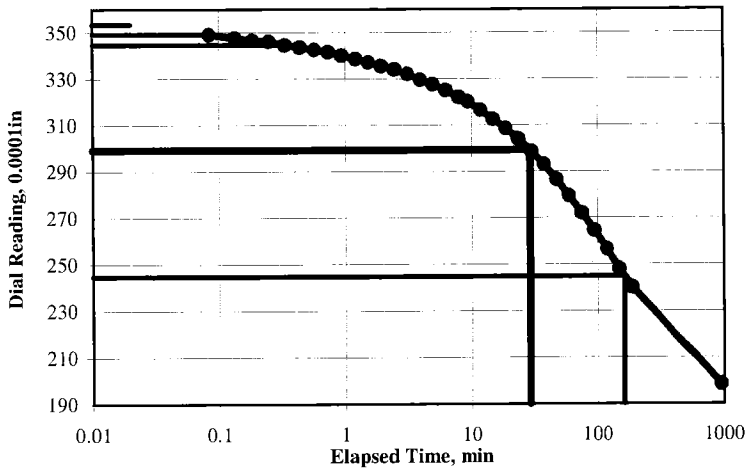
Time Vs. Dial Reading

Elapsed Time (min)	Sqrt Time ($min^{1/2}$)	Dial Reading (0.0001in)	Sample Height (in)	Void Ratio
0	0	364.0	0.9685	0.6247
Corrections*		4.5	0.00045	0.00075
Adjusted Sample Height & Void Ratio				
0.08	0.29	349.0	0.9695	0.6265
0.13	0.37	347.5	0.9697	0.6267
0.18	0.43	346.5	0.9698	0.6269
0.25	0.50	346.0	0.9698	0.6270
0.33	0.58	344.5	0.9700	0.6272
0.43	0.66	343.5	0.9701	0.6274
0.57	0.75	342.5	0.9702	0.6276
0.73	0.86	341.5	0.9703	0.6277
0.93	0.97	340.0	0.9704	0.6280
1.20	1.10	338.5	0.9706	0.6282
1.52	1.23	337.0	0.9707	0.6285
1.93	1.39	335.5	0.9709	0.6287
2.45	1.57	334.0	0.9710	0.6290
3.10	1.76	332.0	0.9712	0.6293
3.93	1.98	329.5	0.9715	0.6297
4.97	2.23	327.5	0.9717	0.6301
6.28	2.51	325.0	0.9719	0.6305
7.93	2.82	322.0	0.9722	0.6310
9.38	3.06	320.0	0.9724	0.6313
11.83	3.44	316.5	0.9728	0.6319
14.93	3.86	312.5	0.9732	0.6326
18.83	4.34	308.5	0.9736	0.6333
23.75	4.87	304.0	0.9740	0.6340
29.93	5.47	298.5	0.9746	0.6349
37.73	6.14	293.0	0.9751	0.6359
47.55	6.90	286.5	0.9758	0.6370
59.93	7.74	279.5	0.9765	0.6381
75.93	8.71	272.0	0.9772	0.6394
94.93	9.74	264.5	0.9780	0.6406
119.93	10.95	256.5	0.9788	0.6420
150.93	12.29	248.0	0.9796	0.6434
189.93	13.78	240.0	0.9804	0.6448
954.93	30.90	198.5	0.9846	0.6517

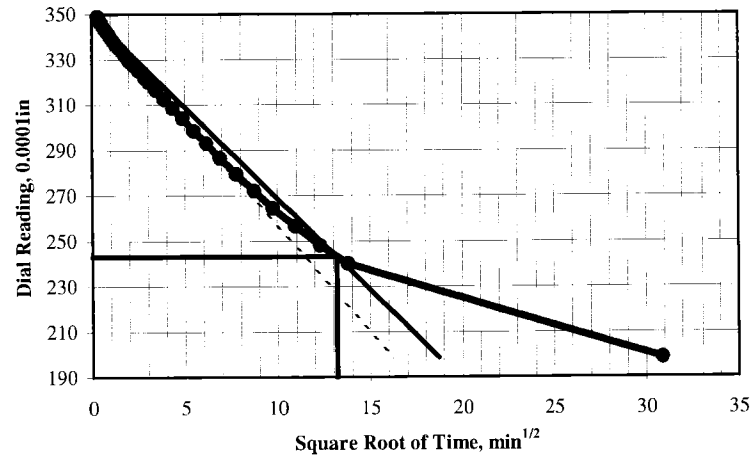
Machine Deflection

Applied Deflection Correction to Sample Height, 0.0001in: 4.5
**Correction is applied to all dial readings.*

Log of Elapsed Time vs. Dial Reading



Square Root of Elapsed Time vs. Dial Reading



Sqrt. of Elapsed Time vs Dial Reading

T0 = 0 min.	D0 = 349.2 div.
T90 = 173.712 min	D90 = 243.2 div.
T100 = NA min	D100 = 231.4 div.
Height at: D90 = 0.9801, D100 = 0.9813	
Average Sample Height, in	0.9765
Average Drainage Height, in	0.4883
T (Time Factor for T90)	0.848
Coef. of Consol., C_v, in^2/min	0.001

Log of Elapsed Time vs Dial Reading

T0 = 0 min.	D0 = 353.5 div.
T50 = 29.1 min.	D50 = 299.2 div.
T100 = 164.38 min.	D100 = 244.8 div.
Height at: D50 = 0.9745, D100 = 0.9799	
Average Sample Height, in	0.9765
Average Drainage Height, in	0.4883
T (Time Factor for T50)	0.197
Coef. of Consol., C_v, in^2/min	0.002

Load Summary

Initial Sample Height, in	0.9685
Initial Sample Void Ratio	0.6247
Final Sample Height, in	0.9846
Final Sample Void Ratio	0.6517
Incremental Strain, %	-1.66%
Loading Duration, min	954.93333

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ONE-DIMENSIONAL CONSOLIDATION PROPERTIES OF SOILS
ASTM D 2435

Client	Civil & Environmental Consultant	Boring	SB-16	**Test Load, tsf 0.25-0.5**
Client Project	091-867 Apex Landfill Expansion	Depth	0.5'-2.5'	Load 8 of 13
Project No.	30598	Sample	ST-1	
		Lab ID#	30598008	

Visual Description: Light Olive Brown Fat Clay
Test Conditions: Undisturbed, Inundated, and Double Drained

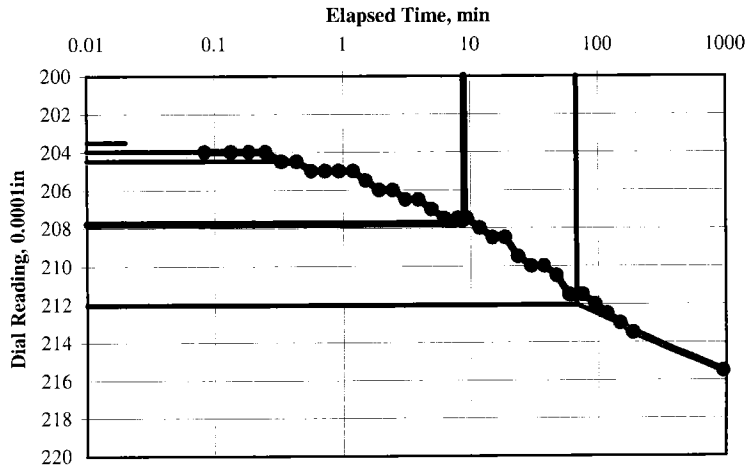
Time Vs. Dial Reading

Elapsed Time (min)	Sqrt Time ($min^{1/2}$)	Dial Reading (0.0001in)	Sample Height (in)	Void Ratio
0	0	198.5	0.9846	0.6517
Corrections*		-1.5	-0.00015	-0.0003
Adjusted Sample Height & Void Ratio				
0.08	0.29	204.0	0.9842	0.6510
0.13	0.37	204.0	0.9842	0.6510
0.18	0.43	204.0	0.9842	0.6510
0.25	0.50	204.0	0.9842	0.6510
0.33	0.58	204.5	0.9841	0.6510
0.43	0.66	204.5	0.9841	0.6510
0.57	0.75	205.0	0.9841	0.6509
0.73	0.86	205.0	0.9841	0.6509
0.93	0.97	205.0	0.9841	0.6509
1.20	1.10	205.0	0.9841	0.6509
1.52	1.23	205.5	0.9840	0.6508
1.93	1.39	206.0	0.9840	0.6507
2.45	1.57	206.0	0.9840	0.6507
3.10	1.76	206.5	0.9839	0.6506
3.95	1.99	206.5	0.9839	0.6506
4.97	2.23	207.0	0.9839	0.6505
6.28	2.51	207.5	0.9838	0.6505
7.93	2.82	207.5	0.9838	0.6505
9.38	3.06	207.5	0.9838	0.6505
11.83	3.44	208.0	0.9838	0.6504
14.93	3.86	208.5	0.9837	0.6503
18.83	4.34	208.5	0.9837	0.6503
23.75	4.87	209.5	0.9836	0.6501
29.93	5.47	210.0	0.9836	0.6500
37.73	6.14	210.0	0.9836	0.6500
47.55	6.90	210.5	0.9835	0.6500
59.93	7.74	211.5	0.9834	0.6498
75.93	8.71	211.5	0.9834	0.6498
94.93	9.74	212.0	0.9834	0.6497
119.93	10.95	212.5	0.9833	0.6496
150.93	12.29	213.0	0.9833	0.6495
189.93	13.78	213.5	0.9832	0.6494
954.93	30.90	215.5	0.9830	0.6491

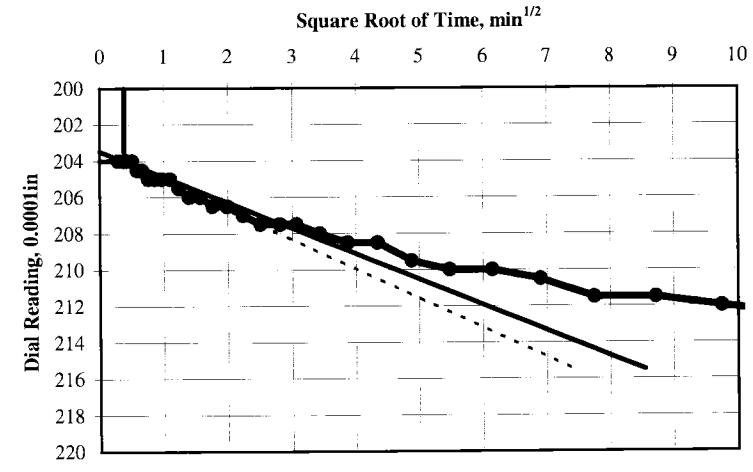
Machine Deflection

Applied Deflection Correction to Sample Height, 0.0001in: -1.5
**Correction is applied to all dial readings.*

Log of Elapsed Time vs. Dial Reading



Square Root of Elapsed Time vs. Dial Reading



Sqrt. of Elapsed Time vs Dial Reading

T0 = 0 min.	D0 = 203.5 div.
T90 = 0.144 min	D90 = 204 div.
T100 = NA min	D100 = 204.1 div.
Height at: D90 = 0.9842, D100 = 0.9842	
Average Sample Height, in	0.9838
Average Drainage Height, in	0.4919
T (Time Factor for T90)	0.848
Coef. of Consol., C_v, in^2/min	1.440

Log of Elapsed Time vs Dial Reading

T0 = 0 min.	D0 = 203.5 div.
T50 = 8.88 min.	D50 = 207.8 div.
T100 = 68.02 min.	D100 = 212 div.
Height at: D50 = 0.9838, D100 = 0.9834	
Average Sample Height, in	0.9838
Average Drainage Height, in	0.4919
T (Time Factor for T50)	0.197
Coef. of Consol., C_v, in^2/min	0.005

Load Summary

Initial Sample Height, in	0.9846
Initial Sample Void Ratio	0.6517
Final Sample Height, in	0.9830
Final Sample Void Ratio	0.6491
Incremental Strain, %	0.16%
Loading Duration, min	954.93333

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ONE-DIMENSIONAL CONSOLIDATION PROPERTIES OF SOILS
ASTM D 2435

Client	Civil & Environmental Consultant	Boring	SB-16	**Test Load, tsf**	**0.5-1**
Client Project	091-867 Apex Landfill Expansion	Depth	0.5'-2.5'		Load 9 of 13
Project No.	30598	Sample	ST-1		
		Lab ID#	30598008		

Visual Description: Light Olive Brown Fat Clay
Test Conditions: Undisturbed, Inundated, and Double Drained

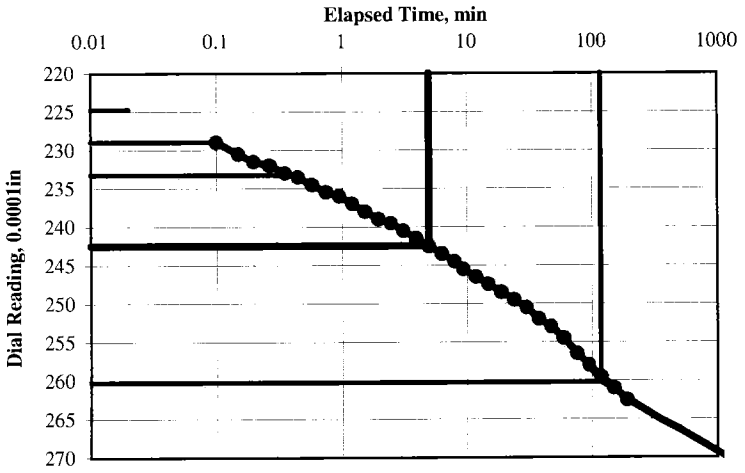
Time Vs. Dial Reading

Elapsed Time (min)	Sqrt Time ($min^{1/2}$)	Dial Reading (0.0001in)	Sample Height (in)	Void Ratio
0	0	215.5	0.9830	0.6491
Corrections*		-2.5	-0.00025	-0.0004
Adjusted Sample Height & Void Ratio				
0.10	0.32	229.0	0.9819	0.6473
0.15	0.39	230.5	0.9818	0.6470
0.20	0.45	231.5	0.9817	0.6468
0.27	0.52	232.0	0.9816	0.6468
0.35	0.59	233.0	0.9815	0.6466
0.45	0.67	233.5	0.9815	0.6465
0.58	0.76	234.5	0.9814	0.6463
0.75	0.87	235.5	0.9813	0.6462
0.95	0.97	236.0	0.9812	0.6461
1.22	1.10	237.0	0.9811	0.6459
1.53	1.24	238.0	0.9810	0.6458
1.95	1.40	239.0	0.9809	0.6456
2.47	1.57	239.5	0.9809	0.6455
3.12	1.77	240.5	0.9808	0.6453
3.95	1.99	241.5	0.9807	0.6452
4.98	2.23	242.5	0.9806	0.6450
6.30	2.51	243.5	0.9805	0.6448
7.95	2.82	244.5	0.9804	0.6447
9.40	3.07	245.5	0.9803	0.6445
11.85	3.44	246.5	0.9802	0.6443
14.95	3.87	247.5	0.9801	0.6442
18.85	4.34	248.5	0.9800	0.6440
23.77	4.88	249.5	0.9799	0.6438
29.95	5.47	250.5	0.9798	0.6437
37.75	6.14	252.0	0.9796	0.6434
47.57	6.90	253.0	0.9795	0.6432
59.95	7.74	254.5	0.9794	0.6430
75.95	8.71	256.5	0.9792	0.6427
94.95	9.74	258.0	0.9790	0.6424
119.95	10.95	259.5	0.9789	0.6422
150.95	12.29	261.0	0.9787	0.6419
189.95	13.78	262.5	0.9786	0.6416
1202.95	34.68	270.0	0.9778	0.6404

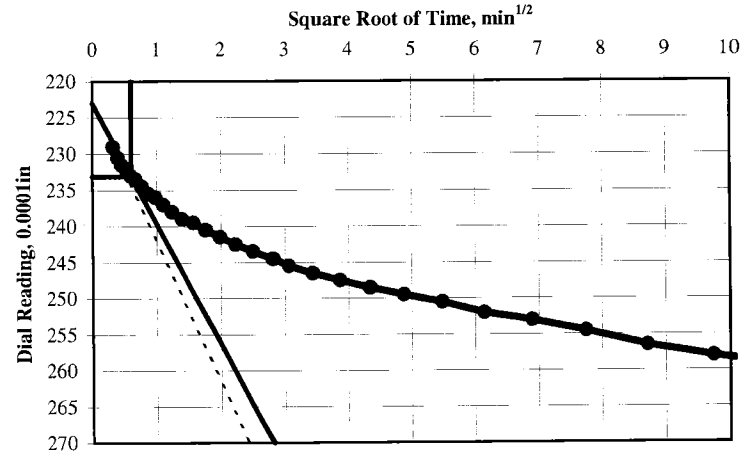
Machine Deflection

Applied Deflection Correction to Sample Height, 0.0001in: -2.5
**Correction is applied to all dial readings.*

Log of Elapsed Time vs. Dial Reading



Square Root of Elapsed Time vs. Dial Reading



Sqrt. of Elapsed Time vs Dial Reading			Log of Elapsed Time vs Dial Reading			Load Summary	
T0 = 0 min.	D0 = 223 div.		T0 = 0 min.	D0 = 224.7 div.			
T90 = 0.372 min	D90 = 233.1 div.		T50 = 4.94 min.	D50 = 242.5 div.		Initial Sample Height, in	0.9830
T100 = NA min	D100 = 234.2 div.		T100 = 117.48 min.	D100 = 260.2 div.		Initial Sample Void Ratio	0.6491
Height at: D90 = 0.9815, D100 = 0.9814			Height at: D50 = 0.9806, D100 = 0.9788			Final Sample Height, in	0.9778
Average Sample Height, in		0.9804	Average Sample Height, in		0.9804	Final Sample Void Ratio	0.6404
Average Drainage Height, in		0.4902	Average Drainage Height, in		0.4902	Incremental Strain, %	0.53%
T (Time Factor for T90)		0.848	T (Time Factor for T50)		0.197	Loading Duration, min	1202.95
Coef. of Consol., C_v, in^2/min		0.553	Coef. of Consol., C_v, in^2/min		0.010		

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ONE-DIMENSIONAL CONSOLIDATION PROPERTIES OF SOILS
ASTM D 2435

Client	Civil & Environmental Consultant	Boring	SB-16	**Test Load, tsf**	**1-2**
Client Project	091-867 Apex Landfill Expansion	Depth	0.5'-2.5'		Load 10 of 13
Project No.	30598	Sample	ST-1		
		Lab ID#	30598008		

Visual Description: Light Olive Brown Fat Clay
Test Conditions: Undisturbed, Inundated, and Double Drained

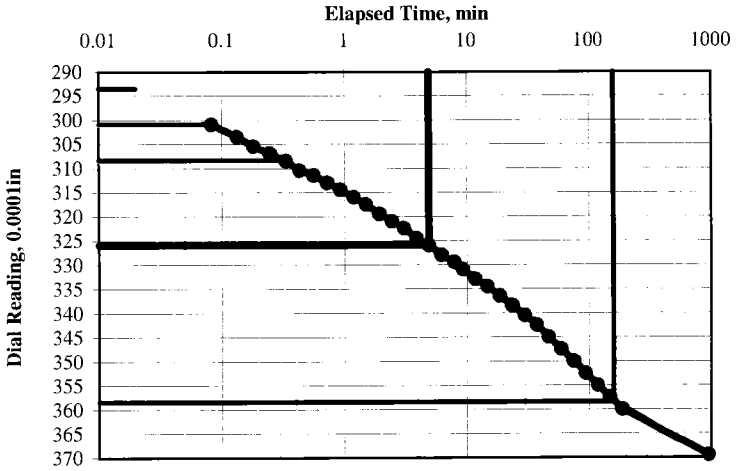
Time Vs. Dial Reading

Elapsed Time (min)	Sqrt Time ($min^{1/2}$)	Dial Reading (0.0001in)	Sample Height (in)	Void Ratio
0	0	270.0	0.9778	0.6404
Corrections*		-3.5	-0.00035	-0.0006
Adjusted Sample Height & Void Ratio				
0.08	0.29	301.0	0.9751	0.6358
0.13	0.37	303.5	0.9748	0.6354
0.18	0.43	305.5	0.9746	0.6350
0.25	0.50	307.0	0.9745	0.6348
0.33	0.58	308.5	0.9743	0.6345
0.43	0.66	310.5	0.9741	0.6342
0.57	0.75	311.5	0.9740	0.6340
0.73	0.86	313.0	0.9739	0.6338
0.93	0.97	314.5	0.9737	0.6335
1.20	1.10	316.0	0.9736	0.6333
1.52	1.23	317.5	0.9734	0.6330
1.95	1.40	319.5	0.9732	0.6327
2.45	1.57	321.0	0.9731	0.6324
3.10	1.76	322.5	0.9729	0.6322
3.93	1.98	324.5	0.9727	0.6318
4.97	2.23	326.0	0.9726	0.6316
6.28	2.51	328.0	0.9724	0.6312
7.93	2.82	329.5	0.9722	0.6310
9.38	3.06	331.0	0.9721	0.6307
11.83	3.44	333.0	0.9719	0.6304
14.93	3.86	334.5	0.9717	0.6302
18.83	4.34	336.5	0.9715	0.6298
23.75	4.87	338.5	0.9713	0.6295
29.93	5.47	340.5	0.9711	0.6291
37.73	6.14	342.5	0.9709	0.6288
47.55	6.90	345.0	0.9707	0.6284
59.93	7.74	347.5	0.9704	0.6280
75.93	8.71	350.0	0.9702	0.6276
94.93	9.74	352.5	0.9699	0.6271
119.93	10.95	355.0	0.9697	0.6267
150.93	12.29	357.5	0.9694	0.6263
189.93	13.78	360.0	0.9692	0.6259
954.93	30.90	369.5	0.9682	0.6243

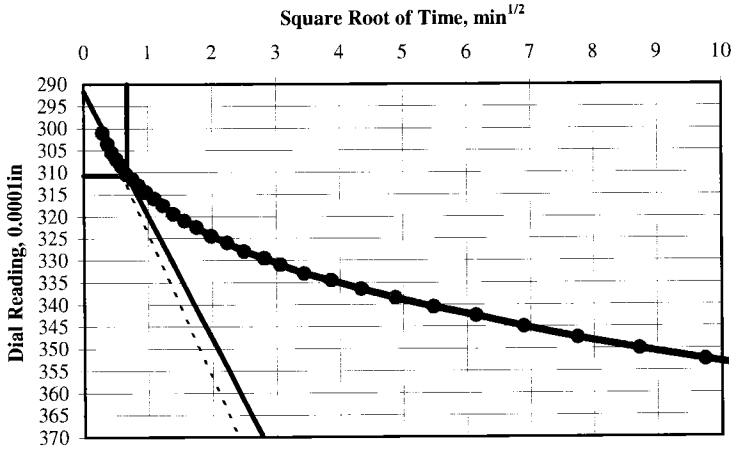
Machine Deflection

Applied Deflection Correction to Sample Height, 0.0001in: -3.5
**Correction is applied to all dial readings.*

Log of Elapsed Time vs. Dial Reading



Square Root of Elapsed Time vs. Dial Reading



Sqrt. of Elapsed Time vs Dial Reading		Log of Elapsed Time vs Dial Reading		Load Summary	
T0 = 0 min.	D0 = 291.7 div.	T0 = 0 min.	D0 = 293.5 div.		
T90 = 0.462 min	D90 = 310.7 div.	T50 = 4.92 min.	D50 = 325.9 div.	Initial Sample Height, in	0.9778
T100 = NA min	D100 = 312.8 div.	T100 = 160.53 min.	D100 = 358.4 div.	Initial Sample Void Ratio	0.6404
Height at: D90 = 0.9741, D100 = 0.9739		Height at: D50 = 0.9726, D100 = 0.9693		Final Sample Height, in	0.9682
Average Sample Height, in	0.9730	Average Sample Height, in	0.9730	Final Sample Void Ratio	0.6243
Average Drainage Height, in	0.4865	Average Drainage Height, in	0.4865	Incremental Strain, %	0.98%
T (Time Factor for T90)	0.848	T (Time Factor for T50)	0.197	Loading Duration, min	954.93333
Coef. of Consol., C_v, in^2/min	0.438	Coef. of Consol., C_v, in^2/min	0.009		

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ONE-DIMENSIONAL CONSOLIDATION PROPERTIES OF SOILS
ASTM D 2435

Client	Civil & Environmental Consultant	Boring	SB-16	**Test Load, tsf**	**2-4**
Client Project	091-867 Apex Landfill Expansion	Depth	0.5'-2.5'		Load 11 of 13
Project No.	30598	Sample	ST-1		
		Lab ID#	30598008		

Visual Description: Light Olive Brown Fat Clay
Test Conditions: Undisturbed, Inundated, and Double Drained

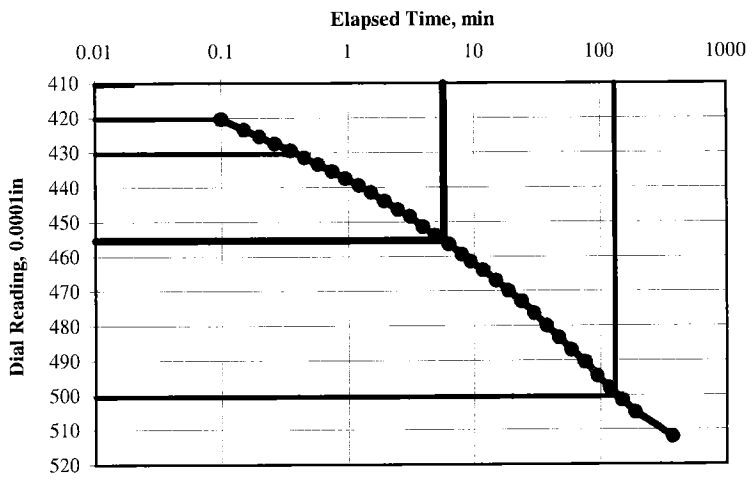
Time Vs. Dial Reading

Elapsed Time (min)	Sqrt Time ($min^{1/2}$)	Dial Reading (0.0001in)	Sample Height (in)	Void Ratio
0	0	369.5	0.9682	0.6243
Corrections*		-4.5	-0.00045	-0.0008
Adjusted Sample Height & Void Ratio				
0.10	0.32	420.5	0.9636	0.6165
0.15	0.39	423.5	0.9633	0.6160
0.20	0.45	425.5	0.9631	0.6156
0.27	0.52	427.5	0.9629	0.6153
0.35	0.59	429.5	0.9627	0.6150
0.45	0.67	431.5	0.9625	0.6146
0.58	0.76	433.5	0.9623	0.6143
0.75	0.87	435.5	0.9621	0.6140
0.95	0.97	437.5	0.9619	0.6136
1.22	1.10	439.5	0.9617	0.6133
1.53	1.24	441.5	0.9615	0.6130
1.95	1.40	444.0	0.9612	0.6125
2.47	1.57	446.5	0.9610	0.6121
3.12	1.77	448.5	0.9608	0.6118
3.95	1.99	451.5	0.9605	0.6113
4.98	2.23	454.0	0.9602	0.6109
6.30	2.51	456.5	0.9600	0.6104
7.95	2.82	459.5	0.9597	0.6099
9.40	3.07	461.5	0.9595	0.6096
11.85	3.44	464.0	0.9592	0.6092
14.95	3.87	467.0	0.9589	0.6087
18.85	4.34	470.0	0.9586	0.6082
23.77	4.88	473.0	0.9583	0.6077
29.95	5.47	476.5	0.9580	0.6071
37.75	6.14	480.0	0.9576	0.6065
47.57	6.90	483.5	0.9573	0.6059
59.95	7.74	487.0	0.9569	0.6053
75.95	8.71	490.5	0.9566	0.6047
94.95	9.74	494.5	0.9562	0.6041
119.95	10.95	498.0	0.9558	0.6035
150.95	12.29	501.5	0.9555	0.6029
189.95	13.78	505.0	0.9551	0.6023
379.95	19.49	512.0	0.9544	0.6011

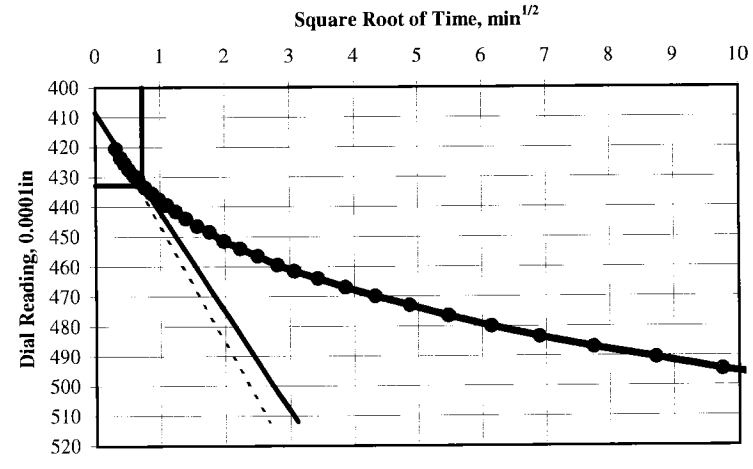
Machine Deflection

Applied Deflection Correction to Sample Height, 0.0001in: -4.5
**Correction is applied to all dial readings.*

Log of Elapsed Time vs. Dial Reading



Square Root of Elapsed Time vs. Dial Reading



Sqrt. of Elapsed Time vs Dial Reading

T0 = 0 min.	D0 = 408.5 div.		
T90 = 0.533 min	D90 = 432.7 div.		
T100 = NA min	D100 = 435.4 div.		
Height at: D90 = 0.9624, D100 = 0.9621			
Average Sample Height, in	0.9613		
Average Drainage Height, in	0.4807		
T (Time Factor for T90)	0.848		
Coef. of Consol., C_v, in^2/min	0.369		

Log of Elapsed Time vs Dial Reading

T0 = 0 min.	D0 = 410.4 div.		
T50 = 5.71 min.	D50 = 455.4 div.		
T100 = 132.4 min.	D100 = 500.5 div.		
Height at: D50 = 0.9601, D100 = 0.9556			
Average Sample Height, in	0.9613		
Average Drainage Height, in	0.4807		
T (Time Factor for T50)	0.197		
Coef. of Consol., C_v, in^2/min	0.008		

Load Summary

Initial Sample Height, in	0.9682
Initial Sample Void Ratio	0.6243
Final Sample Height, in	0.9544
Final Sample Void Ratio	0.6011
Incremental Strain, %	1.43%
Loading Duration, min	379.95

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ONE-DIMENSIONAL CONSOLIDATION PROPERTIES OF SOILS
ASTM D 2435

Client	Civil & Environmental Consultant	Boring	SB-16	**Test Load, tsf**	**4-8**
Client Project	091-867 Apex Landfill Expansion	Depth	0.5'-2.5'		Load 12 of 13
Project No.	30598	Sample	ST-1		
		Lab ID#	30598008		

Visual Description: Light Olive Brown Fat Clay
Test Conditions: Undisturbed, Inundated, and Double Drained

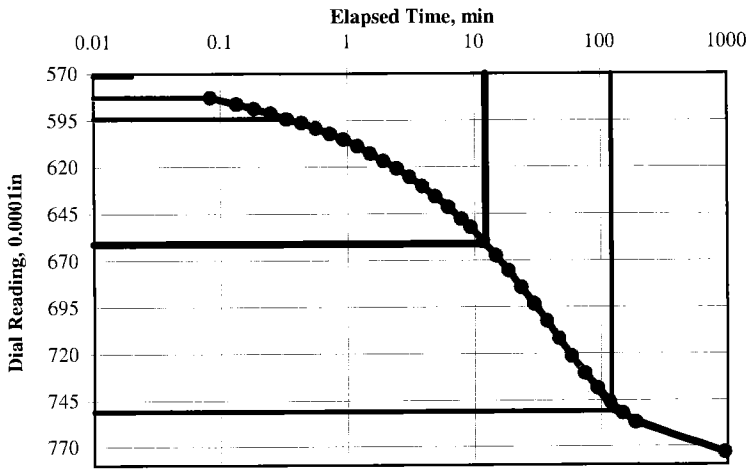
Time Vs. Dial Reading

Elapsed Time (min)	Sqrt Time ($min^{1/2}$)	Dial Reading (0.0001in)	Sample Height (in)	Void Ratio
0	0	512.0	0.9544	0.6011
Corrections*		-10	-0.001	-0.0017
Adjusted Sample Height & Void Ratio				
0.08	0.29	583.0	0.9483	0.5909
0.13	0.37	586.5	0.9480	0.5903
0.18	0.43	589.0	0.9477	0.5899
0.25	0.50	591.5	0.9475	0.5895
0.33	0.58	594.5	0.9472	0.5890
0.43	0.66	596.5	0.9470	0.5886
0.57	0.75	599.5	0.9467	0.5881
0.73	0.86	602.5	0.9464	0.5876
0.93	0.97	605.5	0.9461	0.5871
1.20	1.10	609.0	0.9457	0.5865
1.52	1.23	613.0	0.9453	0.5859
1.93	1.39	617.0	0.9449	0.5852
2.45	1.57	621.0	0.9445	0.5845
3.10	1.76	625.5	0.9441	0.5838
3.93	1.98	630.5	0.9436	0.5829
4.97	2.23	636.0	0.9430	0.5820
6.28	2.51	641.5	0.9425	0.5811
7.93	2.82	648.0	0.9418	0.5800
9.38	3.06	652.5	0.9414	0.5792
11.83	3.44	660.0	0.9406	0.5780
14.93	3.86	667.5	0.9399	0.5767
18.83	4.34	675.5	0.9391	0.5754
23.75	4.87	684.5	0.9382	0.5739
29.93	5.47	693.5	0.9373	0.5724
37.73	6.14	702.5	0.9364	0.5709
47.55	6.90	712.0	0.9354	0.5693
59.93	7.74	721.5	0.9345	0.5677
75.93	8.71	730.5	0.9336	0.5662
94.93	9.74	738.5	0.9328	0.5648
119.93	10.95	746.0	0.9320	0.5636
150.93	12.29	752.0	0.9314	0.5625
189.93	13.78	757.0	0.9309	0.5617
954.93	30.90	773.0	0.9293	0.5590

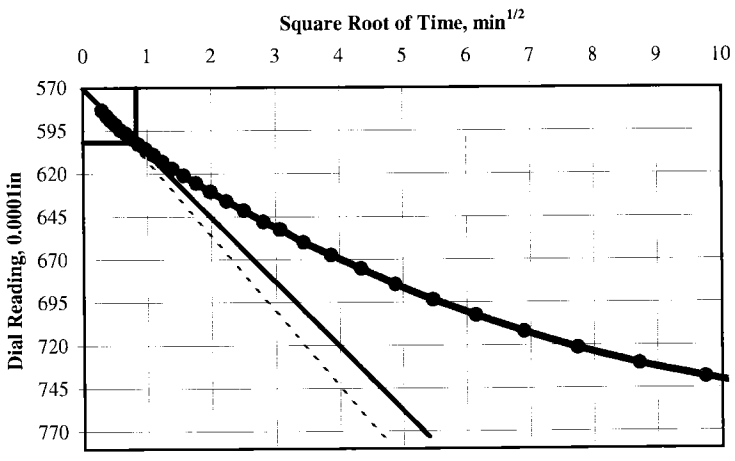
Machine Deflection

Applied Deflection Correction to Sample Height, 0.0001in: -10
**Correction is applied to all dial readings.*

Log of Elapsed Time vs. Dial Reading



Square Root of Elapsed Time vs. Dial Reading



Sqrt. of Elapsed Time vs Dial Reading		Log of Elapsed Time vs Dial Reading		Load Summary	
T0 = 0 min.	D0 = 570.6 div.	T0 = 0 min.	D0 = 571.5 div.		
T90 = 0.689 min	D90 = 601.8 div.	T50 = 12.29 min.	D50 = 661.2 div.	Initial Sample Height, in	0.9544
T100 = NA min	D100 = 605.2 div.	T100 = 122.62 min.	D100 = 750.9 div.	Initial Sample Void Ratio	0.6011
Height at: D90 = 0.9464, D100 = 0.9461		Height at: D50 = 0.9405, D100 = 0.9315		Final Sample Height, in	0.9293
Average Sample Height, in	0.9419	Average Sample Height, in	0.9419	Final Sample Void Ratio	0.5590
Average Drainage Height, in	0.4709	Average Drainage Height, in	0.4709	Incremental Strain, %	2.63%
T (Time Factor for T90)	0.848	T (Time Factor for T50)	0.197	Loading Duration, min	954.93333
Coef. of Consol., C_v, in^2/min	0.273	Coef. of Consol., C_v, in^2/min	0.004		

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ONE-DIMENSIONAL CONSOLIDATION PROPERTIES OF SOILS
ASTM D 2435

Client	Civil & Environmental Consultant	Boring	SB-16	**Test Load, tsf**	**8-16**
Client Project	091-867 Apex Landfill Expansion	Depth	0.5'-2.5'		Load 13 of 13
Project No.	30598	Sample	ST-1		
		Lab ID#	30598008		

Visual Description: Light Olive Brown Fat Clay
Test Conditions: Undisturbed, Inundated, and Double Drained

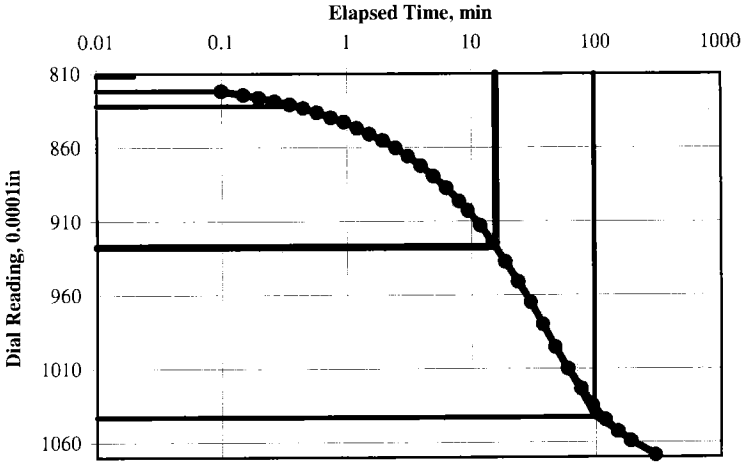
Time Vs. Dial Reading

Elapsed Time (min)	Sqrt Time ($min^{1/2}$)	Dial Reading (0.0001in)	Sample Height (in)	Void Ratio
0	0	773.0	0.9293	0.5590
Corrections*		-13.5	-0.00135	-0.0023
Adjusted Sample Height & Void Ratio				
0.10	0.32	822.0	0.9258	0.5531
0.15	0.39	824.5	0.9255	0.5527
0.20	0.45	826.5	0.9253	0.5523
0.27	0.52	829.0	0.9251	0.5519
0.35	0.59	831.0	0.9249	0.5516
0.45	0.67	833.5	0.9246	0.5511
0.58	0.76	836.5	0.9243	0.5506
0.75	0.87	840.0	0.9240	0.5501
0.95	0.97	843.0	0.9237	0.5495
1.22	1.10	847.0	0.9233	0.5489
1.53	1.24	851.0	0.9229	0.5482
1.95	1.40	855.5	0.9224	0.5475
2.47	1.57	860.5	0.9219	0.5466
3.12	1.77	866.0	0.9214	0.5457
3.95	1.99	872.5	0.9207	0.5446
4.98	2.23	879.5	0.9200	0.5434
6.30	2.51	887.5	0.9192	0.5421
7.95	2.82	896.5	0.9183	0.5406
9.40	3.07	903.0	0.9177	0.5395
11.85	3.44	913.0	0.9167	0.5378
14.95	3.87	924.5	0.9155	0.5359
18.85	4.34	937.5	0.9142	0.5337
23.77	4.88	951.0	0.9129	0.5314
29.95	5.47	965.0	0.9115	0.5291
37.75	6.14	980.0	0.9100	0.5266
47.57	6.90	995.5	0.9084	0.5240
59.95	7.74	1010.0	0.9070	0.5215
75.95	8.71	1023.5	0.9056	0.5193
94.95	9.74	1035.0	0.9045	0.5173
119.95	10.95	1044.5	0.9035	0.5157
150.95	12.29	1052.5	0.9027	0.5144
189.95	13.78	1059.0	0.9021	0.5133
301.95	17.38	1068.5	0.9011	0.5117

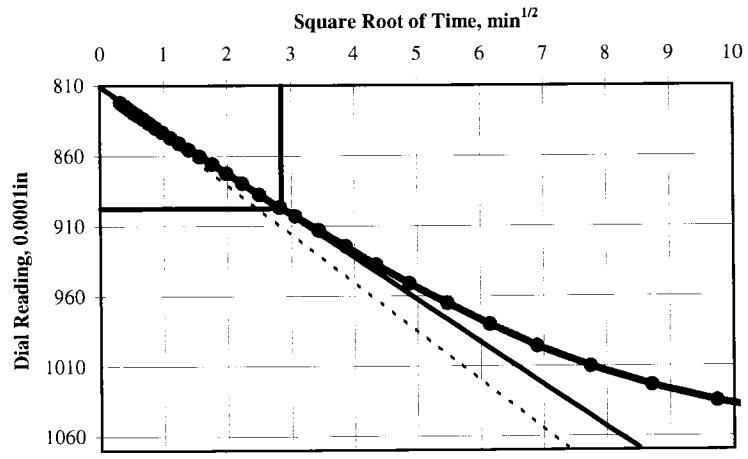
Machine Deflection

Applied Deflection Correction to Sample Height, 0.0001in: -13.5
**Correction is applied to all dial readings.*

Log of Elapsed Time vs. Dial Reading



Square Root of Elapsed Time vs. Dial Reading



Sqrt. of Elapsed Time vs Dial Reading		Log of Elapsed Time vs Dial Reading		Load Summary	
T0 = 0 min.	D0 = 811 div.	T0 = 0 min.	D0 = 811.7 div.		
T90 = 8.123 min	D90 = 897.2 div.	T50 = 15.7 min.	D50 = 927.2 div.	Initial Sample Height, in	0.9293
T100 = NA min	D100 = 906.8 div.	T100 = 96.32 min.	D100 = 1042.8 div.	Initial Sample Void Ratio	0.5590
Height at: D90 = 0.9183, D100 = 0.9173		Height at: D50 = 0.9153, D100 = 0.9037		Final Sample Height, in	0.9011
Average Sample Height, in	0.9152	Average Sample Height, in	0.9152	Final Sample Void Ratio	0.5117
Average Drainage Height, in	0.4576	Average Drainage Height, in	0.4576	Incremental Strain, %	3.03%
T (Time Factor for T90)	0.848	T (Time Factor for T50)	0.197	Loading Duration, min	301.95
Coef. of Consol., C_v, in^2/min	0.022	Coef. of Consol., C_v, in^2/min	0.003		

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OBJECTIVE

The objective of this analysis is to show that strain on the flexible membrane liner (FML) along the interior 3H:1V perimeter berm slope will be within tolerable limits.

DISCUSSION

During construction, the mine spoil at the site will be removed from the proposed footprint of the floor and one area beneath the perimeter berm in the northwest portion of the expansion. Mine spoil is typically a material that is placed without significant compaction effort. Therefore, the potential for excessive differential settlement is mainly focused on the internal 3H:1V perimeter berm slope where mine spoil will remain in place and municipal solid waste (MSW) will be placed.

EVALUATION OF PARAMETERS

Average consolidation parameters were used in the analysis based on the average laboratory data collected from undisturbed mine spoil samples and summarized in Attachment C. Refer to the Geotechnical Summary for more information.

METHODOLOGY

Settlement

A critical cross section based on maximum mine spoil thickness beneath the perimeter berm was evaluated to estimate the maximum differential settlement, which will cause the maximum strain on the FML, anticipated to occur beneath the perimeter berm. This cross section is shown in Attachment A. Three settlement calculation points (A, B, and C) were established along the internal perimeter berm slope at the top, middle, and bottom of mine spoil/RSL interface. The total settlement was estimated using primary consolidation theory at these points based on average laboratory data collected from undisturbed mine spoil samples. The following equations were used to estimate settlement within the mine spoil at the calculation point locations.

Normally consolidated mine spoil:

$$S_c = \frac{C_c H}{1+e_o} \times log\left(\frac{p_o+\Delta p}{p_o}\right)$$

Where: S_c = primary consolidation settlement, (ft);
C_c = compression index;
e_o = initial void ratio;
H = thickness of the compressible layer, (ft);
p_o = initial effective vertical pressure (psf); and
Δp = change in vertical effective pressure (psf).

Overconsolidated mine spoil:

$S_c = \frac{C_r H}{1+e_o} \times log\left(\frac{p_o+\Delta p}{p_o}\right)$ Where: C_r = recompression index;

Overconsolidated mine spoil prior to loading and normally consolidated subsequent to loading:

$S_c = \frac{C_s H}{1+e_o} \times log\left(\frac{p_c}{p_o}\right) + \frac{C_r H}{1+e_o} \times log\left(\frac{p_o+\Delta p}{p_o}\right)$ Where: p_c = preconsolidation pressure (psf);

Strain

Possible effects of differential settlement within the proposed liner system include strain upon the FML. The strain on the most critical segments based on the estimated settlement was compared to the allowable tensile strain of the FML. Strain is defined by the following equation.

$\varepsilon = \frac{\Delta l}{l_o}$ Where: Δl = the change in length between two points (ft)

l_o = the original length between the same two points (ft)

The maximum strain will occur at the location of maximum differential settlement. The maximum strain calculations are presented on in Attachment A and summarized in the following conclusions section. The strain at yield for the HDPE FML is reported to be 13%.

CONCLUSIONS

Strain experienced by the FML on the perimeter berm is expected to range from is -0.475% (compression) to 0.085% (tension) as shown in Attachment A. This is within the allowable limits of the manufacturer's specifications for FML.

As shown in the figure included in Attachment B, as the waste thickness increases the mine spoil thickness decreases. However, as the mine spoil thickness decreases the overconsolidation ratio of the mine spoil increases due to the removal of overburden to construct the perimeter berm. These factors create an effect where consolidation settlement will increase from Point A to approximately Point B (midpoint of the slope) and then decrease from Point B to Point C. This accounts for positive strain (tension) in the upper half of the slope and negative strain (compression) in the lower half of the slope.

CEC recommends proof rolling the mine spoil subgrade prior to placement of RSL. This will help to delineate any soft areas that may be susceptible to settlement. Soft, deflecting material should be removed and replaced with suitable fill and compacted in accordance with the CQA Plan.

CEC does not anticipate any localized intolerable differential settlement to occur within the mine spoil caused by soft, isolated areas. This is based on the boring logs which do not indicate high variability in blow counts, even though high variability in soil types exist within the mine spoil.

ATTACHMENT A

SETTLEMENT CALCULATION SPREADSHEET

FML Strain Analysis on Internal Perimeter Berm Slope

Point No.	A	B	C
Top of Excavation	1300	1270	1240
Top of MSW	1320	1350	1380
Existing Elevation	1300	1300	1300
Top of Mine Spoil	1300	1300	1300
Bottom of Mine Spoil	1240	1240	1240
Top of RSL	1303	1273	1243
Top of Final Cover	1324	1354	1384
MSW Thickness (ft)	17	77	137
Mine Spoil Thickness After Excavation (ft)	60	30	0
C_c	0.154	0.154	0.154
C_r	0.056	0.056	0.056
e_o	0.651	0.651	0.651
P_c (psf)	2,467	3,750	7,500
P_o (psf) [1]	3,750	1,875	0
OCR	0.66	2.00	0
ΔP (psf)	2,405	7,805	13,205
S_c (ft)	1.20	1.46	0.00
S_c (in)	14.43	17.47	0.00

A to B	
Horizontal Dist. A to B (ft)	90
Slope Distance (ft)	94.868
Pre-settlement Slope (%)	33.3%
Post-settlement Slope (%)	33.6%
Post-settlement Dist. (ft)	94.949
Strain on FML [2]	0.085%

B to C	
Horizontal Dist. A to B (ft)	90
Slope Distance (ft)	94.868
Pre-settlement Slope (%)	33.3%
Post-settlement Slope (%)	31.7%
Post-settlement Dist. (ft)	94.418
Strain on FML [2]	-0.475%

A to C	
Horizontal Dist. A to B (ft)	180
Slope Distance (ft)	189.737
Pre-settlement Slope (%)	33.3%
Post-settlement Slope (%)	32.7%
Post-settlement Dist. (ft)	189.360
Strain on FML [2]	-0.199%

[1] P_o was calculated at the center of the mine spoil layer beneath each point along the cross section.

[2] Positive strain indicates tension; negative strain indicates compression.

ATTACHMENT B

CROSS SECTION

Civil & Environmental Consultants, Inc.

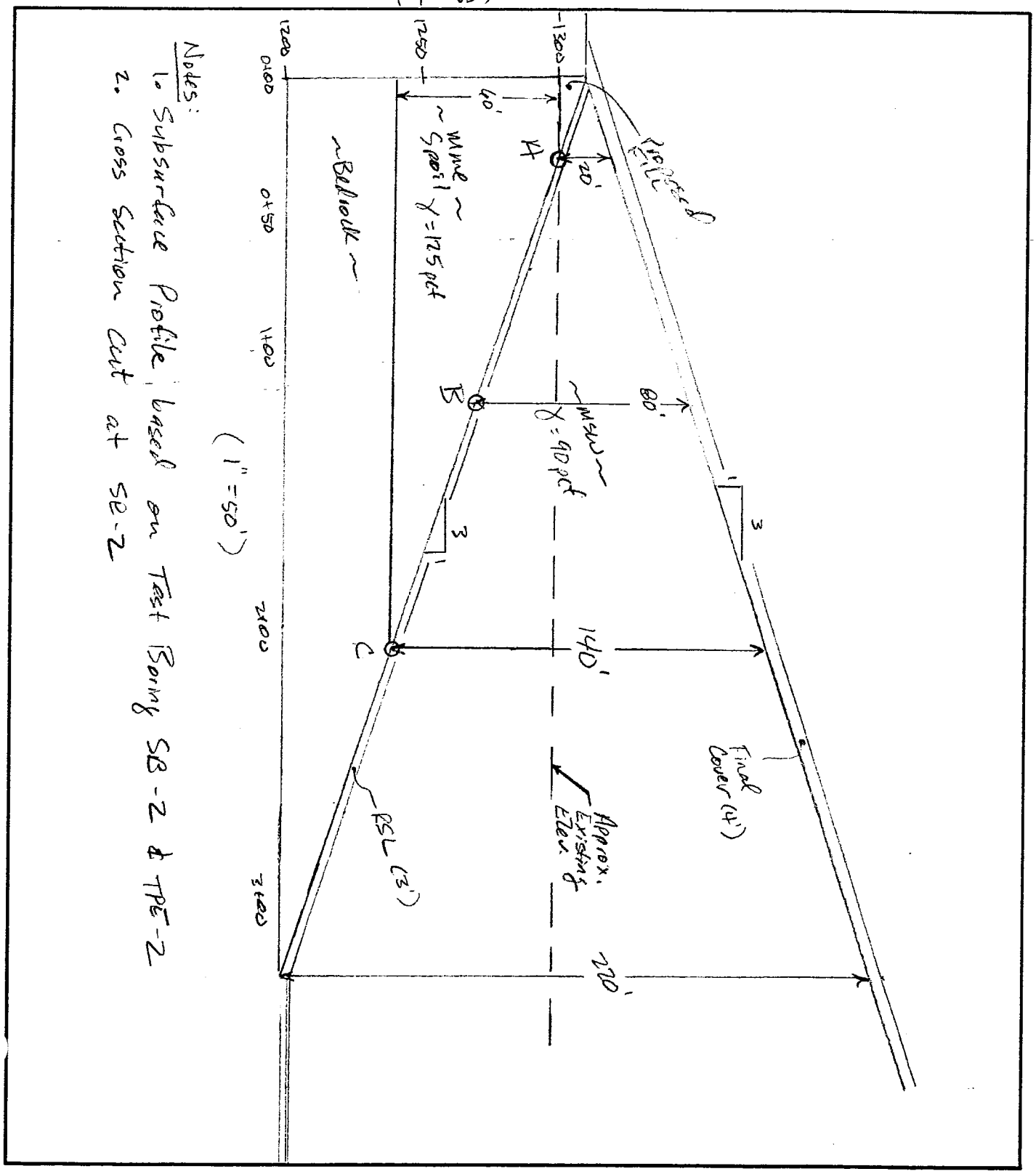
PROJECT Apex Lateral Expansion — PROJECT NO. 091-867.0003

~ FML Strain Analysis ~

PAGE 1 OF 1

PREPARED BY JMH DATE 9-13-11 CHECKED BY MPB DATE 10/25/11

(1" = 50')



Notes:

1. Subsurface Profile based on Test Boring SB-2 & TPE-2
2. Cross Section Cut at SB-2

(1" = 50')

ATTACHMENT C

CONSOLIDATION LAB DATA SUMMARY

Sample Condition	Origin	Boring/ Test Pit Number	Sample Depth (ft)	Sample Number	USCS Symbol	Compression Index (C_c)	Recompression Index (C_r)	Preconsolidation Pressure (psf)	Initial Void Ratio (e_o)
						ASTM D 2435			
Remolded	Mine Spoil	RB-3	20 - 24	B-1	CL	0.172	0.057	2,400	0.5831
	Residual	RB-4	19 - 24	B-1	CL	0.179	0.068	1,200	0.7135
		AVERAGE			--	0.176	0.063	1,800	0.6483
Undisturbed	Mine Spoil	SB-6	10-Sep	ST-2	GC	0.158	0.04	--	0.6339
		SB-16	0.5 - 2.5	ST-1	CH	0.157	0.077	3,600	0.6837
		SB-17	16 - 18	ST-1	SC	0.147	0.045	2,400	0.5933
		SB-18	12-Oct	ST-1	CL	0.153	0.061	1,400	0.6913
		HIGHEST VALUE			--	0.158	0.077	3,600	0.6913
		LOWEST VALUE			--	0.147	0.04	1,400	0.5933
		AVERAGE			--	0.154	0.056	2,467	0.6506
	Residual	SB-21	9-11	ST-1	CL	0.12	0.05	8,200	0.4449
		TPE-18	12-14	ST-1	CL	0.147	0.051	5,800	0.6846
		HIGHEST VALUE			--	0.147	0.051	8,200	0.6846
		LOWEST VALUE			--	0.12	0.05	5,800	0.4449
		AVERAGE			--	0.134	0.051	7,000	0.5648

SEPARATORY LINER SETTLEMENT ANALYSIS

(f) If a separatory liner is used and is designed with a slope other than that specified by rule 3745-27-08 of the Administrative Code, the settlement analysis of the separatory liner shall include the following:

- **(i) A narrative description of the rationale used for the selection of the analysis input parameters.**
- **(ii) A description of the method used to calculate the settlement.**
- **(iii) A description of the assessed failure modes and conditions.**
- **(iv) A summary of the results.**
- **(v) The actual calculations of settlement and/or computer output.**

(C)(4)(f) No separatory liner is designed for the proposed contiguous expansion.

UNSTABLE AREA DESCRIPTIONS

(g) A description, based on publicly available information, of unstable areas within one mile of the limits of solid waste placement. For the purposes of this rule, "publicly available information" means written or published information from public or private sources that is reasonably available to the public, and includes but is not limited to visual surveys from public right-of-ways and public lands of the area surrounding the proposed sanitary landfill facility and/or written or oral surveys of the landowners around the proposed sanitary landfill facility. The description shall include the following:

- **(i) Regional stratigraphic or structural features that are susceptible to bearing capacity failure, static stability failure, seismic stability failure, or settlement.**
- **(ii) Areas susceptible to liquefaction.**
- **(iii) Areas susceptible to mass movement such as landslides, debris slides and falls, and rock falls.**
- **(iv) Areas impacted by natural and human induced activities such as cutting and filling, draw down of ground water, rapid weathering, heavy rain, seismic activity and blasting.**
- **(v) Presence of karst terrain.**
- **(vi) Presence of underground mining.**
- **(vii) Areas susceptible to coastal and river erosion.**

Refer to Section (C)(6) for a discussion evaluating the proposed expansion for the location restrictions for floodplains, faults, seismic impact zone, and karst terrain. Also included is a discussion regarding the discovery of a previously undocumented underground mine and that if any underground mine is located below the permitted base grades, the seam will be overexcavated and replaced with structural fill to achieve the permitted base grades.

Additionally, Section (C)(4)(g) presents an evaluation of the potential for liquefaction using the procedures presented in "RCRA Subtitle D(258) Seismic Design Guidance for Municipal Solid Waste Landfill Facilities," Richardson & Associates, Kavazanjian, and Matasovic, 1995. Specifically Section 5, 258.14 "Seismic Impact Zones Liquefaction Analysis."

OBJECTIVE

The objective of this analysis was to evaluate the potential for liquefaction within the materials beneath the proposed expansion in accordance with OAC 3745-27-08(C)(4)(g). The liquefaction potential was evaluated using the procedures presented in Section 5 of the RCRA Subtitle D(258), "Seismic Design Guidance for Municipal Solid Waste Landfill Facilities", by Richardson & Associates, Kavazanjian, and Matasovic, 1995.

DISCUSSION

The unconsolidated materials at the site consist of mine spoil and residual soil. All of the mine spoil and most of the residual soil will be removed beneath the proposed limits of waste. Mine spoil and residual soil will remain in place beneath most of the perimeter berm. Refer to Drawing 4A for details of the limits of excavation. The mine spoil and residual soil sampled at the site was generally fine-grained; however, some clayey sands and gravels were tested and one elastic silt as shown in Attachment A. These soils were evaluated using the screening criteria outlined in RCRA Subtitle D(258) as outlined in the following section.

INITIAL SCREENING

Initial Screening was performed using the following 5 screening criteria from the above reference. Based on RCRA Subtitle D(258) Seismic Design Guidance for Municipal Solid Waste Landfill Facilities, if 3 or more of these criteria are met, liquefaction is not likely, and the potential for liquefaction can be dismissed, otherwise additional analyses will be necessary.

1. Geologic Age & Origin:

Liquefaction potential decreases with increasing age of a soil deposit. Pre-Holocene age soil deposits generally do not liquefy.

Mine spoil is not a naturally occurring material and is therefore not applicable to this criterion. The residual soils were generated from the weathering of bedrock; they are not glacially derived or of Holocene origin. **This criterion is met.**

2. Fines Content and Plasticity Index:

*Liquefaction potential decreases with increasing fines content and increasing plasticity index. Cohesionless soils having greater than 15% finer than 0.005 mm or a liquid limit (LL) greater than 35%, or an insitu water content less than 0.9 *LL generally do not liquefy.*

The liquid limit of the coarse grained samples tested, ranged from 32 to 81 with an average of 41 and the clay content ($\leq$0.002 mm) ranged from 5.2% to 26.5% with an average of 13.12%. All of the samples had an in-situ water content that was less than 0.9* LL. Refer to Attachment A for details. **This criterion is met.**

3. Saturation:
At least 80-85% saturation is generally necessary for liquefaction to occur.

Saturation (S) is calculated using the following equation:

S = (Moisture Content) / [(62.4 pcf/Dry Density) – (1/Specific Gravity)]

The dry density of the samples evaluated ranged from 52.8 pcf to 122.5 pcf with an average of 104.5 pcf. Moisture content of the samples tested ranged from 9.5% to 38.1% with an average of 16.2%. The specific gravity of the samples tested ranged from 2.70 to 2.72 with an average of 2.71. The amount of samples tested for in-situ dry density and specific gravity was limited to two samples, as shown in Attachment A. The saturation of these samples ranged from 61.1% to 62.5% with an average of 61.8%. **This criterion met.**

4. Depth Below the Ground Surface:
Surface effects are generally not likely to occur from the liquefaction of potentially liquefiable soils more than 50 feet below the ground surface.

Based upon the 3 criteria listed above, there are no potentially liquefiable soils present. **This criterion is met.**

5. Soil Penetration Resistance:
According to Seed and Idriss (1985), liquefaction has not been observed in soils with normalized Standard Penetration Test (SPT) blowcount, $(N_1)_{60} > 22$.

After review of the test borings with SPT data, **this criterion is partially met**.

CONCLUSIONS

Based upon the initial screening criteria, 4 out of 5 of the liquefaction screening criteria factors were met which indicates that liquefaction is not likely. Therefore, the materials beneath the proposed expansion are in accordance with OAC 3745-27-08(C)(4)(g).

ATTACHMENT A

LABORATORY DATA FOR LIQUEFACTION ANALYSIS SUMMARY TABLE

Summary of Laboratory Data for Liquefaction Analysis
Apex Landfill Contiguous Expansion

Origin	Boring/Test Pit Number	Sample Depth (ft)	Sample Number	Moisture Content (%)	Atterberg Limits		0.9 x LL	Moisture Content Less	Specific Gravity	Saturation, S (%)	USDA Classification				USCS Classification[2]			USCS Symbol	USCS Description	In-Situ Wet Density (pcf)	In-Situ Dry Density (pcf)
					Liquid Limit (%)	Plastic Limit (%)					Gravel (%)	Sand (%)	Silt (%)	Clay (%)	% Passing 2" Sieve (%)	% Passing 3/4" Sieve (%)	% Passing No. 200 Sieve (%)				
				ASTM D 2216	ASTM D 4318				ASTM D 854		ASTM D 422									ASTM D 2937	
Mine Spoil	SB-2	22 - 24	SS-12	12.6	33	19	30	Yes	--	--	45.70	15.40	28.00	10.90	100.00	86.70	41.40	GC	Clayey Gravel With Sand	--	--
Mine Spoil	SB-5	6 - 8	SS-4	12.3	37	19	33	Yes	--	--	54.10	24.50	16.10	5.20	100.00	71.40	25.10	GC	Clayey Gravel With Sand	--	--
Mine Spoil	SB-6	9 - 10	ST-2	9.5	34	19	31	Yes	2.72	61.1	44.90	25.10	21.70	8.30	100.00	85.20	32.60	GC	Clayey Gravel With Sand	130.7	119.3
Mine Spoil	SB-18	28 - 30	SS-11	17.3	41	20	37	Yes	--	--	41.70	(1)	(1)	(1)	100.00	100.00	38.20	GC	Clayey Gravel With Sand	--	--
Residual	SB-18	22 - 24	ST-3	15.4	39	22	35	Yes	--	--	31.00	23.60	32.70	12.70	100.00	85.90	47.90	GC	Clayey Gravel With Sand	126.1	109.2
Residual	SB-20	16 - 18, 17 - 19	ST-1, ST-2	20.3	35	17	32	Yes	--	--	48.20	21.60	18.30	11.90	82.30	76.20	31.50	GC	Clayey Gravel With Sand	138.5	115.2
Mine Spoil	SB-14	25 - 25.5	ST-2	38.1	81	48	73	Yes	--	--	0.00	37.40	36.20	26.50	100.00	100.00	72.50	MH	Elastic Silt With Sand	87.1	52.8
Mine Spoil	SB-6	30 - 32	SS-15	14.7	37	19	33	Yes	--	--	25.60	31.30	26.20	16.80	100.00	100.00	45.40	SC	Clayey Sand	--	--
Mine Spoil	TPE-18	18 - 19.7	ST-2	11.9	32	19	29	Yes	--	--	24.50	37.80	30.10	7.60	100.00	100.00	44.40	SC	Clayey Sand With Gravel	137.1	122.5
Residual	SB-17	16 - 18	ST-1	16.4	40	21	36	Yes	2.70	62.5	34.90	21.10	28.10	16.00	100.00	85.50	46.10	SC	Clayey Sand	114.8	98.6
Residual	SB-17	18 - 20	ST-2	10.1	37	18	33	Yes	--	--	25.90	27.50	31.20	15.30	100.00	93.90	49.80	SC	Clayey Sand With Gravel	125.7	114.2
	HIGHEST VALUE			38.1	81	48	73	--	2.72	62.5	54.10	37.80	36.20	26.50	100.00	100.00	72.50	--	--	138.5	122.5
	LOWEST VALUE			9.5	32	17	29	--	2.70	61.1	0.00	15.40	16.10	5.20	82.30	71.40	25.10	--	--	87.1	52.8
	AVERAGE			16.2	41	22	36	--	2.71	61.8	34.23	26.53	26.86	13.12	98.39	89.53	43.17	--	--	122.9	104.5

(1) Hydrometer was unable to be performed due to lack of material

(2) USDA grain size analysis was corrected for 100% Passing a 3-inch sieve.

(C)(5) CALCULATIONS

(C)(5) Calculations. The following design calculations with references to equations used, showing site specific input and assumptions that demonstrate compliance with the design requirements of Rule 3745-27-08 of the Administrative Code.

This section presents landfill design calculations required by OAC 3745-27-06(C)(5). Where appropriate, the calculations include references, assumptions, and site specific input data.

(a) Calculations showing gross volume of the sanitary landfill facility in cubic yards and anticipated life in years, and the gross volume in cubic yards and anticipated life in years of for the sanitary landfill facility.

(b) Recompacted soil liner thickness calculations, from Appendix I of Rule 3745-27-8 of the Administrative Code.

(c) Calculations for leachate head and flow.

(d) If leachate is to be recirculated, calculations for amount of leachate to be recirculated and the leachate head and flow.

(e) Calculations for sizing any leachate storage tanks based on the volume of leachate generated after final closure.

(f) Pump size and pipe size calculations based on paragraphs (C)(5)(c) and (C)(5)(d) of this rule.

(g) Pipe strength and pipe deflection calculations for the leachate collection and management system.

(h) An itemized written closure cost estimate, in current dollars, based on the following:
  (i) The cost of final closure of a sanitary landfill facility in accordance with Rule 3745-27-11 of the Administrative Code.
  (ii) A third-party conducting the final closure activities, assuming payment to employees of not less than the applicable prevailing wage.

(i) An itemized written post-closure cost estimate, in current dollars, based on the following:
  (i) The cost of post-closure care of the unit(s) of the sanitary landfill facility in accordance with Rule 3745-27-14 of the Administrative Code.
  (ii) A separate estimate for each noncontiguous unit(s) of the sanitary landfill facility.
  (iii) A third-party conducting the post-closure activities, assuming payment to its employees of not less than the applicable prevailing wage.

(j) Soil erosion calculations.

(k) Calculations for sizing surface water control structures and verifying that scouring and crushing is minimized.

(l) Sedimentation pond calculations.

(m) Other relevant calculations.

GROSS VOLUME AND ANTICIPATED LIFE

(a) Calculations showing gross volume of the sanitary landfill facility in cubic yards and anticipated life in years, and the gross volume in cubic yards and anticipated life in years of the existing unit and proposed expansion.

OBJECTIVE

In accordance with OAC 3745-27-06(C)(5)(a), the volume and anticipated life of the proposed lateral expansion of the Apex Sanitary Landfill (Landfill) will be determined. Additionally, the total proposed life of the remaining existing unit and proposed lateral expansion will be determined.

METHODOLOGY

These calculations will estimate the total airspace of the proposed Landfill lateral expansion by using the Autodesk Civil 3D computer software through a comparison of the proposed bottom and top of waste surfaces. In addition, the total remaining airspace of the existing unit is determined using records from ~~*December 31, 2012*~~ *December 31, 2015*. The total landfill life will be determined using the combined airspace from what remains in the existing unit and the proposed lateral expansion.

The anticipated facility life will be estimated using the density of waste provided by the site, which includes the daily and intermediate cover soils. The rate of waste placement will be based on the proposed Authorized Maximum Daily Waste Receipt (AMDWR). Additionally, varying daily waste receipts will be used to estimate the anticipated site life.

- Based on information provided by the site, the density of waste including daily and intermediate cover soils is approximately *0.81* gate tons per in-place cubic yard.
- The following values were used for the daily waste receipts: 2,000, 4,000, 6,000, and 8,000 tons per day.
- The proposed AMDWR is 10,000 tons per day.
- It is assumed that the site operates 310 days per year.

VOLUME OF LANDFILL

Remaining Airspace of Existing Unit

Based on records from ~~*December 31, 2012*~~ *December 31, 2015*, the remaining airspace was reported as ~~***9,632,000***~~ ***7,300,606*** **CY**.

Lateral Expansion Airspace

Based on the Autodesk Civil 3D computer software comparing the top and bottom of waste surfaces, the proposed total airspace at the Landfill expansion will be ***61,093,000*** **CY**.

ANTICIPATED FACILITY LIFE

Estimated Daily Waste Receipt

The anticipated life of the facility based on proposed total airspace determined above is calculated considering both scenerios of the estimated daily waste receipt and the proposed AMDWR of 10,000 tons per day.

Because it is difficult to predict waste receipts over the life of the facility, varying daily waste receipts were used to estimate the anticipated life. The estimated daily waste receipts vary between the following: 2,000, 4,000, 6,000, and 8,000.

Remaining Life of Existing Unit (Daily Waste Receipts)

Below is a table summarizing the anticipated life of the existing facility based on the varying daily waste receipts.

Table 1
Remaining Life of Existing Unit

Density of waste (gate tons per in-place cubic yard)	0.81
Remaining airspace of existing unit (cubic yards)	*7,300,606* ~~9,632,000~~
Assume landfill operate (days per year)	310

Remaining Life of Existing Unit	
Estimated Daily Waste Receipt (tons per day)	**Site Life (years)**
2,000	*9.5* ~~12.6~~
4.000	*4.8* ~~6.3~~
6.000	*3.2* ~~4.2~~
8,000	*2.4* ~~3.1~~

Remaining Life of Existing Unit (AMDWR)

Based on the proposed AMDWR of 10,000 tons/day and assuming the landfill *will* operate 310 days per year, the anticipated life is estimated to be:

~~$9{,}632{,}000\ CY \left(0.81\ \frac{tons}{CY}\right)\left(\frac{1\ day}{10{,}000\ tons}\right)\left(\frac{1\ year}{310\ days}\right) = 2.5\ years$~~

$$7{,}300{,}606\ CY \left(0.81\ \frac{tons}{CY}\right)\left(\frac{1\ day}{10{,}000\ tons}\right)\left(\frac{1\ year}{310\ days}\right) = 1.9\ years$$

Life of Lateral Expansion (Daily Waste Receipts)

Below is a table summarizing the anticipated life of the proposed facility expansion based on the varying estimated daily waste receipts.

Table 2
Life of Lateral Expansion

Density of waste (gate tons per in-place cubic yard)	0.81
Remaining airspace of existing unit (cubic yards)	61,093,000
Assume landfill operate (days per year)	310

Life of Lateral Expansion	
Estimated Daily Waste Receipt (tons per day)	**Site Life (years)**
2,000	79.8
4,000	39.9
6,000	26.6
8,000	20.0

Life of Lateral Expansion (AMDWR)

Based on the proposed AMDWR of 10,000 tons/day and assuming the landfill *will* operate 310 days per year, the anticipated life is estimated to be:

$$61{,}093{,}000\ CY\ \left(0.81\ \frac{tons}{CY}\right)\left(\frac{1\ day}{10{,}000\ tons}\right)\left(\frac{1\ year}{310\ days}\right) = 16.0\ years$$

Combined Remaining Life

Below is a table summarizing the combined remaining life of the existing unit and proposed lateral expansion based upon the varying estimated daily waste receipts.

Table 3
Combined Remaining Life

Estimated Daily Waste Receipt (tons per day)	Existing Unit Site Life (years)	Lateral Expansion Site Life (years)	Combined Site Life (years)
2,000	*9.5* ~~12.6~~	79.8	*89.3* ~~92.4~~
4,000	*4.8* ~~6.3~~	39.9	*44.7* ~~46.2~~
6,000	*3.2* ~~4.2~~	26.6	*29.8* ~~30.8~~
8,000	*2.4* ~~3.1~~	20.0	*22.4* ~~23.1~~

The remaining life of the existing unit and proposed lateral expansion based upon the AMDWR is ~~**18.5**~~ ***17.9*** **years**.

CONCLUSION

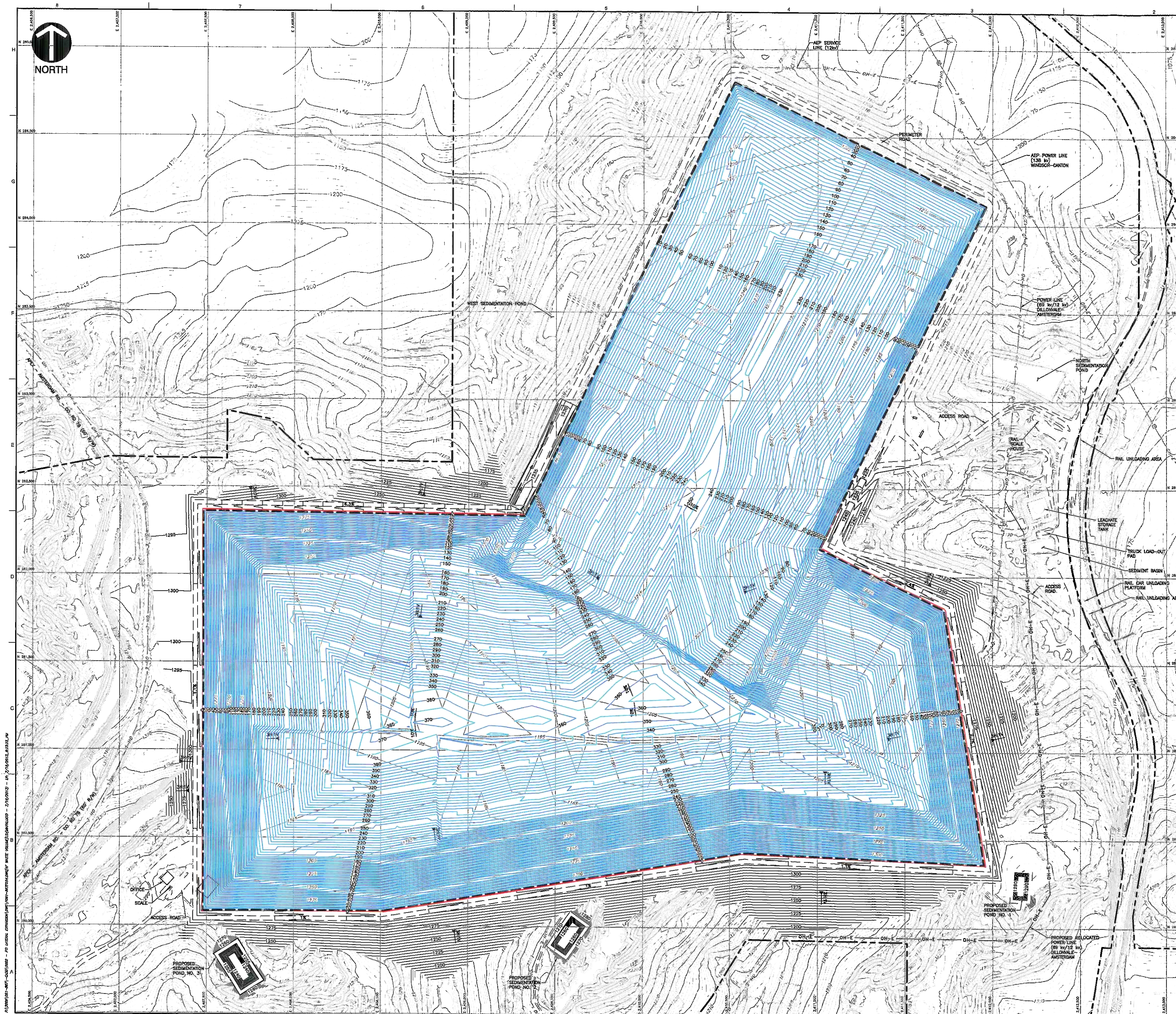
Total Combined Airspace

This calculation estimates the proposed total airspace of the Landfill including the remaining airspace of the existing unit (as of ~~*December 31, 2012*~~ *December 31, 2015*) and the proposed lateral expansion to be ~~***70,725,000***~~ ***68,393,606*** **CY**.

Total Combined Landfill Life (As of December 31, 2015~~June 2013~~)

The combined total anticipated life of the Landfill including the remaining airspace of the existing unit and the proposed lateral expansion is estimated to be:

- ~~**23.1 years to 92.4 years**~~ ***22.4 years to 89.3 years*** based on the varying daily waste receipts; and,
- ~~**18.5**~~ ***17.9 years*** based on the proposed AMDWR of 10,000 tons per day.



REVISION RECORD

NO	DATE	DESCRIPTION
1	7/2013	RESPONSE TO OHIO EPA NOD DATED 12/28/12

SUBMITTAL RECORD

NO	DATE	DESCRIPTION

LEGEND

- 1220 — EXISTING GROUND CONTOUR (SEE REFERENCE)
- PROPERTY LINE
- LIMIT OF SOLID WASTE PLACEMENT
- PERIMETER ROAD
- 1220 — TOP OF PROTECTIVE COVER CONTOUR
- 10 — FILL ISOPACH CONTOUR
- 10 — CUT ISOPACH CONTOUR

NOTES

1. THIS FIGURE REPRESENTS THE AIRSPACE VOLUME BETWEEN THE TOP OF WASTE (DRAWING 4F) AND THE TOP OF PROTECTIVE COVER (DRAWING 4D).
2. APPROXIMATE CUMULATIVE FILL VOLUME IS 83,616,439 CY. APPROXIMATE FILL VOLUME OF THE VERTICAL EXPANSION IS 22,523,618. THE APPROXIMATE WASTE FILL VOLUME OF THE LATERAL EXPANSION IS 61,092,821. MAXIMUM THICKNESS IS 373-FEET.

REFERENCE

EXISTING TOPOGRAPHY PREPARED BY KEDDAL AERIAL MAPPING; DATE OF PHOTOGRAPHY: 1/18/13. ADDITIONAL MAPPING WAS PREPARED BY KEDDAL AERIAL MAPPING FROM AERIAL PHOTOGRAPHY DATED 1/6/12 AND 1/5/11 AND BY M.A.N. MAPPING FROM AERIAL PHOTOGRAPHY DATED 12/14/00.

STATE OF OHIO
RICK BUFFALINI
E-55305
REGISTERED PROFESSIONAL ENGINEER

SCALE IN FEET
0 200 400

*HAND SIGNATURE ON FILE

Authorized Use:

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333 Baldwin Road - Pittsburgh, PA 15205
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www.cecinc.com

APEX ENVIRONMENTAL, LLC.
PERMIT TO INSTALL APPLICATION
CONTIGUOUS EXPANSION
APEX SANITARY LANDFILL
JEFFERSON COUNTY, OHIO

DRAWN BY:	MJI	CHECKED BY:	MRB	APPROVED BY:	RJB*
DATE:	10/17/11	DWG SCALE:	1"=200'	PROJECT NO:	091-867

TOP OF WASTE
GRADING PLAN
ISOPACH

FIGURE NO.: 1

C)(5)(a) VOLUME AND ANTICIPATED LIFE CALCULATION
APEX ENVIRONMENTAL, LLC
APEX SANITARY LANDFILL CONTIGUOUS EXPANSION

Table 1
Remaining Life of Existing Unit

Density of waste (gate tons per in-place cubic yard)	0.81
Remaining airspace of existing unit (cubic yards)	7,300,606
Assume landfill operate (days per year)	310

Remaining Life of Existing Unit	
Estimated Daily Waste Receipt (tons per day)	**Site Life (years)**
2000	9.5
4000	4.8
6000	3.2
8000	2.4

Table 2
Life of Lateral Expansion

Density of waste (gate tons per in-place cubic yard)	0.81
Remaining airspace of existing unit (cubic yards)	61,093,000
Assume landfill operate (days per year)	310

Life of Lateral Expansion	
Estimated Daily Waste Receipt (tons per day)	**Site Life (years)**
2000	79.8
4000	39.9
6000	26.6
8000	20.0

Table 3
Combined Remaining Life

Estimated Daily Waste Receipt (tons per day)	Existing Unit Site Life (years)	Lateral Expansion Site Life (years)	Combined Site Life (years)
2000	9.5	79.8	89.4
4000	4.8	39.9	44.7
6000	3.2	26.6	29.8
8000	2.4	20.0	22.3

LINER THICKNESS

(b) Recompacted soil liner thickness calculations, from Appendix I of Rule 3745-27-08 of the Administrative Code.

A 3-feet thick recompacted soil liner with a geosynthetic clay liner is proposed therefore, a liner thickness calculation is not being submitted.

LEACHATE GENERATION

(c) Calculations for leachate head and flow.

OBJECTIVE

The volume of leachate that will be generated in the proposed expansion of the Apex Sanitary Landfill will be estimated in order to size leachate collection pipes and pumps. This calculation will also demonstrate that the maximum leachate head does not exceed 12 inches in accordance with OAC 3745-27-08 (C)(3)(c) based on the proposed leachate collection pipe spacing.

METHODOLOGY

The Hydrologic Evaluation of Landfill Performance (HELP) Model Version 3.07 was used to simulate leachate generation. The model utilizes climatologic, soil and design data, and performs a solution technique that accounts for the effects of surface layer storage, runoff, infiltration, percolation, evapotranspiration, soil moisture storage, and lateral drainage to calculate a leachate generation volume. This model is applicable for open, partially closed, and fully closed landfills.

PARAMETERS

Climatological Data:

The HELP Model utilizes historical precipitation data and generates synthetic temperature and solar radiation data for various cities in the United States. The nearest pre-defined climatic data location to the Apex Sanitary Landfill is Pittsburgh, Pennsylvania. This data was used to evaluate leachate generation.

Soil and Design Data:

To model the leachate flow to each of the sumps, six profiles were considered and are discussed below.

Profiles 1, 2, and 3 represent waste placement with an aggregate leachate collection, assuming a permeability of 0.01cm/sec. Profile 1 represents conditions during initial waste placement with a 10-foot thick layer of waste considered. Profile 2 represents an active filling condition with 100 feet of waste placed. Profile 3 represents post closure conditions with a waste thickness of 375 feet and the final cover system installed. Profiles 1 and 2 were evaluated for both the floor (3.0%) and the sideslopes (33%). Profile 3 was evaluated for the floor (3.0%).

Profiles 4, 5, and 6 represent waste placement with a leachate collection layer assuming a permeability of 0.1 cm/sec. Profile 4 represents conditions during initial waste placement, Profile 5 represents active filling, and Profile 6 represents post closure conditions. Profiles 4 and 5 were evaluated for both the floor (3.0%) and the sideslopes (33%). Profile 6 was evaluated for the floor (3.0%).

These profiles were evaluated with a leachate collection layer of 12-inches. This thickness was used because the maximum leachate head will not exceed 12-inches, in accordance with OAC 3745-27-08 (C)(3)(c).

The table below presents the profiles and the corresponding data for the HELP Model.

Profile	Slope (%)	Drainage Length (ft)	Waste Thickness (ft)	Ground Conditions	Leaf Area Index	Evaporative Zone Depth (in)	Surface Slope (%)	Surface Drainage Length (ft)
1-Floor	3	420	10	Bare	0	8	3	420
1-Sideslope	33	400	10	Bare	0	8	33	400
2-Floor	3	420	100	Bare	0	8	3	420
2-Sideslope	33	400	100	Bare	0	8	33	400
3-Floor	3	420	375	Grass	3.5	12	33	195
4-Floor	3	840	10	Bare	0	8	3	840
4-Sideslope	33	400	10	Bare	0	8	33	400
5-Floor	3	840	100	Bare	0	8	3	840
5-Sideslope	33	400	100	Bare	0	8	33	400
6-Floor	3	840	375	Grass	3.5	12	33	195

The leaf area index for post closure conditions was modeled with a good stand of grass, 3.5.

The following tables summarize the landfill profiles for each condition from the top to the bottom and present the HELP Model default material texture number, component thickness, and component permeability. The default material texture number classifies each component within the given profile with specific default values for the proposed soil and liner components. Each material has default values for total porosity, field capacity, wilting point, and saturated hydraulic conductivity.

Profile 1 10' of Waste

	Layer	HELP Texture No.	Thickness	Permeability (cm/sec)
Layer 1	Intermediate Cover	12	6 inches	4.20E-05
Layer 2	Waste	18	10 feet	1.00E-03
Layer 3	Leachate Collection Layer	1	12 inches	1.00E-02
Layer 4	Geomembrane Liner	35	60 mils	2.00E-13
Layer 5	Recompacted Soil Liner	16	3 feet	1.00E-07

Profile 2 100' of Waste

	Layer	HELP Texture No.	Thickness	Permeability (cm/sec)
Layer 1	Intermediate Cover	12	6 inches	4.20E-05
Layer 2	Waste	18	100 feet	1.00E-03
Layer 3	Leachate Collection Layer	1	12 inches	1.00E-02
Layer 4	Geomembrane Liner	35	60 mils	2.00E-13
Layer 5	Recompacted Soil Liner	16	3 feet	1.00E-07

Profile 3 375' of Waste

	Layer	HELP Texture No.	Thickness	Permeability (cm/sec)
Layer 1	Final Cover	12	30 inches	4.20E-05
Layer 2	Geocomposite	Custom[1]	0.30 inches	3.21
Layer 3	Geomembrane Liner	35	40 mils	2.00E-13
Layer 4	Recompacted Soil Barrier	Custom[2]	18 inches	1.00E-06
Layer 5	Intermediate Cover	12	12 inches	4.20E-05
Layer 6	Waste	18	375 feet	1.00E-03
Layer 7	Leachate Collection Layer	1	12 inches	1.00E-02
Layer 8	Geomembrane Liner	35	60 mils	2.00E-13
Layer 9	Recompacted Soil Liner	16	3 feet	1.00E-07

Profile 4 100' of Waste

	Layer	HELP Texture No.	Thickness	Permeability (cm/sec)
Layer 1	Intermediate Cover	12	6 inches	4.20E-05
Layer 2	Waste	18	10 feet	1.00E-03
Layer 3	Leachate Collection Layer	Custom[3]	12 inches	0.10
Layer 4	Geomembrane Liner	35	60 mils	2.00E-13
Layer 5	Recompacted Soil Liner	16	3 feet	1.00E-07

Profile 5 100' of Waste

	Layer	HELP Texture No.	Thickness	Permeability (cm/sec)
Layer 1	Intermediate Cover	12	6 inches	4.20E-05
Layer 2	Waste	18	100 feet	1.00E-03
Layer 3	Leachate Collection Layer	Custom(3)	12 inches	0.10
Layer 4	Geomembrane Liner	35	60 mils	2.00E-13
Layer 5	Recompacted Soil Liner	16	3 feet	1.00E-07

Profile 6 375' of Waste

	Layer	HELP Texture No.	Thickness	Permeability (cm/sec)
Layer 1	Final Cover	12	30 inches	4.20E-05
Layer 2	Geocomposite	Custom(1)	0.30 inches	3.21
Layer 3	Geomembrane Liner	35	40 mils	2.00E-13
Layer 4	Recompacted Soil Barrier	Custom(2)	18 inches	1.00E-06
Layer 5	Intermediate Cover	12	12 inches	4.20E-05
Layer 6	Waste	18	375 feet	1.00E-03
Layer 7	Leachate Collection Layer	Custom(3)	12 inches	0.10
Layer 8	Geomembrane Liner	35	60 mils	2.00E-13
Layer 9	Recompacted Soil Liner	16	3 feet	1.00E-07

(1) In this analysis, the permeability of the final cover geocomposite drainage layer is a function of the transmissivity and thickness of the geocomposite. Based on the results of the final cover veneer slope stability analysis included in Section (C)(4), the required long term geocomposite transmissivity equals 2.45 x 10^{-4} m^2/sec assuming a thickness of 300 mils (0.30 inches). Therefore, the permeability of the geocomposite equals 3.21 cm/s. On the HELP Model outputs, the HELP texture number is listed as zero.

(2) HELP material parameters were changed to obtain the Ohio EPA required permeability. On the HELP Model outputs, the HELP texture number is listed as zero.

(3) HELP material parameters were changed due to the use of tire shreds, which is more permeable than requirements of the Ohio EPA. On the HELP Model outputs, the HELP texture number is listed as zero.

ASSUMPTIONS:

1. The geotextiles were omitted from HELP Model runs as their relative thickness and high permeability will not affect leachate generation results.

2. The GCL's were omitted from the HELP Model runs since their inclusion will not affect leachate generation results.
3. The leachate drainage layer conforms to OAC 3745-27-08 (D)(12)(a)(iv) by having a minimum thickness of 12-inches. A minimum aggregate permeability of 1 x 10^{-2} cm/sec was used for Profiles 1 through 3. A minimum aggregate permeability of 0.10 cm/sec was used for Profiles 4 through 6.
4. A 400-foot long drainage length has been assumed for all 33% sideslope scenarios. A 420-foot long drainage length has been assumed for all 3.0% floor scenarios using a leachate collection layer permeability of $1x10^{-2}$ cm/sec. A 840-foot long drainage length has been assumed for all 3.0% floor scenarios using a leachate collection layer permeability of 0.10 cm/sec.
5. The final cover system geocomposite drainage layer in profiles 3 and 6 is modeled with a 33% slope and 195-foot slope drainage length.
6. The recompacted soil barrier layer within the final cover system conforms to OAC 3745-27-08(D)(20)(g)(iv) by having a maximum permeability of $1x10^{-6}$ cm/sec.
7. The geomembrane liner was modeled with an average of 2 pinholes per acres, one resulting from the manufacturing process and one created during installation.
8. In profiles 3 and 6, the final cover flow surface was assumed to be 20% fallow and 80% grass. This yielded a CN number of 77. In all other profiles, the HELP Model automatically calculated the CN number.

CALCULATIONS

The analyses were performed incorporating the design parameters described above. The calculated leachate generation estimates were performed for a landfill area of 1-acres. The calculated leachate generation estimates will be used in other calculations to design components within the leachate management system. Considering 2 alternative aggregates for a protective cover/leachate collection layer, the leachate pipe spacing was calculated. The average annual flow rate for the 5-year simulation period is used as the design basis for the leachate pump and forcemain calculations. The peak daily head is used to compare with the requirements of OAC 3745-27-08(C)(3)(c).

The following table summarizes the results of the analyses.

Profile	Waste Thickness (ft)	Cover Conditions	Slope (%)	Drainage Length (ft)	Max. Daily Ave. Head (in)	Average Annual Flow (in/yr)	Peak Daily Flow Rate (gal/acre/day)
1-Floor	10	Intermediate	3	420	11.904	3.619	1,616
1-Sideslope	10	Intermediate	33	400	3.733	3.370	1,504
2-Floor	100	Intermediate	3	420	11.892	3.622	1,617
2-Sideslope	100	Intermediate	33	400	3.750	3.371	1,505
3-Floor	400	Final Cover	3	420	0.007	0.000	0
4-Floor	10	Intermediate	3	840	6.337	3.696	1,649
4-Sideslope	10	Intermediate	33	400	0.711	3.350	1,495
5-Floor	100	Intermediate	3	840	6.112	3.699	1,651
5-Sideslope	100	Intermediate	33	420	0.653	3.350	1,496
6-Floor	400	Intermediate	3	840	0.195	0.000	0

The average annual flow is converted to a peak daily flow rate (gal/acre/day) by the following method and includes a multiplier of 6 as described in Ohio EPA Guidance Document #0528:

$$6 \times \frac{3.619\,\text{in}}{\text{yr}} \times \frac{1\,\text{yr}}{365\,\text{days}} \times \frac{43{,}560\,\text{ft}^2}{\text{acre}} \times \frac{1\,\text{ft}}{12\,\text{inch}} \times \frac{7.481\,\text{gal}}{\text{ft}^3} = \textbf{1,616 gal/ac/day}$$

CONCLUSIONS

The aggregate leachate drainage layer generation rate is based on a maximum pipe spacing of 420 on the floor and 400 feet on the sideslopes as presented in Drawing 4D of the PTI Application Drawings. The tire shred leachate drainage layer generation rate is based on a maximum pipe spacing of 840 feet on the floor and 400 feet on the sideslopes as presented in Drawing 4E of the PTI Application Drawings. Both alternatives meet the requirements of OAC 3745-27-08(C)(3)(c).

Based on the above calculation, the worst case scenario is Profile 1 which results in a maximum daily head of 11.904 inches. The result meets the requirements of OAC 3745-27-08(C)(3)(c).

The peak daily flow rates from the HELP Model will be used in the Sump Infiltration Estimate Calculation.

Attachment 1

Help Model Output Files

HYDROLOGIC EVALUATION OF LANDFILL PERFORMANCE
HELP MODEL VERSION 3.07 (1 NOVEMBER 1997)
DEVELOPED BY ENVIRONMENTAL LABORATORY
USAE WATERWAYS EXPERIMENT STATION
FOR USEPA RISK REDUCTION ENGINEERING LABORATORY

PRECIPITATION DATA FILE:	C:\HELP3\ALCE\APEX4.D4
TEMPERATURE DATA FILE:	C:\HELP3\ALCE\APEX7.D7
SOLAR RADIATION DATA FILE:	C:\HELP3\ALCE\APEX13.D13
EVAPOTRANSPIRATION DATA:	C:\HELP3\ALCE\APEX11.D11
SOIL AND DESIGN DATA FILE:	C:\HELP3\ALCE\1FL10-12.D10
OUTPUT DATA FILE:	C:\HELP3\ALCE\1FL-120.OUT

TIME: 16:52 DATE: 9/19/2011

TITLE: Apex Landfill Contiguous Expansion, Profile 1, Floor

NOTE: INITIAL MOISTURE CONTENT OF THE LAYERS AND SNOW WATER WERE COMPUTED AS NEARLY STEADY-STATE VALUES BY THE PROGRAM.

LAYER 1

TYPE 1 - VERTICAL PERCOLATION LAYER
MATERIAL TEXTURE NUMBER 12

THICKNESS	=	6.00 INCHES
POROSITY	=	0.4710 VOL/VOL
FIELD CAPACITY	=	0.3420 VOL/VOL
WILTING POINT	=	0.2100 VOL/VOL
INITIAL SOIL WATER CONTENT	=	0.4411 VOL/VOL
EFFECTIVE SAT. HYD. COND.	=	0.419999997000E-04 CM/SEC

LAYER 2

TYPE 1 - VERTICAL PERCOLATION LAYER
MATERIAL TEXTURE NUMBER 18

THICKNESS	=	120.00 INCHES
POROSITY	=	0.6710 VOL/VOL
FIELD CAPACITY	=	0.2920 VOL/VOL
WILTING POINT	=	0.0770 VOL/VOL
INITIAL SOIL WATER CONTENT	=	0.2919 VOL/VOL
EFFECTIVE SAT. HYD. COND.	=	0.100000005000E-02 CM/SEC

LAYER 3

TYPE 2 - LATERAL DRAINAGE LAYER
MATERIAL TEXTURE NUMBER 1

THICKNESS	=	12.00 INCHES
POROSITY	=	0.4170 VOL/VOL
FIELD CAPACITY	=	0.0450 VOL/VOL
WILTING POINT	=	0.0180 VOL/VOL
INITIAL SOIL WATER CONTENT	=	0.1766 VOL/VOL
EFFECTIVE SAT. HYD. COND.	=	0.999999978000E-02 CM/SEC
SLOPE	=	3.00 PERCENT
DRAINAGE LENGTH	=	420.0 FEET

LAYER 4

TYPE 4 - FLEXIBLE MEMBRANE LINER
MATERIAL TEXTURE NUMBER 35

THICKNESS	=	0.06 INCHES
POROSITY	=	0.0000 VOL/VOL
FIELD CAPACITY	=	0.0000 VOL/VOL
WILTING POINT	=	0.0000 VOL/VOL
INITIAL SOIL WATER CONTENT	=	0.0000 VOL/VOL
EFFECTIVE SAT. HYD. COND.	=	0.199999996000E-12 CM/SEC
FML PINHOLE DENSITY	=	1.00 HOLES/ACRE
FML INSTALLATION DEFECTS	=	1.00 HOLES/ACRE
FML PLACEMENT QUALITY	=	3 - GOOD

LAYER 5

TYPE 3 - BARRIER SOIL LINER
MATERIAL TEXTURE NUMBER 16

THICKNESS	=	36.00 INCHES
POROSITY	=	0.4270 VOL/VOL
FIELD CAPACITY	=	0.4180 VOL/VOL
WILTING POINT	=	0.3670 VOL/VOL
INITIAL SOIL WATER CONTENT	=	0.4270 VOL/VOL
EFFECTIVE SAT. HYD. COND.	=	0.100000001000E-06 CM/SEC

GENERAL DESIGN AND EVAPORATIVE ZONE DATA

NOTE: SCS RUNOFF CURVE NUMBER WAS COMPUTED FROM DEFAULT SOIL DATA BASE USING SOIL TEXTURE #12 WITH BARE GROUND CONDITIONS, A SURFACE SLOPE OF 3.% AND A SLOPE LENGTH OF 420. FEET.

SCS RUNOFF CURVE NUMBER	=	95.10
FRACTION OF AREA ALLOWING RUNOFF	=	100.0 PERCENT
AREA PROJECTED ON HORIZONTAL PLANE	=	1.000 ACRES
EVAPORATIVE ZONE DEPTH	=	8.0 INCHES
INITIAL WATER IN EVAPORATIVE ZONE	=	3.218 INCHES
UPPER LIMIT OF EVAPORATIVE STORAGE	=	4.168 INCHES
LOWER LIMIT OF EVAPORATIVE STORAGE	=	1.414 INCHES
INITIAL SNOW WATER	=	0.000 INCHES
INITIAL WATER IN LAYER MATERIALS	=	55.165 INCHES

0.01 cm/sec aggregate
10-ft waste-floor

TOTAL INITIAL WATER	=	55.165 INCHES
TOTAL SUBSURFACE INFLOW	=	0.00 INCHES/YEAR

EVAPOTRANSPIRATION AND WEATHER DATA

NOTE: EVAPOTRANSPIRATION DATA WAS OBTAINED FROM PITTSBURGH PENNSYLVANIA

STATION LATITUDE	=	40.50 DEGREES
MAXIMUM LEAF AREA INDEX	=	0.00
START OF GROWING SEASON (JULIAN DATE)	=	114
END OF GROWING SEASON (JULIAN DATE)	=	288
EVAPORATIVE ZONE DEPTH	=	8.0 INCHES
AVERAGE ANNUAL WIND SPEED	=	9.20 MPH
AVERAGE 1ST QUARTER RELATIVE HUMIDITY	=	67.00 %
AVERAGE 2ND QUARTER RELATIVE HUMIDITY	=	63.00 %
AVERAGE 3RD QUARTER RELATIVE HUMIDITY	=	71.00 %
AVERAGE 4TH QUARTER RELATIVE HUMIDITY	=	70.00 %

NOTE: PRECIPITATION DATA WAS SYNTHETICALLY GENERATED USING COEFFICIENTS FOR PITTSBURGH PENNSYLVANIA

NORMAL MEAN MONTHLY PRECIPITATION (INCHES)

JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
2.86	2.40	3.58	3.28	3.54	3.30
3.83	3.31	2.80	2.49	2.34	2.57

NOTE: TEMPERATURE DATA WAS SYNTHETICALLY GENERATED USING COEFFICIENTS FOR PITTSBURGH PENNSYLVANIA

NORMAL MEAN MONTHLY TEMPERATURE (DEGREES FAHRENHEIT)

JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
26.70	28.80	38.50	50.10	59.70	68.10
72.00	70.60	64.10	52.50	41.60	31.40

NOTE: SOLAR RADIATION DATA WAS SYNTHETICALLY GENERATED USING COEFFICIENTS FOR PITTSBURGH PENNSYLVANIA AND STATION LATITUDE = 40.50 DEGREES

AVERAGE MONTHLY VALUES IN INCHES FOR YEARS 1 THROUGH 5

	JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
PRECIPITATION						
TOTALS	3.33	3.14	4.20	2.96	2.68	2.99
	3.16	3.73	3.70	2.78	2.36	2.71
STD. DEVIATIONS	0.67	1.06	0.65	0.91	1.22	0.43
	1.09	1.44	2.42	1.41	0.85	1.13
RUNOFF						
TOTALS	2.404	2.045	4.292	0.751	0.308	0.456
	0.531	0.918	0.902	0.282	0.220	0.499
STD. DEVIATIONS	1.652	0.912	2.250	0.420	0.275	0.134
	0.270	0.574	0.862	0.260	0.184	0.377
EVAPOTRANSPIRATION						
TOTALS	0.479	0.494	0.547	2.857	1.954	2.413
	2.889	2.443	2.095	2.013	1.772	0.747
STD. DEVIATIONS	0.144	0.159	0.114	0.833	1.304	0.699
	1.037	0.946	0.885	0.839	0.119	0.273
LATERAL DRAINAGE COLLECTED FROM LAYER 3						
TOTALS	0.3477	0.2285	0.2615	0.3656	0.4375	0.3082
	0.2480	0.2022	0.2201	0.3095	0.3320	0.3587
STD. DEVIATIONS	0.1560	0.1017	0.2207	0.2059	0.1595	0.1077
	0.0758	0.0678	0.0466	0.2079	0.2390	0.1877
PERCOLATION/LEAKAGE THROUGH LAYER 5						
TOTALS	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001
	0.0001	0.0000	0.0001	0.0001	0.0001	0.0001
STD. DEVIATIONS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	0.0000	0.0000	0.0000	0.0000	0.0001	0.0000

AVERAGES OF MONTHLY AVERAGED DAILY HEADS (INCHES)

DAILY AVERAGE HEAD ON TOP OF LAYER 4						
AVERAGES	2.7721	2.0126	2.0853	3.0121	3.4887	2.5392
	1.9774	1.6120	1.8130	2.4680	2.7350	2.8596
STD. DEVIATIONS	1.2440	0.9066	1.7600	1.6962	1.2714	0.8873
	0.6047	0.5402	0.3841	1.6573	1.9693	1.4966

AVERAGE ANNUAL TOTALS & (STD. DEVIATIONS) FOR YEARS 1 THROUGH 5

	INCHES	CU. FEET	PERCENT
PRECIPITATION	37.74 (0.555)	136996.2	100.00
RUNOFF	13.607 (2.0772)	49392.08	36.054
EVAPOTRANSPIRATION	20.702 (1.8362)	75149.78	54.855
LATERAL DRAINAGE COLLECTED FROM LAYER 3	3.61942 (1.33627)	13138.511	9.59042
PERCOLATION/LEAKAGE THROUGH LAYER 5	0.00085 (0.00029)	3.092	0.00226
AVERAGE HEAD ON TOP OF LAYER 4	2.448 (0.904)		

CHANGE IN WATER STORAGE	-0.189	(1.4979)	-687.28	-0.502

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PEAK DAILY VALUES FOR YEARS 1 THROUGH 5

	(INCHES)	(CU. FT.)
PRECIPITATION	1.97	7151.100
RUNOFF	3.195	11596.2520
DRAINAGE COLLECTED FROM LAYER 3	0.02864	103.96592
PERCOLATION/LEAKAGE THROUGH LAYER 5	0.000006	0.02272
AVERAGE HEAD ON TOP OF LAYER 4	7.079	
MAXIMUM HEAD ON TOP OF LAYER 4	11.904	
LOCATION OF MAXIMUM HEAD IN LAYER 3 (DISTANCE FROM DRAIN)	66.6 FEET	
SNOW WATER	4.87	17677.5410

MAXIMUM VEG. SOIL WATER (VOL/VOL)	0.4637
MINIMUM VEG. SOIL WATER (VOL/VOL)	0.1767

*** Maximum heads are computed using McEnroe's equations. ***

Reference: Maximum Saturated Depth over Landfill Liner
by Bruce M. McEnroe, University of Kansas
ASCE Journal of Environmental Engineering
Vol. 119, No. 2, March 1993, pp. 262-270.

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FINAL WATER STORAGE AT END OF YEAR 5

LAYER	(INCHES)	(VOL/VOL)
1	2.0007	0.3335
2	35.5575	0.2963
3	1.2881	0.1073
4	0.0000	0.0000
5	15.3720	0.4270
SNOW WATER	0.000	

****
****

0.01 cm/sec aggregate
10-ft waste-sideslope

HYDROLOGIC EVALUATION OF LANDFILL PERFORMANCE
HELP MODEL VERSION 3.07 (1 NOVEMBER 1997)
DEVELOPED BY ENVIRONMENTAL LABORATORY
USAE WATERWAYS EXPERIMENT STATION
FOR USEPA RISK REDUCTION ENGINEERING LABORATORY

PRECIPITATION DATA FILE:	C:\HELP3\ALCE\APEX4.D4
TEMPERATURE DATA FILE:	C:\HELP3\ALCE\APEX7.D7
SOLAR RADIATION DATA FILE:	C:\HELP3\ALCE\APEX13.D13
EVAPOTRANSPIRATION DATA:	C:\HELP3\ALCE\APEX11.D11
SOIL AND DESIGN DATA FILE:	C:\HELP3\ALCE\1SS10-12.D10
OUTPUT DATA FILE:	C:\HELP3\ALCE\1SS-120.OUT

TIME: 16:27 DATE: 9/20/2011

TITLE: Apex Landfill Contiguous Expansion, Profile 1, Sideslope

NOTE: INITIAL MOISTURE CONTENT OF THE LAYERS AND SNOW WATER WERE COMPUTED AS NEARLY STEADY-STATE VALUES BY THE PROGRAM.

LAYER 1

TYPE 1 - VERTICAL PERCOLATION LAYER
MATERIAL TEXTURE NUMBER 12

THICKNESS	= 6.00 INCHES
POROSITY	= 0.4710 VOL/VOL
FIELD CAPACITY	= 0.3420 VOL/VOL
WILTING POINT	= 0.2100 VOL/VOL
INITIAL SOIL WATER CONTENT	= 0.4430 VOL/VOL
EFFECTIVE SAT. HYD. COND.	= 0.419999997000E-04 CM/SEC

LAYER 2

TYPE 1 - VERTICAL PERCOLATION LAYER
MATERIAL TEXTURE NUMBER 18

THICKNESS	= 120.00 INCHES
POROSITY	= 0.6710 VOL/VOL
FIELD CAPACITY	= 0.2920 VOL/VOL
WILTING POINT	= 0.0770 VOL/VOL
INITIAL SOIL WATER CONTENT	= 0.2923 VOL/VOL
EFFECTIVE SAT. HYD. COND.	= 0.100000005000E-02 CM/SEC

LAYER 3

TYPE 2 - LATERAL DRAINAGE LAYER
MATERIAL TEXTURE NUMBER 1

THICKNESS	= 12.00 INCHES
POROSITY	= 0.4170 VOL/VOL
FIELD CAPACITY	= 0.0450 VOL/VOL
WILTING POINT	= 0.0180 VOL/VOL
INITIAL SOIL WATER CONTENT	= 0.0642 VOL/VOL
EFFECTIVE SAT. HYD. COND.	= 0.999999978000E-02 CM/SEC
SLOPE	= 33.00 PERCENT
DRAINAGE LENGTH	= 400.0 FEET

LAYER 4

TYPE 4 - FLEXIBLE MEMBRANE LINER
MATERIAL TEXTURE NUMBER 35

THICKNESS	= 0.06 INCHES
POROSITY	= 0.0000 VOL/VOL
FIELD CAPACITY	= 0.0000 VOL/VOL
WILTING POINT	= 0.0000 VOL/VOL
INITIAL SOIL WATER CONTENT	= 0.0000 VOL/VOL
EFFECTIVE SAT. HYD. COND.	= 0.199999996000E-12 CM/SEC
FML PINHOLE DENSITY	= 1.00 HOLES/ACRE
FML INSTALLATION DEFECTS	= 1.00 HOLES/ACRE
FML PLACEMENT QUALITY	= 3 - GOOD

LAYER 5

TYPE 3 - BARRIER SOIL LINER
MATERIAL TEXTURE NUMBER 16

THICKNESS	= 36.00 INCHES
POROSITY	= 0.4270 VOL/VOL
FIELD CAPACITY	= 0.4180 VOL/VOL
WILTING POINT	= 0.3670 VOL/VOL
INITIAL SOIL WATER CONTENT	= 0.4270 VOL/VOL
EFFECTIVE SAT. HYD. COND.	= 0.100000001000E-06 CM/SEC

GENERAL DESIGN AND EVAPORATIVE ZONE DATA

NOTE: SCS RUNOFF CURVE NUMBER WAS COMPUTED FROM DEFAULT SOIL DATA BASE USING SOIL TEXTURE #12 WITH BARE GROUND CONDITIONS, A SURFACE SLOPE OF 33.% AND A SLOPE LENGTH OF 400. FEET.

SCS RUNOFF CURVE NUMBER	= 95.30
FRACTION OF AREA ALLOWING RUNOFF	= 100.0 PERCENT
AREA PROJECTED ON HORIZONTAL PLANE	= 1.000 ACRES
EVAPORATIVE ZONE DEPTH	= 8.0 INCHES
INITIAL WATER IN EVAPORATIVE ZONE	= 3.280 INCHES
UPPER LIMIT OF EVAPORATIVE STORAGE	= 4.168 INCHES
LOWER LIMIT OF EVAPORATIVE STORAGE	= 1.414 INCHES
INITIAL SNOW WATER	= 0.000 INCHES
INITIAL WATER IN LAYER MATERIALS	= 53.878 INCHES
TOTAL INITIAL WATER	= 53.878 INCHES
TOTAL SUBSURFACE INFLOW	= 0.00 INCHES/YEAR

EVAPOTRANSPIRATION AND WEATHER DATA

NOTE: EVAPOTRANSPIRATION DATA WAS OBTAINED FROM PITTSBURGH PENNSYLVANIA

STATION LATITUDE	= 40.50 DEGREES
MAXIMUM LEAF AREA INDEX	= 0.00
START OF GROWING SEASON (JULIAN DATE)	= 114
END OF GROWING SEASON (JULIAN DATE)	= 288
EVAPORATIVE ZONE DEPTH	= 8.0 INCHES
AVERAGE ANNUAL WIND SPEED	= 9.20 MPH
AVERAGE 1ST QUARTER RELATIVE HUMIDITY	= 67.00 %
AVERAGE 2ND QUARTER RELATIVE HUMIDITY	= 63.00 %
AVERAGE 3RD QUARTER RELATIVE HUMIDITY	= 71.00 %
AVERAGE 4TH QUARTER RELATIVE HUMIDITY	= 70.00 %

NOTE: PRECIPITATION DATA WAS SYNTHETICALLY GENERATED USING COEFFICIENTS FOR PITTSBURGH PENNSYLVANIA

NORMAL MEAN MONTHLY PRECIPITATION (INCHES)

JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
2.86	2.40	3.58	3.28	3.54	3.30
3.83	3.31	2.80	2.49	2.34	2.57

NOTE: TEMPERATURE DATA WAS SYNTHETICALLY GENERATED USING COEFFICIENTS FOR PITTSBURGH PENNSYLVANIA

NORMAL MEAN MONTHLY TEMPERATURE (DEGREES FAHRENHEIT)

JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
26.70	28.80	38.50	50.10	59.70	68.10
72.00	70.60	64.10	52.50	41.60	31.40

NOTE: SOLAR RADIATION DATA WAS SYNTHETICALLY GENERATED USING COEFFICIENTS FOR PITTSBURGH PENNSYLVANIA AND STATION LATITUDE = 40.50 DEGREES

AVERAGE MONTHLY VALUES IN INCHES FOR YEARS 1 THROUGH 5

	JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
PRECIPITATION						
TOTALS	3.33	3.14	4.20	2.96	2.68	2.99
	3.16	3.73	3.70	2.78	2.36	2.71
STD. DEVIATIONS	0.67	1.06	0.65	0.91	1.22	0.43
	1.09	1.44	2.42	1.41	0.85	1.13
RUNOFF						
TOTALS	2.407	2.049	4.295	0.767	0.331	0.495
	0.565	0.974	0.945	0.286	0.232	0.510
STD. DEVIATIONS	1.649	0.910	2.253	0.419	0.280	0.118
	0.288	0.590	0.908	0.247	0.190	0.382
EVAPOTRANSPIRATION						
TOTALS	0.479	0.494	0.547	2.838	1.964	2.229
	2.935	2.456	2.094	2.019	1.770	0.747
STD. DEVIATIONS	0.144	0.159	0.114	0.822	1.316	0.660
	0.900	0.710	0.826	0.844	0.139	0.274
LATERAL DRAINAGE COLLECTED FROM LAYER 3						
TOTALS	0.0971	0.0080	0.3302	0.8984	0.2944	0.0192
	0.0683	0.1338	0.3141	0.4727	0.3866	0.3473
STD. DEVIATIONS	0.1110	0.0139	0.7381	0.1607	0.1650	0.0072
	0.0743	0.1629	0.2894	0.6787	0.4633	0.1204
PERCOLATION/LEAKAGE THROUGH LAYER 5						
TOTALS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
STD. DEVIATIONS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000

AVERAGES OF MONTHLY AVERAGED DAILY HEADS (INCHES)

DAILY AVERAGE HEAD ON TOP OF LAYER 4						
AVERAGES	0.0743	0.0067	0.2525	0.7100	0.2251	0.0152
	0.0522	0.1023	0.2483	0.3615	0.3055	0.2656
STD. DEVIATIONS	0.0849	0.0118	0.5645	0.1270	0.1262	0.0057
	0.0568	0.1246	0.2287	0.5191	0.3662	0.0921

AVERAGE ANNUAL TOTALS & (STD. DEVIATIONS) FOR YEARS 1 THROUGH 5

	INCHES	CU. FEET	PERCENT
PRECIPITATION	37.74 (0.555)	136996.2	100.00
RUNOFF	13.855 (2.0652)	50295.28	36.713
EVAPOTRANSPIRATION	20.570 (1.7276)	74669.06	54.504
LATERAL DRAINAGE COLLECTED FROM LAYER 3	3.37003 (1.52012)	12233.202	8.92959
PERCOLATION/LEAKAGE THROUGH LAYER 5	0.00009 (0.00004)	0.318	0.00023
AVERAGE HEAD ON TOP OF LAYER 4	0.218 (0.098)		

CHANGE IN WATER STORAGE	-0.056	(1.1957)	-201.66	-0.147

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PEAK DAILY VALUES FOR YEARS 1 THROUGH 5

	(INCHES)	(CU. FT.)
PRECIPITATION	1.97	7151.100
RUNOFF	3.196	11602.6523
DRAINAGE COLLECTED FROM LAYER 3	0.07971	289.33664
PERCOLATION/LEAKAGE THROUGH LAYER 5	0.000002	0.00674
AVERAGE HEAD ON TOP OF LAYER 4	1.890	
MAXIMUM HEAD ON TOP OF LAYER 4	3.733	
LOCATION OF MAXIMUM HEAD IN LAYER 3 (DISTANCE FROM DRAIN)	0.0 FEET	
SNOW WATER	4.87	17677.5410

MAXIMUM VEG. SOIL WATER (VOL/VOL)	0.4636
MINIMUM VEG. SOIL WATER (VOL/VOL)	0.1767

*** Maximum heads are computed using McEnroe's equations. ***

Reference: Maximum Saturated Depth over Landfill Liner
by Bruce M. McEnroe, University of Kansas
ASCE Journal of Environmental Engineering
Vol. 119, No. 2, March 1993, pp. 262-270.

****

****

FINAL WATER STORAGE AT END OF YEAR 5

LAYER	(INCHES)	(VOL/VOL)
1	1.9953	0.3326
2	35.5570	0.2963
3	0.6760	0.0563
4	0.0000	0.0000
5	15.3720	0.4270
SNOW WATER	0.000	

****

****

0.01 cm/sec aggregate
100-ft waste-floor

```
**************************************************************************
**************************************************************************
**                                                                      **
**                                                                      **
**          HYDROLOGIC EVALUATION OF LANDFILL PERFORMANCE               **
**             HELP MODEL VERSION 3.07  (1 NOVEMBER 1997)               **
**              DEVELOPED BY ENVIRONMENTAL LABORATORY                   **
**                USAE WATERWAYS EXPERIMENT STATION                     **
**         FOR USEPA RISK REDUCTION ENGINEERING LABORATORY              **
**                                                                      **
**                                                                      **
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**************************************************************************
```

```
PRECIPITATION DATA FILE:     C:\HELP3\ALCE\APEX4.D4
TEMPERATURE DATA FILE:       C:\HELP3\ALCE\APEX7.D7
SOLAR RADIATION DATA FILE:   C:\HELP3\ALCE\APEX13.D13
EVAPOTRANSPIRATION DATA:     C:\HELP3\ALCE\APEX11.D11
SOIL AND DESIGN DATA FILE:   C:\HELP3\ALCE\2FL-12.D10
OUTPUT DATA FILE:            C:\HELP3\ALCE\2FL-120.OUT
```

TIME: 16:54   DATE: 9/19/2011

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TITLE: Apex Landfill Contiguous Expansion, Profile 2, Floor

****

NOTE: INITIAL MOISTURE CONTENT OF THE LAYERS AND SNOW WATER WERE COMPUTED AS NEARLY STEADY-STATE VALUES BY THE PROGRAM.

LAYER 1

```
                TYPE 1 - VERTICAL PERCOLATION LAYER
                  MATERIAL TEXTURE NUMBER 12
THICKNESS                    =     6.00   INCHES
POROSITY                     =     0.4710 VOL/VOL
FIELD CAPACITY               =     0.3420 VOL/VOL
WILTING POINT                =     0.2100 VOL/VOL
INITIAL SOIL WATER CONTENT   =     0.4411 VOL/VOL
EFFECTIVE SAT. HYD. COND.    =  0.419999997000E-04 CM/SEC
```

LAYER 2

```
                TYPE 1 - VERTICAL PERCOLATION LAYER
                  MATERIAL TEXTURE NUMBER 18
THICKNESS                    =  1200.00   INCHES
POROSITY                     =     0.6710 VOL/VOL
FIELD CAPACITY               =     0.2920 VOL/VOL
WILTING POINT                =     0.0770 VOL/VOL
INITIAL SOIL WATER CONTENT   =     0.2920 VOL/VOL
EFFECTIVE SAT. HYD. COND     =  0.100000005000E-02 CM/SEC
```

LAYER 3

```
                 TYPE 2 - LATERAL DRAINAGE LAYER
                  MATERIAL TEXTURE NUMBER 1
THICKNESS                    =    12.00   INCHES
POROSITY                     =     0.4170 VOL/VOL
FIELD CAPACITY               =     0.0450 VOL/VOL
WILTING POINT                =     0.0180 VOL/VOL
INITIAL SOIL WATER CONTENT   =     0.1780 VOL/VOL
EFFECTIVE SAT. HYD. COND.    =  0.999999978000E-02 CM/SEC
SLOPE                        =     3.00   PERCENT
DRAINAGE LENGTH              =   420.0    FEET
```

LAYER 4

```
                 TYPE 4 - FLEXIBLE MEMBRANE LINER
                  MATERIAL TEXTURE NUMBER 35
THICKNESS                    =     0.06   INCHES
POROSITY                     =     0.0000 VOL/VOL
FIELD CAPACITY               =     0.0000 VOL/VOL
WILTING POINT                =     0.0000 VOL/VOL
INITIAL SOIL WATER CONTENT   =     0.0000 VOL/VOL
EFFECTIVE SAT. HYD. COND.    =  0.199999996000E-12 CM/SEC
FML PINHOLE DENSITY          =     1.00   HOLES/ACRE
FML INSTALLATION DEFECTS     =     1.00   HOLES/ACRE
FML PLACEMENT QUALITY        =  3 - GOOD
```

LAYER 5

```
                  TYPE 3 - BARRIER SOIL LINER
                  MATERIAL TEXTURE NUMBER 16
THICKNESS                    =    36.00   INCHES
POROSITY                     =     0.4270 VOL/VOL
FIELD CAPACITY               =     0.4180 VOL/VOL
WILTING POINT                =     0.3670 VOL/VOL
INITIAL SOIL WATER CONTENT   =     0.4270 VOL/VOL
EFFECTIVE SAT. HYD. COND     =  0.100000001000E-06 CM/SEC
```

GENERAL DESIGN AND EVAPORATIVE ZONE DATA

NOTE: SCS RUNOFF CURVE NUMBER WAS COMPUTED FROM DEFAULT SOIL DATA BASE USING SOIL TEXTURE #12 WITH BARE GROUND CONDITIONS, A SURFACE SLOPE OF 3.% AND A SLOPE LENGTH OF 420. FEET.

```
SCS RUNOFF CURVE NUMBER              =    95.10
FRACTION OF AREA ALLOWING RUNOFF     =   100.0    PERCENT
AREA PROJECTED ON HORIZONTAL PLANE   =     1.000  ACRES
EVAPORATIVE ZONE DEPTH               =     8.0    INCHES
INITIAL WATER IN EVAPORATIVE ZONE    =     3.218  INCHES
UPPER LIMIT OF EVAPORATIVE STORAGE   =     4.168  INCHES
LOWER LIMIT OF EVAPORATIVE STORAGE   =     1.414  INCHES
INITIAL SNOW WATER                   =     0.000  INCHES
INITIAL WATER IN LAYER MATERIALS     =   370.542  INCHES
TOTAL INITIAL WATER                  =   370.542  INCHES
TOTAL SUBSURFACE INFLOW              =     0.00   INCHES/YEAR
```

EVAPOTRANSPIRATION AND WEATHER DATA

NOTE: EVAPOTRANSPIRATION DATA WAS OBTAINED FROM PITTSBURGH PENNSYLVANIA

```
STATION LATITUDE                         =  40.50 DEGREES
MAXIMUM LEAF AREA INDEX                  =   0.00
START OF GROWING SEASON (JULIAN DATE)    =   114
END OF GROWING SEASON (JULIAN DATE)      =   288
EVAPORATIVE ZONE DEPTH                   =   8.0  INCHES
AVERAGE ANNUAL WIND SPEED                =   9.20 MPH
AVERAGE 1ST QUARTER RELATIVE HUMIDITY    =  67.00 %
AVERAGE 2ND QUARTER RELATIVE HUMIDITY    =  63.00 %
AVERAGE 3RD QUARTER RELATIVE HUMIDITY    =  71.00 %
AVERAGE 4TH QUARTER RELATIVE HUMIDITY    =  70.00 %
```

NOTE: PRECIPITATION DATA WAS SYNTHETICALLY GENERATED USING COEFFICIENTS FOR PITTSBURGH PENNSYLVANIA

NORMAL MEAN MONTHLY PRECIPITATION (INCHES)

JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
2.86	2.40	3.58	3.28	3.54	3.30
3.83	3.31	2.80	2.49	2.34	2.57

NOTE: TEMPERATURE DATA WAS SYNTHETICALLY GENERATED USING COEFFICIENTS FOR PITTSBURGH PENNSYLVANIA

NORMAL MEAN MONTHLY TEMPERATURE (DEGREES FAHRENHEIT)

JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
26.70	28.80	38.50	50.10	59.70	68.10
72.00	70.60	64.10	52.50	41.60	31.40

NOTE: SOLAR RADIATION DATA WAS SYNTHETICALLY GENERATED USING COEFFICIENTS FOR PITTSBURGH PENNSYLVANIA AND STATION LATITUDE = 40.50 DEGREES

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AVERAGE MONTHLY VALUES IN INCHES FOR YEARS 1 THROUGH 5

	JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
PRECIPITATION						
TOTALS	3.33	3.14	4.20	2.96	2.68	2.99
	3.16	3.73	3.70	2.78	2.36	2.71
STD. DEVIATIONS	0.67	1.06	0.65	0.91	1.22	0.43
	1.09	1.44	2.42	1.41	0.85	1.13
RUNOFF						
TOTALS	2.404	2.045	4.292	0.751	0.308	0.456
	0.531	0.918	0.902	0.282	0.220	0.499
STD. DEVIATIONS	1.652	0.912	2.250	0.420	0.275	0.134
	0.270	0.574	0.862	0.260	0.184	0.377
EVAPOTRANSPIRATION						
TOTALS	0.479	0.494	0.547	2.857	1.954	2.413
	2.889	2.443	2.095	2.013	1.772	0.747
STD. DEVIATIONS	0.144	0.159	0.114	0.833	1.304	0.699
	1.037	0.946	0.885	0.839	0.119	0.273
LATERAL DRAINAGE COLLECTED FROM LAYER 3						
TOTALS	0.3525	0.2315	0.2568	0.3564	0.4441	0.3127
	0.2514	0.2042	0.2195	0.2976	0.3323	0.3635
STD. DEVIATIONS	0.1593	0.1037	0.2063	0.2090	0.1636	0.1106
	0.0780	0.0693	0.0473	0.1821	0.2421	0.1934
PERCOLATION/LEAKAGE THROUGH LAYER 5						
TOTALS	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001
	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001
STD. DEVIATIONS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	0.0000	0.0000	0.0000	0.0000	0.0001	0.0000

AVERAGES OF MONTHLY AVERAGED DAILY HEADS (INCHES)

DAILY AVERAGE HEAD ON TOP OF LAYER 4						
AVERAGES	2.8103	2.0391	2.0477	2.9368	3.5408	2.5766
	2.0042	1.6285	1.8085	2.3724	2.7379	2.8980
STD. DEVIATIONS	1.2698	0.9242	1.6450	1.7217	1.3046	0.9111
	0.6217	0.5525	0.3899	1.4520	1.9943	1.5419

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AVERAGE ANNUAL TOTALS & (STD. DEVIATIONS) FOR YEARS 1 THROUGH 5

	INCHES	CU. FEET	PERCENT
PRECIPITATION	37.74 (0.555)	136996.2	100.00
RUNOFF	13.607 (2.0772)	49392.08	36.054
EVAPOTRANSPIRATION	20.702 (1.8362)	75149.78	54.855
LATERAL DRAINAGE COLLECTED FROM LAYER 3	3.62249 (1.32776)	13149.649	9.59855
PERCOLATION/LEAKAGE THROUGH LAYER 5	0.00085 (0.00029)	3.095	0.00226
AVERAGE HEAD ON TOP OF LAYER 4	2.450 (0.899)		

CHANGE IN WATER STORAGE	-0.192	(1.5033)	-698.44	-0.510

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PEAK DAILY VALUES FOR YEARS 1 THROUGH 5

	(INCHES)	(CU. FT.)
PRECIPITATION	1.97	7151.100
RUNOFF	3.195	11596.2520
DRAINAGE COLLECTED FROM LAYER 3	0.02861	103.85623
PERCOLATION/LEAKAGE THROUGH LAYER 5	0.000006	0.02270
AVERAGE HEAD ON TOP OF LAYER 4	7.072	
MAXIMUM HEAD ON TOP OF LAYER 4	11.892	
LOCATION OF MAXIMUM HEAD IN LAYER 3 (DISTANCE FROM DRAIN)	66.5 FEET	
SNOW WATER	4.87	17677.5410
MAXIMUM VEG. SOIL WATER (VOL/VOL)		0.4637
MINIMUM VEG. SOIL WATER (VOL/VOL)		0.1767

*** Maximum heads are computed using McEnroe's equations. ***

Reference: Maximum Saturated Depth over Landfill Liner
by Bruce M. McEnroe, University of Kansas
ASCE Journal of Environmental Engineering
Vol. 119, No. 2, March 1993, pp. 262-270.

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FINAL WATER STORAGE AT END OF YEAR 5

LAYER	(INCHES)	(VOL/VOL)
1	2.0007	0.3335
2	350.9174	0.2924
3	1.2896	0.1075
4	0.0000	0.0000
5	15.3720	0.4270
SNOW WATER	0.000	

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0.01 cm/sec aggregate
100-ft waste - sideslope

HYDROLOGIC EVALUATION OF LANDFILL PERFORMANCE
HELP MODEL VERSION 3.07 (1 NOVEMBER 1997)
DEVELOPED BY ENVIRONMENTAL LABORATORY
USAE WATERWAYS EXPERIMENT STATION
FOR USEPA RISK REDUCTION ENGINEERING LABORATORY

PRECIPITATION DATA FILE: C:\HELP3\ALCE\APEX4.D4
TEMPERATURE DATA FILE: C:\HELP3\ALCE\APEX7.D7
SOLAR RADIATION DATA FILE: C:\HELP3\ALCE\APEX13.D13
EVAPOTRANSPIRATION DATA: C:\HELP3\ALCE\APEX11.D11
SOIL AND DESIGN DATA FILE: C:\HELP3\ALCE\2SS-12.D10
OUTPUT DATA FILE: C:\HELP3\ALCE\2SS-12O.OUT

TIME: 16:55 DATE: 9/19/2011

TITLE: Apex Landfill Contiguous Expansion, Profile 2, Sideslope

NOTE: INITIAL MOISTURE CONTENT OF THE LAYERS AND SNOW WATER WERE COMPUTED AS NEARLY STEADY-STATE VALUES BY THE PROGRAM.

LAYER 1

TYPE 1 - VERTICAL PERCOLATION LAYER
MATERIAL TEXTURE NUMBER 12

THICKNESS	= 6.00 INCHES
POROSITY	= 0.4710 VOL/VOL
FIELD CAPACITY	= 0.3420 VOL/VOL
WILTING POINT	= 0.2100 VOL/VOL
INITIAL SOIL WATER CONTENT	= 0.4430 VOL/VOL
EFFECTIVE SAT. HYD. COND.	= 0.419999997000E-04 CM/SEC

LAYER 2

TYPE 1 - VERTICAL PERCOLATION LAYER
MATERIAL TEXTURE NUMBER 18

THICKNESS	= 1200.00 INCHES
POROSITY	= 0.6710 VOL/VOL
FIELD CAPACITY	= 0.2920 VOL/VOL
WILTING POINT	= 0.0770 VOL/VOL
INITIAL SOIL WATER CONTENT	= 0.2920 VOL/VOL
EFFECTIVE SAT. HYD. COND.	= 0.100000005000E-02 CM/SEC

LAYER 3

TYPE 2 - LATERAL DRAINAGE LAYER
MATERIAL TEXTURE NUMBER 1

THICKNESS	= 12.00 INCHES
POROSITY	= 0.4170 VOL/VOL
FIELD CAPACITY	= 0.0450 VOL/VOL
WILTING POINT	= 0.0180 VOL/VOL
INITIAL SOIL WATER CONTENT	= 0.0646 VOL/VOL
EFFECTIVE SAT. HYD. COND.	= 0.999999978000E-02 CM/SEC
SLOPE	= 33.00 PERCENT
DRAINAGE LENGTH	= 400.0 FEET

LAYER 4

TYPE 4 - FLEXIBLE MEMBRANE LINER
MATERIAL TEXTURE NUMBER 35

THICKNESS	= 0.06 INCHES
POROSITY	= 0.0000 VOL/VOL
FIELD CAPACITY	= 0.0000 VOL/VOL
WILTING POINT	= 0.0000 VOL/VOL
INITIAL SOIL WATER CONTENT	= 0.0000 VOL/VOL
EFFECTIVE SAT. HYD. COND.	= 0.199999996000E-12 CM/SEC
FML PINHOLE DENSITY	= 1.00 HOLES/ACRE
FML INSTALLATION DEFECTS	= 1.00 HOLES/ACRE
FML PLACEMENT QUALITY	= 3 - GOOD

LAYER 5

TYPE 3 - BARRIER SOIL LINER
MATERIAL TEXTURE NUMBER 16

THICKNESS	= 36.00 INCHES
POROSITY	= 0.4270 VOL/VOL
FIELD CAPACITY	= 0.4180 VOL/VOL
WILTING POINT	= 0.3670 VOL/VOL
INITIAL SOIL WATER CONTENT	= 0.4270 VOL/VOL
EFFECTIVE SAT. HYD. COND.	= 0.100000001000E-06 CM/SEC

GENERAL DESIGN AND EVAPORATIVE ZONE DATA

NOTE: SCS RUNOFF CURVE NUMBER WAS COMPUTED FROM DEFAULT SOIL DATA BASE USING SOIL TEXTURE #12 WITH BARE GROUND CONDITIONS, A SURFACE SLOPE OF 33.% AND A SLOPE LENGTH OF 400. FEET.

SCS RUNOFF CURVE NUMBER	= 95.30
FRACTION OF AREA ALLOWING RUNOFF	= 100.0 PERCENT
AREA PROJECTED ON HORIZONTAL PLANE	= 1.000 ACRES
EVAPORATIVE ZONE DEPTH	= 8.0 INCHES
INITIAL WATER IN EVAPORATIVE ZONE	= 3.280 INCHES
UPPER LIMIT OF EVAPORATIVE STORAGE	= 4.168 INCHES
LOWER LIMIT OF EVAPORATIVE STORAGE	= 1.414 INCHES
INITIAL SNOW WATER	= 0.000 INCHES
INITIAL WATER IN LAYER MATERIALS	= 369.243 INCHES
TOTAL INITIAL WATER	= 369.243 INCHES
TOTAL SUBSURFACE INFLOW	= 0.00 INCHES/YEAR

EVAPOTRANSPIRATION AND WEATHER DATA

NOTE: EVAPOTRANSPIRATION DATA WAS OBTAINED FROM PITTSBURGH PENNSYLVANIA

STATION LATITUDE	= 40.50 DEGREES
MAXIMUM LEAF AREA INDEX	= 0.00
START OF GROWING SEASON (JULIAN DATE)	= 114
END OF GROWING SEASON (JULIAN DATE)	= 288
EVAPORATIVE ZONE DEPTH	= 8.0 INCHES
AVERAGE ANNUAL WIND SPEED	= 9.20 MPH
AVERAGE 1ST QUARTER RELATIVE HUMIDITY	= 67.00 %
AVERAGE 2ND QUARTER RELATIVE HUMIDITY	= 63.00 %
AVERAGE 3RD QUARTER RELATIVE HUMIDITY	= 71.00 %
AVERAGE 4TH QUARTER RELATIVE HUMIDITY	= 70.00 %

NOTE: PRECIPITATION DATA WAS SYNTHETICALLY GENERATED USING COEFFICIENTS FOR PITTSBURGH PENNSYLVANIA

NORMAL MEAN MONTHLY PRECIPITATION (INCHES)

JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
2.86	2.40	3.58	3.28	3.54	3.30
3.83	3.31	2.80	2.49	2.34	2.57

NOTE: TEMPERATURE DATA WAS SYNTHETICALLY GENERATED USING COEFFICIENTS FOR PITTSBURGH PENNSYLVANIA

NORMAL MEAN MONTHLY TEMPERATURE (DEGREES FAHRENHEIT)

JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
26.70	28.80	38.50	50.10	59.70	68.10
72.00	70.60	64.10	52.50	41.60	31.40

NOTE: SOLAR RADIATION DATA WAS SYNTHETICALLY GENERATED USING COEFFICIENTS FOR PITTSBURGH PENNSYLVANIA AND STATION LATITUDE = 40.50 DEGREES

AVERAGE MONTHLY VALUES IN INCHES FOR YEARS 1 THROUGH 5

	JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
PRECIPITATION						
TOTALS	3.33	3.14	4.20	2.96	2.68	2.99
	3.16	3.73	3.70	2.78	2.36	2.71
STD. DEVIATIONS	0.67	1.06	0.65	0.91	1.22	0.43
	1.09	1.44	2.42	1.41	0.85	1.13
RUNOFF						
TOTALS	2.407	2.049	4.295	0.767	0.331	0.495
	0.565	0.974	0.945	0.286	0.232	0.510
STD. DEVIATIONS	1.649	0.910	2.253	0.419	0.280	0.118
	0.288	0.590	0.908	0.247	0.190	0.382
EVAPOTRANSPIRATION						
TOTALS	0.479	0.494	0.547	2.838	1.964	2.229
	2.935	2.456	2.094	2.019	1.770	0.747
STD. DEVIATIONS	0.144	0.159	0.114	0.822	1.316	0.660
	0.900	0.710	0.826	0.844	0.139	0.274
LATERAL DRAINAGE COLLECTED FROM LAYER 3						
TOTALS	0.0994	0.0065	0.3131	0.8657	0.3441	0.0206
	0.0684	0.1301	0.3132	0.4593	0.3939	0.3565
STD. DEVIATIONS	0.1135	0.0107	0.7000	0.1998	0.1943	0.0072
	0.0743	0.1572	0.2840	0.6592	0.4706	0.1261
PERCOLATION/LEAKAGE THROUGH LAYER 5						
TOTALS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
STD. DEVIATIONS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000

AVERAGES OF MONTHLY AVERAGED DAILY HEADS (INCHES)

	JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
DAILY AVERAGE HEAD ON TOP OF LAYER 4						
AVERAGES	0.0760	0.0055	0.2395	0.6842	0.2632	0.0163
	0.0523	0.0995	0.2475	0.3513	0.3113	0.2727
STD. DEVIATIONS	0.0868	0.0091	0.5354	0.1579	0.1486	0.0057
	0.0568	0.1202	0.2244	0.5041	0.3719	0.0965

AVERAGE ANNUAL TOTALS & (STD. DEVIATIONS) FOR YEARS 1 THROUGH 5

	INCHES	CU. FEET	PERCENT
PRECIPITATION	37.74 (0.555)	136996.2	100.00
RUNOFF	13.855 (2.0652)	50295.28	36.713
EVAPOTRANSPIRATION	20.570 (1.7276)	74669.06	54.504
LATERAL DRAINAGE COLLECTED FROM LAYER 3	3.37093 (1.52063)	12236.481	8.93199
PERCOLATION/LEAKAGE THROUGH LAYER 5	0.00009 (0.00004)	0.319	0.00023
AVERAGE HEAD ON TOP OF LAYER 4	0.218 (0.098)		

CHANGE IN WATER STORAGE	-0.056	(1.1971)	-204.92	-0.150

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PEAK DAILY VALUES FOR YEARS 1 THROUGH 5

	(INCHES)	(CU. FT.)
PRECIPITATION	1.97	7151.100
RUNOFF	3.196	11602.6523
DRAINAGE COLLECTED FROM LAYER 3	0.08007	290.66394
PERCOLATION/LEAKAGE THROUGH LAYER 5	0.000002	0.00677
AVERAGE HEAD ON TOP OF LAYER 4	1.898	
MAXIMUM HEAD ON TOP OF LAYER 4	3.750	
LOCATION OF MAXIMUM HEAD IN LAYER 3 (DISTANCE FROM DRAIN)	0.0 FEET	
SNOW WATER	4.87	17677.5410
MAXIMUM VEG. SOIL WATER (VOL/VOL)	0.4636	
MINIMUM VEG. SOIL WATER (VOL/VOL)	0.1767	

*** Maximum heads are computed using McEnroe's equations. ***

Reference: Maximum Saturated Depth over Landfill Liner
by Bruce M. McEnroe, University of Kansas
ASCE Journal of Environmental Engineering
Vol. 119, No. 2, March 1993, pp. 262-270.

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FINAL WATER STORAGE AT END OF YEAR 5

LAYER	(INCHES)	(VOL/VOL)
1	1.9953	0.1326
2	350.9170	0.2924
3	0.6762	0.0564
4	0.0000	0.0000
5	15.3720	0.4270
SNOW WATER	0.000	

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0.01 cm/sec aggregate

final cover conditions

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**              HYDROLOGIC EVALUATION OF LANDFILL PERFORMANCE            **
**                 HELP MODEL VERSION 3.07  (1 NOVEMBER 1997)           **
**                    DEVELOPED BY ENVIRONMENTAL LABORATORY             **
**                      USAE WATERWAYS EXPERIMENT STATION               **
**                 FOR USEPA RISK REDUCTION ENGINEERING LABORATORY       **
**                                                                      **
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PRECIPITATION DATA FILE:     C:\HELP3\ALCE\APEX4-2.D4
TEMPERATURE DATA FILE:       C:\HELP3\ALCE\APEX7-2.D7
SOLAR RADIATION DATA FILE:   C:\HELP3\ALCE\APEX13-2.D13
EVAPOTRANSPIRATION DATA:     C:\HELP3\ALCE\APEX11-2.D11
SOIL AND DESIGN DATA FILE:   C:\HELP3\ALCE\3FL-12.D10
OUTPUT DATA FILE:            C:\HELP3\ALCE\3FL-120.OUT

TIME:  16:12     DATE:  10/20/2011

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     TITLE:  Apex Landfill Contiguous Expansion, Profile 3, Floor

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     NOTE:  INITIAL MOISTURE CONTENT OF THE LAYERS AND SNOW WATER WERE
            COMPUTED AS NEARLY STEADY-STATE VALUES BY THE PROGRAM.

                                LAYER  1
                                -------

                  TYPE 1 - VERTICAL PERCOLATION LAYER
                     MATERIAL TEXTURE NUMBER  12
     THICKNESS                     =     30.00   INCHES
     POROSITY                      =      0.4710 VOL/VOL
     FIELD CAPACITY                =      0.3420 VOL/VOL
     WILTING POINT                 =      0.2100 VOL/VOL
     INITIAL SOIL WATER CONTENT    =      0.3896 VOL/VOL
     EFFECTIVE SAT. HYD. COND.     =  0.419999997000E-04 CM/SEC
     NOTE:  SATURATED HYDRAULIC CONDUCTIVITY IS MULTIPLIED BY  4.63
            FOR ROOT CHANNELS IN TOP HALF OF EVAPORATIVE ZONE.

                                LAYER  2
                                -------

                  TYPE 2 - LATERAL DRAINAGE LAYER
                     MATERIAL TEXTURE NUMBER   0
     THICKNESS                     =      0.30   INCHES
     POROSITY                      =      0.8500 VOL/VOL
     FIELD CAPACITY                =      0.0100 VOL/VOL
     WILTING POINT                 =      0.0050 VOL/VOL
     INITIAL SOIL WATER CONTENT    =      0.0129 VOL/VOL
     EFFECTIVE SAT. HYD. COND.     =  3.210000040000      CM/SEC
     SLOPE                         =     33.00   PERCENT
     DRAINAGE LENGTH               =    195.0    FEET

                                LAYER  3
                                -------

                  TYPE 4 - FLEXIBLE MEMBRANE LINER
                     MATERIAL TEXTURE NUMBER  35
     THICKNESS                     =      0.04   INCHES
     POROSITY                      =      0.0000 VOL/VOL
     FIELD CAPACITY                =      0.0000 VOL/VOL
     WILTING POINT                 =      0.0000 VOL/VOL
     INITIAL SOIL WATER CONTENT    =      0.0000 VOL/VOL
     EFFECTIVE SAT. HYD. COND.     =  0.199999996000E-12 CM/SEC
     FML PINHOLE DENSITY           =      1.00   HOLES/ACRE
     FML INSTALLATION DEFECTS      =      1.00   HOLES/ACRE
     FML PLACEMENT QUALITY         =  3 - GOOD

                                LAYER  4
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                  TYPE 3 - BARRIER SOIL LINER
                     MATERIAL TEXTURE NUMBER   0
     THICKNESS                     =     18.00   INCHES
     POROSITY                      =      0.4270 VOL/VOL
     FIELD CAPACITY                =      0.4180 VOL/VOL
     WILTING POINT                 =      0.3670 VOL/VOL
     INITIAL SOIL WATER CONTENT    =      0.4270 VOL/VOL
     EFFECTIVE SAT. HYD. COND.     =  0.999999997000E-06 CM/SEC

                                LAYER  5
                                -------

                  TYPE 1 - VERTICAL PERCOLATION LAYER
                     MATERIAL TEXTURE NUMBER  12
     THICKNESS                     =     12.00   INCHES
     POROSITY                      =      0.4710 VOL/VOL
     FIELD CAPACITY                =      0.3420 VOL/VOL
     WILTING POINT                 =      0.2100 VOL/VOL
     INITIAL SOIL WATER CONTENT    =      0.3420 VOL/VOL
     EFFECTIVE SAT. HYD. COND.     =  0.419999997000E-04 CM/SEC

                                LAYER  6
                                -------

                  TYPE 1 - VERTICAL PERCOLATION LAYER
                     MATERIAL TEXTURE NUMBER  18
     THICKNESS                     =   4500.00   INCHES
     POROSITY                      =      0.6710 VOL/VOL
     FIELD CAPACITY                =      0.2920 VOL/VOL
     WILTING POINT                 =      0.0770 VOL/VOL
     INITIAL SOIL WATER CONTENT    =      0.2920 VOL/VOL
     EFFECTIVE SAT. HYD. COND.     =  0.100000005000E-02 CM/SEC

                                LAYER  7
                                -------

                  TYPE 2 - LATERAL DRAINAGE LAYER
                     MATERIAL TEXTURE NUMBER   1
     THICKNESS                     =     12.00   INCHES
     POROSITY                      =      0.4170 VOL/VOL
     FIELD CAPACITY                =      0.0450 VOL/VOL
     WILTING POINT                 =      0.0180 VOL/VOL
     INITIAL SOIL WATER CONTENT    =      0.0450 VOL/VOL
     EFFECTIVE SAT. HYD. COND.     =  0.999999978000E-02 CM/SEC
     SLOPE                         =      3.00   PERCENT
     DRAINAGE LENGTH               =    420.0    FEET

                                LAYER  8
                                -------

                  TYPE 4 - FLEXIBLE MEMBRANE LINER
                     MATERIAL TEXTURE NUMBER  35
     THICKNESS                     =      0.06   INCHES
     POROSITY                      =      0.0000 VOL/VOL
     FIELD CAPACITY                =      0.0000 VOL/VOL
     WILTING POINT                 =      0.0000 VOL/VOL
     INITIAL SOIL WATER CONTENT    =      0.0000 VOL/VOL
     EFFECTIVE SAT. HYD. COND.     =  0.199999996000E-12 CM/SEC
     FML PINHOLE DENSITY           =      1.00   HOLES/ACRE
     FML INSTALLATION DEFECTS      =      1.00   HOLES/ACRE
     FML PLACEMENT QUALITY         =  3 - GOOD

                                LAYER  9
                                -------

                  TYPE 3 - BARRIER SOIL LINER
                     MATERIAL TEXTURE NUMBER  16
     THICKNESS                     =     36.00   INCHES
     POROSITY                      =      0.4270 VOL/VOL
     FIELD CAPACITY                =      0.4180 VOL/VOL
     WILTING POINT                 =      0.3670 VOL/VOL
     INITIAL SOIL WATER CONTENT    =      0.4270 VOL/VOL
     EFFECTIVE SAT. HYD. COND.     =  0.100000001000E-06 CM/SEC

                  GENERAL DESIGN AND EVAPORATIVE ZONE DATA
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     NOTE:  SCS RUNOFF CURVE NUMBER WAS COMPUTED FROM A USER-
            SPECIFIED CURVE NUMBER OF 77.0, A SURFACE SLOPE
            OF 33.% AND A SLOPE LENGTH OF  195. FEET.

     SCS RUNOFF CURVE NUMBER       =     79.50
     FRACTION OF AREA ALLOWING RUNOFF  =    100.0    PERCENT
     AREA PROJECTED ON HORIZONTAL PLANE =     1.000  ACRES
     EVAPORATIVE ZONE DEPTH        =     12.0    INCHES
     INITIAL WATER IN EVAPORATIVE ZONE =     5.170  INCHES
     UPPER LIMIT OF EVAPORATIVE STORAGE =    5.652  INCHES
     LOWER LIMIT OF EVAPORATIVE STORAGE =    2.520  INCHES
     INITIAL SNOW WATER            =     0.000    INCHES
     INITIAL WATER IN LAYER MATERIALS  =  1353.393  INCHES
     TOTAL INITIAL WATER           =  1353.393    INCHES
     TOTAL SUBSURFACE INFLOW       =     0.00     INCHES/YEAR

                  EVAPOTRANSPIRATION AND WEATHER DATA
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     NOTE:  EVAPOTRANSPIRATION DATA WAS OBTAINED FROM
            PITTSBURGH                PENNSYLVANIA

          STATION LATITUDE                 =  40.50 DEGREES
          MAXIMUM LEAF AREA INDEX          =   3.50
          START OF GROWING SEASON (JULIAN DATE) =  114
          END OF GROWING SEASON (JULIAN DATE)   =  288
          EVAPORATIVE ZONE DEPTH           =  12.0  INCHES
          AVERAGE ANNUAL WIND SPEED        =   9.20 MPH
          AVERAGE 1ST QUARTER RELATIVE HUMIDITY  =  67.00 %
          AVERAGE 2ND QUARTER RELATIVE HUMIDITY  =  63.00 %
          AVERAGE 3RD QUARTER RELATIVE HUMIDITY  =  71.00 %
          AVERAGE 4TH QUARTER RELATIVE HUMIDITY  =  70.00 %

     NOTE:  PRECIPITATION DATA WAS SYNTHETICALLY GENERATED USING
            COEFFICIENTS FOR    PITTSBURGH              PENNSYLVANIA

            NORMAL MEAN MONTHLY PRECIPITATION (INCHES)

      JAN/JUL    FEB/AUG    MAR/SEP    APR/OCT    MAY/NOV    JUN/DEC
      -------    -------    -------    -------    -------    -------
         2.86       2.40       3.58       3.28       3.54       3.30
         3.83       3.31       2.80       2.49       2.34       2.57

     NOTE:  TEMPERATURE DATA WAS SYNTHETICALLY GENERATED USING
            COEFFICIENTS FOR    PITTSBURGH              PENNSYLVANIA

            NORMAL MEAN MONTHLY TEMPERATURE (DEGREES FAHRENHEIT)

      JAN/JUL    FEB/AUG    MAR/SEP    APR/OCT    MAY/NOV    JUN/DEC
      -------    -------    -------    -------    -------    -------
        26.70      28.80      38.50      50.10      59.70      68.10
        72.00      70.60      64.10      52.50      41.60      31.40

     NOTE:  SOLAR RADIATION DATA WAS SYNTHETICALLY GENERATED USING
            COEFFICIENTS FOR    PITTSBURGH              PENNSYLVANIA
              AND STATION LATITUDE  =  40.50 DEGREES

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          AVERAGE MONTHLY VALUES IN INCHES FOR YEARS    1 THROUGH  100
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                        JAN/JUL    FEB/AUG    MAR/SEP    APR/OCT    MAY/NOV    JUN/DEC
                        -------    -------    -------    -------    -------    -------
PRECIPITATION
-------------
  TOTALS                   2.88       2.32       3.65       3.47       3.44       3.30
                           3.84       3.44       2.68       2.56       2.43       2.71

  STD. DEVIATIONS          1.10       0.89       1.06       1.28       1.56       1.20
                           1.61       1.77       1.45       1.23       0.95       1.00

RUNOFF
------
  TOTALS                   0.871      1.783      3.115      0.303      0.026      0.017
                           0.055      0.090      0.026      0.012      0.015      0.143
```

STD. DEVIATIONS	1.053	1.322	1.825	0.613	0.086	0.052
	0.185	0.290	0.086	0.042	0.111	0.451

EVAPOTRANSPIRATION

TOTALS	0.600	0.479	1.009	3.429	3.429	3.302
	3.540	3.065	2.115	1.494	1.167	0.804
STD. DEVIATIONS	0.152	0.134	0.567	0.638	1.271	1.159
	1.235	1.236	0.967	0.373	0.191	0.194

LATERAL DRAINAGE COLLECTED FROM LAYER 2

TOTALS	0.5643	0.0578	0.5891	1.2900	0.4419	0.1504
	0.1394	0.1976	0.2839	0.3632	0.6796	1.0755
STD. DEVIATIONS	0.6129	0.1484	0.7082	0.6718	0.4081	0.3366
	0.3536	0.3364	0.4959	0.5385	0.7096	0.8335

PERCOLATION/LEAKAGE THROUGH LAYER 4

TOTALS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
STD. DEVIATIONS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000

LATERAL DRAINAGE COLLECTED FROM LAYER 7

TOTALS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
STD. DEVIATIONS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000

PERCOLATION/LEAKAGE THROUGH LAYER 9

TOTALS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
STD. DEVIATIONS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000

AVERAGES OF MONTHLY AVERAGED DAILY HEADS (INCHES)

DAILY AVERAGE HEAD ON TOP OF LAYER 3

AVERAGES	0.0007	0.0001	0.0007	0.0016	0.0005	0.0002
	0.0002	0.0002	0.0003	0.0004	0.0008	0.0013
STD. DEVIATIONS	0.0007	0.0002	0.0008	0.0008	0.0005	0.0004
	0.0004	0.0004	0.0006	0.0006	0.0009	0.0010

DAILY AVERAGE HEAD ON TOP OF LAYER 8

AVERAGES	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
STD. DEVIATIONS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000

AVERAGE ANNUAL TOTALS & (STD. DEVIATIONS) FOR YEARS 1 THROUGH 100

	INCHES		CU. FEET	PERCENT
PRECIPITATION	36.72	(4.356)	133299.0	100.00
RUNOFF	6.458	(2.3716)	23441.76	17.586
EVAPOTRANSPIRATION	24.432	(2.8393)	88687.73	66.533
LATERAL DRAINAGE COLLECTED FROM LAYER 2	5.83268	(2.11969)	21172.633	15.88356
PERCOLATION/LEAKAGE THROUGH LAYER 4	0.00000	(0.00000)	0.011	0.00001
AVERAGE HEAD ON TOP OF LAYER 3	0.001	(0.000)		
LATERAL DRAINAGE COLLECTED FROM LAYER 7	0.00000	(0.00000)	0.004	0.00000
PERCOLATION/LEAKAGE THROUGH LAYER 9	0.00000	(0.00000)	0.007	0.00001
AVERAGE HEAD ON TOP OF LAYER 8	0.000	(0.000)		
CHANGE IN WATER STORAGE	-0.001	(1.0768)	-3.08	-0.002

PEAK DAILY VALUES FOR YEARS 1 THROUGH 100

	(INCHES)	(CU. FT.)
PRECIPITATION	4.44	16117.200
RUNOFF	4.029	14626.5137
DRAINAGE COLLECTED FROM LAYER 2	0.93012	3376.32837
PERCOLATION/LEAKAGE THROUGH LAYER 4	0.000000	0.00089
AVERAGE HEAD ON TOP OF LAYER 3	0.033	
MAXIMUM HEAD ON TOP OF LAYER 3	0.090	
LOCATION OF MAXIMUM HEAD IN LAYER 2 (DISTANCE FROM DRAIN)	0.0 FEET	
DRAINAGE COLLECTED FROM LAYER 7	0.00000	0.00006
PERCOLATION/LEAKAGE THROUGH LAYER 9	0.000000	0.00002
AVERAGE HEAD ON TOP OF LAYER 8	0.000	
MAXIMUM HEAD ON TOP OF LAYER 8	0.007	
LOCATION OF MAXIMUM HEAD IN LAYER 7 (DISTANCE FROM DRAIN)	0.0 FEET	
SNOW WATER	5.36	19474.3164

MAXIMUM VEG. SOIL WATER (VOL/VOL)	0.4677
MINIMUM VEG. SOIL WATER (VOL/VOL)	0.2100

*** Maximum heads are computed using McEnroe's equations. ***

Reference: Maximum Saturated Depth over Landfill Liner
by Bruce M. McEnroe, University of Kansas
ASCE Journal of Environmental Engineering
Vol. 119, No. 2, March 1993, pp. 262-270.

FINAL WATER STORAGE AT END OF YEAR 100

LAYER	(INCHES)	(VOL/VOL)
1	11.5876	0.3863
2	0.0033	0.0111
3	0.0000	0.0000
4	7.6860	0.4270
5	4.1040	0.3420
6	1314.0000	0.2920
7	0.5400	0.0450
8	0.0000	0.0000
9	15.3720	0.4270
SNOW WATER	0.015	

Oil omiscc aggregate
10-ft waste floor

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**                                                                  **
**                                                                  **
**          HYDROLOGIC EVALUATION OF LANDFILL PERFORMANCE           **
**              HELP MODEL VERSION 3.07  (1 NOVEMBER 1997)          **
**              DEVELOPED BY ENVIRONMENTAL LABORATORY               **
**                 USAE WATERWAYS EXPERIMENT STATION                **
**          FOR USEPA RISK REDUCTION ENGINEERING LABORATORY         **
**                                                                  **
**                                                                  **
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PRECIPITATION DATA FILE:      C:\HELP3\ALCE\APEX4.D4
TEMPERATURE DATA FILE:        C:\HELP3\ALCE\APEX7.D7
SOLAR RADIATION DATA FILE:    C:\HELP3\ALCE\APEX13.D13
EVAPOTRANSPIRATION DATA:      C:\HELP3\ALCE\APEX11.D11
SOIL AND DESIGN DATA FILE:    C:\HELP3\ALCE\4FL10.D10
OUTPUT DATA FILE:             C:\HELP3\ALCE\4FL100.OUT
```

TIME: 16: 8   DATE: 10/20/2011

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TITLE: Apex Landfill Contiguous Expansion, Profile 4, Floor

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NOTE: INITIAL MOISTURE CONTENT OF THE LAYERS AND SNOW WATER WERE COMPUTED AS NEARLY STEADY-STATE VALUES BY THE PROGRAM.

LAYER 1

TYPE 1 - VERTICAL PERCOLATION LAYER
MATERIAL TEXTURE NUMBER 12

THICKNESS	=	6.00 INCHES
POROSITY	=	0.4710 VOL/VOL
FIELD CAPACITY	=	0.3420 VOL/VOL
WILTING POINT	=	0.2100 VOL/VOL
INITIAL SOIL WATER CONTENT	=	0.4424 VOL/VOL
EFFECTIVE SAT. HYD. COND.	=	0.419999997000E-04 CM/SEC

LAYER 2

TYPE 1 - VERTICAL PERCOLATION LAYER
MATERIAL TEXTURE NUMBER 18

THICKNESS	=	120.00 INCHES
POROSITY	=	0.6710 VOL/VOL
FIELD CAPACITY	=	0.2920 VOL/VOL
WILTING POINT	=	0.0770 VOL/VOL
INITIAL SOIL WATER CONTENT	=	0.2921 VOL/VOL
EFFECTIVE SAT. HYD. COND.	=	0.100000005000E-02 CM/SEC

LAYER 3

TYPE 2 - LATERAL DRAINAGE LAYER
MATERIAL TEXTURE NUMBER 0

THICKNESS	=	12.00 INCHES
POROSITY	=	0.3970 VOL/VOL
FIELD CAPACITY	=	0.0320 VOL/VOL
WILTING POINT	=	0.0130 VOL/VOL
INITIAL SOIL WATER CONTENT	=	0.0709 VOL/VOL
EFFECTIVE SAT. HYD. COND.	=	0.100000001000 CM/SEC
SLOPE	=	3.00 PERCENT
DRAINAGE LENGTH	=	840.0 FEET

LAYER 4

TYPE 4 - FLEXIBLE MEMBRANE LINER
MATERIAL TEXTURE NUMBER 35

THICKNESS	=	0.06 INCHES
POROSITY	=	0.0000 VOL/VOL
FIELD CAPACITY	=	0.0000 VOL/VOL
WILTING POINT	=	0.0000 VOL/VOL
INITIAL SOIL WATER CONTENT	=	0.0000 VOL/VOL
EFFECTIVE SAT. HYD. COND.	=	0.199999996000E-12 CM/SEC
FML PINHOLE DENSITY	=	1.00 HOLES/ACRE
FML INSTALLATION DEFECTS	=	1.00 HOLES/ACRE
FML PLACEMENT QUALITY	=	3 - GOOD

LAYER 5

TYPE 3 - BARRIER SOIL LINER
MATERIAL TEXTURE NUMBER 16

THICKNESS	=	36.00 INCHES
POROSITY	=	0.4270 VOL/VOL
FIELD CAPACITY	=	0.4180 VOL/VOL
WILTING POINT	=	0.3670 VOL/VOL
INITIAL SOIL WATER CONTENT	=	0.4270 VOL/VOL
EFFECTIVE SAT. HYD. COND.	=	0.100000001000E-06 CM/SEC

GENERAL DESIGN AND EVAPORATIVE ZONE DATA

NOTE: SCS RUNOFF CURVE NUMBER WAS COMPUTED FROM DEFAULT SOIL DATA BASE USING SOIL TEXTURE #12 WITH BARE GROUND CONDITIONS, A SURFACE SLOPE OF 3.% AND A SLOPE LENGTH OF 840 FEET.

SCS RUNOFF CURVE NUMBER	=	94.90
FRACTION OF AREA ALLOWING RUNOFF	=	100.0 PERCENT
AREA PROJECTED ON HORIZONTAL PLANE	=	1.000 ACRES
EVAPORATIVE ZONE DEPTH	=	8.0 INCHES
INITIAL WATER IN EVAPORATIVE ZONE	=	3.247 INCHES
UPPER LIMIT OF EVAPORATIVE STORAGE	=	4.168 INCHES
LOWER LIMIT OF EVAPORATIVE STORAGE	=	1.414 INCHES
INITIAL SNOW WATER	=	0.000 INCHES
INITIAL WATER IN LAYER MATERIALS	=	53.925 INCHES
TOTAL INITIAL WATER	=	53.925 INCHES
TOTAL SUBSURFACE INFLOW	=	0.00 INCHES/YEAR

EVAPOTRANSPIRATION AND WEATHER DATA

NOTE: EVAPOTRANSPIRATION DATA WAS OBTAINED FROM PITTSBURGH PENNSYLVANIA

STATION LATITUDE	=	40.50 DEGREES
MAXIMUM LEAF AREA INDEX	=	0.00
START OF GROWING SEASON (JULIAN DATE)	=	114
END OF GROWING SEASON (JULIAN DATE)	=	288
EVAPORATIVE ZONE DEPTH	=	8.0 INCHES
AVERAGE ANNUAL WIND SPEED	=	9.20 MPH
AVERAGE 1ST QUARTER RELATIVE HUMIDITY	=	67.00 %
AVERAGE 2ND QUARTER RELATIVE HUMIDITY	=	63.00 %
AVERAGE 3RD QUARTER RELATIVE HUMIDITY	=	71.00 %
AVERAGE 4TH QUARTER RELATIVE HUMIDITY	=	70.00 %

NOTE: PRECIPITATION DATA WAS SYNTHETICALLY GENERATED USING COEFFICIENTS FOR PITTSBURGH PENNSYLVANIA

NORMAL MEAN MONTHLY PRECIPITATION (INCHES)

JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
2.86	2.40	3.58	3.28	3.54	3.30
3.83	3.31	2.80	2.49	2.34	2.57

NOTE: TEMPERATURE DATA WAS SYNTHETICALLY GENERATED USING COEFFICIENTS FOR PITTSBURGH PENNSYLVANIA

NORMAL MEAN MONTHLY TEMPERATURE (DEGREES FAHRENHEIT)

JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
26.70	28.80	38.50	50.10	59.70	68.10
72.00	70.60	64.10	52.50	41.60	31.40

NOTE: SOLAR RADIATION DATA WAS SYNTHETICALLY GENERATED USING COEFFICIENTS FOR PITTSBURGH PENNSYLVANIA AND STATION LATITUDE = 40.50 DEGREES

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AVERAGE MONTHLY VALUES IN INCHES FOR YEARS 1 THROUGH 5

	JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
PRECIPITATION						
TOTALS	3.33	3.14	4.20	2.96	2.68	2.99
	3.16	3.73	3.70	2.78	2.36	2.71
STD. DEVIATIONS	0.67	1.06	0.65	0.91	1.22	0.43
	1.09	1.44	2.42	1.41	0.85	1.13
RUNOFF						
TOTALS	2.405	2.047	4.288	0.735	0.289	0.445
	0.502	0.914	0.857	0.261	0.199	0.491
STD. DEVIATIONS	1.650	0.911	2.260	0.423	0.269	0.137
	0.252	0.570	0.818	0.241	0.170	0.374
EVAPOTRANSPIRATION						
TOTALS	0.479	0.494	0.547	2.856	1.966	2.449
	2.988	2.221	2.135	2.025	1.775	0.747
STD. DEVIATIONS	0.144	0.159	0.114	0.836	1.286	0.704
	0.974	0.720	0.836	0.844	0.120	0.274
LATERAL DRAINAGE COLLECTED FROM LAYER 3						
TOTALS	0.2046	0.0376	0.2643	0.6853	0.4847	0.1062
	0.0897	0.1616	0.3483	0.4809	0.4286	0.4047
STD. DEVIATIONS	0.1651	0.0321	0.5778	0.2325	0.1605	0.0167
	0.0712	0.1421	0.1930	0.6644	0.4363	0.1298
PERCOLATION/LEAKAGE THROUGH LAYER 5						
TOTALS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
STD. DEVIATIONS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000

AVERAGES OF MONTHLY AVERAGED DAILY HEADS (INCHES)

DAILY AVERAGE HEAD ON TOP OF LAYER 4						
AVERAGES	0.3263	0.0663	0.4215	1.1292	0.7729	0.1749
	0.1431	0.2576	0.5739	0.7668	0.7062	0.6453
STD. DEVIATIONS	0.2632	0.0569	0.9214	0.3831	0.2560	0.0275
	0.1135	0.2266	0.3181	1.0595	0.7190	0.2070

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AVERAGE ANNUAL TOTALS & (STD. DEVIATIONS) FOR YEARS 1 THROUGH 5

	INCHES	CU. FEET	PERCENT
PRECIPITATION	37.74 (0.555)	136996.2	100.00
RUNOFF	13.433 (2.1061)	48761.77	35.594
EVAPOTRANSPIRATION	20.681 (1.7096)	75071.98	54.799
LATERAL DRAINAGE COLLECTED FROM LAYER 3	3.69639 (1.65050)	13417.892	9.79435
PERCOLATION/LEAKAGE THROUGH LAYER 5	0.00019 (0.00008)	0.694	0.00051
AVERAGE HEAD ON TOP OF LAYER 4	0.499 (0.222)		

CHANGE IN WATER STORAGE	-0.071	(1.2241)	-256.14	-0.187

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PEAK DAILY VALUES FOR YEARS 1 THROUGH 5

	(INCHES)	(CU. FT.)
PRECIPITATION	1.97	7151.100
RUNOFF	3.196	11599.8848
DRAINAGE COLLECTED FROM LAYER 3	0.06853	248.76044
PERCOLATION/LEAKAGE THROUGH LAYER 5	0.000003	0.01152
AVERAGE HEAD ON TOP OF LAYER 4	3.388	
MAXIMUM HEAD ON TOP OF LAYER 4	6.337	
LOCATION OF MAXIMUM HEAD IN LAYER 3 (DISTANCE FROM DRAIN)	53.7 FEET	
SNOW WATER	4.87	17677.5410

MAXIMUM VEG. SOIL WATER (VOL/VOL) 0.4638

MINIMUM VEG. SOIL WATER (VOL/VOL) 0.1767

*** Maximum heads are computed using McEnroe's equations. ***

Reference: Maximum Saturated Depth over Landfill Liner
by Bruce M. McEnroe, University of Kansas
ASCE Journal of Environmental Engineering
Vol. 119, No. 2, March 1993, pp. 262-270

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FINAL WATER STORAGE AT END OF YEAR 5

LAYER	(INCHES)	(VOL/VOL)
1	2.0043	0.3340
2	35.5294	0.2961
3	0.6667	0.0556
4	0.0000	0.0000
5	15.3720	0.4270
SNOW WATER	0.000	

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0.1 cm/sec aggregate
10-ft Waste Sideslope

HYDROLOGIC EVALUATION OF LANDFILL PERFORMANCE
HELP MODEL VERSION 3.07 (1 NOVEMBER 1997)
DEVELOPED BY ENVIRONMENTAL LABORATORY
USAE WATERWAYS EXPERIMENT STATION
FOR USEPA RISK REDUCTION ENGINEERING LABORATORY

PRECIPITATION DATA FILE:	C:\HELP3\ALCE\APEX4.D4
TEMPERATURE DATA FILE:	C:\HELP3\ALCE\APEX7.D7
SOLAR RADIATION DATA FILE:	C:\HELP3\ALCE\APEX13.D13
EVAPOTRANSPIRATION DATA:	C:\HELP3\ALCE\APEX11.D11
SOIL AND DESIGN DATA FILE:	C:\HELP3\ALCE\4SS10.D10
OUTPUT DATA FILE:	C:\HELP3\ALCE\4SS10C.OUT

TIME: 16: 8 DATE: 10/20/2011

TITLE: Apex Landfill Contiguous Expansion, Profile 4, Sideslope

NOTE: INITIAL MOISTURE CONTENT OF THE LAYERS AND SNOW WATER WERE COMPUTED AS NEARLY STEADY-STATE VALUES BY THE PROGRAM.

LAYER 1

TYPE 1 - VERTICAL PERCOLATION LAYER
MATERIAL TEXTURE NUMBER 12

THICKNESS	=	6.00 INCHES
POROSITY	=	0.4710 VOL/VOL
FIELD CAPACITY	=	0.3420 VOL/VOL
WILTING POINT	=	0.2100 VOL/VOL
INITIAL SOIL WATER CONTENT	=	0.4430 VOL/VOL
EFFECTIVE SAT. HYD. COND.	=	0.419999997000E-04 CM/SEC

LAYER 2

TYPE 1 - VERTICAL PERCOLATION LAYER
MATERIAL TEXTURE NUMBER 18

THICKNESS	=	120.00 INCHES
POROSITY	=	0.6710 VOL/VOL
FIELD CAPACITY	=	0.2920 VOL/VOL
WILTING POINT	=	0.0770 VOL/VOL
INITIAL SOIL WATER CONTENT	=	0.2923 VOL/VOL
EFFECTIVE SAT. HYD. COND.	=	0.100000005000E-02 CM/SEC

LAYER 3

TYPE 2 - LATERAL DRAINAGE LAYER
MATERIAL TEXTURE NUMBER 0

THICKNESS	=	12.00 INCHES
POROSITY	=	0.3970 VOL/VOL
FIELD CAPACITY	=	0.0320 VOL/VOL
WILTING POINT	=	0.0130 VOL/VOL
INITIAL SOIL WATER CONTENT	=	0.0320 VOL/VOL
EFFECTIVE SAT. HYD. COND.	=	0.100000001000 CM/SEC
SLOPE	=	33.00 PERCENT
DRAINAGE LENGTH	=	400.0 FEET

LAYER 4

TYPE 4 - FLEXIBLE MEMBRANE LINER
MATERIAL TEXTURE NUMBER 35

THICKNESS	=	0.06 INCHES
POROSITY	=	0.0000 VOL/VOL
FIELD CAPACITY	=	0.0000 VOL/VOL
WILTING POINT	=	0.0000 VOL/VOL
INITIAL SOIL WATER CONTENT	=	0.0000 VOL/VOL
EFFECTIVE SAT. HYD. COND.	=	0.199999996000E-12 CM/SEC
FML PINHOLE DENSITY	=	1.00 HOLES/ACRE
FML INSTALLATION DEFECTS	=	1.00 HOLES/ACRE
FML PLACEMENT QUALITY	=	3 - GOOD

LAYER 5

TYPE 3 - BARRIER SOIL LINER
MATERIAL TEXTURE NUMBER 16

THICKNESS	=	36.00 INCHES
POROSITY	=	0.4270 VOL/VOL
FIELD CAPACITY	=	0.4180 VOL/VOL
WILTING POINT	=	0.3670 VOL/VOL
INITIAL SOIL WATER CONTENT	=	0.4270 VOL/VOL
EFFECTIVE SAT. HYD. COND.	=	0.100000001000E-06 CM/SEC

GENERAL DESIGN AND EVAPORATIVE ZONE DATA

NOTE: SCS RUNOFF CURVE NUMBER WAS COMPUTED FROM DEFAULT SOIL DATA BASE USING SOIL TEXTURE #12 WITH BARE GROUND CONDITIONS, A SURFACE SLOPE OF 33.% AND A SLOPE LENGTH OF 400. FEET.

SCS RUNOFF CURVE NUMBER	=	95.30
FRACTION OF AREA ALLOWING RUNOFF	=	100.0 PERCENT
AREA PROJECTED ON HORIZONTAL PLANE	=	1.000 ACRES
EVAPORATIVE ZONE DEPTH	=	8.0 INCHES
INITIAL WATER IN EVAPORATIVE ZONE	=	3.280 INCHES
UPPER LIMIT OF EVAPORATIVE STORAGE	=	4.168 INCHES
LOWER LIMIT OF EVAPORATIVE STORAGE	=	1.414 INCHES
INITIAL SNOW WATER	=	0.000 INCHES
INITIAL WATER IN LAYER MATERIALS	=	53.492 INCHES
TOTAL INITIAL WATER	=	53.492 INCHES
TOTAL SUBSURFACE INFLOW	=	0.00 INCHES/YEAR

EVAPOTRANSPIRATION AND WEATHER DATA

NOTE: EVAPOTRANSPIRATION DATA WAS OBTAINED FROM PITTSBURGH PENNSYLVANIA

STATION LATITUDE	=	40.50 DEGREES
MAXIMUM LEAF AREA INDEX	=	0.00
START OF GROWING SEASON (JULIAN DATE)	=	114
END OF GROWING SEASON (JULIAN DATE)	=	288
EVAPORATIVE ZONE DEPTH	=	8.0 INCHES
AVERAGE ANNUAL WIND SPEED	=	9.20 MPH
AVERAGE 1ST QUARTER RELATIVE HUMIDITY	=	67.00 %
AVERAGE 2ND QUARTER RELATIVE HUMIDITY	=	63.00 %
AVERAGE 3RD QUARTER RELATIVE HUMIDITY	=	71.00 %
AVERAGE 4TH QUARTER RELATIVE HUMIDITY	=	70.00 %

NOTE: PRECIPITATION DATA WAS SYNTHETICALLY GENERATED USING COEFFICIENTS FOR PITTSBURGH PENNSYLVANIA

NORMAL MEAN MONTHLY PRECIPITATION (INCHES)

JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
2.86	2.40	3.58	3.28	3.54	3.30
3.83	3.31	2.80	2.49	2.34	2.57

NOTE: TEMPERATURE DATA WAS SYNTHETICALLY GENERATED USING COEFFICIENTS FOR PITTSBURGH PENNSYLVANIA

NORMAL MEAN MONTHLY TEMPERATURE (DEGREES FAHRENHEIT)

JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
26.70	28.80	38.50	50.10	59.70	68.10
72.00	70.60	64.10	52.50	41.60	31.40

NOTE: SOLAR RADIATION DATA WAS SYNTHETICALLY GENERATED USING COEFFICIENTS FOR PITTSBURGH PENNSYLVANIA AND STATION LATITUDE = 40.50 DEGREES

AVERAGE MONTHLY VALUES IN INCHES FOR YEARS 1 THROUGH 5

	JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
PRECIPITATION						
TOTALS	3.33	3.14	4.20	2.96	2.68	2.99
	3.16	3.73	3.70	2.78	2.36	2.71
STD. DEVIATIONS	0.67	1.06	0.65	0.91	1.22	0.43
	1.09	1.44	2.42	1.41	0.85	1.13
RUNOFF						
TOTALS	2.407	2.049	4.295	0.767	0.331	0.495
	0.565	0.974	0.945	0.286	0.232	0.510
STD. DEVIATIONS	1.649	0.910	2.253	0.419	0.280	0.118
	0.288	0.590	0.908	0.247	0.190	0.382
EVAPOTRANSPIRATION						
TOTALS	0.479	0.494	0.547	2.838	1.964	2.229
	2.935	2.456	2.094	2.019	1.770	0.747
STD. DEVIATIONS	0.144	0.159	0.114	0.822	1.316	0.660
	0.900	0.710	0.826	0.844	0.139	0.274
LATERAL DRAINAGE COLLECTED FROM LAYER 3						
TOTALS	0.0001	0.0213	0.3553	1.1584	0.0044	0.0111
	0.0704	0.2049	0.3250	0.4750	0.4112	0.3126
STD. DEVIATIONS	0.0002	0.0476	0.7944	0.0258	0.0043	0.0103
	0.0816	0.2848	0.4293	0.6761	0.3988	0.1948
PERCOLATION/LEAKAGE THROUGH LAYER 5						
TOTALS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
STD. DEVIATIONS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000

AVERAGES OF MONTHLY AVERAGED DAILY HEADS (INCHES)

DAILY AVERAGE HEAD ON TOP OF LAYER 4						
AVERAGES	0.0000	0.0018	0.0272	0.0916	0.0003	0.0009
	0.0054	0.0157	0.0257	0.0363	0.0325	0.0239
STD. DEVIATIONS	0.0000	0.0040	0.0608	0.0020	0.0003	0.0008
	0.0062	0.0218	0.0339	0.0517	0.0315	0.0149

AVERAGE ANNUAL TOTALS & (STD. DEVIATIONS) FOR YEARS 1 THROUGH 5

	INCHES	CU. FEET	PERCENT
PRECIPITATION	37.74 (0.555)	136996.2	100.00
RUNOFF	13.855 (2.0652)	50295.28	36.713
EVAPOTRANSPIRATION	20.570 (1.7276)	74669.06	54.504
LATERAL DRAINAGE COLLECTED FROM LAYER 3	3.34977 (1.47025)	12159.682	8.87593
PERCOLATION/LEAKAGE THROUGH LAYER 5	0.00001 (0.00000)	0.039	0.00003
AVERAGE HEAD ON TOP OF LAYER 4	0.022 (0.009)		

CHANGE IN WATER STORAGE	-0.035	(1.2084)	-127.86	-0 093

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PEAK DAILY VALUES FOR YEARS 1 THROUGH 5

	(INCHES)	(CU. FT.)
PRECIPITATION	1.97	7151.100
RUNOFF	3.196	11602.6523
DRAINAGE COLLECTED FROM LAYER 3	0.14981	543.81305
PERCOLATION/LEAKAGE THROUGH LAYER 5	0.000000	0.00147
AVERAGE HEAD ON TOP OF LAYER 4	0.355	
MAXIMUM HEAD ON TOP OF LAYER 4	0.711	
LOCATION OF MAXIMUM HEAD IN LAYER 3 (DISTANCE FROM DRAIN)	0.0 FEET	
SNOW WATER	4.87	17677.5410

MAXIMUM VEG. SOIL WATER (VOL/VOL)	0.4636
MINIMUM VEG. SOIL WATER (VOL/VOL)	0.1767

*** Maximum heads are computed using McEnroe's equations. ***

Reference: Maximum Saturated Depth over Landfill Liner
by Bruce M. McEnroe, University of Kansas
ASCE Journal of Environmental Engineering
Vol. 119, No. 2, March 1993, pp. 262-270.

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FINAL WATER STORAGE AT END OF YEAR 5

LAYER	(INCHES)	(VOL/VOL)
1	1.9953	0.3326
2	35.5570	0.2963
3	0.3914	0.0326
4	0.0000	0.0000
5	15.3720	0.4270
SNOW WATER	0.000	

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0.1 cm/sec aggregate
100-ft waste-floor

HYDROLOGIC EVALUATION OF LANDFILL PERFORMANCE
HELP MODEL VERSION 3.07 (1 NOVEMBER 1997)
DEVELOPED BY ENVIRONMENTAL LABORATORY
USAE WATERWAYS EXPERIMENT STATION
FOR USEPA RISK REDUCTION ENGINEERING LABORATORY

PRECIPITATION DATA FILE:	C:\HELP3\ALCE\APEX4.D4
TEMPERATURE DATA FILE:	C:\HELP3\ALCE\APEX7.D7
SOLAR RADIATION DATA FILE:	C:\HELP3\ALCE\APEX13.D13
EVAPOTRANSPIRATION DATA:	C:\HELP3\ALCE\APEX11.D11
SOIL AND DESIGN DATA FILE:	C:\HELP3\ALCE\5FL100.D10
OUTPUT DATA FILE:	C:\HELP3\ALCE\5FL1000.OUT

TIME: 16: 9 DATE: 10/20/2011

TITLE: Apex Landfill Contiguous Expansion, Profile 5, Floor

NOTE: INITIAL MOISTURE CONTENT OF THE LAYERS AND SNOW WATER WERE COMPUTED AS NEARLY STEADY-STATE VALUES BY THE PROGRAM.

LAYER 1

TYPE 1 - VERTICAL PERCOLATION LAYER
MATERIAL TEXTURE NUMBER 12

THICKNESS	=	6.00 INCHES
POROSITY	=	0.4710 VOL/VOL
FIELD CAPACITY	=	0.3420 VOL/VOL
WILTING POINT	=	0.2100 VOL/VOL
INITIAL SOIL WATER CONTENT	=	0.4424 VOL/VOL
EFFECTIVE SAT. HYD. COND.	=	0.419999997000E-04 CM/SEC

LAYER 2

TYPE 1 - VERTICAL PERCOLATION LAYER
MATERIAL TEXTURE NUMBER 18

THICKNESS	=	1200.00 INCHES
POROSITY	=	0.6710 VOL/VOL
FIELD CAPACITY	=	0.2920 VOL/VOL
WILTING POINT	=	0.0770 VOL/VOL
INITIAL SOIL WATER CONTENT	=	0.2920 VOL/VOL
EFFECTIVE SAT. HYD. COND.	=	0.100000005000E-02 CM/SEC

LAYER 3

TYPE 2 - LATERAL DRAINAGE LAYER
MATERIAL TEXTURE NUMBER 0

THICKNESS	=	12.00 INCHES
POROSITY	=	0.3970 VOL/VOL
FIELD CAPACITY	=	0.0320 VOL/VOL
WILTING POINT	=	0.0130 VOL/VOL
INITIAL SOIL WATER CONTENT	=	0.0720 VOL/VOL
EFFECTIVE SAT. HYD. COND.	=	0.100000001000 CM/SEC
SLOPE	=	3.00 PERCENT
DRAINAGE LENGTH	=	840.0 FEET

LAYER 4

TYPE 4 - FLEXIBLE MEMBRANE LINER
MATERIAL TEXTURE NUMBER 35

THICKNESS	=	0.06 INCHES
POROSITY	=	0.0000 VOL/VOL
FIELD CAPACITY	=	0.0000 VOL/VOL
WILTING POINT	=	0.0000 VOL/VOL
INITIAL SOIL WATER CONTENT	=	0.0000 VOL/VOL
EFFECTIVE SAT. HYD. COND.	=	0.199999996000E-12 CM/SEC
FML PINHOLE DENSITY	=	1.00 HOLES/ACRE
FML INSTALLATION DEFECTS	=	1.00 HOLES/ACRE
FML PLACEMENT QUALITY	=	3 - GOOD

LAYER 5

TYPE 3 - BARRIER SOIL LINER
MATERIAL TEXTURE NUMBER 16

THICKNESS	=	36.00 INCHES
POROSITY	=	0.4270 VOL/VOL
FIELD CAPACITY	=	0.4180 VOL/VOL
WILTING POINT	=	0.3670 VOL/VOL
INITIAL SOIL WATER CONTENT	=	0.4270 VOL/VOL
EFFECTIVE SAT. HYD. COND.	=	0.100000001000E-06 CM/SEC

GENERAL DESIGN AND EVAPORATIVE ZONE DATA

NOTE: SCS RUNOFF CURVE NUMBER WAS COMPUTED FROM DEFAULT SOIL DATA BASE USING SOIL TEXTURE #12 WITH BARE GROUND CONDITIONS, A SURFACE SLOPE OF 3.% AND A SLOPE LENGTH OF 840. FEET.

SCS RUNOFF CURVE NUMBER	=	94.90	
FRACTION OF AREA ALLOWING RUNOFF	=	100.0	PERCENT
AREA PROJECTED ON HORIZONTAL PLANE	=	1.000	ACRES
EVAPORATIVE ZONE DEPTH	=	8.0	INCHES
INITIAL WATER IN EVAPORATIVE ZONE	=	3.247	INCHES
UPPER LIMIT OF EVAPORATIVE STORAGE	=	4.168	INCHES
LOWER LIMIT OF EVAPORATIVE STORAGE	=	1.414	INCHES
INITIAL SNOW WATER	=	0.000	INCHES
INITIAL WATER IN LAYER MATERIALS	=	369.298	INCHES
TOTAL INITIAL WATER	=	369.298	INCHES
TOTAL SUBSURFACE INFLOW	=	0.00	INCHES/YEAR

EVAPOTRANSPIRATION AND WEATHER DATA

NOTE: EVAPOTRANSPIRATION DATA WAS OBTAINED FROM PITTSBURGH PENNSYLVANIA

STATION LATITUDE	=	40.50 DEGREES
MAXIMUM LEAF AREA INDEX	=	0.00
START OF GROWING SEASON (JULIAN DATE)	=	114
END OF GROWING SEASON (JULIAN DATE)	=	288
EVAPORATIVE ZONE DEPTH	=	8.0 INCHES
AVERAGE ANNUAL WIND SPEED	=	9.20 MPH
AVERAGE 1ST QUARTER RELATIVE HUMIDITY	=	67.00 %
AVERAGE 2ND QUARTER RELATIVE HUMIDITY	=	63.00 %
AVERAGE 3RD QUARTER RELATIVE HUMIDITY	=	71.00 %
AVERAGE 4TH QUARTER RELATIVE HUMIDITY	=	70.00 %

NOTE: PRECIPITATION DATA WAS SYNTHETICALLY GENERATED USING COEFFICIENTS FOR PITTSBURGH PENNSYLVANIA

NORMAL MEAN MONTHLY PRECIPITATION (INCHES)

JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
2.86	2.40	3.58	3.28	3.54	3.30
3.83	3.31	2.80	2.49	2.34	2.57

NOTE: TEMPERATURE DATA WAS SYNTHETICALLY GENERATED USING COEFFICIENTS FOR PITTSBURGH PENNSYLVANIA

NORMAL MEAN MONTHLY TEMPERATURE (DEGREES FAHRENHEIT)

JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
26.70	28.80	38.50	50.10	59.70	68.10
72.00	70.60	64.10	52.50	41.60	31.40

NOTE: SOLAR RADIATION DATA WAS SYNTHETICALLY GENERATED USING COEFFICIENTS FOR PITTSBURGH PENNSYLVANIA AND STATION LATITUDE = 40.50 DEGREES

AVERAGE MONTHLY VALUES IN INCHES FOR YEARS 1 THROUGH 5

	JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
PRECIPITATION						
TOTALS	3.33	3.14	4.20	2.96	2.68	2.99
	3.16	3.73	3.70	2.78	2.36	2.71
STD. DEVIATIONS	0.67	1.06	0.65	0.91	1.22	0.43
	1.09	1.44	2.42	1.41	0.85	1.13
RUNOFF						
TOTALS	2.405	2.047	4.288	0.735	0.289	0.445
	0.502	0.914	0.857	0.261	0.199	0.491
STD. DEVIATIONS	1.650	0.911	2.260	0.423	0.269	0.137
	0.252	0.570	0.818	0.241	0.170	0.374
EVAPOTRANSPIRATION						
TOTALS	0.479	0.494	0.547	2.856	1.966	2.449
	2.988	2.221	2.135	2.025	1.775	0.747
STD. DEVIATIONS	0.144	0.159	0.114	0.836	1.286	0.704
	0.974	0.720	0.836	0.844	0.120	0.274
LATERAL DRAINAGE COLLECTED FROM LAYER 3						
TOTALS	0.2103	0.0380	0.2441	0.6603	0.5226	0.1128
	0.0910	0.1568	0.3416	0.4547	0.4477	0.4188
STD. DEVIATIONS	0.1691	0.0320	0.5322	0.2638	0.1767	0.0184
	0.0712	0.1391	0.1885	0.6102	0.4576	0.1374
PERCOLATION/LEAKAGE THROUGH LAYER 5						
TOTALS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
STD. DEVIATIONS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000

AVERAGES OF MONTHLY AVERAGED DAILY HEADS (INCHES)

	JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
DAILY AVERAGE HEAD ON TOP OF LAYER 4						
AVERAGES	0.3354	0.0670	0.3892	1.0881	0.8333	0.1859
	0.1451	0.2501	0.5629	0.7252	0.7378	0.6678
STD. DEVIATIONS	0.2697	0.0566	0.8486	0.4346	0.2818	0.0304
	0.1135	0.2218	0.3105	0.9730	0.7540	0.2192

AVERAGE ANNUAL TOTALS & (STD. DEVIATIONS) FOR YEARS 1 THROUGH 5

	INCHES	CU. FEET	PERCENT
PRECIPITATION	37.74 (0.555)	136996.2	100.00
RUNOFF	13.433 (2.1061)	48761.77	35.594
EVAPOTRANSPIRATION	20.681 (1.7096)	75071.98	54.799
LATERAL DRAINAGE COLLECTED FROM LAYER 3	3.69875 (1.65020)	13426.464	9.80061
PERCOLATION/LEAKAGE THROUGH LAYER 5	0.00019 (0.00008)	0.695	0.00051
AVERAGE HEAD ON TOP OF LAYER 4	0.499 (0.223)		

CHANGE IN WATER STORAGE	-0.073	(1.2276)	-264.69	-0.193

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PEAK DAILY VALUES FOR YEARS 1 THROUGH 5

	(INCHES)	(CU. FT.)
PRECIPITATION	1.97	7151.100
RUNOFF	3.196	11599.8848
DRAINAGE COLLECTED FROM LAYER 3	0.06598	239.50858
PERCOLATION/LEAKAGE THROUGH LAYER 5	0.000003	0.01112
AVERAGE HEAD ON TOP OF LAYER 4	3.262	
MAXIMUM HEAD ON TOP OF LAYER 4	6.132	
LOCATION OF MAXIMUM HEAD IN LAYER 3 (DISTANCE FROM DRAIN)	52.3 FEET	
SNOW WATER	4.87	17677.5410

MAXIMUM VEG. SOIL WATER (VOL/VOL)	0.4638
MINIMUM VEG. SOIL WATER (VOL/VOL)	0.1767

*** Maximum heads are computed using McEnroe's equations. ***

Reference: Maximum Saturated Depth over Landfill Liner
by Bruce M. McEnroe, University of Kansas
ASCE Journal of Environmental Engineering
Vol. 119, No. 2, March 1993, pp. 262-270.

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FINAL WATER STORAGE AT END OF YEAR 5

LAYER	(INCHES)	(VOL/VOL)
1	2.0043	0.3340
2	350.8893	0.2924
3	0.6677	0.0556
4	0.0000	0.0000
5	15.3720	0.4270
SNOW WATER	0.000	

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0.1 cm/sec aggregate

100-ft waste-side slope

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**                                                                      **
**              HYDROLOGIC EVALUATION OF LANDFILL PERFORMANCE            **
**                   HELP MODEL VERSION 3.07  (1 NOVEMBER 1997)         **
**                      DEVELOPED BY ENVIRONMENTAL LABORATORY           **
**                      USAE WATERWAYS EXPERIMENT STATION               **
**                   FOR USEPA RISK REDUCTION ENGINEERING LABORATORY     **
**                                                                      **
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PRECIPITATION DATA FILE:     C:\HELP3\ALCE\APEX4.D4
TEMPERATURE DATA FILE:       C:\HELP3\ALCE\APEX7.D7
SOLAR RADIATION DATA FILE:   C:\HELP3\ALCE\APEX13.D13
EVAPOTRANSPIRATION DATA:     C:\HELP3\ALCE\APEX11.D11
SOIL AND DESIGN DATA FILE:   C:\HELP3\ALCE\5SS100.D10
OUTPUT DATA FILE:            C:\HELP3\ALCE\5SS100O.OUT

TIME:  16:10     DATE:  10/20/2011
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TITLE: Apex Landfill Contiguous Expansion, Profile 5, Sideslope

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NOTE: INITIAL MOISTURE CONTENT OF THE LAYERS AND SNOW WATER WERE COMPUTED AS NEARLY STEADY-STATE VALUES BY THE PROGRAM.

LAYER 1

TYPE 1 - VERTICAL PERCOLATION LAYER
MATERIAL TEXTURE NUMBER 12

THICKNESS	=	6.00	INCHES
POROSITY	=	0.4710	VOL/VOL
FIELD CAPACITY	=	0.3420	VOL/VOL
WILTING POINT	=	0.2100	VOL/VOL
INITIAL SOIL WATER CONTENT	=	0.4430	VOL/VOL
EFFECTIVE SAT. HYD. COND.	=	0.4199999987000E-04	CM/SEC

LAYER 2

TYPE 1 - VERTICAL PERCOLATION LAYER
MATERIAL TEXTURE NUMBER 18

THICKNESS	=	1200.00	INCHES
POROSITY	=	0.6710	VOL/VOL
FIELD CAPACITY	=	0.2920	VOL/VOL
WILTING POINT	=	0.0770	VOL/VOL
INITIAL SOIL WATER CONTENT	=	0.2920	VOL/VOL
EFFECTIVE SAT. HYD. COND.	=	0.1000000050000E-02	CM/SEC

LAYER 3

TYPE 2 - LATERAL DRAINAGE LAYER
MATERIAL TEXTURE NUMBER 0

THICKNESS	=	12.00	INCHES
POROSITY	=	0.3970	VOL/VOL
FIELD CAPACITY	=	0.0320	VOL/VOL
WILTING POINT	=	0.0130	VOL/VOL
INITIAL SOIL WATER CONTENT	=	0.0320	VOL/VOL
EFFECTIVE SAT. HYD. COND.	=	0.1000000010000	CM/SEC
SLOPE	=	33.00	PERCENT
DRAINAGE LENGTH	=	400.0	FEET

LAYER 4

TYPE 4 - FLEXIBLE MEMBRANE LINER
MATERIAL TEXTURE NUMBER 35

THICKNESS	=	0.06	INCHES
POROSITY	=	0.0000	VOL/VOL
FIELD CAPACITY	=	0.0000	VOL/VOL
WILTING POINT	=	0.0000	VOL/VOL
INITIAL SOIL WATER CONTENT	=	0.0000	VOL/VOL
EFFECTIVE SAT. HYD. COND.	=	0.199999996000E-12	CM/SEC
FML PINHOLE DENSITY	=	1.00	HOLES/ACRE
FML INSTALLATION DEFECTS	=	1.00	HOLES/ACRE
FML PLACEMENT QUALITY	=	3 - GOOD	

LAYER 5

TYPE 3 - BARRIER SOIL LINER
MATERIAL TEXTURE NUMBER 16

THICKNESS	=	36.00	INCHES
POROSITY	=	0.4270	VOL/VOL
FIELD CAPACITY	=	0.4180	VOL/VOL
WILTING POINT	=	0.3670	VOL/VOL
INITIAL SOIL WATER CONTENT	=	0.4270	VOL/VOL
EFFECTIVE SAT. HYD. COND.	=	0.100000001000E-06	CM/SEC

GENERAL DESIGN AND EVAPORATIVE ZONE DATA

NOTE: SCS RUNOFF CURVE NUMBER WAS COMPUTED FROM DEFAULT SOIL DATA BASE USING SOIL TEXTURE #12 WITH BARE GROUND CONDITIONS, A SURFACE SLOPE OF 33 % AND A SLOPE LENGTH OF 400. FEET.

SCS RUNOFF CURVE NUMBER	=	95.30	
FRACTION OF AREA ALLOWING RUNOFF	=	100.0	PERCENT
AREA PROJECTED ON HORIZONTAL PLANE	=	1.000	ACRES
EVAPORATIVE ZONE DEPTH	=	8.0	INCHES
INITIAL WATER IN EVAPORATIVE ZONE	=	3.280	INCHES
UPPER LIMIT OF EVAPORATIVE STORAGE	=	4.168	INCHES
LOWER LIMIT OF EVAPORATIVE STORAGE	=	1.414	INCHES
INITIAL SNOW WATER	=	0.000	INCHES
INITIAL WATER IN LAYER MATERIALS	=	368.852	INCHES
TOTAL INITIAL WATER	=	368.852	INCHES
TOTAL SUBSURFACE INFLOW	=	0.00	INCHES/YEAR

EVAPOTRANSPIRATION AND WEATHER DATA

NOTE: EVAPOTRANSPIRATION DATA WAS OBTAINED FROM PITTSBURGH PENNSYLVANIA

STATION LATITUDE	=	40.50	DEGREES
MAXIMUM LEAF AREA INDEX	=	0.00	
START OF GROWING SEASON (JULIAN DATE)	=	114	
END OF GROWING SEASON (JULIAN DATE)	=	288	
EVAPORATIVE ZONE DEPTH	=	8.0	INCHES
AVERAGE ANNUAL WIND SPEED	=	9.20	MPH
AVERAGE 1ST QUARTER RELATIVE HUMIDITY	=	67.00	%
AVERAGE 2ND QUARTER RELATIVE HUMIDITY	=	63.00	%
AVERAGE 3RD QUARTER RELATIVE HUMIDITY	=	71.00	%
AVERAGE 4TH QUARTER RELATIVE HUMIDITY	=	70.00	%

NOTE: PRECIPITATION DATA WAS SYNTHETICALLY GENERATED USING COEFFICIENTS FOR PITTSBURGH PENNSYLVANIA

NORMAL MEAN MONTHLY PRECIPITATION (INCHES)

JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
2.86	2.40	3.58	3.28	3.54	3.30
3.83	3.31	2.80	2.49	2.34	2.57

NOTE: TEMPERATURE DATA WAS SYNTHETICALLY GENERATED USING COEFFICIENTS FOR PITTSBURGH PENNSYLVANIA

NORMAL MEAN MONTHLY TEMPERATURE (DEGREES FAHRENHEIT)

JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
26.70	28.80	38.50	50.10	59.70	68.10
72.00	70.60	64.10	52.50	41.60	31.40

NOTE: SOLAR RADIATION DATA WAS SYNTHETICALLY GENERATED USING COEFFICIENTS FOR PITTSBURGH PENNSYLVANIA AND STATION LATITUDE = 40.50 DEGREES

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AVERAGE MONTHLY VALUES IN INCHES FOR YEARS 1 THROUGH 5

	JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
PRECIPITATION						
TOTALS	3.33	3.14	4.20	2.96	2.68	2.99
	3.16	3.73	3.70	2.78	2.36	2.71
STD. DEVIATIONS	0.67	1.06	0.65	0.91	1.22	0.43
	1.09	1.44	2.42	1.41	0.85	1.13
RUNOFF						
TOTALS	2.407	2.049	4.295	0.767	0.331	0.495
	0.565	0.974	0.945	0.286	0.232	0.510
STD. DEVIATIONS	1.649	0.910	2.253	0.419	0.280	0.118
	0.288	0.590	0.908	0.247	0.190	0.382
EVAPOTRANSPIRATION						
TOTALS	0.479	0.494	0.547	2.838	1.964	2.229
	2.935	2.456	2.094	2.019	1.770	0.747
STD. DEVIATIONS	0.144	0.159	0.114	0.822	1.316	0.660
	0.900	0.710	0.826	0.844	0.139	0.274
LATERAL DRAINAGE COLLECTED FROM LAYER 3						
TOTALS	0.0002	0.0177	0.3588	1.1532	0.0096	0.0111
	0.0704	0.2047	0.3226	0.4660	0.4065	0.3288
STD. DEVIATIONS	0.0003	0.0396	0.8024	0.0255	0.0141	0.0103
	0.0816	0.2844	0.4256	0.6770	0.4111	0.1823
PERCOLATION/LEAKAGE THROUGH LAYER 5						
TOTALS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
STD. DEVIATIONS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000

AVERAGES OF MONTHLY AVERAGED DAILY HEADS (INCHES)

DAILY AVERAGE HEAD ON TOP OF LAYER 4						
AVERAGES	0.0000	0.0015	0.0274	0.0911	0.0007	0.0009
	0.0054	0.0157	0.0255	0.0356	0.0321	0.0251
STD. DEVIATIONS	0.0000	0.0034	0.0614	0.0020	0.0011	0.0008
	0.0062	0.0218	0.0336	0.0518	0.0325	0.0139

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AVERAGE ANNUAL TOTALS & (STD. DEVIATIONS) FOR YEARS 1 THROUGH 5

	INCHES	CU. FEET	PERCENT
PRECIPITATION	37.74 (0.555)	136996.2	100.00
RUNOFF	13.855 (2.0652)	50295.28	36.713
EVAPOTRANSPIRATION	20.570 (1.7276)	74669.06	54.504
LATERAL DRAINAGE COLLECTED FROM LAYER 3	3.3493 (1.4703)	12159.517	8.87581
PERCOLATION/LEAKAGE THROUGH LAYER 5	0.00001 (0.00000)	0.039	0.00003
AVERAGE HEAD ON TOP OF LAYER 4	0.022 (0.009)		

CHANGE IN WATER STORAGE	-0.035	(1.2083)	-127.68	-0.093

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PEAK DAILY VALUES FOR YEARS 1 THROUGH 5

	(INCHES)	(CU. FT.)
PRECIPITATION	1.97	7151.100
RUNOFF	3.196	11602.6523
DRAINAGE COLLECTED FROM LAYER 3	0.13573	492.71606
PERCOLATION/LEAKAGE THROUGH LAYER 5	0.000000	0.00134
AVERAGE HEAD ON TOP OF LAYER 4	0.322	
MAXIMUM HEAD ON TOP OF LAYER 4	0.653	
LOCATION OF MAXIMUM HEAD IN LAYER 3 (DISTANCE FROM DRAIN)	0.0 FEET	
SNOW WATER	4.87	17677.5410

MAXIMUM VEG. SOIL WATER (VOL/VOL)	0.4636
MINIMUM VEG. SOIL WATER (VOL/VOL)	0.1767

*** Maximum heads are computed using McEnroe's equations. ***

Reference: Maximum Saturated Depth over Landfill Liner
by Bruce M. McEnroe, University of Kansas
ASCE Journal of Environmental Engineering
Vol. 119, No. 2, March 1993, pp 262-270.

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FINAL WATER STORAGE AT END OF YEAR 5

LAYER	(INCHES)	(VOL/VOL)
1	1.9953	0.3326
2	350.9170	0.2924
3	0.3919	0.0327
4	0.0000	0.0000
5	15.3720	0.4270
SNOW WATER	0.000	

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0.1 cm/sec aggregate final cover conditions

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**          HYDROLOGIC EVALUATION OF LANDFILL PERFORMANCE           **
**             HELP MODEL VERSION 3.07 (1 NOVEMBER 1997)            **
**              DEVELOPED BY ENVIRONMENTAL LABORATORY               **
**           USAE WATERWAYS EXPERIMENT STATION                      **
**          FOR USEPA RISK REDUCTION ENGINEERING LABORATORY         **
**                                                                  **
**                                                                  **
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PRECIPITATION DATA FILE:     C:\HELP3\ALCE\APEX4-2.D4
TEMPERATURE DATA FILE:       C:\HELP3\ALCE\APEX7-2.D7
SOLAR RADIATION DATA FILE:   C:\HELP3\ALCE\APEX13-2.D13
EVAPOTRANSPIRATION DATA:     C:\HELP3\ALCE\APEX11-2.D11
SOIL AND DESIGN DATA FILE:   C:\HELP3\ALCE\6FL4500.D10
OUTPUT DATA FILE:            C:\HELP3\ALCE\6FL4500O.OUT

TIME:  16:11     DATE:  10/20/2011

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     TITLE:  Apex Landfill Contiguous Expansion, Profile 6, Floor

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     NOTE:  INITIAL MOISTURE CONTENT OF THE LAYERS AND SNOW WATER WERE
            COMPUTED AS NEARLY STEADY-STATE VALUES BY THE PROGRAM.

                                LAYER  1
                                --------

                TYPE 1 - VERTICAL PERCOLATION LAYER
                    MATERIAL TEXTURE NUMBER  12
     THICKNESS                    =     30.00   INCHES
     POROSITY                     =      0.4710 VOL/VOL
     FIELD CAPACITY               =      0.3420 VOL/VOL
     WILTING POINT                =      0.2100 VOL/VOL
     INITIAL SOIL WATER CONTENT   =      0.3896 VOL/VOL
     EFFECTIVE SAT. HYD. COND.    =  0.419999997000E-04 CM/SEC
     NOTE:  SATURATED HYDRAULIC CONDUCTIVITY IS MULTIPLIED BY  4.63
            FOR ROOT CHANNELS IN TOP HALF OF EVAPORATIVE ZONE.

                                LAYER  2
                                --------

                TYPE 2 - LATERAL DRAINAGE LAYER
                    MATERIAL TEXTURE NUMBER   0
     THICKNESS                    =      0.30   INCHES
     POROSITY                     =      0.8500 VOL/VOL
     FIELD CAPACITY               =      0.0100 VOL/VOL
     WILTING POINT                =      0.0050 VOL/VOL
     INITIAL SOIL WATER CONTENT   =      0.0129 VOL/VOL
     EFFECTIVE SAT. HYD. COND.    =  3.210000040000     CM/SEC
     SLOPE                        =     33.00   PERCENT
     DRAINAGE LENGTH              =    195.0    FEET

                                LAYER  3
                                --------

                TYPE 4 - FLEXIBLE MEMBRANE LINER
                    MATERIAL TEXTURE NUMBER  35
     THICKNESS                    =      0.04   INCHES
     POROSITY                     =      0.0000 VOL/VOL
     FIELD CAPACITY               =      0.0000 VOL/VOL
     WILTING POINT                =      0.0000 VOL/VOL
     INITIAL SOIL WATER CONTENT   =      0.0000 VOL/VOL
     EFFECTIVE SAT. HYD. COND.    =  0.199999996000E-12 CM/SEC
     FML PINHOLE DENSITY          =      1.00   HOLES/ACRE
     FML INSTALLATION DEFECTS     =      1.00   HOLES/ACRE
     FML PLACEMENT QUALITY        =  3 - GOOD

                                LAYER  4
                                --------

                TYPE 3 - BARRIER SOIL LINER
                    MATERIAL TEXTURE NUMBER   0
     THICKNESS                    =     18.00   INCHES
     POROSITY                     =      0.4270 VOL/VOL
     FIELD CAPACITY               =      0.4180 VOL/VOL
     WILTING POINT                =      0.3670 VOL/VOL
     INITIAL SOIL WATER CONTENT   =      0.4270 VOL/VOL
     EFFECTIVE SAT. HYD. COND.    =  0.999999997000E-06 CM/SEC

                                LAYER  5
                                --------

                TYPE 1 - VERTICAL PERCOLATION LAYER
                    MATERIAL TEXTURE NUMBER  12
     THICKNESS                    =     12.00   INCHES
     POROSITY                     =      0.4710 VOL/VOL
     FIELD CAPACITY               =      0.3420 VOL/VOL
     WILTING POINT                =      0.2100 VOL/VOL
     INITIAL SOIL WATER CONTENT   =      0.3420 VOL/VOL
     EFFECTIVE SAT. HYD. COND.    =  0.419999997000E-04 CM/SEC

                                LAYER  6
                                --------

                TYPE 1 - VERTICAL PERCOLATION LAYER
                    MATERIAL TEXTURE NUMBER  18
     THICKNESS                    =   4500.00   INCHES
     POROSITY                     =      0.6710 VOL/VOL
     FIELD CAPACITY               =      0.2920 VOL/VOL
     WILTING POINT                =      0.0770 VOL/VOL
     INITIAL SOIL WATER CONTENT   =      0.2920 VOL/VOL
     EFFECTIVE SAT. HYD. COND.    =  0.100000005000E-02 CM/SEC

                                LAYER  7
                                --------

                TYPE 2 - LATERAL DRAINAGE LAYER
                    MATERIAL TEXTURE NUMBER   0
     THICKNESS                    =     12.00   INCHES
     POROSITY                     =      0.3970 VOL/VOL
     FIELD CAPACITY               =      0.0320 VOL/VOL
     WILTING POINT                =      0.0130 VOL/VOL
     INITIAL SOIL WATER CONTENT   =      0.0320 VOL/VOL
     EFFECTIVE SAT. HYD. COND.    =  0.100000001000     CM/SEC
     SLOPE                        =      3.00   PERCENT
     DRAINAGE LENGTH              =    840.0    FEET

                                LAYER  8
                                --------

                TYPE 4 - FLEXIBLE MEMBRANE LINER
                    MATERIAL TEXTURE NUMBER  35
     THICKNESS                    =      0.06   INCHES
     POROSITY                     =      0.0000 VOL/VOL
     FIELD CAPACITY               =      0.0000 VOL/VOL
     WILTING POINT                =      0.0000 VOL/VOL
     INITIAL SOIL WATER CONTENT   =      0.0000 VOL/VOL
     EFFECTIVE SAT. HYD. COND.    =  0.199999996000E-12 CM/SEC
     FML PINHOLE DENSITY          =      1.00   HOLES/ACRE
     FML INSTALLATION DEFECTS     =      1.00   HOLES/ACRE
     FML PLACEMENT QUALITY        =  3 - GOOD

                                LAYER  9
                                --------

                TYPE 3 - BARRIER SOIL LINER
                    MATERIAL TEXTURE NUMBER  16
     THICKNESS                    =     36.00   INCHES
     POROSITY                     =      0.4270 VOL/VOL
     FIELD CAPACITY               =      0.4180 VOL/VOL
     WILTING POINT                =      0.3670 VOL/VOL
     INITIAL SOIL WATER CONTENT   =      0.4270 VOL/VOL
     EFFECTIVE SAT. HYD. COND.    =  0.100000001000E-06 CM/SEC

                    GENERAL DESIGN AND EVAPORATIVE ZONE DATA
                    ----------------------------------------

     NOTE:  SCS RUNOFF CURVE NUMBER WAS COMPUTED FROM A USER-
            SPECIFIED CURVE NUMBER OF 77.0, A SURFACE SLOPE
            OF 33.% AND A SLOPE LENGTH OF  195. FEET.

     SCS RUNOFF CURVE NUMBER             =     79.50
     FRACTION OF AREA ALLOWING RUNOFF    =    100.0    PERCENT
     AREA PROJECTED ON HORIZONTAL PLANE  =      1.000  ACRES
     EVAPORATIVE ZONE DEPTH              =     12.0    INCHES
     INITIAL WATER IN EVAPORATIVE ZONE   =      5.170  INCHES
     UPPER LIMIT OF EVAPORATIVE STORAGE  =      5.652  INCHES
     LOWER LIMIT OF EVAPORATIVE STORAGE  =      2.520  INCHES
     INITIAL SNOW WATER                  =      0.000  INCHES
     INITIAL WATER IN LAYER MATERIALS    =   1353.237  INCHES
     TOTAL INITIAL WATER                 =   1353.237  INCHES
     TOTAL SUBSURFACE INFLOW             =      0.00   INCHES/YEAR

                    EVAPOTRANSPIRATION AND WEATHER DATA
                    -----------------------------------

     NOTE:  EVAPOTRANSPIRATION DATA WAS OBTAINED FROM
            PITTSBURGH                PENNSYLVANIA

          STATION LATITUDE                =  40.50 DEGREES
          MAXIMUM LEAF AREA INDEX         =   3.50
          START OF GROWING SEASON (JULIAN DATE) =  114
          END OF GROWING SEASON (JULIAN DATE)   =  288
          EVAPORATIVE ZONE DEPTH          =  12.0  INCHES
          AVERAGE ANNUAL WIND SPEED       =   9.20 MPH
          AVERAGE 1ST QUARTER RELATIVE HUMIDITY =  67.00 %
          AVERAGE 2ND QUARTER RELATIVE HUMIDITY =  63.00 %
          AVERAGE 3RD QUARTER RELATIVE HUMIDITY =  71.00 %
          AVERAGE 4TH QUARTER RELATIVE HUMIDITY =  70.00 %

     NOTE:  PRECIPITATION DATA WAS SYNTHETICALLY GENERATED USING
            COEFFICIENTS FOR    PITTSBURGH              PENNSYLVANIA

                NORMAL MEAN MONTHLY PRECIPITATION (INCHES)

     JAN/JUL    FEB/AUG    MAR/SEP    APR/OCT    MAY/NOV    JUN/DEC
     -------    -------    -------    -------    -------    -------
        2.86       2.40       3.58       3.28       3.54       3.30
        3.83       3.31       2.80       2.49       2.34       2.57

     NOTE:  TEMPERATURE DATA WAS SYNTHETICALLY GENERATED USING
            COEFFICIENTS FOR    PITTSBURGH              PENNSYLVANIA

                NORMAL MEAN MONTHLY TEMPERATURE (DEGREES FAHRENHEIT)

     JAN/JUL    FEB/AUG    MAR/SEP    APR/OCT    MAY/NOV    JUN/DEC
     -------    -------    -------    -------    -------    -------
       26.70      28.80      38.50      50.10      59.70      68.10
       72.00      70.60      64.10      52.50      41.60      31.40

     NOTE:  SOLAR RADIATION DATA WAS SYNTHETICALLY GENERATED USING
            COEFFICIENTS FOR    PITTSBURGH              PENNSYLVANIA
              AND STATION LATITUDE =  40.50 DEGREES

**********************************************************************

          AVERAGE MONTHLY VALUES IN INCHES FOR YEARS    1 THROUGH  100
------------------------------------------------------------------------------

                        JAN/JUL    FEB/AUG    MAR/SEP    APR/OCT    MAY/NOV    JUN/DEC
                        -------    -------    -------    -------    -------    -------
PRECIPITATION
-------------
  TOTALS                  2.88       2.32       3.65       3.47       3.44       3.30
                          3.84       3.44       2.68       2.56       2.43       2.71

  STD. DEVIATIONS         1.10       0.89       1.06       1.28       1.56       1.20
                          1.61       1.77       1.45       1.23       0.95       1.00

RUNOFF
------
  TOTALS                  0.871      1.783      3.115      0.303      0.026      0.017
                          0.055      0.090      0.026      0.012      0.015      0.143
```

STD. DEVIATIONS	1.053	1.322	1.825	0.613	0.086	0.052
	0.185	0.290	0.086	0.042	0.111	0.451
EVAPOTRANSPIRATION						
TOTALS	0.600	0.479	1.009	3.429	3.429	3.302
	3.540	3.065	2.115	1.494	1.167	0.804
STD. DEVIATIONS	0.152	0.134	0.567	0 638	1.271	1.159
	1.235	1.236	0.967	0.373	0.191	0.194
LATERAL DRAINAGE COLLECTED FROM LAYER 2						
TOTALS	0.5643	0.0578	0.5891	1.2900	0.4419	0.1504
	0.1194	0.1976	0.2839	0.3632	0.6796	1.0755
STD. DEVIATIONS	0.6129	0.1484	0.7082	0.6718	0.4081	0.3366
	0.3536	0.3364	0.4959	0.5385	0.7096	0.8335
PERCOLATION/LEAKAGE THROUGH LAYER 4						
TOTALS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
STD. DEVIATIONS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	0.0000	0.0000	0 0000	0.0000	0.0000	0.0000
LATERAL DRAINAGE COLLECTED FROM LAYER 7						
TOTALS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
STD. DEVIATIONS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
PERCOLATION/LEAKAGE THROUGH LAYER 9						
TOTALS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	0.0000	0 0000	0.0000	0.0000	0.0000	0.0000
STD. DEVIATIONS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000

AVERAGES OF MONTHLY AVERAGED DAILY HEADS (INCHES)

DAILY AVERAGE HEAD ON TOP OF LAYER 3						
AVERAGES	0.0007	0.0001	0.0007	0.0016	0.0005	0.0002
	0 0002	0.0002	0.0003	0.0004	0.0008	0.0013
STD. DEVIATIONS	0 0007	0.0002	0.0008	0.0008	0.0005	0.0004
	0 0004	0.0004	0 0006	0.0006	0.0009	0.0010
DAILY AVERAGE HEAD ON TOP OF LAYER 8						
AVERAGES	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	0.0000	0.0000	0 0000	0.0000	0.0000	0.0000
STD. DEVIATIONS	0.0000	0.0000	0 0000	0.0000	0.0000	0.0000
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000

AVERAGE ANNUAL TOTALS & (STD. DEVIATIONS) FOR YEARS 1 THROUGH 100

	INCHES		CU. FEET	PERCENT
PRECIPITATION	36.72	(4.356)	133299.0	100.00
RUNOFF	6.458	(2.3716)	23441.76	17.586
EVAPOTRANSPIRATION	24.432	(2.8393)	88687.73	66.533
LATERAL DRAINAGE COLLECTED FROM LAYER 2	5.83268	(2.11969)	21172.633	15 88356
PERCOLATION/LEAKAGE THROUGH LAYER 4	0.00000	(0.00000)	0.011	0 00001
AVERAGE HEAD ON TOP OF LAYER 3	0.001	(0 000)		
LATERAL DRAINAGE COLLECTED FROM LAYER 7	0.00000	(0.00000)	0.006	0.00000
PERCOLATION/LEAKAGE THROUGH LAYER 9	0.00000	(0 00000)	0.005	0.00000
AVERAGE HEAD ON TOP OF LAYER 8	0.000	(0.000)		
CHANGE IN WATER STORAGE	-0.001	(1.0768)	-3.08	-0.002

PEAK DAILY VALUES FOR YEARS 1 THROUGH 100

	(INCHES)	(CU. FT.)
PRECIPITATION	4.44	16117.200
RUNOFF	4.029	14626.5137
DRAINAGE COLLECTED FROM LAYER 2	0.93012	3376.32837
PERCOLATION/LEAKAGE THROUGH LAYER 4	0.000000	0.00089
AVERAGE HEAD ON TOP OF LAYER 3	0.033	
MAXIMUM HEAD ON TOP OF LAYER 3	0.090	
LOCATION OF MAXIMUM HEAD IN LAYER 2 (DISTANCE FROM DRAIN)	0.0 FEET	
DRAINAGE COLLECTED FROM LAYER 7	0.00000	0.00014
PERCOLATION/LEAKAGE THROUGH LAYER 9	0.000000	0.00002
AVERAGE HEAD ON TOP OF LAYER 8	0.000	
MAXIMUM HEAD ON TOP OF LAYER 8	0.195	
LOCATION OF MAXIMUM HEAD IN LAYER 7 (DISTANCE FROM DRAIN)	0.0 FEET	
SNOW WATER	5.36	19474.3164

MAXIMUM VEG. SOIL WATER (VOL/VOL)	0.4677
MINIMUM VEG. SOIL WATER (VOL/VOL)	0.2100

*** Maximum heads are computed using McEnroe's equations. ***

Reference: Maximum Saturated Depth over Landfill Liner
by Bruce M. McEnroe, University of Kansas
ASCE Journal of Environmental Engineering
Vol. 119, No. 2, March 1993, pp. 262-270.

FINAL WATER STORAGE AT END OF YEAR 100

LAYER	(INCHES)	(VOL/VOL)
1	11.5876	0.3863
2	0.0033	0.0111
3	0.0000	0.0000
4	7.6860	0.4270
5	4.1040	0.3420
6	1314.0000	0.2920
7	0.3840	0.0320
8	0.0000	0.0000
9	15.3720	0.4270
SNOW WATER	0.015	

OBJECTIVE

In lieu of placement of leachate collection piping at the toe of the slope between the proposed expansion and the existing landfill, the volume of leachate that will accumulate on the cell floor ~~of Phase 8~~ will be estimated to demonstrate that the leachate head does not exceed 12 inches in accordance with OAC 3745-27-08 (C)(3)(c).

The calculation of the volume of leachate on the cell floor accounts for both the flow to the cell floor from the sideslopes and accumulation on the cell floor. Thus, the volume on the cell floor is the worst case scenario and the volume on the sideslopes is not presented in this calculation.

METHODOLOGY

Calculate the depth of leachate on the cell floor for the leachate collection system option with aggregate. Determine if the depth of leachate is less than 12 inches. *The worst case scenario that will be considered is within Phase 8, where the maximum horizontal drainage length before the liquid is intercepted by a pipe is 250 feet on the floor and 70 feet on the sideslope.*

CALCULATIONS

For the aggregate drainage layer with a permeability of 0.01 cm/sec, the worst-case impingement rate was assumed to be 3.622 on the floor and 3.371 on the sideslope. For the aggregate drainage layer with a permeability of 0.1 cm/sec, the worst-case impingement rate was assumed to be 3.699 on the floor and 3.350 on the sideslope. These values are presented in the Leachate Generation Calculation included in Section (C)(5)(c).

AGGREGATE DRAINAGE LAYER (Permeability 0.01 cm/sec)

Floor Impingement Rate

$$\frac{3.622 \text{ inches}}{\text{year}} * \frac{\text{year}}{365 \text{ days}} * \frac{\text{day}}{24 \text{ hours}} * \frac{\text{hours}}{60 \text{ minutes}} * \frac{\text{minutes}}{60 \text{ seconds}} * \frac{2.54 \text{ cm}}{\text{inch}}$$

$3.622 \text{ inches/year} = 2.92 \times 10^{-7} \text{ cm/s}$

Sideslope Impingement Rate

$$\frac{3.371 \text{ inches}}{\text{year}} * \frac{\text{year}}{365 \text{ days}} * \frac{\text{day}}{24 \text{ hours}} * \frac{\text{hours}}{60 \text{ minutes}} * \frac{\text{minutes}}{60 \text{ seconds}} * \frac{2.54 \text{ cm}}{\text{inch}}$$

$3.371 \text{ inches/year} = 2.72 \times 10^{-7} \text{ cm/s}$

Additionally, the required hydraulic conductivity of the aggregate is 0.01 cm/s.

According to Reference 1, the shape of the liquid surface depends on a dimensionless parameter, λ, called the "characteristic parameter". The characteristic parameter can be determined as follows:

$\lambda = q_h / (k * \tan^2\beta)$, where
q_h is the impingement rate
k is the hydraulic conductivity of the liquid collection material in the direction of flow
β is the slope angle in degrees

Using this equation, the characteristic parameter of the sideslope and floor can be determined.

Floor Characteristic Parameter

Note that the slope of the floor is 3 percent ($\beta = 1.718$ degrees), therefore:

$$\lambda_{floor} = q_h / (k * \tan^2\beta) = (2.92 \times 10^{-7} \text{ cm/s}) / (0.01 \text{ cm/s} * (\tan(1.718))^2) = 0.032$$

Sideslope Characteristic Parameter

Note that the slope of the sideslope is 3H:1V, which is 33 percent ($\beta = 18.43$ degrees), therefore:

$$\lambda_{SS} = q_h / (k * \tan^2\beta) = (2.72 \times 10^{-7} \text{ cm/s}) / (0.01 \text{ cm/s} * (\tan(18.43))^2) = 2.45 \times 10^{-4}$$

The thickness of the liquid surface also depends on a dimensionless parameter, j, called the "modifying factor". The modifying factor can be determined as follows:

$$j = 1 - 0.12 \exp\{-[\log(8*\lambda/5)^{5/8})^2]\}$$

Using this equation, the modifying factor of the sideslope and floor can be determined.

Floor Modifying Factor

$$j_{floor} = 1 - 0.12 \exp\{-[\log(8*\lambda/5)^{5/8})^2]\} = 1 - 0.12 \exp\{-[\log(8*(0.032/5)^{5/8})^2]\}$$

$$j_{floor} = 0.937$$

Sideslope Modifying Factor

$j_{SS} = 1 - 0.12 \exp\{-[\log(8*\lambda/5)^{5/8})^2]\} = 1 - 0.12 \exp\{-[\log(8*((2.45 \times 10^{-4})/5)^{5/8})^2]\}$

$j_{SS} = 0.999$

Using the characteristic parameters and modifying factors for the floor and the sideslope, the maximum thickness of liquid can be determined. According to Reference 1, regardless of the shape of the liquid surface, the maximum liquid thickness, t_{max}, in the leachate collection layer can be determined using the following equation:

$t_{max} = j * [(\sqrt{(\tan^2\beta + 4*q_h/k)} - \tan\beta)/(2*\cos(\tan^{-1}(\beta))] * L$

where L is the horizontal length that the flow travels before being intercepted by a pipe.
Using this equation, the maximum liquid thickness on the floor and the sideslope can be determined.

Floor Maximum Liquid Thickness

Note that the maximum horizontal length before the liquid is intercepted by a pipe on the floor is ~~220~~ *250* feet, which equates to ~~67.1~~ *76.2* meters.

$t_{maxfloor} = j * [(\sqrt{(\tan^2\beta + 4*q_h/k)} - \tan\beta)/(2*\cos(\beta)] * L$

~~$t_{maxfloor} = 0.937 [(\sqrt{((0.03^2 + (4*2.92 \times 10^{-7}\ cm/s / 0.01 cm/s)) - 0.03)/(2*\cos(1.718)] * 67.1$~~

~~$= 0.059$ meters $= 5.9$ cm $= 2.3$ inches~~

$t_{maxfloor} = 0.937 [(\sqrt{((0.03^2 + (4*2.92 \times 10^{-7}\ cm/s / 0.01 cm/s)) - 0.03)/(2*\cos(1.718)] * 76.2$

$= 0.067$ meters $= 6.7$ cm $= 2.6$ inches

Sideslope Maximum Liquid Thickness

Note that the maximum horizontal length before the liquid is intercepted by a pipe on the ~~floor~~ *sideslope* is ~~140~~ *70* feet, which equates to ~~42.7~~ *21.3* meters.

$t_{maxsideslope} = j * [(\sqrt{(\tan^2\beta + 4*q_h/k)} - \tan\beta)/(2*\cos(\tan^{-1}(\beta))] * L$

~~$t_{maxsideslope} = 0.999 [(\sqrt{((0.33^2 + (4*2.72 \times 10^{-7}\ cm/s / 0.01 cm/s)) - 0.33)/(2*\cos(18.46)] * 42.7$~~

~~= 0.0037 meters = 0.37 cm = 0.15 inches~~

$t_{maxsideslope} = 0.999\ [(\sqrt{((0.33^2 + (4*2.72 \times 10^{-7}\ cm/s / 0.01 cm/s)) - 0.33)/(2*\cos(18.46)]} * 21.3$

$= 0.0018\ meters = 0.18\ cm = 0.07\ inches$

According to Reference 1, maximum flow on the floor can be approximated by adding the maximum thickness of on the floor and sideslope.

~~$t_{maxfloor} + t_{maxsideslope} = 2.3$ inches + 0.15 inches~~

~~t = 2.5 inches~~

$t_{maxfloor} + t_{maxsideslope} = 2.6\ inches + 0.07\ inches$

$t = 2.7\ inches$

AGGREGATE DRAINAGE LAYER (Permeability 0.1 cm/sec)

The worst-case impingment rates for the aggregate drainage layer with a permeability of 0.1 cm/sec are similar to those of the aggregate drainage layer with a permeability of 0.01 cm/sec, therefore, the maximum leachate thickness will be similar.

CONCLUSIONS

In accordance with OAC 3745-27-08 (C)(3)(c), the calculation indicates less than 12 inches of leachate will accumulate on the floor of the baseliner system due to both the flow to the cell floor from the sideslopes and accumulation on the floor.

REFERENCES

1. Giroud, J.P., et al., Hydraulic Design of Geosynthetic and Granular Liquid Collection Layers Comprising Two Different Slopes. Geosynthetics International, 2000.

OBJECTIVE

The volume of leachate that will flow to the sumps of the proposed expansion will be estimated to size leachate pumps.

METHODOLOGY

The leachate generation volumes estimated in the Leachate Generation Calculation presented in Section (C)(5)(c) will be used to estimate the volume of leachate flowing to the sumps.

CALCULATION

As presented in the Leachate Generation Calculation, the HELP Model was utilized to estimate the volume of leachate generated in the proposed expansion considering the leachate collection layer aggregates, which do not include a geocomposite.

For the aggregate with a permeability of 0.01cm/sec, the calculation estimated a maximum daily flow rate of 1,617 gallons per acre per day (gal/acre/day) for a waste thickness of 100 feet on the floor. The calculation estimated a maximum daily flow rate of 1,505 gal/acre/day for a waste thickness of 100 feet on the sideslope.

For the aggregate with a permeability of 0.1 cm/sec, the calculation estimated a maximum daily flow rate of 1,651 gal/acre/day for a waste thickness of 100 feet on the floor. The calculation estimated a maximum daily flow rate of 1,496 gal/acre/day for a waste thickness of 100 feet on the sideslope. For post closure conditions, the estimated daily flow was 0 gal/acre/day.

SUMP INFILTRATION ESTIMATION

The contributing areas and estimated flows are shown in the table below for the sumps of the proposed expansion. Calculations are based on a waste depth of 100 feet for floor and sideslopes (worst case scenario).

AGGREGATE (Permeability 0.01 cm/sec) PHASE 8/*PHASE 9* SUMP

Contributing Area	Daily Flow Rate (gal/acre/day)	Contributing Acreage (acres)	Daily Flow Rate (gal/day)
Phase 8 Floor	1,617	~~10.0~~ *20.6*	~~16,170~~ *33,310*
Phase 8 Sideslope	1,505	~~12.2~~ *2.7*	~~18,361~~ *4,064*
Phase 9 Floor	*1,617*	*16.2*	*26,195*
	PHASE 8 SUMP TOTAL		~~34,531~~ *63,569*

~~AGGREGATE (Permeability 0.01 cm/sec) PHASE 9 SUMP~~

~~Contributing Area~~	~~Daily Flow Rate (gal/acre/day)~~	~~Contributing Acreage (acres)~~	~~Daily Flow Rate (gal/day)~~
~~Phase 9 Floor~~	~~1,617~~	~~12.4~~	~~20,051~~
~~Phase 9 Sideslope~~	~~1,505~~	~~18.0~~	~~27,090~~
	~~PHASE 9 SUMP TOTAL~~		~~47,141~~

AGGREGATE (Permeability 0.01 cm/sec) PHASE 10 SUMP

Contributing Area	Daily Flow Rate (gal/acre/day)	Contributing Acreage (acres)	Daily Flow Rate (gal/day)
Phase 10 Floor	1,617	~~20.4~~ *19.4*	~~32,987~~ *31,370*
Phase 10 Sideslope	1,505	~~10.3~~ *13.7*	~~15,502~~ *20,619*
	PHASE 10 SUMP TOTAL		~~48,489~~ *51,989*

AGGREGATE (Permeability 0.01 cm/sec) PHASE 11 SUMP

Contributing Area	Daily Flow Rate (gal/acre/day)	Contributing Acreage (acres)	Daily Flow Rate (gal/day)
Phase 11 Floor	1,617	~~15.2~~ *16.7*	~~24,578~~ *27,004*
Phase 11 Sideslope	1,505	~~5.4~~ *15.1*	~~8,127~~ *22,726*
	PHASE 11 SUMP TOTAL		~~32,705~~ *49,730*

AGGREGATE (Permeability 0.01 cm/sec) PHASE 12 SUMP

Contributing Area	Daily Flow Rate (gal/acre/day)	Contributing Acreage (acres)	Daily Flow Rate (gal/day)
Phase 12 Floor	1,617	~~19.4~~ *17.0*	~~31,370~~ *27,489*
Phase 12 Sideslope	1,505	~~15.0~~ *14.8*	~~22,575~~ *22,274*
	PHASE 12 SUMP TOTAL		~~53,945~~ *49,763*

AGGREGATE (Permeability 0.01 cm/sec) PHASE 13 SUMP

Contributing Area	Daily Flow Rate (gal/acre/day)	Contributing Acreage (acres)	Daily Flow Rate (gal/day)
Phase 13 Floor	1,617	~~23.6~~ *9.4*	~~38,161~~ *15,250*
Phase 13 Sideslope	1,505	~~21.2~~ *11.2*	~~31,906~~ *16,856*
	PHASE 13 SUMP TOTAL		~~**70,067**~~ ***32,056***

AGGREGATE (Permeability 0.01 cm/sec) PHASE 14 SUMP

Contributing Area	*Daily Flow Rate (gal/acre/day)*	*Contributing Acreage (acres)*	*Daily Flow Rate (gal/day)*
Phase 14 Floor	*1,617*	*12.6*	*20,374*
Phase 14 Sideslope	*1,505*	*10.7*	*16,104*
	PHASE 14 SUMP TOTAL		***36,478***

AGGREGATE (Permeability 0.1 cm/sec) PHASE 8/*PHASE 9* SUMP

Contributing Area	Daily Flow Rate (gal/acre/day)	Contributing Acreage (acres)	Daily Flow Rate (gal/day)
Phase 8 Floor	1,651	~~10.0~~ *20.6*	~~16,510~~ *34,011*
Phase 8 Sideslope	1,496	~~12.2~~ *2.7*	~~18,251~~ *4,039*
Phase 9 Floor	*1,651*	*16.2*	*26,746*
	PHASE 8 SUMP TOTAL		~~**34,761**~~ ***64,796***

~~**AGGREGATE (Permeability 0.1 cm/sec) PHASE 9 SUMP**~~

~~Contributing Area~~	~~Daily Flow Rate (gal/acre/day)~~	~~Contributing Acreage (acres)~~	~~Daily Flow Rate (gal/day)~~
~~Phase 9 Floor~~	~~1,651~~	~~12.4~~	~~20,472~~
~~Phase 9 Sideslope~~	~~1,496~~	~~18.0~~	~~26,928~~
	~~**PHASE 9 SUMP TOTAL**~~		~~**47,400**~~

AGGREGATE (Permeability 0.1 cm/sec) PHASE 10 SUMP

Contributing Area	Daily Flow Rate (gal/acre/day)	Contributing Acreage (acres)	Daily Flow Rate (gal/day)
Phase 10 Floor	1,651	~~20.4~~ *19.4*	~~33,680~~ *32,029*
Phase 10 Sideslope	1,496	~~10.3~~ *13.7*	~~15,409~~ *20,495*
	PHASE 10 SUMP TOTAL		~~**49,089**~~ ***52,524***

AGGREGATE (Permeability 0.1 cm/sec) PHASE 11 SUMP

Contributing Area	Daily Flow Rate (gal/acre/day)	Contributing Acreage (acres)	Daily Flow Rate (gal/day)
Phase 11 Floor	1,651	~~15.2~~ *16.7*	~~25,095~~ *27,572*
Phase 11 Sideslope	1,496	~~5.4~~ *15.1*	~~8,078~~ *22,590*
	PHASE 11 SUMP TOTAL		~~**33,173**~~ ***50,162***

AGGREGATE (Permeability 0.1 cm/sec) PHASE 12 SUMP

Contributing Area	Daily Flow Rate (gal/acre/day)	Contributing Acreage (acres)	Daily Flow Rate (gal/day)
Phase 12 Floor	1,651	~~19.4~~ *17.0*	~~32,029~~ *28,067*
Phase 12 Sideslope	1,496	~~15.0~~ *14.8*	~~22,440~~ *22,141*
	PHASE 12 SUMP TOTAL		~~**54,469**~~ ***50,208***

AGGREGATE (Permeability 0.1 cm/sec) PHASE 13 SUMP

Contributing Area	Daily Flow Rate (gal/acre/day)	Contributing Acreage (acres)	Daily Flow Rate (gal/day)
Phase 13 Floor	1,651	~~23.6~~ *9.4*	~~38,964~~ *15,519*
Phase 13 Sideslope	1,496	~~21.2~~ *11.2*	~~31,715~~ *16,755*
	PHASE 13 SUMP TOTAL		~~**70,679**~~ ***32,274***

AGGREGATE (Permeability 0.1 cm/sec) PHASE 14 SUMP

Contributing Area	*Daily Flow Rate (gal/acre/day)*	*Contributing Acreage (acres)*	*Daily Flow Rate (gal/day)*
Phase 14 Floor	*1,651*	*12.6*	*20,803*
Phase 14 Sideslope	*1,496*	*10.7*	*16,007*
	PHASE 14 SUMP TOTAL		***36,810***

CONCLUSIONS

The post-closure scenarios indicate that a final cover system will minimize infiltration and substantially reduce leachate generation. The maximum head on the liner does not exceed 12-inches as required by Ohio EPA regulations Section 3745-27-08(C)(3)(c).

For the aggregate drainage layer with a permeability of 0.01 cm/sec, the sump for each phase shall receive the following flows:

- **Phase 8/*Phase 9* sump will receive an estimated leachate flow of ~~34,531~~ *63,569* gallons per day.**
- ~~**Phase 9 sump will receive an estimated leachate flow of 47,141 gallons per day.**~~
- **Phase 10 sump will receive an estimated leachate flow of ~~48,489~~ *51,989* gallons per day.**
- **Phase 11 sump will receive an estimated leachate flow of ~~32,705~~ *49,730* gallons per day.**
- **Phase 12 sump will receive an estimated leachate flow of ~~53,945~~ *49,763* gallons per day.**
- **Phase 13 sump will receive an estimated leachate flow of ~~70,067~~ *32,056* gallons per day.**
- ***Phase 14 sump will receive an estimated leachate flow of 36,478 gallons per day.***

For the aggregate drainage layer with a permeability of 0.1 cm/sec, the sump for each phase shall receive the following flows:

- **Phase 8/*Phase 9* sump will receive an estimated leachate flow of ~~34,761~~ *64,796* gallons per day.**
- ~~**Phase 9 sump will receive an estimated leachate flow of 47,400 gallons per day.**~~
- **Phase 10 sump will receive an estimated leachate flow of ~~49,089~~ *52,524* gallons per day.**

- **Phase 11 sump will receive an estimated leachate flow of ~~33,173~~ *50,162* gallons per day.**
- **Phase 12 sump will receive an estimated leachate flow of ~~54,469~~ *50,208* gallons per day.**
- **Phase 13 sump will receive an estimated leachate flow of ~~70,679~~ *32,274* gallons per day.**
- **Phase 14 sump will receive an estimated leachate flow of *36,810* gallons per day.**

The maximum leachate flow to a sump is ~~70,679~~ *64,796*gallons per day when using aggregate with permeability of 0.1 cm/sec.

LEACHATE RECIRCULATION

(d) If leachate is to be recirculated, calculations for amount of leachate to be recirculated and the leachate head and flow.

Leachate recirculation is not proposed for the contiguous expansion.

LEACHATE STORAGE TANKS

(e) Calculations for sizing any leachate storage tanks based on the volume of leachate generated after final closure.

OBJECTIVE

Using design assumptions simulating final closure of the landfill, determine if the leachate storage tank volume for the Apex Sanitary Landfill will provide a minimum of one week of storage capacity considering flows from the permitted disposal area, ~~and~~ the proposed expansion, *and the proposed landfill gas plant* in accordance with the Ohio Administrative Code (OAC) Section 3745-27-08(D)(17). In addition, evaluate that the leachate storage tank volume provides sufficient capacity under active operating conditions.

Apex Sanitary Landfill currently has a leachate storage tank capacity of 545,000 gallons.

METHODOLOGY

Worst Case Leachate Generation

Active Conditions

For the proposed expansion area, the maximum leachate generation is based on the scenario presented in Drawing ~~6G~~ *6F* of the PTI Application Drawings. This calculation assumes that Phase ~~13~~ *12* is in the initial filling stage with 10 feet of waste. Portions of the landfill that are adjacent to a phase that has not been constructed will not be under final cover conditions. Also, there will be areas constructed to a plateau to allow for truck movement. These areas will not be under final cover conditions. All of these areas will be considered active.

Post Closure Conditions (years 1-5)

This calculation assumes that the proposed expansion and the southern portion of the permitted disposal area are in the first 1-5 years of closure.

Post Closure Conditions (years 6-30)

This calculation assumes that the northern portion of the permitted disposal area has been under closed conditions form more than 5 years, years 6-30 of closure.

Available Storage Capacity

The daily volume of leachate generated will be calculated, and this will be compared to the available storage capacity of 545,000 gallons. The regulations do not require a minimum storage capacity under active operational conditions but is presented for informational purposes.

Initial Leachate Generation in Closed Conditions

This calculation assumes that the proposed expansion area and the southern portion of the permitted disposal area are in the first 1-5 years of closure. The northern portion of the permitted disposal area has been under closed conditions for more than 5 years, years 6-30 of closure.

Final Leachate Generation in Closed Conditions

This calculation assumes that the proposed expansion area and the permitted disposal area are in years 6-30 of closure.

The leachate production volumes are provided in the Leachate Generation Calculation in Section (C)(5)(c) of this PTI Application. For conservatism, the average annual flow when using an aggregate drainage layer with a permeability of 0.1 cm/sec will be used in this calculation. These volumes will be multiplied by the respective total areas of the permitted disposal area and the proposed expansion area and converted to a weekly volume for comparison to the site's leachate storage capacity.

Landfill Gas Plant

The condensate volume generated during the gas conversion process which will be directed to the leachate storage tank is estimated at 6,000 gallons per day. This flow will be considered during both active and closed conditions.

CALCULATIONS

Worst Case Leachate Generation

Active Conditions

Initial Waste Placement Conditions in Proposed Expansion

From the Leachate Generation Calculation contained in Section (C)(5)(c), the average annual flow for the proposed expansion is 3.696 inches per year for areas having a 10-foot waste lift. The average annual flow is converted to an average daily flow rate (gal/acre/day) by the following method and includes a multiplier of 2 as described in Ohio EPA Guidance Document #0528:

$$2 \times \frac{3.696\ \text{in}}{\text{yr}} \times \frac{1\ \text{yr}}{365\ \text{days}} \times \frac{43{,}560\ \text{ft}^2}{\text{acre}} \times \frac{1\ \text{ft}}{12\ \text{inch}} \times \frac{7.481\ \text{gal}}{\text{ft}^3} = 550\ \text{gal/ac/day}$$

The volume of leachate generated daily for *the open area during* Phase ~~13~~ *12 construction* of the proposed expansion, which equals approximately ~~48.2~~ *33.4* acres, equals:

$$\frac{550 \text{ gallons}}{\text{acre day}} * \text{~~48.2 acres = 26,510~~} \frac{\text{gallons}}{\text{day}}$$

$$\frac{550\ gallons}{acre\ day} \times 33.4\ acres = 18{,}370 \frac{gallons}{day}$$

Intermediate Cover Conditions in Proposed Expansion

From the Leachate Generation Calculation contained in Section (C)(5)(c), the average annual flow for the proposed expansion is 3.699 inches per year for areas having 100 feet of waste. The average annual flow is converted to an average daily flow rate (gal/acre/day) by the following method and includes a multiplier of 2 as described in Ohio EPA Guidance Document #0528:

$$2 \times \frac{3.699 \text{ in}}{\text{yr}} \times \frac{1 \text{ yr}}{365 \text{ days}} \times \frac{43{,}560 \text{ ft}^2}{\text{acre}} \times \frac{1 \text{ ft}}{12 \text{ inch}} \times \frac{7.481 \text{ gal}}{\text{ft}^3} = 550 \text{ gal/ac/day}$$

For the proposed expansion area, it is assumed that approximately ~~67.9~~ *61.3* acres of the proposed landfill are not under final cover. For this area, the volume of leachate generated daily equals:

$$\frac{550 \text{ gallons}}{\text{acre day}} * \text{~~67.9acres = 37,345~~} \frac{\text{gallons}}{\text{day}}$$

$$\frac{550\ gallons}{acre\ day} \times 61.3\ acres = 33{,}715\ \frac{gallons}{day}$$

Condensate Generation in Proposed Landfill Gas Plant

The condensate flow generated during the landfill gas conversion process has been estimated at 6,000 gallons per day.

Post Closure Conditions (years 1-5)

It is assumed that approximately ~~89.4~~ *58.9* acres of the landfill are under final cover conditions in years 1-5 after closure. Assuming a conservative estimate of 150 gal/acre/day for final cover conditions in years 1-5 after closure, the volume of leachate generated daily equals:

~~$\frac{150\ gallon}{acre\ day} * (89.4\ acres) = 13{,}410 \frac{gallons}{day}$~~

$$\frac{150\ gallon}{acre\ day} * (58.9\ acres) = 8{,}835 \frac{gallons}{day}$$

Post Closure Conditions (years 6-30)

It was assumed that approximately ~~84.3~~ *91.0* acres of the landfill are under final cover conditions in year 6-30 after closure. A conservative estimate of 10 gal/acre/day was assumed for final cover conditions in years 6-30 after closure. The volume of leachate generated daily equals:

~~$\frac{10\ gallon}{acre\ day} * (84.3\ acres) = 843 \frac{gallons}{day}$~~

$$\frac{10\ gallons}{acre\ day} \times 91.0\ acres = 910\ \frac{gallons}{day}$$

Combined Daily Leachate Generation Volume

Therefore, the ~~combined daily leachate generation volume from the existing disposal area and the proposed expansion area~~ *total flow directed to the leachate storage tank* equals:

~~$26{,}510 \frac{gallons}{day} + 37{,}345 \frac{gallons}{day} + 13{,}410 \frac{gallons}{day} + 843 \frac{gallons}{day} = 78{,}108\ gallons$~~

$$18{,}370 \frac{gallons}{day} + 33{,}715 \frac{gallons}{day} + 6{,}000 \frac{gallons}{day} + 8{,}835 \frac{gallons}{day} + 910 \frac{gallons}{day} = 67{,}830\ gallons$$

The leachate storage volume of the facility is 545,000 gallons. The number of days the tank will provide storage for during the assumed active operational sequence equals:

~~$\frac{545{,}000\ \text{gallons}}{1} * \frac{1\ \text{day}}{78{,}108\ \text{gallons}} = 7.0\ \text{days}$~~

$$\frac{545{,}000\ \text{gallons}}{1} * \frac{1\ \text{day}}{67{,}830\ \text{gallons}} = 8.0\ \text{days}$$

Initial Leachate Generation in Closed Conditions

Condensate Generation in Proposed Landfill Gas Plant

The condensate flow generated during the landfill gas conversion process has been estimated at 6,000 gallons per day. This results in a weekly condensate production volume of:

$$\frac{6{,}000\ \text{gallons}}{\text{day}} * \frac{7\ \text{days}}{1\ \text{week}} = 42{,}000\ \frac{\text{gallons}}{\text{week}}$$

Post Closure Conditions (years 1-5)

It was assumed that approximately ~~205.5~~ *197.5* acres of landfill are under final cover conditions in years 1-5 after closure. Assuming a conservative estimate of 150 gal/acre/day, the volume of leachate generated weekly equals:

$$\left[\frac{150\ \text{gallon}}{\text{acre day}} * \frac{7\ \text{days}}{\text{week}}\right] * [\text{~~(205.5) acres~~}] = \text{~~215,775~~}\ \frac{\text{gallons}}{\text{week}}$$

$$\left[\frac{150\ \text{gallon}}{\text{acre day}} * \frac{7\ \text{days}}{\text{week}}\right] * [(197.5)\ \text{acres}] = 207{,}375\ \frac{\text{gallons}}{\text{week}}$$

Post Closure Conditions (years 6-30)

It was assumed that approximately ~~84.3~~ *91.0* acres of the landfill are under final cover conditions in years 6-30 after closure. Assuming a conservative estimate of 10 gal/acre/day, the volume of leachate generated weekly equals:

The covered areas will result in a weekly leachate production volume of:

$$\left[\frac{10\ \text{gallon}}{\text{acre day}} * \frac{7\ \text{days}}{\text{week}}\right] * [\text{~~(84.3) acres~~}] = \text{~~5,901~~}\ \frac{\text{gallons}}{\text{week}}$$

$$\left[\frac{10\ \text{gallon}}{\text{acre day}} * \frac{7\ \text{days}}{\text{week}}\right] * [(91.0)\ \text{acres}] = 6{,}370\ \frac{\text{gallons}}{\text{week}}$$

Combined Weekly Leachate Generation Volume

The total ~~leachate volume generated~~ *flow directed to the leachate storage tank* in closed conditions is:

~~$(215{,}775\ gallons/week + 5{,}901 gallons/week) = 221{,}676 \frac{gallons}{week}$~~

$$(42{,}000 gallons/week + 207{,}375\ gallons/week + 6{,}370 gallons/week) = 255{,}745 \frac{gallons}{week}$$

The leachate storage capacity of the facility is 545,000 gallons, which provides approximately ~~2.5~~ *2.1* weeks of storage.

Final Leachate Generation in Closed Conditions

Condensate Generation in Proposed Landfill Gas Plant

The condensate flow generated during the landfill gas conversion process has been estimated at 6,000 gallons per day. This results in a weekly condensate production volume of:

$$\frac{6{,}000\ \text{gallons}}{\text{day}} * \frac{7\ \text{days}}{1\ \text{week}} = 42{,}000 \frac{\text{gallons}}{\text{week}}$$

Post Closure Conditions (years 6-30)

It was assumed that approximately ~~289.8~~ *288.5* acres of landfill are under final cover conditions in years 6-30 after closure. A conservative estimate of 10 gal/acre/day was assumed. This results in a weekly leachate production volume of:

~~$\left[\frac{10\ \text{gallon}}{\text{acre day}} * \frac{7\ \text{days}}{\text{week}}\right] * [289.8\ \text{acres}] = 20{,}286 \frac{\text{gallons}}{\text{week}}$~~

$$\left[\frac{10\ \text{gallon}}{\text{acre day}} * \frac{7\ \text{days}}{\text{week}}\right] * [288.5\ \text{acres}] = 20{,}195 \frac{\text{gallons}}{\text{week}}$$

Combined Weekly Leachate Generation Volume

The total flow directed to the leachate storage tank in closed conditions is:

$$(42{,}000\,gallons\,/\,week + 20{,}195\ gallons\,/\,week) = 62{,}195\,\frac{gallons}{week}$$

The leachate storage capacity of the facility is 545,000 gallons, which provides approximately ~~26.9~~ *8.8* weeks of storage and is much greater than the required weekly leachate storage volume.

CONCLUSIONS

The existing leachate storage tank will provide approximately ~~7.0~~ *8.0* days of adequate storage capacity during active waste acceptance operations with a maximum leachate generation scenario assumed.

The existing leachate storage tank will provide approximately ~~2.5~~ *2.1* weeks to ~~26.8~~ *8.8* weeks of storage during post closure conditions for the existing permitted disposal area and the proposed expansion area, which is greater than the one week storage capacity required by OAC 3745-27-08(D)(17).

PUMP AND PIPE SIZE

(f) Pump size and pipe size calculations based on paragraphs (C)(5)(c) and (C)(5)(d) of this rule.

OBJECTIVE

Show that the proposed leachate collection piping can accommodate the anticipated leachate flows.

METHODOLOGY

Manning's equation is used to calculate the required leachate collection pipe diameter given the expected daily peak leachate flow, Q. Leachate generation calculations in this PTI Application resulted in a worst-case leachate volume of 1,651 gal/acre/day for a 100-foot depth of waste.

Manning's Equation.

$$Q = A * \frac{1.49}{n} * \left(\frac{A}{WP}\right)^{(2/3)} * \sqrt{S}$$

Where:

Q = Discharge (cfs); From HELP Model output data
A = Area of pipe (sq. ft); = (π/4) * D^2
D = Pipe diameter (ft);
n = Manning's roughness coefficient;
WP = Wetted Perimeter (ft); = π * D
S = Minimum design slope of leachate collection pipes (ft/ft);

CALCULATIONS

The HELP model estimated a worst-case daily leachate flow rate of 1,617 gal/acre/day for the aggregate drainage layer with a permeability of 0.01 cm/sec and 1,651 gal/acre/day for the aggregate drainage layer with a permeability of 0.1 cm/sec. The worst-case leachate generation is with a 100-foot depth of waste. The rate of 1,651 gal/acre/day obtained for the aggregate drainage layer with a permeability of 0.1 cm/sec was used for this analysis.

The ~~phase~~ *sump* with the largest *contributing* floor area ~~is~~ handles flows from Phase*s* ~~13~~ *8 and 9*, with an approximate *combined floor* area of ~~23.6~~ *36.8* acres. ~~For conservatism, a factor of safety of 5 was applied to the flow rate, t~~ *T*herefore, the largest flow rate a leachate pipe can be expected to handle equals:

~~$5 \times \frac{1{,}651\ \text{gal}}{\text{acre day}} \times \frac{1\ \text{day}}{86{,}400\ \text{sec}} \times \frac{1\ \text{cu. ft.}}{7.481\ \text{gal}} \times 23.6\ \text{acres} = 0.30\ \text{cfs}$~~

$$\frac{1{,}651\ gal}{acre-day} \times \frac{1\ day}{86{,}400\ sec} \times \frac{1\ cu.ft.}{7.481\ gal} \times 36.8\ acres = 0.094\ cfs$$

Leachate Collection Piping

To verify the adequacy of a 6-inch leachate collection pipe to carry the total flow, Manning's Equation and the following assumptions were used.

Assumptions:

Pipe is flowing full
n (for HDPE pipe) = 0.01
S = 1% or 0.01 ft/ft

The table below shows the input parameters and maximum discharge for the HDPE pipe.

DR	Diameter (inches)	Inside Diameter (inches)	Manning's n	Slope (ft/ft)	Area (sq ft)	WP (ft)	Discharge (cfs)
9	6.0	5.065	0.01	0.01	0.140	1.326	0.47
11	6.0	5.349	0.01	0.01	0.156	1.400	0.54

Determine the factor of safety (F.S.) that can be achieved using a 6-in diameter pipe by:

Where $F.S. = \frac{\text{Total Allowbale Discharge of Pipe}}{\text{Estimated Maximum Flow Rate}}$

For DR 9 pipe:

~~$F.S. = \frac{0.47\ cfs}{0.30\ cfs} = 1.57$~~

$$F.S. = \frac{0.47\ cfs}{0.094\ cfs} = 5.00$$

For DR 11 pipe:

$$\text{~~F.S.} = \frac{\text{~~0.54 cfs}}{\text{~~0.30 cfs}} = \text{~~1.80}$$

$$F.S. = \frac{0.54\ cfs}{0.094\ cfs} = 5.74$$

~~* Note that this factor of safety is based upon an assumed flow rate which includes a factor of safety of five; therefore, the factor of safety may be as high as five times the value shown above.~~

CONCLUSIONS

The proposed 6-inch diameter DR 9 leachate collection pipes can handle a flow of 0.47 cfs and the DR 11 leachate collection pipes can handle a flow of 0.54 cfs. The maximum calculated leachate flow is ~~0.30~~ *0.094* cfs, which results in factors of safety of ~~1.57~~ *5.00* and ~~1.80~~ *5.74*, respectively. Therefore, the proposed 6-inch diameter leachate collection pipes will adequately handle the maximum anticipated leachate flows in the proposed expansion.

OBJECTIVE

Determine the leachate pipe perforation diameter and perforation spacing along the collection pipes to accommodate the anticipated daily leachate generation volume.

METHODOLOGY

1. Estimate the maximum leachate flow length into the leachate collection pipe.
2. Estimate the maximum leachate production rate by using the Hydrologic Evaluation of Landfill Performance (HELP) Model.
3. Calculate the minimum required hole spacing based on a maximum entrance velocity of 0.1 ft/sec (Driscol, "Groundwater and Wells").
4. Compare the D_{85} of the drainage media to the hole diameter.

$$\frac{D_{85}\text{ of drainage media}}{\text{hole diameter}} \geq 1.2 *$$

*Based on USEPA publication, "Lining of Waste Containment and Other Impoundment Facilities"

CALCULATIONS

The HELP model considers to alternative aggregates with different permeability. The maximum leachate drainage flow path for aggregate with a permeability of 0.01 cm/sec was determined to be 420 feet along the floor. The maximum daily flow rate as determined based on the average annual flow equaled 1,617 gal/acre/day for aggregate with a permeability of 0.01 cm/sec. The maximum leachate drainage flow path for aggregate with a permeability of 0.1 cm/sec was determined to be 840 feet along the floor. The maximum daily flow rate was 1,651 gal/acre/day for aggregate with a permeability of 0.1 cm/sec.

The worst-case value of 1,651 gal/acre/day with a drainage length of 840 feet will be used for this analysis. For conservatism, this calculation will estimate the maximum leachate flow by considering a factor of safety of 5.

The maximum leachate flow (Q) is:

$$Q = 5 * \frac{1{,}651\text{ gal}}{\text{acre - day}} * \frac{1\text{ day}}{86{,}400\text{ sec}} * \frac{1\text{ cu.ft.}}{7.481\text{ gal}} * \frac{1\text{ acre.}}{43{,}560\text{ sq. ft.}} * \frac{840\text{ sq. ft.}}{1} = 2.46 \times 10^{-4}\text{ cfs}$$

The required open area of the leachate collection pipe is determined by:

$$A = \frac{Q, cfs}{\text{entrance velocity, ft/sec}} = \frac{2.46 \times 10^{-4} cfs}{0.1 \text{ ft/sec}} = 2.46 \times 10^{-3} \text{ ft}^2$$

The minimum number of holes per linear foot is determined by:

$$\#\text{ Holes} = \frac{\text{Required Open Area}}{\text{Area of Holes}}$$

The spreadsheet below shows the required number of holes per linear foot for various hole diameters and various types of drainage media. The proposed leachate collection pipes have 6 holes per foot and the hole diameter is 0.375-inch.

	Perforation Diameter (in)	Perforation Area (ft^2)	Maximum Flow (cfs)	Entrance Velocity (fps)	Required Open Pipe Area (ft^2)	d85 of Stone (in)	d85/Hole Diameter	Required Number of Perforations (per ft)
AASHTO	0.25	3.41E-04	2.46E-04	0.1	2.46E-03	1.83	7.32	7.22
# 3	0.375	7.67E-04	2.46E-04	0.1	2.46E-03	1.83	4.88	3.21
STONE	0.5	1.36E-03	2.46E-04	0.1	2.46E-03	1.83	3.66	1.80
AASHTO	0.25	3.41E-04	2.46E-04	0.1	2.46E-03	0.83	3.32	7.22
# 57	0.375	7.67E-04	2.46E-04	0.1	2.46E-03	0.83	2.21	3.21
STONE	0.5	1.36E-03	2.46E-04	0.1	2.46E-03	0.83	1.66	1.80

SUMMARY AND CONCLUSIONS

From the above spreadsheet, it can be seen that 0.375-inch diameter holes are adequate to use with AASHTO #3 and #57 sized stone since

$$\frac{D_{85} \text{ of drainage media}}{\text{hole diameter}} \geq 1.2.$$

Additionally the leachate collection pipe is proposed to have 6 holes per foot which exceeds the required 3.21 holes per foot shown on the table. Pipes will be fabricated with 3 rows of perforations oriented at 120 degrees from one another. This is a conservative design that considers the possibility of potential hole clogging from biological growth and blockage from the drainage stone.

OBJECTIVE

To size the leachate pumps for use in the sumps of the proposed expansion of the Apex Sanitary Landfill and to evaluate the existing forcemain capacity with the proposed expansion sumps. This calculation considers the pumps at Phases 8/9 and Phase 10 sumps. WaterCAD will be used to model the pumps functioning in series. The locations of the proposed sumps and force main are shown on Drawings 4D and 4E of the PTI Drawing Package.

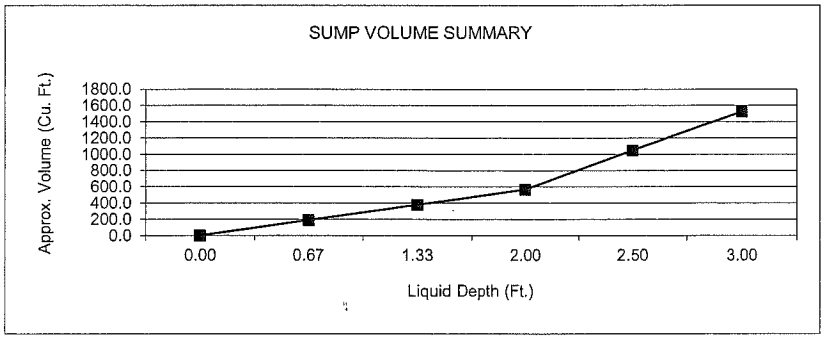
SUMP VOLUME

The respective sumps within the proposed unit will be square shaped with 3H:1V inside slopes. The bottom dimensions will be 20-feet by 20-feet and each sump will be 2-ft deep. Each sump area will be backfilled with AASHTO No. 3 (or equivalent) drainage stone. The sump area 1-foot above the crest has been estimated from the drawings. As per standard aggregate parameters, it has been assumed that the drainage stone to be used in the sump has a porosity of 40%.

SUMP VOLUME PARAMETERS	
Sump Bottom Length (L1)	20 Feet
Sump Bottom Width (W1)	20 Feet
Sump Depth (D)	2 Feet
Sump Sideslope (_H:1V)	3 H:1V
Sump Pipe Diameter	2.00 Feet
Sump Pipe Length	10 Feet
Area at 1-foot above sump crest (1)	3,759 Sq-Feet
Drainage Stone Porosity (2)	40%

SUMP VOLUME CALCULATION PARAMETERS	
Sump Top Length (L2)	32 Feet
Sump Top Width (W2)	32 Feet
Sump Bottom Area	400 Sq-Feet
Sump Top Area (3)	1,024 Sq-Feet
Gross Sump Volume (4)	1,375 Cubic-Feet
Sump Pipe Volume (5)	31.4 Cubic-Feet
Net Sump Volume (6)=(4)-(5)	1,344 Cubic-Feet
Sump Liquid Volume (7)=[(6)*(2)]+(5)	569 Cubic-Feet
Volume 1-foot above (8)=0.5*[(1)+(3)]*(2)	956.6 Cubic-Feet

SUMP VOLUME	
Liquid Depth (Feet)	Approximate Volume (Cubic-Feet)
0.00	0.0
0.67	190.6
1.33	378.4
2.00	569.0
2.50	1047.3
3.00	1525.6



The sump depression for this design is 2-foot deep. The operational volume of the sump will be calculated to 1-foot above the crest of the sump, total depth of 3-feet.

INITIAL PUMP SELECTION

The size of the pump will initially be chosen by plotting the sump inflow rate versus the Total Dynamic Head (TDH) for the phase 10 sump against the manufacturer performance curve. This calculation initially considers the phase 10 sump to choose the pump because phase 10 sump will have the longest force main pipe distance from the leachate storage tank. This calcululation uses leachate production when the leachate drainage aggregate has permeability of 0.1 cm/sec for conservatism.

SUMP INFLOW RATES					
Sump Location	Leachate Production (gal/ac/day)*	Contributing Area (ac)	Total Ave. Leachate (gal/day)	Total Ave. Leachate (gpm)	
Phase 10	1,651	19.4	32,029	22.2	
	1,496	13.7	20,495	14.2	
			Total Flow	**36.5**	**GPM**

*The Average Annual Leachate production was converted to a daily flow rate (gal/ac/day) using a multiplier of 6 as outlined in Ohio EPA Document #0528.

The TDH calculation accounts for static (elevation) head, losses due to friction (as a function of flowrate) and minor losses resulting from fittings.

$$TDH = H_s + H_f + H_m$$

Where

$$H_s = StaticHead, Feet$$

$$H_f = FrictionHeadLoss, Feet$$

$$H_f = \frac{L}{100} * 0.2083 * \frac{100^{1.85} * Q^{1.85}}{C^{1.85} * D^{4.87}}$$

$$H_m = MinorHeadLoss, Feet$$

$$H_m = \frac{V^2}{2g}\sum K_i = \frac{16Q^2(\frac{cfs}{448.8gpm})^2}{2g\pi^2(D\frac{ft}{12in})^4} = \frac{0.0252KQ^2(\frac{cfs}{448.8gpm})^2}{(D\frac{ft}{12in})^4}$$

Where

L = Length, Feet

Q = Flowrate, gpm

K = Minor loss coefficient

C = Hazen Williams Roughness

D = Inside Diameter, Inch

PUMP DESIGN PARAMETERS	
Sump Invert Elevation *	1181.8 Feet
Maximum Elevation *	1279.3 Feet
Hose Length (sump to landfill crest) *	321 Feet
Hose Diameter	1.92 Inch
Hose Roughness C	120
Pipe Length	8,015 Feet
Pipe Diameter **	2.83 Inch
Pipe Roughness C	120
Sump Inflow Rate	36.5 GPM
Sump Inflow Rate (worst case)	0.081 CFS

* Elevations and hose length are taken from the PTI Drawing Package.

** Existing pipe consists of 3-inch diameter HDPE SDR 11.

MINOR LOSS CALCULATION, e			
FITTING	**K - FACTOR**	**QUANTITY**	**TOTAL - K**
Entrance	0.50	1	0.50
Outlet	1.00	1	1.00
90 Degree Elbow	0.30	4	1.20
45 Degree Elbow	0.36	4	1.44
Check Valve	2.50	4	10.00
		Minor Loss Parameter K	**14.14**

Minor loss items assumed from standard leachate management system installation.

Based on the flow conditions for the phase 10 sump:

PUMP TDH CALCULATION					
Static Head (Feet)	Flow Rate (GPM)	Hf, Friction Head Loss		Total Hm Minor Losses (Feet)	TDH (Feet)
		Hose (Feet)	Pipe (Feet)		
97.5	36.5	15.56	58.31	0.76	172.13

For a single pump operating at the phase 10 sump, the pump shall be capable of pumping 37 GPM at a TDH of 171 feet. According to the EPG pump curve, a EPG Series 30-4 7.5 HP pump would meet these requirements for a single pump operating. In reality, the proposed pump at the phases 8/9 sump and the phase 10 sump will likely be operating in series. A WaterCAD analysis will be performed to model the pumps operating in series.

Additionally, the existing pump for phases 4 through 7 (leachate sump No. 3) might be operating at the same time as the proposed pumps for phases 8/9 and phase 10. Since the pumps at the existing sumps for phases 1 through 3 (leachate sump Nos. 1 and 2) will have been under final cover conditions for an extended period of time when phases 8,9, and 10 are constructed, minimal leachate generation is anticipated; therefore these pumps will not be evaluated operating in series. The Leachate Generation Calculation presented in Section (C)(5)(c) shows that the leachate generation is minimal when the landfill is under final cover conditions. A WaterCAD analysis will be performed to model the pumps at the proposed phases 8/9 sumps, proposed phase 10 sump, and existing leachate sump No. 3 operating in series.

WATERCAD ANALYSIS

Two WaterCAD analyses were performed to model the pumps in series. The first analysis modeled the phase 10 pump and phases 8/9 pump operating in series. An initial analysis was performed using the design flow specified above and the TDH associated with the flow for the EPG Series 30-4 7.5 HP pump. When all pumps were operating, this pump did not provide the required flow at the phase 10 sump. An additional analysis was performed and it was determined that the EPG Series 30-6 15 HP (or equal) pump provides the required capacity.

The second analysis modeled the phase 10 pump, phases 8/9 pump, and leachate sump No. 3 pump operating in series. The analysis modeled the EPG Series 30-6 15 HP pump at phase 10 sump and phases 8/9 sump, and the EPG Series 30-5 pump at existing leachate sump No. 3. The pump at existing leachate sump No. 3 was obtained from the Vertical Expansion Permit to Install Application for Apex Sanitary Landfill dated June 2008 and last revised in July 2012. Refer to Attachment 1 for the Pump Curves, Attachment 2 for a summary table of the WaterCAD analysis results, and Attachment 3 for the WaterCAD analysis results.

PUMP OPERATION

ESTIMATED PUMP OPERATION PARAMETERS	
Pump On Depth	2.0 Feet
Pump Off Depth	0.5 Feet
Approximate Operating Pump Discharge	76.0 GPM*

*Discharge rate is based on pump flow rate of 76 GPM for the EPG Series 30-6 pump at the phase 10 sump operating.

ESTIMATED PUMP OPERATION SUMMARY	
Approximate Operating Pump Discharge	0.169 CFS
Volume @ Pump On Depth (A)	569.0 Cubic-Feet
Area of Pipe	0.044 ft^2
Volume @ Pump Off Depth (B)	142.3 Cubic-Feet
Operational Volume (C)=(A)-(B)	426.8 Cubic-Feet
Pump Run Time (Accounting for Peak Inflow)	80.8 Minutes
Pump Run Time (Accounting for No Inflow)	42.0 Minutes
Sump Fill Time	87.5 Minutes

CONCLUSIONS

An EPG Series 30-6 15 HP pump (or equal) shall be utilized at the phases 8/9 sump and the phase 10 sump. As designed in the Vertical Expansion, the pump at the existing leachate sump No. 3 is understood to be an EPG Series 30-5 pump. The existing forcemain network is a 3" diameter HDPE SDR-11 pipe. The proposed segments of the force main network will also be a 3" diameter HDPE SDR-11 pipe and will tie-in to the existing 3" diameter forcemain and tie-in to the existing 3" diameter forcemain. The 3" diameter HDPE SDR-11 pipe meets the design requirements for pressure.

REFERENCES

1. Metcalf & Eddy, Inc. WASTEWATER ENGINEERING: Collection and Pumping of Wastewater, McGraw Hill, New York, 1981.

2. Chevron/Plexco, PLEXCO PIPING SYSTEMS MANUAL.

3. Phillips Driscopipe, Inc., DRISCO PIPE MANUAL.

4. Grundfos USA, SQ SQE SP PRODUCT GUIDE.

5. Plastics Pipe Institute, HANDBOOK OF POLYETHYLENE PIPE.

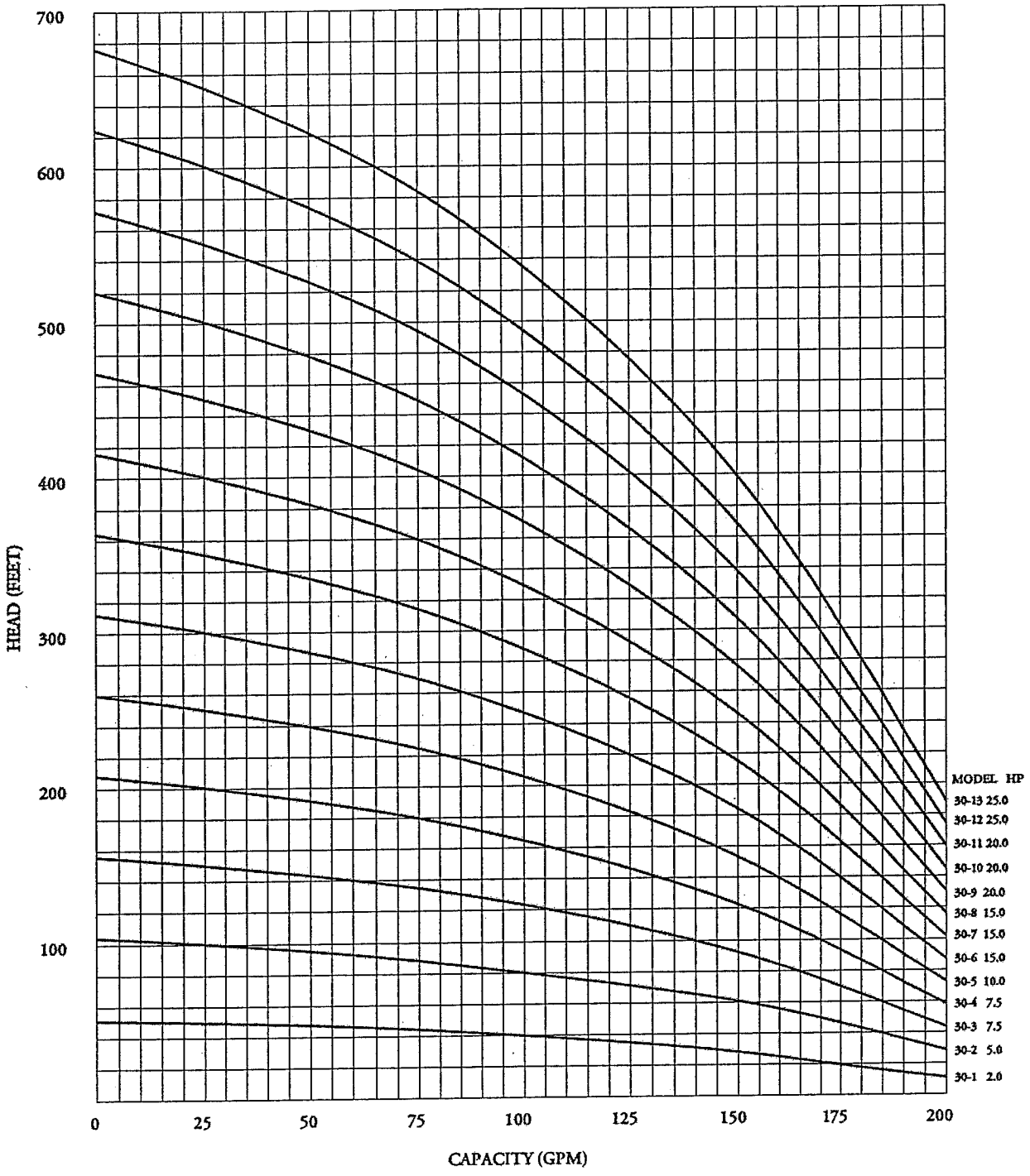
6. Bentley WaterCAD V8i (SELECTseries 3). Haestad Methods Solution Center.

ATTACHMENT 1
PUMP CURVES

SERIES 30 SurePump™

Flow Range 50-200 GPM

60 Hz



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ATTACHMENT 2
WATERCAD ANALYSIS RESULTS SUMMARY TABLE

WaterCAD Analysis lts-Summary Table
Existing forcemain .h Phase 11 Sump
Apex Sanitary Landfill

Table 1 - Estimated Required Flows
Phases 8/9, Phase 10, and Leachate Sump No. 3

Sump Location	Estimated Flow Rate into sump (GPM)
Phase 8/9 sump	45.0
Phase 10 sump	36.5
Leachate Sump No. 3	64.0

Table 2 - Pumps Operating: Existing 3-inch diameter forcemain
Phases 8/9 and Phase 10 pumps

	Phase 8/9 pump			Phase 10 pump			Velocities (ft/s)	
	Calculated Flow (gpm)	Calculated TDH (feet)	Calculated Pressure (lb/in2)	Calculated Flow (gpm)	Calculated TDH (feet)	Calculated Pressure (lb/in2)	Calculated Max. (ft/s)	Calculated Min. (ft/s)
Phase 8/9 pump operating	82	262	113	--	--	--	4.26	4.17
Phase 10 pump operating	--	--	--	76	268	115	3.96	3.88
Both pumps operating	51	291	125	41	298	128	4.78	2.14

Notes:

-- Pump was not running during the analysis

1. Based on the results in the table above, the EPG Series 30-6 15 HP pump provides approximately the required flow rate at the associated TDH at each sump.
2. Based on the TDH of the pumps when operating, the maximum pipe pressure can be determined assuming that 0.43 psi = 1 foot of head. The pressures obtained do not exceed the maximum design criteria of 160 psi.
3. WaterCAD shows that the velocity is greater than 2 ft/s with the two pumps running simultaneously, which is above the 2.0 ft/s suggested to prevent solids deposition in the pipe.

Table 3 - Pumps Operating: Existing 3-inch diameter forcemain
Phases 8/9, Phase 10, and Leachate Sump No. 3

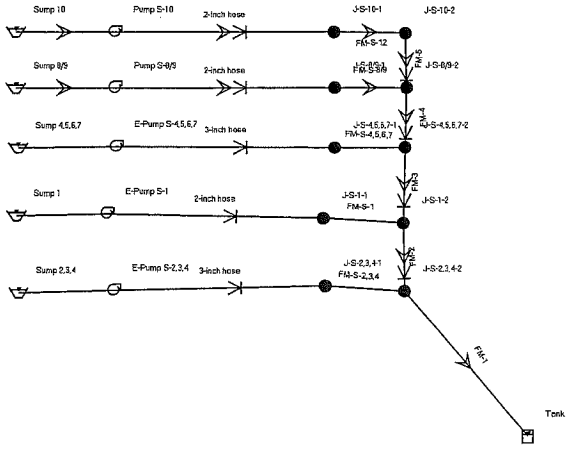
	Phase 8/9 pump			Phase 10 pump			Leachate Sump No. 3 pump			Velocities (ft/s)	
	Calculated Flow (gpm)	Calculated TDH (feet)	Calculated Pressure (lb/in2)	Calculated Flow (gpm)	Calculated TDH (feet)	Calculated Pressure (lb/in2)	Calculated Flow (gpm)	Calculated TDH (feet)	Calculated Pressure (lb/in2)	Calculated Maximum (ft/s)	Calculated Minimum (ft/s)
All pumps operating (Phase 8/9 pumps, Phase 10 pump, and leachate sump No. 3 pump)	37	301	129	30	305	131	33	251	108	5.07	1.54

Notes:

1. This evaluation shows that with EPG Series 30-6 15 HP pumps at the phase 10 and phases 8/9 sumps, and the EPG Series 30-5 pump at existing leachate sump No. 3, the pumps will continue to discharge leachate even if below the estimated inflow rate.
2. Based on the TDH of the pumps when operating, the maximum pipe pressure can be determined assuming that 0.43 psi = 1 foot of head. The pressures obtained do not exceed the maximum design criteria of 160 psi.

ATTACHMENT 3
WATERCAD ANALYSIS RESULTS

Scenario: Base



Scenario: Base
Current Time Step: 0.000Hr
FlexTable: Pump Table

ID	Label	Elevation (ft)	Pump Definition	Status (Initial)	Hydraulic Grade (Suction) (ft)	Hydraulic Grade (Discharge) (ft)	Flow (Total) (gpm)	Pump Head (ft)
147	Pump S-10	1,181.80	Pump S-10	Off	1,182.80	1,397.41	0	0.00
148	Pump S-8/9	1,182.90	Pump S-8/9	On	1,183.69	1,445.39	82	261.71
164	E-Pump S-4,5,6,7	1,197.00	Pump S-4,5,6,7	Off	1,198.00	1,360.79	0	0.00
165	E-Pump S-1	1,212.00	Pump S-1	Off	1,212.00	1,300.44	0	0.00
166	E-Pump S-2,3,4	1,180.00	Pump S-2,3,4	Off	1,180.00	1,208.06	0	0.00

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Phase 8/9 Sump operating

Scenario: Base
Current Time Step: 0.000Hr
FlexTable: Pump Table

ID	Label	Elevation (ft)	Pump Definition	Status (Initial)	Hydraulic Grade (Suction) (ft)	Hydraulic Grade (Discharge) (ft)	Flow (Total) (gpm)	Pump Head (ft)
147	Pump S-10	1,181.80	Pump S-10	On	1,182.61	1,450.20	76	267.59
148	Pump S-8/9	1,182.90	Pump S-8/9	Off	1,183.90	1,368.09	0	0.00
164	E-Pump S-4,5,6,7	1,197.00	Pump S-4,5,6,7	Off	1,198.00	1,335.99	0	0.00
165	E-Pump S-1	1,212.00	Pump S-1	Off	1,212.00	1,283.09	0	0.00
166	E-Pump S-2,3,4	1,180.00	Pump S-2,3,4	Off	1,180.00	1,202.13	0	0.00

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Phase 1D sump operating

Scenario: Base
Current Time Step: 0.000Hr
FlexTable: Pump Table

ID	Label	Elevation (ft)	Pump Definition	Status (Initial)	Hydraulic Grade (Suction) (ft)	Hydraulic Grade (Discharge) (ft)	Flow (Total) (gpm)	Pump Head (ft)
147	Pump S-10	1,181.80	Pump S-10	Off	1,182.80	1,404.79	0	0.00
148	Pump S-8/9	1,182.90	Pump S-8/9	Off	1,183.90	1,404.79	0	0.00
164	E-Pump S-4,5,6,7	1,197.00	Pump S-4,5,6,7	On	1,197.96	1,408.69	91	210.73
165	E-Pump S-1	1,212.00	Pump S-1	Off	1,212.00	1,331.21	0	0.00
166	E-Pump S-2,3,4	1,180.00	Pump S-2,3,4	Off	1,180.00	1,218.59	0	0.00

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Leachate Sump No.3 operating

Scenario: Base
Current Time Step: 0.000Hr
FlexTable: Pump Table

ID	Label	Elevation (ft)	Pump Definition	Status (Initial)	Hydraulic Grade (Suction) (ft)	Hydraulic Grade (Discharge) (ft)	Flow (Total) (gpm)	Pump Head (ft)
147	Pump S-10	1,181.80	Pump S-10	On	1,182.74	1,480.59	41	297.85
148	Pump S-8/9	1,182.90	Pump S-8/9	On	1,183.81	1,474.40	51	290.59
164	E-Pump S-4,5,6,7	1,197.00	Pump S-4,5,6,7	Off	1,198.00	1,409.07	0	0.00
165	E-Pump S-1	1,212.00	Pump S-1	Off	1,212.00	1,334.20	0	0.00
166	E-Pump S-2,3,4	1,180.00	Pump S-2,3,4	Off	1,180.00	1,219.62	0	0.00

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Phases 8/9 and Phase 10 pumps operating

Scenario: Base
Current Time Step: 0.000Hr
FlexTable: Pipe Table

ID	Label	Length (Scaled) (ft)	Start Node	Stop Node	Diameter (in)	Material	Hazen-Williams C	Has Check Valve?	Minor Loss Coefficient (Local)	Flow (gpm)	Velocity (ft/s)	Headloss Gradient (ft/ft)	Has User Defined Length?	Length (User Defined) (ft)
121	FM-3	35.22	J-S-4,5,6,7-2	J-S-1-2	2.8	PVC	120.0	True	0.000	92	4.68	0.040	True	1,866.00
139	FM-2	31.69	J-S-1-2	J-S-2,3,4-2	2.8	PVC	120.0	True	0.000	92	4.68	0.040	True	2,856.00
144	-	46.87	Sump 10	Pump S-10	1.9	PVC	120.0	False	0.000	41	4.54	0.060	True	1.00
146	-	47.05	Sump 8/9	Pump S-8/9	1.9	PVC	120.0	False	0.000	51	5.63	0.089	True	1.00
150	2-inch hose	101.77	Pump S-10	J-S-10-1	1.9	PVC	120.0	True	0.000	41	4.54	0.060	True	321.00
152	2-inch hose	101.95	Pump S-8/9	J-S-8/9-1	1.9	PVC	120.0	True	0.000	51	5.63	0.089	True	224.00
154	FM-S-12	33.29	J-S-10-1	J-S-10-2	2.8	PVC	120.0	False	0.000	41	2.14	0.010	True	1.00
156	FM-S-8/9	33.55	J-S-8/9-1	J-S-8/9-2	2.8	PVC	120.0	False	0.000	51	2.65	0.014	True	1.00
157	FM-5	25.47	J-S-10-2	J-S-8/9-2	2.8	PVC	120.0	True	0.000	41	2.14	0.009	True	732.00
158	FM-4	27.78	J-S-8/9-2	J-S-4,5,6,7-2	2.8	PVC	120.0	True	0.000	92	4.78	0.042	True	1,075.00
170	-	46.44	Sump 4,5,6,7	E-Pump S-4,5,6,7	2.8	PVC	120.0	False	0.000	0	0.00	0.000	True	1.00
171	-	42.95	Sump 1	E-Pump S-1	1.9	PVC	120.0	False	0.000	0	0.00	0.000	True	1.00
172	-	45.13	Sump 2,3,4	E-Pump S-2,3,4	2.8	PVC	120.0	False	0.000	0	0.00	0.000	True	1.00
174	3-inch hose	101.43	E-Pump S-4,5,6,7	J-S-4,5,6,7-1	2.8	PVC	120.0	True	0.000	0	0.00	0.000	True	98.00
176	2-inch hose	100.59	E-Pump S-1	J-S-1-1	1.9	PVC	120.0	True	0.000	0	0.00	0.000	True	82.00
178	3-inch hose	98.32	E-Pump S-2,3,4	J-S-2,3,4-1	2.8	PVC	120.0	True	0.000	0	0.00	0.000	True	132.00
179	FM-S-4,5,6,7	32.86	J-S-4,5,6,7-1	J-S-4,5,6,7-2	2.8	PVC	120.0	False	0.000	0	0.00	0.000	True	1.00
180	FM-S-1	37.32	J-S-1-1	J-S-1-2	2.8	PVC	120.0	False	0.000	0	0.00	0.000	True	1.00
181	FM-S-2,3,4	36.85	J-S-2,3,4-1	J-S-2,3,4-2	2.8	PVC	120.0	False	0.000	0	0.00	0.000	True	1.00
182	FM-1	88.29	J-S-2,3,4-2	Tank	2.8	PVC	120.0	False	0.000	92	4.68	0.040	True	1,486.00

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Phases 8/9 and Phase 10 pumps operating

Scenario: Base
Current Time Step: 0.000Hr
FlexTable: Junction Table

ID	Label	Elevation (ft)	Zone	Demand Collection	Demand (gpm)	Hydraulic Grade (ft)	Pressure (psi)
118	J-S-1-2	1,230.00	<None>	<Collection: 0 items>	0	1,334.20	45.1
131	J-S-4,5,6,7-2	1,230.00	<None>	<Collection: 0 items>	0	1,409.07	77.5
138	J-S-2,3,4-2	1,220.00	<None>	<Collection: 0 items>	0	1,219.62	-0.2
149	J-S-10-1	1,279.25	<None>	<Collection: 0 items>	0	1,461.45	78.8
151	J-S-8/9-1	1,249.25	<None>	<Collection: 0 items>	0	1,454.51	88.8
153	J-S-10-2	1,279.25	<None>	<Collection: 0 items>	0	1,461.44	78.8
155	J-S-8/9-2	1,249.25	<None>	<Collection: 0 items>	0	1,454.49	88.8
173	J-S-4,5,6,7-1	1,230.00	<None>	<Collection: 0 items>	0	1,409.07	77.5
175	J-S-1-1	1,230.00	<None>	<Collection: 0 items>	0	1,334.20	45.1
177	J-S-2,3,4-1	1,220.00	<None>	<Collection: 0 items>	0	1,219.62	-0.2

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Phases 8/9 and Phase 10 pumps operating

Scenario: Base
Current Time Step: 0.000Hr
FlexTable: Pump Table

ID	Label	Elevation (ft)	Pump Definition	Status (Initial)	Hydraulic Grade (Suction) (ft)	Hydraulic Grade (Discharge) (ft)	Flow (Total) (gpm)	Pump Head (ft)
147	Pump S-10	1,181.80	Pump S-10	On	1,182.77	1,487.76	30	305.00
148	Pump S-8/9	1,182.90	Pump S-8/9	On	1,183.85	1,484.49	37	300.64
164	E-Pump S-4,5,6,7	1,197.00	Pump S-4,5,6,7	On	1,197.99	1,449.27	33	251.27
165	E-Pump S-1	1,212.00	Pump S-1	Off	1,212.00	1,361.90	0	0.00
166	E-Pump S-2,3,4	1,180.00	Pump S-2,3,4	Off	1,180.00	1,229.10	0	0.00

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Phases 4-7, Phase 8/9, and Phase 10 pumps operating

Scenario: Base
Current Time Step: 0.000Hr
FlexTable: Pipe Table

ID	Label	Length (Scaled) (ft)	Start Node	Stop Node	Diameter (in)	Material	Hazen-Williams C	Has Check Valve?	Minor Loss Coefficient (Local)	Flow (gpm)	Velocity (ft/s)	Headloss Gradient (ft/ft)	Has User Defined Length?	Length (User Defined) (ft)
121	FM-3	35.22	J-S-4,5,6,7-2	J-S-1-2	2.8	PVC	120.0	True	0.000	99	5.07	0.046	True	1,866.00
139	FM-2	31.69	J-S-1-2	J-S-2,3,4-2	2.8	PVC	120.0	True	0.000	99	5.07	0.046	True	2,856.00
144	-	46.87	Sump 10	Pump S-10	1.9	PVC	120.0	False	0.000	30	3.27	0.032	True	1.00
146	-	47.05	Sump 8/9	Pump S-8/9	1.9	PVC	120.0	False	0.000	37	4.08	0.049	True	1.00
150	2-inch hose	101.77	Pump S-10	J-S-10-1	1.9	PVC	120.0	True	0.000	30	3.27	0.032	True	321.00
152	2-inch hose	101.95	Pump S-8/9	J-S-8/9-1	1.9	PVC	120.0	True	0.000	37	4.08	0.049	True	224.00
154	FM-S-12	33.29	J-S-10-1	J-S-10-2	2.8	PVC	120.0	False	0.000	30	1.54	0.005	True	1.00
156	FM-S-8/9	33.55	J-S-8/9-1	J-S-8/9-2	2.8	PVC	120.0	False	0.000	37	1.92	0.008	True	1.00
157	FM-5	25.47	J-S-10-2	J-S-8/9-2	2.8	PVC	120.0	True	0.000	30	1.54	0.005	True	732.00
158	FM-4	27.78	J-S-8/9-2	J-S-4,5,6,7-2	2.8	PVC	120.0	True	0.000	66	3.45	0.023	True	1,075.00
170	-	46.44	Sump 4,5,6,7	E-Pump S-4,5,6,7	2.8	PVC	120.0	False	0.000	33	1.69	0.006	True	1.00
171	-	42.95	Sump 1	E-Pump S-1	1.9	PVC	120.0	False	0.000	0	0.00	0.000	True	1.00
172	-	45.13	Sump 2,3,4	E-Pump S-2,3,4	2.8	PVC	120.0	False	0.000	0	0.00	0.000	True	1.00
174	3-inch hose	101.43	E-Pump S-4,5,6,7	J-S-4,5,6,7-1	2.8	PVC	120.0	True	0.000	33	1.69	0.006	True	98.00
176	2-inch hose	100.59	E-Pump S-1	J-S-1-1	1.9	PVC	120.0	True	0.000	0	0.00	0.000	True	82.00
178	3-inch hose	98.32	E-Pump S-2,3,4	J-S-2,3,4-1	2.8	PVC	120.0	True	0.000	0	0.00	0.000	True	132.00
179	FM-S-4,5,6,7	32.86	J-S-4,5,6,7-1	J-S-4,5,6,7-2	2.8	PVC	120.0	False	0.000	33	1.69	0.006	True	1.00
180	FM-S-1	37.32	J-S-1-1	J-S-1-2	2.8	PVC	120.0	False	0.000	0	0.00	0.000	True	1.00
181	FM-S-2,3,4	36.85	J-S-2,3,4-1	J-S-2,3,4-2	2.8	PVC	120.0	False	0.000	0	0.00	0.000	True	1.00
182	FM-1	88.29	J-S-2,3,4-2	Tank	2.8	PVC	120.0	False	0.000	99	5.07	0.046	True	1,486.00

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Phases 4-7, Phase 8/9, and Phase 10 pump operating

Scenario: Base
Current Time Step: 0.000Hr
FlexTable: Junction Table

ID	Label	Elevation (ft)	Zone	Demand Collection	Demand (gpm)	Hydraulic Grade (ft)	Pressure (psi)
118	J-S-1-2	1,230.00	<None>	<Collection: 0 items>	0	1,361.90	57.1
131	J-S-4,5,6,7-2	1,230.00	<None>	<Collection: 0 items>	0	1,448.67	94.6
138	J-S-2,3,4-2	1,220.00	<None>	<Collection: 0 items>	0	1,229.10	3.9
149	J-S-10-1	1,279.25	<None>	<Collection: 0 items>	0	1,477.34	85.7
151	J-S-8/9-1	1,249.25	<None>	<Collection: 0 items>	0	1,473.55	97.0
153	J-S-10-2	1,279.25	<None>	<Collection: 0 items>	0	1,477.33	85.7
155	J-S-8/9-2	1,249.25	<None>	<Collection: 0 items>	0	1,473.55	97.0
173	J-S-4,5,6,7-1	1,230.00	<None>	<Collection: 0 items>	0	1,448.67	94.6
175	J-S-1-1	1,230.00	<None>	<Collection: 0 items>	0	1,361.90	57.1
177	J-S-2,3,4-1	1,220.00	<None>	<Collection: 0 items>	0	1,229.10	3.9

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Phases 4-7, Phase 8/9, and Phase 10 pumps operating

OBJECTIVE

To size the leachate pumps for use in the sumps of the proposed expansion of the Apex Sanitary Landfill and to evaluate the existing forcemain capacity with the proposed expansion sumps. This calculation considers directing flow from phase 11 to the existing forcemain instead of through the proposed forcemain during phase 11 development. This option will delay the construction of the proposed 4" diameter pipe to the south of the landfill. WaterCAD will be used to model the pumps at Phases 8/9, Phase 10, and Phase 11 functioning in series. The locations of the proposed sumps and force main are shown on Drawings 4D and 4E of the PTI Drawing Package.

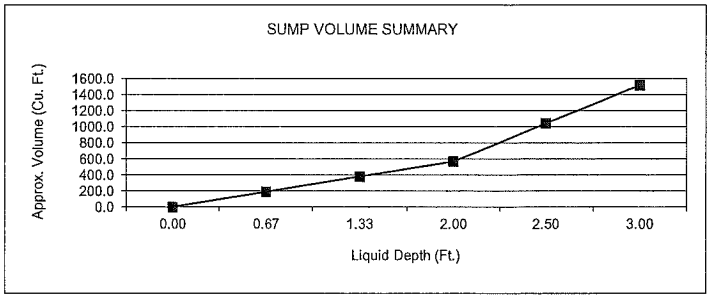
SUMP VOLUME

The respective sumps within the unit are square shaped with 3H:1V inside slopes. The bottom dimensions will be 20-feet by 20-feet and each sump will be 2-ft deep. Each sump area will be backfilled with AASHTO No. 3 (or equivalent) drainage stone. The sump area 1-foot above the crest has been estimated from the drawings. As per standard aggregate parameters, it has been assumed that the drainage stone to be used in the sump has a porosity of 40%.

SUMP VOLUME PARAMETERS	
Sump Bottom Length (L1)	20 Feet
Sump Bottom Width (W1)	20 Feet
Sump Depth (D)	2 Feet
Sump Sideslope (_H:1V)	3 H:1V
Sump Pipe Diameter	2.00 Feet
Sump Pipe Length	10 Feet
Area at 1-foot above sump crest (1)	3,712 Sq-Feet
Drainage Stone Porosity (2)	40%

SUMP VOLUME CALCULATION PARAMETERS	
Sump Top Length (L2)	32 Feet
Sump Top Width (W2)	32 Feet
Sump Bottom Area	400 Sq-Feet
Sump Top Area (3)	1,024 Sq-Feet
Gross Sump Volume (4)	1,375 Cubic-Feet
Sump Pipe Volume (5)	31.4 Cubic-Feet
Net Sump Volume (6)=(4)-(5)	1,344 Cubic-Feet
Sump Liquid Volume (7)=[(6)*(2)]+(5)	569 Cubic-Feet
Volume 1-foot above (8)=0.5*[(1)+(3)]*(2)	947.2 Cubic-Feet

SUMP VOLUME	
Liquid Depth (Feet)	Approximate Volume (Cubic-Feet)
0.00	0.0
0.67	190.6
1.33	378.4
2.00	569.0
2.50	1042.6
3.00	1516.2



The sump depression for this design is 2-foot deep. The operational volume of the sump will be calculated to 1-foot above the crest of the sump, total depth of 3-feet.

INITIAL PUMP SELECTION

The size of the pump will initially be chosen by plotting the sump inflow rate versus the Total Dynamic Head (TDH) for the phase 11 sump against the manufacturer performance curve. This calcululation uses leachate production when the leachate drainage aggregate has permeability of 0.1 cm/sec for conservatism.

SUMP INFLOW RATES					
Sump Location	Leachate Production (gal/ac/day)*	Contributing Area (ac)	Total Ave. Leachate (gal/day)	Total Ave. Leachate (gpm)	
Phase 11	1,651	16.7	27,572	19.1	
	1,496	15.1	22,590	15.7	
			Total Flow	**34.8**	**GPM**

*The Average Annual Leachate production was converted to a daily flow rate (gal/ac/day) using a multiplier of 6 as outlined in Ohio EPA Document #0528.

The TDH calculation accounts for static (elevation) head, losses due to friction (as a function of flowrate) and minor losses resulting from fittings.

$$TDH = H_s + H_f + H_m$$

Where

$$H_s = StaticHead, Feet$$

$$H_f = FrictionHeadLoss, Feet$$

$$H_f = \frac{L}{100} * 0.2083 * \frac{100^{1.85} * Q^{1.85}}{C^{1.85} * D^{4.87}}$$

$$H_m = MinorHeadLoss, Feet$$

$$H_m = \frac{V^2}{2g}\sum K_i = \frac{16Q^2(\frac{cfs}{448.8gpm})^2}{2g\pi^2(D\frac{ft}{12in})^4} = \frac{0.0252KQ^2(\frac{cfs}{448.8gpm})^2}{(D\frac{ft}{12in})^4}$$

Where

L = Length, Feet

Q = Flowrate, gpm

K = Minor loss coefficient

C = Hazen Williams Roughness

D = Inside Diameter, Inch

PUMP DESIGN PARAMETERS	
Sump Invert Elevation *	1175.4 Feet
Maximum Elevation *	1289.3 Feet
Hose Length (sump to landfill crest) *	369 Feet
Hose Diameter	1.92 Inch
Hose Roughness C	120
Pipe Length	10,212 Feet
Pipe Diameter **	2.83 Inch
Pipe Roughness C	120
Sump Inflow Rate	34.8 GPM
Sump Inflow Rate (worst case)	0.078 CFS

* Elevations and hose length are taken from the PTI Drawing Package.

** Existing pipe consists of 3-inch diameter HDPE SDR 11.

MINOR LOSS CALCULATION, e			
FITTING	**K - FACTOR**	**QUANTITY**	**TOTAL - K**
Entrance	0.50	1	0.50
Outlet	1.00	1	1.00
90 Degree Elbow	0.30	4	1.20
45 Degree Elbow	0.36	4	1.44
Check Valve	2.50	4	10.00
		Minor Loss Parameter K	**14.14**

Minor loss items assumed from standard leachate management system installation.

Based on the flow conditions for the phase 11 sump:

PUMP TDH CALCULATION					
Static Head (Feet)	Flow Rate (GPM)	Hf, Friction Head Loss		Total Hm Minor Losses (Feet)	TDH (Feet)
		Hose (Feet)	Pipe (Feet)		
113.9	34.8	16.43	68.23	0.69	199.20

For a single pump operating at the phase 11 sump, the pump shall be capable of pumping 35 GPM at a TDH of 199 feet. According to the EPG pump curve, a EPG Series 30-4 7.5 HP pump would meet these requirements for a single pump operating. In reality, the proposed pumps at the phase 8/9 sump, phase 10 sump, and phase 11 sump will likely be operating in series. A WaterCAD analysis will be performed to model the pumps operating in series.

Since the pumps at the existing sumps for phases 1 through 3 (leachate sump Nos. 1 and 2) and phases 4 through 7 (leachate sump No. 3) will have been under final cover conditions for an extended period of time when phases 8, 9, 10, and 11 are constructed, minimal leachate generation is anticipated; therefore these pumps will not be evaluated in series. The Leachate Generation Calculation presented in Section (C)(5)(c) shows that the leachate generation is minimal when the landfill is under final cover conditions. A WaterCAD analysis will be performed to model the pumps at the phases 8/9 sump, phase 10 sump, and phase 11 sump opreating in series.

WATERCAD ANALYSIS

A model of the pumps in Phases 8/9, 10, and 11 sumps operating in sereis was analyzed in WaterCAD. An initial analysis was performed using the design flow specified above and the TDH associated with the flow for the EPG Series 30-4 7.5 HP pump. When all pumps were operating, this pump did not provide the required flow at the phase 11 sump. An additional analysis was performed and it was determined that the EPG Series 30-7 15 HP pump (or equal) would provide the required capacity at the Phase 11 sump. Refer to Attachment 1 for the Pump Curves, Attachment 2 for a summary table of the WaterCAD analysis results, and Attachment 3 for the WaterCAD Analysis results.

PUMP OPERATION

ESTIMATED PUMP OPERATION PARAMETERS	
Pump On Depth	2.0 Feet
Pump Off Depth	0.5 Feet
Approximate Operating Pump Discharge	72.0 GPM*

*Discharge rate is based on pump flow rate of 72 GPM for the EPG Series 30-7 pump at the phase 11 sump operating.

ESTIMATED PUMP OPERATION SUMMARY	
Approximate Operating Pump Discharge	0.160 CFS
Volume @ Pump On Depth (A)	569.0 Cubic-Feet
Area of Pipe	0.044 ft^2
Volume @ Pump Off Depth (B)	142.3 Cubic-Feet
Operational Volume (C)=(A)-(B)	426.8 Cubic-Feet
Pump Run Time (Accounting for Peak Inflow)	85.9 Minutes
Pump Run Time (Accounting for No Inflow)	44.3 Minutes
Sump Fill Time	91.6 Minutes

CONCLUSIONS

An EPG Series 30-7 15 HP pump (or equal) shall be utilized at the Phase 11 sump if the flow from Phase 11 is pumped to the existing forcemain. The EPG Series 30-6 15 HP pump (or equal) shall be utilized at the Phase 10 sump and the Phases 8/9 sump. The existing forcemain network is a 3" diameter HDPE SDR-11 pipe. The proposed segments of the force main network will also use a 3" diameter SDR-11 pipe. The 3" diameter HDPE SDR-11 pipe meets the design requiremements for pressure.

REFERENCES

1. Metcalf & Eddy, Inc. WASTEWATER ENGINEERING: Collection and Pumping of Wastewater, McGraw Hill, New York, 1981.

2. Chevron/Plexco, PLEXCO PIPING SYSTEMS MANUAL.

3. Phillips Driscopipe, Inc., DRISCO PIPE MANUAL.

4. Grundfos USA, SQ SQE SP PRODUCT GUIDE.

5. Plastics Pipe Institute, HANDBOOK OF POLYETHYLENE PIPE.

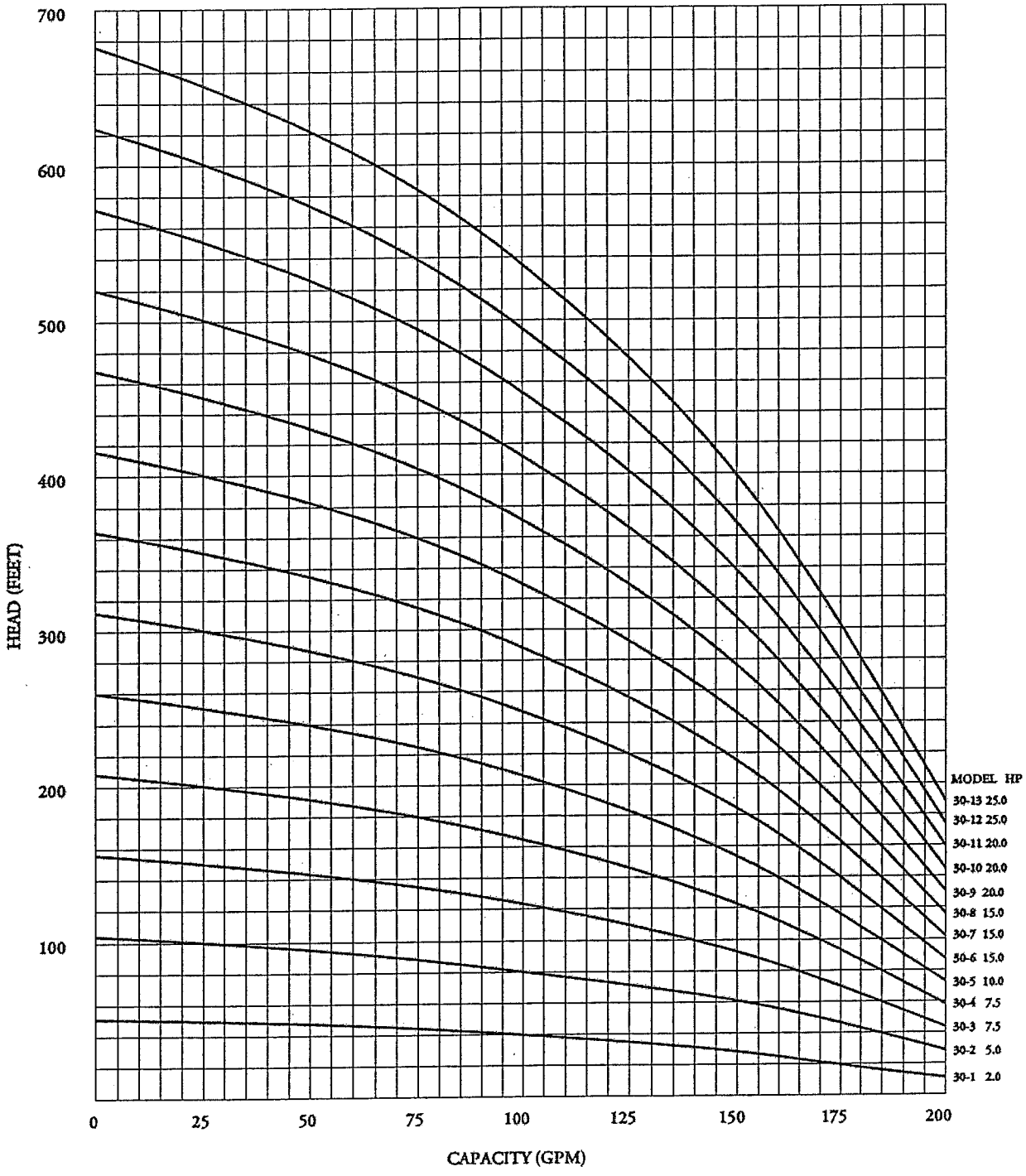
6. Bentley WaterCAD V8i (SELECTseries 3). Haestad Methods Solution Center.

ATTACHMENT 1
PUMP CURVES

SERIES 30 SurePump™

Flow Range 50-200 GPM

60 Hz



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ATTACHMENT 2
WATERCAD ANALYSIS RESULTS SUMMARY TABLE

WaterCAD Analysis Results-Summary Table
Existing forcemain with Phase 11 Sump
Apex Sanitary Landfill

Table 1 - Estimated Required Flows
Phases 8/9, Phase 10, and Phase 11 sumps

Sump Location	Estimated Flow Rate into sump (GPM)
Phase 8/9 sump	34.8
Phase 10 sump	36.5
Phase 11 sump	45.0

Table 2 - Pumps Operating: Existing 3-inch diameter forcemain
Phases 8/9, Phase 10, and Phase 11 pumps

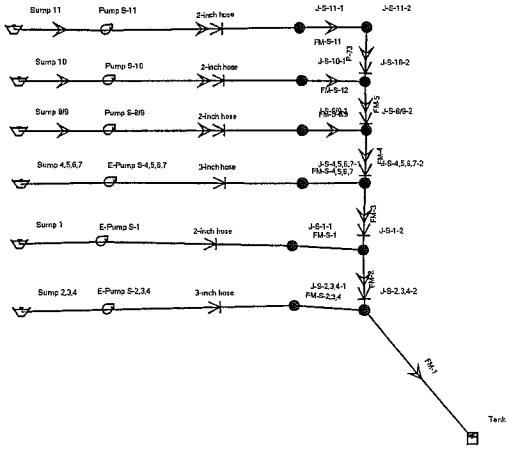
	Phase 8/9 pump			Phase 10 pump			Phase 11 pump			Velocities (ft/s)	
	Calculated Flow (gpm)	Calculated TDH (feet)	Calculated Pressure (lb/in2)	Calculated Flow (gpm)	Calculated TDH (feet)	Calculated Pressure (lb/in2)	Calculated Flow (gpm)	Calculated TDH (feet)	Calculated Pressure (lb/in2)	Calculated Maximum (ft/s)	Calculated Minimum (ft/s)
Phase 8/9 pump operating	82	262	113	--	--	--	--	--	--	4.26	4.17
Phase 10 pump operating	--	--	--	76	268	115	--	--	--	3.96	3.88
Phase 11 pump operating	--	--	--	--	--	--	72	313	135	3.74	3.66
All pumps operating	37	301	129	21	309	133	37	347	149	4.95	1.94

Notes:
-- Pump was not running during the analysis

1. This evaluation shows that with EPG Series 30-7 15 HP pump at the phase 11 sump and the EPG Series 30-6 15 HP pumps at the phase 10 and phases 8/9 sumps, the pumps will continue to discharge leachate even if below the estimated inflow rate.
2. Based on the TDH of the pumps when operating, the maximum pipe pressure can be determined assuming that 0.43 psi = 1 foot of head. The pressures obtained do not exceed the maximum design criteria of 160 psi.
3. WaterCAD provides the velocities in the pipes when the pumps are operating. WaterCAD shows that the velocity is greater than 2 ft/s when one pump is operating, which is above the 2.0 ft/s suggested to prevent solids deposition in the pipe.

ATTACHMENT 3
WATERCAD ANALYSIS RESULTS

Scenario: Base



Scenario: Base
Current Time Step: 0.000Hr
FlexTable: Pump Table

ID	Label	Elevation (ft)	Pump Definition	Status (Initial)	Hydraulic Grade (Suction) (ft)	Hydraulic Grade (Discharge) (ft)	Flow (Total) (gpm)	Pump Head (ft)
147	Pump S-10	1,181.80	Pump S-10	Off	1,182.80	1,397.41	0	0.00
148	Pump S-8/9	1,182.90	Pump S-8/9	On	1,183.69	1,445.39	82	261.71
164	E-Pump S-4,5,6,7	1,197.00	Pump S-4,5,6,7	Off	1,198.00	1,360.79	0	0.00
165	E-Pump S-1	1,212.00	Pump S-1	Off	1,212.00	1,300.44	0	0.00
166	E-Pump S-2,3,4	1,180.00	Pump S-2,3,4	Off	1,180.00	1,208.06	0	0.00
184	Pump S-11	1,175.40	Pump S-11	Off	1,176.40	1,397.41	0	0.00

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Phases 8/9 pump operating

Scenario: Base
Current Time Step: 0.000Hr
FlexTable: Pump Table

ID	Label	Elevation (ft)	Pump Definition	Status (Initial)	Hydraulic Grade (Suction) (ft)	Hydraulic Grade (Discharge) (ft)	Flow (Total) (gpm)	Pump Head (ft)
147	Pump S-10	1,181.80	Pump S-10	On	1,182.61	1,450.20	76	267.59
148	Pump S-8/9	1,182.90	Pump S-8/9	Off	1,183.90	1,368.09	0	0.00
164	E-Pump S-4,5,6,7	1,197.00	Pump S-4,5,6,7	Off	1,198.00	1,335.99	0	0.00
165	E-Pump S-1	1,212.00	Pump S-1	Off	1,212.00	1,283.09	0	0.00
166	E-Pump S-2,3,4	1,180.00	Pump S-2,3,4	Off	1,180.00	1,202.13	0	0.00
184	Pump S-11	1,175.40	Pump S-11	Off	1,176.40	1,389.95	0	0.00

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Phase 10 pump operating

Scenario: Base
Current Time Step: 0.000Hr
FlexTable: Pump Table

ID	Label	Elevation (ft)	Pump Definition	Status (Initial)	Hydraulic Grade (Suction) (ft)	Hydraulic Grade (Discharge) (ft)	Flow (Total) (gpm)	Pump Head (ft)
147	Pump S-10	1,181.80	Pump S-10	Off	1,182.80	1,366.41	0	0.00
148	Pump S-8/9	1,182.90	Pump S-8/9	Off	1,183.90	1,346.79	0	0.00
164	E-Pump S-4,5,6,7	1,197.00	Pump S-4,5,6,7	Off	1,198.00	1,317.97	0	0.00
165	E-Pump S-1	1,212.00	Pump S-1	Off	1,212.00	1,270.49	0	0.00
166	E-Pump S-2,3,4	1,180.00	Pump S-2,3,4	Off	1,180.00	1,197.81	0	0.00
184	Pump S-11	1,175.40	Pump S-11	On	1,176.23	1,489.06	72	312.84

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Phase II pump operating

Scenario: Base
Current Time Step: 0.000Hr
FlexTable: Pump Table

ID	Label	Elevation (ft)	Pump Definition	Status (Initial)	Hydraulic Grade (Suction) (ft)	Hydraulic Grade (Discharge) (ft)	Flow (Total) (gpm)	Pump Head (ft)
147	Pump S-10	1,181.80	Pump S-10	On	1,182.78	1,492.13	21	309.34
148	Pump S-8/9	1,182.90	Pump S-8/9	On	1,183.85	1,484.42	37	300.56
164	E-Pump S-4,5,6,7	1,197.00	Pump S-4,5,6,7	Off	1,198.00	1,425.06	0	0.00
165	E-Pump S-1	1,212.00	Pump S-1	Off	1,212.00	1,345.39	0	0.00
166	E-Pump S-2,3,4	1,180.00	Pump S-2,3,4	Off	1,180.00	1,223.45	0	0.00
184	Pump S-11	1,175.40	Pump S-11	On	1,176.35	1,522.86	37	346.51

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Phases 8/9, Phase 10, and Phase 11 pumps operating

Scenario: Base
Current Time Step: 0.000Hr
FlexTable: Pipe Table

ID	Label	Length (Scaled) (ft)	Start Node	Stop Node	Diameter (in)	Material	Hazen-Williams C	Has Check Valve?	Minor Loss Coefficient (Local)	Flow (gpm)	Velocity (ft/s)	Headloss Gradient (ft/ft)	Has User Defined Length?	Length (User Defined) (ft)
121	FM-3	35.22	J-S-4,5,6,7-2	J-S-1-2	2.8	PVC	120.0	True	0.000	95	4.84	0.043	True	1,866.00
139	FM-2	31.69	J-S-1-2	J-S-2,3,4-2	2.8	PVC	120.0	True	0.000	95	4.84	0.043	True	2,856.00
144	-	46.87	Sump 10	Pump S-10	1.9	PVC	120.0	False	0.000	21	2.31	0.017	True	1.00
146	-	47.05	Sump 8/9	Pump S-8/9	1.9	PVC	120.0	False	0.000	37	4.09	0.049	True	1.00
150	2-inch hose	101.77	Pump S-10	J-S-10-1	1.9	PVC	120.0	True	0.000	21	2.31	0.017	True	321.00
152	2-inch hose	101.95	Pump S-8/9	J-S-8/9-1	1.9	PVC	120.0	True	0.000	37	4.09	0.049	True	224.00
154	FM-S-12	33.29	J-S-10-1	J-S-10-2	2.8	PVC	120.0	False	0.000	21	1.09	0.003	True	1.00
156	FM-S-8/9	33.55	J-S-8/9-1	J-S-8/9-2	2.8	PVC	120.0	False	0.000	37	1.92	0.008	True	1.00
157	FM-5	25.47	J-S-10-2	J-S-8/9-2	2.8	PVC	120.0	True	0.000	58	3.02	0.018	True	732.00
158	FM-4	27.78	J-S-8/9-2	J-S-4,5,6,7-2	2.8	PVC	120.0	True	0.000	95	4.95	0.045	True	1,075.00
170	-	46.44	Sump 4,5,6,7	E-Pump S-4,5,6,7	2.8	PVC	120.0	False	0.000	0	0.00	0.000	True	1.00
171	-	42.95	Sump 1	E-Pump S-1	1.9	PVC	120.0	False	0.000	0	0.00	0.000	True	1.00
172	-	45.13	Sump 2,3,4	E-Pump S-2,3,4	2.8	PVC	120.0	False	0.000	0	0.00	0.000	True	1.00
174	3-inch hose	101.43	E-Pump S-4,5,6,7	J-S-4,5,6,7-1	2.8	PVC	120.0	True	0.000	0	0.00	0.000	True	98.00
176	2-inch hose	100.59	E-Pump S-1	J-S-1-1	1.9	PVC	120.0	True	0.000	0	0.00	0.000	True	82.00
178	3-inch hose	98.32	E-Pump S-2,3,4	J-S-2,3,4-1	2.8	PVC	120.0	True	0.000	0	0.00	0.000	True	132.00
179	FM-S-4,5,6,7	32.86	J-S-4,5,6,7-1	J-S-4,5,6,7-2	2.8	PVC	120.0	False	0.000	0	0.00	0.000	True	1.00
180	FM-S-1	37.32	J-S-1-1	J-S-1-2	2.8	PVC	120.0	False	0.000	0	0.00	0.000	True	1.00
181	FM-S-2,3,4	36.85	J-S-2,3,4-1	J-S-2,3,4-2	2.8	PVC	120.0	False	0.000	0	0.00	0.000	True	1.00
182	FM-1	88.29	J-S-2,3,4-2	Tank	2.8	PVC	120.0	False	0.000	95	4.84	0.043	True	1,486.00
185	-	48.30	Sump 11	Pump S-11	1.9	PVC	120.0	False	0.000	37	4.16	0.051	True	1.00
187	2-inch hose	101.84	Pump S-11	J-S-11-1	1.9	PVC	120.0	True	0.000	37	4.16	0.051	True	369.00
189	FM-S-11	35.28	J-S-11-1	J-S-11-2	2.8	PVC	120.0	False	0.000	37	1.94	0.008	True	1.00
190	P-73	28.75	J-S-11-2	J-S-10-2	2.8	PVC	120.0	True	0.000	37	1.94	0.008	True	2,197.00

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Phases 8/9, Phase 10, and Phase 11 pumps operating

Scenario: Base
Current Time Step: 0.000Hr
FlexTable: Junction Table

ID	Label	Elevation (ft)	Zone	Demand Collection	Demand (gpm)	Hydraulic Grade (ft)	Pressure (psi)
118	J-S-1-2	1,230.00	<None>	<Collection: 0 items>	0	1,345.39	49.9
131	J-S-4,5,6,7-2	1,230.00	<None>	<Collection: 0 items>	0	1,425.06	84.4
138	J-S-2,3,4-2	1,220.00	<None>	<Collection: 0 items>	0	1,223.45	1.5
149	J-S-10-1	1,279.25	<None>	<Collection: 0 items>	0	1,486.64	89.7
151	J-S-8/9-1	1,249.25	<None>	<Collection: 0 items>	0	1,473.42	97.0
153	J-S-10-2	1,279.25	<None>	<Collection: 0 items>	0	1,486.64	89.7
155	J-S-8/9-2	1,249.25	<None>	<Collection: 0 items>	0	1,473.41	97.0
173	J-S-4,5,6,7-1	1,230.00	<None>	<Collection: 0 items>	0	1,425.06	84.4
175	J-S-1-1	1,230.00	<None>	<Collection: 0 items>	0	1,345.39	49.9
177	J-S-2,3,4-1	1,220.00	<None>	<Collection: 0 items>	0	1,223.45	1.5
186	J-S-11-1	1,289.25	<None>	<Collection: 0 items>	0	1,504.04	92.9
188	J-S-11-2	1,289.25	<None>	<Collection: 0 items>	0	1,504.03	92.9

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Phases 8/9, Phase 10, and Phase 11 pumps operating

OBJECTIVE

To size the leachate pumps for use in the sumps and the proposed forcemain of the proposed expansion of the Apex Sanitary Landfill. This calculation considers the pumps at Phases 11 through 13 sumps. WaterCAD will be used to model the pumps functioning in series. The locations of the sumps and force main are shown on Drawings 4D and 4E of the PTI Drawing Package.

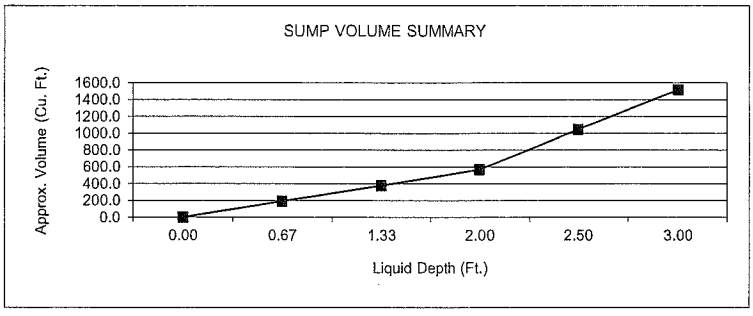
SUMP VOLUME

The respective sumps within the unit will be square shaped with 3H:1V inside slopes. The bottom dimensions will be 20-feet by 20-feet and each sump will be 2-ft deep. Each sump area will be backfilled with AASHTO No. 3 (or equivalent) drainage stone. The sump area 1-foot above the crest has been estimated from the drawings. As per standard aggregate parameters, it has been assumed that the drainage stone to be used in the sump has a porosity of 40%.

SUMP VOLUME PARAMETERS	
Sump Bottom Length (L1)	20 Feet
Sump Bottom Width (W1)	20 Feet
Sump Depth (D)	2 Feet
Sump Sideslope (_H:1V)	3 H:1V
Sump Pipe Diameter	2.00 Feet
Sump Pipe Length	10 Feet
Area at 1-foot above sump crest (1)	3,712 Sq-Feet
Drainage Stone Porosity (2)	40%

SUMP VOLUME CALCULATION PARAMETERS	
Sump Top Length (L2)	32 Feet
Sump Top Width (W2)	32 Feet
Sump Bottom Area	400 Sq-Feet
Sump Top Area (3)	1,024 Sq-Feet
Gross Sump Volume (4)	1,375 Cubic-Feet
Sump Pipe Volume (5)	31.4 Cubic-Feet
Net Sump Volume (6)=(4)-(5)	1,344 Cubic-Feet
Sump Liquid Volume (7)=[(6)*(2)]+(5)	569 Cubic-Feet
Volume 1-foot above (8)=0.5*[(1)+(3)]*(2)	947.2 Cubic-Feet

SUMP VOLUME	
Liquid Depth (Feet)	Approximate Volume (Cubic-Feet)
0.00	0.0
0.67	190.6
1.33	378.4
2.00	569.0
2.50	1042.6
3.00	1516.2



The sump depression for this design is 2-foot deep. The operational volume of the sump will be calculated to 1-foot above the crest of the sump, total depth of 3-feet.

INITIAL PUMP SELECTION

The size of the pump will initially be chosen by plotting the sump inflow rate versus the Total Dynamic Head (TDH) for the phase 11 sump against the manufacturer performance curve. This calculation initially considers the phase 11 sump to choose the pump because the sump will have a large flow and the longest force main pipe distance from the leachate storage tank. This calcululation uses leachate production when the leachate drainage aggregate has permeability of 0.1 cm/sec for conservatism.

SUMP INFLOW RATES					
Sump Location	Leachate Production (gal/ac/day)*	Contributing Area (ac)	Total Ave. Leachate (gal/day)	Total Ave. Leachate (gpm)	
Phase 11	1,651	16.7	27,572	19.1	
	1,496	15.1	22,590	15.7	
			Total Flow	**34.8**	**GPM**

*The Average Annual Leachate production was converted to a daily flow rate (gal/ac/day) using a multiplier of 6 as outlined in Ohio EPA Document #0528.

The TDH calculation accounts for static (elevation) head, losses due to friction (as a function of flowrate) and minor losses resulting from fittings.

$$TDH = H_s + H_f + H_m$$

Where

$$H_s = StaticHead, Feet$$

$$H_f = FrictionHeadLoss, Feet$$

$$H_f = \frac{L}{100} * 0.2083 * \frac{100^{1.85} * Q^{1.85}}{C^{1.85} * D^{4.87}}$$

$$H_m = MinorHeadLoss, Feet$$

$$H_m = \frac{V^2}{2g}\sum K_i = \frac{16Q^2(\frac{cfs}{448.8gpm})^2}{2g\pi^2(D\frac{ft}{12in})^4} = \frac{0.0252KQ^2(\frac{cfs}{448.8gpm})^2}{(D\frac{ft}{12in})^4}$$

Where

L = Length, Feet
Q = Flowrate, gpm
K = Minor loss coefficient
C = Hazen Williams Roughness
D = Inside Diameter, Inch

PUMP DESIGN PARAMETERS	
Sump Invert Elevation *	1175.4 Feet
Maximum Elevation *	1289.3 Feet
Hose Length (sump to landfill crest) *	369 Feet
Hose Diameter	1.92 Inch
Hose Roughness C	120
Pipe Length	8,059 Feet
Pipe Diameter **	3.63 Inch
Pipe Roughness C	120
Sump Inflow Rate	34.8 GPM
Sump Inflow Rate (worst case)	0.078 CFS

* Elevations and hose length are taken from the PTI Drawing Package.
** Pipe consists of 4-inch diameter HDPE SDR 11.

MINOR LOSS CALCULATION, e			
FITTING	K - FACTOR	QUANTITY	TOTAL - K
Entrance	0.50	1	0.50
Outlet	1.00	1	1.00
90 Degree Elbow	0.30	4	1.20
45 Degree Elbow	0.36	4	1.44
Check Valve	2.50	4	10.00
		Minor Loss Parameter K	**14.14**

Minor loss items assumed from standard leachate management system installation.

Based on the flow conditions for the phase 11 sump:

PUMP TDH CALCULATION					
Static Head (Feet)	Flow Rate (GPM)	Hf, Friction Head Loss		Total Hm Minor Losses (Feet)	TDH (Feet)
		Hose (Feet)	Pipe (Feet)		
113.8	34.8	16.43	16.02	0.26	146.52

For a single pump operating at the phase 11 sump, the pump shall be capable of pumping 35 GPM at a TDH of 147 feet. According to the EPG pump curve, a EPG Series 30-5 10 HP pump would meet these requirements for a single pump operating. In reality, the proposed pumps at the phase 11 sump, phase 12 sump, and phase 13 sump will likely be operating in series. A WaterCAD analysis will be performed to model the pumps operating in series.

WATERCAD ANALYSIS

A model of the pumps in Phases 11, 12 and 13 sumps operating in series was analyzed in WaterCAD. An initial analysis was performed using the design flow specified above and the TDH associated with the flow for the EPG Series 30-5 10HP pump. When all pumps were operating, this pump barely provided the flow required at the phase 11 sump. An additional analysis was performed and it was determined that the EPG-6 15HP (or equal) pump provides the required capacity. Refer to Attachment 1 for the Pump Curves, Attachment 2 for a summary table of the WaterCAD analysis results, and Attachment 3 for the WaterCAD analysis results.

PUMP OPERATION

ESTIMATED PUMP OPERATION PARAMETERS	
Pump On Depth	2.0 Feet
Pump Off Depth	0.5 Feet
Approximate Operating Pump Discharge	99.0 GPM*

*Discharge rate is based on pump flow rate of 99 GPM for the EPG-Series 30-6 pump at the phase 11 sump operating.

ESTIMATED PUMP OPERATION SUMMARY	
Approximate Operating Pump Discharge	0.221 CFS
Volume @ Pump On Depth (A)	569.0 Cubic-Feet
Area of Pipe	0.072 ft^2
Volume @ Pump Off Depth (B)	142.3 Cubic-Feet
Operational Volume (C)=(A)-(B)	426.8 Cubic-Feet
Pump Run Time (Accounting for Peak Inflow)	49.7 Minutes
Pump Run Time (Accounting for No Inflow)	32.2 Minutes
Sump Fill Time	91.6 Minutes

CONCLUSIONS

An EPG Series 30-6 15 HP pump (or equal) shall be utilized at the Phases 8/9, Phase 10, and Phase 11 sumps. The force main network using a 4" diameter HDPE SDR-11 pipe from the sump to the leachate storage tank meets the design requiremements for pressure.

REFERENCES

1. Metcalf & Eddy, Inc. WASTEWATER ENGINEERING: Collection and Pumping of Wastewater, McGraw Hill, New York, 1981.

2. Chevron/Plexco, PLEXCO PIPING SYSTEMS MANUAL.

3. Phillips Driscopipe, Inc., DRISCO PIPE MANUAL.

4. Grundfos USA, SQ SQE SP PRODUCT GUIDE.

5. Plastics Pipe Institute, HANDBOOK OF POLYETHYLENE PIPE.

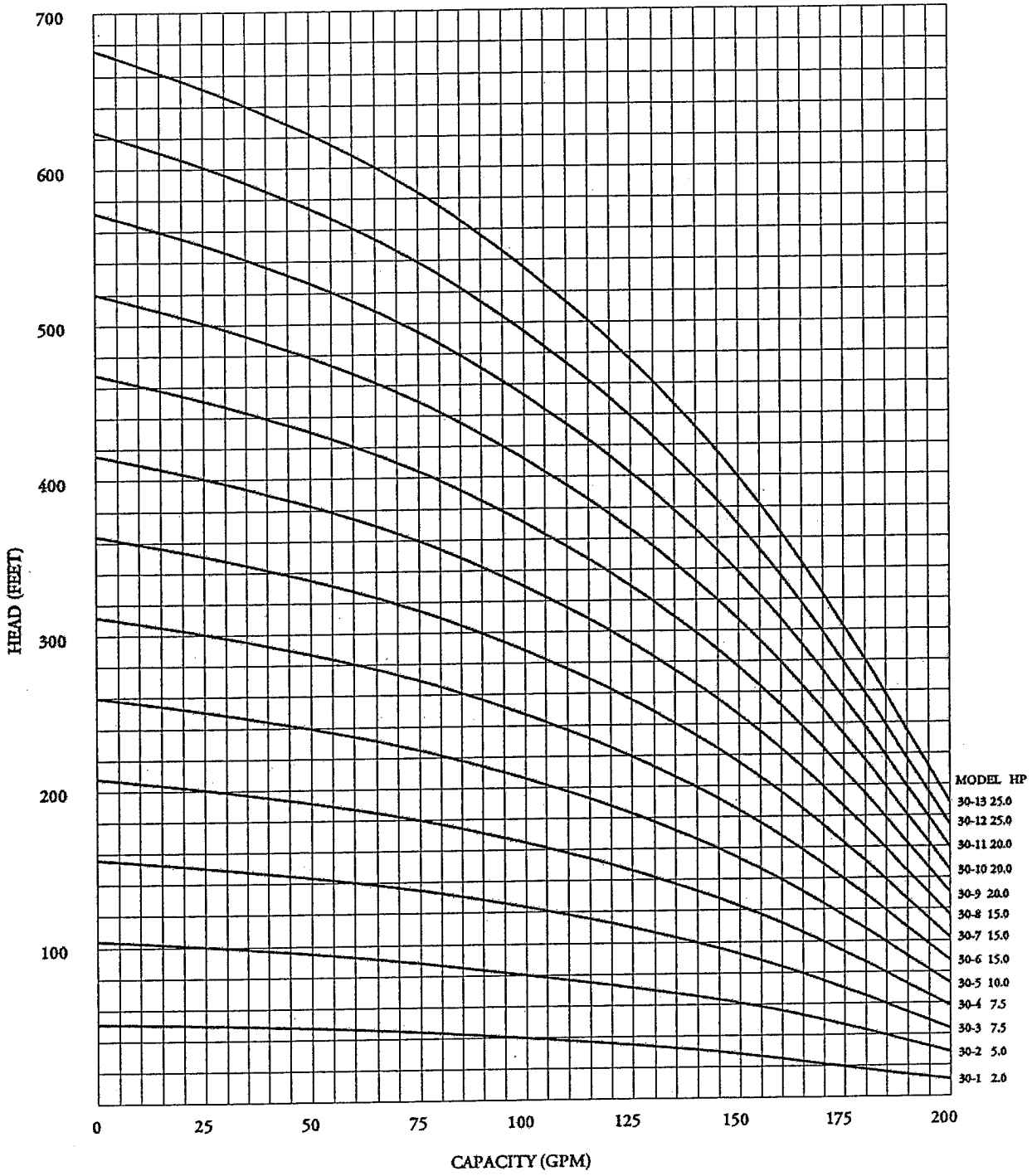
6. Bentley WaterCAD V8i (SELECTseries 3). Haestad Methods Solution Center.

ATTACHMENT 1
PUMP CURVES

SERIES 30 SurePump™

Flow Range 50-200 GPM

60 Hz



DATA SUBJECT TO CHANGE WITHOUT NOTICE

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ATTACHMENT 2
WATERCAD ANALYSIS RESULTS SUMMARY TABLE

WaterCAD Analysis Results-Summary Table
Existing forcemain and Phase 11 Sump
Apex Sanitary Landfill

Table 1 - Estimated Required Flows
Phase 11, Phase 12, and Phase 13 sumps

Sump Location	Estimated Flow Rate into sump (GPM)
Phase 11 sump	34.8
Phase 12 sump	34.9
Phase 13 sump	22.4

Table 2 - Pumps Operating: Existing 3-inch diameter forcemain
Phase 11, Phase 12, and Phase 13 sump

	Phase 11 pump			Phase 12 pump			Phase 13 pump			Velocities (ft/s)	
	Calculated Flow (gpm)	Calculated TDH (feet)	Calculated Pressure (lb/in2)	Calculated Flow (gpm)	Calculated TDH (feet)	Calculated Pressure (lb/in2)	Calculated Flow (gpm)	Calculated TDH (feet)	Calculated Pressure (lb/in2)	Calculated Maximum (ft/s)	Calculated Minimum (ft/s)
Phase 11 pump operating	99	211	91	--	--	--	--	--	--	3.11	3.11
Phase 12 pump operating	--	--	--	103	206	89	--	--	--	3.24	3.24
Phase 13 pump operating	--	--	--	--	--	--	112	194	83	3.54	3.54
All pumps operating	57	259	111	60	256	110	77	236	101	6.09	1.79

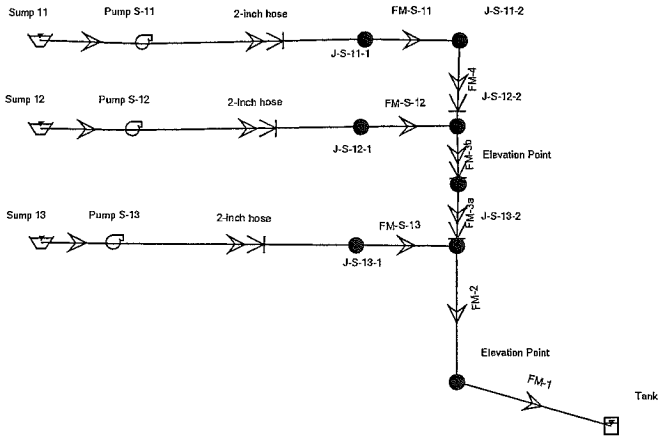
Notes:

-- Pump was not running during the analysis

1. Based on the results in the table above, the EPG-6 15 HP pump provides the required flow rate at the associated TDH at each sump.
2. Based on the TDH of the pumps when operating, the maximum pipe pressure can be determined assuming that 0.43 psi = 1 foot of head. The pressures obtained do not exceed the maximum pressure design criteria of 160 psi.
3. While the minimum velocity in pipe segments are lower than 2 ft/s with the three pumps running simultaneously, WaterCAD shows that the velocity is greater than 2 ft/s when one pumps is operating, which is suggested velocity to prevent solids deposition in the pipe.

ATTACHMENT 3
WATERCAD ANALYSIS RESULTS

Scenario: Base



Scenario: Base
Current Time Step: 0.000Hr
FlexTable: Pump Table

ID	Label	Elevation (ft)	Pump Definition	Status (Initial)	Hydraulic Grade (Suction) (ft)	Hydraulic Grade (Discharge) (ft)	Flow (Total) (gpm)	Pump Head (ft)
25	Pump S-12	1,175.40	Pump S-12	Off	1,176.40	1,237.34	0	0.00
26	Pump S-13	1,194.60	Pump S-13	Off	1,195.60	1,215.11	0	0.00
85	Pump S-11	1,175.40	Pump S-11	On	1,176.09	1,387.00	99	210.90

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Phase II pump operating

Scenario: Base
Current Time Step: 0.000Hr
FlexTable: Pump Table

ID	Label	Elevation (ft)	Pump Definition	Status (Initial)	Hydraulic Grade (Suction) (ft)	Hydraulic Grade (Discharge) (ft)	Flow (Total) (gpm)	Pump Head (ft)
25	Pump S-12	1,175.40	Pump S-12	On	1,176.07	1,381.97	103	205.90
26	Pump S-13	1,194.60	Pump S-13	Off	1,195.60	1,219.50	0	0.00
85	Pump S-11	1,175.40	Pump S-11	Off	1,176.40	1,243.50	0	0.00

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Phase 12 pump operating

Scenario: Base
Current Time Step: 0.000Hr
FlexTable: Pump Table

ID	Label	Elevation (ft)	Pump Definition	Status (Initial)	Hydraulic Grade (Suction) (ft)	Hydraulic Grade (Discharge) (ft)	Flow (Total) (gpm)	Pump Head (ft)
25	Pump S-12	1,175.40	Pump S-12	Off	1,176.40	1,230.08	0	0.00
26	Pump S-13	1,194.60	Pump S-13	On	1,195.21	1,389.63	112	194.42
85	Pump S-11	1,175.40	Pump S-11	Off	1,176.40	1,230.08	0	0.00

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Phase 13 pump operating

Scenario: Base
Current Time Step: 0.000Hr
FlexTable: Pump Table

ID	Label	Elevation (ft)	Pump Definition	Status (Initial)	Hydraulic Grade (Suction) (ft)	Hydraulic Grade (Discharge) (ft)	Flow (Total) (gpm)	Pump Head (ft)
25	Pump S-12	1,175.40	Pump S-12	On	1,176.28	1,432.47	60	256.19
26	Pump S-13	1,194.60	Pump S-13	On	1,195.41	1,431.56	77	236.15
85	Pump S-11	1,175.40	Pump S-11	On	1,176.29	1,435.70	57	259.41

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Phase 11, Phase 12, and Phase 13 pumps operating

Scenario: Base
Current Time Step: 0.000Hr
FlexTable: Pipe Table

ID	Label	Length (Scaled) (ft)	Start Node	Stop Node	Diameter (in)	Material	Hazen-Williams C	Has Check Valve?	Minor Loss Coefficient (Local)	Flow (gpm)	Velocity (ft/s)	Headloss Gradient (ft/ft)	Has User Defined Length?	Length (User Defined) (ft)
33	-	33.34	Sump 12	Pump S-12	1.9	PVC	120.0	False	0.000	60	6.62	0.120	True	1.00
42	-	26.07	Sump 13	Pump S-13	1.9	PVC	120.0	False	0.000	77	8.58	0.194	True	1.00
46	FM-2	48.93	J-S-13-2	Elevation Point	3.6	PVC	120.0	False	0.000	193	6.09	0.049	True	1,302.00
54	2-inch hose	86.96	Pump S-13	J-S-13-1	1.9	PVC	120.0	True	0.000	77	8.58	0.194	True	391.00
55	FM-S-13	36.26	J-S-13-1	J-S-13-2	3.6	PVC	120.0	False	0.000	77	2.43	0.009	True	427.00
66	FM-1	57.27	Elevation Point	Tank	3.6	PVC	120.0	False	0.000	193	6.09	0.049	True	2,584.00
110	2-inch hose	79.58	Pump S-11	J-S-11-1	1.9	PVC	120.0	True	0.000	57	6.30	0.110	True	369.00
113	FM-S-11	34.01	J-S-11-1	J-S-11-2	3.6	PVC	120.0	False	0.000	57	1.76	0.005	True	1.00
115	2-inch hose	81.59	Pump S-12	J-S-12-1	1.9	PVC	120.0	True	0.000	60	6.62	0.120	True	404.00
119	FM-S-12	34.77	J-S-12-1	J-S-12-2	3.6	PVC	120.0	False	0.000	60	1.88	0.006	True	344.00
121	FM-4	30.75	J-S-11-2	J-S-12-2	3.6	PVC	120.0	True	0.000	57	1.79	0.005	True	2,606.00
122	-	37.21	Sump 11	Pump S-11	1.9	PVC	120.0	False	0.000	57	6.30	0.109	True	1.00
139	FM-3b	20.85	J-S-12-2	Elevation Point	3.6	PVC	120.0	True	0.000	116	3.66	0.019	True	480.00
140	FM-3a	22.22	Elevation Point	J-S-13-2	3.6	PVC	120.0	True	0.000	116	3.66	0.019	True	1,087.00

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Phase II, Phase 12, and Phase 13 pumps operating

Scenario: Base
Current Time Step: 0.000Hr
FlexTable: Junction Table

ID	Label	Elevation (ft)	Zone	Demand Collection	Demand (gpm)	Hydraulic Grade (ft)	Pressure (psi)
43	J-S-13-2	1,211.00	<None>	<Collection: 0 items>	0	1,351.90	61.0
45	Elevation Point	1,242.67	<None>	<Collection: 0 items>	0	1,287.60	19.4
109	J-S-11-1	1,289.25	<None>	<Collection: 0 items>	0	1,395.30	45.9
118	J-S-12-2	1,211.00	<None>	<Collection: 0 items>	0	1,382.04	74.0
131	J-S-11-2	1,289.25	<None>	<Collection: 0 items>	0	1,395.29	45.9
132	J-S-12-1	1,299.20	<None>	<Collection: 0 items>	0	1,383.96	36.7
133	J-S-13-1	1,311.67	<None>	<Collection: 0 items>	0	1,355.74	19.1
138	Elevation Point	1,266.67	<None>	<Collection: 0 items>	0	1,372.81	45.9

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Phase 11, Phase 12, and Phase 13 pumps operating

OBJECTIVE

To size the leachate pumps and proposed forcemain for the Phase 14 sump of the proposed expansion at Apex Sanitary Landfill. The locations of the sumps and force main are shown on Drawings 4D and 4E of the PTI Drawing Package.

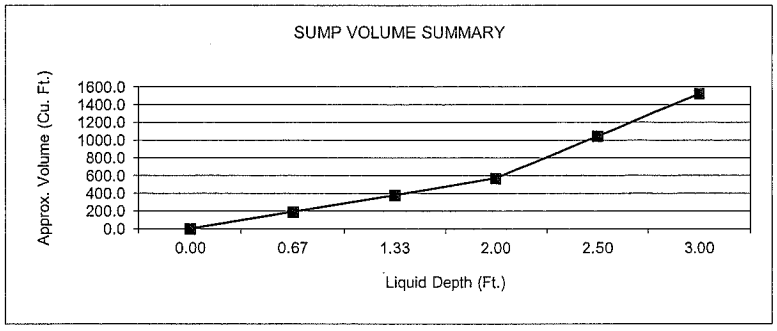
SUMP VOLUME

The respective sump within the unit will be square shaped with 3H:1V inside slopes. The bottom dimensions will be 20-feet by 20-feet and the sump will be 2-ft deep. The sump area will be backfilled with AASHTO No. 3 (or equivalent) drainage stone. The sump area 1-foot above the crest has been estimated from the drawings. As per standard aggregate parameters, it has been assumed that the drainage stone to be used in the sump has a porosity of 40%.

SUMP VOLUME PARAMETERS	
Sump Bottom Length (L1)	20 Feet
Sump Bottom Width (W1)	20 Feet
Sump Depth (D)	2 Feet
Sump Sideslope (_H:1V)	3 H:1V
Sump Pipe Diameter	2.00 Feet
Sump Pipe Length	10 Feet
Area at 1-foot above sump crest (1)	3,737 Sq-Feet
Drainage Stone Porosity (2)	40%

SUMP VOLUME CALCULATION PARAMETERS	
Sump Top Length (L2)	32 Feet
Sump Top Width (W2)	32 Feet
Sump Bottom Area	400 Sq-Feet
Sump Top Area (3)	1,024 Sq-Feet
Gross Sump Volume (4)	1,375 Cubic-Feet
Sump Pipe Volume (5)	31.4 Cubic-Feet
Net Sump Volume (6)=(4)-(5)	1,344 Cubic-Feet
Sump Liquid Volume (7)=[(6)*(2)]+(5)	569 Cubic-Feet
Volume 1-foot above (8)=0.5*[(1)+(3)]*(2)	952.2 Cubic-Feet

SUMP VOLUME	
Liquid Depth (Feet)	Approximate Volume (Cubic-Feet)
0.00	0.0
0.67	190.6
1.33	378.4
2.00	569.0
2.50	1045.1
3.00	1521.2



The sump depression for this design is 2-foot deep. The operational volume of the sump will be calculated to 1-foot above the crest of the sump, total depth of 3-feet.

PUMP SELECTION

The size of the pump will initially be chosen by plotting the sump inflow rate versus the Total Dynamic Head (TDH) for the phase 14 sump against the manufacturer performance curve. This calcululation uses leachate production when the leachate drainage aggregate has permeability of 0.1 cm/sec for conservatism.

SUMP INFLOW RATES					
Sump Location	Leachate Production (gal/ac/day)*	Contributing Area (ac)	Total Ave. Leachate (gal/day)	Total Ave. Leachate (gpm)	
Phase 14	1,651	12.6	20,803	14.4	
	1,496	10.7	16,007	11.1	
			Total Flow	**25.6**	**GPM**

*The Average Annual Leachate production was converted to a daily flow rate (gal/ac/day) using a multiplier of 6 as outlined in Ohio EPA Document #0528.

The TDH calculation accounts for static (elevation) head, losses due to friction (as a function of flowrate) and minor losses resulting from fittings.

$$TDH = H_s + H_f + H_m$$

Where

$$H_s = StaticHead, Feet$$

$$H_f = \text{FrictionHeadLoss, Feet}$$

$$H_f = \frac{L}{100} * 0.2083 * \frac{100^{1.85} * Q^{1.85}}{C^{1.85} * D^{4.87}}$$

$$H_m = MinorHeadLoss, Feet$$

$$H_m = \frac{V^2}{2g}\sum K_i = \frac{16Q^2(\frac{cfs}{448.8gpm})^2}{2g\pi^2(D\frac{ft}{12in})^4} = \frac{0.0252KQ^2(\frac{cfs}{448.8gpm})^2}{(D\frac{ft}{12in})^4}$$

Where

L = Length, Feet

Q = Flowrate, gpm

K = Minor loss coefficient

C = Hazen Williams Roughness

D = Inside Diameter, Inch

PUMP DESIGN PARAMETERS	
Sump Invert Elevation *	1188.1 Feet
Maximum Elevation *	1255.0 Feet
Hose Length (sump to landfill crest) *	220.5 Feet
Hose Diameter	1.92 Inch
Hose Roughness C	120
Pipe Length	1,150 Feet
Pipe Diameter **	2.83 Inch
Pipe Roughness C	120
Sump Inflow Rate	25.6 GPM
Sump Inflow Rate (worst case)	0.057 CFS

* Elevations and hose length are taken from the PTI Drawing Package.

** Pipe consists of 3-inch diameter HDPE SDR 11.

MINOR LOSS CALCULATION, e			
FITTING	**K - FACTOR**	**QUANTITY**	**TOTAL - K**
Entrance	0.50	1	0.50
Outlet	1.00	1	1.00
90 Degree Elbow	0.30	4	1.20
45 Degree Elbow	0.36	4	1.44
Check Valve	2.50	4	10.00
		Minor Loss Parameter K	**14.14**

Minor loss items assumed from standard leachate management system installation.

Based on the flow conditions for the phase 14 sump:

PUMP TDH CALCULATION						
Static Head (Feet)	Estimated Flow Rate (GPM)	Hf, Friction Head Loss		Total Hm Minor Losses (Feet)	Calculated TDH (Feet)	Calculated Pipe Pressure (lb/in^2)
		Hose (Feet)	Pipe (Feet)			
66.9	25.6	5.54	4.34	0.37	77.15	33.18

* For the single pump operating at the phase 14 sump, the pump shall be capable of pumping 26 GPM at a TDH of 74 feet. According to the EPG pump curve, a EPG Series 12-3 2 HP pump provides the required flow rate at the assocated TDH at the sump.

** Based on the TDH of the pump when operating, the maximum pipe pressure can be determined assuming that 0.43 psi = 1 foot of head. The pressure obtained does not exceed the maximum pressure design criteria of 160 psi.

PUMP OPERATION

ESTIMATED PUMP OPERATION PARAMETERS	
Pump On Depth	2.0 Feet
Pump Off Depth	0.5 Feet
Approximate Operating Pump Discharge	26.0 GPM*

*Discharge rate is based on pump flow rate of 26 GPM for the EPG Series 12-3 pump at the phase 11 sump.

ESTIMATED PUMP OPERATION SUMMARY	
Approximate Operating Pump Discharge	0.058 CFS
Volume @ Pump On Depth (A)	569.0 Cubic-Feet
Area of Pipe	0.044 ft^2
Velocity through Pipe*	1.3 feet/second
Volume @ Pump Off Depth (B)	142.3 Cubic-Feet
Operational Volume (C)=(A)-(B)	426.8 Cubic-Feet
Pump Run Time (Accounting for Peak Inflow)	7,264.4 Minutes
Pump Run Time (Accounting for No Inflow)	122.8 Minutes
Sump Fill Time	124.9 Minutes

* Typically, velocity through the pipe should be at least 2.0 feet per second to prevent solids deposition in pipe. This would require a 2-inch diameter forcemain for this sump. A 3-inch diameter forcemain as chosen to account for potential scaling of the pipe.

CONCLUSIONS

An EPG Series 12-3 2 HP pump (or equal) shall be utilized at the Phase 14 sump. The force main using a 3" diameter HDPE SDR-11 pipe from the sump to the leachate storage tank meets the design requiremements for pressure.

REFERENCES

1. Metcalf & Eddy, Inc. WASTEWATER ENGINEERING: Collection and Pumping of Wastewater, McGraw Hill, New York, 1981.

2. Chevron/Plexco, PLEXCO PIPING SYSTEMS MANUAL.

3. Phillips Driscopipe, Inc., DRISCO PIPE MANUAL.

4. Grundfos USA, SQ SQE SP PRODUCT GUIDE.

5. Plastics Pipe Institute, HANDBOOK OF POLYETHYLENE PIPE.

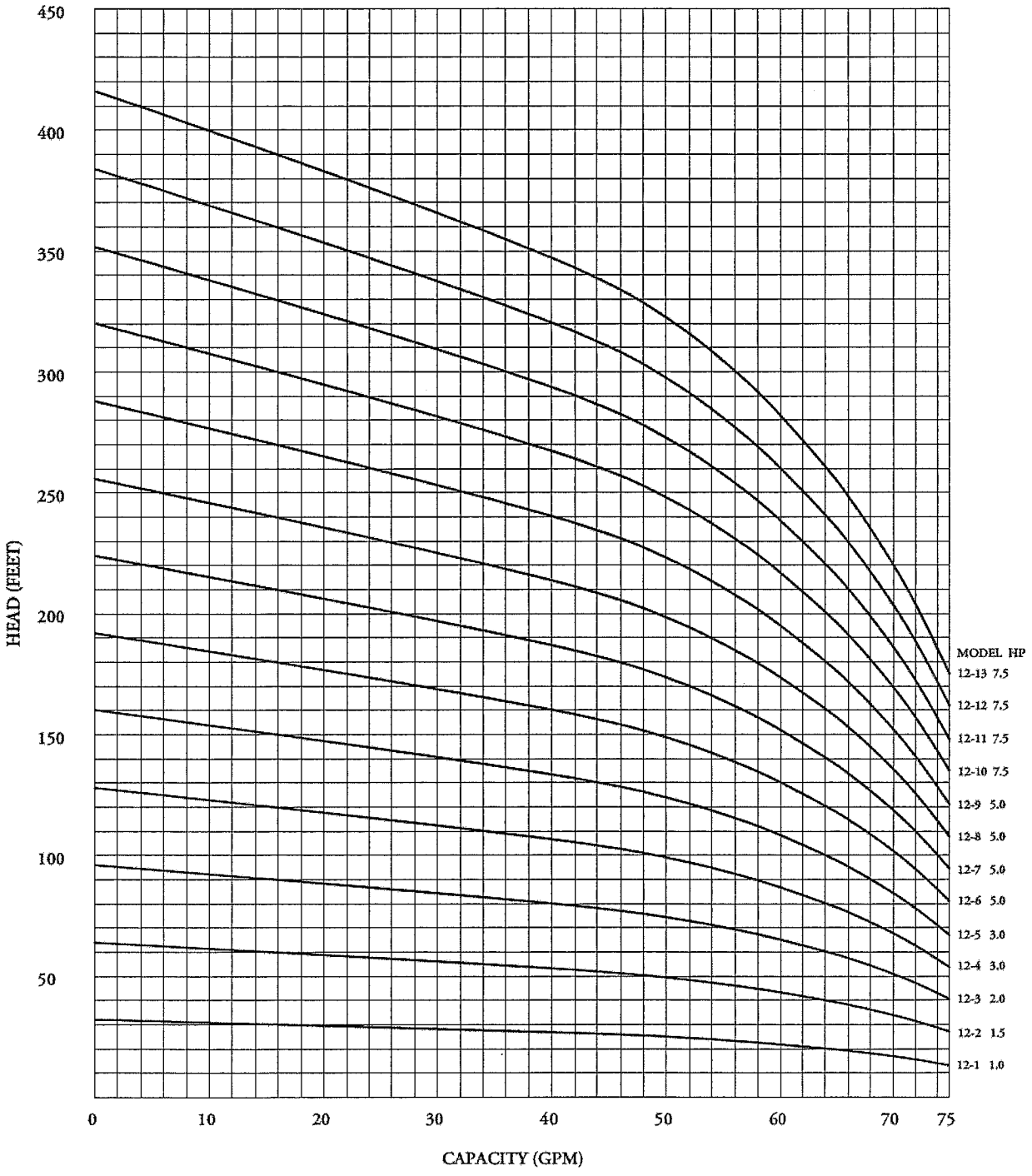
6. Bentley WaterCAD V8i (SELECTseries 3). Haestad Methods Solution Center.

ATTACHMENT 1
PUMP CURVES

SERIES 12 SurePump™

Flow Range 35-75 GPM

60 Hz



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PIPE STRENGTH AND DEFLECTION

(g) Pipe strength and pipe deflection calculations for the leachate collection and management system.

HDPE PIPE STRENGTH AND STABILITY
Leachate Collection Pipes

SDR = 9

OBJECTIVE Assess the strength and stability of the proposed 6-inch diameter leachate collection piping proposed for the proposed expansion of Apex Sanitary Landfill.

METHOD The piping will be evaluated by estimating the maximum loads applied to the pipe. These loads will be used to estimate the pipe's factor of safety for wall buckling and estimate percent deflection and pipe strain for comparison to industry standard maximum values. Adjustments to the pipe loading equation used below are made to account for perforations in pipe.

Pipe Loading (Ref 1)

$$P_t = \frac{12}{12 - N(D)}\left[\sum (L_i) P_{li} + \sum (H_i)\, U_i\right]$$

P_t = Total pipe load, psi (adjusted for pipe perforations)
L_i = Safety Factor for Live Load i (accounts for uncertainty and dynamic loading)
P_{li} = Individual Live Load, transmitted to top of pipe, psi
H_i = Thickness of overburden i, inch
U_i = Unit weight of overburden i, lb/in^3
N = Number of holes per foot of pipe
D = Diameter of perforation, inch

Constrained Wall Buckling (Ref 1)

$$P_{cb} = \frac{5.65}{N}\sqrt{RB'E'\frac{E}{12(DR-1)^3}}$$

$$FS_{cb} = \frac{P_{cb}}{P_t}$$

Where:
P_{cb} = Critical buckling soil pressure at the top of the pipe, psi
P_t = Total pipe load, psi (adjusted for pipe perforations)
E' = Soil Modulus for backfill around pipe, psi
N = Safety Factor, typically 2.
R = buoyancy reduction factor

$$R = 1 - 0.33\frac{H'}{H}$$

H' = groundwater height above pipe, ft (0 for this calculation)
H = cover above pipe, ft
E = Pipe Modulus of Elasticity, psi
Pipe Modulus of Elasticity interpolated from Ref 1, Tech Note 814-TN, Table 1 for 50 year service life @ 110° F. Table 1 included with this report.
DR = Pipe dimension ratio
B' = Elastic support factor

$$B' = \frac{1}{1 + 4e^{(-0.065H)}}$$

Deflection (Modified Iowa, Ref 1)

$$\%Deflection = \frac{\Delta Y}{D_M} = \frac{D_L (K) P_t (100)}{\frac{2E}{3(SDR-1)^3} + 0.061 (E')}$$

Where

% Deflection = Amount of pipe deflection expected for load applied to top of pipe

D_m = Mean pipe diameter.

D_L = Deflection Lag Factor, 1.0 for long term as per Ref 1

K = Bedding Constant, 0.1 as per Ref 1

P_t = Total pipe load, psi (adjusted for pipe perforations)

E = Pipe Modulus of Elasticity, psi

SDR = Standard Dimension Ratio for selected pipe

E' = Soil Modulus for backfill around pipe, psi, calculated as shown below.

Allowable Pipe Strain (Ref 1)

$$\varepsilon_{max} = F_d \frac{\Delta Y}{D_M} \quad \frac{2 * (0.53(t))}{D_M} = Fd \frac{\%\,Deflection}{100} * 2 * \frac{0.53 \frac{Do}{SDR}}{Do - 1.06 \frac{Do}{SDR}}$$

Where

ε(max) = Maximum allowable pipe strain, 4.2% as per Ref 1

F_d = Deformation Shape Factor, 6 as per Ref 1

D_m = Mean pipe diameter, inch

t = Pipe wall thickness, inch = D_o/SDR

SDR = Standard Dimension Ratio for selected pipe

D_o = Pipe outside diameter, inch

As can be seen above, buckling pressure and pipe deflection estimates are dependent upon the modulus of soil reaction (E') for the backfill material used to construct the pipe envelopes, which itself is a function of the backfill soil placement conditions. Previous literature references have often employed E' values of approximately 3,000 psi. However, on page 153 of Reference 6, a relationship between E', constrained modulus, Young's modulus, and Poisson's ration of a soil is given as:

$E' = K M_s$

where: E' = modulus of soil reaction (psi)

K = bulk modulus (varies from 0.7 to 2.3 as seen in Reference 6 on page 153)

M_s = constrained modulus

$$M_s = \frac{E(1-v)}{(1+v)(1-2v)}$$

E = Young's modulus (psi)

v = Poisson's ratio

Typical v values for granular soils are given in Table 2-8 of Reference 7 and vary between 0.2 and 0.4. For this analysis, an average value of 0.3 will be used. Typical E values for granular soils are also give in Reference 7 and are as follows:

Loose Granular Soils: E = 1,000 to 3,000 ksf
Dense Granular Soils: E = 2,000 to 4,000 ksf

Conservatively assuming E = 2,000 ksf (≈13,900 psi), K = 0.7, and v = 0.3, the modulus of soil reaction is calculated as follows:

$$E' = 0.7\left[\frac{2{,}000(1-0.3)}{(1+0.3)(1-(2\times 0.3))}\right] = 1{,}885 ksf \approx 13{,}000 psi$$

CALCULATION

Pipe Loading

Dead Load Summary Table

Description	Thickness (feet)	Density (pcf)	Load (psi)
COLLECTION AGGREGATE	1.25	115	1.0
WASTE *	375	90	234.4
INTERMEDIATE COVER	1	125	0.9
SOIL BARRIER	1.5	125	1.3
VEGETATIVE LAYER	2.5	125	2.2
		Total Dead Load	**239.8** psi

* Maximum waste thickness proposed.

Live Load Summary Table

Description	Total Load (pounds)	Area (sf)	Factor, Li	Load (psi)
826 Compactor	73,370	80.00 Assumes 20 ft² per drum	5.00 Conservative	31.8
			Total Live Load	**31.8** psi

N: 6.00 Number of perforation holes per foot of pipe

D: 0.375 Diameter (inches) of perforation holes

P_t, Total Pipe Load: 334.3 **psi**

Constrained Wall Buckling (Ref 1)

Utilizing the Constrained Wall Buckling Equation listed in the METHOD section,

E': 13,000	Soil modulus, psi, calculated from equation listed in METHOD section.
E: 19,000	Pipe Modulus of Elasticity, psi, interpolated from Ref 1,Technical Note 814-TN, Table 1 for 110 °F and a Service Life of 50 years.
SDR: 9	Standard Dimension Ratio for selected pipe.
B': 1.0000	Elastic support factor, from equation listed in METHOD section.
H: 380.7	Maximum height of cover above pipes, ft.
P_{cb} 566.4	Critical Wall Buckling, psi, from equation listed in METHOD section.
FS_{cb} 1.7	Factor of safety for wall buckling.

Deflection (Modified Iowa, Ref 1)

Utilizing the Deflection Equation listed in the METHOD section,

D_l: 1.0	Deflection Lag Factor, as per Ref 1.
K: 0.1	Bedding Constant, as per Ref 1.
P_t: 334.3	Total Pipe Load, psi
E: 19,000	Pipe Modulus of Elasticity, psi, interpolated from Ref 1,Technical Note 814-TN, Table 1 for 110 °F and a Service Life of 50 years.
SDR: 9	Standard Dimension Ratio for selected pipe.
E': 13,000	Soil modulus, psi, as calculated above
Deflection 4.09	% Deflection, calculated from equation included in METHOD section

Allowable Pipe Strain (Ref 1)

Utilizing the Strain Equation listed in the METHOD section,

D_o: 6.625 Pipe Outside Diameter, inches

F_d: 6.0 Pipe Deformation Factor, non-elliptical shape, Ref 1

Long Term Design Deflection Limits of Buried Pressure and Non-Pressure Polyethylene Pipe

SDR	21	17	15.5	13.5	11
Deflection Limit (%) Non-Pressure	7.5	7.5	7.5	7.5	7.5
Deflection Limit (%) Pressure	7.5	6.0	6.0	6.0	5.0

SDR	9	7.3
Deflection Limit (%) Non-Pressure	7.5	7.5
Deflection Limit (%) Pressure	4.0	3.0

from Ref 5 and Ref 9

Pipe Strain 3.28 % Pipe Strain for design loading conditions

Allowable Strain 4.20 % Pipe Strain allowable for gravity piping, Ref 1

CONCLUSION

Factor of Safety for wall buckling is 1.7

Calculated deflection is 4.09% and calculated pipe strain is 3.28%. The value for deflection is less than the deflection limit of 7.5 % given in the table above. The calculated strain is less than the allowable strain of 4.2%.

The selected DR 9 HDPE pipe is adequate based on a check of wall buckling, deflection, and pipe strain.

The analysis was performed considering HDPE DR 9 leachate collection pipes under the approximate maximum waste thickness of 375 feet, which is the maximum waste thickness for the proposed expansion.

REFERENCES

1 THE PERFORMANCE PIPE ENGINEERING MANUAL, FIRST EDITION
Performance Pipe - 5085 W. Park Blvd., Suite 500
Plano, Texas 75093, (800) 527-0662

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8 PPI HANDBOOK OF POLYETHYLENE PIPE, Plastic Pipe Institute, http://www.plasticpipe.org/general/ppi_handbook.php

TABLE 1 FROM TECHNICAL NOTE 814- TN

Table 1 Typical Elastic Modulus for DriscoPlex® PE 3608

Load Duration	Elastic Modulus†, 1000 psi (MPa), at Temperature, °F (°C)							
	-20 (-29)	0 (-18)	40 (4)	60 (16)	73 (23)	100 (38)	120 (49)	140 (60)
Short-Term	300.0 (2069)	260.0 (1793)	170.0 (1172)	130.0 (896)	110.0 (758)	100.0 (690)	65.0 (448)	50.0 (345)
10 h	140.8 (971)	122.0 (841)	79.8 (550)	61.0 (421)	57.5 (396)	46.9 (323)	30.5 (210)	23.5 (162)
100 h	125.4 (865)	108.7 (749)	71.0 (490)	54.3 (374)	51.2 (353)	41.8 (288)	27.2 (188)	20.9 (144)
1000 h	107.0 (738)	92.8 (640)	60.7 (419)	46.4 (320)	43.7 (301)	35.7 (246)	23.2 (160)	17.8 (123)
1 y	93.0 (641)	80.6 (556)	52.7 (363)	40.3 (278)	38.0 (262)	31.0 (214)	20.2 (139)	15.5 (107)
10 y	77.4 (534)	67.1 (463)	43.9 (303)	33.5 (231)	31.6 (218)	25.8 (178)	16.8 (116)	12.9 (89)
50 y	69.1 (476)	59.9 (413)	39.1 (270)	29.9 (206)	28.2 (194)	23.0 (159)	15.0 (103)	11.5 (79)

† Typical values based on ASTM D 638 testing of molded plaque material specimens.
Modulus values for PE4710 are under development.

HDPE PIPE STRENGTH AND STABILITY
Leachate Collection Pipes

SDR = 11

OBJECTIVE Assess the strength and stability of the proposed 6-inch diameter leachate collection piping proposed for the proposed expansion of Apex Sanitary Landfill.

METHOD The piping will be evaluated by estimating the maximum loads applied to the pipe. These loads will be used to estimate the pipe's factor of safety for wall buckling and estimate percent deflection and pipe strain for comparison to industry standard maximum values. Adjustments to the pipe loading equation used below are made to account for perforations in pipe.

Pipe Loading (Ref 1)

$$P_t = \frac{12}{12 - N(D)}\left[\sum (L_i) P_{li} + \sum (H_i)\, U_i\right]$$

P_t = Total pipe load, psi (adjusted for pipe perforations)
L_i = Safety Factor for Live Load i (accounts for uncertainty and dynamic loading)
P_{li} = Individual Live Load, transmitted to top of pipe, psi
H_i = Thickness of overburden i, inch
U_i = Unit weight of overburden i, lb/in^3
N = Number of holes per foot of pipe
D = Diameter of perforation, inch

Constrained Wall Buckling (Ref 1)

$$P_{cb} = \frac{5.65}{N}\sqrt{RB'E'\frac{E}{12(DR-1)^3}}$$

$$FS_{cb} = \frac{P_{cb}}{P_t}$$

Where:
P_{cb} = Critical buckling soil pressure at the top of the pipe, psi
P_t = Total pipe load, psi (adjusted for pipe perforations)
E' = Soil Modulus for backfill around pipe, psi
N = Safety Factor, typically 2.
R = buoyancy reduction factor

$$R = 1 - 0.33\frac{H'}{H}$$

H' = groundwater height above pipe, ft (0 for this calculation)
H = cover above pipe, ft
E = Pipe Modulus of Elasticity, psi
Pipe Modulus of Elasticity interpolated from Ref 1, Tech Note 814-TN, Table 1 for 50 year service life @ 110° F. Table 1 included with this report.
DR = Pipe dimension ratio
B' = Elastic support factor

$$B' = \frac{1}{1 + 4e^{(-0.065H)}}$$

Deflection (Modified Iowa, Ref 1)

$$\%Deflection = \frac{\Delta Y}{D_M} = \frac{D_L (K)\, P_t (100)}{\frac{2E}{3(SDR-1)^3} + 0.061 (E')}$$

Where

% Deflection = Amount of pipe deflection expected for load applied to top of pipe

D_m = Mean pipe diameter.

D_L = Deflection Lag Factor, 1.0 for long term as per Ref 1

K = Bedding Constant, 0.1 as per Ref 1

P_t = Total pipe load, psi (adjusted for pipe perforations)

E = Pipe Modulus of Elasticity, psi

SDR = Standard Dimension Ratio for selected pipe

E' = Soil Modulus for backfill around pipe, psi, calculated as shown below.

Allowable Pipe Strain (Ref 1)

$$\varepsilon_{max} = F_d \frac{\Delta Y}{D_M} \frac{2 * (0.53(t))}{D_M} = Fd \frac{\%\, Deflection}{100} * 2 * \frac{0.53 \frac{Do}{SDR}}{Do - 1.06 \frac{Do}{SDR}}$$

Where

ε(max) = Maximum allowable pipe strain, 4.2% as per Ref 1

F_d = Deformation Shape Factor, 6 as per Ref 1

D_m = Mean pipe diameter, inch

t = Pipe wall thickness, inch = D_o/SDR

SDR = Standard Dimension Ratio for selected pipe

D_o = Pipe outside diameter, inch

As can be seen above, buckling pressure and pipe deflection estimates are dependent upon the modulus of soil reaction (E') for the backfill material used to construct the pipe envelopes, which itself is a function of the backfill soil placement conditions. Previous literature references have often employed E' values of approximately 3,000 psi. However, on page 153 of Reference 6, a relationship between E', constrained modulus, Young's modulus, and Poisson's ration of a soil is given as:

$E' = K M_s$

where: E' = modulus of soil reaction (psi)

K = bulk modulus (varies from 0.7 to 2.3 as seen in Reference 6 on page 153)

M_s = constrained modulus

$$M_s = \frac{E(1-v)}{(1+v)(1-2v)}$$

E = Young's modulus (psi)

v = Poisson's ratio

Typical v values for granular soils are given in Table 2-8 of Reference 7 and vary between 0.2 and 0.4. For this analysis, an average value of 0.3 will be used. Typical E values for granular soils are also give in Reference 7 and are as follows:

Loose Granular Soils: E = 1,000 to 3,000 ksf
Dense Granular Soils: E = 2,000 to 4,000 ksf

Conservatively assuming E = 2,000 ksf (≈13,900 psi), K = 0.7, and v = 0.3, the modulus of soil reaction is calculated as follows:

$$E' = 0.7\left[\frac{2{,}000(1-0.3)}{(1+0.3)(1-(2\times 0.3))}\right] = 1{,}885 ksf \approx 13{,}000 psi$$

CALCULATION

Pipe Loading

Dead Load Summary Table

Description	Thickness (feet)	Density (pcf)	Load (psi)
COLLECTION AGGREGATE	1.25	115	1.0
WASTE *	300	90	187.5
INTERMEDIATE COVER	1	125	0.9
SOIL BARRIER	1.5	125	1.3
VEGETATIVE LAYER	2.5	125	2.2
		Total Dead Load	**192.9** psi

* Maximum waste thickness proposed.

Live Load Summary Table

Description	Total Load (pounds)	Area (sf)	Factor, Li	Load (psi)
826 Compactor	73,370	80.00 Assumes 20 ft² per drum	5.00 Conservative	31.8
			Total Live Load	**31.8** psi

N: 6.00 Number of perforation holes per foot of pipe

D: 0.375 Diameter (inches) of perforation holes

P_t, Total Pipe Load: 276.6 **psi**

Constrained Wall Buckling (Ref 1)

Utilizing the Constrained Wall Buckling Equation listed in the METHOD section,

E': 13,000	Soil modulus, psi, calculated from equation listed in METHOD section.
E: 19,000	Pipe Modulus of Elasticity, psi, interpolated from Ref 1,Technical Note 814-TN, Table 1 for 110 °F and a Service Life of 50 years.
SDR: 11	Standard Dimension Ratio for selected pipe.
B': 1.0000	Elastic support factor, from equation listed in METHOD section.
H: 305.7	Maximum height of cover above pipes, ft.
P_{cb} 405.3	Critical Wall Buckling, psi, from equation listed in METHOD section.
FS_{cb} 1.5	Factor of safety for wall buckling.

Deflection (Modified Iowa, Ref 1)

Utilizing the Deflection Equation listed in the METHOD section,

D_l: 1.0	Deflection Lag Factor, as per Ref 1.
K: 0.1	Bedding Constant, as per Ref 1.
P_t: 276.6	Total Pipe Load, psi
E: 19,000	Pipe Modulus of Elasticity, psi, interpolated from Ref 1,Technical Note 814-TN, Table 1 for 110 °F and a Service Life of 50 years.
SDR: 11	Standard Dimension Ratio for selected pipe.
E': 13,000	Soil modulus, psi, as calculated above
Deflection 3.43	% Deflection, calculated from equation included in METHOD section

Allowable Pipe Strain (Ref 1)

Utilizing the Strain Equation listed in the METHOD section,

D_o: 6.625 Pipe Outside Diameter, inches

F_d: 6.0 Pipe Deformation Factor, non-elliptical shape, Ref 1

Long Term Design Deflection Limits of Buried Pressure and Non-Pressure Polyethylene Pipe

SDR	21	17	15.5	13.5	11
Deflection Limit (%) Non-Pressure	7.5	7.5	7.5	7.5	7.5
Deflection Limit (%) Pressure	7.5	6.0	6.0	6.0	5.0

SDR	9	7.3
Deflection Limit (%) Non-Pressure	7.5	7.5
Deflection Limit (%) Pressure	4.0	3.0

from Ref 5 and Ref 9

Pipe Strain 2.19 % Pipe Strain for design loading conditions

Allowable Strain 4.20 % Pipe Strain allowable for gravity piping, Ref 1

CONCLUSION

Factor of Safety for wall buckling is 1.5

Calculated deflection is 3.43% and calculated pipe strain is 2.19%. The value for deflection is less than the deflection limit of 7.5 % given in the table above. The calculated strain is less than the allowable strain of 4.2%.

The selected DR 11 HDPE pipe is adequate based on a check of wall buckling, deflection, and pipe strain.

The analysis was performed considering HDPE DR 11 leachate collection pipes under a maximum waste thickness of 300 feet. DR 11 leachate collection pipe can be used where the proposed waste thickness does not exceed 300 feet.

REFERENCES

1 THE PERFORMANCE PIPE ENGINEERING MANUAL, FIRST EDITION
Performance Pipe - 5085 W. Park Blvd., Suite 500
Plano, Texas 75093, (800) 527-0662

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8 PPI HANDBOOK OF POLYETHYLENE PIPE, Plastic Pipe Institute, http://www.plasticpipe.org/general/ppi_handbook.php

TABLE 1 FROM TECHNICAL NOTE 814- TN

Table 1 Typical Elastic Modulus for DriscoPlex® PE 3608

Load Duration	Elastic Modulus†, 1000 psi (MPa), at Temperature, °F (°C)							
	-20 (-29)	0 (-18)	40 (4)	60 (16)	73 (23)	100 (38)	120 (49)	140 (60)
Short-Term	300.0 (2069)	260.0 (1793)	170.0 (1172)	130.0 (896)	110.0 (758)	100.0 (690)	65.0 (448)	50.0 (345)
10 h	140.8 (971)	122.0 (841)	79.8 (550)	61.0 (421)	57.5 (396)	46.9 (323)	30.5 (210)	23.5 (162)
100 h	125.4 (865)	108.7 (749)	71.0 (490)	54.3 (374)	51.2 (353)	41.8 (288)	27.2 (188)	20.9 (144)
1000 h	107.0 (738)	92.8 (640)	60.7 (419)	46.4 (320)	43.7 (301)	35.7 (246)	23.2 (160)	17.8 (123)
1 y	93.0 (641)	80.6 (556)	52.7 (363)	40.3 (278)	38.0 (262)	31.0 (214)	20.2 (139)	15.5 (107)
10 y	77.4 (534)	67.1 (463)	43.9 (303)	33.5 (231)	31.6 (218)	25.8 (178)	16.8 (116)	12.9 (89)
50 y	69.1 (476)	59.9 (413)	39.1 (270)	29.9 (206)	28.2 (194)	23.0 (159)	15.0 (103)	11.5 (79)

† Typical values based on ASTM D 638 testing of molded plaque material specimens.
Modulus values for PE4710 are under development.

HDPE PIPE STRENGTH AND STABILITY
Leachate Sump Pipes

SDR = 11

OBJECTIVE Assess the strength and stability of the proposed 24-inch diameter leachate sump riser piping.

METHOD The piping will be evaluated by estimating the maximum loads applied to the pipe. These loads will be used to estimate the pipe's factor of safety for wall buckling and estimate percent deflection and pipe strain for comparison to industry standard maximum values. Adjustments to the pipe loading equation used below are made to account for perforations in pipe.

Pipe Loading (Ref 1)

$$P_t = \frac{12}{12 - N(D)}\left[\sum (L_i) P_{li} + \sum (H_i) U_i\right]$$

P_t = Total pipe load, psi (adjusted for pipe perforations)
L_i = Safety Factor for Live Load i (accounts for uncertainty and dynamic loading)
P_{li} = Individual Live Load, transmitted to top of pipe, psi
H_i = Thickness of overburden i, inch
U_i = Unit weight of overburden i, lb/in^3
N = Number of holes per foot of pipe
D = Diameter of perforation, inch

Constrained Wall Buckling (Ref 1)

$$P_{cb} = \frac{5.65}{N}\sqrt{RB'E'\frac{E}{12(DR-1)^3}}$$

$$FS_{cb} = \frac{P_{cb}}{P_t}$$

Where:
P_{cb} = Critical buckling soil pressure at the top of the pipe, psi
P_t = Total pipe load, psi (adjusted for pipe perforations)
E' = Soil Modulus for backfill around pipe, psi
N = Safety Factor, typically 2.
R = buoyancy reduction factor

$$R = 1 - 0.33\frac{H'}{H}$$

H' = groundwater height above pipe, ft (0 for this calculation)
H = cover above pipe, ft
E = Pipe Modulus of Elasticity, psi
Pipe Modulus of Elasticity interpolated from Ref 1, Tech Note 814-TN, Table 1 for 50 year service life @ 110° F. Table 1 included with this report.
DR = Pipe dimension ratio
B' = Elastic support factor

$$B' = \frac{1}{1 + 4e^{(-0.065H)}}$$

Deflection (Modified Iowa, Ref 1)

$$\%Deflection = \frac{\Delta Y}{D_M} = \frac{D_L\,(K)\,P_t\,(100)}{\frac{2E}{3(SDR-1)^3} + 0.061\,(E')}$$

Where

% Deflection = Amount of pipe deflection expected for load applied to top of pipe

D_m = Mean pipe diameter.

D_L = Deflection Lag Factor, 1.0 for long term as per Ref 1

K = Bedding Constant, 0.1 as per Ref 1

P_t = Total pipe load, psi (adjusted for pipe perforations)

E = Pipe Modulus of Elasticity, psi

SDR = Standard Dimension Ratio for selected pipe

E' = Soil Modulus for backfill around pipe, psi, calculated as shown below.

Allowable Pipe Strain (Ref 1)

$$\varepsilon_{max} = F_d \frac{\Delta Y}{D_M} \quad \frac{2 * (0.53(t))}{D_M} = Fd \frac{\%\,Deflection}{100} * 2 * \frac{0.53\frac{Do}{SDR}}{Do - 1.06\frac{Do}{SDR}}$$

Where

ε(max) = Maximum allowable pipe strain, 4.2% as per Ref 1

F_d = Deformation Shape Factor, 6 as per Ref 1

D_m = Mean pipe diameter, inch

t = Pipe wall thickness, inches = D_o/SDR

SDR = Standard Dimension Ratio for selected pipe

D_o = Pipe outside diameter, inch

As can be seen above, buckling pressure and pipe deflection estimates are dependent upon the modulus of soil reaction (E') for the backfill material used to construct the pipe envelopes, which itself is a function of the backfill soil placement conditions. Previous literature references have often employed E' values of approximately 3,000 psi. However, on page 153 of Reference 6, a relationship between E', constrained modulus, Young's modulus, and Poisson's ration of a soil is given as:

$E' = K M_s$

where:

E' = modulus of soil reaction (psi)

K = bulk modulus (varies from 0.7 to 2.3 as seen in Reference 6 on page 153)

M_s = constrained modulus

$$M_s = \frac{E(1-v)}{(1+v)(1-2v)}$$

E = Young's modulus (psi)

v = Poisson's ratio

Typical v values for granular soils are given in Table 2-8 of Reference 7 and vary between 0.2 and 0.4. For this analysis, an average value of 0.3 will be used. Typical E values for granular soils are also give in Reference 7 and are as follows:

Loose Granular Soils: E = 1,000 to 3,000 ksf
Dense Granular Soils: E = 2,000 to 4,000 ksf

Conservatively assuming E = 2,000 ksf (≈13,900 psi), K = 0.7, and v = 0.3, the modulus of soil reaction is calculated as follows:

$$E' = 0.7\left[\frac{2{,}000(1-0.3)}{(1+0.3)(1-(2\times 0.3))}\right] = 1{,}885 ksf \approx 13{,}000 psi$$

CALCULATION

Pipe Loading

Dead Load Summary Table

Description	Thickness (feet)	Density (pcf)	Load (psi)
COLLECTION AGGREGATE	1.25	115	1.0
WASTE *	120	90	75.0
INTERMEDIATE COVER	1	125	0.9
SOIL BARRIER	1.5	125	1.3
PROTECTIVE LAYER	2.5	125	2.2
		Total Dead Load	**80.4** psi

* Maximum waste thickness above the sumps proposed in the expansion. Conservative value.

Live Load Summary Table

Description	Total Load (pounds)	Area (sf)	Factor, Li	Load (psi)
826 Compactor	73,370	80.00 Assumes 20 ft² per drum	5.00 Conservative	31.8
			Total Live Load	**31.8** psi

N: 12.00 Number of perforation holes per foot of pipe

D: 0.50 Diameter (inches) of perforation holes

P_t, Total Pipe Load: 224.4 **psi**

Constrained Wall Buckling (Ref 1)

Utilizing the Constrained Wall Buckling Equation listed in the METHOD section,

E': 13,000	Soil modulus, psi, calculated from equation listed in METHOD section.
E: 19,000	Pipe Modulus of Elasticity, psi, interpolated from Ref 1,Technical Note 814-TN, Table 1 for 110 °F and a Service Life of 50 years.
SDR: 11	Standard Dimension Ratio for selected pipe.
B': 0.9988	Elastic support factor, from equation listed in METHOD section.
H: 124.25	Maximum height of cover above pipes, ft.
Pcb 405.0	Critical Wall Buckling, psi, from equation listed in METHOD section.
FS_{cb} 1.8	Factor of safety for wall buckling.

Deflection (Modified Iowa, Ref 1)

Utilizing the Deflection Equation listed in the METHOD section,

D_l: 1.0	Deflection Lag Factor, as per Ref 1.
K: 0.1	Bedding Constant, as per Ref 1.
P_t: 224.4	Total Pipe Load, psi
E: 19,000	Pipe Modulus of Elasticity, psi, interpolated from Ref 1,Technical Note 814-TN, Table 1 for 110 °F and a Service Life of 50 years.
SDR: 11	Standard Dimension Ratio for selected pipe.
E': 13,000	Soil modulus, psi, as calculated above
Deflection 2.79	% Deflection, calculated from equation included in METHOD section

Allowable Pipe Strain, Ref 1

Utilizing the Strain Equation listed in the METHOD section,

D_o: 24 Pipe Outside Diameter, inches

F_d: 6.0 Pipe Deformation Factor, non-elliptical shape, Ref 1

Long Term Design Deflection Limits of Buried Pressure and Non-Pressure Polyethylene Pipe

SDR	21	17	15.5	13.5	11
Deflection Limit (%) Non-Pressure	7.5	7.5	7.5	7.5	7.5
Deflection Limit (%) Pressure	7.5	6.0	6.0	6.0	5.0

SDR	9	7.3
Deflection Limit (%) Non-Pressure	7.5	7.5
Deflection Limit (%) Pressure	4.0	3.0

from Ref 5 and Ref 9

Pipe Strain 1.79 % Pipe Strain for design loading conditions

Allowable Strain 4.20 % Pipe Strain allowable for gravity piping, Ref 1

CONCLUSION

Factor of Safety for wall buckling is 1.8

Calculated deflection is 2.79% and calculated pipe strain is 1.79%. The value for deflection is less than the deflection limit of 7.5 % given in the table above. The calculated strain is less than the allowable strain of 4.2%

The selected SDR 11 HDPE pipe is adequate based on a check of wall buckling, deflection, and pipe strain.

The analysis was performed considering HDPE SDR 11 leachate sump riser pipes under the approximate maximum waste thickness of 120 feet, which is the maximum waste thickness proposed over a leachate sump riser pipe in the proposed expansion.

REFERENCES

1 THE PERFORMANCE PIPE ENGINEERING MANUAL, FIRST EDITION
Performance Pipe - 5085 W. Park Blvd., Suite 500
Plano, Texas 75093, (800) 527-0662

2 HANDBOOK OF PVC PIPE DESIGN AND CONSTRUCTION, Uni-Bell PVC Pipe Association, 1982

3 STRUCTURAL PERFORMANCE OF AN HDPE LEACHATE COLLECTION PIPE, Sargand, Shad M., Mitchell, Gayle F. and Masada, Teruhisa (1993), Ohio University Center for Geotechnical and Environmental Research (614)-593-2476

4 ENGINEERING TECH NOTE:HDD for PE PIPE., "Trenchless Technology Bulletin No. 1, Horizontal Directional Drilling w/ Plexco Pipe, Chevron Chemical Company, March, 1999, 1050 Illinois Route 83, Bensenville, IL 60106, (630)-350-3700

5 BURIED PIPE DESIGN, Moser, A.P., 2001 (2nd Edition), McGraw-Hill, New York, New York

6 BURIED PLASTIC PIPE TECHNOLOGY, ASTM (Buczala and Cassady editors), 1990, ASTM, Philadelphia, Pennsylania

7 FOUNDATION ANALYSIS AND DESIGN, Bowles, J.E., 1982 (3rd Edition) McGraw-Hill Book Company, New York, New York

8 PPI HANDBOOK OF POLYETHYLENE PIPE, Plastic Pipe Institute, http://www.plasticpipe.org/general/ppi_handbook.php

TABLE 1 FROM TECHNICAL NOTE 814- TN

Table 1 Typical Elastic Modulus for DriscoPlex® PE 3608

Load Duration	*Elastic Modulus†, 1000 psi (MPa), at Temperature, °F (°C)*							
	-20 (-29)	*0 (-18)*	*40 (4)*	*60 (16)*	*73 (23)*	*100 (38)*	*120 (49)*	*140 (60)*
Short-Term	300.0 (2069)	260.0 (1793)	170.0 (1172)	130.0 (896)	110.0 (758)	100.0 (690)	65.0 (448)	50.0 (345)
10 h	140.8 (971)	122.0 (841)	79.8 (550)	61.0 (421)	57.5 (396)	46.9 (323)	30.5 (210)	23.5 (162)
100 h	125.4 (865)	108.7 (749)	71.0 (490)	54.3 (374)	51.2 (353)	41.8 (288)	27.2 (188)	20.9 (144)
1000 h	107.0 (738)	92.8 (640)	60.7 (419)	46.4 (320)	43.7 (301)	35.7 (246)	23.2 (160)	17.8 (123)
1 y	93.0 (641)	80.6 (556)	52.7 (363)	40.3 (278)	38.0 (262)	31.0 (214)	20.2 (139)	15.5 (107)
10 y	77.4 (534)	67.1 (463)	43.9 (303)	33.5 (231)	31.6 (218)	25.8 (178)	16.8 (116)	12.9 (89)
50 y	69.1 (476)	59.9 (413)	39.1 (270)	29.9 (206)	28.2 (194)	23.0 (159)	15.0 (103)	11.5 (79)

† Typical values based on ASTM D 638 testing of molded plaque material specimens.
Modulus values for PE4710 are under development.

CLOSURE COST ESTIMATE

(h) An itemized written closure cost estimate, in current dollars, based on the following:

(i) The cost of final closure of a sanitary landfill facility in accordance with Rule 3745-27-11 of the Administrative Code.

(ii) A third-party conducting the final closure activities, assuming payment to employees of not less than the applicable prevailing wage.

APEX ENVIRONMENTAL, LLC
APEX SANITARY LANDFILL CONTIGUOUS EXPANSION
JEFFERSON COUNTY, OHIO

MAXIMUM TOTAL OPEN AREA DETERMINATION

PHASE ID	AREA OF PHASE	TOTAL DEVELOPED AREA		TOTAL CAP INSTALLED		TOTAL OPEN AREA
	AC	AC		AC		AC
Phase 1 to 6B-West	95.7	95.7		0.0		95.7
6B-East	3.2	98.9		0.0		98.9
7A	9.2	108.1		0.0		108.1
8	23.3	131.4		0.0		131.4
9	16.2	147.6		23.3		124.3
10	33.1	180.7		39.5		141.2
11	31.8	212.5		72.6		139.9
12	31.8	244.3		104.4		139.9
13	20.6	264.9		136.2		128.7
14	23.3	288.2		156.8		131.4
FINAL	0	288.2		180.1		108.1
FINAL	0	288.2		288.2		0.0

Note:

Apex intends to cap a portion of the existing landfill unit equal to the lined area being constructed in the contiguous expansion area. Capping will occur within 12 months of construction of the lined area. The table above presents an estimate of the maximum total open area.

APEX ENVIRONMENTAL, LLC
APEX SANITARY LANDFILL CONTIGUOUS EXPANSION
JEFFERSON COUNTY, OHIO
FINAL CLOSURE COST ESTIMATE
REVISED MAY 2016

Apex intends to cap a portion of the landfill equal to the lined area being constructed. The worst case open acreage will be limited to 141.2 acres, which occurs after construction of Phase 10.

Acres to be closed 141.2 AC = 6,150,672 S.F.

ITEM	QUANTITY	UNIT	UNIT COST	EXTENDED COST
1. CAP SYSTEM				
a. Vegetative Cover (30-inches)	597,982	C.Y.	$3.10	$1,853,745
b. Geocomposite Drainage Layer	6,150,672	S.F.	$0.70	$4,305,471
c. 40 mil LLDPE Liner	6,150,672	S.F.	$0.50	$3,075,336
d. Recompacted Soil Barrier Layer (18 inches)	358,789	C.Y.	$5.10	$1,829,825
			Subtotal	**$11,064,377**
2. GAS EXTRACTION SYSTEM (assume 50 acres of GCCS installation)				
a. Drilling Mobilization/Demobilization	1	EA.	$11,100	$11,100
b. Drilling Wells	5,000	L.F.	$75	$375,000
c. Well installation	55	EA.	$525	$28,875
c. Gas Extraction Piping Installation	15,000	L.F.	$45	$675,000
			Subtotal	**$1,089,975**
3. SURFACE WATER CONTROL STRUCTURES	141.2	AC.	$3,300	$465,960
			Subtotal	**$465,960**
4. SEEDING, MULCHING AND FERTILIZER	141.2	AC.	$1,400	$197,680
			Subtotal	**$197,680**
5. REGRADING AND RECLAIMING EXCAVATED AREAS (Reclamation of borrow areas)	10	AC.	$5,500	$55,000
			Subtotal	**$55,000**
6. CLOSURE CERTIFICATION REPORT AND RECORD DRAWINGS				
a. Construction Quality Assurance	141.2	AC.	$11,100	$1,567,320
b. Certification Survey	141.2	AC.	$2,800	$395,360
c. Laboratory Costs	141.2	AC.	$555	$78,366
d. Certification Report	1	L.S.	$22,300	$22,300
			Subtotal	**$2,063,346**
TOTAL COST				**$14,936,338**
TOTAL COST PER ACRE				**$105,782**

NOTES:
1.a Multiplied by a factor of 1.05 to account for compaction.
1.d Multiplied by a factor of 1.05 to account for compaction.
3. Includes surface water benches and rock letdowns where the final cover system must be installed.
5. Includes grading of highwall to acceptable grades.
6.a Cost per acre includes field labor, project management, and expenses.
6.b Cost per acre includes field labor, project management, and expenses.
6.c Includes geosynthetics and soils testing.

POST-CLOSURE COST ESTIMATE

(i) An itemized written post-closure cost estimate, in current dollars, based on the following:

- **(i) The cost of post-closure care of the unit(s) of the sanitary landfill facility in accordance with Rule 3745-27-14 of the Administrative Code.**
- **(ii) A separate estimate for each noncontiguous unit(s) of the sanitary landfill facility.**
- **(iii) A third-party conducting the post-closure activities, assuming payment to employees of not less than the applicable prevailing wage.**

APEX SANITARY LANDFILL CONTIGUOUS EXPANSION
POST-CLOSURE CARE COST ESTIMATE
VERTICAL & LATERAL EXPANSIONS
DETAILED BREAKDOWN TABLE
REVISED MAY 2016

ITEM				ANNUAL COST
I. GROUND WATER MONITORING				
A. LABORATORY ANALYSIS				
UPPERMOST AQUIFER WELLS (OAC 3745-27-10(D)(5)(a))				
77 locations @ $870/event for 2 events per year				$133,980
B. CONSULTING SERVICES (sampling, shipping, data analysis, statistical analysis and report)				$25,000
			Subtotal	**$158,980**
II. EXPLOSIVE GAS MIGRATION MONITORING				
QUARTERLY MONITORING - YEARS 1-5 (OAC 3745-27-12(E)(1)(a))		8 HRS/EVENT; $65/HR; 4 EVENTS/YR		$2,080
SEMI-ANNUAL MONITORING - YEARS 6-30 (OAC 3745-27-12(E)(1)(c))		8 HRS/EVENT; $65/HR; 2 EVENTS/YR		$1,040
			Subtotal	**$1,214**
III. LEACHATE MONITORING (OAC 3745-27-14(A)(6)(b))				
A. LEACHATE SAMPLING/SHIPPING/TESTING - ANNUALLY				$3,250
			Subtotal	**$3,250**
IV. SURFACE WATER MONITORING				
SEDIMENTATION POND NPDES SAMPLING/TESTING - 7 SAMPLES/MONTH; $270/SAMPLE/MONTH			**Subtotal**	**$22,680**
V. OPERATION AND MAINTENANCE OF LEACHATE COLLECTION/TREATMENT SYSTEMS				
A. PUMP REPLACEMENT	9 SUMP PUMPS PER 30 YRS -$5,400/PUMP			$1,620
	1 LOAD OUT PUMP PER 30 YRS - $5,400/PUMP			$180
	1 CONTAINMENT AREA PUMP PER 30 YRS - $2,200/PUMP			$74
	LABOR - 264 HOURS PER 30 YRS AT $65/HOUR			$572
B. SUMP/PIPE CLEANING	1 CLEANING PER 2 YEARS FOR 9 CLEANOUTS AT $1100 PER CLEANOUT			$4,950
C. SYSTEM INSPECTION	2 HR/INSPECTION - 52 INSPECTION/YR AT $65/HOUR			$6,760
D. LEACHATE DISPOSAL (POST-CLOSURE)	1.5 GAL/ACRE*DAY * 365 DAYS/YEAR * $0.05/GAL * 289 ACRES			$7,912
E. TANK CLEANING/REPAIR	Includes cleaning, characterization sampling and sludge disposal every 5 years. ($5,400 per event)			$1,080
F. FORCEMAIN PIPING REPAIR/REPLACEMENT	300 FT AT $30/FT EVERY 5 YEARS			$1,800
			Subtotal	**$24,948**
VI. OPERATION AND MAINTENANCE OF GROUND WATER MONITORING WELLS				
4 MONITORING WELLS, BOLLARDS, ETC. - REPAIR/REPLACE TWO EVERY 15 YRS AT $5,400/WELL				$720
CONSULTING (Includes field oversight, reporting, etc) - TWICE EVERY 15 YEARS AT $2,700/WELL				$360
ROUTINE MAINTENANCE				$500
ABANDONMENT	Assumes $2,200 per well for mobilization, drilling, and grouting of 18 wells to be completed during the 30 years and $1,100 per well abandoned for consulting services (oversight and reporting)			$1,980
			Subtotal	**$3,560**
VII. OPERATION AND MAINTENANCE OF GAS EXTRACTION SYSTEM				
A. GAS WELL REPLACEMENT	3 WELL	$2200 EACH	Three 100 ft well replaced every 10 years.	$660
B. ABANDONMENT	LABOR AND REPORT			$2,000
			Subtotal	**$2,660**
VIII. OPERATION AND MAINTENANCE OF EXPLOSIVE GAS MONITORING SYSTEM				
MONITORING PROBES - REPLACE ONE EVERY 15 YRS AT $1,700/PROBE				$114
ROUTINE MAINTENANCE				$500
ABANDONMENT	Assumes $2,200 per probe for mobilization, drilling, and grouting of 3 probes to be completed during the 30 years.			$220
			Subtotal	**$834**
IX. UTILITIES FOR OPERATION				
A. LEACHATE MANAGEMENT SYSTEM	Operating costs includes utilities, etc.			$13,000
			Subtotal	**$13,000**
X. MAINTENANCE OF COVER SYSTEM				
A. VEGETATIVE COVER (2.5 FT THICK) - 1.0 ACRES PER YEAR @ $3.75/CY				$15,125
B. GEOCOMPOSITE AND FML - 1.0 ACRE PER YEAR @ $1.30/SF INSTALLED				$56,628
C. RSB (1.5-FT THICK) - 1.0 ACRE PER YEAR @ $5.30/CY				$12,826
D. SEEDING/MULCHING - 1.0 ACRES PER YEAR @ $2,200/ACRE				$2,200
E. MOWING (288.5 ACRES)				$11,000
F.CERTIFICATION REPORT				$5,500
			Subtotal	**$103,279**
XI. OPERATION AND MAINTENANCE OF SURFACE WATER MANAGEMENT SYSTEM				
CHANNELS, LETDOWNS, SED. PONDS, ETC.			**Subtotal**	**$13,000**
XII. OPERATION AND MAINTENANCE OF ACCESS CONTROL STRUCTURES				
A. FENCES, GATES AND SIGNS (Assumes 200 ft of fence, 2 gates and one entrance sign in 30 years)				$2,700
B. ROADWAYS (Assumes minor repairs, plowing, etc. every year)				$6,500
			Subtotal	**$9,200**
REPORTING				
A. QUARTERLY INSPECTIONS AND REPORTS BY THIRD PARTY CONSULTANT (24hrs x $95/hr x 4).				$9,120
B. ANNUAL REPORT - (OAC 3745-27-14(A)(6))				$5,500
			Subtotal	**$14,620**
			Annual Post-Closure Cost:	**$371,225**
XV. FINAL CERTIFICATION UPON COMPLETION OF POST-CLOSURE CARE PERIOD				
POST-CLOSURE CERTIFICATION REPORT - (OAC 3745-27-14(B)) ($5,500 LUMP SUM)			**Subtotal**	**$5,500**

APEX SANITARY LANDFILL CONTIGUOUS EXPANSION
POST-CLOSURE CARE COST ESTIMATE
REVISED MAY 2016

SUMMARY TABLE

ACTIVITY				**COSTS**
I	Ground Water Monitoring		$	158,980
II	Explosive Gas Migration Monitoring		$	1,214
III	Leachate Monitoring		$	3,250
IV	Surface Water Monitoring		$	22,680
V	Operation and Maintenance of Leachate Collection/Treatment Systems		$	24,948
VI	Operation and Maintenance of Ground Water Monitoring Wells		$	3,560
VII	Operation and Maintenance of Gas Extraction System		$	2,660
VIII	Operation and Maintenance of Explosive Gas Monitoring System		$	834
IX	Utilities for Operation		$	13,000
X	Maintenance of Cover System		$	103,279
XI	Operation and Maintenance of Surface Water Management System		$	13,000
XII	Operation and Maintenance of Access Control Structures		$	9,200
	Reporting		$	14,620
XIII	**Subtotal of Post-Closure Costs (Annual Costs x 30 years)**		**$**	**11,136,750**
XIV	Administration	% of subtotal: 1	$	111,368
XV	Final Certification Upon Completion of Post-Closure Care Period		$	5,500
XVI	Contingency	% of subtotal: 3	$	334,103
XVII	**TOTAL COST OF POST-CLOSURE (Sum of Lines XIII to XVI)**		**$**	**11,587,721**
XVII-B	**TOTAL COST OF POST-CLOSURE PER ACRE (288.5 acres)**		**$**	**40,166**

SOIL EROSION

(j) **Soil erosion calculations.**

Civil & Environmental Consultants, Inc.					
SUBJECT	(C)(5)(j) Revised Universal Soil Loss Equation			PROJECT NO.	091-867
PROJECT	Apex Sanitary Landfill Contiguous Expansion			PAGE	1
	Apex Environmental, LLC				
MADE BY	AMH	DATE 9/14/2011	CHECKED BY JSO	DATE	10/7/2011

OBJECTIVE:

To determine the maximum allowed length between benches to ensure that Apex Sanitary Landfill Contiguous Expansion meets the soil loss per acre requirements of the Ohio Administrative Code Rule 3745-27-08 (D)(26)(c) which states that the maximum projected erosion rate should not exceed 5 tons per acre per year.

METHOD:

The Revised Universal Soil Loss Equation (RUSLE) will be utilized to estimate the soil loss using the following equation. RUSLE is an empirical equation, which includes several coefficients.

E = R * K * LS * C * P

in which:
E = Computed Soil Loss in tons/acre/year
R = Rainfall Energy Factor (Erosivity Index)
K = Soil Erodibility Factor
LS = Topographic Factor
C = Crop Management Factor
P = Conservation Practice Factor

CALCULATION:

The following scenarios were evaluated based on the various slopes of the expansion:

- **Scenario 1**: Evaluates the soil loss from the crest of the landfill to the top bench. The crest of the landfill has a final cover slope of 10% (10H:1V) and a 3H:1V slope down to the uppermost bench;
- **Scenario 2**: Evaluates the soil loss from the crest of the landfill to the top bench. The crest of the landfill has a final cover slope of 10% (10H:1V) down to the uppermost bench; and
- **Scenario 3:** Evaluates the soil loss between benches. The landfill has a 3H:1V slope between benches.

For ease of calculation, the RUSLE equation was entered into a spreadsheet that includes equations for calculating some of the input variables based on other given input parameters. The figures and tables utilized to determine the input parameters are provided below. Shaded cells are input values.

RAINFALL ENERGY FACTOR

The Rainfall Energy Factor (R) can be determined using the Figure 1 from Reference 2

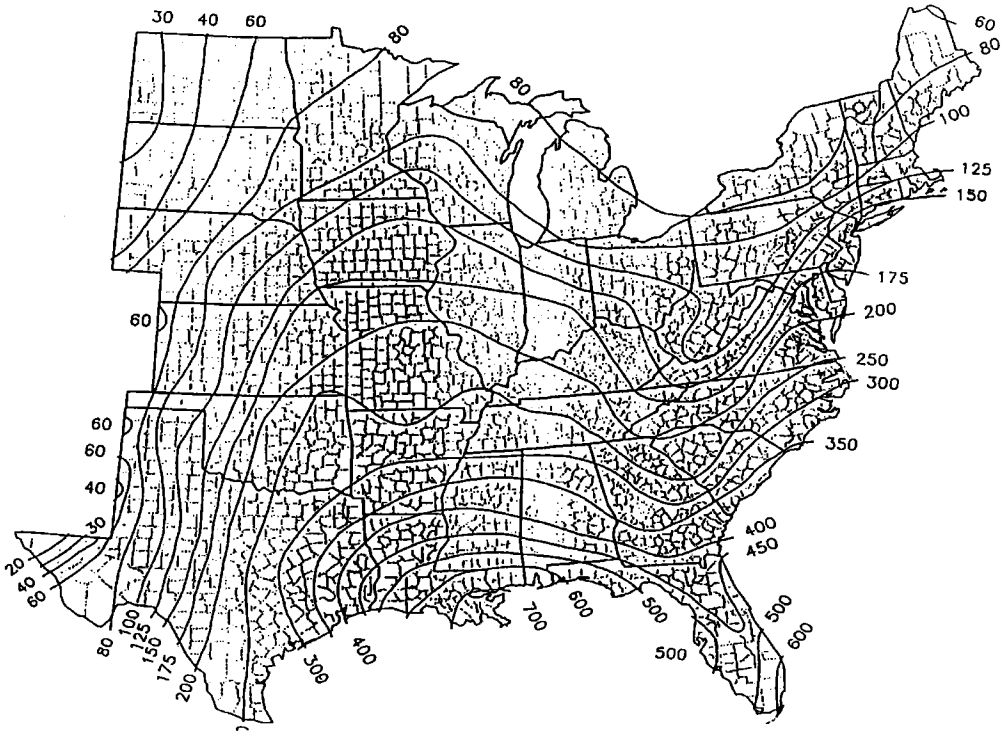


Figure 1 – Isoerodent map of the Eastern US

Rainfall Energy Factor (R) = 110

SOIL ERODIBILITY FACTOR

The Soil Erodibility Factor can be determined from Table 3-2A from Reference 2

K Values for Topsoil

Texture of Surface Layer	Estimated K-Value
Clay, clay loam, loam, silty clay	0.32
Fine sandy loam, loamy very	0.24
Loamy fine sand, loamy sand	0.17
Sand	0.15
Silt loam, silty clay loam, very	0.37

Soil Erodibility Factor (K) = 0.32

TOPOGRAPHIC FACTOR

LS values are determined by using slope length (L) and slope gradient (S). The LS value was calculated by using Equations 4-1, 4-2, 4-3, 4-4, and 4-5 of Reference 1.

Scenario 1

Scenario 1 includes the crest of the landfill to the top bench.

To top bench with 3H:1V slope.

Given a Moderate Rill/Interril Ratio

Horizontal Slope Length (Length) =	170	3H:1V slope length	
Slope Run (H) =	3		
Slope Rise (V) =	1		
Slope Angle (θ) =	0.32	radians	
	18.43	degrees	
Slope Length Factor (L) =	$(Length/72.6)^m$		
=	1.77		*Reference 1; Eqn: 4-1*
Slope Length Exponent (m) =	$\beta/(1+\beta)$		
=	0.67		*Reference 1; Eqn: 4-2*
Ratio of Rill/Interrill Erosion (β) =	$[(\sin(\theta))/0.0896] / [3.0*(\sin(\theta))^{0.8} + 0.561]$		
=	2.01		*Reference 1; Eqn: 4-3*
Slope Steepness Factor (S) =	16.8 * sin (θ) -0.5 (for slopes > 9%)		
=	4.81		*Reference 1; Eqn: 4-5*

Crest of landfill with 10% slope.

Given a Moderate Rill/Interrill Ratio

Horizontal Slope Length (Length) =	270	Top of Landfill	
Slope Run (H) =	10		
Slope Rise (V) =	1		
Slope Angle (θ) =	0.10	radians	
	5.71	degrees	
Slope Length Factor (L) =	$(Length/72.6)^m$		
=	1.97		*Reference 1; Eqn: 4-1*
Slope Length Exponent (m) =	$\beta/(1+\beta)$		
=	0.52		*Reference 1; Eqn: 4-2*

Ratio of Rill/Interrill Erosion (β) = $(\sin(\theta))/0.0896) / [3.0*(\sin(\theta))^{0.8} + 0.561]$

= 1.07 *Reference 1; Eqn: 4-3*

Slope Steepness Factor (S) = 16.8 * sin (θ) -0.5 (for slopes > 9%)

= 1.17 *Reference 1; Eqn: 4-4*

Topographic Factor (LS1) = (L*S)

= 8.49

Topographic Factor (LS2) = (L*S)

= 2.31

Scenario 1 Topographic Factor (LS) = 10.81

Scenario 2

Scenario 2 includes the crest of the landfill to the top bench.

Given a Moderate Rill/Interrill Ratio

Horizontal Slope Length (Length) = 1000 Typical Bench Spacing

Slope Run (H) = 10

Slope Rise (V) = 1

Slope Angle (θ) = 0.10 radians

5.71 degrees

Slope Length Factor (L) = $(\text{Length}/72.6)^{m}$

= 3.89 *Reference 1; Eqn: 4-1*

Slope Length Exponent (m) = β/(1 + β)

= 0.52 *Reference 1; Eqn: 4-2*

Ratio of Rill/Interrill Erosion (β) = $[(\sin(\theta))/0.0896] / [3.0*(\sin(\theta))^{0.8} + 0.561]$

= 1.07 *Reference 1; Eqn: 4-3*

Slope Steepness Factor (S) = 16.8 * sin (θ) -0.5 (for slopes > 9%)

= 1.17 *Reference 1; Eqn: 4-5*

Scenario 2 Topographic Factor (LS) = 4.56

Scenario 3

Scenario 3 includes the distance between benches.

Given a Moderate Rill/Interrill Ratio

Horizontal Slope Length (Length) =	245	Typical Bench Spacing	
Slope Run (H) =	3		
Slope Rise (V) =	1		
Slope Angle (θ) =	0.32	radians	
	18.43	degrees	
Slope Length Factor (L) =	$(\text{Length}/72.6)^m$		
=	2.25		*Reference 1; Eqn: 4-1*
Slope Length Exponent (m) =	$\beta/(1+\beta)$		
=	0.67		*Reference 1; Eqn: 4-2*
Ratio of Rill/Interrill Erosion (β) =	$[(\sin(\theta))/0.0896] / [3.0*(\sin(\theta))^{0.8} + 0.561]$		
=	2.01		*Reference 1; Eqn: 4-3*
Slope Steepness Factor (S) =	16.8 * sin (θ) -0.5 (for slopes > 9%)		
=	4.81		*Reference 1; Eqn: 4-5*
Scenario 3 Topographic Factor (LS) =	10.84		

CROP MANAGEMENT FACTOR

Using Table 10 of Reference 2, and assuming 80 percent ground cover with no appreciable canopy, the value of C is determined to be 0.013 for the site.

"C" for permanent pasture, range and idle land [1]
(Taken from Reference 2, Table 10)

Vegetal Canopy			Cover That Contacts the Surface					
Type and Height Of Raised Canopy [2]	Canopy Cover [3]	Type [4]	0	20	40	60	80	95-100
Column No.:	2	3	4	5	6	7	8	9
No appreciable Canopy		G	.45	.20	.10	.042	.013	.003
		W	.45	.24	.15	.090	.043	.011
Canopy of tall Weeds or short	25	G	.36	.17	.09	.038	.012	.003
		W	.36	.20	.13	.082	.041	.011
Brush (0.5 m fall ht.)	50	G	.26	.13	.07	.035	.012	.003
		W	.26	.16	.11	.075	.039	.011
	75	G	.17	.10	.06	.031	.011	.003
		W	.17	.12	.09	.067	.038	.011
Appreciable brush Or bushes (2 m fall ht.)	25	G	.40	.18	.09	.040	.013	.003
		W	.40	.22	.14	.085	.042	.011
	50	G	.34	.16	.085	.038	.012	.003
		W	.34	.19	.13	.081	.041	.011
	75	G	.28	.14	.08	.036	.012	.003
		W	.28	.17	.12	.077	.041	.011
Trees but no Appreciable low Brush (4 m Fall ht.)	25	G	.42	.19	.10	.041	.013	.003
		W	.42	.23	.14	.087	.042	.011
	50	G	.39	.18	.09	.040	.013	.003
		W	.39	.21	.14	.085	.042	.011
	75	G	.36	.17	.09	.039	.012	.003
		W	.36	.20	.13	.083	.041	.011

1 The listed C values assume that the vegetation and mulch are randomly distributed over the entire area.
2 Canopy height is measured as the average fall height of water drops falling from the canopy to the ground. Canopy effect is inversely proportional to drop fall height and is negligible if fall height exceeds 33-ft.
3 Portion of total-area surface that would be hidden from view by canopy in a vertical projection, (a bird's-eye view).
4 G: Cover at surface is grass, grass like plants, decaying compacted duff, or litter at least 2 inches deep.
W: Cover at surface is mostly broadleaf herbaceous plant (as weeds with little lateral-root network near the surface) or undecayed residues or both

Crop Management Factor (C) = 0.013

SUPPORT PRACTICE FACTOR

P values range between 0 and 1.0 from Reference 3. The value of 1.0 is chosen as a conservative measure.

Support Practice Factor (P) = 1.00

SOIL LOSS

Scenario 1 Soil Loss (E=R*K*LS*C*P) =	**110*0.32*10.81*0.013*1.0 =**	**4.95**	tons/acre/year
Scenario 2 Soil Loss (E=R*K*LS*C*P) =	**110*0.32*4.56*0.013*1.0 =**	**2.08**	tons/acre/year
Scenario 3 Soil Loss (E=R*K*LS*C*P) =	**110*0.32*10.84*0.013*1.0 =**	**4.96**	tons/acre/year

CONCLUSIONS:

Three scenarios were evaluated based on the various slopes of Apex Sanitary Landfill contiguous expansion. The results were as follows:

• **Scenario 1:** The soil loss from the crest of the landfill to the top bench. The crest of the landfill has a final cover slope of 10% (10H:1V) and a 3H:1V slope down to the uppermost bench.

For this scenario, the 10% slope can have a horizontal length of 270 feet and the 3H:1V slope can have a horizontal length of 170 feet without exceeding the maximum allowed soil loss of 5.0 tons/acre/year. The maximum horizontal slope lengths proposed are 228 feet on the 10% slope and 147 feet on the 3H:1V slope to the uppermost bench.

• **Scenario 2:** The soil loss from the crest of the landfill to the top bench. The crest of the landfill has a final cover slope of 10% (10H:1V) down to the uppermost bench.

For this sceneario, the 10% slope can have a horizontal length greater than 1,000 feet without exceeding the maximum allowed soil loss of 5.0 tons/acre/year. The maximum horizontal slope length proposed is 185 feet on the 10% slope to the uppermost bench.

• **Scenario 3:** The soil loss between benches. The landfill has a 3H:1V slope between benches.

For this scenario, the 3H:1V slope can have a horizontal length up to 245 feet without exceeding the maximum allowed soil loss of 5.0 tons/acre/year. The maximum horizontal slope length proposed is 184 feet between benches.

REFERENCES:

1.Predicting Soil Erosion by Water: A Guide to Conservative Planning With the Revised Universal Soil Loss Equation (RUSLE), Agricultural Handbook No. 703, United States Department of Agriculture.

2.Predicting Rainfall Erosion Losses, Agricultural Handbook 537, United States Department of Agriculture.

3. Renard, K.G., G.R. Foster, G.A. Weesies, D.K. McCool, and D.C. Yoder coordinators. 1997. Predicting Soil Erosion by Water: A Guide to Conservation Planning with the Revised Universal Soil Loss Equation (RUSLE). U.S. Department of Agriculture, Agricultural Handbook 703, 404 pp.

SURFACE WATER CONTROL STRUCTURES

(k) Calculations for sizing surface water control structures and verifying that scouring and crushing is minimized.

- **Bench Sizing Calculations**
- **Downchute Sizing Calculation**
- **Surface Water Channel Design**
- **Culvert Sizing Calculation**

OBJECTIVE

The purpose of this calculation is to show that the bench channel design is adequate in size to handle the expected flows on the site. Each bench varies in watershed size and flow length. A "worst case" scenario was analyzed for this calculation.

METHODOLOGY

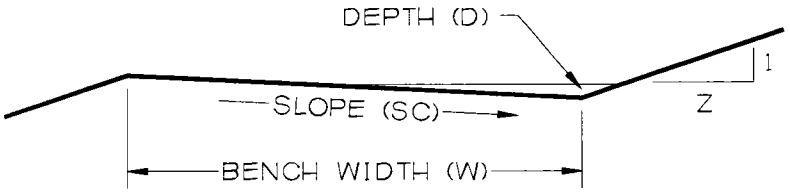
The flow surface was assumed to be a grassed surface, similar to a nongrazed meadow. The flow surface was assigned a curve number of 71. The bench channel was assumed to be similar be a grassed channel, and was assigned a Manning's number of 0.030. The benches have been designed utilizing the 25-year, 24-hour storm event. From Reference 1 and provided as Attachment 1, the rainfall depths for the facility are summarized in the following table:

RAINFALL DATA		
Frequency	**Duration**	**Depth (in)**
2 yr	24 hr	2.44
25 yr	24 hr	4.12

BENCH DIMENSIONS

A computer software package entitled HydroCAD was used to determine the peak discharge, capacity, and peak flow depth of the channel. One "worst case" scenario was analyzed. The "worst case" scenario located within drainage area DA-8 includes a watershed area (5.62 acres) and longest channel flow length (1,510 feet) for any bench. The attached Figure 1 presents the area and channel flow length utilized in this calculation.

The figure below illustrates the cross section of the surface water bench being used in this calculation. The maximum depth of flow is assumed to be 1.5 ft. The side slope is equal to 3H:1V and the bench has a cross slope of 10H:1V. The slope of the bench channel is assumed to be a minimum of 0.03 ft/ft.



D = 1.5 ft
SC = 10H:1V
W = 15.38 ft
Z = 3H:1V

CONCLUSION

From the HydroCAD analysis, the flow in the bench is shown to be 15.12 cfs and the peak depth is 0.66 feet for the 25-year/24-hour storm event. This demonstrates that the bench configuration presented is adequate to carry the expected flows.

REFERENCES

1. National Climatic Data Center, *Precipitation Frequency Estimates*, Point Precipitation Frequency Estimate From NOAA Atlas 14 Ohio 40.4353 N 80.9122 W, Viewed 27 September 2011,< http://hdsc.nws.noaa.gov>.

2 National Resources Conservation Service, PART 630 HYDROLOGY NATIONAL ENGINEERING HANDBOOK, July 2004.

3. Ven Te Chow, OPEN CHANNEL HYDRAULICS, Mc-Graw Hill Book Company, 1959.

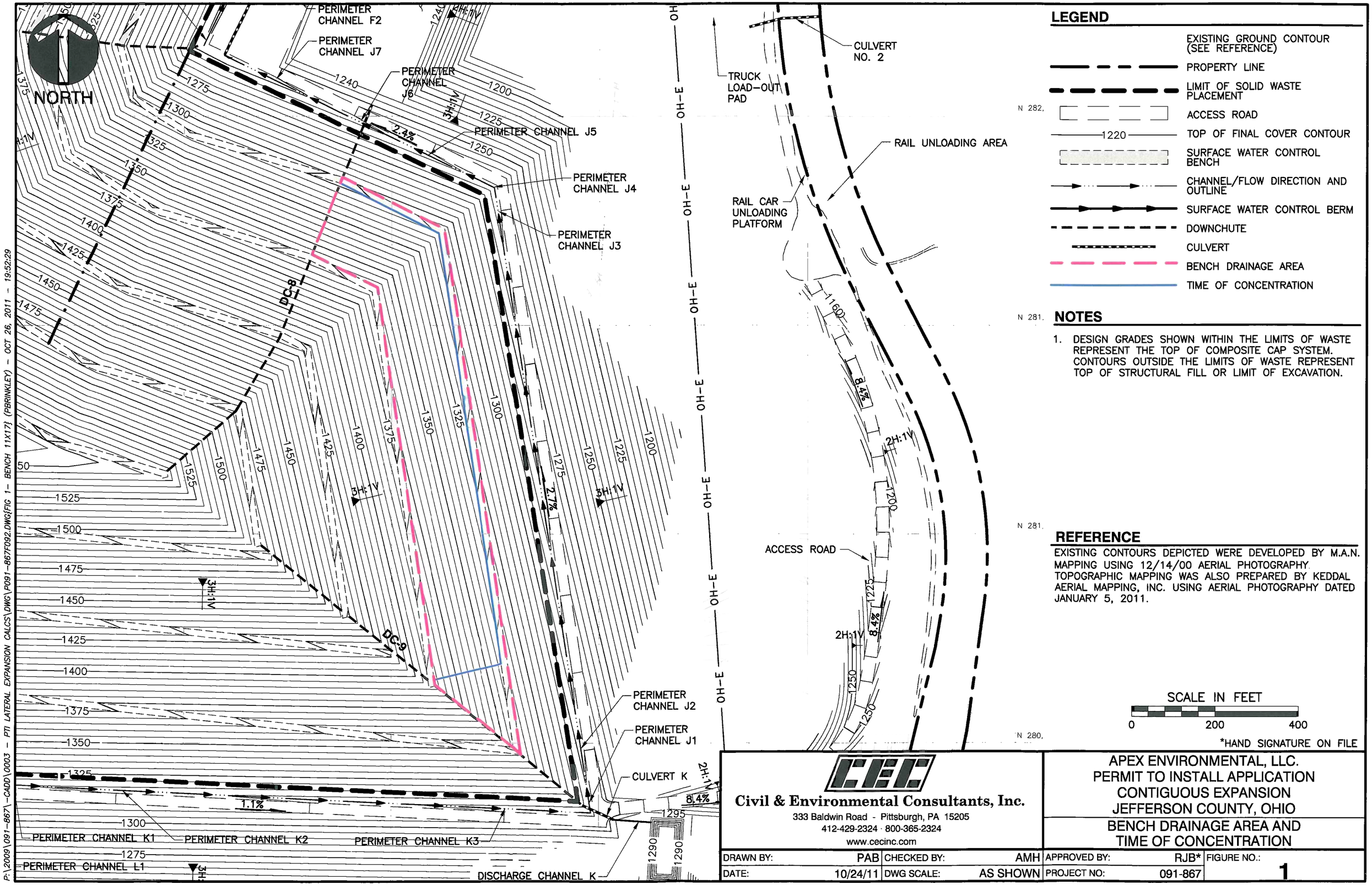
4. Goldman, Jackson and Bursztynsky, EROSION AND SEDIMENT CONTROL HANDBOOK, Mc-Graw Hill Book Company, 1986.

5. Soil Conservation Service, WATER MANAGEMENT AND SEDIMENT CONTROL FOR URBANIZING AREAS, distributed by Ohio Soil and Water Conservation Service

6. Pennsylvania State University, COMPUTATIONAL METHODS IN STORMWATER MANAGEMENT, short course reference document.

7. HydroCAD Software Solutions, LLC., HYDROCAD, Version 10.0, 2011, Computer Software Program.

FIGURE 1



LEGEND

- EXISTING GROUND CONTOUR (SEE REFERENCE)
- PROPERTY LINE
- LIMIT OF SOLID WASTE PLACEMENT
- ACCESS ROAD
- 1220 — TOP OF FINAL COVER CONTOUR
- SURFACE WATER CONTROL BENCH
- CHANNEL/FLOW DIRECTION AND OUTLINE
- SURFACE WATER CONTROL BERM
- DOWNCHUTE
- CULVERT
- BENCH DRAINAGE AREA
- TIME OF CONCENTRATION

NOTES

1. DESIGN GRADES SHOWN WITHIN THE LIMITS OF WASTE REPRESENT THE TOP OF COMPOSITE CAP SYSTEM. CONTOURS OUTSIDE THE LIMITS OF WASTE REPRESENT TOP OF STRUCTURAL FILL OR LIMIT OF EXCAVATION.

REFERENCE

EXISTING CONTOURS DEPICTED WERE DEVELOPED BY M.A.N. MAPPING USING 12/14/00 AERIAL PHOTOGRAPHY. TOPOGRAPHIC MAPPING WAS ALSO PREPARED BY KEDDAL AERIAL MAPPING, INC. USING AERIAL PHOTOGRAPHY DATED JANUARY 5, 2011.

SCALE IN FEET

0 200 400

*HAND SIGNATURE ON FILE

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JEFFERSON COUNTY, OHIO

BENCH DRAINAGE AREA AND TIME OF CONCENTRATION

DRAWN BY:	PAB	CHECKED BY:	AMH	APPROVED BY:	RJB*	FIGURE NO.:	1
DATE:	10/24/11	DWG SCALE:	AS SHOWN	PROJECT NO:	091-867		

P:\2009\091-867\-CADD\0003 - PTI LATERAL EXPANSION CALCS\DWG\P091-867F092.DWG[FIG 1- BENCH 11X17] (PBRINKLEY) - OCT 26, 2011 - 19:52:29

ATTACHMENT 1

NOAA PRECIPITATION ESTIMATE

www.nws.noaa.gov

NOAA's National Weather Service
Hydrometeorological Design Studies Center
Precipitation Frequency Data Server (PFDS)

Home Site Map News Organization Search NWS All NOAA Go

General Info
Homepage
Current Projects
FAQ

Precipitation Frequency (PF)
PF Data Server
- PF in GIS Format
- PF Maps
- Temporal Distr.
- Time Series Data
- PFDS Perform.

PF Documents

Probable Maximum Precipitation (PMP)
PMP Documents
Record Precipitation

Contact Us
Inquiries
List-server

USA.gov

NOAA ATLAS 14 POINT PRECIPITATION FREQUENCY ESTIMATES

DATA DESCRIPTION

Data type: precipitation depth - **Units:** english - **Time series type:** partial duration -

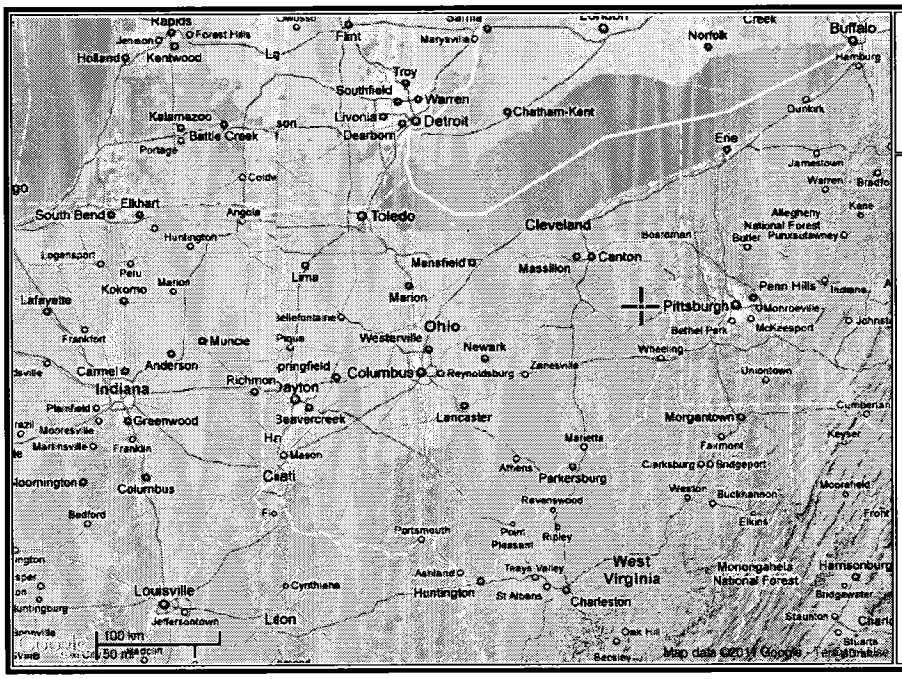
SELECT LOCATION

1. Manually:

a) Enter location (decimal degrees, use "-" for S and W): latitude: 40.4353 longitude: -80.9122 submit

b) Select station: select station

2. Use map:



a) **Select location** (move crosshair)
b) **Click on station icon**
(show stations on map)

LOCATION INFORMATION:
Name: Amsterdam, Ohio, US*
Latitude: 40.4353
Longitude: -80.9122
Elevation: 1230ft*

* source: Google Maps

POINT PRECIPITATION FREQUENCY (PF) ESTIMATES

WITH 90% CONFIDENCE INTERVALS AND SUPPLEMENTARY INFORMATION
NOAA Atlas 14, Volume 2, Version 3

PF tabular PF graphical Supplementary information Print Page

PDS-based precipitation frequency estimates with 90% confidence intervals (in inches)[1]

Duration	Average recurrence interval(years)									
	1	2	5	10	25	50	100	200	500	1000
5-min	0.326 (0.292-0.364)	0.390 (0.350-0.435)	0.472 (0.422-0.527)	0.534 (0.477-0.595)	0.614 (0.546-0.683)	0.676 (0.599-0.751)	0.735 (0.649-0.815)	0.796 (0.700-0.883)	0.878 (0.767-0.972)	0.938 (0.816-1.04)
10-min	0.507 (0.454-0.566)	0.609 (0.546-0.680)	0.733 (0.656-0.819)	0.825 (0.736-0.919)	0.940 (0.836-1.05)	1.02 (0.908-1.14)	1.11 (0.977-1.23)	1.19 (1.05-1.32)	1.29 (1.13-1.43)	1.37 (1.19-1.51)
15-min	0.621 (0.556-0.693)	0.745 (0.667-0.831)	0.900 (0.806-1.01)	1.02 (0.906-1.13)	1.16 (1.03-1.29)	1.27 (1.12-1.41)	1.37 (1.21-1.53)	1.48 (1.30-1.64)	1.61 (1.41-1.78)	1.71 (1.48-1.89)
30-min	0.821 (0.736-0.917)	0.997 (0.893-1.11)	1.23 (1.10-1.38)	1.41 (1.26-1.57)	1.64 (1.46-1.82)	1.81 (1.61-2.01)	1.98 (1.75-2.20)	2.16 (1.90-2.39)	2.39 (2.09-2.64)	2.56 (2.23-2.83)
60-min	1.00 (0.899-1.12)	1.22 (1.10-1.37)	1.55 (1.39-1.73)	1.79 (1.60-2.00)	2.13 (1.89-2.37)	2.39 (2.12-2.65)	2.65 (2.34-2.94)	2.93 (2.57-3.25)	3.30 (2.88-3.66)	3.59 (3.13-3.98)
2-hr	1.16 (1.03-1.30)	1.41 (1.25-1.58)	1.80 (1.59-2.02)	2.10 (1.86-2.35)	2.53 (2.23-2.83)	2.88 (2.54-3.22)	3.25 (2.85-3.62)	3.65 (3.18-4.05)	4.21 (3.65-4.66)	4.66 (4.02-5.16)
3-hr	1.23 (1.10-1.39)	1.49 (1.33-1.69)	1.90 (1.69-2.15)	2.22 (1.98-2.51)	2.69 (2.38-3.02)	3.07 (2.71-3.44)	3.47 (3.05-3.88)	3.91 (3.41-4.36)	4.53 (3.92-5.05)	5.03 (4.34-5.60)
6-hr	1.47 (1.32-1.66)	1.77 (1.59-2.00)	2.24 (2.00-2.52)	2.61 (2.33-2.94)	3.17 (2.81-3.55)	3.62 (3.20-4.05)	4.11 (3.61-4.58)	4.65 (4.06-5.16)	5.42 (4.68-6.00)	6.06 (5.19-6.69)
12-hr	1.74 (1.57-1.94)	2.09 (1.88-2.33)	2.60 (2.34-2.91)	3.04 (2.72-3.38)	3.67 (3.27-4.07)	4.20 (3.73-4.65)	4.78 (4.22-5.27)	5.41 (4.74-5.95)	6.34 (5.50-6.93)	7.11 (6.12-7.75)

24-hr	**2.04** (1.88-2.21)	**2.44** (2.26-2.64)	**3.00** (2.77-3.25)	**3.46** (3.20-3.75)	**4.12** (3.79-4.45)	**4.66** (4.26-5.03)	**5.23** (4.76-5.64)	**5.84** (5.28-6.28)	**6.69** (6.00-7.20)	**7.39** (6.57-7.95)
2-day	**2.38** (2.22-2.58)	**2.85** (2.64-3.08)	**3.47** (3.22-3.75)	**3.98** (3.69-4.30)	**4.69** (4.33-5.05)	**5.27** (4.84-5.67)	**5.87** (5.36-6.31)	**6.49** (5.90-6.99)	**7.37** (6.63-7.94)	**8.06** (7.20-8.70)
3-day	**2.55** (2.38-2.75)	**3.04** (2.83-3.27)	**3.68** (3.43-3.97)	**4.21** (3.91-4.52)	**4.93** (4.57-5.30)	**5.52** (5.09-5.92)	**6.13** (5.62-6.57)	**6.75** (6.17-7.24)	**7.62** (6.90-8.19)	**8.31** (7.47-8.94)
4-day	**2.72** (2.54-2.91)	**3.23** (3.02-3.47)	**3.90** (3.64-4.18)	**4.44** (4.14-4.75)	**5.18** (4.81-5.54)	**5.77** (5.35-6.17)	**6.38** (5.89-6.82)	**7.01** (6.43-7.50)	**7.88** (7.17-8.45)	**8.56** (7.74-9.19)
7-day	**3.25** (3.06-3.47)	**3.86** (3.63-4.12)	**4.63** (4.35-4.94)	**5.24** (4.92-5.59)	**6.09** (5.69-6.49)	**6.77** (6.30-7.21)	**7.45** (6.91-7.94)	**8.16** (7.53-8.69)	**9.11** (8.35-9.73)	**9.86** (8.96-10.5)
10-day	**3.75** (3.54-3.98)	**4.45** (4.20-4.72)	**5.28** (4.98-5.60)	**5.94** (5.60-6.29)	**6.83** (6.42-7.23)	**7.53** (7.06-7.98)	**8.24** (7.70-8.73)	**8.94** (8.33-9.50)	**9.89** (9.15-10.5)	**10.6** (9.76-11.3)
20-day	**5.27** (5.00-5.55)	**6.21** (5.90-6.55)	**7.27** (6.91-7.66)	**8.10** (7.68-8.52)	**9.17** (8.68-9.65)	**9.99** (9.44-10.5)	**10.8** (10.2-11.4)	**11.6** (10.9-12.2)	**12.6** (11.8-13.3)	**13.3** (12.4-14.1)
30-day	**6.61** (6.27-6.98)	**7.77** (7.37-8.21)	**9.01** (8.54-9.51)	**9.97** (9.44-10.5)	**11.2** (10.6-11.8)	**12.2** (11.5-12.8)	**13.1** (12.3-13.8)	**14.0** (13.1-14.8)	**15.1** (14.1-16.0)	**15.9** (14.8-16.9)
45-day	**8.46** (8.05-8.90)	**9.91** (9.42-10.4)	**11.3** (10.8-11.9)	**12.4** (11.8-13.1)	**13.8** (13.1-14.5)	**14.8** (14.0-15.6)	**15.8** (14.9-16.7)	**16.7** (15.8-17.7)	**17.9** (16.8-18.9)	**18.7** (17.5-19.8)
60-day	**10.2** (9.75-10.7)	**11.9** (11.4-12.5)	**13.5** (12.9-14.2)	**14.7** (14.0-15.4)	**16.2** (15.5-17.0)	**17.3** (16.5-18.1)	**18.3** (17.4-19.2)	**19.2** (18.2-20.2)	**20.4** (19.3-21.4)	**21.1** (20.0-22.3)

[1] Precipitation frequency (PF) estimates in this table are based on frequency analysis of partial duration series (PDS).

Numbers in parenthesis are PF estimates at lower and upper bounds of the 90% confidence interval. The probability that precipitation frequency estimates (for a given duration and average recurrence interval) will be greater than the upper bound (or less than the lower bound) is 5%. Estimates at upper bounds are not checked against probable maximum precipitation (PMP) estimates and may be higher than currently valid PMP values.

Please refer to NOAA Atlas 14 document for more information.

Estimates from the table in csv format: precipitation frequency estimates - Submit

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ATTACHMENT 2

HYDROCAD OUTPUT FILES

bench

Subcat Reach Pond Link

Routing Diagram for Bench Calculation
Prepared by Microsoft, Printed 10/21/2011
HydroCAD® 10.00 s/n 01006 © 2011 HydroCAD Software Solutions LLC

Summary for Subcatchment DA-1: DA- 1a

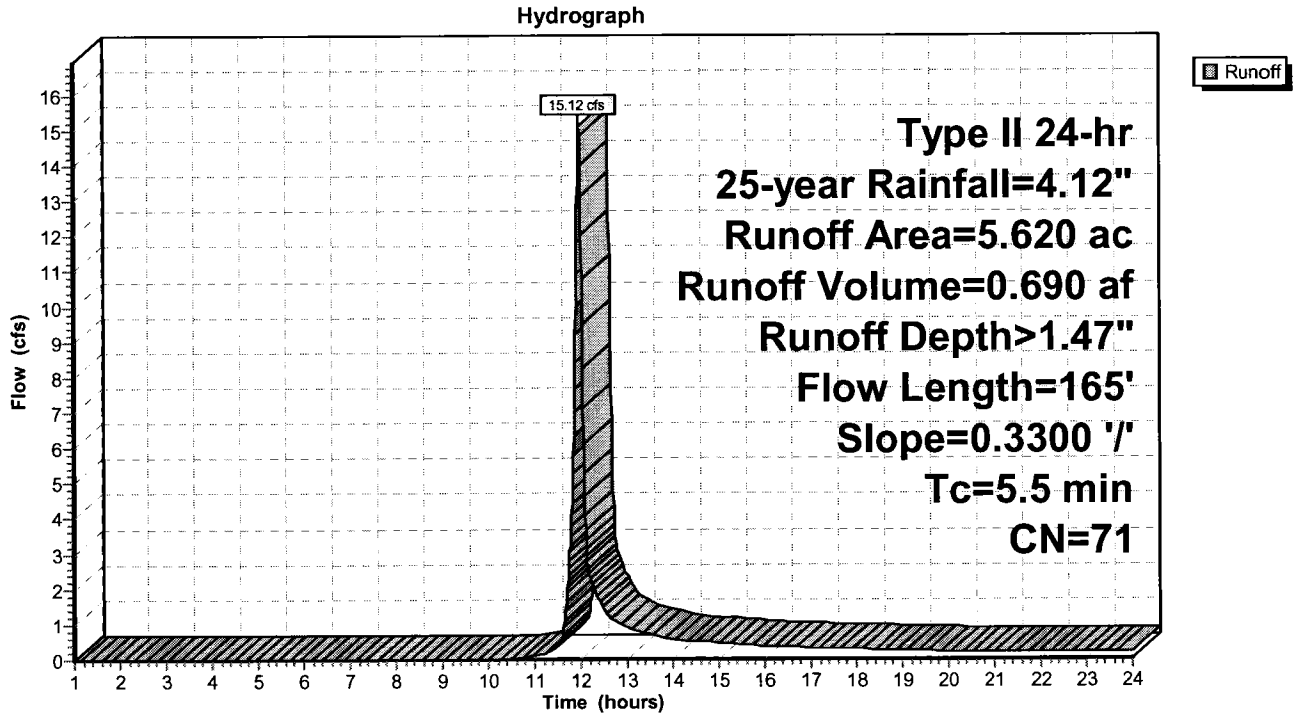
Runoff = 15.12 cfs @ 11.97 hrs, Volume= 0.690 af, Depth> 1.47"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 1.00-24.00 hrs, dt= 0.01 hrs
Type II 24-hr 25-year Rainfall=4.12"

Area (ac)	CN	Description
5.620	71	Meadow, non-grazed, HSG C
5.620		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.5	165	0.3300	0.50		**Sheet Flow, 165 feet 3H:1V sheet flow** Grass: Short n= 0.150 P2= 2.44"

Subcatchment DA-1: DA- 1a



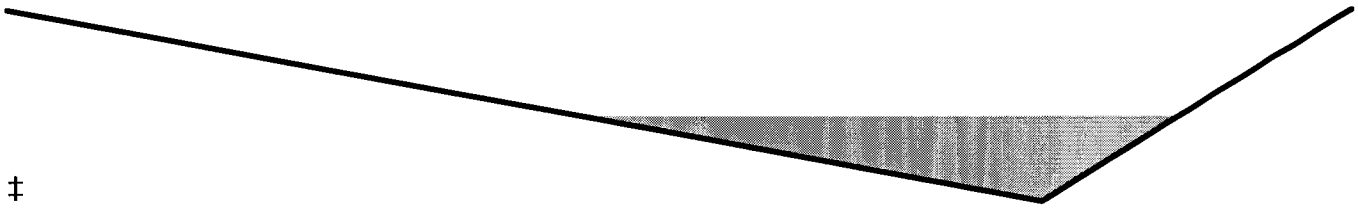
Summary for Reach B-1: bench

Inflow Area = 5.620 ac, 0.00% Impervious, Inflow Depth > 1.47" for 25-year event
Inflow = 15.12 cfs @ 11.97 hrs, Volume= 0.690 af
Outflow = 11.65 cfs @ 12.13 hrs, Volume= 0.685 af, Atten= 23%, Lag= 9.2 min

Routing by Stor-Ind+Trans method, Time Span= 1.00-24.00 hrs, dt= 0.01 hrs
Max. Velocity= 4.07 fps, Min. Travel Time= 6.2 min
Avg. Velocity = 1.70 fps, Avg. Travel Time= 14.8 min

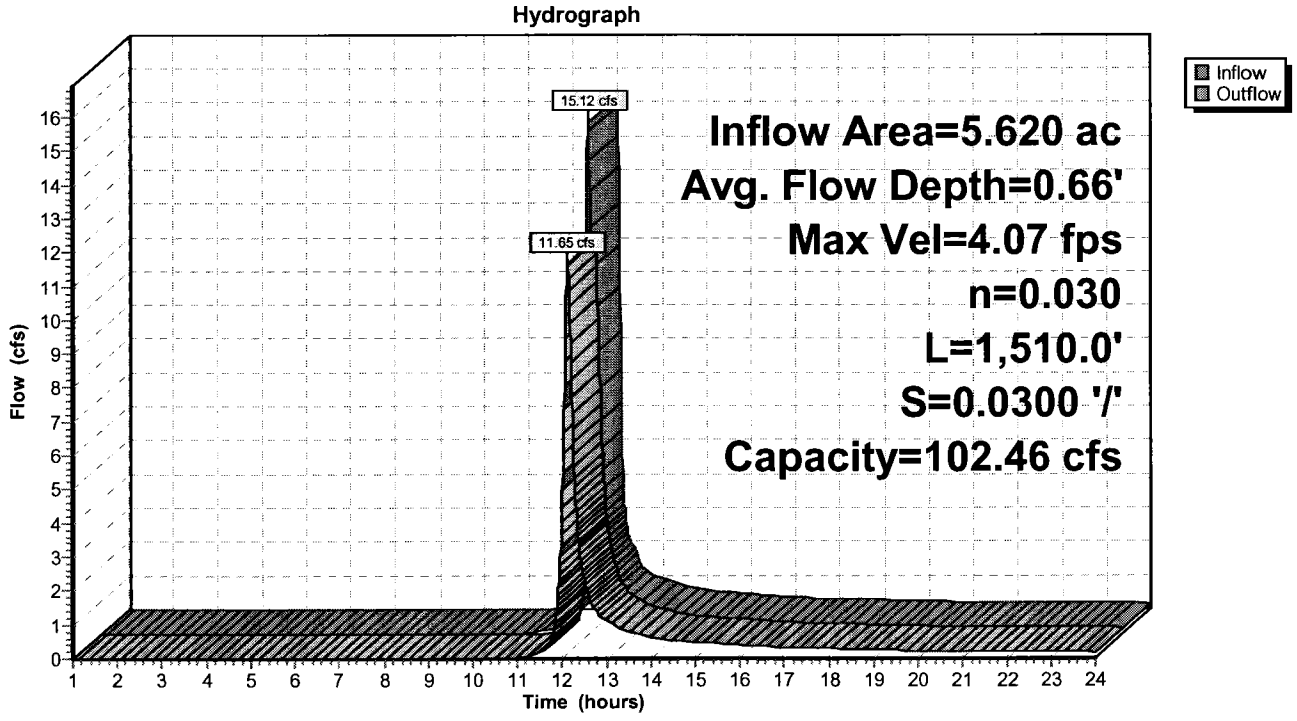
Peak Storage= 4,330 cf @ 12.02 hrs
Average Depth at Peak Storage= 0.66'
Bank-Full Depth= 1.50' Flow Area= 14.6 sf, Capacity= 102.46 cfs

0.00' x 1.50' deep channel, n= 0.030 Earth, grassed & winding
Side Slope Z-value= 10.0 3.0 '/' Top Width= 19.50'
Length= 1,510.0' Slope= 0.0300 '/'
Inlet Invert= 1,345.30', Outlet Invert= 1,300.00'



‡

Reach B-1: bench



OBJECTIVE

This calculation involves the estimation of peak flows for the design of surface water downchutes. Peak flows utilized for downchute sizing have been estimated by use of the SCS TR-20 (Soil Conservation Services Technical Release - 20) graphical peak method. The downchutes have been designed for the 25-year/24-hour storm event, as required by Ohio Administrative Code 3745-27-08(D)(2)(a).

METHODOLOGY

Peak flows have been estimated with SCS TR-20 by calculating the time of concentration of each downchute, the composite runoff curve number describing the reach's watershed, and the total area of the reach's watershed. With this information, the peak flow is found with the TR-20 graphical peak discharge method. A computer software package, Hydrocad 10 (Reference 7), was utilized to perform the SCS TR-20 calculations.

As per the TR-20 methods, times of concentration will be estimated as the sum of sheet flow, shallow flow and channel flow. This site is located in an area of hydrologic soil group C. The surface in the existing and proposed landfill will be similar to a non-grazed meadow in hydrologic soil group C, and was therefore modeled using a curve number of 71.

From Reference 2, the following runoff coefficients have been found and will be utilized.

CN DATA	
Description	**CN**
Non-grazed meadow	71

Sheet flow calculations will use an average roughness of 0.150, which corresponds to short grass. The maximum sheet flow length will be 300 feet. Shallow flow times of concentration will be estimated using the velocity factor for short grass pasture. Where applicable, flow times of concentration through benches or berms will be estimated using the cross section design, which takes into account actual flow depth and velocity information. A figure showing the locations of the drainage areas and the longest time of concentration path to each downchute is included as an attachment to the Surface Water Channel Design Calulation.

As mentioned above, the downchutes have been designed utilizing the 25-year, 24-hour storm event. From Reference 1 and provided as an attachment, the rainfall depths for the facility are summarized in the following table:

RAINFALL DATA		
Frequency	**Duration**	**Depth (in)**
2 yr	24 hr	2.44
25 yr	24 hr	4.12

The locations of the downchutes are shown on Drawing 4H of the PTI Application Drawings.

CALCULATIONS

Given the peak discharge for each downchute, a cross section is sized and lining material is selected. The table below shows the drainage area identification and corresponding acreage contributing to each downchute.

Table 1 shows the downchute ID, contributing drainage are designation, acreage of drainage area, invert elevations, length, and peak flow for each downchute. During this design process, downchutes that were designed for the Vertical Expansion were revised. Table 1 also shows the information for the revised downchutes. See Figure 1 of the Surface Water Channel Design Calculation for the drainage areas to each downchute and the Sedimentation Pond Design Calculations for the hydrographs of the downchutes.

The maximum peak flow in the downchutes will occur in downchute DC-5 from drainage area DA-5, which encompasses approximately 26.71 acres. This downchute discharges into the North Sedimentation Pond. The hydrograph for this area peaked at 51.94 cfs during the 25-year, 24-hour storm event. See the Sedimentation Pond Design Calculations for the hydrographs of the downchutes.

DOWNCHUTE DIMENSIONS

The downchutes will be constructed with a cross section that is trapezoidal in shape with a 6-foot bottom width and 2H:1V sideslopes. The overall depth of the downchute is 1.5 feet, which was analyzed to determine the available freeboard when it is flowing at peak flow. The HydroCAD output hydrographs are included in Attachment 1.

For lining of the downchutes, ODOT Type C rock was chosen. Rock gradations are shown in the following table.

ODOT Type	Graded Rock Size (in)			Max Velocity (ft./sec)
	Maximum	d_{50}	Minimum	
C	18	9	5	11.5

Using an iterative process with the attached graph and HydroCAD, the size of riprap and corresponding Manning's "n" value were determined. The graph is presented as an attachment. Riprap R-5 is equivalent to ODOT Type C.

CONCLUSIONS

Since the downchutes were evaluated using HydroCAD. The HydroCAD analyses show that the downchutes will function as intended. The worst case peak flow resulted in a critical flow depth of 1.05-feet in downchute DC-11 considering the 25-year, 24-hour storm event.

REFERENCES

1. National Climatic Data Center, *Precipitation Frequency Estimates*, Point Precipitation Frequency Estimate From NOAA Atlas 14 Ohio 40.4353 N 80.9122 W, Viewed 27 September 2011, < http://hdsc.nws.noaa.gov>.

2. National Resources Conservation Service, PART 630 HYDROLOGY NATIONAL ENGINEERING HANDBOOK, July 2004.

3. Ven Te Chow, OPEN CHANNEL HYDRAULICS, Mc-Graw Hill Book Company, 1959.

4. Goldman, Jackson and Bursztynsky, EROSION AND SEDIMENT CONTROL HANDBOOK, Mc-Graw Hill Book Company, 1986.

5. Soil Conservation Service, WATER MANAGEMENT AND SEDIMENT CONTROL FOR URBANIZING AREAS, distributed by Ohio Soil and Water Conservation Service

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7. HydroCAD Software Solutions, LLC., HYDROCAD, Version 10.0, 2011, Computer Software Program.

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NOAA PRECIPITATION ESTIMATE

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NOAA ATLAS 14 POINT PRECIPITATION FREQUENCY ESTIMATES

DATA DESCRIPTION

Data type: precipitation depth - **Units:** english - **Time series type:** partial duration -

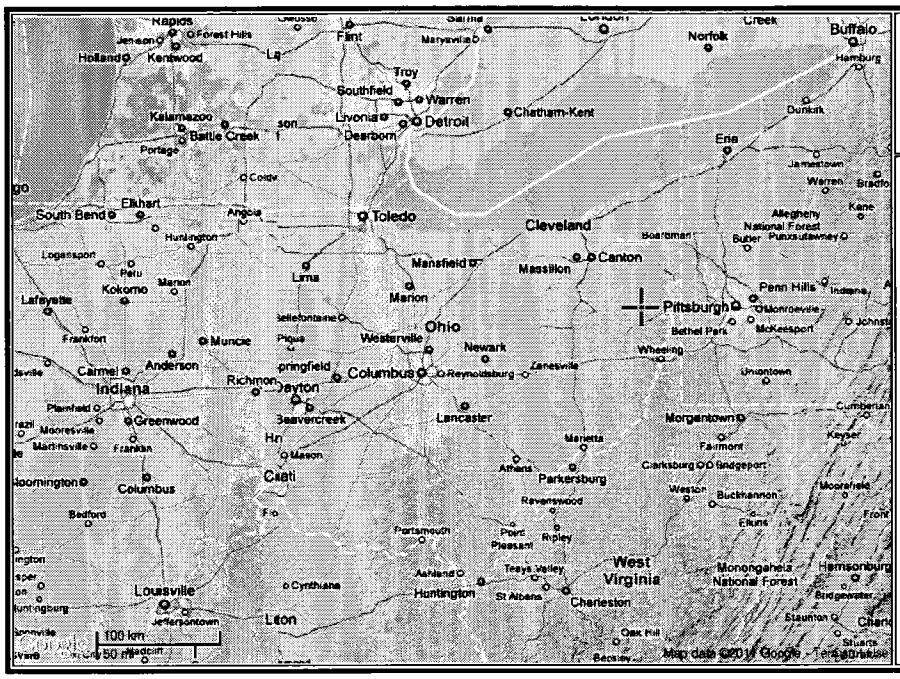
SELECT LOCATION

1. Manually:

a) Enter location (decimal degrees, use "-" for S and W): latitude: 40.4353 longitude: -80.9122 submit

b) Select station: select station

2. Use map:



a) **Select location** (move crosshair)
b) **Click on station icon**
(show stations on map)

LOCATION INFORMATION:
Name: Amsterdam, Ohio, US*
Latitude: 40.4353
Longitude: -80.9122
Elevation: 1230ft*

* source: Google Maps

POINT PRECIPITATION FREQUENCY (PF) ESTIMATES

WITH 90% CONFIDENCE INTERVALS AND SUPPLEMENTARY INFORMATION
NOAA Atlas 14, Volume 2, Version 3

PF tabular PF graphical Supplementary information Print Page

PDS-based precipitation frequency estimates with 90% confidence intervals (in inches)[1]

Duration	Average recurrence interval(years)									
	1	2	5	10	25	50	100	200	500	1000
5-min	0.326 (0.292-0.364)	0.390 (0.350-0.435)	0.472 (0.422-0.527)	0.534 (0.477-0.595)	0.614 (0.546-0.683)	0.676 (0.599-0.751)	0.735 (0.649-0.815)	0.796 (0.700-0.883)	0.878 (0.767-0.972)	0.938 (0.816-1.04)
10-min	0.507 (0.454-0.566)	0.609 (0.546-0.680)	0.733 (0.656-0.819)	0.825 (0.736-0.919)	0.940 (0.836-1.05)	1.02 (0.908-1.14)	1.11 (0.977-1.23)	1.19 (1.05-1.32)	1.29 (1.13-1.43)	1.37 (1.19-1.51)
15-min	0.621 (0.556-0.693)	0.745 (0.667-0.831)	0.900 (0.806-1.01)	1.02 (0.906-1.13)	1.16 (1.03-1.29)	1.27 (1.12-1.41)	1.37 (1.21-1.53)	1.48 (1.30-1.64)	1.61 (1.41-1.78)	1.71 (1.48-1.89)
30-min	0.821 (0.736-0.917)	0.997 (0.893-1.11)	1.23 (1.10-1.38)	1.41 (1.26-1.57)	1.64 (1.46-1.82)	1.81 (1.61-2.01)	1.98 (1.75-2.20)	2.16 (1.90-2.39)	2.39 (2.09-2.64)	2.56 (2.23-2.83)
60-min	1.00 (0.899-1.12)	1.22 (1.10-1.37)	1.55 (1.39-1.73)	1.79 (1.60-2.00)	2.13 (1.89-2.37)	2.39 (2.12-2.65)	2.65 (2.34-2.94)	2.93 (2.57-3.25)	3.30 (2.88-3.66)	3.59 (3.13-3.98)
2-hr	1.16 (1.03-1.30)	1.41 (1.25-1.58)	1.80 (1.59-2.02)	2.10 (1.86-2.35)	2.53 (2.23-2.83)	2.88 (2.54-3.22)	3.25 (2.85-3.62)	3.65 (3.18-4.05)	4.21 (3.65-4.66)	4.66 (4.02-5.16)
3-hr	1.23 (1.10-1.39)	1.49 (1.33-1.69)	1.90 (1.69-2.15)	2.22 (1.98-2.51)	2.69 (2.38-3.02)	3.07 (2.71-3.44)	3.47 (3.05-3.88)	3.91 (3.41-4.36)	4.53 (3.92-5.05)	5.03 (4.34-5.60)
6-hr	1.47 (1.32-1.66)	1.77 (1.59-2.00)	2.24 (2.00-2.52)	2.61 (2.33-2.94)	3.17 (2.81-3.55)	3.62 (3.20-4.05)	4.11 (3.61-4.58)	4.65 (4.06-5.16)	5.42 (4.68-6.00)	6.06 (5.19-6.69)
12-hr	1.74 (1.57-1.94)	2.09 (1.88-2.33)	2.60 (2.34-2.91)	3.04 (2.72-3.38)	3.67 (3.27-4.07)	4.20 (3.73-4.65)	4.78 (4.22-5.27)	5.41 (4.74-5.95)	6.34 (5.50-6.93)	7.11 (6.12-7.75)

24-hr	**2.04** (1.88-2.21)	**2.44** (2.26-2.64)	**3.00** (2.77-3.25)	**3.46** (3.20-3.75)	**4.12** (3.79-4.45)	**4.66** (4.26-5.03)	**5.23** (4.76-5.64)	**5.84** (5.28-6.28)	**6.69** (6.00-7.20)	**7.39** (6.57-7.95)
2-day	**2.38** (2.22-2.58)	**2.85** (2.64-3.08)	**3.47** (3.22-3.75)	**3.98** (3.69-4.30)	**4.69** (4.33-5.05)	**5.27** (4.84-5.67)	**5.87** (5.36-6.31)	**6.49** (5.90-6.99)	**7.37** (6.63-7.94)	**8.06** (7.20-8.70)
3-day	**2.55** (2.38-2.75)	**3.04** (2.83-3.27)	**3.68** (3.43-3.97)	**4.21** (3.91-4.52)	**4.93** (4.57-5.30)	**5.52** (5.09-5.92)	**6.13** (5.62-6.57)	**6.75** (6.17-7.24)	**7.62** (6.90-8.19)	**8.31** (7.47-8.94)
4-day	**2.72** (2.54-2.91)	**3.23** (3.02-3.47)	**3.90** (3.64-4.18)	**4.44** (4.14-4.75)	**5.18** (4.81-5.54)	**5.77** (5.35-6.17)	**6.38** (5.89-6.82)	**7.01** (6.43-7.50)	**7.88** (7.17-8.45)	**8.56** (7.74-9.19)
7-day	**3.25** (3.06-3.47)	**3.86** (3.63-4.12)	**4.63** (4.35-4.94)	**5.24** (4.92-5.59)	**6.09** (5.69-6.49)	**6.77** (6.30-7.21)	**7.45** (6.91-7.94)	**8.16** (7.53-8.69)	**9.11** (8.35-9.73)	**9.86** (8.96-10.5)
10-day	**3.75** (3.54-3.98)	**4.45** (4.20-4.72)	**5.28** (4.98-5.60)	**5.94** (5.60-6.29)	**6.83** (6.42-7.23)	**7.53** (7.06-7.98)	**8.24** (7.70-8.73)	**8.94** (8.33-9.50)	**9.89** (9.15-10.5)	**10.6** (9.76-11.3)
20-day	**5.27** (5.00-5.55)	**6.21** (5.90-6.55)	**7.27** (6.91-7.66)	**8.10** (7.68-8.52)	**9.17** (8.68-9.65)	**9.99** (9.44-10.5)	**10.8** (10.2-11.4)	**11.6** (10.9-12.2)	**12.6** (11.8-13.3)	**13.3** (12.4-14.1)
30-day	**6.61** (6.27-6.98)	**7.77** (7.37-8.21)	**9.01** (8.54-9.51)	**9.97** (9.44-10.5)	**11.2** (10.6-11.8)	**12.2** (11.5-12.8)	**13.1** (12.3-13.8)	**14.0** (13.1-14.8)	**15.1** (14.1-16.0)	**15.9** (14.8-16.9)
45-day	**8.46** (8.05-8.90)	**9.91** (9.42-10.4)	**11.3** (10.8-11.9)	**12.4** (11.8-13.1)	**13.8** (13.1-14.5)	**14.8** (14.0-15.6)	**15.8** (14.9-16.7)	**16.7** (15.8-17.7)	**17.9** (16.8-18.9)	**18.7** (17.5-19.8)
60-day	**10.2** (9.75-10.7)	**11.9** (11.4-12.5)	**13.5** (12.9-14.2)	**14.7** (14.0-15.4)	**16.2** (15.5-17.0)	**17.3** (16.5-18.1)	**18.3** (17.4-19.2)	**19.2** (18.2-20.2)	**20.4** (19.3-21.4)	**21.1** (20.0-22.3)

[1] Precipitation frequency (PF) estimates in this table are based on frequency analysis of partial duration series (PDS).

Numbers in parenthesis are PF estimates at lower and upper bounds of the 90% confidence interval. The probability that precipitation frequency estimates (for a given duration and average recurrence interval) will be greater than the upper bound (or less than the lower bound) is 5%. Estimates at upper bounds are not checked against probable maximum precipitation (PMP) estimates and may be higher than currently valid PMP values.

Please refer to NOAA Atlas 14 document for more information.

Estimates from the table in csv format: precipitation frequency estimates - Submit

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TABLE

Table 1
Downchutes
Apex Sanitary Landfill Contiguous Expansion

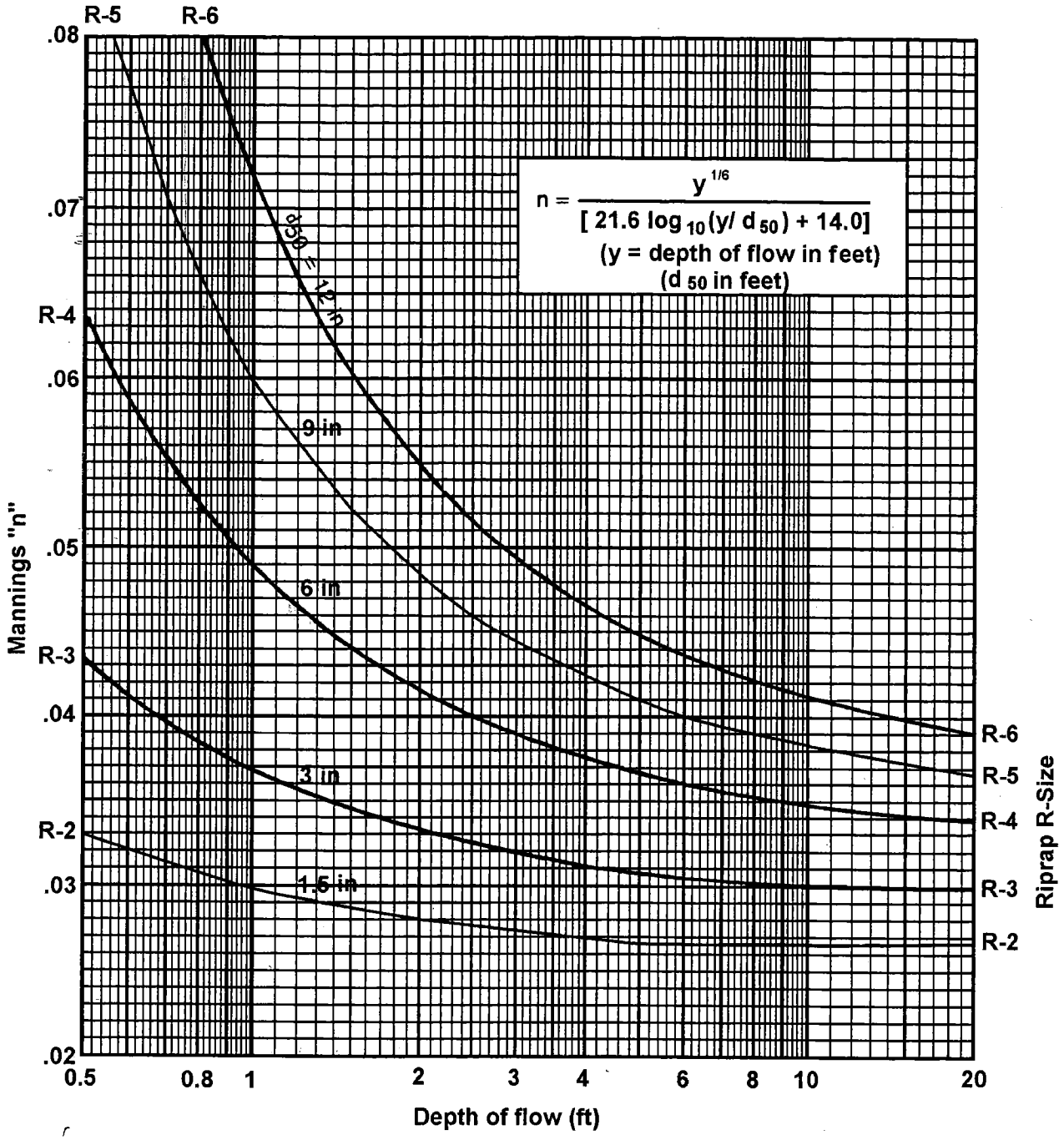
Downchute ID	Drainage Area ID	Drainage Area (acres)	Invert Elevations		Length (ft)	Peak Flow (cfs)
			Inlet	Outlet		
DC-1	DA-1	10.1	1548.4	1231.0	1084	19
DC-2	DA-2	20.9	1468.7	1229.3	778	48
DC-3	DA-3	14.7	1403.2	1225.7	592	33
DC-4	DA-4	9.3	1392.5	1243.4	637	22
DC-5	DA-5	26.7	1390.3	1221.6	566	52
DC-6	DA-6, DA-14	14.7	1458.4	1242.4	768	50
DC-7	DA-7	2.8	1521.1	1465.6	186	6
DC-8	DA-8	20.0	1538.1	1251.0	976	47
DC-9	DA-9	10.9	1478.8	1302.0	1008	24
DC-10	DA-10	17.9	1469.7	1302.5	556	37
DC-11	DA-11	31.8	1501.0	1294.5	679	60
DC-12	DA-12	22.5	1501.4	1293.2	694	42
DC-13	DA-13	27.8	1505.0	1264.6	792	51

(1) Downchute was designed for the Vertical Expansion. Design was re-evaluted because the capacities of the West Sedimentation Pond and the North Sedimentation Pond were re-evaluated. These downchutes discharge into either the West Sedimentation Pond or the North Sedimentation Pond.

(2) Downchute DC-2 was extended for the proposed expansion.

MANNINGS "n" GRAPH

Figure 3
"n" Values for Riprap Channels



OBJECTIVE

This calculation involves the estimation of peak flows for the design of surface water channels. Peak flows utilized for channel sizing have been estimated by use of the SCS TR-20 (Soil Conservation Services Technical Release - 20) graphical peak method. The channels have been designed for the 25-year/24-hour storm event, as required Ohio Administrative Code 3745-27-08(D)(2)(a).

METHODOLOGY

Peak flows have been estimated with SCS TR-20 by calculating the time of concentration of each channel reach, the composite runoff curve number describing the reach's watershed and the total area of the reach's watershed. With this information, the peak flow is found with the TR-20 graphical peak discharge method. A computer software package, Hydrocad 10 (Reference 7), was utilized to perform the SCS TR-20 calculations.

As per the TR-20 methods, times of concentration will be estimated as the sum of sheet flow, shallow flow and channel flow. This site is locatd in an area of hydrologic soil group C. The surface in the existing and proposed landfill will be similar to a non-grazed meadow in hydrologic soil group, and was therefore modeled using a curve number of 71.

CN DATA	
Description	**CN**
Non-grazed meadow	71

Sheet flow calculations will use an average roughness of 0.150, which corresponds to short grass. The maximum sheet flow length will be 300 feet. Shallow flow times of concentration will be estimated using the velocity factor for short grass pasture. Flow times of concentration through channels will be estimated using the channel cross section design, which takes into account actual flow depth and velocity information. Figure 1, which delineates the drainage areas and the longest time of concentration path to each channel is included in the attachment section of this calculation.

As mentioned above, the channels have been designed utilizing the 25-year, 24-hour storm event. From Reference 1 and provided as an attachment, the rainfall depths for the facility are summarized in the following table:

RAINFALL DATA		
Frequency	**Duration**	**Depth (in)**
2 yr	24 hr	2.44
25 yr	24 hr	4.12

The locations of the channels are shown on Drawing 4H of the PTI Application Drawings.

CALCULATIONS

With the peak discharge for each channel, the channel cross section is sized and a channel lining material is selected. Flow properties within the channels are estimated from Manning's Equation:

$$V = \frac{Q}{A} = 1.49\frac{R^{2/3}\sqrt{S_f}}{n} = 1.49\frac{\left[\frac{A}{WP}\right]^{2/3}\sqrt{S_f}}{n}$$

Where:

V = Velocity, fps

Q = Flowrate, cfs

A = Cross – Sectional area of flow, sf

R = Hydraulic Radius, ft

WP = Wetted Perimeter, ft

S_f = Slope of channel, ft / ft

n = Manning's roughness coefficient

Grass or riprap lining was chosen, depending upon the maximum velocity in the channels. Channel lining maximum allowable velocity values are provided in the following table.

CHANNEL LININGS		
Material	n	Vmax (fps)
Grass	0.030	5.0
Type D (R-4) Riprap	Varies	9.0
Type C (R-5) Riprap	Varies	11.5
Type B (R-6) Riprap	Varies	13.0

Table 1 shows the drainage watershed identification, length, inlet and outlet invert elevations, contributing area, and peak flow for each proposed channel. During this design process, dimensions of channels that were designed for the Vertical Expansion were revised. Table 1 also shows the drainage watershed identification, length, inlet and outlet invert elevations, contributing area, and peak flow for each revised channel.

The maximum peak flow during the 25-year/24-hour storm will occur in Discharge Channel D-H3, which discharges into the North Sedimentation Pond. The peak flow for Discharge Channel D-H3 is ~~158.21~~ *162.52* -

cfs from a drainage area of ~~99.82~~ *100.83* acres. Refer to the Sedimentation Pond Design Calculations for the HydroCAD outputs for each surface water channel.

CONCLUSIONS

Since the channels were conservatively designed based on the drainage area, flow rate, and channel slope, all channels will function as intended. The worst-case peak flow from the 25-year, 24-hour storm event was considered in all channels.

Channels will be trapezoidal in shape and will be constructed with the cross sections and depths provided on Table 1. All surface water channels will either be lined with grass or riprap depending on flow velocity.

REFERENCES

1. National Climatic Data Center, *Precipitation Frequency Estimates*, Point Precipitation Frequency Estimate From NOAA Atlas 14 Ohio 40.4353 N 80.9122 W, Viewed 27 September 2011,< http://hdsc.nws.noaa.gov>.

2. National Resources Conservation Service, PART 630 HYDROLOGY NATIONAL ENGINEERING HANDBOOK, July 2004.

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5. Soil Conservation Service, WATER MANAGEMENT AND SEDIMENT CONTROL FOR URBANIZING AREAS, distributed by Ohio Soil and Water Conservation Service

6. Pennsylvania State University, COMPUTATIONAL METHODS IN STORMWATER MANAGEMENT, short course reference document.

7. HydroCAD Software Solutions, LLC., HYDROCAD, Version 10.0, 2011, Computer Software Program.

NOAA PRECIPITATION ESTIMATE

www.nws.noaa.gov

NOAA's National Weather Service
Hydrometeorological Design Studies Center
Precipitation Frequency Data Server (PFDS)

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NOAA ATLAS 14 POINT PRECIPITATION FREQUENCY ESTIMATES

DATA DESCRIPTION

Data type: precipitation depth - Units: english - Time series type: partial duration -

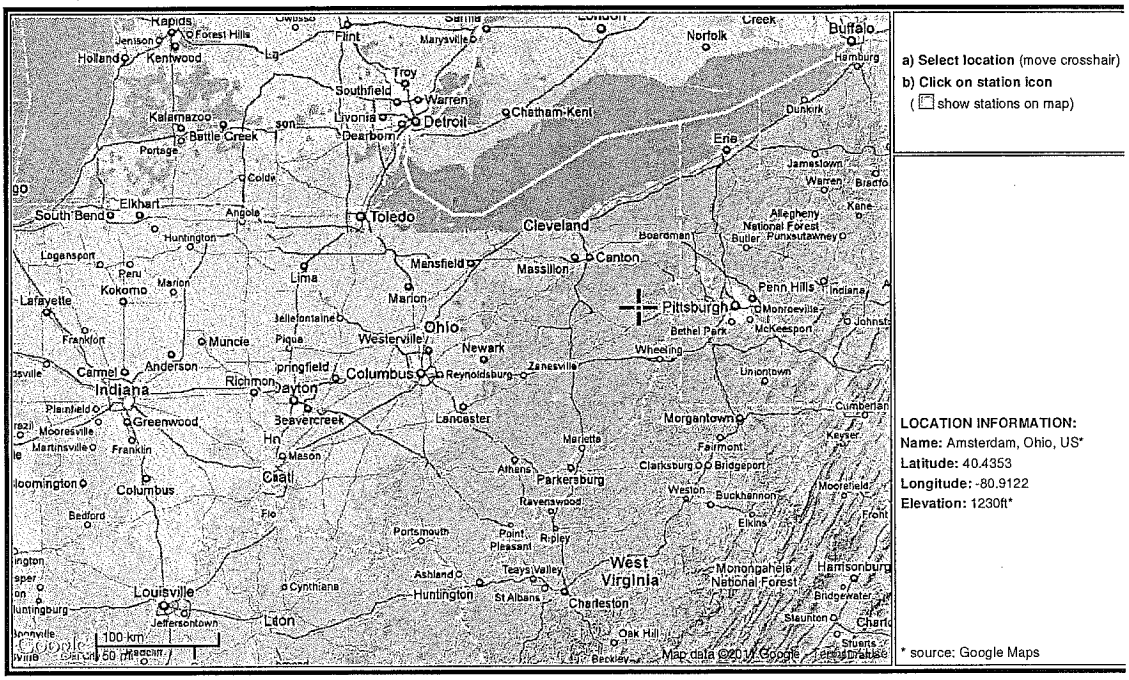
SELECT LOCATION

1. Manually:

a) Enter location (decimal degrees, use "-" for S and W): latitude: 40.4353 longitude: -80.9122 submit

b) Select station: select station

2. Use map:



a) Select location (move crosshair)
b) Click on station icon
(show stations on map)

LOCATION INFORMATION:
Name: Amsterdam, Ohio, US*
Latitude: 40.4353
Longitude: -80.9122
Elevation: 1230ft*

* source: Google Maps

POINT PRECIPITATION FREQUENCY (PF) ESTIMATES

WITH 90% CONFIDENCE INTERVALS AND SUPPLEMENTARY INFORMATION
NOAA Atlas 14, Volume 2, Version 3

PF tabular PF graphical Supplementary information Print Page

PDS-based precipitation frequency estimates with 90% confidence intervals (in inches)[1]

Duration	Average recurrence interval(years)									
	1	2	5	10	25	50	100	200	500	1000
5-min	0.326 (0.292-0.364)	0.390 (0.350-0.435)	0.472 (0.422-0.527)	0.534 (0.477-0.595)	0.614 (0.546-0.683)	0.676 (0.599-0.751)	0.735 (0.649-0.815)	0.796 (0.700-0.883)	0.878 (0.767-0.972)	0.938 (0.816-1.04)
10-min	0.507 (0.454-0.566)	0.609 (0.546-0.680)	0.733 (0.656-0.819)	0.825 (0.736-0.919)	0.940 (0.836-1.05)	1.02 (0.908-1.14)	1.11 (0.977-1.23)	1.19 (1.05-1.32)	1.29 (1.13-1.43)	1.37 (1.19-1.51)
15-min	0.621 (0.556-0.693)	0.745 (0.667-0.831)	0.900 (0.806-1.01)	1.02 (0.906-1.13)	1.16 (1.03-1.29)	1.27 (1.12-1.41)	1.37 (1.21-1.53)	1.48 (1.30-1.64)	1.61 (1.41-1.78)	1.71 (1.48-1.89)
30-min	0.821 (0.736-0.917)	0.997 (0.893-1.11)	1.23 (1.10-1.38)	1.41 (1.26-1.57)	1.64 (1.46-1.82)	1.81 (1.61-2.01)	1.98 (1.75-2.20)	2.16 (1.90-2.39)	2.39 (2.09-2.64)	2.56 (2.23-2.83)
60-min	1.00 (0.899-1.12)	1.22 (1.10-1.37)	1.55 (1.39-1.73)	1.79 (1.60-2.00)	2.13 (1.89-2.37)	2.39 (2.12-2.65)	2.65 (2.34-2.94)	2.93 (2.57-3.25)	3.30 (2.88-3.66)	3.59 (3.13-3.98)
2-hr	1.16 (1.03-1.30)	1.41 (1.25-1.58)	1.80 (1.59-2.02)	2.10 (1.86-2.35)	2.53 (2.23-2.83)	2.88 (2.54-3.22)	3.25 (2.85-3.62)	3.65 (3.18-4.05)	4.21 (3.65-4.66)	4.66 (4.02-5.16)
3-hr	1.23 (1.10-1.39)	1.49 (1.33-1.69)	1.90 (1.69-2.15)	2.22 (1.98-2.51)	2.69 (2.38-3.02)	3.07 (2.71-3.44)	3.47 (3.05-3.88)	3.91 (3.41-4.36)	4.53 (3.92-5.05)	5.03 (4.34-5.60)
6-hr	1.47 (1.32-1.66)	1.77 (1.59-2.00)	2.24 (2.00-2.52)	2.61 (2.33-2.94)	3.17 (2.81-3.55)	3.62 (3.20-4.05)	4.11 (3.61-4.58)	4.65 (4.06-5.16)	5.42 (4.68-6.00)	6.06 (5.19-6.69)
12-hr	1.74 (1.57-1.94)	2.09 (1.88-2.33)	2.60 (2.34-2.91)	3.04 (2.72-3.38)	3.67 (3.27-4.07)	4.20 (3.73-4.65)	4.78 (4.22-5.27)	5.41 (4.74-5.95)	6.34 (5.50-6.93)	7.11 (6.12-7.75)

24-hr	2.04 (1.88-2.21)	2.44 (2.26-2.64)	3.00 (2.77-3.25)	3.46 (3.20-3.75)	4.12 (3.79-4.45)	4.66 (4.26-5.03)	5.23 (4.76-5.64)	5.84 (5.28-6.28)	6.69 (6.00-7.20)	7.39 (6.57-7.95)
2-day	2.38 (2.22-2.58)	2.85 (2.64-3.08)	3.47 (3.22-3.75)	3.98 (3.69-4.30)	4.69 (4.33-5.05)	5.27 (4.84-5.67)	5.87 (5.36-6.31)	6.49 (5.90-6.99)	7.37 (6.63-7.94)	8.06 (7.20-8.70)
3-day	2.55 (2.38-2.75)	3.04 (2.83-3.27)	3.68 (3.43-3.97)	4.21 (3.91-4.52)	4.93 (4.57-5.30)	5.52 (5.09-5.92)	6.13 (5.62-6.57)	6.75 (6.17-7.24)	7.62 (6.90-8.19)	8.31 (7.47-8.94)
4-day	2.72 (2.54-2.91)	3.23 (3.02-3.47)	3.90 (3.64-4.18)	4.44 (4.14-4.75)	5.18 (4.81-5.54)	5.77 (5.35-6.17)	6.38 (5.89-6.82)	7.01 (6.43-7.50)	7.88 (7.17-8.45)	8.56 (7.74-9.19)
7-day	3.25 (3.06-3.47)	3.86 (3.63-4.12)	4.63 (4.35-4.94)	5.24 (4.92-5.59)	6.09 (5.69-6.49)	6.77 (6.30-7.21)	7.45 (6.91-7.94)	8.16 (7.53-8.69)	9.11 (8.35-9.73)	9.86 (8.96-10.5)
10-day	3.75 (3.54-3.98)	4.45 (4.20-4.72)	5.28 (4.98-5.60)	5.94 (5.60-6.29)	6.83 (6.42-7.23)	7.53 (7.06-7.98)	8.24 (7.70-8.73)	8.94 (8.33-9.50)	9.89 (9.15-10.5)	10.6 (9.76-11.3)
20-day	5.27 (5.00-5.55)	6.21 (5.90-6.55)	7.27 (6.91-7.66)	8.10 (7.68-8.52)	9.17 (8.68-9.65)	9.99 (9.44-10.5)	10.8 (10.2-11.4)	11.6 (10.9-12.2)	12.6 (11.8-13.3)	13.3 (12.4-14.1)
30-day	6.61 (6.27-6.98)	7.77 (7.37-8.21)	9.01 (8.54-9.51)	9.97 (9.44-10.5)	11.2 (10.6-11.8)	12.2 (11.5-12.8)	13.1 (12.3-13.8)	14.0 (13.1-14.8)	15.1 (14.1-16.0)	15.9 (14.8-16.9)
45-day	8.46 (8.05-8.90)	9.91 (9.42-10.4)	11.3 (10.8-11.9)	12.4 (11.8-13.1)	13.8 (13.1-14.5)	14.8 (14.0-15.6)	15.8 (14.9-16.7)	16.7 (15.8-17.7)	17.9 (16.8-18.9)	18.7 (17.5-19.8)
60-day	10.2 (9.75-10.7)	11.9 (11.4-12.5)	13.5 (12.9-14.2)	14.7 (14.0-15.4)	16.2 (15.5-17.0)	17.3 (16.5-18.1)	18.3 (17.4-19.2)	19.2 (18.2-20.2)	20.4 (19.3-21.4)	21.1 (20.0-22.3)

[1] Precipitation frequency (PF) estimates in this table are based on frequency analysis of partial duration series (PDS).

Numbers in parenthesis are PF estimates at lower and upper bounds of the 90% confidence interval. The probability that precipitation frequency estimates (for a given duration and average recurrence interval) will be greater than the upper bound (or less than the lower bound) is 5%. Estimates at upper bounds are not checked against probable maximum precipitation (PMP) estimates and may be higher than currently valid PMP values.

Please refer to NOAA Atlas 14 document for more information.

csv Estimates from the table in csv format: precipitation frequency estimates Submit

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TABLE

T
Ch. .s
Apex Sanitary Landfill Contiguous Expansion

Channel	Drainage Area ID	Drainage Area (acres)	Inlet Elevations		Length (ft)	Slope (ft/ft)	Peak Flow (cfs)	Maximum Velocity (fps)	Lining	Dimensions		
			Inlet	Outlet						base (ft)	depth (ft)	sideslopes (zH:1V)
North Sedimentation Pond - Proposed Channels												
CH-J1	DA-49	0.4	1300.1	1297.1	173	0.0178	1	~~1.1~~ *1.8*	~~Riprap Type D (R-4)~~ *Grass*	3	3	2
CH-J2	DA-49,29	5.5	1297.1	1262.0	1300	0.0270	~~14~~ *15*	~~3.0~~ *4.8*	~~Riprap Type D (R-4)~~ *Grass*	3	3	2
CH-J3	DA-49,29,48	5.6	1262.0	1260.9	70	0.0163	~~10.0~~ *12*	~~2.6~~ *4.0*	~~Riprap Type D (R-4)~~ *Grass*	3	3	2
CH-J4	DA-49,29,48,47	6.2	1260.9	1257.0	171	0.0226	~~11.0~~ *12*	~~2.9~~ *4.5*	~~Riprap Type D (R-4)~~ *Grass*	3	3	2
CH-J5	DA-49,29,48,47,28	6.9	1257.0	1251.0	180	0.0333	~~11.0~~ *12*	~~3.2~~ *3.4*	Riprap Type D (R-4)	3	3	2
CH-J6	DA-49,29,48,47,28,8,27	27.9	~~1250~~ *1251.0*	1247.0	236	~~0.0127~~ *0.0169*	~~51.0~~ *55*	~~4.1~~ *4.7*	Riprap Type D (R-4)	3	3	2
CH-J7	DA-49,29,48,47,28,8,27,46	29.4	1247.0	1242.5	~~144~~ *86*	~~0.0313~~ *0.0523*	~~51.0~~ *55*	~~5.7~~ *7.0*	Riprap Type D (R-4)	3	3	2
CH-E2	*DA-24*	*1.2*	*1223.8*	*1222.0*	*352*	*0.0050*	*3*	*1.7*	*Grass*	*2*	*3*	*3*
CH-Z1	*DA-57*	*30.2*	*1210.3*	*1172.4*	*377*	*0.1005*	*54*	*8.8*	*Riprap Type D (R-4)*	*2*	*2*	*2*
North Sedimentation Pond - Revised Channels												
D-F1	DA-55,46,27,8,28,47,48,29,49	29.7	~~1229.5~~ *1241.0*	~~1217~~ *1227.5*	~~256~~ 343	~~0.0488~~ *0.0394*	~~51~~ *55*	~~6.2~~ *5.8*	Riprap Type D (R-4)	2	3	3
D-H3	All areas to North Pond except undisturbed area to pond (UA-1)	~~99.8~~ *100.8*	1160.0	1129.3	130	0.2371	~~158~~ *163*	~~11.8~~ *11.9*	~~Riprap Type B (R-6)~~ *Riprap Type C (R-5)*	4	3	3
~~D-C1~~ *NOT USED*	~~DA-24,25,26,6,14,7,56,55,46,27,8,28,47,48,29,49~~	~~52.2~~	~~1217.0~~	~~1215.5~~	~~232~~	~~0.0065~~	~~92~~	~~4.7~~	~~Riprap Type C (R-5)~~	~~2~~	~~3~~	~~3~~
D-C2	DA-24,25,26,6,14,7,*56*,55,46,27,8,28,47,48,29,49,*57*	~~52.2~~ *53.2*	1212.5	1165.0	434	0.1094	~~90~~ *95*	9.0	~~Riprap Type C (R-5)~~ *Riprap Type D (R-4)*	4	3	2
D-C3	DA-24,25,26,6,14,7,*56*,55,46,27,8,28,47,48,29,49,*57*	~~52.2~~ *53.2*	1165.0	1160.0	174	0.0287	~~89~~ *93*	~~5.5~~ *5.6*	~~Riprap Type C (R-5)~~ *Riprap Type D (R-4)*	4	3	2
CH-F2	DA-25,26,6,14,7	20.5	1242.4	~~1218.7~~ *1222.0*	524	~~0.0452~~ *0.0389*	41	~~5~~ *4.7*	Riprap Type C (R-5)	2	3	3
West Sedimentation Pond-Proposed Channels												
CH-I1	DA-39	0.3	1306.0	1302.0	93	0.0430	1	1.4	Riprap Type D (R-4)	3	3	2
CH-I2	DA-39,36,53	5.3	1302.0	1264.6	869	0.0430	14	3.6	Riprap Type D (R-4)	3	3	2
CH-I3	DA-39,36,53,13,37,38	41.2	1264.6	1232.2	755	0.0430	73	7.1	Riprap Type D (R-4)	3	3	2
CH-I4	DA-39,36,53,13,37,38	41.2	1232.2	1231.0	311	0.0037	70	3.7	Grass	3	3	2
West Sedimentation Pond-Revised Channels												
CH-A2	DA-39,36,53,13,37,38,15,1	54.0	1231.0	1229.3	165	0.0130	87	4.2	Riprap Type D (R-4)	2	3	3
CH-A3	DA-39,36,53,13,37,38,15,1,2,40	77.4	1229.3	1217.0	405	0.0304	110	6.2	Riprap Type C (R-5)	2	3	3
Sedimentation Pond 1												
CH-K1	DA-51	1.4	1314.8	1312.0	259	0.0107	4	2.3	Grass	3	3	2
CH-K2	DA-51,30	5.6	1312.0	1302.0	910	0.0110	13	3.4	Grass	3	3	2
CH-K3	DA-51,30,9,50	17.0	1302.0	1298.0	287	0.0140	32	4.9	Grass	3	3	2
D-K	DA-51,30,9,50	17.0	1297.0	1295.0	84	0.0238	32	4.4	Riprap Type D (R-4)	3	3	2
Sedimentation Pond 2												
CH-L1	DA-52	1.5	1314.8	1311.2	276	0.0129	4	2.6	Grass	3	3	2
CH-L2	DA-52,31	4.4	1311.2	1302.5	660	0.0132	11	3.5	Grass	3	3	2
D-L	DA-52,31,10	22.3	1295.0	1270.0	145	0.1727	47	8.5	Riprap Type C (R-5)	3	3	2
Sedimentation Pond 3												
CH-M1	DA-32	3.3	1304.6	1294.5	1009	0.0100	9	~~1.8~~ *2.8*	~~Riprap Type D (R-4)~~ *Grass*	3	3	2
CH-M2	DA-32,11,33	37.9	1294.5	1286.8	770	0.0100	~~64~~ 67	~~4.1~~ 4.2	Riprap Type D (R-4)	3	3	2
CH-M3	DA-32,11,33,45	39.7	1286.8	1280.0	457	0.0149	~~62~~ 64	4.7	Riprap Type D (R-4)	3	3	2
CH-N1	DA-43	1.7	1306.0	1302.0	362	0.0110	4	~~1.6~~ *2.5*	~~Riprap Type D (R-4)~~ *Grass*	3	3	2
CH-N2	DA-43,35	4.5	1302.0	1293.2	805	0.0110	~~10~~ 11	~~2.1~~ *3.2*	~~Riprap Type D (R-4)~~ *Grass*	3	3	2
CH-N3	DA-43,35,12,34	29.2	1293.2	1287.0	559	0.0110	~~49~~ 51	3.9	Riprap Type D (R-4)	3	3	2
CH-N4	DA-43,35,12,34,44	31.2	1287.0	1280.0	507	0.0138	~~48~~ 50	4.3	Riprap Type D (R-4)	3	3	2
D-M1	32,11,33,45,43,35,12,34	70.9	1270.0	1255.0	197	0.0761	~~107~~ 111	~~7.8~~ 8.6	Riprap Type D (R-4)	8	3	2

FIGURE

NORTH

REVISION RECORD		
NO	DATE	DESCRIPTION
1	7/2013	UPDATED AERIAL TOPOGRAPHY AND MOVED LANDFILL GAS PROCESSING PLANT AREA
2		
3		
4		

SUBMITTAL RECORD		
NO	DATE	DESCRIPTION

LEGEND

- EXISTING GROUND CONTOUR (SEE REFERENCE)
- PROPERTY LINE
- LIMIT OF SOLID WASTE PLACEMENT
- ACCESS ROAD
- TOP OF FINAL COVER CONTOUR
- SURFACE WATER CONTROL BENCH
- CHANNEL/FLOW DIRECTION AND OUTLINE
- SURFACE WATER CONTROL BERM
- DOWNCHUTE
- CULVERT
- DRAINAGE AREA
- TIME OF CONCENTRATION

NOTES

1. DESIGN GRADES SHOWN WITHIN THE LIMITS OF WASTE REPRESENT THE TOP OF COMPOSITE CAP SYSTEM. CONTOURS OUTSIDE THE LIMITS OF WASTE REPRESENT TOP OF STRUCTURAL FILL OR LIMIT OF EXCAVATION.

REFERENCE

EXISTING TOPOGRAPHY PREPARED BY KEDDAL AERIAL MAPPING; DATE OF PHOTOGRAPHY: 1/18/13. ADDITIONAL MAPPING WAS PREPARED BY KEDDAL AERIAL MAPPING FROM AERIAL PHOTOGRAPHY DATED 1/6/12 AND 1/5/11 AND BY M.A.N. MAPPING FROM AERIAL PHOTOGRAPHY DATED 12/14/00.

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CONTIGUOUS EXPANSION
APEX SANITARY LANDFILL
JEFFERSON COUNTY, OHIO

DRAWN BY:	MJI	CHECKED BY:	AMH	APPROVED BY:	RJB*
DATE:	10/24/11	DWG SCALE:	1"=200'	PROJECT NO:	091-867

DRAINAGE AREAS AND TIMES OF CONCENTRATION

FIGURE NO.: 1

P:\2009\091-867_CAD\0003 - PTI LATERAL EXPANSION CALCS\DWG\PDF\REPORT\DWG\FIG 1- BASE(MANUALCO - 7/19/2013) - LH 8/5/2013 1:29:24 PM

OBJECTIVE

The purpose of this calculation is to determine the culvert sizes necessary to handle the anticipated surface water flows from the landfill and its expansion. Storm routings for the 25-year, 24-hour storm event were performed using a computer software package entitled HydroCAD 10. All culverts have been designed for the 25-year/24-hour storm event, as required in OAC 3745-27-08(D)(2)(a).

METHODOLOGY

Peak flows have been calculated by computing areas of the watershed and times of concentration from each watershed to each channel reach.

The culverts were evaluated assuming inlet and outlet conditions using HydroCAD. Entrance loss coefficients for the culverts of 0.5 were used for square edge headwalls. All culverts were designed as corrugated plastic pipe, which has a Manning's n-value of 0.13. The culverts were sized to convey the 25-year/24-hour storm event without overtopping the road. From Reference 1 and provided as an attachment, the rainfall depths for the facility are summarized in the following table:

RAINFALL DATA		
Frequency	**Duration**	**Depth (in)**
2 yr	24 hr	2.44
25 yr	24 hr	4.12

The locations of the culverts are shown on Drawing 4H of the PTI Application Drawings.

CALCULATIONS

Given the anticipated flows for each culvert, and the design slope, a culvert size is chosen and verified within HydroCAD.

Table 1 shows the culvert ID, culvert diameter, contributing drainage area designation, acreage of drainage area, invert elevations, length, slope, peak flow rate and peak elevation due to the 25-year/24-hour storm event, the elevation of the road, and culvert quantity for each new culvert. During this design process, culverts that were designed for the Vertical Expansion were revised. Table 1 also shows the information for the revised culverts. See Figure 1 of the Surface Water Channel Design Calculation for the drainage areas to each culvert and the Sedimentation Pond Design Calculations for the hydrographs of the culverts.

CONCLUSIONS

Culverts were designed to handle the worst-case peak flow based on the 25-year, 24 hour storm event. The maximum peak flow of ~~107.49~~ *111.04* cfs will occur in culvert CU-M. The area draining to this culvert CU-M is 70.94 acres.

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3. Ven Te Chow, OPEN CHANNEL HYDRAULICS, Mc-Graw Hill Book Company, 1959.

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5. Soil Conservation Service, WATER MANAGEMENT AND SEDIMENT CONTROL FOR URBANIZING AREAS, distributed by Ohio Soil and Water Conservation Service

6. Pennsylvania State University, COMPUTATIONAL METHODS IN STORMWATER MANAGEMENT, short course reference document.

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NOAA ATLAS 14 POINT PRECIPITATION FREQUENCY ESTIMATES

DATA DESCRIPTION

Data type: precipitation depth · Units: english · Time series type: partial duration

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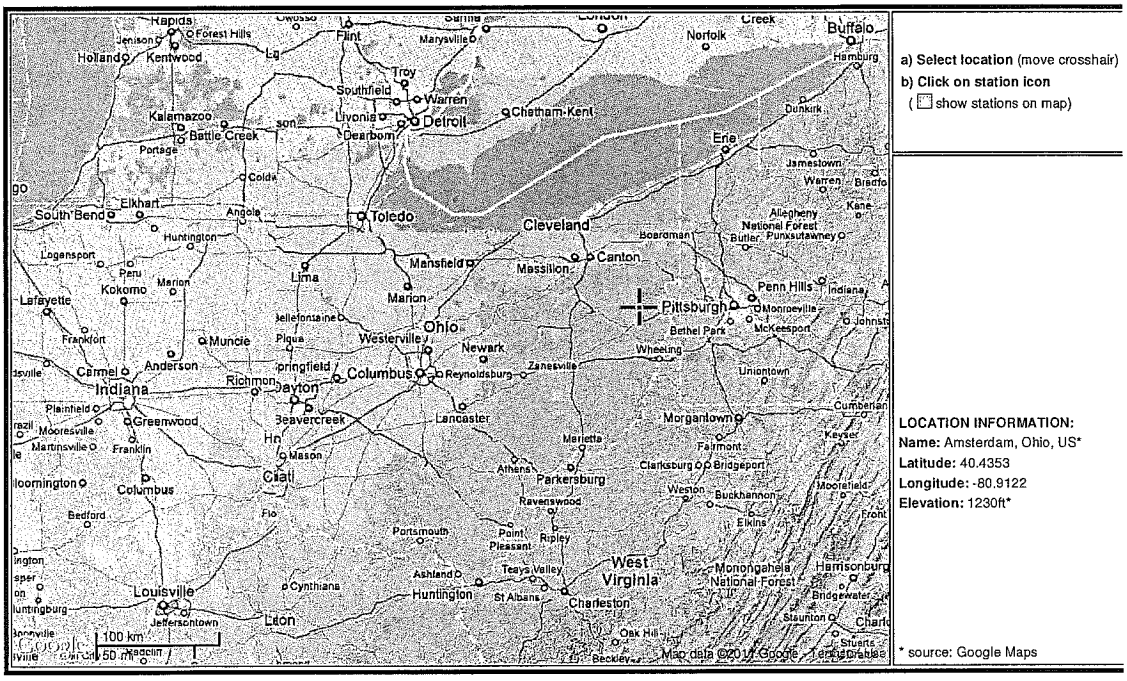

a) Select location (move crosshair)
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LOCATION INFORMATION:
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Latitude: 40.4353
Longitude: -80.9122
Elevation: 1230ft*

* source: Google Maps

POINT PRECIPITATION FREQUENCY (PF) ESTIMATES

WITH 90% CONFIDENCE INTERVALS AND SUPPLEMENTARY INFORMATION
NOAA Atlas 14, Volume 2, Version 3

PF tabular PF graphical Supplementary information Print Page

PDS-based precipitation frequency estimates with 90% confidence intervals (in inches)[1]

Duration	Average recurrence interval(years)									
	1	2	5	10	25	50	100	200	500	1000
5-min	0.326 (0.292-0.364)	0.390 (0.350-0.435)	0.472 (0.422-0.527)	0.534 (0.477-0.595)	0.614 (0.546-0.683)	0.676 (0.599-0.751)	0.735 (0.649-0.815)	0.796 (0.700-0.883)	0.878 (0.767-0.972)	0.938 (0.816-1.04)
10-min	0.507 (0.454-0.566)	0.609 (0.546-0.680)	0.733 (0.656-0.819)	0.825 (0.736-0.919)	0.940 (0.836-1.05)	1.02 (0.908-1.14)	1.11 (0.977-1.23)	1.19 (1.05-1.32)	1.29 (1.13-1.43)	1.37 (1.19-1.51)
15-min	0.621 (0.556-0.693)	0.745 (0.667-0.831)	0.900 (0.806-1.01)	1.02 (0.908-1.13)	1.16 (1.03-1.29)	1.27 (1.12-1.41)	1.37 (1.21-1.53)	1.48 (1.30-1.64)	1.61 (1.41-1.78)	1.71 (1.48-1.89)
30-min	0.821 (0.736-0.917)	0.997 (0.893-1.11)	1.23 (1.10-1.38)	1.41 (1.26-1.57)	1.64 (1.46-1.82)	1.81 (1.61-2.01)	1.98 (1.75-2.20)	2.16 (1.90-2.39)	2.39 (2.09-2.64)	2.56 (2.23-2.83)
60-min	1.00 (0.899-1.12)	1.22 (1.10-1.37)	1.55 (1.39-1.73)	1.79 (1.60-2.00)	2.13 (1.89-2.37)	2.39 (2.12-2.65)	2.65 (2.34-2.94)	2.93 (2.57-3.25)	3.30 (2.88-3.66)	3.59 (3.13-3.98)
2-hr	1.16 (1.03-1.30)	1.41 (1.25-1.58)	1.80 (1.59-2.02)	2.10 (1.86-2.35)	2.53 (2.23-2.83)	2.88 (2.54-3.22)	3.25 (2.85-3.62)	3.65 (3.18-4.05)	4.21 (3.65-4.66)	4.66 (4.02-5.16)
3-hr	1.23 (1.10-1.39)	1.49 (1.33-1.69)	1.90 (1.69-2.15)	2.22 (1.98-2.51)	2.69 (2.38-3.02)	3.07 (2.71-3.44)	3.47 (3.05-3.88)	3.91 (3.41-4.36)	4.53 (3.92-5.05)	5.03 (4.34-5.60)
6-hr	1.47 (1.32-1.66)	1.77 (1.59-2.00)	2.24 (2.00-2.52)	2.61 (2.33-2.94)	3.17 (2.81-3.55)	3.62 (3.20-4.05)	4.11 (3.61-4.58)	4.65 (4.06-5.16)	5.42 (4.68-6.00)	6.06 (5.19-6.69)
12-hr	1.74 (1.57-1.94)	2.09 (1.88-2.33)	2.60 (2.34-2.91)	3.04 (2.72-3.38)	3.67 (3.27-4.07)	4.20 (3.73-4.65)	4.78 (4.22-5.27)	5.41 (4.74-5.95)	6.34 (5.50-6.93)	7.11 (6.12-7.75)

24-hr	2.04 (1.88-2.21)	2.44 (2.26-2.64)	3.00 (2.77-3.25)	3.46 (3.20-3.75)	4.12 (3.79-4.45)	4.66 (4.26-5.03)	5.23 (4.76-5.64)	5.84 (5.28-6.28)	6.69 (6.00-7.20)	7.39 (6.57-7.95)
2-day	2.38 (2.22-2.58)	2.85 (2.64-3.08)	3.47 (3.22-3.75)	3.98 (3.69-4.30)	4.69 (4.33-5.05)	5.27 (4.84-5.67)	5.87 (5.36-6.31)	6.49 (5.90-6.99)	7.37 (6.63-7.94)	8.06 (7.20-8.70)
3-day	2.55 (2.38-2.75)	3.04 (2.83-3.27)	3.68 (3.43-3.97)	4.21 (3.91-4.52)	4.93 (4.57-5.30)	5.52 (5.09-5.92)	6.13 (5.62-6.57)	6.75 (6.17-7.24)	7.62 (6.90-8.19)	8.31 (7.47-8.94)
4-day	2.72 (2.54-2.91)	3.23 (3.02-3.47)	3.90 (3.64-4.18)	4.44 (4.14-4.75)	5.18 (4.81-5.54)	5.77[1] (5.35-6.17)	6.38 (5.89-6.82)	7.01 (6.43-7.50)	7.88 (7.17-8.45)	8.56 (7.74-9.19)
7-day	3.25 (3.06-3.47)	3.86 (3.63-4.12)	4.63 (4.35-4.94)	5.24 (4.92-5.59)	6.09 (5.69-6.49)	6.77 (6.30-7.21)	7.45 (6.91-7.94)	8.16 (7.53-8.69)	9.11 (8.35-9.73)	9.86 (8.96-10.5)
10-day	3.75 (3.54-3.98)	4.45 (4.20-4.72)	5.28 (4.98-5.60)	5.94 (5.60-6.29)	6.83 (6.42-7.23)	7.53 (7.06-7.98)	8.24 (7.70-8.73)	8.94 (8.33-9.50)	9.89 (9.15-10.5)	10.6 (9.76-11.3)
20-day	5.27 (5.00-5.55)	6.21 (5.90-6.55)	7.27 (6.91-7.66)	8.10 (7.68-8.52)	9.17 (8.68-9.65)	9.99 (9.44-10.5)	10.8 (10.2-11.4)	11.6 (10.9-12.2)	12.6 (11.8-13.3)	13.3 (12.4-14.1)
30-day	6.61 (6.27-6.98)	7.77 (7.37-8.21)	9.01 (8.54-9.51)	9.97 (9.44-10.5)	11.2 (10.6-11.8)	12.2 (11.5-12.8)	13.1 (12.3-13.8)	14.0 (13.1-14.8)	15.1 (14.1-16.0)	15.9 (14.8-16.9)
45-day	8.46 (8.05-8.90)	9.91 (9.42-10.4)	11.3 (10.8-11.9)	12.4 (11.8-13.1)	13.8 (13.1-14.5)	14.8 (14.0-15.6)	15.8 (14.9-16.7)	16.7 (15.8-17.7)	17.9 (16.8-18.9)	18.7 (17.5-19.8)
60-day	10.2 (9.75-10.7)	11.9 (11.4-12.5)	13.5 (12.9-14.2)	14.7 (14.0-15.4)	16.2 (15.5-17.0)	17.3 (16.5-18.1)	18.3 (17.4-19.2)	19.2 (18.2-20.2)	20.4 (19.3-21.4)	21.1 (20.0-22.3)

[1] Precipitation frequency (PF) estimates in this table are based on frequency analysis of partial duration series (PDS).

Numbers in parenthesis are PF estimates at lower and upper bounds of the 90% confidence interval. The probability that precipitation frequency estimates (for a given duration and average recurrence interval) will be greater than the upper bound (or less than the lower bound) is 5%. Estimates at upper bounds are not checked against probable maximum precipitation (PMP) estimates and may be higher than currently valid PMP values.

Please refer to NOAA Atlas 14 document for more information.

CSV Estimates from the table in csv format: precipitation frequency estimates - Submit

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TABLE

Table 1
Culverts
Apex Sanitary Landfill Contiguous Expansion

Culvert	Culvert Diameter (in)	Drainage Area ID	Drainage Area (acres)	Invert Elevations		Length (ft)	Slope (ft/ft)	Peak Flow (cfs)	**Peak Elevation**	**Road Elevation**	Quantity
				Inlet	Outlet						
North Sedimentation Pond - Culverts											
CU-O	36	DA-49,29,48,47,28,8,27,46	29.4	~~1242.5~~ *1242.0*	~~1229.5~~ *1241.0*	~~240~~ *193*	~~0.0542~~ *0.0052*	~~50~~ *55*	~~1244.6~~ *1244.4*	1247	2
CU-Z	*36*	*DA - 49,29,48,47,28,8,27,46 ,55*	*29.7*	*1227.5*	*1210.3*	*310*	*0.0553*	*54*	*1229.6*	*N/A*	*2*
CU-Y	*36*	*DA - 49,29,48,47,28,8,27,46 ,55,57*	*30.2*	*1172.4*	*1172*	*87*	*0.0049*	*53*	*1174.9*	*1177*	*2*
North Sedimentation Pond - Revised Culverts											
CU-K	~~24~~ *30*	DA-4,~~0,51~~,23,5,*20,21*	~~26.7~~ 47.6	1221.0	1215.0	~~60~~ *85*	~~0.1000~~ *0.0706*	~~50~~ *71*	~~1224.7~~ *1224.5*	1225	2
CU-H	30	DA-24,25,26,6,14,7,~~46,27,8 ,28,47,48,29,49~~	21.7	~~1218.2~~ *1222.0*	~~1217.0~~ *1212.0*	~~60~~ *358*	~~0.02~~ *0.0279*	42	~~1219.8~~ *1223.6*	~~1220~~ *1228*	3
~~CU-G~~	~~30~~	~~DA-24,25,26,6,14,7,46,27,8 ,28,47,48,29,49,55,56~~	~~52.2~~	~~1215.5~~	~~1212.5~~	~~100~~	~~0.0300~~	~~90~~	~~1218.4~~	~~1220~~	~~3~~
Sedimentation Pond 1											
CU-K	30	DA-51,30,9,50	17.0	1298.0	1297.0	83	0.0120	32	1301.0	1303	1
Sedimentation Pond 2											
CU-L	36	DA-52,31,10	22.3	1302.5	1295.0	70	0.1071	47	1305.9	1308	1
Sedimentation Pond 3											
CU-M	36	DA-43,35,12,34,44,45,33,1 1,32	70.9	1280.0	1270.0	47	0.2128	~~107~~ *111*	~~1284.0~~ *1284.2*	1285	2

Note:
No revisions were made to the culverts draining to the West Sedimentation Pond. No culverts were added in this area.

SEDIMENTATION PONDS

(l) Sedimentation pond calculations.

1.0 INTRODUCTION

The proposed Sedimentation Pond 1 was designed to collect stormwater for the southeastern portion of the proposed expansion.

This sedimentation pond must meet the following regulations:

OAC 3745-27-08 (D)(3)

(i) Minimum storage volume shall be provided based on either the calculated runoff from a 10-year/24-hour storm event, or 0.125 acre-feet per year (for each acre of disturbed area within the upstream drainage area) multiplied by the scheduled frequency of pond clean-out (in years), which ever is greater; and

(ii) The principal spillway shall safely discharge the flow from a 10-year/24-hour storm event. The inlet elevation of the emergency spillway shall be designed to provide flood storage, with no flow entering the emergency spillway, for a 25-year/24-hour storm event, with allowance provided for the flow passed by the principal spillway during the event; and

(iii) The combination of the principal and emergency spillways shall safely discharge the flow from the 100-year/24-hour storm event using non mechanical means. The embankment design shall provide for no less than 1-foot net freeboard when flow is at the design depth, after allowance for embankment settlement.

All designs are based upon accepted design equations, methodologies and assumptions. Where applicable, design references have been made. Calculations have been performed using the software package, HydroCAD Version 10, Copyright 2011.

2.0 DESIGN ASSUMPTIONS

1. The pond was designed based on the proposed top of final cover grade for the proposed expansion.

2. The inflow hydrographs were developed by HydroCAD for each contributing watershed.

3. The inflow for this sedimentation pond is summarized below:

Drainage Area	Watershed Area (Acre)	Composite CN
DA-51	1.41	71
DA-30	4.15	71
DA-50	0.57	71
DA-9	10.87	71
DA-2	0.40	71
Total	17.4	

Times of concentration will be estimated as the sum of sheet flow, shallow flow and channel flow. The surface in the existing and proposed landfill will be similar to a non-grazed meadow in hydrologic soil group C, and was therefore modeled using a curve number of 71. Sheet flow calculations will use an average roughness of 0.150, which corresponds to short grass. The maximum sheet flow length will be 300 feet. Shallow flow times of concentration will be estimated using the velocity factor for short grass pasture.

From Reference 2, the following runoff coefficients have been found and will be utilized.

CN DATA	
Description	**CN**
Non-grazed meadow	71

3.0 VOLUME SIZING

As per OAC 3745-27-08 (D)(3)(i), the sedimentation pond must provide adequate storage volume for the larger of: (1) the runoff from the 10-year/24-hour storm event or (2) 0.125 acre-ft per acre of disturbed area multiplied by the cleaning frequency in years.

Volume Requirement for 10-year/24-hour storm:

Utilizing HydroCAD for a 10-year/24-hour storm event, the inflow hydrographs were developed for each contributing watershed.

From Reference 9 and presented as an attachment, the rainfall depths for the facility are summarized in the following table:

Storm Event	Rainfall Depth (inches)
10-year/24-hour	3.46
25-year/24-hour	4.12
100-year/24-hour	5.23

Utilizing the watershed information included in Section 2.0 of this calculation, the required storage volume from the runoff from a 10-year/24-hour storm event was calculated by HydroCAD to be approximately 57,412-cf of storage volume. The HydroCAD output files for a 10-year/24-hour storm event are included in an attachment to this calculation.

Volume Requirement for 0.125 acre-ft per disturbed acre:

Given the watershed information included in Section 2.0 of this calculation:

Drainage Area	Watershed Area (acres)	Disturbed Area (acres) **[Calculated]**	Volume (cf) **[Calculated]**
DA-51	1.41	0.42	2,287
DA-30	4.15	1.25	6,806
DA-50	0.57	0.17	926
DA-9	10.87	3.26	17,751
A-2	0.22	0.07	381
Totals	17.22	5.17	28,151

For disturbed area, a conservative assumption of 30% of the watershed was used.

In the above table, the volume for each Drainage Area is calculated as follows assuming one scheduled pond cleaning event per year.

From the above calculations, the controlling volume for the design of this sedimentation pond is 57,412-cf, based on the runoff from the HydroCAD 10-year/24-hour storm event.

4.0 PRINCIPAL SPILLWAY DESIGN

Using HydroCAD, a 10-year/24-hour storm event was run through the sedimentation pond to determine the required storage capacity below the prinicipal spillway. The principal spillway invert elevation should be set at elevation 1291.70-feet.

As per OAC 3745-27-08(D)(3)(b), the principal spillway shall be designed to safely discharge the flow from a 10-year/24-hour storm event without the use of mechanical means. Based on the HydroCAD analysis, Sedimentation Pond 1 will not discharge from the emergency spillway during the 10-year/24-hour storm event. The principal spillway is able to discharge flow from a 25-year/24-hour storm event without the use of mechanical means, thus, the principal spillway is adequate.

Item	Value
Culvert Type	CPP
Culvert Quantity	1
Principal Spillway Diameter	30-inch
Principal Spillway Invert Elevation	1,291.70-ft
Maximum pool elevation for routing of 10-year/24-hour storm	1,291.50-ft
Maximum pool elevation for routing of 25-year/24-hour storm	1,292.13-ft

5.0 ANTI-SEEP COLLAR DESIGN

Anti-seep collars are required for culverts that are placed in the saturated zone of the pond embankment. The culvert used as the principal spillway for Sedimentation Pond 1 is above the saturated zone of the embankment and thus, does not require anti-seep collars.

6.0 EMERGENCY SPILLWAY DESIGN

In accordance with the regulations, the emergency spillway must be set so that there is no discharge during the 25-year/24-hour storm. The combination of the principal and emergency spillway must discharge the 100-year/24-hour storm event while maintaining a minimum of 1.0 foot of freeboard to the embankment crest. These design requirements have been checked by routing the 25-year/24-hour storm and 100-year/24-hour storm through the pond.

The emergency spillway is analyzed as a sharp-crested weir with the invert elevation at 1,292.20-ft. The crest of the emergency spillway has been set so that there is no discharge during the 25-year/24-hour storm. The maximum elevation provided with routing the 25-year/24-hour storm is 1,292.13-ft. The emergency spillway is set at elevation 1,292.20-ft, thus, there is no discharge from the emergency spillway during the 25-year/24-hour storm. During the routing of the 100-year/24-hour storm, a minimum of 1 foot of freeboard is maintained to the perimeter elevation for the pond. The maximum elevation provided with routing of a 100-year/24-hour storm through the pond is 1,292.52-ft. The crest of the embankment is 1,295.00-ft, thus, Sedimentation Pond 1 provides more than 1 foot of freeboard from the embankment crest.

Item	Value
Spillway Type	Sharp-Cressted Vee/Trap Weir
Quantity	1
Emergency Spillway Dimensions	151.9 degrees x 8.0 feet long
Emergency Spillway Invert Elevation	1,292.20-ft
Pond Embankment Crest Elevation	1,295.0-ft
Maximum pool elevation for routing of 100-year/24-hour storm	1292.52-ft (>1.0-ft freeboard)
Maximum pool elevation for routing of 25-year/24-hour storm	1,292.13-ft

7.0 OUTLET CHANNEL

The outlet channel was analyzed so that the flow from the 100-year/24-hour storm is safely discharged. Based on HydroCAD, the maximum velocity from the 100-year/24-hour storm event when using R-4 riprap is 5.17 feet per second, which is below the permissible velocity for R-4 riprap.

8.0 CONCLUSION

Sedimentation Pond 1 will meet the requirements outlined in OAC 3745-27-08 (D)(3). The pond provides 58,980-cf of storage below the principal spillway meeting the requirement for the 10-year/24-hour storm. The principal spillway is able to discharge flow from the 25-year/24-hour storm event without the use of mechanical means, thus, the principal spillway is adequately sized. There is no flow from the emergency spillway during the routing of the 25-year/24-hour storm. The emergency spillway and principal spillway can discharge the 100-year/24-hour storm while maintaining a minimum of 1.0 foot of freeboard.

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Data type: precipitation depth - **Units:** english - **Time series type:** partial duration

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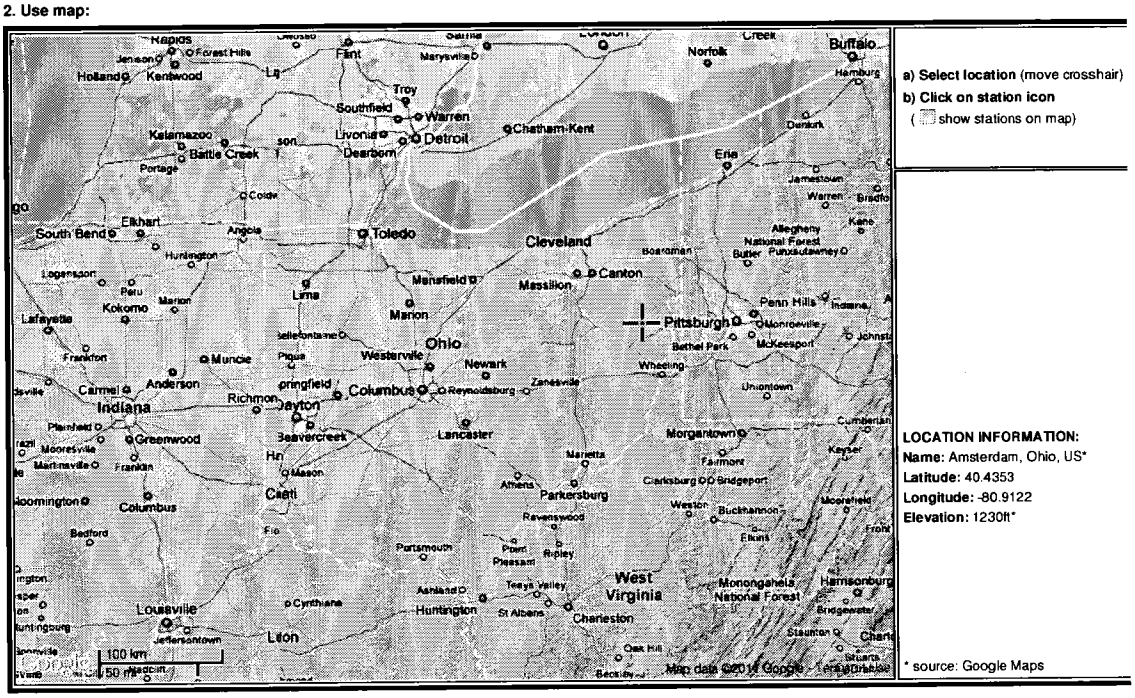

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POINT PRECIPITATION FREQUENCY (PF) ESTIMATES

WITH 90% CONFIDENCE INTERVALS AND SUPPLEMENTARY INFORMATION
NOAA Atlas 14, Volume 2, Version 3

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PDS-based precipitation frequency estimates with 90% confidence intervals (in inches)[1]

Duration	Average recurrence interval(years)									
	1	2	5	10	25	50	100	200	500	1000
5-min	0.326 (0.292-0.364)	0.390 (0.350-0.435)	0.472 (0.422-0.527)	0.534 (0.477-0.595)	0.614 (0.546-0.683)	0.676 (0.599-0.751)	0.735 (0.649-0.815)	0.796 (0.700-0.883)	0.878 (0.767-0.972)	0.938 (0.816-1.04)
10-min	0.507 (0.454-0.566)	0.609 (0.546-0.680)	0.733 (0.656-0.819)	0.825 (0.736-0.919)	0.940 (0.836-1.05)	1.02 (0.908-1.14)	1.11 (0.977-1.23)	1.19 (1.05-1.32)	1.29 (1.13-1.43)	1.37 (1.19-1.51)
15-min	0.621 (0.556-0.693)	0.745 (0.667-0.831)	0.900 (0.806-1.01)	1.02 (0.906-1.13)	1.16 (1.03-1.29)	1.27 (1.12-1.41)	1.37 (1.21-1.53)	1.48 (1.30-1.64)	1.61 (1.41-1.78)	1.71 (1.48-1.89)
30-min	0.821 (0.736-0.917)	0.997 (0.893-1.11)	1.23 (1.10-1.38)	1.41 (1.26-1.57)	1.64 (1.46-1.82)	1.81 (1.61-2.01)	1.98 (1.75-2.20)	2.16 (1.90-2.39)	2.39 (2.09-2.64)	2.56 (2.23-2.83)
60-min	1.00 (0.899-1.12)	1.22 (1.10-1.37)	1.55 (1.39-1.73)	1.79 (1.60-2.00)	2.13 (1.89-2.37)	2.39 (2.12-2.65)	2.65 (2.34-2.94)	2.93 (2.57-3.25)	3.30 (2.88-3.66)	3.59 (3.13-3.98)
2-hr	1.16 (1.03-1.30)	1.41 (1.25-1.58)	1.80 (1.59-2.02)	2.10 (1.86-2.35)	2.53 (2.23-2.83)	2.88 (2.54-3.22)	3.25 (2.85-3.62)	3.65 (3.18-4.05)	4.21 (3.65-4.66)	4.66 (4.02-5.16)
3-hr	1.23 (1.10-1.39)	1.49 (1.33-1.69)	1.90 (1.69-2.15)	2.22 (1.98-2.51)	2.69 (2.38-3.02)	3.07 (2.71-3.44)	3.47 (3.05-3.88)	3.91 (3.41-4.36)	4.53 (3.92-5.05)	5.03 (4.34-5.60)
6-hr	1.47 (1.32-1.66)	1.77 (1.59-2.00)	2.24 (2.00-2.52)	2.61 (2.33-2.94)	3.17 (2.81-3.55)	3.62 (3.20-4.05)	4.11 (3.61-4.58)	4.65 (4.06-5.16)	5.42 (4.68-6.00)	6.06 (5.19-6.69)
12-hr	1.74 (1.57-1.94)	2.09 (1.88-2.33)	2.60 (2.34-2.91)	3.04 (2.72-3.38)	3.67 (3.27-4.07)	4.20 (3.73-4.65)	4.78 (4.22-5.27)	5.41 (4.74-5.95)	6.34 (5.50-6.93)	7.11 (6.12-7.75)

24-hr	**2.04** (1.88-2.21)	**2.44** (2.26-2.64)	**3.00** (2.77-3.25)	**3.46** (3.20-3.75)	**4.12** (3.79-4.45)	**4.66** (4.26-5.03)	**5.23** (4.76-5.64)	**5.84** (5.28-6.28)	**6.69** (6.00-7.20)	**7.39** (6.57-7.95)
2-day	**2.38** (2.22-2.58)	**2.85** (2.64-3.08)	**3.47** (3.22-3.75)	**3.98** (3.69-4.30)	**4.69** (4.33-5.05)	**5.27** (4.84-5.67)	**5.87** (5.36-6.31)	**6.49** (5.90-6.99)	**7.37** (6.63-7.94)	**8.06** (7.20-8.70)
3-day	**2.55** (2.38-2.75)	**3.04** (2.83-3.27)	**3.68** (3.43-3.97)	**4.21** (3.91-4.52)	**4.93** (4.57-5.30)	**5.52** (5.09-5.92)	**6.13** (5.62-6.57)	**6.75** (6.17-7.24)	**7.62** (6.90-8.19)	**8.31** (7.47-8.94)
4-day	**2.72** (2.54-2.91)	**3.23** (3.02-3.47)	**3.90** (3.64-4.18)	**4.44** (4.14-4.75)	**5.18** (4.81-5.54)	**5.77** (5.35-6.17)	**6.38** (5.89-6.82)	**7.01** (6.43-7.50)	**7.88** (7.17-8.45)	**8.56** (7.74-9.19)
7-day	**3.25** (3.06-3.47)	**3.86** (3.63-4.12)	**4.63** (4.35-4.94)	**5.24** (4.92-5.59)	**6.09** (5.69-6.49)	**6.77** (6.30-7.21)	**7.45** (6.91-7.94)	**8.16** (7.53-8.69)	**9.11** (8.35-9.73)	**9.86** (8.96-10.5)
10-day	**3.75** (3.54-3.98)	**4.45** (4.20-4.72)	**5.28** (4.98-5.60)	**5.94** (5.60-6.29)	**6.83** (6.42-7.23)	**7.53** (7.06-7.98)	**8.24** (7.70-8.73)	**8.94** (8.33-9.50)	**9.89** (9.15-10.5)	**10.6** (9.76-11.3)
20-day	**5.27** (5.00-5.55)	**6.21** (5.90-6.55)	**7.27** (6.91-7.66)	**8.10** (7.68-8.52)	**9.17** (8.68-9.65)	**9.99** (9.44-10.5)	**10.8** (10.2-11.4)	**11.6** (10.9-12.2)	**12.6** (11.8-13.3)	**13.3** (12.4-14.1)
30-day	**6.61** (6.27-6.98)	**7.77** (7.37-8.21)	**9.01** (8.54-9.51)	**9.97** (9.44-10.5)	**11.2** (10.6-11.8)	**12.2** (11.5-12.8)	**13.1** (12.3-13.8)	**14.0** (13.1-14.8)	**15.1** (14.1-16.0)	**15.9** (14.8-16.9)
45-day	**8.46** (8.05-8.90)	**9.91** (9.42-10.4)	**11.3** (10.8-11.9)	**12.4** (11.8-13.1)	**13.8** (13.1-14.5)	**14.8** (14.0-15.6)	**15.8** (14.9-16.7)	**16.7** (15.8-17.7)	**17.9** (16.8-18.9)	**18.7** (17.5-19.8)
60-day	**10.2** (9.75-10.7)	**11.9** (11.4-12.5)	**13.5** (12.9-14.2)	**14.7** (14.0-15.4)	**16.2** (15.5-17.0)	**17.3** (16.5-18.1)	**18.3** (17.4-19.2)	**19.2** (18.2-20.2)	**20.4** (19.3-21.4)	**21.1** (20.0-22.3)

[1] Precipitation frequency (PF) estimates in this table are based on frequency analysis of partial duration series (PDS).

Numbers in parenthesis are PF estimates at lower and upper bounds of the 90% confidence interval. The probability that precipitation frequency estimates (for a given duration and average recurrence interval) will be greater than the upper bound (or less than the lower bound) is 5%. Estimates at upper bounds are not checked against probable maximum precipitation (PMP) estimates and may be higher than currently valid PMP values.

Please refer to NOAA Atlas 14 document for more information.

csv Estimates from the table in csv format: precipitation frequency estimates - Submit

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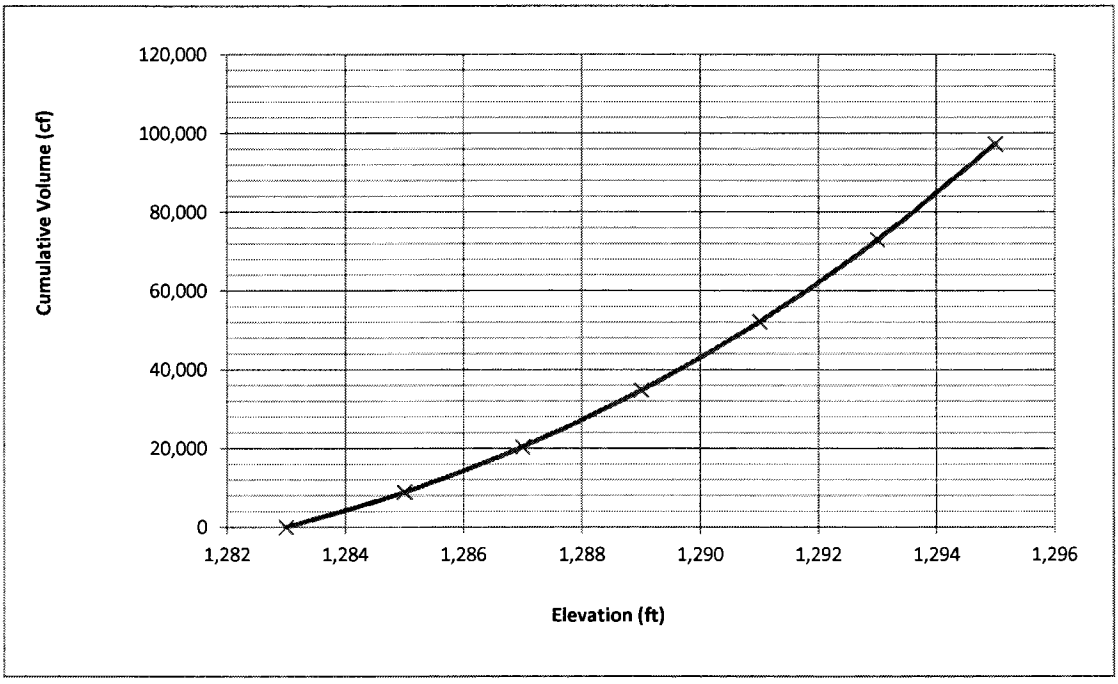
SEDIMENTATION POND
ELEVATION - STORAGE

Apex Sanitary Landfill
Sedimentation Pond 1
Elevation Storage

Elevation	Pool Area	Average Area	Incremental Volume	Cumulative Volume	Cumulative Volume
1,283.00	3,850	0	0	0	0.00
1,285.00	5,074	4,462	8,924	8,924	0.20
1,287.00	6,426	5,750	11,500	20,424	0.47
1,289.00	7,906	7,166	14,332	34,756	0.80
1,291.00	9,514	8,710	17,420	52,176	1.20
1,293.00	11,250	10,382	20,764	72,940	1.67
1,295.00	13,114	12,182	24,364	97,304	2.23



Principal Spillway

1,291.00	9,514	8,710	17,420	52,176	1.20
1,291.70	10,122	9,818	6,872	59,048	1.36
1,293.00	11,250	10,382	20,764	72,940	1.67

Principal spillway inlet invert is at El. 1,291.70-ft which has a storage capacity 59,048-cf.

SEDIMENTATION POND
ROUTING OF 10-YEAR 24-HOUR STORM

Summary for Pond P1: Sedimentation Pond 1

Inflow Area = 17.220 ac, 0.00% Impervious, Inflow Depth > 0.92" for 10 year event
Inflow = 20.93 cfs @ 12.18 hrs, Volume= 1.319 af
Outflow = 0.00 cfs @ 5.00 hrs, Volume= 0.000 af, Atten= 100%, Lag= 0.0 min
Primary = 0.00 cfs @ 5.00 hrs, Volume= 0.000 af
Secondary = 0.00 cfs @ 5.00 hrs, Volume= 0.000 af

Routing by Stor-Ind method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Peak Elev= 1,291.50' @ 20.00 hrs Surf.Area= 0.000 ac Storage= 1.318 af

Plug-Flow detention time= (not calculated: initial storage excedes outflow)
Center-of-Mass det. time= (not calculated: no outflow)

Volume	Invert	Avail.Storage	Storage Description
#1	1,283.00'	2.230 af	**Custom Stage Data** Listed below

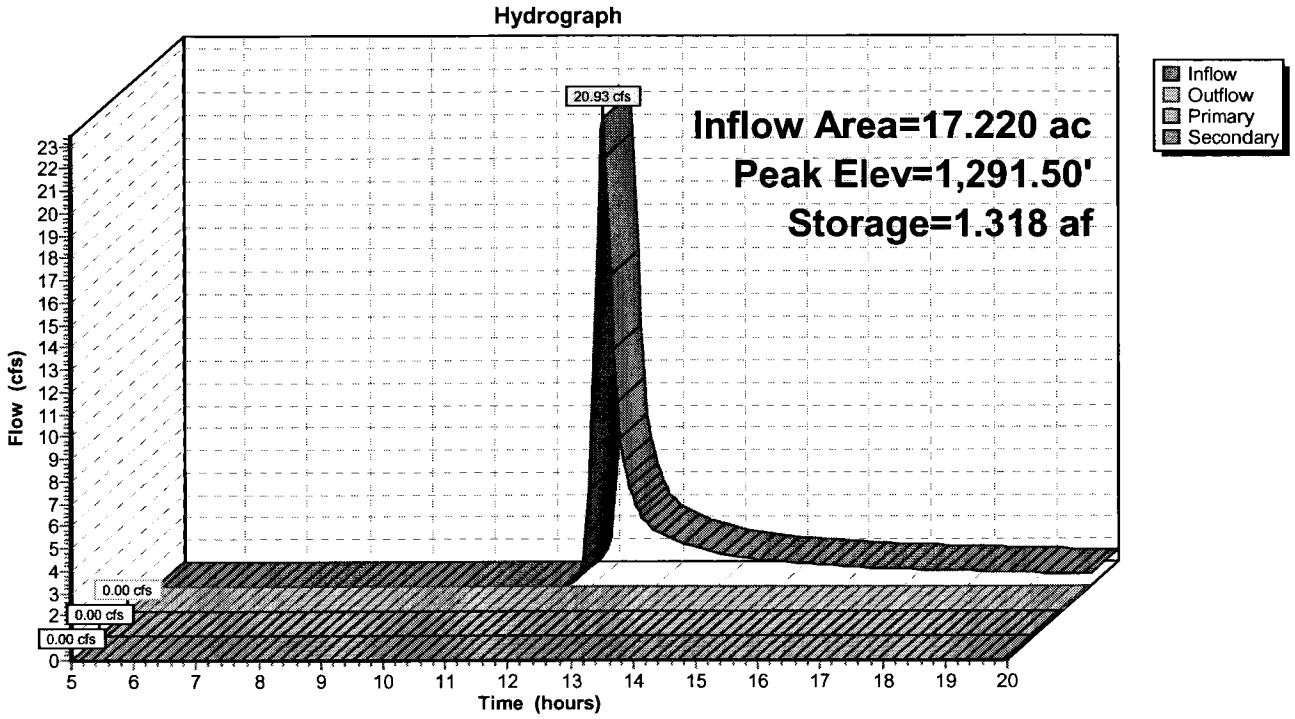
Elevation (feet)	Cum.Store (acre-feet)
1,283.00	0.000
1,285.00	0.200
1,287.00	0.470
1,289.00	0.800
1,291.00	1.200
1,293.00	1.670
1,295.00	2.230

Device	Routing	Invert	Outlet Devices
#1	Primary	1,291.70'	**30.0" Round Culvert** L= 125.0' CPP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 1,291.70' / 1,287.00' S= 0.0376 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 4.91 sf
#2	Secondary	1,292.20'	**151.9 deg x 8.0' long Sharp-Crested Vee/Trap Weir** Cv= 2.47 (C= 3.09)

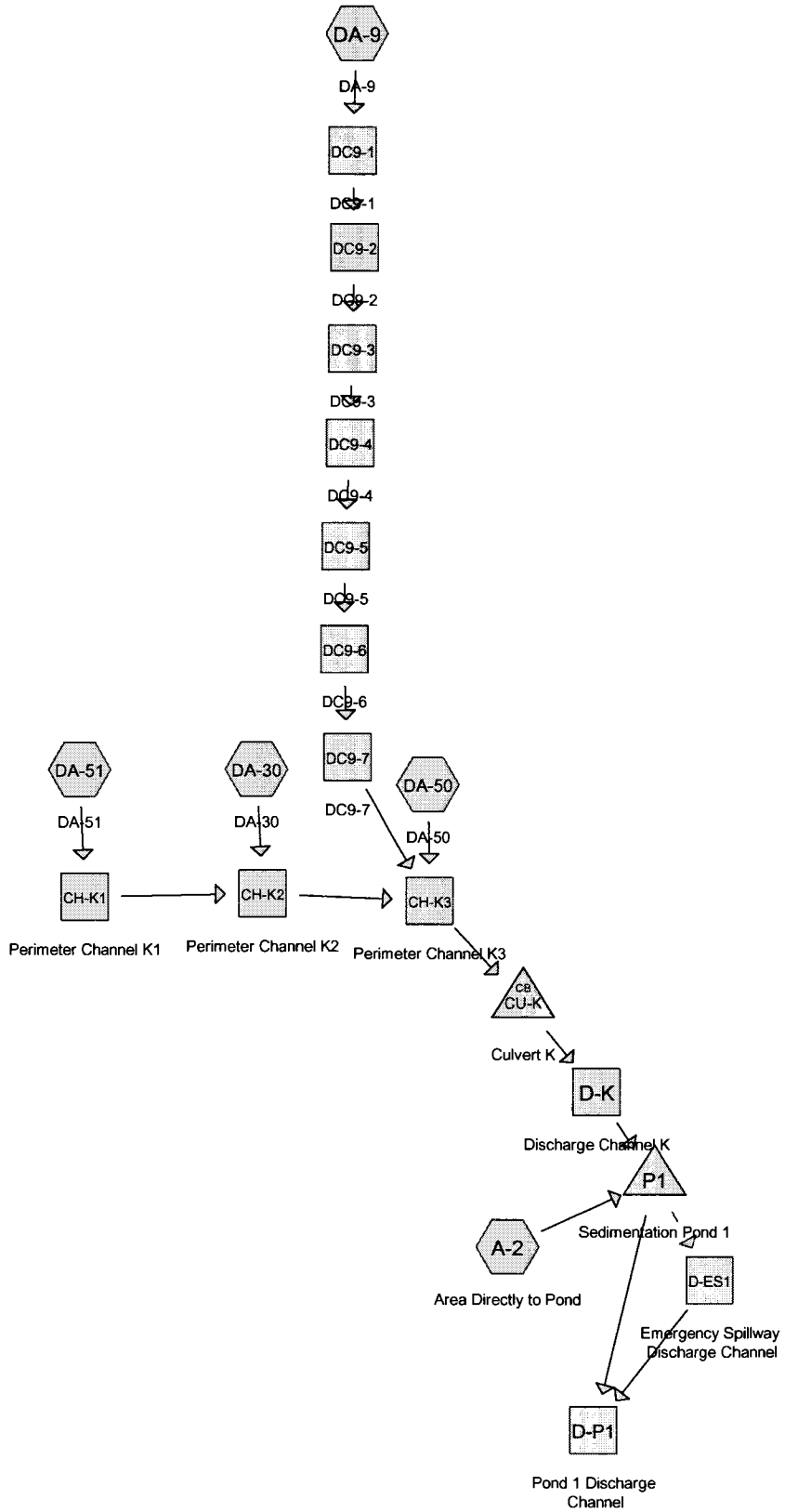
Primary OutFlow Max=0.00 cfs @ 5.00 hrs HW=1,283.00' (Free Discharge)
↑—**1=Culvert** (Controls 0.00 cfs)

Secondary OutFlow Max=0.00 cfs @ 5.00 hrs HW=1,283.00' (Free Discharge)
↑—**2=Sharp-Crested Vee/Trap Weir** (Controls 0.00 cfs)

Pond P1: Sedimentation Pond 1



SEDIMENTATION POND
ROUTING OF 25-YEAR 24-HOUR STORM



Subcat Reach Pond Link

Routing Diagram for Sedimentation Pond 1
Prepared by Microsoft, Printed 10/21/2011
HydroCAD® 10.00 s/n 01006 © 2011 HydroCAD Software Solutions LLC

Summary for Subcatchment A-2: Area Directly to Pond

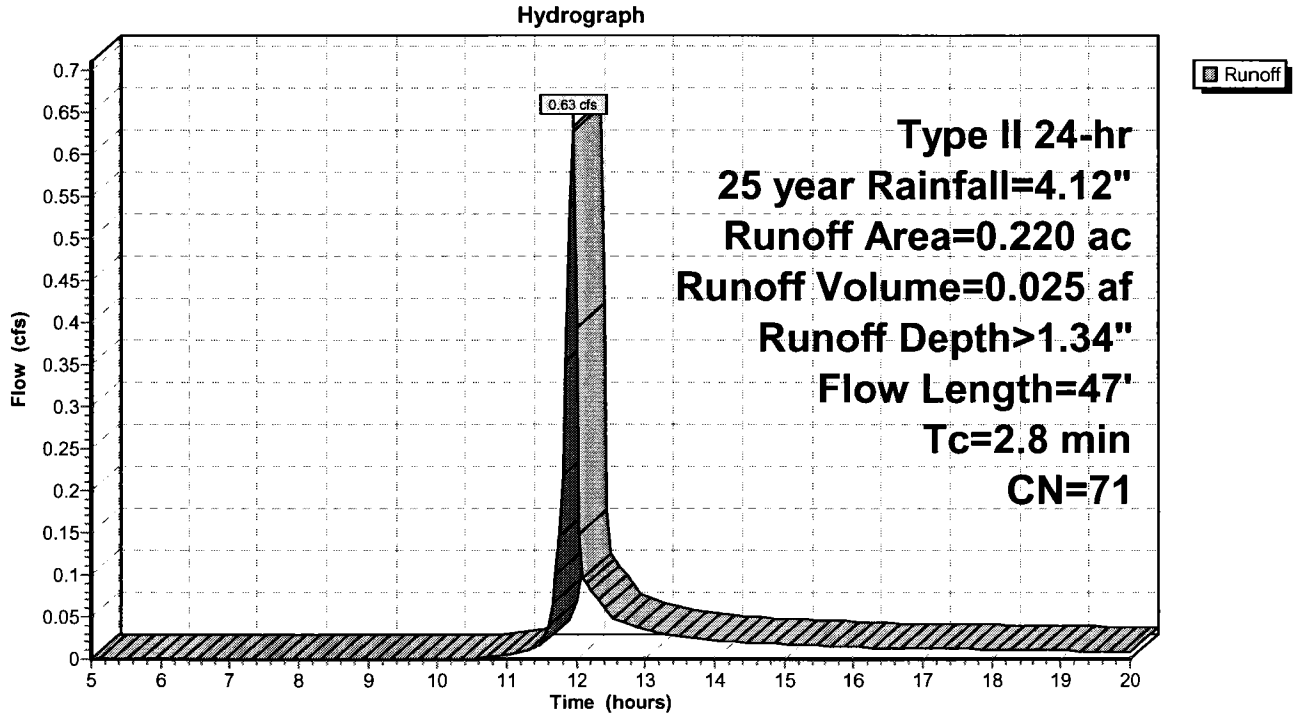
Runoff = 0.63 cfs @ 11.94 hrs, Volume= 0.025 af, Depth> 1.34"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type II 24-hr 25 year Rainfall=4.12"

Area (ac)	CN	Description
0.220	71	Meadow, non-grazed, HSG C
0.220		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
1.5	32	0.3300	0.36		**Sheet Flow, 32 feet 3H:1V sheet flow** Grass: Short n= 0.150 P2= 2.44"
1.3	15	0.0100	0.19		**Sheet Flow, 15 feet 1 percent sheet flow** Fallow n= 0.050 P2= 2.44"
2.8	47	Total			

Subcatchment A-2: Area Directly to Pond



Summary for Subcatchment DA-30: DA-30

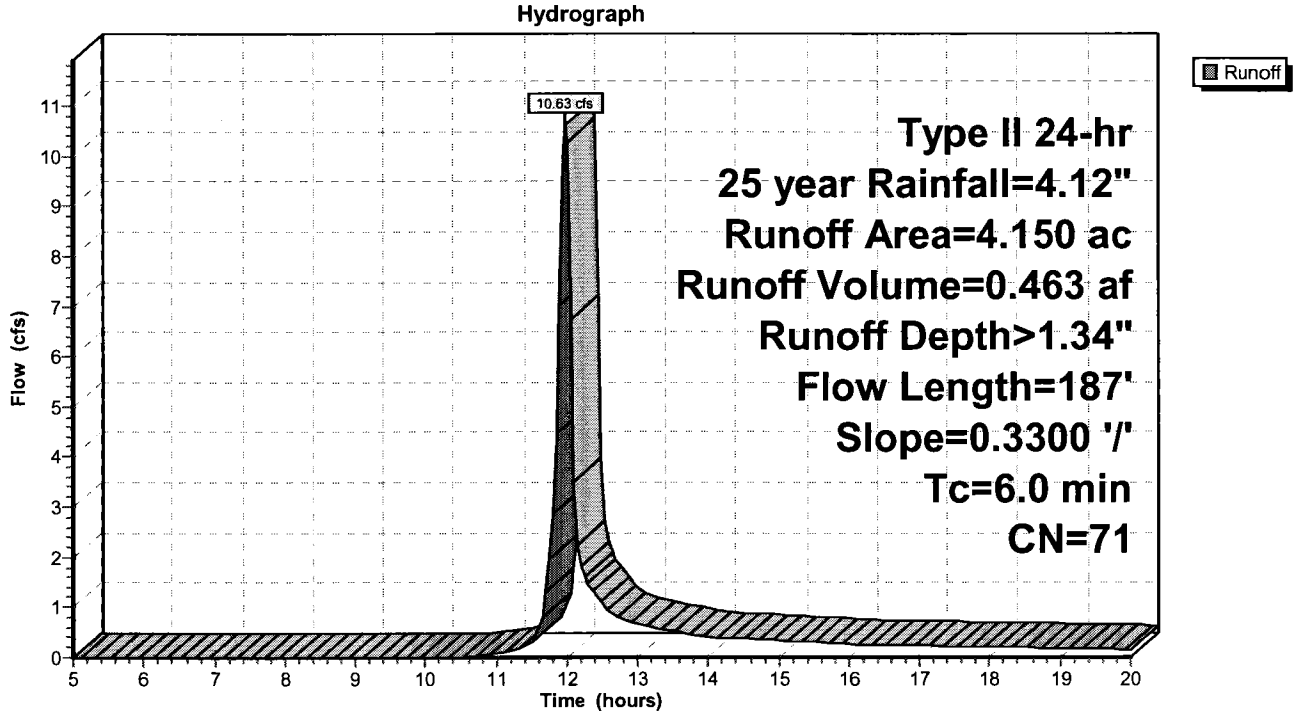
Runoff = 10.63 cfs @ 11.98 hrs, Volume= 0.463 af, Depth> 1.34"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type II 24-hr 25 year Rainfall=4.12"

Area (ac)	CN	Description
4.150	71	Meadow, non-grazed, HSG C
4.150		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.0	187	0.3300	0.52		**Sheet Flow, 187 feet 3H:1V sheet flow** Grass: Short n= 0.150 P2= 2.44"

Subcatchment DA-30: DA-30



Summary for Subcatchment DA-50: DA-50

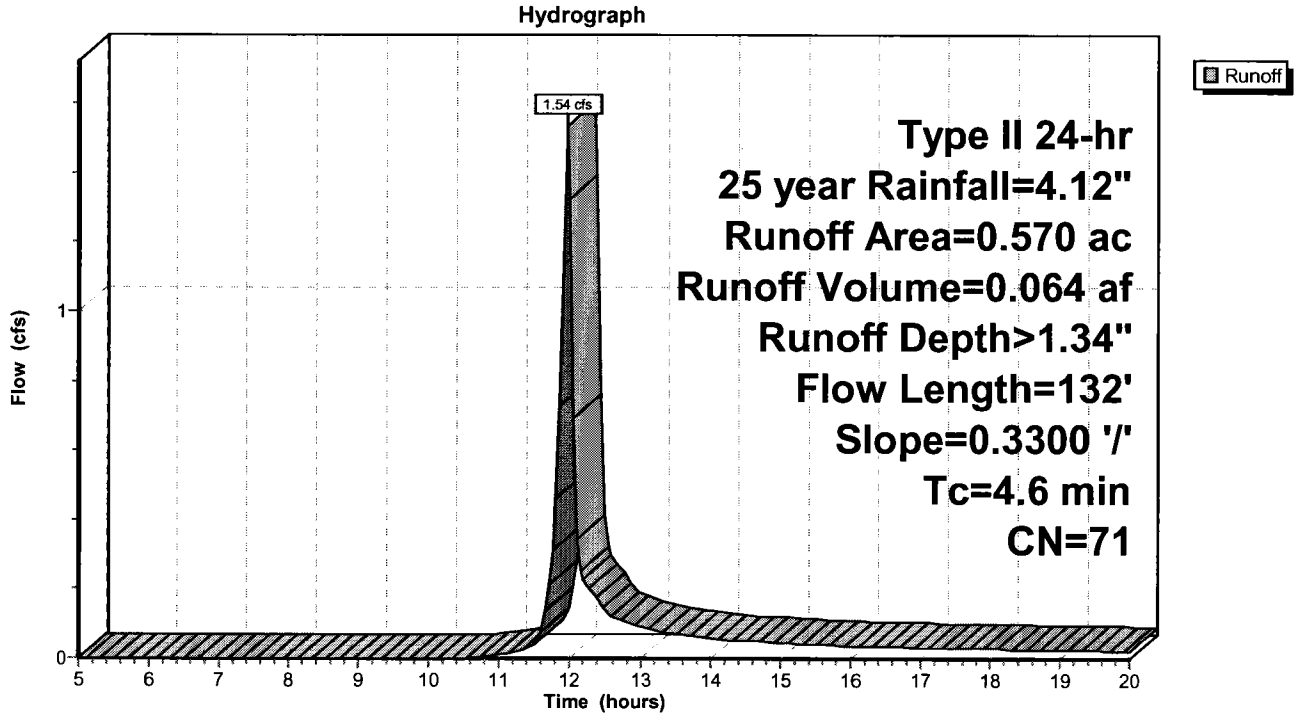
Runoff = 1.54 cfs @ 11.96 hrs, Volume= 0.064 af, Depth> 1.34"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type II 24-hr 25 year Rainfall=4.12"

Area (ac)	CN	Description
0.570	71	Meadow, non-grazed, HSG C
0.570		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
4.6	132	0.3300	0.48		**Sheet Flow, 132 feet 3H:1V sheet flow** Grass: Short n= 0.150 P2= 2.44"

Subcatchment DA-50: DA-50



Summary for Subcatchment DA-51: DA-51

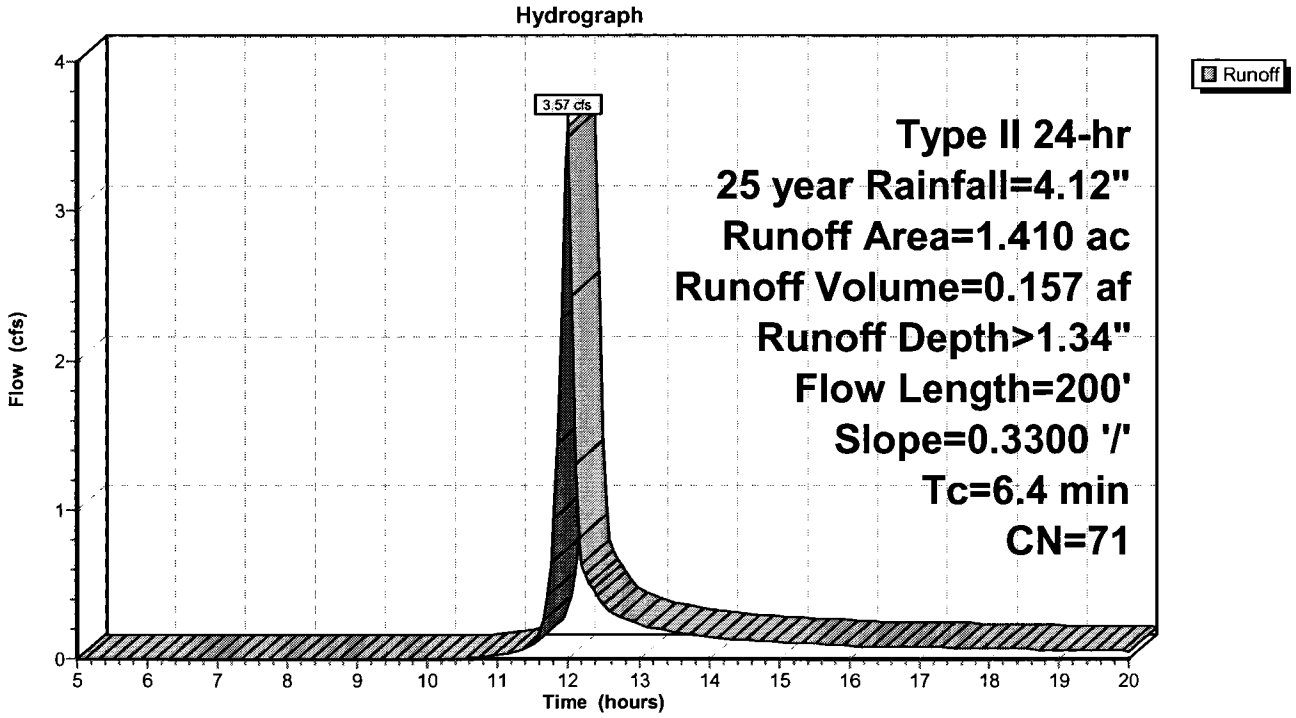
Runoff = 3.57 cfs @ 11.98 hrs, Volume= 0.157 af, Depth> 1.34"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type II 24-hr 25 year Rainfall=4.12"

Area (ac)	CN	Description
1.410	71	Meadow, non-grazed, HSG C
1.410		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.4	200	0.3300	0.52		**Sheet Flow, 200 feet 3H:1V sheet flow** Grass: Short n= 0.150 P2= 2.44"

Subcatchment DA-51: DA-51



Summary for Subcatchment DA-9: DA-9

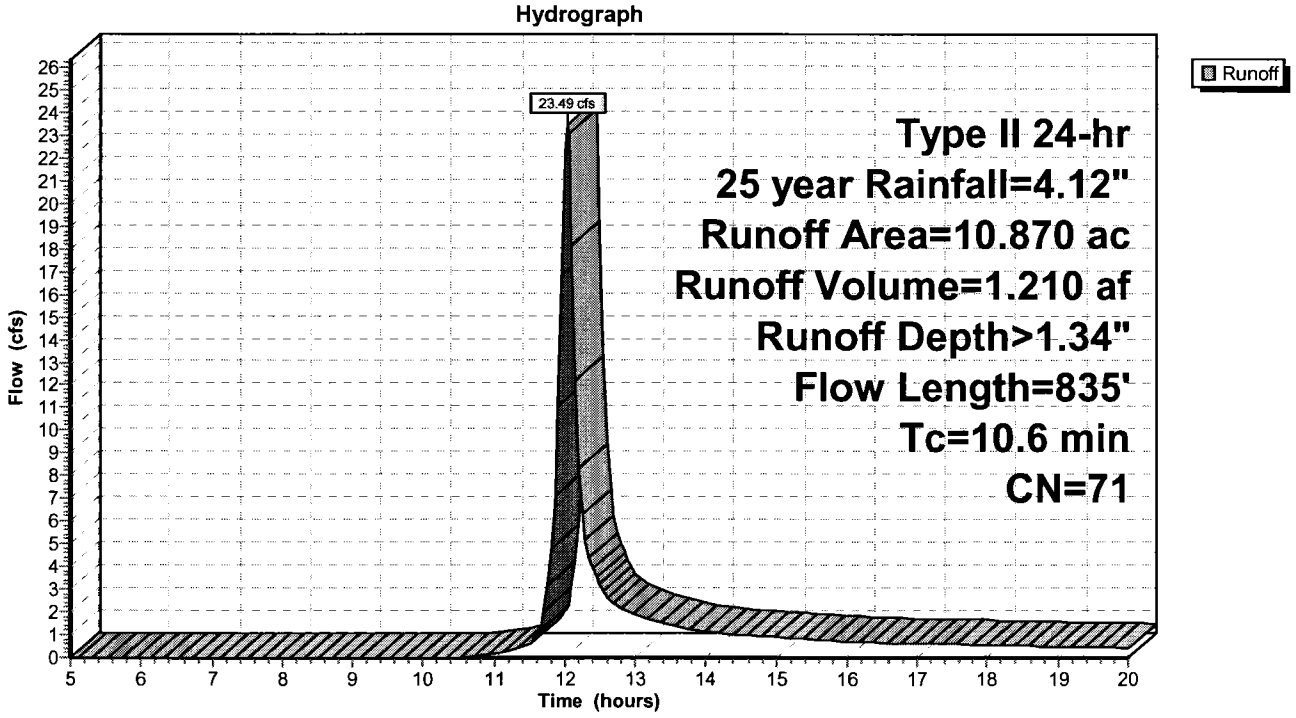
Runoff = 23.49 cfs @ 12.03 hrs, Volume= 1.210 af, Depth> 1.34"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type II 24-hr 25 year Rainfall=4.12"

Area (ac)	CN	Description
10.870	71	Meadow, non-grazed, HSG C
10.870		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
4.4	70	0.1000	0.26		**Sheet Flow, 70 feet 10% sheet flow** Grass: Short n= 0.150 P2= 2.44"
4.7	136	0.3300	0.48		**Sheet Flow, 136 feet 3H:1V sheet flow** Grass: Short n= 0.150 P2= 2.44"
1.5	629	0.0300	7.00	102.24	**Channel Flow, 629 feet bench flow** Area= 14.6 sf Perim= 19.8' r= 0.74' n= 0.030 Earth, grassed & winding
10.6	835	Total			

Subcatchment DA-9: DA-9



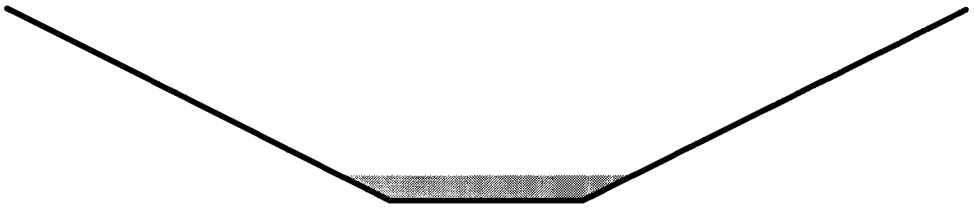
Summary for Reach CH-K1: Perimeter Channel K1

Inflow Area = 1.410 ac, 0.00% Impervious, Inflow Depth > 1.34" for 25 year event
Inflow = 3.57 cfs @ 11.98 hrs, Volume= 0.157 af
Outflow = 3.28 cfs @ 12.04 hrs, Volume= 0.157 af, Atten= 8%, Lag= 3.1 min

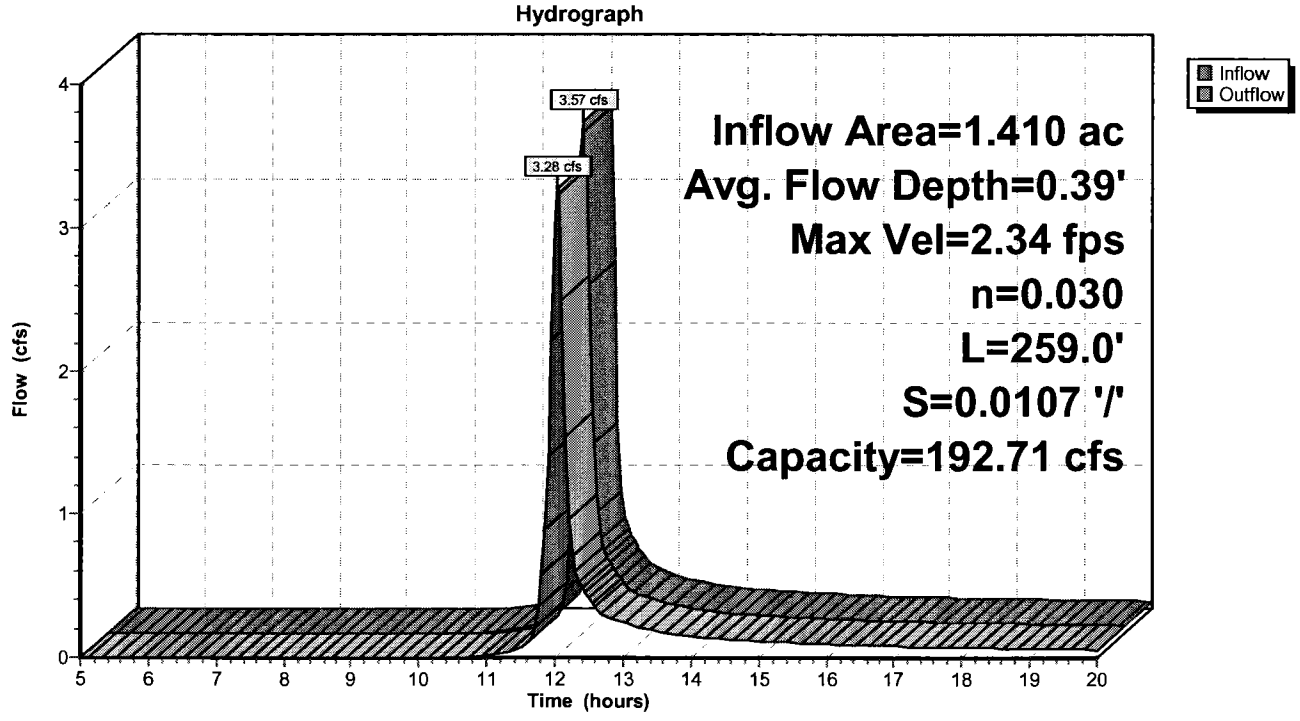
Routing by Stor-Ind+Trans method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Max. Velocity= 2.34 fps, Min. Travel Time= 1.8 min
Avg. Velocity = 0.74 fps, Avg. Travel Time= 5.8 min

Peak Storage= 380 cf @ 12.00 hrs
Average Depth at Peak Storage= 0.39'
Bank-Full Depth= 3.00' Flow Area= 27.0 sf, Capacity= 192.71 cfs

3.00' x 3.00' deep channel, n= 0.030 Earth, grassed & winding
Side Slope Z-value= 2.0 '/' Top Width= 15.00'
Length= 259.0' Slope= 0.0107 '/'
Inlet Invert= 1,314.77', Outlet Invert= 1,312.00'



Reach CH-K1: Perimeter Channel K1



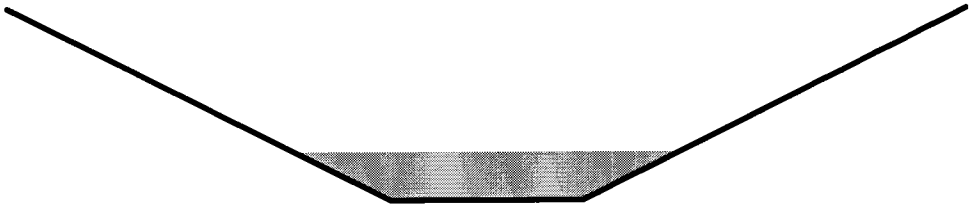
Summary for Reach CH-K2: Perimeter Channel K2

Inflow Area = 5.560 ac, 0.00% Impervious, Inflow Depth > 1.34" for 25 year event
Inflow = 13.47 cfs @ 11.99 hrs, Volume= 0.620 af
Outflow = 11.25 cfs @ 12.11 hrs, Volume= 0.613 af, Atten= 17%, Lag= 7.2 min

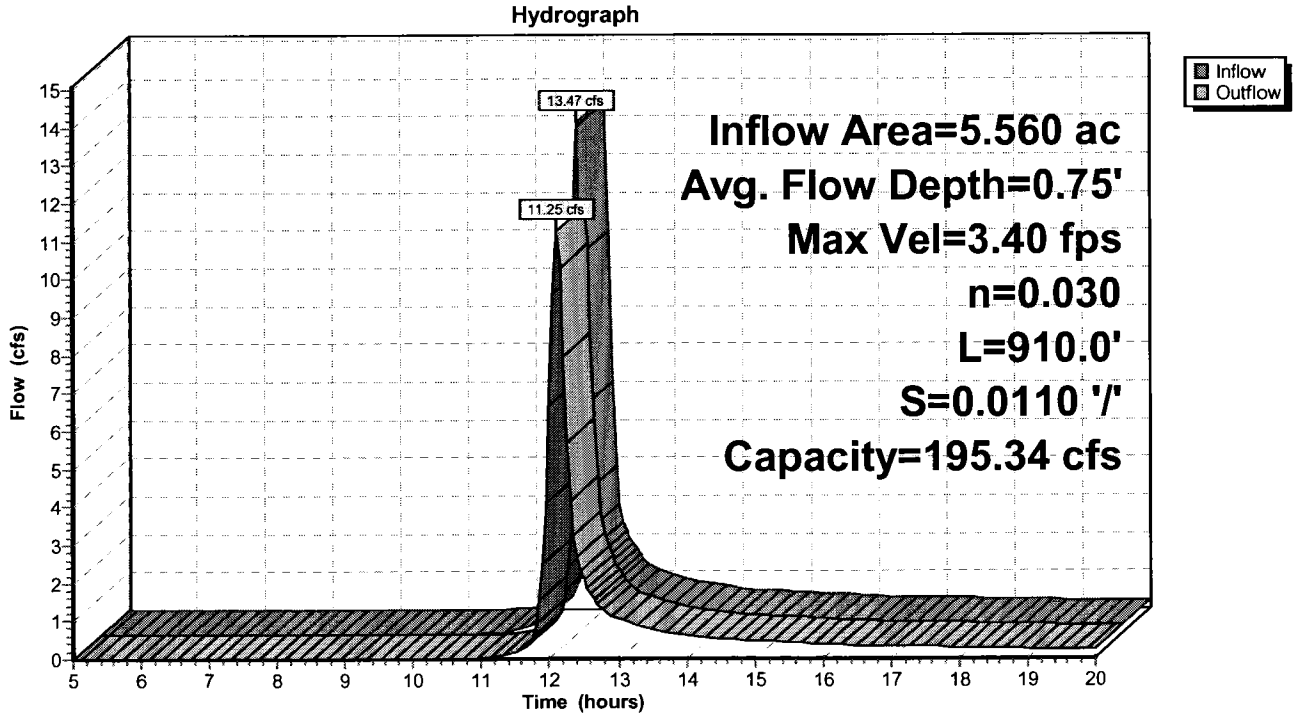
Routing by Stor-Ind+Trans method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Max. Velocity= 3.40 fps, Min. Travel Time= 4.5 min
Avg. Velocity = 1.20 fps, Avg. Travel Time= 12.6 min

Peak Storage= 3,087 cf @ 12.03 hrs
Average Depth at Peak Storage= 0.75'
Bank-Full Depth= 3.00' Flow Area= 27.0 sf, Capacity= 195.34 cfs

3.00' x 3.00' deep channel, n= 0.030 Earth, grassed & winding
Side Slope Z-value= 2.0 '/' Top Width= 15.00'
Length= 910.0' Slope= 0.0110 '/'
Inlet Invert= 1,312.00', Outlet Invert= 1,302.00'



Reach CH-K2: Perimeter Channel K2



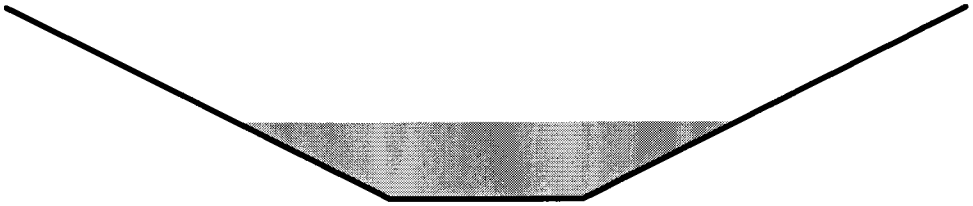
Summary for Reach CH-K3: Perimeter Channel K3

Inflow Area = 17.000 ac, 0.00% Impervious, Inflow Depth > 1.33" for 25 year event
Inflow = 32.38 cfs @ 12.12 hrs, Volume= 1.877 af
Outflow = 31.52 cfs @ 12.15 hrs, Volume= 1.873 af, Atten= 3%, Lag= 1.8 min

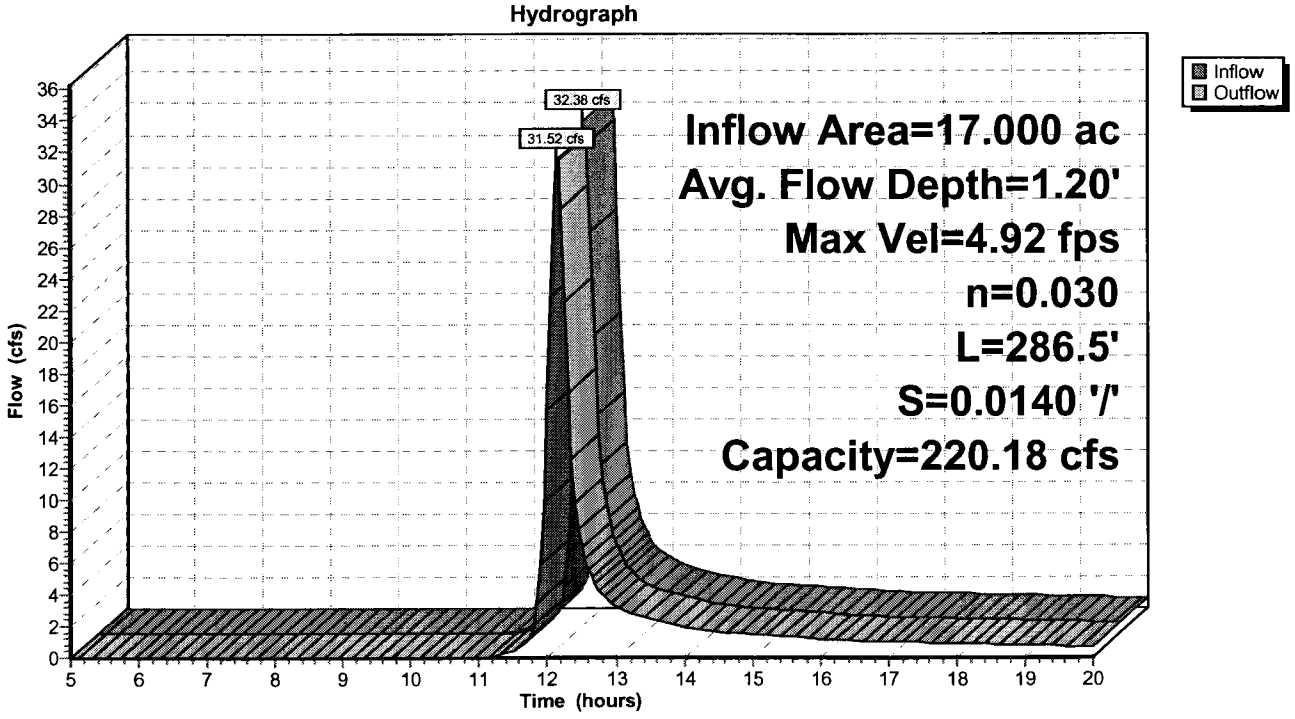
Routing by Stor-Ind+Trans method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Max. Velocity= 4.92 fps, Min. Travel Time= 1.0 min
Avg. Velocity = 1.88 fps, Avg. Travel Time= 2.5 min

Peak Storage= 1,862 cf @ 12.13 hrs
Average Depth at Peak Storage= 1.20'
Bank-Full Depth= 3.00' Flow Area= 27.0 sf, Capacity= 220.18 cfs

3.00' x 3.00' deep channel, n= 0.030 Earth, grassed & winding
Side Slope Z-value= 2.0 '/' Top Width= 15.00'
Length= 286.5' Slope= 0.0140 '/'
Inlet Invert= 1,302.00', Outlet Invert= 1,298.00'



Reach CH-K3: Perimeter Channel K3



Summary for Reach D-ES1: Emergency Spillway Discharge Channel

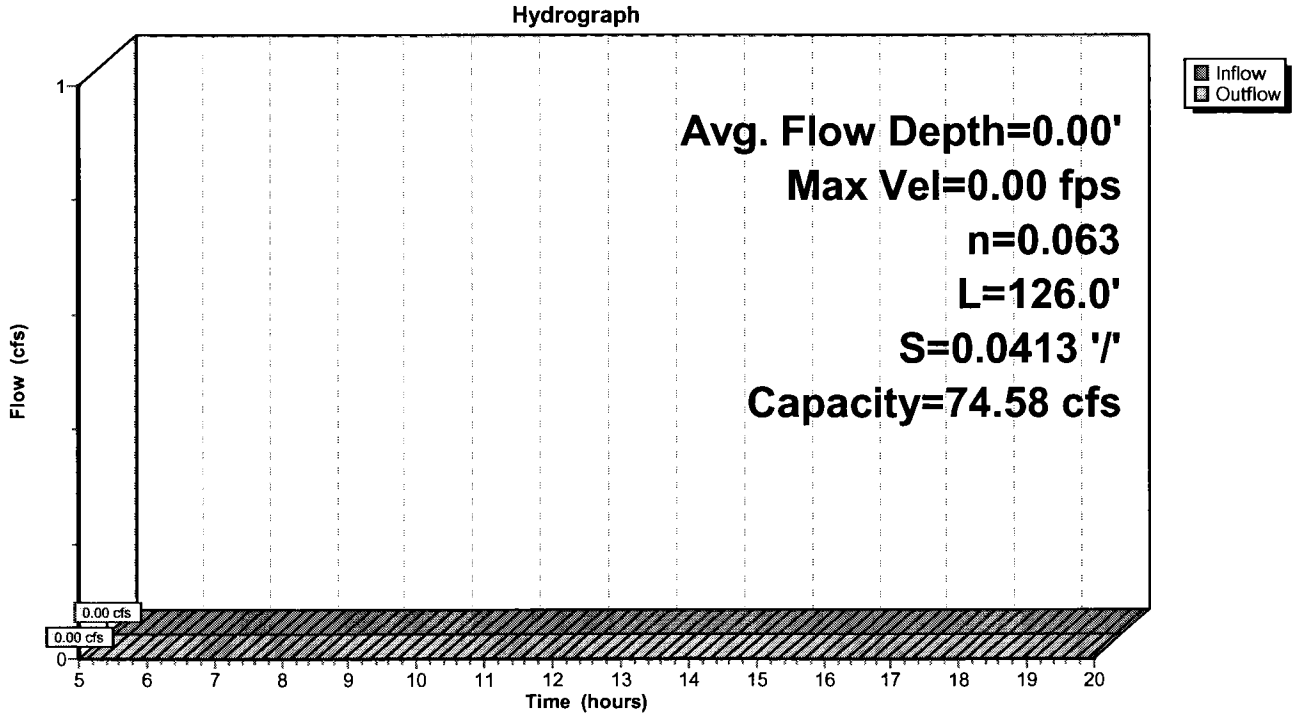
Inflow = 0.00 cfs @ 5.00 hrs, Volume= 0.000 af
Outflow = 0.00 cfs @ 5.00 hrs, Volume= 0.000 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Max. Velocity= 0.00 fps, Min. Travel Time= 0.0 min
Avg. Velocity = 0.00 fps, Avg. Travel Time= 0.0 min

Peak Storage= 0 cf @ 5.00 hrs
Average Depth at Peak Storage= 0.00'
Bank-Full Depth= 2.00' Flow Area= 14.0 sf, Capacity= 74.58 cfs

3.00' x 2.00' deep channel, n= 0.063
Side Slope Z-value= 2.0 '/' Top Width= 11.00'
Length= 126.0' Slope= 0.0413 '/'
Inlet Invert= 1,292.20', Outlet Invert= 1,287.00'

Reach D-ES1: Emergency Spillway Discharge Channel



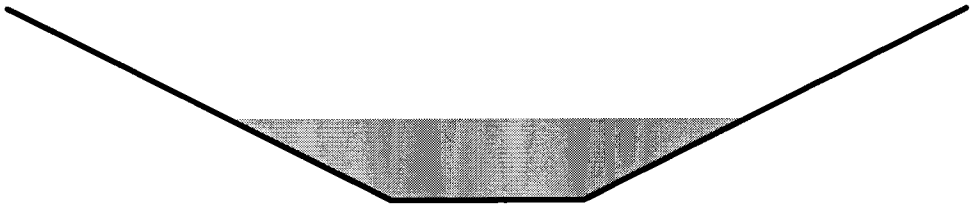
Summary for Reach D-K: Discharge Channel K

Inflow Area = 17.000 ac, 0.00% Impervious, Inflow Depth > 1.32" for 25 year event
Inflow = 31.52 cfs @ 12.15 hrs, Volume= 1.873 af
Outflow = 31.25 cfs @ 12.15 hrs, Volume= 1.872 af, Atten= 1%, Lag= 0.5 min

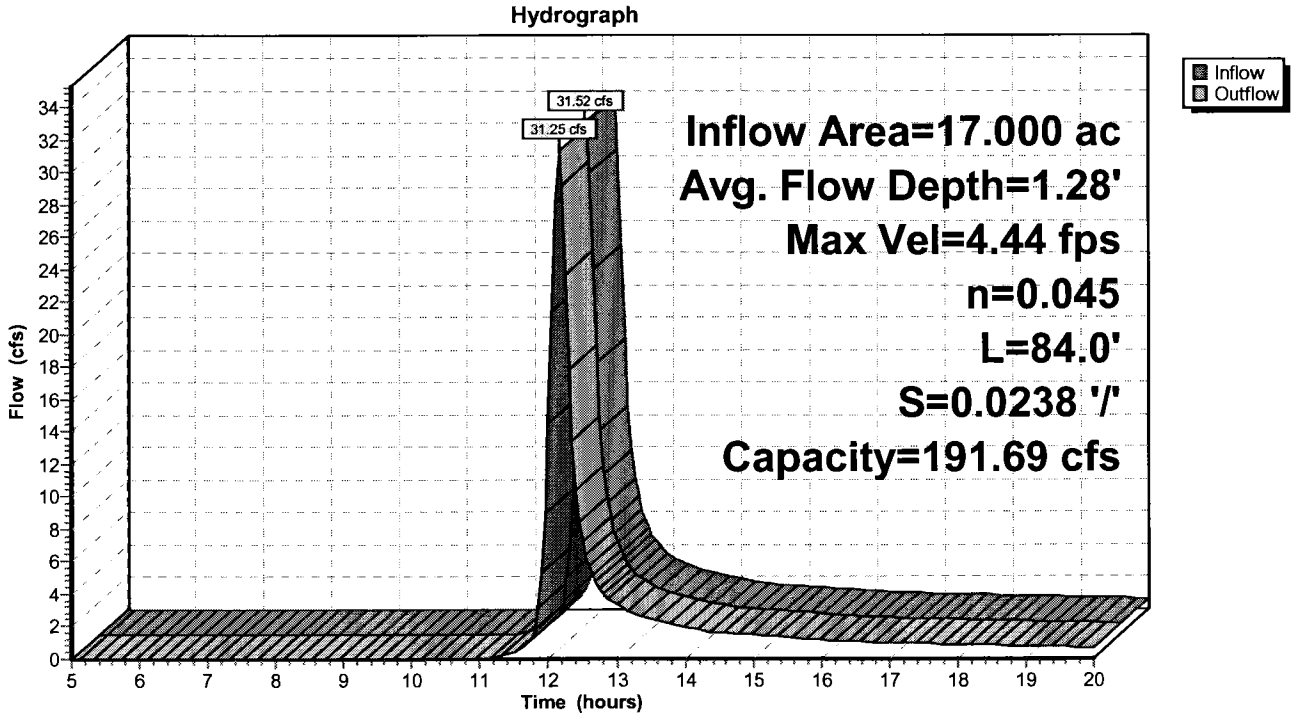
Routing by Stor-Ind+Trans method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Max. Velocity= 4.44 fps, Min. Travel Time= 0.3 min
Avg. Velocity = 1.72 fps, Avg. Travel Time= 0.8 min

Peak Storage= 596 cf @ 12.15 hrs
Average Depth at Peak Storage= 1.28'
Bank-Full Depth= 3.00' Flow Area= 27.0 sf, Capacity= 191.69 cfs

3.00' x 3.00' deep channel, n= 0.045
Side Slope Z-value= 2.0 '/' Top Width= 15.00'
Length= 84.0' Slope= 0.0238 '/'
Inlet Invert= 1,297.00', Outlet Invert= 1,295.00'



Reach D-K: Discharge Channel K



Summary for Reach D-P1: Pond 1 Discharge Channel

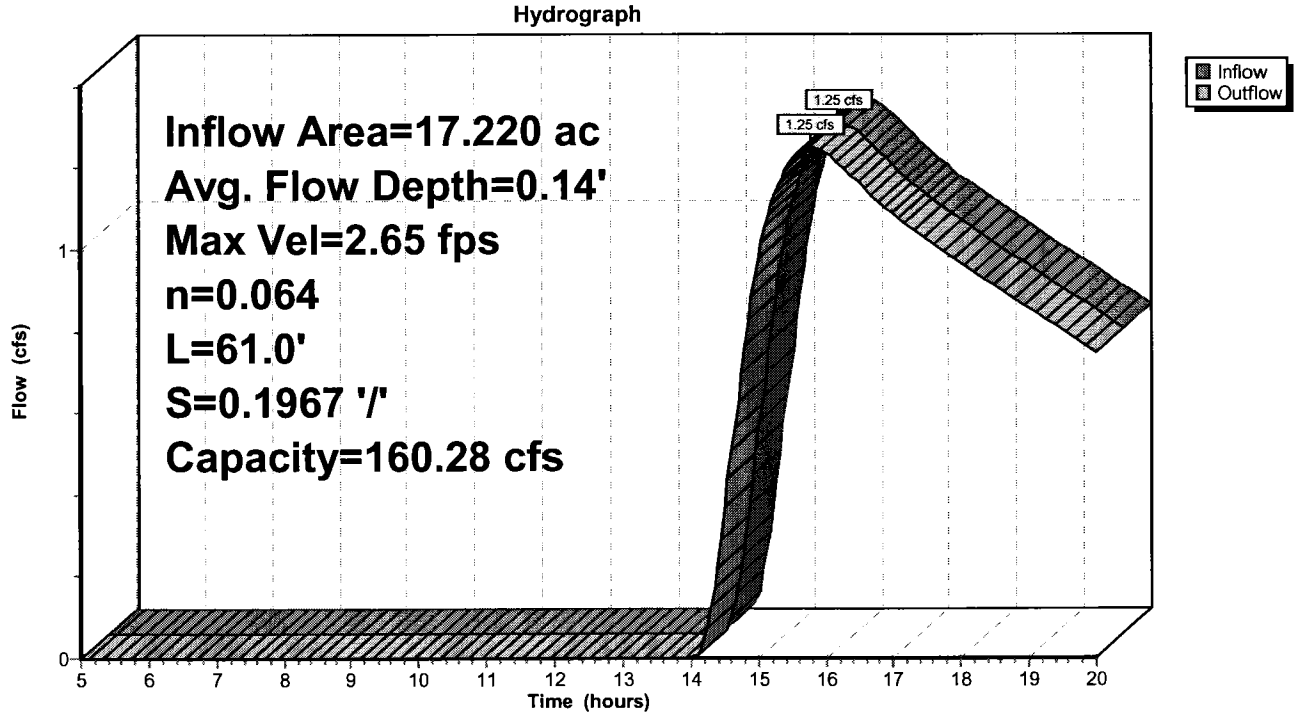
Inflow Area = 17.220 ac, 0.00% Impervious, Inflow Depth > 0.32" for 25 year event
Inflow = 1.25 cfs @ 15.77 hrs, Volume= 0.456 af
Outflow = 1.25 cfs @ 15.78 hrs, Volume= 0.455 af, Atten= 0%, Lag= 0.7 min

Routing by Stor-Ind+Trans method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Max. Velocity= 2.65 fps, Min. Travel Time= 0.4 min
Avg. Velocity = 2.32 fps, Avg. Travel Time= 0.4 min

Peak Storage= 29 cf @ 15.78 hrs
Average Depth at Peak Storage= 0.14'
Bank-Full Depth= 2.00' Flow Area= 14.0 sf, Capacity= 160.28 cfs

3.00' x 2.00' deep channel, n= 0.064
Side Slope Z-value= 2.0 '/' Top Width= 11.00'
Length= 61.0' Slope= 0.1967 '/'
Inlet Invert= 1,287.00', Outlet Invert= 1,275.00'

Reach D-P1: Pond 1 Discharge Channel



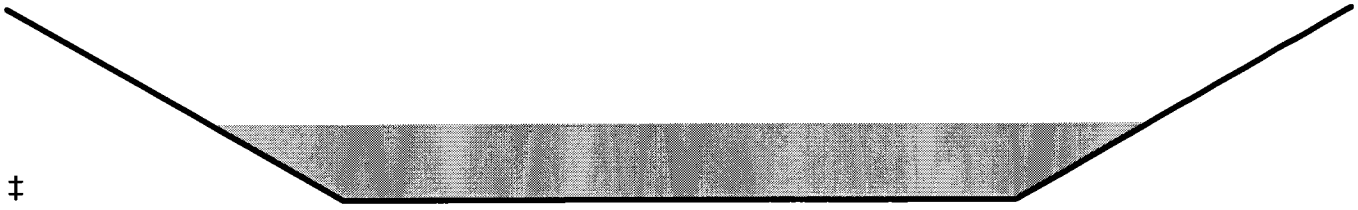
Summary for Reach DC9-1: DC9-1

Inflow Area = 10.870 ac, 0.00% Impervious, Inflow Depth > 1.34" for 25 year event
Inflow = 23.49 cfs @ 12.03 hrs, Volume= 1.210 af
Outflow = 22.89 cfs @ 12.05 hrs, Volume= 1.208 af, Atten= 3%, Lag= 1.2 min

Routing by Stor-Ind+Trans method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Max. Velocity= 5.50 fps, Min. Travel Time= 0.8 min
Avg. Velocity = 1.72 fps, Avg. Travel Time= 2.4 min

Peak Storage= 1,061 cf @ 12.04 hrs
Average Depth at Peak Storage= 0.59'
Bank-Full Depth= 1.50' Flow Area= 13.5 sf, Capacity= 124.18 cfs

6.00' x 1.50' deep channel, n= 0.076
Side Slope Z-value= 2.0 '/' Top Width= 12.00'
Length= 249.1' Slope= 0.2042 '/'
Inlet Invert= 1,487.82', Outlet Invert= 1,436.96'



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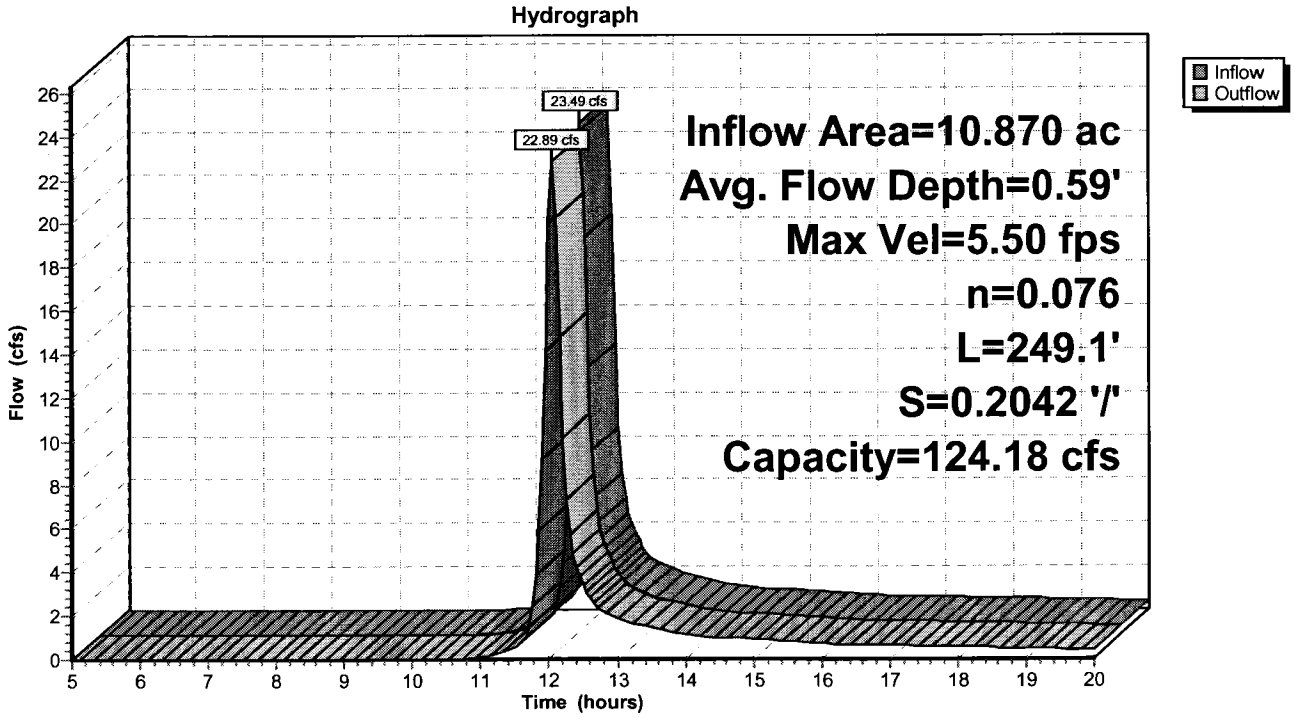
Reach DC9-1: DC9-1



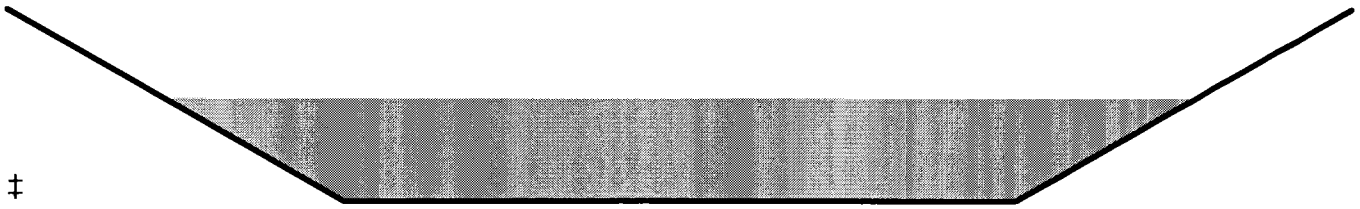
Summary for Reach DC9-2: DC9-2

Inflow Area = 10.870 ac, 0.00% Impervious, Inflow Depth > 1.33" for 25 year event
Inflow = 22.89 cfs @ 12.05 hrs, Volume= 1.208 af
Outflow = 22.71 cfs @ 12.06 hrs, Volume= 1.207 af, Atten= 1%, Lag= 0.3 min

Routing by Stor-Ind+Trans method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Max. Velocity= 3.75 fps, Min. Travel Time= 0.2 min
Avg. Velocity = 1.22 fps, Avg. Travel Time= 0.6 min

Peak Storage= 261 cf @ 12.05 hrs
Average Depth at Peak Storage= 0.80'
Bank-Full Depth= 1.50' Flow Area= 13.5 sf, Capacity= 71.34 cfs

6.00' x 1.50' deep channel, n= 0.065
Side Slope Z-value= 2.0 '/' Top Width= 12.00'
Length= 42.8' Slope= 0.0493 '/'
Inlet Invert= 1,436.96', Outlet Invert= 1,434.85'



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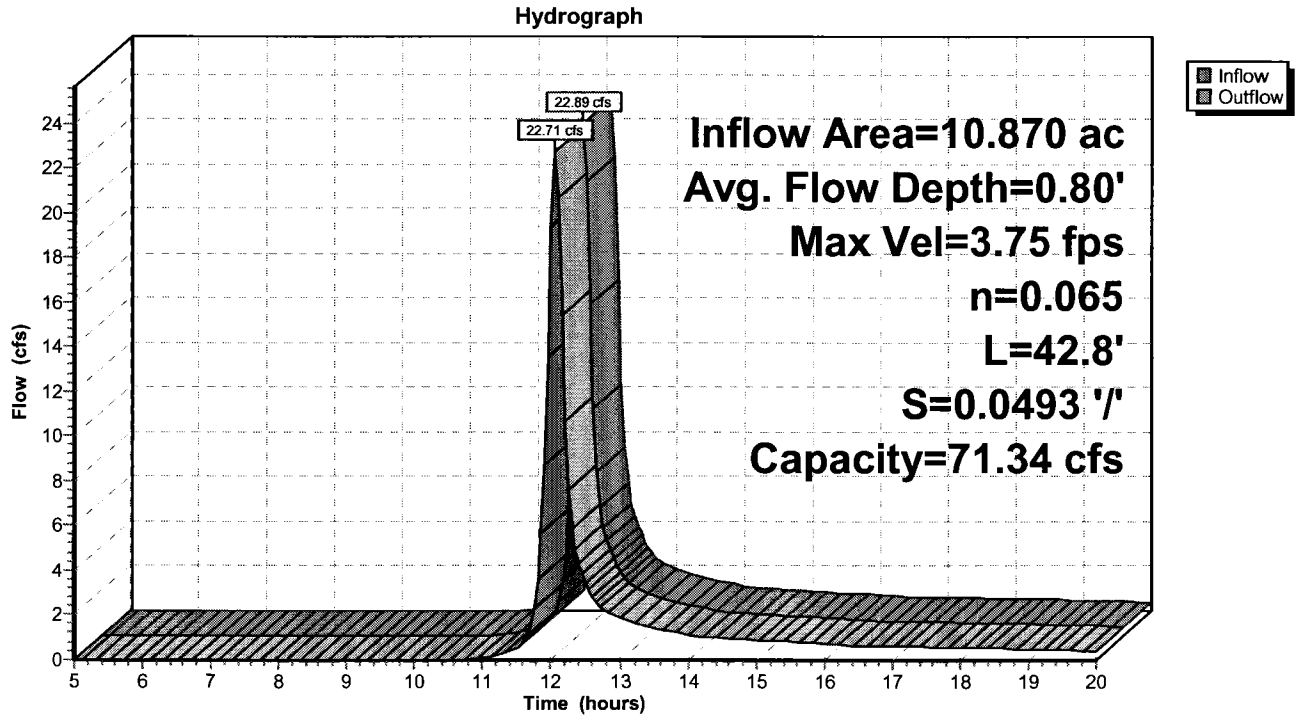
Reach DC9-2: DC9-2



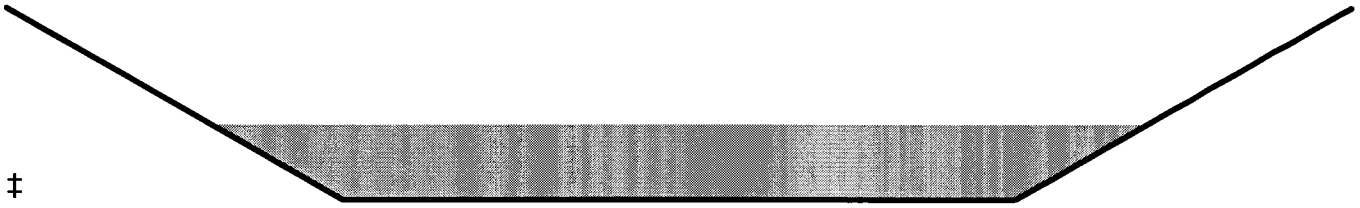
Summary for Reach DC9-3: DC9-3

Inflow Area = 10.870 ac, 0.00% Impervious, Inflow Depth > 1.33" for 25 year event
Inflow = 22.71 cfs @ 12.06 hrs, Volume= 1.207 af
Outflow = 22.02 cfs @ 12.08 hrs, Volume= 1.205 af, Atten= 3%, Lag= 1.2 min

Routing by Stor-Ind+Trans method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Max. Velocity= 5.33 fps, Min. Travel Time= 0.7 min
Avg. Velocity = 1.70 fps, Avg. Travel Time= 2.2 min

Peak Storage= 945 cf @ 12.06 hrs
Average Depth at Peak Storage= 0.59'
Bank-Full Depth= 1.50' Flow Area= 13.5 sf, Capacity= 120.99 cfs

6.00' x 1.50' deep channel, n= 0.078
Side Slope Z-value= 2.0 '/' Top Width= 12.00'
Length= 223.5' Slope= 0.2042 '/'
Inlet Invert= 1,434.85', Outlet Invert= 1,389.22'



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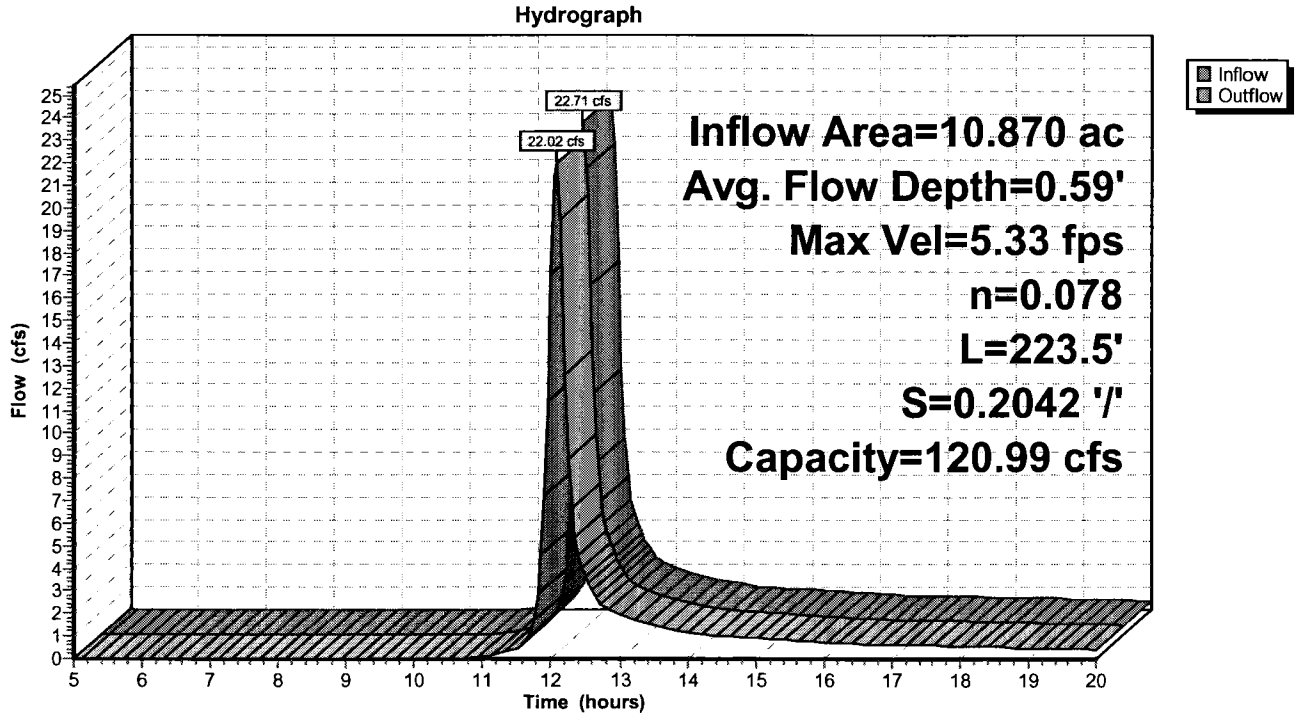
Reach DC9-3: DC9-3



Summary for Reach DC9-4: DC9-4

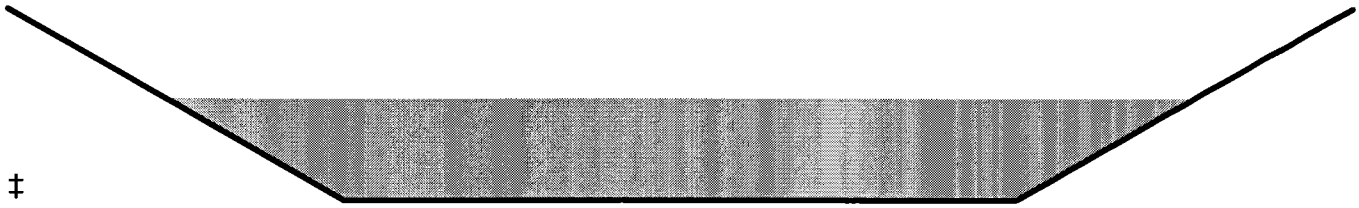
Inflow Area = 10.870 ac, 0.00% Impervious, Inflow Depth > 1.33" for 25 year event
Inflow = 22.02 cfs @ 12.08 hrs, Volume= 1.205 af
Outflow = 21.90 cfs @ 12.08 hrs, Volume= 1.205 af, Atten= 1%, Lag= 0.4 min

Routing by Stor-Ind+Trans method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Max. Velocity= 3.65 fps, Min. Travel Time= 0.2 min
Avg. Velocity = 1.20 fps, Avg. Travel Time= 0.6 min

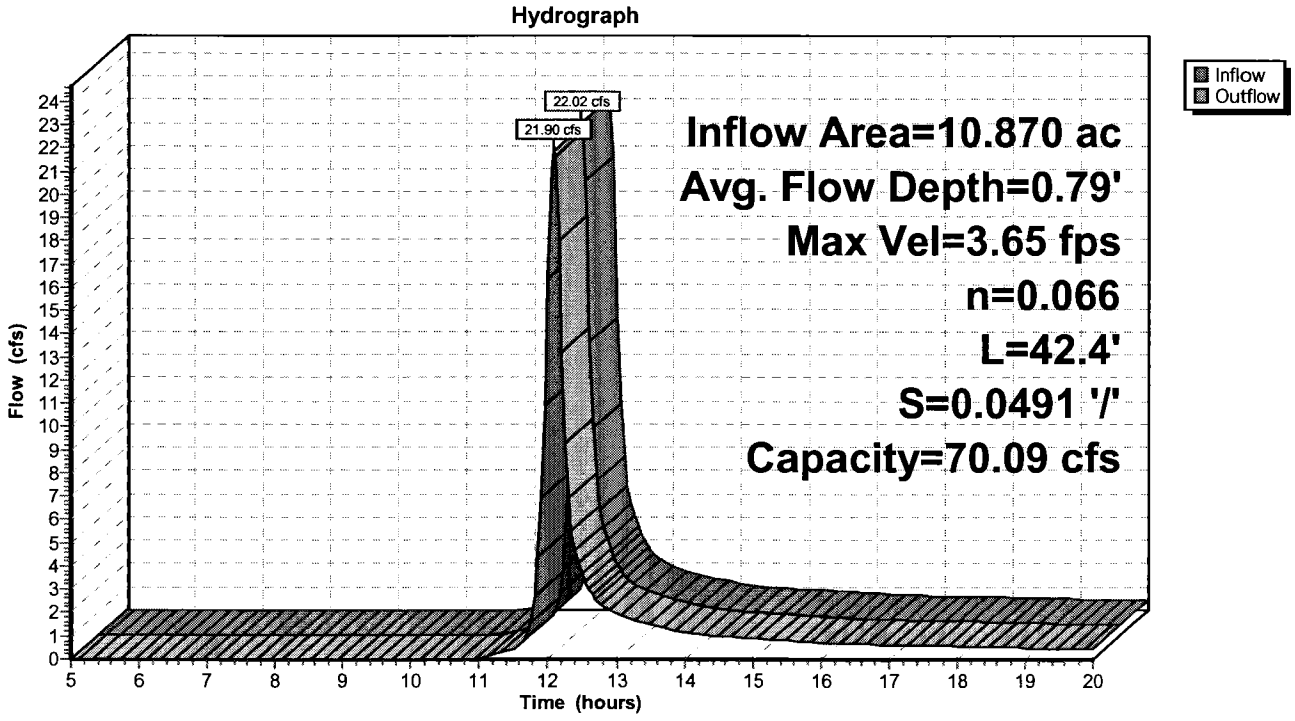
Peak Storage= 255 cf @ 12.08 hrs
Average Depth at Peak Storage= 0.79'
Bank-Full Depth= 1.50' Flow Area= 13.5 sf, Capacity= 70.09 cfs

6.00' x 1.50' deep channel, n= 0.066
Side Slope Z-value= 2.0 '/' Top Width= 12.00'
Length= 42.4' Slope= 0.0491 '/'
Inlet Invert= 1,389.22', Outlet Invert= 1,387.14'

‡



Reach DC9-4: DC9-4



Summary for Reach DC9-5: DC9-5

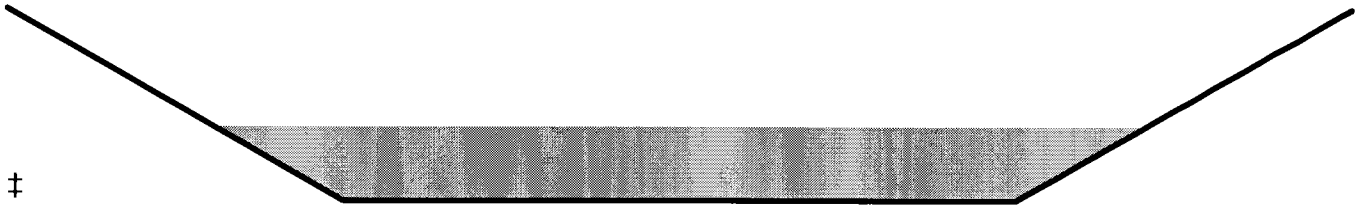
Inflow Area = 10.870 ac, 0.00% Impervious, Inflow Depth > 1.33" for 25 year event
Inflow = 21.90 cfs @ 12.08 hrs, Volume= 1.205 af
Outflow = 21.50 cfs @ 12.10 hrs, Volume= 1.203 af, Atten= 2%, Lag= 1.1 min

Routing by Stor-Ind+Trans method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Max. Velocity= 5.29 fps, Min. Travel Time= 0.7 min
Avg. Velocity = 1.70 fps, Avg. Travel Time= 2.1 min

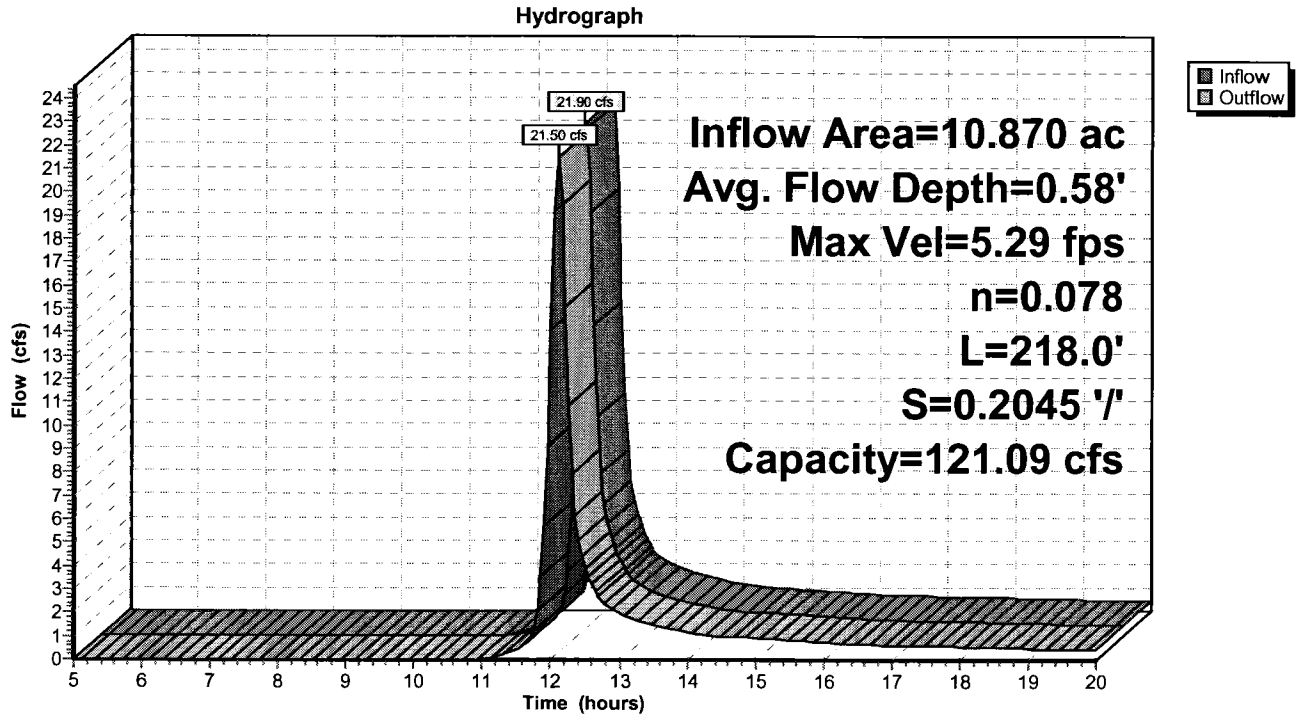
Peak Storage= 902 cf @ 12.09 hrs
Average Depth at Peak Storage= 0.58'
Bank-Full Depth= 1.50' Flow Area= 13.5 sf, Capacity= 121.09 cfs

6.00' x 1.50' deep channel, n= 0.078
Side Slope Z-value= 2.0 '/' Top Width= 12.00'
Length= 218.0' Slope= 0.2045 '/'
Inlet Invert= 1,387.14', Outlet Invert= 1,342.56'

‡



Reach DC9-5: DC9-5



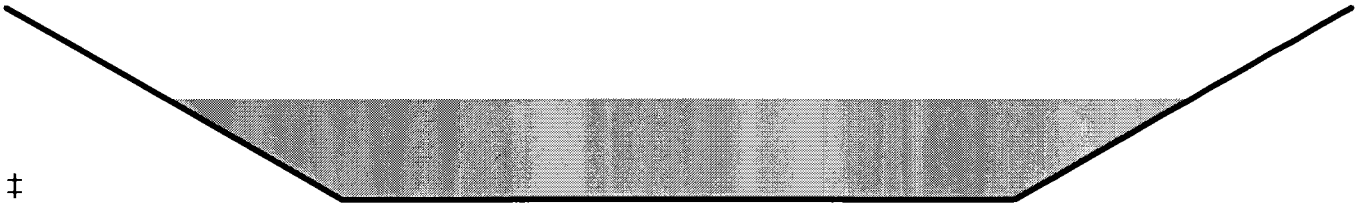
Summary for Reach DC9-6: DC9-6

Inflow Area = 10.870 ac, 0.00% Impervious, Inflow Depth > 1.33" for 25 year event
Inflow = 21.50 cfs @ 12.10 hrs, Volume= 1.203 af
Outflow = 21.36 cfs @ 12.11 hrs, Volume= 1.202 af, Atten= 1%, Lag= 0.3 min

Routing by Stor-Ind+Trans method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Max. Velocity= 3.62 fps, Min. Travel Time= 0.2 min
Avg. Velocity = 1.20 fps, Avg. Travel Time= 0.6 min

Peak Storage= 257 cf @ 12.10 hrs
Average Depth at Peak Storage= 0.79'
Bank-Full Depth= 1.50' Flow Area= 13.5 sf, Capacity= 69.52 cfs

6.00' x 1.50' deep channel, n= 0.066
Side Slope Z-value= 2.0 '/' Top Width= 12.00'
Length= 43.3' Slope= 0.0483 '/'
Inlet Invert= 1,342.56', Outlet Invert= 1,340.47'



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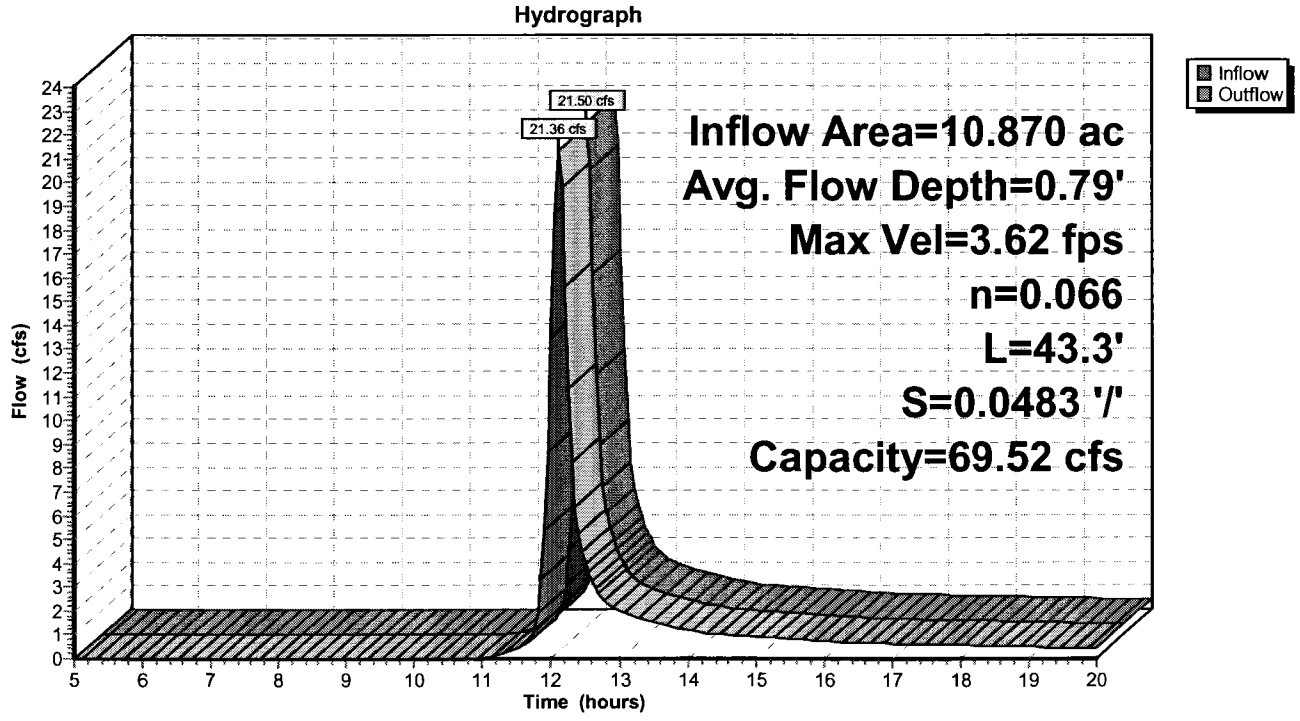
Reach DC9-6: DC9-6



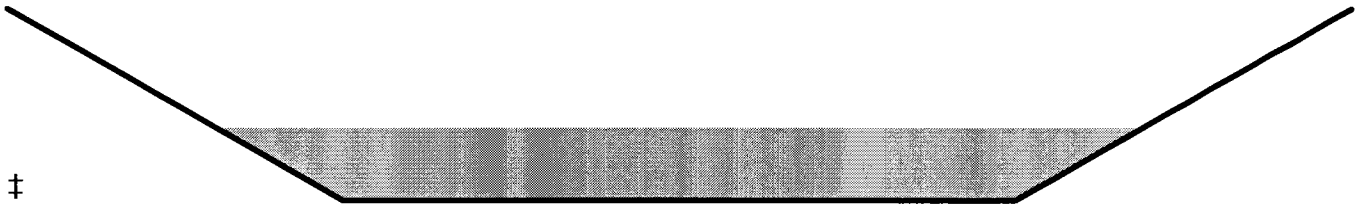
Summary for Reach DC9-7: DC9-7

Inflow Area = 10.870 ac, 0.00% Impervious, Inflow Depth > 1.33" for 25 year event
Inflow = 21.36 cfs @ 12.11 hrs, Volume= 1.202 af
Outflow = 20.93 cfs @ 12.12 hrs, Volume= 1.200 af, Atten= 2%, Lag= 1.0 min

Routing by Stor-Ind+Trans method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Max. Velocity= 5.23 fps, Min. Travel Time= 0.6 min
Avg. Velocity = 1.71 fps, Avg. Travel Time= 1.8 min

Peak Storage= 767 cf @ 12.11 hrs
Average Depth at Peak Storage= 0.57'
Bank-Full Depth= 1.50' Flow Area= 13.5 sf, Capacity= 120.93 cfs

6.00' x 1.50' deep channel, n= 0.078
Side Slope Z-value= 2.0 '/' Top Width= 12.00'
Length= 188.6' Slope= 0.2040 '/'
Inlet Invert= 1,340.47', Outlet Invert= 1,302.00'



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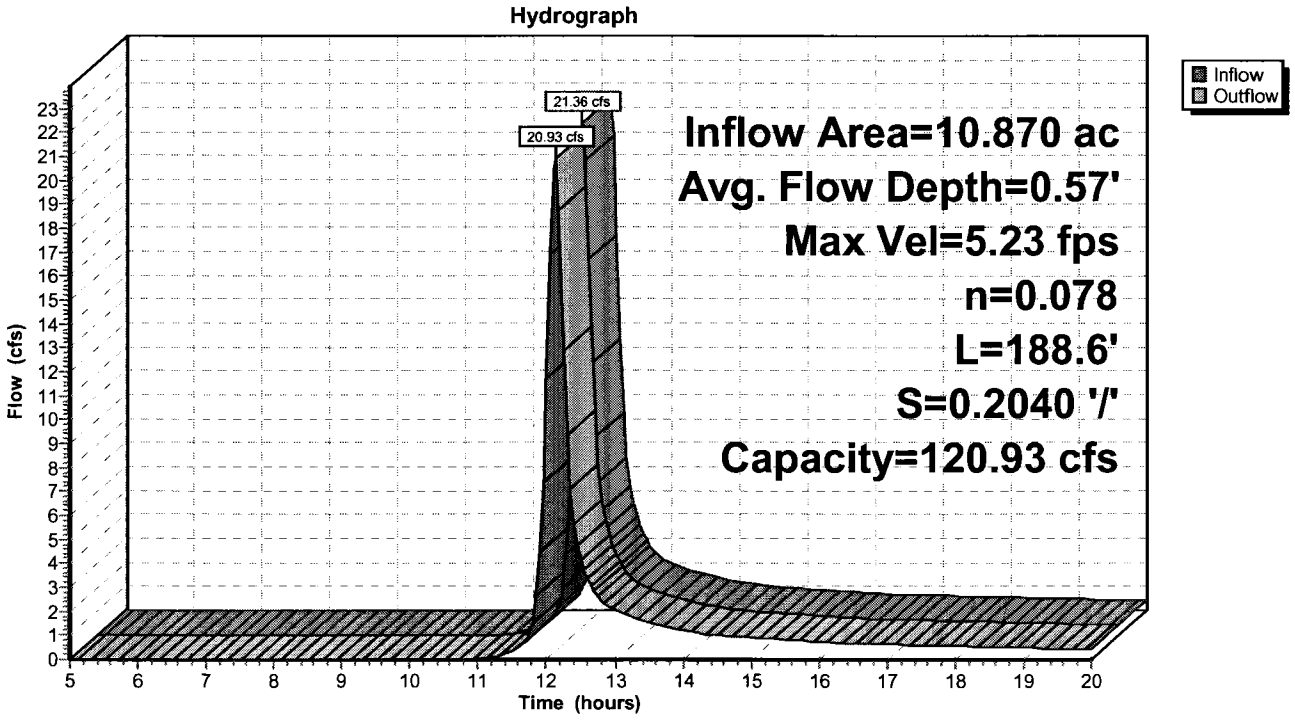
Reach DC9-7: DC9-7



Summary for Pond CU-K: Culvert K

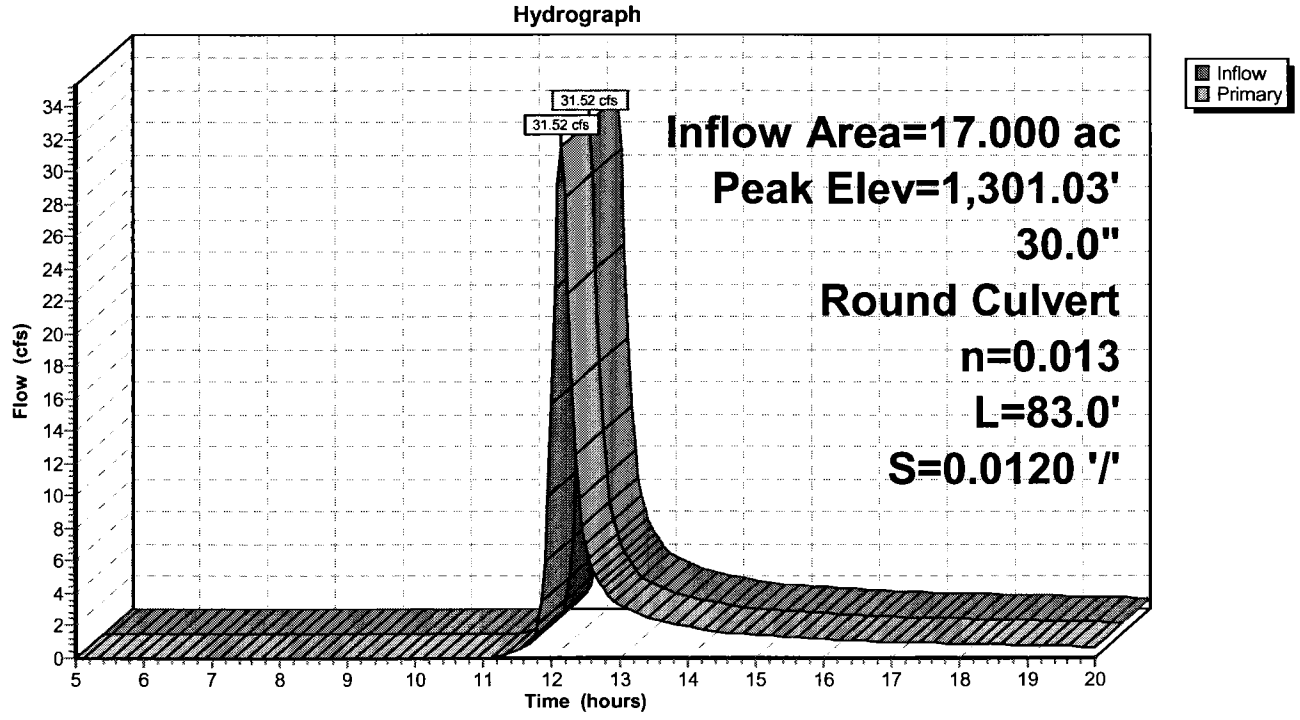
Inflow Area = 17.000 ac, 0.00% Impervious, Inflow Depth > 1.32" for 25 year event
Inflow = 31.52 cfs @ 12.15 hrs, Volume= 1.873 af
Outflow = 31.52 cfs @ 12.15 hrs, Volume= 1.873 af, Atten= 0%, Lag= 0.0 min
Primary = 31.52 cfs @ 12.15 hrs, Volume= 1.873 af

Routing by Stor-Ind method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Peak Elev= 1,301.03' @ 12.15 hrs

Device	Routing	Invert	Outlet Devices
#1	Primary	1,298.00'	**30.0" Round Culvert** L= 83.0' CPP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 1,298.00' / 1,297.00' S= 0.0120 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 4.91 sf

Primary OutFlow Max=31.33 cfs @ 12.15 hrs HW=1,301.01' (Free Discharge)
↑**1=Culvert** (Inlet Controls 31.33 cfs @ 6.38 fps)

Pond CU-K: Culvert K



Summary for Pond P1: Sedimentation Pond 1

Inflow Area = 17.220 ac, 0.00% Impervious, Inflow Depth > 1.32" for 25 year event
Inflow = 31.34 cfs @ 12.15 hrs, Volume= 1.897 af
Outflow = 1.25 cfs @ 15.77 hrs, Volume= 0.456 af, Atten= 96%, Lag= 217.1 min
Primary = 1.25 cfs @ 15.77 hrs, Volume= 0.456 af
Secondary = 0.00 cfs @ 5.00 hrs, Volume= 0.000 af

Routing by Stor-Ind method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Peak Elev= 1,292.13' @ 15.77 hrs Surf.Area= 0.000 ac Storage= 1.465 af

Plug-Flow detention time= 304.7 min calculated for 0.454 af (24% of inflow)
Center-of-Mass det. time= 209.8 min (1,026.7 - 816.8)

Volume	Invert	Avail.Storage	Storage Description
#1	1,283.00'	2.230 af	**Custom Stage Data** Listed below

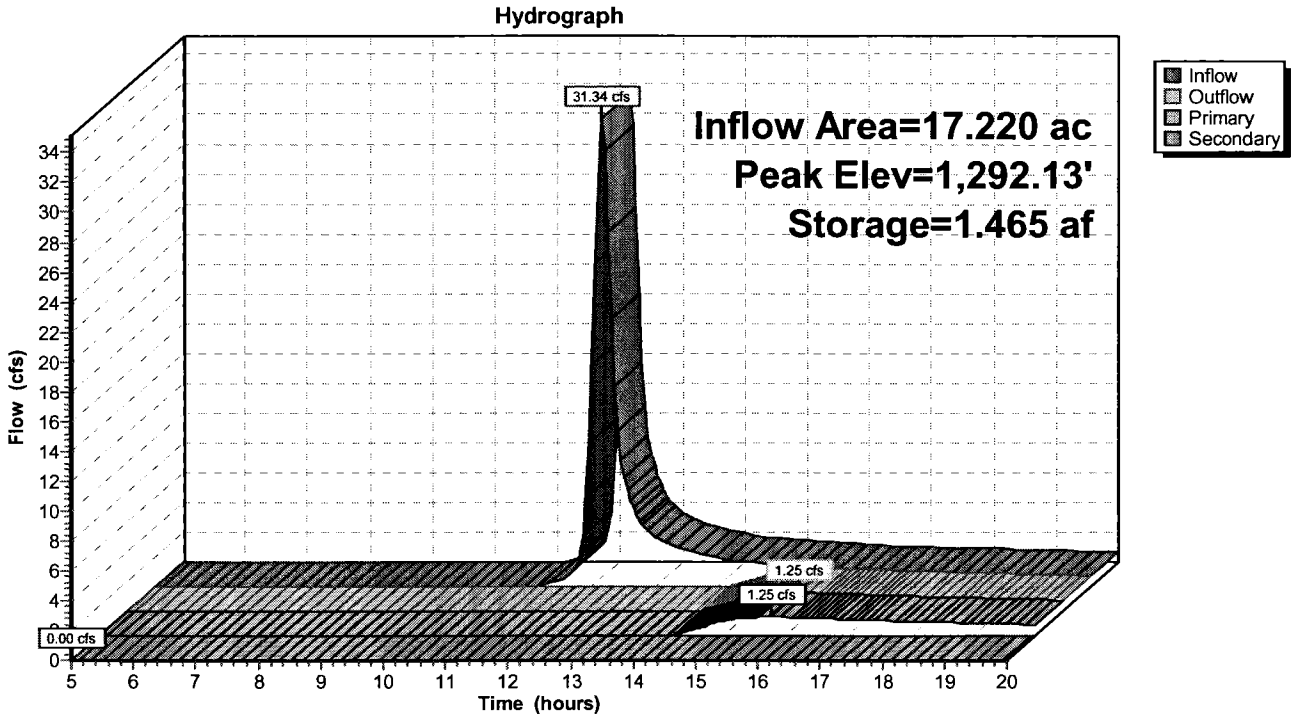
Elevation (feet)	Cum.Store (acre-feet)
1,283.00	0.000
1,285.00	0.200
1,287.00	0.470
1,289.00	0.800
1,291.00	1.200
1,293.00	1.670
1,295.00	2.230

Device	Routing	Invert	Outlet Devices
#1	Primary	1,291.70'	**30.0" Round Culvert** L= 125.0' CPP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 1,291.70' / 1,287.00' S= 0.0376 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 4.91 sf
#2	Secondary	1,292.20'	**151.9 deg x 8.0' long Sharp-Crested Vee/Trap Weir** Cv= 2.47 (C= 3.09)

Primary OutFlow Max=1.25 cfs @ 15.77 hrs HW=1,292.13' (Free Discharge)
↑—**1=Culvert** (Inlet Controls 1.25 cfs @ 2.23 fps)

Secondary OutFlow Max=0.00 cfs @ 5.00 hrs HW=1,283.00' (Free Discharge)
↑—**2=Sharp-Crested Vee/Trap Weir** (Controls 0.00 cfs)

Pond P1: Sedimentation Pond 1



Summary for Pond P1: Sedimentation Pond 1

Inflow Area = 17.220 ac, 0.00% Impervious, Inflow Depth > 2.08" for 100 year event
Inflow = 50.49 cfs @ 12.13 hrs, Volume= 2.979 af
Outflow = 9.41 cfs @ 12.54 hrs, Volume= 1.523 af, Atten= 81%, Lag= 24.5 min
Primary = 4.32 cfs @ 12.54 hrs, Volume= 1.189 af
Secondary = 5.09 cfs @ 12.54 hrs, Volume= 0.334 af

Routing by Stor-Ind method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Peak Elev= 1,292.52' @ 12.54 hrs Surf.Area= 0.000 ac Storage= 1.557 af

Plug-Flow detention time= 170.2 min calculated for 1.518 af (51% of inflow)
Center-of-Mass det. time= 88.9 min (895.3 - 806.4)

Volume	Invert	Avail.Storage	Storage Description
#1	1,283.00'	2.230 af	**Custom Stage Data** Listed below

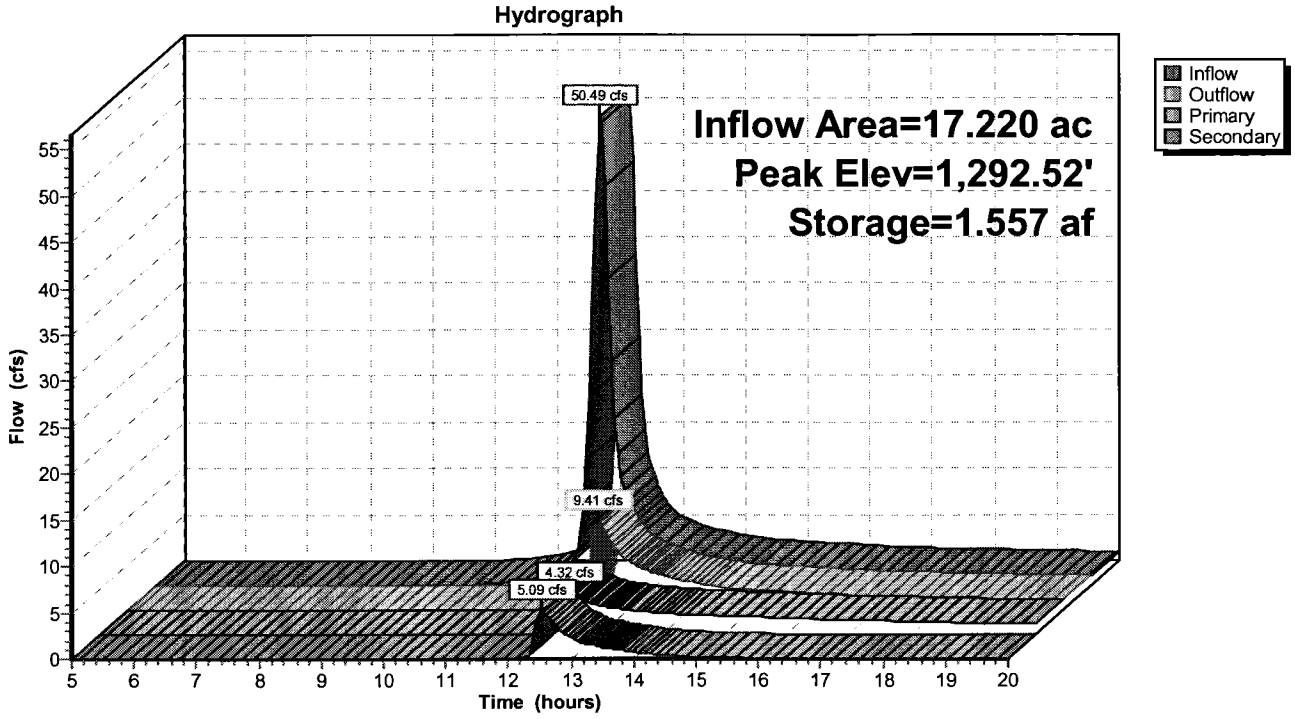
Elevation (feet)	Cum.Store (acre-feet)
1,283.00	0.000
1,285.00	0.200
1,287.00	0.470
1,289.00	0.800
1,291.00	1.200
1,293.00	1.670
1,295.00	2.230

Device	Routing	Invert	Outlet Devices
#1	Primary	1,291.70'	**30.0" Round Culvert** L= 125.0' CPP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 1,291.70' / 1,287.00' S= 0.0376 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 4.91 sf
#2	Secondary	1,292.20'	**151.9 deg x 8.0' long Sharp-Crested Vee/Trap Weir** Cv= 2.47 (C= 3.09)

Primary OutFlow Max=4.29 cfs @ 12.54 hrs HW=1,292.52' (Free Discharge)
↑—**1=Culvert** (Inlet Controls 4.29 cfs @ 3.08 fps)

Secondary OutFlow Max=4.97 cfs @ 12.54 hrs HW=1,292.52' (Free Discharge)
↑—**2=Sharp-Crested Vee/Trap Weir** (Weir Controls 4.97 cfs @ 1.69 fps)

Pond P1: Sedimentation Pond 1



SEDIMENTATION POND
ROUTING OF 100-YEAR 24-HOUR STORM

Summary for Reach D-ES1: Emergency Spillway Discharge Channel

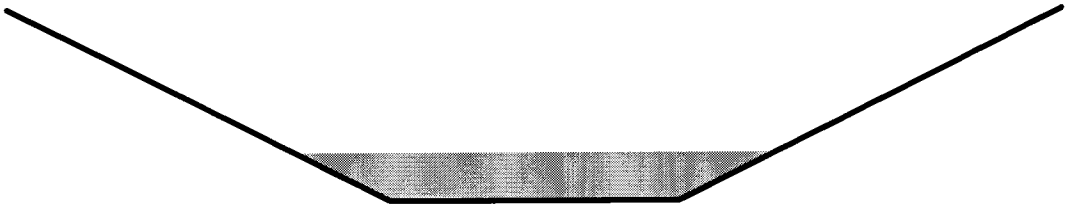
[81] Warning: Exceeded Pond P1 by 0.18' @ 12.55 hrs

Inflow	=	5.09 cfs @	12.54 hrs, Volume=	0.334 af
Outflow	=	5.07 cfs @	12.57 hrs, Volume=	0.334 af, Atten= 0%, Lag= 1.7 min

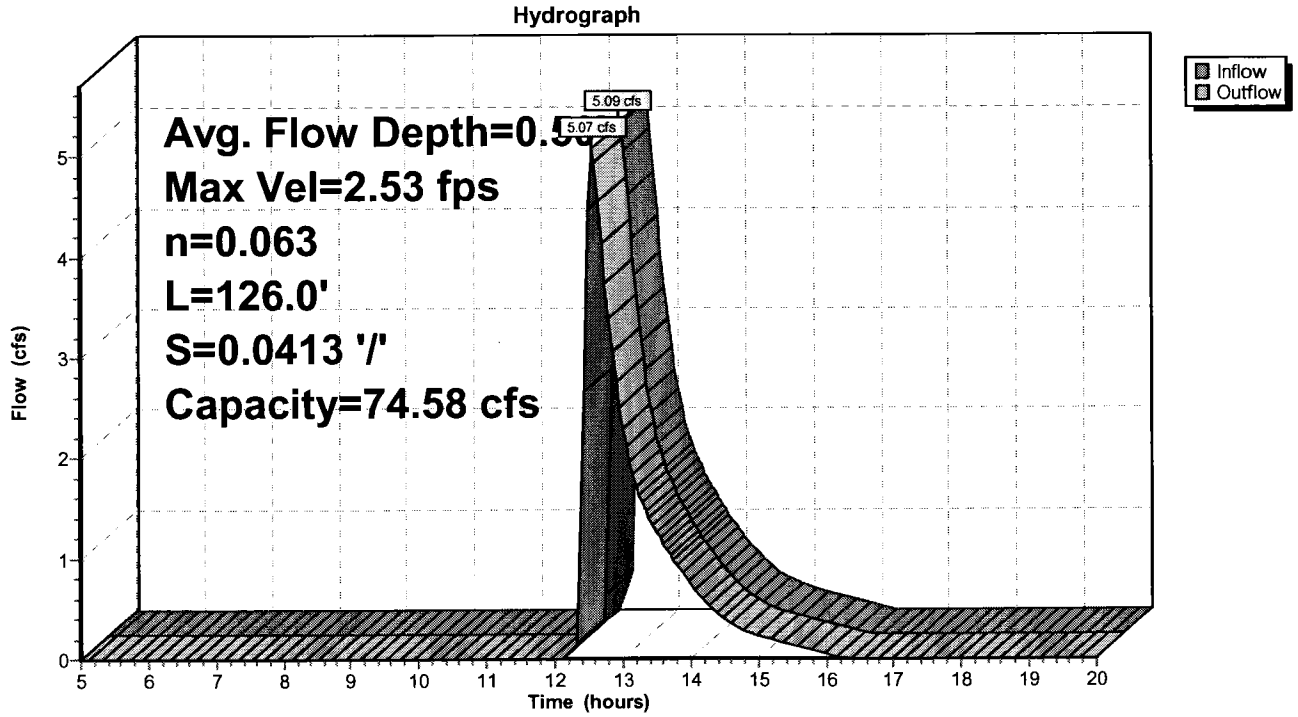
Routing by Stor-Ind+Trans method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Max. Velocity= 2.53 fps, Min. Travel Time= 0.8 min
Avg. Velocity = 1.14 fps, Avg. Travel Time= 1.8 min

Peak Storage= 253 cf @ 12.55 hrs
Average Depth at Peak Storage= 0.50'
Bank-Full Depth= 2.00' Flow Area= 14.0 sf, Capacity= 74.58 cfs

3.00' x 2.00' deep channel, n= 0.063
Side Slope Z-value= 2.0 '/' Top Width= 11.00'
Length= 126.0' Slope= 0.0413 '/'
Inlet Invert= 1,292.20', Outlet Invert= 1,287.00'



Reach D-ES1: Emergency Spillway Discharge Channel



Summary for Reach D-P1: Pond 1 Discharge Channel

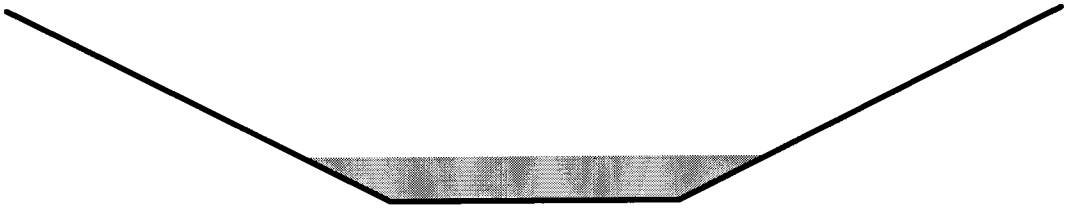
[62] Hint: Exceeded Reach D-ES1 OUTLET depth by 0.17' @ 16.45 hrs
[79] Warning: Submerged Pond P1 Primary device # 1 OUTLET by 0.46'

Inflow Area = 17.220 ac, 0.00% Impervious, Inflow Depth > 1.06" for 100 year event
Inflow = 9.37 cfs @ 12.56 hrs, Volume= 1.523 af
Outflow = 9.32 cfs @ 12.57 hrs, Volume= 1.522 af, Atten= 1%, Lag= 0.6 min

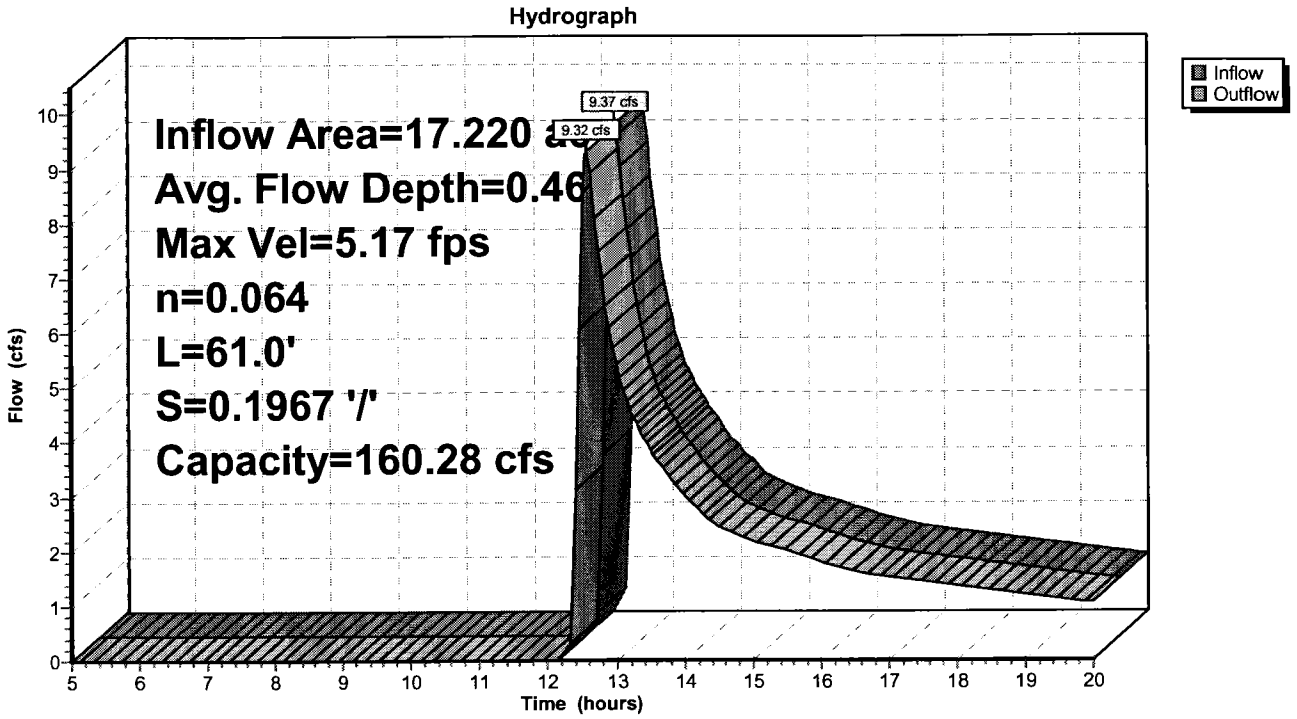
Routing by Stor-Ind+Trans method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Max. Velocity= 5.17 fps, Min. Travel Time= 0.2 min
Avg. Velocity = 3.16 fps, Avg. Travel Time= 0.3 min

Peak Storage= 110 cf @ 12.57 hrs
Average Depth at Peak Storage= 0.46'
Bank-Full Depth= 2.00' Flow Area= 14.0 sf, Capacity= 160.28 cfs

3.00' x 2.00' deep channel, n= 0.064
Side Slope Z-value= 2.0 '/' Top Width= 11.00'
Length= 61.0' Slope= 0.1967 '/'
Inlet Invert= 1,287.00', Outlet Invert= 1,275.00'



Reach D-P1: Pond 1 Discharge Channel



1.0 INTRODUCTION

The proposed Sedimentation Pond 2 was designed to collect stormwater for the southern, central portion of the proposed expansion.

This sedimentation pond must meet the following regulations:

OAC 3745-27-08 (D)(3)

(i) Minimum storage volume shall be provided based on either the calculated runoff from a 10-year/24-hour storm event, or 0.125 acre-feet per year (for each acre of disturbed area within the upstream drainage area) multiplied by the scheduled frequency of pond clean-out (in years), which ever is greater; and

(ii) The principal spillway shall safely discharge the flow from a 10-year/24-hour storm event. The inlet elevation of the emergency spillway shall be designed to provide flood storage, with no flow entering the emergency spillway, for a 25-year/24-hour storm event, with allowance provided for the flow passed by the principal spillway during the event; and

(iii) The combination of the principal and emergency spillways shall safely discharge the flow from the 100-year/24-hour storm event using non mechanical means. The embankment design shall provide for no less than 1-foot net freeboard when flow is at the design depth, after allowance for embankment settlement.

All designs are based upon accepted design equations, methodologies and assumptions. Where applicable, design references have been made. Calculations have been performed using the software package, HydroCAD Version 10, Copyright 2011.

2.0 DESIGN ASSUMPTIONS

1. The pond was designed based on the proposed top of final cover grade for the proposed expansion.

2. The inflow hydrographs were developed by HydroCAD for each contributing watershed.

3. The inflow for this sedimentation pond is summarized below:

Drainage Area	Watershed Area (Acre)	Composite CN
DA-52	1.49	71
DA-31	2.91	71
DA-10	17.89	71
A-3	0.57	71
Total	22.86	

Times of concentration will be estimated as the sum of sheet flow, shallow flow and channel flow. The surface in the existing and proposed landfill will be similar to a non-grazed meadow in hydrologic soil group C, and was therefore modeled using a curve number of 71. Sheet flow calculations will use an average roughness of 0.150, which corresponds to short grass. The maximum sheet flow length will be 300 feet. Shallow flow times of concentration will be estimated using the velocity factor for short grass pasture.

From Reference 2, the following runoff coefficients have been found and will be utilized.

CN DATA	
Description	**CN**
Non-grazed meadow	71

3.0 VOLUME SIZING

As per OAC 3745-27-08 (D)(3)(i), the sedimentation pond must provide adequate storage volume for the larger of: (1) the runoff from the 10-year/24-hour storm event or (2) 0.125 acre-ft per acre of disturbed area multiplied by the cleaning frequency in years.

Volume Requirement for 10-year/24-hour storm:

Utilizing HydroCAD for a 10-year/24-hour storm event, the inflow hydrographs were developed for each contributing watershed.

From Reference 9 and presented in an attachment, the rainfall depths for the facility are summarized in the following table:

Storm Event	Rainfall Depth (inches)
10-year/24-hour	3.46
25-year/24-hour	4.12
100-year/24-hour	5.23

Utilizing the watershed information included in Section 2.0 of this calculation, the required storage volume from the runoff from a 10-year/24-hour storm event was calculated by HydroCAD to be approximately 85,465-cf of

storage volume. The HydroCAD output files for a 10-year/24-hour storm event are included in an attachment to this calculation.

Volume Requirement for 0.125 acre-ft per disturbed acre:

Given the watershed information included in Section 2.0 of this calculation:

Drainage Area	Watershed Area (acres)	Disturbed Area (acres) [Calculated]	Volume (cf) [Calculated]
DA-52	1.49	0.45	2,450
DA-31	2.91	0.87	4,737
DA-10	17.89	5.37	29,240
A-3	0.57	0.17	926
Totals	22.86	6.86	37,353

For disturbed area, a conservative assumption of 30% of the watershed was used.

In the above table, the volume for each Drainage Area is calculated as follows assuming one scheduled pond cleaning event per year.

From the above calculations, the controlling volume for the design of this sedimentation pond is 85,465-cf, based on the runoff from the HydroCAD 10-year/24-hour storm event.

4.0 PRINCIPAL SPILLWAY DESIGN

Using HydroCAD, a 10-year/24-hour storm event was routed through the sedimentation pond to determine the required storage capacity below the prinicipal spillway. The principal spillway invert elevation should be set at elevation 1,265.70-feet.

As per OAC 3745-27-08(D)(3)(b), the principal spillway shall be designed to safely discharge the flow from a 10-year/24-hour storm event without the use of mechanical means. Based on the HydroCAD analysis, Sedimentation Pond 2 will not discharge from the emergency spillway during the 10-year/24-hour storm event. The principal spillway is able to discharge flow from a 25-year/24-hour storm event without the use of mechanical means, thus, the principal spillway is adequate.

Item	Value
Culvert Type	CMP
Culvert Quantity	1
Principal Spillway Diameter	30-inch
Principal Spillway Invert Elevation	1,265.70-ft
Maximum pool elevation for routing of 10-year/24-hour storm	1,265.53-ft
Maximum pool elevation for routing of 25-year/24-hour storm	1,266.12-ft

5.0 ANTI-SEEP COLLAR DESIGN

Anti-seep collars are required for culverts that are placed in the saturated zone of the pond embankment. The culvert used as the principal spillway for Sedimentation Pond 2 is above the saturated zone of the embankment and thus, does not require anti-seep collars.

6.0 EMERGENCY SPILLWAY DESIGN

In accordance with the regulations, the emergency spillway must be set so that there is no discharge during the 25-year/24-hour storm. The combination of the principal and emergency spillway must discharge the 100-year/24-hour storm event while maintaining a minimum of 1.0 foot of freeboard to the embankment crest. These design requirements have been checked by routing the 25-year/24-hour and 100-year/24-hour storms through the pond.

The emergency spillway is analyzed as a sharp-crested vee/trap weir with the invert at elevation 1,266.30-ft. The crest of the emergency spillway has been set so that there is no discharge during the 25-yer/24-hour storm. The maximum elevation provided with routing the 25-year/24-hour storm is 1,266.12-ft. The emergency spillway is set at elevation 1,266.30-ft, thus there is no discharge from the emergency spillway during the 25-year/24-hour storm. During the routing of the 100-year/24-hour storm, a minimum of 1.0 foot of freeboard is maintained to the perimeter elevation for the pond. The maximum elevation provided with the routing of a 100-year/24-hour storm through the pond is 1266.52-ft. The crest of the embankment is at elevation 1,270.00-ft, thus Sedimentation Pond 2 provides more than 1.0 foot of freeboard from the embankment crest.

Item	Value
Spillway Type	Sharp-Cressted Vee/Trap Weir
Quantity	1
Emergency Spillway Dimensions	151.9 degrees x 8.0 feet long
Emergency Spillway Invert Elevation	1266.30-ft
Pond Embankment Crest Elevation	1,270.0-ft
Maximum pool for routing of 100-year/24-hour storm	1266.52-ft (>1.0-ft freeboard)
Maximum pool for routing of 25-year/24-hour storm	1,266.12-ft

7.0 OUTLET CHANNEL

The outlet channel was analyzed so that the flow from the 100-year/24-hour storm is safely discharged. Based on HydroCAD, the maximum velocity from the 100-year/24-hour storm event when using R-5 riprap is 4.84 feet per second, which is below the permissible velocity for R-5 riprap.

8.0 CONCLUSION

Sedimentation Pond 2 will meet the requirements outlined in OAC 3745-27-08 (D)(3). The pond provides 87,570-cf of storage below the principal spillway meeting the required storage for the 10-year/24-hour storm. The principal spillway is able to discharge flow from the 25-year/24-hour storm event without the use of mechanical means, thus, the principal spillway is adequately sized. There is no flow from the emergency spillway during the routing of the 25-year/24-hour storm. The emergency spillway and principal spillway can discharge the 100-year/24-hour storm while maintaining a minimum of 1.0 foot of freeboard.

REFERENCES

1. Soil Conservation Service, URBAN HYDROLOGY FOR SMALL WATERSHEDS, Technical Release 55, June 1986.

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3. Ven Te Chow, OPEN CHANNEL HYDRAULICS, Mc-Graw Hill Book Company, 1959

4. Goldman, Jackson and Bursztynsky, EROSION AND SEDIMENT CONTROL HANDBOOK, Mc-Graw Hill Book Company, 1986.

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7. HydroCAD Software Solutions, LLC., HYDROCAD, Version 10.0, 2011, Computer Software Program.

8. National Climatic Data Center, *Precipitation Frequency Estimates*, Point Precipitation Frequency Estimate From NOAA Atlas 14 Ohio 40.4353 N 80.9122 W, Viewed 27 September 2011,< http://hdsc.nws.noaa.gov>.

9. Ohio Department of Natural Resources, Division of Soil and Water Conservation, RAINWATER AND LAND DEVELOPMENT, Third Edition, 2006.

NOAA PRECIPITATION ESTIMATE

www.nws.noaa.gov

NOAA's National Weather Service
Hydrometeorological Design Studies Center
Precipitation Frequency Data Server (PFDS)

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- Temporal Distr.
- Time Series Data
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NOAA ATLAS 14 POINT PRECIPITATION FREQUENCY ESTIMATES

DATA DESCRIPTION

Data type: precipitation depth - **Units:** english - **Time series type:** partial duration -

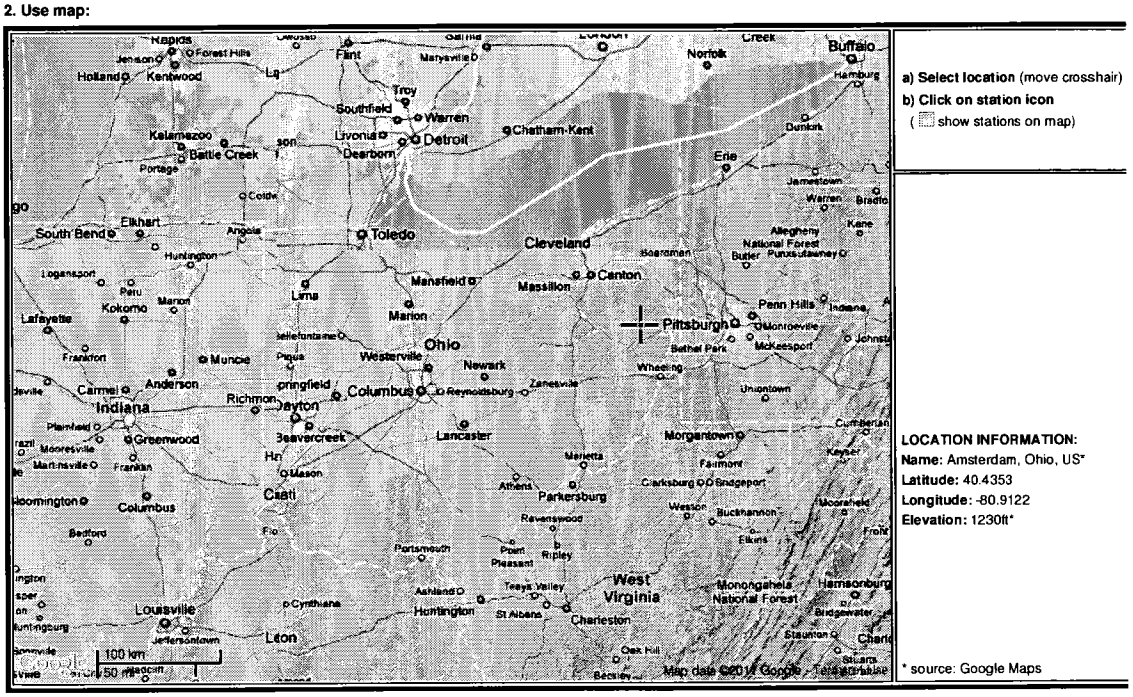
SELECT LOCATION

1. Manually:

a) Enter location (decimal degrees, use "-" for S and W): latitude: 40.4353 longitude: -80.9122 submit

b) Select station: select station

2. Use map:



a) **Select location** (move crosshair)
b) **Click on station icon**
(show stations on map)

LOCATION INFORMATION:
Name: Amsterdam, Ohio, US*
Latitude: 40.4353
Longitude: -80.9122
Elevation: 1230ft*

* source: Google Maps

POINT PRECIPITATION FREQUENCY (PF) ESTIMATES

WITH 90% CONFIDENCE INTERVALS AND SUPPLEMENTARY INFORMATION
NOAA Atlas 14, Volume 2, Version 3

PF tabular PF graphical Supplementary information Print Page

PDS-based precipitation frequency estimates with 90% confidence intervals (in inches)[1]

Duration	Average recurrence interval(years)									
	1	2	5	10	25	50	100	200	500	1000
5-min	0.326 (0.292-0.364)	0.390 (0.350-0.435)	0.472 (0.422-0.527)	0.534 (0.477-0.595)	0.614 (0.546-0.683)	0.676 (0.599-0.751)	0.735 (0.649-0.815)	0.796 (0.700-0.883)	0.878 (0.767-0.972)	0.938 (0.816-1.04)
10-min	0.507 (0.454-0.566)	0.609 (0.546-0.680)	0.733 (0.656-0.819)	0.825 (0.736-0.919)	0.940 (0.836-1.05)	1.02 (0.908-1.14)	1.11 (0.977-1.23)	1.19 (1.05-1.32)	1.29 (1.13-1.43)	1.37 (1.19-1.51)
15-min	0.621 (0.556-0.693)	0.745 (0.667-0.831)	0.900 (0.806-1.01)	1.02 (0.906-1.13)	1.16 (1.03-1.29)	1.27 (1.12-1.41)	1.37 (1.21-1.53)	1.48 (1.30-1.64)	1.61 (1.41-1.78)	1.71 (1.48-1.89)
30-min	0.821 (0.736-0.917)	0.997 (0.893-1.11)	1.23 (1.10-1.38)	1.41 (1.26-1.57)	1.64 (1.46-1.82)	1.81 (1.61-2.01)	1.98 (1.75-2.20)	2.16 (1.90-2.39)	2.39 (2.09-2.64)	2.56 (2.23-2.83)
60-min	1.00 (0.899-1.12)	1.22 (1.10-1.37)	1.55 (1.39-1.73)	1.79 (1.60-2.00)	2.13 (1.89-2.37)	2.39 (2.12-2.65)	2.65 (2.34-2.94)	2.93 (2.57-3.25)	3.30 (2.88-3.66)	3.59 (3.13-3.98)
2-hr	1.16 (1.03-1.30)	1.41 (1.25-1.58)	1.80 (1.59-2.02)	2.10 (1.86-2.35)	2.53 (2.23-2.83)	2.88 (2.54-3.22)	3.25 (2.85-3.62)	3.65 (3.18-4.05)	4.21 (3.65-4.66)	4.66 (4.02-5.16)
3-hr	1.23 (1.10-1.39)	1.49 (1.33-1.69)	1.90 (1.69-2.15)	2.22 (1.98-2.51)	2.69 (2.38-3.02)	3.07 (2.71-3.44)	3.47 (3.05-3.88)	3.91 (3.41-4.36)	4.53 (3.92-5.05)	5.03 (4.34-5.60)
6-hr	1.47 (1.32-1.66)	1.77 (1.59-2.00)	2.24 (2.00-2.52)	2.61 (2.33-2.94)	3.17 (2.81-3.55)	3.62 (3.20-4.05)	4.11 (3.61-4.58)	4.65 (4.06-5.16)	5.42 (4.68-6.00)	6.06 (5.19-6.69)
12-hr	1.74 (1.57-1.94)	2.09 (1.88-2.33)	2.60 (2.34-2.91)	3.04 (2.72-3.38)	3.67 (3.27-4.07)	4.20 (3.73-4.65)	4.78 (4.22-5.27)	5.41 (4.74-5.95)	6.34 (5.50-6.93)	7.11 (6.12-7.75)

24-hr	**2.04** (1.88-2.21)	**2.44** (2.26-2.64)	**3.00** (2.77-3.25)	**3.46** (3.20-3.75)	**4.12** (3.79-4.45)	**4.66** (4.26-5.03)	**5.23** (4.76-5.64)	**5.84** (5.28-6.28)	**6.69** (6.00-7.20)	**7.39** (6.57-7.95)
2-day	**2.38** (2.22-2.58)	**2.85** (2.64-3.08)	**3.47** (3.22-3.75)	**3.98** (3.69-4.30)	**4.69** (4.33-5.05)	**5.27** (4.84-5.67)	**5.87** (5.36-6.31)	**6.49** (5.90-6.99)	**7.37** (6.63-7.94)	**8.06** (7.20-8.70)
3-day	**2.55** (2.38-2.75)	**3.04** (2.83-3.27)	**3.68** (3.43-3.97)	**4.21** (3.91-4.52)	**4.93** (4.57-5.30)	**5.52** (5.09-5.92)	**6.13** (5.62-6.57)	**6.75** (6.17-7.24)	**7.62** (6.90-8.19)	**8.31** (7.47-8.94)
4-day	**2.72** (2.54-2.91)	**3.23** (3.02-3.47)	**3.90** (3.64-4.18)	**4.44** (4.14-4.75)	**5.18** (4.81-5.54)	**5.77** (5.35-6.17)	**6.38** (5.89-6.82)	**7.01** (6.43-7.50)	**7.88** (7.17-8.45)	**8.56** (7.74-9.19)
7-day	**3.25** (3.06-3.47)	**3.86** (3.63-4.12)	**4.63** (4.35-4.94)	**5.24** (4.92-5.59)	**6.09** (5.69-6.49)	**6.77** (6.30-7.21)	**7.45** (6.91-7.94)	**8.16** (7.53-8.69)	**9.11** (8.35-9.73)	**9.86** (8.96-10.5)
10-day	**3.75** (3.54-3.98)	**4.45** (4.20-4.72)	**5.28** (4.98-5.60)	**5.94** (5.60-6.29)	**6.83** (6.42-7.23)	**7.53** (7.06-7.98)	**8.24** (7.70-8.73)	**8.94** (8.33-9.50)	**9.89** (9.15-10.5)	**10.6** (9.76-11.3)
20-day	**5.27** (5.00-5.55)	**6.21** (5.90-6.55)	**7.27** (6.91-7.66)	**8.10** (7.68-8.52)	**9.17** (8.68-9.65)	**9.99** (9.44-10.5)	**10.8** (10.2-11.4)	**11.6** (10.9-12.2)	**12.6** (11.8-13.3)	**13.3** (12.4-14.1)
30-day	**6.61** (6.27-6.98)	**7.77** (7.37-8.21)	**9.01** (8.54-9.51)	**9.97** (9.44-10.5)	**11.2** (10.6-11.8)	**12.2** (11.5-12.8)	**13.1** (12.3-13.8)	**14.0** (13.1-14.8)	**15.1** (14.1-16.0)	**15.9** (14.8-16.9)
45-day	**8.46** (8.05-8.90)	**9.91** (9.42-10.4)	**11.3** (10.8-11.9)	**12.4** (11.8-13.1)	**13.8** (13.1-14.5)	**14.8** (14.0-15.6)	**15.8** (14.9-16.7)	**16.7** (15.8-17.7)	**17.9** (16.8-18.9)	**18.7** (17.5-19.8)
60-day	**10.2** (9.75-10.7)	**11.9** (11.4-12.5)	**13.5** (12.9-14.2)	**14.7** (14.0-15.4)	**16.2** (15.5-17.0)	**17.3** (16.5-18.1)	**18.3** (17.4-19.2)	**19.2** (18.2-20.2)	**20.4** (19.3-21.4)	**21.1** (20.0-22.3)

[1] Precipitation frequency (PF) estimates in this table are based on frequency analysis of partial duration series (PDS).

Numbers in parenthesis are PF estimates at lower and upper bounds of the 90% confidence interval. The probability that precipitation frequency estimates (for a given duration and average recurrence interval) will be greater than the upper bound (or less than the lower bound) is 5%. Estimates at upper bounds are not checked against probable maximum precipitation (PMP) estimates and may be higher than currently valid PMP values.

Please refer to NOAA Atlas 14 document for more information.

csv Estimates from the table in csv format: precipitation frequency estimates - Submit

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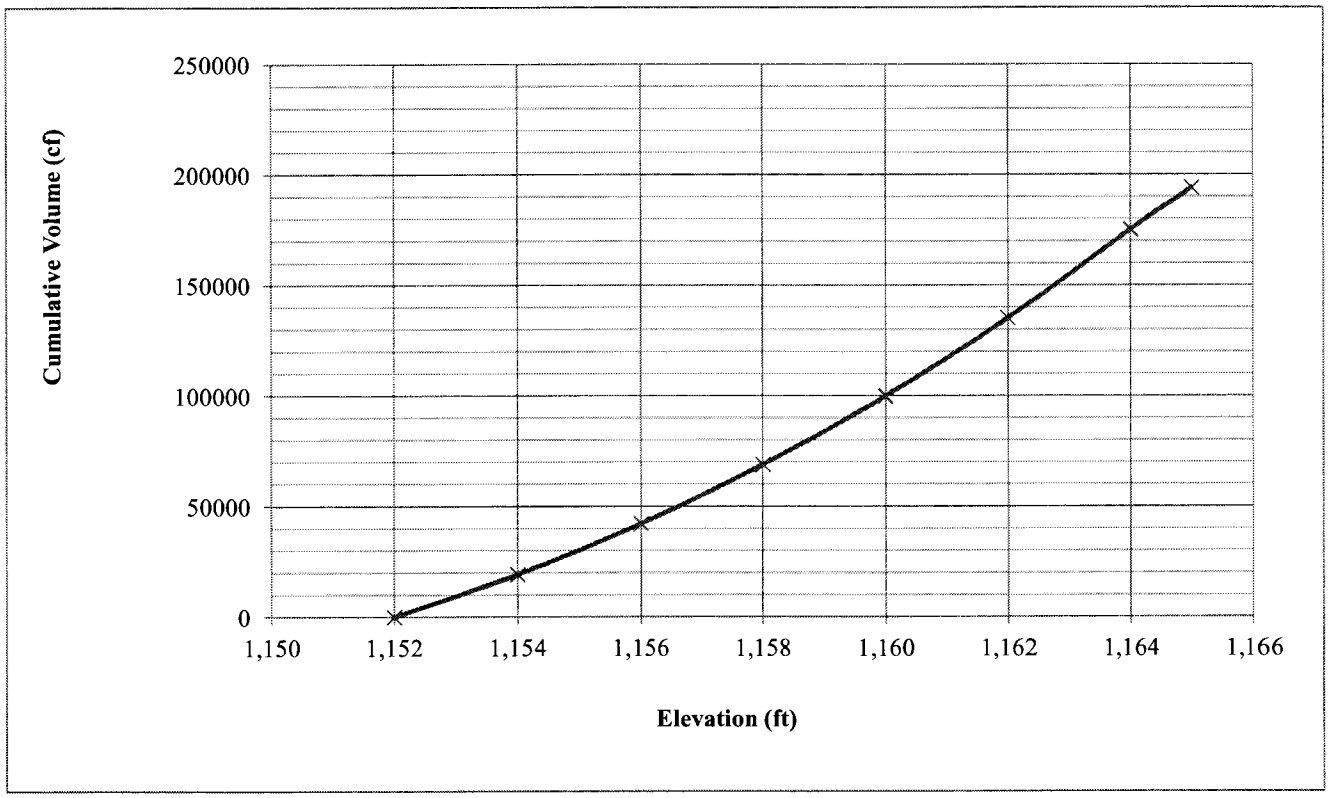
SEDIMENTATION POND
ELEVATION - STORAGE

Apex Sanitary Landfill
Sedimentation Pond 2 Support
Elevation Storage

Elevation (ft)	Pool Area (sf)	Average Area (sf)	Incremental Volume (cf)	Cumulative Volume (cf)	Cumulative Volume (ac-ft)
1,258.00	7,904	0	0	0	0.00
1,260.00	9,600	8,752	17,504	17,504	0.40
1,262.00	11,424	10,512	21,024	38,528	0.88
1,264.00	13,376	12,400	24,800	63,328	1.45
1,266.00	15,456	14,416	28,832	92,160	2.12
1,268.00	17,664	16,560	33,120	125,280	2.88
1,270.00	20,000	18,832	37,664	162,944	3.74



Principal Spillway

1,264.00	13,376	12,400	24,800	63,328	1.45
1,265.70	15,144	14,260	24,242	87,570	2.01
1,266.00	15,456	14,416	28,832	92,160	2.12

Principal spillway inlet invert is at El. 1,265.70-ft which has a storage capacity 87,570-cf.

SEDIMENTATION POND
ROUTING OF 10-YEAR 24-HOUR STORM

Summary for Pond P2: Sedimentation Pond 2

Inflow Area = 22.860 ac, 0.00% Impervious, Inflow Depth > 1.03" for 10-year event
Inflow = 32.30 cfs @ 12.10 hrs, Volume= 1.962 af
Outflow = 0.00 cfs @ 1.00 hrs, Volume= 0.000 af, Atten= 100%, Lag= 0.0 min
Primary = 0.00 cfs @ 1.00 hrs, Volume= 0.000 af
Secondary = 0.00 cfs @ 1.00 hrs, Volume= 0.000 af

Routing by Stor-Ind method, Time Span= 1.00-24.00 hrs, dt= 0.01 hrs
Peak Elev= 1,265.53' @ 24.00 hrs Surf.Area= 0.000 ac Storage= 1.962 af

Plug-Flow detention time= (not calculated: initial storage excedes outflow)
Center-of-Mass det. time= (not calculated: no outflow)

Volume	Invert	Avail.Storage	Storage Description
#1	1,258.00'	3.740 af	**Custom Stage Data** Listed below

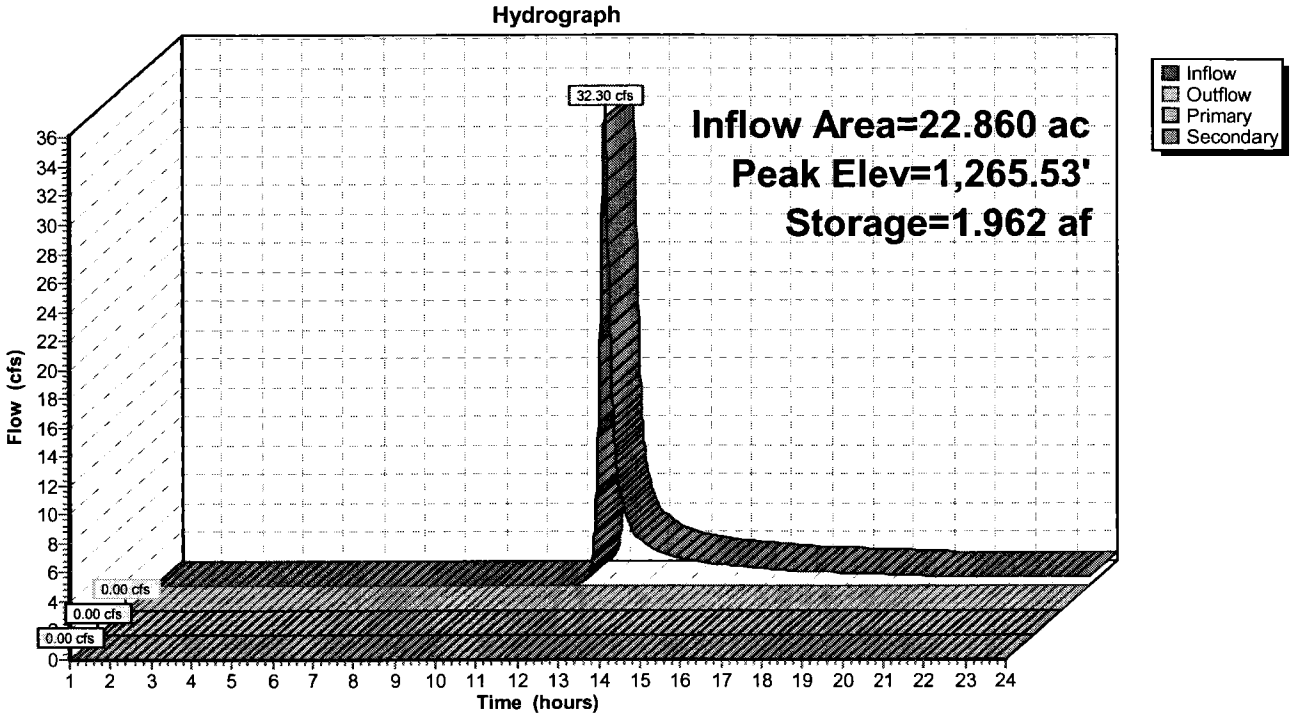
Elevation (feet)	Cum.Store (acre-feet)
1,258.00	0.000
1,260.00	0.400
1,262.00	0.880
1,264.00	1.450
1,266.00	2.120
1,268.00	2.880
1,270.00	3.740

Device	Routing	Invert	Outlet Devices
#1	Primary	1,265.70'	**30.0" Round Culvert** L= 42.0' CPP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 1,265.70' / 1,260.00' S= 0.1357 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 4.91 sf
#2	Secondary	1,266.30'	**151.9 deg x 8.0' long Sharp-Crested Vee/Trap Weir** Cv= 2.47 (C= 3.09)

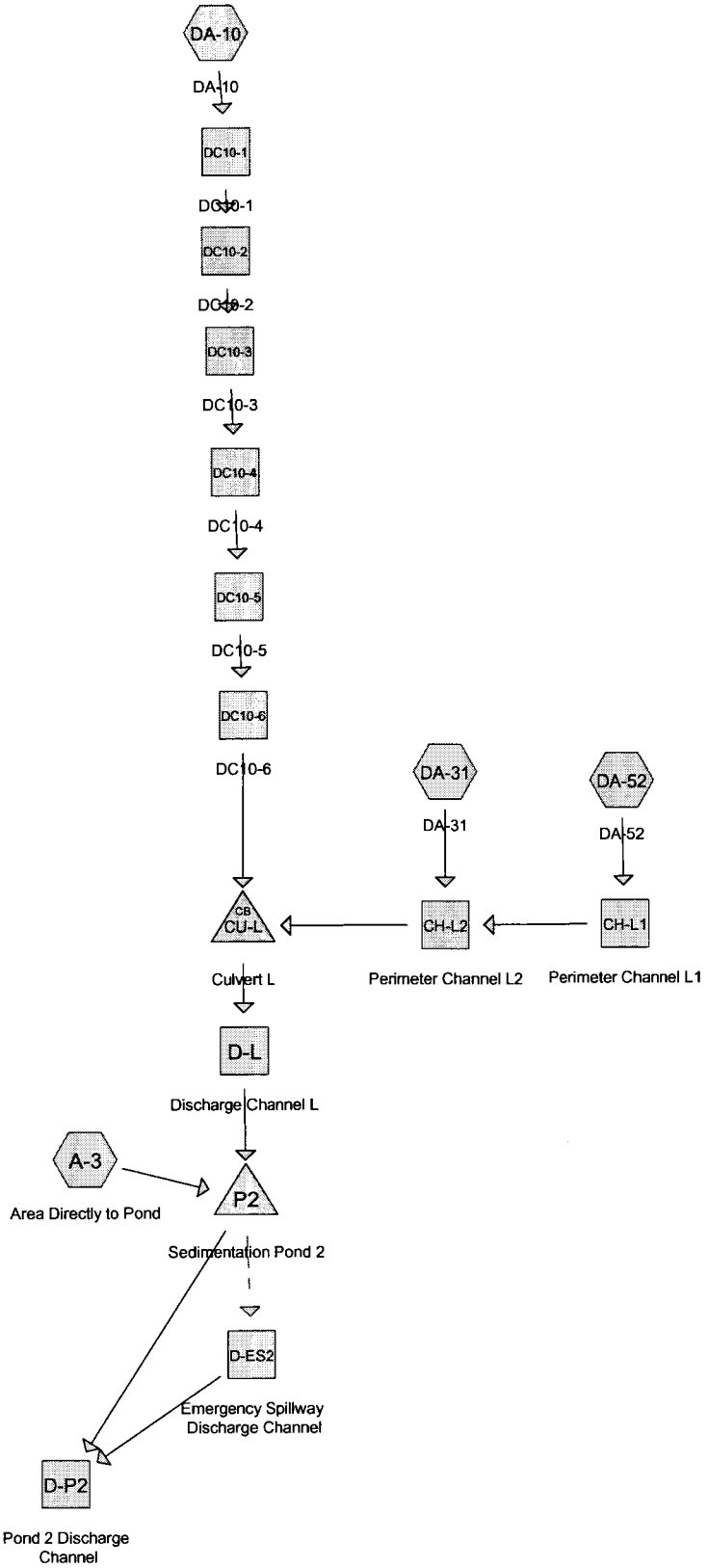
Primary OutFlow Max=0.00 cfs @ 1.00 hrs HW=1,258.00' (Free Discharge)
↑—**1=Culvert** (Controls 0.00 cfs)

Secondary OutFlow Max=0.00 cfs @ 1.00 hrs HW=1,258.00' (Free Discharge)
↑—**2=Sharp-Crested Vee/Trap Weir** (Controls 0.00 cfs)

Pond P2: Sedimentation Pond 2



SEDIMENTATION POND
ROUTING OF 25-YEAR 24-HOUR STORM



Subcat Reach Pond Link

Routing Diagram for Sedimentation Pond 2
Prepared by Microsoft, Printed 10/21/2011
HydroCAD® 10.00 s/n 01006 © 2011 HydroCAD Software Solutions LLC

Summary for Subcatchment A-3: Area Directly to Pond

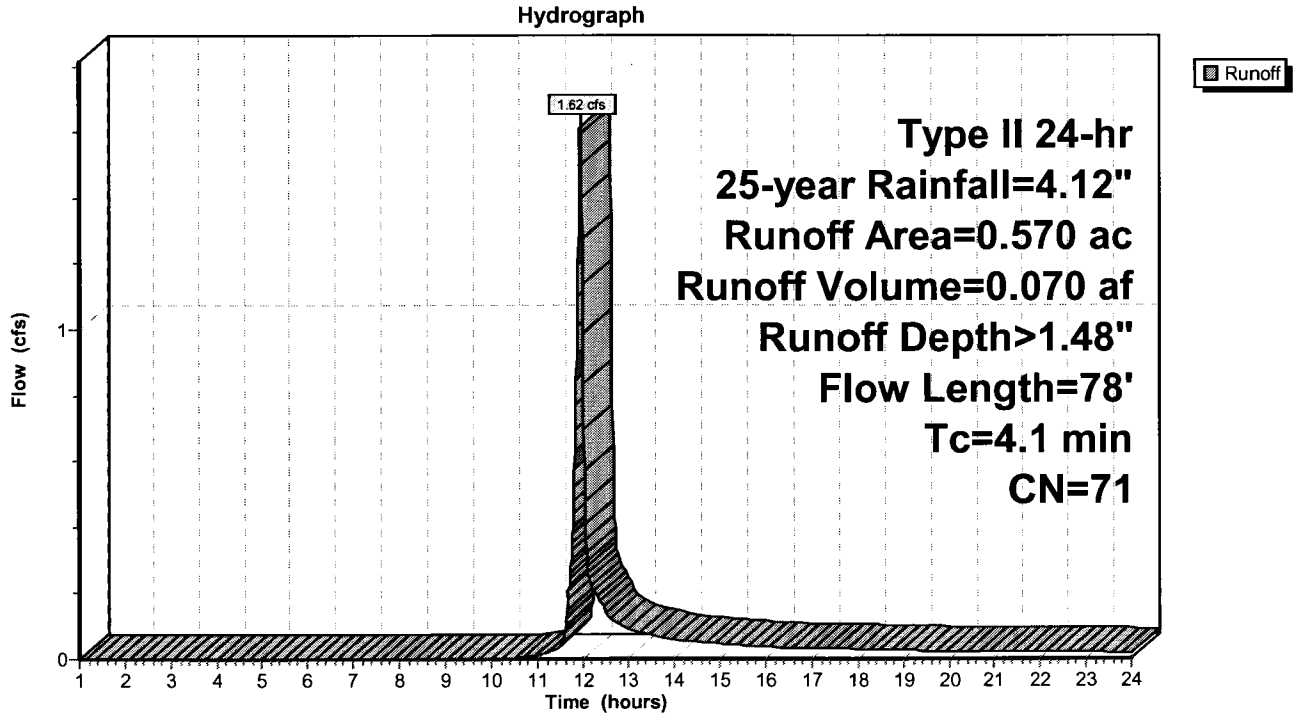
Runoff = 1.62 cfs @ 11.96 hrs, Volume= 0.070 af, Depth> 1.48"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 1.00-24.00 hrs, dt= 0.01 hrs
Type II 24-hr 25-year Rainfall=4.12"

Area (ac)	CN	Description
0.570	71	Meadow, non-grazed, HSG C
0.570		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
2.4	58	0.3300	0.41		**Sheet Flow, 58 feet 3H:1V sheet flow** Grass: Short n= 0.150 P2= 2.44"
1.7	20	0.0100	0.20		**Sheet Flow, 20 feet 100H:1V sheet flow** Fallow n= 0.050 P2= 2.44"
4.1	78	Total			

Subcatchment A-3: Area Directly to Pond



Summary for Subcatchment DA-10: DA-10

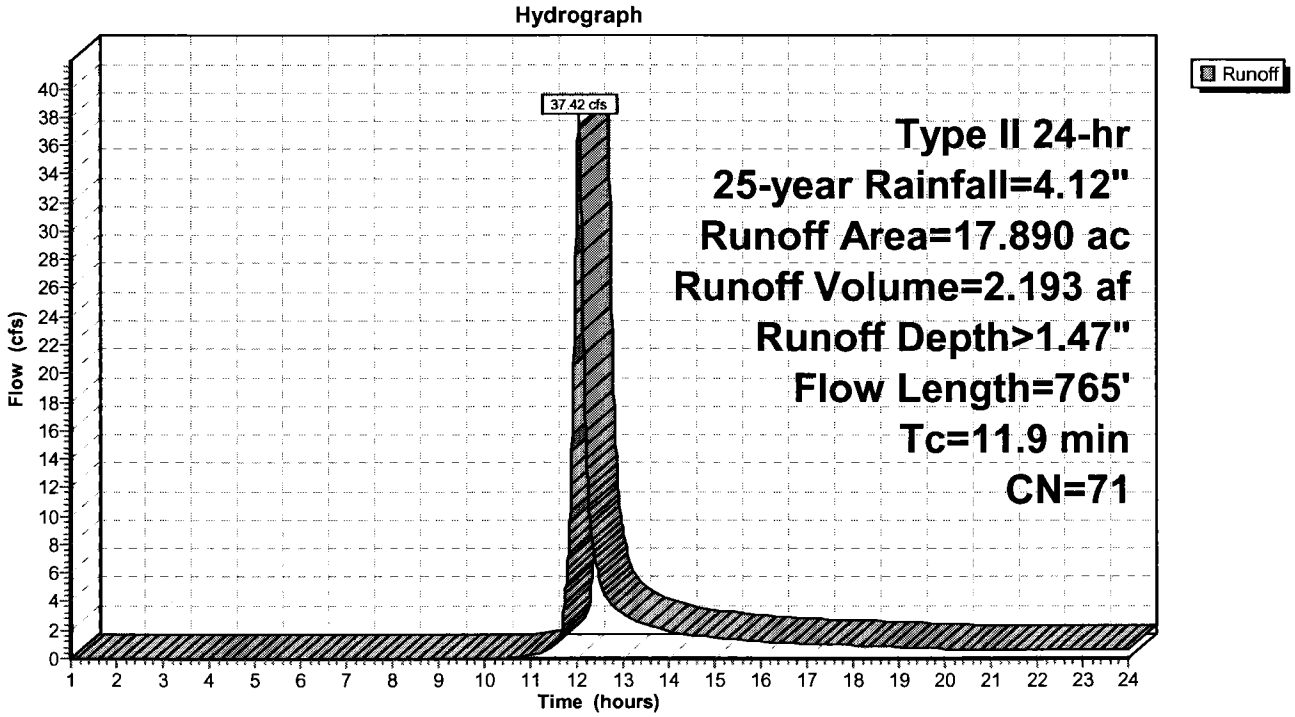
Runoff = 37.42 cfs @ 12.04 hrs, Volume= 2.193 af, Depth> 1.47"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 1.00-24.00 hrs, dt= 0.01 hrs
Type II 24-hr 25-year Rainfall=4.12"

Area (ac)	CN	Description
17.890	71	Meadow, non-grazed, HSG C
17.890		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
10.6	209	0.1000	0.33		**Sheet Flow, 209 feet 10% sheet flow** Grass: Short n= 0.150 P2= 2.44"
1.3	556	0.0300	7.00	102.24	**Channel Flow, 556 feet bench flow** Area= 14.6 sf Perim= 19.8' r= 0.74' n= 0.030 Earth, grassed & winding
11.9	765	Total			

Subcatchment DA-10: DA-10



Summary for Subcatchment DA-31: DA-31

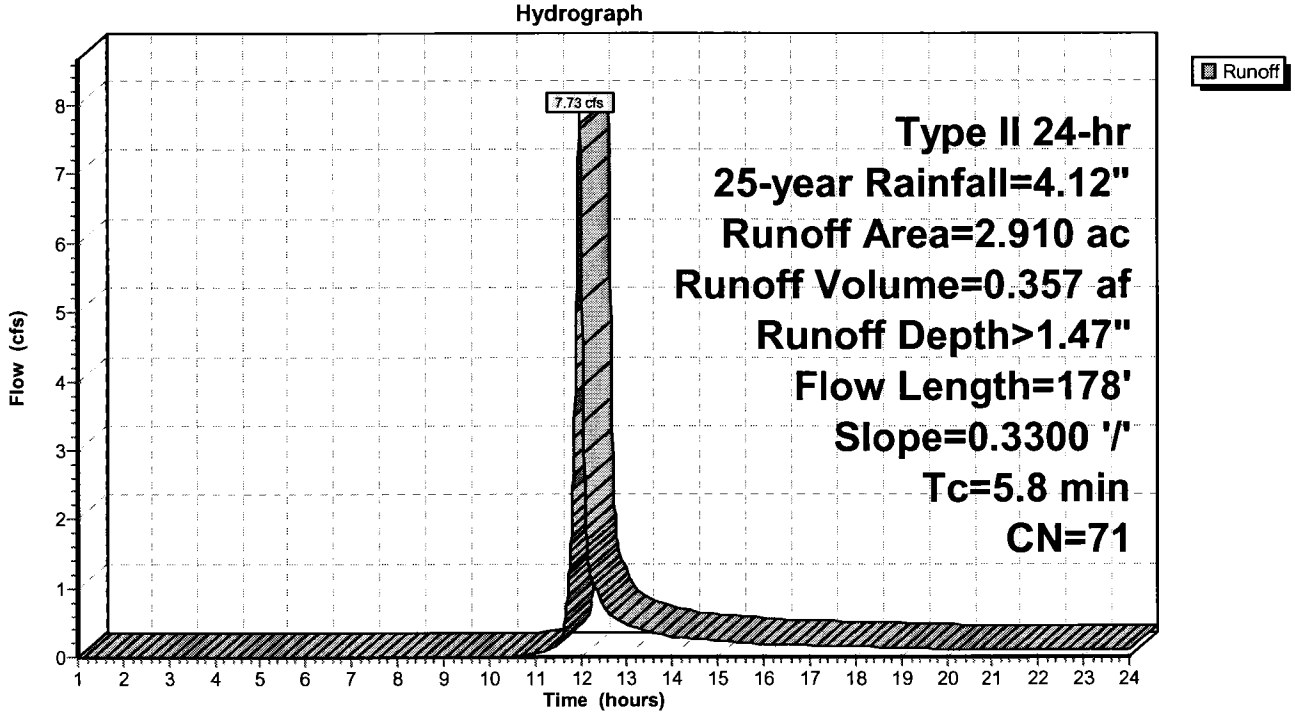
Runoff = 7.73 cfs @ 11.98 hrs, Volume= 0.357 af, Depth> 1.47"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 1.00-24.00 hrs, dt= 0.01 hrs
Type II 24-hr 25-year Rainfall=4.12"

Area (ac)	CN	Description
2.910	71	Meadow, non-grazed, HSG C
2.910		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.8	178	0.3300	0.51		**Sheet Flow, 178 feet 3H:1V sheet flow** Grass: Short n= 0.150 P2= 2.44"

Subcatchment DA-31: DA-31



Summary for Subcatchment DA-52: DA-52

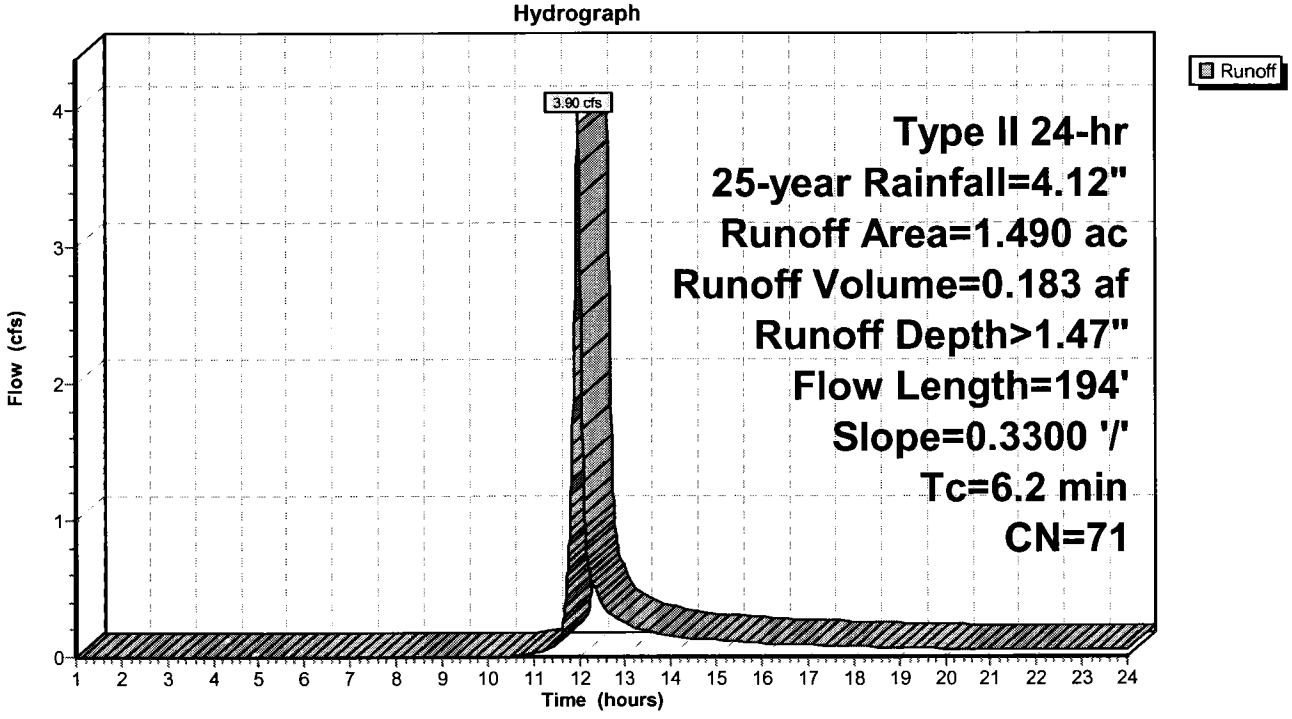
Runoff = 3.90 cfs @ 11.98 hrs, Volume= 0.183 af, Depth> 1.47"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 1.00-24.00 hrs, dt= 0.01 hrs
Type II 24-hr 25-year Rainfall=4.12"

Area (ac)	CN	Description
1.490	71	Meadow, non-grazed, HSG C
1.490		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.2	194	0.3300	0.52		**Sheet Flow, 194 feet 3H:1V sheet flow** Grass: Short n= 0.150 P2= 2.44"

Subcatchment DA-52: DA-52



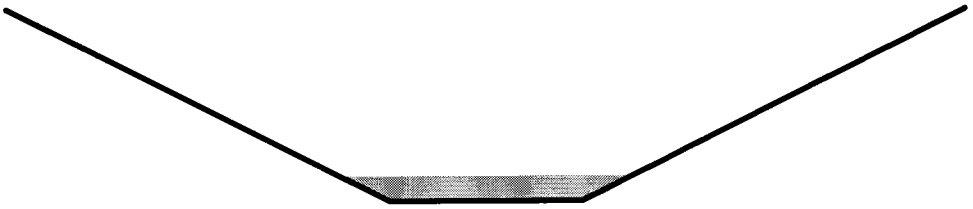
Summary for Reach CH-L1: Perimeter Channel L1

Inflow Area = 1.490 ac, 0.00% Impervious, Inflow Depth > 1.47" for 25-year event
Inflow = 3.90 cfs @ 11.98 hrs, Volume= 0.183 af
Outflow = 3.77 cfs @ 12.03 hrs, Volume= 0.182 af, Atten= 3%, Lag= 2.9 min

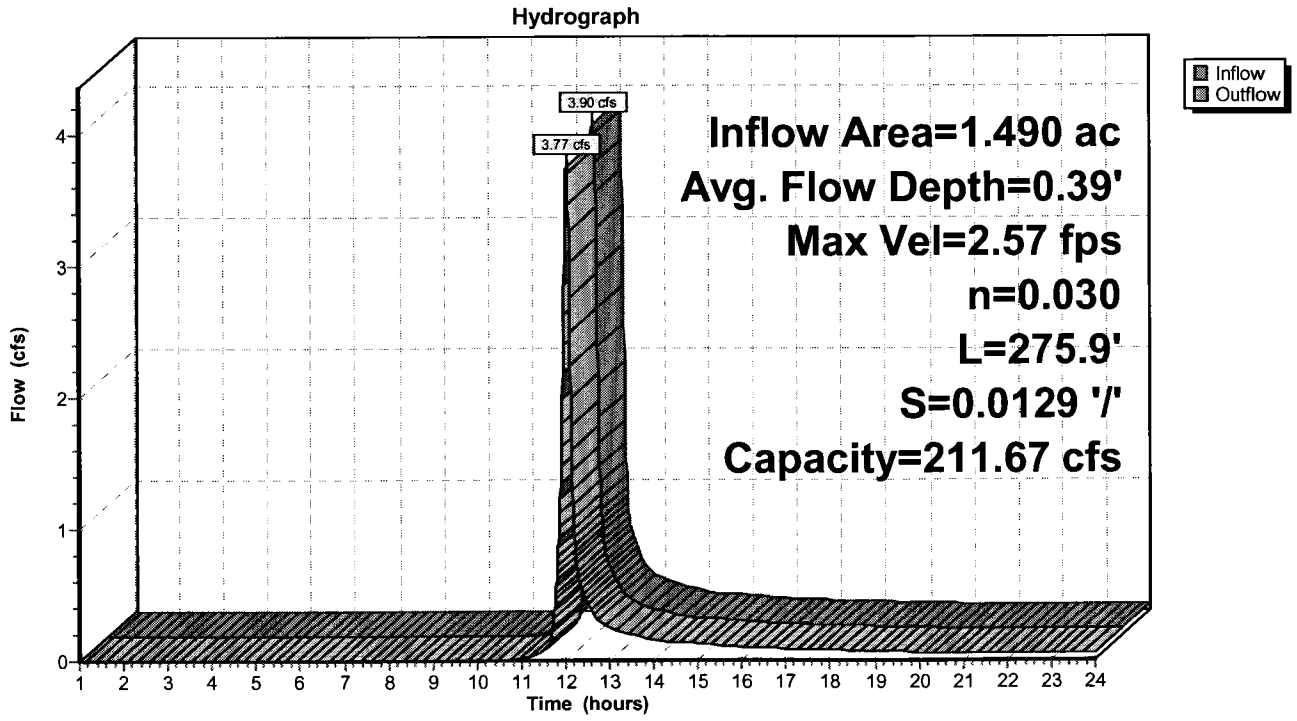
Routing by Stor-Ind+Trans method, Time Span= 1.00-24.00 hrs, dt= 0.01 hrs
Max. Velocity= 2.57 fps, Min. Travel Time= 1.8 min
Avg. Velocity = 0.73 fps, Avg. Travel Time= 6.3 min

Peak Storage= 404 cf @ 12.00 hrs
Average Depth at Peak Storage= 0.39'
Bank-Full Depth= 3.00' Flow Area= 27.0 sf, Capacity= 211.67 cfs

3.00' x 3.00' deep channel, n= 0.030 Earth, grassed & winding
Side Slope Z-value= 2.0 '/' Top Width= 15.00'
Length= 275.9' Slope= 0.0129 '/'
Inlet Invert= 1,314.77', Outlet Invert= 1,311.21'



Reach CH-L1: Perimeter Channel L1



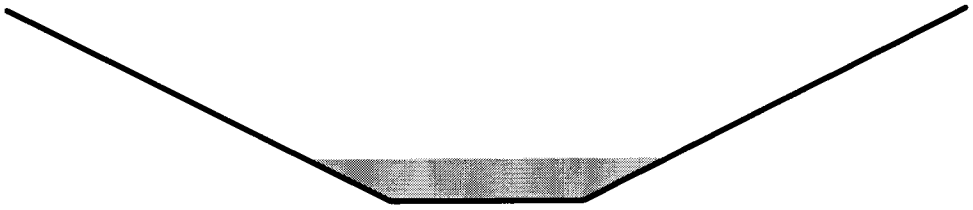
Summary for Reach CH-L2: Perimeter Channel L2

Inflow Area = 4.400 ac, 0.00% Impervious, Inflow Depth > 1.47" for 25-year event
Inflow = 10.89 cfs @ 11.99 hrs, Volume= 0.540 af
Outflow = 10.01 cfs @ 12.07 hrs, Volume= 0.537 af, Atten= 8%, Lag= 5.1 min

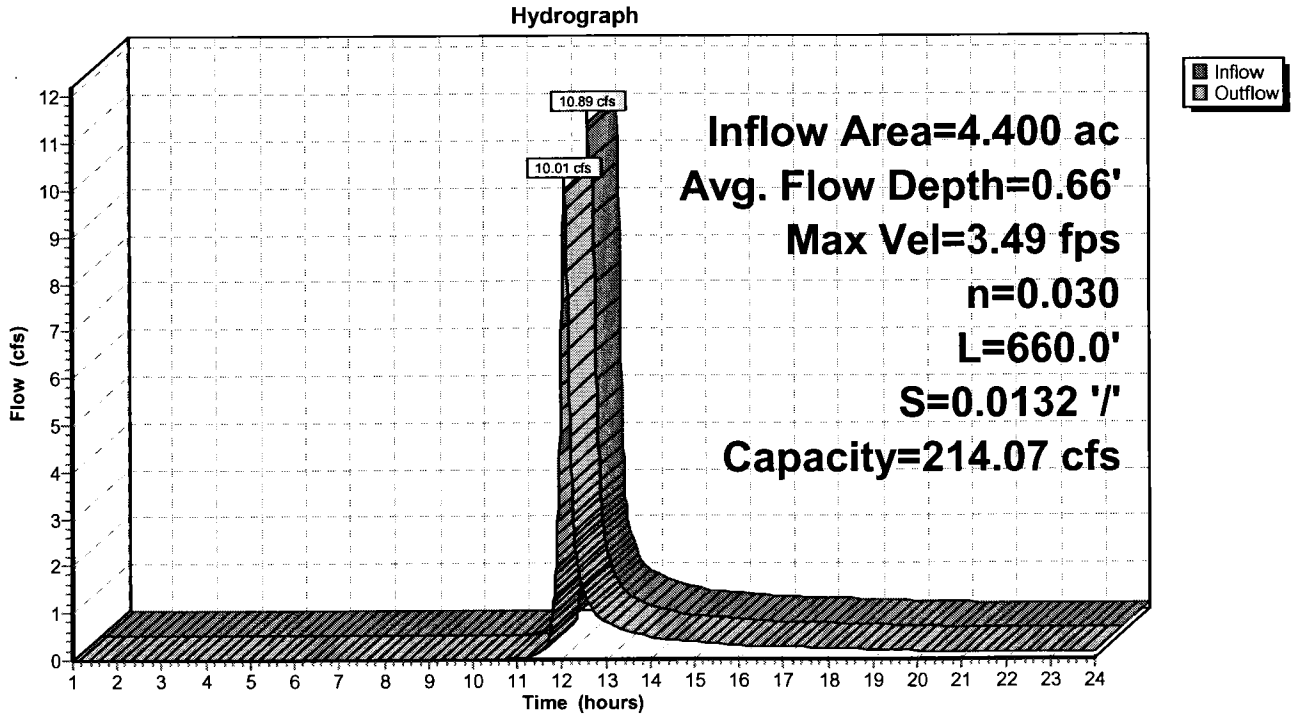
Routing by Stor-Ind+Trans method, Time Span= 1.00-24.00 hrs, dt= 0.01 hrs
Max. Velocity= 3.49 fps, Min. Travel Time= 3.1 min
Avg. Velocity = 1.08 fps, Avg. Travel Time= 10.2 min

Peak Storage= 1,894 cf @ 12.02 hrs
Average Depth at Peak Storage= 0.66'
Bank-Full Depth= 3.00' Flow Area= 27.0 sf, Capacity= 214.07 cfs

3.00' x 3.00' deep channel, n= 0.030 Earth, grassed & winding
Side Slope Z-value= 2.0 '/' Top Width= 15.00'
Length= 660.0' Slope= 0.0132 '/'
Inlet Invert= 1,311.21', Outlet Invert= 1,302.50'



Reach CH-L2: Perimeter Channel L2



Summary for Reach D-ES2: Emergency Spillway Discharge Channel

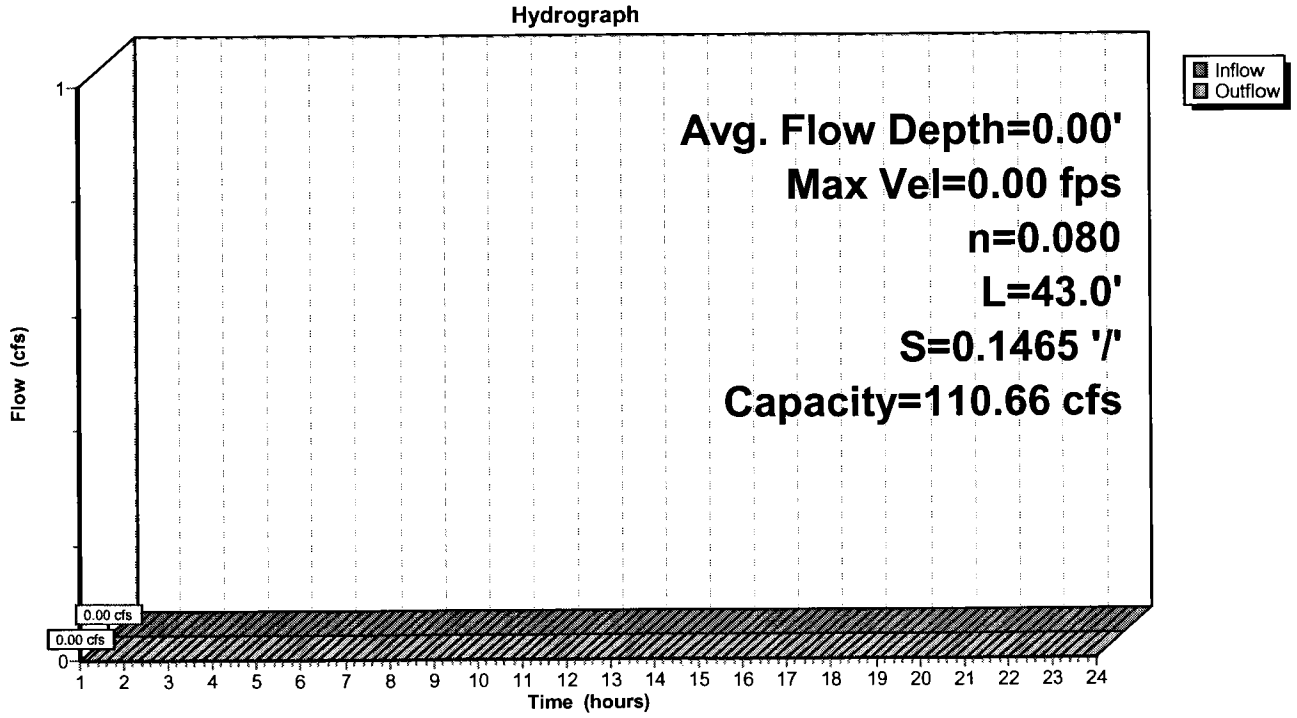
Inflow	=	0.00 cfs @	1.00 hrs, Volume=	0.000 af
Outflow	=	0.00 cfs @	1.00 hrs, Volume=	0.000 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 1.00-24.00 hrs, dt= 0.01 hrs
Max. Velocity= 0.00 fps, Min. Travel Time= 0.0 min
Avg. Velocity = 0.00 fps, Avg. Travel Time= 0.0 min

Peak Storage= 0 cf @ 1.00 hrs
Average Depth at Peak Storage= 0.00'
Bank-Full Depth= 2.00' Flow Area= 14.0 sf, Capacity= 110.66 cfs

3.00' x 2.00' deep channel, n= 0.080
Side Slope Z-value= 2.0 '/' Top Width= 11.00'
Length= 43.0' Slope= 0.1465 '/'
Inlet Invert= 1,266.30', Outlet Invert= 1,260.00'

Reach D-ES2: Emergency Spillway Discharge Channel



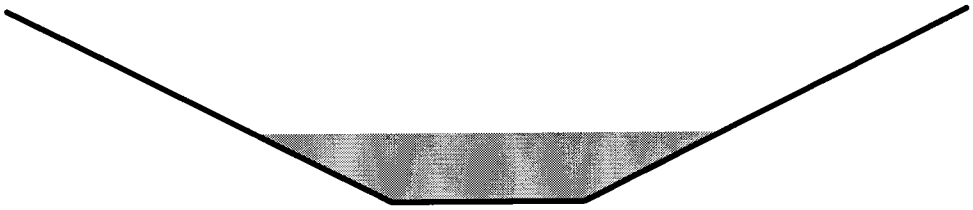
Summary for Reach D-L: Discharge Channel L

Inflow Area = 22.290 ac, 0.00% Impervious, Inflow Depth > 1.47" for 25-year event
Inflow = 47.11 cfs @ 12.08 hrs, Volume= 2.724 af
Outflow = 47.01 cfs @ 12.09 hrs, Volume= 2.723 af, Atten= 0%, Lag= 0.5 min

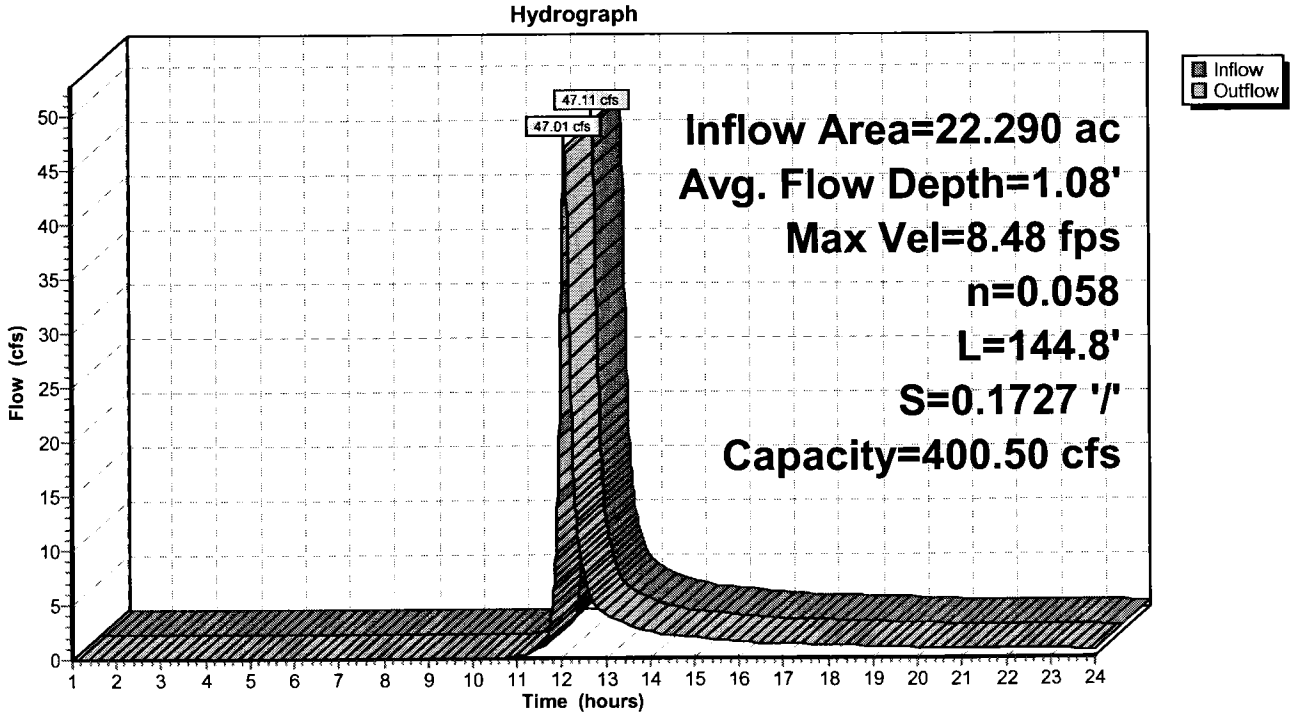
Routing by Stor-Ind+Trans method, Time Span= 1.00-24.00 hrs, dt= 0.01 hrs
Max. Velocity= 8.48 fps, Min. Travel Time= 0.3 min
Avg. Velocity = 2.87 fps, Avg. Travel Time= 0.8 min

Peak Storage= 804 cf @ 12.08 hrs
Average Depth at Peak Storage= 1.08'
Bank-Full Depth= 3.00' Flow Area= 27.0 sf, Capacity= 400.50 cfs

3.00' x 3.00' deep channel, n= 0.058
Side Slope Z-value= 2.0 '/' Top Width= 15.00'
Length= 144.8' Slope= 0.1727 '/'
Inlet Invert= 1,295.00', Outlet Invert= 1,270.00'



Reach D-L: Discharge Channel L



Summary for Reach D-P2: Pond 2 Discharge Channel

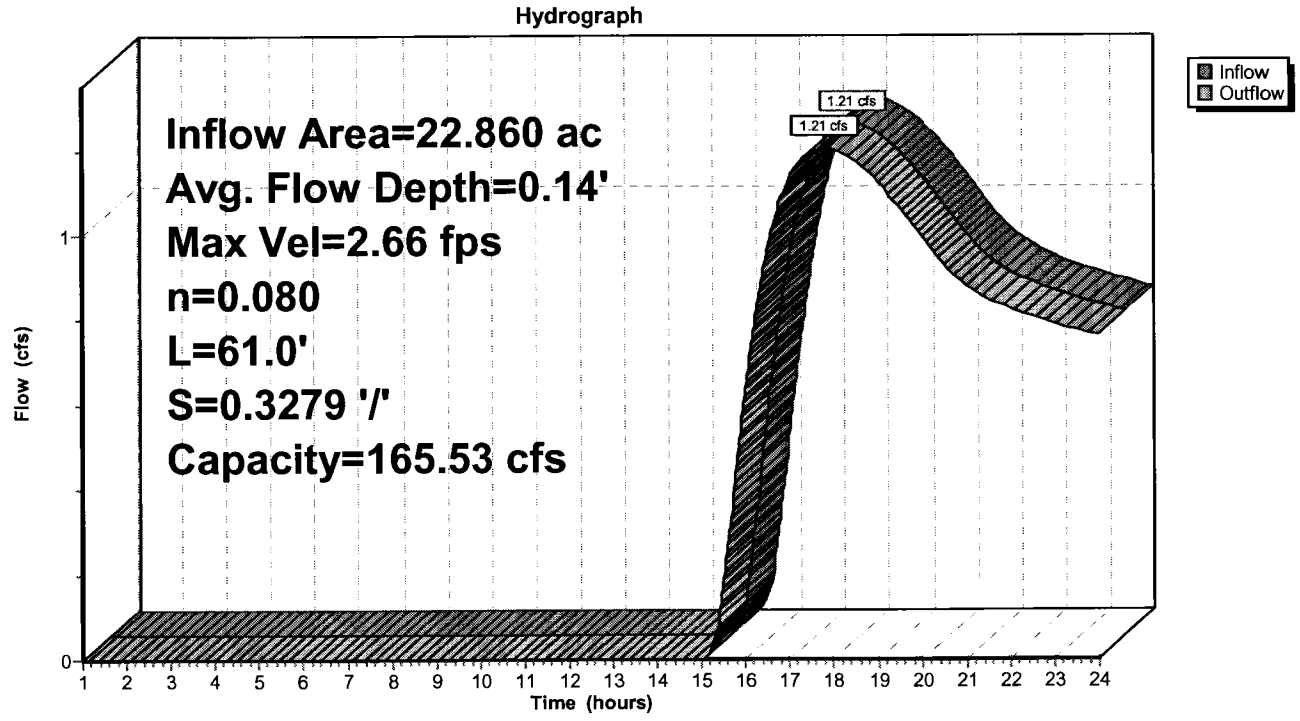
Inflow Area = 22.860 ac, 0.00% Impervious, Inflow Depth > 0.35" for 25-year event
Inflow = 1.21 cfs @ 17.78 hrs, Volume= 0.661 af
Outflow = 1.21 cfs @ 17.79 hrs, Volume= 0.660 af, Atten= 0%, Lag= 0.6 min

Routing by Stor-Ind+Trans method, Time Span= 1.00-24.00 hrs, dt= 0.01 hrs
Max. Velocity= 2.66 fps, Min. Travel Time= 0.4 min
Avg. Velocity = 2.35 fps, Avg. Travel Time= 0.4 min

Peak Storage= 28 cf @ 17.79 hrs
Average Depth at Peak Storage= 0.14'
Bank-Full Depth= 2.00' Flow Area= 14.0 sf, Capacity= 165.53 cfs

3.00' x 2.00' deep channel, n= 0.080
Side Slope Z-value= 2.0 '/' Top Width= 11.00'
Length= 61.0' Slope= 0.3279 '/'
Inlet Invert= 1,260.00', Outlet Invert= 1,240.00'

Reach D-P2: Pond 2 Discharge Channel



Summary for Reach DC10-1: DC10-1

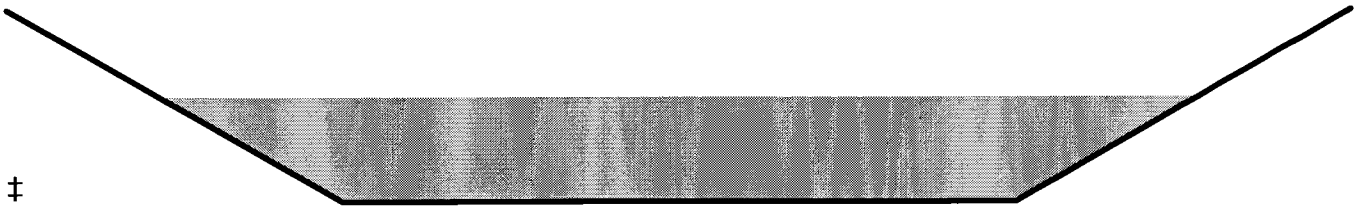
Inflow Area = 17.890 ac, 0.00% Impervious, Inflow Depth > 1.47" for 25-year event
Inflow = 37.42 cfs @ 12.04 hrs, Volume= 2.193 af
Outflow = 37.40 cfs @ 12.05 hrs, Volume= 2.193 af, Atten= 0%, Lag= 0.1 min

Routing by Stor-Ind+Trans method, Time Span= 1.00-24.00 hrs, dt= 0.01 hrs
Max. Velocity= 5.99 fps, Min. Travel Time= 0.1 min
Avg. Velocity = 1.78 fps, Avg. Travel Time= 0.2 min

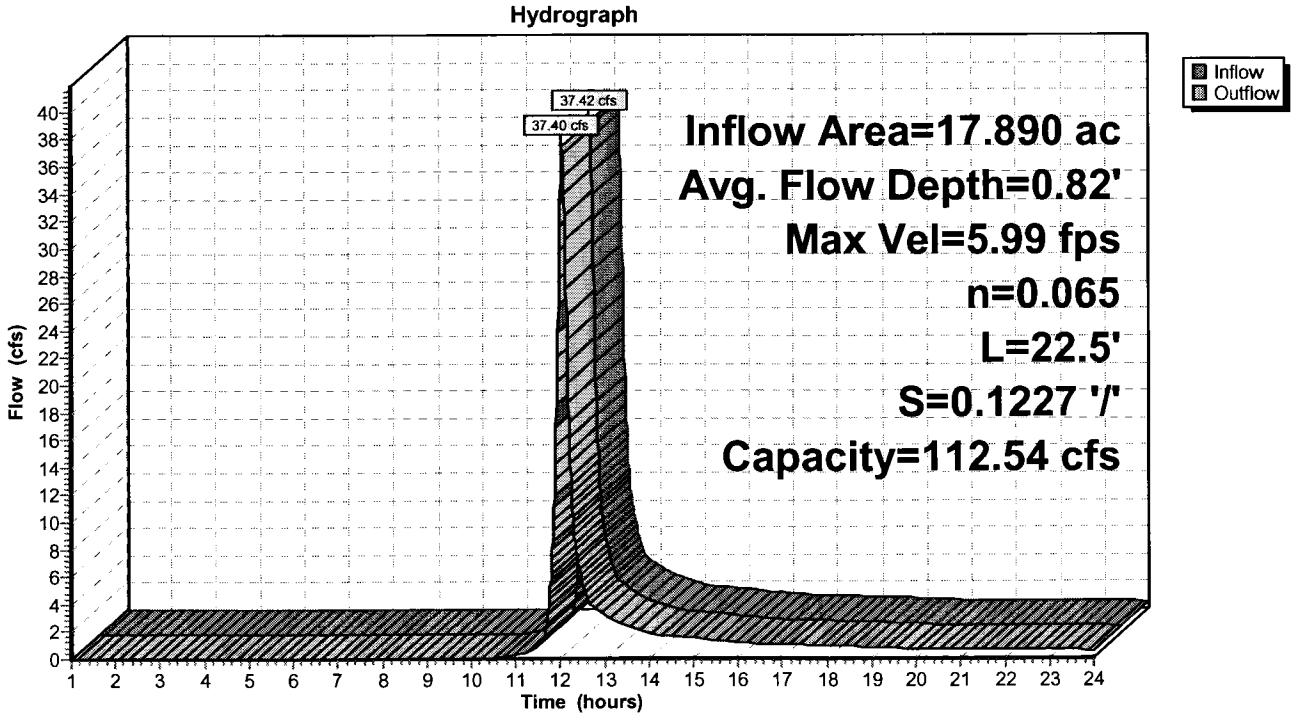
Peak Storage= 141 cf @ 12.05 hrs
Average Depth at Peak Storage= 0.82'
Bank-Full Depth= 1.50' Flow Area= 13.5 sf, Capacity= 112.54 cfs

6.00' x 1.50' deep channel, n= 0.065
Side Slope Z-value= 2.0 '/' Top Width= 12.00'
Length= 22.5' Slope= 0.1227 '/'
Inlet Invert= 1,469.73', Outlet Invert= 1,466.97'

‡



Reach DC10-1: DC10-1



Summary for Reach DC10-2: DC10-2

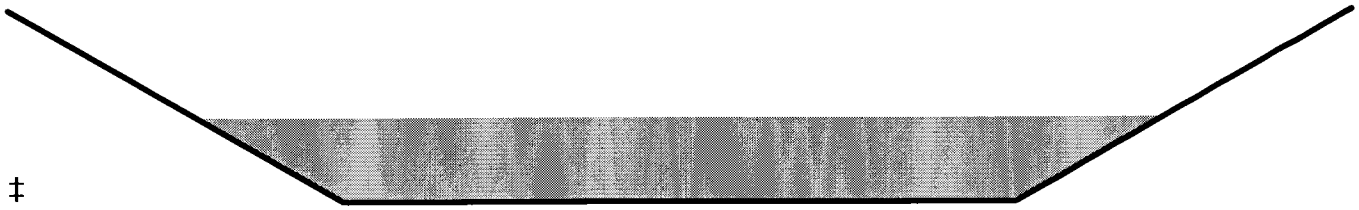
Inflow Area = 17.890 ac, 0.00% Impervious, Inflow Depth > 1.47" for 25-year event
Inflow = 37.40 cfs @ 12.05 hrs, Volume= 2.193 af
Outflow = 37.31 cfs @ 12.06 hrs, Volume= 2.191 af, Atten= 0%, Lag= 0.6 min

Routing by Stor-Ind+Trans method, Time Span= 1.00-24.00 hrs, dt= 0.01 hrs
Max. Velocity= 7.77 fps, Min. Travel Time= 0.4 min
Avg. Velocity = 2.27 fps, Avg. Travel Time= 1.3 min

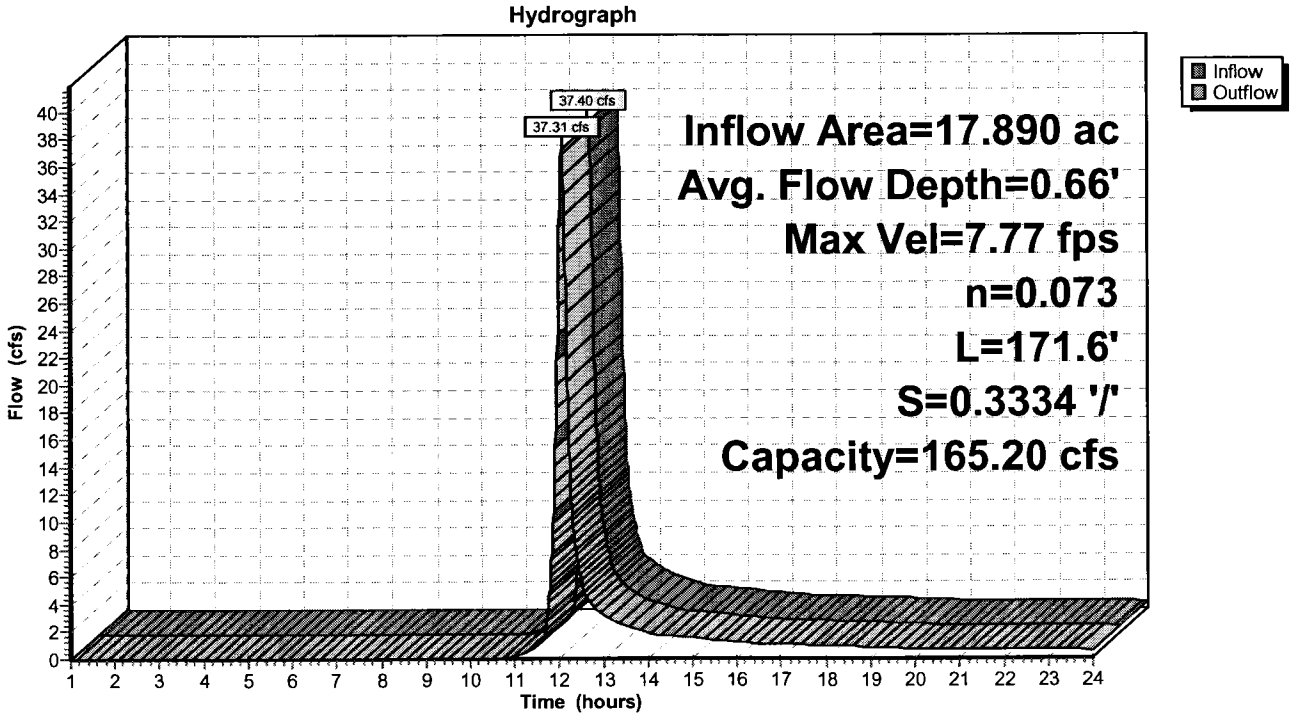
Peak Storage= 825 cf @ 12.05 hrs
Average Depth at Peak Storage= 0.66'
Bank-Full Depth= 1.50' Flow Area= 13.5 sf, Capacity= 165.20 cfs

6.00' x 1.50' deep channel, n= 0.073
Side Slope Z-value= 2.0 '/' Top Width= 12.00'
Length= 171.6' Slope= 0.3334 '/'
Inlet Invert= 1,466.97', Outlet Invert= 1,409.76'

‡



Reach DC10-2: DC10-2



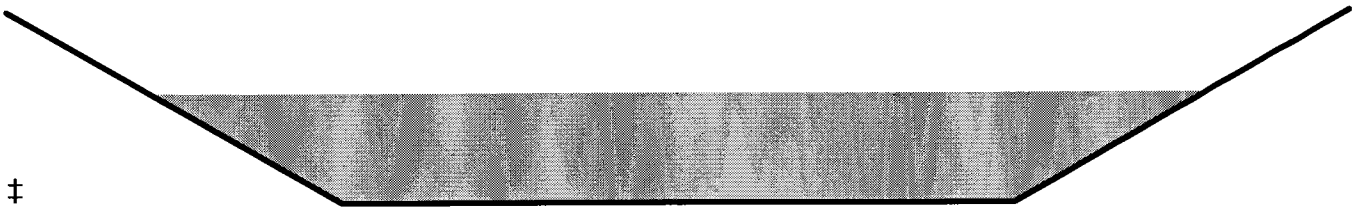
Summary for Reach DC10-3: DC10-3

Inflow Area = 17.890 ac, 0.00% Impervious, Inflow Depth > 1.47" for 25-year event
Inflow = 37.31 cfs @ 12.06 hrs, Volume= 2.191 af
Outflow = 37.28 cfs @ 12.06 hrs, Volume= 2.191 af, Atten= 0%, Lag= 0.1 min

Routing by Stor-Ind+Trans method, Time Span= 1.00-24.00 hrs, dt= 0.01 hrs
Max. Velocity= 5.64 fps, Min. Travel Time= 0.1 min
Avg. Velocity = 1.69 fps, Avg. Travel Time= 0.3 min

Peak Storage= 189 cf @ 12.06 hrs
Average Depth at Peak Storage= 0.86'
Bank-Full Depth= 1.50' Flow Area= 13.5 sf, Capacity= 103.20 cfs

6.00' x 1.50' deep channel, n= 0.064
Side Slope Z-value= 2.0 '/' Top Width= 12.00'
Length= 28.5' Slope= 0.1000 '/'
Inlet Invert= 1,409.76', Outlet Invert= 1,406.91'



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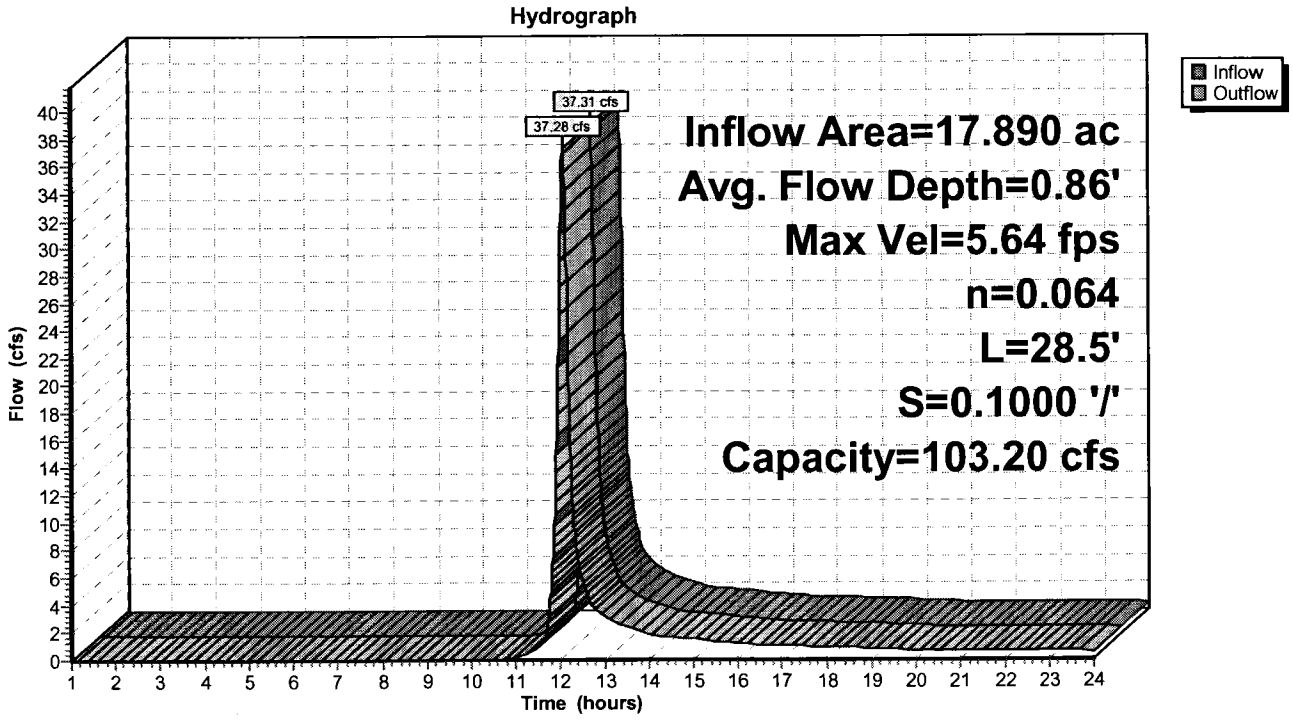
Reach DC10-3: DC10-3



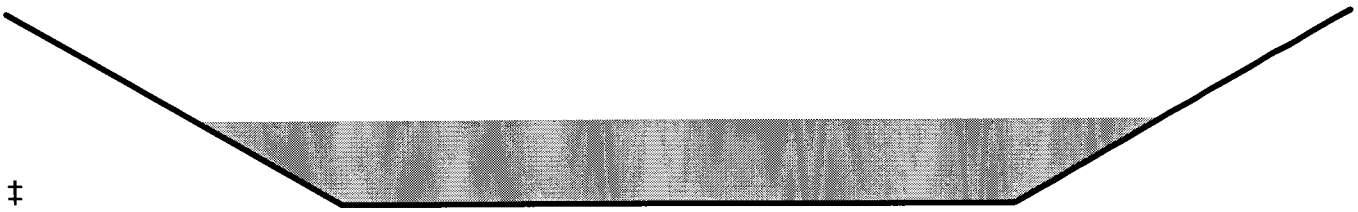
Summary for Reach DC10-4: DC10-4

Inflow Area = 17.890 ac, 0.00% Impervious, Inflow Depth > 1.47" for 25-year event
Inflow = 37.28 cfs @ 12.06 hrs, Volume= 2.191 af
Outflow = 37.20 cfs @ 12.07 hrs, Volume= 2.189 af, Atten= 0%, Lag= 0.6 min

Routing by Stor-Ind+Trans method, Time Span= 1.00-24.00 hrs, dt= 0.01 hrs
Max. Velocity= 7.76 fps, Min. Travel Time= 0.4 min
Avg. Velocity = 2.27 fps, Avg. Travel Time= 1.3 min

Peak Storage= 823 cf @ 12.06 hrs
Average Depth at Peak Storage= 0.66'
Bank-Full Depth= 1.50' Flow Area= 13.5 sf, Capacity= 165.18 cfs

6.00' x 1.50' deep channel, n= 0.073
Side Slope Z-value= 2.0 '/' Top Width= 12.00'
Length= 171.6' Slope= 0.3333 '/'
Inlet Invert= 1,406.91', Outlet Invert= 1,349.71'



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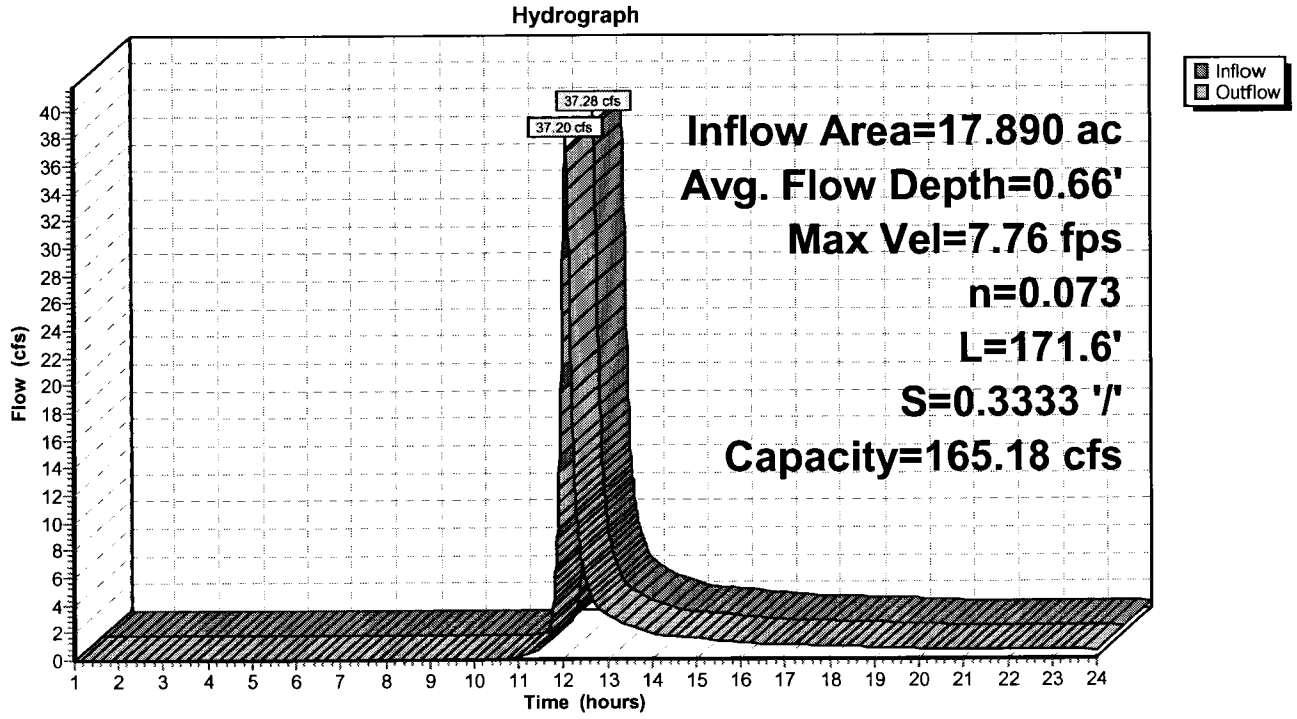
Reach DC10-4: DC10-4



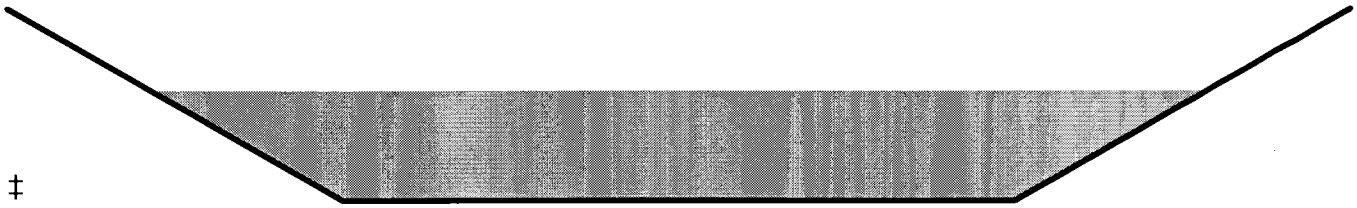
Summary for Reach DC10-5: DC10-5

Inflow Area = 17.890 ac, 0.00% Impervious, Inflow Depth > 1.47" for 25-year event
Inflow = 37.20 cfs @ 12.07 hrs, Volume= 2.189 af
Outflow = 37.18 cfs @ 12.07 hrs, Volume= 2.189 af, Atten= 0%, Lag= 0.1 min

Routing by Stor-Ind+Trans method, Time Span= 1.00-24.00 hrs, dt= 0.01 hrs
Max. Velocity= 5.63 fps, Min. Travel Time= 0.1 min
Avg. Velocity = 1.69 fps, Avg. Travel Time= 0.3 min

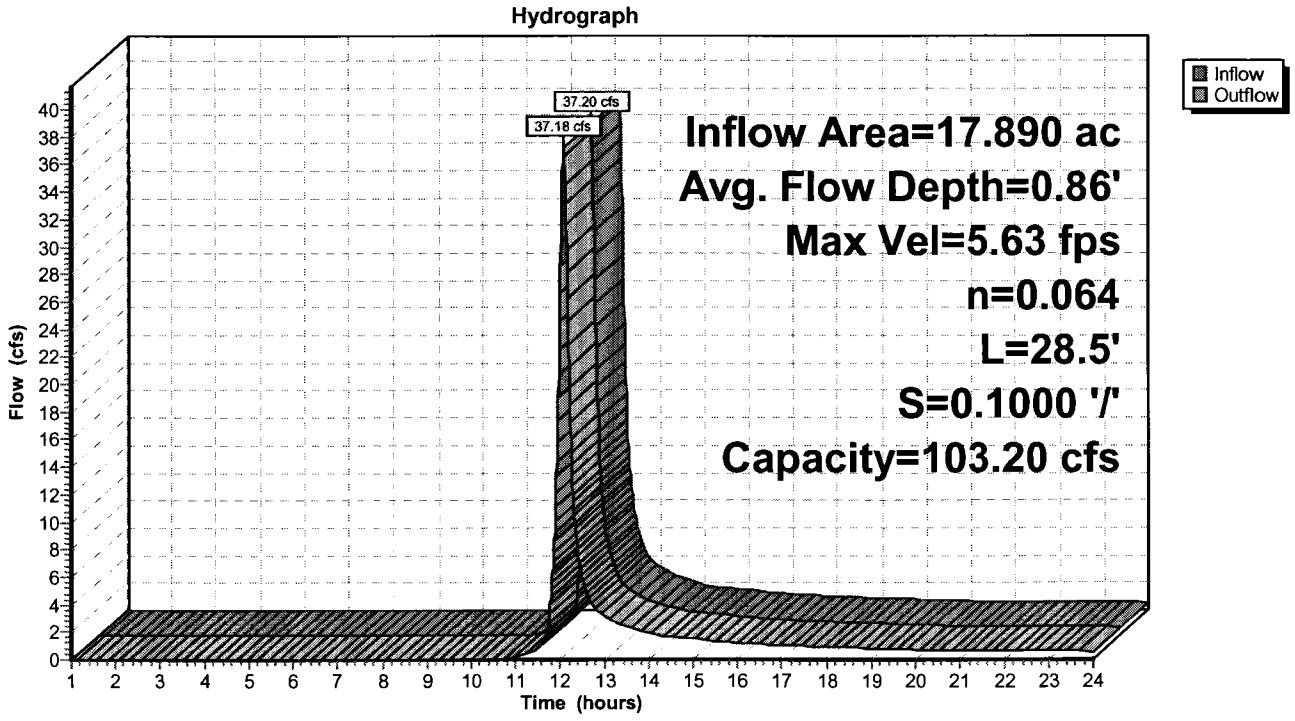
Peak Storage= 188 cf @ 12.07 hrs
Average Depth at Peak Storage= 0.86'
Bank-Full Depth= 1.50' Flow Area= 13.5 sf, Capacity= 103.20 cfs

6.00' x 1.50' deep channel, n= 0.064
Side Slope Z-value= 2.0 '/' Top Width= 12.00'
Length= 28.5' Slope= 0.1000 '/'
Inlet Invert= 1,349.71', Outlet Invert= 1,346.86'



‡

Reach DC10-5: DC10-5



Summary for Reach DC10-6: DC10-6

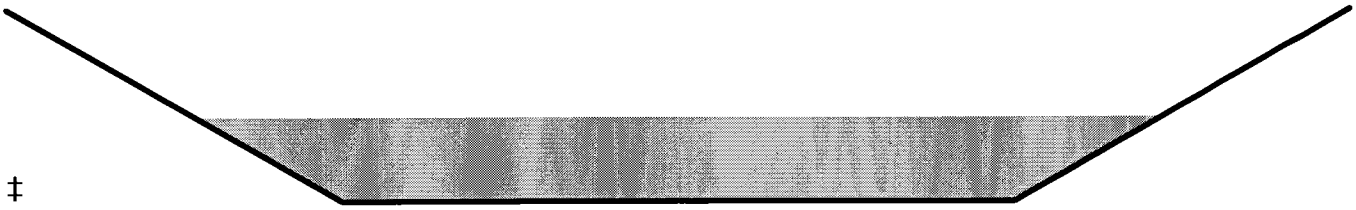
Inflow Area = 17.890 ac, 0.00% Impervious, Inflow Depth > 1.47" for 25-year event
Inflow = 37.18 cfs @ 12.07 hrs, Volume= 2.189 af
Outflow = 37.11 cfs @ 12.08 hrs, Volume= 2.188 af, Atten= 0%, Lag= 0.5 min

Routing by Stor-Ind+Trans method, Time Span= 1.00-24.00 hrs, dt= 0.01 hrs
Max. Velocity= 7.76 fps, Min. Travel Time= 0.3 min
Avg. Velocity = 2.27 fps, Avg. Travel Time= 1.0 min

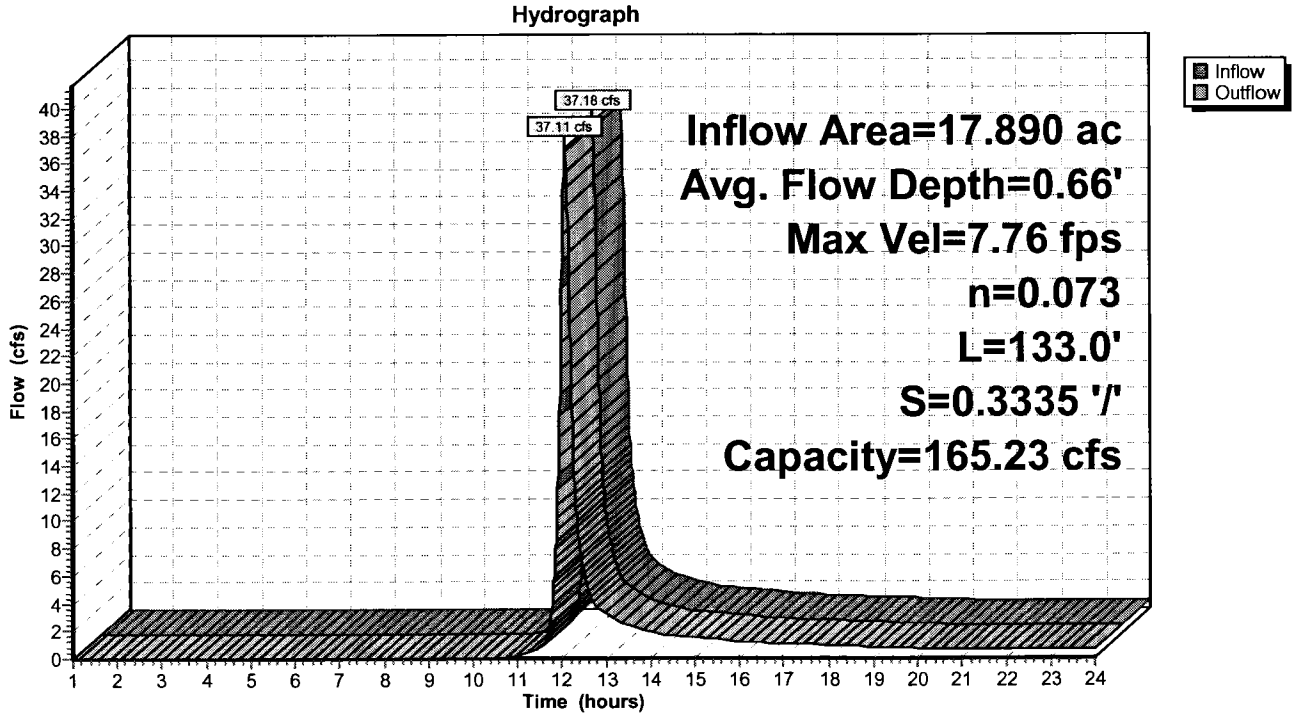
Peak Storage= 637 cf @ 12.08 hrs
Average Depth at Peak Storage= 0.66'
Bank-Full Depth= 1.50' Flow Area= 13.5 sf, Capacity= 165.23 cfs

6.00' x 1.50' deep channel, n= 0.073
Side Slope Z-value= 2.0 '/' Top Width= 12.00'
Length= 133.0' Slope= 0.3335 '/'
Inlet Invert= 1,346.86', Outlet Invert= 1,302.50'

‡



Reach DC10-6: DC10-6



Summary for Pond CU-L: Culvert L

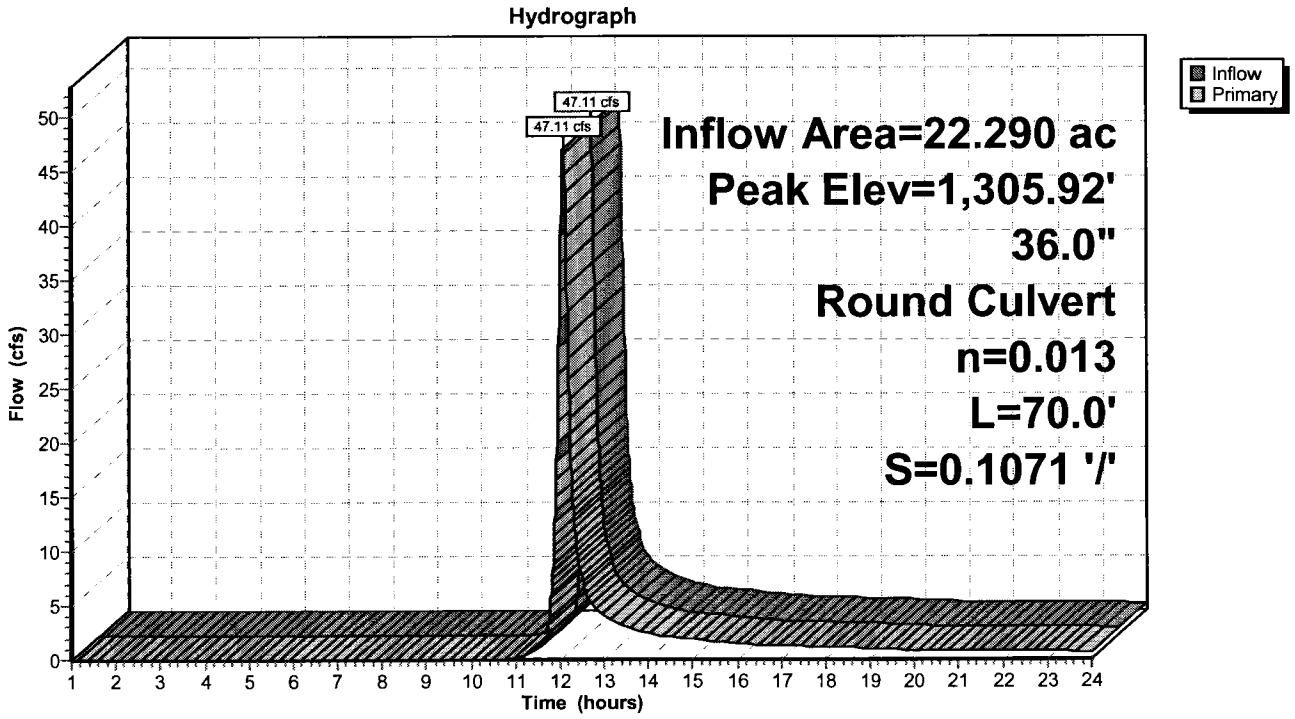
Inflow Area = 22.290 ac, 0.00% Impervious, Inflow Depth > 1.47" for 25-year event
Inflow = 47.11 cfs @ 12.08 hrs, Volume= 2.724 af
Outflow = 47.11 cfs @ 12.08 hrs, Volume= 2.724 af, Atten= 0%, Lag= 0.0 min
Primary = 47.11 cfs @ 12.08 hrs, Volume= 2.724 af

Routing by Stor-Ind method, Time Span= 1.00-24.00 hrs, dt= 0.01 hrs
Peak Elev= 1,305.92' @ 12.08 hrs

Device	Routing	Invert	Outlet Devices
#1	Primary	1,302.50'	**36.0" Round Culvert** L= 70.0' CPP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 1,302.50' / 1,295.00' S= 0.1071 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 7.07 sf

Primary OutFlow Max=47.07 cfs @ 12.08 hrs HW=1,305.91' (Free Discharge)
1=Culvert (Inlet Controls 47.07 cfs @ 6.66 fps)

Pond CU-L: Culvert L



Summary for Pond P2: Sedimentation Pond 2

Inflow Area = 22.860 ac, 0.00% Impervious, Inflow Depth > 1.47" for 25-year event
Inflow = 47.35 cfs @ 12.09 hrs, Volume= 2.793 af
Outflow = 1.21 cfs @ 17.78 hrs, Volume= 0.661 af, Atten= 97%, Lag= 341.8 min
Primary = 1.21 cfs @ 17.78 hrs, Volume= 0.661 af
Secondary = 0.00 cfs @ 1.00 hrs, Volume= 0.000 af

Routing by Stor-Ind method, Time Span= 1.00-24.00 hrs, dt= 0.01 hrs
Peak Elev= 1,266.12' @ 17.78 hrs Surf.Area= 0.000 ac Storage= 2.165 af

Plug-Flow detention time= 459.6 min calculated for 0.661 af (24% of inflow)
Center-of-Mass det. time= 317.7 min (1,176.8 - 859.0)

Volume	Invert	Avail.Storage	Storage Description
#1	1,258.00'	3.740 af	**Custom Stage Data** Listed below

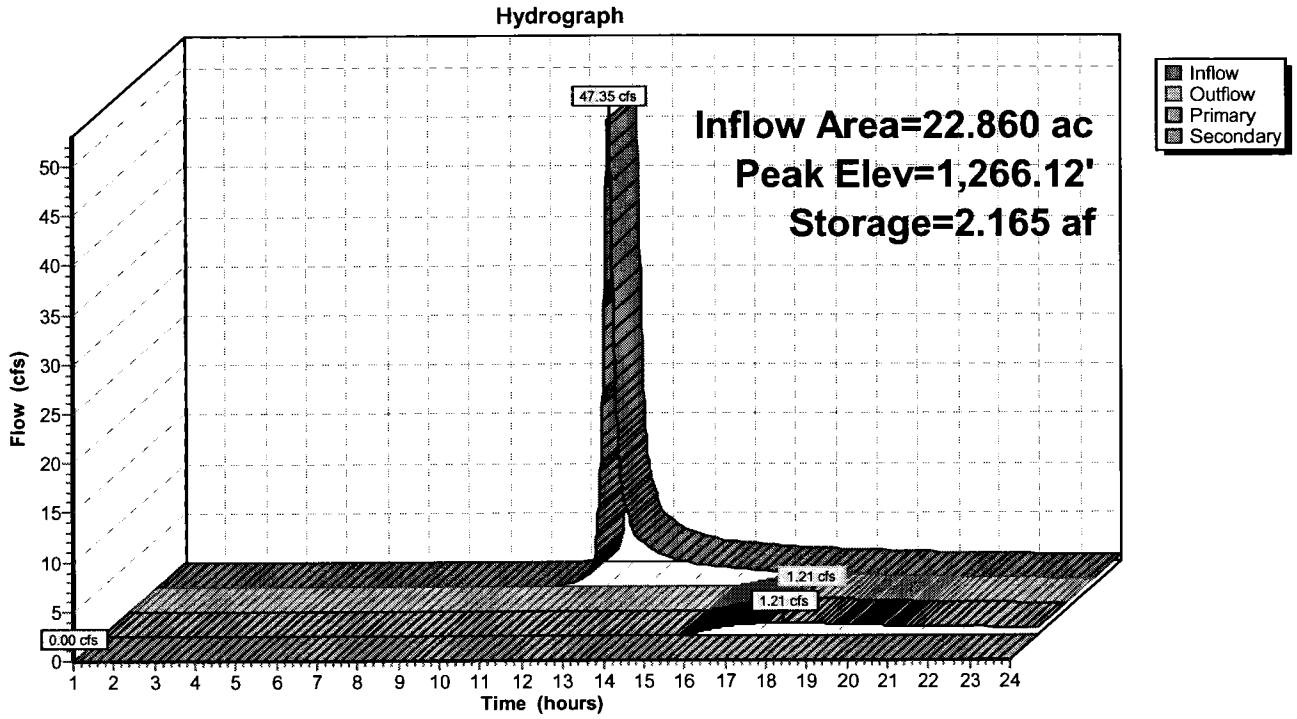
Elevation (feet)	Cum.Store (acre-feet)
1,258.00	0.000
1,260.00	0.400
1,262.00	0.880
1,264.00	1.450
1,266.00	2.120
1,268.00	2.880
1,270.00	3.740

Device	Routing	Invert	Outlet Devices
#1	Primary	1,265.70'	**30.0" Round Culvert** L= 42.0' CPP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 1,265.70' / 1,260.00' S= 0.1357 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 4.91 sf
#2	Secondary	1,266.30'	**151.9 deg x 8.0' long Sharp-Crested Vee/Trap Weir** Cv= 2.47 (C= 3.09)

Primary OutFlow Max=1.19 cfs @ 17.78 hrs HW=1,266.12' (Free Discharge)
↑—**1=Culvert** (Inlet Controls 1.19 cfs @ 2.20 fps)

Secondary OutFlow Max=0.00 cfs @ 1.00 hrs HW=1,258.00' (Free Discharge)
↑—**2=Sharp-Crested Vee/Trap Weir** (Controls 0.00 cfs)

Pond P2: Sedimentation Pond 2



SEDIMENTATION POND
ROUTING OF 100-YEAR 24-HOUR STORM

Summary for Pond P2: Sedimentation Pond 2

Inflow Area = 22.860 ac, 0.00% Impervious, Inflow Depth > 2.28" for 100-year event
Inflow = 74.93 cfs @ 12.07 hrs, Volume= 4.339 af
Outflow = 7.02 cfs @ 12.79 hrs, Volume= 2.185 af, Atten= 91%, Lag= 43.1 min
Primary = 4.29 cfs @ 12.79 hrs, Volume= 1.922 af
Secondary = 2.72 cfs @ 12.79 hrs, Volume= 0.263 af

Routing by Stor-Ind method, Time Span= 1.00-24.00 hrs, dt= 0.01 hrs
Peak Elev= 1,266.52' @ 12.79 hrs Surf.Area= 0.000 ac Storage= 2.316 af

Plug-Flow detention time= 264.7 min calculated for 2.185 af (50% of inflow)
Center-of-Mass det. time= 140.3 min (986.0 - 845.7)

Volume	Invert	Avail.Storage	Storage Description
#1	1,258.00'	3.740 af	**Custom Stage Data** Listed below

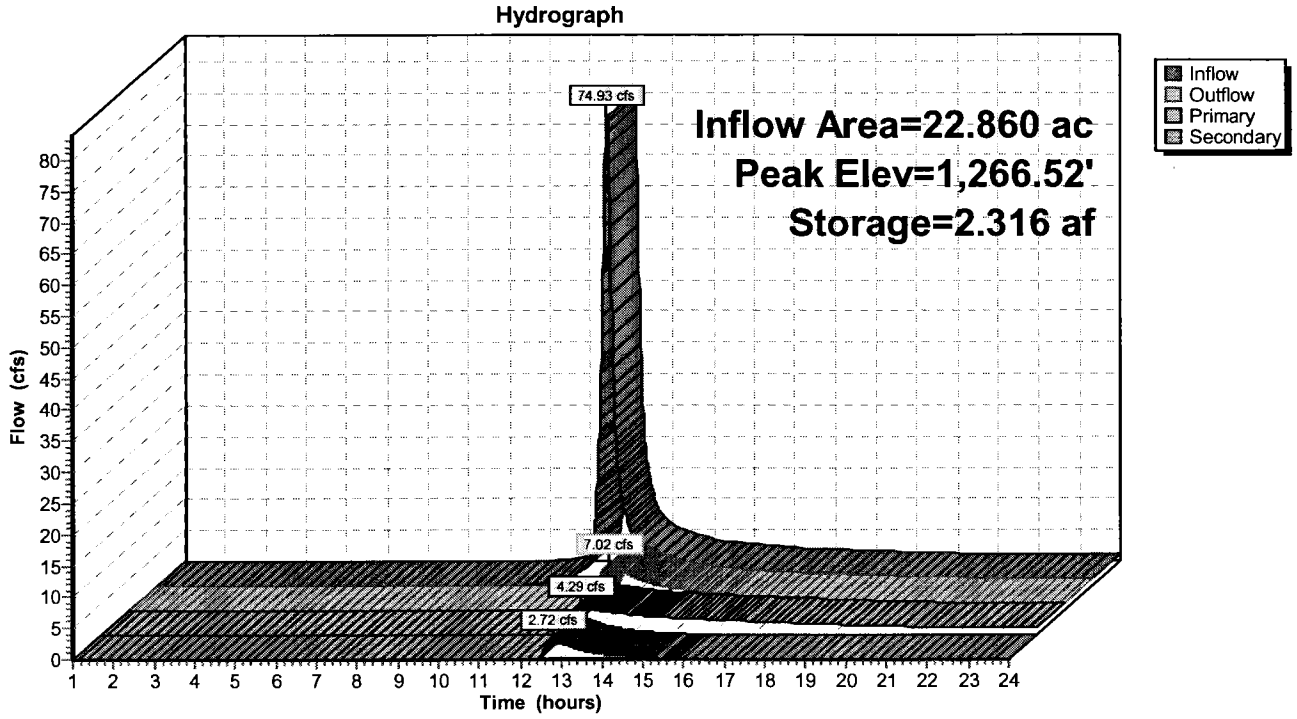
Elevation (feet)	Cum.Store (acre-feet)
1,258.00	0.000
1,260.00	0.400
1,262.00	0.880
1,264.00	1.450
1,266.00	2.120
1,268.00	2.880
1,270.00	3.740

Device	Routing	Invert	Outlet Devices
#1	Primary	1,265.70'	**30.0" Round Culvert** L= 42.0' CPP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 1,265.70' / 1,260.00' S= 0.1357 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 4.91 sf
#2	Secondary	1,266.30'	**151.9 deg x 8.0' long Sharp-Crested Vee/Trap Weir** Cv= 2.47 (C= 3.09)

Primary OutFlow Max=4.29 cfs @ 12.79 hrs HW=1,266.52' (Free Discharge)
↑—**1=Culvert** (Inlet Controls 4.29 cfs @ 3.08 fps)

Secondary OutFlow Max=2.71 cfs @ 12.79 hrs HW=1,266.52' (Free Discharge)
↑—**2=Sharp-Crested Vee/Trap Weir** (Weir Controls 2.71 cfs @ 1.41 fps)

Pond P2: Sedimentation Pond 2



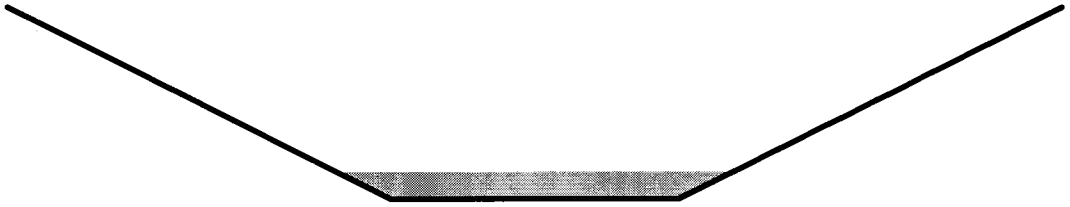
Summary for Reach D-ES2: Emergency Spillway Discharge Channel

Inflow = 2.72 cfs @ 12.79 hrs, Volume= 0.263 af
Outflow = 2.72 cfs @ 12.80 hrs, Volume= 0.263 af, Atten= 0%, Lag= 0.5 min

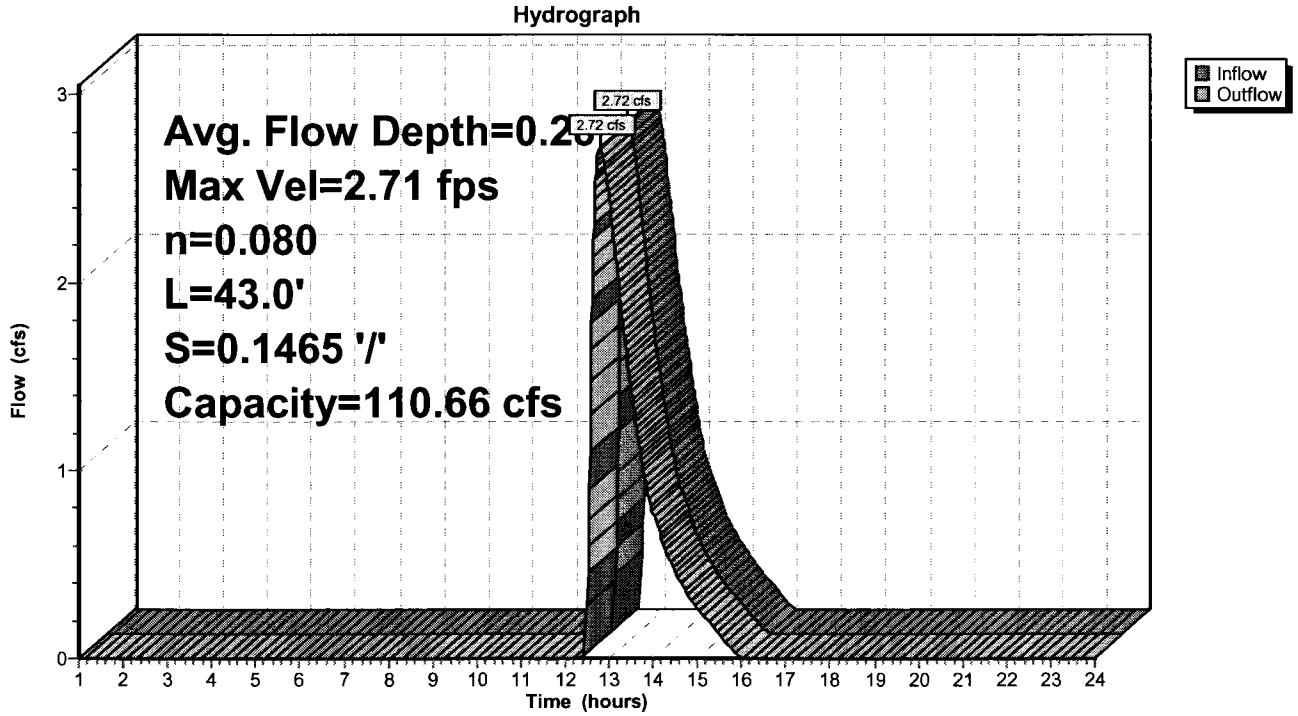
Routing by Stor-Ind+Trans method, Time Span= 1.00-24.00 hrs, dt= 0.01 hrs
Max. Velocity= 2.71 fps, Min. Travel Time= 0.3 min
Avg. Velocity = 1.62 fps, Avg. Travel Time= 0.4 min

Peak Storage= 43 cf @ 12.80 hrs
Average Depth at Peak Storage= 0.28'
Bank-Full Depth= 2.00' Flow Area= 14.0 sf, Capacity= 110.66 cfs

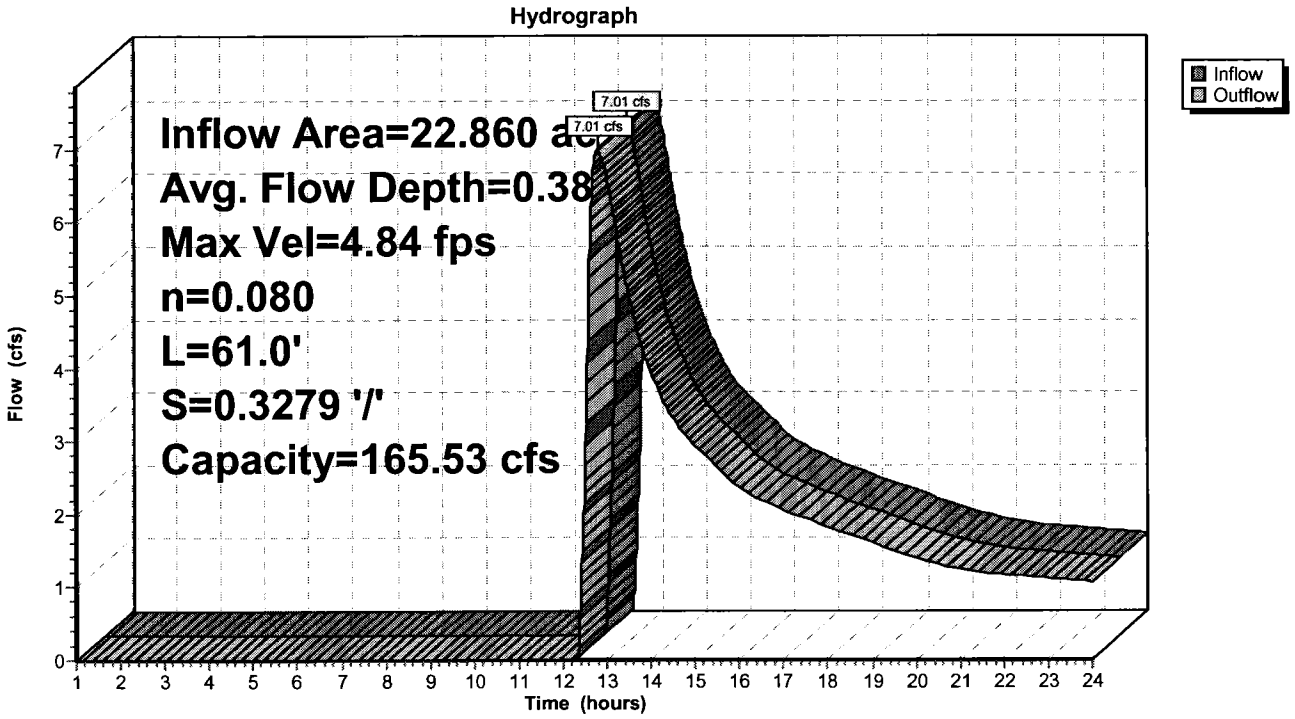
3.00' x 2.00' deep channel, n= 0.080
Side Slope Z-value= 2.0 '/' Top Width= 11.00'
Length= 43.0' Slope= 0.1465 '/'
Inlet Invert= 1,266.30', Outlet Invert= 1,260.00'



Reach D-ES2: Emergency Spillway Discharge Channel



Reach D-P2: Pond 2 Discharge Channel



1.0 INTRODUCTION

The proposed Sedimentation Pond 3 was designed to collect stormwater for the southwestern portion of the proposed expansion.

This sedimentation pond must meet the following regulations:

OAC 3745-27-08 (D)(3)

(i) Minimum storage volume shall be provided based on either the calculated runoff from a 10-year/24-hour storm event, or 0.125 acre-feet per year (for each acre of disturbed area within the upstream drainage area) multiplied by the scheduled frequency of pond clean-out (in years), which ever is greater; and

(ii) The principal spillway shall safely discharge the flow from a 10-year/24-hour storm event. The inlet elevation of the emergency spillway shall be designed to provide flood storage, with no flow entering the emergency spillway, for a 25-year/24-hour storm event, with allowance provided for the flow passed by the principal spillway during the event; and

(iii) The combination of the principal and emergency spillways shall safely discharge the flow from the 100-year/24-hour storm event using non mechanical means. The embankment design shall provide for no less than 1-foot net freeboard when flow is at the design depth, after allowance for embankment settlement.

All designs are based upon accepted design equations, methodologies and assumptions. Where applicable, design references have been made. Calculations have been performed using the software package, HydroCAD Version 10, Copyright 2011.

2.0 DESIGN ASSUMPTIONS

1. The pond was designed based on the proposed top of final cover grade for the proposed expansion.

2. The inflow hydrographs were developed by HydroCAD for each contributing watershed.

3. The inflow for this sedimentation pond is summarized below:

Drainage Area	Watershed Area (Acre)	Composite CN
DA-32	3.27	71
DA-33	2.76	71
DA-45	1.84	71
DA-11	31.83	71
DA-43	1.67	71
DA-35	2.80	71
DA-34	2.22	71
DA-44	2.08	71
DA-12	22.47	71
A-4	~~0.51~~ 1.30	71
Total	~~71.45~~ 72.24	

Times of concentration will be estimated as the sum of sheet flow, shallow flow and channel flow. The surface in the existing and proposed landfill will be similar to a non-grazed meadow in hydrologic soil group C, and was therefore modeled using a curve number of 71. Sheet flow calculations will use an average roughness of 0.150, which corresponds to short grass. The maximum sheet flow length will be 300 feet. Shallow flow times of concentration will be estimated using the velocity factor for short grass pasture.

From Reference 2, the following runoff coefficients have been found and will be utilized.

CN DATA	
Description	**CN**
Non-grazed meadow	71

3.0 VOLUME SIZING

As per OAC 3745-27-08 (D)(3)(i), the sedimentation pond must provide adequate storage volume for the larger of: (1) the runoff from the 10-year/24-hour storm event or (2) 0.125 acre-ft per acre of disturbed area multiplied by the cleaning frequency in years.

Volume Requirement for 10-year/24-hour storm:

Utilizing HydroCAD for a 10-year/24-hour storm event, the inflow hydrographs were developed for each contributing watershed.

From Reference 9 and presented as an attachment, the rainfall depths for the facility are summarized in the following table:

Storm Event	Rainfall Depth (inches)
10-year/24-hour	3.46
25-year/24-hour	4.12
100-year/24-hour	5.23

Utilizing the watershed information included in Section 2.0 of this calculation, the required storage volume from the runoff from a 10-year/24-hour storm event was calculated by HydroCAD to be approximately ~~237,097~~ 240,059-cf of storage volume. The HydroCAD output files for a 10-year/24-hour storm event are included in an attachment to this calculation.

Volume Requirement for 0.125 acre-ft per disturbed acre:

Given the watershed information included in Section 2.0 of this calculation:

Drainage Area	Watershed Area (acres)	Disturbed Area (acres) [Calculated]	Volume (cf) [Calculated]
DA-32	3.27	0.98	5,336
DA-33	2.76	0.83	4,519
DA-45	1.84	0.55	2,995
DA-11	31.83	9.55	52,000
DA-43	1.67	0.50	2,723
DA-35	2.80	0.84	4,574
DA-34	2.22	0.67	3,648
DA-44	2.08	0.62	3,376
DA-12	22.47	6.74	36,699
A-4	~~0.51~~ 1.30	~~0.15~~ 0.39	~~817~~ 2,124
Totals	~~71.45~~ 72.24	~~21.44~~ 21.67	~~116,741~~ 117,994

For disturbed area, a conservative assumption of 30% of the watershed was used.

In the above table, the volume for each Drainage Area is calculated as follows assuming one scheduled pond cleaning event per year.

From the above calculations, the controlling volume for the design of this sedimentation pond is ~~237,097~~ 240,057-cf, based on the runoff from the HydroCAD 10-year/24-hour storm event.

4.0 PRINCIPAL SPILLWAY DESIGN

Using HydroCAD, a 10-year/24-hour storm event was routed through the sedimentation pond to determine the required storage capacity below the prinicipal spillway. The principal spillway invert elevation should be set at elevation ~~1,251.70~~ 1,241.70-feet.

As per OAC 3745-27-08(D)(3)(b), the principal spillway shall be designed to safely discharge the flow from a 10-year/24-hour storm event without the use of mechanical means. Based on the HydroCAD analysis, Sedimentation Pond 3 will not discharge from the emergency spillway during the 10-year/24-hour storm event. The principal spillway is able to discharge flow from a 25-year/24-hour storm event without the use of mechanical means, thus, the principal spillway is adequately sized.

Item	Value
Culvert Type	CPP
Culvert Quantity	1
Principal Spillway Diameter	30-inch
Principal Spillway Invert Elevation	~~1,251.70~~ 1,241.70-ft
Maximum pool elevation for routing of the 10-year/24-hour storm	~~1,251.45~~ ~~*1251.46*~~ 1241.57-ft
Maximum pool elevation for routing of 25-year/24-hour storm	~~1,252.59~~ 1242.61-ft

5.0 ANTI-SEEP COLLAR DESIGN

Anti-seep collars are required for culverts that are placed in the saturated zone of the pond embankment. The culvert used as the principal spillway for Sedimentation Pond 3 is above the saturated zone of the embankment and thus, does not require anti-seep collars.

6.0 EMERGENCY SPILLWAY DESIGN

In accordance with the regulations, the emergency spillway must be set so that there is no discharge during the 25-year/24-hour storm. The combination of the principal and emergency spillway must discharge the 100-year/24-hour storm event while maintaining a minimum of 1.0 foot of freeboard to the embankment crest. These design requirements have been checked by routing the 25-year/24-hour and 100-year/24-hour storms through the pond.

The emergency spillway is analyzed as a sharp-crested vee/trap weir with the invert at elevation ~~1,252.90~~ 1,242.90-ft. The crest of the emergency spillway has been set so that there is no discharge during the 25-year/24-hour storm. The maximum elevation provided with routing the 25-year/24-hour storm is ~~1252.59~~ 1,242.61-ft. The emergency spillway is set at elevation ~~1,252.90-ft~~ 1,242.90, thus there is no discharge from the emergency spillway during the 25-year/24-hour storm. During the routing of the 100-year/24-hour storm, a minimum of 1.0 foot of freeboard is maintained to the perimeter of the pond. The maximum elevation provided with the routing of a 100-year/24-hour storm through the pond is ~~1,253.52~~ 1,243.55-ft. The crest of the embankment is at elevation ~~1,255.00~~ 1,245.00-ft, thus Sedimentation Pond 3 provides more than 1.0 foot of freeboard from the embankment crest.

Item	Value
Spillway Type	Sharp-Cressted Vee/Trap Weir
Quantity	1
Emergency Spillway Dimensions	151.9 degrees x 8.0 feet long
Emergency Spillway Invert Elevation	~~1,252.90~~ 1,242.90-ft
Pond Embankment Crest Elevation	~~1,255.0~~ 1,245.0-ft
Maximum pool elevation for routing of 100-year/24-hour storm	~~1253.52~~ 1,243.55-ft (>1.0-ft freeboard)
Maximum elevation pool for routing of 25-year/24-hour storm	~~1,252.59~~ 1,242.61-ft

7.0 OUTLET CHANNEL

The outlet channel was analyzed so that the flow from the 100-year/24-hour storm is safely discharged. Based on HydroCAD, the maximum velocity from the 100-year/24-hour storm event is ~~8.85~~ ~~8.87~~ 4.95 feet per second, which is below the permissible velocity for R-4 riprap.

8.0 CONCLUSION

Sedimentation Pond 3 will meet the requirements outlined in OAC 3745-27-08 (D)(3). The pond provides 242,862-cf of storage below the principal spillway meeting the required storage for the 10-year/24-hour storm. The principal spillway is able to discharge flow from the 25-year/24-hour storm event without the use of mechanical means, thus, the principal spillway is adequately sized. There is no flow from the emergency spillway during the routing of the 25-year/24-hour storm. The emergency spillway and principal spillway can discharge the 100-year/24-hour storm while maintaining a minimum of 1.0 foot of freeboard.

REFERENCES

1. Soil Conservation Service, URBAN HYDROLOGY FOR SMALL WATERSHEDS, Technical Release 55, June 1986.

2. Soil Conservation Service, ENGINEERING FIELD MANUAL FOR CONSERVATION PRACTICES, November 1986.

3. Ven Te Chow, OPEN CHANNEL HYDRAULICS, Mc-Graw Hill Book Company, 1959

4. Goldman, Jackson and Bursztynsky, EROSION AND SEDIMENT CONTROL HANDBOOK, Mc-Graw Hill Book Company, 1986.

5. Soil Conservation Service, WATER MANAGEMENT AND SEDIMENT CONTROL FOR URBANIZING AREAS, distributed by Ohio Soil and Water Conservation Service.

6. American Iron and Steel Institute, HANDBOOK OF STEEL DRAINAGE & HIGHWAY PRODUCTS, 1971.

7. HydroCAD Software Solutions, LLC., HYDROCAD, Version 10.0, 2011, Computer Software Program.

8. National Climatic Data Center, *Precipitation Frequency Estimates*, Point Precipitation Frequency Estimate From NOAA Atlas 14 Ohio 40.4353 N 80.9122 W, Viewed 27 September 2011,< http://hdsc.nws.noaa.gov>.

9. Ohio Department of Natural Resources, Division of Soil and Water Conservation, RAINWATER AND LAND DEVELOPMENT, Third Edition, 2006.

NOAA PRECIPITATION ESTIMATE

www.nws.noaa.gov

NOAA's National Weather Service
Hydrometeorological Design Studies Center
Precipitation Frequency Data Server (PFDS)

General Info
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Precipitation Frequency (PF)
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- PF in GIS Format
- PF Maps
- Temporal Distr.
- Time Series Data
- PFDS Perform.

PF Documents

Probable Maximum Precipitation (PMP)
PMP Documents
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NOAA ATLAS 14 POINT PRECIPITATION FREQUENCY ESTIMATES

DATA DESCRIPTION

Data type: precipitation depth - Units: english - Time series type: partial duration -

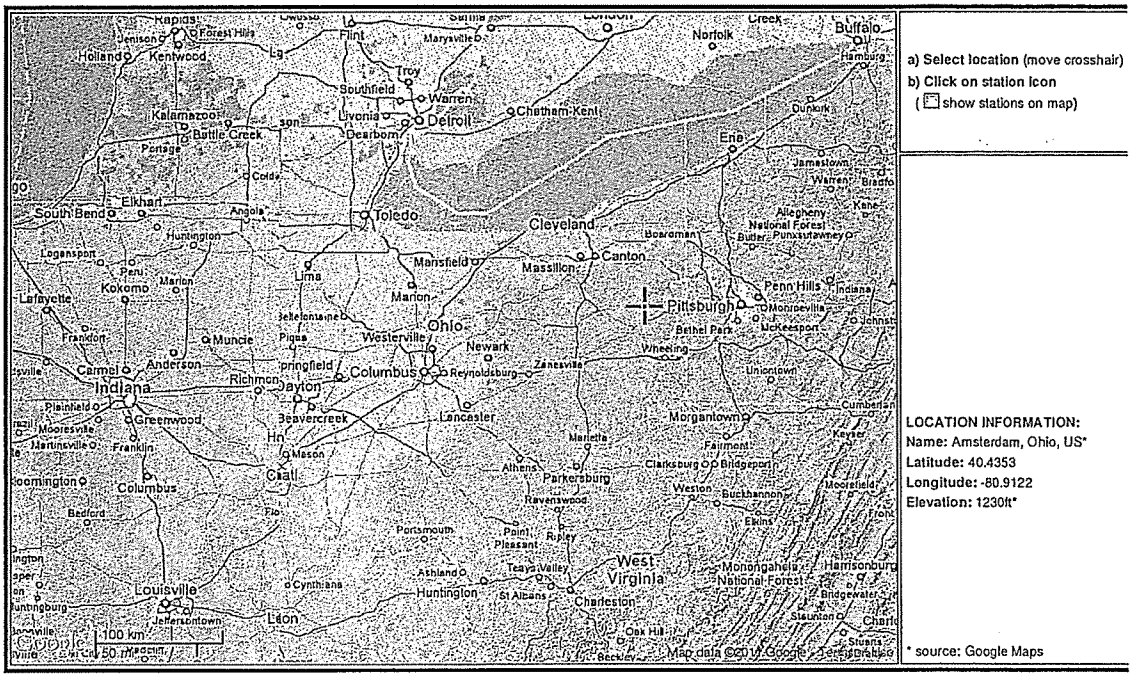
SELECT LOCATION

1. Manually:

a) Enter location (decimal degrees, use "-" for S and W): latitude: 40.4353 longitude: -80.9122 submit

b) Select station: select station

2. Use map:



a) Select location (move crosshair)
b) Click on station icon
(show stations on map)

LOCATION INFORMATION:
Name: Amsterdam, Ohio, US*
Latitude: 40.4353
Longitude: -80.9122
Elevation: 1230ft*

* source: Google Maps

POINT PRECIPITATION FREQUENCY (PF) ESTIMATES

WITH 90% CONFIDENCE INTERVALS AND SUPPLEMENTARY INFORMATION
NOAA Atlas 14, Volume 2, Version 3

PF tabular PF graphical Supplementary information Print Page

PDS-based precipitation frequency estimates with 90% confidence intervals (in inches)[1]

Duration	Average recurrence interval(years)									
	1	2	5	10	25	50	100	200	500	1000
5-min	0.326 (0.292-0.364)	0.390 (0.350-0.435)	0.472 (0.422-0.527)	0.534 (0.477-0.595)	0.614 (0.546-0.683)	0.676 (0.599-0.751)	0.735 (0.649-0.815)	0.796 (0.700-0.883)	0.878 (0.767-0.972)	0.938 (0.816-1.04)
10-min	0.507 (0.454-0.566)	0.609 (0.546-0.680)	0.733 (0.656-0.819)	0.825 (0.736-0.919)	0.940 (0.836-1.05)	1.02 (0.908-1.14)	1.11 (0.977-1.23)	1.19 (1.05-1.32)	1.29 (1.13-1.43)	1.37 (1.19-1.51)
15-min	0.621 (0.556-0.693)	0.745 (0.667-0.831)	0.900 (0.806-1.01)	1.02 (0.906-1.13)	1.16 (1.03-1.29)	1.27 (1.12-1.41)	1.37 (1.21-1.53)	1.48 (1.30-1.64)	1.61 (1.41-1.78)	1.71 (1.48-1.89)
30-min	0.821 (0.736-0.917)	0.997 (0.893-1.11)	1.23 (1.10-1.38)	1.41 (1.26-1.57)	1.64 (1.46-1.82)	1.81 (1.61-2.01)	1.98 (1.75-2.20)	2.16 (1.90-2.39)	2.39 (2.09-2.64)	2.56 (2.23-2.83)
60-min	1.00 (0.899-1.12)	1.22 (1.10-1.37)	1.55 (1.39-1.73)	1.79 (1.60-2.00)	2.13 (1.89-2.37)	2.39 (2.12-2.65)	2.65 (2.34-2.94)	2.93 (2.57-3.25)	3.30 (2.88-3.66)	3.59 (3.13-3.98)
2-hr	1.16 (1.03-1.30)	1.41 (1.25-1.58)	1.80 (1.59-2.02)	2.10 (1.86-2.35)	2.53 (2.23-2.83)	2.88 (2.54-3.22)	3.25 (2.85-3.62)	3.65 (3.18-4.05)	4.21 (3.65-4.66)	4.66 (4.02-5.16)
3-hr	1.23 (1.10-1.39)	1.49 (1.33-1.69)	1.90 (1.69-2.15)	2.22 (1.96-2.51)	2.69 (2.38-3.02)	3.07 (2.71-3.44)	3.47 (3.05-3.88)	3.91 (3.41-4.36)	4.53 (3.92-5.05)	5.03 (4.34-5.60)
6-hr	1.47 (1.32-1.66)	1.77 (1.59-2.00)	2.24 (2.00-2.52)	2.61 (2.33-2.94)	3.17 (2.81-3.55)	3.62 (3.20-4.05)	4.11 (3.61-4.58)	4.65 (4.06-5.16)	5.42 (4.68-6.00)	6.06 (5.19-6.69)
12-hr	1.74 (1.57-1.94)	2.09 (1.88-2.33)	2.60 (2.34-2.91)	3.04 (2.72-3.38)	3.67 (3.27-4.07)	4.20 (3.73-4.65)	4.78 (4.22-5.27)	5.41 (4.74-5.95)	6.34 (5.50-6.93)	7.11 (6.12-7.75)

24-hr	2.04 (1.88-2.21)	2.44 (2.26-2.64)	3.00 (2.77-3.25)	3.46 (3.20-3.75)	4.12 (3.79-4.45)	4.66 (4.26-5.03)	5.23 (4.76-5.64)	5.84 (5.28-6.28)	6.69 (6.00-7.20)	7.39 (6.57-7.95)
2-day	2.38 (2.22-2.58)	2.85 (2.64-3.08)	3.47 (3.22-3.75)	3.98 (3.69-4.30)	4.69 (4.33-5.05)	5.27 (4.84-5.67)	5.87 (5.36-6.31)	6.49 (5.90-6.99)	7.37 (6.63-7.94)	8.06 (7.20-8.70)
3-day	2.55 (2.38-2.75)	3.04 (2.83-3.27)	3.68 (3.43-3.97)	4.21 (3.91-4.52)	4.93 (4.57-5.30)	5.52 (5.09-5.92)	6.13 (5.62-6.57)	6.75 (6.17-7.24)	7.62 (6.90-8.19)	8.31 (7.47-8.94)
4-day	2.72 (2.54-2.91)	3.23 (3.02-3.47)	3.90 (3.64-4.18)	4.44 (4.14-4.75)	5.18 (4.81-5.54)	5.77 (5.35-6.17)	6.38 (5.89-6.82)	7.01 (6.43-7.50)	7.88 (7.17-8.45)	8.56 (7.74-9.19)
7-day	3.25 (3.06-3.47)	3.86 (3.63-4.12)	4.63 (4.35-4.94)	5.24 (4.92-5.59)	6.09 (5.69-6.49)	6.77 (6.30-7.21)	7.45 (6.91-7.94)	8.16 (7.53-8.69)	9.11 (8.35-9.73)	9.86 (8.96-10.5)
10-day	3.75 (3.54-3.98)	4.45 (4.20-4.72)	5.28 (4.98-5.60)	5.94 (5.60-6.29)	6.83 (6.42-7.23)	7.53 (7.06-7.98)	8.24 (7.70-8.73)	8.94 (8.33-9.50)	9.89 (9.15-10.5)	10.6 (9.76-11.3)
20-day	5.27 (5.00-5.55)	6.21 (5.90-6.55)	7.27 (6.91-7.66)	8.10 (7.68-8.52)	9.17 (8.68-9.65)	9.99 (9.44-10.5)	10.8 (10.2-11.4)	11.6 (10.9-12.2)	12.6 (11.8-13.3)	13.3 (12.4-14.1)
30-day	6.61 (6.27-6.98)	7.77 (7.37-8.21)	9.01 (8.54-9.51)	9.97 (9.44-10.5)	11.2 (10.6-11.8)	12.2 (11.5-12.8)	13.1 (12.3-13.8)	14.0 (13.1-14.8)	15.1 (14.1-16.0)	15.9 (14.8-16.9)
45-day	8.46 (8.05-8.90)	9.91 (9.42-10.4)	11.3 (10.8-11.9)	12.4 (11.8-13.1)	13.8 (13.1-14.5)	14.8 (14.0-15.6)	15.8 (14.9-16.7)	16.7 (15.8-17.7)	17.9 (16.8-18.9)	18.7 (17.5-19.8)
60-day	10.2 (9.75-10.7)	11.9 (11.4-12.5)	13.5 (12.9-14.2)	14.7 (14.0-15.4)	16.2 (15.5-17.0)	17.3 (16.5-18.1)	18.3 (17.4-19.2)	19.2 (18.2-20.2)	20.4 (19.3-21.4)	21.1 (20.0-22.3)

[1] Precipitation frequency (PF) estimates in this table are based on frequency analysis of partial duration series (PDS).

Numbers in parenthesis are PF estimates at lower and upper bounds of the 90% confidence interval. The probability that precipitation frequency estimates (for a given duration and average recurrence interval) will be greater than the upper bound (or less than the lower bound) is 5%. Estimates at upper bounds are not checked against probable maximum precipitation (PMP) estimates and may be higher than currently valid PMP values.

Please refer to NOAA Atlas 14 document for more information.

csv Estimates from the table in csv format: precipitation frequency estimates - Submit

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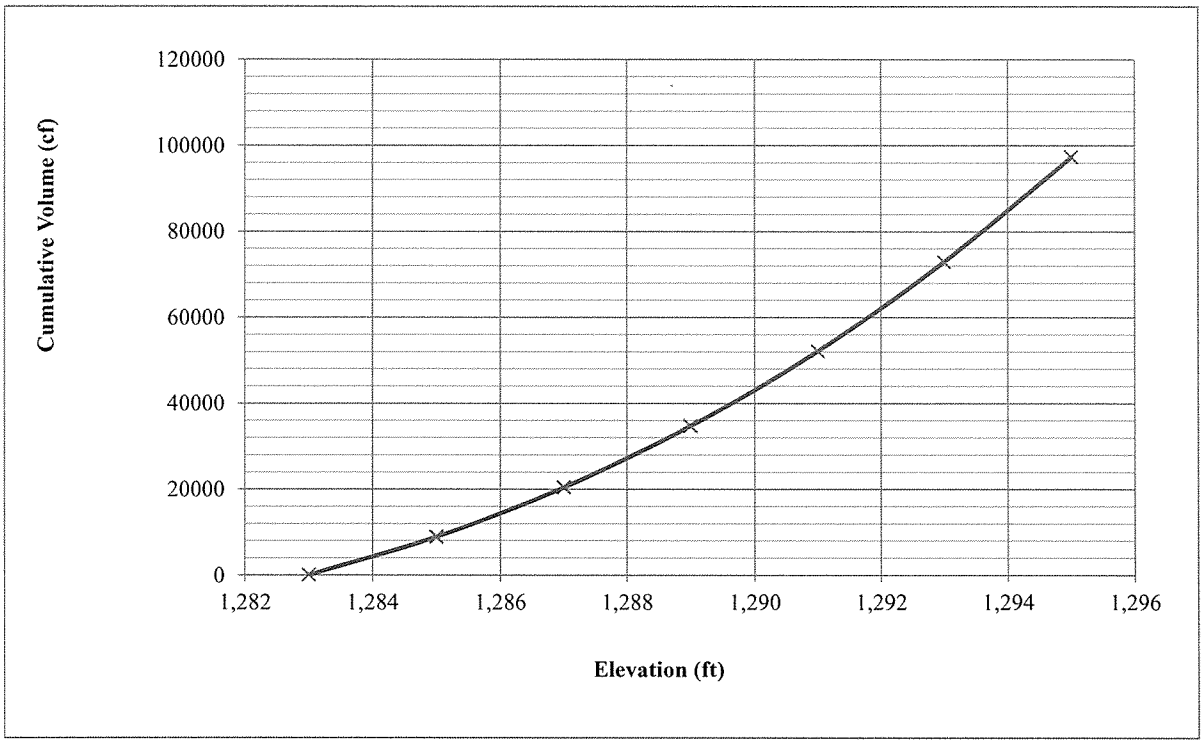
SEDIMENTATION POND
ELEVATION - STORAGE

Apex Sanitary Landfill
Sedimentation Pond 3 Support
Elevation Storage

Elevation	Pool Area	Average Area	Incremental Volume	Cumulative Volume	Cumulative Volume
1,225.00	6,372	0	0	0	0.00
1,227.00	8,035	7,204	14,407	14,407	0.33
1,229.00	9,826	8,931	17,861	32,268	0.74
1,231.00	11,722	10,774	21,548	53,816	1.24
1,233.00	13,791	12,757	25,513	79,329	1.82
1,235.00	15,966	14,879	29,757	109,086	2.50
1,237.00	18,268	17,117	34,234	143,320	3.29
1,239.00	20,699	19,484	38,967	182,287	4.18
1,241.00	23,257	21,978	43,956	226,243	5.19
1,243.00	25,944	24,601	49,201	275,444	6.32
1,245.00	28,800	27,372	54,744	330,188	7.58



Principal Spillway

1,241.00	23,257	21,978	43,956	226,243	5.19
1,241.70	24,227	23,742	16,619	242,862	5.58
1,245.00	28,800	27,372	54,744	330,188	7.58

Principal spillway inlet invert is at El. 1,241.70-ft which has a storage capacity 242,862-cf.

SEDIMENTATION POND
ROUTING OF 10-YEAR 24-HOUR STORM

Summary for Pond 3P: Sedimentation Pond 3

Inflow Area = 72.240 ac, 0.00% Impervious, Inflow Depth > 0.92" for 10 year event
Inflow = 73.97 cfs @ 12.27 hrs, Volume= 5.516 af
Outflow = 0.00 cfs @ 5.00 hrs, Volume= 0.000 af, Atten= 100%, Lag= 0.0 min
Primary = 0.00 cfs @ 5.00 hrs, Volume= 0.000 af
Secondary = 0.00 cfs @ 5.00 hrs, Volume= 0.000 af

Routing by Stor-Ind method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Peak Elev= 1,241.57' @ 20.00 hrs Surf.Area= 0.000 ac Storage= 5.511 af

Plug-Flow detention time= (not calculated: initial storage excedes outflow)
Center-of-Mass det. time= (not calculated: no outflow)

Volume	Invert	Avail.Storage	Storage Description
#1	1,225.00'	7.580 af	**Custom Stage Data** Listed below

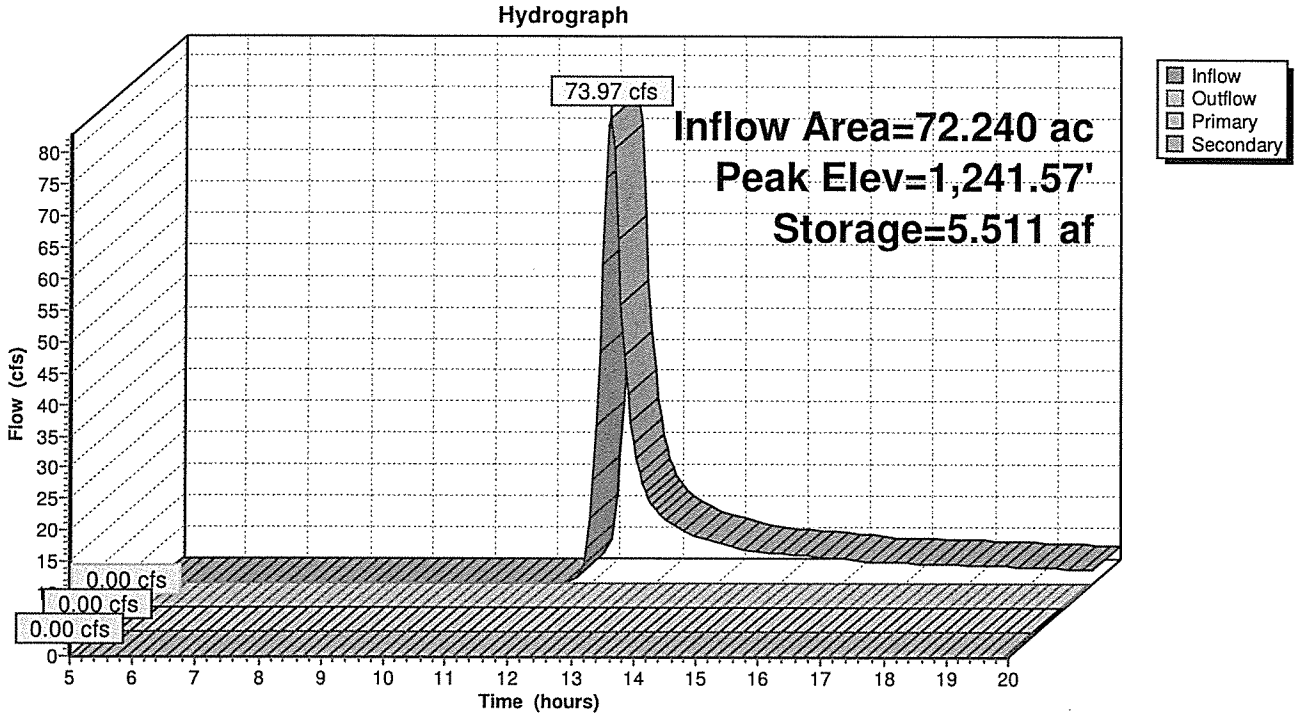
Elevation (feet)	Cum.Store (acre-feet)
1,225.00	0.000
1,227.00	0.330
1,229.00	0.740
1,231.00	1.240
1,233.00	1.820
1,235.00	2.500
1,237.00	3.290
1,239.00	4.180
1,241.00	5.190
1,243.00	6.320
1,245.00	7.580

Device	Routing	Invert	Outlet Devices
#1	Primary	1,241.70'	**30.0" Round Primary** L= 37.0' CPP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 1,241.70' / 1,240.96' S= 0.0200 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 4.91 sf
#2	Secondary	1,242.90'	**151.9 deg x 8.0' long Sharp-Crested Vee/Trap Weir** Cv= 2.47 (C= 3.09)

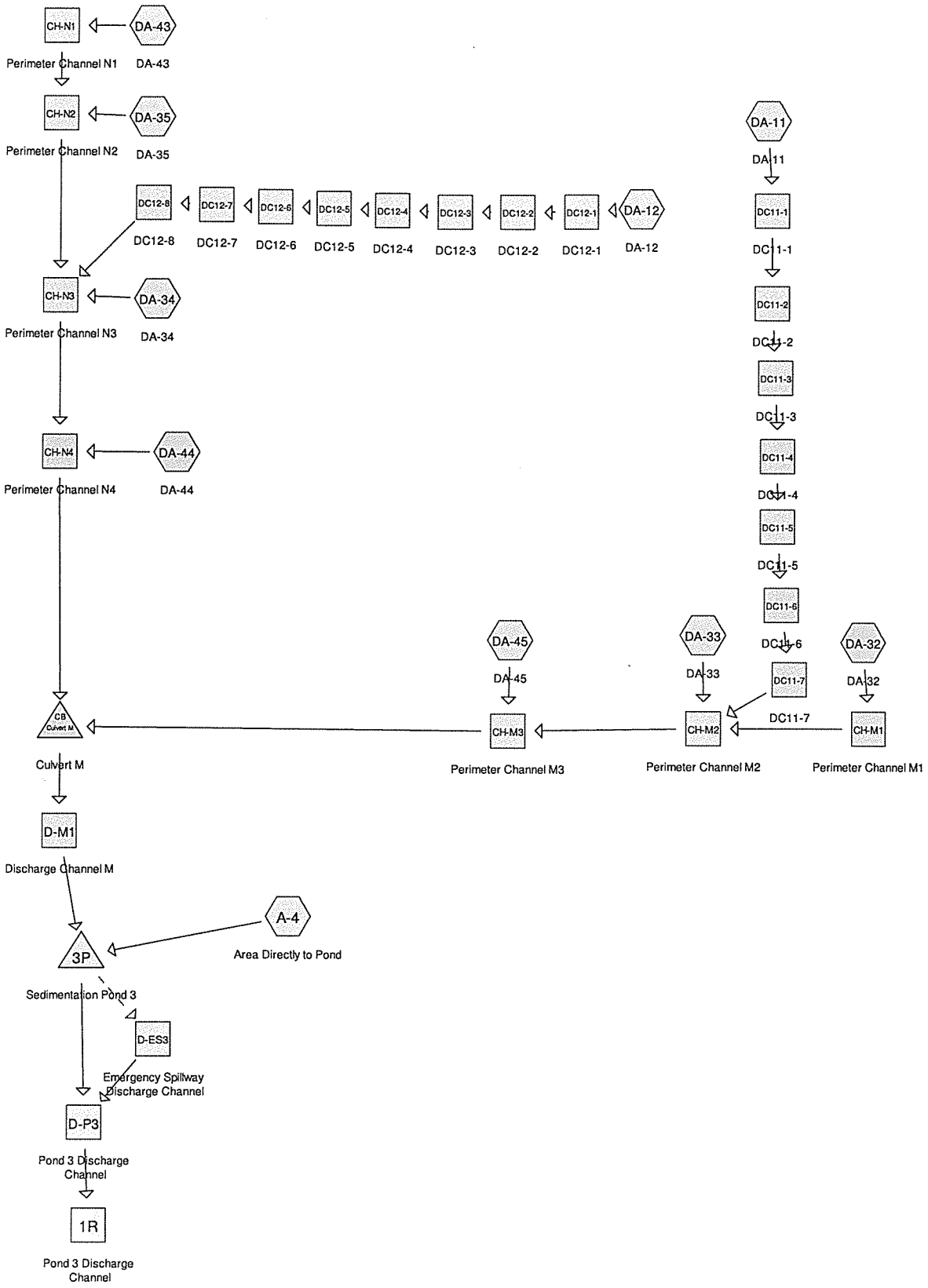
Primary OutFlow Max=0.00 cfs @ 5.00 hrs HW=1,225.00' (Free Discharge)
↑—**1=Primary** (Controls 0.00 cfs)

Secondary OutFlow Max=0.00 cfs @ 5.00 hrs HW=1,225.00' (Free Discharge)
↑—**2=Sharp-Crested Vee/Trap Weir** (Controls 0.00 cfs)

Pond 3P: Sedimentation Pond 3



SEDIMENTATION POND
ROUTING OF 25-YEAR 24-HOUR STORM



Routing Diagram for Sedimentation Pond 3

Prepared by {enter your company name here}, Printed 12/28/2015

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Summary for Subcatchment A-4: Area Directly to Pond

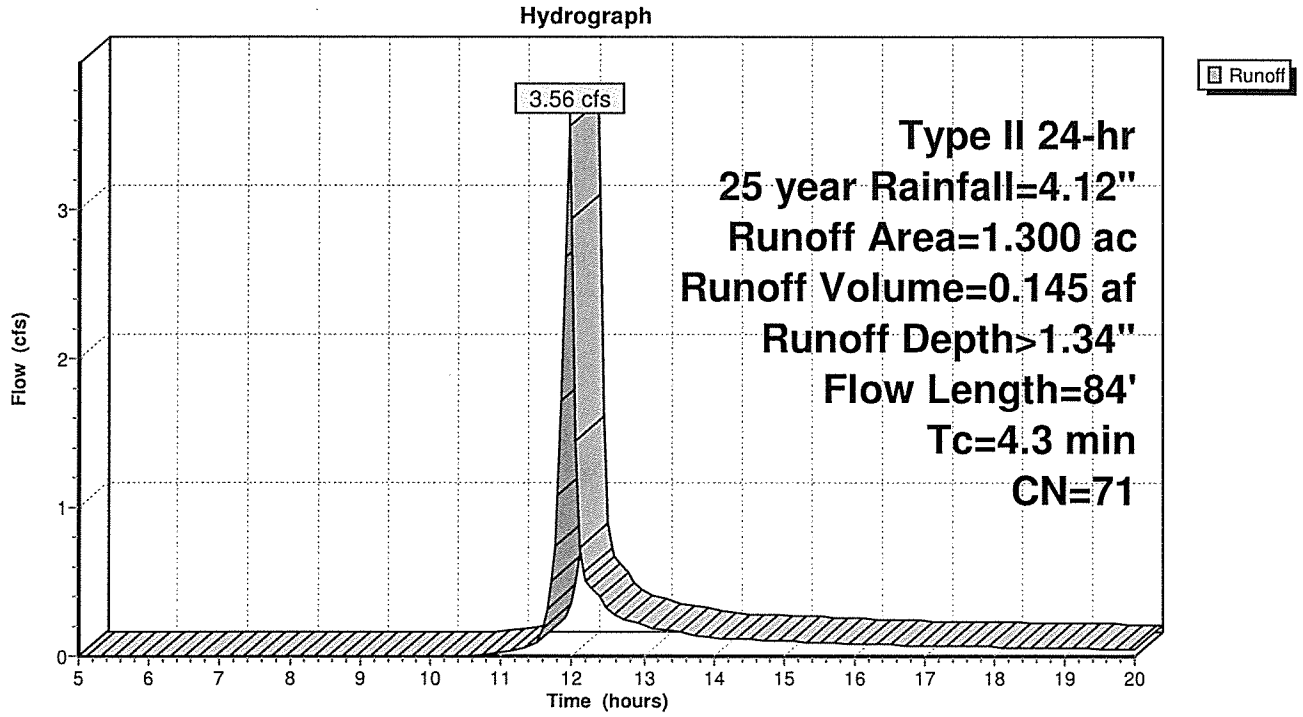
Runoff = 3.56 cfs @ 11.95 hrs, Volume= 0.145 af, Depth> 1.34"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type II 24-hr 25 year Rainfall=4.12"

Area (ac)	CN	Description
1.300	71	Meadow, non-grazed, HSG C
1.300		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
2.6	64	0.3300	0.42		**Sheet Flow, 64 feet 3H:1V sheet flow** Grass: Short n= 0.150 P2= 2.44"
1.7	20	0.0100	0.20		**Sheet Flow, 20 feet 100H:1V sheet flow** Fallow n= 0.050 P2= 2.44"
4.3	84	Total			

Subcatchment A-4: Area Directly to Pond



Summary for Subcatchment DA-11: DA-11

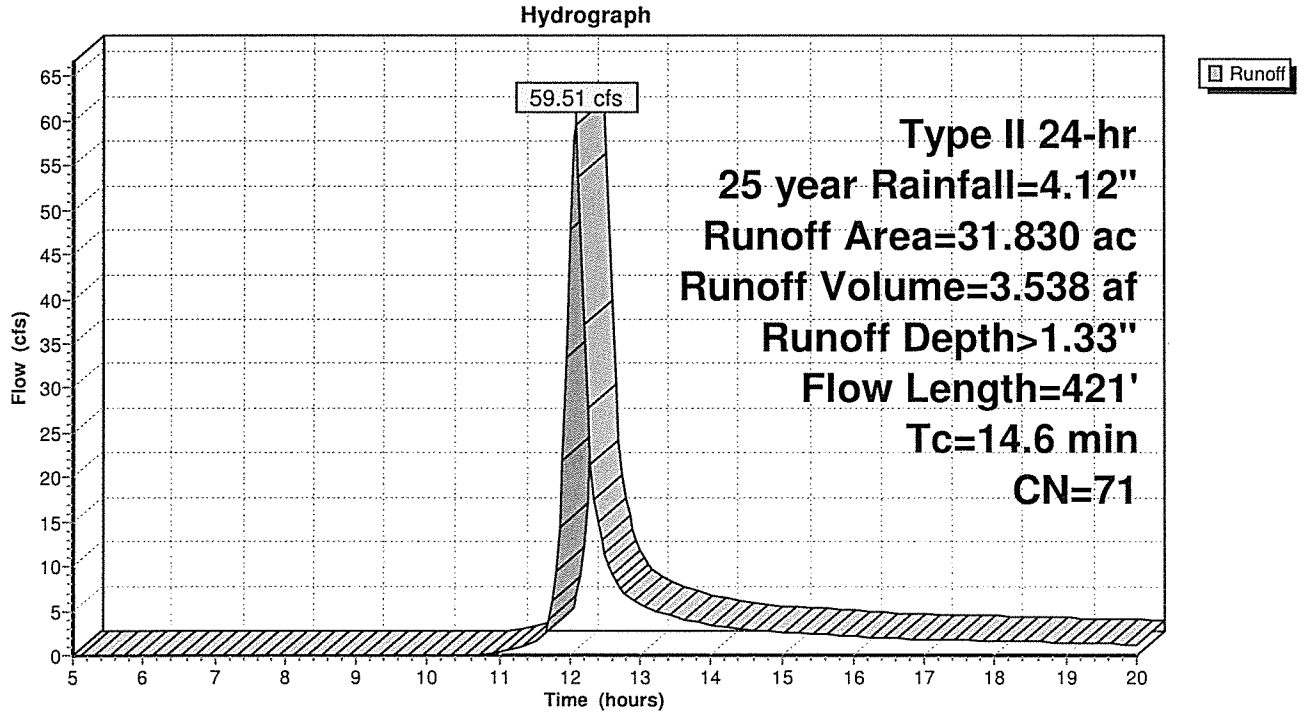
Runoff = 59.51 cfs @ 12.08 hrs, Volume= 3.538 af, Depth> 1.33"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type II 24-hr 25 year Rainfall=4.12"

Area (ac)	CN	Description
31.830	71	Meadow, non-grazed, HSG C
31.830		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
11.3	226	0.1000	0.33		**Sheet Flow, 226 feet 10% sheet flow** Grass: Short n= 0.150 P2= 2.44"
2.9	74	0.3300	0.43		**Sheet Flow, 74 feet 3H:1V sheet flow** Grass: Short n= 0.150 P2= 2.44"
0.3	81	0.3300	4.02		**Shallow Concentrated Flow, 81 feet 3H:1V shallow conc. flow** Short Grass Pasture Kv= 7.0 fps
0.1	40	0.0300	7.00	102.24	**Channel Flow, 40 feet bench flow** Area= 14.6 sf Perim= 19.8' r= 0.74' n= 0.030 Earth, grassed & winding
14.6	421	Total			

Subcatchment DA-11: DA-11



Summary for Subcatchment DA-12: DA-12

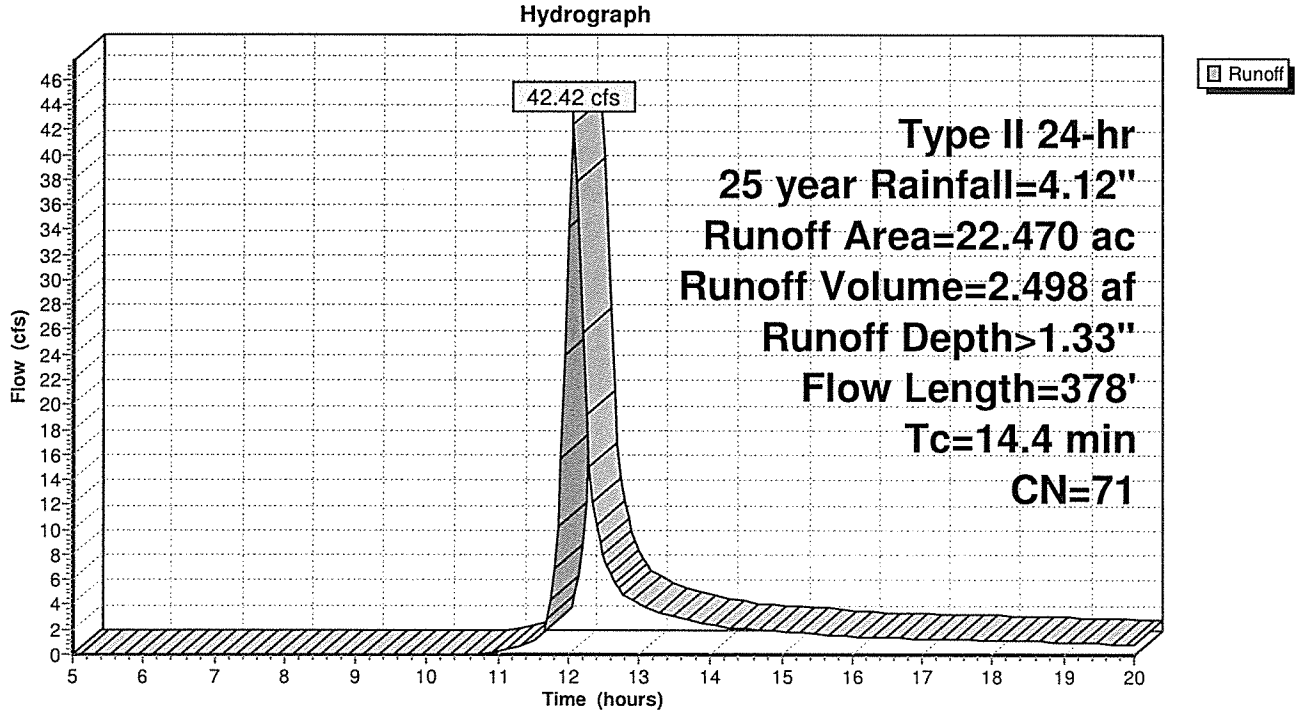
Runoff = 42.42 cfs @ 12.07 hrs, Volume= 2.498 af, Depth> 1.33"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type II 24-hr 25 year Rainfall=4.12"

Area (ac)	CN	Description
22.470	71	Meadow, non-grazed, HSG C
22.470		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
11.1	221	0.1000	0.33		**Sheet Flow, 221 feet 10% sheet flow** Grass: Short n= 0.150 P2= 2.44"
3.0	79	0.3300	0.43		**Sheet Flow, 79 feet 3H:1V sheet flow** Grass: Short n= 0.150 P2= 2.44"
0.3	69	0.3300	4.02		**Shallow Concentrated Flow, 69 feet 3H:1V shallow conc. flow** Short Grass Pasture Kv= 7.0 fps
0.0	9	0.0300	7.00	102.24	**Channel Flow, 9 feet bench flow** Area= 14.6 sf Perim= 19.8' r= 0.74' n= 0.030 Earth, grassed & winding
14.4	378	Total			

Subcatchment DA-12: DA-12



Summary for Subcatchment DA-32: DA-32

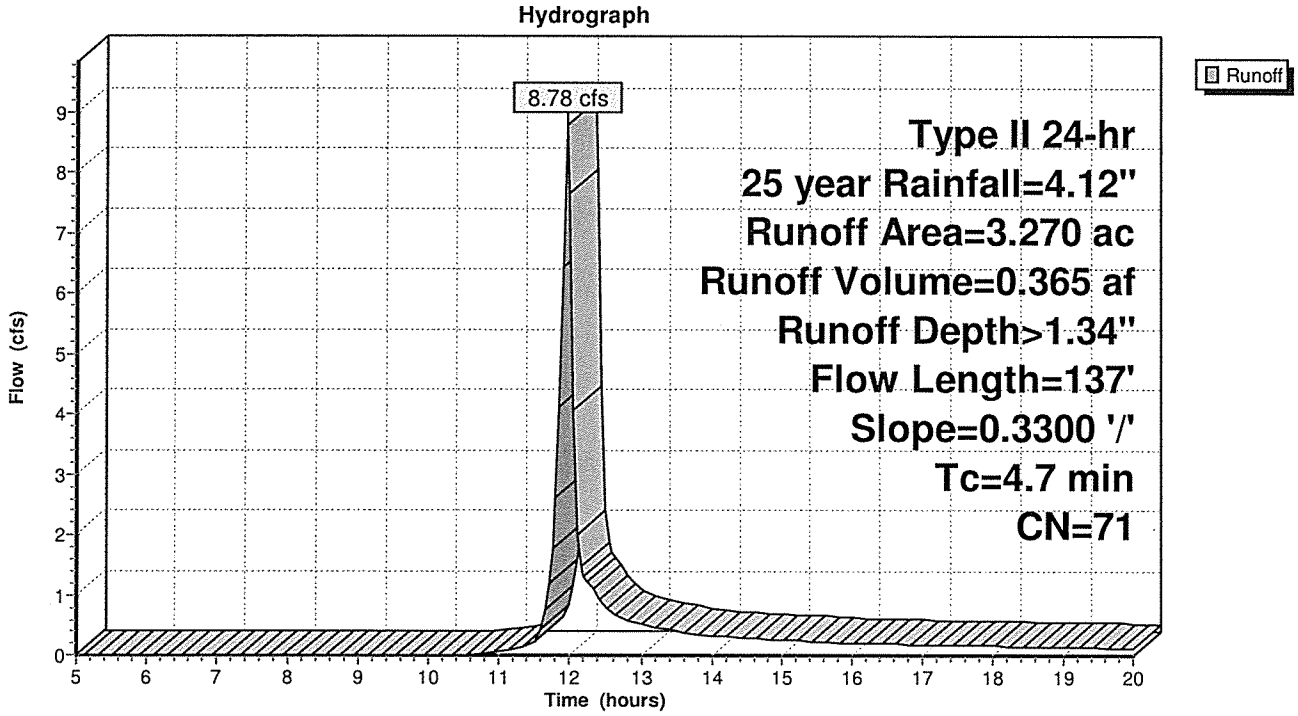
Runoff = 8.78 cfs @ 11.96 hrs, Volume= 0.365 af, Depth> 1.34"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type II 24-hr 25 year Rainfall=4.12"

Area (ac)	CN	Description
3.270	71	Meadow, non-grazed, HSG C
3.270		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
4.7	137	0.3300	0.49		**Sheet Flow, 137 feet 3H:1V sheet flow** Grass: Short n= 0.150 P2= 2.44"

Subcatchment DA-32: DA-32



Summary for Subcatchment DA-33: DA-33

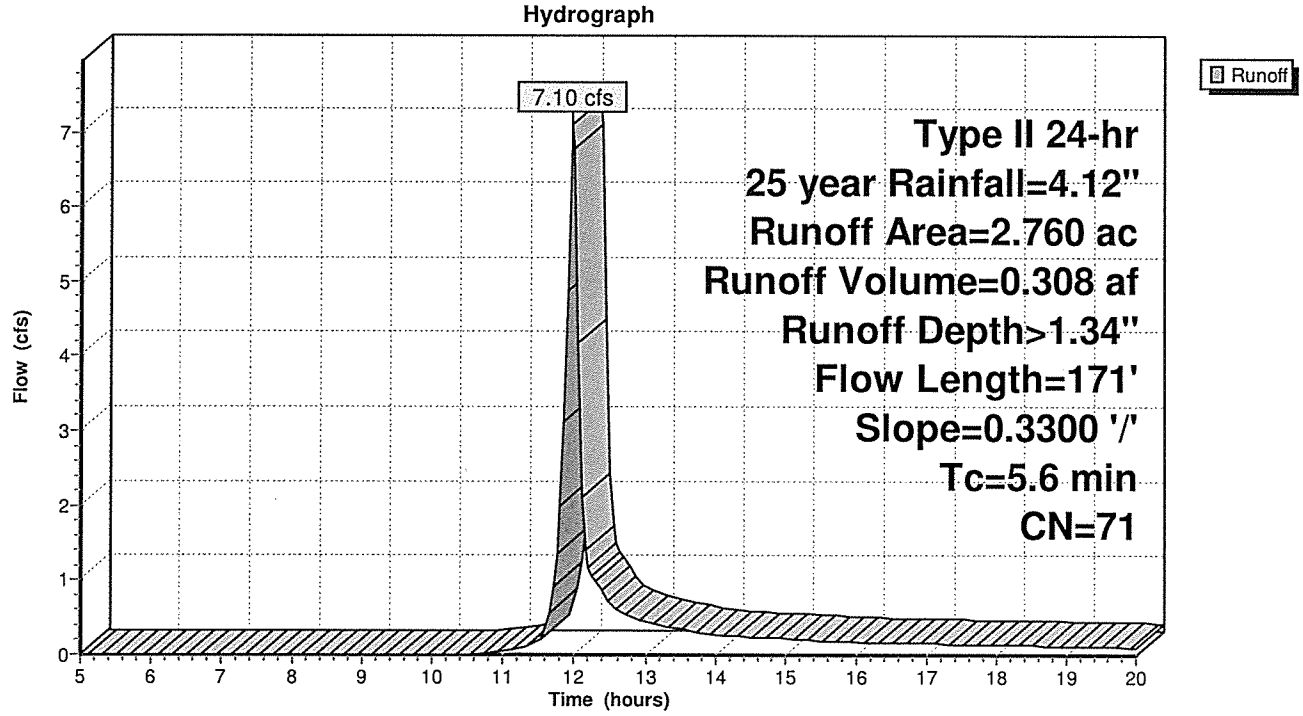
Runoff = 7.10 cfs @ 11.97 hrs, Volume= 0.308 af, Depth> 1.34"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type II 24-hr 25 year Rainfall=4.12"

Area (ac)	CN	Description
2.760	71	Meadow, non-grazed, HSG C
2.760		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.6	171	0.3300	0.51		**Sheet Flow, 171 feet 3H:1V sheet flow** Grass: Short n= 0.150 P2= 2.44"

Subcatchment DA-33: DA-33



Summary for Subcatchment DA-34: DA-34

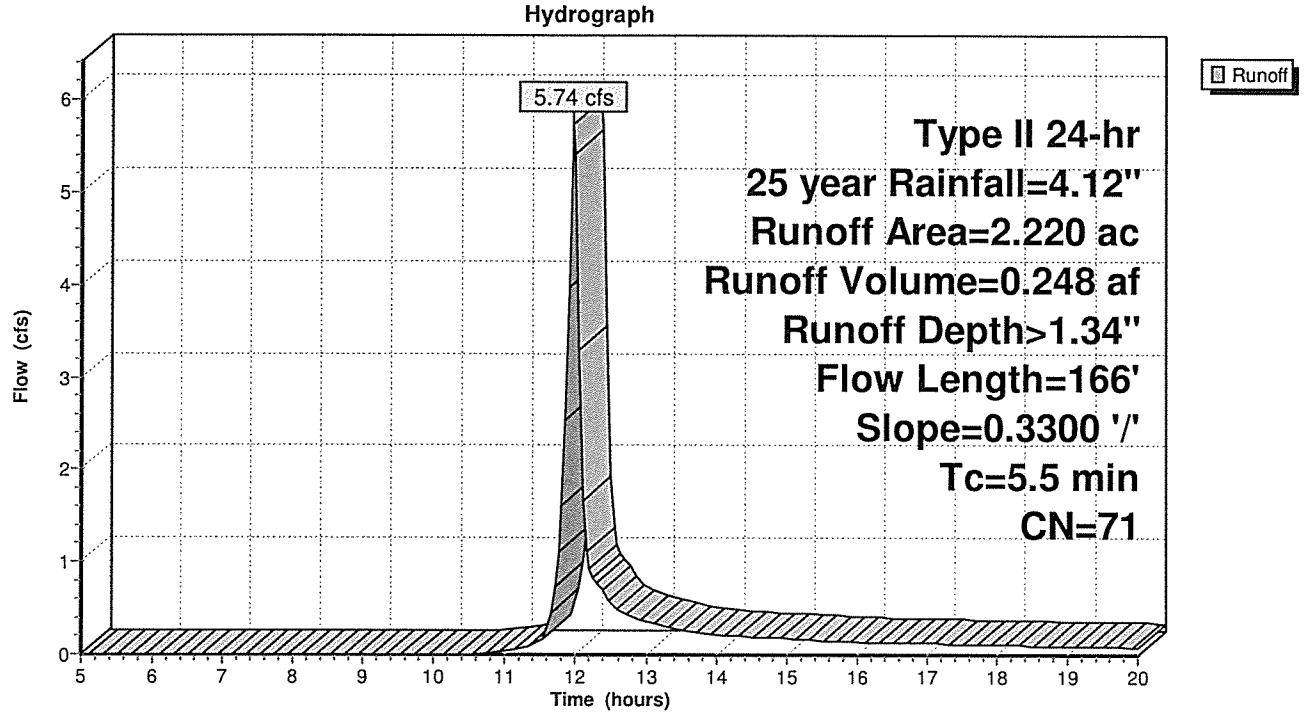
Runoff = 5.74 cfs @ 11.97 hrs, Volume= 0.248 af, Depth> 1.34"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type II 24-hr 25 year Rainfall=4.12"

Area (ac)	CN	Description
2.220	71	Meadow, non-grazed, HSG C
2.220		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.5	166	0.3300	0.50		**Sheet Flow, 166 feet 3H:1V sheet flow** Grass: Short n= 0.150 P2= 2.44"

Subcatchment DA-34: DA-34



Summary for Subcatchment DA-35: DA-35

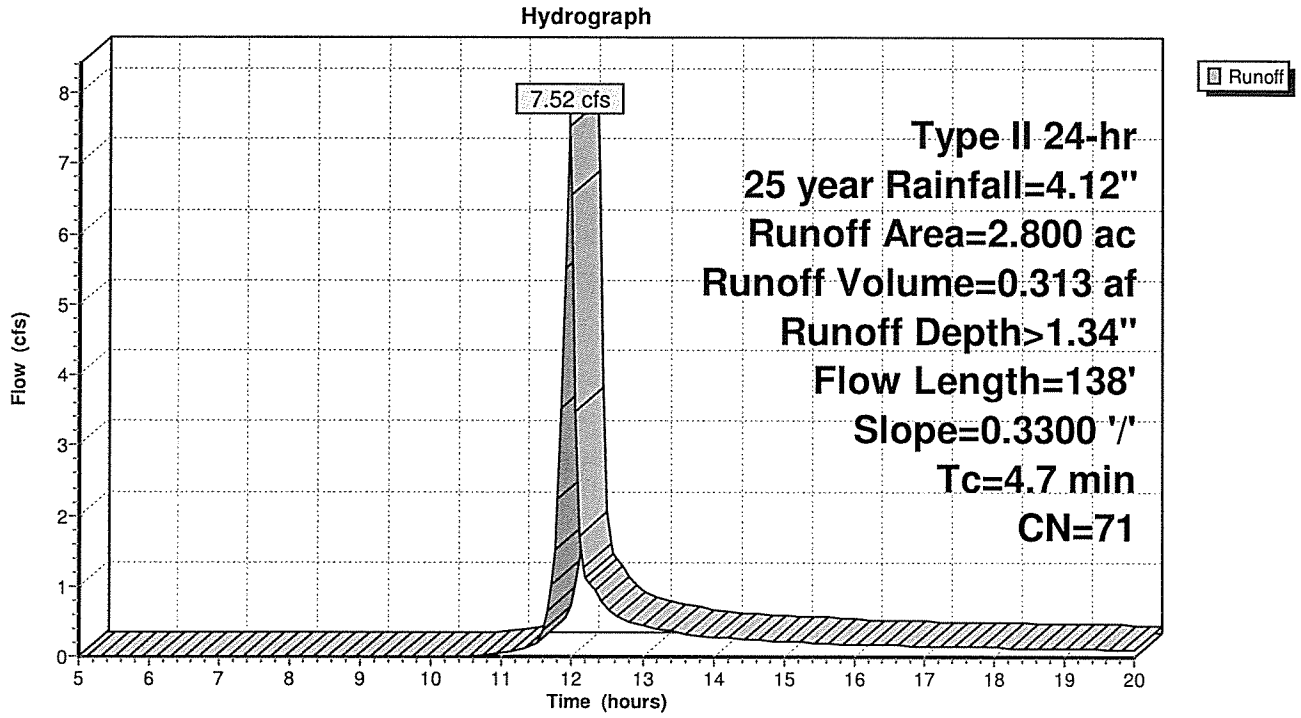
Runoff = 7.52 cfs @ 11.96 hrs, Volume= 0.313 af, Depth> 1.34"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type II 24-hr 25 year Rainfall=4.12"

Area (ac)	CN	Description
2.800	71	Meadow, non-grazed, HSG C
2.800		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
4.7	138	0.3300	0.49		**Sheet Flow, 138 feet 3H:1V sheet flow** Grass: Short n= 0.150 P2= 2.44"

Subcatchment DA-35: DA-35



Summary for Subcatchment DA-43: DA-43

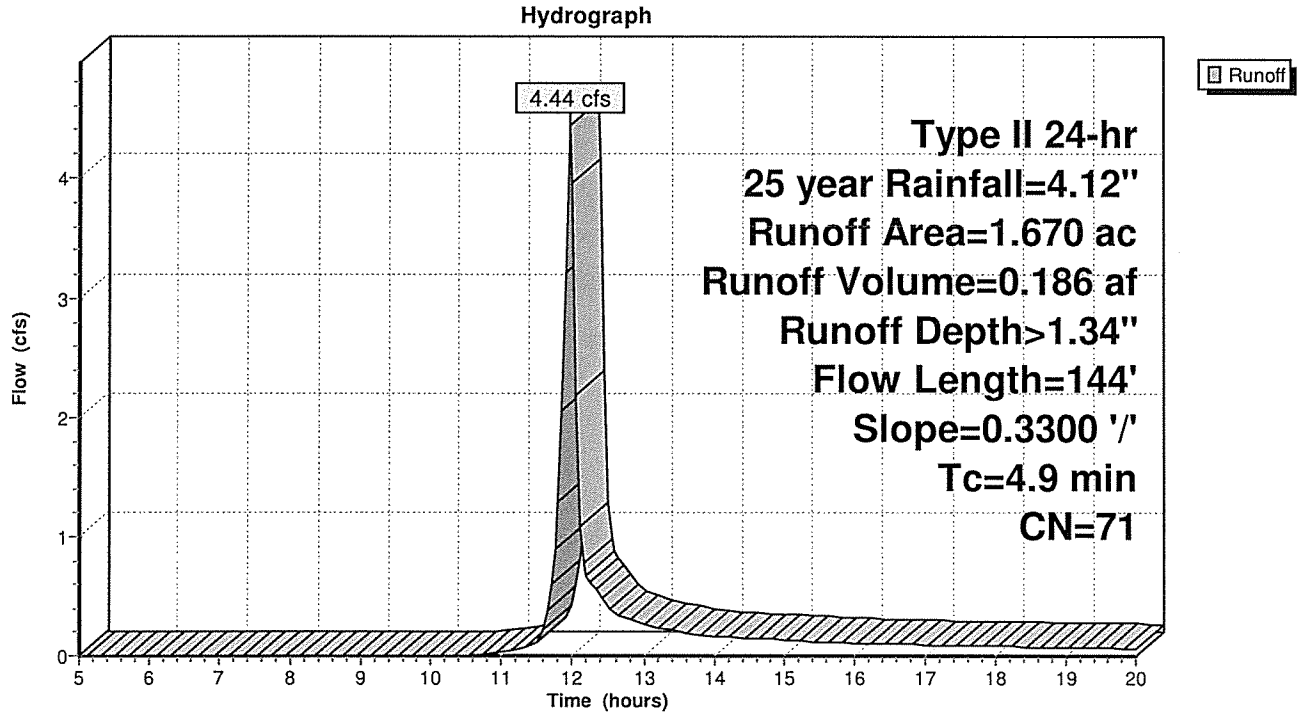
Runoff = 4.44 cfs @ 11.96 hrs, Volume= 0.186 af, Depth> 1.34"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type II 24-hr 25 year Rainfall=4.12"

Area (ac)	CN	Description
1.670	71	Meadow, non-grazed, HSG C
1.670		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
4.9	144	0.3300	0.49		**Sheet Flow, 144 feet 3H:1V sheet flow** Grass: Short n= 0.150 P2= 2.44"

Subcatchment DA-43: DA-43



Summary for Subcatchment DA-44: DA-44

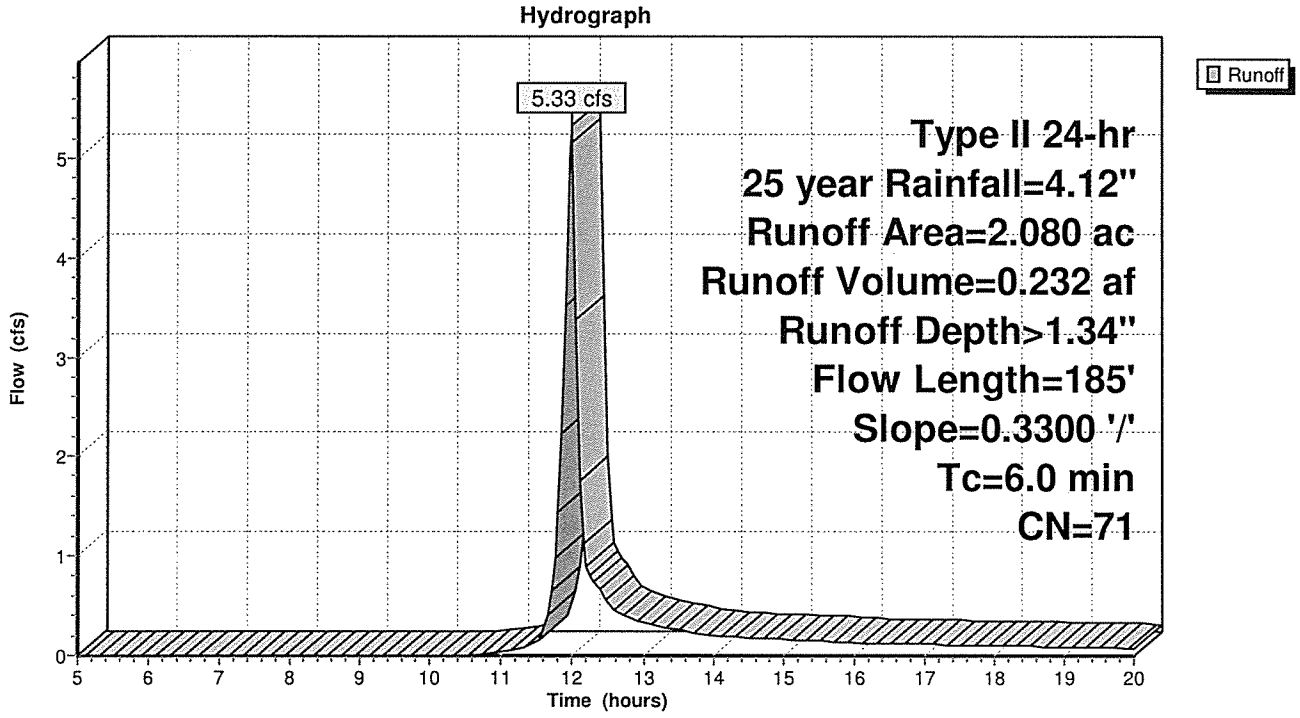
Runoff = 5.33 cfs @ 11.98 hrs, Volume= 0.232 af, Depth> 1.34"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type II 24-hr 25 year Rainfall=4.12"

Area (ac)	CN	Description
2.080	71	Meadow, non-grazed, HSG C
2.080		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.0	185	0.3300	0.52		**Sheet Flow, 185 feet 3H:1V sheet flow** Grass: Short n= 0.150 P2= 2.44"

Subcatchment DA-44: DA-44



Summary for Subcatchment DA-45: DA-45

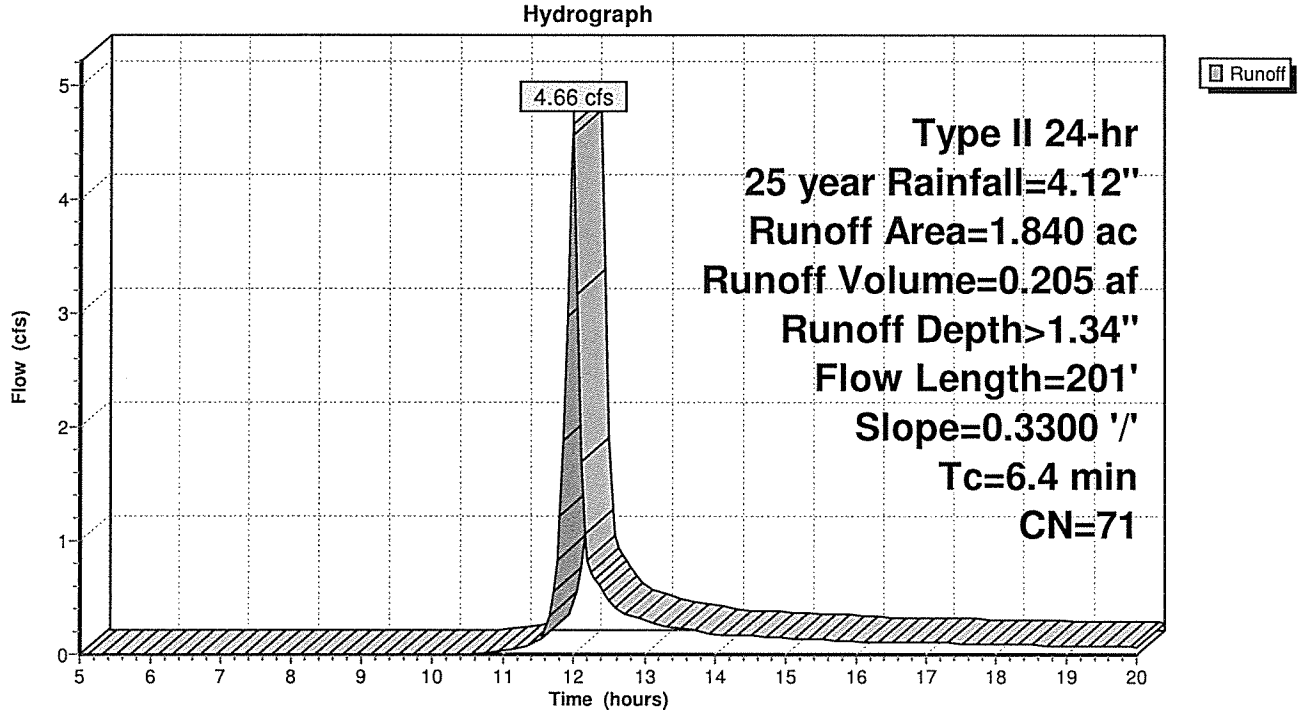
Runoff = 4.66 cfs @ 11.98 hrs, Volume= 0.205 af, Depth> 1.34"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type II 24-hr 25 year Rainfall=4.12"

Area (ac)	CN	Description
1.840	71	Meadow, non-grazed, HSG C
1.840		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.4	201	0.3300	0.52		**Sheet Flow, 201 feet 3H:1V sheet flow** Grass: Short n= 0.150 P2= 2.44"

Subcatchment DA-45: DA-45



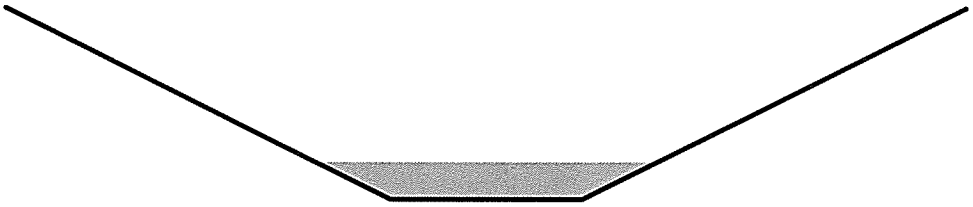
Summary for Reach CH-M1: Perimeter Channel M1

Inflow Area = 3.270 ac, 0.00% Impervious, Inflow Depth > 1.34" for 25 year event
Inflow = 8.78 cfs @ 11.96 hrs, Volume= 0.365 af
Outflow = 6.91 cfs @ 12.11 hrs, Volume= 0.360 af, Atten= 21%, Lag= 9.1 min

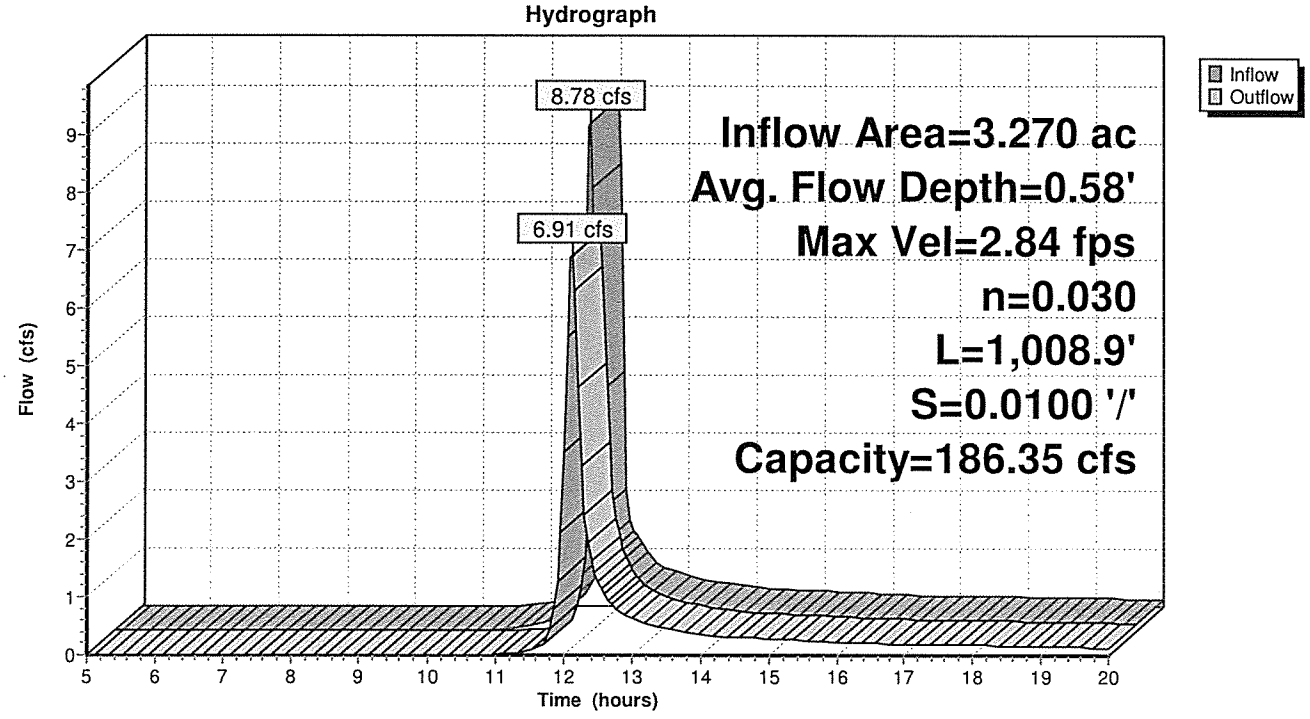
Routing by Stor-Ind+Trans method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Max. Velocity= 2.84 fps, Min. Travel Time= 5.9 min
Avg. Velocity = 0.97 fps, Avg. Travel Time= 17.3 min

Peak Storage= 2,461 cf @ 12.01 hrs
Average Depth at Peak Storage= 0.58'
Bank-Full Depth= 3.00' Flow Area= 27.0 sf, Capacity= 186.35 cfs

3.00' x 3.00' deep channel, n= 0.030 Earth, grassed & winding
Side Slope Z-value= 2.0 '/' Top Width= 15.00'
Length= 1,008.9' Slope= 0.0100 '/'
Inlet Invert= 1,304.61', Outlet Invert= 1,294.52'



Reach CH-M1: Perimeter Channel M1



Summary for Reach CH-M2: Perimeter Channel M2

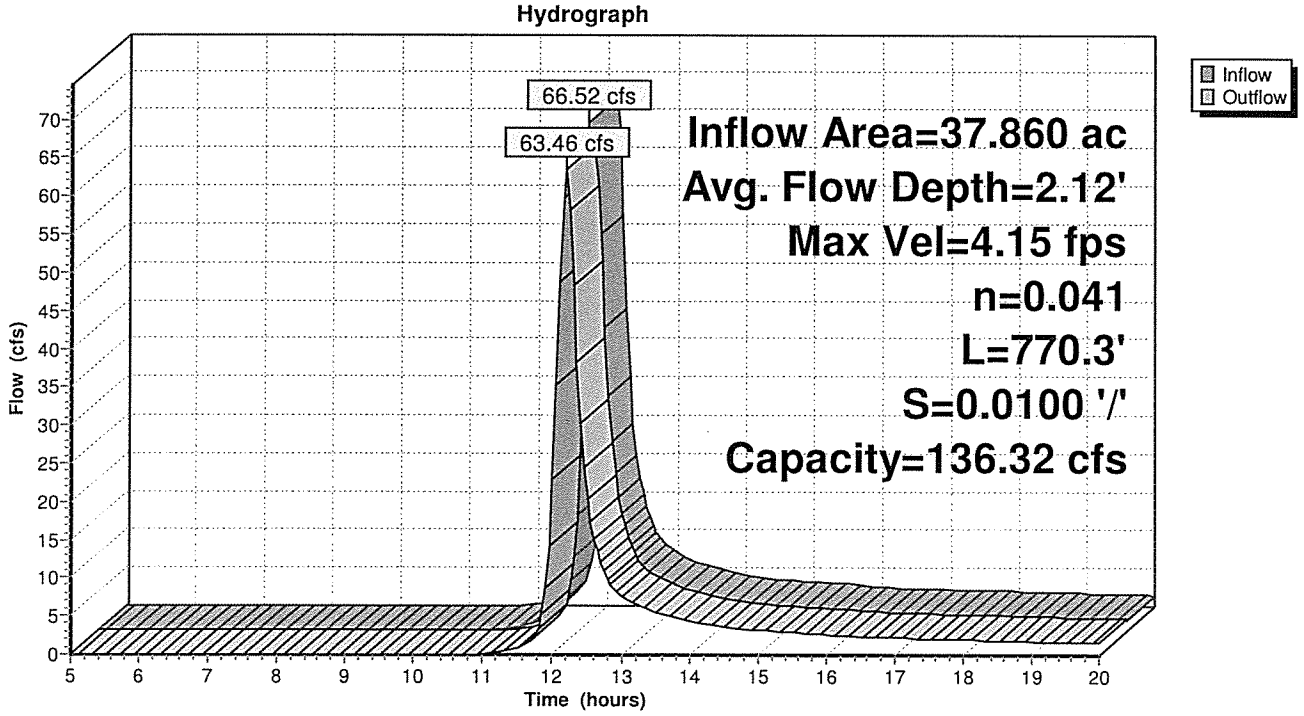
Inflow Area = 37.860 ac, 0.00% Impervious, Inflow Depth > 1.33" for 25 year event
Inflow = 66.52 cfs @ 12.10 hrs, Volume= 4.195 af
Outflow = 63.46 cfs @ 12.20 hrs, Volume= 4.171 af, Atten= 5%, Lag= 5.4 min

Routing by Stor-Ind+Trans method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Max. Velocity= 4.15 fps, Min. Travel Time= 3.1 min
Avg. Velocity = 1.76 fps, Avg. Travel Time= 7.3 min

Peak Storage= 11,787 cf @ 12.14 hrs
Average Depth at Peak Storage= 2.12'
Bank-Full Depth= 3.00' Flow Area= 27.0 sf, Capacity= 136.32 cfs

3.00' x 3.00' deep channel, n= 0.041
Side Slope Z-value= 2.0 '/' Top Width= 15.00'
Length= 770.3' Slope= 0.0100 '/'
Inlet Invert= 1,294.52', Outlet Invert= 1,286.82'

Reach CH-M2: Perimeter Channel M2



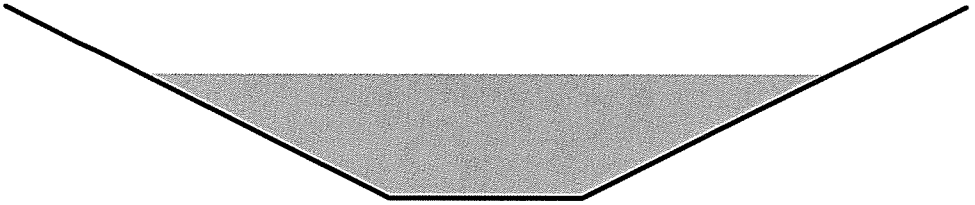
Summary for Reach CH-M3: Perimeter Channel M3

Inflow Area = 39.700 ac, 0.00% Impervious, Inflow Depth > 1.32" for 25 year event
Inflow = 64.30 cfs @ 12.19 hrs, Volume= 4.376 af
Outflow = 62.49 cfs @ 12.24 hrs, Volume= 4.362 af, Atten= 3%, Lag= 2.9 min

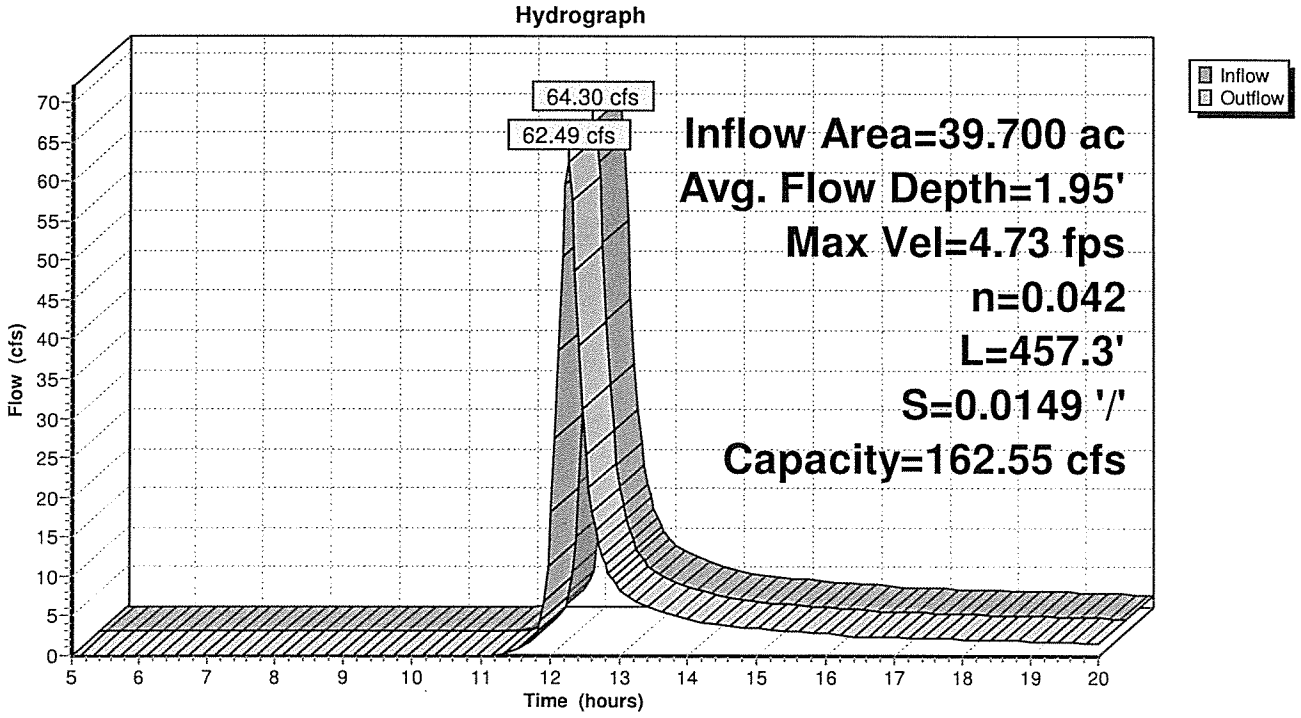
Routing by Stor-Ind+Trans method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Max. Velocity= 4.73 fps, Min. Travel Time= 1.6 min
Avg. Velocity = 2.00 fps, Avg. Travel Time= 3.8 min

Peak Storage= 6,141 cf @ 12.21 hrs
Average Depth at Peak Storage= 1.95'
Bank-Full Depth= 3.00' Flow Area= 27.0 sf, Capacity= 162.55 cfs

3.00' x 3.00' deep channel, n= 0.042
Side Slope Z-value= 2.0 '/' Top Width= 15.00'
Length= 457.3' Slope= 0.0149 '/'
Inlet Invert= 1,286.82', Outlet Invert= 1,280.00'



Reach CH-M3: Perimeter Channel M3



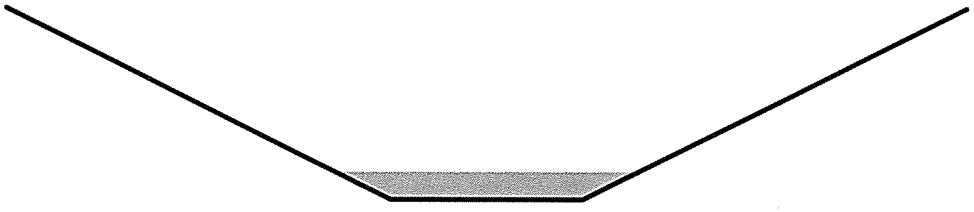
Summary for Reach CH-N1: Perimeter Channel N1

Inflow Area = 1.670 ac, 0.00% Impervious, Inflow Depth > 1.34" for 25 year event
Inflow = 4.44 cfs @ 11.96 hrs, Volume= 0.186 af
Outflow = 4.03 cfs @ 12.03 hrs, Volume= 0.185 af, Atten= 9%, Lag= 4.2 min

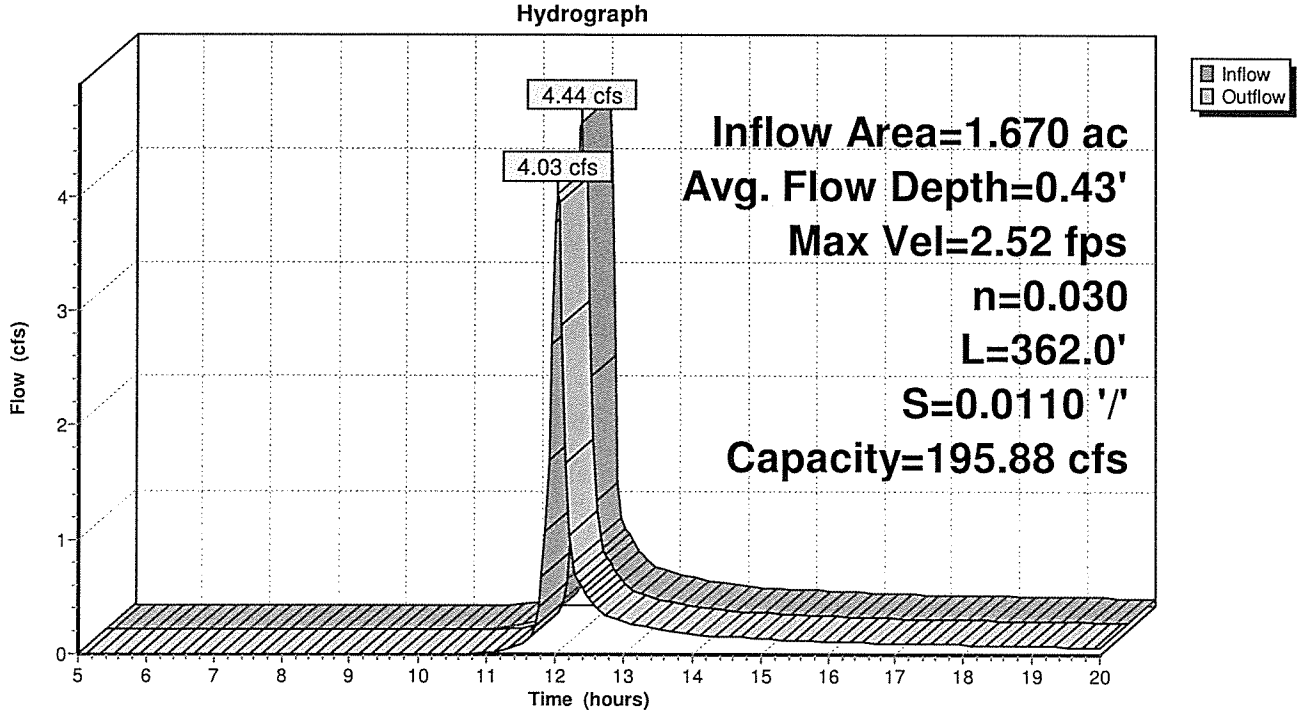
Routing by Stor-Ind+Trans method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Max. Velocity= 2.52 fps, Min. Travel Time= 2.4 min
Avg. Velocity = 0.80 fps, Avg. Travel Time= 7.6 min

Peak Storage= 600 cf @ 11.99 hrs
Average Depth at Peak Storage= 0.43'
Bank-Full Depth= 3.00' Flow Area= 27.0 sf, Capacity= 195.88 cfs

3.00' x 3.00' deep channel, n= 0.030 Earth, grassed & winding
Side Slope Z-value= 2.0 '/' Top Width= 15.00'
Length= 362.0' Slope= 0.0110 '/'
Inlet Invert= 1,306.00', Outlet Invert= 1,302.00'



Reach CH-N1: Perimeter Channel N1



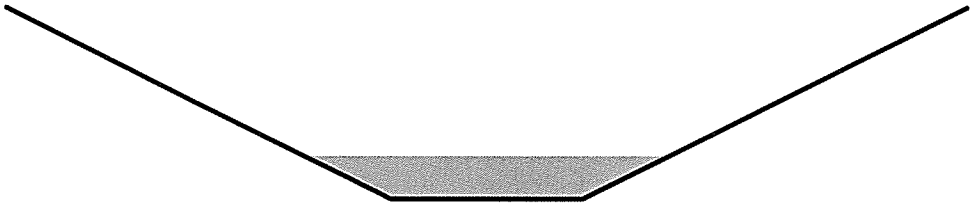
Summary for Reach CH-N2: Perimeter Channel N2

Inflow Area = 4.470 ac, 0.00% Impervious, Inflow Depth > 1.34" for 25 year event
Inflow = 10.64 cfs @ 11.98 hrs, Volume= 0.498 af
Outflow = 9.07 cfs @ 12.09 hrs, Volume= 0.493 af, Atten= 15%, Lag= 7.0 min

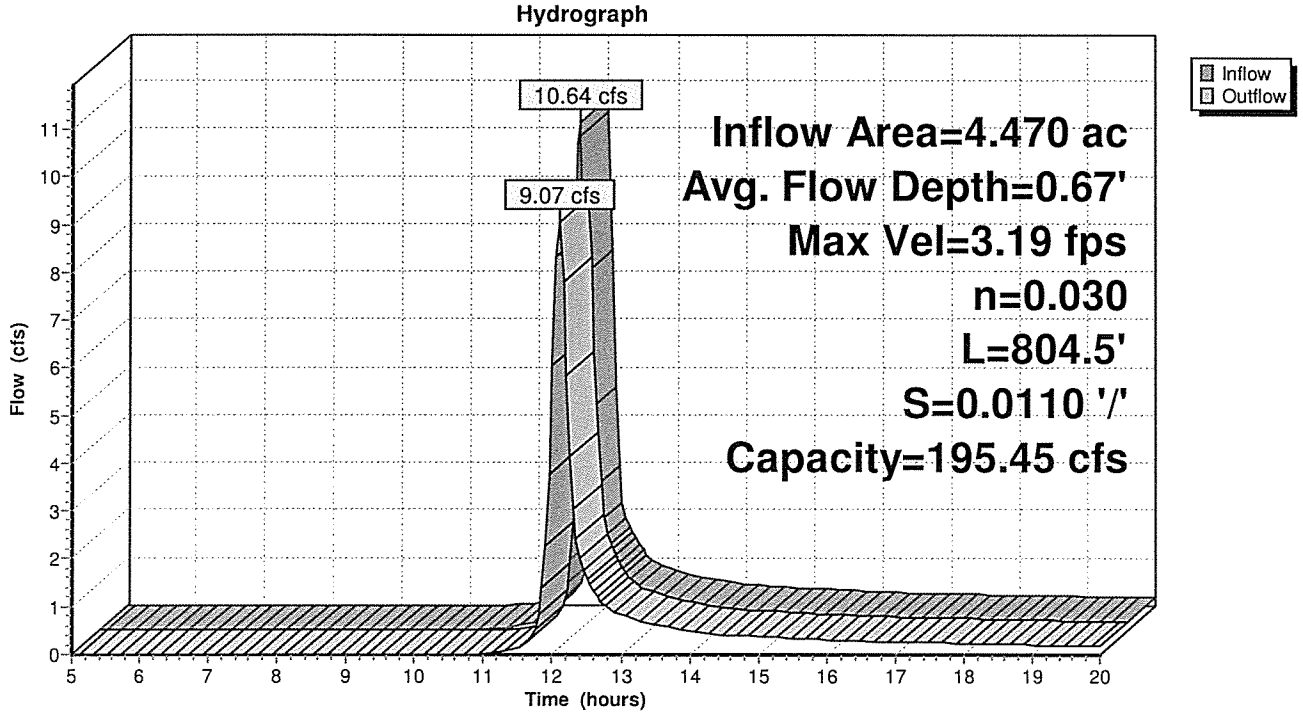
Routing by Stor-Ind+Trans method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Max. Velocity= 3.19 fps, Min. Travel Time= 4.2 min
Avg. Velocity = 1.12 fps, Avg. Travel Time= 12.0 min

Peak Storage= 2,348 cf @ 12.02 hrs
Average Depth at Peak Storage= 0.67'
Bank-Full Depth= 3.00' Flow Area= 27.0 sf, Capacity= 195.45 cfs

3.00' x 3.00' deep channel, n= 0.030 Earth, grassed & winding
Side Slope Z-value= 2.0 '/' Top Width= 15.00'
Length= 804.5' Slope= 0.0110 '/'
Inlet Invert= 1,302.00', Outlet Invert= 1,293.15'



Reach CH-N2: Perimeter Channel N2



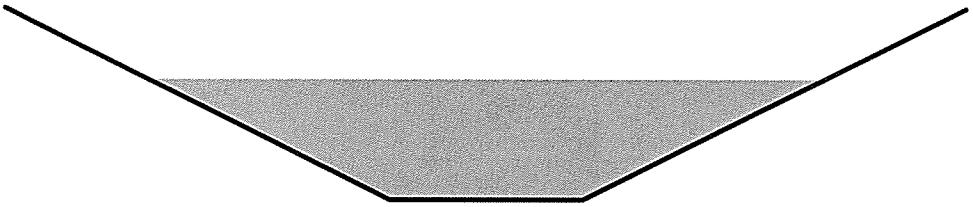
Summary for Reach CH-N3: Perimeter Channel N3

Inflow Area = 29.160 ac, 0.00% Impervious, Inflow Depth > 1.33" for 25 year event
Inflow = 51.14 cfs @ 12.10 hrs, Volume= 3.230 af
Outflow = 49.06 cfs @ 12.18 hrs, Volume= 3.215 af, Atten= 4%, Lag= 4.3 min

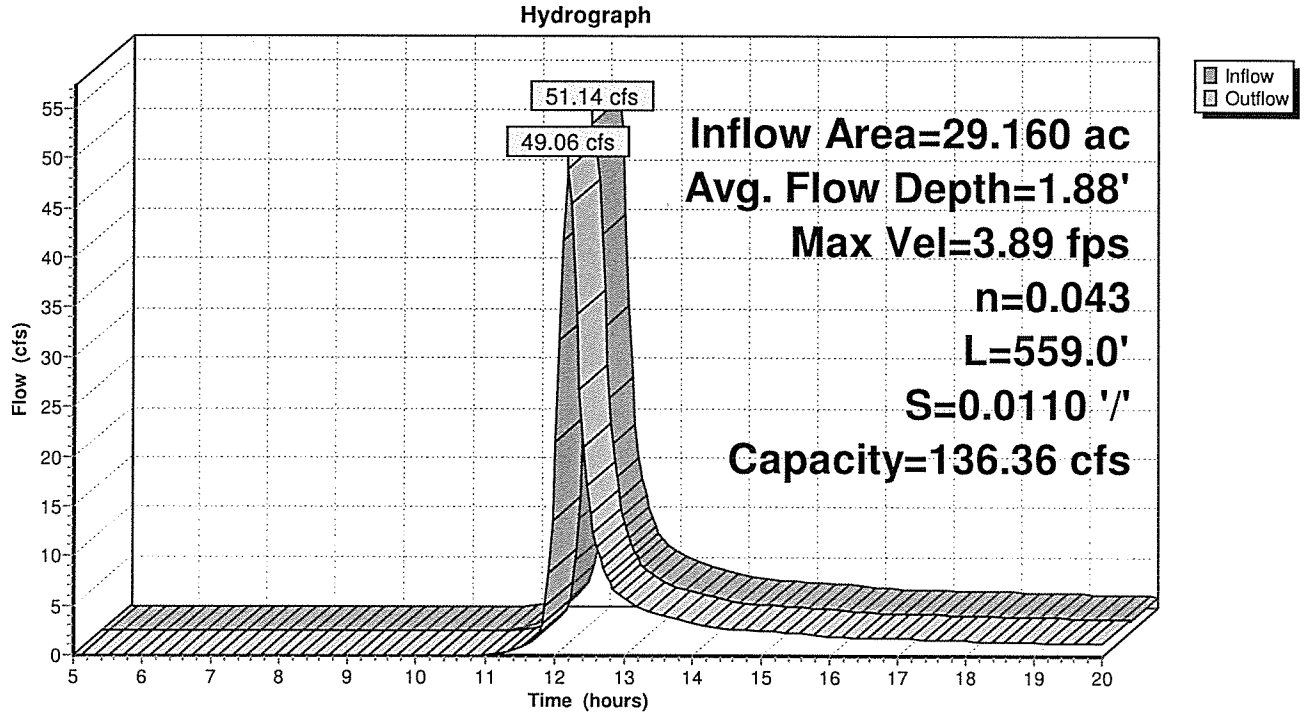
Routing by Stor-Ind+Trans method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Max. Velocity= 3.89 fps, Min. Travel Time= 2.4 min
Avg. Velocity = 1.62 fps, Avg. Travel Time= 5.7 min

Peak Storage= 7,123 cf @ 12.14 hrs
Average Depth at Peak Storage= 1.88'
Bank-Full Depth= 3.00' Flow Area= 27.0 sf, Capacity= 136.36 cfs

3.00' x 3.00' deep channel, n= 0.043
Side Slope Z-value= 2.0 '/' Top Width= 15.00'
Length= 559.0' Slope= 0.0110 '/'
Inlet Invert= 1,293.15', Outlet Invert= 1,287.00'



Reach CH-N3: Perimeter Channel N3



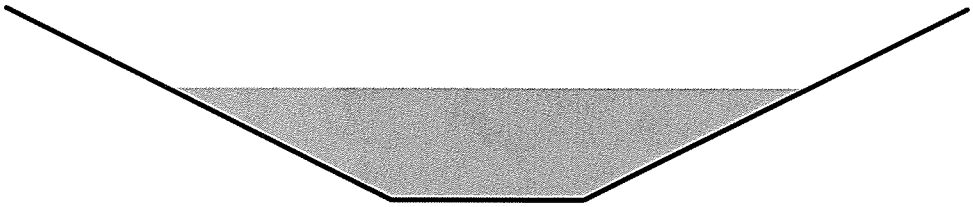
Summary for Reach CH-N4: Perimeter Channel N4

Inflow Area = 31.240 ac, 0.00% Impervious, Inflow Depth > 1.32" for 25 year event
Inflow = 50.09 cfs @ 12.17 hrs, Volume= 3.447 af
Outflow = 48.62 cfs @ 12.23 hrs, Volume= 3.433 af, Atten= 3%, Lag= 3.5 min

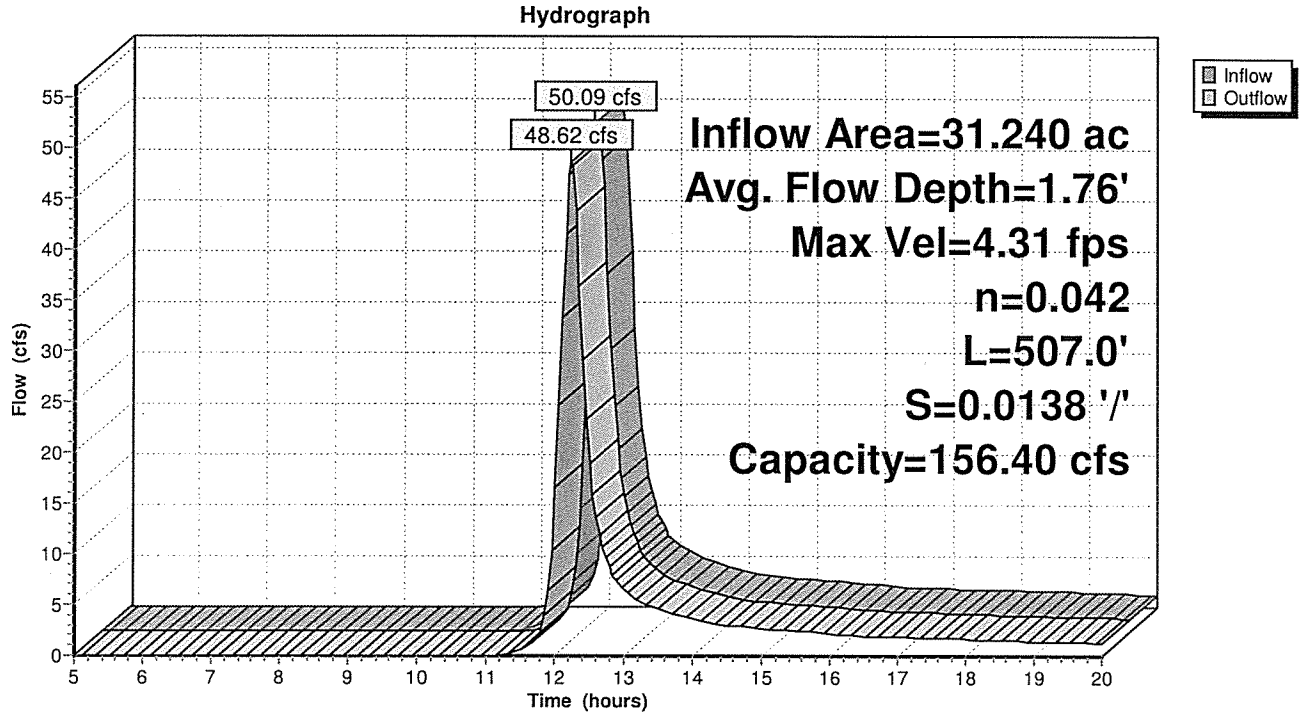
Routing by Stor-Ind+Trans method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Max. Velocity= 4.31 fps, Min. Travel Time= 2.0 min
Avg. Velocity = 1.81 fps, Avg. Travel Time= 4.7 min

Peak Storage= 5,811 cf @ 12.20 hrs
Average Depth at Peak Storage= 1.76'
Bank-Full Depth= 3.00' Flow Area= 27.0 sf, Capacity= 156.40 cfs

3.00' x 3.00' deep channel, n= 0.042
Side Slope Z-value= 2.0 '/' Top Width= 15.00'
Length= 507.0' Slope= 0.0138 '/'
Inlet Invert= 1,287.00', Outlet Invert= 1,280.00'



Reach CH-N4: Perimeter Channel N4



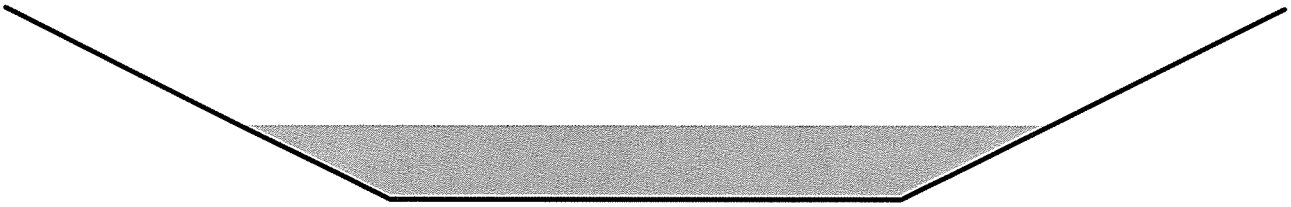
Summary for Reach D-M1: Discharge Channel M

Inflow Area = 70.940 ac, 0.00% Impervious, Inflow Depth > 1.32" for 25 year event
Inflow = 111.04 cfs @ 12.24 hrs, Volume= 7.796 af
Outflow = 110.44 cfs @ 12.25 hrs, Volume= 7.790 af, Atten= 1%, Lag= 0.5 min

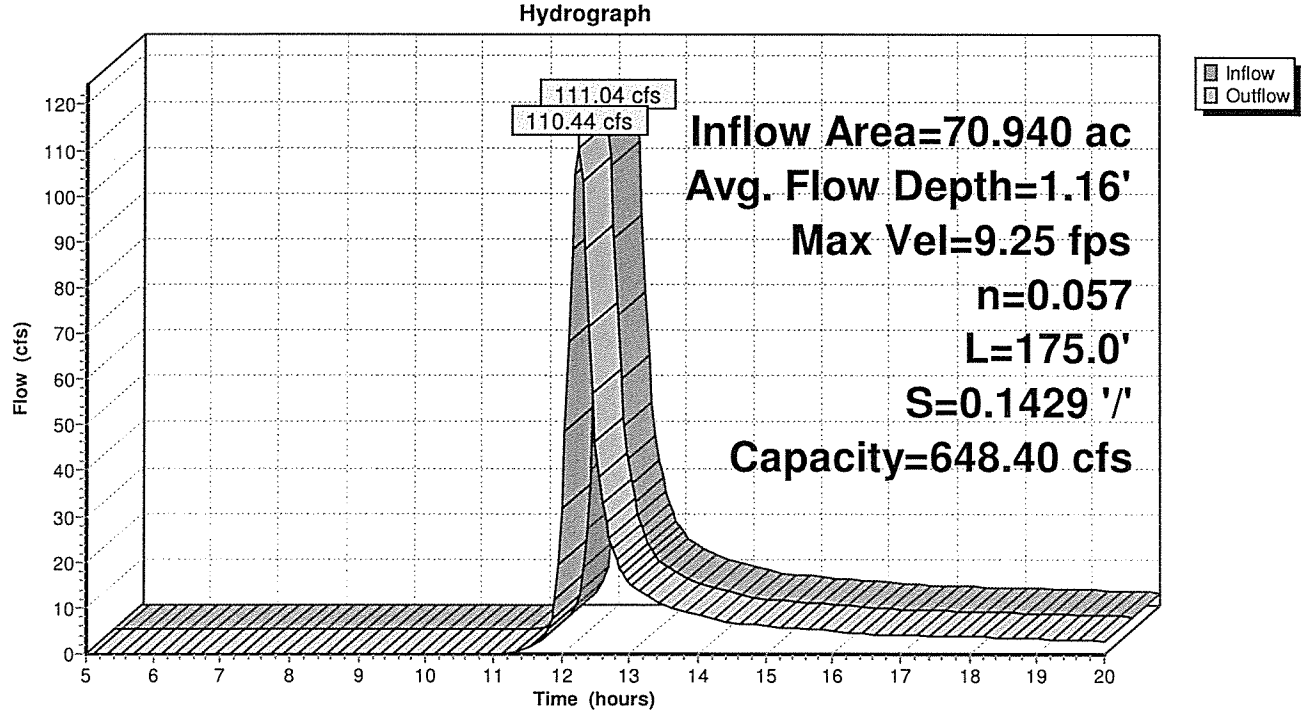
Routing by Stor-Ind+Trans method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Max. Velocity= 9.25 fps, Min. Travel Time= 0.3 min
Avg. Velocity = 3.36 fps, Avg. Travel Time= 0.9 min

Peak Storage= 2,101 cf @ 12.24 hrs
Average Depth at Peak Storage= 1.16'
Bank-Full Depth= 3.00' Flow Area= 42.0 sf, Capacity= 648.40 cfs

8.00' x 3.00' deep channel, n= 0.057
Side Slope Z-value= 2.0 '/' Top Width= 20.00'
Length= 175.0' Slope= 0.1429 '/'
Inlet Invert= 1,270.00', Outlet Invert= 1,245.00'



Reach D-M1: Discharge Channel M



Summary for Reach D-ES3: Emergency Spillway Discharge Channel

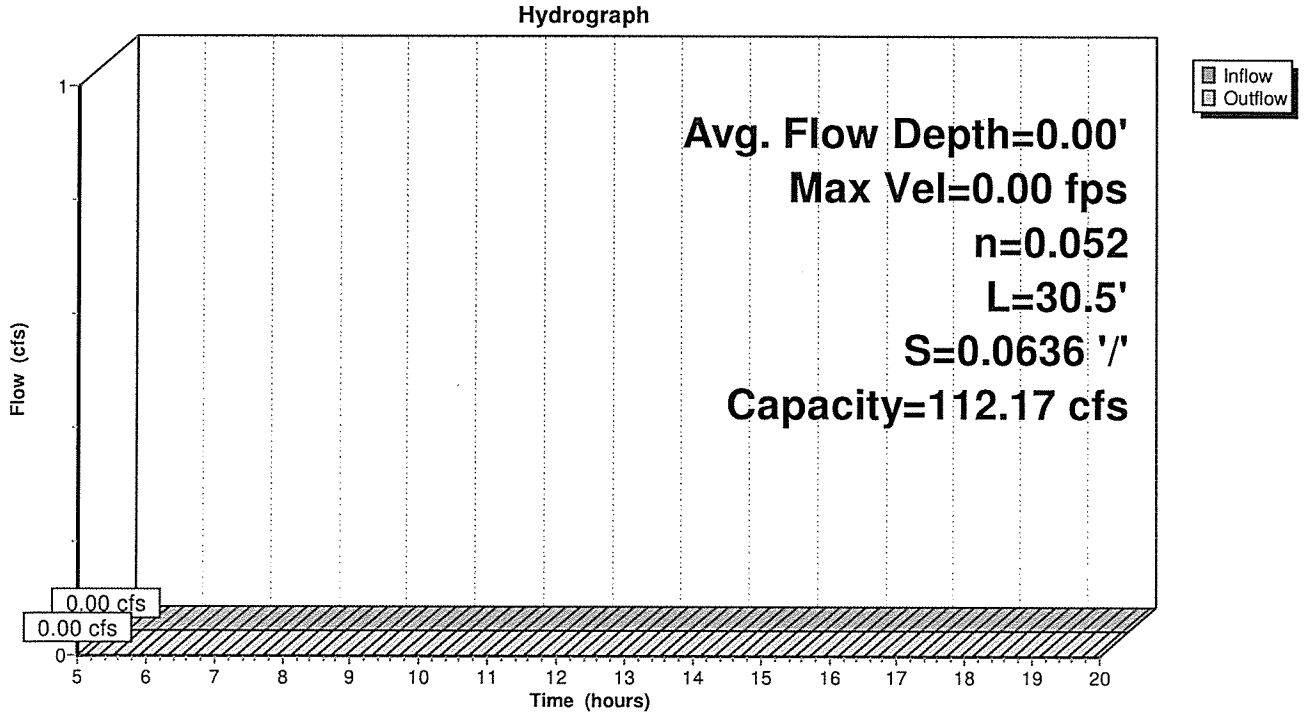
Inflow = 0.00 cfs @ 5.00 hrs, Volume= 0.000 af
Outflow = 0.00 cfs @ 5.00 hrs, Volume= 0.000 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Max. Velocity= 0.00 fps, Min. Travel Time= 0.0 min
Avg. Velocity = 0.00 fps, Avg. Travel Time= 0.0 min

Peak Storage= 0 cf @ 5.00 hrs
Average Depth at Peak Storage= 0.00'
Bank-Full Depth= 2.00' Flow Area= 14.0 sf, Capacity= 112.17 cfs

3.00' x 2.00' deep channel, n= 0.052
Side Slope Z-value= 2.0 '/' Top Width= 11.00'
Length= 30.5' Slope= 0.0636 '/'
Inlet Invert= 1,242.90', Outlet Invert= 1,240.96'

Reach D-ES3: Emergency Spillway Discharge Channel



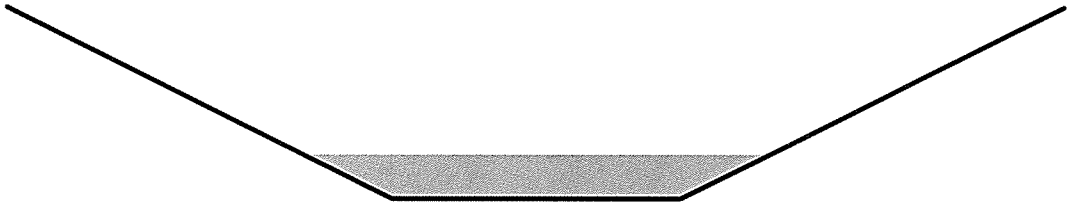
Summary for Reach D-P3: Pond 3 Discharge Channel

Inflow Area = 72.240 ac, 0.00% Impervious, Inflow Depth > 0.32" for 25 year event
Inflow = 5.21 cfs @ 15.90 hrs, Volume= 1.954 af
Outflow = 5.21 cfs @ 15.92 hrs, Volume= 1.947 af, Atten= 0%, Lag= 1.2 min

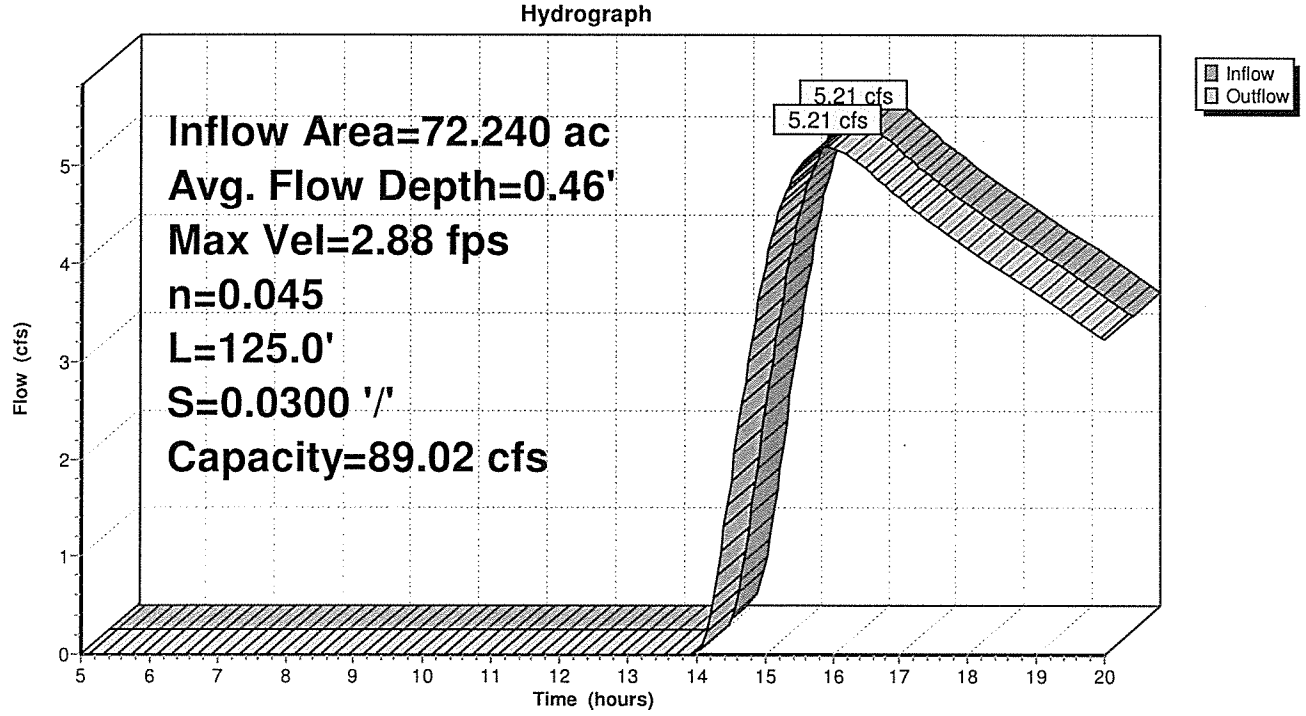
Routing by Stor-Ind+Trans method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Max. Velocity= 2.88 fps, Min. Travel Time= 0.7 min
Avg. Velocity = 2.56 fps, Avg. Travel Time= 0.8 min

Peak Storage= 226 cf @ 15.91 hrs
Average Depth at Peak Storage= 0.46'
Bank-Full Depth= 2.00' Flow Area= 14.0 sf, Capacity= 89.02 cfs

3.00' x 2.00' deep channel, n= 0.045
Side Slope Z-value= 2.0 '/' Top Width= 11.00'
Length= 125.0' Slope= 0.0300 '/'
Inlet Invert= 1,240.96', Outlet Invert= 1,237.21'



Reach D-P3: Pond 3 Discharge Channel



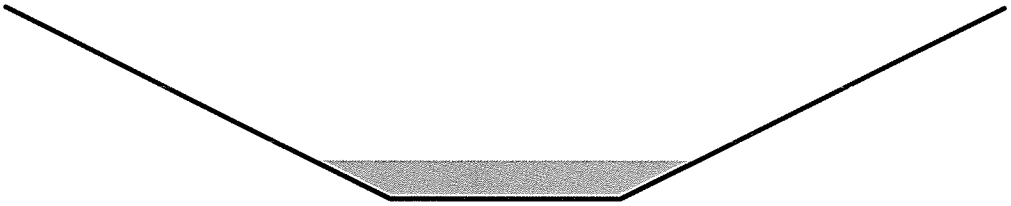
Summary for Reach 1R: Pond 3 Discharge Channel

Inflow Area = 72.240 ac, 0.00% Impervious, Inflow Depth > 0.32" for 25 year event
Inflow = 5.21 cfs @ 15.92 hrs, Volume= 1.947 af
Outflow = 5.21 cfs @ 16.00 hrs, Volume= 1.921 af, Atten= 0%, Lag= 4.6 min

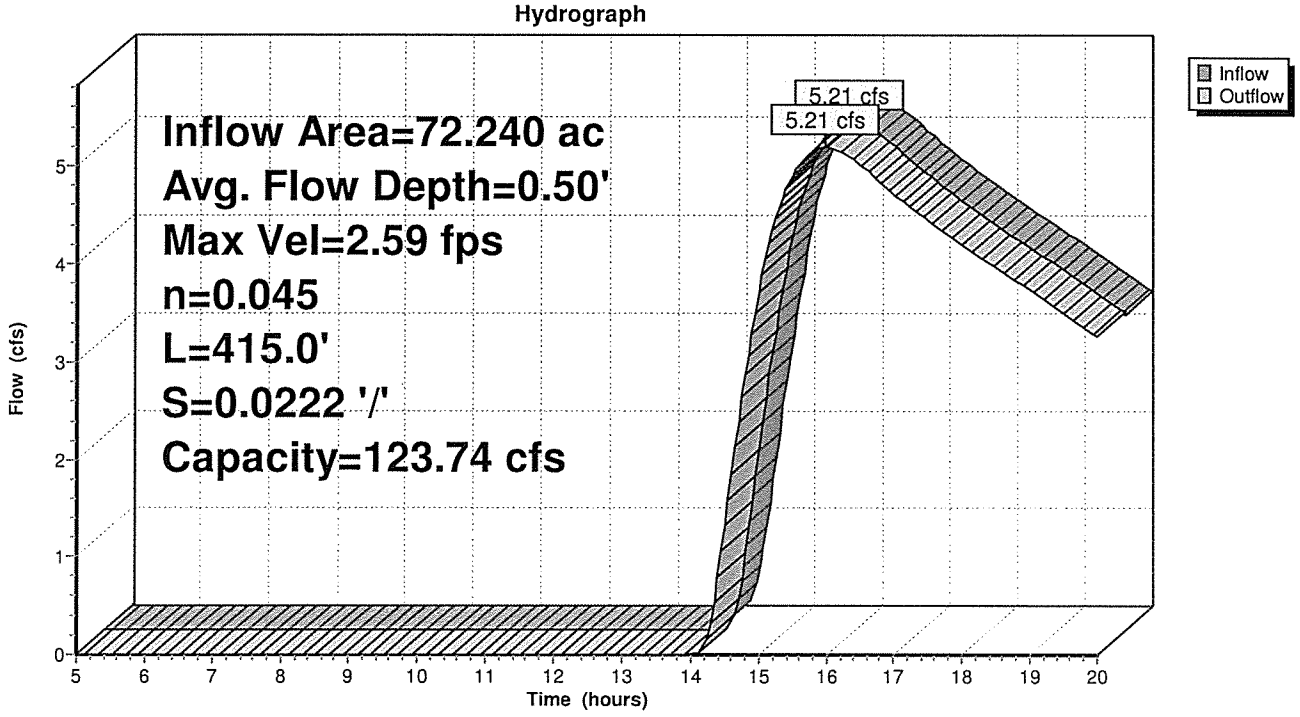
Routing by Stor-Ind+Trans method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Max. Velocity= 2.59 fps, Min. Travel Time= 2.7 min
Avg. Velocity = 2.29 fps, Avg. Travel Time= 3.0 min

Peak Storage= 833 cf @ 15.95 hrs
Average Depth at Peak Storage= 0.50'
Bank-Full Depth= 2.50' Flow Area= 20.0 sf, Capacity= 123.74 cfs

3.00' x 2.50' deep channel, n= 0.045
Side Slope Z-value= 2.0 '/' Top Width= 13.00'
Length= 415.0' Slope= 0.0222 '/'
Inlet Invert= 1,237.21', Outlet Invert= 1,228.00'



Reach 1R: Pond 3 Discharge Channel



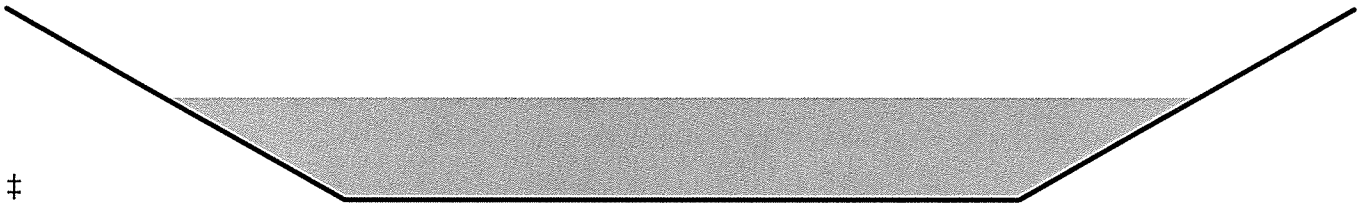
Summary for Reach DC11-1: DC11-1

Inflow Area = 31.830 ac, 0.00% Impervious, Inflow Depth > 1.33" for 25 year event
Inflow = 59.51 cfs @ 12.08 hrs, Volume= 3.538 af
Outflow = 59.06 cfs @ 12.09 hrs, Volume= 3.535 af, Atten= 1%, Lag= 0.6 min

Routing by Stor-Ind+Trans method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Max. Velocity= 9.72 fps, Min. Travel Time= 0.3 min
Avg. Velocity = 3.31 fps, Avg. Travel Time= 0.9 min

Peak Storage= 1,125 cf @ 12.08 hrs
Average Depth at Peak Storage= 0.80'
Bank-Full Depth= 1.50' Flow Area= 13.5 sf, Capacity= 185.50 cfs

6.00' x 1.50' deep channel, n= 0.065
Side Slope Z-value= 2.0 '/' Top Width= 12.00'
Length= 184.5' Slope= 0.3333 '/'
Inlet Invert= 1,500.96', Outlet Invert= 1,439.47'



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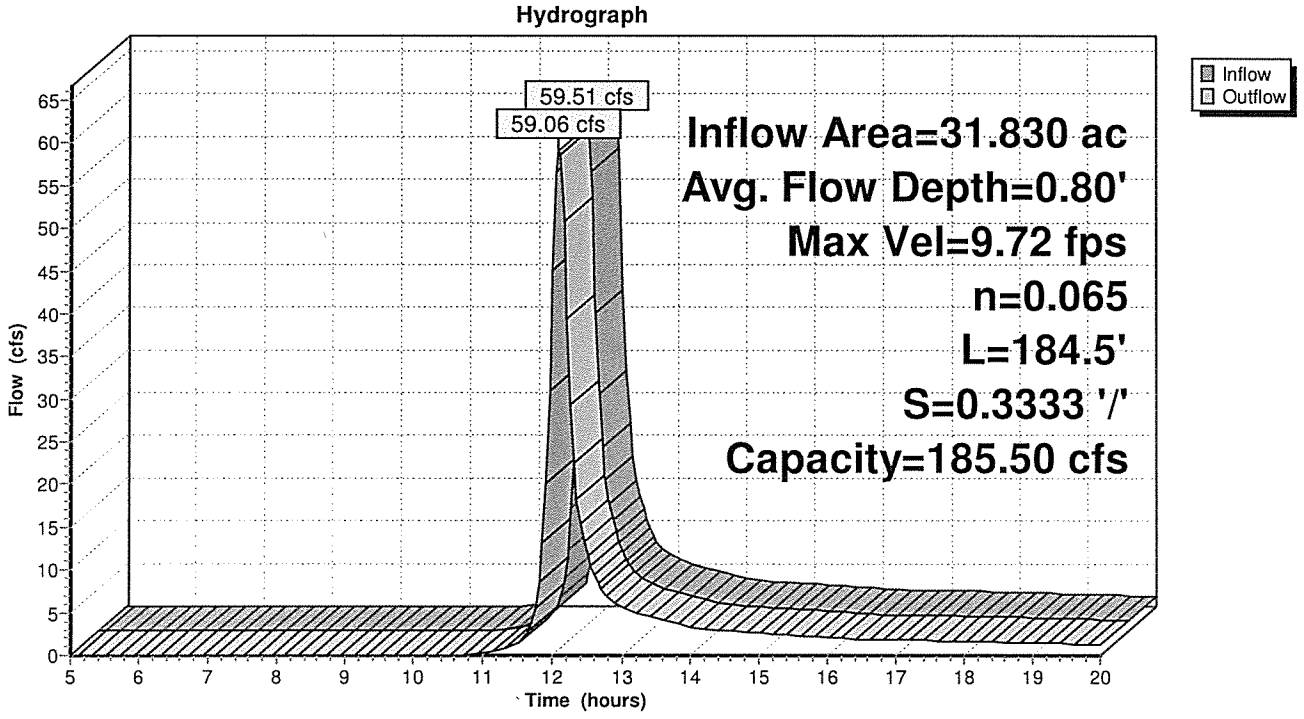
Reach DC11-1: DC11-1



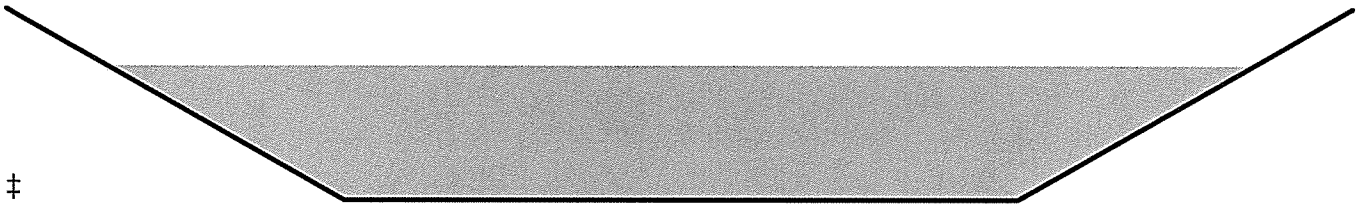
Summary for Reach DC11-2: DC11-2

Inflow Area = 31.830 ac, 0.00% Impervious, Inflow Depth > 1.33" for 25 year event
Inflow = 59.06 cfs @ 12.09 hrs, Volume= 3.535 af
Outflow = 58.97 cfs @ 12.09 hrs, Volume= 3.535 af, Atten= 0%, Lag= 0.1 min

Routing by Stor-Ind+Trans method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Max. Velocity= 6.90 fps, Min. Travel Time= 0.1 min
Avg. Velocity = 2.42 fps, Avg. Travel Time= 0.2 min

Peak Storage= 241 cf @ 12.09 hrs
Average Depth at Peak Storage= 1.05'
Bank-Full Depth= 1.50' Flow Area= 13.5 sf, Capacity= 113.06 cfs

6.00' x 1.50' deep channel, n= 0.058
Side Slope Z-value= 2.0 '/' Top Width= 12.00'
Length= 28.2' Slope= 0.0986 '/'
Inlet Invert= 1,439.47', Outlet Invert= 1,436.69'



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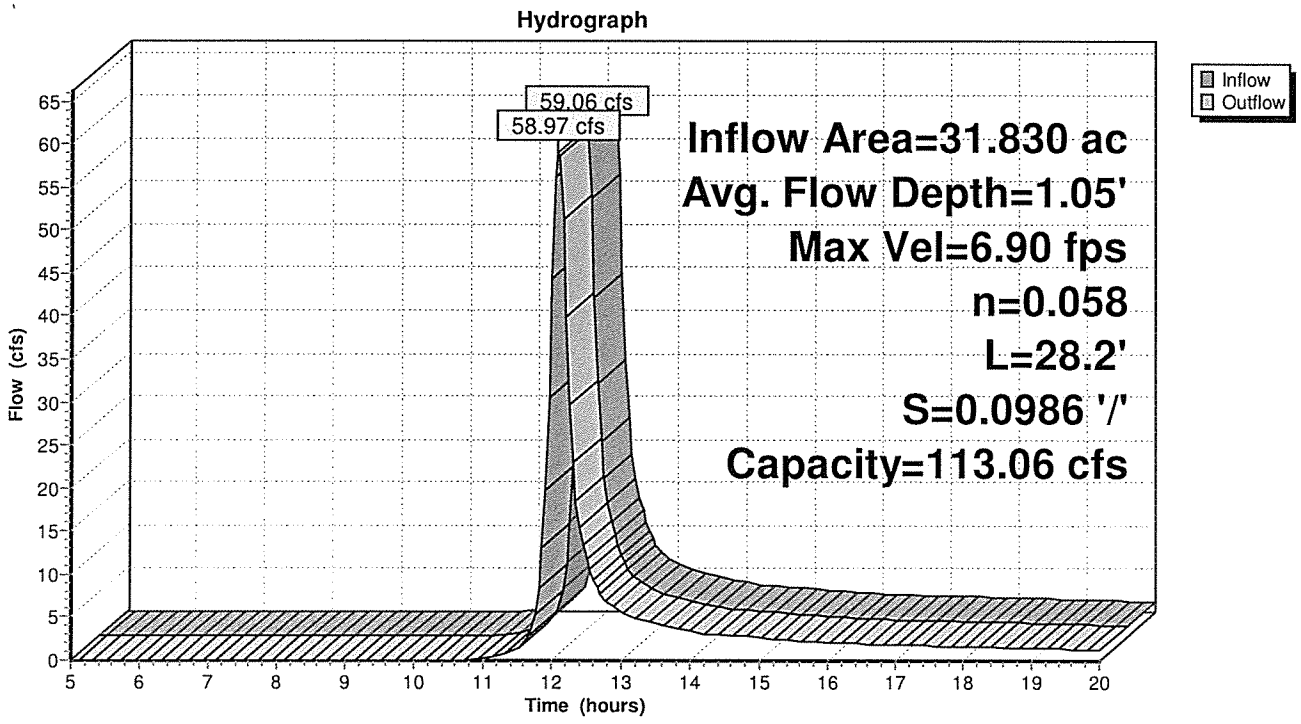
Reach DC11-2: DC11-2



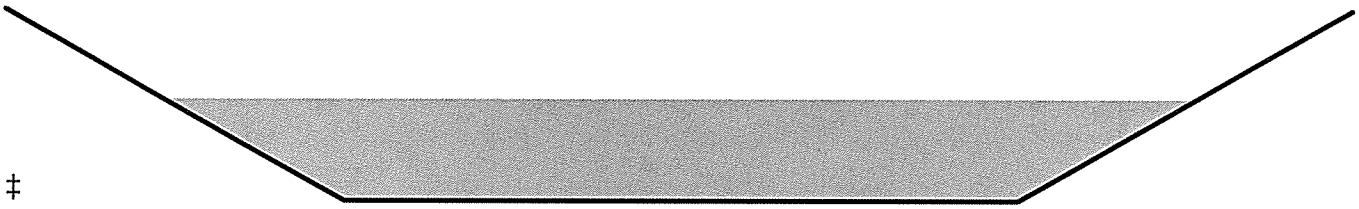
Summary for Reach DC11-3: DC11-3

Inflow Area = 31.830 ac, 0.00% Impervious, Inflow Depth > 1.33" for 25 year event
Inflow = 58.97 cfs @ 12.09 hrs, Volume= 3.535 af
Outflow = 58.55 cfs @ 12.10 hrs, Volume= 3.532 af, Atten= 1%, Lag= 0.5 min

Routing by Stor-Ind+Trans method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Max. Velocity= 9.72 fps, Min. Travel Time= 0.3 min
Avg. Velocity = 3.31 fps, Avg. Travel Time= 0.9 min

Peak Storage= 1,042 cf @ 12.09 hrs
Average Depth at Peak Storage= 0.80'
Bank-Full Depth= 1.50' Flow Area= 13.5 sf, Capacity= 185.47 cfs

6.00' x 1.50' deep channel, n= 0.065
Side Slope Z-value= 2.0 '/' Top Width= 12.00'
Length= 171.9' Slope= 0.3332 '/'
Inlet Invert= 1,436.69', Outlet Invert= 1,379.42'



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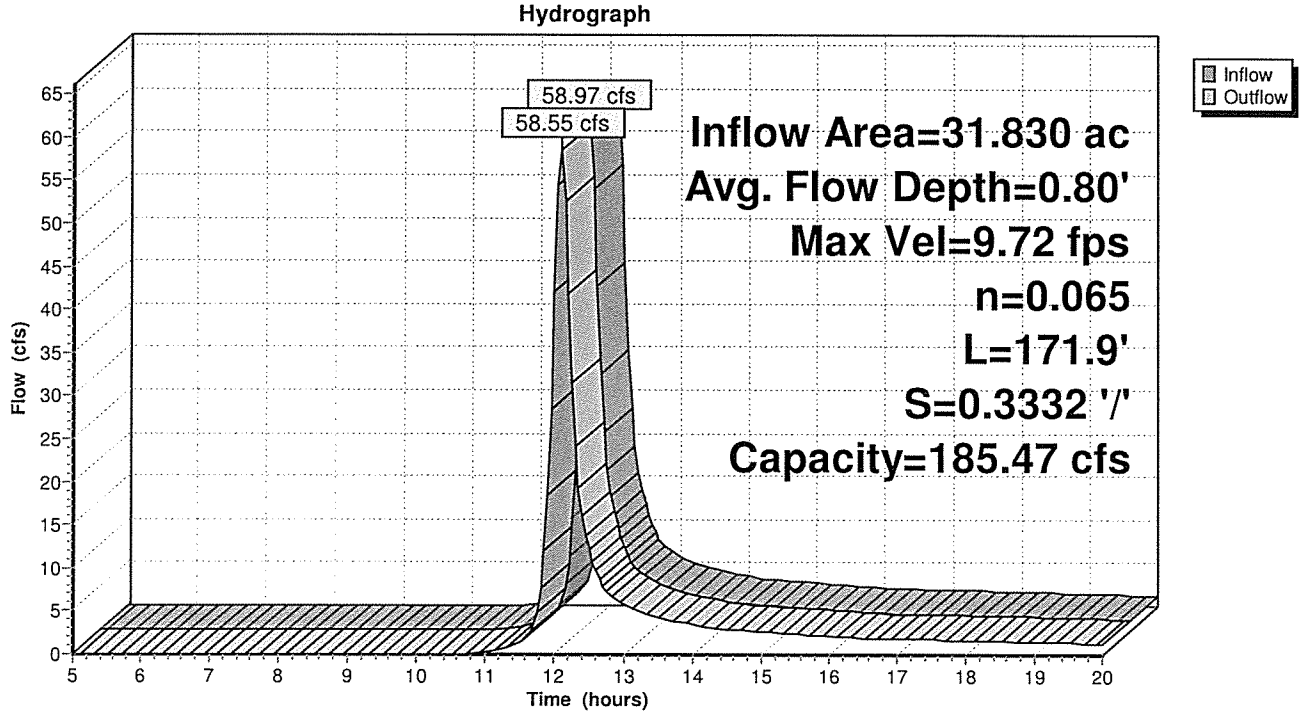
Reach DC11-3: DC11-3



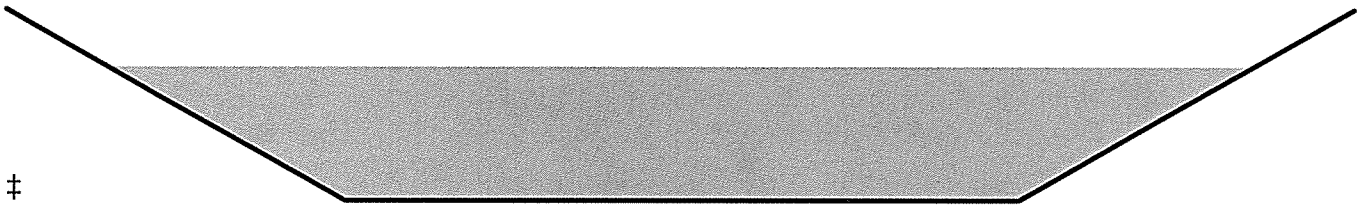
Summary for Reach DC11-4: DC11-4

Inflow Area = 31.830 ac, 0.00% Impervious, Inflow Depth > 1.33" for 25 year event
Inflow = 58.55 cfs @ 12.10 hrs, Volume= 3.532 af
Outflow = 58.45 cfs @ 12.10 hrs, Volume= 3.532 af, Atten= 0%, Lag= 0.1 min

Routing by Stor-Ind+Trans method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Max. Velocity= 6.92 fps, Min. Travel Time= 0.1 min
Avg. Velocity = 2.42 fps, Avg. Travel Time= 0.2 min

Peak Storage= 236 cf @ 12.10 hrs
Average Depth at Peak Storage= 1.05'
Bank-Full Depth= 1.50' Flow Area= 13.5 sf, Capacity= 113.47 cfs

6.00' x 1.50' deep channel, n= 0.058
Side Slope Z-value= 2.0 '/' Top Width= 12.00'
Length= 27.9' Slope= 0.0993 '/'
Inlet Invert= 1,379.42', Outlet Invert= 1,376.65'



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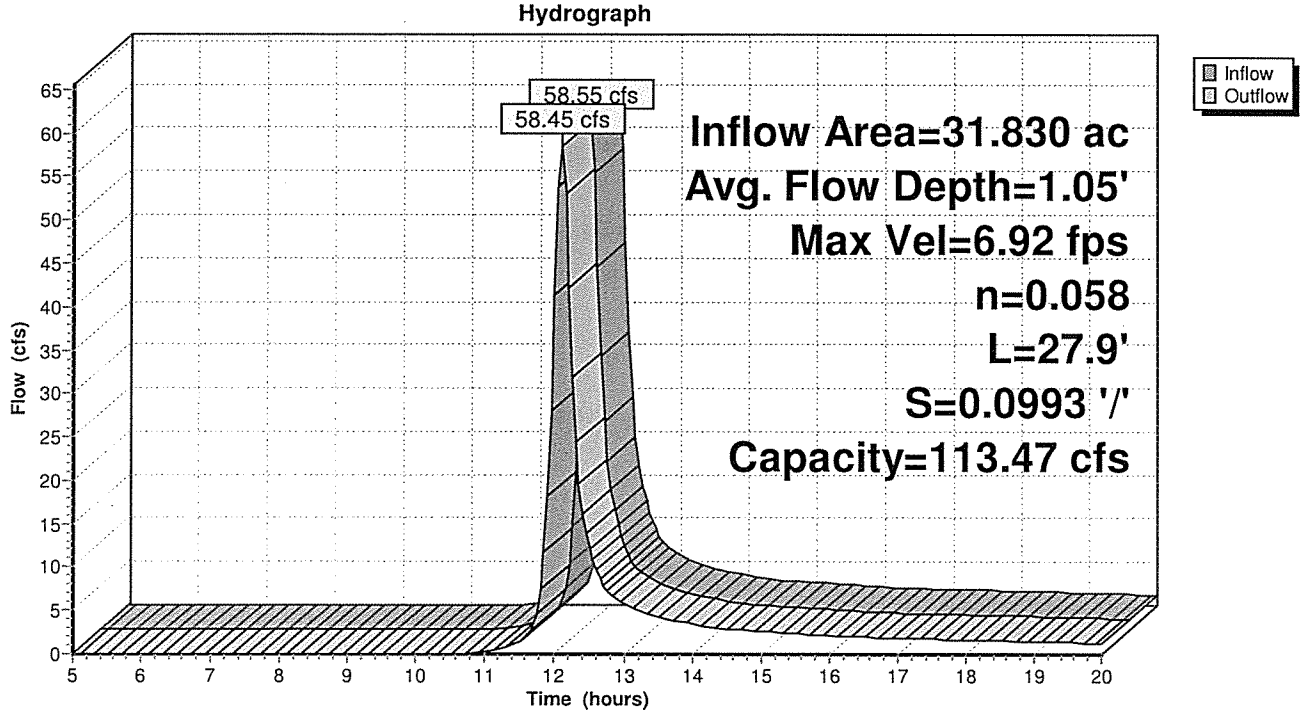
Reach DC11-4: DC11-4



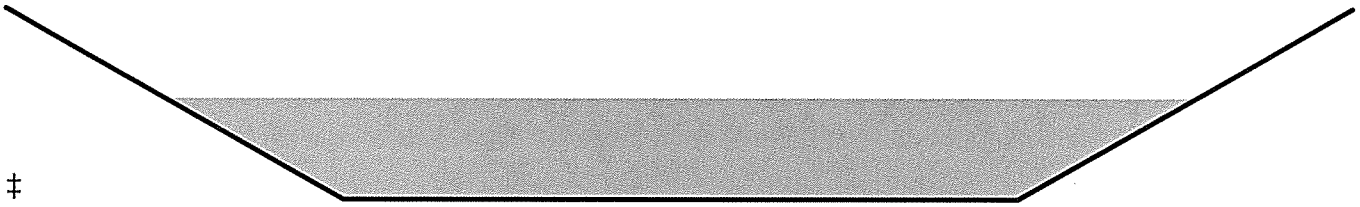
Summary for Reach DC11-5: DC11-5

Inflow Area = 31.830 ac, 0.00% Impervious, Inflow Depth > 1.33" for 25 year event
Inflow = 58.45 cfs @ 12.10 hrs, Volume= 3.532 af
Outflow = 58.00 cfs @ 12.11 hrs, Volume= 3.529 af, Atten= 1%, Lag= 0.5 min

Routing by Stor-Ind+Trans method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Max. Velocity= 9.70 fps, Min. Travel Time= 0.3 min
Avg. Velocity = 3.32 fps, Avg. Travel Time= 0.9 min

Peak Storage= 1,037 cf @ 12.10 hrs
Average Depth at Peak Storage= 0.79'
Bank-Full Depth= 1.50' Flow Area= 13.5 sf, Capacity= 185.42 cfs

6.00' x 1.50' deep channel, n= 0.065
Side Slope Z-value= 2.0 '/' Top Width= 12.00'
Length= 172.2' Slope= 0.3330 '/'
Inlet Invert= 1,376.65', Outlet Invert= 1,319.31'



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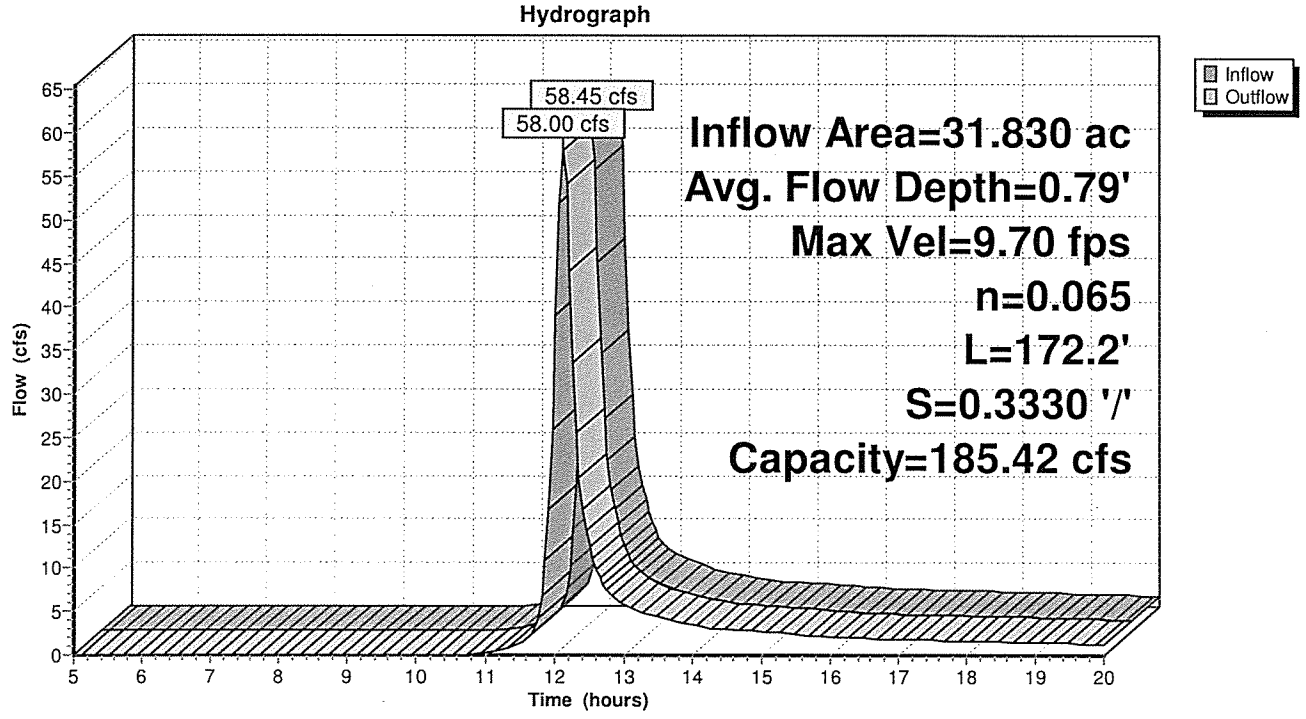
Reach DC11-5: DC11-5



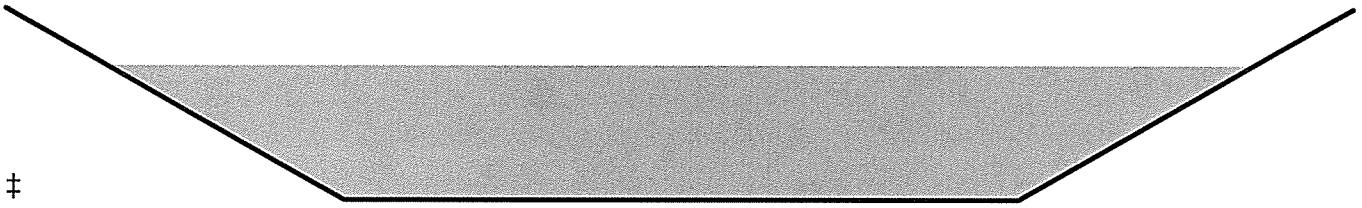
Summary for Reach DC11-6: DC11-6

Inflow Area = 31.830 ac, 0.00% Impervious, Inflow Depth > 1.33" for 25 year event
Inflow = 58.00 cfs @ 12.11 hrs, Volume= 3.529 af
Outflow = 57.89 cfs @ 12.11 hrs, Volume= 3.529 af, Atten= 0%, Lag= 0.1 min

Routing by Stor-Ind+Trans method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Max. Velocity= 6.80 fps, Min. Travel Time= 0.1 min
Avg. Velocity = 2.40 fps, Avg. Travel Time= 0.2 min

Peak Storage= 240 cf @ 12.11 hrs
Average Depth at Peak Storage= 1.05'
Bank-Full Depth= 1.50' Flow Area= 13.5 sf, Capacity= 111.34 cfs

6.00' x 1.50' deep channel, n= 0.059
Side Slope Z-value= 2.0 '/' Top Width= 12.00'
Length= 28.1' Slope= 0.0989 '/'
Inlet Invert= 1,319.31', Outlet Invert= 1,316.53'



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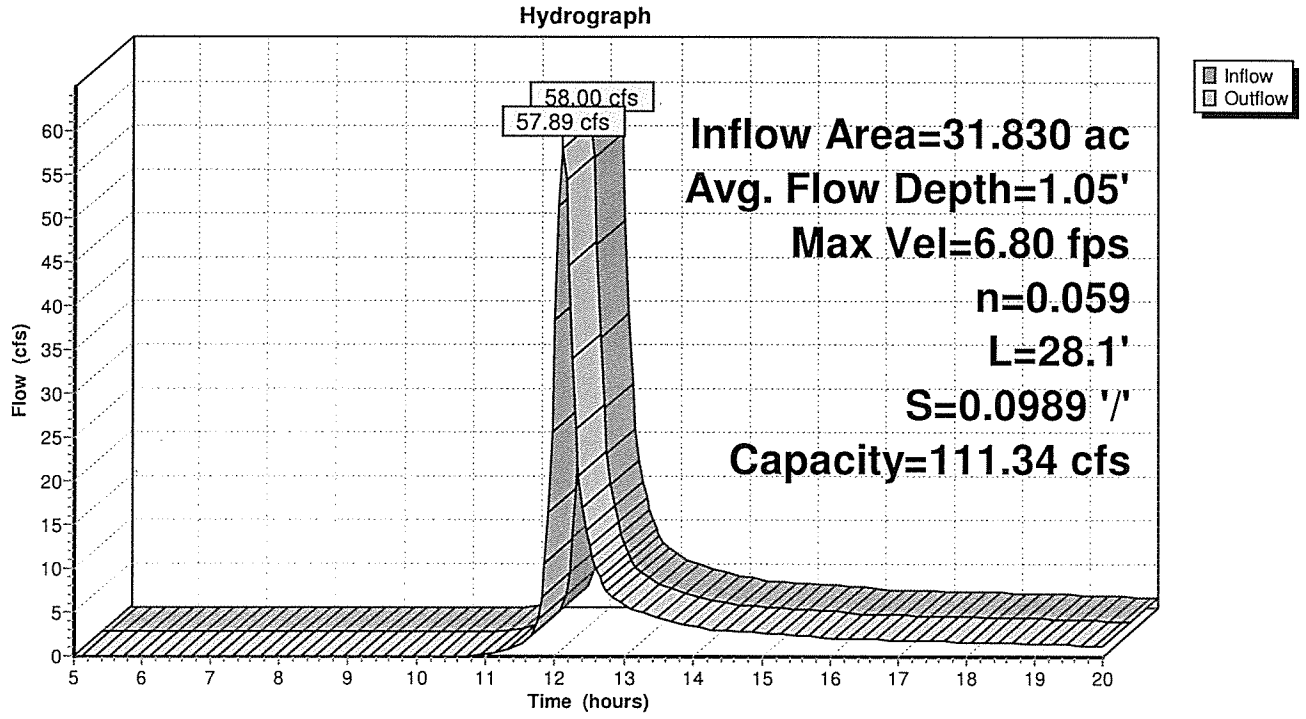
Reach DC11-6: DC11-6



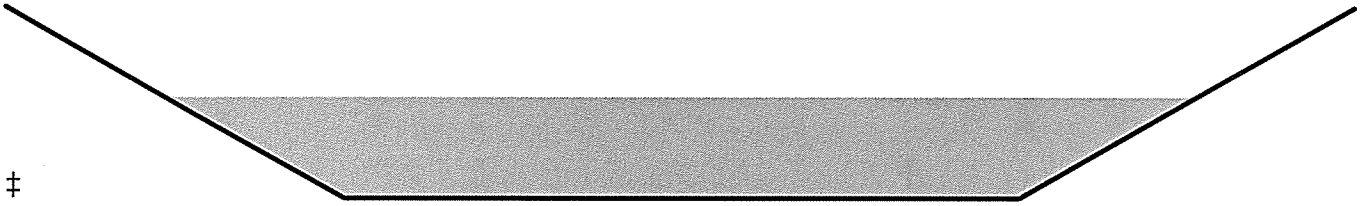
Summary for Reach DC11-7: DC11-7

Inflow Area = 31.830 ac, 0.00% Impervious, Inflow Depth > 1.33" for 25 year event
Inflow = 57.89 cfs @ 12.11 hrs, Volume= 3.529 af
Outflow = 57.70 cfs @ 12.11 hrs, Volume= 3.528 af, Atten= 0%, Lag= 0.2 min

Routing by Stor-Ind+Trans method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Max. Velocity= 9.66 fps, Min. Travel Time= 0.1 min
Avg. Velocity = 3.32 fps, Avg. Travel Time= 0.3 min

Peak Storage= 397 cf @ 12.11 hrs
Average Depth at Peak Storage= 0.79'
Bank-Full Depth= 1.50' Flow Area= 13.5 sf, Capacity= 185.14 cfs

6.00' x 1.50' deep channel, n= 0.065
Side Slope Z-value= 2.0 '/' Top Width= 12.00'
Length= 66.3' Slope= 0.3320 '/'
Inlet Invert= 1,316.53', Outlet Invert= 1,294.52'



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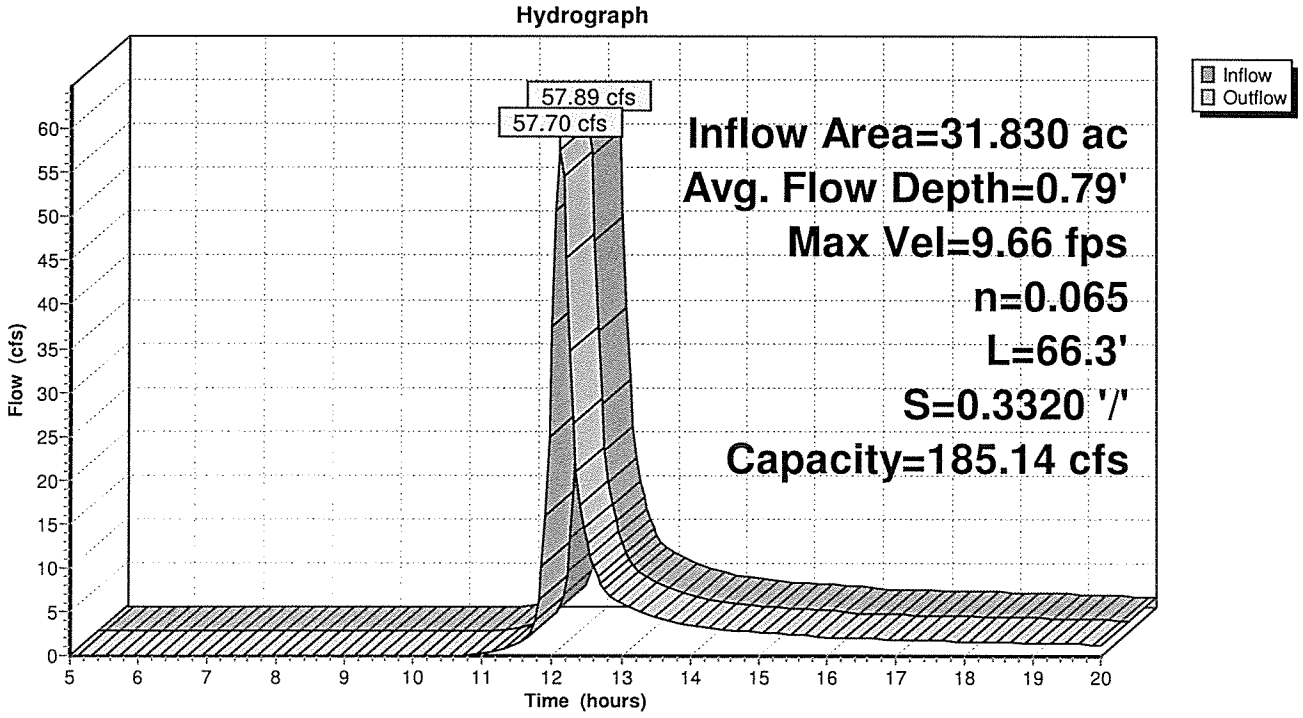
Reach DC11-7: DC11-7



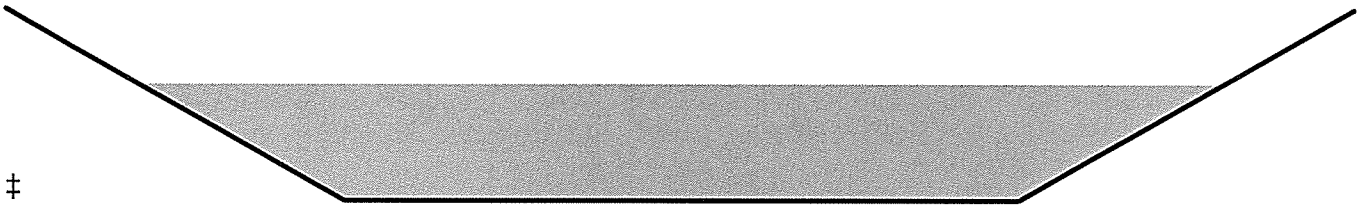
Summary for Reach DC12-1: DC12-1

Inflow Area = 22.470 ac, 0.00% Impervious, Inflow Depth > 1.33" for 25 year event
Inflow = 42.42 cfs @ 12.07 hrs, Volume= 2.498 af
Outflow = 42.36 cfs @ 12.07 hrs, Volume= 2.497 af, Atten= 0%, Lag= 0.1 min

Routing by Stor-Ind+Trans method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Max. Velocity= 5.91 fps, Min. Travel Time= 0.0 min
Avg. Velocity = 2.03 fps, Avg. Travel Time= 0.1 min

Peak Storage= 93 cf @ 12.07 hrs
Average Depth at Peak Storage= 0.91'
Bank-Full Depth= 1.50' Flow Area= 13.5 sf, Capacity= 105.30 cfs

6.00' x 1.50' deep channel, n= 0.062
Side Slope Z-value= 2.0 '/' Top Width= 12.00'
Length= 13.1' Slope= 0.0977 '/'
Inlet Invert= 1,501.35', Outlet Invert= 1,500.07'



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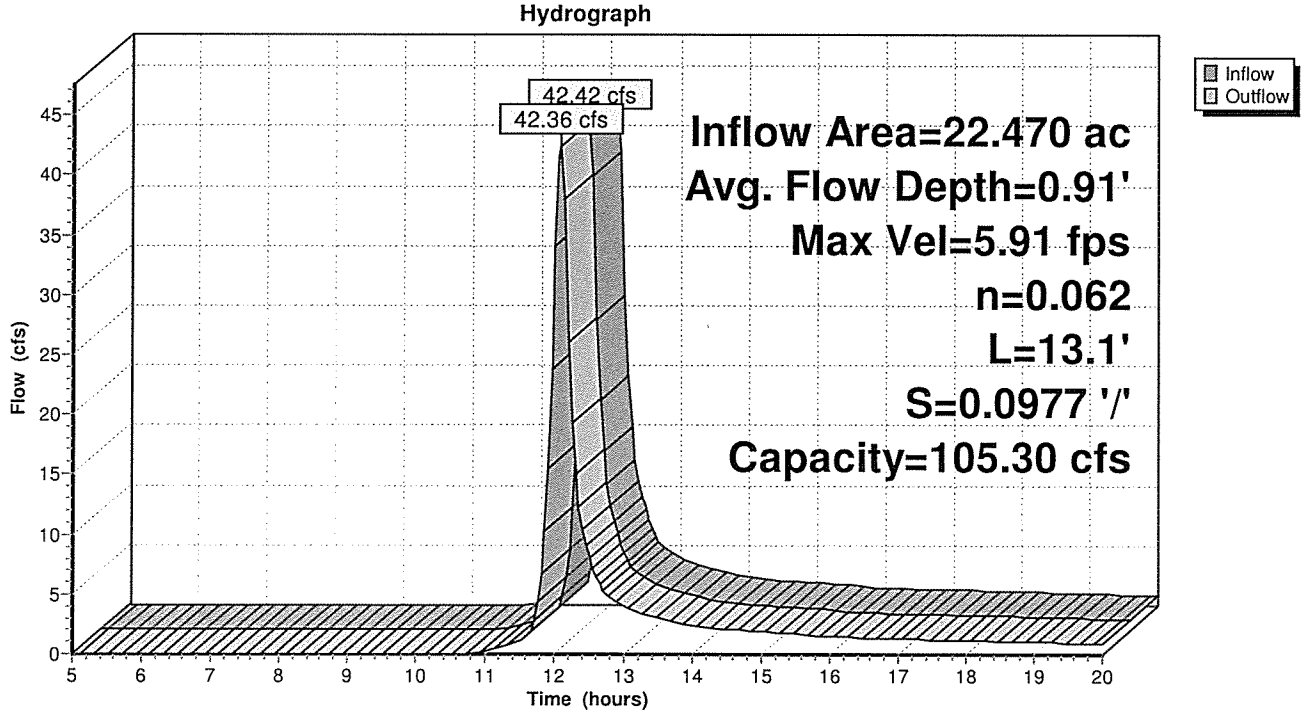
Reach DC12-1: DC12-1



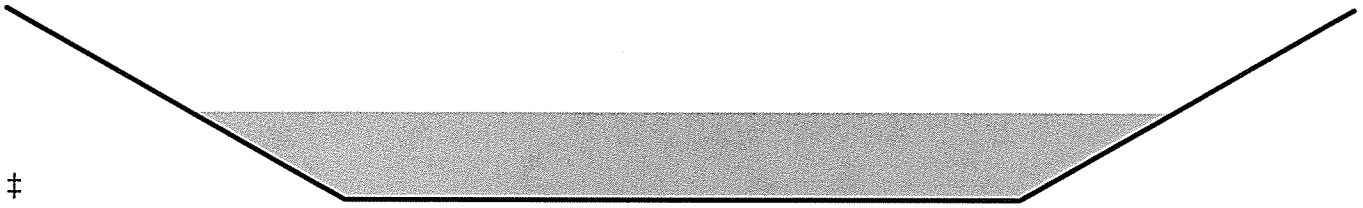
Summary for Reach DC12-2: DC12-2

Inflow Area = 22.470 ac, 0.00% Impervious, Inflow Depth > 1.33" for 25 year event
Inflow = 42.36 cfs @ 12.07 hrs, Volume= 2.497 af
Outflow = 41.89 cfs @ 12.09 hrs, Volume= 2.495 af, Atten= 1%, Lag= 0.7 min

Routing by Stor-Ind+Trans method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Max. Velocity= 8.29 fps, Min. Travel Time= 0.3 min
Avg. Velocity = 2.78 fps, Avg. Travel Time= 1.0 min

Peak Storage= 870 cf @ 12.08 hrs
Average Depth at Peak Storage= 0.69'
Bank-Full Depth= 1.50' Flow Area= 13.5 sf, Capacity= 172.38 cfs

6.00' x 1.50' deep channel, n= 0.070
Side Slope Z-value= 2.0 '/' Top Width= 12.00'
Length= 171.4' Slope= 0.3338 '/'
Inlet Invert= 1,500.07', Outlet Invert= 1,442.86'



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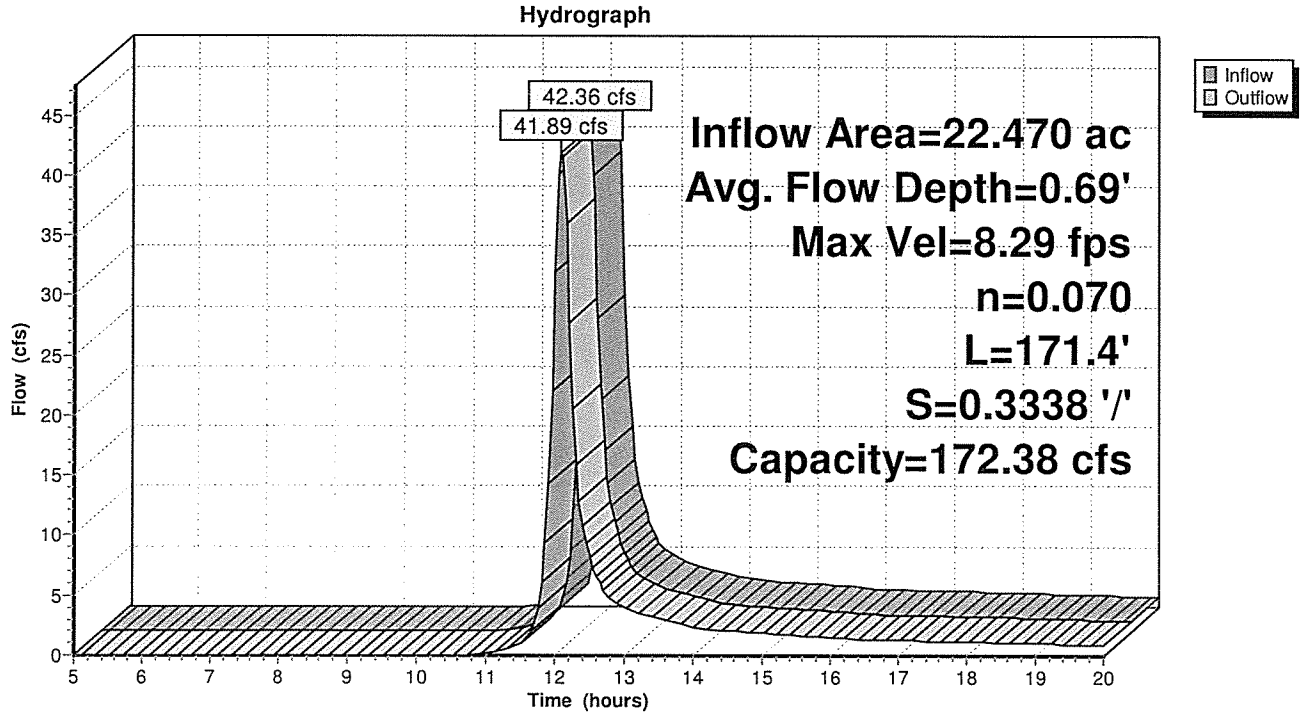
Reach DC12-2: DC12-2



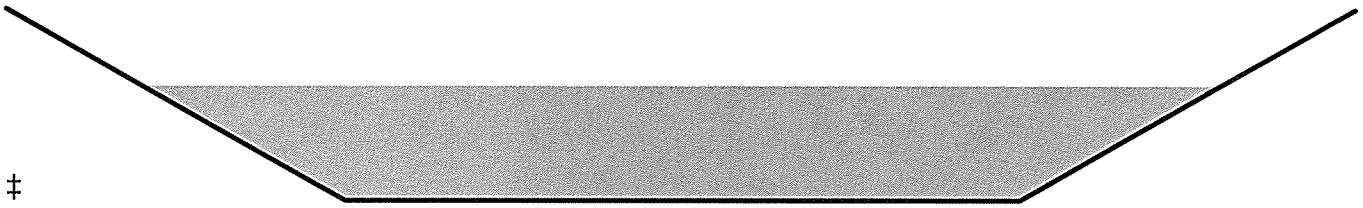
Summary for Reach DC12-3: DC12-3

Inflow Area = 22.470 ac, 0.00% Impervious, Inflow Depth > 1.33" for 25 year event
Inflow = 41.89 cfs @ 12.09 hrs, Volume= 2.495 af
Outflow = 41.82 cfs @ 12.09 hrs, Volume= 2.495 af, Atten= 0%, Lag= 0.1 min

Routing by Stor-Ind+Trans method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Max. Velocity= 5.96 fps, Min. Travel Time= 0.1 min
Avg. Velocity = 2.05 fps, Avg. Travel Time= 0.2 min

Peak Storage= 199 cf @ 12.09 hrs
Average Depth at Peak Storage= 0.90'
Bank-Full Depth= 1.50' Flow Area= 13.5 sf, Capacity= 106.53 cfs

6.00' x 1.50' deep channel, n= 0.062
Side Slope Z-value= 2.0 '/' Top Width= 12.00'
Length= 28.3' Slope= 0.1000 '/'
Inlet Invert= 1,442.86', Outlet Invert= 1,440.03'



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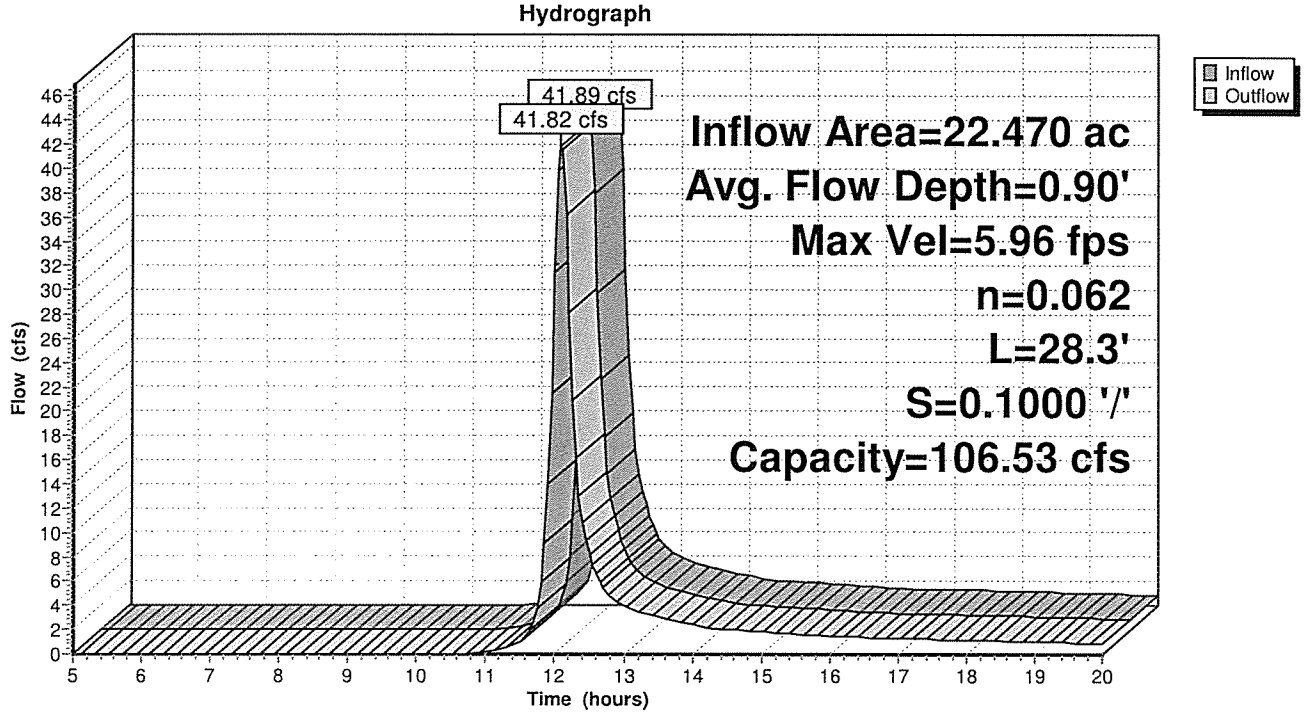
Reach DC12-3: DC12-3



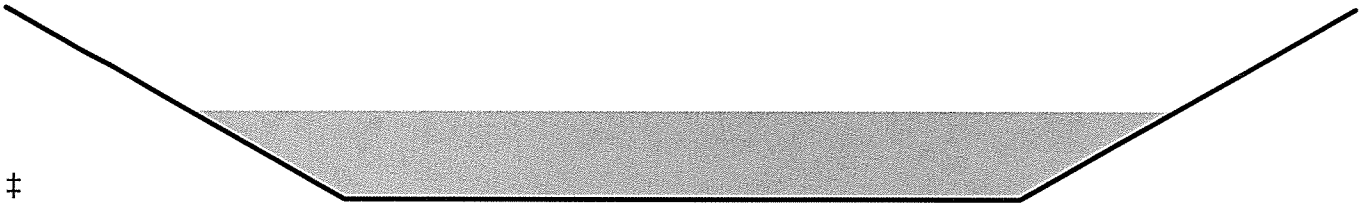
Summary for Reach DC12-4: DC12-4

Inflow Area = 22.470 ac, 0.00% Impervious, Inflow Depth > 1.33" for 25 year event
Inflow = 41.82 cfs @ 12.09 hrs, Volume= 2.495 af
Outflow = 41.47 cfs @ 12.10 hrs, Volume= 2.493 af, Atten= 1%, Lag= 0.6 min

Routing by Stor-Ind+Trans method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Max. Velocity= 8.21 fps, Min. Travel Time= 0.3 min
Avg. Velocity = 2.76 fps, Avg. Travel Time= 1.0 min

Peak Storage= 875 cf @ 12.09 hrs
Average Depth at Peak Storage= 0.69'
Bank-Full Depth= 1.50' Flow Area= 13.5 sf, Capacity= 169.77 cfs

6.00' x 1.50' deep channel, n= 0.071
Side Slope Z-value= 2.0 '/' Top Width= 12.00'
Length= 171.8' Slope= 0.3331 '/'
Inlet Invert= 1,440.03', Outlet Invert= 1,382.81'



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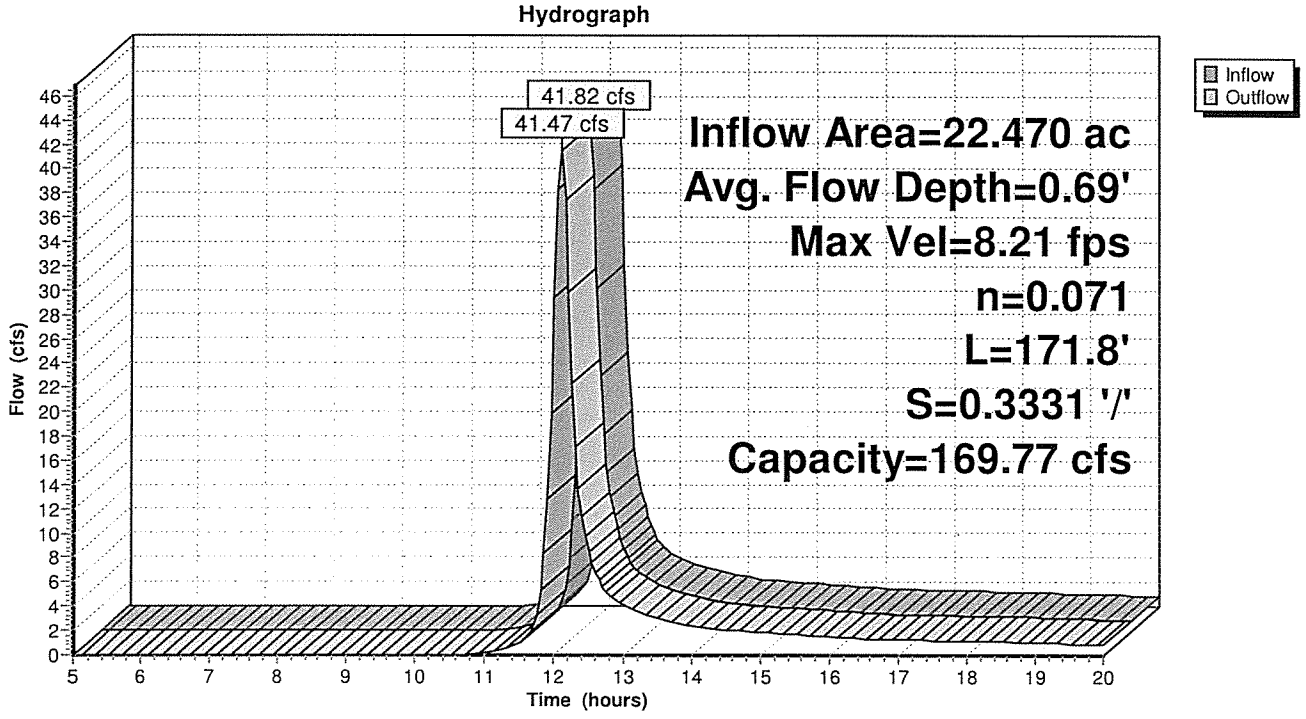
Reach DC12-4: DC12-4



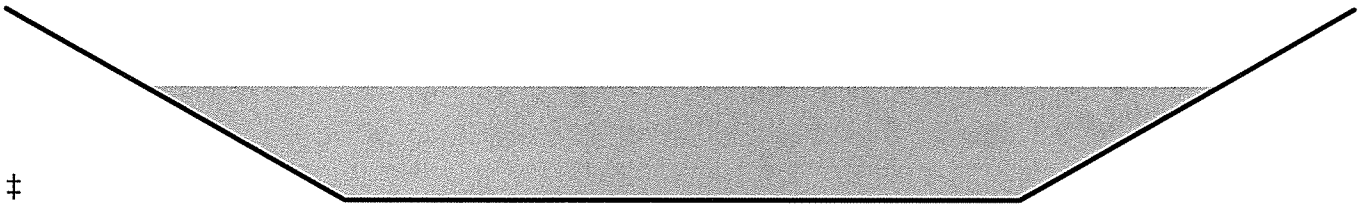
Summary for Reach DC12-5: DC12-5

Inflow Area = 22.470 ac, 0.00% Impervious, Inflow Depth > 1.33" for 25 year event
Inflow = 41.47 cfs @ 12.10 hrs, Volume= 2.493 af
Outflow = 41.38 cfs @ 12.10 hrs, Volume= 2.492 af, Atten= 0%, Lag= 0.1 min

Routing by Stor-Ind+Trans method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Max. Velocity= 5.96 fps, Min. Travel Time= 0.1 min
Avg. Velocity = 2.06 fps, Avg. Travel Time= 0.2 min

Peak Storage= 197 cf @ 12.10 hrs
Average Depth at Peak Storage= 0.89'
Bank-Full Depth= 1.50' Flow Area= 13.5 sf, Capacity= 106.53 cfs

6.00' x 1.50' deep channel, n= 0.062
Side Slope Z-value= 2.0 '/' Top Width= 12.00'
Length= 28.3' Slope= 0.1000 '/'
Inlet Invert= 1,382.81', Outlet Invert= 1,379.98'



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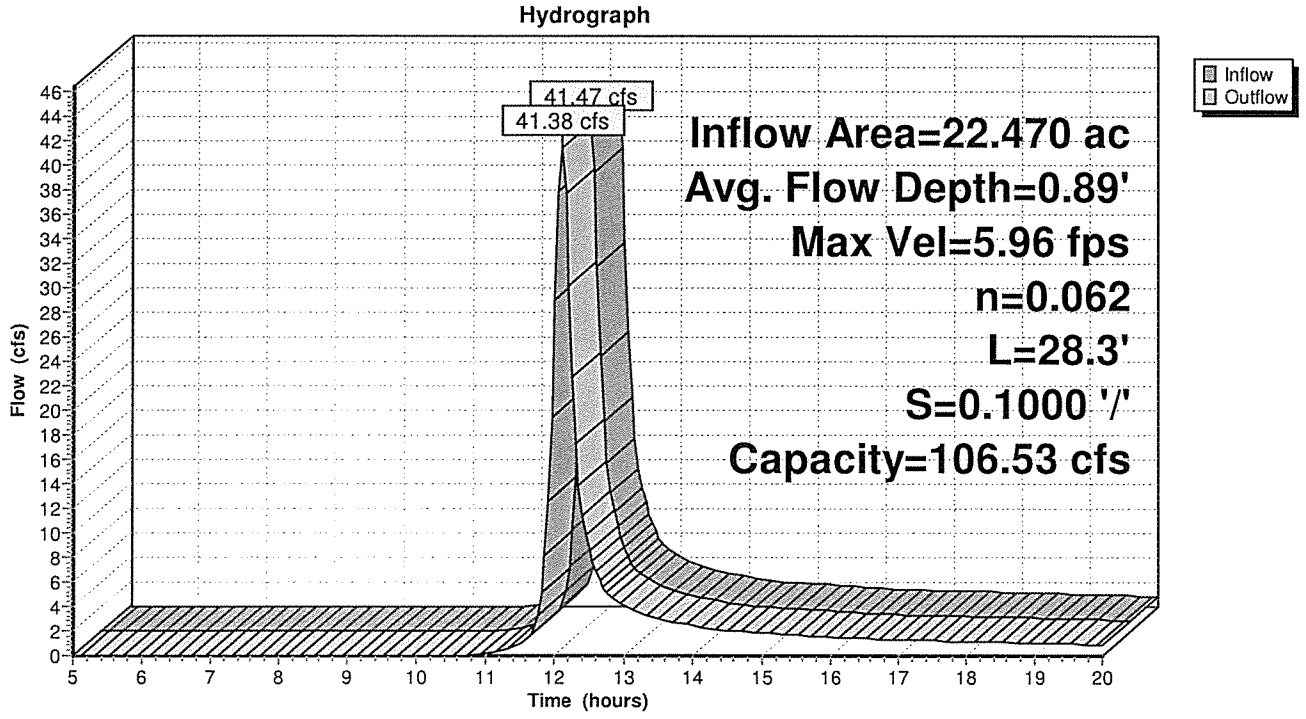
Reach DC12-5: DC12-5



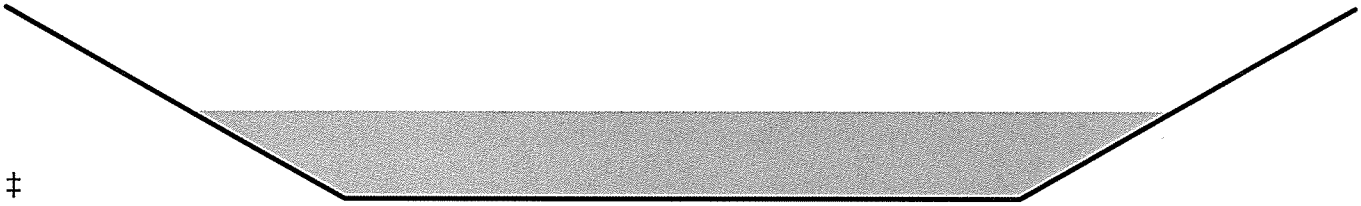
Summary for Reach DC12-6: DC12-6

Inflow Area = 22.470 ac, 0.00% Impervious, Inflow Depth > 1.33" for 25 year event
Inflow = 41.38 cfs @ 12.10 hrs, Volume= 2.492 af
Outflow = 40.99 cfs @ 12.11 hrs, Volume= 2.490 af, Atten= 1%, Lag= 0.6 min

Routing by Stor-Ind+Trans method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Max. Velocity= 8.19 fps, Min. Travel Time= 0.3 min
Avg. Velocity = 2.76 fps, Avg. Travel Time= 1.0 min

Peak Storage= 868 cf @ 12.10 hrs
Average Depth at Peak Storage= 0.69'
Bank-Full Depth= 1.50' Flow Area= 13.5 sf, Capacity= 169.86 cfs

6.00' x 1.50' deep channel, n= 0.071
Side Slope Z-value= 2.0 '/' Top Width= 12.00'
Length= 171.8' Slope= 0.3334 '/'
Inlet Invert= 1,379.98', Outlet Invert= 1,322.70'



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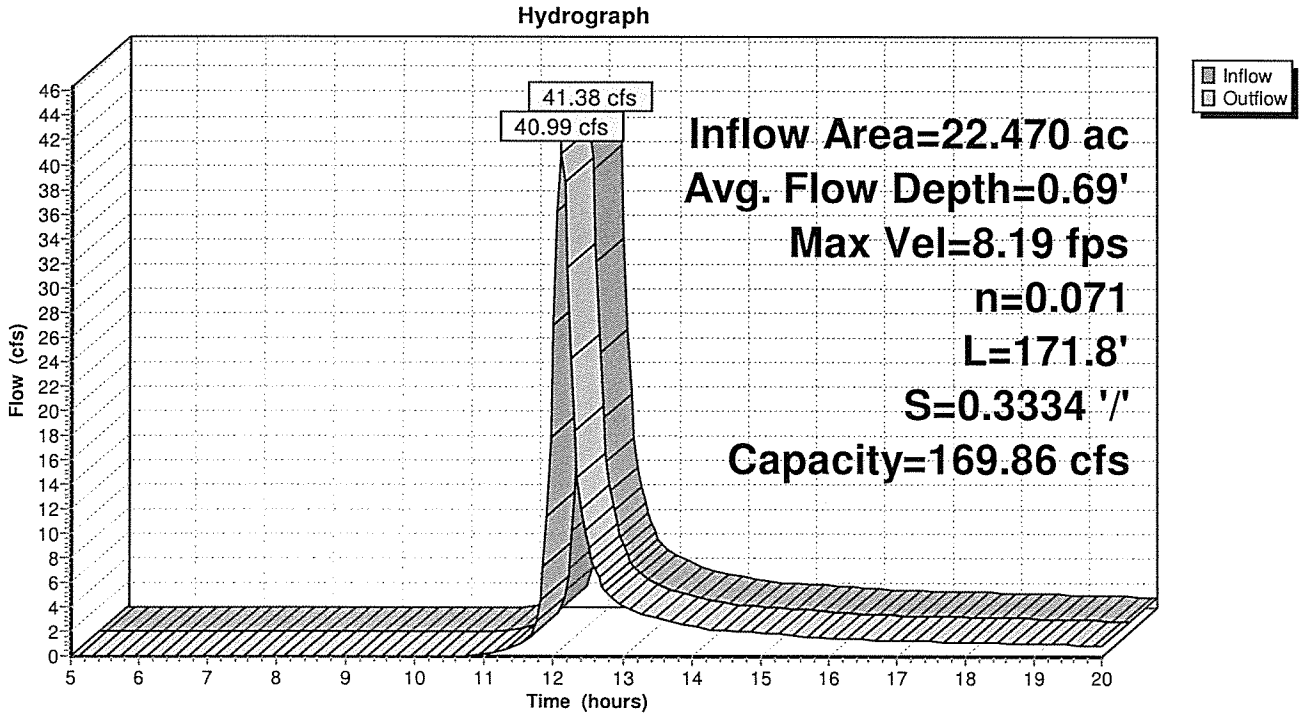
Reach DC12-6: DC12-6



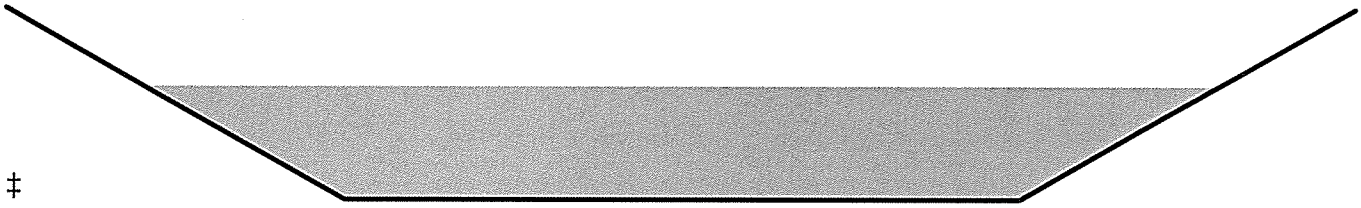
Summary for Reach DC12-7: DC12-7

Inflow Area = 22.470 ac, 0.00% Impervious, Inflow Depth > 1.33" for 25 year event
Inflow = 40.99 cfs @ 12.11 hrs, Volume= 2.490 af
Outflow = 40.90 cfs @ 12.11 hrs, Volume= 2.490 af, Atten= 0%, Lag= 0.1 min

Routing by Stor-Ind+Trans method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Max. Velocity= 5.93 fps, Min. Travel Time= 0.1 min
Avg. Velocity = 2.05 fps, Avg. Travel Time= 0.2 min

Peak Storage= 198 cf @ 12.11 hrs
Average Depth at Peak Storage= 0.89'
Bank-Full Depth= 1.50' Flow Area= 13.5 sf, Capacity= 106.53 cfs

6.00' x 1.50' deep channel, n= 0.062
Side Slope Z-value= 2.0 '/' Top Width= 12.00'
Length= 28.7' Slope= 0.1000 '/'
Inlet Invert= 1,322.70', Outlet Invert= 1,319.83'



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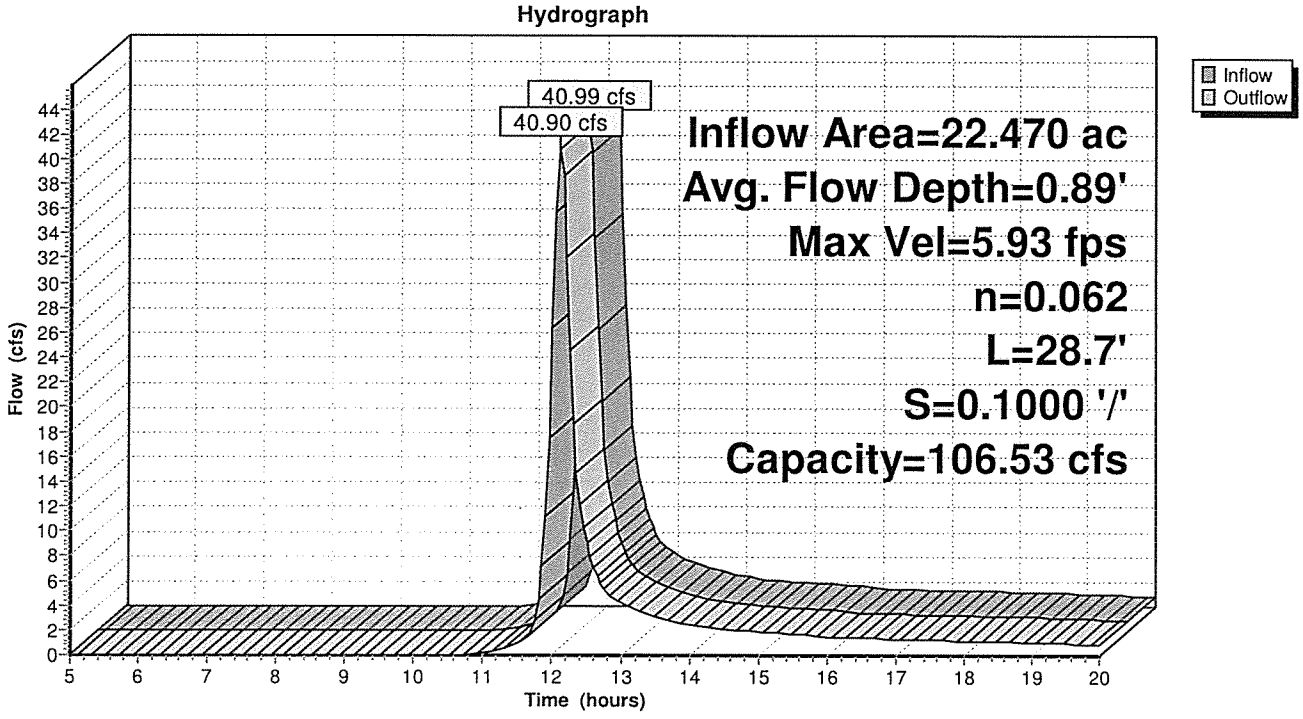
Reach DC12-7: DC12-7



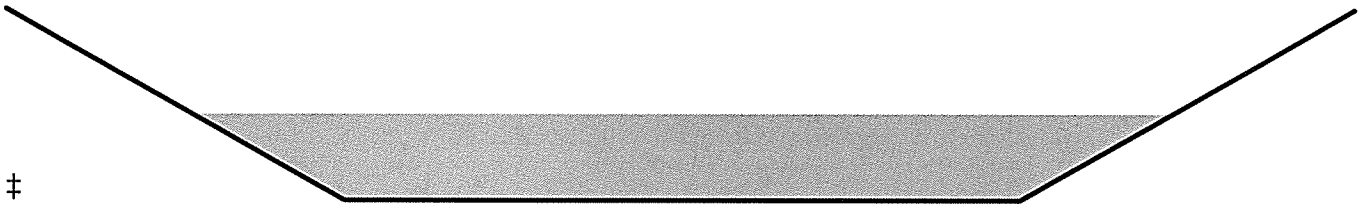
Summary for Reach DC12-8: DC12-8

Inflow Area = 22.470 ac, 0.00% Impervious, Inflow Depth > 1.33" for 25 year event
Inflow = 40.90 cfs @ 12.11 hrs, Volume= 2.490 af
Outflow = 40.70 cfs @ 12.12 hrs, Volume= 2.489 af, Atten= 0%, Lag= 0.3 min

Routing by Stor-Ind+Trans method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Max. Velocity= 8.21 fps, Min. Travel Time= 0.2 min
Avg. Velocity = 2.79 fps, Avg. Travel Time= 0.5 min

Peak Storage= 399 cf @ 12.11 hrs
Average Depth at Peak Storage= 0.68'
Bank-Full Depth= 1.50' Flow Area= 13.5 sf, Capacity= 172.09 cfs

6.00' x 1.50' deep channel, n= 0.070
Side Slope Z-value= 2.0 '/' Top Width= 12.00'
Length= 80.2' Slope= 0.3327 '/'
Inlet Invert= 1,319.83', Outlet Invert= 1,293.15'



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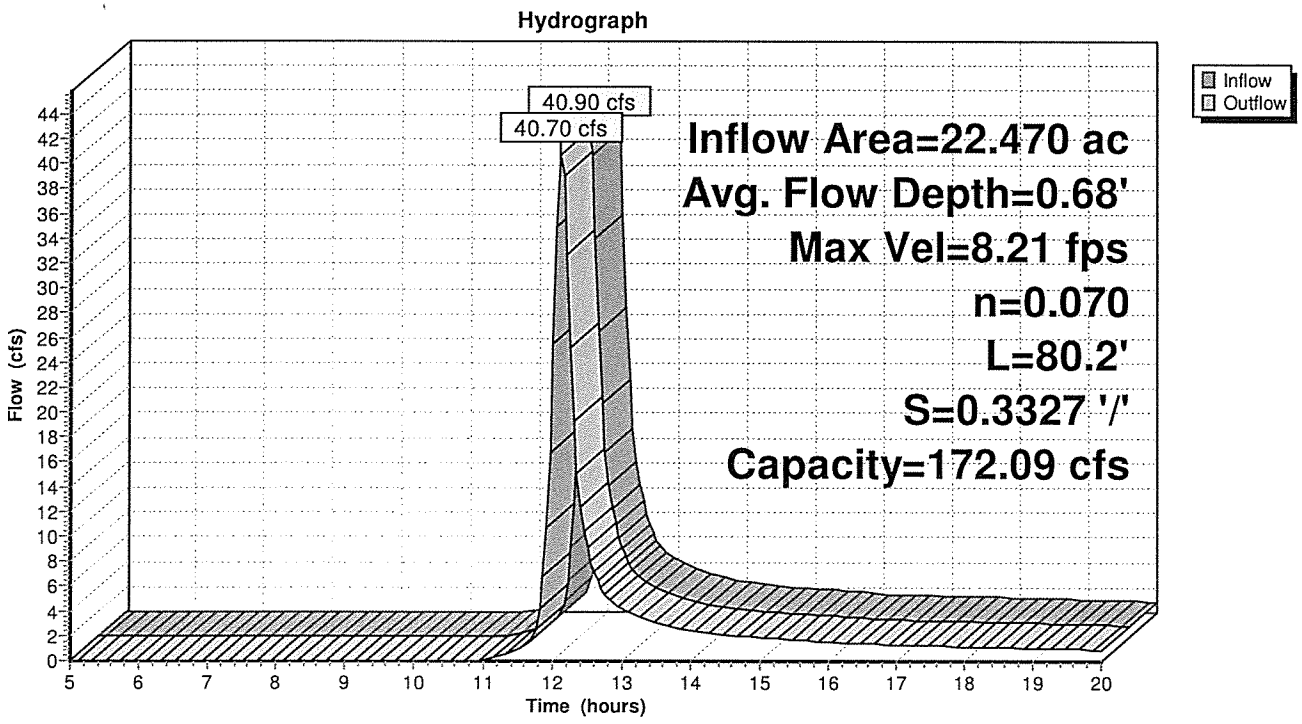
Reach DC12-8: DC12-8



Summary for Pond 3P: Sedimentation Pond 3

Inflow Area = 72.240 ac, 0.00% Impervious, Inflow Depth > 1.32" for 25 year event
Inflow = 110.92 cfs @ 12.25 hrs, Volume= 7.935 af
Outflow = 5.21 cfs @ 15.90 hrs, Volume= 1.954 af, Atten= 95%, Lag= 219.2 min
Primary = 5.21 cfs @ 15.90 hrs, Volume= 1.954 af
Secondary = 0.00 cfs @ 5.00 hrs, Volume= 0.000 af

Routing by Stor-Ind method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Peak Elev= 1,242.61' @ 15.90 hrs Surf.Area= 0.000 ac Storage= 6.097 af

Plug-Flow detention time= 300.3 min calculated for 1.947 af (25% of inflow)
Center-of-Mass det. time= 205.3 min (1,026.6 - 821.3)

Volume	Invert	Avail.Storage	Storage Description
#1	1,225.00'	7.580 af	**Custom Stage Data** Listed below

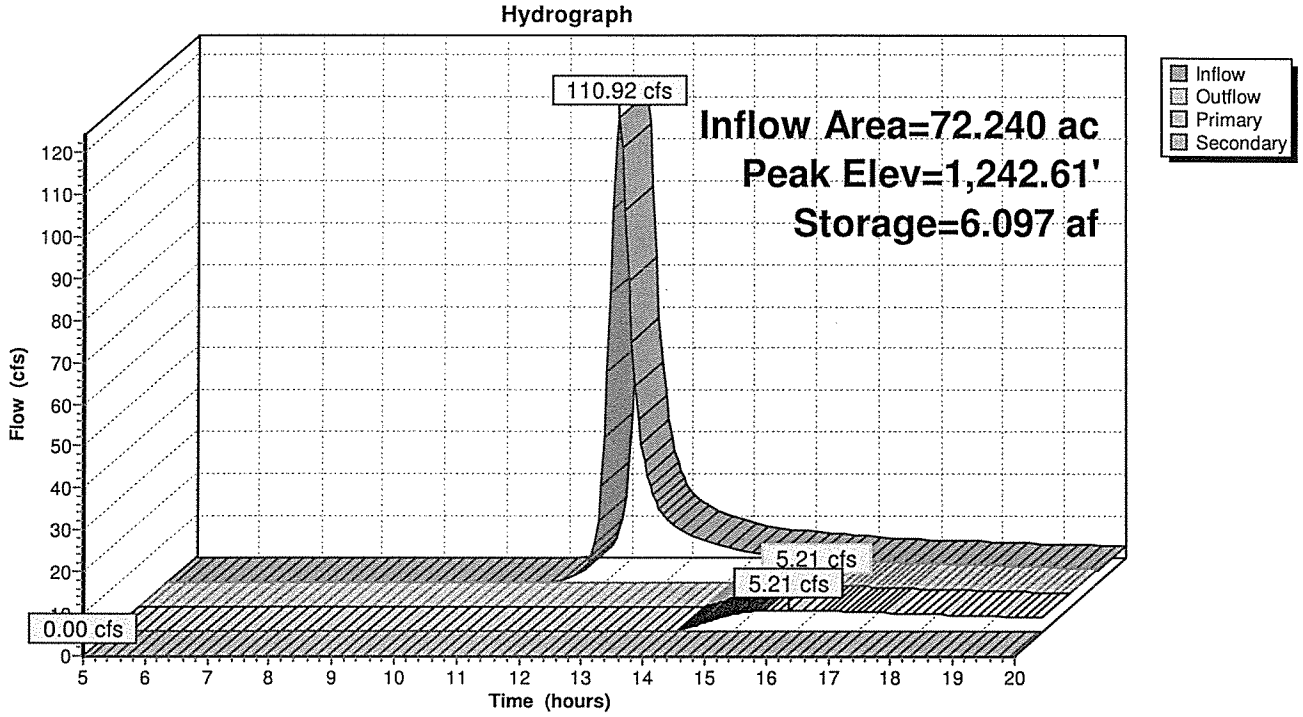
Elevation (feet)	Cum.Store (acre-feet)
1,225.00	0.000
1,227.00	0.330
1,229.00	0.740
1,231.00	1.240
1,233.00	1.820
1,235.00	2.500
1,237.00	3.290
1,239.00	4.180
1,241.00	5.190
1,243.00	6.320
1,245.00	7.580

Device	Routing	Invert	Outlet Devices
#1	Primary	1,241.70'	**30.0" Round Primary** L= 37.0' CPP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 1,241.70' / 1,240.96' S= 0.0200 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 4.91 sf
#2	Secondary	1,242.90'	**151.9 deg x 8.0' long Sharp-Crested Vee/Trap Weir** Cv= 2.47 (C= 3.09)

Primary OutFlow Max=5.20 cfs @ 15.90 hrs HW=1,242.61' (Free Discharge)
↑—**1=Primary** (Inlet Controls 5.20 cfs @ 3.24 fps)

Secondary OutFlow Max=0.00 cfs @ 5.00 hrs HW=1,225.00' (Free Discharge)
↑—**2=Sharp-Crested Vee/Trap Weir** (Controls 0.00 cfs)

Pond 3P: Sedimentation Pond 3



Summary for Pond Culvert M: Culvert M

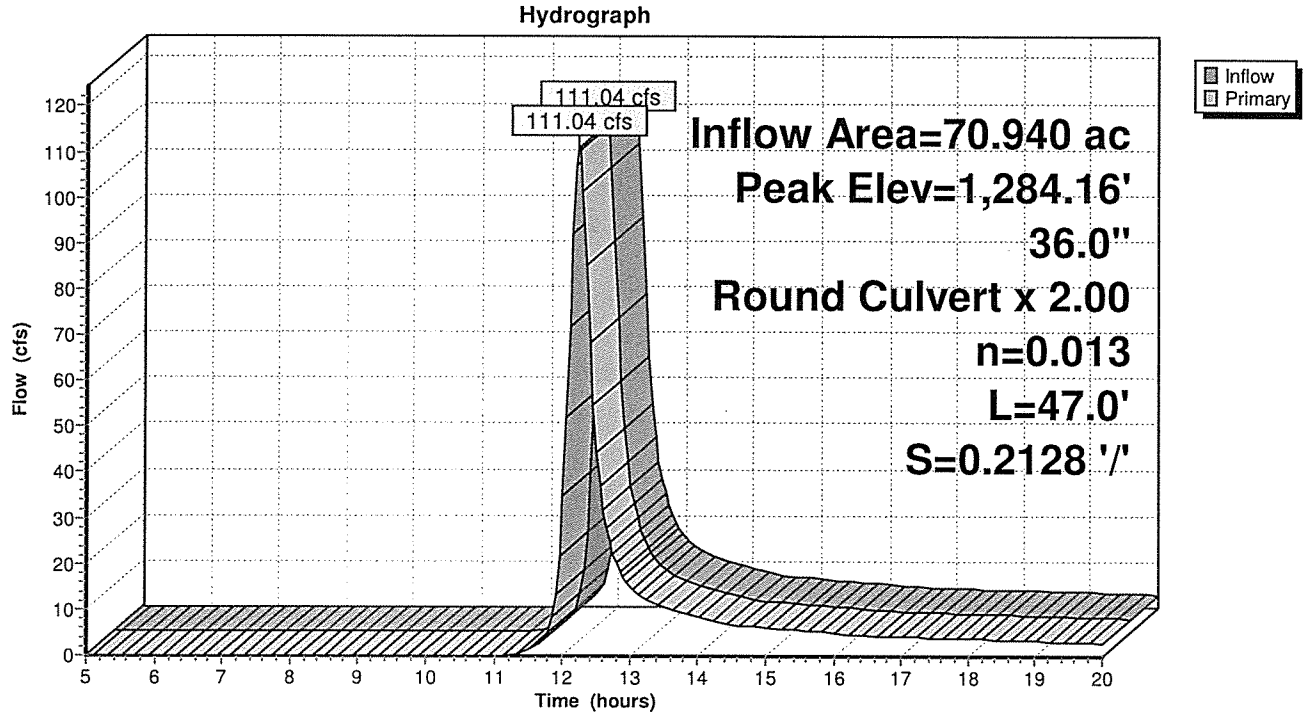
Inflow Area = 70.940 ac, 0.00% Impervious, Inflow Depth > 1.32" for 25 year event
Inflow = 111.04 cfs @ 12.24 hrs, Volume= 7.796 af
Outflow = 111.04 cfs @ 12.24 hrs, Volume= 7.796 af, Atten= 0%, Lag= 0.0 min
Primary = 111.04 cfs @ 12.24 hrs, Volume= 7.796 af

Routing by Stor-Ind method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Peak Elev= 1,284.16' @ 12.24 hrs

Device	Routing	Invert	Outlet Devices
#1	Primary	1,280.00'	**36.0" Round Culvert X 2.00** L= 47.0' CPP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 1,280.00' / 1,270.00' S= 0.2128 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 7.07 sf

Primary OutFlow Max=109.94 cfs @ 12.24 hrs HW=1,284.11' (Free Discharge)
1=Culvert (Inlet Controls 109.94 cfs @ 7.78 fps)

Pond Culvert M: Culvert M



SEDIMENTATION POND
ROUTING OF 100-YEAR 24-HOUR STORM

Summary for Pond 3P: Sedimentation Pond 3

Inflow Area = 72.240 ac, 0.00% Impervious, Inflow Depth > 2.07" for 100 year event
Inflow = 178.52 cfs @ 12.22 hrs, Volume= 12.466 af
Outflow = 34.68 cfs @ 12.72 hrs, Volume= 6.408 af, Atten= 81%, Lag= 30.4 min
Primary = 18.07 cfs @ 12.72 hrs, Volume= 5.339 af
Secondary = 16.61 cfs @ 12.72 hrs, Volume= 1.069 af

Routing by Stor-Ind method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Peak Elev= 1,243.55' @ 12.72 hrs Surf.Area= 0.000 ac Storage= 6.668 af

Plug-Flow detention time= 172.5 min calculated for 6.387 af (51% of inflow)
Center-of-Mass det. time= 92.0 min (902.8 - 810.8)

Volume	Invert	Avail.Storage	Storage Description
#1	1,225.00'	7.580 af	**Custom Stage Data** Listed below

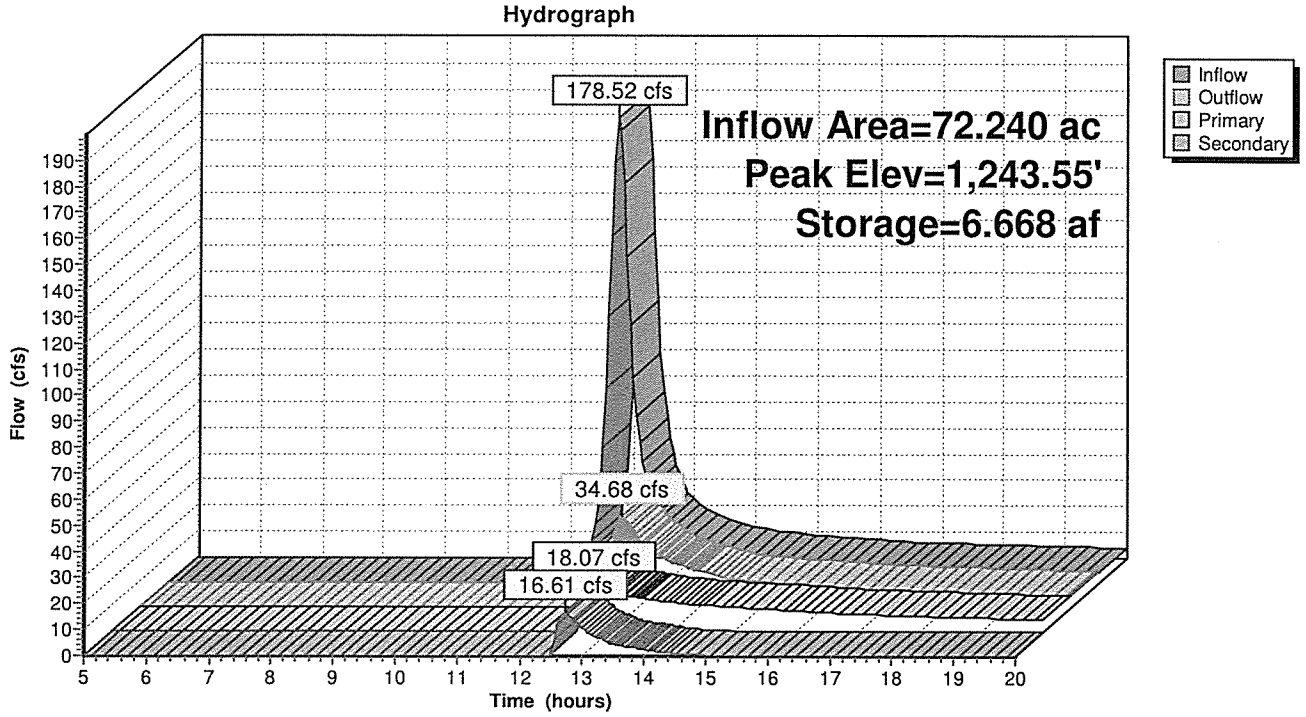
Elevation (feet)	Cum.Store (acre-feet)
1,225.00	0.000
1,227.00	0.330
1,229.00	0.740
1,231.00	1.240
1,233.00	1.820
1,235.00	2.500
1,237.00	3.290
1,239.00	4.180
1,241.00	5.190
1,243.00	6.320
1,245.00	7.580

Device	Routing	Invert	Outlet Devices
#1	Primary	1,241.70'	**30.0" Round Primary** L= 37.0' CPP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 1,241.70' / 1,240.96' S= 0.0200 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 4.91 sf
#2	Secondary	1,242.90'	**151.9 deg x 8.0' long Sharp-Crested Vee/Trap Weir** Cv= 2.47 (C= 3.09)

Primary OutFlow Max=18.02 cfs @ 12.72 hrs HW=1,243.55' (Free Discharge)
↑—**1=Primary** (Inlet Controls 18.02 cfs @ 4.63 fps)

Secondary OutFlow Max=16.25 cfs @ 12.72 hrs HW=1,243.55' (Free Discharge)
↑—**2=Sharp-Crested Vee/Trap Weir** (Weir Controls 16.25 cfs @ 2.37 fps)

Pond 3P: Sedimentation Pond 3



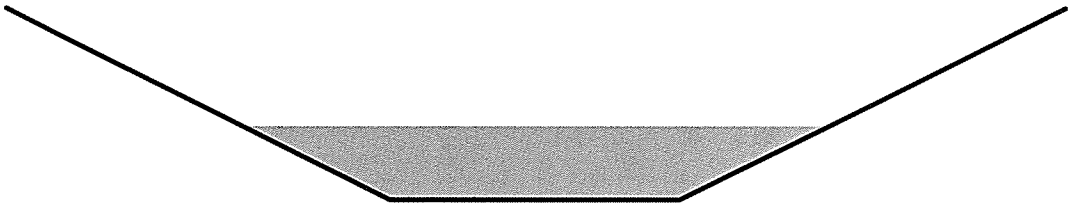
Summary for Reach D-ES3: Emergency Spillway Discharge Channel

Inflow = 16.61 cfs @ 12.72 hrs, Volume= 1.069 af
Outflow = 16.67 cfs @ 12.72 hrs, Volume= 1.069 af, Atten= 0%, Lag= 0.0 min

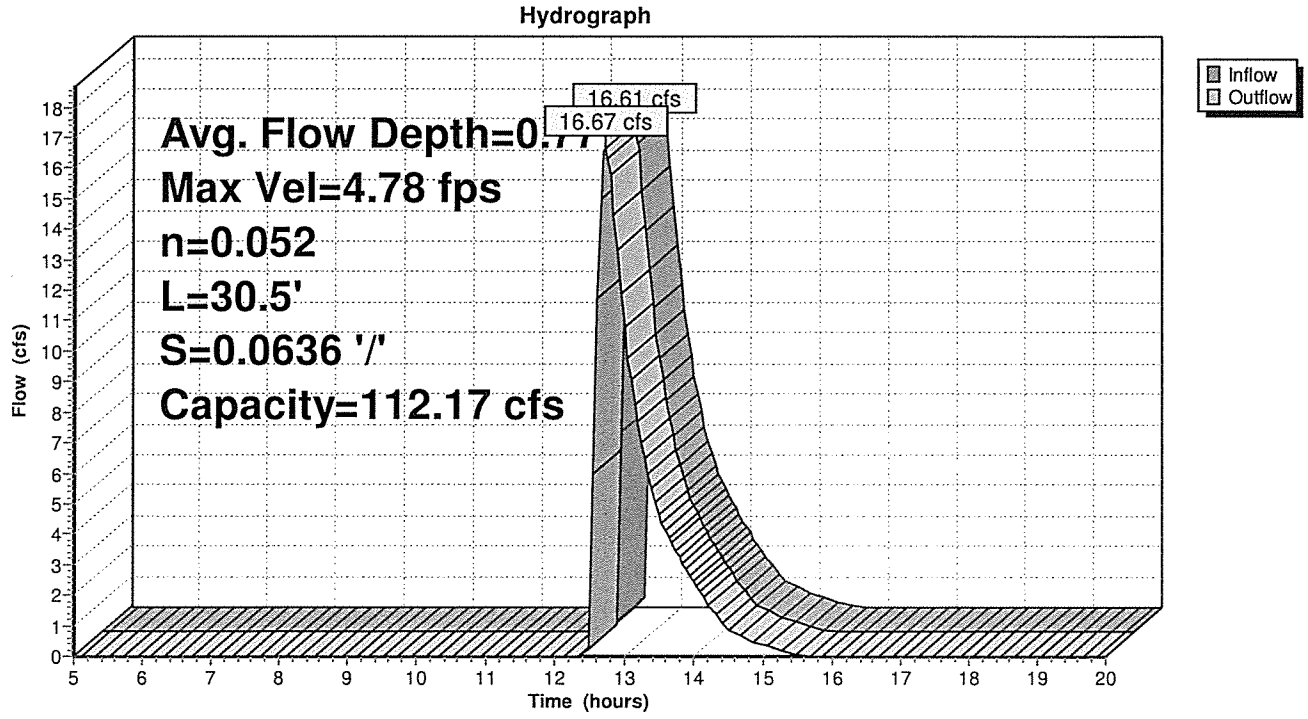
Routing by Stor-Ind+Trans method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Max. Velocity= 4.78 fps, Min. Travel Time= 0.1 min
Avg. Velocity = 2.59 fps, Avg. Travel Time= 0.2 min

Peak Storage= 106 cf @ 12.72 hrs
Average Depth at Peak Storage= 0.77'
Bank-Full Depth= 2.00' Flow Area= 14.0 sf, Capacity= 112.17 cfs

3.00' x 2.00' deep channel, n= 0.052
Side Slope Z-value= 2.0 '/' Top Width= 11.00'
Length= 30.5' Slope= 0.0636 '/'
Inlet Invert= 1,242.90', Outlet Invert= 1,240.96'



Reach D-ES3: Emergency Spillway Discharge Channel



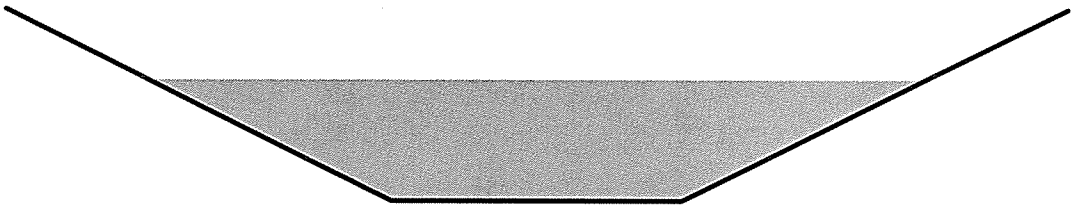
Summary for Reach D-P3: Pond 3 Discharge Channel

Inflow Area = 72.240 ac, 0.00% Impervious, Inflow Depth > 1.06" for 100 year event
Inflow = 34.74 cfs @ 12.72 hrs, Volume= 6.408 af
Outflow = 34.46 cfs @ 12.74 hrs, Volume= 6.401 af, Atten= 1%, Lag= 1.1 min

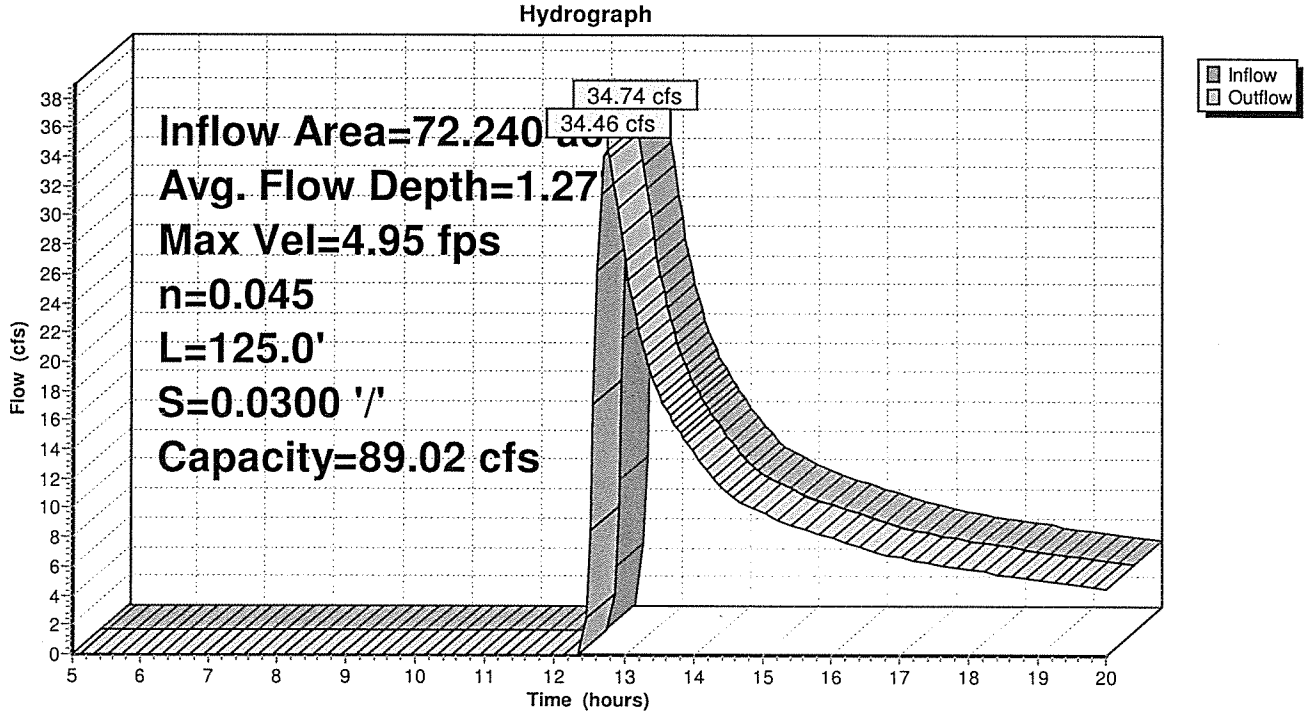
Routing by Stor-Ind+Trans method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Max. Velocity= 4.95 fps, Min. Travel Time= 0.4 min
Avg. Velocity = 3.37 fps, Avg. Travel Time= 0.6 min

Peak Storage= 875 cf @ 12.72 hrs
Average Depth at Peak Storage= 1.27'
Bank-Full Depth= 2.00' Flow Area= 14.0 sf, Capacity= 89.02 cfs

3.00' x 2.00' deep channel, n= 0.045
Side Slope Z-value= 2.0 '/' Top Width= 11.00'
Length= 125.0' Slope= 0.0300 '/'
Inlet Invert= 1,240.96', Outlet Invert= 1,237.21'



Reach D-P3: Pond 3 Discharge Channel



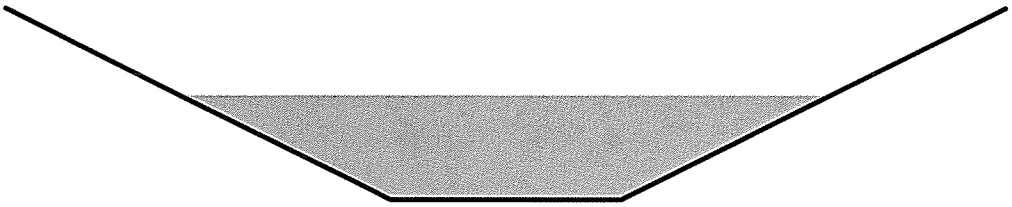
Summary for Reach 1R: Pond 3 Discharge Channel

Inflow Area = 72.240 ac, 0.00% Impervious, Inflow Depth > 1.06" for 100 year event
Inflow = 34.46 cfs @ 12.74 hrs, Volume= 6.401 af
Outflow = 34.24 cfs @ 12.79 hrs, Volume= 6.374 af, Atten= 1%, Lag= 3.2 min

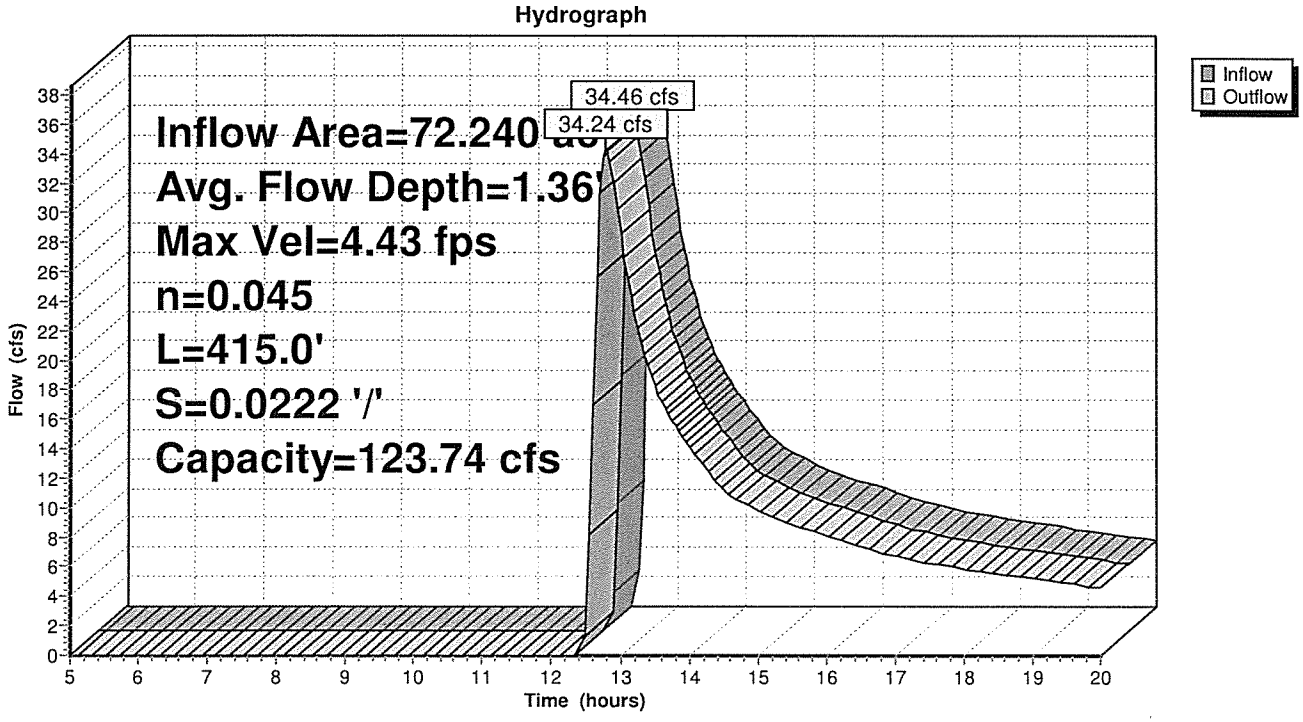
Routing by Stor-Ind+Trans method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Max. Velocity= 4.43 fps, Min. Travel Time= 1.6 min
Avg. Velocity = 3.02 fps, Avg. Travel Time= 2.3 min

Peak Storage= 3,226 cf @ 12.76 hrs
Average Depth at Peak Storage= 1.36'
Bank-Full Depth= 2.50' Flow Area= 20.0 sf, Capacity= 123.74 cfs

3.00' x 2.50' deep channel, n= 0.045
Side Slope Z-value= 2.0 '/' Top Width= 13.00'
Length= 415.0' Slope= 0.0222 '/'
Inlet Invert= 1,237.21', Outlet Invert= 1,228.00'



Reach 1R: Pond 3 Discharge Channel



1.0 INTRODUCTION

This calculation was performed to determine whether the West Sedimentation Pond can handle the additional flow from the northwest portion of the proposed expansion.

This sedimentation pond must meet the following regulations:

OAC 3745-27-08 (D)(3)

(i) Minimum storage volume shall be provided based on either the calculated runoff from a 10-year/24-hour storm event, or 0.125 acre-feet per year (for each acre of disturbed area within the upstream drainage area) multiplied by the scheduled frequency of pond clean-out (in years), which ever is greater; and

(ii) The principal spillway shall safely discharge the flow from a 10-year/24-hour storm event. The inlet elevation of the emergency spillway shall be designed to provide flood storage, with no flow entering the emergency spillway, for a 25-year/24-hour storm event, with allowance provided for the flow passed by the principal spillway during the event; and

(iii) The combination of the principal and emergency spillways shall safely discharge the flow from the 100-year/24-hour storm event using non mechanical means. The embankment design shall provide for no less than 1-foot net freeboard when flow is at the design depth, after allowance for embankment settlement.

All designs are based upon accepted design equations, methodologies and assumptions. Where applicable, design references have been made. Calculations have been performed using the software package, HydroCAD Version 10, Copyright 2011.

2.0 DESIGN ASSUMPTIONS

1. The sedimentation pond was evaluated using the proposed top of final cover grades.

2. The inflow hydrographs were developed by HydroCAD for each contributing watershed.

3. The inflow for this pond is summarized below:

Drainage Area	Watershed Area (Acre)	Composite CN
DA-39	0.33	71
DA-36	4.14	71
DA-53	0.83	71
DA-13	27.83	71
DA-37	4.92	71
DA-38	3.15	71
DA-15	2.70	71
DA-1	10.07	71
DA-2	20.88	71
DA-40	2.53	71
DA-42	1.88	71
DA-41	1.36	71
DA-16	3.44	71
DA-3	14.73	71
DA-17	4.22	71
DA-18	2.56	71
DA-19	2.62	71
A-WP	4.42	71
Total	112.61	

Times of concentration will be estimated as the sum of sheet flow, shallow flow and channel flow. The surface in the existing and proposed landfill will be similar to a non-grazed meadow in hydrologic soil group C, and was therefore modeled using a curve number of 71. Sheet flow calculations over areas with final cover or other grassed areas will use an average roughness of 0.150, which corresponds to short grass. The maximum sheet flow length will be 300 feet. Shallow flow times of concentration will be estimated using the velocity factor for short grass pasture.

From Reference 2, the following runoff coefficients have been found and will be utilized.

CN DATA	
Description	**CN**
Non-grazed meadow	71

3.0 VOLUME SIZING

As per OAC 3745-27-08 (D)(3)(i), the pond must provide adequate storage volume for the larger of: (1) the runoff from the 10-year/24-hour storm event or (2) 0.125 acre-ft per acre of disturbed area multiplied by the cleaning frequency in years.

Volume Requirement for 10-year/24-hour storm:

Utilizing HydroCAD for a 10-year/24-hour storm event, the inflow hydrographs were developed for each contributing watershed.

From Reference 9, the rainfall depths for the facility are summarized in the following table:

Storm Event	Rainfall Depth (inches)
10-year/24-hour	3.46
25-year/24-hour	4.12
100-year/24-hour	5.23

Utilizing the watershed information included in Section 2.0 of this calculation, the required storage volume from the runoff from a 10-year/24-hour storm event was calculated by HydroCAD to be approximately 375,661-cf of storage volume. The HydroCAD output files for a 10-year/24-hour storm event are included in an attachment to this calculation.

Volume Requirement for 0.125 acre-ft per disturbed acre:

Given the watershed information included in Section 2.0 of this calculation:

Drainage Area	Watershed Area (acres)	Disturbed Area (acres) [Calculated]	Volume (cf) [Calculated]
DA-39	0.33	0.10	545
DA-36	4.14	1.24	6,752
DA-53	0.83	0.25	1,361
DA-13	27.83	8.35	45,466
DA-37	4.92	1.48	8,059
DA-38	3.15	0.95	5,173
DA-15	2.70	0.81	4,410
DA-1	10.07	3.02	16,444
DA-2	20.88	6.26	34,086
DA-40	2.53	0.76	4,138
DA-42	1.88	0.56	3,049
DA-41	1.36	0.41	2,232
DA-16	3.44	1.03	5,608
DA-3	14.73	4.42	24,067
DA-17	4.22	1.27	6,915
DA-18	2.56	0.77	4,193
DA-19	2.62	0.79	4,302
A-WP	4.42	1.33	7,242
Totals	112.61	33.78	183,948

For disturbed area, a conservative assumption of 30% of the watershed was used.

In the above table, the volume for each Drainage Area is calculated as follows assuming one scheduled pond cleaning event per year.

From the above calculations, the controlling volume for the evaluation of this sedimentation pond is 375,661-cf, based on the runoff from the HydroCAD 10-year/24-hour storm event.

4.0 PRINCIPAL SPILLWAY DESIGN

Using HydroCAD, a 10-year/24-hour storm event was routed through the sedimentation pond to determine the required storage capacity below the prinicipal spillway with the higher flow rates from the proposed expansion.

As per OAC 3745-27-08(D)(3)(b), the principal spillway shall be designed to safely discharge the flow from a 10-year/24-hour storm event without the use of mechanical means. Based on the HydroCAD analysis, the West Sedimentation pond will not discharge from the principal or emergency spillway during the 10-year/24-hour storm or the 25-year/24-hour storm. The principal spillway is able to discharge the flow from a 100-year/24-hour storm event without the use of mechanical means, thus, the principal spillway is adequately sized.

The existing design for the principal spillway culvert is being analyzed in this calculation, thus, the need for anti-seep collars will not be evaluated.

Item	Value
Culvert Type	CPP
Culvert Quantity	1
Principal Spillway Diameter	30-inch
Principal Spillway Invert Elevation	1,170.00-ft
Maximum pool elevation for routing of 10-year/24-hour storm	1,166.18-ft
Maximum pool elevation for routing of 25-year/24-hour storm	1,168.77-ft
Maximum pool elevation for routing of 100-year/24-hour storm	1,171.16-ft

5.0 EMERGENCY SPILLWAY AND EMBANKMENT CREST DESIGN

According to the regulations, the emergency spillway must be set so that there is no discharge during the 25-year/24-hour storm. The combination of the principal and emergency spillways must discharge the 100-year/24-hour storm event while maintaining a minimum of 1.0 foot of freeboard to the embankment crest. These requirements have been checked by routing the 25-year/24-hour and 100-year/24-hour storms through the existing pond.

Currently, the emergency spillway is a sharp-crested/vee trap weir with the invert at elevation 1,173.00-ft and the embankment crest at 1,175.00-ft. Based on the HydroCAD analysis, only the principal spillway will discharge during a 100-year/24-hour storm event. The maximum elevation during the routing of a 100-year/24-hour strom is 1,171.16-ft, which is below the emergency spillway invert. The West Sedimentation Pond provides more than 1 foot of freeboard from the embankment crest.

Item	Value
Spillway Type	Sharp-Cressted Vee/Trap Weir
Quantity	1
Emergency Spillway Dimensions	151.9 degrees x 8.0 feet long
Emergency Spillway Invert Elevation	1,173.00-ft
Pond Embankment Crest Elevation	1,175.00-ft
Maximum pool elevation for routing of 100-year/24-hour storm	1,171.16-ft (>1.0-ft freeboard)
Maximum pool elevation for routing of 25-year/24-hour storm	1,168.77-ft

6.0 CONCLUSION

As designed, the West Sedimentation Pond will meet the requirements outlined in OAC 3745-27-08 (D)(3) with the additional flow from the proposed expansion. During the 10-year/24-hour storm and 25-year/24-hour storm events, the principal spillway will not discharge. During the 100-year/24-hour storm event, the principal spillway will discharge. The West Sedimentation Pond provides more than 1 foot of freeboard from the embankment crest to the maximum pool during the 100-year/24-hour storm.

REFERENCES

1. Soil Conservation Service, URBAN HYDROLOGY FOR SMALL WATERSHEDS, Technical Release 55, June 1986.

2. Soil Conservation Service, ENGINEERING FIELD MANUAL FOR CONSERVATION PRACTICES, November 1986.

3. Ven Te Chow, OPEN CHANNEL HYDRAULICS, Mc-Graw Hill Book Company, 1959

4. Goldman, Jackson and Bursztynsky, EROSION AND SEDIMENT CONTROL HANDBOOK, Mc-Graw Hill Book Company, 1986.

5. Soil Conservation Service, WATER MANAGEMENT AND SEDIMENT CONTROL FOR URBANIZING AREAS, distributed by Ohio Soil and Water Conservation Service.

6. American Iron and Steel Institute, HANDBOOK OF STEEL DRAINAGE & HIGHWAY PRODUCTS, 1971.

7. HydroCAD Software Solutions, LLC., HYDROCAD, Version 10.0, 2011, Computer Software Program.

8. National Climatic Data Center, *Precipitation Frequency Estimates*, Point Precipitation Frequency Estimate From NOAA Atlas 14 Ohio 40.4353 N 80.9122 W, Viewed 27 September 2011,< http://hdsc.nws.noaa.gov>.

9. Ohio Department of Natural Resources, Division of Soil and Water Conservation, RAINWATER AND LAND DEVELOPMENT, Third Edition, 2006.

NOAA PRECIPITATION ESTIMATE

www.nws.noaa.gov

NOAA's National Weather Service
Hydrometeorological Design Studies Center
Precipitation Frequency Data Server (PFDS)

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- PF in GIS Format
- PF Maps
- Temporal Distr.
- Time Series Data
- PFDS Perform.

PF Documents

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NOAA ATLAS 14 POINT PRECIPITATION FREQUENCY ESTIMATES

DATA DESCRIPTION

Data type: precipitation depth - **Units:** english - **Time series type:** partial duration -

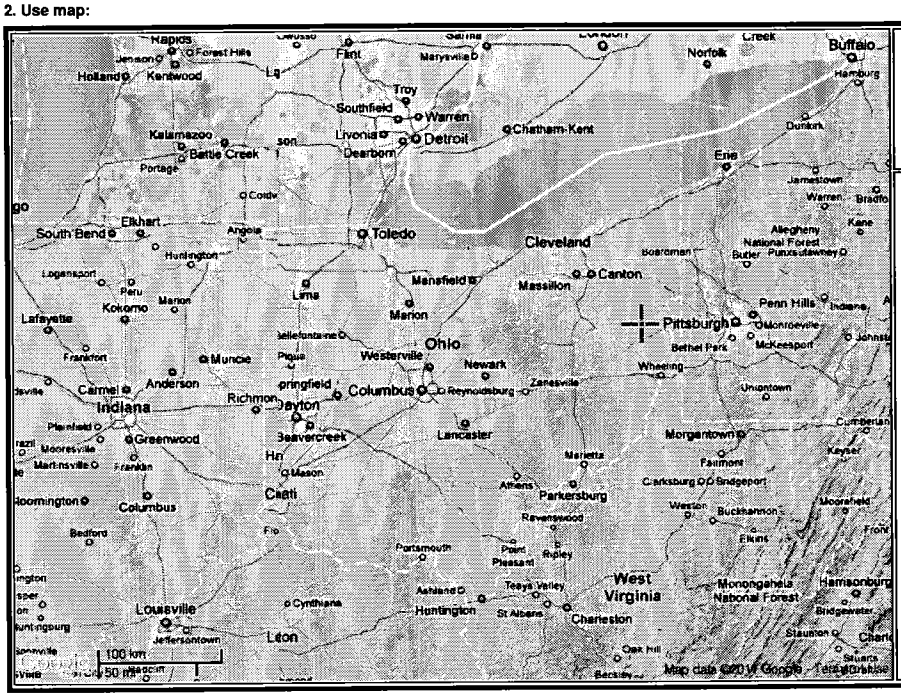
SELECT LOCATION

1. Manually:

a) Enter location (decimal degrees, use "-" for S and W): latitude: 40.4353 longitude: -80.9122 submit

b) Select station: select station

2. Use map:



a) **Select location** (move crosshair)
b) **Click on station icon**
(show stations on map)

LOCATION INFORMATION:
Name: Amsterdam, Ohio, US*
Latitude: 40.4353
Longitude: -80.9122
Elevation: 1230ft*

* source: Google Maps

POINT PRECIPITATION FREQUENCY (PF) ESTIMATES

WITH 90% CONFIDENCE INTERVALS AND SUPPLEMENTARY INFORMATION
NOAA Atlas 14, Volume 2, Version 3

PF tabular PF graphical Supplementary information Print Page

PDS-based precipitation frequency estimates with 90% confidence intervals (in inches)[1]

Duration	Average recurrence interval(years)								
	1	2	5	10	25	50	100	200	500	1000
5-min	0.326 (0.292-0.364)	0.390 (0.350-0.435)	0.472 (0.422-0.527)	0.534 (0.477-0.595)	0.614 (0.546-0.683)	0.676 (0.599-0.751)	0.735 (0.649-0.815)	0.796 (0.700-0.883)	0.878 (0.767-0.972)	0.938 (0.816-1.04)
10-min	0.507 (0.454-0.566)	0.609 (0.546-0.680)	0.733 (0.656-0.819)	0.825 (0.736-0.919)	0.940 (0.836-1.05)	1.02 (0.908-1.14)	1.11 (0.977-1.23)	1.19 (1.05-1.32)	1.29 (1.13-1.43)	1.37 (1.19-1.51)
15-min	0.621 (0.556-0.693)	0.745 (0.667-0.831)	0.900 (0.806-1.01)	1.02 (0.906-1.13)	1.16 (1.03-1.29)	1.27 (1.12-1.41)	1.37 (1.21-1.53)	1.48 (1.30-1.64)	1.61 (1.41-1.78)	1.71 (1.48-1.89)
30-min	0.821 (0.736-0.917)	0.997 (0.893-1.11)	1.23 (1.10-1.38)	1.41 (1.26-1.57)	1.64 (1.46-1.82)	1.81 (1.61-2.01)	1.98 (1.75-2.20)	2.16 (1.90-2.39)	2.39 (2.09-2.64)	2.56 (2.23-2.83)
60-min	1.00 (0.899-1.12)	1.22 (1.10-1.37)	1.55 (1.39-1.73)	1.79 (1.60-2.00)	2.13 (1.89-2.37)	2.39 (2.12-2.65)	2.65 (2.34-2.94)	2.93 (2.57-3.25)	3.30 (2.88-3.66)	3.59 (3.13-3.98)
2-hr	1.16 (1.03-1.30)	1.41 (1.25-1.58)	1.80 (1.59-2.02)	2.10 (1.86-2.35)	2.53 (2.23-2.83)	2.88 (2.54-3.22)	3.25 (2.85-3.62)	3.65 (3.18-4.05)	4.21 (3.65-4.66)	4.66 (4.02-5.16)
3-hr	1.23 (1.10-1.39)	1.49 (1.33-1.69)	1.90 (1.69-2.15)	2.22 (1.98-2.51)	2.69 (2.38-3.02)	3.07 (2.71-3.44)	3.47 (3.05-3 88)	3.91 (3.41-4.36)	4.53 (3.92-5.05)	5.03 (4.34-5.60)
6-hr	1.47 (1.32-1.66)	1.77 (1.59-2.00)	2.24 (2.00-2.52)	2.61 (2.33-2.94)	3.17 (2.81-3.55)	3.62 (3.20-4.05)	4.11 (3.61-4.58)	4.65 (4.06-5 16)	5.42 (4.68-6.00)	6.06 (5.19-6.69)
12-hr	1.74 (1.57-1.94)	2.09 (1.88-2.33)	2.60 (2.34-2.91)	3.04 (2.72-3.38)	3.67 (3.27-4.07)	4.20 (3.73-4.65)	4.78 (4.22-5.27)	5.41 (4.74-5.95)	6.34 (5.50-6.93)	7.11 (6.12-7.75)

24-hr	**2.04** (1.88-2.21)	**2.44** (2.26-2.64)	**3.00** (2.77-3.25)	**3.46** (3.20-3.75)	**4.12** (3.79-4.45)	**4.66** (4.26-5.03)	**5.23** (4.76-5.64)	**5.84** (5.28-6.28)	**6.69** (6.00-7.20)	**7.39** (6.57-7.95)
2-day	**2.38** (2.22-2.58)	**2.85** (2.64-3.08)	**3.47** (3.22-3.75)	**3.98** (3.69-4.30)	**4.69** (4.33-5.05)	**5.27** (4.84-5.67)	**5.87** (5.36-6.31)	**6.49** (5.90-6.99)	**7.37** (6.63-7.94)	**8.06** (7.20-8.70)
3-day	**2.55** (2.38-2.75)	**3.04** (2.83-3.27)	**3.68** (3.43-3.97)	**4.21** (3.91-4.52)	**4.93** (4.57-5.30)	**5.52** (5.09-5.92)	**6.13** (5.62-6.57)	**6.75** (6.17-7.24)	**7.62** (6.90-8.19)	**8.31** (7.47-8.94)
4-day	**2.72** (2.54-2.91)	**3.23** (3.02-3.47)	**3.90** (3.64-4.18)	**4.44** (4.14-4.75)	**5.18** (4.81-5.54)	**5.77** (5.35-6.17)	**6.38** (5.89-6.82)	**7.01** (6.43-7.50)	**7.88** (7.17-8.45)	**8.56** (7.74-9.19)
7-day	**3.25** (3.06-3.47)	**3.86** (3.63-4.12)	**4.63** (4.35-4.94)	**5.24** (4.92-5.59)	**6.09** (5.69-6.49)	**6.77** (6.30-7.21)	**7.45** (6.91-7.94)	**8.16** (7.53-8.69)	**9.11** (8.35-9.73)	**9.86** (8.96-10.5)
10-day	**3.75** (3.54-3.98)	**4.45** (4.20-4.72)	**5.28** (4.98-5.60)	**5.94** (5.60-6.29)	**6.83** (6.42-7.23)	**7.53** (7.06-7.98)	**8.24** (7.70-8.73)	**8.94** (8.33-9.50)	**9.89** (9.15-10.5)	**10.6** (9.76-11.3)
20-day	**5.27** (5.00-5.55)	**6.21** (5.90-6.55)	**7.27** (6.91-7.66)	**8.10** (7.68-8.52)	**9.17** (8.68-9.65)	**9.99** (9.44-10.5)	**10.8** (10.2-11.4)	**11.6** (10.9-12.2)	**12.6** (11.8-13.3)	**13.3** (12.4-14.1)
30-day	**6.61** (6.27-6.98)	**7.77** (7.37-8.21)	**9.01** (8.54-9.51)	**9.97** (9.44-10.5)	**11.2** (10.6-11.8)	**12.2** (11.5-12.8)	**13.1** (12.3-13.8)	**14.0** (13.1-14.8)	**15.1** (14.1-16.0)	**15.9** (14.8-16.9)
45-day	**8.46** (8.05-8.90)	**9.91** (9.42-10.4)	**11.3** (10.8-11.9)	**12.4** (11.8-13.1)	**13.8** (13.1-14.5)	**14.8** (14.0-15.6)	**15.8** (14.9-16.7)	**16.7** (15.8-17.7)	**17.9** (16.8-18.9)	**18.7** (17.5-19.8)
60-day	**10.2** (9.75-10.7)	**11.9** (11.4-12.5)	**13.5** (12.9-14.2)	**14.7** (14.0-15.4)	**16.2** (15.5-17.0)	**17.3** (16.5-18.1)	**18.3** (17.4-19.2)	**19.2** (18.2-20.2)	**20.4** (19.3-21.4)	**21.1** (20.0-22.3)

[1] Precipitation frequency (PF) estimates in this table are based on frequency analysis of partial duration series (PDS).

Numbers in parenthesis are PF estimates at lower and upper bounds of the 90% confidence interval. The probability that precipitation frequency estimates (for a given duration and average recurrence interval) will be greater than the upper bound (or less than the lower bound) is 5%. Estimates at upper bounds are not checked against probable maximum precipitation (PMP) estimates and may be higher than currently valid PMP values.

Please refer to NOAA Atlas 14 document for more information.

csv Estimates from the table in csv format: precipitation frequency estimates - Submit

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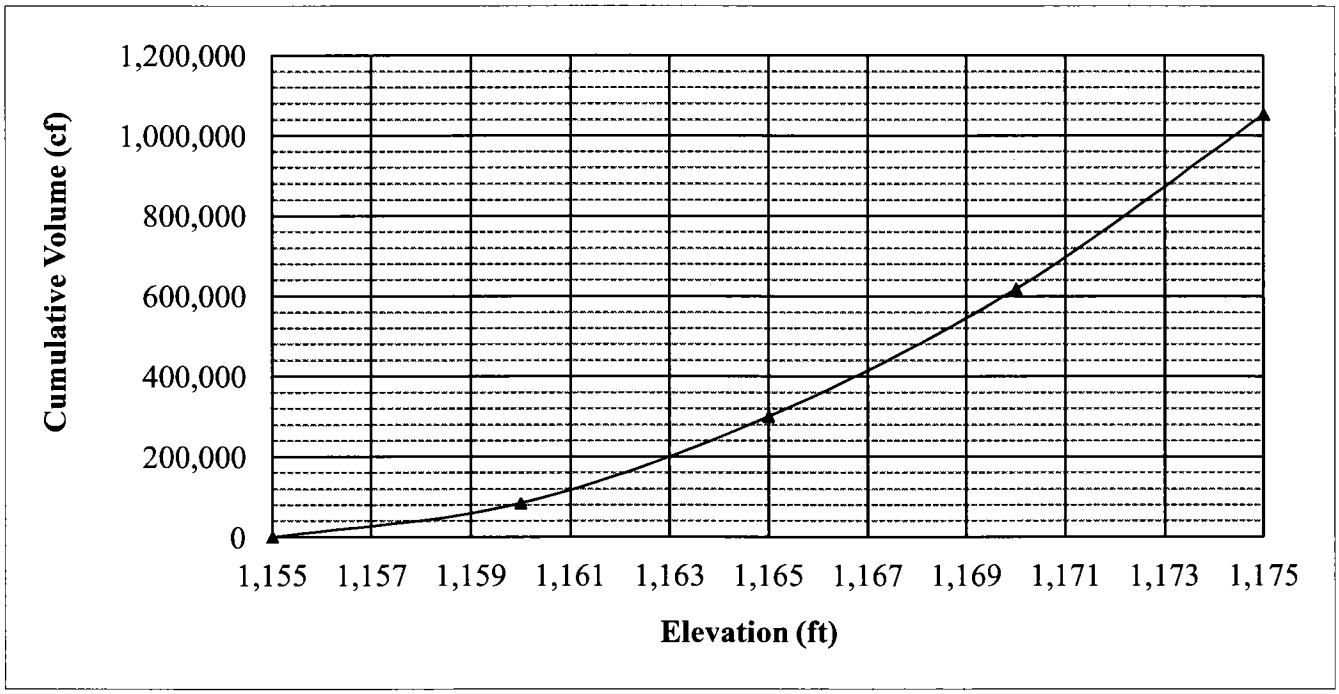
SEDIMENTATION POND
ELEVATION - STORAGE

Apex Sanitary Landfill
West Sedimentation Pond
Elevation Storage

Elevation (ft)	Pool Area (sf)	Average Area (sf)	Incremental Volume (cf)	Cumulative Volume (cf)	Cumulative Volume (ac-ft)
1,155.00	0	0	0	0	0.00
1,160.00	33,723	16,862	84,308	84,308	1.94
1,165.00	52,718	43,221	216,103	300,410	6.90
1,170.00	74,512	63,615	318,075	618,485	14.20
1,175.00	99,105	86,809	434,043	1,052,528	24.16



Principal spillway inlet invert is at El. 1,170-ft which has a storage capacity 618,485-cf.

SEDIMENTATION POND
ROUTING OF 10-YEAR 24-HOUR STORM

Summary for Pond WP: West Sedimentation Pond

Inflow Area = 112.610 ac, 0.00% Impervious, Inflow Depth > 0.92" for 10 year event
Inflow = 101.14 cfs @ 12.17 hrs, Volume= 8.631 af
Outflow = 0.00 cfs @ 5.00 hrs, Volume= 0.000 af, Atten= 100%, Lag= 0.0 min
Primary = 0.00 cfs @ 5.00 hrs, Volume= 0.000 af
Secondary = 0.00 cfs @ 5.00 hrs, Volume= 0.000 af

Routing by Stor-Ind method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Peak Elev= 1,166.18' @ 20.00 hrs Surf.Area= 0.000 ac Storage= 8.624 af

Plug-Flow detention time= (not calculated: initial storage excedes outflow)
Center-of-Mass det. time= (not calculated: no outflow)

Volume	Invert	Avail.Storage	Storage Description
#1	1,155.00'	24.160 af	**Custom Stage Data** Listed below

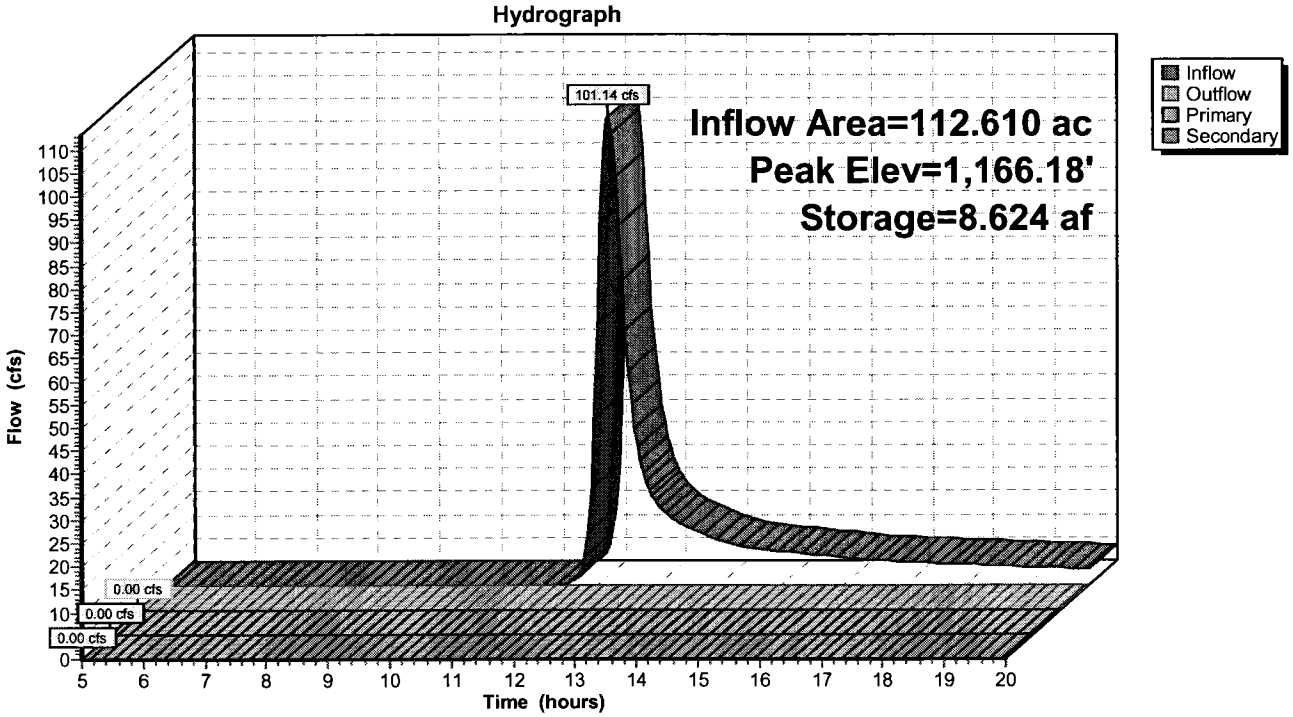
Elevation (feet)	Cum.Store (acre-feet)
1,155.00	0.000
1,160.00	1.940
1,165.00	6.900
1,170.00	14.200
1,175.00	24.160

Device	Routing	Invert	Outlet Devices
#1	Primary	1,170.00'	**30.0" Round Culvert** L= 85.0' CPP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 1,170.00' / 1,169.15' S= 0.0100 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 4.91 sf
#2	Secondary	1,173.00'	**151.9 deg x 8.0' long Sharp-Crested Vee/Trap Weir** Cv= 2.47 (C= 3.09)

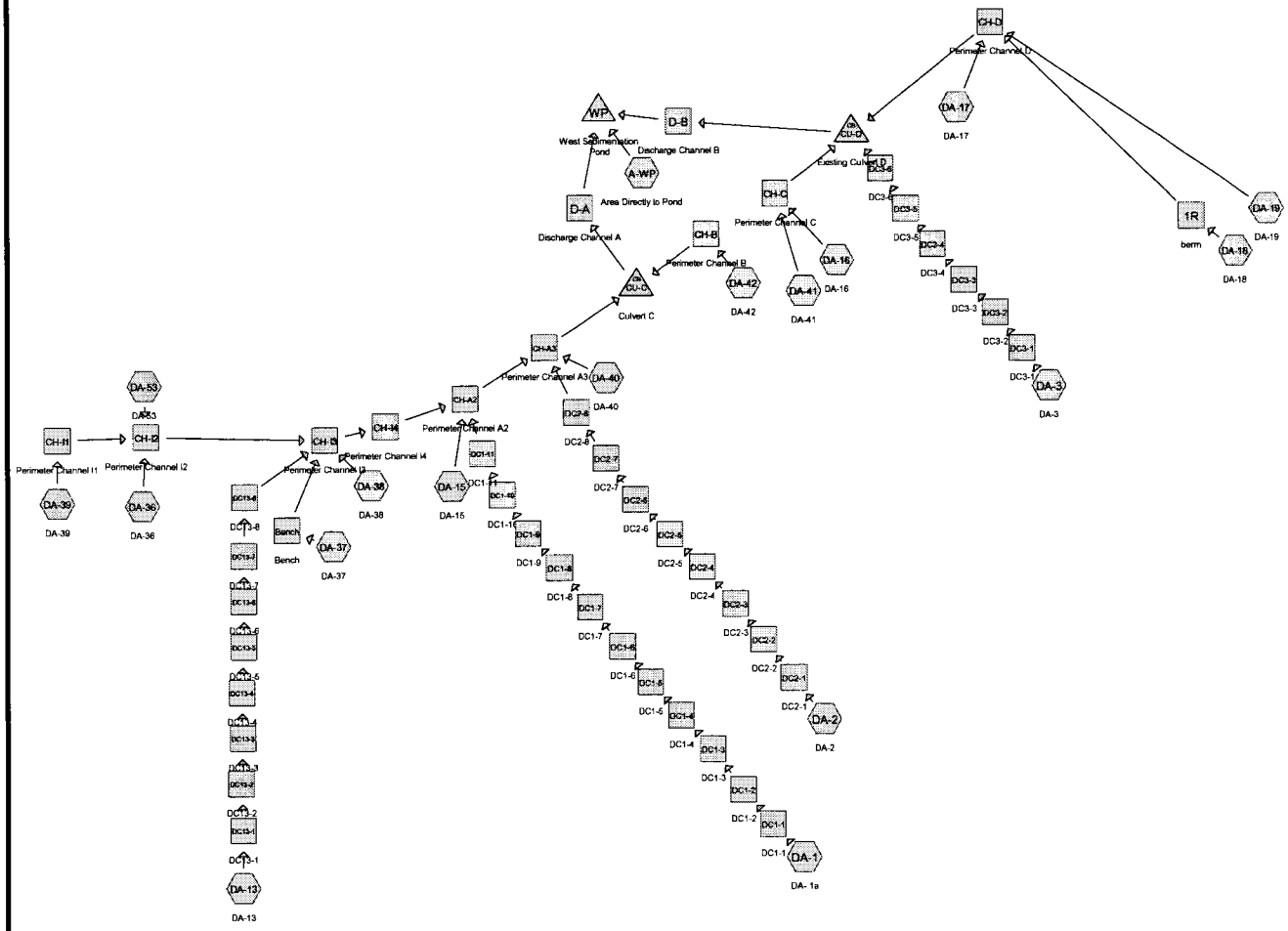
Primary OutFlow Max=0.00 cfs @ 5.00 hrs HW=1,155.00' (Free Discharge)
↑—**1=Culvert** (Controls 0.00 cfs)

Secondary OutFlow Max=0.00 cfs @ 5.00 hrs HW=1,155.00' (Free Discharge)
↑—**2=Sharp-Crested Vee/Trap Weir** (Controls 0.00 cfs)

Pond WP: West Sedimentation Pond



SEDIMENTATION POND
ROUTING OF 25-YEAR 24-HOUR STORM



Subcat Reach Pond Link

Routing Diagram for West Sedimentation Pond
Prepared by Microsoft, Printed 10/21/2011
HydroCAD® 10.00 s/n 01006 © 2011 HydroCAD Software Solutions LLC

Summary for Subcatchment A-WP: Area Directly to Pond

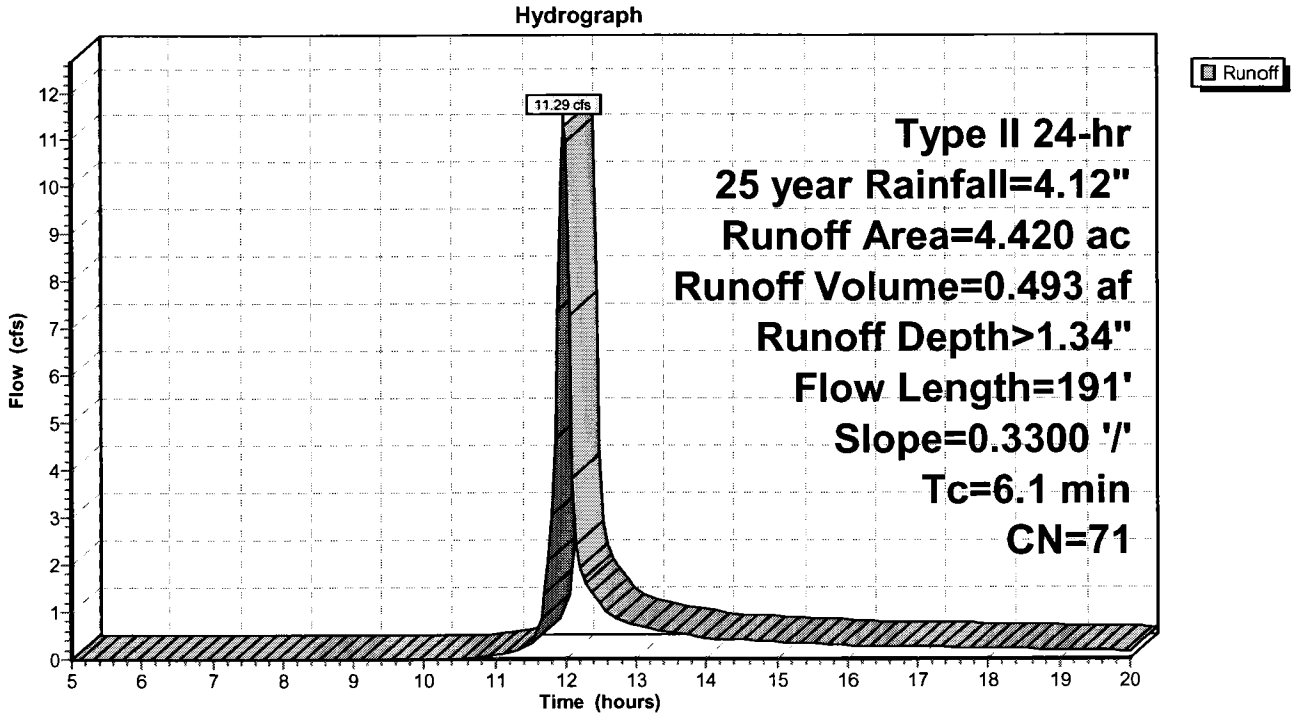
Runoff = 11.29 cfs @ 11.98 hrs, Volume= 0.493 af, Depth> 1.34"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type II 24-hr 25 year Rainfall=4.12"

Area (ac)	CN	Description
4.420	71	Meadow, non-grazed, HSG C
4.420		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.1	191	0.3300	0.52		**Sheet Flow, 191 feet 3H:1V sheet flow** Grass: Short n= 0.150 P2= 2.44"

Subcatchment A-WP: Area Directly to Pond



Summary for Subcatchment DA-1: DA- 1a

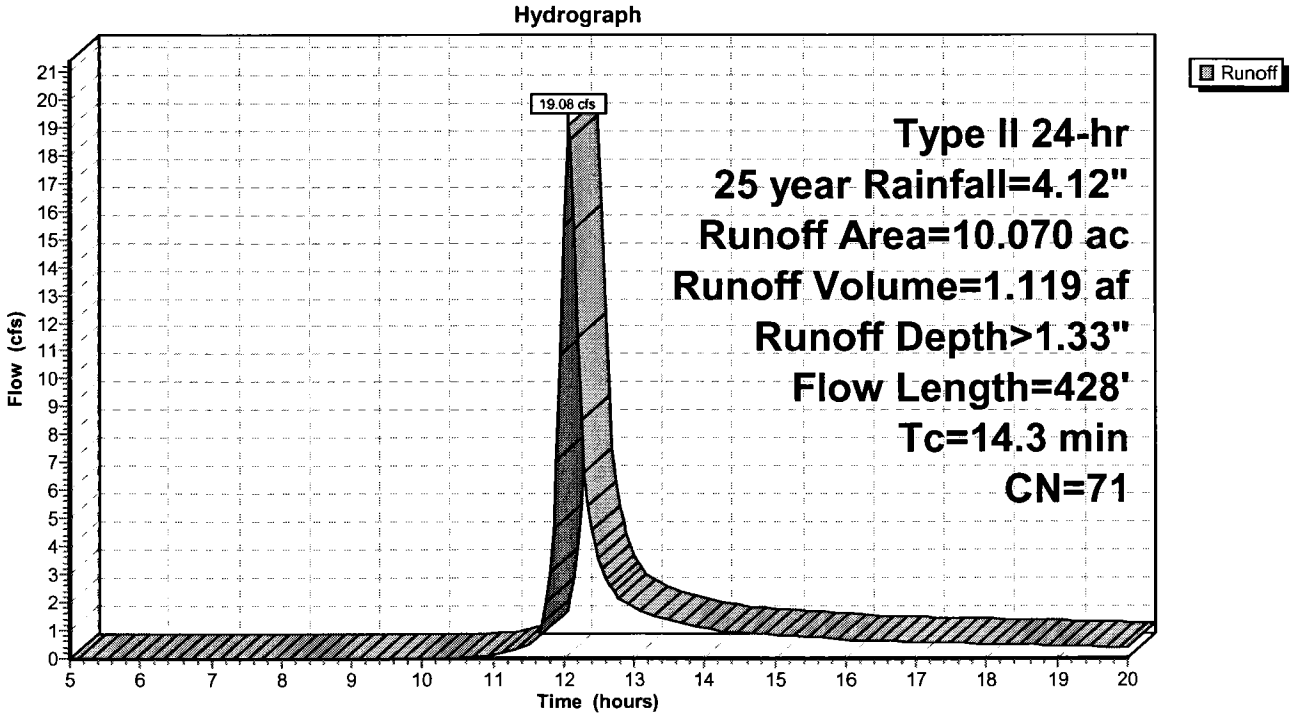
Runoff = 19.08 cfs @ 12.07 hrs, Volume= 1.119 af, Depth> 1.33"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type II 24-hr 25 year Rainfall=4.12"

Area (ac)	CN	Description
10.070	71	Meadow, non-grazed, HSG C
10.070		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
10.8	214	0.1000	0.33		**Sheet Flow, 214 feet 10% sheet flow** Grass: Short n= 0.150 P2= 2.44"
3.2	86	0.3300	0.44		**Sheet Flow, 86 feet 3H:1V sheet flow** Grass: Short n= 0.150 P2= 2.44"
0.0	7	0.3300	4.02		**Shallow Concentrated Flow, 7 feet 3H:1V shallow conc. flow** Short Grass Pasture Kv= 7.0 fps
0.3	121	0.0300	7.00	102.24	**Channel Flow, 121 feet bench flow** Area= 14.6 sf Perim= 19.8' r= 0.74' n= 0.030 Earth, grassed & winding
14.3	428	Total			

Subcatchment DA-1: DA- 1a



Summary for Subcatchment DA-13: DA-13

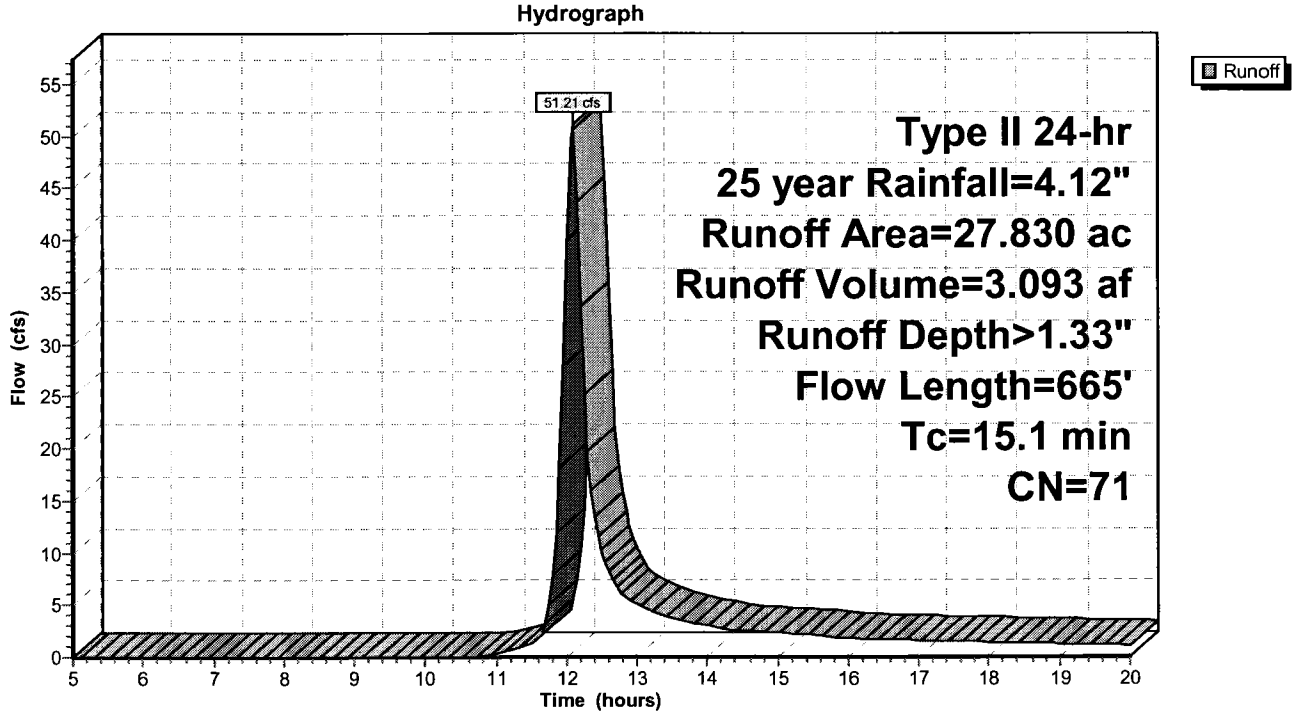
Runoff = 51.21 cfs @ 12.08 hrs, Volume= 3.093 af, Depth> 1.33"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type II 24-hr 25 year Rainfall=4.12"

Area (ac)	CN	Description
27.830	71	Meadow, non-grazed, HSG C
27.830		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
11.3	226	0.1000	0.33		**Sheet Flow, 226 feet 10% sheet flow** Grass: Short n= 0.150 P2= 2.44"
2.9	74	0.3300	0.43		**Sheet Flow, 74 feet 3H:1V sheet flow** Grass: Short n= 0.150 P2= 2.44"
0.1	35	0.3300	4.02		**Shallow Concentrated Flow, 35 feet 3H:1V shallow conc. flow** Short Grass Pasture Kv= 7.0 fps
0.8	330	0.0300	7.00	102.24	**Channel Flow, 330 feet bench flow** Area= 14.6 sf Perim= 19.8' r= 0.74' n= 0.030 Earth, grassed & winding
15.1	665	Total			

Subcatchment DA-13: DA-13



Summary for Subcatchment DA-15: DA-15

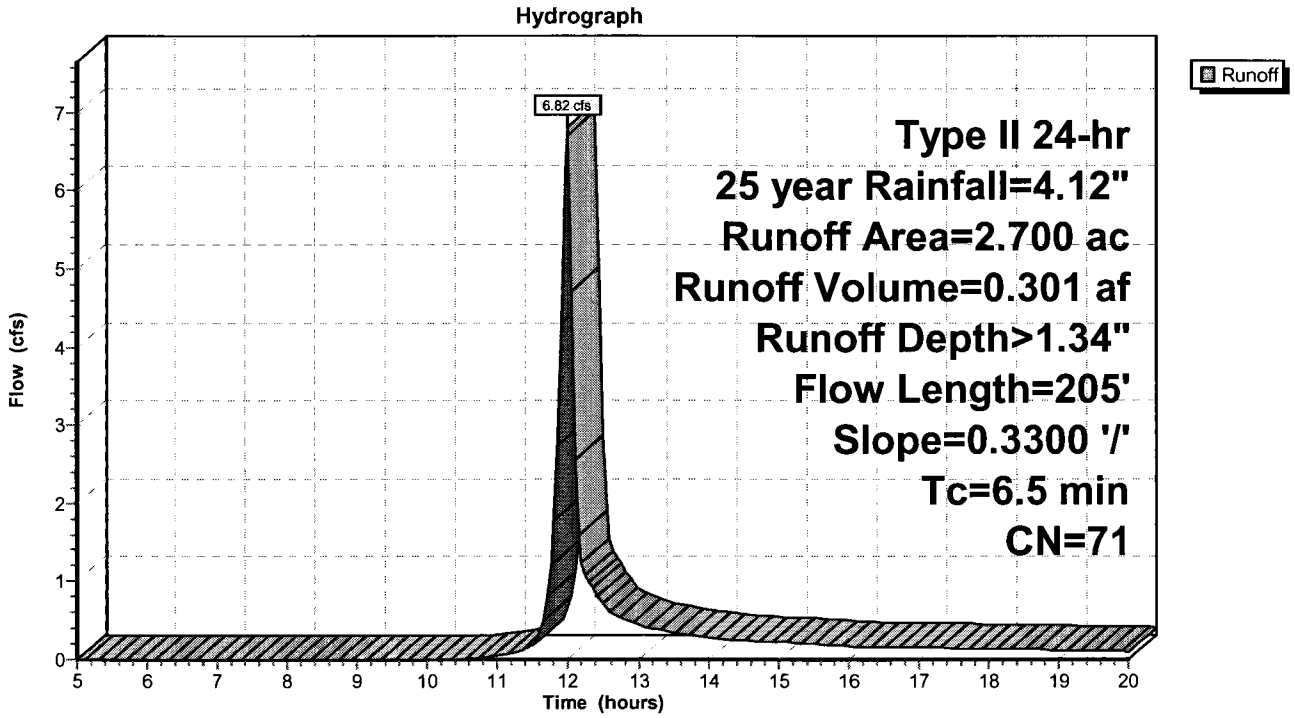
Runoff = 6.82 cfs @ 11.98 hrs, Volume= 0.301 af, Depth> 1.34"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type II 24-hr 25 year Rainfall=4.12"

Area (ac)	CN	Description
2.700	71	Meadow, non-grazed, HSG C
2.700		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.5	205	0.3300	0.53		**Sheet Flow, 205 feet 3H:1V sheet flow** Grass: Short n= 0.150 P2= 2.44"

Subcatchment DA-15: DA-15



Summary for Subcatchment DA-16: DA-16

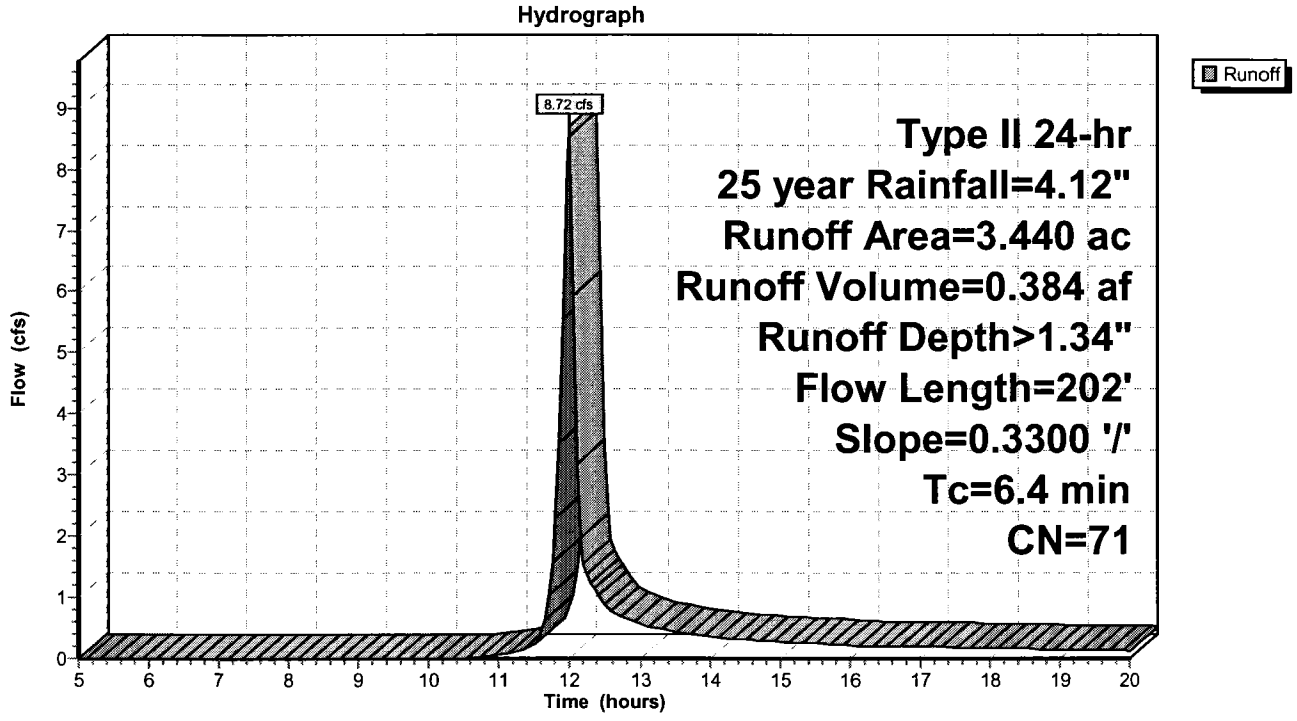
Runoff = 8.72 cfs @ 11.98 hrs, Volume= 0.384 af, Depth> 1.34"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type II 24-hr 25 year Rainfall=4.12"

Area (ac)	CN	Description
3.440	71	Meadow, non-grazed, HSG C
3.440		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.4	202	0.3300	0.52		**Sheet Flow, 202 feet 3H:1V sheet flow** Grass: Short n= 0.150 P2= 2.44"

Subcatchment DA-16: DA-16



Summary for Subcatchment DA-17: DA-17

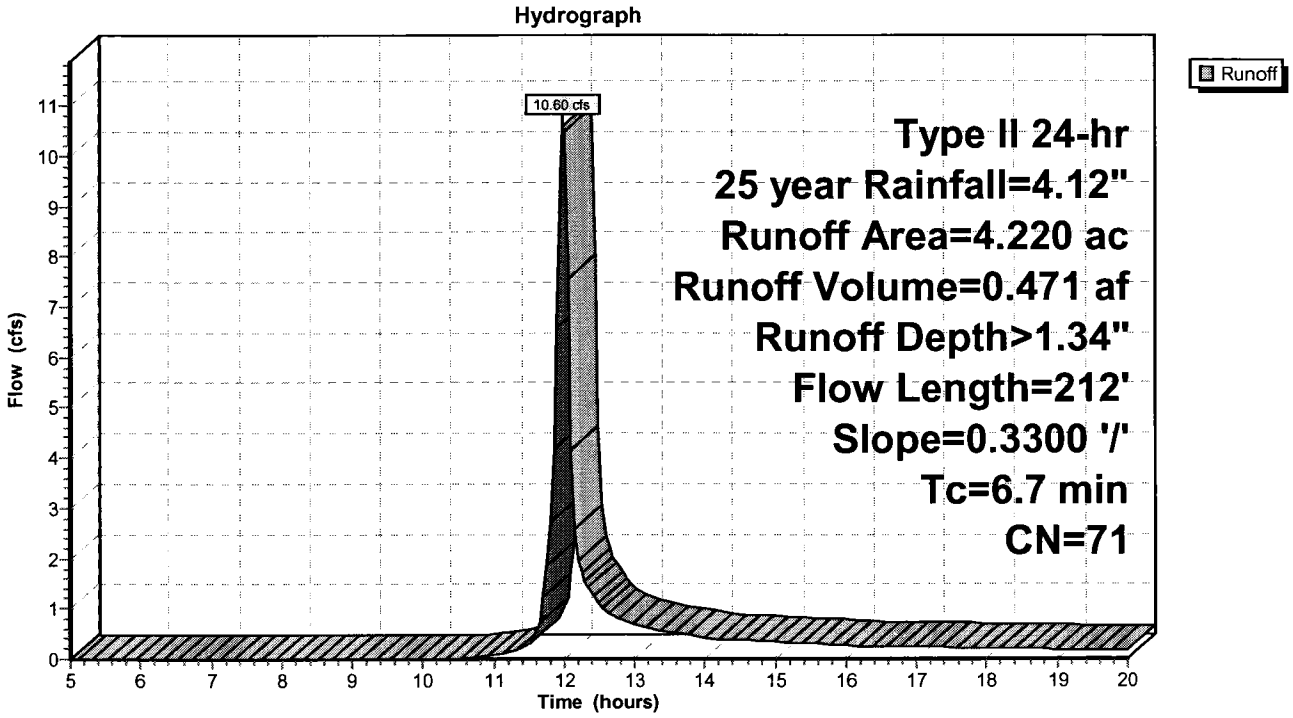
Runoff = 10.60 cfs @ 11.99 hrs, Volume= 0.471 af, Depth> 1.34"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type II 24-hr 25 year Rainfall=4.12"

Area (ac)	CN	Description
4.220	71	Meadow, non-grazed, HSG C
4.220		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.7	212	0.3300	0.53		**Sheet Flow, 212 feet 3H:1V sheet flow** Grass: Short n= 0.150 P2= 2.44"

Subcatchment DA-17: DA-17



Summary for Subcatchment DA-18: DA-18

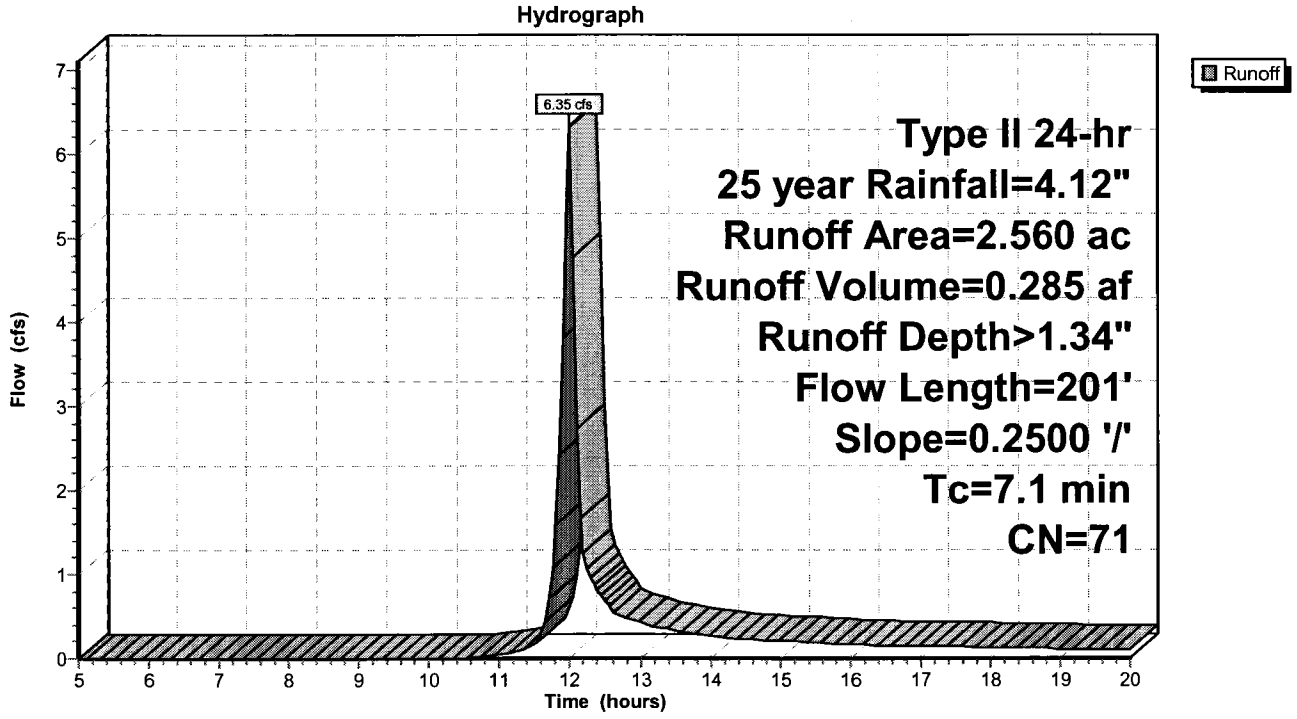
Runoff = 6.35 cfs @ 11.99 hrs, Volume= 0.285 af, Depth> 1.34"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type II 24-hr 25 year Rainfall=4.12"

Area (ac)	CN	Description
2.560	71	Meadow, non-grazed, HSG C
2.560		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
7.1	201	0.2500	0.47		**Sheet Flow, 201 feet 4H:1V sheet flow** Grass: Short n= 0.150 P2= 2.44"

Subcatchment DA-18: DA-18



Summary for Subcatchment DA-19: DA-19

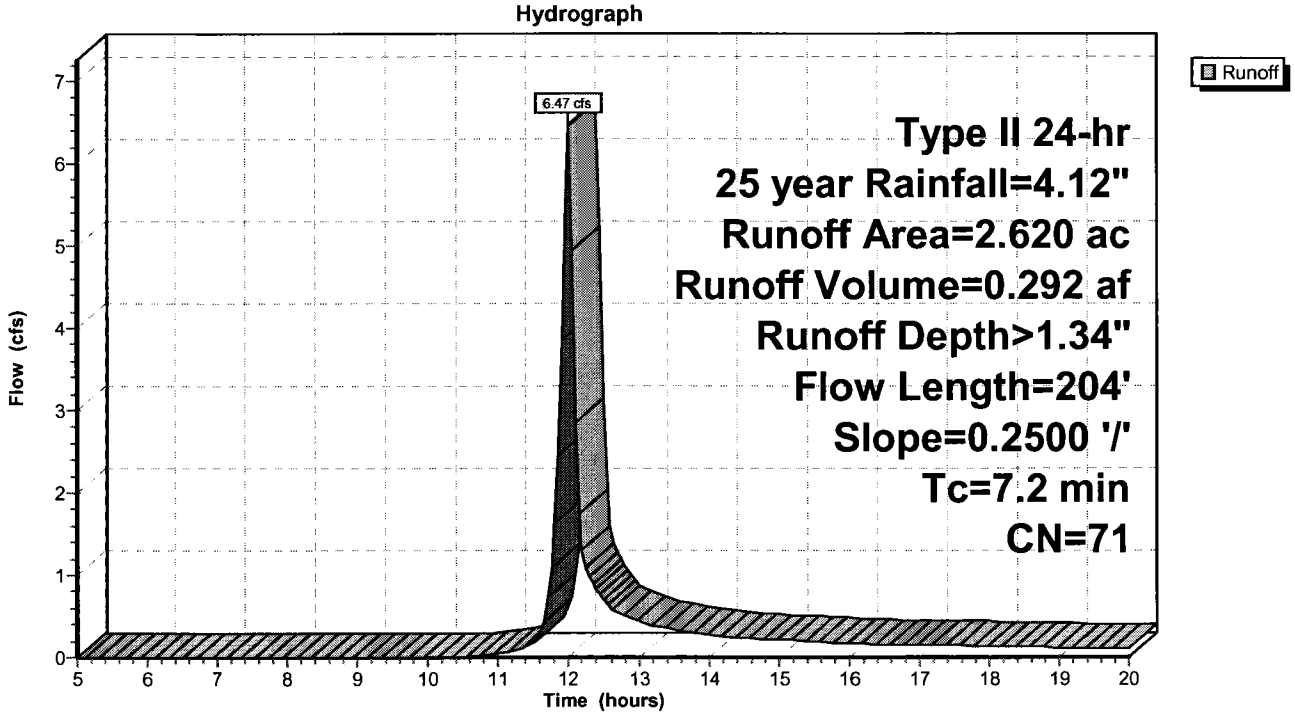
Runoff = 6.47 cfs @ 11.99 hrs, Volume= 0.292 af, Depth> 1.34"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type II 24-hr 25 year Rainfall=4.12"

Area (ac)	CN	Description
2.620	71	Meadow, non-grazed, HSG C
2.620		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
7.2	204	0.2500	0.47		**Sheet Flow, 204 feet 4H:1V sheet flow** Grass: Short n= 0.150 P2= 2.44"

Subcatchment DA-19: DA-19



Summary for Subcatchment DA-2: DA-2

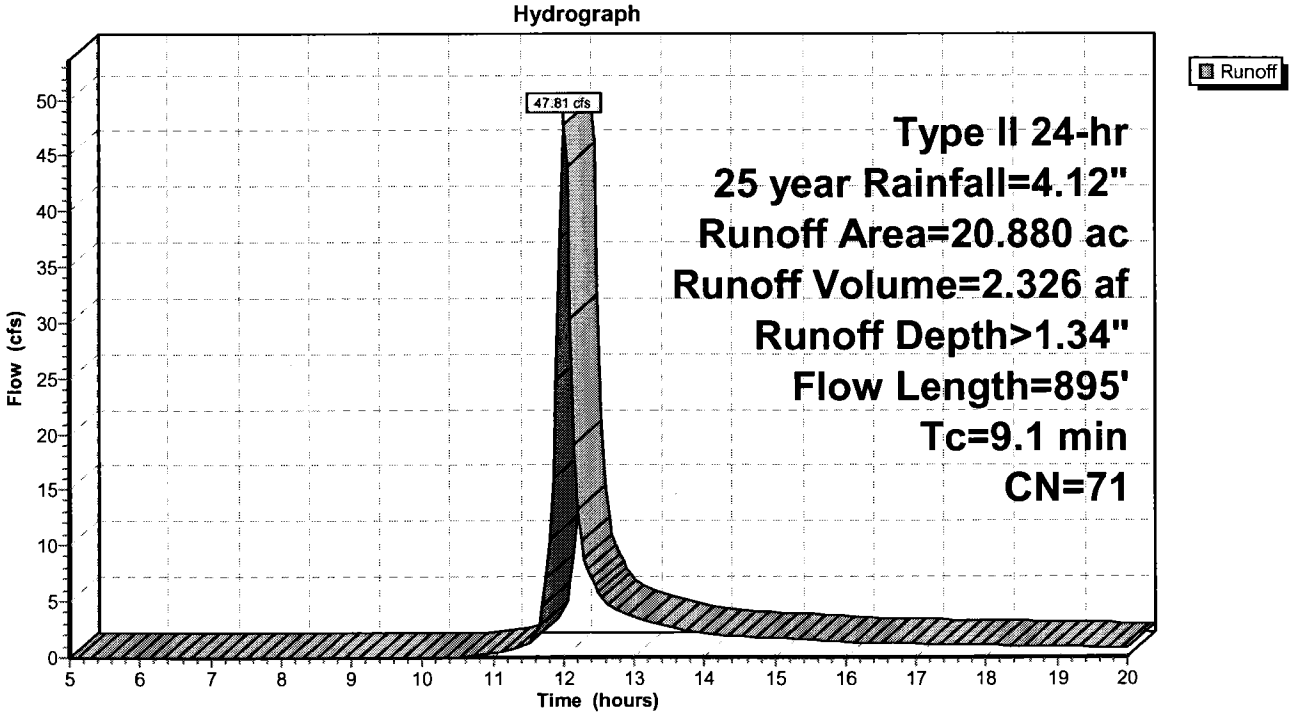
Runoff = 47.81 cfs @ 12.01 hrs, Volume= 2.326 af, Depth> 1.34"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type II 24-hr 25 year Rainfall=4.12"

Area (ac)	CN	Description
20.880	71	Meadow, non-grazed, HSG C
20.880		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
4.0	62	0.1000	0.26		**Sheet Flow, 62 feet 10% sheet flow** Grass: Short n= 0.150 P2= 2.44"
3.3	89	0.3300	0.45		**Sheet Flow, 89 feet 3H:1V sheet flow** Grass: Short n= 0.150 P2= 2.44"
1.8	744	0.0300	7.00	102.24	**Channel Flow, 744 feet channel flow** Area= 14.6 sf Perim= 19.8' r= 0.74' n= 0.030 Earth, grassed & winding
9.1	895	Total			

Subcatchment DA-2: DA-2



Summary for Subcatchment DA-3: DA-3

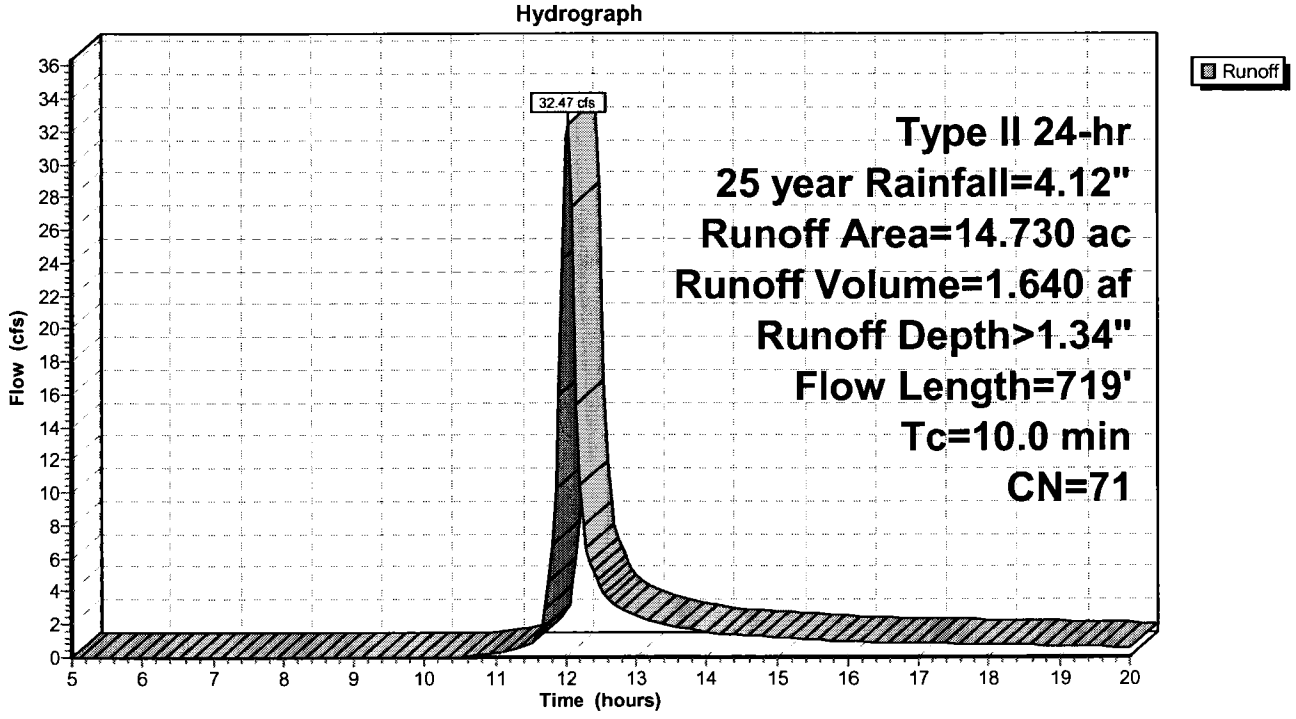
Runoff = 32.47 cfs @ 12.02 hrs, Volume= 1.640 af, Depth> 1.34"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type II 24-hr 25 year Rainfall=4.12"

Area (ac)	CN	Description
14.730	71	Meadow, non-grazed, HSG C
14.730		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
4.6	73	0.1000	0.27		**Sheet Flow, 73 feet 10% sheet flow** Grass: Short n= 0.150 P2= 2.44"
4.1	115	0.3300	0.47		**Sheet Flow, 115 feet 3H:1V sheet flow** Grass: Short n= 0.150 P2= 2.44"
1.3	531	0.0300	7.00	102.24	**Channel Flow, 531 feet bench flow** Area= 14.6 sf Perim= 19.8' r= 0.74' n= 0.030 Earth, grassed & winding
10.0	719	Total			

Subcatchment DA-3: DA-3



Summary for Subcatchment DA-36: DA-36

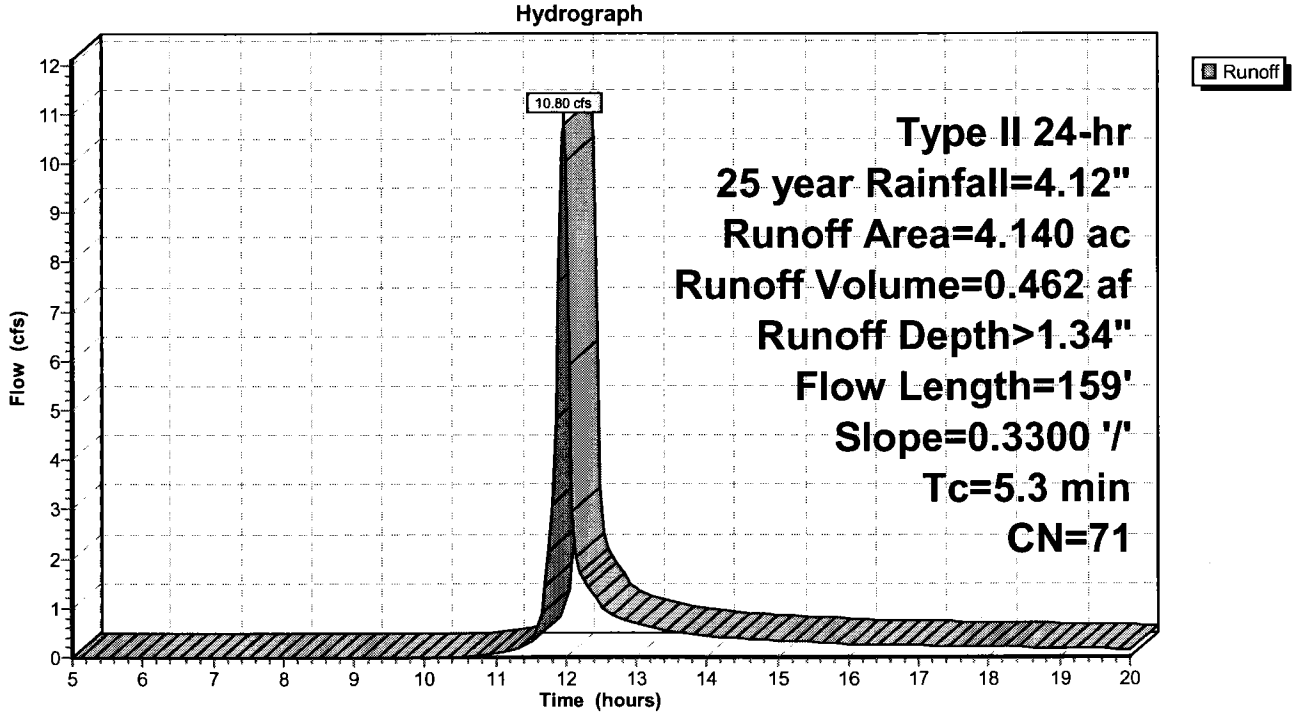
Runoff = 10.80 cfs @ 11.97 hrs, Volume= 0.462 af, Depth> 1.34"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type II 24-hr 25 year Rainfall=4.12"

Area (ac)	CN	Description
4.140	71	Meadow, non-grazed, HSG C
4.140		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.3	159	0.3300	0.50		**Sheet Flow, 159 feet 3H:1V sheet flow** Grass: Short n= 0.150 P2= 2.44"

Subcatchment DA-36: DA-36



Summary for Subcatchment DA-37: DA-37

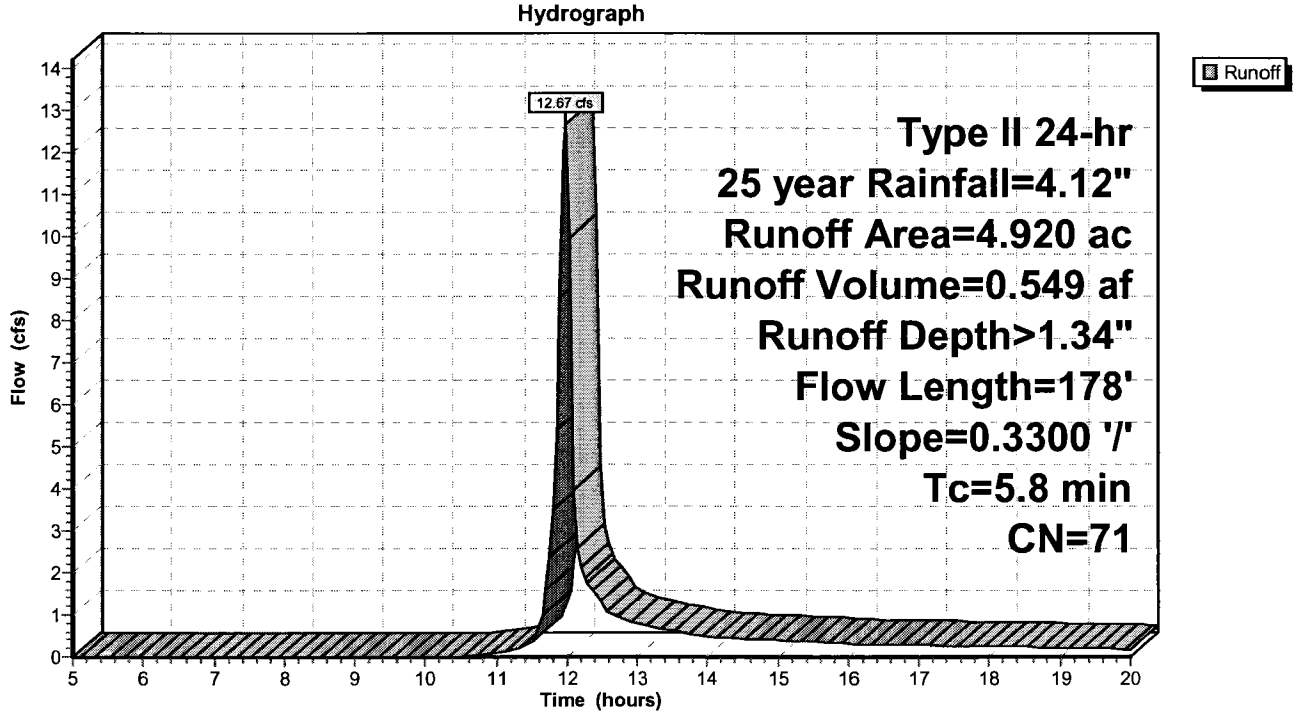
Runoff = 12.67 cfs @ 11.98 hrs, Volume= 0.549 af, Depth> 1.34"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type II 24-hr 25 year Rainfall=4.12"

Area (ac)	CN	Description
4.920	71	Meadow, non-grazed, HSG C
4.920		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.8	178	0.3300	0.51		**Sheet Flow, 178 feet 3H:1V sheet flow** Grass: Short n= 0.150 P2= 2.44"

Subcatchment DA-37: DA-37



Summary for Subcatchment DA-38: DA-38

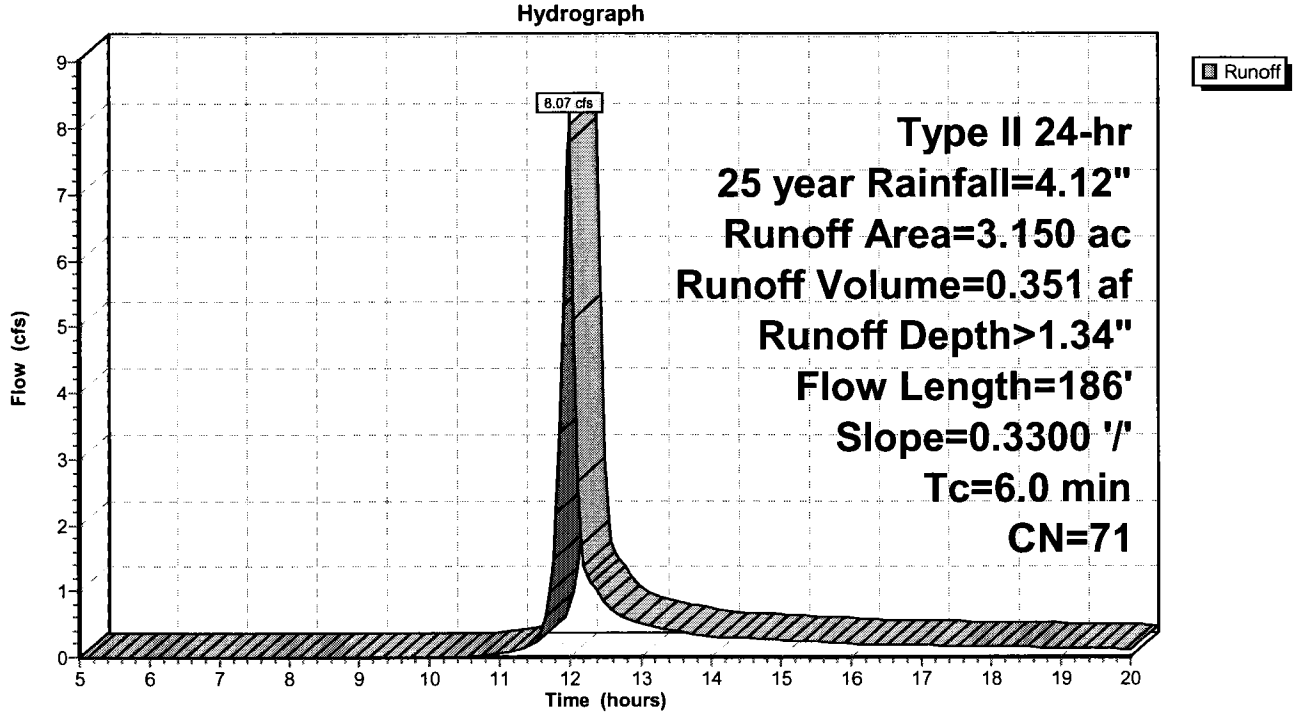
Runoff = 8.07 cfs @ 11.98 hrs, Volume= 0.351 af, Depth> 1.34"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type II 24-hr 25 year Rainfall=4.12"

Area (ac)	CN	Description
3.150	71	Meadow, non-grazed, HSG C
3.150		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.0	186	0.3300	0.52		**Sheet Flow, 186 feet 3H:1V sheet flow** Grass: Short n= 0.150 P2= 2.44"

Subcatchment DA-38: DA-38



Summary for Subcatchment DA-39: DA-39

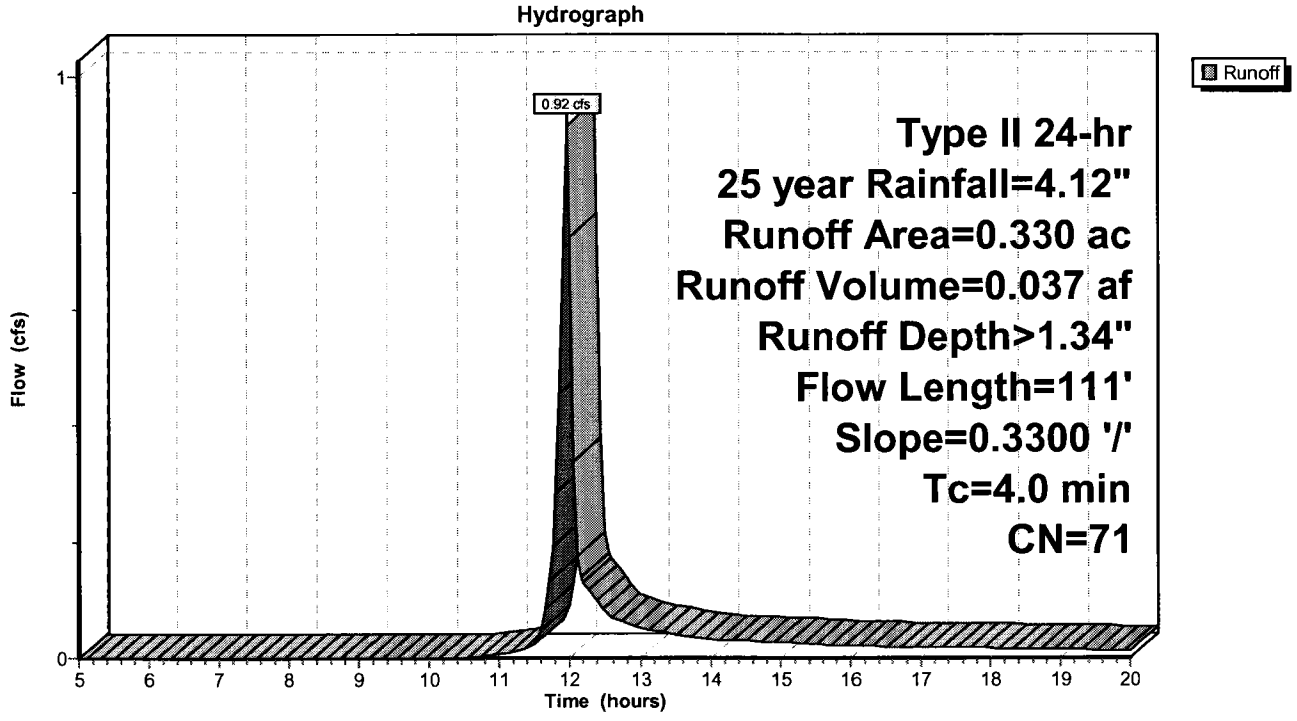
Runoff = 0.92 cfs @ 11.95 hrs, Volume= 0.037 af, Depth> 1.34"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type II 24-hr 25 year Rainfall=4.12"

Area (ac)	CN	Description
0.330	71	Meadow, non-grazed, HSG C
0.330		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
4.0	111	0.3300	0.47		**Sheet Flow, 111 feet 3H:1V sheet flow** Grass: Short n= 0.150 P2= 2.44"

Subcatchment DA-39: DA-39



Summary for Subcatchment DA-40: DA-40

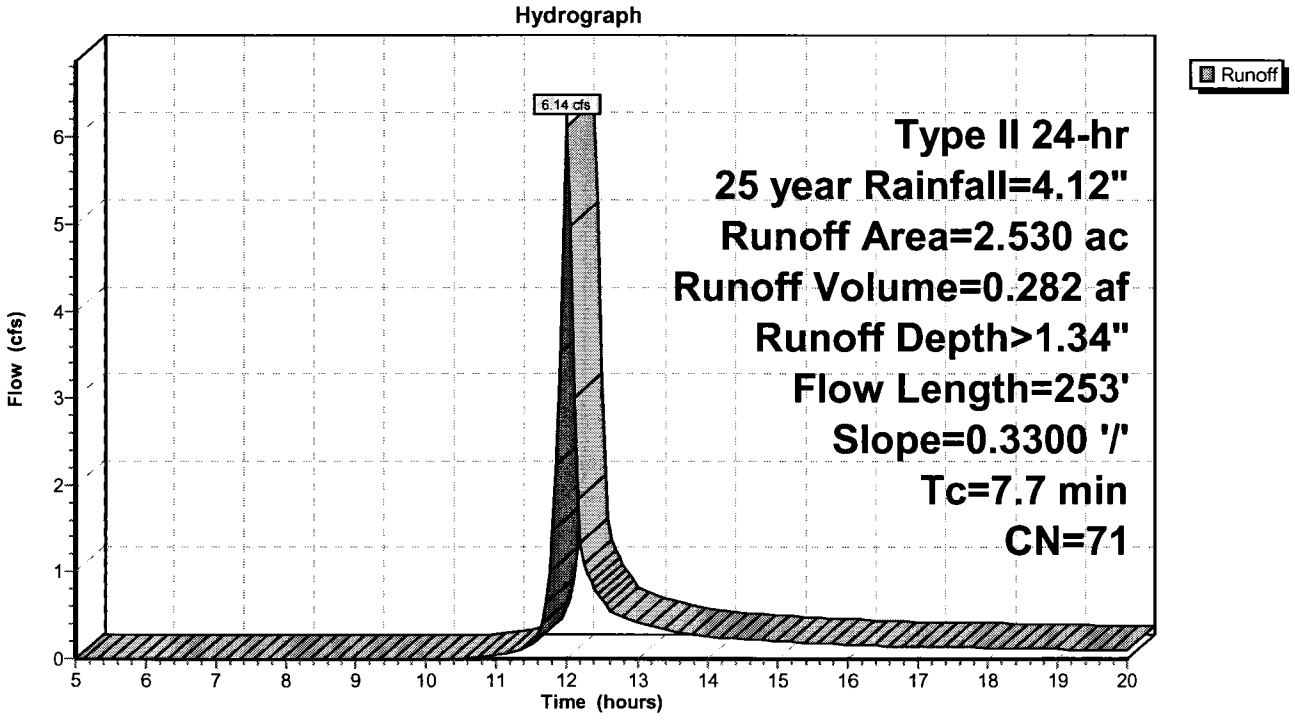
Runoff = 6.14 cfs @ 12.00 hrs, Volume= 0.282 af, Depth> 1.34"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type II 24-hr 25 year Rainfall=4.12"

Area (ac)	CN	Description
2.530	71	Meadow, non-grazed, HSG C
2.530		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
7.7	253	0.3300	0.55		**Sheet Flow, 253 feet 3H:1V sheet flow** Grass: Short n= 0.150 P2= 2.44"

Subcatchment DA-40: DA-40



Summary for Subcatchment DA-41: DA-41

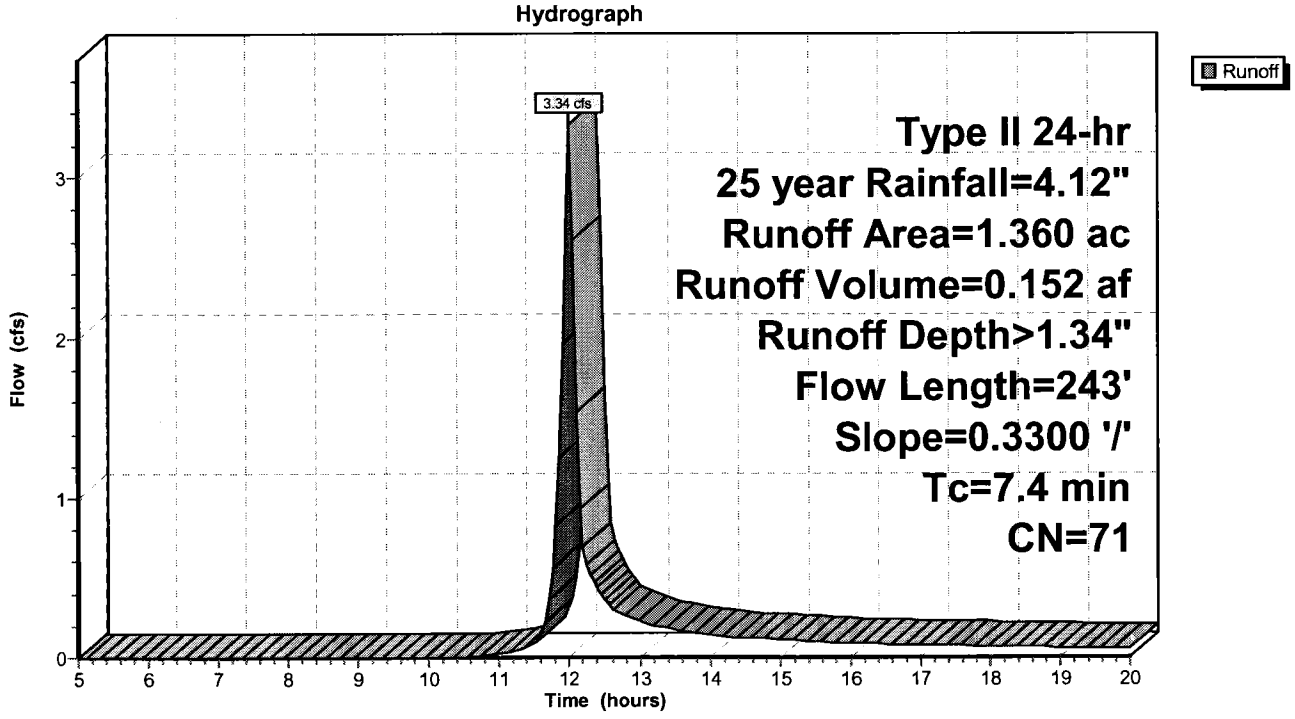
Runoff = 3.34 cfs @ 11.99 hrs, Volume= 0.152 af, Depth> 1.34"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type II 24-hr 25 year Rainfall=4.12"

Area (ac)	CN	Description
1.360	71	Meadow, non-grazed, HSG C
1.360		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
7.4	243	0.3300	0.54		**Sheet Flow, 243 feet 3H:1V sheet flow** Grass: Short n= 0.150 P2= 2.44"

Subcatchment DA-41: DA-41



Summary for Subcatchment DA-42: DA-42

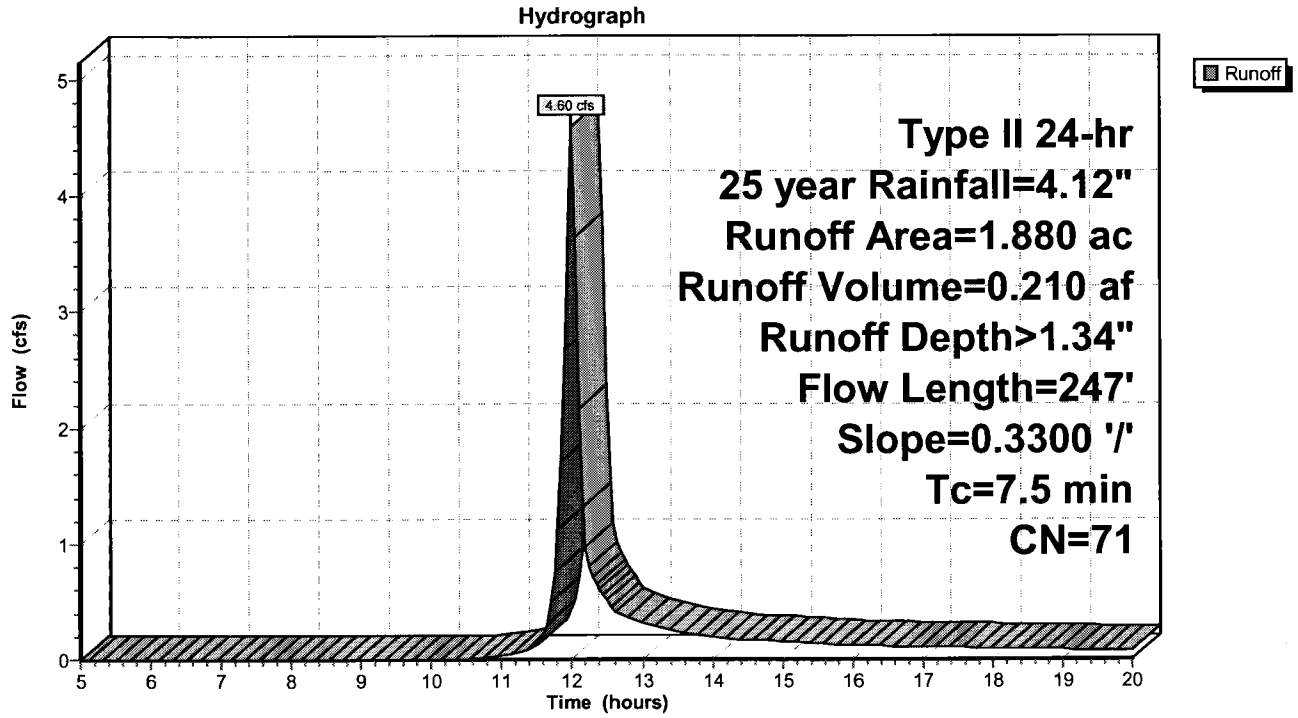
Runoff = 4.60 cfs @ 12.00 hrs, Volume= 0.210 af, Depth> 1.34"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type II 24-hr 25 year Rainfall=4.12"

Area (ac)	CN	Description
1.880	71	Meadow, non-grazed, HSG C
1.880		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
7.5	247	0.3300	0.55		**Sheet Flow, 247 feet 3H:1V sheet flow** Grass: Short n= 0.150 P2= 2.44"

Subcatchment DA-42: DA-42



Summary for Subcatchment DA-53: DA-53

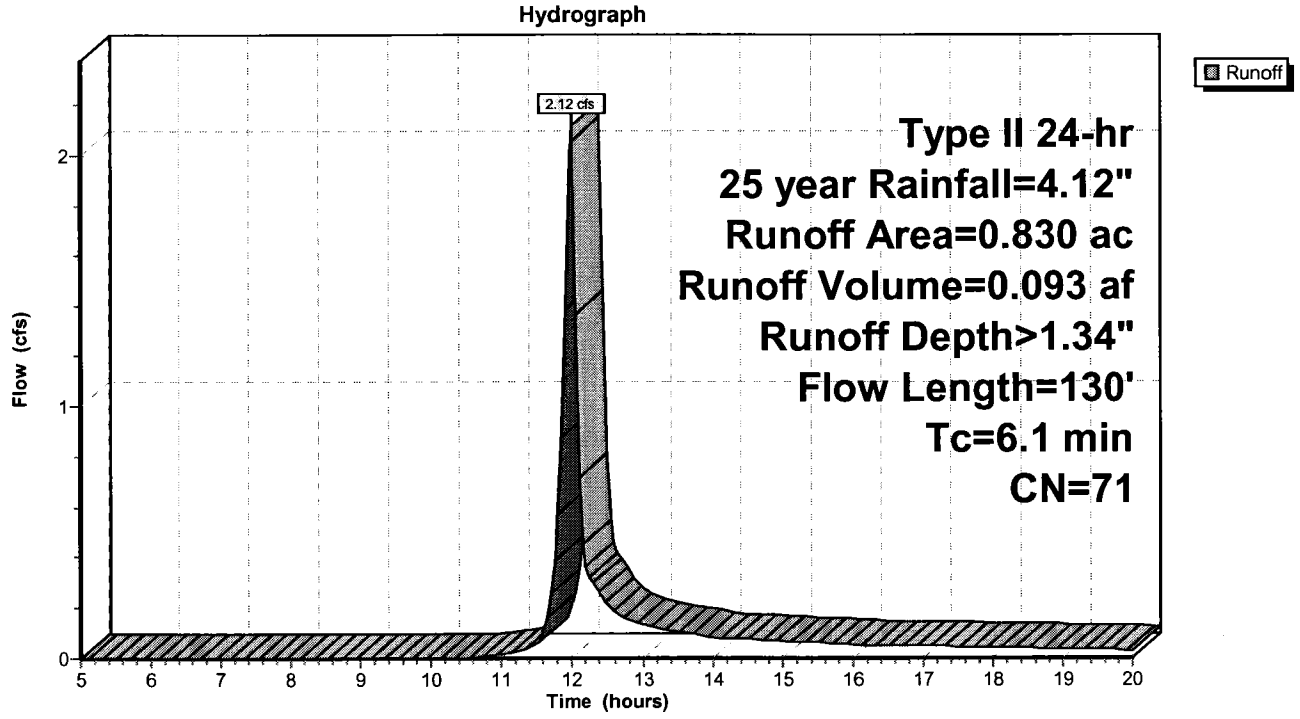
Runoff = 2.12 cfs @ 11.98 hrs, Volume= 0.093 af, Depth> 1.34"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type II 24-hr 25 year Rainfall=4.12"

Area (ac)	CN	Description
0.830	71	Meadow, non-grazed, HSG C
0.830		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
3.6	97	0.3300	0.45		**Sheet Flow, 97 feet 3H:1V sheet flow** Grass: Short n= 0.150 P2= 2.44"
2.5	33	0.0100	0.22		**Sheet Flow, 33 feet 100H:1V sheet flow** Fallow n= 0.050 P2= 2.44"
6.1	130	Total			

Subcatchment DA-53: DA-53



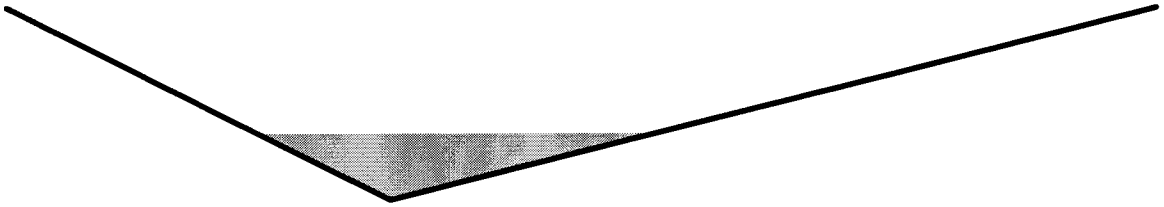
Summary for Reach 1R: berm

Inflow Area = 2.560 ac, 0.00% Impervious, Inflow Depth > 1.34" for 25 year event
Inflow = 6.35 cfs @ 11.99 hrs, Volume= 0.285 af
Outflow = 5.76 cfs @ 12.06 hrs, Volume= 0.284 af, Atten= 9%, Lag= 4.4 min

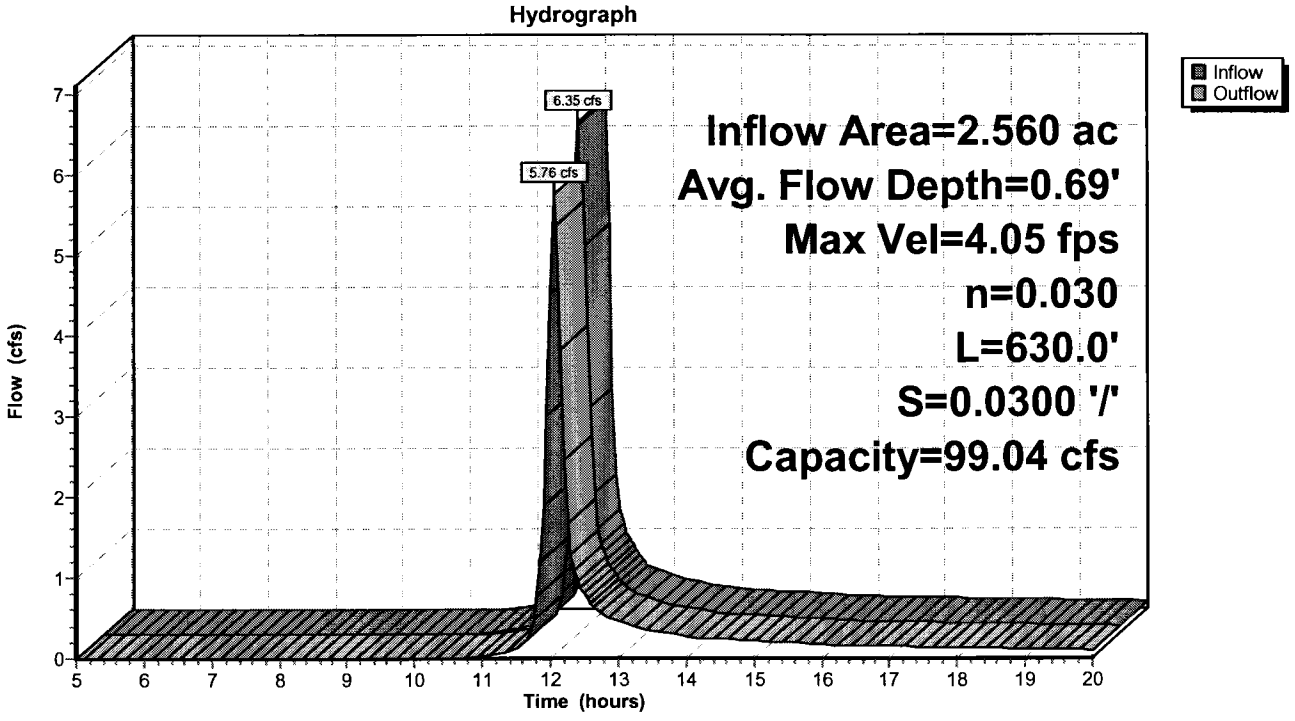
Routing by Stor-Ind+Trans method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Max. Velocity= 4.05 fps, Min. Travel Time= 2.6 min
Avg. Velocity = 1.76 fps, Avg. Travel Time= 6.0 min

Peak Storage= 905 cf @ 12.02 hrs
Average Depth at Peak Storage= 0.69'
Bank-Full Depth= 2.00' Flow Area= 12.0 sf, Capacity= 99.04 cfs

0.00' x 2.00' deep channel, n= 0.030 Earth, grassed & winding
Side Slope Z-value= 2.0 4.0 '/' Top Width= 12.00'
Length= 630.0' Slope= 0.0300 '/'
Inlet Invert= 1,267.00', Outlet Invert= 1,248.10'



Reach 1R: berm



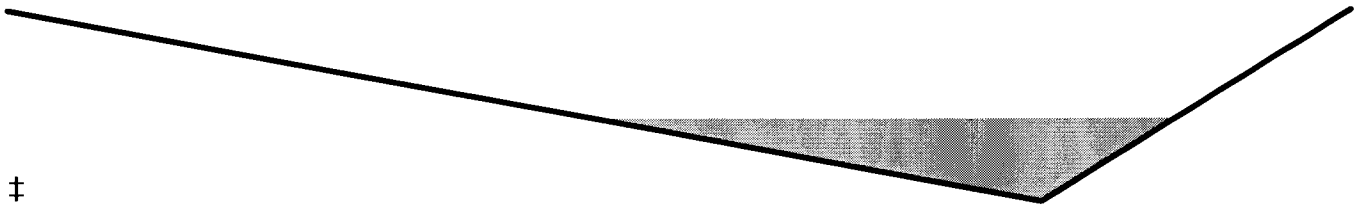
Summary for Reach Bench: Bench

Inflow Area = 4.920 ac, 0.00% Impervious, Inflow Depth > 1.34" for 25 year event
Inflow = 12.67 cfs @ 11.98 hrs, Volume= 0.549 af
Outflow = 10.44 cfs @ 12.09 hrs, Volume= 0.545 af, Atten= 18%, Lag= 6.9 min

Routing by Stor-Ind+Trans method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Max. Velocity= 3.98 fps, Min. Travel Time= 4.3 min
Avg. Velocity = 1.74 fps, Avg. Travel Time= 9.7 min

Peak Storage= 2,760 cf @ 12.02 hrs
Average Depth at Peak Storage= 0.65'
Bank-Full Depth= 1.50' Flow Area= 14.6 sf, Capacity= 102.46 cfs

0.00' x 1.50' deep channel, n= 0.030 Earth, grassed & winding
Side Slope Z-value= 10.0 3.0 '/' Top Width= 19.50'
Length= 1,018.0' Slope= 0.0300 '/'
Inlet Invert= 1,300.00', Outlet Invert= 1,269.46'



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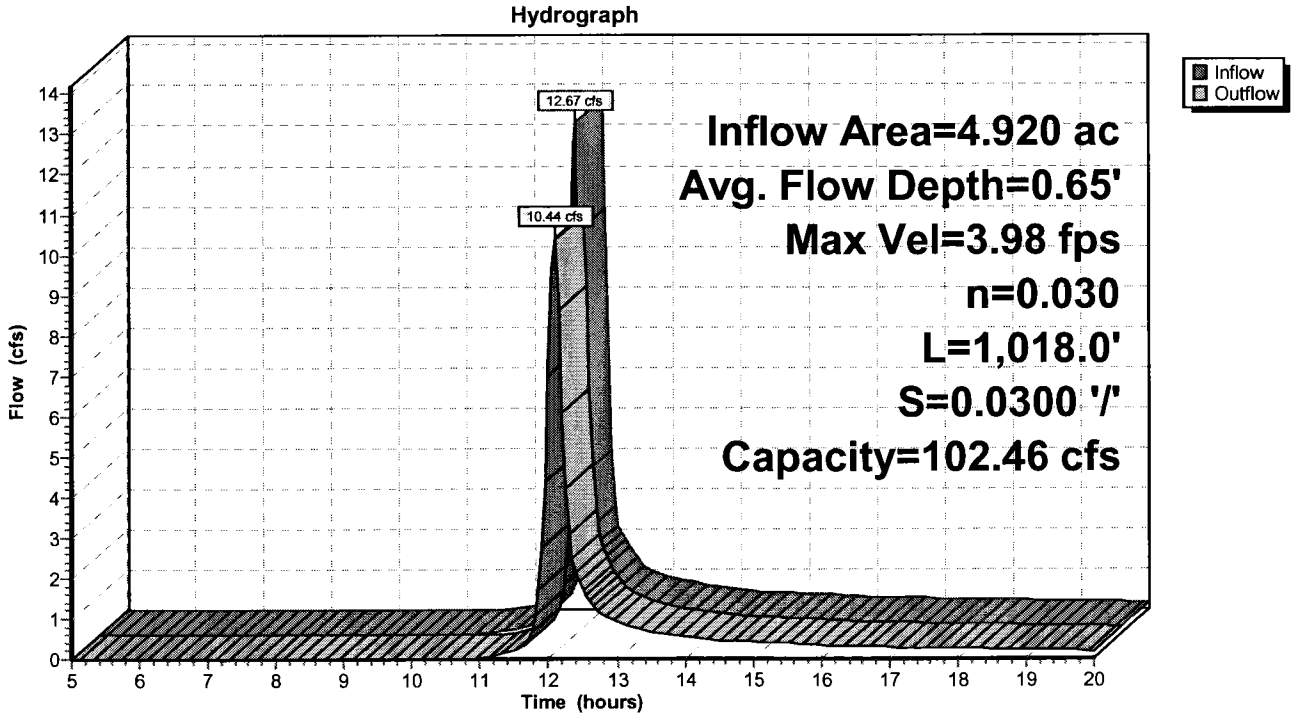
Reach Bench: Bench



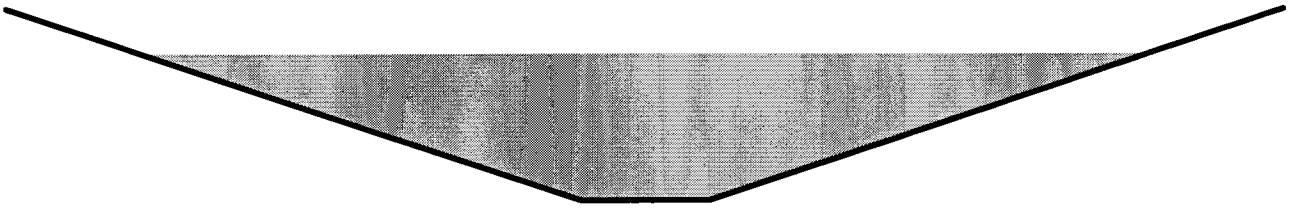
Summary for Reach CH-A2: Perimeter Channel A2

Inflow Area = 53.970 ac, 0.00% Impervious, Inflow Depth > 1.32" for 25 year event
Inflow = 86.53 cfs @ 12.19 hrs, Volume= 5.946 af
Outflow = 85.52 cfs @ 12.21 hrs, Volume= 5.940 af, Atten= 1%, Lag= 1.1 min

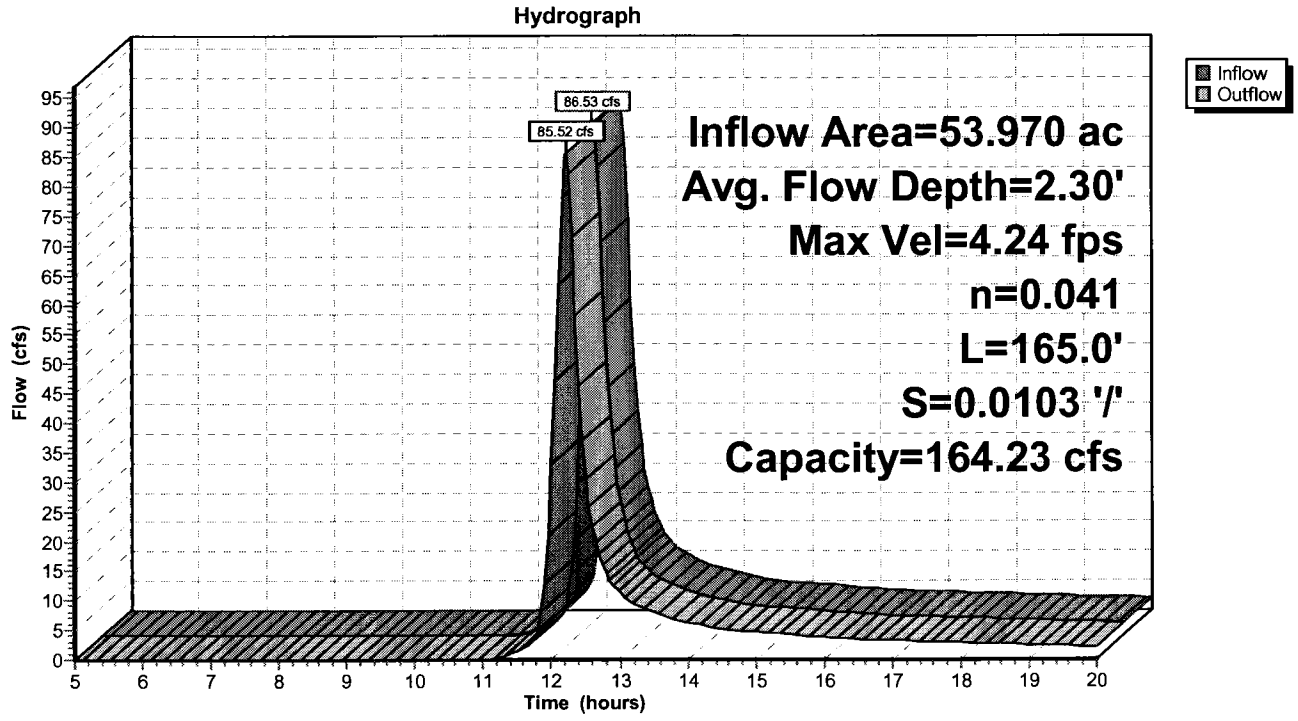
Routing by Stor-Ind+Trans method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Max. Velocity= 4.24 fps, Min. Travel Time= 0.6 min
Avg. Velocity = 1.91 fps, Avg. Travel Time= 1.4 min

Peak Storage= 3,368 cf @ 12.20 hrs
Average Depth at Peak Storage= 2.30'
Bank-Full Depth= 3.00' Flow Area= 33.0 sf, Capacity= 164.23 cfs

2.00' x 3.00' deep channel, n= 0.041
Side Slope Z-value= 3.0 '/' Top Width= 20.00'
Length= 165.0' Slope= 0.0103 '/'
Inlet Invert= 1,231.00', Outlet Invert= 1,229.30'



Reach CH-A2: Perimeter Channel A2



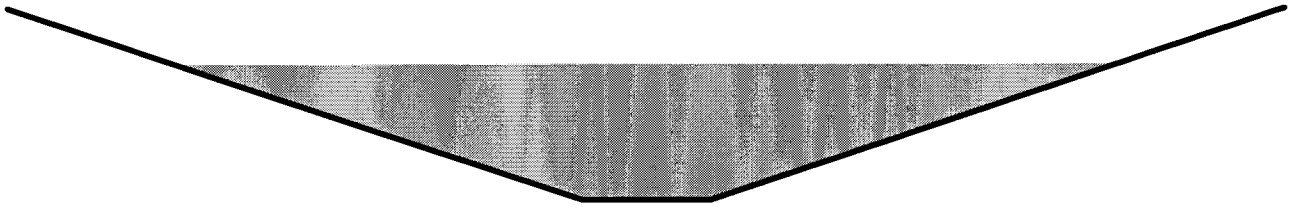
Summary for Reach CH-A3: Perimeter Channel A3

Inflow Area = 77.380 ac, 0.00% Impervious, Inflow Depth > 1.32" for 25 year event
Inflow = 109.95 cfs @ 12.15 hrs, Volume= 8.539 af
Outflow = 109.06 cfs @ 12.18 hrs, Volume= 8.522 af, Atten= 1%, Lag= 1.9 min

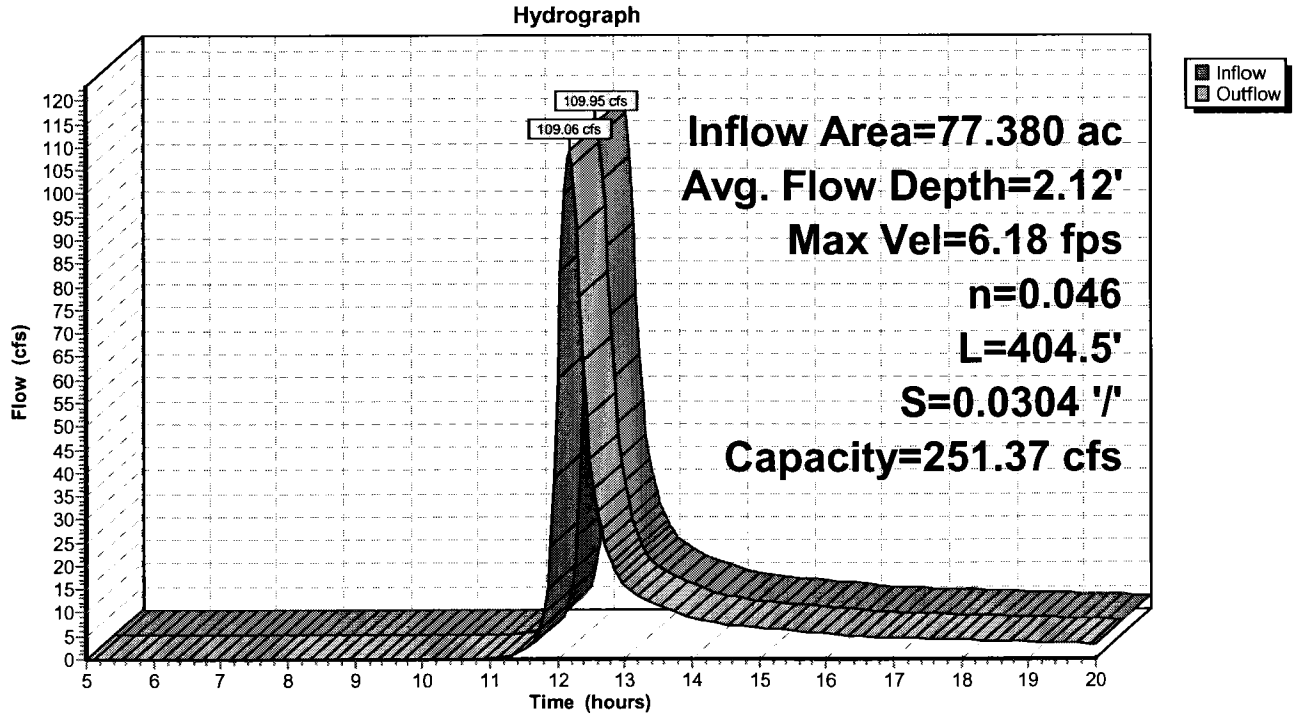
Routing by Stor-Ind+Trans method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Max. Velocity= 6.18 fps, Min. Travel Time= 1.1 min
Avg. Velocity = 2.89 fps, Avg. Travel Time= 2.3 min

Peak Storage= 7,179 cf @ 12.16 hrs
Average Depth at Peak Storage= 2.12'
Bank-Full Depth= 3.00' Flow Area= 33.0 sf, Capacity= 251.37 cfs

2.00' x 3.00' deep channel, n= 0.046
Side Slope Z-value= 3.0 '/' Top Width= 20.00'
Length= 404.5' Slope= 0.0304 '/'
Inlet Invert= 1,229.30', Outlet Invert= 1,217.01'



Reach CH-A3: Perimeter Channel A3



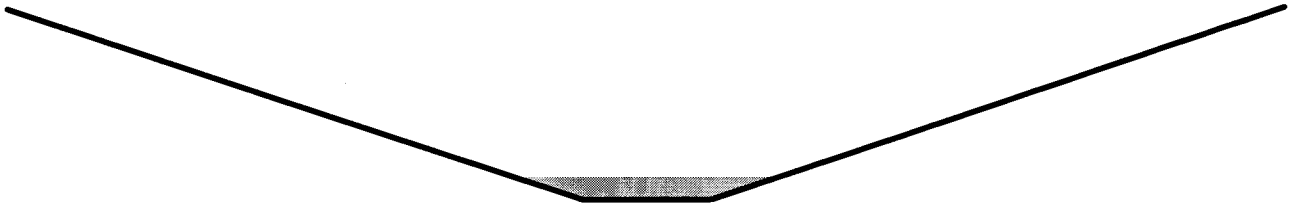
Summary for Reach CH-B: Perimeter Channel B

Inflow Area = 1.880 ac, 0.00% Impervious, Inflow Depth > 1.34" for 25 year event
Inflow = 4.60 cfs @ 12.00 hrs, Volume= 0.210 af
Outflow = 4.22 cfs @ 12.05 hrs, Volume= 0.209 af, Atten= 8%, Lag= 3.5 min

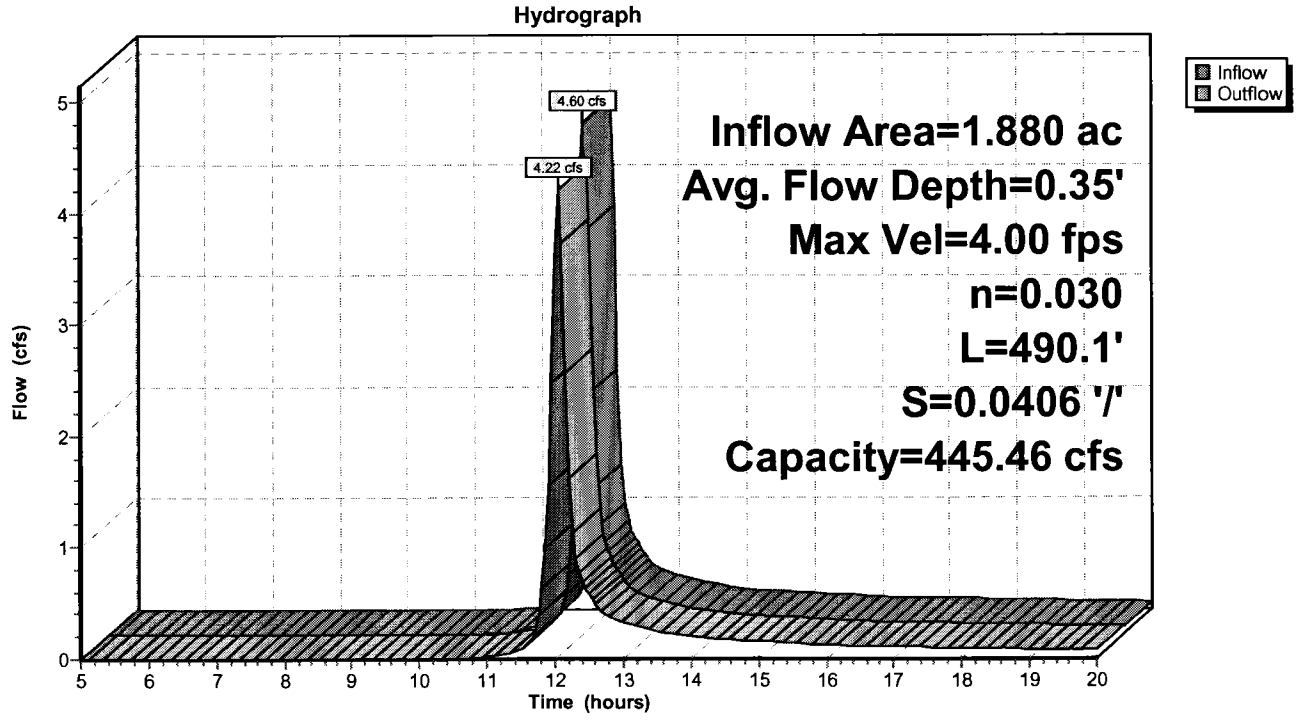
Routing by Stor-Ind+Trans method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Max. Velocity= 4.00 fps, Min. Travel Time= 2.0 min
Avg. Velocity = 1.41 fps, Avg. Travel Time= 5.8 min

Peak Storage= 531 cf @ 12.02 hrs
Average Depth at Peak Storage= 0.35'
Bank-Full Depth= 3.00' Flow Area= 33.0 sf, Capacity= 445.46 cfs

2.00' x 3.00' deep channel, n= 0.030 Earth, grassed & winding
Side Slope Z-value= 3.0 '/' Top Width= 20.00'
Length= 490.1' Slope= 0.0406 '/'
Inlet Invert= 1,236.90', Outlet Invert= 1,217.01'



Reach CH-B: Perimeter Channel B



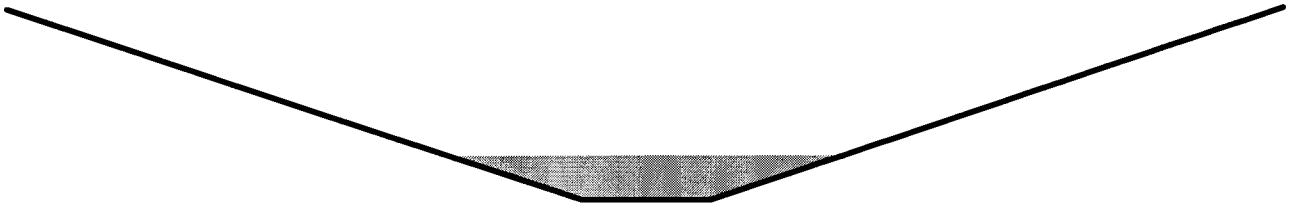
Summary for Reach CH-C: Perimeter Channel C

Inflow Area = 4.800 ac, 0.00% Impervious, Inflow Depth > 1.34" for 25 year event
Inflow = 12.04 cfs @ 11.99 hrs, Volume= 0.535 af
Outflow = 10.96 cfs @ 12.06 hrs, Volume= 0.532 af, Atten= 9%, Lag= 4.2 min

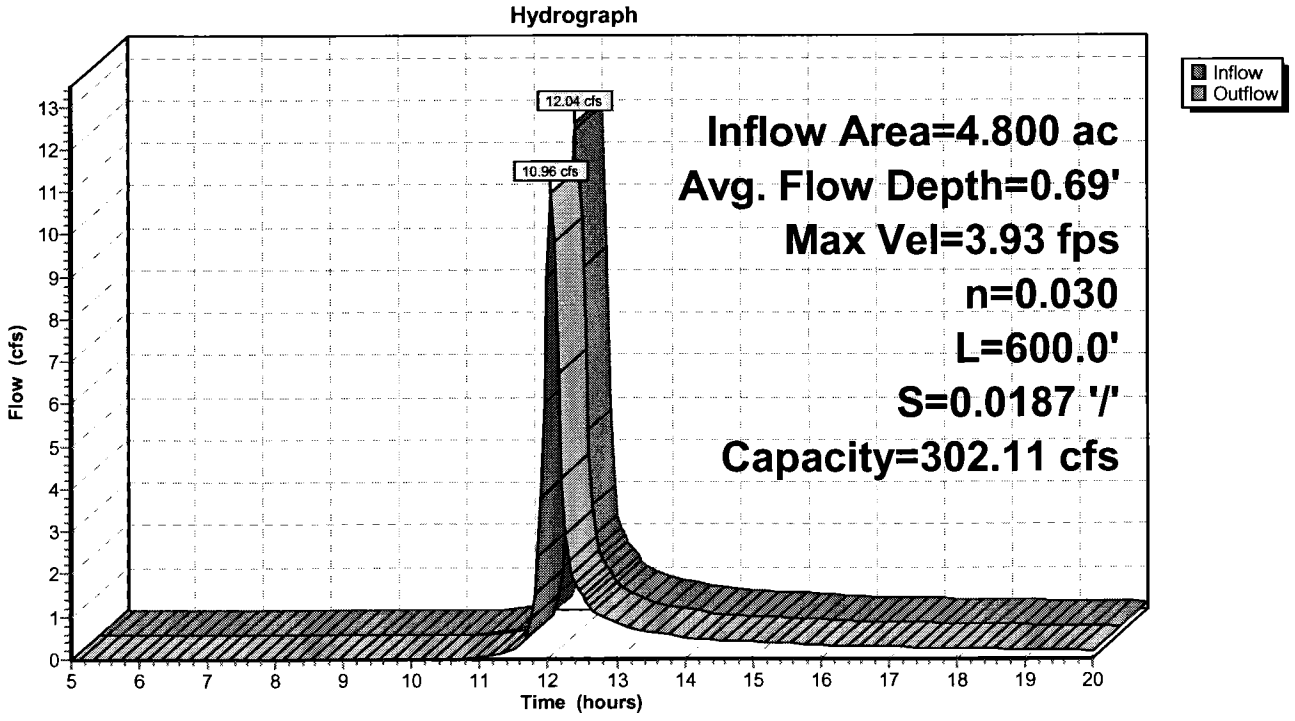
Routing by Stor-Ind+Trans method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Max. Velocity= 3.93 fps, Min. Travel Time= 2.5 min
Avg. Velocity = 1.46 fps, Avg. Travel Time= 6.8 min

Peak Storage= 1,701 cf @ 12.01 hrs
Average Depth at Peak Storage= 0.69'
Bank-Full Depth= 3.00' Flow Area= 33.0 sf, Capacity= 302.11 cfs

2.00' x 3.00' deep channel, n= 0.030 Earth, grassed & winding
Side Slope Z-value= 3.0 '/' Top Width= 20.00'
Length= 600.0' Slope= 0.0187 '/'
Inlet Invert= 1,236.90', Outlet Invert= 1,225.70'



Reach CH-C: Perimeter Channel C



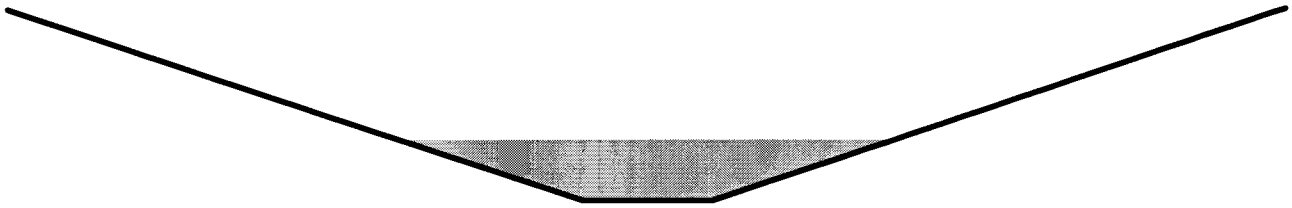
Summary for Reach CH-D: Perimeter Channel D

Inflow Area = 9.400 ac, 0.00% Impervious, Inflow Depth > 1.34" for 25 year event
Inflow = 21.44 cfs @ 12.00 hrs, Volume= 1.047 af
Outflow = 15.59 cfs @ 12.21 hrs, Volume= 1.031 af, Atten= 27%, Lag= 12.7 min

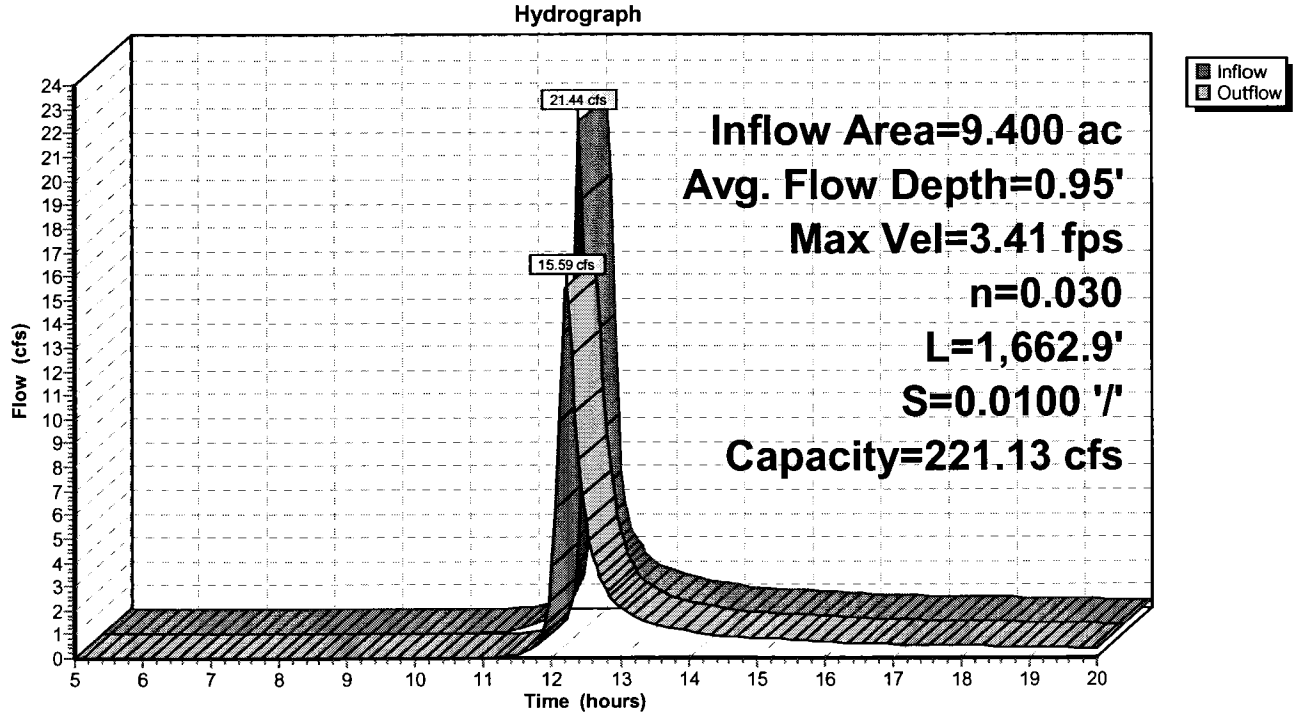
Routing by Stor-Ind+Trans method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Max. Velocity= 3.41 fps, Min. Travel Time= 8.1 min
Avg. Velocity = 1.45 fps, Avg. Travel Time= 19.1 min

Peak Storage= 7,689 cf @ 12.07 hrs
Average Depth at Peak Storage= 0.95'
Bank-Full Depth= 3.00' Flow Area= 33.0 sf, Capacity= 221.13 cfs

2.00' x 3.00' deep channel, n= 0.030 Earth, grassed & winding
Side Slope Z-value= 3.0 '/' Top Width= 20.00'
Length= 1,662.9' Slope= 0.0100 '/'
Inlet Invert= 1,242.33', Outlet Invert= 1,225.70'



Reach CH-D: Perimeter Channel D



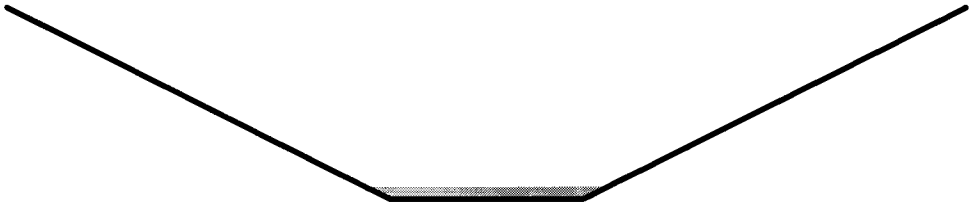
Summary for Reach CH-I1: Perimeter Channel I1

Inflow Area = 0.330 ac, 0.00% Impervious, Inflow Depth > 1.34" for 25 year event
Inflow = 0.92 cfs @ 11.95 hrs, Volume= 0.037 af
Outflow = 0.85 cfs @ 11.98 hrs, Volume= 0.037 af, Atten= 8%, Lag= 1.9 min

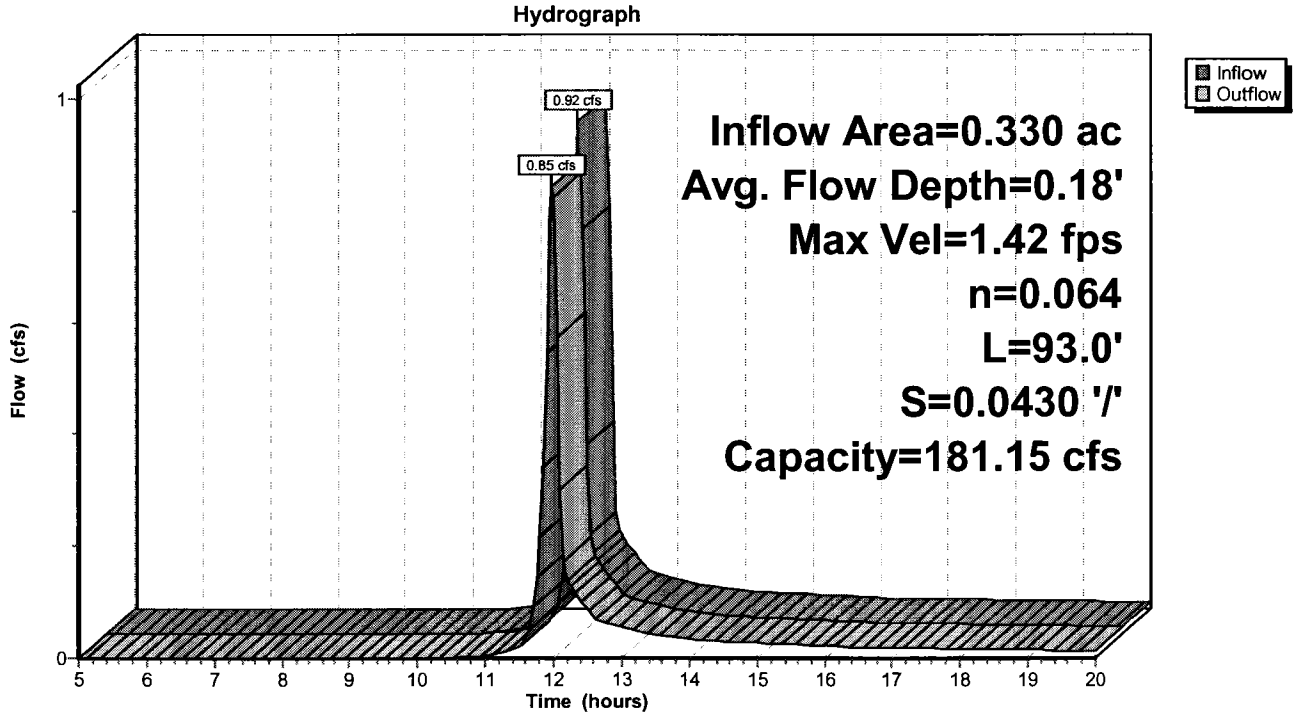
Routing by Stor-Ind+Trans method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Max. Velocity= 1.42 fps, Min. Travel Time= 1.1 min
Avg. Velocity = 0.50 fps, Avg. Travel Time= 3.1 min

Peak Storage= 57 cf @ 11.96 hrs
Average Depth at Peak Storage= 0.18'
Bank-Full Depth= 3.00' Flow Area= 27.0 sf, Capacity= 181.15 cfs

3.00' x 3.00' deep channel, n= 0.064
Side Slope Z-value= 2.0 '/' Top Width= 15.00'
Length= 93.0' Slope= 0.0430 '/'
Inlet Invert= 1,306.00', Outlet Invert= 1,302.00'



Reach CH-I1: Perimeter Channel I1



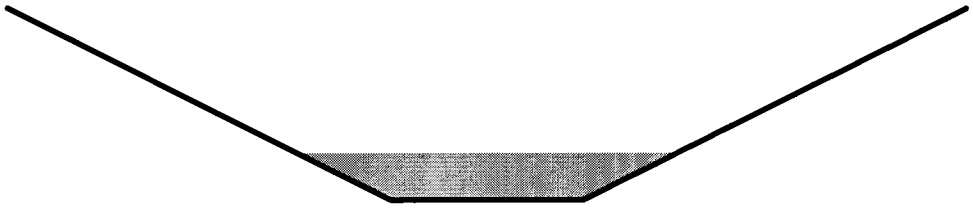
Summary for Reach CH-I2: Perimeter Channel I2

Inflow Area = 5.300 ac, 0.00% Impervious, Inflow Depth > 1.34" for 25 year event
Inflow = 13.70 cfs @ 11.97 hrs, Volume= 0.591 af
Outflow = 11.55 cfs @ 12.08 hrs, Volume= 0.586 af, Atten= 16%, Lag= 6.4 min

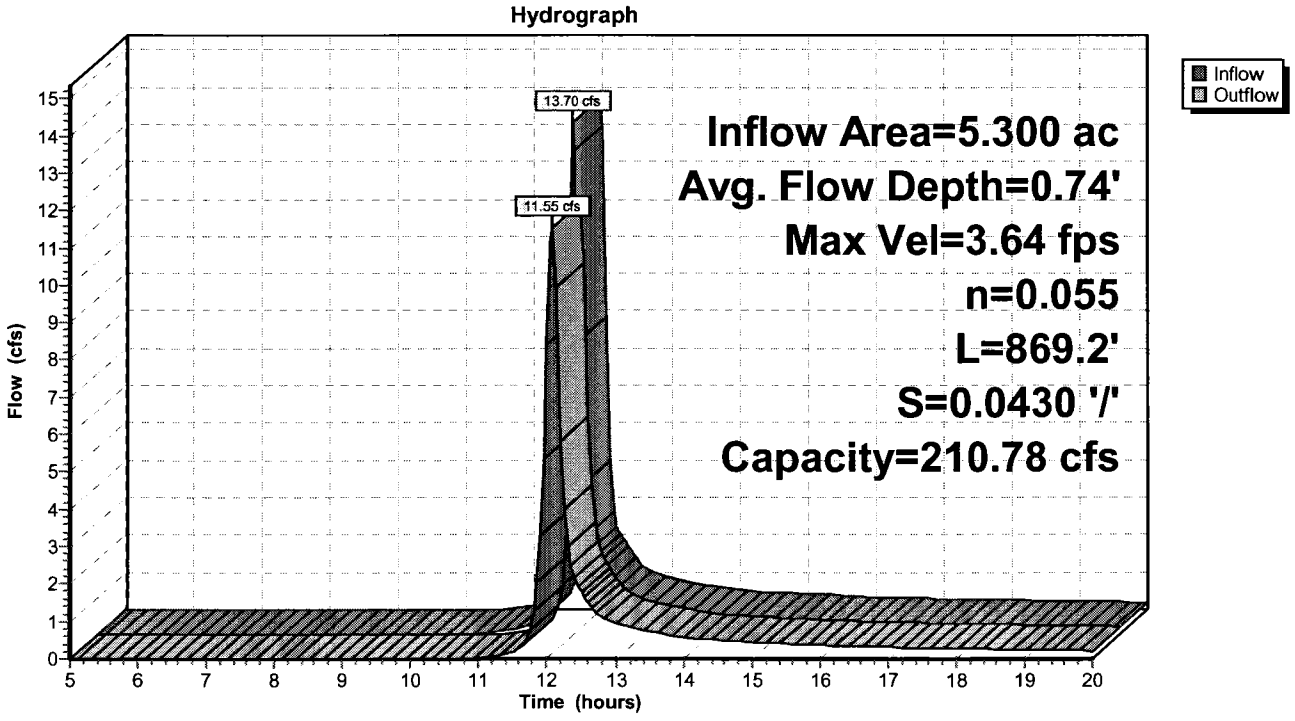
Routing by Stor-Ind+Trans method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Max. Velocity= 3.64 fps, Min. Travel Time= 4.0 min
Avg. Velocity = 1.24 fps, Avg. Travel Time= 11.7 min

Peak Storage= 2,874 cf @ 12.01 hrs
Average Depth at Peak Storage= 0.74'
Bank-Full Depth= 3.00' Flow Area= 27.0 sf, Capacity= 210.78 cfs

3.00' x 3.00' deep channel, n= 0.055
Side Slope Z-value= 2.0 '/' Top Width= 15.00'
Length= 869.2' Slope= 0.0430 '/'
Inlet Invert= 1,302.00', Outlet Invert= 1,264.62'



Reach CH-I2: Perimeter Channel I2



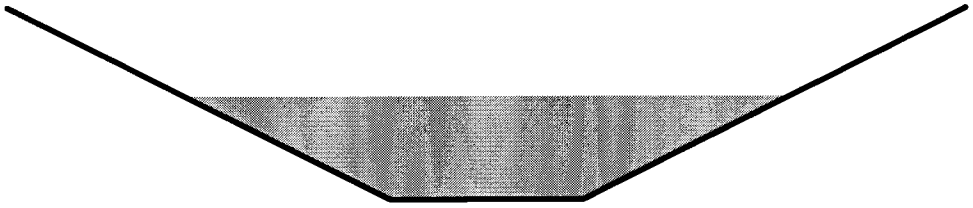
Summary for Reach CH-I3: Perimeter Channel I3

Inflow Area = 41.200 ac, 0.00% Impervious, Inflow Depth > 1.33" for 25 year event
Inflow = 72.57 cfs @ 12.10 hrs, Volume= 4.563 af
Outflow = 70.09 cfs @ 12.16 hrs, Volume= 4.547 af, Atten= 3%, Lag= 3.2 min

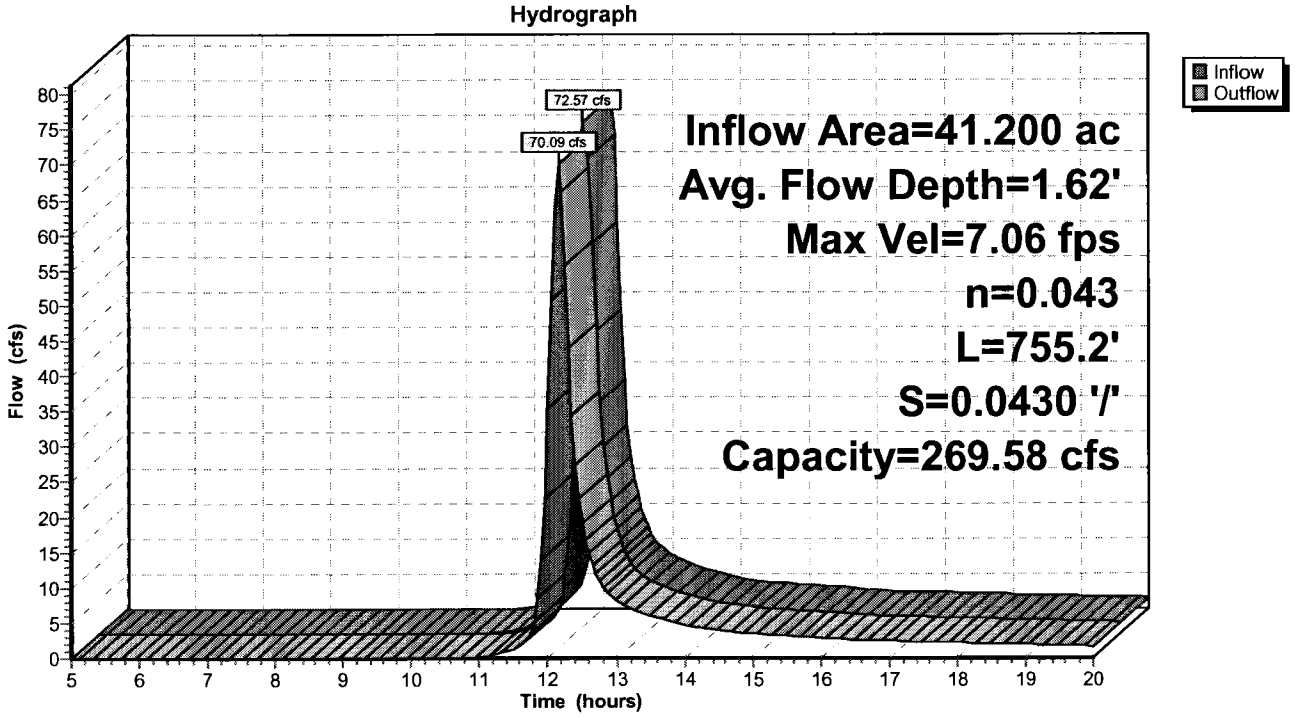
Routing by Stor-Ind+Trans method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Max. Velocity= 7.06 fps, Min. Travel Time= 1.8 min
Avg. Velocity = 2.89 fps, Avg. Travel Time= 4.4 min

Peak Storage= 7,599 cf @ 12.12 hrs
Average Depth at Peak Storage= 1.62'
Bank-Full Depth= 3.00' Flow Area= 27.0 sf, Capacity= 269.58 cfs

3.00' x 3.00' deep channel, n= 0.043
Side Slope Z-value= 2.0 '/' Top Width= 15.00'
Length= 755.2' Slope= 0.0430 '/'
Inlet Invert= 1,264.62', Outlet Invert= 1,232.15'



Reach CH-I3: Perimeter Channel I3



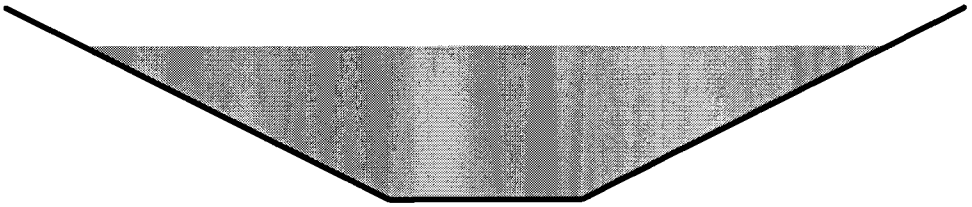
Summary for Reach CH-I4: Perimeter Channel I4

Inflow Area = 41.200 ac, 0.00% Impervious, Inflow Depth > 1.32" for 25 year event
Inflow = 70.09 cfs @ 12.16 hrs, Volume= 4.547 af
Outflow = 68.21 cfs @ 12.20 hrs, Volume= 4.535 af, Atten= 3%, Lag= 2.6 min

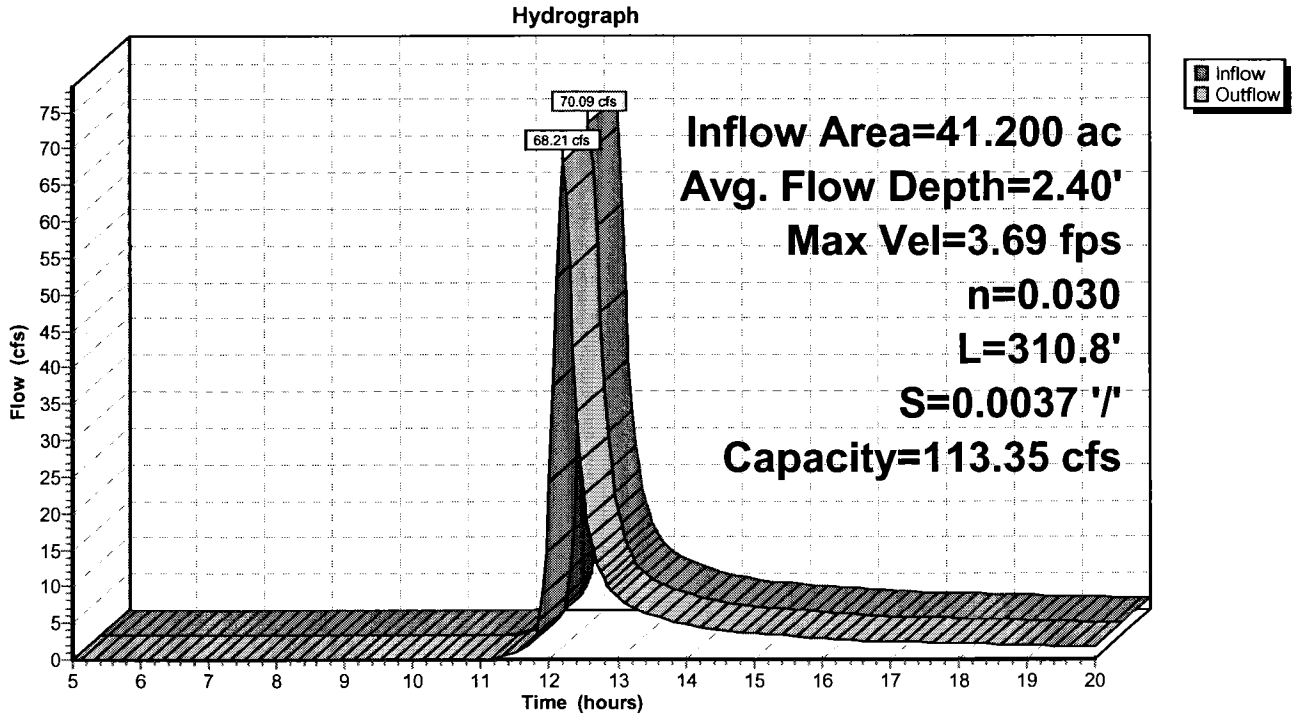
Routing by Stor-Ind+Trans method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Max. Velocity= 3.69 fps, Min. Travel Time= 1.4 min
Avg. Velocity = 1.58 fps, Avg. Travel Time= 3.3 min

Peak Storage= 5,824 cf @ 12.17 hrs
Average Depth at Peak Storage= 2.40'
Bank-Full Depth= 3.00' Flow Area= 27.0 sf, Capacity= 113.35 cfs

3.00' x 3.00' deep channel, n= 0.030 Earth, grassed & winding
Side Slope Z-value= 2.0 '/' Top Width= 15.00'
Length= 310.8' Slope= 0.0037 '/'
Inlet Invert= 1,232.15', Outlet Invert= 1,231.00'



Reach CH-I4: Perimeter Channel I4



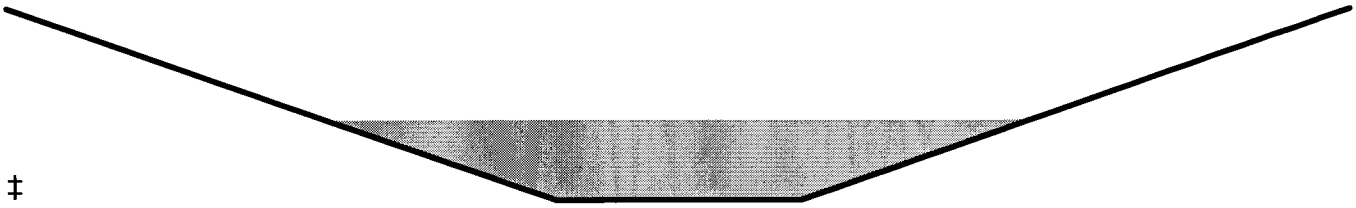
Summary for Reach D-A: Discharge Channel A

Inflow Area = 79.260 ac, 0.00% Impervious, Inflow Depth > 1.32" for 25 year event
Inflow = 111.19 cfs @ 12.17 hrs, Volume= 8.731 af
Outflow = 110.74 cfs @ 12.18 hrs, Volume= 8.726 af, Atten= 0%, Lag= 0.6 min

Routing by Stor-Ind+Trans method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Max. Velocity= 11.39 fps, Min. Travel Time= 0.3 min
Avg. Velocity = 4.88 fps, Avg. Travel Time= 0.7 min

Peak Storage= 1,978 cf @ 12.18 hrs
Average Depth at Peak Storage= 1.25'
Bank-Full Depth= 3.00' Flow Area= 39.0 sf, Capacity= 725.15 cfs

4.00' x 3.00' deep channel, n= 0.054
Side Slope Z-value= 3.0 '/' Top Width= 22.00'
Length= 203.2' Slope= 0.2254 '/'
Inlet Invert= 1,215.81', Outlet Invert= 1,170.00'



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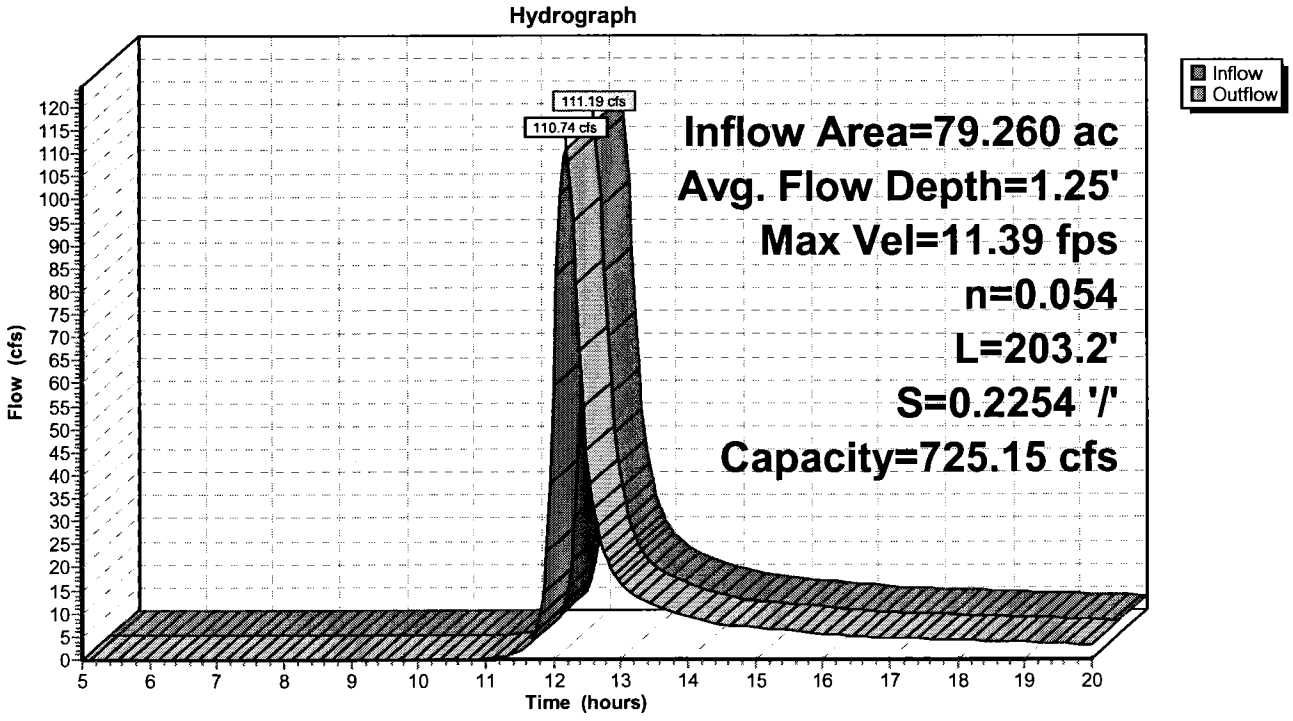
Reach D-A: Discharge Channel A



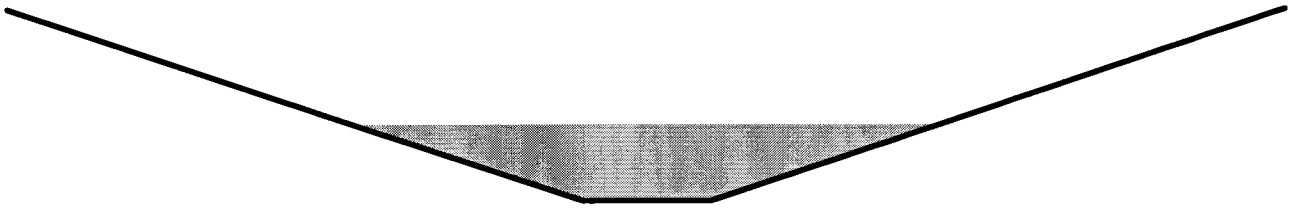
Summary for Reach D-B: Discharge Channel B

Inflow Area = 28.930 ac, 0.00% Impervious, Inflow Depth > 1.33" for 25 year event
Inflow = 48.99 cfs @ 12.08 hrs, Volume= 3.198 af
Outflow = 48.03 cfs @ 12.11 hrs, Volume= 3.191 af, Atten= 2%, Lag= 2.0 min

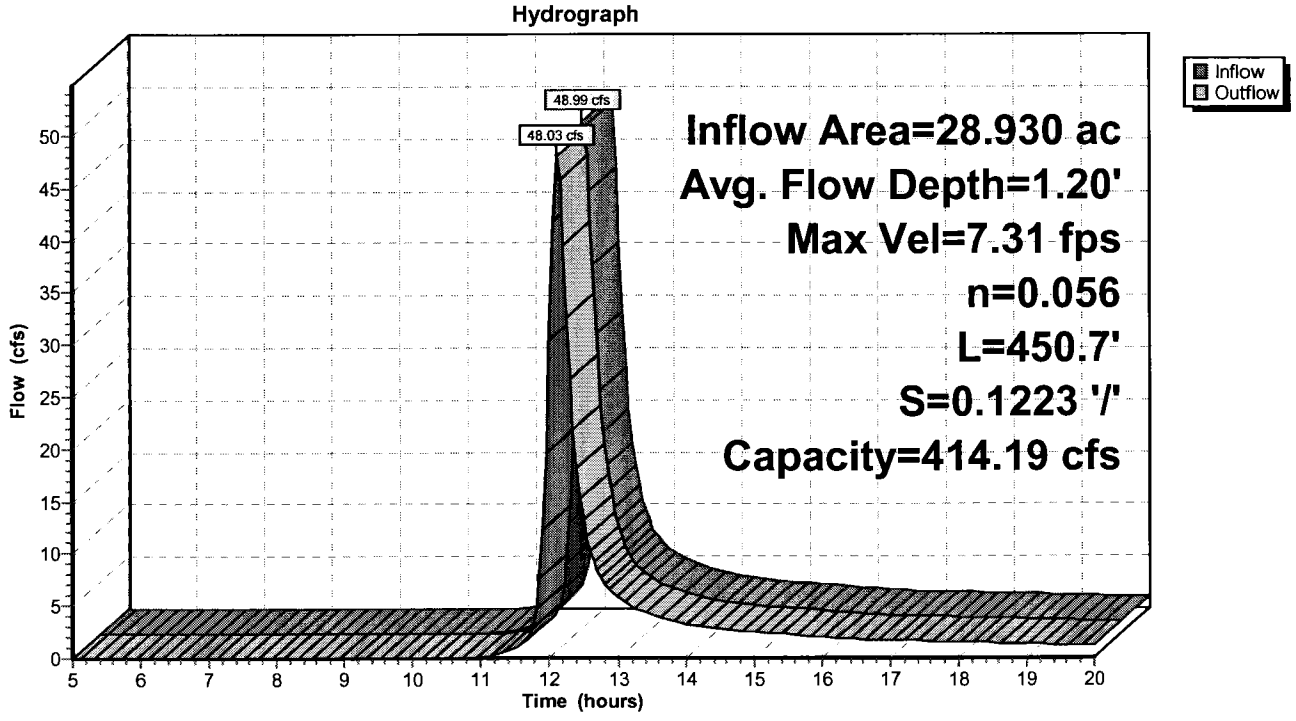
Routing by Stor-Ind+Trans method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Max. Velocity= 7.31 fps, Min. Travel Time= 1.0 min
Avg. Velocity = 3.17 fps, Avg. Travel Time= 2.4 min

Peak Storage= 3,018 cf @ 12.10 hrs
Average Depth at Peak Storage= 1.20'
Bank-Full Depth= 3.00' Flow Area= 33.0 sf, Capacity= 414.19 cfs

2.00' x 3.00' deep channel, n= 0.056
Side Slope Z-value= 3.0 '/' Top Width= 20.00'
Length= 450.7' Slope= 0.1223 '/'
Inlet Invert= 1,225.10', Outlet Invert= 1,170.00'



Reach D-B: Discharge Channel B



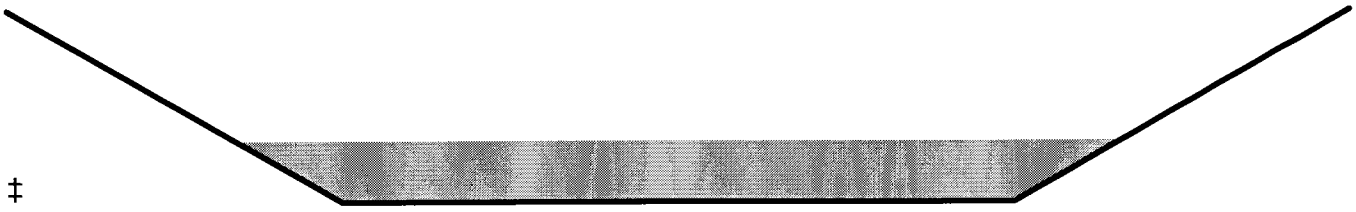
Summary for Reach DC1-1: DC1-1

Inflow Area = 10.070 ac, 0.00% Impervious, Inflow Depth > 1.33" for 25 year event
Inflow = 19.08 cfs @ 12.07 hrs, Volume= 1.119 af
Outflow = 18.88 cfs @ 12.08 hrs, Volume= 1.119 af, Atten= 1%, Lag= 0.5 min

Routing by Stor-Ind+Trans method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Max. Velocity= 5.73 fps, Min. Travel Time= 0.3 min
Avg. Velocity = 1.87 fps, Avg. Travel Time= 0.9 min

Peak Storage= 319 cf @ 12.08 hrs
Average Depth at Peak Storage= 0.47'
Bank-Full Depth= 1.50' Flow Area= 13.5 sf, Capacity= 147.80 cfs

6.00' x 1.50' deep channel, n= 0.080
Side Slope Z-value= 2.0 '/' Top Width= 12.00'
Length= 96.7' Slope= 0.3205 '/'
Inlet Invert= 1,548.39', Outlet Invert= 1,517.40'



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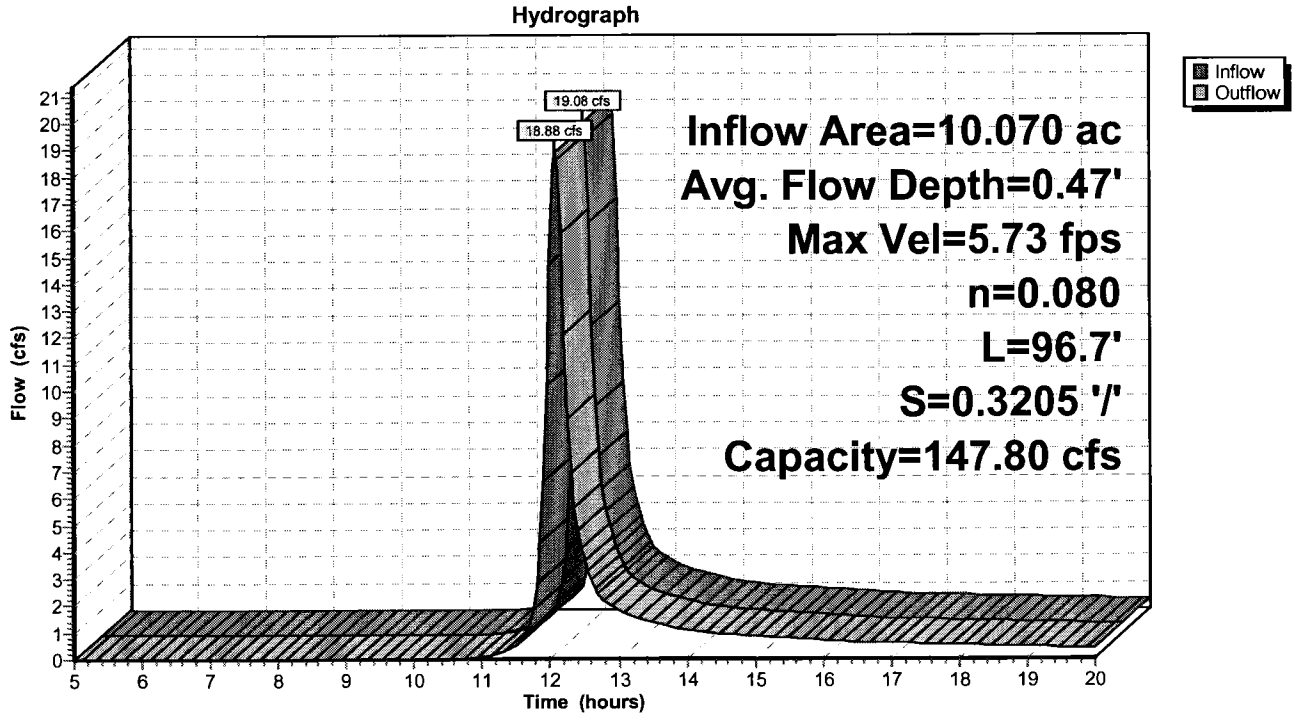
Reach DC1-1: DC1-1



Summary for Reach DC1-10: DC1-10

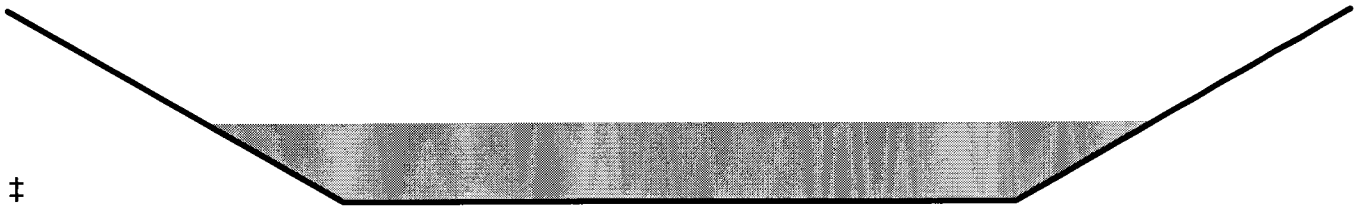
Inflow Area = 10.070 ac, 0.00% Impervious, Inflow Depth > 1.33" for 25 year event
Inflow = 17.75 cfs @ 12.15 hrs, Volume= 1.112 af
Outflow = 17.70 cfs @ 12.15 hrs, Volume= 1.112 af, Atten= 0%, Lag= 0.2 min

Routing by Stor-Ind+Trans method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Max. Velocity= 3.96 fps, Min. Travel Time= 0.1 min
Avg. Velocity = 1.35 fps, Avg. Travel Time= 0.4 min

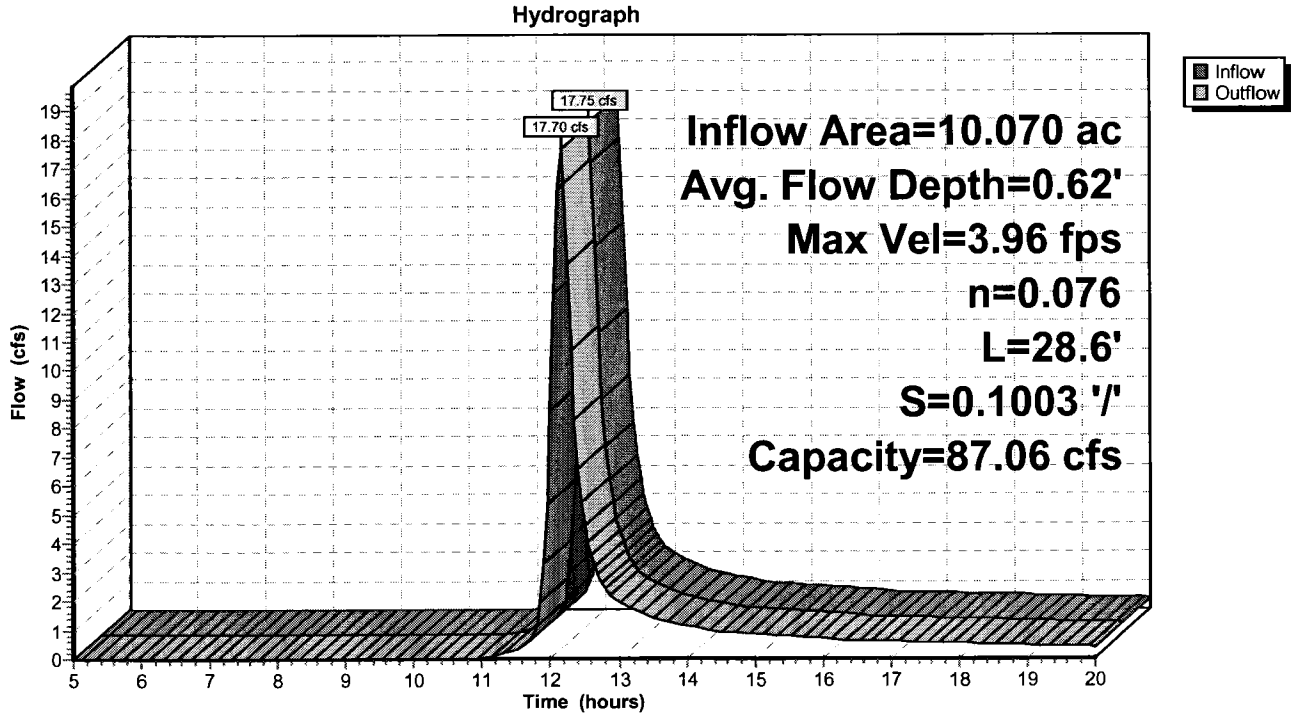
Peak Storage= 128 cf @ 12.15 hrs
Average Depth at Peak Storage= 0.62'
Bank-Full Depth= 1.50' Flow Area= 13.5 sf, Capacity= 87.06 cfs

6.00' x 1.50' deep channel, n= 0.076
Side Slope Z-value= 2.0 '/' Top Width= 12.00'
Length= 28.6' Slope= 0.1003 '/'
Inlet Invert= 1,297.73', Outlet Invert= 1,294.86'

‡



Reach DC1-10: DC1-10



Summary for Reach DC1-11: DC1-11

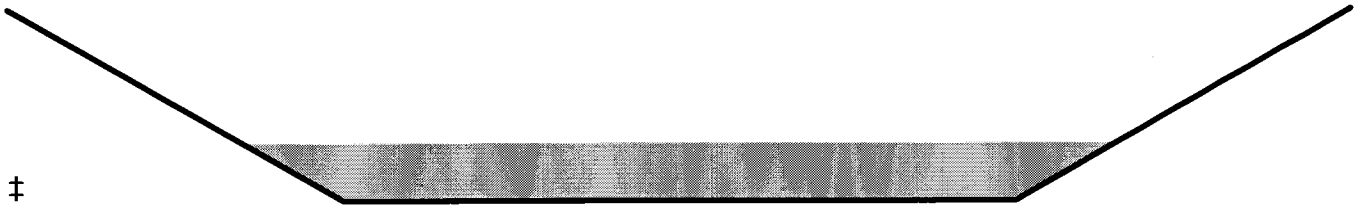
Inflow Area = 10.070 ac, 0.00% Impervious, Inflow Depth > 1.32" for 25 year event
Inflow = 17.70 cfs @ 12.15 hrs, Volume= 1.112 af
Outflow = 17.47 cfs @ 12.17 hrs, Volume= 1.110 af, Atten= 1%, Lag= 0.9 min

Routing by Stor-Ind+Trans method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Max. Velocity= 5.69 fps, Min. Travel Time= 0.6 min
Avg. Velocity = 1.91 fps, Avg. Travel Time= 1.7 min

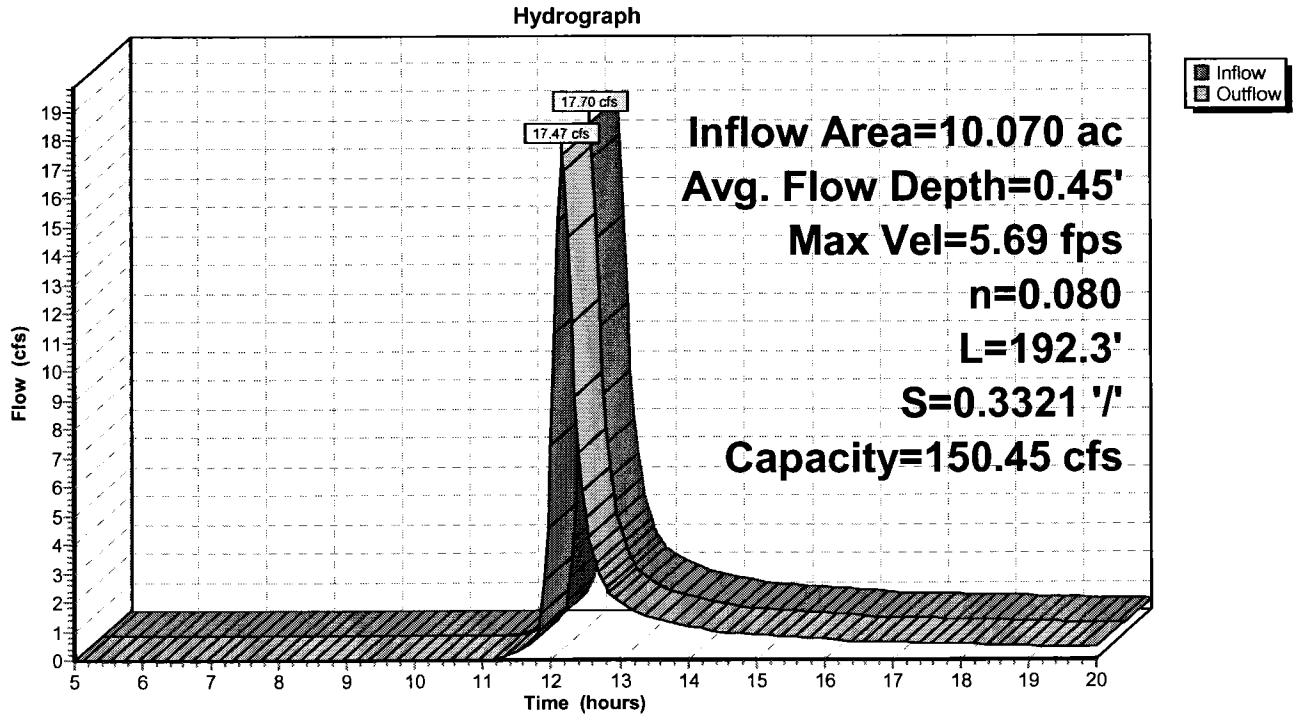
Peak Storage= 598 cf @ 12.16 hrs
Average Depth at Peak Storage= 0.45'
Bank-Full Depth= 1.50' Flow Area= 13.5 sf, Capacity= 150.45 cfs

6.00' x 1.50' deep channel, n= 0.080
Side Slope Z-value= 2.0 '/' Top Width= 12.00'
Length= 192.3' Slope= 0.3321 '/'
Inlet Invert= 1,294.86', Outlet Invert= 1,231.00'

‡



Reach DC1-11: DC1-11



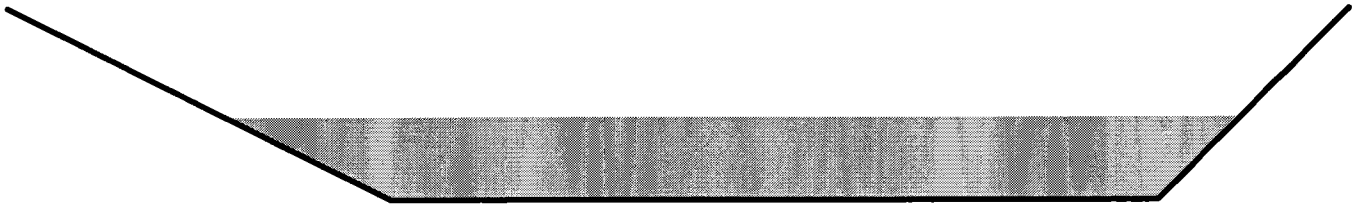
Summary for Reach DC1-2: DC1-2

Inflow Area = 10.070 ac, 0.00% Impervious, Inflow Depth > 1.33" for 25 year event
Inflow = 18.88 cfs @ 12.08 hrs, Volume= 1.119 af
Outflow = 18.82 cfs @ 12.08 hrs, Volume= 1.118 af, Atten= 0%, Lag= 0.2 min

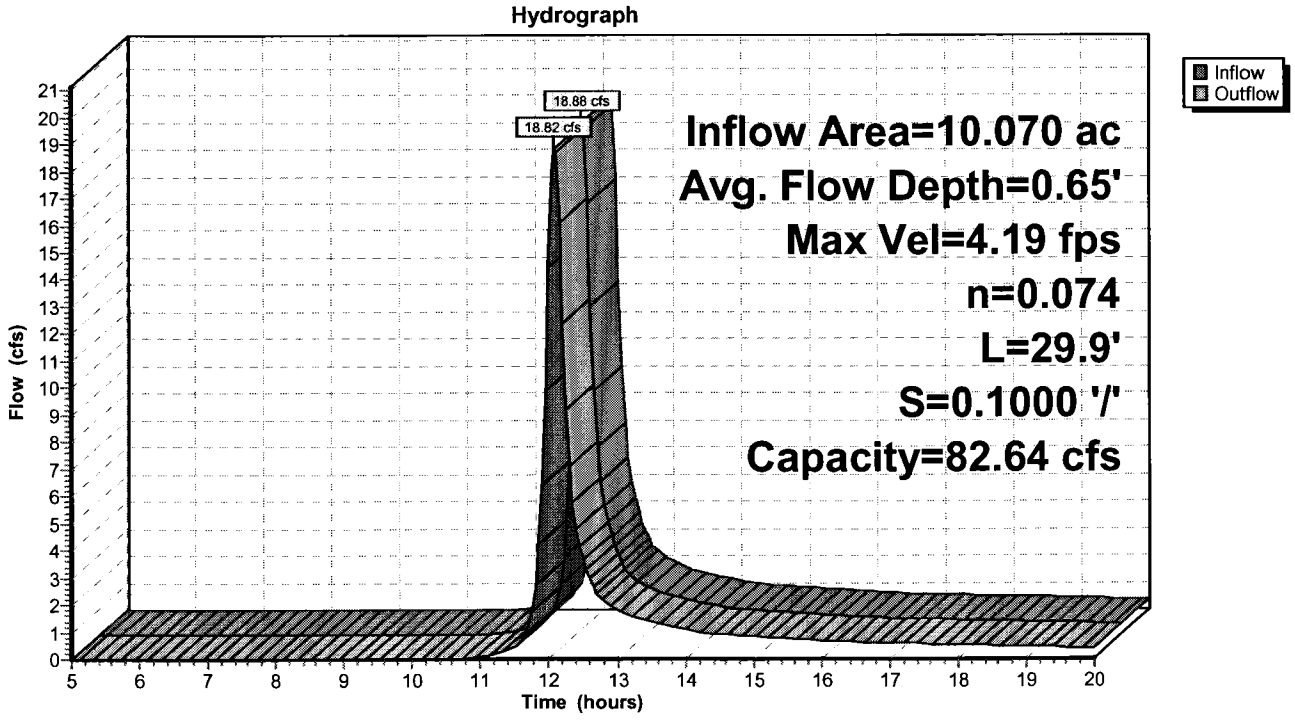
Routing by Stor-Ind+Trans method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Max. Velocity= 4.19 fps, Min. Travel Time= 0.1 min
Avg. Velocity = 1.37 fps, Avg. Travel Time= 0.4 min

Peak Storage= 134 cf @ 12.08 hrs
Average Depth at Peak Storage= 0.65'
Bank-Full Depth= 1.50' Flow Area= 12.4 sf, Capacity= 82.64 cfs

6.00' x 1.50' deep channel, n= 0.074
Side Slope Z-value= 2.0 1.0 '/' Top Width= 10.50'
Length= 29.9' Slope= 0.1000 '/'
Inlet Invert= 1,517.40', Outlet Invert= 1,514.41'



Reach DC1-2: DC1-2



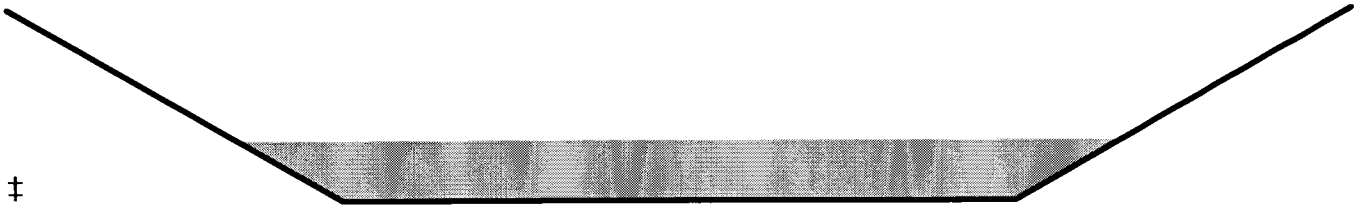
Summary for Reach DC1-3: DC1-3

Inflow Area = 10.070 ac, 0.00% Impervious, Inflow Depth > 1.33" for 25 year event
Inflow = 18.82 cfs @ 12.08 hrs, Volume= 1.118 af
Outflow = 18.62 cfs @ 12.10 hrs, Volume= 1.117 af, Atten= 1%, Lag= 0.8 min

Routing by Stor-Ind+Trans method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Max. Velocity= 5.75 fps, Min. Travel Time= 0.5 min
Avg. Velocity = 1.88 fps, Avg. Travel Time= 1.4 min

Peak Storage= 532 cf @ 12.09 hrs
Average Depth at Peak Storage= 0.47'
Bank-Full Depth= 1.50' Flow Area= 13.5 sf, Capacity= 147.98 cfs

6.00' x 1.50' deep channel, n= 0.080
Side Slope Z-value= 2.0 '/' Top Width= 12.00'
Length= 162.5' Slope= 0.3213 '/'
Inlet Invert= 1,514.41', Outlet Invert= 1,462.20'



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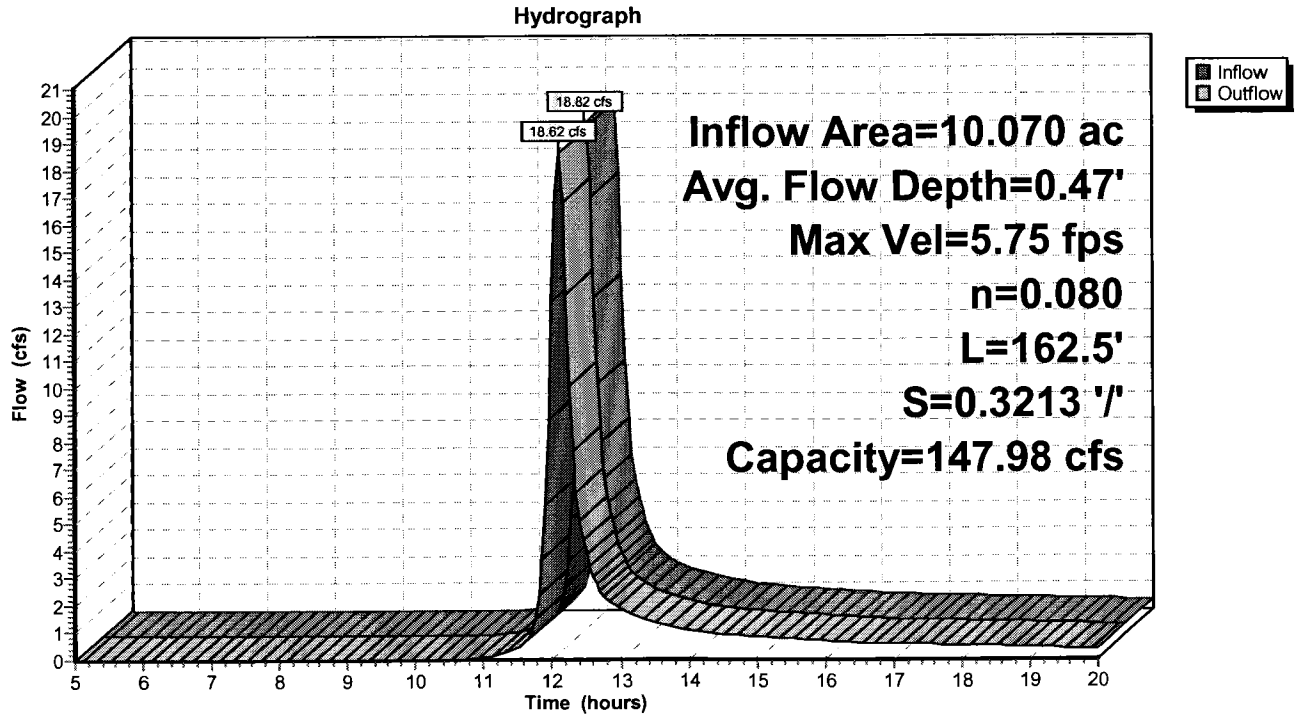
Reach DC1-3: DC1-3



Summary for Reach DC1-4: DC1-4

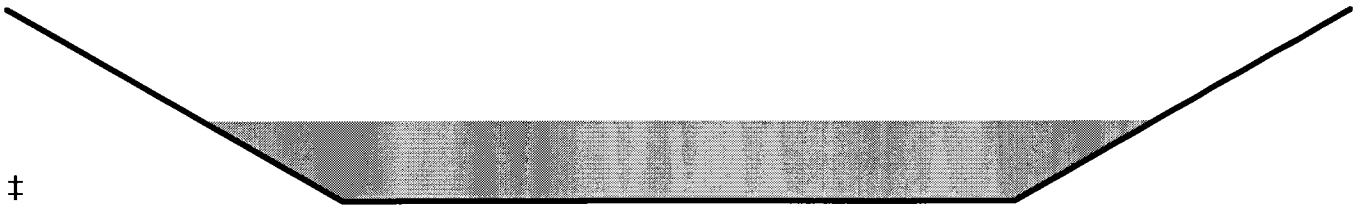
Inflow Area = 10.070 ac, 0.00% Impervious, Inflow Depth > 1.33" for 25 year event
Inflow = 18.62 cfs @ 12.10 hrs, Volume= 1.117 af
Outflow = 18.56 cfs @ 12.10 hrs, Volume= 1.117 af, Atten= 0%, Lag= 0.2 min

Routing by Stor-Ind+Trans method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Max. Velocity= 4.09 fps, Min. Travel Time= 0.1 min
Avg. Velocity = 1.37 fps, Avg. Travel Time= 0.4 min

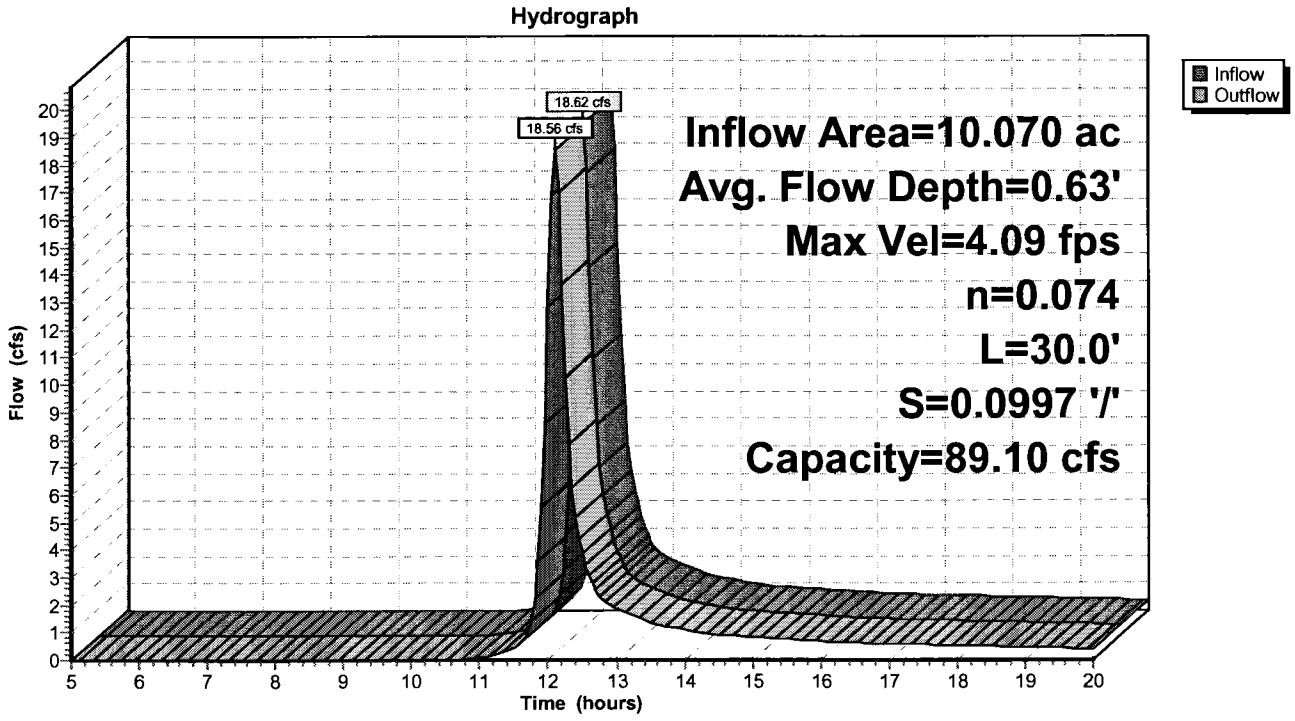
Peak Storage= 137 cf @ 12.10 hrs
Average Depth at Peak Storage= 0.63'
Bank-Full Depth= 1.50' Flow Area= 13.5 sf, Capacity= 89.10 cfs

6.00' x 1.50' deep channel, n= 0.074
Side Slope Z-value= 2.0 '/' Top Width= 12.00'
Length= 30.0' Slope= 0.0997 '/'
Inlet Invert= 1,462.20', Outlet Invert= 1,459.21'

‡



Reach DC1-4: DC1-4



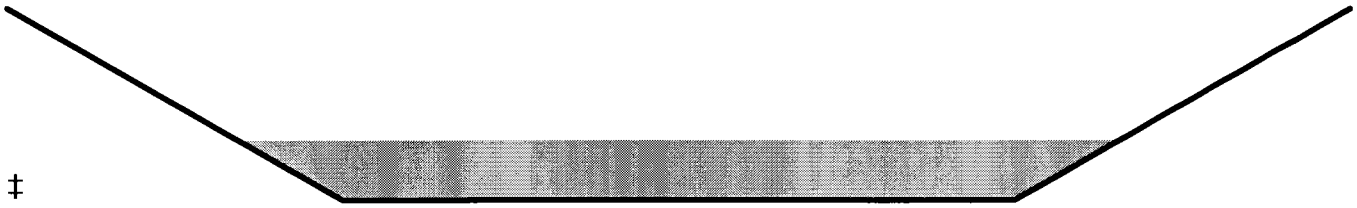
Summary for Reach DC1-5: DC1-5

Inflow Area = 10.070 ac, 0.00% Impervious, Inflow Depth > 1.33" for 25 year event
Inflow = 18.56 cfs @ 12.10 hrs, Volume= 1.117 af
Outflow = 18.32 cfs @ 12.11 hrs, Volume= 1.115 af, Atten= 1%, Lag= 0.8 min

Routing by Stor-Ind+Trans method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Max. Velocity= 5.72 fps, Min. Travel Time= 0.5 min
Avg. Velocity = 1.88 fps, Avg. Travel Time= 1.4 min

Peak Storage= 527 cf @ 12.11 hrs
Average Depth at Peak Storage= 0.47'
Bank-Full Depth= 1.50' Flow Area= 13.5 sf, Capacity= 147.97 cfs

6.00' x 1.50' deep channel, n= 0.080
Side Slope Z-value= 2.0 '/' Top Width= 12.00'
Length= 162.5' Slope= 0.3212 '/'
Inlet Invert= 1,459.21', Outlet Invert= 1,407.01'



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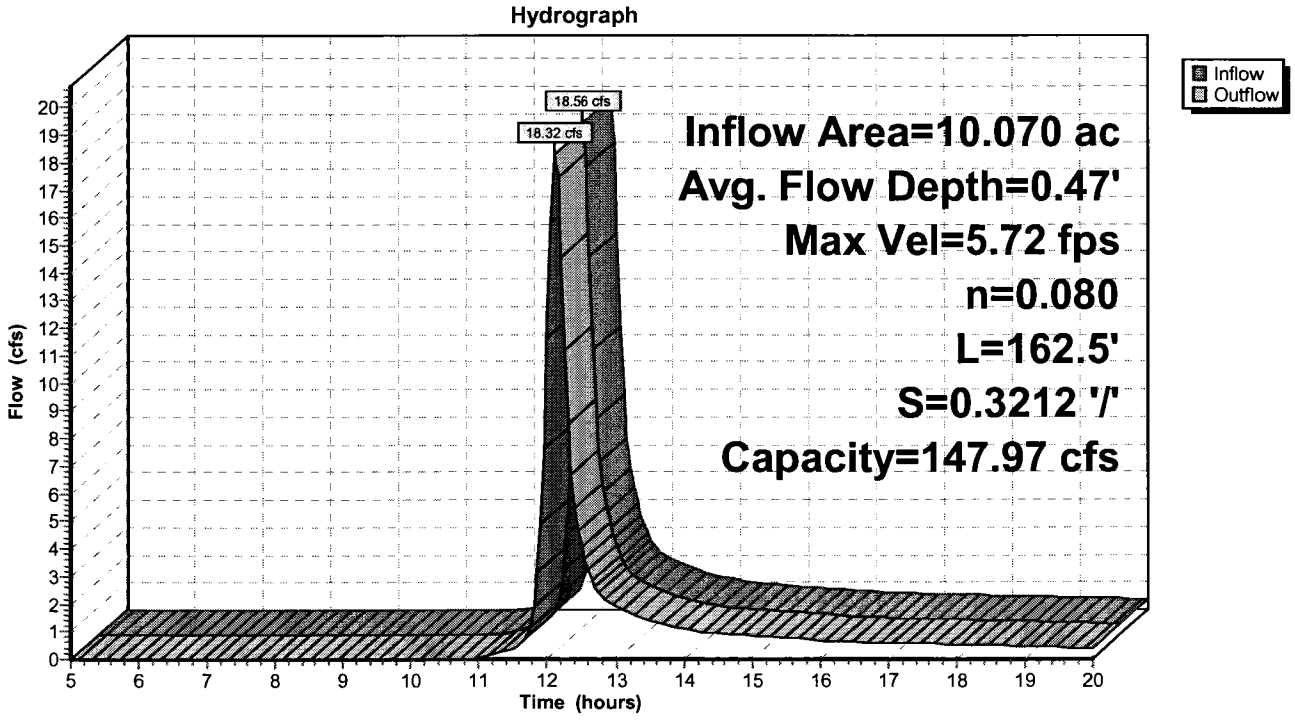
Reach DC1-5: DC1-5



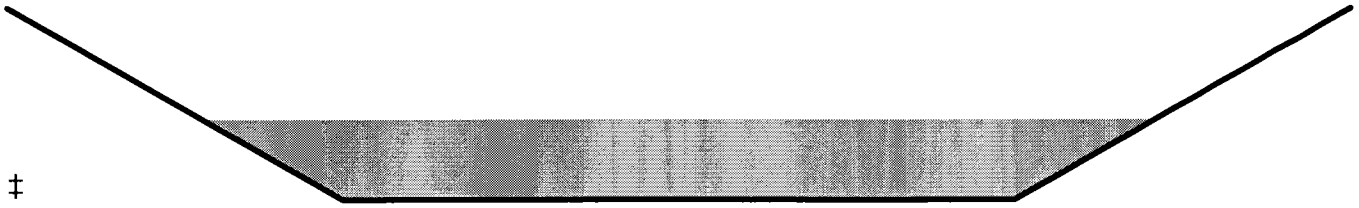
Summary for Reach DC1-6: DC1-6

Inflow Area = 10.070 ac, 0.00% Impervious, Inflow Depth > 1.33" for 25 year event
Inflow = 18.32 cfs @ 12.11 hrs, Volume= 1.115 af
Outflow = 18.25 cfs @ 12.12 hrs, Volume= 1.115 af, Atten= 0%, Lag= 0.2 min

Routing by Stor-Ind+Trans method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Max. Velocity= 4.02 fps, Min. Travel Time= 0.1 min
Avg. Velocity = 1.36 fps, Avg. Travel Time= 0.4 min

Peak Storage= 136 cf @ 12.11 hrs
Average Depth at Peak Storage= 0.63'
Bank-Full Depth= 1.50' Flow Area= 13.5 sf, Capacity= 88.06 cfs

6.00' x 1.50' deep channel, n= 0.075
Side Slope Z-value= 2.0 '/' Top Width= 12.00'
Length= 30.0' Slope= 0.1000 '/'
Inlet Invert= 1,407.01', Outlet Invert= 1,404.01'



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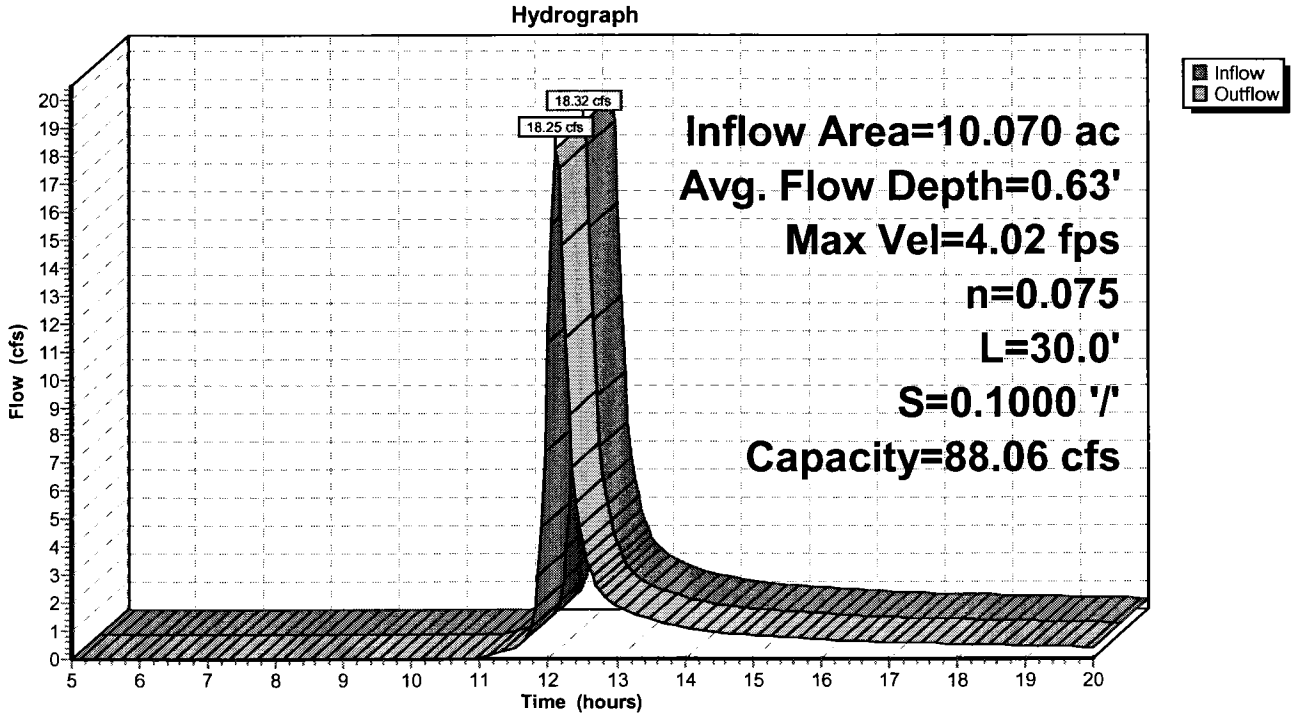
Reach DC1-6: DC1-6



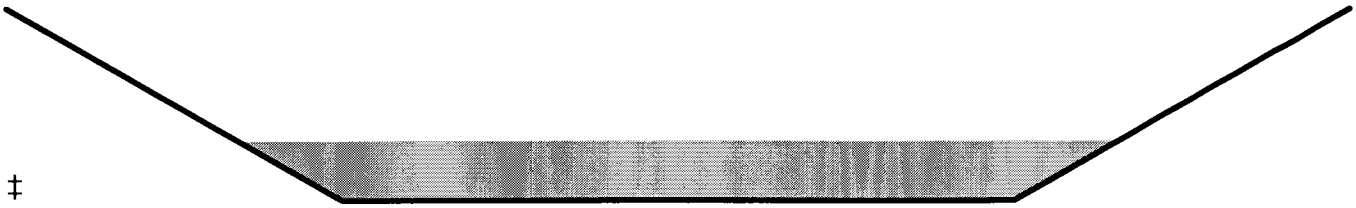
Summary for Reach DC1-7: DC1-7

Inflow Area = 10.070 ac, 0.00% Impervious, Inflow Depth > 1.33" for 25 year event
Inflow = 18.25 cfs @ 12.12 hrs, Volume= 1.115 af
Outflow = 17.96 cfs @ 12.13 hrs, Volume= 1.114 af, Atten= 2%, Lag= 0.9 min

Routing by Stor-Ind+Trans method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Max. Velocity= 5.66 fps, Min. Travel Time= 0.5 min
Avg. Velocity = 1.88 fps, Avg. Travel Time= 1.4 min

Peak Storage= 522 cf @ 12.12 hrs
Average Depth at Peak Storage= 0.46'
Bank-Full Depth= 1.50' Flow Area= 13.5 sf, Capacity= 147.95 cfs

6.00' x 1.50' deep channel, n= 0.080
Side Slope Z-value= 2.0 '/' Top Width= 12.00'
Length= 162.8' Slope= 0.3211 '/'
Inlet Invert= 1,404.01', Outlet Invert= 1,351.73'



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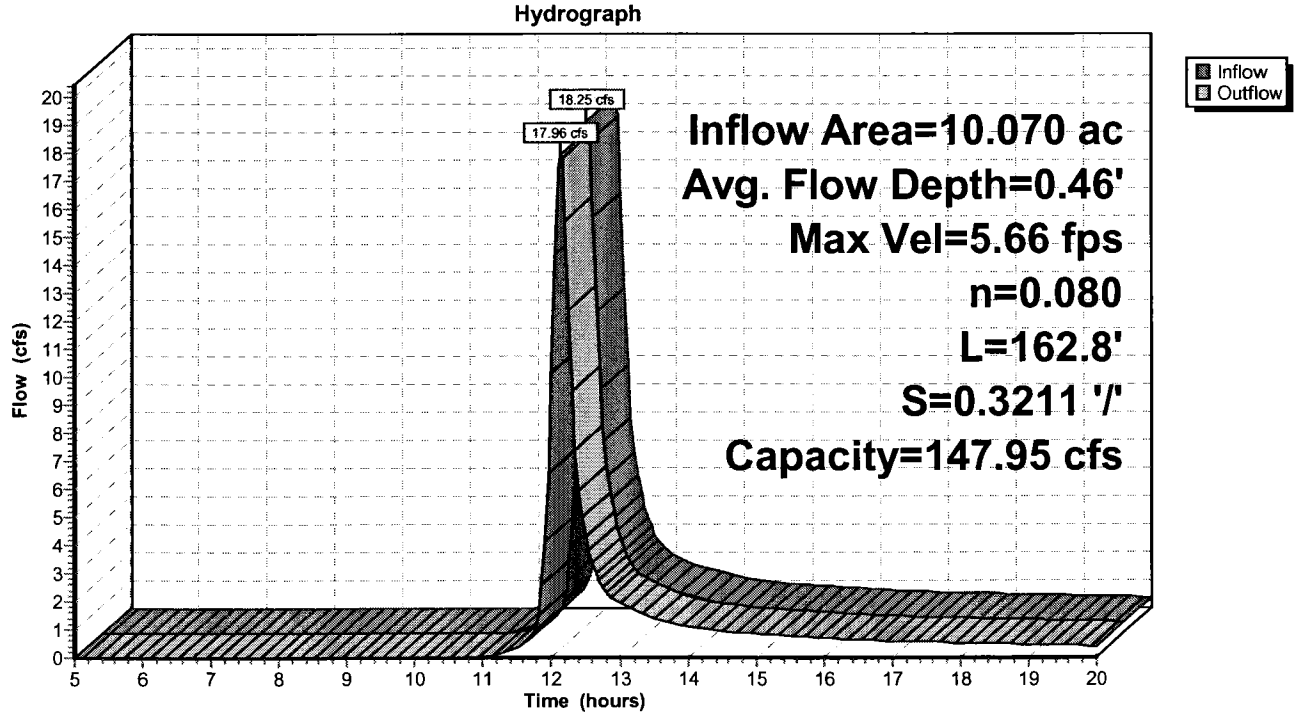
Reach DC1-7: DC1-7



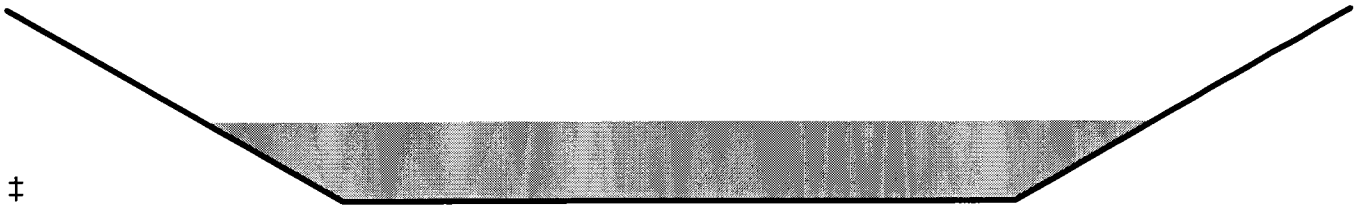
Summary for Reach DC1-8: DC1-8

Inflow Area = 10.070 ac, 0.00% Impervious, Inflow Depth > 1.33" for 25 year event
Inflow = 17.96 cfs @ 12.13 hrs, Volume= 1.114 af
Outflow = 17.92 cfs @ 12.14 hrs, Volume= 1.113 af, Atten= 0%, Lag= 0.2 min

Routing by Stor-Ind+Trans method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Max. Velocity= 3.99 fps, Min. Travel Time= 0.1 min
Avg. Velocity = 1.36 fps, Avg. Travel Time= 0.4 min

Peak Storage= 135 cf @ 12.13 hrs
Average Depth at Peak Storage= 0.62'
Bank-Full Depth= 1.50' Flow Area= 13.5 sf, Capacity= 87.77 cfs

6.00' x 1.50' deep channel, n= 0.075
Side Slope Z-value= 2.0 '/' Top Width= 12.00'
Length= 30.0' Slope= 0.0993 '/'
Inlet Invert= 1,351.73', Outlet Invert= 1,348.75'



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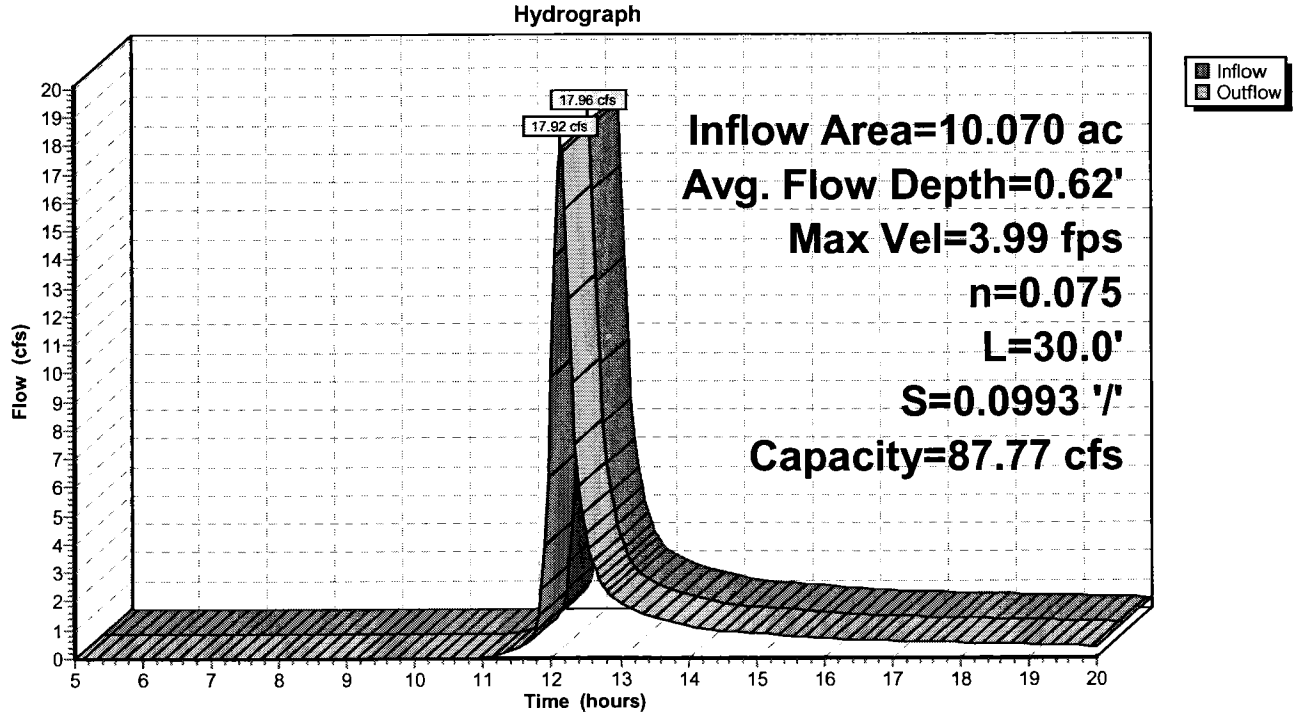
Reach DC1-8: DC1-8



Summary for Reach DC1-9: DC1-9

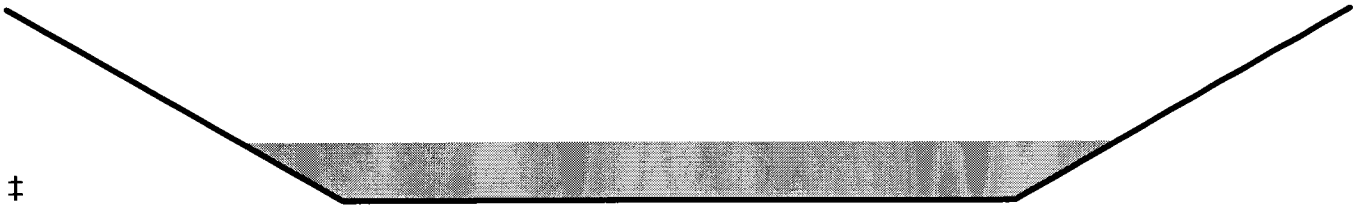
Inflow Area = 10.070 ac, 0.00% Impervious, Inflow Depth > 1.33" for 25 year event
Inflow = 17.92 cfs @ 12.14 hrs, Volume= 1.113 af
Outflow = 17.75 cfs @ 12.15 hrs, Volume= 1.112 af, Atten= 1%, Lag= 0.8 min

Routing by Stor-Ind+Trans method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Max. Velocity= 5.65 fps, Min. Travel Time= 0.5 min
Avg. Velocity = 1.89 fps, Avg. Travel Time= 1.4 min

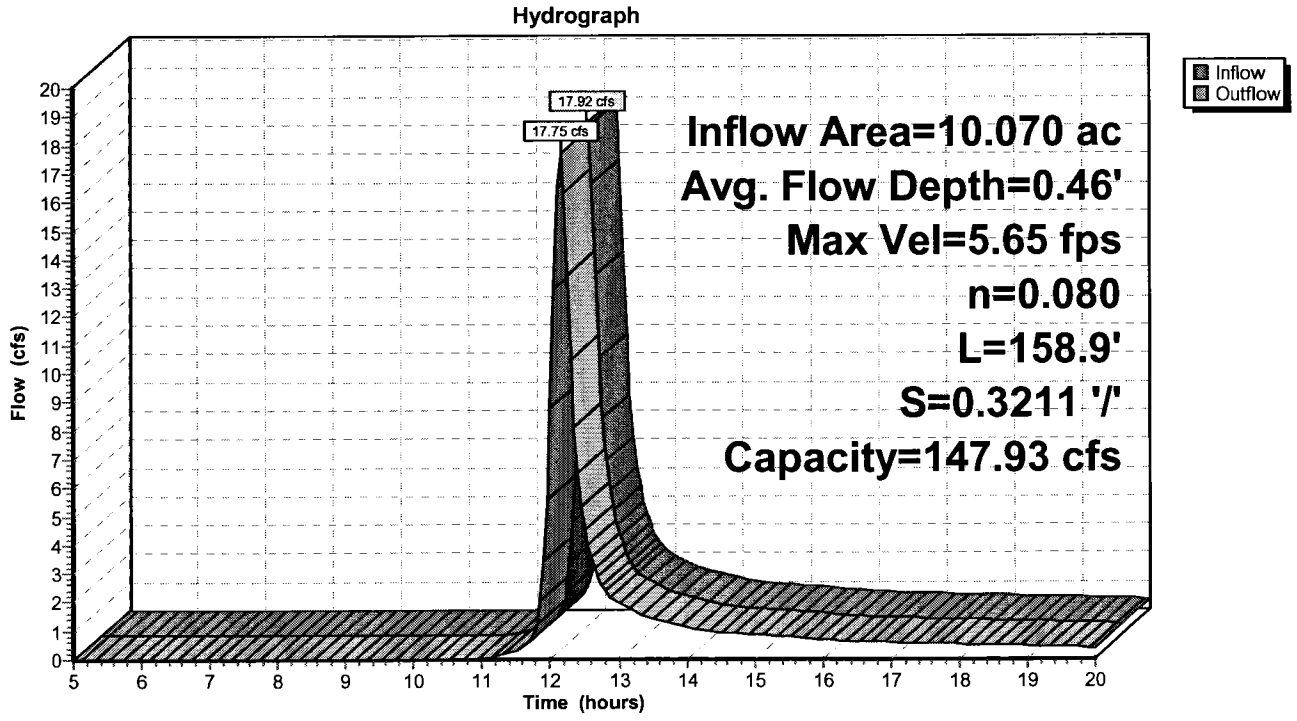
Peak Storage= 504 cf @ 12.14 hrs
Average Depth at Peak Storage= 0.46'
Bank-Full Depth= 1.50' Flow Area= 13.5 sf, Capacity= 147.93 cfs

6.00' x 1.50' deep channel, n= 0.080
Side Slope Z-value= 2.0 '/' Top Width= 12.00'
Length= 158.9' Slope= 0.3211 '/'
Inlet Invert= 1,348.75', Outlet Invert= 1,297.73'

‡



Reach DC1-9: DC1-9



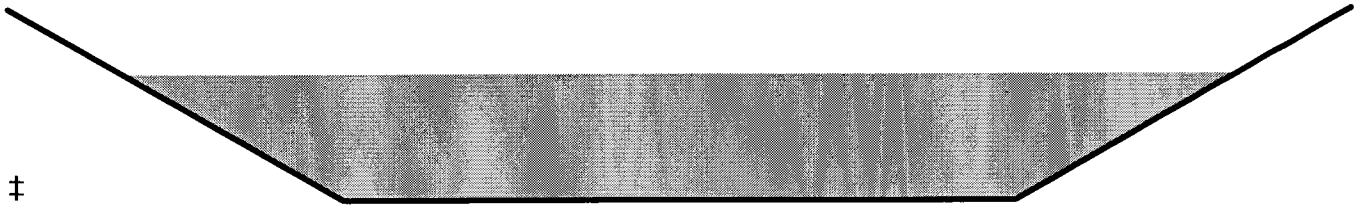
Summary for Reach DC13-1: DC13-1

Inflow Area = 27.830 ac, 0.00% Impervious, Inflow Depth > 1.33" for 25 year event
Inflow = 51.21 cfs @ 12.08 hrs, Volume= 3.093 af
Outflow = 51.17 cfs @ 12.08 hrs, Volume= 3.092 af, Atten= 0%, Lag= 0.1 min

Routing by Stor-Ind+Trans method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Max. Velocity= 6.46 fps, Min. Travel Time= 0.0 min
Avg. Velocity = 2.25 fps, Avg. Travel Time= 0.1 min

Peak Storage= 96 cf @ 12.08 hrs
Average Depth at Peak Storage= 0.99'
Bank-Full Depth= 1.50' Flow Area= 13.5 sf, Capacity= 109.63 cfs

6.00' x 1.50' deep channel, n= 0.060
Side Slope Z-value= 2.0 '/' Top Width= 12.00'
Length= 12.2' Slope= 0.0992 '/'
Inlet Invert= 1,504.95', Outlet Invert= 1,503.74'



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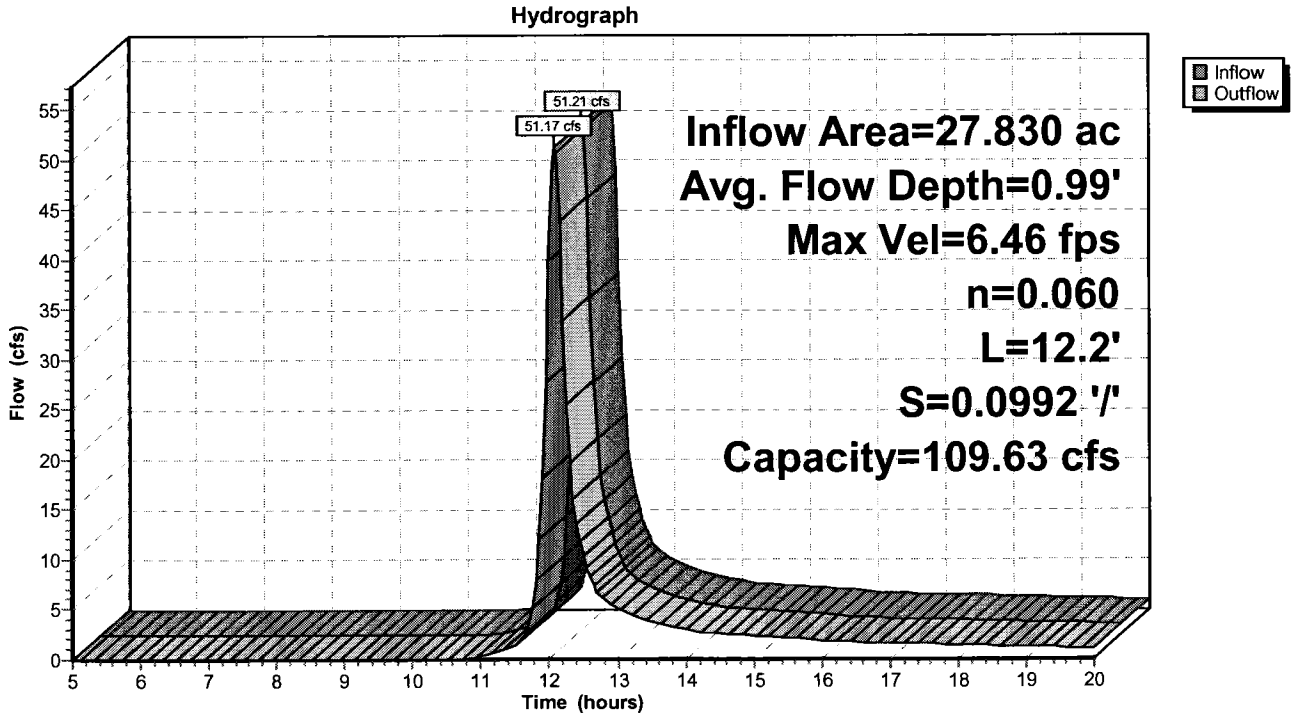
Reach DC13-1: DC13-1



Summary for Reach DC13-2: DC13-2

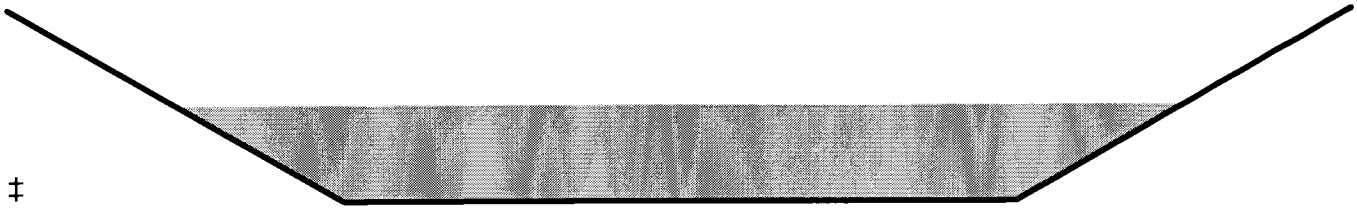
Inflow Area = 27.830 ac, 0.00% Impervious, Inflow Depth > 1.33" for 25 year event
Inflow = 51.17 cfs @ 12.08 hrs, Volume= 3.092 af
Outflow = 50.81 cfs @ 12.09 hrs, Volume= 3.090 af, Atten= 1%, Lag= 0.6 min

Routing by Stor-Ind+Trans method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Max. Velocity= 9.09 fps, Min. Travel Time= 0.3 min
Avg. Velocity = 3.09 fps, Avg. Travel Time= 0.9 min

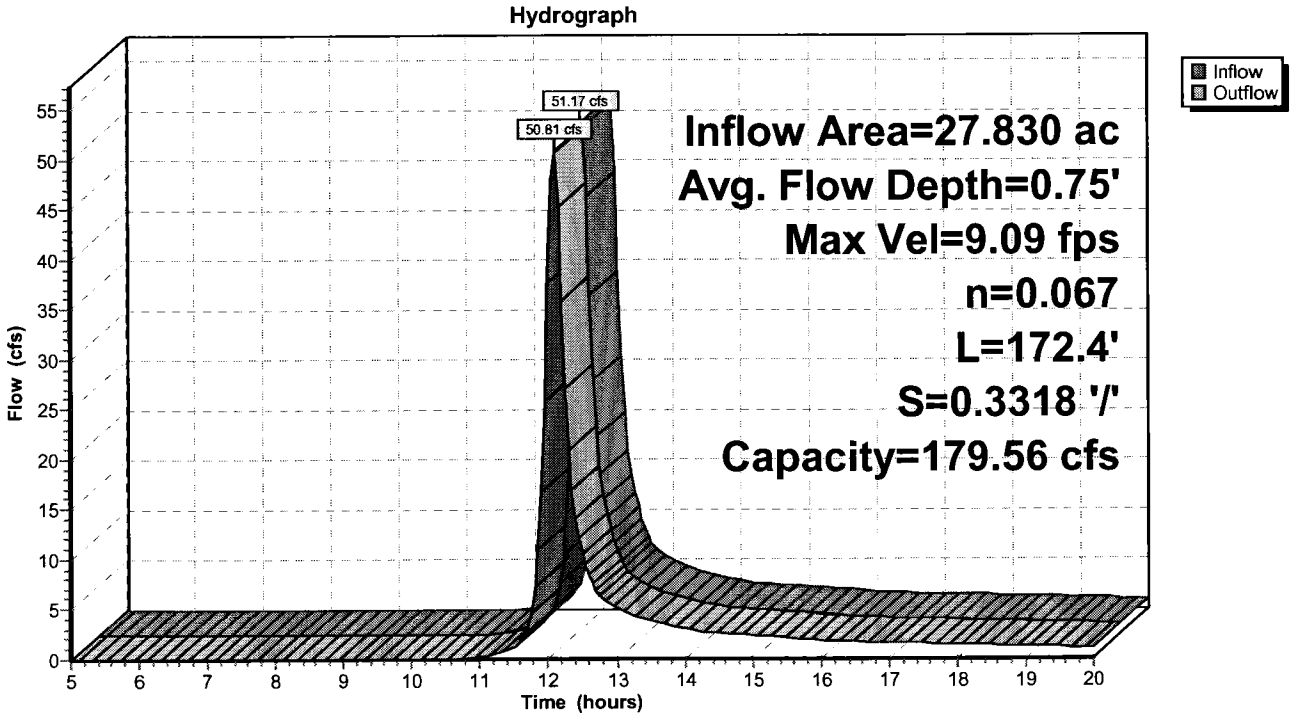
Peak Storage= 970 cf @ 12.09 hrs
Average Depth at Peak Storage= 0.75'
Bank-Full Depth= 1.50' Flow Area= 13.5 sf, Capacity= 179.56 cfs

6.00' x 1.50' deep channel, n= 0.067
Side Slope Z-value= 2.0 '/' Top Width= 12.00'
Length= 172.4' Slope= 0.3318 '/'
Inlet Invert= 1,503.74', Outlet Invert= 1,446.54'

‡



Reach DC13-2: DC13-2



Summary for Reach DC13-3: DC13-3

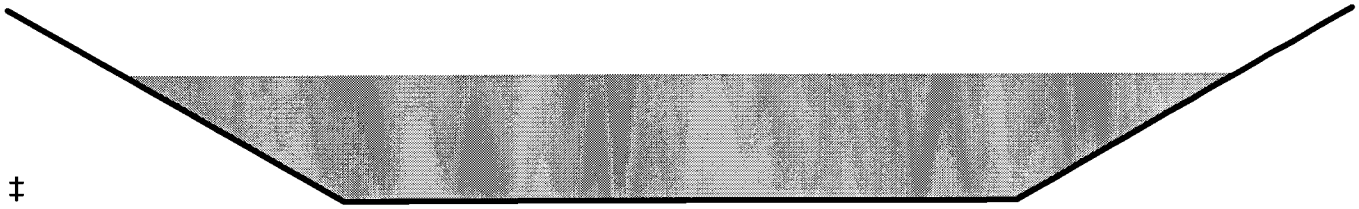
Inflow Area = 27.830 ac, 0.00% Impervious, Inflow Depth > 1.33" for 25 year event
Inflow = 50.81 cfs @ 12.09 hrs, Volume= 3.090 af
Outflow = 50.72 cfs @ 12.09 hrs, Volume= 3.089 af, Atten= 0%, Lag= 0.1 min

Routing by Stor-Ind+Trans method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Max. Velocity= 6.46 fps, Min. Travel Time= 0.1 min
Avg. Velocity = 2.26 fps, Avg. Travel Time= 0.2 min

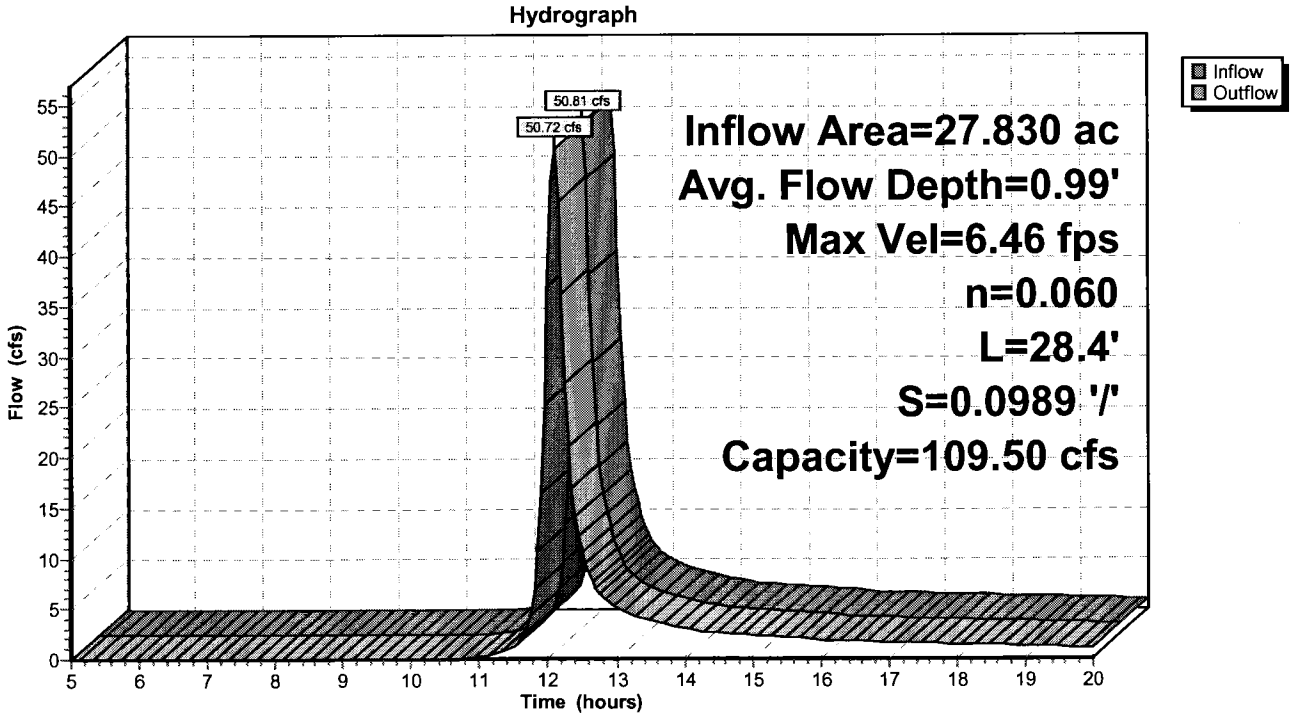
Peak Storage= 223 cf @ 12.09 hrs
Average Depth at Peak Storage= 0.99'
Bank-Full Depth= 1.50' Flow Area= 13.5 sf, Capacity= 109.50 cfs

6.00' x 1.50' deep channel, n= 0.060
Side Slope Z-value= 2.0 '/' Top Width= 12.00'
Length= 28.4' Slope= 0.0989 '/'
Inlet Invert= 1,446.54', Outlet Invert= 1,443.73'

‡



Reach DC13-3: DC13-3



Summary for Reach DC13-4: DC13-4

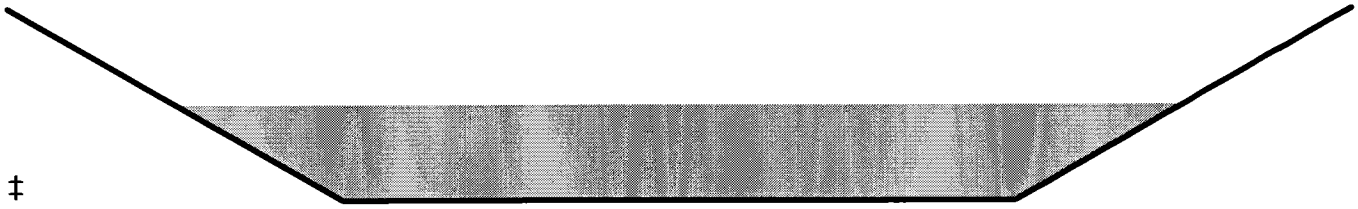
Inflow Area = 27.830 ac, 0.00% Impervious, Inflow Depth > 1.33" for 25 year event
Inflow = 50.72 cfs @ 12.09 hrs, Volume= 3.089 af
Outflow = 50.33 cfs @ 12.10 hrs, Volume= 3.087 af, Atten= 1%, Lag= 0.5 min

Routing by Stor-Ind+Trans method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Max. Velocity= 9.07 fps, Min. Travel Time= 0.3 min
Avg. Velocity = 3.08 fps, Avg. Travel Time= 0.9 min

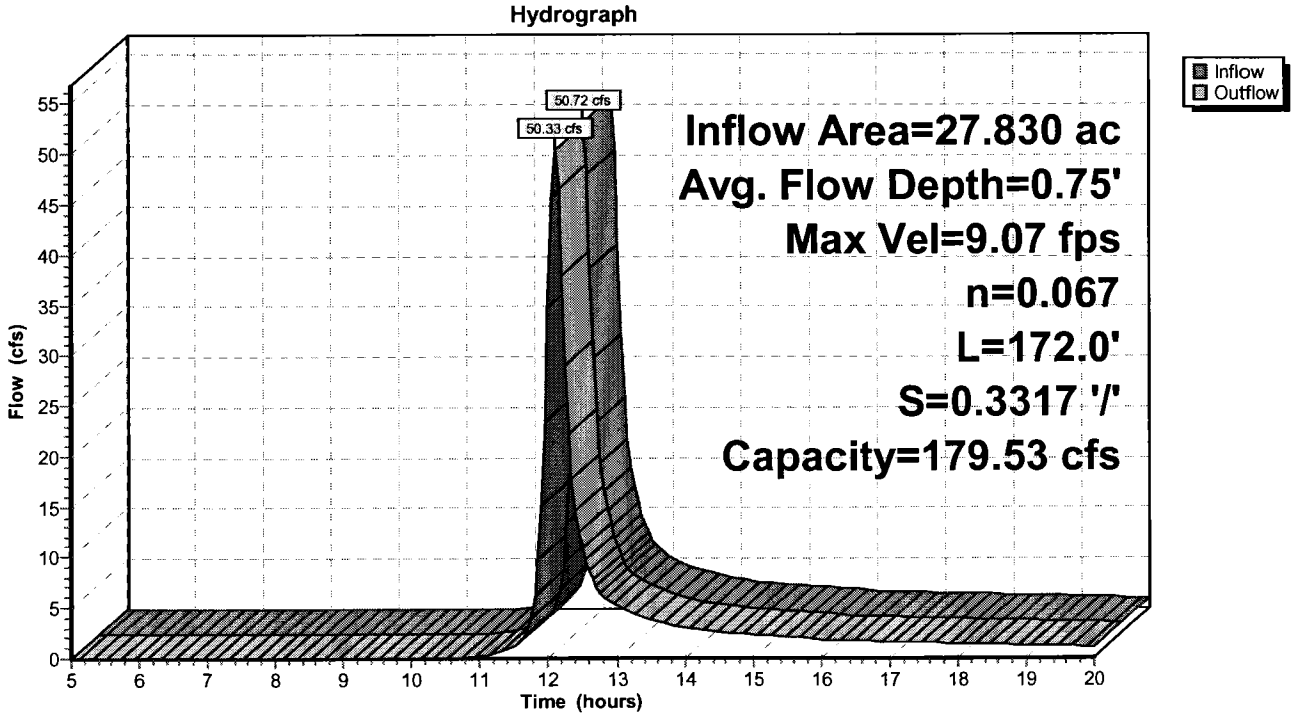
Peak Storage= 962 cf @ 12.10 hrs
Average Depth at Peak Storage= 0.75'
Bank-Full Depth= 1.50' Flow Area= 13.5 sf, Capacity= 179.53 cfs

6.00' x 1.50' deep channel, n= 0.067
Side Slope Z-value= 2.0 '/' Top Width= 12.00'
Length= 172.0' Slope= 0.3317 '/'
Inlet Invert= 1,443.73', Outlet Invert= 1,386.68'

‡



Reach DC13-4: DC13-4



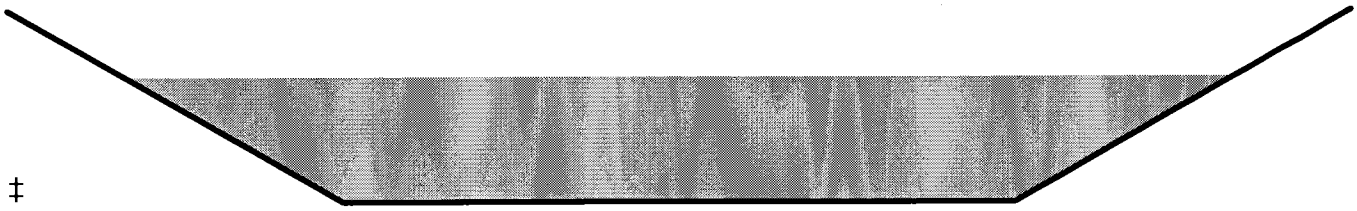
Summary for Reach DC13-5: DC13-5

Inflow Area = 27.830 ac, 0.00% Impervious, Inflow Depth > 1.33" for 25 year event
Inflow = 50.33 cfs @ 12.10 hrs, Volume= 3.087 af
Outflow = 50.23 cfs @ 12.10 hrs, Volume= 3.087 af, Atten= 0%, Lag= 0.1 min

Routing by Stor-Ind+Trans method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Max. Velocity= 6.45 fps, Min. Travel Time= 0.1 min
Avg. Velocity = 2.26 fps, Avg. Travel Time= 0.2 min

Peak Storage= 222 cf @ 12.10 hrs
Average Depth at Peak Storage= 0.98'
Bank-Full Depth= 1.50' Flow Area= 13.5 sf, Capacity= 109.69 cfs

6.00' x 1.50' deep channel, n= 0.060
Side Slope Z-value= 2.0 '/' Top Width= 12.00'
Length= 28.4' Slope= 0.0993 '/'
Inlet Invert= 1,386.68', Outlet Invert= 1,383.86'



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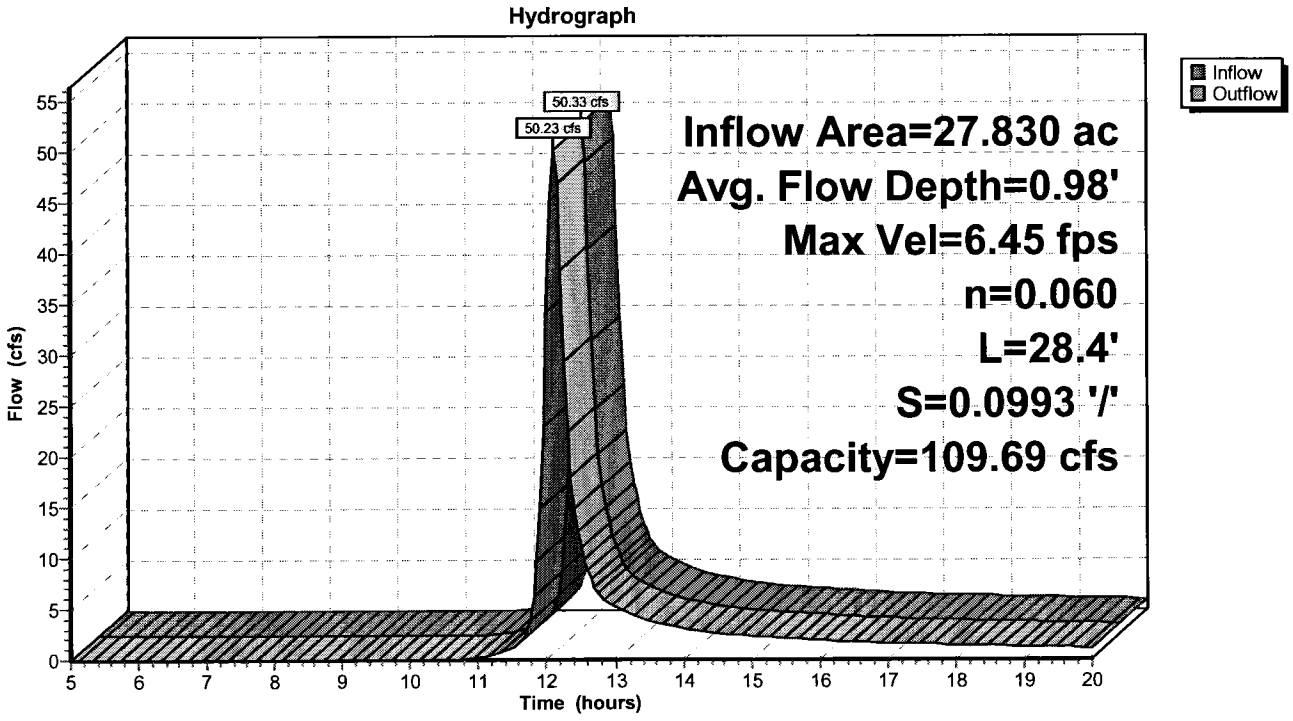
Reach DC13-5: DC13-5



Summary for Reach DC13-6: DC13-6

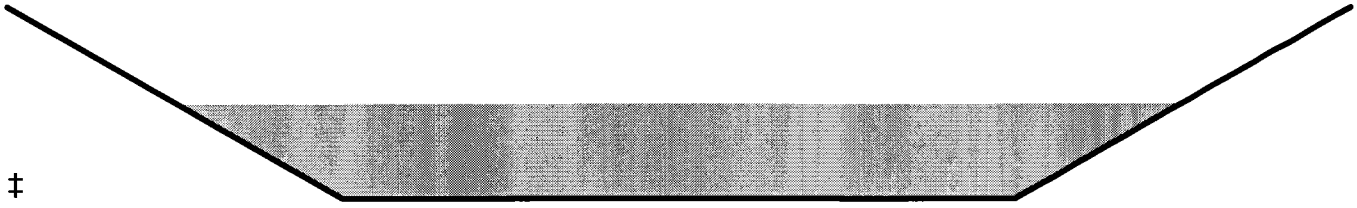
Inflow Area = 27.830 ac, 0.00% Impervious, Inflow Depth > 1.33" for 25 year event
Inflow = 50.23 cfs @ 12.10 hrs, Volume= 3.087 af
Outflow = 49.79 cfs @ 12.11 hrs, Volume= 3.084 af, Atten= 1%, Lag= 0.5 min

Routing by Stor-Ind+Trans method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Max. Velocity= 9.04 fps, Min. Travel Time= 0.3 min
Avg. Velocity = 3.09 fps, Avg. Travel Time= 0.9 min

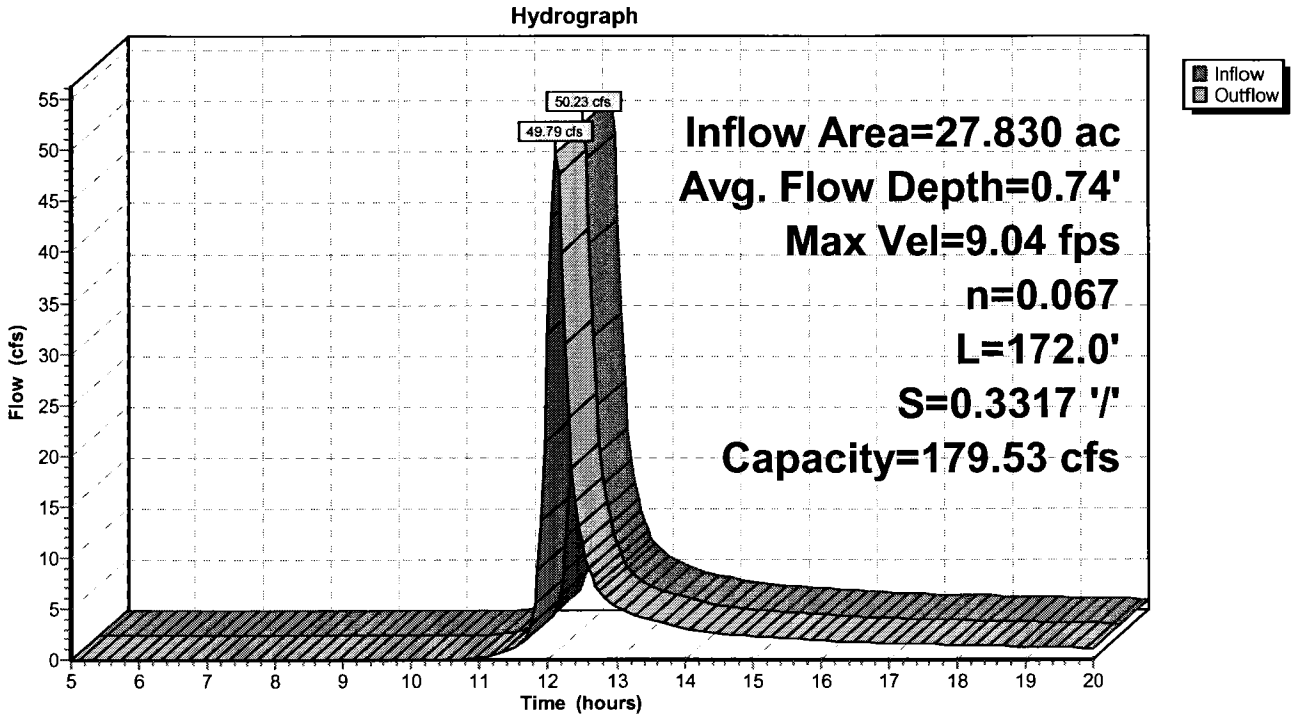
Peak Storage= 955 cf @ 12.11 hrs
Average Depth at Peak Storage= 0.74'
Bank-Full Depth= 1.50' Flow Area= 13.5 sf, Capacity= 179.53 cfs

6.00' x 1.50' deep channel, n= 0.067
Side Slope Z-value= 2.0 '/' Top Width= 12.00'
Length= 172.0' Slope= 0.3317 '/'
Inlet Invert= 1,383.86', Outlet Invert= 1,326.81'

‡



Reach DC13-6: DC13-6



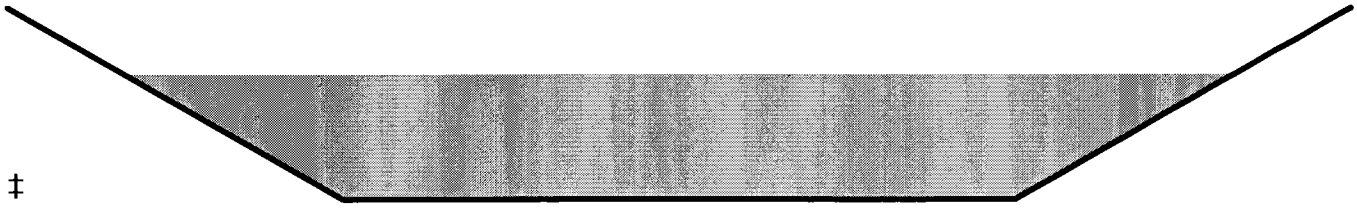
Summary for Reach DC13-7: DC13-7

Inflow Area = 27.830 ac, 0.00% Impervious, Inflow Depth > 1.33" for 25 year event
Inflow = 49.79 cfs @ 12.11 hrs, Volume= 3.084 af
Outflow = 49.69 cfs @ 12.12 hrs, Volume= 3.084 af, Atten= 0%, Lag= 0.1 min

Routing by Stor-Ind+Trans method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Max. Velocity= 6.41 fps, Min. Travel Time= 0.1 min
Avg. Velocity = 2.26 fps, Avg. Travel Time= 0.2 min

Peak Storage= 219 cf @ 12.11 hrs
Average Depth at Peak Storage= 0.98'
Bank-Full Depth= 1.50' Flow Area= 13.5 sf, Capacity= 109.49 cfs

6.00' x 1.50' deep channel, n= 0.060
Side Slope Z-value= 2.0 '/' Top Width= 12.00'
Length= 28.3' Slope= 0.0989 '/'
Inlet Invert= 1,326.81', Outlet Invert= 1,324.01'



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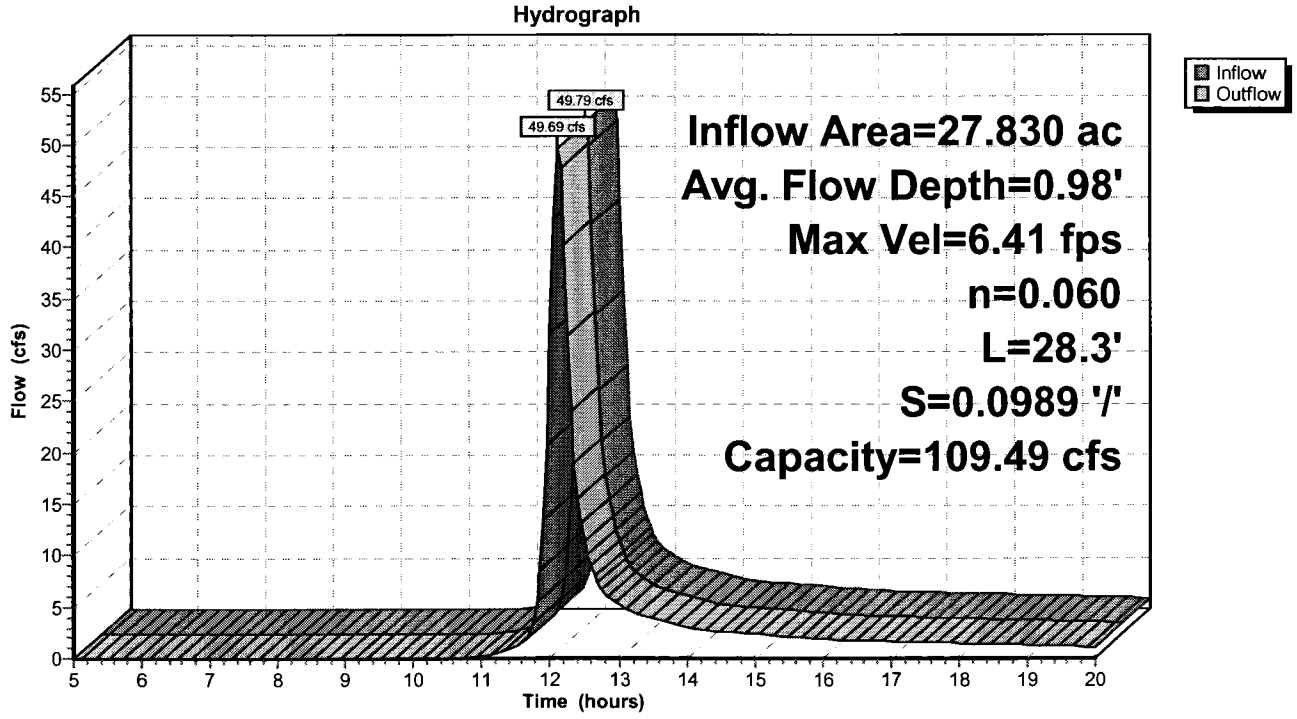
Reach DC13-7: DC13-7



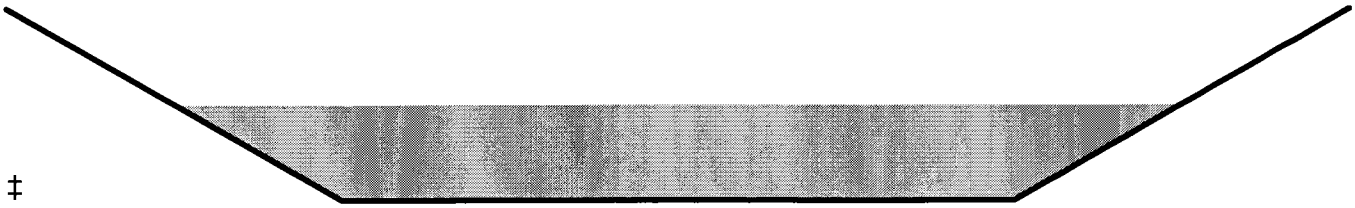
Summary for Reach DC13-8: DC13-8

Inflow Area = 27.830 ac, 0.00% Impervious, Inflow Depth > 1.33" for 25 year event
Inflow = 49.69 cfs @ 12.12 hrs, Volume= 3.084 af
Outflow = 49.21 cfs @ 12.12 hrs, Volume= 3.081 af, Atten= 1%, Lag= 0.6 min

Routing by Stor-Ind+Trans method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Max. Velocity= 8.90 fps, Min. Travel Time= 0.3 min
Avg. Velocity = 3.08 fps, Avg. Travel Time= 1.0 min

Peak Storage= 990 cf @ 12.12 hrs
Average Depth at Peak Storage= 0.74'
Bank-Full Depth= 1.50' Flow Area= 13.5 sf, Capacity= 177.32 cfs

6.00' x 1.50' deep channel, n= 0.068
Side Slope Z-value= 2.0 '/' Top Width= 12.00'
Length= 178.2' Slope= 0.3333 '/'
Inlet Invert= 1,324.01', Outlet Invert= 1,264.62'



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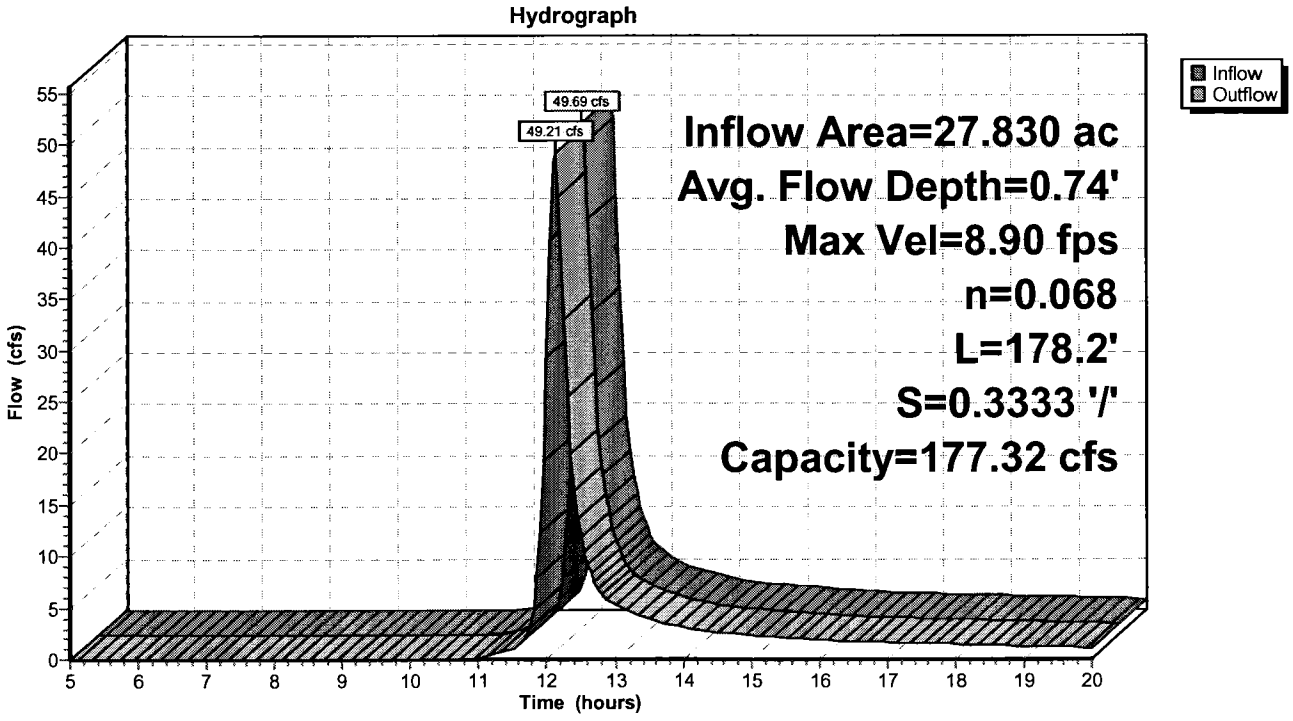
Reach DC13-8: DC13-8



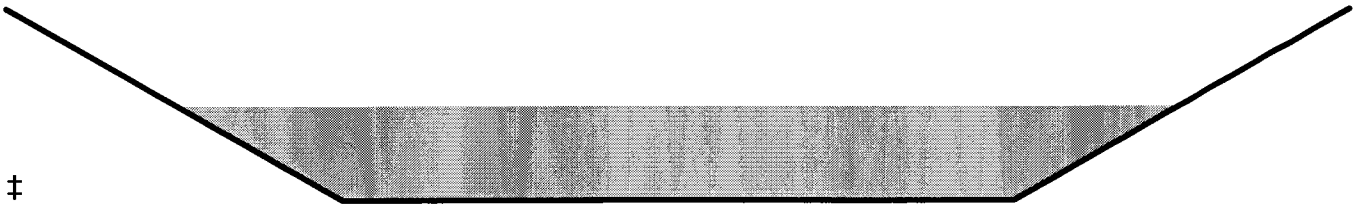
Summary for Reach DC2-1: DC2-1

Inflow Area = 20.880 ac, 0.00% Impervious, Inflow Depth > 1.34" for 25 year event
Inflow = 47.81 cfs @ 12.01 hrs, Volume= 2.326 af
Outflow = 47.73 cfs @ 12.01 hrs, Volume= 2.326 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Max. Velocity= 8.71 fps, Min. Travel Time= 0.0 min
Avg. Velocity = 2.72 fps, Avg. Travel Time= 0.1 min

Peak Storage= 72 cf @ 12.01 hrs
Average Depth at Peak Storage= 0.73'
Bank-Full Depth= 1.50' Flow Area= 13.5 sf, Capacity= 174.63 cfs

6.00' x 1.50' deep channel, n= 0.069
Side Slope Z-value= 2.0 '/' Top Width= 12.00'
Length= 13.1' Slope= 0.3328 '/'
Inlet Invert= 1,468.73', Outlet Invert= 1,464.37'



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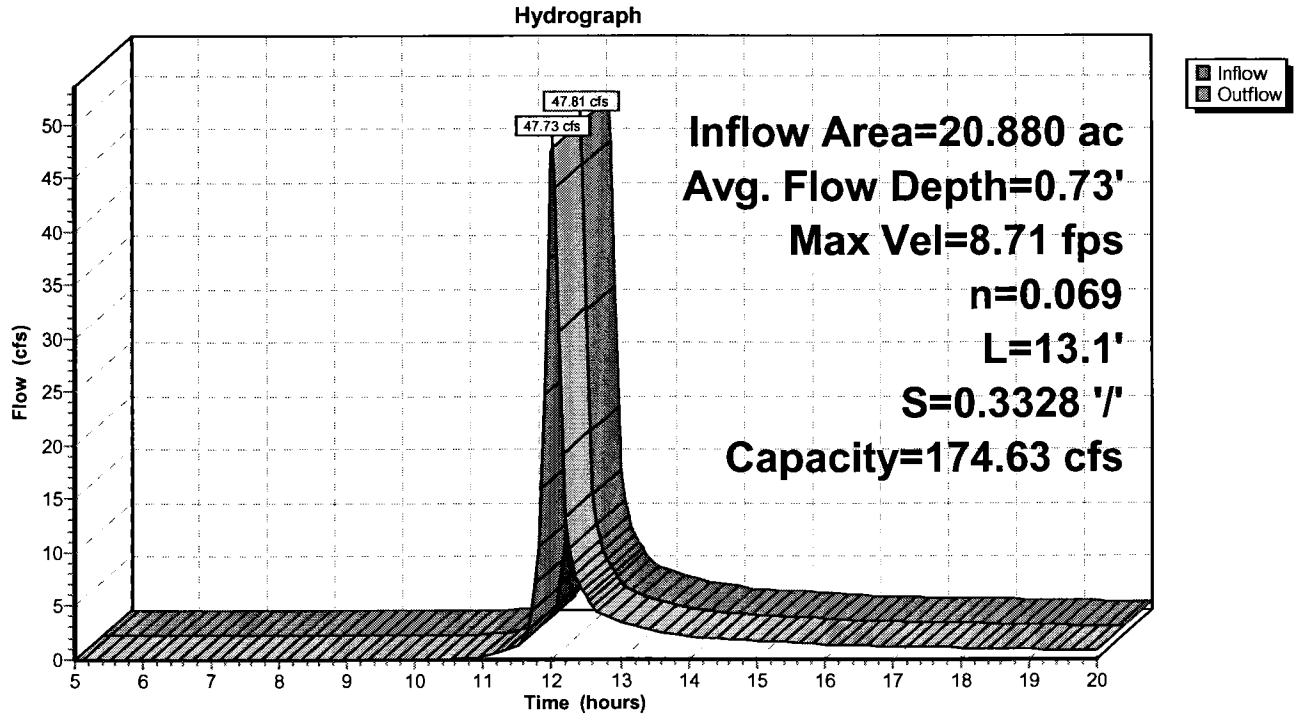
Reach DC2-1: DC2-1



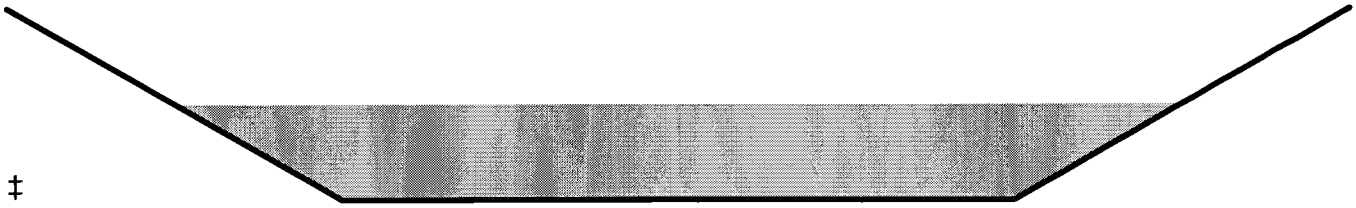
Summary for Reach DC2-2: DC2-2

Inflow Area = 20.880 ac, 0.00% Impervious, Inflow Depth > 1.34" for 25 year event
Inflow = 47.73 cfs @ 12.01 hrs, Volume= 2.326 af
Outflow = 46.76 cfs @ 12.02 hrs, Volume= 2.324 af, Atten= 2%, Lag= 0.6 min

Routing by Stor-Ind+Trans method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Max. Velocity= 8.43 fps, Min. Travel Time= 0.3 min
Avg. Velocity = 2.64 fps, Avg. Travel Time= 1.1 min

Peak Storage= 963 cf @ 12.02 hrs
Average Depth at Peak Storage= 0.75'
Bank-Full Depth= 1.50' Flow Area= 13.5 sf, Capacity= 167.21 cfs

6.00' x 1.50' deep channel, n= 0.072
Side Slope Z-value= 2.0 '/' Top Width= 12.00'
Length= 171.4' Slope= 0.3323 '/'
Inlet Invert= 1,464.37', Outlet Invert= 1,407.42'



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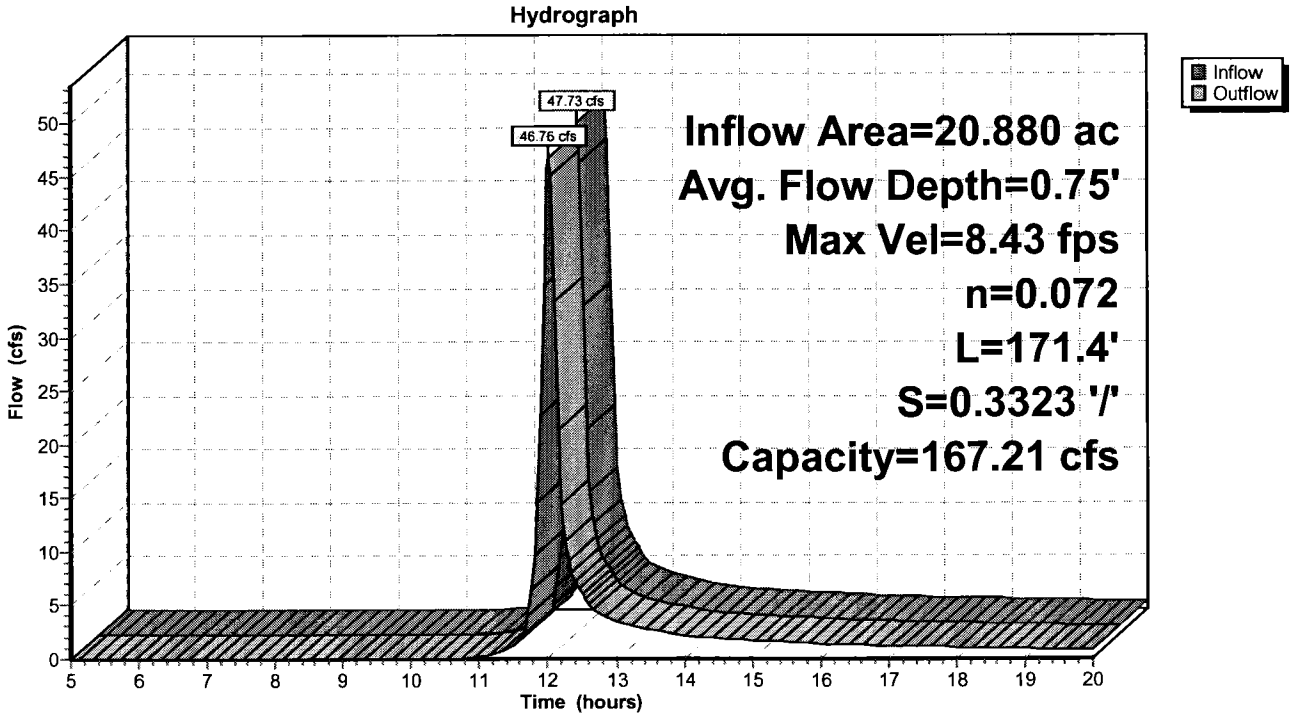
Reach DC2-2: DC2-2



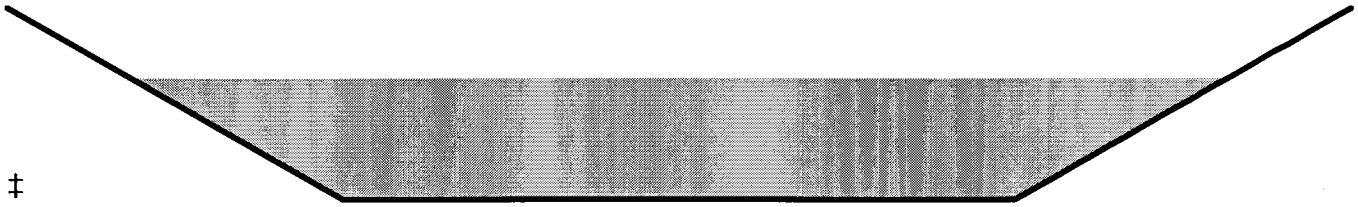
Summary for Reach DC2-3: DC2-3

Inflow Area = 20.880 ac, 0.00% Impervious, Inflow Depth > 1.34" for 25 year event
Inflow = 46.76 cfs @ 12.02 hrs, Volume= 2.324 af
Outflow = 46.62 cfs @ 12.03 hrs, Volume= 2.324 af, Atten= 0%, Lag= 0.2 min

Routing by Stor-Ind+Trans method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Max. Velocity= 6.19 fps, Min. Travel Time= 0.1 min
Avg. Velocity = 2.00 fps, Avg. Travel Time= 0.2 min

Peak Storage= 214 cf @ 12.02 hrs
Average Depth at Peak Storage= 0.95'
Bank-Full Depth= 1.50' Flow Area= 13.5 sf, Capacity= 108.08 cfs

6.00' x 1.50' deep channel, n= 0.061
Side Slope Z-value= 2.0 '/' Top Width= 12.00'
Length= 28.5' Slope= 0.0996 '/'
Inlet Invert= 1,407.42', Outlet Invert= 1,404.58'



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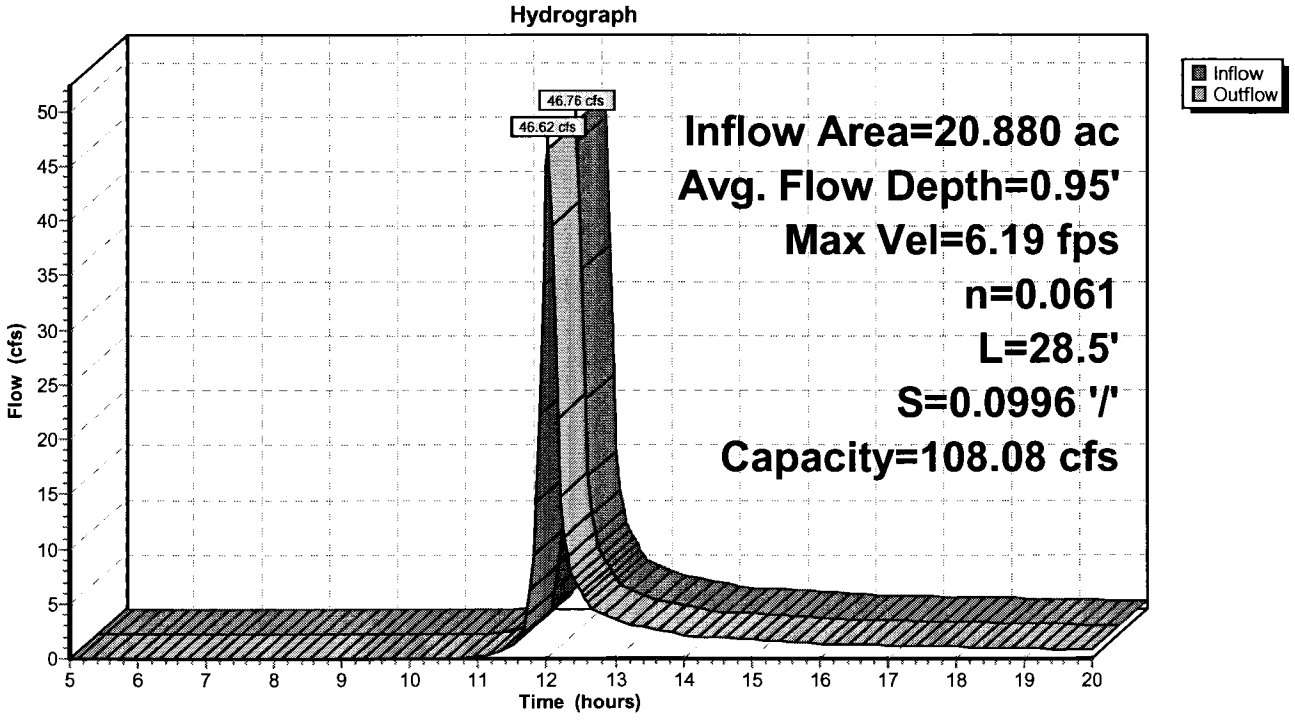
Reach DC2-3: DC2-3



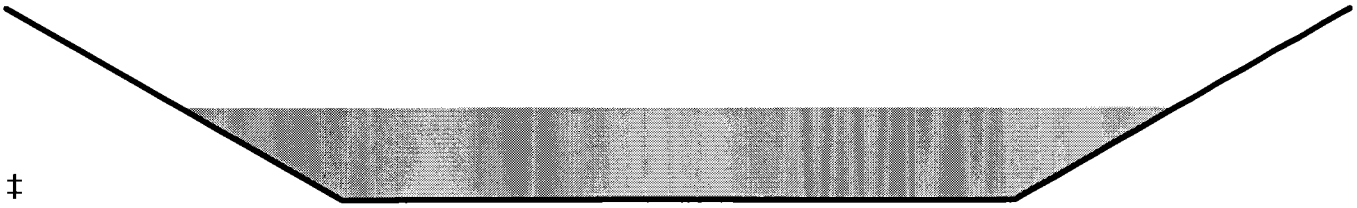
Summary for Reach DC2-4: DC2-4

Inflow Area = 20.880 ac, 0.00% Impervious, Inflow Depth > 1.34" for 25 year event
Inflow = 46.62 cfs @ 12.03 hrs, Volume= 2.324 af
Outflow = 46.10 cfs @ 12.04 hrs, Volume= 2.322 af, Atten= 1%, Lag= 0.6 min

Routing by Stor-Ind+Trans method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Max. Velocity= 8.63 fps, Min. Travel Time= 0.3 min
Avg. Velocity = 2.73 fps, Avg. Travel Time= 1.1 min

Peak Storage= 926 cf @ 12.03 hrs
Average Depth at Peak Storage= 0.72'
Bank-Full Depth= 1.50' Flow Area= 13.5 sf, Capacity= 175.13 cfs

6.00' x 1.50' deep channel, n= 0.069
Side Slope Z-value= 2.0 '/' Top Width= 12.00'
Length= 172.4' Slope= 0.3347 '/'
Inlet Invert= 1,404.58', Outlet Invert= 1,346.87'



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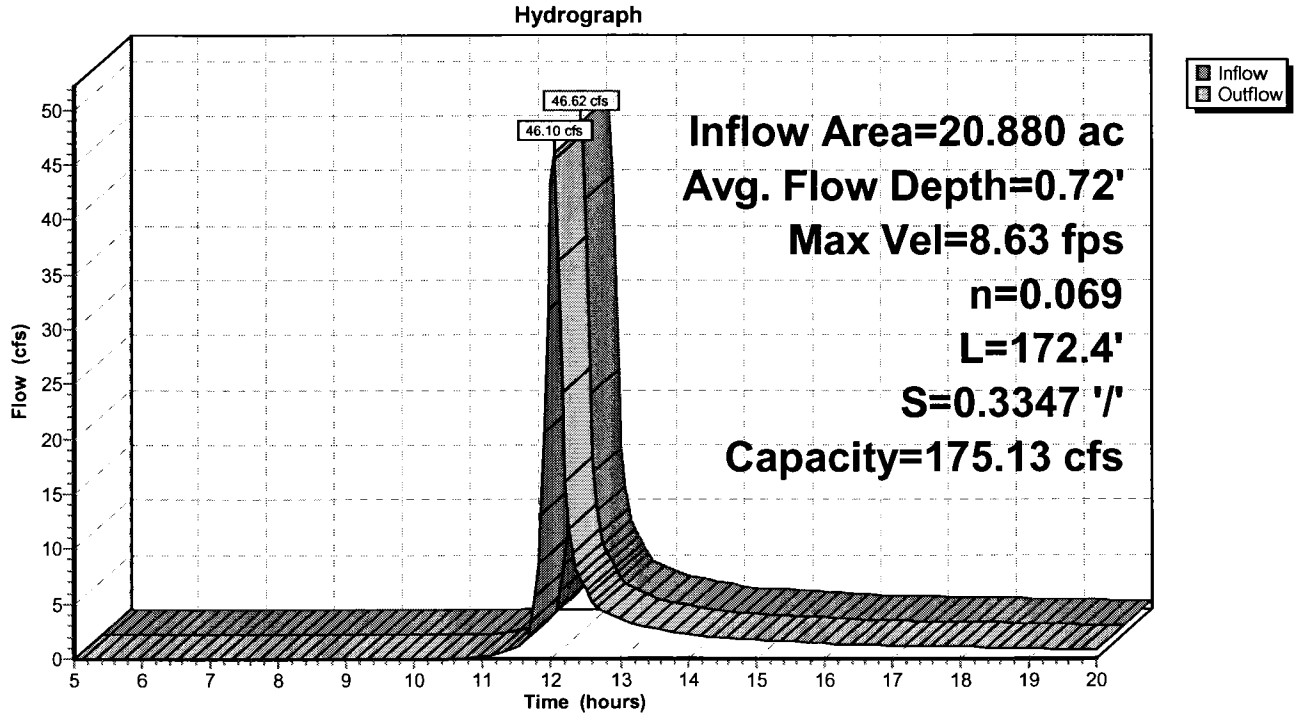
Reach DC2-4: DC2-4



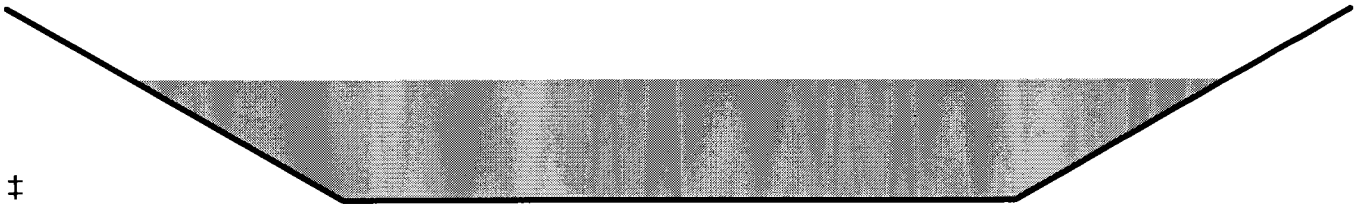
Summary for Reach DC2-5: DC2-5

Inflow Area = 20.880 ac, 0.00% Impervious, Inflow Depth > 1.33" for 25 year event
Inflow = 46.10 cfs @ 12.04 hrs, Volume= 2.322 af
Outflow = 45.98 cfs @ 12.04 hrs, Volume= 2.321 af, Atten= 0%, Lag= 0.1 min

Routing by Stor-Ind+Trans method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Max. Velocity= 6.20 fps, Min. Travel Time= 0.1 min
Avg. Velocity = 2.01 fps, Avg. Travel Time= 0.2 min

Peak Storage= 212 cf @ 12.04 hrs
Average Depth at Peak Storage= 0.94'
Bank-Full Depth= 1.50' Flow Area= 13.5 sf, Capacity= 108.27 cfs

6.00' x 1.50' deep channel, n= 0.061
Side Slope Z-value= 2.0 '/' Top Width= 12.00'
Length= 28.6' Slope= 0.1000 '/'
Inlet Invert= 1,346.87', Outlet Invert= 1,344.01'



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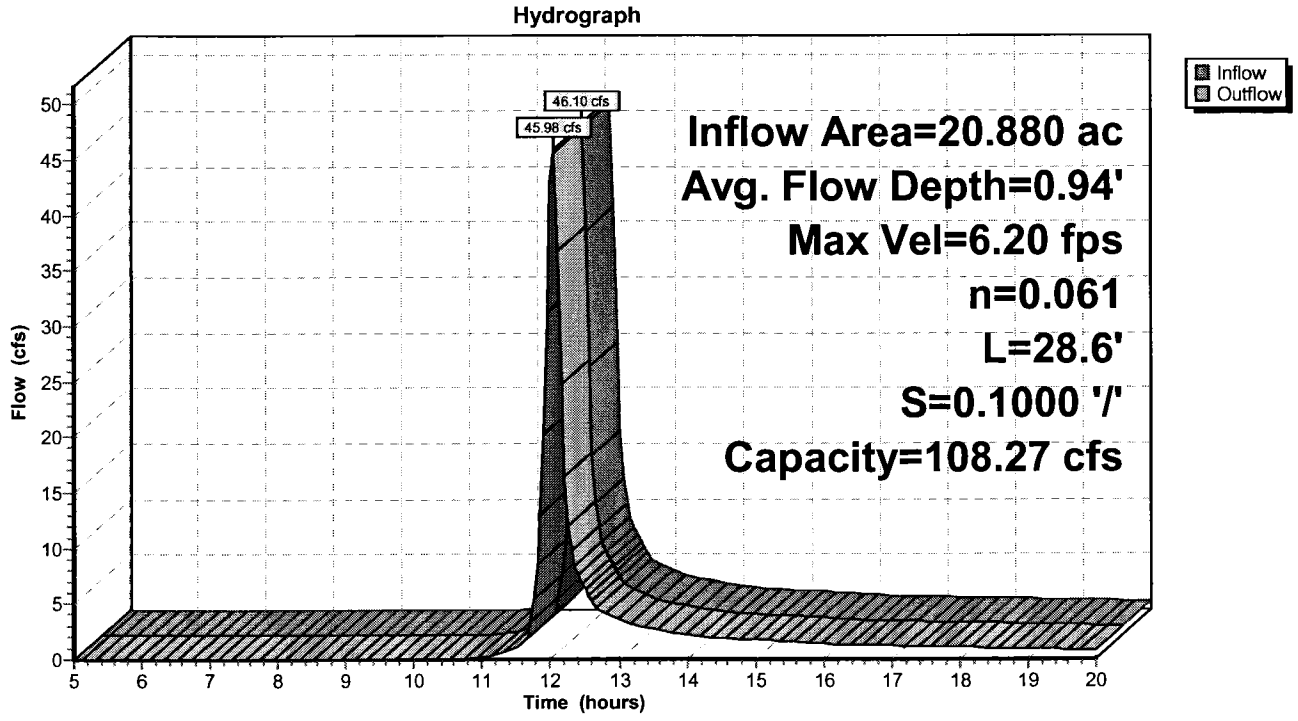
Reach DC2-5: DC2-5



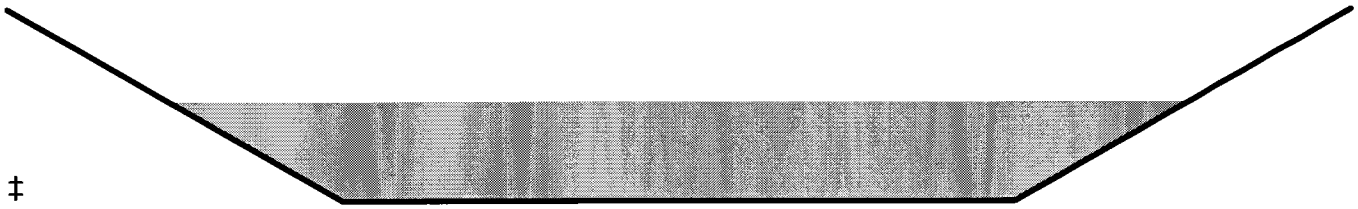
Summary for Reach DC2-6: DC2-6

Inflow Area = 20.880 ac, 0.00% Impervious, Inflow Depth > 1.33" for 25 year event
Inflow = 45.98 cfs @ 12.04 hrs, Volume= 2.321 af
Outflow = 45.37 cfs @ 12.05 hrs, Volume= 2.319 af, Atten= 1%, Lag= 0.6 min

Routing by Stor-Ind+Trans method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Max. Velocity= 7.87 fps, Min. Travel Time= 0.4 min
Avg. Velocity = 2.50 fps, Avg. Travel Time= 1.1 min

Peak Storage= 1,006 cf @ 12.04 hrs
Average Depth at Peak Storage= 0.77'
Bank-Full Depth= 1.50' Flow Area= 13.5 sf, Capacity= 152.64 cfs

6.00' x 1.50' deep channel, n= 0.079
Side Slope Z-value= 2.0 '/' Top Width= 12.00'
Length= 172.2' Slope= 0.3333 '/'
Inlet Invert= 1,344.01', Outlet Invert= 1,286.61'



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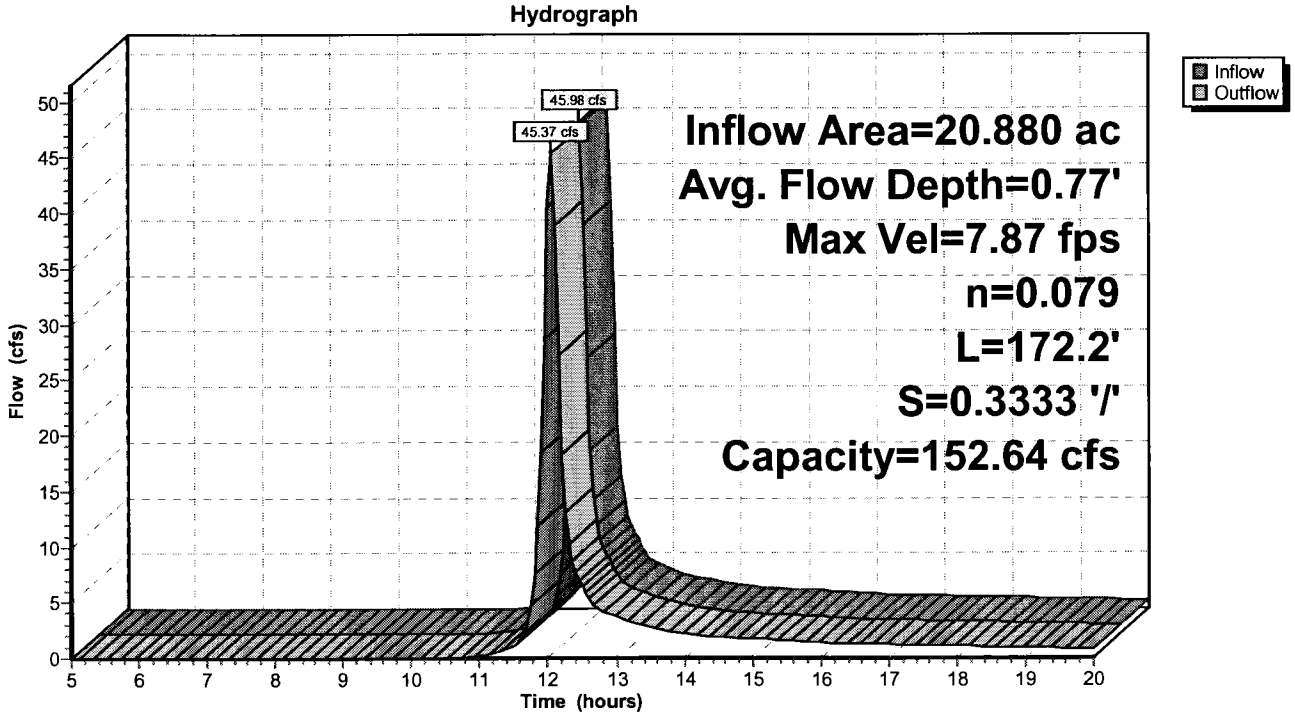
Reach DC2-6: DC2-6



Summary for Reach DC2-7: DC2-7

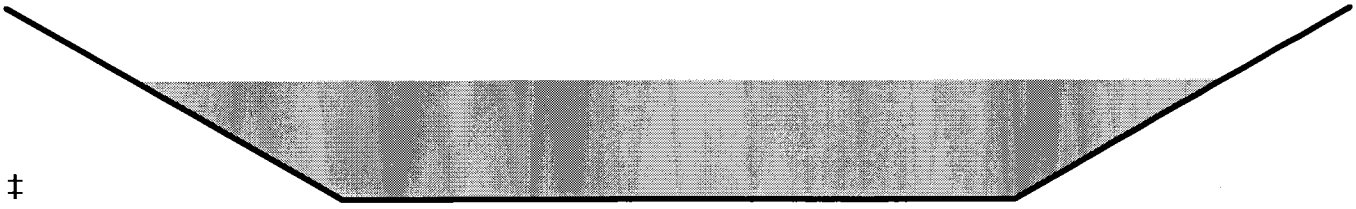
Inflow Area = 20.880 ac, 0.00% Impervious, Inflow Depth > 1.33" for 25 year event
Inflow = 45.37 cfs @ 12.05 hrs, Volume= 2.319 af
Outflow = 45.23 cfs @ 12.05 hrs, Volume= 2.319 af, Atten= 0%, Lag= 0.1 min

Routing by Stor-Ind+Trans method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Max. Velocity= 6.19 fps, Min. Travel Time= 0.1 min
Avg. Velocity = 2.02 fps, Avg. Travel Time= 0.2 min

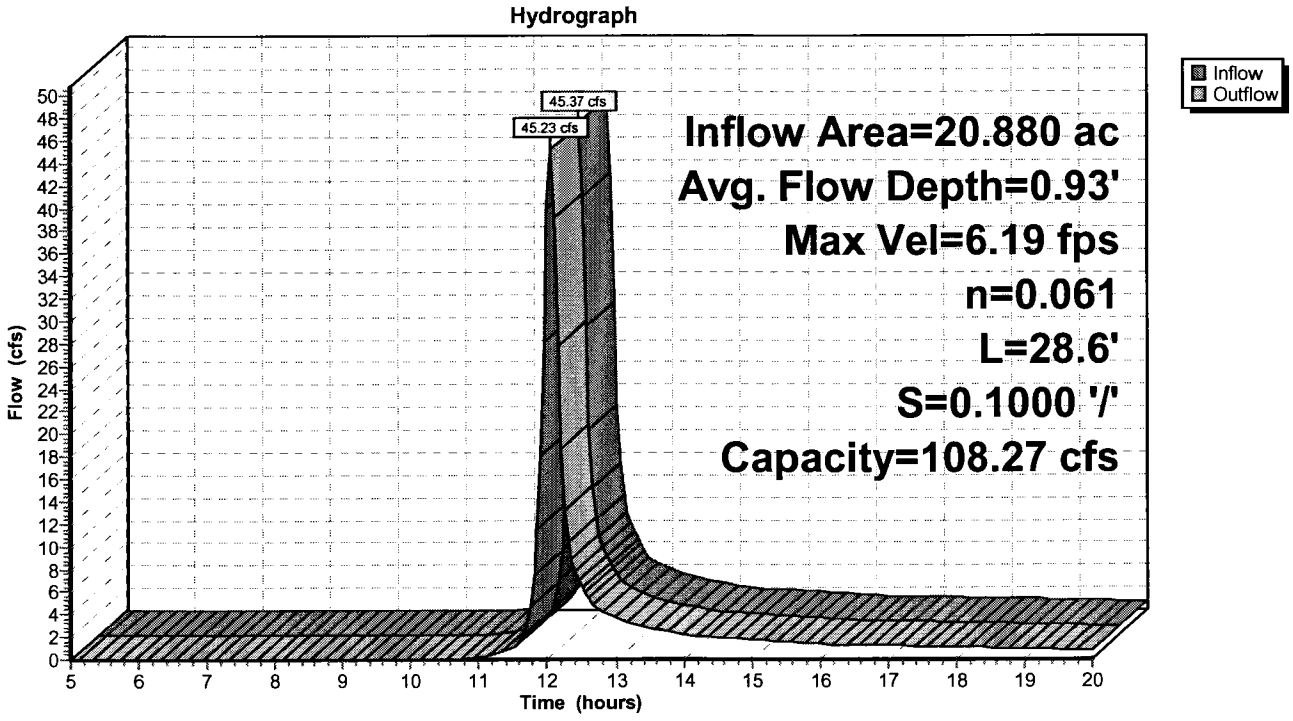
Peak Storage= 210 cf @ 12.05 hrs
Average Depth at Peak Storage= 0.93'
Bank-Full Depth= 1.50' Flow Area= 13.5 sf, Capacity= 108.27 cfs

6.00' x 1.50' deep channel, n= 0.061
Side Slope Z-value= 2.0 '/' Top Width= 12.00'
Length= 28.6' Slope= 0.1000 '/'
Inlet Invert= 1,286.61', Outlet Invert= 1,283.75'

‡



Reach DC2-7: DC2-7



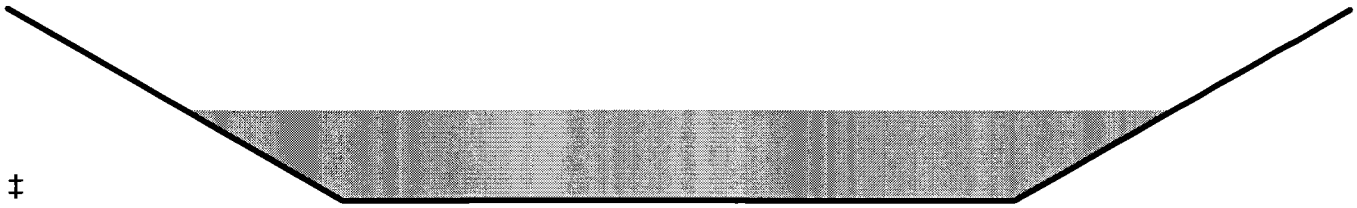
Summary for Reach DC2-8: DC2-8

Inflow Area = 20.880 ac, 0.00% Impervious, Inflow Depth > 1.33" for 25 year event
Inflow = 45.23 cfs @ 12.05 hrs, Volume= 2.319 af
Outflow = 44.63 cfs @ 12.06 hrs, Volume= 2.317 af, Atten= 1%, Lag= 0.5 min

Routing by Stor-Ind+Trans method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Max. Velocity= 8.58 fps, Min. Travel Time= 0.3 min
Avg. Velocity = 2.73 fps, Avg. Travel Time= 1.0 min

Peak Storage= 860 cf @ 12.05 hrs
Average Depth at Peak Storage= 0.71'
Bank-Full Depth= 1.50' Flow Area= 13.5 sf, Capacity= 174.73 cfs

6.00' x 1.50' deep channel, n= 0.069
Side Slope Z-value= 2.0 '/' Top Width= 12.00'
Length= 163.4' Slope= 0.3332 '/'
Inlet Invert= 1,283.75', Outlet Invert= 1,229.30'



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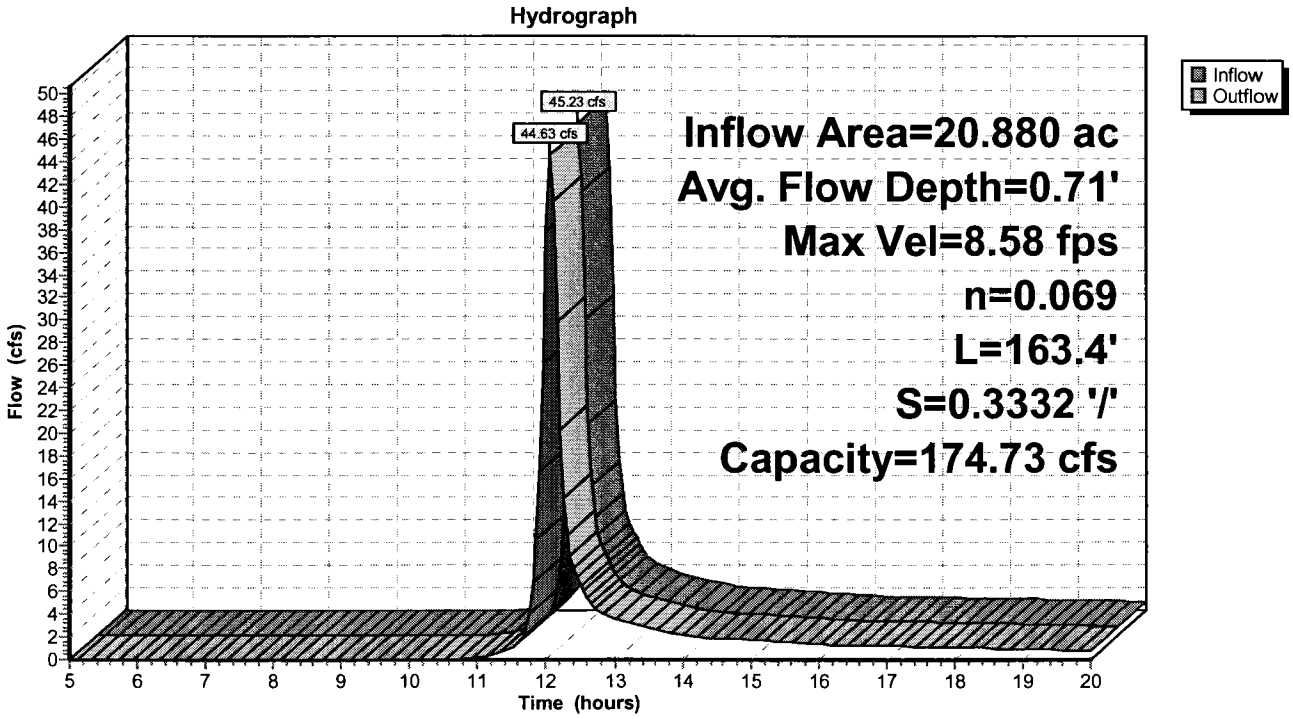
Reach DC2-8: DC2-8



Summary for Reach DC3-1: DC3-1

Inflow Area = 14.730 ac, 0.00% Impervious, Inflow Depth > 1.34" for 25 year event
Inflow = 32.47 cfs @ 12.02 hrs, Volume= 1.640 af
Outflow = 32.36 cfs @ 12.03 hrs, Volume= 1.640 af, Atten= 0%, Lag= 0.2 min

Routing by Stor-Ind+Trans method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Max. Velocity= 5.27 fps, Min. Travel Time= 0.1 min
Avg. Velocity = 1.69 fps, Avg. Travel Time= 0.3 min

Peak Storage= 159 cf @ 12.02 hrs
Average Depth at Peak Storage= 0.80'
Bank-Full Depth= 1.50' Flow Area= 13.5 sf, Capacity= 101.02 cfs

6.00' x 1.50' deep channel, n= 0.065
Side Slope Z-value= 2.0 '/' Top Width= 12.00'
Length= 26.1' Slope= 0.0989 '/'
Inlet Invert= 1,403.15', Outlet Invert= 1,400.57'

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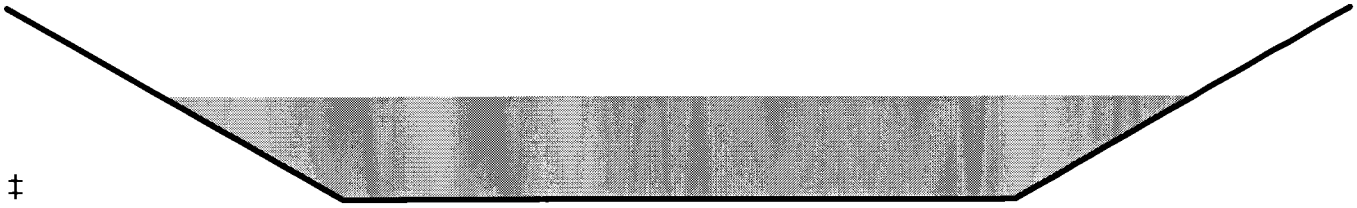
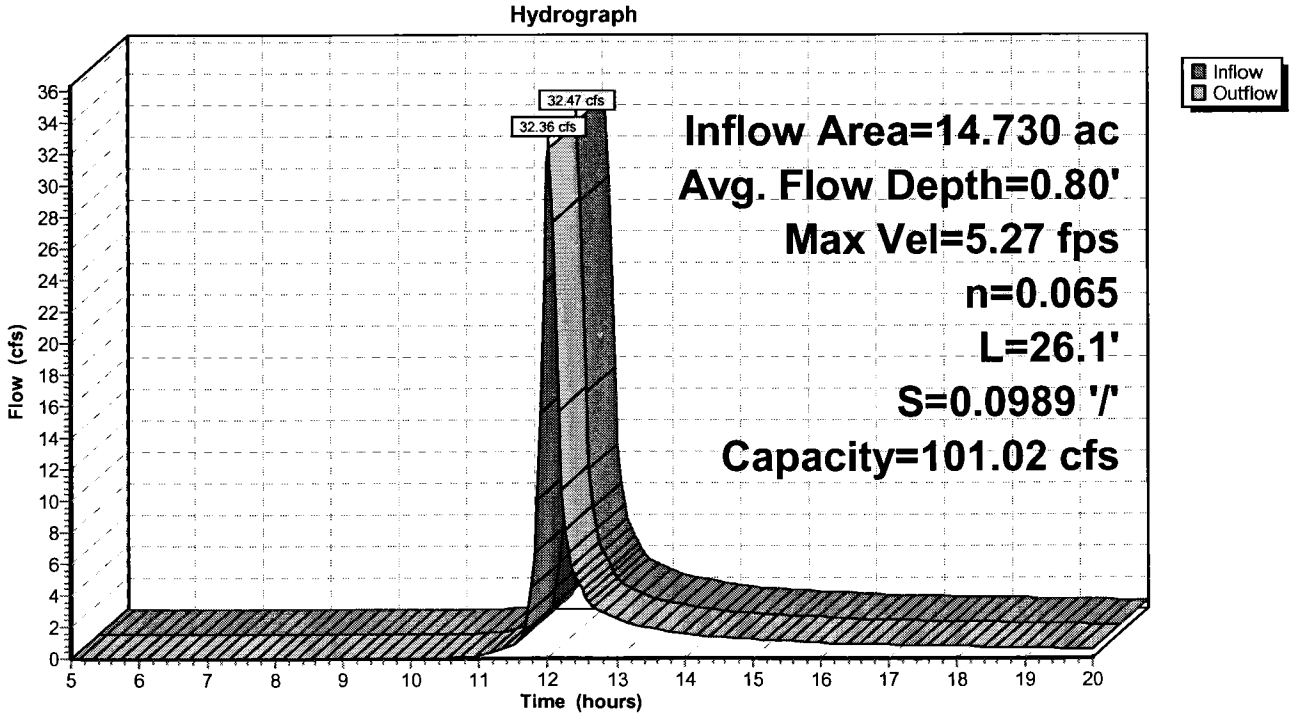


Reach DC3-1: DC3-1



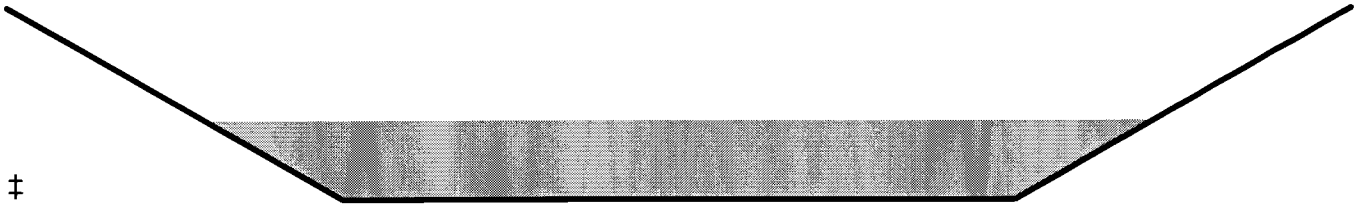
Summary for Reach DC3-2: DC3-2

Inflow Area = 14.730 ac, 0.00% Impervious, Inflow Depth > 1.34" for 25 year event
Inflow = 32.36 cfs @ 12.03 hrs, Volume= 1.640 af
Outflow = 31.95 cfs @ 12.04 hrs, Volume= 1.639 af, Atten= 1%, Lag= 0.7 min

Routing by Stor-Ind+Trans method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Max. Velocity= 7.25 fps, Min. Travel Time= 0.4 min
Avg. Velocity = 2.27 fps, Avg. Travel Time= 1.3 min

Peak Storage= 765 cf @ 12.03 hrs
Average Depth at Peak Storage= 0.62'
Bank-Full Depth= 1.50' Flow Area= 13.5 sf, Capacity= 160.83 cfs

6.00' x 1.50' deep channel, n= 0.075
Side Slope Z-value= 2.0 '/' Top Width= 12.00'
Length= 172.0' Slope= 0.3335 '/'
Inlet Invert= 1,400.57', Outlet Invert= 1,343.20'



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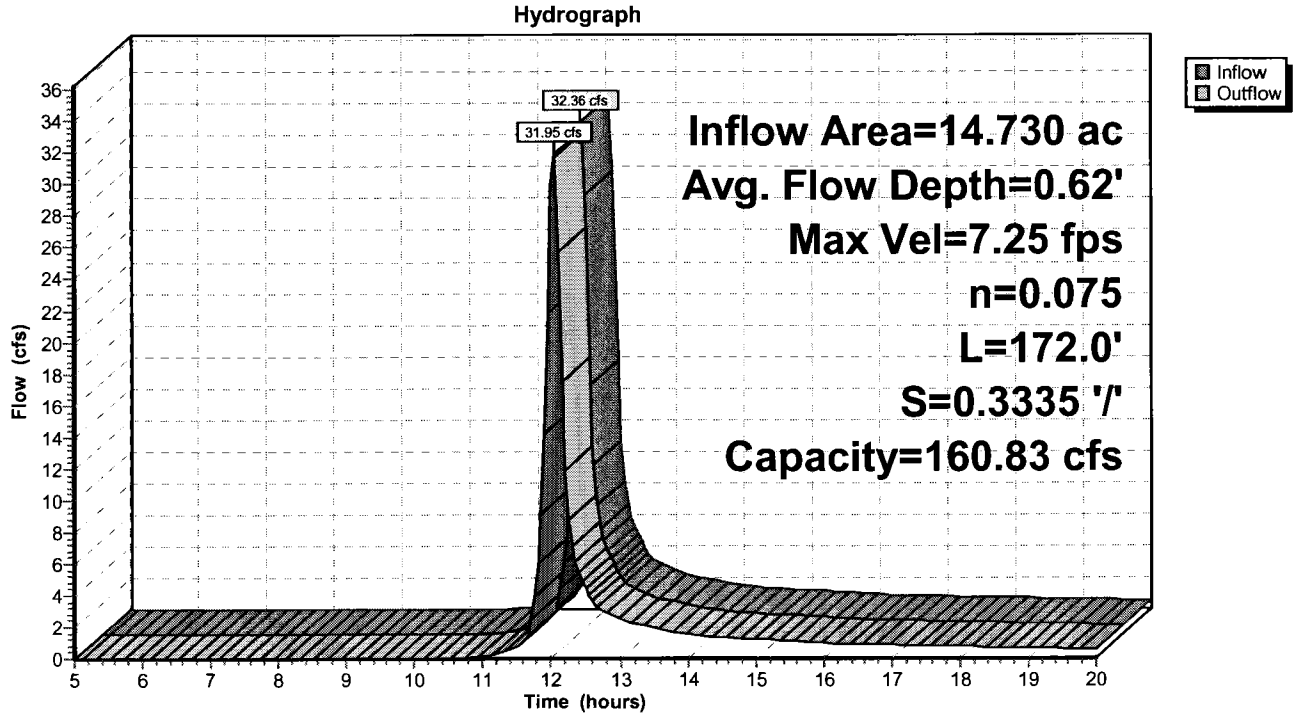
Reach DC3-2: DC3-2



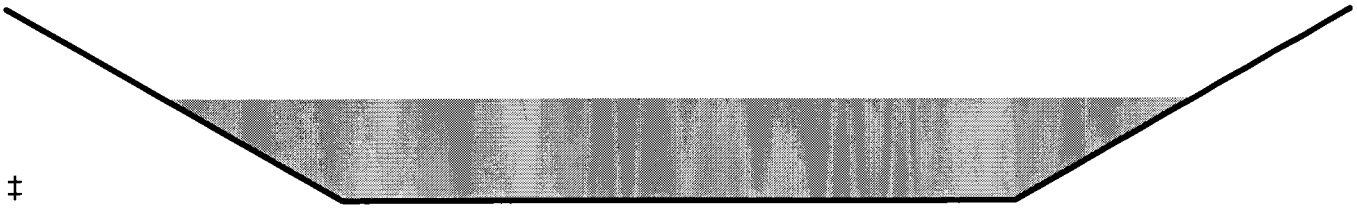
Summary for Reach DC3-3: DC3-3

Inflow Area = 14.730 ac, 0.00% Impervious, Inflow Depth > 1.33" for 25 year event
Inflow = 31.95 cfs @ 12.04 hrs, Volume= 1.639 af
Outflow = 31.85 cfs @ 12.04 hrs, Volume= 1.638 af, Atten= 0%, Lag= 0.1 min

Routing by Stor-Ind+Trans method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Max. Velocity= 5.28 fps, Min. Travel Time= 0.1 min
Avg. Velocity = 1.70 fps, Avg. Travel Time= 0.3 min

Peak Storage= 171 cf @ 12.04 hrs
Average Depth at Peak Storage= 0.80'
Bank-Full Depth= 1.50' Flow Area= 13.5 sf, Capacity= 101.07 cfs

6.00' x 1.50' deep channel, n= 0.065
Side Slope Z-value= 2.0 '/' Top Width= 12.00'
Length= 28.4' Slope= 0.0989 '/'
Inlet Invert= 1,343.20', Outlet Invert= 1,340.39'



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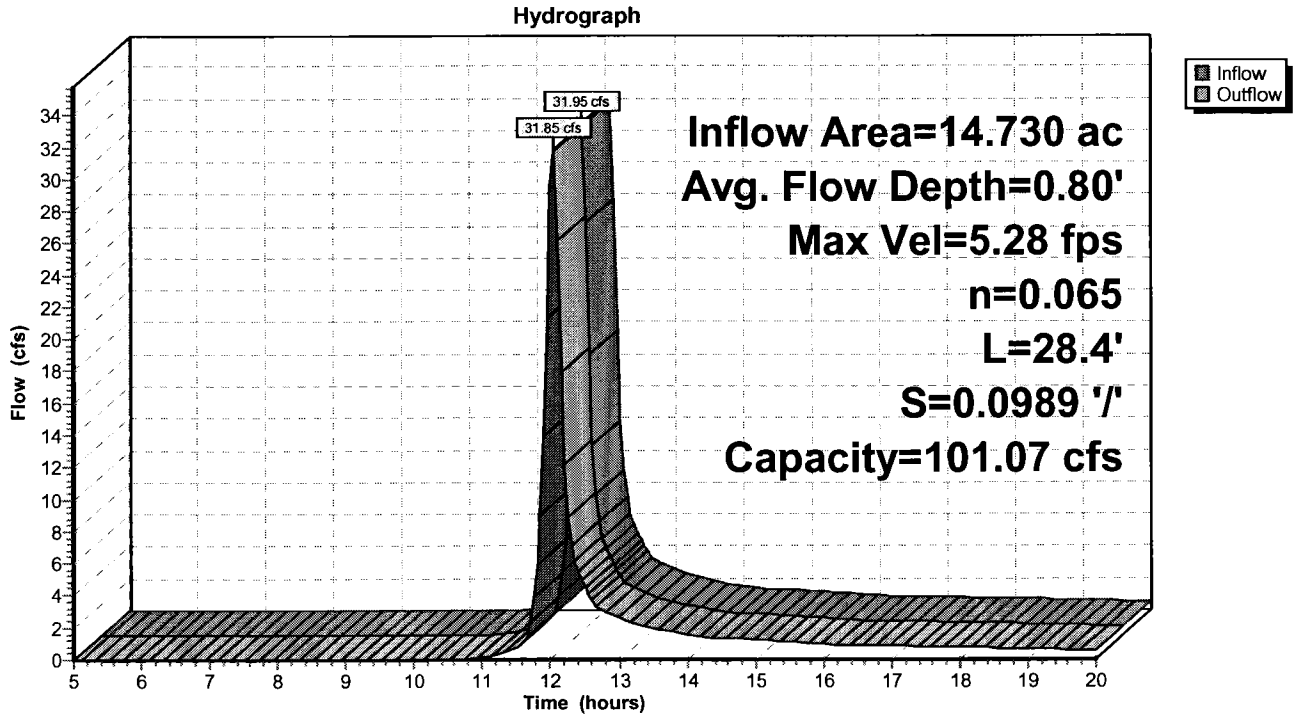
Reach DC3-3: DC3-3



Summary for Reach DC3-4: DC3-4

Inflow Area = 14.730 ac, 0.00% Impervious, Inflow Depth > 1.33" for 25 year event
Inflow = 31.85 cfs @ 12.04 hrs, Volume= 1.638 af
Outflow = 31.38 cfs @ 12.05 hrs, Volume= 1.637 af, Atten= 1%, Lag= 0.6 min

Routing by Stor-Ind+Trans method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Max. Velocity= 7.18 fps, Min. Travel Time= 0.4 min
Avg. Velocity = 2.25 fps, Avg. Travel Time= 1.3 min

Peak Storage= 763 cf @ 12.04 hrs
Average Depth at Peak Storage= 0.61'
Bank-Full Depth= 1.50' Flow Area= 13.5 sf, Capacity= 158.70 cfs

6.00' x 1.50' deep channel, n= 0.076
Side Slope Z-value= 2.0 '/' Top Width= 12.00'
Length= 172.0' Slope= 0.3335 '/'
Inlet Invert= 1,340.39', Outlet Invert= 1,283.03'

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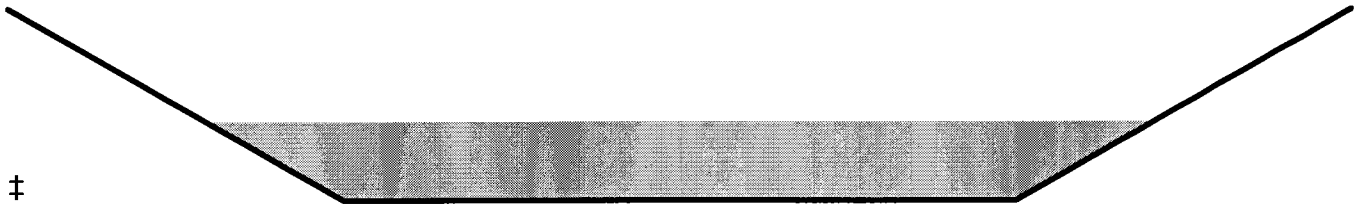
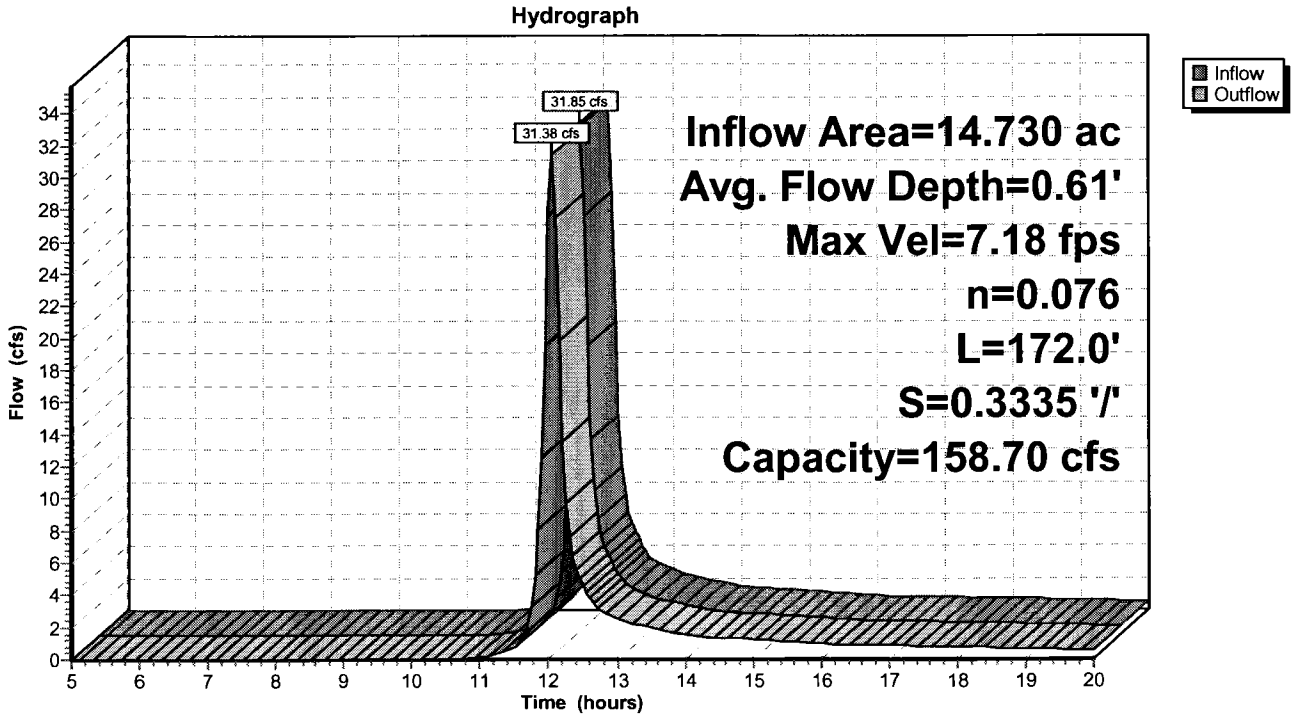


Reach DC3-4: DC3-4



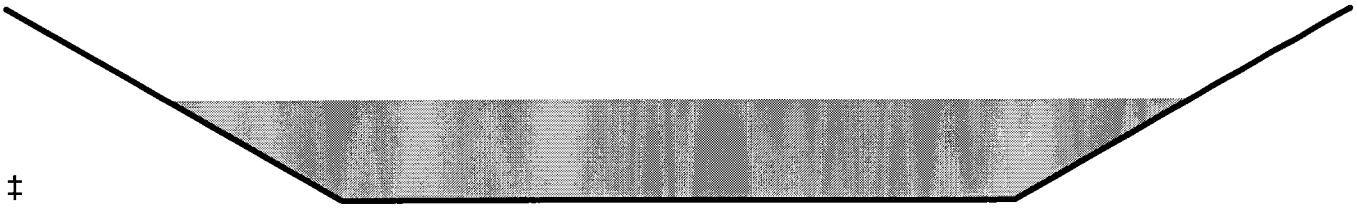
Summary for Reach DC3-5: DC3-5

Inflow Area = 14.730 ac, 0.00% Impervious, Inflow Depth > 1.33" for 25 year event
Inflow = 31.38 cfs @ 12.05 hrs, Volume= 1.637 af
Outflow = 31.25 cfs @ 12.05 hrs, Volume= 1.636 af, Atten= 0%, Lag= 0.1 min

Routing by Stor-Ind+Trans method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Max. Velocity= 5.27 fps, Min. Travel Time= 0.1 min
Avg. Velocity = 1.69 fps, Avg. Travel Time= 0.3 min

Peak Storage= 186 cf @ 12.05 hrs
Average Depth at Peak Storage= 0.79'
Bank-Full Depth= 1.50' Flow Area= 13.5 sf, Capacity= 101.12 cfs

6.00' x 1.50' deep channel, n= 0.065
Side Slope Z-value= 2.0 '/' Top Width= 12.00'
Length= 31.2' Slope= 0.0990 '/'
Inlet Invert= 1,283.03', Outlet Invert= 1,279.94'



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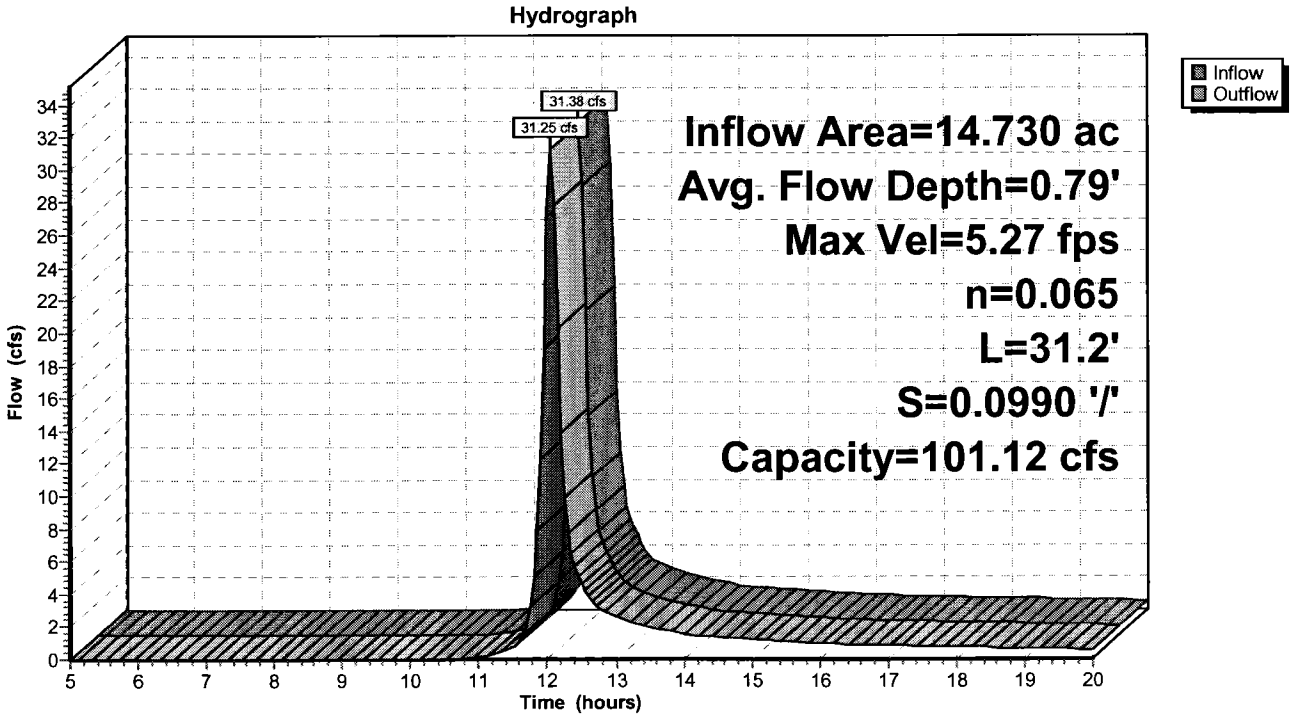
Reach DC3-5: DC3-5



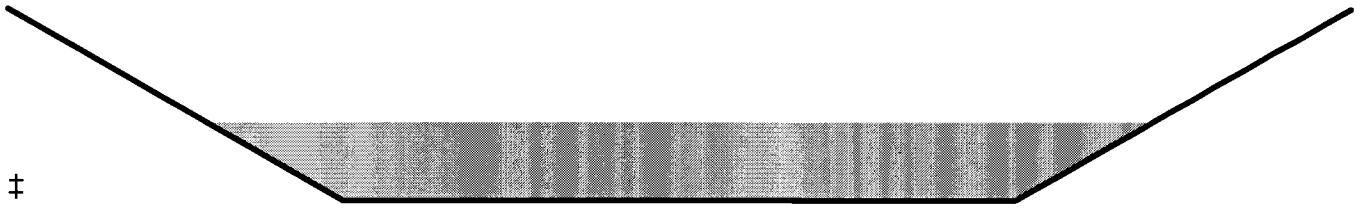
Summary for Reach DC3-6: DC3-6

Inflow Area = 14.730 ac, 0.00% Impervious, Inflow Depth > 1.33" for 25 year event
Inflow = 31.25 cfs @ 12.05 hrs, Volume= 1.636 af
Outflow = 30.75 cfs @ 12.06 hrs, Volume= 1.635 af, Atten= 2%, Lag= 0.6 min

Routing by Stor-Ind+Trans method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Max. Velocity= 7.08 fps, Min. Travel Time= 0.4 min
Avg. Velocity = 2.24 fps, Avg. Travel Time= 1.2 min

Peak Storage= 713 cf @ 12.06 hrs
Average Depth at Peak Storage= 0.61'
Bank-Full Depth= 1.50' Flow Area= 13.5 sf, Capacity= 157.00 cfs

6.00' x 1.50' deep channel, n= 0.077
Side Slope Z-value= 2.0 '/' Top Width= 12.00'
Length= 161.9' Slope= 0.3350 '/'
Inlet Invert= 1,279.94', Outlet Invert= 1,225.70'



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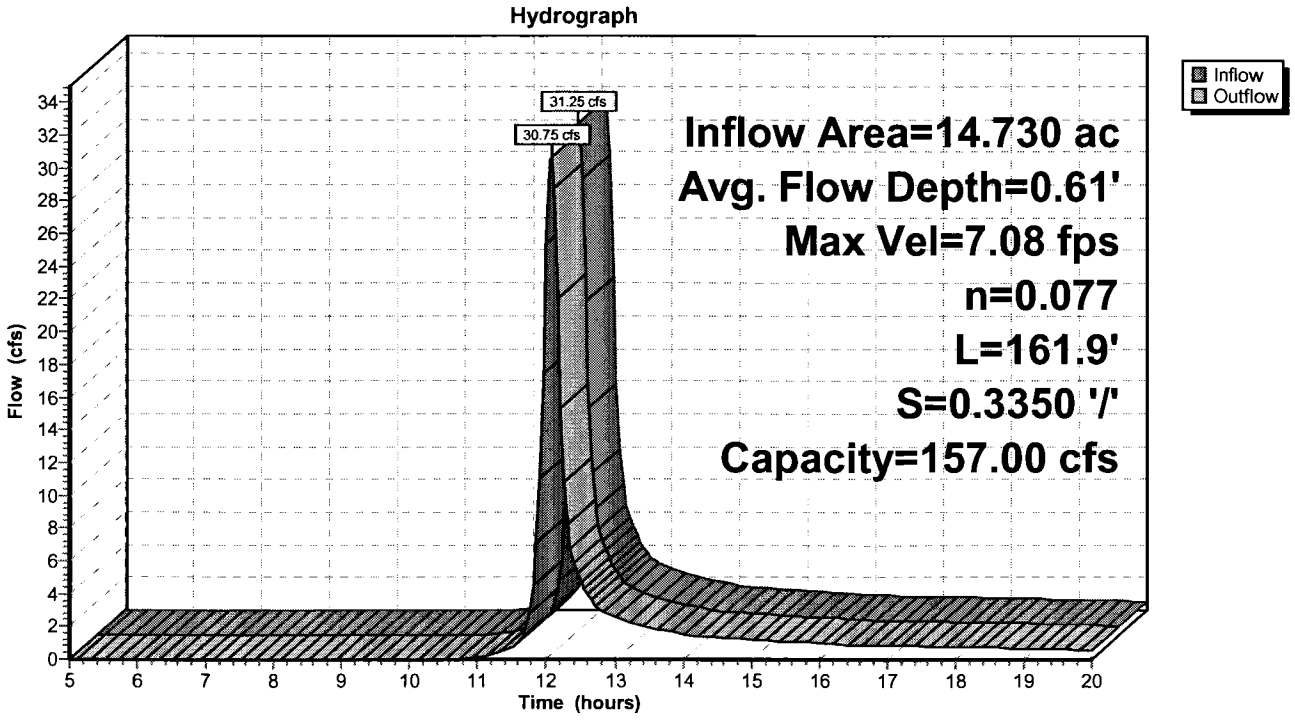
Reach DC3-6: DC3-6



Summary for Pond CU-C: Culvert C

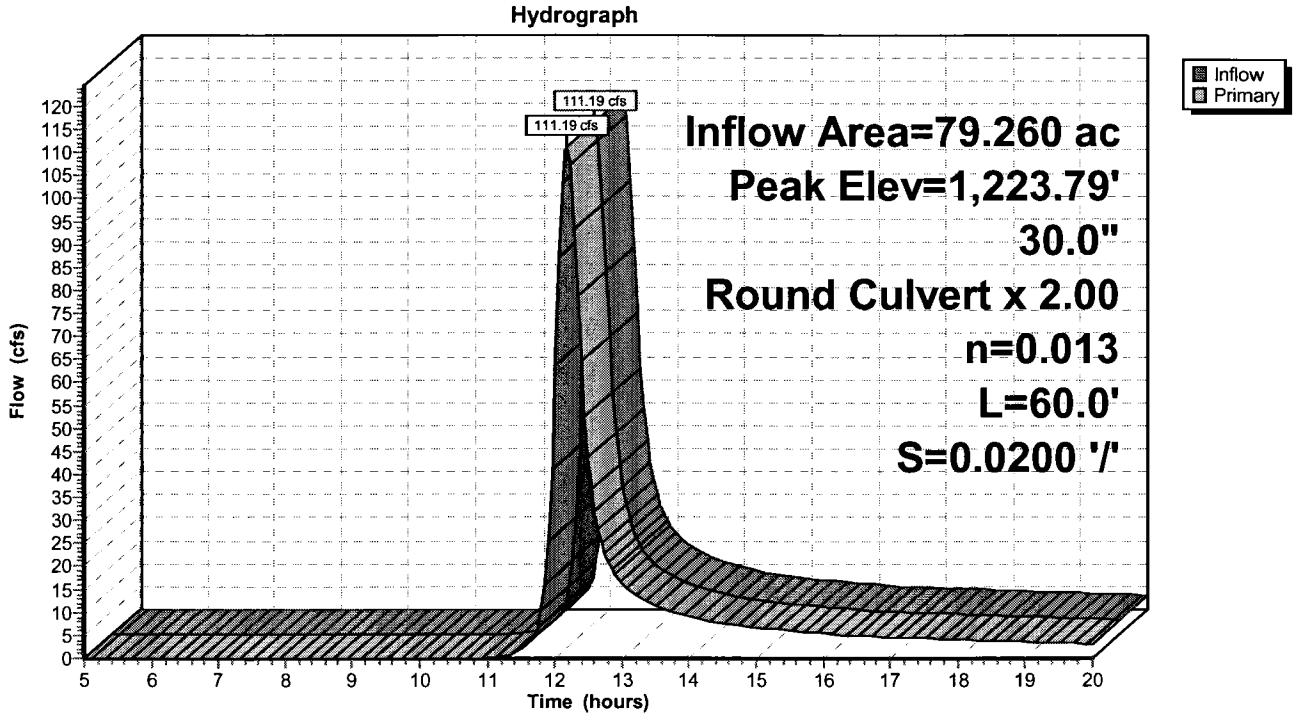
Inflow Area = 79.260 ac, 0.00% Impervious, Inflow Depth > 1.32" for 25 year event
Inflow = 111.19 cfs @ 12.17 hrs, Volume= 8.731 af
Outflow = 111.19 cfs @ 12.17 hrs, Volume= 8.731 af, Atten= 0%, Lag= 0.0 min
Primary = 111.19 cfs @ 12.17 hrs, Volume= 8.731 af

Routing by Stor-Ind method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Peak Elev= 1,223.79' @ 12.17 hrs

Device	Routing	Invert	Outlet Devices
#1	Primary	1,217.01'	**30.0" Round Culvert X 2.00** L= 60.0' CPP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 1,217.01' / 1,215.81' S= 0.0200 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 4.91 sf

Primary OutFlow Max=110.33 cfs @ 12.17 hrs HW=1,223.71' (Free Discharge)
1=Culvert (Inlet Controls 110.33 cfs @ 11.24 fps)

Pond CU-C: Culvert C



Summary for Pond CU-D: Existing Culvert D

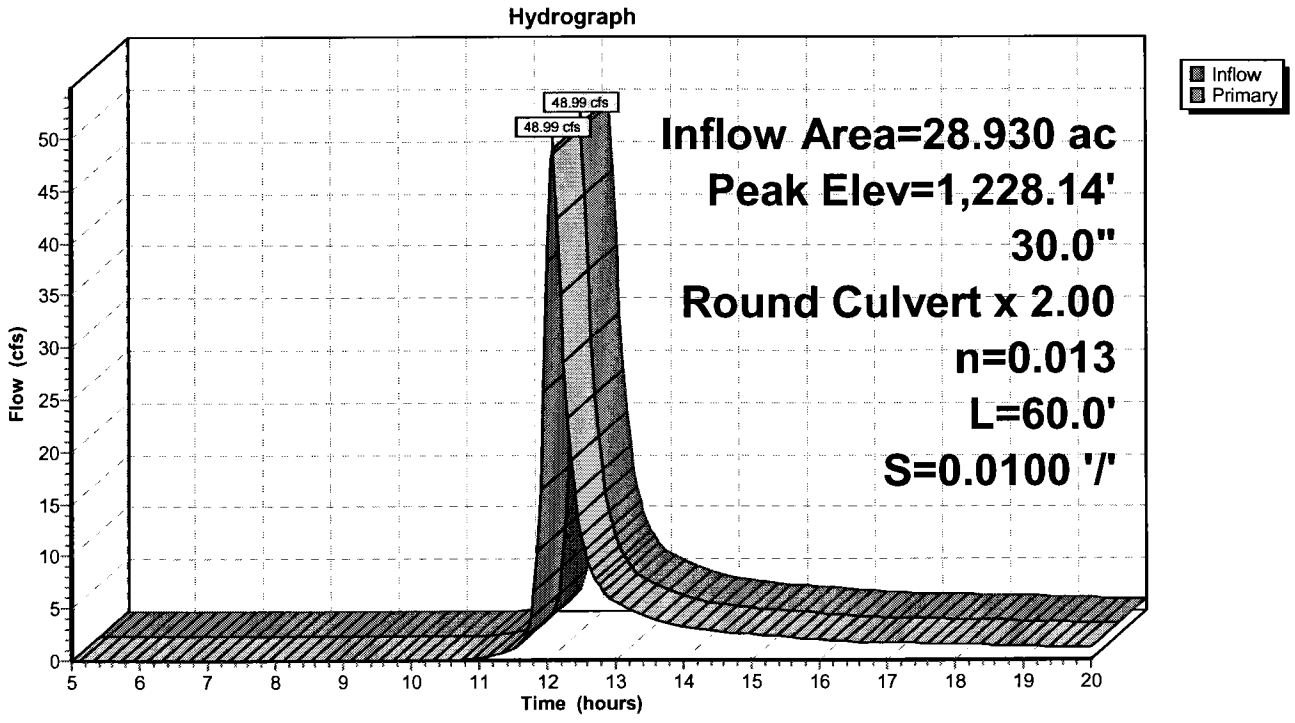
Inflow Area = 28.930 ac, 0.00% Impervious, Inflow Depth > 1.33" for 25 year event
Inflow = 48.99 cfs @ 12.08 hrs, Volume= 3.198 af
Outflow = 48.99 cfs @ 12.08 hrs, Volume= 3.198 af, Atten= 0%, Lag= 0.0 min
Primary = 48.99 cfs @ 12.08 hrs, Volume= 3.198 af

Routing by Stor-Ind method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Peak Elev= 1,228.14' @ 12.08 hrs

Device	Routing	Invert	Outlet Devices
#1	Primary	1,225.70'	**30.0" Round Culvert X 2.00** L= 60.0' CPP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 1,225.70' / 1,225.10' S= 0.0100 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 4.91 sf

Primary OutFlow Max=48.18 cfs @ 12.08 hrs HW=1,228.11' (Free Discharge)
1=Culvert (Barrel Controls 48.18 cfs @ 6.33 fps)

Pond CU-D: Existing Culvert D



Summary for Pond WP: West Sedimentation Pond

Inflow Area = 112.610 ac, 0.00% Impervious, Inflow Depth > 1.32" for 25 year event
Inflow = 157.75 cfs @ 12.15 hrs, Volume= 12.410 af
Outflow = 0.00 cfs @ 5.00 hrs, Volume= 0.000 af, Atten= 100%, Lag= 0.0 min
Primary = 0.00 cfs @ 5.00 hrs, Volume= 0.000 af
Secondary = 0.00 cfs @ 5.00 hrs, Volume= 0.000 af

Routing by Stor-Ind method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Peak Elev= 1,168.77' @ 20.00 hrs Surf.Area= 0.000 ac Storage= 12.401 af

Plug-Flow detention time= (not calculated: initial storage excedes outflow)
Center-of-Mass det. time= (not calculated: no outflow)

Volume	Invert	Avail.Storage	Storage Description
#1	1,155.00'	24.160 af	**Custom Stage Data** Listed below

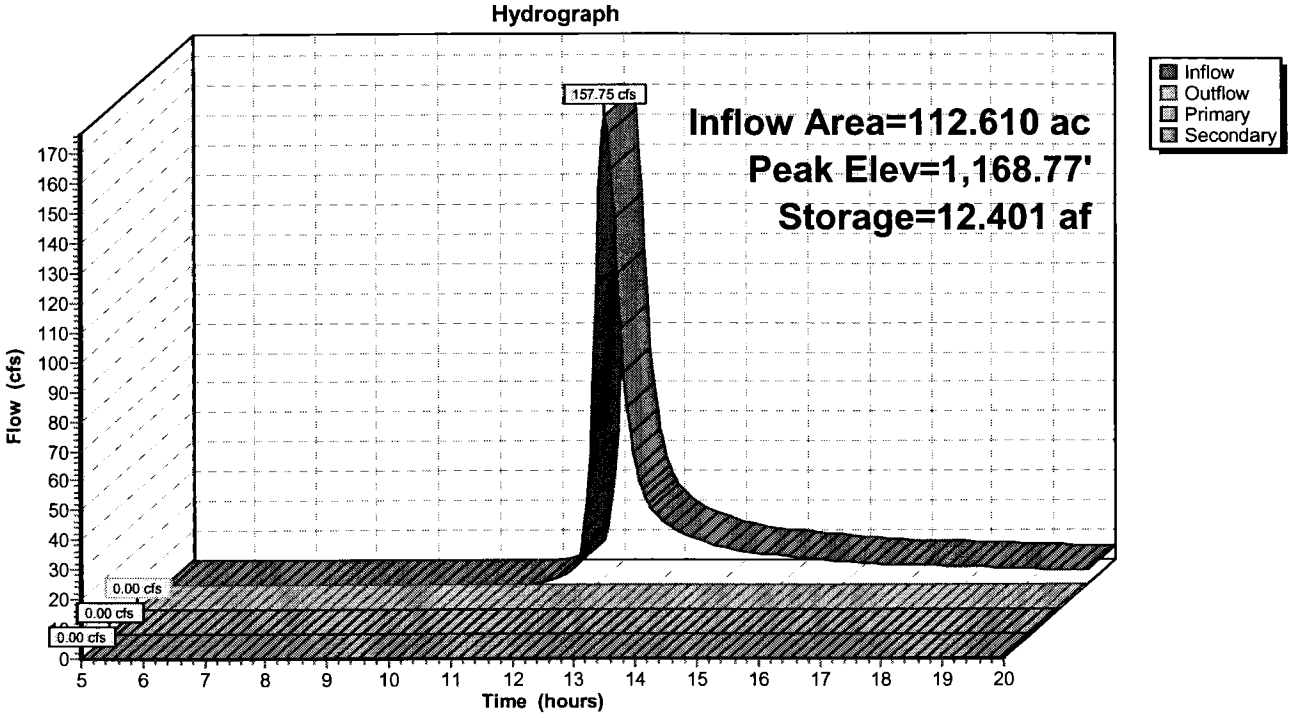
Elevation (feet)	Cum.Store (acre-feet)
1,155.00	0.000
1,160.00	1.940
1,165.00	6.900
1,170.00	14.200
1,175.00	24.160

Device	Routing	Invert	Outlet Devices
#1	Primary	1,170.00'	**30.0" Round Culvert** L= 85.0' CPP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 1,170.00' / 1,169.15' S= 0.0100 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 4.91 sf
#2	Secondary	1,173.00'	**151.9 deg x 8.0' long Sharp-Crested Vee/Trap Weir** Cv= 2.47 (C= 3.09)

Primary OutFlow Max=0.00 cfs @ 5.00 hrs HW=1,155.00' (Free Discharge)
↑—**1=Culvert** (Controls 0.00 cfs)

Secondary OutFlow Max=0.00 cfs @ 5.00 hrs HW=1,155.00' (Free Discharge)
↑—**2=Sharp-Crested Vee/Trap Weir** (Controls 0.00 cfs)

Pond WP: West Sedimentation Pond



SEDIMENTATION POND
ROUTING OF 100-YEAR 24-HOUR STORM

Summary for Pond WP: West Sedimentation Pond

Inflow Area = 112.610 ac, 0.00% Impervious, Inflow Depth > 2.08" for 100 year event
Inflow = 266.59 cfs @ 12.12 hrs, Volume= 19.485 af
Outflow = 8.11 cfs @ 18.24 hrs, Volume= 3.073 af, Atten= 97%, Lag= 367.1 min
Primary = 8.11 cfs @ 18.24 hrs, Volume= 3.073 af
Secondary = 0.00 cfs @ 5.00 hrs, Volume= 0.000 af

Routing by Stor-Ind method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Peak Elev= 1,171.16' @ 18.24 hrs Surf.Area= 0.000 ac Storage= 16.517 af

Plug-Flow detention time= 348.3 min calculated for 3.073 af (16% of inflow)
Center-of-Mass det. time= 249.0 min (1,056.3 - 807.3)

Volume	Invert	Avail.Storage	Storage Description
#1	1,155.00'	24.160 af	**Custom Stage Data** Listed below

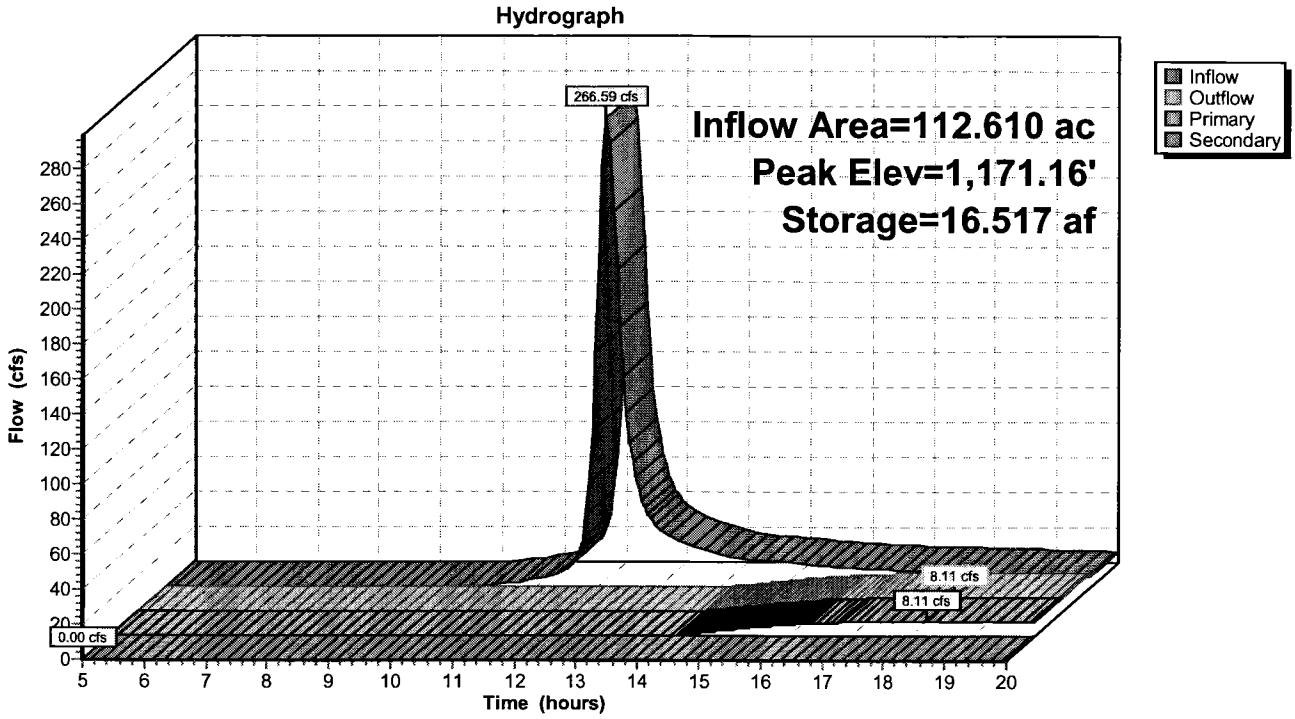
Elevation (feet)	Cum.Store (acre-feet)
1,155.00	0.000
1,160.00	1.940
1,165.00	6.900
1,170.00	14.200
1,175.00	24.160

Device	Routing	Invert	Outlet Devices
#1	Primary	1,170.00'	**30.0" Round Culvert** L= 85.0' CPP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 1,170.00' / 1,169.15' S= 0.0100 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 4.91 sf
#2	Secondary	1,173.00'	**151.9 deg x 8.0' long Sharp-Crested Vee/Trap Weir** Cv= 2.47 (C= 3.09)

Primary OutFlow Max=8.09 cfs @ 18.24 hrs HW=1,171.16' (Free Discharge)
↑—**1=Culvert** (Barrel Controls 8.09 cfs @ 5.30 fps)

Secondary OutFlow Max=0.00 cfs @ 5.00 hrs HW=1,155.00' (Free Discharge)
↑—**2=Sharp-Crested Vee/Trap Weir** (Controls 0.00 cfs)

Pond WP: West Sedimentation Pond



1.0 INTRODUCTION

This calculation was performed to determine whether the North Sedimentation Pond can handle the additional flow from the northeast portion of the proposed expansion.

This sedimentation pond must meet the following regulations:

OAC 3745-27-08 (D)(3)

(i) Minimum storage volume shall be provided based on either the calculated runoff from a 10-year/24-hour storm event, or 0.125 acre-feet per year (for each acre of disturbed area within the upstream drainage area) multiplied by the scheduled frequency of pond clean-out (in years), which ever is greater; and

(ii) The principal spillway shall safely discharge the flow from a 10-year/24-hour storm event. The inlet elevation of the emergency spillway shall be designed to provide flood storage, with no flow entering the emergency spillway, for a 25-year/24-hour storm event, with allowance provided for the flow passed by the principal spillway during the event; and

(iii) The combination of the principal and emergency spillways shall safely discharge the flow from the 100-year/24-hour storm event using non mechanical means. The embankment design shall provide for no less than 1-foot net freeboard when flow is at the design depth, after allowance for embankment settlement.

All designs are based upon accepted design equations, methodologies and assumptions. Where applicable, design references have been made. Calculations have been performed using the software package, HydroCAD Version 10, Copyright 2011.

2.0 DESIGN ASSUMPTIONS

1. The sedimentation pond was evaluated using the proposed top of final cover grades.

2. The inflow hydrographs were developed by HydroCAD for each contributing watershed.

3. The inflow for this pond is summarized below:

Drainage Area	Watershed Area (Acre)	Composite CN
DA-4	9.34	71
DA-20	2.52	71
DA-21	2.61	71
DA-23	6.43	71
DA-5	26.71	71
DA-24	1.24	71
DA-25	0.62	71
DA-26	2.44	71
DA-6	13.80	71
DA-14	0.86	71
DA-7	2.75	71
DA-46	1.48	71
DA-27	1.03	71
DA-8	19.95	71
DA-28	0.69	71
DA-47	0.57	71
DA-48	0.12	71
DA-29	5.15	71
DA-49	0.36	71
DA-56	~~0.85~~ *1.35*	71
DA-55	0.30	71
DA-57	*0.51*	*71*
UA	~~24.00~~ *23.5*	71
Total	~~123.82~~ *124.33*	

Times of concentration will be estimated as the sum of sheet flow, shallow flow and channel flow. The surface in the existing and proposed landfill will be similar to a non-grazed meadow in hydrologic soil group C, and was therefore modeled using a curve number of 71. Sheet flow calculations over areas with final cover or other grassed areas will use an average roughness of 0.150, which corresponds to short grass. The maximum sheet flow length will be 300 feet. Shallow flow times of concentration will be estimated using the velocity factor for short grass pasture.

From Reference 2, the following runoff coefficients have been found and will be utilized.

CN DATA	
Description	**CN**
Non-grazed meadow	71

3.0 VOLUME SIZING

As per OAC 3745-27-08 (D)(3)(i), the pond must provide adequate storage volume for the larger of: (1) the runoff from the 10-year/24-hour storm event or (2) 0.125 acre-ft per acre of disturbed area multiplied by the cleaning frequency in years.

Volume Requirement for 10-year/24-hour storm:

Utilizing HydroCAD for a 10-year/24-hour storm event, the inflow hydrographs were developed for each contributing watershed.

From Reference 9, the rainfall depths for the facility are summarized in the following table:

Storm Event	Rainfall Depth (inches)
10-year/24-hour	3.46
25-year/24-hour	4.12
100-year/24-hour	5.23

Utilizing the watershed information included in Section 2.0 of this calculation, the required storage volume from the runoff from a 10-year/24-hour storm event was calculated by HydroCAD to be approximately ~~413,123~~ *415,126*-cf of storage volume. The HydroCAD output files for a 10-year/24-hour storm event are included in an attachment to this calculation.

Volume Requirement for 0.125 acre-ft per disturbed acre:

Given the watershed information included in Section 2.0 of this calculation:

Drainage Area	Watershed Area (acres)	Disturbed Area (acres) [Calculated]	Volume (cf) [Calculated]
DA-4	9.34	2.80	15,246
DA-20	2.52	0.76	4,138
DA-21	2.61	0.78	4,247
DA-23	6.43	1.93	10,509
DA-5	26.71	8.01	43,614
DA-24	1.24	0.37	2,015
DA-25	0.62	0.19	1,035
DA-26	2.44	0.73	3,795
DA-6	13.80	4.14	22,542
DA-14	0.86	0.26	1,416
DA-7	2.75	0.83	4,519
DA-46	1.48	0.44	2,396
DA-27	1.03	0.31	1,688
DA-8	19.95	5.99	32,616
DA-28	0.69	0.21	1,143
DA-47	0.57	0.17	926
DA-48	0.12	0.04	218
DA-29	5.15	1.55	8,440
DA-49	0.36	0.11	599
DA-56	~~0.85~~ *1.35*	~~0.26~~ *0.41*	~~1,416~~ *2,232*
DA-55	0.30	0.09	490
DA-57	*0.51*	*0.15*	*833*
UA	~~24.00~~ *23.5*	~~7.20~~ *7.05*	~~39,204~~ *38,387*
Totals	~~123.82~~ *124.33*	~~37.15~~ *37.32*	~~202,282~~ *203,044*

For disturbed area, a conservative assumption of 30% of the watershed was used.

In the above table, the volume for each Drainage Area is calculated as follows assuming one scheduled pond cleaning event per year.

From the above calculations, the controlling volume for the evaluation of this sedimentation pond is ~~413,123~~ *415,126*-cf, based on the runoff from the HydroCAD 10-year/24-hour storm event.

4.0 PRINCIPAL SPILLWAY DESIGN

Using HydroCAD, a 10-year/24-hour storm event was routed through the sedimentation pond to determine the required storage capacity below the prinicipal spillway with the higher flow rates from the proposed expansion.

As per OAC 3745-27-08(D)(3)(b), the principal spillway shall be designed to safely discharge the flow from a 10-year/24-hour storm event without the use of mechanical means. Based on the HydroCAD analysis, the East Sedimentation pond will not discharge from the principal or emergency spillway during the 10-year/24-hour storm or the 25-year/24-hour storm. The principal spillway is able to discharge the flow from a 100-year/24-hour storm event without the use of mechanical means, thus, the principal spillway is adequately sized.

The existing design for the principal spillway culvert is being analyzed in this calculation, thus, the need for anti-seep collars will not be evaluated.

Item	Value
Culvert Type	CPP
Culvert Quantity	1
Principal Spillway Diameter	30-inch
Principal Spillway Invert Elevation	1,126.29-ft
Maximum pool elevation for routing of 10-year/24-hour storm	~~1,122.09~~ *1122.13* ft
Maximum pool elevation for routing of 25-year/24-hour storm	~~1,125.83~~ *1125.88* ft
Maximum pool elevation for routing of 100-year/24-hour storm	~~1,127.83~~ *1127.85* ft

5.0 EMERGENCY SPILLWAY AND EMBANKMENT CREST DESIGN

According to the regulations, the emergency spillway must be set so that there is no discharge during the 25-year/24-hour storm. The combination of the principal and emergency spillways must discharge the 100-year/24-hour storm event while maintaining a minimum of 1.0 foot of freeboard to the embankment crest. These requirements have been checked by routing the 25-year/24-hour and 100-year/24-hour storms through the existing pond.

Currently, the emergency spillway is a sharp-crested/vee trap weir with the invert at elevation 1,131.00-ft and the embankment crest at 1,133.00-ft. Based on the HydroCAD analysis, only the principal spillway will discharge during a 100-year/24-hour storm event. The maximum elevation during the routing of a 100-year/24-hour strom is ~~1,127.83~~ *1127.85* ft, which is below the emergency spillway invert. The East Sedimentation Pond provides more than 1.0 foot of freeboard from the embankment crest.

Item	Value
Spillway Type	Sharp-Cressted Vee/Trap Weir
Quantity	1
Emergency Spillway Dimensions	151.9 degrees x 8.0 feet long
Emergency Spillway Invert Elevation	1,131.00-ft
Pond Embankment Crest Elevation	1,133.00-ft
Maximum pool elevation for routing of 100-year/24-hour storm	~~1,127.83~~ *1127.85* ft (>1.0-ft freeboard)
Maximum pool elevation for routing of 25-year/24-hour storm	~~1,122.09~~ *1125.88* ft

6.0 CONCLUSION

As designed, the East Sedimentation Pond will meet the requirements outlined in OAC 3745-27-08 (D)(3) with the additional flow from the proposed expansion. During the 10-year/24-hour storm and 25-year/24-hour storm events, the principal spillway will not discharge. During the 100-year/24-hour storm event, the principal spillway will discharge. The East Sedimentation Pond provides more than 1 foot of freeboard from the embankment crest to the maximum pool during the 100-year/24-hour storm.

REFERENCES

1. Soil Conservation Service, URBAN HYDROLOGY FOR SMALL WATERSHEDS, Technical Release 55, June 1986.

2. Soil Conservation Service, ENGINEERING FIELD MANUAL FOR CONSERVATION PRACTICES, November 1986.

3. Ven Te Chow, OPEN CHANNEL HYDRAULICS, Mc-Graw Hill Book Company, 1959

4. Goldman, Jackson and Bursztynsky, EROSION AND SEDIMENT CONTROL HANDBOOK, Mc-Graw Hill Book Company, 1986.

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7. HydroCAD Software Solutions, LLC., HYDROCAD, Version 10.0, 2011, Computer Software Program.

8. National Climatic Data Center, *Precipitation Frequency Estimates*, Point Precipitation Frequency Estimate From NOAA Atlas 14 Ohio 40.4353 N 80.9122 W, Viewed 27 September 2011,< http://hdsc.nws.noaa.gov>.

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NOAA PRECIPITATION ESTIMATE

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NOAA's National Weather Service
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NOAA ATLAS 14 POINT PRECIPITATION FREQUENCY ESTIMATES

DATA DESCRIPTION

Data type: precipitation depth · Units: english · Time series type: partial duration

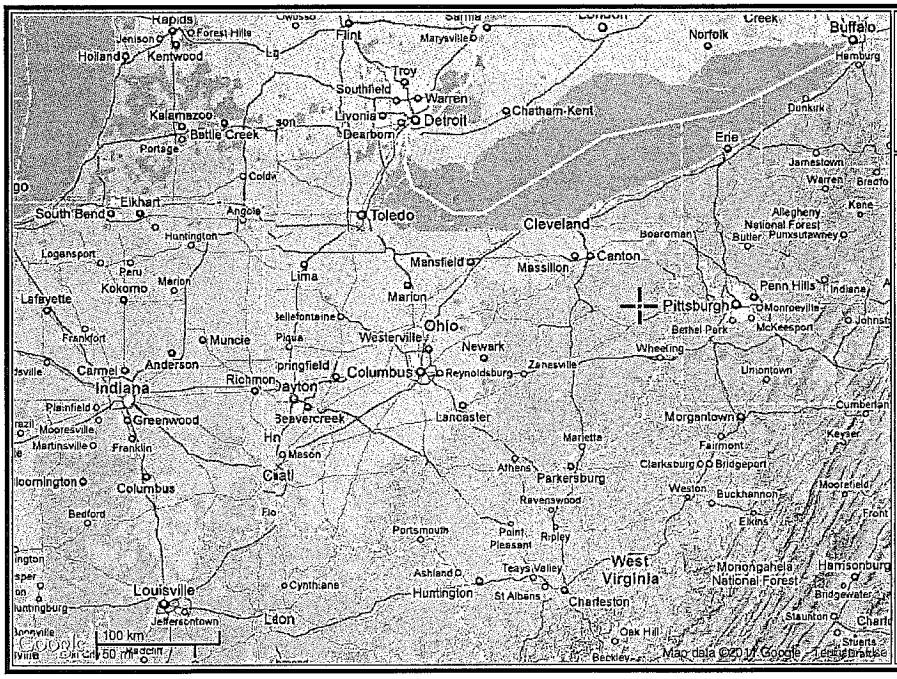
SELECT LOCATION

1. Manually:

a) Enter location (decimal degrees, use "-" for S and W): latitude: 40.4353 longitude: -80.9122 submit

b) Select station: select station

2. Use map:



a) Select location (move crosshair)
b) Click on station icon
(show stations on map)

LOCATION INFORMATION:
Name: Amsterdam, Ohio, US*
Latitude: 40.4353
Longitude: -80.9122
Elevation: 1230ft*

* source: Google Maps

POINT PRECIPITATION FREQUENCY (PF) ESTIMATES

WITH 90% CONFIDENCE INTERVALS AND SUPPLEMENTARY INFORMATION
NOAA Atlas 14, Volume 2, Version 3

PF tabular PF graphical Supplementary information Print Page

PDS-based precipitation frequency estimates with 90% confidence intervals (in inches)[1]

Duration	Average recurrence interval(years)									
	1	2	5	10	25	50	100	200	500	1000
5-min	0.326 (0.292-0.364)	0.390 (0.350-0.435)	0.472 (0.422-0.527)	0.534 (0.477-0.595)	0.614 (0.546-0.683)	0.676 (0.599-0.751)	0.735 (0.649-0.815)	0.796 (0.700-0.883)	0.878 (0.767-0.972)	0.938 (0.816-1.04)
10-min	0.507 (0.454-0.566)	0.609 (0.546-0.680)	0.733 (0.656-0.819)	0.825 (0.736-0.919)	0.940 (0.836-1.05)	1.02 (0.908-1.14)	1.11 (0.977-1.23)	1.19 (1.05-1.32)	1.29 (1.13-1.43)	1.37 (1.19-1.51)
15-min	0.621 (0.556-0.693)	0.745 (0.667-0.831)	0.900 (0.806-1.01)	1.02 (0.906-1.13)	1.16 (1.03-1.29)	1.27 (1.12-1.41)	1.37 (1.21-1.53)	1.48 (1.30-1.64)	1.61 (1.41-1.78)	1.71 (1.48-1.89)
30-min	0.821 (0.736-0.917)	0.997 (0.893-1.11)	1.23 (1.10-1.38)	1.41 (1.26-1.57)	1.64 (1.46-1.82)	1.81 (1.61-2.01)	1.98 (1.75-2.20)	2.16 (1.90-2.39)	2.39 (2.09-2.64)	2.56 (2.23-2.83)
60-min	1.00 (0.899-1.12)	1.22 (1.10-1.37)	1.55 (1.39-1.73)	1.79 (1.60-2.00)	2.13 (1.89-2.37)	2.39 (2.12-2.65)	2.65 (2.34-2.94)	2.93 (2.57-3.25)	3.30 (2.88-3.66)	3.59 (3.13-3.98)
2-hr	1.16 (1.03-1.30)	1.41 (1.25-1.58)	1.80 (1.59-2.02)	2.10 (1.86-2.35)	2.53 (2.23-2.83)	2.88 (2.54-3.22)	3.25 (2.85-3.62)	3.65 (3.18-4.05)	4.21 (3.65-4.66)	4.66 (4.02-5.16)
3-hr	1.23 (1.10-1.39)	1.49 (1.33-1.69)	1.90 (1.69-2.15)	2.22 (1.98-2.51)	2.69 (2.38-3.02)	3.07 (2.71-3.44)	3.47 (3.05-3.88)	3.91 (3.41-4.36)	4.53 (3.92-5.05)	5.03 (4.34-5.60)
6-hr	1.47 (1.32-1.66)	1.77 (1.59-2.00)	2.24 (2.00-2.52)	2.61 (2.33-2.94)	3.17 (2.81-3.55)	3.62 (3.20-4.05)	4.11 (3.61-4.58)	4.65 (4.06-5.16)	5.42 (4.68-6.00)	6.06 (5.19-6.69)
12-hr	1.74 (1.57-1.94)	2.09 (1.88-2.33)	2.60 (2.34-2.91)	3.04 (2.72-3.38)	3.67 (3.27-4.07)	4.20 (3.73-4.65)	4.78 (4.22-5.27)	5.41 (4.74-5.95)	6.34 (5.50-6.93)	7.11 (6.12-7.75)

24-hr	2.04 (1.88-2.21)	2.44 (2.26-2.64)	3.00 (2.77-3.25)	3.46 (3.20-3.75)	4.12 (3.79-4.45)	4.66 (4.26-5.03)	5.23 (4.76-5.64)	5.84 (5.28-6.28)	6.69 (6.00-7.20)	7.39 (6.57-7.95)
2-day	2.38 (2.22-2.58)	2.85 (2.64-3.08)	3.47 (3.22-3.75)	3.98 (3.69-4.30)	4.69 (4.33-5.05)	5.27 (4.84-5.67)	5.87 (5.36-6.31)	6.49 (5.90-6.99)	7.37 (6.63-7.94)	8.06 (7.20-8.70)
3-day	2.55 (2.38-2.75)	3.04 (2.83-3.27)	3.68 (3.43-3.97)	4.21 (3.91-4.52)	4.93 (4.57-5.30)	5.52 (5.09-5.92)	6.13 (5.62-6.57)	6.75 (6.17-7.24)	7.62 (6.90-8.19)	8.31 (7.47-8.94)
4-day	2.72 (2.54-2.91)	3.23 (3.02-3.47)	3.90 (3.64-4.18)	4.44 (4.14-4.75)	5.18 (4.81-5.54)	5.77 (5.35-6.17)	6.38 (5.89-6.82)	7.01 (6.43-7.50)	7.88 (7.17-8.45)	8.56 (7.74-9.19)
7-day	3.25 (3.06-3.47)	3.86 (3.63-4.12)	4.63 (4.35-4.94)	5.24 (4.92-5.59)	6.09 (5.69-6.49)	6.77 (6.30-7.21)	7.45 (6.91-7.94)	8.16 (7.53-8.69)	9.11 (8.35-9.73)	9.86 (8.96-10.5)
10-day	3.75 (3.54-3.98)	4.45 (4.20-4.72)	5.28 (4.98-5.60)	5.94 (5.60-6.29)	6.83 (6.42-7.23)	7.53 (7.06-7.98)	8.24 (7.70-8.73)	8.94 (8.33-9.50)	9.89 (9.15-10.5)	10.6 (9.76-11.3)
20-day	5.27 (5.00-5.55)	6.21 (5.90-6.55)	7.27 (6.91-7.66)	8.10 (7.68-8.52)	9.17 (8.68-9.65)	9.99 (9.44-10.5)	10.8 (10.2-11.4)	11.6 (10.9-12.2)	12.6 (11.8-13.3)	13.3 (12.4-14.1)
30-day	6.61 (6.27-6.98)	7.77 (7.37-8.21)	9.01 (8.54-9.51)	9.97 (9.44-10.5)	11.2 (10.6-11.8)	12.2 (11.5-12.8)	13.1 (12.3-13.8)	14.0 (13.1-14.8)	15.1 (14.1-16.0)	15.9 (14.8-16.9)
45-day	8.46 (8.05-8.90)	9.91 (9.42-10.4)	11.3 (10.8-11.9)	12.4 (11.8-13.1)	13.8 (13.1-14.5)	14.8 (14.0-15.6)	15.8 (14.9-16.7)	16.7 (15.8-17.7)	17.9 (16.8-18.9)	18.7 (17.5-19.8)
60-day	10.2 (9.75-10.7)	11.9 (11.4-12.5)	13.5 (12.9-14.2)	14.7 (14.0-15.4)	16.2 (15.5-17.0)	17.3 (16.5-18.1)	18.3 (17.4-19.2)	19.2 (18.2-20.2)	20.4 (19.3-21.4)	21.1 (20.0-22.3)

[1] Precipitation frequency (PF) estimates in this table are based on frequency analysis of partial duration series (PDS).

Numbers in parenthesis are PF estimates at lower and upper bounds of the 90% confidence interval. The probability that precipitation frequency estimates (for a given duration and average recurrence interval) will be greater than the upper bound (or less than the lower bound) is 5%. Estimates at upper bounds are not checked against probable maximum precipitation (PMP) estimates and may be higher than currently valid PMP values.

Please refer to NOAA Atlas 14 document for more information.

Estimates from the table in csv format: precipitation frequency estimates Submit

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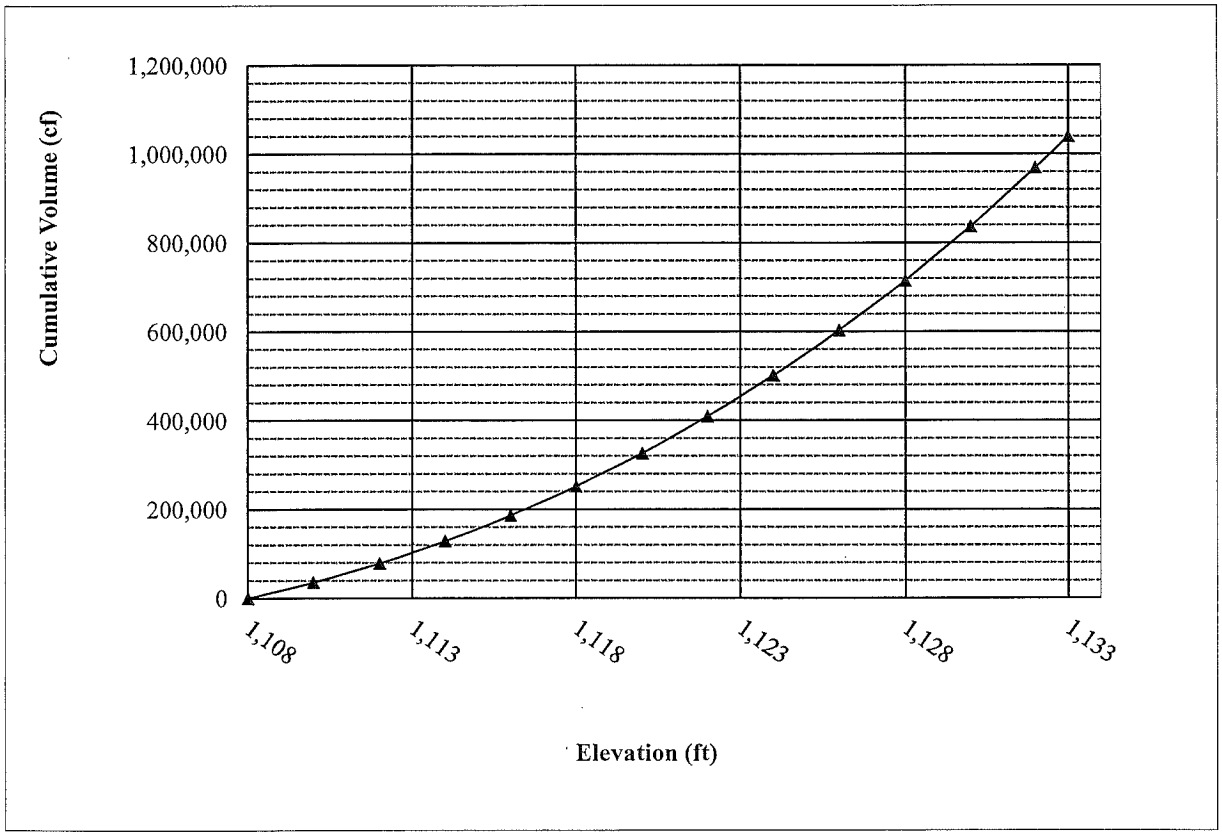
SEDIMENTATION POND
ELEVATION - STORAGE

Apex Sanitary Landfill
North Sedimentation Pond
Elevation Storage

Elevation (ft)	Pool Area (sf)	Average Area (sf)	Incremental Volume (cf)	Cumulative Volume (cf)	Cumulative Volume (ac-ft)
1,108.00	16,163	0	0	0	0.00
1,110.00	19,548	17,856	35,711	35,711	0.82
1,112.00	23,119	21,334	42,668	78,379	1.80
1,114.00	26,875	24,997	49,995	128,374	2.95
1,116.00	30,817	28,846	57,692	186,066	4.27
1,118.00	34,943	32,880	65,760	251,825	5.78
1,120.00	39,254	37,099	74,197	326,023	7.48
1,122.00	43,751	41,503	83,005	409,028	9.39
1,124.00	48,432	46,092	92,183	501,211	11.51
1,126.00	53,299	50,866	101,732	602,943	13.84
1,128.00	58,351	55,825	111,650	714,593	16.40
1,130.00	63,588	60,970	121,939	836,532	19.20
1,132.00	69,010	66,299	132,598	969,130	22.25
1,133.00	71,790	70,400	70,400	1,039,530	23.86



Principal spillway inlet invert is at El. 1,126.29-ft which has a storage capacity 617,694-cf.

SEDIMENTATION POND
ROUTING OF 10-YEAR 24-HOUR STORM

Summary for Pond NP: North Pond

Inflow Area = 124.330 ac, 0.00% Impervious, Inflow Depth > 0.92" for 10 year event
Inflow = 127.49 cfs @ 12.16 hrs, Volume= 9.538 af
Outflow = 0.00 cfs @ 5.00 hrs, Volume= 0.000 af, Atten= 100%, Lag= 0.0 min
Primary = 0.00 cfs @ 5.00 hrs, Volume= 0.000 af
Secondary = 0.00 cfs @ 5.00 hrs, Volume= 0.000 af

Routing by Stor-Ind method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Peak Elev= 1,122.13' @ 20.00 hrs Surf.Area= 0.000 ac Storage= 9.530 af

Plug-Flow detention time= (not calculated: initial storage excedes outflow)
Center-of-Mass det. time= (not calculated: no outflow)

Volume	Invert	Avail.Storage	Storage Description
#1	1,108.00'	23.860 af	**Custom Stage Data** Listed below

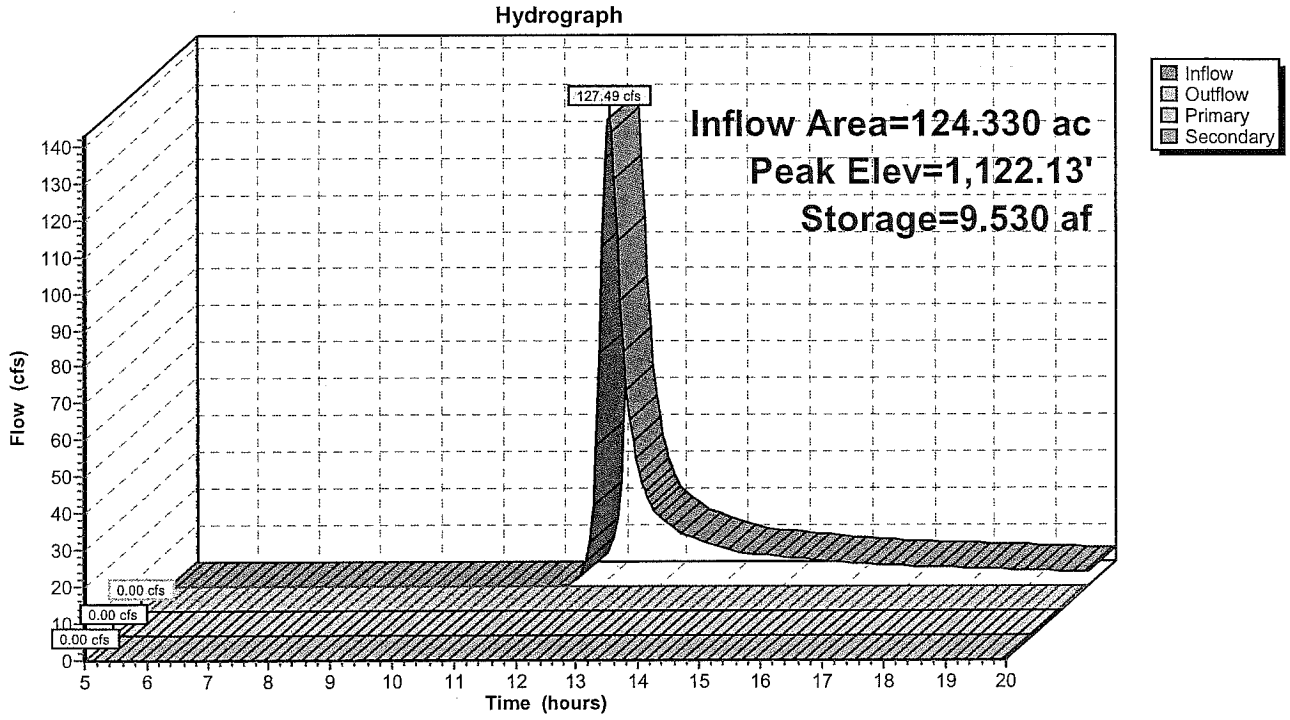
Elevation (feet)	Cum.Store (acre-feet)
1,108.00	0.000
1,110.00	0.820
1,112.00	1.800
1,114.00	2.950
1,116.00	4.270
1,118.00	5.780
1,120.00	7.480
1,122.00	9.390
1,124.00	11.510
1,126.00	13.840
1,128.00	16.400
1,130.00	19.200
1,132.00	22.250
1,133.00	23.860

Device	Routing	Invert	Outlet Devices
#1	Primary	1,126.29'	**30.0" Round Culvert** L= 60.0' CPP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 1,126.29' / 1,111.07' S= 0.2537 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 4.91 sf
#2	Secondary	1,131.00'	**151.9 deg x 8.0' long Sharp-Crested Vee/Trap Weir** Cv= 2.47 (C= 3.09)

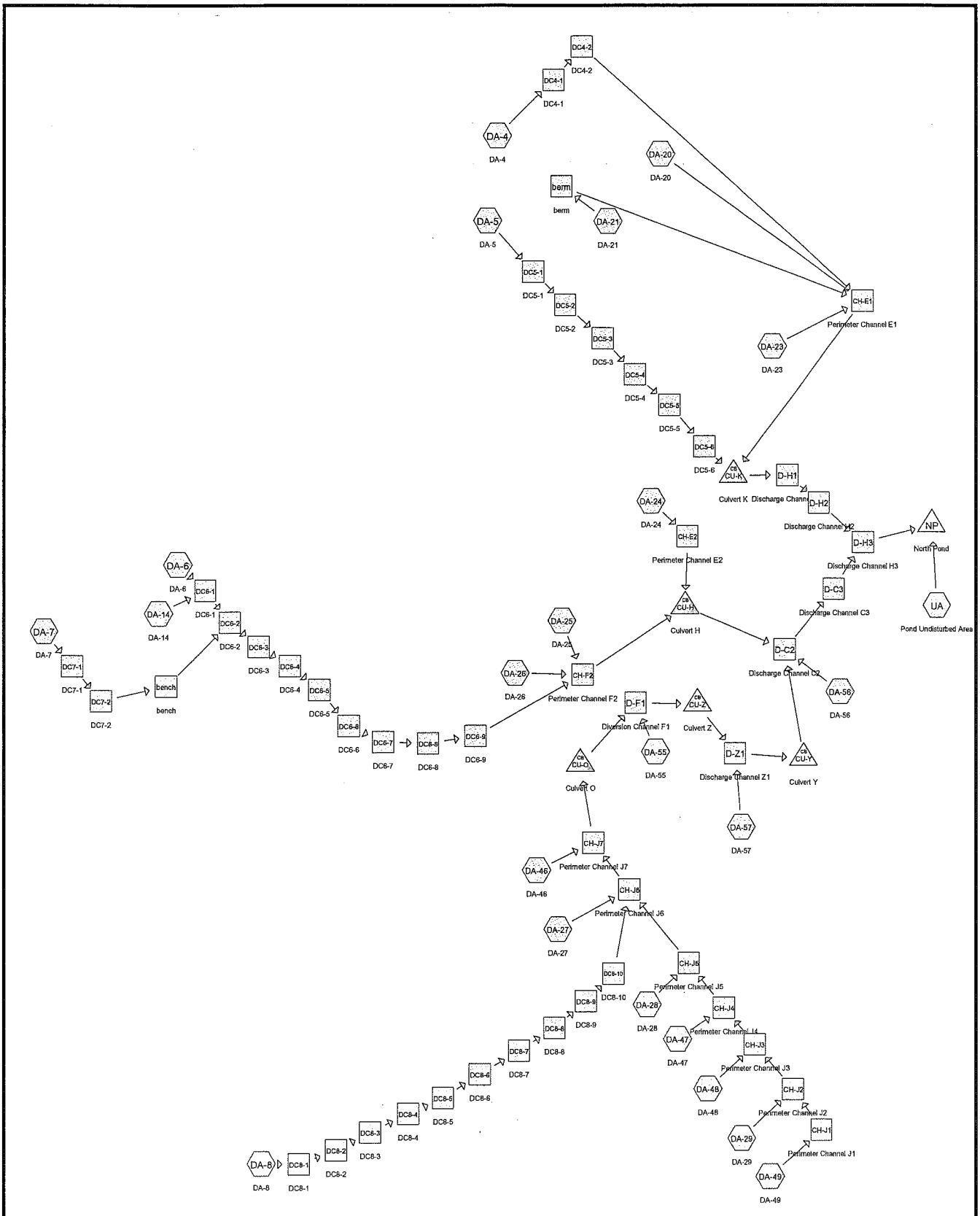
Primary OutFlow Max=0.00 cfs @ 5.00 hrs HW=1,108.00' (Free Discharge)
↑—**1=Culvert** (Controls 0.00 cfs)

Secondary OutFlow Max=0.00 cfs @ 5.00 hrs HW=1,108.00' (Free Discharge)
↑—**2=Sharp-Crested Vee/Trap Weir** (Controls 0.00 cfs)

Pond NP: North Pond



SEDIMENTATION POND
ROUTING OF 25-YEAR 24-HOUR STORM



Routing Diagram for North Sedimentation Pond

Prepared by {enter your company name here}, Printed 7/16/2013

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Summary for Subcatchment DA-14: DA-14

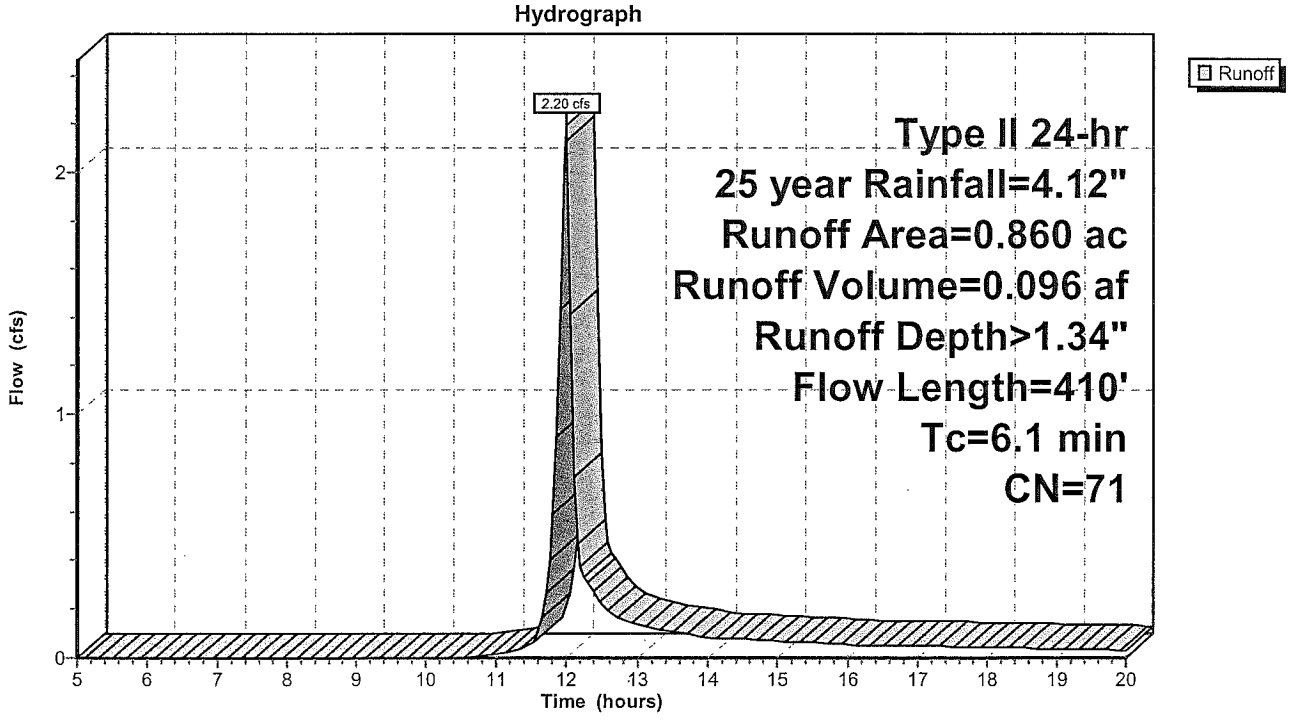
Runoff = 2.20 cfs @ 11.98 hrs, Volume= 0.096 af, Depth> 1.34"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type II 24-hr 25 year Rainfall=4.12"

Area (ac)	CN	Description
0.860	71	Meadow, non-grazed, HSG C
0.860		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.5	168	0.3300	0.51		**Sheet Flow, 168 feet 3H:1V sheet flow** Grass: Short n= 0.150 P2= 2.44"
0.6	242	0.0300	7.00	102.24	**Channel Flow, 242 feet bench flow** Area= 14.6 sf Perim= 19.8' r= 0.74' n= 0.030 Earth, grassed & winding
6.1	410	Total			

Subcatchment DA-14: DA-14



Summary for Subcatchment DA-20: DA-20

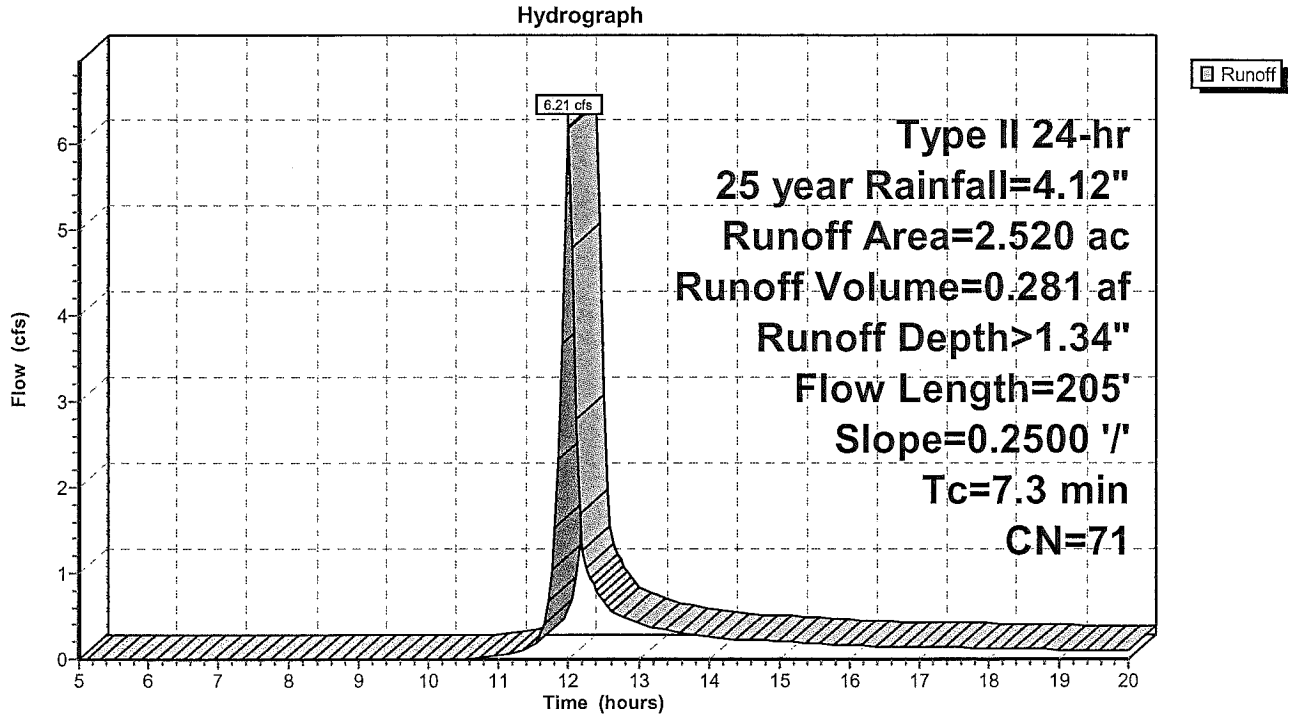
Runoff = 6.21 cfs @ 11.99 hrs, Volume= 0.281 af, Depth> 1.34"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type II 24-hr 25 year Rainfall=4.12"

Area (ac)	CN	Description
2.520	71	Meadow, non-grazed, HSG C
2.520		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
7.3	205	0.2500	0.47		**Sheet Flow, 205 feet 4H:1V sheet flow** Grass: Short n= 0.150 P2= 2.44"

Subcatchment DA-20: DA-20



Summary for Subcatchment DA-21: DA-21

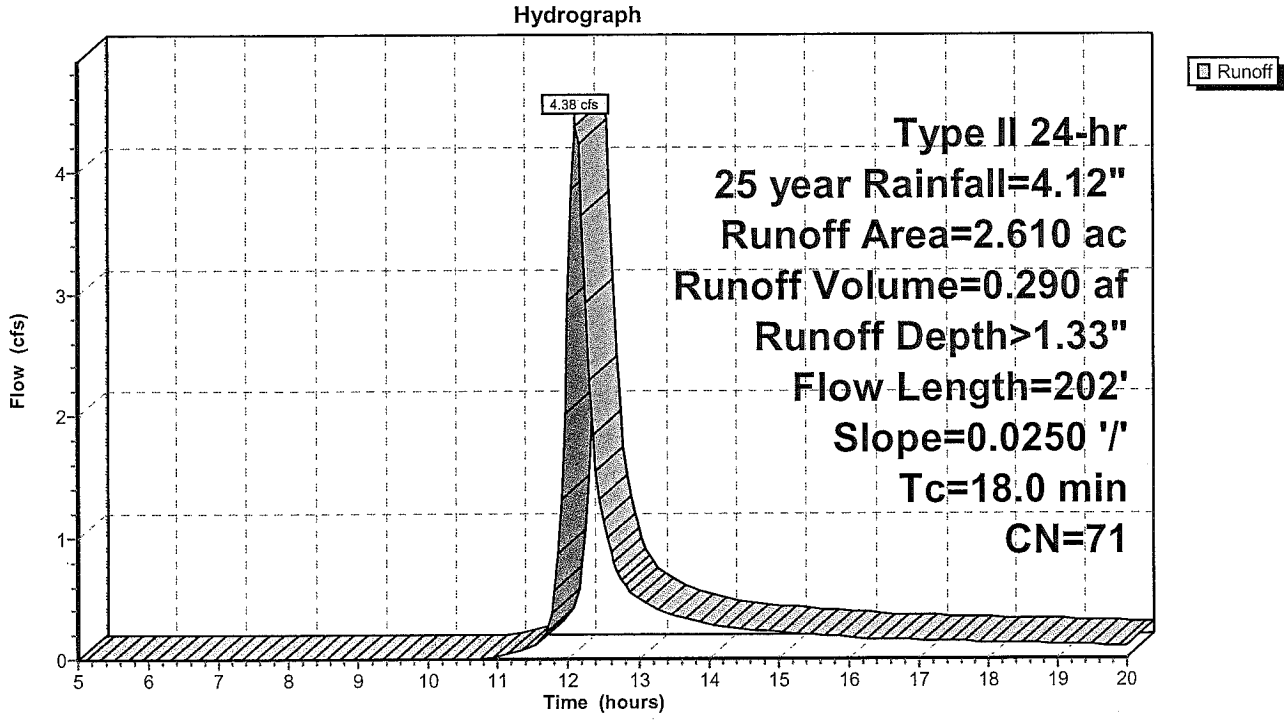
Runoff = 4.38 cfs @ 12.11 hrs, Volume= 0.290 af, Depth> 1.33"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type II 24-hr 25 year Rainfall=4.12"

Area (ac)	CN	Description
2.610	71	Meadow, non-grazed, HSG C
2.610		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
18.0	202	0.0250	0.19		**Sheet Flow, 202 feet 4H:1V sheet flow** Grass: Short n= 0.150 P2= 2.44"

Subcatchment DA-21: DA-21



Summary for Subcatchment DA-23: DA-23

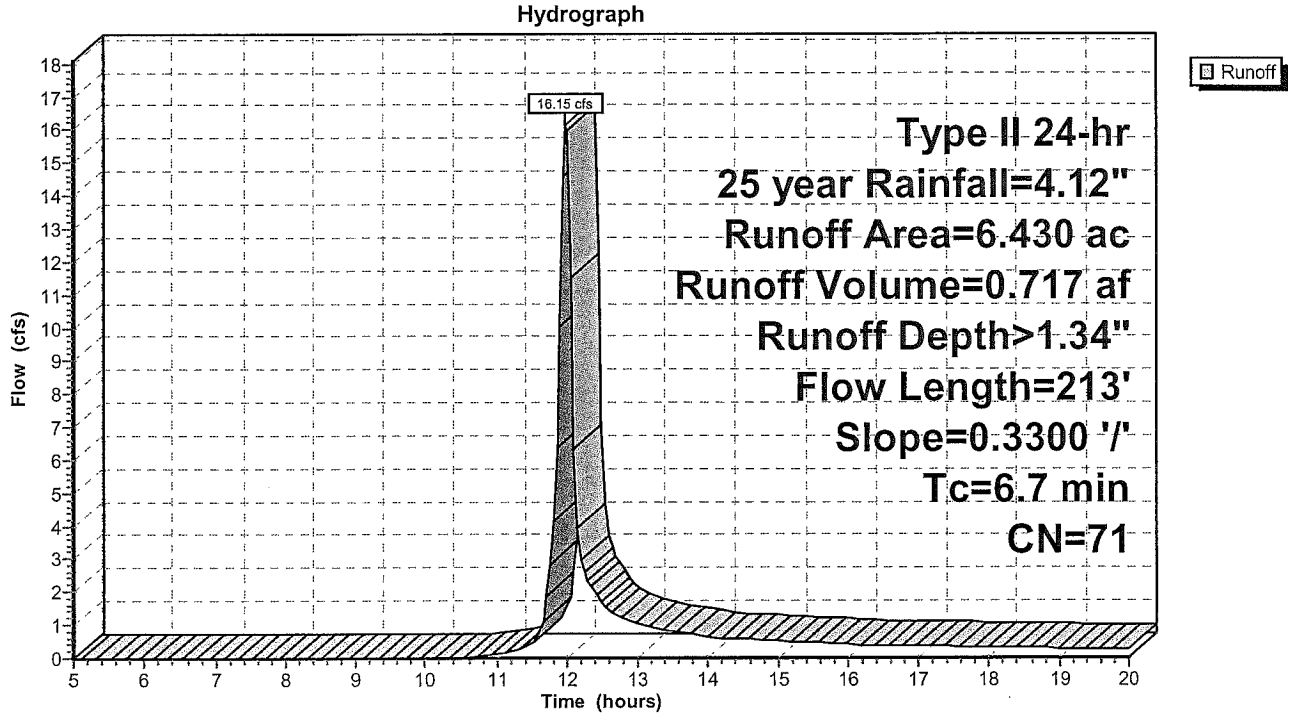
Runoff = 16.15 cfs @ 11.99 hrs, Volume= 0.717 af, Depth> 1.34"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type II 24-hr 25 year Rainfall=4.12"

Area (ac)	CN	Description
6.430	71	Meadow, non-grazed, HSG C
6.430		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.7	213	0.3300	0.53		**Sheet Flow, 213 feet 3H:1V sheet flow** Grass: Short n= 0.150 P2= 2.44"

Subcatchment DA-23: DA-23



Summary for Subcatchment DA-24: DA-24

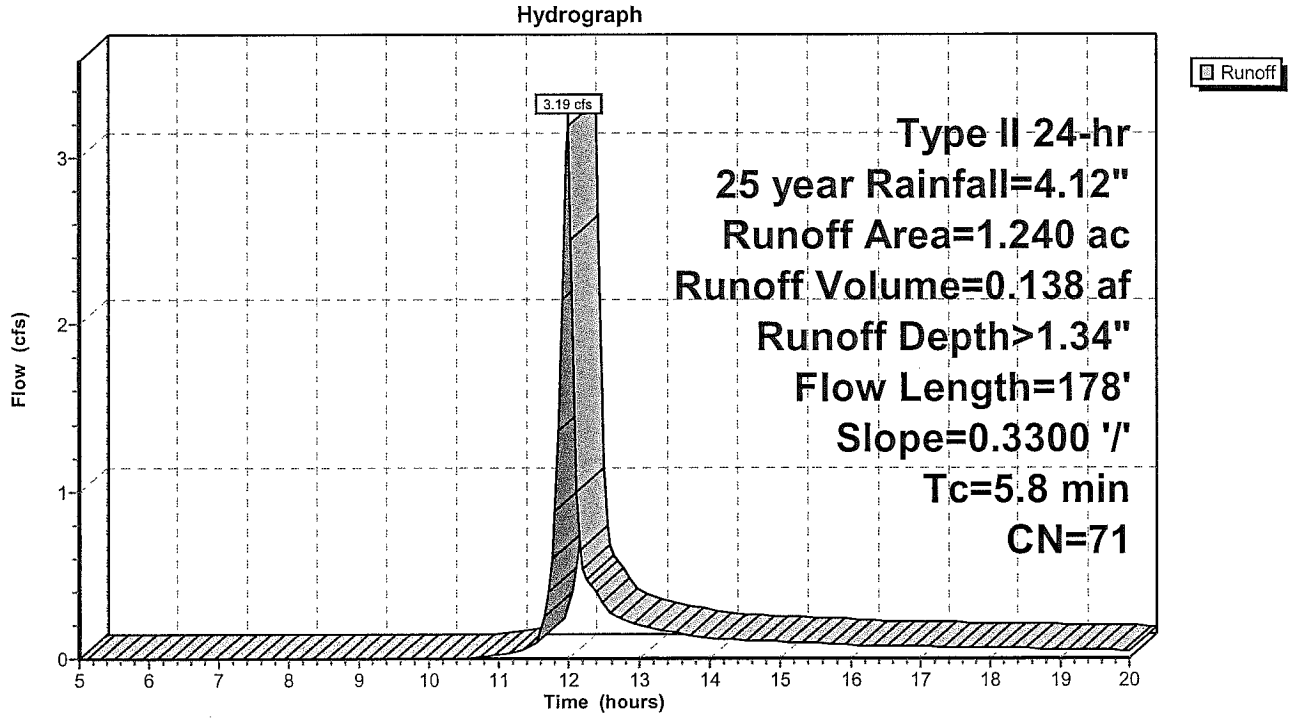
Runoff = 3.19 cfs @ 11.98 hrs, Volume= 0.138 af, Depth> 1.34"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type II 24-hr 25 year Rainfall=4.12"

Area (ac)	CN	Description
1.240	71	Meadow, non-grazed, HSG C
1.240		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.8	178	0.3300	0.51		**Sheet Flow, 178 feet 3H:1V sheet flow** Grass: Short n= 0.150 P2= 2.44"

Subcatchment DA-24: DA-24



Summary for Subcatchment DA-25: DA-25

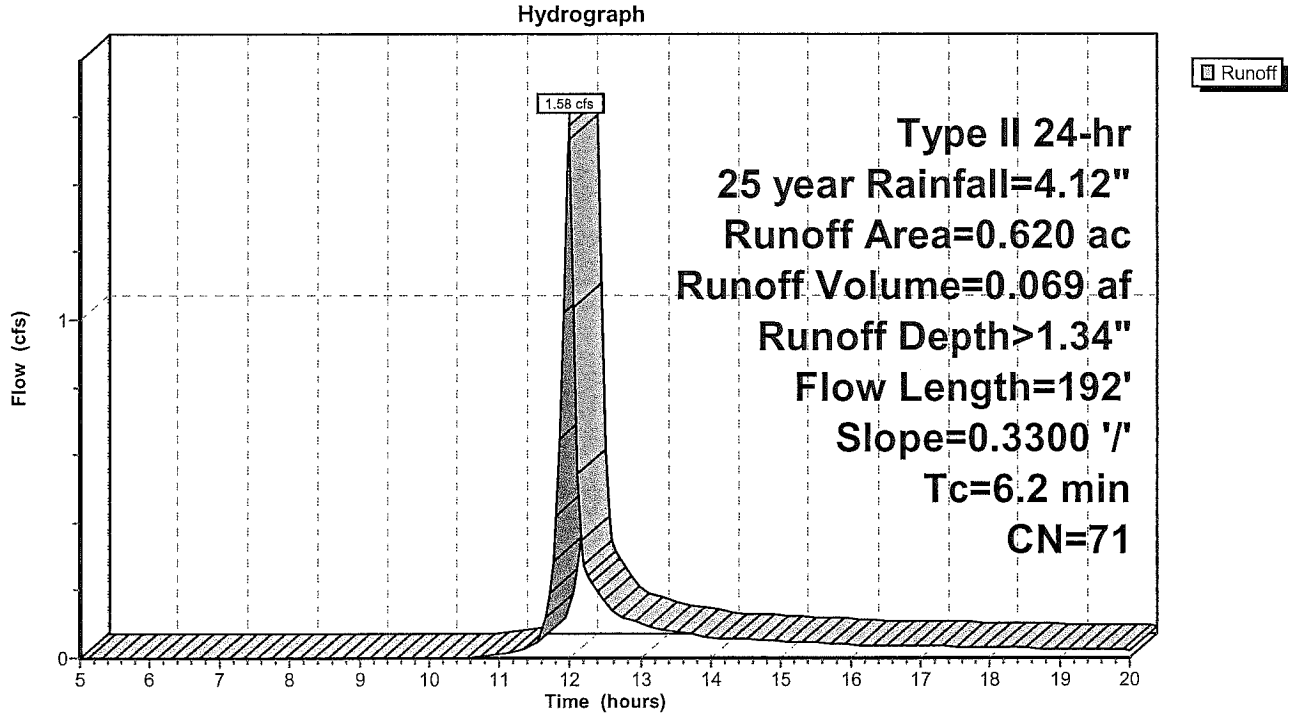
Runoff = 1.58 cfs @ 11.98 hrs, Volume= 0.069 af, Depth> 1.34"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type II 24-hr 25 year Rainfall=4.12"

Area (ac)	CN	Description
0.620	71	Meadow, non-grazed, HSG C
0.620		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.2	192	0.3300	0.52		**Sheet Flow, 192 feet 3H:1V sheet flow** Grass: Short n= 0.150 P2= 2.44"

Subcatchment DA-25: DA-25



Summary for Subcatchment DA-26: DA-26

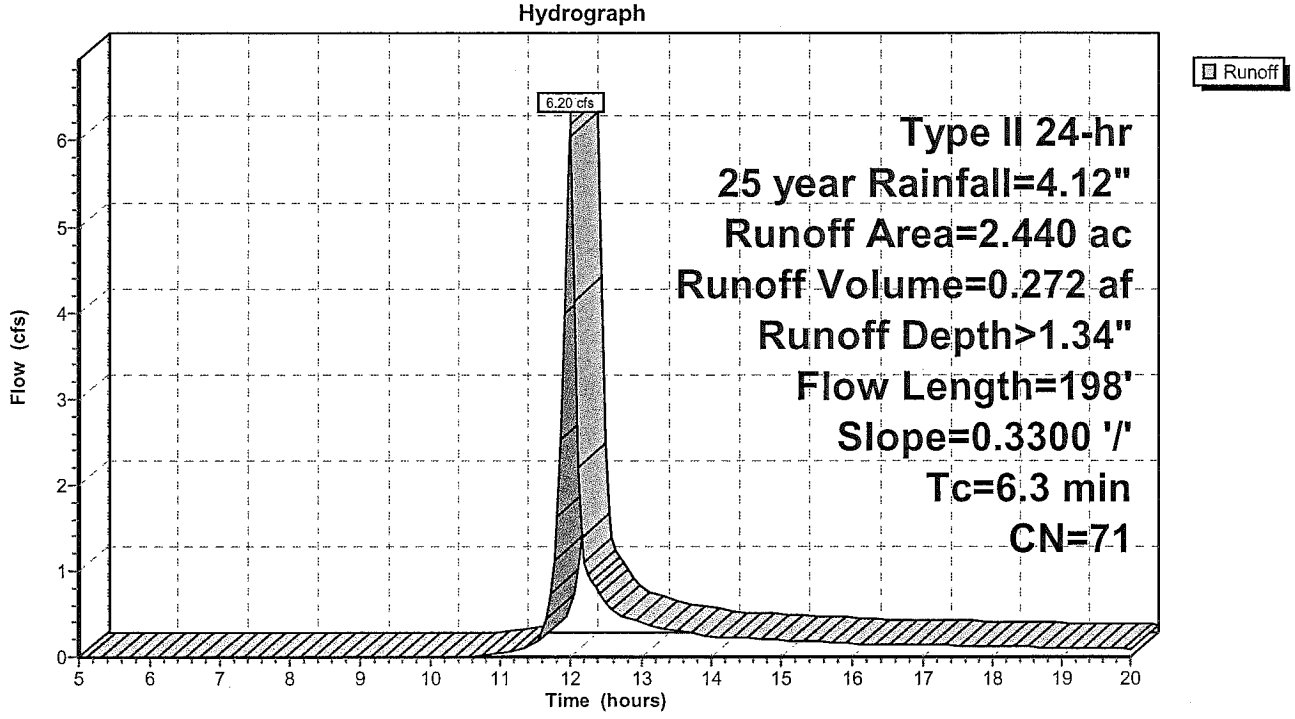
Runoff = 6.20 cfs @ 11.98 hrs, Volume= 0.272 af, Depth> 1.34"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type II 24-hr 25 year Rainfall=4.12"

Area (ac)	CN	Description
2.440	71	Meadow, non-grazed, HSG C
2.440		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.3	198	0.3300	0.52		**Sheet Flow, 198 feet 3H:1V sheet flow** Grass: Short n= 0.150 P2= 2.44"

Subcatchment DA-26: DA-26



Summary for Subcatchment DA-27: DA-27

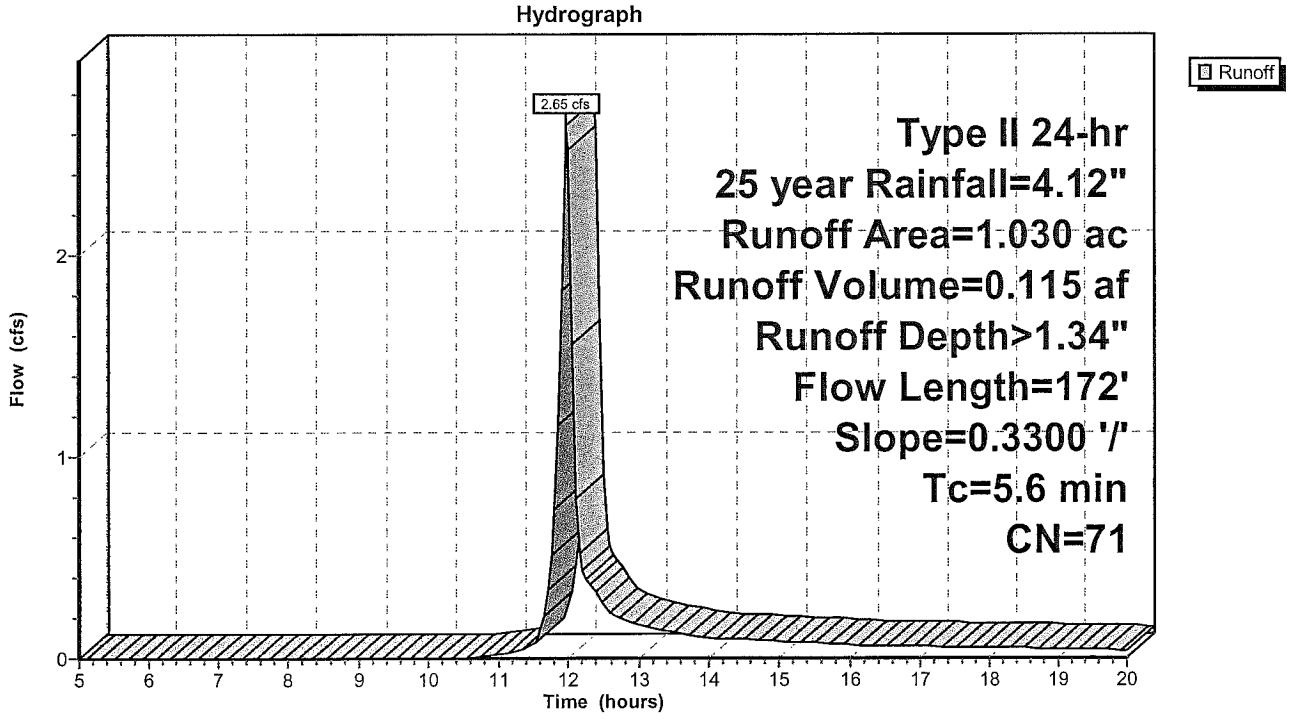
Runoff = 2.65 cfs @ 11.97 hrs, Volume= 0.115 af, Depth> 1.34"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type II 24-hr 25 year Rainfall=4.12"

Area (ac)	CN	Description
1.030	71	Meadow, non-grazed, HSG C
1.030		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.6	172	0.3300	0.51		**Sheet Flow, 172 feet 3H:1V sheet flow** Grass: Short n= 0.150 P2= 2.44"

Subcatchment DA-27: DA-27



Summary for Subcatchment DA-28: DA-28

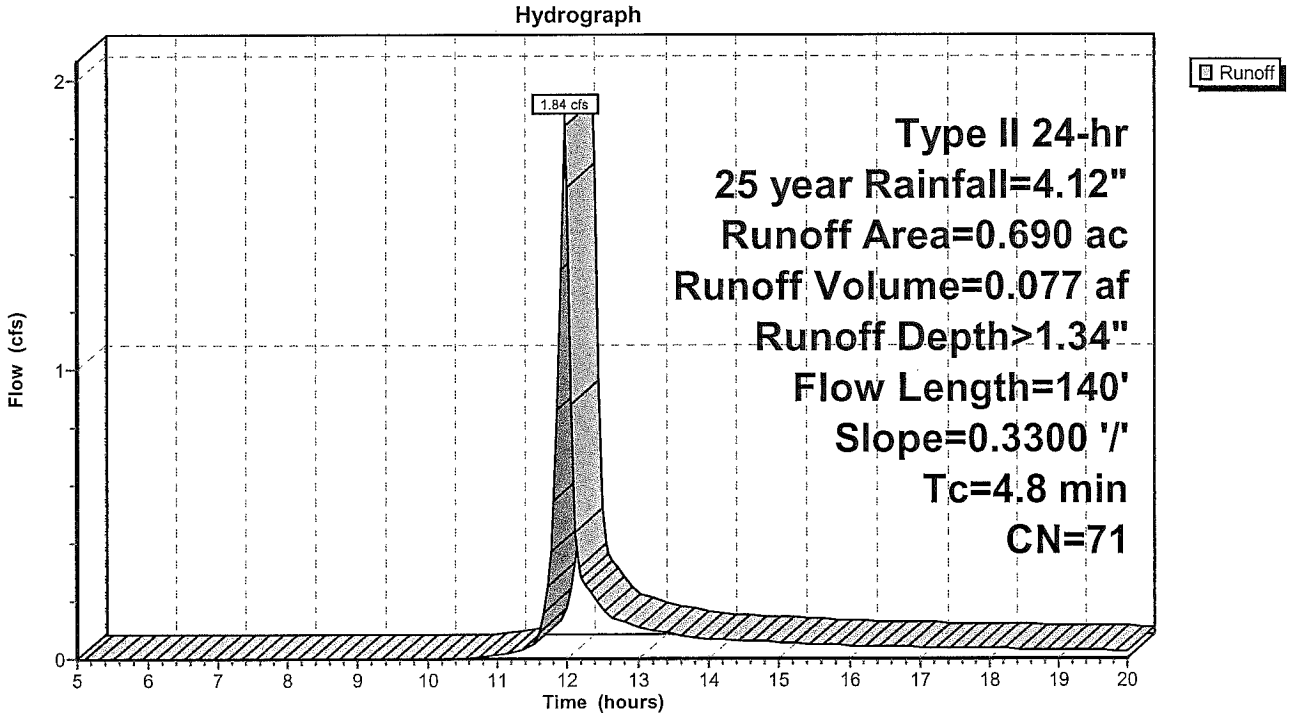
Runoff = 1.84 cfs @ 11.96 hrs, Volume= 0.077 af, Depth> 1.34"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type II 24-hr 25 year Rainfall=4.12"

Area (ac)	CN	Description
0.690	71	Meadow, non-grazed, HSG C
0.690		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
4.8	140	0.3300	0.49		**Sheet Flow, 140 feet 3H:1V sheet flow** Grass: Short n= 0.150 P2= 2.44"

Subcatchment DA-28: DA-28



Summary for Subcatchment DA-29: DA-29

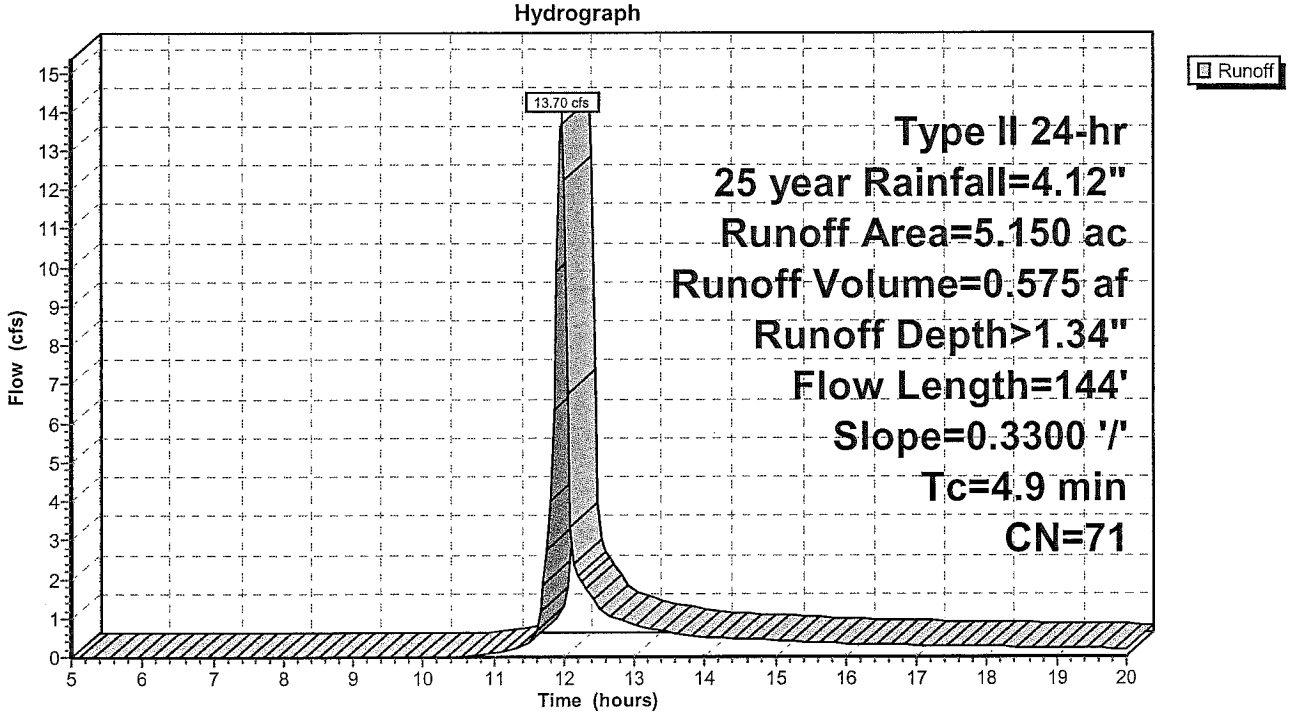
Runoff = 13.70 cfs @ 11.96 hrs, Volume= 0.575 af, Depth> 1.34"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type II 24-hr 25 year Rainfall=4.12"

Area (ac)	CN	Description
5.150	71	Meadow, non-grazed, HSG C
5.150		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
4.9	144	0.3300	0.49		**Sheet Flow, 144 feet 3H:1V sheet flow** Grass: Short n= 0.150 P2= 2.44"

Subcatchment DA-29: DA-29



Summary for Subcatchment DA-4: DA-4

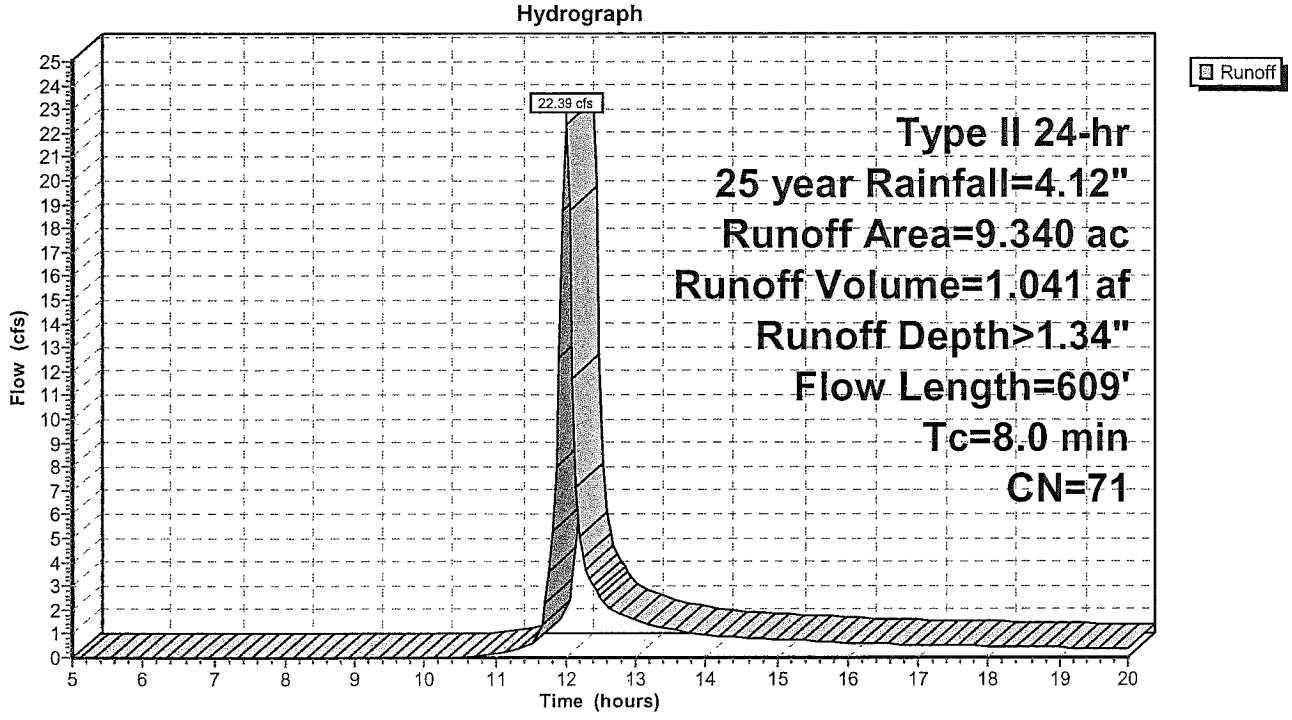
Runoff = 22.39 cfs @ 12.00 hrs, Volume= 1.041 af, Depth> 1.34"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type II 24-hr 25 year Rainfall=4.12"

Area (ac)	CN	Description
9.340	71	Meadow, non-grazed, HSG C
9.340		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
7.2	202	0.2500	0.47		**Sheet Flow, 202 feet 4H:1V sheet flow** Grass: Short n= 0.150 P2= 2.44"
0.8	407	0.0300	8.26	99.13	**Channel Flow, 407 feet berm flow** Area= 12.0 sf Perim= 12.7' r= 0.94' n= 0.030 Earth, grassed & winding
8.0	609	Total			

Subcatchment DA-4: DA-4



Summary for Subcatchment DA-46: DA-46

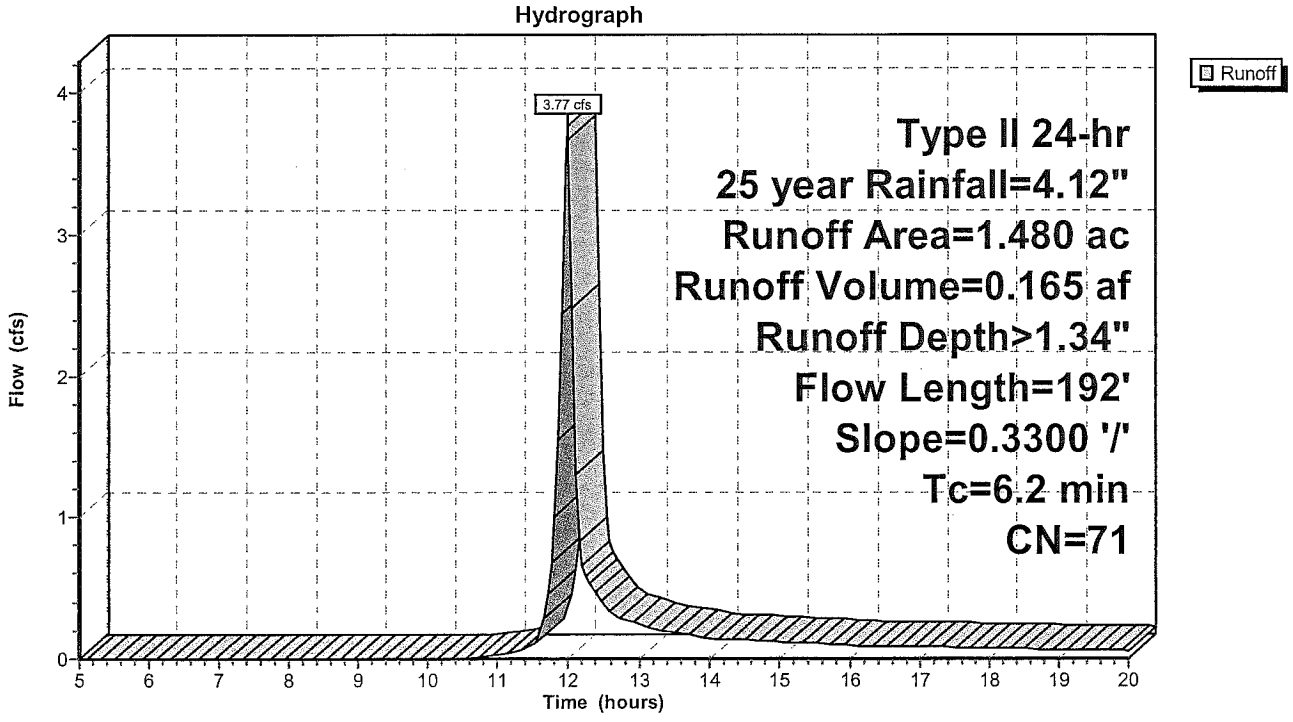
Runoff = 3.77 cfs @ 11.98 hrs, Volume= 0.165 af, Depth> 1.34"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type II 24-hr 25 year Rainfall=4.12"

Area (ac)	CN	Description
1.480	71	Meadow, non-grazed, HSG C
1.480		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.2	192	0.3300	0.52		**Sheet Flow, 192 feet 3H:1V sheet flow** Grass: Short n= 0.150 P2= 2.44"

Subcatchment DA-46: DA-46



Summary for Subcatchment DA-47: DA-47

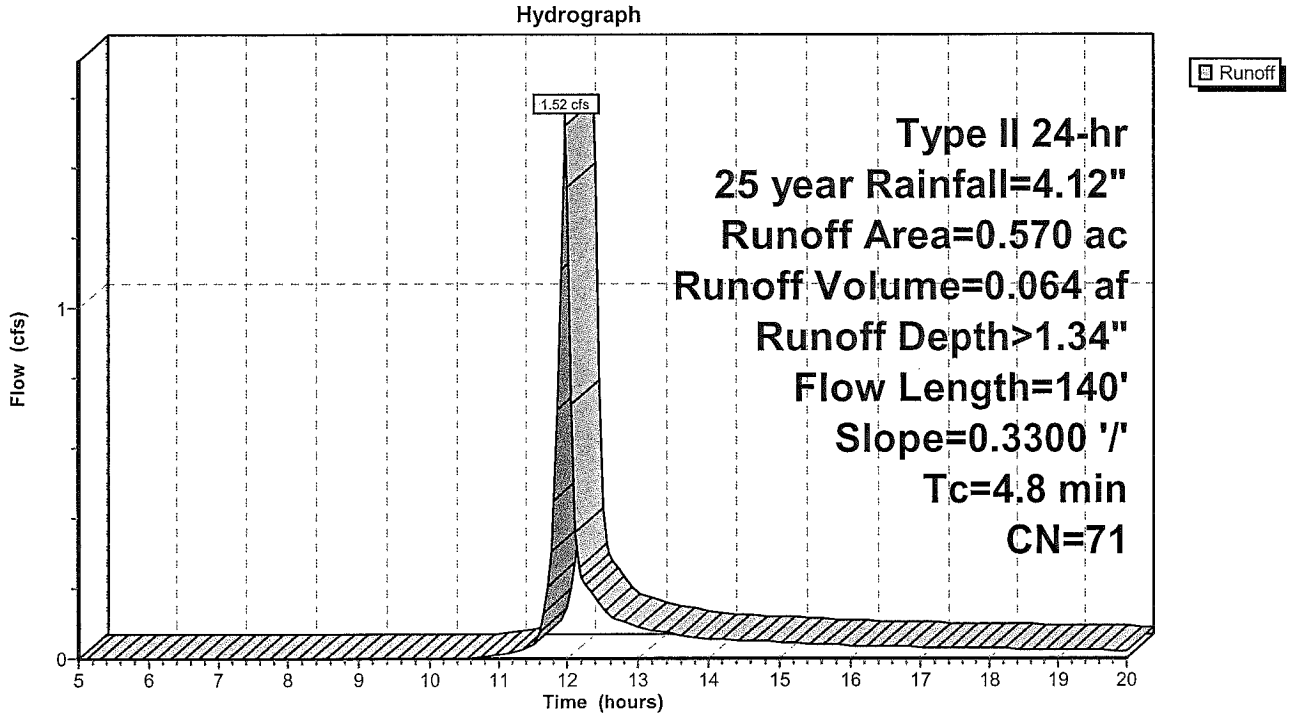
Runoff = 1.52 cfs @ 11.96 hrs, Volume= 0.064 af, Depth> 1.34"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type II 24-hr 25 year Rainfall=4.12"

Area (ac)	CN	Description
0.570	71	Meadow, non-grazed, HSG C
0.570		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
4.8	140	0.3300	0.49		**Sheet Flow, 140 feet 3H:1V sheet flow** Grass: Short n= 0.150 P2= 2.44"

Subcatchment DA-47: DA-47



Summary for Subcatchment DA-48: DA-48

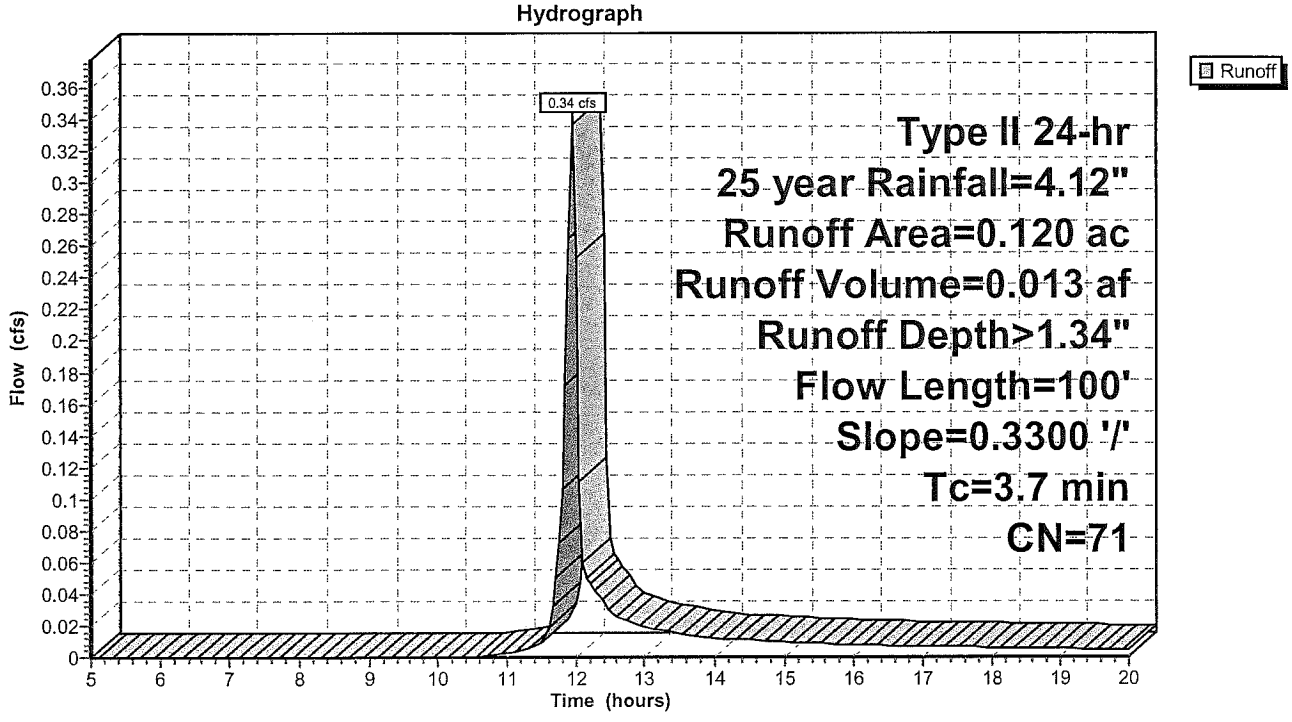
Runoff = 0.34 cfs @ 11.95 hrs, Volume= 0.013 af, Depth> 1.34"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type II 24-hr 25 year Rainfall=4.12"

Area (ac)	CN	Description
0.120	71	Meadow, non-grazed, HSG C
0.120		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
3.7	100	0.3300	0.46		**Sheet Flow, 100 feet 3H:1V sheet flow** Grass: Short n= 0.150 P2= 2.44"

Subcatchment DA-48: DA-48



Summary for Subcatchment DA-49: DA-49

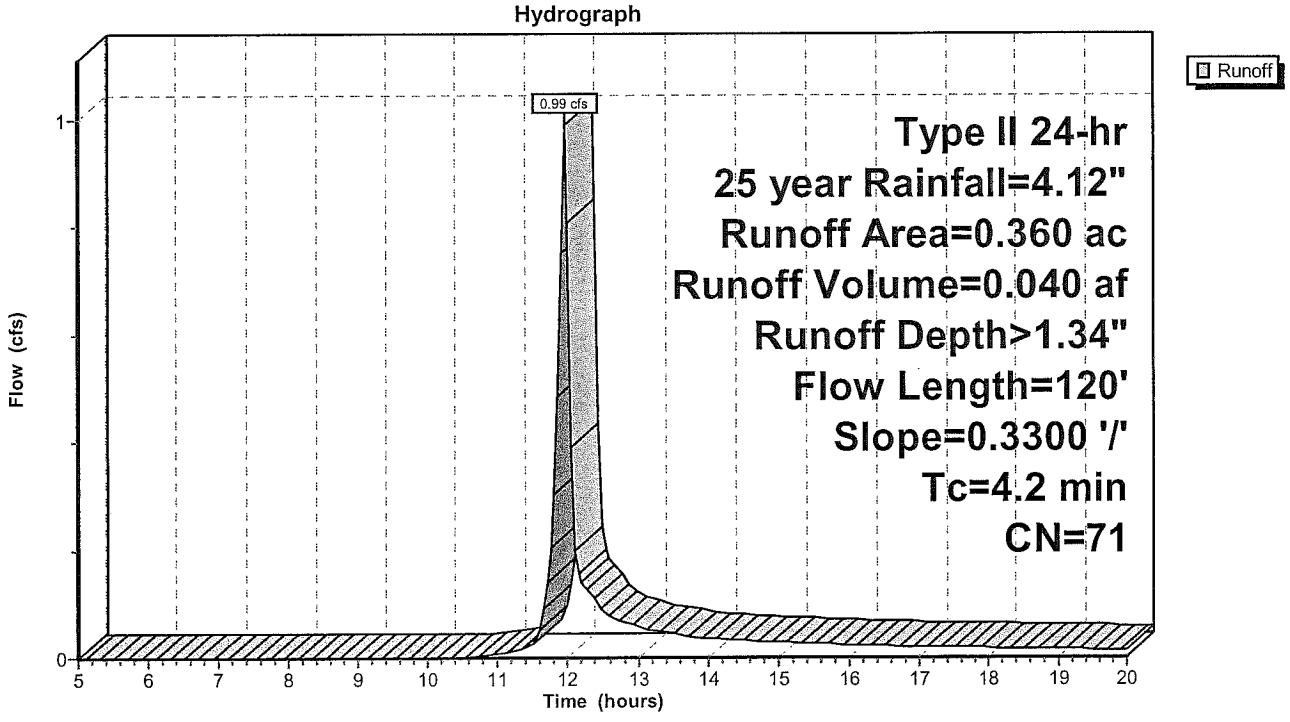
Runoff = 0.99 cfs @ 11.95 hrs, Volume= 0.040 af, Depth> 1.34"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type II 24-hr 25 year Rainfall=4.12"

Area (ac)	CN	Description
0.360	71	Meadow, non-grazed, HSG C
0.360		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
4.2	120	0.3300	0.47		**Sheet Flow, 120 feet 3H:1V sheet flow** Grass: Short n= 0.150 P2= 2.44"

Subcatchment DA-49: DA-49



Summary for Subcatchment DA-5: DA-5

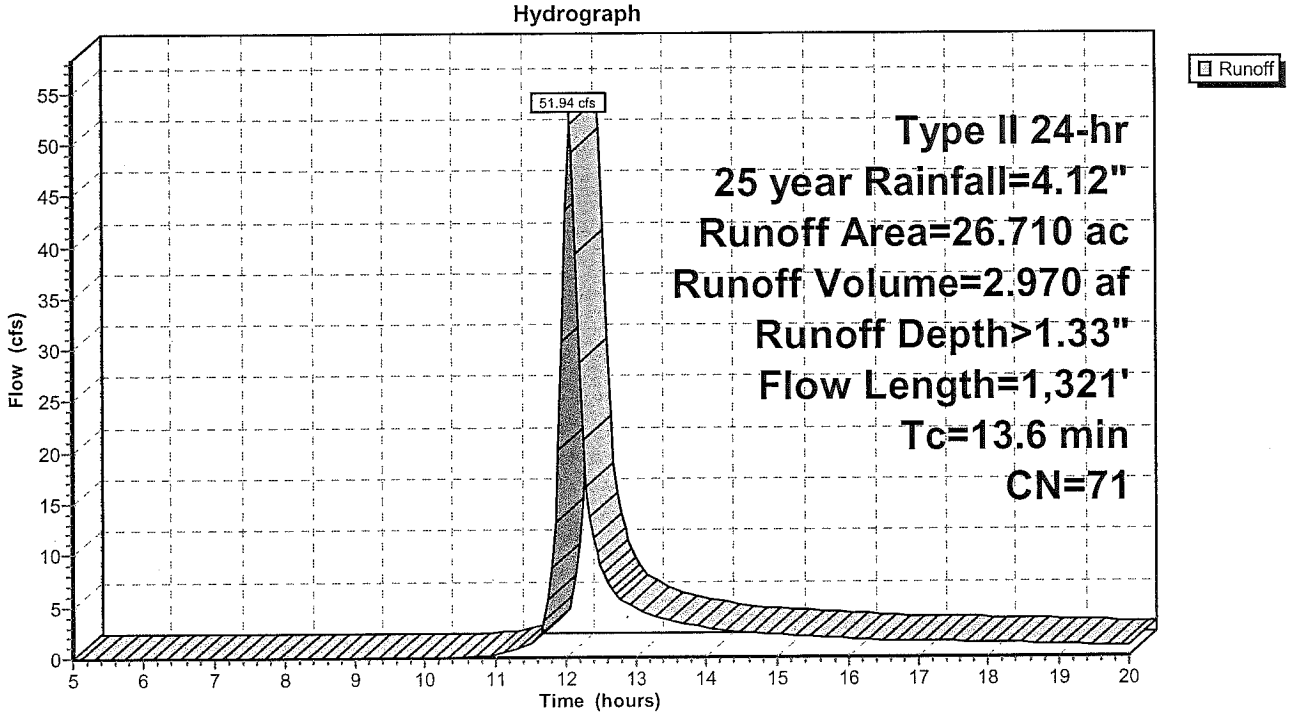
Runoff = 51.94 cfs @ 12.06 hrs, Volume= 2.970 af, Depth> 1.33"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type II 24-hr 25 year Rainfall=4.12"

Area (ac)	CN	Description
26.710	71	Meadow, non-grazed, HSG C
26.710		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
7.2	128	0.1000	0.30		**Sheet Flow, 128 feet 10% sheet flow** Grass: Short n= 0.150 P2= 2.44"
3.8	105	0.3300	0.46		**Sheet Flow, 105 feet 3H:1V sheet flow** Grass: Short n= 0.150 P2= 2.44"
2.6	1,088	0.0300	7.00	102.24	**Channel Flow, 1088 feet bench flow** Area= 14.6 sf Perim= 19.8' r= 0.74' n= 0.030 Earth, grassed & winding
13.6	1,321	Total			

Subcatchment DA-5: DA-5



Summary for Subcatchment DA-55: DA-55

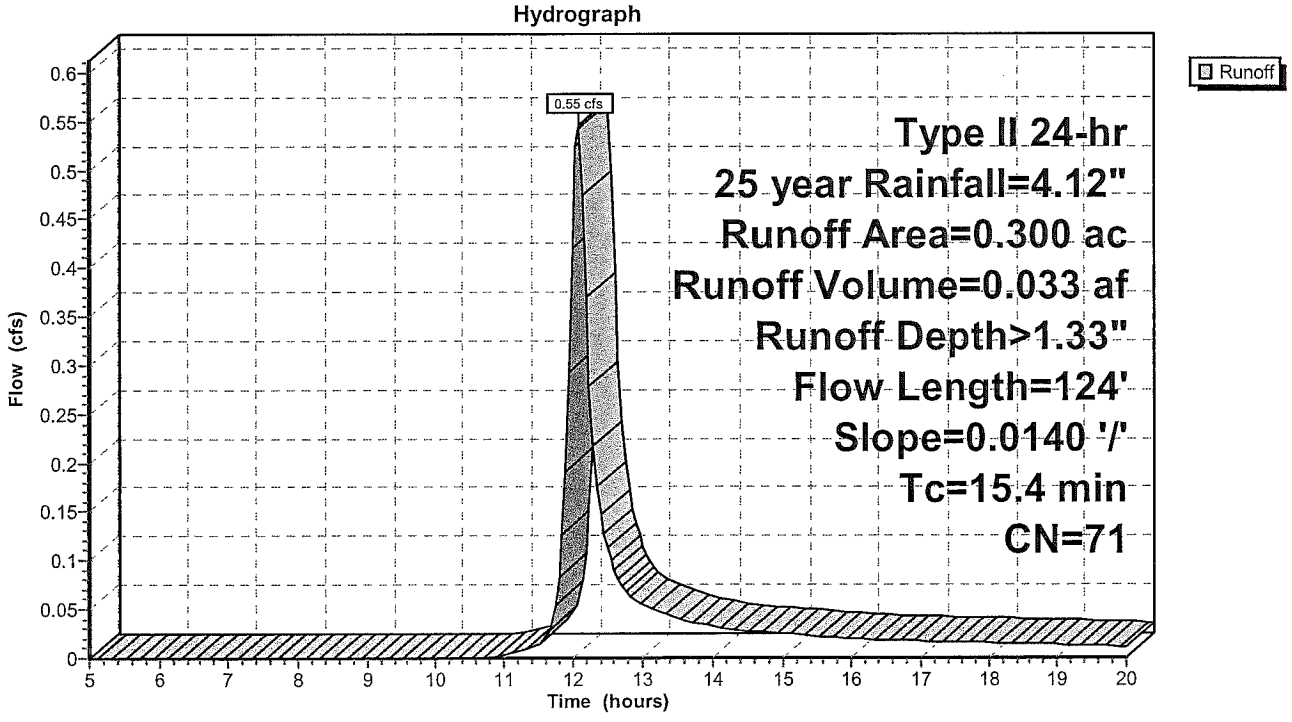
Runoff = 0.55 cfs @ 12.09 hrs, Volume= 0.033 af, Depth> 1.33"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type II 24-hr 25 year Rainfall=4.12"

Area (ac)	CN	Description
0.300	71	Meadow, non-grazed, HSG C
0.300		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
15.4	124	0.0140	0.13		**Sheet Flow, 124 feet 7H:1V sheet flow** Grass: Short n= 0.150 P2= 2.44"

Subcatchment DA-55: DA-55



Summary for Subcatchment DA-56: DA-56

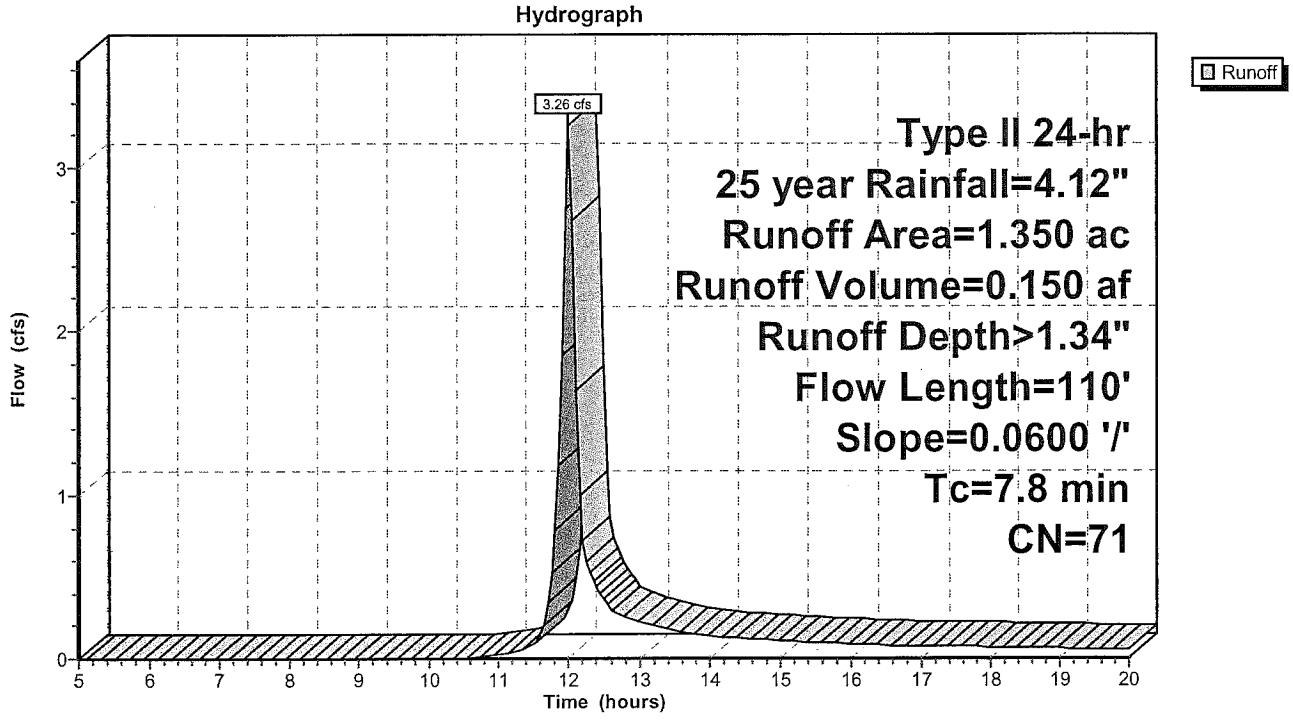
Runoff = 3.26 cfs @ 12.00 hrs, Volume= 0.150 af, Depth> 1.34"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type II 24-hr 25 year Rainfall=4.12"

Area (ac)	CN	Description
1.350	71	Meadow, non-grazed, HSG C
1.350		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
7.8	110	0.0600	0.23		**Sheet Flow, 110 feet 6 percent sheet flow** Grass: Short n= 0.150 P2= 2.44"

Subcatchment DA-56: DA-56



Summary for Subcatchment DA-57: DA-57

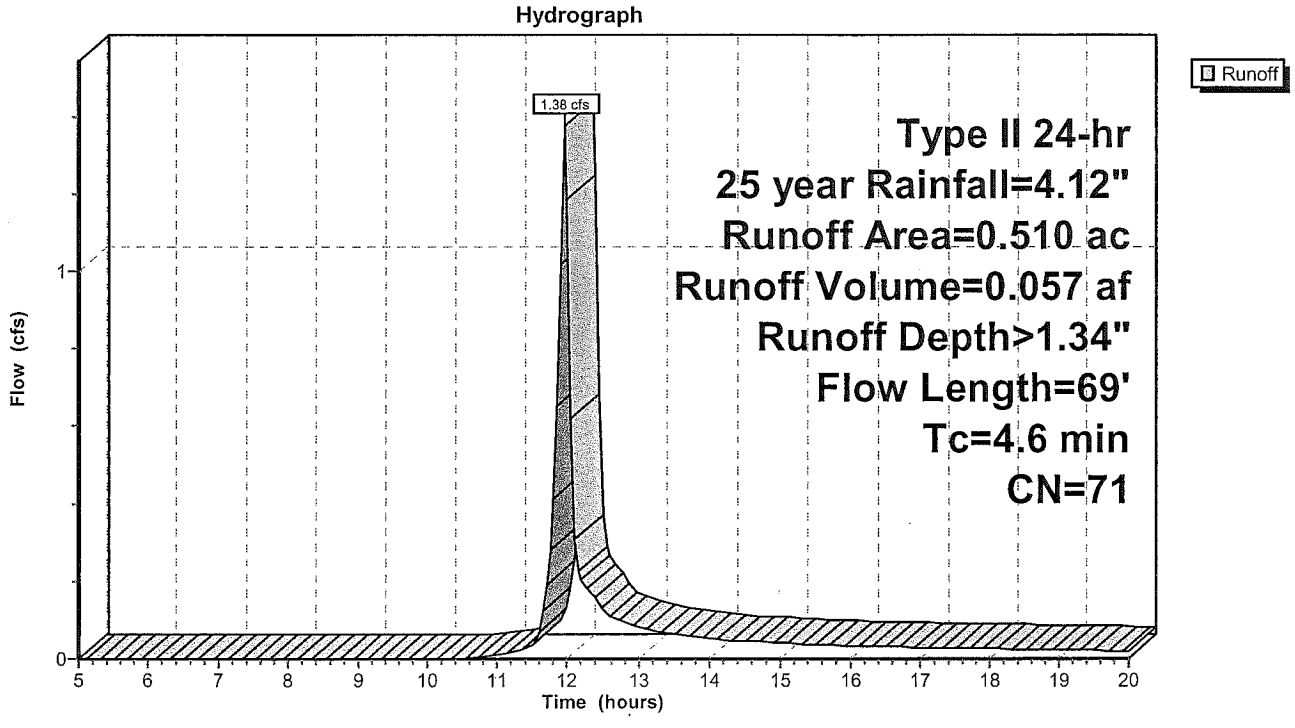
Runoff = 1.38 cfs @ 11.96 hrs, Volume= 0.057 af, Depth> 1.34"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type II 24-hr 25 year Rainfall=4.12"

	Area (ac)	CN	Description
*	0.510	71	
	0.510		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
4.5	10	0.0050	0.04		**Sheet Flow,** Grass: Dense n= 0.240 P2= 2.44"
0.1	59	0.2710	8.38		**Shallow Concentrated Flow,** Unpaved Kv= 16.1 fps
4.6	69	Total			

Subcatchment DA-57: DA-57



Summary for Subcatchment DA-6: DA-6

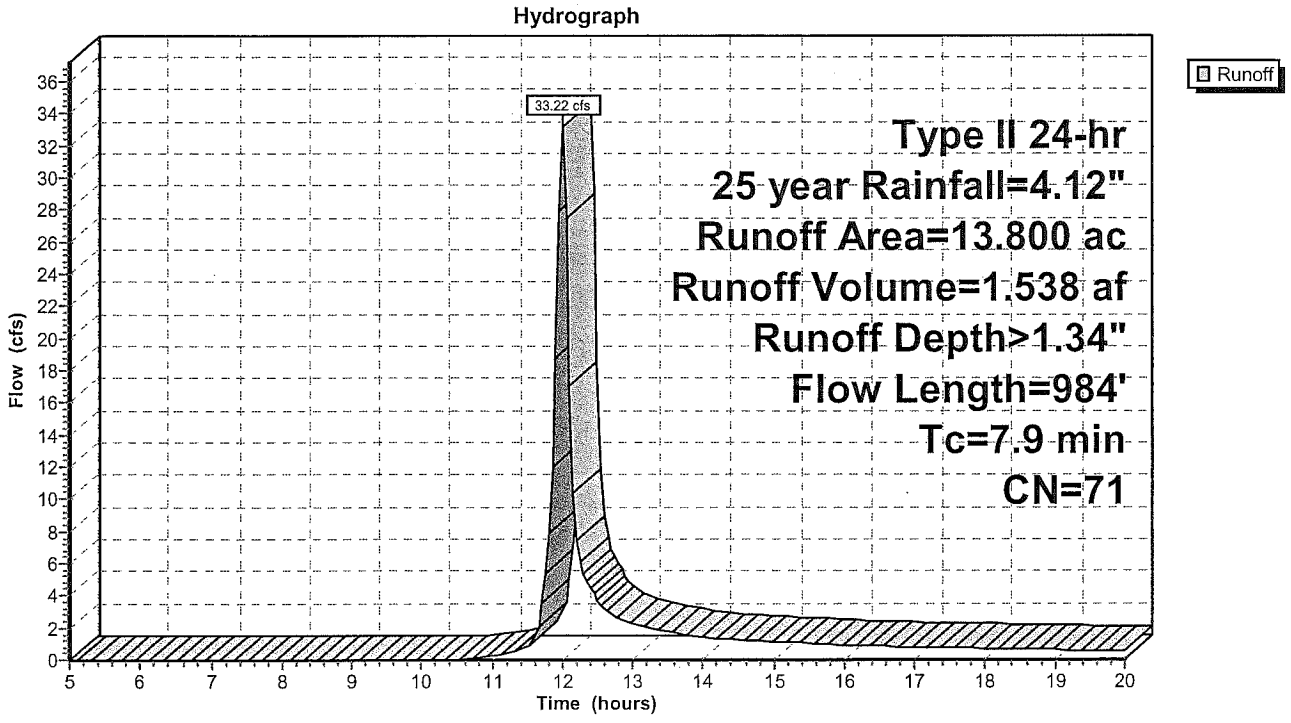
Runoff = 33.22 cfs @ 12.00 hrs, Volume= 1.538 af, Depth> 1.34"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type II 24-hr 25 year Rainfall=4.12"

Area (ac)	CN	Description
13.800	71	Meadow, non-grazed, HSG C
13.800		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.0	185	0.3300	0.52		**Sheet Flow, 185 feet 3H:1V sheet flow** Grass: Short n= 0.150 P2= 2.44"
1.9	799	0.0300	7.00	102.24	**Channel Flow, 779 feet bench flow** Area= 14.6 sf Perim= 19.8' r= 0.74' n= 0.030 Earth, grassed & winding
7.9	984	Total			

Subcatchment DA-6: DA-6



Summary for Subcatchment DA-7: DA-7

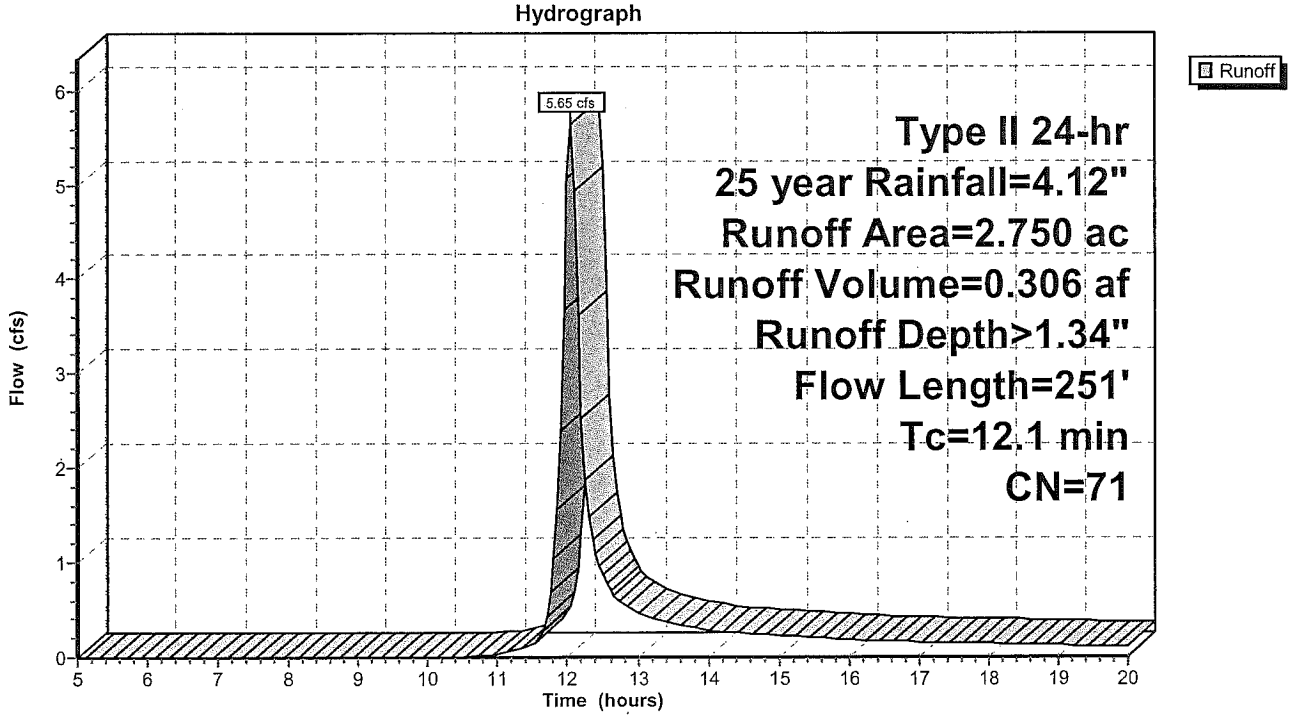
Runoff = 5.65 cfs @ 12.05 hrs, Volume= 0.306 af, Depth> 1.34"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type II 24-hr 25 year Rainfall=4.12"

Area (ac)	CN	Description
2.750	71	Meadow, non-grazed, HSG C
2.750		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
9.3	178	0.1000	0.32		**Sheet Flow, 178 feet 10% sheet flow** Grass: Short n= 0.150 P2= 2.44"
2.8	73	0.3300	0.43		**Sheet Flow, 73 feet 3H:1V sheet flow** Grass: Short n= 0.150 P2= 2.44"
12.1	251	Total			

Subcatchment DA-7: DA-7



Summary for Subcatchment DA-8: DA-8

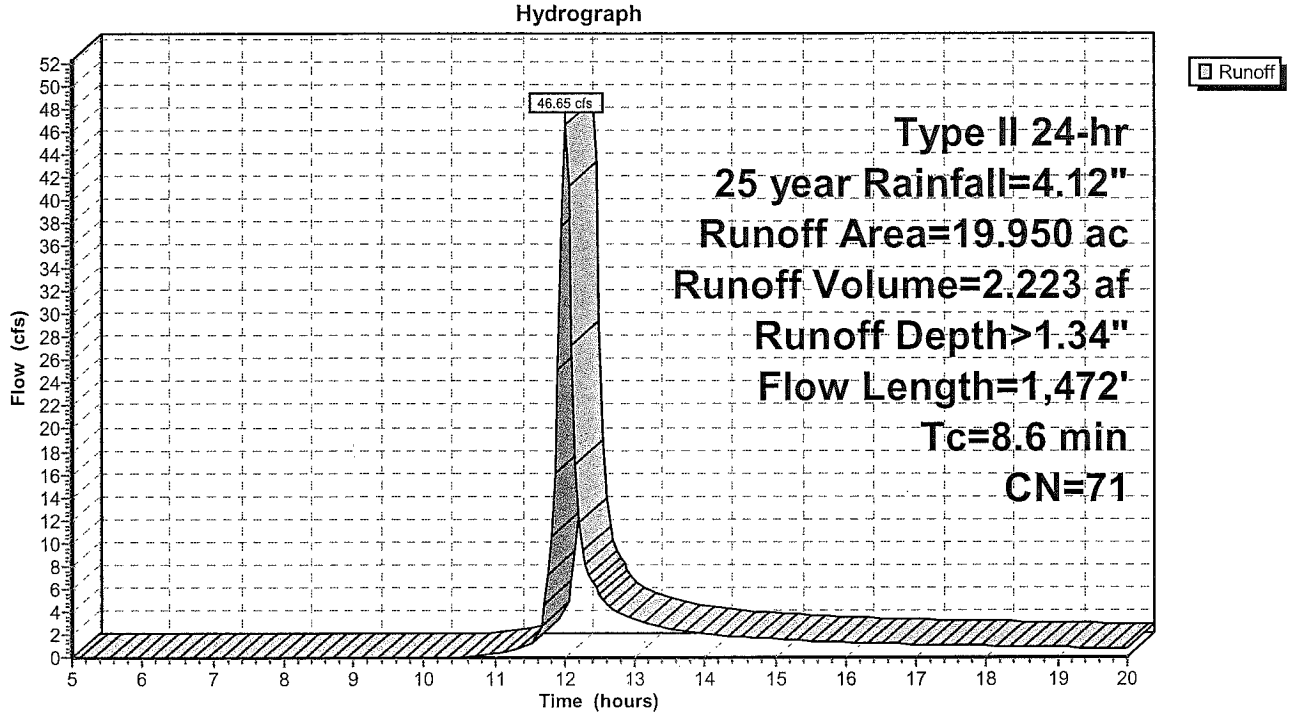
Runoff = 46.65 cfs @ 12.01 hrs, Volume= 2.223 af, Depth> 1.34"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type II 24-hr 25 year Rainfall=4.12"

Area (ac)	CN	Description
19.950	71	Meadow, non-grazed, HSG C
19.950		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.5	165	0.3300	0.50		**Sheet Flow, 165 feet 3H:1V sheet flow** Grass: Short n= 0.150 P2= 2.44"
3.1	1,307	0.0300	7.00	102.24	**Channel Flow, 1307 feet bench flow** Area= 14.6 sf Perim= 19.8' r= 0.74' n= 0.030 Earth, grassed & winding
8.6	1,472	Total			

Subcatchment DA-8: DA-8



Summary for Subcatchment UA: Pond Undisturbed Area

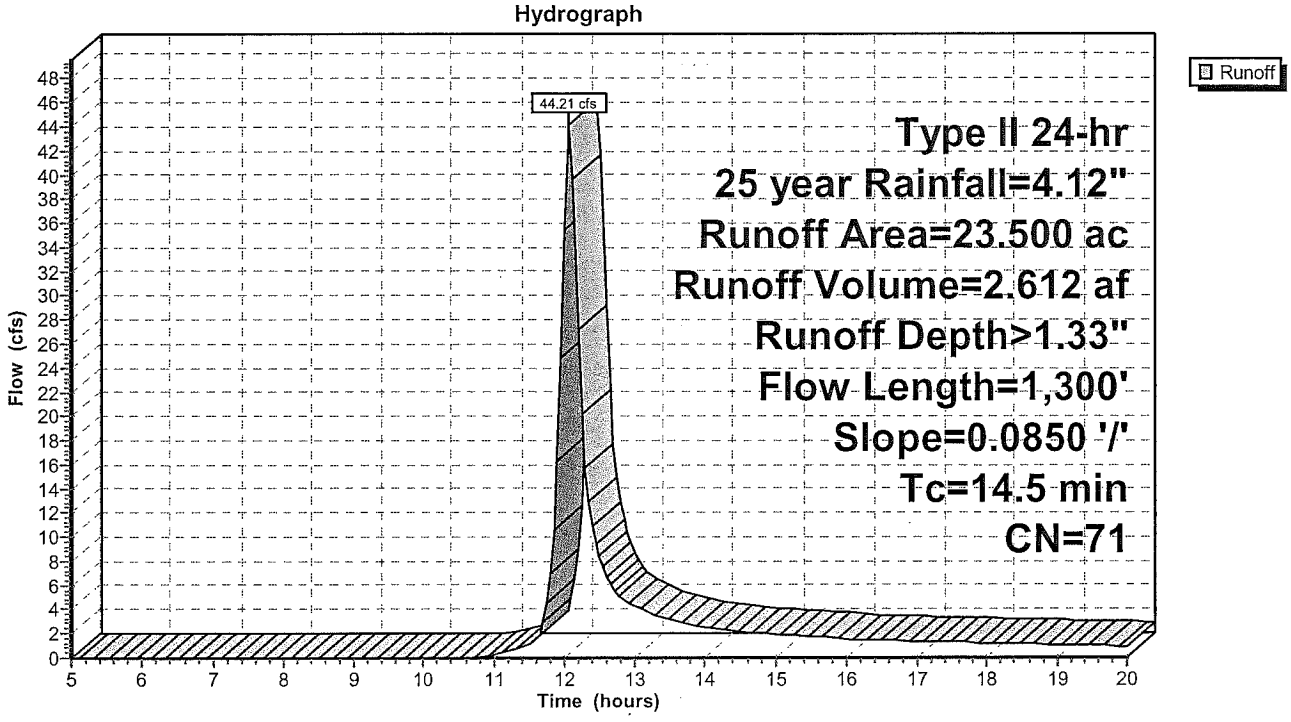
Runoff = 44.21 cfs @ 12.07 hrs, Volume= 2.612 af, Depth> 1.33"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type II 24-hr 25 year Rainfall=4.12"

Area (ac)	CN	Description
23.500	71	Meadow, non-grazed, HSG C
23.500		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.3	300	0.0850	0.79		**Sheet Flow, 300 feet 8.5 percent sheet flow** Fallow n= 0.050 P2= 2.44"
8.2	1,000	0.0850	2.04		**Shallow Concentrated Flow, 1000 feet 8.5 percent sheet flow** Short Grass Pasture Kv= 7.0 fps
14.5	1,300	Total			

Subcatchment UA: Pond Undisturbed Area



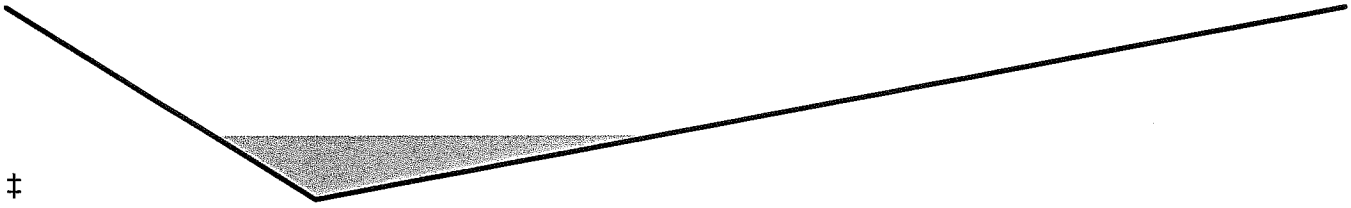
Summary for Reach bench: bench

Inflow Area = 2.750 ac, 0.00% Impervious, Inflow Depth > 1.33" for 25 year event
Inflow = 5.46 cfs @ 12.07 hrs, Volume= 0.305 af
Outflow = 5.27 cfs @ 12.11 hrs, Volume= 0.305 af, Atten= 4%, Lag= 2.3 min

Routing by Stor-Ind+Trans method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Max. Velocity= 3.35 fps, Min. Travel Time= 1.3 min
Avg. Velocity = 1.51 fps, Avg. Travel Time= 2.8 min

Peak Storage= 409 cf @ 12.09 hrs
Average Depth at Peak Storage= 0.50'
Bank-Full Depth= 1.50' Flow Area= 14.6 sf, Capacity= 102.46 cfs

0.00' x 1.50' deep channel, n= 0.030 Earth, grassed & winding
Side Slope Z-value= 3.0 10.0 '/' Top Width= 19.50'
Length= 254.0' Slope= 0.0300 '/'
Inlet Invert= 1,467.00', Outlet Invert= 1,459.38'



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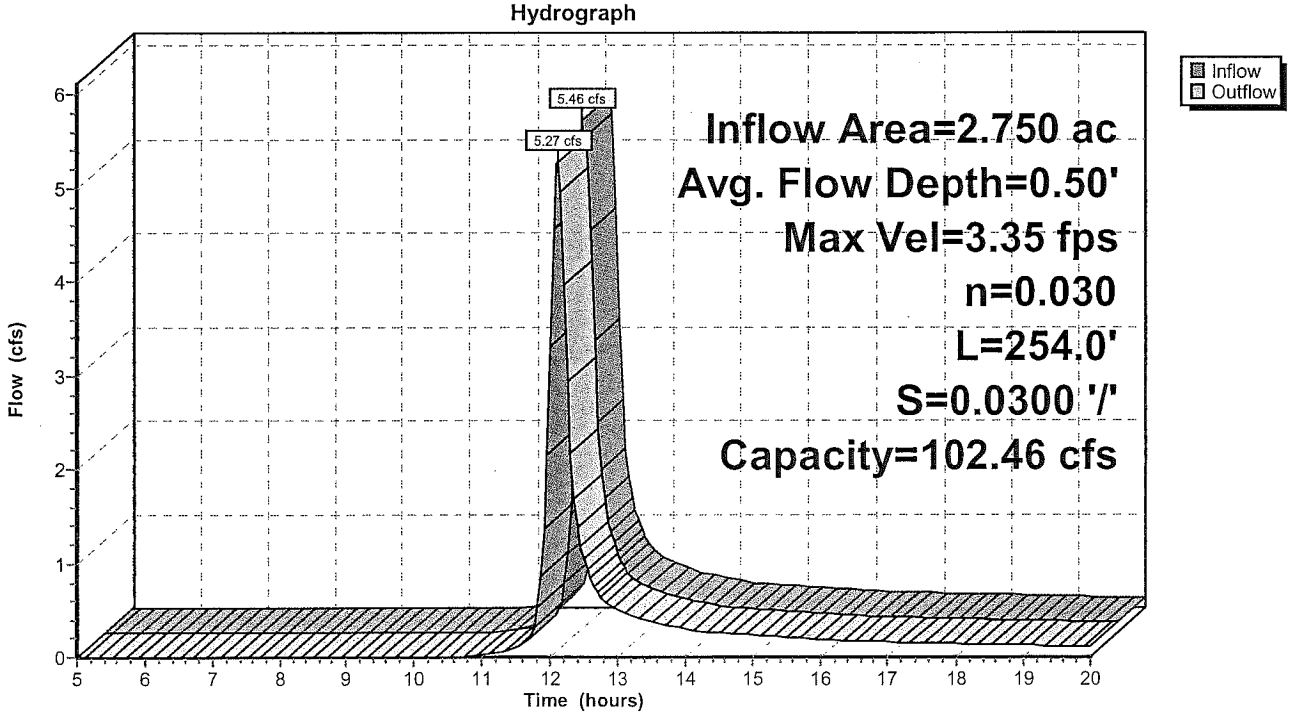
Reach bench: bench



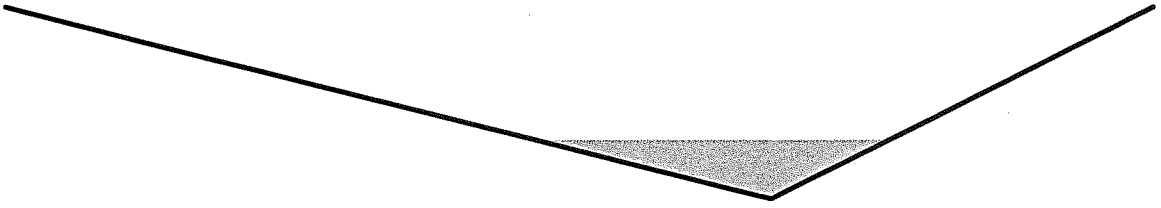
Summary for Reach berm: berm

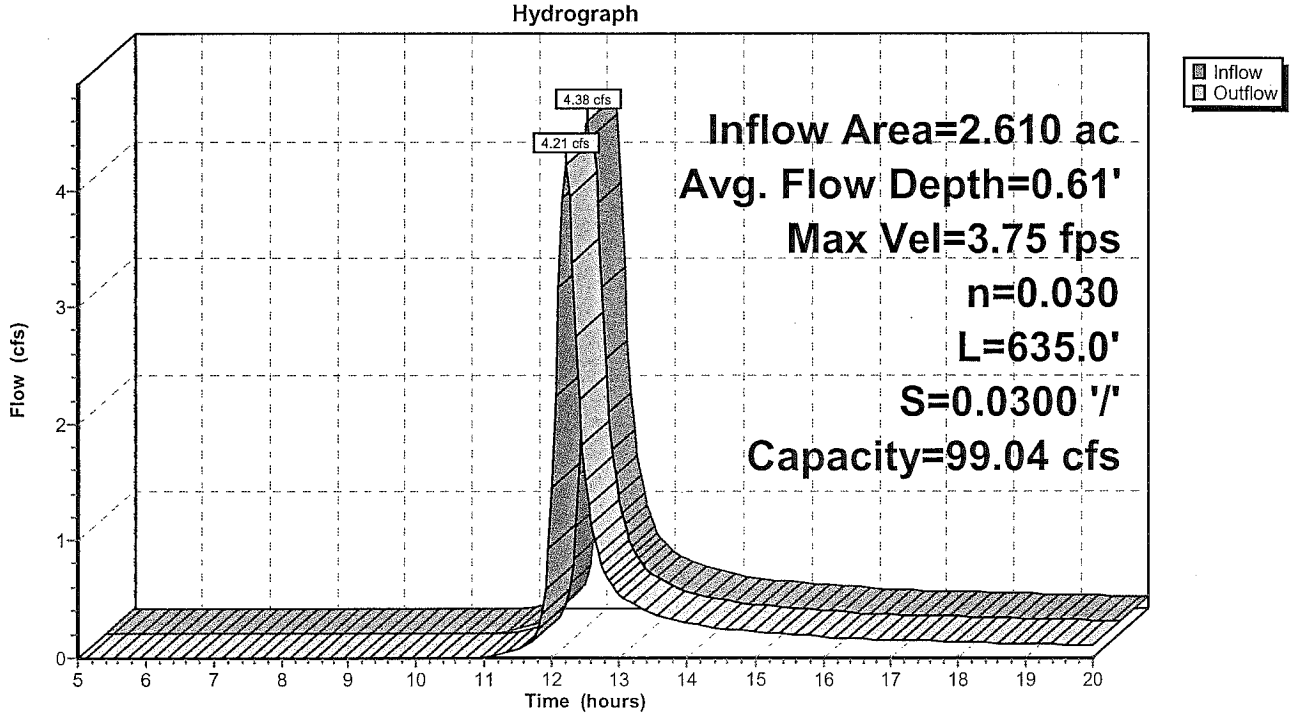
Inflow Area = 2.610 ac, 0.00% Impervious, Inflow Depth > 1.33" for 25 year event
Inflow = 4.38 cfs @ 12.11 hrs, Volume= 0.290 af
Outflow = 4.21 cfs @ 12.20 hrs, Volume= 0.288 af, Atten= 4%, Lag= 5.2 min

Routing by Stor-Ind+Trans method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Max. Velocity= 3.75 fps, Min. Travel Time= 2.8 min
Avg. Velocity = 1.78 fps, Avg. Travel Time= 6.0 min

Peak Storage= 715 cf @ 12.15 hrs
Average Depth at Peak Storage= 0.61'
Bank-Full Depth= 2.00' Flow Area= 12.0 sf, Capacity= 99.04 cfs

0.00' x 2.00' deep channel, n= 0.030 Earth, grassed & winding
Side Slope Z-value= 4.0 2.0 '/' Top Width= 12.00'
Length= 635.0' Slope= 0.0300 '/'
Inlet Invert= 1,267.00', Outlet Invert= 1,247.95'





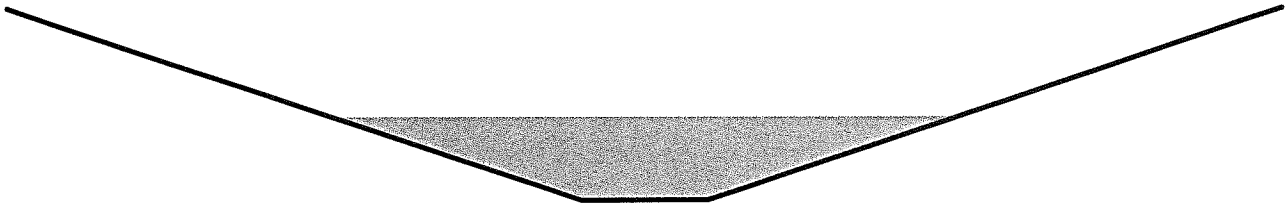
Summary for Reach CH-E1: Perimeter Channel E1

Inflow Area = 20.900 ac, 0.00% Impervious, Inflow Depth > 1.33" for 25 year event
Inflow = 41.34 cfs @ 12.02 hrs, Volume= 2.322 af
Outflow = 31.44 cfs @ 12.23 hrs, Volume= 2.289 af, Atten= 24%, Lag= 12.8 min

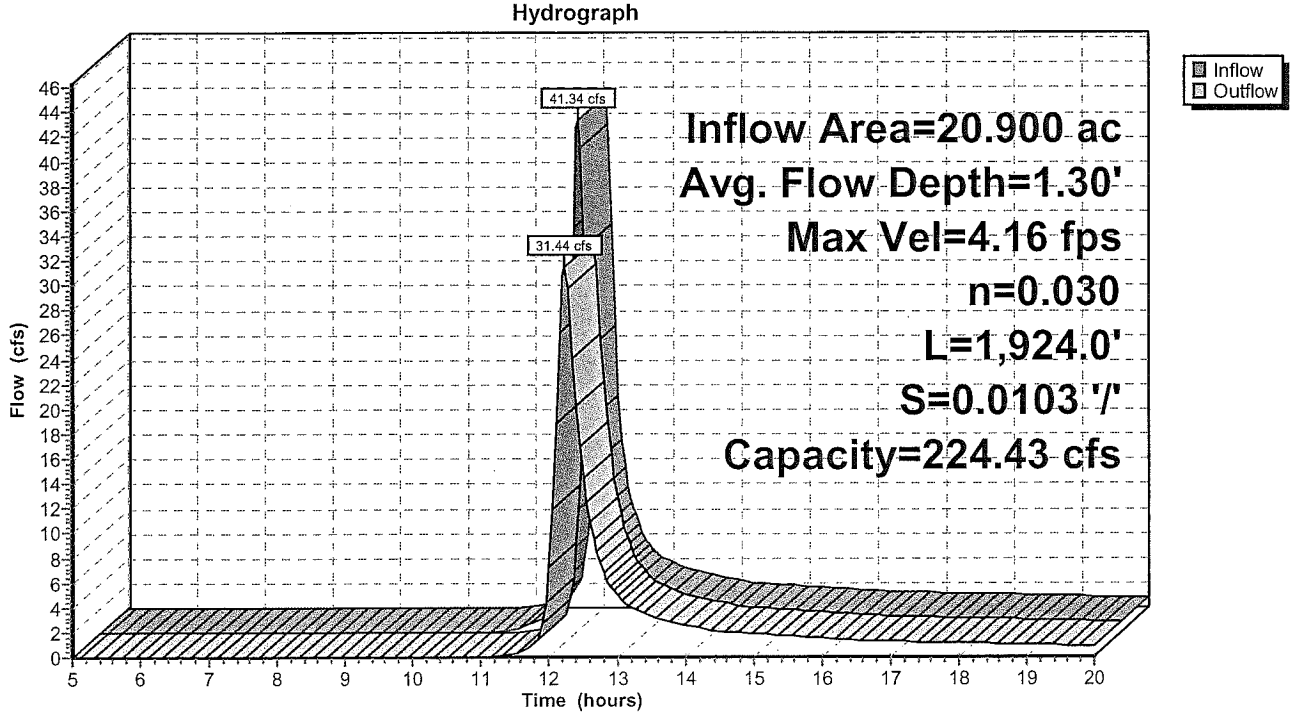
Routing by Stor-Ind+Trans method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Max. Velocity= 4.16 fps, Min. Travel Time= 7.7 min
Avg. Velocity = 1.85 fps, Avg. Travel Time= 17.3 min

Peak Storage= 14,838 cf @ 12.10 hrs
Average Depth at Peak Storage= 1.30'
Bank-Full Depth= 3.00' Flow Area= 33.0 sf, Capacity= 224.43 cfs

2.00' x 3.00' deep channel, n= 0.030 Earth, grassed & winding
Side Slope Z-value= 3.0 '/' Top Width= 20.00'
Length= 1,924.0' Slope= 0.0103 '/'
Inlet Invert= 1,243.40', Outlet Invert= 1,223.58'



Reach CH-E1: Perimeter Channel E1



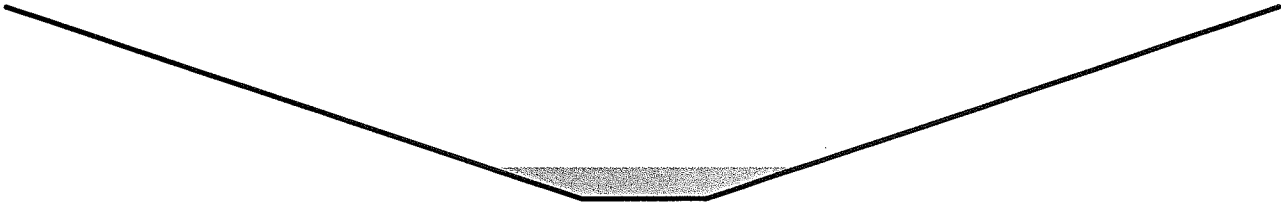
Summary for Reach CH-E2: Perimeter Channel E2

Inflow Area = 1.240 ac, 0.00% Impervious, Inflow Depth > 1.34" for 25 year event
Inflow = 3.19 cfs @ 11.98 hrs, Volume= 0.138 af
Outflow = 2.78 cfs @ 12.07 hrs, Volume= 0.137 af, Atten= 13%, Lag= 5.5 min

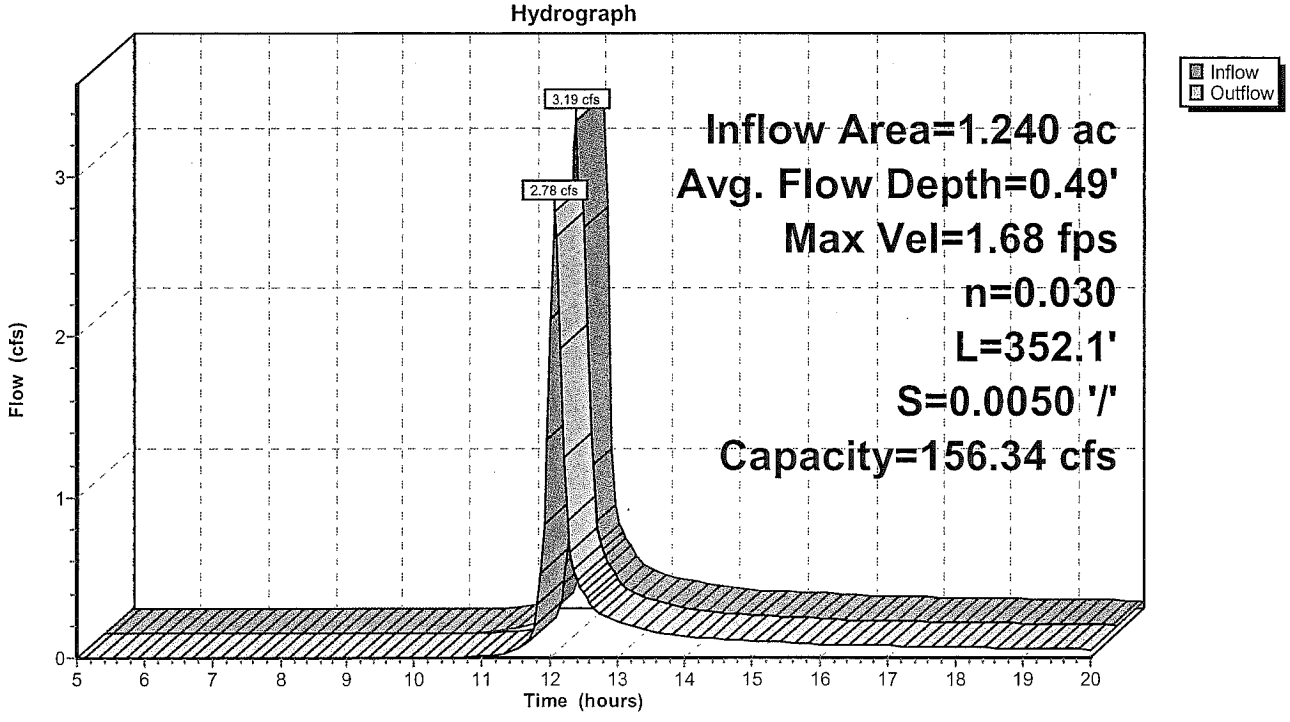
Routing by Stor-Ind+Trans method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Max. Velocity= 1.68 fps, Min. Travel Time= 3.5 min
Avg. Velocity = 0.60 fps, Avg. Travel Time= 9.7 min

Peak Storage= 597 cf @ 12.01 hrs
Average Depth at Peak Storage= 0.49'
Bank-Full Depth= 3.00' Flow Area= 33.0 sf, Capacity= 156.34 cfs

2.00' x 3.00' deep channel, n= 0.030
Side Slope Z-value= 3.0 '/' Top Width= 20.00'
Length= 352.1' Slope= 0.0050 '/'
Inlet Invert= 1,223.76', Outlet Invert= 1,222.00'



Reach CH-E2: Perimeter Channel E2



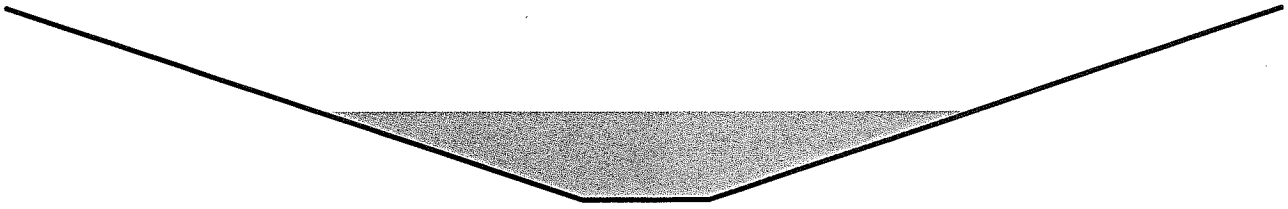
Summary for Reach CH-F2: Perimeter Channel F2

Inflow Area = 20.470 ac, 0.00% Impervious, Inflow Depth > 1.33" for 25 year event
Inflow = 41.19 cfs @ 12.04 hrs, Volume= 2.272 af
Outflow = 39.20 cfs @ 12.09 hrs, Volume= 2.264 af, Atten= 5%, Lag= 3.4 min

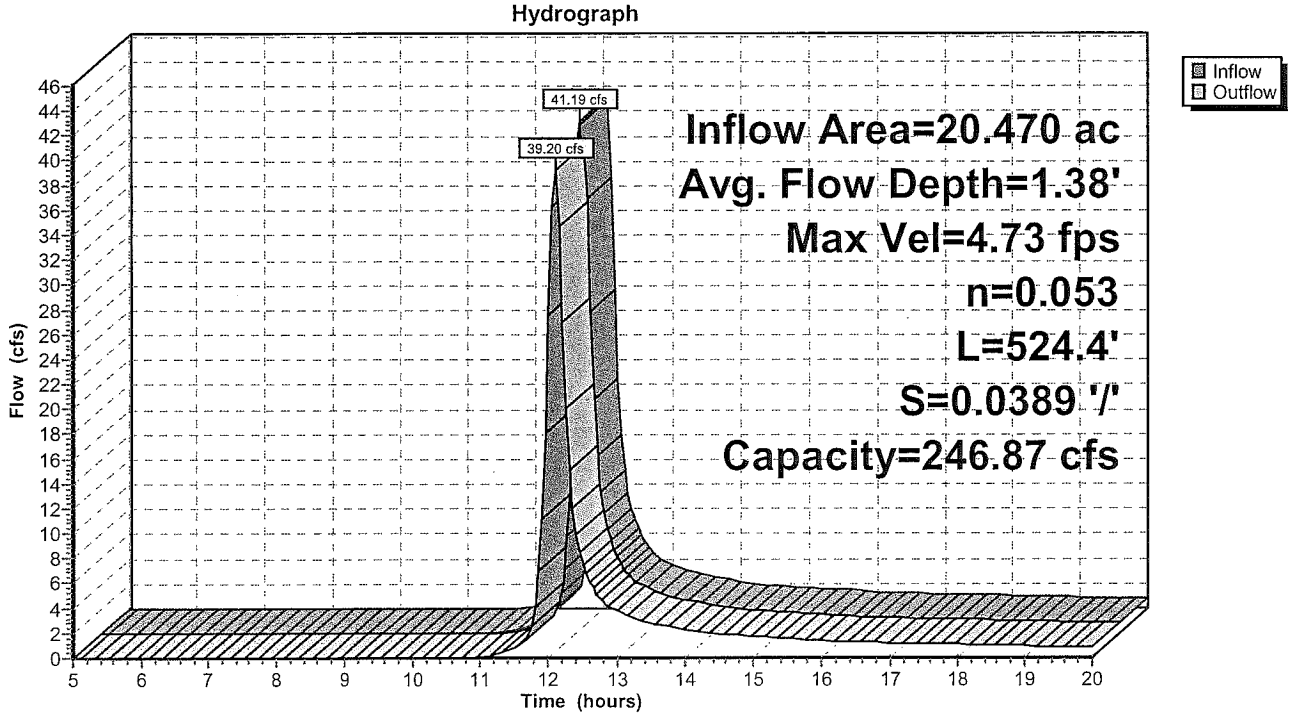
Routing by Stor-Ind+Trans method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Max. Velocity= 4.73 fps, Min. Travel Time= 1.8 min
Avg. Velocity = 1.97 fps, Avg. Travel Time= 4.4 min

Peak Storage= 4,463 cf @ 12.06 hrs
Average Depth at Peak Storage= 1.38'
Bank-Full Depth= 3.00' Flow Area= 33.0 sf, Capacity= 246.87 cfs

2.00' x 3.00' deep channel, n= 0.053
Side Slope Z-value= 3.0 '/' Top Width= 20.00'
Length= 524.4' Slope= 0.0389 '/'
Inlet Invert= 1,242.40', Outlet Invert= 1,222.00'



Reach CH-F2: Perimeter Channel F2



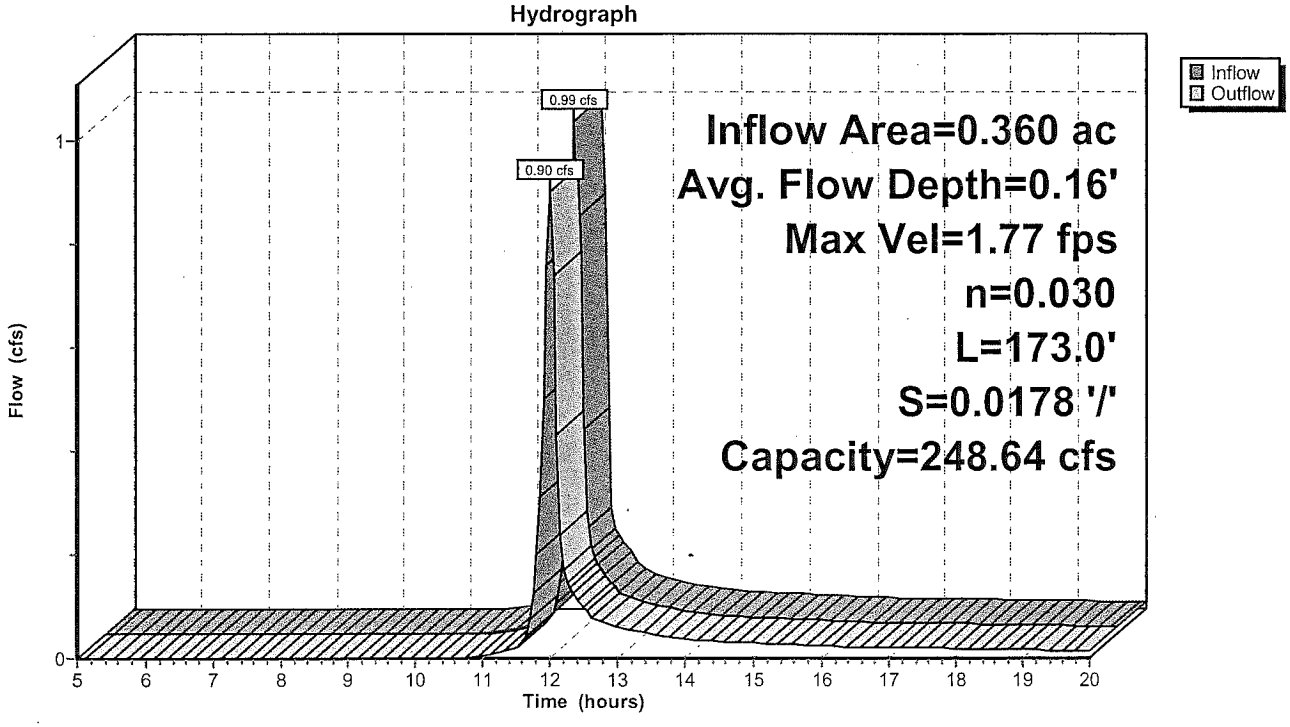
Summary for Reach CH-J1: Perimeter Channel J1

Inflow Area = 0.360 ac, 0.00% Impervious, Inflow Depth > 1.34" for 25 year event
Inflow = 0.99 cfs @ 11.95 hrs, Volume= 0.040 af
Outflow = 0.90 cfs @ 12.00 hrs, Volume= 0.040 af, Atten= 9%, Lag= 2.7 min

Routing by Stor-Ind+Trans method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Max. Velocity= 1.77 fps, Min. Travel Time= 1.6 min
Avg. Velocity = 0.67 fps, Avg. Travel Time= 4.3 min

Peak Storage= 90 cf @ 11.97 hrs
Average Depth at Peak Storage= 0.16'
Bank-Full Depth= 3.00' Flow Area= 27.0 sf, Capacity= 248.64 cfs

3.00' x 3.00' deep channel, n= 0.030
Side Slope Z-value= 2.0 '/' Top Width= 15.00'
Length= 173.0' Slope= 0.0178 '/'
Inlet Invert= 1,300.13', Outlet Invert= 1,297.05'



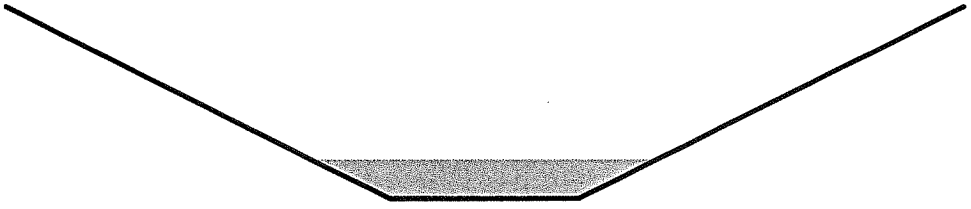
Summary for Reach CH-J2: Perimeter Channel J2

Inflow Area = 5.510 ac, 0.00% Impervious, Inflow Depth > 1.34" for 25 year event
Inflow = 14.50 cfs @ 11.96 hrs, Volume= 0.615 af
Outflow = 11.80 cfs @ 12.09 hrs, Volume= 0.608 af, Atten= 19%, Lag= 7.3 min

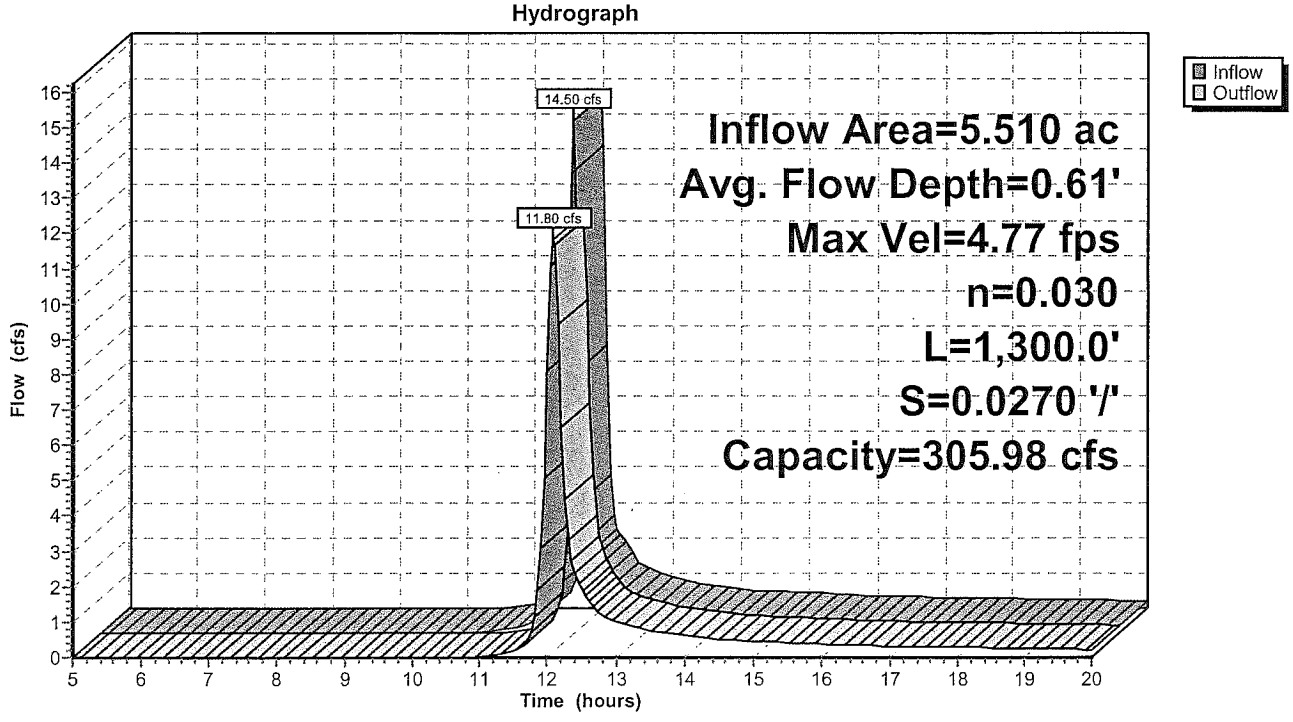
Routing by Stor-Ind+Trans method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Max. Velocity= 4.77 fps, Min. Travel Time= 4.5 min
Avg. Velocity = 1.61 fps, Avg. Travel Time= 13.5 min

Peak Storage= 3,358 cf @ 12.01 hrs
Average Depth at Peak Storage= 0.61'
Bank-Full Depth= 3.00' Flow Area= 27.0 sf, Capacity= 305.98 cfs

3.00' x 3.00' deep channel, n= 0.030
Side Slope Z-value= 2.0 '/' Top Width= 15.00'
Length= 1,300.0' Slope= 0.0270 '/'
Inlet Invert= 1,297.05', Outlet Invert= 1,262.00'



Reach CH-J2: Perimeter Channel J2



Summary for Reach CH-J3: Perimeter Channel J3

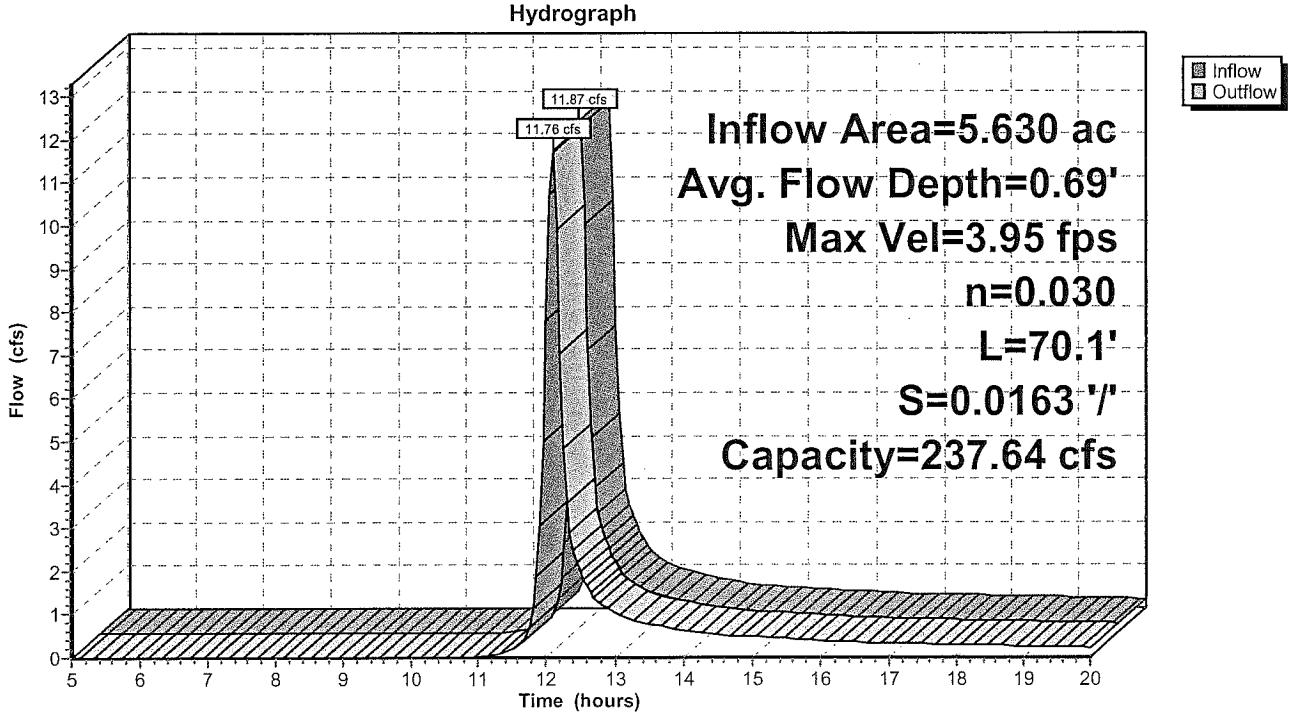
Inflow Area = 5.630 ac, 0.00% Impervious, Inflow Depth > 1.32" for 25 year event
Inflow = 11.87 cfs @ 12.08 hrs, Volume= 0.622 af
Outflow = 11.76 cfs @ 12.09 hrs, Volume= 0.621 af, Atten= 1%, Lag= 0.5 min

Routing by Stor-Ind+Trans method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Max. Velocity= 3.95 fps, Min. Travel Time= 0.3 min
Avg. Velocity = 1.37 fps, Avg. Travel Time= 0.9 min

Peak Storage= 211 cf @ 12.09 hrs
Average Depth at Peak Storage= 0.69'
Bank-Full Depth= 3.00' Flow Area= 27.0 sf, Capacity= 237.64 cfs

3.00' x 3.00' deep channel, n= 0.030
Side Slope Z-value= 2.0 '/' Top Width= 15.00'
Length= 70.1' Slope= 0.0163 '/'
Inlet Invert= 1,262.00', Outlet Invert= 1,260.86'

Reach CH-J3: Perimeter Channel J3



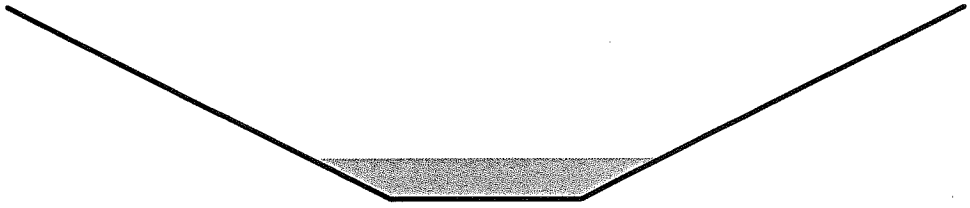
Summary for Reach CH-J4: Perimeter Channel J4

Inflow Area = 6.200 ac, 0.00% Impervious, Inflow Depth > 1.33" for 25 year event
Inflow = 12.17 cfs @ 12.09 hrs, Volume= 0.685 af
Outflow = 11.91 cfs @ 12.10 hrs, Volume= 0.684 af, Atten= 2%, Lag= 1.0 min

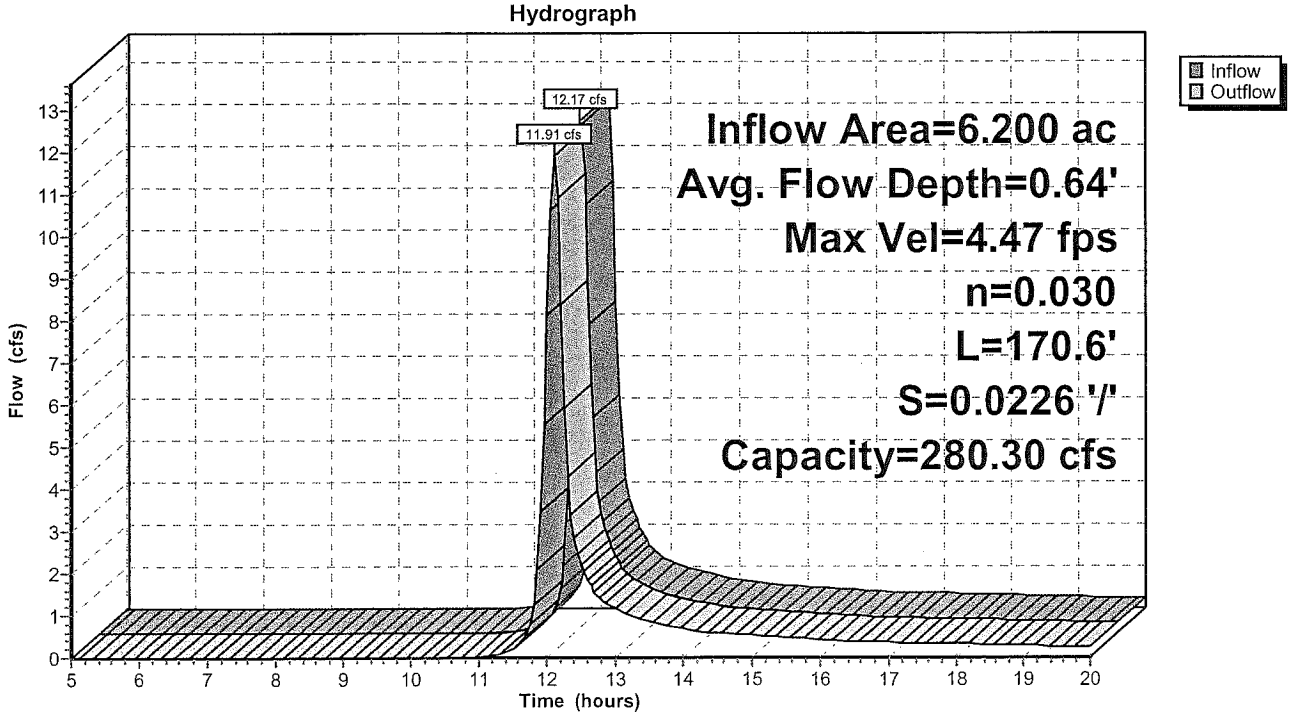
Routing by Stor-Ind+Trans method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Max. Velocity= 4.47 fps, Min. Travel Time= 0.6 min
Avg. Velocity = 1.58 fps, Avg. Travel Time= 1.8 min

Peak Storage= 463 cf @ 12.09 hrs
Average Depth at Peak Storage= 0.64'
Bank-Full Depth= 3.00' Flow Area= 27.0 sf, Capacity= 280.30 cfs

3.00' x 3.00' deep channel, n= 0.030
Side Slope Z-value= 2.0 '/' Top Width= 15.00'
Length= 170.6' Slope= 0.0226 '/'
Inlet Invert= 1,260.86', Outlet Invert= 1,257.00'



Reach CH-J4: Perimeter Channel J4



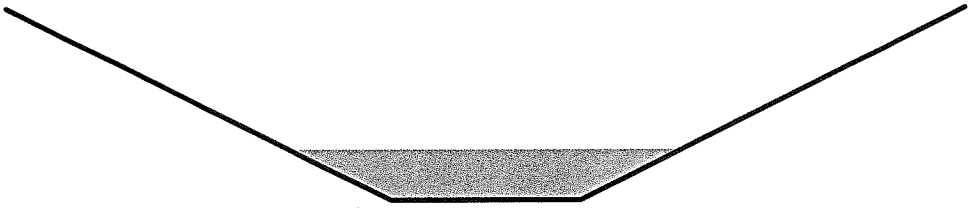
Summary for Reach CH-J5: Perimeter Channel J5

Inflow Area = 6.890 ac, 0.00% Impervious, Inflow Depth > 1.33" for 25 year event
Inflow = 12.34 cfs @ 12.10 hrs, Volume= 0.761 af
Outflow = 12.03 cfs @ 12.12 hrs, Volume= 0.759 af, Atten= 3%, Lag= 1.5 min

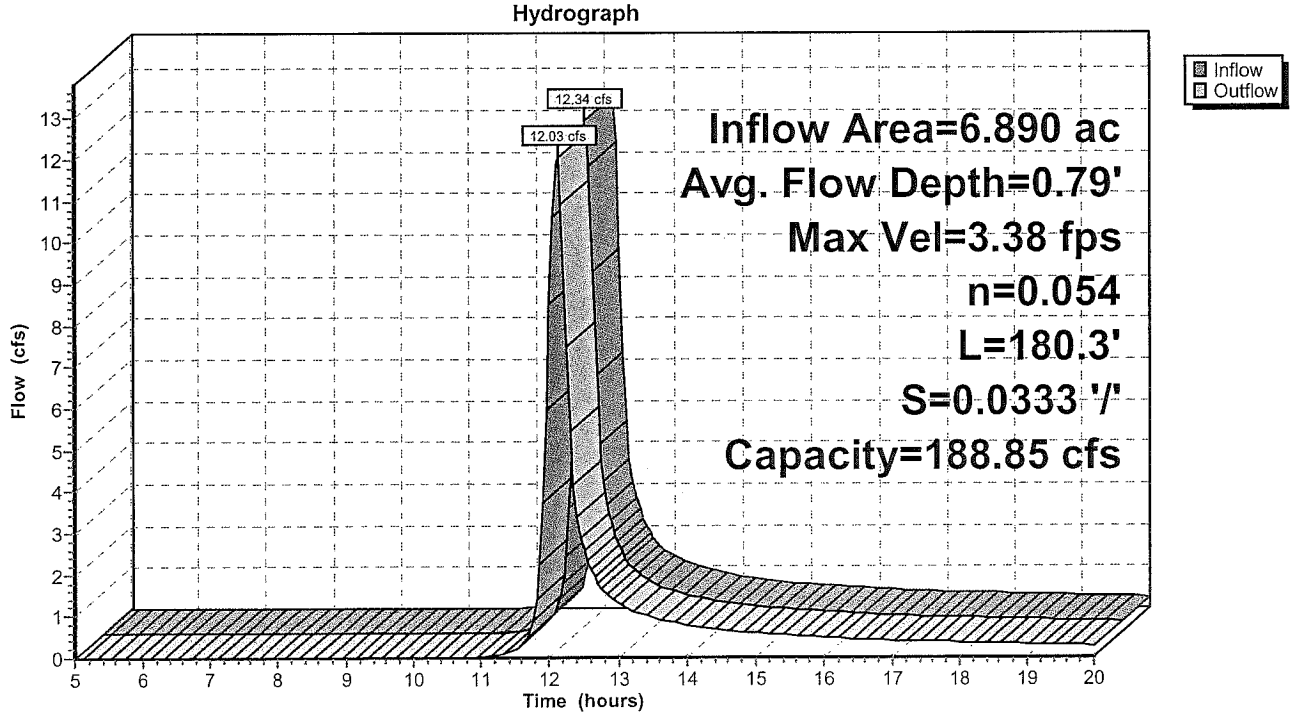
Routing by Stor-Ind+Trans method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Max. Velocity= 3.38 fps, Min. Travel Time= 0.9 min
Avg. Velocity = 1.26 fps, Avg. Travel Time= 2.4 min

Peak Storage= 652 cf @ 12.11 hrs
Average Depth at Peak Storage= 0.79'
Bank-Full Depth= 3.00' Flow Area= 27.0 sf, Capacity= 188.85 cfs

3.00' x 3.00' deep channel, n= 0.054
Side Slope Z-value= 2.0 '/' Top Width= 15.00'
Length= 180.3' Slope= 0.0333 '/'
Inlet Invert= 1,257.00', Outlet Invert= 1,251.00'



Reach CH-J5: Perimeter Channel J5



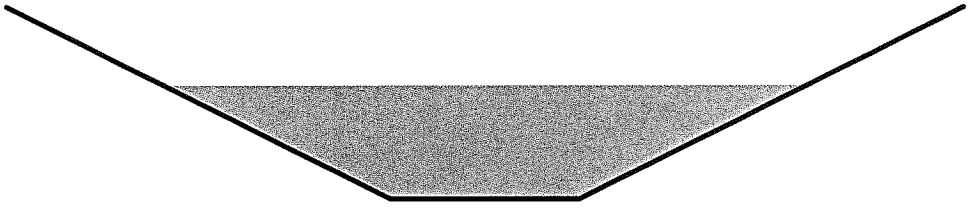
Summary for Reach CH-J6: Perimeter Channel J6

Inflow Area = 27.870 ac, 0.00% Impervious, Inflow Depth > 1.33" for 25 year event
Inflow = 54.89 cfs @ 12.07 hrs, Volume= 3.086 af
Outflow = 53.49 cfs @ 12.09 hrs, Volume= 3.081 af, Atten= 3%, Lag= 1.6 min

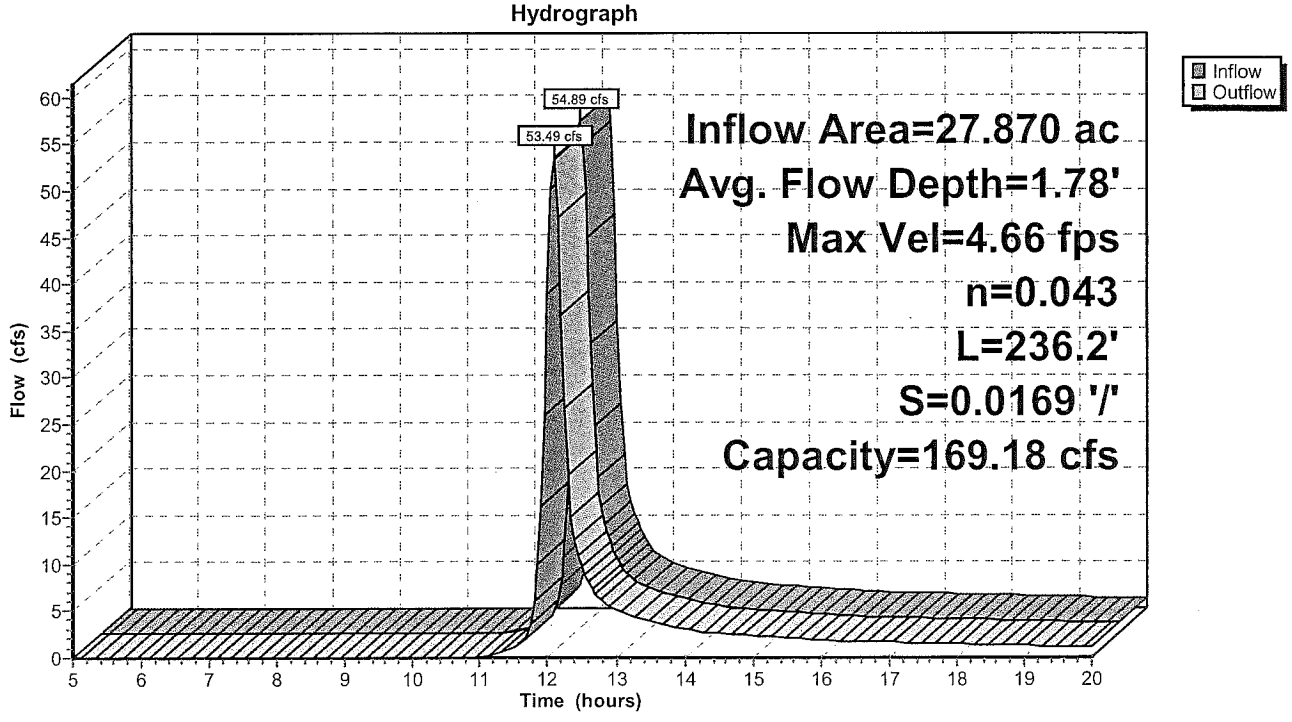
Routing by Stor-Ind+Trans method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Max. Velocity= 4.66 fps, Min. Travel Time= 0.8 min
Avg. Velocity = 1.86 fps, Avg. Travel Time= 2.1 min

Peak Storage= 2,746 cf @ 12.08 hrs
Average Depth at Peak Storage= 1.78'
Bank-Full Depth= 3.00' Flow Area= 27.0 sf, Capacity= 169.18 cfs

3.00' x 3.00' deep channel, n= 0.043
Side Slope Z-value= 2.0 '/' Top Width= 15.00'
Length= 236.2' Slope= 0.0169 '/'
Inlet Invert= 1,251.00', Outlet Invert= 1,247.00'



Reach CH-J6: Perimeter Channel J6



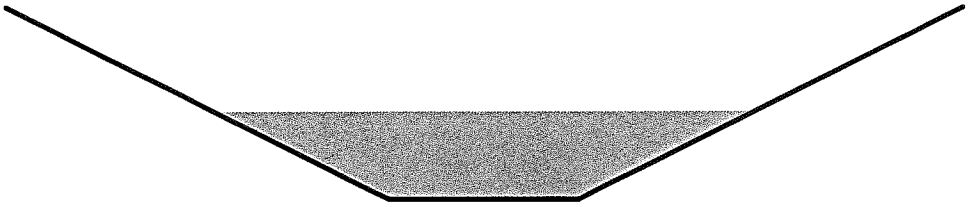
Summary for Reach CH-J7: Perimeter Channel J7

Inflow Area = 29.350 ac, 0.00% Impervious, Inflow Depth > 1.33" for 25 year event
Inflow = 54.99 cfs @ 12.09 hrs, Volume= 3.246 af
Outflow = 54.73 cfs @ 12.09 hrs, Volume= 3.245 af, Atten= 0%, Lag= 0.4 min

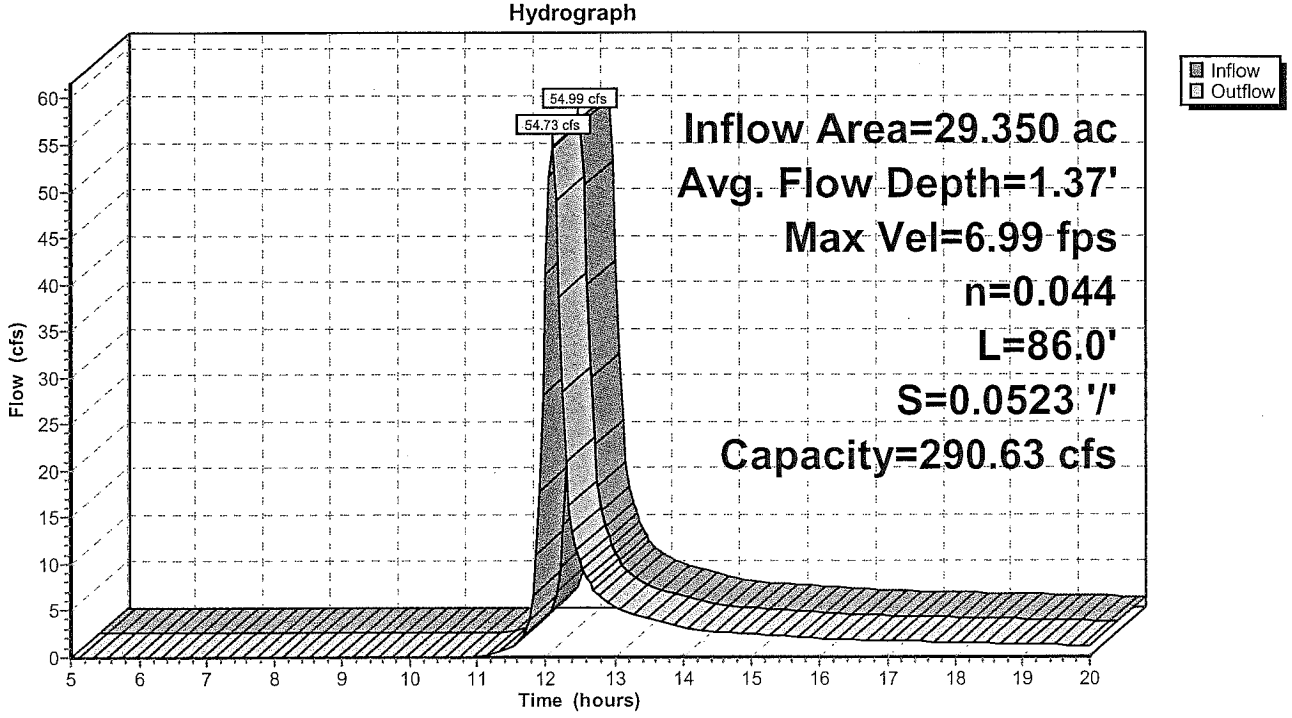
Routing by Stor-Ind+Trans method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Max. Velocity= 6.99 fps, Min. Travel Time= 0.2 min
Avg. Velocity = 2.73 fps, Avg. Travel Time= 0.5 min

Peak Storage= 676 cf @ 12.09 hrs
Average Depth at Peak Storage= 1.37'
Bank-Full Depth= 3.00' Flow Area= 27.0 sf, Capacity= 290.63 cfs

3.00' x 3.00' deep channel, n= 0.044
Side Slope Z-value= 2.0 '/' Top Width= 15.00'
Length= 86.0' Slope= 0.0523 '/'
Inlet Invert= 1,247.00', Outlet Invert= 1,242.50'



Reach CH-J7: Perimeter Channel J7



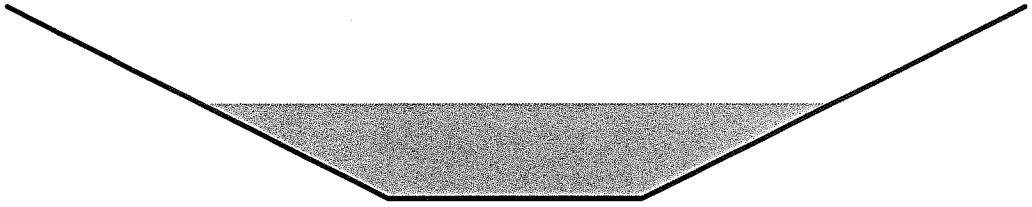
Summary for Reach D-C2: Discharge Channel C2

Inflow Area = 53.220 ac, 0.00% Impervious, Inflow Depth > 1.32" for 25 year event
Inflow = 94.65 cfs @ 12.11 hrs, Volume= 5.876 af
Outflow = 92.81 cfs @ 12.14 hrs, Volume= 5.866 af, Atten= 2%, Lag= 1.5 min

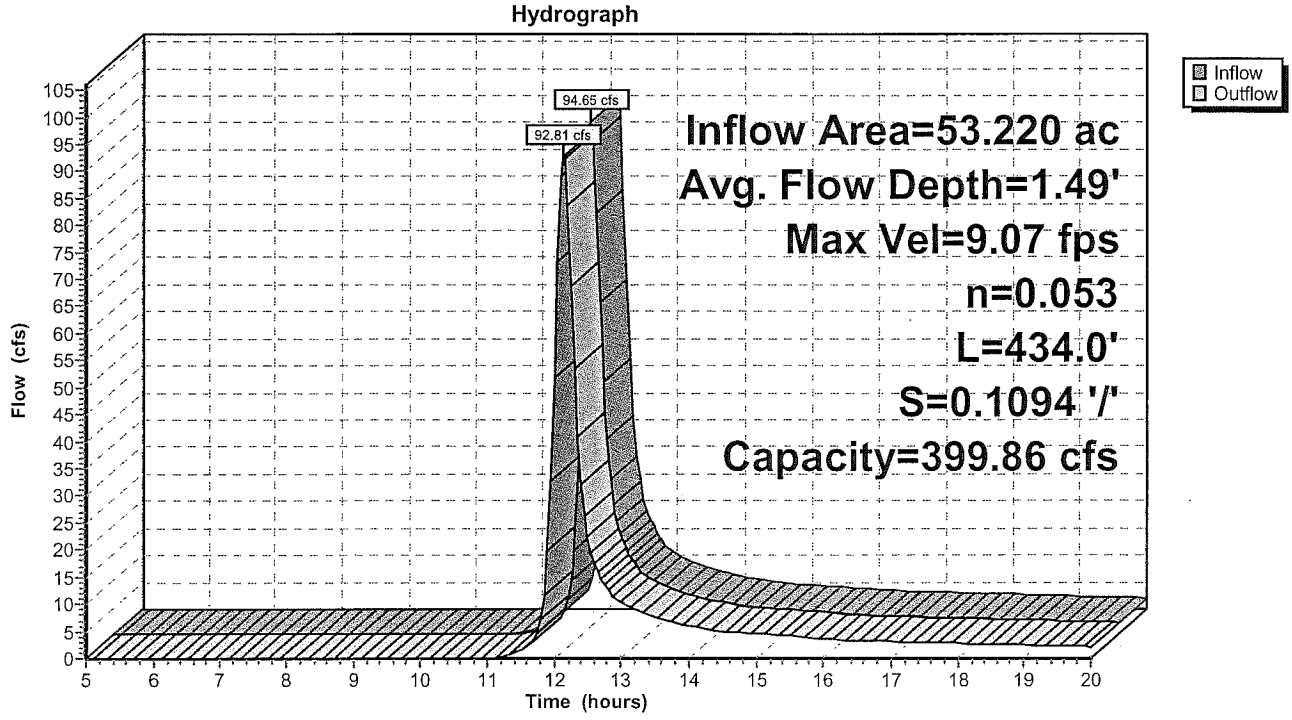
Routing by Stor-Ind+Trans method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Max. Velocity= 9.07 fps, Min. Travel Time= 0.8 min
Avg. Velocity = 3.51 fps, Avg. Travel Time= 2.1 min

Peak Storage= 4,497 cf @ 12.12 hrs
Average Depth at Peak Storage= 1.49'
Bank-Full Depth= 3.00' Flow Area= 30.0 sf, Capacity= 399.86 cfs

4.00' x 3.00' deep channel, n= 0.053
Side Slope Z-value= 2.0 '/' Top Width= 16.00'
Length= 434.0' Slope= 0.1094 '/'
Inlet Invert= 1,212.50', Outlet Invert= 1,165.00'



Reach D-C2: Discharge Channel C2



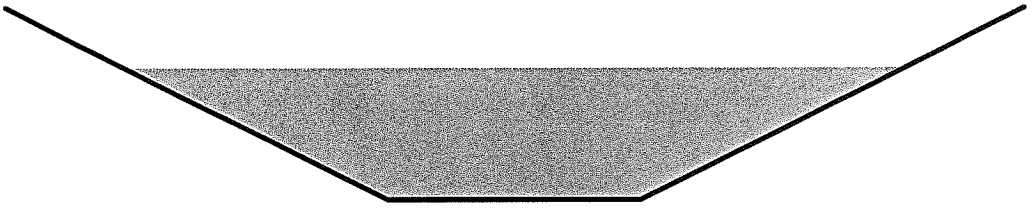
Summary for Reach D-C3: Discharge Channel C3

Inflow Area = 53.220 ac, 0.00% Impervious, Inflow Depth > 1.32" for 25 year event
Inflow = 92.81 cfs @ 12.14 hrs, Volume= 5.866 af
Outflow = 91.89 cfs @ 12.15 hrs, Volume= 5.860 af, Atten= 1%, Lag= 0.9 min

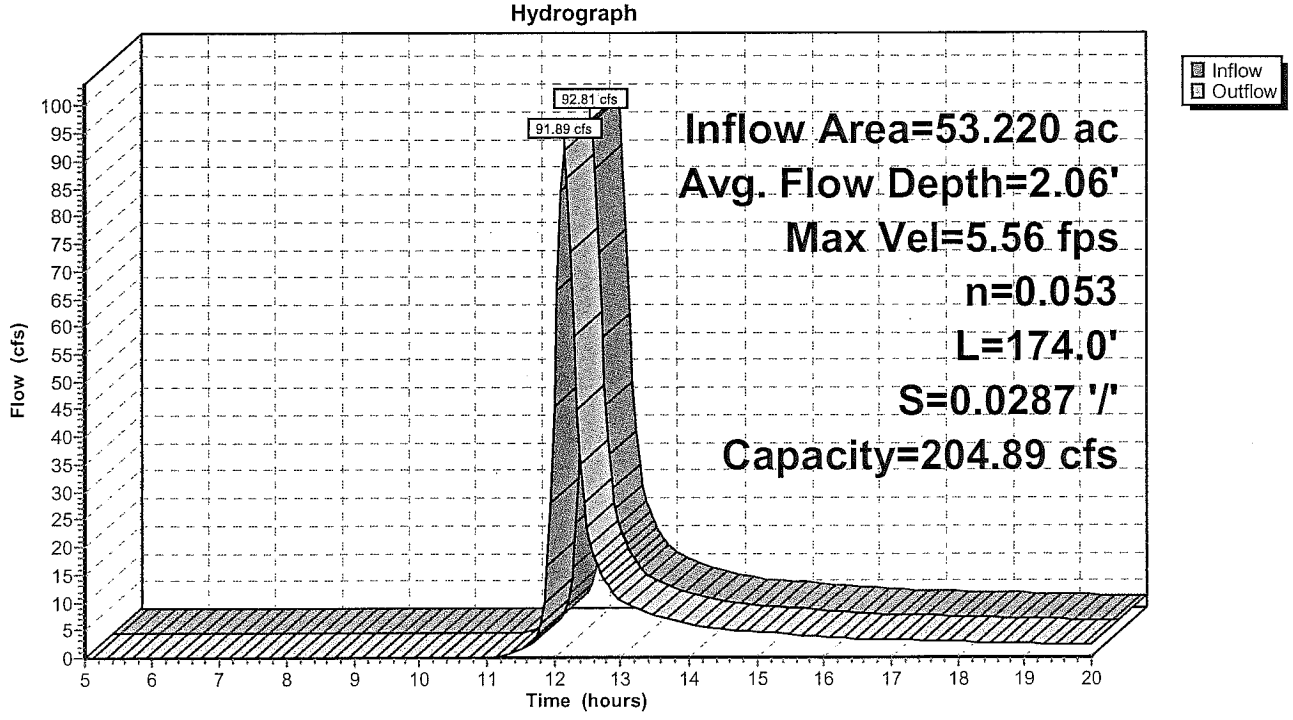
Routing by Stor-Ind+Trans method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Max. Velocity= 5.56 fps, Min. Travel Time= 0.5 min
Avg. Velocity = 2.24 fps, Avg. Travel Time= 1.3 min

Peak Storage= 2,905 cf @ 12.15 hrs
Average Depth at Peak Storage= 2.06'
Bank-Full Depth= 3.00' Flow Area= 30.0 sf, Capacity= 204.89 cfs

4.00' x 3.00' deep channel, n= 0.053
Side Slope Z-value= 2.0 '/' Top Width= 16.00'
Length= 174.0' Slope= 0.0287 '/'
Inlet Invert= 1,165.00', Outlet Invert= 1,160.00'



Reach D-C3: Discharge Channel C3



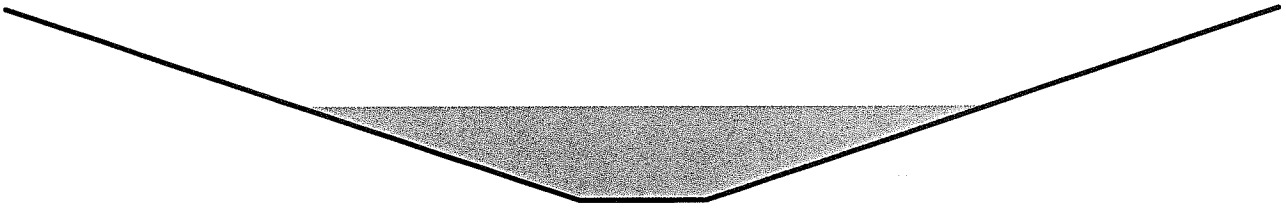
Summary for Reach D-F1: Diversion Channel F1

Inflow Area = 29.650 ac, 0.00% Impervious, Inflow Depth > 1.33" for 25 year event
Inflow = 55.28 cfs @ 12.09 hrs, Volume= 3.278 af
Outflow = 53.99 cfs @ 12.12 hrs, Volume= 3.272 af, Atten= 2%, Lag= 1.7 min

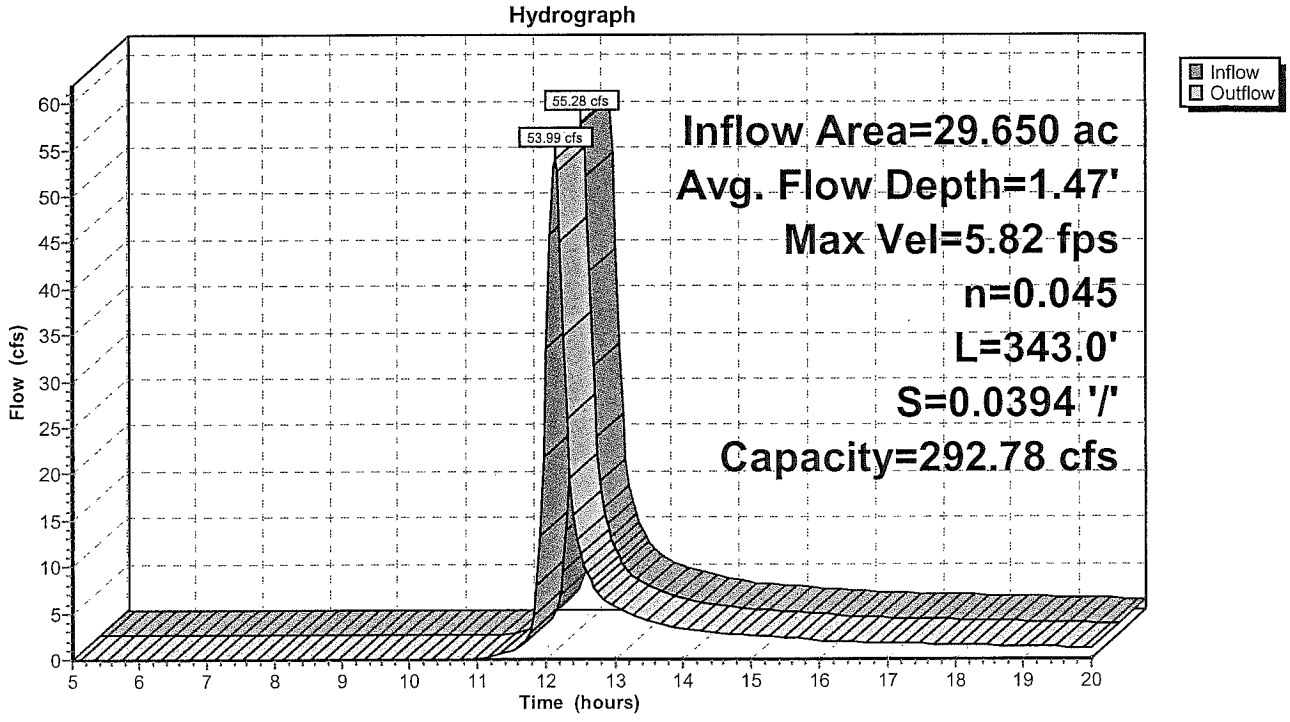
Routing by Stor-Ind+Trans method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Max. Velocity= 5.82 fps, Min. Travel Time= 1.0 min
Avg. Velocity = 2.47 fps, Avg. Travel Time= 2.3 min

Peak Storage= 3,245 cf @ 12.10 hrs
Average Depth at Peak Storage= 1.47'
Bank-Full Depth= 3.00' Flow Area= 33.0 sf, Capacity= 292.78 cfs

2.00' x 3.00' deep channel, n= 0.045
Side Slope Z-value= 3.0 '/' Top Width= 20.00'
Length= 343.0' Slope= 0.0394 '/'
Inlet Invert= 1,241.00', Outlet Invert= 1,227.47'



Reach D-F1: Diversion Channel F1



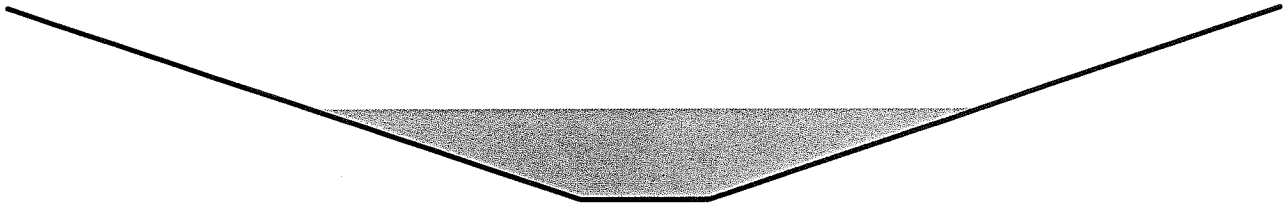
Summary for Reach D-H1: Discharge Channel H1

Inflow Area = 47.610 ac, 0.00% Impervious, Inflow Depth > 1.32" for 25 year event
Inflow = 71.46 cfs @ 12.14 hrs, Volume= 5.251 af
Outflow = 71.16 cfs @ 12.15 hrs, Volume= 5.248 af, Atten= 0%, Lag= 0.5 min

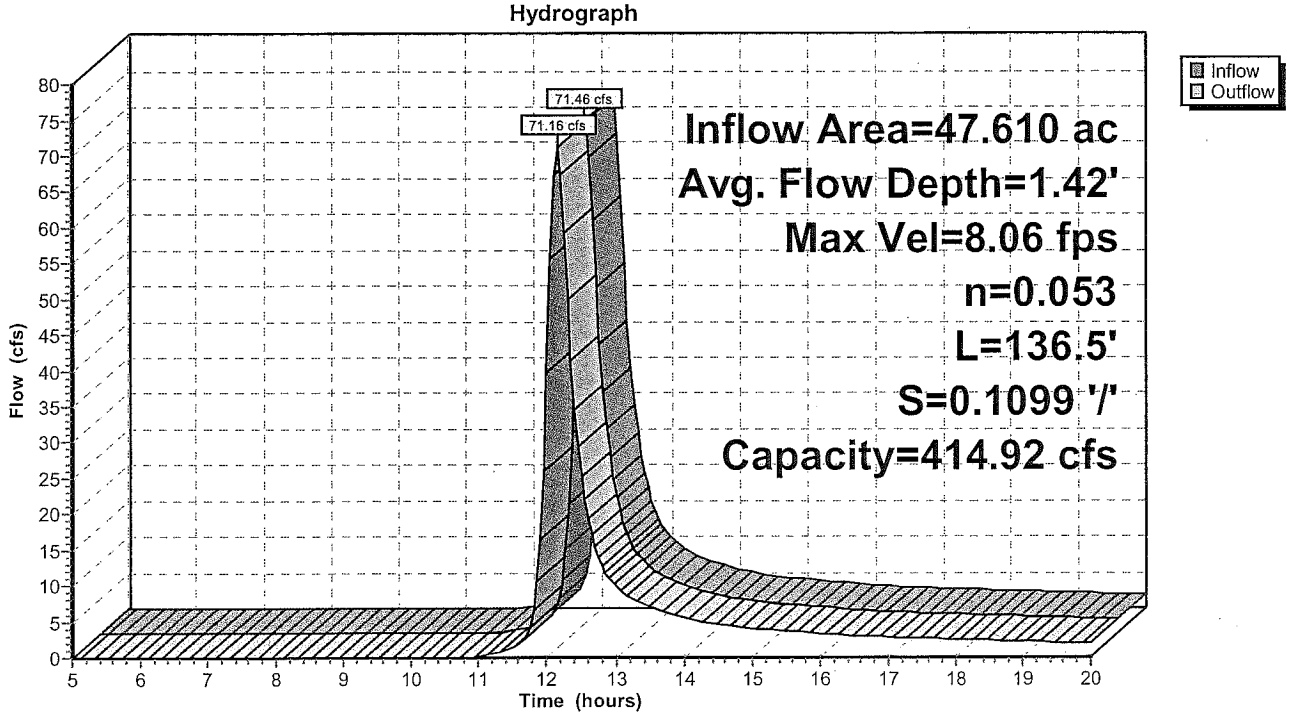
Routing by Stor-Ind+Trans method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Max. Velocity= 8.06 fps, Min. Travel Time= 0.3 min
Avg. Velocity = 3.68 fps, Avg. Travel Time= 0.6 min

Peak Storage= 1,210 cf @ 12.15 hrs
Average Depth at Peak Storage= 1.42'
Bank-Full Depth= 3.00' Flow Area= 33.0 sf, Capacity= 414.92 cfs

2.00' x 3.00' deep channel, n= 0.053
Side Slope Z-value= 3.0 '/' Top Width= 20.00'
Length= 136.5' Slope= 0.1099 '/'
Inlet Invert= 1,215.00', Outlet Invert= 1,200.00'



Reach D-H1: Discharge Channel H1



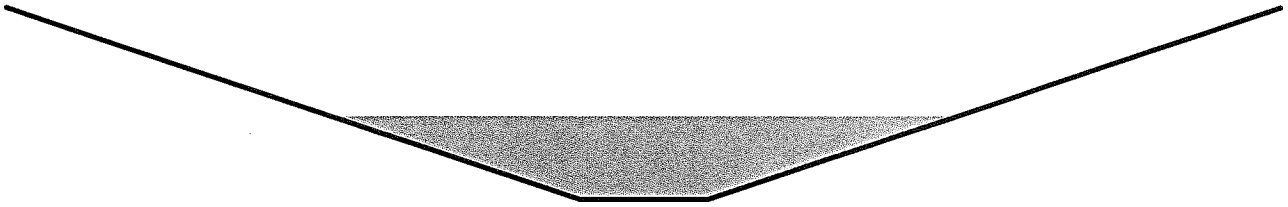
Summary for Reach D-H2: Discharge Channel H2

Inflow Area = 47.610 ac, 0.00% Impervious, Inflow Depth > 1.32" for 25 year event
Inflow = 71.16 cfs @ 12.15 hrs, Volume= 5.248 af
Outflow = 70.70 cfs @ 12.16 hrs, Volume= 5.244 af, Atten= 1%, Lag= 0.8 min

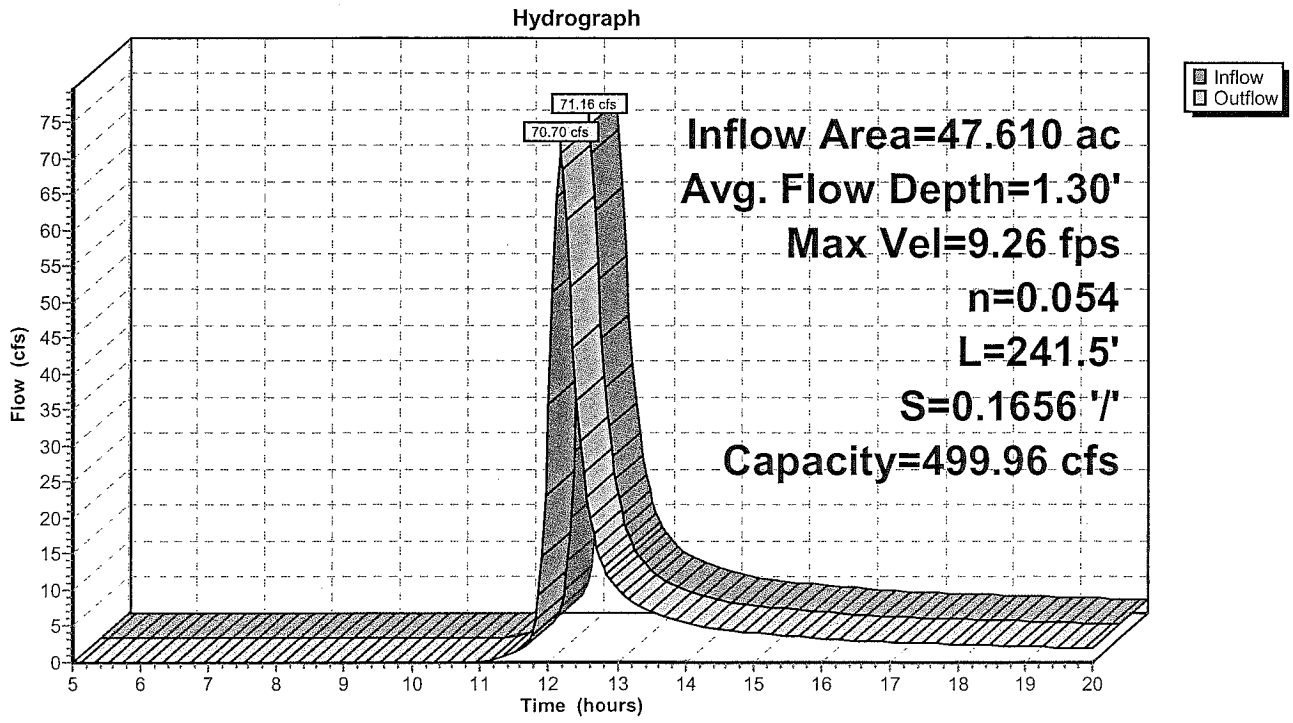
Routing by Stor-Ind+Trans method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Max. Velocity= 9.26 fps, Min. Travel Time= 0.4 min
Avg. Velocity = 4.22 fps, Avg. Travel Time= 1.0 min

Peak Storage= 1,857 cf @ 12.16 hrs
Average Depth at Peak Storage= 1.30'
Bank-Full Depth= 3.00' Flow Area= 33.0 sf, Capacity= 499.96 cfs

2.00' x 3.00' deep channel, n= 0.054
Side Slope Z-value= 3.0 '/' Top Width= 20.00'
Length= 241.5' Slope= 0.1656 '/'
Inlet Invert= 1,200.00', Outlet Invert= 1,160.00'



Reach D-H2: Discharge Channel H2



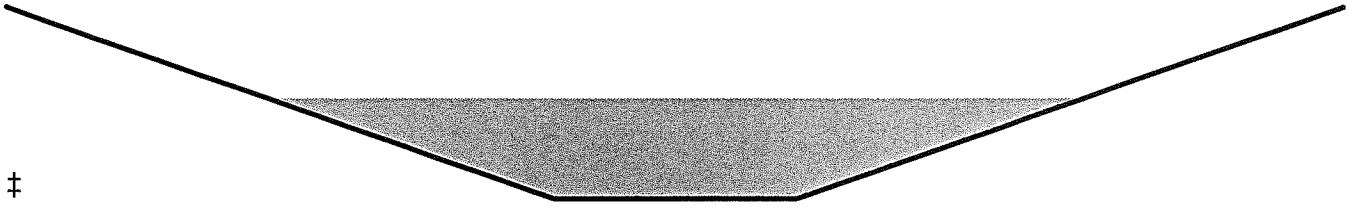
Summary for Reach D-H3: Discharge Channel H3

Inflow Area = 100.830 ac, 0.00% Impervious, Inflow Depth > 1.32" for 25 year event
Inflow = 162.52 cfs @ 12.16 hrs, Volume= 11.104 af
Outflow = 161.94 cfs @ 12.16 hrs, Volume= 11.100 af, Atten= 0%, Lag= 0.3 min

Routing by Stor-Ind+Trans method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Max. Velocity= 11.90 fps, Min. Travel Time= 0.2 min
Avg. Velocity = 5.00 fps, Avg. Travel Time= 0.4 min

Peak Storage= 1,768 cf @ 12.16 hrs
Average Depth at Peak Storage= 1.57'
Bank-Full Depth= 3.00' Flow Area= 39.0 sf, Capacity= 669.25 cfs

4.00' x 3.00' deep channel, n= 0.060
Side Slope Z-value= 3.0 '/' Top Width= 22.00'
Length= 129.5' Slope= 0.2371 '/'
Inlet Invert= 1,160.00', Outlet Invert= 1,129.30'



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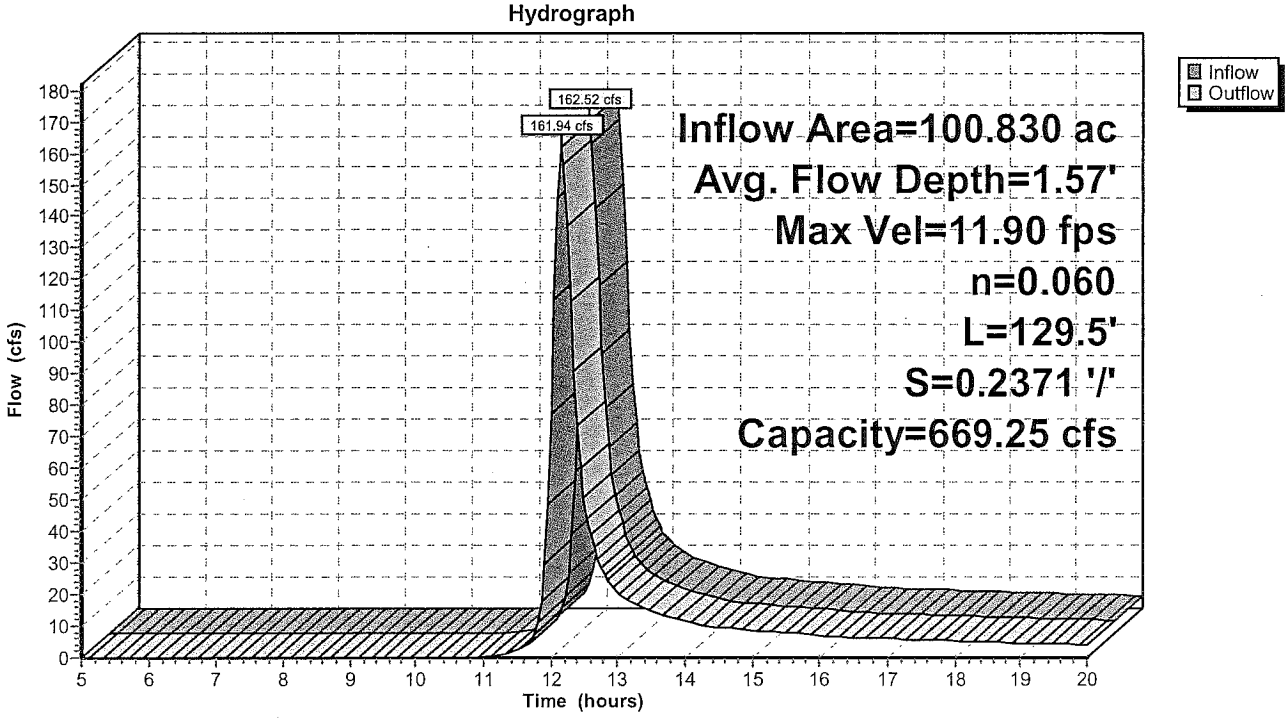
Reach D-H3: Discharge Channel H3



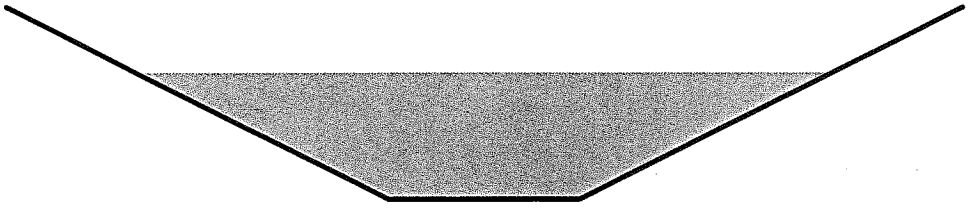
Summary for Reach D-Z1: Discharge Channel Z1

Inflow Area = 30.160 ac, 0.00% Impervious, Inflow Depth > 1.32" for 25 year event
Inflow = 54.23 cfs @ 12.12 hrs, Volume= 3.329 af
Outflow = 53.35 cfs @ 12.14 hrs, Volume= 3.324 af, Atten= 2%, Lag= 1.3 min

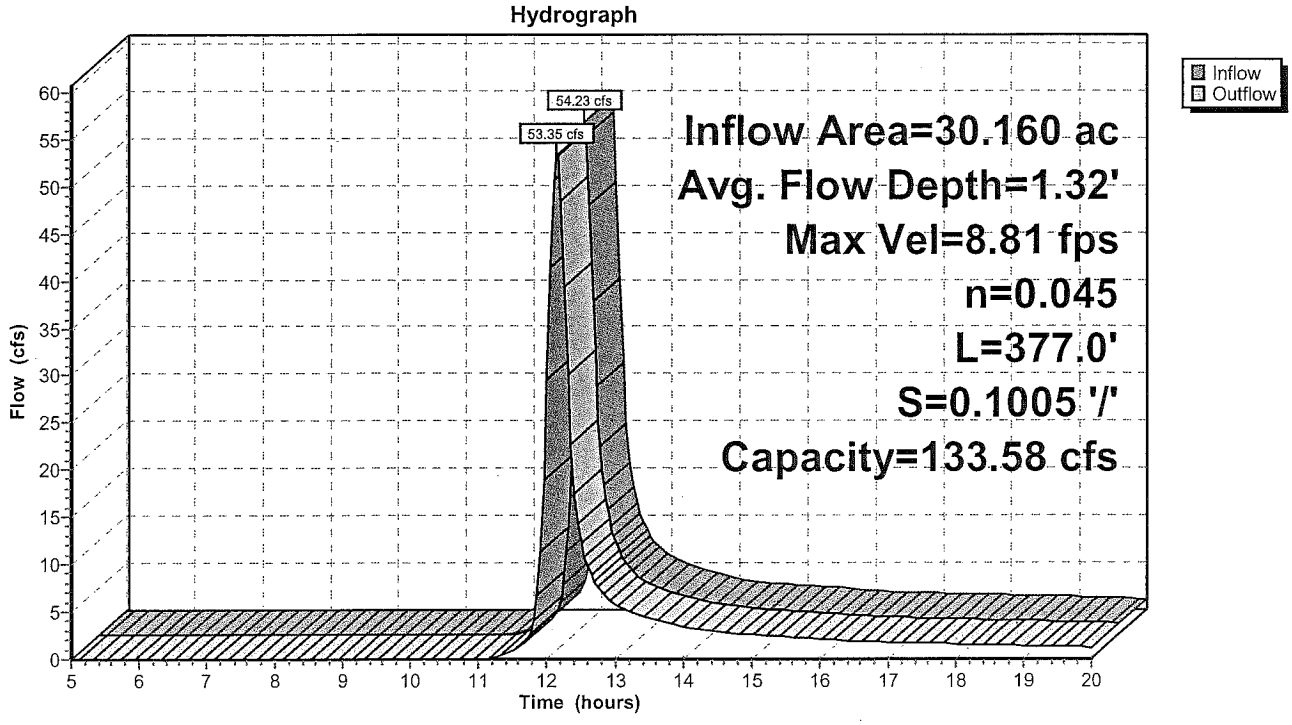
Routing by Stor-Ind+Trans method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Max. Velocity= 8.81 fps, Min. Travel Time= 0.7 min
Avg. Velocity = 3.62 fps, Avg. Travel Time= 1.7 min

Peak Storage= 2,307 cf @ 12.13 hrs
Average Depth at Peak Storage= 1.32'
Bank-Full Depth= 2.00' Flow Area= 12.0 sf, Capacity= 133.58 cfs

2.00' x 2.00' deep channel, n= 0.045
Side Slope Z-value= 2.0 '/' Top Width= 10.00'
Length= 377.0' Slope= 0.1005 '/'
Inlet Invert= 1,210.32', Outlet Invert= 1,172.43'



Reach D-Z1: Discharge Channel Z1



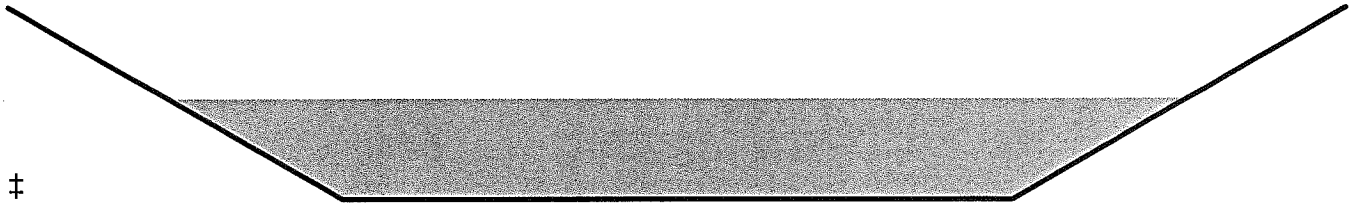
Summary for Reach DC4-1: DC4-1

Inflow Area = 9.340 ac, 0.00% Impervious, Inflow Depth > 1.34" for 25 year event
Inflow = 22.39 cfs @ 12.00 hrs, Volume= 1.041 af
Outflow = 22.08 cfs @ 12.01 hrs, Volume= 1.041 af, Atten= 1%, Lag= 0.3 min

Routing by Stor-Ind+Trans method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Max. Velocity= 3.75 fps, Min. Travel Time= 0.2 min
Avg. Velocity = 1.15 fps, Avg. Travel Time= 0.7 min

Peak Storage= 298 cf @ 12.00 hrs
Average Depth at Peak Storage= 0.79'
Bank-Full Depth= 1.50' Flow Area= 13.5 sf, Capacity= 71.96 cfs

6.00' x 1.50' deep channel, n= 0.066
Side Slope Z-value= 2.0 '/' Top Width= 12.00'
Length= 49.9' Slope= 0.0517 '/'
Inlet Invert= 1,392.51', Outlet Invert= 1,389.93'



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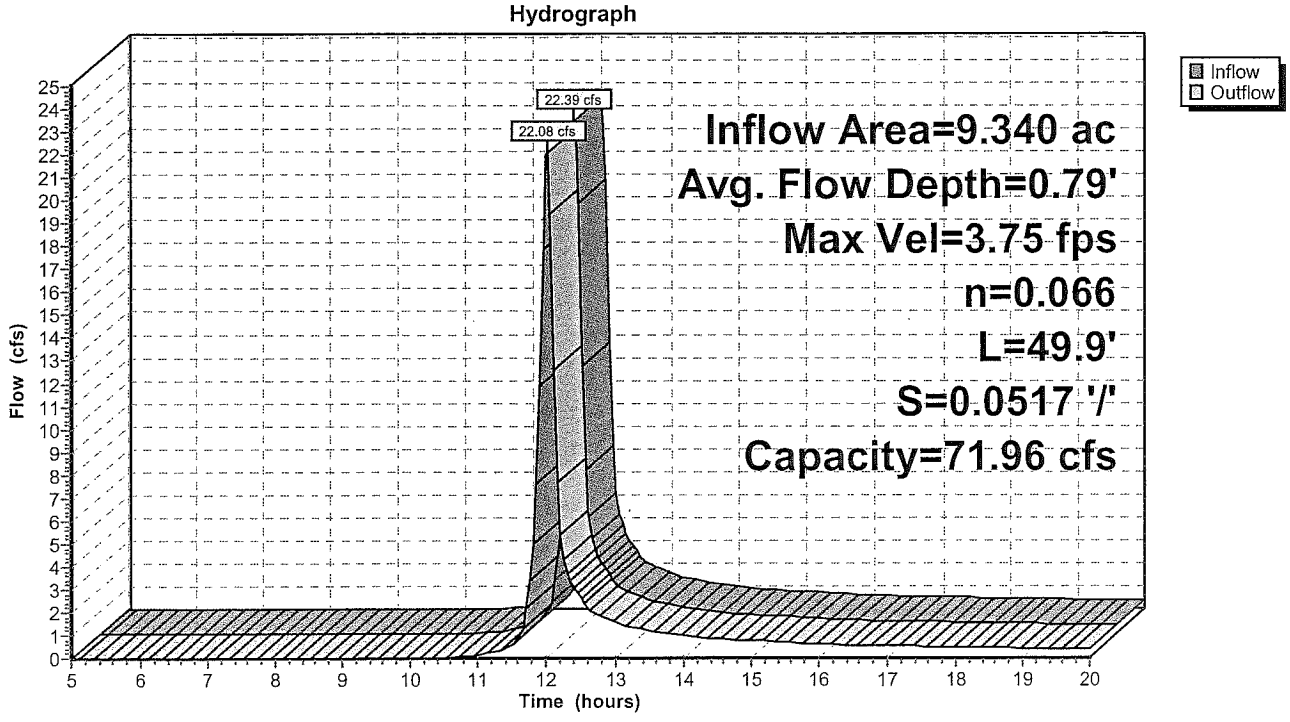
Reach DC4-1: DC4-1



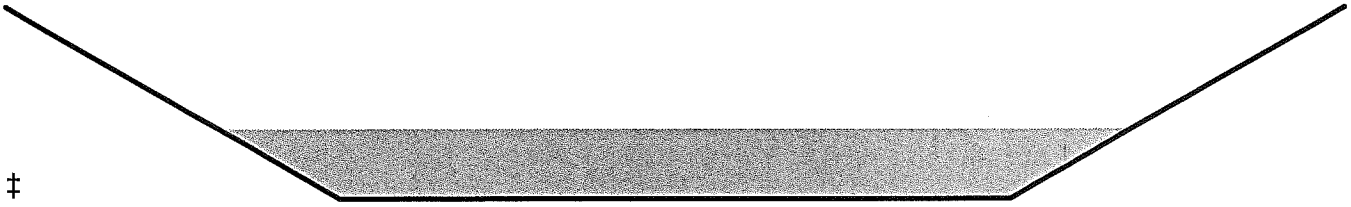
Summary for Reach DC4-2: DC4-2

Inflow Area = 9.340 ac, 0.00% Impervious, Inflow Depth > 1.34" for 25 year event
Inflow = 22.08 cfs @ 12.01 hrs, Volume= 1.041 af
Outflow = 20.60 cfs @ 12.06 hrs, Volume= 1.036 af, Atten= 7%, Lag= 3.1 min

Routing by Stor-Ind+Trans method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Max. Velocity= 5.46 fps, Min. Travel Time= 1.8 min
Avg. Velocity = 1.67 fps, Avg. Travel Time= 5.8 min

Peak Storage= 2,269 cf @ 12.03 hrs
Average Depth at Peak Storage= 0.55'
Bank-Full Depth= 1.50' Flow Area= 13.5 sf, Capacity= 130.43 cfs

6.00' x 1.50' deep channel, n= 0.080
Side Slope Z-value= 2.0 '/' Top Width= 12.00'
Length= 587.1' Slope= 0.2496 '/'
Inlet Invert= 1,389.93', Outlet Invert= 1,243.40'



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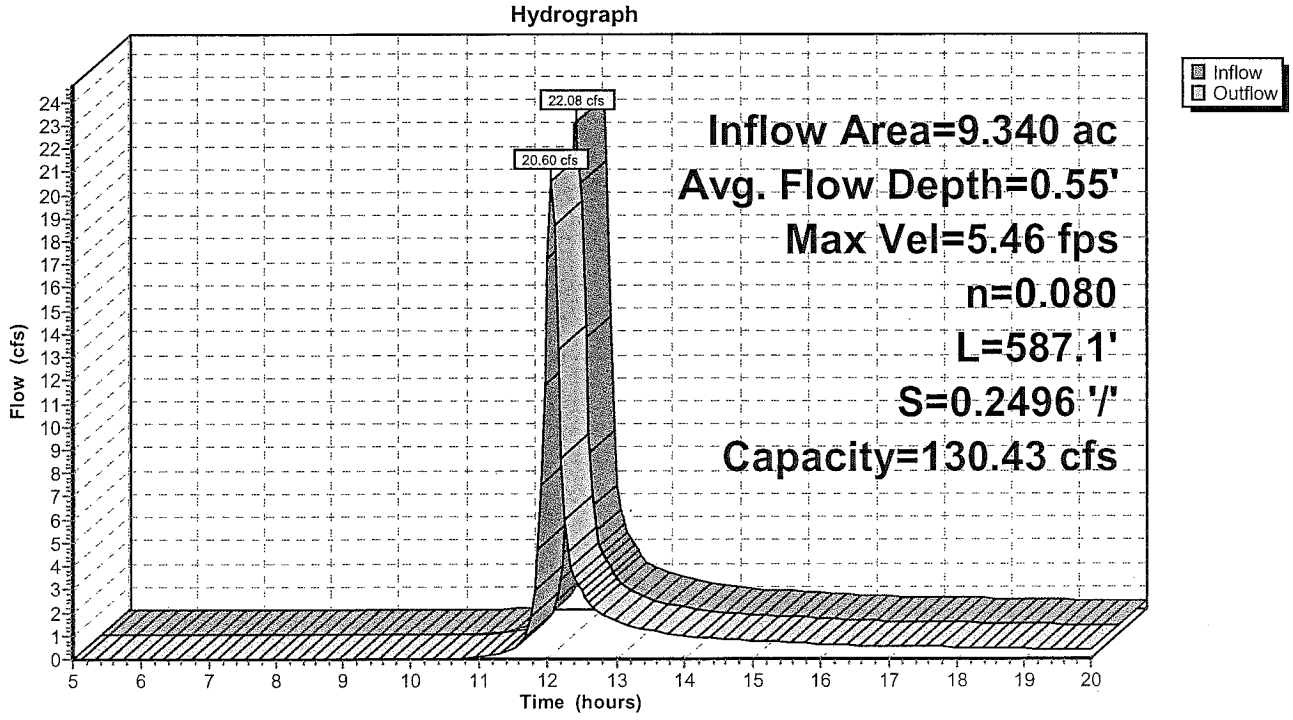
Reach DC4-2: DC4-2



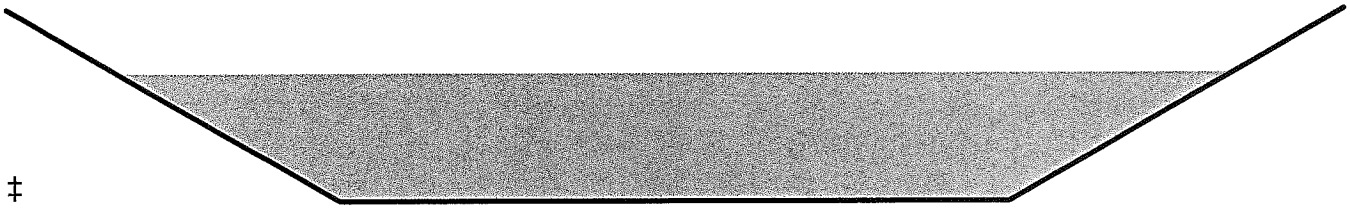
Summary for Reach DC5-1: DC5-1

Inflow Area = 26.710 ac, 0.00% Impervious, Inflow Depth > 1.33" for 25 year event
Inflow = 51.94 cfs @ 12.06 hrs, Volume= 2.970 af
Outflow = 51.80 cfs @ 12.07 hrs, Volume= 2.970 af, Atten= 0%, Lag= 0.1 min

Routing by Stor-Ind+Trans method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Max. Velocity= 6.49 fps, Min. Travel Time= 0.1 min
Avg. Velocity = 2.22 fps, Avg. Travel Time= 0.2 min

Peak Storage= 227 cf @ 12.06 hrs
Average Depth at Peak Storage= 1.00'
Bank-Full Depth= 1.50' Flow Area= 13.5 sf, Capacity= 109.50 cfs

6.00' x 1.50' deep channel, n= 0.060
Side Slope Z-value= 2.0 '/' Top Width= 12.00'
Length= 28.4' Slope= 0.0989 '/'
Inlet Invert= 1,390.31', Outlet Invert= 1,387.50'



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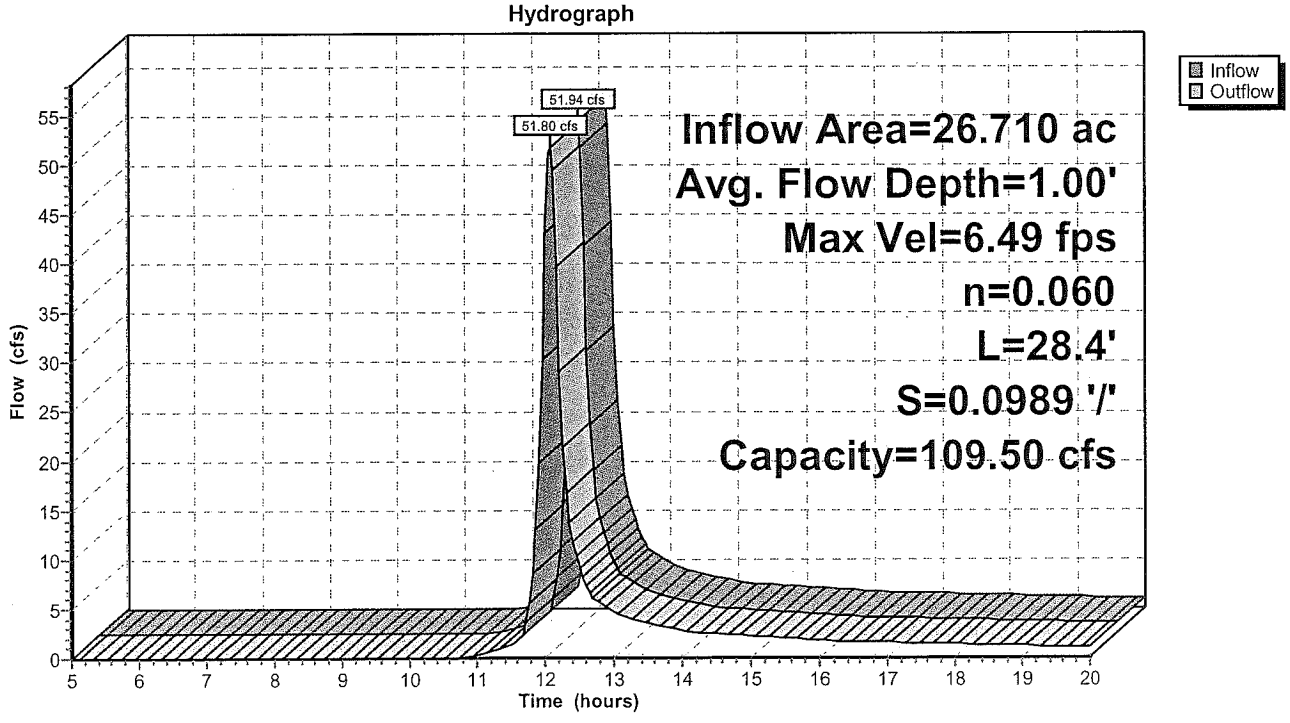
Reach DC5-1: DC5-1



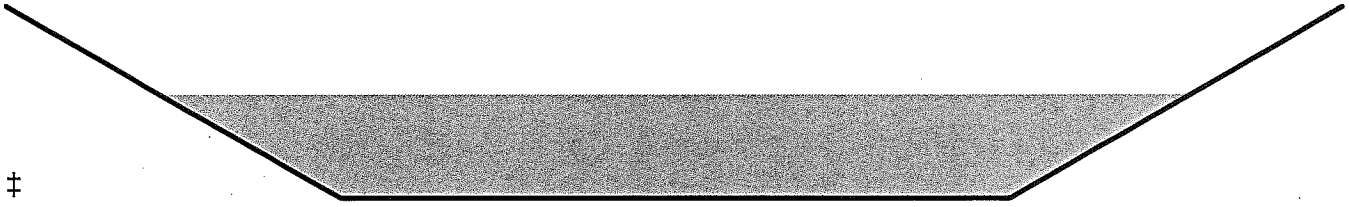
Summary for Reach DC5-2: DC5-2

Inflow Area = 26.710 ac, 0.00% Impervious, Inflow Depth > 1.33" for 25 year event
Inflow = 51.80 cfs @ 12.07 hrs, Volume= 2.970 af
Outflow = 51.01 cfs @ 12.08 hrs, Volume= 2.967 af, Atten= 2%, Lag= 0.6 min

Routing by Stor-Ind+Trans method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Max. Velocity= 8.35 fps, Min. Travel Time= 0.3 min
Avg. Velocity = 2.81 fps, Avg. Travel Time= 1.0 min

Peak Storage= 1,062 cf @ 12.07 hrs
Average Depth at Peak Storage= 0.81'
Bank-Full Depth= 1.50' Flow Area= 13.5 sf, Capacity= 158.71 cfs

6.00' x 1.50' deep channel, n= 0.076
Side Slope Z-value= 2.0 '/' Top Width= 12.00'
Length= 172.2' Slope= 0.3335 '/'
Inlet Invert= 1,387.50', Outlet Invert= 1,330.07'



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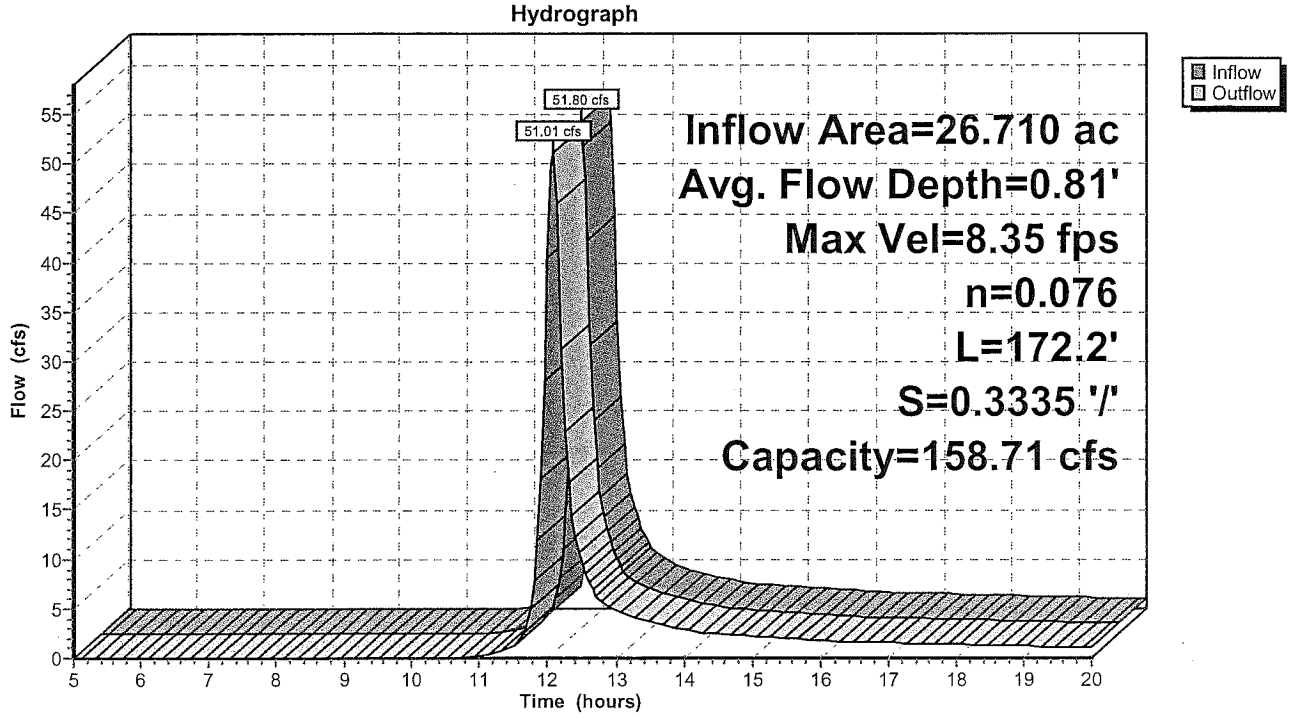
Reach DC5-2: DC5-2



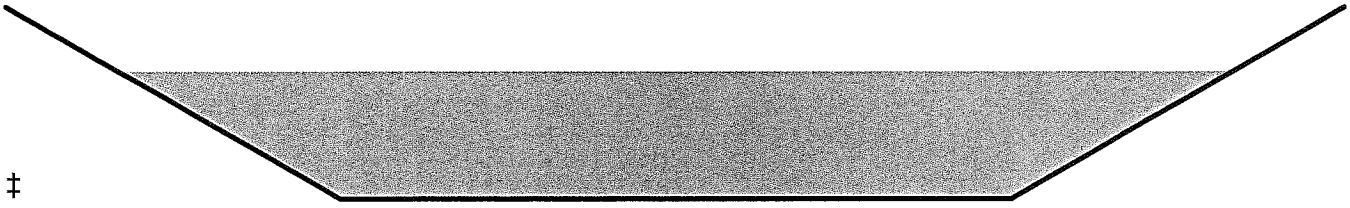
Summary for Reach DC5-3: DC5-3

Inflow Area = 26.710 ac, 0.00% Impervious, Inflow Depth > 1.33" for 25 year event
Inflow = 51.01 cfs @ 12.08 hrs, Volume= 2.967 af
Outflow = 50.91 cfs @ 12.08 hrs, Volume= 2.967 af, Atten= 0%, Lag= 0.1 min

Routing by Stor-Ind+Trans method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Max. Velocity= 6.38 fps, Min. Travel Time= 0.1 min
Avg. Velocity = 2.20 fps, Avg. Travel Time= 0.2 min

Peak Storage= 227 cf @ 12.08 hrs
Average Depth at Peak Storage= 1.00'
Bank-Full Depth= 1.50' Flow Area= 13.5 sf, Capacity= 108.13 cfs

6.00' x 1.50' deep channel, n= 0.060
Side Slope Z-value= 2.0 '/' Top Width= 12.00'
Length= 28.5' Slope= 0.0965 '/'
Inlet Invert= 1,330.00', Outlet Invert= 1,327.25'



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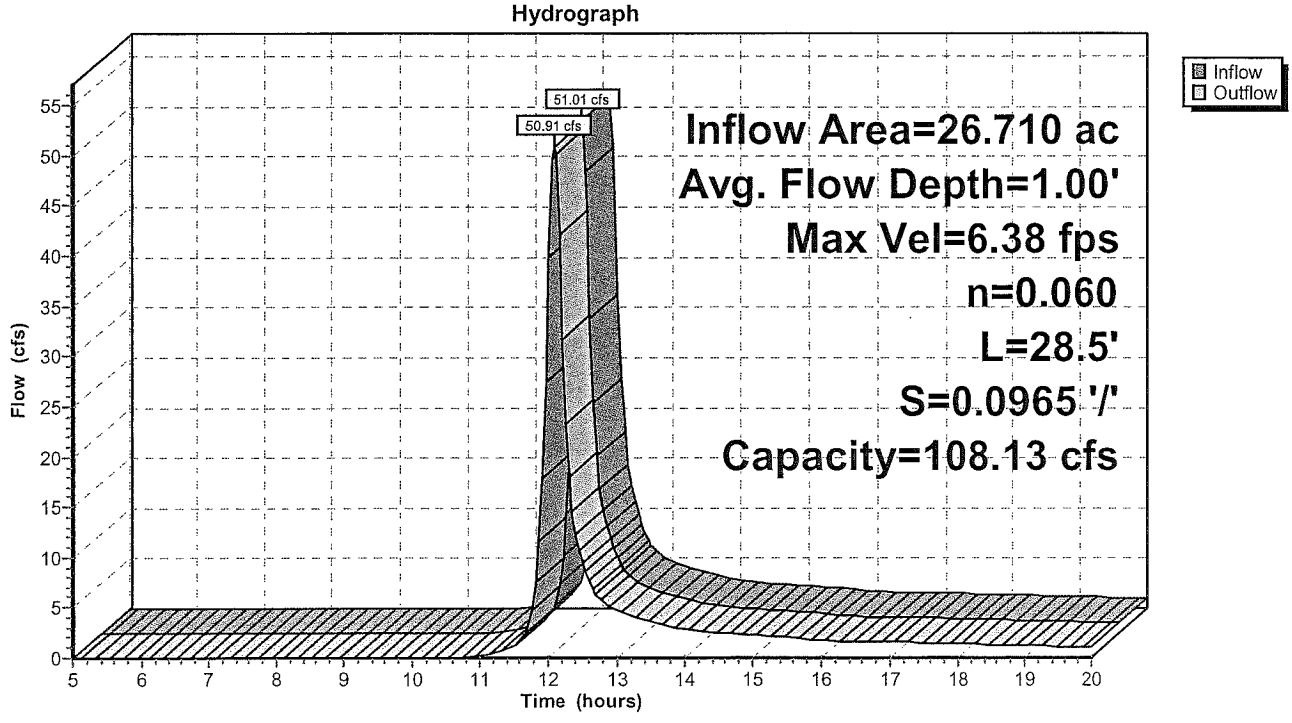
Reach DC5-3: DC5-3



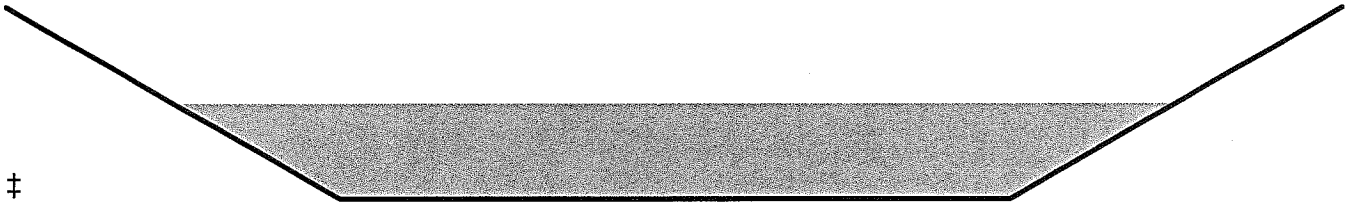
Summary for Reach DC5-4: DC5-4

Inflow Area = 26.710 ac, 0.00% Impervious, Inflow Depth > 1.33" for 25 year event
Inflow = 50.91 cfs @ 12.08 hrs, Volume= 2.967 af
Outflow = 50.53 cfs @ 12.09 hrs, Volume= 2.964 af, Atten= 1%, Lag= 0.6 min

Routing by Stor-Ind+Trans method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Max. Velocity= 9.07 fps, Min. Travel Time= 0.3 min
Avg. Velocity = 3.05 fps, Avg. Travel Time= 0.9 min

Peak Storage= 964 cf @ 12.08 hrs
Average Depth at Peak Storage= 0.75'
Bank-Full Depth= 1.50' Flow Area= 13.5 sf, Capacity= 180.02 cfs

6.00' x 1.50' deep channel, n= 0.067
Side Slope Z-value= 2.0 '/' Top Width= 12.00'
Length= 172.2' Slope= 0.3335 '/'
Inlet Invert= 1,327.25', Outlet Invert= 1,269.82'



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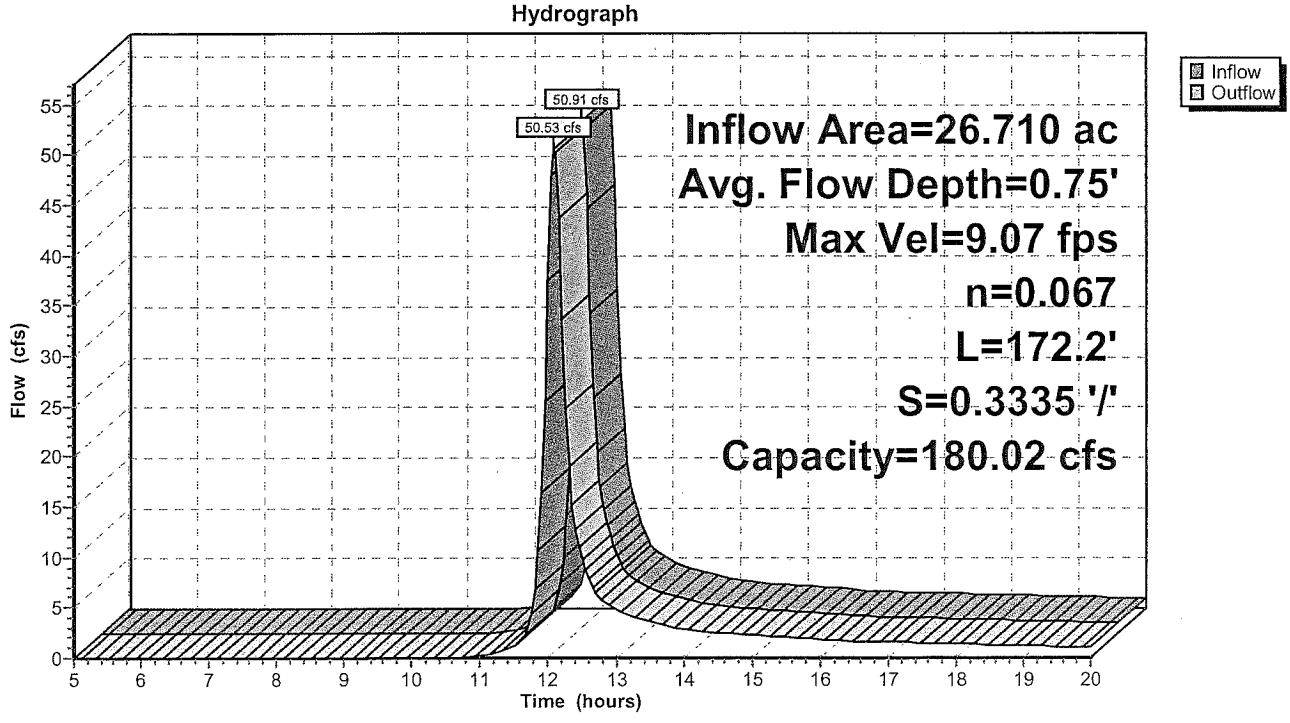
Reach DC5-4: DC5-4



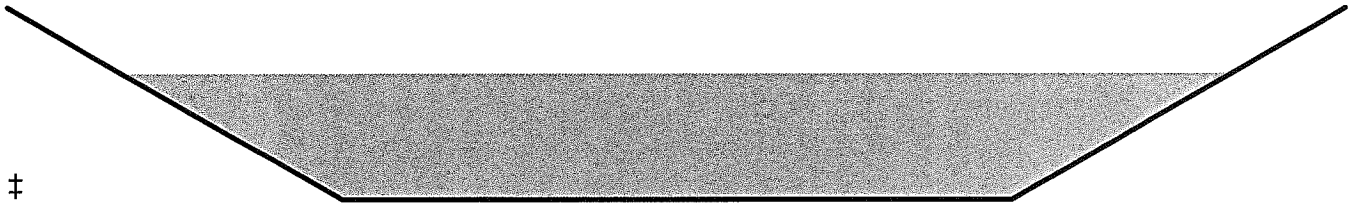
Summary for Reach DC5-5: DC5-5

Inflow Area = 26.710 ac, 0.00% Impervious, Inflow Depth > 1.33" for 25 year event
Inflow = 50.53 cfs @ 12.09 hrs, Volume= 2.964 af
Outflow = 50.43 cfs @ 12.09 hrs, Volume= 2.964 af, Atten= 0%, Lag= 0.1 min

Routing by Stor-Ind+Trans method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Max. Velocity= 6.44 fps, Min. Travel Time= 0.1 min
Avg. Velocity = 2.23 fps, Avg. Travel Time= 0.2 min

Peak Storage= 223 cf @ 12.09 hrs
Average Depth at Peak Storage= 0.98'
Bank-Full Depth= 1.50' Flow Area= 13.5 sf, Capacity= 109.50 cfs

6.00' x 1.50' deep channel, n= 0.060
Side Slope Z-value= 2.0 '/' Top Width= 12.00'
Length= 28.5' Slope= 0.0989 '/'
Inlet Invert= 1,269.82', Outlet Invert= 1,267.00'



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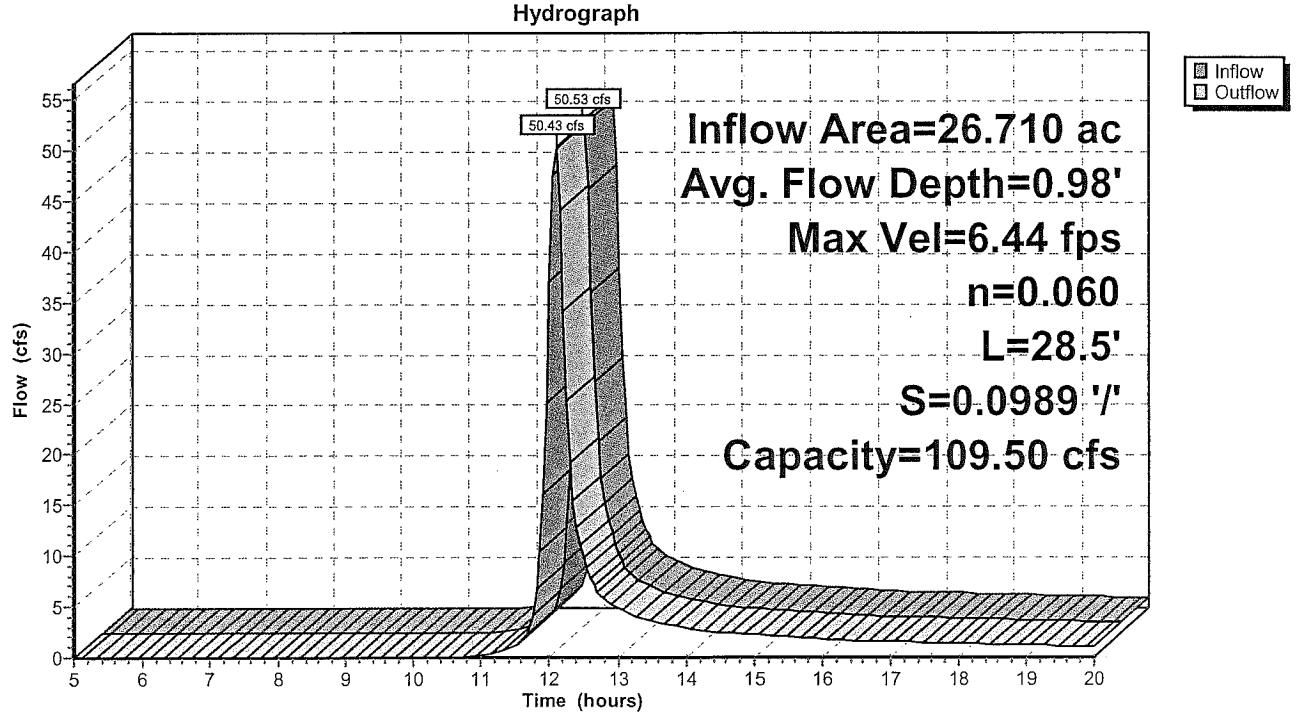
Reach DC5-5: DC5-5



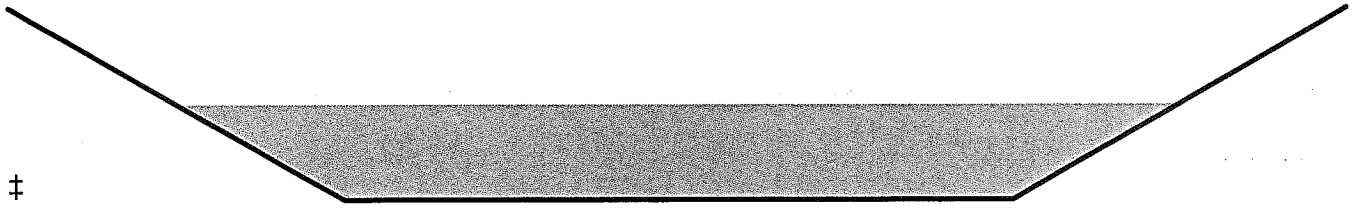
Summary for Reach DC5-6: DC5-6

Inflow Area = 26.710 ac, 0.00% Impervious, Inflow Depth > 1.33" for 25 year event
Inflow = 50.43 cfs @ 12.09 hrs, Volume= 2.964 af
Outflow = 50.11 cfs @ 12.10 hrs, Volume= 2.962 af, Atten= 1%, Lag= 0.4 min

Routing by Stor-Ind+Trans method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Max. Velocity= 9.07 fps, Min. Travel Time= 0.3 min
Avg. Velocity = 3.05 fps, Avg. Travel Time= 0.7 min

Peak Storage= 757 cf @ 12.09 hrs
Average Depth at Peak Storage= 0.74'
Bank-Full Depth= 1.50' Flow Area= 13.5 sf, Capacity= 180.00 cfs

6.00' x 1.50' deep channel, n= 0.067
Side Slope Z-value= 2.0 '/' Top Width= 12.00'
Length= 136.2' Slope= 0.3334 '/'
Inlet Invert= 1,267.00', Outlet Invert= 1,221.59'



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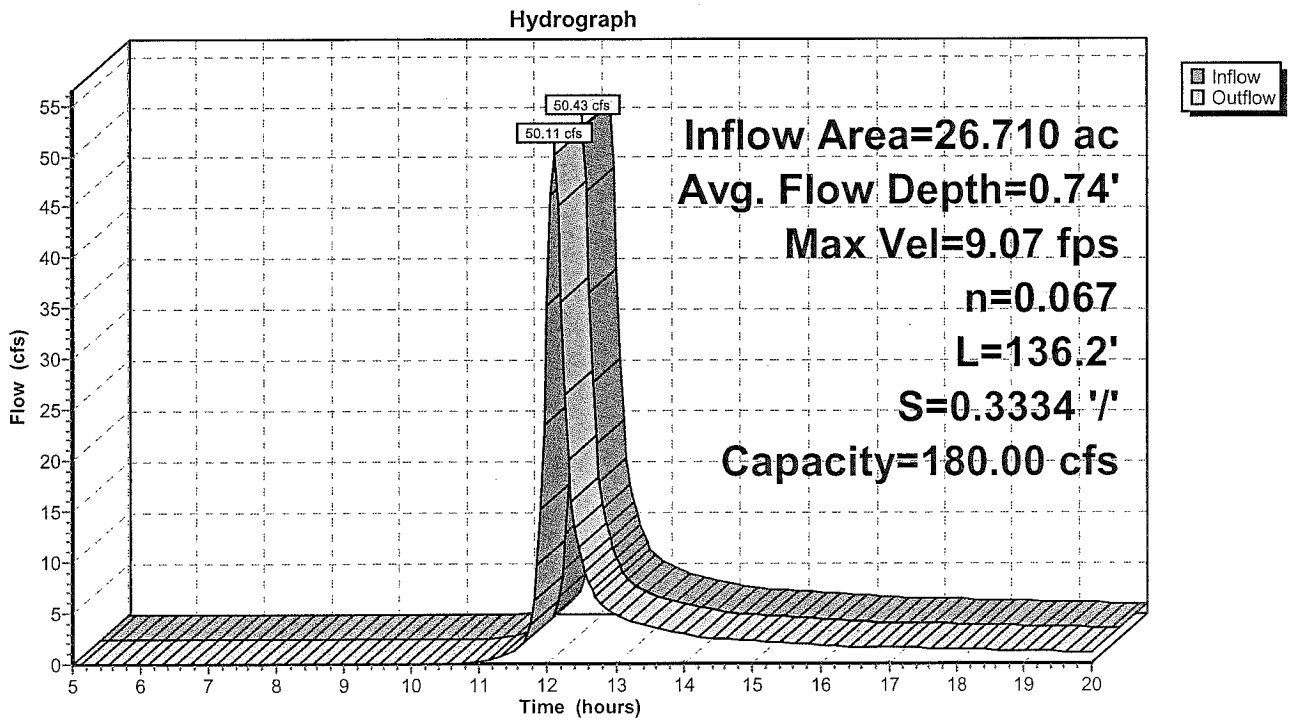
Reach DC5-6: DC5-6



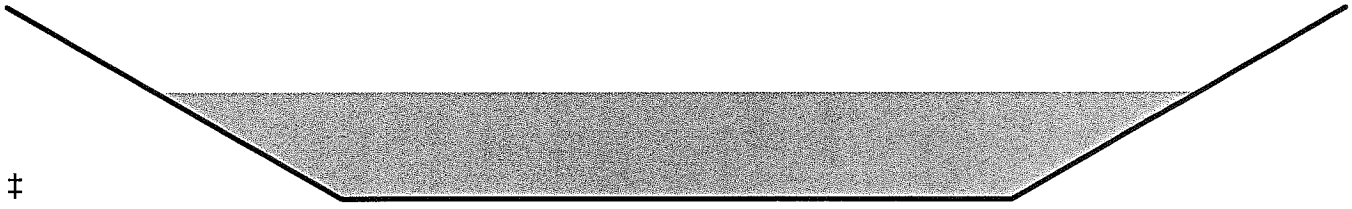
Summary for Reach DC6-1: DC6-1

Inflow Area = 14.660 ac, 0.00% Impervious, Inflow Depth > 1.34" for 25 year event
Inflow = 35.36 cfs @ 12.00 hrs, Volume= 1.634 af
Outflow = 35.18 cfs @ 12.00 hrs, Volume= 1.634 af, Atten= 1%, Lag= 0.1 min

Routing by Stor-Ind+Trans method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Max. Velocity= 5.53 fps, Min. Travel Time= 0.1 min
Avg. Velocity = 1.71 fps, Avg. Travel Time= 0.3 min

Peak Storage= 188 cf @ 12.00 hrs
Average Depth at Peak Storage= 0.83'
Bank-Full Depth= 1.50' Flow Area= 13.5 sf, Capacity= 102.85 cfs

6.00' x 1.50' deep channel, n= 0.064
Side Slope Z-value= 2.0 '/' Top Width= 12.00'
Length= 29.4' Slope= 0.0993 '/'
Inlet Invert= 1,458.43', Outlet Invert= 1,455.51'



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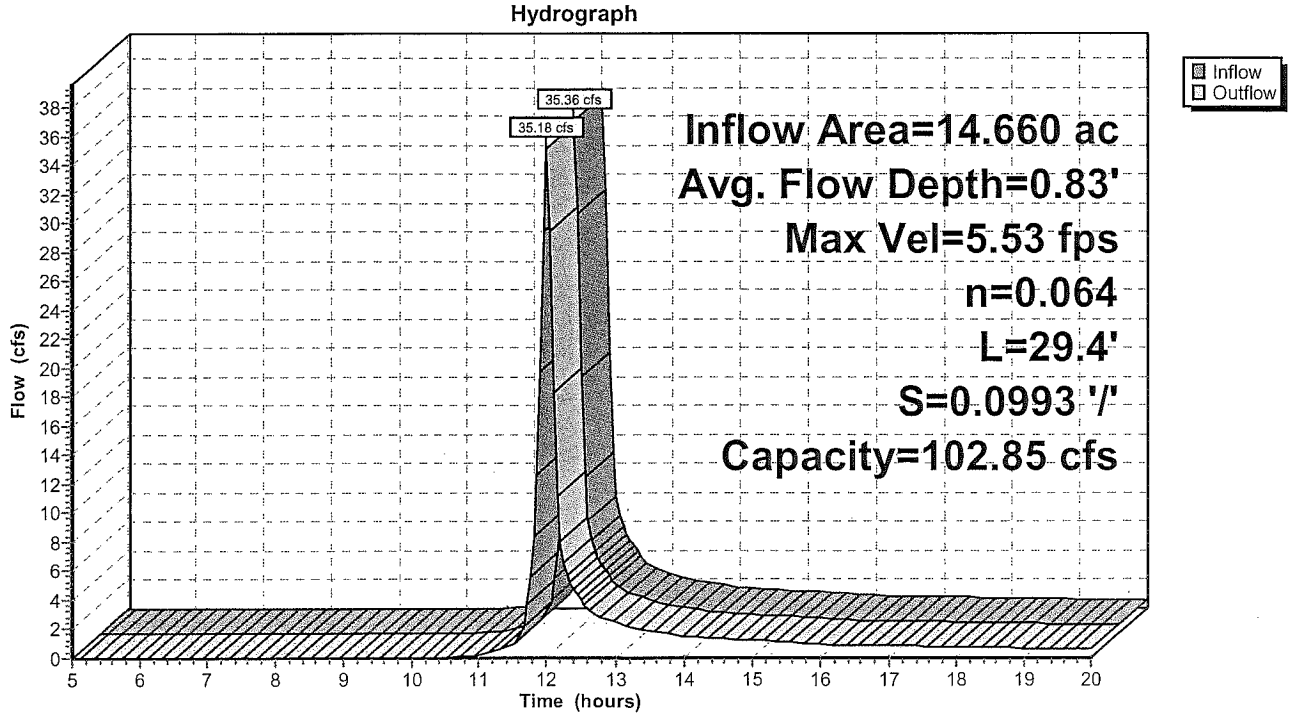
Reach DC6-1: DC6-1



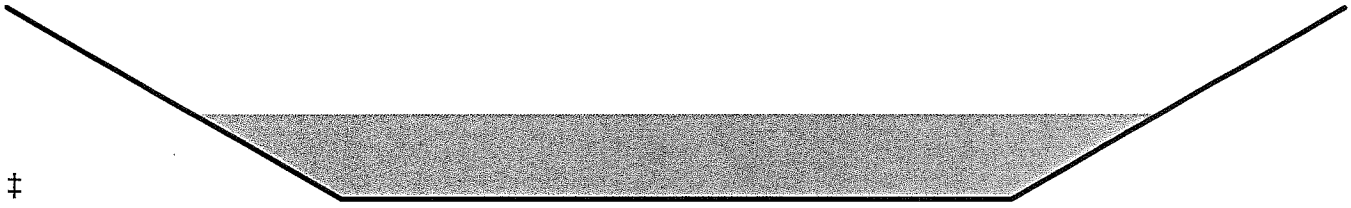
Summary for Reach DC6-2: DC6-2

Inflow Area = 17.410 ac, 0.00% Impervious, Inflow Depth > 1.34" for 25 year event
Inflow = 38.55 cfs @ 12.01 hrs, Volume= 1.938 af
Outflow = 38.09 cfs @ 12.01 hrs, Volume= 1.938 af, Atten= 1%, Lag= 0.3 min

Routing by Stor-Ind+Trans method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Max. Velocity= 7.90 fps, Min. Travel Time= 0.2 min
Avg. Velocity = 2.47 fps, Avg. Travel Time= 0.6 min

Peak Storage= 468 cf @ 12.01 hrs
Average Depth at Peak Storage= 0.66'
Bank-Full Depth= 1.50' Flow Area= 13.5 sf, Capacity= 167.07 cfs

6.00' x 1.50' deep channel, n= 0.072
Side Slope Z-value= 2.0 '/' Top Width= 12.00'
Length= 96.2' Slope= 0.3317 '/'
Inlet Invert= 1,455.51', Outlet Invert= 1,423.60'



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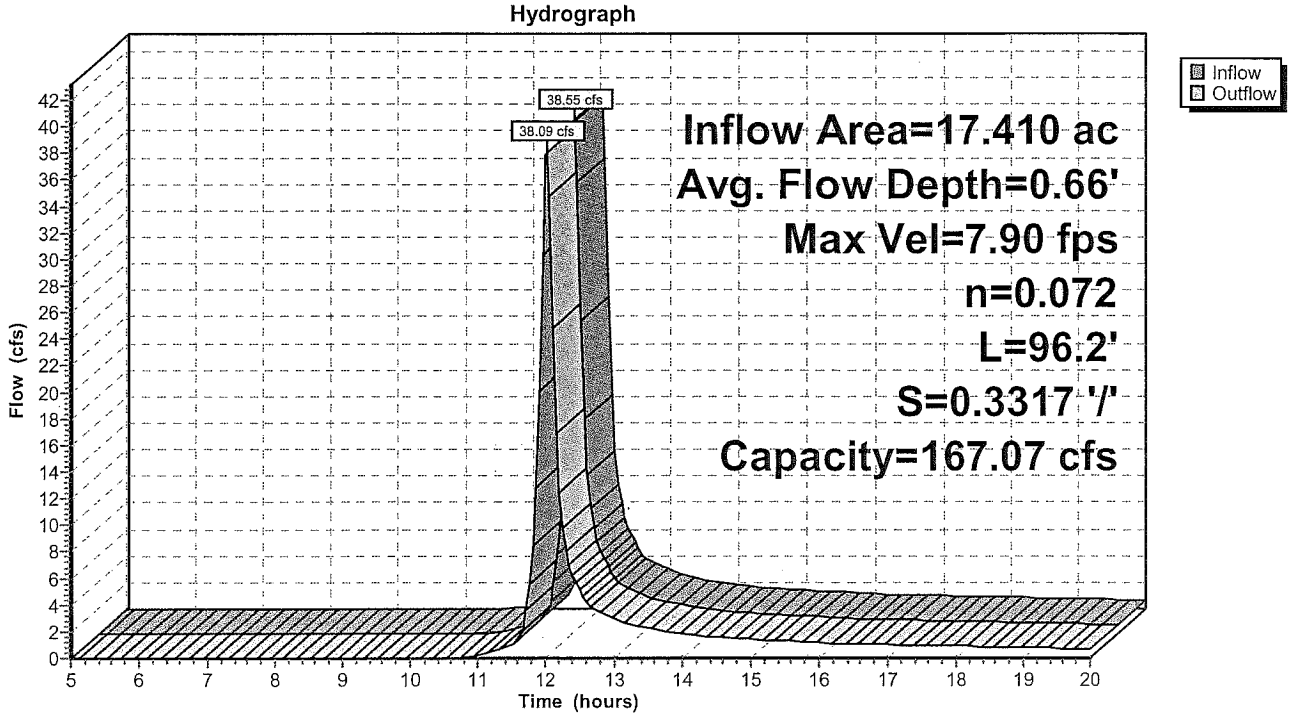
Reach DC6-2: DC6-2



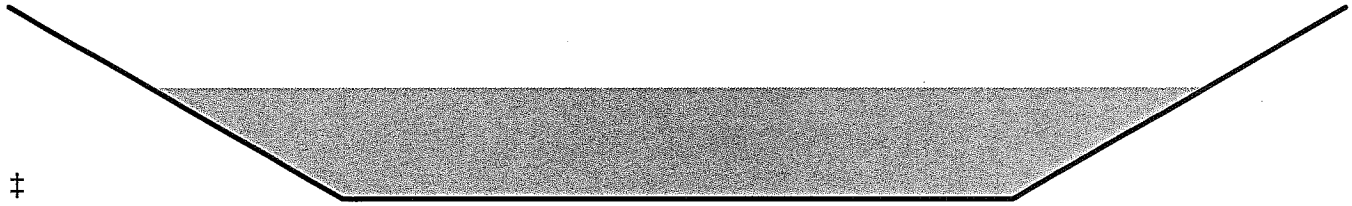
Summary for Reach DC6-3: DC6-3

Inflow Area = 17.410 ac, 0.00% Impervious, Inflow Depth > 1.34" for 25 year event
Inflow = 38.09 cfs @ 12.01 hrs, Volume= 1.938 af
Outflow = 37.89 cfs @ 12.01 hrs, Volume= 1.937 af, Atten= 1%, Lag= 0.1 min

Routing by Stor-Ind+Trans method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Max. Velocity= 5.65 fps, Min. Travel Time= 0.1 min
Avg. Velocity = 1.82 fps, Avg. Travel Time= 0.3 min

Peak Storage= 203 cf @ 12.01 hrs
Average Depth at Peak Storage= 0.87'
Bank-Full Depth= 1.50' Flow Area= 13.5 sf, Capacity= 102.86 cfs

6.00' x 1.50' deep channel, n= 0.064
Side Slope Z-value= 2.0 '/' Top Width= 12.00'
Length= 30.2' Slope= 0.0993 '/'
Inlet Invert= 1,423.60', Outlet Invert= 1,420.60'



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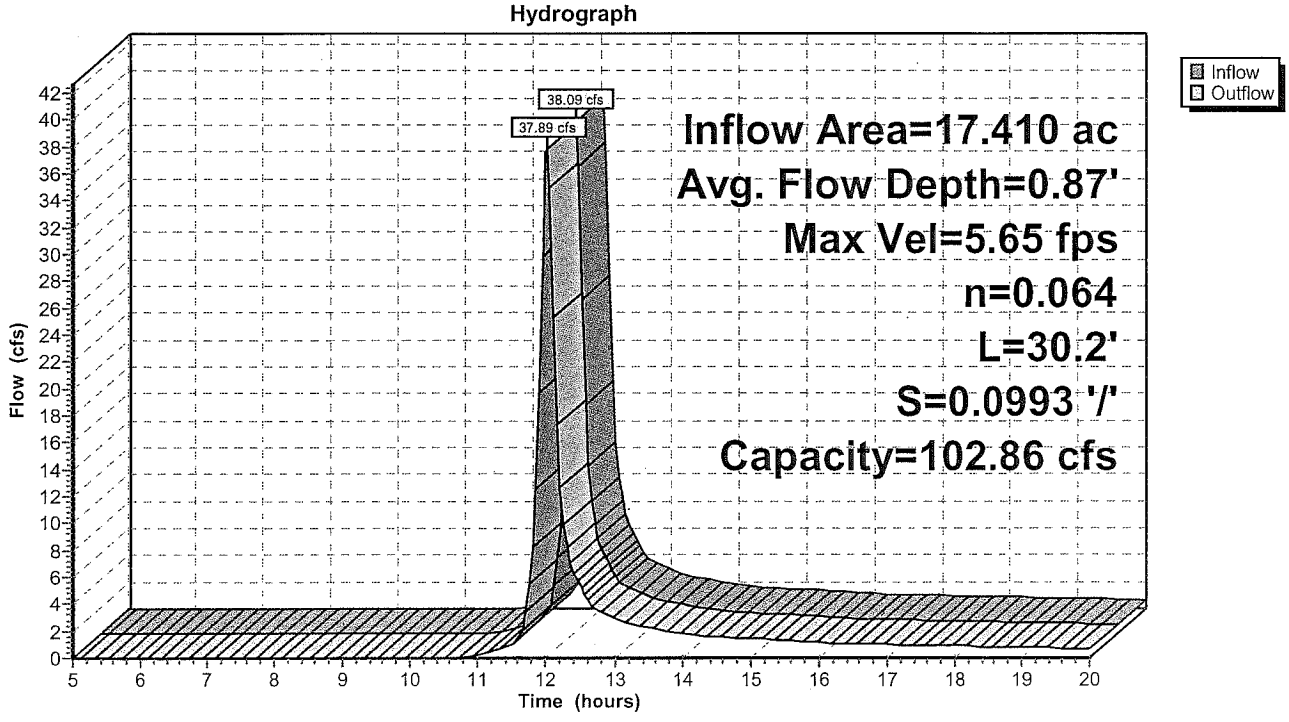
Reach DC6-3: DC6-3



Summary for Reach DC6-4: DC6-4

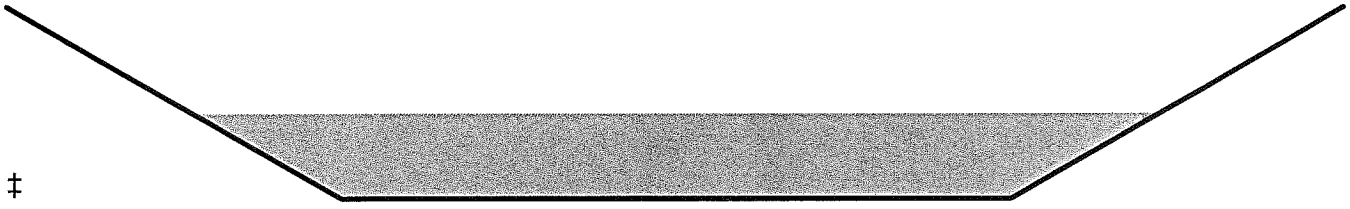
Inflow Area = 17.410 ac, 0.00% Impervious, Inflow Depth > 1.34" for 25 year event
Inflow = 37.89 cfs @ 12.01 hrs, Volume= 1.937 af
Outflow = 37.03 cfs @ 12.02 hrs, Volume= 1.935 af, Atten= 2%, Lag= 0.7 min

Routing by Stor-Ind+Trans method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Max. Velocity= 7.72 fps, Min. Travel Time= 0.4 min
Avg. Velocity = 2.45 fps, Avg. Travel Time= 1.3 min

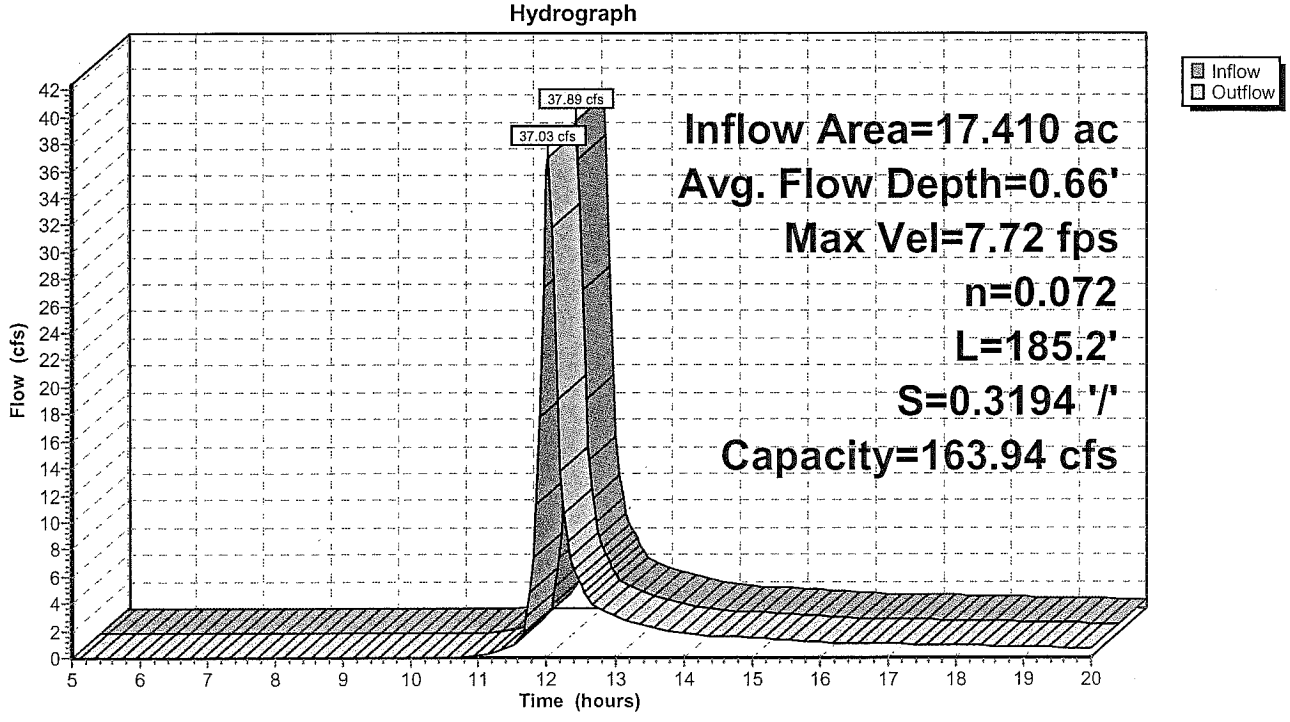
Peak Storage= 901 cf @ 12.02 hrs
Average Depth at Peak Storage= 0.66'
Bank-Full Depth= 1.50' Flow Area= 13.5 sf, Capacity= 163.94 cfs

6.00' x 1.50' deep channel, n= 0.072
Side Slope Z-value= 2.0 '/' Top Width= 12.00'
Length= 185.2' Slope= 0.3194 '/'
Inlet Invert= 1,420.60', Outlet Invert= 1,361.45'

‡



Reach DC6-4: DC6-4



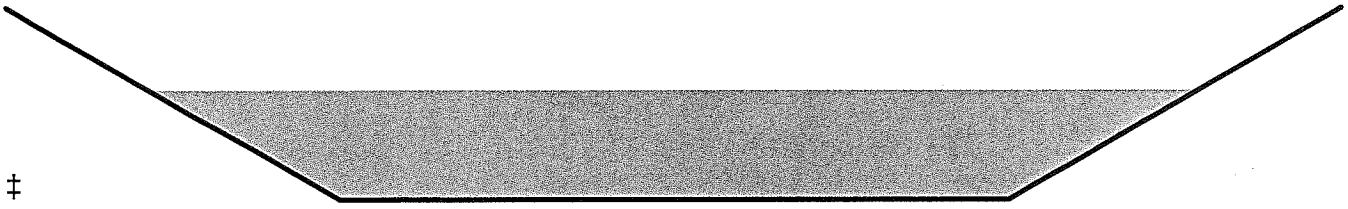
Summary for Reach DC6-5: DC6-5

Inflow Area = 17.410 ac, 0.00% Impervious, Inflow Depth > 1.33" for 25 year event
Inflow = 37.03 cfs @ 12.02 hrs, Volume= 1.935 af
Outflow = 36.86 cfs @ 12.03 hrs, Volume= 1.935 af, Atten= 0%, Lag= 0.2 min

Routing by Stor-Ind+Trans method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Max. Velocity= 5.56 fps, Min. Travel Time= 0.1 min
Avg. Velocity = 1.82 fps, Avg. Travel Time= 0.3 min

Peak Storage= 199 cf @ 12.03 hrs
Average Depth at Peak Storage= 0.86'
Bank-Full Depth= 1.50' Flow Area= 13.5 sf, Capacity= 102.86 cfs

6.00' x 1.50' deep channel, n= 0.064
Side Slope Z-value= 2.0 '/' Top Width= 12.00'
Length= 30.2' Slope= 0.0993 '/'
Inlet Invert= 1,361.45', Outlet Invert= 1,358.45'



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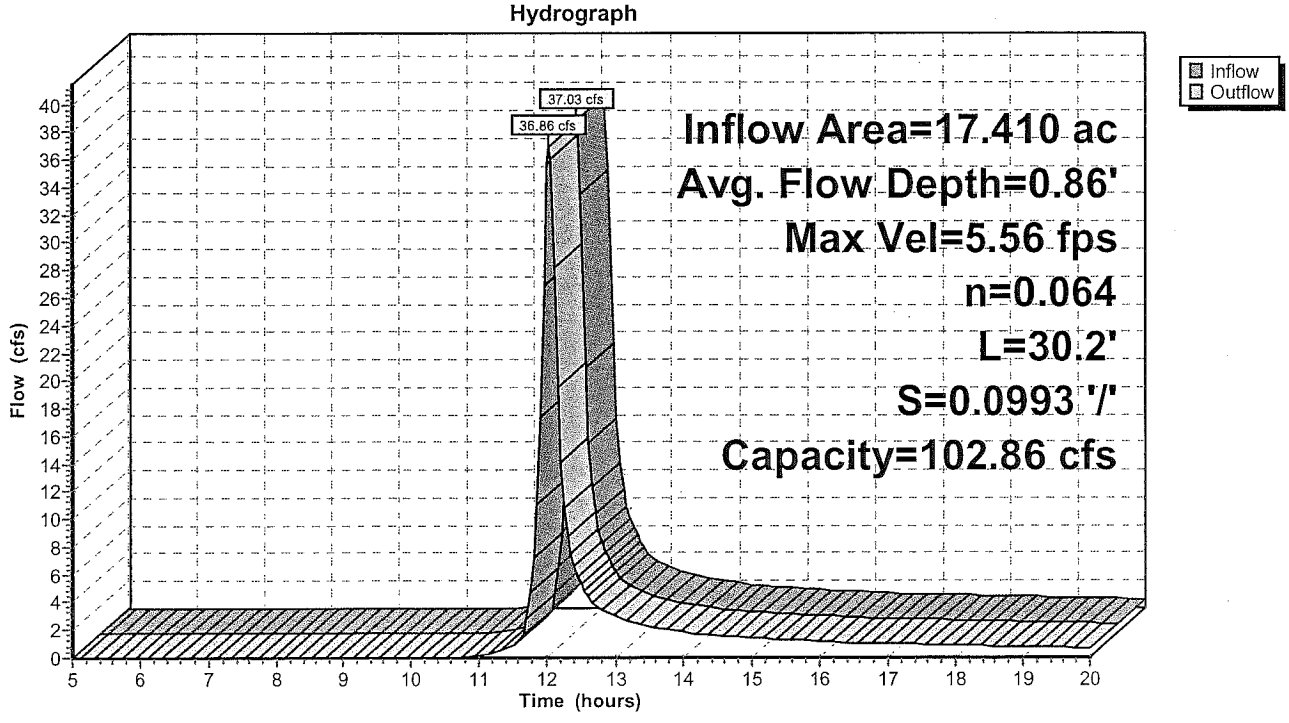
Reach DC6-5: DC6-5



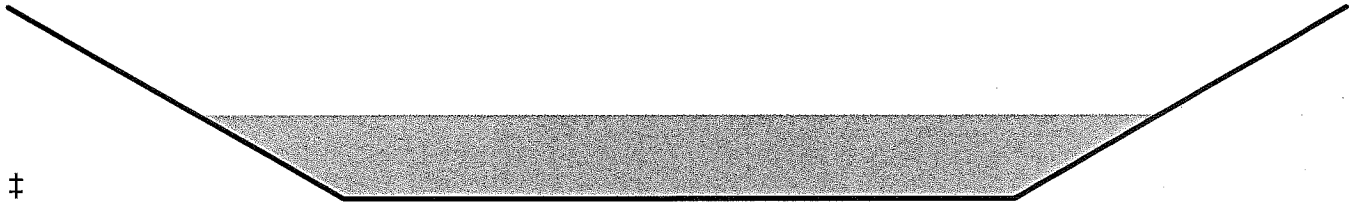
Summary for Reach DC6-6: DC6-6

Inflow Area = 17.410 ac, 0.00% Impervious, Inflow Depth > 1.33" for 25 year event
Inflow = 36.86 cfs @ 12.03 hrs, Volume= 1.935 af
Outflow = 36.40 cfs @ 12.04 hrs, Volume= 1.933 af, Atten= 1%, Lag= 0.7 min

Routing by Stor-Ind+Trans method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Max. Velocity= 7.67 fps, Min. Travel Time= 0.4 min
Avg. Velocity = 2.45 fps, Avg. Travel Time= 1.3 min

Peak Storage= 888 cf @ 12.03 hrs
Average Depth at Peak Storage= 0.66'
Bank-Full Depth= 1.50' Flow Area= 13.5 sf, Capacity= 163.94 cfs

6.00' x 1.50' deep channel, n= 0.072
Side Slope Z-value= 2.0 '/' Top Width= 12.00'
Length= 185.2' Slope= 0.3194 '/'
Inlet Invert= 1,358.45', Outlet Invert= 1,299.30'



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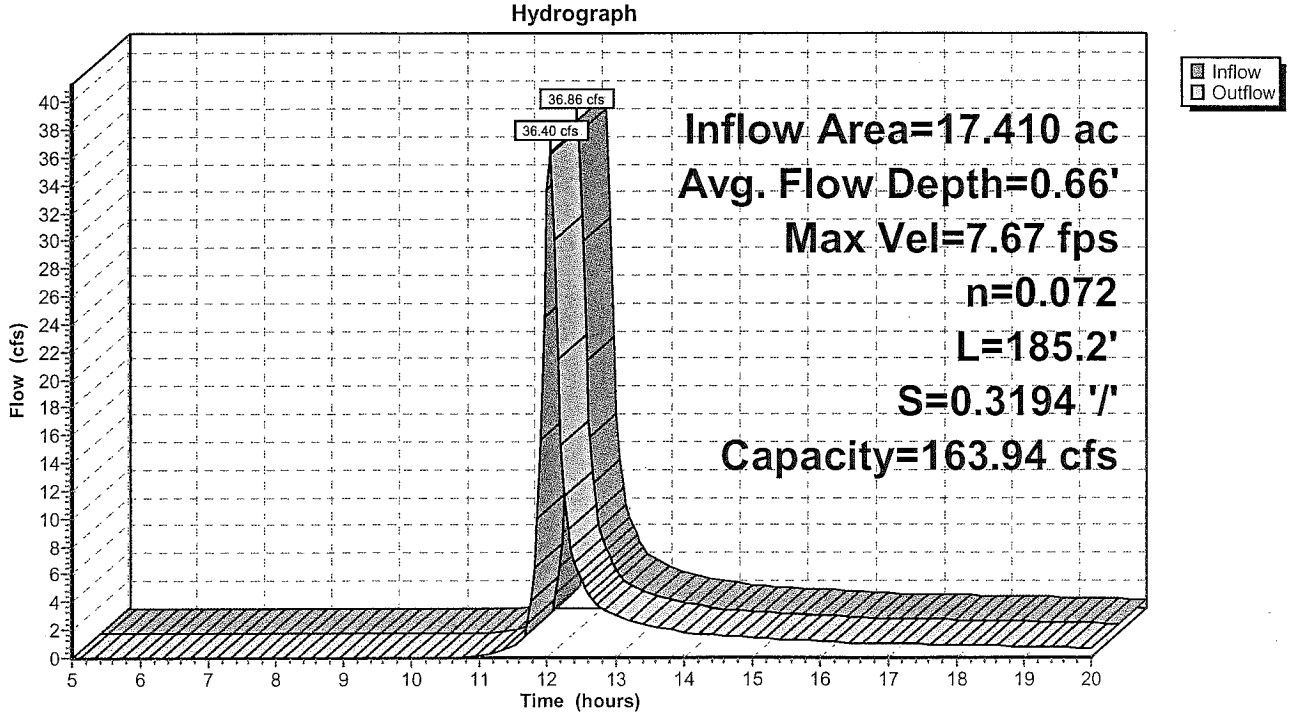
Reach DC6-6: DC6-6



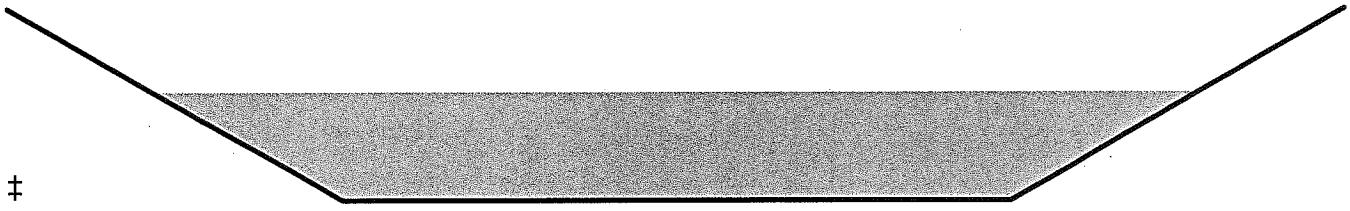
Summary for Reach DC6-7: DC6-7

Inflow Area = 17.410 ac, 0.00% Impervious, Inflow Depth > 1.33" for 25 year event
Inflow = 36.40 cfs @ 12.04 hrs, Volume= 1.933 af
Outflow = 36.29 cfs @ 12.04 hrs, Volume= 1.932 af, Atten= 0%, Lag= 0.1 min

Routing by Stor-Ind+Trans method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Max. Velocity= 5.58 fps, Min. Travel Time= 0.1 min
Avg. Velocity = 1.83 fps, Avg. Travel Time= 0.3 min

Peak Storage= 201 cf @ 12.04 hrs
Average Depth at Peak Storage= 0.85'
Bank-Full Depth= 1.50' Flow Area= 13.5 sf, Capacity= 103.03 cfs

6.00' x 1.50' deep channel, n= 0.064
Side Slope Z-value= 2.0 '/' Top Width= 12.00'
Length= 30.9' Slope= 0.0997 '/'
Inlet Invert= 1,299.30', Outlet Invert= 1,296.22'



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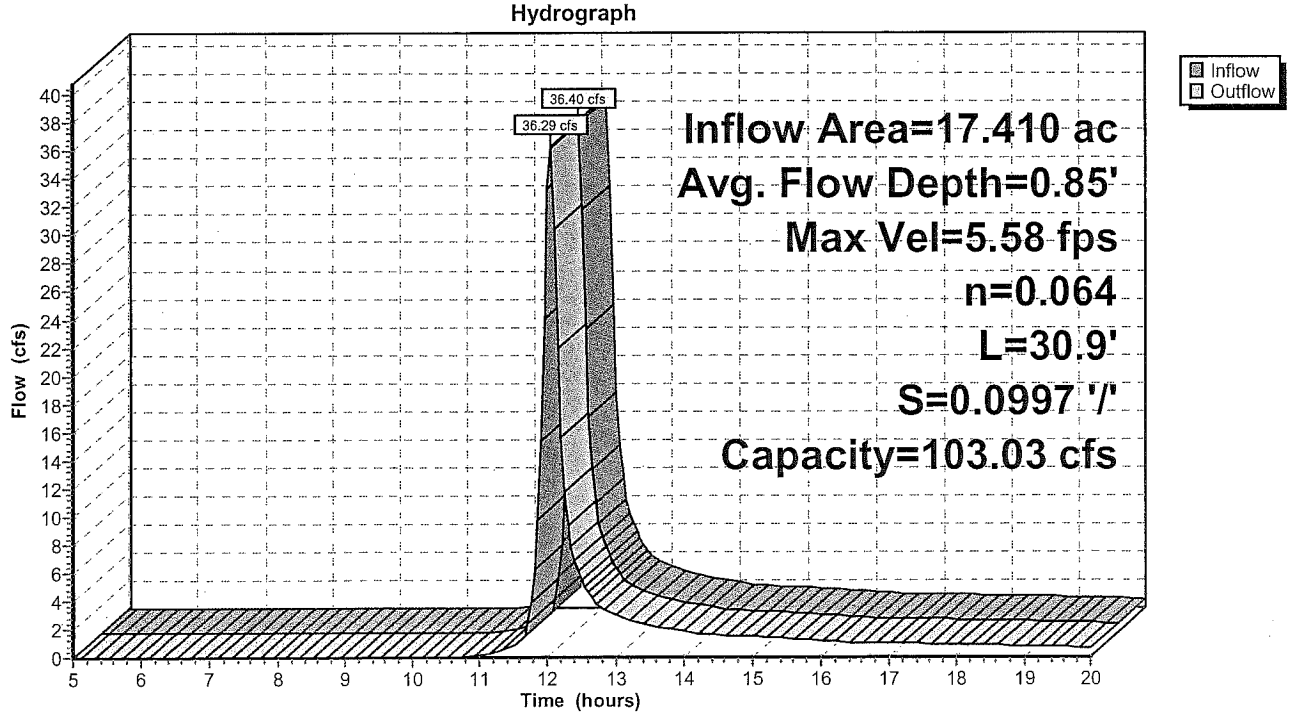
Reach DC6-7: DC6-7



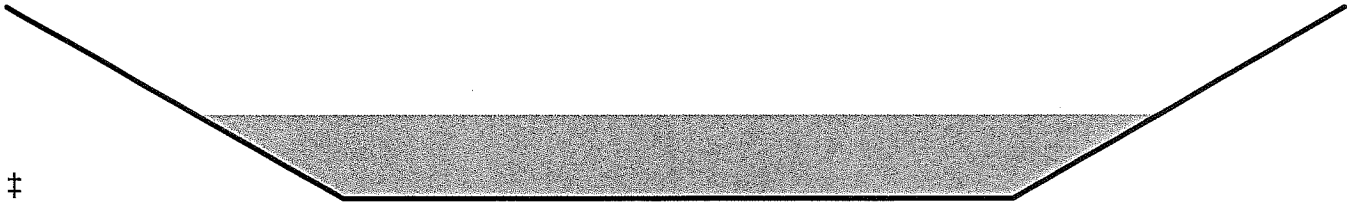
Summary for Reach DC6-8: DC6-8

Inflow Area = 17.410 ac, 0.00% Impervious, Inflow Depth > 1.33" for 25 year event
Inflow = 36.29 cfs @ 12.04 hrs, Volume= 1.932 af
Outflow = 35.88 cfs @ 12.05 hrs, Volume= 1.931 af, Atten= 1%, Lag= 0.5 min

Routing by Stor-Ind+Trans method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Max. Velocity= 7.58 fps, Min. Travel Time= 0.3 min
Avg. Velocity = 2.43 fps, Avg. Travel Time= 1.0 min

Peak Storage= 709 cf @ 12.05 hrs
Average Depth at Peak Storage= 0.66'
Bank-Full Depth= 1.50' Flow Area= 13.5 sf, Capacity= 161.44 cfs

6.00' x 1.50' deep channel, n= 0.072
Side Slope Z-value= 2.0 '/' Top Width= 12.00'
Length= 148.1' Slope= 0.3097 '/'
Inlet Invert= 1,296.22', Outlet Invert= 1,250.35'



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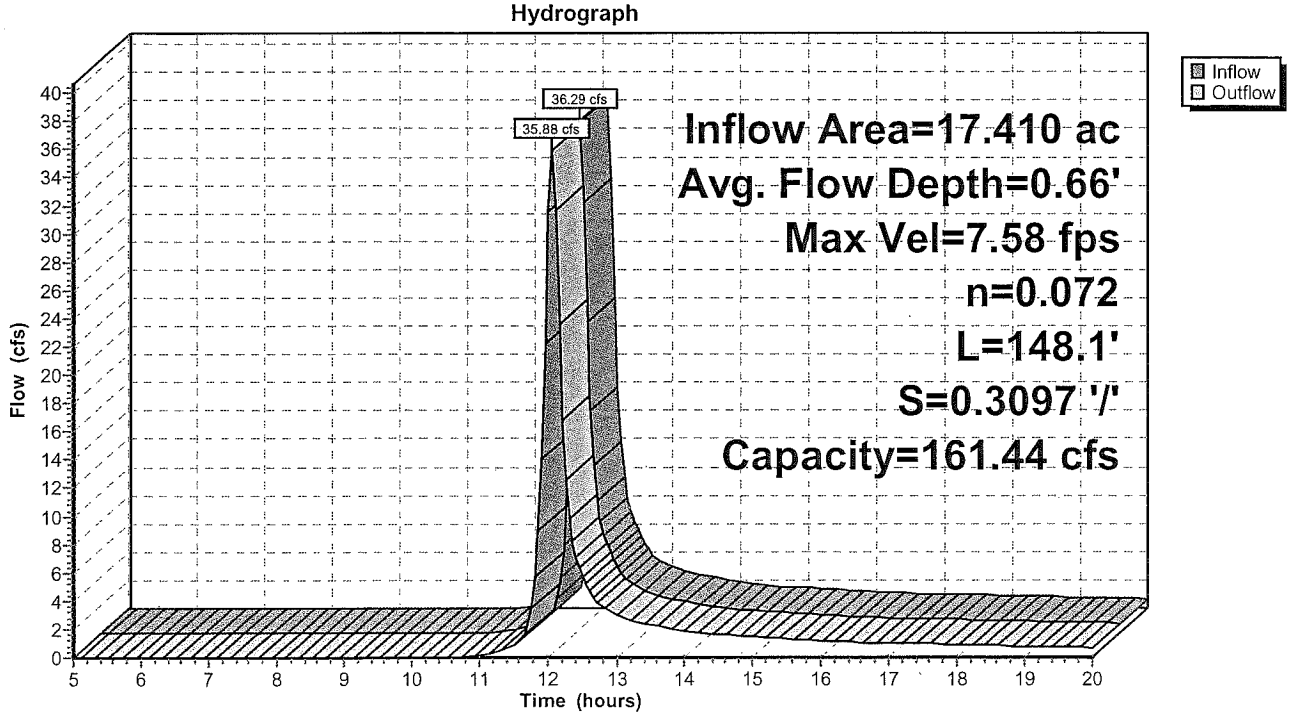
Reach DC6-8: DC6-8



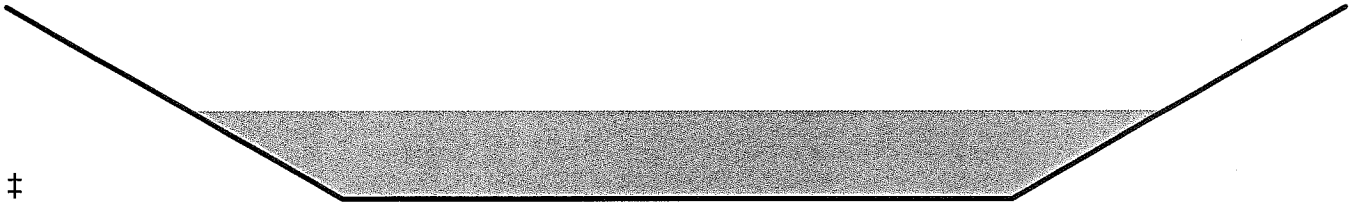
Summary for Reach DC6-9: DC6-9

Inflow Area = 17.410 ac, 0.00% Impervious, Inflow Depth > 1.33" for 25 year event
Inflow = 35.88 cfs @ 12.05 hrs, Volume= 1.931 af
Outflow = 35.77 cfs @ 12.05 hrs, Volume= 1.930 af, Atten= 0%, Lag= 0.1 min

Routing by Stor-Ind+Trans method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Max. Velocity= 7.07 fps, Min. Travel Time= 0.1 min
Avg. Velocity = 2.29 fps, Avg. Travel Time= 0.2 min

Peak Storage= 167 cf @ 12.05 hrs
Average Depth at Peak Storage= 0.69'
Bank-Full Depth= 1.50' Flow Area= 13.5 sf, Capacity= 146.45 cfs

6.00' x 1.50' deep channel, n= 0.070
Side Slope Z-value= 2.0 '/' Top Width= 12.00'
Length= 33.0' Slope= 0.2409 '/'
Inlet Invert= 1,250.35', Outlet Invert= 1,242.40'



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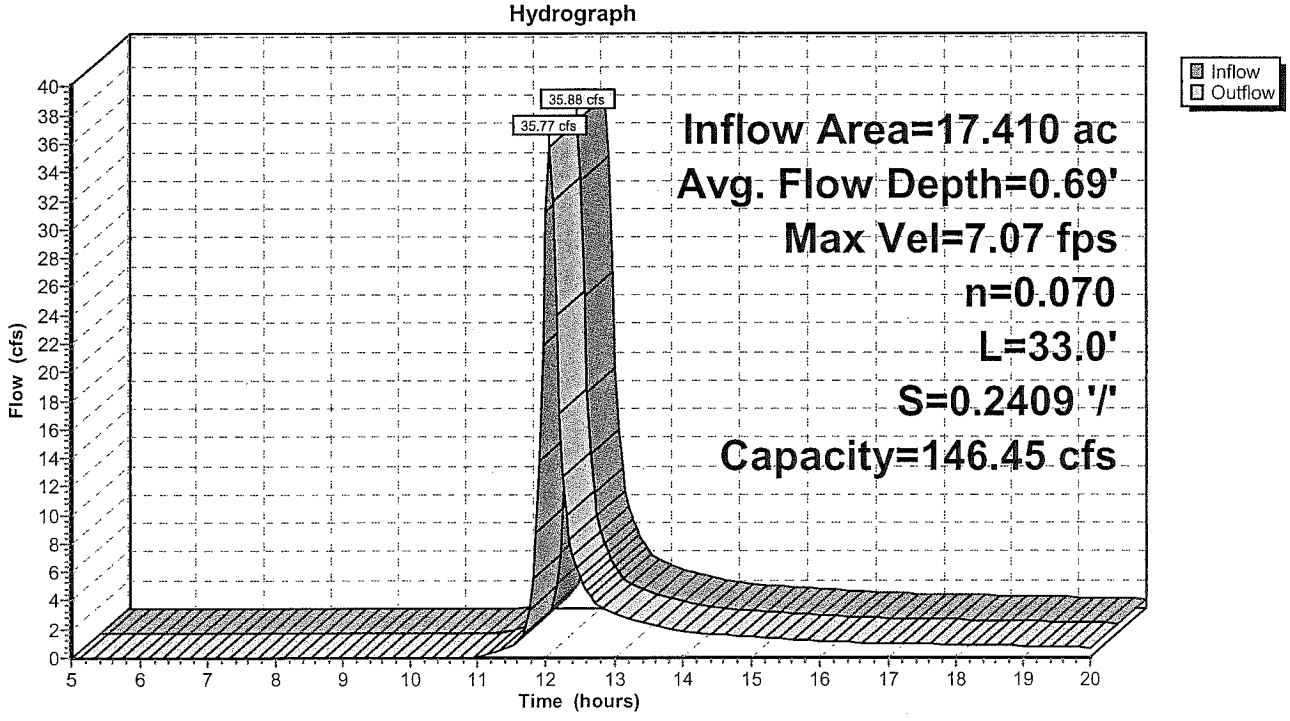
Reach DC6-9: DC6-9



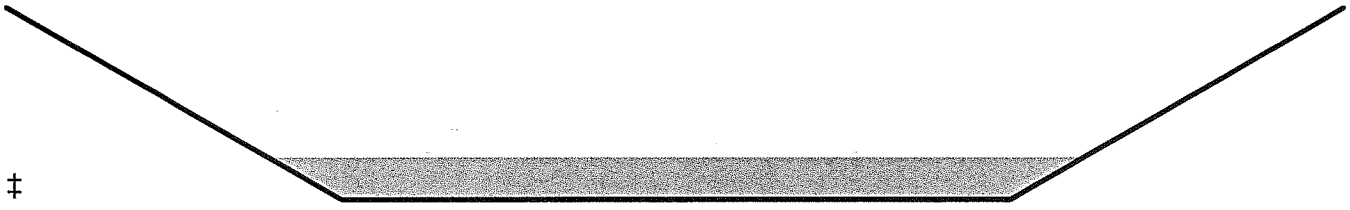
Summary for Reach DC7-1: DC7-1

Inflow Area = 2.750 ac, 0.00% Impervious, Inflow Depth > 1.34" for 25 year event
Inflow = 5.65 cfs @ 12.05 hrs, Volume= 0.306 af
Outflow = 5.61 cfs @ 12.05 hrs, Volume= 0.306 af, Atten= 1%, Lag= 0.3 min

Routing by Stor-Ind+Trans method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Max. Velocity= 2.59 fps, Min. Travel Time= 0.2 min
Avg. Velocity = 0.80 fps, Avg. Travel Time= 0.6 min

Peak Storage= 61 cf @ 12.05 hrs
Average Depth at Peak Storage= 0.33'
Bank-Full Depth= 1.50' Flow Area= 13.5 sf, Capacity= 82.85 cfs

6.00' x 1.50' deep channel, n= 0.080
Side Slope Z-value= 2.0 '/' Top Width= 12.00'
Length= 28.1' Slope= 0.1007 '/'
Inlet Invert= 1,521.08', Outlet Invert= 1,518.25'



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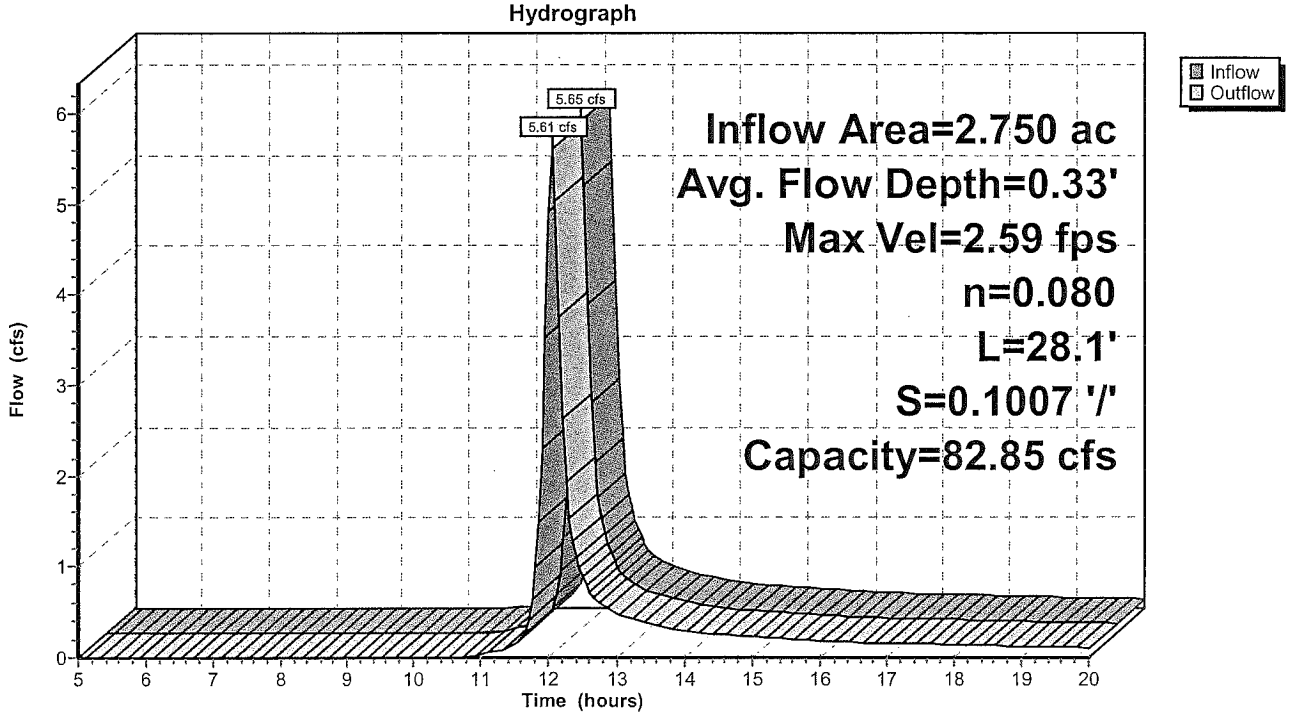
Reach DC7-1: DC7-1



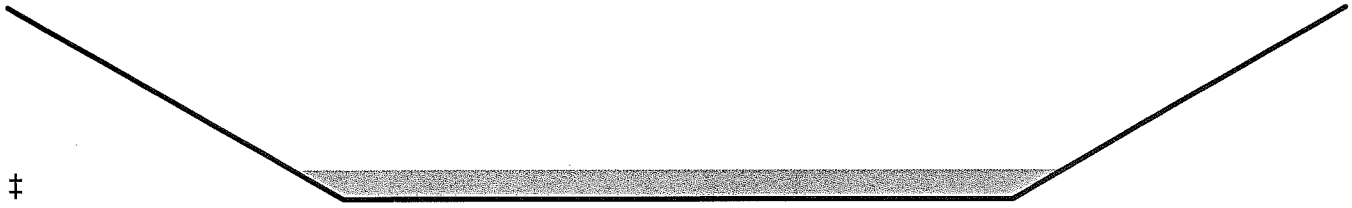
Summary for Reach DC7-2: DC7-2

Inflow Area = 2.750 ac, 0.00% Impervious, Inflow Depth > 1.33" for 25 year event
Inflow = 5.61 cfs @ 12.05 hrs, Volume= 0.306 af
Outflow = 5.46 cfs @ 12.07 hrs, Volume= 0.305 af, Atten= 3%, Lag= 1.1 min

Routing by Stor-Ind+Trans method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Max. Velocity= 3.79 fps, Min. Travel Time= 0.7 min
Avg. Velocity = 1.18 fps, Avg. Travel Time= 2.2 min

Peak Storage= 233 cf @ 12.06 hrs
Average Depth at Peak Storage= 0.23'
Bank-Full Depth= 1.50' Flow Area= 13.5 sf, Capacity= 150.75 cfs

6.00' x 1.50' deep channel, n= 0.080
Side Slope Z-value= 2.0 '/' Top Width= 12.00'
Length= 158.0' Slope= 0.3334 '/'
Inlet Invert= 1,518.25', Outlet Invert= 1,465.57'



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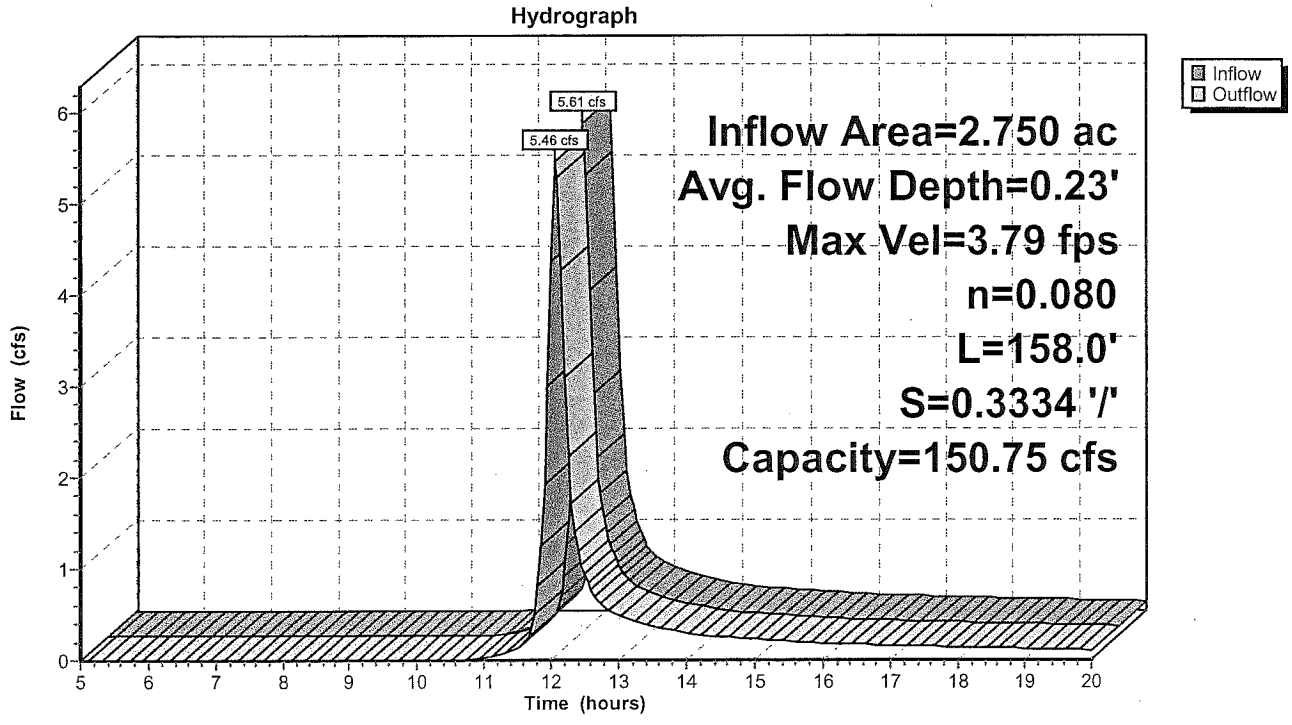
Reach DC7-2: DC7-2



Summary for Reach DC8-1: DC8-1

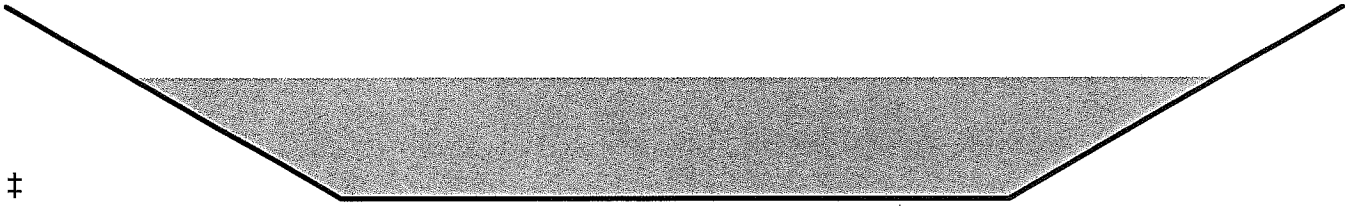
Inflow Area = 19.950 ac, 0.00% Impervious, Inflow Depth > 1.34" for 25 year event
Inflow = 46.65 cfs @ 12.01 hrs, Volume= 2.223 af
Outflow = 46.54 cfs @ 12.01 hrs, Volume= 2.223 af, Atten= 0%, Lag= 0.1 min

Routing by Stor-Ind+Trans method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Max. Velocity= 6.24 fps, Min. Travel Time= 0.0 min
Avg. Velocity = 1.98 fps, Avg. Travel Time= 0.1 min

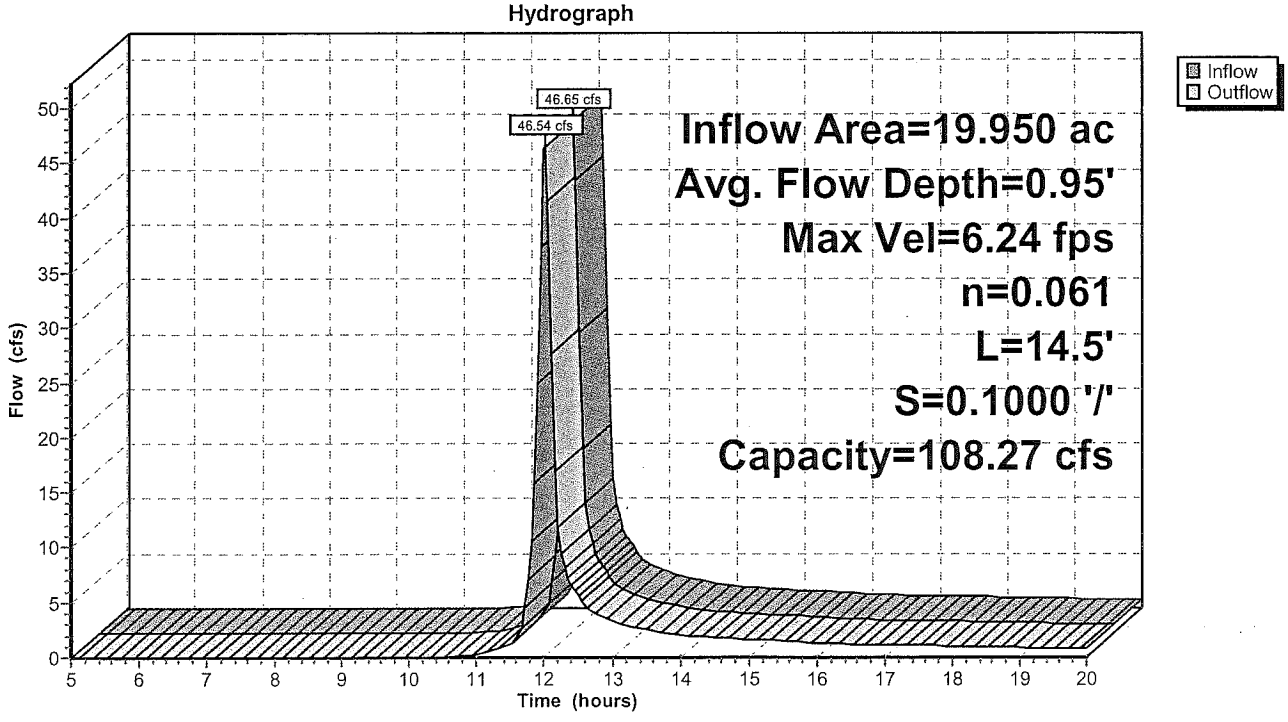
Peak Storage= 108 cf @ 12.01 hrs
Average Depth at Peak Storage= 0.95'
Bank-Full Depth= 1.50' Flow Area= 13.5 sf, Capacity= 108.27 cfs

6.00' x 1.50' deep channel, n= 0.061
Side Slope Z-value= 2.0 '/' Top Width= 12.00'
Length= 14.5' Slope= 0.1000 '/'
Inlet Invert= 1,538.08', Outlet Invert= 1,536.63'

‡



Reach DC8-1: DC8-1



Summary for Reach DC8-10: DC8-10

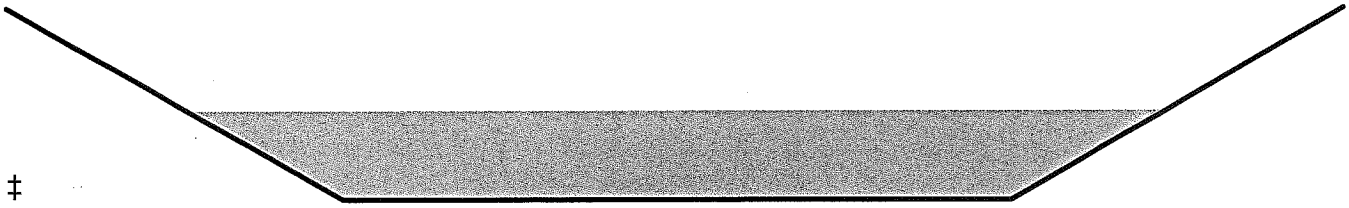
Inflow Area = 19.950 ac, 0.00% Impervious, Inflow Depth > 1.33" for 25 year event
Inflow = 43.02 cfs @ 12.06 hrs, Volume= 2.213 af
Outflow = 42.54 cfs @ 12.06 hrs, Volume= 2.212 af, Atten= 1%, Lag= 0.4 min

Routing by Stor-Ind+Trans method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Max. Velocity= 8.36 fps, Min. Travel Time= 0.3 min
Avg. Velocity = 2.67 fps, Avg. Travel Time= 0.8 min

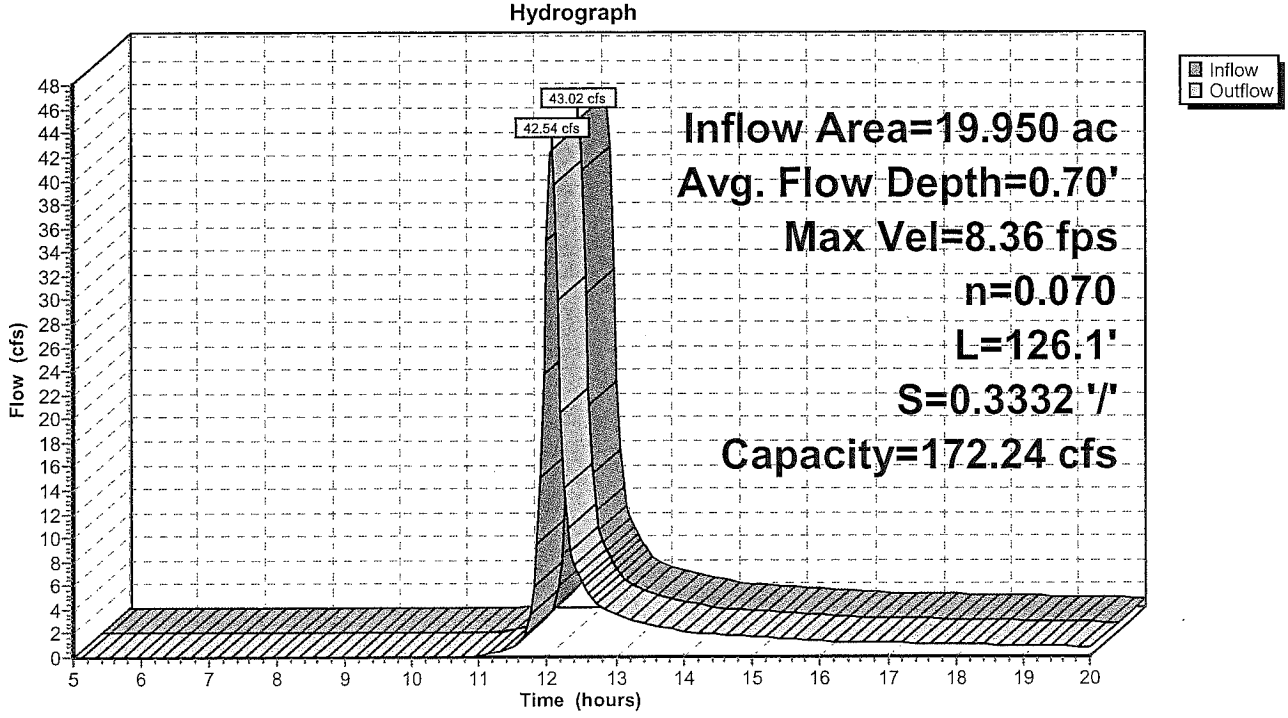
Peak Storage= 648 cf @ 12.06 hrs
Average Depth at Peak Storage= 0.70'
Bank-Full Depth= 1.50' Flow Area= 13.5 sf, Capacity= 172.24 cfs

6.00' x 1.50' deep channel, n= 0.070
Side Slope Z-value= 2.0 '/' Top Width= 12.00'
Length= 126.1' Slope= 0.3332 '/'
Inlet Invert= 1,293.02', Outlet Invert= 1,251.00'

‡



Reach DC8-10: DC8-10



Summary for Reach DC8-2: DC8-2

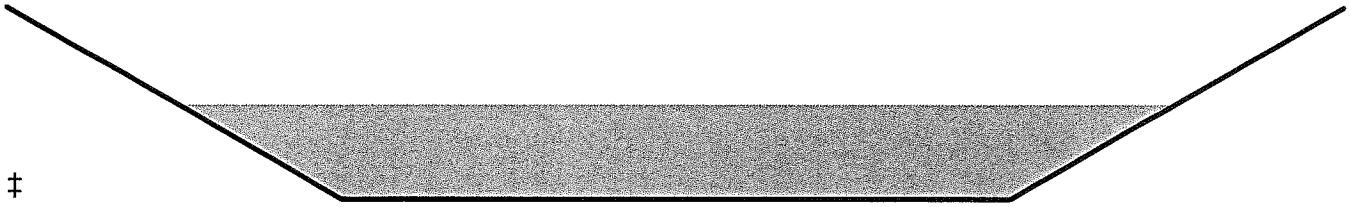
Inflow Area = 19.950 ac, 0.00% Impervious, Inflow Depth > 1.34" for 25 year event
Inflow = 46.54 cfs @ 12.01 hrs, Volume= 2.223 af
Outflow = 45.37 cfs @ 12.02 hrs, Volume= 2.221 af, Atten= 3%, Lag= 0.7 min

Routing by Stor-Ind+Trans method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Max. Velocity= 8.38 fps, Min. Travel Time= 0.4 min
Avg. Velocity = 2.60 fps, Avg. Travel Time= 1.3 min

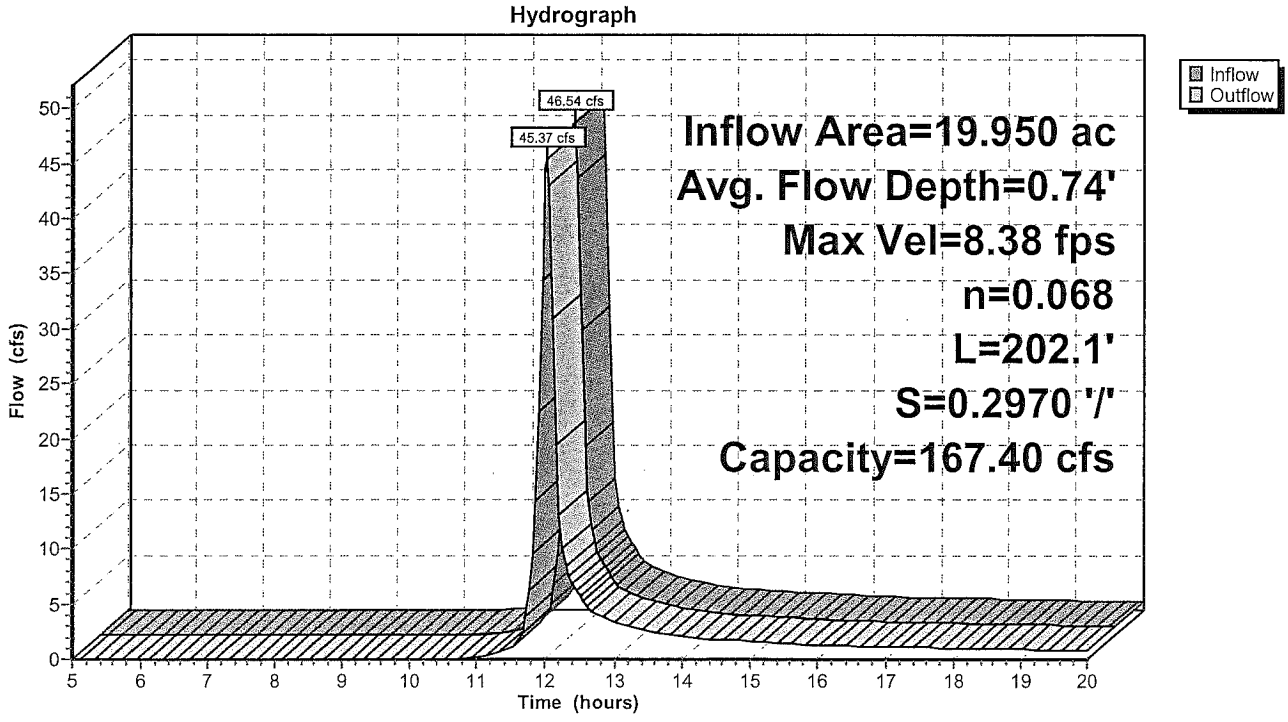
Peak Storage= 1,114 cf @ 12.01 hrs
Average Depth at Peak Storage= 0.74'
Bank-Full Depth= 1.50' Flow Area= 13.5 sf, Capacity= 167.40 cfs

6.00' x 1.50' deep channel, n= 0.068
Side Slope Z-value= 2.0 '/' Top Width= 12.00'
Length= 202.1' Slope= 0.2970 '/'
Inlet Invert= 1,536.63', Outlet Invert= 1,476.60'

‡



Reach DC8-2: DC8-2



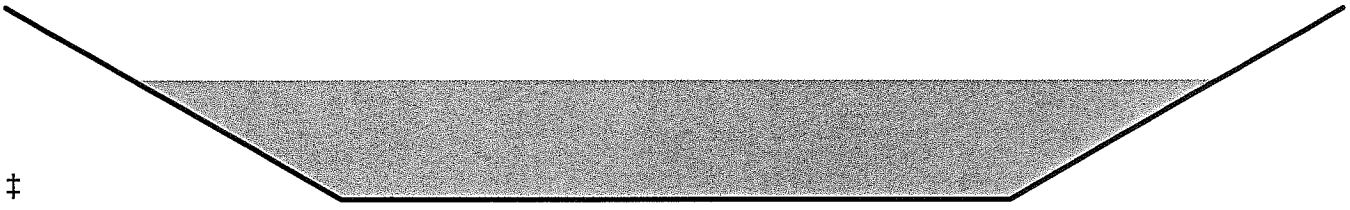
Summary for Reach DC8-3: DC8-3

Inflow Area = 19.950 ac, 0.00% Impervious, Inflow Depth > 1.34" for 25 year event
Inflow = 45.37 cfs @ 12.02 hrs, Volume= 2.221 af
Outflow = 45.15 cfs @ 12.02 hrs, Volume= 2.220 af, Atten= 0%, Lag= 0.1 min

Routing by Stor-Ind+Trans method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Max. Velocity= 6.15 fps, Min. Travel Time= 0.1 min
Avg. Velocity = 1.97 fps, Avg. Travel Time= 0.3 min

Peak Storage= 217 cf @ 12.02 hrs
Average Depth at Peak Storage= 0.93'
Bank-Full Depth= 1.50' Flow Area= 13.5 sf, Capacity= 108.09 cfs

6.00' x 1.50' deep channel, n= 0.061
Side Slope Z-value= 2.0 '/' Top Width= 12.00'
Length= 29.6' Slope= 0.0997 '/'
Inlet Invert= 1,476.60', Outlet Invert= 1,473.65'



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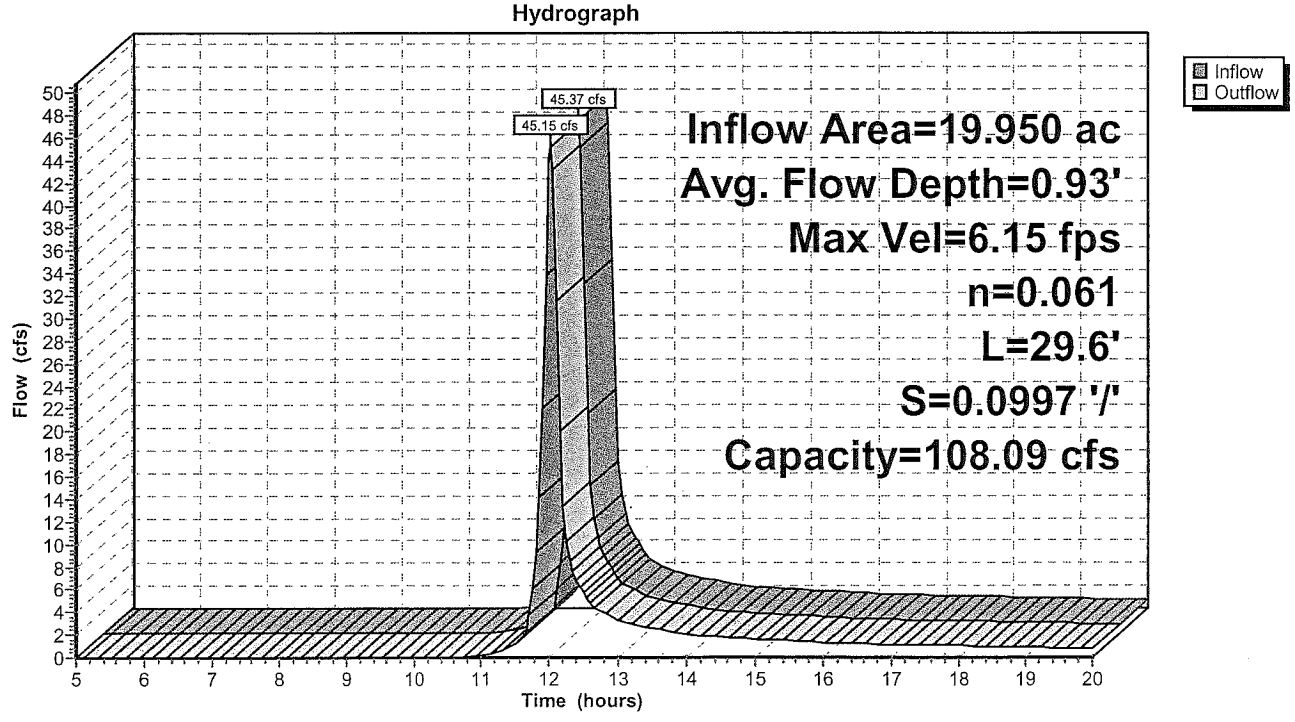
Reach DC8-3: DC8-3



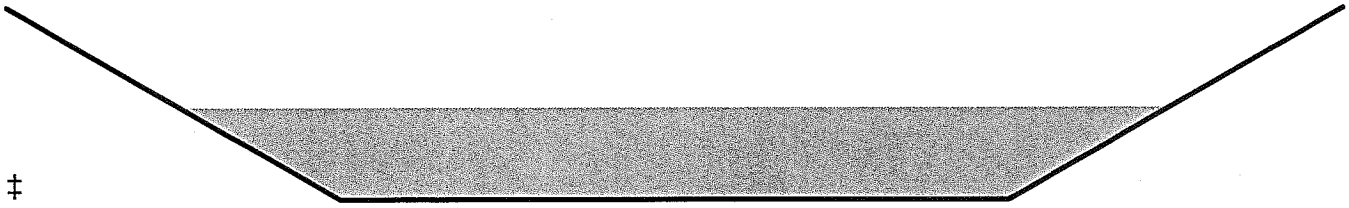
Summary for Reach DC8-4: DC8-4

Inflow Area = 19.950 ac, 0.00% Impervious, Inflow Depth > 1.34" for 25 year event
Inflow = 45.15 cfs @ 12.02 hrs, Volume= 2.220 af
Outflow = 44.54 cfs @ 12.03 hrs, Volume= 2.218 af, Atten= 1%, Lag= 0.7 min

Routing by Stor-Ind+Trans method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Max. Velocity= 8.38 fps, Min. Travel Time= 0.4 min
Avg. Velocity = 2.64 fps, Avg. Travel Time= 1.1 min

Peak Storage= 944 cf @ 12.03 hrs
Average Depth at Peak Storage= 0.72'
Bank-Full Depth= 1.50' Flow Area= 13.5 sf, Capacity= 171.14 cfs

6.00' x 1.50' deep channel, n= 0.070
Side Slope Z-value= 2.0 '/' Top Width= 12.00'
Length= 176.8' Slope= 0.3290 '/'
Inlet Invert= 1,473.65', Outlet Invert= 1,415.48'



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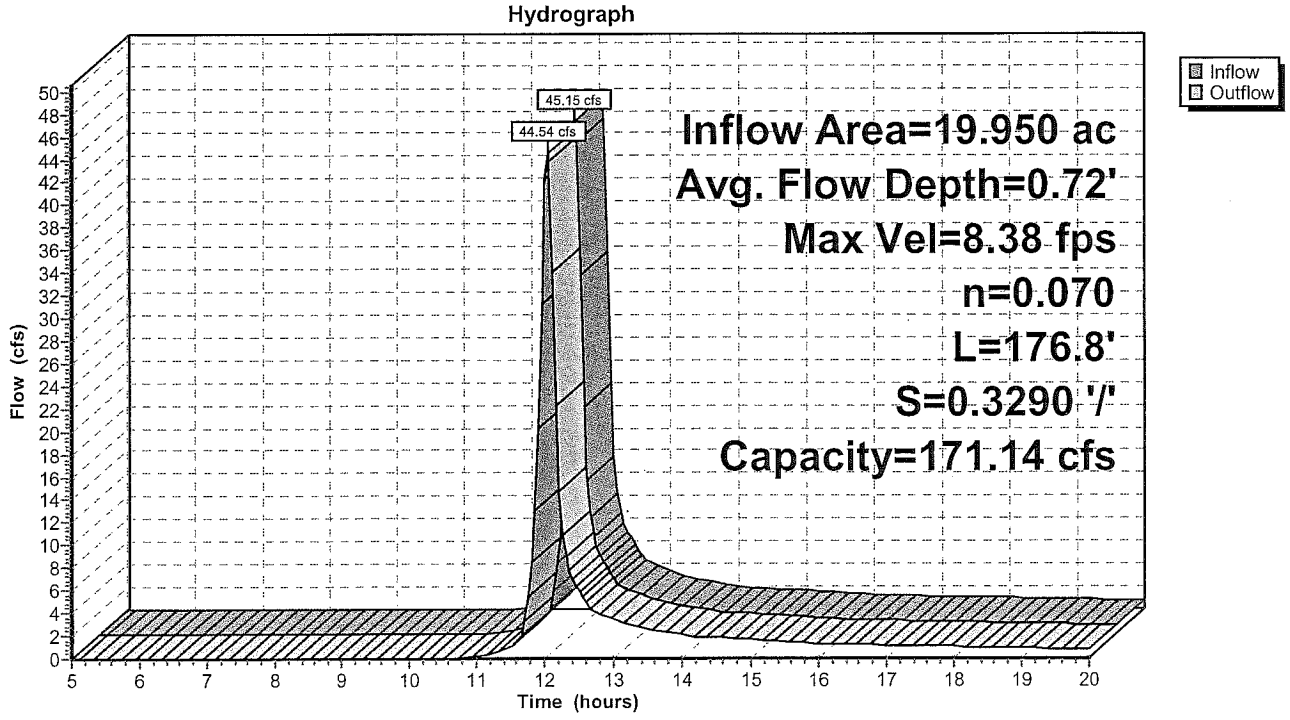
Reach DC8-4: DC8-4



Summary for Reach DC8-5: DC8-5

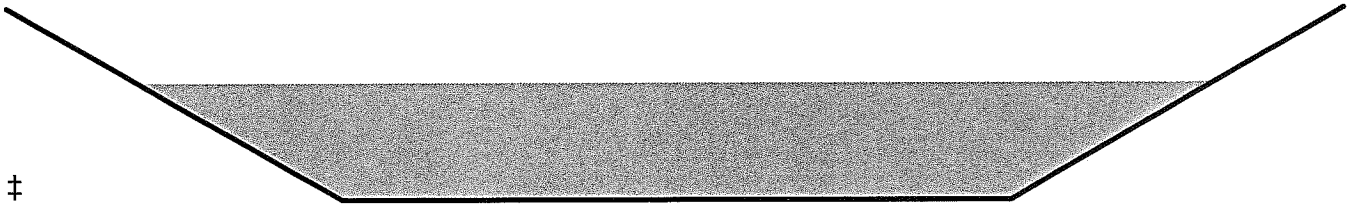
Inflow Area = 19.950 ac, 0.00% Impervious, Inflow Depth > 1.33" for 25 year event
Inflow = 44.54 cfs @ 12.03 hrs, Volume= 2.218 af
Outflow = 44.43 cfs @ 12.03 hrs, Volume= 2.218 af, Atten= 0%, Lag= 0.1 min

Routing by Stor-Ind+Trans method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Max. Velocity= 6.20 fps, Min. Travel Time= 0.1 min
Avg. Velocity = 2.00 fps, Avg. Travel Time= 0.2 min

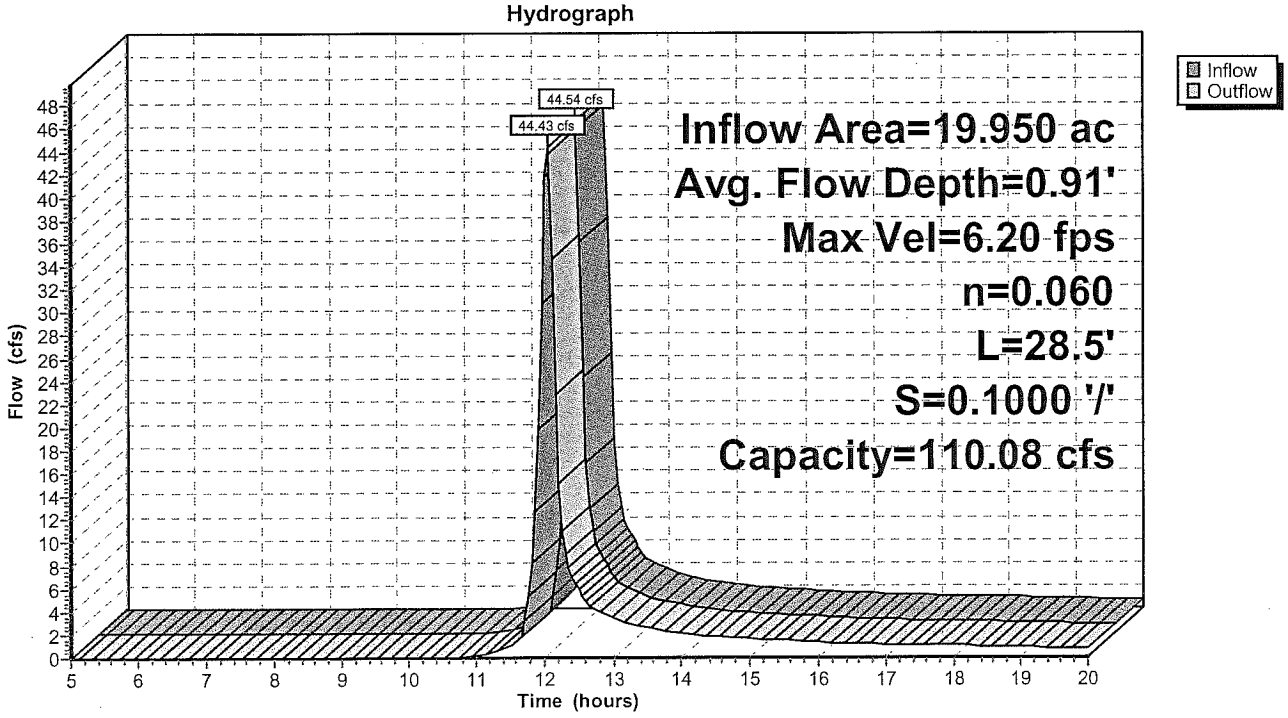
Peak Storage= 204 cf @ 12.03 hrs
Average Depth at Peak Storage= 0.91'
Bank-Full Depth= 1.50' Flow Area= 13.5 sf, Capacity= 110.08 cfs

6.00' x 1.50' deep channel, n= 0.060
Side Slope Z-value= 2.0 '/' Top Width= 12.00'
Length= 28.5' Slope= 0.1000 '/'
Inlet Invert= 1,415.48', Outlet Invert= 1,412.63'

‡



Reach DC8-5: DC8-5



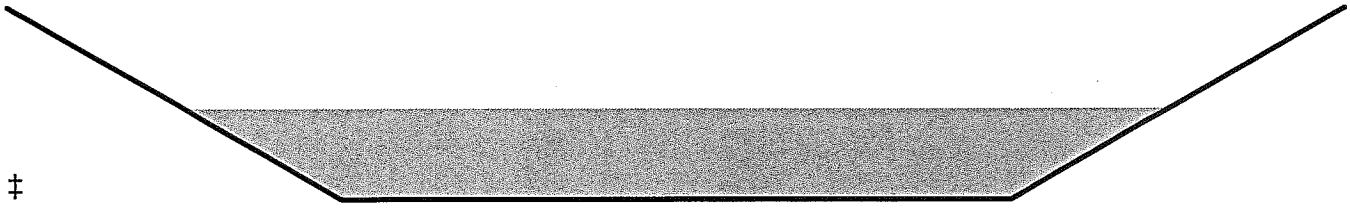
Summary for Reach DC8-6: DC8-6

Inflow Area = 19.950 ac, 0.00% Impervious, Inflow Depth > 1.33" for 25 year event
Inflow = 44.43 cfs @ 12.03 hrs, Volume= 2.218 af
Outflow = 43.90 cfs @ 12.04 hrs, Volume= 2.216 af, Atten= 1%, Lag= 0.5 min

Routing by Stor-Ind+Trans method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Max. Velocity= 8.44 fps, Min. Travel Time= 0.3 min
Avg. Velocity = 2.66 fps, Avg. Travel Time= 1.1 min

Peak Storage= 903 cf @ 12.04 hrs
Average Depth at Peak Storage= 0.71'
Bank-Full Depth= 1.50' Flow Area= 13.5 sf, Capacity= 172.24 cfs

6.00' x 1.50' deep channel, n= 0.070
Side Slope Z-value= 2.0 '/' Top Width= 12.00'
Length= 171.7' Slope= 0.3333 '/'
Inlet Invert= 1,412.63', Outlet Invert= 1,355.41'



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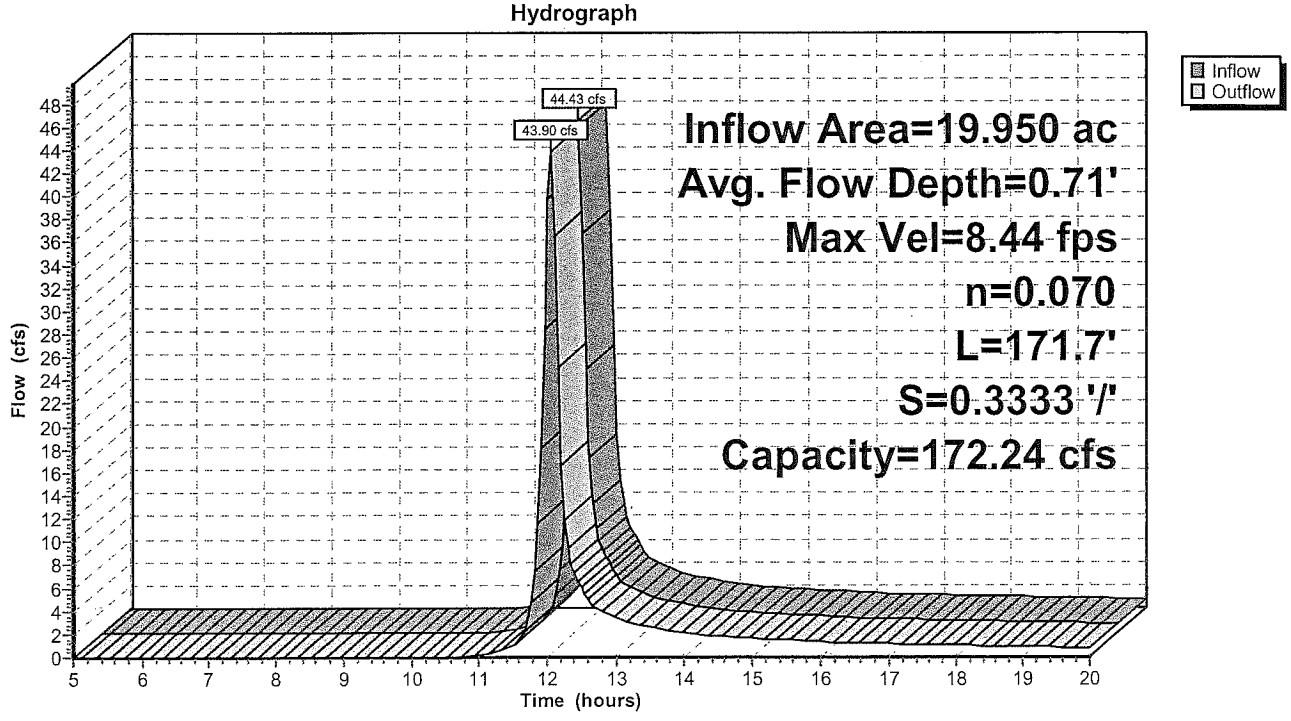
Reach DC8-6: DC8-6



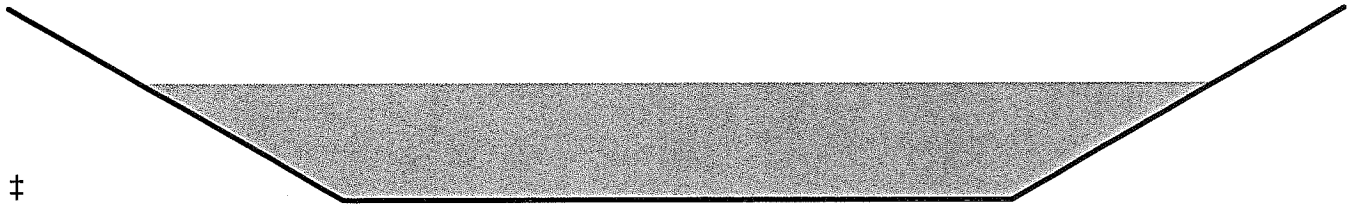
Summary for Reach DC8-7: DC8-7

Inflow Area = 19.950 ac, 0.00% Impervious, Inflow Depth > 1.33" for 25 year event
Inflow = 43.90 cfs @ 12.04 hrs, Volume= 2.216 af
Outflow = 43.77 cfs @ 12.04 hrs, Volume= 2.216 af, Atten= 0%, Lag= 0.1 min

Routing by Stor-Ind+Trans method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Max. Velocity= 6.13 fps, Min. Travel Time= 0.1 min
Avg. Velocity = 1.98 fps, Avg. Travel Time= 0.2 min

Peak Storage= 203 cf @ 12.04 hrs
Average Depth at Peak Storage= 0.91'
Bank-Full Depth= 1.50' Flow Area= 13.5 sf, Capacity= 108.46 cfs

6.00' x 1.50' deep channel, n= 0.061
Side Slope Z-value= 2.0 '/' Top Width= 12.00'
Length= 28.4' Slope= 0.1004 '/'
Inlet Invert= 1,355.41', Outlet Invert= 1,352.56'



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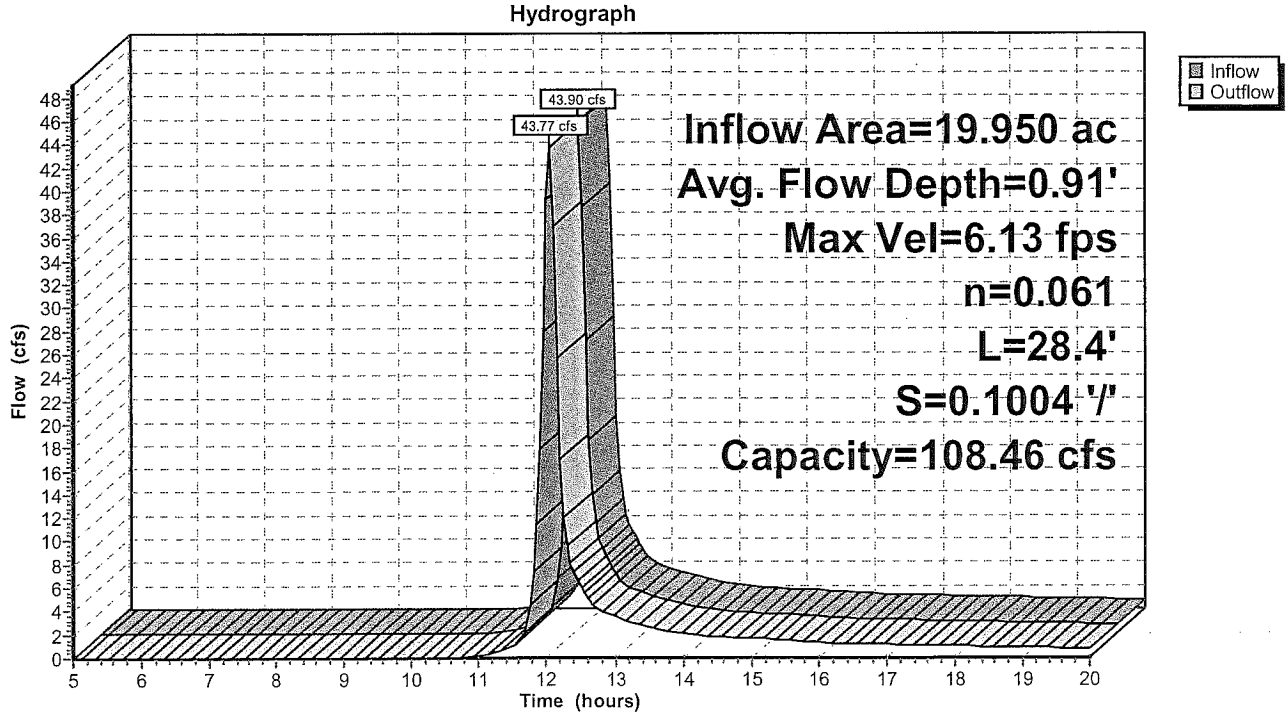
Reach DC8-7: DC8-7



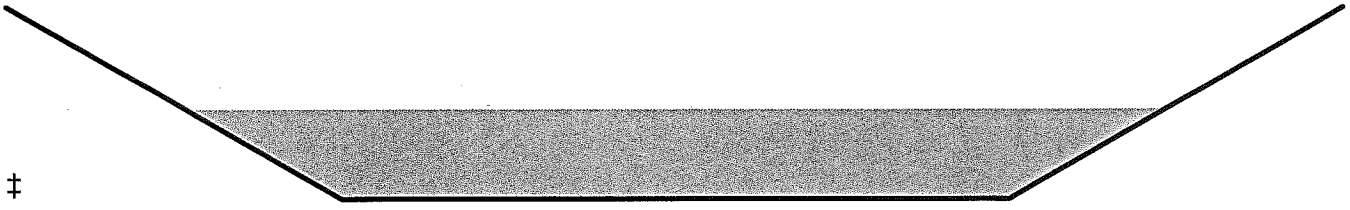
Summary for Reach DC8-8: DC8-8

Inflow Area = 19.950 ac, 0.00% Impervious, Inflow Depth > 1.33" for 25 year event
Inflow = 43.77 cfs @ 12.04 hrs, Volume= 2.216 af
Outflow = 43.17 cfs @ 12.05 hrs, Volume= 2.214 af, Atten= 1%, Lag= 0.5 min

Routing by Stor-Ind+Trans method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Max. Velocity= 8.42 fps, Min. Travel Time= 0.3 min
Avg. Velocity = 2.66 fps, Avg. Travel Time= 1.1 min

Peak Storage= 883 cf @ 12.05 hrs
Average Depth at Peak Storage= 0.70'
Bank-Full Depth= 1.50' Flow Area= 13.5 sf, Capacity= 172.32 cfs

6.00' x 1.50' deep channel, n= 0.070
Side Slope Z-value= 2.0 '/' Top Width= 12.00'
Length= 169.9' Slope= 0.3335 '/'
Inlet Invert= 1,352.56', Outlet Invert= 1,295.89'



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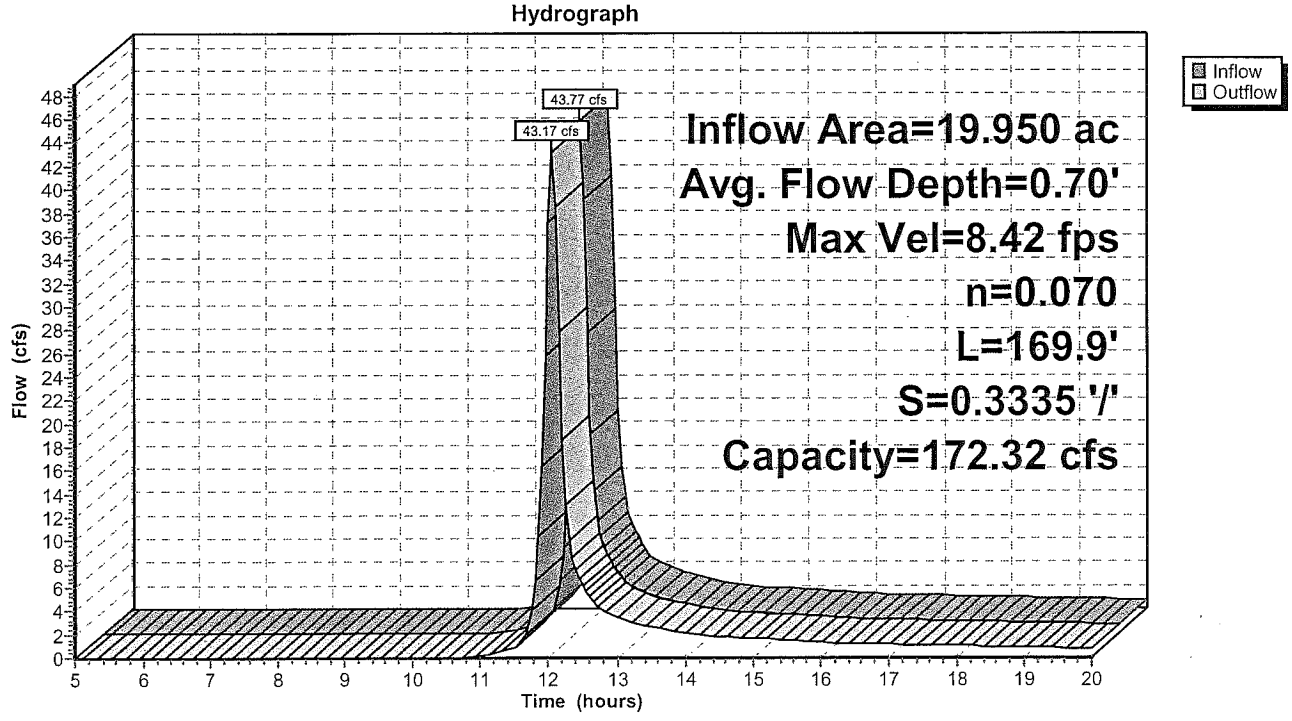
Reach DC8-8: DC8-8



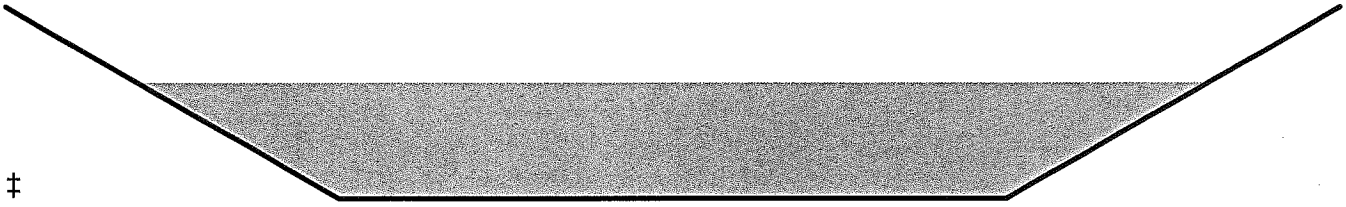
Summary for Reach DC8-9: DC8-9

Inflow Area = 19.950 ac, 0.00% Impervious, Inflow Depth > 1.33" for 25 year event
Inflow = 43.17 cfs @ 12.05 hrs, Volume= 2.214 af
Outflow = 43.02 cfs @ 12.06 hrs, Volume= 2.213 af, Atten= 0%, Lag= 0.1 min

Routing by Stor-Ind+Trans method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Max. Velocity= 6.10 fps, Min. Travel Time= 0.1 min
Avg. Velocity = 1.99 fps, Avg. Travel Time= 0.2 min

Peak Storage= 202 cf @ 12.05 hrs
Average Depth at Peak Storage= 0.91'
Bank-Full Depth= 1.50' Flow Area= 13.5 sf, Capacity= 108.46 cfs

6.00' x 1.50' deep channel, n= 0.061
Side Slope Z-value= 2.0 '/' Top Width= 12.00'
Length= 28.6' Slope= 0.1003 '/'
Inlet Invert= 1,295.89', Outlet Invert= 1,293.02'



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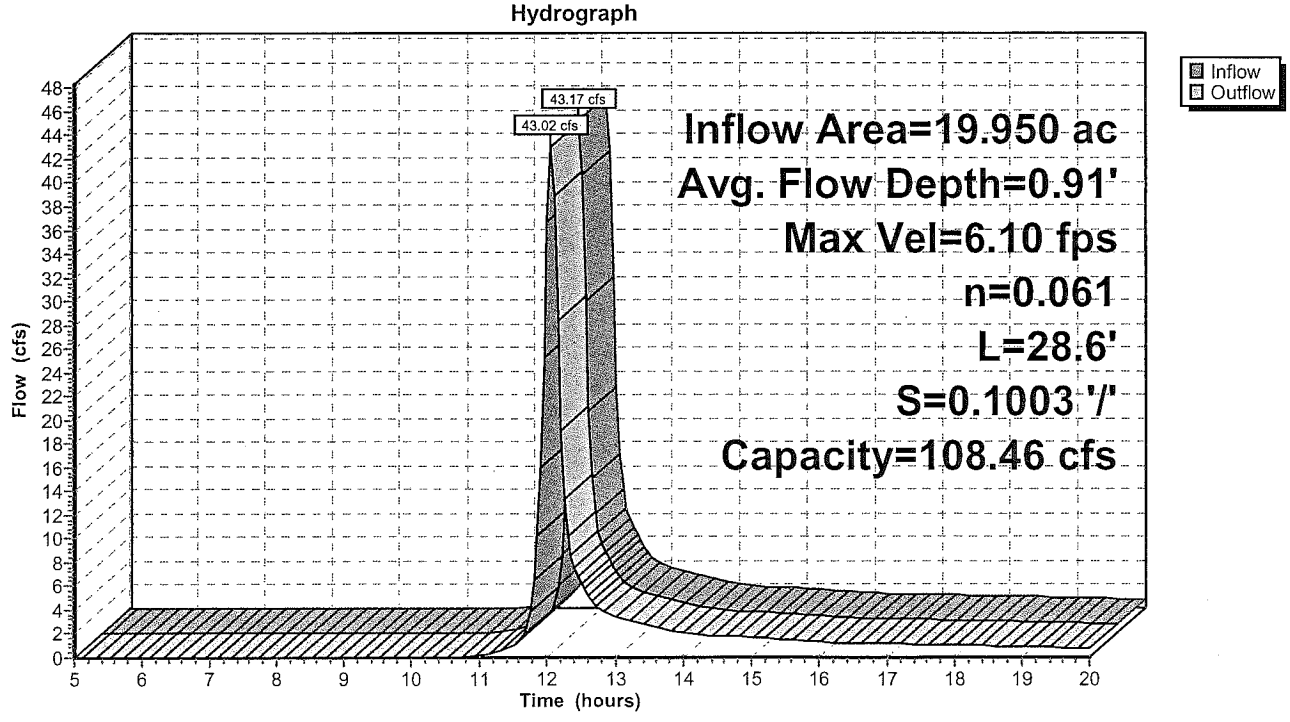
Reach DC8-9: DC8-9



Summary for Pond CU-H: Culvert H

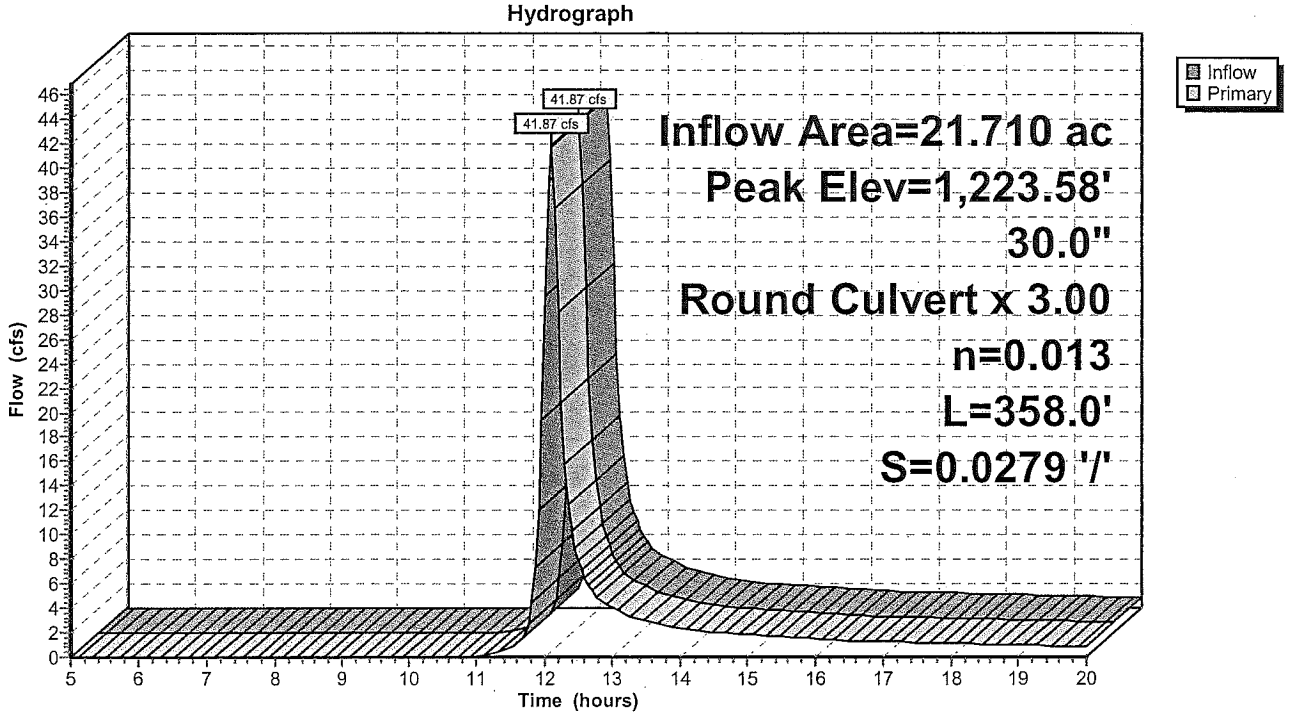
Inflow Area = 21.710 ac, 0.00% Impervious, Inflow Depth > 1.33" for 25 year event
Inflow = 41.87 cfs @ 12.09 hrs, Volume= 2.401 af
Outflow = 41.87 cfs @ 12.09 hrs, Volume= 2.401 af, Atten= 0%, Lag= 0.0 min
Primary = 41.87 cfs @ 12.09 hrs, Volume= 2.401 af

Routing by Stor-Ind method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Peak Elev= 1,223.58' @ 12.09 hrs

Device	Routing	Invert	Outlet Devices
#1	Primary	1,222.00'	**30.0" Round Culvert X 3.00** L= 358.0' CPP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 1,222.00' / 1,212.00' S= 0.0279 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 4.91 sf

Primary OutFlow Max=41.38 cfs @ 12.09 hrs HW=1,223.57' (Free Discharge)
↑**1=Culvert** (Inlet Controls 41.38 cfs @ 4.26 fps)

Pond CU-H: Culvert H



Summary for Pond CU-K: Culvert K

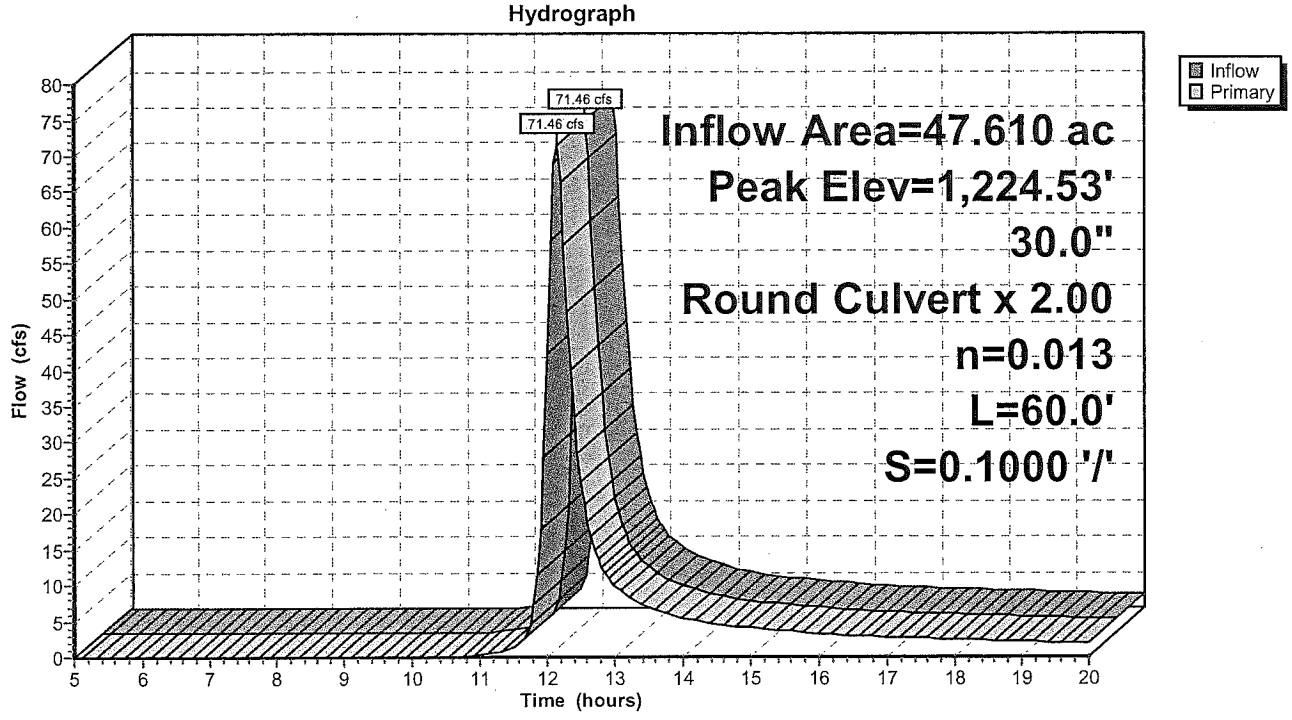
Inflow Area = 47.610 ac, 0.00% Impervious, Inflow Depth > 1.32" for 25 year event
Inflow = 71.46 cfs @ 12.14 hrs, Volume= 5.251 af
Outflow = 71.46 cfs @ 12.14 hrs, Volume= 5.251 af, Atten= 0%, Lag= 0.0 min
Primary = 71.46 cfs @ 12.14 hrs, Volume= 5.251 af

Routing by Stor-Ind method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Peak Elev= 1,224.53' @ 12.14 hrs

Device	Routing	Invert	Outlet Devices
#1	Primary	1,221.00'	**30.0" Round Culvert X 2.00** L= 60.0' CPP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 1,221.00' / 1,215.00' S= 0.1000 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 4.91 sf

Primary OutFlow Max=70.94 cfs @ 12.14 hrs HW=1,224.50' (Free Discharge)
1=Culvert (Inlet Controls 70.94 cfs @ 7.23 fps)

Pond CU-K: Culvert K



Summary for Pond CU-O: Culvert O

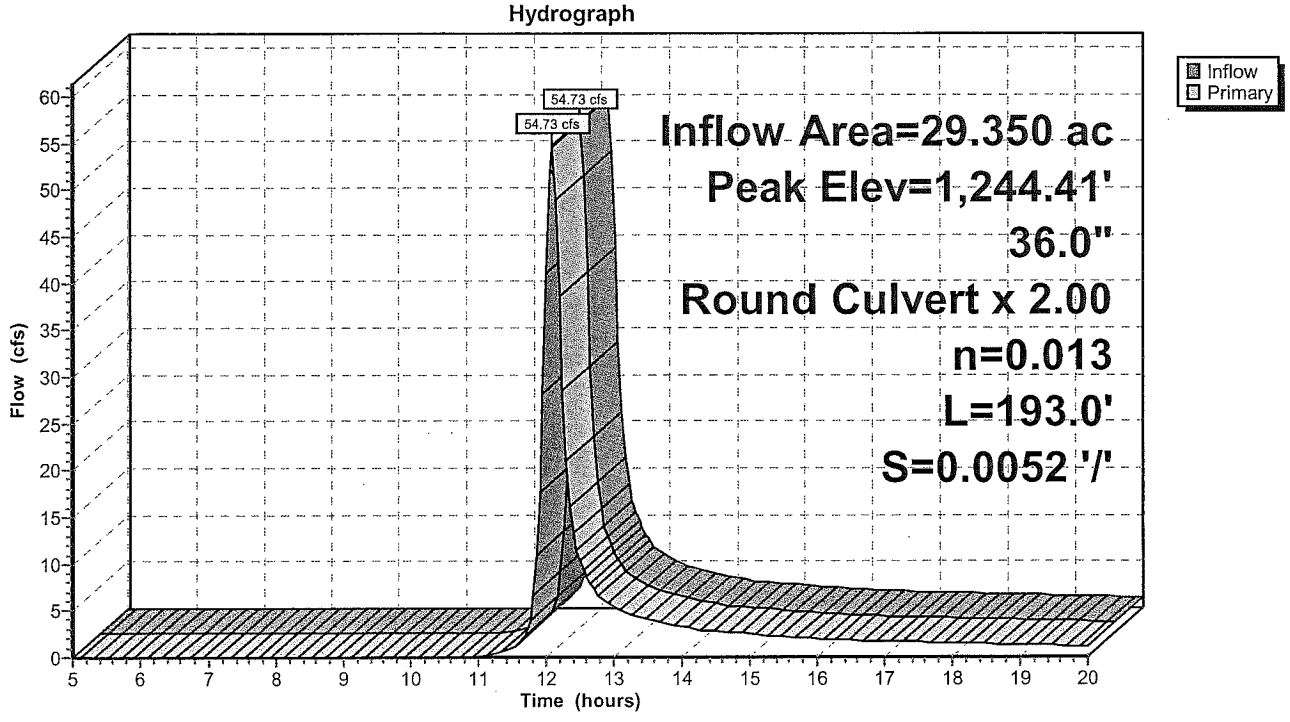
Inflow Area = 29.350 ac, 0.00% Impervious, Inflow Depth > 1.33" for 25 year event
Inflow = 54.73 cfs @ 12.09 hrs, Volume= 3.245 af
Outflow = 54.73 cfs @ 12.09 hrs, Volume= 3.245 af, Atten= 0%, Lag= 0.0 min
Primary = 54.73 cfs @ 12.09 hrs, Volume= 3.245 af

Routing by Stor-Ind method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Peak Elev= 1,244.41' @ 12.09 hrs

Device	Routing	Invert	Outlet Devices
#1	Primary	1,242.00'	**36.0" Round Culvert X 2.00** L= 193.0' CPP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 1,242.00' / 1,241.00' S= 0.0052 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 7.07 sf

Primary OutFlow Max=54.17 cfs @ 12.09 hrs HW=1,244.39' (Free Discharge)
↑—**1=Culvert** (Barrel Controls 54.17 cfs @ 6.15 fps)

Pond CU-O: Culvert O



Summary for Pond CU-Y: Culvert Y

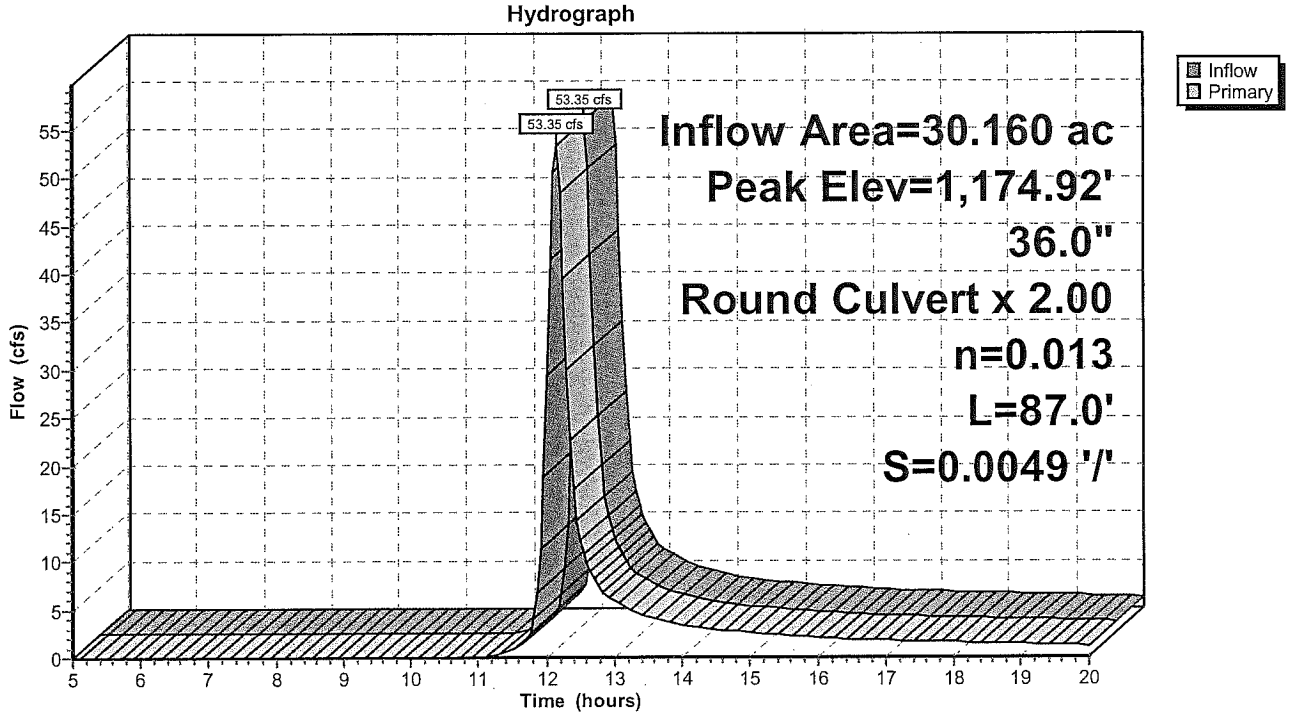
Inflow Area = 30.160 ac, 0.00% Impervious, Inflow Depth > 1.32" for 25 year event
Inflow = 53.35 cfs @ 12.14 hrs, Volume= 3.324 af
Outflow = 53.35 cfs @ 12.14 hrs, Volume= 3.324 af, Atten= 0%, Lag= 0.0 min
Primary = 53.35 cfs @ 12.14 hrs, Volume= 3.324 af

Routing by Stor-Ind method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Peak Elev= 1,174.92' @ 12.14 hrs

Device	Routing	Invert	Outlet Devices
#1	Primary	1,172.43'	**36.0" Round Culvert X 2.00** L= 87.0' CPP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 1,172.43' / 1,172.00' S= 0.0049 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 7.07 sf

Primary OutFlow Max=52.89 cfs @ 12.14 hrs HW=1,174.91' (Free Discharge)
1=Culvert (Barrel Controls 52.89 cfs @ 5.76 fps)

Pond CU-Y: Culvert Y



Summary for Pond CU-Z: Culvert Z

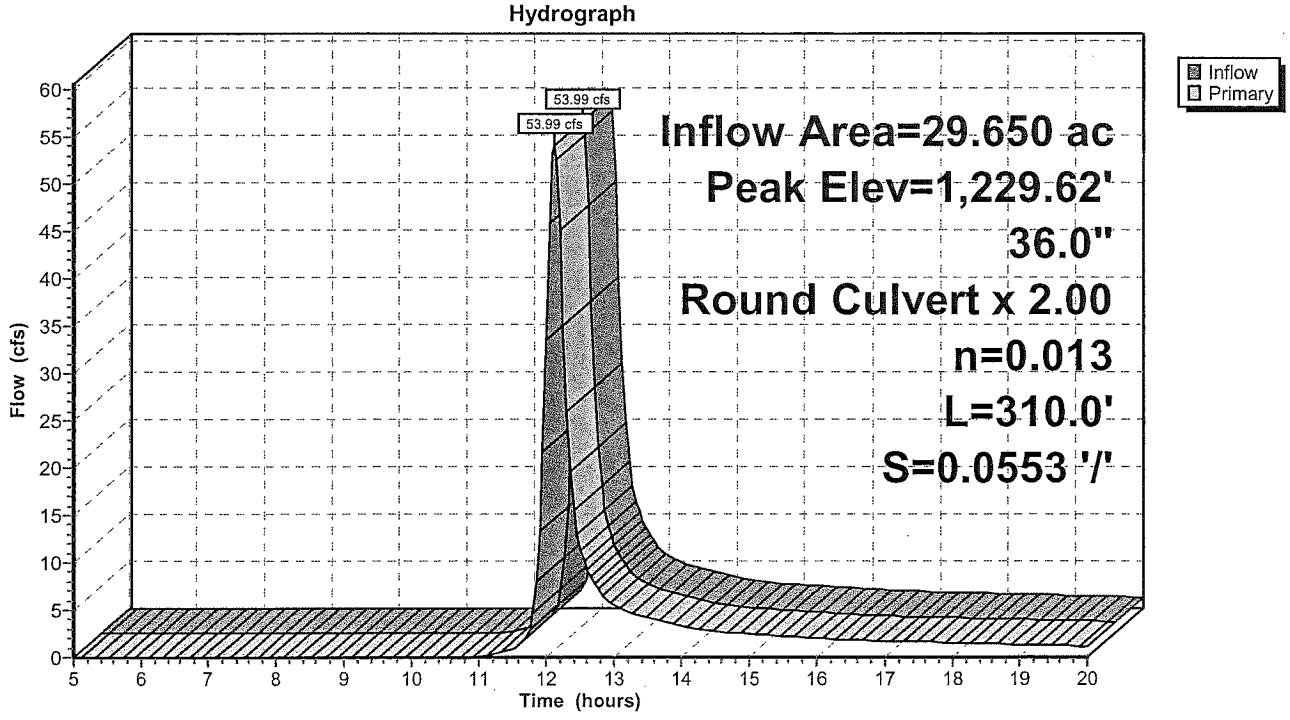
Inflow Area = 29.650 ac, 0.00% Impervious, Inflow Depth > 1.32" for 25 year event
Inflow = 53.99 cfs @ 12.12 hrs, Volume= 3.272 af
Outflow = 53.99 cfs @ 12.12 hrs, Volume= 3.272 af, Atten= 0%, Lag= 0.0 min
Primary = 53.99 cfs @ 12.12 hrs, Volume= 3.272 af

Routing by Stor-Ind method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Peak Elev= 1,229.62' @ 12.12 hrs

Device	Routing	Invert	Outlet Devices
#1	Primary	1,227.47'	**36.0" Round Culvert X 2.00** L= 310.0' CPP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 1,227.47' / 1,210.32' S= 0.0553 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 7.07 sf

Primary OutFlow Max=53.00 cfs @ 12.12 hrs HW=1,229.59' (Free Discharge)
1=Culvert (Inlet Controls 53.00 cfs @ 4.96 fps)

Pond CU-Z: Culvert Z



Summary for Pond NP: North Pond

Inflow Area = 124.330 ac, 0.00% Impervious, Inflow Depth > 1.32" for 25 year event
Inflow = 197.58 cfs @ 12.14 hrs, Volume= 13.712 af
Outflow = 0.00 cfs @ 5.00 hrs, Volume= 0.000 af, Atten= 100%, Lag= 0.0 min
Primary = 0.00 cfs @ 5.00 hrs, Volume= 0.000 af
Secondary = 0.00 cfs @ 5.00 hrs, Volume= 0.000 af

Routing by Stor-Ind method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Peak Elev= 1,125.88' @ 20.00 hrs Surf.Area= 0.000 ac Storage= 13.702 af

Plug-Flow detention time= (not calculated: initial storage excedes outflow)
Center-of-Mass det. time= (not calculated: no outflow)

Volume	Invert	Avail.Storage	Storage Description
#1	1,108.00'	23.860 af	**Custom Stage Data** Listed below

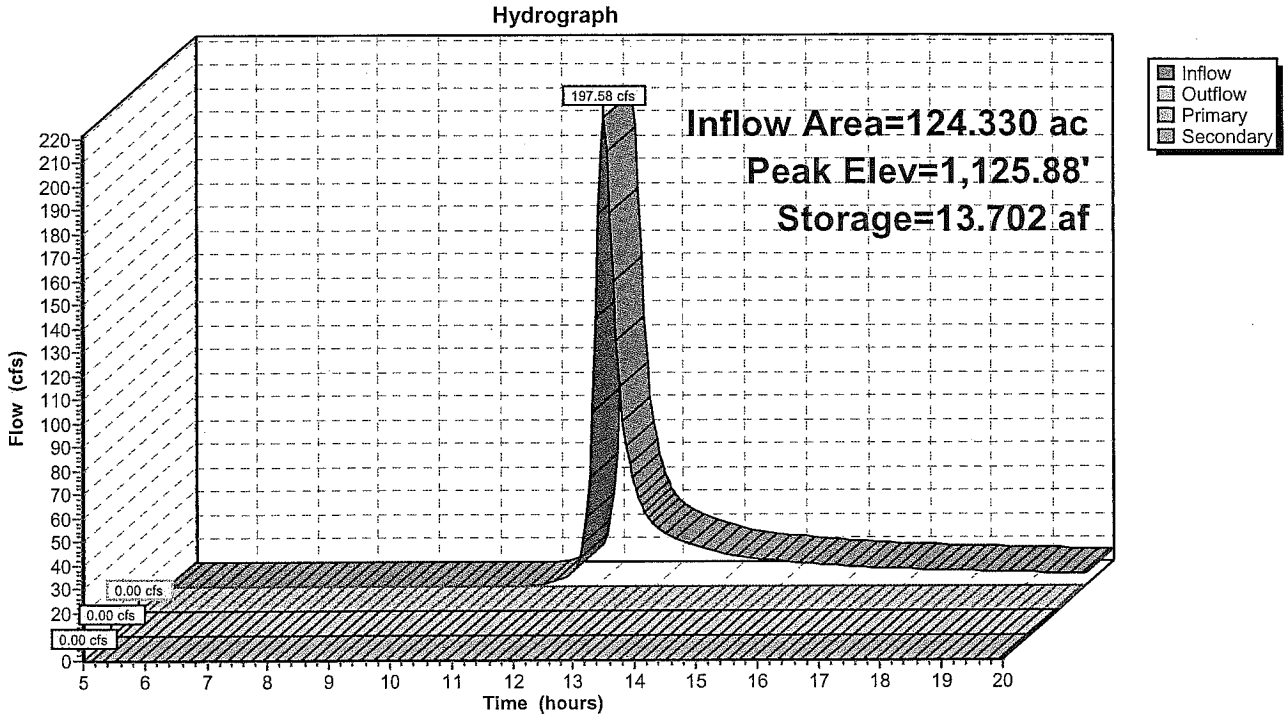
Elevation (feet)	Cum.Store (acre-feet)
1,108.00	0.000
1,110.00	0.820
1,112.00	1.800
1,114.00	2.950
1,116.00	4.270
1,118.00	5.780
1,120.00	7.480
1,122.00	9.390
1,124.00	11.510
1,126.00	13.840
1,128.00	16.400
1,130.00	19.200
1,132.00	22.250
1,133.00	23.860

Device	Routing	Invert	Outlet Devices
#1	Primary	1,126.29'	**30.0" Round Culvert** L= 60.0' CPP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 1,126.29' / 1,111.07' S= 0.2537 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 4.91 sf
#2	Secondary	1,131.00'	**151.9 deg x 8.0' long Sharp-Crested Vee/Trap Weir** Cv= 2.47 (C= 3.09)

Primary OutFlow Max=0.00 cfs @ 5.00 hrs HW=1,108.00' (Free Discharge)
↑—**1=Culvert** (Controls 0.00 cfs)

Secondary OutFlow Max=0.00 cfs @ 5.00 hrs HW=1,108.00' (Free Discharge)
↑—**2=Sharp-Crested Vee/Trap Weir** (Controls 0.00 cfs)

Pond NP: North Pond



SEDIMENTATION POND
ROUTING OF 100-YEAR 24-HOUR STORM

Summary for Pond NP: North Pond

Inflow Area = 124.330 ac, 0.00% Impervious, Inflow Depth > 2.08" for 100 year event
Inflow = 330.07 cfs @ 12.12 hrs, Volume= 21.525 af
Outflow = 13.65 cfs @ 15.52 hrs, Volume= 5.826 af, Atten= 96%, Lag= 203.7 min
Primary = 13.65 cfs @ 15.52 hrs, Volume= 5.826 af
Secondary = 0.00 cfs @ 5.00 hrs, Volume= 0.000 af

Routing by Stor-Ind method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Peak Elev= 1,127.85' @ 15.52 hrs Surf.Area= 0.000 ac Storage= 16.202 af

Plug-Flow detention time= 287.2 min calculated for 5.826 af (27% of inflow)
Center-of-Mass det. time= 195.7 min (1,002.3 - 806.6)

Volume	Invert	Avail.Storage	Storage Description
#1	1,108.00'	23.860 af	**Custom Stage Data** Listed below

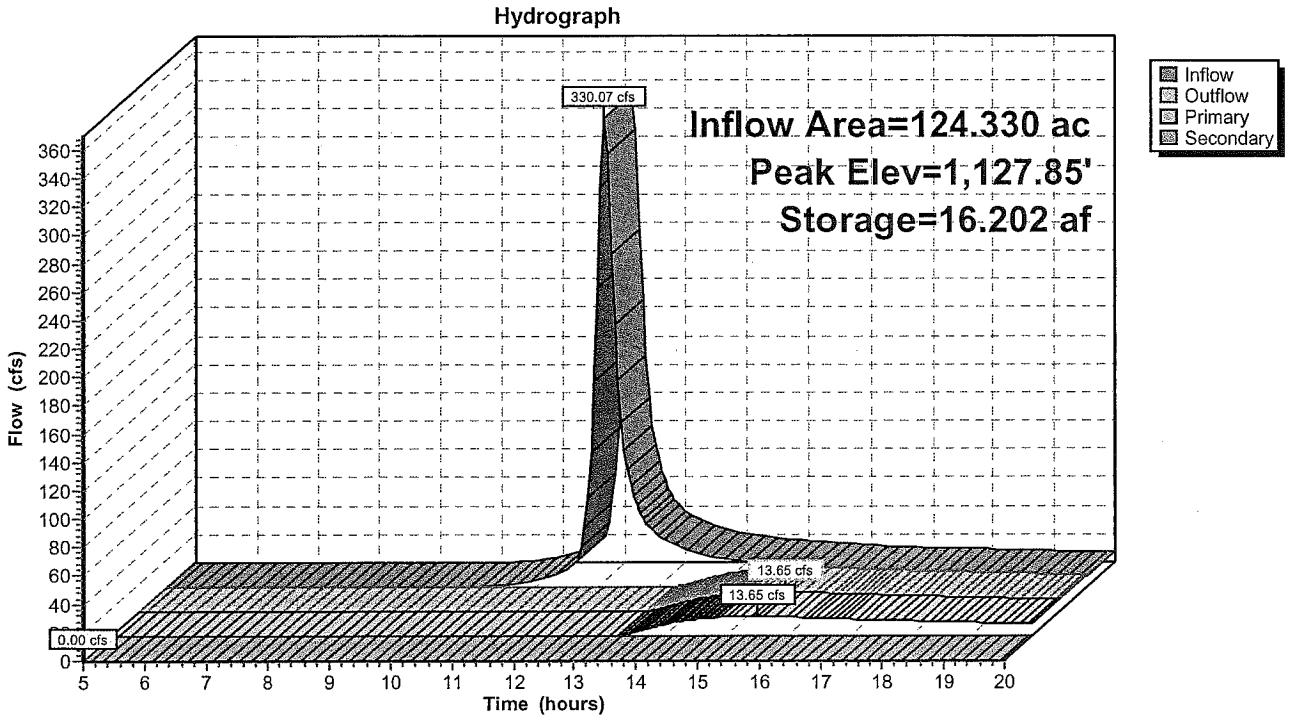
Elevation (feet)	Cum.Store (acre-feet)
1,108.00	0.000
1,110.00	0.820
1,112.00	1.800
1,114.00	2.950
1,116.00	4.270
1,118.00	5.780
1,120.00	7.480
1,122.00	9.390
1,124.00	11.510
1,126.00	13.840
1,128.00	16.400
1,130.00	19.200
1,132.00	22.250
1,133.00	23.860

Device	Routing	Invert	Outlet Devices
#1	Primary	1,126.29'	**30.0" Round Culvert** L= 60.0' CPP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 1,126.29' / 1,111.07' S= 0.2537 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 4.91 sf
#2	Secondary	1,131.00'	**151.9 deg x 8.0' long Sharp-Crested Vee/Trap Weir** Cv= 2.47 (C= 3.09)

Primary OutFlow Max=13.63 cfs @ 15.52 hrs HW=1,127.85' (Free Discharge)
↑—**1=Culvert** (Inlet Controls 13.63 cfs @ 4.25 fps)

Secondary OutFlow Max=0.00 cfs @ 5.00 hrs HW=1,108.00' (Free Discharge)
↑—**2=Sharp-Crested Vee/Trap Weir** (Controls 0.00 cfs)

Pond NP: North Pond



OTHER CALCULATIONS

(m) Other relevant calculations.

- Soil Balance

Civil & Environmental Consultants, Inc.

PROJECT	(C)(5)(m) OVERALL SOIL BALANCE				PROJECT NO.	091-867	
	APEX SANITARY LANDFILL LATERAL EXPANSION				PAGE	1	OF 7
MADE BY	JSO	DATE	10/06/11	CHECKED BY	MRF	DATE	10/24/11
MADE BY	JMC	DATE	07/10/13	CHECKED BY	AMR	DATE	07/10/13

INTRODUCTION

Determine the soil balance for the construction, operation, and closure of the proposed lateral expansion of the Apex Sanitary Landfill (Landfill). This calculation will estimate the soil quantities available from on-site excavation activities and the quantities required for construction, operation and closure of the Landfill. From these quantity estimates, the amount of remaining soil surplus or deficit will be determined and reported in **Table 1**.

METHOD

Quantities have been estimated using Civil 3D design software through comparison of the aerial mapping dated ~~January 5, 2011~~ for the lateral expansion and the proposed design surface. *Aerial mapping dated January 5, 2011 was used for the initial calculation and updated aerial mapping dated January 18, 2013 was used for the revised calculation. Quantities in areas that remained unchanged from the initial to updated topography were not revised.* The soil balance calculations have been presented by line item so that the available soil from different portions of the site and the required soil for construction, operation, and closure items may be estimated.

CALCULATION SUMMARY

The cut and fill volumes from the landfill baseliner grades were utilized to calculate the excavation quantities presented. The following summary describes each line item of the attached soil balance calculation table.

Available Soils

This calculation provides a summary of the available construction cut from the landfill soil liner and over-excavation from the excess soil disposal area for the lateral expansion of the Landfill. *The total material available for construction does not account for the loss of limestone due to processing for aggregate.*

Item	Description
Construction Cut for Landfill Baseliner System	This quantity represents the available soil excavation required to achieve the design baseliner grades for the construction of the Landfill Lateral Expansion. These volumes were determined by using AutoCad Civil 3D and comparing the design excavation grades to the updated topography dated ~~January 5, 2011~~ *January 18, 2013*. **Figure 1** presents an isopach map of the facility and provides the cut volumes from excavation activities and structural fill quantities required. This quantity of soil excavation is ~~14,412,700~~ *14,528,400* cy
Excess Spoil Disposal Area Over-Excavation	This quantity represents the available soil excavation cut achieved from over-excavation of the Excess Spoil Disposal Area. These volumes were determined by using AutoCad Civil 3D and comparing the design excavation grades to the updated topography dated ~~January 5, 2011~~ *January 18, 2013*. **Figure 2** presents an isopach map of the Excess Spoil Disposal Area and provides the cut volumes from this area. This quantity of soil excavation is ~~194,000~~ *191,900* cy
Sediment Pond Excavation	The Sediment Pond Excavation represents material excavated at each of the sediment ponds constructed for the lateral expansion of the landfill. This quantity has been determined using AutoCad Civil 3D and comparing the pond excavation grades with the updated topography dated January 5, 2011. This quantity of soil excavation is 39,800 cy

Required Soils

This calculation provides a summary of the material required for liner construction, operations and landfill closure. It is assumed that the source of material required will be available from the quantity of soil available. No compaction factors have been accounted for in these quantities.

Item	Description
Structural Fill for Landfill Baseliner System	This quantity represents the structural fill material required to achieve the design baseliner grades for the construction of the Landfill Lateral Expansion. These volumes were determined by using AutoCad Civil 3D and comparing the design excavation grades to the updated topography dated ~~January 5, 2011~~ *January 18, 2013.* **Figure 1** presents an isopach map of the facility and provides the cut volumes from excavation activities and structural fill quantities required. This quantity of structural fill required is ~~4,574,900~~ *4,514,600* cy
Excess Spoil Disposal Area Backfill	This quantity represents the required soil backfill material required to fill the over-excavation of the Excess Spoil Disposal Area. These volumes were determined by using AutoCad Civil 3D and comparing the design excavation grades to the updated topography dated ~~January 5, 2011~~ *January 18, 2013.* This quantity of backfill required is ~~194,000~~ *191,900* cy
Recompacted Soil Liner (RSL)	The RSL is designed to be a 3-feet thick layer of clay material meeting a maximum hydraulic conductivity of 1 x 10^{-7} cm/sec. Based on field investigation, a sufficient quantity of this material can be found within the quantity of the material excavation. The volume is determined by the following: $(170.93\,\text{ac})\left(43{,}560\frac{\text{ft}^2}{\text{acre}}\right)(3\,\text{ft})\left(\frac{1\,\text{yd}^3}{27\,\text{ft}^3}\right) = 827{,}300\,\text{yd}^3$

Daily/Intermediate Cover	The required quantity of daily/intermediate cover is calculated as 15% of the lateral expansion's airspace. It is assumed that soil and rock excavation will be used as daily/intermediate cover. The calculated airspace of the lateral expansion is approximately ~~60,633,600~~ *61,104,900* cubic yards. The daily/intermediate cover quantity is then calculated as follows: ~~$(60{,}633{,}600\ yd^3\ Airspace)\left(\frac{15\%}{100}\right) = 9{,}095{,}000\ yd^3$~~ $(61{,}104{,}900\ yd^3\ Airspace)\frac{15}{100} = 9{,}165{,}700\ yd^3$
Recompacted Soil Barrier (RSB)	The RSB is designed to be a 1.5-feet thick layer of clay material meeting a maximum hydraulic conductivity of 1 x 10-6 cm/sec. Based on field investigation, a sufficient quantity of this material can be found within the quantity of the material excavation. The volume is determined by the following, which includes a slope correction factor of 5% to account for the 3H:1V slopes of the final cover system: $(170.93\,ac)\left(43{,}560\frac{ft^2}{acre}\right)(1.5\,ft)\left(\frac{1\,yd^3}{27\,ft^3}\right)\left(\frac{105\%}{100}\right) = 434{,}300\,yd^3$
Vegetative Cover Soil	The Vegetative Cover Soil is designed to be a 2.5-feet thick layer of cover material capable of supporting vegetative growth. The volume is determined by the following, which includes a slope correction factor of 5% to account for the 3H:1V slopes of the final cover system: $(170.93\,ac)\left(43{,}560\frac{ft^2}{acre}\right)(2.5\,ft)\left(\frac{1\,yd^3}{27\,ft^3}\right)\left(\frac{105\%}{100}\right) = 723{,}900\,yd^3$
Sediment Pond Fill Material	The Sediment Pond Fill Material represents material required to be placed at each of the sediment ponds constructed for the lateral expansion of the landfill. This quantity has been determined using AutoCad Civil 3D and comparing the pond excavation grades with the updated topography dated January 5, 2011. This quantity of structural fill required is 3,800 cy

SOIL BALANCE

Refer to **Table 1** for calculations of the combined soil balance of material available vs. material required. Based on this Table, there will be a shortfall ~~1,206,700~~ *1,101,400* cy of material.

CONCLUSION

The Apex Sanitary Landfill lateral expansion will have a total of ~~14,646,500~~ *14,760,100* cy of soil available on-site for use in construction and operation of the facility. Construction, operations and closure of the Landfill will require a total of ~~15,853,200~~ *15,681,500* cy of material. The facility soil balance results in a combined shortage of ~~1,206,700~~ *1,101,400* cy. This shortage will be made up of on-site borrow areas ~~and material imported from off-site~~.

TABLE 1

TABLE 1
OVERALL SOIL BALANCE
APEX SANITARY LANDFILL
LATERAL EXPANSION

Item	Units	Soil Quantity
Plan Areas and Airspace		
Plan Area for Final Cover in Permitted Unit	(acres)	170.9
Proposed Airspace in Lateral Expansion	(cy)	61,104,900
Available Materials (See Notes 1 and 2)		
Construction Cut for Landfill Baseliner System	(cy)	14,528,400
Excess Spoil Disposal Area Overexcavation	(cy)	191,900
Sediment Pond Excavation Material	(cy)	39,800
Total Lateral Expansion Material Available (See Note 2)	(cy)	14,760,100
Required Soil (See Notes 3 and 4)		
Structural Fill for Landfill Baseliner System	(cy)	4,514,600
Excess Spoil Disposal Area Backfill	(cy)	191,900
Recompacted Soil Liner	(cy)	827,300
Daily/Intermediate Cover Soil (15% of Airspace)	(cy)	9,165,700
Recompacted Soil Barrier	(cy)	434,300
Vegetative Cover Soil	(cy)	723,900
Sediment Pond Fill Material	(cy)	3,800
Total Lateral Expansion Material Required	(cy)	15,861,500
TOTAL BALANCE	*(cy)*	***(1,101,400)***

Notes:

1. This calculation is based only on the unconstructed portion of the landfill.
2. The total material available for construction does not account for the loss of limestone due to processing for aggregate.
3. No compaction factors have been accounted for in the required soil quantities.
4. Additional soils needed for construction of landfill components will be taken from on-site borrow areas.

FIGURES

NORTH

REVISION RECORD		
NO	DATE	DESCRIPTION
1	7/5/13	RESPONSE TO OEPA NOV DATED 12/23/12 AND REVISED PHASING
2		
3		
4		

SUBMITTAL RECORD		
NO	DATE	DESCRIPTION

LEGEND

- 1220 — EXISTING GROUND CONTOUR (SEE REFERENCE)
- PROPERTY LINE
- LIMIT OF SOLID WASTE PLACEMENT
- 1220 — PERMITTED BASE OF EXCAVATION CONTOUR
- 1220 — PROPOSED BASE OF EXCAVATION CONTOUR
- 10 — FILL ISOPACH CONTOUR
- 10 — CUT ISOPACH CONTOUR

NOTES

1. ISOPACH CONTOURS ARE SHOWN AT EVERY 5-FEET.
2. APPROXIMATE VOLUME OF CUT IS 14,529,400 CY.
   APPROXIMATE VOLUME OF FILL IS 4,514,800 CY.

REFERENCE

EXISTING TOPOGRAPHY PREPARED BY KEDDAL AERIAL MAPPING, DATE OF PHOTOGRAPHY: 1/18/13. ADDITIONAL MAPPING WAS PREPARED BY KEDDAL AERIAL MAPPING FROM AERIAL PHOTOGRAPHY DATED 1/6/12 AND 1/5/11 AND BY M.A.N. MAPPING FROM AERIAL PHOTOGRAPHY DATED 12/14/00.

STATE OF OHIO
RICK BUFFALINI
REGISTERED
PROFESSIONAL ENGINEER

SCALE IN FEET
0 200 400

*HAND SIGNATURE ON FILE

Authorized Use:

☐ Survey	☑ Permitting	☐ Construction
☐ Design Dev.	☐ Bidding	☐ -

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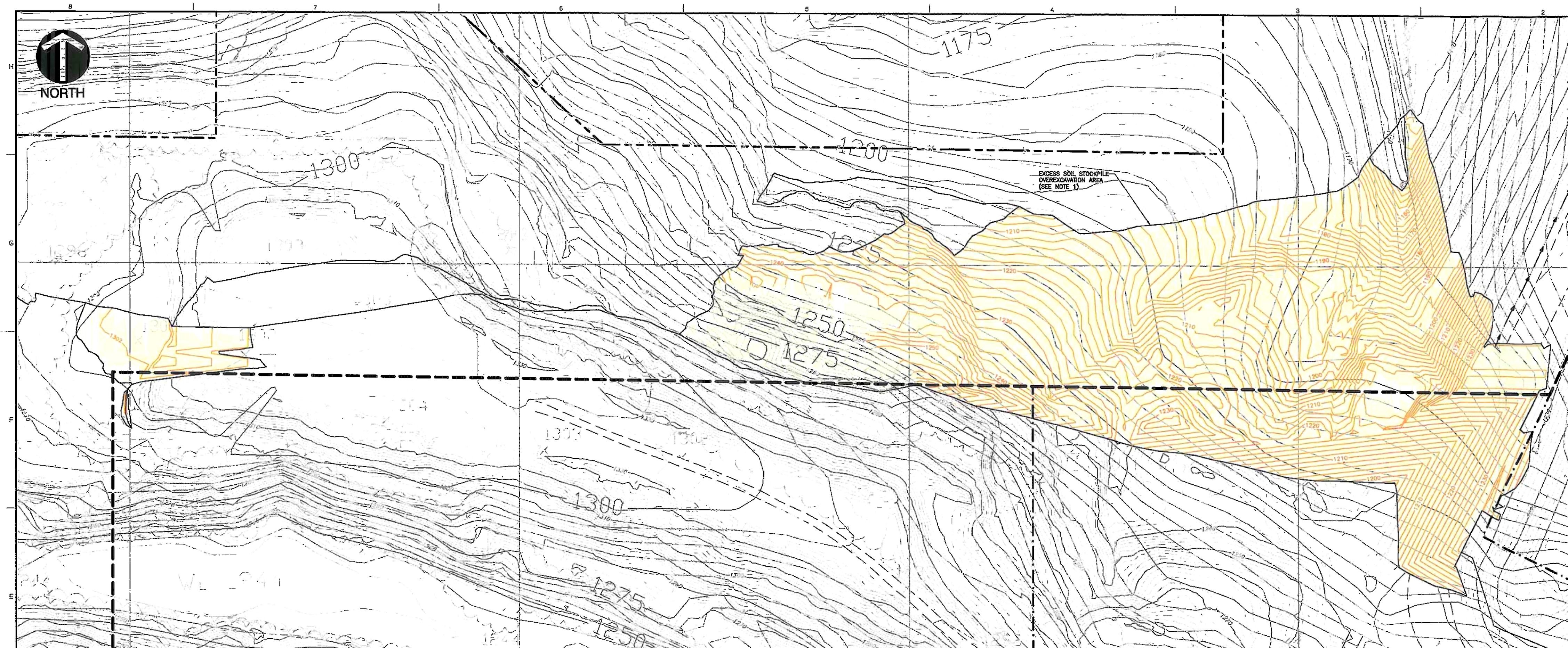
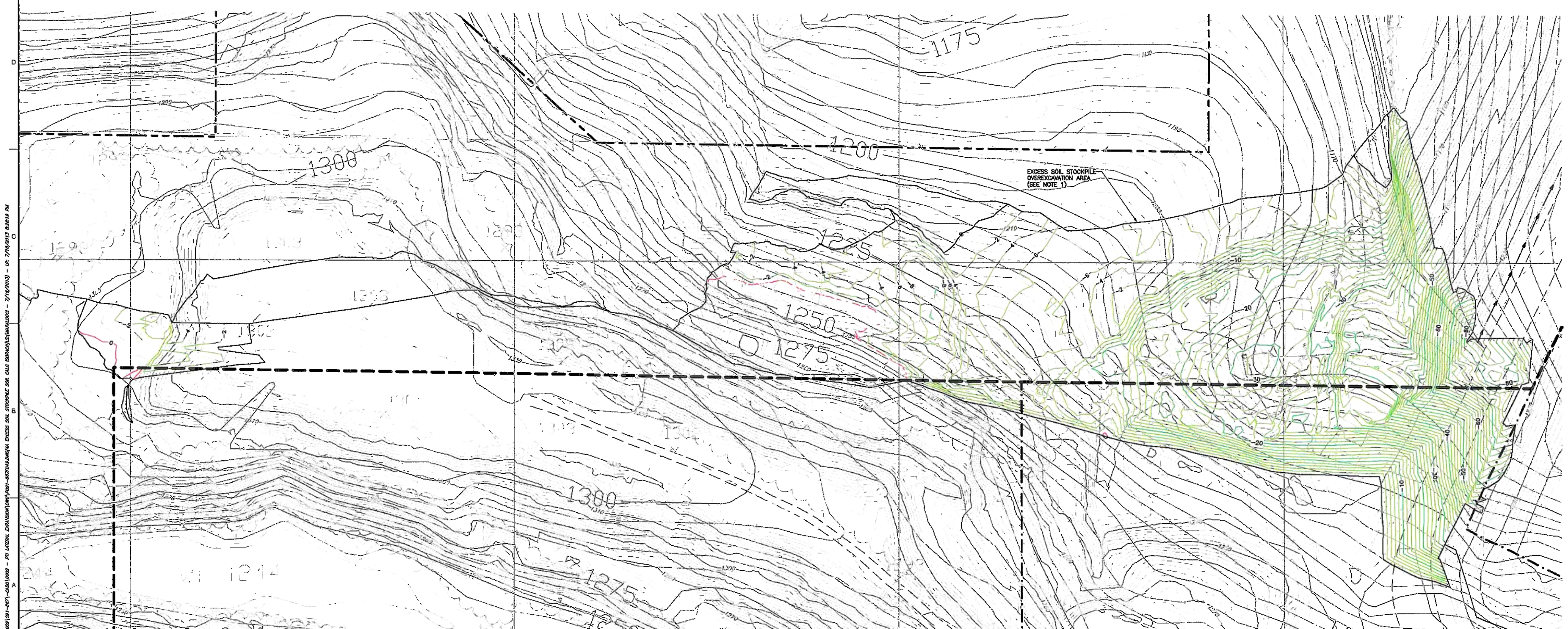
APEX ENVIRONMENTAL, LLC.
PERMIT TO INSTALL APPLICATION
CONTIGUOUS EXPANSION
APEX SANITARY LANDFILL
JEFFERSON COUNTY, OHIO

DRAWN BY:	MJI	CHECKED BY:	MRB	APPROVED BY: RJB
DATE:	10/17/11	DWG SCALE:	1"=200'	PROJECT NO: 091-557

LIMITS OF EXCAVATION/
STRUCTURAL FILL ISOPACH

FIGURE NO.: 1





REVISION RECORD

NO	DATE	DESCRIPTION
1	7/2013	RESPONSE TO OHIO EPA NOD DATED 12/28/12 AND REVISED PHASING

SUBMITTAL RECORD

NO	DATE	DESCRIPTION

LEGEND

- 1220 — EXISTING GROUND CONTOUR (SEE REFERENCE)
- PROPERTY LINE
- LIMIT OF SOLID WASTE PLACEMENT
- 1220 — ESTIMATED TOP OF OVEREXCAVATION
- 10 — FILL ISOPACH CONTOUR
- 10 — CUT ISOPACH CONTOUR
- APPROXIMATE LOCATION OF EXCESS SOIL STOCKPILE OVER EXCAVATION

NOTES

1. EXCESS SOIL STOCKPILE AREA WILL BE OVEREXCAVATED TO THE 12/14/00 CONTOURS WHICH INDICATE CONDITIONS PRIOR TO PLACING EXCESS SOIL IN THIS AREA. REPLACE WITH STRUCTURAL FILL TO DESIGN GRADES.
2. APPROXIMATE VOLUME OF CUT IS 191,900 CY.

REFERENCE

EXISTING TOPOGRAPHY PREPARED BY KEDDAL AERIAL MAPPING; DATE OF PHOTOGRAPHY: 1/18/13. ADDITIONAL MAPPING WAS PREPARED BY KEDDAL AERIAL MAPPING FROM AERIAL PHOTOGRAPHY DATED 1/6/12 AND 1/5/11 AND BY M.A.N. MAPPING FROM AERIAL PHOTOGRAPHY DATED 12/14/00.

STATE OF OHIO
RICK BUFFALINI
E-55305
REGISTERED
PROFESSIONAL ENGINEER

SCALE IN FEET
0 60 120

*HAND SIGNATURE ON FILE

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- ☐ Bidding
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APEX ENVIRONMENTAL, LLC.
PERMIT TO INSTALL APPLICATION
CONTIGUOUS EXPANSION
APEX SANITARY LANDFILL
JEFFERSON COUNTY, OHIO

DRAWN BY: MJI	CHECKED BY: MRB	APPROVED BY: RJB *
DATE: 10/17/11	DWG SCALE: 1"=200'	PROJECT NO: 091-867

LIMITS OF EXCAVATION/
STRUCTURAL FILL ISOPACH
EXCESS SOIL STOCKPILE OVEREXCAVATION

FIGURE NO.: 2

(C)(6) LOCATION RESTRICTION DEMONSTRATIONS

This section provides the information required in OAC 3745-27-06(C)(6). This PTI Application for a lateral expansion constitutes a new unit, therefore, the location restriction demonstrations are required. The location restrictions demonstrations address the items in rule 3745-27-20 of the Administrative Code.

Rule 3745-27-20(C) requires that a demonstration be made showing that new municipal solid waste landfills meet location restrictions for airports, floodplains, faults, seismic impact zone, and unstable areas. These demonstrations are made in accordance with the appropriate DSIWM Interpretations. The following paragraphs provide the location restriction demonstration and identify where additional information can be found in this application that demonstrates compliance with this requirement.

Rule 3745-27-20

(C)(1) **The limits of solid waste placement of the sanitary landfill facility are not located within ten thousand feet of any airport runway end used by only piston-type aircraft, unless the owner or operator can demonstrate that the sanitary landfill facility will be so designated and operated that the sanitary landfill will not pose a "bird hazard" to aircraft as that term is defined in rule 3745-27-01 of the Administrative Code.**

(20)(C)(1): There are no airport runways within 10,000 feet of the limits of solid waste placement at the proposed vertical expansion. The closest airport to the facility is Pine Acres, which is approximately 5 miles south of the landfill. The location is provided on the Title Sheet of the drawings.

(C)(2) The limits of solid waste placement of the sanitary landfill facility are not located in a "regulatory floodplain" as that term is refined in rule 3745-27-01 of the Administrative Code, unless the owner or operator can demonstrate that the unit(s) of the sanitary landfill facility will not restrict the flow of the one hundred year flood, reduce the temporary water storage capacity of the floodplain, or result in washout of solid waste so as to pose a hazard to human health and the environment.

(20(C)(2): A regulatory floodplain is defined in Rule 3745-27-01 as areas adjoining a watercourse which have been, or may be, covered by a 100 year flood as depicted on a Federal Emergency Management Agency (FEMA) Map. Based on FEMA maps, the limits of solid

waste placement of the landfill expansion are not located in a regulatory floodplain as defined in the Ohio Solid Waste Regulation.

(C)(3) The sanitary landfill facility is not located within two hundred feet of a fault that has had displacement in Holocene time unless the owner or operator can demonstrate that a distance less than two hundred feet will prevent damage to the structural integrity of the sanitary landfill facility and will be protective of human health and the environment. For the purpose of the rule, "fault," "displacement," and "Holocene" have the following meanings:
(a) "Fault" means a fracture along which strata on one side of the fracture have been displaced with respect to strata on the other side of the fracture; (b) "Displacement" means the relative movement of any two sides of a fault measured in any direction; and (c) "Holocene" means the most recent epoch of the Quaternary period extending from the end of the Pleistocene to the present.

(C)(3): The DSIWM Interpretation document concerning Holocene Faults dated June 12, 2004, references the 1978 version of the "Preliminary Young Fault Maps, Miscellaneous File Investigation (MF) 916," and indicated that there are not faults dated to Holocene time in Ohio. Additionally, the facility is not located near an earthquake epicenter, as published by the Ohio Department of Natural Resources, Division of Geological Survey. Therefore, the sanity landfill facility will not be located within 200 feet of a fault that has had displacement since Holocene time.

(C)(4) The sanitary landfill facility is not located in a "seismic impact zone" as that term is defined in rule 3745-27-01 of the Administrative code, unless the owner or operator demonstrates that all containment structures, including liners, leachate collections systems, sedimentation ponds, and surface water control systems, are designed to resist the maximum horizontal acceleration in lithified earth material for the site.

(C)(4): The site is designed to resist the maximum horizontal acceleration in lithified earth material at the site. Seismic slope stability calculations were performed using the USGS National Seismic Hazard Mapping Project map entitled, "Peak Acceleration (%g) with 2% Probability of Exceedance in 50 Years (site: NEHRP-B-C bounty)", dated June 1996. The calculations are provided in Section (C)(4)(d) of this PTI Application.

(C)(5) The sanitary landfill facility is not located in an "unstable area" as that term is defined in rule 3745-27-01 of the Administrative Code, unless the owner or operator

demonstrates that engineering measures have been incorporated into the design of the sanitary landfill facility to ensure that the integrity of the structural components will not be disrupted; except, that for an area of potential subsidence resulting from underground mining, the demonstration must show that the voids are filled or removed is the sanitary landfill facility is located above an underground mine or within the angle of draw of an underground mine. The following factors shall be considered when determining whether an area is unstable:
(a) On-site or local soil type and hydraulic conditions; (b) On site local geologic or geomorphologic features; (c) On site or local human-made features (both surface and subsurface); and (d) On site or local events (both surface and subsurface).

(C)(5): An unstable area is defined in Rule 3745-27-01 as "a location that is susceptible to natural or human induced events or forces capable of impairing the integrity of some or all of the structural components of a landfill that are responsible for preventing releases from the landfill and can include areas where on-site or local soil conditions result in significant differential settling; areas where the downslope movement of soil or rock due to gravitational influences occurs; or areas where the lowering or collapse of the land surface occurs either locally or over broad regional areas."

No documented underground coal mines exist within the landfill footprint. An undocumented underground mining was discovered in a small portion of Phase 4A in the existing unit. The mine workings were overexcavated and replaced with structural fill. During the subsurface investigation as part of the contiguous expansion, one mine void was encountered during this investigation in Test Boring SB-6 at a depth of 46 to 49.5 feet bgs (El. 1232.3 to 1228.8) and in a previous investigation from approximately 55 to 56 feet bgs (El. 1227.3 to 1226.3) in Test Boring B-12. These void elevations and locations correlate with that of the previously mined Pittsburgh Coal Seam. Both of these test borings area located in the southwest corner of the proposed expansion floor. See the Geotechnical Summary in Section (C)(4)(e) for additional information. The excavation grades of the proposed expansion were established to remove the Pittsburgh Coal Seam where it is present. If an underground mine is discovered at the perimeter of the excavated base grades, it will be overexcavated to the limits of waste and replaced with structural fill.

The proposed floor grades of the contiguous expansion unit are excavated into bedrock and will remove all mine spoil; therefore, excess differential settlement or bearing capacity failure is not likely to occur.

In portions of the perimeter berm of the contiguous lateral expansion, existing mine spoil will remain in place and not be removed. An evaluation has been made of the differential settlement that could occur on the portions of liner system that are founded on 3H:1V mine spoil slopes. These calculations show that a maximum estimated strain of 0.085% will occur, which is well below the strain that could damage the liner system. Refer to the post settlement slope and strain analysis (C)(4)(e) for these calculations. Therefore, the mine spoil may remain in-place beneath the proposed perimeter berm with one local exception as discussed below.

While strength of mine spoil tends to be variable over short distances, the material is reasonably strong overall and can safely be represented with average overall strength parameters that represent the material as a whole. Calculations supporting this conclusion are included in the static and seismic stability analysis included in Sections (C)(4)(c)&(d).

One area of mine spoil has been identified that could lead to potential excessive differential settlements and loss of bearing capacity or stability is located adjacent to Phase*s* ~~12~~ *8 and 10*. Organic and other unsuitable materials were stockpiled in this area during development of the existing unit. Material in this area will be overexcavated to the grades existing prior to unsuitable material being stockpiled here which are represented by the 2000 topographic mapping. Drawing 4A presents the location and proposed grades of the area to be overexcavated.

The proposed landfill expansion is not an unstable area based on the following factors listed in DSIWM Procedural and Technical Considerations for the Unstable Areas Location Restriction Demonstration, dated, June 12, 3004.

- On-site or local soil type and hydraulic conditions,
- On-site or local geologic or geomorphic features,
- On-site or local human made features (surface and subsurface), and
- On-site or local events (surface and subsurface).

Surface geomorphology does not suggest the presence of Karst features at or in the vicinity of the site. The surface topography does not indicate that areas susceptible to mass movements of earth materials are present.

(C)(7) CONSTRUCTION INFORMATION

This section provides the information required in OAC 3745-27-06 (C)(7).

(C)(7)(a) Installation of the items specified in rule 3745-27-10 of the Administrative Code.

For the existing landfill, installation of the items in Rule 3745-27-10 is included in the Ground Water Monitoring Program dated April 2007 and approved July 11, 2007. For the expansion area, new ground water monitoring wells will be needed as presented in the Ground Water Detection Monitoring Plan ~~which was submitted separately on October 20, 2011. The proposed monitoring wells are shown on Drawing 6H~~.

(C)(7)(b) Demonstration of physical and chemical resistance as required in paragraphs (D)(10) and (D)(13) of rule 3745-27-08 of the Administrative Code.

In accordance with OAC 3745-27-08(D)(10)(b) and (D)(13)(f), geosynthetic materials used in the liner/leachate management system will be physically and chemically resistant to attack by solid waste, leachate or other materials that they may come in contact with. USEPA Method 9090 will be used to determine that the materials are physically and chemically resistant. Geosynthetic materials proposed for use in the liner/leachate management system include:

- Polyethylene flexible membrane liners,
- Polypropylene or polyester geotextiles, and
- HDPE pipe.

Extensive compatibility testing has been performed by the geosynthetics industry on the HDPE materials proposed for use in the liner/leachate management system using artificial and actual leachates. The results of the testing program indicate no significant degradation of the geosynthetics proposed for this facility. Consequently, no additional site-specific compatibility testing is proposed.

In accordance with OAC 3745-27-08(D)(12)(a), the soil and aggregate materials used in the leachate collection system will be tested for carbonate content as specified in the CQA/QC Plan included in Appendix C9-C of this PTI Application.

(C)(7)(c) Compaction equipment slope limitations.

The maximum design slope for the recompacted soil liner (RSL) and recompacted soil barrier (RSB) is 3H:1V. Commonly used compactors have demonstrated that compaction can be achieved on these slopes.

CONSTRUCTION INFORMATION PER OAC 3745-27-08

3745-27-08(B) Engineered Components for Sanitary Landfill Facilities.

(B) The proposed contiguous lateral expansion will comply with OAC 3745-27-08(B)(1) to include the following engineered components:

- Survey marks,
- A prepared in-situ foundation,
- A composite liner system,
- A leachate collection and management system,
- Surface water control structures including sedimentation ponds,
- A composite cap system,
- An explosive gas control system, and
- Access roads

Supplemental engineered components defined in OAC 3745-27-08(B)(2) that are included to address site specific conditions:

- Structural fill,
- Added geologic material (if required),

- Liner cushion layer,
- A gas collection system, and
- Ground water control structures.

Optional engineered components as defined in OAC 3745-27-08(B)(3) that may be used include:

- Transitional cover

3745-27-08(C) General Design Criteria. The objective of the design for any engineered component or system of components shall be to meet or exceed the specifications for design, construction and quality assurance testing required in paragraph (D) of this rule along with the following general design criteria:

3745-27-08(C)(1) The composite liner system shall be designed to do the following:
(a) Serve as a barrier to prevent the discharge of any leachate to ground or surface waters.
(b) For new facilities or lateral expansions of existing facilities, the composite liner system shall have at least a 2.0 percent slope in all areas, except along flow lines augmented by leachate collection pipes, after accounting for one hundred percent of the primary consolidation settlement and the secondary consolidation settlement of the compressible materials beneath the facility which includes, as applicable, in-situ soil, added geologic material, structural fill material, and recompacted soil liner.
For the purposes of this paragraph, secondary settlement shall be calculated using a 100-year time frame or another time frame acceptable to the director.
(c) For existing facilities where an owner or operator proposes to vertically expand over a composite liner system that was constructed after December 31, 2003, the slope of the existing composite liner system located beneath the vertical expansion shall meet the design standard in paragraph (C)(1)(b) of this rule.
(d) For existing facilities where an owner or operator proposes to vertically expand over a composite liner system that was constructed before December 31, 2003, the owner or operator shall demonstrate to the director that the existing composite liner system located beneath the vertical expansion maintains, at a minimum, positive drainage in the leachate collection system and has no more than one foot of head of leachate after accounting for the additional waste and one hundred percent of the primary consolidation settlement and the secondary consolidation settlement of the compressible materials beneath the facility which includes, as applicable, in-situ soil, added geologic material, structural fill material, and recompacted soil liner.
For the purposes of this paragraph, secondary settlement shall be calculated using a 100-year time frame or another time frame acceptable to the director.
(e) Have a maximum slope based on the following:
(i) Compaction equipment limitations.
(ii) Slope stability.

All phases of the purposed expansion area comply with OAC 3745-27-08(C)(1)(c), and are designed with a minimum slope of 3 percent. The minimum slopes of the composite liner system are greater than the 2 percent after accounting for primary and secondary settlement, except along flow lines augmented by leachate collection pipes in accordance with 3745-27-08(C)(1)(b). Section (C)(4) provides the settlement analyses for the composite liner system. Drawings 4A through 4E provide plan views of the composite liner system components.

3745-27-08(C)(2) The separatory liner/leachate collection system shall be designed to do the following:

(a) Serve as a barrier to direct all leachate from new waste placement into the leachate collection system associated with the vertical expansion and to manage any explosive gas generated from the waste placement below the barrier.

(b) Have at least a 10.0 percent constructed grade in all areas except along flow lines augmented by leachate collection pipes, or have some other minimum slope based on a design acceptable to the director.

(c) Have a maximum slope based on the following:

(i) Compaction equipment limitations.

(ii) Slope stability.

(d) The leachate collection and management system portion of the separatory liner shall be designed to limit the level of leachate to a maximum of one foot on the separatory liner throughout the operation and post closure of the facility.

(e) Include a combination of engineered components as listed in paragraph (B)(2)(f) of this rule that will function throughout the operational life and post closure period of the landfill. Alternative specifications to those included in paragraph (D) of this rule may be proposed in any new permit or permit modification.

(f) Minimize the amount of waste filled beneath the separatory liner system needed to obtain the required minimum slope.

(C)(2) The proposed lateral expansion does not require a separatory liner system.

3745-27-08(C)(3) The leachate collection and management system shall be designed to do the following:

(a) Any components located outside of the limits of solid waste placement shall be no less protective of the environment than the sanitary landfill facility by complying with this paragraph.

(b) The selection and specifications for the materials that will make up the leachate collection layer shall be protective of the flexible membrane liner or the design must include a liner cushion layer.

(c) Limit the level of leachate in areas other than sumps to a maximum of one foot throughout the operation and post closure of the facility.

For the purposes of this rule, a sump is an excavated depression of limited size that serves as a collection and transfer point for leachate.

(d) Have at least a 0.5 percent grade for the leachate collection pipes after accounting for one hundred percent of the primary consolidation settlement and the secondary consolidation settlement of the compressible materials beneath the facility which includes, as applicable, in-situ soil, added geologic material, structural fill material, and recompacted soil liner. For the purposes of this paragraph, secondary settlement shall be calculated using a 100-year time frame or another time frame acceptable to the director.

(C)(3) The proposed contiguous expansion complies with OAC 3745-27-08(C)(3). The expansion includes leachate force mains that will be dual-contained where located outside of the composite lined area. The leachate collection layer will consist of a geotextile cushion layer overlain with one of three options: a 12 inch thick granular drainage/protective layer overlain with a geotextile filter layer, ~~and~~ or a 15-inch thick granular drainage/protective layer where the top 3 inches serve as a filter layer, or a geotextile cushion layer overlain with a 24-inch thick tire shred layer overlain with a geotextile filter layer. The existing leachate storage tank has a concrete secondary containment area which is sized to hold 110 percent of the tank volume.

The cell floor and leachate collection system are designed so that the maximum level of leachate in areas other than the sumps will be less than 1 foot. The minimum slopes of the leachate collection pipes are greater than 0.5 percent after accounting for primary and secondary settlement in both the previously constructed phases and the proposed phases.

Sections (C)(5)(c) through (C)(5)(g) provide leachate generation, pump and pipe size, and pipe strength and deflection calculations for the leachate management system. Drawings 4D and 4E provide a plan view of the leachate management system components. Drawing 4D represents a 1-foot thick granular leachate collection layer and the leachate collection piping layout to be used with a leachate collection material with a permeability equal to or greater than 1×10^{-2} cm/sec. Drawing 4E represents a 2-feet thick tire shred leachate collection layer and the leachate collection piping layout to be used with a leachate collection material with a permeability equal to or greater than 0.1 cm/sec. Drawings 7A through 7C provide details of the composite liner system. Drawings 7D through 7F provide details of the leachate collection and management system.

3745-27-08(C)(4) The composite cap system shall be designed to do the following:
(a) Minimize infiltration of surface water.

(b) Serve as a barrier to prevent leachate outbreaks.
(c) Have at least a 5.0 percent grade in all areas except where surface water control structures are located.
(d) Have a maximum slope based on the following:
(i) Compaction and maintenance equipment limitations.
(ii) Slope stability.
(e) Provide protection for all composite cap system components from the effects of the formation of landfill gas.

(C)(4) The proposed lateral expansion complies with OAC 3745-27-08(C)(4). The minimum design slope of the composite cap system is 10 percent except where surface water control structures are located. The maximum design slope of the composite cap system is 3H:1V, which is acceptable based on compaction equipment limitations and the slope stability analysis. A gas collection and control system will manage landfill gas and protect the composite cap system from the effects of the formation of landfill gas. Section (C)(4) provides the stability analysis for the composite cap system. Drawings 4F and 4G provide plan views of the composite cap system. Drawings 7A through 7C provide details of the composite cap system.

3745-27-08(C)(5) If applicable, the design of the explosive gas control system may utilize a passive venting system or an active extraction system to satisfy air pollution control requirements and shall be designed to maintain explosive gas concentrations below the explosive gas threshold limits in rule 3745-27-12 of the administrative code.

The lateral expansion includes a proposed active gas extraction system. The proposed explosive gas control system will comply with air pollution control requirements and is designed to maintain explosive gas concentrations below the explosive gas threshold limits in accordance with OAC 3745-27-12. Drawing 3B provides the plan view of the explosive gas control system. Drawings 7G through 7J provide details of the explosive gas control system components.

Apex submitted the Gas Collection and Control System Design Plan to the Division of Air Pollution Control on February 26, 2009 in accordance with 40 CFR §60.752(b). This GCCS Design Plan will be revised to incorporate the lateral expansion area.

3745-27-08(C)(6) The design of all geosynthetic materials specified in the engineered components, including but not limited to, flexible membrane liners, geosynthetic clay liners, and geosynthetic drainage nets, shall not rely on any of the tensile qualities of these geosynthetic components.

(C)(6) The proposed contiguous expansion complies with OAC 3745-27-08(C)(6). The design of the geosynthetic materials included in the composite liner system and composite cap system do not rely on the tensile properties of the geosynthetic components.

3745-27-08(C)(7) The design for the stability of all engineered components and the waste mass shall address any configuration throughout the applicable developmental and post closure periods. Potential failures associated with internal, interim and final slopes as these slopes are defined in 3745-27-06 of the administrative code, shall be used to define the minimum construction specifications and materials that, at a minimum, will meet the following:

(a) The factor of safety for hydrostatic uplift shall not be less than 1.40 at any location during the construction and operation of the facility.

(C)(7)(a) Hydrostatic uplift calculations are provided in Section (C)(4)(a). The analysis was performed by determining the minimum separation required between the base of the Recompacted Soil Liner and the potentiometric surface of the Uppermost Aquifer System for a factor of safety of 1.4 and comparing it to the proposed separation. It was determined that some local areas near sumps in the contiguous expansion area required temporary ground water control to exceed the minimum safety against uplift. Therefore, the proposed expansion will utilize temporary ground water control structures as shown on Drawing 4A. *The groundwater control structures include a pipe installed in an aggregate filled trench and geocomposite.* The groundwater will be conveyed to an underdrain sump at the low point in the phase. *In Phases 11 and 12, the underdrain sump will drain by gravity. In the other phases,* the underdrain sump will either drain by gravity or be pumped to discharge in the perimeter channel which flows to a proposed sedimentation pond. Details for these structures are provided on Drawing *7A and* 7B. In all other locations, the proposed separation exceeds the minimum separation required for a factor of safety of 1.4.

(b) The factor of safety for bearing capacity of any vertical sump risers on the composite liner system shall not be less than 3.0.

(C)(7)(b) The proposed vertical expansion does not include any vertical sump risers and therefore, a bearing capacity calculation is not required.

(c) The factor of safety for static slope stability shall not be less than 1.50 using two dimensional limit equilibrium methods or another factor of safety using a method acceptable to the director when assessed for any of the following failure modes and conditions:

(i) Deep-seated translational and deep-seated rotational failure mechanisms of internal slopes, interim slopes, and final slopes for drained conditions and as applicable conditions representing the presence of excess pore water pressure at the onset of loading or unloading. For slopes containing geosynthetic interfaces placed at grades greater than 5.0 percent, residual shear strength conditions shall be used for any soil to geosynthetic or geosynthetic to geosynthetic interfaces.

(ii) Shallow translational and shallow rotational failure mechanisms of internal slopes and final slopes for unsaturated conditions.

(C)(7)(c) The factor of safety for static slope stability for the proposed vertical expansion is greater than or equal to 1.50. Section (C)(4)(c) provides the static slope stability calculations.

(d) The factor of safety for seismic slope stability shall not be less than 1.00 using two or three dimensional limit equilibrium methods, or another factor of safety using a method acceptable to the director when assessed for any of the following failure modes and conditions:

(i) Deep-seated translational and deep-seated rotational failure mechanisms of final slopes for drained conditions and as applicable conditions representing the presence of excess pore water pressure at the onset of loading or unloading. For slopes containing geosynthetic interfaces placed at grades greater than 5.0 percent, residual shear strength conditions shall be used for any soil to geosynthetic or geosynthetic to geosynthetic interfaces. If required by the director, deep-seated translational and deep-seated rotational failure mechanisms of interim and internal slopes for drained conditions and as applicable conditions representing the presence of excess pore water pressure at the onset of loading or unloading. For slopes containing geosynthetic interfaces placed at grades greater than 5.0 percent, residual shear strength conditions shall be used for any soil to geosynthetic or geosynthetic to geosynthetic interfaces.

(ii) Shallow translational and shallow rotational failure mechanisms of final slopes for unsaturated conditions.

(C)(7)(d) The factor of safety for seismic slope stability for the proposed vertical expansion is greater than or equal to 1.00. Section (C)(4)(d) provides the seismic slope stability calculations.

(e) The factor of safety against liquefaction shall not be less than 1.00 for internal slopes, interim slopes and final slopes.

(C)(7)(e) An evaluation of the potential for liquefaction was performed and demonstrates that liquefaction is not likely. Therefore, the factor of safety against liquefaction is greater than 1.00 for internal slopes, interim slopes and final slopes. Section (C)(4)(g) provides the liquefaction evaluation.

(f) The factor of safety for static slope stability shall not be less than 1.10 using two dimensional limit equilibrium methods or other methods acceptable to the director when assessed for any of the following failure modes and conditions:

(i) If required by the director, shallow translational and shallow rotational failure mechanisms of internal slopes in which the protective soils over the leachate collection layer have reached field capacity. Calculations shall use the maximum head predicted for the fifty year, one hour design storm.

(ii) Shallow translational and shallow rotational failure mechanisms of final slopes in which the cover soils over the drainage layer have reached field capacity. Calculations shall use the maximum head predicted for the one hundred year, one hour design storm.

(C)(7)(f) The shallow translational and shallow rotational static slope stability analyses for the final slopes considering the one hundred year, one hour design storm provides a factor of safety greater than or equal to 1.10. Section (C)(4)(c) provides the static slope stability calculations.

3745-27-08(D) Design, construction and testing specifications. The owner or operator shall meet or exceed the following specifications in the design, construction, and quality assurance testing of all engineered components of a sanitary landfill facility.

(D)(1) For survey marks: At least three permanent survey marks with each located on separate sides of the proposed sanitary landfill facility shall be established prior to any construction and within easy access to the limits of solid waste placement in accordance with the following:

(a) Survey marks shall be referenced horizontally to the 1927 north American datum, 1983 north American datum, or state plane coordinate system and vertically to the 1929 or 1988 north American vertical sea level datum as identified on the 7.5 minute series quadrangle sheets published by the united states geological survey.

(b) Survey marks shall be at least as stable as a poured concrete monument ten inches in diameter installed to a depth of forty-two inches below the ground surface. Each constructed survey mark shall include a corrosion resistant metallic disk which indicates horizontal and vertical coordinates of the survey mark and shall contain a magnet or ferromagnetic rod to allow identification through magnetic detection methods.

(c) Survey control standards for the survey marks shall be in accordance with the following:

(i) For the first facility survey mark established from the known control point, minimum horizontal distance accuracy shall be one foot horizontal to two thousand five hundred feet horizontal.

(ii) For each facility survey mark established from the first facility survey mark, minimum horizontal accuracy shall be one foot horizontal distance to five thousand feet horizontal.

(iii) For the first facility survey mark established from the known control point and for each facility survey mark established from the first facility survey mark, minimum vertical accuracy shall be one inch to five thousand feet horizontal.

There are six existing survey monuments. Any new monuments will be constructed to comply with the following:

- Be permanent third order within easy access to the limits of waste placement on separate sides of the landfill,
- Be referenced horizontally to the Ohio State Plane Coordinate System,
- Be referenced vertically to the North American Vertical Sea Level Datum as identified on the 7.5 minute USGS quadrangle,
- Be at least 10-inch diameter, 42-inch deep poured concrete constructed with corrosion resistant metallic disk identifying coordinates and elevation,
- Contain a magnet or ferromagnetic rod, and
- Be established at the accuracy required by Rule 3745-27-08(D)(1)(c).

Specifications for survey monuments in accordance with OAC 3745-27-08(D)(1) are provided in the CQA/QC Plan located in Section (C)(9). Drawing 2A presents the existing survey monument locations.

(D)(2) For surface water control structures: surface water run-on and run-off control structures shall comply with the following:
(a) Accommodate the peak flow from the twenty-five year/twenty-four hour storm event.
(b) Minimize silting and scouring.
(c) Use non-mechanical means for all permanent structures.

(D)(2) The temporary and permanent surface water control structures are designed in accordance with the OAC 3745-27-08(D)(2). The surface water management system is designed to minimize silting and scouring, and collect, route, and retain surface water run-on, run-off, and sediment discharge from the facility. The surface water management and erosion control systems consist of:

- Surface water control benches,
- Downchutes,
- Perimeter surface water channels,

- Perimeter surface water channels,
- Drainage culverts,
- Sedimentation ponds,
- Intercell and intracell rainflaps,
- Temporary diversion berms,
- Temporary erosion controls,
- Temporary seeding, and
- Permanent seeding.

The permanent and temporary surface water control structures *associated with the disposal area*, excluding sedimentation ponds, are designed to convey the peak flow resulting from the 25-year/24-hour storm event by non-mechanical means. To reduce erosion, the structures are lined with grass, rock, or synthetic mat depending on the design velocity.

Surface water collection benches are designed to collect precipitation on the intermediate and final cover 3H:1V slopes. The benches are spaced at a maximum 60-feet vertical interval. The benches are approximately 15 feet wide within the cap protection layer and slope inwards at 10 percent to provide channel capacity to convey surface water and provide a location to anchor the geosynthetics in the final cover system. The benches and berms are grass lined and slope at 3 percent towards downchutes. The final cover slopes are designed to result in less than 5 tons per acre per year of sediment discharge from the final cover system in accordance with OAC 3745-27-06(C)(5)(j).

Surface water downchutes will either be trapezoidal channels or culverts. Channel downchutes are lined to reduce erosion and are built above the grade of the final cover system to improve constructability and maintenance. The pipe downchutes are 2-feet diameter HDPE pipe. A catch basin will be installed on each bench to allow surface water to enter the pipe. The downchutes discharge into channels which are used to convey the water to the sedimentation ponds.

Areas of potential high erosion will be lined with riprap or other acceptable erosion control materials. These areas include where the downchutes enter the perimeter channels, at the inlets

and outlets of culverts, where the perimeter channels enter the sedimentation ponds, and at the outlet of the sedimentation ponds.

Design calculations for the surface water control structures are included in Section (C)(5)(k). A plan view of the surface water management system is presented on Drawing 4H and details of the surface water control structures are presented on Drawings 7G and 7H.

Surface water controls are designed in the rail unloading area to direct surface water run-off to sedimentation ponds. Structures include channels, culverts, and sedimentation ponds. The surface water management system components were designed in accordance with the Ohio DNR, Division of Soil and Water Conservation, Rainwater and Land Development Manual. The design calculations were submitted to Ohio EPA Division of Surface Water (DSW) as part of a PTI Application because these structures do not control run-off from the disposal area. In addition, the discharge from the sediment basin is covered under the site NPDES Permit.

(D)(3) For sedimentation ponds: sedimentation ponds shall comply with the following:
(a) Minimum storage volume, excluding sediment volume, shall be based on the larger of the following:
(i) The calculated run-off volume from a ten year/twenty-four hour storm event.
(ii) The scheduled frequency of pond clean-out, that shall be no more often than once per year, multiplied by 0.125 acre-feet per year for each acre of disturbed area within the upstream drainage area.
(b) The principal spillway shall safely discharge the flow from a ten-year/twenty-four hour storm event using non-mechanical means.
(c) The inlet elevation of the emergency spillway shall provide flood storage with no flow entering the emergency spillway while allowing flow through the principal spillway during a twenty-five year/twenty-four hour storm event.
(d) The combination of principal and emergency spillways shall safely discharge the flow from a one-hundred year/twenty-four hour storm event using non-mechanical means.
(e) The embankment design shall provide for no less than one foot net freeboard when flow is at the design depth, after allowance for embankment settlement.

(D)(3) Surface water runoff for the proposed contiguous expansion will be directed to two existing sedimentation basins and to the three new basins at the locations presented on Drawing 4H. Existing basins were evaluated to determine if they meet the regulatory requirements considering the proposed contiguous and vertical expansion grades. The evaluation demonstrates that the existing basins as constructed meet the requirements.

The new proposed basins are also designed in accordance with the OAC 3745-27-08(D)(3) to store the 10-year/24-hour storm, to pass the 10-year/24-hour storm through the principal spillway, to route the 25-year/24-hour storm below the emergency spillway, and to discharge the 100-year/24-hour storm through the combination of the principal and emergency spillways. The sedimentation basins provide a freeboard of at least 1 foot above the 100-year/24-hour storm pool elevation.

Basin structures include the principal/emergency spillways, and riprap-lined aprons. Riprap-lined aprons will be installed wherever concentrated flow enters the basin. The riprap or other acceptable erosion control materials will act to dissipate energy and to prevent scour of the basin bottom and sides. The principal spillway consists of an outlet pipe. The emergency spillways are trapezoidal channels. Design calculations for the sedimentation basins are included in Section (C)(5)(l).

(D)(4) For permanent ground water control structures: permanent ground water control structures shall adequately control ground water infiltration through the use of non-mechanical means such as impermeable barriers or permeable drainage structures. However, no permanent ground water control structures may be used to dewater an aquifer system, except if the recharge and discharge zone of the aquifer system are located entirely within the boundary of the sanitary landfill facility.

(D)(4) The proposed lateral expansion will utilize temporary ground water control structures in the form of *geocomposite and trench* underdrains. These underdrains are required to provide adequate protection against hydrostatic uplift on a temporary basis as described in Section (C)(7)(a) of this narrative. *The geocomposite underdrains underlie the RSL and direct flow to ~~the trench underdrains~~* a sump at the low point in the phase. *In Phases 11 and 12, the underdrain sump will drain by gravity. In the other phases,* the underdrain sump will either drain by gravity to a topographic low area outside the limits of waste or be pumped to discharge into the perimeter channel which flows to a proposed sedimentation pond. In addition, permanent trench underdrains are proposed, as needed, to collect ground water seepage where structural fill will be placed in existing valleys. The *trench* underdrains consist of a 6-inch perforated HDPE pipe and aggregate backfill and will flow by gravity to topographic low areas outside the limits of waste. The locations of the existing and proposed underdrains are presented on Drawing 4A and details are provided on Drawings 7A and 7B.

(D)(5) For the in-situ foundation: the unconsolidated or consolidated stratigraphic units that make up the in-situ foundation shall comply with the following:
(a) Be free of debris, foreign material, and deleterious material.
(b) Not be comprised of solid waste.

(c) Not have any abrupt changes in grade that may result in damage to the composite liner system.
(d) Be proof rolled, if applicable.
(e) Be determined to have adequate strength to satisfy bearing capacity and slope stability strength requirements.
(f) Have quality control testing of any stratigraphic units that have not been anticipated and that are more susceptible to slope failure than the stratigraphic units that were tested and reported in the permit to install. This testing shall be in accordance with the following:

(i) The effective shear strength of each unconsolidated stratigraphic unit that may be susceptible to slope failure and the recompacted soil liner shall be determined using ASTM D3080-98 (Direct Shear Test) or ASTM D4767-95 (Consolidated-Undrained Triaxial Compression Test), or ASTM D6467-99 (Torsional Ring Shear Test).

(ii) The undrained shear strength of all applicable unconsolidated stratigraphic units using fully saturated samples shall be determined using ASTM D2850-95 (unconsolidated-undrained triaxial compression).

(D)(5) The in-situ foundation will comply with OAC 3745-27-08(D)(5). The in-situ foundation at the landfill base of the expansion area is an excavated rock surface. If needed, compacted structural fill will be added to make the excavated surface free of abrupt grade breaks, in which case, the added material will be proof-rolled with heavy equipment prior to the construction of the recompacted soil liner.

At the side slopes of the landfill, existing mine spoil will remain in place and not be removed. This mine spoil has been in place and consolidated under its own weight for some time. Excavation to form the side slopes will remove overburden resulting in a preloaded material that will resist deformation and settlement as a liner system and waste are placed upon it. Calculations estimating settlement that may occur on the side slopes and maximum predicted liner strains are included in Section (C)(4).

Organic and other unsuitable materials were stockpiled in an area adjacent to proposed Phase*s* ~~12~~ *8 and 10* during development of the existing unit. Material in this area will be overexcavated to the grades existing prior to unsuitable material being stockpiled here which are represented by the 2000 topographic mapping. Drawing 4A presents the location and proposed grades of the area to be overexcavated.

Slope stability analyses are included in Section (C)(4) which demonstrates adequate factors of safety assuming conservative shear strength parameters. If stratigraphic units are discovered that were not anticipated and are more susceptible to slope failure than the stratigraphic units that were evaluated in the stability analysis, the testing will be conducted on these stratigraphic units in accordance with OAC 3745-27-08(D)(5)(f).

Drawing 4A presents the excavation grading plan. Specifications for the in-situ foundation are included in the CQA/QC Plan in Section (C)9.

(6) For Structural Fill: rock fills or soil fills for a structural berm or subbase shall comply with the following:

(a) Be durable rock for rock fills only.

(b) Be free of debris, foreign material, and deleterious material.

(c) Not be comprised of solid waste.

(d) Not have any abrupt changes in grade that may result in damage to the composite liner system.

(e) For soil fills, have pre-construction testing of the borrow soils performed on representative samples to determine the maximum dry density and optimum moisture content according to ASTM D698-00a (Standard proctor), or ASTM D1557-00 (Modified proctor) at a frequency of no less than once for every ten thousand cubic yards.

(f) Be constructed in lifts to achieve uniform compaction of soil fills. Each lift shall comply with the following:

(i) Be constructed in loose lifts of twelve inches or less.

(ii) Be compacted to at least ninety five percent of the maximum dry density as determined by ASTM D698-00a (Standard proctor) or at least ninety percent of the maximum dry density as determined by ASTM D1557-00 (Modified proctor).

(g) Be determined to have adequate strength to satisfy bearing capacity and slope stability strength requirements.

(h) Have quality control testing of the soil fills on the constructed lifts performed to determine the density and moisture content according to ASTM D2922-01 and ASTM D3017-01 (Nuclear Methods), ASTM D1556-00 (Sand Cone), ASTM D2167-94 (Rubber Balloon) or other methods acceptable to the director or his authorized representative at a frequency of no less than five tests per acre per lift. The locations of the individual tests shall be adequately spaced to represent the constructed area.

(D)(6) The structural fill will comply with OAC 3745-27-08(D)(6). The structural fill will be free of deleterious materials and be free of abrupt grade breaks. Slope stability and settlement analysis are included in Section (C)(4) which demonstrates that the structural fill will provide sufficient strength. Specifications for the structural fill are included in the CQA/QC Plan in Section (C)(9).

(7) For Added Geologic Material: added geologic material shall comply with the following:

(a) Provide at least fifteen feet of isolation distance between the uppermost aquifer system and the bottom of the recompacted soil liner.

(b) Be free of debris, foreign material, and deleterious material.

(c) Not be comprised of solid waste.

(d) Shall have low permeability, good compactability, cohesiveness, relatively uniform texture, and shall not contain large objects in such quantities as may interfere with its application and intended purpose. The soil shall be a well-compacted loam, silt loam, clay loam, silty clay loam, silty clay or other soil types that can achieve the intended purpose.

(e) Not have any abrupt changes in grade that may result in damage to the composite liner system.

(f) Have pre-construction testing of the borrow soils performed on representative samples to determine the following:

(i) The maximum dry density and optimum moisture content according to ASTM D698-00a (Standard proctor), or ASTM D1557-00 (Modified proctor) at a frequency of no less than once for every ten thousand cubic yards.

(ii) The recompacted laboratory permeability using ASTM D5084-00E1 (Falling Head) at a frequency of no less than once for every ten thousand cubic yards.

(iii) The grain size distribution according to ASTM D422-63 (Sieve and Hydrometer) at a frequency of no less than once for every three thousand cubic yards.

(g) Be constructed in lifts to achieve uniform compaction. Each lift shall comply with the following:

(i) Be constructed in loose lifts of twelve inches or less.

(ii) Be constructed of a soil with a maximum clod size that does not exceed the lift thickness.

(iii) Be compacted to at least ninety five percent of the maximum dry density as determined by ASTM D698-00a (Standard proctor) or at least ninety percent of the maximum dry density as determined by ASTM D1557-00 (Modified proctor).

(iv) Be placed with a soil moisture content that shall not be less than two percent below or more than four percent above the optimum moisture content as determined by ASTM D698-00a or ASTM D1557-00.

(v) Have a maximum permeability of one times ten to the negative five centimeters per second (1×10^{-5} cm/sec).

(h) Be determined to have adequate strength to satisfy bearing capacity and slope stability strength requirements.

(i) Have quality control testing of the constructed lifts performed to determine the density and moisture content according to ASTM D2922-01 and ASTM D3017-01 (Nuclear Methods), ASTM D1556-00 (Sand Cone), ASTM D2167-92 (Rubber Balloon) or other methods acceptable to the director or his authorized representative at a frequency of no less than five tests per acre per lift. The locations of the individual tests shall be adequately spaced to represent the constructed area. Any penetrations shall be repaired using bentonite.

(D)(7) The isolation distance between the uppermost aquifer system (UAS) and the bottom of the recompacted soil liner (RSL) in the existing unit is greater than 15 feet of in-situ or Added Geologic Material (AGM). AGM was installed under Phase 1 and complies with OAC 3745-27-08(D)(7). No AGM is proposed for the remaining phases of the authorized fill area or the proposed lateral expansion. Refer to PTI Drawing 3C for an isopach representing the isolation distance between the UAS and the bottom of the RSL.

(8) For Recompacted Soil Liners: the recompacted soil liner shall comply with the following:

(a) Be at least five feet thick or as follows:

(i) An alternate thickness, to be no less than three feet, based on the result of the calculations outlined in Appendix I of this rule.

(ii) Three-feet thick if used in conjunction with a geosynthetic clay liner that meets the specifications in paragraph (D)(9) of this rule.

(iii) An alternate thickness, to be no less than one and one-half feet thick, based on the results of the calculations outlined in Appendix I of this rule if used in conjunction with a geosynthetic clay liner that meets the specifications in paragraph (D)(9) of this rule.

(iv) Two-feet thick for the recompacted soil liner component of an interim composite liner/leachate collection system.

(v) Two-feet thick for the recompacted soil liner component of a separatory liner/leachate collection system.

(b) Be free of debris, foreign material, and deleterious material.

(c) Not be comprised of solid waste.

(d) Be placed beneath all areas of waste placement.

(e) Not have any abrupt changes in grade that may result in damage to the geosynthetics.

(f) Have pre-construction testing of the borrow soils performed on representative samples and the results submitted to the appropriate Ohio EPA district office no later than seven days prior to the intended use of the material in the construction of the recompacted soil liner. The pre-construction testing shall determine the following:

(i) The maximum dry density and optimum moisture content according to ASTM D698-00a (Standard proctor), or ASTM D1557-00 (Modified proctor) at a frequency of no less than once for every one thousand five hundred cubic yards.

(ii) The grain size distribution according to ASTM D422-63 (Sieve and Hydrometer) at a frequency of no less than once for every one thousand five hundred cubic yards.

(iii) The Atterberg limits according to ASTM D4318-00 at a frequency of no less than once for every one thousand five hundred cubic yards.

(iv) The recompacted laboratory permeability according to ASTM D5084-00E1 (Falling Head) at a frequency of no less than once for every ten thousand cubic yards.

(g) Be constructed in lifts to achieve uniform compaction. Each lift shall include the following:

(i) Be constructed with qualified soils and the corresponding construction details established by written concurrence from Ohio EPA with the test pad certification report required by paragraph (E) of this rule and the following specifications or an alternative to qualifying soils with a test pad if it is demonstrated to the satisfaction of the director or his authorized representative that the materials and techniques will result in each lift having a maximum permeability of 1 x 10^{-7} cm/sec and the following specifications:

(*a*) With loose lifts of eight inches or less.

(*b*) With a maximum clod size of three inches or half the lift thickness, whichever is less.

(*c*) With one hundred percent of the particles having a maximum dimension not greater than two inches.

(*d*) With not more than ten percent of the particles, by weight, having a dimension greater than 0.75 inches.

(ii) Be compacted to at least ninety five percent of the maximum dry density as determined by ASTM D698-00a (Standard Proctor) or at least ninety percent of the maximum dry density as determined by ASTM D1557-00 (Modified proctor) or an alternative compaction specification approved by the director.

(iii) Be placed with a minimum soil moisture content that shall not be less than the optimum moisture content as determined by ASTM D698-00A or ASTM D1557-00 or an alternative soil moisture content specification approved by the director.

(iv) Have a maximum permeability of one times ten to the negative seven centimeters per second (1 x 10^{-7} cm/sec).

(h) Be adequately protected from damage due to desiccation, freeze/thaw cycles, wet/dry cycles, and the intrusion of objects during construction and operation.

(i) Be determined to have adequate strength to satisfy bearing capacity and slope stability strength requirements.

(j) Have quality control testing of the constructed lifts performed to determine the density and moisture content according to ASTM D2922-01 and ASTM D3017-01 (Nuclear Methods), ASTM D1556-00 (Sand Cone), ASTM D2167-94 (Rubber Balloon), or other methods acceptable to the director or his authorized representative at a frequency of no less than five times per acre per lift. The locations of the individual tests shall be adequately spaced to represent the constructed area. Any penetrations shall be repaired using bentonite.

(D)(8) The recompacted soil liner will comply with OAC 3745-27-08(D)(8). The recompacted soil liner will be constructed of low permeability soils obtained during excavation of future landfill cells or borrow areas. The soil liner will have a maximum permeability of 1.0 x 10^{-7} cm/sec. Requirements regarding preconstruction testing, compaction testing, and protecting the recompacted soil liner are addressed in the CQA/QC Plan in Section (C)(9).

The proposed recompacted soil liner is 3-feet thick in conjunction with a geosynthetic clay liner (GCL). The grading plan of the base of recompacted soil liner is shown on Drawing 4B and the

top of recompacted soil liner is shown on Drawing 4C. Details of the recompacted soil liner are shown on Drawing 7A.

The stability analysis presented in Section (C)(4) indicates that the proposed liner system at the design grades provides an adequate factor of safety against failure. A shear strength envelope for material interfaces has been established for the soil and geosynthetic materials to be used in the composite liner system. This envelope provides the minimum interface friction values used in the slope stability analysis based on laboratory testing of site specific soils and typical geosynthetic materials.

(D)(9) For Geosynthetic Clay Liners: a geosynthetic clay liner used in lieu of part of the recompacted soil liner pursuant to paragraph (D)(8) of this rule, or in lieu of the recompacted soil barrier layer, pursuant to paragraph (D)(21) of this rule, shall comply with the following:

(a) Be negligibly permeable to fluid migration.

(b) Have a dry bentonite mass per unit area of at least 0.75 pounds per square foot at zero percent moisture content.

(c) Have pre-construction testing of the geosynthetic clay liner material performed on representative samples and the results submitted to the appropriate Ohio EPA district office no later than seven days prior to the intended use of the material. The pre-construction testing shall determine:

(i) The internal drained shear strength using ASTM D6243-98 (Direct Shear Test) at least twice for the initial use and at least once for each subsequent construction event. Tests involving geosynthetic clay liner material shall be conducted with hydrated samples.

(ii) The dry bentonite mass (at zero percent moisture content) per square foot of geosynthetic clay liners according to ASTM D5993-99 at a frequency of no less than once per fifty thousand square feet.

(iii) The interface shear strength according to paragraph (G) of this rule.

(d) Be installed in the following manner:

(i) To allow no more than negligible amounts of leakage by a minimum overlap of six inches, or, for end-of-panel seams, a minimum overlap of twelve inches. Overlap shall be increased in accordance with manufacturer's specifications or to account for shrinkage due to weather conditions.

(ii) In accordance with the manufacturer's specifications in regards to handling and the use of granular or powdered bentonite to enhance bonding at the seams.

(iii) Above the recompacted soil liner when used in liner systems or above an engineered subbase pursuant to paragraph (D)(22) of this rule when used in cap systems. Geosynthetic clay liners without internal reinforcement shall not be used in areas beneath leachate collection piping, in sump areas, or on any slope with a grade that is steeper than ten percent.

(iv) On a surface that shall not have any sharp edged protrusions or any particles protruding more than one quarter of one inch.

(D)(9) A GCL is proposed as part of the liner/leachate collection system. The GCL will comply with OAC 3745-27-08(D)(9).

Stability analysis presented in Section (C)(4) indicate that the proposed liner system at the design grades provides the required factor of safety against failure. In order to provide adequate safety, minimum strength values will be required for all of the components of the liner system. The minimum values have been provided in the Table 9 of the CQA/QC Plan which is provided in Section (C)(9) of this permit application.

Details of the GCL in the liner system are shown on Drawing 7A. Specifications and requirements regarding preconstruction testing, shear strength, and installation of GCLs are addressed in the CQA/QC Plan.

(D)(10) For Flexible Membrane Liners. The flexible membrane liner shall comply with the following:
(a) Be, at a minimum, a sixty-mil high density polyethylene (HDPE) geomembrane for composite liner systems or be , at a minimum, a forty-mil geomembrane for composite cap systems or other materials and/or thicknesses acceptable to the director.
(b) Be physically and chemically resistant to attack by the solid waste, leachate, or other materials that may come in contact with it using USEPA method 9090 or other documented data.
(c) Have pre-construction interface testing performed according to paragraph (G) of this rule.
(d) Be placed above and in direct and uniform contact with the recompacted soil liner or the recompacted soil barrier layer or the geosynthetic clay liner.
(e) Be seamed to allow no more than negligible amounts of leakage; the seaming material shall be physically and chemically resistant to chemical attack by the solid waste, leachate, or other materials that may come in contact with the seams.
(f) Have quality control testing in accordance with the following, unless the manufacturer's specifications for testing are more stringent, in which case the manufacturer's specifications shall be used:
(i) For the purpose of testing every seaming apparatus in use each day, peel tests according to an appropriate method shall be performed on scrap pieces of flexible membrane liner when an apparatus is started, operators change, an apparatus is restarted, or at the beginning of each seaming period.
(ii) Nondestructive testing shall be performed on one hundred percent of the flexible membrane liner seams.

(iii) Destructive testing for peel according to the appropriate ASTM method shall be performed on randomly selected samples at a frequency of no less than once per five hundred feet of seam completed by a particular seaming apparatus. An alternate means may be used if it is demonstrated to the satisfaction of the director or his authorized representative that the alternate means meets the requirements of this paragraph.

(D)(10) A flexible membrane liner (FML) will be placed above the GCL in the baseliner system and on the recompacted soil barrier in the final cover system. The baseliner system FML will be manufactured from high density polyethylene (HDPE) and will be a minimum average thickness of 60 mils. A final cover system FML manufactured from HDPE or linear low density polyethylene (LLDPE) will be a minimum average thickness of 40 mils. Materials of alternate composition and/or thickness may be incorporated if comparable performance can be demonstrated. Details of the liner and final cover systems are shown on Drawings 7A through 7C.

Extensive testing has demonstrated that HDPE and LLDPE geomembranes are physically and chemically resistant to degradation from leachate and solid waste. Chemical compatibility is discussed further in Section (C)(7)(b). A textured FML will be installed in the baseliner and final cover systems.

The CQA/QC Plan contains material and installation specifications for the FML including trial seams, non-destructive testing, and destructive testing of seams. Stability analysis presented in Section (C)(4) indicate that the proposed liner systems and cover systems at the design grades provides the required factor of safety against failure. In order to provide adequate safety, minimum strength values will be required for all of the components of the liner and cover systems. The minimum values have been provided in the Table 9 of the CQA/QC Plan which is provided in Section (C)(9) of this permit application.

(11) For the Liner Cushion Layer: the liner cushion layer shall be placed above the flexible membrane liner and protect it from damage that may be caused by construction materials and activities and have pre-construction interface testing performed according to paragraph (G) of this rule.

(D)(11) A geotextile cushion will be installed above the FML in the liner system. When an aggregate leachate collection layer is used, a 6 oz/sy mass per unit area geotextile will be used. When tire shreds are used as the leachate collection layer, a 16 oz/sy mass per unit area geotextile will be used. The drainage geocomposite installed above the FML in the final cover system will function as both a drainage and a cushion layer. Specifications of these materials are included in the CQA/QC Plan in Section (C)(9). Details of the liner and final cover systems are shown on Drawings 7A through 7C.

(12) For the leachate collection layer: the leachate collection layer shall be placed above the composite liner system which may be protected by the cushion layer and shall comply with the following:

(a) Be comprised of granular materials that meet the following requirements:

(i) Have a minimum thickness of one foot.

(ii) Have no more than five percent of the particles, by weight, passing through the 200-mesh sieve.

(iii) Have no more than five percent carbonate content by weight.

(iv) Have a minimum permeability of one times ten to the negative two centimeters per second (1×10^{-2} cm/sec).

(v) Granular materials shall have quality control testing in accordance with the following at a frequency of no less than once for every three thousand cubic yards of material:

(*a*) Permeability using ASTM D2434-68 (Constant Head).

(*b*) Grain size distribution using ASTM D422-63 (Sieve).

(*c*) Carbonate content using ASTM D3042-97 at a pH of 4.0.

(vi) An alternate material and/or thickness may be used provided that it is demonstrated to the satisfaction of the director or his authorized representative that the material meets the requirements of this paragraph. The appropriate quality control testing and frequency of testing needs to be approved by Ohio EPA prior to use.

(b) A geosynthetic drainage net used in lieu of a granular drainage layer shall meet the following requirements:

(i) Have a minimum transmissivity to ensure that the leachate collection system meets the one foot of head of leachate requirement of this rule. The transmissivity shall be adjusted for elastic deformation, creep deformation, biological clogging, and chemical clogging by using the appropriate reduction factors.

(ii) The composite liner system must be protected from the intrusion of objects during construction and operation by at least twelve inches of permeable material acceptable to the director.

(iii) Have quality control testing for transmissivity using ASTM D4716-01 at the maximum projected load and a frequency of once per fifty thousand square feet.

(iv) Any geosynthetic materials shall have pre-construction interface testing performed according to paragraph (G) of this rule.

(D)(12) The leachate collection layer consists of a 12-inch thick granular layer with an overlying geotextile or a 15-inch thick granular layer without n overlying geotextile. Alternatively, a 24-inch thick tire shred layer may be used as the leachate collection layer. The material specifications are provided in the CQA/QC Plan. Details of the leachate collection layer are shown on Drawing 7A.

(13) For Leachate Collection Pipes: the leachate collection pipes shall comply with the following:
(a) Be imbedded in the drainage layer.
(b) Be designed not to crush or deform under expected maximum loads and settlement to an extent where the crushing or deformation negatively impacts the performance of the leachate collection and management system.
If an owner or operator is proposing a vertical expansion over areas that have leachate collection pipes in place, the leachate collection pipes will be re-evaluated and this performance standard shall be applied to allow for any additional loads or settlement from the vertical expansion. A conservative design may be needed initially to prepare for any possible future expansion.
(c) Be provided with access for clean-out devices which shall be protected from differential settling.
(d) Have lengths and configurations that shall not exceed the capabilities of clean-out devices.
(e) Have joints sealed to prevent separation.
(f) Be physically and chemically resistant to attack by the solid waste, leachate, or other materials with which they may come into contact. Sealing material and means of access for cleanout devices shall also be resistant to physical and chemical attack by the solid waste, leachate, or other materials with which they may come into contact.
(g) An alternative to leachate collection pipes may be used if it is demonstrated to the satisfaction of the director or his authorized representative that the means for leachate transport meet the requirements of this paragraph.

(D)(13) The leachate collection pipes direct flow to the leachate collection sumps. Leachate collection pipes that run at the toe of the 3H:1V perimeter berm slopes will be 6-inch diameter SDR-11 perforated HDPE pipe. Other leachate collection pipes in the contiguous expansion area will be need to be 6-inch diameter, SDR-9, perforated HDPE pipe which is thicker than the pipe required in the existing permitted areas due to higher waste thicknesses in the expansion area. A coarse aggregate will be placed around the pipes to provide structural support and facilitate leachate flow. The aggregate will be wrapped with geotextile. The pipes will be manufactured of HDPE which has been shown to be physically and chemically resistant to leachate and solid wastes. The pipes will be joined by the butt fusion or electrofusion method.

The pipes in the existing and proposed areas were designed to not crush or deform beyond specification under the expected maximum loads. Calculations for leachate collection pipe crushing are included in Section (C)(5)(f).

Cleanout access is provided for the leachate collection piping. Cleanout pipes are located at the sumps and along the perimeter berm. Cleanout pipes consist of 6-inch diameter, solid wall HDPE pipe utilizing the same wall thickness as the pipe for which it provides cleanout access. All leachate collection pipes will be able to be cleaned using standard equipment. Detailed material requirements, installation methods, and testing programs for the leachate collection piping are included in the CQA/QC Plan.

(14) For Filter Layers: the filter layer of the leachate collection and management system shall comply with the following:
(a) Be placed above the leachate collection layer and leachate collection pipes.
(b) Be designed to minimize clogging of the leachate collection layer, leachate collection pipes, and sumps.

(D)(14) The filter layer will consist of a geotextile above the 12-inch thick granular leachate collection layer or an additional 3-inches of granular leachate collection layer. If the optional 24-inch tire shred leachate collection layer is utilized, a 6-oz/sy geotextile filter layer will be installed above the tire shreds.

The proposed leachate collection pipes will be installed in aggregate drainage material wrapped in a geotextile filter. Material requirements, installation methods, and testing for the geotextile filter layer are included in the CQA/QC Plan.

(15) For Sumps: the leachate collection and management system shall incorporate an adequate number of sumps that shall comply with the following:
(a) Be protected from adverse effects from leachate and differential settling.
(b) Be equipped with automatic high level alarms located no greater than one foot above the top elevation of the sump.

(D)(15) Six additional leachate sumps are designed at the low points within the lined lateral expansion area. The sumps have dimensions of 20-feet by 20-feet wide by 2-feet deep. The sumps will be filled with a large, non-carbonate aggregate to provide sufficient void space for

leachate storage in the sump. Two side slope risers will be placed in each sump. The risers will extend from the sump to the top of the perimeter berm. Side slope risers will be 24-inch diameter, SDR-11~~17~~ HDPE pipe.

One of the side slope riser pipes will contain a submersible pump along with retrieval cables, power cables, control cables, and discharge piping. An automatic high level alarm will be installed to indicate if leachate levels exceed 1 foot above the top of the sump. Details of the leachate collection sump and side slope riser pipe are included in Drawings 7D through 7F. The riser pipe strength calculation is included in Section (C)(5)(g).

(16) For Leachate Conveyance Apparatus: the leachate collection and management system shall incorporate adequate measures that will automatically remove leachate from the landfill to the leachate storage tank(s), a permitted discharge to a public sewer, or a permitted waste water treatment system to facilitate the transfer of leachate from the storage tank(s) for the purpose of disposal. Any leachate conveyance apparatus located outside of the limits of solid waste placement shall comply with the following:

(a) Be monitored, as required by the director or his authorized representative.

(b) Be double cased with a witness zone.

(c) Be protected from the effects of freezing temperatures, crushing, or excess deflection.

(D)(16) The leachate conveyance system consists of the leachate pumping system and force main which convey leachate to the existing storage tank via existing and proposed force mains. Each sump will contain a submersible pump. Pumps will have level sensors to turn on and off automatically to maintain a leachate level less than 1 foot above the top of the sump. A valve box will be installed at the top of the sideslope adjacent to the sumps to house piping and valves. To facilitate removal of pumps, the discharge piping is joined with a quick-connect coupling inside the riser pipe.

The expansion design proposes a dual-contained force main pipe for each sump to convey leachate to the storage tank. The dual-contained force mains are installed at least 3 feet below grade to provide protection from crushing and freezing.

The design calculations of the leachate pumping system and force main are presented in Section (C)(5)(f) and (g). The locations of existing and proposed force mains are presented on Drawings 4D and 4E and details are provided on Drawing 7F.

(17) For Leachate Storage Tanks: leachate storage tanks shall have adequate storage capacity to receive the anticipated amount of leachate removed during normal operations from the leachate sumps to maintain a maximum one foot of head and at a minimum have at least one week of storage capacity using design assumptions simulating final closure completed in accordance with Rule 3745-27-11 of the administrative code. Any leachate storage tanks located outside of the limits of solid waste placement shall be monitored, as required by the director or his authorized representative, and include one of the following:
(a) For above ground leachate storage tanks be provided with spill containment no less than one hundred ten percent of the tank volume.
(b) For underground leachate storage tanks, be double cased with a witness zone.

(D)(17) The existing 545,000-gallon leachate storage tank is located east of Phase 4A in the leachate management area shown on Drawings 4D and 4E. The tank has a concrete lined secondary containment area that provides the required 110 percent volume of the tank. A truck loading pad is located adjacent to the tank where leachate is transferred to tanker trucks. The truck loading pad contains a sump to contain spills that can be pumped back to the leachate storage tank. *The loading pad includes a concrete wall around the loading pad and a paved ramp at the entrance to minimize surface water run-on and reduce the tracking of mud into the area.*

The existing leachate storage tank provides adequate storage capacity for the anticipated amount of leachate generated during normal operations and at least 7 days of storage capacity for the entire landfill based on the estimated volume of leachate generated during the post-closure period as required by Rule 3745-27-06(C)(5). *The calculation also includes the expected additional volume of condensate generated by a proposed landfill gas plant which will be directed to the leachate storage tank.* The calculations are included in Section (C)(5)(e). Apex has an existing Indirect Discharge Permit to treat the leachate at the City of Steubenville Wastewater Treatment Plant (WWTP); however, Apex has not been discharging leachate there. If Apex intends to resume discharging leachate at Steubenville WWTP after the proposed landfill gas project is developed, we will contact Ohio EPA Division of Surface Water to determine whether modification of the Indirect Discharge Permit is needed.

(18) For Access Roads: all access roads used for waste hauling that are constructed within the horizontal limits of waste placement shall comply with the following:
(a) Not have grades in excess of twelve percent.
(b) Be designed to be stable and to prevent damage to the liner or cap systems caused by the effects of traffic loading and braking or any other action.

(D)(18) A permanent access road will be constructed along the perimeter of the landfill and from the rail unloading area. Roads used for waste hauling vehicles will have a maximum slope of 12 percent. The permanent access road located along the perimeter of the landfill is designed with a compacted subgrade and an aggregate layer placed above it. A geotextile will be installed below the road base material if required. The road design and maintenance will allow all weather access for the vehicles using the road and minimize erosion and dust generation.

Temporary access roads will be constructed from the permanent access roads to the working face. The temporary access roads to the working face will have a maximum slope of 12 percent. The roads will be constructed of subbase material sufficient to provide all weather access. Permanent access roads locations are presented on Drawing 4G.

(19) For Transitional Covers: Within sixty days of a portion of the facility reaching final elevations, transitional cover, as specified in Rule 3745-27-19 of the administrative code, shall be installed and comply with the following:
(a) A twenty-four inch thick layer of soil that shall be nonputrescible and have low permeability, good compactability, cohesiveness, and relatively uniform texture, and shall not contain large objects in such quantities as may interfere with its application and intended purpose. The soil shall be a well-compacted loam, silt loam, clay loam, silty clay loam, silty clay or other soil types that can achieve the intended purpose.
(b) The soil shall be of sufficient thickness and fertility to support vegetation and shall be seeded as soon as practicable. Healthy grasses or other vegetation shall form a complete and dense vegetative cover within one year of soil placement.
(c) In preparation for construction of the final cap system in accordance with this paragraph, the transitional cover shall be partially or completely removed or otherwise prepared as necessary for construction of the final cap system.

(D)(19) A transitional cover may be used in accordance with OAC 3745-27-19(H)(2). The transitional cover will be placed within 60 days after a phase of the facility has attained final waste elevations. The transitional cover will be constructed in accordance with OAC 3745-27-08(D)(19). Material requirements and installation methods for transitional cover are included in the CQA/QC Plan.

When constructing the composite cap system, the transitional cover may remain in place as subgrade for the flexible membrane cap if it meets permeability requirements. Alternately, the

transitional cover may be partially or completely removed or prepared for installation of the final cover system.

(20) For a Gas Collection System: the gas collection system shall be installed prior to the final cap system and shall comply with the following:
(a) Collect and transport gas and condensate without adversely impacting the final cap system.
(b) Facilitate maintenance to portions of the component without requiring the entire system to be closed down.

(D)(20) The Gas Collection and Control System (GCCS) design is based on the proposed final grades of the facility. The installation of the GCCS will be completed in phases to comply with the New Source Performance Standards (NSPS) requirements to install control devices where waste is 5 years old or at final grades for 2 years when required by the applicable regulations.

Gas Collection and Control System Design

The GCCS design is presented on Drawing 3B. Details are presented on Drawings 7G through 7J. The GCCS design consists of gas extraction wells, and includes optional air and condensate force main piping to dewater the wells if necessary. The gas collection pipe is designed around the perimeter of the disposal area. Access risers will be installed at intervals along the piping to provide access points to the pipe.

GCCS COMPONENTS

The GCCS design consists of the following components.

Vertical Extraction Wells: Gas extraction wells have been located at a spacing of approximately 200 feet between the wells. This spacing of extraction wells accomplishes the objectives of controlling gas migration and odors at landfill facilities.

Each gas extraction well will consist of a minimum 24-inch diameter well bore, high density polyethylene (HDPE), polyvinyl chloride (PVC), or equivalent solid riser and perforated pipe, gravel

pack, bentonite well seals and a control valve. Alternate construction materials may be used. The total depth of each well is dependent upon its location and the depth of waste at that location. The extraction wells will not be drilled any deeper than 10 feet above the underlying liner system. The maximum proposed well depth will be 120 feet based on limitations of normal drill rigs and the condition of the waste. Lengths of perforated and solid pipe will be joined together and placed inside the borehole. The solid portion of the pipe will be approximately 1/3 of the well depth with a minimum length of 15 feet and a maximum length of 25 feet at the time of installation. Additional solid wall pipe may be installed to extend a well as required by operations. The remaining portion of the pipe will be perforated.

Following installation of the extraction well solid riser and perforated pipe within the borehole, materials will be installed within the well annulus to complete the well and will consist of (from bottom to top):

- A gravel pack, consisting of a coarse aggregate, placed around the perforated portion of the well pipe. This will provide a highly permeable medium for gas to readily flow to the well.
- A geotextile or bentonite isolation layer above the gravel pack.
- Clay or well graded soil.
- A hydrated layer of bentonite to provide an upper seal.

The well plug functions as a seal preventing air from being drawn into the landfill as a vacuum is applied within an extraction well. A graded layer of soil will be placed around the solid riser pipe at ground level to divert stormwater away from the well.

Each extraction well will extend approximately 3 feet above grade and a valve will be installed on each well to allow for isolation and to adjust the extraction rates by controlling the amount of vacuum applied to each well. Sample ports will be installed within the well riser pipe or wellhead to allow for the measurement of methane concentration, vacuum, temperature, and flow rate.

Horizontal Gas Collectors: Horizontal gas collectors (HGC) may be installed depending on site conditions and regulatory requirements to provide gas controls prior to reaching final grades of

the landfill. The HGC consists of perforated pipe placed in trenches backfilled with a high permeable material, which will transmit the flow of gas. The HGC will be connected to the gas pipe to create a vacuum within the HGC. A wellhead may be placed at the connection of the HGC to the gas piping to provide a sample location and a valve to control gas flows.

Gas Piping System: Gas extraction pipes and fittings will be constructed of HDPE or equivalent pipe. HDPE is highly resistant to the corrosive nature of the constituents commonly found within landfill gas. The flexible characteristic of HDPE allows the piping system to conform to the differential settlement associated with a landfill environment and endure the corresponding stresses placed upon the pipe. The piping system is designed to convey landfill gas to the gas management area. Pipes conveying the landfill gas will be installed at a minimum 2 percent slope where within the limits of waste to transport the condensate to low points in the piping system.

Condensate Management System: Condensate is produced as the landfill gas cools when it is drawn from the landfill interior to the surface. To prevent condensate from forming to a level that would block the flow of gas in the collection piping, the pipe network slopes at a minimum of 2 percent where located within the limits of waste placement to low points in the system. Condensate sumps or traps will be installed at the low points in the piping. Collected condensate will be discharged into the landfill leachate management system. Condensate will be discharged into leachate riser pipe locations or directly into the liner system protective cover layer.

Condensate from the proposed landfill gas plant will be routed through a dual-contained leachate forcemain pipe to the existing leachate tank.

Leachate Collection Pipe Tie-in: Landfill gas may be collected from leachate side slope risers and cleanout pipes to provide additional collection.

Gas Management Area: Landfill gas will be managed by combusting in a flare or through a beneficial gas reuse project. *A landfill gas plant is proposed at the Apex Sanitary Landfill. Landfill gas will be diverted from the flare(s) to the landfill gas plant. The landfill gas plant will*

produce high BTU gas, which will be piped to a regional commercial natural gas pipeline. Condensate from the process will be collected and directed through a dual contained pipeline to Apex's existing leachate collection tank. Approximately 6,000 gallons per day of condensate is estimated to be produced by the plant. The revised calculation in Section (C)(5)(e) demonstrates the existing leachate storage tank provides adequate capacity for the increased flow. As the GCCS is expanded to control additional areas of the landfill as required by NSPS, the capacity of the flare and blower will be evaluated to determine at what point they will need to be upgraded to handle the increased gas flows.

(21) For Cap Soil Barrier Layers: design and construction of a recompacted soil barrier layer in the composite cap system shall comply with the following:

(a) Be at least one of the following:

(i) Eighteen inches thick.

(ii) A geosynthetic clay liner that complies with paragraph (D)(9) of this rule with an engineered subbase, constructed in accordance with paragraph (D)(22) of this rule.

(b) Be free of debris, foreign material, and deleterious material.

(c) Not be comprised of solid waste.

(d) Be placed above all areas of waste placement.

(e) Not have any abrupt changes in grade that may result in damage to the geosynthetics.

(f) Have pre-construction testing of the borrow soils performed on representative samples and the results submitted to the appropriate Ohio EPA district office no later than seven days prior to the intended use of the material in the construction of the cap soil barrier layer. The pre-construction testing shall determine the following:

(i) The maximum dry density and optimum moisture content according to ASTM D698-00a (Standard proctor), or ASTM D1557-00 (Modified proctor) at a frequency of no less than once for every one thousand five hundred cubic yards.

(ii) The grain size distribution according to ASTM D422-63 (Sieve and Hydrometer) at a frequency of no less than once for every one thousand five hundred cubic yards.

(iii) The recompacted laboratory permeability using ASTM D5084-00E1 (Falling Head) at a frequency of no less than once for every ten thousand cubic yards.

(g) Be constructed in lifts to achieve uniform compaction. Each lift shall:

(i) Be constructed of soil in accordance with the following:

(*a*) With loose lifts of eight inches or less.

(*b*) With a maximum clod size of three inches or half the lift thickness, whichever is less.

(*c*) With one hundred percent of the particles having a maximum dimension not greater than two inches.

(*d*) With not more than ten percent of the particles, by weight, having a dimension greater than 0.75 inches.

(*e*) With at least fifty percent of the particles, by weight, passing through the 200-mesh screen.

(*f*) Alternative soil specifications may be used provided that it is demonstrated to the satisfaction of the director or his authorized representative that the materials and techniques will result in each lift having a maximum permeability of 1 x 10^{-6} cm/sec.

(ii) Be compacted to at least ninety five percent of the maximum dry density as determined by ASTM D698-00a (Standard proctor) or at least ninety percent of the maximum dry density as determined by ASTM D1557-00 (Modified proctor) or an alternative compaction specification approved by the director.

(iii) Be placed with a minimum soil moisture content that shall not be less than the optimum moisture content as determined by ASTM D698-00a (Standard proctor), or ASTM D1557-00 (Modified proctor) or an alternative moisture content specification approved by the director.

(iv) Have a maximum permeability of one times ten to the negative six centimeters per second (1 x 10^{-6} cm/sec).

(h) Be adequately protected from damage due to desiccation, freeze/thaw cycles, wet/dry cycles, and the intrusion of objects during construction of the cap system.

(i) Have quality control testing of the constructed lifts performed to determine the density and moisture content according to ASTM D2922-01 and ASTM D3017-01 (Nuclear Methods), ASTM D1556-00 (Sand Cone), ASTM D2167-94 (Rubber Balloon) or other methods acceptable to the director or his authorized representative at a frequency of no less than five tests per acre per lift. The locations of the individual tests shall be adequately spaced to represent the constructed area. Any penetrations shall be repaired using bentonite.

(D)(21) The cap system will comply with OAC 3745-27-08(D)(21). A cap system will be constructed on all areas of the vertical expansion. The cap system will minimize infiltration and control erosion. The cap system will consist of the following systems (from bottom to top):

- 18-inch thick recompacted soil barrier;
- 40-mil textured FML;
- Double-sided geocomposite; and
- 30-inch thick frost protection/vegetative layer.

Details of the cap system are shown on Drawings 7A through 7C. Detailed material requirements, installation methods, and testing programs for the final cover system are included in the CQA/QC Plan presented in Section (C)(9).

(22) For Engineered Subbases: if a geosynthetic clay liner is used in the composite cap system in accordance with paragraph (D)(21) of this rule, it shall be placed above an engineered subbase. Design and construction of the engineered subbase shall comply with the following:

(a) The thickness of the subbase shall be sufficient to achieve an evenly graded surface and shall be a minimum of twelve inches thick.

(b) Be free of debris, foreign material, and deleterious material.

(c) Not be comprised of solid waste.

(d) Not have any abrupt changes in grade that may result in damage to the geosynthetics.

(e) Not have any sharp edged protrusions or any particles protruding more than one quarter of one inch.

(f) Have pre-construction testing of the borrow soils performed on representative samples to determine the maximum dry density and optimum moisture content according to ASTM D698-00a (Standard proctor), or ASTM D1557-00 (Modified proctor) at a frequency of no less than once for every ten thousand cubic yards.

(g) Be constructed in lifts to achieve uniform compaction. Each lift shall include the following:

(i) Be constructed of soil as follows:

(*a*) Be constructed in loose lifts of twelve inches or less.

(*b*) Be constructed of a soil with a maximum clod size that does not exceed the lift thickness.

(ii) Be compacted to at least ninety five percent of the maximum dry density as determined by ASTM D698-00a (Standard proctor) or at least ninety percent of the maximum dry density as determined by ASTM D1557-00 (Modified proctor).

(h) Have quality control testing of the constructed lifts performed to determine the density and moisture content according to ASTM D2922-01 and ASTM D3017-01 (Nuclear Methods), ASTM D1556-00 (Sand Cone), ASTM D2167-94 (Rubber Balloon) or other methods acceptable to the director or his authorized representative at a frequency of no less than five tests per acre per lift. The locations of the individual tests shall be adequately spaced to represent the constructed area. Any penetrations shall be repaired using bentonite.

(D)(22) This application does not propose to use a GCL in the final cover and therefore will not require an engineered subbase per this rule.

(23) For Cap Geosynthetic Clay Liners: A geosynthetic clay liner meeting the requirements of paragraph (D)(9) of this rule shall be placed above the engineered subgrade in the composite cap system.

(D)(23) This application does not propose to use a geosynthetic clay liner for the cap system.

(24) For Cap Flexible Membrane Liners: A flexible membrane liner meeting the requirements of paragraph (D)(10) of this rule shall be placed above the recompacted soil barrier layer or the geosynthetic clay liner in the composite cap system.

(D)(24) An FML will be placed on the recompacted soil barrier to provide a composite cap system. The FML will be manufactured from textured HDPE, LLDPE, or another approved material and will be a minimum average thickness of 40 mils. Materials of alternate composition and/or thickness may be incorporated if comparable performance can be demonstrated. The CQA/QC Plan contains material and installation specifications for the FML.

(25) For the Cap Drainage Layers: the drainage layer for the composite cap system shall comply with the following:

(a) Be comprised of granular materials that meet the following requirements:

(i) Have a minimum thickness of one foot.

(ii) Not clog or freeze.

(iii) Not damage the underlying flexible membrane liner.

(iv) Have no more than five percent of the particles, by weight, passing through the 200-mesh sieve.

(v) Have no greater than ten percent carbonate content by weight.

(vi) Have a minimum permeability of one times ten to the negative three centimeters per second (1×10^{-3} cm/sec).

(vii) Granular materials shall have quality control testing in accordance with the following at a frequency of no less than once for every three thousand cubic yards of material:

(*a*) Permeability using ASTM D2434-68 (Constant Head).

(*b*) Grain size distribution using ASTM D422-63 (Sieve).

(*c*) Carbonate content using ASTM D3042-97 at a pH of 4.0.

(viii) An alternative material and/or thickness may be used provided it is demonstrated to the satisfaction of the director or his authorized representative that the material meets the requirements of this paragraph. The appropriate quality control testing and frequency of testing needs to be approved by Ohio EPA prior to use.

(b) A geosynthetic drainage net used in lieu of a granular drainage layer shall meet the following requirements:

(i) Have a minimum transmissivity to ensure that the cap system meets the slope stability requirements of this rule. The transmissivity shall be adjusted for elastic deformation, creep deformation, biological clogging, and chemical clogging by using the appropriate reduction factors.

(ii) The composite liner system must be protected from the intrusion of objects during construction.

(iii) Have quality control testing for transmissivity using ASTM D4716-01 at the maximum projected load and a frequency of once per fifty thousand square feet.

(iv) Any geosynthetic materials shall have pre-construction interface testing performed according to paragraph (G) of this rule.

(D)(25) The cap drainage layer will be a geocomposite drainage layer which complies with OAC 3745-27-08(D)(25). The geocomposite drainage layer will be a geonet with a geotextile

heat bonded to both sides to improve stability. The geotextile will be a non-woven material with a 6 oz/sy (MARV) mass per unit area. The bottom geotextile on the side slopes will provide a high interface friction angle against the 40-mil textured FML. The top geotextile of the geocomposite will filter water as it percolates into the geonet. The CQA/QC Plan provides interface shear strength testing requirements, material specifications, and installation procedures for the drainage geocomposite.

(26) For Cap Protection Layers: a cap protection layer shall comply with the following:
(a) Be placed above the cap drainage layer.
(b) Be a minimum of thirty-six inches thick for facilities located in the northern tier of counties in Ohio (Williams, Fulton, Lucas, Ottawa, Erie, Lorain, Cuyahoga, Lake, Geauga, and Ashtabula Counties) and thirty inches thick for facilities located elsewhere in Ohio. The thickness of the drainage layer may be used to satisfy the thickness requirement of the cap protection layer.
(c) Have a maximum projected erosion rate of five tons per acre per year.
(d) Have sufficient fertility in the uppermost portion to support vegetation.
(e) Be constructed as follows:
(i) With best management practices for erosion control.
(ii) In a manner that healthy grasses or other vegetation shall form a complete and dense vegetative cover within one year of placement.

(D)(26) The cap protection layer will comply with OAC 3745-27-08(D)(25). The cap protection layer will consist of 30 inches of soil. The soil will be of sufficient fertility to provide a vegetative cover. Grass seed, fertilizer, and mulch mixes and rates will be in keeping with past site practice to provide a complete and dense vegetative growth. The vertical separation between surface water control benches is a maximum of 60 feet. The calculation in (C)(5)(j) shows that the maximum projected erosion rate does not exceed 5 tons per acre per year for the maximum vertical distance of 60 feet.

(27) For Explosive Gas Control Systems: an explosive gas control system shall not compromise the integrity of the cap system, the leachate management system, or the composite liner system, and shall comply with the following:
(a) Accommodate waste settlement.
(b) Provide for the removal of condensate.
(c) Prevent lateral movement of explosive gas from the sanitary landfill facility.
(d) Prevent fires within the limits of solid waste placement.

(D)(27) The explosive gas control system will comply with OAC 3745-27-08(D)(27) and is discussed in response to rule 3745-27-08(D)(20) in this section.

(E) Test Pad Construction and Certification. The construction of the recompacted soil liner shall be modeled by an approved test pad. The test pad shall determine the construction details required to achieve the permeability standard for recompacted soil liners and shall establish a set of parameters for certification of the soils to be used in the construction of the recompacted soil liner. Test pad construction and certification shall comply with the following:

(1) Be designed such that the proposed tests are appropriate and the results of each test are valid.

(2) Have an area large enough to perform valid field permeability testing and a minimum width three times the width of compaction equipment, and a minimum length two times the length of compaction equipment, including power equipment and any attachments.

(3) Have a thickness of no less than thirty inches.

(4) Have the following pre-construction testing performed on representative samples of the test pad construction soils at a minimum frequency of twice per lift for:

(a) The maximum dry density and optimum moisture content according to ASTM D698-00a (standard proctor), or ASTM D1557-00 (modified proctor).

(b) Grain size distribution using ASTM D422-63 (sieve and hydrometer).

(c) Atterberg limits using ASTM D4318-00.

(5) Be constructed as follows:

(a) Prior to the construction of the sanitary landfill component that the test pad will model.

(b) The construction details include the following:

(i) The maximum loose lift thickness.

(ii) The minimum soil moisture content that shall not be less than the optimum moisture content as determined by ASTM D698-00a or ASTM D1557-00.

(iii) The minimum soil dry density that shall not be less than ninety five percent of the maximum "Standard Proctor Density" using ASTM D698-00a or at least ninety percent of the maximum "Modified Proctor Density" using ASTM d1557-00.

(iv) The specific type and weight of compaction equipment manufactured for the purpose of compacting cohesive soils.

(v) The minimum number of passes of the compaction equipment. For the purpose of this rule, one pass is defined as a single contact of the compactor over an area.

(6) Be reconstructed as follows:

(a) With new borrow soil as many times as necessary to meet the permeability requirement.

(b) Whenever there is a significant change in soil material properties.

(c) Whenever the owner or operator would like to amend the construction details.

(7) Have quality control testing of the constructed lifts performed to determine the density and moisture content according to ASTM D2922-01 and ASTM D3017-01 (nuclear methods), ASTM D1556-00 (sand cone), ASTM D2167-94 (rubber balloon) or other methods acceptable to the director or his authorized representative at a frequency of no less than three tests per lift. The locations of the individual tests shall be adequately spaced to represent the constructed area. Any penetrations shall be repaired using bentonite.

(8) Have post-construction testing performed for field permeability using one of the following:

(a) ASTM D6391-99 (two stage borehole).

(b) ASTM D3385-94 (double ring infiltrometer).

(c) ASTM D5093-90 (sealed double ring infiltrometer).
(d) Other methods acceptable to the director or his authorized representative.
(9) Be described in a certification report, signed and sealed by a professional engineer registered in the state of Ohio, containing a narrative that proposes: The construction details, the range of soil properties that will be used to construct the recompacted soil liner, and the results of all the testing required by this paragraph. The report shall be submitted to the appropriate Ohio EPA district office for written concurrence no later than fourteen days prior to the intended construction of the recompacted soil liner that will be modeled by the test pad.
(10) An alternative to the test pads required by this rule may be used if it is demonstrated to the satisfaction of the director or his authorized representative that the alternative meets the permeability requirements in this rule.

(E) Test pad construction will comply with OAC 3745-27-08(E). Test pad requirements are addressed in the CQA/QC Plan in Section (C)(9).

(G) Pre-construction Interface Testing and Reporting. The specific soils and representative samples of the geosynthetic materials that will be used at the site shall be tested for interface shear strength over the entire range of normal stresses that will develop at the facility. Prior to the initial use of each specific geosynthetic material(s) in the construction of engineered components at a facility, the appropriate shear strengths for all soil to geosynthetic and geosynthetic to geosynthetic interfaces that include the material(s) shall be determined at least twice using ASTM D5321-92 (Direct Shear Test) or ASTM D6243-98 (Direct Shear Test for GCL) and at least once for each subsequent construction event using samples of the materials identified by the initial two tests to be at the highest risk for slope failure. Tests involving the flexible membrane liner interface shall be conducted with a recompacted soil that has the highest moisture content and the lowest density specified for construction of the recompacted soil liner. Tests involving geosynthetic clay liner material shall be conducted with hydrated samples. The results of pre-construction testing required by this rule must meet all applicable specifications in this rule and the set of approved parameters in the permit to install application that were established by the slope stability analysis and shall be evaluated and signed and sealed by a professional engineer registered in the state of Ohio and submitted to the appropriate Ohio EPA district office no later than seven days prior to the intended use of the materials.

(G) Specifications for pre-construction interface testing and reporting will comply with OAC 3745-27-08(G). Pre-construction interface testing requirements are addressed in the CQA/QC Plan.

(H) Construction Certification Report. Pursuant to Rule 3745-27-19 of the Administrative Code, a construction certification report shall be prepared and signed and sealed by a professional engineer registered in the state of Ohio and other professionals skilled in the appropriate discipline(s) and submitted to Ohio EPA and to the approved health department. Copies of the daily construction activity logs must be kept at the facility

and upon request made available to Ohio EPA. The construction certification report shall include the following:

(1) A narrative section that identifies the engineering components that were constructed during the construction event and includes the following:

(a) A summary of the design and construction specifications given in the approved permit to install and a comparison with the components that were constructed during the construction event.

(b) A summary of how construction was impacted by weather and equipment limitations and other difficulties encountered.

(2) All alterations and other changes that relate to the installation of any of the components to be certified are to be presented as follows:

(a) A listing of all alterations previously concurred with by Ohio EPA.

(b) All alteration requests and supporting documentation which are proposed for concurrence. The alteration request shall be equivalent or more protective than the approved permit to install.

(c) A list of any other changes made by the owner or operator which do not require Ohio EPA concurrence but which affect construction or the record drawings.

(3) Results of all testing required by this rule and the quality assurance/quality control plan for the construction of any engineered component or group of components. If the results of pre-construction testing of borrow soils were submitted in a format that is acceptable to Ohio EPA, only summary tables of data need to be included in the construction certification report.

However, if a quality assurance/quality control plan is not required by the applicable authorizing document(s), including an approved permit(s) to install, plan approval, operational report, or approved closure plan, the owner or operator shall include the results of testing, testing procedures, sampling frequency and location, parameters tested for, etc., performed to certify compliance with this rule.

(4) Results of all surveys required by this rule, the quality assurance/quality control plan, or the approved permit to install for the construction of any engineered component or group of components. Survey data shall at a minimum be reported in a table(s) at the northing and easting for each designated survey point established to be no more than one hundred feet apart. The Northings and Eastings shall be based on the grid system established in the permit in accordance with Rule 3745-27-06 of the Administrative Code. If the permit to install does not establish a grid system, the owner or operator shall establish a grid system for the purposes of construction certification. Additional points should be established at grade breaks and other critical locations.

(a) For the purpose of confirming the constructed elevations of the composite liner system and its distance to the uppermost aquifer system, the bottom of recompacted soil liner elevations shall be compared to the elevations in the approved permit to install.

(b) The survey grid shall also be used to demonstrate the thickness of the following constructed components with a comparison of the constructed thickness to the thickness specified in the approved permit to install:

- **(i) Added geologic material.**
- **(ii) The recompacted soil liner.**
- **(iii) The leachate collection layer.**
- **(iv) The separatory soil barrier layer.**

(v) The separatory leachate collection layer
(vi) The cap drainage layer.
(vii) The cap protection layer.

(5) Record drawings of the constructed facility components showing the following:

(a) Plan views with topographic representation with the elevations of the top of recompacted soil liner and the location of any berms and leachate collection pipes with inverts noted.

(b) Plan views with topographic representation with the elevations of the top of the separatory soil barrier layer and the location of any berms and leachate collection pipes with inverts noted.

(c) Plan views with topographic representation with the horizontal limits of all existing waste and the top elevations of the composite cap system and surface water control structures including permanent ditches to control run on and run off; and sedimentation ponds including the inlet and outlet; and any permanent ground water control structures.

(d) Plan views of the deployment of the flexible membrane liner panels and the location and identification of the destructive tests and all repairs.

(e) The location and as-built detail drawings of all components to be certified using the same views as required in Rule 3745-27-06 of the Administrative Code.

(f) If the certification report is submitted for the composite cap system, cross sections showing the top elevations of the existing waste, top elevation of the composite cap system, and the elevations of the surface water management system. The cross sections shall be taken at the same locations and using the same scale as in the approved permit to install. Otherwise, the cross sections shall be taken at an interval no greater than every three hundred feet of length and width.

(6) After the initial construction and establishment of facility survey marks, the following information summarizing the activities performed to construct and establish the facility survey marks:

(a) An identification and description of the known control point(s) used to establish the horizontal and vertical coordinate(s) of the facility survey marks.

(b) The horizontal and vertical coordinates of the known control point(s) and facility survey marks.

(c) A summary of surveying activities performed in determining the coordinates of the facility survey marks.

(d) A copy of the 7.5 minute series quadrangle sheet(s) used in establishing the survey marks with the known control point(s) and the location of the facility survey marks clearly identified.

(e) A detailed drawing(s) illustrating the design of the facility survey marks, as constructed.

(7) Qualifications of testing personnel. A description of the experience, training, responsibilities in decision making, and other qualifications of the personnel that provided construction oversight and conducted all the testing on the engineered components for which the certification report is submitted.

(8) Documentation demonstrating that any oil or gas wells that have been identified within the limits of solid waste placement have been properly plugged and abandoned in accordance with Chapter 1509. Of the revised code prior to any construction in the area of the well(s).

(9) A notarized statement that, to the best of the knowledge of the owner or operator, the certification report is true, accurate, and contains all information required by this rule and by a quality assurance/quality control plan.

(H) The construction certification report will comply with OAC 3745-27-08(H). The requirements of the construction certification report are included in the CQA/QC Plan.

(C)(8) OPERATIONAL INFORMATION

The operational information regarding the proposed contiguous expansion is provided to address the information required in Ohio Administrative Code (OAC) Rule 3745-27-06(C)(8).

(C)(8)(a): Authorized maximum daily waste receipt, as defined in rule 3745-27-01 of the Administrative Code, requested for the sanitary landfill facility.

The proposed lateral expansion will be used for the disposal of municipal, industrial, and residual solid wastes as defined in the Ohio Administrative Code. The proposed authorized maximum daily waste receipt (AMDWR), as defined in OAC Rule 3745-27-01(B)(5), for the Apex Sanitary Landfill is 10,000 tons per day. Apex has demonstrated that sufficient personnel and staff are available to provide proper operations and maintenance of the facility at the current AMDWR, and has proposed additional resources to accommodate the proposed increase in AMDWR (see Section (C)(1) of this application).

(C)(8)(b): Technique of waste receipt, including but not limited to acceptance of baled waste or loose waste.

The methods used to handle solid waste, including bulky and dusty materials, are discussed below. Other general operating information is also presented. In addition, landfill operations will conform to OAC 3745-27-19 which addresses the handling of waste and placement of daily and intermediate cover. *Acceptance and disposal of liquid and semisolid wastes or sludges (wastes that cannot pass the paint filter test) is prohibited at the working face. The liquid and semisolid wastes or sludges that are transported to Apex must be solidified with an admixture material at the Solidification Basin until no free liquids are present (the paint filter test is passed), prior to disposal at the working face. The methods used to handle liquid waste are presented in the Authorization Request to Operate a Solidification Basin, which was submitted in June 2012 and revised in July 2012. The request was authorized and issued on November 27, 2012. The Authorization to Construct and Operate a Solidification Basin and the Construction Documentation Submittal for the Solidification Basin are included in Appendix C8-B.*

Receiving Waste:

Waste will arrive on-site in intermodal rail containers, open top rail cars, rolloffs, walking floors, transfer trailers, front-end loaders, rear-end loaders, long bed dump trucks, local municipal trucks, and similar refuse vehicles. Trucks entering the site via roads will be weighed at the scales at the main office. Signs will be posted along the access roads to direct landfill traffic and control vehicle speed. Paved and unpaved roads will be maintained to provide all weather access to the working face. The site access road and temporary roads will be extended as necessary in order for the waste vehicles to reach the working face of the landfill. Trucks will enter and leave the working area by the site access and temporary roads. The temporary access roads will be constructed (or removed from service) as the landfill working face advances. Intermodal containers ~~will be~~ *are* unloaded using top-picks and/or gantry cranes which ~~will~~ place the containers on trucks for transport to the working face. *Because waste is not unloaded from the intermodal containers until the container reaches the waste disposal area, leachate management is not required for the unloading or staging areas.* Open top rail cars ~~will be~~ *are* unloaded using an excavator operating on a platform. Waste will be placed in trucks and hauled to the working face. *Two haul roads are proposed from the rail unloading area to the working face. One road is primarily for returning from the working face. The existing rail car unloading area includes a trench drain to collect water that may contact the waste that spills during unloading. The unloading side of the rail car unloading platform is surfaced with concrete or asphalt and sloped for liquids to drain to the existing trench drain. The collected liquids are conveyed through double-wall HDPE gravity sewers to a pump station at the leachate loading pad. The pump station discharges the collected liquid through a HDPE force main to the leachate storage tank.*

Additional new rail tracks will be constructed to the west of the existing tracks to provide capacity to accept additional rail cars. The rail cars will be unloaded within a proposed rail unloading building to reduce the potential for dust emissions, surface water contacting waste materials, or spillage. Rail cars will be unloaded using an excavator operating on a platform or a raised material handler which is an excavator capable of unloading rail cars by straddling the car or by sitting adjacent to the car. If the platform option is used, a ramp will be constructed up to the height of the platform so that the excavator can be mobile and not be stationary on the platform. The building will be sized so that two unloading platforms or three raised material

handlers can be used simultaneously. The floor of the building will be reinforced concrete and will be sloped towards a trench drain or catch basin to collect leachate that may spill during unloading operations. Leachate collected in the trench drain will be conveyed through a dual-contained HDPE pipe to a manhole in an existing gravity sewer line from the existing rail unloading area. The leachate will be conveyed to the pump station at the leachate loading pad from where it will be pumped into the leachate storage tank. See Drawings 7O and 7P for the conceptual design of the rail unloading building.

Handling Solid Waste:

Normal operations will use the area method of landfilling and will typically use one working face. Each phase will be filled in a series of horizontal lifts. As an area reaches final waste elevations at the end of a phase, operations may need to be divided and two working faces used to provide safe placement and optimum compaction of the waste. Two working faces may also be used when installing the 5 feet of select waste over the leachate collection layer in a newly-constructed cell. During this activity, both working faces will be covered with daily cover.

The waste initially placed in a newly lined area will be select waste, and will be a layer at least 5 feet thick. The 5 feet of material includes the thickness of the drainage medium used for the leachate collection system. The placement of the select waste layer will be documented in accordance with OAC 3745-27-19(D)(2). Following placement of the select waste layer, additional waste will be placed in individual lifts not exceeding 2 feet in thickness and then compacted. The unloading of waste will be confined to the smallest practical area. Operating personnel will be present at the working face at all times to assist vehicles disposing of waste and to help prevent unauthorized wastes from being deposited in the landfill. The waste will be dumped, pushed into place with trash compactors or bulldozers, and then compacted using the trash compactors.

Bulky and Dusty Wastes:

Bulky items will be kept near the toe of the active slope and will be ramped over to avoid damage to the equipment. Dusty wastes will be covered with soil or refuse to reduce the potential for dust generation. Dusty wastes may also be sprayed with water during and after

unloading and prior to covering with soil or refuse. Surface water runoff will be controlled during watering activities.

Baled and Loose Waste:
Baled items will be broken apart at the working face. Loose waste will be disposed at the working face. The site will contain blowing litter using portable and/or permanent litter fences on the downwind side of the working face, maintaining a smaller working face on windy days, using personnel to collect wind-blown litter on the fencing, property and daily cover.

Odorous Sludge:
Odorous sludges will be disposed at the working face and immediately covered with additional nonputrescrible waste.

(C)(8)(c) Type of waste to be received, including but not limited to municipal solid waste, industrial solid waste, residual solid waste, asbestos or asbestos containing waste that is subject to the provisions of NESHAP, 40 CFR Part 61, Subpart M, July 1, 2002, or construction and demolition debris.

The proposed contiguous expansion will receive only non-hazardous municipal solid waste, commercial, asbestos or asbestos-containing material not subject to the NESHAP Provisions, construction and demolition debris, industrial and residual solid wastes for disposal. Asbestos or asbestos-containing material will be disposed of in accordance with Ohio EPA guidance document No. 587 dated November 2002. No asbestos or asbestos-containing material that is subject to the provisions of NESHAP, 40 CFR Part 61 and Subpart M will be accepted at the Apex Sanitary Landfill. The landfill will not accept regulated hazardous waste as defined in Rule 3745-51-03 or PCB-containing wastes as defined in 40 CFR Part 761. The site will continue to comply with the current PCB and Hazardous Waste Prevention and Detection Plan.

The landfill will not accept for disposal infectious wastes as defined in OAC Rule 3745-27-01 unless the infectious waste has been treated to render it noninfectious in accordance with OAC Rule 3745-27-32, or is allowed by other regulations.

(C)(8)(d) Type of equipment to be used to construct, operate, and maintain the sanitary landfill facility.

Refer to Section (C)(1) Summary of Site Environs for a discussion of the equipment that will be used to operate and maintain the landfill facility.

The approved Odor Management Plan is provided in Appendix C8-A.

APPENDIX C8-A

ODOR MANAGEMENT PLAN

OhioEPA

John R. Kasich, Governor
Mary Taylor, Lt. Governor
Craig W. Butler, Director

July 20, 2015

Certified Mail
#7013 2630 0000 7356 9550

Apex Environmental, LLC
Attention: Joe Tatarek, Director
P.O. Box 157
Amsterdam, OH 43903

Re: Apex Sanitary LDF
PTI - Long Term
Approval
Municipal Solid Waste Landfills
Jefferson County
MSWL018772

Subject: Alteration of PTI No. 06-08438,
2015 Revised Odor Management Plan - Approval

Dear Mr. Tatarek:

On July 17, 2015, Ohio Environmental Protection Agency (Ohio EPA) received a submission titled: ***"PTI Alteration Request, Revised Odor Management Plan, Apex Sanitary Landfill"*** (Revised OMP), which was a proposed alteration to Permit-to-Install (PTI) No. 06-08438 for the Apex Sanitary Landfill (Facility) in Jefferson County. Apex Environmental, LLC (Apex) had previously submitted the Revised OMP on June 21, 2013.

As attached here, the Revised OMP consists of the descriptive narrative, and includes Figure C8-1 (Temporary Intercell Separation Berm), Attachment A (Sludge Analytical Requirements), and Attachment B (Sludge Constituent Levels).

Ohio EPA has completed the review of the Revised OMP, which appears to be an acceptable alteration to PTI No. 06-08438, approved December 31, 2009.

The Revised OMP replaces the Odor Management Plan found within the PTI's Section (C)(8), which addresses landfill operational information.

This alteration provides equal or better landfill performance and does not change the original siting and engineering functions of the Facility as defined within PTI No. 06-08438. The aforementioned approval does not release Apex from complying with

any other requirements of the approved PTI or the requirements of Ohio Administrative Code Chapter 3745-27.

This approval should be recorded into the Facility's Operating Record.

Sincerely,

Craig Walkenspaw
District Engineer
Division of Materials and Waste Management

Authorized by:

Richard J. Fox
Group Supervisor
Division of Materials and Waste Management
Southeast District Office, Ohio EPA

Attachment

CW/mr

ec: Sara Anderson, SEDO-DMWM w/ attachment
ec: Jefferson County General Health District w/ attachment
Carla@JChealth.com
ec: CO-DMWM w/ attachment
Janine.Maney@epa.ohio.gov
ec: Civil & Environmental Consultants, Inc. w/ attachment
rbuffalini@cecinc.com

Odor Management Plan

The goal of this Odor Management Plan (OMP) is to establish best operational practices for the control of odors originating from the Apex Sanitary Landfill, located at 11 County Road 78, Amsterdam, Jefferson County, Ohio (Facility). Apex Environmental, LLC (Apex) shall perform the following measures in accordance with this OMP and applicable law. Should the measures performed in accordance with this OMP fail to strictly control odors, Apex will promptly work to identify and implement additional measures.

This OMP is divided into the following sections:

1. Control and Monitoring of Landfill Gas Emissions,
2. Acceptance and Management of Potentially Odorous Waste,
3. Complaint Procedures and Odor Monitoring Response,
4. Communication Strategy,
5. Savings Clause, and
6. Updates to the OMP.

SOLID WASTE
APPROVED
OHIO ENVIRONMENTAL PROTECTION AGENCY
JUL 20 2015
ALTERS AUTHORIZATION APPROVED
DATE DEC 31, 2009

1. Control and Monitoring of Landfill Gas Emissions

1.1 GCCS System Design

The Facility's landfill gas collection and control system (GCCS) shall be designed to maximize the control of odors and the capture of landfill gas at the Facility. The general design of the GCCS is based on the proposed final waste grades of the landfill. The GCCS includes gas extraction wells with lateral pipes connecting to the header pipe. In final conditions, the header pipe will encircle the entire waste disposal area near the perimeter of the landfill's footprint. Isolation valves installed within the system allow for operation of a portion of the GCCS while another portion is shut down for maintenance or repair and to balance the system's vacuum depending on which flares are being used. Blowers are utilized to move flow through the lateral and header pipes and deliver the gas collected from the extraction wells and auxiliary piping to the flares. As permitted devices, flares are utilized to combust landfill gas delivered by the blowers. Apex will maintain the GCCS.

1.2 Flare Utilization

Currently, three flares having a total capacity of 6500 standard cubic feet per minute (scfm) are utilized at the site. Flares 001 and 002 are located to the east of the landfill and Flare 003 is located to the west of the landfill. Typically, two primary flares (Flares 001 and 002) are in

operation, while there is one redundant flare (Flare 003) that can be manually implemented in the event of a problem or required maintenance on either of the two primary flares.

The facility uses open (utility) flares equipped with thermocouples to continuously monitor the presence of a flare flame and to monitor pilot temperature start up. Upon loss of flame, the thermocouples automatically shut down the flare so that raw landfill gas will not be emitted without combustion. The pilot thermocouple provides a lock-out on the startup of the flare until such time as pilot flame is confirmed. In case of shut down, the flare system will initiate automatic restart procedures when the pilot flame is confirmed.

1.3 Protocols for Flare Outages

Apex will perform the following monitoring and recording requirements related to flare utilization. New Source Performance Standards (NSPS) require continuous records monitoring the flare pilot flame or flare flame, and records of all periods of operation during which the pilot flame and the flare flame is absent. NSPS also requires that an owner or operator using an open flare keep up-to-date, readily accessible records of all periods of operation in which the flare pilot flame or flare flame is absent. One potential intent of the regulation is to report periods of system exceedances, i.e., those periods of time when raw landfill gas is emitted into the atmosphere without first being combusted. As described in Section 1.2, the system shuts itself down if the flare loses the flame by use of thermocouples; therefore, there are no emissions through the flare stack when the flare flame is absent.

In order to meet the recording requirements, Apex utilizes a device that measures gas flow to the flare on a continuous basis. The records of flow are reviewed on a monthly basis, and any periods of flow that are measured as zero are assumed to correspond to periods of time during which the flare was not operating. The time, date, and duration of these periods of zero flow are recorded. These records shall be made available to Ohio EPA and Jefferson County General Health District, upon request.

The presence of a third and redundant flare at the facility should significantly reduce the possibility of diminished gas collection events. However, in the event of an extended significant disruption (e.g. electrical service failure) that results in landfill gas not being flared, Apex agrees to promptly notify Ohio EPA and Jefferson County General Health District.

Apex has contingency plans in place for the event that a flare becomes inoperable or requires maintenance. The three flares will be used in various combinations and permutations to provide sufficient vacuum distribution through the well field.

1.4 Hydrogen Sulfide Odor Study

In light of the 2015 solid waste operating license condition issued by Jefferson County General Health District, the trigger level for hydrogen sulfide for this OMP is currently set at 20 ppb. Apex may commence a twelve month study that compares the presence of offsite hydrogen sulfide odors, including the location, duration, and concentration of the offsite hydrogen sulfide odors, to data obtained from corresponding surface emission scans required by Section 1.5 of this OMP. Based on the results of this study, Apex may submit a request to update this OMP, in accordance with Section 6.0 of this OMP, to establish an onsite threshold concentration for hydrogen sulfide to ensure the GCCS is designed to maximize the control of odors and capture of landfill gas.

If Apex performs a study in accordance with this Section, at a minimum, Apex shall do the following:

- Notify Ohio EPA and Jefferson County General Health District at least 60 days prior to commencing a study;
- Notify Ohio EPA and Jefferson County General Health District at least seven days prior to performing surface scans so that corresponding hydrogen sulfide data can be collected;
- Share with Ohio EPA and Jefferson County General Health District all data collected during required surface scans in formats appropriate to evaluate relationship with hydrogen sulfide data and offsite odor monitoring; and
- Participate in discussions regarding collected data and recommend an appropriate hydrogen sulfide concentration trigger level that may be incorporated into this OMP.

1.5 Surface Scanning

1.5(a) Description of Scanning Frequency

At a minimum, Apex will continue to perform surface scanning to measure methane emissions from the landfill on a monthly basis. Ohio EPA and Jefferson County General Health District may perform surface scanning to measure hydrogen sulfide emissions or other landfill gases from the landfill.

1.5(b) Locations of Surface Scan

Apex will perform a surface emission monitoring pursuant to 40 CFR 60.755(c), except that a serpentine pattern shall be conducted at 50-feet spacing rather than a 30-meter interval. Surface areas with steep side slopes (greater than 3H:1V) or other potentially-dangerous areas (roads, landfill working face, truck traffic areas, construction areas, areas with snow or ice cover and overly saturated soil conditions) are excluded from the OMP more stringent 50-feet spacing, and shall implement the 30-meter interval spacing as applicable under NSPS for surface scanning.

Apex may submit to Ohio EPA for written concurrence a request for the exclusion of delineated areas from surface scans required by this OMP. Requests for such a modified surface scan pattern must be consistent with the requirements of 40 CFR 60.755 and must contain a plan view drawing delineating the proposed area where the following conditions are satisfied:

- Transitional cover has been placed and certified, as required by rule;
- Dense vegetation has been established, as required by rule; and
- Concentration values established in Section 1.5(c) of this OMP have not been exceeded for six consecutive months.

For areas excluded from the surface scanning required by this OMP, Apex will perform surface scanning as required by NSPS. NSPS requires that for areas where waste has been present for at least five years, or where waste has been present at final grades for at least two years, the landfill owner or operator must conduct surface scanning for methane around the perimeter of the collection area and along a pattern that traverses the landfill at 30-meter intervals.

Apex will employ the corrective actions identified in Section 1.5(d) of this OMP for all surface scans performed at the facility.

1.5(c) Surface Scan Reporting

Within seven days of completing surface scans required by this Section, Apex will provide the following documents electronically to Ohio EPA and Jefferson County General Health District:

- Plan view drawing that shows the approximate location of each monitoring point and methane or hydrogen sulfide concentrations. Methane concentrations will be represented by ranges of less than or equal to 250 ppm, 251 to 499 ppm, and greater than or equal to 500 ppm, and hydrogen sulfide concentrations will be represented by ranges of less than or equal to 20 ppb and greater than 20 ppb; and
- Summary of action taken to address exceedances.

1.5(d) Corrective Actions

Apex will employ a methane concentration value of 250 parts per million (ppm) or hydrogen sulfide concentration value of 20 parts per billion (ppb) to trigger odor control measures. Apex will follow this section when assessing results obtained during monthly surface scans required by this Section and any surface scan results provided by Ohio EPA and Jefferson County General Health District. If the concentration exceeds the established values, Apex will respond and apply one or both of the following measures as soon as reasonably practical:

- Apply at least six inches of soil cover satisfying the specifications described in Section 1.8(a) to the affected area;
- Adjust the vacuum of adjacent wells and other control devices to increase the gas collection in the vicinity of each elevated concentration. Adjustments will consider impact to oxygen concentrations.

Within seven days of a measured exceedance, Apex will perform the corrective measures stated above and rescan the area in the vicinity of each elevated concentration to determine whether the methane or hydrogen sulfide concentration value exceeds levels established in this Section.

If the rescan of a location shows a second exceedance, Apex will perform the corrective measures stated above and rescan within seven days. This procedure will be repeated until gas concentration values do not exceed levels established in this Section.

If a rescan shows a third exceedance, Apex will delineate the extent of the affected area on a plan view drawing and send the plan view drawing to Ohio EPA and Jefferson County General Health District within 10 days. Not later than 45 days after the delineation, Apex will install either of the following:

- A new well or other gas collection device, or
- An odor control blanket that covers the delineated area and extends 50 feet beyond the delineated area in each direction, in accordance with Section 1.9 of this OMP.

Not later than 10 days after the third exceedance, Apex may request an alternative remedy, such as upgrading the blower, header pipes, or control devices, and corresponding timeline for installation by submitting a written request to Ohio EPA for written concurrence. Upon written concurrence from Ohio EPA, Apex will implement the alternative remedy and corresponding timeline in accordance with the concurrence.

If Ohio EPA does not concur with the proposed remedy, the Director may select an alternative corrective measure by a final appealable action directing Apex to abate the odors and to implement the selected corrective measure.

1.6 GCCS Semi-Annual Review and Expansion Protocol

Apex will perform semiannual reviews of its GCCS and by February 1 and August 1 of each year, Apex shall submit to Ohio EPA for review and concurrence a proposed plan for the expansion of the Facility landfill gas collection and control system. GCCS expansion activities include the installation of permanent or temporary vertical extraction wells, horizontal collectors, and/or odor control blankets that will effectively expand the landfill's deployed active gas collection system to its entire developed footprint, inclusive of all final and intermediate slopes.

The proposed expansion plan must include, but is not limited to, vertical wells and ancillary components in areas of the landfill at final grade without GCCS installation.

Apex's review and evaluation of the existing landfill GCCS shall include an evaluation of the effectiveness of the GCCS, and shall consider the following factors:

- Explanation of whether the GCCS is designed in its current state to maximize the control of odors,
- Explanation of whether the GCCS is designed in its current state to adequately capture landfill gas at the Facility,
- Explanation of whether the design has failed to perform as intended,
- Explanation of whether the gas collection system no longer provides adequate coverage over the filled waste areas,
- A summary of any new wells or other gas collection devices installed in accordance with the corrective action Section 1.5 since the prior semi-annual review, and
- A summary of any proposed new wells or other gas collection devices required to be installed in accordance with the corrective action Section 1.5 since the prior semi-annual review.

Each proposed GCCS expansion plan will consider the following GCCS features:

- Vertical gas extraction wells,
- Horizontal gas collectors,
- Dual gas/leachate removal at select gas extraction wells,
- Connection to leachate cleanout risers and sumps,
- Connection to gas collection piping within the leachate collection system, and
- Odor Control Blanket (a temporary synthetic cap with gas collection piping beneath) if other corrective action measures fail to achieve the limits and timelines established in Section 1.5(c).

The efficacy of the GCCS to control fugitive gas emissions will be measured by:

- Monthly surface scans, as described in Section 1.5 of this OMP,
- Visual inspections, or
- Odor detections.

Apex will take prompt and reactive measures to reduce detected emissions. Examples of these measures include but are not limited to:

- Tuning of gas extraction wells,
- Placement of soils,
- Compaction of soils,
- Odor Control Blanket (after Ohio EPA concurrence or approval of design plan), and
- Expansion and improvement of the GCCS.

No later than 90 days after receipt of Ohio EPA's written concurrence with or approval of a proposed gas collection expansion plan, Apex shall complete installation and commence operation of the expanded landfill gas collection system components.

If appropriate, Apex may choose to submit a justification applying the factors and considering the features in Section 1.6 of this OMP explaining that: (1) the existing GCCS is designed in its current state to maximize the control of odors and capture of landfill gas at the Facility; (2) the GCCS design is performing as intended; and (3) the GCCS provides adequate coverage over the entire developed footprint, inclusive of all final and intermediate slopes. In this instance, Apex shall submit the justification at least 60 days before the proposed expansion plan required under Section 1.6 of this OMP is due. If Ohio EPA notifies Apex in writing of its concurrence with Apex's justification within 30 days prior to the applicable February 1 or August 1 deadline, then Apex may be relieved of its obligation to propose an expansion plan for that single semi-annual submission. If Apex does not receive such written concurrence with the justification from Ohio EPA prior to the applicable February 1 or August 1 deadline, Apex shall submit the proposed GCCS expansion plan by the applicable February 1 or August 1 deadline in accordance with Section 1.6. This provision may not be relied upon by Apex for two consecutive semi-annual submissions.

1.7 Construction Practices

Apex will employ construction practices that are designed to contain and minimize fugitive gas emissions. Such construction practices include, but are not limited to, the following:

- Perforated gas collection pipes added to the sideslope granular leachate collection layer,
- Inter-cell berms designed to contain gas at the temporary cell edges (see Figure C8-1), and

- Leachate cleanout risers and sumps are equipped with sealed caps and are also gas collection vacuum points (provided that vacuum points do not conflict with NSPS regulations).

1.8 Daily Cover, Intermediate Cover, Transitional Cover, and Final Cover

Apex will use soil of proper thickness to maintain proper daily, intermediate, and transitional covers. Apex will install daily cover in accordance with Ohio Administrative Code (OAC) Rule 3745-27-19(F), intermediate cover in accordance with OAC Rule 3745-27-19(G), transitional cover in accordance with OAC Rule 3745-27-19(H)(2) and OAC Rule 3745-27-08(D)(19), and final cover in accordance with OAC Rule 3745-27-19(H)(1) and OAC Rule 3745-27-08(D)(21). Apex will comply with the approved phase development plans to fill to the permitted final waste grades as presented on the approved PTI drawings.

1.8(a) Screening and Application of Daily Cover

Apex will minimize the working face to the smallest practical area. As required in OAC Rule 3745-27-19(F), six inches of daily cover shall be applied to all exposed solid waste by the end of the working day or no more than 24 hours after unloading as stated by the rule. Daily cover material shall be nonputrescible, shall not contain large objects in quantities as may interfere with its application and intended purpose, and shall not be solid waste. Daily cover material will be applied to all solid waste at the end of the working day.

Soil will be screened or mechanically processed, as necessary, to remove large objects to meet rule specifications. Screening will be performed using specialized mechanical soil screens, which remove oversize objects and clumps.

1.8(b) Screening and Application of Intermediate Cover

As required in OAC Rule 3745-27-19(G), intermediate cover shall be applied to all filled areas of a sanitary landfill facility where additional waste is not to be deposited for at least 30 days. Intermediate cover material shall be nonputrescible and have low permeability to water, good compactability, cohesiveness, and relatively uniform texture, and shall not contain large objects in such quantities as may interfere with its application and intended purpose. The intermediate cover will be a minimum of 12 inches thick, consisting of well-compacted loam, silt loam, clay loam, silty clay loam, silty clay, or some combination thereof. Intermediate cover material will be well-compacted after its placement. As required by OAC Rule 3745-27-19(G)(4), Apex will perform measures to protect intermediate cover from erosion.

Soil will be screened and mechanically processed, as necessary, to remove large objects to meet rule specifications. Screening will be performed using specialized mechanical soil screens, which remove oversize objects and clumps.

1.8(c) Screening and Application of Transitional Cover

Apex shall comply with the provisions of OAC Rule 3745-27-19(H)(2). As required in OAC Rule 3745-27-08(D)(19), transitional cover will be installed within 60 days of a portion of the facility reaching final elevations. Transitional cover material shall be nonputrescible and have low permeability, good compactability, cohesiveness, and relatively uniform texture, and shall not contain large objects in such quantities as may interfere with its application and intended purpose. The transitional cover will be a minimum of 24 inches thick. The material shall be a well-compacted loam, silt loam, clay loam, silty clay loam, silty clay or other soil types that can achieve the intended purpose. Transitional cover material will be well-compacted after its placement. The transitional cover shall be of sufficient thickness and fertility to support vegetation and shall be seeded as soon as practical.

Screening or mechanical processing will be performed if it is necessary to remove large objects in such quantities as may interfere with its application and intended purpose. Screening is performed using specialized mechanical soil screens which remove oversize objects and clumps.

Apex will seed to ensure that healthy grasses or other vegetation form a complete and dense vegetative cover within one year of soil placement.

For the annual certification of transitional cover, test pits are excavated to verify the soil types and thicknesses of available soils. Apex will inform Ohio EPA and Jefferson County General Health District when the test pits are being excavated so that they can be onsite to observe activities.

Apex will not reopen an area that has transitional cover without a plan for controlling odors and in accordance with applicable authorizations from Ohio EPA.

1.9 Odor Control Blanket

Not later than 30 days after the effective date of this OMP, Apex will submit to Ohio EPA for written concurrence an odor control blanket contingency plan including drawings that describe how an LLDPE, PVC liner, or equivalent material would be used over filled areas that have not reached final grade in order to control odors. The design will include gas collection piping incorporated beneath the deployed odor control blanket that will be connected to a gas collection header. The plan will also include any proposed request made pursuant to Section 1.5(b) of this

OMP to alter the serpentine pattern for surface emission monitoring required by Section 1.5(b) of this OMP. If Apex proposes to install an odor control blanket pursuant to Sections 1.5(d) or 1.6 of this OMP, Apex will install the odor control blanket as depicted in the plan and as concurred with by Ohio EPA. Once the odor control blanket is deployed, Apex will ensure the integrity of the engineered component is maintained so that methane concentrations measured during surface scans do not exceed 250 ppm. If an odor control blanket is deployed before an alternate hydrogen sulfide trigger has been established in accordance with Section 1.4 of this OMP, Apex also will ensure the integrity of the engineered component is maintained so that hydrogen sulfide concentrations measured during surface scans do not exceed 20 ppb.

2. Acceptance and Management of Potentially Odorous Waste

2.1 General Waste Handling and Disposal Practices

2.1(a) Transit

To reduce the potential for odors resulting from active waste disposal operations, Apex will work to mitigate odor generation by minimizing transit time from its source to the facility and from arrival at the facility to disposal at the working face.

2.1(b) Untarping

Apex will prohibit untarping of odorous waste containers in the rail yard area.

2.1(c) Waste Placement

During waste placement, Apex will minimize the size of the working face to the smallest practical area. Daily cover will be applied as soon as practical after it is determined that waste has reached the daily planned elevation in any location of the working face. Apex will review the aerial extent of the working face each day by 4:00 pm and apply daily cover as soon as practicable to areas of exposed waste where waste placement has reached the daily planned elevation. In no event shall solid waste be exposed for more than twenty-four hours after unloading. Form 3 of the MSW Landfill Daily Log of Operations will include time of review, approximate size of working face at time of review, approximate size of working face that had reached the daily planned elevation, and projected planned location for the next day. Furthermore, Apex will handle more odorous waste by quickly covering with low odor waste and/or spraying directly with odor neutralizer and/or water.

2.2 *Alternative Daily Cover*

OAC Rule 3745-27-19(F) states an alternative daily cover (ADC) material or thickness may be used if the owner and operator can demonstrate that the alternative method or thickness provides protection that is comparable to six inches of soil.

An alternative daily cover is currently not approved for use. In the future, Apex may request approval from Ohio EPA in a separate submittal to use an alternative daily cover.

2.3 *Pre-acceptance and Handling Procedures for Odorous Sludge Material*

Odorous sludge may be sewage sludge or industrial sludge. Sewage sludge is defined as solid, semi-solid, or liquid residue generated during treatment of sewage in treatment works. All sludge materials are pre-approved for acceptance by Apex through the evaluation of chemical analytical characterization, paint filter testing, and offsite odor potential. Apex will require a detailed explanation of the sludge generation, processing, and treatment from the generator. A table of analytical requirements and a table of allowable constituent levels as it pertains to sludge management is included in Attachments A & B.

Experience has shown that sludge processes similar to those used by a former undigested aerobic process customer(s) resulted in inherently higher odor intensities than other processes. As a result, similarly processed sewage sludges (undigested aerobic process) will not be accepted at the facility unless the generator has incorporated odor-minimization technology in its process and Ohio EPA approves acceptance of the material.

If an odorous sludge has the potential to contribute to offsite odors, Apex will immediately deposit the waste at the working face and cover with non-odorous waste or spray with odor neutralizer or water.

2.4 *Odor Control Systems*

In addition to the above best operational practices, Apex may employ various water-based odor masking agents, which will be dispersed using the following equipment:

2.4(a) HVMU (High Volume Misting Unit)

This system is a modified snow making machine with modified spray nozzles to offer superior misting coverage. This type of mobile unit is typically mounted on a trailer to facilitate movement around the facility. This unit is capable of fogging very large areas with water, deodorizer, odor neutralizer agents or any combination thereof. The HVMU also automatically

oscillates allowing this machine to cover the entire working face with little to no adjustments to the machine.

2.4(b) HVMU with Water Cannon

This system is a modified snow-making machine with modified spray nozzles to offer superior coverage. This unit is capable of fogging very large areas with water, deodorizer, odor neutralizing agents or any combination thereof. The HVMU also automatically oscillates allowing this machine to cover the entire working face with few adjustments to the machine. The unit is also equipped with a water cannon that can be used to directly apply odor neutralizer.

2.4(c) Mobile Sprayer

Apex utilizes several mobile sprayers. Water, deodorizer, odor neutralizer agents or any combination thereof may be pumped through a variety of nozzles then ejected by a fan creating a mist capable of covering the entire tipping area. The mobile sprayers are intended to be quickly re-positioned as needed in response to changing operational conditions and can be located at the working face or in the vicinity of the working face. Currently, an agricultural sprayer is used for this component of the odor management program.

2.4(d) Water Truck Direct Application

Water, deodorizer, odor neutralizer agents or any combination thereof may be added to the water truck and the mixture is directly applied to odor emitting areas as needed by utilizing the trucks front, side, and rear spray bars. In addition to the spray bars, the truck is equipped with a fire hose which provides additional working face coverage helping to eliminate odor directly from the source.

2.4(e) Tote-Based Fogger System

This system is comprised of a 275 gallon portable tote with compressed air-operated misting heads. This unit is mobile and is easily and quickly deployed as needed. This unit is capable of fogging areas with water, deodorizer, odor neutralizer agents or any combination thereof.

Apex will use reasonable efforts to make equipment available during inclement weather.

3. Complaint Procedures and Odor Monitoring Response

3.1 Apex Odor Complaint Received (OCR) Personnel

3.1(a) Purpose of OCR Personnel

Apex employs "Odor Complaint Received Personnel" (OCR Personnel) to perform odor monitoring of the landfill. OCR personnel have developed a responsive program for detecting and remediating odors.

3.1(b) Roles and Responsibilities of OCR Personnel

OCR personnel are trained to determine odor character, concentration, intensity, duration, and frequency, and also have other administrative or operational duties. Apex requires OCR personnel to undertake olfactory tests to evaluate odor sensitivity of individuals prior to employment. Individuals who are anosmic or hypersensitive to odors are excluded from performing odor monitoring.

The OCR team will perform the following functions:

- Daily morning (4:00 am to 9:00 am) and evening (4:00 pm to 9:00 pm) offsite monitoring loop. OCR personnel will record findings from not less than 20 offsite monitoring points evenly spread in all directions radiating from the facility, including at least three focused monitoring points located in the direction of the prevailing wind, if present. OCR personnel will remain at each focused monitoring point for at least 5 minutes to assess presence of odor. Additional monitoring points may be needed when odors are detected in transit. Apex will record the following investigative information for each monitoring loop:
    - Date and start/end time of monitoring loop
    - For each monitoring point, the arrival time and following odor information:
        - If odor is present, the intensity, character, duration, and concentration of the odor.
        - If odor is present, the action Apex has taken to correct the problem.

- Daily morning (4:00 am to 9:00 am) and evening (4:00 pm and 9:00 pm) onsite perimeter monitoring. Currently there are 17 monitoring points located around the perimeter of the landfill, including the area surrounding the leachate storage tank. Apex will record the following investigative information for each monitoring loop:
    - Date and start/end time of monitoring loop
    - For each monitoring point, the arrival time and following odor information:

        - If odor is present, the intensity, character, duration, and concentration of the odor.
        - If odor is present, the action Apex has taken to correct the problem.

- Investigate complaint events that are separate in nature, as needed, to assess reported offsite odors. A complaint event may include multiple complaints reported in the same general vicinity over an extended period of time and that likely allege the same odor type and source. Apex will record the following investigative information for each complaint event:
    - Whether or not a complaint event was investigated
    - Date and start/end times of investigation
    - Location of reported odor
    - Verified odor present (y/n)
        - If odor is present, the intensity, character, duration, and concentration of the odor.
        - If odor is present, the action Apex has taken to correct the problem.

- Apex will report information provided in this Section in accordance with Section 4 of this OMP.

3.1(c) Receiving and Logging Odor Complaints

Apex has established a 24-hour, 7-day per week odor complaint telephone hotline that is operated by a third party. The hotline can be reached by dialing (888) 878-7919. The third party answering service, upon receipt of any odor complaint, records reported information including, but not limited to the following:

- date and time that the complaint was received,
- complainant name,
- location of the odor,
- description of the odor, and
- duration of odor.

The third party answering service notifies Ohio EPA Southeast District Office and Jefferson County General Health District daily by electronic mail. At the end of each month, the third party answering service will provide Apex with a compilation of all odor complaints received. Apex will review the compilation for accuracy and completeness. Apex will add monitoring and complaint investigation information from Section 3.1(b) to the monthly report. Apex will then email the monthly report to Ohio EPA Southeast District Office and Jefferson County General Health District within two weeks of the end of the respective calendar month.

4. Communication Strategy

Communication between Apex, Jefferson County General Health District, Ohio EPA, and the community is important. Apex will continue meeting with the local health department every two weeks to communicate pertinent information including, but not limited to, recent and future activities designed to mitigate odors, actions taken by Apex in response to confirmed detections, and planned construction and maintenance activities at the site. Apex will also promptly notify the local health department whenever operational or maintenance activities may cause or contribute to offsite odors. On February 1, May 1, August 1, and November 1 of each year, Apex shall submit a written report to Ohio EPA Southeast District Office and Jefferson County General Health District that documents these activities and information. The report shall also provide a summary of odor monitoring loops and complaint investigations, including the information collected in accordance with Sections 3.1(b) and 3.1(c) of this OMP.

5. Savings Clause

The Facility is subject to the "Standards for air emissions for municipal solid waste landfills," 40 CFR § 60.752(b). As such, Apex is required to implement and comply with provisions of 40 CFR § 60. Compliance with this OMP does not satisfy Apex's obligation to also comply with the provisions of 40 CFR § 60. Nothing in this OMP shall be construed to authorize any waiver from the requirements of 40 CFR § 60 or from the requirements of any applicable state or federal laws or regulations. All actions required to be taken in accordance with this plan shall be undertaken in accordance with all applicable law and requirements.

6. Updates to the OMP

Any revisions to this OMP shall be submitted in the same manner as prescribed in OAC Chapter 3745-27 for an alteration.

ATTACHMENT A

SLUDGE WASTE ANALYTICAL REQUIREMENTS

Apex Environnmental, LLC
Sludge Waste Analytical Requirements

Waste Code	Waste Types	Analytical Requirements													Remarks
		pH (ASTM leachate)	Ignitability	Reactivity	Paint Filter	TCLP Metals	TCLP Volatiles	TCLP Semi-Volatiles	TCLP Herbs/Pests	PCBs	TPH	Other	MSDS	Re-analysis Frequency (yrs)	
A	Car Wash Sludge		X		X							BTEX		1	
B	Cooling Tower Debris/Sludge					X							X	1	MSDS for water treatment chemical/corrosion inhibitors
C	Dry Cleaning Sludge														Hazardous Waste - Not Acceptable
D	Emission Control Sludge	X		X	X	X	X	X						1	
E	Food Processing Sludge	X		X	X	X	X	X						1	
F	Ink Sludge				X	X	X							1	
G	Laundry Sludge			X	X	X	X	X						1	
H	Lime-Cement Kiln Scale, Residue	X			X	X	X	X						1	
I	Lime-Stabilized Pickle Liquor	X			X	X		X						1	
J	Metallurgical Sludge	X		X	X	X	X							1	
K	Oily Sludge, Petroleum Derived	X	X	X	X	X	X	X		X				1	
L	Paint/Coating Sludge & Scale	X	X	X	X	X	X	X						1	Verification required regarding spent solvent management
M	Paper Mill Sludge				X	X								1	
N	Still Bottoms	X	X	X	X	X	X	X						1	
O	Tank Bottoms	X	X	X	X	X	X	X						1	
P	Wastewater Treatment Plant Sludge (Municipal)				X	X	X	X	X					1	
Q	Wastewater Treatment Plant Sludge (Industrial)	X	X	X	X	X	X	X	X					1	
R	Water Treatment Sludge	X		X	X	X								1	
S	Delisted Residue from the Treament of Listed Hazardous Waste	X	X	X	X	X	X	X						0.25	
T	Non-Hazardous Residue from the Treatment of Hazardous Waste	X	X	X	X	X	X	X						0.25	
U	Other Industrial Sludges and Scales													1	Analytical requirements to be determined on a case-by-case basis (process dependent)

ATTACHMENT B

RECOMMENDED ANALYTICAL METHODS AND MAXIMUM ALLOWABLE CONSTITUENT LEVELS

APEX ENVIRONMENTAL, LLC

Attachment B

Recommended Analytical Methods and Maximum Allowable Constituent Levels

Parameter	TCLP Extraction Procedure[a]	Analytical Method[b]	Recommended Apex Maximum Allowable Level	Regulatory Maximum Allowable Level	Units
TCLP Metals[c]					
Arsenic	SW-846-1311	SW-846-6010	<4.0	<5.0	mg/l
Barium	SW-846-1311	SW-846-6010	<80.0	<100.0	mg/l
Cadmium	SW-846-1311	SW-846-6010	<0.8	<1.0	mg/l
Chromium	SW-846-1311	SW-846-6010	<4.0	<5.0	mg/l
Lead	SW-846-1311	SW-846-6010	<4.0	<5.0	mg/l
Mercury	SW-846-1311	SW-846-7470	<0.16	<0.2	mg/l
Selenium	SW-846-1311	SW-846-6010	<0.8	<1.0	mg/l
Silver	SW-846-1311	SW-846-6010	<4.0	<5.0	mg/l
TCLP Volatile Organics[c]					
Benzene	SW-846-1311	SW-846-8260	<0.4	<0.5	mg/l
Carbon Tetrachloride	SW-846-1311	SW-846-8260	<0.4	<0.5	mg/l
Chlorobenzene	SW-846-1311	SW-846-8260	<80.0	<100.0	mg/l
Chloroform	SW-846-1311	SW-846-8260	<4.8	<6.0	mg/l
1,4-Dichlorobenzene	SW-846-1311	SW-846-8260/8270	<6.0	<7.5	mg/l
1,2-Dichloroethane	SW-846-1311	SW-846-8260	<0.4	<0.5	mg/l
1,1-Dichloroethene	SW-846-1311	SW-846-8260	<0.56	<0.7	mg/l
Methyl Ethyl Ketone(2-Butanone)	SW-846-1311	SW-846-8260	<160.0	<200.0	mg/l
Tetrachloroethene	SW-846-1311	SW-846-8260	<0.56	<0.7	mg/l
Trichloroethene	SW-846-1311	SW-846-8260	<0.4	<0.5	mg/l
Vinyl Chloride	SW-846-1311	SW-846-8260	<0.16	<0.2	mg/l
TCLP Semi-Volatile Organics[c]					
o-Cresol	SW-846-1311	SW-846-8270	<160.0	<200.0	mg/l
m-Cresol	SW-846-1311	SW-846-8270	<160.0	<200.0	mg/l
p-Cresol	SW-846-1311	SW-846-8270	<160.0	<200.0	mg/l
Cresol, Total	SW-846-1311	SW-846-8270	<160.0	<200.0	mg/l
2,4-Dinitrotoluene	SW-846-1311	SW-846-8270	<0.104	<0.13	mg/l
Hexachlorobenzene	SW-846-1311	SW-846-8270	<0.104	<0.13	mg/l
Hexachlorobutadiene	SW-846-1311	SW-846-8270	<0.4	<0.5	mg/l
Hexachloroethane	SW-846-1311	SW-846-8270	<2.4	<3.0	mg/l
Nitrobenzene	SW-846-1311	SW-846-8270	<1.6	<2.0	mg/l
Pentachlorophenol	SW-846-1311	SW-846-8270	<80.0	<100.0	mg/l
Pyridine	SW-846-1311	SW-846-8270	<4.0	<5.0	mg/l
2,4,5-Trichlorophenol	SW-846-1311	SW-846-8270	<320.0	<400.0	mg/l
2,4,6-Trichlorophenol	SW-846-1311	SW-846-8270	<1.6	<2.0	mg/l
TCLP Pesticides[c]					
Chlordane	SW-846-1311	SW-846-8081	<0.024	<0.03	mg/l
Endrin	SW-846-1311	SW-846-8081	<0.016	<0.02	mg/l
Heptachlor (and its epoxide)	SW-846-1311	SW-846-8081	<0.0064	<0.008	mg/l
Lindane	SW-846-1311	SW-846-8081	<0.32	<0.4	mg/l
Methoxychlor	SW-846-1311	SW-846-8081	<8.0	<10.0	mg/l
Toxaphene	SW-846-1311	SW-846-8081	<0.4	<0.5	mg/l
TCLP Herbicides[c]					
2,4-D	SW-846-1311	SW-846-8151	<8.0	<10.0	mg/l
2,4,5-TP (Silvex)	SW-846-1311	SW-846-8151	<0.8	<1.0	mg/l

NOTE: THE RECOMMENDED APEX MAXIMUM ALLOWABLE LEVEL MAY BE EXCEEDED ON A CASE-BY-CASE BASIS UP TO THE REGULATORY MAXIMUM LEVEL

APEX ENVIRONMENTAL, LLC

Attachment B

Recommended Analytical Methods and Maximum Allowable Constituent Levels

Parameter	TCLP Extraction Procedure[a]	Analytical Method[b]	Recommended Apex Maximum Allowable Level	Regulatory Maximum Allowable Level	Units
General					
pH[c]	ASTM D 3987-95	SW-846-9045	2.0<pH<12.5	2.0<pH<12.5	Standard Units
Ignitability[c]	NA	Na[d]	Negative	Negative	-
Reactivity[c]	NA	Na[e]	Negative	Negative	-
Reactive Cyanide[c]	NA	SW-846-C7.3.3.2/9012	<500	-	mg/kg
Reactive Sulfide[c]	NA	SW-846-C7.3.4.2/9030	<500	-	mg/kg
Free Liquids	NA	SW-846-9095	Pass	Pass	-
PCBs	NA	SW-846-8082	<40	<50	mg/kg
TPH	NA	EPA 600-418.1(IR)	<100,000[f]	-	mg/kg
Benzene	NA	SW-846-8021/8260	<8[g]	-	mg/kg
Toluene	NA	SW-846-8021/8260	<5000	-	mg/kg
Ethylbenzene	NA	SW-846-8021/8260	<5000	-	mg/kg
Xylene	NA	SW-846-8021/8260	<5000	-	mg/kg
Lead	NA	SW-846-6010	<80[h]	-	mg/kg
Phenol	ASTM D 3987-95	SW-846-9065/9066	Na[i]	Na[i]	mg/l
Cyanide	ASTM D 3987-95	SW-846-9012	Na[i]	Na[i]	mg/l
Fluoride	ASTM D 3987-95	EPA 600-340.2/SW-846-9056	Na[i]	Na[i]	mg/l
Radium 226	NA	E 901.1	<5[j]	<5[j]	pCi/g
Radium 228	NA	E 901.1	<5[j]	<5[j]	pCi/g

NOTE: THE RECOMMENDED APEX MAXIMUM ALLOWABLE LEVEL MAY BE EXCEEDED ON A CASE-BY-CASE BASIS UP TO THE REGULATORY MAXIMUM LEVEL

[a] TOTAL analyses may be used instead of TCLP analyses for reanalysis approvals (see footnote c). TCLP analyses must be used for initial approvals.

[b] Analytical methods listed are only suggested methods, other methods may be utilized with the prior approval of Apex or its consultant. All laboratory reports should indicate the reference document, method number for each test performed and the result reported. All laboratory reports must be signed by an authorized laboratory representative.

[c] Parameter used to determine if a waste can be classified as a characteristic hazardous waste.

[d] Refer to 40 CFR 261.21 for a general description of the laboratory testing required.

[e] Refer to 40 CFR 261.23 for a general description of the laboratory testing required.

[f] If TPH > 100,000 mg/kg and the source of contamination is ignitable, an ignitability test must be performed.

[g] If benzene > 8 mg/kg, then a TCLP Benzene must be performed.

[h] If total lead > 80 mg/kg, then a TCLP Lead must be performed.

[i] Test to be perfomed on spent foundry sand only to determine if it qualifies as a "non-toxic" exempt waste.

[j] Test to be performed on ever load of Oil and Gas Industry Exploration and Production (E&P) Wastes, not including shallow drill cuttings.

Unit Conversions

1 part per million (ppm) = 1 milligram per liter (mg/l) [TCLP Analysis] = 1 milligram per kilogram (mg/kg) [Total Analysis]

1 part per billion (ppb) = 1 microgram per liter (ug/l) [TCLP Analysis] = 1 microgram per kilogram (ug/kg) [Total Analysis]

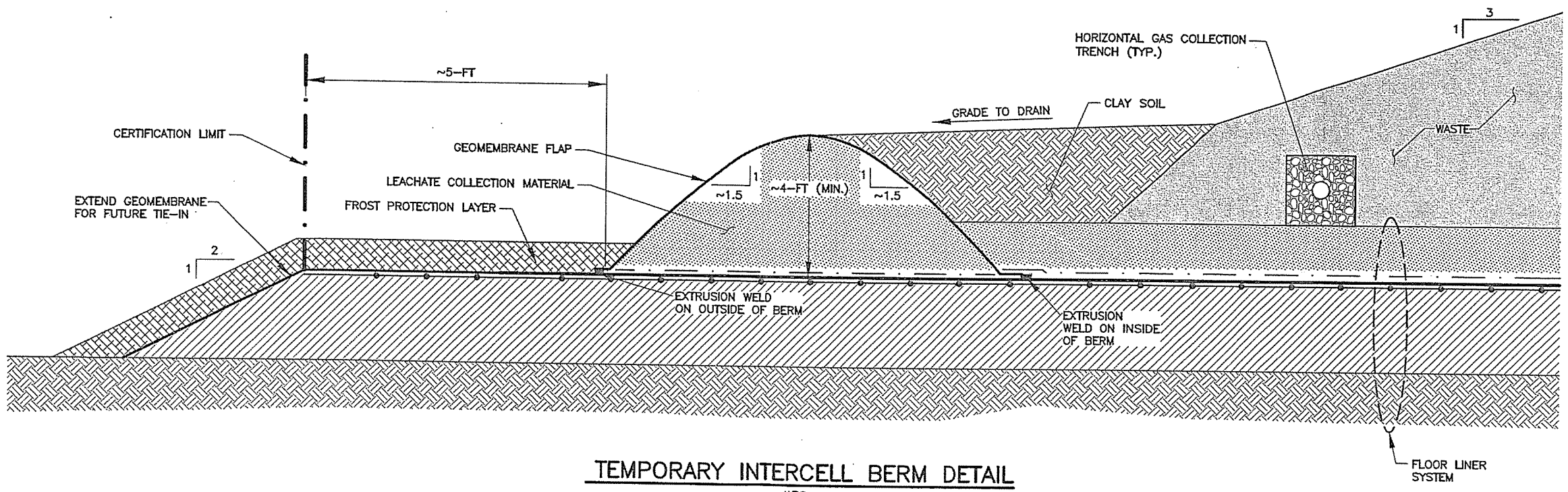
1 ppm = 1,000 ppb

1 mg/l = 1,000 ug/l

1 mg/kg = 1,000 ug/kg

140 degrees Fahrenheit = 60 degrees Centigrade

FIGURES



TEMPORARY INTERCELL BERM DETAIL

N.T.S.

Civil & Environmental Consultants, Inc.
333 Baldwin Road - Pittsburgh, PA 15205
412-429-2324 · 800-365-2324
www.cecinc.com

APEX ENVIRONMENTAL, LLC
APEX SANITARY LANDFILL
SPRINGFIELD TOWNSHIP
JEFFERSON COUNTY, OHIO

TEMPORARY INTERCELL SEPARATION BERM

DRAWN BY:	MJI	CHECKED BY:	MB	APPROVED BY:	MB	FIGURE NO.:	C8-1
DATE:	04/19/13	DWG SCALE:	N.T.S.	PROJECT NO:	091-867		

P:\2011\110-007\-CADD\DWG\TASK 0020\DWG\110-007B007.DWG[DETAIL FIG 2] (MAPALUCCI) - DEC 14, 2011 - 11:57:32

APPENDIX C8-B

AUTHORIZATION AND CONSTRUCTION DOCUMENTATION SUBMITTAL FOR SOLIDIFICATION BASIN

Ohio EPA
40 years and moving forward

John R. Kasich, Governor
Mary Taylor, Lt. Governor
Scott J. Nally, Director

OHIO E.P.A.

NOV 27 2012

ENTERED DIRECTOR'S JOURNAL

I certify this to be a true and accurate copy of the official documents as filed in the records of the Ohio Environmental Protection Agency.

Date: 11.27.2012

CERTIFIED

November 27, 2012

Dave Mathews
Apex Environmental, LLC
P.O. Box 157
Amsterdam, OH 43903

Re: Apex Sanitary Landfill, Jefferson County
Authorization to Construct and Operate a Solidification Basin

Dear Mr. Mathews:

On June 15, 2012, the Ohio Environmental Protection Agency (Ohio EPA), Division of Materials and Waste Management (DMWM), Southeast District Office (SEDO), received a request titled *Authorization Request to Operate a Solidification Basin, Apex Sanitary Landfill, Jefferson County, Ohio.* Civil & Environmental Consultants, Inc., on behalf of Apex Environmental, LLC (Apex), prepared the submission. Apex has requested to receive non-hazardous bulk liquids, process the wastes through a proposed solidification basin, and then dispose of the created solid wastes at the Apex Sanitary Landfill. The non-hazardous liquid wastes are to be mixed with a proprietary admixture or select absorbent solid wastes (solidification agents) until the resultant mixture passes the paint-filter test and meets the definition of a solid waste. Apex has also requested to divert accepted select solid wastes and not immediately deposit them at the working face, as required by rule, so that they may be staged within an enclosed freestanding structure for use in the solidification basin. Revisions to this request were received on July 5, 2012.

Ohio EPA has completed a review of the request in accordance with Ohio Administrative Code (OAC) Rules 3745-27-19(E)(7)(e), (E)(8)(b), and (E)(8)(i), which state, in part, that:

> **OAC Rule 3745-27-19(E)(7)(e):** *"...the owner or operator shall ensure that all waste admitted to the sanitary landfill facility is deposited at the working face, spread in layers not more than two feet thick, and compacted to the smallest practical volume. An alternate method may be used if approved in writing by the director. . ."*
>
> **OAC Rule 3745-27-19(E)(8)(b):** *"The owner or operator shall not accept for disposal or dispose of . . . Containerized bulk liquids or non-containerized liquids without authorization from the director."*

> **OAC Rule 3745-27-19(E)(8)(i):** *"The owner or operator shall not accept for disposal or dispose of . . . Semi-solid material containing free liquids . . .unless the owner or operator has obtained prior written authorization from Ohio EPA to dispose of that semi-solid material in the facility."*

Based upon a review of the request submitted June 15, 2012 and the revised request received July 5, 2012, I have determined, pursuant to OAC Rules 3745-27-19(E)(7)(e), 3745-27-19(E)(8)(b), and 3745-27-19(E)(8)(i), that the proposed solidification basin, if constructed and operated in accordance with the request and the following conditions, will not result in a violation of applicable laws or regulations and is unlikely to adversely affect the public safety or health or the environment. Therefore, Apex is hereby authorized to construct and operate a solidification basin in accordance with the submitted plans, specifications, and information subject to the following conditions.

CONDITIONS

1. Apex shall ensure that all applicable authorizations are obtained.

2. Apex shall ensure that state solid waste fees are paid on the combined weight of the bulk liquid and solidification agent.

3. Apex shall ensure that liquid waste is received solely from pre-screened customers.

4. Apex shall maintain current OAC Rule 3745-52-11 documentation available for inspection by Ohio EPA. This information shall be updated, at a minimum, on a yearly basis.

5. Apex shall ensure that materials used as solidification agents are non-hazardous waste, compatible with the liquid waste, and can result in a mixture that meets the definition of "solid waste."

6. Apex shall ensure that the solidification basin area and solidification agent staging areas are bermed to control run-off and run-on.

7. Apex shall ensure that liquid which comes in contact with staged solidification agent is properly contained and managed as leachate.

8. Apex shall ensure that bulk liquids are not stored in the solidification basin. Bulk liquids shall be mixed, removed, and disposed in the landfill the same business day.

9. Apex shall ensure that storage of solidification agents occurs near the solidification basin, that the staging is in compliance with all applicable rules and regulations, and that storage and staging do not create a nuisance.

10. Apex shall ensure that the mixing basin is moved, or removed from the landfill all together, if the unit interferes with the landfill operation or phasing.

11. Apex shall ensure that each load removed from the basin after mixing meets the definition of "solid waste" as specified in OAC Rule 3745-27-01(S)(23). At a minimum, Apex must visually inspect every mixed load. Any loads which release liquid must be re-mixed with additional solidification agent or be tested in accordance with method 9095 (paint filter liquids test) in SW-846.

12. Apex shall maintain a separate daily log, in addition to the standard daily log of operations required by OAC Rule 3745-27-19(E)(10), that lists the following information: date, the generator of liquid waste and solidification agent (if the agent meets the definition of a "solid waste"), description of the liquid wastes and solidification agents received, quantity of both the liquid waste and solidification agent used for each mix, and documentation to ensure compliance with conditions 14 and 15 of this authorization.

13. Apex shall not accept for disposal hazardous waste as defined in section 3734.01 of the Revised Code.

14. Apex shall not receive, accept, process, handle, manage, or dispose of technologically enhanced naturally occurring radioactive material (TENORM), as defined in OAC Rule 3701:1-43-01, associated with drilling operations without first obtaining representative analytical results to determine concentrations of radium-226 and radium-228 present in the material.

15. Apex shall not accept for disposal any TENORM material if that material contains or is contaminated with radium-226 or radium-228, or any combination of radium-226 and radium-228, at concentrations greater than or equal to 5 picocuries per gram above natural background. For the purpose of this authorization, natural background means 2 picocuries per gram.

16. Apex shall not accept for disposal brine as defined in section 1509.01 of the Revised Code.

17. Apex shall not accept for disposal any bulk liquid wastes that increase the potential for a landfill fire.

18. Apex shall comply with this authorization, including the details outlined in the request to construct and operate a solidification basin, as revised and received on July 5, 2012, unless changes are otherwise authorized in writing by Ohio EPA.

Nothing in this authorization shall be construed to authorize any waiver from the requirements of any other applicable federal or state laws or regulations.

You are hereby notified that this action of the Director is final and may be appealed to the Environmental Review Appeals Commission pursuant to ORC Section 3745.04. The appeal must be in writing and set forth the action complained of and the grounds upon which the appeal is based. The appeal must be filed with the Commission within thirty (30) days after notice of the Director's action. The appeal must be accompanied by a filing fee of $70.00, made payable to "Treasurer, State of Ohio," which the Commission, in its discretion, may reduce if by affidavit it is demonstrated that payment of the full amount of the fee would cause extreme hardship. Notice of the filing of the appeal shall be filed with the Director within three (3) days of filing with the Commission. Ohio EPA requests that a copy of the appeal be served upon the Ohio Attorney General's Office, Environmental Enforcement Section. An appeal may be filed with the Environmental Review Appeals Commission at the following address:

Environmental Review Appeals Commission
77 South High Street, 17th Floor
Columbus, OH 43215

If you have any questions concerning this authorization, please contact Craig Walkenspaw of Ohio EPA, SEDO at (740) 380-5440.

Sincerely,

Scott J. Nally
Director

SN/CW/sb

cc: Rich Fox, DMWM-SEDO
Scott Hester, DMWM-CO
Jefferson County General Health District

Apex Environmental, LLC

April 30, 2013

Mr. Craig Walkenspaw, R.S., District Engineer
Ohio EPA Southeast District Office
Division of Materials and Waste Management
2195 Front Street
Logan, Ohio 43138

Dear Mr. Walkenspaw:

Subject: Construction Documentation Submittal
Solidification Basin
Apex Sanitary Landfill

Apex Environmental, LLC (Apex) is providing this Construction Documentation Submittal for the construction of the solidification basins and enclosure at the Apex Sanitary Landfill. The basins and enclosure were constructed in accordance with the Authorization Request to Operate a Solidification Basin (Authorization Request) submitted to the Ohio EPA on June 13, 2012 and revised on July 3, 2012. The Ohio EPA approved the Authorization Request on November 27, 2012.

Apex had the solidification basins and enclosure constructed in accordance with the Authorization Request. The location of the storage of the admixture material has been revised from between the basins, as shown in the Authorization Request, to behind the southern basin closer to the haul-out truck exit. Photos of the construction of the solidification basins, completed enclosure, and new location for the admixture material are provided in the photo log included in Attachment 1.

Please contact me if you have any questions.

Sincerely,

APEX ENVIRONMENTAL, LLC

Dave Matthews
District Manager

Attachments

cc: Bruce Misselwitz, JCGHD (w/attachments)
Apex Environmental, LLC – file (w/ attachments)
Rick Buffalini, CEC (w/ attachments)

130-018-L-SBPhoto-4.30.13/P

ATTACHMENT 1

PHOTO LOG

Photograph 1 – Installed Leak Detection Pipe

Photograph 2 – Completed Enclosure

Photograph 3 - Installed Solidification Basins

Photograph 4 – Installed Railings

Photograph 5 – Admixture Material Location

Photograph 6 – Admixture Material Storage

(C)(9) PLANS

This section provides the information required in OAC 3745-27-06(C)(9).

(a) Ground Water Detection Monitoring Plan as required in Rule 3745-27-10 of the Administrative Code, and if applicable the ground water quality assessment plan and/or corrective measures plan required pursuant to Rule 3745-27-10 of the Administrative Code.

The Apex Sanitary Landfill has an approved ground water detection monitoring plan (GWDMP). A revised GWDMP is provided for the proposed expansion. The Ground Water Detection Monitoring Program has been prepared by CEC in accordance with OAC 3745-27-10 and was submitted to the Ohio EPA in a separate submittal ~~dated October 20, 2011~~. The final approved document will be included in Appendix C9-A upon Ohio EPA approval.

(b) Explosive gas monitoring plan as required in Rule 3745-27-12 of the Administrative Code.

The EGMP has been prepared in accordance with OAC 3745-27-12 and is included in Appendix C9-B.

(c) The quality assurance/quality control plan for the engineered components addressing the following:

(i) Surveying.

(ii) Calibration of testing equipment.

(iii) Sampling and testing procedures to be used in the field and in the laboratory, including but not limited to the following:

- **(*a*) Testing required by rule 3745-27-08 of the Administrative Code.**
- **(*b*) Testing required due to design requirements that must be met.**
- **(*c*) Voluntary testing.**

Procedures shall establish testing frequency, parameters, and sample locations.

(iv) Procedures to be followed if a test fails.

The Construction Quality Assurance/Quality Control Plan (CQA Plan) has been prepared in accordance with OAC 3745-27-08(D), (E), (G) and (H) and is included in Appendix C9-C.

(d) The "Final Closure/Post-Closure Plan" as detailed in paragraph (B) of Rule 3745-27-11 of the Administrative Code.

The Final Closure/Post Closure Plan has been developed in accordance with OAC 3745-27-11 and OAC 3745-27-14, and is included in Appendix C9-D. The plan provides the steps necessary to close the landfill and maintain the facility for the post-closure period.

APPENDIX C9-A

GROUND WATER DETECTION MONITORING PROGRAM

Prepared by CEC and *included as Volume VI* ~~**submitted under separate cover**~~**.**

APPENDIX C9-B

EXPLOSIVE GAS MONITORING PLAN

EXPLOSIVE GAS MONITORING PLAN

Prepared for:

APEX SANITARY LANDFILL
11 County Road 78
Amsterdam, Ohio 43903

Prepared by:

CIVIL & ENVIRONMENTAL CONSULTANTS, INC.
333 Baldwin Road
Pittsburgh, Pa 15205
(800) 365-2324

CEC Project 091-867

October 2011
Revised July 2013
Revised May 2016

EXPLOSIVE GAS MIGRATION MONITORING PLAN APPLICATION FORM

FACILITY DATA SHEET

Owner __X__

Name of Applicant Apex Environmental, LLC Operator __X__

Name of Sanitary Landfill Facility Apex Sanitary Landfill

Address of Facility 11 County Road 78, Amsterdam, Ohio 43903
(number, street or route, city, zip code)

County Jefferson Township Springfield

Exact Location This site is located east of Jefferson CR-78 and Harrison CR-51 and approximately one mile north of SR-646.

Status of Facility: __X__ Operating Number of Occupied Structures: __4__ within 200 ft.

___ Closed __7,10__ within 1000 ft.

Facility Operator of Licensee: (Person legally responsible for the operation)

Name Apex Environmental, LLC Street, R.D.# or Box # 11 County Road 78

City Amsterdam State Ohio Zip 43903

Telephone (740) 543-4389

Any prior landfill experience? __X__ Yes ___ No If yes, explain. Apex Environmental, LLC has owned and operated Apex Sanitary Landfill since 2005.

Landowner/Lessee/or Person who has control of the land:

Name Apex Environmental, LLC Street, R.D.# or Box # 11 County Road 78

City Amsterdam State Ohio Zip 43903

Telephone (740) 543-4389

Designer:

Name Civil & Environmental Consultants, Inc. Street, R.D.# or Box # 333 Baldwin Rd.

City Pittsburgh State Pennsylvania Zip 15205

Reg. Engineer Rick J. Buffalini Reg. Surveyor N/A

Reg. No. E-55305 Reg. No. N/A

Any prior explosive gas monitoring system design experience?

__X__ Yes ___ No If yes, explain. Prepared and implemented monitoring plans, designed and installed monitoring probes and active and passive venting systems at landfills in Ohio.

EXPLOSIVE GAS MONITORING PLAN
APEX SANITARY LANDFILL
JEFFERSON COUNTY, OHIO

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EXPLOSIVE GAS MONITORING PLAN

Apex Sanitary Landfill is an active landfill located in Jefferson County, Ohio. In accordance with the Ohio Administrative Code (OAC) 3745-27-12(A)(1), an Explosive Gas Monitoring Plan must be implemented for this facility.

(D) EXPLOSIVE GAS MONITORING SYSTEM

In accordance with OAC 3745-27-12, an Explosive Gas Monitoring Plan (EGMP) must be placed in the operating record of a solid waste disposal facility. As required by OAC 3745-27-12, the EGMP will consist of the information specified in Paragraphs (D), (E), (F), (G), and (H) of Rule 3745-27-12.

Apex Environmental, LLC. (Apex) conducts explosive gas monitoring for the existing permitted facility in accordance with the EGMP included in approved PTI No. 06-6279 dated July 31, 2002. This EGMP was prepared in accordance with OAC 3745-27-12 and incorporates the existing permitted facility and the proposed contiguous expansion unit. Upon issuance of the PTI for the proposed landfill expansion, this EGMP will supersede the existing one.

(D)(1) APPLICATION FORM

A completed Explosive Gas Monitoring Plan Application form precedes this document.

(D)(2) SITE EVIRONS

The Apex Sanitary Landfill is located in Springfield Township, Jefferson County, Ohio; approximately one mile north of SR-646 and east of Jefferson CR-78 and Harrison CR-51, and west of Township Highway 266. A location map showing the site on a United States Geological Survey (USGS) quadrangle is included on the Title Sheet of the PTI Application Drawing Set.

(D)(2)(a) Detailed Site Topography

The site topography and the items listed in paragraphs (D)(2)(a)(i) through (D)(2)(a)(vi) are presented on the drawings as indicated in the sections below.

(D)(2)(a)(i) Property Boundary and Facility Boundary

The landfill property boundary, facility boundary and the horizontal limits of waste placement are illustrated on Drawings 2A, 2A-1, and 2A-2.

(D)(2)(a)(ii) 1,000-Feet and 200-Feet Offset Zones

Drawings 2A, 2A-1, and 2A-2 and 3B present the 1,000-feet and 200-feet offset from the limit of solid waste placement.

(D)(2)(a)(iii) Property Boundaries and Property Ownership

Property boundaries, property ownership, political subdivisions and zoning classifications within 1,000-feet of the limit of solid waste placement are included on Drawings 2B, 2B-1, and 2B-2. Property deeds are provided in Appendix C1-D of the PTI Application.

(D)(2)(a)(iv) Onsite and Offsite Structures

Several occupied structures, including the odor control shed, the landfill main office, and the employee trailers, are located within the 200-foot offset from the existing or proposed limit of waste placement. There are other *occupied* structures within the 1,000-foot offset from the limit of waste including the rail scale house, compressor building, and electric distribution box which are owned by Apex. *The landfill gas plant and rail unloading building are proposed occupied structures within the 1,000-foot offset from the limit of waste. The maintenance building is located within the footprint of the proposed contiguous expansion. This building will remain until the limits of solid waste placement are within 200-feet of the building at which time it will be relocated. The solidification basin enclosure is located within the footprint of the proposed contiguous expansion and will be relocated prior to waste placement in the area. The enclosure is not considered an occupied structure because it is open to natural free air circulation.* The locations of these structures are illustrated on Drawing 3B.

(D)(2)(a)(v) Potential Explosive Gas Migration Pathways

Potential man-made gas migration pathways leading offsite from the landfill include:

- Roadways;
- Railroads;
- Underground utilities;
- Leachate force mains;
- Landfill gas conveyance piping; and
- Underdrains.

The majority of the underdrain systems are limited to beneath the waste limits with the underdrain outlets daylighting at the toe of the perimeter berm of the landfill. The locations of these man-made pathways are shown on Drawings 2C-1 and 2C-2.

(D)(2)(a)(vi) Potential Sources of Explosive Gas

Additional potential sources of explosive gas within the 1,000-foot zone include septic leach fields located south of the Rail Scale House and west of the Main Office. The location of the leach fields are shown on Drawings 2C-1 and 2C-2.

(D)(2)(b) Legal Description of Landfill Property

The property survey and deeds of the landfill property are included in Appendix C1-D of the PTI Application.

(D)(2)(c) Geologic Information

Paragraphs (D)(2)(c)(i) through (D)(2)(c)(vi) of this EGMP provide hydrogeologic site information for the site.

(D)(2)(c)(i) Depth to Groundwater, Fluctuations, and Influencing Factors

Site-wide groundwater level measurement events were conducted in October 2010, December 2010, ~~and~~ March 2011, *November 2011, May 2012, and December 2012*. The water levels are summarized in Table C3-6 of the Hydrogeologic Site Investigation Report (HSIR)~~ dated August 31, 2011~~. Potentiometric maps for the Mine Spoil Significant Zone of Saturation (SZS), Limestone/Shallow Bedrock SZS, Bellaire/Summerfield SZS, and Connellsville/Morgantown Uppermost Aquifer System (UAS) units from the December 2010, ~~and~~ March 2011, *and December 2012* event*s* are shown in Drawings 3G through 3*R*~~N~~ of the HSIR.

The groundwater levels are consistent over the period during which measurements were evaluated and it can be concluded that the groundwater flow regime in each zone does not change seasonally. In almost all cases, the groundwater levels in each well or piezometer increased or decreased consistently with each other and vary from approximately 0.01 to 9.2 feet. Inconsistencies and variations in the groundwater elevations noted greater than 9.2 feet, especially in the shallower zones (Mine Spoil SZS and Limestone/Shallow Bedrock SZS) can generally be accounted for by precipitation and ongoing construction and de-watering activities toward the southern portion of the existing facility due to the underdrain systems. The shallowest groundwater elevation observed during the monitoring period was collected from Mine Spoil SZS well P-2A at approximately 2.3 feet below ground surface. This piezometer is located next to an existing surface water pond which will be removed during landfill construction of the expansion area.

(D)(2)(c)(ii) Site and Surrounding Topography

Topographic mapping of the site and surrounding area are presented on Drawings 2B, 2B-1, and 2B-2. The existing ground elevation in the area of the lateral expansion varies from approximately 1320 feet (msl) along the western boundary to 1180 feet (msl) along the southern boundary. This results in a relief across the site of approximately 140 feet generally sloping to the south.

(D)(2)(c)(iii) Natural Boundaries to Gas Migration

Natural barriers to explosive gas migration are the geological and topographic features of the site. The most significant natural site characteristics acting as boundaries to gas migration are the streams located to the north, south, and east of the facility.

(D)(2)(c)(iv) Characterizing Potential Gas Migration Pathways

The potential gas migration pathways are identified in Paragraph (D)(2)(a)(v) of this EGMP. The potential pathways are generally shallow trenches for pipes or roadways and do not extend off of the facility boundary. Therefore, the potential pathways are not of significance.

(D)(2)(c)(v) Other Gas Sources Within 1,000 Feet

No other known geological gas sources are within 1,000 feet other than discussed in Paragraph (D)(2)(a)(vi).

(D)(2)(c)(vi) Geologic Cross-sections of the Perimeter of the Landfill Property Showing Potential Natural Pathways

Geologic cross sections were developed to illustrate the geologic conditions. Refer to Drawings 5A through 5G, Cross Sections A-A' through F-F' of the HSIR.

(D)(3) LANDFILL CHARACTERISTICS

Paragraphs (D)(3)(a) through (D)(3)(g) provide historical, existing and proposed characteristics of Apex Sanitary Landfill.

(D)(3)(a) Lowest Elevation of Waste Placement

The lowest elevation of waste placement is approximately at elevation ~~1183~~ *1178* feet in Phase ~~13~~ *12*. Refer to Drawing 4D for the lateral limits and bottom of waste placement grades for the landfill.

(D)(3)(b) Depth of Excavation

The lowest excavation elevation is approximately at elevation ~~1179~~ *1174* feet in Phase ~~13~~ *12*. Refer to Drawing 4A for the lateral limits and grades of the excavation for the landfill.

(D)(3)(c) Historical Operations

Apex Sanitary Landfill is owned and operated by Apex Environmental, LLC. Ohio EPA issued PTI No. 17-1194 on January 23, 1998 and PTI No. 06-6219 on July 31, 2002. Disposal operations began November 2005.

(D)(3)(d) Type of Waste Disposed

Apex Sanitary Landfill is permitted to accept municipal solid waste, non-hazardous industrial wastes, and construction and demolition debris.

(D)(3)(e) Construction Details

Apex Sanitary Landfill is designed with a composite liner system that consists of (from top to bottom):

- 15-inch thick leachate collection layer;
- Geotextile cushion;
- 60-mil HDPE textured geomembrane;
- Geosynthetic Clay Liner (GCL); and
- 3-feet thick Recompacted Soil Liner.

The proposed landfill final cover system consists of (from top to bottom):

- 30-inch thick vegetative layer;
- Geocomposite;
- 40-mil FML;
- 18-inch thick Recompacted Soil Barrier; and

- 12-inches of intermediate cover.

The landfill liner system will function as a barrier to lateral and downward migration of landfill gas generated within the solid waste disposal areas. The final cover system will function as a barrier to gas migration to the atmosphere.

(D)(3)(f) Existing Gas Extraction or Venting System

Apex Sanitary Landfill has a permitted gas extraction system. The current system includes gas extraction wells, gas collection piping, and a blower/flare for gas combustion. The proposed gas extraction system for the contiguous expansion includes gas extraction wells, horizontal gas collectors (if necessary), gas piping, condensate management, blowers, and flare. The gas extraction system plan view is shown on Drawing 3B with details provided on Drawings 7G through 7J.

(D)(3)(g) Existing Explosive Gas Monitoring System

The existing explosive gas monitoring system for Apex Sanitary Landfill consists of 10 explosive gas monitoring punch bar stations. The stations monitor potential gas migration towards the property lines, underground electrical lines, and on-site structures. A continuous explosive gas alarm is installed in the rail scale house, odor control building, electrical distribution box, and compressor building. Drawing 3B provides the locations of the existing punch bar stations.

The existing gas monitoring system is considered effective in detecting landfill gas migrating from the site due to the spacing of punch bar stations.

(D)(4) EXPLOSIVE GAS GENERATION POTENTIAL

Landfill gas produced at municipal solid waste landfills is generated during anaerobic degradation of organic wastes (food, paper, wood, etc.). Landfill gas consists of methane, carbon dioxide and small trace levels of non-methane organic compounds. Paragraphs (D)(4)(a) through (D)(4)(b) of this EGMP discuss the potential of explosive gas generation.

(D)(4)(a) Review of Historical Data

Following the installation of the existing explosive gas monitoring system, the first round of sampling was conducted during December 2005. A review of the monitoring results from 2005

through ~~October 2011~~ *June 2013* indicates that no exceedances at the punch bar locations or continuous monitors have occurred at the site.

(D)(4)(b) Discussion of Latest Explosive Gas Investigation

The latest explosive gas investigation was performed in ~~October 2011~~ *June 2013* and indicates that the explosive gas threshold limit has not been exceeded at the monitoring locations.

(D)(5) DESCRIPTION OF THE PROPOSED MONITORING SYSTEM

The proposed Explosive Gas Monitoring System for the Apex Sanitary Landfill contiguous expansion consists of the existing and proposed punch bar stations and continuous explosive gas alarms in the occupied structures within the 200-feet offset limit. Additionally, a permanent gas monitoring probe will be installed between the proposed disposal area and the main landfill office and employee trailers which are within 200-feet of the waste limit. *A permanent gas monitoring probe will be installed between the limits of waste and any other structures which are within 200 feet of the waste limits.* The monitoring system is designed to detect the migration of landfill gas towards the property line and onsite structures within the 1,000-feet zone around the landfill.

(D)(5)(a) Proposed Permanent Monitors and Punch Bar Stations

The existing and proposed punch bar stations are spaced around the perimeter of the site at maximum spacing of 1,000 feet. Punch bar stations are also proposed between the limits of waste placement and existing structures located within the 200 feet or 1,000 feet offsets including the odor control building, electric distribution box, rail scale house, ~~and~~ compressor building, *and proposed landfill gas plant. A punch bar is also proposed between the limits of waste and the maintenance building. The maintenance building will remain until the limits of solid waste placement are within 200-feet of the building.* Punch bars are proposed because the gas pathways do not represent a potential hazard to the structure. A total of ~~18~~ *19* punch bars will be monitored as part of the proposed contiguous expansion when the landfill is completely constructed. In addition, one permanent gas monitoring probe will be installed between the landfill office/employee trailers and the limits of waste. During construction of the landfill, temporary punch bar stations are proposed within the landfill footprint to maintain the maximum perimeter spacing of 1,000 feet. Refer to Drawings 6A through ~~6H~~ *6I* for the locations of the temporary punch bar stations during construction of the landfill. Refer to Drawing 3B for the location of the punch bar stations and the permanent gas monitoring probes after completion of landfill construction.

A continuous explosive gas alarm will be located in the interior of each occupied structure within the 200-feet offset from the limit of waste placement, which includes the odor control building, main landfill office, and employee trailers.

(D)(5)(b) Construction Details, Installation Procedures and Quality Assurance Procedures

If the explosive gas pathway represents a potential hazard to an occupied structure, a permanent gas monitoring probe will be installed in lieu of a punch bar station. The typical gas monitoring probe detail is included on Drawing 7J. Each proposed gas monitoring probe will be drilled to a depth equal to the greatest depth of waste nearest to the probe. Boreholes will be advanced with 4.25-inch I.D. hollow stem augers and monitoring probes will be constructed using a 1-inch or 2-inch I.D., Schedule 40 PVC solid riser and screened pipe. A drilling rig capable of completing rock drilling may be required should bedrock be encountered before reaching the required total depth of the gas monitoring probe.

The screened section of the probe will be either perforated with 3/16-inch diameter holes or slotted with 0.02-inch wide slots to allow gas to collect within the probe. The flush threaded solid riser pipe will extend from the perforations to approximately 3 feet above ground surface and be fitted with a sample port. The sample port will provide positive closure when not being sampled and facilitate connection to the gas sampling instrument. The screened section of the probe will extend from approximately 3 feet below the ground surface to the bottom of the borehole. Pea gravel will be backfilled into the borehole annulus from the total depth of the boring to approximately 3 feet below the ground surface. A 2-feet thick bentonite seal will be placed above the pea gravel and a 1-foot thick concrete seal will be placed in the remaining annulus and tied into the surficial concrete pad. The probe is then completed with a steel protective casing, concrete pad, and lock. The concrete pad will be sloped away from the casing to ensure positive drainage after settlement and concrete shrinkage. The casings will have weep holes, and bollards will be installed as necessary.

The gas monitoring probes will be constructed and installed under the supervision of a qualified engineer or geologist. In addition to supervising the installation, this person will also document the installation to assure compliance with the approved Explosive Gas Monitoring Plan. Documentation will include boring logs and installation details which will be forwarded to the Ohio EPA.

Drawing 7J also includes the construction detail of a permanent punch bar that may be installed instead of monitoring each location by performing punch bar testing.

(D)(5)(c) Location and Installation of New and Replacement Probes

A new monitoring probe or punch bar location shall be installed within one year of a new occupied structures or explosive gas pathway being built within 1,000 feet of solid waste

placement. The new monitoring probe will be located between the new occupied structure or explosive gas pathway and the limit of solid waste placement. The permanent gas monitoring probe at the main landfill office and employee trailers will be installed before waste placement is within 1,000 feet of the structures. The structures will also be equipped with an explosive gas alarm at that time.

A damaged gas monitoring probe shall be replaced before the next monitoring event. A gas monitoring probe will be considered damaged if it cannot be monitored for two consecutive months. The replacement monitoring probe shall be located to monitor the same pathway and in the same vicinity as the damaged monitoring probe.

The Ohio EPA will be notified if a monitoring probe must be installed due to damage, vandalism, or site development. The materials and construction of the new or replacement monitoring probe shall be in accordance with Section (D)(5)(b). The installation of the new or replacement monitoring probe shall be certified in accordance with Section (F).

(D)(5)(d) Probe Abandonment Procedure

The Ohio EPA will be notified if a probe must be abandoned due to damage, vandalism or site development. Abandonment will be requested from the Ohio EPA in accordance with OAC 3745-27-12(H) and abandonment activities will not be conducted until receipt of written approval of the abandonment request from the Ohio EPA. Abandonment activities shall be in accordance with OAC 3745-9-10. Gas monitoring probes will be abandoned using a conventional drill rig to remove as much of the probe materials (i.e., PVC pipe, protective casing, grout, pea gravel) as possible. The borehole will then be redrilled to its original depth using minimum 8-inch O.D. hollow stem augers. The probe will be abandoned using a bentonite grout injected at the total depth of the probe hole using a tremie pipe. The borehole will be pumped full of grout to within 2 feet of the surface and allowed to settle for a minimum of 24 hours. Additional grout will be added as necessary to maintain the grout level at 2 feet below the surface. Soil will be used to fill the borehole to the surface to allow for vegetative growth. The abandoned gas probe will be checked after a period of time to determine if additional settlement has occurred.

A replacement probe will be installed, if required, in the same general location and completed at the appropriate depth so that the same unit is being monitored. The replacement probe(s) will be constructed as described in Section (D)(5)(b) and located as described in Section (D)(5)(c). Documentation for abandoned and replacement probes shall be certified in accordance with Section (F).

If an occupied structure within the 1,000-foot radius is removed, a request to discontinue monitoring or abandonment of the permanent monitors may be submitted to the Ohio EPA. The request to discontinue monitoring or abandonment of the permanent monitors shall include:

- Identification of the landfill site;
- Description of the proposed activity for which authorization is being requested;
- Details regarding how the potential hazard to the occupied structure has been eliminated; and,
- A proposed schedule for the implementation of the proposed activity.

(D)(5)(e) Permanent Monitor

A permanent monitor is a monitor which will perform throughout the duration of the monitoring period and which meets the performance standards established in Section (D)(5)(a) and (D)(5)(b).

(D)(5)(f) Location and Installation of New and Replacement Punch Bar Stations

If a new punch bar station must be installed, it shall be in place by the next monitoring event after a new occupied structure or explosive gas pathway is built within 1,000 feet of solid waste placement, if an explosive gas pathway does not represent a potential hazard to the occupied structure. Otherwise, a permanent monitoring probe shall be installed in accordance with Section (D)(5)(c).

An inaccessible punch bar station shall be relocated in the same vicinity. The location of the new or relocated punch bar station shall be certified in accordance with Section (F) if applicable.

(E) EXPLOSIVE GAS MONITORING, SAMPLING AND REPORTING PROCEDURES

(E)(1) MONITORING FREQUENCY

Punch bar stations and monitoring probes locations are identified on Drawing 3B. The specified monitoring frequency will be:

- In accordance with (E)(1)(a), quarterly monitoring will be performed through closure and to the end of 5 years of post-closure;
- All areas of Apex Sanitary Landfill are lined with a flexible membrane liner and will not require monthly monitoring as required by (E)(1)(b);

- In accordance with (E)(1)(c), quarterly monitoring will be performed through the end of 5 years of post-closure;
- In accordance with (E)(1)(d), semi-annual monitoring will be performed between 5 years of post-closure to year 30 of post-closure, after demonstrating that semiannual monitoring will detect off-site migration of explosive gases and is protective of human health and the environment.
- Upon completion of the 30-year post-closure, an authorization to abandon punch bars and probes in accordance with the approved explosive gas monitoring plan may be requested.

(E)(2) MONITORING PARAMETERS

Monitoring equipment shall have a detection limit below 25 percent of the Lower Explosive Limit (LEL) with a minimum detection limit. The following parameters are to be monitored as described in the following order:

- Gas pressure in the permanent monitor;
- Initial combustible gas concentration in percent methane by volume;
- Water level in the permanent monitor;
- Ambient barometric pressure;
- Ambient air temperature;
- Observed weather conditions; and
- Relative humidity.

The collected data will be recorded on the Explosive Gas Monitoring Probe Report Form presented in Appendix A and submitted to the appropriate agencies identified in Paragraph (E)(4).

Monitoring Equipment, Maintenance, and Calibration

Landfill gas monitoring will be performed with a combustible gas indicator that measures concentration as percent by volume of methane equivalents. The combustible gas indicator will be equipped with a flexible extension hose and 30-in. long rigid metal or fiberglass probe for punch bar monitoring. The combustible gas indicator will be calibrated in accordance with the manufacturer's specifications. The amount of monitoring and handling of the meter will dictate if the calibration frequency should be increased.

Monitoring Pressure

Gas probe pressure shall be measured by the use of a differential pressure gauge such as the GEM 2000 or equivalent digital manometer. The instrument provides readings for positive and negative pressure in a probe.

Monitoring Liquid Level

Liquid level in each probe shall be measured using an electronic water level indicator such as the Solinst Water Level Meter Model 101 or equivalent water level indicator.

Maintenance and calibration of these instruments shall be performed according to the manufacture's schedule and recommendations.

Permanent Monitors

The following step-by-step procedures will be followed for explosive gas monitoring at permanent monitor locations. These standard monitoring procedures must be followed to ensure the safety of site monitoring personnel and the accuracy of monitoring results.

1. Prior to monitoring at the first location, the meter(s) and instruments shall be calibrated per the manufacturer's instructions.

2. At each monitor location, record the permanent monitor number and the time of reading. Observe the general condition of each monitor, and record any condition problems or repairs needed.

3. Unlock and open the protective casing.

4. Connect the pressure meter to the quick connect on the riser cap and record the pressure in the casing. Disconnect pressure meter if it is separate from the combustible gas meter. The monitor must not be inadvertently vented prior to the measurement of the initial gas concentration.

5. Immediately after the pressure reading, connect combustible gas meter to quick connect and operate the meter. Record the initial gas concentrations in percent by volume (v/v), and disconnect combustible gas meter.

6. Remove the slip cap from the top of riser if a port for water level readings is not provided.

7. Lower the water level indicator into the well. When the indicator responds, record the depth to water level measurement.

8. Replace the riser cap and lock the protective casing.

9. Record the observed weather conditions, and contact the local weather station for temperature, barometric pressure, and relative humidity.

Punch Bar Stations

The following step-by-step procedures shall be followed for monitoring at permanent punch bar stations:

1. Prior to monitoring at the first location, the meter(s) and instruments shall be calibrated per the manufacturer's instructions.

2. Locate the punch bar station.

3. Locate the test within a 10-foot radius of the marked location and drive the punch bar to a depth of approximately 3 feet.

4. To begin measuring the explosive gas percent, lower the probe tube of the gas meter into the punch bar hole and operate the combustible gas meter. Record all initial readings.

5. Record the observed weather conditions, and contact the local weather station for temperature, barometric pressure, and relative humidity.

Explosive Gas Alarms

Continuous explosive gas alarms located in the occupied structures within the 200-foot offset from the limit of waste placement will be monitored quarterly during the explosive gas monitoring events to confirm that the monitors are operational.

(E)(3) VALIDATION AND EVALUATION OF FIELD SAMPLING RESULTS

After sampling has been completed, the results are recorded in the appropriate column of the Explosive Gas Monitoring Report Form provided in Appendix A and reviewed to identify possible anomalous readings. If such readings are evident, the monitoring probe in question should be resampled to verify results.

If an exceedance of the explosive gas threshold limit is detected in a gas monitoring probe, the equipment shall be recalibrated prior to conducting a validation test. A validation test will be obtained within the monitoring event in which the exceedance was detected. If the anomalous test results are verified, the procedures outlines in Section (E)(5) will be followed. If the anomalous test is not verified, quarterly monitoring will be initiated.

An anomalous reading is considered one that exceeds the explosive gas threshold limit or maximum percent of gas allowable for each monitor location, which is listed in the Explosive Gas Monitoring Probe Report Form. In accordance with OAC 3745-27-12(E)(5)(a), the explosive gas threshold limit is either 100 percent of the LEL at the facility boundary or 25 percent of the LEL for structures lying within the facility boundary.

(E)(4) REPORTING PROCEDURES

Upon completion of the evaluation of data for a particular monitoring event, a copy of the data accompanied by a summary narrative shall be forwarded to the following agencies within 15 days of the date of sampling:

Ohio EPA Southeast District Office
2195 Front Street
Logan, Ohio 43138
(740) 385-8501

Jefferson County General Health District
500 Market Street, 7th Floor
Steubenville, Ohio 43952
(740) 283-8530

Harrison County Health Department
438 North Main Street
Cadiz, Ohio 43907
(740) 942-2616

(E)(5) CONTINGENCY PLAN

In the event that the validation test indicates explosive gas concentrations equal to or exceeding the explosive gas threshold limit for a particular gas monitoring probe or punch bar station, the following sections of the Contingency Plan will be implemented.

(E)(5)(a) Establishment of Explosive Gas Threshold Limit

The explosive gas threshold limits are as follows:

- 100 percent of LEL (5% CH_4 v/v) at or within the facility boundary; and,
- 25 percent of LEL (1.25 % CH_4 v/v) in structures.

(E)(5)(b) Notification of Authorities

If the validated concentration of explosive gas is greater than or equal to the threshold limit, the following public safety authorities will be notified within two business days:

- Ohio EPA Southeast District Office (740) 385-8501;
- Jefferson County General Health District (740) 283-8530;
- Jefferson County Sheriff's Office (740) 283-8600;
- Amsterdam Volunteer Fire Department (740) 543-4332;
- Harrison County Health Department (740) 942-2616; and
- Harrison County Sheriff's Office (740) 942-2197.

If the Ohio EPA determines that the concentration of explosive gas is of concern, punch bar samples will be collected in addition to the gas monitoring probes in the vicinity of the area of concern to determine the extent of gas migration.

Appendix B contains letters notifying local authorities that they will be notified if the explosive gas threshold limits are exceeded.

(E)(5)(c) Increasing Monitoring Frequency upon Validated Finding of Methane Migration

Probes with concentrations equal to or exceeding the threshold limit will be retested on a weekly basis to determine whether or not the explosive gas concentrations are rising. If the

concentrations continue to rise, Apex will consult with Ohio EPA on the appropriate action to be undertaken.

(E)(5)(d) Additional Monitors to Be Installed

In the event that validation testing indicates explosive gas concentrations equal to or exceeding the explosive gas threshold limit, additional gas monitoring probes, punch bar stations or continuous explosive gas alarms may be installed to ensure that potential gas migration can be monitored.

(E)(5)(e) Criteria to Discontinue Contingency Monitoring

After four sequential monitoring events of concentrations below the explosive gas threshold limit over a minimum period of two weeks a report shall be submittal to the Ohio EPA and Jefferson County General Health District in accordance with OAC 3745-27-12(E)(5)(g)(iii) as part of the quarterly reporting procedures described in Section (F)(3). Upon submittal of this report, Apex may cease following the contingency procedures and return to quarterly monitoring of the probes.

(E)(5)(f) Protection of Human Health and the Environment

If exceedances in gas concentrations occur, Apex will provide more frequent monitoring. Adjustments to the gas extraction system will be performed to reduce gas migration. Additional remedial measures will be taken as necessary to ensure that the validated exceedance of explosive gas is decreased to at or below the Explosive Gas Threshold Limit. These steps will be taken to ensure protection of human health and the environment.

(E)(5)(g) Reporting Procedures

Detection of explosive gas during the validation test, as presented in Section (E)(3), which equals or exceeds the explosive gas threshold limits in Paragraph (E)(5)(a) requires that the following steps be taken:

- Within seven days of initial detection above the gas threshold limit, the monitoring results and a description of the steps taken to protect human health and the environment shall be submitted to the Ohio EPA and the Jefferson County General Health District. These steps may include the installation of explosive gas alarms in occupied structures, upon the consent of the owner of the occupied structure; and,

- Within 30 days of initial detection of explosive gas concentrations above the gas threshold limit and every 30 days for the duration that the facility remains in contingency monitoring, a report shall be submit to the Ohio EPA and Jefferson County General Health District. This report shall contain the following:

  - Analysis and summary of the results from the contingency monitoring, including required components of OAC 3745-27-12(E)(5)(g)(ii)(a) and (E)(5)(g)(iii)(a); and
  - Summary of steps taken to ensure protection of human health and the environment and analysis of their effectiveness.

- When criteria to no longer follow contingency procedures are met, submit to the Ohio EPA and Jefferson County General Health District a report containing the following:

  - Analysis and summary of the results from the contingency monitoring, including the required components of OAC 3745-27-12(E)(5)(g)(ii)(a) and (E)(5)(g)(iii)(a); and
  - Consideration of possible causes of the increase in gas concentrations, such as landfill operational procedures, gas control system failure or upset, climatic conditions, or closure activity.

Reports regarding the Contingency Plan shall be submitted to the Operating Record in accordance with OAC 3745-27-09 and 3745-27-12(K).

(E)(6) APPENDICES

The following information which is pertinent to the gas monitoring program is included as Appendices organized as follows:

- Appendix A: Gas Monitoring Reporting Forms
- Appendix B: Letters of Notification to Appropriate Authorities
- Appendix C: Geologic Boring Logs
- Appendix D: Certification Report

(F) CERTIFICATION REPORT

There are currently no permanent punch bar stations or monitoring probes in place at the site. Therefore, a certification report is not required. Upon installation of new or replacement permanent monitoring probes or permanent punch bar stations, a certification report shall be

submitted with the initial reporting of the monitoring results. The documentation shall include the following information:

- Record drawing showing the locations and identifications of punch bar stations and monitoring probes;
- Geologic logs from installation of each monitoring probe/punch bar;
- Depth and length of screened intervals for each probe; and
- Initial gas monitoring results.

Certification reports, monitoring results, contingency reports, and revisions will be submitted to the Operating Record in accordance with OAC 3745-27-09 and 3745-27-12(K).

(G) DISCONTINUATION OF POST-CLOSURE MONITORING

After 30 years of post-closure monitoring, a written request may be submitted to the Ohio EPA Director for authorization to discontinue monitoring and to abandon any monitoring probes or punch bar stations in accordance with this EGMP.

(H) REVISIONS TO THE EXPLOSIVE GAS MONITORING PLAN

The approved monitoring system may need to be modified in the future. Events that would require a modification include but are not limited to:

- The erection of any structures within 1,000 feet of waste placement;
- The demolition of existing structures within 1,000 feet of waste placement;
- The elimination of a potential explosive gas migration pathway;
- Changes in monitoring equipment;
- Changes in monitoring procedures;
- Construction of a new explosive gas migration pathway within 1,000 feet of waste placement; and
- Topographic or other changes in the vicinity of the landfill that create a potential for explosive gas migration towards an occupied structure within 1,000 feet of waste placement.

Requests to discontinue monitoring or abandon probes if an occupied structure is abandoned or a potential migration pathway is eliminated shall be submitted to the Ohio EPA for concurrence prior to implementation and will include:

- Identification of the landfill site;
- Description of the proposed activity being requested;
- Details regarding how the potential hazard to occupied structures has been eliminated; and,
- Proposed schedule.

Revisions to the approved explosive gas monitoring plan to alter monitoring, sampling or reporting will be submitted to the Ohio EPA Southeast District Office for concurrence prior to implementation.

APPENDIX A

GAS MONITORING PROBE REPORT FORMS

EXPLOSIVE GAS MONITORING PLAN
PUNCH BAR LOCATIONS
APEX SANITARY LANDFILL
JEFFERSON COUNTY, OHIO

TESTING DONE BY:	DATE:
GAS INSTRUMENT TYPE:	MODEL NO.:
DATE LAST CALIBRATED:	COMBUSTIBLE GAS:
DETECTION LIMIT:	
SAMPLING METHOD:	

PUNCH BAR DESIGNATION	TIME OF SAMPLING	EXPLOSIVE GAS % VOLUME OR % LEL (CIRCLE ONE)	THRESHOLD LIMIT	% GAS IS HIGHER/LOWER THAN THRESHOLD	PUNCH BAR HOLE DEPTH

WEATHER CONDITIONS:
BAROMETRIC PRESSURE:
RELATIVE HUMIDITY:
OUTSIDE AIR TEMPERATURE:
CONTINUOUS GAS ALARMS OPERABLE (Y/N):
COMMENTS:

EXPLOSIVE GAS MONITORING PLAN
PERMANENT MONITORING PROBES
APEX SANITARY LANDFILL
JEFFERSON COUNTY, OHIO

TESTING DONE BY:		DATE:
GAS INSTRUMENT TYPE:		MODEL NO.:
DATE LAST CALIBRATED:	COMBUSTIBLE GAS:	
SAMPLING METHOD:		
PRESSURE INSTRUMENT TYPE:		MODEL NO.:
WATER LEVEL INSTRUMENT TYPE:		MODEL NO.:

PROBE DESIGNATION	TIME OF SAMPLING	PRESSURE (inches of H_2O)	PERCENT COMBUSTIBLE GAS [1]		DEPTH TO WATER (feet)	PERCENT LEL
			INITIAL	VERIFICATION		

NOTES: 1. All readings are 0-100% combustible gas volume by air.

WEATHER CONDITIONS:
BAROMETRIC PRESSURE:
RELATIVE HUMIDITY:
OUTSIDE AIR TEMPERATURE:
CONTINUOUS GAS ALARMS OPERABLE (Y/N):
COMMENTS:

APPENDIX B

LETTERS OF NOTIFICATION TO APPROPRIATE AUTHORITIES

October 24, 2011

Fire Chief
Amsterdam Volunteer Fire Department
6223 Steubenville Road, SE
Amsterdam, Ohio 43903

Dear Fire Chief:

Subject: Notification Letter
Explosive Gas Monitoring Plan
Apex Sanitary Landfill
Springfield Township, Jefferson County, Ohio

Apex Environmental, LLC (Apex) is submitting this letter in accordance with Ohio Administrative Code 3745-27-12 (E)(6)(b) as part of generating the Explosive Gas Monitoring Plan for the Apex Sanitary Landfill. The Apex Sanitary Landfill is located at 11 County Road 78, Amsterdam, Ohio and is approximately one mile north of SR 646 and east of Jefferson CR-78 and Harrison CR-51 in Springfield Township, Jefferson County, Ohio.

Apex will notify you if explosive gas concentrations exceed the threshold limits. The threshold limit values are 100 percent of the lower explosive limit (5% CH_4 v/v) at the facility boundary and 25 percent of the lower explosive limit (1.25% CH_4 v/v) in structures.

There are two structures within 200 feet from the existing and proposed limits of waste placement. These include the odor control building and the main landfill office building. Based on the limited use of the odor control building, a punch bar station is located between the existing landfill and the structure. An explosive gas alarm is also located within the odor control building. A permanent gas monitoring probe will be installed between the main landfill office and the proposed landfill upon waste placement in Phase 12. An explosive gas alarm will also be installed in the main landfill office at that time.

Please contact me if you have any questions.

Sincerely,

Brendon Pantano
Vice President of Operations
Apex Environmental, LLC.

cc: Rick Buffalini, CEC

October 24, 2011

Mr. Fred J. Abdalla, Sheriff
Jefferson County Sheriff's Department
16001 State Route 7
Steubenville, Ohio 43952

Dear Sheriff Abdalla:

Subject: Notification Letter
Explosive Gas Monitoring Plan
Apex Sanitary Landfill
Springfield Township, Jefferson County, Ohio

Apex Environmental, LLC (Apex) is submitting this letter in accordance with Ohio Administrative Code 3745-27-12 (E)(6)(b) as part of generating the Explosive Gas Monitoring Plan for the Apex Sanitary Landfill. The Apex Sanitary Landfill is located at 11 County Road 78, Amsterdam, Ohio and is approximately one mile north of SR 646 and east of Jefferson CR-78 and Harrison CR-51 in Springfield Township, Jefferson County, Ohio.

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Please contact me if you have any questions.

Sincerely,

Brendon Pantano
Vice President of Operations
Apex Environmental, LLC.

cc: Rick Buffalini, CEC

October 24, 2011

Dr. Frank L. Petrola, M.D.
Jefferson County General Health District
500 Market Street, 7th Floor
Steubenville, Ohio 43952

Dear Dr. Petrola:

Subject: Notification Letter
Explosive Gas Monitoring Plan
Apex Sanitary Landfill
Springfield Township, Jefferson County, Ohio

Apex Environmental, LLC (Apex) is submitting this letter in accordance with Ohio Administrative Code 3745-27-12 (E)(6)(b) as part of generating the Explosive Gas Monitoring Plan for the Apex Sanitary Landfill. The Apex Sanitary Landfill is located at 11 County Road 78, Amsterdam, Ohio and is approximately one mile north of SR 646 and east of Jefferson CR-78 and Harrison CR-51 in Springfield Township, Jefferson County, Ohio.

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Please contact me if you have any questions.

Sincerely,

Brendon Pantano
Vice President of Operations
Apex Environmental, LLC.

cc: Rick Buffalini, CEC

October 24, 2011

Dr. Isam Tabbah
Harrison County Department of Health
438 North Main Street
Cadiz, Ohio 43907

Dear Dr. Tabbah:

Subject: Notification Letter
Explosive Gas Monitoring Plan
Apex Sanitary Landfill
Springfield Township, Jefferson County, Ohio

Apex Environmental, LLC (Apex) is submitting this letter in accordance with Ohio Administrative Code 3745-27-12 (E)(6)(b) as part of generating the Explosive Gas Monitoring Plan for the Apex Sanitary Landfill. The Apex Sanitary Landfill is located at 11 County Road 78, Amsterdam, Ohio and is approximately one mile north of SR 646 and east of Jefferson CR-78 and Harrison CR-51 in Springfield Township, Jefferson County, Ohio.

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Please contact me if you have any questions.

Sincerely,

Brendon Pantano
Vice President of Operations
Apex Environmental, LLC.

cc: Rick Buffalini, CEC

October 24, 2011

Mr. Ronald J. Myers, Sheriff
Harrison County Sheriff's Office
114 Court Street
Cadiz, Ohio 43907

Dear Sheriff Myers:

Subject: Notification Letter
Explosive Gas Monitoring Plan
Apex Sanitary Landfill
Springfield Township, Jefferson County, Ohio

Apex Environmental, LLC (Apex) is submitting this letter in accordance with Ohio Administrative Code 3745-27-12 (E)(6)(b) as part of generating the Explosive Gas Monitoring Plan for the Apex Sanitary Landfill. The Apex Sanitary Landfill is located at 11 County Road 78, Amsterdam, Ohio and is approximately one mile north of SR 646 and east of Jefferson CR-78 and Harrison CR-51 in Springfield Township, Jefferson County, Ohio.

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Please contact me if you have any questions.

Sincerely,

Brendon Pantano
Vice President of Operations
Apex Environmental, LLC.

cc: Rick Buffalini, CEC

October 24, 2011

Mr. Dale Warner
Ohio EPA Southeast District
2195 Front Street
Logan, Ohio 43138

Dear Mr. Warner:

Subject: Notification Letter
Explosive Gas Monitoring Plan
Apex Sanitary Landfill
Springfield Township, Jefferson County, Ohio

Apex Environmental, LLC (Apex) is submitting this letter in accordance with Ohio Administrative Code 3745-27-12 (E)(6)(b) as part of generating the Explosive Gas Monitoring Plan for the Apex Sanitary Landfill. The Apex Sanitary Landfill is located at 11 County Road 78, Amsterdam, Ohio and is approximately one mile north of SR 646 and east of Jefferson CR-78 and Harrison CR-51 in Springfield Township, Jefferson County, Ohio.

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Please contact me if you have any questions.

Sincerely,

Brendon Pantano
Vice President of Operations
Apex Environmental, LLC.

cc: Rick Buffalini, CEC

This tracking update has been requested by:

Company Name:	CIVIL&ENVIRONMENTAL CONSULTANTS
Name:	MARLENE TUSCAN
E-mail:	rbuffalini@cecinc.com

Our records indicate that the following shipment has been delivered:

Reference:	091-867.0002 RJ BUFFALINI
Ship (P/U) date:	Oct 26, 2011
Delivery date:	Oct 27, 2011 11:37 AM
Sign for by:	L.GRAZIANO
Delivery location:	AMSTERDAM, OH
Delivered to:	Receptionist/Front Desk
Service type:	FedEx 2Day
Packaging type:	FedEx Envelope
Number of pieces:	1
Weight:	0.50 lb.
Special handling/Services:	Deliver Weekday
Tracking number:	502941155331

Shipper Information	Recipient Information
MARLENE TUSCAN	ATTN: FIRE CHIEF
CIVIL&ENVIRONMENTAL CONSULTANTS	AMSTERDAM VOLUNTEER FIRE DEPARTMENT
333 Baldwin Road	6223 STEUBENVILLE ROAD SE
Pittsburgh	AMSTERDAM
PA	OH
US	US
15205	43903

This tracking update has been requested by:

Company Name:	CIVIL&ENVIRONMENTAL CONSULTANTS
Name:	MARLENE TUSCAN
E-mail:	rbuffalini@cecinc.com

Our records indicate that the following shipment has been delivered:

Reference:	091-867.0002 RJ BUFFALINI
Ship (P/U) date:	Oct 26, 2011
Delivery date:	Oct 27, 2011 1:47 PM
Sign for by:	A.BAHEN
Delivery location:	STEUBENVILLE, OH
Delivered to:	Receptionist/Front Desk
Service type:	FedEx 2Day
Packaging type:	FedEx Envelope
Number of pieces:	1
Weight:	0.50 lb.
Special handling/Services:	Deliver Weekday
Tracking number:	502941155342

Shipper Information	Recipient Information
MARLENE TUSCAN	MR FRED J ABDALLA SHERIFF
CIVIL&ENVIRONMENTAL CONSULTANTS	JEFFERSON COUNTY SHERIFF'S DEPT
333 Baldwin Road	16001 STATE ROUTE 7
Pittsburgh	STEUBENVILLE
PA	OH
US	US
15205	43952

This tracking update has been requested by:

Company Name:	CIVIL&ENVIRONMENTAL CONSULTANTS
Name:	MARLENE TUSCAN
E-mail:	rbuffalini@cecinc.com

Our records indicate that the following shipment has been delivered:

Reference:	091-867.0002 RJ BUFFALINI
Ship (P/U) date:	Oct 26, 2011
Delivery date:	Oct 27, 2011 1:31 PM
Sign for by:	G.LOUK
Delivery location:	STEUBENVILLE, OH
Delivered to:	Receptionist/Front Desk
Service type:	FedEx 2Day
Packaging type:	FedEx Envelope
Number of pieces:	1
Weight:	0.50 lb.
Special handling/Services:	Deliver Weekday
Tracking number:	502941155353

Shipper Information	Recipient Information
MARLENE TUSCAN	FRANK L PETROLA M D
CIVIL&ENVIRONMENTAL CONSULTANTS	JEFFERSON CNTY GENERAL HEALTH DISTR
333 Baldwin Road	500 MARKET STREET
Pittsburgh	7TH FL
PA	STEUBENVILLE
US	OH
15205	US
	43952

This tracking update has been requested by:

Company Name:	CIVIL&ENVIRONMENTAL CONSULTANTS
Name:	MARLENE TUSCAN
E-mail:	rbuffalini@cecinc.com

Our records indicate that the following shipment has been delivered:

Reference:	091-867.0002 RJ BUFFALINI
Ship (P/U) date:	Oct 26, 2011
Delivery date:	Oct 27, 2011 12:41 PM
Sign for by:	R.BEAR
Delivery location:	CADIZ, OH
Delivered to:	Receptionist/Front Desk
Service type:	FedEx 2Day
Packaging type:	FedEx Envelope
Number of pieces:	1
Weight:	0.50 lb.
Special handling/Services:	Deliver Weekday
Tracking number:	502941155364

Shipper Information	Recipient Information
MARLENE TUSCAN	DR ISAM TABBAH
CIVIL&ENVIRONMENTAL CONSULTANTS	HARRISON COUNTY DEPT OF HEALTH
333 Baldwin Road	438 NORTH MAIN STREET
Pittsburgh	CADIZ
PA	OH
US	US
15205	43907

This tracking update has been requested by:

Company Name:	CIVIL&ENVIRONMENTAL CONSULTANTS
Name:	MARLENE TUSCAN
E-mail:	rbuffalini@cecinc.com

Our records indicate that the following shipment has been delivered:

Reference:	091-867.0002 RJ BUFFALINI
Ship (P/U) date:	Oct 26, 2011
Delivery date:	Oct 27, 2011 12:31 PM
Sign for by:	.CARTER
Delivery location:	CADIZ, OH
Delivered to:	Receptionist/Front Desk
Service type:	FedEx 2Day
Packaging type:	FedEx Envelope
Number of pieces:	1
Weight:	0.50 lb.
Special handling/Services:	Deliver Weekday
Tracking number:	502941155375

Shipper Information	Recipient Information
MARLENE TUSCAN	MR RONALD J MYERS SHERIFF
CIVIL&ENVIRONMENTAL CONSULTANTS	HARRISON COUNTY SHERIFF'S OFFICE
333 Baldwin Road	114 COURT STREET
Pittsburgh	CADIZ
PA	OH
US	US
15205	43907

APPENDIX C

GEOLOGIC BORING LOGS

REFER TO THE HYDROGEOLOGIC SITE INVESTIGATION REPORT,
APPENDIX C3-C

APPENDIX D

CERTIFICATION REPORT

APPENDIX C9-C

CONSTRUCTION QUALITY ASSURANCE/ QUALITY CONTROL PLAN

CONSTRUCTION QUALITY ASSURANCE/QUALITY CONTROL PLAN

Prepared for:

APEX ENVIRONMENTAL LLC

APEX SANITARY LANDFILL
11 County Road 78
Amsterdam, Ohio 43903

Prepared by:

CIVIL & ENVIRONMENTAL CONSULTANTS, INC.
333 Baldwin Road
Pittsburgh, Pa 15205
(800) 365-2324

CEC Project 091-867

October 2011
Revised July 2013
Revised May 2016

APEX SANITARY LANDFILL
CONSTRUCTION QUALITY ASSURANCE/QUALITY CONTROL PLAN

SECTION SUMMARY

Section I	General
Section II	Soils Construction Quality Assurance
Section III	Geosynthetic Clay Liner Construction Quality Assurance
Section IV	Geomembrane Construction Quality Assurance
Section V	Geocomposite Construction Quality Assurance
Section VI	Geotextile Construction Quality Assurance
Section VII	High Density Polyethylene Pipe and Fittings Construction Quality Assurance
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SECTION I

GENERAL

SECTION I
GENERAL
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SECTION I
GENERAL

1.0 INTRODUCTION

This Construction Quality Assurance/Quality Control Plan (CQA/QC Plan) has been prepared for Apex Sanitary Landfill located in Jefferson County, Ohio. This CQA/QC Plan is provided as required in Ohio Administrative Code (OAC) 3745-27-06(C)(9)(c) and contains the information specified in OAC 3745-27-08. In addition to the regulations, the following technical references were used during plan preparation:

- USEPA Seminar Publication - Design and Construction of RCRA/CERCLA Final Covers, EPA/625/4-91/025, May 1991.
- USEPA Technical Guidance Document: Quality Assurance and Quality Control for Waste Containment Facilities, EPA/600/R-93/182.
- USEPA Technical Guidance Document: Construction Quality Assurance for Hazardous Waste Land Disposal Facilities, EPA/530-SW-86-031, October 1986.
- GRI Test Method GM13, April 11, 2011, "Test Properties, Test Frequencies and Recommended Warranty for High Density Polyethylene (HDPE) Smooth and Textured Geomembranes."
- GRI Test Method GM17, April 11, 2011, "Test Properties, Test Frequencies, and Recommended Warranty for Linear Low Density Polyethylene (LLDPE) Smooth and Textured Geomembranes."
- GRI Test Method GT12, February 18, 2002, "Test Methods and Properties for Non-Woven Geotextiles Used as Protection (or Cushioning) Materials."

The purpose of the CQA/QC Plan is to present the principles and practices of quality management that will be implemented during the construction of the engineered components at the facility including the liner/leachate collection system, final cover system, landfill gas extraction system, and permanent groundwater quality control structures. Quality management involves the performance of both quality assurance and quality control activities to verify that the construction meets design criteria, plans, and specifications.

Prior to the initiation of construction activities, the specific parties involved will review this CQA/QC Plan and modify it as necessary. Any revisions to the CQA/QC Plan will be submitted to the Ohio Environmental Protection Agency (Ohio EPA) for approval.

The remainder of this section, Section I, presents general information including the following:

- The scope of the plan;
- Definitions used;
- The responsibility and authority of the parties involved in construction;
- Qualifications of the organizations and key personnel involved in implementing the CQA/QC Plan; and
- A description of project meetings to be held.

2.0 SCOPE OF THE CQA/QC PLAN

The CQA/QC Plan contains the following components included in OAC Rule 3745-27-08 and the site-specific design:

- In-situ Foundation Preparation;
- Structural Fill;
- Added Geologic Material;
- Recompacted Soil Liner;
- Geosynthetic Clay Liner;
- Flexible Membrane Liner;
- Leachate Collection System; and
- Final Cover System.

The CQA/QC Plan includes the information specified in OAC Rule 3745-27-06 (C)(9)(c) including:

- Surveying;
- Calibration of testing equipment;
- Sampling and testing procedures to be used in the field and in the laboratory;
- Testing frequency;
- Parameters and sample locations; and
- Procedures to follow if a test fails.

Responsibility, authority, and personnel qualifications are discussed in Section I of the CQA/QC Plan. Monitoring activities, sampling strategies and testing requirements are presented for the soil and aggregate components of the baseliner/leachate collection and final cover system in Section II, Soils Construction Quality Assurance. The following sections discuss the placement, monitoring activities, sampling strategies, and testing of geosynthetic components of the baseliner/leachate collection and final cover systems; Section III, Geosynthetic Clay Liner Construction Quality Assurance; Section IV,

Geomembrane Construction Quality Assurance; Section V, Geocomposite Construction Quality Assurance; and Section VI, Geotextile Construction Quality Assurance. Monitoring activities and testing requirements are presented for the piping in the leachate collection system in Section VII, High-Density Polyethylene Pipe and Fittings Construction Quality Assurance.

Section VIII, Surveying Construction Quality Assurance, presents details for surveying to be performed throughout the construction of the engineered components to determine constructed dimensions. Section IX addresses the documentation required to adequately report the CQA activities. Quality Assurance/Quality Control Testing Tables are included following the text.

3.0 DEFINITIONS AND USE OF TERMS

The following provides general information regarding specific terms, references and units as used in the CQA/QC Plan.

3.1 Definitions Relating To CQA

In the context of this CQA/QC Plan, Construction Quality Assurance and Construction Quality Control are defined as follows:

- Construction Quality Assurance (CQA): A planned and systematic pattern of means and actions designed to provide adequate confidence that items or services meet contractual and regulatory requirements, and will perform satisfactorily in service.
- Construction Quality Control (CQC): Those actions that provide a means to measure and regulate the characteristics of an item or service to contractual and regulatory requirements.

3.2 Use of Terms

In the context of this CQA/QC Plan, the terms CQA and CQC are used as follows:

- CQA refers to means and actions employed by the CQA Consultant (see Section I, Sub-section 4.5) to assess conformity of construction with the CQA/QC Plan, Drawings, and Specifications. The CQA Consultant is a party independent from the Owner and Contractors.
- CQC refers to those actions taken by manufacturer, supplier, and contractor to meet the requirements for materials and workmanship as stated in the CQA/QC Plan, Construction Drawings, and Specifications.

3.3 References to Standards

The CQA/QC Plan includes references to test procedures of the American Society for Testing and Materials (ASTM), the Federal Test Method Standards (FTMS), the Standards for Flexible Membrane Liners of the National Sanitation Foundation (NSF), Geosynthetic Research Institute (GRI), and other relevant guidelines.

3.4 Units

Properties and dimensions given in the CQA/QC Plan are expressed in Standard U.S. units and/or the International System of Units (SI).

4.0 RESPONSIBILITY AND AUTHORITY

The principal parties involved in the CQA of the construction of the engineered components include the Regulatory Agency, Owner, Project Manager, Design Engineer, CQA Consultant, Soils CQA Laboratory, Geosynthetics CQA Laboratory, Earthwork Contractor, Soils Supplier, Resin Supplier, Geosynthetics Manufacturer, Geosynthetics Installer, Pipe Manufacturer, Pipe Installer, and Transporter. The general responsibilities and authorities of each of these parties are described in the following paragraphs. The responsibility and/or authority of a given party may be modified or expanded as dictated by specific project needs during pre-construction meetings. The changes shall be incorporated into the CQA/QC Plan and submitted to the Regulatory Agency for approval prior to construction.

4.1 Regulatory Agency

The Regulatory Agency (Ohio EPA) provides authorization for construction based on review and acceptance of the PTI Application of which this CQA/QC Plan is a part. The Regulatory Agency must have approved the PTI Application for the project before construction can begin. As construction progresses, the Regulatory Agency has the responsibility and authority to review and accept or reject design revisions or requests for variance submitted by the Owner. The Regulatory Agency also has the responsibility and authority to review CQA documentation during and after construction to confirm that the CQA/QC Plan was followed and that construction met the requirements of the Drawings and Specifications.

4.2 Owner

The Owner is responsible for the design of the landfill, including the engineered components and related items. This responsibility includes compliance with the PTI Application and the submission of CQA documentation demonstrating that the facility was constructed in conformance with the Drawings and Specifications. The Owner is

responsible for the surveying to be conducted but may designate the Design Engineer or CQA Consultant to perform the work.

The Owner has the authority to select and dismiss parties charged with design, CQA, and construction activities. The Owner also has the authority to accept or reject design plans and specifications, CQA/QC Plans, reports and recommendations of the CQA Consultant, and the materials and workmanship of contractors.

4.3 Project Manager

The Project Manager is the official representative of the Owner and is responsible for coordinating field activities. He has authority to direct contractors hired by the Owner and is responsible for communications between the Owner, Design Engineer, CQA Consultant, Earthwork Contractor, Geosynthetics Installer, and Regulatory Agency.

4.4 Design Engineer

The Design Engineer's primary responsibility is for a design that fulfills the requirements of the Owner and the Regulatory Agency. It is the Design Engineer's responsibility to provide the Drawings and Specifications necessary to construct the facility in accordance with all applicable laws and regulations. During construction, the Design Engineer may be requested to modify elements of the design due to unforeseen site conditions or changes in construction methodology.

4.5 CQA Consultant

The CQA Consultant is responsible for observing and documenting activities related to the CQA of the construction of the baseliner/leachate collection, final cover, permanent groundwater control, and landfill gas control systems as outlined in the CQA/QC Plan. The CQA Consultant is represented by a Certifying Engineer and on-site CQA Monitoring Personnel as appropriate.

In general, the responsibilities and authorities of the CQA Consultant include:

- Scheduling, coordinating, and performing CQA activities;
- Performing independent on-site observation of the work in progress to assess compliance with Drawings and Specifications;
- Determining that test equipment meets testing and calibration requirements, and that tests are conducted according to standardized procedures defined in the CQA/QC Plan;
- Recording and maintaining test data accurately;
- Identifying CQC-tested work that should be accepted, rejected, or further evaluated;
- Documenting that corrective measures are implemented;
- Documenting and reporting CQA activities;
- Collecting data needed for CQA Documentation as defined in Section IX; and
- Maintaining open lines of communications with the other parties involved in the construction.

4.6 Soils CQA Laboratory

The Soils CQA Laboratory is independent from the Soils Supplier and Earthwork Contractor, and is responsible for performing the laboratory testing required by the CQA/QC Plan to determine specific characteristics of the soils. The Soils CQA Laboratory is also responsible for providing adequate documentation of analytical results, test methods followed, and testing equipment used.

4.7 Geosynthetics CQA Laboratory

The Geosynthetics CQA Laboratory is independent from the Geosynthetics Manufacturer, and Geosynthetics Installer, and is responsible for conducting quality assurance tests on samples of geosynthetics. The Geosynthetics CQA Laboratory cannot

be provided by any party involved with the manufacturer, fabrication, or installation of any of the geosynthetics components.

4.8 Earthwork Contractor

The Earthwork Contractor is responsible for:

- Preparation of the subbase;
- Placement of the structural fill, added geologic material, recompacted soil liner and protective cover layer components of the liner/leachate collection systems;
- Preparation and completion of the geosynthetics anchor trenches (unless otherwise specified);
- Dewatering of surface water from placed soils, geosynthetics, and anchor trenches (unless otherwise specified); and
- Placement of the intermediate cover, recompacted soil barrier, and vegetative cover/frost protection layer components within the final cover system.

It is the responsibility of the Earthwork Contractor that the construction be performed using the procedures and equipment necessary to produce results in conformance with the CQA/QC Plan, Drawings, and Specifications. If the Earthwork Contractor uses a subcontractor, the Earthwork Contractor retains responsibility for the quality of the work performed.

4.9 Soils Supplier

The Soils Supplier delivers soils to the Earthwork Contractor. The Owner or Earthwork Contractor may be the Soils Supplier.

4.10 Resin Supplier

The Resin Supplier produces and delivers the resin to the Geosynthetics Manufacturer.

4.11 Geosynthetics Manufacturer

The Geosynthetics Manufacturer is responsible for the production of the geosynthetics, which include the Geosynthetic Clay Liner (GCL), Flexible Membrane Liners (FML), geocomposite, and geotextile.

4.12 Geosynthetics Installer

The Geosynthetics Installer is responsible for unloading from shipment, storage, field handling, placing, seaming, field testing, temporarily securing (against wind), and other aspects of the geosynthetics installation. If specified, the Geosynthetics Installer may also be responsible for the preparation and completion of any anchor trenches.

4.13 Pipe Manufacturer

The Pipe Manufacturer is responsible for the production of the piping used in the leachate collection, leachate transmission, and gas extraction systems.

4.14 Pipe Installer

The Pipe Installer is responsible for unloading from shipment, storage, field handling, placing, joining, field testing, temporarily securing (against flotation), and other aspects of the pipe installation. The Pipe Installer is also responsible for the excavation and backfilling of the excavation. The Pipe Installer may be the Earthwork Contractor.

4.15 Transporter

The Transporter transports the geosynthetics, including GCL, geomembranes, geotextiles, and geocomposite between the manufacturing plant and the site, and/or between the manufacturing plant and the fabrication plant, and/or between the fabrication plant and the site. The Transporter also is responsible for transporting the pipe to the site. The Transporter may be the Geosynthetics Manufacturer, Pipe Manufacturer, Pipe Installer, or an assigned party of any of these.

5.0 QUALIFICATIONS OF KEY PERSONNEL AND ORGANIZATIONS

The following qualifications shall be required of the key personnel and organizations involved in CQA and/or CQC for the construction of the liner/leachate collection and final cover systems and other related work.

5.1 CQA Consultant

The CQA Consultant shall be a qualified engineering firm with experience in construction quality assurance and quality control, particularly on projects involving similar liner/leachate collection, final cover, permanent groundwater control, and gas extraction systems. The CQA Consultant shall be capable of assigning technically qualified personnel to the project, including a supervising CQA engineer and CQA monitors, as needed. The person designated as the Certifying Engineer should possess an engineering degree and should be a Professional Engineer registered in the state of the Regulatory Agency.

The corporate qualifications to be presented by the CQA Consultant include:

- Brief corporate history;
- Proof of insurance;
- Summary of the firm's relevant experience; and
- Resumes of personnel proposed for assignment to the project.

5.2 Soils CQA Laboratory

The Soils CQA Laboratory shall be a qualified laboratory with experience in performing laboratory tests to determine soils characteristics as required by this CQA/QC Plan. The Soils CQA Laboratory shall demonstrate that it follows the standard test methods listed in the CQA/QC Plan and maintains the appropriate, calibrated equipment to perform the tests. The Soils CQA Laboratory shall also demonstrate to the Project Manager and CQA

Consultant that it adheres to a formal in-house QA/QC program and can provide the required analytical documentation and reports.

5.3 Geosynthetics CQA Laboratory

The Geosynthetics CQA Laboratory shall be a qualified laboratory with experience in performing laboratory tests to determine geosynthetics characteristics as required by this CQA/QC Plan. The Geosynthetics CQA Laboratory shall demonstrate that it follows the standard test methods listed in the CQA/QC Plan and maintains the appropriate, calibrated equipment to perform the tests. The Geosynthetics CQA Laboratory shall also demonstrate to the Project Manager and CQA Consultant that it adheres to a formal in-house QA/QC program and can provide the required analytical documentation and reports.

5.4 Earthwork Contractor

The Earthwork Contractor shall be qualified to construct the soils portions of the engineered components. The Earthwork Contractor shall be capable of assigning the personnel and equipment required to perform the work within the schedule and according to the Specifications and Drawings.

5.5 Geosynthetics Manufacturer

The Geosynthetics Manufacturer must be able to demonstrate that they have completed projects of similar size and scope. The Geosynthetics Manufacturer shall be able to provide sufficient production capacity and qualified personnel to meet the demands of the Specifications. The Geosynthetics Manufacturer shall demonstrate to the Project Manager and CQA Consultant that it adheres to a formal in-house QA/QC program and can provide the required geosynthetics documentation.

5.6 Geosynthetics Installer

The Geosynthetics Installer shall be trained and qualified to install geosynthetics. The Geosynthetics Installer must be able to demonstrate that they have completed projects of similar size and scope. The Geosynthetics Installer will designate one representative as his Superintendent, who will represent the Geosynthetics Installer at all site meetings and be responsible for acting as the Geosynthetics Installer's spokesperson on site.

5.7 Pipe Manufacturer

The Pipe Manufacturer shall be able to provide sufficient production capacity and qualified personnel to meet the demands of the project. The Pipe Manufacturer shall demonstrate to the Project Manager and CQA Consultant that it adheres to a formal in-house QA/QC program and can provide the required pipe documentation.

5.8 Pipe Installer

The Pipe Installer must be trained and qualified to install the piping required for the project.

5.9 Transporter

All personnel responsible for the loading, transport, and unloading of the geosynthetics and piping must be fully aware of the consequences of damage to the geosynthetics and piping, and familiar with handling and transport constraints required by the Manufacturer.

6.0 PROJECT MEETINGS

To achieve a high degree of quality during construction/installation, clear, open channels of communication are essential. To that end, meetings are critical.

6.1 Resolution Meeting

Following the completion of the design, Drawings and Specifications for the project and the Regulatory Agency's approval of the PTI Application and prior to construction of the liner/leachate collection, final cover, permanent groundwater control, or landfill gas extraction systems, a Resolution Meeting may be held. This meeting may include the parties to be involved, including the Project Manager, Design Engineer, CQA Consultant, Regulatory Agency (if appropriate), and Contractors.

The purpose of this meeting is to begin planning for coordination of tasks, anticipate problems that might cause difficulties and delays in construction, and present the CQA/QC Plan to the parties involved. It is very important that the rules regarding testing, repair, etc., be known and accepted by all parties present at the Resolution Meeting.

The meeting shall include the following activities:

- Distribute relevant documents;
- Review critical design details of the project;
- Review the site-specific CQA/QC Plan;
- Make appropriate modifications to the CQA/QC Plan to include CQA activities that are necessary or update test methods;
- Determine quality control procedures, especially on methods for determining acceptability of the soils and geosynthetics comprising the liner/leachate collection and final cover systems;
- Select testing equipment and review protocols for testing and placement of soil materials;

- Confirm the methods for documenting and reporting, and for distributing documents and reports; and
- Confirm the lines of authority and communication.

The meeting shall be documented by a person designated at the beginning of the meeting and minutes shall be transmitted to the parties involved. The Resolution Meeting may be combined with the Pre-Construction Meeting described below.

6.2 Pre-Construction Meeting

A Pre-Construction Meeting shall be held at the site. At a minimum, the meeting shall be attended by the Design Engineer, the CQA Consultant, the Earthwork Contractor, the Geosynthetics Installer, and the Project Manager.

Specific topics considered for this meeting include:

- Make additional appropriate modifications to the CQA/QC Plan if needed;
- Review the responsibilities of each party;
- Review lines of authority and communication;
- Review methods for documenting and reporting, and for distributing documents and reports;
- Establish protocols for testing;
- Establish protocols for handling deficiencies, repairs, and retesting;
- Review the time schedule for operations;
- Review repair procedures;
- Conduct a site walk-around to determine that preparation for construction is proceeding on schedule; and
- Review material storage location and soil and aggregate stockpile locations (if any).

The meeting shall be documented by a person designated at the beginning of the meeting, and a meeting summary shall be transmitted to the parties involved.

6.3 Progress Meetings

Progress meetings may be held as necessary between the CQA Consultant, the Earthwork Contractor, the Geosynthetics Installer, the Project Manager, the Regulatory Agency, and other involved parties. Items to discuss include current progress, planned activities for the next week, and changes to the work. The CQA Consultant will log problems, decisions, or questions arising at this meeting in the daily report. Matters requiring action raised in this meeting shall be reported to the appropriate parties.

6.4 Problem or Work Deficiency Meeting

A special meeting may be held when and if a problem or deficiency is present or likely to occur. At a minimum, the meeting may be attended by the affected contractors, the Project Manager, Regulatory Agency (if appropriate) and the CQA Consultant. If the problem requires a design modification, the Design Engineer should also be present. The purpose of the meeting is to define and resolve the problem or work deficiency as follows:

- Define and discuss the problem or deficiency;
- Review alternative solutions; and
- Implement an action plan to resolve the problem or deficiency.

The meeting shall be documented by a person designated at the meeting and, if appropriate, minutes shall be transmitted to the parties involved.

SECTION II

SOILS CONSTRUCTION QUALITY ASSURANCE

SECTION II
SOILS CONSTRUCTION QUALITY ASSURANCE
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SECTION II
SOILS CONSTRUCTION QUALITY ASSURANCE

1.0 INTRODUCTION

This section of the CQA/QC Plan addresses the CQA and CQC activities associated with the soil and aggregate components of the liner/leachate collection and final cover systems. This includes materials selection and evaluation, laboratory testing requirements, field testing requirements, and resolution of problems. The soil and aggregate components of the liner/leachate collection system are as follows:

- In-situ Foundation;
- Structural Fill;
- Added Geologic Material;
- Recompacted Soil Liner;
- Protective Cover Layer; and
- Coarse Aggregate around pipes.

The soil and aggregate components of the final cover system are as follows:

- Transitional Cover;
- Recompacted Soil Barrier; and
- Frost Protection/Vegetative Layer.

The soil and aggregate components shall meet requirements related to material characteristics and construction quality. Both field and laboratory tests shall be performed prior to construction to evaluate if the characteristics of soil and aggregate from proposed sources meet the material acceptance requirements. Throughout construction, additional field and laboratory testing shall be performed to evaluate if the placed material meets the requirements with regard to material acceptance and construction quality.

1.1 Section Format

A summary of the test methods and requirements is provided for use in conjunction with the text. The following information is then presented for each soil and aggregate component of the liner/leachate collection and final cover systems:

- Criteria which must be met with regard to material acceptance and construction quality;
- Field and laboratory testing to be performed to determine that the criteria are met; and
- Construction monitoring activities to be performed to assess construction quality.

The section concludes with a discussion of the resolution of potential problems and deficiencies.

1.2 Responsibilities

The Earthwork Contractor shall be responsible for construction of soil and aggregate components of the liner/leachate collection and final cover systems. The CQA Consultant shall be responsible for both the soil and aggregate CQA and CQC activities described in the CQA/QC Plan. The Soils CQA Laboratory shall perform the laboratory testing.

1.3 Surveying and Documentation

Two other elements of the CQA/QC Plan shall be performed in conjunction with the CQA and CQC activities described in this section are surveying and documentation which are discussed in Sections VIII and IX, respectively.

2.0 TEST METHODS AND SAMPLING REQUIREMENTS

Table 1 presents information regarding the laboratory and field test methods that shall be used to determine material characteristics and evaluate construction quality for soil and aggregate components of the liner/leachate collection and final cover systems. The table includes the test frequency, sample locations, sample size, and the acceptance criteria.

Three types of sampling strategies shall be used for the various soil and aggregate components:

- As required by the CQA Consultant to evaluate material characteristics prior to the use of the material in construction and to confirm that those characteristics do not change significantly during construction (i.e., no longer meet specifications or require changes in construction methodology).
- For specific bulk volumes of material in stockpiles (e.g., 1 sample per 1,500 cubic yards).
- Using a grid pattern to establish sampling points on nodes or sampling blocks. For example: "On a 100-foot grid" means that a grid pattern with line spacing of 100 feet shall be superimposed on a plan of the area to be sampled. Each node (intersection of perpendicular grid lines) represents a sample location.

Grid pattern sampling strategies shall be used on placed material and offer several advantages over sampling strategies which require that samples be collected on a "per acre" or "per 10,000 square feet" basis:

- Grid patterns can be superimposed and sampling locations plotted on plans for the areas to be sampled prior to construction. Sampling can thus be conducted systematically.
- Samples and sample locations can be labeled in accordance with the grid pattern thus increasing the effectiveness of documentation.

- The size of the sampling block can be increased to decrease the frequency of sampling without changing the grid pattern.
- Sample frequency terminology can be used and applied consistently.

3.0 IN-SITU FOUNDATION

The surface of the in-situ foundation (subbase) will be prepared in accordance with OAC 3745-27-08(D)(5). The surface will consist of soils that are free of debris, solid waste, rocks greater than 6 inches in diameter, vegetation and organic materials, frozen materials, foreign objects, excess silt, and soft areas. The surface shall be able to bear the weight of the landfill and its construction and operations without causing or allowing failure of the liner to occur through settling. The surface shall not have abrupt changes in grade that may result in damage to geosynthetics. The subbase will be proof rolled using a compactor or other heavy equipment prior to placement of the next soil component. The surface of the subbase will be hard, uniform, and smooth and will be compacted to the specifications included in Table 1. Table 1 also provides the testing required for unconsolidated stratigraphic units that have not been anticipated and are more susceptible to slope failure than the units that were reported in the PTI Application.

4.0 STRUCTURAL FILL

Structural fill will be placed in accordance with the requirements of OAC 3745-27-08(D)(6). Structural fill may be used to establish the base of added geologic material or recompacted soil layer elevations, construct berms, roads, sedimentation basins, channels, etc. Structural fill shall be durable rock (for rock fills only), free of debris, foreign material, and deleterious material, not comprised of solid waste. Both soil and rock structural fill will be utilized. Soil or rock structural fill may be used to construct the perimeter berm.

Prior to placement of the structural fill, the surface of the underlying soil shall consist of soils that are free of debris, rocks greater than 6 inches in diameter, vegetation and organic materials, frozen materials, foreign objects, excess silt, and soft areas. The underlying soil will be proof rolled using a compactor or other heavy equipment prior to placement of the next soil component. The surface of the underlying soil will be hard, uniform, and smooth.

Structural fill shall be determined to have adequate strength to satisfy bearing capacity and slope stability strength requirements. The finished surface of the structural fill shall be uniform and smooth prior to placing the recompacted soil liner. Surveying shall be performed to determine that finished dimensions are as specified in the design. Details regarding surveying are presented in Section VIII of the CQA/QC Plan.

4.1 Soil Structural Fill

Soil structural fill shall be placed in uniform layers not to exceed 12 inches in uncompacted thickness. Each lift of soil structural fill shall be rolled and compacted to a density of at least 95 percent of the Standard Proctor maximum dry density or 90 percent of the Modified Proctor maximum dry density. Moisture conditioning shall be conducted as necessary to preserve the homogeneity of the soil and to obtain uniform moisture content throughout the soil mass.

Refer to Table 1 for the specific test methods of the field and laboratory testing to be performed, sample locations, sample sizes, test frequencies, and acceptance criteria for the material acceptance evaluation of soil structural fill.

4.2 Rock Structural Fill

Rock structural fill shall consist of well-graded crushed or excavated durable rock that can provide a range of rock sizes such that smaller rock particles will fill the voids between larger rock particles. The durable rock to be utilized as rock structural fill is sandstone, limestone, or other material meeting the classification of durable rock. The material shall have a maximum particle size of 24 inches and be placed in uniform layers not to exceed 24 inches in uncompacted thickness.

Each lift of rock structural fill shall be compacted until a visual observation of non-movement is achieved. Moisture may be added to improve the material placement and compaction as approved by the CQA Consultant. No laboratory testing will be performed for rock structural fill.

5.0 ADDED GEOLOGIC MATERIAL

The material to be used as added geologic material (AGM) in the liner system shall meet material acceptance and construction evaluation criteria as detailed in the following paragraphs and as required by OAC Rule 3745-27-08(D)(7). In addition, a rigorous monitoring program shall be implemented during the construction of the AGM layer. AGM is also referred to as Geologic Isolation Fill elsewhere in the PTI Application.

5.1 Material Acceptance Criteria

The physical characteristics of the material to be used in the AGM layer shall be evaluated through visual observation and field and laboratory classification testing both before and during construction. The classification testing shall include determination of the moisture/density relationship, grain size analysis, and permeability. The material acceptance criteria for the AGM as required in OAC 3745-27-08(D)(7)(g) are as follows:

- Permeability less than or equal to 1×10^{-5} cm/sec; and
- One hundred percent of material with a maximum particle size of 12 inches.

Refer to Table 1 for the specific test methods of the field and laboratory testing to be performed, sample locations, sample sizes, test frequencies, and acceptance criteria for the material acceptance evaluation of the AGM layer.

5.2 Construction Quality Evaluation Criteria

Prior to placement of the AGM, the surface of the subbase shall be prepared as described in Subsection 3.0, In-Situ Foundation. All lifts of the AGM shall be placed in uniform layers not to exceed 12 inches in uncompacted thickness. The lift depth shall be determined by visual observation or by survey. Soil clods shall be broken down to a maximum of 12 inches. Moisture conditioning shall be conducted to preserve the homogeneity of the soil and to obtain a relatively uniform moisture content throughout

the soil mass. The moisture content of the AGM layer shall be field tested during placement and compaction. Each lift shall be scarified prior to placing the subsequent lift to sufficiently bond it to the previous lift.

Each lift of the AGM shall be compacted to a density of at least 95 percent of the Standard Proctor maximum dry density or 90 percent of Modified Proctor maximum dry density and at a moisture content of not less than 2 percent below or more than four percent above the optimum moisture content. The finished surface of the AGM layer shall be uniform and smooth. Surveying shall be performed to document that finished dimensions are as specified in the design; details regarding surveying are presented in Section VIII of the CQA/QC Plan.

Refer to Table 1 for a summary of the field and laboratory testing to be performed, sample locations, sample sizes, test frequencies, and acceptance criteria for the evaluation of the AGM layer.

5.3 Monitoring Program for Construction of AGM

Visual monitoring of the construction of the AGM shall consist of observing and documenting the following:

- Identification of changes in material characteristics causing a change in construction specifications;
- Adequate spreading of AGM to obtain complete coverage and loose lift thickness;
- Removal of debris, rocks, vegetation and organic materials, frozen materials, foreign objects, excess silt, and soft areas;
- Adequate clod-size reduction;
- Mixing of water to obtain uniform distribution;
- Proper adjustment of the water content of the in-place material in the event of prolonged rain or drought during construction;

- Prevention of significant water loss and desiccation cracking before and after compaction;
- Use of compaction equipment of the proper type, configuration, and weight;
- Appropriate equipment speed and number of equipment passes used for compaction;
- Uniformity of coverage by compaction equipment, particularly at fill edges, in equipment turn-around areas, and on slopes;
- Use of sufficient methods to tie lifts together;
- Proper repair of penetrations resulting from the use of density and moisture probes using bentonite;
- Sealing the working surface when work is stopped for a period of time or precipitation is expected by compacting the surface and sloping it to allow run-off of precipitation;
- Timely placement of protective covers to prevent desiccation of AGM material between the installation of lifts or after completion of AGM;
- Prevention of accidental damage to installed portions of the AGM; and
- Observation and documentation of activities to correct conditions not meeting Specifications for the construction of the AGM.

The CQA Consultant shall monitor the in-place moisture content and density of the AGM using a nuclear density gauge. For each lift, the density and moisture shall be tested at a frequency of five tests per acre as required by OAC 3745-27-08(D)(7)(i) (tested on a 100-foot grid superimposed on the construction area). All penetrations will be filled with bentonite.

Construction activities for installation of the AGM shall be documented on a daily basis. CQA personnel shall maintain daily summary reports with supporting data sheets and, when appropriate, problem identification and corrective measures reports. Documentation activities are addressed in Section IX of the CQA/QC Plan.

The CQA Consultant shall approve the installation of the AGM prior to the placement of structural fill. Approval shall be based on the CQA monitoring activities performed during construction of the AGM layer.

6.0 RECOMPACTED SOIL LINER

The material to be used in the recompacted soil liner (RSL) in the liner system shall meet material acceptance and construction evaluation criteria as detailed in the following paragraphs and as required by OAC Rule 3745-27-08(D)(8). In addition, a rigorous monitoring program shall be implemented during the construction of the RSL layer.

6.1 Material Acceptance Criteria

The physical characteristics of the material to be used in the RSL layer shall be evaluated through visual observation and field and laboratory classification testing both before and during construction. The classification testing shall include determination of the moisture/density relationship, Atterberg Limits, grain size analysis, and permeability.

The material acceptance criteria for the RSL as required in OAC 3745-27-08(D)(8)(g)(i) are as follows:

- Permeability less than or equal to 1×10^{-7} cm/sec;
- One hundred percent of material with a maximum particle size of 2 inches; and
- Not less than 90 percent of material, by weight, with a particle size less than 0.75 inches.

Refer to Table 1 for the specific test methods of the field and laboratory testing to be performed, sample locations, sample sizes, test frequencies, and acceptance criteria for the material acceptance evaluation of the RSL layer. The acceptance criteria include the requirements established by Test Pad Numbers 1, 2 and 3 previously constructed at the site. Material specifications may be revised based on future test pad construction results.

Results of pre-construction testing of the borrow soils performed on representative samples shall be submitted to the Ohio EPA no later than seven days prior to the intended use of the material in the construction of the RSL.

6.2 RSL Test Pad

Test pads shall be constructed in accordance with OAC Rule 3745-27-08(E). A test pad shall be constructed for each borrow source to establish construction details or verify or amend the construction details proposed in the approved permit. A test pad shall be constructed prior to the construction of the sanitary landfill component that the test pad will model and will be constructed as many times as necessary to meet the permeability requirement. In addition, a test pad shall be constructed whenever there is a significant change in soil material properties as required in the regulations. The test pads shall be used to evaluate the following:

- Material handling and placement requirements;
- Lift thickness;
- Water content necessary to achieve the desired compaction;
- Compaction equipment type, weight, and number of passes; and
- Field permeability.

The results of test pad construction may be used to verify or amend construction details proposed in the approved permit for the site. Test pads shall be constructed using the same material, equipment, and procedures to be used in the construction of the RSL. A test pad plan shall be prepared by the Design Engineer, if necessary. The test pad will have dimensions of at least three times the width of the compaction equipment and two times the length of the compaction equipment including power equipment and attachments. The test pad will consist of at least 4 lifts with the thickness of the test pad being no less than 30 inches. In-situ density and moisture testing will be performed at least 3 times per lift, and all penetrations will be repaired with bentonite. The construction of the test pad shall be closely monitored, and the following tests shall be performed at a frequency of at least twice per lift:

- Maximum dry density and optimum moisture content;

- Grain size distribution with hydrometer; and
- Atterberg limits.

Following the construction of the test pad, a determination of permeability through field testing shall be performed. Refer to Table 1 for a summary of the field and laboratory testing to be performed, sample locations, sample sizes, test frequencies, and acceptance criteria for the test pad.

6.3 Construction Quality Evaluation Criteria

Prior to placement of the RSL, the surface of the subbase shall be prepared as described in Subsection 3.0, In-Situ Foundation. All lifts of the RSL shall be placed in uniform layers not to exceed 8 inches in uncompacted thickness. The lift depth shall be determined by visual observation or by survey. The minimum total thickness of the RSL shall be 3 feet. Soil clods shall be broken down to 3 inches or half the lift thickness, whichever is less. Moisture conditioning shall be conducted to preserve the homogeneity of the soil and to obtain a relatively uniform moisture content throughout the soil mass. The moisture content of the RSL layer shall be field tested during placement and compaction. Each lift shall be scarified prior to placing the subsequent lift to sufficiently bond it to the previous lift.

Each lift of the RSL shall be compacted to a density of at least 95 percent of the Standard Proctor maximum dry density or 90 percent of Modified Proctor maximum dry density and at a moisture content of at or above optimum or Best Fit Line of Optimums (BFLO). The compaction specifications may be modified based on the results of the test pad. The finished surface of the RSL layer shall be uniform and smooth. Surveying shall be performed to document that finished dimensions are as specified in the design; details regarding surveying are presented in Section VIII of the CQA/QC Plan.

Refer to Table 1 for a summary of the field and laboratory testing to be performed, sample locations, sample sizes, test frequencies, and acceptance criteria for the evaluation

of the RSL layer. The acceptance criteria for the RSL may be modified based on test pad results.

6.4 Monitoring Program for Construction of RSL

Visual monitoring of the construction of the RSL shall consist of observing and documenting the following:

- Identification of changes in material characteristics causing a change in construction specifications;
- Adequate spreading of RSL to obtain complete coverage and loose lift thickness;
- Removal of debris, rocks, vegetation and organic materials, frozen materials, foreign objects, excess silt, and soft areas;
- Adequate clod-size reduction;
- Mixing of water to obtain uniform distribution;
- Proper adjustment of the water content of the in-place material in the event of prolonged rain or drought during construction;
- Prevention of significant water loss and desiccation cracking before and after compaction;
- Use of compaction equipment of the proper type, configuration, and weight;
- Appropriate equipment speed and number of equipment passes used for compaction;
- Uniformity of coverage by compaction equipment, particularly at fill edges, in equipment turn-around areas, and on slopes;
- Use of sufficient methods to tie lifts together;
- Proper repair of penetrations resulting from the use of density and moisture probes using bentonite;
- Sealing the working surface when work is stopped for a period of time or precipitation is expected by compacting the surface and sloping it to allow run-off of precipitation;

- Timely placement of protective covers to prevent desiccation of RSL material between the installation of lifts or after completion of RSL;
- Prevention of accidental damage to installed portions of the RSL; and
- Observation and documentation of activities to correct conditions not meeting Specifications for the construction of the RSL.

The CQA Consultant shall monitor the in-place moisture content and density of the RSL using a nuclear density gauge. For each lift, the density and moisture shall be tested at a frequency of five tests per acre as required by OAC 3745-27-08(D)(8)(j) (tested on a 100-foot grid superimposed on the construction area). All penetrations will be filled with bentonite.

Construction activities for installation of the RSL shall be documented on a daily basis. CQA personnel shall maintain daily summary reports with supporting data sheets and, when appropriate, problem identification and corrective measures reports. Documentation activities are addressed in Section IX of the CQA/QC Plan.

The CQA Consultant shall approve the installation of the RSL prior to the placement of the overlying geosynthetics. Approval shall be based on the CQA monitoring activities performed during construction of the RSL layer.

7.0 PROTECTIVE COVER LAYER

Coarse-grained soils or tire shreds will be used in the construction of the protective cover/filter (protective cover) layer. The protective cover layer shall be placed above the geosynthetics in the liner/leachate collection system to protect the underlying composite liner system from intrusion of objects during construction and operation.

Special care shall be taken to avoid damaging the underlying liner/leachate collection system when placing the protective cover layer. Prior to placement of the protective cover layer on the side slopes, the geosynthetic anchor trenches shall be properly backfilled and compacted. The CQA Consultant shall be present as necessary during protective cover layer placement to determine that no damage to the underlying RSL or geosynthetics materials occurs and that no unacceptable materials are placed. During placement of the protective cover layer, care shall be taken such that large wrinkles do not develop in the geomembrane or geocomposite. Wrinkles that may form will be repaired as required by the CQA Consultant.

The protective cover layer shall be placed and spread to the required thickness using a low ground pressure dozer or other suitable earth moving equipment with a maximum ground pressure of five (5) psi. The protective cover layer installation shall proceed upslope only; at no time will equipment be permitted to install protective cover material down slope. Precautions shall be taken to make sure that at least 3 feet of material is provided for trucks to run on when bringing protective cover material to the work area. The operators of all equipment used in transporting or spreading the material shall be advised to use gradual turns and stop/starts. Refer to Table 1 for a summary of the laboratory testing to be performed, sample locations, sample sizes, test frequencies, and acceptance criteria for the protective cover layer.

7.1 Tire Shred Testing

If tire shreds are used as leachate collection material, gradation and permeability testing shall be performed on representative samples of tire chips. Refer to Table 1 for a summary of the laboratory testing to be performed, sample locations, sample sizes, test frequencies, and acceptance criteria for the tire shred leachate collection layer.

7.2 Tire Shred Test Pits

If tire shreds are used as leachate collection material, after the tire shred leachate collection layer is placed and graded, the 60-mil geomembrane shall be investigated to determine that no damage has occurred to the geomembrane by the placement and spreading of the tire shreds. The Ohio EPA will be notified of the test pit investigation to confirm the test pit locations. At least one test pit per acre of liner construction shall be excavated at areas representative of cell construction. Each test pit shall be excavated through the tires to expose the cushion geotextile above the geomembrane. The test pits shall be large enough to expose at least 3 ft x 3 ft of the geomembrane. The non-woven geotextile shall be carefully cut and peeled back in order to expose the geomembrane. The geomembrane will be investigated for damage, punctures, or imbedded wires from the tire shreds. Each test pit will be documented and photographed. Upon completion of the investigation, the geotextile shall be repaired. The construction certification report shall include the locations of the test pits and the findings of the inspection of the geomembrane.

7.2.1 Contingency Plan

The following presents the Contingency Plan to be followed in the event that damage to the geomembrane is found during test pit excavation.

- The degree of damage to the geomembrane will be determined at each test pit. Any damage that punctures the geomembrane or penetrates the geomembrane so that less than 40-mil of the 60-mil geomembrane thickness remains will be considered significant damage that requires further action.

- At any test pit where damage is found as described above, three additional test pits will be excavated surrounding the area of the original test pit.
- If damage to the geomembrane is found in the additional test pits, the above procedure will be repeated until no further damage is found.
- After the limits of damage to the geomembrane are determined, the tire shreds and geotextile will be removed in the area bound by the test pits where damage was documented. The exposed area of geomembrane will be investigated to determine if additional damage is present.
- The damaged geomembrane will be repaired using multiple extrusion-welded patches or one large patch as determined by the CQA Consultant. All patches shall be vacuum tested in accordance with Section IV, Subsection 5.7.1.
- Once vacuum testing is completed, the geotextile will be repaired.
- The Owner may propose in writing alternatives for remediation of liner damaged by tire shreds for consideration by the Regulatory Agency. The alternatives may be implemented if approved by the Regulatory Agency.

7.3 Tire Shred Storage

OAC 3745-27-78(E)(1) authorizes the beneficial use of shredded scrap tires for civil engineering applications in a solid waste landfill. To accomplish this, the facility will temporarily store tire shreds on-site as described here. Tire shreds shall be stored at the facility in storage piles (windrows) that meet the requirements of OAC 3745-27-65 (F). Tire shreds which are larger than tire derived chips (TDC) (size-reduced scrap tires where the maximum size of 95 percent of the shreds are less than 4 inches in any dimension) shall be stored in piles no greater than 2,500 square feet in basal area, limited to 14 feet in height with fire lanes of 137 feet. Tire shreds which meet the TDC size requirement will be stored in piles not to exceed 250 feet long and 50 feet wide, limited to 14 feet in height with fire lanes of 137 feet. Corridors shall be kept free from obstructions that could limit access in the event of an emergency. An area extending 200 feet from the outside perimeter of the pile(s) will be clear of any sources of ignition. Piles will not be located near or below power lines. The facility will have equipment and material on-site to isolate, maintain, suffocate, etc. any fire that could ignite.

8.0 COARSE AGGREGATE AROUND PIPES

The coarse aggregate placed around the leachate collection pipes shall be rounded, non-carbonate stones meeting the requirements of the American Association of State Highway and Transportation Officials (AASHTO) No. 57 gradation or equivalent. The coarse aggregate shall not contain organics, frozen material, foreign objects, or other deleterious materials.

Refer to Table 1 for a summary of the laboratory testing to be performed, sample locations, sample sizes, test frequencies, and acceptance criteria for the coarse aggregate.

9.0 RECOMPACTED SOIL BARRIER LAYER

An 18-inch thick recompacted soil barrier (RSB) layer will be constructed as part of the composite cap of the final cover system. The material used in the construction of RSB layer shall meet the material acceptance and construction evaluation criteria as detailed in the following paragraphs and as required by OAC Rule 3745-27-08 (D)(21). The criteria for the RSB are as follows:

- Minimum installed thickness of 18 inches;
- Permeability shall be less than or equal to 1×10^{-6} cm/sec;
- One hundred percent of material with a maximum particle size of 2 inches;
- No more than 10 percent of material, by weight, having a particle size greater than 0.75 inches; and
- At least 50 percent of the particles, by weight, passing through the No. 200 sieve.

Results of pre-construction testing of the borrow soils performed on representative samples shall be submitted to the Ohio EPA no later than seven days prior to the intended use of the material in the construction of the RSB.

Prior to placement of the RSB, the surface of the intermediate cover shall be prepared and proof rolled. The surface shall be free of debris, rocks, vegetation and organic materials, frozen materials, foreign objects, excess silt, and soft areas.

The 18-inch thick RSB shall be placed in 8-inch thick maximum loose lifts. Soil clods shall be broken down to 3 inches or half the lift thickness, whichever is less. Moisture conditioning may be conducted to preserve the homogeneity of the soil and to obtain a relatively uniform moisture content throughout the soil mass. The RSB will be compacted to a density of at least 95 percent of the Standard Proctor maximum dry density or 90 percent of the Modified Proctor maximum dry density at a moisture content of at or above the optimum moisture content. For each lift, the density and moisture shall

be tested at a frequency of five tests per acre as required by OAC 3745-27-08(D)(21)(h). All penetrations will be filled with bentonite.

The surface of the RSB shall have no abrupt changes in grade that may result in damage to the geosynthetics. Surveying shall be performed to document that finished dimensions are as specified in the design. Details regarding surveying are presented in Section VIII of the CQA/QC Plan. The CQA Consultant shall approve the installation of the RSB prior to the placement of any overlying geosynthetics.

Refer to Table 1 for a summary of the field and laboratory testing to be performed, sample locations, sample sizes, test frequencies, and acceptance criteria for the RSB.

10.0 TRANSITIONAL COVER

The material used in the transitional cover shall meet the material acceptance and construction evaluation criteria as detailed in this section. A transitional cover may be placed within sixty days of a portion of the facility reaching final elevations, in lieu of installing the final cover system.

Prior to placement of the transitional cover, the ground surface shall be stripped of vegetation and proof rolled. The 24-inch thick transitional cover shall be placed in two or more uniform lifts so that the thickness and slopes meet the design specifications. Soil clods shall be broken down, and moisture conditioning may be conducted to preserve the homogeneity of the soil and to obtain a relatively uniform moisture content throughout the soil mass. The surface of the transitional cover shall be prepared to allow for vegetation growth. Healthy grasses or other vegetation shall form a complete and dense vegetative cover within one year of soil placement. Surveying shall be performed to verify that finished dimensions are as specified in the design. Details regarding surveying are presented in Section 8 of the CQA Plan.

Notification and documentation of transitional cover construction shall be completed in accordance with OAC 3745-27-19(H)(2). Construction activities for installation of the transitional cover shall be documented on a daily basis. On-site inspection personnel shall maintain daily summary reports with supporting inspection data sheets and, when appropriate, problem identification and corrective measures reports.

Refer to Table 1 for a summary of the field and laboratory testing to be performed, sample locations, sample sizes, and acceptance criteria for the transitional cover.

11.0 VEGETATIVE COVER/CAP PROTECTION LAYER

The vegetative cover/cap protection layer (vegetative cover) for the final cover system shall meet the performance and design standards in OAC Rule 3745-27-08(D)(26). The vegetative cover layer shall have a thickness of 30 inches. The upper portion of the layer shall consist of final cover soil able to support vegetation and be reasonably free of large particles, frozen materials, foreign objects and organics. The physical characteristics of the materials shall be evaluated through visual observation both before and during placement of the vegetative cover layer.

The vegetative cover layer shall be placed in one or more uniform lifts so that thickness and slopes meet the design specifications. During placement of the vegetative cover, care shall be taken such that wrinkles do not develop in the underlying geosynthetics. The CQA Consultant shall be present, as necessary, during vegetative cover layer placement to determine that no damage to the underlying geosynthetics occurs and that no unacceptable materials are placed.

The vegetative cover layer shall be placed and spread to the required thickness using a low ground pressure dozer or other suitable earth moving equipment. Equipment used for spreading the soil material shall be low ground pressure dozers or backhoes that result in low contact pressure to the geosynthetics under the vegetative cover layer. The vegetative cover layer installation shall proceed upslope only; at no time will equipment be permitted to install vegetative cover material down slope. Precautions shall be taken to make sure that at least 3 feet of soil material is provided for trucks to run on when bringing vegetative cover material to the work area. The operators of all equipment used in transporting or spreading the soil material shall be advised to use gradual turns and stop/starts.

The final surface of the vegetative cover shall be scarified, seeded, mulched, and fertilized as required to establish a dense vegetative growth. Surveying shall be

performed to document that finished final cover dimensions are as specified in the design. Details regarding surveying are presented in Section VIII of the CQA/QC Plan.

Refer to Table 1 for a summary of the field and laboratory testing to be performed, sample locations, sample sizes, test frequencies, and acceptance criteria for the vegetative cover layer.

12.0 POTENTIAL PROBLEMS AND DEFICIENCIES

During construction, the frequency of testing may be increased at the discretion of the CQA Consultant or the Owner when visual observations of construction performance indicate a potential problem. Additional testing shall be considered when:

- The compaction equipment slips during compaction of soils;
- The material is at improper and/or variable moisture content;
- Dirt-clogged teeth of the compaction equipment are used to compact the material;
- Desiccation has occurred or the soils are saturated;
- The compaction equipment may not have used optimum ballast;
- The materials differ substantially from those specified; or
- The degree of compaction is doubtful.

If a defect is detected within a soil component of either the liner or final cover systems, the CQA Consultant shall determine the extent and nature of the defect. If the defect is indicated by an unsatisfactory test result, the CQA Consultant shall determine the extent of the deficient area by additional tests, observations, a review of records, or other means that the CQA Consultant deems appropriate. If the defect is related to adverse site conditions, such as overly wet soils or surface desiccation, the CQA Consultant shall define the limits and nature of the defect.

12.1 Notification

The CQA Consultant shall notify the Earthwork Contractor immediately upon discovering the defect. After determining the extent and nature of the defect, the CQA Consultant shall notify the Project Manager as necessary.

12.2 Repairs and Retesting

The Earthwork Contractor shall correct the deficiency to the satisfaction of the CQA Consultant and Owner. The CQA Consultant shall conduct appropriate retests after the work deficiency has been corrected. Retests recommended by the CQA Consultant must document that the defect has been corrected before any additional work is performed by the Earthwork Contractor in the area of the deficiency.

12.3 Layer Thickness

Surveying, as described in Section VIII, shall be the primary method of documenting the thickness of all soil components in the liner and final cover systems. Soil layers that require documentation include in-situ foundation, AGM, structural fill, RSL, protective cover layer, RSB, and vegetative cover.

SECTION III

GEOSYNTHETIC CLAY LINER CONSTRUCTION QUALITY ASSURANCE

SECTION III
GEOSYNTHETIC CLAY LINER
CONSTRUCTION QUALITY ASSURANCE
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SECTION III
GEOSYNTHETIC CLAY LINER
CONSTRUCTION QUALITY ASSURANCE

1.0 GEOSYNTHETIC CLAY LINER MANUFACTURING

The GCL material and installation shall comply with OAC Rule 3745-27-08(D)(9). The geosynthetic clay liner (GCL) shall be prefabricated in a manufacturing facility with a layer of natural sodium bentonite (bentonite) between two layers of geotextile. The geotextiles and any adhesives that may be used in the manufacturing shall not interfere with the swelling, self-healing or low permeability characteristics of the bentonite.

1.1 Sodium Bentonite

The primary component of the GCL shall be a high quality sodium bentonite (montmorillonite). The bentonite shall be applied to the geotextile at the minimum rate specified in Table 2.

1.2 Primary Backing Material

The primary backing material shall be a woven or nonwoven geotextile and perform the following functions:

- Protect the bentonite from displacement during shipping, handling and placement of cover material;
- Support the normal load and improve the slope stability properties of the liner system;
- Protect the bentonite from exposure to humidity changes and other factors which may cause shrinkage or desiccation; and
- Provide a degree of protection against puncture.

1.3 Finished Product

The finished product shall have the following properties:

- Minimum bentonite content as specified in Table 2; and
- Maximum hydraulic conductivity as specified in Table 2.

Six and twelve-inch overlap marks shall be marked longitudinally on the GCL by the Manufacturer to assist in obtaining the proper overlap.

Prior to rolling, the finished product shall be visually inspected over 100 percent of the surface area of the GCL to detect deficiencies in the uniformity of the bentonite. Regions of the product in which a bentonite deficiency is noted shall be removed from the production line.

The product shall be rolled around a core that is structurally sound and can support the weight of the roll without excessive bending or buckling under normal handling conditions.

1.4 Manufacturer Qualifications

Manufacturer of the GCL shall have a minimum of three years of continuous experience in the manufacture of similar GCL products.

2.0 CERTIFICATION OF PROPERTY VALUES

2.1 QC Testing

The GCL shall be subject to quality control (QC) testing to assure that the materials provided meet the minimum performance requirements. The bentonite and geotextile backings shall be tested in accordance with the Manufacturer's QC program and meet the Manufacturer's minimum published standards and frequencies as well as those listed in Table 2. This testing shall be performed by the Manufacturer. In most cases, sampling can be carried out on sacrificial portions of the material. Consequently, repair of sampled locations will not be required.

2.2 QC Test Failure Procedure

Samples not satisfying the specifications will result in the rejection of the applicable rolls. At the Manufacturer's discretion and expense, additional testing of individual rolls may be performed to more closely identify the non-complying rolls and/or to qualify individual rolls.

2.3 Certification Documentation

Prior to shipment, the GCL Manufacturer shall provide the Project Manager and the CQA Consultant with quality control certificates and a list of the applicable rolls. The quality control certificate shall be signed by a responsible party employed by the GCL Manufacturer, such as the production manager.

The quality control certificate shall include:

- Roll numbers and identification;
- Sampling procedure; and
- Results of all quality control tests, including a description of test methods used (ASTM or other test procedure references).

The CQA Consultant will:

- Document that the quality control certificates have been provided at the specified frequency for all rolls, and that each certificate identifies the rolls related to it;
- Review the quality control certificates and document that the certified roll properties meet the specifications; and
- Submit the results of pre-construction testing to the appropriate Ohio EPA district office no later than seven days prior to the intended use of the material.

3.0 DELIVERY

3.1 Packaging and Labeling

The finished GCL shall be completely wrapped and adequately secured with a durable opaque protective cover in order to provide protection from ultraviolet degradation of the geotextile and excessive loss and/or gain of moisture during shipping and storage. The central core shall be accessible for handling. The GCL rolls shall be marked or tagged with the following information:

- Manufacturer's name;
- Product identification;
- Lot or batch number;
- Roll number;
- Roll weight; and
- Roll dimensions.

The CQA Consultant shall examine rolls upon delivery and any deviation from the above requirements shall be reported to the Project Manager.

3.2 Transportation and Handling

Transportation of the GCL is the responsibility of the GCL Manufacturer, Geosynthetics Installer, or Transporter, as directed by the Geosynthetic Installer. All handling on site is the responsibility of the Geosynthetics Installer.

The GCL shall be shipped in accordance with the GCL Manufacturer's recommendations. Upon delivery to the site, the Geosynthetics Installer and CQA Consultant shall review all rolls for defects and for damage. This review shall be conducted without unrolling the rolls unless defects or damages are found or suspected. The CQA Consultant shall indicate to the Project

Manager any rolls with minor repairable flaws and any rolls or portions of rolls which should be rejected and removed from the site because of severe flaws.

3.3 Storage

The Geosynthetic Installer shall be responsible for the storage of the GCL on site. The Project Manager shall provide storage space in a location (or several locations) such that on-site transportation and handling are minimized. Storage space should protect the GCL from vandalism, passage of vehicles, precipitation, etc.

The rolls of GCL shall be stored in their original, unopened, wrapped cover in a clean dry area. The GCL shall be protected from precipitation, excessive heat or cold, puncture, or other damaging or deleterious conditions. The rolls shall not be stacked more than three rolls high, due to the possibility of thinning of the product at points of contact. Any additional procedures required by the GCL Manufacturer shall be the Geosynthetics Installer's responsibility.

The CQA Consultant will confirm that:

- Handling equipment is adequate and does not pose any risk of damage;
- storage of the GCL ensures adequate protection against precipitation, dirt, traffic, and other sources of damage; and
- The GCL is handled with care.

4.0 CONFORMANCE TESTING OF DELIVERED GCL

4.1 Sampling Procedures

GCL sampling for conformance testing may take place at the GCL manufacturing plant by the GCL Manufacturer, Geosynthetics CQA Laboratory, a representative of the Owner, or the CQA Consultant. The samples shall then be forwarded to the Geosynthetics CQA Laboratory. Conversely, the CQA consultant may retrieve GCL samples from material delivered to the site and forward them to the Geosynthetics CQA Laboratory. The Geosynthetic CQA Laboratory will conduct the conformance testing to ensure conformance to the specifications and the list of guaranteed properties.

Sample locations shall be selected in accordance with the sampling frequency. Samples shall be taken across the entire width of the roll and will be at least 3-feet wide. The sample shall be clearly marked and indicate the roll number from which the sample was taken.

4.2 Test Results

The CQA Consultant will examine all results from the laboratory conformance testing and shall report any non-conformance to the Project Manager. The minimum standards for the GCL are given in Table 2.

4.3 Conformance Test Failure

The following procedure shall apply whenever a sample fails a conformance test that is conducted by the Geosynthetics CQA Laboratory. The GCL Manufacturer or CQA Consultant shall remove conformance samples for testing by the Geosynthetic CQA Laboratory from the closest numerical roll on both sides of the failed roll. These two samples must both conform to the Specifications. If either of these samples fails, testing will proceed on samples from the closest numerical roll to the failed roll until rolls are tested that conform to the Specifications.

The GCL Manufacturer shall replace any roll of GCL that is in non-conformance with the Specifications with a roll that meets the Specifications.

The CQA Consultant shall document actions taken in conjunction with conformance test failures.

5.0 HANDLING AND INSTALLATION

5.1 Handling

The Geosynthetics Installer shall handle GCL in such a manner as to minimize damage to the GCL and comply with the following:

- The equipment or tools used for handling, trafficking, or other operations shall not cause damage to the GCL;
- Personnel working on the GCL shall not smoke, wear damaging shoes, or engage in activities which will cause damage to the GCL; and
- The equipment used to deploy the GCL shall not cause damage to the RSL.

5.2 Earthwork

5.2.1 Surface Preparation

The Earthwork Contractor shall be responsible for preparing the surface of the RSL according to the specifications in Section II. Prior to deploying GCL, the CQA Consultant shall document that:

- A Surveyor has documented all lines and grades of the RSL; and
- The requirements of Section II, Soils Construction Quality Assurance, are satisfied.

The Geosynthetics Installer shall provide, in writing, that the surface on which the GCL shall be installed is acceptable. The Certificate of Acceptance shall be given by the Geosynthetic Installer to the CQA Consultant or Project Manager prior to commencement of GCL installation in the area under consideration.

After the underlying soil has been accepted by the Geosynthetics Installer, it shall be the CQA Consultant's and/or the Geosynthetics Installer's responsibility to indicate to the Project Manager

any change in underlying soil condition that may require repair work. If the CQA Consultant concurs with the Geosynthetics Installer, then the Project Manager shall ensure that the underlying soil is repaired.

5.2.2 Anchoring System

Anchor trenches shall be excavated by the Earthwork Contractor (unless otherwise specified) to the lines and widths shown on the design drawings, prior to GCL placement. The CQA Consultant shall determine that the anchor trenches have been constructed according to design drawings.

Slightly rounded corners shall be provided in the trenches where the GCL adjoins the trench so as to avoid sharp bends in the GCL. Backfilling of the anchor trenches shall be done in accordance with Sub-section 5.4.

5.3 Geosynthetic Clay Liner Installation

As each GCL roll is moved from the storage area the labels shall be removed by the Geosynthetics Installer and submitted to the CQA Consultant.

The GCL rolls shall be brought to the area to be lined in accordance with the GCL Manufacturer's recommendations such that the GCL roll is fully supported across its length. A front-end loader with a pipe and spreader bar or similar devices shall be used to prevent the roll from sagging and lifting chains or slings from damaging the edges. A "stinger" bar of sufficient strength may also be used, if it is long enough and provides adequate support along the length of the GCL roll. Dragging of the GCL panels over the surface shall be minimized.

The CQA Consultant will document that the following conditions are satisfied by the Geosynthetics Installer:

- Equipment does not damage the GCL or underlying soil by handling, trafficking, excessive heat, leakage of machine operating fuels or oils, or other means.

- The GCL shall be installed in a relaxed condition and shall be free of tension or stress upon completion of the installation. Stretching of the GCL to fit shall not be allowed.
- The GCL shall be straightened to smooth out creases or irregularities in the panels.
- The underlying soil is free of entrapped stones, debris, and moisture.
- No heavy equipment shall drive directly on the GCL.
- If white colored geotextile is used to encapsulate the bentonite, precautions, such as sunglasses, shall be taken against "snowblindness" of personnel.
- The GCL shall not be installed on a saturated subbase or standing water.
- The GCL shall not be installed during precipitation, high winds, or other conditions that may cause hydration of or damage to the GCL.

Geomembrane installation shall immediately follow the GCL installation. The Geosynthetics Installer shall obtain approval of the CQA Consultant prior to placing geomembrane. All GCL that is placed during a day's work shall be covered with geomembrane before the Installer leaves the site at the end of the day. All geomembrane seams shall be welded after each geomembrane panel is placed. Temporary heat sealing of the seam alone is not acceptable unless approved by the Owner's Representative and CQA Consultant. All geomembrane defects and destructive sample locations shall be immediately repaired so as to minimize exposure of the GCL

.

5.3.1 Overlaps

All GCL seams shall be overlapped in accordance with the manufacturer's recommendation. Generally, along the length of the panel, the overlap shall be a minimum of 6 inches, and along the width of the panel, the overlap shall be a minimum of 12 inches. The edges of the GCL panels shall be adjusted to smooth out any wrinkles, creases, or "fishmouths" in order to maximize contact with the underlying panel.

If temperatures are higher than 85 degrees Fahrenheit and humidity is low, contraction may occur soon after placement. In order to account for the possibility of contraction under these conditions, the overlaps may be increased at the discretion of the Geosynthetic Installer and CQA Consultant. However, a minimum overlap of 6 inches along the length of the panel and 12

inches along the width at the panel immediately prior to installation of the geomembrane must be maintained at all times. The overlaps shall not be nailed or stapled to the underlying materials.

After panels are placed, proper overlap orientation shall be established and the edge of the panel shall be pulled back to expose the overlap zone. Any soil or deleterious material present in the overlap zone shall be removed. If required by the GCL Manufacturer, a fillet of granular bentonite, or other sealing material acceptable to the Manufacturer shall be poured in a continuous manner along the overlap zone at a rate of at least 1/4-pound per linear foot or as required by the manufacturer, and around a repair prior to the placement of a patch.

5.3.2 Repair

Any holes or tears in the GCL shall be repaired by placing a patch cut from the same type of GCL over the hole. The patch shall overlap the edges of the hole or tear by at least 1 foot in all directions. If required by the GCL Manufacturer, a fillet of granular bentonite shall be poured in a continuous manner along the overlap zone at a rate of at least 1/4-pound per linear foot or as required by the manufacturer. The patch may be secured with a water-based adhesive approved by the Manufacturer.

Care shall be taken to remove any soil or other material that may have penetrated the torn GCL. Patches shall not be nailed or stapled.

5.3.3 Materials In Contact With GCL

The Geosynthetics Installer shall place all material above the GCL in such a manner so that the GCL is not damaged. No equipment shall drive directly on the GCL unless approved by the Manufacturer, Owner, CQA Consultant, and Regulatory Agency. A minimum thickness of 1 foot of soil shall be required between a low ground-pressure dozer and the GCL. In areas of heavy vehicle traffic, such as access ramps, the soil thickness above the GCL shall be at least 3 feet.

5.4 Backfilling of Anchoring Trench

Anchor trenches shall be adequately drained to prevent ponding or otherwise softening of the adjacent soils while the trench is open. Anchor trenches shall be backfilled and compacted in specified lifts.

Care shall be taken when backfilling the trenches to prevent any damage to the geosynthetics. The CQA Consultant will observe the backfilling operation and advise the Project Manager of any problems.

SECTION IV

GEOMEMBRANE CONSTRUCTION QUALITY ASSURANCE

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GEOMEMBRANE
CONSTRUCTION QUALITY ASSURANCE
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SECTION IV
GEOMEMBRANE CONSTRUCTION QUALITY ASSURANCE

1.0 MANUFACTURER'S DOCUMENTATION

The geomembrane material and installation shall comply with OAC Rule 3745-27-08(D)(10). Prior to delivery, the Geosynthetics Manufacturer shall provide documentation that demonstrates that the property values of the material meet the project requirements. Delivered rolls of geomembrane must be appropriately labeled. Sixty-mil smooth or textured high density polyethylene (HDPE) will be used in the liner system. Forty-mil textured HDPE or 40-mil textured linear low density polyethylene (LLDPE) will be used in the final cover systems.

1.1 Raw Material

The polyethylene shall be an unmodified HDPE or LLDPE containing no plasticizers, fillers, chemical additives, reclaimed polymers, or extenders. Resins used during the manufacturing shall conform to either the resin/geosynthetics manufacturing specifications or to the specified values in Tables 3, 4, and 5, whichever are more stringent.

1.2 Certification of Property Values

The Geosynthetics Manufacturer shall provide the Project Manager with a list of guaranteed minimum average roll values (MARV) for the types of geomembrane to be supplied. The Geosynthetics Manufacturer shall supply the resin quality control certificates provided by the Resin Manufacturer. The Geosynthetics Manufacturer shall provide to the Project Manager quality control certification for each roll of geomembrane shipped to the site confirming that each roll meets or exceeds the guaranteed minimum requirements of the Geosynthetics Manufacturer. The QC certifications shall contain results of the manufacturer's CQC testing ensuring that the physical properties of the final product are in accordance with the manufacturer's specifications and that of Tables 3, 4, and 5.

The CQA Consultant shall examine the manufacturer's certifications and CQC testing results to confirm that the property values meet or exceed the specified values. Deviations shall be reported to the Project Manager.

2.0 DELIVERY

2.1 Packing and Labeling

The geomembrane rolls shall be protected from damage during shipment of the rolls. The central core shall be accessible for handling. The Geosynthetics Manufacturer shall identify all rolls of geomembrane with the following information:

- Manufacturer's name;
- Product identification, including thickness and material type;
- Lot number;
- Roll number;
- Roll weight; and
- Roll dimensions.

The geomembrane roll number or lot number shall directly correspond to the resin identification.

In addition, if any special handling of the geomembrane is required, it shall be so marked on the outside covering of the geomembrane roll. The CQA Consultant shall examine rolls upon delivery and any deviation from the above requirements shall be reported to the Project Manager.

2.2 Transportation and Handling

Transportation of the geomembrane is the responsibility of the Geomembrane Manufacturer, Geosynthetics Installer, or Transporter as directed by the Geosynthetic Installer. All handing on the site is the responsibility of the Geosynthetic Installer.

The CQA Consultant will confirm that:

- Handling equipment used on the site is adequate and does not damage the geomembrane; and
- The Geosynthetics Installer's personnel handle the geomembrane with care.

The geomembrane shall be shipped in accordance with the Geosynthetic Manufacturer's recommendations. Upon delivery to the site, the Geosynthetics Installer and CQA Consultant shall review all rolls for defects and damage. This review shall be conducted without unrolling the rolls unless defects or damages are found or suspected. The CQA Consultant shall indicate to the Project Manager any rolls with minor repairable flaws and any rolls or portions of rolls which should be rejected because of severe flaws.

2.3 Storage

The Geosynthetics Installer shall be responsible for the storage of the geomembrane on-site. The Project Manager shall provide storage space in one or more locations such that on-site transportation and handling are minimized. Storage space shall protect the geomembrane from vandalism, passage of vehicles, etc.

The geomembrane shall be stored on a prepared surface no more than three rolls in height or as recommended by the Geosynthetics Manufacturer. The CQA Consultant shall inspect the storage areas to verify that the surface is smooth, flat, and free of rocks or other objects that could cut or puncture the liner. The CQA Consultant shall also document that storage of the geomembrane provides adequate protection against dirt, impact, and other sources of damage.

3.0 CONFORMANCE TESTING OF DELIVERED GEOMEMBRANES

Geomembrane sampling for conformance testing may take place at the geomembrane manufacturing plant by the Geomembrane Manufacturer, the Geosynthetics CQA Laboratory, or a representative of the Owner or the CQA Consultant. The samples shall be forwarded to the Geosynthetics CQA Laboratory. Conversely, the CQA consultant may retrieve geomembrane samples from material delivered to the site and forward them to the Geosynthetics CQA Laboratory for conformance testing to determine compliance with the project specifications.

3.1 Sampling Procedures

Sample locations shall be selected in accordance with the sampling frequency. Samples shall be taken across the entire width of the roll and shall not include the first 3 feet. Unless otherwise specified, samples shall be 3 feet long by the roll width. Samples of geomembrane shall be taken at the frequencies listed in Tables 3, 4, and 5. The sample shall be clearly marked and indicate the roll number from which the sample was taken.

3.2 Test Results

The CQA Consultant shall examine the results of laboratory conformance testing and shall report any non-conformance to the Project Manager. The minimum standards for the geomembrane are given in Tables 3, 4, and 5.

3.3 Conformance Test Failure

The following procedure shall apply whenever a sample fails a conformance test that is conducted by the Geosynthetics CQA Laboratory:

- The Geosynthetics Manufacturer or CQA Consultant shall remove conformance samples for testing by the Geosynthetics CQA Laboratory from the closest numerical roll on both sides of the failed roll. These two samples must conform to the Specifications. If either

of these samples fail, testing will proceed on samples collected from the closest numerical roll to the failed roll until rolls are located that conform to the Specifications.

- The Geosynthetics Manufacturer shall replace any roll of geomembrane that is in non-conformance with the Specifications with a roll that meets the Specifications.

The CQA Consultant shall document actions taken in conjunction with conformance test failures.

4.0 HANDLING AND PLACEMENT

4.1 Handling

The Geosynthetic Installer shall handle geomembrane in such a manner as to minimize damage to the geomembrane and comply with the following:

- The equipment or tools used for handling, trafficking, or other operations shall not cause damage to the geomembrane;
- Personnel working on the geomembrane shall not smoke, wear damaging shoes, or engage in activities that will cause damage to the geomembrane;
- The equipment used to deploy the geomembrane shall not cause damage to the GCL and/or recompacted soil liner; and
- To prevent geomembrane uplift by wind, sand bags or tires shall be placed as frequently along the edges as deemed necessary.

4.2 Installation Schedule

Geomembrane installation shall immediately follow GCL installation. The Geosynthetics Installer shall obtain approval from the CQA Consultant prior to placing the field panels. Field panels shall be placed one at a time and each field panel shall be seamed on the same day as placement. The panels shall be shingled from the highest elevation toward the lowest elevation. Up-slope panels shall be shingled over down-slope panels to direct flow over the seam and not into the seam. When in position, the field panels shall be checked for any physical damage caused either during manufacture or during installation.

4.3 Field Panel Identification

A field panel is the unit area of geomembrane that is to be seamed in the field. The CQA Consultant shall document that the Geosynthetics Installer labels each field panel with an "identification code" (alphanumeric). This identification code will be decided upon by the CQA Consultant and Geosynthetics Installer during the pre-construction meeting. The CQA

Consultant may consider using P (for Panel) as an identification code. A seam between P1 and P2 may be identified as S 1/2 (Seam 1/2), where 1 and 2 are unique identifications for panels. It will be the responsibility of the Geosynthetics Installer to mark each field panel with the original roll number, date, and time of deployment. The roll number shall be conspicuously marked.

The CQA Consultant will document the correspondence between roll numbers and field panel identification codes. The field panel identification code will be used for all quality assurance records.

4.4 Weather Conditions

Geomembrane placement and welding shall not proceed at an ambient temperature below 35°F or above 110°F unless the Geosynthetics Installer can provide documentation to the Project Manager that the resulting seam meets or exceeds the required seam properties as set forth in Tables 3, 4, and 5. In addition, the seaming procedure shall not cause any physical or chemical modifications to the geomembrane that will generate short or long term damage. Geomembrane placement shall not be performed during significant precipitation, in an area of ponded water, or in the presence of excessive winds.

The CQA Consultant shall verify that the above conditions are fulfilled. Additionally, the CQA Consultant shall verify that the supporting soil or GCL have not been damaged by weather conditions.

The Geosynthetics Installer shall deploy the geomembrane from the higher elevation to the lower elevation. The CQA Consultant shall note non-compliance and report it to the Project Manager.

4.5 Method of Placement

The CQA Consultant shall document that the following conditions are satisfied by the Geosynthetics Installer:

- Any equipment used does not damage the geomembrane or underlying GCL by handling, trafficking, excessive heat, leakage of machine operating fuels or oils, or other means.
- The method used to place the panels minimizes wrinkles (especially differential wrinkles between adjacent panels).
- When deployed over a GCL, geomembrane deployment on the underlying GCL shall be by hand or lightweight vehicle as approved by the CQA Consultant. The underlying GCL will be clean and free of debris.
- No personnel working on the geomembrane will smoke, wear damaging shoes, or engage in other activities that could damage the geomembrane.
- The method used to unroll the geomembrane does not cause scratches or crimps in the geomembrane and does not damage the underlying soils and/or GCL.
- Adequate temporary loading and/or anchoring (e.g., sand bags, tires), not likely to damage the geomembrane, has been placed to prevent uplift by wind (In case of high winds, continuous loading by adjacent sand bags, or soil is recommended along edges of panels to minimize risk of wind flow under the panels).
- Direct contact with the geomembrane is minimized, i.e., the geosynthetics are protected by geotextiles, extra geomembrane, or other suitable materials in areas where excessive traffic may be expected.

The CQA Consultant shall inform the Project Manager if the above conditions are not satisfied.

4.6 Damage

The CQA Consultant and Geosynthetics Installer shall inspect each geomembrane panel for damage prior to seaming. The CQA Consultant shall advise the Project Manager what panel or portions of panels shall be rejected. Damaged panels or portions of damaged panels that have been rejected shall be marked and their removal from the work area recorded by the CQA Consultant. Repairs to geomembrane shall be made according to procedures described in Section 5.9.2.

5.0 SEAMING AND TESTING

5.1 Seaming Strategies

The Geosynthetics Installer shall provide the Project Manager with the panel layout drawings. The Project Manager, CQA Consultant, and the Geosynthetics Installer shall agree on the proposed layout before deployment of the geomembrane.

The layout drawings shall meet the following requirements as far as practicable:

- Seams shall be oriented parallel to the line of maximum slope, i.e., oriented down, not across the slope.
- If the area to be lined is an unusual geometric shape, the Geosynthetics Installer shall minimize the number or length of seams.
- For horizontal seams running perpendicular to the slope (i.e., on the floor), a distance of at least 10 feet shall be maintained from the toe and/or crest of slope.

The Geosynthetics Installer shall avoid seaming areas with wrinkles and "fishmouths." Before seaming can start, the Geosynthetics Installer shall confirm the following:

- The panels of the geomembrane have a finished overlap of a minimum of 3 inches for extrusion seaming and 4 inches for fusion seaming, or otherwise matching the Geosynthetic Installer's equipment. Sufficient overlap shall be provided to allow peel tests to be performed on the seam.
- No solvent or adhesive is used.
- The procedure used to temporarily bond adjacent panels together does not damage the geomembrane; in particular, the temperature of hot air at the nozzle of any spot welding apparatus shall be controlled such that the geomembrane is not damaged.

The seams shall be marked with a seam numbering system compatible with the panel numbering system that shall be agreed upon at the Pre-construction meeting. Labeling of the seams shall

include, seam identification, weld start time, weld equipment, equipment settings, weld technician, and all data related to the CQC testing of the seam integrity.

5.2 Seaming Equipment and Products

Approved processes for field seaming are extrusion welding and hot wedge (fusion) welding. Proposed alternate processes shall be documented and submitted to the Project Manager for approval. Only apparatus that have been specifically approved by make and model shall be used. The Geosynthetic Installer shall maintain spare operable seaming apparatus on-site.

The CQA Consultant will also confirm that:

- Equipment used for seaming is not likely to damage the geomembrane;
- The electric generator is placed on a base such that no damage occurs to the geomembrane from puncture or leaking fluids;
- A smooth insulating plate or fabric is placed beneath the hot seaming apparatus after usage; and
- The geomembrane is protected from damage in heavily traffic areas.

5.2.1 Extrusion Welder

The extrusion welder shall be equipped with gauges giving the relevant temperatures of the apparatus at the nozzle and extruder barrel. The extrusion welder shall be purged prior to beginning a seam until all heat-degraded extrudate has been removed from the barrel. The Geosynthetics Installer shall certify that the extrudate is compatible with and is comprised of the same resin as the geomembrane and shall provide documentation regarding the extrudate to the Project Manager and the CQA Consultant.

5.2.2 Fusion Welder

The fusion welding apparatus shall be equipped with gauges giving the applicable temperatures. Pressure settings shall be verified by the Geosynthetic Installer prior to each seaming period. A

double-wedge fusion welder produces a double seam with an enclosed air space between the seams. The Geosynthetics Installer shall prevent build-up of moisture between the sheets. A moveable protective sheet may be used as required directly below each overlap of geomembrane that is to be seamed. The CQA Consultant shall log ambient temperatures, seaming apparatus temperatures, and speeds.

5.3 Seam Preparation

The CQA Consultant shall confirm that:

- Prior to seaming, the seam area is clean and free of moisture, dust, dirt, oils, greases, debris of any kind, and foreign material;
- Seams are aligned with the proper overlap and the fewest possible number of wrinkles and fishmouths;
- If seam overlap grinding is required, the process is completed according to the Geosynthetics Manufacturer's instructions within 30 minutes of the seaming operation, and in a way that does not damage the geomembrane;
- The abrasion does not extend more than 0.25 inches on either side of the extrusion seam;
- The procedure used to temporarily bond seams together does not damage the geomembrane; and
- Solvents or adhesives shall not be used unless the product is approved in writing by the Project Manager.

5.4 Weather Conditions for Seaming

The normally required weather conditions for seaming are the same as those for deploying geomembrane discussed in Section 4.4, which are as follows:

- Unless authorized in writing by the Project Manager, no seaming shall be attempted at an ambient temperature below 35° F or above 110° F; and
- The geomembrane shall be dry and protected from wind.

If the Geosynthetics Installer wishes to use methods which may allow seaming at ambient temperatures below 35°F or above 110°F, the Geosynthetics Installer shall demonstrate that such methods produce seams which are entirely equivalent to seams produced within the acceptable ambient temperature range, and that the overall quality of the geomembrane is not adversely affected. The Geosynthetics Installer is required to provide documentation that the seaming procedure does not cause any physical or chemical modification to the geomembrane that will generate any short or long term damage to the geomembrane. If these requirements are met, the temperatures in the above quality assurance procedure shall be modified accordingly.

The CQA Consultant shall document that those weather conditions are fulfilled and shall advise the Project Manager if they are not.

5.5 Trial Seams

Trial seams shall be made on fragments of geomembrane liner to document that seaming equipment and conditions are adequate. Such trial seams shall be made at the beginning of each seaming period for each operator/equipment combination used in the seaming period. A trial seam shall also be made in the event that the equipment is turned off, or an operator changes, or if the CQA Consultant requests. Trial seams shall be made under the same conditions as actual seams.

The Geosynthetics Installer shall provide a tensiometer for on-site peel testing of geomembrane seams. The tensiometer shall be in good working order, built to ASTM specifications, and accompanied by evidence of recent calibration. The tensiometer shall be motor driven and have jaws capable of traveling at a measured rate of 2 inches per minute. It shall be equipped with a gauge that measures the force in pounds exerted between the jaws and have a digital readout.

The trial seam sample shall be the dimensions required by the Geosynthetics Installer with the seam centered lengthwise. Seam overlap shall be approximately 3 inches for extrusion welds and 4 inches for fusion welds or as required by Geosynthetic Installer equipment. Refer to Tables 3, 4, and 5 for the trial seam test method, test frequency and acceptance criteria.

In each type of test, all specimens shall meet the minimum strength requirements. If a trial seam fails, the entire operation should be repeated. If the additional trial seam fails, the seaming apparatus and seamer shall not be accepted and shall not be used for seaming until the deficiencies are corrected and two consecutive successful full trial seams are achieved.

The CQA Consultant shall observe all trial seam procedures. All trial seams shall be assigned a number and marked accordingly by the CQA Consultant. The CQA Consultant shall log the date, hour, ambient temperature, number of seaming unit, name of seamer, and pass or fail description. The sample itself shall be cut into two pieces, one to be retained in the Owner's archives, one to be given to the Geosynthetics Installer.

5.6 Seaming Procedure

5.6.1 Extrusion Seaming

Unless otherwise specified, the general seaming procedure for extrusion seaming used by the Geosynthetics Installer shall be as follows:

- The upper sheet is lowered and laid flat against the lower sheet and all surface sheen in the area to be seamed must be removed. Sand paper coarser than No. 80 is unacceptable, because it can leave deep grooves in the weld area that represent potential stress points or leak channels. All material dust generated by grinding the liner sheets must be wiped or blown away from the seaming zone.
- Grind marks should never be deeper than 10 percent of the sheet thickness. Optimally, they should be about 5 percent of the sheet thickness. The only purpose of grinding is the removal of oxide layers and dirt from the liner surfaces, and the roughening of their interface for the extrudate.
- Grinding marks should not extend beyond 1/4 inches of either side of the extrudate after its placement. For example, if the final extrudate bead width is 1.5 inches, the width of the grinding trail should not exceed 2 inches.
- Seaming must take place no more than 30 minutes after grinding, so that surface oxide layers do not reappear where the extrudate must be placed.

- A hot air device (often called a "liester") may be used to temporarily bond or "tack" the two sheets together, ahead of the extrusion welder. The hot air device prepares the seam for the extrusion welder by heating the ground surface and by creating a light bond between the two sheets, securing their position. The hot air gun is not meant to create a final seam. No heat distortion should be evident on the sheets.
- The extrusion welder's barrel shall be purged of all heat-degraded extrudate before starting a seam. This must be done every time the extruder is restarted after two or more minutes of inactivity. The purged extrudate shall not be discharged onto the surface of previously placed liner, prepared soils, or installed GCL where it would eventually form a hard lump under the liner and cause stress concentrations.
- The center of the extrudate shall pass directly along the edge of the upper liner, at sufficient width to completely cover the edge and most of the outlying grind marks, at least to within 1/4 inch of their extremity.
- The extrudate should be approximately twice the specified sheet thickness, measured from the top of the bottom sheet to the top or "crown" of the extrudate.
- Where possible, inspect the underside of the lower liner for heat distortion. This can be done at the end of seams, and wherever samples are cut out of the seam. A slight amount of thermal "puckering" on relatively thin liners (less than 50-mil) is acceptable. It indicates that the heat penetrated entirely through the sheet. However, if the underside is greatly distorted, either lower the temperature or increase the rate of seaming. Any change in the welding procedure requires replacement trial seams to be prepared.
- If the seaming process must be interrupted at mid-seam, the extrudate should trail off gradually, not terminate in a large mass of solidified extrudate. Where such welds are abandoned long enough to cool, they must be ground prior to continuing with new extrudate over the remainder of the seam. Grind where the extrudate trail-off begins. This restart procedure must be followed for patches, pipes, fittings, and appurtenances.

5.6.2 Fusion Seaming Process

Unless otherwise specified, the general seaming procedures for fusion seaming used by the Geosynthetics Installer shall be as follows:

- The fusion seaming apparatus should be properly positioned for making the desired single or dual weld seam.
- Ambient variables such as temperature, cloud cover, and wind speed may make it necessary to vary the temperature of the wedge. It may be useful to document wedge temperatures used successfully in a variety of ambient conditions, so that the hot wedge can be more accurately adjusted if new conditions develop.
- The drive motor should be off when positioning the welding machine to seam. Place the machine where the sheets overlap. Guide the overlapped material between the idlers and the wedge, and into the drive/nip rollers. When continuing a weld that has been abandoned mid-seam, the liners must be spread where the seam leaves off and loaded into the respective sides of the machine. Raise the machine a few inches, load the bottom sheet first, and then load the top sheet. When the nip rollers engage and the wedge is in position, turn on the drive motor. Immediately engage the sheets when they are between the nip rollers to prevent an imminent melt-through. Move the hot wedge into position and lock it.
- The operator must constantly monitor the temperature controls, as well as the completed seam passing out of the machine. Occasional adjustments in temperature or speed may be necessary to maintain a consistent weld. Visual inspection and constant hand testing by the peel method (or other) is also recommended.

5.7 Non-Destructive Seam Continuity Testing

The Geosynthetics Installer shall non-destructively test all field seams over their full length using a vacuum test unit, air pressure test (for double fusion seams only), spark test, or other approved method. The testing shall be carried out to the accepted standards of the industry. The purpose of non-destructive tests is to check the seams for leaks. It does not provide any information on seam strength or quality of bonding. Non-destructive testing shall be carried out as the seaming work progresses, not at the completion of all field seaming. Non-destructive testing shall be performed during daylight hours unless the Geosynthetics Installer demonstrates capabilities to do so.

The CQA Consultant shall:

- Observe all non-destructive testing;
- Record location, date, test unit number, name of tester, and outcome of all testing; and
- Inform the Geosynthetics Installer and Project Manager of any test failures and required repairs.

The Geosynthetics Installer shall complete any required repairs in accordance with Section 5.9.2.

The CQA Consultant shall:

- Observe the repair and retesting of the repair;
- Mark on the geomembrane that the repair has been made; and
- Document the results.

The Geosynthetics Installer shall use the following procedures at locations where seams cannot be non-destructively tested, such as double hot wedge segments that are short or areas where extrusion beads do not permit the vacuum box to completely seal:

- All such seams shall be cap-stripped with the same geomembrane; and
- Each cap strip shall be vacuum tested in accordance with Section 5.7.1.

The seam number, date of observation, name of tester, and outcome of the test or observation shall be recorded by the CQA Consultant.

5.7.1 Vacuum Testing

The equipment shall be comprised of the following:

- A vacuum box assembly consisting of a rigid housing, a transparent viewing window, a soft neoprene gasket attached to the bottom, port hole or valve assembly, and a gauge to indicate chamber vacuum;
- A steel vacuum tank and pump assembly equipped with a vacuum gauge and pipe connections;
- A rubber pressure/vacuum hose with fittings and connections;
- A bucket and wide brush, mop or spray assembly; and
- A soapy solution.

The following procedures shall be followed:

- Energize the vacuum pump;
- Wet a strip of geomembrane approximately 12 inches by 48 inches with a soapy solution;
- Place the box over the wet area;
- Close the bleed valve and open the vacuum valve;
- Ensure that a leak tight seal is created;
- At a vacuum of at least 5 psi, for a period of approximately 10 seconds, examine the geomembrane through the viewing window for the propagation of soap bubbles;
- Close the vacuum valve and open the bleed valve, move the box over the adjoining area with a minimum 3 inches overlap, and repeat the process;
- All areas where soap bubbles appear shall be marked and repaired in accordance with Section 5.9.2; and
- Vacuum tested seams shall be recorded.

5.7.2 Air Pressure Testing (For Double Hot Wedge Seam Only)

The equipment shall be comprised of the following:

- An air pump (manual or motor driven) equipment with pressure gauge capable of generating a minimum pressure of 30 pounds per square inch (psi);
- A rubber hose with fittings and connections; and
- Hollow needle and clamp assembly or other approved pressure feed device.

The following procedures shall be followed:

- Seal one end of the seam to be tested;
- Insert needle or other approved pressure feed device into the air channel created by the fusion weld;
- Energize the air pump to a pressure of 30 to 35 psi, close valve, and hold pressure for approximately 5 minutes;
- If loss of pressure exceeds 3 psi, or does not stabilize, locate faulty area and repair in accordance with Section 5.9.2;
- Release air pressure by puncturing seam at opposite end of where pressure is applied to assure there is no blockage in the air channel and verify that the full seam has been pressurized;
- Remove needle or other approved pressure feed device and seal; and
- Pressure tested seams shall be recorded.

5.7.3 Spark Testing

For those extrusion welded seams that are unable to be tested by a vacuum box, the spark test method shall be used. The spark test method utilizes a 24 gauge copper wire placed 1/8 inch under the top sheet overlap and a holiday detector operating at 20,000 volts.

The testing activities shall be performed by the Geosynthetics Installer by placing the electrically conductive wire beneath the seam prior to welding. A trial seam containing a non-welded segment shall be subject to a calibration test to ensure that such a defect (non-welded segment) will be identified under the planned machine settings and procedures.

Upon completion of the weld, enable the spark tester and hold approximately 1 inch above the weld moving slowly over the entire length of the weld in accordance with ASTM D6365. If there is no spark, the weld is considered to be leak free.

A spark indicates a hole in the seam. The faulty area shall be located, repaired, and retested by the Geomembrane Installer.
Care shall be taken if flammable gases are present in the area to be tested.

5.8 Destructive Testing

Destructive testing of seams shall be performed at locations selected by the CQA Consultant. The purpose of these tests is to evaluate seam strength and bonding efficiency, which indicates seam durability. Seam strength testing shall be done as the seaming work progresses, not at the completion of all field seaming.

5.8.1 Location and Frequency

The CQA Consultant shall select locations where seam samples shall be cut out for laboratory testing. Those locations shall be established as follows:

- A minimum average frequency of one test location per 500 feet of seam length per seaming device for each type of seaming. This minimum frequency is to be determined as an average taken throughout the entire facility for each type of seaming.
- Test locations shall be random and shall be selected during seaming by the CQA Consultant. Selection of such locations may be prompted by suspicion of excess crystallinity, contamination, offset seams, or any other potential cause of imperfect seaming.

The Geosynthetics Installer shall not be informed in advance of the locations where the seam samples shall be taken.

5.8.2 Sampling Procedure

Samples shall be cut by the Geosynthetics Installer as the seaming progresses in order to have laboratory test results before the geomembrane is covered by another material.

The CQA Consultant shall:

- Select sample locations;
- Observe sample cutting;
- Assign a number to each sample, and mark it accordingly;
- Record the sample location on the as-built layout drawing; and
- Record any special reason for taking the sample at this location (e.g., suspicious feature of the geomembrane).

All holes in the geomembrane resulting from destructive seam sampling shall be immediately repaired by capping in accordance with repair procedures described in Section 5.9.2. The continuity of the new seams in the repaired area shall be tested according to Section 5.7.

5.8.3 Size of Samples

At a given sampling location, a destructive sample shall be cut from the seam by the Geosynthetic Installer with dimensions as stated in Tables 3, 4, and 5. The seam shall then be distributed as follows:

- One portion to be tested onsite by the Geosynthetics Installer;
- One portion to the Owner for archive storage; and
- One portion for Geosynthetics CQA Laboratory testing.

5.8.4 Field Testing

Five 1-inch wide samples, or "bones" shall be tested by the Geosynthetic Installer in the field for peel strength using a tensiometer. The results of field testing shall meet the acceptance criteria shown on Tables 3, 4, and 5. If any field test sample fails, then the procedures outlined in Section 5.8.7 shall be followed. If the field test sample passes, the sample shall be sent to the Geosynthetics CQA Laboratory for testing.

The CQA Consultant shall document all field tests and mark all samples and portions with their number. The CQA Consultant shall also log the date and time, number of seaming unit, name of technician, seaming apparatus temperatures and speeds, and pass or fail description.

5.8.5 Geosynthetics CQA Laboratory Testing

Destructive test samples being forwarded to the geosynthetics CQA laboratory shall be packaged and shipped under the responsibility of the CQA Consultant in a manner that will not damage the test sample. The Project Manager shall be responsible for storing the archive samples. Test samples shall be tested by the Geosynthetics CQA Laboratory. The Geosynthetics CQA Laboratory shall be selected by the Project Manager.

The Geosynthetics CQA Laboratory shall provide test results no more than 24 hours after they receive the samples. The CQA Consultant shall review laboratory test results as soon as they become available and make appropriate recommendations to the Project Manager. Refer to Tables 3, 4, and 5 for the test method and acceptance criteria.

5.8.6 Geosynthetics Installer's Laboratory Testing

If performed, the Geosynthetics Installer's laboratory test results shall be presented to the Project Manager and the CQA Consultant for review.

5.8.7 Procedures for Destructive Test Failure

The following procedures shall apply whenever a sample fails a destructive test, whether that test is conducted by the Geosynthetics CQA Laboratory, the Geosynthetics Installer's laboratory, or by field testing. The Geosynthetics Installer has two options:

- The Geosynthetics Installer can reconstruct the seam between any two passed destructive seam test locations; or
- The Geosynthetics Installer can trace the seaming path to an intermediate location at least 10 feet in both directions from the point of the failed test. Check the next seam welded using the same welding device if required to obtain additional sample (i.e., if one side of the seam is less than 10 feet long). A small sample for an additional field test at each location shall be taken. If these additional samples pass tensiometer testing, then full destructive laboratory samples are taken. If these destructive laboratory samples pass the tests, then the seam is reconstructed between these locations by capping. If either sample fails, the process is repeated to establish the segment in which the seam should be reconstructed.

If a fusion type seam fails destructive testing and the Geosynthetics Installer chooses to repair the seam, it shall be repaired as described in Section 5.9.2.

All acceptable seams must be bounded by two locations from which destructive samples passing laboratory tests have been taken. In cases exceeding 150 feet of reconstructed seam, a seam sample shall be taken from the zone in which the seam has been reconstructed. This sample must pass destructive testing or the procedure outlined in this Section must be repeated. The CQA Consultant shall document all actions taken in conjunction with destructive test failures.

5.9 Defects, Repairs, and Retests

5.9.1 Defects

The CQA Consultant shall visually monitor each panel and seam for identification of defects, holes, blisters, undispersed raw materials, and any sign of contamination by foreign matter. The geomembrane shall be clean at the time of the inspection. Any defects or damage shall be logged on deficiency forms. The actions taken to resolve or correct the problem along with non-destructive test results shall also be recorded on the form. Geomembrane shall not be covered at locations that have been repaired until test results with passing values are available.

5.9.2 Repairs

Any portion of the geomembrane failing a destructive or non-destructive test shall be repaired. Prior to repairing a problem area, the CQA Consultant and the Geosynthetics Installer shall agree on the repair method to be used. If no concurrence is reached, the Project Manager's decision shall be final. The procedures available include:

- Patching - used to repair holes and tears, along with tees, and wyes at the ends of a seam, and contamination by foreign matter;
- Buffing and re-welding - used to repair small sections of extruded seams;
- Spot welding or seaming - used to repair minor localized flaws; and
- Capping - used to repair large lengths of seams or panels.

In addition, the following provisions shall be satisfied:

- Surfaces of the geomembrane which are to be repaired shall be abraded no more than 30 minutes prior to the repair;
- All surfaces must be clean and dry at the time of the repair;
- All seaming equipment used in repair procedures must be approved;
- The repair procedures, materials, and techniques shall be approved in advance of the specific repair by the Project Manager and CQA Consultant; and

- Patches or caps shall extend at least 6 inches beyond the edge of the defect, and all corners of patches shall be rounded with a radius of at least 3 inches.

5.9.3 Retests

Each repair shall be non-destructively tested unless the CQA Consultant deems otherwise. If a repair passes the non-destructive test, it shall be documented as satisfactory by the CQA Consultant. Failed tests shall require the repair to be redone and retested until a passing test results.

5.10 ELECTRICAL CONDUCTIVITY INTEGRITY TESTING

'Following placement of the leachate collection layer in Phases 5 thought 7, electrical conductivity integrity testing of the geomembrane may be conducted. The test cannot be performed if the tire shreds are placed for the leachate collection layer because of their insulating property. Defective areas or seams identified during the test shall be repaired as discussed in section 5.9. The CQA consultant shall document the results of the test and note defective areas and repairs.

6.0 GEOSYNTHETICS CERTIFICATION/ACCEPTANCE

The Geosynthetics Installer, Geosynthetics Manufacturers, and the Geosynthetics Fabricator shall retain all ownership and responsibility for the geosynthetic materials until they are accepted by the Owner.

The geosynthetics system shall be accepted by the Owner when:

- The installation is finished;
- Verification of the adequacy of all seams and repairs, including associated testing, is complete;
- Geosynthetics Installer's representative furnishes the Project Manager with documentation that the geomembrane was installed in accordance with the Geosynthetics Manufacturer and Geosynthetic Fabricator's recommendations as well as the Drawings and Specifications; and
- All documentation of installation is completed including the CQA Consultant's final report.

The CQA Consultant shall document that installation has proceeded in accordance with this CQA/QC Plan for the project except as noted to the Project Manager.

7.0 MATERIALS IN CONTACT WITH GEOMEMBRANES

The quality assurance procedures indicated in this Section are only intended to assess that the installation of these materials does not damage the geomembrane. Additional quality assurance procedures are necessary to determine that systems built with these materials shall be constructed in such a way to enable proper performance.

7.1 Geotextile

The CQA Consultant shall document that the geotextile is installed in accordance with the procedures described in Section VI, Geotextile Construction Quality Assurance, of this CQA/QC Plan. Care shall be exercised so as not to damage the geomembrane during placement of the geotextile.

7.2 Geocomposite

The CQA Consultant shall document that the geocomposite is installed in accordance with the procedures described in Section V, Geocomposite Construction Quality Assurance, of this CQA/QC Plan. Care shall be exercised so as not to damage the geomembrane during placement of the geocomposite.

7.3 Appurtenances

A copy of the Specifications and Drawings prepared by the Design Engineer for appurtenances shall be given by the Project Manager to the CQA Consultant for review.

The CQA Consultant shall document that:

- Installation of the geomembrane in appurtenance areas, and connection of geomembrane to appurtenances have been made according to Specifications.

- Extreme care is taken while seaming around appurtenances, and that non-destructive testing using appropriate methods is performed.
- The geomembrane has not been visibly damaged while making connections to appurtenances.
- The Project Manager is informed if the above conditions are not fulfilled.

7.4 Backfilling of Anchor Trench

Anchor trenches shall be adequately drained, to prevent ponding or otherwise softening of the adjacent soils while the trench is open. Anchor trenches shall be backfilled as outlined in Sub-Section 5.4 of Section III of this CQA/QC Plan.

Care shall be taken when backfilling the trenches to prevent any damage to the geosynthetics. The CQA Consultant shall observe the backfilling operation and advise the Project Manager of any problems.

SECTION V

GEOCOMPOSITE CONSTRUCTION QUALITY ASSURANCE

SECTION V
GEOCOMPOSITE
CONSTRUCTION QUALITY ASSURANCE
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SECTION V
GEOCOMPOSITE
CONSTRUCTION QUALITY ASSURANCE

1.0 INTRODUCTION

A double-sided geocomposite consisting of a geonet with geotextile bonded to both sides will be installed within the final cover system of the landfill as the drainage layer. *A geocomposite will also be used in the underdrain system.*

Prior to delivery, the Geocomposite Fabricator shall provide to the Project Manager quality control certification for the geocomposite delivered to the site confirming that the material meets the guaranteed minimum requirements of the Geocomposite Fabricator. The geotextile shall be a non-woven polypropylene or polyester material. The geonet shall consist of two or more traverse strands of high density polyethylene. The geocomposite shall be free of oil, grease and other foreign materials.

1.1 Certification of Property Values

The Geocomposite Fabricator shall provide the Project Manager with a list of guaranteed minimum average roll values (MARV) for the type of geocomposite to be supplied. The Geosynthetics Manufacturer shall provide to the Project Manager quality control certification for each roll of geocomposite shipped to the site confirming that each roll meets or exceeds the guaranteed minimum requirements of the Geosynthetics Manufacturer. The QC certifications shall contain results of the manufacturer's CQC testing ensuring that the physical properties of the final product are in accordance with the manufacturer's specifications and that of Table 6. Prior to use in the manufacturing of the geonet, raw material resins used in the manufacturing of the geonet shall be tested by the resin manufacturer or geosynthetics manufacturer. Results of all resin testing shall conform to either the resin/geosynthetics specifications or to the specified values in Table 6, whichever is more stringent.

The CQA Consultant shall examine manufacturer's certifications and CQC testing results to confirm that the property values meet or exceed those specified in Table 6. Deviations shall be reported to the Project Manager.

1.2 Labeling

The Geocomposite Fabricator shall identify all rolls of geocomposite with the following:

- Manufacturer's name;
- Product identification;
- Lot number;
- Roll number; and
- Roll dimensions.

In addition, if any special handling of the geocomposite is required, it shall be so marked on the top surface of the geocomposite, e.g., "This Side Up." The CQA Consultant shall examine rolls upon delivery and any deviation from the above requirements shall be reported to the Project Manager.

2.0 SHIPMENT AND STORAGE

2.1 Packaging and Labeling

The finished geocomposite shall be completely wrapped and adequately secured with a durable opaque cover in order to provide protection from ultraviolet degradation of the geotextile, precipitation, mud, dirt dust, puncture, cutting, or any other damaging or deleterious conditions during shipping and storage. The central core shall be accessible for handling. The geocomposite rolls shall be marked or tagged with the following information:

- Manufacturer's name;
- Product identification;
- Lot or batch number;
- Roll number;
- Roll weight; and
- Roll dimensions.

The CQA Consultant shall examine rolls upon delivery and any deviation from the above requirements shall be reported to the Project Manager.

2.2 Transportation and Handling

Transportation of the geocomposite is the responsibility of the Geocomposite Manufacturer, Geosynthetics Installer, or Transporter, as directed by the Geosynthetic Installer. All handling on site is the responsibility of the Geosynthetics Installer.

The CQA Consultant will confirm that:

- Handling equipment used on the site is adequate and does not damage the geocomposite; and
- The geocomposite is handled with care.

The geocomposite shall be shipped in accordance with the Geocomposite Manufacturer's recommendations. Upon delivery to the site, the Geosynthetics Installer and CQA Consultant shall review all rolls for defects and for damage. This review shall be conducted without unrolling the rolls unless defects or damages are found or suspected. The CQA Consultant shall indicate to the Project Manager any rolls with minor repairable flaws and any rolls or portions of rolls which should be rejected because of severe flaws.

2.3 Storage

The Geosynthetic Installer shall be responsible for the storage of the geocomposite on site. The Project Manager shall provide storage space in a location (or several locations) such that on-site transportation and handling are minimized. Storage space should protect the geocomposite from vandalism, passage of vehicles, precipitation, etc.

The rolls of geocomposite shall be stored in their original, unopened, wrapped cover in a clean dry area. The geocomposite shall be protected from mud, dirt, dust, excessive heat or cold, puncture, cutting, or other damaging or deleterious conditions. The rolls shall not be stacked more than six rolls high, due to the possibility of thinning of the product at points of contact. Any additional procedures required by the Geocomposite Manufacturer shall be the Geosynthetics Installer's responsibility.

3.0 CONFORMANCE TESTING OF DELIVERED GEOCOMPOSITE

The Geocomposite Fabricator shall remove samples of geotextile for testing by the Geosynthetics CQA Laboratory to confirm that the geotextile used in the geocomposite meets the requirements for material acceptance. The geotextile samples shall be removed before the geotextile is bonded to the geonet.

Geocomposite sampling for conformance testing may take place at the geocomposite manufacturing plant by the Geocomposite Manufacturer, the Geosynthetics CQA Laboratory, a representative of the Owner, or the CQA Consultant. The samples shall be forwarded to the Geosynthetics CQA Laboratory. Conversely, the CQA consultant may retrieve geocomposite samples from material delivered to the site and forward them to the Geosynthetics CQA Laboratory for conformance testing to determine compliance with the project specifications. The CQA Consultant will document that the delivered geocomposite meets the requirements in Table 6 for material acceptance.

3.1 Sampling Procedures

Samples of geotextile shall be taken from the rolls of geotextile used in the geocomposite to be delivered to the site. Samples shall be taken across the entire width of the roll and shall be taken prior to the geotextile being bonded to the geonet. Samples of geocomposite shall be taken across the entire width of the roll and will not include the first 3 linear feet. Unless otherwise specified, all samples shall be 3 feet long by the roll width. The machine direction shall be marked on the samples with an arrow. Samples of geotextile and/or geocomposite shall be taken at the rates specified in Table 6.

3.2 Test Results

The CQA Consultant shall examine results from laboratory conformance testing and shall report non-conformance to the Project Manager.

3.3 Conformance Test Failure

The following procedure shall apply whenever a sample fails a conformance test that is conducted by the Geosynthetics CQA Laboratory:

- The Geosynthetics Installer shall remove conformance samples for testing by the Geosynthetics CQA Laboratory from the closest numerical roll on both sides of the failed roll. These two samples must conform to the Specifications. If either of these samples fail, testing will proceed on samples from the closest numerical roll to the failed roll until rolls are located that conform to the Specifications.
- The Geosynthetics Installer shall replace the roll of geocomposite that is in non-conformance with the Specifications with a roll that meets the Specifications.

The CQA Consultant shall document actions taken in conjunction with conformance test failures.

4.0 HANDLING

As each geocomposite roll is moved from the storage area, the labels shall be removed by the Geosynthetics Installer and submitted to the CQA Consultant. The Geosynthetics Installer shall handle geocomposite in such a manner as to minimize damage to the geocomposite and comply with the following:

- The equipment or tools used for handling, trafficking, or other operations shall not cause damage to the geocomposite;
- Personnel working on the geocomposite shall not smoke, wear damaging shoes, or engage in activities which will cause damage to the geocomposite; and
- The equipment used to deploy the geocomposite shall not cause damage to the underlying layers.

5.0 INSTALLATION AND REPAIR

5.1 Installation

The surfaces on which the geocomposite will be placed shall be free of objects which may damage the material. The CQA Consultant shall visually monitor the surface prior to geocomposite installation and document the findings. The Geosynthetics Installer shall remove all materials that may potentially damage the geocomposite. Prior to and during installation, the Geosynthetics Installer shall observe the following:

- Equipment does not damage the geocomposite or underlying materials by handling, trafficking, excessive heat, leakage of machine operating fuels or oils, or other means.
- Care shall be taken not to entrap dirt or excessive dust that could cause clogging of the drainage system, and/or stones that could damage the material. If dirt, excessive dust, and/or stones are entrapped in the geocomposites, the geocomposites shall be cleaned prior to placement of material on it.
- Tying devices shall be placed every 5 feet along the slope, every 2 feet across the slope, every 6 inches in the anchor trench, and every 10 feet on horizontal surfaces.
- Horizontal seams on slopes shall be staggered.
- The material overlap for butted panels on slopes shall be a minimum of 2 feet. The tie spacing for butted panels on the slopes shall be 2 rows at 12-inch spacing. Ties in the two rows shall be offset.
- Geocomposite shall be placed parallel to the slope.
- Wrinkles and "fishmouths" shall be eliminated before sewing of the top geotextile can begin.
- All geotextiles bonded to the geonet shall have a minimum 2-inch overlap at the seams. Only the top seams shall be sewn. Sewn seams shall be "prayer" type with a double lock stitch using polymeric thread.
- The minimum geonet overlap on seams shall be 4 inches.

- The geonet overlaps shall be secured by tying using strings, plastic fasteners, or polymer braid. Tying devices will be of any visible color other than black for easy observation. Metallic devices are not allowed.
- If white colored geotextile is used on the geocomposite, precautions, such as sunglasses, shall be taken against "snow blindness" of personnel.
- Adequate temporary loading and/or anchoring (e.g., sand bags, tires), not likely to damage the geocomposite shall be placed to prevent uplift by wind.
- The geocomposite shall be anchored as shown on the Drawings.

The CQA Consultant shall note any non-compliance and report it to the Project Manager.

5.2 Repair

Damaged geocomposite shall be repaired by overlapping the damaged area with the same geocomposite. The damaged area shall be overlapped on all sides a minimum of 6 inches and secured in place with ties every 6 inches around the circumference of the patch.

6.0 PLACEMENT OF MATERIALS ON GEOCOMPOSITE

The placement of materials on geocomposite shall be such that:

- The geocomposite is not damaged;
- Minimal slippage of the geocomposite on the underlying layer occurs;
- No excess tensile stresses occur within the geocomposite;
- Equipment used for placing the overlying soil material will not be driven directly on the geocomposite;
- A minimum thickness of 1 foot of soil shall be required between a low ground-pressure dozer and the geocomposite;
- A minimum thickness of 2 feet of soil shall be required between light-weight rubber-tired vehicles and the geocomposite; and
- In areas of heavy vehicle traffic, the soil thickness shall be a minimum of 3 feet.

Non-compliance shall be noted by the CQA Consultant and reported to the Project Manager.

SECTION VI

GEOTEXTILE CONSTRUCTION QUALITY ASSURANCE

SECTION VI
GEOTEXTILE
CONSTRUCTION QUALITY ASSURANCE
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SECTION VI
GEOTEXTILE
CONSTRUCTION QUALITY ASSURANCE

1.0 INTRODUCTION

A geotextile will be installed within the liner/leachate collection system of the landfill as a cushion layer. A 6-oz/sy nominal nonwoven geotextile shall be utilized if a granular leachate drainage material is utilized. ~~and a~~ A 16-oz/sy nominal nonwoven geotextile shall be utilized AS A CUSHION LAYER AND A 6-OZ/SY NOMINAL NONWOVEN GEOTEXTILE SHALL BE UTILIZED AS A FILTER LAYER if tire chips are used as leachate drainage material. The geotextile shall be a nonwoven polypropylene or polyester material and shall be free of oil, grease, and other foreign materials.

1.1 Certification of Property Values

The Geotextile Fabricator shall provide the Project Manager with a list of guaranteed minimum average roll values (MARV) for each type of geotextile to be supplied. Prior to delivery, the Geotextile Fabricator shall provide to the Project Manager quality control certification for the geotextile delivered to the site confirming that the material meets the Specifications.

The CQA Consultant shall examine manufacturer's certifications and CQC testing results to confirm that the property values meet those specified in Tables 7 and 8. Deviations shall be reported to the Project Manager.

1.2 Labeling

The Geotextile Fabricator shall identify all rolls of geotextile with the following:

- Manufacturer's name;
- Product identification;
- Lot number;
- Roll number;
- Roll weight; and

- Roll dimensions.

The CQA Consultant shall examine rolls upon delivery and any deviation from the above requirements shall be reported to the Project Manager.

2.0 SHIPMENT AND STORAGE

2.1 Packaging and Labeling

The finished geotextile shall be completely wrapped and adequately secured with a durable opaque polyethylene protective cover in order to provide protection from ultraviolet degradation of the geotextile, precipitation, mud, dirt dust, puncture, cutting, or any other damaging or deleterious conditions during shipping and storage. The central core shall be accessible for handling. The geotextile rolls shall be marked or tagged with the following information:

- Manufacturer's name;
- Product identification;
- Lot or batch number;
- Roll number;
- Roll weight; and
- Roll dimensions.

The CQA Consultant shall examine rolls upon delivery and any deviation from the above requirements shall be reported to the Project Manager.

2.2 Transportation and Handling

Transportation of the geotextile is the responsibility of the Geotextile Manufacturer, Geosynthetics Installer, or Transporter, as directed by the Geosynthetic Installer. All handling on site is the responsibility of the Geosynthetics Installer.

The CQA Consultant will confirm that:

- Handling equipment used on the site is adequate and does not damage the geotextile; and
- The geotextile is handled with care.

The geotextile shall be shipped in accordance with the Geotextile Manufacturer's recommendations. Upon delivery to the site, the Geosynthetics Installer and CQA Consultant shall review all rolls for defects and for damage. This review shall be conducted without unrolling the rolls unless defects or damages are found or suspected. The CQA Consultant shall indicate to the Project Manager any rolls with minor repairable flaws and any rolls or portions of rolls which should be rejected because of severe flaws.

2.3 Storage

The Geosynthetic Installer shall be responsible for the storage of the geotextile on site. The Project Manager shall provide storage space in a location (or several locations) such that on-site transportation and handling are minimized. Storage space should protect the geotextile from vandalism, passage of vehicles, precipitation, etc. The rolls of geotextile shall be stored in their original, unopened, wrapped cover in a clean dry area. The geotextile shall be protected from mud, dirt, dust, excessive heat or cold, puncture, cutting, or other damaging or deleterious conditions. The rolls shall not be stacked more than six rolls high, due to the possibility of thinning of the product at points of contact. Any additional procedures required by the Geotextile Manufacturer shall be the Geosynthetics Installer's responsibility.

3.0 CONFORMANCE TESTING OF DELIVERED GEOTEXTILE

Conformance sampling may take place at the geotextile manufacturing plant by either the Geotextile Manufacturer, Geosynthetics CQA Laboratory, a representative of the Owner, or the CQA Consultant. The samples shall then be forwarded to the Geosynthetics CQA Laboratory for testing. Conversely, the CQA consultant may retrieve geotextile samples from material delivered to the site and forward them to the Geosynthetics CQA Laboratory for conformance testing to determine compliance with the project requirements in Tables 7 and 8 for material acceptance.

3.1 Sampling Procedures

Samples of geotextile shall be taken from the rolls of geotextile to be delivered to the site. Samples of geotextile shall be taken across the entire width of the roll and will not include the first 3 linear feet. Unless otherwise specified, all samples shall be 3 feet long by the roll width. The machine direction shall be marked on the samples with an arrow. Samples of geotextile shall be taken at the rates specified in Tables 7 and 8.

3.2 Test Results

The CQA Consultant shall examine results from laboratory conformance testing and shall report non-conformance to the Project Manager.

3.3 Conformance Test Failure

The following procedure shall apply whenever a sample fails a conformance test that is conducted by the Geosynthetics CQA Laboratory:

- The Geosynthetics Manufacturer or CQA Consultant shall remove conformance samples for testing by the Geosynthetics CQA Laboratory from the closest numerical roll on both sides of the failed roll. These two samples must conform to the Specifications. If either

of these samples fail, testing will proceed on samples collected from the closest numerical roll to the failed roll until rolls are located that conform to the Specifications.

- The Geosynthetics Manufacturer shall replace any roll of geotextile that is in non-conformance with the Specifications with a roll that meets the Specifications.

The CQA Consultant shall document actions taken in conjunction with conformance test failures.

4.0 HANDLING AND PLACEMENT

The Geosynthetics Installer shall handle geotextile in such a manner as to minimize damage to the geotextile and comply with the following:

- In the presence of wind, all geotextile will be weighted with sandbags or the equivalent.
- Geotextile will deployed in a manner to minimize the presence of wrinkles in the geotextile.
- Geotextile will be cut using an approved geotextile cutter only. If in place, special care must be taken to protect other materials from damage, which could be caused by the cutting of geotextile.
- The Geosynthetics Installer shall take necessary precautions to prevent damage to underlying layers during placement of the geotextile.
- During placement of geotextile, care shall be taken not to entrap dirt or excessive dust that could cause clogging of the drainage system, and/or stones that could damage the material. If dirt, excessive dust, and/or stones are entrapped in the geotextile, the geotextile shall be cleaned prior to placement of material on it.
- After installation, a visual examination of the geotextile will be carried out over the entire surface to ensure that no potentially harmful foreign objects, such as needles, are present.
- If white geotextile is used, precautions, such as sunglasses, shall be taken against "snow blindness" of personnel.

The CQA Consultant shall note non-compliance and report it to the Project Manager.

5.0 INSTALLATION AND REPAIR

5.1 Installation

The surfaces on which the geotextile will be placed shall be free of objects that may damage the material. The CQA Consultant shall visually inspect the surface prior to geotextile installation. The Geosynthetics Installer shall remove all materials that may potentially damage the geotextile. Prior to and during installation, the Geosynthetics Installer and CQA Consultant shall observe the following:

- All geotextiles shall be continuously sewn (i.e. spot sewing is not allowed). Geotextiles shall be overlapped at a minimum of 6 inches prior to seaming. Thermal bonding shall be allowed only after written approval of the Project Manager.
- There shall be no horizontal seams on side slopes steeper than 20% (i.e. seams shall be along, not across, slopes steeper than 5H:1V), except as part of a patch, unless approved by the Design Engineer.
- The Geosynthetics Installer shall pay particular attention at seams to ensure that no protective cover material could be inadvertently inserted beneath the geotextile.
- Geotextile sewing shall be done using polymeric thread.
- The geotextile shall be anchored as shown on the Drawings.

The CQA Consultant shall note any non-compliance and report it to the Project Manager.

5.2 Repair

Any holes or tears in the geotextile shall be repaired as follows:

- On slopes steeper than 20%. A patch made from the same geotextile shall be seamed into place no closer than 1 inch from any edge. Should any tear exceed 10% of the width of the roll, that roll shall be removed from the slope and replaced.
- On slopes less than or equal to 20%. A patch made from the same geotextile shall be spot-seamed in place with a minimum of 24 inches overlap in all directions.

6.0 PLACEMENT OF MATERIALS ON GEOTEXTILE

The placement of materials on geotextile shall be such that:

- The geotextile is not damaged;
- Minimal slippage of the geotextile on the underlying layer occurs;
- No excess tensile stresses occurs within the geotextile;
- Equipment used for placing the overlying soil material shall not be driven directly on the geotextile;
- A minimum thickness of 1 foot of soil shall be required between a low ground-pressure dozer and the geotextile;
- A minimum thickness of 2 feet of soil shall be required between light-weight rubber-tired vehicles and the geotextile; and
- In areas of heavy vehicle traffic, the soil thickness shall be a minimum of 3 feet.

Non-compliance shall be noted by the CQA Consultant and reported to the Project Manager.

SECTION VII

HIGH DENSITY POLYETHYLENE PIPE AND FITTINGS CONSTRUCTION QUALITY ASSURANCE

SECTION VII
HIGH DENSITY POLYETHYLENE PIPE AND FITTINGS CONSTRUCTION QUALITY ASSURANCE
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SECTION VII
HIGH DENSITY POLYETHYLENE PIPE AND FITTINGS CONSTRUCTION QUALITY ASSURANCE

1.0 MANUFACTURER'S DOCUMENTATION

1.1 Raw Materials

High-density polyethylene (HDPE) pipe and fittings will be used in the leachate collection and transport system and the gas extraction system. Raw materials used for the manufacture of HDPE pipe and fittings shall be extra high molecular weight, high-density ethylene/hexene copolymer PE 3408 polyethylene resin. The resin shall meet the specifications of ASTM D3350 with cell classification of PE: 345434C and ASTM D1248 with pipe grade resin Type III, Class C, Category 5, grade P34 polyethylene compound.

1.2 Pipe

The pipe shall be manufactured to the dimensions and tolerances specified in ASTM F714. Additionally the pipe shall be inspected per industry accepted manufacturer standards for the following:

- Diameter;
- Wall thickness;
- Concentricity;
- Quick burst pressure and ductility;
- Joint length;
- Straightness;
- Ovality;
- Toe-in; and
- Overall workmanship inspection on inner diameter (ID) and outer diameter (OD).

The pipe shall not contain recycled compound except that generated in the HDPE Pipe Manufacturer's own plant from resin of the same specification from the same raw material. The

pipe shall be homogeneous throughout and free of visible cracks, holes, voids, foreign inclusions, or other deleterious defects. The pipe shall also be identical in color, density, melt index, and other physical properties throughout. Perforations shall be prefabricated to size, orientation, and spacing specified in the drawings.

1.3 Fittings

The standard HDPE fittings shall be standard commercial products manufactured by injection molding, or by extrusion and seaming, or shall be fabricated from HDPE pipe conforming to the Sub-section above. The fittings shall be fully pressure tested by the HDPE Pipe Manufacturer to provide a working pressure equal to the pipe for 50 years service at 73.4 °F with an included 2:1 factor of safety. The fittings shall be manufactured from the same resin type, grade, and cell classification as the pipe itself. The manufacture of the fittings shall be in accordance with good commercial practice to provide fittings homogeneous throughout and free from cracks, holes, foreign inclusions, voids, or other deleterious defects. The fittings shall be as uniform as commercially practicable in color, opacity, density, and other physical properties. The minimum "quick-burst" strength of the fittings shall not be less than that of the pipe with which the fittings are to be used.

1.4 Certification of Property Values

The HDPE Pipe Manufacturer's certification shall include the following:

- Resin Supplier's name;
- Specific resin used;
- Copies of Resin Supplier's certifications;
- Property sheet listing pipe properties;
- List of quantities and descriptions of materials, other than base resin, that comprise the pipe;
- Sampling procedures and results of testing; and
- Certification of the minimum property values listed on the property sheet.

The CQA Consultant shall confirm that the property values certified by the HDPE Pipe Manufacturer meet all the Specifications. The CQA Consultant shall also confirm that the proper test methods and documentation procedures were used.

2.0 DELIVERY

2.1 Labeling

The HDPE Pipe Manufacturer shall identify the segments of pipe with the following:

- Nominal size;
- SDR value;
- Pressure rating;
- Type or trade name of pipe; and
- Material Classification.

The CQA Consultant shall examine the pipe upon delivery and any deviation from the above requirements shall be reported to the Project Manager.

2.2 Transportation and Handling

Transportation of the HDPE pipe is the responsibility of the HDPE Pipe Manufacturer, Earthwork Contractor, or Transporter. All handling on site is the responsibility of the Earthwork Contractor.

The pipe shall be transported in a manner designed to deliver the pipe to the project neatly, intact, and without physical damage. The pipe shall be properly supported, stacked, and restrained during transport such that the pipe is not nicked, gouged, or physically damaged. The CQA Consultant shall examine the pipe for defects and damage upon delivery to the site.

2.3 Storage

The Earthwork Contractor shall be responsible for the storage of the HDPE pipe on-site. The Project Manager shall provide storage space in one or more locations such that on-site transportation and handling are minimized. The storage space shall protect the pipe from theft, vandalism, passage of vehicles, etc.

Pipe shall be stored on clean, level ground to prevent undue scratching or gouging of the pipe. If the pipe must be stacked for storage, such stacking shall be done in accordance with the HDPE Pipe Manufacturer's recommendations. The handling of the pipe shall be done in such a manner that it is not damaged by dragging over sharp objects or cut by chokers or lifting equipment.

Sections of pipe with cut or gouges greater than 10 percent of the wall thickness of the pipe shall be cut out and removed. The undamaged portions of the pipe shall be rejoined using the butt fusion joining method.

3.0 JOINING

As many sections of HDPE pipe should be joined into continuous lengths above ground on the job site as possible. The joining method shall be the butt fusion method and shall be performed in strict accordance with the HDPE Pipe Manufacturer's recommendations. The butt fusion equipment used in the joining procedures should be capable of meeting all conditions recommended by the HDPE Pipe Manufacturer including, but not limited to, temperature requirements of 440 °F, alignment, and 75 psi interfacial fusion pressure.

Butt fusion joining shall be 100 percent efficient, offering a joint weld strength equal to or greater than the tensile strength of the HDPE pipe. Socket fusion shall not be used except for tie-in locations. Extrusion welding or hot gas welding of HDPE pipe shall not be used in the force main construction or in fabrications where shear or structural strength is important. Flanges, unions, grooved-couplers, transition fittings, and some mechanical couplers may be used to mechanically connect HDPE pipe without butt fusion in strict accordance with the HDPE Pipe Manufacturer's recommendations.

3.1 Joining Process Preparation

All pipes, fittings, and fusion joints shall be examined by the CQA Consultant and the Pipe Installer. The Pipe Installer shall insure that pipes and fittings are not broken, cracked, or otherwise contain damaged or unsatisfactory material. Prior to fusion, the Pipe Installer shall ensure that the fusion surface area is clean and free of moisture, dust, dirt, debris, and foreign material.

3.2 Butt Fusion Weather Conditions

Joining HDPE pipe using the butt fusion method shall not proceed at an ambient temperature below 32 °F unless the Pipe Installer can document to the Project Manager that the resulting joint weld strength is equal to or greater than the tensile strength of the pipe.

3.3 Butt Fusion Procedures

It is important during the butt fusion process to maintain the proper temperature of the heater plate. The Pipe Installer shall check the temperature with a tempilstik or pyrometer for the correct surface temperature. Unless otherwise specified, the general butt fusion procedures used by the Pipe Installer are as follows:

- Install pipe in machine, allowing pipe ends to protrude 1 to 2 inches past face of jaw.
- Clean pipe ends inside and out with a clean cotton cloth to remove dirt, water, grease and other foreign materials.
- Square (face) the pipe ends using facing tool of the fusion machine and do not touch the newly faced surfaces with hands, as perspiration and body oils could contaminate the joint area resulting in a weakened joint.
- Check the line-up of the pipe ends in fusion machine to see that pipe ends meet squarely and completely over the entire surface to be fused. If any adjustment is made to the clamps following facing, the facing unit should be re-installed and the pipe ends given several turns with the cutter before continuing with the fusion process.
- Insert clean heater plate between aligned ends, and bring both ends firmly in contact with plate but do not apply pressure while achieving melt pattern.
- Allow pipe end to heat, soften, and form a melt bead to the approximate width recommended by the HDPE Pipe Manufacturer based on pipe diameter. The melt bead should be the same size on both pipe ends and should be uniformly sized around the pipe.
- Carefully move the pipe ends away from the heater plate after achieving the proper melt bead on both pipe ends. If the softened material sticks to the plate, discontinue the joint, allow to cool, and start the fusion process from the beginning.

- Quickly bring the pipe ends together with the pressure recommended by the HDPE Pipe Manufacturer. The force applied will cause each bead to rollback onto the pipe. Insufficient rollback is one indication of a faulty joint.
- While maintaining pressure used in making the joints, allow the joint to cool for 30 to 90 seconds per inch of pipe diameter before removing from machine. The joint is cool when the bead feels hard and your finger can remain comfortably on the bead.
- Remove fused pipe from fusion machine and allow to cool at least 20 minutes after removal before subjecting it to testing, bending, or backfilling stresses.

The CQA Consultant and Pipe Installer shall examine all joints following removal from fusion machine. Fused segments of pipe shall be handled so as to avoid damage to the pipe. When lifting fused sections of pipe, chains or cable type chokers must be avoided. Nylon slings are preferred. Spreader bars are recommended when lifting long fused sections. Care must be exercised to avoid cutting or gouging the pipe.

4.0 NON-DESTRUCTIVE TESTING

All solid wall HDPE joints must be non-destructively tested. Leachate collection and gas extraction system pipe joints shall be tested using either the low or high air pressure test. The hydrostatic pressure test may also be used if approved by the Project Manager. Other non-destructive tests may be used if all of the following conditions are satisfied:

- The Pipe Installer can document its effectiveness;
- The method is approved by the HDPE Pipe Manufacturer; and
- The method is approved by the Project Manager.

The Project Manager and CQA Consultant shall determine the effectiveness and validity of the proposed test method.

The low air pressure test shall be performed in accordance with the HDPE Pipe Manufacturer's recommendations and in accordance with current industry standards. The Pipe Installer shall follow all safety requirements. The general procedures for the low air pressure test are as follows:

- The pipe shall be placed in the trench and sufficient backfill installed between joints to prevent movement.
- A maximum length of 450 feet shall be tested separately as construction progresses and before the trench is completely backfilled, unless approved by the Owner.
- Pneumatic plugs shall have a sealing length equal to or greater than the diameter of the pipe to be tested and shall be able to resist internal test pressure without requiring external bracing or blocking. All air shall pass through a single control panel that has a header and gauges to record pressure in the plug and in the pipe. Two individual hoses will be used to connect the control panel to the pneumatic plugs and sealed line and one hose will be used to connect the sealed line to the control panel for monitoring air pressure in the sealed line.

- All pneumatic plugs shall be seal tested prior to actual testing. Lay a length of pipe on ground and seal it with the plugs to be tested. Inflate the plugs to 25 psi and the pipe to 5 psi. Plugs are satisfactory if they withstand the pressure without bracing.
- To test the fused pipe, place the seal tested plugs into the line at each test section end and inflate to 25 psi. Introduce low air pressure into the sealed line until the air pressure is 4 psi. Allow at least 2 minutes for the air pressure to stabilize. The minimum air pressure shall be 3.5 psi after stabilization. After the stabilization period, disconnect the air hose from the control panel to the air supply. The line pressures may be adjusted based on pipe diameter and HDPE Pipe Manufacturer's recommendations. The Pipe Installer must receive prior approval from the Project Manager to adjust pressures.
- The line being tested is acceptable if there is no pressure drop over 10 minutes. Every mechanical joint will be inspected while under pressure, and any joint that shows any leakage shall be repaired and then retested. Leaks may be found using a mild soap and water solution

The high air pressure test shall be performed in accordance with the HDPE Pipe Manufacturer's recommendations and in accordance with current industry standards. The Pipe Installer shall follow all safety requirements. The general procedures for the high air pressure test are as follows:

- The pipe shall have sufficient backfill installed between joints to prevent movement.
- To test the fused pipe, weld an end cap to the one end of the pipe and a valve and pressure gauge to the other end. Introduce high air pressure into the pipe through the valve into the sealed line until the air pressure is 30 psi. Allow at least 2 minutes for the air pressure to stabilize. After the stabilization period, disconnect the hose line from the valve.
- The line being tested is acceptable if there is a maximum pressure drop of 1.5 psi over 1 hour. Every mechanical joint will be inspected while under pressure, and any joint that shows any leakage shall be repaired and then retested. Leaks may be found using a mild soap and water solution.

The CQA Consultant shall record the beginning pressure, end pressure, start time, and end time of each test. The CQA Consultant shall report any non-conformance of testing methods to the Project Manager.

SECTION VIII

SURVEYING CONSTRUCTION QUALITY ASSURANCE

SECTION VIII
SURVEYING
CONSTRUCTION QUALITY ASSURANCE
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SECTION VIII
SURVEYING CONSTRUCTION QUALITY ASSURANCE

1.0 INTRODUCTION

Surveying of lines and grades is conducted on an ongoing basis during construction of the landfill components. Surveying is to provide documentation for record drawings and determine quantities of materials. CQA surveying is essential to ensure that the landfill components are properly constructed. The surveying conducted at the site shall be part of the construction quality assurance program.

2.0 SURVEY CONTROL

At least three (3) permanent benchmarks shall be established on separate sides of the landfill facility within easy access to the limits of solid waste placement.

The construction of the benchmarks shall be in accordance with OAC Rule 3745-27-08(D)(1), which specifies that benchmarks shall be at least as stable as a poured concrete monument ten inches in diameter installed to a depth of forty-two inches below the ground surface. Each constructed survey mark shall include a corrosion resistant metallic disk which indicates horizontal and vertical coordinates of the survey mark and shall contain a magnet or ferromagnetic rod to allow identification through magnetic detection methods.

Settlement plates may be used during placement of the CAP System to determine the thickness of RSB and/or CAP protection layer. The settlement plates shall be placed at each survey control point location. The settlement plates must be a metal plate so it can be found by magnetic survey if necessary. For the RSB, a hand auger or drill with a bit less than 1 inch in diameter will be driven through the layer to determine the RSB thickness. For the CAP protection layer, the settlement plate must have a screw-in rod that can be removed after documentation of the layer thickness. Penetration holes will be backfilled with bentonite

3.0 SURVEYING PERSONNEL

The survey crew will consist of a Senior Surveyor and as many Surveying Assistants as are required to satisfactorily undertake the requirements for the work. Surveying personnel shall be experienced in the provision of these services, including detailed, accurate documentation.

All Surveying Construction Quality Assurance shall be performed under the direct supervision of a qualified Land Surveyor, who may be the Senior Surveyor.

4.0 PRECISION AND ACCURACY

A wide variety of survey equipment is available to meet the requirements of this project. The survey instruments used for this work should be sufficiently precise and accurate to meet the needs of the project. All survey instruments should be capable of reading to a precision of 0.01 feet and with a setting accuracy of 20 sec. (5.6×10^{-3} degrees).

5.0 LINES AND GRADES

The following surfaces shall be surveyed to document the lines and grades achieved during construction.

The survey of the baseliner/leachate collection system should at least include:

- Surface of subgrade;
- Surface of the added geologic material;
- Surface of the structural fill;
- Surface of recompacted soil liner;
- Geomembrane panel and destructive sample locations;
- Surface of leachate collection/protective cover; and
- Leachate piping alignment.

The survey of the cap system should at least include:

- Surface of the intermediate cover;
- Surface of recompacted soil barrier;
- Geomembrane panel and destructive sample locations; and
- Surface of the vegetative layer.

Other landfill components to be surveyed include the gas extraction system and permanent groundwater control structure.

6.0 FREQUENCY AND SPACING

All surveying will be carried out as soon as possible upon completion of a given installation to facilitate progress and avoid delaying commencement of the next installation. In addition, spot checks during construction will be necessary to assist the Contractor in complying with the required grades.

The following spacings and locations will be provided, as a minimum, for survey points:

- Surfaces with slopes less than 10 percent will be surveyed on a square grid not wider than 100 feet;
- On slopes greater than 10 percent, a square grid not wider than 100 feet will be used, but in any case, a line at the crest, midpoint, and toe of the slope will be taken; and
- A line of survey points no farther than 100 feet apart will be taken along any slope break (this will include the inside edge and outside edge of any bench on a slope).

7.0 TOLERANCES

Acceptable survey tolerances between the design and as-built elevations and coordinates shall be 0.2 feet on elevations and 0.2 feet on coordinates. The minimum required thickness of the surveyed layers shall be maintained.

8.0 DOCUMENTATION

All field survey notes will be retained by the Senior Surveyor. A copy of these notes will be given to the Owner or CQA Consultant at the end of each day or surveying task. The results from the field surveys will be documented on a set of Survey Record Drawings. These drawings shall show the final elevations of the surfaces surveyed in Sub-section 5.0.

SECTION IX

CONSTRUCTION QUALITY ASSURANCE DOCUMENTATION

SECTION IX
CONSTRUCTION QUALITY ASSURANCE DOCUMENTATION
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SECTION IX
CONSTRUCTION QUALITY ASSURANCE DOCUMENTATION

1.0 INTRODUCTION

An effective CQA/QC Plan depends largely on recognition of all construction activities that should be monitored, and on assigning responsibilities for the monitoring of each activity. This is most effectively accomplished by the documentation of quality assurance activities. The CQA Consultant will document that quality assurance requirements have been addressed and satisfied.

The CQA Consultant will provide the Project Manager with signed field activity logs, data sheets, and forms to document that all monitoring activities have been carried out. The CQA Consultant will also maintain at the job site a complete file of the Plans and Specifications, a CQA/QC Plan, checklists, test procedures, daily logs, and other pertinent documents.

2.0 DAILY RECORDKEEPING

Standard reporting procedures will include preparation of a daily report that, at a minimum, will consist of:

- Field notes, including memoranda of meetings and/or discussions with the Earthwork Contractor, Geosynthetics Installer, or other Contractor;
- Observation logs, and testing data sheets; and
- Construction problem and solution data sheets.

This information shall be regularly submitted to and reviewed by the Project Manager.

2.1 Memorandum of Discussion with Contractors

A memorandum shall be prepared as necessary, summarizing discussions between the CQA Consultant and the Contractors. At a minimum, the memorandum will include the following information:

- Date, project name, location, and other identification;
- Name of parties involved in the discussion;
- Relevant subject matter or issues;
- Activities planned and scheduled; and
- Signature of the CQA Consultant.

2.2 Observation Logs and Testing Data Sheets

Observation logs and testing data sheets shall be prepared daily. When necessary, these logs and data sheets will include the following information:

- An identifying sheet number for cross referencing and document control;
- Date, project name, location, and other identification;
- Data on weather conditions;
- A reduced-scale Site Plan showing work areas and test locations;
- Descriptions and locations of ongoing construction;
- Descriptions and specific locations of areas, or units, of work being tested and/or observed and documented;
- Locations where tests and samples were taken;
- A summary of test results;
- Calibrations or recalibrations of test equipment, and actions taken as a result of calibration;
- Off-site materials received, including quality verification documentation;
- Decisions made regarding acceptance of units of work, and/or corrective actions to be taken in instances of substandard quality; and
- The CQA Consultant's signature.

2.3 Construction Problem and Solution Data Sheets

Sheets describing special construction situations shall be cross-referenced with specific observation logs and testing data sheets, and must include the following information, where available:

- An identifying sheet number for cross-referencing and document control;
- A detailed description of the situation or deficiency;
- The location and probable cause of the situation or deficiency;

- How and when the situation or deficiency was found or located;
- Documentation of the response to the situation or deficiency;
- Final results of any responses;
- Any measures taken to prevent a similar situation from occurring in the future; and
- The signature of the CQA Consultant and signature of the Project Manager indicating concurrence.

The Project Manager shall be made aware of any significant recurring non-conformance with Specifications. The Project Manager will then determine the cause of the non-conformance and recommend appropriate changes in procedures or specifications. These changes shall be submitted to the Design Engineer for approval. When this type of evaluation is made, the results shall be documented, and any revision to procedures or Specifications shall be approved by the Owner and Design Engineer.

3.0 PHOTOGRAPHIC REPORTING DATA SHEETS

Photographic reporting data sheets, where used, shall be cross-referenced with observation logs and testing data sheets and/or construction problem and solution data sheets when appropriate.

These photographs will serve as a pictorial record of work progress, problems, and mitigation activities. The basic file will contain color prints; negatives will also be stored in a separate file. These records shall be presented to the Project Manager upon completion of the project.

In lieu of photographic documentation, videotaping may be used to record work progress, problems, and mitigation activities.

4.0 DESIGN AND/OR SPECIFICATIONS CHANGES

Design and/or specifications changes may be required during construction. In such cases, the CQA Manager will notify the Project Manager and the Design Engineer. The Project Manager will notify the Ohio EPA prior to implementing design and/or specification changes that require their approval.

5.0 PROGRESS REPORTS

The CQA Monitor will prepare a summary progress report each week, or at time intervals established at the pre-construction meeting. At a minimum, this report will include the following information:

- A unique identifying sheet number for cross-referencing and document control;
- The date, project name, location, and other information;
- A summary of work activities during progress reporting period;
- A summary of construction situations, deficiencies, and/or defects occurring during the progress reporting period; and
- A summary of test results, failures and retests.

Progress reports will be distributed to all involved parties.

6.0 DOCUMENTATION REPORT

At the completion of the work, the CQA Manager will submit to the Project Manager a Construction Documentation Report. This report will document that the work has been performed in compliance with the approved Permit, Plans and Specifications, and that sampling and testing, except as properly authorized, has been implemented. The summary document will provide the necessary supporting information.

The report shall be in accordance with OAC Rule 3745-27-08(H), which requires the following:

- Narrative section that identifies engineering components constructed including a summary of specifications in the approved Permit to Install;
- Any alterations or other changes from the approved Permit to Install Application;
- Results of all testing;
- Survey Results;
- Documentation demonstrating that any oil or gas wells that have been identified within the limits of solid waste placement have been properly plugged and abandoned in accordance with Chapter 1509. of the Revised Code prior to any construction in the area of the well(s);
- Record drawings showing plan views, cross-sections, and details;
- Information regarding facility survey marks;
- Qualifications of testing personnel; and
- A notarized statement from the Owner that the report is true and accurate, and contains the information required by OAC Rule 3745-27-08(H) and the CQA/QC Plan.

The Record Drawings will include scale drawings depicting the location of the construction and details pertaining to the extent of construction (e.g., depths, plan dimensions, elevations, soil component thicknesses, etc.). All surveying and base maps required for development of the Record Drawings shall be done by a qualified land surveyor. These documents shall be prepared by the CQA Consultant and included as part of the CQA/QC Plan documentation.

7.0 STORAGE OF RECORDS

All data sheet originals, especially those containing signatures, should be stored by the Project Manager in a safe depository. Other reports may be stored by any standard method that will allow for easy access.

TABLES

TABLE 1
MINIMUM TEST FREQUENCIES FOR SOIL AND AGGREGATE COMPONENTS

Component	Required Test	Minimum Frequency	Acceptance Criteria	Sample Size
IN-SITU FOUNDATION	Density/Moisture Relationship (ASTM D698 or D1557)	1 per material type for each unconsolidated stratigraphic unit that has not been anticipated and that may be susceptible to slope failure.	N/A	50 lb
	Nuclear Density Gauge In-Place Density (ASTM D2922) and Moisture Content (ASTM D3017)	1 test per 200-ft grid only on each unconsolidated stratigraphic unit that has not been anticipated and that may be susceptible to slope failure.	≥ 95% of Standard Proctor maximum dry density or ≥ 90% of Modified Proctor maximum dry density	N/A
	Consolidated Undrained Triaxial Compression Test (ASTM D4767) -with Pore Pressure Readings or Direct Shear Test (ASTM D3080)	1 per material type for each unconsolidated stratigraphic unit that has not been anticipated and that may be susceptible to slope failure.	See Table 9 for required shear strength.	N/A
SOIL STRUCTURAL FILL	Density/Moisture Relationship (ASTM D698 or D1557)	1 per 10,000 cu.yd.	N/A	50 lb
	Nuclear Density Gauge In-Place Density (ASTM D2922) and Moisture Content (ASTM D3017)	Placed Material: 5 tests per acre/lift	≥ 95% of Standard Proctor maximum dry density or ≥ 90% of Modified Proctor maximum dry density	N/A
	Lift Depth	Placed Material	Visual ≤ 12 inches uncompacted thickness	N/A
	Consolidated Undrained Triaxial Compression Test (ASTM D4767) -with Pore Pressure Readings or Direct Shear Test (ASTM D3080)	Each unconsolidated stratigraphic unit that has not been anticipated and that may be susceptible to slope failure.	See Table 9 for required shear strength.	N/A
INSITU RESIDUAL SOIL	Consolidated Undrained Triaxial Compression Test (ASTM D4767) -with Pore Pressure Readings or Direct Shear Test (ASTM D3080)	One per material type if it is desired to leave this material in place beneath structural fill.	See Table 9 for required shear strength.	N/A

TABLE 1
MINIMUM TEST FREQUENCIES FOR SOIL AND AGGREGATE COMPONENTS

Component	Required Test	Minimum Frequency	Acceptance Criteria	Sample Size
ROCK STRUCTURAL FILL	Material Type	Placed Material	Sandstone, Limestone or other material meeting the classification of Durable Rock	N/A
	Particle Size	Placed Material	Visual 100% ≤ 24-inches	N/A
	Lift Depth	Placed Material	Visual ≤ 24 inches uncompacted thickness	N/A
	Compaction	Placed Material	Visual Observation of non-movement	N/A
ADDED GEOLOGIC MATERIAL	Sieve and Hydrometer Analysis / USDA Classification (ASTM D422)	1 per 3,000 cu.yd.	loam, silt loam, silty clay loam, silty clay, or other soil type that can achieve the intended purpose	5-10 lb
	Density/Moisture Relationship [2] (ASTM D698 or D1557)	1 per 10,000 cu.yd.	N/A	50 lb
	Specific Gravity [3] (ASTM D854)	1 per 10,000 cu.yd.	N/A	5-10 lb
	Permeability: Flexible Wall Permeameter (ASTM 5084)	1 per 10,000 cu.yd.	Permeability ≤ 1 x 10^{-5} cm/sec	50 lb
	Nuclear Density Gauge In-Place Density (ASTM D2922) and Moisture Content (ASTM D3017)	Placed Material: 5 tests per acre/lift	≥ 95% of Standard Proctor maximum dry density or ≥ 90% of Modified Proctor maximum dry density with a moisture content no less than 2% below or more than 4% above optimum moisture content; or Compaction to a moisture content and dry density that meets or exceeds the best fit line of optimums.	N/A
	Lift Depth	Placed Material	≤ 12 inches uncompacted thickness	N/A
	Total Thickness	Placed Material	Required thickness to provide a minimum of 15 feet of separation from UAS as verified by survey	N/A
	Consolidated Undrained Triaxial Compression Test (ASTM D4767) -with Pore Pressure Readings or Direct Shear Test (ASTM D3080)	One sample per material type	See Table 9 for required shear strength.	N/A

TABLE 1
MINIMUM TEST FREQUENCIES FOR SOIL AND AGGREGATE COMPONENTS

Component	Required Test	Minimum Frequency	Acceptance Criteria	Sample Size
RECOMPACTED SOIL LINER (See Note 1)	Sieve and Hydrometer Analysis (ASTM D422)	1 per 1,500 cu.yd.	100% ≤ 2-inch, 90% ≤ 3/4-inch, or as modified by test pad results.	5-10 lb
	Unified Soil Classification (ASTM D2487)	1 per 1,500 cu.yd.	Correlation with test pad results	5-10 lb
	Atterberg Limits (ASTM D4318)	1 per 1,500 cu.yd.	Correlation with test pad results	5-10 lb
	Density/Moisture Relationship [2] (ASTM D698 or D1557)	1 per 1,500 cu.yd.	Correlation with test pad results	50 lb
	Specific Gravity [3] (ASTM D854)	1 per 1,500 cu.yd.	N/A	5-10 lb
	Permeability: Flexible Wall Permeameter (ASTM 5084)	1 per 10,000 cu.yd.	Permeability ≤ 1 x 10^{-7} cm/sec	50 lb
	Nuclear Density Gauge In-Place Density (ASTM D2922) and Moisture Content (ASTM D3017)	Placed Material: 5 tests per acre/lift	≥ 95% of Standard Proctor maximum dry density or ≥ 90% of Modified Proctor maximum dry density with a moisture content at or above optimum, or as modified by test pad; or Compaction to a moisture content and dry density that meets or exceeds the best fit line of optimums.	N/A
	Moisture Content (ASTM D2216)	Prior to RSL placement at discretion of CQA firm.	N/A; To confirm nuclear density gauge moisture correction.	Varies
	Lift Depth	Placed Material	≤ 8 inches uncompacted thickness or as modified by test pad.	N/A
	Total Thickness	Placed Material	required thickness verified by survey	N/A
	Consolidated Undrained Triaxial Compression Test (ASTM D4767) -with Pore Pressure Readings or Direct Shear Test (ASTM D3080)	One sample per material type	See Table 9 for required shear strength.	N/A

TABLE 1
MINIMUM TEST FREQUENCIES FOR SOIL AND AGGREGATE COMPONENTS

Component	Required Test	Minimum Frequency	Acceptance Criteria	Sample Size
RECOMPACTED SOIL LINER (See Note 1)	Classification of Dispersive Clay Soils by Pinhole Test (ASTM D4647)	Prior to construction of Phase 8 and one sample per material type.	Classifies as ND1 to ND4.	5-10 lb
	Dispersive Characteristics of Clay Soil by Double Hydrometer (ASTM D4221)	On same sample as pinhole test and 1 per 10,000 cu. yd.	Classifies as non-dispersive indicated by dispersion less than 30%	5-10 lb

TABLE 1
MINIMUM TEST FREQUENCIES FOR SOIL AND AGGREGATE COMPONENTS

Component	Required Test	Minimum Frequency	Acceptance Criteria	Sample Size
TEST PAD	Sieve and Hydrometer Analysis (ASTM D422)	2 per lift	Prior to placement: 100% ≤ 2-inch, 90% ≤ 3/4-inch, or as modified by test pad results.	5-10 lb
	Unified Soil Classification (ASTM D2487)	2 per lift	Prior to placement.	5-10 lb
	Atterberg Limits (ASTM D4318)	2 per lift	Prior to placement.	5-10 lb
	Density/Moisture Relationship [2] (ASTM D698 or D1557)	2 per lift	Prior to placement.	50 lb
	Specific Gravity [3] (ASTM D854)	2 per lift	Prior to placement.	5-10 lb
	Nuclear Density Gauge In-Place Density (ASTM D2922) and Moisture Content (ASTM D3017)	3 tests per lift	≥ 95% of Standard Proctor maximum dry density or ≥ 90% of Modified Proctor maximum dry density with a moisture content at or above optimum, or as modified by test pad; or Compaction to a moisture content and dry density that meets or exceeds the best fit line of optimums.	N/A
	Field Permeability: Boutwell Two-Stage Permeameter (ASTM D6391)	Test Pad: 5 test locations per test pad	Permeability ≤ 1×10^{-7} cm/sec	N/A
	Lift Depth	As required to maintain consistent lift thickness	Visual, ≤ 8 inches uncompacted depth	N/A
	Overall Size	Construction survey layout according to design of pad and a final as-built survey	A minimum three times the width and two times the length of the compaction equipment. The test pad will have a minimum thickness of 30 inches.	N/A

TABLE 1
MINIMUM TEST FREQUENCIES FOR SOIL AND AGGREGATE COMPONENTS

Component	Required Test	Minimum Frequency	Acceptance Criteria	Sample Size
ANCHOR TRENCH BACKFILL	Maximum Particle Size	Placed Material	Field observation - material less than 2 inches	N/A
GRANULAR LEACHATE COLLECTION LAYER	Sieve Analysis (ASTM D422)	1 per 3,000 cu. yd.	Not more than 5% of the material by weight passing through the #200 sieve.	50 lbs
	Carbonate Content (ASTM D3042) pH=4.0	1 per 3,000 cu. yd.	$\leq$ 5%	50 lbs
	Permeability (ASTM D2434)	1 per 3,000 cu. yd.	Permeability $\geq$ 1 x 10^{-2} cm/sec	50 lbs
	Total Thickness	Placed Material	$\geq$ 12 inches with filter geotextile. $\geq$ 15 inches without filter geotextile. Required thickness verified by survey.	N/A
	Shear Strength (ASTM D3080)	One sample per material type	See Table 9 for required shear strength.	50 lbs
TIRE SHRED LEACHATE COLLECTION LAYER	Sieve Analysis (ASTM D422)	1 per 3,000 cu. yd.	Material free of debris, plant materials, large wires, and other foreign matter. 100% passing 6-inch sieve with not more than 5% of the material by weight passing through the #200 sieve	N/A
	Permeability (ASTM D2434)	1 per 10,000 cu. yd.	Permeability $\geq$ 0.1 cm/sec under a normal load of 13,500 psf	25 lbs
	Test Pits	Excavate 1 per acre	See Section II, Sub-Section 7.1 of the CQA/QC Plan	N/A
	Total Thickness	Placed Material	$\geq$ 24 inches. Required thickness verified by survey	N/A

TABLE 1
MINIMUM TEST FREQUENCIES FOR SOIL AND AGGREGATE COMPONENTS

Component	Required Test	Minimum Frequency	Acceptance Criteria	Sample Size
COARSE AGGREGATE AROUND PIPES	Sieve Analysis (ASTM D422)	1 per 3,000 cu. yd.	AASHTO No. 57 gradation or equivalent with not more than 5% of the material by weight passing through the #200 sieve.	50 lbs
	Permeability (ASTM D2434)	1 per 3,000 cu. yd.	Permeability $\geq$ 1 x 10^{-2} cm/sec	50 lbs.
	Carbonate Content (ASTM D3042) pH=4.0	1 per 3,000 cu. yd.	$\leq$ 5%	50 lbs
RECOMPACTED SOIL BARRIER (See Note 1)	Sieve and Hydrometer (ASTM D422)	1 per 1,500 cu.yd.	100% $\leq$ 2-inch, 90% $\leq$ 3/ 4-inch, and 50% $\leq$ No. 200 sieve.	5-10 lb
	Unified Soil Classification (ASTM D2487)	1 per 1,500 cu.yd.	Prior to placement.	5-10 lb
	Density/Moisture Relationship[2] (ASTM D698 or D1557)	1 per 1,500 cu.yd.	Prior to placement.	50 lb
	Specific Gravity [3] (ASTM D854)	1 per 1,500 cu.yd.	N/A	5-10 lb
	Permeability: Flexible Wall Permeameter (ASTM 5084)	1 per 10,000 cu.yd.	Permeability $\leq$ 1 x 10^{-6} cm/sec	50 lb
	Nuclear Density Gauge In-Place Density (ASTM D2922) and Moisture Content (ASTM D3017)	Placed Material: 5 tests per acre/lift	$\geq$ 95% of Standard Proctor maximum dry density or $\geq$ 90% of Modified Proctor maximum dry density with a moisture content at or above optimum, or as modified by test pad; or Compaction to a moisture content and dry density that meets or exceeds the best fit line of optimums.	N/A
	Moisture Content (ASTM D2216)	At discretion of CQA firm.	N/A; To confirm nuclear density gauge moisture correction.	Varies
	Lift Depth	Placed Material	$\leq$ 8 inches uncompacted depth	N/A
	Total Thickness	Placed Material	Minimum 18 inches. Required thickness verified by survey	N/A
	Consolidated Undrained Triaxial Compression Test (ASTM D4767) -with Pore Pressure Readings or Direct Shear Test (ASTM D3080)	One sample per material type	See Table 9 for required shear strength.	N/A

TABLE 1
MINIMUM TEST FREQUENCIES FOR SOIL AND AGGREGATE COMPONENTS

Component	Required Test	Minimum Frequency	Acceptance Criteria	Sample Size
VEGETATIVE COVER LAYER	Visual Observation	Placed Material	Reasonably free of debris, plant materials, and foreign objects.	N/A
	Sieve and Hydrometer Analysis (ASTM D422)	1 per material type	(2 to 3) * d_{85} > AOS of the geotextile component of the Final Cover Geocomposite (see Table 6) where d_{85} =the diameter at which 85 percent of the protective layer soil particles are finer	5-10 lb
	Total Thickness	Placed Material	≥ 30 inches verified through survey or direct measurement	N/A
TRANSITIONAL COVER	Visual Classification (ASTM D2488)	During Placement	Soil shall be non-putrescible and have low permeability, good compactability, cohesiveness, and relatively uniform texture, and shall not contain large objects in such quantities as may interfere with its application and intended purpose.	N/A
	USDA Classification Visual Classification (ASTM D2488)	1 sample per 2 acres	well-compacted loam, silt loam, clay loam, silty clay loam, silty clay or other soil types that can achieve the intended purpose	N/A
	Total Thickness	Placed Material	> 24 inches verified through survey or direct measurement	N/A

Notes:

1. Results of pre-construction testing of the borrow soils performed on representative samples shall be submitted to the Ohio EPA no later than seven days prior to the intended use of the material during construction.
2. If the use of the Best Fit Line of Optimums is proposed, both standard and modified Proctor tests will performed on alternating samples.
3. This testing is only required if the use of the Best Fit Line of Optimums is proposed.

TABLE 2
GEOSYNTHETIC CLAY LINER
QA/QC TESTING

PROPERTY	TEST METHOD	REQUIRED QA/QC TESTING VALUE	QC TEST FREQUENCY (1)	QA TEST FREQUENCY
Bentonite Content @ 0 Percent Moisture (lbs/ft^2)	ASTM D5993	0.75	1 per 50,000 ft^2	100,000 ft^2
Permeability (cm/sec) (max.)	ASTM D5887	5×10^{-9}	See Note 2	N/A
Peel Bond Strength (lbs/in)	ASTM D6496	2.5	See Note 2	See Note 3
Internal and Interface Shear Strength Testing	ASTM D6243	See Table 9	N/A	See Table 9

NOTES:
(1) Results of preconstruction testing for the internal shear strength, dry bentonite content, and interface shear strength of the geosynthetic clay liner material performed on representative samples shall be submitted to the Ohio EPA Southeast district office no later than seven days prior to the intended use of the material. In subsequent years, the interface shear strength shall be required if it is identified to be at the highest risk for slope failure.
(2) Testing shall be completed at the manufacturer's standard test frequency.
(3) Peel bond strength testing will be completed on the same representative sample as the internal shear strength testing.

TABLE 3
60 mil HDPE SMOOTH / TEXTURED GEOMEMBRANE
QA/QC TESTING

REQUIRED PHYSICAL PROPERTIES				
PROPERTY	**TEST METHOD**	**REQUIRED VALUES** (1)	**MANUFACTURER QC TEST FREQUENCY**	**QUALITY ASSURANCE TEST FREQUENCY**
THICKNESS (mil)	ASTM D5199 (Smooth)	54 minimum 60 minimum average	Each Roll	Every 100,000 sf
	ASTM D5994 (Textured)	51 minimum 54 lowest individual for 8 of 10 values 57 minimum average		
ASPERITY HEIGHT (textured only) (mil) (min. avg.)	ASTM D7466	QC: Average ≥ minimum tested avG. QA: Refer to Note 3	See Note 2	Every 100,000 sf Both sides of geomembrane
SHEET DENSITY (g/cm^3) (min.)	ASTM D1505 Or ASTM D792	0.940	See Note 2	Every 100,000 sf
TENSILE PROPERTIES (min.) (each direction) • Yield Strength (lb/in) • Yield Elongation (%) • Break Strength (lb/in) • Break Elongation (%)	ASTM D6693 Type IV	126 12 228(smooth) 90(text.) 700(smooth) 100(text.)	See Note 2	Every 100,000 sf
CARBON BLACK CONTENT (allowable range in %)	ASTM D1603	2.0 – 3.0 %	See Note 2	Every 100,000 sf
CARBON BLACK DISPERSION (acceptable levels)	ASTM D5596	9 in Categories 1 or 2, and 1 in Category 3	See Note 2	Every 100,000 sf
PUNCTURE RESISTANCE (avg. min.) (lb)	ASTM D4833	108 (smooth) 90 (textured)	See Note 2	Every 100,000 sf
TEAR RESISTANCE (avg. min.) (lb)	ASTM D1004	42	See Note 2	Every 100,000 sf

Notes: (1) Required values are from GRI Test Method GM 13, Standard Specification for "Test Properties, Testing Frequency and Recommended Warranty for High Density Polyethylene Smooth and Textured Geomembranes".
(2) Testing shall be completed at the manufacturer's standard testing frequency.
(3) The required asperity height value for QA testing shall be equivalent to the minimum average asperity height of the material used during preconstruction interface shear strength testing (herein "Shear Tested Value"). The average value reported for QA testing may be less than the Shear Tested Value if the following criteria are met: 8 out of 10 individual readings must be equal to or greater than the Shear Tested Value minus 3 mils. The lowest individual reading must be greater than or equal to the Shear Tested Value minus 4 mils.

TABLE 3 (CONT.)

REQUIRED PHYSICAL PROPERTIES				
PROPERTY	**TEST METHOD**	**REQUIRED VALUES** (1)	**MANUFACTURER QC TEST FREQUENCY**	**QUALITY ASSURANCE TEST FREQUENCY**
OXIDATIVE INDUCTION TIME • Standard (avg. min.) or • High Pressure (avg. min.)	ASTM D3895 ASTM D5885	100 min 400 min	See Note 2	See Note 3
OVEN AGING AT 85°C •Standard OIT (min avg % retained after 90 days) or • High Pressure OIT (min avg % retained after 90 days)	ASTM D5721 ASTM D3895 ASTM D5885	55% 80%	Certify Each Formulation	See Note 3
UV RESISTANCE • High Pressure OIT (min avg % retained after 1600 hours)	ASTM D5885	50%	Certify Each Formulation	See Note 3
STRESS CRACK RESISTANCE	ASTM D5397	200 hours	Per GRI GM 10	See Note 3
INTERFACE SHEAR STRENGTH	ASTM D5321	See Table 9	See Note 3	See Table 9
GEOMEMBRANE RESIN				
DENSITY (min.) (g/ml)	ASTM D1505/D792	0.932	Each Resin Batch	See Note 3
MELT FLOW INDEX (g/10 min) (max.)	ASTM D1238	1.0	Each Resin Batch	See Note 3

Notes: (1) Required values are from GRI Test Method GM 13, Standard Specification for "Test Properties, Testing Frequency and Recommended Warranty for High Density Polyethylene Smooth and Textured Geomembranes".
(2) Testing shall be completed at the manufacturer's standard testing frequency.
(3) Not Required

TABLE 3 (CONT.)

INSTALLATION TESTING SUMMARY				
PROPERTY	**TEST METHOD**	**SAMPLE SIZE**	**FIELD TEST FREQUENCY**	**ACCEPTANCE CRITERIA[2]**
TRIAL SEAM TESTING [1]:				
PEEL TEST (lb/in) Fusion Welds	ASTM D6392	As Needed	Minimum 1 test per welder/machine combination; and prior to each seaming period	4 out of 5 tests shall be greater than 91 lb/in. The result of the fifth must be greater than 73 lb/in. AD and AD-BRK codes are acceptable break code if seam incursion is less than 25%. Refer to schematic on Page 4 for break codes.
PEEL TEST (lb/in) Extrusion Welds	ASTM D6392		Minimum 1 test per welder/machine combination; and prior to each seaming period	4 out of 5 tests shall be greater than 78 lb/in. The result of the fifth must be greater than 62 lb/in. AD1 and AD2 break codes are not acceptable. AD-WLD break code is acceptable only if required strength is reached. Refer to schematic on Page 4 for break codes.
DESTRUCTIVE SEAM TESTING [1]:				
PEEL TEST (lb/in) Fusion Welds	ASTM D6392	As Needed	Minimum 1 per 500 lf of seaming per device	4 out of 5 tests shall be greater than 91 lb/in. The result of the fifth must be greater than 73 lb/in. AD break code is not acceptable. AD-BRK codes are acceptable break code if seam incursion is less than 25%. Refer to schematic on Page 4 for break codes.
PEEL TEST (lb/in) Extrusion Welds	ASTM D6392		Minimum 1 per 500 lf of seaming per device	4 out of 5 tests shall be greater than 78 lb/in. The result of the fifth must be greater than 62 lb/in. AD1, AD2, AD-BRK and AD-WLD break codes are not acceptable. Refer to schematic on Page 4 for break codes.
NON-DESTRUCTIVE SEAM TESTING:				
AIR-PRESSURE	ASTM D5820		Every Fusion Welded Seam	No more than 3 psi drop with initial pressure of 30 to 35 psi for 5 minutes.
VACUUM	ASTM D5641		Every Extrusion Weld	Examine weld for 10 seconds with minimum vacuum of 3 psi.
LINER INTEGRITY TESTING:				
ELECTRICAL CONDUCTIVITY	ASTM D7007 ASTM D6747	N/A	Total liner area	No anomalies in the measured electrical potential.

Notes:

(1) For double fusion welded seams, both tracks shall be tested for compliance with the minimum property values listed.

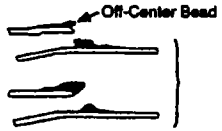
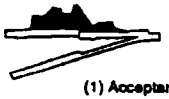
(2) Accepted specifications for breaks and unacceptable break codes obtained from the standard specifications in GRI-GM19.

TABLE 3 (CONT.)

ASTM D 6392 LOCATION OF SEAM STRENGTH TESTING BREAK CODES FOR SEAMS TESTED IN SHEAR AND PEEL

EXTRUSION WELDED SEAMS

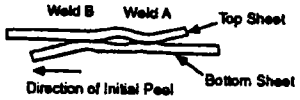
Schematic of Untested Specimen

Types of Break	Location of Break Code	Break Description
	AD1	Failure in adhesion. Specimens may also delaminate under the bead and break through the thin extruded material in the outer area.
	AD2	Failure in adhesion.
	AD-WLD[1]	Break through the fillet.
	SE1	Break at seam edge in the bottom sheet (applicable to shear only).
	SE2	Break at seam edge in the top sheet (applicable to shear only).
	SE3	Break at seam edge in the bottom sheet (applicable to peel only).
	BRK1	Break in the bottom sheeting. A "B" in parebtheses following the code means the specimen broke in the buffed area.
	BRK2	Break in the top sheeting. A "B" in parebtheses following the code means the specimen broke in the buffed area.
	AD-BRK	Break in the bottom sheeting after some adhesion failure between the fillet and the bottom sheet.
	HT	Break at the edge of the hot tack for specimens which could not be delaminated in the hot tack.
	SIP	Separation in the plane of the sheet.

(1) Acceptance of AD-WLD breaks may depend on whether test values meet a minimum specification value.

FUSION WELDED SEAMS

Schematic of Untested Specimen



Types of Break	Location of Break Code	Break Description
	AD	Adhesion Failure
	BRK	Break in sheeting. Break can be in either top or bottom sheet
	SE1	Break in outer edge of seam. Break can be in either top or bottom sheet.
	SE2	Break at inner edge of seam through both sheets.
	AD-BRK	Break in first seam after some adhesion failure. Break can be in either top or bottom sheet.
	SIP	Separation in the plane of the sheet. Break can be in either top or bottom sheet.

TABLE 4

40 mil LLDPE TEXTURED GEOMEMBRANE QA/QC TESTING

REQUIRED PHYSICAL PROPERTIES				
PROPERTY	**TEST METHOD**	**REQUIRED VALUES** (1)	**MANUFACTURER QC TEST FREQUENCY**	**QUALITY ASSURANCE TEST FREQUENCY**
THICKNESS (mil)	ASTM D5994	34 minimum 36 lowest individual for 8 of 10 values 38 minimum average	Each Roll	Every 100,000 sf
ASPERITY HEIGHT (mil) (min. avg.)	ASTM D7466	QC: Average ≥ minimum tested avG. QA: Refer to Note 3	See Note 2	Every 100,000 sf Both Sides of Geomembrane
SHEET DENSITY (g/cm^3) (max.)	ASTM D1505 Or ASTM D792	0.939	See Note 2	Every 100,000 sf
TENSILE PROPERTIES (min.) (each direction) • Break Strength (lb/in) • Break Elongation (%)	ASTM D6693 Type IV	 60 250	See Note 2	Every 100,000 sf
CARBON BLACK CONTENT (allowable range in %)	ASTM D1603	2.0 – 3.0 %	See Note 2	Every 100,000 sf
CARBON BLACK DISPERSION (acceptable levels)	ASTM D5596	9 in Categories 1 or 2, and 1 in Category 3	See Note 2	Every 100,000 sf
PUNCTURE RESISTANCE (avg. min.) (lb)	ASTM D4833	44	See Note 2	Every 100,000 sf
TEAR RESISTANCE (avg. min.) (lb)	ASTM D1004	22	See Note 2	Every 100,000 sf

Notes: (1) Required values are from GRI Test Method GM 17, Standard Specification for "Test Properties, Testing Frequency and Recommended Warranty for Linear Low Density Polyethylene Smooth and Textured Geomembranes".
(2) Testing shall be completed at the manufacturer's standard testing frequency.
(3) The required asperity height value for QA testing shall be equivalent to the minimum average asperity height of the material used during preconstruction interface shear strength testing (herein "Shear Tested Value"). The average value reported for QA testing may be less than the Shear Tested Value if the following criteria are met: 8 out of 10 individual readings must be equal to or greater than the Shear Tested Value minus 3 mils. The lowest individual reading must be greater than or equal to the Shear Tested Value minus 4 mils.

TABLE 4 (CONT.)

REQUIRED PHYSICAL PROPERTIES				
PROPERTY	**TEST METHOD**	**REQUIRED VALUES** (1)	**MANUFACTURER QC TEST FREQUENCY**	**QUALITY ASSURANCE TEST FREQUENCY**
OXIDATIVE INDUCTION TIME • Standard (avg. min.) or • High Pressure (avg. in.)	ASTM D3895 ASTM D5885	100 min 400 min	See Note 2	See Note 3
OVEN AGING AT 85°C • Standard OIT (min avg % retained after 90 days) or • High Pressure OIT (min avg % retained after 90 days)	ASTM D5721 ASTM D3895 ASTM D5885	35% 60%	Certify Each Formulation	See Note 3
UV RESISTANCE • High Pressure OIT (min avg % retained after 1600 hours)	ASTM D5885	35%	Certify Each Formulation	See Note 3
STRESS CRACK RESISTANCE	ASTM D5397	200 hours	Per GRI GM 10	See Note 3
INTERFACE SHEAR STRENGTH	ASTM D5321	See Table 9	See Note 3	See Table 9
GEOMEMBRANE RESIN				
DENSITY (max.) (g/ml)	ASTM D1505/D792	0.926	Each Resin Batch	See Note 3
MELT FLOW INDEX (g/10 min) (max.)	ASTM D1238	1.0	Each Resin Batch	See Note 3

Notes: (1) Required values are from GRI Test Method GM 17, Standard Specification for "Test Properties, Testing Frequency and Recommended Warranty for Linear Low Density Polyethylene Smooth and Textured Geomembranes".
(2) Testing shall be completed at the manufacturer's standard testing frequency.
(3) Not Required

TABLE 4 (CONT.)

INSTALLATION TESTING SUMMARY				
PROPERTY	**TEST METHOD**	**SAMPLE SIZE**	**FIELD TEST FREQUENCY**	**ACCEPTANCE CRITERIA[2]**
TRIAL SEAM TESTING [1]:				
PEEL TEST (lb/in) Fusion Welds	ASTM D6392	As Needed	Minimum 1 test per welder/machine combination; and prior to each seaming period	4 out of 5 tests shall be greater than 50 lb/in. The result of the fifth must be greater than 40 lb/in. AD and AD-BRK codes are acceptable break code if seam incursion is less than 25%. Refer to schematic on Page 4 for break codes.
PEEL TEST (lb/in) Extrusion Welds	ASTM D6392		Minimum 1 test per welder/machine combination; and prior to each seaming period	4 out of 5 tests shall be greater than 44 lb/in. The result of the fifth must be greater than 35 lb/in. AD1 and AD2 break codes are not acceptable. AD-WLD break code is acceptable only if required strength is reached. Refer to schematic on Page 4 for break codes.
DESTRUCTIVE SEAM TESTING [1]:				
PEEL TEST (lb/in) Fusion Welds	ASTM D6392	As Needed	Minimum 1 per 500 lf of seaming per device	4 out of 5 tests shall be greater than 50 lb/in. The result of the fifth must be greater than 40 lb/in. AD break code is not acceptable. AD-BRK codes are acceptable break code if seam incursion is less than 25%. Refer to schematic on Page 4 for break codes.
PEEL TEST (lb/in) Extrusion Welds	ASTM D6392		Minimum 1 per 500 lf of seaming per device	4 out of 5 tests shall be greater than 44 lb/in. The result of the fifth must be greater than 35 lb/in. AD1, AD2, AD-BRK and AD-WLD break codes are not acceptable. Refer to schematic on Page 4 for break codes.
NON-DESTRUCTIVE SEAM TESTING:				
AIR-PRESSURE	ASTM D5820		Every Fusion Welded Seam	No more than 3 psi drop with initial pressure of 30 to 35 psi for 5 minutes.
VACUUM	ASTM D5641		Every Extrusion Weld	Examine weld for 10 seconds with minimum vacuum of 3 psi.

Notes:

(2) For double fusion welded seams, both tracks shall be tested for compliance with the minimum property values listed.

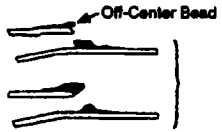
(2) Accepted specifications for breaks and unacceptable break codes obtained from the standard specifications in GRI-GM19.

TABLE 4 (CONT.)

ASTM D 6392 LOCATION OF SEAM STRENGTH TESTING BREAK CODES FOR SEAMS TESTED IN SHEAR AND PEEL

EXTRUSION WELDED SEAMS

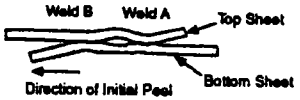
Schematic of Untested Specimen

Types of Break	Location of Break Code	Break Description
	AD1	Failure in adhesion. Specimens may also delaminate under the bead and break through the thin extruded material in the outer area.
	AD2	Failure in adhesion.
	AD-WLD[1]	Break through the fillet.
	SE1	Break at seam edge in the bottom sheet (applicable to shear only).
	SE2	Break at seam edge in the top sheet (applicable to shear only).
	SE3	Break at seam edge in the bottom sheet (applicable to peel only).
	BRK1	Break in the bottom sheeting. A "B" in parebtheses following the code means the specimen broke in the buffed area.
	BRK2	Break in the top sheeting. A "B" in parebtheses following the code means the specimen broke in the buffed area.
	AD-BRK	Break in the bottom sheeting after some adhesion failure between the fillet and the bottom sheet.
	HT	Break at the edge of the hot tack for specimens which could not be delaminated in the hot tack.
	SIP	Separation in the plane of the sheet.

(1) Acceptance of AD-WLD breaks may depend on whether test values meet a minimum specification value.

FUSION WELDED SEAMS

Schematic of Untested Specimen



Types of Break	Location of Break Code	Break Description
	AD	Adhesion Failure
	BRK	Break in sheeting. Break can be in either top or bottom sheet
	SE1	Break in outer edge of seam. Break can be in either top or bottom sheet.
	SE2	Break at inner edge of seam through both sheets.
	AD-BRK	Break in first seam after some adhesion failure. Break can be in either top or bottom sheet.
	SIP	Separation in the plane of the sheet. Break can be in either top or bottom sheet.

TABLE 5
40 mil HDPE TEXTURED GEOMEMBRANE
QA/QC TESTING

REQUIRED PHYSICAL PROPERTIES				
PROPERTY	**TEST METHOD**	**REQUIRED VALUES** (1)	**MANUFACTURER QC TEST FREQUENCY**	**QUALITY ASSURANCE TEST FREQUENCY**
THICKNESS (mil)	ASTM D5994	34 minimum 36 lowest individual for 8 of 10 values 38 minimum average	Each Roll	Every 100,000 sf
ASPERITY HEIGHT (mil) (min. avg.)	ASTM D7466	QC: Average ≥ minimum tested avG. QA: Refer to Note 3	See Note 2	Every 100,000 sf Both sides of geomembrane
SHEET DENSITY (g/cm^3) (min.)	ASTM D1505 Or ASTM D792	0.940	See Note 2	Every 100,000 sf
TENSILE PROPERTIES (min.) (each direction) • Yield Strength (lb/in) • Yield Elongation (%) • Break Strength (lb/in) • Break Elongation (%)	ASTM D6693 Type IV	 84 12 60 100	See Note 2	Every 100,000 sf
CARBON BLACK CONTENT (allowable range in %)	ASTM D1603	2.0 – 3.0 %	See Note 2	Every 100,000 sf
CARBON BLACK DISPERSION (acceptable levels)	ASTM D5596	9 in Categories 1 or 2, and 1 in Category 3	See Note 2	Every 100,000 sf
PUNCTURE RESISTANCE (avg. min.) (lb)	ASTM D4833	60	See Note 2	Every 100,000 sf
TEAR RESISTANCE (avg. min.) (lb)	ASTM D1004	28	See Note 2	Every 100,000 sf

Notes: (1) Required values are from GRI Test Method GM 13, Standard Specification for "Test Properties, Testing Frequency and Recommended Warranty for High Density Polyethylene Smooth and Textured Geomembranes".
(2) Testing shall be completed at the manufacturer's standard testing frequency.
(3) The required asperity height value for QA testing shall be equivalent to the minimum average asperity height of the material used during preconstruction interface shear strength testing (herein "Shear Tested Value"). The average value reported for QA testing may be less than the Shear Tested Value if the following criteria are met: 8 out of 10 individual readings must be equal to or greater than the Shear Tested Value minus 3 mils. The lowest individual reading must be greater than or equal to the Shear Tested Value minus 4 mils.

TABLE 5 (CONT.)

REQUIRED PHYSICAL PROPERTIES				
PROPERTY	**TEST METHOD**	**REQUIRED VALUES** (1)	**MANUFACTURER QC TEST FREQUENCY**	**QUALITY ASSURANCE TEST FREQUENCY**
OXIDATIVE INDUCTION TIME • Standard (avg. min.) or • High Pressure (avg. min.)	ASTM D3895 ASTM D5885	100 min 400 min	See Note 2	See Note 3
OVEN AGING AT 85°C • Standard OIT (min avg % retained after 90 days) or • High Pressure OIT (min avg % retained after 90 days)	ASTM D5721 ASTM D3895 ASTM D5885	55% 80%	Certify Each Formulation	See Note 3
UV RESISTANCE • High Pressure OIT (min avg % retained after 1600 hours)	ASTM D5885	50%	Certify Each Formulation	See Note 3
STRESS CRACK RESISTANCE	ASTM D5397	200 hours	Per GRI GM 10	See Note 3
INTERFACE SHEAR STRENGTH	ASTM D5321	See Table 9	See Note 3	See Table 9
GEOMEMBRANE RESIN				
DENSITY (min.) (g/ml)	ASTM D1505/D792	0.932	Each Resin Batch	See Note 3
MELT FLOW INDEX (g/10 min) (max.)	ASTM D1238	1.0	Each Resin Batch	See Note 3

Notes: (1) Required values are from GRI Test Method GM 13, Standard Specification for "Test Properties, Testing Frequency and Recommended Warranty for High Density Polyethylene Smooth and Textured Geomembranes".
(2) Testing shall be completed at the manufacturer's standard testing frequency.
(3) Not Required

TABLE 5 (CONT.)

INSTALLATION TESTING SUMMARY				
PROPERTY	**TEST METHOD**	**SAMPLE SIZE**	**FIELD TEST FREQUENCY**	**ACCEPTANCE CRITERIA[2]**
TRIAL SEAM TESTING [1]:				
PEEL TEST (lb/in) Fusion Welds	ASTM D6392	As Needed	Minimum 1 test per welder/machine combination; and prior to each seaming period	4 out of 5 tests shall be greater than 50 lb/in. The result of the fifth must be greater than 40 lb/in. AD and AD-BRK codes are acceptable break code if seam incursion is less than 25%. Refer to schematic on Page 4 for break codes
PEEL TEST (lb/in) Extrusion Welds	ASTM D6392		Minimum 1 test per welder/machine combination; and prior to each seaming period	4 out of 5 tests shall be greater than 44 lb/in. The result of the fifth must be greater than 35 lb/in. AD1 and AD2 break codes are not acceptable. AD-WLD break code is acceptable only if required strength is reached. Refer to schematic on Page 4 for break codes.
DESTRUCTIVE SEAM TESTING [1]:				
PEEL TEST (lb/in) Fusion Welds	ASTM D6392	As Needed	Minimum 1 per 500 lf of seaming per device	4 out of 5 tests shall be greater than 50 lb/in. The result of the fifth must be greater than 40 lb/in. AD break code is not acceptable. AD-BRK codes are acceptable break code if seam incursion is less than 25%. Refer to schematic on Page 4 for break codes.
PEEL TEST (lb/in) Extrusion Welds	ASTM D6392		Minimum 1 per 500 lf of seaming per device	4 out of 5 tests shall be greater than 44 lb/in. The result of the fifth must be greater than 35 lb/in. AD1, AD2, AD-BRK and AD-WLD break codes are not acceptable. Refer to schematic on Page 4 for break codes.
NON-DESTRUCTIVE SEAM TESTING:				
AIR-PRESSURE	ASTM D5820		Every Fusion Welded Seam	No more than 3 psi drop with initial pressure of 30 to 35 psi for 5 minutes.
VACUUM	ASTM D5641		Every Extrusion Weld	Examine weld for 10 seconds with minimum vacuum of 3 psi.

Notes:

(3) For double fusion welded seams, both tracks shall be tested for compliance with the minimum property values listed.

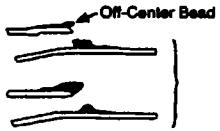
(2) Accepted specifications for breaks and unacceptable break codes obtained from the standard specifications in GRI-GM19.

TABLE 5 (CONT.)

ASTM D 6392 LOCATION OF SEAM STRENGTH TESTING BREAK CODES FOR SEAMS TESTED IN SHEAR AND PEEL

EXTRUSION WELDED SEAMS

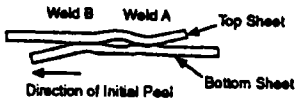
Schematic of Untested Specimen

Types of Break	Location of Break Code	Break Description
	AD1	Failure in adhesion. Specimens may also delaminate under the bead and break through the thin extruded material in the outer area.
	AD2	Failure in adhesion.
	AD-WLD(1)	Break through the fillet.
	SE1	Break at seam edge in the bottom sheet (applicable to shear only).
	SE2	Break at seam edge in the top sheet (applicable to shear only).
	SE3	Break at seam edge in the bottom sheet (applicable to peel only).
	BRK1	Break in the bottom sheeting. A "B" in parebtheses following the code means the specimen broke in the buffed area.
	BRK2	Break in the top sheeting. A "B" in parebtheses following the code means the specimen broke in the buffed area.
	AD-BRK	Break in the bottom sheeting after some adhesion failure between the fillet and the bottom sheet.
	HT	Break at the edge of the hot tack for specimens which could not be delaminated in the hot tack.
	SIP	Separation in the plane of the sheet.

(1) Acceptance of AD-WLD breaks may depend on whether test values meet a minimum specification value.

FUSION WELDED SEAMS

Schematic of Untested Specimen



Types of Break	Location of Break Code	Break Description
	AD	Adhesion Failure
	BRK	Break in sheeting. Break can be in either top or bottom sheet
	SE1	Break in outer edge of seam. Break can be in either top or bottom sheet.
	SE2	Break at inner edge of seam through both sheets.
	AD-BRK	Break in first seam after some adhesion failure. Break can be in either top or bottom sheet.
	SIP	Separation in the plane of the sheet. Break can be in either top or bottom sheet.

TABLE 6

FINAL COVER SYSTEM *AND UNDERDRAIN* DOUBLE SIDED GEOCOMPOSITE QA/QC TESTING

PROPERTY	TEST METHOD	*FINAL COVER* REQUIRED VALUES	*UNDERDRAIN REQUIRED VALUES*	MANUFACTURER QC TEST FREQUENCY	QUALITY ASSURANCE TEST FREQUENCY
GEONET COMPONENT:					
THICKNESS (mil) (min.)	ASTM D5199	300	*200*	See Note 1	1 per 250,000 sf
DENSITY (g/cm^3) (min.)	ASTM D792 or ASTM D1505	0.94 (g/cm^3)	*0.94 (g/cm^3)*	See Note 1	1 per 250,000 sf
CARBON BLACK CONTENT (%) (min.)	ASTM D1603	2.0 - 3.5 %	*2.0 - 3.5 %*	See Note 1	1 per 250,000 sf
GEOTEXTILE COMPONENT:					
MASS PER UNIT AREA (oz/sy) (min.)	ASTM D5261	5.0	*5.0*	See Note 1	1 per 250,000 sf
APPARENT OPENING SIZE (Sieve)	ASTM D4751	70 - 140	*70 - 140*	See Note 1	1 per 250,000 sf
PERMITTIVITY (sec^{-1}) (min.)	ASTM D4491	1.20	*1.20*	See Note 1	1 per 250,000 sf
GRAB STRENGTH[(2)] (lbs) (min.)	ASTM D4632	160	*160*	See Note 1	1 per 250,000 sf
TRAPEZOIDAL TEAR[(2)] (lbs) (min.)	ASTM D4533	65	*65*	See Note 1	1 per 250,000 sf
PUNCTURE STRENGTH (lbs) (min.)	ASTM D6241	80	*80*	See Note 1	1 per 250,000 sf
UV RESISTANCE (%) (min.) **At 500 hours of exposure**	ASTM D4355	70	*70*	Certify	N/A
GEOCOMPOSITE:					
TRANSMISSIVITY (m^2/sec) (min.)	ASTM D4716	~~1.02×10^{-3}~~ *1.47×10^{-3}*	*1.00×10^{-3}*	See Note 1	1 per 50,000 sf[(4)]
INTERFACE SHEAR STRENGTH (min)	ASTM D5321	See Table 9	*See Table 9*	N/A	See Table 9

Notes:
(1) Testing shall be completed at the manufacturer's standard testing frequency.
(2) Minimum values measured in machine and cross machine direction.
(3) The geonet and geotextile components of the double sided geocomposite shall be tested separately for the above parameters.
(4) Transmissivity testing *for the final cover geocomposite* shall be performed at a gradient of 0.25, at a normal load of 300 psf, and between soil and textured geomembrane.
(5) Transmissivity testing for the underdrain geocomposite shall be performed at a gradient of 0.03, at a normal load of 3,000 psf, and between representative samples of in-situ soil and RSL.

TABLE 7
6 OZ/SY MARV NONWOVEN GEOTEXTILE
QA/QC TESTING

PROPERTY	TEST METHOD	REQUIRED VALUES	MANUFACTURER QC TEST FREQUENCY	QUALITY ASSURANCE TEST FREQUENCY
CUSHION MATERIAL				
MASS PER UNIT AREA (oz/sy) (min.)	ASTM D5261	5.0	See Note 1	1 per 250,000 sf
GRAB TENSILE STRENGTH (lb) (min.)	ASTM D4632	160	See Note 1	1 per 250,000 sf
TRAPEZOIDAL TEAR (lb) (min.)	ASTM D4533	65	See Note 1	1 per 250,000 sf
PUNCTURE STRENGTH (lb) (min.)	ASTM D6241	80	See Note 1	1 per 250,000 sf
UV RESISTANCE (%) (min.) at 500 hours of exposure	ASTM D4355	70	Certify	N/A
INTERFACE SHEAR STRENGTH (min.)	ASTM D5321	See Table 9	N/A	See Table 9
FILTER MATERIAL [2]				
APPARENT OPENING SIZE (Sieve)	ASTM D4751	70 - 140	See Note 1	1 per 250,000 sf
PERMITTIVITY (sec^{-1}) (min.)	ASTM D4491	1.20	See Note 1	1 per 250,000 sf

Notes:
(1) Testing shall be completed at the manufacturer's standard testing frequency.
(2) If a geotextile filter is used, testing for these properties must be done in addition to the cushion material testing.

TABLE 8
16 OZ/SY MARV NONWOVEN GEOTEXTILE
QA/QC TESTING

PROPERTY	TEST METHOD	REQUIRED VALUES	MANUFACTURER QC TEST FREQUENCY	QUALITY ASSURANCE TEST FREQUENCY
MASS PER UNIT AREA (oz/sy) (min.)	ASTM D5261	15.0	See Note 1	1 per 250,000 sf
GRAB TENSILE STRENGTH (lb) (min.)	ASTM D4632	370	See Note 1	1 per 250,000 sf
TRAPEZOIDAL TEAR (lb) (min.)	ASTM D4533	145	See Note 1	1 per 250,000 sf
PUNCTURE STRENGTH (lb) (min.)	ASTM D6241	170	See Note 1	1 per 250,000 sf
UV RESISTANCE (%) (min.) at 500 hours of exposure	ASTM D4355	70	Certify	N/A
INTERFACE SHEAR STRENGTH (min)	ASTM D5321	See Table 9	N/A	See Table 9

Notes:
(1) Testing shall be completed at the manufacturer's standard testing frequency.

TABLE 9

MINIMUM INTERNAL/INTERFACE SHEAR STRENGTHS

		Interface or Material which Internal Shear Strength is to be Measured [3][4]	Friction Angle[1] (degrees)	Normal Stress σ (psf)	Shear Strength[1] τ (psf)
In-Situ Soils		*Mine Spoil / Residual Soil*	*Effective Stress: C = 0 psf, ϕ = 27° (or equivalent shear strength)*		
Soil Fill		3H:1V Soil Structural Fill	Effective Stress: C = 0 psf, ϕ = 27° (or equivalent shear strength)		
		2H:1V Soil Structural Fill	Effective Stress: C = 0 psf, ϕ = 36.9° (or equivalent shear strength)		
		Granular Drainage Layer / Protective Cover	Effective Stress: C = 0 psf, ϕ = 30.0° (or equivalent shear strength)		
		Recompacted Soil Liner (RSL) (internal)	Effective Stress: C = 0 psf, ϕ = 27° (or equivalent shear strength)		
		Recompacted Soil Barrier (RSB) (internal)	*NA*	*1,100*	*560*
Baseliner System	Peak Strengths (Slopes ≤ 5 percent)	Internal Geosynthetic Clay Liner (GCL) RSL to GCL GCL to Geomembrane RSL to Geomembrane Geomembrane to Geotextile Geotextile to Granular Drainage Layer *Geocomposite Underdrain to RSL*	NA	0 3,000 6,000 13,500	0 ~~1,500~~ *1,250* 2,000 ~~4,100~~ *3,500*
	Post-Peak Strengths (3H:1V sideslopes)	Internal GCL RSL to GCL GCL to Geomembrane RSL to Geomembrane Geomembrane to Geotextile Geotextile to Granular Drainage Layer	NA	0 3,000 6,000 13,500	0 875 1,290 2,100

TABLE 9

MINIMUM INTERNAL/INTERFACE SHEAR STRENGTHS (continued)

Final Cover System	Peak Strengths	~~Recompacted Soil Barrier~~ Textured Geomembrane to Recompacted Soil Barrier Double Sided Geocomposite to Textured Geomembrane Vegetative Cover/Frost Protection Layer to Double Sided Geocomposite	26.6	~~800~~ *1,100*	~~401~~ *551*

Notes:

(1) Minimum peak shear strengths are provided in both friction angle and shear stress at specified normal loads. Shear stress is calculated using the equation: $\tau = c + [\sigma * \tan(\phi)]$ where c equals cohesion or adhesion. Exceeding either the required friction angle with cohesion and adhesion equal to zero or the minimum shear stress at the required normal loads is acceptable.

(2) Each interface and internal shear strength will be tested twice prior to using a new material at the facility, and once per construction event thereafter for the interface with the highest risk of slope failure. The internal shear strength testing of the GCL must be tested prior to each construction event.

(3) As required in OAC 3745-27-08(G), the results of interface and internal shear strength testing results must be submitted to the Ohio EPA no later than seven days prior to the intended use of the materials.

(4) For internal testing of the GCL, the rate of shear displacement may not exceed 0.10 mm/min, and the material must be hydrated under a normal load of 150 psf until equilibrium is achieved.

(5) Peel strength testing shall be completed on the same representative sample of GCL as the internal shear strength testing.

(6) Interface shear strength tests of interfaces involving a tire chip drainage layer are not required.

(7) Conformance with the post-peak shear strength requirement is only required for the interface with the lowest peak shear strength.

APPENDIX C9-D

FINAL CLOSURE/POST CLOSURE PLAN

FINAL CLOSURE/POST-CLOSURE PLAN
APEX SANITARY LANDFILL
JEFFERSON COUNTY, OHIO

PREPARED FOR:

APEX ENVIRONMENTAL, LLC
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AMSTERDAM, OHIO 43903

PREPARED BY:

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OCTOBER 2011
REVISED JULY 2013

CEC PROJECT 091-867

FINAL CLOSURE/POST-CLOSURE PLAN
APEX SANITARY LANDFILL
JEFFERSON COUNTY, OHIO

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FINAL CLOSURE/POST-CLOSURE PLAN
APEX SANITARY LANDFILL
JEFFERSON COUNTY, OHIO

INTRODUCTION

This Final Closure/Post-Closure Plan (Closure Plan) has been prepared for the proposed contiguous expansion of the Apex Sanitary Landfill which is owned and operated by Apex Environmental, LLC (Apex). The currently permitted limits of waste placement are approximately 117 acres. The contiguous expansion would provide an additional 171 acres of disposal area for a total of approximately 288 acres.

This Closure Plan addresses the requirements of OAC Rule 3745-27-11 (Final Closure of a Sanitary Landfill Facility) and OAC Rule 3745-27-14 (Post-Closure Care of Sanitary Landfill Facilities). These rules require the plan to address OAC Rule 3745-27-10 (Groundwater Monitoring Program for a Sanitary Landfill Facility), OAC Rule 3745-27-12 (Explosive Gas Monitoring for a Sanitary Landfill Facility), OAC Rule 3745-27-15 (Financial Assurance for Solid Waste Facility Final Closure), and OAC Rule 3745-27-16 (Financial Assurance for Sanitary Landfill Facility Post-Closure Care). The closure cost estimates and design calculations are included as separate portions of this PTI Application.

This Closure Plan is presented in the order and format of the relevant regulations (Rule 3745-27-11 and Rule 3745-27-14) providing informational narrative to fulfill each regulation. Informational or policy portions of the regulations are not addressed in this plan.

11(A) APPLICABILITY

11(A)(1) Operating Record

The Final Closure/Post Closure Plan will be kept in the operating record in accordance with OAC 3745-27-09.

11(A)(2) Acceptance of Waste Ceased Prior to June 1, 1994

This requirement does not apply to the proposed contiguous expansion of the Apex Sanitary Landfill.

11(B) FINAL CLOSURE/POST-CLOSURE PLAN

The owner or operator shall prepare a final closure/post-closure plan in accordance with this rule for the sanitary landfill facility, which shall, at a minimum, contain all the items specified in paragraphs (B)(1) to (B)(6) of this rule. The final closure/post-closure plan shall contain all of the items specified in paragraphs (B)(1) to (B)(6) of this rule for each noncontiguous unit of a sanitary landfill facility.

11(B)(1) Facility Name and Location

The Apex Sanitary Landfill is located in Springfield Township, Jefferson County, Ohio; 11 County Road 78 Amsterdam, Ohio 43903. The facility has been in operation since November 2005. A location map is included on the Title Sheet of the PTI Application drawing package.

Final closure will comply with Paragraphs (G), (H), (I) and (J) of Rule 3745-27-11 which are addressed below. In addition, final closure activities will include the installation of a landfill gas extraction system, which is described in Section (C)(7) of this PTI Application. The site is designed to minimize the need for further maintenance and to minimize the post-closure formation and release of leachate and landfill gases to air, soil, groundwater, or surface water.

11(B)(2) Variances and Exemptions

No variance or exemptions from OAC 3745-27-11 or OAC 3745-27-14, or any alternative schedule for completing final closure activities is proposed in the Closure Plan.

11(B)(3) Facility Contact

The contact regarding the sanitary landfill facility during closure and post-closure will be:

~~Dave Matthews,~~ District Manager
Apex Environmental, LLC.
11 County Road 78
Amsterdam, Ohio 43903
(740) 543-4389

The Ohio EPA Southeast District Office will be notified in the event that the contact changes.

11(B)(4) Installation of Explosive Gas Control System

The explosive gas control system will be built prior to final cover placement or to meet Title V Permit and NSPS requirements. Municipal solid waste landfills produce gases (primarily methane and carbon dioxide) as a result of the decomposition of organic material within the waste. The purpose of a landfill gas control system is to control gases generated within a landfill. An active gas system has been designed for the landfill as a means to control odor, gas migration and gas pressure buildup within the facility.

Since the waste within the landfill will be encapsulated by a liner and final cover system, the gas generated by decomposing waste will be prevented from moving off site. However, a gas control system is needed to mitigate the gas pressure placed upon landfill components, especially the flexible membrane liner (FML) within the final cover system. A gas control system thereby provides a controlled removal of gas reducing stress upon overlying intermediate and/or final cover layers.

Landfill gas will be removed from the landfill through a series of extraction wells spaced across the landfill. Landfill gas will then be conveyed via piping through a blower to a flare or other combustion devise. See Section (C)(7) of this PTI Application for a detailed description of the landfill gas extraction system.

11(B)(5) Compliance with OAC 3745-27-06

The following information is provided in this PTI Application which meets the requirements of OAC 3745-27-06.

11(B)(5)(a) Plan Drawings

Drawings 4F and 4G present the proposed top of waste and final grades of the composite cap system, respectively. The side slopes of the final cover are graded at 33 percent (3H:1V) with 20-foot wide waste benches spaced at approximate 60 feet vertical intervals, with the exception of the north slope of the existing unit which is graded at 25 percent (4H:1V) below elevation 1390 feet. The benches are designed to slope towards collection channels at 3 percent minimum slope.

The components comprising the proposed final cover system, from the top to bottom, are discussed below. A detailed description of the composite cap system materials, construction methods and construction quality assurance/quality control procedures are included in the CQA/QC Plan in Section (C)(9).

Cap Protection Layer: This layer will be 30-inches thick and will consist of clean soil capable of supporting vegetation. The surface of the cap protection layer will be fertilized, seeded and mulched as necessary to provide a dense vegetative cover. The soil will not contain excessively large materials.

Geocomposite Drainage Layer: This drainage layer will consist of a geotextile layer bonded to each side of a geonet. The geonet provides drainage of percolated water. The upper geotextile layer provides a filter to allow percolated water to enter the geonet and reduce the infiltration of soil from the overlying soil cover. The bottom layer of geotextile along the side slopes provides a cushion for the underlying FML and provides a high frictional interface contact between the textured FML and geocomposite layer.

Flexible Membrane Liner: The FML will be a 40-mil thick LLDPE or HDPE FML material, textured to increase friction thereby increasing the stability of the final cover. The FML material and installation methods will meet the specifications in the CQA/QC Plan.

Recompacted Soil Barrier: This layer will consist of soil with a permeability less than or equal to 1×10^{-6} cm/sec. The material and installation methods will meet the specifications in the CQA/QC Plan.

Drawing 4H presents the proposed surface water management plan. The surface water management system is designed to convey surface water to the sedimentation ponds. The system consists of surface water control benches, collection channels, culverts, perimeter channels and the sedimentation ponds. A detailed description of the surface water management system is included in Section (C)(7).

11(B)(5)(b) Grid System

A grid system with northing and easting coordinates spaced no more than 500 feet apart is provided on the plan drawings of the PTI Application.

11(B)(5)(c) Detail Drawings – Composite Cap System

Drawings 7A, 7C, 7G, and 7H present the composite cap system details including but not limited to the key trench, penetrations, cap drainage structures and surface water drainage structures.

11(B)(5)(d) Detail Drawings – Surface Water Control Structures

Drawings 7G and 7H present the surface water control structure details including culverts, channels, and downchutes.

11(B)(5)(e) Static and Seismic Stability

A slope stability analysis was performed to evaluate the overall stability of the proposed final cover grading plan and final cover system of the landfill. Both static and seismic conditions were evaluated. Results of the analysis indicate an acceptable factor of safety against slope failure for both static and seismic conditions. Slope stability analysis is included in Section (C)(4)(e).

11(B)(5)(f) Groundwater Detection Monitoring Plan

The Groundwater Detection Monitoring Program is provided in Section (C)(9).

11(B)(5)(g) Financial Assurance

Financial assurance information, including cost estimates for final closure of the landfill and for the 30-year post-closure period, is addressed. In addition, the financial assurance mechanism as required by Rules 3745-27-15 and 3745-27-16 are addressed.

Financial Assurance Instrument: Apex Sanitary Landfill currently maintains a financial assurance instrument for the facility. A financial assurance instrument for the proposed contiguous expansion will be executed following issuance of the PTI for the expansion and prior to placing waste in the expansion area. The financial assurance instrument will satisfy the financial responsibility provisions in OAC Rule 3745-27-15 and OAC Rule 3745-27-16. The calculated closure and post closure costs are provided in Sections (C)(5)(h) and (i).

Closure Cost Estimate: Estimated costs for performing final closure of the facility including construction of the cap system, surface water drainage control structures, gas collection system, and construction quality assurance are included in Section (C)(5)(h). This estimate is based on a third party conducting the final closure activities. The calculation presents the cost estimate for installing final cover for the worst case phase presented on the proposed phase development plans as part of the final closure of the contiguous expansion. *Apex intends to cap a portion of the existing landfill unit equal to the lined area being constructed in the contiguous expansion area. Capping will occur within 12 months of construction of the lined area.*

Post-Closure Cost Estimate: Estimated costs for post-closure maintenance and monitoring over the 30-year post-closure period are included in Section (C)(5)(i). The estimate is based on a third party conducting the post-closure activities.

11(B)(6) Final Cover Material, Availability and Suitability

Soils for the RSB and cap protection layer will be obtained from the cell excavation for the landfill and borrow sources on the property. The final cover material will be prequalified as described in the CQA/QC Plan provide in Section (C)(9). The soil balance demonstrating final cover material availability is included in Section (C)(5)(m).

11(B)(7) Quality Assurance/Quality Control Plan

The Quality Assurance/Quality Control Plan for constructing the final cover system is included in Section (C)(9)(a).

11(B)(8) Explosive Gas Monitoring Plan

An Explosive Gas Monitoring Plan is provided in Section (C)(9)(b).

11(B)(9) Erosion Control

The proposed final cover slopes are 33 percent. Based upon calculations performed using the Revised Universal Soil Loss Equation (RUSLE), the maximum erosion rate after establishment of vegetative cover is less than the 5 tons per acre per year as required in Rule 3745-27-08(C)(15). Calculations are included in Section (C)(5)(j).

The primary means to control erosion will be achieved by establishing and maintaining a dense, vegetative cover on the final cover. The surface of the cap will be mulched, fertilized and seeded after construction. The seed mix used on the cap will be dependent on the season and will include mixes previously demonstrated to provide a dense growth. Mulch will consist of hay or straw applied to minimize erosion until the vegetation is established. Areas exhibiting excessive erosion will be regraded, reseeded, mulched, and fertilized as necessary.

Erosion may occur in and around surface water control structures which include surface water control benches, surface water diversion berms, downchutes, collection channels, culverts, perimeter channels and the sedimentation ponds. Surface water control structures will be lined with either rip-rap or vegetation to prevent erosion. Erosion matting may be used in grass lined benches and channels if necessary to prevent erosion.

Temporary erosion control measures include the use of sediment barriers, such as silt fences and straw bales, which will be used as necessary to reduce the sediment load in surface water run-off entering the sedimentation ponds. They will also be used in areas where run-off can not be diverted to the sedimentation ponds.

Surface water runoff from the disposal area will be directed to the site sedimentation ponds. The sedimentation ponds will reduce the transport of sediment off-site during and after earth moving activities associated with construction of the landfill.

11(B)(10) Contingency Plans

Leachate: Leachate seeps are not anticipated in the landfill after construction of the final cover system. If seeps are detected, the area will be investigated by qualified personnel to determine the cause. If a breach in the RSB or FML is suspected, the damaged portion of the cap will be excavated and reconstructed. Leachate outbreaks will be prevented from flowing off-site by constructing dikes. The facility will take immediate steps to eliminate or control the conditions contributing to leachate production or buildup.

Fire: In the event of a fire during closure or post-closure periods, soil will be used to smother the flame. If a fire is burning uncontrollably, a fire break will be excavated to isolate the affected area. The local fire department will be contacted for all fires reported at the site.

Differential Settlement: Areas of final cover exhibiting excessive amounts of differential settlement may be excavated to determine the extent of potential problems. Remediation could include removing the cover system in the area of the potential problem to determine if the cap system is damaged. If necessary, the area will be backfilled and the cap system rebuilt over the new fill. If no damage to the RSB layer is disclosed, these areas will be repaired and regraded to promote run-off of surface water and reseeded. Areas will be repaired as weather permits.

11(G) COMPOSITE CAP SYSTEM CONSTRUCTION

In accordance with OAC 3745-27-11(G)(1), a composite cap system will be constructed for the proposed contiguous expansion. Refer to Section (C)(7) of this PTI Application for a more detailed discussion of the proposed composite cap system. The CQA/QC Plan addresses the material, construction and quality assurance procedures related to the cap system.

11(G)(1) Composite Cap System Design

The cap system or transitional cover will be installed when landfill areas of the proposed contiguous expansion reach final grade in accordance with the phase development of the landfill. The cap system is designed to reduce the infiltration of water into the landfill and the subsequent generation of leachate. Additionally, the cap system will reduce the likelihood of adverse effects due to ponding of surface water, excessive settlement, subsidence, desiccation and erosion. Cap system details are presented on Drawings 7A and 7C depicting the components within the composite cap system.

The RSB will be constructed upon the surface of the prepared intermediate cover soil and will have a maximum permeability of 1×10^{-6} centimeters per second (cm/sec) and a minimum thickness of 1.5 feet. The material, construction and quality assurance specifications for the RSB layer are included in the CQA/QC Plan.

The FML will consist of a 40-mil high density polyethylene (HDPE), linear low density polyethylene (LLDPE) or another approved 40-mil thick FML material. The FML will be textured to provide resistance to veneer sliding.

The side slopes will have a geocomposite within the composite cap system consisting of a geonet with geotextile bonded to both sides. The geocomposite materials will be placed upon the FML within the cap

system to collect surface water that has infiltrated through the cap protection layer. The FML and geocomposite material, installation and quality assurance procedures are specified in the CQA/QC Plan.

The cap protection cover soil will be a 30-inch thick layer and will consist of clean soil capable of supporting vegetation. The surface will be fertilized, seeded and mulched as necessary to promote the establishment of a dense vegetative cover.

11(H) OTHER CLOSURE ACTIVITIES

11(H)(1) Compliance with Rule 3745-27-19

Apex will continue to comply with Rule 3745-27-19 until the closure certification of the proposed contiguous expansion of the Apex Sanitary Landfill is submitted and the post-closure care period begins.

11(H)(2) Surface Water and Erosion Control

The proposed contiguous expansion will have surface water control structures and erosion control measures as indicated in this PTI Application. Efficient drainage control serves the purposes of:

- Reducing excess surface water run-off in operational areas;
- Directly removing run-off from the landfill to minimize leachate generation; and
- Providing controlled run-off from the landfill side slopes to reduce erosion.

The various proposed surface water drainage control structures at the landfill are:

- Downchutes;
- Surface water control benches;
- Collection channels;
- Culverts;
- Perimeter channels; and
- Sedimentation ponds.

Areas of final waste placement will grade towards the surface water control structures. The construction of the drainage structures will occur sequentially with the installation of the final cover system. The actual sequence of construction will be implemented in such a way that will allow for discharge to be conveyed completely off the surface of the landfill. For example, perimeter channels will be constructed initially to provide an outlet for runoff from surface water benches. In general, structures at the lower reaches of the landfill will be constructed prior to those located at the upper reaches. Construction of the drainage system will occur as areas of the landfill attain final grade and receive final cover, until the entire system is constructed across the landfill. Details of the surface water control structures are included in Section (C)(7).

The final cover slope will be maintained to repair erosion rills and poorly vegetated areas. Erosion rills will be backfilled with soil, drainage will be redirected to the proper surface water control structure, and the area will be vegetated. Poorly vegetated areas will be repaired with additional seed, fertilizer, and mulch.

11(H)(3) Groundwater Monitoring System

The Groundwater Detection Monitoring Program is provided in Section (C)(9).

11(H)(4) Vector Control

Inactive areas of the landfill not accepting waste for more than 30 days will have a 1-foot thick layer of intermediate cover placed over in-place waste until the final cover system is installed. Transitional cover may also be placed in areas at final grade providing additional soil cover. The final cover will provide an additional 4 feet of soil and geosynthetic components. Subsequently, the waste will not be exposed and become sources of food or harborage for insects and rodents. Additionally, drainage of surface water will be maintained to reduce potential mosquito breeding areas. In the event that a problem does arise with rodents or other vectors, a professional experienced in the removal of pests will be consulted to determine appropriate action.

11(H)(5) Verification of Notices

No later than 60 days, following the completion of final closure construction activities, Apex will record on the plat and deed to the sanitary landfill facility, a notation describing the acreage, location, approximate depth, volume and nature of solid waste deposited within the proposed contiguous expansion. The plat and deed will be submitted to the following agencies:

- Jefferson County Health Department;
- Jefferson County Recorder of Deeds; and
- Ohio EPA Southeast District Office.

11(H)(6) Posting of Signs

Following closure of the landfill, a sign with lettering at least three inches high, will be posted at the landfill entrance indicating that the landfill no longer accepts solid waste. This sign will be maintained in a legible condition at least two years after final closure activities of all phases have been completed.

11(H)(7) Gates/Fencing

Access control will be accomplished by a secure chain-link steel fence gate with a locking gate at the site entrance. The site entrance gate will be maintained as needed to remain functional during the post-closure care period.

11(I) COMPLETION OF FINAL CLOSURE ACTIVITIES

Final closure activities will be completed within 180 days after any of the occurrences listed in 3745-27-11(C) unless an alternate schedule has been approved by the Director.

11(J) FINAL CLOSURE CERTIFICATION

Not later than 90 days after the completion of final closure activities, Apex will submit to the Ohio EPA Southeast District Office and Jefferson County General Health District, a written certification report that includes verification that the facility has been closed in accordance with Rule 3745-27-11 and this Closure Plan.

11(J)(1) List of Construction Certification Reports

The Final Closure Certification will include a list of construction certification reports for construction of the composite cap system with submittal dates and a topographic map of the entire landfill facility showing the

areas certified by each report. The map shall show horizontal limits of waste placement and surface water control structures, groundwater control structures, and explosive gas control system.

11(J)(2) Groundwater Monitoring System

The Final Closure Certification will include a demonstration that the groundwater monitoring system meets the requirements of OAC 3745-27-10.

11(J)(3) Plat and Deed

The Final Closure Certification will include a copy of the plat and deed showing the notation required by Paragraph (H)(5) of this Closure Plan and bearing the mark of recordation of the office of Jefferson County.

11(J)(4) Posted Signs

The Final Closure Certification will include a demonstration that the sign required by Paragraph (H)(6) has been posted and that all entrances and access roads have been blocked as required by Paragraph (H)(7) of this Closure Plan.

11(K) ENTRANCE TO FACILITY

The health commissioner and the director, or their authorized representatives, upon prior identification, may enter any unit(s) of the sanitary landfill facility at any time during the final closure period for the purpose of determining compliance with this rule.

11(L) FINAL CLOSURE OF UNIT

Apex will complete final closure of the unit(s) in a manner that minimizes the need for further maintenance and minimizes post-closure formation and release of leachate and explosive gases to air, soil, groundwater, or surface water to the extent necessary to protect human health and the environment.

14(A) POST-CLOSURE ACTIVITIES

Post-closure activities will comply with Rule 3745-27-14 and will be performed during a 30-year post-closure care period. Upon completion of the 30-year period, written certification will be submitted to the Ohio EPA Southeast District Office indicating that post-closure activities are completed. Post-closure activities will comply with Paragraphs (A) and (B) of OAC Rule 3745-27-14 as described in the following sections.

14(A)(1) Continuing Operation and Maintenance of Landfill Systems

The post-closure activities will be comprised of continuing operation and maintenance of the following:

- Composite cap system;
- Leachate management system;
- Surface water management system;
- Explosive gas extraction and monitoring; and
- Groundwater monitoring.

These systems will be monitored as part of the regular quarterly inspection process throughout the 30-year post-closure care period.

Composite Cap System: The composite cap system consists of a recompacted soil barrier, 40-mil FML, geocomposite drainage layer and cap protection layer. The composite cap system will be inspected regularly and repaired as necessary. Corrective measures will be required if inspections reveal erosions, non-vegetated areas or damage. Repairs may include regrading, seeding non-vegetated areas, or replacement of composite cap system components depending on the depth of any observed damage.

Leachate Management: The leachate management system consists of leachate collection pipes, side slope risers and pumps, forcemains and a leachate storage tank. Leachate generated within the landfill will flow to leachate collection pipes which will convey leachate to sumps. Leachate will be pumped from the sumps using a submersible pump within a side slope riser. Leachate will then be pumped through a forcemain to the onsite leachate storage tank.

Each leachate sump will contain a leachate pump. The pump will be fitted with quick disconnects to allow for easy removal. The side slope risers and pumps will be inspected regularly and repaired as necessary. Cleanouts located at the crest of landfill cells will provide access to the perforated leachate collection pipe to allow for removal of sediment using high pressure water jet cleaning devices.

The leachate transport forcemain will be single contained where it lies within the composite lined area and will be dual contained where it lies outside of composite lined landfill areas. Leachate is stored in a 545,000 gallon storage tank with secondary containment. The storage tank, piping, valves and pumps will be inspected regularly and repaired as necessary. The secondary containment will also be checked regularly and if problems or leaks become apparent, an evaluation will be performed by qualified personnel to remedy the problem.

Surface Water Management: The surface water management system includes surface water control benches, collection channels, culverts, perimeter channels and sedimentation ponds. These drainage structures will be inspected regularly and repaired as necessary. Corrective measures will be required if inspections reveal settlement, erosion, displacement of rip-rap, or silting of the system. Repairs may include regrading, physical repair of structure, replacement of rip-rap, or revegetation. During the post-closure period, accumulated silt will be removed from the sedimentation pond on an as-needed basis to comply with NPDES Permit limits.

Explosive Gas Extraction and Monitoring: The landfill gas extraction system will require regular maintenance. Possible maintenance includes replacing or repairing damaged extraction wells, pipes, valves, exhaust blowers, flares, or electric generators. The condition of gas monitoring probes and punch bar stations will be noted as part of the quarterly inspection. Appropriate repairs will be performed as needed.

Groundwater Monitoring: Groundwater monitoring wells will be inspected at the time of groundwater sample collection for cracks in the concrete pad, frost heave, and damage or vandalism to the protective steel casing. Appropriate repairs will be performed as necessary. Protective steel casings will be repainted with a high visibility paint and well identification numbers will be stenciled with black paint approximately every three years or as needed.

14(A)(2) Maintaining the Integrity and Effectiveness of the Cap System

Areas displaying noticeable amounts of differential settlement may be excavated to determine the extent of potential problems. Remediation could include removing the cap system in the area of the potential problem to

determine if the cap system is damaged. If necessary, the area will be reconstructed and soil will be used as backfill to raise the area to intermediate cover grades and the cap system will be rebuilt over the new fill. If no damage to the RSB and geomembrane is observed, only the components within the cap system overlying the RSB and FML will be repaired, regraded and reseeded to promote run-off of surface water. Repairs will be performed as weather conditions allow.

Overgrowth of the vegetative cover will be controlled by mowing. Large wooded plants will be pulled from the site to prevent root penetrations into the drainage geocomposite. Any areas lacking vegetation will be reseeded, fertilized and mulched as needed to maintain adequate vegetative cover. Areas of the cap that are eroded will be regraded to fill in erosion rills as weather permits. The area will then be seeded, fertilized and mulched.

14(A)(3) Leachate Outbreak Repair

Leachate outbreaks will be repaired by the following methods:

- Contain and properly manage the leachate;
- If necessary, collect, treat and dispose of the leachate; and
- Take action to minimize, control or eliminate the conditions which contribute to the production of leachate.

14(A)(4) Quarterly Inspection of the Sanitary Landfill Facility

The facility will be inspected on a quarterly basis. Within 15 days after inspection, a report will be submitted to the Ohio EPA Southeast District Office detailing the inspection results and the schedule of any actions to be taken to maintain compliance with Rule 3745-27-14 (A)(1) and (A)(2).

14(A)(5) Monitoring and Reporting Requirements

Groundwater sampling and reporting will proceed as required by OAC 3745-27-10(D)(5) or as altered by (D)(6) during the post-closure care period.

Explosive gas monitoring and reporting will comply with OAC 3745-27-12. The reporting schedule for explosive gas monitoring will be quarterly between the time of closure and 5 years post-closure. Monitoring will be semi-annual between 5 years post-closure and the Ohio EPA director's authorization to cease monitoring. Apex will comply with OAC 3745-76 for landfill emissions.

Leachate will be monitored for quality and quantity at the leachate storage tank. The leachate will be analyzed for the parameters listed in Appendix I of OAC Rule 3745-27-10 on an annual basis. Additionally, monthly records of the leachate quantity collected for treatment and disposal will be documented.

Apex Sanitary Landfill will comply with any monitoring required by any orders or authorizing documents.

14(A)(6) Annual Report

An annual report submitted no later than the first day of April to the Ohio EPA Southeast District Office, Jefferson County General Health District, and to the Operating Record. The annual report will contain the following information:

- A summary of the quantity of leachate collected for treatment and disposal on a monthly basis during the year, and the location of leachate treatment and/or disposal;
- Results of analytical testing of an annual grab sample of leachate for the parameters specified in Appendix I of OAC 3745-27-10. The grab sample will be collected from the leachate storage tanks or other composite sample locations; and
- The most recent updated post-closure cost estimate adjusted for inflation and for any change in the post-closure cost estimate required by OAC 3745-27-16.

14(A)(7) Reports and Record Keeping

Records and reports generated by OAC 3745-27-14 (A)(4) and (A)(6) will be kept for the duration of the post-closure period in the operating record where the records and reports are available for inspection by the Ohio EPA or Jefferson County General Health District during normal working hours.

14(B) WRITTEN CERTIFICATION

Upon completion of the post-closure period, Apex will submit to the Ohio EPA written certification that the facility has completed post-closure activities in accordance with Rule 3745-27-14 and this Closure Plan. The report will be prepared and signed by an independent, professional engineer registered in the State of Ohio. The certification will include documentation which demonstrates that all post-closure care activities have been completed. The documentation will include the following:

- A summary of changes to leachate quality and quantity;
- Rate of leachate generation and depth of leachate at each leachate sump, with an explanation of how the figures were derived;
- A summary of any on-going groundwater assessment or corrective measures;
- A summary of explosive gas migration and generation by the landfill; and
- An assessment of the integrity and stability of the cap system if post-closure care activities cease.

14(C) COMPLETION OF GROUNDWATER DETECTION MONITORING IN NON-CONTIGUOUS UNITS

Not applicable.

14(D) ENTRANCE TO FACILITY

The health commissioner and the director, or their authorized representatives, upon prior identification, may enter any unit(s) of the sanitary landfill facility at any time during the post-closure period for the purpose of determining compliance with this rule.

(C)(10) NOTIFICATION AND CERTIFICATION

This section presents the information required in OAC 3745-27-06(C)(10).

(a) Letters of intent to establish or modify a sanitary landfill facility, which include a description of property and facility boundaries, shall be sent via certified mail or any other form of mail accompanied by a receipt to the following entities (copies of these letters of intent with copies of the certified mail or any other form of mail accompanied by a receipt shall be included with the application):
i) The governments of the general purpose political subdivisions where the sanitary landfill facility is located, e.g., county commissioner, legislative authority of a municipal corporation, or the board of township trustees.
(ii) The single county or joint county solid waste management district.
(iii) The owner or lessee of any easement or right of way bordering or within the proposed facility boundaries which may be affected by the proposed sanitary landfill facility.
(iv) The local zoning authority having jurisdiction, if any.
(v) The airport administrator and the federal aviation administration, if the placement of solid waste will occur within five miles of any airport runway. "Airport" is defined in rule 3745-27-01 of the Administrative Code.
(vi) The park system administrator, if any part of the sanitary landfill facility is located within or shares the park boundary.
(vii) The conservancy district, if any part of the sanitary landfill facility is located within or shares the conservancy district boundary.

Letters of intent to modify the sanitary landfill have been sent to the following by certified mail. Copies of the letter and certified mail receipts are included in Appendix C10-A.

- Springfield Township Trustees,
- German Township Trustees,
- Jefferson County Board of Commissioners,
- Harrison County Board of Commissioners; and
- Jefferson-Belmont Regional Solid Waste Management Authority

Springfield Township does not have a zoning authority. No airports are located within 5 miles of the limit of solid waste placement; therefore, the FAA and airports were not notified. The facility does not border a park system or conservancy district.

(b) A list of the permits, licenses, plan approvals, authorizations or other approvals that have been applied for and the local, state or federal office or agency where application has been made.

A Table of Effective and Pending Permits is presented in Appendix (C)(10)-C.

Permit Description	Permit No.	Approval Agency	Effective Date
PTI – Solid Waste Facility	17-1194	Ohio EPA-DSIWM	1-21-98
PTI – Vertical Expansion	06-6219	Ohio EPA-DSIWM	7-31-02
PTI – AMDWR Increase	06-07409	Ohio EPA-DSIWM	10-28-04
PTI – Vertical Expansion	06-08438	Ohio EPA-DSIWM	12-31-09
Indirect Discharge Permit – Steubenville WWTP	0DP00050*BP	Ohio EPA – DSW	03-01-11
NPDES Individual Permit	OIN00198*ED	Ohio EPA-DSW	08-09-08
NPDES Construction Activity Permit	0GC00235*AG	Ohio EPA-DSW	11-23-04
ACOE Section 404 Permit – Wetlands	200400270	ACOE	12-10-04
Section 401 Certification – Wetlands	049815	Ohio EPA-DSW	11-23-04
Air PTI, F001, F002, F003, T001, T002	06-06987	Ohio EPA-DAPC	12-10-02
Air PTI, F004, F005, P001	06-07264	Ohio EPA-DAPC	1-15-04
Air PTI, F002, F003	06-07467	Ohio EPA-DAPC	10-28-04
Air PTI F001, F002, F004, F005	P0103987	Ohio EPA-DAPC	12-31-09

(c) Wetland demonstration. Applications which propose to locate the sanitary landfill facility in wetlands, as defined in rule 3745-27-01 of the Administrative Code, shall include a copy of a certification and permit approved in accordance with section 401 and 404 of the Clean Water Act, 33 U.S.C. 1251 et seq. (2003), or other permit or certification authorizing the discharge of dredge or fill material under state law.

A wetlands and stream delineation was performed in the proposed limit of disturbance of the contiguous expansion. The Wetland and Stream Delineation and Functional Assessment Report for the proposed expansion was sent to the Pittsburgh District, U.S. Army Corps of Engineers (COE) in October 2010 and is included in Appendix C10-B. A site visit was held with the Ohio EPA on May 19, 2011 and with the COE on November 15, 2010 and July 18, 2011. Based on the site visits, CEC submitted an addendum to the report on October 17, 2011. *The COE approved the Jurisdictional Delineation in a letter dated September 21, 2012 which has been included in Appendix C10-B.* ~~A jurisdictional letter is expected from the COE based on the revised report.~~ CEC is currently preparing a joint permit application package to request Clean Water Act Section 404 Individual authorization from the COE and Section 401 Individual and Isolated Wetland authorization from the Ohio EPA for proposed stream and wetland impacts. Apex will provide the Ohio EPA Division of Materials and Waste with copies of the wetlands permits upon receipt.

(d) Proof of property ownership or lease agreement to use the property as a sanitary landfill facility.

Drawing 2A presents the property boundary owned by Apex. Appendix C1-D provides the property deeds and a survey of the landfill property prepared by Bair Goodie and Associates, Inc.

APPENDIX C10-A

LETTERS OF INTENT

ENVIRONMENTAL
LOGISTICS SERVICES

Apex Environmental, LLC

October 18, 2011

Certified Mail # _____

Springfield Township Trustees
722 Monroe St.
Bergholz. Ohio 43908

Re: Letter of Intent
Contiguous Lateral Expansion Permit to Install Application
Apex Sanitary Landfill
Springfield Township, Jefferson County, Ohio

Dear Trustees,

In accordance with Ohio Administrative Code (OAC) 3745-27-06(C)(10), Apex Environmental, LLC is notifying you of our intent to submit a Permit to Install (PTI) Application for a contiguous lateral expansion of the Apex Sanitary Landfill. The lateral expansion will be located on Apex's Springfield Township property and will result in an increase of the vertical elevation of the final fill. See the attached figure for the property and facility boundaries for the proposed expansion. This PTI application also requests an increase in the Authorized Maximum Daily Waste Receipt.

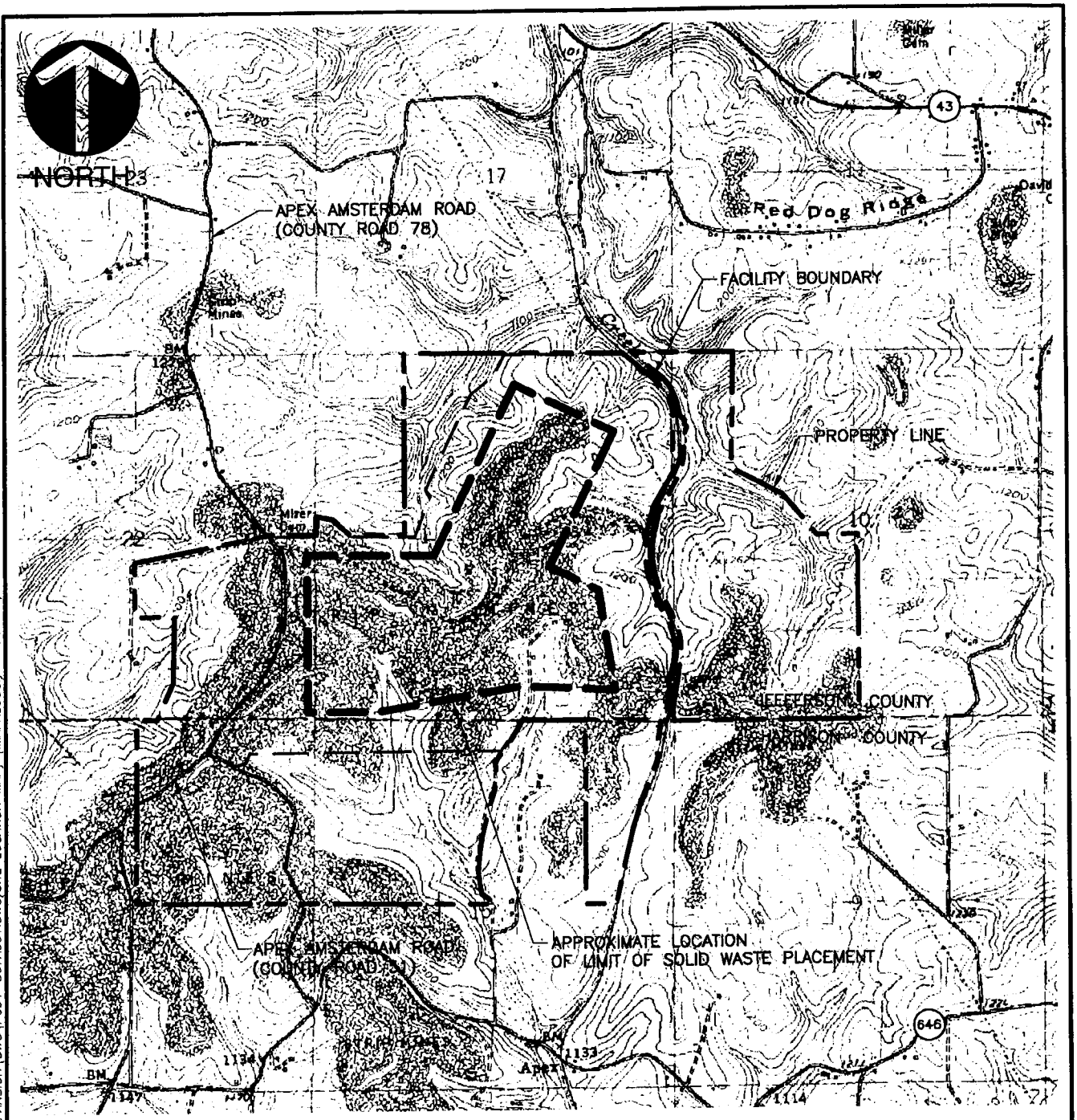
Copies of the PTI Application may be viewed at the Ohio EPA Southeast District Office or at the Apex Sanitary Landfill after it is submitted to the Ohio EPA (anticipated submittal date is late October 2011). Please contact me if you have any questions.

Sincerely,

Brendon Pantano
Vice President of Operations

cc: Rick Buffalini, CEC

PO Box 157 ♦ 11 County 78 ♦ Amsterdam Ohio 43903 ♦ Tel: 740-543-4389 ♦ Fax: 740-543-3862



REFERENCE

1. U.S.G.S. 7.5' TOPOGRAPHIC MAP, AMSTERDAM QUADRANGLE, OHIO DATED: 1960, PHOTOREVISED: 1972 & 1978.

SCALE IN FEET

0 2000 4000

Civil & Environmental Consultants, Inc.

333 Baldwin Road - Pittsburgh, PA 15205-9072
412-429-2324 · 800-365-2324
www.cecinc.com

APEX ENVIRONMENTAL, LLC
PERMIT TO INSTALL APPLICATION
APEX SANITARY LANDFILL
JEFFERSON COUNTY, OHIO

SITE LOCATION MAP

DRAWN BY:	MJI	CHECKED BY:	MRB	APPROVED BY:	RJB *	FIGURE NO.:
DATE:	10/18/11	DWG SCALE:	AS SHOWN	PROJECT NO:	091-867.0002	1

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ENVIRONMENTAL
LOGISTICS SERVICES

Apex Environmental, LLC

October 18, 2011

Certified Mail # _____

German Township Trustees
90670 Mill Road
Jewett, Ohio 43986

Re: Letter of Intent
Contiguous Lateral Expansion Permit to Install Application
Apex Sanitary Landfill
Springfield Township, Jefferson County, Ohio

Dear German Township Trustees:

In accordance with Ohio Administrative Code (OAC) 3745-27-06(C)(10), Apex Environmental, LLC is notifying you of our intent to submit a Permit to Install (PTI) Application for a contiguous lateral expansion of the Apex Sanitary Landfill. The lateral expansion will be located on Apex's Springfield Township property and will result in an increase of the vertical elevation of the final fill. See the attached figure for the property and facility boundaries for the proposed expansion. This PTI application also requests an increase in the Authorized Maximum Daily Waste Receipt.

Copies of the PTI Application may be viewed at the Ohio EPA Southeast District Office or at the Apex Sanitary Landfill after it is submitted to the Ohio EPA (anticipated submittal date is late October 2011). Please contact me if you have any questions.

Sincerely,

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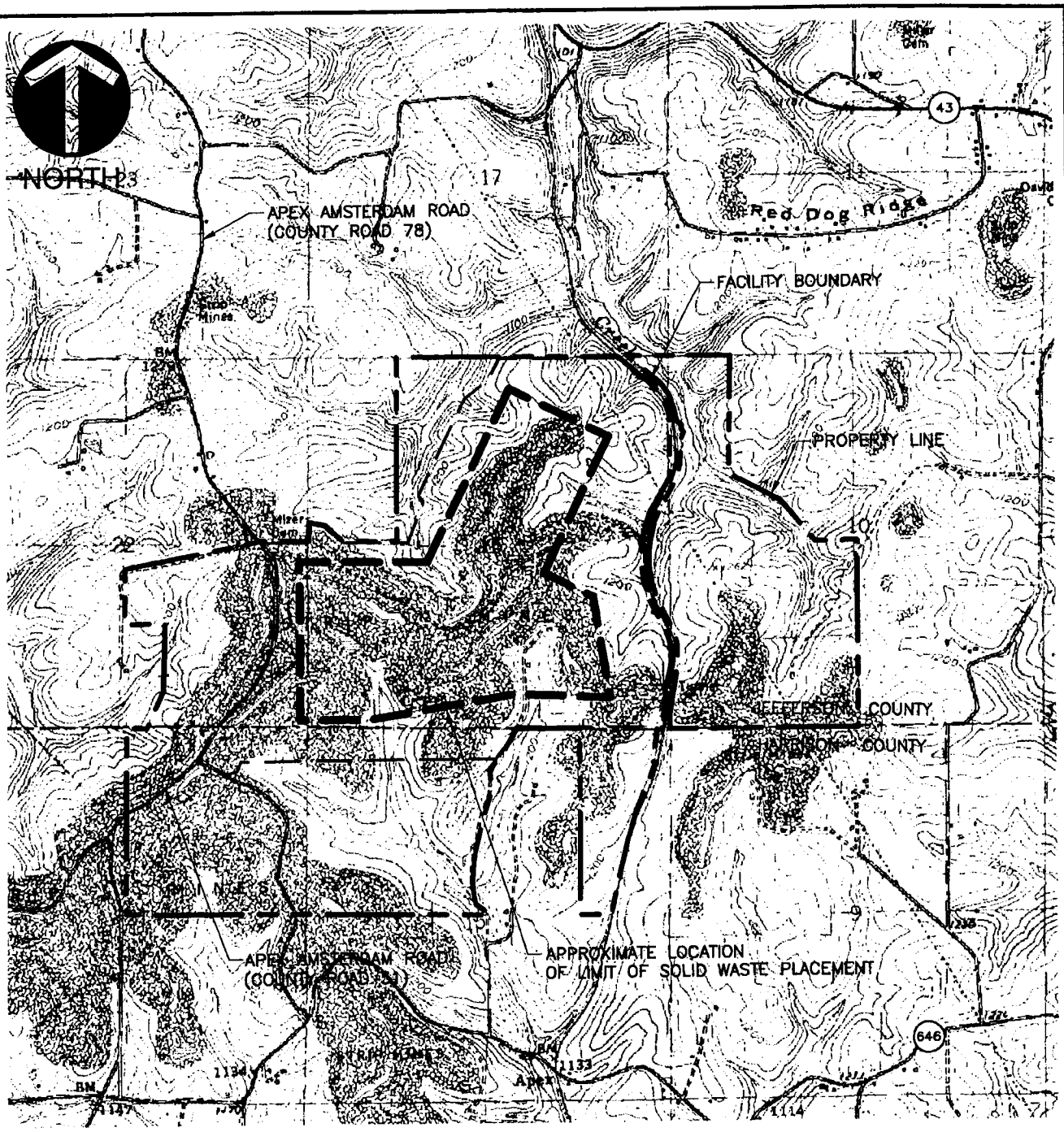

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ENVIRONMENTAL
LOGISTICS SERVICES

Apex Environmental, LLC

October 18, 2011

Certified Mail # _____

Harrison County Commissioners
538 North Main St., Suite A
Cadiz, Ohio 43907

Re: Letter of Intent
Contiguous Lateral Expansion Permit to Install Application
Apex Sanitary Landfill
Springfield Township, Jefferson County, Ohio

Dear Commissioners,

In accordance with Ohio Administrative Code (OAC) 3745-27-06(C)(10), Apex Environmental, LLC is notifying you of our intent to submit a Permit to Install (PTI) Application for a contiguous lateral expansion of the Apex Sanitary Landfill. The lateral expansion will be located on Apex's Springfield Township property and will result in an increase of the vertical elevation of the final fill. See the attached figure for the property and facility boundaries for the proposed expansion. This PTI application also requests an increase in the Authorized Maximum Daily Waste Receipt.

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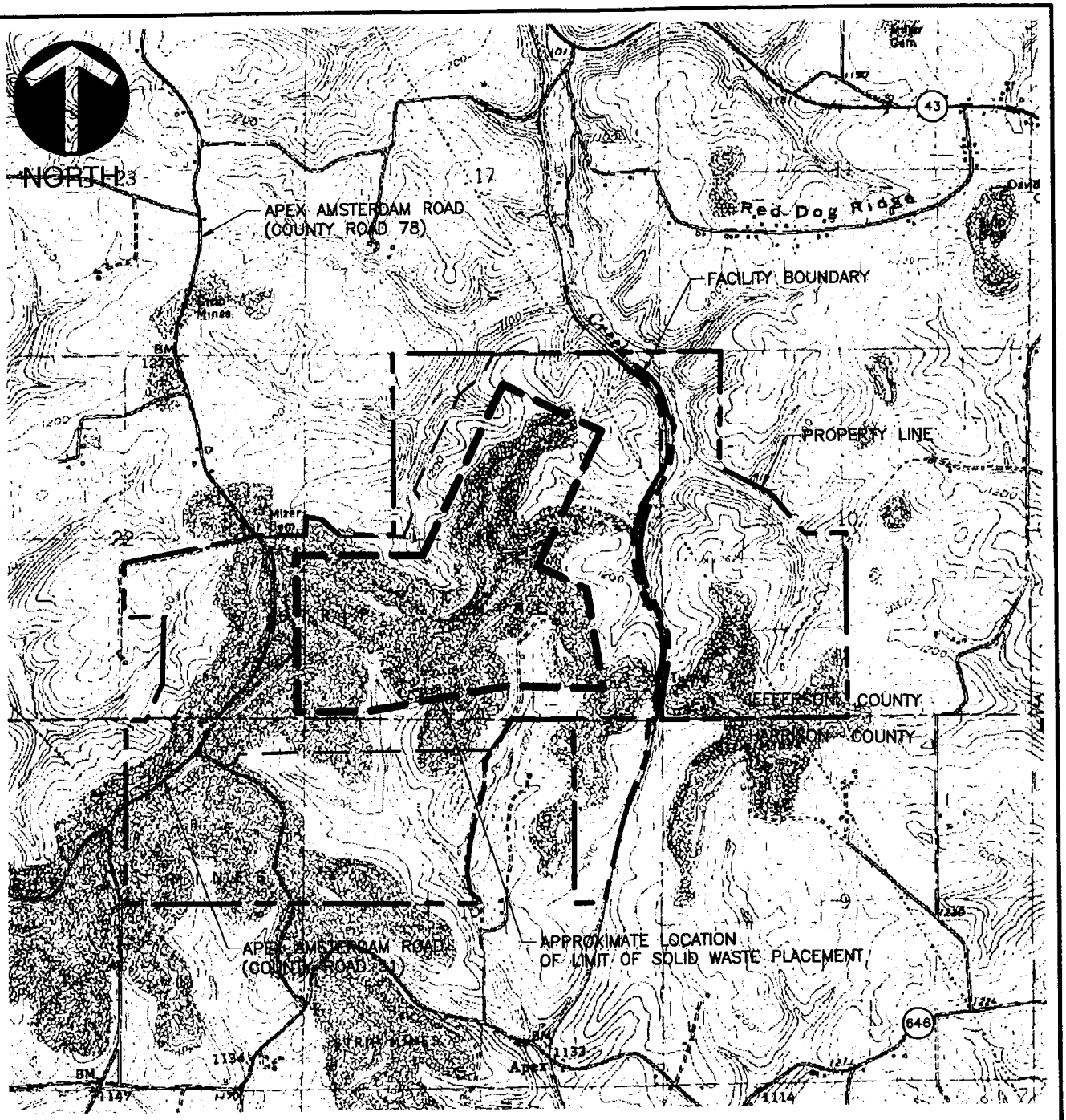
Brendon Pantano
Vice President of Operations

cc: Rick Buffalini, CEC



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ENVIRONMENTAL
LOGISTICS SERVICES

Apex Environmental, LLC

October 18, 2011

Certified Mail # _____

Jefferson County Commissioners
301 Market St., #4
Steubenville, Ohio 43952

Re: Letter of Intent
Contiguous Lateral Expansion Permit to Install Application
Apex Sanitary Landfill
Springfield Township, Jefferson County, Ohio

Dear Commissioners,

In accordance with Ohio Administrative Code (OAC) 3745-27-06(C)(10), Apex Environmental, LLC is notifying you of our intent to submit a Permit to Install (PTI) Application for a contiguous lateral expansion of the Apex Sanitary Landfill. The lateral expansion will be located on Apex's Springfield Township property and will result in an increase of the vertical elevation of the final fill. See the attached figure for the property and facility boundaries for the proposed expansion. This PTI application also requests an increase in the Authorized Maximum Daily Waste Receipt.

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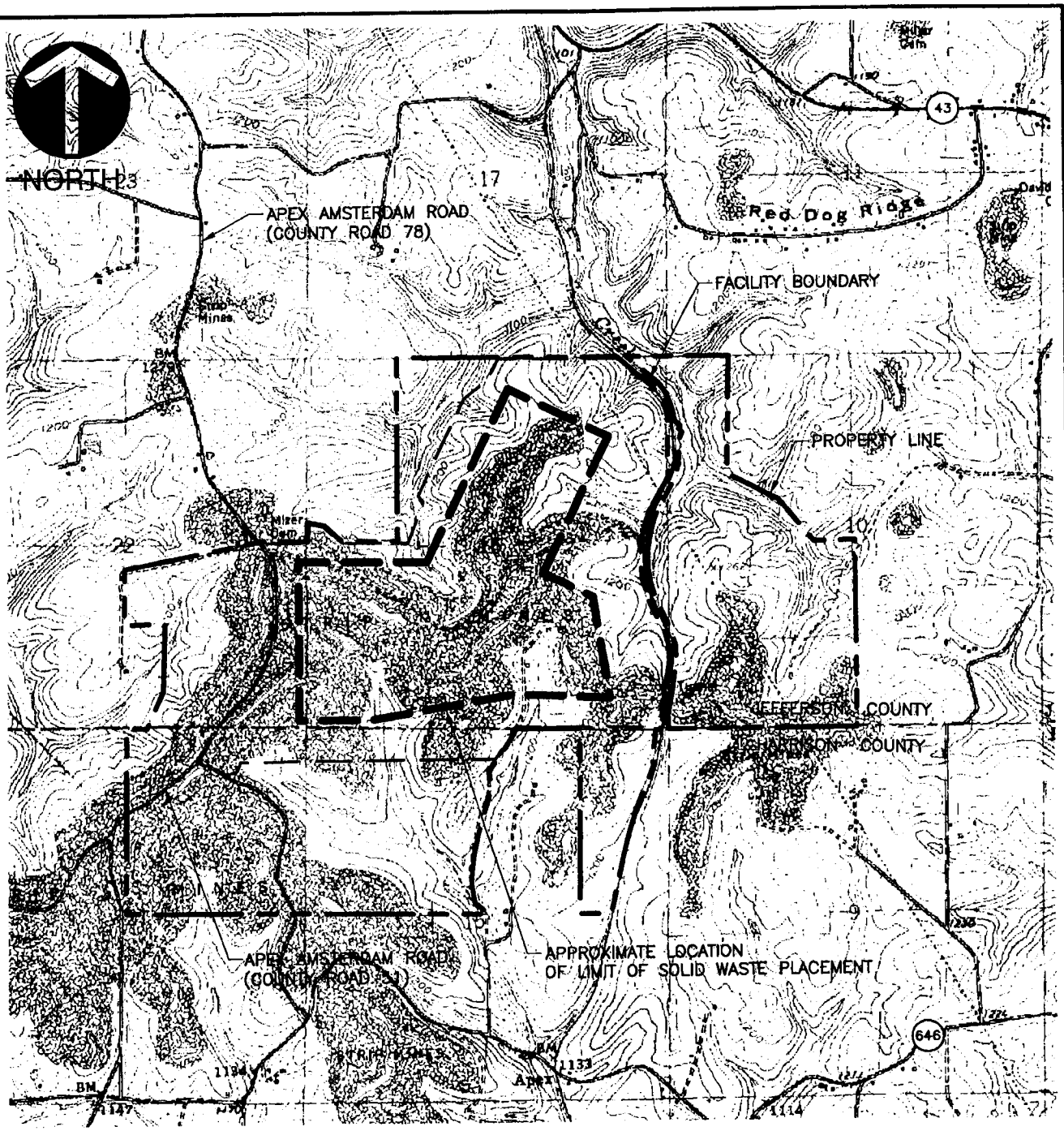
Sincerely,

Brendon Pantano
Vice President of Operations

cc: Rick Buffalini, CEC



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ENVIRONMENTAL
LOGISTICS SERVICES

Apex Environmental, LLC

October 18, 2011

Certified Mail # _____

Jefferson-Belmont Regional Solid Waste Management Authority
Jack Cera, Executive Director
125 Fernwood Road
Suite 300
Wintersville, Ohio 43953

Re: Letter of Intent
Contiguous Lateral Expansion Permit to Install Application
Apex Sanitary Landfill
Springfield Township, Jefferson County, Ohio

Dear Mr. Cera,

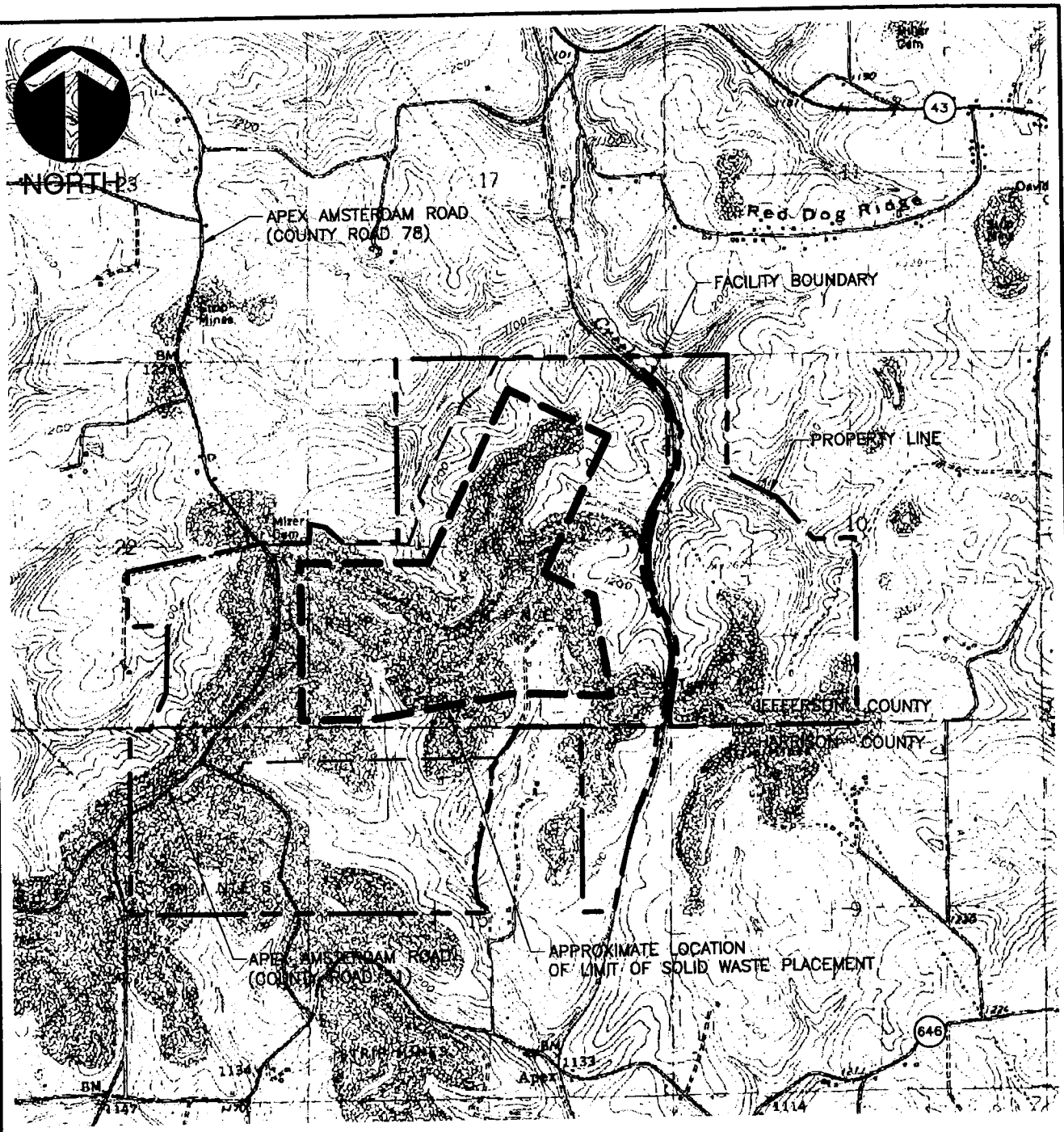
In accordance with Ohio Administrative Code (OAC) 3745-27-06(C)(10), Apex Environmental, LLC is notifying you of our intent to submit a Permit to Install (PTI) Application for a contiguous lateral expansion of the Apex Sanitary Landfill. The lateral expansion will be located on Apex's Springfield Township property and will result in an increase of the vertical elevation of the final fill. See the attached figure for the property and facility boundaries for the proposed expansion. This PTI application also requests an increase in the Authorized Maximum Daily Waste Receipt.

Copies of the PTI Application may be viewed at the Ohio EPA Southeast District Office or at the Apex Sanitary Landfill after it is submitted to the Ohio EPA (anticipated submittal date is late October 2011). Please contact me if you have any questions.

Sincerely,

Brendon Pantano
Vice President of Operations

cc: Rick Buffalini, CEC



REFERENCE

1. U.S.G.S. 7.5' TOPOGRAPHIC MAP, AMSTERDAM QUADRANGLE, OHIO DATED: 1960, PHOTOREVISED: 1972 & 1978.

SCALE IN FEET

0 2000 4000

Civil & Environmental Consultants, Inc.

333 Baldwin Road - Pittsburgh, PA 15205-9072

412-429-2324 · 800-365-2324

www.cecinc.com

APEX ENVIRONMENTAL, LLC
PERMIT TO INSTALL APPLICATION
APEX SANITARY LANDFILL
JEFFERSON COUNTY, OHIO

SITE LOCATION MAP

DRAWN BY:	MJI	CHECKED BY:	MRB	APPROVED BY:	RJB *	FIGURE NO.:	1
DATE:	10/18/11	DWG SCALE:	AS SHOWN	PROJECT NO:	091-867.0002		

P:\2009\091-867\-CADD\0002 - PTI LATERAL EXPANSION\DWG\P091-867A001.DWG\SITE LOCATION MAP1 (MAPALUCCI) - OCT 18, 2011 - 14:40:13

ENVIRONMENTAL
LOGISTICS SERVICES

Apex Environmental, LLC

October 18, 2011

Certified Mail # _____

Ohio Environmental Protection Agency
P.O. Box 1049
Columbus, Ohio 43266

Re: Letter of Intent
Contiguous Lateral Expansion Permit to Install Application
Apex Sanitary Landfill
Springfield Township, Jefferson County, Ohio

Dear Sir/Madam:

In accordance with Ohio Administrative Code (OAC) 3745-27-06(C)(10), Apex Environmental, LLC is notifying you of our intent to submit a Permit to Install (PTI) Application for a contiguous lateral expansion of the Apex Sanitary Landfill. The lateral expansion will be located on Apex's Springfield Township property and will result in an increase of the vertical elevation of the final fill. See the attached figure for the property and facility boundaries for the proposed expansion. This PTI application also requests an increase in the Authorized Maximum Daily Waste Receipt.

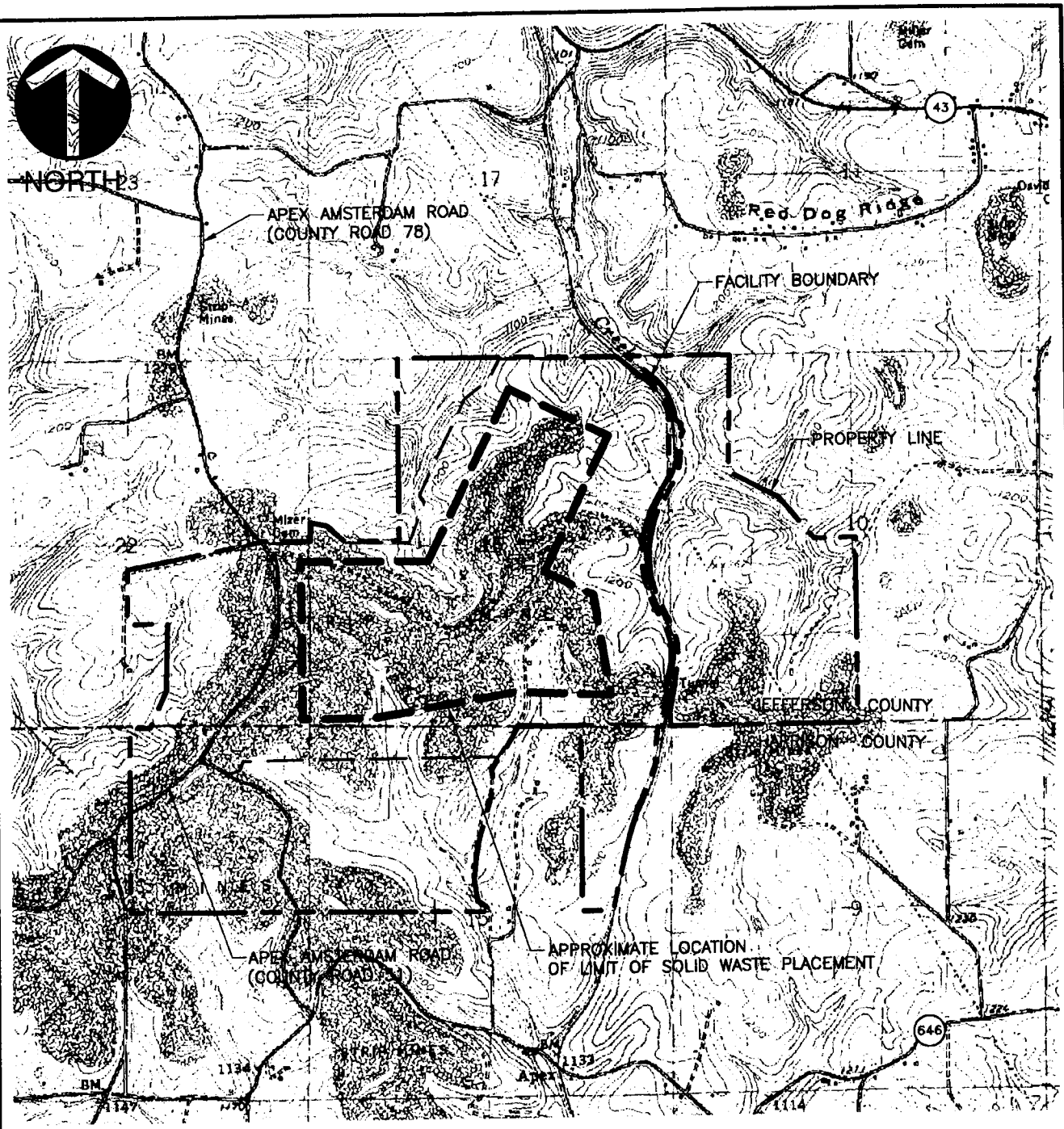
Copies of the PTI Application may be viewed at the Ohio EPA Southeast District Office or at the Apex Sanitary Landfill after it is submitted to the Ohio EPA (anticipated submittal date is late October 2011). Please contact me if you have any questions.

Sincerely,

Brendon Pantano
Vice President of Operations

cc: Rick Buffalini, CEC

PO Box 157 ♦ 11 County 78 ♦ Amsterdam Ohio 43903 ♦ Tel: 740-543-4389 ♦ Fax: 740-543-3862



REFERENCE

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SCALE IN FEET

0 2000 4000

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APEX ENVIRONMENTAL, LLC
PERMIT TO INSTALL APPLICATION
APEX SANITARY LANDFILL
JEFFERSON COUNTY, OHIO

SITE LOCATION MAP

DRAWN BY:	MJI	CHECKED BY:	MRB	APPROVED BY:	RJB *	FIGURE NO.:	1
DATE:	10/18/11	DWG SCALE:	AS SHOWN	PROJECT NO:	091-867.0002		

P:\2009\091-867\-CADD\0002 - PTI LATERAL EXPANSION\DWG\P091-867A001.DWG\SITE LOCATION MAP (MAPALUCCI) - OCT 18, 2011 - 14:40:13

ENVIRONMENTAL
LOGISTICS SERVICES

Apex Environmental, LLC

October 25, 2011

Certified Mail # 7010 0290 0002
2783 0746

American Electric Power of Ohio
Transmission and Distribution Section
1 Riverside Plaza
Columbus, Ohio 43215-2372

Re: Letter of Intent
Lateral Expansion Permit to Install Application
Apex Sanitary Landfill
Springfield Township, Jefferson County, Ohio

Dear Sir/Madam

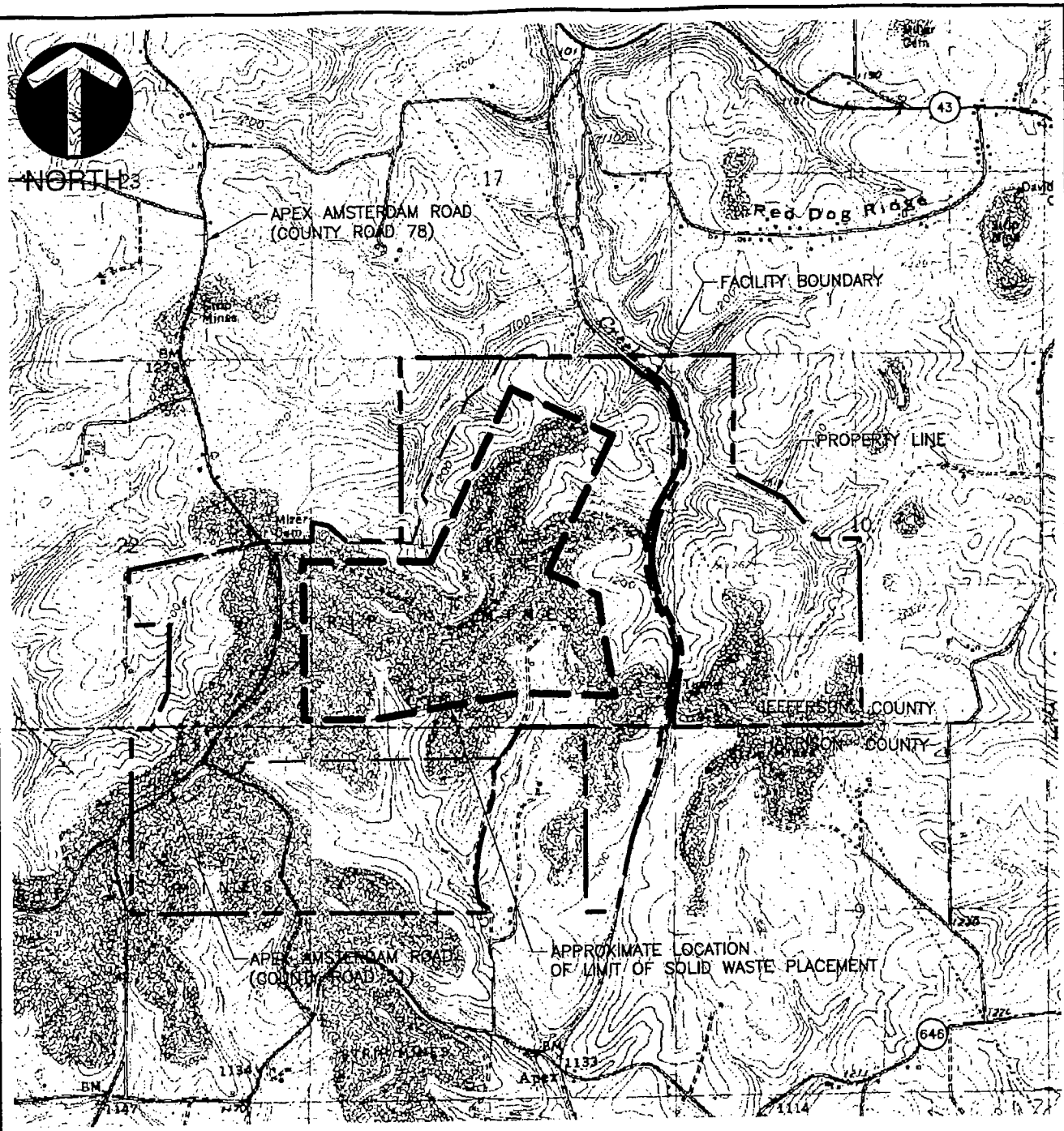
In accordance with Ohio Administrative Code (OAC) 3745-27-06(C)(10), Apex Environmental, LLC is notifying you of our intent to submit a Permit to Install (PTI) Application for the lateral expansion of the Apex Sanitary Landfill. The lateral expansion will be located on Apex's Springfield Township property and will result in an increase of the vertical elevation of the final fill. See the attached figure for the property and facility boundaries for the proposed expansion. This PTI application also requests an increase in the Authorized Maximum Daily Waste Receipt.

Copies of the PTI Application may be viewed at the Ohio EPA Southeast District Office or at the Apex Sanitary Landfill after it is submitted to the Ohio EPA (anticipated submittal date is late October 2011). Please contact me if you have any questions.

Sincerely,

Brendon Pantano
Vice President of Operations

cc: Rick Buffalini, CEC



REFERENCE

1. U.S.G.S. 7.5' TOPOGRAPHIC MAP, AMSTERDAM QUADRANGLE, OHIO DATED: 1960, PHOTOREVISED: 1972 & 1978.

SCALE IN FEET

0 2000 4000

Civil & Environmental Consultants, Inc.

333 Baldwin Road - Pittsburgh, PA 15205-9072

412-429-2324 · 800-365-2324

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APEX ENVIRONMENTAL, LLC
PERMIT TO INSTALL APPLICATION
APEX SANITARY LANDFILL
JEFFERSON COUNTY, OHIO

SITE LOCATION MAP

DRAWN BY:	MJI	CHECKED BY:	MRB	APPROVED BY:	RJB *	FIGURE NO.:	1
DATE:	10/18/11	DWG SCALE:	AS SHOWN	PROJECT NO:	091-867.0002		

P:\2009\091-867\-CADD\0002 - PTI LATERAL EXPANSION\DWG\P091-867A001.DWG\SITE LOCATION MAP (MIAPALUCCI) - OCT 18, 2011 - 14:40:13

SENDER: COMPLETE THIS SECTION

- Complete items 1, 2, and 3. Also complete item 4 if Restricted Delivery is desired.
- Print your name and address on the reverse so that we can return the card to you.
- Attach this card to the back of the mailpiece, or on the front if space permits.

1. Article Addressed to:

German Township Trustees
90670 Mill Road
Jewett, OH 43986

COMPLETE THIS SECTION ON DELIVERY

A. Signature
X [signature] ☐ Agent ☐ Addressee

B. Received by (Printed Name) [illegible] C. Date of Delivery 10/24/11

D. Is delivery address different from item 1? ☐ Yes
If YES, enter delivery address below: ☐ No

3. Service Type
☒ Certified Mail ☐ Express Mail
☐ Registered ☒ Return Receipt for Merchandise
☐ Insured Mail ☐ C.O.D.

4. Restricted Delivery? (Extra Fee) ☐ Yes

2. Article Number (Transfer from service label) 7011 0470 0000 4431 9106

PS Form 3811, February 2004 Domestic Return Receipt 102595-02-M-1540

SENDER: COMPLETE THIS SECTION

- Complete items 1, 2, and 3. Also complete item 4 if Restricted Delivery is desired.
- Print your name and address on the reverse so that we can return the card to you.
- Attach this card to the back of the mailpiece, or on the front if space permits.

1. Article Addressed to:

Harrison County Commissioners
538 Main St. Ste A
Cadiz, OH
43907

COMPLETE THIS SECTION ON DELIVERY

A. Signature
X Brandi Burton ☑ Agent ☐ Addressee

B. Received by (Printed Name) Brandi Burton C. Date of Delivery 10-24-11

D. Is delivery address different from item 1? ☐ Yes
If YES, enter delivery address below: ☐ No

3. Service Type
☒ Certified Mail ☐ Express Mail
☐ Registered ☒ Return Receipt for Merchandise
☐ Insured Mail ☐ C.O.D.

4. Restricted Delivery? (Extra Fee) ☐ Yes

2. Article Number (Transfer from service label) 7011 0470 0000 4431 9090

PS Form 3811, February 2004 Domestic Return Receipt 102595-02-M-1540

SENDER: COMPLETE THIS SECTION

- Complete items 1, 2, and 3. Also complete item 4 if Restricted Delivery is desired.
- Print your name and address on the reverse so that we can return the card to you.
- Attach this card to the back of the mailpiece, or on the front if space permits.

1. Article Addressed to:

Jefferson-Belmont Regional Solid Waste Management Authority
Jack Cera, Exec. Director
125 Fernwood Road
Suite 300
Wintersville. OH 43953

COMPLETE THIS SECTION ON DELIVERY

A. Signature
X Natalie Lysle ☐ Agent ☐ Addressee

B. Received by (Printed Name) Natalie Lysle C. Date of Delivery 10-24-11

D. Is delivery address different from item 1? ☐ Yes
If YES, enter delivery address below: ☐ No

3. Service Type
☒ Certified Mail ☐ Express Mail
☐ Registered ☒ Return Receipt for Merchandise
☐ Insured Mail ☐ C.O.D.

4. Restricted Delivery? (Extra Fee) ☐ Yes

2. Article Number (Transfer from service label) 7011 0470 0000 4431 9137

PS Form 3811, February 2004 Domestic Return Receipt 102595-02-M-1540

PLACE STICKER AT TOP OF ENVELOPE TO THE RIGHT OF THE RETURN ADDRESS, FOLD AT DOTTED LINE

CERTIFIED MAIL™

7010 0290 0002 2783 0746

7010 0290 0002 2783 0746

U.S. Postal Service™
CERTIFIED MAIL™ RECEIPT
(Domestic Mail Only; No Insurance Coverage Provided)

For delivery information visit our website at www.usps.com®

OFFICIAL USE

Postage	$ .44
Certified Fee	2.85
Return Receipt Fee (Endorsement Required)	2.30
Restricted Delivery Fee (Endorsement Required)	
Total Postage & Fees	$ 5.59

Postmark Here

Sent To: AEP of Ohio - Trans. + Dist.
Street, Apt. No.; or PO Box No.: 1 Riverside Plaza
City, State, ZIP+4: Columbus, OH 43215-2372

PS Form 3800, August 2006 — See Reverse for Instructions

SENDER: COMPLETE THIS SECTION

- Complete items 1, 2, and 3. Also complete item 4 if Restricted Delivery is desired.
- Print your name and address on the reverse so that we can return the card to you.
- Attach this card to the back of the mailpiece, or on the front if space permits.

1. Article Addressed to:

AEP of Ohio
Transmission + Distribution Section
1 Riverside Plaza
Columbus, OH 43215-2372

COMPLETE THIS SECTION ON DELIVERY

A. Signature
X ☐ Agent ☐ Addressee

B. Received by (Printed Name) | C. Date of Delivery

D. Is delivery address different from item 1? ☐ Yes
If YES, enter delivery address below: ☐ No

3. Service Type
☐ Certified Mail ☐ Express Mail
☐ Registered ☐ Return Receipt for Merchandise
☐ Insured Mail ☐ C.O.D.

4. Restricted Delivery? (Extra Fee) ☐ Yes

2. Article Number (Transfer from service label) 7010 0290 0002 2783 0746

PS Form 3811, February 2004 — Domestic Return Receipt — 102595-02-M-1540

APPENDIX C10-B

WETLANDS INFORMATION

DEPARTMENT OF THE ARMY
PITTSBURGH DISTRICT, CORPS OF ENGINEERS
WILLIAM S. MOORHEAD FEDERAL BUILDING
1000 LIBERTY AVENUE
PITTSBURGH, PA 15222-4186

REPLY TO
ATTENTION OF

September 21, 2012

Operations Division
Regulatory Branch
2004-270

Apex Environmental, LLC
Attn: Mr. Scott Lockhart
11 County Road
Amsterdam, Ohio 43903

Dear Mr. Lockhart:

Reference is made to your request for Wetland Boundary Verification and Jurisdictional Waters Determination for the potential Apex Landfill Expansion. Field views of the site located within Harrison and Jefferson Counties, Ohio were conducted on November 15, 2010 and July 18, 2011 by Matt Mason of this office.

The Corps of Engineers' authority to regulate waters of the United States is based on the definitions and limits of jurisdiction contained in 33 CFR 328. Navigable waters, their tributaries, and surrounding wetlands are waters of the United States subject to the provisions of Section 404 of the Clean Water Act. A Jurisdictional Determination letter was issued on February 8, 2011 for the initial field view conducted on November 15, 2010 (copy enclosed). Based on the information submitted in 2011 (Wetland and Stream Delineation Report Revisions September and October 2011) and the field verification on July 18, 2011 with Dan Osterfield of the OEPA it has been determined that Open Water Area 16 (a pond at the lower end of Stream 3A upslope of the railroad embankment) is jurisdictional as it discharges into an Unnamed Tributary to Goose Creek a Relatively Permanent Water (RPW) and therefore jurisdictional under the Clean Water Act guidance. Wetland S and Stream 1E (located east of Wetland P) were determined to be isolated and are not jurisdictional under Section 404 of the Clean Water Act. These resources do not have a nexus with interstate or foreign commerce and therefore cannot be regulated. This significant nexus and non-jurisdictional determinations were coordinated and approved by the US Environmental Protection Agency and the US Army Corps of Engineers Headquarters.

A revised Stream and Wetland Delineation Map (original map dated 8-6-2010) was received on October 17, 2011 which included the changes resulting from the two field views. A summary table of all aquatic resources identified within the proposed project area is enclosed. References to each aquatic resource match those identified on the revised map received on October 17, 2011.

This delineation verification will remain valid for a period of five years from the date of this letter, unless new information warrants revision of the delineation. Every effort should be made to avoid impacts to the aquatic resources on-site. If wetland or stream impacts are proposed this office should be contacted to discuss permit requirements.

If you have any questions, please contact Matt Mason at (412) 395-7129 or via email at Matthew.R.Mason@usace.army.mil. Please reference Project No. 2004-270 in all future correspondence with this office regarding this delineation.

Sincerely,

SIGNED

Nancy Mullen
Chief, North Section
Regulatory Branch

Enclosures

Copy furnished (via email):
Mark Haibach, CEC
Laura Shema, CEC
Ed Wilk, Ohio EPA

NOTIFICATION OF ADMINISTRATIVE APPEAL OPTIONS AND PROCESS AND REQUEST FOR APPEAL

Applicant: **Apex Environmental**	File Number: **2004-270**	Date: **9-21-12**

Attached is:		See Section Below
	INITIAL PROFFERED PERMIT (Standard Permit or Letter of Permission)	A
	PROFFERED PERMIT (Standard Permit or Letter of Permission)	B
	PERMIT DENIAL	C
X	APPROVED JURISDICTIONAL DETERMINATION	D
	PRELIMINARY JURISDICTIONAL DETERMINATION	E

SECTION I: The following identifies your rights and options regarding an administrative appeal of the above decision. Additional information may be found at: http://www.usace.army.mil/inet/functions/cw/cecwo/reg/appeals.htm or Corps regulations at 33 CFR Part 331.

A: INITIAL PROFFERED PERMIT: You may accept or object to the permit.

- **ACCEPT:** If you received a Standard Permit, you may sign the permit document and return it to the district engineer for final authorization. If you received a Letter of Permission (LOP), you may accept the LOP and your work is authorized. Your signature on the Standard Permit or acceptance of the LOP means that you accept the permit in its entirety, and waive all rights to appeal the permit, including its terms and conditions, and approved jurisdictional determinations associated with the permit.
- **OBJECT:** If you object to the permit (Standard or LOP) because of certain terms and conditions therein, you may request that the permit be modified accordingly. You must complete Section II of this form and return the form to the district engineer. Your objections must be received by the district engineer within 60 days of the date of this notice, or you will forfeit your right to appeal the permit in the future. Upon receipt of your letter, the district engineer will evaluate your objections and may: (a) modify the permit to address all of your concerns, (b) modify the permit to address some of your objections, or (c) not modify the permit having determined that the permit should be issued as previously written. After evaluating your objections, the district engineer will send you a proffered permit for your reconsideration, as indicated in Section B below.

B: PROFFERED PERMIT: You may accept or appeal the permit.

- **ACCEPT:** If you received a Standard Permit, you may sign the permit document and return it to the district engineer for final authorization. If you received a Letter of Permission (LOP), you may accept the LOP and your work is authorized. Your signature on the Standard Permit or acceptance of the LOP means that you accept the permit in its entirety, and waive all rights to appeal the permit, including its terms and conditions, and approved jurisdictional determinations associated with the permit.
- **APPEAL:** If you choose to decline the proffered permit (Standard or LOP) because of certain terms and conditions therein, you may appeal the declined permit under the Corps of Engineers Administrative Appeal Process by completing Section II of this form and sending the form to the division engineer. This form must be received by the division engineer within 60 days of the date of this notice.

C: PERMIT DENIAL: You may appeal the denial of a permit under the Corps of Engineers Administrative Appeal Process by completing Section II of this form and sending the form to the division engineer. This form must be received by the division engineer within 60 days of the date of this notice.

D: APPROVED JURISDICTIONAL DETERMINATION: You may accept or appeal the approved JD or provide new information.

- **ACCEPT:** You do not need to notify the Corps to accept an approved JD. Failure to notify the Corps within 60 days of the date of this notice, means that you accept the approved JD in its entirety, and waive all rights to appeal the approved JD.
- **APPEAL:** If you disagree with the approved JD, you may appeal the approved JD under the Corps of Engineers Administrative Appeal Process by completing Section II of this form and sending the form to the division engineer. This form must be received by the division engineer within 60 days of the date of this notice.

E: PRELIMINARY JURISDICTIONAL DETERMINATION: You do not need to respond to the Corps regarding the preliminary JD. The Preliminary JD is not appealable. If you wish, you may request an approved JD (which may be appealed), by contacting the Corps district for further instruction. Also you may provide new information for further consideration by the Corps to reevaluate the JD.

SECTION II:

REQUEST FOR APPEAL OR OBJECTIONS TO AN INITIAL PROFFERED PERMIT

REASONS FOR APPEAL OR OBJECTIONS: (Describe your reasons for appealing the decision or your objections to an initial proffered permit in clear concise statements. You may attach additional information to this form to clarify where your reasons or objections are addressed in the administrative record.)

ADDITIONAL INFORMATION: The appeal is limited to a review of the administrative record, the Corps memorandum for the record of the appeal conference or meeting, and any supplemental information that the review officer has determined is needed to clarify the administrative record. Neither the appellant nor the Corps may add new information or analyses to the record. However, you may provide additional information to clarify the location of information that is already in the administrative record.

POINT OF CONTACT FOR QUESTIONS OR INFORMATION:

If you have questions regarding this decision and/or the appeal process you may contact:
The Project Manager Identified In Your Jurisdictional Determination Letter
or
Appeal Review Officer
U.S. Army Corps of Engineers
Great Lakes and Ohio River Division
550 Main Street, Room 10032
Cincinnati, OH 45202-3222
(513) 684-6212

RIGHT OF ENTRY: Your signature below grants the right of entry to Corps of Engineers personnel, and any government consultants, to conduct investigations of the project site during the course of the appeal process. You will be provided a 15 day notice of any site investigation, and will have the opportunity to participate in all site investigations.

_____	_____	(___)_____
Signature of appellant or agent	Date	Telephone Number

Water	Linear Ft	Acres	Signex determination made?	Jurisdictional
Wetland B		2.21	no, isolated	no
Wetland C		0.05	no, isolated	no
Wetland D		0.58	no, isolated	no
Wetland E		0.01	yes, adjacent NRPW 3a	yes
Wetland F		0.05	no, isolated	no
Wetland G		1.13	no, isolated	no
Wetland H		3.15	yes, abutting RPW 2c	yes
Wetland M		0.6	no, isolated	no
Wetland N		0.44	no, isolated	no
Wetland O		0.2	no, isolated	no
Wetland P		7.86	n/a abutting RPW 1d	yes
Wetland Q		1.82	no, isolated	no
Wetland R		0.18	n/a abutting RPW 1	yes
Wetland S		0.02	no, isolated	no
Open Water 1		2.94	no, isolated	no
Open Water 4		0.79	no, isolated	no
Open Water 5		0.24	no, isolated	no
Open Water 6		0.18	no, isolated	no
Open Water 7		0.07	no, isolated	no
Open Water 8		0.96	n/a abutting RPW 1	yes
Open Water 9		1.75	no, isolated	no
Open Water 10		0.77	no, isolated	no
Open Water 11		0.09	no, isolated	no
Open Water 12		1.37	no, isolated	no
Open Water 13		0.16	no, isolated	no
Open Water 14		0.04	no, isolated	no
Open Water 15		0.11	no, isolated	no
Open Water 16		0.14	no, isolated	no
Stream 1a	637		n/a RPW	yes
Stream 1b	338		n/a RPW	yes
Stream 1c	113		n/a RPW	yes
Stream 1d	1,821		n/a RPW	yes
Stream 1e	380		no, isolated	no
Stream 2a upper	480		no, isolated	no
Stream 2b lower	252		yes, NRPW	yes
Stream 2b	131		yes, NRPW	yes
Stream 2c	637		n/a RPW	yes
Stream 3a	474		yes, NRPW	yes
Stream 3b	257		yes, NRPW	yes
Stream 3c	39		yes, NRPW	yes
Stream 3d	68		yes, NRPW	yes

DEPARTMENT OF THE ARMY
PITTSBURGH DISTRICT, CORPS OF ENGINEERS
WILLIAM S. MOORHEAD FEDERAL BUILDING
1000 LIBERTY AVENUE
PITTSBURGH, PA 15222-4186

REPLY TO
ATTENTION OF

February 8, 2011

Operations Division
Regulatory Branch
2004-270

Apex Environmental, LLC
Attn: Mr. Scott Lockhart
11 County Road, P.O. Box 157
Amsterdam, Ohio 43903

Dear Mr. Lockhart:

Reference is made to your request for Wetland Boundary Verification and Jurisdictional Waters Determination for the Potential Apex Sanitary Landfill Expansion. A field view of the property located in Harrison and Jefferson Counties, Ohio was performed on November 15, 2010 by Matt Mason of this office.

The Corps of Engineers' authority to regulate waters of the United States is based on the definitions and limits of jurisdiction contained in 33 CFR 328. Navigable waters, their tributaries, and surrounding wetlands are waters of the United States subject to the provisions of Section 404 of the Clean Water Act. Based on the information submitted (Wetland and Stream Delineation and Functional Assessment Report –October 2010) and the field verification it has been determined that Stream 1a, 1b, 1c, and 1d are Relatively Permanent Waters (RPW) and are jurisdictional under Section 404 of the Clean Water Act. The upper section of Stream 2a is an isolated section of stream and therefore is non-jurisdictional. The remaining streams within the site- Stream 2a lower, Stream 2b, Stream 3a, 3b, 3c, and 3d are Non-Relatively Permanent Waters (NRPW) which have a significant effect on the chemical, biological, and physical characteristics of the downstream waters and are jurisdictional under Section 404 of the Clean Water Act. The following wetlands have been determined to be jurisdictional - Wetland E is adjacent to Stream 3a, Wetland H which abuts Stream 2a, Wetlands P and R which abut Stream 1. In addition, Open Water 8 is jurisdictional as it abuts Stream 1. The following wetlands were determined to be isolated waters and are not jurisdictional under Section 404 of the Clean Water Act – Wetlands A, B, C, D, F, G, I, J, K, L, M, N, O, and Q. The following open water areas identified within the project site have been determined to be isolated and therefore would not be jurisdictional under Section 404 of the Clean Water Act – 1, 2, 3, 4, 5, 6, 7, 9, 10, and 11. This non-jurisdictional determination was coordinated and approved by the US Environmental Protection Agency. A summary of the Jurisdictional Determination is included on the attached table.

This delineation verification will remain valid for a period of five years from the date of this letter, unless new information warrants revision of the delineation. Every effort should be made to avoid impacts to the aquatic resources on-site. If stream or wetland impacts are proposed, this office should be contacted to discuss permit requirements. The Ohio Environmental Protection Agency may take jurisdiction of the isolated water and wetlands on the project site and should be contacted.

If you have any questions, please contact Matt Mason at (412) 395-7129 or via email at Matthew.R.Mason@usace.army.mil. Please reference Project No.2004-270 in all future correspondence with this office regarding this delineation.

Sincerely,

Nancy Mullen

Nancy Mullen
Chief, North Section
Regulatory Branch

Enclosure

Copy furnished:

Dan Osterfield, OEPA
Ms. Laura Shema, CEC

WETLAND AND STREAM DELINEATION AND FUNCTIONAL ASSESSMENT REPORT POTENTIAL APEX SANITARY LANDFILL EXPANSION JEFFERSON AND HARRISON COUNTIES, OHIO

Prepared for:

APEX ENVIRONMENTAL, LLC
11 COUNTY ROAD
AMSTERDAM, OHIO 43903

CEC Project 080-608.0001

October 2010

Civil & Environmental Consultants, Inc.

Pittsburgh 333 Baldwin Road
Pittsburgh, Pennsylvania 15205
Phone 412/429-2324
Fax 412/429-2114
Toll Free 800/365-2324
E-mail info@cecinc.com

Austin	855/365-2324	**Export**	800/899-3610
Chicago	877/963-6026	**Indianapolis**	877/746-0749
Cincinnati	800/759-5614	**Nashville**	800/763-2326
Cleveland	866/507-2324	**North Central PA**	877/389-1852
Columbus	888/598-6808	**Phoenix**	877/231-2324
Detroit	866/380-2324	**St. Louis**	866/250-3679

Corporate Web Site http://www.cecinc.com

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FIGURES

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APPENDICES

Appendix A – Wetland Determination Data Forms
Appendix B – Photographs
Appendix C – ORAM Data Forms
Appendix D – Primary Headwater Habitat Evaluation Forms

1.0 INTRODUCTION

1.1 GENERAL INFORMATION

This report presents the findings of a wetland and stream delineation and functional assessment study conducted at the Apex Sanitary Landfill located in Jefferson County, Ohio, which is owned by Apex Environmental, LLC. The project area is a proposed landfill expansion located south of the existing Apex Landfill in Jefferson County and Harrison County, Ohio. The project area consists of former coal strip mine pits and associated overburden piles, re-vegetated mine spoil, wooded areas, and active portions of the existing landfill, including office buildings and roadways. Agricultural properties, private residences, and the existing Apex Landfill surround the site.

Civil & Environmental Consultants, Inc. (CEC) conducted the initial field inspection and data collection for the wetland and stream delineation and wetland assessment between May 20, 2008 and May 28, 2008. CEC completed a review of the individual wetlands to determine their status and to verify and re-mark their boundaries in June and July 2010.

1.2 METHODOLOGY

This report identifies delineated wetlands, streams (ephemeral, intermittent, and perennial), and other waters within the study area. The methodology for conducting the wetland and stream delineation and wetland functional assessment is presented below.

1.2.1 Wetlands

The delineation was based on CEC's professional judgment and interpretation of the technical criteria presented in the 1987 *Corps of Engineers Wetlands Delineation Manual* (USACE Manual). The wetland boundaries, where present, were delineated using the routine onsite determination method described in the USACE Manual, supplemented by the *National List of*

Plant Species That Occur in Wetlands: Northeast (Region 1) (Reed 1988) and *Hydric Soils of the United States* (USDA 1991).

CEC reviewed the U.S. Geological Survey (USGS) topographic mapping (Figure 1), U.S. Fish and Wildlife Service (USF&WS) National Wetlands Inventory (NWI) map (Figure 2), U.S. Department of Agriculture (USDA) *Soil Survey of Jefferson County, Ohio* (Figure 3), and the corresponding county hydric soils list. These resources were used to identify potential wetland areas prior to conducting the site reconnaissance.

CEC performed the onsite inspection for the wetland delineation on March 26, 2008 and March 28, 2008. First, plant communities present on the site and the dominant plant species in each community were identified and a determination was made on whether the plant community was dominated by hydrophytic (wetland) plants. Next, a representative test site was located within the plant community and soils were sampled using a tile spade to determine if hydric soil indicators were present. Lastly, the test site was inspected to determine if indicators of wetland hydrology (ponding, soil saturation, etc.) were present. When a test site was determined to be within a wetland, further testing was performed to locate the wetland/non-wetland boundary and a second test site was established outside the wetland boundary to document conditions in the non-wetland area.

The boundaries of areas having all three necessary criteria were marked in the field with consecutively numbered surveyor's stakes and ribbon and subsequently located using a Trimble Geo-XT Global Positioning System (GPS) unit. In areas where steep high walls obscured GPS satellite reception, a combination of GPS point offsets using compass and laser rangefinder distance measurements and GIS/aerial photography data were used to supplement field GPS data for wetland boundary delineations. CEC subsequently verified the wetland delineation and re-marked the wetland boundaries in June and July 2010

Other potential jurisdictional water bodies, such as streams, located within the project area were also identified. The locations and lengths of stream segments were identified using GPS surveying equipment.

CEC also inspected and verified the accuracy the boundaries of several wetlands within the project area – wetlands H, M, and P -- that had been previously delineated by others and approved by the USACE during a jurisdictional determination for the existing landfill. CEC's verification entailed loading the wetland boundary survey data on the Trimble Geo-XT GPS unit and navigating to selected wetland boundary points. At each point, CEC marked the location with a stake and observed the plant community composition and hydrology indicators to check the accuracy of the wetland boundary.

Data forms for the routine onsite determination method were completed for twenty-one representative locations within the site boundaries (see Figure 4 for test site locations and Appendix A for the wetland data forms). The data sheets provide a record of the vegetation, soils and hydrology observations used in making the wetland determination.

CEC photographed the test site locations and wetland areas located within the project area. Representative photographs of the site and the wetland areas are presented in Appendix B.

CEC conducted a functional assessment of all delineated wetlands using the Ohio Rapid Assessment Method (ORAM version 5.0) for wetlands (Ohio Environmental Protection Agency (Ohio EPA), 2001). The ORAM characterizes wetlands into one of three categories (Category I, II or III) based upon their functions, value, and overall quality. Category I wetlands typically have minimal functions and low quality and are often dominated by invasive species and are hydrologically isolated. Category II wetlands typically have moderate or intermediate functions and quality. Category III wetlands typically have superior functions and quality and may include wetlands which provide habitat for threatened and endangered species or contain unique habitats. Although the ORAM only lists three categories of wetlands, some wetlands fall into "gray zones" that exist between the categories. These wetlands must be further assessed by using either another technique or professional judgment.

The ORAM quantitative rating assigns a numerical score to a wetland or wetland complex based on the results on the background information, narrative rating, and quantitative rating. The score is on a 100 point scale and is interpreted to assign the wetland antidegradation category pursuant

to OAC 3745-1-54. The wetland categories were determined using *ORAM Score Calibration Report* revised August 15, 2000. The following ORAM scores are currently being used by the Ohio EPA to determine a wetland's antidegradation category:

Scoring Breakpoints for Wetland Regulatory Categories for ORAM v. 5.0 (Mack 2000)	
ORAM v. 5.0 Score	Category
1 – 29.9	1
30 – 34.9	1 or 2 gray zone
35 – 44.9	modified 2
45 – 59.9	2
60 – 64.9	2 or 3
65 – 100	3

The completed ORAM forms are included in Appendix C.

1.2.2 Streams

In addition to the identification of wetlands, CEC identified all streams within the study area that may be considered jurisdictional by the Ohio EPA and/or the U.S. Army Corps of Engineers (USACE). Using professional judgment and field indicators such as flow, substrate composition, embeddedness, defined bed and bank, vegetation, and benthic macroinvertebrates, CEC classified on-site stream segments into three stream types: ephemeral, intermittent, and perennial. The following descriptions are provided to clarify the different stream classifications.

- Ephemeral Stream – An ephemeral stream has flowing water only during, and for a short duration after, precipitation events in a typical year. Ephemeral stream beds are located above the water table year-round. Groundwater is not a source of water for the stream. Runoff from rainfall is the primary source of water for stream flow.

- Intermittent Stream – An intermittent stream has flowing water during certain times of the year, when groundwater provides water for stream flow. During dry periods, intermittent streams may not have flowing water. Runoff from rainfall is a supplemental source of water for stream flow.

- Perennial Stream – A perennial stream has flowing water year-round during a typical year. The water table is located above the stream bed for most of the year. Groundwater is the primary source of water for stream flow. Runoff from rainfall is a supplemental source of water for stream flow.

The uppermost limit of an ephemeral stream was determined at the point where the stream lost its defined "bed and banks" or ordinary high water mark (OHWM) and a predominance of upland vegetation was found in the channel. Under natural, undisturbed conditions, the onsite streams generally originate as headwater ephemeral drainages along the tops of ridges, transition into intermittent stream systems, and eventually transition into perennial stream systems.

The limit of each distinct stream segment was located in the field using a GeoXT GPS unit. The total stream segment lengths and stream designation are summarized in Section 2.6 of this report.

Streams were assessed in 2008 and 2010 using the Ohio EPA's *Headwater Habitat Evaluation Index (HHEI)*, which is used by the Ohio EPA to determine the ecological condition and potential surface water classification for streams. Three metrics (substrate type, maximum pool depth, and bankfull width) are scored and tallied to determine the HHEI score. The *Field Evaluation Manual for Ohio's Primary Headwater Habitat Streams* (Ohio EPA 2001) provides detailed procedures for scoring streams and interpreting the results of the evaluation.

The following HHEI scores are currently being used by the Ohio EPA to determine the classification of Primary Headwater Habitat (PHWH) Streams:

Scoring Breakpoints for PHWH Stream Classes (Ohio EPA 2001)		
HHEI Score	Natural or Recovered Channel	Modified Channel
<15	Class I or PHWH	Modified Class I PHWH
15 to <30	Class II PHWH	
15 to <53		Modified Class II PHWH

Scoring Breakpoints for PHWH Stream Classes (Ohio EPA 2001)		
30 to <53	Class II or Class III PHWH[1]	
≥53	Class III PHWH	Modified Class III PHWH
[1] If bedrock, boulder, and cobble comprise ≥20% of the substrate, then the stream is a Class III PHWH		

2.0 FINDINGS

2.1 WETLAND INVENTORY MAPS

National Wetland Inventory (NWI) maps have been prepared by the U.S. Fish & Wildlife Services (USFWS) based on high altitude infrared aerial photography and limited ground truthing. Wetlands and deep water habitats are identified on these maps and classified according to the system developed by Cowardin and co-workers (1979). The satellite data reflect conditions during the specific year and season the data was acquired and all wetlands may not be indicated.

The NWI map for the Amsterdam, OH quadrangle identifies several wetlands within the project area (Figure 2). The wetlands consist of the following: palustrine, open water, intermittently exposed/permanent, excavated (POWZx), palustrine, scrub-shrub/emergent, saturated semipermanent seasonal (PSS/EMY) and palustrine, emergent, saturated semipermanent seasonal (PEMY). As noted in the following sections of this report, the NWI map may not accurately depict the current wetland conditions observed by CEC at the site.

Ohio Wetland Inventory (OWI) maps have been prepared by the Ohio Department of Natural Resources (ODNR) using May 1987 Landsat Thematic mapper data (cell size 30 meters by 30 meters) using ERDAS Image processing software (ODNR, 1999). Unfortunately, OWI data for the Amsterdam, OH quadrangle are not available through the ODNR and could not be used to identify potential wetlands areas.

2.2 SITE SOILS

A review of *Soil Survey Geographic (SSURGO) Database for Jefferson and Harrison County* (NRCS, 1980) shows thirteen soil mapping units within the project site (Figure 3). The soil mapping units identified at the site are described in the following table.

TABLE 1 SOILS INFORMATION			
Soil Mapping Unit Symbol [1]	**Soil Mapping Unit Name** [2]	**Drainage Class** [2]	**Hydric Soil List Designation** [2]
GrC	Gilpin-Lowell complex, 6 to 15% slopes	Well drained	Not listed
GnC	Gilpin silt loam, 8 to 15% slopes	Well drained	Not listed
GnD	Gilpin silt loam, 15 to 25% slopes	Well Drained	Not listed
GpC	Gilpin-Lowell silt loams, 8 to 15% slopes	Well drained	Not listed
GpD	Gilpin-Lowell silt loams, 15 to 25% slopes	Well drained	Not listed
GrC	Gilpin-Lowell silt loams, 6 to 15% slopes	Well drained	Not listed
GuD2	Guernsey silty clay loams, 15 to 25% slopes, eroded	Well drained	Not listed
HgE	Hazleton-Westmoreland complex, 25 to 40% slopes	Well drained	Not listed
Me	Melvin silt loam, ponded	Poorly drained	Listed
MnC	Morristown silty clay loam 3 to 15% slopes	Well drained	Not listed
MrF	Morristown shaly silty clay loam 25 to 70% slopes	Well drained	Not listed
MuD	Morristown channery silty clay loam 8 to 25% slopes	Well drained	Not listed
MpF	Morristown channery silt loam 25 to 70% slopes	Well drained	Not listed

(1) NRCS, USDA, 1980

The site consists predominantly of well-drained, non-hydric soils. Melvin silt loam has been identified as a hydric soil by the NRCS. The Melvin silt loam soils are located along the south-central portion of the site. The majority of the site soils have been disturbed by historical open

cut/strip mining activities; as such, the soils may no longer reflect the characteristics of the soil mapping units in the NRCS database and soil survey.

2.3 PLANT COMMUNITIES

The plant communities present on the site are dominated by herbaceous uplands, shrub and forested uplands and wetlands. Dominant plant species comprising these plant communities were identified and the USFWS wetland plant indicator status was determined according to Reed (1988). The USFWS has defined five wetland plant indicator categories, which include:

(1) Obligate wetland (OBL – has >99% probability of occurring in wetlands);
(2) Facultative wetland (FACW – has 66% to 99% chance of occurring in wetlands);
(3) Facultative (FAC – has 33% to 66% chance of occurring in wetlands);
(4) Facultative upland (FACU – has 1 to 33% chance of occurring in wetlands); and
(5) Upland (UPL – has <1% chance of occurring in wetlands).

Plants classified as OBL, FACW or FAC are considered to be wetland plants (hydrophytes) by the USFWS and U.S. Corps of Army Engineers (USACE). The following plant species are representative of wetland and non-wetland vegetation on the site:

Wetlands

- *Ceratophyllum demersum* (common hornwort – OBL)
- *Najas minor* (brittle water nymph – OBL)
- *Scirpus atrovirens* (green bulrush – OBL)
- *Lemna minor* (common duckweed –OBL)
- *Salix nigra* (black willow – FACW+)
- *Glyceria striata* (fowl mannagrass – OBL)
- *Typha angustifolia* (narrow leaf cattail – OBL)
- *Impatiens capensis* (spotted touch me not – FACW)
- *Bidens frondosa* (devils beggar tick – FACW)
- *Carex vulpinoidea* (fox sedge – OBL)

- *Equisetum arvense* (field horse tail – FAC)
- *Onoclea sensibilis* (sensitive fern – FACW)
- *Ulmus americana* (American elm – FAC)
- *Potamgeton x. spathuliformis* (pondweed – OBL)

Non-wetlands

- *Rubus uvidus* (blackberry – UPL)
- *Rosa multiflora* (multiflora rose – FACU)
- *Daucus carota* (Queen Anne's lace – UPL)
- *Tussilago farfara* (colts foot – FACU)
- *Rhus radicans* (poison ivy – FACU)
- *Achillea millefolium* (common yarrow – FACU)
- *Taraxacum officinale* (common dandelion – UPL)
- *Anthoxanthum odoratum* (sweet vernal grass – FACU)
- *Lonicera maackii* (Amur honeysuckle – UPL)
- *Festuca rubra* (red fescue – FACU)
- *Solidago canadensis* (Canada goldenrod – FACU)
- *Jugans nigra* (black walnut – FACU)
- *Fraxinus americana* (white ash – FACU)

Individual wetland areas and their characteristics are listed on Table 2 in Section 2.5 of this report. In addition, dominant plant species observed in the wetlands and their indicator status is recorded on the wetland determination data forms in Appendix A.

2.4 HYDROLOGY

Hydrologic features at the site include open water mining cuts, wetlands and tributaries of Cross Creek along the southern boundary and Yellow Creek and Goose Creek along the northern boundary of the study area (Figure 4). The natural hydrology of the site has been altered by

mining activities. The hydrology of individual wetlands and streams is described based on the findings of the office data review and our observations in Sections 2.5 and 2.6.

2.5 WETLANDS

Seventeen wetland areas (A, B, C, D, E, F, G, H, I, J, K, L, M, N, O, P and Q), totaling 23.22 acres, were delineated within the study area (Figures 4 and 5). A field survey of the delineated wetland boundaries (Figures 4 and 5) was completed by CEC using a Trimble Geo-XT Global Positioning System survey units, GIS images, and field notes. The wetland area, size, CEC's interpretation of the USFWS classification, and hydrological characteristics of the wetlands are summarized in Table 2. The following appendices contain supporting wetland data:

- Appendix A – wetland determination data forms;
- Appendix B – wetland photographs
- Appendix C – ORAM scoring forms

Wetlands H, M and P were previously delineated by others (Mallory Gilbert (2003), Midwestern Bioconsulting (2000), and Metcalfe & Eddy, Inc (1994)) and approved by the USACE in a jurisdictional determination and Section 404 Permit issued for the existing landfill. CEC re-evaluated the wetland areas by inspecting and verifying individual wetland boundary points, as described in Section 1.2. The boundary points inspected by CEC are shown on Figure 5. Based on our inspection, CEC believes that, with the minor modification shown on Figure 5, the previously delineated wetland boundaries are accurate and has incorporated into this report the boundary delineations and wetland determination data prepared previously by others. Wetland H and P extended beyond the limits of the study area, but include approximately 12.27 acres within the study area.

The results of the wetland delineation and ORAM classification are presented in the following table:

TABLE 2
WETLAND CHARACTERISTICS

Wetland	Area Within Study Boundary (acres)	USFWS Classification[1]	Test Site Number	ORAM v. 5.0 Score	ORAM Category
A[2]	2.16	PAB/POWZx	1	42	Modified 2
B[2]	2.21	PEM/PAB/POWZx	3	44	Modified 2
C[2, 5]	0.05	PAB/POWZx/PSS	5	37	Modified 2
D[2]	0.58	PAB/POWZx	7	42	Modified 2
E	0.01	PEMB	9	16.5	1
F[2]	0.04	PEM/PSSB	11	15.5	1
G	1.16	PEM/PABZx	13	41	Modified 2
H[3]	3.27	PAB/POWZx/PEM1	-	52	2
I[2, 6]	0.11	PAB/POWZx/PEM	15	44.5	Modified 2
J[2, 6]	0.04	PAB/PEM/POWZx	17	44.5	Modified 2
K[2, 6]	0.16	PAB/POWZx	19	44.5	Modified 2
L[2]	1.37	PAB/POWZx	21	46	2
M[2, 3]	0.60	PAB/POWZx	-	25.5	1
N[2]	0.44	PAB/POWZx	23	43	Modified 2
O[2, 5]	0.20	PAB/POWZx	25	37	Modified 2
P[3]	9.00[4]	PEM/PSS/PFO/PAB/POW-C/Zh	29	53	2
Q[2]	1.82	PEM/PAB/POWZx	27	42	Modified 2
Total	23.22				

[1] Based on Cowardin and coworkers, 1979. P – palustrine; AB – aquatic bed; EM – emergent; SS - scrub-shrub; OW – open water.
[2] Isolated wetland.
[3] Data for wetlands H, M, and P taken from Gilbert (2003)
[4] Total delineated area is 10.01 acres; 9.00 acres are located within the project area.
[5] Wetlands C and O were scored as a complex for the ORAM.
[6] Wetlands I, J, and K were scored as a complex for the ORAM.

Wetland A is located in a flooded strip mine pit along the west portion of the study area. CEC classified this 2.16-acre wetland and 0.78-acre associated open water as a palustrine aquatic bed, open water, intermittently exposed/permanently inundated (PAB/POWZx) wetland area (Cowardin, 1979). Based on the ORAM score of 42, this wetland was classified as a Modified Category 2 wetland (Ohio EPA, 2001). The wetland vegetation is dominated by common hornwort and brittle water nymph. The hydrology of this excavated wetland is maintained by

precipitation and influenced by shallow groundwater associated with the mine spoil. Amphibians were observed within the wetland during the field survey.

Wetland B is located in a flooded strip mine pit in the west portion of the study area. CEC classified this 2.21-acre wetland and associated 0.79-acre open water as a palustrine persistent emergent, aquatic bed, open water, intermittently exposed/permanently inundated (PEM1/PAB/POWZx) wetland area (Cowardin, 1979). Based on the ORAM score of 44, this wetland was classified as a Modified Category 2 wetland (Ohio EPA, 2001). The wetland vegetation is dominated by broad-leaf cattail, green bulrush, and brittle water nymph. The hydrology of this excavated wetland is maintained by precipitation and influenced by shallow groundwater associated with the mine spoil. Amphibians were observed within the wetland during the field survey.

Wetland C is located in the south portion of the study area. CEC classified this 0.05-acre wetland area as a palustrine aquatic bed, open water, intermittently exposed/permanently inundated, deciduous scrub-shrub (PAB/POWZx/PSS1) wetland area (Cowardin, 1979). For the ORAM, wetland C was scored together with Wetland O as a complex. The complex has an ORAM score of 37 indicating that the wetlands have a Modified Category 2 classification (Ohio EPA, 2001). The wetland vegetation is dominated by black willow, common duckweed, and fowl mannagrass. The hydrology of this excavated wetland is maintained by precipitation and influenced by shallow groundwater associated with the mine spoil. Amphibians were observed within the wetland during the field survey.

Wetland D is located in a flooded strip mine pit in the northwest portion of the study area. CEC classified this 0.57-acre wetland and associated 0.09-acre open water as a palustrine aquatic bed, open water, intermittently exposed/permanently inundated (PAB/POWZx) wetland area (Cowardin, 1979). Based on the ORAM score of 42, this wetland was classified as a Modified Category 2 wetland (Ohio EPA, 2001). The wetland vegetation is dominated by common duckweed, spotted touch-me-not, fowl mannagrass, and devil's beggar-ticks. The hydrology of this excavated wetland is maintained by precipitation and influenced by shallow groundwater

associated with the mine spoil. Amphibians were observed within the wetland during the field survey.

Wetland E is located in the east portion of the study area. CEC classified this 0.01-acre wetland as a palustrine persistent emergent, saturated (PEM1B) wetland area (Cowardin, 1979). Based on the ORAM score of 16.5, this wetland was classified as a Category 1 wetland (Ohio EPA, 2001). The wetland vegetation is dominated by fowl mannagrass, narrow leaf cattail, and fox sedge. The hydrology of this wetland is maintained by precipitation and a groundwater seep, most likely originating from the mine spoil. Fish and amphibians were not observed within the wetland during the field survey.

Wetland F is located in the east portion of the study area. CEC classified this 0.04-acre wetland area as a palustrine emergent, deciduous scrub-shrub, saturated (PEM1/PSS1B) wetland area (Cowardin, 1979). Based on the ORAM score of 15.5, this wetland was classified as a Category 1 wetland (Ohio EPA, 2001). The wetland vegetation is dominated by narrow leaf cattail, black willow, and field horsetail. The hydrology of this wetland is maintained by precipitation. Fish and amphibians were not observed within the wetland during the field survey.

Wetland G is located in the southeast portion of the study area. CEC classified this 1.16-acre wetland area as a palustrine emergent, aquatic bed, intermittently exposed/permanently inundated (PEM1/PABZx) wetland area (Cowardin, 1979). Based on the ORAM score of 41, this wetland was classified as a Modified Category 2 wetland (Ohio EPA, 2001). Green bullrush, sensitive fern, American elm, fowl mannagrass, and narrow leaf cattail dominate the wetland plant community. The hydrology of this wetland is mainly maintained by precipitation. The northern portion of Wetland G appears to be an excavation and the hydrology is maintained by precipitation and influenced by shallow groundwater seepage associated with the mine spoil. Amphibians were observed within the wetland.

Wetland H is located in the east-central portion of the study area and was classified as a broad-leaf deciduous, palustrine forested (PFO1) wetland (Cowardin, 1979). CEC classified this 3.27-acre wetland area as a palustrine aquatic bed, open water, intermittently exposed/permanently

inundated, persistent emergent, (PAB/POWZx/PEM1) wetland area (Cowardin, 1979). Based on an ORAM score of 52, this wetland was classified as a Category 2 wetland (Ohio EPA, 2001). Red maple, American elm, and sensitive fern dominate the wetland plant community. The hydrology of this wetland is maintained by precipitation and a groundwater seep, most likely originating from the mine spoil. Fish and amphibians were not observed within the wetland during the field survey.

Wetland I is located in the central portion of the study area on old mine spoils. CEC classified this 0.11-acre wetland area as a palustrine aquatic bed, open water, intermittently exposed/permanently inundated, persistent emergent, (PAB/POWZx/PEM1) wetland area (Cowardin, 1979). Wetlands I, J, and K were scored as a wetland complex for the ORAM. The ORAM score of 44.5 gives this wetland a classification of Modified Category 2 (Ohio EPA, 2001). The wetland vegetation is dominated by common hornwort, and fowl mannagrass. The hydrology of this excavated wetland is maintained by precipitation and influenced by shallow groundwater associated with the mine spoil. Amphibians were observed within the wetland during the field survey.

Wetland J is located in the central portion of the study area on old mine spoils. CEC classified this 0.04-acre wetland area as a palustrine aquatic bed, open water, intermittently exposed/permanently inundated, persistent emergent, (PAB/POWZx/PEM1) wetland area (Cowardin, 1979). Wetlands I, J, and K were scored as a wetland complex for the ORAM. The ORAM score of 44.5 gives this wetland a classification of Modified Category 2 (Ohio EPA, 2001). Fowl mannagrass, devil's beggar tick, seedbox, and spearmint dominate the wetland vegetation. The hydrology of this excavated wetland is maintained by precipitation and influenced by shallow groundwater associated with the mine spoil. Amphibians were observed within the wetland during the field survey.

Wetland K is located in the central portion of the study area on old mine spoils. CEC classified this 0.16-acre wetland area as a palustrine aquatic bed, open water, intermittently exposed/permanently inundated (PAB/POWZx) wetland area (Cowardin, 1979). Wetlands I, J, and K were scored as a wetland complex for the ORAM. The ORAM score of 44.5 gives this

wetland a classification of Modified Category 2 (Ohio EPA, 2001). Fowl mannagrass dominated the plant community. The hydrology of this excavated wetland is maintained by precipitation. Amphibians were observed within the wetland during the field survey.

Wetland L is located in the central portion of the study area. CEC classified this 1.37-acre wetland area as a palustrine aquatic bed, open water, intermittently exposed/permanently inundated (PAB/POWZx) wetland area (Cowardin, 1979). Based on the ORAM score of 46, this wetland was classified as a Category 2 wetland (Ohio EPA, 2001). The wetland vegetation is dominated by common duckweed and common hornwort. The hydrology of this excavated wetland is maintained by precipitation and influenced by shallow groundwater associated with the mine spoil. Amphibians were observed within the wetland during the field survey.

Wetland M is located in the northeastern portion of the study area. CEC classified this 0.60-acre wetland area as a palustrine, aquatic bed, open water, intermittently exposed/permanently inundated (PAB/POWZx) wetland area (Cowardin, 1979). Based on the ORAM score of 25.5, this wetland was classified as a Category 1 wetland (Ohio EPA, 2001). Narrow-leaf cattail, broad-leaf cattail, reed canary grass, soft rush, devil's beggar-ticks, common reed, and an unidentified willow (*Salix* sp.) comprise the wetland plant community. This wetland is located in an impounded depression and wetland hydrology appears to be maintained by a shallow groundwater seep.

Wetland N is located in a flooded strip mine pit in the south portion of the study area. CEC classified this 0.44-acre wetland and the associated 0.42-acre open water as a palustrine aquatic bed, open water, intermittently exposed/permanently inundated (PAB/POWZx) wetland area (Cowardin, 1979). Based on the ORAM score of 43, this wetland was classified as a Modified Category 2 wetland (Ohio EPA, 2001). The wetland vegetation is dominated by black willow, common duckweed, and fowl mannagrass. The hydrology of this excavated wetland is maintained by precipitation and influenced by shallow groundwater associated with the mine spoil. Fish and amphibians were observed within the wetland during the field survey.

Wetland O is located in a flooded strip mine pit in the south portion of the study area. CEC classified this 0.20-acre wetland and the associated 0.06-acre open water as a palustrine aquatic bed, open water, intermittently exposed/permanently inundated (PAB/POWZx) wetland area (Cowardin, 1979). Wetland O and wetland C were scored as a complex for the ORAM. Based on the ORAM score of 37 for the wetland complex, this wetland was classified as a Modified Category 2 wetland (Ohio EPA, 2001). The wetland vegetation is dominated by black willow, common duckweed, and fowl mannagrass. The hydrology of this excavated wetland is maintained by precipitation and influenced by shallow groundwater associated with the mine spoil. Amphibians were observed within the wetland during the field survey.

Wetland P is located in the south portion of the study area. CEC classified this 10.01-acre wetland complex as a palustrine wetland containing forested, shrub, emergent, aquatic bed, and open water components, having a range of hydroperiod conditions ranging from seasonal to intermittently exposed to permanently inundated (PEM/PSS/PFO/PAB/POW-C/Zx)(Cowardin, 1979). Based on the ORAM score of 53, this wetland was classified as a Category 2 wetland (Ohio EPA, 2001). The wetland vegetation is dominated by narrow-leaf cattail. The hydrology of this wetland is maintained by seasonal surface water sources, precipitation, and influenced by shallow groundwater associated with the mine spoil. An offsite impoundment pools water south of the landfill boundary and this may contributes to the maintenance of wetland hydrology in Wetland P. Amphibians were observed within the onsite wetland during the field survey.

Wetland Q is located in a flooded strip mine pit in the northwest portion of the study area. CEC classified this 1.82-acre wetland and its associated 2.52-acre open water component as a palustrine persistent emergent, aquatic bed, open water, intermittently exposed/permanent (PEM1/PAB/POWZx) wetland area (Cowardin, 1979). Based on the ORAM score of 42, this wetland was classified as a Modified Category 2 wetland (Ohio EPA, 2001). The wetland vegetation is dominated by narrow leaf cattail. The hydrology of this excavated wetland is maintained by precipitation. Fish and amphibians were observed within the wetland during the field survey.

2.6 OTHER WATERS

In addition to the identified wetland areas, three streams totaling 2,066 linear feet were identified within the project area. A field survey of the stream channels (Figure 4) was completed by CEC using Trimble Geo-XT Global Positioning System survey units, GIS mapping, aerial photography, and field notes. These streams were evaluated to determine flow regime using physical characteristics and biotic community assessments and none of the stream segments were classified as perennial streams. In addition, individual stream segments were classified using the OhioEPA's Primary Headwater Habitat Evaluation (HHEI) method. Copies of the HHEI evaluation forms are presented in Appendix D. The stream assessment is summarized in the following table.

TABLE 3
STREAM CHARACTERISTICS

Stream	Onsite Length (linear feet)			HHEI Score	HHEI Classification	Watershed Drainage Area
	Intermittent	Ephemeral	Total			
Stream 1	233	133	366	44	Class II	10.93 acres
Stream 2		861	861	17	Class I	12.83 acres
Stream 3a	363		363	49	Class II	8.30 acres
Stream 3a		111	111	18	Class I	
Stream 3b		258	258			
Stream 3c		39	39			
Stream 3d		68	68			
Total	596	1,470	2,066			32.06 acres

Stream 1 is located on the south-central portion of the site and contains 233 linear feet of intermittent stream channel and 133 linear feet of ephemeral stream channel. This stream is located in the eastern arm of Wetland P where water down cuts the soil to form a defined stream channel through a silt-dominated substrate. This stream is approximately 2-4 feet wide and was

dry at the time of the site reconnaissance. Fish and amphibians were not observed in Stream 1 during the field survey.

Stream 2 is located on the southeast portion of the site and the channel extends 861 feet downslope from Wetland F West to Wetland H. This ephemeral stream exhibits loss of a defined channel near the center of the stream course and the upper portion of Stream 2 may be isolated from waters of the United States. This stream is approximately 2-3 feet wide and was dry at the time of the site reconnaissance. Fish and amphibians were not observed in Stream 2 during the field survey.

Stream 3 is located on the northeast portion of the site and contains intermittent and ephemeral stream segments as shown on Figure 4. The main stem of Stream 3a was mainly classified as an intermittent stream (363 linear feet) and it is located between Wetland E and a sedimentation control pond. The upper portion of Stream 3a and all of tributaries 3b, 3c, and 3d were classified as ephemeral streams, which total approximately 476 linear feet. The intermittent portion of Stream 3a was approximately 2-4 feet wide and contained 1 to 3 inches of flowing water at the time of the site reconnaissance. The ephemeral segment of Stream 3a and tributaries 3b, 3c, and 3d were not flowing at the time of the field reconnaissance. Fish and amphibians were not observed in Stream 3 during the field survey.

Precipitation was limited before and during the time of the field surveys of the streams present on site. An onsite weather station monitors the precipitation daily, which allows for comparisons between the onsite rainfall and field conditions observed at the time of the assessment. Significant rain occurred 5 days before the field visits of streams 1 and 3. Streams 1 and 3 were assessed on June 18, 2010 and 0.48 inches of rain occurred on June 13, 2010. Significant rain occurred 2.5 weeks before the field site visit of stream 2. Stream 2 was assessed on July 1, 2010 and 0.48 inches of rain occurred on June 13, 2010. No precipitation occurred during the field site visits of each stream. A heavy precipitation event occurred on June 5, 2010 with 2.19 inches of rain.

Other waters present within the study area included eleven open water areas located within strip mine cuts (Figure 4). All but one of these open water areas are associated with delineated wetlands and all open water areas are isolated from waters of the United States. Some characteristics of these open water areas are summarized in the following table.

TABLE 4
OPEN WATER CHARACTERISTICS

Waterbody Name	Size (acres)	Wetland Association
Open Water 1	0.23	Wetland A
Open Water 2	0.28	Wetland A
Open Water 3	0.27	Wetland A
Open Water 4	0.79	Wetland B
Open Water 5	0.24	Wetland N
Open Water 6	0.18	Wetland N
Open Water 7	0.06	Wetland O
Open Water 8	1.14	None
Open Water 9	1.75	Wetland Q
Open Water 10	0.77	Wetland Q
Open Water 11	0.09	Wetland D
Total	5.80	

3.0 REGULATORY CONSIDERATIONS

3.1 MEETINGS WITH REGULATORY AGENCIES

Meetings have not yet been held with regulatory agencies regarding permitting at the proposed project site. Wetland and stream encroachment permits will be required for any potential landfill expansion. CEC recommends meeting with the USACE and Ohio EPA to obtain a jurisdictional determination (JD) for the wetland and other waters identified in this study. A second pre-application meeting is suggested to discuss proposed wetland and stream impacts and possible mitigation measures, once the USACE and the Ohio EPA concur with the wetland and stream boundary delineations.

3.2 REGULATORY ISSUES

The USACE and Ohio EPA regulate impacts to jurisdictional waters in the state of Ohio. Discharges of dredged or fill material into waters of the U.S., including non-isolated wetlands, must obtain permits from the USACE under the provisions of Section 404 of the Clean Water Act. Discharges of dredged or fill material into waters of the State, including isolated wetlands, require permits from the Ohio EPA under provisions of Section 401 of the Clean Water Act or the Ohio Isolated Wetland Permit regulations (Ohio House Bill 231).

Wetland and stream impacts requiring an individual Section 401 water quality certification from the Ohio EPA must conform to the anti-degradation provisions in the Ohio EPA's Wetland Water Quality Standards. Ohio's wetland standards require that wetlands be classified and placed into one of three tiered anti-degradation categories according to the wetlands relative functions and values, rarity, and degree of disturbance and the ability to mitigate for loss. The anti-degradation criteria become increasingly more stringent for ecologically valuable and/or rare wetlands. The anti-degradation regulations require that wetlands be assessed using either the ORAM method or another accepted wetland methodology to classify the wetland functions and values.

Both the Section 404 and Section 401 permitting criteria require that the permit applicant demonstrate that the project purpose cannot be accomplished without impacting jurisdictional waters. If this can be demonstrated, then the applicant may be required to further demonstrate that the scope of the project has been revised to minimize impacts. An alternative analysis may need to be performed, and that the alternative analysis may need to address other potential development sites. The regulatory agencies may not consider mitigation of jurisdictional waters impacts until after satisfactory completion of these requirements. A compensatory mitigation plan may be required for any unavoidable impacts to jurisdictional waters.

4.0 CONCLUSIONS

Seventeen wetland areas totaling approximately 23.22 acres were identified and delineated within the study area. Wetlands H, L, and P were assigned ORAM Category 2 classifications; all other wetlands scored as Modified Category 2, Category 1 – 2 gray zone, or Category 1. Three streams totaling approximately 2,066 linear feet of intermittent and ephemeral streams and 11 open water bodies totaling 5.80 acres were also identified within the study area. The delineated wetland boundaries, stream channels, and open water areas were staked/flagged in the field and subsequently located by CEC scientists using Trimble GPS survey equipment, GIS imagery, aerial photography, and field notes. Wetland and stream boundaries are shown on Figures 4 and 5.

5.0 LEVEL OF CARE

The wetland and stream delineation and wetland assessment services performed by CEC were conducted in a manner consistent with the criteria contained in the USACE Manual and with the level of care and skill ordinarily exercised by members of the environmental consulting profession practicing contemporaneously under similar conditions in the locality of the project. It must be recognized that the jurisdictional wetland delineation was based on field observations and CEC's professional interpretation of the criteria in the USACE Manual at the time of our field work. Wetland determinations may change subsequent to CEC's delineation based on changes in the regulatory criteria, seasonal variations in hydrology, alterations to drainage patterns and other human activities and/or land disturbances.

6.0 REFERENCES

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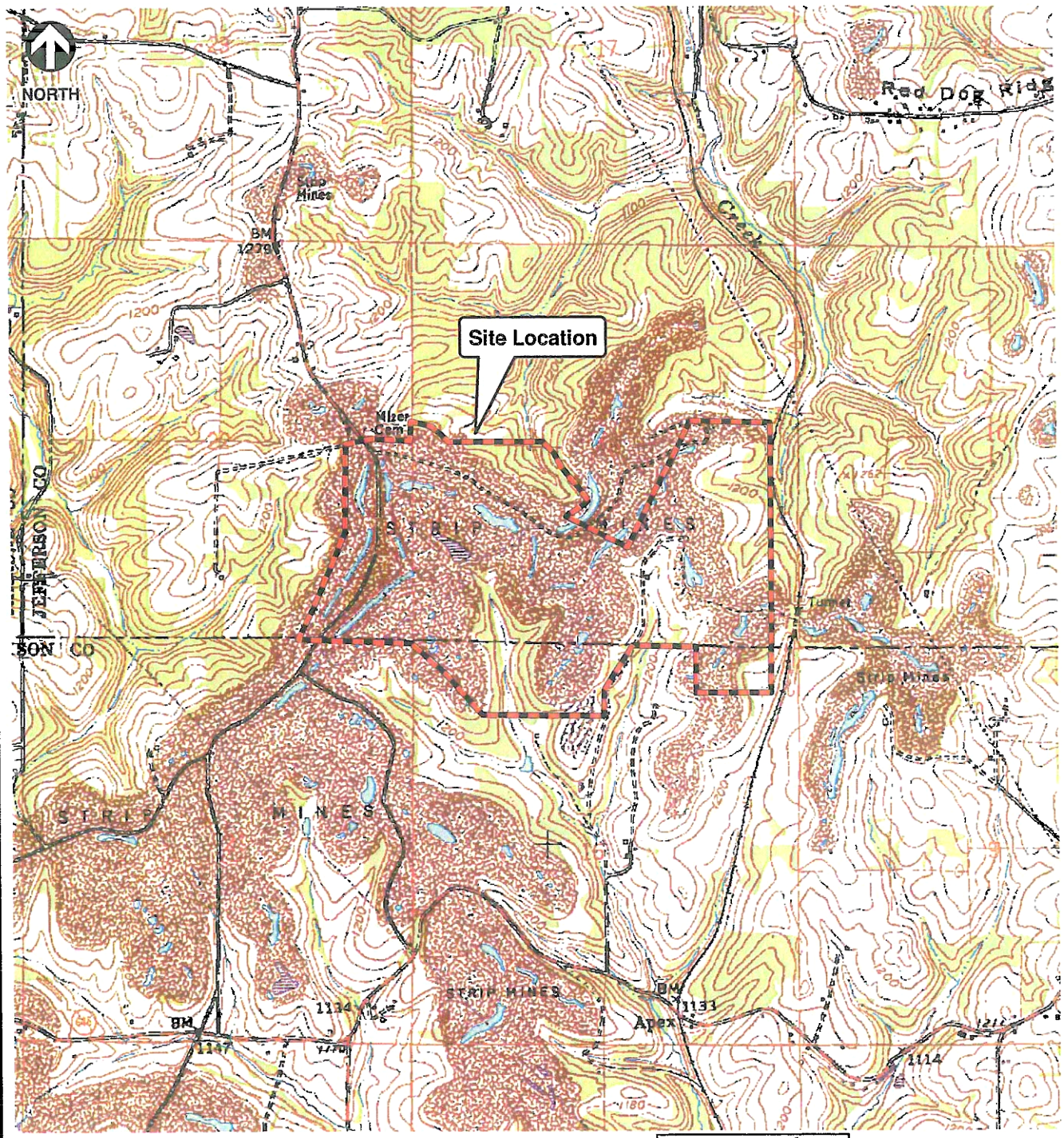
FIGURES



SOURCE: USGS 7.5 MINUTE TOPOGRAPHIC QUADRANGLE MAP - AMSTERDAM, OHIO, 1978.

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Site Location Map

APEX ENVIRONMENTAL, LLC

Intersection of Apex and Worth Roads
Amsterdam, Harrison/Jefferson Counties, Ohio

DWN. BY: MJB	SCALE:	DATE:	PROJECT NO:	FIGURE NO:
CHKD. BY: LFO	1 " equals 2,000 '	07/1/2008	080-608	1

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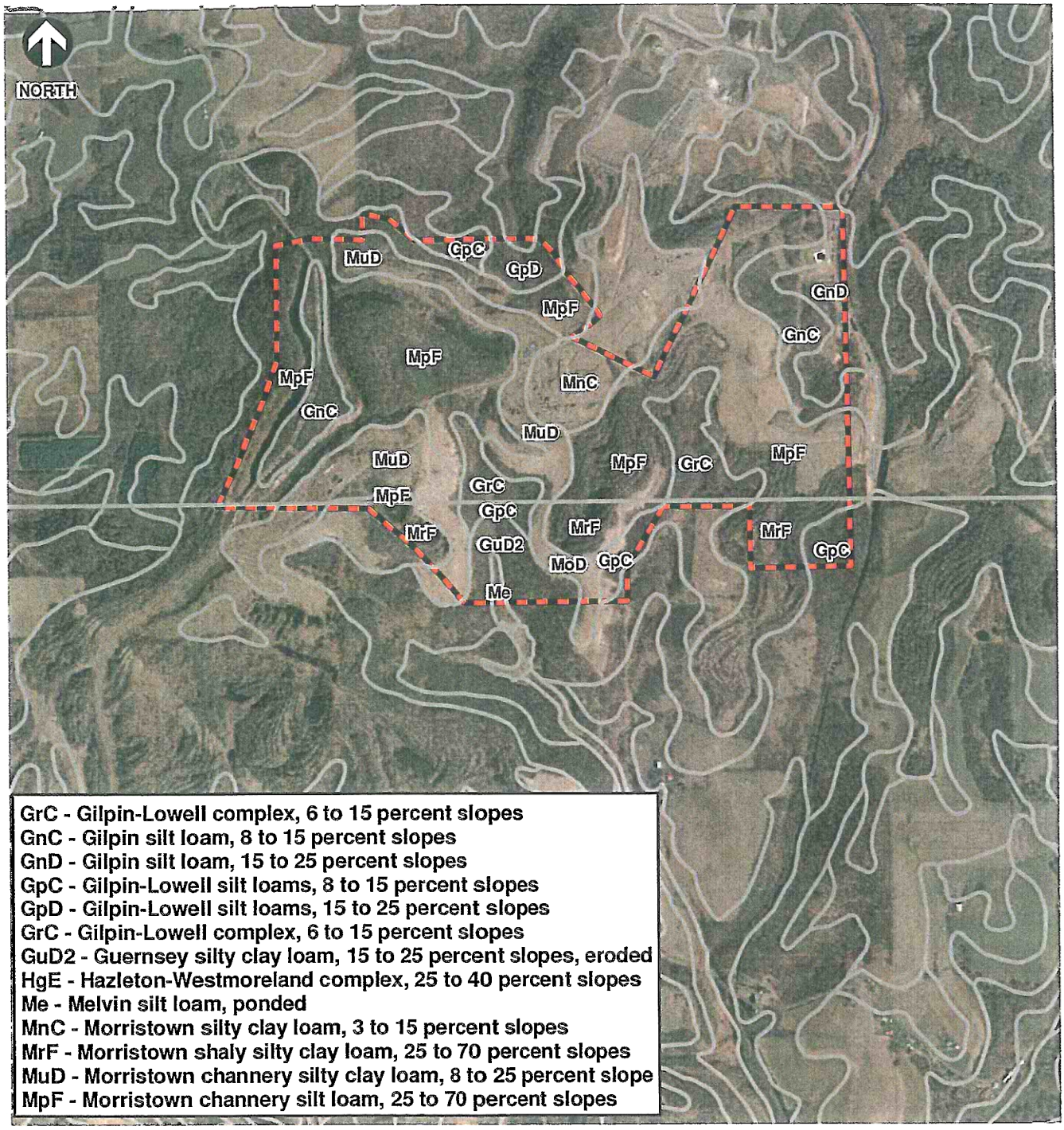

GrC - Gilpin-Lowell complex, 6 to 15 percent slopes
GnC - Gilpin silt loam, 8 to 15 percent slopes
GnD - Gilpin silt loam, 15 to 25 percent slopes
GpC - Gilpin-Lowell silt loams, 8 to 15 percent slopes
GpD - Gilpin-Lowell silt loams, 15 to 25 percent slopes
GrC - Gilpin-Lowell complex, 6 to 15 percent slopes
GuD2 - Guernsey silty clay loam, 15 to 25 percent slopes, eroded
HgE - Hazleton-Westmoreland complex, 25 to 40 percent slopes
Me - Melvin silt loam, ponded
MnC - Morristown silty clay loam, 3 to 15 percent slopes
MrF - Morristown shaly silty clay loam, 25 to 70 percent slopes
MuD - Morristown channery silty clay loam, 8 to 25 percent slope
MpF - Morristown channery silt loam, 25 to 70 percent slopes

USDA Soils Features
Approximate Site Boundary

750 0 750 1,500
Feet

SOURCE:SOILS DATA OBTAINED FROM THE USDA NCRS WEBSITE (http://soildatamart.nrcs.usda.gov/), July 1, 2008.
PORTION OF A OHIO STATE IMAGERY PROGRAM (OSIP) 1-FOOT RESOLUTION COLOR COUNTY MOSAIC - HARRISON AND JEFFERSON COUNTIES, OHIO 2007.

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USDA Soil Survey Map

APEX ENVIRONMENTAL, LLC

Intersection of Apex and Worth Roads
Amsterdam, Harrison/Jefferson Counties, Ohio

DWN. BY: MJB	SCALE:	DATE:	PROJECT NO:	FIGURE NO:
CHKD. BY: LFO	1 " equals 1,500 '	07/1/2008	080-608	2

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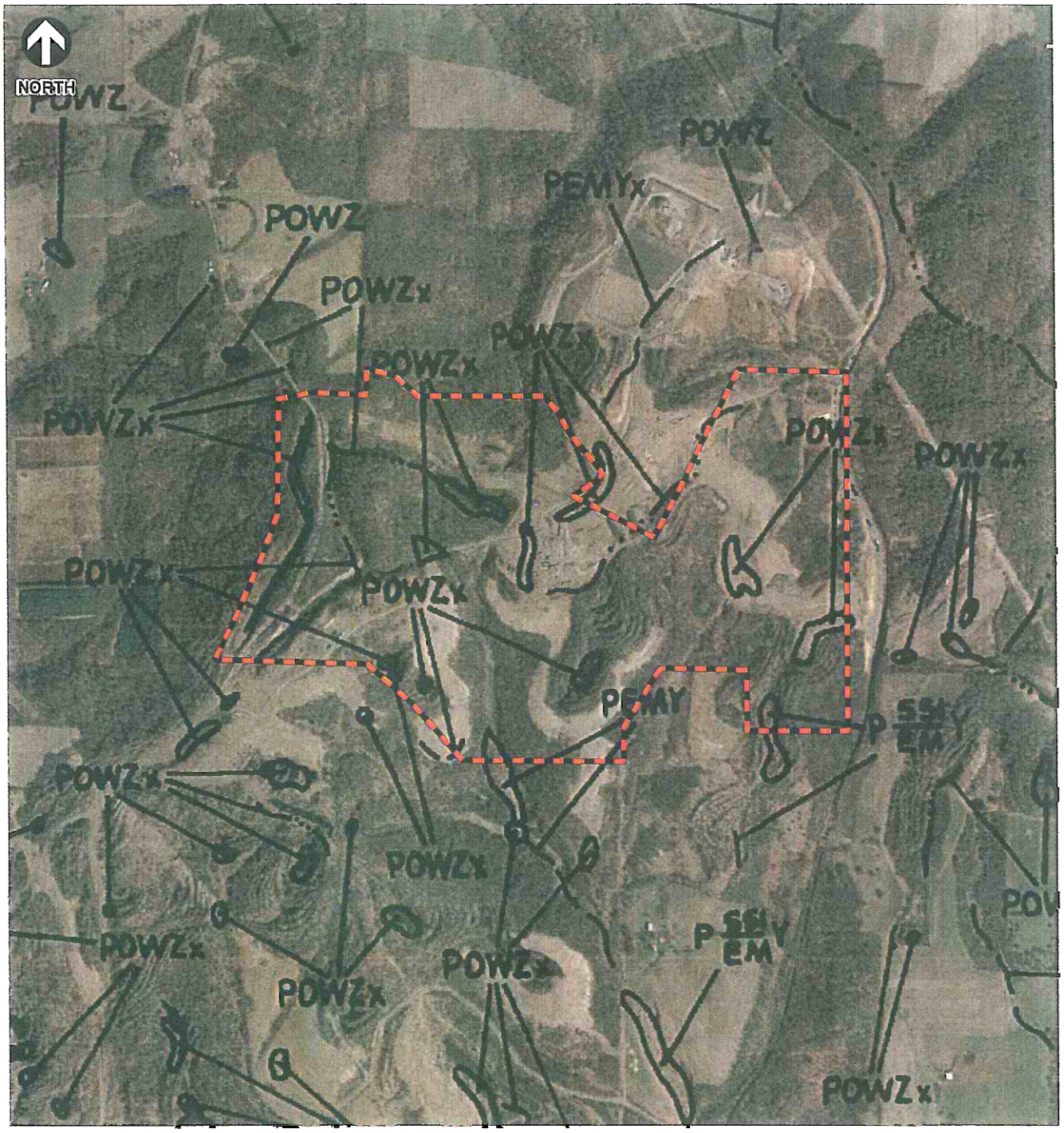

Approximate Site Boundary

750 0 750 1,500 Feet

SOURCE.
WETLANDS DATA OBTAINED FROM THE USFWS WEBSITE WMS Server: http://wetlandswms.er.usgs.gov/wmsconnector/com.esri.wms.Esrimap
PORTION OF A OHIO STATE IMAGERY PROGRAM (OSIP) 1-FOOT RESOLUTION COLOR COUNTY MOSAIC - HARRISON AND JEFFERSON COUNTIES, OHIO 2007.

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USFWS Wetlands Inventory Map

APEX ENVIRONMENTAL, LLC

Intersection of Apex and Worth Roads
Amsterdam, Harrison/Jefferson Counties, Ohio

DWN. BY: MJB	SCALE:	DATE:	PROJECT NO:	FIGURE NO:
CHKD. BY: LFO	1 " equals 1,500 '	07/1/2008	080-608	3

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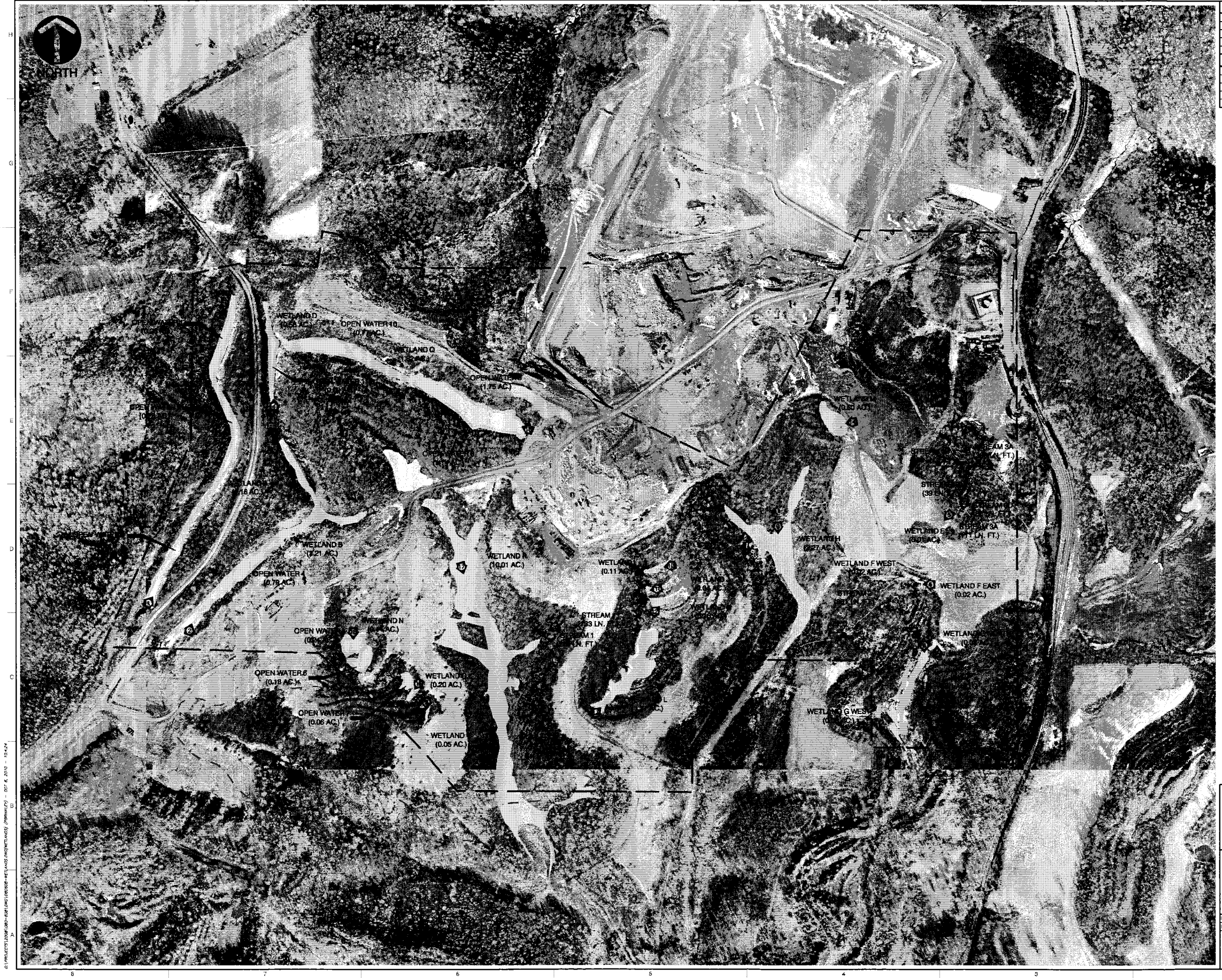

REVISION RECORD		
NO	DATE	DESCRIPTION
1		
2		
3		
4		
5		

SUBMITTAL RECORD		
NO	DATE	DESCRIPTION

WETLAND	AREA (ACRES	USFWS CLASSIFICATION[1]	TEST SITE NO.
A[2]	2.16	PAB/POWZx	1
B[2]	2.21	PEM/PAB/POWZx	3
C[2]	0.06	PAB/POWZx/PSS	5
D[2]	0.58	PAB/POWZx	7
E	0.01	PEMB	9
F[2]	0.04	PEM/PSSB	11
G	1.16	PEM/PABZx	13
H[3]	3.27	PAB/POWZx/PEM1	--
I[2]	0.11	PAB/POWZx/PEM	15
J[2]	0.04	PAB/PEM/POWZx	17
K[2]	0.16	PAB/POWZx	19
L[2]	1.37	PAB/POWZx	21
M[2,3]	0.60	PAB/POWZx	--
N[2]	0.44	PAB/POWZx	23
O[2]	0.20	PAB/POWZx	25
P[3]	9.00[4]	PEM/PSS/PFO/PAB/POW-C/Zh	29
Q[2]	1.82	PEM/PAB/POWZx	27
TOTAL	23.22		

[1] BASED ON COWARDIN AND COWORKERS, 1979 P-PALUSTRINE; AB-AQUATIC BED; EM-EMERGENT; SS-SCRUB-SHRUB; OW-OPEN WATER.

[2] ISOLATED WETLAND

[3] DATA FOR WETLANDS H, M, AND P TAKEN FROM GILBERT (2003) AND FIELD VERIFIED BY CEC IN 2010.

[4] TOTAL DELINEATION AREA IS 10.01 ACRES; 9.00 ACRES ARE LOCATED WITHIN THE PROJECT AREA.

STREAM	ONSITE LENGTH (LINEAR FEET)		
	INTERMITTENT	EPHEMERAL	TOTAL
STREAM 1	233	133	366
STREAM 2	--	861	861
STREAM 3A	363	111	474
STREAM 3B	--	258	258
STREAM 3C	--	39	39
STREAM 3D	--	68	68
TOTAL	596	1,470	2,066

NAME	AREA (ACRES)
OPEN WATER 1	0.23
OPEN WATER 2	0.28
OPEN WATER 3	0.27
OPEN WATER 4	0.79
OPEN WATER 5	0.24
OPEN WATER 6	0.18
OPEN WATER 7	0.06
OPEN WATER 8	1.14
OPEN WATER 9	1.75
OPEN WATER 10	0.77
OPEN WATER 11	0.09
TOTAL	5.80

LEGEND

- WETLAND INVESTIGATION AREA
- CONSERVATION EASEMENT
- OPEN WATER
- WETLAND FEATURE
- EPHEMERAL STREAM
- INTERMITTENT STREAM
- PHOTOGRAPH LOCATION AND DIRECTION
- HHEI STATION

REFERENCE

AERIAL PHOTOGRAPHY FROM KEDDAL AERIAL MAPPING DEVELOPED ON 12/29/08 AND 01/21/10.

SCALE IN FEET
0 300 600

* HAND SIGNATURE ON FILE

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333 Baldwin Road • Pittsburgh, PA 15205-9872
Ph: 412.429.2324 • 800.365.2324 • Fax: 412.429.2114
www.cecinc.com

APEX ENVIRONMENTAL, LLC
SPRINGFIELD TOWNSHIP
JEFFERSON COUNTY, OHIO

DRAWN BY:	DWD	CHECKED BY:	MAT	APPROVED BY:	MRH *
DATE:	8/06/10	DWG SCALE:	1"=300'	PROJECT NO:	060-808

STREAM AND WETLAND DELINEATION MAP

DRAWING NO.: **4**

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REVISION RECORD		
NO	DATE	DESCRIPTION
1		
2		
3		
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SUBMITTAL RECORD		
NO	DATE	DESCRIPTION

LEGEND

- WETLAND INVESTIGATION AREA
- CONSERVATION EASEMENT
- OPEN WATER
- WETLAND FEATURE
- EPHEMERAL STREAM
- INTERMITTENT STREAM
- ● D-202 WETLAND POINT
- ▲ TS-1 WETLAND TEST SITE

REFERENCE

AERIAL PHOTOGRAPHY FROM KEDDAL AERIAL MAPPING DEVELOPED ON 12/29/08 AND 01/21/10.

SCALE IN FEET

0 300 600

* HAND SIGNATURE ON FILE

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APEX ENVIRONMENTAL, LLC
SPRINGFIELD TOWNSHIP
JEFFERSON COUNTY, OHIO

DRAWN BY:	DWD	CHECKED BY:	MAT	APPROVED BY:	MRH *
DATE:	08/06/10	DWG SCALE:	1"=300'	PROJECT NO:	080-806

WETLAND BOUNDARY POINTS

DRAWING NO.: **5**

APPENDIX A

WETLAND DETERMINATION DATA FORMS

DATA FORM
ROUTINE WETLAND DETERMINATION
(1987 COE Wetlands Delineation Manual)

Project/Site: 080-608 / Apex Sanitary Landfill Applicant/Owner: Apex Environmental, LLC Investigator: Lance Opiela and Matt Lauffer	Date: 5/20/08 County: Jefferson State: Ohio
Do Normal Circumstances exist on the site? Yes (No) Is the site significantly disturbed (Atypical Situation)? (Yes) No Is the area a potential Problem Area? Yes (No) (If needed, explain on reverse.)	Community ID: PAB/POW2 Transect ID: TS-1 Plot ID: Wetland A

VEGETATION

Dominant Plant Species	Stratum	Indicator
1. Ceratophyllum demersum	sub	OBL
2. Najas minor	sub	OBL
3.		
4.		
5.		
6.		
7.		
8.		
9.		
10.		
11.		
12.		
13.		
14.		
15.		
16.		

Percent of Dominant Species that are OBL, FACW or FAC (excluding FAC-). 2/2 100%

Remarks:

HYDROLOGY

___ Recorded Data (Describe in Remarks):
- ___ Stream, Lake, or Tide Gauge
- ___ Aerial Photographs
- ___ Other

___ No Recorded Data Available

Field Observations:

Depth of Surface Water:	20 (in.)
Depth to Free Water in Pit:	0 (in.)
Depth to Saturated Soil:	0 (in.)

Wetland Hydrology Indicators:

Primary Indicators:
- X Inundated
- X Saturated in Upper 12 Inches
- ___ Water Marks
- ___ Drift Lines
- ___ Sediment Deposits
- ___ Drainage Patterns in Wetlands

Secondary Indicators (2 or more required):
- ___ Oxidized Root Channels in Upper 12 Inches
- X Water-Stained Leaves
- ___ Local Soil Survey Data
- ___ FAC-Neutral Test
- ___ Other (Explain in Remarks)

Remarks: Abandoned / Inundated mine cut

SOILS

Map Unit Name (Series and Phase): Morristown channery silt loam (MpF)

Drainage Class: well drained

Taxonomy (Subgroup): Typic Udorthents

Field Observations Confirm Mapped Type? Yes (No)

Profile Description:

Depth (inches)	Horizon	Matrix Color (Munsell Moist)	Mottle Colors (Munsell Moist)	Mottle Abundance/ Size/Contrast	Texture, Concretions, Structure, etc.
0-16	A	5Y 4/2	-	-	silt loam - rocky spoils

Hydric Soil Indicators:

- ___ Histosol
- ___ Histic Epipedon
- ___ Sulfidic Odor
- ___ Aquic Moisture Regime
- ___ Reducing Conditions
- ___ Gleyed or Low-Chroma Colors
- ___ Concretions
- ___ High Organic Content in Surface Layer in Sandy Soils
- ___ Organic Streaking in Sandy Soils
- ___ Listed on Local Hydric Soils List
- ___ Listed on National Hydric Soils List
- ___ Other (Explain in Remarks)

Remarks:

WETLAND DETERMINATION

Hydrophytic Vegetation Present? (Yes) No (Circle)
Wetland Hydrology Present? (Yes) No
Hydric Soils Present? (Yes) No

(Circle)
Is this Samplig Point Within a Wetland? (Yes) No

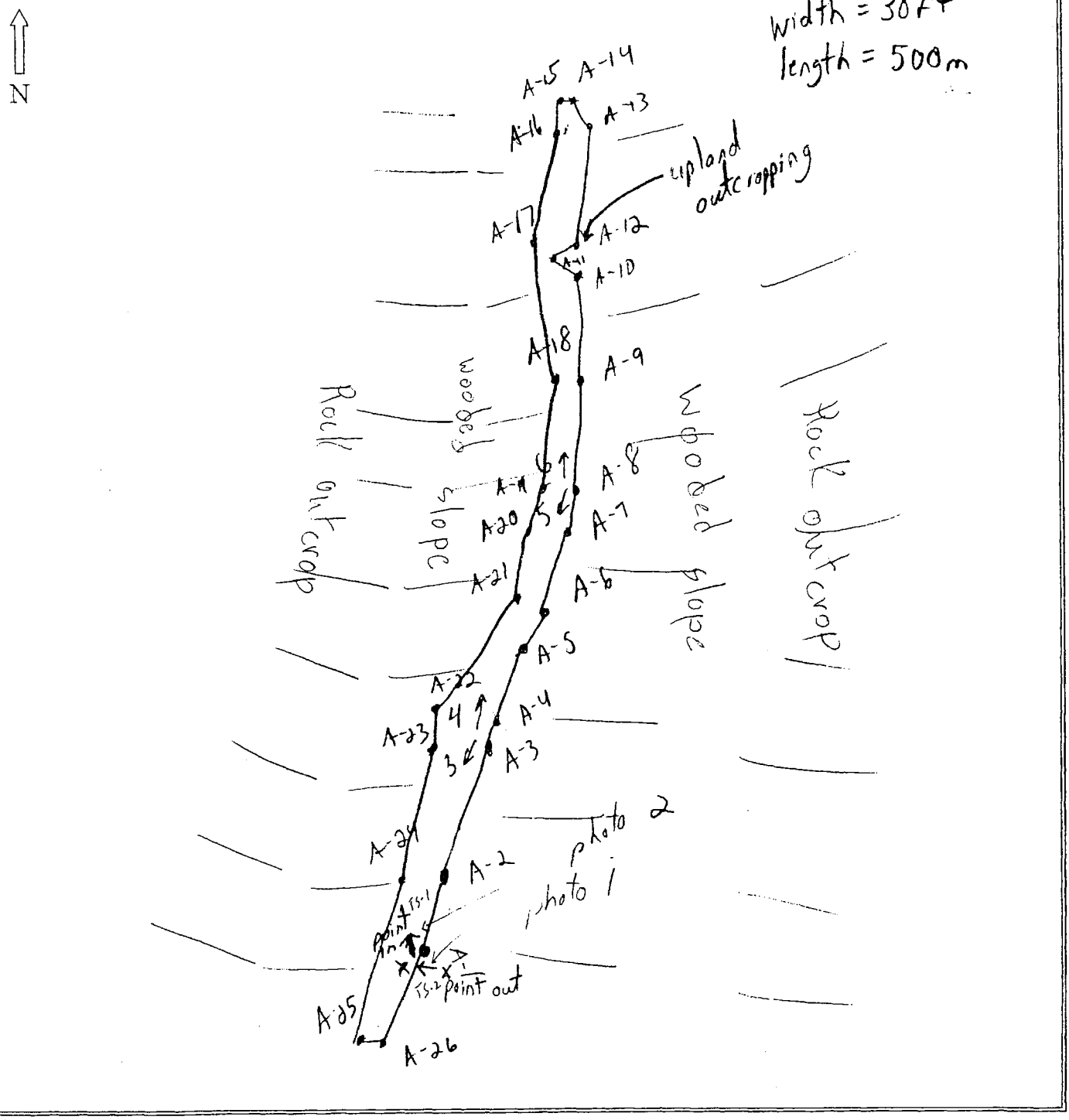
Remarks: Adandoned / inundated mine cut. The soils cousist of spoils and rock from surrounding slopes. Aquatic vegitation w/ distinct borders.

Approved by HQUSACE 3/92

Project/Site: 080-608 Apex Landfill
Wetland ID: Wetland A

Date: 5/20/08
Acre(s): 2.16

SKETCH MAP:



Notes:
1. Show approximate size and shape of wetland boundaries, adjacent drainage features (streams, ponds, etc.), photograph view, test site
2. Show approximate dimensions of major axes of wetland (i.e., length and width)

DATA FORM
ROUTINE WETLAND DETERMINATION
(1987 COE Wetlands Delineation Manual)

Project/Site: 080-608 / Apex Sanitary Landfill Applicant/Owner: Apex Environmental, LLC Investigator: Lance Opiela and Matt Lauffer	Date: 5/20/08 County: Jefferson State: Ohio
Do Normal Circumstances exist on the site? Yes (No) Is the site significantly disturbed (Atypical Situation)? (Yes) No Is the area a potential Problem Area? Yes (No) (If needed, explain on reverse.)	Community ID: herbaceous slope Transect ID: TS 2. Plot ID: outside wetland A

VEGETATION

Dominant Plant Species	Stratum	Indicator
1. Tussilago farfara	Herb	FACU
2. Ulmus rubra	Seedling	FAC
3. Rhus radicans	vine	FAC
4. Common dock	herb	UPL
5. Achillea millefolium	herb	FACU
6. Taraxacum officinale	herb	UPL
7. Xanthoxanthum odoratus	herb	FACU
8.		

Dominant Plant Species	Stratum	Indicator
9.		
10.		
11.		
12.		
13.		
14.		
15.		
16.		

Percent of Dominant Species that are OBL, FACW or FAC (excluding FAC-). 2/7 = 29%

Remarks: mwc cut slope

HYDROLOGY

___ Recorded Data (Describe in Remarks):
- ___ Stream, Lake, or Tide Gauge
- ___ Aerial Photographs
- ___ Other

___ No Recorded Data Available

Field Observations:

Depth of Surface Water: >16 (in.)

Depth to Free Water in Pit: >16 (in.)

Depth to Saturated Soil: >16 (in.)

Wetland Hydrology Indicators:

Primary Indicators:
- ___ Inundated
- ___ Saturated in Upper 12 Inches
- ___ Water Marks
- ___ Drift Lines
- ___ Sediment Deposits
- ___ Drainage Patterns in Wetlands

Secondary Indicators (2 or more required):
- ___ Oxidized Root Channels in Upper 12 Inches
- ___ Water-Stained Leaves
- ___ Local Soil Survey Data
- ___ FAC-Neutral Test
- ___ Other (Explain in Remarks)

Remarks:

SOILS

Map Unit Name (Series and Phase): Gilpin silt loam (GnC)

Drainage Class: well drained

Field Observations
Confirm Mapped Type? Yes (No)

Taxonomy (Subgroup): _____

Profile Description:

Depth (inches)	Horizon	Matrix Color (Munsell Moist)	Mottle Colors (Munsell Moist)	Mottle Abundance/ Size/Contrast	Texture, Concretions, Structure, etc.
0-16		10YR 5/4	-	-	clay loam - rocky spoils

Hydric Soil Indicators:

___ Histosol
___ Histic Epipedon
___ Sulfidic Odor
___ Aquic Moisture Regime
___ Reducing Conditions
___ Gleyed or Low-Chroma Colors
___ Concretions
___ High Organic Content in Surface Layer in Sandy Soils
___ Organic Streaking in Sandy Soils
___ Listed on Local Hydric Soils List
___ Listed on National Hydric Soils List
___ Other (Explain in Remarks)

Remarks:

WETLAND DETERMINATION

Hydrophytic Vegetation Present? Yes (No) (Circle)
Wetland Hydrology Present? Yes (No)
Hydric Soils Present? Yes (No)

Is this Samplig Point Within a Wetland? Yes (No) (Circle)

Remarks:

This is the side slope of an abandoned mine cut

Approved by HQUSACE 3/92

DATA FORM
ROUTINE WETLAND DETERMINATION
(1987 COE Wetlands Delineation Manual)

Project/Site: 080-608 / Apex Sanitary Landfill Applicant/Owner: Apex Environmental, LLC Investigator: Lance Opiela and Matt Lauffer	Date: 5-21-08 County: Jefferson State: Ohio
Do Normal Circumstances exist on the site? Yes (No) Is the site significantly disturbed (Atypical Situation)? (Yes) No Is the area a potential Problem Area? Yes (No) (If needed, explain on reverse.)	Community ID: PEM/PAB/POW2x Transect ID: TS 3 Plot ID: wetland B plot in

VEGETATION

Dominant Plant Species	Stratum	Indicator
1. Typha latifolia	Herb	OBL
2. Scirpus atrovirens	Herb	OBL
3. Nagas minor	Aqua	OBL
4.		
5.		
6.		
7.		
8.		

Dominant Plant Species	Stratum	Indicator
9.		
10.		
11.		
12.		
13.		
14.		
15.		
16.		

Percent of Dominant Species that are OBL, FACW or FAC (excluding FAC-). 3/3 = 100%

Remarks:

HYDROLOGY

___ Recorded Data (Describe in Remarks):
- ___ Stream, Lake, or Tide Gauge
- ___ Aerial Photographs
- ___ Other

___ No Recorded Data Available

Field Observations:

Depth of Surface Water:	-	(in.)
Depth to Free Water in Pit:	4	(in.)
Depth to Saturated Soil:	0	(in.)

Wetland Hydrology Indicators:
Primary Indicators:
- X Inundated
- X Saturated in Upper 12 Inches
- ___ Water Marks
- ___ Drift Lines
- ___ Sediment Deposits
- X Drainage Patterns in Wetlands

Secondary Indicators (2 or more required):
- ___ Oxidized Root Channels in Upper 12 Inches
- ___ Water-Stained Leaves
- ___ Local Soil Survey Data
- ___ FAC-Neutral Test
- ___ Other (Explain in Remarks)

Remarks:

SOILS

Map Unit Name (Series and Phase): Morristown channery silt loam (MpF) Drainage Class: well drained

Taxonomy (Subgroup): Typic Udorthents Field Observations Confirm Mapped Type? Yes (No)

Profile Description:

Depth (inches)	Horizon	Matrix Color (Munsell Moist)	Mottle Colors (Munsell Moist)	Mottle Abundance/ Size/Contrast	Texture, Concretions, Structure, etc.
0-10	A	10YR 3/1	-	-	silty clay w/ gravel spoils
10-16	B	10YR 5/8	10YR 6/8	large/many	clay/gravel rock

Hydric Soil Indicators:

- ___ Histosol
- ___ Histic Epipedon
- ___ Sulfidic Odor
- ___ Aquic Moisture Regime
- ___ Reducing Conditions
- ___ Gleyed or Low-Chroma Colors
- ___ Concretions
- ___ High Organic Content in Surface Layer in Sandy Soils
- ___ Organic Streaking in Sandy Soils
- ___ Listed on Local Hydric Soils List
- ___ Listed on National Hydric Soils List
- ___ Other (Explain in Remarks)

Remarks: mine cut gravel rock w/ clay

WETLAND DETERMINATION

Hydrophytic Vegetation Present?	(Yes) No	(Circle)
Wetland Hydrology Present?	(Yes) No	
Hydric Soils Present?	(Yes) No	
Is this Samplig Point Within a Wetland?	(Yes) No	(Circle)

Remarks:

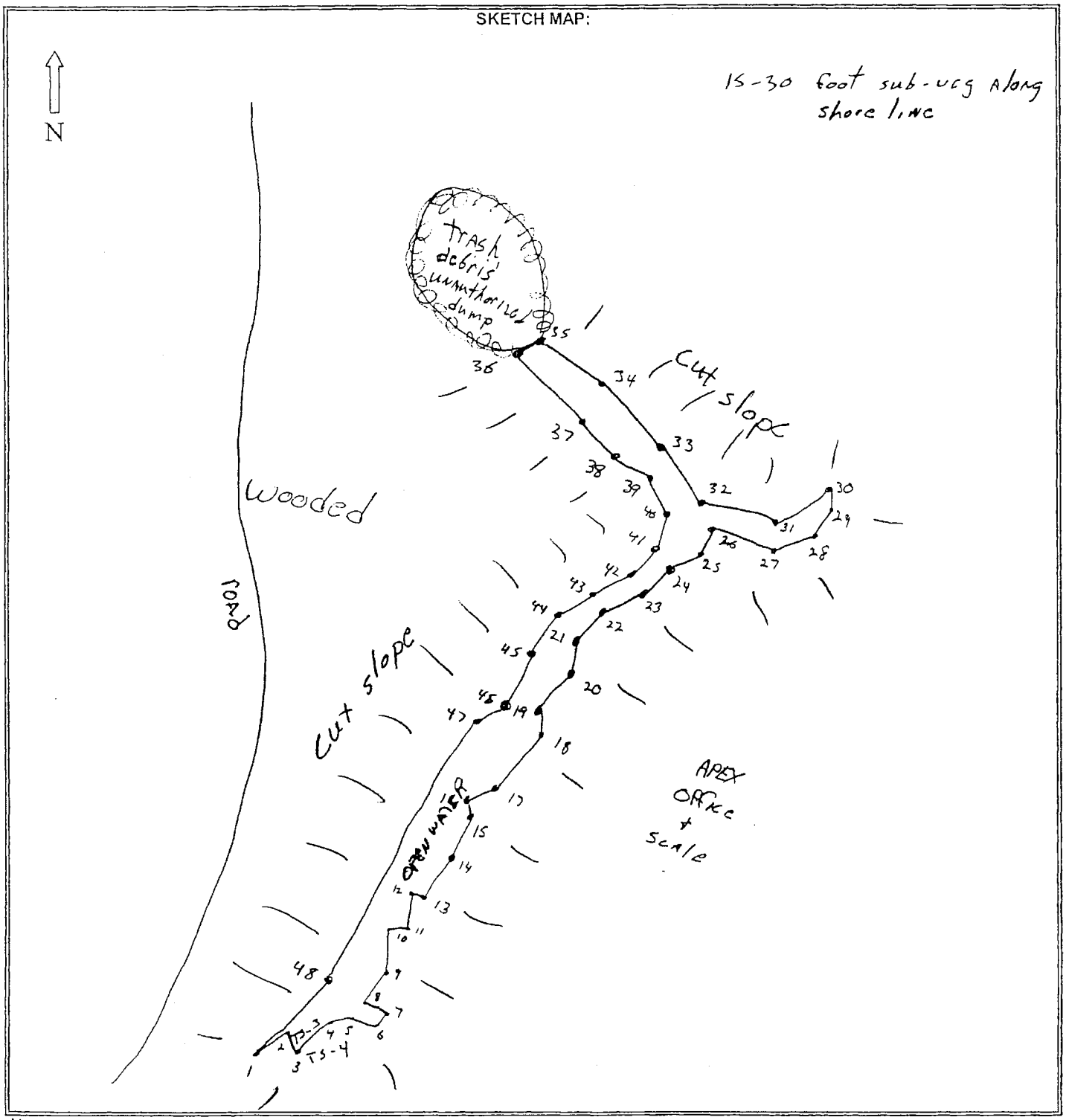
This is the emergent portion of a PUB/POW/PEM in an abandoned mine cut.

Approved by HQUSACE 3/92

Project/Site: 080-608 Apex
Wetland ID: Wetland B

Date: 5/20/08
Acre(s): 2.21

SKETCH MAP:



Notes:
1. Show approximate size and shape of wetland boundaries, adjacent drainage features (streams, ponds, etc.), photograph view, test site
2. Show approximate dimensions of major axes of wetland (i.e., length and width)

DATA FORM
ROUTINE WETLAND DETERMINATION
(1987 COE Wetlands Delineation Manual)

Project/Site: 080-608 / Apex Sanitary Landfill Applicant/Owner: Apex Environmental, LLC Investigator: Lance Opiela and Matt Lauffer	Date: 5-21-08 County: Jefferson State: Ohio
Do Normal Circumstances exist on the site? Yes (No) Is the site significantly disturbed (Atypical Situation)? (Yes) No Is the area a potential Problem Area? Yes (No) (If needed, explain on reverse.)	Community ID: herbaceous Transect ID: TS 4 Plot ID: Wetland B out

VEGETATION

Dominant Plant Species	Stratum	Indicator
1. Lonicera maackii	shrub	UPL
2. Fleangus angustifolium	shrub	FACW
3. Ulmus rubra	shrub	FAC
4. Festuca rubra	herb	FACW
5. Daucus Carota	herb	UPL
6. Solidago canadensis	herb	FACU
7. Potentilla simplex	herb	FACU
8.		
9.		
10.		
11.		
12.		
13.		
14.		
15.		
16.		

Percent of Dominant Species that are OBL, FACW or FAC (excluding FAC-). 1/7 = 14%

Remarks:

HYDROLOGY

___ Recorded Data (Describe in Remarks):
- ___ Stream, Lake, or Tide Gauge
- ___ Aerial Photographs
- ___ Other

___ No Recorded Data Available

Field Observations:

Depth of Surface Water:	0 (in.)
Depth to Free Water in Pit:	>16 (in.)
Depth to Saturated Soil:	>16 (in.)

Wetland Hydrology Indicators:

Primary Indicators:
- ___ Inundated
- ___ Saturated in Upper 12 Inches
- ___ Water Marks
- ___ Drift Lines
- ___ Sediment Deposits
- ___ Drainage Patterns in Wetlands

Secondary Indicators (2 or more required):
- ___ Oxidized Root Channels in Upper 12 Inches
- ___ Water-Stained Leaves
- ___ Local Soil Survey Data
- ___ FAC-Neutral Test
- ___ Other (Explain in Remarks)

Remarks:

SOILS

Map Unit Name (Series and Phase): Morristown channery silt loam (MpF)

Drainage Class: well drained

Taxonomy (Subgroup): Typic Udorthents

Field Observations Confirm Mapped Type? Yes (No)

Profile Description:

Depth (inches)	Horizon	Matrix Color (Munsell Moist)	Mottle Colors (Munsell Moist)	Mottle Abundance/ Size/Contrast	Texture, Concretions, Structure, etc.
0-16		10YR 5/4	-	-	silty loam - gravel spoils

Hydric Soil Indicators:

___ Histosol
___ Histic Epipedon
___ Sulfidic Odor
___ Aquic Moisture Regime
___ Reducing Conditions
___ Gleyed or Low-Chroma Colors
___ Concretions
___ High Organic Content in Surface Layer in Sandy Soils
___ Organic Streaking in Sandy Soils
___ Listed on Local Hydric Soils List
___ Listed on National Hydric Soils List
___ Other (Explain in Remarks)

Remarks:

WETLAND DETERMINATION

Hydrophytic Vegetation Present? Yes (No) (Circle)
Wetland Hydrology Present? Yes (No)
Hydric Soils Present? Yes (No)

Is this Samplig Point Within a Wetland? (Circle) Yes (No)

Remarks:

Approved by HQUSACE 3/92

DATA FORM
ROUTINE WETLAND DETERMINATION
(1987 COE Wetlands Delineation Manual)

Project/Site: 080-608 / Apex Sanitary Landfill Applicant/Owner: Apex Environmental, LLC. Investigator: Lance Opiela and Matt Lauffer	Date: 5-22-08 County: Jefferson State: Ohio
Do Normal Circumstances exist on the site? Yes (No) Is the site significantly disturbed (Atypical Situation)? (Yes) No Is the area a potential Problem Area? Yes (No) (If needed, explain on reverse.)	Community ID: POW/PSS1/PA EV x Transect ID: TS 5 Plot ID: wetland C in

VEGETATION

Dominant Plant Species	Stratum	Indicator
1. Salix nigra	Shrub	FACW+
2. Lemna minor	Aquatic	OBL
3. Glyceria striata	herb	OBL
4.		
5.		
6.		
7.		
8.		

Dominant Plant Species	Stratum	Indicator
9.		
10.		
11.		
12.		
13.		
14.		
15.		
16.		

Percent of Dominant Species that are OBL, FACW or FAC (excluding FAC-). 100

Remarks:

HYDROLOGY

___ Recorded Data (Describe in Remarks):
- ___ Stream, Lake, or Tide Gauge
- ___ Aerial Photographs
- ___ Other

___ No Recorded Data Available

Field Observations:

Depth of Surface Water:	4	(in.)
Depth to Free Water in Pit:	0	(in.)
Depth to Saturated Soil:	0	(in.)

Wetland Hydrology Indicators:

Primary Indicators:
- X Inundated
- X Saturated in Upper 12 Inches
- ___ Water Marks
- ___ Drift Lines
- ___ Sediment Deposits
- X Drainage Patterns in Wetlands

Secondary Indicators (2 or more required):
- ___ Oxidized Root Channels in Upper 12 Inches
- X Water-Stained Leaves
- ___ Local Soil Survey Data
- X FAC-Neutral Test
- ___ Other (Explain in Remarks)

Remarks:
Sampled edge of open water

SOILS

Map Unit Name (Series and Phase): Morristown shaly silty clay loam (MrF)
Drainage Class: well drained
Taxonomy (Subgroup): Typic Udorthents
Field Observations Confirm Mapped Type? Yes (No)

Profile Description:

Depth (inches)	Horizon	Matrix Color (Munsell Moist)	Mottle Colors (Munsell Moist)	Mottle Abundance/ Size/Contrast	Texture, Concretions, Structure, etc.
0-8	A	2.5Y 6/1	2.5Y 6/3	F/F	clay
8	rock	refusal			

Hydric Soil Indicators:

- ___ Histosol
- ___ Histic Epipedon
- ___ Sulfidic Odor
- ___ Aquic Moisture Regime
- ___ Reducing Conditions
- X Gleyed or Low-Chroma Colors
- ___ Concretions
- ___ High Organic Content in Surface Layer in Sandy Soils
- ___ Organic Streaking in Sandy Soils
- ___ Listed on Local Hydric Soils List
- ___ Listed on National Hydric Soils List
- ___ Other (Explain in Remarks)

Remarks:

WETLAND DETERMINATION

Hydrophytic Vegetation Present?	(Yes) No (Circle)	(Circle)
Wetland Hydrology Present?	(Yes) No	Is this Samplig Point Within a Wetland? (Yes) No
Hydric Soils Present?	(Yes) No	

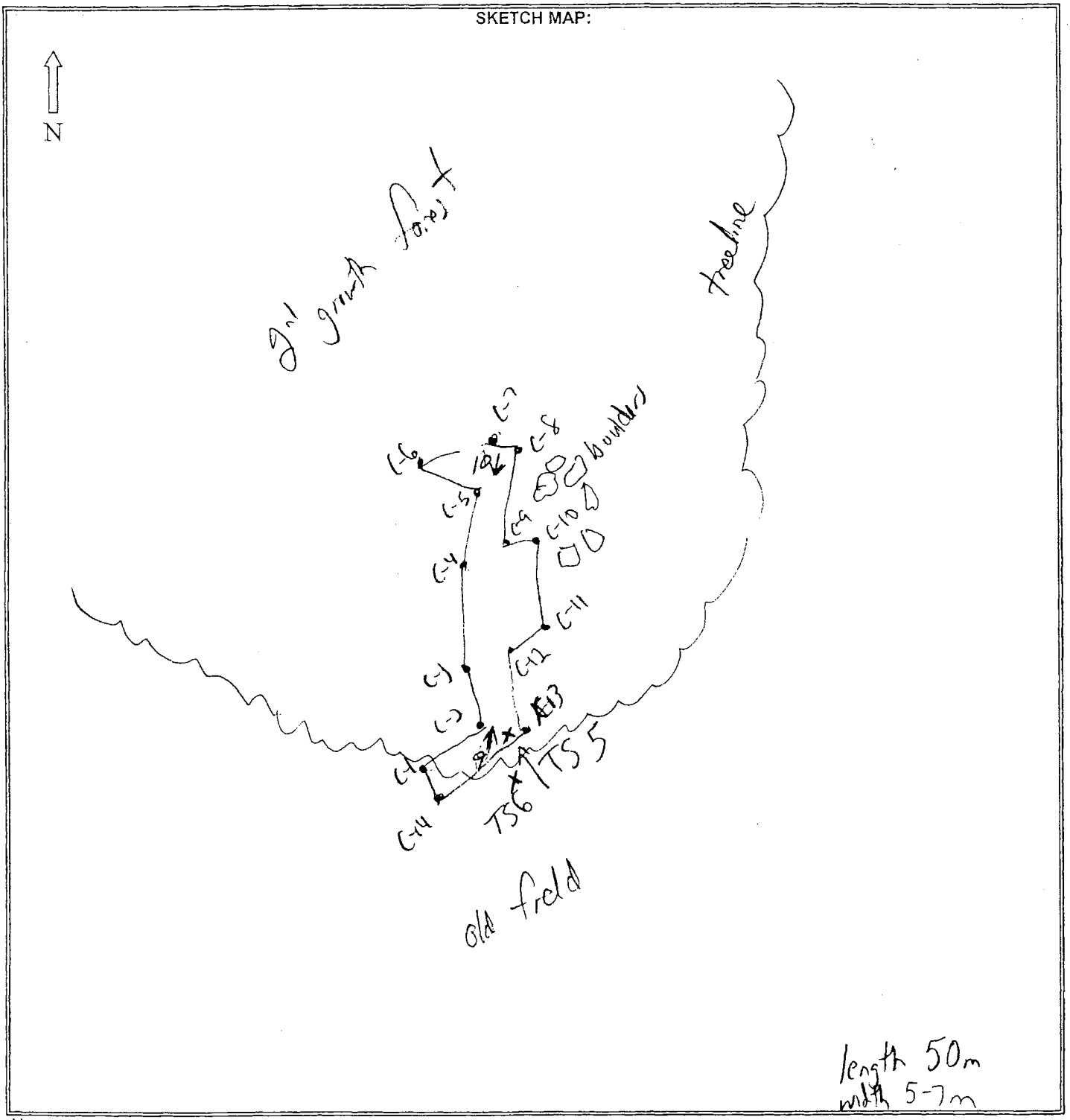
Remarks: mine cut

Approved by HQUSACE 3/92

Project/Site: 080-6008 Apex
Wetland ID: wetland C

Date: 5/22/08
Acre(s): 0.05

SKETCH MAP:



Notes:
1. Show approximate size and shape of wetland boundaries, adjacent drainage features (streams, ponds, etc.), photograph view, test site
2. Show approximate dimensions of major axes of wetland (i.e., length and width)

DATA FORM
ROUTINE WETLAND DETERMINATION
(1987 COE Wetlands Delineation Manual)

Project/Site: 080-608 / Apex Sanitary Landfill Applicant/Owner: Apex Environmental, LLC Investigator: Lance Opiela and Matt Lauffer	Date: 5-22-08 County: Jefferson State: Ohio
Do Normal Circumstances exist on the site? Yes (No) Is the site significantly disturbed (Atypical Situation)? (Yes) No Is the area a potential Problem Area? Yes (No) (If needed, explain on reverse.)	Community ID: herb Transect ID: TS 6 Plot ID: wetland C out

VEGETATION

Dominant Plant Species	Stratum	Indicator
1. Festuca rubra	herb	FACU
2. Tussilago farfara	herb	FACU
3. Common dock	herb	
4. Galium aparine	herb	
5. Daucus carota	herb	UPL
6.		
7.		
8.		
9.		
10.		
11.		
12.		
13.		
14.		
15.		
16.		

Percent of Dominant Species that are OBL, FACW or FAC (excluding FAC-). 0/5 = 0

Remarks:

HYDROLOGY

___ Recorded Data (Describe in Remarks):
- ___ Stream, Lake, or Tide Gauge
- ___ Aerial Photographs
- ___ Other

___ No Recorded Data Available

Field Observations:

Depth of Surface Water:	0	(in.)
Depth to Free Water in Pit:	>16	(in.)
Depth to Saturated Soil:	>16	(in.)

Wetland Hydrology Indicators:

Primary Indicators:
- ___ Inundated
- ___ Saturated in Upper 12 Inches
- ___ Water Marks
- ___ Drift Lines
- ___ Sediment Deposits
- ___ Drainage Patterns in Wetlands

Secondary Indicators (2 or more required):
- ___ Oxidized Root Channels in Upper 12 Inches
- ___ Water-Stained Leaves
- ___ Local Soil Survey Data
- ___ FAC-Neutral Test
- ___ Other (Explain in Remarks)

Remarks:

SOILS

Map Unit Name (Series and Phase): Morristown shaly silty clay loam (MrF)

Drainage Class: well drained

Field Observations Confirm Mapped Type? Yes (No)

Taxonomy (Subgroup): Typic Udorthents

Profile Description:

Depth (inches)	Horizon	Matrix Color (Munsell Moist)	Mottle Colors (Munsell Moist)	Mottle Abundance/ Size/Contrast	Texture, Concretions, Structure, etc.
0-2	A	2.5Y 3/2	-	-	loam clay
2-16	B	2.5Y 4/3	-	-	gravelly loam clay

Hydric Soil Indicators:

- ___ Histosol
- ___ Histic Epipedon
- ___ Sulfidic Odor
- ___ Aquic Moisture Regime
- ___ Reducing Conditions
- ___ Gleyed or Low-Chroma Colors
- ___ Concretions
- ___ High Organic Content in Surface Layer in Sandy Soils
- ___ Organic Streaking in Sandy Soils
- ___ Listed on Local Hydric Soils List
- ___ Listed on National Hydric Soils List
- ___ Other (Explain in Remarks)

Remarks:

soils consist of fill.

WETLAND DETERMINATION

Hydrophytic Vegetation Present? Yes (No) (Circle)

Wetland Hydrology Present? Yes (No)

Hydric Soils Present? Yes (No)

Is this Samplig Point Within a Wetland? Yes (No) (Circle)

Remarks:

Approved by HQUSACE 3/92

DATA FORM
ROUTINE WETLAND DETERMINATION
(1987 COE Wetlands Delineation Manual)

Project/Site: 080-608 / Apex Sanitary Landfill Applicant/Owner: Apex Environmental, LLC Investigator: Lance Opiela and Matt Lauffer	Date: 5-23-08 County: Jefferson State: Ohio
Do Normal Circumstances exist on the site? Yes (No) Is the site significantly disturbed (Atypical Situation)? (Yes) No Is the area a potential Problem Area? Yes (No) (If needed, explain on reverse.)	Community ID: POW/PAB/PSS Transect ID: TS 1 Plot ID: Wetland D in

VEGETATION

Dominant Plant Species	Stratum	Indicator
1. Lemna minor	Floating	OBL
2. Impatiens capensis	Herb	FACW
3. Glyceria striata	Herb	OBL
4. Bidens frondosa	Herb	FACW
5.		
6.		
7.		
8.		

Dominant Plant Species	Stratum	Indicator
9.		
10.		
11.		
12.		
13.		
14.		
15.		
16.		

Percent of Dominant Species that are OBL, FACW or FAC (excluding FAC-). 4/4=100%

Remarks:

Sample taken at PEM/POW boundary

HYDROLOGY

___ Recorded Data (Describe in Remarks):
- ___ Stream, Lake, or Tide Gauge
- ___ Aerial Photographs
- ___ Other

___ No Recorded Data Available

Field Observations:

Depth of Surface Water:	2 (in.)
Depth to Free Water in Pit:	0 (in.)
Depth to Saturated Soil:	0 (in.)

Wetland Hydrology Indicators:

Primary Indicators:
- X Inundated
- X Saturated in Upper 12 Inches
- ___ Water Marks
- ___ Drift Lines
- ___ Sediment Deposits
- X Drainage Patterns in Wetlands

Secondary Indicators (2 or more required):
- ___ Oxidized Root Channels in Upper 12 Inches
- X Water-Stained Leaves
- ___ Local Soil Survey Data
- X FAC-Neutral Test
- ___ Other (Explain in Remarks)

Remarks:

SOILS

Map Unit Name (Series and Phase): Morristown channery silt loam (MpF)

Drainage Class: well drained

Taxonomy (Subgroup): Typic Udorthents

Field Observations Confirm Mapped Type? Yes (No)

Profile Description:

Depth (inches)	Horizon	Matrix Color (Munsell Moist)	Mottle Colors (Munsell Moist)	Mottle Abundance/ Size/Contrast	Texture, Concretions, Structure, etc.
0-16	A	2.5Y 4/1	10YR 4/4	F/D	silt loam

Hydric Soil Indicators:

- ___ Histosol
- ___ Histic Epipedon
- ___ Sulfidic Odor
- ___ Aquic Moisture Regime
- X Reducing Conditions
- X Gleyed or Low-Chroma Colors
- ___ Concretions
- ___ High Organic Content in Surface Layer in Sandy Soils
- ___ Organic Streaking in Sandy Soils
- ___ Listed on Local Hydric Soils List
- ___ Listed on National Hydric Soils List
- ___ Other (Explain in Remarks)

Remarks:

WETLAND DETERMINATION

Hydrophytic Vegetation Present?	(Yes) No (Circle)	(Circle)
Wetland Hydrology Present?	(Yes) No	Is this Samplig Point Within a Wetland? (Yes) No
Hydric Soils Present?	(Yes) No	

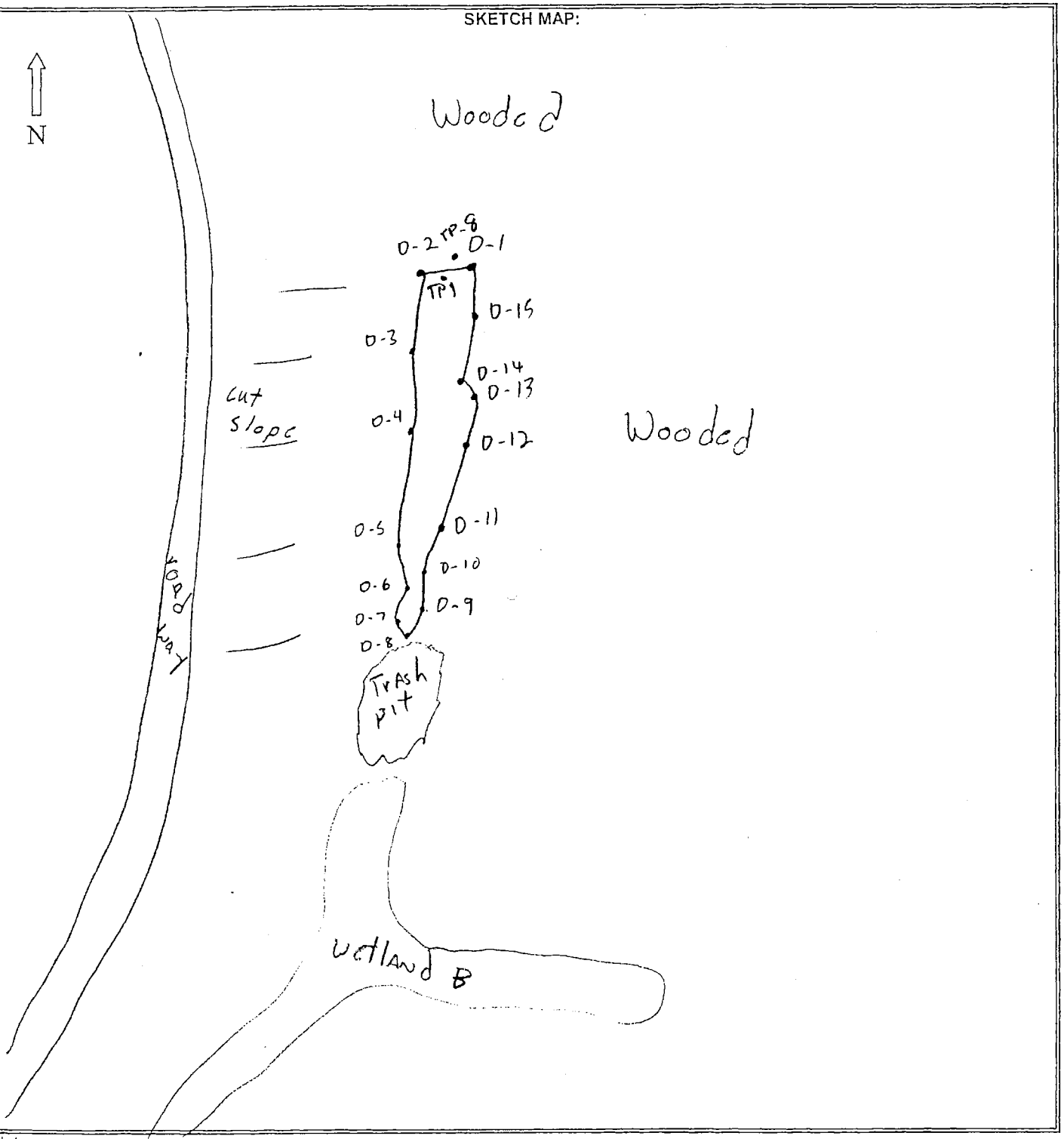
Remarks: Minc cut

Approved by HQUSACE 3/92

Project/Site: 080-608 Apex
Wetland ID: Wetland D

Date: 5-23-08
Acre(s): 0.57

SKETCH MAP:



Notes:
1. Show approximate size and shape of wetland boundaries, adjacent drainage features (streams, ponds, etc.), photograph view, test site
2. Show approximate dimensions of major axes of wetland (i.e., length and width)

DATA FORM
ROUTINE WETLAND DETERMINATION
(1987 COE Wetlands Delineation Manual)

Project/Site: 080-608 / Apex Sanitary Landfill Applicant/Owner: Apex Environmental, LLC Investigator: Lance Opiela and Matt Lauffer	Date: 5-23-08 County: Jefferson State: Ohio
Do Normal Circumstances exist on the site? Yes (No) Is the site significantly disturbed (Atypical Situation)? (Yes) No Is the area a potential Problem Area? Yes (No) (If needed, explain on reverse.)	Community ID: 2nd growth forest Transect ID: TS 8 Plot ID: wetland 0 out

VEGETATION

Dominant Plant Species	Stratum	Indicator
1. Ulmus rubra	tree	FAC+
2. Rosa multiflora	shrub	FACU
3. Fraxinus americana	tree	FACU
4. Juglans nigra	tree	FACU
5. Helianthus matrionalis	herb	FACU
6. Urtica dioica	herb	FACU
7. Dactylis glomerata	herb	FACU
8. Lactuca federacea	herb	FACU
9. Parthenocissus quinquefolia	WV	FACU
10.		
11.		
12.		
13.		
14.		
15.		
16.		

Percent of Dominant Species that are OBL, FACW or FAC (excluding FAC-). 1/9 = 11%

Remarks:

HYDROLOGY

___ Recorded Data (Describe in Remarks):
- ___ Stream, Lake, or Tide Gauge
- ___ Aerial Photographs
- ___ Other

___ No Recorded Data Available

Field Observations:

Depth of Surface Water:	0	(in.)
Depth to Free Water in Pit:	>16	(in.)
Depth to Saturated Soil:	>16	(in.)

Wetland Hydrology Indicators:

Primary Indicators:
- ___ Inundated
- ___ Saturated in Upper 12 Inches
- ___ Water Marks
- ___ Drift Lines
- ___ Sediment Deposits
- ___ Drainage Patterns in Wetlands

Secondary Indicators (2 or more required):
- ___ Oxidized Root Channels in Upper 12 Inches
- ___ Water-Stained Leaves
- ___ Local Soil Survey Data
- ___ FAC-Neutral Test
- ___ Other (Explain in Remarks)

Remarks:

SOILS

Map Unit Name (Series and Phase): Morristown channery silt loam (MpF)
Drainage Class: well drained
Field Observations
Taxonomy (Subgroup): Typic Udorthents
Confirm Mapped Type? Yes (No)

Profile Description:

Depth (inches)	Horizon	Matrix Color (Munsell Moist)	Mottle Colors (Munsell Moist)	Mottle Abundance/ Size/Contrast	Texture, Concretions, Structure, etc.
0-12	A	10YR 4/1	-	-	loam
12-16	B	10YR 5/6	10YR 4/6	C/D	silty loam
			5GY 3/1	C/D	

Hydric Soil Indicators:

- ___ Histosol
- ___ Histic Epipedon
- ___ Sulfidic Odor
- ___ Aquic Moisture Regime
- ___ Reducing Conditions
- X Gleyed or Low-Chroma Colors
- ___ Concretions
- ___ High Organic Content in Surface Layer in Sandy Soils
- ___ Organic Streaking in Sandy Soils
- ___ Listed on Local Hydric Soils List
- ___ Listed on National Hydric Soils List
- ___ Other (Explain in Remarks)

Remarks:
The B layer consist of silt full the 5GY 3/1 is bits of coal spots

WETLAND DETERMINATION

Hydrophytic Vegetation Present?	Yes (No) (Circle)	(Circle)
Wetland Hydrology Present?	Yes (No)	Is this Samplig Point Within a Wetland? Yes (No)
Hydric Soils Present?	(Yes) No	

Remarks:

Approved by HQUSACE 3/92

DATA FORM
ROUTINE WETLAND DETERMINATION
(1987 COE Wetlands Delineation Manual)

Project/Site: 080-608 / Apex Sanitary Landfill Applicant/Owner: Apex Environmental, LLC Investigator: Lance Opiela and Matt Lauffer	Date: 5-27-08 County: Jefferson State: Ohio
Do Normal Circumstances exist on the site? Yes (No) Is the site significantly disturbed (Atypical Situation)? (Yes) No Is the area a potential Problem Area? Yes (No) (If needed, explain on reverse.)	Community ID: PEMB Transect ID: TS 9 Plot ID: wet E in

VEGETATION

Dominant Plant Species	Stratum	Indicator
1. Cyperus strigosa	Herb	OBL
2. Typha angustifolia	herb	OBL
3. Juncus tenuis	herb	FAC-
4. Carex unlpinoidea	herb	OBL
5.		
6.		
7.		
8.		

Dominant Plant Species	Stratum	Indicator
9.		
10.		
11.		
12.		
13.		
14.		
15.		
16.		

Percent of Dominant Species that are OBL, FACW or FAC (excluding FAC-). 3/4 75%

Remarks:

HYDROLOGY

___ Recorded Data (Describe in Remarks):
___ Stream, Lake, or Tide Gauge
___ Aerial Photographs
___ Other
___ No Recorded Data Available

Field Observations:

Depth of Surface Water: 1/2 (in.)

Depth to Free Water in Pit: 0 (in.)

Depth to Saturated Soil: 0 (in.)

Wetland Hydrology Indicators:
Primary Indicators:
X Inundated
X Saturated in Upper 12 Inches
___ Water Marks
___ Drift Lines
___ Sediment Deposits
___ Drainage Patterns in Wetlands
Secondary Indicators (2 or more required):
X Oxidized Root Channels in Upper 12 Inches
___ Water-Stained Leaves
___ Local Soil Survey Data
___ FAC-Neutral Test
___ Other (Explain in Remarks)

Remarks:

SOILS

Map Unit Name (Series and Phase): Gilpin silt loam (6NC)

Drainage Class: well drained

Taxonomy (Subgroup): Typic Hapludults

Field Observations Confirm Mapped Type? Yes (No)

Profile Description:

Depth (inches)	Horizon	Matrix Color (Munsell Moist)	Mottle Colors (Munsell Moist)	Mottle Abundance/ Size/Contrast	Texture, Concretions, Structure, etc.
0-16	A	2.5Y 5/1	2.5Y 5/5	C/D	[illegible]

Hydric Soil Indicators:

- ___ Histosol
- ___ Histic Epipedon
- X Sulfidic Odor
- ___ Aquic Moisture Regime
- ___ Reducing Conditions
- X Gleyed or Low-Chroma Colors
- ___ Concretions
- ___ High Organic Content in Surface Layer in Sandy Soils
- ___ Organic Streaking in Sandy Soils
- ___ Listed on Local Hydric Soils List
- ___ Listed on National Hydric Soils List
- ___ Other (Explain in Remarks)

Remarks:

WETLAND DETERMINATION

Hydrophytic Vegetation Present? (Yes) No (Circle)

Wetland Hydrology Present? (Yes) No

Hydric Soils Present? (Yes) No

(Circle)

Is this Samplig Point Within a Wetland? (Yes) No

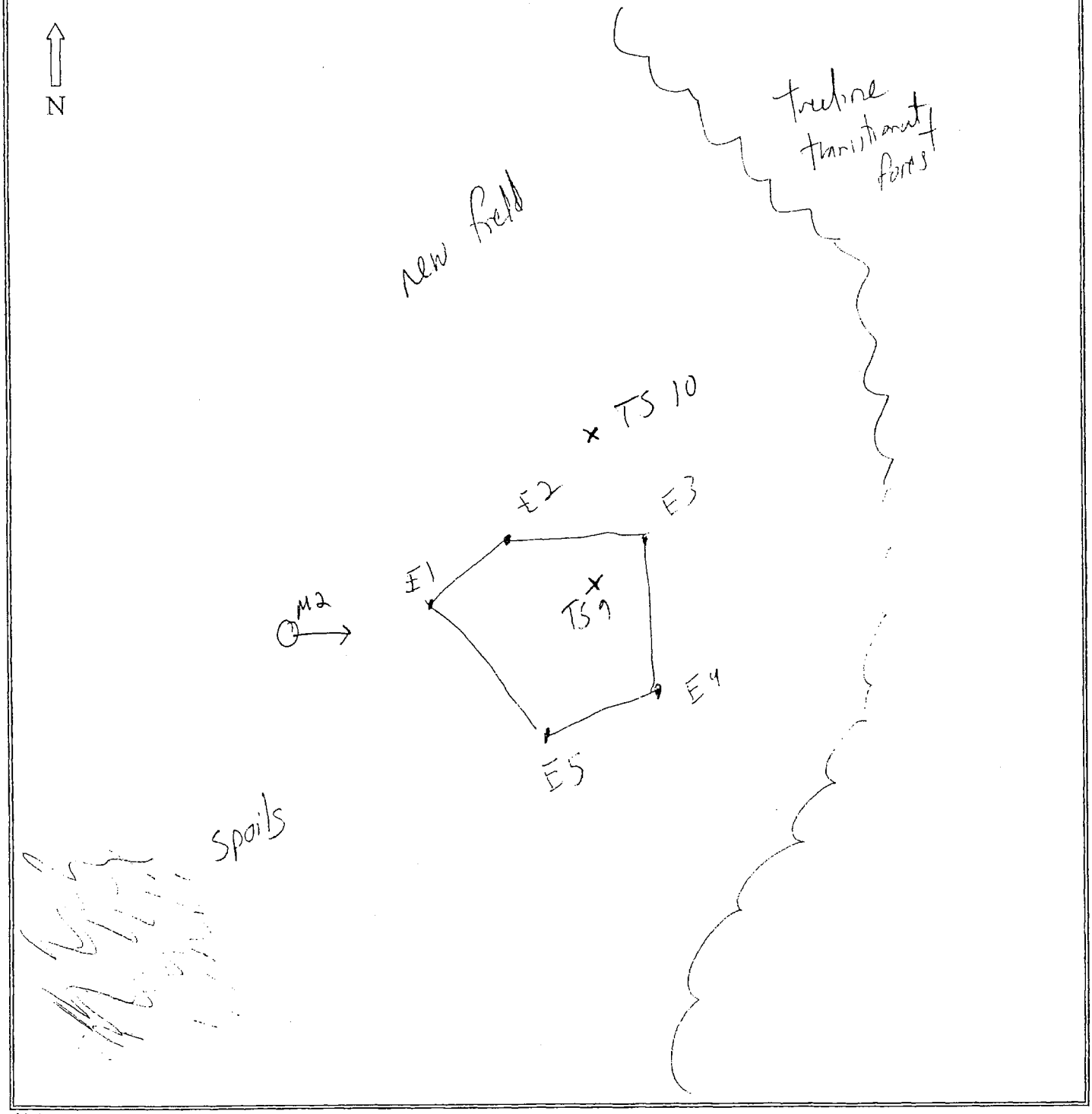
Remarks:

Approved by HQUSACE 3/92

Project/Site: 080-608 Apex
Wetland ID: Wetland E

Date: 5-27-08
Acre(s): 0.01

SKETCH MAP:



Notes:
1. Show approximate size and shape of wetland boundaries, adjacent drainage features (streams, ponds, etc.), photograph view, test site
2. Show approximate dimensions of major axes of wetland (i.e., length and width)

DATA FORM
ROUTINE WETLAND DETERMINATION
(1987 COE Wetlands Delineation Manual)

Project/Site: 080-608 / Apex Sanitary Landfill Applicant/Owner: Apex Environmental, LLC Investigator: Lance Opiela and Matt Lauffer	Date: 5-27-08 County: Jefferson State: Ohio
Do Normal Circumstances exist on the site? (Yes) No Is the site significantly disturbed (Atypical Situation)? Yes (No) Is the area a potential Problem Area? Yes (No) (If needed, explain on reverse.)	Community ID: herb Transect ID: TS1D Plot ID: wetland E out

VEGETATION

Dominant Plant Species	Stratum	Indicator	Dominant Plant Species	Stratum	Indicator
1. Festuca rubra	herb	FACU	9.		
2. Rhus radicans	herb	FAC	10.		
3. Solidago canadensis	herb	FACU	11.		
4. Potentilla simplex	herb	FACU	12.		
5. Arctium incarnata	herb	UPL	13.		
6. purple clover	herb		14.		
7. Plantago major	herb	FACU	15.		
8. Achillea millefolium	herb	FACU	16.		

Percent of Dominant Species that are OBL, FACW or FAC (excluding FAC-). 1/8 = 13%

Remarks:

HYDROLOGY

___ Recorded Data (Describe in Remarks):
- ___ Stream, Lake, or Tide Gauge
- ___ Aerial Photographs
- ___ Other

___ No Recorded Data Available

Field Observations:

Depth of Surface Water:	0 (in.)
Depth to Free Water in Pit:	7/6 (in.)
Depth to Saturated Soil:	7/6 (in.)

Wetland Hydrology Indicators:

Primary Indicators:
- ___ Inundated
- ___ Saturated in Upper 12 Inches
- ___ Water Marks
- ___ Drift Lines
- ___ Sediment Deposits
- ___ Drainage Patterns in Wetlands

Secondary Indicators (2 or more required):
- ___ Oxidized Root Channels in Upper 12 Inches
- ___ Water-Stained Leaves
- ___ Local Soil Survey Data
- ___ FAC-Neutral Test
- ___ Other (Explain in Remarks)

Remarks:

SOILS

Map Unit Name (Series and Phase): Gilpin silt loam (GnC)
Taxonomy (Subgroup): Typic Hapludults
Drainage Class: well drained
Field Observations Confirm Mapped Type? Yes (No)

Profile Description:

Depth (inches)	Horizon	Matrix Color (Munsell Moist)	Mottle Colors (Munsell Moist)	Mottle Abundance/ Size/Contrast	Texture, Concretions, Structure, etc.
0-4	A	5Y 3/2	—	—	silt loam
4-16	B	5Y 5/3	—	—	silt loam clay

Hydric Soil Indicators:

___ Histosol
___ Histic Epipedon
___ Sulfidic Odor
___ Aquic Moisture Regime
___ Reducing Conditions
___ Gleyed or Low-Chroma Colors
___ Concretions
___ High Organic Content in Surface Layer in Sandy Soils
___ Organic Streaking in Sandy Soils
___ Listed on Local Hydric Soils List
___ Listed on National Hydric Soils List
___ Other (Explain in Remarks)

Remarks:

WETLAND DETERMINATION

Hydrophytic Vegetation Present? Yes (No) (Circle)
Wetland Hydrology Present? Yes (No)
Hydric Soils Present? Yes (No)

(Circle)
Is this Samplig Point Within a Wetland? Yes (No)

Remarks:

Approved by HQUSACE 3/92

DATA FORM
ROUTINE WETLAND DETERMINATION
(1987 COE Wetlands Delineation Manual)

Project/Site: 080-608 / Apex Sanitary Landfill Applicant/Owner: Apex Environmental, LLC Investigator: Lance Opiela and Matt Lauffer	Date: 5-27-08 County: Jefferson State: Ohio
Do Normal Circumstances exist on the site? (Yes) No Is the site significantly disturbed (Atypical Situation)? Yes (No) Is the area a potential Problem Area? Yes (No) (If needed, explain on reverse.)	Community ID: PEM/PSSB Transect ID: TS11 Plot ID: Wetland F,n

VEGETATION

Dominant Plant Species	Stratum	Indicator
1. Typha angustifolia	Herb	OBL
2. Salix nigra	Shrub	FACW
3. Equisetum arvense	Herb	FAC
4.		
5.		
6.		
7.		
8.		

Dominant Plant Species	Stratum	Indicator
9.		
10.		
11.		
12.		
13.		
14.		
15.		
16.		

Percent of Dominant Species that are OBL, FACW or FAC (excluding FAC-). 3/3 100

Remarks:

HYDROLOGY

___ Recorded Data (Describe in Remarks):
- ___ Stream, Lake, or Tide Gauge
- ___ Aerial Photographs
- ___ Other

___ No Recorded Data Available

Field Observations:

Depth of Surface Water: 0 (in.)

Depth to Free Water in Pit: 5 (in.)

Depth to Saturated Soil: 0 (in.)

Wetland Hydrology Indicators:

Primary Indicators:
- ___ Inundated
- X Saturated in Upper 12 Inches
- ___ Water Marks
- ___ Drift Lines
- ___ Sediment Deposits
- X Drainage Patterns in Wetlands

Secondary Indicators (2 or more required):
- ___ Oxidized Root Channels in Upper 12 Inches
- ___ Water-Stained Leaves
- ___ Local Soil Survey Data
- ___ FAC-Neutral Test
- ___ Other (Explain in Remarks)

Remarks:

SOILS

Map Unit Name (Series and Phase): Morristown channery silt loam (MpF)

Drainage Class: well drained

Taxonomy (Subgroup): Typic Udorthents

Field Observations
Confirm Mapped Type? Yes (No)

Profile Description:

Depth (inches)	Horizon	Matrix Color (Munsell Moist)	Mottle Colors (Munsell Moist)	Mottle Abundance/ Size/Contrast	Texture, Concretions, Structure, etc.
0-6	A	2.5Y 6/1	2.5Y [illegible]	F/L	silty clay

Hydric Soil Indicators:

- ___ Histosol
- ___ Histic Epipedon
- X Sulfidic Odor
- ___ Aquic Moisture Regime
- ___ Reducing Conditions
- X Gleyed or Low-Chroma Colors
- ___ Concretions
- ___ High Organic Content in Surface Layer in Sandy Soils
- ___ Organic Streaking in Sandy Soils
- ___ Listed on Local Hydric Soils List
- ___ Listed on National Hydric Soils List
- ___ Other (Explain in Remarks)

Remarks:

WETLAND DETERMINATION

Hydrophytic Vegetation Present?	(Yes) No (Circle)	(Circle)
Wetland Hydrology Present?	(Yes) No	Is this Samplig Point Within a Wetland? (Yes) No
Hydric Soils Present?	(Yes) No	

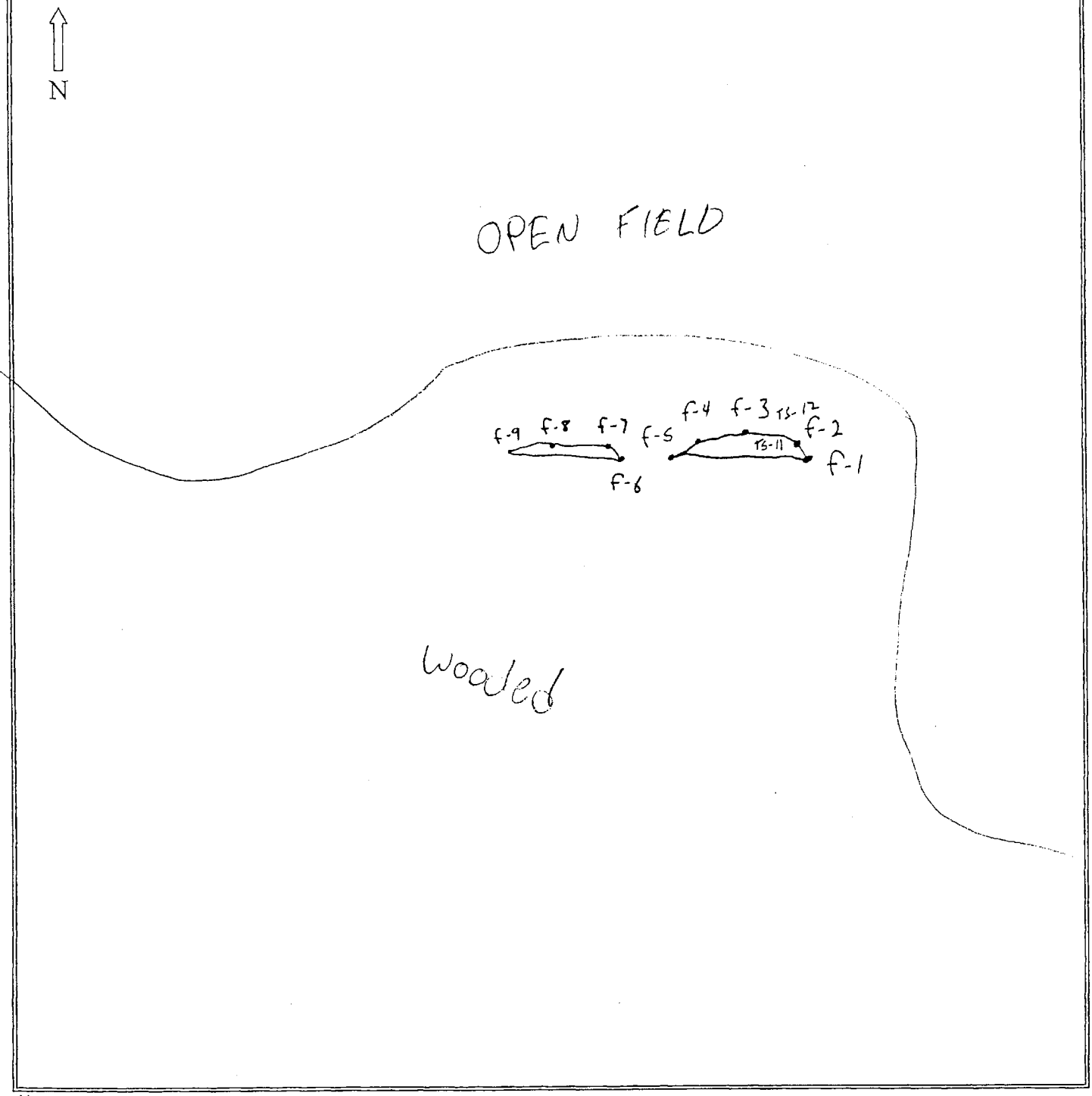
Remarks:

Approved by HQUSACE 3/92

Project/Site: 080-608 Apex
Wetland ID: Wetland F

Date: 5-27-08
Acre(s): 0.04

SKETCH MAP:



Notes:
1. Show approximate size and shape of wetland boundaries, adjacent drainage features (streams, ponds, etc.), photograph view, test site
2. Show approximate dimensions of major axes of wetland (i.e., length and width)

DATA FORM
ROUTINE WETLAND DETERMINATION
(1987 COE Wetlands Delineation Manual)

Project/Site: 080-608 / Apex Sanitary Landfill Applicant/Owner: Apex Environmental, LLC Investigator: Lance Opiela and Matt Lauffer	Date: 5-27-08 County: Jefferson State: Ohio
Do Normal Circumstances exist on the site? Yes (No) Is the site significantly disturbed (Atypical Situation)? (Yes) No Is the area a potential Problem Area? Yes (No) (If needed, explain on reverse.)	Community ID: Herb Transect ID: T-B Plot ID: Wetland Four

VEGETATION

Dominant Plant Species	Stratum	Indicator
1. Yellow clover	herb	
2. Achillea millefolium	herb	PACU
3. Solidago canadensis	herb	PACU
4. Dark pod	herb	
5. Trifolium spec.	herb	PACU
6. Daucus carota	herb	UPL
7.		
8.		
9.		
10.		
11.		
12.		
13.		
14.		
15.		
16.		

Percent of Dominant Species that are OBL, FACW or FAC (excluding FAC-). 0%

Remarks:

HYDROLOGY

___ Recorded Data (Describe in Remarks):
- ___ Stream, Lake, or Tide Gauge
- ___ Aerial Photographs
- ___ Other

___ No Recorded Data Available

Field Observations:

Depth of Surface Water:	0 (in.)
Depth to Free Water in Pit:	7 1/6 (in.)
Depth to Saturated Soil:	7 1/6 (in.)

Wetland Hydrology Indicators:

Primary Indicators:
- ___ Inundated
- ___ Saturated in Upper 12 Inches
- ___ Water Marks
- ___ Drift Lines
- ___ Sediment Deposits
- ___ Drainage Patterns in Wetlands

Secondary Indicators (2 or more required):
- ___ Oxidized Root Channels in Upper 12 Inches
- ___ Water-Stained Leaves
- ___ Local Soil Survey Data
- ___ FAC-Neutral Test
- ___ Other (Explain in Remarks)

Remarks:

SOILS

Map Unit Name (Series and Phase): Morristown channery silt loam (MpF)

Drainage Class: well drained

Taxonomy (Subgroup): Typic Udorthents

Field Observations Confirm Mapped Type? Yes (No)

Profile Description:

Depth (inches)	Horizon	Matrix Color (Munsell Moist)	Mottle Colors (Munsell Moist)	Mottle Abundance/ Size/Contrast	Texture, Concretions, Structure, etc.
0-16	A	2.5Y 4/2	2.5Y 5/6	C/D	loam clay, bouldery

Hydric Soil Indicators:

___ Histosol
___ Histic Epipedon
___ Sulfidic Odor
___ Aquic Moisture Regime
___ Reducing Conditions
___ Gleyed or Low-Chroma Colors
___ Concretions
___ High Organic Content in Surface Layer in Sandy Soils
___ Organic Streaking in Sandy Soils
___ Listed on Local Hydric Soils List
___ Listed on National Hydric Soils List
___ Other (Explain in Remarks)

Remarks:

Soils are very disturbed. 4/2 appears to be parent material not indicative of hydric conditions

WETLAND DETERMINATION

Hydrophytic Vegetation Present? Yes (No) (Circle)
Wetland Hydrology Present? Yes (No)
Hydric Soils Present? Yes (No)

Is this Samplig Point Within a Wetland? (Circle) Yes (No)

Remarks:

This is a backfill area with very disturbed soils

Approved by HQUSACE 3/92

DATA FORM
ROUTINE WETLAND DETERMINATION
(1987 COE Wetlands Delineation Manual)

Project/Site: 080-608 / Apex Sanitary Landfill Applicant/Owner: Apex Environmental, LLC Investigator: Lance Opiela and Matt Lauffer	Date: 5-27-08 County: Jefferson State: Ohio
Do Normal Circumstances exist on the site? Yes (No) Is the site significantly disturbed (Atypical Situation)? (Yes) No Is the area a potential Problem Area? Yes (No) (If needed, explain on reverse.)	Community ID: PEM/PAB Transect ID: TS 13 Plot ID: Wetland G in

VEGETATION

Dominant Plant Species	Stratum	Indicator
1. Scirpus cyperinus	herb	FACW
2. Onoclea sensibilis	herb	FACW
3. Ulmus americana	shrub	FACW
4. Glyceria grandis	herb	OBL
5. Typha angustifolia	herb	OBL
6.		
7.		
8.		

Dominant Plant Species	Stratum	Indicator
9.		
10.		
11.		
12.		
13.		
14.		
15.		
16.		

Percent of Dominant Species that are OBL, FACW or FAC (excluding FAC-). 5/5 = 100

Remarks:

HYDROLOGY

___ Recorded Data (Describe in Remarks):
- ___ Stream, Lake, or Tide Gauge
- ___ Aerial Photographs
- ___ Other

___ No Recorded Data Available

Field Observations:

Depth of Surface Water:	<1 (in.)
Depth to Free Water in Pit:	0 (in.)
Depth to Saturated Soil:	0 (in.)

Wetland Hydrology Indicators:

Primary Indicators:
- X Inundated
- X Saturated in Upper 12 Inches
- ___ Water Marks
- ___ Drift Lines
- ___ Sediment Deposits
- X Drainage Patterns in Wetlands

Secondary Indicators (2 or more required):
- X Oxidized Root Channels in Upper 12 Inches
- X Water-Stained Leaves
- ___ Local Soil Survey Data
- X FAC-Neutral Test
- ___ Other (Explain in Remarks)

Remarks:

SOILS

Map Unit Name (Series and Phase): Morristown shaly silty clay loam (MrF)

Drainage Class: well drained

Field Observations Confirm Mapped Type? Yes (No)

Taxonomy (Subgroup): Typic Udorthents

Profile Description:

Depth (inches)	Horizon	Matrix Color (Munsell Moist)	Mottle Colors (Munsell Moist)	Mottle Abundance/ Size/Contrast	Texture, Concretions, Structure, etc.
0-2	O				organic
2-12	A	2.5YR 2.5/1	-	-	silty loam
12	rock fill	natural			

Hydric Soil Indicators:

- ___ Histosol
- ___ Histic Epipedon
- X Sulfidic Odor
- X Aquic Moisture Regime
- X Reducing Conditions
- X Gleyed or Low-Chroma Colors
- ___ Concretions
- ___ High Organic Content in Surface Layer in Sandy Soils
- ___ Organic Streaking in Sandy Soils
- ___ Listed on Local Hydric Soils List
- ___ Listed on National Hydric Soils List
- ___ Other (Explain in Remarks)

Remarks:

WETLAND DETERMINATION

Hydrophytic Vegetation Present? (Yes) No (Circle)

Wetland Hydrology Present? (Yes) No

Hydric Soils Present? (Yes) No

Is this Sampling Point Within a Wetland? (Yes) No (Circle)

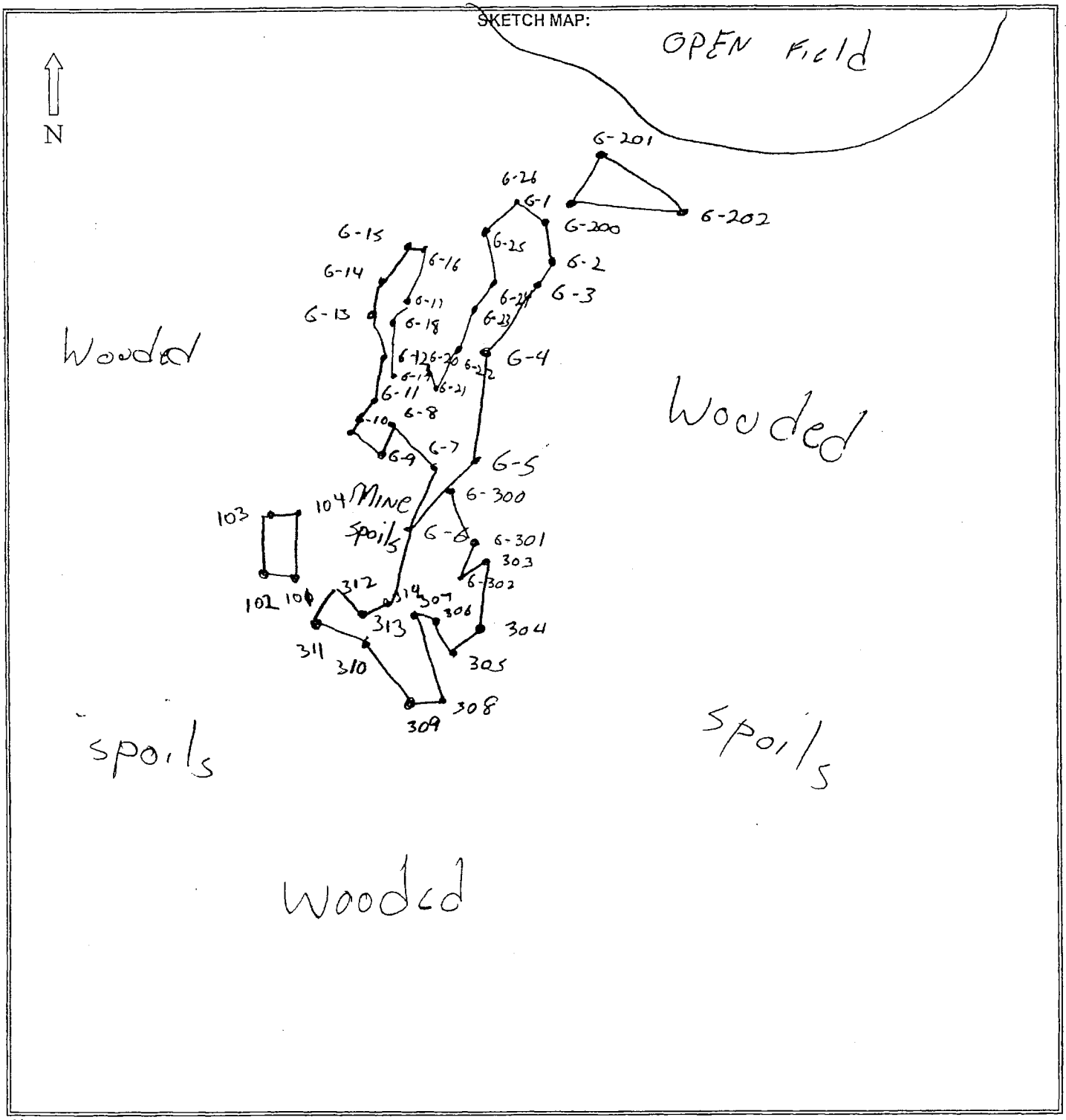
Remarks:

Approved by HQUSACE 3/92

Project/Site: 080-608 Apex
Wetland ID: wetland G

Date: 5-27-08
Acre(s): 1.13

SKETCH MAP:



Notes:
1. Show approximate size and shape of wetland boundaries, adjacent drainage features (streams, ponds, etc.), photograph view, test site
2. Show approximate dimensions of major axes of wetland (i.e., length and width)

DATA FORM
ROUTINE WETLAND DETERMINATION
(1987 COE Wetlands Delineation Manual)

Project/Site: 080-608 / Apex Sanitary Landfill Applicant/Owner: Apex Environmental, LLC Investigator: Lance Opiela and Matt Lauffer	Date: 5-27-08 County: Jefferson State: Ohio
Do Normal Circumstances exist on the site? Yes (No) Is the site significantly disturbed (Atypical Situation)? (Yes) No Is the area a potential Problem Area? Yes (No) (If needed, explain on reverse.)	Community ID: transitional Area + Transect ID: TS 1C1 Plot ID: wetland 6 out

VEGETATION

Dominant Plant Species	Stratum	Indicator
1. Ulmus rubra	Shrub	FAC+
2. Crataegus crus-galli	Shrub	FACW
3. Fraxinus americana	shrub	FACW
4. Vitis riparia	WV	FACW
5. Lonicera morrowii	Shrub	UPL
6. Rosa multiflora	shrub	FACW
7. Rhus radicans	Herb	FAC
8. Agrimonia parviflora	herb	FAC
9. Achillea millefolium	herb	FACU
10. Rosa multiflora	shrub	FACU
11.		
12.		
13.		
14.		
15.		
16.		

Percent of Dominant Species that are OBL, FACW or FAC (excluding FAC-). 3/10 30%

Remarks:

HYDROLOGY

___ Recorded Data (Describe in Remarks):
- ___ Stream, Lake, or Tide Gauge
- ___ Aerial Photographs
- ___ Other

___ No Recorded Data Available

Field Observations:

Depth of Surface Water:	0 (in.)
Depth to Free Water in Pit:	>16 (in.)
Depth to Saturated Soil:	>16 (in.)

Wetland Hydrology Indicators:

Primary Indicators:
- ___ Inundated
- ___ Saturated in Upper 12 Inches
- ___ Water Marks
- ___ Drift Lines
- ___ Sediment Deposits
- ___ Drainage Patterns in Wetlands

Secondary Indicators (2 or more required):
- ___ Oxidized Root Channels in Upper 12 Inches
- ___ Water-Stained Leaves
- ___ Local Soil Survey Data
- ___ FAC-Neutral Test
- ___ Other (Explain in Remarks)

Remarks:

SOILS

Map Unit Name (Series and Phase): Morristown channery silt loam (MpF) Drainage Class: well drained

Taxonomy (Subgroup): Typic Udorthents Field Observations Confirm Mapped Type? Yes (No)

Profile Description:

Depth (inches)	Horizon	Matrix Color (Munsell Moist)	Mottle Colors (Munsell Moist)	Mottle Abundance/ Size/Contrast	Texture, Concretions, Structure, etc.
0-3	A	2.5Y 2/1	-	-	loam
3-16	B	2.5Y 6/1	2.5Y 6/6	FD	loam clay

Hydric Soil Indicators:

- ___ Histosol
- ___ Histic Epipedon
- ___ Sulfidic Odor
- ___ Aquic Moisture Regime
- ___ Reducing Conditions
- X Gleyed or Low-Chroma Colors
- ___ Concretions
- ___ High Organic Content in Surface Layer in Sandy Soils
- ___ Organic Streaking in Sandy Soils
- ___ Listed on Local Hydric Soils List
- ___ Listed on National Hydric Soils List
- ___ Other (Explain in Remarks)

Remarks:

WETLAND DETERMINATION

Hydrophytic Vegetation Present? Yes (No) (Circle)

Wetland Hydrology Present? Yes (No)

Hydric Soils Present? (Yes) No

(Circle)

Is this Samplig Point Within a Wetland? Yes (No)

Remarks:

Taken at toe of slope W of wetland

Approved by HQUSACE 3/92

(6)

CEC

DATA FORM
ROUTINE WETLAND DETERMINATION
(1987 COE Wetlands Delineation Manual)

Wetland H"

Project/Site: APEX LANDFILL	Date: 13 OCT 03
Applicant/Owner: APEX ENERGY, INC	County: JEFFERSON
Investigator: MAL GILBERT	State: OHIO
Do Normal Circumstances exist on the site? Yes No	Community ID: I
Is the site significantly disturbed (Atypical Situation)? Yes No	Transect ID: I-SUP
Is the area a potential Problem Area? Yes No	Plot ID: I-PFO
(If needed, explain on reverse.)	

PALUSTRINE FORESTED INCLUSION AT EXTREME NORTHERN END OF WETLAND "I".

VEGETATION

Dominant Plant Species	Stratum	Indicator	Dominant Plant Species	Stratum	Indicator
1. RED MAPLE	T	FAC	9.		
2. AMERICAN ELM	T	FACW	10.		
3. SENSITIVE FERN	H	FACW	11.		
4.			12.		
5. BY:			13.		
6. 50/20 RULE OF			14.		
7. AREAL DOM.			15.		
8.			16.		

Percent of Dominant Species that are OBL, FACW or FAC (excluding FAC-). 100 %

Remarks: ONE OF THREE AREAS INCLUDED TO THE UPPER LIMITS OF WETLAND "I" TO SUPPLEMENT THE 1994 DELINEATION.

HYDROLOGY

- [X] Recorded Data (Describe in Remarks):
  - [ ] Stream, Lake, or Tide Gauge
  - [X] Aerial Photographs
  - [ ] Other
- [ ] No Recorded Data Available

Field Observations:

Depth of Surface Water:	0"	(in.)
Depth to Free Water in Pit:	3"	(in.)
Depth to Saturated Soil:	0"	(in.)

Wetland Hydrology Indicators:

Primary Indicators:
- [X] Inundated IN PLACES
- [X] Saturated in Upper 12 Inches
- [ ] Water Marks
- [ ] Drift Lines
- [X] Sediment Deposits
- [X] Drainage Patterns in Wetlands

Secondary Indicators (2 or more required):
- [ ] Oxidized Root Channels in Upper 12 Inches
- [ ] Water-Stained Leaves
- [ ] Local Soil Survey Data
- [ ] FAC-Neutral Test
- [ ] Other (Explain in Remarks)

Remarks: GROUNDWATER SEEPAGE WITHIN A FORESTED CORRIDOR —

CEC Wetland H

SOILS

Map Unit Name (Series and Phase): HYDRIC INCLUSION IN GILPIN SERIES Drainage Class: PD

Taxonomy (Subgroup): TYPIC HAPLAQUOLTS Field Observations Confirm Mapped Type? (Yes) No

Profile Description:

Depth (inches)	Horizon	Matrix Color (Munsell Moist)	Mottle Colors (Munsell Moist)	Mottle Abundance/Contrast	Texture, Concretions, Structure, etc.
0-4"	A	10YR 4/1	—	—	SIL, WFGRAN TO WFSAB
4-12"	Bt1	10YR 5/2	10YR 6/1 10YR 5/8	MANY DISTINCT + PROMINENT	SICL, WMSAB
12"+	Bt2	10YR 5/1	"	"	SICL, WMSAB
	SATURATED THROUGHOUT				

Hydric Soil Indicators:

- ___ Histosol
- ___ Histic Epipedon
- ___ Sulfidic Odor
- X Aquic Moisture Regime
- X Reducing Conditions OBSERVED
- X Gleyed or Low-Chroma Colors
- ___ Concretions
- ___ High Organic Content in Surface Layer in Sandy Soils
- ___ Organic Streaking in Sandy Soils
- ___ Listed on Local Hydric Soils List
- ___ Listed on National Hydric Soils List
- ___ Other (Explain in Remarks)

Remarks: INCLUSION WITHIN GILPIN MAPPING UNIT — — NOT UNEXPECTED AS PER SOIL SURVEY.

WETLAND DETERMINATION

Hydrophytic Vegetation Present?	(Yes)	No	(Circle)
Wetland Hydrology Present?	(Yes)	No	
Hydric Soils Present?	(Yes)	No	

Is this Sampling Point Within a Wetland? (Yes) No (Circle)

Remarks: PFO INCLUSION —

DATA FORM
ROUTINE WETLAND DETERMINATION
(1987 COE Wetlands Delineation Manual)

Project/Site: 080-608 / Apex Sanitary Landfill Applicant/Owner: Apex Environmental, LLC Investigator: Lance Opiela and Matt Lauffer	Date: 5-28-08 County: Jefferson State: Ohio
Do Normal Circumstances exist on the site? Yes (No) Is the site significantly disturbed (Atypical Situation)? (Yes) No Is the area a potential Problem Area? Yes (No) (If needed, explain on reverse.)	Community ID: PEM/PUB/POW Transect ID: TS15 Plot ID: Wetland I in

VEGETATION

Dominant Plant Species	Stratum	Indicator
1. Ceratophyllum demersum	Sub	OBL
2. Typha sp.	Herb	OBL
3.		
4.		
5.		
6.		
7.		
8.		

Dominant Plant Species	Stratum	Indicator
9.		
10.		
11.		
12.		
13.		
14.		
15.		
16.		

Percent of Dominant Species that are OBL, FACW or FAC (excluding FAC-). 100

Remarks:

HYDROLOGY

___ Recorded Data (Describe in Remarks):
- ___ Stream, Lake, or Tide Gauge
- ___ Aerial Photographs
- ___ Other

___ No Recorded Data Available

Field Observations:

Depth of Surface Water:	4 (in.)
Depth to Free Water in Pit:	0 (in.)
Depth to Saturated Soil:	0 (in.)

Wetland Hydrology Indicators:

Primary Indicators:
- X Inundated
- X Saturated in Upper 12 Inches
- ___ Water Marks
- ___ Drift Lines
- ___ Sediment Deposits
- X Drainage Patterns in Wetlands

Secondary Indicators (2 or more required):
- ___ Oxidized Root Channels in Upper 12 Inches
- ___ Water-Stained Leaves
- ___ Local Soil Survey Data
- ___ FAC-Neutral Test
- ___ Other (Explain in Remarks)

Remarks:

SOILS

Map Unit Name (Series and Phase): Morristown channery silt loam (MpF)
Drainage Class: well drained
Taxonomy (Subgroup): Typic Udorthents
Field Observations Confirm Mapped Type? Yes (No)

Profile Description:

Depth (inches)	Horizon	Matrix Color (Munsell Moist)	Mottle Colors (Munsell Moist)	Mottle Abundance/ Size/Contrast	Texture, Concretions, Structure, etc.
0-16	A	2.5Y 2.5/1	2.5Y 4/3	C/D	gravelly silt

Hydric Soil Indicators:

- ___ Histosol
- ___ Histic Epipedon
- ___ Sulfidic Odor
- ___ Aquic Moisture Regime
- ___ Reducing Conditions
- X Gleyed or Low-Chroma Colors
- ___ Concretions
- ___ High Organic Content in Surface Layer in Sandy Soils
- ___ Organic Streaking in Sandy Soils
- ___ Listed on Local Hydric Soils List
- ___ Listed on National Hydric Soils List
- ___ Other (Explain in Remarks)

Remarks:
Soils are from old mine spoils

WETLAND DETERMINATION

Hydrophytic Vegetation Present? (Yes) No (Circle)
Wetland Hydrology Present? (Yes) No
Hydric Soils Present? (Yes) No

(Circle)
Is this Samplig Point Within a Wetland? (Yes) No

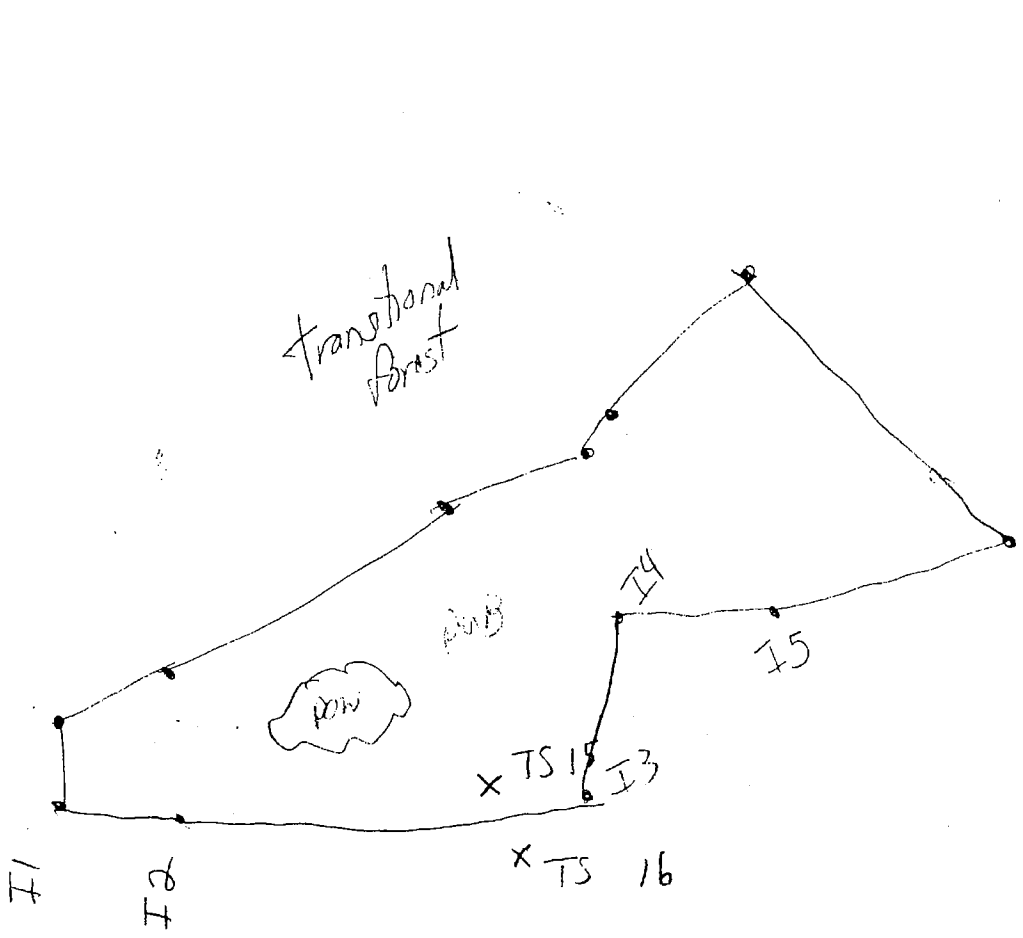
Remarks:
This wetland is in an abandoned mine cut
The soils are previous mine spoils
Most of the wetland is Ceratophyllum beds

Approved by HQUSACE 3/92

Project/Site: Apex 060-806
Wetland ID: Wetland I

Date: 5-28-08
Acre(s): 0.11

SKETCH MAP:



unnumbered points shot on offsets - no flags

Notes:
1. Show approximate size and shape of wetland boundaries, adjacent drainage features (streams, ponds, etc.), photograph view, test site
2. Show approximate dimensions of major axes of wetland (i.e., length and width)

DATA FORM
ROUTINE WETLAND DETERMINATION
(1987 COE Wetlands Delineation Manual)

Project/Site: 080-608 / Apex Sanitary Landfill Applicant/Owner: Apex Environmental, LLC Investigator: Lance Opiela and Matt Lauffer	Date: 5-28-08 County: Jefferson State: Ohio
Do Normal Circumstances exist on the site? No Is the site significantly disturbed (Atypical Situation)? Yes Is the area a potential Problem Area? No (If needed, explain on reverse.)	Community ID: herb Transect ID: TS-16 Plot ID: Wetland I out

VEGETATION

Dominant Plant Species	Stratum	Indicator
1. Equisetum arvense	herb	FAC
2. Anthoxanthum odoratum	herb	FACU
3. Solidago canadensis	herb	FACU
4. Rubus occidentalis	shrub	UPL
5. Rubus allegheniensis	shrub	FACU
6. Achillea millefolium	herb	FACU
7. Rosa radicans	herb	FAC
8. Taraxacum officinale	herb	UPL

Dominant Plant Species	Stratum	Indicator
9.		
10.		
11.		
12.		
13.		
14.		
15.		
16.		

Percent of Dominant Species that are OBL, FACW or FAC (excluding FAC-). 25%

Remarks:

HYDROLOGY

___ Recorded Data (Describe in Remarks):
- ___ Stream, Lake, or Tide Gauge
- ___ Aerial Photographs
- ___ Other

___ No Recorded Data Available

Field Observations:

Depth of Surface Water:	0 (in.)
Depth to Free Water in Pit:	7/16 (in.)
Depth to Saturated Soil:	7/16 (in.)

Wetland Hydrology Indicators:

Primary Indicators:
- ___ Inundated
- ___ Saturated in Upper 12 Inches
- ___ Water Marks
- ___ Drift Lines
- ___ Sediment Deposits
- ___ Drainage Patterns in Wetlands

Secondary Indicators (2 or more required):
- ___ Oxidized Root Channels in Upper 12 Inches
- ___ Water-Stained Leaves
- ___ Local Soil Survey Data
- ___ FAC-Neutral Test
- ___ Other (Explain in Remarks)

Remarks:

SOILS

Map Unit Name (Series and Phase): Morristown channery silt loam (MpF) Drainage Class: well drained

Field Observations

Taxonomy (Subgroup): Typic Udorthents Confirm Mapped Type? Yes (No)

Profile Description:

Depth (inches)	Horizon	Matrix Color (Munsell Moist)	Mottle Colors (Munsell Moist)	Mottle Abundance/ Size/Contrast	Texture, Concretions, Structure, etc.
0-5	A	2.5Y 3/1	—	—	gravelly silt loam
5-16	B	2.5Y 5/1	2.5Y 5/4	c/d	gravelly silt loam

Hydric Soil Indicators:

- ___ Histosol
- ___ Histic Epipedon
- ___ Sulfidic Odor
- ___ Aquic Moisture Regime
- ___ Reducing Conditions
- X Gleyed or Low-Chroma Colors
- ___ Concretions
- ___ High Organic Content in Surface Layer in Sandy Soils
- ___ Organic Streaking in Sandy Soils
- ___ Listed on Local Hydric Soils List
- ___ Listed on National Hydric Soils List
- ___ Other (Explain in Remarks)

Remarks:

WETLAND DETERMINATION

		(Circle)
Hydrophytic Vegetation Present?	Yes (No)	
Wetland Hydrology Present?	Yes (No)	
Hydric Soils Present?	(Yes) No	
Is this Samplig Point Within a Wetland?	Yes (No)	

Remarks:

Soils are previous mine spoils

Approved by HQUSACE 3/92

DATA FORM
ROUTINE WETLAND DETERMINATION
(1987 COE Wetlands Delineation Manual)

Project/Site: 080-608 / Apex Sanitary Landfill Applicant/Owner: Apex Environmental, LLC Investigator: Lance Opiela and Matt Lauffer	Date: 5-28-08 County: Jefferson State: Ohio
Do Normal Circumstances exist on the site? (Yes) No Is the site significantly disturbed (Atypical Situation)? Yes (No) Is the area a potential Problem Area? Yes (No) (If needed, explain on reverse.)	Community ID: PEM/PAB/POW2x Transect ID: TS17 Plot ID: Wetland TS17

VEGETATION

Dominant Plant Species	Stratum	Indicator
1. Glyceria striata	Herb	OBL
2. Rhamnus frangula	Shrub	FACW
3. Ludwigia sp.	Herb	OBL
4. Mentha spicata	Herb	FACW
5.		
6.		
7.		
8.		
9.		
10.		
11.		
12.		
13.		
14.		
15.		
16.		

Percent of Dominant Species that are OBL, FACW or FAC (excluding FAC-). 4/4 100%

Remarks:

HYDROLOGY

___ Recorded Data (Describe in Remarks):
___ Stream, Lake, or Tide Gauge
___ Aerial Photographs
___ Other
___ No Recorded Data Available

Field Observations:

Depth of Surface Water: 3 (in.)

Depth to Free Water in Pit: 0 (in.)

Depth to Saturated Soil: 0 (in.)

Wetland Hydrology Indicators:
Primary Indicators:
X Inundated
X Saturated in Upper 12 Inches
___ Water Marks
___ Drift Lines
___ Sediment Deposits
X Drainage Patterns in Wetlands
Secondary Indicators (2 or more required):
X Oxidized Root Channels in Upper 12 Inches
___ Water-Stained Leaves
___ Local Soil Survey Data
X FAC-Neutral Test
___ Other (Explain in Remarks)

Remarks:

SOILS

Map Unit Name (Series and Phase): Mexistown channery silt loam (MpF)

Drainage Class: well drained

Field Observations Confirm Mapped Type? Yes (No)

Taxonomy (Subgroup): Typic Udorthents

Profile Description:

Depth (inches)	Horizon	Matrix Color (Munsell Moist)	Mottle Colors (Munsell Moist)	Mottle Abundance/ Size/Contrast	Texture, Concretions, Structure, etc.
0-1	A	2.5Y 2.5/1	-	-	silty clay
1-16	B	2.5Y 5/1	2.5Y 5/6	C/D	clay

Hydric Soil Indicators:

- ___ Histosol
- ___ Histic Epipedon
- X Sulfidic Odor
- X Aquic Moisture Regime
- X Reducing Conditions
- X Gleyed or Low-Chroma Colors
- ___ Concretions
- ___ High Organic Content in Surface Layer in Sandy Soils
- ___ Organic Streaking in Sandy Soils
- ___ Listed on Local Hydric Soils List
- ___ Listed on National Hydric Soils List
- ___ Other (Explain in Remarks)

Remarks:

WETLAND DETERMINATION

Hydrophytic Vegetation Present?	(Yes) No	(Circle)
Wetland Hydrology Present?	(Yes) No	
Hydric Soils Present?	(Yes) No	
Is this Sampling Point Within a Wetland?	(Yes) No	(Circle)

Remarks:

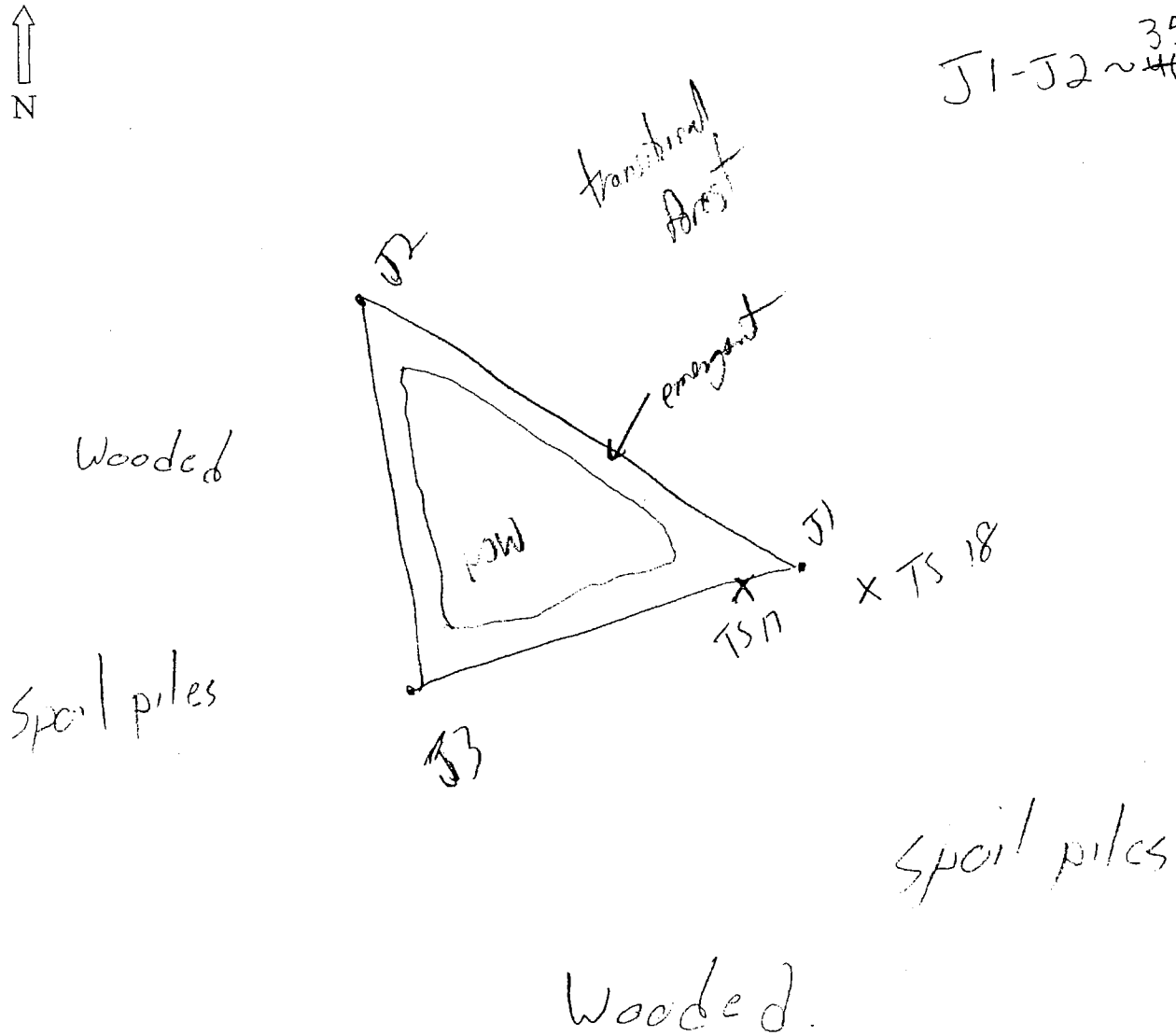
Although this depression was a mine cut, the soils are well developed

Approved by HQUSACE 3/92

Project/Site: 080-608 Apex
Wetland ID: wetland 1

Date: 5-28-08
Acre(s): 0.04

SKETCH MAP:



Notes: .
1. Show approximate size and shape of wetland boundaries, adjacent drainage features (streams, ponds, etc.), photograph view, test site
2. Show approximate dimensions of major axes of wetland (i.e., length and width)

DATA FORM
ROUTINE WETLAND DETERMINATION
(1987 COE Wetlands Delineation Manual)

Project/Site: 080-608 / Apex Sanitary Landfill Applicant/Owner: Apex Environmental, LLC Investigator: Lance Opiela and Matt Lauffer	Date: 5-28-08 County: Jefferson State: Ohio
Do Normal Circumstances exist on the site? Yes (No) Is the site significantly disturbed (Atypical Situation)? (Yes) No Is the area a potential Problem Area? Yes (No) (If needed, explain on reverse.)	Community ID: SS/herb Transect ID: TST8 Plot ID: wetland 3 out

VEGETATION

Dominant Plant Species	Stratum	Indicator
1. Rosa multiflora	herb	FACU
2. Ulmus rubra	tree	FAC+
3. Robinia pseudoacacia	tree	FACU-
4. Rosa radicans	WV	FAC
5. Urtica dioica	herb	FACU
6. Solidago canadensis	herb	FACU
7. Parthenocissus quinquefolia	WV	FACU
8. Callium aparine	herb	FACU

Dominant Plant Species	Stratum	Indicator
9.		
10.		
11.		
12.		
13.		
14.		
15.		
16.		

Percent of Dominant Species that are OBL, FACW or FAC (excluding FAC-). 2/8 25%

Remarks:

HYDROLOGY

___ Recorded Data (Describe in Remarks):
- ___ Stream, Lake, or Tide Gauge
- ___ Aerial Photographs
- ___ Other

___ No Recorded Data Available

Field Observations:

Depth of Surface Water:	0 (in.)
Depth to Free Water in Pit:	>16 (in.)
Depth to Saturated Soil:	>16 (in.)

Wetland Hydrology Indicators:

Primary Indicators:
- ___ Inundated
- ___ Saturated in Upper 12 Inches
- ___ Water Marks
- ___ Drift Lines
- ___ Sediment Deposits
- ___ Drainage Patterns in Wetlands

Secondary Indicators (2 or more required):
- X Oxidized Root Channels in Upper 12 Inches
- ___ Water-Stained Leaves
- ___ Local Soil Survey Data
- ___ FAC-Neutral Test
- ___ Other (Explain in Remarks)

Remarks:

SOILS

Map Unit Name (Series and Phase): Morristown channery silt loam (MpF) Drainage Class: well drained
Field Observations
Taxonomy (Subgroup): Typic Udorthents Confirm Mapped Type? Yes (No)

Profile Description:

Depth (inches)	Horizon	Matrix Color (Munsell Moist)	Mottle Colors (Munsell Moist)	Mottle Abundance/ Size/Contrast	Texture, Concretions, Structure, etc.
0-2	A	10YR 3/1	—	—	silt loam
2-16	B	10YR 4/1	7.5YR 3/4	C/D	silt loam

Hydric Soil Indicators:

- ___ Histosol
- ___ Histic Epipedon
- ___ Sulfidic Odor
- ___ Aquic Moisture Regime
- ___ Reducing Conditions
- X Gleyed or Low-Chroma Colors
- ___ Concretions
- ___ High Organic Content in Surface Layer in Sandy Soils
- ___ Organic Streaking in Sandy Soils
- ___ Listed on Local Hydric Soils List
- ___ Listed on National Hydric Soils List
- ___ Other (Explain in Remarks)

Remarks:

WETLAND DETERMINATION

Hydrophytic Vegetation Present? Yes (No) (Circle)
Wetland Hydrology Present? Yes (No)
Hydric Soils Present? (Yes) No

(Circle)
Is this Samplig Point Within a Wetland? Yes (No)

Remarks:

Taken in gully drawing into wetland

Approved by HQUSACE 3/92

DATA FORM
ROUTINE WETLAND DETERMINATION
(1987 COE Wetlands Delineation Manual)

Project/Site: 080-608 / Apex Sanitary Landfill Applicant/Owner: Apex Environmental, LLC Investigator: Lance Opiela and Matt Lauffer	Date: 5-28-08 County: Jefferson State: Ohio
Do Normal Circumstances exist on the site? Yes (No) Is the site significantly disturbed (Atypical Situation)? (Yes) No Is the area a potential Problem Area? Yes (No) (If needed, explain on reverse.)	Community ID: POW/PAB Transect ID: 1519 Plot ID: wetland K in

VEGETATION

Dominant Plant Species	Stratum	Indicator	Dominant Plant Species	Stratum	Indicator
1. Glyceria striata	herb	OBL	9.		
2.			10.		
3.			11.		
4.			12.		
5.			13.		
6.			14.		
7.			15.		
8.			16.		

Percent of Dominant Species that are OBL, FACW or FAC (excluding FAC-). 100

Remarks:
Open water with scattered Glyceria

HYDROLOGY

___ Recorded Data (Describe in Remarks):
___ Stream, Lake, or Tide Gauge
___ Aerial Photographs
___ Other
___ No Recorded Data Available

Field Observations:
Depth of Surface Water: 5 (In.)
Depth to Free Water in Pit: 0 (in.)
Depth to Saturated Soil: 0 (in.)

Wetland Hydrology Indicators:
Primary Indicators:
X Inundated
X Saturated in Upper 12 Inches
___ Water Marks
___ Drift Lines
___ Sediment Deposits
X Drainage Patterns in Wetlands
Secondary Indicators (2 or more required):
___ Oxidized Root Channels in Upper 12 Inches
___ Water-Stained Leaves
___ Local Soil Survey Data
___ FAC-Neutral Test
___ Other (Explain in Remarks)

Remarks:

SOILS

Map Unit Name (Series and Phase): Morristown channery silt loam (MpF)

Drainage Class: well drained

Taxonomy (Subgroup): Typic Udarthents

Field Observations Confirm Mapped Type? Yes (No)

Profile Description:

Depth (inches)	Horizon	Matrix Color (Munsell Moist)	Mottle Colors (Munsell Moist)	Mottle Abundance/ Size/Contrast	Texture, Concretions, Structure, etc.
0-16	A	2.5Y 3/1	-	-	gravelly silt

Hydric Soil Indicators:

- ___ Histosol
- ___ Histic Epipedon
- ___ Sulfidic Odor
- ___ Aquic Moisture Regime
- ___ Reducing Conditions
- X Gleyed or Low-Chroma Colors
- ___ Concretions
- ___ High Organic Content in Surface Layer in Sandy Soils
- ___ Organic Streaking In Sandy Soils
- ___ Listed on Local Hydric Soils List
- ___ Listed on National Hydric Soils List
- ___ Other (Explain in Remarks)

Remarks:

WETLAND DETERMINATION

Hydrophytic Vegetation Present? (Yes) No (Circle)

Wetland Hydrology Present? (Yes) No

Hydric Soils Present? (Yes) No

(Circle)

Is this Samplig Point Within a Wetland? (Yes) No

Remarks:

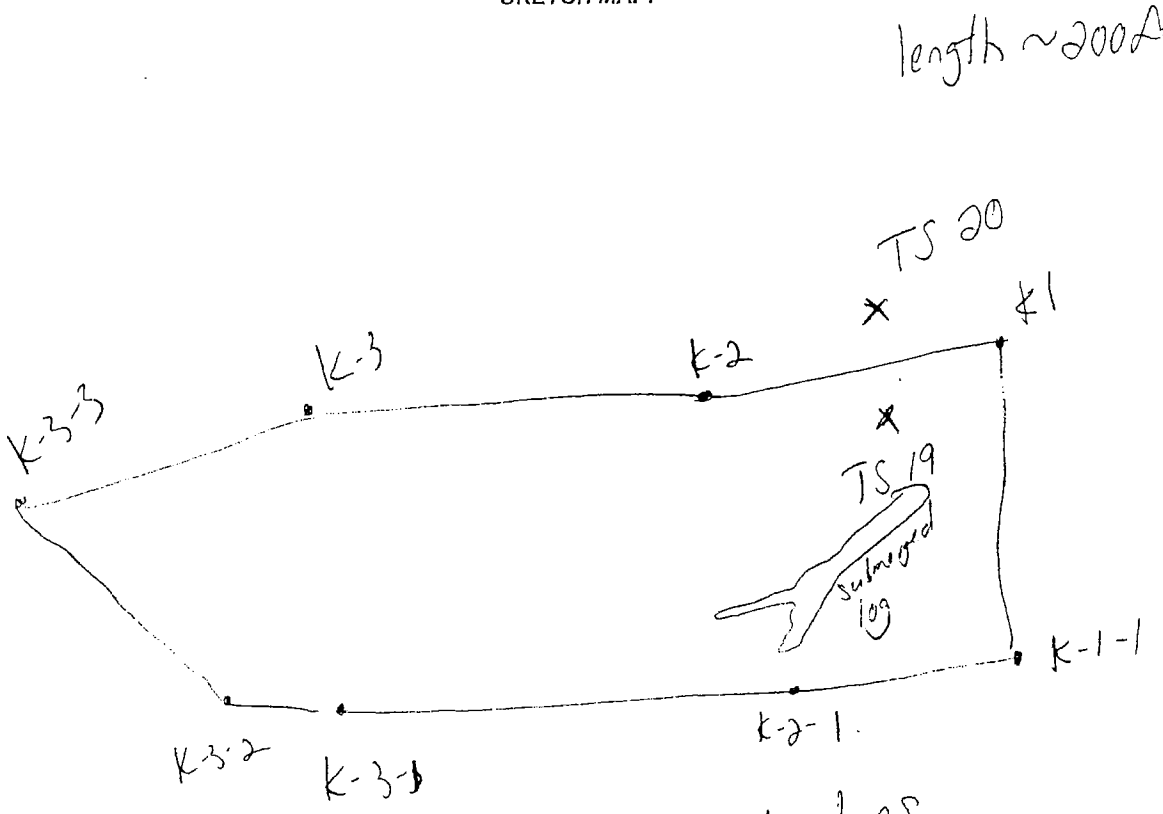
Soils consist of old mine spoils

Approved by HQUSACE 3/92

Project/Site: 080-608 Apex
Wetland ID: wetland K

Date: 5-28-08
Acre(s): 6.15

SKETCH MAP:



Notes:
1. Show approximate size and shape of wetland boundaries, adjacent drainage features (streams, ponds, etc.), photograph view, test site
2. Show approximate dimensions of major axes of wetland (i.e., length and width)

DATA FORM
ROUTINE WETLAND DETERMINATION
(1987 COE Wetlands Delineation Manual)

Project/Site: 080-608 / Apex Sanitary Landfill Applicant/Owner: Apex Environmental, LLC Investigator: Lance Opiela and Matt Lauffer	Date: 5-28-08 County: Jefferson State: Ohio
Do Normal Circumstances exist on the site? Yes (No) Is the site significantly disturbed (Atypical Situation)? (Yes) No Is the area a potential Problem Area? Yes (No) (If needed, explain on reverse.)	Community ID: SS Transect ID: TS 20 Plot ID: wetland Out

VEGETATION

Dominant Plant Species	Stratum	Indicator
1. Lonicera maackii	shrub	UPL
2. Robinia pseudoacacia	shrub	FACU-
3. Rosa multiflora	shrub	FACU
4. Rubus allegheniensis	shrub	FACU
5. Ulmus rubra	shrub	FAC+
6. Rhus radicans	NV	FAC
7. Potentilla simplex	herb	FACU
8. Solidago canadensis	herb	FACU
9. Achillea millefolium	herb	FACU
10. Allium aporine	herb	FACU
11.		
12.		
13.		
14.		
15.		
16.		

Percent of Dominant Species that are OBL, FACW or FAC (excluding FAC-). 2/10 = 20%

Remarks:

HYDROLOGY

___ Recorded Data (Describe in Remarks):
- ___ Stream, Lake, or Tide Gauge
- ___ Aerial Photographs
- ___ Other

___ No Recorded Data Available

Field Observations:

Depth of Surface Water:	0 (in.)
Depth to Free Water in Pit:	> 16 (in.)
Depth to Saturated Soil:	7/6 (in.)

Wetland Hydrology Indicators:

Primary Indicators:
- ___ Inundated
- ___ Saturated in Upper 12 Inches
- ___ Water Marks
- ___ Drift Lines
- ___ Sediment Deposits
- ___ Drainage Patterns in Wetlands

Secondary Indicators (2 or more required):
- ___ Oxidized Root Channels in Upper 12 Inches
- ___ Water-Stained Leaves
- ___ Local Soil Survey Data
- ___ FAC-Neutral Test
- ___ Other (Explain in Remarks)

Remarks:

SOILS

Map Unit Name (Series and Phase): Morristown channery silt loam

Drainage Class: well drained

Taxonomy (Subgroup): Typic Udorthents

Field Observations Confirm Mapped Type? Yes (No)

Profile Description:

Depth (inches)	Horizon	Matrix Color (Munsell Moist)	Mottle Colors (Munsell Moist)	Mottle Abundance/ Size/Contrast	Texture, Concretions, Structure, etc.
0-2	A	2.5Y 3/2	–	–	silt loam
2-14	B	2.5Y 4/2	–	–	silt loam

Hydric Soil Indicators:

___ Histosol
___ Histic Epipedon
___ Sulfidic Odor
___ Aquic Moisture Regime
___ Reducing Conditions
___ Gleyed or Low-Chroma Colors
___ Concretions
___ High Organic Content in Surface Layer in Sandy Soils
___ Organic Streaking in Sandy Soils
___ Listed on Local Hydric Soils List
___ Listed on National Hydric Soils List
___ Other (Explain in Remarks)

Remarks:

WETLAND DETERMINATION

Hydrophytic Vegetation Present? Yes (No) (Circle)
Wetland Hydrology Present? Yes (No)
Hydric Soils Present? Yes (No)

Is this Samplig Point Within a Wetland? Yes (No) (Circle)

Remarks:

Wall of old mine cut

Approved by HQUSACE 3/92

DATA FORM
ROUTINE WETLAND DETERMINATION
(1987 COE Wetlands Delineation Manual)

Project/Site: 080-608 / Apex Sanitary Landfill Applicant/Owner: Apex Environmental, LLC Investigator: Lance Opiela and Matt Lauffer	Date: 5-28-08 County: Jefferson State: Ohio
Do Normal Circumstances exist on the site? Yes (No) Is the site significantly disturbed (Atypical Situation)? Yes (No) Is the area a potential Problem Area? Yes (No) (If needed, explain on reverse.)	Community ID: POW/PAB Transect ID: TS 21 Plot ID: Wetland L in

VEGETATION

Dominant Plant Species	Stratum	Indicator
1. Lemna minor	Dom	OBL
2. Ceratophyllum demersum	Sub	OBL
3.		
4.		
5.		
6.		
7.		
8.		

Dominant Plant Species	Stratum	Indicator
9.		
10.		
11.		
12.		
13.		
14.		
15.		
16.		

Percent of Dominant Species that are OBL, FACW or FAC (excluding FAC-). 2/2 = 100%

Remarks:

HYDROLOGY

___ Recorded Data (Describe in Remarks):
- ___ Stream, Lake, or Tide Gauge
- ___ Aerial Photographs
- ___ Other

___ No Recorded Data Available

Field Observations:

Depth of Surface Water: 5 (in.)

Depth to Free Water in Pit: 0 (in.)

Depth to Saturated Soil: 0 (in.)

Wetland Hydrology Indicators:

Primary Indicators:
- X Inundated
- X Saturated in Upper 12 Inches
- ___ Water Marks
- ___ Drift Lines
- ___ Sediment Deposits
- X Drainage Patterns in Wetlands

Secondary Indicators (2 or more required):
- ___ Oxidized Root Channels in Upper 12 Inches
- ___ Water-Stained Leaves
- ___ Local Soil Survey Data
- ___ FAC-Neutral Test
- ___ Other (Explain in Remarks)

Remarks:

SOILS

Map Unit Name (Series and Phase): Morristown shaly silty clay loam (MrF) Drainage Class: well drained

Taxonomy (Subgroup): Typic Udorthents Field Observations Confirm Mapped Type? Yes (No)

Profile Description: Depth (inches)	Horizon	Matrix Color (Munsell Moist)	Mottle Colors (Munsell Moist)	Mottle Abundance/ Size/Contrast	Texture, Concretions, Structure, etc.
0-16	A	2.5Y 3/1	–	–	gravelly silt

Hydric Soil Indicators:

- ___ Histosol
- ___ Histic Epipedon
- X Sulfidic Odor
- X Aquic Moisture Regime
- X Reducing Conditions
- X Gleyed or Low-Chroma Colors
- ___ Concretions
- ___ High Organic Content in Surface Layer in Sandy Soils
- ___ Organic Streaking in Sandy Soils
- ___ Listed on Local Hydric Soils List
- ___ Listed on National Hydric Soils List
- ___ Other (Explain in Remarks)

Remarks:

WETLAND DETERMINATION

Hydrophytic Vegetation Present? (Yes) No (Circle)
Wetland Hydrology Present? (Yes) No
Hydric Soils Present? (Yes) No

Is this Samplig Point Within a Wetland? (Yes) No (Circle)

Remarks:

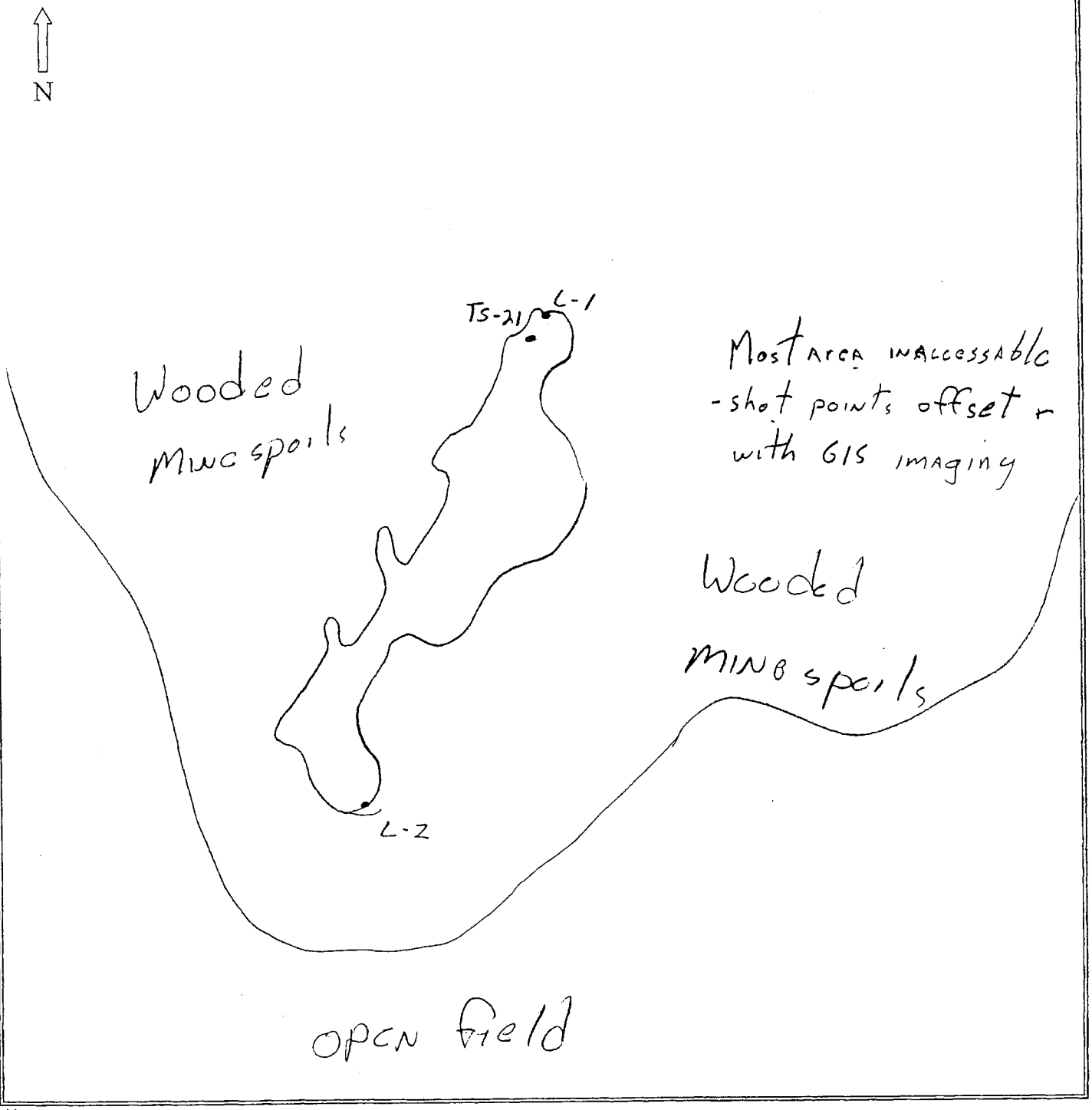
Old mine cut with undeveloped soils.
About 60% PUB, 40% POW

Approved by HQUSACE 3/92

Project/Site: 060-608 Apex
Wetland ID: Wetland L

Date: 5-28-08
Acre(s): 1.37

SKETCH MAP:



Notes:
1. Show approximate size and shape of wetland boundaries, adjacent drainage features (streams, ponds, etc.), photograph view, test site
2. Show approximate dimensions of major axes of wetland (i.e., length and width)

DATA FORM
ROUTINE WETLAND DETERMINATION
(1987 COE Wetlands Delineation Manual)

Project/Site: 080-608 / Apex Sanitary Landfill Applicant/Owner: Apex Environmental, LLC Investigator: Lance Opiela and Matt Lauffer	Date: 5-28-08 County: Jefferson State: Ohio
Do Normal Circumstances exist on the site? Yes (No) Is the site significantly disturbed (Atypical Situation)? Yes (No) Is the area a potential Problem Area? Yes (No) (If needed, explain on reverse.)	Community ID: FO Transect ID: TS22 Plot ID: Wetland L out

VEGETATION

Dominant Plant Species	Stratum	Indicator
1. Acer saccharinum	tree	
2. Ulmus rubra	tree	FACF
3. Rhododendron	shrub	
4. Lonicera maackii	shrub	UPL
5. Urtica dioica	herb	FACU
6. Geranium robertianum	herb	FACU
7. Solidago canadensis	herb	FACU
8. Galium aparine	herb	FACU
9. Stellaria media	herb	UPL
10.		
11.		
12.		
13.		
14.		
15.		
16.		

Percent of Dominant Species that are OBL, FACW or FAC (excluding FAC-). 1/9

Remarks:

HYDROLOGY

___ Recorded Data (Describe in Remarks):
- ___ Stream, Lake, or Tide Gauge
- ___ Aerial Photographs
- ___ Other

___ No Recorded Data Available

Field Observations:

Depth of Surface Water:	0 (in.)
Depth to Free Water in Pit:	7/16 (in.)
Depth to Saturated Soil:	7/16 (in.)

Wetland Hydrology Indicators:

Primary Indicators:
- ___ Inundated
- ___ Saturated in Upper 12 Inches
- ___ Water Marks
- ___ Drift Lines
- ___ Sediment Deposits
- ___ Drainage Patterns in Wetlands

Secondary Indicators (2 or more required):
- ___ Oxidized Root Channels in Upper 12 Inches
- ___ Water-Stained Leaves
- ___ Local Soil Survey Data
- ___ FAC-Neutral Test
- ___ Other (Explain in Remarks)

Remarks:

SOILS

Map Unit Name (Series and Phase): Morristown shaly silty clay loam (MrF) Drainage Class: well drained

Taxonomy (Subgroup): Typic Udorthents Field Observations Confirm Mapped Type? Yes (No)

Profile Description:

Depth (inches)	Horizon	Matrix Color (Munsell Moist)	Mottle Colors (Munsell Moist)	Mottle Abundance/ Size/Contrast	Texture, Concretions, Structure, etc.
0-2	A	2.5Y 3/1	-	-	silt loam
2-16	B	2.5Y 4/2	-	-	silt loam

Hydric Soil Indicators:

___ Histosol
___ Histic Epipedon
___ Sulfidic Odor
___ Aquic Moisture Regime
___ Reducing Conditions
___ Gleyed or Low-Chroma Colors
___ Concretions
___ High Organic Content in Surface Layer in Sandy Soils
___ Organic Streaking in Sandy Soils
___ Listed on Local Hydric Soils List
___ Listed on National Hydric Soils List
___ Other (Explain in Remarks)

Remarks:

WETLAND DETERMINATION

Hydrophytic Vegetation Present? Yes (No) (Circle)
Wetland Hydrology Present? Yes (No)
Hydric Soils Present? Yes (No)

(Circle)
Is this Samplig Point Within a Wetland? Yes (No)

Remarks:

Bank of old mine cut

Approved by HQUSACE 3/92

CEC (9)

DATA FORM
ROUTINE WETLAND DETERMINATION "Wetland N"
(1987 COE Wetlands Delineation Manual)

Project/Site: APEX LANDFILL	Date: 18OCT03
Applicant/Owner: APEX ENERGY	County: JEFFERSON
Investigator:	State: OHIO

Do Normal Circumstances exist on the site?	Yes	No	Community ID: N
Is the site significantly disturbed (Atypical Situation)?	Yes	No	Transect ID: N-1
Is the area a potential Problem Area?	Yes	No	Plot ID: N-SED PND
(If needed, explain on reverse.)			

OLD SEDIMENT BASIN/MINE PIT ADJACENT TO ACTIVE LIMESTONE QUARRY — ENTIRELY ISOLATED DEPRESSION

VEGETATION

Dominant Plant Species	Stratum	Indicator
1. NL CATTAIL	H	OBL
2. BL CATTAIL	H	OBL
3. REED CANARY GRASS	H	FACW
4. SOFT RUSH	H	FACW
5. BEGGAR-TICKS	H	FACW
6. COMMON REED	H	FACW
7. WILLOW	SH	FACW
8.		
9.		
10.		
11.		
12.		
13.		
14.		
15.		
16.		

DOMINANTS BY 50/20 ARE REEDCANARY, TYPHA + PHRAGMITES.

Percent of Dominant Species that are OBL, FACW or FAC (excluding FAC-). 100%

Remarks: AREA ADDED AS A RESULT OF 16 OCT 03 SITE VISIT WITH USACOE + OEPA — OUTSIDE CURRENT LANDFILL FOOTPRINT.

HYDROLOGY

- [X] Recorded Data (Describe in Remarks):
  - [ ] Stream, Lake, or Tide Gauge
  - [X] Aerial Photographs
  - [ ] Other
- [ ] No Recorded Data Available

Field Observations:

Depth of Surface Water:	0-24" (in.)
Depth to Free Water in Pit:	0" (in.)
Depth to Saturated Soil:	0" (in.)

Wetland Hydrology Indicators:

Primary Indicators:
- [X] Inundated
- [X] Saturated in Upper 12 Inches
- [ ] Water Marks
- [X] Drift Lines
- [X] Sediment Deposits
- [ ] Drainage Patterns in Wetlands

Secondary Indicators (2 or more required):
- [ ] Oxidized Root Channels in Upper 12 Inches
- [ ] Water-Stained Leaves
- [ ] Local Soil Survey Data
- [ ] FAC-Neutral Test
- [ ] Other (Explain in Remarks)

Remarks: CLOSED, PONDED DEPRESSION.

CEC "Wetland M"

SOILS

Map Unit Name (Series and Phase): SPOILS

Drainage Class: VPD

Taxonomy (Subgroup): UDORTHENTS

Field Observations Confirm Mapped Type? (Yes) No

Profile Description:

Depth (inches)	Horizon	Matrix Color (Munsell Moist)	Mottle Colors (Munsell Moist)	Mottle Abundance/Contrast	Texture, Concretions, Structure, etc.
	ENTIRELY SEDIMENTS FROM ADJOINING PAST/PRESENT MINING AND RECLAIM OPERATIONS.				
	HYDRIC CRITERION #3 : POND FOR LONG OR VERY LONG DURATION DURING THE GROWING SEASON.				

Hydric Soil Indicators:

- ___ Histosol
- ___ Histic Epipedon
- ___ Sulfidic Odor
- X Aquic Moisture Regime
- X Reducing Conditions
- ___ Gleyed or Low-Chroma Colors
- ___ Concretions
- ___ High Organic Content in Surface Layer in Sandy Soils
- ___ Organic Streaking in Sandy Soils
- ___ Listed on Local Hydric Soils List
- ___ Listed on National Hydric Soils List
- ___ Other (Explain in Remarks)

Remarks: STANDING WATER — SATURATED FRINGE AREA.

WETLAND DETERMINATION

Hydrophytic Vegetation Present? (Yes) No (Circle)
Wetland Hydrology Present? (Yes) No
Hydric Soils Present? (Yes) No

Is this Sampling Point Within a Wetland? (Circle) (Yes) No

Remarks: CLOSED DEPRESSION WITH NO SURFACE WATER OUTLET — REGULATED BY OEPA AS AN "ISOLATED" WETLAND.

Approved by HQUSACE 3/92

DATA FORM
ROUTINE WETLAND DETERMINATION
(1987 COE Wetlands Delineation Manual)

Project/Site: 080-608 / Apex Sanitary Landfill Applicant/Owner: Apex Environmental, LLC Investigator: Lance Opiela and Matt Lauffer	Date: 5-28-08 County: Jefferson State: Ohio
Do Normal Circumstances exist on the site? Yes (No) Is the site significantly disturbed (Atypical Situation)? (Yes) No Is the area a potential Problem Area? Yes (No) (If needed, explain on reverse.)	Community ID: POW/PSS Transect ID: TS-23 Plot ID: Wetland N 1N

VEGETATION

Dominant Plant Species	Stratum	Indicator
1. Salix nigra	Shrub	FACW+
2. Lemna minor	Sub	OBL
3. Glyceria striata	herb	OBL
4.		
5.		
6.		
7.		
8.		
9.		
10.		
11.		
12.		
13.		
14.		
15.		
16.		

Percent of Dominant Species that are OBL, FACW or FAC (excluding FAC-). 3/3 = 100

Remarks:

HYDROLOGY

___ Recorded Data (Describe in Remarks):
___ Stream, Lake, or Tide Gauge
___ Aerial Photographs
___ Other
___ No Recorded Data Available

Field Observations:

Depth of Surface Water: 4 (in.)
Depth to Free Water in Pit: 0 (in.)
Depth to Saturated Soil: 0 (in.)

Wetland Hydrology Indicators:
Primary Indicators:
X Inundated
X Saturated in Upper 12 Inches
___ Water Marks
___ Drift Lines
___ Sediment Deposits
X Drainage Patterns in Wetlands
Secondary Indicators (2 or more required):
___ Oxidized Root Channels in Upper 12 Inches
X Water-Stained Leaves
___ Local Soil Survey Data
___ FAC-Neutral Test
___ Other (Explain in Remarks)

Remarks: edge of open water

SOILS

Map Unit Name (Series and Phase): Morristown shaly silty clay loam (MtF) Drainage Class: well drained

Taxonomy (Subgroup): Typic Udorthents Field Observations Confirm Mapped Type? Yes (No)

Profile Description:

Depth (inches)	Horizon	Matrix Color (Munsell Moist)	Mottle Colors (Munsell Moist)	Mottle Abundance/ Size/Contrast	Texture, Concretions, Structure, etc.
0-8	A	2.5Y 6/1	2-5Y 6/3	F/F	clay
8-16	rock	refusal			

Hydric Soil Indicators:

- ___ Histosol
- ___ Histic Epipedon
- ___ Sulfidic Odor
- ___ Aquic Moisture Regime
- ___ Reducing Conditions
- X Gleyed or Low-Chroma Colors
- ___ Concretions
- ___ High Organic Content in Surface Layer in Sandy Soils
- ___ Organic Streaking in Sandy Soils
- ___ Listed on Local Hydric Soils List
- ___ Listed on National Hydric Soils List
- ___ Other (Explain in Remarks)

Remarks:

WETLAND DETERMINATION

Hydrophytic Vegetation Present? (Yes) No (Circle)
Wetland Hydrology Present? (Yes) No
Hydric Soils Present? (Yes) No

(Circle)
Is this Samplig Point Within a Wetland? (Yes) No

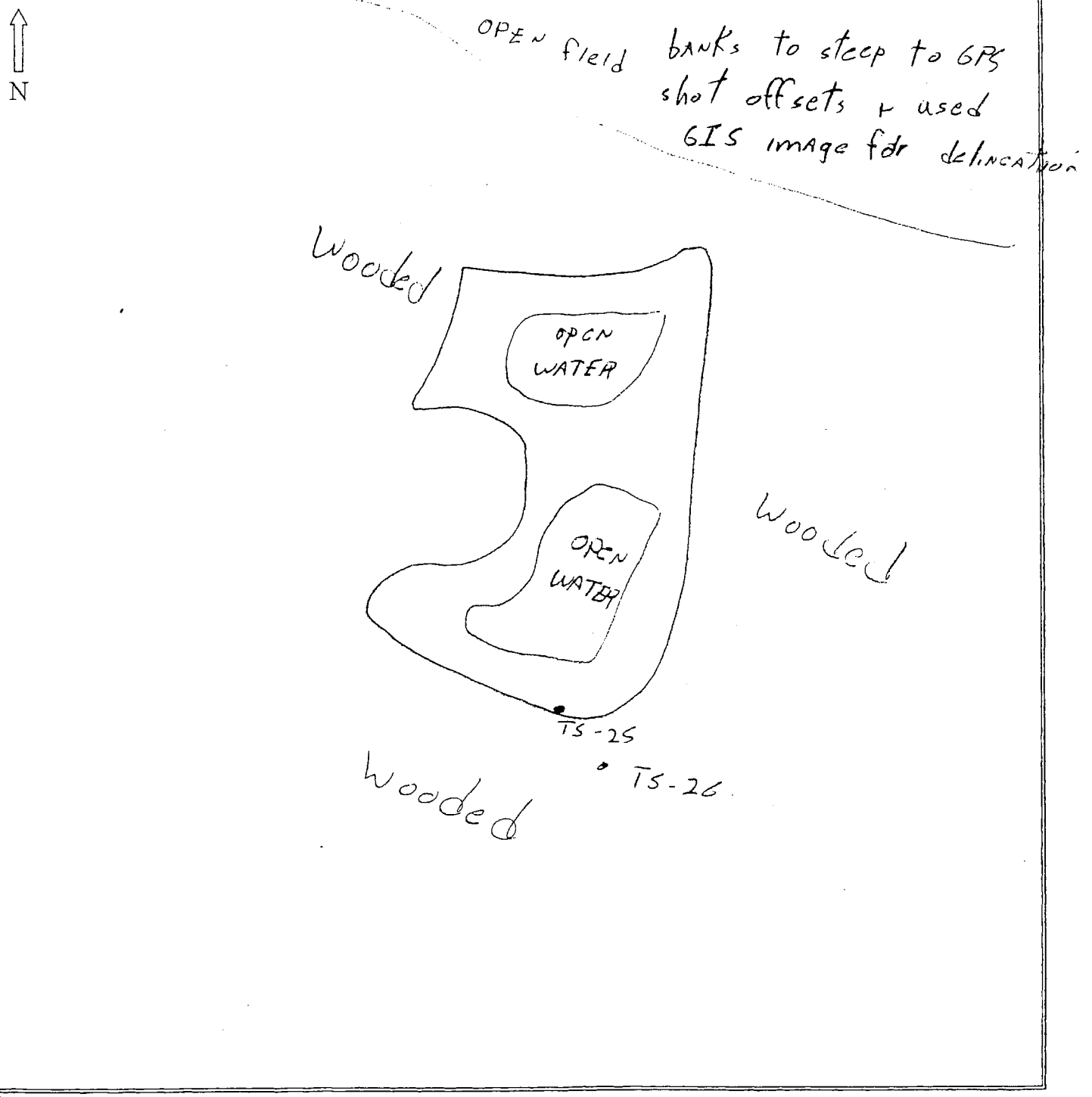
Remarks: MINE cut

Approved by HQUSACE 3/92

Project/Site: 060-608 Apex
Wetland ID: wetland N

Date: 5/28/08
Acre(s): 0.86

SKETCH MAP:



Notes:
1. Show approximate size and shape of wetland boundaries, adjacent drainage features (streams, ponds, etc.), photograph view, test site
2. Show approximate dimensions of major axes of wetland (i.e., length and width)

DATA FORM
ROUTINE WETLAND DETERMINATION
(1987 COE Wetlands Delineation Manual)

Project/Site: 080-608 / Apex Sanitary Landfill
Applicant/Owner: Apex Environmental, LLC
Investigator: Lance Opiela and Matt Lauffer

Date: 5-28-08
County: Jefferson
State: Ohio

Do Normal Circumstances exist on the site? Yes (No)
Is the site significantly disturbed (Atypical Situation)? (Yes) No
Is the area a potential Problem Area? Yes (No)
(If needed, explain on reverse.)

Community ID: 2nd growth forest
Transect ID: TS-24
Plot ID: wetland N out

VEGETATION

Dominant Plant Species	Stratum	Indicator
1. Ulmus rubra	tree	FAC+
2. Rosa multiflora	shrub	FACU
3. Fraxinus Americana	tree	FACU
4. Juglans nigra	tree	FACU
5. Urtica dioca	herb	FACU
6. Dactylis glomerata	herb	FACU
7. Glechoma hederacea	herb	FACU
8.		
9.		
10.		
11.		
12.		
13.		
14.		
15.		
16.		

Percent of Dominant Species that are OBL, FACW or FAC (excluding FAC-). 1/8 13%

Remarks:

HYDROLOGY

___ Recorded Data (Describe in Remarks):
___ Stream, Lake, or Tide Gauge
___ Aerial Photographs
___ Other
___ No Recorded Data Available

Field Observations:

Depth of Surface Water: 0 (in.)
Depth to Free Water in Pit: >16 (in.)
Depth to Saturated Soil: >16 (in.)

Wetland Hydrology Indicators:
Primary Indicators:
___ Inundated
___ Saturated in Upper 12 Inches
___ Water Marks
___ Drift Lines
___ Sediment Deposits
___ Drainage Patterns in Wetlands
Secondary Indicators (2 or more required):
___ Oxidized Root Channels in Upper 12 Inches
___ Water-Stained Leaves
___ Local Soil Survey Data
___ FAC-Neutral Test
___ Other (Explain in Remarks)

Remarks:

SOILS

Map Unit Name (Series and Phase): Morristown channery silt loam (MpF)

Drainage Class: well drained

Field Observations Confirm Mapped Type? Yes (No)

Taxonomy (Subgroup): Typic Udarthents

Profile Description:

Depth (inches)	Horizon	Matrix Color (Munsell Moist)	Mottle Colors (Munsell Moist)	Mottle Abundance/ Size/Contrast	Texture, Concretions, Structure, etc.
0-12	A	10YR 4/1	—	—	silty loam
12-16	B	10YR 6/1	10YR 4/6	C/D	silty loam

Hydric Soil Indicators:

___ Histosol
___ Histic Epipedon
___ Sulfidic Odor
___ Aquic Moisture Regime
___ Reducing Conditions
___ Gleyed or Low-Chroma Colors
___ Concretions
___ High Organic Content in Surface Layer in Sandy Soils
___ Organic Streaking in Sandy Soils
___ Listed on Local Hydric Soils List
___ Listed on National Hydric Soils List
___ Other (Explain in Remarks)

Remarks:

WETLAND DETERMINATION

Hydrophytic Vegetation Present? Yes (No) (Circle)
Wetland Hydrology Present? Yes No
Hydric Soils Present? (Yes) No

(Circle)
Is this Samplig Point Within a Wetland? Yes (No)

Remarks:

Approved by HQUSACE 3/92

DATA FORM
ROUTINE WETLAND DETERMINATION
(1987 COE Wetlands Delineation Manual)

Project/Site: 080-608 / Apex Sanitary Landfill
Applicant/Owner: Apex Environmental, LLC
Investigator: Lance Opiela and Matt Lauffer

Date: 5-28-08
County: Jefferson
State: Ohio

Do Normal Circumstances exist on the site? Yes (No)
Is the site significantly disturbed (Atypical Situation)? (Yes) No
Is the area a potential Problem Area? Yes (No)
(If needed, explain on reverse.)

Community ID: PAB/POW2x
Transect ID: TS-AS
Plot ID: wetland 0 W

VEGETATION

Dominant Plant Species	Stratum	Indicator
1. Salix nigra	shrub	FACW+
2. Lemna minor	sub	OBL
3. Glyceria striata	herb	OBL
4.		
5.		
6.		
7.		
8.		
9.		
10.		
11.		
12.		
13.		
14.		
15.		
16.		

Percent of Dominant Species that are OBL, FACW or FAC (excluding FAC-). 3/3 = 100

Remarks:

HYDROLOGY

___ Recorded Data (Describe in Remarks):
___ Stream, Lake, or Tide Gauge
___ Aerial Photographs
___ Other
___ No Recorded Data Available

Field Observations:

Depth of Surface Water: 6 (in.)
Depth to Free Water in Pit: 0 (in.)
Depth to Saturated Soil: 0 (in.)

Wetland Hydrology Indicators:
Primary Indicators:
X Inundated
X Saturated in Upper 12 Inches
___ Water Marks
___ Drift Lines
___ Sediment Deposits
___ Drainage Patterns in Wetlands
Secondary Indicators (2 or more required):
___ Oxidized Root Channels in Upper 12 Inches
X Water-Stained Leaves
___ Local Soil Survey Data
___ FAC-Neutral Test
___ Other (Explain in Remarks)

Remarks: edge of open water

SOILS

Map Unit Name (Series and Phase): Morristown shaly silty clay loam (MrF) Drainage Class: well drained

Field Observations

Taxonomy (Subgroup): Typic Udorthents Confirm Mapped Type? Yes (No)

Profile Description:

Depth (inches)	Horizon	Matrix Color (Munsell Moist)	Mottle Colors (Munsell Moist)	Mottle Abundance/ Size/Contrast	Texture, Concretions, Structure, etc.
0-16	A	2.5YR 6/1	2-5yr 6/3	F/F	clay

Hydric Soil Indicators:

- ___ Histosol
- ___ Histic Epipedon
- ___ Sulfidic Odor
- ___ Aquic Moisture Regime
- ___ Reducing Conditions
- X Gleyed or Low-Chroma Colors
- ___ Concretions
- ___ High Organic Content in Surface Layer in Sandy Soils
- ___ Organic Streaking in Sandy Soils
- ___ Listed on Local Hydric Soils List
- ___ Listed on National Hydric Soils List
- ___ Other (Explain in Remarks)

Remarks:

WETLAND DETERMINATION

Hydrophytic Vegetation Present?	(Yes) No (Circle)	(Circle)
Wetland Hydrology Present?	(Yes) No	Is this Samplig Point Within a Wetland? (Yes) No
Hydric Soils Present?	(Yes) No	

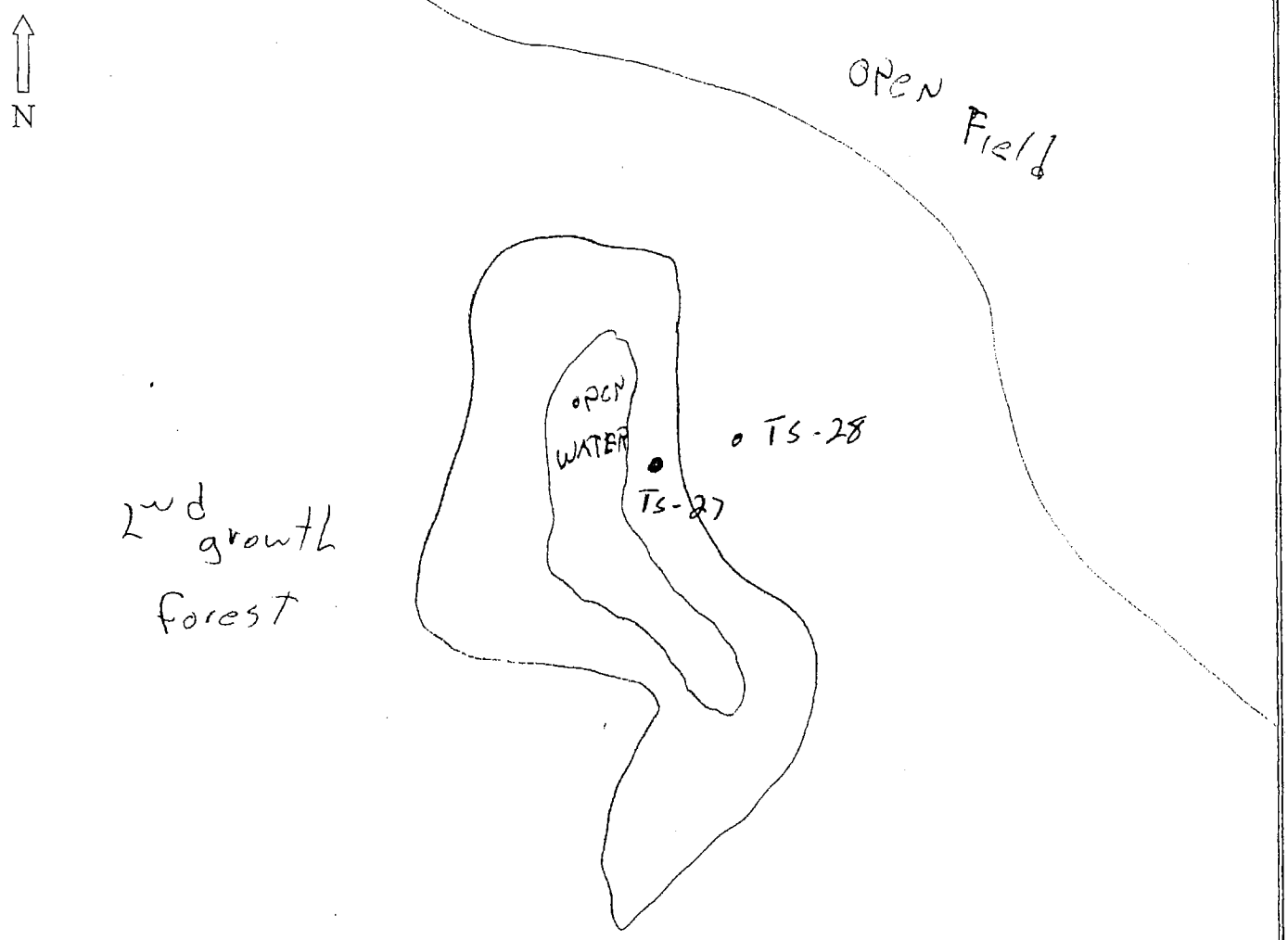
Remarks: mwc cnt

Approved by HQUSACE 3/92

Project/Site: 080-608 Apex
Wetland ID: Wetland D

Date: 5-28-08
Acre(s): 0.27

SKETCH MAP:



Notes:
1. Show approximate size and shape of wetland boundaries, adjacent drainage features (streams, ponds, etc.), photograph view, test site
2. Show approximate dimensions of major axes of wetland (i.e., length and width)

DATA FORM
ROUTINE WETLAND DETERMINATION
(1987 COE Wetlands Delineation Manual)

Project/Site: 080-608 / Apex Sanitary Landfill Applicant/Owner: Apex Environmental, LLC Investigator: Lance Opiela and Matt Lauffer	Date: 5-28-08 County: Jefferson State: Ohio
Do Normal Circumstances exist on the site? Yes (No) Is the site significantly disturbed (Atypical Situation)? (Yes) No Is the area a potential Problem Area? Yes (No) (If needed, explain on reverse.)	Community ID: 2nd growth forest Transect ID: TS-26 Plot ID: wetland 0 out

VEGETATION

Dominant Plant Species	Stratum	Indicator	Dominant Plant Species	Stratum	Indicator
1. Ulmus rubra	tree	FAC+	9.		
2. Rosa multiflora	shrub	FACU	10.		
3. Fraxinus americana	tree	FACU	11.		
4. Sugars nigra	tree	FACU	12.		
5. Urtica dioica	herb	FACU	13.		
6. Dactylis glomerata	herb	FACU	14.		
7. Glechoma hederacea	herb	FACU	15.		
8.			16.		

Percent of Dominant Species that are OBL, FACW or FAC (excluding FAC-). 1/8 = 13%

Remarks:

HYDROLOGY

___ Recorded Data (Describe in Remarks):
- ___ Stream, Lake, or Tide Gauge
- ___ Aerial Photographs
- ___ Other

___ No Recorded Data Available

Field Observations:

Depth of Surface Water: 0 (in.)

Depth to Free Water in Pit: >16 (in.)

Depth to Saturated Soil: >16 (in.)

Wetland Hydrology Indicators:
Primary Indicators:
- ___ Inundated
- ___ Saturated in Upper 12 Inches
- ___ Water Marks
- ___ Drift Lines
- ___ Sediment Deposits
- ___ Drainage Patterns in Wetlands

Secondary Indicators (2 or more required):
- ___ Oxidized Root Channels in Upper 12 Inches
- ___ Water-Stained Leaves
- ___ Local Soil Survey Data
- ___ FAC-Neutral Test
- ___ Other (Explain in Remarks)

Remarks:

SOILS

Map Unit Name (Series and Phase): Morristown channery silt loam (MpF) Drainage Class: well drained

Field Observations

Taxonomy (Subgroup): Typic Udorthents Confirm Mapped Type? Yes (No)

Profile Description:

Depth (inches)	Horizon	Matrix Color (Munsell Moist)	Mottle Colors (Munsell Moist)	Mottle Abundance/ Size/Contrast	Texture, Concretions, Structure, etc.
0-16	A	10YR 4/1	-	-	silty loam

Hydric Soil Indicators:

___ Histosol
___ Histic Epipedon
___ Sulfidic Odor
___ Aquic Moisture Regime
___ Reducing Conditions
___ Gleyed or Low-Chroma Colors
___ Concretions
___ High Organic Content in Surface Layer in Sandy Soils
___ Organic Streaking in Sandy Soils
___ Listed on Local Hydric Soils List
___ Listed on National Hydric Soils List
___ Other (Explain in Remarks)

Remarks:

WETLAND DETERMINATION

Hydrophytic Vegetation Present? Yes (No) (Circle)
Wetland Hydrology Present? Yes (No)
Hydric Soils Present? (Yes) No

(Circle)
Is this Samplig Point Within a Wetland? Yes (No)

Remarks:

Approved by HQUSACE 3/92

DATA FORM
ROUTINE WETLAND DETERMINATION
(1987 COE Wetlands Delineation Manual)

Project/Site: 080-608 / Apex Sanitary Landfill Applicant/Owner: Apex Environmental, LLC Investigator: Lance Opiela and Matt Lauffer	Date: 5-28-08 County: Jefferson State: Ohio
Do Normal Circumstances exist on the site? Yes (No) Is the site significantly disturbed (Atypical Situation)? (Yes) No Is the area a potential Problem Area? Yes (No) (If needed, explain on reverse.)	Community ID: PEM/PAB/POWZx Transect ID: TS 27 Plot ID: Wetland Q in

VEGETATION

Dominant Plant Species	Stratum	Indicator	Dominant Plant Species	Stratum	Indicator
1. Typha angustifolia	Herb	OBL	9.		
2.			10.		
3.			11.		
4.			12.		
5.			13.		
6.			14.		
7.			15.		
8.			16.		

Percent of Dominant Species that are OBL, FACW or FAC (excluding FAC-). 100

Remarks:
Typha > 95% cover

HYDROLOGY

___ Recorded Data (Describe in Remarks):
___ Stream, Lake, or Tide Gauge
___ Aerial Photographs
___ Other
___ No Recorded Data Available

Field Observations:

Depth of Surface Water: 3 (in.)

Depth to Free Water in Pit: 0 (in.)

Depth to Saturated Soil: 0 (in.)

Wetland Hydrology Indicators:
Primary Indicators:
X Inundated
X Saturated in Upper 12 Inches
___ Water Marks
___ Drift Lines
___ Sediment Deposits
X Drainage Patterns in Wetlands
Secondary Indicators (2 or more required):
___ Oxidized Root Channels in Upper 12 Inches
___ Water-Stained Leaves
___ Local Soil Survey Data
___ FAC-Neutral Test
___ Other (Explain in Remarks)

Remarks:

SOILS

Map Unit Name (Series and Phase): Morristown channery silt loam (MpF) Drainage Class: well drained
Field Observations
Taxonomy (Subgroup): Typic Udorthents Confirm Mapped Type? Yes (No)

Profile Description:

Depth (inches)	Horizon	Matrix Color (Munsell Moist)	Mottle Colors (Munsell Moist)	Mottle Abundance/ Size/Contrast	Texture, Concretions, Structure, etc.
0-1	O		-	-	fine organic
1-16	A	10YR 4/1	-	-	silt

Hydric Soil Indicators:

- ___ Histosol
- ___ Histic Epipedon
- X Sulfidic Odor
- X Aquic Moisture Regime
- X Reducing Conditions
- X Gleyed or Low-Chroma Colors
- ___ Concretions
- ___ High Organic Content in Surface Layer in Sandy Soils
- ___ Organic Streaking in Sandy Soils
- ___ Listed on Local Hydric Soils List
- ___ Listed on National Hydric Soils List
- ___ Other (Explain in Remarks)

Remarks:

WETLAND DETERMINATION

Hydrophytic Vegetation Present?	(Yes) No (Circle)	(Circle)
Wetland Hydrology Present?	(Yes) No	Is this Samplig Point Within a Wetland? (Yes) No
Hydric Soils Present?	(Yes) No	

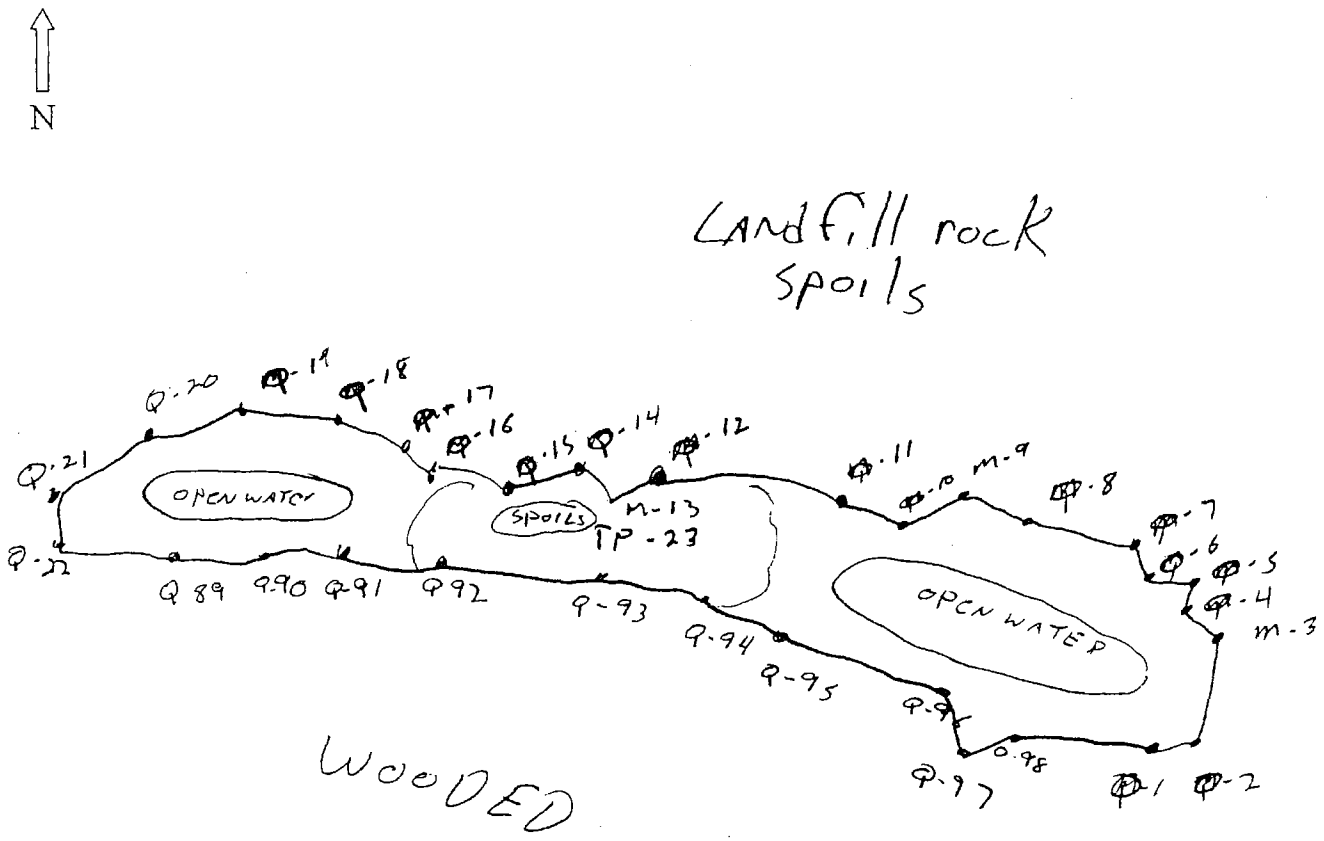
Remarks: Mine cut

Approved by HQUSACE 3/92

Project/Site: CBO-608 Apex
Wetland ID: Wetland Q

Date: 5-28-08
Acre(s): 1.75

SKETCH MAP:



Notes:
1. Show approximate size and shape of wetland boundaries, adjacent drainage features (streams, ponds, etc.), photograph view, test site
2. Show approximate dimensions of major axes of wetland (i.e., length and width)

DATA FORM
ROUTINE WETLAND DETERMINATION
(1987 COE Wetlands Delineation Manual)

Project/Site: 080-608 / Apex Sanitary Landfill Applicant/Owner: Apex Environmental, LLC Investigator: Lance Opiela and Matt Lauffer	Date: 5-28-08 County: Jefferson State: Ohio
Do Normal Circumstances exist on the site? (Yes) No Is the site significantly disturbed (Atypical Situation)? Yes (No) Is the area a potential Problem Area? Yes (No) (If needed, explain on reverse.)	Community ID: herb Transect ID: TS 28 Plot ID: wetland Q out

VEGETATION

Dominant Plant Species	Stratum	Indicator
1. Rosa multiflora	shrub	FACU
2. Ulmus rubra	shrub	FAC+
3. yellow hardwood	herb	
4. Apocynum cannabinum	herb	FACU
5. Solidago canadensis	herb	FACU
6. Dicanthelium clandestinum	herb	FAC
7. Rubus allegheniensis	shrub	FACU
8. Achillea millefolium	herb	FACU

Dominant Plant Species	Stratum	Indicator
9.		
10.		
11.		
12.		
13.		
14.		
15.		
16.		

Percent of Dominant Species that are OBL, FACW or FAC (excluding FAC-). 25%

Remarks:

HYDROLOGY

___ Recorded Data (Describe in Remarks):
- ___ Stream, Lake, or Tide Gauge
- ___ Aerial Photographs
- ___ Other

___ No Recorded Data Available

Field Observations:

Depth of Surface Water: _____ (in.)

Depth to Free Water in Pit: _____ (in.)

Depth to Saturated Soil: >16 (in.)

Wetland Hydrology Indicators:

Primary Indicators:
- ___ Inundated
- ___ Saturated in Upper 12 Inches
- ___ Water Marks
- ___ Drift Lines
- ___ Sediment Deposits
- ___ Drainage Patterns in Wetlands

Secondary Indicators (2 or more required):
- ___ Oxidized Root Channels in Upper 12 Inches
- ___ Water-Stained Leaves
- ___ Local Soil Survey Data
- ___ FAC-Neutral Test
- ___ Other (Explain in Remarks)

Remarks:

SOILS

Map Unit Name (Series and Phase): Morristown channery silt loam (MpF)

Drainage Class: well drained

Taxonomy (Subgroup): Typic Udorthents

Field Observations Confirm Mapped Type? Yes (No)

Profile Description:

Depth (inches)	Horizon	Matrix Color (Munsell Moist)	Mottle Colors (Munsell Moist)	Mottle Abundance/ Size/Contrast	Texture, Concretions, Structure, etc.
0-2	A	10YR 2/2	-	-	silt loam
2-16	B	10YR 4/1	7.5YR 3/4	c/D	silt loam

Hydric Soil Indicators:

- ___ Histosol
- ___ Histic Epipedon
- ___ Sulfidic Odor
- ___ Aquic Moisture Regime
- ___ Reducing Conditions
- X Gleyed or Low-Chroma Colors
- ___ Concretions
- ___ High Organic Content in Surface Layer in Sandy Soils
- ___ Organic Streaking in Sandy Soils
- ___ Listed on Local Hydric Soils List
- ___ Listed on National Hydric Soils List
- ___ Other (Explain in Remarks)

Remarks:

WETLAND DETERMINATION

Hydrophytic Vegetation Present? Yes (No) (Circle)

Wetland Hydrology Present? Yes (No)

Hydric Soils Present? (Yes) No

(Circle)

Is this Samplig Point Within a Wetland? Yes (No)

Remarks:

Approved by HQUSACE 3/92

DATA FORM
ROUTINE WETLAND DETERMINATION
(1987 COE Wetland Delineation Manual)

Test Site 29 Wetland P

Project/Site: Apex Landfill				Date: 14 Sept 2010
Applicant/Owner: Apex Environmental, LLC				County: Jefferson
Investigator(s): Mike A. Takacs, Ryan Barnhill				State: Ohio
Do normal circumstances exist on the site?	Yes ✓	No		Community ID: Wetland P
Is the site significantly disturbed (Atypical?)	Yes	No ✓		Plot ID:
Is the area a potential problem area?	Yes	No ✓		Test Site 29
(if needed, explain on reverse.)				

VEGETATION

	Dominant Plant Species:	Stratum:	Indicator:		Dominant Plant Species:	Stratum:	Indicator:
1.	Typha angustifolia	H	OBL	11.			
2.	Onoclea sensibilis	H	FACW	12.			
3.	Eupatorium perfoliatum	H	FACW+	13.			
4.	Equisetum arvense	H	FAC	14.			
5.	Epilobium coloratum	H	OBL	15.			
6.				16.			
7.				17.			
8.				18.			
9.				19.			
10.				20.			

Percent of dominant species that are OBL, FACW or FAC (and excluding FAC-) = 100% (5/5)

Remarks:
Greater than 50% of the dominant plant species are hydrophytes. Therefore, the hydrophytic vegetation criterion is satisfied.

HYDROLOGY

Recorded Data (Describe in Remarks)
Stream, Lake, or Tide Gauge
✓ Aerial Photographs
✓ No Recorded Data Available

Field Observations:

Depth of Surface Water: 5 (inches)

Depth to Free Water in Pit: 11 (inches)

Depth to Saturated Soil: 21 (inches)

Wetland Hydrology Indicators:
Primary Indicators:
Inundated
X Saturated in upper 12 inches
Water Marks
Drift Lines
X Sediment Deposits
X Drainage Patterns in Wetlands

Secondary Indicators:
Oxidized Root Channels in Upper 12 Inches
Water Stained Leaves
Local Soil Survey Data
FAC-Neutral Test
Others (Explain in Remarks)

Remarks:
Primary indicators of wetland hydrology were observed at the test site. Therefore, the wetland hydrology criterion is satisfied.

Project/Site: Apex Sanitrary Landfill
Site/Area ID: Test Site 29 - Wetland P

SOILS

Map Unit Name:
(Series and Phase): Gilpin-Iredell silt loams, 8-15% (GpC) Drainage Class: well drained
(Taxonomy Subgroup): Typic Hapludults, Typic Hapludalfs Field Observations Confirm Mapped Type?
Yes _____ No X

Profile Description:

Depth (inches):	Horizon:	Matrix Color (Munsell Moist):	Mottle Colors (Munsell Moist):	Mottle (Abundance/Size):	Texture, Concretions, Structure:
0-16	A	10YR 3/1	None	NA	silt clay

Hydric Soil Indicators:

_____	Histosol	_____	Concretions
_____	Histic Epipedon	_____	High Organic Content in Surface Layer in Sandy Soils
_____	Sulfidic Odor	_____	Organic Streaking in Sandy Soil
_____	Aquic Moisture Regimes	_____	Listed on Local Hydric Soils List
_____	Reducing Conditions	_____	Listed on National Hydric Soils List
✓	Gleyed or Low Chroma Colors	_____	Other (Explain in Remarks)

Remarks:
A field indicator of hydric soil conditions was observed in the test pit, Therefore, the hydric soil criterion is satisfied.

WETLAND DETERMINATION

Hydrophytic Vegetation Present?	Yes ✓	No _____	Is this Sampling Point Within a Wetland?	
Wetland Hydrology Present?	Yes ✓	No _____	Yes ✓	
Hydric Soils Present?	Yes ✓	No _____	No _____	

Remarks:
It was determined that this test site is located in a wetland area based on the presence of hydrophytic vegetation, wetland hydrology, and hydric soils.

DATA FORM
ROUTINE WETLAND DETERMINATION
(1987 COE Wetland Delineation Manual)

Test Site 30 Wetland Non-wetland

Project/Site: Apex Sanitary Landfill Applicant/Owner: Apex Environmental, LLC Investigator(s): Mike A. Takacs	Date: 14 Sept 2010 County: Jefferson State: Ohio
Do normal circumstances exist on the site? Yes ✓ No Is the site significantly disturbed (Atypical?) Yes No ✓ Is the area a potential problem area? Yes No ✓ (if needed, explain on reverse.)	Community ID: Upland Forest Plot ID: Test Site 30

VEGETATION

	Dominant Plant Species:	Stratum:	Indicator:		Dominant Plant Species:	Stratum:	Indicator:
1.	Quercus rubra	T	FACU-	11.			
2.	Fraxinus americana	T	FACW	12.			
3.	Elaeagnus umbellata	S	UPL	13.			
4.	Asimina triloba	S	FACU+	14.			
5.	Carya ovata	S	FACU-	15.			
6.	Equisetum arvense	H	FAC	16.			
7.	Senecio aureus	H	FACW	17.			
8.	Ageratina altissima	H	FACU	18.			
9.				19.			
10.				20.			

Percent of dominant species that are OBL, FACW or FAC (and excluding FAC-) = 25 % (2/8)

Remarks: Less than 50% of the dominant plant species are hydrophytes. Therefore, the hydrophytic vegetation criterion is not satisfied.

HYDROLOGY

_____ Recorded Data (Describe in Remarks) _____ Stream, Lake, or Tide Gauge _____ Aerial Photographs ✓ No Recorded Data Available	**Wetland Hydrology Indicators:** Primary Indicators: _____ Inundated _____ Saturated in upper 12 inches _____ Water Marks _____ Drift Lines _____ Sediment Deposits _____ Drainage Patterns in Wetlands Secondary Indicators: _____ Oxidized Root Channels in Upper 12 Inches _____ Water Stained Leaves _____ Local Soil Survey Data _____ FAC-Neutral Test _____ Others (Explain in Remarks)
Field Observations: Depth of Surface Water: None (inches) Depth to Free Water in Pit: > 16 (inches) Depth to Saturated Soil: > 16 (inches)	

Remarks: Primary and secondary indicators of wetland hydrology were not observed at the test site. Therefore, the wetland hydrology criterion is not satisfied.

Project/Site: Apex Sanitary Landfill
Site/Area ID: Test Site 30, Non-wetland - upland forest

SOILS

Map Unit Name:
(Series and Phase): Gilpin-Lawell silt loams, 8-15% (GpC) Drainage Class: well drained
(Taxonomy Subgroup): Typic Hapludults / Typic Hapludalfs Field Observations Confirm Mapped Type?
Yes ✓ No

Profile Description:

Depth (inches):	Horizon:	Matrix Color (Munsell Moist):	Mottle Colors (Munsell Moist):	Mottle (Abundance/Size):	Texture, Concretions, Structure:
0-4	A	10YR 3/2	None	NA	silt loam
4-16	B	10YR 5/6	None	NA	silt loam

Hydric Soil Indicators:

	Histosol		Concretions
	Histic Epipedon		High Organic Content in Surface Layer in Sandy Soils
	Sulfidic Odor		Organic Streaking in Sandy Soil
	Aquic Moisture Regimes		Listed on Local Hydric Soils List
	Reducing Conditions		Listed on National Hydric Soils List
	Gleyed or Low Chroma Colors		Other (Explain in Remarks)

Remarks:
Field indicators of hydric soil conditions were not observed in the upper portion of the B horizon in the test pit. Therefore, the hydric soil criterion is not satisfied

WETLAND DETERMINATION

Hydrophytic Vegetation Present?	Yes		No	✓
Wetland Hydrology Present?	Yes		No	✓
Hydric Soils Present?	Yes		No	✓

Is this Sampling Point Within a Wetland?
Yes
No ✓

Remarks: It was determined that this test site is not located within a wetland due to the absence of hydrophytic vegetation, wetland hydrology, and hydric soils.

DATA FORM
ROUTINE WETLAND DETERMINATION
(1987 COE Wetland Delineation Manual)

Test Site 31 Wetland Non-wetland

Project/Site: Apex Sanitary Landfill	Date: 15 Sept 2010
Applicant/Owner: Apex Environmental, LLC	County: Jefferson
Investigator(s): Mike A. Takacs, Ryan Barnhill	State: Ohio
Do normal circumstances exist on the site? Yes ✓ No	Community ID: Upland Forest
Is the site significantly disturbed (Atypical?) Yes No ✓	Plot ID: Test Site 31
Is the area a potential problem area? Yes No ✓	
(if needed, explain on reverse.)	

VEGETATION

	Dominant Plant Species:	Stratum:	Indicator:		Dominant Plant Species:	Stratum:	Indicator:
1.	Quercus rubra	T	FACU-	11.			
2.	Acer saccharum	T	FACU-	12.			
3.	Asimina triloba	T	FACU+	13.			
4.	Elaeagnus umbellata	S	UPL	14.			
5.	Parthenocissus quinquefolia	WV	FACU	15.			
6.	Carex pensylvanica	H	UPL	16.			
7.	Ageratina altissima	H	FACU	17.			
8.	Polystichum acrostichoides	H	FACU-	18.			
9.				19.			
10.				20.			

Percent of dominant species that are OBL, FACW or FAC (and excluding FAC-) = 0 % (0/8)

Remarks: Less than 50% of the dominant plant species are hydrophytes. Therefore, the hydrophytic vegetation criterion is not satisfied.

HYDROLOGY

Recorded Data (Describe in Remarks)
Stream, Lake, or Tide Gauge
✓ Aerial Photographs
✓ No Recorded Data Available

Field Observations:

Depth of Surface Water: None (inches)

Depth to Free Water in Pit: >16 (inches)

Depth to Saturated Soil: >16 (inches)

Wetland Hydrology Indicators:

Primary Indicators:
- Inundated
- Saturated in upper 12 inches
- Water Marks
- Drift Lines
- Sediment Deposits
- Drainage Patterns in Wetlands

Secondary Indicators:
- Oxidized Root Channels in Upper 12 Inches
- Water Stained Leaves
- Local Soil Survey Data
- FAC-Neutral Test
- Others (Explain in Remarks)

Remarks: Primary and secondary indicators of wetland hydrology were not observed at the test site. Therefore, the wetland hydrology criterion is not satisfied.

Project/Site: Apex Sanitary Landfill
Site/Area ID: Test Site 31, Non-wetland

SOILS

Map Unit Name:
(Series and Phase): Gilpin-Howell silt loams, 8-15%(6pc) Drainage Class: well drained
(Taxonomy Subgroup): Typic Hapludults, Typic Hapludalfs Field Observations Confirm Mapped Type?
Yes ✓ No ____

Profile Description:

Depth (inches):	Horizon:	Matrix Color (Munsell Moist):	Mottle Colors (Munsell Moist):	Mottle (Abundance/Size):	Texture, Concretions, Structure:
0-3	A	10YR 4/3	None	NA	silt loam
3-11	B	10YR 6/6	None	NA	silt loam
11	Refusal on roots				

Hydric Soil Indicators:

____	Histosol	____	Concretions
____	Histic Epipedon	____	High Organic Content in Surface Layer in Sandy Soils
____	Sulfidic Odor	____	Organic Streaking in Sandy Soil
____	Aquic Moisture Regimes	____	Listed on Local Hydric Soils List
____	Reducing Conditions	____	Listed on National Hydric Soils List
____	Gleyed or Low Chroma Colors	____	Other (Explain in Remarks)

Remarks:
Field indicators of hydric soil conditions were not observed at the test pit. Therefore, the hydric soil criterion is not satisfied.

WETLAND DETERMINATION

Hydrophytic Vegetation Present?	Yes ____	No	✓	Is this Sampling Point Within a Wetland?
Wetland Hydrology Present?	Yes ____	No	✓	Yes ____
Hydric Soils Present?	Yes ____	No	✓	No ✓

Remarks:
It was determined that this test site is not located in a wetland area based on the absence of hydrophytic vegetation, wetland hydrology, and hydric soils.

APPENDIX B

PHOTOGRAPHS

Apex Landfill Expansion,
Harrison and Jefferson Counties, Ohio

Photograph 1: Wetland A viewed to the northeast.
June 17, 2010

Photograph 2: Wetland B viewed to the northeast.
June 17, 2010

Photograph 3: Wetland C viewed to the south.
June 17, 2010

Photograph 4: Wetland D viewed to the north.
June 17, 2010

Photograph 5: Wetland E viewed to the west.
June 18, 2010

Photograph 6: Wetland F viewed to the west.
June 18, 2010

Apex Landfill Expansion,
Harrison and Jefferson Counties, Ohio

Photograph 7: Wetland G (North) viewed to the north.
March 26, 2008

Photograph 8: Wetland G viewed to the south.
March 26, 2008

Photograph 9: Wetland H viewed to the south.
July 1, 2010

Photograph 10: Wetland I viewed to the west.
March 26, 2008

Photograph 11: Wetland J viewed to the south.
July 1, 2010

Photograph 12: Wetland K viewed to the northeast.
July 1, 2010

Photograph 13: Wetland L viewed to the northeast.
July 1, 2010

Photograph 14: Wetland M viewed to the west.
July 1, 2010

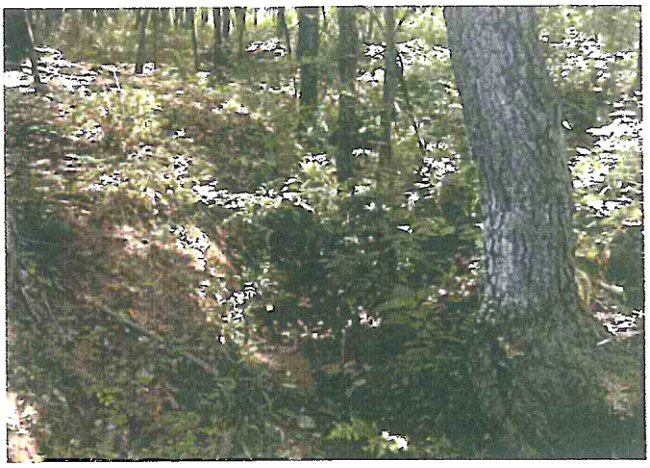
Photograph 15: Wetland N viewed to the south.
June 17, 2010

Photograph 16: Wetland O viewed to the south.
June 17, 2010

Photograph 17: Wetland P viewed to the south.
June 18, 2010

Photograph 18: Wetland Q viewed to the northwest.
July 1, 2010

Apex Landfill Expansion,
Harrison and Jefferson Counties, Ohio



Photograph 20: Stream 1 (intermittent) viewed upstream. June 18, 2010.

Photograph 21: Stream 2 (ephemeral) viewed upstream. July 1, 2010.

Photograph 22: Stream 3a (intermittent) viewed upstream. June 18, 2010.

Photograph 23: Stream 3a (ephemeral) viewed upstream. June 18, 2010.

Photograph 24: Stream 3b (ephemeral) viewed upstream. June 18, 2010.

APPENDIX C

ORAM DATA FORMS

Version 5.0	Ohio Rapid Assessment Method for Wetlands 10 Page Form for Wetland Categorization	
	Background Information **Scoring Boundary Worksheet** **Narrative Rating** **Field Form Quantitative Rating** **ORAM Summary Worksheet** **Wetland Categorization Worksheet**	Ohio EPA, Division of Surface Water Final: February 1, 2001

Instructions

The investigator is *STRONGLY URGED* to read the Manual for Using the Ohio Rapid Assessment Method for Wetlands for further elaboration and discussion of the questions below prior to using the rating forms.

The Narrative Rating is designed to categorize a wetland or to provide alerts to the Rater based on the presence or possible presence of threatened or endangered species. The presence or proximity of such species is often an indicator of the quality and lack of disturbance of the wetland being evaluated. In addition, it is designed to categorize certain wetlands as very low quality (Category 1) or very high quality (Category 3) regardless of the wetland's score on the Quantitative Rating. In addition, the Narrative Rating also alerts the investigator that a particular wetland *may* be a Category 3 wetland, again, regardless of the wetland's score on the Quantitative Rating.

It is *VERY IMPORTANT* to properly and thoroughly answer each of the questions in the ORAM in order to properly categorize a wetland. To *properly* answer all the questions, the boundaries of the wetland being assessed must be correctly identified. Refer to Scoring Boundary worksheet and the User's Manual for a discussion of how to determine the "scoring boundaries." In some instances, the scoring boundaries may differ from the "jurisdictional boundaries."

Refer to the most recent ORAM Score Calibration Report for the scoring breakpoints between wetland categories. The most recent version of this document is posted on Ohio EPA's Division of Surface Water web page at: http://www.epa.ohio.gov/dsw/wetlands/WetlandEcologySection.aspx

Background Information

Name:	Michael A. Takacs, Mark R. Haibach
Date:	30 July 2010
Affiliation:	Civil & Environmental Consultants, Inc.
Address:	333 Baldwin Road, Pittsburgh, PA 15205
Phone Number:	(412) 249-3188, (412)249-3156
e-mail address:	mtakacs@cecinc.com, mhaibach@cecinc.com
Name of Wetland:	Wetland A
Vegetation Communit(ies):	PEM1, POWZ/AB2
HGM Class(es):	SWD, GWD

Location of Wetland: include map, address, north arrow, landmarks, distances, roads, etc.

See Stream and Wetland Delineation Report, Figures 1 and 4.

Lat/Long or UTM Coordinate	
USGS Quad Name: Amsterdam, OH	
County: Jefferson	
Township: Springfield	
Section and Subsection	
Hydrologic Unit Code: 05030101340	
Site Visit: 30 July 2010	
National Wetland Inventory Map: Amsterdam, OH	
Ohio Wetland Inventory Map: —	
Soil Survey: Soil Survey of Jefferson County, Ohio	
Delineation report/map: Wetland and Stream Delineation and Functional Assessment Report, Potential Apex Sanitary Landfill Expansion, CEC 2010.	

Name of Wetland: Wetland A

Wetland Size (acres, hectares): 2.16 acres wetlands + 0.78 acre open water

Sketch: Include north arrow, relationship with other surface waters, vegetation zones, etc.

See Stream and Wetland Delineation Map (Figure 4)

Comments, Narrative Discussion, Justification of Category Changes:

Final score : 42 Category: mod. 2

Scoring Boundary Worksheet

INSTRUCTIONS. The initial step in completing the ORAM is to identify the "scoring boundaries" of the wetland being rated. In many instances this determination will be relatively easy and the scoring boundaries will coincide with the "jurisdictional boundaries." For example, the scoring boundary of an isolated cattail marsh located in the middle of a farm field will likely be the same as that wetland's jurisdictional boundaries. In other instances, however, the scoring boundary will not be as easily determined. Wetlands that are small or isolated from other surface waters often form large contiguous areas or heterogeneous complexes of wetland and upland. In separating wetlands for scoring purposes, the hydrologic regime of the wetland is the main criterion that should be used. Boundaries between contiguous or connected wetlands should be established where the volume, flow, or velocity of water moving through the wetland changes significantly. *Areas with a high degree of hydrologic interaction should be scored as a single wetland.* In determining a wetland's scoring boundaries, use the guidelines in the ORAM Manual Section 5.0. In certain instances, it may be difficult to establish the scoring boundary for the wetland being rated. These problem situations include wetlands that form a patchwork on the landscape, wetlands divided by artificial boundaries like property fences, roads, or railroad embankments, wetlands that are contiguous with streams, lakes, or rivers, and estuarine or coastal wetlands. These situations are discussed below, however, it is recommended that Rater contact Ohio EPA, Division of Surface Water, 401/Wetlands Section if there are additional questions or a need for further clarification of the appropriate scoring boundaries of a particular wetland.

#	Steps in properly establishing scoring boundaries	done?	not applicable
Step 1	Identify the wetland area of interest. This may be the site of a proposed impact, a reference site, conservation site, etc.	Yes	
Step 2	Identify the locations where there is physical evidence that hydrology changes rapidly. Such evidence includes both natural and human-induced changes including, constrictions caused by berms or dikes, points where the water velocity changes rapidly at rapids or falls, points where significant inflows occur at the confluence of rivers, or other factors that may restrict hydrologic interaction between the wetlands or parts of a single wetland.	Yes	
Step 3	Delineate the boundary of the wetland to be rated such that all areas of interest that are contiguous to and within the areas where the hydrology does not change significantly, i.e. areas that have a high degree of hydrologic interaction are included within the scoring boundary.	Yes	
Step 4	Determine if artificial boundaries, such as property lines, state lines, roads, railroad embankments, etc., are present. These should not be used to establish scoring boundaries unless they coincide with areas where the hydrologic regime changes.	Yes	
Step 5	In all instances, the Rater may enlarge the minimum scoring boundaries discussed here to score together wetlands that could be scored separately.	Yes	
Step 6	Consult ORAM Manual Section 5.0 for how to establish scoring boundaries for wetlands that form a patchwork on the landscape, divided by artificial boundaries, contiguous to streams, lakes or rivers, or for dual classifications.	Yes	

End of Scoring Boundary Determination. Begin Narrative Rating on next page.

Apex Sanitary Landfill
Wetland A
30 July 2010

Narrative Rating

INSTRUCTIONS. Answer each of the following questions. Questions 1, 2, 3 and 4 should be answered based on information obtained from the site visit or the literature *and* by submitting a Data Services Request to the Ohio Department of Natural Resources, Division of Natural Areas and Preserves, Natural Heritage Data Services, 1889 Fountain Square Court, Building F-1, Columbus, Ohio 43224, 614-265-6453 (phone), 614-265-3096 (fax), http://www.dnr.state.oh.us/dnap . The remaining questions are designed to be answered primarily by the results of the site visit. Refer to the User's Manual for descriptions of these wetland types. Note: "Critical habitat" is legally defined in the Endangered Species Act and is the geographic area containing physical or biological features essential to the conservation of a listed species or as an area that may require special management considerations or protection. The Rater should contact the Region 3 Headquarters or the Columbus Ecological Services Office for updates as to whether critical habitat has been designated for other federally listed threatened or endangered species. "Documented" means the wetland is listed in the appropriate State of Ohio database.

#	Question	Circle one	
1	**Critical Habitat.** Is the wetland in a township, section, or subsection of a United States Geological Survey 7.5 minute Quadrangle that has been designated by the U.S. Fish and Wildlife Service as "critical habitat" for any threatened or endangered plant or animal species? Note: as of January 1, 2001, of the federally listed endangered or threatened species which can be found in Ohio, the Indiana Bat has had critical habitat designated (50 CFR 17.95(a)) and the piping plover has had critical habitat proposed (65 FR 41812 July 6, 2000).	YES Wetland should be evaluated for possible Category 3 status Go to Question 2	(NO) Go to Question 2
2	**Threatened or Endangered Species.** Is the wetland known to contain an individual of, or documented occurrences of federal or state-listed threatened or endangered plant or animal species?	YES Wetland is a Category 3 wetland. Go to Question 3	(NO) Go to Question 3
3	**Documented High Quality Wetland.** Is the wetland on record in Natural Heritage Database as a high quality wetland?	YES Wetland is a Category 3 wetland Go to Question 4	(NO) Go to Question 4
4	**Significant Breeding or Concentration Area.** Does the wetland contain documented regionally significant breeding or nonbreeding waterfowl, neotropical songbird, or shorebird concentration areas?	YES Wetland is a Category 3 wetland Go to Question 5	(NO) Go to Question 5
5	**Category 1 Wetlands.** Is the wetland less than 0.5 hectares (1 acre) in size and **hydrologically isolated** and either 1) comprised of vegetation that is dominated (greater than eighty per cent areal cover) by *Phalaris arundinacea, Lythrum salicaria,* or *Phragmites australis*, or 2) an acidic pond created or excavated on mined lands that has little or no vegetation?	YES Wetland is a Category 1 wetland Go to Question 6	(NO) Go to Question 6
6	**Bogs.** Is the wetland a peat-accumulating wetland that 1) has no significant inflows or outflows, 2) supports acidophilic mosses, particularly *Sphagnum* spp., 3) the acidophilic mosses have >30% cover, 4) at least one species from Table 1 is present, and 5) the cover of invasive species (see Table 1) is <25%?	YES Wetland is a Category 3 wetland Go to Question 7	(NO) Go to Question 7
7	**Fens.** Is the wetland a carbon accumulating (peat, muck) wetland that is saturated during most of the year, primarily by a discharge of free flowing, mineral rich, ground water with a circumneutral ph (5.5-9.0) and with one or more plant species listed in Table 1 and the cover of invasive species listed in Table 1 is <25%?	YES Wetland is a Category 3 wetland Go to Question 8a	(NO) Go to Question 8a
8a	**"Old Growth Forest."** Is the wetland a forested wetland and is the forest characterized by, but not limited to, the following characteristics: overstory canopy trees of great age (exceeding at least 50% of a projected maximum attainable age for a species); little or no evidence of human-caused understory disturbance during the past 80 to 100 years; an all-aged structure and multilayered canopies; aggregations of canopy trees interspersed with canopy gaps; and significant numbers of standing dead snags and downed logs?	YES Wetland is a Category 3 wetland. Go to Question 8b	(NO) Go to Question 8b

8b	**Mature forested wetlands.** Is the wetland a forested wetland with 50% or more of the cover of upper forest canopy consisting of deciduous trees with large diameters at breast height (dbh), generally diameters greater than 45cm (17.7in) dbh?	YES Wetland should be evaluated for possible Category 3 status. Go to Question 9a	NO Go to Question 9a
9a	**Lake Erie coastal and tributary wetlands.** Is the wetland located at an elevation less than 575 feet on the USGS map, adjacent to this elevation, or along a tributary to Lake Erie that is accessible to fish?	YES Go to Question 9b	NO Go to Question 10
9b	Does the wetland's hydrology result from measures designed to prevent erosion and the loss of aquatic plants, i.e. the wetland is partially hydrologically restricted from Lake Erie due to lakeward or landward dikes or other hydrological controls?	YES Wetland should be evaluated for possible Category 3 status Go to Question 10	NO Go to Question 9c
9c	Are Lake Erie water levels the wetland's primary hydrological influence, i.e. the wetland is hydrologically unrestricted (no lakeward or upland border alterations), or the wetland can be characterized as an "estuarine" wetland with lake and river influenced hydrology. These include sandbar deposition wetlands, estuarine wetlands, river mouth wetlands, or those dominated by submersed aquatic vegetation.	YES Go to Question 9d	NO Go to Question 10
9d	Does the wetland have a predominance of native species within its vegetation communities, although non-native or disturbance tolerant native species can also be present?	YES Wetland is a Category 3 wetland Go to Question 10	NO Go to Question 9e
9e	Does the wetland have a predominance of non-native or disturbance tolerant native plant species within its vegetation communities?	YES Wetland should be evaluated for possible Category 3 status Go to Question 10	NO Go to Question 10
10	**Lake Plain Sand Prairies (Oak Openings)** Is the wetland located in Lucas, Fulton, Henry, or Wood Counties and can the wetland be characterized by the following description: the wetland has a sandy substrate with interspersed organic matter, a water table often within several inches of the surface, and often with a dominance of the gramineous vegetation listed in Table 1 (woody species may also be present). The Ohio Department of Natural Resources Division of Natural Areas and Preserves can provide assistance in confirming this type of wetland and its quality.	YES Wetland is a Category 3 wetland. Go to Question 11	NO Go to Question 11
11	**Relict Wet Prairies.** Is the wetland a relict wet prairie community dominated by some or all of the species in Table 1. Extensive prairies were formerly located in the Darby Plains (Madison and Union Counties), Sandusky Plains (Wyandot, Crawford, and Marion Counties), northwest Ohio (e.g. Erie, Huron, Lucas, Wood Counties), and portions of western Ohio Counties (e.g. Darke, Mercer, Miami, Montgomery, Van Wert etc.).	YES Wetland should be evaluated for possible Category 3 status Complete Quantitative Rating	NO Complete Quantitative Rating

Table 1. Characteristic plant species.

invasive/exotic spp	fen species	bog species	0ak Opening species	wet prairie species
Lythrum salicaria	*Zygadenus elegans var. glaucus*	*Calla palustris*	*Carex cryptolepis*	*Calamagrostis canadensis*
Myriophyllum spicatum	*Cacalia plantaginea*	*Carex atlantica var. capillacea*	*Carex lasiocarpa*	*Calamogrostis stricta*
Najas minor	*Carex flava*	*Carex echinata*	*Carex stricta*	*Carex atherodes*
Phalaris arundinacea	*Carex sterilis*	*Carex oligosperma*	*Cladium mariscoides*	*Carex buxbaumii*
Phragmites australis	*Carex stricta*	*Carex trisperma*	*Calamagrostis stricta*	*Carex pellita*
Potamogeton crispus	*Deschampsia caespitosa*	*Chamaedaphne calyculata*	*Calamagrostis canadensis*	*Carex sartwellii*
Ranunculus ficaria	*Eleocharis rostellata*	*Decodon verticillatus*	*Quercus palustris*	*Gentiana andrewsii*
Rhamnus frangula	*Eriophorum viridicarinatum*	*Eriophorum virginicum*		*Helianthus grosseserratus*
Typha angustifolia	*Gentianopsis spp.*	*Larix laricina*		*Liatris spicata*
Typha xglauca	*Lobelia kalmii*	*Nemopanthus mucronatus*		*Lysimachia quadriflora*
	Parnassia glauca	*Schechzeria palustris*		*Lythrum alatum*
	Potentilla fruticosa	*Sphagnum spp.*		*Pycnanthemum virginianum*
	Rhamnus alnifolia	*Vaccinium macrocarpon*		*Silphium terebinthinaceum*
	Rhynchospora capillacea	*Vaccinium corymbosum*		*Sorghastrum nutans*
	Salix candida	*Vaccinium oxycoccos*		*Spartina pectinata*
	Salix myricoides	*Woodwardia virginica*		*Solidago riddellii*
	Salix serissima	*Xyris difformis*		
	Solidago ohioensis			
	Tofieldia glutinosa			
	Triglochin maritimum			
	Triglochin palustre			

End of Narrative Rating. Begin Quantitative Rating on next page.

Wetland A

Site: Apex Sanitary Landfill, Amsterdam, OH | **Rater(s):** Mike A. Takacs, Mark Neubacher | **Date:** 30 July 2010

Metric 1. Wetland Area (size).

2	2
max 6 pts.	subtotal

Select one size class and assign score.

- [ ] >50 acres (>20.2ha) (6 pts)
- [ ] 25 to <50 acres (10.1 to <20.2ha) (5 pts)
- [ ] 10 to <25 acres (4 to <10.1ha) (4 pts)
- [ ] 3 to <10 acres (1.2 to <4ha) (3 pts)
- [x] 0.3 to <3 acres (0.12 to <1.2ha) (2pts)
- [ ] 0.1 to <0.3 acres (0.04 to <0.12ha) (1 pt)
- [ ] <0.1 acres (0.04ha) (0 pts)

2.16 wetland + 0.78 open water/AB = 2.94 ac.

Metric 2. Upland buffers and surrounding land use.

9	11
max 14 pts.	subtotal

2a. Calculate average buffer width. Select only one and assign score. Do not double check.

- [ ] WIDE. Buffers average 50m (164ft) or more around wetland perimeter (7)
- [x] MEDIUM. Buffers average 25m to <50m (82 to <164ft) around wetland perimeter (4)
- [ ] NARROW. Buffers average 10m to <25m (32ft to <82ft) around wetland perimeter (1)
- [ ] VERY NARROW. Buffers average <10m (<32ft) around wetland perimeter (0)

$\bar{x} = 123$

2b. Intensity of surrounding land use. Select one or double check and average.

- [ ] VERY LOW. 2nd growth or older forest, prairie, savannah, wildlife area, etc. (7)
- [x] LOW. Old field (>10 years), shrub land, young second growth forest. (5)
- [ ] MODERATELY HIGH. Residential, fenced pasture, park, conservation tillage, new fallow field. (3)
- [ ] HIGH. Urban, industrial, open pasture, row cropping, mining, construction. (1)

Metric 3. Hydrology.

17	28
max 30 pts.	subtotal

3a. Sources of Water. Score all that apply.

- [ ] High pH groundwater (5)
- [x] Other groundwater (3)
- [x] Precipitation (1)
- [ ] Seasonal/Intermittent surface water (3)
- [ ] Perennial surface water (lake or stream) (5)

3b. Connectivity. Score all that apply.

- [ ] 100 year floodplain (1)
- [ ] Between stream/lake and other human use (1)
- [x] Part of wetland/upland (e.g. forest), complex (1)
- [ ] Part of riparian or upland corridor (1)

3c. Maximum water depth. Select only one and assign score.

- [x] >0.7 (27.6in) (3)
- [ ] 0.4 to 0.7m (15.7 to 27.6in) (2)
- [ ] <0.4m (<15.7in) (1)

3d. Duration inundation/saturation. Score one or dbl check.

- [x] Semi- to permanently inundated/saturated (4)
- [ ] Regularly inundated/saturated (3)
- [ ] Seasonally inundated (2)
- [ ] Seasonally saturated in upper 30cm (12in) (1)

3e. Modifications to natural hydrologic regime. Score one or double check and average.

- [ ] None or none apparent (12)
- [x] Recovered (7) 5
- [x] Recovering (3)
- [ ] Recent or no recovery (1)

Check all disturbances observed

- [ ] ditch
- [ ] tile
- [ ] dike
- [ ] weir
- [ ] stormwater input
- [ ] point source (nonstormwater)
- [x] filling/grading spoils
- [ ] road bed/RR track
- [x] dredging
- [x] other past mining

Metric 4. Habitat Alteration and Development.

9	37
max 20 pts.	subtotal

4a. Substrate disturbance. Score one or double check and average.

- [ ] None or none apparent (4)
- [ ] Recovered (3)
- [x] Recovering (2) 1.5 mine spoils
- [x] Recent or no recovery (1)

4b. Habitat development. Select only one and assign score.

- [ ] Excellent (7)
- [ ] Very good (6)
- [ ] Good (5)
- [ ] Moderately good (4)
- [x] Fair (3)
- [ ] Poor to fair (2)
- [ ] Poor (1)

4c. Habitat alteration. Score one or double check and average.

- [ ] None or none apparent (9)
- [x] Recovered (6) 4.5
- [x] Recovering (3)
- [ ] Recent or no recovery (1)

strip cut

Check all disturbances observed

- [ ] mowing
- [ ] grazing
- [ ] clearcutting
- [ ] selective cutting
- [ ] woody debris removal
- [ ] toxic pollutants
- [ ] shrub/sapling removal
- [ ] herbaceous/aquatic bed removal
- [x] sedimentation
- [ ] dredging
- [ ] farming
- [ ] nutrient enrichment
- [x] past mining

37
subtotal this page

last revised 1 February 2001 jjm

Apex Sanitary Landfill
Wetland A

ORAM v. 5.0 Field Form Quantitative Rating

Site: Apex Sanitary Landfill, Amsterdam, OH | Rater(s): Mike A. Takacs, Mark Haibach | Date: 30 July 2010

37
subtotal first page

Metric 5. Special Wetlands.

0 (max 10 pts.) | 37 (subtotal)

Check all that apply and score as indicated.

- [ ] Bog (10)
- [ ] Fen (10)
- [ ] Old growth forest (10)
- [ ] Mature forested wetland (5)
- [ ] Lake Erie coastal/tributary wetland-unrestricted hydrology (10)
- [ ] Lake Erie coastal/tributary wetland-restricted hydrology (5)
- [ ] Lake Plain Sand Prairies (Oak Openings) (10)
- [ ] Relict Wet Prairies (10)
- [ ] Known occurrence state/federal threatened or endangered species (10)
- [ ] Significant migratory songbird/water fowl habitat or usage (10)
- [ ] Category 1 Wetland. See Question 1 Qualitative Rating (-10)

Metric 6. Plant communities, interspersion, microtopography.

5 (max 20 pts.) | 42 (subtotal)

6a. Wetland Vegetation Communities.
Score all present using 0 to 3 scale.

- [2] Aquatic bed
- [0] Emergent
- [ ] Shrub
- [ ] Forest
- [ ] Mudflats
- [1] Open water
- [ ] Other_____

6b. horizontal (plan view) Interspersion.
Select only one.

- [ ] High (5)
- [ ] Moderately high(4)
- [ ] Moderate (3)
- [ ] Moderately low (2)
- [X] Low (1)
- [ ] None (0)

6c. Coverage of invasive plants. Refer to Table 1 ORAM long form for list. Add or deduct points for coverage

- [ ] Extensive >75% cover (-5)
- [ ] Moderate 25-75% cover (-3)
- [X] Sparse 5-25% cover (-1)
- [ ] Nearly absent <5% cover (0)
- [ ] Absent (1)

Najas minor

6d. Microtopography.
Score all present using 0 to 3 scale.

- [ ] Vegetated hummucks/tussucks
- [ ] Coarse woody debris >15cm (6in)
- [ ] Standing dead >25cm (10in) dbh
- [2] Amphibian breeding pools

Vegetation Community Cover Scale

0	Absent or comprises <0.1ha (0.2471 acres) contiguous area
1	Present and either comprises small part of wetland's vegetation and is of moderate quality, or comprises a significant part but is of low quality
2	Present and either comprises significant part of wetland's vegetation and is of moderate quality or comprises a small part and is of high quality
3	Present and comprises significant part, or more, of wetland's vegetation and is of high quality

Narrative Description of Vegetation Quality

low	Low spp diversity and/or predominance of nonnative or disturbance tolerant native species
mod	Native spp are dominant component of the vegetation, although nonnative and/or disturbance tolerant native spp can also be present, and species diversity moderate to moderately high, but generally w/o presence of rare threatened or endangered spp
high	A predominance of native species, with nonnative spp and/or disturbance tolerant native spp absent or virtually absent, and high spp diversity and often, but not always, the presence of rare, threatened, or endangered spp

Mudflat and Open Water Class Quality

0	Absent <0.1ha (0.247 acres)
1	Low 0.1 to <1ha (0.247 to 2.47 acres)
2	Moderate 1 to <4ha (2.47 to 9.88 acres)
3	High 4ha (9.88 acres) or more

Microtopography Cover Scale

0	Absent
1	Present very small amounts or if more common of marginal quality
2	Present in moderate amounts, but not of highest quality or in small amounts of highest quality
3	Present in moderate or greater amounts and of highest quality

42

End of Quantitative Rating. Complete Categorization Worksheets.

Modified Category 2

Apex Sanitary Landfill
Wetland A
30 July 2010

ORAM Summary Worksheet

		circle answer or insert score	Result
Narrative Rating	Question 1 Critical Habitat	YES (NO)	If yes, Category 3.
	Question 2. Threatened or Endangered Species	YES (NO)	If yes, Category 3.
	Question 3. High Quality Natural Wetland	YES (NO)	If yes, Category 3.
	Question 4. Significant bird habitat	YES (NO)	If yes, Category 3.
	Question 5. Category 1 Wetlands	YES (NO)	If yes, Category 1.
	Question 6. Bogs	YES (NO)	If yes, Category 3.
	Question 7. Fens	YES (NO)	If yes, Category 3.
	Question 8a. Old Growth Forest	YES (NO)	If yes, Category 3.
	Question 8b. Mature Forested Wetland	YES (NO)	If yes, evaluate for Category 3; may also be 1 or 2.
	Question 9b. Lake Erie Wetlands - Restricted	YES (NO)	If yes, evaluate for Category 3; may also be 1 or 2.
	Question 9d. Lake Erie Wetlands – Unrestricted with native plants	YES NO	If yes, Category 3
	Question 9e. Lake Erie Wetlands - Unrestricted with invasive plants	YES NO	If yes, evaluate for Category 3; may also be 1 or 2.
	Question 10. Oak Openings	YES (NO)	If yes, Category 3
	Question 11. Relict Wet Prairies	YES (NO)	If yes, evaluate for Category 3; may also be 1 or 2.
Quantitative Rating	Metric 1. Size	2	
	Metric 2. Buffers and surrounding land use	9	
	Metric 3. Hydrology	17	
	Metric 4. Habitat	9	
	Metric 5. Special Wetland Communities	0	
	Metric 6. Plant communities, interspersion, microtopography	5	
	TOTAL SCORE	42	Category based on score breakpoints Modified Category 2

Complete Wetland Categorization Worksheet.

Apex Sanitary Landfill
Wetland A
30 July 2010

Wetland Categorization Worksheet

Choices	Circle one		Evaluation of Categorization Result of ORAM
Did you answer "Yes" to any of the following questions: Narrative Rating Nos. 2, 3, 4, 6, 7, 8a, 9d, 10	YES Wetland is categorized as a Category 3 wetland	(NO)	Is quantitative rating score *less* than the Category 2 scoring threshold (*excluding* gray zone)? If yes, reevaluate the category of the wetland using the narrative criteria in OAC Rule 3745-1-54(C) and biological and/or functional assessments to determine if the wetland has been over-categorized by the ORAM
Did you answer "Yes" to any of the following questions: Narrative Rating Nos. 1, 8b, 9b, 9e, 11	YES Wetland should be evaluated for possible Category 3 status	(NO)	Evaluate the wetland using the 1) narrative criteria in OAC Rule 3745-1-54(C) and 2) the quantitative rating score. If the wetland is determined to be a Category 3 wetland using either of these, it should be categorized as a Category 3 wetland. Detailed biological and/or functional assessments may also be used to determine the wetland's category.
Did you answer "Yes" to Narrative Rating No. 5	YES Wetland is categorized as a Category 1 wetland	(NO)	Is quantitative rating score *greater* than the Category 2 scoring threshold *(including* any gray zone)? If yes, reevaluate the category of the wetland using the narrative criteria in OAC Rule 3745-1-54(C) and biological and/or functional assessments to determine if the wetland has been under-categorized by the ORAM
Does the quantitative score fall within the scoring range of a Category 1, 2, or 3 wetland?	(YES) Wetland is assigned to the appropriate category based on the scoring range	NO	If the score of the wetland is located within the scoring range for a particular category, the wetland should be assigned to that category. In all instances however, the narrative criteria described in OAC Rule 3745-1-54(C) can be used to clarify or change a categorization based on a quantitative score.
Does the quantitative score fall with the *"gray zone"* for Category 1 or 2 or Category 2 or 3 wetlands?	YES Wetland is assigned to the higher of the two categories or assigned to a category based on detailed assessments and the narrative criteria	(NO)	Rater has the option of assigning the wetland to the higher of the two categories or to assign a category based on the results of a nonrapid wetland assessment method, e.g. functional assessment, biological assessment, etc, and a consideration of the narrative criteria in OAC rule 3745-1-54(C).
Does the wetland otherwise exhibit *moderate OR superior* hydrologic OR habitat, OR recreational functions AND the wetland was *not* categorized as a Category 2 wetland (in the case of moderate functions) or a Category 3 wetland (in the case of superior functions) by this method?	YES Wetland was undercategorized by this method. A written justification for recategorization should be provided on Background Information Form	(NO) Wetland is assigned to category as determined by the ORAM.	A wetland may be undercategorized using this method, but still exhibit one or more superior functions, e.g. a wetland's biotic communities may be degraded by human activities, but the wetland may still exhibit superior hydrologic functions because of its type, landscape position, size, local or regional significance, etc. In this circumstance, the narrative criteria in OAC Rule 3745-1-54(C)(2) and (3) are controlling, and the under-categorization should be corrected. A written justification with supporting reasons or information for this determination should be provided.

Final Category

Choose one	Category 1	(Category 2)	Category 3

End of Ohio Rapid Assessment Method for Wetlands.

Background Information

Name:	Michael A. Takacs, Mark R. Haibach
Date:	30 July 2010
Affiliation:	Civil & Environmental Consultants, Inc.
Address:	333 Baldwin Road, Pittsburgh, PA 15205
Phone Number:	(412) 249-3188, (412) 249-3156
e-mail address:	mtakacs@cecinc.com, mhaibach@cecinc.com
Name of Wetland:	Wetland B
Vegetation Communit(ies):	POW2 / AB2, PEM1
HGM Class(es):	SWD, GWD
Location of Wetland: include map, address, north arrow, landmarks, distances, roads, etc.	See Stream and Wetland Delineation Report, Figures 1 and 4

Lat/Long or UTM Coordinate	
USGS Quad Name: Amsterdam, OH	
County: Jefferson	
Township: Springfield	
Section and Subsection	
Hydrologic Unit Code: 05030101340	
Site Visit: 30 July 2010	
National Wetland Inventory Map: Amsterdam, OH	
Ohio Wetland Inventory Map: —	
Soil Survey: Soil Survey of Jefferson County, Ohio	
Delineation report/map: Wetland and stream Delineation and Assessment Report Potential Apex Sanitary Landfill Expansion. CEC 2010.	

Name of Wetland: Wetland B

Wetland Size (acres, hectares): 2.21 acres wetland + 0.79 acre OW/AB = 3.0 acres

Sketch: Include north arrow, relationship with other surface waters, vegetation zones, etc.

See Stream and Wetland Delineation Map (Figure 4)

Comments, Narrative Discussion, Justification of Category Changes:

Final score : 44	Category: Mod. 2

Apex Sanitary Landfill
Wetland B
30 July 2010

Scoring Boundary Worksheet

INSTRUCTIONS. The initial step in completing the ORAM is to identify the "scoring boundaries" of the wetland being rated. In many instances this determination will be relatively easy and the scoring boundaries will coincide with the "jurisdictional boundaries." For example, the scoring boundary of an isolated cattail marsh located in the middle of a farm field will likely be the same as that wetland's jurisdictional boundaries. In other instances, however, the scoring boundary will not be as easily determined. Wetlands that are small or isolated from other surface waters often form large contiguous areas or heterogeneous complexes of wetland and upland. In separating wetlands for scoring purposes, the hydrologic regime of the wetland is the main criterion that should be used. Boundaries between contiguous or connected wetlands should be established where the volume, flow, or velocity of water moving through the wetland changes significantly. *Areas with a high degree of hydrologic interaction should be scored as a single wetland.* In determining a wetland's scoring boundaries, use the guidelines in the ORAM Manual Section 5.0. In certain instances, it may be difficult to establish the scoring boundary for the wetland being rated. These problem situations include wetlands that form a patchwork on the landscape, wetlands divided by artificial boundaries like property fences, roads, or railroad embankments, wetlands that are contiguous with streams, lakes, or rivers, and estuarine or coastal wetlands. These situations are discussed below, however, it is recommended that Rater contact Ohio EPA, Division of Surface Water, 401/Wetlands Section if there are additional questions or a need for further clarification of the appropriate scoring boundaries of a particular wetland.

#	Steps in properly establishing scoring boundaries	done?	not applicable
Step 1	Identify the wetland area of interest. This may be the site of a proposed impact, a reference site, conservation site, etc.	Yes	
Step 2	Identify the locations where there is physical evidence that hydrology changes rapidly. Such evidence includes both natural and human-induced changes including, constrictions caused by berms or dikes, points where the water velocity changes rapidly at rapids or falls, points where significant inflows occur at the confluence of rivers, or other factors that may restrict hydrologic interaction between the wetlands or parts of a single wetland.	Yes	
Step 3	Delineate the boundary of the wetland to be rated such that all areas of interest that are contiguous to and within the areas where the hydrology does not change significantly, i.e. areas that have a high degree of hydrologic interaction are included within the scoring boundary.	Yes	
Step 4	Determine if artificial boundaries, such as property lines, state lines, roads, railroad embankments, etc., are present. These should not be used to establish scoring boundaries unless they coincide with areas where the hydrologic regime changes.	Yes	
Step 5	In all instances, the Rater may enlarge the minimum scoring boundaries discussed here to score together wetlands that could be scored separately.	Yes	
Step 6	Consult ORAM Manual Section 5.0 for how to establish scoring boundaries for wetlands that form a patchwork on the landscape, divided by artificial boundaries, contiguous to streams, lakes or rivers, or for dual classifications.	Yes	

End of Scoring Boundary Determination. Begin Narrative Rating on next page.

Apex Sanitary Landfill
Wetland B
30 July 2010

Narrative Rating

INSTRUCTIONS. Answer each of the following questions. Questions 1, 2, 3 and 4 should be answered based on information obtained from the site visit or the literature *and* by submitting a Data Services Request to the Ohio Department of Natural Resources, Division of Natural Areas and Preserves, Natural Heritage Data Services, 1889 Fountain Square Court, Building F-1, Columbus, Ohio 43224, 614-265-6453 (phone), 614-265-3096 (fax), http://www.dnr.state.oh.us/dnap . The remaining questions are designed to be answered primarily by the results of the site visit. Refer to the User's Manual for descriptions of these wetland types. Note: "Critical habitat" is legally defined in the Endangered Species Act and is the geographic area containing physical or biological features essential to the conservation of a listed species or as an area that may require special management considerations or protection. The Rater should contact the Region 3 Headquarters or the Columbus Ecological Services Office for updates as to whether critical habitat has been designated for other federally listed threatened or endangered species. "Documented" means the wetland is listed in the appropriate State of Ohio database.

#	Question	Circle one	
1	**Critical Habitat.** Is the wetland in a township, section, or subsection of a United States Geological Survey 7.5 minute Quadrangle that has been designated by the U.S. Fish and Wildlife Service as "critical habitat" for any threatened or endangered plant or animal species? Note: as of January 1, 2001, of the federally listed endangered or threatened species which can be found in Ohio, the Indiana Bat has had critical habitat designated (50 CFR 17.95(a)) and the piping plover has had critical habitat proposed (65 FR 41812 July 6, 2000).	YES Wetland should be evaluated for possible Category 3 status Go to Question 2	(NO) Go to Question 2
2	**Threatened or Endangered Species.** Is the wetland known to contain an individual of, or documented occurrences of federal or state-listed threatened or endangered plant or animal species?	YES Wetland is a Category 3 wetland. Go to Question 3	(NO) Go to Question 3
3	**Documented High Quality Wetland.** Is the wetland on record in Natural Heritage Database as a high quality wetland?	YES Wetland is a Category 3 wetland Go to Question 4	(NO) Go to Question 4
4	**Significant Breeding or Concentration Area.** Does the wetland contain documented regionally significant breeding or nonbreeding waterfowl, neotropical songbird, or shorebird concentration areas?	YES Wetland is a Category 3 wetland Go to Question 5	(NO) Go to Question 5
5	**Category 1 Wetlands.** Is the wetland less than 0.5 hectares (1 acre) in size and **hydrologically isolated** and either 1) comprised of vegetation that is dominated (greater than eighty per cent areal cover) by *Phalaris arundinacea, Lythrum salicaria,* or *Phragmites australis*, or 2) an acidic pond created or excavated on mined lands that has little or no vegetation?	YES Wetland is a Category 1 wetland Go to Question 6	(NO) Go to Question 6
6	**Bogs.** Is the wetland a peat-accumulating wetland that 1) has no significant inflows or outflows, 2) supports acidophilic mosses, particularly *Sphagnum* spp., 3) the acidophilic mosses have >30% cover, 4) at least one species from Table 1 is present, and 5) the cover of invasive species (see Table 1) is <25%?	YES Wetland is a Category 3 wetland Go to Question 7	(NO) Go to Question 7
7	**Fens.** Is the wetland a carbon accumulating (peat, muck) wetland that is saturated during most of the year, primarily by a discharge of free flowing, mineral rich, ground water with a circumneutral ph (5.5-9.0) and with one or more plant species listed in Table 1 and the cover of invasive species listed in Table 1 is <25%?	YES Wetland is a Category 3 wetland Go to Question 8a	(NO) Go to Question 8a
8a	**"Old Growth Forest."** Is the wetland a forested wetland and is the forest characterized by, but not limited to, the following characteristics: overstory canopy trees of great age (exceeding at least 50% of a projected maximum attainable age for a species); little or no evidence of human-caused understory disturbance during the past 80 to 100 years; an all-aged structure and multilayered canopies; aggregations of canopy trees interspersed with canopy gaps; and significant numbers of standing dead snags and downed logs?	YES Wetland is a Category 3 wetland. Go to Question 8b	(NO) Go to Question 8b

8b	**Mature forested wetlands.** Is the wetland a forested wetland with 50% or more of the cover of upper forest canopy consisting of deciduous trees with large diameters at breast height (dbh), generally diameters greater than 45cm (17.7in) dbh?	YES Wetland should be evaluated for possible Category 3 status. Go to Question 9a	NO Go to Question 9a
9a	**Lake Erie coastal and tributary wetlands.** Is the wetland located at an elevation less than 575 feet on the USGS map, adjacent to this elevation, or along a tributary to Lake Erie that is accessible to fish?	YES Go to Question 9b	NO Go to Question 10
9b	Does the wetland's hydrology result from measures designed to prevent erosion and the loss of aquatic plants, i.e. the wetland is partially hydrologically restricted from Lake Erie due to lakeward or landward dikes or other hydrological controls?	YES Wetland should be evaluated for possible Category 3 status Go to Question 10	NO Go to Question 9c
9c	Are Lake Erie water levels the wetland's primary hydrological influence, i.e. the wetland is hydrologically unrestricted (no lakeward or upland border alterations), or the wetland can be characterized as an "estuarine" wetland with lake and river influenced hydrology. These include sandbar deposition wetlands, estuarine wetlands, river mouth wetlands, or those dominated by submersed aquatic vegetation.	YES Go to Question 9d	NO Go to Question 10
9d	Does the wetland have a predominance of native species within its vegetation communities, although non-native or disturbance tolerant native species can also be present?	YES Wetland is a Category 3 wetland Go to Question 10	NO Go to Question 9e
9e	Does the wetland have a predominance of non-native or disturbance tolerant native plant species within its vegetation communities?	YES Wetland should be evaluated for possible Category 3 status Go to Question 10	NO Go to Question 10
10	**Lake Plain Sand Prairies (Oak Openings)** Is the wetland located in Lucas, Fulton, Henry, or Wood Counties and can the wetland be characterized by the following description: the wetland has a sandy substrate with interspersed organic matter, a water table often within several inches of the surface, and often with a dominance of the gramineous vegetation listed in Table 1 (woody species may also be present). The Ohio Department of Natural Resources Division of Natural Areas and Preserves can provide assistance in confirming this type of wetland and its quality.	YES Wetland is a Category 3 wetland. Go to Question 11	NO Go to Question 11
11	**Relict Wet Prairies.** Is the wetland a relict wet prairie community dominated by some or all of the species in Table 1. Extensive prairies were formerly located in the Darby Plains (Madison and Union Counties), Sandusky Plains (Wyandot, Crawford, and Marion Counties), northwest Ohio (e.g. Erie, Huron, Lucas, Wood Counties), and portions of western Ohio Counties (e.g. Darke, Mercer, Miami, Montgomery, Van Wert etc.).	YES Wetland should be evaluated for possible Category 3 status Complete Quantitative Rating	NO Complete Quantitative Rating

Table 1. Characteristic plant species.

invasive/exotic spp	fen species	bog species	0ak Opening species	wet prairie species
Lythrum salicaria	*Zygadenus elegans var. glaucus*	*Calla palustris*	*Carex cryptolepis*	*Calamagrostis canadensis*
Myriophyllum spicatum	*Cacalia plantaginea*	*Carex atlantica var. capillacea*	*Carex lasiocarpa*	*Calamogrostis stricta*
Najas minor	*Carex flava*	*Carex echinata*	*Carex stricta*	*Carex atherodes*
Phalaris arundinacea	*Carex sterilis*	*Carex oligosperma*	*Cladium mariscoides*	*Carex buxbaumii*
Phragmites australis	*Carex stricta*	*Carex trisperma*	*Calamagrostis stricta*	*Carex pellita*
Potamogeton crispus	*Deschampsia caespitosa*	*Chamaedaphne calyculata*	*Calamagrostis canadensis*	*Carex sartwellii*
Ranunculus ficaria	*Eleocharis rostellata*	*Decodon verticillatus*	*Quercus palustris*	*Gentiana andrewsii*
Rhamnus frangula	*Eriophorum viridicarinatum*	*Eriophorum virginicum*		*Helianthus grosseserratus*
Typha angustifolia	*Gentianopsis spp.*	*Larix laricina*		*Liatris spicata*
Typha xglauca	*Lobelia kalmii*	*Nemopanthus mucronatus*		*Lysimachia quadriflora*
	Parnassia glauca	*Schechzeria palustris*		*Lythrum alatum*
	Potentilla fruticosa	*Sphagnum spp.*		*Pycnanthemum virginianum*
	Rhamnus alnifolia	*Vaccinium macrocarpon*		*Silphium terebinthinaceum*
	Rhynchospora capillacea	*Vaccinium corymbosum*		*Sorghastrum nutans*
	Salix candida	*Vaccinium oxycoccos*		*Spartina pectinata*
	Salix myricoides	*Woodwardia virginica*		*Solidago riddellii*
	Salix serissima	*Xyris difformis*		
	Solidago ohioensis			
	Tofieldia glutinosa			
	Triglochin maritimum			
	Triglochin palustre			

End of Narrative Rating. Begin Quantitative Rating on next page.

ORAM v. 5.0 Field Form Quantitative Rating

Wetland B

Site: Apex Sanitary Landfill, Amsterdam, OH Rater(s): Michael A. Takacs, Mark Kaiser Date: 30 July 2010

3	3
max 6 pts.	subtotal

Metric 1. Wetland Area (size).

Select one size class and assign score.

- [ ] >50 acres (>20.2ha) (6 pts)
- [ ] 25 to <50 acres (10.1 to <20.2ha) (5 pts)
- [ ] 10 to <25 acres (4 to <10.1ha) (4 pts)
- [x] 3 to <10 acres (1.2 to <4ha) (3 pts) 2.21 acre wetlands + 0.79 acres OW/AB = 3.0 acres
- [ ] 0.3 to <3 acres (0.12 to <1.2ha) (2pts)
- [ ] 0.1 to <0.3 acres (0.04 to <0.12ha) (1 pt)
- [ ] <0.1 acres (0.04ha) (0 pts)

9	12
max 14 pts.	subtotal

Metric 2. Upland buffers and surrounding land use.

2a. Calculate average buffer width. Select only one and assign score. Do not double check.

- [ ] WIDE. Buffers average 50m (164ft) or more around wetland perimeter (7)
- [x] MEDIUM. Buffers average 25m to <50m (82 to <164ft) around wetland perimeter (4) $\bar{x} = 116'$
- [ ] NARROW. Buffers average 10m to <25m (32ft to <82ft) around wetland perimeter (1)
- [ ] VERY NARROW. Buffers average <10m (<32ft) around wetland perimeter (0)

2b. Intensity of surrounding land use. Select one or double check and average.

- [ ] VERY LOW. 2nd growth or older forest, prairie, savannah, wildlife area, etc. (7)
- [x] LOW. Old field (>10 years), shrub land, young second growth forest. (5)
- [ ] MODERATELY HIGH. Residential, fenced pasture, park, conservation tillage, new fallow field. (3)
- [ ] HIGH. Urban, industrial, open pasture, row cropping, mining, construction. (1)

17	29
max 30 pts.	subtotal

Metric 3. Hydrology.

3a. Sources of Water. Score all that apply.

- [ ] High pH groundwater (5)
- [x] Other groundwater (3)
- [x] Precipitation (1)
- [ ] Seasonal/Intermittent surface water (3)
- [ ] Perennial surface water (lake or stream) (5)

3b. Connectivity. Score all that apply.

- [ ] 100 year floodplain (1)
- [ ] Between stream/lake and other human use (1)
- [x] Part of wetland/upland (e.g. forest), complex (1)
- [ ] Part of riparian or upland corridor (1)

3c. Maximum water depth. Select only one and assign score.

- [x] >0.7 (27.6in) (3)
- [ ] 0.4 to 0.7m (15.7 to 27.6in) (2)
- [ ] <0.4m (<15.7in) (1)

3d. Duration inundation/saturation. Score one or dbl check.

- [x] Semi- to permanently inundated/saturated (4)
- [ ] Regularly inundated/saturated (3)
- [ ] Seasonally inundated (2)
- [ ] Seasonally saturated in upper 30cm (12in) (1)

3e. Modifications to natural hydrologic regime. Score one or double check and average.

- [ ] None or none apparent (12)
- [x] Recovered (7) 5
- [x] Recovering (3)
- [ ] Recent or no recovery (1)

Check all disturbances observed

- [ ] ditch
- [ ] tile
- [ ] dike
- [ ] weir
- [ ] stormwater input
- [ ] point source (nonstormwater)
- [x] filling/grading spoils
- [ ] road bed/RR track
- [x] dredging
- [x] other past mining

9	38
max 20 pts.	subtotal

Metric 4. Habitat Alteration and Development.

4a. Substrate disturbance. Score one or double check and average.

- [ ] None or none apparent (4)
- [ ] Recovered (3)
- [x] Recovering (2)
- [x] Recent or no recovery (1) 1.5 mine spoils

4b. Habitat development. Select only one and assign score.

- [ ] Excellent (7)
- [ ] Very good (6)
- [ ] Good (5)
- [ ] Moderately good (4)
- [x] Fair (3)
- [ ] Poor to fair (2)
- [ ] Poor (1)

4c. Habitat alteration. Score one or double check and average.

- [ ] None or none apparent (9)
- [x] Recovered (6) 4.5
- [x] Recovering (3)
- [ ] Recent or no recovery (1)

strip cut

Check all disturbances observed

- [ ] mowing
- [ ] grazing
- [ ] clearcutting
- [ ] selective cutting
- [ ] woody debris removal
- [ ] toxic pollutants
- [ ] shrub/sapling removal
- [ ] herbaceous/aquatic bed removal
- [x] sedimentation
- [ ] dredging
- [ ] farming
- [ ] nutrient enrichment
- [x] past mining

38
subtotal this page

last revised 1 February 2001 jjm

Site: Apex Sanitary Landfill, Amsterdam, OH Rater(s): Mike A. Takacs, Mark Haibach Date: 30 July 2010

38
subtotal first page

max 10 pts.	subtotal
0	38

Metric 5. Special Wetlands.

Check all that apply and score as indicated.

- [ ] Bog (10)
- [ ] Fen (10)
- [ ] Old growth forest (10)
- [ ] Mature forested wetland (5)
- [ ] Lake Erie coastal/tributary wetland-unrestricted hydrology (10)
- [ ] Lake Erie coastal/tributary wetland-restricted hydrology (5)
- [ ] Lake Plain Sand Prairies (Oak Openings) (10)
- [ ] Relict Wet Prairies (10)
- [ ] Known occurrence state/federal threatened or endangered species (10)
- [ ] Significant migratory songbird/water fowl habitat or usage (10)
- [ ] Category 1 Wetland. See Question 1 Qualitative Rating (-10)

max 20 pts.	subtotal
6	44

Metric 6. Plant communities, interspersion, microtopography.

6a. Wetland Vegetation Communities.
Score all present using 0 to 3 scale.

- [2] Aquatic bed
- [1] Emergent
- [ ] Shrub
- [ ] Forest
- [ ] Mudflats
- [1] Open water
- [ ] Other_____

6b. horizontal (plan view) Interspersion.
Select only one.

- [ ] High (5)
- [ ] Moderately high(4)
- [ ] Moderate (3)
- [ ] Moderately low (2)
- [X] Low (1)
- [ ] None (0)

6c. Coverage of invasive plants. Refer to Table 1 ORAM long form for list. Add or deduct points for coverage

- [ ] Extensive >75% cover (-5)
- [ ] Moderate 25-75% cover (-3)
- [X] Sparse 5-25% cover (-1)
- [ ] Nearly absent <5% cover (0)
- [ ] Absent (1)

Typha angustifolia
Najas minor

6d. Microtopography.
Score all present using 0 to 3 scale.

- [ ] Vegetated hummucks/tussucks
- [ ] Coarse woody debris >15cm (6in)
- [ ] Standing dead >25cm (10in) dbh
- [2] Amphibian breeding pools

Vegetation Community Cover Scale

0	Absent or comprises <0.1ha (0.2471 acres) contiguous area
1	Present and either comprises small part of wetland's vegetation and is of moderate quality, or comprises a significant part but is of low quality
2	Present and either comprises significant part of wetland's vegetation and is of moderate quality or comprises a small part and is of high quality
3	Present and comprises significant part, or more, of wetland's vegetation and is of high quality

Narrative Description of Vegetation Quality

low	Low spp diversity and/or predominance of nonnative or disturbance tolerant native species
mod	Native spp are dominant component of the vegetation, although nonnative and/or disturbance tolerant native spp can also be present, and species diversity moderate to moderately high, but generally w/o presence of rare threatened or endangered spp
high	A predominance of native species, with nonnative spp and/or disturbance tolerant native spp absent or virtually absent, and high spp diversity and often, but not always, the presence of rare, threatened, or endangered spp

Mudflat and Open Water Class Quality

0	Absent <0.1ha (0.247 acres)
1	Low 0.1 to <1ha (0.247 to 2.47 acres)
2	Moderate 1 to <4ha (2.47 to 9.88 acres)
3	High 4ha (9.88 acres) or more

Microtopography Cover Scale

0	Absent
1	Present very small amounts or if more common of marginal quality
2	Present in moderate amounts, but not of highest quality or in small amounts of highest quality
3	Present in moderate or greater amounts and of highest quality

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End of Quantitative Rating. Complete Categorization Worksheets.

Apex Sanitary Landfill
Wetland B
30 July 2010

ORAM Summary Worksheet

		circle answer or insert score	Result
Narrative Rating	Question 1 Critical Habitat	YES (NO)	If yes, Category 3.
	Question 2. Threatened or Endangered Species	YES (NO)	If yes, Category 3.
	Question 3. High Quality Natural Wetland	YES (NO)	If yes, Category 3.
	Question 4. Significant bird habitat	YES (NO)	If yes, Category 3.
	Question 5. Category 1 Wetlands	YES (NO)	If yes, Category 1.
	Question 6. Bogs	YES (NO)	If yes, Category 3.
	Question 7. Fens	YES (NO)	If yes, Category 3.
	Question 8a. Old Growth Forest	YES (NO)	If yes, Category 3.
	Question 8b. Mature Forested Wetland	YES (NO)	If yes, evaluate for Category 3; may also be 1 or 2.
	Question 9b. Lake Erie Wetlands - Restricted	YES (NO)	If yes, evaluate for Category 3; may also be 1 or 2.
	Question 9d. Lake Erie Wetlands – Unrestricted with native plants	YES NO	If yes, Category 3
	Question 9e. Lake Erie Wetlands - Unrestricted with invasive plants	YES NO	If yes, evaluate for Category 3; may also be 1 or 2.
	Question 10. Oak Openings	YES (NO)	If yes, Category 3
	Question 11. Relict Wet Prairies	YES (NO)	If yes, evaluate for Category 3; may also be 1 or 2.
Quantitative Rating	Metric 1. Size	3	
	Metric 2. Buffers and surrounding land use	9	
	Metric 3. Hydrology	17	
	Metric 4. Habitat	9	
	Metric 5. Special Wetland Communities	0	
	Metric 6. Plant communities, interspersion, microtopography	6	
	TOTAL SCORE	44	Category based on score breakpoints Modified Category 2

Complete Wetland Categorization Worksheet.

Apex Sanitary Landfill
Wetland B
30 July 2010

Wetland Categorization Worksheet

Choices	Circle one		Evaluation of Categorization Result of ORAM
Did you answer "Yes" to any of the following questions: Narrative Rating Nos. 2, 3, 4, 6, 7, 8a, 9d, 10	YES Wetland is categorized as a Category 3 wetland	(NO)	Is quantitative rating score *less* than the Category 2 scoring threshold (*excluding* gray zone)? If yes, reevaluate the category of the wetland using the narrative criteria in OAC Rule 3745-1-54(C) and biological and/or functional assessments to determine if the wetland has been over-categorized by the ORAM
Did you answer "Yes" to any of the following questions: Narrative Rating Nos. 1, 8b, 9b, 9e, 11	YES Wetland should be evaluated for possible Category 3 status	(NO)	Evaluate the wetland using the 1) narrative criteria in OAC Rule 3745-1-54(C) and 2) the quantitative rating score. If the wetland is determined to be a Category 3 wetland using either of these, it should be categorized as a Category 3 wetland. Detailed biological and/or functional assessments may also be used to determine the wetland's category.
Did you answer "Yes" to Narrative Rating No. 5	YES Wetland is categorized as a Category 1 wetland	(NO)	Is quantitative rating score *greater* than the Category 2 scoring threshold *(including* any gray zone)? If yes, reevaluate the category of the wetland using the narrative criteria in OAC Rule 3745-1-54(C) and biological and/or functional assessments to determine if the wetland has been under-categorized by the ORAM
Does the quantitative score fall within the scoring range of a Category 1, 2, or 3 wetland?	(YES) Wetland is assigned to the appropriate category based on the scoring range	NO	If the score of the wetland is located within the scoring range for a particular category, the wetland should be assigned to that category. In all instances however, the narrative criteria described in OAC Rule 3745-1-54(C) can be used to clarify or change a categorization based on a quantitative score.
Does the quantitative score fall with the *"gray zone"* for Category 1 or 2 or Category 2 or 3 wetlands?	YES Wetland is assigned to the higher of the two categories or assigned to a category based on detailed assessments and the narrative criteria	(NO)	Rater has the option of assigning the wetland to the higher of the two categories or to assign a category based on the results of a nonrapid wetland assessment method, e.g. functional assessment, biological assessment, etc, and a consideration of the narrative criteria in OAC rule 3745-1-54(C).
Does the wetland otherwise exhibit *moderate OR superior* hydrologic OR habitat, OR recreational functions AND the wetland was *not* categorized as a Category 2 wetland (in the case of moderate functions) or a Category 3 wetland (in the case of superior functions) by this method?	YES Wetland was undercategorized by this method. A written justification for recategorization should be provided on Background Information Form	(NO) Wetland is assigned to category as determined by the ORAM.	A wetland may be undercategorized using this method, but still exhibit one or more superior functions, e.g. a wetland's biotic communities may be degraded by human activities, but the wetland may still exhibit superior hydrologic functions because of its type, landscape position, size, local or regional significance, etc. In this circumstance, the narrative criteria in OAC Rule 3745-1-54(C)(2) and (3) are controlling, and the under-categorization should be corrected. A written justification with supporting reasons or information for this determination should be provided.

Final Category

Choose one	Category 1	(Category 2)	Category 3

End of Ohio Rapid Assessment Method for Wetlands.

Background Information

Name:	Michael A. Takacs, Mark R. Haibach
Date:	30 July 2010
Affiliation:	Civil & Environmental Consultants, Inc.
Address:	333 Baldwin Road, Pittsburgh, PA 15205
Phone Number:	(412) 249-3188, (412) 249-3156
e-mail address:	mtakacs@cecinc.com, mhaibach@cecinc.com
Name of Wetland:	Wetland C/Wetland O Complex
Vegetation Communit(ies):	PSS1/EM1, POW2/AB2
HGM Class(es):	SWD, GWD

Location of Wetland: include map, address, north arrow, landmarks, distances, roads, etc.

See Stream and Wetland Delineation Report, Figures 1 and 4.

Lat/Long or UTM Coordinate	
USGS Quad Name: Amsterdam, OH	
County: Harrison	
Township	
Section and Subsection	
Hydrologic Unit Code: 05030101340	
Site Visit: 30 July 2010	
National Wetland Inventory Map: Amsterdam, OH	
Ohio Wetland Inventory Map	
Soil Survey: Soil Survey of Harrison County, Ohio	
Delineation report/map: Wetland and Stream Delineation and Functional Assessment Report, Potential Apex sanitary Landfill Expansion, CEC 2010.	

Name of Wetland: Wetland C/Wetland O Complex

Wetland Size (acres, hectares): Wetland C (0.5ac) Wetland O (0.20ac.) + Open Water 7 (0.6ac.) = 0.31ac.

Sketch: Include north arrow, relationship with other surface waters, vegetation zones, etc.

See Stream and Wetland Delineation Map (Figure 4).

Comments, Narrative Discussion, Justification of Category Changes:

Final score : 37	Category:	Mod. 2

Apex Sanitary Landfill
Wetland C/Wetland O Complex
30 July 2010

Scoring Boundary Worksheet

INSTRUCTIONS. The initial step in completing the ORAM is to identify the "scoring boundaries" of the wetland being rated. In many instances this determination will be relatively easy and the scoring boundaries will coincide with the "jurisdictional boundaries." For example, the scoring boundary of an isolated cattail marsh located in the middle of a farm field will likely be the same as that wetland's jurisdictional boundaries. In other instances, however, the scoring boundary will not be as easily determined. Wetlands that are small or isolated from other surface waters often form large contiguous areas or heterogeneous complexes of wetland and upland. In separating wetlands for scoring purposes, the hydrologic regime of the wetland is the main criterion that should be used. Boundaries between contiguous or connected wetlands should be established where the volume, flow, or velocity of water moving through the wetland changes significantly. *Areas with a high degree of hydrologic interaction should be scored as a single wetland.* In determining a wetland's scoring boundaries, use the guidelines in the ORAM Manual Section 5.0. In certain instances, it may be difficult to establish the scoring boundary for the wetland being rated. These problem situations include wetlands that form a patchwork on the landscape, wetlands divided by artificial boundaries like property fences, roads, or railroad embankments, wetlands that are contiguous with streams, lakes, or rivers, and estuarine or coastal wetlands. These situations are discussed below, however, it is recommended that Rater contact Ohio EPA, Division of Surface Water, 401/Wetlands Section if there are additional questions or a need for further clarification of the appropriate scoring boundaries of a particular wetland.

#	Steps in properly establishing scoring boundaries	done?	not applicable
Step 1	Identify the wetland area of interest. This may be the site of a proposed impact, a reference site, conservation site, etc.	Yes	
Step 2	Identify the locations where there is physical evidence that hydrology changes rapidly. Such evidence includes both natural and human-induced changes including, constrictions caused by berms or dikes, points where the water velocity changes rapidly at rapids or falls, points where significant inflows occur at the confluence of rivers, or other factors that may restrict hydrologic interaction between the wetlands or parts of a single wetland.	Yes	
Step 3	Delineate the boundary of the wetland to be rated such that all areas of interest that are contiguous to and within the areas where the hydrology does not change significantly, i.e. areas that have a high degree of hydrologic interaction are included within the scoring boundary.	Yes	
Step 4	Determine if artificial boundaries, such as property lines, state lines, roads, railroad embankments, etc., are present. These should not be used to establish scoring boundaries unless they coincide with areas where the hydrologic regime changes.	Yes	
Step 5	In all instances, the Rater may enlarge the minimum scoring boundaries discussed here to score together wetlands that could be scored separately.	Yes	
Step 6	Consult ORAM Manual Section 5.0 for how to establish scoring boundaries for wetlands that form a patchwork on the landscape, divided by artificial boundaries, contiguous to streams, lakes or rivers, or for dual classifications.	Yes	

End of Scoring Boundary Determination. Begin Narrative Rating on next page.

Apex Sanitary Landfill
Wetland C/Wetland O Complex
30 July 2010

Narrative Rating

INSTRUCTIONS. Answer each of the following questions. Questions 1, 2, 3 and 4 should be answered based on information obtained from the site visit or the literature *and* by submitting a Data Services Request to the Ohio Department of Natural Resources, Division of Natural Areas and Preserves, Natural Heritage Data Services, 1889 Fountain Square Court, Building F-1, Columbus, Ohio 43224, 614-265-6453 (phone), 614-265-3096 (fax), http://www.dnr.state.oh.us/dnap . The remaining questions are designed to be answered primarily by the results of the site visit. Refer to the User's Manual for descriptions of these wetland types. Note: "Critical habitat" is legally defined in the Endangered Species Act and is the geographic area containing physical or biological features essential to the conservation of a listed species or as an area that may require special management considerations or protection. The Rater should contact the Region 3 Headquarters or the Columbus Ecological Services Office for updates as to whether critical habitat has been designated for other federally listed threatened or endangered species. "Documented" means the wetland is listed in the appropriate State of Ohio database.

#	Question	Circle one	
1	**Critical Habitat.** Is the wetland in a township, section, or subsection of a United States Geological Survey 7.5 minute Quadrangle that has been designated by the U.S. Fish and Wildlife Service as "critical habitat" for any threatened or endangered plant or animal species? Note: as of January 1, 2001, of the federally listed endangered or threatened species which can be found in Ohio, the Indiana Bat has had critical habitat designated (50 CFR 17.95(a)) and the piping plover has had critical habitat proposed (65 FR 41812 July 6, 2000).	YES Wetland should be evaluated for possible Category 3 status Go to Question 2	(NO) Go to Question 2
2	**Threatened or Endangered Species.** Is the wetland known to contain an individual of, or documented occurrences of federal or state-listed threatened or endangered plant or animal species?	YES Wetland is a Category 3 wetland. Go to Question 3	(NO) Go to Question 3
3	**Documented High Quality Wetland.** Is the wetland on record in Natural Heritage Database as a high quality wetland?	YES Wetland is a Category 3 wetland Go to Question 4	(NO) Go to Question 4
4	**Significant Breeding or Concentration Area.** Does the wetland contain documented regionally significant breeding or nonbreeding waterfowl, neotropical songbird, or shorebird concentration areas?	YES Wetland is a Category 3 wetland Go to Question 5	(NO) Go to Question 5
5	**Category 1 Wetlands.** Is the wetland less than 0.5 hectares (1 acre) in size and **hydrologically isolated** and either 1) comprised of vegetation that is dominated (greater than eighty per cent areal cover) by *Phalaris arundinacea, Lythrum salicaria,* or *Phragmites australis*, or 2) an acidic pond created or excavated on mined lands that has little or no vegetation?	YES Wetland is a Category 1 wetland Go to Question 6	(NO) Go to Question 6
6	**Bogs.** Is the wetland a peat-accumulating wetland that 1) has no significant inflows or outflows, 2) supports acidophilic mosses, particularly *Sphagnum* spp., 3) the acidophilic mosses have >30% cover, 4) at least one species from Table 1 is present, and 5) the cover of invasive species (see Table 1) is <25%?	YES Wetland is a Category 3 wetland Go to Question 7	(NO) Go to Question 7
7	**Fens.** Is the wetland a carbon accumulating (peat, muck) wetland that is saturated during most of the year, primarily by a discharge of free flowing, mineral rich, ground water with a circumneutral ph (5.5-9.0) and with one or more plant species listed in Table 1 and the cover of invasive species listed in Table 1 is <25%?	YES Wetland is a Category 3 wetland Go to Question 8a	(NO) Go to Question 8a
8a	**"Old Growth Forest."** Is the wetland a forested wetland and is the forest characterized by, but not limited to, the following characteristics: overstory canopy trees of great age (exceeding at least 50% of a projected maximum attainable age for a species); little or no evidence of human-caused understory disturbance during the past 80 to 100 years; an all-aged structure and multilayered canopies; aggregations of canopy trees interspersed with canopy gaps; and significant numbers of standing dead snags and downed logs?	YES Wetland is a Category 3 wetland. Go to Question 8b	(NO) Go to Question 8b

8b	**Mature forested wetlands**. Is the wetland a forested wetland with 50% or more of the cover of upper forest canopy consisting of deciduous trees with large diameters at breast height (dbh), generally diameters greater than 45cm (17.7in) dbh?	YES Wetland should be evaluated for possible Category 3 status. Go to Question 9a	NO Go to Question 9a
9a	**Lake Erie coastal and tributary wetlands**. Is the wetland located at an elevation less than 575 feet on the USGS map, adjacent to this elevation, or along a tributary to Lake Erie that is accessible to fish?	YES Go to Question 9b	NO Go to Question 10
9b	Does the wetland's hydrology result from measures designed to prevent erosion and the loss of aquatic plants, i.e. the wetland is partially hydrologically restricted from Lake Erie due to lakeward or landward dikes or other hydrological controls?	YES Wetland should be evaluated for possible Category 3 status Go to Question 10	NO Go to Question 9c
9c	Are Lake Erie water levels the wetland's primary hydrological influence, i.e. the wetland is hydrologically unrestricted (no lakeward or upland border alterations), or the wetland can be characterized as an "estuarine" wetland with lake and river influenced hydrology. These include sandbar deposition wetlands, estuarine wetlands, river mouth wetlands, or those dominated by submersed aquatic vegetation.	YES Go to Question 9d	NO Go to Question 10
9d	Does the wetland have a predominance of native species within its vegetation communities, although non-native or disturbance tolerant native species can also be present?	YES Wetland is a Category 3 wetland Go to Question 10	NO Go to Question 9e
9e	Does the wetland have a predominance of non-native or disturbance tolerant native plant species within its vegetation communities?	YES Wetland should be evaluated for possible Category 3 status Go to Question 10	NO Go to Question 10
10	**Lake Plain Sand Prairies (Oak Openings)** Is the wetland located in Lucas, Fulton, Henry, or Wood Counties and can the wetland be characterized by the following description: the wetland has a sandy substrate with interspersed organic matter, a water table often within several inches of the surface, and often with a dominance of the gramineous vegetation listed in Table 1 (woody species may also be present). The Ohio Department of Natural Resources Division of Natural Areas and Preserves can provide assistance in confirming this type of wetland and its quality.	YES Wetland is a Category 3 wetland. Go to Question 11	NO Go to Question 11
11	**Relict Wet Prairies**. Is the wetland a relict wet prairie community dominated by some or all of the species in Table 1. Extensive prairies were formerly located in the Darby Plains (Madison and Union Counties), Sandusky Plains (Wyandot, Crawford, and Marion Counties), northwest Ohio (e.g. Erie, Huron, Lucas, Wood Counties), and portions of western Ohio Counties (e.g. Darke, Mercer, Miami, Montgomery, Van Wert etc.).	YES Wetland should be evaluated for possible Category 3 status Complete Quantitative Rating	NO Complete Quantitative Rating

Table 1. Characteristic plant species.

invasive/exotic spp	fen species	bog species	0ak Opening species	wet prairie species
Lythrum salicaria	*Zygadenus elegans var. glaucus*	*Calla palustris*	*Carex cryptolepis*	*Calamagrostis canadensis*
Myriophyllum spicatum	*Cacalia plantaginea*	*Carex atlantica var. capillacea*	*Carex lasiocarpa*	*Calamogrostis stricta*
Najas minor	*Carex flava*	*Carex echinata*	*Carex stricta*	*Carex atherodes*
Phalaris arundinacea	*Carex sterilis*	*Carex oligosperma*	*Cladium mariscoides*	*Carex buxbaumii*
Phragmites australis	*Carex stricta*	*Carex trisperma*	*Calamagrostis stricta*	*Carex pellita*
Potamogeton crispus	*Deschampsia caespitosa*	*Chamaedaphne calyculata*	*Calamagrostis canadensis*	*Carex sartwellii*
Ranunculus ficaria	*Eleocharis rostellata*	*Decodon verticillatus*	*Quercus palustris*	*Gentiana andrewsii*
Rhamnus frangula	*Eriophorum viridicarinatum*	*Eriophorum virginicum*		*Helianthus grosseserratus*
Typha angustifolia	*Gentianopsis spp.*	*Larix laricina*		*Liatris spicata*
Typha xglauca	*Lobelia kalmii*	*Nemopanthus mucronatus*		*Lysimachia quadriflora*
	Parnassia glauca	*Schechzeria palustris*		*Lythrum alatum*
	Potentilla fruticosa	*Sphagnum spp.*		*Pycnanthemum virginianum*
	Rhamnus alnifolia	*Vaccinium macrocarpon*		*Silphium terebinthinaceum*
	Rhynchospora capillacea	*Vaccinium corymbosum*		*Sorghastrum nutans*
	Salix candida	*Vaccinium oxycoccos*		*Spartina pectinata*
	Salix myricoides	*Woodwardia virginica*		*Solidago riddellii*
	Salix serissima	*Xyris difformis*		
	Solidago ohioensis			
	Tofieldia glutinosa			
	Triglochin maritimum			
	Triglochin palustre			

End of Narrative Rating. Begin Quantitative Rating on next page.

Site: Apex Sanitary Landfill, Amsterdam, OH | Rater(s): Mike A. Takacs, Mark Halbach | Date: 30 July 2010

Wetland C / Wetland O Complex

Metric 1. Wetland Area (size).

max 6 pts. | subtotal: 1 | 1

Select one size class and assign score.

- [ ] >50 acres (>20.2ha) (6 pts)
- [ ] 25 to <50 acres (10.1 to <20.2ha) (5 pts)
- [ ] 10 to <25 acres (4 to <10.1ha) (4 pts)
- [ ] 3 to <10 acres (1.2 to <4ha) (3 pts)
- [ ] 0.3 to <3 acres (0.12 to <1.2ha) (2pts)
- [x] 0.1 to <0.3 acres (0.04 to <0.12ha) (1 pt)
- [ ] <0.1 acres (0.04ha) (0 pts)

Wetland C 6.50ac + Wetland O 0.20ac. + Open Water 7 0.06ac. = 0.31ac.

Metric 2. Upland buffers and surrounding land use.

max 14 pts. | subtotal: 5 | 6

2a. Calculate average buffer width. Select only one and assign score. Do not double check.

- [ ] WIDE. Buffers average 50m (164ft) or more around wetland perimeter (7)
- [ ] MEDIUM. Buffers average 25m to <50m (82 to <164ft) around wetland perimeter (4)
- [x] NARROW. Buffers average 10m to <25m (32ft to <82ft) around wetland perimeter (1)
- [ ] VERY NARROW. Buffers average <10m (<32ft) around wetland perimeter (0)

$\bar{X} = 82'$

2b. Intensity of surrounding land use. Select one or double check and average.

- [ ] VERY LOW. 2nd growth or older forest, prairie, savannah, wildlife area, etc. (7)
- [x] LOW. Old field (>10 years), shrub land, young second growth forest. (5)
- [x] MODERATELY HIGH. Residential, fenced pasture, park, conservation tillage, new fallow field. (3)
- [ ] HIGH. Urban, industrial, open pasture, row cropping, mining, construction. (1)

4 pts. Spoils, Fields

Metric 3. Hydrology.

max 30 pts. | subtotal: 20 | 26

3a. Sources of Water. Score all that apply.

- [ ] High pH groundwater (5)
- [x] Other groundwater (3)
- [x] Precipitation (1)
- [x] Seasonal/Intermittent surface water (3)
- [ ] Perennial surface water (lake or stream) (5)

3b. Connectivity. Score all that apply.

- [ ] 100 year floodplain (1)
- [ ] Between stream/lake and other human use (1)
- [x] Part of wetland/upland (e.g. forest), complex (1)
- [ ] Part of riparian or upland corridor (1)

3c. Maximum water depth. Select only one and assign score.

- [x] >0.7 (27.6in) (3)
- [ ] 0.4 to 0.7m (15.7 to 27.6in) (2)
- [ ] <0.4m (<15.7in) (1)

3d. Duration inundation/saturation. Score one or dbl check.

- [x] Semi- to permanently inundated/saturated (4)
- [ ] Regularly inundated/saturated (3)
- [ ] Seasonally inundated (2)
- [ ] Seasonally saturated in upper 30cm (12in) (1)

3e. Modifications to natural hydrologic regime. Score one or double check and average.

- [ ] None or none apparent (12)
- [x] Recovered (7)
- [x] Recovering (3) 5
- [ ] Recent or no recovery (1)

Check all disturbances observed

- [ ] ditch
- [ ] tile
- [ ] dike
- [ ] weir
- [ ] stormwater input
- [ ] point source (nonstormwater)
- [x] filling/grading spoils
- [ ] road bed/RR track
- [x] dredging
- [x] other past mining

Metric 4. Habitat Alteration and Development.

max 20 pts. | subtotal: 9 | 33

4a. Substrate disturbance. Score one or double check and average.

- [ ] None or none apparent (4)
- [ ] Recovered (3)
- [x] Recovering (2)
- [x] Recent or no recovery (1) 1.5

Wetland C excavated subsoil

Wetland O mine spoil, excavated subsoils, sediments

4b. Habitat development. Select only one and assign score.

- [ ] Excellent (7)
- [ ] Very good (6)
- [ ] Good (5)
- [ ] Moderately good (4)
- [x] Fair (3)
- [ ] Poor to fair (2)
- [ ] Poor (1)

4c. Habitat alteration. Score one or double check and average.

- [ ] None or none apparent (9)
- [x] Recovered (6)
- [x] Recovering (3) 4.5
- [ ] Recent or no recovery (1)

Check all disturbances observed

- [ ] mowing
- [ ] grazing
- [ ] clearcutting
- [ ] selective cutting
- [ ] woody debris removal
- [ ] toxic pollutants
- [ ] shrub/sapling removal
- [ ] herbaceous/aquatic bed removal
- [x] sedimentation
- [ ] dredging
- [ ] farming
- [ ] nutrient enrichment
- [x] past mining

33

subtotal this page

last revised 1 February 2001 jjm

Site: Apex Sanitary Landfill, Amsterdam, OH	Rater(s): Mike A. Takacs, Mark Haibach	Date: 30 July 2010

Wetland C/Wetland O Complex

33
subtotal first page

Metric 5. Special Wetlands.

0 max 10 pts. | 33 subtotal

Check all that apply and score as indicated.

- [ ] Bog (10)
- [ ] Fen (10)
- [ ] Old growth forest (10)
- [ ] Mature forested wetland (5)
- [ ] Lake Erie coastal/tributary wetland-unrestricted hydrology (10)
- [ ] Lake Erie coastal/tributary wetland-restricted hydrology (5)
- [ ] Lake Plain Sand Prairies (Oak Openings) (10)
- [ ] Relict Wet Prairies (10)
- [ ] Known occurrence state/federal threatened or endangered species (10)
- [ ] Significant migratory songbird/water fowl habitat or usage (10)
- [ ] Category 1 Wetland. See Question 1 Qualitative Rating (-10)

Metric 6. Plant communities, interspersion, microtopography.

4 max 20 pts. | 37 subtotal

6a. Wetland Vegetation Communities.
Score all present using 0 to 3 scale.

- [ ] Aquatic bed
- [0] Emergent
- [0] Shrub
- [ ] Forest
- [ ] Mudflats
- [0] Open water
- [ ] Other_____

6b. horizontal (plan view) Interspersion.
Select only one.

- [ ] High (5)
- [ ] Moderately high(4)
- [ ] Moderate (3)
- [ ] Moderately low (2)
- [X] Low (1)
- [ ] None (0)

6c. Coverage of invasive plants. Refer to Table 1 ORAM long form for list. Add or deduct points for coverage

- [ ] Extensive >75% cover (-5)
- [ ] Moderate 25-75% cover (-3)
- [ ] Sparse 5-25% cover (-1)
- [ ] Nearly absent <5% cover (0)
- [X] Absent (1)

6d. Microtopography.
Score all present using 0 to 3 scale.

- [ ] Vegetated hummucks/tussucks
- [1] Coarse woody debris >15cm (6in)
- [ ] Standing dead >25cm (10in) dbh
- [1] Amphibian breeding pools

Vegetation Community Cover Scale

0	Absent or comprises <0.1ha (0.2471 acres) contiguous area
1	Present and either comprises small part of wetland's vegetation and is of moderate quality, or comprises a significant part but is of low quality
2	Present and either comprises significant part of wetland's vegetation and is of moderate quality or comprises a small part and is of high quality
3	Present and comprises significant part, or more, of wetland's vegetation and is of high quality

Narrative Description of Vegetation Quality

low	Low spp diversity and/or predominance of nonnative or disturbance tolerant native species
mod	Native spp are dominant component of the vegetation, although nonnative and/or disturbance tolerant native spp can also be present, and species diversity moderate to moderately high, but generally w/o presence of rare threatened or endangered spp
high	A predominance of native species, with nonnative spp and/or disturbance tolerant native spp absent or virtually absent, and high spp diversity and often, but not always, the presence of rare, threatened, or endangered spp

Mudflat and Open Water Class Quality

0	Absent <0.1ha (0.247 acres)
1	Low 0.1 to <1ha (0.247 to 2.47 acres)
2	Moderate 1 to <4ha (2.47 to 9.88 acres)
3	High 4ha (9.88 acres) or more

Microtopography Cover Scale

0	Absent
1	Present very small amounts or if more common of marginal quality
2	Present in moderate amounts, but not of highest quality or in small amounts of highest quality
3	Present in moderate or greater amounts and of highest quality

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End of Quantitative Rating. Complete Categorization Worksheets.

Modified Category 2

Apex Sanitary Landfill
Wetland C/Wetland O Complex
30 July 2010

ORAM Summary Worksheet

		circle answer or insert score	Result
Narrative Rating	Question 1 Critical Habitat	YES (NO)	If yes, Category 3.
	Question 2. Threatened or Endangered Species	YES (NO)	If yes, Category 3.
	Question 3. High Quality Natural Wetland	YES (NO)	If yes, Category 3.
	Question 4. Significant bird habitat	YES (NO)	If yes, Category 3.
	Question 5. Category 1 Wetlands	YES (NO)	If yes, Category 1.
	Question 6. Bogs	YES (NO)	If yes, Category 3.
	Question 7. Fens	YES (NO)	If yes, Category 3.
	Question 8a. Old Growth Forest	YES (NO)	If yes, Category 3.
	Question 8b. Mature Forested Wetland	YES (NO)	If yes, evaluate for Category 3; may also be 1 or 2.
	Question 9b. Lake Erie Wetlands - Restricted	YES (NO)	If yes, evaluate for Category 3; may also be 1 or 2.
	Question 9d. Lake Erie Wetlands – Unrestricted with native plants	YES NO	If yes, Category 3
	Question 9e. Lake Erie Wetlands - Unrestricted with invasive plants	YES NO	If yes, evaluate for Category 3; may also be 1 or 2.
	Question 10. Oak Openings	YES (NO)	If yes, Category 3
	Question 11. Relict Wet Prairies	YES (NO)	If yes, evaluate for Category 3; may also be 1 or 2.
Quantitative Rating	Metric 1. Size	1	
	Metric 2. Buffers and surrounding land use	5	
	Metric 3. Hydrology	20	
	Metric 4. Habitat	9	
	Metric 5. Special Wetland Communities	0	
	Metric 6. Plant communities, interspersion, microtopography	4	
	TOTAL SCORE	37	Category based on score breakpoints Category 2

Complete Wetland Categorization Worksheet.

Apex Sanitary Landfill
Wetland C/Wetland O Complex
30 July 2010

Wetland Categorization Worksheet

Choices	Circle one		Evaluation of Categorization Result of ORAM
Did you answer "Yes" to any of the following questions: Narrative Rating Nos. 2, 3, 4, 6, 7, 8a, 9d, 10	YES Wetland is categorized as a Category 3 wetland	(NO)	Is quantitative rating score *less* than the Category 2 scoring threshold (*excluding* gray zone)? If yes, reevaluate the category of the wetland using the narrative criteria in OAC Rule 3745-1-54(C) and biological and/or functional assessments to determine if the wetland has been over-categorized by the ORAM
Did you answer "Yes" to any of the following questions: Narrative Rating Nos. 1, 8b, 9b, 9e, 11	YES Wetland should be evaluated for possible Category 3 status	(NO)	Evaluate the wetland using the 1) narrative criteria in OAC Rule 3745-1-54(C) and 2) the quantitative rating score. If the wetland is determined to be a Category 3 wetland using either of these, it should be categorized as a Category 3 wetland. Detailed biological and/or functional assessments may also be used to determine the wetland's category.
Did you answer "Yes" to Narrative Rating No. 5	YES Wetland is categorized as a Category 1 wetland	(NO)	Is quantitative rating score *greater* than the Category 2 scoring threshold *(including* any gray zone)? If yes, reevaluate the category of the wetland using the narrative criteria in OAC Rule 3745-1-54(C) and biological and/or functional assessments to determine if the wetland has been under-categorized by the ORAM
Does the quantitative score fall within the scoring range of a Category 1, 2, or 3 wetland?	(YES) Wetland is assigned to the appropriate category based on the scoring range	NO	If the score of the wetland is located within the scoring range for a particular category, the wetland should be assigned to that category. In all instances however, the narrative criteria described in OAC Rule 3745-1-54(C) can be used to clarify or change a categorization based on a quantitative score.
Does the quantitative score fall with the *"gray zone"* for Category 1 or 2 or Category 2 or 3 wetlands?	YES Wetland is assigned to the higher of the two categories or assigned to a category based on detailed assessments and the narrative criteria	(NO)	Rater has the option of assigning the wetland to the higher of the two categories or to assign a category based on the results of a nonrapid wetland assessment method, e.g. functional assessment, biological assessment, etc, and a consideration of the narrative criteria in OAC rule 3745-1-54(C).
Does the wetland otherwise exhibit *moderate OR superior* hydrologic OR habitat, OR recreational functions AND the wetland was *not* categorized as a Category 2 wetland (in the case of moderate functions) or a Category 3 wetland (in the case of superior functions) by this method?	YES Wetland was undercategorized by this method. A written justification for recategorization should be provided on Background Information Form	(NO) Wetland is assigned to category as determined by the ORAM.	A wetland may be undercategorized using this method, but still exhibit one or more superior functions, e.g. a wetland's biotic communities may be degraded by human activities, but the wetland may still exhibit superior hydrologic functions because of its type, landscape position, size, local or regional significance, etc. In this circumstance, the narrative criteria in OAC Rule 3745-1-54(C)(2) and (3) are controlling, and the under-categorization should be corrected. A written justification with supporting reasons or information for this determination should be provided.

Final Category

Choose one	Category 1	(Category 2)	Category 3

End of Ohio Rapid Assessment Method for Wetlands.

Background Information

Name: Michael A. Takacs, Mark R. Haibach	
Date: 30 July 2010	
Affiliation: Civil & Environmental Consultants, Inc.	
Address: 333 Baldwin Road, Pittsburgh, PA 15205	
Phone Number: (412) 249-3188, (412) 249-3156	
e-mail address: mtakacs@cecinc.com, mhaibach@cecinc.com	
Name of Wetland: Wetland D	
Vegetation Communit(ies): PAB / POWZx	
HGM Class(es): SWD / GWD	
Location of Wetland: include map, address, north arrow, landmarks, distances, roads, etc. See Stream and Wetland Delineation Report, Figures 1 and 4.	

Lat/Long or UTM Coordinate	
USGS Quad Name: Amsterdam, OH	
County: Jefferson / Harrison	
Township: Springfield	
Section and Subsection	
Hydrologic Unit Code: 05030101340	
Site Visit: 30 July 2010	
National Wetland Inventory Map: Amsterdam, OH	
Ohio Wetland Inventory Map: —	
Soil Survey: Soil Survey of Jefferson County, Ohio	
Delineation report/map: Wetland and Stream Delineation and Functional Assessment Report, Potential Apex Sanitary Landfill Expansion. CEC 2010.	

Name of Wetland:	Wetland D
Wetland Size (acres, hectares):	0.58 ac. wetland + 0.09 ac. open water

Sketch: Include north arrow, relationship with other surface waters, vegetation zones, etc.

See Stream and Wetland Delineation Map (Figure 4).

Comments, Narrative Discussion, Justification of Category Changes:

Final score : 42	Category: Mod. 2

Apex Sanitary Landfill
Wetland D
30 July 2010

Scoring Boundary Worksheet

INSTRUCTIONS. The initial step in completing the ORAM is to identify the "scoring boundaries" of the wetland being rated. In many instances this determination will be relatively easy and the scoring boundaries will coincide with the "jurisdictional boundaries." For example, the scoring boundary of an isolated cattail marsh located in the middle of a farm field will likely be the same as that wetland's jurisdictional boundaries. In other instances, however, the scoring boundary will not be as easily determined. Wetlands that are small or isolated from other surface waters often form large contiguous areas or heterogeneous complexes of wetland and upland. In separating wetlands for scoring purposes, the hydrologic regime of the wetland is the main criterion that should be used. Boundaries between contiguous or connected wetlands should be established where the volume, flow, or velocity of water moving through the wetland changes significantly. *Areas with a high degree of hydrologic interaction should be scored as a single wetland.* In determining a wetland's scoring boundaries, use the guidelines in the ORAM Manual Section 5.0. In certain instances, it may be difficult to establish the scoring boundary for the wetland being rated. These problem situations include wetlands that form a patchwork on the landscape, wetlands divided by artificial boundaries like property fences, roads, or railroad embankments, wetlands that are contiguous with streams, lakes, or rivers, and estuarine or coastal wetlands. These situations are discussed below, however, it is recommended that Rater contact Ohio EPA, Division of Surface Water, 401/Wetlands Section if there are additional questions or a need for further clarification of the appropriate scoring boundaries of a particular wetland.

#	Steps in properly establishing scoring boundaries	done?	not applicable
Step 1	Identify the wetland area of interest. This may be the site of a proposed impact, a reference site, conservation site, etc.	Yes	
Step 2	Identify the locations where there is physical evidence that hydrology changes rapidly. Such evidence includes both natural and human-induced changes including, constrictions caused by berms or dikes, points where the water velocity changes rapidly at rapids or falls, points where significant inflows occur at the confluence of rivers, or other factors that may restrict hydrologic interaction between the wetlands or parts of a single wetland.	Yes	
Step 3	Delineate the boundary of the wetland to be rated such that all areas of interest that are contiguous to and within the areas where the hydrology does not change significantly, i.e. areas that have a high degree of hydrologic interaction are included within the scoring boundary.	Yes	
Step 4	Determine if artificial boundaries, such as property lines, state lines, roads, railroad embankments, etc., are present. These should not be used to establish scoring boundaries unless they coincide with areas where the hydrologic regime changes.	Yes	
Step 5	In all instances, the Rater may enlarge the minimum scoring boundaries discussed here to score together wetlands that could be scored separately.	Yes	
Step 6	Consult ORAM Manual Section 5.0 for how to establish scoring boundaries for wetlands that form a patchwork on the landscape, divided by artificial boundaries, contiguous to streams, lakes or rivers, or for dual classifications.	Yes	

End of Scoring Boundary Determination. Begin Narrative Rating on next page.

Apex Sanitary Landfill
Wetland D
30 July 2010

Narrative Rating

INSTRUCTIONS. Answer each of the following questions. Questions 1, 2, 3 and 4 should be answered based on information obtained from the site visit or the literature *and* by submitting a Data Services Request to the Ohio Department of Natural Resources, Division of Natural Areas and Preserves, Natural Heritage Data Services, 1889 Fountain Square Court, Building F-1, Columbus, Ohio 43224, 614-265-6453 (phone), 614-265-3096 (fax), http://www.dnr.state.oh.us/dnap . The remaining questions are designed to be answered primarily by the results of the site visit. Refer to the User's Manual for descriptions of these wetland types. Note: "Critical habitat" is legally defined in the Endangered Species Act and is the geographic area containing physical or biological features essential to the conservation of a listed species or as an area that may require special management considerations or protection. The Rater should contact the Region 3 Headquarters or the Columbus Ecological Services Office for updates as to whether critical habitat has been designated for other federally listed threatened or endangered species. "Documented" means the wetland is listed in the appropriate State of Ohio database.

#	Question	Circle one	
1	**Critical Habitat.** Is the wetland in a township, section, or subsection of a United States Geological Survey 7.5 minute Quadrangle that has been designated by the U.S. Fish and Wildlife Service as "critical habitat" for any threatened or endangered plant or animal species? Note: as of January 1, 2001, of the federally listed endangered or threatened species which can be found in Ohio, the Indiana Bat has had critical habitat designated (50 CFR 17.95(a)) and the piping plover has had critical habitat proposed (65 FR 41812 July 6, 2000).	YES Wetland should be evaluated for possible Category 3 status Go to Question 2	(NO) Go to Question 2
2	**Threatened or Endangered Species.** Is the wetland known to contain an individual of, or documented occurrences of federal or state-listed threatened or endangered plant or animal species?	YES Wetland is a Category 3 wetland. Go to Question 3	(NO) Go to Question 3
3	**Documented High Quality Wetland.** Is the wetland on record in Natural Heritage Database as a high quality wetland?	YES Wetland is a Category 3 wetland Go to Question 4	(NO) Go to Question 4
4	**Significant Breeding or Concentration Area.** Does the wetland contain documented regionally significant breeding or nonbreeding waterfowl, neotropical songbird, or shorebird concentration areas?	YES Wetland is a Category 3 wetland Go to Question 5	(NO) Go to Question 5
5	**Category 1 Wetlands.** Is the wetland less than 0.5 hectares (1 acre) in size and **hydrologically isolated** and either 1) comprised of vegetation that is dominated (greater than eighty per cent areal cover) by *Phalaris arundinacea, Lythrum salicaria,* or *Phragmites australis*, or 2) an acidic pond created or excavated on mined lands that has little or no vegetation?	YES Wetland is a Category 1 wetland Go to Question 6	(NO) Go to Question 6
6	**Bogs.** Is the wetland a peat-accumulating wetland that 1) has no significant inflows or outflows, 2) supports acidophilic mosses, particularly *Sphagnum* spp., 3) the acidophilic mosses have >30% cover, 4) at least one species from Table 1 is present, and 5) the cover of invasive species (see Table 1) is <25%?	YES Wetland is a Category 3 wetland Go to Question 7	(NO) Go to Question 7
7	**Fens.** Is the wetland a carbon accumulating (peat, muck) wetland that is saturated during most of the year, primarily by a discharge of free flowing, mineral rich, ground water with a circumneutral ph (5.5-9.0) and with one or more plant species listed in Table 1 and the cover of invasive species listed in Table 1 is <25%?	YES Wetland is a Category 3 wetland Go to Question 8a	(NO) Go to Question 8a
8a	**"Old Growth Forest."** Is the wetland a forested wetland and is the forest characterized by, but not limited to, the following characteristics: overstory canopy trees of great age (exceeding at least 50% of a projected maximum attainable age for a species); little or no evidence of human-caused understory disturbance during the past 80 to 100 years; an all-aged structure and multilayered canopies; aggregations of canopy trees interspersed with canopy gaps; and significant numbers of standing dead snags and downed logs?	YES Wetland is a Category 3 wetland. Go to Question 8b	(NO) Go to Question 8b

8b	**Mature forested wetlands.** Is the wetland a forested wetland with 50% or more of the cover of upper forest canopy consisting of deciduous trees with large diameters at breast height (dbh), generally diameters greater than 45cm (17.7in) dbh?	YES Wetland should be evaluated for possible Category 3 status. Go to Question 9a	NO Go to Question 9a
9a	**Lake Erie coastal and tributary wetlands.** Is the wetland located at an elevation less than 575 feet on the USGS map, adjacent to this elevation, or along a tributary to Lake Erie that is accessible to fish?	YES Go to Question 9b	NO Go to Question 10
9b	Does the wetland's hydrology result from measures designed to prevent erosion and the loss of aquatic plants, i.e. the wetland is partially hydrologically restricted from Lake Erie due to lakeward or landward dikes or other hydrological controls?	YES Wetland should be evaluated for possible Category 3 status Go to Question 10	NO Go to Question 9c
9c	Are Lake Erie water levels the wetland's primary hydrological influence, i.e. the wetland is hydrologically unrestricted (no lakeward or upland border alterations), or the wetland can be characterized as an "estuarine" wetland with lake and river influenced hydrology. These include sandbar deposition wetlands, estuarine wetlands, river mouth wetlands, or those dominated by submersed aquatic vegetation.	YES Go to Question 9d	NO Go to Question 10
9d	Does the wetland have a predominance of native species within its vegetation communities, although non-native or disturbance tolerant native species can also be present?	YES Wetland is a Category 3 wetland Go to Question 10	NO Go to Question 9e
9e	Does the wetland have a predominance of non-native or disturbance tolerant native plant species within its vegetation communities?	YES Wetland should be evaluated for possible Category 3 status Go to Question 10	NO Go to Question 10
10	**Lake Plain Sand Prairies (Oak Openings)** Is the wetland located in Lucas, Fulton, Henry, or Wood Counties and can the wetland be characterized by the following description: the wetland has a sandy substrate with interspersed organic matter, a water table often within several inches of the surface, and often with a dominance of the gramineous vegetation listed in Table 1 (woody species may also be present). The Ohio Department of Natural Resources Division of Natural Areas and Preserves can provide assistance in confirming this type of wetland and its quality.	YES Wetland is a Category 3 wetland. Go to Question 11	NO Go to Question 11
11	**Relict Wet Prairies.** Is the wetland a relict wet prairie community dominated by some or all of the species in Table 1. Extensive prairies were formerly located in the Darby Plains (Madison and Union Counties), Sandusky Plains (Wyandot, Crawford, and Marion Counties), northwest Ohio (e.g. Erie, Huron, Lucas, Wood Counties), and portions of western Ohio Counties (e.g. Darke, Mercer, Miami, Montgomery, Van Wert etc.).	YES Wetland should be evaluated for possible Category 3 status Complete Quantitative Rating	NO Complete Quantitative Rating

Table 1. Characteristic plant species.

invasive/exotic spp	fen species	bog species	0ak Opening species	wet prairie species
Lythrum salicaria	*Zygadenus elegans var. glaucus*	*Calla palustris*	*Carex cryptolepis*	*Calamagrostis canadensis*
Myriophyllum spicatum	*Cacalia plantaginea*	*Carex atlantica var. capillacea*	*Carex lasiocarpa*	*Calamogrostis stricta*
Najas minor	*Carex flava*	*Carex echinata*	*Carex stricta*	*Carex atherodes*
Phalaris arundinacea	*Carex sterilis*	*Carex oligosperma*	*Cladium mariscoides*	*Carex buxbaumii*
Phragmites australis	*Carex stricta*	*Carex trisperma*	*Calamagrostis stricta*	*Carex pellita*
Potamogeton crispus	*Deschampsia caespitosa*	*Chamaedaphne calyculata*	*Calamagrostis canadensis*	*Carex sartwellii*
Ranunculus ficaria	*Eleocharis rostellata*	*Decodon verticillatus*	*Quercus palustris*	*Gentiana andrewsii*
Rhamnus frangula	*Eriophorum viridicarinatum*	*Eriophorum virginicum*		*Helianthus grosseserratus*
Typha angustifolia	*Gentianopsis spp.*	*Larix laricina*		*Liatris spicata*
Typha xglauca	*Lobelia kalmii*	*Nemopanthus mucronatus*		*Lysimachia quadriflora*
	Parnassia glauca	*Schechzeria palustris*		*Lythrum alatum*
	Potentilla fruticosa	*Sphagnum spp.*		*Pycnanthemum virginianum*
	Rhamnus alnifolia	*Vaccinium macrocarpon*		*Silphium terebinthinaceum*
	Rhynchospora capillacea	*Vaccinium corymbosum*		*Sorghastrum nutans*
	Salix candida	*Vaccinium oxycoccos*		*Spartina pectinata*
	Salix myricoides	*Woodwardia virginica*		*Solidago riddellii*
	Salix serissima	*Xyris difformis*		
	Solidago ohioensis			
	Tofieldia glutinosa			
	Triglochin maritimum			
	Triglochin palustre			

End of Narrative Rating. Begin Quantitative Rating on next page.

ORAM v. 5.0 Field Form Quantitative Rating

WETLAND D

Site: Apex Landfill	Rater(s): MAT / MRH	Date: 7/30/10

Metric 1. Wetland Area (size).

2 (max 6 pts.) | 2 (subtotal)

Select one size class and assign score.

- [ ] >50 acres (>20.2ha) (6 pts)
- [ ] 25 to <50 acres (10.1 to <20.2ha) (5 pts)
- [ ] 10 to <25 acres (4 to <10.1ha) (4 pts)
- [ ] 3 to <10 acres (1.2 to <4ha) (3 pts)
- [x] 0.3 to <3 acres (0.12 to <1.2ha) (2pts)
- [ ] 0.1 to <0.3 acres (0.04 to <0.12ha) (1 pt)
- [ ] <0.1 acres (0.04ha) (0 pts)

0.58 ac. wetland + 0.09 ac. open water = 0.67 ac.

Metric 2. Upland buffers and surrounding land use.

9 (max 14 pts.) | 11 (subtotal)

2a. Calculate average buffer width. Select only one and assign score. Do not double check.

- [ ] WIDE. Buffers average 50m (164ft) or more around wetland perimeter (7)
- [x] MEDIUM. Buffers average 25m to <50m (82 to <164ft) around wetland perimeter (4)
- [ ] NARROW. Buffers average 10m to <25m (32ft to <82ft) around wetland perimeter (1)
- [ ] VERY NARROW. Buffers average <10m (<32ft) around wetland perimeter (0)

$\bar{x} = 108'$

2b. Intensity of surrounding land use. Select one or double check and average.

- [ ] VERY LOW. 2nd growth or older forest, prairie, savannah, wildlife area, etc. (7)
- [x] LOW. Old field (>10 years), shrubland, young second growth forest. (5)
- [ ] MODERATELY HIGH. Residential, fenced pasture, park, conservation tillage, new fallow field. (3)
- [ ] HIGH. Urban, industrial, open pasture, row cropping, mining, construction. (1)

Metric 3. Hydrology.

15 (max 30 pts.) | 26 (subtotal)

3a. Sources of Water. Score all that apply.

- [ ] High pH groundwater (5)
- [x] Other groundwater (3)
- [x] Precipitation (1)
- [ ] Seasonal/Intermittent surface water (3)
- [ ] Perennial surface water (lake or stream) (5)

3b. Connectivity. Score all that apply.

- [ ] 100 year floodplain (1)
- [ ] Between stream/lake and other human use (1)
- [x] Part of wetland/upland (e.g. forest), complex (1)
- [ ] Part of riparian or upland corridor (1)

3c. Maximum water depth. Select only one and assign score.

- [ ] >0.7 (27.6in) (3)
- [ ] 0.4 to 0.7m (15.7 to 27.6in) (2)
- [x] <0.4m (<15.7in) (1)

3d. Duration inundation/saturation. Score one or dbl check.

- [x] Semi- to permanently inundated/saturated (4)
- [ ] Regularly inundated/saturated (3)
- [ ] Seasonally inundated (2)
- [ ] Seasonally saturated in upper 30cm (12in) (1)

3e. Modifications to natural hydrologic regime. Score one or double check and average.

- [ ] None or none apparent (12)
- [x] Recovered (7)
- [x] Recovering (3) 5
- [ ] Recent or no recovery (1)

Check all disturbances observed

- [ ] ditch
- [ ] tile
- [ ] dike
- [ ] weir
- [ ] stormwater input
- [ ] point source (nonstormwater)
- [x] filling/grading, Spoils
- [ ] road bed/RR track
- [x] dredging
- [x] other past mining

Metric 4. Habitat Alteration and Development.

9 (max 20 pts.) | 35 (subtotal)

4a. Substrate disturbance. Score one or double check and average.

- [ ] None or none apparent (4)
- [ ] Recovered (3)
- [x] Recovering (2) 1.5 Spoils
- [x] Recent or no recovery (1)

4b. Habitat development. Select only one and assign score.

- [ ] Excellent (7)
- [ ] Very good (6)
- [ ] Good (5)
- [ ] Moderately good (4)
- [x] Fair (3)
- [ ] Poor to fair (2)
- [ ] Poor (1)

4c. Habitat alteration. Score one or double check and average.

- [ ] None or none apparent (9)
- [x] Recovered (6) 4.5
- [x] Recovering (3)
- [ ] Recent or no recovery (1)

Stripcut

Check all disturbances observed

- [ ] mowing
- [ ] grazing
- [ ] clearcutting
- [ ] selective cutting
- [ ] woody debris removal
- [ ] toxic pollutants
- [ ] shrub/sapling removal
- [ ] herbaceous/aquatic bed removal
- [x] sedimentation
- [ ] dredging
- [ ] farming
- [ ] nutrient enrichment
- [x] Past mining

35 subtotal this page

WETLAND D

Site: Apex Landfill	Rater(s): MAT / MRH	Date: 7/30/10

35
subtotal this page

0 | 35 max 10 pts. / subtotal

Metric 5. Special Wetlands.

Check all that apply and score as indicated.

- [ ] Bog (10)
- [ ] Fen (10)
- [ ] Old growth forest (10)
- [ ] Mature forested wetland (5)
- [ ] Lake Erie coastal/tributary wetland-unrestricted hydrology (10)
- [ ] Lake Erie coastal/tributary wetland-restricted hydrology (5)
- [ ] Lake Plain Sand Prairies (Oak Openings) (10)
- [ ] Relict Wet Praires (10)
- [ ] Known occurrence state/federal threatened or endangered species (10)
- [ ] Significant migratory songbird/water fowl habitat or usage (10)
- [ ] Category 1 Wetland. See Question 1 Qualitative Rating (-10)

7 | 42 max 20 pts. / subtotal

Metric 6. Plant communities, interspersion, microtopography.

6a. Wetland Vegetation Communities.
Score all present using 0 to 3 scale.

- [ ] Aquatic bed
- [1] Emergent
- [ ] Shrub
- [ ] Forest
- [ ] Mudflats
- [2] Open water
- [ ] Other_____

6b. horizontal (plan view) Interspersion.
Select only one.

- [ ] High (5)
- [ ] Moderately high(4)
- [ ] Moderate (3)
- [ ] Moderately low (2)
- [X] Low (1)
- [ ] None (0)

6c. Coverage of invasive plants. Refer to Table 1 ORAM long form for list. Add or deduct points for coverage

- [ ] Extensive >75% cover (-5)
- [ ] Moderate 25-75% cover (-3)
- [ ] Sparse 5-25% cover (-1)
- [ ] Nearly absent <5% cover (0)
- [X] Absent (1)

6d. Microtopography.
Score all present using 0 to 3 scale.

- [ ] Vegetated hummucks/tussucks
- [2] Coarse woody debris >15cm (6in)
- [ ] Standing dead >25cm (10in) dbh
- [2] Amphibian breeding pools

Vegetation Community Cover Scale

0	Absent or comprises <0.1ha (0.2471 acres) contiguous area
1	Present and either comprises small part of wetland's vegetation and is of moderate quality, or comprises a significant part but is of low quality
2	Present and either comprises significant part of wetland's vegetation and is of moderate quality or comprises a small part and is of high quality
3	Present and comprises significant part, or more, of wetland's vegetation and is of high quality

Narrative Description of Vegetation Quality

low	Low spp diversity and/or predominance of nonnative or disturbance tolerant native species
mod	Native spp are dominant component of the vegetation, although nonnative and/or disturbance tolerant native spp can also be present, and species diversity moderate to moderately high, but generallyw/o presence of rare threatened or endangered spp
high	A predominance of native species, with nonnative spp and/or disturbance tolerant native spp absent or virtually absent, and high spp diversity and often, but not always, the presence of rare, threatened, or endangered spp

Mudflat and Open Water Class Quality

0	Absent <0.1ha (0.247 acres)
1	Low 0.1 to <1ha (0.247 to 2.47 acres)
2	Moderate 1 to <4ha (2.47 to 9.88 acres)
3	High 4ha (9.88 acres) or more

Microtopography Cover Scale

0	Absent
1	Present very small amounts or if more common of marginal quality
2	Present in moderate amounts, but not of highest quality or in small amounts of highest quality
3	Present in moderate or greater amounts and of highest quality

42 **GRAND TOTAL(max 100 pts)** Modified Category 2

Refer to the most recent ORAM Score Calibration Report for the scoring breakpoints between wetland categories at the following address: http://www.epa.state.oh.us/dsw/401/401.html

Apex Sanitary Landfill
Wetland D
30 July 2010

ORAM Summary Worksheet

		circle answer or insert score	Result
Narrative Rating	Question 1 Critical Habitat	YES (NO)	If yes, Category 3.
	Question 2. Threatened or Endangered Species	YES (NO)	If yes, Category 3.
	Question 3. High Quality Natural Wetland	YES (NO)	If yes, Category 3.
	Question 4. Significant bird habitat	YES (NO)	If yes, Category 3.
	Question 5. Category 1 Wetlands	YES (NO)	If yes, Category 1.
	Question 6. Bogs	YES (NO)	If yes, Category 3.
	Question 7. Fens	YES (NO)	If yes, Category 3.
	Question 8a. Old Growth Forest	YES (NO)	If yes, Category 3.
	Question 8b. Mature Forested Wetland	YES (NO)	If yes, evaluate for Category 3; may also be 1 or 2.
	Question 9b. Lake Erie Wetlands - Restricted	YES (NO)	If yes, evaluate for Category 3; may also be 1 or 2.
	Question 9d. Lake Erie Wetlands – Unrestricted with native plants	YES NO	If yes, Category 3
	Question 9e. Lake Erie Wetlands - Unrestricted with invasive plants	YES NO	If yes, evaluate for Category 3; may also be 1 or 2.
	Question 10. Oak Openings	YES (NO)	If yes, Category 3
	Question 11. Relict Wet Prairies	YES (NO)	If yes, evaluate for Category 3; may also be 1 or 2.
Quantitative Rating	Metric 1. Size	2	
	Metric 2. Buffers and surrounding land use	9	
	Metric 3. Hydrology	15	
	Metric 4. Habitat	9	
	Metric 5. Special Wetland Communities	0	
	Metric 6. Plant communities, interspersion, microtopography	7	
	TOTAL SCORE	42	Category based on score breakpoints Modified Category 2

Complete Wetland Categorization Worksheet.

Apex Sanitary Landfill
Wetland D
30 July 2010

Wetland Categorization Worksheet

Choices	Circle one		Evaluation of Categorization Result of ORAM
Did you answer "Yes" to any of the following questions: Narrative Rating Nos. 2, 3, 4, 6, 7, 8a, 9d, 10	YES Wetland is categorized as a Category 3 wetland	(NO)	Is quantitative rating score *less* than the Category 2 scoring threshold (*excluding* gray zone)? If yes, reevaluate the category of the wetland using the narrative criteria in OAC Rule 3745-1-54(C) and biological and/or functional assessments to determine if the wetland has been over-categorized by the ORAM
Did you answer "Yes" to any of the following questions: Narrative Rating Nos. 1, 8b, 9b, 9e, 11	YES Wetland should be evaluated for possible Category 3 status	(NO)	Evaluate the wetland using the 1) narrative criteria in OAC Rule 3745-1-54(C) and 2) the quantitative rating score. If the wetland is determined to be a Category 3 wetland using either of these, it should be categorized as a Category 3 wetland. Detailed biological and/or functional assessments may also be used to determine the wetland's category.
Did you answer "Yes" to Narrative Rating No. 5	YES Wetland is categorized as a Category 1 wetland	(NO)	Is quantitative rating score *greater* than the Category 2 scoring threshold *(including* any gray zone)? If yes, reevaluate the category of the wetland using the narrative criteria in OAC Rule 3745-1-54(C) and biological and/or functional assessments to determine if the wetland has been under-categorized by the ORAM
Does the quantitative score fall within the scoring range of a Category 1, 2, or 3 wetland?	(YES) Wetland is assigned to the appropriate category based on the scoring range	NO	If the score of the wetland is located within the scoring range for a particular category, the wetland should be assigned to that category. In all instances however, the narrative criteria described in OAC Rule 3745-1-54(C) can be used to clarify or change a categorization based on a quantitative score.
Does the quantitative score fall with the *"gray zone"* for Category 1 or 2 or Category 2 or 3 wetlands?	YES Wetland is assigned to the higher of the two categories or assigned to a category based on detailed assessments and the narrative criteria	(NO)	Rater has the option of assigning the wetland to the higher of the two categories or to assign a category based on the results of a nonrapid wetland assessment method, e.g. functional assessment, biological assessment, etc, and a consideration of the narrative criteria in OAC rule 3745-1-54(C).
Does the wetland otherwise exhibit *moderate OR superior* hydrologic OR habitat, OR recreational functions AND the wetland was *not* categorized as a Category 2 wetland (in the case of moderate functions) or a Category 3 wetland (in the case of superior functions) by this method?	YES Wetland was undercategorized by this method. A written justification for recategorization should be provided on Background Information Form	(NO) Wetland is assigned to category as determined by the ORAM.	A wetland may be undercategorized using this method, but still exhibit one or more superior functions, e.g. a wetland's biotic communities may be degraded by human activities, but the wetland may still exhibit superior hydrologic functions because of its type, landscape position, size, local or regional significance, etc. In this circumstance, the narrative criteria in OAC Rule 3745-1-54(C)(2) and (3) are controlling, and the under-categorization should be corrected. A written justification with supporting reasons or information for this determination should be provided.

Final Category			
Choose one	Category 1	(Category 2)	Category 3

End of Ohio Rapid Assessment Method for Wetlands.

Background Information

Name:	Michael A. Takacs, Mark R. Haibach
Date:	30 July 2010
Affiliation:	Civil & Environmental Consultants, Inc.
Address:	333 Baldwin Road, Pittsburgh, PA 15205
Phone Number:	(412) 249-3188, (412) 249-3156
e-mail address:	mtakacs@cecinc.com, mhaibach@cecinc.com
Name of Wetland:	Wetland E
Vegetation Communit(ies):	PEM1
HGM Class(es):	GWS

Location of Wetland: include map, address, north arrow, landmarks, distances, roads, etc.

see Stream and Wetland Delineation Report, Figures 1 and 4.

Lat/Long or UTM Coordinate	
USGS Quad Name: Amsterdam, OH	
County: Jefferson	
Township: Springfield	
Section and Subsection	
Hydrologic Unit Code: 05030101304	
Site Visit: 30 July 2010	
National Wetland Inventory Map: Amsterdam, OH	
Ohio Wetland Inventory Map: —	
Soil Survey: Soil Survey of Jefferson County, Ohio	
Delineation report/map: Wetland and Stream Delineation and Functional Assessment Report, Potential Apex Sanitary Landfill Expansion	

Name of Wetland: Wetland E

Wetland Size (acres, hectares): 0.01 acre

Sketch: Include north arrow, relationship with other surface waters, vegetation zones, etc.

See Stream and Wetland Delineation Map (Figure 4).

Comments, Narrative Discussion, Justification of Category Changes:

Final score : Category:

Apex Sanitary Landfill
Wetland E
30 July 2010

Scoring Boundary Worksheet

INSTRUCTIONS. The initial step in completing the ORAM is to identify the "scoring boundaries" of the wetland being rated. In many instances this determination will be relatively easy and the scoring boundaries will coincide with the "jurisdictional boundaries." For example, the scoring boundary of an isolated cattail marsh located in the middle of a farm field will likely be the same as that wetland's jurisdictional boundaries. In other instances, however, the scoring boundary will not be as easily determined. Wetlands that are small or isolated from other surface waters often form large contiguous areas or heterogeneous complexes of wetland and upland. In separating wetlands for scoring purposes, the hydrologic regime of the wetland is the main criterion that should be used. Boundaries between contiguous or connected wetlands should be established where the volume, flow, or velocity of water moving through the wetland changes significantly. *Areas with a high degree of hydrologic interaction should be scored as a single wetland.* In determining a wetland's scoring boundaries, use the guidelines in the ORAM Manual Section 5.0. In certain instances, it may be difficult to establish the scoring boundary for the wetland being rated. These problem situations include wetlands that form a patchwork on the landscape, wetlands divided by artificial boundaries like property fences, roads, or railroad embankments, wetlands that are contiguous with streams, lakes, or rivers, and estuarine or coastal wetlands. These situations are discussed below, however, it is recommended that Rater contact Ohio EPA, Division of Surface Water, 401/Wetlands Section if there are additional questions or a need for further clarification of the appropriate scoring boundaries of a particular wetland.

#	Steps in properly establishing scoring boundaries	done?	not applicable
Step 1	Identify the wetland area of interest. This may be the site of a proposed impact, a reference site, conservation site, etc.	Yes	
Step 2	Identify the locations where there is physical evidence that hydrology changes rapidly. Such evidence includes both natural and human-induced changes including, constrictions caused by berms or dikes, points where the water velocity changes rapidly at rapids or falls, points where significant inflows occur at the confluence of rivers, or other factors that may restrict hydrologic interaction between the wetlands or parts of a single wetland.	Yes	
Step 3	Delineate the boundary of the wetland to be rated such that all areas of interest that are contiguous to and within the areas where the hydrology does not change significantly, i.e. areas that have a high degree of hydrologic interaction are included within the scoring boundary.	Yes	
Step 4	Determine if artificial boundaries, such as property lines, state lines, roads, railroad embankments, etc., are present. These should not be used to establish scoring boundaries unless they coincide with areas where the hydrologic regime changes.	Yes	
Step 5	In all instances, the Rater may enlarge the minimum scoring boundaries discussed here to score together wetlands that could be scored separately.	Yes	
Step 6	Consult ORAM Manual Section 5.0 for how to establish scoring boundaries for wetlands that form a patchwork on the landscape, divided by artificial boundaries, contiguous to streams, lakes or rivers, or for dual classifications.	Yes	

End of Scoring Boundary Determination. Begin Narrative Rating on next page.

Apex Sanitary Landfill
Wetland E
30 July 2010

Narrative Rating

INSTRUCTIONS. Answer each of the following questions. Questions 1, 2, 3 and 4 should be answered based on information obtained from the site visit or the literature *and* by submitting a Data Services Request to the Ohio Department of Natural Resources, Division of Natural Areas and Preserves, Natural Heritage Data Services, 1889 Fountain Square Court, Building F-1, Columbus, Ohio 43224, 614-265-6453 (phone), 614-265-3096 (fax), http://www.dnr.state.oh.us/dnap . The remaining questions are designed to be answered primarily by the results of the site visit. Refer to the User's Manual for descriptions of these wetland types. Note: "Critical habitat" is legally defined in the Endangered Species Act and is the geographic area containing physical or biological features essential to the conservation of a listed species or as an area that may require special management considerations or protection. The Rater should contact the Region 3 Headquarters or the Columbus Ecological Services Office for updates as to whether critical habitat has been designated for other federally listed threatened or endangered species. "Documented" means the wetland is listed in the appropriate State of Ohio database.

#	Question	Circle one	
1	**Critical Habitat.** Is the wetland in a township, section, or subsection of a United States Geological Survey 7.5 minute Quadrangle that has been designated by the U.S. Fish and Wildlife Service as "critical habitat" for any threatened or endangered plant or animal species? Note: as of January 1, 2001, of the federally listed endangered or threatened species which can be found in Ohio, the Indiana Bat has had critical habitat designated (50 CFR 17.95(a)) and the piping plover has had critical habitat proposed (65 FR 41812 July 6, 2000).	YES Wetland should be evaluated for possible Category 3 status Go to Question 2	(NO) Go to Question 2
2	**Threatened or Endangered Species.** Is the wetland known to contain an individual of, or documented occurrences of federal or state-listed threatened or endangered plant or animal species?	YES Wetland is a Category 3 wetland. Go to Question 3	(NO) Go to Question 3
3	**Documented High Quality Wetland.** Is the wetland on record in Natural Heritage Database as a high quality wetland?	YES Wetland is a Category 3 wetland Go to Question 4	(NO) Go to Question 4
4	**Significant Breeding or Concentration Area.** Does the wetland contain documented regionally significant breeding or nonbreeding waterfowl, neotropical songbird, or shorebird concentration areas?	YES Wetland is a Category 3 wetland Go to Question 5	(NO) Go to Question 5
5	**Category 1 Wetlands.** Is the wetland less than 0.5 hectares (1 acre) in size and **hydrologically isolated** and either 1) comprised of vegetation that is dominated (greater than eighty per cent areal cover) by *Phalaris arundinacea, Lythrum salicaria,* or *Phragmites australis*, or 2) an acidic pond created or excavated on mined lands that has little or no vegetation?	YES Wetland is a Category 1 wetland Go to Question 6	(NO) Go to Question 6
6	**Bogs.** Is the wetland a peat-accumulating wetland that 1) has no significant inflows or outflows, 2) supports acidophilic mosses, particularly *Sphagnum* spp., 3) the acidophilic mosses have >30% cover, 4) at least one species from Table 1 is present, and 5) the cover of invasive species (see Table 1) is <25%?	YES Wetland is a Category 3 wetland Go to Question 7	(NO) Go to Question 7
7	**Fens.** Is the wetland a carbon accumulating (peat, muck) wetland that is saturated during most of the year, primarily by a discharge of free flowing, mineral rich, ground water with a circumneutral ph (5.5-9.0) and with one or more plant species listed in Table 1 and the cover of invasive species listed in Table 1 is <25%?	YES Wetland is a Category 3 wetland Go to Question 8a	(NO) Go to Question 8a
8a	**"Old Growth Forest."** Is the wetland a forested wetland and is the forest characterized by, but not limited to, the following characteristics: overstory canopy trees of great age (exceeding at least 50% of a projected maximum attainable age for a species); little or no evidence of human-caused understory disturbance during the past 80 to 100 years; an all-aged structure and multilayered canopies; aggregations of canopy trees interspersed with canopy gaps; and significant numbers of standing dead snags and downed logs?	YES Wetland is a Category 3 wetland. Go to Question 8b	(NO) Go to Question 8b

8b	**Mature forested wetlands.** Is the wetland a forested wetland with 50% or more of the cover of upper forest canopy consisting of deciduous trees with large diameters at breast height (dbh), generally diameters greater than 45cm (17.7in) dbh?	YES Wetland should be evaluated for possible Category 3 status. Go to Question 9a	NO Go to Question 9a
9a	**Lake Erie coastal and tributary wetlands.** Is the wetland located at an elevation less than 575 feet on the USGS map, adjacent to this elevation, or along a tributary to Lake Erie that is accessible to fish?	YES Go to Question 9b	NO Go to Question 10
9b	Does the wetland's hydrology result from measures designed to prevent erosion and the loss of aquatic plants, i.e. the wetland is partially hydrologically restricted from Lake Erie due to lakeward or landward dikes or other hydrological controls?	YES Wetland should be evaluated for possible Category 3 status Go to Question 10	NO Go to Question 9c
9c	Are Lake Erie water levels the wetland's primary hydrological influence, i.e. the wetland is hydrologically unrestricted (no lakeward or upland border alterations), or the wetland can be characterized as an "estuarine" wetland with lake and river influenced hydrology. These include sandbar deposition wetlands, estuarine wetlands, river mouth wetlands, or those dominated by submersed aquatic vegetation.	YES Go to Question 9d	NO Go to Question 10
9d	Does the wetland have a predominance of native species within its vegetation communities, although non-native or disturbance tolerant native species can also be present?	YES Wetland is a Category 3 wetland Go to Question 10	NO Go to Question 9e
9e	Does the wetland have a predominance of non-native or disturbance tolerant native plant species within its vegetation communities?	YES Wetland should be evaluated for possible Category 3 status Go to Question 10	NO Go to Question 10
10	**Lake Plain Sand Prairies (Oak Openings)** Is the wetland located in Lucas, Fulton, Henry, or Wood Counties and can the wetland be characterized by the following description: the wetland has a sandy substrate with interspersed organic matter, a water table often within several inches of the surface, and often with a dominance of the gramineous vegetation listed in Table 1 (woody species may also be present). The Ohio Department of Natural Resources Division of Natural Areas and Preserves can provide assistance in confirming this type of wetland and its quality.	YES Wetland is a Category 3 wetland. Go to Question 11	NO Go to Question 11
11	**Relict Wet Prairies.** Is the wetland a relict wet prairie community dominated by some or all of the species in Table 1. Extensive prairies were formerly located in the Darby Plains (Madison and Union Counties), Sandusky Plains (Wyandot, Crawford, and Marion Counties), northwest Ohio (e.g. Erie, Huron, Lucas, Wood Counties), and portions of western Ohio Counties (e.g. Darke, Mercer, Miami, Montgomery, Van Wert etc.).	YES Wetland should be evaluated for possible Category 3 status Complete Quantitative Rating	NO Complete Quantitative Rating

Table 1. Characteristic plant species.

invasive/exotic spp	fen species	bog species	0ak Opening species	wet prairie species
Lythrum salicaria	*Zygadenus elegans var. glaucus*	*Calla palustris*	*Carex cryptolepis*	*Calamagrostis canadensis*
Myriophyllum spicatum	*Cacalia plantaginea*	*Carex atlantica var. capillacea*	*Carex lasiocarpa*	*Calamogrostis stricta*
Najas minor	*Carex flava*	*Carex echinata*	*Carex stricta*	*Carex atherodes*
Phalaris arundinacea	*Carex sterilis*	*Carex oligosperma*	*Cladium mariscoides*	*Carex buxbaumii*
Phragmites australis	*Carex stricta*	*Carex trisperma*	*Calamagrostis stricta*	*Carex pellita*
Potamogeton crispus	*Deschampsia caespitosa*	*Chamaedaphne calyculata*	*Calamagrostis canadensis*	*Carex sartwellii*
Ranunculus ficaria	*Eleocharis rostellata*	*Decodon verticillatus*	*Quercus palustris*	*Gentiana andrewsii*
Rhamnus frangula	*Eriophorum viridicarinatum*	*Eriophorum virginicum*		*Helianthus grosseserratus*
Typha angustifolia	*Gentianopsis spp.*	*Larix laricina*		*Liatris spicata*
Typha xglauca	*Lobelia kalmii*	*Nemopanthus mucronatus*		*Lysimachia quadriflora*
	Parnassia glauca	*Schechzeria palustris*		*Lythrum alatum*
	Potentilla fruticosa	*Sphagnum spp.*		*Pycnanthemum virginianum*
	Rhamnus alnifolia	*Vaccinium macrocarpon*		*Silphium terebinthinaceum*
	Rhynchospora capillacea	*Vaccinium corymbosum*		*Sorghastrum nutans*
	Salix candida	*Vaccinium oxycoccos*		*Spartina pectinata*
	Salix myricoides	*Woodwardia virginica*		*Solidago riddellii*
	Salix serissima	*Xyris difformis*		
	Solidago ohioensis			
	Tofieldia glutinosa			
	Triglochin maritimum			
	Triglochin palustre			

End of Narrative Rating. Begin Quantitative Rating on next page.

ORAM v. 5.0 Field Form Quantitative Rating

Site: Apex Sanitary Landfill, Amsterdam OH Wetland E	Rater(s): Mike A. Takacs, Mark Haibach	Date: 30 July 2010

Metric 1. Wetland Area (size).

0 (max 6 pts.) | 0 (subtotal)

Select one size class and assign score.

- [ ] >50 acres (>20.2ha) (6 pts)
- [ ] 25 to <50 acres (10.1 to <20.2ha) (5 pts)
- [ ] 10 to <25 acres (4 to <10.1ha) (4 pts)
- [ ] 3 to <10 acres (1.2 to <4ha) (3 pts)
- [ ] 0.3 to <3 acres (0.12 to <1.2ha) (2pts)
- [ ] 0.1 to <0.3 acres (0.04 to <0.12ha) (1 pt)
- [x] <0.1 acres (0.04ha) (0 pts) 0.01 acre

Metric 2. Upland buffers and surrounding land use.

3 (max 14 pts.) | 3 (subtotal)

2a. Calculate average buffer width. Select only one and assign score. Do not double check.

- [ ] WIDE. Buffers average 50m (164ft) or more around wetland perimeter (7)
- [ ] MEDIUM. Buffers average 25m to <50m (82 to <164ft) around wetland perimeter (4)
- [ ] NARROW. Buffers average 10m to <25m (32ft to <82ft) around wetland perimeter (1)
- [x] VERY NARROW. Buffers average <10m (<32ft) around wetland perimeter (0)

2b. Intensity of surrounding land use. Select one or double check and average.

- [ ] VERY LOW. 2nd growth or older forest, prairie, savannah, wildlife area, etc. (7)
- [ ] LOW. Old field (>10 years), shrub land, young second growth forest. (5)
- [x] MODERATELY HIGH. Residential, fenced pasture, park, conservation tillage, new fallow field. (3)
- [ ] HIGH. Urban, industrial, open pasture, row cropping, mining, construction. (1)

Metric 3. Hydrology.

10 (max 30 pts.) | 13 (subtotal)

3a. Sources of Water. Score all that apply.

- [ ] High pH groundwater (5)
- [x] Other groundwater (3) see page, seasonal
- [x] Precipitation (1)
- [ ] Seasonal/Intermittent surface water (3)
- [ ] Perennial surface water (lake or stream) (5)

3b. Connectivity. Score all that apply.

- [ ] 100 year floodplain (1)
- [x] Between stream/lake and other human use (1)
- [x] Part of wetland/upland (e.g. forest), complex (1)
- [ ] Part of riparian or upland corridor (1)

3c. Maximum water depth. Select only one and assign score.

- [ ] >0.7 (27.6in) (3)
- [ ] 0.4 to 0.7m (15.7 to 27.6in) (2)
- [x] <0.4m (<15.7in) (1)

3d. Duration inundation/saturation. Score one or dbl check.

- [ ] Semi- to permanently inundated/saturated (4)
- [ ] Regularly inundated/saturated (3)
- [x] Seasonally inundated (2) saturated
- [ ] Seasonally saturated in upper 30cm (12in) (1)

3e. Modifications to natural hydrologic regime. Score one or double check and average.

- [ ] None or none apparent (12)
- [ ] Recovered (7)
- [x] Recovering (3) 2
- [x] Recent or no recovery (1)

Check all disturbances observed

- [ ] ditch
- [ ] tile
- [ ] dike
- [ ] weir
- [ ] stormwater input
- [ ] point source (nonstormwater)
- [x] filling/grading spoil
- [ ] road bed/RR track
- [ ] dredging
- [x] other land clearing, past mining

Metric 4. Habitat Alteration and Development.

4.5 (max 20 pts.) | 17.5 (subtotal)

4a. Substrate disturbance. Score one or double check and average.

- [ ] None or none apparent (4)
- [ ] Recovered (3)
- [x] Recovering (2)
- [x] Recent or no recovery (1) 1.5 mine spoil

4b. Habitat development. Select only one and assign score.

- [ ] Excellent (7)
- [ ] Very good (6)
- [ ] Good (5)
- [ ] Moderately good (4)
- [ ] Fair (3)
- [ ] Poor to fair (2)
- [x] Poor (1)

4c. Habitat alteration. Score one or double check and average.

- [ ] None or none apparent (9)
- [ ] Recovered (6)
- [x] Recovering (3) 2
- [x] Recent or no recovery (1)

Check all disturbances observed

- [ ] mowing
- [ ] grazing
- [x] clearcutting
- [ ] selective cutting
- [ ] woody debris removal
- [ ] toxic pollutants
- [ ] shrub/sapling removal
- [ ] herbaceous/aquatic bed removal
- [x] sedimentation
- [ ] dredging
- [ ] farming
- [ ] nutrient enrichment
- [x] land clearing, past mining

17.5 subtotal this page

last revised 1 February 2001 jjm

ORAM v. 5.0 Field Form Quantitative Rating

Site: Apex Sanitary Landfill, Amsterdam, OH Wetland E	Rater(s): Mike A. Takacs, Mark Haibach	Date: 30 July 2010

17.5
subtotal first page

Metric 5. Special Wetlands.

max 10 pts.	subtotal
0	17.5

Check all that apply and score as indicated.

- [ ] Bog (10)
- [ ] Fen (10)
- [ ] Old growth forest (10)
- [ ] Mature forested wetland (5)
- [ ] Lake Erie coastal/tributary wetland-unrestricted hydrology (10)
- [ ] Lake Erie coastal/tributary wetland-restricted hydrology (5)
- [ ] Lake Plain Sand Prairies (Oak Openings) (10)
- [ ] Relict Wet Prairies (10)
- [ ] Known occurrence state/federal threatened or endangered species (10)
- [ ] Significant migratory songbird/water fowl habitat or usage (10)
- [ ] Category 1 Wetland. See Question 1 Qualitative Rating (-10)

Metric 6. Plant communities, interspersion, microtopography.

max 20 pts.	subtotal
-1	16.5

6a. Wetland Vegetation Communities.
Score all present using 0 to 3 scale.

- [ ] Aquatic bed
- [0] Emergent
- [ ] Shrub
- [ ] Forest
- [ ] Mudflats
- [ ] Open water
- [ ] Other_____

6b. horizontal (plan view) Interspersion.
Select only one.

- [ ] High (5)
- [ ] Moderately high(4)
- [ ] Moderate (3)
- [ ] Moderately low (2)
- [ ] Low (1)
- [X] None (0)

6c. Coverage of invasive plants. Refer to Table 1 ORAM long form for list. Add or deduct points for coverage

- [ ] Extensive >75% cover (-5)
- [ ] Moderate 25-75% cover (-3)
- [X] Sparse 5-25% cover (-1)
- [ ] Nearly absent <5% cover (0)
- [ ] Absent (1)

Typha angustifolia

6d. Microtopography.
Score all present using 0 to 3 scale.

- [0] Vegetated hummucks/tussucks
- [0] Coarse woody debris >15cm (6in)
- [0] Standing dead >25cm (10in) dbh
- [0] Amphibian breeding pools

Vegetation Community Cover Scale

0	Absent or comprises <0.1ha (0.2471 acres) contiguous area
1	Present and either comprises small part of wetland's vegetation and is of moderate quality, or comprises a significant part but is of low quality
2	Present and either comprises significant part of wetland's vegetation and is of moderate quality or comprises a small part and is of high quality
3	Present and comprises significant part, or more, of wetland's vegetation and is of high quality

Narrative Description of Vegetation Quality

low	Low spp diversity and/or predominance of nonnative or disturbance tolerant native species
mod	Native spp are dominant component of the vegetation, although nonnative and/or disturbance tolerant native spp can also be present, and species diversity moderate to moderately high, but generally w/o presence of rare threatened or endangered spp
high	A predominance of native species, with nonnative spp and/or disturbance tolerant native spp absent or virtually absent, and high spp diversity and often, but not always, the presence of rare, threatened, or endangered spp

Mudflat and Open Water Class Quality

0	Absent <0.1ha (0.247 acres)
1	Low 0.1 to <1ha (0.247 to 2.47 acres)
2	Moderate 1 to <4ha (2.47 to 9.88 acres)
3	High 4ha (9.88 acres) or more

Microtopography Cover Scale

0	Absent
1	Present very small amounts or if more common of marginal quality
2	Present in moderate amounts, but not of highest quality or in small amounts of highest quality
3	Present in moderate or greater amounts and of highest quality

16.5

End of Quantitative Rating. Complete Categorization Worksheets.

Category 1

Apex Sanitary Landfill
Wetland E
30 July 2010

ORAM Summary Worksheet

		circle answer or insert score	Result
Narrative Rating	Question 1 Critical Habitat	YES (NO)	If yes, Category 3.
	Question 2. Threatened or Endangered Species	YES (NO)	If yes, Category 3.
	Question 3. High Quality Natural Wetland	YES (NO)	If yes, Category 3.
	Question 4. Significant bird habitat	YES (NO)	If yes, Category 3.
	Question 5. Category 1 Wetlands	YES (NO)	If yes, Category 1.
	Question 6. Bogs	YES (NO)	If yes, Category 3.
	Question 7. Fens	YES (NO)	If yes, Category 3.
	Question 8a. Old Growth Forest	YES (NO)	If yes, Category 3.
	Question 8b. Mature Forested Wetland	YES (NO)	If yes, evaluate for Category 3; may also be 1 or 2.
	Question 9b. Lake Erie Wetlands - Restricted	YES (NO)	If yes, evaluate for Category 3; may also be 1 or 2.
	Question 9d. Lake Erie Wetlands – Unrestricted with native plants	YES NO	If yes, Category 3
	Question 9e. Lake Erie Wetlands - Unrestricted with invasive plants	YES NO	If yes, evaluate for Category 3; may also be 1 or 2.
	Question 10. Oak Openings	YES (NO)	If yes, Category 3
	Question 11. Relict Wet Prairies	YES (NO)	If yes, evaluate for Category 3; may also be 1 or 2.
Quantitative Rating	Metric 1. Size	0	
	Metric 2. Buffers and surrounding land use	3	
	Metric 3. Hydrology	10	
	Metric 4. Habitat	4.5	
	Metric 5. Special Wetland Communities	0	
	Metric 6. Plant communities, interspersion, microtopography	−1	
	TOTAL SCORE	16.5	Category based on score breakpoints

Complete Wetland Categorization Worksheet.

Apex Sanitary Landfill
Wetland E
30 July 2010

Wetland Categorization Worksheet

Choices	Circle one		Evaluation of Categorization Result of ORAM
Did you answer "Yes" to any of the following questions: Narrative Rating Nos. 2, 3, 4, 6, 7, 8a, 9d, 10	YES Wetland is categorized as a Category 3 wetland	(NO)	Is quantitative rating score *less* than the Category 2 scoring threshold (*excluding* gray zone)? If yes, reevaluate the category of the wetland using the narrative criteria in OAC Rule 3745-1-54(C) and biological and/or functional assessments to determine if the wetland has been over-categorized by the ORAM
Did you answer "Yes" to any of the following questions: Narrative Rating Nos. 1, 8b, 9b, 9e, 11	YES Wetland should be evaluated for possible Category 3 status	(NO)	Evaluate the wetland using the 1) narrative criteria in OAC Rule 3745-1-54(C) and 2) the quantitative rating score. If the wetland is determined to be a Category 3 wetland using either of these, it should be categorized as a Category 3 wetland. Detailed biological and/or functional assessments may also be used to determine the wetland's category.
Did you answer "Yes" to Narrative Rating No. 5	YES Wetland is categorized as a Category 1 wetland	(NO)	Is quantitative rating score *greater* than the Category 2 scoring threshold *(including* any gray zone)? If yes, reevaluate the category of the wetland using the narrative criteria in OAC Rule 3745-1-54(C) and biological and/or functional assessments to determine if the wetland has been under-categorized by the ORAM
Does the quantitative score fall within the scoring range of a Category 1, 2, or 3 wetland?	(YES) Wetland is assigned to the appropriate category based on the scoring range	NO	If the score of the wetland is located within the scoring range for a particular category, the wetland should be assigned to that category. In all instances however, the narrative criteria described in OAC Rule 3745-1-54(C) can be used to clarify or change a categorization based on a quantitative score.
Does the quantitative score fall with the *"gray zone"* for Category 1 or 2 or Category 2 or 3 wetlands?	YES Wetland is assigned to the higher of the two categories or assigned to a category based on detailed assessments and the narrative criteria	(NO)	Rater has the option of assigning the wetland to the higher of the two categories or to assign a category based on the results of a nonrapid wetland assessment method, e.g. functional assessment, biological assessment, etc, and a consideration of the narrative criteria in OAC rule 3745-1-54(C).
Does the wetland otherwise exhibit *moderate OR superior* hydrologic OR habitat, OR recreational functions AND the wetland was *not* categorized as a Category 2 wetland (in the case of moderate functions) or a Category 3 wetland (in the case of superior functions) by this method?	YES Wetland was undercategorized by this method. A written justification for recategorization should be provided on Background Information Form	(NO) Wetland is assigned to category as determined by the ORAM.	A wetland may be undercategorized using this method, but still exhibit one or more superior functions, e.g. a wetland's biotic communities may be degraded by human activities, but the wetland may still exhibit superior hydrologic functions because of its type, landscape position, size, local or regional significance, etc. In this circumstance, the narrative criteria in OAC Rule 3745-1-54(C)(2) and (3) are controlling, and the under-categorization should be corrected. A written justification with supporting reasons or information for this determination should be provided.

	Final Category		
Choose one	(Category 1)	Category 2	Category 3

End of Ohio Rapid Assessment Method for Wetlands.

Background Information

Name:	Michael A. Takacs, Mark R. Haibach
Date:	30 July 2010
Affiliation:	Civil & Environmental Consultants, Inc.
Address:	333 Baldwin Road, Pittsburgh, PA 15205
Phone Number:	(412) 249-3188, (412) 249-3156
e-mail address:	mtakacs@cecinc.com, mhaibach@cecinc.com
Name of Wetland:	Wetland F
Vegetation Communit(ies):	PSS1/EM1
HGM Class(es):	SWD

Location of Wetland: include map, address, north arrow, landmarks, distances, roads, etc.

See Stream and Wetland Delineation Report, Figures 1 and 4.

Lat/Long or UTM Coordinate	
USGS Quad Name: Amsterdam, OH	
County: Jefferson	
Township: Springfield	
Section and Subsection	
Hydrologic Unit Code: 050301011180	
Site Visit: 30 July 2010	
National Wetland Inventory Map: Amsterdam, OH	
Ohio Wetland Inventory Map: —	
Soil Survey: Soil Survey of Jefferson County, Ohio	
Delineation report/map: Wetland and Stream Delineation and Functional Assessment Report, Potential Apex Sanitary Landfill Expansion. CEC 2010.	

Name of Wetland: Wetland F	
Wetland Size (acres, hectares): 0.04 acre	

Sketch: Include north arrow, relationship with other surface waters, vegetation zones, etc.

See stream and wetland delineation map (Figure 4).

Comments, Narrative Discussion, Justification of Category Changes:

Final score : 15.5	Category: 1

Apex Sanitary Landfill
Wetland F
30 July 2010

Scoring Boundary Worksheet

INSTRUCTIONS. The initial step in completing the ORAM is to identify the "scoring boundaries" of the wetland being rated. In many instances this determination will be relatively easy and the scoring boundaries will coincide with the "jurisdictional boundaries." For example, the scoring boundary of an isolated cattail marsh located in the middle of a farm field will likely be the same as that wetland's jurisdictional boundaries. In other instances, however, the scoring boundary will not be as easily determined. Wetlands that are small or isolated from other surface waters often form large contiguous areas or heterogeneous complexes of wetland and upland. In separating wetlands for scoring purposes, the hydrologic regime of the wetland is the main criterion that should be used. Boundaries between contiguous or connected wetlands should be established where the volume, flow, or velocity of water moving through the wetland changes significantly. *Areas with a high degree of hydrologic interaction should be scored as a single wetland.* In determining a wetland's scoring boundaries, use the guidelines in the ORAM Manual Section 5.0. In certain instances, it may be difficult to establish the scoring boundary for the wetland being rated. These problem situations include wetlands that form a patchwork on the landscape, wetlands divided by artificial boundaries like property fences, roads, or railroad embankments, wetlands that are contiguous with streams, lakes, or rivers, and estuarine or coastal wetlands. These situations are discussed below, however, it is recommended that Rater contact Ohio EPA, Division of Surface Water, 401/Wetlands Section if there are additional questions or a need for further clarification of the appropriate scoring boundaries of a particular wetland.

#	Steps in properly establishing scoring boundaries	done?	not applicable
Step 1	Identify the wetland area of interest. This may be the site of a proposed impact, a reference site, conservation site, etc.	Yes	
Step 2	Identify the locations where there is physical evidence that hydrology changes rapidly. Such evidence includes both natural and human-induced changes including, constrictions caused by berms or dikes, points where the water velocity changes rapidly at rapids or falls, points where significant inflows occur at the confluence of rivers, or other factors that may restrict hydrologic interaction between the wetlands or parts of a single wetland.	Yes	
Step 3	Delineate the boundary of the wetland to be rated such that all areas of interest that are contiguous to and within the areas where the hydrology does not change significantly, i.e. areas that have a high degree of hydrologic interaction are included within the scoring boundary.	Yes	
Step 4	Determine if artificial boundaries, such as property lines, state lines, roads, railroad embankments, etc., are present. These should not be used to establish scoring boundaries unless they coincide with areas where the hydrologic regime changes.	Yes	
Step 5	In all instances, the Rater may enlarge the minimum scoring boundaries discussed here to score together wetlands that could be scored separately.	Yes	
Step 6	Consult ORAM Manual Section 5.0 for how to establish scoring boundaries for wetlands that form a patchwork on the landscape, divided by artificial boundaries, contiguous to streams, lakes or rivers, or for dual classifications.	Yes	

End of Scoring Boundary Determination. Begin Narrative Rating on next page.

Apex Sanitary Landfill
Wetland F
30 July 2010

Narrative Rating

INSTRUCTIONS. Answer each of the following questions. Questions 1, 2, 3 and 4 should be answered based on information obtained from the site visit or the literature *and* by submitting a Data Services Request to the Ohio Department of Natural Resources, Division of Natural Areas and Preserves, Natural Heritage Data Services, 1889 Fountain Square Court, Building F-1, Columbus, Ohio 43224, 614-265-6453 (phone), 614-265-3096 (fax), http://www.dnr.state.oh.us/dnap . The remaining questions are designed to be answered primarily by the results of the site visit. Refer to the User's Manual for descriptions of these wetland types. Note: "Critical habitat" is legally defined in the Endangered Species Act and is the geographic area containing physical or biological features essential to the conservation of a listed species or as an area that may require special management considerations or protection. The Rater should contact the Region 3 Headquarters or the Columbus Ecological Services Office for updates as to whether critical habitat has been designated for other federally listed threatened or endangered species. "Documented" means the wetland is listed in the appropriate State of Ohio database.

#	Question	Circle one	
1	**Critical Habitat.** Is the wetland in a township, section, or subsection of a United States Geological Survey 7.5 minute Quadrangle that has been designated by the U.S. Fish and Wildlife Service as "critical habitat" for any threatened or endangered plant or animal species? Note: as of January 1, 2001, of the federally listed endangered or threatened species which can be found in Ohio, the Indiana Bat has had critical habitat designated (50 CFR 17.95(a)) and the piping plover has had critical habitat proposed (65 FR 41812 July 6, 2000).	YES Wetland should be evaluated for possible Category 3 status Go to Question 2	(NO) Go to Question 2
2	**Threatened or Endangered Species.** Is the wetland known to contain an individual of, or documented occurrences of federal or state-listed threatened or endangered plant or animal species?	YES Wetland is a Category 3 wetland. Go to Question 3	(NO) Go to Question 3
3	**Documented High Quality Wetland.** Is the wetland on record in Natural Heritage Database as a high quality wetland?	YES Wetland is a Category 3 wetland Go to Question 4	(NO) Go to Question 4
4	**Significant Breeding or Concentration Area.** Does the wetland contain documented regionally significant breeding or nonbreeding waterfowl, neotropical songbird, or shorebird concentration areas?	YES Wetland is a Category 3 wetland Go to Question 5	(NO) Go to Question 5
5	**Category 1 Wetlands.** Is the wetland less than 0.5 hectares (1 acre) in size and **hydrologically isolated** and either 1) comprised of vegetation that is dominated (greater than eighty per cent areal cover) by *Phalaris arundinacea, Lythrum salicaria,* or *Phragmites australis*, or 2) an acidic pond created or excavated on mined lands that has little or no vegetation?	YES Wetland is a Category 1 wetland Go to Question 6	(NO) Go to Question 6
6	**Bogs.** Is the wetland a peat-accumulating wetland that 1) has no significant inflows or outflows, 2) supports acidophilic mosses, particularly *Sphagnum* spp., 3) the acidophilic mosses have >30% cover, 4) at least one species from Table 1 is present, and 5) the cover of invasive species (see Table 1) is <25%?	YES Wetland is a Category 3 wetland Go to Question 7	(NO) Go to Question 7
7	**Fens.** Is the wetland a carbon accumulating (peat, muck) wetland that is saturated during most of the year, primarily by a discharge of free flowing, mineral rich, ground water with a circumneutral ph (5.5-9.0) and with one or more plant species listed in Table 1 and the cover of invasive species listed in Table 1 is <25%?	YES Wetland is a Category 3 wetland Go to Question 8a	(NO) Go to Question 8a
8a	**"Old Growth Forest."** Is the wetland a forested wetland and is the forest characterized by, but not limited to, the following characteristics: overstory canopy trees of great age (exceeding at least 50% of a projected maximum attainable age for a species); little or no evidence of human-caused understory disturbance during the past 80 to 100 years; an all-aged structure and multilayered canopies; aggregations of canopy trees interspersed with canopy gaps; and significant numbers of standing dead snags and downed logs?	YES Wetland is a Category 3 wetland. Go to Question 8b	(NO) Go to Question 8b

8b	**Mature forested wetlands**. Is the wetland a forested wetland with 50% or more of the cover of upper forest canopy consisting of deciduous trees with large diameters at breast height (dbh), generally diameters greater than 45cm (17.7in) dbh?	YES Wetland should be evaluated for possible Category 3 status. Go to Question 9a	NO Go to Question 9a
9a	**Lake Erie coastal and tributary wetlands**. Is the wetland located at an elevation less than 575 feet on the USGS map, adjacent to this elevation, or along a tributary to Lake Erie that is accessible to fish?	YES Go to Question 9b	NO Go to Question 10
9b	Does the wetland's hydrology result from measures designed to prevent erosion and the loss of aquatic plants, i.e. the wetland is partially hydrologically restricted from Lake Erie due to lakeward or landward dikes or other hydrological controls?	YES Wetland should be evaluated for possible Category 3 status Go to Question 10	NO Go to Question 9c
9c	Are Lake Erie water levels the wetland's primary hydrological influence, i.e. the wetland is hydrologically unrestricted (no lakeward or upland border alterations), or the wetland can be characterized as an "estuarine" wetland with lake and river influenced hydrology. These include sandbar deposition wetlands, estuarine wetlands, river mouth wetlands, or those dominated by submersed aquatic vegetation.	YES Go to Question 9d	NO Go to Question 10
9d	Does the wetland have a predominance of native species within its vegetation communities, although non-native or disturbance tolerant native species can also be present?	YES Wetland is a Category 3 wetland Go to Question 10	NO Go to Question 9e
9e	Does the wetland have a predominance of non-native or disturbance tolerant native plant species within its vegetation communities?	YES Wetland should be evaluated for possible Category 3 status Go to Question 10	NO Go to Question 10
10	**Lake Plain Sand Prairies (Oak Openings)** Is the wetland located in Lucas, Fulton, Henry, or Wood Counties and can the wetland be characterized by the following description: the wetland has a sandy substrate with interspersed organic matter, a water table often within several inches of the surface, and often with a dominance of the gramineous vegetation listed in Table 1 (woody species may also be present). The Ohio Department of Natural Resources Division of Natural Areas and Preserves can provide assistance in confirming this type of wetland and its quality.	YES Wetland is a Category 3 wetland. Go to Question 11	NO Go to Question 11
11	**Relict Wet Prairies**. Is the wetland a relict wet prairie community dominated by some or all of the species in Table 1. Extensive prairies were formerly located in the Darby Plains (Madison and Union Counties), Sandusky Plains (Wyandot, Crawford, and Marion Counties), northwest Ohio (e.g. Erie, Huron, Lucas, Wood Counties), and portions of western Ohio Counties (e.g. Darke, Mercer, Miami, Montgomery, Van Wert etc.).	YES Wetland should be evaluated for possible Category 3 status Complete Quantitative Rating	NO Complete Quantitative Rating

Table 1. Characteristic plant species.

invasive/exotic spp	fen species	bog species	0ak Opening species	wet prairie species
Lythrum salicaria	*Zygadenus elegans var. glaucus*	*Calla palustris*	*Carex cryptolepis*	*Calamagrostis canadensis*
Myriophyllum spicatum	*Cacalia plantaginea*	*Carex atlantica var. capillacea*	*Carex lasiocarpa*	*Calamogrostis stricta*
Najas minor	*Carex flava*	*Carex echinata*	*Carex stricta*	*Carex atherodes*
Phalaris arundinacea	*Carex sterilis*	*Carex oligosperma*	*Cladium mariscoides*	*Carex buxbaumii*
Phragmites australis	*Carex stricta*	*Carex trisperma*	*Calamagrostis stricta*	*Carex pellita*
Potamogeton crispus	*Deschampsia caespitosa*	*Chamaedaphne calyculata*	*Calamagrostis canadensis*	*Carex sartwellii*
Ranunculus ficaria	*Eleocharis rostellata*	*Decodon verticillatus*	*Quercus palustris*	*Gentiana andrewsii*
Rhamnus frangula	*Eriophorum viridicarinatum*	*Eriophorum virginicum*		*Helianthus grosseserratus*
Typha angustifolia	*Gentianopsis spp.*	*Larix laricina*		*Liatris spicata*
Typha xglauca	*Lobelia kalmii*	*Nemopanthus mucronatus*		*Lysimachia quadriflora*
	Parnassia glauca	*Schechzeria palustris*		*Lythrum alatum*
	Potentilla fruticosa	*Sphagnum spp.*		*Pycnanthemum virginianum*
	Rhamnus alnifolia	*Vaccinium macrocarpon*		*Silphium terebinthinaceum*
	Rhynchospora capillacea	*Vaccinium corymbosum*		*Sorghastrum nutans*
	Salix candida	*Vaccinium oxycoccos*		*Spartina pectinata*
	Salix myricoides	*Woodwardia virginica*		*Solidago riddellii*
	Salix serissima	*Xyris difformis*		
	Solidago ohioensis			
	Tofieldia glutinosa			
	Triglochin maritimum			
	Triglochin palustre			

End of Narrative Rating. Begin Quantitative Rating on next page.

ORAM v. 5.0 Field Form Quantitative Rating

Site: Apex Sanitary Landfill, Amsterdam, OH | Rater(s): Nike A. Takacs, Mark Haibach | Date: 30 July 2010

Metric 1. Wetland Area (size).

0 (max 6 pts.) | 0 (subtotal)

Select one size class and assign score.

- [ ] >50 acres (>20.2ha) (6 pts)
- [ ] 25 to <50 acres (10.1 to <20.2ha) (5 pts)
- [ ] 10 to <25 acres (4 to <10.1ha) (4 pts)
- [ ] 3 to <10 acres (1.2 to <4ha) (3 pts)
- [ ] 0.3 to <3 acres (0.12 to <1.2ha) (2pts)
- [ ] 0.1 to <0.3 acres (0.04 to <0.12ha) (1 pt)
- [x] <0.1 acres (0.04ha) (0 pts) 0.04 acre

Metric 2. Upland buffers and surrounding land use.

5 (max 14 pts.) | 5 (subtotal)

2a. Calculate average buffer width. Select only one and assign score. Do not double check.

- [ ] WIDE. Buffers average 50m (164ft) or more around wetland perimeter (7)
- [ ] MEDIUM. Buffers average 25m to <50m (82 to <164ft) around wetland perimeter (4)
- [x] NARROW. Buffers average 10m to <25m (32ft to <82ft) around wetland perimeter (1) $\bar{X} = 51'$
- [ ] VERY NARROW. Buffers average <10m (<32ft) around wetland perimeter (0)

2b. Intensity of surrounding land use. Select one or double check and average.

- [ ] VERY LOW. 2nd growth or older forest, prairie, savannah, wildlife area, etc. (7)
- [x] LOW. Old field (>10 years), shrub land, young second growth forest. (5) 4pts.
- [x] MODERATELY HIGH. Residential, fenced pasture, park, conservation tillage, new fallow field. (3)
- [ ] HIGH. Urban, industrial, open pasture, row cropping, mining, construction. (1)

Metric 3. Hydrology.

7 (max 30 pts.) | 12 (subtotal)

3a. Sources of Water. Score all that apply.

- [ ] High pH groundwater (5)
- [ ] Other groundwater (3)
- [x] Precipitation (1)
- [ ] Seasonal/Intermittent surface water (3)
- [ ] Perennial surface water (lake or stream) (5)

3b. Connectivity. Score all that apply.

- [ ] 100 year floodplain (1)
- [x] Between stream/lake and other human use (1)
- [ ] Part of wetland/upland (e.g. forest), complex (1)
- [ ] Part of riparian or upland corridor (1)

3c. Maximum water depth. Select only one and assign score.

- [ ] >0.7 (27.6in) (3)
- [ ] 0.4 to 0.7m (15.7 to 27.6in) (2)
- [x] <0.4m (<15.7in) (1)

3d. Duration inundation/saturation. Score one or dbl check.

- [ ] Semi- to permanently inundated/saturated (4)
- [ ] Regularly inundated/saturated (3)
- [x] Seasonally inundated (2)
- [ ] Seasonally saturated in upper 30cm (12in) (1)

3e. Modifications to natural hydrologic regime. Score one or double check and average.

- [ ] None or none apparent (12)
- [ ] Recovered (7)
- [x] Recovering (3) 2pts.
- [x] Recent or no recovery (1)

Check all disturbances observed

- [ ] ditch
- [ ] tile
- [ ] dike
- [ ] weir
- [ ] stormwater input
- [ ] point source (nonstormwater)
- [x] filling/grading, spoils
- [ ] road bed/RR track
- [ ] dredging
- [x] other past mining

Metric 4. Habitat Alteration and Development.

5.5 (max 20 pts.) | 17.5 (subtotal)

4a. Substrate disturbance. Score one or double check and average.

- [ ] None or none apparent (4)
- [ ] Recovered (3)
- [x] Recovering (2)
- [x] Recent or no recovery (1) 1.5 pts. spoils

4b. Habitat development. Select only one and assign score.

- [ ] Excellent (7)
- [ ] Very good (6)
- [ ] Good (5)
- [ ] Moderately good (4)
- [ ] Fair (3)
- [x] Poor to fair (2)
- [ ] Poor (1)

4c. Habitat alteration. Score one or double check and average.

- [ ] None or none apparent (9)
- [ ] Recovered (6)
- [x] Recovering (3) 2pts.
- [x] Recent or no recovery (1)

Check all disturbances observed

- [ ] mowing
- [ ] grazing
- [ ] clearcutting
- [ ] selective cutting
- [ ] woody debris removal
- [ ] toxic pollutants
- [ ] shrub/sapling removal
- [x] herbaceous/aquatic bed removal
- [x] sedimentation
- [ ] dredging
- [ ] farming
- [ ] nutrient enrichment
- [x] filling, grading, mining

17.5 subtotal this page

last revised 1 February 2001 jjm

ORAM v. 5.0 Field Form Quantitative Rating

Site: Apex Sanitary Landfill, Amsterdam, OH Wetland F	Rater(s): Mike A. Takacs, Mark Halbach	Date: 30 July 2010

17.5
subtotal first page

Metric 5. Special Wetlands.

0 (max 10 pts.) | 17.5 (subtotal)

Check all that apply and score as indicated.

- [ ] Bog (10)
- [ ] Fen (10)
- [ ] Old growth forest (10)
- [ ] Mature forested wetland (5)
- [ ] Lake Erie coastal/tributary wetland-unrestricted hydrology (10)
- [ ] Lake Erie coastal/tributary wetland-restricted hydrology (5)
- [ ] Lake Plain Sand Prairies (Oak Openings) (10)
- [ ] Relict Wet Prairies (10)
- [ ] Known occurrence state/federal threatened or endangered species (10)
- [ ] Significant migratory songbird/water fowl habitat or usage (10)
- [ ] Category 1 Wetland. See Question 1 Qualitative Rating (-10)

Metric 6. Plant communities, interspersion, microtopography.

−2 (max 20 pts.) | 15.5 (subtotal)

6a. Wetland Vegetation Communities.
Score all present using 0 to 3 scale.

- [ ] Aquatic bed
- [2] Emergent
- [0] Shrub
- [ ] Forest
- [ ] Mudflats
- [ ] Open water
- [ ] Other_____

6b. horizontal (plan view) Interspersion.
Select only one.

- [ ] High (5)
- [ ] Moderately high(4)
- [ ] Moderate (3)
- [ ] Moderately low (2)
- [X] Low (1)
- [ ] None (0)

6c. Coverage of invasive plants. Refer to Table 1 ORAM long form for list. Add or deduct points for coverage

Typha angustifolia

- [ ] Extensive >75% cover (-5)
- [X] Moderate 25-75% cover (-3)
- [ ] Sparse 5-25% cover (-1)
- [ ] Nearly absent <5% cover (0)
- [ ] Absent (1)

6d. Microtopography.
Score all present using 0 to 3 scale.

- [0] Vegetated hummucks/tussucks
- [0] Coarse woody debris >15cm (6in)
- [0] Standing dead >25cm (10in) dbh
- [0] Amphibian breeding pools

Vegetation Community Cover Scale

0	Absent or comprises <0.1ha (0.2471 acres) contiguous area
1	Present and either comprises small part of wetland's vegetation and is of moderate quality, or comprises a significant part but is of low quality
2	Present and either comprises significant part of wetland's vegetation and is of moderate quality or comprises a small part and is of high quality
3	Present and comprises significant part, or more, of wetland's vegetation and is of high quality

Narrative Description of Vegetation Quality

low	Low spp diversity and/or predominance of nonnative or disturbance tolerant native species
mod	Native spp are dominant component of the vegetation, although nonnative and/or disturbance tolerant native spp can also be present, and species diversity moderate to moderately high, but generally w/o presence of rare threatened or endangered spp
high	A predominance of native species, with nonnative spp and/or disturbance tolerant native spp absent or virtually absent, and high spp diversity and often, but not always, the presence of rare, threatened, or endangered spp

Mudflat and Open Water Class Quality

0	Absent <0.1ha (0.247 acres)
1	Low 0.1 to <1ha (0.247 to 2.47 acres)
2	Moderate 1 to <4ha (2.47 to 9.88 acres)
3	High 4ha (9.88 acres) or more

Microtopography Cover Scale

0	Absent
1	Present very small amounts or if more common of marginal quality
2	Present in moderate amounts, but not of highest quality or in small amounts of highest quality
3	Present in moderate or greater amounts and of highest quality

15.5

End of Quantitative Rating. Complete Categorization Worksheets.

Category 1

Apex Sanitary LandFill
Wetland F
30 July 2010

ORAM Summary Worksheet

		circle answer or insert score	Result
Narrative Rating	Question 1 Critical Habitat	YES (NO)	If yes, Category 3.
	Question 2. Threatened or Endangered Species	YES (NO)	If yes, Category 3.
	Question 3. High Quality Natural Wetland	YES (NO)	If yes, Category 3.
	Question 4. Significant bird habitat	YES (NO)	If yes, Category 3.
	Question 5. Category 1 Wetlands	YES (NO)	If yes, Category 1.
	Question 6. Bogs	YES (NO)	If yes, Category 3.
	Question 7. Fens	YES (NO)	If yes, Category 3.
	Question 8a. Old Growth Forest	YES (NO)	If yes, Category 3.
	Question 8b. Mature Forested Wetland	YES (NO)	If yes, evaluate for Category 3; may also be 1 or 2.
	Question 9b. Lake Erie Wetlands - Restricted	YES (NO)	If yes, evaluate for Category 3; may also be 1 or 2.
	Question 9d. Lake Erie Wetlands – Unrestricted with native plants	YES NO	If yes, Category 3
	Question 9e. Lake Erie Wetlands - Unrestricted with invasive plants	YES NO	If yes, evaluate for Category 3; may also be 1 or 2.
	Question 10. Oak Openings	YES (NO)	If yes, Category 3
	Question 11. Relict Wet Prairies	YES (NO)	If yes, evaluate for Category 3; may also be 1 or 2.
Quantitative Rating	Metric 1. Size	0	
	Metric 2. Buffers and surrounding land use	5	
	Metric 3. Hydrology	7	
	Metric 4. Habitat	5.5	
	Metric 5. Special Wetland Communities	0	
	Metric 6. Plant communities, interspersion, microtopography	-2	
	TOTAL SCORE	15.5	Category based on score breakpoints Category 1

Complete Wetland Categorization Worksheet.

Apex Sanitary Landfill
Wetland F
30 July 2010

Wetland Categorization Worksheet

Choices	Circle one		Evaluation of Categorization Result of ORAM
Did you answer "Yes" to any of the following questions: Narrative Rating Nos. 2, 3, 4, 6, 7, 8a, 9d, 10	YES Wetland is categorized as a Category 3 wetland	(NO)	Is quantitative rating score *less* than the Category 2 scoring threshold (*excluding* gray zone)? If yes, reevaluate the category of the wetland using the narrative criteria in OAC Rule 3745-1-54(C) and biological and/or functional assessments to determine if the wetland has been over-categorized by the ORAM
Did you answer "Yes" to any of the following questions: Narrative Rating Nos. 1, 8b, 9b, 9e, 11	YES Wetland should be evaluated for possible Category 3 status	(NO)	Evaluate the wetland using the 1) narrative criteria in OAC Rule 3745-1-54(C) and 2) the quantitative rating score. If the wetland is determined to be a Category 3 wetland using either of these, it should be categorized as a Category 3 wetland. Detailed biological and/or functional assessments may also be used to determine the wetland's category.
Did you answer "Yes" to Narrative Rating No. 5	YES Wetland is categorized as a Category 1 wetland	(NO)	Is quantitative rating score *greater* than the Category 2 scoring threshold *(including* any gray zone)? If yes, reevaluate the category of the wetland using the narrative criteria in OAC Rule 3745-1-54(C) and biological and/or functional assessments to determine if the wetland has been under-categorized by the ORAM
Does the quantitative score fall within the scoring range of a Category 1, 2, or 3 wetland?	(YES) Wetland is assigned to the appropriate category based on the scoring range	NO	If the score of the wetland is located within the scoring range for a particular category, the wetland should be assigned to that category. In all instances however, the narrative criteria described in OAC Rule 3745-1-54(C) can be used to clarify or change a categorization based on a quantitative score.
Does the quantitative score fall with the *"gray zone"* for Category 1 or 2 or Category 2 or 3 wetlands?	YES Wetland is assigned to the higher of the two categories or assigned to a category based on detailed assessments and the narrative criteria	(NO)	Rater has the option of assigning the wetland to the higher of the two categories or to assign a category based on the results of a nonrapid wetland assessment method, e.g. functional assessment, biological assessment, etc, and a consideration of the narrative criteria in OAC rule 3745-1-54(C).
Does the wetland otherwise exhibit *moderate OR superior* hydrologic OR habitat, OR recreational functions AND the wetland was *not* categorized as a Category 2 wetland (in the case of moderate functions) or a Category 3 wetland (in the case of superior functions) by this method?	YES Wetland was undercategorized by this method. A written justification for recategorization should be provided on Background Information Form	(NO) Wetland is assigned to category as determined by the ORAM.	A wetland may be undercategorized using this method, but still exhibit one or more superior functions, e.g. a wetland's biotic communities may be degraded by human activities, but the wetland may still exhibit superior hydrologic functions because of its type, landscape position, size, local or regional significance, etc. In this circumstance, the narrative criteria in OAC Rule 3745-1-54(C)(2) and (3) are controlling, and the under-categorization should be corrected. A written justification with supporting reasons or information for this determination should be provided.

Final Category			
Choose one	(Category 1)	Category 2	Category 3

End of Ohio Rapid Assessment Method for Wetlands.

Background Information

Name:	Michael A. Takacs, Mark R. Haibach
Date:	30 July 2010
Affiliation:	Civil & Environmental Consultants, Inc.
Address:	333 Baldwin Road, Pittsburgh, PA 15205
Phone Number:	(412) 249-3188, (412) 249-3156
e-mail address:	mtakacs@cecinc.com
Name of Wetland:	Wetland G
Vegetation Communit(ies):	PSS1 / EM1
HGM Class(es):	SWD, GWD, GWS
Location of Wetland: include map, address, north arrow, landmarks, distances, roads, etc.	See Stream and Wetland Delineation Report, Figures 1 and 4.

Lat/Long or UTM Coordinate	
USGS Quad Name: Amsterdam, OH	
County: Jefferson / Harrison	
Township: Springfield	
Section and Subsection	
Hydrologic Unit Code: 05030101180	
Site Visit: 30 July 2010	
National Wetland Inventory Map: Amsterdam, OH	
Ohio Wetland Inventory Map	
Soil Survey: Soil Survey of Jefferson County, Ohio	
Delineation report/map: Wetland and Stream Delineation and Functional Assessment Report, Potential Apex Sanitary Landfill Expansion, CEC, 2010.	

Name of Wetland: Wetland G

Wetland Size (acres, hectares): 1.16 acres

Sketch: Include north arrow, relationship with other surface waters, vegetation zones, etc.

See Stream and Wetland Delineation Map (Figure 4)

Comments, Narrative Discussion, Justification of Category Changes:

Final score : 41 Category: Mod. 2

Apex Sanitary Landfill
Wetland G
30 July 2010

Scoring Boundary Worksheet

INSTRUCTIONS. The initial step in completing the ORAM is to identify the "scoring boundaries" of the wetland being rated. In many instances this determination will be relatively easy and the scoring boundaries will coincide with the "jurisdictional boundaries." For example, the scoring boundary of an isolated cattail marsh located in the middle of a farm field will likely be the same as that wetland's jurisdictional boundaries. In other instances, however, the scoring boundary will not be as easily determined. Wetlands that are small or isolated from other surface waters often form large contiguous areas or heterogeneous complexes of wetland and upland. In separating wetlands for scoring purposes, the hydrologic regime of the wetland is the main criterion that should be used. Boundaries between contiguous or connected wetlands should be established where the volume, flow, or velocity of water moving through the wetland changes significantly. *Areas with a high degree of hydrologic interaction should be scored as a single wetland.* In determining a wetland's scoring boundaries, use the guidelines in the ORAM Manual Section 5.0. In certain instances, it may be difficult to establish the scoring boundary for the wetland being rated. These problem situations include wetlands that form a patchwork on the landscape, wetlands divided by artificial boundaries like property fences, roads, or railroad embankments, wetlands that are contiguous with streams, lakes, or rivers, and estuarine or coastal wetlands. These situations are discussed below, however, it is recommended that Rater contact Ohio EPA, Division of Surface Water, 401/Wetlands Section if there are additional questions or a need for further clarification of the appropriate scoring boundaries of a particular wetland.

#	Steps in properly establishing scoring boundaries	done?	not applicable
Step 1	Identify the wetland area of interest. This may be the site of a proposed impact, a reference site, conservation site, etc.	Yes	
Step 2	Identify the locations where there is physical evidence that hydrology changes rapidly. Such evidence includes both natural and human-induced changes including, constrictions caused by berms or dikes, points where the water velocity changes rapidly at rapids or falls, points where significant inflows occur at the confluence of rivers, or other factors that may restrict hydrologic interaction between the wetlands or parts of a single wetland.	Yes	
Step 3	Delineate the boundary of the wetland to be rated such that all areas of interest that are contiguous to and within the areas where the hydrology does not change significantly, i.e. areas that have a high degree of hydrologic interaction are included within the scoring boundary.	Yes	
Step 4	Determine if artificial boundaries, such as property lines, state lines, roads, railroad embankments, etc., are present. These should not be used to establish scoring boundaries unless they coincide with areas where the hydrologic regime changes.	Yes	
Step 5	In all instances, the Rater may enlarge the minimum scoring boundaries discussed here to score together wetlands that could be scored separately.	Yes	
Step 6	Consult ORAM Manual Section 5.0 for how to establish scoring boundaries for wetlands that form a patchwork on the landscape, divided by artificial boundaries, contiguous to streams, lakes or rivers, or for dual classifications.	Yes	

End of Scoring Boundary Determination. Begin Narrative Rating on next page.

Apex Sanitary Landfill
Wetland G
30 July 2010

Narrative Rating

INSTRUCTIONS. Answer each of the following questions. Questions 1, 2, 3 and 4 should be answered based on information obtained from the site visit or the literature *and* by submitting a Data Services Request to the Ohio Department of Natural Resources, Division of Natural Areas and Preserves, Natural Heritage Data Services, 1889 Fountain Square Court, Building F-1, Columbus, Ohio 43224, 614-265-6453 (phone), 614-265-3096 (fax), http://www.dnr.state.oh.us/dnap . The remaining questions are designed to be answered primarily by the results of the site visit. Refer to the User's Manual for descriptions of these wetland types. Note: "Critical habitat" is legally defined in the Endangered Species Act and is the geographic area containing physical or biological features essential to the conservation of a listed species or as an area that may require special management considerations or protection. The Rater should contact the Region 3 Headquarters or the Columbus Ecological Services Office for updates as to whether critical habitat has been designated for other federally listed threatened or endangered species. "Documented" means the wetland is listed in the appropriate State of Ohio database.

#	Question	Circle one	
1	**Critical Habitat.** Is the wetland in a township, section, or subsection of a United States Geological Survey 7.5 minute Quadrangle that has been designated by the U.S. Fish and Wildlife Service as "critical habitat" for any threatened or endangered plant or animal species? Note: as of January 1, 2001, of the federally listed endangered or threatened species which can be found in Ohio, the Indiana Bat has had critical habitat designated (50 CFR 17.95(a)) and the piping plover has had critical habitat proposed (65 FR 41812 July 6, 2000).	YES Wetland should be evaluated for possible Category 3 status Go to Question 2	(NO) Go to Question 2
2	**Threatened or Endangered Species.** Is the wetland known to contain an individual of, or documented occurrences of federal or state-listed threatened or endangered plant or animal species?	YES Wetland is a Category 3 wetland. Go to Question 3	(NO) Go to Question 3
3	**Documented High Quality Wetland.** Is the wetland on record in Natural Heritage Database as a high quality wetland?	YES Wetland is a Category 3 wetland Go to Question 4	(NO) Go to Question 4
4	**Significant Breeding or Concentration Area.** Does the wetland contain documented regionally significant breeding or nonbreeding waterfowl, neotropical songbird, or shorebird concentration areas?	YES Wetland is a Category 3 wetland Go to Question 5	(NO) Go to Question 5
5	**Category 1 Wetlands.** Is the wetland less than 0.5 hectares (1 acre) in size and **hydrologically isolated** and either 1) comprised of vegetation that is dominated (greater than eighty per cent areal cover) by *Phalaris arundinacea, Lythrum salicaria,* or *Phragmites australis*, or 2) an acidic pond created or excavated on mined lands that has little or no vegetation?	YES Wetland is a Category 1 wetland Go to Question 6	(NO) Go to Question 6
6	**Bogs.** Is the wetland a peat-accumulating wetland that 1) has no significant inflows or outflows, 2) supports acidophilic mosses, particularly *Sphagnum* spp., 3) the acidophilic mosses have >30% cover, 4) at least one species from Table 1 is present, and 5) the cover of invasive species (see Table 1) is <25%?	YES Wetland is a Category 3 wetland Go to Question 7	(NO) Go to Question 7
7	**Fens.** Is the wetland a carbon accumulating (peat, muck) wetland that is saturated during most of the year, primarily by a discharge of free flowing, mineral rich, ground water with a circumneutral ph (5.5-9.0) and with one or more plant species listed in Table 1 and the cover of invasive species listed in Table 1 is <25%?	YES Wetland is a Category 3 wetland Go to Question 8a	(NO) Go to Question 8a
8a	**"Old Growth Forest."** Is the wetland a forested wetland and is the forest characterized by, but not limited to, the following characteristics: overstory canopy trees of great age (exceeding at least 50% of a projected maximum attainable age for a species); little or no evidence of human-caused understory disturbance during the past 80 to 100 years; an all-aged structure and multilayered canopies; aggregations of canopy trees interspersed with canopy gaps; and significant numbers of standing dead snags and downed logs?	YES Wetland is a Category 3 wetland. Go to Question 8b	(NO) Go to Question 8b

8b	**Mature forested wetlands.** Is the wetland a forested wetland with 50% or more of the cover of upper forest canopy consisting of deciduous trees with large diameters at breast height (dbh), generally diameters greater than 45cm (17.7in) dbh?	YES Wetland should be evaluated for possible Category 3 status. Go to Question 9a	NO Go to Question 9a
9a	**Lake Erie coastal and tributary wetlands.** Is the wetland located at an elevation less than 575 feet on the USGS map, adjacent to this elevation, or along a tributary to Lake Erie that is accessible to fish?	YES Go to Question 9b	NO Go to Question 10
9b	Does the wetland's hydrology result from measures designed to prevent erosion and the loss of aquatic plants, i.e. the wetland is partially hydrologically restricted from Lake Erie due to lakeward or landward dikes or other hydrological controls?	YES Wetland should be evaluated for possible Category 3 status Go to Question 10	NO Go to Question 9c
9c	Are Lake Erie water levels the wetland's primary hydrological influence, i.e. the wetland is hydrologically unrestricted (no lakeward or upland border alterations), or the wetland can be characterized as an "estuarine" wetland with lake and river influenced hydrology. These include sandbar deposition wetlands, estuarine wetlands, river mouth wetlands, or those dominated by submersed aquatic vegetation.	YES Go to Question 9d	NO Go to Question 10
9d	Does the wetland have a predominance of native species within its vegetation communities, although non-native or disturbance tolerant native species can also be present?	YES Wetland is a Category 3 wetland Go to Question 10	NO Go to Question 9e
9e	Does the wetland have a predominance of non-native or disturbance tolerant native plant species within its vegetation communities?	YES Wetland should be evaluated for possible Category 3 status Go to Question 10	NO Go to Question 10
10	**Lake Plain Sand Prairies (Oak Openings)** Is the wetland located in Lucas, Fulton, Henry, or Wood Counties and can the wetland be characterized by the following description: the wetland has a sandy substrate with interspersed organic matter, a water table often within several inches of the surface, and often with a dominance of the gramineous vegetation listed in Table 1 (woody species may also be present). The Ohio Department of Natural Resources Division of Natural Areas and Preserves can provide assistance in confirming this type of wetland and its quality.	YES Wetland is a Category 3 wetland. Go to Question 11	NO Go to Question 11
11	**Relict Wet Prairies.** Is the wetland a relict wet prairie community dominated by some or all of the species in Table 1. Extensive prairies were formerly located in the Darby Plains (Madison and Union Counties), Sandusky Plains (Wyandot, Crawford, and Marion Counties), northwest Ohio (e.g. Erie, Huron, Lucas, Wood Counties), and portions of western Ohio Counties (e.g. Darke, Mercer, Miami, Montgomery, Van Wert etc.).	YES Wetland should be evaluated for possible Category 3 status Complete Quantitative Rating	NO Complete Quantitative Rating

Table 1. Characteristic plant species.

invasive/exotic spp	fen species	bog species	0ak Opening species	wet prairie species
Lythrum salicaria	*Zygadenus elegans var. glaucus*	*Calla palustris*	*Carex cryptolepis*	*Calamagrostis canadensis*
Myriophyllum spicatum	*Cacalia plantaginea*	*Carex atlantica var. capillacea*	*Carex lasiocarpa*	*Calamogrostis stricta*
Najas minor	*Carex flava*	*Carex echinata*	*Carex stricta*	*Carex atherodes*
Phalaris arundinacea	*Carex sterilis*	*Carex oligosperma*	*Cladium mariscoides*	*Carex buxbaumii*
Phragmites australis	*Carex stricta*	*Carex trisperma*	*Calamagrostis stricta*	*Carex pellita*
Potamogeton crispus	*Deschampsia caespitosa*	*Chamaedaphne calyculata*	*Calamagrostis canadensis*	*Carex sartwellii*
Ranunculus ficaria	*Eleocharis rostellata*	*Decodon verticillatus*	*Quercus palustris*	*Gentiana andrewsii*
Rhamnus frangula	*Eriophorum viridicarinatum*	*Eriophorum virginicum*		*Helianthus grosseserratus*
Typha angustifolia	*Gentianopsis spp.*	*Larix laricina*		*Liatris spicata*
Typha xglauca	*Lobelia kalmii*	*Nemopanthus mucronatus*		*Lysimachia quadriflora*
	Parnassia glauca	*Schechzeria palustris*		*Lythrum alatum*
	Potentilla fruticosa	*Sphagnum spp.*		*Pycnanthemum virginianum*
	Rhamnus alnifolia	*Vaccinium macrocarpon*		*Silphium terebinthinaceum*
	Rhynchospora capillacea	*Vaccinium corymbosum*		*Sorghastrum nutans*
	Salix candida	*Vaccinium oxycoccos*		*Spartina pectinata*
	Salix myricoides	*Woodwardia virginica*		*Solidago riddellii*
	Salix serissima	*Xyris difformis*		
	Solidago ohioensis			
	Tofieldia glutinosa			
	Triglochin maritimum			
	Triglochin palustre			

End of Narrative Rating. Begin Quantitative Rating on next page.

Site: Apex Sanitary Landfill, Amsterdam, OH | **Rater(s):** Mike A. Takacs, Mark Heirbach | **Date:** 30 July 2010

Wetland G

Metric 1. Wetland Area (size).

2 (max 6 pts.) | 2 (subtotal)

Select one size class and assign score.

- [ ] >50 acres (>20.2ha) (6 pts)
- [ ] 25 to <50 acres (10.1 to <20.2ha) (5 pts)
- [ ] 10 to <25 acres (4 to <10.1ha) (4 pts)
- [ ] 3 to <10 acres (1.2 to <4ha) (3 pts)
- [x] 0.3 to <3 acres (0.12 to <1.2ha) (2pts) 1.16 acres
- [ ] 0.1 to <0.3 acres (0.04 to <0.12ha) (1 pt)
- [ ] <0.1 acres (0.04ha) (0 pts)

Metric 2. Upland buffers and surrounding land use.

8 (max 14 pts.) | 10 (subtotal)

2a. Calculate average buffer width. Select only one and assign score. Do not double check.

- [ ] WIDE. Buffers average 50m (164ft) or more around wetland perimeter (7)
- [x] MEDIUM. Buffers average 25m to <50m (82 to <164ft) around wetland perimeter (4) 128'
- [ ] NARROW. Buffers average 10m to <25m (32ft to <82ft) around wetland perimeter (1)
- [ ] VERY NARROW. Buffers average <10m (<32ft) around wetland perimeter (0)

2b. Intensity of surrounding land use. Select one or double check and average.

- [ ] VERY LOW. 2nd growth or older forest, prairie, savannah, wildlife area, etc. (7)
- [x] LOW. Old field (>10 years), shrub land, young second growth forest. (5) 4 pts.
- [x] MODERATELY HIGH. Residential, fenced pasture, park, conservation tillage, new fallow field. (3) spoil
- [ ] HIGH. Urban, industrial, open pasture, row cropping, mining, construction. (1)

Metric 3. Hydrology.

13 (max 30 pts.) | 23 (subtotal)

3a. Sources of Water. Score all that apply.

- [ ] High pH groundwater (5)
- [x] Other groundwater (3)
- [x] Precipitation (1)
- [ ] Seasonal/Intermittent surface water (3)
- [ ] Perennial surface water (lake or stream) (5)

3b. Connectivity. Score all that apply.

- [ ] 100 year floodplain (1)
- [ ] Between stream/lake and other human use (1)
- [x] Part of wetland/upland (e.g. forest), complex (1)
- [ ] Part of riparian or upland corridor (1)

3c. Maximum water depth. Select only one and assign score.

- [ ] >0.7 (27.6in) (3)
- [ ] 0.4 to 0.7m (15.7 to 27.6in) (2)
- [x] <0.4m (<15.7in) (1)

3d. Duration inundation/saturation. Score one or dbl check.

- [ ] Semi- to permanently inundated/saturated (4)
- [ ] Regularly inundated/saturated (3)
- [x] Seasonally inundated (2)
- [ ] Seasonally saturated in upper 30cm (12in) (1)

3e. Modifications to natural hydrologic regime. Score one or double check and average.

- [ ] None or none apparent (12)
- [x] Recovered (7) 5
- [x] Recovering (3)
- [ ] Recent or no recovery (1)

Check all disturbances observed

- [ ] ditch
- [ ] tile
- [ ] dike
- [ ] weir
- [ ] stormwater input
- [ ] point source (nonstormwater)
- [x] filling/grading Spoil
- [ ] road bed/RR track
- [x] dredging
- [x] other past mining

Metric 4. Habitat Alteration and Development.

11 (max 20 pts.) | 34 (subtotal)

4a. Substrate disturbance. Score one or double check and average.

- [ ] None or none apparent (4)
- [x] Recovered (3) 2.5 pts.
- [x] Recovering (2)
- [ ] Recent or no recovery (1)

4b. Habitat development. Select only one and assign score.

- [ ] Excellent (7)
- [ ] Very good (6)
- [ ] Good (5)
- [x] Moderately good (4)
- [ ] Fair (3)
- [ ] Poor to fair (2)
- [ ] Poor (1)

4c. Habitat alteration. Score one or double check and average.

- [ ] None or none apparent (9)
- [x] Recovered (6) 4.5 pts.
- [x] Recovering (3)
- [ ] Recent or no recovery (1)

Check all disturbances observed

- [ ] mowing
- [ ] grazing
- [x] clearcutting
- [ ] selective cutting
- [ ] woody debris removal
- [ ] toxic pollutants
- [ ] shrub/sapling removal
- [ ] herbaceous/aquatic bed removal
- [x] sedimentation / Spoil
- [ ] dredging
- [ ] farming
- [ ] nutrient enrichment.
- [x] past mining

34 subtotal this page

last revised 1 February 2001 jjm

ORAM v. 5.0 Field Form Quantitative Rating

Site: Apex Sanitary Landfill, Amsterdam, OH | Rater(s): Mike A Takacs, Mark Haibach | Date: 30 July 2010

Wetland 6

34
subtotal first page

Metric 5. Special Wetlands.

0 max 10 pts. | 34 subtotal

Check all that apply and score as indicated.

- [ ] Bog (10)
- [ ] Fen (10)
- [ ] Old growth forest (10)
- [ ] Mature forested wetland (5)
- [ ] Lake Erie coastal/tributary wetland-unrestricted hydrology (10)
- [ ] Lake Erie coastal/tributary wetland-restricted hydrology (5)
- [ ] Lake Plain Sand Prairies (Oak Openings) (10)
- [ ] Relict Wet Prairies (10)
- [ ] Known occurrence state/federal threatened or endangered species (10)
- [ ] Significant migratory songbird/water fowl habitat or usage (10)
- [ ] Category 1 Wetland. See Question 1 Qualitative Rating (-10)

Metric 6. Plant communities, interspersion, microtopography.

7 max 20 pts. | 41 subtotal

6a. Wetland Vegetation Communities.
Score all present using 0 to 3 scale.

- [ ] Aquatic bed
- [2] Emergent
- [1] Shrub
- [ ] Forest
- [ ] Mudflats
- [ ] Open water
- [ ] Other_____

6b. horizontal (plan view) Interspersion.
Select only one.

- [ ] High (5)
- [ ] Moderately high(4)
- [ ] Moderate (3)
- [ ] Moderately low (2)
- [X] Low (1)
- [ ] None (0)

6c. Coverage of invasive plants. Refer to Table 1 ORAM long form for list. Add or deduct points for coverage

- [ ] Extensive >75% cover (-5)
- [ ] Moderate 25-75% cover (-3)
- [X] Sparse 5-25% cover (-1)
- [ ] Nearly absent <5% cover (0)
- [ ] Absent (1)

Typha angustifolia

6d. Microtopography.
Score all present using 0 to 3 scale.

- [1] Vegetated hummucks/tussucks
- [1] Coarse woody debris >15cm (6in)
- [1] Standing dead >25cm (10in) dbh
- [1] Amphibian breeding pools

Vegetation Community Cover Scale

0	Absent or comprises <0.1ha (0.2471 acres) contiguous area
1	Present and either comprises small part of wetland's vegetation and is of moderate quality, or comprises a significant part but is of low quality
2	Present and either comprises significant part of wetland's vegetation and is of moderate quality or comprises a small part and is of high quality
3	Present and comprises significant part, or more, of wetland's vegetation and is of high quality

Narrative Description of Vegetation Quality

low	Low spp diversity and/or predominance of nonnative or disturbance tolerant native species
mod	Native spp are dominant component of the vegetation, although nonnative and/or disturbance tolerant native spp can also be present, and species diversity moderate to moderately high, but generally w/o presence of rare threatened or endangered spp
high	A predominance of native species, with nonnative spp and/or disturbance tolerant native spp absent or virtually absent, and high spp diversity and often, but not always, the presence of rare, threatened, or endangered spp

Mudflat and Open Water Class Quality

0	Absent <0.1ha (0.247 acres)
1	Low 0.1 to <1ha (0.247 to 2.47 acres)
2	Moderate 1 to <4ha (2.47 to 9.88 acres)
3	High 4ha (9.88 acres) or more

Microtopography Cover Scale

0	Absent
1	Present very small amounts or if more common of marginal quality
2	Present in moderate amounts, but not of highest quality or in small amounts of highest quality
3	Present in moderate or greater amounts and of highest quality

41

End of Quantitative Rating. Complete Categorization Worksheets.

Modified Category 2

Apex Sanitary Landfill
Wetland G
30 July 2010

ORAM Summary Worksheet

		circle answer or insert score	Result
Narrative Rating	Question 1 Critical Habitat	YES (NO)	If yes, Category 3.
	Question 2. Threatened or Endangered Species	YES (NO)	If yes, Category 3.
	Question 3. High Quality Natural Wetland	YES (NO)	If yes, Category 3.
	Question 4. Significant bird habitat	YES (NO)	If yes, Category 3.
	Question 5. Category 1 Wetlands	YES (NO)	If yes, Category 1.
	Question 6. Bogs	YES (NO)	If yes, Category 3.
	Question 7. Fens	YES (NO)	If yes, Category 3.
	Question 8a. Old Growth Forest	YES (NO)	If yes, Category 3.
	Question 8b. Mature Forested Wetland	YES (NO)	If yes, evaluate for Category 3; may also be 1 or 2.
	Question 9b. Lake Erie Wetlands - Restricted	YES (NO)	If yes, evaluate for Category 3; may also be 1 or 2.
	Question 9d. Lake Erie Wetlands – Unrestricted with native plants	YES NO	If yes, Category 3
	Question 9e. Lake Erie Wetlands - Unrestricted with invasive plants	YES NO	If yes, evaluate for Category 3; may also be 1 or 2.
	Question 10. Oak Openings	YES (NO)	If yes, Category 3
	Question 11. Relict Wet Prairies	YES (NO)	If yes, evaluate for Category 3; may also be 1 or 2.
Quantitative Rating	Metric 1. Size	2	
	Metric 2. Buffers and surrounding land use	8	
	Metric 3. Hydrology	13	
	Metric 4. Habitat	11	
	Metric 5. Special Wetland Communities	0	
	Metric 6. Plant communities, interspersion, microtopography	7	
	TOTAL SCORE	41	Category based on score breakpoints

Complete Wetland Categorization Worksheet.

Apex Sanitary Landfill
Wetland G
30 July 2010

Wetland Categorization Worksheet

Choices	Circle one		Evaluation of Categorization Result of ORAM
Did you answer "Yes" to any of the following questions: Narrative Rating Nos. 2, 3, 4, 6, 7, 8a, 9d, 10	YES Wetland is categorized as a Category 3 wetland	(NO)	Is quantitative rating score *less* than the Category 2 scoring threshold (*excluding* gray zone)? If yes, reevaluate the category of the wetland using the narrative criteria in OAC Rule 3745-1-54(C) and biological and/or functional assessments to determine if the wetland has been over-categorized by the ORAM
Did you answer "Yes" to any of the following questions: Narrative Rating Nos. 1, 8b, 9b, 9e, 11	YES Wetland should be evaluated for possible Category 3 status	(NO)	Evaluate the wetland using the 1) narrative criteria in OAC Rule 3745-1-54(C) and 2) the quantitative rating score. If the wetland is determined to be a Category 3 wetland using either of these, it should be categorized as a Category 3 wetland. Detailed biological and/or functional assessments may also be used to determine the wetland's category.
Did you answer "Yes" to Narrative Rating No. 5	YES Wetland is categorized as a Category 1 wetland	(NO)	Is quantitative rating score *greater* than the Category 2 scoring threshold *(including* any gray zone)? If yes, reevaluate the category of the wetland using the narrative criteria in OAC Rule 3745-1-54(C) and biological and/or functional assessments to determine if the wetland has been under-categorized by the ORAM
Does the quantitative score fall within the scoring range of a Category 1, 2, or 3 wetland?	(YES) Wetland is assigned to the appropriate category based on the scoring range	NO	If the score of the wetland is located within the scoring range for a particular category, the wetland should be assigned to that category. In all instances however, the narrative criteria described in OAC Rule 3745-1-54(C) can be used to clarify or change a categorization based on a quantitative score.
Does the quantitative score fall with the *"gray zone"* for Category 1 or 2 or Category 2 or 3 wetlands?	YES Wetland is assigned to the higher of the two categories or assigned to a category based on detailed assessments and the narrative criteria	(NO)	Rater has the option of assigning the wetland to the higher of the two categories or to assign a category based on the results of a nonrapid wetland assessment method, e.g. functional assessment, biological assessment, etc, and a consideration of the narrative criteria in OAC rule 3745-1-54(C).
Does the wetland otherwise exhibit *moderate OR superior* hydrologic OR habitat, OR recreational functions AND the wetland was *not* categorized as a Category 2 wetland (in the case of moderate functions) or a Category 3 wetland (in the case of superior functions) by this method?	YES Wetland was undercategorized by this method. A written justification for recategorization should be provided on Background Information Form	(NO) Wetland is assigned to category as determined by the ORAM.	A wetland may be undercategorized using this method, but still exhibit one or more superior functions, e.g. a wetland's biotic communities may be degraded by human activities, but the wetland may still exhibit superior hydrologic functions because of its type, landscape position, size, local or regional significance, etc. In this circumstance, the narrative criteria in OAC Rule 3745-1-54(C)(2) and (3) are controlling, and the under-categorization should be corrected. A written justification with supporting reasons or information for this determination should be provided.

Final Category

Choose one	Category 1	(Category 2)	Category 3

End of Ohio Rapid Assessment Method for Wetlands.

Background Information

Name:	Mike A. Takacs, Mark R. Haibach
Date:	30 July 2010
Affiliation:	Civil & Environmental Consultants, Inc.
Address:	333 Baldwin Road, Pittsburgh, PA 15205
Phone Number:	(412) 249-3188, (412) 249-3156
e-mail address:	mtakacs@cecinc.com, mhaibach@cecinc.com
Name of Wetland:	Wetland H
Vegetation Communit(ies):	PFO1/SS1, PSS1/EM1, POW2
HGM Class(es):	SWD, GWD, GWS
Location of Wetland: include map, address, north arrow, landmarks, distances, roads, etc.	see Stream and Wetland Delineation Report, Figures 1 and 4.

Lat/Long or UTM Coordinate	
USGS Quad Name: Amsterdam, OH	
County: Jefferson	
Township: Springfield	
Section and Subsection	
Hydrologic Unit Code: 05030101180	
Site Visit: 30 July 2010	
National Wetland Inventory Map: Amsterdam, OH	
Ohio Wetland Inventory Map: —	
Soil Survey: Soil Survey of Jefferson County, Ohio	
Delineation report/map: Wetland and Stream Delineation and Functional Assessment Report, Potential Apex Sanitary Landfill Expansion, CEC, 2010.	

Name of Wetland: Wetland H	
Wetland Size (acres, hectares): 3.27 acres	

Sketch: Include north arrow, relationship with other surface waters, vegetation zones, etc.

See Stream and Wetland Delineation Map (Figure 4)

Comments, Narrative Discussion, Justification of Category Changes:

Final score : 52	Category: 2

Apex Sanitary Landfill
Wetland H
30 July 2010

Scoring Boundary Worksheet

INSTRUCTIONS. The initial step in completing the ORAM is to identify the "scoring boundaries" of the wetland being rated. In many instances this determination will be relatively easy and the scoring boundaries will coincide with the "jurisdictional boundaries." For example, the scoring boundary of an isolated cattail marsh located in the middle of a farm field will likely be the same as that wetland's jurisdictional boundaries. In other instances, however, the scoring boundary will not be as easily determined. Wetlands that are small or isolated from other surface waters often form large contiguous areas or heterogeneous complexes of wetland and upland. In separating wetlands for scoring purposes, the hydrologic regime of the wetland is the main criterion that should be used. Boundaries between contiguous or connected wetlands should be established where the volume, flow, or velocity of water moving through the wetland changes significantly. *Areas with a high degree of hydrologic interaction should be scored as a single wetland.* In determining a wetland's scoring boundaries, use the guidelines in the ORAM Manual Section 5.0. In certain instances, it may be difficult to establish the scoring boundary for the wetland being rated. These problem situations include wetlands that form a patchwork on the landscape, wetlands divided by artificial boundaries like property fences, roads, or railroad embankments, wetlands that are contiguous with streams, lakes, or rivers, and estuarine or coastal wetlands. These situations are discussed below, however, it is recommended that Rater contact Ohio EPA, Division of Surface Water, 401/Wetlands Section if there are additional questions or a need for further clarification of the appropriate scoring boundaries of a particular wetland.

#	Steps in properly establishing scoring boundaries	done?	not applicable
Step 1	Identify the wetland area of interest. This may be the site of a proposed impact, a reference site, conservation site, etc.	Yes	
Step 2	Identify the locations where there is physical evidence that hydrology changes rapidly. Such evidence includes both natural and human-induced changes including, constrictions caused by berms or dikes, points where the water velocity changes rapidly at rapids or falls, points where significant inflows occur at the confluence of rivers, or other factors that may restrict hydrologic interaction between the wetlands or parts of a single wetland.	Yes	
Step 3	Delineate the boundary of the wetland to be rated such that all areas of interest that are contiguous to and within the areas where the hydrology does not change significantly, i.e. areas that have a high degree of hydrologic interaction are included within the scoring boundary.	Yes	
Step 4	Determine if artificial boundaries, such as property lines, state lines, roads, railroad embankments, etc., are present. These should not be used to establish scoring boundaries unless they coincide with areas where the hydrologic regime changes.	Yes	
Step 5	In all instances, the Rater may enlarge the minimum scoring boundaries discussed here to score together wetlands that could be scored separately.	Yes	
Step 6	Consult ORAM Manual Section 5.0 for how to establish scoring boundaries for wetlands that form a patchwork on the landscape, divided by artificial boundaries, contiguous to streams, lakes or rivers, or for dual classifications.	Yes	

End of Scoring Boundary Determination. Begin Narrative Rating on next page.

Apex Sanitary Landfill
Wetland H
30 July 2010

Narrative Rating

INSTRUCTIONS. Answer each of the following questions. Questions 1, 2, 3 and 4 should be answered based on information obtained from the site visit or the literature *and* by submitting a Data Services Request to the Ohio Department of Natural Resources, Division of Natural Areas and Preserves, Natural Heritage Data Services, 1889 Fountain Square Court, Building F-1, Columbus, Ohio 43224, 614-265-6453 (phone), 614-265-3096 (fax), http://www.dnr.state.oh.us/dnap . The remaining questions are designed to be answered primarily by the results of the site visit. Refer to the User's Manual for descriptions of these wetland types. Note: "Critical habitat" is legally defined in the Endangered Species Act and is the geographic area containing physical or biological features essential to the conservation of a listed species or as an area that may require special management considerations or protection. The Rater should contact the Region 3 Headquarters or the Columbus Ecological Services Office for updates as to whether critical habitat has been designated for other federally listed threatened or endangered species. "Documented" means the wetland is listed in the appropriate State of Ohio database.

#	Question	Circle one	
1	**Critical Habitat.** Is the wetland in a township, section, or subsection of a United States Geological Survey 7.5 minute Quadrangle that has been designated by the U.S. Fish and Wildlife Service as "critical habitat" for any threatened or endangered plant or animal species? Note: as of January 1, 2001, of the federally listed endangered or threatened species which can be found in Ohio, the Indiana Bat has had critical habitat designated (50 CFR 17.95(a)) and the piping plover has had critical habitat proposed (65 FR 41812 July 6, 2000).	YES Wetland should be evaluated for possible Category 3 status Go to Question 2	(NO) Go to Question 2
2	**Threatened or Endangered Species.** Is the wetland known to contain an individual of, or documented occurrences of federal or state-listed threatened or endangered plant or animal species?	YES Wetland is a Category 3 wetland. Go to Question 3	(NO) Go to Question 3
3	**Documented High Quality Wetland.** Is the wetland on record in Natural Heritage Database as a high quality wetland?	YES Wetland is a Category 3 wetland Go to Question 4	(NO) Go to Question 4
4	**Significant Breeding or Concentration Area.** Does the wetland contain documented regionally significant breeding or nonbreeding waterfowl, neotropical songbird, or shorebird concentration areas?	YES Wetland is a Category 3 wetland Go to Question 5	(NO) Go to Question 5
5	**Category 1 Wetlands.** Is the wetland less than 0.5 hectares (1 acre) in size and **hydrologically isolated** and either 1) comprised of vegetation that is dominated (greater than eighty per cent areal cover) by *Phalaris arundinacea, Lythrum salicaria,* or *Phragmites australis*, or 2) an acidic pond created or excavated on mined lands that has little or no vegetation?	YES Wetland is a Category 1 wetland Go to Question 6	(NO) Go to Question 6
6	**Bogs.** Is the wetland a peat-accumulating wetland that 1) has no significant inflows or outflows, 2) supports acidophilic mosses, particularly *Sphagnum* spp., 3) the acidophilic mosses have >30% cover, 4) at least one species from Table 1 is present, and 5) the cover of invasive species (see Table 1) is <25%?	YES Wetland is a Category 3 wetland Go to Question 7	(NO) Go to Question 7
7	**Fens.** Is the wetland a carbon accumulating (peat, muck) wetland that is saturated during most of the year, primarily by a discharge of free flowing, mineral rich, ground water with a circumneutral ph (5.5-9.0) and with one or more plant species listed in Table 1 and the cover of invasive species listed in Table 1 is <25%?	YES Wetland is a Category 3 wetland Go to Question 8a	(NO) Go to Question 8a
8a	**"Old Growth Forest."** Is the wetland a forested wetland and is the forest characterized by, but not limited to, the following characteristics: overstory canopy trees of great age (exceeding at least 50% of a projected maximum attainable age for a species); little or no evidence of human-caused understory disturbance during the past 80 to 100 years; an all-aged structure and multilayered canopies; aggregations of canopy trees interspersed with canopy gaps; and significant numbers of standing dead snags and downed logs?	YES Wetland is a Category 3 wetland. Go to Question 8b	(NO) Go to Question 8b

8b	**Mature forested wetlands.** Is the wetland a forested wetland with 50% or more of the cover of upper forest canopy consisting of deciduous trees with large diameters at breast height (dbh), generally diameters greater than 45cm (17.7in) dbh?	YES Wetland should be evaluated for possible Category 3 status. Go to Question 9a	NO Go to Question 9a
9a	**Lake Erie coastal and tributary wetlands.** Is the wetland located at an elevation less than 575 feet on the USGS map, adjacent to this elevation, or along a tributary to Lake Erie that is accessible to fish?	YES Go to Question 9b	NO Go to Question 10
9b	Does the wetland's hydrology result from measures designed to prevent erosion and the loss of aquatic plants, i.e. the wetland is partially hydrologically restricted from Lake Erie due to lakeward or landward dikes or other hydrological controls?	YES Wetland should be evaluated for possible Category 3 status Go to Question 10	NO Go to Question 9c
9c	Are Lake Erie water levels the wetland's primary hydrological influence, i.e. the wetland is hydrologically unrestricted (no lakeward or upland border alterations), or the wetland can be characterized as an "estuarine" wetland with lake and river influenced hydrology. These include sandbar deposition wetlands, estuarine wetlands, river mouth wetlands, or those dominated by submersed aquatic vegetation.	YES Go to Question 9d	NO Go to Question 10
9d	Does the wetland have a predominance of native species within its vegetation communities, although non-native or disturbance tolerant native species can also be present?	YES Wetland is a Category 3 wetland Go to Question 10	NO Go to Question 9e
9e	Does the wetland have a predominance of non-native or disturbance tolerant native plant species within its vegetation communities?	YES Wetland should be evaluated for possible Category 3 status Go to Question 10	NO Go to Question 10
10	**Lake Plain Sand Prairies (Oak Openings)** Is the wetland located in Lucas, Fulton, Henry, or Wood Counties and can the wetland be characterized by the following description: the wetland has a sandy substrate with interspersed organic matter, a water table often within several inches of the surface, and often with a dominance of the gramineous vegetation listed in Table 1 (woody species may also be present). The Ohio Department of Natural Resources Division of Natural Areas and Preserves can provide assistance in confirming this type of wetland and its quality.	YES Wetland is a Category 3 wetland. Go to Question 11	NO Go to Question 11
11	**Relict Wet Prairies.** Is the wetland a relict wet prairie community dominated by some or all of the species in Table 1. Extensive prairies were formerly located in the Darby Plains (Madison and Union Counties), Sandusky Plains (Wyandot, Crawford, and Marion Counties), northwest Ohio (e.g. Erie, Huron, Lucas, Wood Counties), and portions of western Ohio Counties (e.g. Darke, Mercer, Miami, Montgomery, Van Wert etc.).	YES Wetland should be evaluated for possible Category 3 status Complete Quantitative Rating	NO Complete Quantitative Rating

Table 1. Characteristic plant species.

invasive/exotic spp	fen species	bog species	0ak Opening species	wet prairie species
Lythrum salicaria	*Zygadenus elegans var. glaucus*	*Calla palustris*	*Carex cryptolepis*	*Calamagrostis canadensis*
Myriophyllum spicatum	*Cacalia plantaginea*	*Carex atlantica var. capillacea*	*Carex lasiocarpa*	*Calamogrostis stricta*
Najas minor	*Carex flava*	*Carex echinata*	*Carex stricta*	*Carex atherodes*
Phalaris arundinacea	*Carex sterilis*	*Carex oligosperma*	*Cladium mariscoides*	*Carex buxbaumii*
Phragmites australis	*Carex stricta*	*Carex trisperma*	*Calamagrostis stricta*	*Carex pellita*
Potamogeton crispus	*Deschampsia caespitosa*	*Chamaedaphne calyculata*	*Calamagrostis canadensis*	*Carex sartwellii*
Ranunculus ficaria	*Eleocharis rostellata*	*Decodon verticillatus*	*Quercus palustris*	*Gentiana andrewsii*
Rhamnus frangula	*Eriophorum viridicarinatum*	*Eriophorum virginicum*		*Helianthus grosseserratus*
Typha angustifolia	*Gentianopsis spp.*	*Larix laricina*		*Liatris spicata*
Typha xglauca	*Lobelia kalmii*	*Nemopanthus mucronatus*		*Lysimachia quadriflora*
	Parnassia glauca	*Schechzeria palustris*		*Lythrum alatum*
	Potentilla fruticosa	*Sphagnum spp.*		*Pycnanthemum virginianum*
	Rhamnus alnifolia	*Vaccinium macrocarpon*		*Silphium terebinthinaceum*
	Rhynchospora capillacea	*Vaccinium corymbosum*		*Sorghastrum nutans*
	Salix candida	*Vaccinium oxycoccos*		*Spartina pectinata*
	Salix myricoides	*Woodwardia virginica*		*Solidago riddellii*
	Salix serissima	*Xyris difformis*		
	Solidago ohioensis			
	Tofieldia glutinosa			
	Triglochin maritimum			
	Triglochin palustre			

End of Narrative Rating. Begin Quantitative Rating on next page.

ORAM v. 5.0 Field Form Quantitative Rating

Site: Apex Sanitary Landfill, Amsterdam, OH | Rater(s): Mike A. Takacs, Mark Haibach | Date: 30 July 2010

Metric 1. Wetland Area (size).

3 (max 6 pts.) | 3 (subtotal)

Select one size class and assign score.

- [ ] >50 acres (>20.2ha) (6 pts)
- [ ] 25 to <50 acres (10.1 to <20.2ha) (5 pts)
- [ ] 10 to <25 acres (4 to <10.1ha) (4 pts)
- [x] 3 to <10 acres (1.2 to <4ha) (3 pts) 3.27 acres
- [ ] 0.3 to <3 acres (0.12 to <1.2ha) (2pts)
- [ ] 0.1 to <0.3 acres (0.04 to <0.12ha) (1 pt)
- [ ] <0.1 acres (0.04ha) (0 pts)

Metric 2. Upland buffers and surrounding land use.

9 (max 14 pts.) | 12 (subtotal)

2a. Calculate average buffer width. Select only one and assign score. Do not double check.

- [ ] WIDE. Buffers average 50m (164ft) or more around wetland perimeter (7)
- [x] MEDIUM. Buffers average 25m to <50m (82 to <164ft) around wetland perimeter (4) X = 140'
- [ ] NARROW. Buffers average 10m to <25m (32ft to <82ft) around wetland perimeter (1)
- [ ] VERY NARROW. Buffers average <10m (<32ft) around wetland perimeter (0)

2b. Intensity of surrounding land use. Select one or double check and average.

- [ ] VERY LOW. 2nd growth or older forest, prairie, savannah, wildlife area, etc. (7)
- [x] LOW. Old field (>10 years), shrub land, young second growth forest. (5)
- [ ] MODERATELY HIGH. Residential, fenced pasture, park, conservation tillage, new fallow field. (3)
- [ ] HIGH. Urban, industrial, open pasture, row cropping, mining, construction. (1)

Metric 3. Hydrology.

16 (max 30 pts.) | 28 (subtotal)

3a. Sources of Water. Score all that apply.

- [ ] High pH groundwater (5)
- [x] Other groundwater (3)
- [x] Precipitation (1)
- [ ] Seasonal/Intermittent surface water (3)
- [ ] Perennial surface water (lake or stream) (5)

3b. Connectivity. Score all that apply.

- [ ] 100 year floodplain (1)
- [x] Between stream/lake and other human use (1)
- [ ] Part of wetland/upland (e.g. forest), complex (1)
- [ ] Part of riparian or upland corridor (1)

3c. Maximum water depth. Select only one and assign score.

- [ ] >0.7 (27.6in) (3)
- [ ] 0.4 to 0.7m (15.7 to 27.6in) (2)
- [x] <0.4m (<15.7in) (1)

3d. Duration inundation/saturation. Score one or dbl check.

- [ ] Semi- to permanently inundated/saturated (4)
- [x] Regularly inundated/saturated (3)
- [ ] Seasonally inundated (2)
- [ ] Seasonally saturated in upper 30cm (12in) (1)

3e. Modifications to natural hydrologic regime. Score one or double check and average.

- [ ] None or none apparent (12)
- [x] Recovered (7)
- [ ] Recovering (3)
- [ ] Recent or no recovery (1)

Check all disturbances observed

- [ ] ditch
- [ ] tile
- [ ] dike
- [ ] weir
- [ ] stormwater input
- [ ] point source (nonstormwater)
- [ ] filling/grading
- [ ] road bed/RR track
- [ ] dredging
- [x] other past mining

Metric 4. Habitat Alteration and Development.

13 (max 20 pts.) | 41 (subtotal)

4a. Substrate disturbance. Score one or double check and average.

- [ ] None or none apparent (4)
- [x] Recovered (3)
- [ ] Recovering (2)
- [ ] Recent or no recovery (1)

4b. Habitat development. Select only one and assign score.

- [ ] Excellent (7)
- [ ] Very good (6)
- [ ] Good (5)
- [x] Moderately good (4)
- [ ] Fair (3)
- [ ] Poor to fair (2)
- [ ] Poor (1)

4c. Habitat alteration. Score one or double check and average.

- [ ] None or none apparent (9)
- [x] Recovered (6)
- [ ] Recovering (3)
- [ ] Recent or no recovery (1)

Check all disturbances observed

- [ ] mowing
- [ ] grazing
- [x] clearcutting
- [ ] selective cutting
- [ ] woody debris removal
- [ ] toxic pollutants
- [ ] shrub/sapling removal
- [ ] herbaceous/aquatic bed removal
- [x] sedimentation
- [ ] dredging
- [ ] farming
- [ ] nutrient enrichment
- [x] past mining

41 subtotal this page

last revised 1 February 2001 jjm

Site: Apex Sanitary Landfill, Amsterdam, OH Wetland #1 | Rater(s): Mike A. Takacs, Mark Harbach | Date: 30 July 2010

41
subtotal first page

Metric 5. Special Wetlands.

0 (max 10 pts.) | 41 (subtotal)

Check all that apply and score as indicated.

- [ ] Bog (10)
- [ ] Fen (10)
- [ ] Old growth forest (10)
- [ ] Mature forested wetland (5)
- [ ] Lake Erie coastal/tributary wetland-unrestricted hydrology (10)
- [ ] Lake Erie coastal/tributary wetland-restricted hydrology (5)
- [ ] Lake Plain Sand Prairies (Oak Openings) (10)
- [ ] Relict Wet Prairies (10)
- [ ] Known occurrence state/federal threatened or endangered species (10)
- [ ] Significant migratory songbird/water fowl habitat or usage (10)
- [ ] Category 1 Wetland. See Question 1 Qualitative Rating (-10)

Metric 6. Plant communities, interspersion, microtopography.

11 (max 20 pts.) | 52 (subtotal)

6a. Wetland Vegetation Communities.
Score all present using 0 to 3 scale.

- [ ] Aquatic bed
- [2] Emergent
- [1] Shrub
- [1] Forest
- [ ] Mudflats
- [0] Open water
- [ ] Other_____

6b. horizontal (plan view) Interspersion.
Select only one.

- [ ] High (5)
- [ ] Moderately high(4)
- [X] Moderate (3)
- [ ] Moderately low (2)
- [ ] Low (1)
- [ ] None (0)

6c. Coverage of invasive plants. Refer to Table 1 ORAM long form for list. Add or deduct points for coverage

- [ ] Extensive >75% cover (-5)
- [ ] Moderate 25-75% cover (-3)
- [ ] Sparse 5-25% cover (-1)
- [X] Nearly absent <5% cover (0)
- [ ] Absent (1)

6d. Microtopography.
Score all present using 0 to 3 scale.

- [1] Vegetated hummucks/tussucks
- [1] Coarse woody debris >15cm (6in)
- [1] Standing dead >25cm (10in) dbh
- [1] Amphibian breeding pools

Vegetation Community Cover Scale

0	Absent or comprises <0.1ha (0.2471 acres) contiguous area
1	Present and either comprises small part of wetland's vegetation and is of moderate quality, or comprises a significant part but is of low quality
2	Present and either comprises significant part of wetland's vegetation and is of moderate quality or comprises a small part and is of high quality
3	Present and comprises significant part, or more, of wetland's vegetation and is of high quality

Narrative Description of Vegetation Quality

low	Low spp diversity and/or predominance of nonnative or disturbance tolerant native species
mod	Native spp are dominant component of the vegetation, although nonnative and/or disturbance tolerant native spp can also be present, and species diversity moderate to moderately high, but generally w/o presence of rare threatened or endangered spp
high	A predominance of native species, with nonnative spp and/or disturbance tolerant native spp absent or virtually absent, and high spp diversity and often, but not always, the presence of rare, threatened, or endangered spp

Mudflat and Open Water Class Quality

0	Absent <0.1ha (0.247 acres)
1	Low 0.1 to <1ha (0.247 to 2.47 acres)
2	Moderate 1 to <4ha (2.47 to 9.88 acres)
3	High 4ha (9.88 acres) or more

Microtopography Cover Scale

0	Absent
1	Present very small amounts or if more common of marginal quality
2	Present in moderate amounts, but not of highest quality or in small amounts of highest quality
3	Present in moderate or greater amounts and of highest quality

52

End of Quantitative Rating. Complete Categorization Worksheets.

Category 2

Apex Sanitary Landfill
Wetland H
30 July 2010

ORAM Summary Worksheet

		circle answer or insert score	Result
Narrative Rating	Question 1 Critical Habitat	YES (NO)	If yes, Category 3.
	Question 2. Threatened or Endangered Species	YES (NO)	If yes, Category 3.
	Question 3. High Quality Natural Wetland	YES (NO)	If yes, Category 3.
	Question 4. Significant bird habitat	YES (NO)	If yes, Category 3.
	Question 5. Category 1 Wetlands	YES (NO)	If yes, Category 1.
	Question 6. Bogs	YES (NO)	If yes, Category 3.
	Question 7. Fens	YES (NO)	If yes, Category 3.
	Question 8a. Old Growth Forest	YES (NO)	If yes, Category 3.
	Question 8b. Mature Forested Wetland	YES (NO)	If yes, evaluate for Category 3; may also be 1 or 2.
	Question 9b. Lake Erie Wetlands - Restricted	YES (NO)	If yes, evaluate for Category 3; may also be 1 or 2.
	Question 9d. Lake Erie Wetlands – Unrestricted with native plants	YES NO	If yes, Category 3
	Question 9e. Lake Erie Wetlands - Unrestricted with invasive plants	YES NO	If yes, evaluate for Category 3; may also be 1 or 2.
	Question 10. Oak Openings	YES (NO)	If yes, Category 3
	Question 11. Relict Wet Prairies	YES (NO)	If yes, evaluate for Category 3; may also be 1 or 2.
Quantitative Rating	Metric 1. Size	3	
	Metric 2. Buffers and surrounding land use	9	
	Metric 3. Hydrology	16	
	Metric 4. Habitat	13	
	Metric 5. Special Wetland Communities	0	
	Metric 6. Plant communities, interspersion, microtopography	11	
	TOTAL SCORE	52	Category based on score breakpoints Category 2

Complete Wetland Categorization Worksheet.

Apex Sanitary Landfill
Wetland H
30 July 2010

Wetland Categorization Worksheet

Choices	Circle one		Evaluation of Categorization Result of ORAM
Did you answer "Yes" to any of the following questions: Narrative Rating Nos. 2, 3, 4, 6, 7, 8a, 9d, 10	YES Wetland is categorized as a Category 3 wetland	(NO)	Is quantitative rating score *less* than the Category 2 scoring threshold (*excluding* gray zone)? If yes, reevaluate the category of the wetland using the narrative criteria in OAC Rule 3745-1-54(C) and biological and/or functional assessments to determine if the wetland has been over-categorized by the ORAM
Did you answer "Yes" to any of the following questions: Narrative Rating Nos. 1, 8b, 9b, 9e, 11	YES Wetland should be evaluated for possible Category 3 status	(NO)	Evaluate the wetland using the 1) narrative criteria in OAC Rule 3745-1-54(C) and 2) the quantitative rating score. If the wetland is determined to be a Category 3 wetland using either of these, it should be categorized as a Category 3 wetland. Detailed biological and/or functional assessments may also be used to determine the wetland's category.
Did you answer "Yes" to Narrative Rating No. 5	YES Wetland is categorized as a Category 1 wetland	(NO)	Is quantitative rating score *greater* than the Category 2 scoring threshold *(including* any gray zone)? If yes, reevaluate the category of the wetland using the narrative criteria in OAC Rule 3745-1-54(C) and biological and/or functional assessments to determine if the wetland has been under-categorized by the ORAM
Does the quantitative score fall within the scoring range of a Category 1, 2, or 3 wetland?	(YES) Wetland is assigned to the appropriate category based on the scoring range	NO	If the score of the wetland is located within the scoring range for a particular category, the wetland should be assigned to that category. In all instances however, the narrative criteria described in OAC Rule 3745-1-54(C) can be used to clarify or change a categorization based on a quantitative score.
Does the quantitative score fall with the *"gray zone"* for Category 1 or 2 or Category 2 or 3 wetlands?	YES Wetland is assigned to the higher of the two categories or assigned to a category based on detailed assessments and the narrative criteria	(NO)	Rater has the option of assigning the wetland to the higher of the two categories or to assign a category based on the results of a nonrapid wetland assessment method, e.g. functional assessment, biological assessment, etc, and a consideration of the narrative criteria in OAC rule 3745-1-54(C).
Does the wetland otherwise exhibit *moderate OR superior* hydrologic OR habitat, OR recreational functions AND the wetland was *not* categorized as a Category 2 wetland (in the case of moderate functions) or a Category 3 wetland (in the case of superior functions) by this method?	YES Wetland was undercategorized by this method. A written justification for recategorization should be provided on Background Information Form	(NO) Wetland is assigned to category as determined by the ORAM.	A wetland may be undercategorized using this method, but still exhibit one or more superior functions, e.g. a wetland's biotic communities may be degraded by human activities, but the wetland may still exhibit superior hydrologic functions because of its type, landscape position, size, local or regional significance, etc. In this circumstance, the narrative criteria in OAC Rule 3745-1-54(C)(2) and (3) are controlling, and the under-categorization should be corrected. A written justification with supporting reasons or information for this determination should be provided.

Choose one	Final Category		
	Category 1	(Category 2)	Category 3

End of Ohio Rapid Assessment Method for Wetlands.

Background Information

Name:	Michael A. Takacs, Mark R. Haibach
Date:	30 July 2010
Affiliation:	Civil & Environmental Consultants, Inc.
Address:	333 Baldwin Road, Pittsburgh, PA 15205
Phone Number:	(412) 249-3188, (412) 249-3156
e-mail address:	mtakacs@cecinc.com, mhaibach@cecinc.com
Name of Wetland:	Wetland I-J-K Complex
Vegetation Communit(ies):	PAB / POWZx / PEM
HGM Class(es):	SWD, GWD
Location of Wetland: include map, address, north arrow, landmarks, distances, roads, etc.	See Stream and Wetland Delineation Report, Figures 1 and 4

Lat/Long or UTM Coordinate	
USGS Quad Name: Amsterdam, OH	
County: Jefferson / Harrison	
Township: Springfield	
Section and Subsection	
Hydrologic Unit Code: 05030101180	
Site Visit: 30 July 2010	
National Wetland Inventory Map: Amsterdam, OH	
Ohio Wetland Inventory Map	
Soil Survey: Soil Survey of Jefferson County, Ohio	
Delineation report/map: Wetland and Stream Delineation and Functional Assessment Report, Potential Apex Sanitary Landfill Expansion, CEC 2010.	

Name of Wetland: Wetland I-J-K Complex

Wetland Size (acres, hectares): 0.11(I) + 0.04(J) + 0.16(K) = 0.31 ac.

Sketch: Include north arrow, relationship with other surface waters, vegetation zones, etc.

See Stream and Wetland Delineation Map (Figure 4).

Comments, Narrative Discussion, Justification of Category Changes:

Final score : 44.5 **Category:** Mod. 2

Apex Sanitary Landfill
Wetland I-J-K Complex
30 July 2010

Scoring Boundary Worksheet

INSTRUCTIONS. The initial step in completing the ORAM is to identify the "scoring boundaries" of the wetland being rated. In many instances this determination will be relatively easy and the scoring boundaries will coincide with the "jurisdictional boundaries." For example, the scoring boundary of an isolated cattail marsh located in the middle of a farm field will likely be the same as that wetland's jurisdictional boundaries. In other instances, however, the scoring boundary will not be as easily determined. Wetlands that are small or isolated from other surface waters often form large contiguous areas or heterogeneous complexes of wetland and upland. In separating wetlands for scoring purposes, the hydrologic regime of the wetland is the main criterion that should be used. Boundaries between contiguous or connected wetlands should be established where the volume, flow, or velocity of water moving through the wetland changes significantly. *Areas with a high degree of hydrologic interaction should be scored as a single wetland.* In determining a wetland's scoring boundaries, use the guidelines in the ORAM Manual Section 5.0. In certain instances, it may be difficult to establish the scoring boundary for the wetland being rated. These problem situations include wetlands that form a patchwork on the landscape, wetlands divided by artificial boundaries like property fences, roads, or railroad embankments, wetlands that are contiguous with streams, lakes, or rivers, and estuarine or coastal wetlands. These situations are discussed below, however, it is recommended that Rater contact Ohio EPA, Division of Surface Water, 401/Wetlands Section if there are additional questions or a need for further clarification of the appropriate scoring boundaries of a particular wetland.

#	Steps in properly establishing scoring boundaries	done?	not applicable
Step 1	Identify the wetland area of interest. This may be the site of a proposed impact, a reference site, conservation site, etc.	Yes	
Step 2	Identify the locations where there is physical evidence that hydrology changes rapidly. Such evidence includes both natural and human-induced changes including, constrictions caused by berms or dikes, points where the water velocity changes rapidly at rapids or falls, points where significant inflows occur at the confluence of rivers, or other factors that may restrict hydrologic interaction between the wetlands or parts of a single wetland.	Yes	
Step 3	Delineate the boundary of the wetland to be rated such that all areas of interest that are contiguous to and within the areas where the hydrology does not change significantly, i.e. areas that have a high degree of hydrologic interaction are included within the scoring boundary.	Yes	
Step 4	Determine if artificial boundaries, such as property lines, state lines, roads, railroad embankments, etc., are present. These should not be used to establish scoring boundaries unless they coincide with areas where the hydrologic regime changes.	Yes	
Step 5	In all instances, the Rater may enlarge the minimum scoring boundaries discussed here to score together wetlands that could be scored separately.	Yes	
Step 6	Consult ORAM Manual Section 5.0 for how to establish scoring boundaries for wetlands that form a patchwork on the landscape, divided by artificial boundaries, contiguous to streams, lakes or rivers, or for dual classifications.	Yes	

End of Scoring Boundary Determination. Begin Narrative Rating on next page.

Apex Sanitary Landfill
Wetland I-J-K Complex
30 July 2010

Narrative Rating

INSTRUCTIONS. Answer each of the following questions. Questions 1, 2, 3 and 4 should be answered based on information obtained from the site visit or the literature *and* by submitting a Data Services Request to the Ohio Department of Natural Resources, Division of Natural Areas and Preserves, Natural Heritage Data Services, 1889 Fountain Square Court, Building F-1, Columbus, Ohio 43224, 614-265-6453 (phone), 614-265-3096 (fax), http://www.dnr.state.oh.us/dnap . The remaining questions are designed to be answered primarily by the results of the site visit. Refer to the User's Manual for descriptions of these wetland types. Note: "Critical habitat" is legally defined in the Endangered Species Act and is the geographic area containing physical or biological features essential to the conservation of a listed species or as an area that may require special management considerations or protection. The Rater should contact the Region 3 Headquarters or the Columbus Ecological Services Office for updates as to whether critical habitat has been designated for other federally listed threatened or endangered species. "Documented" means the wetland is listed in the appropriate State of Ohio database.

#	Question	Circle one	
1	**Critical Habitat.** Is the wetland in a township, section, or subsection of a United States Geological Survey 7.5 minute Quadrangle that has been designated by the U.S. Fish and Wildlife Service as "critical habitat" for any threatened or endangered plant or animal species? Note: as of January 1, 2001, of the federally listed endangered or threatened species which can be found in Ohio, the Indiana Bat has had critical habitat designated (50 CFR 17.95(a)) and the piping plover has had critical habitat proposed (65 FR 41812 July 6, 2000).	YES Wetland should be evaluated for possible Category 3 status Go to Question 2	(NO) Go to Question 2
2	**Threatened or Endangered Species.** Is the wetland known to contain an individual of, or documented occurrences of federal or state-listed threatened or endangered plant or animal species?	YES Wetland is a Category 3 wetland. Go to Question 3	(NO) Go to Question 3
3	**Documented High Quality Wetland.** Is the wetland on record in Natural Heritage Database as a high quality wetland?	YES Wetland is a Category 3 wetland Go to Question 4	(NO) Go to Question 4
4	**Significant Breeding or Concentration Area.** Does the wetland contain documented regionally significant breeding or nonbreeding waterfowl, neotropical songbird, or shorebird concentration areas?	YES Wetland is a Category 3 wetland Go to Question 5	(NO) Go to Question 5
5	**Category 1 Wetlands.** Is the wetland less than 0.5 hectares (1 acre) in size and **hydrologically isolated** and either 1) comprised of vegetation that is dominated (greater than eighty per cent areal cover) by *Phalaris arundinacea, Lythrum salicaria,* or *Phragmites australis*, or 2) an acidic pond created or excavated on mined lands that has little or no vegetation?	YES Wetland is a Category 1 wetland Go to Question 6	(NO) Go to Question 6
6	**Bogs.** Is the wetland a peat-accumulating wetland that 1) has no significant inflows or outflows, 2) supports acidophilic mosses, particularly *Sphagnum* spp., 3) the acidophilic mosses have >30% cover, 4) at least one species from Table 1 is present, and 5) the cover of invasive species (see Table 1) is <25%?	YES Wetland is a Category 3 wetland Go to Question 7	(NO) Go to Question 7
7	**Fens.** Is the wetland a carbon accumulating (peat, muck) wetland that is saturated during most of the year, primarily by a discharge of free flowing, mineral rich, ground water with a circumneutral ph (5.5-9.0) and with one or more plant species listed in Table 1 and the cover of invasive species listed in Table 1 is <25%?	YES Wetland is a Category 3 wetland Go to Question 8a	(NO) Go to Question 8a
8a	**"Old Growth Forest."** Is the wetland a forested wetland and is the forest characterized by, but not limited to, the following characteristics: overstory canopy trees of great age (exceeding at least 50% of a projected maximum attainable age for a species); little or no evidence of human-caused understory disturbance during the past 80 to 100 years; an all-aged structure and multilayered canopies; aggregations of canopy trees interspersed with canopy gaps; and significant numbers of standing dead snags and downed logs?	YES Wetland is a Category 3 wetland. Go to Question 8b	(NO) Go to Question 8b

8b	**Mature forested wetlands.** Is the wetland a forested wetland with 50% or more of the cover of upper forest canopy consisting of deciduous trees with large diameters at breast height (dbh), generally diameters greater than 45cm (17.7in) dbh?	YES Wetland should be evaluated for possible Category 3 status. Go to Question 9a	NO Go to Question 9a
9a	**Lake Erie coastal and tributary wetlands.** Is the wetland located at an elevation less than 575 feet on the USGS map, adjacent to this elevation, or along a tributary to Lake Erie that is accessible to fish?	YES Go to Question 9b	NO Go to Question 10
9b	Does the wetland's hydrology result from measures designed to prevent erosion and the loss of aquatic plants, i.e. the wetland is partially hydrologically restricted from Lake Erie due to lakeward or landward dikes or other hydrological controls?	YES Wetland should be evaluated for possible Category 3 status Go to Question 10	NO Go to Question 9c
9c	Are Lake Erie water levels the wetland's primary hydrological influence, i.e. the wetland is hydrologically unrestricted (no lakeward or upland border alterations), or the wetland can be characterized as an "estuarine" wetland with lake and river influenced hydrology. These include sandbar deposition wetlands, estuarine wetlands, river mouth wetlands, or those dominated by submersed aquatic vegetation.	YES Go to Question 9d	NO Go to Question 10
9d	Does the wetland have a predominance of native species within its vegetation communities, although non-native or disturbance tolerant native species can also be present?	YES Wetland is a Category 3 wetland Go to Question 10	NO Go to Question 9e
9e	Does the wetland have a predominance of non-native or disturbance tolerant native plant species within its vegetation communities?	YES Wetland should be evaluated for possible Category 3 status Go to Question 10	NO Go to Question 10
10	**Lake Plain Sand Prairies (Oak Openings)** Is the wetland located in Lucas, Fulton, Henry, or Wood Counties and can the wetland be characterized by the following description: the wetland has a sandy substrate with interspersed organic matter, a water table often within several inches of the surface, and often with a dominance of the gramineous vegetation listed in Table 1 (woody species may also be present). The Ohio Department of Natural Resources Division of Natural Areas and Preserves can provide assistance in confirming this type of wetland and its quality.	YES Wetland is a Category 3 wetland. Go to Question 11	NO Go to Question 11
11	**Relict Wet Prairies.** Is the wetland a relict wet prairie community dominated by some or all of the species in Table 1. Extensive prairies were formerly located in the Darby Plains (Madison and Union Counties), Sandusky Plains (Wyandot, Crawford, and Marion Counties), northwest Ohio (e.g. Erie, Huron, Lucas, Wood Counties), and portions of western Ohio Counties (e.g. Darke, Mercer, Miami, Montgomery, Van Wert etc.).	YES Wetland should be evaluated for possible Category 3 status Complete Quantitative Rating	NO Complete Quantitative Rating

Table 1. Characteristic plant species.

invasive/exotic spp	fen species	bog species	0ak Opening species	wet prairie species
Lythrum salicaria	*Zygadenus elegans var. glaucus*	*Calla palustris*	*Carex cryptolepis*	*Calamagrostis canadensis*
Myriophyllum spicatum	*Cacalia plantaginea*	*Carex atlantica var. capillacea*	*Carex lasiocarpa*	*Calamogrostis stricta*
Najas minor	*Carex flava*	*Carex echinata*	*Carex stricta*	*Carex atherodes*
Phalaris arundinacea	*Carex sterilis*	*Carex oligosperma*	*Cladium mariscoides*	*Carex buxbaumii*
Phragmites australis	*Carex stricta*	*Carex trisperma*	*Calamagrostis stricta*	*Carex pellita*
Potamogeton crispus	*Deschampsia caespitosa*	*Chamaedaphne calyculata*	*Calamagrostis canadensis*	*Carex sartwellii*
Ranunculus ficaria	*Eleocharis rostellata*	*Decodon verticillatus*	*Quercus palustris*	*Gentiana andrewsii*
Rhamnus frangula	*Eriophorum viridicarinatum*	*Eriophorum virginicum*		*Helianthus grosseserratus*
Typha angustifolia	*Gentianopsis spp.*	*Larix laricina*		*Liatris spicata*
Typha xglauca	*Lobelia kalmii*	*Nemopanthus mucronatus*		*Lysimachia quadriflora*
	Parnassia glauca	*Schechzeria palustris*		*Lythrum alatum*
	Potentilla fruticosa	*Sphagnum spp.*		*Pycnanthemum virginianum*
	Rhamnus alnifolia	*Vaccinium macrocarpon*		*Silphium terebinthinaceum*
	Rhynchospora capillacea	*Vaccinium corymbosum*		*Sorghastrum nutans*
	Salix candida	*Vaccinium oxycoccos*		*Spartina pectinata*
	Salix myricoides	*Woodwardia virginica*		*Solidago riddellii*
	Salix serissima	*Xyris difformis*		
	Solidago ohioensis			
	Tofieldia glutinosa			
	Triglochin maritimum			
	Triglochin palustre			

End of Narrative Rating. Begin Quantitative Rating on next page.

Site: Apex Sanitary Landfill, Amsterdam OH	Rater(s): Mike A. Takacs, Mark Kubach	Date: 30 July 2010

Wetland I-J-K Complex

Metric 1. Wetland Area (size).

2 (max 6 pts.) | 2 (subtotal)

Select one size class and assign score.

- [ ] >50 acres (>20.2ha) (6 pts)
- [ ] 25 to <50 acres (10.1 to <20.2ha) (5 pts)
- [ ] 10 to <25 acres (4 to <10.1ha) (4 pts)
- [ ] 3 to <10 acres (1.2 to <4ha) (3 pts)
- [x] 0.3 to <3 acres (0.12 to <1.2ha) (2pts)
- [ ] 0.1 to <0.3 acres (0.04 to <0.12ha) (1 pt)
- [ ] <0.1 acres (0.04ha) (0 pts)

0.11 + 0.04 + 0.16 = 0.31 ac.

Metric 2. Upland buffers and surrounding land use.

9 (max 14 pts.) | 11 (subtotal)

2a. Calculate average buffer width. Select only one and assign score. Do not double check.

- [ ] WIDE. Buffers average 50m (164ft) or more around wetland perimeter (7)
- [x] MEDIUM. Buffers average 25m to <50m (82 to <164ft) around wetland perimeter (4)
- [ ] NARROW. Buffers average 10m to <25m (32ft to <82ft) around wetland perimeter (1)
- [ ] VERY NARROW. Buffers average <10m (<32ft) around wetland perimeter (0)

$\bar{x} = \sim 125'$

2b. Intensity of surrounding land use. Select one or double check and average.

- [ ] VERY LOW. 2nd growth or older forest, prairie, savannah, wildlife area, etc. (7)
- [x] LOW. Old field (>10 years), shrub land, young second growth forest. (5)
- [ ] MODERATELY HIGH. Residential, fenced pasture, park, conservation tillage, new fallow field. (3)
- [ ] HIGH. Urban, industrial, open pasture, row cropping, mining, construction. (1)

Metric 3. Hydrology.

17 (max 30 pts.) | 28 (subtotal)

3a. Sources of Water. Score all that apply.

- [ ] High pH groundwater (5)
- [x] Other groundwater (3)
- [x] Precipitation (1)
- [ ] Seasonal/Intermittent surface water (3)
- [ ] Perennial surface water (lake or stream) (5)

3b. Connectivity. Score all that apply.

- [ ] 100 year floodplain (1)
- [ ] Between stream/lake and other human use (1)
- [x] Part of wetland/upland (e.g. forest), complex (1)
- [ ] Part of riparian or upland corridor (1)

3c. Maximum water depth. Select only one and assign score.

- [x] >0.7 (27.6in) (3)
- [ ] 0.4 to 0.7m (15.7 to 27.6in) (2)
- [ ] <0.4m (<15.7in) (1)

3d. Duration inundation/saturation. Score one or dbl check.

- [x] Semi- to permanently inundated/saturated (4)
- [ ] Regularly inundated/saturated (3)
- [ ] Seasonally inundated (2)
- [ ] Seasonally saturated in upper 30cm (12in) (1)

3e. Modifications to natural hydrologic regime. Score one or double check and average.

- [ ] None or none apparent (12)
- [x] Recovered (7) 5 pts.
- [x] Recovering (3)
- [ ] Recent or no recovery (1)

Check all disturbances observed

- [ ] ditch
- [ ] tile
- [ ] dike
- [ ] weir
- [ ] stormwater input
- [ ] point source (nonstormwater)
- [x] filling/grading spoil
- [ ] road bed/RR track
- [ ] dredging
- [x] other past mining

Metric 4. Habitat Alteration and Development.

9.5 (max 20 pts.) | 37.5 (subtotal)

4a. Substrate disturbance. Score one or double check and average.

- [ ] None or none apparent (4)
- [x] Recovered (3) 2 pts.
- [ ] Recovering (2)
- [x] Recent or no recovery (1)

I - Soils are mine spoil
J - soil present, spoil adjacent
K - soils are mine spoil

4b. Habitat development. Select only one and assign score.

- [ ] Excellent (7)
- [ ] Very good (6)
- [ ] Good (5)
- [ ] Moderately good (4)
- [x] Fair (3)
- [ ] Poor to fair (2)
- [ ] Poor (1)

4c. Habitat alteration. Score one or double check and average.

- [ ] None or none apparent (9)
- [x] Recovered (6) +1.5 pts.
- [x] Recovering (3)
- [ ] Recent or no recovery (1)

Strip cut

Check all disturbances observed

- [ ] mowing
- [ ] grazing
- [x] clearcutting
- [ ] selective cutting
- [ ] woody debris removal
- [ ] toxic pollutants
- [ ] shrub/sapling removal
- [ ] herbaceous/aquatic bed removal
- [x] sedimentation spoil
- [ ] dredging
- [ ] farming
- [ ] nutrient enrichment
- [x] past mining

37.5 subtotal this page

last revised 1 February 2001 jjm

ORAM v. 5.0 Field Form Quantitative Rating

Site: ApexSanitary Landfill, Amsterdam, OH	Rater(s): Mike A. Takacs, Mark Haibach	Date: 30 July 2010

Wetland I-J-K Complex

37.5
subtotal first page

0	37.5
max 10 pts.	subtotal

Metric 5. Special Wetlands.

Check all that apply and score as indicated.

- [ ] Bog (10)
- [ ] Fen (10)
- [ ] Old growth forest (10)
- [ ] Mature forested wetland (5)
- [ ] Lake Erie coastal/tributary wetland-unrestricted hydrology (10)
- [ ] Lake Erie coastal/tributary wetland-restricted hydrology (5)
- [ ] Lake Plain Sand Prairies (Oak Openings) (10)
- [ ] Relict Wet Prairies (10)
- [ ] Known occurrence state/federal threatened or endangered species (10)
- [ ] Significant migratory songbird/water fowl habitat or usage (10)
- [ ] Category 1 Wetland. See Question 1 Qualitative Rating (-10)

7	44.5
max 20 pts.	subtotal

Metric 6. Plant communities, interspersion, microtopography.

6a. Wetland Vegetation Communities.
Score all present using 0 to 3 scale.

- [0] Aquatic bed
- [0] Emergent
- [ ] Shrub
- [ ] Forest
- [ ] Mudflats
- [1] Open water
- [ ] Other_____

6b. horizontal (plan view) Interspersion.
Select only one.

- [ ] High (5)
- [ ] Moderately high(4)
- [ ] Moderate (3)
- [ ] Moderately low (2)
- [X] Low (1)
- [ ] None (0)

6c. Coverage of invasive plants. Refer to Table 1 ORAM long form for list. Add or deduct points for coverage

- [ ] Extensive >75% cover (-5)
- [ ] Moderate 25-75% cover (-3)
- [ ] Sparse 5-25% cover (-1)
- [ ] Nearly absent <5% cover (0)
- [X] Absent (1)

6d. Microtopography.
Score all present using 0 to 3 scale.

- [ ] Vegetated hummucks/tussucks
- [1] Coarse woody debris >15cm (6in)
- [ ] Standing dead >25cm (10in) dbh
- [2] Amphibian breeding pools

Vegetation Community Cover Scale

0	Absent or comprises <0.1ha (0.2471 acres) contiguous area
1	Present and either comprises small part of wetland's vegetation and is of moderate quality, or comprises a significant part but is of low quality
2	Present and either comprises significant part of wetland's vegetation and is of moderate quality or comprises a small part and is of high quality
3	Present and comprises significant part, or more, of wetland's vegetation and is of high quality

Narrative Description of Vegetation Quality

low	Low spp diversity and/or predominance of nonnative or disturbance tolerant native species
mod	Native spp are dominant component of the vegetation, although nonnative and/or disturbance tolerant native spp can also be present, and species diversity moderate to moderately high, but generally w/o presence of rare threatened or endangered spp
high	A predominance of native species, with nonnative spp and/or disturbance tolerant native spp absent or virtually absent, and high spp diversity and often, but not always, the presence of rare, threatened, or endangered spp

Mudflat and Open Water Class Quality

0	Absent <0.1ha (0.247 acres)
1	Low 0.1 to <1ha (0.247 to 2.47 acres)
2	Moderate 1 to <4ha (2.47 to 9.88 acres)
3	High 4ha (9.88 acres) or more

Microtopography Cover Scale

0	Absent
1	Present very small amounts or if more common of marginal quality
2	Present in moderate amounts, but not of highest quality or in small amounts of highest quality
3	Present in moderate or greater amounts and of highest quality

44.5

End of Quantitative Rating. Complete Categorization Worksheets.

Modified Category 2

ORAM Summary Worksheet

Apex Sanitary Landfill
Wetland I-J-K Complex
30 July 2010

		circle answer or insert score	Result
Narrative Rating	Question 1 Critical Habitat	YES (NO)	If yes, Category 3.
	Question 2. Threatened or Endangered Species	YES (NO)	If yes, Category 3.
	Question 3. High Quality Natural Wetland	YES (NO)	If yes, Category 3.
	Question 4. Significant bird habitat	YES (NO)	If yes, Category 3.
	Question 5. Category 1 Wetlands	YES (NO)	If yes, Category 1.
	Question 6. Bogs	YES (NO)	If yes, Category 3.
	Question 7. Fens	YES (NO)	If yes, Category 3.
	Question 8a. Old Growth Forest	YES (NO)	If yes, Category 3.
	Question 8b. Mature Forested Wetland	YES (NO)	If yes, evaluate for Category 3; may also be 1 or 2.
	Question 9b. Lake Erie Wetlands - Restricted	YES (NO)	If yes, evaluate for Category 3; may also be 1 or 2.
	Question 9d. Lake Erie Wetlands – Unrestricted with native plants	YES NO	If yes, Category 3
	Question 9e. Lake Erie Wetlands - Unrestricted with invasive plants	YES NO	If yes, evaluate for Category 3; may also be 1 or 2.
	Question 10. Oak Openings	YES (NO)	If yes, Category 3
	Question 11. Relict Wet Prairies	YES (NO)	If yes, evaluate for Category 3; may also be 1 or 2.
Quantitative Rating	Metric 1. Size	2	
	Metric 2. Buffers and surrounding land use	9	
	Metric 3. Hydrology	17	
	Metric 4. Habitat	9.5	
	Metric 5. Special Wetland Communities	0	
	Metric 6. Plant communities, interspersion, microtopography	7	
	TOTAL SCORE	44.5	Category based on score breakpoints modified Cat. 2

Complete Wetland Categorization Worksheet.

Apex Sanitary Landfill
Wetland I-J-K Complex
30 July 2010

Wetland Categorization Worksheet

Choices	Circle one		Evaluation of Categorization Result of ORAM
Did you answer "Yes" to any of the following questions: Narrative Rating Nos. 2, 3, 4, 6, 7, 8a, 9d, 10	YES Wetland is categorized as a Category 3 wetland	(NO)	Is quantitative rating score *less* than the Category 2 scoring threshold (*excluding* gray zone)? If yes, reevaluate the category of the wetland using the narrative criteria in OAC Rule 3745-1-54(C) and biological and/or functional assessments to determine if the wetland has been over-categorized by the ORAM
Did you answer "Yes" to any of the following questions: Narrative Rating Nos. 1, 8b, 9b, 9e, 11	YES Wetland should be evaluated for possible Category 3 status	(NO)	Evaluate the wetland using the 1) narrative criteria in OAC Rule 3745-1-54(C) and 2) the quantitative rating score. If the wetland is determined to be a Category 3 wetland using either of these, it should be categorized as a Category 3 wetland. Detailed biological and/or functional assessments may also be used to determine the wetland's category.
Did you answer "Yes" to Narrative Rating No. 5	YES Wetland is categorized as a Category 1 wetland	(NO)	Is quantitative rating score *greater* than the Category 2 scoring threshold *(including* any gray zone)? If yes, reevaluate the category of the wetland using the narrative criteria in OAC Rule 3745-1-54(C) and biological and/or functional assessments to determine if the wetland has been under-categorized by the ORAM
Does the quantitative score fall within the scoring range of a Category 1, 2, or 3 wetland?	(YES) Wetland is assigned to the appropriate category based on the scoring range	NO	If the score of the wetland is located within the scoring range for a particular category, the wetland should be assigned to that category. In all instances however, the narrative criteria described in OAC Rule 3745-1-54(C) can be used to clarify or change a categorization based on a quantitative score.
Does the quantitative score fall with the *"gray zone"* for Category 1 or 2 or Category 2 or 3 wetlands?	YES Wetland is assigned to the higher of the two categories or assigned to a category based on detailed assessments and the narrative criteria	(NO)	Rater has the option of assigning the wetland to the higher of the two categories or to assign a category based on the results of a nonrapid wetland assessment method, e.g. functional assessment, biological assessment, etc, and a consideration of the narrative criteria in OAC rule 3745-1-54(C).
Does the wetland otherwise exhibit *moderate OR superior* hydrologic OR habitat, OR recreational functions AND the wetland was *not* categorized as a Category 2 wetland (in the case of moderate functions) or a Category 3 wetland (in the case of superior functions) by this method?	YES Wetland was undercategorized by this method. A written justification for recategorization should be provided on Background Information Form	(NO) Wetland is assigned to category as determined by the ORAM.	A wetland may be undercategorized using this method, but still exhibit one or more superior functions, e.g. a wetland's biotic communities may be degraded by human activities, but the wetland may still exhibit superior hydrologic functions because of its type, landscape position, size, local or regional significance, etc. In this circumstance, the narrative criteria in OAC Rule 3745-1-54(C)(2) and (3) are controlling, and the under-categorization should be corrected. A written justification with supporting reasons or information for this determination should be provided.

Final Category

Choose one	Category 1	(Category 2)	Category 3

End of Ohio Rapid Assessment Method for Wetlands.

Background Information

Name:	Michael A. Takacs, Mark R. Haibach
Date:	30 July 2010
Affiliation:	Civil & Environmental Consultants, Inc.
Address:	333 Baldwin Road, Pittsburgh, PA 15205
Phone Number:	(412) 249-3188, (412) 249-3156
e-mail address:	mtakacs@cecinc.com, mhaibach@cecinc.com
Name of Wetland:	Wetland L
Vegetation Communit(ies):	PAB / POWZx
HGM Class(es):	SWD, GWD

Location of Wetland: include map, address, north arrow, landmarks, distances, roads, etc.

See Stream and Wetland Delineation Report, Figures 1 and 4

Lat/Long or UTM Coordinate	
USGS Quad Name: Amsterdam, OH	
County: Jefferson / Harrison	
Township: Springfield	
Section and Subsection	
Hydrologic Unit Code: 05030101180	
Site Visit: 30 July 2010	
National Wetland Inventory Map: Amsterdam, OH	
Ohio Wetland Inventory Map	
Soil Survey: Soil Survey of Jefferson County, Ohio	
Delineation report/map: Wetland and Stream Delineation and Functional Assessment Report, Potential Apex Sanitary Landfill Expansion, CEC 2010.	

Name of Wetland: Wetland L	
Wetland Size (acres, hectares): 1.37 ac.	

Sketch: Include north arrow, relationship with other surface waters, vegetation zones, etc.

See Stream and Wetland Delineation Map, Figure 4.

Comments, Narrative Discussion, Justification of Category Changes:

Final score : 46	Category: 2

Apex Sanitary Landfill
Wetland L
30 July 2010

Scoring Boundary Worksheet

INSTRUCTIONS. The initial step in completing the ORAM is to identify the "scoring boundaries" of the wetland being rated. In many instances this determination will be relatively easy and the scoring boundaries will coincide with the "jurisdictional boundaries." For example, the scoring boundary of an isolated cattail marsh located in the middle of a farm field will likely be the same as that wetland's jurisdictional boundaries. In other instances, however, the scoring boundary will not be as easily determined. Wetlands that are small or isolated from other surface waters often form large contiguous areas or heterogeneous complexes of wetland and upland. In separating wetlands for scoring purposes, the hydrologic regime of the wetland is the main criterion that should be used. Boundaries between contiguous or connected wetlands should be established where the volume, flow, or velocity of water moving through the wetland changes significantly. *Areas with a high degree of hydrologic interaction should be scored as a single wetland.* In determining a wetland's scoring boundaries, use the guidelines in the ORAM Manual Section 5.0. In certain instances, it may be difficult to establish the scoring boundary for the wetland being rated. These problem situations include wetlands that form a patchwork on the landscape, wetlands divided by artificial boundaries like property fences, roads, or railroad embankments, wetlands that are contiguous with streams, lakes, or rivers, and estuarine or coastal wetlands. These situations are discussed below, however, it is recommended that Rater contact Ohio EPA, Division of Surface Water, 401/Wetlands Section if there are additional questions or a need for further clarification of the appropriate scoring boundaries of a particular wetland.

#	Steps in properly establishing scoring boundaries	done?	not applicable
Step 1	Identify the wetland area of interest. This may be the site of a proposed impact, a reference site, conservation site, etc.	Yes	
Step 2	Identify the locations where there is physical evidence that hydrology changes rapidly. Such evidence includes both natural and human-induced changes including, constrictions caused by berms or dikes, points where the water velocity changes rapidly at rapids or falls, points where significant inflows occur at the confluence of rivers, or other factors that may restrict hydrologic interaction between the wetlands or parts of a single wetland.	Yes	
Step 3	Delineate the boundary of the wetland to be rated such that all areas of interest that are contiguous to and within the areas where the hydrology does not change significantly, i.e. areas that have a high degree of hydrologic interaction are included within the scoring boundary.	Yes	
Step 4	Determine if artificial boundaries, such as property lines, state lines, roads, railroad embankments, etc., are present. These should not be used to establish scoring boundaries unless they coincide with areas where the hydrologic regime changes.	Yes	
Step 5	In all instances, the Rater may enlarge the minimum scoring boundaries discussed here to score together wetlands that could be scored separately.	Yes	
Step 6	Consult ORAM Manual Section 5.0 for how to establish scoring boundaries for wetlands that form a patchwork on the landscape, divided by artificial boundaries, contiguous to streams, lakes or rivers, or for dual classifications.	Yes	

End of Scoring Boundary Determination. Begin Narrative Rating on next page.

Apex Sanitary Landfill
Wetland L
30 July 2010

Narrative Rating

INSTRUCTIONS. Answer each of the following questions. Questions 1, 2, 3 and 4 should be answered based on information obtained from the site visit or the literature *and* by submitting a Data Services Request to the Ohio Department of Natural Resources, Division of Natural Areas and Preserves, Natural Heritage Data Services, 1889 Fountain Square Court, Building F-1, Columbus, Ohio 43224, 614-265-6453 (phone), 614-265-3096 (fax), http://www.dnr.state.oh.us/dnap . The remaining questions are designed to be answered primarily by the results of the site visit. Refer to the User's Manual for descriptions of these wetland types. Note: "Critical habitat" is legally defined in the Endangered Species Act and is the geographic area containing physical or biological features essential to the conservation of a listed species or as an area that may require special management considerations or protection. The Rater should contact the Region 3 Headquarters or the Columbus Ecological Services Office for updates as to whether critical habitat has been designated for other federally listed threatened or endangered species. "Documented" means the wetland is listed in the appropriate State of Ohio database.

#	Question	Circle one	
1	**Critical Habitat.** Is the wetland in a township, section, or subsection of a United States Geological Survey 7.5 minute Quadrangle that has been designated by the U.S. Fish and Wildlife Service as "critical habitat" for any threatened or endangered plant or animal species? Note: as of January 1, 2001, of the federally listed endangered or threatened species which can be found in Ohio, the Indiana Bat has had critical habitat designated (50 CFR 17.95(a)) and the piping plover has had critical habitat proposed (65 FR 41812 July 6, 2000).	YES Wetland should be evaluated for possible Category 3 status Go to Question 2	(NO) Go to Question 2
2	**Threatened or Endangered Species.** Is the wetland known to contain an individual of, or documented occurrences of federal or state-listed threatened or endangered plant or animal species?	YES Wetland is a Category 3 wetland. Go to Question 3	(NO) Go to Question 3
3	**Documented High Quality Wetland.** Is the wetland on record in Natural Heritage Database as a high quality wetland?	YES Wetland is a Category 3 wetland Go to Question 4	(NO) Go to Question 4
4	**Significant Breeding or Concentration Area.** Does the wetland contain documented regionally significant breeding or nonbreeding waterfowl, neotropical songbird, or shorebird concentration areas?	YES Wetland is a Category 3 wetland Go to Question 5	(NO) Go to Question 5
5	**Category 1 Wetlands.** Is the wetland less than 0.5 hectares (1 acre) in size and **hydrologically isolated** and either 1) comprised of vegetation that is dominated (greater than eighty per cent areal cover) by *Phalaris arundinacea, Lythrum salicaria,* or *Phragmites australis,* or 2) an acidic pond created or excavated on mined lands that has little or no vegetation?	YES Wetland is a Category 1 wetland Go to Question 6	(NO) Go to Question 6
6	**Bogs.** Is the wetland a peat-accumulating wetland that 1) has no significant inflows or outflows, 2) supports acidophilic mosses, particularly *Sphagnum* spp., 3) the acidophilic mosses have >30% cover, 4) at least one species from Table 1 is present, and 5) the cover of invasive species (see Table 1) is <25%?	YES Wetland is a Category 3 wetland Go to Question 7	(NO) Go to Question 7
7	**Fens.** Is the wetland a carbon accumulating (peat, muck) wetland that is saturated during most of the year, primarily by a discharge of free flowing, mineral rich, ground water with a circumneutral ph (5.5-9.0) and with one or more plant species listed in Table 1 and the cover of invasive species listed in Table 1 is <25%?	YES Wetland is a Category 3 wetland Go to Question 8a	(NO) Go to Question 8a
8a	**"Old Growth Forest."** Is the wetland a forested wetland and is the forest characterized by, but not limited to, the following characteristics: overstory canopy trees of great age (exceeding at least 50% of a projected maximum attainable age for a species); little or no evidence of human-caused understory disturbance during the past 80 to 100 years; an all-aged structure and multilayered canopies; aggregations of canopy trees interspersed with canopy gaps; and significant numbers of standing dead snags and downed logs?	YES Wetland is a Category 3 wetland. Go to Question 8b	(NO) Go to Question 8b

8b	**Mature forested wetlands.** Is the wetland a forested wetland with 50% or more of the cover of upper forest canopy consisting of deciduous trees with large diameters at breast height (dbh), generally diameters greater than 45cm (17.7in) dbh?	YES Wetland should be evaluated for possible Category 3 status. Go to Question 9a	NO Go to Question 9a
9a	**Lake Erie coastal and tributary wetlands.** Is the wetland located at an elevation less than 575 feet on the USGS map, adjacent to this elevation, or along a tributary to Lake Erie that is accessible to fish?	YES Go to Question 9b	NO Go to Question 10
9b	Does the wetland's hydrology result from measures designed to prevent erosion and the loss of aquatic plants, i.e. the wetland is partially hydrologically restricted from Lake Erie due to lakeward or landward dikes or other hydrological controls?	YES Wetland should be evaluated for possible Category 3 status Go to Question 10	NO Go to Question 9c
9c	Are Lake Erie water levels the wetland's primary hydrological influence, i.e. the wetland is hydrologically unrestricted (no lakeward or upland border alterations), or the wetland can be characterized as an "estuarine" wetland with lake and river influenced hydrology. These include sandbar deposition wetlands, estuarine wetlands, river mouth wetlands, or those dominated by submersed aquatic vegetation.	YES Go to Question 9d	NO Go to Question 10
9d	Does the wetland have a predominance of native species within its vegetation communities, although non-native or disturbance tolerant native species can also be present?	YES Wetland is a Category 3 wetland Go to Question 10	NO Go to Question 9e
9e	Does the wetland have a predominance of non-native or disturbance tolerant native plant species within its vegetation communities?	YES Wetland should be evaluated for possible Category 3 status Go to Question 10	NO Go to Question 10
10	**Lake Plain Sand Prairies (Oak Openings)** Is the wetland located in Lucas, Fulton, Henry, or Wood Counties and can the wetland be characterized by the following description: the wetland has a sandy substrate with interspersed organic matter, a water table often within several inches of the surface, and often with a dominance of the gramineous vegetation listed in Table 1 (woody species may also be present). The Ohio Department of Natural Resources Division of Natural Areas and Preserves can provide assistance in confirming this type of wetland and its quality.	YES Wetland is a Category 3 wetland. Go to Question 11	NO Go to Question 11
11	**Relict Wet Prairies.** Is the wetland a relict wet prairie community dominated by some or all of the species in Table 1. Extensive prairies were formerly located in the Darby Plains (Madison and Union Counties), Sandusky Plains (Wyandot, Crawford, and Marion Counties), northwest Ohio (e.g. Erie, Huron, Lucas, Wood Counties), and portions of western Ohio Counties (e.g. Darke, Mercer, Miami, Montgomery, Van Wert etc.).	YES Wetland should be evaluated for possible Category 3 status Complete Quantitative Rating	NO Complete Quantitative Rating

Table 1. Characteristic plant species.

invasive/exotic spp	fen species	bog species	0ak Opening species	wet prairie species
Lythrum salicaria	*Zygadenus elegans var. glaucus*	*Calla palustris*	*Carex cryptolepis*	*Calamagrostis canadensis*
Myriophyllum spicatum	*Cacalia plantaginea*	*Carex atlantica var. capillacea*	*Carex lasiocarpa*	*Calamogrostis stricta*
Najas minor	*Carex flava*	*Carex echinata*	*Carex stricta*	*Carex atherodes*
Phalaris arundinacea	*Carex sterilis*	*Carex oligosperma*	*Cladium mariscoides*	*Carex buxbaumii*
Phragmites australis	*Carex stricta*	*Carex trisperma*	*Calamagrostis stricta*	*Carex pellita*
Potamogeton crispus	*Deschampsia caespitosa*	*Chamaedaphne calyculata*	*Calamagrostis canadensis*	*Carex sartwellii*
Ranunculus ficaria	*Eleocharis rostellata*	*Decodon verticillatus*	*Quercus palustris*	*Gentiana andrewsii*
Rhamnus frangula	*Eriophorum viridicarinatum*	*Eriophorum virginicum*		*Helianthus grosseserratus*
Typha angustifolia	*Gentianopsis spp.*	*Larix laricina*		*Liatris spicata*
Typha xglauca	*Lobelia kalmii*	*Nemopanthus mucronatus*		*Lysimachia quadriflora*
	Parnassia glauca	*Schechzeria palustris*		*Lythrum alatum*
	Potentilla fruticosa	*Sphagnum spp.*		*Pycnanthemum virginianum*
	Rhamnus alnifolia	*Vaccinium macrocarpon*		*Silphium terebinthinaceum*
	Rhynchospora capillacea	*Vaccinium corymbosum*		*Sorghastrum nutans*
	Salix candida	*Vaccinium oxycoccos*		*Spartina pectinata*
	Salix myricoides	*Woodwardia virginica*		*Solidago riddellii*
	Salix serissima	*Xyris difformis*		
	Solidago ohioensis			
	Tofieldia glutinosa			
	Triglochin maritimum			
	Triglochin palustre			

End of Narrative Rating. Begin Quantitative Rating on next page.

ORAM v. 5.0 Field Form Quantitative Rating

Wetland L

Site: Apex Landfill	Rater(s): MAT, MRH	Date: 7/30/10

Metric 1. Wetland Area (size).

2 | 2 (max 6 pts. | subtotal)

Select one size class and assign score.

- [ ] >50 acres (>20.2ha) (6 pts)
- [ ] 25 to <50 acres (10.1 to <20.2ha) (5 pts)
- [ ] 10 to <25 acres (4 to <10.1ha) (4 pts)
- [ ] 3 to <10 acres (1.2 to <4ha) (3 pts)
- [x] 0.3 to <3 acres (0.12 to <1.2ha) (2pts) 1.37 ac.
- [ ] 0.1 to <0.3 acres (0.04 to <0.12ha) (1 pt)
- [ ] <0.1 acres (0.04ha) (0 pts)

Metric 2. Upland buffers and surrounding land use.

9 | 11 (max 14 pts. | subtotal)

2a. Calculate average buffer width. Select only one and assign score. Do not double check.

- [ ] WIDE. Buffers average 50m (164ft) or more around wetland perimeter (7)
- [x] MEDIUM. Buffers average 25m to <50m (82 to <164ft) around wetland perimeter (4) 136'
- [ ] NARROW. Buffers average 10m to <25m (32ft to <82ft) around wetland perimeter (1)
- [ ] VERY NARROW. Buffers average <10m (<32ft) around wetland perimeter (0)

2b. Intensity of surrounding land use. Select one or double check and average.

- [ ] VERY LOW. 2nd growth or older forest, prairie, savannah, wildlife area, etc. (7)
- [x] LOW. Old field (>10 years), shrubland, young second growth forest. (5)
- [ ] MODERATELY HIGH. Residential, fenced pasture, park, conservation tillage, new fallow field. (3)
- [ ] HIGH. Urban, industrial, open pasture, row cropping, mining, construction. (1)

Metric 3. Hydrology.

17 | 28 (max 30 pts. | subtotal)

3a. Sources of Water. Score all that apply.

- [ ] High pH groundwater (5)
- [x] Other groundwater (3)
- [x] Precipitation (1)
- [ ] Seasonal/Intermittent surface water (3)
- [ ] Perennial surface water (lake or stream) (5)

3b. Connectivity. Score all that apply.

- [ ] 100 year floodplain (1)
- [ ] Between stream/lake and other human use (1)
- [x] Part of wetland/upland (e.g. forest), complex (1)
- [ ] Part of riparian or upland corridor (1)

3c. Maximum water depth. Select only one and assign score.

- [x] >0.7 (27.6in) (3)
- [ ] 0.4 to 0.7m (15.7 to 27.6in) (2)
- [ ] <0.4m (<15.7in) (1)

3d. Duration inundation/saturation. Score one or dbl check.

- [x] Semi- to permanently inundated/saturated (4)
- [ ] Regularly inundated/saturated (3)
- [ ] Seasonally inundated (2)
- [ ] Seasonally saturated in upper 30cm (12in) (1)

3e. Modifications to natural hydrologic regime. Score one or double check and average.

- [ ] None or none apparent (12)
- [x] Recovered (7)
- [x] Recovering (3) 5
- [ ] Recent or no recovery (1)

Check all disturbances observed

- [ ] ditch
- [ ] tile
- [ ] dike
- [ ] weir
- [ ] stormwater input
- [ ] point source (nonstormwater)
- [x] filling/grading
- [ ] road bed/RR track
- [ ] dredging
- [x] other past mining

Metric 4. Habitat Alteration and Development.

9 | 37 (max 20 pts. | subtotal)

4a. Substrate disturbance. Score one or double check and average.

- [ ] None or none apparent (4)
- [ ] Recovered (3)
- [x] Recovering (2) 1.5 mine spoils
- [x] Recent or no recovery (1)

4b. Habitat development. Select only one and assign score.

- [ ] Excellent (7)
- [ ] Very good (6)
- [ ] Good (5)
- [ ] Moderately good (4)
- [x] Fair (3)
- [ ] Poor to fair (2)
- [ ] Poor (1)

4c. Habitat alteration. Score one or double check and average.

- [ ] None or none apparent (9)
- [x] Recovered (6)
- [x] Recovering (3) 4.5
- [ ] Recent or no recovery (1)

Check all disturbances observed

- [ ] mowing
- [ ] grazing
- [ ] clearcutting
- [ ] selective cutting
- [ ] woody debris removal
- [ ] toxic pollutants
- [ ] shrub/sapling removal
- [ ] herbaceous/aquatic bed removal
- [x] sedimentation, spoils
- [ ] dredging
- [ ] farming
- [ ] nutrient enrichment
- [x] past mining

37 (subtotal this page)

ORAM v. 5.0 Field Form Quantitative Rating

Wetland L

Site: Apex Landfill	Rater(s): MAT, MRH	Date: 7/30/10

37 subtotal ~~this page~~

0 | 37 | **Metric 5. Special Wetlands.**

max 10 pts. | subtotal

Check all that apply and score as indicated.

- [ ] Bog (10)
- [ ] Fen (10)
- [ ] Old growth forest (10)
- [ ] Mature forested wetland (5)
- [ ] Lake Erie coastal/tributary wetland-unrestricted hydrology (10)
- [ ] Lake Erie coastal/tributary wetland-restricted hydrology (5)
- [ ] Lake Plain Sand Prairies (Oak Openings) (10)
- [ ] Relict Wet Praires (10)
- [ ] Known occurrence state/federal threatened or endangered species (10)
- [ ] Significant migratory songbird/water fowl habitat or usage (10)
- [ ] Category 1 Wetland. See Question 1 Qualitative Rating (-10)

9 | 46 | **Metric 6. Plant communities, interspersion, microtopography.**

max 20 pts. | subtotal

6a. Wetland Vegetation Communities.

Score all present using 0 to 3 scale.

- [2] Aquatic bed
- [ ] Emergent
- [ ] Shrub
- [ ] Forest
- [ ] Mudflats
- [2] Open water
- [ ] Other_____

6b. horizontal (plan view) Interspersion.

Select only one.

- [ ] High (5)
- [ ] Moderately high(4)
- [ ] Moderate (3)
- [ ] Moderately low (2)
- [X] Low (1)
- [ ] None (0)

6c. Coverage of invasive plants. Refer to Table 1 ORAM long form for list. Add or deduct points for coverage

- [ ] Extensive >75% cover (-5)
- [ ] Moderate 25-75% cover (-3)
- [ ] Sparse 5-25% cover (-1)
- [ ] Nearly absent <5% cover (0)
- [X] Absent (1)

6d. Microtopography.

Score all present using 0 to 3 scale.

- [ ] Vegetated hummucks/tussucks
- [1] Coarse woody debris >15cm (6in)
- [ ] Standing dead >25cm (10in) dbh
- [2] Amphibian breeding pools

Vegetation Community Cover Scale

0	Absent or comprises <0.1ha (0.2471 acres) contiguous area
1	Present and either comprises small part of wetland's vegetation and is of moderate quality, or comprises a significant part but is of low quality
2	Present and either comprises significant part of wetland's vegetation and is of moderate quality or comprises a small part and is of high quality
3	Present and comprises significant part, or more, of wetland's vegetation and is of high quality

Narrative Description of Vegetation Quality

low	Low spp diversity and/or predominance of nonnative or disturbance tolerant native species
mod	Native spp are dominant component of the vegetation, although nonnative and/or disturbance tolerant native spp can also be present, and species diversity moderate to moderately high, but generallyw/o presence of rare threatened or endangered spp
high	A predominance of native species, with nonnative spp and/or disturbance tolerant native spp absent or virtually absent, and high spp diversity and often, but not always, the presence of rare, threatened, or endangered spp

Mudflat and Open Water Class Quality

0	Absent <0.1ha (0.247 acres)
1	Low 0.1 to <1ha (0.247 to 2.47 acres)
2	Moderate 1 to <4ha (2.47 to 9.88 acres)
3	High 4ha (9.88 acres) or more

Microtopography Cover Scale

0	Absent
1	Present very small amounts or if more common of marginal quality
2	Present in moderate amounts, but not of highest quality or in small amounts of highest quality
3	Present in moderate or greater amounts and of highest quality

46 **GRAND TOTAL(max 100 pts)** Category 2

Refer to the most recent ORAM Score Calibration Report for the scoring breakpoints between wetland categories at the following address: http://www.epa.state.oh.us/dsw/401/401.html

last revised 1 February 2001 jjm

ORAM Summary Worksheet

Apex Sanitary Landfill
Wetland L
30 July 2010

		circle answer or insert score	Result
Narrative Rating	Question 1 Critical Habitat	YES (NO)	If yes, Category 3.
	Question 2. Threatened or Endangered Species	YES (NO)	If yes, Category 3.
	Question 3. High Quality Natural Wetland	YES (NO)	If yes, Category 3.
	Question 4. Significant bird habitat	YES (NO)	If yes, Category 3.
	Question 5. Category 1 Wetlands	YES (NO)	If yes, Category 1.
	Question 6. Bogs	YES (NO)	If yes, Category 3.
	Question 7. Fens	YES (NO)	If yes, Category 3.
	Question 8a. Old Growth Forest	YES (NO)	If yes, Category 3.
	Question 8b. Mature Forested Wetland	YES (NO)	If yes, evaluate for Category 3; may also be 1 or 2.
	Question 9b. Lake Erie Wetlands - Restricted	YES (NO)	If yes, evaluate for Category 3; may also be 1 or 2.
	Question 9d. Lake Erie Wetlands – Unrestricted with native plants	YES NO	If yes, Category 3
	Question 9e. Lake Erie Wetlands - Unrestricted with invasive plants	YES NO	If yes, evaluate for Category 3; may also be 1 or 2.
	Question 10. Oak Openings	YES (NO)	If yes, Category 3
	Question 11. Relict Wet Prairies	YES (NO)	If yes, evaluate for Category 3; may also be 1 or 2.
Quantitative Rating	Metric 1. Size	2	
	Metric 2. Buffers and surrounding land use	9	
	Metric 3. Hydrology	17	
	Metric 4. Habitat	9	
	Metric 5. Special Wetland Communities	0	
	Metric 6. Plant communities, interspersion, microtopography	9	
	TOTAL SCORE	46	Category based on score breakpoints 2

Complete Wetland Categorization Worksheet.

Apex Sanitary Landfill
Wetland L
30 July 2010

Wetland Categorization Worksheet

Choices	Circle one		Evaluation of Categorization Result of ORAM
Did you answer "Yes" to any of the following questions: Narrative Rating Nos. 2, 3, 4, 6, 7, 8a, 9d, 10	YES Wetland is categorized as a Category 3 wetland	(NO)	Is quantitative rating score *less* than the Category 2 scoring threshold (*excluding* gray zone)? If yes, reevaluate the category of the wetland using the narrative criteria in OAC Rule 3745-1-54(C) and biological and/or functional assessments to determine if the wetland has been over-categorized by the ORAM
Did you answer "Yes" to any of the following questions: Narrative Rating Nos. 1, 8b, 9b, 9e, 11	YES Wetland should be evaluated for possible Category 3 status	(NO)	Evaluate the wetland using the 1) narrative criteria in OAC Rule 3745-1-54(C) and 2) the quantitative rating score. If the wetland is determined to be a Category 3 wetland using either of these, it should be categorized as a Category 3 wetland. Detailed biological and/or functional assessments may also be used to determine the wetland's category.
Did you answer "Yes" to Narrative Rating No. 5	YES Wetland is categorized as a Category 1 wetland	(NO)	Is quantitative rating score *greater* than the Category 2 scoring threshold *(including* any gray zone)? If yes, reevaluate the category of the wetland using the narrative criteria in OAC Rule 3745-1-54(C) and biological and/or functional assessments to determine if the wetland has been under-categorized by the ORAM
Does the quantitative score fall within the scoring range of a Category 1, 2, or 3 wetland?	(YES) Wetland is assigned to the appropriate category based on the scoring range	NO	If the score of the wetland is located within the scoring range for a particular category, the wetland should be assigned to that category. In all instances however, the narrative criteria described in OAC Rule 3745-1-54(C) can be used to clarify or change a categorization based on a quantitative score.
Does the quantitative score fall with the *"gray zone"* for Category 1 or 2 or Category 2 or 3 wetlands?	YES Wetland is assigned to the higher of the two categories or assigned to a category based on detailed assessments and the narrative criteria	(NO)	Rater has the option of assigning the wetland to the higher of the two categories or to assign a category based on the results of a nonrapid wetland assessment method, e.g. functional assessment, biological assessment, etc, and a consideration of the narrative criteria in OAC rule 3745-1-54(C).
Does the wetland otherwise exhibit *moderate OR superior* hydrologic OR habitat, OR recreational functions AND the wetland was *not* categorized as a Category 2 wetland (in the case of moderate functions) or a Category 3 wetland (in the case of superior functions) by this method?	YES Wetland was undercategorized by this method. A written justification for recategorization should be provided on Background Information Form	(NO) Wetland is assigned to category as determined by the ORAM.	A wetland may be undercategorized using this method, but still exhibit one or more superior functions, e.g. a wetland's biotic communities may be degraded by human activities, but the wetland may still exhibit superior hydrologic functions because of its type, landscape position, size, local or regional significance, etc. In this circumstance, the narrative criteria in OAC Rule 3745-1-54(C)(2) and (3) are controlling, and the under-categorization should be corrected. A written justification with supporting reasons or information for this determination should be provided.

Final Category			
Choose one	Category 1	(Category 2)	Category 3

End of Ohio Rapid Assessment Method for Wetlands.

Background Information

Name:	Michael A. Takacs, Mark R. Haibach
Date:	30 July 2010
Affiliation:	Civil & Environmental Consultants, Inc.
Address:	333 Baldwin Road, Pittsburgh, PA 15205
Phone Number:	(412) 249-3188, (412) 249-3156
e-mail address:	mtakacs@cecinc.com, mhaibach@cecinc.com
Name of Wetland:	Wetland M
Vegetation Communit(ies):	PEM1
HGM Class(es):	SWD, GWD

Location of Wetland: include map, address, north arrow, landmarks, distances, roads, etc.

See Stream and Wetland Delineation Report, Figures 1 and 4.

Lat/Long or UTM Coordinate	
USGS Quad Name: Amsterdam, OH	
County: Jefferson	
Township: Springfield	
Section and Subsection	
Hydrologic Unit Code: 05030101340	
Site Visit: 30 July 2010	
National Wetland Inventory Map: Amsterdam, OH	
Ohio Wetland Inventory Map: —	
Soil Survey: Soil Survey of Jefferson County, Ohio	
Delineation report/map: Wetland and Stream Delineation and Functional Assessment Report, Potential Apex Sanitary Landfill Expansion. CEC 2010.	

Name of Wetland: Wetland M	
Wetland Size (acres, hectares): 0.60 acre	

Sketch: Include north arrow, relationship with other surface waters, vegetation zones, etc.

See Stream and Wetland Delineation Map (Figure 4).

Comments, Narrative Discussion, Justification of Category Changes:

Final score : 25.5	Category: 1

Apex Sanitary Landfill
Wetland M
30 July 2010

Scoring Boundary Worksheet

INSTRUCTIONS. The initial step in completing the ORAM is to identify the "scoring boundaries" of the wetland being rated. In many instances this determination will be relatively easy and the scoring boundaries will coincide with the "jurisdictional boundaries." For example, the scoring boundary of an isolated cattail marsh located in the middle of a farm field will likely be the same as that wetland's jurisdictional boundaries. In other instances, however, the scoring boundary will not be as easily determined. Wetlands that are small or isolated from other surface waters often form large contiguous areas or heterogeneous complexes of wetland and upland. In separating wetlands for scoring purposes, the hydrologic regime of the wetland is the main criterion that should be used. Boundaries between contiguous or connected wetlands should be established where the volume, flow, or velocity of water moving through the wetland changes significantly. *Areas with a high degree of hydrologic interaction should be scored as a single wetland.* In determining a wetland's scoring boundaries, use the guidelines in the ORAM Manual Section 5.0. In certain instances, it may be difficult to establish the scoring boundary for the wetland being rated. These problem situations include wetlands that form a patchwork on the landscape, wetlands divided by artificial boundaries like property fences, roads, or railroad embankments, wetlands that are contiguous with streams, lakes, or rivers, and estuarine or coastal wetlands. These situations are discussed below, however, it is recommended that Rater contact Ohio EPA, Division of Surface Water, 401/Wetlands Section if there are additional questions or a need for further clarification of the appropriate scoring boundaries of a particular wetland.

#	Steps in properly establishing scoring boundaries	done?	not applicable
Step 1	Identify the wetland area of interest. This may be the site of a proposed impact, a reference site, conservation site, etc.	Yes	
Step 2	Identify the locations where there is physical evidence that hydrology changes rapidly. Such evidence includes both natural and human-induced changes including, constrictions caused by berms or dikes, points where the water velocity changes rapidly at rapids or falls, points where significant inflows occur at the confluence of rivers, or other factors that may restrict hydrologic interaction between the wetlands or parts of a single wetland.	Yes	
Step 3	Delineate the boundary of the wetland to be rated such that all areas of interest that are contiguous to and within the areas where the hydrology does not change significantly, i.e. areas that have a high degree of hydrologic interaction are included within the scoring boundary.	Yes	
Step 4	Determine if artificial boundaries, such as property lines, state lines, roads, railroad embankments, etc., are present. These should not be used to establish scoring boundaries unless they coincide with areas where the hydrologic regime changes.	Yes	
Step 5	In all instances, the Rater may enlarge the minimum scoring boundaries discussed here to score together wetlands that could be scored separately.	Yes	
Step 6	Consult ORAM Manual Section 5.0 for how to establish scoring boundaries for wetlands that form a patchwork on the landscape, divided by artificial boundaries, contiguous to streams, lakes or rivers, or for dual classifications.	Yes	

End of Scoring Boundary Determination. Begin Narrative Rating on next page.

Apex Sanitary Landfill
Wetland M
30 July 2010

Narrative Rating

INSTRUCTIONS. Answer each of the following questions. Questions 1, 2, 3 and 4 should be answered based on information obtained from the site visit or the literature *and* by submitting a Data Services Request to the Ohio Department of Natural Resources, Division of Natural Areas and Preserves, Natural Heritage Data Services, 1889 Fountain Square Court, Building F-1, Columbus, Ohio 43224, 614-265-6453 (phone), 614-265-3096 (fax), http://www.dnr.state.oh.us/dnap . The remaining questions are designed to be answered primarily by the results of the site visit. Refer to the User's Manual for descriptions of these wetland types. Note: "Critical habitat" is legally defined in the Endangered Species Act and is the geographic area containing physical or biological features essential to the conservation of a listed species or as an area that may require special management considerations or protection. The Rater should contact the Region 3 Headquarters or the Columbus Ecological Services Office for updates as to whether critical habitat has been designated for other federally listed threatened or endangered species. "Documented" means the wetland is listed in the appropriate State of Ohio database.

#	Question	Circle one	
1	**Critical Habitat.** Is the wetland in a township, section, or subsection of a United States Geological Survey 7.5 minute Quadrangle that has been designated by the U.S. Fish and Wildlife Service as "critical habitat" for any threatened or endangered plant or animal species? Note: as of January 1, 2001, of the federally listed endangered or threatened species which can be found in Ohio, the Indiana Bat has had critical habitat designated (50 CFR 17.95(a)) and the piping plover has had critical habitat proposed (65 FR 41812 July 6, 2000).	YES Wetland should be evaluated for possible Category 3 status Go to Question 2	(NO) Go to Question 2
2	**Threatened or Endangered Species.** Is the wetland known to contain an individual of, or documented occurrences of federal or state-listed threatened or endangered plant or animal species?	YES Wetland is a Category 3 wetland. Go to Question 3	(NO) Go to Question 3
3	**Documented High Quality Wetland.** Is the wetland on record in Natural Heritage Database as a high quality wetland?	YES Wetland is a Category 3 wetland Go to Question 4	(NO) Go to Question 4
4	**Significant Breeding or Concentration Area.** Does the wetland contain documented regionally significant breeding or nonbreeding waterfowl, neotropical songbird, or shorebird concentration areas?	YES Wetland is a Category 3 wetland Go to Question 5	(NO) Go to Question 5
5	**Category 1 Wetlands.** Is the wetland less than 0.5 hectares (1 acre) in size and **hydrologically isolated** and either 1) comprised of vegetation that is dominated (greater than eighty per cent areal cover) by *Phalaris arundinacea, Lythrum salicaria,* or *Phragmites australis*, or 2) an acidic pond created or excavated on mined lands that has little or no vegetation?	YES Wetland is a Category 1 wetland Go to Question 6	(NO) Go to Question 6
6	**Bogs.** Is the wetland a peat-accumulating wetland that 1) has no significant inflows or outflows, 2) supports acidophilic mosses, particularly *Sphagnum* spp., 3) the acidophilic mosses have >30% cover, 4) at least one species from Table 1 is present, and 5) the cover of invasive species (see Table 1) is <25%?	YES Wetland is a Category 3 wetland Go to Question 7	(NO) Go to Question 7
7	**Fens.** Is the wetland a carbon accumulating (peat, muck) wetland that is saturated during most of the year, primarily by a discharge of free flowing, mineral rich, ground water with a circumneutral ph (5.5-9.0) and with one or more plant species listed in Table 1 and the cover of invasive species listed in Table 1 is <25%?	YES Wetland is a Category 3 wetland Go to Question 8a	(NO) Go to Question 8a
8a	**"Old Growth Forest."** Is the wetland a forested wetland and is the forest characterized by, but not limited to, the following characteristics: overstory canopy trees of great age (exceeding at least 50% of a projected maximum attainable age for a species); little or no evidence of human-caused understory disturbance during the past 80 to 100 years; an all-aged structure and multilayered canopies; aggregations of canopy trees interspersed with canopy gaps; and significant numbers of standing dead snags and downed logs?	YES Wetland is a Category 3 wetland. Go to Question 8b	(NO) Go to Question 8b

8b	**Mature forested wetlands**. Is the wetland a forested wetland with 50% or more of the cover of upper forest canopy consisting of deciduous trees with large diameters at breast height (dbh), generally diameters greater than 45cm (17.7in) dbh?	YES Wetland should be evaluated for possible Category 3 status. Go to Question 9a	NO Go to Question 9a
9a	**Lake Erie coastal and tributary wetlands**. Is the wetland located at an elevation less than 575 feet on the USGS map, adjacent to this elevation, or along a tributary to Lake Erie that is accessible to fish?	YES Go to Question 9b	NO Go to Question 10
9b	Does the wetland's hydrology result from measures designed to prevent erosion and the loss of aquatic plants, i.e. the wetland is partially hydrologically restricted from Lake Erie due to lakeward or landward dikes or other hydrological controls?	YES Wetland should be evaluated for possible Category 3 status Go to Question 10	NO Go to Question 9c
9c	Are Lake Erie water levels the wetland's primary hydrological influence, i.e. the wetland is hydrologically unrestricted (no lakeward or upland border alterations), or the wetland can be characterized as an "estuarine" wetland with lake and river influenced hydrology. These include sandbar deposition wetlands, estuarine wetlands, river mouth wetlands, or those dominated by submersed aquatic vegetation.	YES Go to Question 9d	NO Go to Question 10
9d	Does the wetland have a predominance of native species within its vegetation communities, although non-native or disturbance tolerant native species can also be present?	YES Wetland is a Category 3 wetland Go to Question 10	NO Go to Question 9e
9e	Does the wetland have a predominance of non-native or disturbance tolerant native plant species within its vegetation communities?	YES Wetland should be evaluated for possible Category 3 status Go to Question 10	NO Go to Question 10
10	**Lake Plain Sand Prairies (Oak Openings)** Is the wetland located in Lucas, Fulton, Henry, or Wood Counties and can the wetland be characterized by the following description: the wetland has a sandy substrate with interspersed organic matter, a water table often within several inches of the surface, and often with a dominance of the gramineous vegetation listed in Table 1 (woody species may also be present). The Ohio Department of Natural Resources Division of Natural Areas and Preserves can provide assistance in confirming this type of wetland and its quality.	YES Wetland is a Category 3 wetland. Go to Question 11	NO Go to Question 11
11	**Relict Wet Prairies**. Is the wetland a relict wet prairie community dominated by some or all of the species in Table 1. Extensive prairies were formerly located in the Darby Plains (Madison and Union Counties), Sandusky Plains (Wyandot, Crawford, and Marion Counties), northwest Ohio (e.g. Erie, Huron, Lucas, Wood Counties), and portions of western Ohio Counties (e.g. Darke, Mercer, Miami, Montgomery, Van Wert etc.).	YES Wetland should be evaluated for possible Category 3 status Complete Quantitative Rating	NO Complete Quantitative Rating

Table 1. Characteristic plant species.

invasive/exotic spp	fen species	bog species	0ak Opening species	wet prairie species
Lythrum salicaria	*Zygadenus elegans var. glaucus*	*Calla palustris*	*Carex cryptolepis*	*Calamagrostis canadensis*
Myriophyllum spicatum	*Cacalia plantaginea*	*Carex atlantica var. capillacea*	*Carex lasiocarpa*	*Calamogrostis stricta*
Najas minor	*Carex flava*	*Carex echinata*	*Carex stricta*	*Carex atherodes*
Phalaris arundinacea	*Carex sterilis*	*Carex oligosperma*	*Cladium mariscoides*	*Carex buxbaumii*
Phragmites australis	*Carex stricta*	*Carex trisperma*	*Calamagrostis stricta*	*Carex pellita*
Potamogeton crispus	*Deschampsia caespitosa*	*Chamaedaphne calyculata*	*Calamagrostis canadensis*	*Carex sartwellii*
Ranunculus ficaria	*Eleocharis rostellata*	*Decodon verticillatus*	*Quercus palustris*	*Gentiana andrewsii*
Rhamnus frangula	*Eriophorum viridicarinatum*	*Eriophorum virginicum*		*Helianthus grosseserratus*
Typha angustifolia	*Gentianopsis spp.*	*Larix laricina*		*Liatris spicata*
Typha xglauca	*Lobelia kalmii*	*Nemopanthus mucronatus*		*Lysimachia quadriflora*
	Parnassia glauca	*Schechzeria palustris*		*Lythrum alatum*
	Potentilla fruticosa	*Sphagnum spp.*		*Pycnanthemum virginianum*
	Rhamnus alnifolia	*Vaccinium macrocarpon*		*Silphium terebinthinaceum*
	Rhynchospora capillacea	*Vaccinium corymbosum*		*Sorghastrum nutans*
	Salix candida	*Vaccinium oxycoccos*		*Spartina pectinata*
	Salix myricoides	*Woodwardia virginica*		*Solidago riddellii*
	Salix serissima	*Xyris difformis*		
	Solidago ohioensis			
	Tofieldia glutinosa			
	Triglochin maritimum			
	Triglochin palustre			

End of Narrative Rating. Begin Quantitative Rating on next page.

Site: Apex Sanitary Landfill, Amsterdam, OH | Rater(s): Mike A. Takacs, Mark Thibeault | Date: 30 July 2010

Wetland M

Metric 1. Wetland Area (size).

2 | 2 (max 6 pts. | subtotal)

Select one size class and assign score.

- [ ] >50 acres (>20.2ha) (6 pts)
- [ ] 25 to <50 acres (10.1 to <20.2ha) (5 pts)
- [ ] 10 to <25 acres (4 to <10.1ha) (4 pts)
- [ ] 3 to <10 acres (1.2 to <4ha) (3 pts)
- [x] 0.3 to <3 acres (0.12 to <1.2ha) (2pts) 0.60 acre
- [ ] 0.1 to <0.3 acres (0.04 to <0.12ha) (1 pt)
- [ ] <0.1 acres (0.04ha) (0 pts)

Metric 2. Upland buffers and surrounding land use.

4 | 6 (max 14 pts. | subtotal)

2a. Calculate average buffer width. Select only one and assign score. Do not double check.

- [ ] WIDE. Buffers average 50m (164ft) or more around wetland perimeter (7)
- [ ] MEDIUM. Buffers average 25m to <50m (82 to <164ft) around wetland perimeter (4)
- [x] NARROW. Buffers average 10m to <25m (32ft to <82ft) around wetland perimeter (1)
- [ ] VERY NARROW. Buffers average <10m (<32ft) around wetland perimeter (0)

$\bar{x} = 66'$

2b. Intensity of surrounding land use. Select one or double check and average.

- [ ] VERY LOW. 2nd growth or older forest, prairie, savannah, wildlife area, etc. (7)
- [x] LOW. Old field (>10 years), shrub land, young second growth forest. (5) 3 pts.
- [ ] MODERATELY HIGH. Residential, fenced pasture, park, conservation tillage, new fallow field. (3)
- [x] HIGH. Urban, industrial, open pasture, row cropping, mining, construction. (1) mining, landfill

Metric 3. Hydrology.

15 | 21 (max 30 pts. | subtotal)

3a. Sources of Water. Score all that apply.

- [ ] High pH groundwater (5)
- [x] Other groundwater (3)
- [x] Precipitation (1)
- [ ] Seasonal/Intermittent surface water (3)
- [ ] Perennial surface water (lake or stream) (5)

3b. Connectivity. Score all that apply.

- [ ] 100 year floodplain (1)
- [ ] Between stream/lake and other human use (1)
- [x] Part of wetland/upland (e.g. forest), complex (1)
- [ ] Part of riparian or upland corridor (1)

3c. Maximum water depth. Select only one and assign score.

- [ ] >0.7 (27.6in) (3)
- [ ] 0.4 to 0.7m (15.7 to 27.6in) (2)
- [x] <0.4m (<15.7in) (1)

3d. Duration inundation/saturation. Score one or dbl check.

- [x] Semi- to permanently inundated/saturated (4)
- [ ] Regularly inundated/saturated (3)
- [ ] Seasonally inundated (2)
- [ ] Seasonally saturated in upper 30cm (12in) (1)

3e. Modifications to natural hydrologic regime. Score one or double check and average.

- [ ] None or none apparent (12)
- [x] Recovered (7) 5 pts.
- [x] Recovering (3)
- [ ] Recent or no recovery (1)

Check all disturbances observed

- [ ] ditch
- [ ] tile
- [ ] dike
- [ ] weir
- [ ] stormwater input
- [ ] point source (nonstormwater)
- [x] filling/grading spoil
- [ ] road bed/RR track
- [ ] dredging
- [x] other past mining

Metric 4. Habitat Alteration and Development.

6.5 | 27.5 (max 20 pts. | subtotal)

4a. Substrate disturbance. Score one or double check and average.

- [ ] None or none apparent (4)
- [ ] Recovered (3)
- [x] Recovering (2)
- [x] Recent or no recovery (1)

1.5 pts mine spoil

4b. Habitat development. Select only one and assign score.

- [ ] Excellent (7)
- [ ] Very good (6)
- [ ] Good (5)
- [ ] Moderately good (4)
- [ ] Fair (3)
- [x] Poor to fair (2) invasives dominate plant community
- [ ] Poor (1)

4c. Habitat alteration. Score one or double check and average.

- [ ] None or none apparent (9)
- [ ] Recovered (6)
- [x] Recovering (3)
- [ ] Recent or no recovery (1)

Check all disturbances observed

- [ ] mowing
- [ ] grazing
- [ ] clearcutting
- [ ] selective cutting
- [ ] woody debris removal
- [ ] toxic pollutants
- [ ] shrub/sapling removal
- [ ] herbaceous/aquatic bed removal
- [x] sedimentation spoil
- [ ] dredging
- [ ] farming
- [ ] nutrient enrichment
- [x] past mining

27.5 (subtotal this page)

last revised 1 February 2001 jjm

ORAM v. 5.0 Field Form Quantitative Rating

Site: Apex Sanitary Landfill, Amsterdam, OH	Rater(s): Mike A. Takacs, Mark Hai bach	Date: 30 July 2010

Wetland M

27.5
subtotal first page

Metric 5. Special Wetlands.

0	27.5
max 10 pts.	subtotal

Check all that apply and score as indicated.

- [ ] Bog (10)
- [ ] Fen (10)
- [ ] Old growth forest (10)
- [ ] Mature forested wetland (5)
- [ ] Lake Erie coastal/tributary wetland-unrestricted hydrology (10)
- [ ] Lake Erie coastal/tributary wetland-restricted hydrology (5)
- [ ] Lake Plain Sand Prairies (Oak Openings) (10)
- [ ] Relict Wet Prairies (10)
- [ ] Known occurrence state/federal threatened or endangered species (10)
- [ ] Significant migratory songbird/water fowl habitat or usage (10)
- [ ] Category 1 Wetland. See Question 1 Qualitative Rating (-10)

Metric 6. Plant communities, interspersion, microtopography.

-2	25.5
max 20 pts.	subtotal

6a. Wetland Vegetation Communities.
Score all present using 0 to 3 scale.

- [ ] Aquatic bed
- [1] Emergent
- [ ] Shrub
- [ ] Forest
- [ ] Mudflats
- [ ] Open water
- [ ] Other_____

6b. horizontal (plan view) Interspersion.
Select only one.

- [ ] High (5)
- [ ] Moderately high(4)
- [ ] Moderate (3)
- [ ] Moderately low (2)
- [X] Low (1)
- [ ] None (0)

6c. Coverage of invasive plants. Refer to Table 1 ORAM long form for list. Add or deduct points for coverage

Typha angustifolia
Phragmites australis
Phalaris arundinacea

- [X] Extensive >75% cover (-5)
- [ ] Moderate 25-75% cover (-3)
- [ ] Sparse 5-25% cover (-1)
- [ ] Nearly absent <5% cover (0)
- [ ] Absent (1)

6d. Microtopography.
Score all present using 0 to 3 scale.

- [ ] Vegetated hummucks/tussucks
- [ ] Coarse woody debris >15cm (6in)
- [ ] Standing dead >25cm (10in) dbh
- [1] Amphibian breeding pools

Vegetation Community Cover Scale

0	Absent or comprises <0.1ha (0.2471 acres) contiguous area
1	Present and either comprises small part of wetland's vegetation and is of moderate quality, or comprises a significant part but is of low quality
2	Present and either comprises significant part of wetland's vegetation and is of moderate quality or comprises a small part and is of high quality
3	Present and comprises significant part, or more, of wetland's vegetation and is of high quality

Narrative Description of Vegetation Quality

low	Low spp diversity and/or predominance of nonnative or disturbance tolerant native species
mod	Native spp are dominant component of the vegetation, although nonnative and/or disturbance tolerant native spp can also be present, and species diversity moderate to moderately high, but generally w/o presence of rare threatened or endangered spp
high	A predominance of native species, with nonnative spp and/or disturbance tolerant native spp absent or virtually absent, and high spp diversity and often, but not always, the presence of rare, threatened, or endangered spp

Mudflat and Open Water Class Quality

0	Absent <0.1ha (0.247 acres)
1	Low 0.1 to <1ha (0.247 to 2.47 acres)
2	Moderate 1 to <4ha (2.47 to 9.88 acres)
3	High 4ha (9.88 acres) or more

Microtopography Cover Scale

0	Absent
1	Present very small amounts or if more common of marginal quality
2	Present in moderate amounts, but not of highest quality or in small amounts of highest quality
3	Present in moderate or greater amounts and of highest quality

25.5

End of Quantitative Rating. Complete Categorization Worksheets.

Category 1

Apex Sanitary Landfill
Wetland M
30 July 2010

ORAM Summary Worksheet

		circle answer or insert score	Result
Narrative Rating	Question 1 Critical Habitat	YES (NO)	If yes, Category 3.
	Question 2. Threatened or Endangered Species	YES (NO)	If yes, Category 3.
	Question 3. High Quality Natural Wetland	YES (NO)	If yes, Category 3.
	Question 4. Significant bird habitat	YES (NO)	If yes, Category 3.
	Question 5. Category 1 Wetlands	YES (NO)	If yes, Category 1.
	Question 6. Bogs	YES (NO)	If yes, Category 3.
	Question 7. Fens	YES (NO)	If yes, Category 3.
	Question 8a. Old Growth Forest	YES (NO)	If yes, Category 3.
	Question 8b. Mature Forested Wetland	YES (NO)	If yes, evaluate for Category 3; may also be 1 or 2.
	Question 9b. Lake Erie Wetlands - Restricted	YES (NO)	If yes, evaluate for Category 3; may also be 1 or 2.
	Question 9d. Lake Erie Wetlands – Unrestricted with native plants	YES NO	If yes, Category 3
	Question 9e. Lake Erie Wetlands - Unrestricted with invasive plants	YES NO	If yes, evaluate for Category 3; may also be 1 or 2.
	Question 10. Oak Openings	YES (NO)	If yes, Category 3
	Question 11. Relict Wet Prairies	YES (NO)	If yes, evaluate for Category 3; may also be 1 or 2.
Quantitative Rating	Metric 1. Size	2	
	Metric 2. Buffers and surrounding land use	4	
	Metric 3. Hydrology	15	
	Metric 4. Habitat	6.5	
	Metric 5. Special Wetland Communities	0	
	Metric 6. Plant communities, interspersion, microtopography	-2	
	TOTAL SCORE	25.5	Category based on score breakpoints Category 1

Complete Wetland Categorization Worksheet.

Apex Sanitary Landfill
Wetland M
30 July 2010

Wetland Categorization Worksheet

Choices	Circle one		Evaluation of Categorization Result of ORAM
Did you answer "Yes" to any of the following questions: Narrative Rating Nos. 2, 3, 4, 6, 7, 8a, 9d, 10	YES Wetland is categorized as a Category 3 wetland	NO	Is quantitative rating score *less* than the Category 2 scoring threshold (*excluding* gray zone)? If yes, reevaluate the category of the wetland using the narrative criteria in OAC Rule 3745-1-54(C) and biological and/or functional assessments to determine if the wetland has been over-categorized by the ORAM
Did you answer "Yes" to any of the following questions: Narrative Rating Nos. 1, 8b, 9b, 9e, 11	YES Wetland should be evaluated for possible Category 3 status	NO	Evaluate the wetland using the 1) narrative criteria in OAC Rule 3745-1-54(C) and 2) the quantitative rating score. If the wetland is determined to be a Category 3 wetland using either of these, it should be categorized as a Category 3 wetland. Detailed biological and/or functional assessments may also be used to determine the wetland's category.
Did you answer "Yes" to Narrative Rating No. 5	YES Wetland is categorized as a Category 1 wetland	NO	Is quantitative rating score *greater* than the Category 2 scoring threshold *(including* any gray zone)? If yes, reevaluate the category of the wetland using the narrative criteria in OAC Rule 3745-1-54(C) and biological and/or functional assessments to determine if the wetland has been under-categorized by the ORAM
Does the quantitative score fall within the scoring range of a Category 1, 2, or 3 wetland?	YES Wetland is assigned to the appropriate category based on the scoring range	NO	If the score of the wetland is located within the scoring range for a particular category, the wetland should be assigned to that category. In all instances however, the narrative criteria described in OAC Rule 3745-1-54(C) can be used to clarify or change a categorization based on a quantitative score.
Does the quantitative score fall with the *"gray zone"* for Category 1 or 2 or Category 2 or 3 wetlands?	YES Wetland is assigned to the higher of the two categories or assigned to a category based on detailed assessments and the narrative criteria	NO	Rater has the option of assigning the wetland to the higher of the two categories or to assign a category based on the results of a nonrapid wetland assessment method, e.g. functional assessment, biological assessment, etc, and a consideration of the narrative criteria in OAC rule 3745-1-54(C).
Does the wetland otherwise exhibit *moderate OR superior* hydrologic OR habitat, OR recreational functions AND the wetland was *not* categorized as a Category 2 wetland (in the case of moderate functions) or a Category 3 wetland (in the case of superior functions) by this method?	YES Wetland was undercategorized by this method. A written justification for recategorization should be provided on Background Information Form	NO Wetland is assigned to category as determined by the ORAM.	A wetland may be undercategorized using this method, but still exhibit one or more superior functions, e.g. a wetland's biotic communities may be degraded by human activities, but the wetland may still exhibit superior hydrologic functions because of its type, landscape position, size, local or regional significance, etc. In this circumstance, the narrative criteria in OAC Rule 3745-1-54(C)(2) and (3) are controlling, and the under-categorization should be corrected. A written justification with supporting reasons or information for this determination should be provided.

Final Category			
Choose one	Category 1	Category 2	Category 3

End of Ohio Rapid Assessment Method for Wetlands.

Background Information

Name:	Michael A. Takacs, Mark R. Haibach
Date:	30 July 2010
Affiliation:	Civil & Environmental Consultants, Inc.
Address:	333 Baldwin Road, Pittsburgh, PA 15205
Phone Number:	(412) 249-3188, (412) 249-3156
e-mail address:	mtakacs@cecinc.com, mhaibach@cecinc.com
Name of Wetland:	Wetland N
Vegetation Communit(ies):	PEM1, POW2/AB2
HGM Class(es):	SWD, GWD

Location of Wetland: include map, address, north arrow, landmarks, distances, roads, etc.

See Stream and Wetland Delineation Report, Figures 1 and 4.

Lat/Long or UTM Coordinate	
USGS Quad Name: Amsterdam, OH	
County: Jefferson / Harrison	
Township: Springfield	
Section and Subsection	
Hydrologic Unit Code: 05030101340	
Site Visit: 30 July 2010	
National Wetland Inventory Map: Amsterdam, OH	
Ohio Wetland Inventory Map: —	
Soil Survey: Soil Survey of Jefferson County, Ohio	
Delineation report/map: Wetland and Stream Delineation and Functional Assessment Report, Potential Apex Sanitary Landfill Expansion. CEC 2010.	

Name of Wetland: Wetland N

Wetland Size (acres, hectares): 0.44 ac wetland N + 0.42 ac. OW#5 = 0.86 acre

Sketch: Include north arrow, relationship with other surface waters, vegetation zones, etc.

See Stream and Wetland Delineation Map (Figure 4).

Comments, Narrative Discussion, Justification of Category Changes:

Final score : 43 Category: Mod. 2

Apex Sanitary Landfill
Wetland N
30 July 2010

Scoring Boundary Worksheet

INSTRUCTIONS. The initial step in completing the ORAM is to identify the "scoring boundaries" of the wetland being rated. In many instances this determination will be relatively easy and the scoring boundaries will coincide with the "jurisdictional boundaries." For example, the scoring boundary of an isolated cattail marsh located in the middle of a farm field will likely be the same as that wetland's jurisdictional boundaries. In other instances, however, the scoring boundary will not be as easily determined. Wetlands that are small or isolated from other surface waters often form large contiguous areas or heterogeneous complexes of wetland and upland. In separating wetlands for scoring purposes, the hydrologic regime of the wetland is the main criterion that should be used. Boundaries between contiguous or connected wetlands should be established where the volume, flow, or velocity of water moving through the wetland changes significantly. *Areas with a high degree of hydrologic interaction should be scored as a single wetland.* In determining a wetland's scoring boundaries, use the guidelines in the ORAM Manual Section 5.0. In certain instances, it may be difficult to establish the scoring boundary for the wetland being rated. These problem situations include wetlands that form a patchwork on the landscape, wetlands divided by artificial boundaries like property fences, roads, or railroad embankments, wetlands that are contiguous with streams, lakes, or rivers, and estuarine or coastal wetlands. These situations are discussed below, however, it is recommended that Rater contact Ohio EPA, Division of Surface Water, 401/Wetlands Section if there are additional questions or a need for further clarification of the appropriate scoring boundaries of a particular wetland.

#	Steps in properly establishing scoring boundaries	done?	not applicable
Step 1	Identify the wetland area of interest. This may be the site of a proposed impact, a reference site, conservation site, etc.	Yes	
Step 2	Identify the locations where there is physical evidence that hydrology changes rapidly. Such evidence includes both natural and human-induced changes including, constrictions caused by berms or dikes, points where the water velocity changes rapidly at rapids or falls, points where significant inflows occur at the confluence of rivers, or other factors that may restrict hydrologic interaction between the wetlands or parts of a single wetland.	Yes	
Step 3	Delineate the boundary of the wetland to be rated such that all areas of interest that are contiguous to and within the areas where the hydrology does not change significantly, i.e. areas that have a high degree of hydrologic interaction are included within the scoring boundary.	Yes	
Step 4	Determine if artificial boundaries, such as property lines, state lines, roads, railroad embankments, etc., are present. These should not be used to establish scoring boundaries unless they coincide with areas where the hydrologic regime changes.	Yes	
Step 5	In all instances, the Rater may enlarge the minimum scoring boundaries discussed here to score together wetlands that could be scored separately.	Yes	
Step 6	Consult ORAM Manual Section 5.0 for how to establish scoring boundaries for wetlands that form a patchwork on the landscape, divided by artificial boundaries, contiguous to streams, lakes or rivers, or for dual classifications.	Yes	

End of Scoring Boundary Determination. Begin Narrative Rating on next page.

Apex Sanitary Landfill
Wetland A
30 July 2010

Narrative Rating

INSTRUCTIONS. Answer each of the following questions. Questions 1, 2, 3 and 4 should be answered based on information obtained from the site visit or the literature *and* by submitting a Data Services Request to the Ohio Department of Natural Resources, Division of Natural Areas and Preserves, Natural Heritage Data Services, 1889 Fountain Square Court, Building F-1, Columbus, Ohio 43224, 614-265-6453 (phone), 614-265-3096 (fax), http://www.dnr.state.oh.us/dnap . The remaining questions are designed to be answered primarily by the results of the site visit. Refer to the User's Manual for descriptions of these wetland types. Note: "Critical habitat" is legally defined in the Endangered Species Act and is the geographic area containing physical or biological features essential to the conservation of a listed species or as an area that may require special management considerations or protection. The Rater should contact the Region 3 Headquarters or the Columbus Ecological Services Office for updates as to whether critical habitat has been designated for other federally listed threatened or endangered species. "Documented" means the wetland is listed in the appropriate State of Ohio database.

#	Question	Circle one	
1	**Critical Habitat.** Is the wetland in a township, section, or subsection of a United States Geological Survey 7.5 minute Quadrangle that has been designated by the U.S. Fish and Wildlife Service as "critical habitat" for any threatened or endangered plant or animal species? Note: as of January 1, 2001, of the federally listed endangered or threatened species which can be found in Ohio, the Indiana Bat has had critical habitat designated (50 CFR 17.95(a)) and the piping plover has had critical habitat proposed (65 FR 41812 July 6, 2000).	YES Wetland should be evaluated for possible Category 3 status Go to Question 2	(NO) Go to Question 2
2	**Threatened or Endangered Species.** Is the wetland known to contain an individual of, or documented occurrences of federal or state-listed threatened or endangered plant or animal species?	YES Wetland is a Category 3 wetland. Go to Question 3	(NO) Go to Question 3
3	**Documented High Quality Wetland.** Is the wetland on record in Natural Heritage Database as a high quality wetland?	YES Wetland is a Category 3 wetland Go to Question 4	(NO) Go to Question 4
4	**Significant Breeding or Concentration Area.** Does the wetland contain documented regionally significant breeding or nonbreeding waterfowl, neotropical songbird, or shorebird concentration areas?	YES Wetland is a Category 3 wetland Go to Question 5	(NO) Go to Question 5
5	**Category 1 Wetlands.** Is the wetland less than 0.5 hectares (1 acre) in size and **hydrologically isolated** and either 1) comprised of vegetation that is dominated (greater than eighty per cent areal cover) by *Phalaris arundinacea, Lythrum salicaria,* or *Phragmites australis*, or 2) an acidic pond created or excavated on mined lands that has little or no vegetation?	YES Wetland is a Category 1 wetland Go to Question 6	(NO) Go to Question 6
6	**Bogs.** Is the wetland a peat-accumulating wetland that 1) has no significant inflows or outflows, 2) supports acidophilic mosses, particularly *Sphagnum* spp., 3) the acidophilic mosses have >30% cover, 4) at least one species from Table 1 is present, and 5) the cover of invasive species (see Table 1) is <25%?	YES Wetland is a Category 3 wetland Go to Question 7	(NO) Go to Question 7
7	**Fens.** Is the wetland a carbon accumulating (peat, muck) wetland that is saturated during most of the year, primarily by a discharge of free flowing, mineral rich, ground water with a circumneutral ph (5.5-9.0) and with one or more plant species listed in Table 1 and the cover of invasive species listed in Table 1 is <25%?	YES Wetland is a Category 3 wetland Go to Question 8a	(NO) Go to Question 8a
8a	**"Old Growth Forest."** Is the wetland a forested wetland and is the forest characterized by, but not limited to, the following characteristics: overstory canopy trees of great age (exceeding at least 50% of a projected maximum attainable age for a species); little or no evidence of human-caused understory disturbance during the past 80 to 100 years; an all-aged structure and multilayered canopies; aggregations of canopy trees interspersed with canopy gaps; and significant numbers of standing dead snags and downed logs?	YES Wetland is a Category 3 wetland. Go to Question 8b	(NO) Go to Question 8b

8b	**Mature forested wetlands.** Is the wetland a forested wetland with 50% or more of the cover of upper forest canopy consisting of deciduous trees with large diameters at breast height (dbh), generally diameters greater than 45cm (17.7in) dbh?	YES Wetland should be evaluated for possible Category 3 status. Go to Question 9a	NO Go to Question 9a
9a	**Lake Erie coastal and tributary wetlands.** Is the wetland located at an elevation less than 575 feet on the USGS map, adjacent to this elevation, or along a tributary to Lake Erie that is accessible to fish?	YES Go to Question 9b	NO Go to Question 10
9b	Does the wetland's hydrology result from measures designed to prevent erosion and the loss of aquatic plants, i.e. the wetland is partially hydrologically restricted from Lake Erie due to lakeward or landward dikes or other hydrological controls?	YES Wetland should be evaluated for possible Category 3 status Go to Question 10	NO Go to Question 9c
9c	Are Lake Erie water levels the wetland's primary hydrological influence, i.e. the wetland is hydrologically unrestricted (no lakeward or upland border alterations), or the wetland can be characterized as an "estuarine" wetland with lake and river influenced hydrology. These include sandbar deposition wetlands, estuarine wetlands, river mouth wetlands, or those dominated by submersed aquatic vegetation.	YES Go to Question 9d	NO Go to Question 10
9d	Does the wetland have a predominance of native species within its vegetation communities, although non-native or disturbance tolerant native species can also be present?	YES Wetland is a Category 3 wetland Go to Question 10	NO Go to Question 9e
9e	Does the wetland have a predominance of non-native or disturbance tolerant native plant species within its vegetation communities?	YES Wetland should be evaluated for possible Category 3 status Go to Question 10	NO Go to Question 10
10	**Lake Plain Sand Prairies (Oak Openings)** Is the wetland located in Lucas, Fulton, Henry, or Wood Counties and can the wetland be characterized by the following description: the wetland has a sandy substrate with interspersed organic matter, a water table often within several inches of the surface, and often with a dominance of the gramineous vegetation listed in Table 1 (woody species may also be present). The Ohio Department of Natural Resources Division of Natural Areas and Preserves can provide assistance in confirming this type of wetland and its quality.	YES Wetland is a Category 3 wetland. Go to Question 11	NO Go to Question 11
11	**Relict Wet Prairies.** Is the wetland a relict wet prairie community dominated by some or all of the species in Table 1. Extensive prairies were formerly located in the Darby Plains (Madison and Union Counties), Sandusky Plains (Wyandot, Crawford, and Marion Counties), northwest Ohio (e.g. Erie, Huron, Lucas, Wood Counties), and portions of western Ohio Counties (e.g. Darke, Mercer, Miami, Montgomery, Van Wert etc.).	YES Wetland should be evaluated for possible Category 3 status Complete Quantitative Rating	NO Complete Quantitative Rating

Table 1. Characteristic plant species.

invasive/exotic spp	fen species	bog species	0ak Opening species	wet prairie species
Lythrum salicaria	*Zygadenus elegans var. glaucus*	*Calla palustris*	*Carex cryptolepis*	*Calamagrostis canadensis*
Myriophyllum spicatum	*Cacalia plantaginea*	*Carex atlantica var. capillacea*	*Carex lasiocarpa*	*Calamogrostis stricta*
Najas minor	*Carex flava*	*Carex echinata*	*Carex stricta*	*Carex atherodes*
Phalaris arundinacea	*Carex sterilis*	*Carex oligosperma*	*Cladium mariscoides*	*Carex buxbaumii*
Phragmites australis	*Carex stricta*	*Carex trisperma*	*Calamagrostis stricta*	*Carex pellita*
Potamogeton crispus	*Deschampsia caespitosa*	*Chamaedaphne calyculata*	*Calamagrostis canadensis*	*Carex sartwellii*
Ranunculus ficaria	*Eleocharis rostellata*	*Decodon verticillatus*	*Quercus palustris*	*Gentiana andrewsii*
Rhamnus frangula	*Eriophorum viridicarinatum*	*Eriophorum virginicum*		*Helianthus grosseserratus*
Typha angustifolia	*Gentianopsis spp.*	*Larix laricina*		*Liatris spicata*
Typha xglauca	*Lobelia kalmii*	*Nemopanthus mucronatus*		*Lysimachia quadriflora*
	Parnassia glauca	*Schechzeria palustris*		*Lythrum alatum*
	Potentilla fruticosa	*Sphagnum spp.*		*Pycnanthemum virginianum*
	Rhamnus alnifolia	*Vaccinium macrocarpon*		*Silphium terebinthinaceum*
	Rhynchospora capillacea	*Vaccinium corymbosum*		*Sorghastrum nutans*
	Salix candida	*Vaccinium oxycoccos*		*Spartina pectinata*
	Salix myricoides	*Woodwardia virginica*		*Solidago riddellii*
	Salix serissima	*Xyris difformis*		
	Solidago ohioensis			
	Tofieldia glutinosa			
	Triglochin maritimum			
	Triglochin palustre			

End of Narrative Rating. Begin Quantitative Rating on next page.

ORAM v. 5.0 Field Form Quantitative Rating

Site: Apex Sanitary Landfill, Amsterdam OH | Rater(s): Mike A. Tkac, Mark Haibach | Date: 30 July 2010

Wetland N

Metric 1. Wetland Area (size).

2 / 2 (max 6 pts. / subtotal)

Select one size class and assign score.

- [ ] >50 acres (>20.2ha) (6 pts)
- [ ] 25 to <50 acres (10.1 to <20.2ha) (5 pts)
- [ ] 10 to <25 acres (4 to <10.1ha) (4 pts)
- [ ] 3 to <10 acres (1.2 to <4ha) (3 pts)
- [x] 0.3 to <3 acres (0.12 to <1.2ha) (2pts)
- [ ] 0.1 to <0.3 acres (0.04 to <0.12ha) (1 pt)
- [ ] <0.1 acres (0.04ha) (0 pts)

0.44 ac. Wetland N + 0.42 ac. Open Water 5 = 0.86 acre

Metric 2. Upland buffers and surrounding land use.

8 / 10 (max 14 pts. / subtotal)

2a. Calculate average buffer width. Select only one and assign score. Do not double check.

- [ ] WIDE. Buffers average 50m (164ft) or more around wetland perimeter (7)
- [x] MEDIUM. Buffers average 25m to <50m (82 to <164ft) around wetland perimeter (4)
- [ ] NARROW. Buffers average 10m to <25m (32ft to <82ft) around wetland perimeter (1)
- [ ] VERY NARROW. Buffers average <10m (<32ft) around wetland perimeter (0)

$\bar{X} = 123'$

2b. Intensity of surrounding land use. Select one or double check and average.

- [ ] VERY LOW. 2nd growth or older forest, prairie, savannah, wildlife area, etc. (7)
- [x] LOW. Old field (>10 years), shrub land, young second growth forest. (5)
- [x] MODERATELY HIGH. Residential, fenced pasture, park, conservation tillage, new fallow field. (3)
- [ ] HIGH. Urban, industrial, open pasture, row cropping, mining, construction. (1)

4 pts.

Metric 3. Hydrology.

17 / 27 (max 30 pts. / subtotal)

3a. Sources of Water. Score all that apply.

- [ ] High pH groundwater (5)
- [x] Other groundwater (3)
- [x] Precipitation (1)
- [ ] Seasonal/Intermittent surface water (3)
- [ ] Perennial surface water (lake or stream) (5)

3b. Connectivity. Score all that apply.

- [ ] 100 year floodplain (1)
- [ ] Between stream/lake and other human use (1)
- [x] Part of wetland/upland (e.g. forest), complex (1)
- [ ] Part of riparian or upland corridor (1)

3c. Maximum water depth. Select only one and assign score.

- [x] >0.7 (27.6in) (3)
- [ ] 0.4 to 0.7m (15.7 to 27.6in) (2)
- [ ] <0.4m (<15.7in) (1)

3d. Duration inundation/saturation. Score one or dbl check.

- [x] Semi- to permanently inundated/saturated (4)
- [ ] Regularly inundated/saturated (3)
- [ ] Seasonally inundated (2)
- [ ] Seasonally saturated in upper 30cm (12in) (1)

3e. Modifications to natural hydrologic regime. Score one or double check and average.

- [ ] None or none apparent (12)
- [x] Recovered (7)
- [x] Recovering (3)
- [ ] Recent or no recovery (1)

5 pts.

Check all disturbances observed

- [ ] ditch
- [ ] tile
- [ ] dike
- [ ] weir
- [ ] stormwater input
- [ ] point source (nonstormwater)
- [x] filling/grading
- [ ] road bed/RR track
- [x] dredging
- [x] other past mining

Metric 4. Habitat Alteration and Development.

9 / 36 (max 20 pts. / subtotal)

4a. Substrate disturbance. Score one or double check and average.

- [ ] None or none apparent (4)
- [ ] Recovered (3)
- [x] Recovering (2)
- [x] Recent or no recovery (1)

1.5 mine spoil, eroded sediment

4b. Habitat development. Select only one and assign score.

- [ ] Excellent (7)
- [ ] Very good (6)
- [ ] Good (5)
- [ ] Moderately good (4)
- [x] Fair (3)
- [ ] Poor to fair (2)
- [ ] Poor (1)

4c. Habitat alteration. Score one or double check and average.

- [ ] None or none apparent (9)
- [x] Recovered (6)
- [x] Recovering (3)
- [ ] Recent or no recovery (1)

4.5 pts.

Check all disturbances observed

- [ ] mowing
- [ ] grazing
- [ ] clearcutting
- [ ] selective cutting
- [ ] woody debris removal
- [ ] toxic pollutants
- [ ] shrub/sapling removal
- [ ] herbaceous/aquatic bed removal
- [x] sedimentation spoil
- [ ] dredging
- [ ] farming
- [ ] nutrient enrichment

x past mining

36 (subtotal this page)

last revised 1 February 2001 jjm

Site: Apex Sanitary Land Fill, Amsterdam, OH Rater(s): Mike A. Takacs, Mark Kaisbeck Date: 30 July 2010

Wetland N

36
subtotal first page

Metric 5. Special Wetlands.

0	36
max 10 pts.	subtotal

Check all that apply and score as indicated.

- [ ] Bog (10)
- [ ] Fen (10)
- [ ] Old growth forest (10)
- [ ] Mature forested wetland (5)
- [ ] Lake Erie coastal/tributary wetland-unrestricted hydrology (10)
- [ ] Lake Erie coastal/tributary wetland-restricted hydrology (5)
- [ ] Lake Plain Sand Prairies (Oak Openings) (10)
- [ ] Relict Wet Prairies (10)
- [ ] Known occurrence state/federal threatened or endangered species (10)
- [ ] Significant migratory songbird/water fowl habitat or usage (10)
- [ ] Category 1 Wetland. See Question 1 Qualitative Rating (-10)

Metric 6. Plant communities, interspersion, microtopography.

7	43
max 20 pts.	subtotal

6a. Wetland Vegetation Communities.
Score all present using 0 to 3 scale.

- [1] Aquatic bed
- [1] Emergent
- [ ] Shrub
- [ ] Forest
- [ ] Mudflats
- [1] Open water
- [ ] Other_____

6b. horizontal (plan view) Interspersion.
Select only one.

- [ ] High (5)
- [ ] Moderately high(4)
- [ ] Moderate (3)
- [ ] Moderately low (2)
- [X] Low (1)
- [ ] None (0)

6c. Coverage of invasive plants. Refer to Table 1 ORAM long form for list. Add or deduct points for coverage

- [ ] Extensive >75% cover (-5)
- [ ] Moderate 25-75% cover (-3)
- [ ] Sparse 5-25% cover (-1)
- [ ] Nearly absent <5% cover (0)
- [X] Absent (1)

6d. Microtopography.
Score all present using 0 to 3 scale.

- [ ] Vegetated hummucks/tussucks
- [1] Coarse woody debris >15cm (6in)
- [ ] Standing dead >25cm (10in) dbh
- [1] Amphibian breeding pools

Vegetation Community Cover Scale

0	Absent or comprises <0.1ha (0.2471 acres) contiguous area
1	Present and either comprises small part of wetland's vegetation and is of moderate quality, or comprises a significant part but is of low quality
2	Present and either comprises significant part of wetland's vegetation and is of moderate quality or comprises a small part and is of high quality
3	Present and comprises significant part, or more, of wetland's vegetation and is of high quality

Narrative Description of Vegetation Quality

low	Low spp diversity and/or predominance of nonnative or disturbance tolerant native species
mod	Native spp are dominant component of the vegetation, although nonnative and/or disturbance tolerant native spp can also be present, and species diversity moderate to moderately high, but generally w/o presence of rare threatened or endangered spp
high	A predominance of native species, with nonnative spp and/or disturbance tolerant native spp absent or virtually absent, and high spp diversity and often, but not always, the presence of rare, threatened, or endangered spp

Mudflat and Open Water Class Quality

0	Absent <0.1ha (0.247 acres)
1	Low 0.1 to <1ha (0.247 to 2.47 acres)
2	Moderate 1 to <4ha (2.47 to 9.88 acres)
3	High 4ha (9.88 acres) or more

Microtopography Cover Scale

0	Absent
1	Present very small amounts or if more common of marginal quality
2	Present in moderate amounts, but not of highest quality or in small amounts of highest quality
3	Present in moderate or greater amounts and of highest quality

43

End of Quantitative Rating. Complete Categorization Worksheets.

Modified Category 2

Apex Sanitary LandFill
Wetland N
30 July 2010

ORAM Summary Worksheet

		circle answer or insert score	Result
Narrative Rating	Question 1 Critical Habitat	YES (NO)	If yes, Category 3.
	Question 2. Threatened or Endangered Species	YES (NO)	If yes, Category 3.
	Question 3. High Quality Natural Wetland	YES (NO)	If yes, Category 3.
	Question 4. Significant bird habitat	YES (NO)	If yes, Category 3.
	Question 5. Category 1 Wetlands	YES (NO)	If yes, Category 1.
	Question 6. Bogs	YES (NO)	If yes, Category 3.
	Question 7. Fens	YES (NO)	If yes, Category 3.
	Question 8a. Old Growth Forest	YES (NO)	If yes, Category 3.
	Question 8b. Mature Forested Wetland	YES (NO)	If yes, evaluate for Category 3; may also be 1 or 2.
	Question 9b. Lake Erie Wetlands - Restricted	YES (NO)	If yes, evaluate for Category 3; may also be 1 or 2.
	Question 9d. Lake Erie Wetlands – Unrestricted with native plants	YES NO	If yes, Category 3
	Question 9e. Lake Erie Wetlands - Unrestricted with invasive plants	YES NO	If yes, evaluate for Category 3; may also be 1 or 2.
	Question 10. Oak Openings	YES (NO)	If yes, Category 3
	Question 11. Relict Wet Prairies	YES (NO)	If yes, evaluate for Category 3; may also be 1 or 2.
Quantitative Rating	Metric 1. Size	2	
	Metric 2. Buffers and surrounding land use	8	
	Metric 3. Hydrology	17	
	Metric 4. Habitat	9	
	Metric 5. Special Wetland Communities	0	
	Metric 6. Plant communities, interspersion, microtopography	7	
	TOTAL SCORE	43	Category based on score breakpoints Modified Category 2

Complete Wetland Categorization Worksheet.

Apex Sanitary Land Fill
Wetland N
30 July 2010

Wetland Categorization Worksheet

Choices	Circle one		Evaluation of Categorization Result of ORAM
Did you answer "Yes" to any of the following questions: Narrative Rating Nos. 2, 3, 4, 6, 7, 8a, 9d, 10	YES Wetland is categorized as a Category 3 wetland	(NO)	Is quantitative rating score *less* than the Category 2 scoring threshold (*excluding* gray zone)? If yes, reevaluate the category of the wetland using the narrative criteria in OAC Rule 3745-1-54(C) and biological and/or functional assessments to determine if the wetland has been over-categorized by the ORAM
Did you answer "Yes" to any of the following questions: Narrative Rating Nos. 1, 8b, 9b, 9e, 11	YES Wetland should be evaluated for possible Category 3 status	(NO)	Evaluate the wetland using the 1) narrative criteria in OAC Rule 3745-1-54(C) and 2) the quantitative rating score. If the wetland is determined to be a Category 3 wetland using either of these, it should be categorized as a Category 3 wetland. Detailed biological and/or functional assessments may also be used to determine the wetland's category.
Did you answer "Yes" to Narrative Rating No. 5	YES Wetland is categorized as a Category 1 wetland	(NO)	Is quantitative rating score *greater* than the Category 2 scoring threshold *(including* any gray zone)? If yes, reevaluate the category of the wetland using the narrative criteria in OAC Rule 3745-1-54(C) and biological and/or functional assessments to determine if the wetland has been under-categorized by the ORAM
Does the quantitative score fall within the scoring range of a Category 1, 2, or 3 wetland?	(YES) Wetland is assigned to the appropriate category based on the scoring range	NO	If the score of the wetland is located within the scoring range for a particular category, the wetland should be assigned to that category. In all instances however, the narrative criteria described in OAC Rule 3745-1-54(C) can be used to clarify or change a categorization based on a quantitative score.
Does the quantitative score fall with the *"gray zone"* for Category 1 or 2 or Category 2 or 3 wetlands?	YES Wetland is assigned to the higher of the two categories or assigned to a category based on detailed assessments and the narrative criteria	(NO)	Rater has the option of assigning the wetland to the higher of the two categories or to assign a category based on the results of a nonrapid wetland assessment method, e.g. functional assessment, biological assessment, etc, and a consideration of the narrative criteria in OAC rule 3745-1-54(C).
Does the wetland otherwise exhibit *moderate OR superior* hydrologic OR habitat, OR recreational functions AND the wetland was *not* categorized as a Category 2 wetland (in the case of moderate functions) or a Category 3 wetland (in the case of superior functions) by this method?	YES Wetland was undercategorized by this method. A written justification for recategorization should be provided on Background Information Form	(NO) Wetland is assigned to category as determined by the ORAM.	A wetland may be undercategorized using this method, but still exhibit one or more superior functions, e.g. a wetland's biotic communities may be degraded by human activities, but the wetland may still exhibit superior hydrologic functions because of its type, landscape position, size, local or regional significance, etc. In this circumstance, the narrative criteria in OAC Rule 3745-1-54(C)(2) and (3) are controlling, and the under-categorization should be corrected. A written justification with supporting reasons or information for this determination should be provided.

Final Category

Choose one	Category 1	Category 2	Category 3

End of Ohio Rapid Assessment Method for Wetlands.

Background Information

Name:	Michael A. Takacs, Mark R. Haibach
Date:	30 July 2010
Affiliation:	Civil & Environmental Consultants, Inc.
Address:	333 Baldwin Road, Pittsburgh, PA 15205
Phone Number:	(412) 249-3188, (412) 249-3156
e-mail address:	mtakacs@cecinc.com, mhaibach@cecinc.com
Name of Wetland:	Wetland P
Vegetation Communit(ies):	PFO1/SS1, PSS1/EM1, POW2
HGM Class(es):	SWD, GWD, GWS

Location of Wetland: include map, address, north arrow, landmarks, distances, roads, etc.

See stream and wetland Delineation Report, Figures 1 and 4.

Lat/Long or UTM Coordinate	
USGS Quad Name: Amsterdam, OH	
County: Jefferson / Harrison	
Township: Springfield	
Section and Subsection	
Hydrologic Unit Code: 05030101340	
Site Visit: 30 July 2010	
National Wetland Inventory Map: Amsterdam, OH	
Ohio Wetland Inventory Map: —	
Soil Survey: Soil Survey of Jefferson County, Ohio	
Delineation report/map: Wetland and Stream Delineation and Functional Assessment Report, Potential Apex Sanitary Landfill Expansion. CEC 2010.	

Name of Wetland: Wetland P	
Wetland Size (acres, hectares): >10 acres	

Sketch: Include north arrow, relationship with other surface waters, vegetation zones, etc.

See Stream and Wetland Delineation Map (Figure 4)

Comments, Narrative Discussion, Justification of Category Changes:

Final score : 53	Category: 2

Apex Sanitary Landfill
Wetland P
30 July 2010

Scoring Boundary Worksheet

INSTRUCTIONS. The initial step in completing the ORAM is to identify the "scoring boundaries" of the wetland being rated. In many instances this determination will be relatively easy and the scoring boundaries will coincide with the "jurisdictional boundaries." For example, the scoring boundary of an isolated cattail marsh located in the middle of a farm field will likely be the same as that wetland's jurisdictional boundaries. In other instances, however, the scoring boundary will not be as easily determined. Wetlands that are small or isolated from other surface waters often form large contiguous areas or heterogeneous complexes of wetland and upland. In separating wetlands for scoring purposes, the hydrologic regime of the wetland is the main criterion that should be used. Boundaries between contiguous or connected wetlands should be established where the volume, flow, or velocity of water moving through the wetland changes significantly. *Areas with a high degree of hydrologic interaction should be scored as a single wetland.* In determining a wetland's scoring boundaries, use the guidelines in the ORAM Manual Section 5.0. In certain instances, it may be difficult to establish the scoring boundary for the wetland being rated. These problem situations include wetlands that form a patchwork on the landscape, wetlands divided by artificial boundaries like property fences, roads, or railroad embankments, wetlands that are contiguous with streams, lakes, or rivers, and estuarine or coastal wetlands. These situations are discussed below, however, it is recommended that Rater contact Ohio EPA, Division of Surface Water, 401/Wetlands Section if there are additional questions or a need for further clarification of the appropriate scoring boundaries of a particular wetland.

#	Steps in properly establishing scoring boundaries	done?	not applicable
Step 1	Identify the wetland area of interest. This may be the site of a proposed impact, a reference site, conservation site, etc.	Yes	
Step 2	Identify the locations where there is physical evidence that hydrology changes rapidly. Such evidence includes both natural and human-induced changes including, constrictions caused by berms or dikes, points where the water velocity changes rapidly at rapids or falls, points where significant inflows occur at the confluence of rivers, or other factors that may restrict hydrologic interaction between the wetlands or parts of a single wetland.	Yes	
Step 3	Delineate the boundary of the wetland to be rated such that all areas of interest that are contiguous to and within the areas where the hydrology does not change significantly, i.e. areas that have a high degree of hydrologic interaction are included within the scoring boundary.	Yes	
Step 4	Determine if artificial boundaries, such as property lines, state lines, roads, railroad embankments, etc., are present. These should not be used to establish scoring boundaries unless they coincide with areas where the hydrologic regime changes.	Yes	
Step 5	In all instances, the Rater may enlarge the minimum scoring boundaries discussed here to score together wetlands that could be scored separately.	Yes	
Step 6	Consult ORAM Manual Section 5.0 for how to establish scoring boundaries for wetlands that form a patchwork on the landscape, divided by artificial boundaries, contiguous to streams, lakes or rivers, or for dual classifications.	Yes	

End of Scoring Boundary Determination. Begin Narrative Rating on next page.

Apex Sanitary Land Fill
Wetland P

Narrative Rating

30 July 2010

INSTRUCTIONS. Answer each of the following questions. Questions 1, 2, 3 and 4 should be answered based on information obtained from the site visit or the literature *and* by submitting a Data Services Request to the Ohio Department of Natural Resources, Division of Natural Areas and Preserves, Natural Heritage Data Services, 1889 Fountain Square Court, Building F-1, Columbus, Ohio 43224, 614-265-6453 (phone), 614-265-3096 (fax), http://www.dnr.state.oh.us/dnap . The remaining questions are designed to be answered primarily by the results of the site visit. Refer to the User's Manual for descriptions of these wetland types. Note: "Critical habitat" is legally defined in the Endangered Species Act and is the geographic area containing physical or biological features essential to the conservation of a listed species or as an area that may require special management considerations or protection. The Rater should contact the Region 3 Headquarters or the Columbus Ecological Services Office for updates as to whether critical habitat has been designated for other federally listed threatened or endangered species. "Documented" means the wetland is listed in the appropriate State of Ohio database.

#	Question	Circle one	
1	**Critical Habitat.** Is the wetland in a township, section, or subsection of a United States Geological Survey 7.5 minute Quadrangle that has been designated by the U.S. Fish and Wildlife Service as "critical habitat" for any threatened or endangered plant or animal species? Note: as of January 1, 2001, of the federally listed endangered or threatened species which can be found in Ohio, the Indiana Bat has had critical habitat designated (50 CFR 17.95(a)) and the piping plover has had critical habitat proposed (65 FR 41812 July 6, 2000).	YES Wetland should be evaluated for possible Category 3 status Go to Question 2	(NO) Go to Question 2
2	**Threatened or Endangered Species.** Is the wetland known to contain an individual of, or documented occurrences of federal or state-listed threatened or endangered plant or animal species?	YES Wetland is a Category 3 wetland. Go to Question 3	(NO) Go to Question 3
3	**Documented High Quality Wetland.** Is the wetland on record in Natural Heritage Database as a high quality wetland?	YES Wetland is a Category 3 wetland Go to Question 4	(NO) Go to Question 4
4	**Significant Breeding or Concentration Area.** Does the wetland contain documented regionally significant breeding or nonbreeding waterfowl, neotropical songbird, or shorebird concentration areas?	YES Wetland is a Category 3 wetland Go to Question 5	(NO) Go to Question 5
5	**Category 1 Wetlands.** Is the wetland less than 0.5 hectares (1 acre) in size and **hydrologically isolated** and either 1) comprised of vegetation that is dominated (greater than eighty per cent areal cover) by *Phalaris arundinacea, Lythrum salicaria,* or *Phragmites australis*, or 2) an acidic pond created or excavated on mined lands that has little or no vegetation?	YES Wetland is a Category 1 wetland Go to Question 6	(NO) Go to Question 6
6	**Bogs.** Is the wetland a peat-accumulating wetland that 1) has no significant inflows or outflows, 2) supports acidophilic mosses, particularly *Sphagnum* spp., 3) the acidophilic mosses have >30% cover, 4) at least one species from Table 1 is present, and 5) the cover of invasive species (see Table 1) is <25%?	YES Wetland is a Category 3 wetland Go to Question 7	(NO) Go to Question 7
7	**Fens.** Is the wetland a carbon accumulating (peat, muck) wetland that is saturated during most of the year, primarily by a discharge of free flowing, mineral rich, ground water with a circumneutral ph (5.5-9.0) and with one or more plant species listed in Table 1 and the cover of invasive species listed in Table 1 is <25%?	YES Wetland is a Category 3 wetland Go to Question 8a	(NO) Go to Question 8a
8a	**"Old Growth Forest."** Is the wetland a forested wetland and is the forest characterized by, but not limited to, the following characteristics: overstory canopy trees of great age (exceeding at least 50% of a projected maximum attainable age for a species); little or no evidence of human-caused understory disturbance during the past 80 to 100 years; an all-aged structure and multilayered canopies; aggregations of canopy trees interspersed with canopy gaps; and significant numbers of standing dead snags and downed logs?	YES Wetland is a Category 3 wetland. Go to Question 8b	(NO) Go to Question 8b

8b	**Mature forested wetlands**. Is the wetland a forested wetland with 50% or more of the cover of upper forest canopy consisting of deciduous trees with large diameters at breast height (dbh), generally diameters greater than 45cm (17.7in) dbh?	YES Wetland should be evaluated for possible Category 3 status. Go to Question 9a	NO Go to Question 9a
9a	**Lake Erie coastal and tributary wetlands.** Is the wetland located at an elevation less than 575 feet on the USGS map, adjacent to this elevation, or along a tributary to Lake Erie that is accessible to fish?	YES Go to Question 9b	NO Go to Question 10
9b	Does the wetland's hydrology result from measures designed to prevent erosion and the loss of aquatic plants, i.e. the wetland is partially hydrologically restricted from Lake Erie due to lakeward or landward dikes or other hydrological controls?	YES Wetland should be evaluated for possible Category 3 status Go to Question 10	NO Go to Question 9c
9c	Are Lake Erie water levels the wetland's primary hydrological influence, i.e. the wetland is hydrologically unrestricted (no lakeward or upland border alterations), or the wetland can be characterized as an "estuarine" wetland with lake and river influenced hydrology. These include sandbar deposition wetlands, estuarine wetlands, river mouth wetlands, or those dominated by submersed aquatic vegetation.	YES Go to Question 9d	NO Go to Question 10
9d	Does the wetland have a predominance of native species within its vegetation communities, although non-native or disturbance tolerant native species can also be present?	YES Wetland is a Category 3 wetland Go to Question 10	NO Go to Question 9e
9e	Does the wetland have a predominance of non-native or disturbance tolerant native plant species within its vegetation communities?	YES Wetland should be evaluated for possible Category 3 status Go to Question 10	NO Go to Question 10
10	**Lake Plain Sand Prairies (Oak Openings)** Is the wetland located in Lucas, Fulton, Henry, or Wood Counties and can the wetland be characterized by the following description: the wetland has a sandy substrate with interspersed organic matter, a water table often within several inches of the surface, and often with a dominance of the gramineous vegetation listed in Table 1 (woody species may also be present). The Ohio Department of Natural Resources Division of Natural Areas and Preserves can provide assistance in confirming this type of wetland and its quality.	YES Wetland is a Category 3 wetland. Go to Question 11	NO Go to Question 11
11	**Relict Wet Prairies**. Is the wetland a relict wet prairie community dominated by some or all of the species in Table 1. Extensive prairies were formerly located in the Darby Plains (Madison and Union Counties), Sandusky Plains (Wyandot, Crawford, and Marion Counties), northwest Ohio (e.g. Erie, Huron, Lucas, Wood Counties), and portions of western Ohio Counties (e.g. Darke, Mercer, Miami, Montgomery, Van Wert etc.).	YES Wetland should be evaluated for possible Category 3 status Complete Quantitative Rating	NO Complete Quantitative Rating

Table 1. Characteristic plant species.

invasive/exotic spp	fen species	bog species	0ak Opening species	wet prairie species
Lythrum salicaria	*Zygadenus elegans var. glaucus*	*Calla palustris*	*Carex cryptolepis*	*Calamagrostis canadensis*
Myriophyllum spicatum	*Cacalia plantaginea*	*Carex atlantica var. capillacea*	*Carex lasiocarpa*	*Calamogrostis stricta*
Najas minor	*Carex flava*	*Carex echinata*	*Carex stricta*	*Carex atherodes*
Phalaris arundinacea	*Carex sterilis*	*Carex oligosperma*	*Cladium mariscoides*	*Carex buxbaumii*
Phragmites australis	*Carex stricta*	*Carex trisperma*	*Calamagrostis stricta*	*Carex pellita*
Potamogeton crispus	*Deschampsia caespitosa*	*Chamaedaphne calyculata*	*Calamagrostis canadensis*	*Carex sartwellii*
Ranunculus ficaria	*Eleocharis rostellata*	*Decodon verticillatus*	*Quercus palustris*	*Gentiana andrewsii*
Rhamnus frangula	*Eriophorum viridicarinatum*	*Eriophorum virginicum*		*Helianthus grosseserratus*
Typha angustifolia	*Gentianopsis spp.*	*Larix laricina*		*Liatris spicata*
Typha xglauca	*Lobelia kalmii*	*Nemopanthus mucronatus*		*Lysimachia quadriflora*
	Parnassia glauca	*Schechzeria palustris*		*Lythrum alatum*
	Potentilla fruticosa	*Sphagnum spp.*		*Pycnanthemum virginianum*
	Rhamnus alnifolia	*Vaccinium macrocarpon*		*Silphium terebinthinaceum*
	Rhynchospora capillacea	*Vaccinium corymbosum*		*Sorghastrum nutans*
	Salix candida	*Vaccinium oxycoccos*		*Spartina pectinata*
	Salix myricoides	*Woodwardia virginica*		*Solidago riddellii*
	Salix serissima	*Xyris difformis*		
	Solidago ohioensis			
	Tofieldia glutinosa			
	Triglochin maritimum			
	Triglochin palustre			

End of Narrative Rating. Begin Quantitative Rating on next page.

Site: Apex Sanitary Landfill, Amsterdam, OH Rater(s): Mike A. Takacs, Mark Haibach Date: 30 July 2010

Wetland P

Metric 1. Wetland Area (size).

4 | 4 (max 6 pts. | subtotal)

Select one size class and assign score.

- [ ] >50 acres (>20.2ha) (6 pts)
- [ ] 25 to <50 acres (10.1 to <20.2ha) (5 pts)
- [X] 10 to <25 acres (4 to <10.1ha) (4 pts) > 10 ac., < 25 ac.
- [ ] 3 to <10 acres (1.2 to <4ha) (3 pts)
- [ ] 0.3 to <3 acres (0.12 to <1.2ha) (2pts)
- [ ] 0.1 to <0.3 acres (0.04 to <0.12ha) (1 pt)
- [ ] <0.1 acres (0.04ha) (0 pts)

Metric 2. Upland buffers and surrounding land use.

10 | 14 (max 14 pts. | subtotal)

2a. Calculate average buffer width. Select only one and assign score. Do not double check.

- [ ] WIDE. Buffers average 50m (164ft) or more around wetland perimeter (7)
- [X] MEDIUM. Buffers average 25m to <50m (82 to <164ft) around wetland perimeter (4) $\bar{X} = 125'$
- [ ] NARROW. Buffers average 10m to <25m (32ft to <82ft) around wetland perimeter (1)
- [ ] VERY NARROW. Buffers average <10m (<32ft) around wetland perimeter (0)

2b. Intensity of surrounding land use. Select one or double check and average.

- [X] VERY LOW. 2nd growth or older forest, prairie, savannah, wildlife area, etc. (7) 6 pts.
- [X] LOW. Old field (>10 years), shrub land, young second growth forest. (5)
- [ ] MODERATELY HIGH. Residential, fenced pasture, park, conservation tillage, new fallow field. (3)
- [ ] HIGH. Urban, industrial, open pasture, row cropping, mining, construction. (1)

Metric 3. Hydrology.

17 | 31 (max 30 pts. | subtotal)

3a. Sources of Water. Score all that apply.

- [ ] High pH groundwater (5)
- [X] Other groundwater (3)
- [X] Precipitation (1)
- [X] Seasonal/Intermittent surface water (3)
- [ ] Perennial surface water (lake or stream) (5)

3b. Connectivity. Score all that apply.

- [ ] 100 year floodplain (1)
- [ ] Between stream/lake and other human use (1)
- [X] Part of wetland/upland (e.g. forest), complex (1)
- [ ] Part of riparian or upland corridor (1)

3c. Maximum water depth. Select only one and assign score.

- [ ] >0.7 (27.6in) (3)
- [ ] 0.4 to 0.7m (15.7 to 27.6in) (2)
- [X] <0.4m (<15.7in) (1)

3d. Duration inundation/saturation. Score one or dbl check.

- [X] Semi- to permanently inundated/saturated (4)
- [ ] Regularly inundated/saturated (3)
- [X] Seasonally inundated (2) 3 pts.
- [ ] Seasonally saturated in upper 30cm (12in) (1)

3e. Modifications to natural hydrologic regime. Score one or double check and average.

- [ ] None or none apparent (12)
- [X] Recovered (7)
- [X] Recovering (3) 5 pts.
- [ ] Recent or no recovery (1)

Check all disturbances observed

- [ ] ditch
- [ ] tile
- [ ] dike
- [ ] weir
- [X] stormwater input
- [ ] point source (nonstormwater)
- [X] filling/grading
- [ ] road bed/RR track
- [ ] dredging
- [X] other past mining

Metric 4. Habitat Alteration and Development.

11 | 42 (max 20 pts. | subtotal)

4a. Substrate disturbance. Score one or double check and average.

- [ ] None or none apparent (4)
- [X] Recovered (3) 2.5 pts
- [X] Recovering (2)
- [ ] Recent or no recovery (1)

4b. Habitat development. Select only one and assign score.

- [ ] Excellent (7)
- [ ] Very good (6)
- [ ] Good (5)
- [X] Moderately good (4)
- [ ] Fair (3)
- [ ] Poor to fair (2)
- [ ] Poor (1)

4c. Habitat alteration. Score one or double check and average.

- [ ] None or none apparent (9)
- [X] Recovered (6) 4.5 pts
- [X] Recovering (3)
- [ ] Recent or no recovery (1)

Check all disturbances observed

- [ ] mowing
- [ ] grazing
- [ ] clearcutting
- [ ] selective cutting
- [ ] woody debris removal
- [ ] toxic pollutants
- [ ] shrub/sapling removal
- [ ] herbaceous/aquatic bed removal
- [X] sedimentation
- [ ] dredging
- [ ] farming
- [ ] nutrient enrichment
- [X] past mining

42 (subtotal this page)

last revised 1 February 2001 jjm

Site: Apex Sanitary Landfill, Amsterdam, OH	Rater(s): Mike A. Takacs, Mark Haibach	Date: 30 July 2010

42
subtotal first page

Metric 5. Special Wetlands.

0 (max 10 pts.) | 42 (subtotal)

Check all that apply and score as indicated.

- [ ] Bog (10)
- [ ] Fen (10)
- [ ] Old growth forest (10)
- [ ] Mature forested wetland (5)
- [ ] Lake Erie coastal/tributary wetland-unrestricted hydrology (10)
- [ ] Lake Erie coastal/tributary wetland-restricted hydrology (5)
- [ ] Lake Plain Sand Prairies (Oak Openings) (10)
- [ ] Relict Wet Prairies (10)
- [ ] Known occurrence state/federal threatened or endangered species (10)
- [ ] Significant migratory songbird/water fowl habitat or usage (10)
- [ ] Category 1 Wetland. See Question 1 Qualitative Rating (-10)

Metric 6. Plant communities, interspersion, microtopography.

11 (max 20 pts.) | 53 (subtotal)

6a. Wetland Vegetation Communities.
Score all present using 0 to 3 scale.

- [ ] Aquatic bed
- [2] Emergent
- [1] Shrub
- [1] Forest
- [ ] Mudflats
- [1] Open water
- [ ] Other_____

6b. horizontal (plan view) Interspersion.
Select only one.

- [ ] High (5)
- [ ] Moderately high(4)
- [X] Moderate (3)
- [ ] Moderately low (2)
- [ ] Low (1)
- [ ] None (0)

6c. Coverage of invasive plants. Refer to Table 1 ORAM long form for list. Add or deduct points for coverage

- [ ] Extensive >75% cover (-5)
- [ ] Moderate 25-75% cover (-3)
- [X] Sparse 5-25% cover (-1)
- [ ] Nearly absent <5% cover (0)
- [ ] Absent (1)

Typha angustifolia

6d. Microtopography.
Score all present using 0 to 3 scale.

- [1] Vegetated hummucks/tussucks
- [1] Coarse woody debris >15cm (6in)
- [1] Standing dead >25cm (10in) dbh
- [1] Amphibian breeding pools

Vegetation Community Cover Scale

0	Absent or comprises <0.1ha (0.2471 acres) contiguous area
1	Present and either comprises small part of wetland's vegetation and is of moderate quality, or comprises a significant part but is of low quality
2	Present and either comprises significant part of wetland's vegetation and is of moderate quality or comprises a small part and is of high quality
3	Present and comprises significant part, or more, of wetland's vegetation and is of high quality

Narrative Description of Vegetation Quality

low	Low spp diversity and/or predominance of nonnative or disturbance tolerant native species
mod	Native spp are dominant component of the vegetation, although nonnative and/or disturbance tolerant native spp can also be present, and species diversity moderate to moderately high, but generally w/o presence of rare threatened or endangered spp
high	A predominance of native species, with nonnative spp and/or disturbance tolerant native spp absent or virtually absent, and high spp diversity and often, but not always, the presence of rare, threatened, or endangered spp

Mudflat and Open Water Class Quality

0	Absent <0.1ha (0.247 acres)
1	Low 0.1 to <1ha (0.247 to 2.47 acres)
2	Moderate 1 to <4ha (2.47 to 9.88 acres)
3	High 4ha (9.88 acres) or more

Microtopography Cover Scale

0	Absent
1	Present very small amounts or if more common of marginal quality
2	Present in moderate amounts, but not of highest quality or in small amounts of highest quality
3	Present in moderate or greater amounts and of highest quality

53

End of Quantitative Rating. Complete Categorization Worksheets.

Category 2

ORAM Summary Worksheet

Apex Sanitary Landfill Wetland P
30 July 2010

		circle answer or insert score	Result
Narrative Rating	Question 1 Critical Habitat	YES (NO)	If yes, Category 3.
	Question 2. Threatened or Endangered Species	YES (NO)	If yes, Category 3.
	Question 3. High Quality Natural Wetland	YES (NO)	If yes, Category 3.
	Question 4. Significant bird habitat	YES (NO)	If yes, Category 3.
	Question 5. Category 1 Wetlands	YES (NO)	If yes, Category 1.
	Question 6. Bogs	YES (NO)	If yes, Category 3.
	Question 7. Fens	YES (NO)	If yes, Category 3.
	Question 8a. Old Growth Forest	YES (NO)	If yes, Category 3.
	Question 8b. Mature Forested Wetland	YES (NO)	If yes, evaluate for Category 3; may also be 1 or 2.
	Question 9b. Lake Erie Wetlands - Restricted	YES (NO)	If yes, evaluate for Category 3; may also be 1 or 2.
	Question 9d. Lake Erie Wetlands – Unrestricted with native plants	YES NO	If yes, Category 3
	Question 9e. Lake Erie Wetlands - Unrestricted with invasive plants	YES NO	If yes, evaluate for Category 3; may also be 1 or 2.
	Question 10. Oak Openings	YES (NO)	If yes, Category 3
	Question 11. Relict Wet Prairies	YES (NO)	If yes, evaluate for Category 3; may also be 1 or 2.
Quantitative Rating	Metric 1. Size	4	
	Metric 2. Buffers and surrounding land use	10	
	Metric 3. Hydrology	17	
	Metric 4. Habitat	11	
	Metric 5. Special Wetland Communities	0	
	Metric 6. Plant communities, interspersion, microtopography	11	
	TOTAL SCORE	53	Category based on score breakpoints Category 2

Complete Wetland Categorization Worksheet.

Apex Sanitary Landfill
Wetland P
30 July 2010

Wetland Categorization Worksheet

Choices	Circle one		Evaluation of Categorization Result of ORAM
Did you answer "Yes" to any of the following questions: Narrative Rating Nos. 2, 3, 4, 6, 7, 8a, 9d, 10	YES Wetland is categorized as a Category 3 wetland	(NO)	Is quantitative rating score *less* than the Category 2 scoring threshold (*excluding* gray zone)? If yes, reevaluate the category of the wetland using the narrative criteria in OAC Rule 3745-1-54(C) and biological and/or functional assessments to determine if the wetland has been over-categorized by the ORAM
Did you answer "Yes" to any of the following questions: Narrative Rating Nos. 1, 8b, 9b, 9e, 11	YES Wetland should be evaluated for possible Category 3 status	(NO)	Evaluate the wetland using the 1) narrative criteria in OAC Rule 3745-1-54(C) and 2) the quantitative rating score. If the wetland is determined to be a Category 3 wetland using either of these, it should be categorized as a Category 3 wetland. Detailed biological and/or functional assessments may also be used to determine the wetland's category.
Did you answer "Yes" to Narrative Rating No. 5	YES Wetland is categorized as a Category 1 wetland	(NO)	Is quantitative rating score *greater* than the Category 2 scoring threshold *(including* any gray zone)? If yes, reevaluate the category of the wetland using the narrative criteria in OAC Rule 3745-1-54(C) and biological and/or functional assessments to determine if the wetland has been under-categorized by the ORAM
Does the quantitative score fall within the scoring range of a Category 1, 2, or 3 wetland?	(YES) Wetland is assigned to the appropriate category based on the scoring range	NO	If the score of the wetland is located within the scoring range for a particular category, the wetland should be assigned to that category. In all instances however, the narrative criteria described in OAC Rule 3745-1-54(C) can be used to clarify or change a categorization based on a quantitative score.
Does the quantitative score fall with the *"gray zone"* for Category 1 or 2 or Category 2 or 3 wetlands?	YES Wetland is assigned to the higher of the two categories or assigned to a category based on detailed assessments and the narrative criteria	(NO)	Rater has the option of assigning the wetland to the higher of the two categories or to assign a category based on the results of a nonrapid wetland assessment method, e.g. functional assessment, biological assessment, etc, and a consideration of the narrative criteria in OAC rule 3745-1-54(C).
Does the wetland otherwise exhibit *moderate OR superior* hydrologic OR habitat, OR recreational functions AND the wetland was *not* categorized as a Category 2 wetland (in the case of moderate functions) or a Category 3 wetland (in the case of superior functions) by this method?	YES Wetland was undercategorized by this method. A written justification for recategorization should be provided on Background Information Form	(NO) Wetland is assigned to category as determined by the ORAM.	A wetland may be undercategorized using this method, but still exhibit one or more superior functions, e.g. a wetland's biotic communities may be degraded by human activities, but the wetland may still exhibit superior hydrologic functions because of its type, landscape position, size, local or regional significance, etc. In this circumstance, the narrative criteria in OAC Rule 3745-1-54(C)(2) and (3) are controlling, and the under-categorization should be corrected. A written justification with supporting reasons or information for this determination should be provided.

Final Category

Choose one	Category 1	Category 2	Category 3

End of Ohio Rapid Assessment Method for Wetlands.

Background Information

Name:	Michael A. Takacs, Mark R. Haibach
Date:	30 July 2010
Affiliation:	Civil & Environmental Consultants, Inc.
Address:	333 Baldwin Road, Pittsburgh, PA 15205
Phone Number:	(412) 249-3188, (412) 249-3156
e-mail address:	mtakacs@cecinc.com, mhaibach@cecinc.com
Name of Wetland:	Wetland Q
Vegetation Communit(ies):	PEM / PAB / POWZx
HGM Class(es):	SWD / GWD

Location of Wetland: include map, address, north arrow, landmarks, distances, roads, etc.

See Stream and Wetland Delineation Map (Figure 4).

Lat/Long or UTM Coordinate	
USGS Quad Name: Amsterdam, OH	
County: Jefferson / Harrison	
Township: Springfield	
Section and Subsection	
Hydrologic Unit Code: 05030101340	
Site Visit: 30 July 2010	
National Wetland Inventory Map: Amsterdam, OH	
Ohio Wetland Inventory Map: —	
Soil Survey: Soil Survey of Jefferson County, Ohio	
Delineation report/map: Wetland and Stream Delineation and Functional Assessment Report, Potential Apex Sanitary Landfill Expansion. CEC 2010.	

Name of Wetland: Wetland Q	
Wetland Size (acres, hectares): 1.82 ac. wetland + 2.52 open water =	4.34 ac.

Sketch: Include north arrow, relationship with other surface waters, vegetation zones, etc.

See Stream and Wetland Delineation Map (Figure 4).

Comments, Narrative Discussion, Justification of Category Changes:

Final score : 42	Category:	Mod. 2

Apex Sanitary Landfill
Wetland Q
30 July 2010

Scoring Boundary Worksheet

INSTRUCTIONS. The initial step in completing the ORAM is to identify the "scoring boundaries" of the wetland being rated. In many instances this determination will be relatively easy and the scoring boundaries will coincide with the "jurisdictional boundaries." For example, the scoring boundary of an isolated cattail marsh located in the middle of a farm field will likely be the same as that wetland's jurisdictional boundaries. In other instances, however, the scoring boundary will not be as easily determined. Wetlands that are small or isolated from other surface waters often form large contiguous areas or heterogeneous complexes of wetland and upland. In separating wetlands for scoring purposes, the hydrologic regime of the wetland is the main criterion that should be used. Boundaries between contiguous or connected wetlands should be established where the volume, flow, or velocity of water moving through the wetland changes significantly. *Areas with a high degree of hydrologic interaction should be scored as a single wetland.* In determining a wetland's scoring boundaries, use the guidelines in the ORAM Manual Section 5.0. In certain instances, it may be difficult to establish the scoring boundary for the wetland being rated. These problem situations include wetlands that form a patchwork on the landscape, wetlands divided by artificial boundaries like property fences, roads, or railroad embankments, wetlands that are contiguous with streams, lakes, or rivers, and estuarine or coastal wetlands. These situations are discussed below, however, it is recommended that Rater contact Ohio EPA, Division of Surface Water, 401/Wetlands Section if there are additional questions or a need for further clarification of the appropriate scoring boundaries of a particular wetland.

#	Steps in properly establishing scoring boundaries	done?	not applicable
Step 1	Identify the wetland area of interest. This may be the site of a proposed impact, a reference site, conservation site, etc.	Yes	
Step 2	Identify the locations where there is physical evidence that hydrology changes rapidly. Such evidence includes both natural and human-induced changes including, constrictions caused by berms or dikes, points where the water velocity changes rapidly at rapids or falls, points where significant inflows occur at the confluence of rivers, or other factors that may restrict hydrologic interaction between the wetlands or parts of a single wetland.	Yes	
Step 3	Delineate the boundary of the wetland to be rated such that all areas of interest that are contiguous to and within the areas where the hydrology does not change significantly, i.e. areas that have a high degree of hydrologic interaction are included within the scoring boundary.	Yes	
Step 4	Determine if artificial boundaries, such as property lines, state lines, roads, railroad embankments, etc., are present. These should not be used to establish scoring boundaries unless they coincide with areas where the hydrologic regime changes.	Yes	
Step 5	In all instances, the Rater may enlarge the minimum scoring boundaries discussed here to score together wetlands that could be scored separately.	Yes	
Step 6	Consult ORAM Manual Section 5.0 for how to establish scoring boundaries for wetlands that form a patchwork on the landscape, divided by artificial boundaries, contiguous to streams, lakes or rivers, or for dual classifications.	Yes	

End of Scoring Boundary Determination. Begin Narrative Rating on next page.

Apex Sanitary Landfill
Wetland Q
30 July 2010

Narrative Rating

INSTRUCTIONS. Answer each of the following questions. Questions 1, 2, 3 and 4 should be answered based on information obtained from the site visit or the literature *and* by submitting a Data Services Request to the Ohio Department of Natural Resources, Division of Natural Areas and Preserves, Natural Heritage Data Services, 1889 Fountain Square Court, Building F-1, Columbus, Ohio 43224, 614-265-6453 (phone), 614-265-3096 (fax), http://www.dnr.state.oh.us/dnap . The remaining questions are designed to be answered primarily by the results of the site visit. Refer to the User's Manual for descriptions of these wetland types. Note: "Critical habitat" is legally defined in the Endangered Species Act and is the geographic area containing physical or biological features essential to the conservation of a listed species or as an area that may require special management considerations or protection. The Rater should contact the Region 3 Headquarters or the Columbus Ecological Services Office for updates as to whether critical habitat has been designated for other federally listed threatened or endangered species. "Documented" means the wetland is listed in the appropriate State of Ohio database.

#	Question	Circle one	
1	**Critical Habitat.** Is the wetland in a township, section, or subsection of a United States Geological Survey 7.5 minute Quadrangle that has been designated by the U.S. Fish and Wildlife Service as "critical habitat" for any threatened or endangered plant or animal species? Note: as of January 1, 2001, of the federally listed endangered or threatened species which can be found in Ohio, the Indiana Bat has had critical habitat designated (50 CFR 17.95(a)) and the piping plover has had critical habitat proposed (65 FR 41812 July 6, 2000).	YES Wetland should be evaluated for possible Category 3 status Go to Question 2	(NO) Go to Question 2
2	**Threatened or Endangered Species.** Is the wetland known to contain an individual of, or documented occurrences of federal or state-listed threatened or endangered plant or animal species?	YES Wetland is a Category 3 wetland. Go to Question 3	(NO) Go to Question 3
3	**Documented High Quality Wetland.** Is the wetland on record in Natural Heritage Database as a high quality wetland?	YES Wetland is a Category 3 wetland Go to Question 4	(NO) Go to Question 4
4	**Significant Breeding or Concentration Area.** Does the wetland contain documented regionally significant breeding or nonbreeding waterfowl, neotropical songbird, or shorebird concentration areas?	YES Wetland is a Category 3 wetland Go to Question 5	(NO) Go to Question 5
5	**Category 1 Wetlands.** Is the wetland less than 0.5 hectares (1 acre) in size and **hydrologically isolated** and either 1) comprised of vegetation that is dominated (greater than eighty per cent areal cover) by *Phalaris arundinacea, Lythrum salicaria,* or *Phragmites australis,* or 2) an acidic pond created or excavated on mined lands that has little or no vegetation?	YES Wetland is a Category 1 wetland Go to Question 6	(NO) Go to Question 6
6	**Bogs.** Is the wetland a peat-accumulating wetland that 1) has no significant inflows or outflows, 2) supports acidophilic mosses, particularly *Sphagnum* spp., 3) the acidophilic mosses have >30% cover, 4) at least one species from Table 1 is present, and 5) the cover of invasive species (see Table 1) is <25%?	YES Wetland is a Category 3 wetland Go to Question 7	(NO) Go to Question 7
7	**Fens.** Is the wetland a carbon accumulating (peat, muck) wetland that is saturated during most of the year, primarily by a discharge of free flowing, mineral rich, ground water with a circumneutral ph (5.5-9.0) and with one or more plant species listed in Table 1 and the cover of invasive species listed in Table 1 is <25%?	YES Wetland is a Category 3 wetland Go to Question 8a	(NO) Go to Question 8a
8a	**"Old Growth Forest."** Is the wetland a forested wetland and is the forest characterized by, but not limited to, the following characteristics: overstory canopy trees of great age (exceeding at least 50% of a projected maximum attainable age for a species); little or no evidence of human-caused understory disturbance during the past 80 to 100 years; an all-aged structure and multilayered canopies; aggregations of canopy trees interspersed with canopy gaps; and significant numbers of standing dead snags and downed logs?	YES Wetland is a Category 3 wetland. Go to Question 8b	(NO) Go to Question 8b

8b	**Mature forested wetlands.** Is the wetland a forested wetland with 50% or more of the cover of upper forest canopy consisting of deciduous trees with large diameters at breast height (dbh), generally diameters greater than 45cm (17.7in) dbh?	YES Wetland should be evaluated for possible Category 3 status. Go to Question 9a	NO Go to Question 9a
9a	**Lake Erie coastal and tributary wetlands.** Is the wetland located at an elevation less than 575 feet on the USGS map, adjacent to this elevation, or along a tributary to Lake Erie that is accessible to fish?	YES Go to Question 9b	NO Go to Question 10
9b	Does the wetland's hydrology result from measures designed to prevent erosion and the loss of aquatic plants, i.e. the wetland is partially hydrologically restricted from Lake Erie due to lakeward or landward dikes or other hydrological controls?	YES Wetland should be evaluated for possible Category 3 status Go to Question 10	NO Go to Question 9c
9c	Are Lake Erie water levels the wetland's primary hydrological influence, i.e. the wetland is hydrologically unrestricted (no lakeward or upland border alterations), or the wetland can be characterized as an "estuarine" wetland with lake and river influenced hydrology. These include sandbar deposition wetlands, estuarine wetlands, river mouth wetlands, or those dominated by submersed aquatic vegetation.	YES Go to Question 9d	NO Go to Question 10
9d	Does the wetland have a predominance of native species within its vegetation communities, although non-native or disturbance tolerant native species can also be present?	YES Wetland is a Category 3 wetland Go to Question 10	NO Go to Question 9e
9e	Does the wetland have a predominance of non-native or disturbance tolerant native plant species within its vegetation communities?	YES Wetland should be evaluated for possible Category 3 status Go to Question 10	NO Go to Question 10
10	**Lake Plain Sand Prairies (Oak Openings)** Is the wetland located in Lucas, Fulton, Henry, or Wood Counties and can the wetland be characterized by the following description: the wetland has a sandy substrate with interspersed organic matter, a water table often within several inches of the surface, and often with a dominance of the gramineous vegetation listed in Table 1 (woody species may also be present). The Ohio Department of Natural Resources Division of Natural Areas and Preserves can provide assistance in confirming this type of wetland and its quality.	YES Wetland is a Category 3 wetland. Go to Question 11	NO Go to Question 11
11	**Relict Wet Prairies.** Is the wetland a relict wet prairie community dominated by some or all of the species in Table 1. Extensive prairies were formerly located in the Darby Plains (Madison and Union Counties), Sandusky Plains (Wyandot, Crawford, and Marion Counties), northwest Ohio (e.g. Erie, Huron, Lucas, Wood Counties), and portions of western Ohio Counties (e.g. Darke, Mercer, Miami, Montgomery, Van Wert etc.).	YES Wetland should be evaluated for possible Category 3 status Complete Quantitative Rating	NO Complete Quantitative Rating

Table 1. Characteristic plant species.

invasive/exotic spp	fen species	bog species	0ak Opening species	wet prairie species
Lythrum salicaria	*Zygadenus elegans var. glaucus*	*Calla palustris*	*Carex cryptolepis*	*Calamagrostis canadensis*
Myriophyllum spicatum	*Cacalia plantaginea*	*Carex atlantica var. capillacea*	*Carex lasiocarpa*	*Calamogrostis stricta*
Najas minor	*Carex flava*	*Carex echinata*	*Carex stricta*	*Carex atherodes*
Phalaris arundinacea	*Carex sterilis*	*Carex oligosperma*	*Cladium mariscoides*	*Carex buxbaumii*
Phragmites australis	*Carex stricta*	*Carex trisperma*	*Calamagrostis stricta*	*Carex pellita*
Potamogeton crispus	*Deschampsia caespitosa*	*Chamaedaphne calyculata*	*Calamagrostis canadensis*	*Carex sartwellii*
Ranunculus ficaria	*Eleocharis rostellata*	*Decodon verticillatus*	*Quercus palustris*	*Gentiana andrewsii*
Rhamnus frangula	*Eriophorum viridicarinatum*	*Eriophorum virginicum*		*Helianthus grosseserratus*
Typha angustifolia	*Gentianopsis spp.*	*Larix laricina*		*Liatris spicata*
Typha xglauca	*Lobelia kalmii*	*Nemopanthus mucronatus*		*Lysimachia quadriflora*
	Parnassia glauca	*Schechzeria palustris*		*Lythrum alatum*
	Potentilla fruticosa	*Sphagnum spp.*		*Pycnanthemum virginianum*
	Rhamnus alnifolia	*Vaccinium macrocarpon*		*Silphium terebinthinaceum*
	Rhynchospora capillacea	*Vaccinium corymbosum*		*Sorghastrum nutans*
	Salix candida	*Vaccinium oxycoccos*		*Spartina pectinata*
	Salix myricoides	*Woodwardia virginica*		*Solidago riddellii*
	Salix serissima	*Xyris difformis*		
	Solidago ohioensis			
	Tofieldia glutinosa			
	Triglochin maritimum			
	Triglochin palustre			

End of Narrative Rating. Begin Quantitative Rating on next page.

ORAM v. 5.0 Field Form Quantitative Rating

Wetland Q

Site: Apex Landfill	Rater(s): MAT, MRH	Date: 7/30/10

Metric 1. Wetland Area (size).

3 | 3 (max 6 pts. | subtotal)

Select one size class and assign score.

- [ ] >50 acres (>20.2ha) (6 pts)
- [ ] 25 to <50 acres (10.1 to <20.2ha) (5 pts)
- [ ] 10 to <25 acres (4 to <10.1ha) (4 pts)
- [x] 3 to <10 acres (1.2 to <4ha) (3 pts)
- [ ] 0.3 to <3 acres (0.12 to <1.2ha) (2pts)
- [ ] 0.1 to <0.3 acres (0.04 to <0.12ha) (1 pt)
- [ ] <0.1 acres (0.04ha) (0 pts)

1.82 ac. Wetland + 2.52 Open water/AB = 4.34 ac.

Metric 2. Upland buffers and surrounding land use.

9 | 12 (max 14 pts. | subtotal)

2a. Calculate average buffer width. Select only one and assign score. Do not double check.

- [ ] WIDE. Buffers average 50m (164ft) or more around wetland perimeter (7)
- [x] MEDIUM. Buffers average 25m to <50m (82 to <164ft) around wetland perimeter (4)
- [ ] NARROW. Buffers average 10m to <25m (32ft to <82ft) around wetland perimeter (1)
- [ ] VERY NARROW. Buffers average <10m (<32ft) around wetland perimeter (0)

$\bar{X}$ = 145'

2b. Intensity of surrounding land use. Select one or double check and average.

- [ ] VERY LOW. 2nd growth or older forest, prairie, savannah, wildlife area, etc. (7)
- [x] LOW. Old field (>10 years), shrubland, young second growth forest. (5)
- [ ] MODERATELY HIGH. Residential, fenced pasture, park, conservation tillage, new fallow field. (3)
- [ ] HIGH. Urban, industrial, open pasture, row cropping, mining, construction. (1)

Metric 3. Hydrology.

17 | 29 (max 30 pts. | subtotal)

3a. Sources of Water. Score all that apply.

- [ ] High pH groundwater (5)
- [x] Other groundwater (3)
- [x] Precipitation (1)
- [ ] Seasonal/Intermittent surface water (3)
- [ ] Perennial surface water (lake or stream) (5)

3b. Connectivity. Score all that apply.

- [ ] 100 year floodplain (1)
- [ ] Between stream/lake and other human use (1)
- [x] Part of wetland/upland (e.g. forest), complex (1)
- [ ] Part of riparian or upland corridor (1)

3c. Maximum water depth. Select only one and assign score.

- [x] >0.7 (27.6in) (3)
- [ ] 0.4 to 0.7m (15.7 to 27.6in) (2)
- [ ] <0.4m (<15.7in) (1)

3d. Duration inundation/saturation. Score one or dbl check.

- [x] Semi- to permanently inundated/saturated (4)
- [ ] Regularly inundated/saturated (3)
- [ ] Seasonally inundated (2)
- [ ] Seasonally saturated in upper 30cm (12in) (1)

3e. Modifications to natural hydrologic regime. Score one or double check and average.

- [ ] None or none apparent (12)
- [x] Recovered (7)
- [x] Recovering (3) 5
- [ ] Recent or no recovery (1)

Check all disturbances observed

- [ ] ditch
- [ ] tile
- [ ] dike
- [ ] weir
- [ ] stormwater input
- [ ] point source (nonstormwater)
- [x] filling/grading, Spoils
- [ ] road bed/RR track
- [x] dredging
- [x] other Past mining

Metric 4. Habitat Alteration and Development.

9 | 38 (max 20 pts. | subtotal)

4a. Substrate disturbance. Score one or double check and average.

- [ ] None or none apparent (4)
- [ ] Recovered (3)
- [x] Recovering (2) 1.5 mine Spoils
- [x] Recent or no recovery (1)

4b. Habitat development. Select only one and assign score.

- [ ] Excellent (7)
- [ ] Very good (6)
- [ ] Good (5)
- [ ] Moderately good (4)
- [x] Fair (3)
- [ ] Poor to fair (2)
- [ ] Poor (1)

4c. Habitat alteration. Score one or double check and average.

- [ ] None or none apparent (9)
- [x] Recovered (6)
- [x] Recovering (3) 4.5
- [ ] Recent or no recovery (1)

Check all disturbances observed

- [ ] mowing
- [ ] grazing
- [ ] clearcutting
- [ ] selective cutting
- [ ] woody debris removal
- [ ] toxic pollutants
- [ ] shrub/sapling removal
- [ ] herbaceous/aquatic bed removal
- [x] sedimentation
- [ ] dredging
- [ ] farming
- [ ] nutrient enrichment
- [x] Past mining

38

subtotal this page

ORAM v. 5.0 Field Form Quantitative Rating

Wetland Q

Site: Apex Landfill	Rater(s): MAT, MRH	Date: 7/30/10

38 subtotal ~~this page~~

0 (max 10 pts.) | 38 (subtotal)

Metric 5. Special Wetlands.

Check all that apply and score as indicated.

- [ ] Bog (10)
- [ ] Fen (10)
- [ ] Old growth forest (10)
- [ ] Mature forested wetland (5)
- [ ] Lake Erie coastal/tributary wetland-unrestricted hydrology (10)
- [ ] Lake Erie coastal/tributary wetland-restricted hydrology (5)
- [ ] Lake Plain Sand Prairies (Oak Openings) (10)
- [ ] Relict Wet Praires (10)
- [ ] Known occurrence state/federal threatened or endangered species (10)
- [ ] Significant migratory songbird/water fowl habitat or usage (10)
- [ ] Category 1 Wetland. See Question 1 Qualitative Rating (-10)

4 (max 20 pts.) | 42 (subtotal)

Metric 6. Plant communities, interspersion, microtopography.

6a. Wetland Vegetation Communities. Score all present using 0 to 3 scale.

- [2] Aquatic bed
- [1] Emergent
- [ ] Shrub
- [ ] Forest
- [ ] Mudflats
- [2] Open water
- [ ] Other_____

6b. horizontal (plan view) Interspersion. Select only one.

- [ ] High (5)
- [ ] Moderately high(4)
- [ ] Moderate (3)
- [X] Moderately low (2)
- [ ] Low (1)
- [ ] None (0)

6c. Coverage of invasive plants. Refer to Table 1 ORAM long form for list. Add or deduct points for coverage

- [X] Extensive >75% cover (-5)
- [ ] Moderate 25-75% cover (-3)
- [ ] Sparse 5-25% cover (-1)
- [ ] Nearly absent <5% cover (0)
- [ ] Absent (1)

Typha angustifolia
Potomogeton crispis
Najas minir

6d. Microtopography. Score all present using 0 to 3 scale.

- [ ] Vegetated hummucks/tussucks
- [ ] Coarse woody debris >15cm (6in)
- [ ] Standing dead >25cm (10in) dbh
- [2] Amphibian breeding pools

Vegetation Community Cover Scale

0	Absent or comprises <0.1ha (0.2471 acres) contiguous area
1	Present and either comprises small part of wetland's vegetation and is of moderate quality, or comprises a significant part but is of low quality
2	Present and either comprises significant part of wetland's vegetation and is of moderate quality or comprises a small part and is of high quality
3	Present and comprises significant part, or more, of wetland's vegetation and is of high quality

Narrative Description of Vegetation Quality

low	Low spp diversity and/or predominance of nonnative or disturbance tolerant native species
mod	Native spp are dominant component of the vegetation, although nonnative and/or disturbance tolerant native spp can also be present, and species diversity moderate to moderately high, but generallyw/o presence of rare threatened or endangered spp
high	A predominance of native species, with nonnative spp and/or disturbance tolerant native spp absent or virtually absent, and high spp diversity and often, but not always, the presence of rare, threatened, or endangered spp

Mudflat and Open Water Class Quality

0	Absent <0.1ha (0.247 acres)
1	Low 0.1 to <1ha (0.247 to 2.47 acres)
2	Moderate 1 to <4ha (2.47 to 9.88 acres)
3	High 4ha (9.88 acres) or more

Microtopography Cover Scale

0	Absent
1	Present very small amounts or if more common of marginal quality
2	Present in moderate amounts, but not of highest quality or in small amounts of highest quality
3	Present in moderate or greater amounts and of highest quality

42 **GRAND TOTAL(max 100 pts)** Modified Category 2

Refer to the most recent ORAM Score Calibration Report for the scoring breakpoints between wetland categories at the following address: http://www.epa.state.oh.us/dsw/401/401.html

last revised 1 February 2001 jjm

Apex Sanitary Landfill
Wetland Q
30 July 2010

ORAM Summary Worksheet

		circle answer or insert score	Result
Narrative Rating	Question 1 Critical Habitat	YES (NO)	If yes, Category 3.
	Question 2. Threatened or Endangered Species	YES (NO)	If yes, Category 3.
	Question 3. High Quality Natural Wetland	YES (NO)	If yes, Category 3.
	Question 4. Significant bird habitat	YES (NO)	If yes, Category 3.
	Question 5. Category 1 Wetlands	YES (NO)	If yes, Category 1.
	Question 6. Bogs	YES (NO)	If yes, Category 3.
	Question 7. Fens	YES (NO)	If yes, Category 3.
	Question 8a. Old Growth Forest	YES (NO)	If yes, Category 3.
	Question 8b. Mature Forested Wetland	YES (NO)	If yes, evaluate for Category 3; may also be 1 or 2.
	Question 9b. Lake Erie Wetlands - Restricted	YES (NO)	If yes, evaluate for Category 3; may also be 1 or 2.
	Question 9d. Lake Erie Wetlands – Unrestricted with native plants	YES NO	If yes, Category 3
	Question 9e. Lake Erie Wetlands - Unrestricted with invasive plants	YES NO	If yes, evaluate for Category 3; may also be 1 or 2.
	Question 10. Oak Openings	YES (NO)	If yes, Category 3
	Question 11. Relict Wet Prairies	YES (NO)	If yes, evaluate for Category 3; may also be 1 or 2.
Quantitative Rating	Metric 1. Size	3	
	Metric 2. Buffers and surrounding land use	9	
	Metric 3. Hydrology	17	
	Metric 4. Habitat	9	
	Metric 5. Special Wetland Communities	0	
	Metric 6. Plant communities, interspersion, microtopography	4	
	TOTAL SCORE	42	Category based on score breakpoints Modified Category 2

Complete Wetland Categorization Worksheet.

Apex Sanitary Landfill
Wetland Q
30 July 2010

Wetland Categorization Worksheet

Choices	Circle one		Evaluation of Categorization Result of ORAM
Did you answer "Yes" to any of the following questions: Narrative Rating Nos. 2, 3, 4, 6, 7, 8a, 9d, 10	YES Wetland is categorized as a Category 3 wetland	(NO)	Is quantitative rating score *less* than the Category 2 scoring threshold (*excluding* gray zone)? If yes, reevaluate the category of the wetland using the narrative criteria in OAC Rule 3745-1-54(C) and biological and/or functional assessments to determine if the wetland has been over-categorized by the ORAM.
Did you answer "Yes" to any of the following questions: Narrative Rating Nos. 1, 8b, 9b, 9e, 11	YES Wetland should be evaluated for possible Category 3 status	(NO)	Evaluate the wetland using the 1) narrative criteria in OAC Rule 3745-1-54(C) and 2) the quantitative rating score. If the wetland is determined to be a Category 3 wetland using either of these, it should be categorized as a Category 3 wetland. Detailed biological and/or functional assessments may also be used to determine the wetland's category.
Did you answer "Yes" to Narrative Rating No. 5	YES Wetland is categorized as a Category 1 wetland	(NO)	Is quantitative rating score *greater* than the Category 2 scoring threshold *(including* any gray zone)? If yes, reevaluate the category of the wetland using the narrative criteria in OAC Rule 3745-1-54(C) and biological and/or functional assessments to determine if the wetland has been under-categorized by the ORAM.
Does the quantitative score fall within the scoring range of a Category 1, 2, or 3 wetland?	(YES) Wetland is assigned to the appropriate category based on the scoring range	NO	If the score of the wetland is located within the scoring range for a particular category, the wetland should be assigned to that category. In all instances however, the narrative criteria described in OAC Rule 3745-1-54(C) can be used to clarify or change a categorization based on a quantitative score.
Does the quantitative score fall with the *"gray zone"* for Category 1 or 2 or Category 2 or 3 wetlands?	YES Wetland is assigned to the higher of the two categories or assigned to a category based on detailed assessments and the narrative criteria	(NO)	Rater has the option of assigning the wetland to the higher of the two categories or to assign a category based on the results of a nonrapid wetland assessment method, e.g. functional assessment, biological assessment, etc, and a consideration of the narrative criteria in OAC rule 3745-1-54(C).
Does the wetland otherwise exhibit *moderate OR superior* hydrologic OR habitat, OR recreational functions AND the wetland was *not* categorized as a Category 2 wetland (in the case of moderate functions) or a Category 3 wetland (in the case of superior functions) by this method?	YES Wetland was undercategorized by this method. A written justification for recategorization should be provided on Background Information Form	(NO) Wetland is assigned to category as determined by the ORAM.	A wetland may be undercategorized using this method, but still exhibit one or more superior functions, e.g. a wetland's biotic communities may be degraded by human activities, but the wetland may still exhibit superior hydrologic functions because of its type, landscape position, size, local or regional significance, etc. In this circumstance, the narrative criteria in OAC Rule 3745-1-54(C)(2) and (3) are controlling, and the under-categorization should be corrected. A written justification with supporting reasons or information for this determination should be provided.

Final Category			
Choose one	Category 1	(Category 2)	Category 3

End of Ohio Rapid Assessment Method for Wetlands.

APPENDIX D

PRIMARY HEADWATER HABITAT EVALUATION FORMS

OhioEPA Primary Headwater Habitat Evaluation Form

HHEI Score (sum of metrics 1, 2, 3) : 44

SITE NAME/LOCATION Apex Sanitary Landfill Expansion

Stream 1 SITE NUMBER Station 1 RIVER BASIN Ohio DRAINAGE AREA (mi²) ~0.02

LENGTH OF STREAM REACH (ft) ~200 LAT. _____ LONG. _____ RIVER CODE _____ RIVER MILE _____

DATE 06/18/10 SCORER Mike A. Tkacs COMMENTS Stream 1 Intermittent Segment - Class II PHWH

NOTE: Complete All Items On This Form - Refer to "Field Evaluation Manual for Ohio's PHWH Streams" for Instructions

STREAM CHANNEL MODIFICATIONS: ☒ NONE / NATURAL CHANNEL ☐ RECOVERED ☐ RECOVERING ☐ RECENT OR NO RECOVERY

1. **SUBSTRATE (Estimate percent of every type of substrate present.** Check *ONLY* two predominant substrate *TYPE* boxes (Max of 32). Add total number of significant substrate types found (Max of 8). Final metric score is sum of boxes A & B.

TYPE		PERCENT	TYPE		PERCENT
☐	BLDR SLABS [16 pts]		☐	SILT [3 pt]	5
☐	BOULDER (>256 mm) [16 pts]		☐	LEAF PACK/WOODY DEBRIS [3 pts]	
☐	BEDROCK [16 pt]		☐	FINE DETRITUS [3 pts]	
☐	COBBLE (65-256 mm) [12 pts]	5	☐	CLAY or HARDPAN [0 pt]	
■	GRAVEL (2-64 mm) [9 pts]	60	☐	MUCK [0 pts]	
■	SAND (<2 mm) [6 pts]	30	☐	ARTIFICIAL [3 pts]	

Total of Percentages of Bldr Slabs, Boulder, Cobble, Bedrock 5 (A) 15 (B) 4

SCORE OF TWO MOST PREDOMINATE SUBSTRATE TYPES: TOTAL NUMBER OF SUBSTRATE TYPES:

2. **Maximum Pool Depth** ***(Measure the maximum pool depth within the 61 meter (200 ft)*** evaluation reach at the time of evaluation. Avoid plunge pools from road culverts or storm water pipes) (Check *ONLY* one box):

☐	> 30 centimeters [20 pts]	☐	> 5 cm - 10 cm [15 pts]
☐	> 22.5 - 30 cm [30 pts]	■	< 5 cm [5 pts]
☐	> 10 - 22.5 cm [25 pts]	☐	NO WATER OR MOIST CHANNEL [0 pts]

5

COMMENTS _____ MAXIMUM POOL DEPTH (centimeters):

3. **BANK FULL WIDTH (Measured as the average of 3-4 measurements)** (Check *ONLY* one box):

☐	> 4.0 meters (> 13') [30 pts]	☐	> 1.0 m - 1.5 m (> 3' 3" - 4' 8") [15 pts]
☐	> 3.0 m - 4.0 m (> 9' 7" - 13') [25 pts]	☐	≤ 1.0 m (≤ 3' 3") [5 pts]
■	> 1.5 m - 3.0 m (> 9' 7" - 4' 8") [20 pts]		

20

COMMENTS _____ AVERAGE BANKFULL WIDTH (meters)

HHEI Metric Points

Substrate Max = 40: 19 (A + B)

Pool Depth Max = 30: 5

Bankfull Width Max=30: 20

This information must also be completed

RIPARIAN ZONE AND FLOODPLAIN QUALITY ☆NOTE: River Left (L) and Right (R) as looking downstream☆

RIPARIAN WIDTH L	R	(Per Bank)	FLOODPLAIN QUALITY L	R	(Most Predominant per Bank)	L	R	
■	■	Wide >10m	☐	☐	Mature Forest, Wetland	☐	☐	Conservation Tillage
☐	☐	Moderate 5-10m	■	■	Immature Forest, Shrub or Old Field	☐	☐	Urban or Industrial
☐	☐	Narrow <5m	☐	☐	Residential, Park, New Field	☐	☐	Open Pasture, Row Crop
☐	☐	None	☐	☐	Fenced Pasture	☐	☐	Mining or Construction

COMMENTS _____

FLOW REGIME *(At Time of Evaluation)* (Check *ONLY* one box):

- ■ Stream Flowing
- ☐ Subsurface flow with isolated pools (Interstitial)
- ☐ Moist Channel, isolated pools, no flow (Intermittent)
- ☐ Dry channel, no water (Ephemeral)

COMMENTS _____

SINUOSITY (Number of bends per 61 m (200 ft) of channel) (Check *ONLY* one box):

☐ None	☐ 1.0	☐ 2.0	☐ 3.0
☐ 0.5	■ 1.5	☐ 2.5	☐ >3

STREAM GRADIENT ESTIMATE

☐ Flat (0.5 ft/100 ft) ■ Flat to Moderate ☐ Moderate (2 ft/100 ft) ☐ Moderate to Severe ☐ Severe (10 ft/100 ft)

October 24, 2002 Revision

ADDITIONAL STREAM INFORMATION (This Information Must Also be Completed):

QHEI PERFORMED? - ☐ Yes ■ No QHEI Score _____ (If Yes, Attach Completed QHEI Form)

DOWNSTREAM DESIGNATED USE(S)

■ WWH Name: Cross Creek, Ohio River Distance from Evaluated Stream North Branch Cross Creek ≈ 12,000'

☐ CWH Name: _____ Distance from Evaluated Stream _____

☐ EWH Name: _____ Distance from Evaluated Stream _____

MAPPING: ATTACH COPIES OF MAPS, INCLUDING THE ENTIRE WATERSHED AREA. CLEARLY MARK THE SITE LOCATION

USGS Quadrangle Name: Amsterdam, OH NRCS Soil Map Page: 22 NRCS Soil Map Stream Order 1

County: Jefferson Township / City: Springfield Twp.

MISCELLANEOUS HUC 05030101340

Base Flow Conditions? (Y/N): _____ Date of last precipitation: 6/13/10 Quantity: 0.48" (landfill weather station records)

Photograph Information: See Wetland Delineation Report - Appendix B, Photo 20.

Elevated Turbidity? (Y/N) _____ Canopy (% open): 10-15%

Were samples collected for water chemistry? (Y/N) _____ (Note lab sample no. or id. and attach results) Lab Number: _____

Field Measures: Temp (°C) — Dissolved Oxygen (mg/l) — pH (S.U.) — Conductivity (µmhos/cm) —

Is the sampling reach representative of the stream (Y/N) _____ If not, please explain: _____

Unamed Tributary to North Branch Cross Creek

Additional comments/description of pollution impacts: _____

BIOTIC EVALUATION

Performed? (Y/N) _____ (If Yes, Record all observations. Voucher collections optional. NOTE: all voucher samples must be labeled with the site ID number. Include appropriate field data sheets from the Primary Headwater Habitat Assessment Manual)

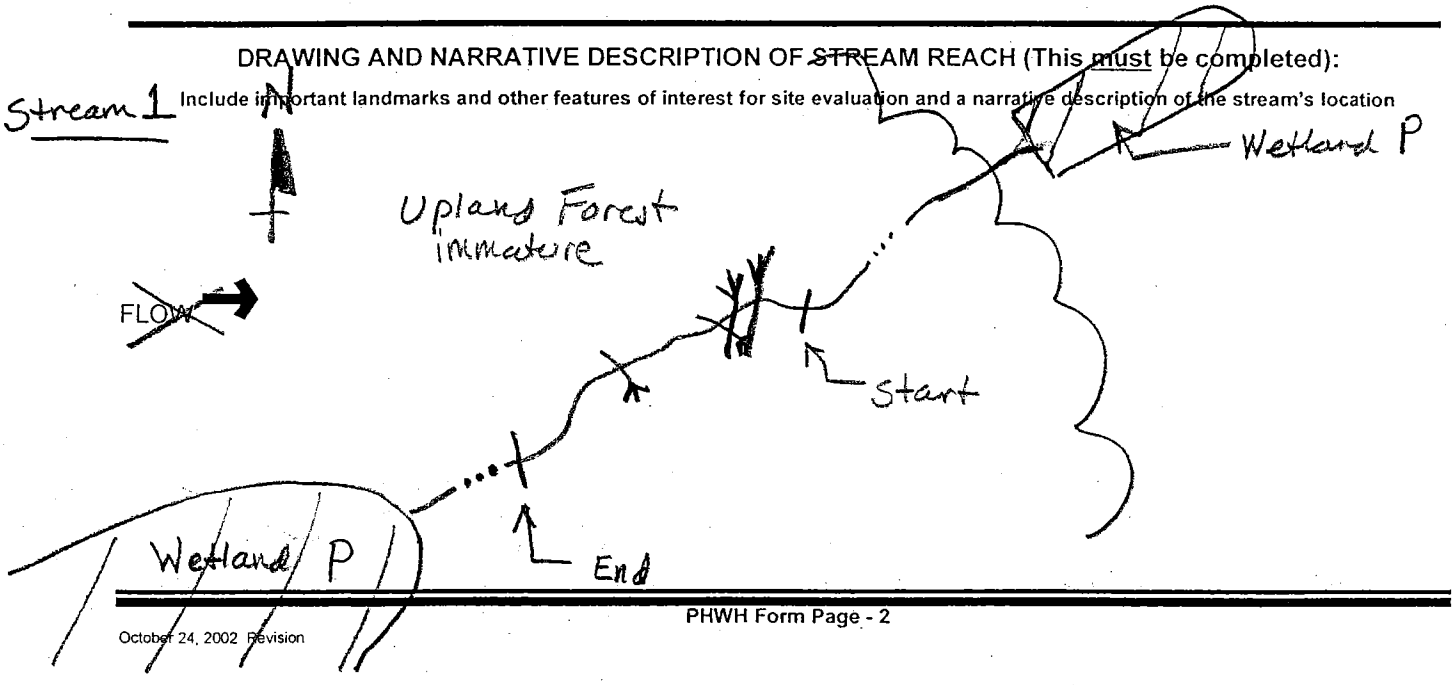
Fish Observed? (Y/N) _____ Voucher? (Y/N) — Salamanders Observed? (Y/N) _____ Voucher? (Y/N) —

Frogs or Tadpoles Observed? (Y/N) _____ Voucher? (Y/N) — Aquatic Macroinvertebrates Observed? (Y/N) _____ Voucher? (Y/N) _____

Comments Regarding Biology: Benthic macroinvertebrates observed: Platyhelminthes (common), Hydrophilidae (beetles) Few, Nemouridae (stone flies) Few.

DRAWING AND NARRATIVE DESCRIPTION OF ~~STREAM~~ REACH (This must be completed):

Include important landmarks and other features of interest for site evaluation and a narrative description of the stream's location



Stream 2

Ohio EPA Primary Headwater Habitat Evaluation Form

HHEI Score (sum of metrics 1, 2, 3) : 17

SITE NAME/LOCATION Apex Sanitary Landfill Expansion
Stream 2 SITE NUMBER Station 1 RIVER BASIN Ohio DRAINAGE AREA (mi²) <0.1
LENGTH OF STREAM REACH (ft) ~ 200' LAT. _____ LONG. _____ RIVER CODE _____ RIVER MILE _____
DATE 6/18/10 SCORER Mike A. Takacs COMMENTS Stream 2 - ephemeral; Class I PHWH

NOTE: Complete All Items On This Form - Refer to "Field Evaluation Manual for Ohio's PHWH Streams" for Instructions

STREAM CHANNEL MODIFICATIONS: ■ NONE / NATURAL CHANNEL ☐ RECOVERED ☐ RECOVERING ☐ RECENT OR NO RECOVERY

1. SUBSTRATE (Estimate percent of every type of substrate present. Check *ONLY* two predominant substrate *TYPE* boxes (Max of 32). Add total number of significant substrate types found (Max of 8). Final metric score is sum of boxes A & B.

TYPE		PERCENT	TYPE		PERCENT
☐☐	BLDR SLABS [16 pts]		■☐	SILT [3 pt]	75
☐☐	BOULDER (>256 mm) [16 pts]		☐☐	LEAF PACK/WOODY DEBRIS [3 pts]	
☐☐	BEDROCK [16 pt]		☐☐	FINE DETRITUS [3 pts]	
☐☐	COBBLE (65-256 mm) [12 pts]	<2	☐☐	CLAY or HARDPAN [0 pt]	<2
☐☐	GRAVEL (2-64 mm) [9 pts]	5	☐☐	MUCK [0 pts]	<1
☐■	SAND (<2 mm) [6 pts]	15	☐☐	ARTIFICIAL [3 pts]	

Total of Percentages of Bldr Slabs, Boulder, Cobble, Bedrock <2 (A) 9 (B) 3

SCORE OF TWO MOST PREDOMINATE SUBSTRATE TYPES: TOTAL NUMBER OF SUBSTRATE TYPES:

HHEI Metric Points
Substrate Max = 40: 12
A + B

2. Maximum Pool Depth ***(Measure the maximum pool depth within the 61 meter (200 ft)*** evaluation reach at the time of evaluation. Avoid plunge pools from road culverts or storm water pipes) (Check *ONLY* one box):

☐	> 30 centimeters [20 pts]	☐	> 5 cm - 10 cm [15 pts]
☐	> 22.5 - 30 cm [30 pts]	☐	< 5 cm [5 pts]
☐	> 10 - 22.5 cm [25 pts]	■	NO WATER OR MOIST CHANNEL [0 pts]

COMMENTS _____ MAXIMUM POOL DEPTH (centimeters): 0

Pool Depth Max = 30: 0

3. BANK FULL WIDTH (Measured as the average of 3-4 measurements) (Check *ONLY* one box):

☐	> 4.0 meters (> 13') [30 pts]	☐	> 1.0 m - 1.5 m (> 3' 3" - 4' 8") [15 pts]
☐	> 3.0 m - 4.0 m (> 9' 7" - 13') [25 pts]	■	≤ 1.0 m (≤ 3' 3") [5 pts]
☐	> 1.5 m - 3.0 m (> 9' 7" - 4' 8") [20 pts]		

COMMENTS _____ AVERAGE BANKFULL WIDTH (meters) 5

Bankfull Width Max=30: 5

This information must also be completed

RIPARIAN ZONE AND FLOODPLAIN QUALITY ☆NOTE: River Left (L) and Right (R) as looking downstream☆

RIPARIAN WIDTH (Per Bank) L R		FLOODPLAIN QUALITY (Most Predominant per Bank) L R		L R	
■■	Wide >10m	☐☐	Mature Forest, Wetland	☐☐	Conservation Tillage
☐☐	Moderate 5-10m	■■	Immature Forest, Shrub or Old Field	☐☐	Urban or Industrial
☐☐	Narrow <5m	☐☐	Residential, Park, New Field	☐☐	Open Pasture, Row Crop
☐☐	None	☐☐	Fenced Pasture	☐☐	Mining or Construction

COMMENTS _____

FLOW REGIME *(At Time of Evaluation)* (Check *ONLY* one box):

☐	Stream Flowing	☐	Moist Channel, isolated pools, no flow (Intermittent)
☐	Subsurface flow with isolated pools (Interstitial)	■	Dry channel, no water (Ephemeral)

COMMENTS _____

SINUOSITY (Number of bends per 61 m (200 ft) of channel) (Check *ONLY* one box):

☐	None	■	1.0	☐	2.0	☐	3.0
☐	0.5	☐	1.5	☐	2.5	☐	>3

STREAM GRADIENT ESTIMATE

☐ Flat (0.5 ft/100 ft) ☐ Flat to Moderate ■ Moderate (2 ft/100 ft) ☐ Moderate to Severe ☐ Severe (10 ft/100 ft)

October 24, 2002 Revision

ADDITIONAL STREAM INFORMATION (This Information Must Also be Completed):

QHEI PERFORMED? - ☐ Yes ■ No QHEI Score _____ (If Yes, Attach Completed QHEI Form)

DOWNSTREAM DESIGNATED USE(S)

■ WWH Name: Cross Creek, Ohio River Distance from Evaluated Stream North Branch Cross Creek ≈ 11,500'

☐ CWH Name: _____ Distance from Evaluated Stream _____

☐ EWH Name: _____ Distance from Evaluated Stream _____

MAPPING: ATTACH COPIES OF MAPS, INCLUDING THE ENTIRE WATERSHED AREA. CLEARLY MARK THE SITE LOCATION

USGS Quadrangle Name: Amsterdam, OH NRCS Soil Map Page: 22 NRCS Soil Map Stream Order 1

County: Jefferson Township / City: Spring Field Twp.

MISCELLANEOUS HUC 05030101340

Base Flow Conditions? (Y/N): _____ Date of last precipitation: 6/13/10 Quantity: 0.48" (Landfill weather station records)

Photograph Information: See Wetland Delineation Report - Appendix B, Photo 21.

Elevated Turbidity? (Y/N): NA Canopy (% open): 15-25%

Were samples collected for water chemistry? (Y/N): _____ (Note lab sample no. or id. and attach results) Lab Number: _____

Field Measures: Temp (°C) — Dissolved Oxygen (mg/l) — pH (S.U.) — Conductivity (µmhos/cm) —

Is the sampling reach representative of the stream? (Y/N) _____ If not, please explain: _____

Unnamed tributary to North Branch Cross Creek

Additional comments/description of pollution impacts: _____

BIOTIC EVALUATION

Performed? (Y/N) _____ (If Yes, Record all observations. Voucher collections optional. NOTE: all voucher samples must be labeled with the site ID number. Include appropriate field data sheets from the Primary Headwater Habitat Assessment Manual)

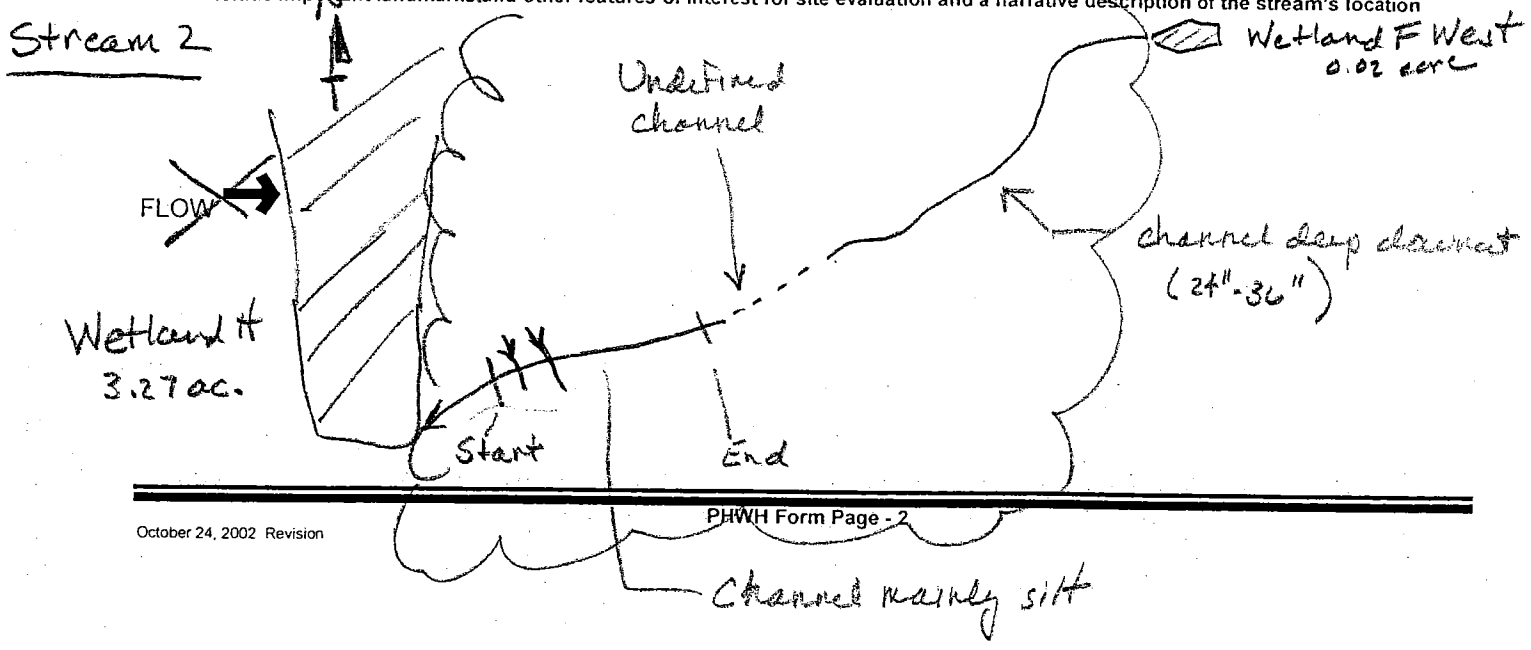
Fish Observed? (Y/N) _____ Voucher? (Y/N) — Salamanders Observed? (Y/N) _____ Voucher? (Y/N) —

Frogs or Tadpoles Observed? (Y/N) _____ Voucher? (Y/N) — Aquatic Macroinvertebrates Observed? (Y/N) _____ Voucher? (Y/N) —

Comments Regarding Biology: Stream channel mainly in silt downcut, 50 m areas w/ alluvial deposits. No flow.

DRAWING AND NARRATIVE DESCRIPTION OF STREAM REACH (This must be completed):

Include important landmarks and other features of interest for site evaluation and a narrative description of the stream's location



OhioEPA Primary Headwater Habitat Evaluation Form

HHEI Score (sum of metrics 1, 2, 3) : 49

SITE NAME/LOCATION Apex Sanitary Landfill Expansion

STREAM 3a SITE NUMBER STATION 1 RIVER BASIN Ohio DRAINAGE AREA (mi²) <0.1

LENGTH OF STREAM REACH (ft) 200 LAT. 126288.616 LONG. 332260.99 RIVER CODE _____ RIVER MILE _____

DATE 6/18/2010 SCORER Mike A. Takacs COMMENTS Stream 3a (int.) Class II PHWH

NOTE: Complete All Items On This Form - Refer to "Field Evaluation Manual for Ohio's PHWH Streams" for Instructions

STREAM CHANNEL MODIFICATIONS: ☒ NONE / NATURAL CHANNEL ☐ RECOVERED ☐ RECOVERING ☐ RECENT OR NO RECOVERY

1. SUBSTRATE (Estimate percent of every type of substrate present. Check *ONLY* two predominant substrate *TYPE* boxes (Max of 32). Add total number of significant substrate types found (Max of 8). Final metric score is sum of boxes A & B.

TYPE		PERCENT	TYPE		PERCENT
☐☐	BLDR SLABS [16 pts]		☐☐	SILT [3 pt]	10
☐☐	BOULDER (>256 mm) [16 pts]	40.1	☐☐	LEAF PACK/WOODY DEBRIS [3 pts]	1
☐☐	BEDROCK [16 pt]		☐☐	FINE DETRITUS [3 pts]	
☐☐	COBBLE (65-256 mm) [12 pts]	5	☐☐	CLAY or HARDPAN [0 pt]	
☐■	GRAVEL (2-64 mm) [9 pts]	25	☐☐	MUCK [0 pts]	
■☐	SAND (<2 mm) [6 pts]	60	☐☐	ARTIFICIAL [3 pts]	

Total of Percentages of Bldr Slabs, Boulder, Cobble, Bedrock 5,46 (A) 15

SCORE OF TWO MOST PREDOMINATE SUBSTRATE TYPES:

(B) 4 TOTAL NUMBER OF SUBSTRATE TYPES:

HHEI Metric Points

Substrate Max = 40: 19

A + B

2. Maximum Pool Depth ***(Measure the maximum pool depth within the 61 meter (200 ft)*** evaluation reach at the time of evaluation. Avoid plunge pools from road culverts or storm water pipes) (Check *ONLY* one box):

☐	> 30 centimeters [20 pts]	■	> 5 cm - 10 cm [15 pts]
☐	> 22.5 - 30 cm [30 pts]	☐	< 5 cm [5 pts]
☐	> 10 - 22.5 cm [25 pts]	☐	NO WATER OR MOIST CHANNEL [0 pts]

COMMENTS mid-reach plunge pool to 10cm MAXIMUM POOL DEPTH (centimeters): 15

Pool Depth Max = 30: 15

3. BANK FULL WIDTH (Measured as the average of 3-4 measurements) (Check *ONLY* one box):

☐	> 4.0 meters (> 13') [30 pts]	■	> 1.0 m - 1.5 m (> 3' 3" - 4' 8") [15 pts]
☐	> 3.0 m - 4.0 m (> 9' 7" - 13') [25 pts]	☐	≤ 1.0 m (≤ 3' 3") [5 pts]
☐	> 1.5 m - 3.0 m (> 9' 7" - 4' 8") [20 pts]		

COMMENTS upper reach 0.6-0.8m; lower reach 0.8-1.1m AVERAGE BANKFULL WIDTH (meters): 15

Bankfull Width Max=30: 15

This information must also be completed

RIPARIAN ZONE AND FLOODPLAIN QUALITY ☆NOTE: River Left (L) and Right (R) as looking downstream☆

RIPARIAN WIDTH (Per Bank) L	R	FLOODPLAIN QUALITY (Most Predominant per Bank) L	R	L	R
■	■ Wide >10m	☐	☐ Mature Forest, Wetland	☐	☐ Conservation Tillage
☐	☐ Moderate 5-10m	■	■ Immature Forest, Shrub or Old Field	☐	☐ Urban or Industrial
☐	☐ Narrow <5m	☐	☐ Residential, Park, New Field	☐	☐ Open Pasture, Row Crop
☐	☐ None	☐	☐ Fenced Pasture	☐	☐ Mining or Construction

COMMENTS _____

FLOW REGIME *(At Time of Evaluation)* (Check *ONLY* one box):

☒ Stream Flowing	☐ Moist Channel, isolated pools, no flow (Intermittent)
☐ Subsurface flow with isolated pools (Interstitial)	☐ Dry channel, no water (Ephemeral)

COMMENTS _____

SINUOSITY (Number of bends per 61 m (200 ft) of channel) (Check *ONLY* one box):

☐ None	☐ 1.0	☐ 2.0	☐ 3.0
☐ 0.5	☐ 1.5	■ 2.5	☐ >3

STREAM GRADIENT ESTIMATE

☐ Flat (0.5 ft/100 ft) ☐ Flat to Moderate ■ Moderate (2 ft/100 ft) ☐ Moderate to Severe ☐ Severe (10 ft/100 ft)

October 24, 2002 Revision

ADDITIONAL STREAM INFORMATION (This Information Must Also be Completed):

QHEI PERFORMED? - ☐ Yes ■ No QHEI Score ________ (If Yes, Attach Completed QHEI Form)

DOWNSTREAM DESIGNATED USE(S)

■ WWH Name: Yellow Creek, Ohio River — Distance from Evaluated Stream: Goose Creek ~3000', Yellow Creek ~ 17,000

☐ CWH Name: ________ Distance from Evaluated Stream ________

☐ EWH Name: ________ Distance from Evaluated Stream ________

MAPPING: ATTACH COPIES OF MAPS, INCLUDING THE ENTIRE WATERSHED AREA. CLEARLY MARK THE SITE LOCATION

USGS Quadrangle Name: Amsterdam, OH NRCS Soil Map Page: 22 NRCS Soil Map Stream Order 1

County: Jefferson Township / City: Springfield Twp.

MISCELLANEOUS HUC 05030101180

Base Flow Conditions? (Y/N): Y (circled) Date of last precipitation: 6/13/10 Quantity: 0.48" (landfill weather station records)

Photograph Information: See Wetland Delineation Report - Appendix B, Photo 22.

Elevated Turbidity? (Y/N): N (circled) Canopy (% open): 10-15%

Were samples collected for water chemistry? (Y/N): N (circled) ________ (Note lab sample no. or id. and attach results) Lab Number: ________

Field Measures: Temp (°C) — Dissolved Oxygen (mg/l) — pH (S.U.) — Conductivity (µmhos/cm) —

Is the sampling reach representative of the stream (Y/N): Y (circled) ______ If not, please explain: ________

Additional comments/description of pollution impacts: No visible staining, debris, or sheens were observed in the water column or sediment.

BIOTIC EVALUATION

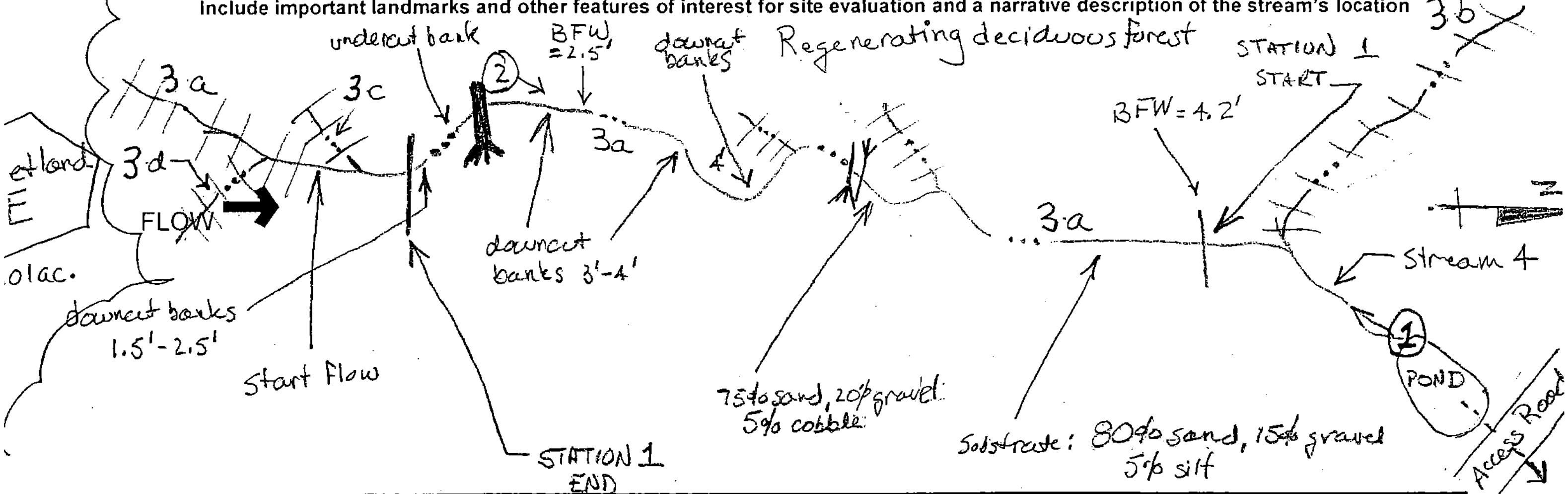
Performed? (Y/N): N (circled) ________ (If Yes, Record all observations. Voucher collections optional. NOTE: all voucher samples must be labeled with the site ID number. Include appropriate field data sheets from the Primary Headwater Habitat Assessment Manual)

Fish Observed? (Y/N): N (circled) ____ Voucher? (Y/N) ____ Salamanders Observed? (Y/N): N (circled) ____ Voucher? (Y/N) ____
Frogs or Tadpoles Observed? (Y/N): N (circled) ____ Voucher? (Y/N) ____ Aquatic Macroinvertebrates Observed? (Y/N): Y (circled) ____ Voucher? (Y/N): N (circled) ____

Comments Regarding Biology: Low density benthic macroinvertebrate population

DRAWING AND NARRATIVE DESCRIPTION OF STREAM REACH (This must be completed):

Include important landmarks and other features of interest for site evaluation and a narrative description of the stream's location



October 24, 2002 Revision

Overhanging vegetation: Rosa multiflora; 5-10%

N.T.S.

— … — intermittent

① Photograph location (field #) +/…/+ ephemeral

3b, 3c, 3d

OhioEPA Primary Headwater Habitat Evaluation Form

HHEI Score (sum of metrics 1, 2, 3) : 18

SITE NAME/LOCATION Stream 3a, b, c, d SITE NUMBER STATION 2 RIVER BASIN Ohio DRAINAGE AREA (mi²) <0.1

LENGTH OF STREAM REACH (ft) ~100 LAT. _____ LONG. _____ RIVER CODE _____ RIVER MILE _____

DATE 6/18/2010 SCORER Mike A. Takacs COMMENTS Streams 3b, 3c, 3d - Class I PHWH

NOTE: Complete All Items On This Form - Refer to "Field Evaluation Manual for Ohio's PHWH Streams" for Instructions

STREAM CHANNEL MODIFICATIONS: ☒ NONE / NATURAL CHANNEL ☐ RECOVERED ☐ RECOVERING ☐ RECENT OR NO RECOVERY

1. SUBSTRATE (Estimate percent of every type of substrate present. Check *ONLY* two predominant substrate *TYPE* boxes (Max of 32). Add total number of significant substrate types found (Max of 8). Final metric score is sum of boxes A & B.

TYPE		PERCENT	TYPE		PERCENT
☐	BLDR SLABS [16 pts]		☒	SILT [3 pt]	80
☐	BOULDER (>256 mm) [16 pts]		☐	LEAF PACK/WOODY DEBRIS [3 pts]	1-3
☐	BEDROCK [16 pt]		☐	FINE DETRITUS [3 pts]	
☐	COBBLE (65-256 mm) [12 pts]	<1	☐	CLAY or HARDPAN [0 pt]	<1
☐	GRAVEL (2-64 mm) [9 pts]	5	☐	MUCK [0 pts]	
☒	SAND (<2 mm) [6 pts]	10	☐	ARTIFICIAL [3 pts]	

Total of Percentages of Bldr Slabs, Boulder, Cobble, Bedrock <1 (A) 9 (B) 4

SCORE OF TWO MOST PREDOMINATE SUBSTRATE TYPES: TOTAL NUMBER OF SUBSTRATE TYPES: A + B

HHEI Metric Points

Substrate Max = 40 13.

2. Maximum Pool Depth ***(Measure the maximum pool depth within the 61 meter (200 ft)*** evaluation reach at the time of evaluation. Avoid plunge pools from road culverts or storm water pipes) (Check *ONLY* one box):

☐	> 30 centimeters [20 pts]	☐	> 5 cm - 10 cm [15 pts]
☐	> 22.5 - 30 cm [30 pts]	☐	< 5 cm [5 pts]
☐	> 10 - 22.5 cm [25 pts]	☒	NO WATER OR MOIST CHANNEL [0 pts]

COMMENTS no flow, ephemeral, typical of upper 3a, 3b, 3c, & 3d MAXIMUM POOL DEPTH (centimeters): 0

Pool Depth Max = 30 0

3. BANK FULL WIDTH (Measured as the average of 3-4 measurements) (Check *ONLY* one box):

☐	> 4.0 meters (> 13') [30 pts]	☐	> 1.0 m - 1.5 m (> 3' 3" - 4' 8") [15 pts]
☐	> 3.0 m - 4.0 m (> 9' 7" - 13') [25 pts]	☒	≤ 1.0 m (≤ 3' 3") [5 pts]
☐	> 1.5 m - 3.0 m (> 9' 7" - 4' 8") [20 pts]		

COMMENTS _____ AVERAGE BANKFULL WIDTH (meters) 5

Bankfull Width Max=30 5

This information must also be completed

RIPARIAN ZONE AND FLOODPLAIN QUALITY ☆NOTE: River Left (L) and Right (R) as looking downstream☆

RIPARIAN WIDTH (Per Bank) L	R	FLOODPLAIN QUALITY (Most Predominant per Bank) L	R		L	R	
☒	☒	Wide >10m	☐	☐	Mature Forest, Wetland	☐	☐ Conservation Tillage
☐	☐	Moderate 5-10m	☒	☒	Immature Forest, Shrub or Old Field	☐	☐ Urban or Industrial
☐	☐	Narrow <5m	☐	☐	Residential, Park, New Field	☐	☐ Open Pasture, Row Crop
☐	☐	None	☐	☐	Fenced Pasture	☐	☐ Mining or Construction

COMMENTS _____

FLOW REGIME *(At Time of Evaluation)* (Check *ONLY* one box):

☐	Stream Flowing	☐	Moist Channel, isolated pools, no flow (Intermittent)
☐	Subsurface flow with isolated pools (Interstitial)	☒	Dry channel, no water (Ephemeral)

COMMENTS _____

SINUOSITY (Number of bends per 61 m (200 ft) of channel) (Check *ONLY* one box):

☐	None	☐	1.0	☐	2.0	☐	3.0
☐	0.5	☒	1.5	☐	2.5	☐	>3

STREAM GRADIENT ESTIMATE

☐ Flat (0.5 ft/100 ft) ☐ Flat to Moderate ☒ Moderate (2 ft/100 ft) ☐ Moderate to Severe ☐ Severe (10 ft/100 ft)

October 24, 2002 Revision

Upland forest

3b, 3c, 3d

ADDITIONAL STREAM INFORMATION (This Information Must Also be Completed):

QHEI PERFORMED? - ☐ Yes ☒ No QHEI Score _____ (If Yes, Attach Completed QHEI Form)

DOWNSTREAM DESIGNATED USE(S)

☒ WWH Name: Yellow Creek, Ohio River Distance from Evaluated Stream Yellow Creek ~17,000' Goose Creek ~3000'

☐ CWH Name: _____ Distance from Evaluated Stream _____

☐ EWH Name: _____ Distance from Evaluated Stream _____

MAPPING: ATTACH COPIES OF MAPS, INCLUDING THE ENTIRE WATERSHED AREA. CLEARLY MARK THE SITE LOCATION

USGS Quadrangle Name: Amsterdam, OH NRCS Soil Map Page: 22 NRCS Soil Map Stream Order 1

County: Jefferson Township / City: Springfield Twp.

MISCELLANEOUS No flow. HUC 05030101180

Base Flow Conditions? (Y/N): _____ Date of last precipitation: 6/13/10 Quantity: 0.48" (Landfill weather station records)

Photograph Information: See Wetland Delineation Report - Appendix B, Photos 23 and 24.

Elevated Turbidity? (Y/N): NA Canopy (% open): 15-25%

Were samples collected for water chemistry? (Y/N) NA (Note lab sample no. or id. and attach results) Lab Number: _____

Field Measures: Temp (°C) — Dissolved Oxygen (mg/l) — pH (S.U.) — Conductivity (µmhos/cm) —

Is the sampling reach representative of the stream (Y/N) _____ If not, please explain: Upper section of Stream Segment 3a. Ephemeral channel typical of upper 3a, 3b, 3c, and 3d.

Additional comments/description of pollution impacts: NA

BIOTIC EVALUATION

Performed? (Y/N) _____ (If Yes, Record all observations. Voucher collections optional. NOTE: all voucher samples must be labeled with the site ID number. Include appropriate field data sheets from the Primary Headwater Habitat Assessment Manual)

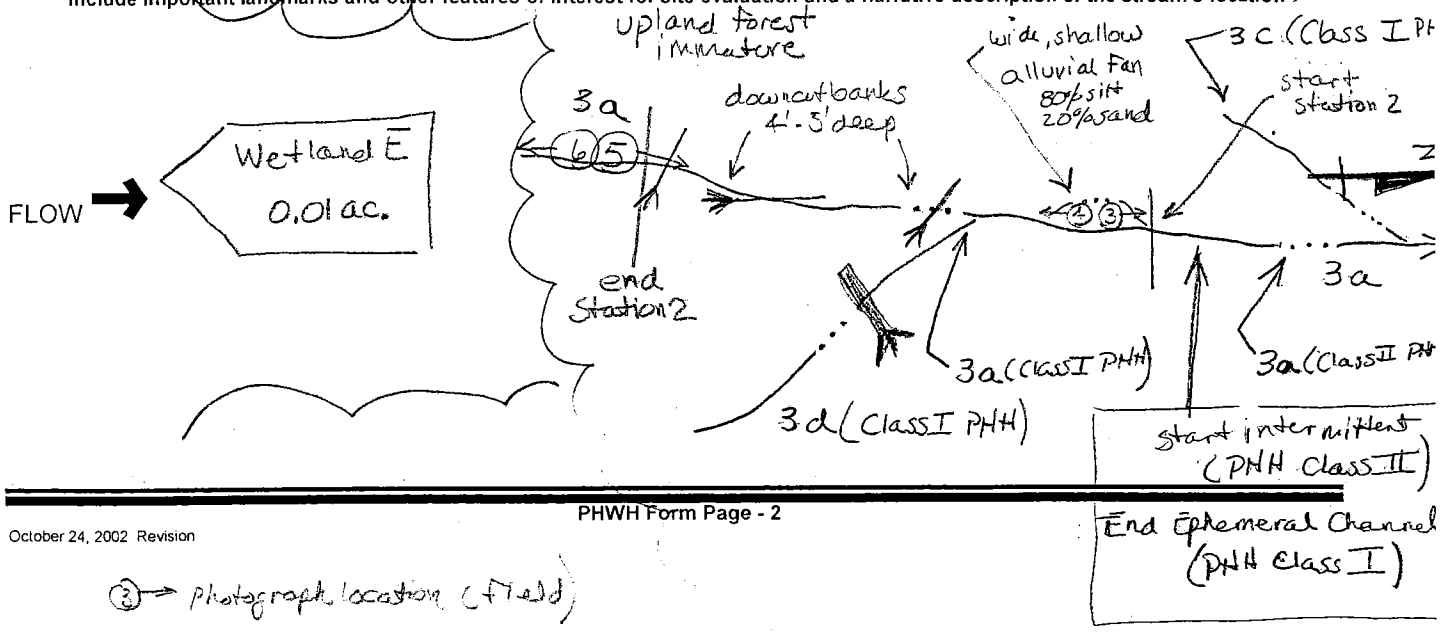
Fish Observed? (Y/N) _____ Voucher? (Y/N) _____ Salamanders Observed? (Y/N) _____ Voucher? (Y/N) _____

Frogs or Tadpoles Observed? (Y/N) _____ Voucher? (Y/N) _____ Aquatic Macroinvertebrates Observed? (Y/N) _____ Voucher? (Y/N) _____

Comments Regarding Biology: No benthic macroinvertebrates or crayfish were observed in ephemeral streams: upper 3A, 3B, 3C, and 3D.

DRAWING AND NARRATIVE DESCRIPTION OF STREAM REACH (This must be completed):

Include important landmarks and other features of interest for site evaluation and a narrative description of the stream's location.



③ → Photograph location (Field)

October 17, 2011

Mr. Matt Mason
U.S. Army Corps of Engineers
Federal Building
1000 Liberty Avenue
Pittsburgh, Pennsylvania 15222-4186

Dear Mr. Mason:

Subject: Wetland and Stream Delineation Report Revisions and Addendum
As per the July 18, 2011 field meeting and October 6, 2011 e-mail
Potential Apex Sanitary Landfill Expansion
Jefferson, and Harrison Counties, Ohio
CEC Project 080-608.0001

As discussed in our e-mail correspondence with you on October 6, 2011, this submittal replaces the letter previously submitted to your office on September 15, 2011. Civil & Environmental Consultants, Inc. (CEC), on behalf of Apex Environmental, LLC, is submitting the enclosed revised wetland and stream delineation map and summary tables, which incorporate revisions discussed at the meeting held on-site on July 18, 2011 as well as an additional meeting held on-site with the Ohio EPA on May 19, 2011. This information, along with the enclosed additional and revised wetland and stream data forms serve as an addendum to CEC's Wetland and Stream Delineation Report dated October 2010.

The following list summarizes the revisions that were made to the Wetland and Stream Delineation Report:

- A small isolated wetland (Wetland S, 0.02 acre) and a small isolated ephemeral stream (Stream 1E, 380 l.f.) were found near the southeastern edge of Wetland P.
- Isolated wetlands A, I, J, K, L were determined by the Ohio EPA to not be wetlands, but to consist entirely of open water (Open Water 1, 12, 13, 14, 15).
- A length of intermittent stream was added to the interior of Wetland H (Stream 2C, 637 l.f.).
- The downstream reach of Stream 1A was determined to be connected to Wetland P and intermittent.
- When Wetland R was broken out as a separate wetland from Wetland P, we did not subtract the acreage of wetland R from Wetland P. We have subtracted the acreage of Wetland R from Wetland P, and the acreage for Wetland P has been updated to show the accurate total acreage.
- An error was made during the calculation of the length of Stream 1E. This isolated stream was added during the site visit held on May 19, 2011 with the Ohio EPA. The stream length for Stream 1E has been updated to show the accurate stream length.
- New ORAM forms have been completed and provided for Wetlands R and S.
- New HHEI forms have been provided for Streams 1B, 1C, 1E, 2B, and 2C.
- Updated forms, including corrections, have been provided for Streams 1A, 1D, and 2A.

As discussed during our debriefing after the July 18, 2011 field inspection and the additional e-mail correspondence on October 6, 2011, you will incorporate these revisions into the previously issued jurisdictional determination dated February 8, 2011. We are enclosing the following revised documents for your review:

- Figure 4 – Stream and Wetland Delineation Map
- Figure 5 – Wetland Boundary Points
- Table 1 – Wetland Characteristics
- Table 2 – Stream Characteristics
- Table 3 – Open Water Characteristics
- Wetland Determination Data Forms for Wetland S
- New ORAM forms for Wetlands R and S
- New HHEI forms for Streams 1B, 1C, 1E, 2B, and 2C
- Updated/corrected HHEI forms for Streams 1A, 1D, and 2A

We respectfully request that you revise the jurisdictional determination letter for the Apex Sanitary Landfill Lateral Expansion. If you have any questions or require additional information to complete the revised jurisdictional determination letter, please feel free to contact me at (412) 429-2324 or lshema@cecinc.com. Thank you for your continued assistance in this matter.

Very truly yours,

CIVIL & ENVIRONMENTAL CONSULTANTS, INC.

Laura C. P. Shema

Laura C. P. Shema
Project Manager, Ecological Services

cc: Scott Lockhart, Apex Environmental, LLC
Dan Osterfeld, Ohio Environmental Protection Agency

080-608.0001-L-Wetland Rev-10-17-11/W

TABLE 1
WETLAND CHARACTERISTICS

Wetland	Area Within Study Boundary (acres)	USFWS Classification[1]	Test Site Number
B[2]	2.21	PEM/PAB/POWZx	3
C[2, 5]	0.05	PAB/POWZx/PSS	5
D[2]	0.58	PAB/POWZx	7
E	0.01	PEMB	9
F[2]	0.05	PEM/PSSB	11
G[2]	1.13	PEM/PABZx	13
H[3]	3.15	PAB/POWZx/PEM1	-
M[2, 3]	0.60	PAB/POWZx	-
N[2]	0.44	PAB/POWZx	23
O[2, 5]	0.20	PAB/POWZx	25
P[3,4]	7.86	PEM/PSS/PFO/PAB/POW-C/Zh	29
Q[2]	1.82	PEM/PAB/POWZx	27
R	0.18	PEM	-
S[2]	0.02	PEM	Wetland S
Total	18.30		

[1] Based on Cowardin and coworkers, 1979. P – palustrine; AB – aquatic bed; EM – emergent; SS - scrub-shrub; OW – open water.

[2] It is CEC's opinion that this is an isolated wetland. Final classification pending USACE jurisdicitonal determination.

[3] Data for wetlands H, M, and P taken from Gilbert (2003)

[4] Total delineated area is 10.01 acres; 7.86 acres are located within the project area.

[5] Wetlands C and O were scored as a complex for the ORAM.

TABLE 2
STREAM CHARACTERISTICS

Stream	Onsite Length (linear feet)		
	Intermittent	Ephemeral	Total
Stream 1A	505	-	505
Stream 1A	-	132	132
Stream 1B	338	-	338
Stream 1C	113	-	113
Stream 1D	1,821	-	1,821
Stream 1E[1]		380	380
Stream 2A[2]	-	732	732
Stream 2B	-	131	131
Stream 2C	637	-	637
Stream 3A	363		363
Stream 3A		111	111
Stream 3B		257	257
Stream 3C		39	39
Stream 3D		68	68
Total	3,777	1,850	5,627

[1] It is CEC's opinion that this is an isolated stream. Final classification pending USACE jurisdicitonal determination.

[2] It is CEC's opinion that 480 linear feet of this stream is isolated. Final classification pending USACE jurisdicitonal determination.

TABLE 3
OPEN WATER CHARACTERISTICS

Waterbody Name	Size (acres)	Wetland Association
Open Water 1[1]	2.94	None
Open Water 4[1]	0.79	Wetland B
Open Water 5[1]	0.24	Wetland N
Open Water 6[1]	0.18	Wetland N
Open Water 7[1]	0.07	Wetland O
Open Water 8	0.96	Wetland R
Open Water 9[1]	1.75	Wetland Q
Open Water 10[1]	0.77	Wetland Q
Open Water 11[1]	0.09	Wetland D
Open Water 12[1]	1.37	None
Open Water 13[1]	0.16	None
Open Water 14[1]	0.04	None
Open Water 15[1]	0.11	None
Total	9.47	

[1] It is CEC's opinion that this is an isolated open water. Final classification pending USACE jurisdicitonal determination.

DATA FORM
ROUTINE WETLAND DETERMINATION
(1987 COE Wetland Delineation Manual)

Project/Site:	080-608 Apex Sanitary Landfill		**Date:** May 19, 2011
Applicant/Owner:	Apex Environmental, LLC		**County:** Jefferson
Investigator(s):	Mark Haibach and Laura Shema		**State:** Ohio
Do normal circumstances exist on the site?	Yes X	No	**Community ID:** PEM
Is the site significantly disturbed (Atypical?)	Yes	No X	
Is the area a potential problem area? (if needed, explain on reverse.)	Yes	No X	**Plot ID:** Wetland S

VEGETATION

Dominant Plant Species:	Stratum:	Indicator:	Dominant Plant Species:	Stratum:	Indicator:
1. *Glyceria striata*	H	OBL	11.		
2. *Solidago gigantea*	H	FACW	12.		
3. *Rumex obtusifolius*	H	FACU-	13.		
4. *Symplocarpus foetidus*	H	OBL	14.		
5. *Equisetum sp.*	H	N.I.	15.		
6. *Poa trivalis*	H	FACW	16.		
7. *Rosa multiflora*	S	FACU	17.		
8. *Acer rubrum*	T	FAC	18.		
9.			19.		
10.			20.		

Percent of dominant species that are OBL, FACW or FAC (and excluding FAC-) = 71 % (5 / 7)

Remarks:

HYDROLOGY

_____ Recorded Data (Describe in Remarks)
_____ Stream, Lake, or Tide Gauge
_____ Aerial Photographs
_____ No Recorded Data Available

Field Observations:

Depth of Surface Water: 0-1 (inches)

Depth to Free Water in Pit: >16 (inches)

Depth to Saturated Soil: to surface (inches)

Wetland Hydrology Indicators:
Primary Indicators:
X Inundated
_____ Saturated in upper 12 inches
_____ Water Marks
_____ Drift Lines
_____ Sediment Deposits
X Drainage Patterns in Wetlands

Secondary Indicators:
_____ Oxidized Root Channels in Upper 12 Inches
_____ Water Stained Leaves
_____ Local Soil Survey Data
_____ FAC-Neutral Test
_____ Others (Explain in Remarks)

Remarks:

Project/Site: 080-608 Apex Sanitary Landfill
Site/Area ID: Wetland S

SOILS

Map Unit Name:
(Series and Phase): Guernsey silty clay loam, 15-25% (GuD2) Drainage Class: moderately well drained
(Taxonomy Subgroup): Aquic Hapludalfs Field Observations Confirm Mapped Type? Yes ____ No X

Profile Description:

Depth (inches):	Horizon:	Matrix Color (Munsell Moist):	Mottle Colors (Munsell Moist):	Mottle (Abundance/Size):	Texture, Concretions, Structure:
0-2		5Y 2.5/1	None	N/A	silt loam
2-4		N 2.5/0	None	N/A	fibric organic/sapric organic
4-12		N 2.5/0	None	N/A	silt loam
12-16		5Y 5/2	None	N/A	silt loam

Hydric Soil Indicators:

____	Histosol	____	Concretions
____	Histic Epipedon	____	High Organic Content in Surface Layer in Sandy Soils
____	Sulfidic Odor	____	Organic Streaking in Sandy Soil
____	Aquic Moisture Regimes	____	Listed on Local Hydric Soils List
____	Reducing Conditions	____	Listed on National Hydric Soils List
X	Gleyed or Low Chroma Colors	____	Other (Explain in Remarks)

Remarks:

WETLAND DETERMINATION

Hydrophytic Vegetation Present?	Yes X	No ____	Is this Sampling Point Within a Wetland?	
Wetland Hydrology Present?	Yes X	No ____	Yes X	
Hydric Soils Present?	Yes X	No ____	No ____	

Remarks:

DATA FORM
ROUTINE WETLAND DETERMINATION
(1987 COE Wetland Delineation Manual)

Project/Site:	080-608 Apex Sanitary Landfill		**Date:** May 19, 2011
Applicant/Owner:	Apex Environmental, LLC		**County:** Jefferson
Investigator(s):	Mark Haibach and Laura Shema		**State:** Ohio
Do normal circumstances exist on the site?	Yes X	No	**Community ID:** Non-Wetland
Is the site significantly disturbed (Atypical?)	Yes	No X	**Plot ID:** Upland Pair for Wetland S
Is the area a potential problem area? (if needed, explain on reverse.)	Yes	No X	

VEGETATION

Dominant Plant Species:	Stratum:	Indicator:	Dominant Plant Species:	Stratum:	Indicator:
1. *Robinia pseudoacacia*	T	FACU-	11.		
2. *Vitis sp.*	WV	N.I.	12.		
3. *Rubus occidentalis*	S	UPL	13.		
4. *Rosa multiflora*	S	FACU	14.		
5. *Equisetum arvense*	H	FAC	15.		
6. *Solidago altissima*	H	FACU-	16.		
7. *Stellaria media*	H	UPL	17.		
8. *Lamium purpureum*	H	UPL	18.		
9. *Galium aparine*	H	FACU	19.		
10.			20.		

Percent of dominant species that are OBL, FACW or FAC (and excluding FAC-) = 13 % (1 / 8)

Remarks:

HYDROLOGY

_____ Recorded Data (Describe in Remarks)
_____ Stream, Lake, or Tide Gauge
_____ Aerial Photographs
_____ No Recorded Data Available

Field Observations:

Depth of Surface Water: N/A (inches)

Depth to Free Water in Pit: 10 (inches)

Depth to Saturated Soil: 5-16 (inches)

Wetland Hydrology Indicators:

Primary Indicators:
_____ Inundated
X Saturated in upper 12 inches
_____ Water Marks
_____ Drift Lines
_____ Sediment Deposits
_____ Drainage Patterns in Wetlands

Secondary Indicators:
_____ Oxidized Root Channels in Upper 12 Inches
_____ Water Stained Leaves
_____ Local Soil Survey Data
_____ FAC-Neutral Test
_____ Others (Explain in Remarks)

Remarks:

Project/Site: 080-608 Apex Sanitary Landfill
Site/Area ID: Upland Pair for Wetland S

SOILS

Map Unit Name:

(Series and Phase): Guernsey silty clay loam, 15-25% (GuD2) Drainage Class: moderately well drained

(Taxonomy Subgroup): Aquic Hapludalfs Field Observations Confirm Mapped Type? Yes X No

Profile Description:

Depth (inches):	Horizon:	Matrix Color (Munsell Moist):	Mottle Colors (Munsell Moist):	Mottle (Abundance/Size):	Texture, Concretions, Structure:
0-5		10YR 3/2	None	N/A	clayey silt loam
5-15		2.5Y 5/3	10YR 6/8	few/medium	gravelly clay loam

Hydric Soil Indicators:

	Histosol		Concretions
	Histic Epipedon		High Organic Content in Surface Layer in Sandy Soils
	Sulfidic Odor		Organic Streaking in Sandy Soil
	Aquic Moisture Regimes		Listed on Local Hydric Soils List
	Reducing Conditions		Listed on National Hydric Soils List
	Gleyed or Low Chroma Colors		Other (Explain in Remarks)

Remarks:

WETLAND DETERMINATION

Hydrophytic Vegetation Present?	Yes		No	X
Wetland Hydrology Present?	Yes	X	No	
Hydric Soils Present?	Yes		No	X

Is this Sampling Point Within a Wetland? Yes No X

Remarks:

Apex Landfill Expansion
Harrison and Jefferson Counties, Ohio

Photo 1: Wetland S

Background Information

Name:	Mark R. Haibach
Date:	11/15/10
Affiliation:	Civil & Environmental Consultants, Inc
Address:	333 Baldwin Road, Pittsburgh, PA 15221
Phone Number:	412-249-3156
e-mail address:	mhaibach@cecinc.com
Name of Wetland:	Wetland R
Vegetation Communit(ies):	PEM / POW
HGM Class(es):	Fringe wetlands (basin)

Location of Wetland include map, address, north arrow, landmarks, distances, roads, etc.

See wetland and stream delineation map

Lat/Long or UTM Coordinate	
USGS Quad Name	Amsterdam, OH
County	Jefferson / Harrison
Township	Springfield /
Section and Subsection	
Hydrologic Unit Code	05030101340
Site Visit	11/15/10
National Wetland Inventory Map	Amsterdam, OH
Ohio Wetland Inventory Map	—
Soil Survey	Soil Survey of Harrison County, OH
Delineation report/map	Wetland and Stream Delin. & Assess. Rpt. (CEC 2010, 2011)
Wetland Size (acres, hectares)	0.18 ac.

Name: Wetland R

sketch (include north arrow, relationship with other surface waters, vegetation zones, etc.)

See Stream and Wetland Delineation Map (Figure 4).

Comments, Narrative Discussion, Justification of Category Changes

Final score : 39.5	Category	2

Wetland R

Scoring Boundary Worksheet

INSTRUCTIONS. The initial step in completing the ORAM is to identify the "scoring boundaries" of the wetland being rated. In many instances this determination will be relatively easy and the scoring boundaries will coincide with the "jurisdictional boundaries." For example, the scoring boundary of an isolated cattail marsh located in the middle of a farm field will likely be the same as that wetland's jurisdictional boundaries. In other instances, however, the scoring boundary will not be as easily determined. Wetlands that are small or isolated from other surface waters often form large contiguous areas or heterogeneous complexes of wetland and upland. In separating wetlands for scoring purposes, the hydrologic regime of the wetland is the main criterion that should be used. Boundaries between contiguous or connected wetlands should be established where the volume, flow, or velocity of water moving through the wetland changes significantly. *Areas with a high degree of hydrologic interaction should be scored as a single wetland.* In determining a wetland's scoring boundaries, use the guidelines in the ORAM Manual Section 5.0. In certain instances, it may be difficult to establish the scoring boundary for the wetland being rated. These problem situations include wetlands that form a patchwork on the landscape, wetlands divided by artificial boundaries like property fences, roads, or railroad embankments, wetlands that are contiguous with streams, lakes, or rivers, and estuarine or coastal wetlands. These situations are discussed below, however, it is recommended that Rater contact Ohio EPA, Division of Surface Water, 401/Wetlands Unit if there are additional questions or a need for further clarification of the appropriate scoring boundaries of a particular wetland.

#	Steps in properly establishing scoring boundaries	done?	not applicable
Step 1	Identify the wetland area of interest. This may be the site of a proposed impact, a mitigation site, conservation site, etc.	Yes	
Step 2	Identify the locations where there is physical evidence that hydrology changes rapidly. Such evidence includes both natural and human-induced changes including, constrictions caused by berms or dikes, points where the water velocity changes rapidly at rapids or falls, points where significant inflows occur at the confluence of rivers, or other factors that may restrict hydrologic interaction between the wetlands or parts of a single wetland.	Yes	
Step 3	Delineate the boundary of the wetland to be rated such that all areas of interest that are contiguous to and within the areas where the hydrology does not change significantly, i.e. areas that have a high degree of hydrologic interaction are included within the scoring boundary.	Yes	
Step 4	Determine if artificial boundaries, such as property lines, state lines, roads, railroad embankments, etc., are present. These should not be used to establish scoring boundaries unless they coincide with areas where the hydrologic regime changes.	Yes	
Step 5	In all instances, the Rater may enlarge the minimum scoring boundaries discussed here to score together wetlands that could be scored separately.	Yes	
Step 6	Consult ORAM Manual Section 5.0 for how to establish scoring boundaries for wetlands that form a patchwork on the landscape, divided by artificial boundaries, contiguous to streams, lakes or rivers, or for dual classifications.	Yes	

Wetland R

Narrative Rating

INSTRUCTIONS. Answer each of the following questions. Questions 1, 2, 3 and 4 should be answered based on information obtained from the site visit or the literature *and* by submitting a Data Services Request to the Ohio Department of Natural Resources, Division of Natural Areas and Preserves, Natural Heritage Data Services, 1889 Fountain Square Court, Building F-1, Columbus, Ohio 43224, 614-265-6453 (phone), 614-265-3096 (fax), http://www.dnr.state.oh.us/odnr/dnap/. The remaining questions are designed to be answered primarily by the results of the site visit. Refer to the User's Manual for descriptions of these wetland types. Note: "Critical habitat" is a legally defined in the Endangered Species Act and is the geographic area containing physical or biological features essential to the conservation of a listed species or as an area that may require special management considerations or protection. The Rater should contact the Region 3 Headquarters or the Reynoldsburg Ecological Services Office for updates as to whether critical habitat has been designated for other federally listed threatened or endangered species. "Documented" means the wetland is listed in the appropriate State of Ohio database.

#	Question	Circle one	
1	**Critical Habitat.** Is the wetland in a township, section, or subsection of a United States Geological Survey 7.5 minute Quadrangle that has been designated by the U.S. Fish and Wildlife Service as "critical habitat" for any threatened or endangered plant or animal species? Note: as of January 1, 2001, of the federally listed endangered or threatened species which can be found in Ohio, the Indiana Bat has had critical habitat designated (50 CFR 17.95(a)) and the piping plover has had critical habitat proposed (65 FR 41812 July 6, 2000).	YES Wetland should be evaluated for possible Category 3 status Go to Question 2	(NO) Go to Question 2
2	**Threatened or Endangered Species.** Is the wetland known to contain an individual of, or documented occurrences of federal or state-listed threatened or endangered plant or animal species?	YES Wetland is a Category 3 wetland. Go to Question 3	(NO) Go to Question 3
3	**Documented High Quality Wetland.** Is the wetland on record in Natural Heritage Database as a high quality wetland?	YES Wetland is a Category 3 wetland Go to Question 4	(NO) Go to Question 4
4	**Significant Breeding or Concentration Area.** Does the wetland contain documented regionally significant breeding or nonbreeding waterfowl, neotropical songbird, or shorebird concentration areas?	YES Wetland is a Category 3 wetland Go to Question 5	(NO) Go to Question 5
5	**Category 1 Wetlands.** Is the wetland less than 0.5 hectares (1 acre) in size and **hydrologically isolated** and either 1) comprised of vegetation that is dominated (greater than eighty per cent areal cover) by *Phalaris arundinacea, Lythrum salicaria,* or *Phragmites australis*, or 2) an acidic pond created or excavated on mined lands that has little or no vegetation?	YES Wetland is a Category 1 wetland Go to Question 6	(NO) Go to Question 6
6	**Bogs.** Is the wetland a peat-accumulating wetland that 1) has no significant inflows or outflows, 2) supports acidophilic mosses, particularly *Sphagnum* spp., 3) the acidophilic mosses have >30% cover, 4) at least one species from Table 1 is present, and 5) the cover of invasive species (see Table 1) is <25%?	YES Wetland is a Category 3 wetland Go to Question 7	(NO) Go to Question 7
7	**Fens.** Is the wetland a carbon accumulating (peat, muck) wetland that is the saturated during most of the year, primarily by a discharge of free flowing, mineral rich, ground water with a circumneutral ph (5.5-9.0) and with one or more plant species listed in Table 1 and the cover of invasive species listed in Table 1 is <25%?	YES Wetland is a Category 3 wetland Go to Question 8a	(NO) Go to Question 8a

Wetland R.

#	Question	Circle one	
8a	**"Old Growth Forest."** Is the wetland a forested wetland and is the forest characterized by, but not limited to, the following characteristics: overstory canopy trees of great age (exceeding at least 50% of a projected maximum attainable age for a species); little or no evidence of human-caused understory disturbance during the past 80 to 100 years; an all-aged structure and multilayered canopies; aggregations of canopy trees interspersed with canopy gaps; and significant numbers of standing dead snags and downed logs?	YES Wetland is a Category 3 wetland. Go to Question 8b	(NO) Go to Question 8b
8b	**Mature forested wetlands.** Is the wetland a forested wetland with 50% or more of the cover of upper forest canopy consisting of deciduous trees with large diameters at breast height (dbh), generally diameters greater than 45cm (17.7in) dbh?	YES Wetland should be evaluated for possible Category 3 status. Go to Question 9a	(NO) Go to Question 9a
9a	**Lake Erie coastal and tributary wetlands.** Is the wetland located at an elevation less than 575 feet on the USGS map, adjacent to this elevation, or along a tributary to Lake Erie that is accessible to fish?	YES Go to Question 9b	(NO) Go to Question 10
9b	Does the wetland's hydrology result from measures designed to prevent erosion and the loss of aquatic plants, i.e. the wetland is partially hydrologically restricted from Lake Erie due to lakeward or landward dikes or other hydrological controls?	YES Wetland should be evaluated for possible Category 3 status Go to Question 9d	(NO) Go to Question 9c
9c	Are Lake Erie water levels the wetland's primary hydrological influence, i.e. the wetland is hydrologically unrestricted (no lakeward or upland border alterations), or the wetland can be characterized as an "estuarine" wetland with lake and river influenced hydrology. These include sandbar deposition wetlands, estuarine wetlands, river mouth wetlands, or those dominated by submersed aquatic vegetation.	YES Go to Question 9d	NO Go to Question 9d
9d	Does the wetland have a predominance of native species within its vegetation communities, although non-native or disturbance tolerant native species can also be present?	YES Wetland is a Category 3 wetland Go to Question 10	NO Go to Question 9e
9e	Does the wetland have a predominance of non-native or disturbance tolerant native plant species within its vegetation communities?	YES Wetland should be evaluated for possible Category 3 status Go to Question 10	NO Go to Question 10
10	**Lake Plain Sand Prairies (Oak Openings)** Is the wetland located in Lucas, Fulton, Henry, or Wood Counties and can the wetland be characterized by the following description: the wetland has a sandy substrate with interspersed organic matter, a water table often within several inches of the surface, and often with a dominance of the gramineous vegetation listed in Table 1 (woody species may also be present). The Ohio Department of Natural Resources Division of Natural Areas and Preserves can provide assistance in confirming this type of wetland and its quality.	YES Wetland is a Category 3 wetland. Go to Question 11	(NO) Go to Question 11
11	**Relict Wet Prairies.** Is the wetland a relict wet prairie community dominated by some or all of the species in Table 1. Extensive prairies were formerly located in the Darby Plains (Madison and Union Counties), Sandusky Plains (Wyandot, Crawford, and Marion Counties), northwest Ohio, Erie County, and portions of western Ohio Counties (e.g. Darke, Mercer, Miami, Montgomery, etc.).	YES Wetland should be evaluated for possible Category 3 status Complete Quantitative Rating	(NO) Complete Quantitative Rating

Quantitative Rating

Wetland R

Metric 1. Wetland area (max 6 pts). Estimate the area of wetland. Select the appropriate size class and assign score. Estimated areas should clearly place the wetland within the appropriate class.		score
6pts	≥50 acres (≥ 20.2ha)	
5pts	25 - <50 acres (10.1 - <20.2ha)	
4pts	10 - <25 acres (4.0 - <10.1ha)	
3pts	3 - <10 acres (1.2 - <4.0ha)	
2pts	0.3 - <3 acres (0.12 - <1.2ha)	
1pt	0.1 - <0.3 acres (0.04 - <0.12ha)	1
0pts	< 0.1 acres (0.04ha)	

Table 2. Metric to English conversion table with visual estimation sizes.

acres	ft²	yd²	ft on side	yd on side	ha	m²	m on side
50	2,177,983	241,998	1476	492	20.2	202,000	449
25	1,088,992	120,999	1044	348	10.1	101,000	318
10	435,596	48,340	660	220	4.1	41,000	203
3	130,679	14,520	362	121	1.2	12,000	110
0.3	13,067	1,452	114	38	0.12	1,200	35
0.1	4,356	484	66	22	0.04	400	20

Metric 2. Upland buffers and intensity of surrounding land uses. Maximum 14 points. Wetlands are systems transitional between upland and aquatic environments. Wetlands without "buffers", or that are located where human land use is more intensive, are often, but not always, more degraded.		score
2a. Average Buffer Width (abw). Calculate the average buffer width and select only one score. To calculate abw, estimate buffer width on each side (max of 50m) and divide by the number of sides. Example: abw of a wetland with buffers of 100m, 25m, 10m and 0m would be calculated as follows: abw = (50m + 25m + 10m + 0m)/4 = 21.25m. Intensive land uses are not buffers, e.g. active row cropping, recently abandoned fields, paved areas, housing developments, unfenced pasture, etc.		
7pts	WIDE. >50m (164ft) or more around perimeter.	
4pts	MEDIUM. 25m to <50m (82 to <164ft) around the perimeter.	4
1pt	NARROW. 10m to <25m (32 to <82ft) around the perimeter.	
0pts	VERY NARROW. <10m (<32ft) around perimeter.	
2b. Intensity of predominant surrounding land use(s). Select one, or double check up to two and average score, for the intensity of the predominant land use(s) outside the wetland's buffer zone (if any).		
7pts	VERY LOW. 2nd growth or older forest, prairie, savannah, wildlife area, etc.	
5pts	LOW. Old field (>10 yrs), shrubland, young 2nd growth forest, etc. ✓	4
3pts	MODERATELY HIGH. Residential, fenced pasture, park, conservation tillage, new fallow field, etc. ✓	
1pt	HIGH. urban, industrial, open pasture, row cropping, mining, construction, etc.	

X ~ 30m

9

subtotal

Wetland R

9

subtotal from previous page

Metric 3. Hydrology. Maximum 30 points. This metric evaluates the wetland's water budget, hydroperiod, the hydrologic connectivity of the wetland to other surface waters, and the degree to which the wetland's hydrology has been altered by human activity. A wetland can receive no more than 30 points for Metric 3 even though it is possible, to score more than 30 points.		
3a. Sources of Water. Select all that apply and sum score. This question relates to a wetland's water budget. It also is reflective that wetlands with certain types of water sources, or multiple water sources, e.g. high pH groundwater or perennial surface water connections, can be very high quality wetlands or can have high functions and values.		
5pts	High pH groundwater (7.5-9.0)	
3pts	Other groundwater	3
1pts	Precipitation	1
3pts	Seasonal surface water	3
5pts	Perennial surface water (lake or stream)	
3b. Connectivity. Select all that apply and sum score.		
1pt	**100 year floodplain.** "Floodplain" is defined in OAC Rule 3745-1-50(P) as "...the relatively level land next to a stream or river channel that is periodically submerged by flood waters. It is composed of alluvium deposited by the present stream or river when it floods." Where they are available, flood insurance rate maps (FIRMs) and flood boundary and floodway maps may be used.	
1pt	**between stream/lake and other human land use.** This question asks whether the wetland is located between a surface water and a different adjacent land use, such that run-off from the adjacent land use could flow through wetland before it discharges into the surface water. "Different adjacent land uses" include agricultural, commercial, industrial, mining, or residential uses.	
1pt	**part of wetland or upland (e.g. forest, prairie) complex.** Both this and the next question ask whether the wetland is in physical proximity to, or a part of other nearby wetland or upland natural areas. The difference is whether the area the wetland is "long and narrow" like a river, or more "squarish"like a large forest or woodlot. If the latter is the case, this question applies; if the former, the next question applies. In a few instances, both may apply	1
1pt	**part of riparian or upland corridor.** See description above.	
3c. Maximum water depth. Select only one and assign score. The Rater *does not* need to actually observe the wetland when its water depth is greatest in order to award the maximum points for this question. The use of secondary indicators, as outlined in the 1987 Manual will be useful in answering this question.		
3pts	>0.7m (27.6in) Assoc. w/ OW 8	3
2pts	0.4 to 0.7m (15.7 to 27.6in)	
1pt	<0.4m (<15.7in)	
3d. Duration of inundation/saturation. Select one or double check and average the scores if duration is uncertain. The use of secondary indicators is necessary and expected in order to properly answer this Question. Categories correspond to Zones II, III, and IV of 1987 Manual (Table 5). Zone IV subdivided into seasonally inundated and seasonally saturated.		
4pts	Semipermanently to permanently inundated or saturated.	
3pts	Regularly inundated or saturated. (Wetland fringe w/ pond)	3
2pts	Seasonally inundated.	
1pt	Seasonally saturated in the upper 30cm (12in) of soil.	

23

subtotal

Wetland R

23

subtotal from previous page

3e. Modifications to natural hydrologic regime. Check all observable modifications from list below. Score by selecting the most appropriate description of the wetland. Scores may be double checked and averaged. This question asks the Rater to evaluate the "intactness" of, or lack of disturbance to, the natural hydrologic regime of the type of wetland that is being evaluated.

It is very important to stress that this question does not discriminate between wetlands with different types of hydrologic regimes, e.g. between a forested seep wetland located on a floodplain with seasonal inundation and a leatherleaf (*Chamaedaphne calyculata*) bog with precipitation and minor amounts of surface run-off from a small watershed. Rather, it asks the rater to evaluate the "intactness" of the hydrologic regime attributable to *that type of wetland*. In the example above, both the forested seep wetland and the leatherleaf bog can score the maximum points (12) if there no, or no apparent, modifications to the natural hydrologic regime.

Once the Rater has listed all possible past and ongoing disturbances, the Rater should check the most appropriate category to describe the present state of the wetland. In instances where the Rater believes that a wetland falls between two categories, or where the Rater is uncertain as to which category is appropriate, it is appropriate to "double check" and average the score.

The labels on the scoring categories are intended to be descriptive but not controlling. In some instances, it may be more appropriate to consider the scoring categories as fixed locations on a hydrologic disturbance continuum, from very high to very low or no disturbance.

The Rater may check one or several of these possible disturbances, yet still determine that the natural hydrologic regime is intact. However, see Metric 4 where these same disturbances may be habitat alterations.

Check all that are observed present in or near the wetland.

	ditch(es), in or near the wetland		point source discharges to the (non-stormwater)
	tile(s), in or near the wetland		filling/grading activities in or near the wetland
✓	dike(s), in or near the wetland (road)	✓	road beds/RR beds in or near the wetland
	weir(s), in or near the wetland		dredging activities in or near the wetland
✓	stormwater inputs (addition of water)	✓	other (specify) water withdrawal from pond (OW8)

Circle one answer. Have any of the disturbances identified above caused or appear to have caused more than trivial alterations to the wetland's natural hydrologic regime, or have they occurred so far in the past that current hydrology should be considered to be "natural."?	**YES** Assign a score 1, 3 or 7, or an intermediate score, depending on degree of recovery from the disturbance.	**NO** Assign a score of 12 since there are no or no apparent modifications.	**NOT SURE** Double check "none or none apparent" and "recovered" and assign a score of 9.5.

Select one or double check adjoining numbers and average the score.		**score**
12pts	NONE OR NONE APPARENT. There are no modifications or no modifications that are apparent to the rater.	
7pts	RECOVERED. The wetland appears to have recovered from past modifications. ✓	5
3pts	RECOVERING. The wetland appears to be in the process of recovering from past modifications. ✓	7
1pt	RECENT OR NO RECOVERY. The modifications have occurred recently occurred, and/or the wetland has not recovered from past modifications, and/or the modifications are ongoing.	

28

subtotal

Wetland R. 28

subtotal from previous page

Metric 4. Habitat Alteration and Development. Maximum 20 points. While hydrology may be the single most important determinant for the establishment and maintenance of specific types of wetlands and wetland processes, there is a range of other factors and activities which affect wetland quality and cause disturbances to wetlands that are unrelated to hydrology. This metric attempts to evaluate these things under the rubric "habitat alteration." In many instances, items checked as possible hydrologic disturbances in Question 3e will be instead alterations to a wetland's habitat or disruptions in its development (successional state). In other instances, a disturbance may be appropriately considered under both Metric 3 and Metric 4. In any case, the Rater should carefully consider what is the actual proximate (direct) cause of the disturbance to the wetland.

4a. Substrate/Soil Disturbance. Select one or double check and average. This question evaluates physical disturbances to the soil and surface substrates of the wetland. Note also that the labels on the scoring categories are intended to be descriptive but not controlling. In some instances, it may be more appropriate to consider the scoring categories as fixed locations on a disturbance continuum, from very high to very low or no disturbance.

Examples of substrate/soil disturbance include filling and grading, plowing, grazing (hooves), vehicle use (motorbikes, off-road vehicles, construction vehicles), sedimentation, dredging, and other mechanical disturbances to the surface substrates or soils.

Circle one answer. Have any of soil or substrate disturbances caused or appear to have caused more than trivial alterations to the wetland's natural soils or substrates, or have they occurred so far in the past that current conditions should be considered to be "natural."?	**YES** (circled) Assign a score 1, 2 or 3, or an intermediate score, depending on degree of recovery from the disturbance.	**NO** Assign a score of 4 since there are no or no apparent modifications.	**NOT SURE** Double check "none or none apparent" and "recovered" and assign a score of 3.5.

Select one or double check adjoining numbers and average the score.		**score**
4pts	NONE OR NONE APPARENT. There are no disturbances, or no disturbances apparent to the Rater.	
(3pts)	RECOVERED. The wetland appears to have recovered from past disturbances.	2,5
(2pts)	RECOVERING. The wetland appears to be in the process of recovering from past disturbances.	
1pt	RECENT OR NO RECOVERY. The disturbances have occurred recently, and/or the wetland has not recovered from past disturbances, and/or the disturbances are ongoing.	

4b. Habitat development. Select only one and assign score. This question asks the Rater to assign an overall qualitative rating of how well-developed the wetland is in comparison to other ecologically or hydrogeomorphically similar wetlands. This question presumes a good sense of the types of wetlands and the range in quality typical of the region, watershed, or state.

7pts	EXCELLENT. Wetland appears to represent the best of its type or class.	
6pts	VERY GOOD. Wetland appears to be a very good example of its type or class but is lacking in characteristics which would make it excellent.	
5pts	GOOD. Wetland appears to be a good example of its type or class but because of past or present disturbances, successional state, or other reasons, is not excellent.	
4pts	MODERATELY GOOD. Wetland appears to be a fair to good example of its type or class.	
3pts	FAIR. Wetland appears to be a moderately good example of its type or class but because of past or present disturbances, successional state, etc. is not good.	
(2pts)	POOR TO FAIR. Wetland appears to be a poor to fair example of its type or class.	2
1pt	POOR. Wetland appears to not be a good example of its type or class because of past or present disturbances, successional state, etc.	

32.5

subtotal

Wetland R. 32.5

subtotal from previous page

4c. Habitat alteration. This question evaluates the "intactness" the natural habitat of the type of wetland that is being evaluated. This question does not discriminate between wetlands with different types of habitat. Check all possible alterations that are observed. All available information, field visits, aerial photos, maps, etc. can be used to identify a possible alterations. Evaluate whether the alteration is trivial in relation to the wetlands overall habitat. Select the most appropriate score that best describes the present state of the wetland. It is appropriate to "double check" and average scores. In some instances, the scores can be viewed as a habitat alteration continuum, from very high to very low or no disturbance. **The Rater may check one or several of these possible disturbances, yet still determine that the natural habitat is intact.**

Check all that are observed present in or near the wetland.

	Mowing		Herbaceous layer/aquatic bed removal
	Grazing (cattle, sheep, pigs, etc.)	✓	Sedimentation
	Clearcutting		Dredging
	Selective cutting		Farming
	Woody debris removal		Nutrient enrichment, e.g. nuisance algae
	Toxic pollutants	✓	Other (specify) periodic water draw-down / flooding
	Shrub/sapling removal		Other (specify)

Circle one answer. Have any of the disturbances identified above caused or appeared to cause more than trivial alterations to the wetland's natural habitat, or have occurred so far in the past that current habitat should be considered to be "natural."?	YES Assign a score 1, 3 or 6, or an intermediate score, depending on degree of recovery from the disturbance.	NO Assign a score of 9 since there are no or no apparent modifications.	NOT SURE Double check "none or none apparent" and "recovered" and assign a score of 7.5.

Select one score or double check adjoining numbers and average the score.		
9pts	NONE OR NONE APPARENT. There are no alterations, or no alterations that are apparent to the Rater.	
6pts	RECOVERED. The wetland appears to have recovered from past alterations.	
(3pts)	RECOVERING. The wetland appears to be in the process of recovering from past alterations.	7 2
(1pt)	RECENT OR NO RECOVERY. The alterations have occurred recently, and/or the wetland has not recovered from past alterations, and/or the alterations are ongoing.	

Metric 5. Special wetland communities. Maximum 10 points. Assign or deduct points if wetland has the feature described. Refer to Narrative Rating for guidance. No wetland can receive more than 10 points even if multiple categories are applicable.			**score**
	Bog (10 pts)		Lake plains sand prairies (Oak Openings) (10 pts)
	Fen (10 pts)		Relict wet prairies (10 pts)
	Old Growth Forest (10 pts)		Known occurrence of threatened/endangered species (10 pts)
	Mature Forested Wetland (5 pts)		Significant migratory songbird/waterfowl habitat (10 pts)
	Coastal wetlands, unrestricted hydrology (10 pts)		Category 1 wetlands (See Narrative Rating #5) (-10 pts)
	Coastal wetlands, restricted hydrology (5 pts)		

34.5

subtotal

Wetland R. 34.5

subtotal from previous page

Metric 6. Vegetation, Interspersion, and Microtopography. Maximum 20 points. **6a. Wetland Vegetation Communities.** Check each community present both vertically and horizontally within the wetland with an area of at least 0.1hectares or 1000m^2 (0.2471 acres). Assign a score of 0 to 3 using Tables 3, Table 4 or Table 5. Sum the scores for the classes present.		
	Aquatic Bed. Includes areas of wetlands dominated by plants that grow principally on or below the surface of the water for most of the growing season in most years. Floating aquatic species like duckweed (*Lemna* spp., *Spirodela* spp.) are excluded from definition of "aquatic bed." Aquatic beds often occur as a distinct zone as an "understory" below shrubs or trees.	
✓	**Emergent.** Includes areas of wetlands dominated by erect, rooted, herbaceous hydrophytes, excluding mosses and lichens. This vegetation is present for most of the growing season in most years. Common names for emergent communities include marsh, wet meadow, wet prairie, sedge meadow, fens, prairie pothole, and bluejoint slough.	1
	Shrub. Includes areas of wetlands dominated by woody vegetation less than 6m (20 ft) tall. The plant species include true shrubs, young trees, or trees or shrubs that are small or stunted because of environmental conditions. Shrub wetlands may represent a successional stage leading to a forested wetland or they may be relatively stable plant communities.	
	Forested. Includes wetlands or areas of wetlands characterized by woody vegetation greater than 6m (20ft) or taller. Forested wetlands have an overstory of trees and often contain an understory of young trees and shrubs and an herbaceous layer, although the young tree/shrub and herbaceous layers can be largely missing from some types of forested wetlands. Some forested wetlands are defined as "vernal pools" in OAC Rule 3745-1-50.	
	Mudflats. The "mudflat" class is equivalent to the "unconsolidated bottom/mud" class/subclass (PUB_3) described in Cowardin et al. (1979) and includes areas of wetlands characterized by exposed or shallowly inundated substrates with vegetative cover less than 30%.	
✓	**Open water.** The "open water" class is equivalent to the "open water - unknown bottom" class in Cowardin et al. (1979) and includes areas re 1) inundated, 2) unvegetated, and 3) and "open", i.e. there is no "canopy" of any type of vegetation.	1
	Other (See User's Manual)	

Table 3. Use this table to assign a cover score for Metric 6a to each of the vegetation communities identified on the preceding page. Refer to Table 6 for narrative descriptions of what "low," "moderate," and "high" quality mean.

Cover scale	Description
0	the vegetation community is either, 1) absent from wetland, or 2) comprises less than 0.1ha (0.2471 acres) of contiguous area within the wetland
1	vegetation community is present and either, 1) comprises a small part of the wetland's vegetation and is of low or moderate quality, or 2) if it comprises a significant part of the wetland's vegetation, the community is of low quality
2	the vegetation community is present and either, 1) comprises a significant part of the wetland's vegetation and is of moderate quality, or 2) the vegetation community comprises a small part of the wetland's vegetation but is of high quality
3	the vegetation community is of high quality and comprises a significant part, or more, of the wetland's vegetation.

Table 4. Use this table in conjunction with Table 5 to determine what is a "low," "moderate," or "high" quality community.

narrative	description
low	low species diversity and/or a predominance of non-native or disturbance tolerant native species
moderate	native species are the dominant component of the vegetation, although non-native or disturbance tolerant native species can also be present, and species diversity is moderate to moderately high, but generally without the presence of rare, threatened, or endangered species
high	a predominance of native species, with non-native species absent or virtually absent, and high species diversity and sometimes, but not always, the presence of rare, threatened or endangered species.

Table 5. Mudflat and open water community cover scale.

0	Absent <0.1ha (0.247 acres)
1	Low 0.1 to <1ha (0.247 to 2.47 acres)
2	Moderate 1ha to <4ha (2.47 to 9.88 acres)
3	High 4ha (9.88 acres) or more

36.5

subtotal

Wetland R. 36.5

subtotal from previous page

6b. Horizontal (plan view) interspersion. Select only one and assign score. Evaluate the wetland from a "plan view," i.e. as if the looking down upon it. See Figure 1.	
5pts HIGH. Wetland has a high degree of interspersion.	
4pts MODERATELY HIGH. Wetland has a moderately high degree of interspersion.	
3pts MODERATE. Wetland has a moderate degree of interspersion.	
2pts MODERATELY LOW. Wetland has a moderately low degree of interspersion.	2
1pt LOW. Wetland has a low degree of interspersion.	
0pts NONE. Wetland has no plan view interspersion.	

6c. Coverage of Invasive Plant Species. Refer to Table 1 on Page 7 for list. Select only one and assign score.	
-5pts Extensive. >75% areal cover of invasive species	
-3pts Moderate 25-75% areal cover of invasive species	
-1pt Sparse. 5-25% areal cover of invasive species	
0pts Nearly absent. <5% areal cover of invasive species	0
1pt Absent.	

6d. Microtopography. Check each feature present in the wetland. Assign cover score of 0 to 3 using Table 6. Evaluate various microtopograhic habitat features often present in wetlands.	
Vegetated hummocks and tussocks.	
Coarse woody debris >15cm (6in) in diameter	
Standing dead trees >25cm (10in) diameter at breast height	
Amphibian breeding habitat, e.g. vernal pools with standing water of sufficient duration and depth to support reproduction, or habitat for frog reproduction.	1

Table 6. Cover scale for microtopographic habitat features.

microtopographic habitat quality	narrative description
0	feature is absent or functionally absent from the wetland
1	feature is present in the wetland in very small amounts or if more common, of low quality
2	feature is present in moderate amounts, but not of highest quality, or in small amounts of highest quality
3	present in moderate or greater amounts and of highest quality

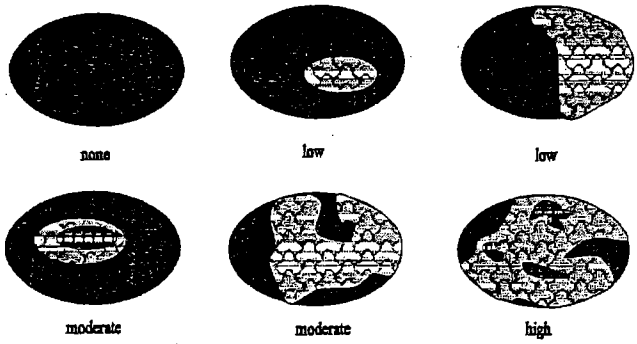


Figure 1. Hypothetical wetlands for estimating degree of interspersion.

39.5

GRAND TOTAL

End of Quantitative Rating. Complete Categorization Worksheets.

Refer to the most recent ORAM Score Calibration Report for the scoring breakpoints between wetland categories at the following address: http://www.epa.state.oh.us/dsw/401/401.html

ORAM Summary Worksheet

Wetland R

		circle answer or insert score	Result
Narrative Rating	Question 1 Critical Habitat	YES (NO)	If yes, Category 3.
	Question 2. Threatened or Endangered Species	YES (NO)	If yes, Category 3.
	Question 3. High Quality Natural Wetland	YES (NO)	If yes, Category 3.
	Question 4. Significant bird habitat	YES (NO)	If yes, Category 3.
	Question 5. Category 1 Wetlands	YES (NO)	If yes, Category 1.
	Question 6. Bogs	YES (NO)	If yes, Category 3.
	Question 7. Fens	YES (NO)	If yes, Category 3.
	Question 8a. Old Growth Forest	YES (NO)	If yes, Category 3.
	Question 8b. Mature Forested Wetland	YES (NO)	If yes, evaluate for Category 3; may also be 1 or 2.
	Question 9b. Lake Erie Wetlands - Restricted	YES (NO)	If yes, evaluate for Category 3; may also be 1 or 2.
	Question 9d. Lake Erie Wetlands - Unrestricted.	YES (NO)	If yes, Category 3
	Question 9e. Lake Erie Wetlands - Unrestricted with invasive plants	YES (NO)	If yes, evaluate for Category 3; may also be 1 or 2.
	Question 10. Oak Openings	YES (NO)	If yes, Category 3
	Question 11. Relict Wet Prairies	YES (NO)	If yes, evaluate for Category 3; may also be 1 or 2.
Quantitative Rating	Metric 1. Size	1	
	Metric 2. Buffers and surrounding land use	8	
	Metric 3. Hydrology	19	
	Metric 4. Habitat	6.5	
	Metric 5. Special Wetland Communities	0	
	Metric 6. Plant communities, interspersion, microtopography	5	
	TOTAL SCORE Consult most recent score calibration report at http://www.epa.state.oh.us/dsw/401/401.html to determine the wetland's category based on its quantitative score	39.5	Category based on score breakpoints modified Cat. 2

Complete Wetland Categorization Worksheet.

Wetland Categorization Worksheet

Wetland R.

Choices	Circle one		Evaluation of Categorization Result of ORAM
Did you answer "Yes" to any of the following questions: Narrative Rating Nos. 2, 3, 4, 6, 7, 8a, 9d, 10	YES Wetland is categorized as a Category 3 wetland	(NO)	Is quantitative rating score *less* than the Category 2 scoring threshold (*excluding* gray zone)? If yes, reevaluate the category of the wetland using the narrative criteria in OAC Rule 3745-1-54(C) and biological and/or functional assessments to determine if the wetland has been over-categorized by the ORAM
Did you answer "Yes" to any of the following questions: Narrative Rating Nos. 1, 8b, 9b, 9e, 11	YES Wetland should be evaluated for possible Category 3 status	(NO)	Evaluate the wetland using the 1) narrative criteria in OAC Rule 3745-1-54(C) and 2) the quantitative rating score. If the wetland is determined to be a Category 3 wetland using either of these, it should be categorized as a Category 3 wetland. Detailed biological and/or functional assessments may also be used to determine the wetland's category.
Did you answer "Yes" to Narrative Rating No. 5	YES Wetland is categorized as a Category 1 wetland	(NO)	Is quantitative rating score *greater* than the Category 2 scoring threshold *(including* any gray zone)? If yes, reevaluate the category of the wetland using the narrative criteria in OAC Rule 3745-1-54(C) and biological and/or functional assessments to determine if the wetland has been under-categorized by the ORAM
Does the quantitative score fall within the scoring range of a Category 1, 2, or 3 wetland?	(YES) Wetland is assigned to the appropriate category based on the scoring range	NO	If the score of the wetland is located within the scoring range for a particular category, the wetland should be assigned to that category. In all instances however, the narrative criteria described in OAC Rule 3745-1-54(C) can be used to clarify or change a categorization based on an quantitative score.
Does the quantitative score fall with the *"gray zone"* for Category 1 or 2 or Category 2 or 3 wetlands?	YES Wetland is assigned to the higher of the two categories or assigned to a category based on detailed assessments and the narrative criteria	(NO)	Rater has the option of assigning the wetland to the higher of the two categories or to assign a category based on the results of a nonrapid wetland assessment method, e.g. functional assessment, biological assessment, etc, and a consideration of the narrative criteria in OAC rule 3745-1-54(C).
Does the wetland otherwise exhibit *moderate OR superior* hydrologic OR habitat, OR recreational functions AND the wetland was *not* categorized as a Category 2 wetland (in the case of moderate functions) or a Category 3 wetland (in the case of superior functions) by this method?	YES Wetland was undercategorized by this method. A written justification for recategorization should be provided on Background Information Form	(NO) Wetland is assigned to category as determined by the ORAM.	A wetland may be undercategorized using this method, but still exhibit one or more superior functions, e.g. a wetland's biotic communities may be degraded by human activities, but the wetland may still exhibit superior hydrologic functions because of its type, landscape position, size, local or regional significance, etc. In this circumstance, the narrative criteria in OAC Rule 3745-1-54(C)(2) and (3) are controlling, and the under-categorization should be corrected. A written justification with supporting reasons or information for this determination should be provided.

Final Category

Choose one	Category 1	(Category 2)	Category 3

End of Ohio Rapid Assessment Method for Wetlands.

Background Information

Name:	Mark R. Haibach
Date:	5/19/11
Affiliation:	Civil & Envirnmental Consultnts, Inc
Address:	333 Baldwin Road, Pittsburgh, PA 15221
Phone Number:	412-249-3156
e-mail address:	mhaibach@cecinc.com
Name of Wetland:	Wetland S
Vegetation Communit(ies):	PEM
HGM Class(es):	Groundwater Slope

Location of Wetland include map, address, north arrow, landmarks, distances, roads, etc.

Lat/Long or UTM Coordinate	
USGS Quad Name	Amsterdam, OH
County	Jefferson / Harrison
Township	Springfield /
Section and Subsection	
Hydrologic Unit Code	05030101340
Site Visit	5/19/11
National Wetland Inventory Map	Amsterdam, OH
Ohio Wetland Inventory Map	—
Soil Survey	Soil Survey of Harrison County, OH
Delineation report/map	Wetland and Stream Delin. & Assess. Rpt. (CEC 2010, 2011)
Wetland Size (acres, hectares)	0.02

Name: Wetland S

sketch (include north arrow, relationship with other surface waters, vegetation zones, etc.)

See Stream and Wetland Delineation Map (Figure 4).

Comments, Narrative Discussion, Justification of Category Changes

Final score : 46	Category	2

Wetlands

Scoring Boundary Worksheet

INSTRUCTIONS. The initial step in completing the ORAM is to identify the "scoring boundaries" of the wetland being rated. In many instances this determination will be relatively easy and the scoring boundaries will coincide with the "jurisdictional boundaries." For example, the scoring boundary of an isolated cattail marsh located in the middle of a farm field will likely be the same as that wetland's jurisdictional boundaries. In other instances, however, the scoring boundary will not be as easily determined. Wetlands that are small or isolated from other surface waters often form large contiguous areas or heterogeneous complexes of wetland and upland. In separating wetlands for scoring purposes, the hydrologic regime of the wetland is the main criterion that should be used. Boundaries between contiguous or connected wetlands should be established where the volume, flow, or velocity of water moving through the wetland changes significantly. *Areas with a high degree of hydrologic interaction should be scored as a single wetland.* In determining a wetland's scoring boundaries, use the guidelines in the ORAM Manual Section 5.0. In certain instances, it may be difficult to establish the scoring boundary for the wetland being rated. These problem situations include wetlands that form a patchwork on the landscape, wetlands divided by artificial boundaries like property fences, roads, or railroad embankments, wetlands that are contiguous with streams, lakes, or rivers, and estuarine or coastal wetlands. These situations are discussed below, however, it is recommended that Rater contact Ohio EPA, Division of Surface Water, 401/Wetlands Unit if there are additional questions or a need for further clarification of the appropriate scoring boundaries of a particular wetland.

#	Steps in properly establishing scoring boundaries	done?	not applicable
Step 1	Identify the wetland area of interest. This may be the site of a proposed impact, a mitigation site, conservation site, etc.	Yes	
Step 2	Identify the locations where there is physical evidence that hydrology changes rapidly. Such evidence includes both natural and human-induced changes including, constrictions caused by berms or dikes, points where the water velocity changes rapidly at rapids or falls, points where significant inflows occur at the confluence of rivers, or other factors that may restrict hydrologic interaction between the wetlands or parts of a single wetland.	Yes	
Step 3	Delineate the boundary of the wetland to be rated such that all areas of interest that are contiguous to and within the areas where the hydrology does not change significantly, i.e. areas that have a high degree of hydrologic interaction are included within the scoring boundary.	Yes	
Step 4	Determine if artificial boundaries, such as property lines, state lines, roads, railroad embankments, etc., are present. These should not be used to establish scoring boundaries unless they coincide with areas where the hydrologic regime changes.	Yes	
Step 5	In all instances, the Rater may enlarge the minimum scoring boundaries discussed here to score together wetlands that could be scored separately.	Yes	
Step 6	Consult ORAM Manual Section 5.0 for how to establish scoring boundaries for wetlands that form a patchwork on the landscape, divided by artificial boundaries, contiguous to streams, lakes or rivers, or for dual classifications.	Yes	

Wetland 5

Narrative Rating

INSTRUCTIONS. Answer each of the following questions. Questions 1, 2, 3 and 4 should be answered based on information obtained from the site visit or the literature *and* by submitting a Data Services Request to the Ohio Department of Natural Resources, Division of Natural Areas and Preserves, Natural Heritage Data Services, 1889 Fountain Square Court, Building F-1, Columbus, Ohio 43224, 614-265-6453 (phone), 614-265-3096 (fax), http://www.dnr.state.oh.us/odnr/dnap/. The remaining questions are designed to be answered primarily by the results of the site visit. Refer to the User's Manual for descriptions of these wetland types. Note: "Critical habitat" is a legally defined in the Endangered Species Act and is the geographic area containing physical or biological features essential to the conservation of a listed species or as an area that may require special management considerations or protection. The Rater should contact the Region 3 Headquarters or the Reynoldsburg Ecological Services Office for updates as to whether critical habitat has been designated for other federally listed threatened or endangered species. "Documented" means the wetland is listed in the appropriate State of Ohio database.

#	Question	Circle one	
1	**Critical Habitat.** Is the wetland in a township, section, or subsection of a United States Geological Survey 7.5 minute Quadrangle that has been designated by the U.S. Fish and Wildlife Service as "critical habitat" for any threatened or endangered plant or animal species? Note: as of January 1, 2001, of the federally listed endangered or threatened species which can be found in Ohio, the Indiana Bat has had critical habitat designated (50 CFR 17.95(a)) and the piping plover has had critical habitat proposed (65 FR 41812 July 6, 2000).	YES Wetland should be evaluated for possible Category 3 status Go to Question 2	(NO) Go to Question 2
2	**Threatened or Endangered Species.** Is the wetland known to contain an individual of, or documented occurrences of federal or state-listed threatened or endangered plant or animal species?	YES Wetland is a Category 3 wetland. Go to Question 3	(NO) Go to Question 3
3	**Documented High Quality Wetland.** Is the wetland on record in Natural Heritage Database as a high quality wetland?	YES Wetland is a Category 3 wetland Go to Question 4	(NO) Go to Question 4
4	**Significant Breeding or Concentration Area.** Does the wetland contain documented regionally significant breeding or nonbreeding waterfowl, neotropical songbird, or shorebird concentration areas?	YES Wetland is a Category 3 wetland Go to Question 5	(NO) Go to Question 5
5	**Category 1 Wetlands.** Is the wetland less than 0.5 hectares (1 acre) in size and **hydrologically isolated** and either 1) comprised of vegetation that is dominated (greater than eighty per cent areal cover) by *Phalaris arundinacea, Lythrum salicaria,* or *Phragmites australis*, or 2) an acidic pond created or excavated on mined lands that has little or no vegetation?	YES Wetland is a Category 1 wetland Go to Question 6	(NO) Go to Question 6
6	**Bogs.** Is the wetland a peat-accumulating wetland that 1) has no significant inflows or outflows, 2) supports acidophilic mosses, particularly *Sphagnum* spp., 3) the acidophilic mosses have >30% cover, 4) at least one species from Table 1 is present, and 5) the cover of invasive species (see Table 1) is <25%?	YES Wetland is a Category 3 wetland Go to Question 7	(NO) Go to Question 7
7	**Fens.** Is the wetland a carbon accumulating (peat, muck) wetland that is the saturated during most of the year, primarily by a discharge of free flowing, mineral rich, ground water with a circumneutral ph (5.5-9.0) and with one or more plant species listed in Table 1 and the cover of invasive species listed in Table 1 is <25%?	YES Wetland is a Category 3 wetland Go to Question 8a	(NO) Go to Question 8a

Wetland S

#	Question	Circle one	
8a	**"Old Growth Forest."** Is the wetland a forested wetland and is the forest characterized by, but not limited to, the following characteristics: overstory canopy trees of great age (exceeding at least 50% of a projected maximum attainable age for a species); little or no evidence of human-caused understory disturbance during the past 80 to 100 years; an all-aged structure and multilayered canopies; aggregations of canopy trees interspersed with canopy gaps; and significant numbers of standing dead snags and downed logs?	YES Wetland is a Category 3 wetland. Go to Question 8b	(NO) Go to Question 8b
8b	**Mature forested wetlands.** Is the wetland a forested wetland with 50% or more of the cover of upper forest canopy consisting of deciduous trees with large diameters at breast height (dbh), generally diameters greater than 45cm (17.7in) dbh?	YES Wetland should be evaluated for possible Category 3 status. Go to Question 9a	(NO) Go to Question 9a
9a	**Lake Erie coastal and tributary wetlands.** Is the wetland located at an elevation less than 575 feet on the USGS map, adjacent to this elevation, or along a tributary to Lake Erie that is accessible to fish?	YES Go to Question 9b	(NO) Go to Question 10
9b	Does the wetland's hydrology result from measures designed to prevent erosion and the loss of aquatic plants, i.e. the wetland is partially hydrologically restricted from Lake Erie due to lakeward or landward dikes or other hydrological controls?	YES Wetland should be evaluated for possible Category 3 status Go to Question 9d	(NO) Go to Question 9c
9c	Are Lake Erie water levels the wetland's primary hydrological influence, i.e. the wetland is hydrologically unrestricted (no lakeward or upland border alterations), or the wetland can be characterized as an "estuarine" wetland with lake and river influenced hydrology. These include sandbar deposition wetlands, estuarine wetlands, river mouth wetlands, or those dominated by submersed aquatic vegetation.	YES Go to Question 9d	NO Go to Question 9d
9d	Does the wetland have a predominance of native species within its vegetation communities, although non-native or disturbance tolerant native species can also be present?	YES Wetland is a Category 3 wetland Go to Question 10	NO Go to Question 9e
9e	Does the wetland have a predominance of non-native or disturbance tolerant native plant species within its vegetation communities?	YES Wetland should be evaluated for possible Category 3 status Go to Question 10	NO Go to Question 10
10	**Lake Plain Sand Prairies (Oak Openings)** Is the wetland located in Lucas, Fulton, Henry, or Wood Counties and can the wetland be characterized by the following description: the wetland has a sandy substrate with interspersed organic matter, a water table often within several inches of the surface, and often with a dominance of the gramineous vegetation listed in Table 1 (woody species may also be present). The Ohio Department of Natural Resources Division of Natural Areas and Preserves can provide assistance in confirming this type of wetland and its quality.	YES Wetland is a Category 3 wetland. Go to Question 11	(NO) Go to Question 11
11	**Relict Wet Prairies.** Is the wetland a relict wet prairie community dominated by some or all of the species in Table 1. Extensive prairies were formerly located in the Darby Plains (Madison and Union Counties), Sandusky Plains (Wyandot, Crawford, and Marion Counties), northwest Ohio, Erie County, and portions of western Ohio Counties (e.g. Darke, Mercer, Miami, Montgomery, etc.).	YES Wetland should be evaluated for possible Category 3 status Complete Quantitative Rating	(NO) Complete Quantitative Rating

Quantitative Rating

Wetland S

Metric 1. Wetland area (max 6 pts). Estimate the area of wetland. Select the appropriate size class and assign score. Estimated areas should clearly place the wetland within the appropriate class.		score
6pts	≥50 acres (≥ 20.2ha)	
5pts	25 - <50 acres (10.1 - <20.2ha)	
4pts	10 - <25 acres (4.0 - <10.1ha)	
3pts	3 - <10 acres (1.2 - <4.0ha)	
2pts	0.3 - <3 acres (0.12 - <1.2ha)	
1pt	0.1 - <0.3 acres (0.04 - <0.12ha)	
0pts	< 0.1 acres (0.04ha)	0

Table 2. Metric to English conversion table with visual estimation sizes.

acres	ft²	yd²	ft on side	yd on side	ha	m²	m on side
50	2,177,983	241,998	1476	492	20.2	202,000	449
25	1,088,992	120,999	1044	348	10.1	101,000	318
10	435,596	48,340	660	220	4.1	41,000	203
3	130,679	14,520	362	121	1.2	12,000	110
0.3	13,067	1,452	114	38	0.12	1,200	35
0.1	4,356	484	66	22	0.04	400	20

Metric 2. Upland buffers and intensity of surrounding land uses. Maximum 14 points. Wetlands are systems transitional between upland and aquatic environments. Wetlands without "buffers", or that are located where human land use is more intensive, are often, but not always, more degraded.		score
2a. Average Buffer Width (abw). Calculate the average buffer width and select only one score. To calculate abw, estimate buffer width on each side (max of 50m) and divide by the number of sides. Example: abw of a wetland with buffers of 100m, 25m, 10m and 0m would be calculated as follows: abw = (50m + 25m + 10m + 0m)/4 = 21.25m. Intensive land uses are not buffers, e.g. active row cropping, recently abandoned fields, paved areas, housing developments, unfenced pasture, etc.		
7pts	WIDE. >50m (164ft) or more around perimeter.	
4pts	MEDIUM. 25m to <50m (82 to <164ft) around the perimeter.	4
1pt	NARROW. 10m to <25m (32 to <82ft) around the perimeter.	
0pts	VERY NARROW. <10m (<32ft) around perimeter.	
2b. Intensity of predominant surrounding land use(s). Select one, or double check up to two and average score, for the intensity of the predominant land use(s) outside the wetland's buffer zone (if any).		
(7pts)	VERY LOW. 2nd growth or older forest, prairie, savannah, wildlife area, etc.	6
(5pts)	LOW. Old field (>10 yrs), shrubland, young 2nd growth forest, etc.	
3pts	MODERATELY HIGH. Residential, fenced pasture, park, conservation tillage, new fallow field, etc.	
1pt	HIGH. urban, industrial, open pasture, row cropping, mining, construction, etc.	

ave = 45m

10

subtotal

Wetland S

10

subtotal from previous page

Metric 3. Hydrology. Maximum 30 points. This metric evaluates the wetland's water budget, hydroperiod, the hydrologic connectivity of the wetland to other surface waters, and the degree to which the wetland's hydrology has been altered by human activity. A wetland can receive no more than 30 points for Metric 3 even though it is possible, to score more than 30 points.		
3a. Sources of Water. Select all that apply and sum score. This question relates to a wetland's water budget. It also is reflective that wetlands with certain types of water sources, or multiple water sources, e.g. high pH groundwater or perennial surface water connections, can be very high quality wetlands or can have high functions and values.		
5pts	High pH groundwater (7.5-9.0)	
3pts	Other groundwater	3
1pts	Precipitation	1
3pts	Seasonal surface water	3
5pts	Perennial surface water (lake or stream)	
3b. Connectivity. Select all that apply and sum score.		
1pt	**100 year floodplain.** "Floodplain" is defined in OAC Rule 3745-1-50(P) as "...the relatively level land next to a stream or river channel that is periodically submerged by flood waters. It is composed of alluvium deposited by the present stream or river when it floods." Where they are available, flood insurance rate maps (FIRMs) and flood boundary and floodway maps may be used.	
1pt	**between stream/lake and other human land use.** This question asks whether the wetland is located between a surface water and a different adjacent land use, such that run-off from the adjacent land use could flow through wetland before it discharges into the surface water. "Different adjacent land uses" include agricultural, commercial, industrial, mining, or residential uses.	
1pt	**part of wetland or upland (e.g. forest, prairie) complex.** Both this and the next question ask whether the wetland is in physical proximity to, or a part of other nearby wetland or upland natural areas. The difference is whether the area the wetland is "long and narrow" like a river, or more "squarish"like a large forest or woodlot. If the latter is the case, this question applies; if the former, the next question applies. In a few instances, both may apply	1
1pt	**part of riparian or upland corridor.** See description above.	
3c. Maximum water depth. Select only one and assign score. The Rater *does not* need to actually observe the wetland when its water depth is greatest in order to award the maximum points for this question. The use of secondary indicators, as outlined in the 1987 Manual will be useful in answering this question.		
3pts	>0.7m (27.6in)	
2pts	0.4 to 0.7m (15.7 to 27.6in)	
1pt	<0.4m (<15.7in)	1
3d. Duration of inundation/saturation. Select one or double check and average the scores if duration is uncertain. The use of secondary indicators is necessary and expected in order to properly answer this Question. Categories correspond to Zones II, III, and IV of 1987 Manual (Table 5). Zone IV subdivided into seasonally inundated and seasonally saturated.		
4pts	Semipermanently to permanently inundated or saturated.	
3pts	Regularly inundated or saturated.	
2pts	Seasonally inundated.	
1pt	Seasonally saturated in the upper 30cm (12in) of soil.	1

20

subtotal

wetlands 20

subtotal from previous page

3e. Modifications to natural hydrologic regime. Check all observable modifications from list below. Score by selecting the most appropriate description of the wetland. Scores may be double checked and averaged. This question asks the Rater to evaluate the "intactness" of, or lack of disturbance to, the natural hydrologic regime of the type of wetland that is being evaluated.

It is very important to stress that this question does not discriminate between wetlands with different types of hydrologic regimes, e.g. between a forested seep wetland located on a floodplain with seasonal inundation and a leatherleaf (*Chamaedaphne calyculata*) bog with precipitation and minor amounts of surface run-off from a small watershed. Rather, it asks the rater to evaluate the "intactness" of the hydrologic regime attributable to *that type of wetland*. In the example above, both the forested seep wetland and the leatherleaf bog can score the maximum points (12) if there no, or no apparent, modifications to the natural hydrologic regime.

Once the Rater has listed all possible past and ongoing disturbances, the Rater should check the most appropriate category to describe the present state of the wetland. In instances where the Rater believes that a wetland falls between two categories, or where the Rater is uncertain as to which category is appropriate, it is appropriate to "double check" and average the score.

The labels on the scoring categories are intended to be descriptive but not controlling. In some instances, it may be more appropriate to consider the scoring categories as fixed locations on a hydrologic disturbance continuum, from very high to very low or no disturbance.

The Rater may check one or several of these possible disturbances, yet still determine that the natural hydrologic regime is intact. However, see Metric 4 where these same disturbances may be habitat alterations.

Check all that are observed present in or near the wetland.

	ditch(es), in or near the wetland		point source discharges to the (non-stormwater)
	tile(s), in or near the wetland		filling/grading activities in or near the wetland
	dike(s), in or near the wetland		road beds/RR beds in or near the wetland
	weir(s), in or near the wetland		dredging activities in or near the wetland
	stormwater inputs (addition of water)	✓	other (specify) upslope mining

Circle one answer. Have any of the disturbances identified above caused or appear to have caused more than trivial alterations to the wetland's natural hydrologic regime, or have they occurred so far in the past that current hydrology should be considered to be "natural."?	**YES** Assign a score 1, 3 or 7, or an intermediate score, depending on degree of recovery from the disturbance.	**NO** Assign a score of 12 since there are no or no apparent modifications.	**NOT SURE** Double check "none or none apparent" and "recovered" and assign a score of 9.5.

Select one or double check adjoining numbers and average the score.		**score**
(12pts)	NONE OR NONE APPARENT. There are no modifications or no modifications that are apparent to the rater.	9.5
(7pts)	RECOVERED. The wetland appears to have recovered from past modifications.	
3pts	RECOVERING. The wetland appears to be in the process of recovering from past modifications.	
1pt	RECENT OR NO RECOVERY. The modifications have occurred recently occurred, and/or the wetland has not recovered from past modifications, and/or the modifications are ongoing.	

29.5

subtotal

Wetlands 29.5

subtotal from previous page

Metric 4. Habitat Alteration and Development. Maximum 20 points. While hydrology may be the single most important determinant for the establishment and maintenance of specific types of wetlands and wetland processes, there is a range of other factors and activities which affect wetland quality and cause disturbances to wetlands that are unrelated to hydrology. This metric attempts to evaluate these things under the rubric "habitat alteration." In many instances, items checked as possible hydrologic disturbances in Question 3e will be instead alterations to a wetland's habitat or disruptions in its development (successional state). In other instances, a disturbance may be appropriately considered under both Metric 3 and Metric 4. In any case, the Rater should carefully consider what is the actual proximate (direct) cause of the disturbance to the wetland.
4a. Substrate/Soil Disturbance. Select one or double check and average. This question evaluates physical disturbances to the soil and surface substrates of the wetland. Note also that the labels on the scoring categories are intended to be descriptive but not controlling. In some instances, it may be more appropriate to consider the scoring categories as fixed locations on a disturbance continuum, from very high to very low or no disturbance. Examples of substrate/soil disturbance include filling and grading, plowing, grazing (hooves), vehicle use (motorbikes, off-road vehicles, construction vehicles), sedimentation, dredging, and other mechanical disturbances to the surface substrates or soils.

Circle one answer. Have any of soil or substrate disturbances caused or appear to have caused more than trivial alterations to the wetland's natural soils or substrates, or have they occurred so far in the past that current conditions should be considered to be "natural."?	**YES** Assign a score 1, 2 or 3, or an intermediate score, depending on degree of recovery from the disturbance.	**NO** Assign a score of 4 since there are no or no apparent modifications.	**NOT SURE** Double check "none or none apparent" and "recovered" and assign a score of 3.5.

Select one or double check adjoining numbers and average the score.		**score**
(4pts)	NONE OR NONE APPARENT. There are no disturbances, or no disturbances apparent to the Rater.	4
3pts	RECOVERED. The wetland appears to have recovered from past disturbances.	
2pts	RECOVERING. The wetland appears to be in the process of recovering from past disturbances.	
1pt	RECENT OR NO RECOVERY. The disturbances have occurred recently, and/or the wetland has not recovered from past disturbances, and/or the disturbances are ongoing.	

4b. Habitat development. Select only one and assign score. This question asks the Rater to assign an overall qualitative rating of how well-developed the wetland is in comparison to other ecologically or hydrogeomorphically similar wetlands. This question presumes a good sense of the types of wetlands and the range in quality typical of the region, watershed, or state.		
7pts	EXCELLENT. Wetland appears to represent the best of its type or class.	
6pts	VERY GOOD. Wetland appears to be a very good example of its type or class but is lacking in characteristics which would make it excellent.	
5pts	GOOD. Wetland appears to be a good example of its type or class but because of past or present disturbances, successional state, or other reasons, is not excellent.	
(4pts)	MODERATELY GOOD. Wetland appears to be a fair to good example of its type or class.	4
3pts	FAIR. Wetland appears to be a moderately good example of its type or class but because of past or present disturbances, successional state, etc. is not good.	
2pts	POOR TO FAIR. Wetland appears to be a poor to fair example of its type or class.	
1pt	POOR. Wetland appears to not be a good example of its type or class because of past or present disturbances, successional state, etc.	

37.5

subtotal

Wetland S

38.5

subtotal from previous page

4c. Habitat alteration. This question evaluates the "intactness" the natural habitat of the type of wetland that is being evaluated. This question does not discriminate between wetlands with different types of habitat. Check all possible alterations that are observed. All available information, field visits, aerial photos, maps, etc. can be used to identify a possible alterations. Evaluate whether the alteration is trivial in relation to the wetlands overall habitat. Select the most appropriate score that best describes the present state of the wetland. It is appropriate to "double check" and average scores. In some instances, the scores can be viewed as a habitat alteration continuum, from very high to very low or no disturbance. **The Rater may check one or several of these possible disturbances, yet still determine that the natural habitat is intact.**

Check all that are observed present in or near the wetland.

	Mowing		Herbaceous layer/aquatic bed removal
	Grazing (cattle, sheep, pigs, etc.)	✓	Sedimentation upslope mining
	Clearcutting		Dredging
	Selective cutting		Farming
	Woody debris removal		Nutrient enrichment, e.g. nuisance algae
	Toxic pollutants		Other (specify)
	Shrub/sapling removal		Other (specify)

Circle one answer. Have any of the disturbances identified above caused or appeared to cause more than trivial alterations to the wetland's natural habitat, or have occurred so far in the past that current habitat should be considered to be "natural."?	YES Assign a score 1, 3 or 6, or an intermediate score, depending on degree of recovery from the disturbance.	NO Assign a score of 9 since there are no or no apparent modifications.	NOT SURE Double check "none or none apparent" and "recovered" and assign a score of 7.5.

Select one score or double check adjoining numbers and average the score.		
(9pts)	NONE OR NONE APPARENT. There are no alterations, or no alterations that are apparent to the Rater.	7.5
(6pts)	RECOVERED. The wetland appears to have recovered from past alterations.	
3pts	RECOVERING. The wetland appears to be in the process of recovering from past alterations.	
1pt	RECENT OR NO RECOVERY. The alterations have occurred recently, and/or the wetland has not recovered from past alterations, and/or the alterations are ongoing.	

Metric 5. Special wetland communities. Maximum 10 points. Assign or deduct points if wetland has the feature described. Refer to Narrative Rating for guidance. No wetland can receive more than 10 points even if multiple categories are applicable.			**score**
	Bog (10 pts)		Lake plains sand prairies (Oak Openings) (10 pts)
	Fen (10 pts)		Relict wet prairies (10 pts)
	Old Growth Forest (10 pts)		Known occurrence of threatened/endangered species (10 pts)
	Mature Forested Wetland (5 pts)		Significant migratory songbird/waterfowl habitat (10 pts)
	Coastal wetlands, unrestricted hydrology (10 pts)		Category 1 wetlands (See Narrative Rating #5) (-10 pts)
	Coastal wetlands, restricted hydrology (5 pts)		

46

subtotal

46

subtotal from previous page

Metric 6. Vegetation, Interspersion, and Microtopography. Maximum 20 points. **6a. Wetland Vegetation Communities.** Check each community present both vertically and horizontally within the wetland with an area of at least 0.1hectares or 1000m^2 (0.2471 acres). Assign a score of 0 to 3 using Tables 3, Table 4 or Table 5. Sum the scores for the classes present.		
	Aquatic Bed. Includes areas of wetlands dominated by plants that grow principally on or below the surface of the water for most of the growing season in most years. Floating aquatic species like duckweed (*Lemna* spp., *Spirodela* spp.) are excluded from definition of "aquatic bed." Aquatic beds often occur as a distinct zone as an "understory" below shrubs or trees.	
✓	**Emergent.** Includes areas of wetlands dominated by erect, rooted, herbaceous hydrophytes, excluding mosses and lichens. This vegetation is present for most of the growing season in most years. Common names for emergent communities include marsh, wet meadow, wet prairie, sedge meadow, fens, prairie pothole, and bluejoint slough.	2
	Shrub. Includes areas of wetlands dominated by woody vegetation less than 6m (20 ft) tall. The plant species include true shrubs, young trees, or trees or shrubs that are small or stunted because of environmental conditions. Shrub wetlands may represent a successional stage leading to a forested wetland or they may be relatively stable plant communities.	
	Forested. Includes wetlands or areas of wetlands characterized by woody vegetation greater than 6m (20ft) or taller. Forested wetlands have an overstory of trees and often contain an understory of young trees and shrubs and an herbaceous layer, although the young tree/shrub and herbaceous layers can be largely missing from some types of forested wetlands. Some forested wetlands are defined as "vernal pools" in OAC Rule 3745-1-50.	
	Mudflats. The "mudflat" class is equivalent to the "unconsolidated bottom/mud" class/subclass (PUB_3) described in Cowardin et al. (1979) and includes areas of wetlands characterized by exposed or shallowly inundated substrates with vegetative cover less than 30%.	
	Open water. The "open water" class is equivalent to the "open water - unknown bottom" class in Cowardin et al. (1979) and includes areas re 1) inundated, 2) unvegetated, and 3) and "open", i.e. there is no "canopy" of any type of vegetation.	
	Other (See User's Manual)	

Table 3. Use this table to assign a cover score for Metric 6a to each of the vegetation communities identified on the preceding page. Refer to Table 6 for narrative descriptions of what "low," "moderate," and "high" quality mean.

Cover scale	Description
0	the vegetation community is either, 1) absent from wetland, or 2) comprises less than 0.1ha (0.2471 acres) of contiguous area within the wetland
1	vegetation community is present and either, 1) comprises a small part of the wetland's vegetation and is of low or moderate quality, or 2) if it comprises a significant part of the wetland's vegetation, the community is of low quality
2	the vegetation community is present and either, 1) comprises a significant part of the wetland's vegetation and is of moderate quality, or 2) the vegetation community comprises a small part of the wetland's vegetation but is of high quality
3	the vegetation community is of high quality and comprises a significant part, or more, of the wetland's vegetation.

Table 4. Use this table in conjunction with Table 5 to determine what is a "low," "moderate," or "high" quality community.

narrative	description
low	low species diversity and/or a predominance of non-native or disturbance tolerant native species
moderate	native species are the dominant component of the vegetation, although non-native or disturbance tolerant native species can also be present, and species diversity is moderate to moderately high, but generally without the presence of rare, threatened, or endangered species
high	a predominance of native species, with non-native species absent or virtually absent, and high species diversity and sometimes, but not always, the presence of rare, threatened or endangered species.

Table 5. Mudflat and open water community cover scale.

0	Absent <0.1ha (0.247 acres)
1	Low 0.1 to <1ha (0.247 to 2.47 acres)
2	Moderate 1ha to <4ha (2.47 to 9.88 acres)
3	High 4ha (9.88 acres) or more

48

subtotal

Wetland S | 48

subtotal from previous page

6b. Horizontal (plan view) interspersion. Select only one and assign score. Evaluate the wetland from a "plan view," i.e. as if the looking down upon it. See Figure 1.		
5pts	HIGH. Wetland has a high degree of interspersion.	
4pts	MODERATELY HIGH. Wetland has a moderately high degree of interspersion.	
3pts	MODERATE. Wetland has a moderate degree of interspersion.	
2pts	MODERATELY LOW. Wetland has a moderately low degree of interspersion.	
1pt	LOW. Wetland has a low degree of interspersion.	1
0pts	NONE. Wetland has no plan view interspersion.	

6c. Coverage of Invasive Plant Species. Refer to Table 1 on Page 7 for list. Select only one and assign score.		
-5pts	Extensive. >75% areal cover of invasive species	
-3pts	Moderate 25-75% areal cover of invasive species	
-1pt	Sparse. 5-25% areal cover of invasive species	
0pts	Nearly absent. <5% areal cover of invasive species	
1pt	Absent.	1

6d. Microtopography. Check each feature present in the wetland. Assign cover score of 0 to 3 using Table 6. Evaluate various microtopograhic habitat features often present in wetlands.	
Vegetated hummocks and tussocks.	
Coarse woody debris >15cm (6in) in diameter	1
Standing dead trees >25cm (10in) diameter at breast height	
Amphibian breeding habitat, e.g. vernal pools with standing water of sufficient duration and depth to support reproduction, or habitat for frog reproduction.	

Table 6. Cover scale for microtopographic habitat features.

microtopographic habitat quality	narrative description
0	feature is absent or functionally absent from the wetland
1	feature is present in the wetland in very small amounts or if more common, of low quality
2	feature is present in moderate amounts, but not of highest quality, or in small amounts of highest quality
3	present in moderate or greater amounts and of highest quality

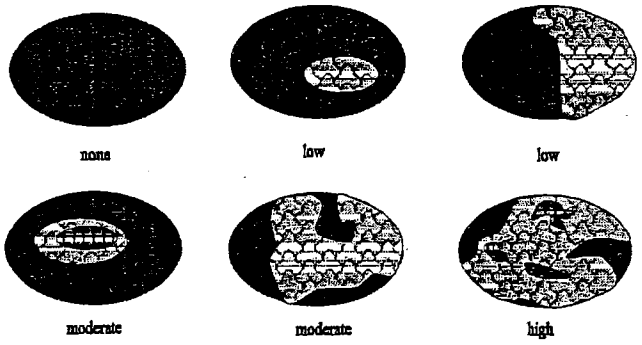


Figure 1. Hypothetical wetlands for estimating degree of interspersion.

51

GRAND TOTAL

End of Quantitative Rating. Complete Categorization Worksheets.

Refer to the most recent ORAM Score Calibration Report for the scoring breakpoints between wetland categories at the following address: http://www.epa.state.oh.us/dsw/401/401.html

ORAM Summary Worksheet Wetland 5

		circle answer or insert score	Result
Narrative Rating	Question 1 Critical Habitat	YES (NO)	If yes, Category 3.
	Question 2. Threatened or Endangered Species	YES (NO)	If yes, Category 3.
	Question 3. High Quality Natural Wetland	YES (NO)	If yes, Category 3.
	Question 4. Significant bird habitat	YES (NO)	If yes, Category 3.
	Question 5. Category 1 Wetlands	YES (NO)	If yes, Category 1.
	Question 6. Bogs	YES (NO)	If yes, Category 3.
	Question 7. Fens	YES (NO)	If yes, Category 3.
	Question 8a. Old Growth Forest	YES (NO)	If yes, Category 3.
	Question 8b. Mature Forested Wetland	YES (NO)	If yes, evaluate for Category 3; may also be 1 or 2.
	Question 9b. Lake Erie Wetlands - Restricted	YES (NO)	If yes, evaluate for Category 3; may also be 1 or 2.
	Question 9d. Lake Erie Wetlands - Unrestricted.	YES (NO)	If yes, Category 3
	Question 9e. Lake Erie Wetlands - Unrestricted with invasive plants	YES (NO)	If yes, evaluate for Category 3; may also be 1 or 2.
	Question 10. Oak Openings	YES (NO)	If yes, Category 3
	Question 11. Relict Wet Prairies	YES (NO)	If yes, evaluate for Category 3; may also be 1 or 2.
Quantitative Rating	Metric 1. Size	0	
	Metric 2. Buffers and surrounding land use	10	
	Metric 3. Hydrology	15,5	
	Metric 4. Habitat	15,5	
	Metric 5. Special Wetland Communities	0	
	Metric 6. Plant communities, interspersion, microtopography	5	
	TOTAL SCORE Consult most recent score calibration report at http://www.epa.state.oh.us/dsw/401/401.html to determine the wetland's category based on its quantitative score	46	Category based on score breakpoints 2

Complete Wetland Categorization Worksheet.

Wetland Categorization Worksheet Wetlands

Choices	Circle one		Evaluation of Categorization Result of ORAM
Did you answer "Yes" to any of the following questions: Narrative Rating Nos. 2, 3, 4, 6, 7, 8a, 9d, 10	YES Wetland is categorized as a Category 3 wetland	(NO)	Is quantitative rating score *less* than the Category 2 scoring threshold (*excluding* gray zone)? If yes, reevaluate the category of the wetland using the narrative criteria in OAC Rule 3745-1-54(C) and biological and/or functional assessments to determine if the wetland has been over-categorized by the ORAM
Did you answer "Yes" to any of the following questions: Narrative Rating Nos. 1, 8b, 9b, 9e, 11	YES Wetland should be evaluated for possible Category 3 status	(NO)	Evaluate the wetland using the 1) narrative criteria in OAC Rule 3745-1-54(C) and 2) the quantitative rating score. If the wetland is determined to be a Category 3 wetland using either of these, it should be categorized as a Category 3 wetland. Detailed biological and/or functional assessments may also be used to determine the wetland's category.
Did you answer "Yes" to Narrative Rating No. 5	YES Wetland is categorized as a Category 1 wetland	(NO)	Is quantitative rating score *greater* than the Category 2 scoring threshold *(including* any gray zone)? If yes, reevaluate the category of the wetland using the narrative criteria in OAC Rule 3745-1-54(C) and biological and/or functional assessments to determine if the wetland has been under-categorized by the ORAM
Does the quantitative score fall within the scoring range of a Category 1, 2, or 3 wetland?	(YES) Wetland is assigned to the appropriate category based on the scoring range	NO	If the score of the wetland is located within the scoring range for a particular category, the wetland should be assigned to that category. In all instances however, the narrative criteria described in OAC Rule 3745-1-54(C) can be used to clarify or change a categorization based on an quantitative score.
Does the quantitative score fall with the *"gray zone"* for Category 1 or 2 or Category 2 or 3 wetlands?	YES Wetland is assigned to the higher of the two categories or assigned to a category based on detailed assessments and the narrative criteria	(NO)	Rater has the option of assigning the wetland to the higher of the two categories or to assign a category based on the results of a nonrapid wetland assessment method, e.g. functional assessment, biological assessment, etc, and a consideration of the narrative criteria in OAC rule 3745-1-54(C).
Does the wetland otherwise exhibit *moderate OR superior* hydrologic OR habitat, OR recreational functions AND the wetland was *not* categorized as a Category 2 wetland (in the case of moderate functions) or a Category 3 wetland (in the case of superior functions) by this method?	YES Wetland was undercategorized by this method. A written justification for recategorization should be provided on Background Information Form	(NO) Wetland is assigned to category as determined by the ORAM.	A wetland may be undercategorized using this method, but still exhibit one or more superior functions, e.g. a wetland's biotic communities may be degraded by human activities, but the wetland may still exhibit superior hydrologic functions because of its type, landscape position, size, local or regional significance, etc. In this circumstance, the narrative criteria in OAC Rule 3745-1-54(C)(2) and (3) are controlling, and the under-categorization should be corrected. A written justification with supporting reasons or information for this determination should be provided.

Final Category

Choose one	Category 1	(Category 2)	Category 3

End of Ohio Rapid Assessment Method for Wetlands.

OhioEPA Primary Headwater Habitat Evaluation Form

HHEI Score (sum of metrics 1, 2, 3) : 44

SITE NAME/LOCATION Stream 1A, Apex Landfill Expansion

SITE NUMBER STA 1 RIVER BASIN Ohio DRAINAGE AREA (mi²) ~0.02

LENGTH OF STREAM REACH (ft) ~200 LAT. _____ LONG. _____ RIVER CODE NA RIVER MILE NA

DATE 06/18/10 SCORER Mike A. Tkacs COMMENTS Stream 1 Intermittent Segment - Class I PHWH

NOTE: Complete All Items On This Form - Refer to "Field Evaluation Manual for Ohio's PHWH Streams" for Instructions

STREAM CHANNEL MODIFICATIONS: ☒ NONE / NATURAL CHANNEL ☐ RECOVERED ☐ RECOVERING ☐ RECENT OR NO RECOVERY

1. SUBSTRATE (Estimate percent of every type of substrate present. Check *ONLY* two predominant substrate *TYPE* boxes (Max of 32). Add total number of significant substrate types found (Max of 8). Final metric score is sum of boxes A & B.

TYPE		PERCENT	TYPE		PERCENT
☐	BLDR SLABS [16 pts]		☐	SILT [3 pt]	5
☐	BOULDER (>256 mm) [16 pts]		☐	LEAF PACK/WOODY DEBRIS [3 pts]	
☐	BEDROCK [16 pt]		☐	FINE DETRITUS [3 pts]	
☐	COBBLE (65-256 mm) [12 pts]	5	☐	CLAY or HARDPAN [0 pt]	
☒	GRAVEL (2-64 mm) [9 pts]	60	☐	MUCK [0 pts]	
☐	SAND (<2 mm) [6 pts]	30	☐	ARTIFICIAL [3 pts]	

Total of Percentages of Bldr Slabs, Boulder, Cobble, Bedrock 5 (A) 15 (B) 4

SCORE OF TWO MOST PREDOMINATE SUBSTRATE TYPES: TOTAL NUMBER OF SUBSTRATE TYPES:

2. Maximum Pool Depth ***(Measure the maximum pool depth within the 61 meter (200 ft)*** evaluation reach at the time of evaluation. Avoid plunge pools from road culverts or storm water pipes) (Check *ONLY* one box):

- ☐ > 30 centimeters [20 pts]
- ☐ > 22.5 - 30 cm [30 pts]
- ☐ > 10 - 22.5 cm [25 pts]
- ☐ > 5 cm - 10 cm [15 pts]
- ☒ < 5 cm [5 pts]
- ☐ NO WATER OR MOIST CHANNEL [0 pts]

<5

COMMENTS _____ MAXIMUM POOL DEPTH (centimeters):

3. BANK FULL WIDTH (Measured as the average of 3-4 measurements) (Check *ONLY* one box):

- ☐ > 4.0 meters (> 13') [30 pts]
- ☐ > 3.0 m - 4.0 m (> 9' 7" - 13') [25 pts]
- ☒ > 1.5 m - 3.0 m (> 4' 8" - 9' 7") [20 pts]
- ☐ > 1.0 m - 1.5 m (> 3' 3" - 4' 8") [15 pts]
- ☐ ≤ 1.0 m (≤ 3' 3") [5 pts]

20

COMMENTS _____ AVERAGE BANKFULL WIDTH (meters)

HHEI Metric Points

Substrate Max = 40: 19

A + B

Pool Depth Max = 30: 5

Bankfull Width Max=30: 20

This information must also be completed

RIPARIAN ZONE AND FLOODPLAIN QUALITY ☆NOTE: River Left (L) and Right (R) as looking downstream☆

RIPARIAN WIDTH (Per Bank) L	R	FLOODPLAIN QUALITY (Most Predominant per Bank) L	R	L	R
☒	☒ Wide >10m	☐	☐ Mature Forest, Wetland	☐	☐ Conservation Tillage
☐	☐ Moderate 5-10m	☒	☒ Immature Forest, Shrub or Old Field	☐	☐ Urban or Industrial
☐	☐ Narrow <5m	☐	☐ Residential, Park, New Field	☐	☐ Open Pasture, Row Crop
☐	☐ None	☐	☐ Fenced Pasture	☐	☐ Mining or Construction

COMMENTS _____

FLOW REGIME *(At Time of Evaluation)* (Check *ONLY* one box):

- ☒ Stream Flowing
- ☐ Subsurface flow with isolated pools (Interstitial)
- ☐ Moist Channel, isolated pools, no flow (Intermittent)
- ☐ Dry channel, no water (Ephemeral)

COMMENTS _____

SINUOSITY (Number of bends per 61 m (200 ft) of channel) (Check *ONLY* one box):

- ☐ None
- ☐ 0.5
- ☐ 1.0
- ☒ 1.5
- ☐ 2.0
- ☐ 2.5
- ☐ 3.0
- ☐ >3

STREAM GRADIENT ESTIMATE

☐ Flat (0.5 ft/100 ft) ☒ Flat to Moderate ☐ Moderate (2 ft/100 ft) ☐ Moderate to Severe ☐ Severe (10 ft/100 ft)

October 24, 2002 Revision

ADDITIONAL STREAM INFORMATION (This Information Must Also be Completed):

QHEI PERFORMED? - ☐ Yes ■ No QHEI Score _____ (If Yes, Attach Completed QHEI Form)

DOWNSTREAM DESIGNATED USE(S)

■ WWH Name: Cross Creek, Ohio River Distance from Evaluated Stream ~14,000 ft (N. Br. Cross Creek)

☐ CWH Name: _____ Distance from Evaluated Stream _____

☐ EWH Name: _____ Distance from Evaluated Stream _____

MAPPING: ATTACH COPIES OF MAPS, INCLUDING THE ENTIRE WATERSHED AREA. CLEARLY MARK THE SITE LOCATION

USGS Quadrangle Name: Amsterdam, OH NRCS Soil Map Page: 22 NRCS Soil Map Stream Order 1

County: Jefferson Township / City: Springfield Twp.

MISCELLANEOUS HUC 05030101340

Base Flow Conditions? (Y/N): Y Date of last precipitation: 6/13/10 Quantity: 0.48" (landfill weather station records)

Photograph Information: See attached photo

Elevated Turbidity? (Y/N) N Canopy (% open): 10-15%

Were samples collected for water chemistry? (Y/N) N (Note lab sample no. or id. and attach results) Lab Number: NA

Field Measures: Temp (°C) — Dissolved Oxygen (mg/l) — pH (S.U.) — Conductivity (µmhos/cm) —

Is the sampling reach representative of the stream (Y/N) _____ If not, please explain: _____

Unamed Tributary to North Branch Cross Creek

Additional comments/description of pollution impacts: _____

BIOTIC EVALUATION

Performed? (Y/N) _____ (If Yes, Record all observations. Voucher collections optional. NOTE: all voucher samples must be labeled with the site ID number. Include appropriate field data sheets from the Primary Headwater Habitat Assessment Manual)

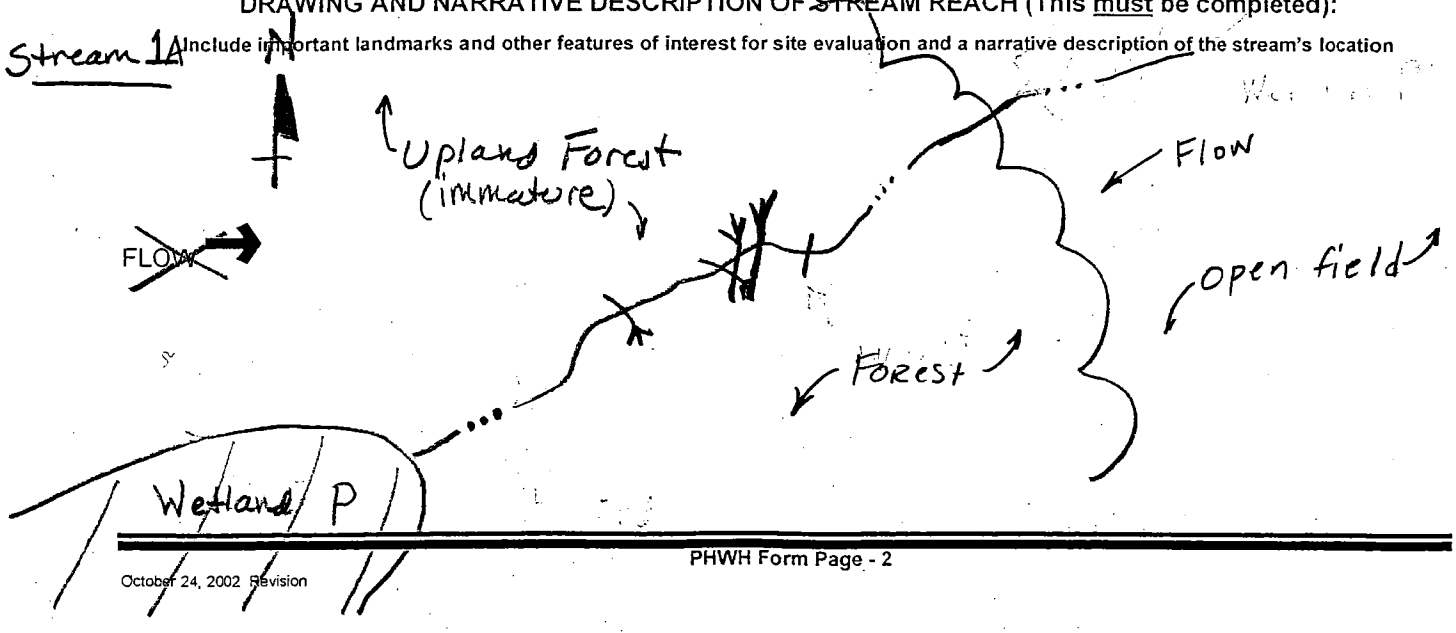
Fish Observed? (Y/N) _____ Voucher? (Y/N) — Salamanders Observed? (Y/N) _____ Voucher? (Y/N) —

Frogs or Tadpoles Observed? (Y/N) _____ Voucher? (Y/N) — Aquatic Macroinvertebrates Observed? (Y/N) _____ Voucher? (Y/N) _____

Comments Regarding Biology: Benthic macroinvertebrates observed: Platyhelminthes (common), Hydrophilidae (beetles) Few, Nemouridae (stone flies) Few.

DRAWING AND NARRATIVE DESCRIPTION OF ~~STREAM~~ REACH (This must be completed):

Include important landmarks and other features of interest for site evaluation and a narrative description of the stream's location



OhioEPA Primary Headwater Habitat Evaluation Form

HHEI Score (sum of metrics 1, 2, 3) : 32

SITE NAME/LOCATION Stream 1B / Apex Landfill Expansion

SITE NUMBER STA 1 RIVER BASIN Ohio DRAINAGE AREA (mi²) _____

LENGTH OF STREAM REACH (ft) 200 LAT. _____ LONG. _____ RIVER CODE NA RIVER MILE NA

DATE 5/19/11 SCORER LCPS, MRH COMMENTS Small headwater stream in mine spoil

NOTE: Complete All Items On This Form - Refer to "Field Evaluation Manual for Ohio's PHWH Streams" for Instructions

STREAM CHANNEL MODIFICATIONS: ☐ NONE / NATURAL CHANNEL ☒ RECOVERED ☐ RECOVERING ☐ RECENT OR NO RECOVERY
Stream downcut through mine spoil

1. SUBSTRATE (Estimate percent of every type of substrate present. Check *ONLY* two predominant substrate *TYPE* boxes (Max of 32). Add total number of significant substrate types found (Max of 8). Final metric score is sum of boxes A & B.

TYPE		PERCENT	TYPE		PERCENT
☐	BLDR SLABS [16 pts]		☒	SILT [3 pt]	25%
☐	BOULDER (>256 mm) [16 pts]		☐	LEAF PACK/WOODY DEBRIS [3 pts]	
☐	BEDROCK [16 pt]		☐	FINE DETRITUS [3 pts]	
☐	COBBLE (65-256 mm) [12 pts]		☐	CLAY or HARDPAN [0 pt]	
☒	GRAVEL (2-64 mm) [9 pts]	15%	☐	MUCK [0 pts]	
☒	SAND (<2 mm) [6 pts]	60%	☐	ARTIFICIAL [3 pts]	

Total of Percentages of Bldr Slabs, Boulder, Cobble, Bedrock 0%

(A) 9 SCORE OF TWO MOST PREDOMINATE SUBSTRATE TYPES:

Stream banks consist of coal spoil, coal fines

(B) 3 TOTAL NUMBER OF SUBSTRATE TYPES:

HHEI Metric Points

Substrate Max = 40: 12

A + B

2. Maximum Pool Depth ***(Measure the maximum pool depth within the 61 meter (200 ft)*** evaluation reach at the time of evaluation. Avoid plunge pools from road culverts or storm water pipes) (Check *ONLY* one box):

☐	> 30 centimeters [20 pts]	☒	> 5 cm - 10 cm [15 pts]
☐	> 22.5 - 30 cm [30 pts]	☐	< 5 cm [5 pts]
☐	> 10 - 22.5 cm [25 pts]	☐	NO WATER OR MOIST CHANNEL [0 pts]

COMMENTS Pools not present - Ri/Ru MAXIMUM POOL DEPTH (centimeters): 7.5

Pool Depth Max = 30: 15

3. BANK FULL WIDTH (Measured as the average of 3-4 measurements) (Check *ONLY* one box):

☐	> 4.0 meters (> 13') [30 pts]	☐	> 1.0 m - 1.5 m (> 3' 3" - 4' 8") [15 pts]
☐	> 3.0 m - 4.0 m (> 9' 7" - 13') [25 pts]	☒	≤ 1.0 m (≤ 3' 3") [5 pts]
☐	> 1.5 m - 3.0 m (> 9' 7" - 4' 8") [20 pts]		

COMMENTS deeply incised channel, lacks flood plain AVERAGE BANKFULL WIDTH (meters): 0.9

Bankfull Width Max=30: 5

This information must also be completed

RIPARIAN ZONE AND FLOODPLAIN QUALITY ☆NOTE: River Left (L) and Right (R) as looking downstream☆

RIPARIAN WIDTH L	R	(Per Bank)	FLOODPLAIN QUALITY L	R	(Most Predominant per Bank)	L	R	
☐	☒	Wide >10m	☐	☒	Mature Forest, Wetland	☐	☐	Conservation Tillage
☒	☐	Moderate 5-10m	☒	☒	Immature Forest, Shrub or Old Field	☐	☐	Urban or Industrial
☐	☐	Narrow <5m	☐	☐	Residential, Park, New Field	☐	☐	Open Pasture, Row Crop
☐	☐	None	☐	☐	Fenced Pasture	☐	☐	Mining or Construction

COMMENTS Stream originates @ rock channel adjacent to road.

FLOW REGIME *(At Time of Evaluation)* (Check *ONLY* one box):

☒	Stream Flowing	☐	Moist Channel, isolated pools, no flow (Intermittent)
☐	Subsurface flow with isolated pools (Interstitial)	☐	Dry channel, no water (Ephemeral)

COMMENTS 15-20 gpm

SINUOSITY (Number of bends per 61 m (200 ft) of channel) (Check *ONLY* one box):

☐	None	☒	1.0	☐	2.0	☐	3.0
☐	0.5	☐	1.5	☐	2.5	☐	>3

STREAM GRADIENT ESTIMATE

☐ Flat (0.5 ft/100 ft) ☐ Flat to Moderate ☐ Moderate (2 ft/100 ft) ☒ Moderate to Severe (3-4%) ☐ Severe (10 ft/100 ft)

October 24, 2002 Revision

Stream 1B

Apex Landfill

ADDITIONAL STREAM INFORMATION (This Information Must Also be Completed):

QHEI PERFORMED? - ☐ Yes ☒ No QHEI Score _____ (If Yes, Attach Completed QHEI Form)

DOWNSTREAM DESIGNATED USE(S)

☒ WWH Name: Cross Creek Distance from Evaluated Stream 14,000ft (N. Br. Cross Creek)

☐ CWH Name: _____ Distance from Evaluated Stream _____

☐ EWH Name: _____ Distance from Evaluated Stream _____

MAPPING: ATTACH COPIES OF MAPS, INCLUDING THE ENTIRE WATERSHED AREA. CLEARLY MARK THE SITE LOCATION

USGS Quadrangle Name: Amsterdam, OH NRCS Soil Map Page: 22 NRCS Soil Map Stream Order 0

County: Jefferson Township / City: Springfield Twp.

MISCELLANEOUS

Base Flow Conditions? (Y/N): N Date of last precipitation: 5/18/11 Quantity: _____

Photograph Information: See attached photo

Elevated Turbidity? (Y/N): Y Canopy (% open): 10%

Were samples collected for water chemistry? (Y/N): N (Note lab sample no. or id. and attach results) Lab Number: NA

Field Measures: Temp (°C) Not measured Dissolved Oxygen (mg/l) — pH (S.U.) — Conductivity (µmhos/cm) —

Is the sampling reach representative of the stream (Y/N) Y If not, please explain: _____

Additional comments/description of pollution impacts: exposed coal fines, reddog, and other mine spoil on banks; iron staining in channel.

BIOTIC EVALUATION

Performed? (Y/N): N (If Yes, Record all observations. Voucher collections optional. NOTE: all voucher samples must be labeled with the site ID number. Include appropriate field data sheets from the Primary Headwater Habitat Assessment Manual)

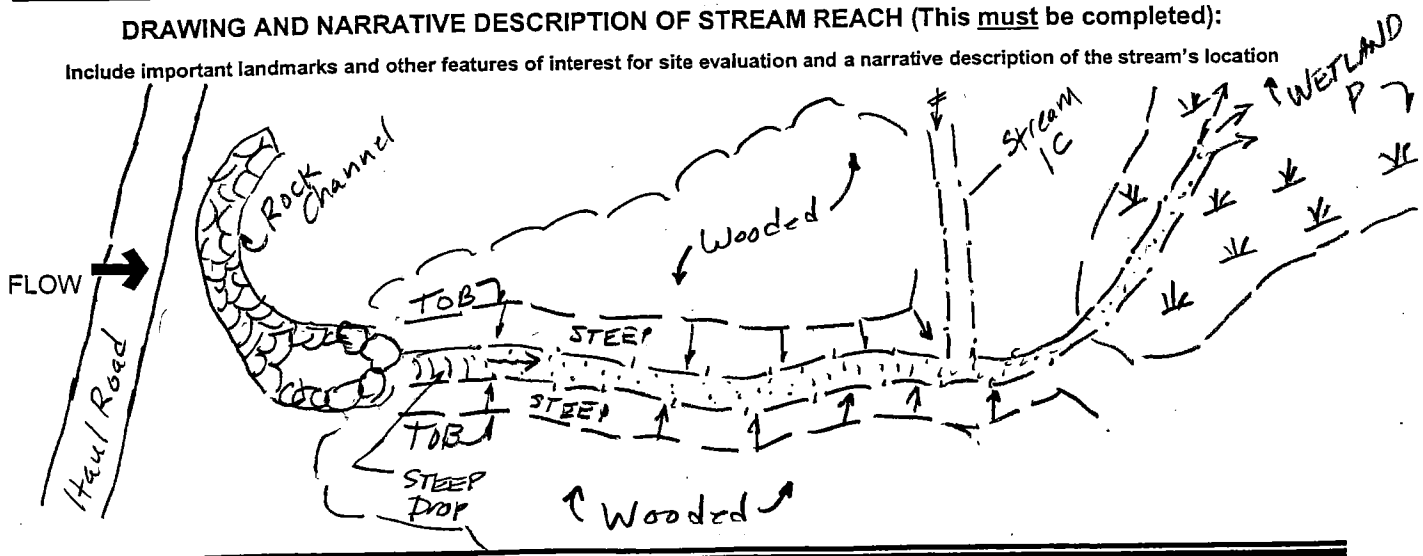
Fish Observed? (Y/N)_____ Voucher? (Y/N)_____ Salamanders Observed? (Y/N)_____ Voucher? (Y/N)_____

Frogs or Tadpoles Observed? (Y/N)_____ Voucher? (Y/N)_____ Aquatic Macroinvertebrates Observed? (Y/N)_____ Voucher? (Y/N)_____

Comments Regarding Biology: _____

DRAWING AND NARRATIVE DESCRIPTION OF STREAM REACH (This must be completed):

Include important landmarks and other features of interest for site evaluation and a narrative description of the stream's location



OhioEPA Primary Headwater Habitat Evaluation Form

HHEI Score (sum of metrics 1, 2, 3) : 24

SITE NAME/LOCATION Stream 1C / Apex Landfill Expansion

SITE NUMBER SRA 1 RIVER BASIN Ohio DRAINAGE AREA (mi²) _____

LENGTH OF STREAM REACH (ft) ~110 * LAT. _____ LONG. _____ RIVER CODE NA RIVER MILE NA

DATE 5/19/11 SCORER LCPS, MRH COMMENTS Small headwater stream in mine spoil

NOTE: Complete All Items On This Form - Refer to "Field Evaluation Manual for Ohio's PHWH Streams" for Instructions

STREAM CHANNEL ☐ NONE / NATURAL CHANNEL ☒ RECOVERED ☐ RECOVERING ☐ RECENT OR NO RECOVERY

MODIFICATIONS: * Stream only 113 ft long; Ephemeral channel on steep slope.

1. SUBSTRATE (Estimate percent of every type of substrate present. Check *ONLY* two predominant substrate *TYPE* boxes (Max of 32). Add total number of significant substrate types found (Max of 8). Final metric score is sum of boxes A & B.

TYPE		PERCENT	TYPE		PERCENT
☐	BLDR SLABS [16 pts]		☒	SILT [3 pt]	35%
☐	BOULDER (>256 mm) [16 pts]		☐	LEAF PACK/WOODY DEBRIS [3 pts]	5%
☐	BEDROCK [16 pt]		☐	FINE DETRITUS [3 pts]	
☐	COBBLE (65-256 mm) [12 pts]	5%	☐	CLAY or HARDPAN [0 pt]	
☐	GRAVEL (2-64 mm) [9 pts]	15%	☐	MUCK [0 pts]	
☒	SAND (<2 mm) [6 pts]	40%	☐	ARTIFICIAL [3 pts]	

Total of Percentages of Bldr Slabs, Boulder, Cobble, Bedrock 5% (A) 9

SCORE OF TWO MOST PREDOMINATE SUBSTRATE TYPES:

(B) 5

TOTAL NUMBER OF SUBSTRATE TYPES:

HHEI Metric Points

Substrate Max = 40: 14

A + B

2. Maximum Pool Depth ***(Measure the maximum pool depth within the 61 meter (200 ft)*** evaluation reach at the time of evaluation. Avoid plunge pools from road culverts or storm water pipes) (Check *ONLY* one box):

- ☐ > 30 centimeters [20 pts]
- ☐ > 22.5 - 30 cm [30 pts]
- ☐ > 10 - 22.5 cm [25 pts]
- ☐ > 5 cm - 10 cm [15 pts]
- ☒ < 5 cm [5 pts]
- ☐ NO WATER OR MOIST CHANNEL [0 pts]

COMMENTS Pools not present

MAXIMUM POOL DEPTH (centimeters): 3

Pool Depth Max = 30: 5

3. BANK FULL WIDTH (Measured as the average of 3-4 measurements) (Check *ONLY* one box):

- ☐ > 4.0 meters (> 13') [30 pts]
- ☐ > 3.0 m - 4.0 m (> 9' 7" - 13') [25 pts]
- ☐ > 1.5 m - 3.0 m (> 4' 8" - 9' 7") [20 pts]
- ☐ > 1.0 m - 1.5 m (> 3' 3" - 4' 8") [15 pts]
- ☒ ≤ 1.0 m (≤ 3' 3") [5 pts]

COMMENTS very narrow, steeply sloped

AVERAGE BANKFULL WIDTH (meters): 0.5

Bankfull Width Max=30: 5

This information must also be completed

RIPARIAN ZONE AND FLOODPLAIN QUALITY ☆NOTE: River Left (L) and Right (R) as looking downstream☆

RIPARIAN WIDTH (Per Bank) L	R	FLOODPLAIN QUALITY (Most Predominant per Bank) L	R		L	R	
☐	☐	Wide >10m	☐	☐	Mature Forest, Wetland	☐	☐	Conservation Tillage
☒	☒	Moderate 5-10m	☒	☒	Immature Forest, Shrub or Old Field	☐	☐	Urban or Industrial
☐	☐	Narrow <5m	☐	☐	Residential, Park, New Field	☐	☐	Open Pasture, Row Crop
☐	☐	None	☐	☐	Fenced Pasture	☐	☐	Mining or Construction

COMMENTS recovering forest on mined land

FLOW REGIME *(At Time of Evaluation)* (Check *ONLY* one box):

- ☒ Stream Flowing
- ☐ Subsurface flow with isolated pools (Interstitial)
- ☐ Moist Channel, isolated pools, no flow (Intermittent)
- ☐ Dry channel, no water (Ephemeral)

COMMENTS ~5gpm

SINUOSITY (Number of bends per 61 m (200 ft) of channel) (Check *ONLY* one box):

- ☒ None
- ☐ 0.5
- ☐ 1.0
- ☐ 1.5
- ☐ 2.0
- ☐ 2.5
- ☐ 3.0
- ☐ >3

STREAM GRADIENT ESTIMATE

☐ Flat (0.5 ft/100 ft) ☐ Flat to Moderate ☐ Moderate (2 ft/100 ft) ☒ Moderate to Severe (6-7%) ☐ Severe (10 ft/100 ft)

October 24, 2002 Revision

Stream 1C
Apex Landfill

ADDITIONAL STREAM INFORMATION (This Information Must Also be Completed):

QHEI PERFORMED? - ☐ Yes ☒ No QHEI Score _____ (If Yes, Attach Completed QHEI Form)

DOWNSTREAM DESIGNATED USE(S)

☒ WWH Name: Cross Creek Distance from Evaluated Stream 14,000 ft (N. Br. Cross Creek)
☐ CWH Name: _____ Distance from Evaluated Stream _____
☐ EWH Name: _____ Distance from Evaluated Stream _____

MAPPING: ATTACH COPIES OF MAPS, INCLUDING THE ENTIRE WATERSHED AREA. CLEARLY MARK THE SITE LOCATION

USGS Quadrangle Name: Amsterdam, OH NRCS Soil Map Page: 22 NRCS Soil Map Stream Order 0

County: Jefferson Co. Township / City: Springfield Twp.

MISCELLANEOUS

Base Flow Conditions? (Y/N): N Date of last precipitation: 5/18/11 Quantity: _____

Photograph Information: See attached photo

Elevated Turbidity? (Y/N): N Canopy (% open): 15%

Were samples collected for water chemistry? (Y/N): N (Note lab sample no. or id. and attach results) Lab Number: NA

Field Measures: Temp (°C) Not measured Dissolved Oxygen (mg/l) — pH (S.U.) — Conductivity (µmhos/cm) —

Is the sampling reach representative of the stream (Y/N) Y If not, please explain: _____

Additional comments/description of pollution impacts: Small steeply sloped ephemeral stream, eroded into mine spoil

BIOTIC EVALUATION

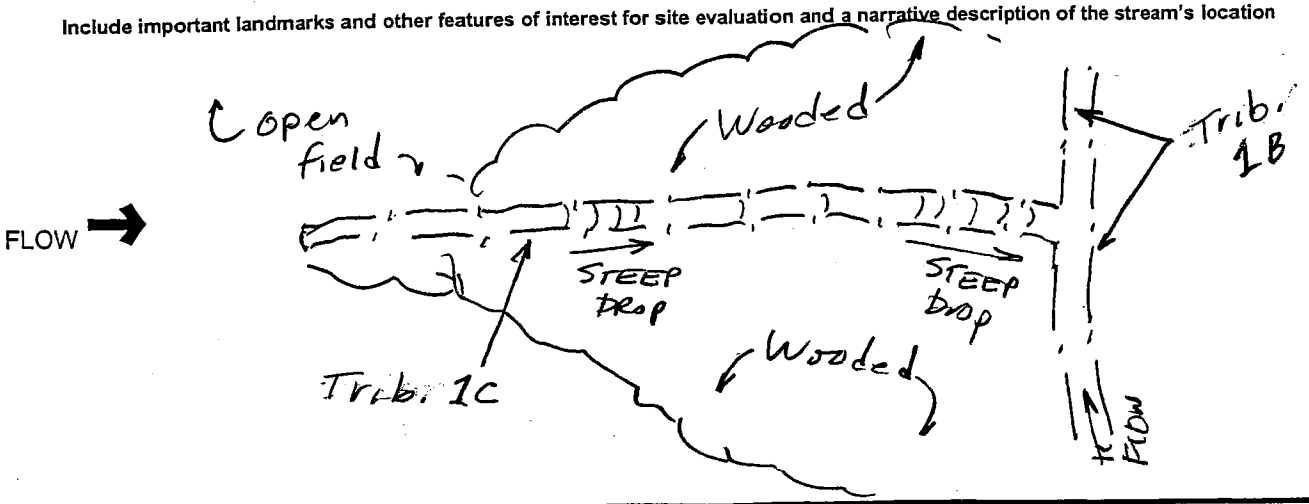
Performed? (Y/N): N (If Yes, Record all observations. Voucher collections optional. NOTE: all voucher samples must be labeled with the site ID number. Include appropriate field data sheets from the Primary Headwater Habitat Assessment Manual)

Fish Observed? (Y/N)_____ Voucher? (Y/N)_____ Salamanders Observed? (Y/N)_____ Voucher? (Y/N)_____
Frogs or Tadpoles Observed? (Y/N)____ Voucher? (Y/N)____ Aquatic Macroinvertebrates Observed? (Y/N)____ Voucher? (Y/N)____

Comments Regarding Biology: _____

DRAWING AND NARRATIVE DESCRIPTION OF STREAM REACH (This must be completed):

Include important landmarks and other features of interest for site evaluation and a narrative description of the stream's location



Ohio EPA Primary Headwater Habitat Evaluation Form

HHEI Score (sum of metrics 1, 2, 3) : 41

SITE NAME/LOCATION Stream 1D-upstream / Apex Landfill Expansion

SITE NUMBER STA 2 RIVER BASIN Ohio DRAINAGE AREA (mi²) < 0.10

LENGTH OF STREAM REACH (ft) 200 LAT. _____ LONG. _____ RIVER CODE NA RIVER MILE NA

DATE 2/16/11 SCORER LCPS, MRH COMMENTS Small headwater stream w/in Wetland P

NOTE: Complete All Items On This Form - Refer to "Field Evaluation Manual for Ohio's PHWH Streams" for Instructions

STREAM CHANNEL ☐ NONE / NATURAL CHANNEL ☒ RECOVERED ☐ RECOVERING ☐ RECENT OR NO RECOVERY

MODIFICATIONS: Stream developed in sediments from upslope strip mining.

1. SUBSTRATE (Estimate percent of every type of substrate present. Check *ONLY* two predominant substrate *TYPE* boxes (Max of 32). Add total number of significant substrate types found (Max of 8). Final metric score is sum of boxes A & B.

TYPE		PERCENT	TYPE		PERCENT
☐	BLDR SLABS [16 pts]		☒	SILT [3 pt]	90%
☐	BOULDER (>256 mm) [16 pts]		☐	LEAF PACK/WOODY DEBRIS [3 pts]	
☐	BEDROCK [16 pt]		☐	FINE DETRITUS [3 pts]	
☐	COBBLE (65-256 mm) [12 pts]		☐	CLAY or HARDPAN [0 pt]	
☐	GRAVEL (2-64 mm) [9 pts]		☐	MUCK [0 pts]	
☒	SAND (<2 mm) [6 pts]	10%	☐	ARTIFICIAL [3 pts]	

Total of Percentages of Bldr Slabs, Boulder, Cobble, Bedrock 0% (A) 9

SCORE OF TWO MOST PREDOMINATE SUBSTRATE TYPES:

(B) 2 **TOTAL NUMBER OF SUBSTRATE TYPES:**

HHEI Metric Points

Substrate Max = 40

11

A + B

2. Maximum Pool Depth ***(Measure the maximum pool depth within the 61 meter (200 ft)*** evaluation reach at the time of evaluation. Avoid plunge pools from road culverts or storm water pipes) (Check *ONLY* one box):

- ☐ > 30 centimeters [20 pts]
- ☐ > 22.5 - 30 cm [30 pts]
- ☐ > 10 - 22.5 cm [25 pts]
- ☒ > 5 cm - 10 cm [15 pts]
- ☐ ≤ 5 cm [5 pts]
- ☐ NO WATER OR MOIST CHANNEL [0 pts]

COMMENTS _____ **MAXIMUM POOL DEPTH (centimeters):** 10

Pool Depth Max = 30

15

3. BANK FULL WIDTH (Measured as the average of 3-4 measurements) (Check *ONLY* one box):

- ☐ > 4.0 meters (> 13') [30 pts]
- ☐ > 3.0 m - 4.0 m (> 9' 7" - 13') [25 pts]
- ☐ > 1.5 m - 3.0 m (> 9' 7" - 4' 8") [20 pts]
- ☐ > 1.0 m - 1.5 m (> 3' 3" - 4' 8") [15 pts]
- ☒ ≤ 1.0 m (≤ 3' 3") [5 pts]

COMMENTS 1.1m, 0.9m, 2.0m, 2.0m: $\bar{X}$ = 1.5m **AVERAGE BANKFULL WIDTH (meters)** 1.5

Bankfull Width Max=30

15

This information must also be completed

RIPARIAN ZONE AND FLOODPLAIN QUALITY ☆NOTE: River Left (L) and Right (R) as looking downstream☆

RIPARIAN WIDTH L	RIPARIAN WIDTH R	(Per Bank)	FLOODPLAIN QUALITY L	FLOODPLAIN QUALITY R	(Most Predominant per Bank)	L	R	
☒	☒	Wide >10m	☒	☒	Mature Forest, Wetland	☐	☐	Conservation Tillage
☐	☐	Moderate 5-10m	☐	☐	Immature Forest, Shrub or Old Field	☐	☐	Urban or Industrial
☐	☐	Narrow <5m	☐	☐	Residential, Park, New Field	☐	☐	Open Pasture, Row Crop
☐	☐	None	☐	☐	Fenced Pasture	☐	☐	Mining or Construction

COMMENTS Stream near center of wetland w/ facented slopes adjacent to wetland

FLOW REGIME *(At Time of Evaluation)* (Check *ONLY* one box):

- ☒ Stream Flowing
- ☐ Subsurface flow with isolated pools (Interstitial)
- ☐ Moist Channel, isolated pools, no flow (Intermittent)
- ☐ Dry channel, no water (Ephemeral)

COMMENTS ~15 gpm (visual est.)

SINUOSITY (Number of bends per 61 m (200 ft) of channel) (Check *ONLY* one box):

- ☐ None
- ☐ 0.5
- ☐ 1.0
- ☐ 1.5
- ☒ 2.0
- ☐ 2.5
- ☐ 3.0
- ☐ >3

1 bend / 100 ft.

STREAM GRADIENT ESTIMATE

- ☒ Flat (0.5 ft/100 ft)
- ☐ Flat to Moderate
- ☐ Moderate (2 ft/100 ft)
- ☐ Moderate to Severe
- ☐ Severe (10 ft/100 ft)

ADDITIONAL STREAM INFORMATION (This Information Must Also be Completed): Stream 1D- Upstream

QHEI PERFORMED? - ☐ Yes ☒ No QHEI Score _____ (If Yes, Attach Completed QHEI Form)

DOWNSTREAM DESIGNATED USE(S)

			North Branch Cross Creek
☒ WWH Name:	Cross Creek, Ohio River	Distance from Evaluated Stream	~14,000'
☐ CWH Name:		Distance from Evaluated Stream	
☐ EWH Name:		Distance from Evaluated Stream	

MAPPING: ATTACH COPIES OF MAPS, INCLUDING THE ENTIRE WATERSHED AREA. CLEARLY MARK THE SITE LOCATION

USGS Quadrangle Name: Amsterdam, OH NRCS Soil Map Page: 22 NRCS Soil Map Stream Order 1

County: Jefferson Township / City: Springfield Twp.

MISCELLANEOUS

Base Flow Conditions? (Y/N): Y/N Date of last precipitation: 2/8/11 Quantity: 0.25"

Photograph Information: US 5,6 DS 7,8 US 9,10 US 11 → sheet flow, wetland (see attached photo).

Elevated Turbidity? (Y/N): N Canopy (% open): 10-15%

Were samples collected for water chemistry? (Y/N): N (Note lab sample no. or id. and attach results) Lab Number: _____

Field Measures: Temp (°C) _____ Dissolved Oxygen (mg/l) _____ pH (S.U.) _____ Conductivity (µmhos/cm) _____

Is the sampling reach representative of the stream (Y/N) Y If not, please explain: _____

Unnamed Tributary to North Branch Cross Creek

Additional comments/description of pollution impacts: _____

BIOTIC EVALUATION

Performed? (Y/N): Y (If Yes, Record all observations. Voucher collections optional. NOTE: all voucher samples must be labeled with the site ID number. Include appropriate field data sheets from the Primary Headwater Habitat Assessment Manual)

Fish Observed? (Y/N) _____ Voucher? (Y/N) _____ Salamanders Observed? (Y/N) _____ Voucher? (Y/N) _____

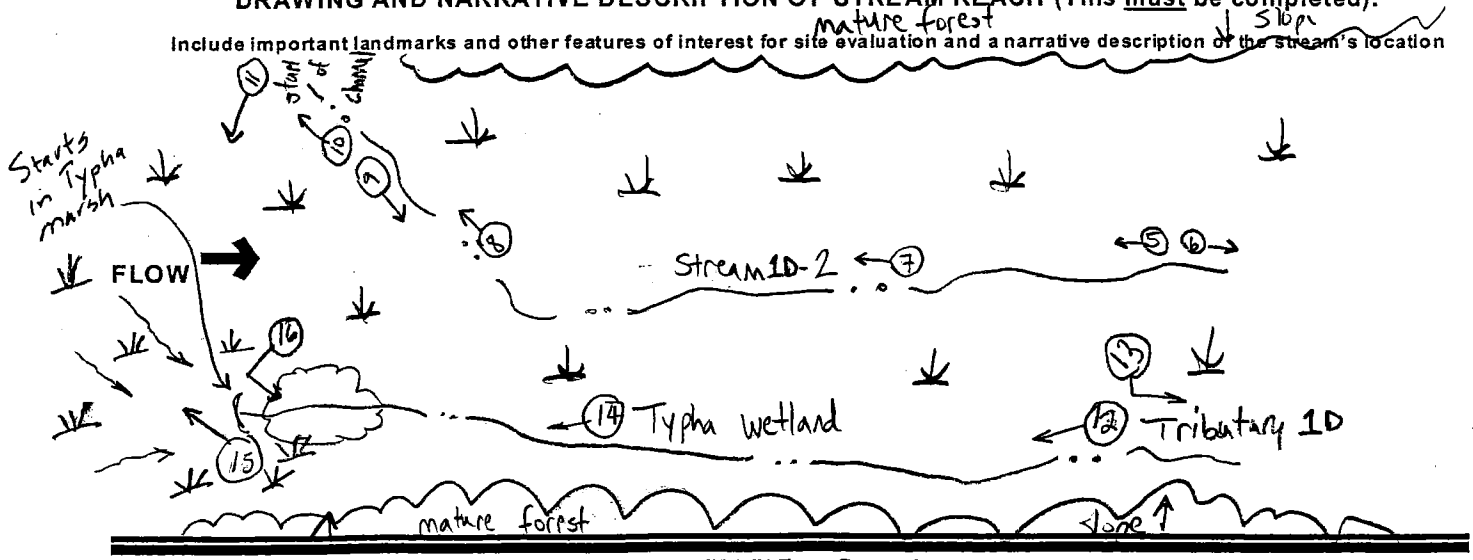
Frogs or Tadpoles Observed? (Y/N) _____ Voucher? (Y/N) _____ Aquatic Macroinvertebrates Observed? (Y/N) _____ Voucher? (Y/N) _____

Comments Regarding Biology: _____

Ice cover obscured fish, amphibian observations

DRAWING AND NARRATIVE DESCRIPTION OF STREAM REACH (This must be completed):

Include important landmarks and other features of interest for site evaluation and a narrative description of the stream's location



Stream ID - Upstream

3. Macroinvertebrate Scoring Sheet:

THE HEADWATER MACROINVERTEBRATE FIELD EVALUATION INDEX (HMFEI) SCORING SHEET

Indicate Abundance of Each Taxa Above each White Box.

Record HMFEI Scoring Value Points Within each Box.

For EPT taxa, also indicate the different taxa present.

Key: V = Very Abundant (> 50); **A** = Abundant (10 -50); **C** = Common (3 -9); **R** = Rare (< 3)

Sessile Animals (**Porifera, Cnidaria, Bryozoa**) (HMFEI pts = 1) NA 0	Crayfish (**Decapoda**) (HMFEI pts = 2) NA 0	Fishfly Larvae (**Corydalidae**) (HMFEI pts = 3) NA 0
Aquatic Worms (**Turbellaria, Hirudinea, Oligochaeta**) (HMFEI pts = 1) NA 0	Dragonfly Nymphs (**Anisoptera**) (HMFEI pts = 2) NA 0	Water Penny Beetles (**Psephenidae**) (HMFEI pts = 3) NA 0
Sow Bugs (**Isopoda**) (HMFEI pts = 1) NA 0	Riffle Beetles (**Dryopidae, Elmidae, Ptilodactylidae**) (HMFEI pts = 2) NA 0	Cranefly Larvae (**Tipulidae**) (HMFEI pts = 3) NA 0
Scuds (**Amphipoda**) (HMFEI pts = 1) NA 0	Larvae of other Flies (enter name in comments) (**Diptera**): (HMFEI pts = 1) NA 0	**EPT TAXA*** Total No. EPT Taxa = 0
Water Mites (**Hydracarina**) (HMFEI pts = 1) NA 0	Midges (**Chironomidae**) (HMFEI pts = 1) NA 0	Mayfly Nymphs (**Ephemeroptera**) Taxa Present: 0 [HMFEI pts = No. Taxa (x) 3] NA 0
Damselfly Nymphs (**Zygoptera**) (HMFEI pts = 1) NA 0	Snails (**Gastropoda**) (HMFEI pts = 1) R 1	
Alderfly Larvae (**Sialidae**) (HMFEI pts = 1) C 7	Clams (**Bivalvia**) (HMFEI pts = 1) NA 0	Stonefly Nymphs (**Plecoptera**) Taxa Present: 0 [HMFEI pts = No. Taxa (x) 3] NA 0
Other Beetles (**Coleoptera**) (HMFEI pts = 1) NA 0	Other Taxa :	
Other Taxa:	Other Taxa:	Caddisfly Larvae (**Trichoptera**) Taxa Present: 0 [HMFEI pts = No. Taxa (x) 3] NA 0
Other Taxa:	Other Taxa	

*Note: EPT identification based upon Family or Genus level of taxonomy

Voucher Sample ID: none Time Spent (minutes): 15 minutes

Notes on Macroinvertebrates: (Predominant Organisms; Other Common Organisms; Diversity Estimate)

Final HMFEI Calculated Score (Sum of All White Box Scores) = **0**

IF Final HMFEI Score is > 19, Then CLASS III PHWH STREAM
IF Final HMFEI Score is 7 to 19, Then CLASS II PHWH STREAM
IF Final HMFEI Score is < 7, Then CLASS I PHWH STREAM

[redacted]

Reset Form

OhioEPA Primary Headwater Habitat Evaluation Form

HHEI Score (sum of metrics 1, 2, 3) : 51

SITE NAME/LOCATION Stream 1D- Downstream/Apex Landfill Expansion

SITE NUMBER STA 1 RIVER BASIN Ohio DRAINAGE AREA (mi²) <0.10

LENGTH OF STREAM REACH (ft) 200 LAT. _____ LONG. _____ RIVER CODE NA RIVER MILE NA

DATE 2/16/11 SCORER LCPS, MRH COMMENTS Small headwater stream in Wetland P

NOTE: Complete All Items On This Form - Refer to "Field Evaluation Manual for Ohio's PHWH Streams" for Instructions

STREAM CHANNEL MODIFICATIONS: ☐ NONE / NATURAL CHANNEL ☒ RECOVERED ☐ RECOVERING ☐ RECENT OR NO RECOVERY

Stream developed in sediments from upslope strip mining

1. SUBSTRATE (Estimate percent of every type of substrate present. Check *ONLY* two predominant substrate *TYPE* boxes (Max of 32). Add total number of significant substrate types found (Max of 8). Final metric score is sum of boxes A & B.

TYPE		PERCENT
☐	BLDR SLABS [16 pts]	
☐	BOULDER (>256 mm) [16 pts]	
☐	BEDROCK [16 pt]	
☐	COBBLE (65-256 mm) [12 pts]	
☐	GRAVEL (2-64 mm) [9 pts]	
☒	SAND (<2 mm) [6 pts]	70%

TYPE		PERCENT
☒	SILT [3 pt]	30%
☐	LEAF PACK/WOODY DEBRIS [3 pts]	
☐	FINE DETRITUS [3 pts]	
☐	CLAY or HARDPAN [0 pts]	
☐	MUCK [0 pts]	
☐	ARTIFICIAL [3 pts]	

Total of Percentages of Bldr Slabs, Boulder, Cobble, Bedrock 0%

(A) 9 SCORE OF TWO MOST PREDOMINATE SUBSTRATE TYPES:

(B) 2 TOTAL NUMBER OF SUBSTRATE TYPES:

2. Maximum Pool Depth *(Measure the maximum pool depth within the 61 meter (200 ft)* evaluation reach at the time of evaluation. Avoid plunge pools from road culverts or storm water pipes) (Check *ONLY* one box):

- ☐ > 30 centimeters [20 pts]
- ☐ > 22.5 - 30 cm [30 pts]
- ☒ > 10 - 22.5 cm [25 pts]
- ☐ > 5 cm - 10 cm [15 pts]
- ☐ ≤ 5 cm [5 pts]
- ☐ NO WATER OR MOIST CHANNEL [0 pts]

18 MAXIMUM POOL DEPTH (centimeters):

COMMENTS Short pools (4-5ft long)

3. BANK FULL WIDTH (Measured as the average of 3-4 measurements) (Check *ONLY* one box):

- ☐ > 4.0 meters (> 13') [30 pts]
- ☐ > 3.0 m - 4.0 m (> 9' 7" - 13') [25 pts]
- ☐ > 1.5 m - 3.0 m (> 9' 7" - 4' 8") [20 pts]
- ☒ > 1.0 m - 1.5 m (> 3' 3" - 4' 8") [15 pts]
- ☐ ≤ 1.0 m (≤ 3' 3") [5 pts]

1.1 AVERAGE BANKFULL WIDTH (meters)

COMMENTS 1.2m, 1.0m, 1.2m, 0.7m, 1.3m (0') (50') (100') (150') (200')

HHEI Metric Points

Substrate Max = 40: 11

A + B

Pool Depth Max = 30: 25

Bankfull Width Max=30: 15

This information must also be completed

RIPARIAN ZONE AND FLOODPLAIN QUALITY ☆NOTE: River Left (L) and Right (R) as looking downstream☆

RIPARIAN WIDTH (Per Bank) L	R	FLOODPLAIN QUALITY (Most Predominant per Bank) L	R		L	R	
☒	☒	Wide >10m	☒	☒	Mature Forest, Wetland	☐	☐	Conservation Tillage
☐	☐	Moderate 5-10m	☐	☐	Immature Forest, Shrub or Old Field	☐	☐	Urban or Industrial
☐	☐	Narrow <5m	☐	☐	Residential, Park, New Field	☐	☐	Open Pasture, Row Crop
☐	☐	None	☐	☐	Fenced Pasture	☐	☐	Mining or Construction

COMMENTS Mature forest on RDB, Typha wetland on LDB

FLOW REGIME *(At Time of Evaluation)* (Check *ONLY* one box):

- ☒ Stream Flowing
- ☐ Subsurface flow with isolated pools (Interstitial)
- ☐ Moist Channel, isolated pools, no flow (Intermittent)
- ☐ Dry channel, no water (Ephemeral)

COMMENTS ~15 gpm (visual est)

SINUOSITY (Number of bends per 61 m (200 ft) of channel) (Check *ONLY* one box):

- ☐ None
- ☐ 0.5
- ☐ 1.0
- ☐ 1.5
- ☐ 2.0
- ☐ 2.5
- ☐ 3.0
- ☒ >3 (shallow meanders)

STREAM GRADIENT ESTIMATE

☒ Flat (0.5 ft/100 ft) ☐ Flat to Moderate ☐ Moderate (2 ft/100 ft) ☐ Moderate to Severe ☐ Severe (10 ft/100 ft)

October 24, 2002 Revision

Stream ID - Downstream

ADDITIONAL STREAM INFORMATION (This Information Must Also be Completed):

QHEI PERFORMED? - ☐ Yes ☒ No QHEI Score _____ (If Yes, Attach Completed QHEI Form)

DOWNSTREAM DESIGNATED USE(S)

North Branch Cross Creek

☒ WWH Name:	Cross Creek, Ohio River	Distance from Evaluated Stream	~13,000'
☐ CWH Name:		Distance from Evaluated Stream	
☐ EWH Name:		Distance from Evaluated Stream	

MAPPING: ATTACH COPIES OF MAPS, INCLUDING THE ENTIRE WATERSHED AREA. CLEARLY MARK THE SITE LOCATION

USGS Quadrangle Name: Amsterdam, OH NRCS Soil Map Page: 22 NRCS Soil Map Stream Order 1

County: Jefferson Township / City: Springfield Twp.

MISCELLANEOUS

Base Flow Conditions? (Y/N): N Date of last precipitation: 2/8/11 Quantity: 0.25"

Photograph Information: Photos 1, 2 (Camera B); see attached photo

Elevated Turbidity? (Y/N): N Canopy (% open): 10-15%

Were samples collected for water chemistry? (Y/N): N (Note lab sample no. or id. and attach results) Lab Number: _____

Field Measures: Temp (°C) _____ Dissolved Oxygen (mg/l) _____ pH (S.U.) _____ Conductivity (µmhos/cm) _____

Is the sampling reach representative of the stream (Y/N): Y If not, please explain: _____

Unamed Tributary to North Branch Cross Creek

Additional comments/description of pollution impacts: _____

BIOTIC EVALUATION

Performed? (Y/N): Y (If Yes, Record all observations. Voucher collections optional. NOTE: all voucher samples must be labeled with the site ID number. Include appropriate field data sheets from the Primary Headwater Habitat Assessment Manual)

Fish Observed? (Y/N): _____ Voucher? (Y/N) _____ Salamanders Observed? (Y/N) _____ Voucher? (Y/N) _____

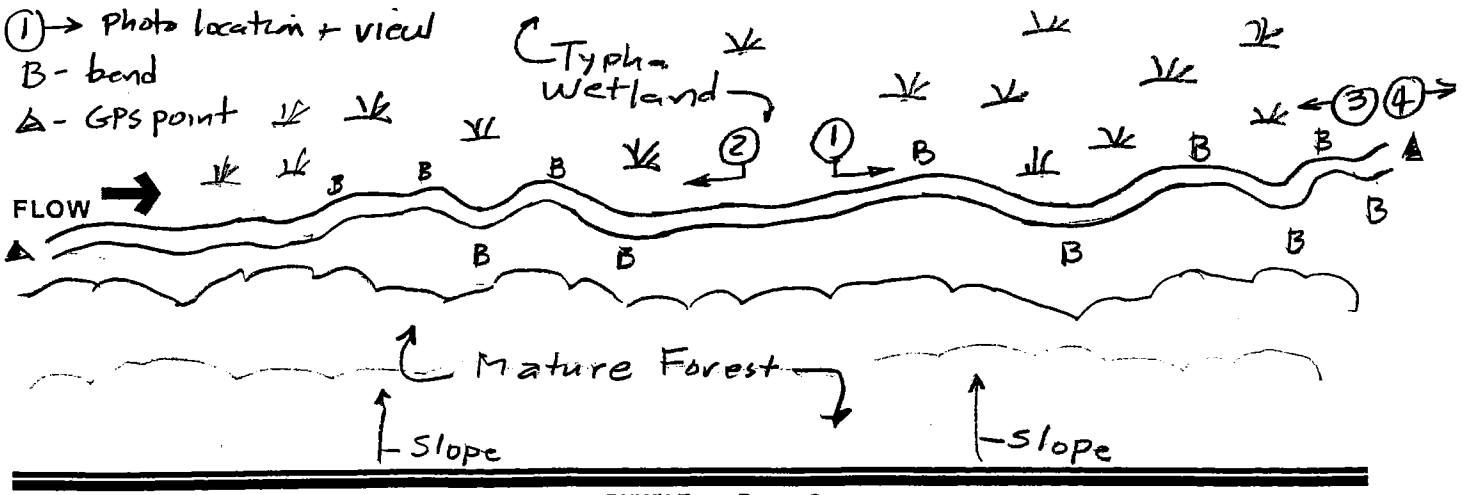
Frogs or Tadpoles Observed? (Y/N): _____ Voucher? (Y/N) _____ Aquatic Macroinvertebrates Observed? (Y/N _____ Voucher? (Y/N) _____

Comments Regarding Biology: _____

Ice cover obscured fish, amphibian observations

DRAWING AND NARRATIVE DESCRIPTION OF STREAM REACH (This must be completed):

Include important landmarks and other features of interest for site evaluation and a narrative description of the stream's location



Stream 1D - Downstream

3. Macroinvertebrate Scoring Sheet:

THE HEADWATER MACROINVERTEBRATE FIELD EVALUATION INDEX (HMFEI) SCORING SHEET

Indicate Abundance of Each Taxa Above each White Box.

Record HMFEI Scoring Value Points Within each Box.

For EPT taxa, also indicate the different taxa present.

Key: V = Very Abundant (> 50); **A** = Abundant (10 -50); **C** = Common (3 -9); **R** = Rare (< 3)

Sessile Animals (**Porifera, Cnidaria, Bryozoa**) (HMFEI pts = 1) NA 0	Crayfish (**Decapoda**) (HMFEI pts = 2) NA 0	Fishfly Larvae (**Corydalidae**) (HMFEI pts = 3) NA 0
Aquatic Worms (**Turbellaria, Hirudinea, Oligochaeta**) (HMFEI pts = 1) NA 0	Dragonfly Nymphs (**Anisoptera**) (HMFEI pts = 2) NA 0	Water Penny Beetles (**Psephenidae**) (HMFEI pts = 3) NA 0
Sow Bugs (**Isopoda**) (HMFEI pts = 1) NA 0	Riffle Beetles (**Dryopidae, Elmidae, Ptilodactylidae**) (HMFEI pts = 2) NA 0	Cranefly Larvae (5) (**Tipulidae**) (HMFEI pts = 3) NA 0
Scuds (**Amphipoda**) (HMFEI pts = 1) NA 0	Larvae of other Flies (enter name in comments) (**Diptera**): Ceratopogonidae (3) (HMFEI pts = 1) NA 0	**EPT TAXA*** Total No. EPT Taxa = 0
Water Mites (**Hydracarina**) (HMFEI pts = 1) NA 0	Midges (**Chironomidae**) (HMFEI pts = 1) NA 0	Mayfly Nymphs (**Ephemeroptera**) Taxa Present: 0 [HMFEI pts = No. Taxa (x) 3] NA 0
Damselfly Nymphs (**Zygoptera**) (HMFEI pts = 1) NA 0	Snails (**Gastropoda**) (HMFEI pts = 1) NA 0	
Alderfly Larvae (**Sialidae**) (1) (HMFEI pts = 1) NA 0	Clams (**Bivalvia**) (HMFEI pts = 1) NA 0	Stonefly Nymphs (**Plecoptera**) Taxa Present: 0 [HMFEI pts = . No. Taxa (x) 3] NA 0
Other Beetles (**Coleoptera**) (HMFEI pts = 1) NA 0	Other Taxa :	
Other Taxa:	Other Taxa:	Caddisfly Larvae (**Trichoptera**) Taxa Present: 0 [HMFEI pts = No. Taxa (x) 3] NA 0
Other Taxa:	Other Taxa	

*Note: EPT identification based upon Family or Genus level of taxonomy

Voucher Sample ID None Time Spent (minutes): 20 min

Notes on Macroinvertebrates: (Predominant Organisms; Other Common Organisms; Diversity Estimate)

ice cover ~ 60-70% stream

Final HMFEI Calculated Score (Sum of All White Box Scores) = 0

IF Final HMFEI Score is > 19, Then CLASS III PHWH STREAM
IF Final HMFEI Score is 7 to 19, Then CLASS II PHWH STREAM
IF Final HMFEI Score is < 7, Then CLASS I PHWH STREAM

[redacted] Reset Form

Ohio EPA Primary Headwater Habitat Evaluation Form

HHEI Score (sum of metrics 1, 2, 3) : 23

SITE NAME/LOCATION Stream 1E / Apex Landfill Expansion

SITE NUMBER STA 1 RIVER BASIN Ohio DRAINAGE AREA (mi²) < 0.01

LENGTH OF STREAM REACH (ft) 200' LAT. _____ LONG. _____ RIVER CODE NA RIVER MILE NA

DATE 5/19/11 SCORER MRH, LCPS COMMENTS Isolated ephemeral channel assoc. w/ Wetland S

NOTE: Complete All Items On This Form - Refer to "Field Evaluation Manual for Ohio's PHWH Streams" for Instructions

STREAM CHANNEL MODIFICATIONS: ☒ NONE / NATURAL CHANNEL ☐ RECOVERED ☐ RECOVERING ☐ RECENT OR NO RECOVERY

1. SUBSTRATE (Estimate percent of every type of substrate present. Check *ONLY* two predominant substrate *TYPE* boxes (Max of 32). Add total number of significant substrate types found (Max of 8). Final metric score is sum of boxes A & B.

TYPE		PERCENT	TYPE		PERCENT
☐	BLDR SLABS [16 pts]		☐	SILT [3 pt]	40
☐	BOULDER (>256 mm) [16 pts]		☐	LEAF PACK/WOODY DEBRIS [3 pts]	10
☐	BEDROCK [16 pt]		☐	FINE DETRITUS [3 pts]	10
☐	COBBLE (65-256 mm) [12 pts]		☐	CLAY or HARDPAN [0 pt]	
☐	GRAVEL (2-64 mm) [9 pts]		☐	MUCK [0 pts]	
☒	SAND (<2 mm) [6 pts]	40	☐	ARTIFICIAL [3 pts]	

Total of Percentages of Bldr Slabs, Boulder, Cobble, Bedrock _____ (A) 9

SCORE OF TWO MOST PREDOMINATE SUBSTRATE TYPES:

(B) 4

TOTAL NUMBER OF SUBSTRATE TYPES:

HHEI Metric Points

Substrate Max = 40 13

A + B

2. Maximum Pool Depth ***(Measure the maximum pool depth within the 61 meter (200 ft)*** evaluation reach at the time of evaluation. Avoid plunge pools from road culverts or storm water pipes) (Check *ONLY* one box):

- ☐ > 30 centimeters [20 pts]
- ☐ > 22.5 - 30 cm [30 pts]
- ☐ > 10 - 22.5 cm [25 pts]
- ☐ > 5 cm - 10 cm [15 pts]
- ☒ < 5 cm [5 pts]
- ☐ NO WATER OR MOIST CHANNEL [0 pts]

COMMENTS Pools not present MAXIMUM POOL DEPTH (centimeters): 2

Pool Depth Max = 30 5

3. BANK FULL WIDTH (Measured as the average of 3-4 measurements) (Check *ONLY* one box):

- ☐ > 4.0 meters (> 13') [30 pts]
- ☐ > 3.0 m - 4.0 m (> 9' 7" - 13') [25 pts]
- ☐ > 1.5 m - 3.0 m (> 4' 8" - 9' 7") [20 pts]
- ☐ > 1.0 m - 1.5 m (> 3' 3" - 4' 8") [15 pts]
- ☒ ≤ 1.0 m (≤ 3' 3") [5 pts]

COMMENTS _____ AVERAGE BANKFULL WIDTH (meters) 0.3

Bankfull Width Max=30 5

This information must also be completed

RIPARIAN ZONE AND FLOODPLAIN QUALITY ☆NOTE: River Left (L) and Right (R) as looking downstream☆

RIPARIAN WIDTH L	R	(Per Bank)	FLOODPLAIN QUALITY L	R	(Most Predominant per Bank)	L	R	
☒	☒	Wide >10m	☒	☒	Mature Forest, Wetland	☐	☐	Conservation Tillage
☐	☐	Moderate 5-10m	☐	☐	Immature Forest, Shrub or Old Field	☐	☐	Urban or Industrial
☐	☐	Narrow <5m	☐	☐	Residential, Park, New Field	☐	☐	Open Pasture, Row Crop
☐	☐	None	☐	☐	Fenced Pasture	☐	☐	Mining or Construction

COMMENTS Entirely w/in forested setting

FLOW REGIME *(At Time of Evaluation)* (Check *ONLY* one box):

- ☒ Stream Flowing
- ☐ Subsurface flow with isolated pools (Interstitial)
- ☐ Moist Channel, isolated pools, no flow (Intermittent)
- ☐ Dry channel, no water (Ephemeral)

COMMENTS ~ 0.2 gpm; flow disappears @ downstream end.

SINUOSITY (Number of bends per 61 m (200 ft) of channel) (Check *ONLY* one box):

☒ None	☐ 1.0	☐ 2.0	☐ 3.0
☐ 0.5	☐ 1.5	☐ 2.5	☐ >3

STREAM GRADIENT ESTIMATE

☐ Flat (0.5 ft/100 ft) ☐ Flat to Moderate ☒ Moderate (2 ft/100 ft) ☐ Moderate to Severe ☐ Severe (10 ft/100 ft)

Stream 1E
Apex Landfill

ADDITIONAL STREAM INFORMATION (This Information Must Also be Completed):

QHEI PERFORMED? - ☐ Yes ☒ No QHEI Score _____ (If Yes, Attach Completed QHEI Form)

DOWNSTREAM DESIGNATED USE(S)

☒ WWH Name: Cross Creek Distance from Evaluated Stream 13,000ft (N. Br. Cross Creek)

☐ CWH Name: _____ Distance from Evaluated Stream _____

☐ EWH Name: _____ Distance from Evaluated Stream _____

MAPPING: ATTACH COPIES OF MAPS, INCLUDING THE ENTIRE WATERSHED AREA. CLEARLY MARK THE SITE LOCATION

USGS Quadrangle Name: Amsterdam OH NRCS Soil Map Page: _____ NRCS Soil Map Stream Order _____

County: Harrison Township / City: _____

MISCELLANEOUS

Base Flow Conditions? (Y/N): N Date of last precipitation: 5/18/11 Quantity: _____

Photograph Information: See attached photo

Elevated Turbidity? (Y/N): N Canopy (% open): _____

Were samples collected for water chemistry? (Y/N): N (Note lab sample no. or id. and attach results) Lab Number: NA

Field Measures: Temp (°C) Not measured Dissolved Oxygen (mg/l) — pH (S.U.) — Conductivity (µmhos/cm) —

Is the sampling reach representative of the stream (Y/N) Y If not, please explain: _____

Additional comments/description of pollution impacts: _____

BIOTIC EVALUATION

Performed? (Y/N): N (If Yes, Record all observations. Voucher collections optional. NOTE: all voucher samples must be labeled with the site ID number. Include appropriate field data sheets from the Primary Headwater Habitat Assessment Manual)

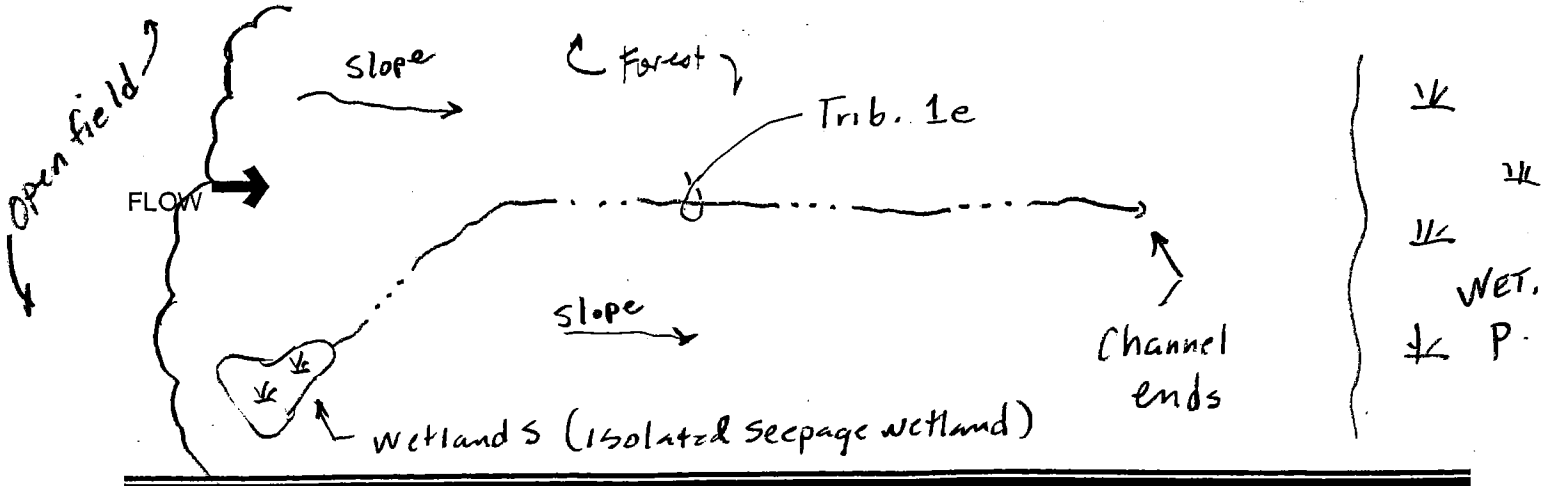
Fish Observed? (Y/N) N Voucher? (Y/N) ____ Salamanders Observed? (Y/N) N Voucher? (Y/N) ____

Frogs or Tadpoles Observed? (Y/N) N Voucher? (Y/N) ____ Aquatic Macroinvertebrates Observed? (Y/N) N Voucher? (Y/N) ____

Comments Regarding Biology: _____

DRAWING AND NARRATIVE DESCRIPTION OF STREAM REACH (This must be completed):

Include important landmarks and other features of interest for site evaluation and a narrative description of the stream's location



OhioEPA Primary Headwater Habitat Evaluation Form

HHEI Score (sum of metrics 1, 2, 3) : 17

SITE NAME/LOCATION Stream 2A, Apex Landfill Expansion

Stream — SITE NUMBER Sta 1 RIVER BASIN Ohio DRAINAGE AREA (mi²) <0.10

LENGTH OF STREAM REACH (ft) ~200' LAT. _____ LONG. _____ RIVER CODE _____ RIVER MILE _____

DATE 6/18/10 SCORER Mike A. Takacs COMMENTS Stream 2 - ephemeral; Class I PHWH

NOTE: Complete All Items On This Form - Refer to "Field Evaluation Manual for Ohio's PHWH Streams" for Instructions

STREAM CHANNEL MODIFICATIONS: ■ NONE / NATURAL CHANNEL ☐ RECOVERED ☐ RECOVERING ☐ RECENT OR NO RECOVERY

1. SUBSTRATE (Estimate percent of every type of substrate present. Check *ONLY* two predominant substrate *TYPE* boxes (Max of 32). Add total number of significant substrate types found (Max of 8). Final metric score is sum of boxes A & B.

TYPE		PERCENT	TYPE		PERCENT
☐	BLDR SLABS [16 pts]		■	SILT [3 pt]	75
☐	BOULDER (>256 mm) [16 pts]		☐	LEAF PACK/WOODY DEBRIS [3 pts]	
☐	BEDROCK [16 pt]		☐	FINE DETRITUS [3 pts]	
☐	COBBLE (65-256 mm) [12 pts]	(<2)*	☐	CLAY or HARDPAN [0 pt]	(<2)*
☐	GRAVEL (2-64 mm) [9 pts]	5	☐	MUCK [0 pts]	(<1)*
■	SAND (<2 mm) [6 pts]	15	☐	ARTIFICIAL [3 pts]	

Total of Percentages of Bldr Slabs, Boulder, Cobble, Bedrock <2 (A) 9 * not significant (B) 3

SCORE OF TWO MOST PREDOMINATE SUBSTRATE TYPES: TOTAL NUMBER OF SUBSTRATE TYPES:

2. Maximum Pool Depth ***(Measure the maximum pool depth within the 61 meter (200 ft)*** evaluation reach at the time of evaluation. Avoid plunge pools from road culverts or storm water pipes) (Check *ONLY* one box):

☐	> 30 centimeters [20 pts]	☐	> 5 cm - 10 cm [15 pts]
☐	> 22.5 - 30 cm [30 pts]	☐	< 5 cm [5 pts]
☐	> 10 - 22.5 cm [25 pts]	■	NO WATER OR MOIST CHANNEL [0 pts]

COMMENTS _____ MAXIMUM POOL DEPTH (centimeters): 0

3. BANK FULL WIDTH (Measured as the average of 3-4 measurements) (Check *ONLY* one box):

☐	> 4.0 meters (> 13') [30 pts]	☐	> 1.0 m - 1.5 m (> 3' 3" - 4' 8") [15 pts]
☐	> 3.0 m - 4.0 m (> 9' 7" - 13') [25 pts]	■	≤ 1.0 m (≤ 3' 3") [5 pts]
☐	> 1.5 m - 3.0 m (> 4' 8" - 9' 7") [20 pts]		

COMMENTS _____ AVERAGE BANKFULL WIDTH (meters) 5

HHEI Metric Points

Substrate Max = 40: 12

A + B

Pool Depth Max = 30: 0

Bankfull Width Max=30: 5

This information must also be completed

RIPARIAN ZONE AND FLOODPLAIN QUALITY ☆NOTE: River Left (L) and Right (R) as looking downstream☆

RIPARIAN WIDTH (Per Bank) L	R	FLOODPLAIN QUALITY (Most Predominant per Bank) L	R		L	R	
■	■	Wide >10m	☐	☐	Mature Forest, Wetland	☐	☐	Conservation Tillage
☐	☐	Moderate 5-10m	■	■	Immature Forest, Shrub or Old Field	☐	☐	Urban or Industrial
☐	☐	Narrow <5m	☐	☐	Residential, Park, New Field	☐	☐	Open Pasture, Row Crop
☐	☐	None	☐	☐	Fenced Pasture	☐	☐	Mining or Construction

COMMENTS _____

FLOW REGIME *(At Time of Evaluation)* (Check *ONLY* one box):

☐	Stream Flowing	☐	Moist Channel, isolated pools, no flow (Intermittent)
☐	Subsurface flow with isolated pools (Interstitial)	■	Dry channel, no water (Ephemeral)

COMMENTS _____

SINUOSITY (Number of bends per 61 m (200 ft) of channel) (Check *ONLY* one box):

☐	None	■	1.0	☐	2.0	☐	3.0
☐	0.5	☐	1.5	☐	2.5	☐	>3

STREAM GRADIENT ESTIMATE

☐ Flat (0.5 ft/100 ft) ☐ Flat to Moderate ■ Moderate (2 ft/100 ft) ☐ Moderate to Severe ☐ Severe (10 ft/100 ft)

ADDITIONAL STREAM INFORMATION (This Information Must Also be Completed):

QHEI PERFORMED? - ☐ Yes ■ No QHEI Score _____ (If Yes, Attach Completed QHEI Form)

DOWNSTREAM DESIGNATED USE(S)

■ WWH Name: Cross Creek, Ohio River Distance from Evaluated Stream North Branch Cross Creek ≈ 11,500'

☐ CWH Name: _____ Distance from Evaluated Stream _____

☐ EWH Name: _____ Distance from Evaluated Stream _____

MAPPING: ATTACH COPIES OF MAPS, INCLUDING THE ENTIRE WATERSHED AREA. CLEARLY MARK THE SITE LOCATION

USGS Quadrangle Name: Amsterdam, OH NRCS Soil Map Page: 22 NRCS Soil Map Stream Order 1

County: Jefferson Township / City: Springfield Twp.

MISCELLANEOUS HUC 05030101340

Base Flow Conditions? (Y/N): _____ Date of last precipitation: 6/13/10 Quantity: 0.48" (Landfill weather station records)

Photograph Information: See Wetland Delineation Report - Appendix B, Photo 21.

Elevated Turbidity? (Y/N): NA Canopy (% open): 15-25%

Were samples collected for water chemistry? (Y/N): _____ (Note lab sample no. or id. and attach results) Lab Number: _____

Field Measures: Temp (°C) — Dissolved Oxygen (mg/l) — pH (S.U.) — Conductivity (µmhos/cm) —

Is the sampling reach representative of the stream? (Y/N) _____ If not, please explain: _____

Unnamed tributary to North Branch Cross Creek

Additional comments/description of pollution impacts: _____

BIOTIC EVALUATION

Performed? (Y/N) _____ (If Yes, Record all observations. Voucher collections optional. NOTE: all voucher samples must be labeled with the site ID number. Include appropriate field data sheets from the Primary Headwater Habitat Assessment Manual)

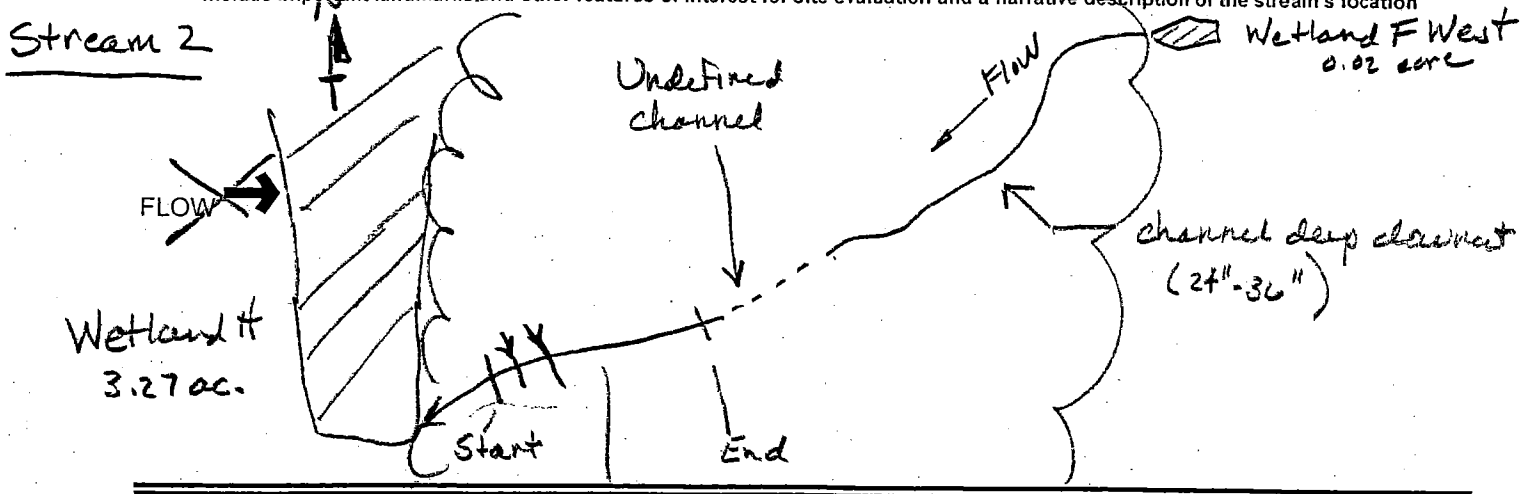
Fish Observed? (Y/N) _____ Voucher? (Y/N) — Salamanders Observed? (Y/N) _____ Voucher? (Y/N) —

Frogs or Tadpoles Observed? (Y/N) _____ Voucher? (Y/N) — Aquatic Macroinvertebrates Observed? (Y/N) _____ Voucher? (Y/N) —

Comments Regarding Biology: Stream channel mainly in silt-dominant; some areas w/ alluvial deposits. No flow.

DRAWING AND NARRATIVE DESCRIPTION OF STREAM REACH (This must be completed):

Include important landmarks and other features of interest for site evaluation and a narrative description of the stream's location



OhioEPA Primary Headwater Habitat Evaluation Form

HHEI Score (sum of metrics 1, 2, 3) : 12

SITE NAME/LOCATION Stream 2B, Apex Sanitary Landfill

SITE NUMBER STA 1 RIVER BASIN Ohio DRAINAGE AREA (mi²) <0.01

LENGTH OF STREAM REACH (ft) 100* LAT. _____ LONG. _____ RIVER CODE NA RIVER MILE NA

DATE 11/15/10 SCORER MRH COMMENTS Small, Isolated stream in headwaters of Wetland H

NOTE: Complete All Items On This Form - Refer to "Field Evaluation Manual for Ohio's PHWH Streams" for Instructions

STREAM CHANNEL MODIFICATIONS: ☒ NONE / NATURAL CHANNEL ☐ RECOVERED ☐ RECOVERING ☐ RECENT OR NO RECOVERY (* channel is only 131 ft long)

1. SUBSTRATE (Estimate percent of every type of substrate present. Check *ONLY* two predominant substrate *TYPE* boxes (Max of 32). Add total number of significant substrate types found (Max of 8). Final metric score is sum of boxes A & B.

TYPE		PERCENT	TYPE		PERCENT
☐☐	BLDR SLABS [16 pts]		☒☒	SILT [3 pt]	100
☐☐	BOULDER (>256 mm) [16 pts]		☐☐	LEAF PACK/WOODY DEBRIS [3 pts]	
☐☐	BEDROCK [16 pt]		☐☐	FINE DETRITUS [3 pts]	
☐☐	COBBLE (65-256 mm) [12 pts]		☐☐	CLAY or HARDPAN [0 pt]	
☐☐	GRAVEL (2-64 mm) [9 pts]		☐☐	MUCK [0 pts]	
☐☐	SAND (<2 mm) [6 pts]		☐☐	ARTIFICIAL [3 pts]	

Total of Percentages of Bldr Slabs, Boulder, Cobble, Bedrock 0% (A) 6

SCORE OF TWO MOST PREDOMINATE SUBSTRATE TYPES:

Small eroded channel in silt-loam soils

(B) 1 TOTAL NUMBER OF SUBSTRATE TYPES:

HHEI Metric Points

Substrate Max = 40: 7

A + B

2. Maximum Pool Depth ***(Measure the maximum pool depth within the 61 meter (200 ft)*** evaluation reach at the time of evaluation. Avoid plunge pools from road culverts or storm water pipes) (Check *ONLY* one box):

- ☐ > 30 centimeters [20 pts]
- ☐ > 22.5 - 30 cm [30 pts]
- ☐ > 10 - 22.5 cm [25 pts]
- ☐ > 5 cm - 10 cm [15 pts]
- ☐ < 5 cm [5 pts]
- ☒ NO WATER OR MOIST CHANNEL [0 pts]

COMMENTS Channel dry; appears to be Ephemeral MAXIMUM POOL DEPTH (centimeters): 0

Pool Depth Max = 30: 0

3. BANK FULL WIDTH (Measured as the average of 3-4 measurements) (Check *ONLY* one box):

- ☐ > 4.0 meters (> 13') [30 pts]
- ☐ > 3.0 m - 4.0 m (> 9' 7" - 13') [25 pts]
- ☐ > 1.5 m - 3.0 m (> 4' 8" - 9' 7") [20 pts]
- ☐ > 1.0 m - 1.5 m (> 3' 3" - 4' 8") [15 pts]
- ☒ ≤ 1.0 m (≤ 3' 3") [5 pts]

COMMENTS Channel ranges from 1' to 1.5' Wide AVERAGE BANKFULL WIDTH (meters): 5

Bankfull Width Max=30: 5

This information must also be completed

RIPARIAN ZONE AND FLOODPLAIN QUALITY ☆NOTE: River Left (L) and Right (R) as looking downstream☆

RIPARIAN WIDTH L	R	(Per Bank)	FLOODPLAIN QUALITY L	R	(Most Predominant per Bank)	L	R	
☐	☐	Wide >10m	☐	☐	Mature Forest, Wetland	☐	☐	Conservation Tillage
☐	☐	Moderate 5-10m	☒	☒	Immature Forest, Shrub or Old Field	☐	☐	Urban or Industrial
☐	☐	Narrow <5m	☐	☐	Residential, Park, New Field	☐	☐	Open Pasture, Row Crop
☐	☐	None	☐	☐	Fenced Pasture	☐	☐	Mining or Construction

COMMENTS _____

FLOW REGIME *(At Time of Evaluation)* (Check *ONLY* one box):

- ☐ Stream Flowing
- ☐ Subsurface flow with isolated pools (Interstitial)
- ☐ Moist Channel, isolated pools, no flow (Intermittent)
- ☒ Dry channel, no water (Ephemeral)

COMMENTS _____

SINUOSITY (Number of bends per 61 m (200 ft) of channel) (Check *ONLY* one box):

- ☐ None
- ☒ 0.5
- ☐ 1.0
- ☐ 1.5
- ☐ 2.0
- ☐ 2.5
- ☐ 3.0
- ☐ >3

STREAM GRADIENT ESTIMATE

☐ Flat (0.5 ft/100 ft) ☒ Flat to Moderate ☐ Moderate (2 ft/100 ft) ☐ Moderate to Severe ☐ Severe (10 ft/100 ft)

October 24, 2002 Revision

Stream 2B

Apex Landfill

ADDITIONAL STREAM INFORMATION (This Information Must Also be Completed):

QHEI PERFORMED? - ☐ Yes ☒ No QHEI Score _____ (If Yes, Attach Completed QHEI Form)

DOWNSTREAM DESIGNATED USE(S)

☒ WWH Name: Cross Creek Distance from Evaluated Stream ~13,000 ft (N. Br. Cross Creek)

☐ CWH Name: _____ Distance from Evaluated Stream _____

☐ EWH Name: _____ Distance from Evaluated Stream _____

MAPPING: ATTACH COPIES OF MAPS, INCLUDING THE ENTIRE WATERSHED AREA. CLEARLY MARK THE SITE LOCATION

USGS Quadrangle Name: Amsterdam, OH NRCS Soil Map Page: 22 NRCS Soil Map Stream Order 0

County: Jefferson Township / City: Springfield Twp.

MISCELLANEOUS

Base Flow Conditions? (Y/N): N Date of last precipitation: — Quantity: —

Photograph Information: See attached photos

Elevated Turbidity? (Y/N): NA Canopy (% open): 20-25%

Were samples collected for water chemistry? (Y/N): N (Note lab sample no. or id. and attach results) Lab Number: NA

Field Measures: (Not sampled) Temp (°C) — Dissolved Oxygen (mg/l) — pH (S.U.) — Conductivity (µmhos/cm) —

Is the sampling reach representative of the stream (Y/N) Y If not, please explain: _____

Additional comments/description of pollution impacts: _____

BIOTIC EVALUATION

Performed? (Y/N): N (If Yes, Record all observations. Voucher collections optional. NOTE: all voucher samples must be labeled with the site ID number. Include appropriate field data sheets from the Primary Headwater Habitat Assessment Manual)

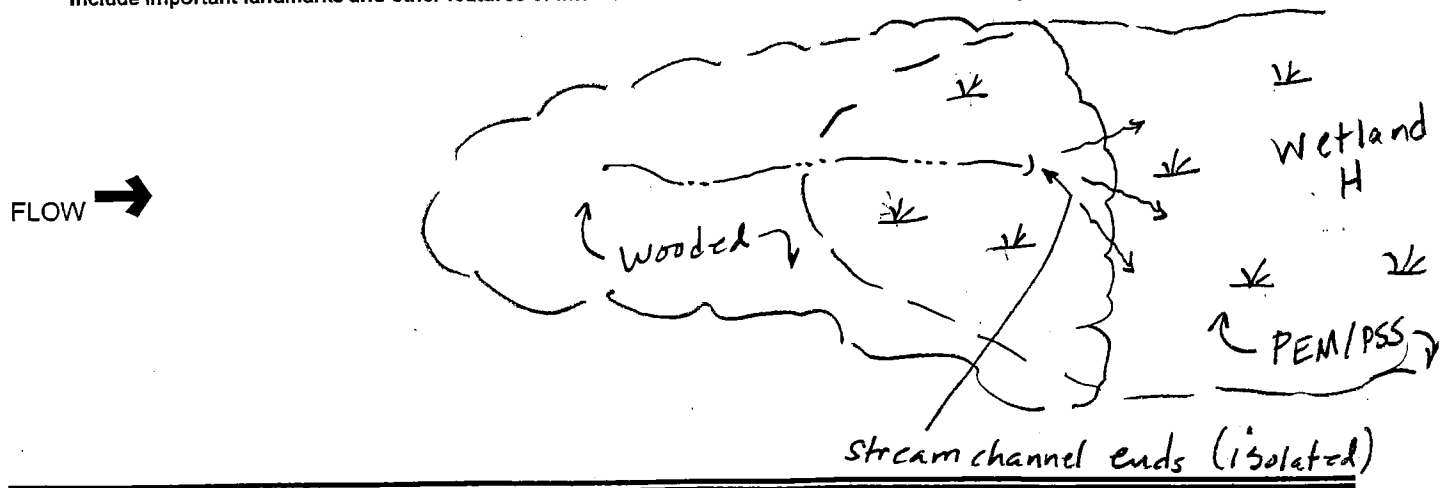
Fish Observed? (Y/N) — Voucher? (Y/N) — Salamanders Observed? (Y/N) — Voucher? (Y/N) —

Frogs or Tadpoles Observed? (Y/N) — Voucher? (Y/N) — Aquatic Macroinvertebrates Observed? (Y/N) — Voucher? (Y/N) —

Comments Regarding Biology: _____

DRAWING AND NARRATIVE DESCRIPTION OF STREAM REACH (This must be completed):

Include important landmarks and other features of interest for site evaluation and a narrative description of the stream's location



Ohio EPA Primary Headwater Habitat Evaluation Form

HHEI Score (sum of metrics 1, 2, 3) : 51

SITE NAME/LOCATION Stream 2C, Apex Landfill Expansion

SITE NUMBER STA 1 RIVER BASIN Ohio DRAINAGE AREA (mi²) < 0.1

LENGTH OF STREAM REACH (ft) 200 LAT. _____ LONG. _____ RIVER CODE NA RIVER MILE NA

DATE 5/19/11 SCORER MEH COMMENTS headwater stream assoc. w/ Wetland H

NOTE: Complete All Items On This Form - Refer to "Field Evaluation Manual for Ohio's PHWH Streams" for Instructions

STREAM CHANNEL ☐ NONE / NATURAL CHANNEL ☑ RECOVERED ☐ RECOVERING ☐ RECENT OR NO RECOVERY

MODIFICATIONS: Stream formed in sediments from upslope strip mine; head-cutting in wetland

1. SUBSTRATE (Estimate percent of every type of substrate present. Check *ONLY* two predominant substrate *TYPE* boxes (Max of 32). Add total number of significant substrate types found (Max of 8). Final metric score is sum of boxes A & B.

TYPE		PERCENT
☐	BLDR SLABS [16 pts]	
☐	BOULDER (>256 mm) [16 pts]	
☐	BEDROCK [16 pt]	
☐	COBBLE (65-256 mm) [12 pts]	
☐	GRAVEL (2-64 mm) [9 pts]	minor
☒	SAND (<2 mm) [6 pts]	50%

TYPE		PERCENT
☒	SILT [3 pt]	50%
☒	LEAF PACK/WOODY DEBRIS [3 pts]	minor
☐	FINE DETRITUS [3 pts]	minor
☐	CLAY or HARDPAN [0 pt]	minor
☐	MUCK [0 pts]	
☐	ARTIFICIAL [3 pts]	

Total of Percentages of Bldr Slabs, Boulder, Cobble, Bedrock _____ (A) 9

SCORE OF TWO MOST PREDOMINATE SUBSTRATE TYPES:

(B) 2 TOTAL NUMBER OF SUBSTRATE TYPES:

HHEI Metric Points

Substrate Max = 40: 11

A + B

2. Maximum Pool Depth ***(Measure the maximum pool depth within the 61 meter (200 ft)*** evaluation reach at the time of evaluation. Avoid plunge pools from road culverts or storm water pipes) (Check *ONLY* one box):

☐	> 30 centimeters [20 pts]	☐	> 5 cm - 10 cm [15 pts]
☐	> 22.5 - 30 cm [30 pts]	☐	≤ 5 cm [5 pts]
☒	> 10 - 22.5 cm [25 pts]	☐	NO WATER OR MOIST CHANNEL [0 pts]

COMMENTS _____ MAXIMUM POOL DEPTH (centimeters): 20

Pool Depth Max = 30: 25

3. BANK FULL WIDTH (Measured as the average of 3-4 measurements) (Check *ONLY* one box):

☐	> 4.0 meters (> 13') [30 pts]	☒	> 1.0 m - 1.5 m (> 3' 3" - 4' 8") [15 pts]
☐	> 3.0 m - 4.0 m (> 9' 7" - 13') [25 pts]	☐	≤ 1.0 m (≤ 3' 3") [5 pts]
☐	> 1.5 m - 3.0 m (> 4' 8" - 9' 7") [20 pts]		

COMMENTS width ranges from 0.5 - 2 m AVERAGE BANKFULL WIDTH (meters): 1.3

Bankfull Width Max=30: 15

This information must also be completed

RIPARIAN ZONE AND FLOODPLAIN QUALITY ☆NOTE: River Left (L) and Right (R) as looking downstream☆

RIPARIAN WIDTH L	R	(Per Bank)	FLOODPLAIN QUALITY L	R	(Most Predominant per Bank)	L	R	
☐	☐	Wide >10m	☒	☒	Mature Forest, Wetland	☐	☐	Conservation Tillage
☐	☐	Moderate 5-10m	☐	☐	Immature Forest, Shrub or Old Field	☐	☐	Urban or Industrial
☐	☐	Narrow <5m	☐	☐	Residential, Park, New Field	☐	☐	Open Pasture, Row Crop
☐	☐	None	☐	☐	Fenced Pasture	☐	☐	Mining or Construction

COMMENTS Within Wetland H; forest along LDB

FLOW REGIME *(At Time of Evaluation)* (Check *ONLY* one box):

☒	Stream Flowing	☐	Moist Channel, isolated pools, no flow (Intermittent)
☐	Subsurface flow with isolated pools (Interstitial)	☐	Dry channel, no water (Ephemeral)

COMMENTS _____

SINUOSITY (Number of bends per 61 m (200 ft) of channel) (Check *ONLY* one box):

☐	None	☐	1.0	☒	2.0	☐	3.0
☐	0.5	☐	1.5	☐	2.5	☐	>3

STREAM GRADIENT ESTIMATE

☐ Flat (0.5 ft/100 ft) ☒ Flat to Moderate ☐ Moderate (2 ft/100 ft) ☐ Moderate to Severe ☐ Severe (10 ft/100 ft)

Stream 2C
Apex Landfill

ADDITIONAL STREAM INFORMATION (This Information Must Also be Completed):

QHEI PERFORMED? - ☐ Yes ☒ No QHEI Score _____ (If Yes, Attach Completed QHEI Form)

DOWNSTREAM DESIGNATED USE(S)

☒ WWH Name: Criss Creek Distance from Evaluated Stream ~12,000 ft (N. Br. Criss Creek)

☐ CWH Name: _____ Distance from Evaluated Stream _____

☐ EWH Name: _____ Distance from Evaluated Stream _____

MAPPING: ATTACH COPIES OF MAPS, INCLUDING THE ENTIRE WATERSHED AREA. CLEARLY MARK THE SITE LOCATION

USGS Quadrangle Name: Amsterdam, OH NRCS Soil Map Page: 22 NRCS Soil Map Stream Order 1-2

County: Jefferson Township / City: Springfield Twp.

MISCELLANEOUS

Base Flow Conditions? (Y/N): N Date of last precipitation: 5/19/11 Quantity: _____

Photograph Information: See attached photo

Elevated Turbidity? (Y/N): N Canopy (% open): 100%

Were samples collected for water chemistry? (Y/N): N (Note lab sample no. or id. and attach results) Lab Number: NA

Field Measures: (Not measured) Temp (°C) — Dissolved Oxygen (mg/l) — pH (S.U.) — Conductivity (µmhos/cm) —

Is the sampling reach representative of the stream (Y/N) Y If not, please explain: _____

Additional comments/description of pollution impacts: _____

BIOTIC EVALUATION

Performed? (Y/N): N (If Yes, Record all observations. Voucher collections optional. NOTE: all voucher samples must be labeled with the site ID number. Include appropriate field data sheets from the Primary Headwater Habitat Assessment Manual)

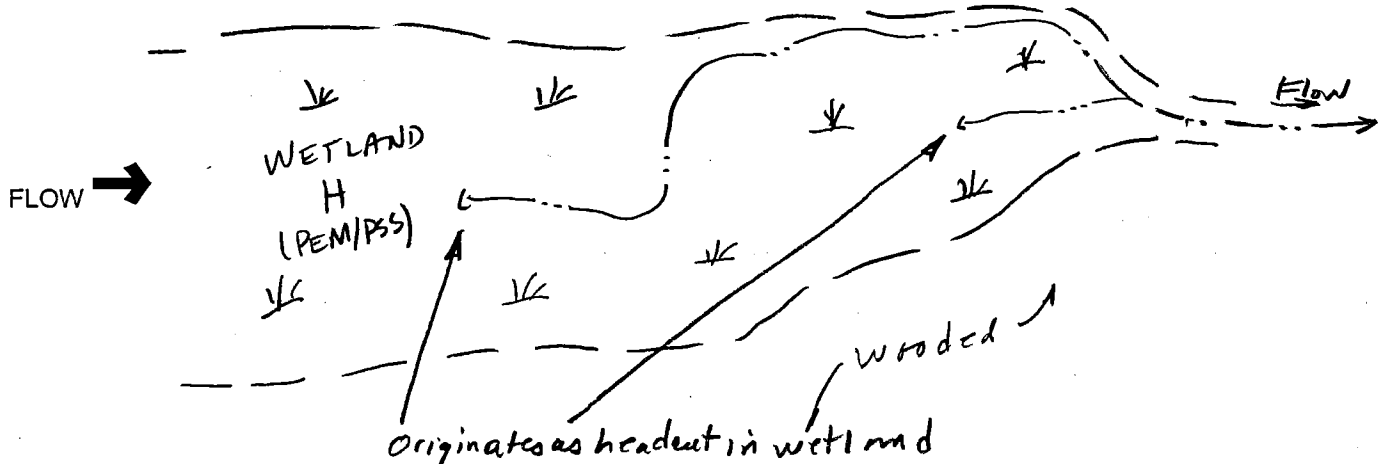
Fish Observed? (Y/N) — Voucher? (Y/N) — Salamanders Observed? (Y/N) — Voucher? (Y/N) —

Frogs or Tadpoles Observed? (Y/N) — Voucher? (Y/N) — Aquatic Macroinvertebrates Observed? (Y/N) — Voucher? (Y/N) —

Comments Regarding Biology: _____

DRAWING AND NARRATIVE DESCRIPTION OF STREAM REACH (This must be completed):

Include important landmarks and other features of interest for site evaluation and a narrative description of the stream's location



OhioEPA Primary Headwater Habitat Evaluation Form

HHEI Score (sum of metrics 1, 2, 3) : 49

SITE NAME/LOCATION Stream 3A (int), Apex Landfill Expansion

SITE NUMBER STATION 1 RIVER BASIN Ohio DRAINAGE AREA (mi²) <0.1

LENGTH OF STREAM REACH (ft) 200 LAT. 126288.66 LONG 332260.99 RIVER CODE _____ RIVER MILE _____

DATE 6/18/2010 SCORER Mike A. Tkacs COMMENTS Stream 3a (int.) Class II PHWH

NOTE: Complete All Items On This Form - Refer to "Field Evaluation Manual for Ohio's PHWH Streams" for Instructions

STREAM CHANNEL MODIFICATIONS: ☒ NONE / NATURAL CHANNEL ☐ RECOVERED ☐ RECOVERING ☐ RECENT OR NO RECOVERY

1. SUBSTRATE (Estimate percent of every type of substrate present. Check *ONLY* two predominant substrate *TYPE* boxes (Max of 32). Add total number of significant substrate types found (Max of 8). Final metric score is sum of boxes A & B.

TYPE		PERCENT	TYPE		PERCENT
☐☐	BLDR SLABS [16 pts]		☐☐	SILT [3 pt]	10
☐☐	BOULDER (>256 mm) [16 pts]	<0.1*	☐☐	LEAF PACK/WOODY DEBRIS [3 pts]	21*
☐☐	BEDROCK [16 pt]		☐☐	FINE DETRITUS [3 pts]	
☐☐	COBBLE (65-256 mm) [12 pts]	5	☐☐	CLAY or HARDPAN [0 pt]	
☐■	GRAVEL (2-64 mm) [9 pts]	25	☐☐	MUCK [0 pts]	
■☐	SAND (<2 mm) [6 pts]	60	☐☐	ARTIFICIAL [3 pts]	

* not significant

Total of Percentages of Bldr Slabs, Boulder, Cobble, Bedrock 5, 46 (A) 15 (B) 4

SCORE OF TWO MOST PREDOMINATE SUBSTRATE TYPES: TOTAL NUMBER OF SUBSTRATE TYPES:

2. Maximum Pool Depth ***(Measure the maximum pool depth within the 61 meter (200 ft)*** evaluation reach at the time of evaluation. Avoid plunge pools from road culverts or storm water pipes) (Check *ONLY* one box):

☐ > 30 centimeters [20 pts]
☐ > 22.5 - 30 cm [30 pts]
☐ > 10 - 22.5 cm [25 pts]
■ > 5 cm - 10 cm [15 pts]
☐ ≤ 5 cm [5 pts]
☐ NO WATER OR MOIST CHANNEL [0 pts]

COMMENTS mid-reach plunge pool to 10cm MAXIMUM POOL DEPTH (centimeters): 10

3. BANK FULL WIDTH (Measured as the average of 3-4 measurements) (Check *ONLY* one box):

☐ > 4.0 meters (> 13') [30 pts]
☐ > 3.0 m - 4.0 m (> 9' 7" - 13') [25 pts]
☐ > 1.5 m - 3.0 m (> 9' 7" - 4' 8") [20 pts]
■ > 1.0 m - 1.5 m (> 3' 3" - 4' 8") [15 pts]
☐ ≤ 1.0 m (≤ 3' 3") [5 pts]

COMMENTS upper reach 0.6-0.8m; lower reach 0.8-1.1m AVERAGE BANKFULL WIDTH (meters): 0.8

HHEI Metric Points

Substrate Max = 40	19
A + B	
Pool Depth Max = 30	15
Bankfull Width Max=30	15

This information must also be completed

RIPARIAN ZONE AND FLOODPLAIN QUALITY ☆NOTE: River Left (L) and Right (R) as looking downstream☆

RIPARIAN WIDTH L	R	(Per Bank)	FLOODPLAIN QUALITY L	R	(Most Predominant per Bank)	L	R	
■	■	Wide >10m	☐	☐	Mature Forest, Wetland	☐	☐	Conservation Tillage
☐	☐	Moderate 5-10m	■	■	Immature Forest, Shrub or Old Field	☐	☐	Urban or Industrial
☐	☐	Narrow <5m	☐	☐	Residential, Park, New Field	☐	☐	Open Pasture, Row Crop
☐	☐	None	☐	☐	Fenced Pasture	☐	☐	Mining or Construction

COMMENTS _____

FLOW REGIME *(At Time of Evaluation)* (Check *ONLY* one box):

☒ Stream Flowing
☐ Subsurface flow with isolated pools (Interstitial)
☐ Moist Channel, isolated pools, no flow (Intermittent)
☐ Dry channel, no water (Ephemeral)

COMMENTS _____

SINUOSITY (Number of bends per 61 m (200 ft) of channel) (Check *ONLY* one box):

☐ None ☐ 1.0 ☐ 2.0 ☐ 3.0
☐ 0.5 ☐ 1.5 ■ 2.5 ☐ >3

STREAM GRADIENT ESTIMATE

☐ Flat (0.5 ft/100 ft) ☐ Flat to Moderate ■ Moderate (2 ft/100 ft) ☐ Moderate to Severe ☐ Severe (10 ft/100 ft)

October 24, 2002 Revision

Stream 3A.

Apex Landfill

ADDITIONAL STREAM INFORMATION (This Information Must Also be Completed):

QHEI PERFORMED? - ☐ Yes ■ No QHEI Score _____ (If Yes, Attach Completed QHEI Form)

DOWNSTREAM DESIGNATED USE(S)

■ WWH Name: Yellow Creek, Ohio River Distance from Evaluated Stream Yellow Creek ~ 17,000 (Goose Creek ~3000')

☐ CWH Name: _____ Distance from Evaluated Stream _____

☐ EWH Name: _____ Distance from Evaluated Stream _____

MAPPING: ATTACH COPIES OF MAPS, INCLUDING THE ENTIRE WATERSHED AREA. CLEARLY MARK THE SITE LOCATION

USGS Quadrangle Name: Amsterdam, OH NRCS Soil Map Page: 22 NRCS Soil Map Stream Order 1

County: Jefferson Township / City: Springfield Twp.

MISCELLANEOUS HUC 05030101180

Base Flow Conditions? (Y/N): Y Date of last precipitation: 6/13/10 Quantity: 0.48" (landfill weather station records)

Photograph Information: See Wetland Delineation Report - Appendix B, Photo 22.

Elevated Turbidity? (Y/N) N Canopy (% open): 10-15%

Were samples collected for water chemistry? (Y/N) N (Note lab sample no. or id. and attach results) Lab Number: _____

Field Measures: Temp (°C) — Dissolved Oxygen (mg/l) — pH (S.U.) — Conductivity (µmhos/cm) —

Is the sampling reach representative of the stream (Y/N) Y If not, please explain: _____

Additional comments/description of pollution impacts: No visible staining, debris, or sheens were observed in the water column or sediment.

BIOTIC EVALUATION

Performed? (Y/N): N (If Yes, Record all observations. Voucher collections optional. NOTE: all voucher samples must be labeled with the site ID number. Include appropriate field data sheets from the Primary Headwater Habitat Assessment Manual)

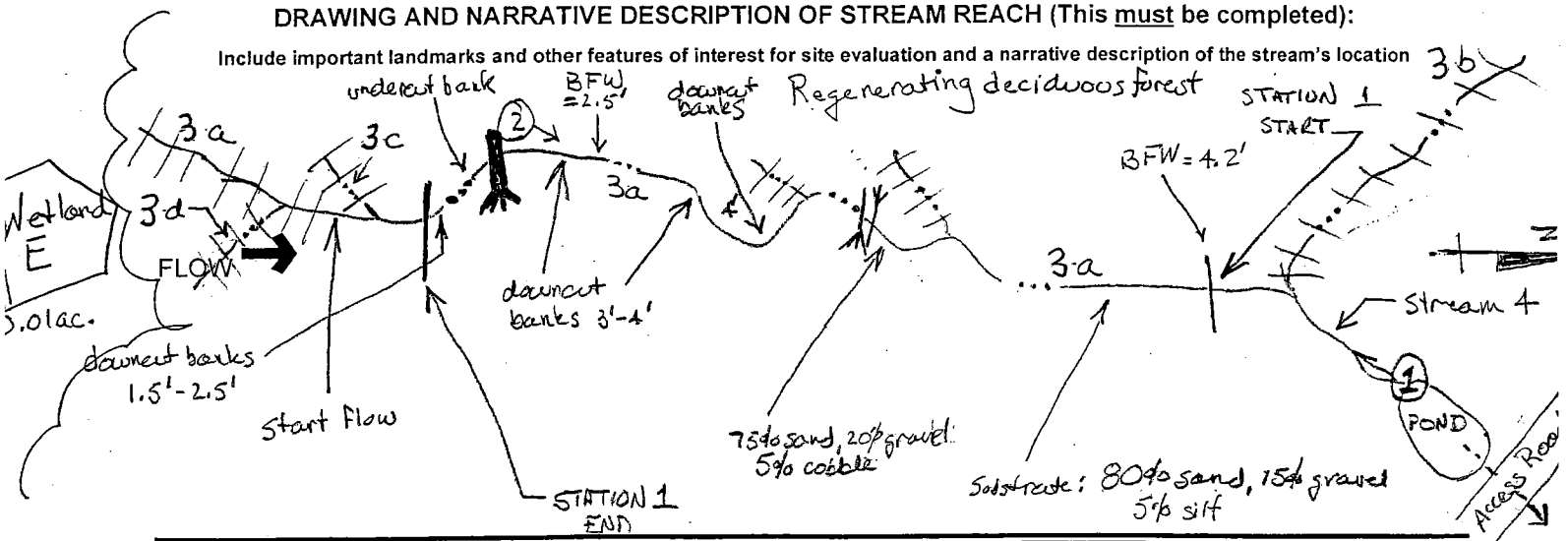
Fish Observed? (Y/N) — Voucher? (Y/N) — Salamanders Observed? (Y/N) — Voucher? (Y/N) —

Frogs or Tadpoles Observed? (Y/N) — Voucher? (Y/N) — Aquatic Macroinvertebrates Observed? (Y/N) — Voucher? (Y/N) —

Comments Regarding Biology: Low density benthic macroinvertebrate population

DRAWING AND NARRATIVE DESCRIPTION OF STREAM REACH (This must be completed):

Include important landmarks and other features of interest for site evaluation and a narrative description of the stream's location



OhioEPA Primary Headwater Habitat Evaluation Form

HHEI Score (sum of metrics 1, 2, 3) : 18

SITE NAME/LOCATION Streams 3A (EPH), 3B, 3C, + 3D; Apex Landfill Expansion
SITE NUMBER STATION 2 RIVER BASIN Ohio DRAINAGE AREA (mi²) <0.1
LENGTH OF STREAM REACH (ft) ~100 LAT. _____ LONG. _____ RIVER CODE NA RIVER MILE NA
DATE 6/18/2010 SCORER Mike A. Takacs COMMENTS Streams 3b, 3c, 3d - Class I PHWH

NOTE: Complete All Items On This Form - Refer to "Field Evaluation Manual for Ohio's PHWH Streams" for Instructions

STREAM CHANNEL MODIFICATIONS: ☒ NONE / NATURAL CHANNEL ☐ RECOVERED ☐ RECOVERING ☐ RECENT OR NO RECOVERY

1. SUBSTRATE (Estimate percent of every type of substrate present. Check *ONLY* two predominant substrate *TYPE* boxes (Max of 32). Add total number of significant substrate types found (Max of 8). Final metric score is sum of boxes A & B.

TYPE		PERCENT	TYPE		PERCENT
☐☐	BLDR SLABS [16 pts]		☒☐	SILT [3 pt]	80
☐☐	BOULDER (>256 mm) [16 pts]		☐☐	LEAF PACK/WOODY DEBRIS [3 pts]	1-3
☐☐	BEDROCK [16 pt]		☐☐	FINE DETRITUS [3 pts]	
☐☐	COBBLE (65-256 mm) [12 pts]	<1 *	☐☐	CLAY or HARDPAN [0 pt]	<1 *
☐☐	GRAVEL (2-64 mm) [9 pts]	5	☐☐	MUCK [0 pts]	
☐☒	SAND (<2 mm) [6 pts]	10	☐☐	ARTIFICIAL [3 pts]	

* not significant

Total of Percentages of Bldr Slabs, Boulder, Cobble, Bedrock <1 (A) 9 (B) 4

SCORE OF TWO MOST PREDOMINATE SUBSTRATE TYPES: TOTAL NUMBER OF SUBSTRATE TYPES:

HHEI Metric Points
Substrate Max = 40: 13
A + B

2. Maximum Pool Depth ***(Measure the maximum pool depth within the 61 meter (200 ft)*** evaluation reach at the time of evaluation. Avoid plunge pools from road culverts or storm water pipes) (Check *ONLY* one box):

☐	> 30 centimeters [20 pts]	☐	> 5 cm - 10 cm [15 pts]
☐	> 22.5 - 30 cm [30 pts]	☐	< 5 cm [5 pts]
☐	> 10 - 22.5 cm [25 pts]	☒	NO WATER OR MOIST CHANNEL [0 pts]

COMMENTS No flow, ephemeral; typical of upper 3a, 3b, 3c, & 3d MAXIMUM POOL DEPTH (centimeters): 0 (Pools not present)

Pool Depth Max = 30: 0

3. BANK FULL WIDTH (Measured as the average of 3-4 measurements) (Check *ONLY* one box):

☐	> 4.0 meters (> 13') [30 pts]	☐	> 1.0 m - 1.5 m (> 3' 3" - 4' 8") [15 pts]
☐	> 3.0 m - 4.0 m (> 9' 7" - 13') [25 pts]	☒	≤ 1.0 m (≤ 3' 3") [5 pts]
☐	> 1.5 m - 3.0 m (> 9' 7" - 4' 8") [20 pts]		

COMMENTS Width ranges from 1-2 ft wide AVERAGE BANKFULL WIDTH (meters): 0.5

Bankfull Width Max=30: 5

This information must also be completed

RIPARIAN ZONE AND FLOODPLAIN QUALITY ☆NOTE: River Left (L) and Right (R) as looking downstream☆

RIPARIAN WIDTH L	R	(Per Bank)	FLOODPLAIN QUALITY L	R	(Most Predominant per Bank)	L	R	
■	■	Wide >10m	☐	☐	Mature Forest, Wetland	☐	☐	Conservation Tillage
☐	☐	Moderate 5-10m	■	■	Immature Forest, Shrub or Old Field	☐	☐	Urban or Industrial
☐	☐	Narrow <5m	☐	☐	Residential, Park, New Field	☐	☐	Open Pasture, Row Crop
☐	☐	None	☐	☐	Fenced Pasture	☐	☐	Mining or Construction

COMMENTS _____

FLOW REGIME *(At Time of Evaluation)* (Check *ONLY* one box):

☐	Stream Flowing	☐	Moist Channel, isolated pools, no flow (Intermittent)
☐	Subsurface flow with isolated pools (Interstitial)	■	Dry channel, no water (Ephemeral)

COMMENTS _____

SINUOSITY (Number of bends per 61 m (200 ft) of channel) (Check *ONLY* one box):

☐	None	☐	1.0	☐	2.0	☐	3.0
☐	0.5	■	1.5	☐	2.5	☐	>3

STREAM GRADIENT ESTIMATE

☐ Flat (0.5 ft/100 ft) ☐ Flat to Moderate ■ Moderate (2 ft/100 ft) ☐ Moderate to Severe ☐ Severe (10 ft/100 ft)

October 24, 2002 Revision

Stream 3a (eph)

3b, 3c, 3d

ADDITIONAL STREAM INFORMATION (This Information Must Also be Completed):

QHEI PERFORMED? - ☐ Yes ☒ No QHEI Score _____ (If Yes, Attach Completed QHEI Form)

DOWNSTREAM DESIGNATED USE(S)

Goose Creek ~3000'

☒ WWH Name: Yellow Creek, Ohio River Distance from Evaluated Stream Yellow Creek ~17,00

☐ CWH Name: _____ Distance from Evaluated Stream _____

☐ EWH Name: _____ Distance from Evaluated Stream _____

MAPPING: ATTACH COPIES OF MAPS, INCLUDING THE ENTIRE WATERSHED AREA. CLEARLY MARK THE SITE LOCATION

USGS Quadrangle Name: Amsterdam, OH NRCS Soil Map Page: 22 NRCS Soil Map Stream Order 1

County: Jefferson Township / City: Springfield Twp

MISCELLANEOUS No flow. HUC 05030101180

Base Flow Conditions? (Y/N): _____ Date of last precipitation: 6/13/10 Quantity: 0.48" (Landfill weather station records)

Photograph Information: See Wetland Delineation Report - Appendix B, photos 23 and 24.

Elevated Turbidity? (Y/N): NA Canopy (% open): 15-25%

Were samples collected for water chemistry? (Y/(N)) NA (Note lab sample no. or id. and attach results) Lab Number: _____

Field Measures: Temp (°C) — Dissolved Oxygen (mg/l) — pH (S.U.) — Conductivity (µmhos/cm) —

Is the sampling reach representative of the stream (Y/N) Y If not, please explain: Upper section of stream segment 3a. Ephemeral channel typical of upper 3a, 3b, 3c, and 3d.

Additional comments/description of pollution impacts: NA

BIOTIC EVALUATION

Performed? (Y/(N)) N (If Yes, Record all observations. Voucher collections optional. NOTE: all voucher samples must be labeled with the site ID number. Include appropriate field data sheets from the Primary Headwater Habitat Assessment Manual)

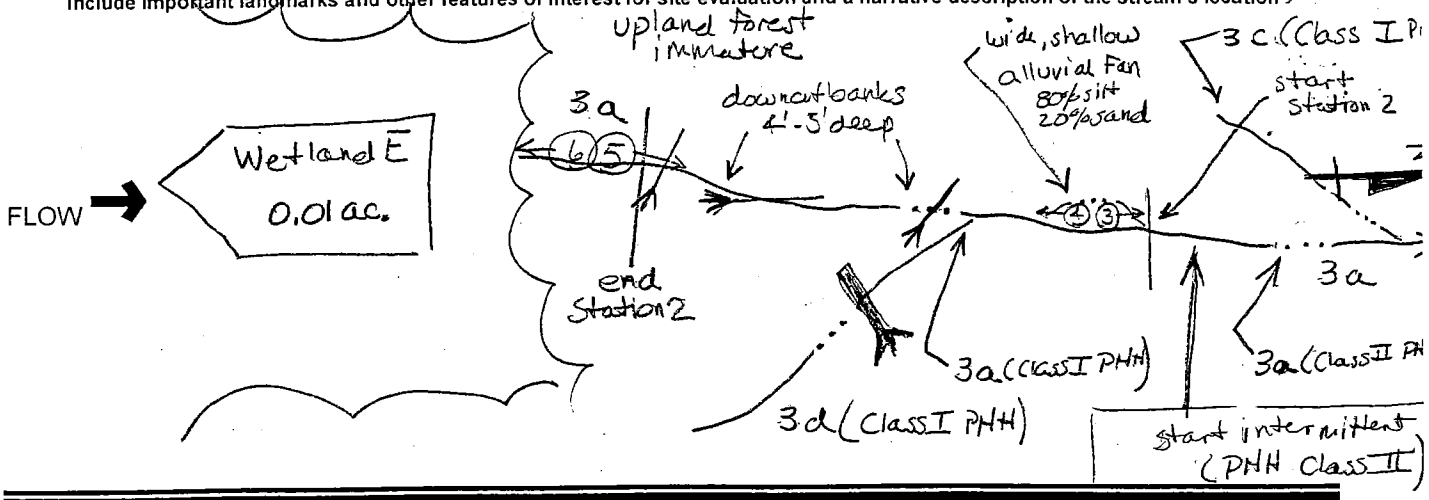
Fish Observed? (Y/(N)) — Voucher? (Y/N) — Salamanders Observed? (Y/(N)) — Voucher? (Y/N) —

Frogs or Tadpoles Observed? (Y/(N)) — Voucher? (Y/N) — Aquatic Macroinvertebrates Observed? (Y/(N)) — Voucher? (Y/N) —

Comments Regarding Biology: No benthic macroinvertebrates or crayfish were observed in ephemeral streams: upper 3A, 3B, 3C, and 3D.

DRAWING AND NARRATIVE DESCRIPTION OF STREAM REACH (This must be completed):

Include important landmarks and other features of interest for site evaluation and a narrative description of the stream's location.



(3) → photograph location (field)

Apex Landfill Expansion
Harrison and Jefferson Counties, Ohio

Photo 1: Stream 1A (intermittent) viewed upstream.
June 18, 2010

Photo 2: Stream 1A (ephemeral) viewed upstream.
June 18, 2010

Apex Landfill Expansion
Harrison and Jefferson Counties, Ohio

Photo 3: Stream 1D, downstream station (intermittent) viewed upstream.
February 16, 2011

Photo 4: Stream 1D, upstream station (intermittent) viewed upstream
February 16, 2011

Apex Landfill Expansion
Harrison and Jefferson Counties, Ohio

Photo 5: Stream 1E (ephemeral and isolated) viewed upstream.
May 19, 2011

Photo 6: Stream 2A (ephemeral) viewed upstream.
July 1, 2010

Apex Landfill Expansion
Harrison and Jefferson Counties, Ohio

Photo 7: Stream 2B (ephemeral) viewed upstream
November 15, 2010

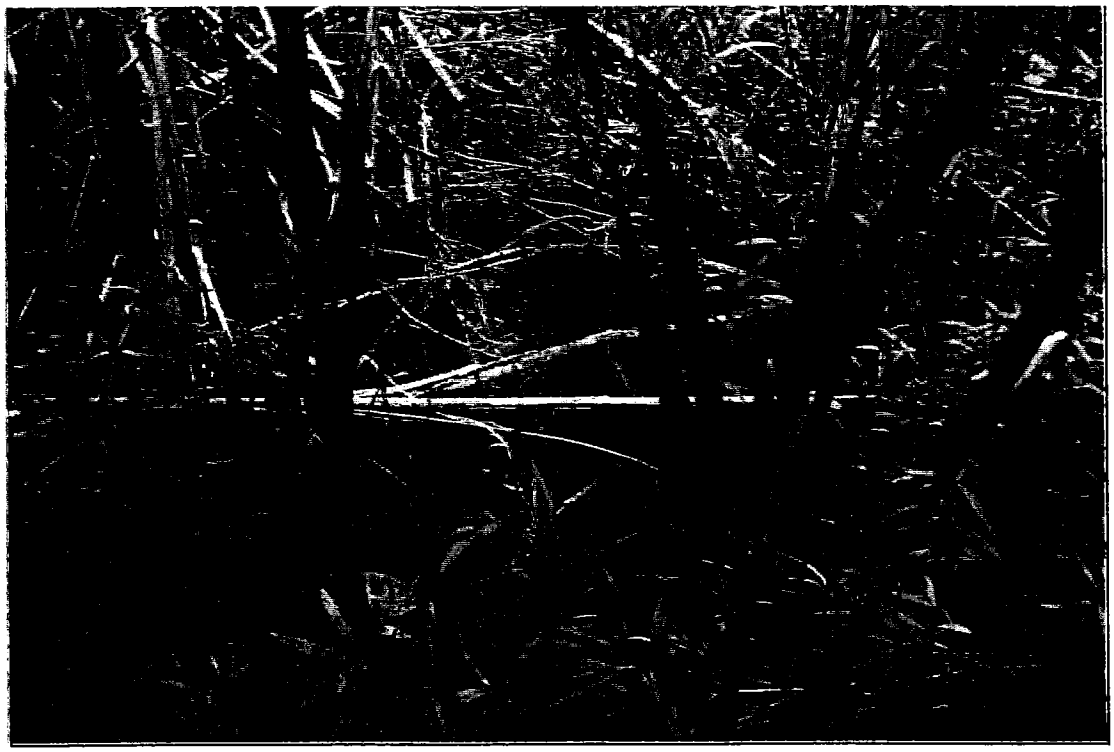


Photo 8: Stream 2C (intermittent) viewed upstream
May 19, 2011

Apex Landfill Expansion
Harrison and Jefferson Counties, Ohio

Photo 9: Stream 3A (intermittent) viewed upstream.
June 18, 2010

Photo 10: Stream 3A (ephemeral) viewed upstream.
June 18, 2010

Apex Landfill Expansion
Harrison and Jefferson Counties, Ohio

Photo 11: Stream 3B (ephemeral) viewed upstream.
June 18, 2010

REVISION RECORD

NO	DATE	DESCRIPTION
1	12/2010	REVISED PER JD MEETING ON 11/15/10
2	5/2011	REVISED PER CONFERENCE CALL WITH OEPA ON MAY 10, 2011.
3	10/2011	REVISIONS PER SITE VISITS WITH USACE, OEPA, AND INTERAL QA

SUBMITTAL RECORD

NO	DATE	DESCRIPTION
1	10/2010	SUBMITTED TO USACE & OEPA FOR REVIEW
2	8/2011	SUBMITTED TO USACE FOR JD LETTER REVISIONS

WETLAND	AREA (ACRES)	USFWS CLASSIFICATION[1]	TEST SITE NO.
B[2]	2.21	PEM/PAB/POWZx	3
C[2]	0.05	PAB/POWZx/PSS	5
D[2]	0.58	PAB/POWZx	7
E	0.01	PEMB	9
F[2]	0.05	PEM/PSSB	11
G	1.13	PEM/PABZx	13
H[3]	3.15	PAB/POWZx/PEM1	–
M[2,3]	0.60	PAB/POWZx	–
N[2]	0.44	PAB/POWZx	23
O[2]	0.20	PAB/POWZx	25
P[3]	7.86	PEM/PSS/PFO/PAB/POW–C/Zh	29
Q[2]	1.82	PEM/PAB/POWZx	27
R	0.18	PEM	–
S	0.02	PEM	–
TOTAL	18.30		

[1] BASED ON COWARDIN AND COWORKERS, 1979 P–PALUSTRINE; AB–AQUATIC BED; EM–EMERGENT; SS–SCRUB–SHRUB; OW–OPEN WATER.

[2] ISOLATED WETLAND

[3] DATA FOR WETLANDS H, M, AND P TAKEN FROM GILBERT (2003) AND FIELD VERIFIED BY CEC IN 2010.

[4] TOTAL DELINEATION AREA IS 10.01 ACRES; 9.00 ACRES ARE LOCATED WITHIN THE PROJECT AREA.

STREAM	ONSITE LENGTH (LINEAR FEET)		
	INTERMITTENT	EPHEMERAL	TOTAL
STREAM 1A	505	132	637
STREAM 1B	338	–	338
STREAM 1C	113	–	113
STREAM 1D	1821	–	1,821
STREAM 1E	–	380	380
STREAM 2A	–	732	732
STREAM 2B	–	131	131
STREAM 2C	637	–	637
STREAM 3A	363	111	474
STREAM 3B	–	257	257
STREAM 3C	–	39	39
STREAM 3D	–	68	68
TOTAL	3,777	1,850	5,627

NAME	AREA (ACRES)
OPEN WATER 1	2.94
OPEN WATER 4	0.79
OPEN WATER 5	0.24
OPEN WATER 6	0.18
OPEN WATER 7	0.07
OPEN WATER 8	0.96
OPEN WATER 9	1.75
OPEN WATER 10	0.77
OPEN WATER 11	0.09
OPEN WATER 12	1.37
OPEN WATER 13	0.16
OPEN WATER 14	0.04
OPEN WATER 15	0.11
TOTAL	9.47

LEGEND

- WETLAND INVESTIGATION AREA
- CONSERVATION EASEMENT
- OPEN WATER
- USACE JURISDICTIONAL WETLAND
- ISOLATED WETLAND
- EPHEMERAL STREAM
- INTERMITTENT STREAM
- PHOTOGRAPH LOCATION AND DIRECTION
- HHEI STATION

REFERENCE

AERIAL PHOTOGRAPHY FROM KEDDAL AERIAL MAPPING DEVELOPED ON 12/29/08 AND 01/21/10.

SCALE IN FEET
0 300 600

* HAND SIGNATURE ON FILE

CEC
Civil & Environmental Consultants, Inc.
333 Baldwin Road - Pittsburgh, PA 15205-9072
Ph: 412.429.2324 · 800.365.2324 · Fax: 412.429.2114
www.cecinc.com

APEX ENVIRONMENTAL, LLC
SPRINGFIELD TOWNSHIP
JEFFERSON COUNTY, OHIO

DRAWN BY:	DWD	CHECKED BY:	LCPS	APPROVED BY:	MRH*/MLS*
DATE:	8/06/10	DWG SCALE:	1"=300'	PROJECT NO:	080-608

STREAM AND WETLAND DELINEATION MAP

DRAWING NO.: 4

NORTH
WETLAND A-7 (OHD)
UPLAND A-7
UPLAND A-8
WETLAND B-1
WETLAND B-2
UPLAND B-1
UPLAND B-2
WETLAND C-1
WETLAND C-2
WETLAND C-3
UPLAND C-1
UPLAND C-2
UPLAND C-3
WETLAND D-1
WETLAND D-2
WETLAND D-3
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WETLAND H-1
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WETLAND J-1
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WETLAND W-1
WETLAND W-2
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UPLAND PP-1
UPLAND PP-2
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WETLAND QQ-1
WETLAND QQ-2
WETLAND QQ-3
UPLAND QQ-1
UPLAND QQ-2
UPLAND QQ-3
WETLAND RR-1
WETLAND RR-2
WETLAND RR-3
UPLAND RR-1
UPLAND RR-2
UPLAND RR-3
WETLAND SS-1
WETLAND SS-2
WETLAND SS-3
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WETLAND YY-3
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UPLAND YY-3
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WETLAND ZZ-3
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UPLAND ZZ-3
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UPLAND AAA-3
WETLAND BBB-1
WETLAND BBB-2
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UPLAND BBB-3
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WETLAND CCC-2
WETLAND CCC-3
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UPLAND CCC-2
UPLAND CCC-3
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WETLAND DDD-3
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UPLAND FFF-3
WETLAND GGG-1
WETLAND GGG-2
WETLAND GGG-3
UPLAND GGG-1
UPLAND GGG-2
UPLAND GGG-3
WETLAND HHH-1
WETLAND HHH-2
WETLAND HHH-3
UPLAND HHH-1
UPLAND HHH-2
UPLAND HHH-3
WETLAND III-1
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WETLAND JJJ-2
WETLAND JJJ-3
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UPLAND JJJ-3
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WETLAND KKK-2
WETLAND KKK-3
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WETLAND SSS-2
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UPLAND SSS-1
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UPLAND SSS-3
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WETLAND WWWWWWWW-1
WETLAND WWWWWWWW-2
WETLAND WWWWWWWW-3
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APPENDIX C10-C

TABLE OF EFFECTIVE AND PENDING PERMITS

Table of Effective and Pending Permits
Updated May 2016
Apex Sanitary Landfill

Regulator	Description	Permit ID #	Issue Date
Water and Wastewater Permitting			
Ohio EPA	PTI, On-site Wastewater Treatment/Disposal System for Office Building	06-7901	10/13/05
Ohio EPA	PTI, On-site Wastewater Treatment/Disposal System for Rail Facility Breakroom/Scalehouse	06-8015	02/01/06
Jefferson County GHD	Private Water System Installation Permit for Scale House/Office	29-2005	01/20/06
Jefferson County GHD	Private Water System Installation Permit for Rail House	2005-0029	06/01/07
Ohio EPA	PTI, Installation of a Sedimentation Impoundment	870776	06/06/12
Ohio EPA	NPDES Permit Renewal	0IN00198*GD	01/22/15
Ohio EPA	NPDES Permit Renewal	0II00022*DD	01/23/15
Ohio EPA	Indirect Discharge Permit	0DP00050*BP	02/15/11
Ohio EPA	Indirect Discharge Permit	0DP00050*CP	Pending, submitted 09/01/15
Ohio EPA	NPDES Permit Modification for the Contiguous Expansion	0IN00198*HD	Pending, submitted 12/28/15
Dam Permitting			
ODNR	Dam Safety Engineering Program Class IV dam exemption from construction permit requirements	n/a	10/29/04
Solid Waste Permitting			
Ohio EPA	PTI, Vertical Expansion and AMDWR Increase	06-08438	12/31/09
Ohio EPA	PTI Alteration Request, Phase 5 Revisions	06-08438	10/27/10
Ohio EPA	PTI Alteration Request, 2011 Phasing Revisions	06-08438	06/14/11
Ohio EPA	PTI Alteration Request, 2011 Revision to Odor Management Plan	06-08438	08/05/11
Ohio EPA	PTI Alteration Request, 2012 Rail Area Improvements	06-08438	03/16/12
Ohio EPA	April 2012 GCCS As-built Alteration	06-08438	05/29/12
Ohio EPA	June 2012 GCCS As-built Alteration	06-08438	06/14/12
Ohio EPA	PTI Alteration Request, 2012 Rail Yard Expansion	06-08438	08/09/12

Regulator	Description	Permit ID #	Issue Date
Ohio EPA	Authorization to Construct and Operate a Solidification Basin	06-08438	11/27/12
Ohio EPA	PTI Alteration Request, 2012 Phase 6 Subdivision	06-08438	12/21/12
Ohio EPA	Fall 2012 GCCS As-Built Alteration	06-08438	02/28/13
Ohio EPA	Spring 2013 GCCS As-Built Alteration	06-08438	07/16/13
Ohio EPA	PTI Alteration Request, 2015 Phase 6 Phasing Revision	06-08438	01/21/15
Ohio EPA	Odor Management Plan Alteration	06-08438	07/20/15
Ohio EPA	PTI Modification, Contiguous Expansion and AMDWR Increase	06-08448	Pending, submitted 10/27/11
Air Permitting			
Ohio EPA	Final Permit to Install and Operate for Emissions Unit P001 (Caterpillar 330C Hydraulic Excavator diesel engine)	06-07264	1/15/2004 (Emissions Source Removed 11/30/2015)
Ohio EPA	Final Permit to Install and Operate for Emissions Unit F003 (Storage Piles)	06-07467	10/28/04
Ohio EPA	Environmentally Beneficial Determination for Installation of Temporary Flare		04/10/09
Ohio EPA	Final Permit to Install for Modifications of PTI 06-06987, 06-07467, 06-07264 for Emissions Sources F001 (Paved and Unpaved Roadways and Parking Areas), F002 (Refuse Disposal Activities), F004 (Rail Unloading Facility Unpaved Roadway), and F005 (Materials Handling Operations)	P0103987	12/31/09
Ohio EPA	Final Permit to Install for Emissions Unit F008 (Aggregate Processing Plant)	P0109402	02/13/12
Ohio EPA	Air Pollution Source Permit to Install Modification Application for Contiguous Expansion and AMDWR Increase	Pending	Pending, submitted 12/30/15
Wetlands Permitting			
Department of Army Corps of Engineers	Section 404 Clean Water Act permit for wetland and stream impacts	200400270	12/13/04
Ohio EPA	Section 401 Water Quality Certification and/or Isolated Wetland Permit	049815	11/23/04

Regulator	Description	Permit ID #	Issue Date
Ohio EPA	Modification of Section 401 Water Quality Certification and/or Isolated Wetland Permit to transfer to Apex	049815	12/17/04
Department of Army Corps of Engineers	Revised Mitigation Compliance Schedule and Permit Extension	200400270	10/09/09
Ohio EPA	401 Water Quality Certification and the Ohio Isolated Wetland Permit	124004	Pending, submitted 2/12/2016
Department of Army Corps of Engineers	Section 404 Clean Water Act permit for wetland and stream impacts	2004-270	Pending, submitted 2/12/2016
Limestone Mining Permitting			
ODNR	Limestone Mining Permit	IM1164	07/13/02

CONTIGUOUS EXPANSION
PERMIT TO INSTALL APPLICATION
APEX SANITARY LANDFILL
JEFFERSON COUNTY, OHIO

PREPARED FOR

Apex Environmental LLC
11 County Road 78
Amsterdam, Ohio 43903

PREPARED BY

Civil & Environmental Consultants, Inc.
333 Baldwin Road
Pittsburgh, Pennsylvania 15205

October 2011
Revised July 2013
Revised May 2016

CEC Project 101-049

Volume II of VI

Section (C)(3)

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Volume II of VI
Section (C)(3)

PERMIT TO INSTALL APPLICATION

HYDROGEOLOGIC SITE INVESTIGATION REPORT

APEX SANITARY LANDFILL

JEFFERSON COUNTY, OHIO

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Appendix C3-C – Soil Boring Logs, Well Construction Logs, Test Pit Logs
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(C)(3) HYDROGEOLOGIC SITE INVESTIGATION REPORT

INTRODUCTION

This Hydrogeologic Site Investigation (HSI) Report provides the narrative documentation for the Permit to Install (PTI) Application for the proposed contiguous expansion of the Apex Sanitary Landfill (Apex) in Springfield Township, Jefferson County, Ohio in accordance with Ohio Administrative Code (OAC) 3745-27-06(C)(3). The regional location of the facility is shown on the title sheet for the Drawing set. The proposed contiguous expansion area is positioned along the southern portion of the existing Apex Sanitary Landfill and adjacent property within the facility boundary, as shown on Drawing 3D. The Apex Landfill is located within Springfield Township, approximately three miles south of Amsterdam, Ohio.

This HSI document presents the findings of the most recent subsurface field investigation performed by Civil & Environmental Consultants, Inc. (CEC) in 2010 and 2011. In addition, CEC references data obtained during the installation of the existing landfill's groundwater monitoring well network installed by CEC from 2005 to 2010. This HSI also incorporates portions of a May 2001 HSI document prepared by BBC&M Engineering, Inc. (BBC&M) in support of the PTI application for the existing landfill. This document provides a comprehensive characterization of the geology and hydrogeology underlying the Apex Landfill. A summary of the investigations is provided below.

The original siting and permitting work for the Apex Landfill was conducted in the early 1990's by BBC&M in conjunction with Linn Engineering. The original Permit to Install (PTI) Application (#17-1194), including the HSI, appears to have been submitted on July 12, 1993. BBC&M submitted addendums to the original HSI based on comments from the Ohio Environmental Protection Agency (OEPA) in 1994, 1995, and 1996. Additionally, an addendum to the HSI was submitted to the OEPA on October 3, 1995 determining the rate and extent of contamination from an underground storage tank located at the facility. A review of historic documentation indicates that PTI #17-1194 was approved by the Ohio EPA on January 21, 1998.

In support of a proposed vertical landfill expansion at the facility, BBC&M conducted an additional investigation in 1999-2000. The details, data, and interpretations of this later investigation combined with their previous work compiled the above referenced May 2001 HSI.

Prior to implementing CEC's investigation, a *Hydrogeologic and Geotechnical Site Investigation Work Plan* was prepared and submitted to the Ohio EPA on July 2, 2010. A meeting was also held at the Ohio EPA Southeast District Office between representatives of the Ohio EPA, Apex, and CEC on July 15, 2010 to discuss the proposed investigation. CEC subsequently conducted the hydrogeologic investigation in two phases. The first phase was initiated in August 2010, while the second phase was initiated in February 2011. Both phases of work provided further characterization of the southern expansion areas in support of a planned Contiguous Lateral Expansion. Work conducted during the investigation included advancing 34 soil borings for stratigraphic and geotechnical evaluation; the installation of 26 piezometers; the excavation of 14 test pits; geotechnical analysis to determine the properties of the subsurface material in the southern expansion area; piezometer development, hydrogeologic testing, and groundwater quality testing of the newly installed piezometers and existing wells/piezometers; and collection of comprehensive site-wide potentiometric surface measurements.

This report presents the required information and has been structured in accordance with the regulations in OAC 3745-27-06(C)(3), which outline the requirements for the hydrogeologic site investigation report. Each regulation is cited in bold followed by a response to the regulation. Supporting documentation is provided in the drawing sheets, and in the tables and appendices following the narrative of Section (C)(3).

Plan drawings referenced in Section (C)(3), which present hydrogeologic information required in OAC 3745-27-06(B)(1) through (B)(7), will be included with the master set of drawings accompanying the PTI Application for the Apex Landfill expansion, as outlined below.

Plan Drawing	Regulations Section
Water Supply Wells Within 2000 Feet	3745-27-06(B)(2)(b)(vi)
Soil Boring, Piezometer and Monitoring Well Locations	3745-27-06(B)(3)(c)
Potentiometric Surface Maps	3745-27-06(B)(3)(d)
Site Hydrogeology Maps & Cross-Sections	3745-27-06(B)(5)(a)

(C)(3) HYDROGEOLOGIC SITE INVESTIGATION REPORT

A hydrogeologic and geotechnical site investigation report(s), which shall at a minimum include the following:

(C)(3)(a) SITE SUITABILITY

Sufficient information to allow the director to determine the suitability of the site for solid waste disposal through the following:
(i) Identification and characterization of the hydrogeology of the uppermost aquifer system and all stratigraphic units that exist above the uppermost aquifer system.
(ii) Characterization of the site geology and hydrogeology to allow for the evaluation of the proposed design of the sanitary landfill facility and to ensure that it will be in compliance with the requirements of rule 3745-27-07 and rule 3745-27-10 of the Administrative Code.

The information to be documented in the Hydrogeologic Site Investigation Report consists of the following:

- A description of the regional geology and hydrogeology within one mile of the proposed landfill, as outlined in OAC 3745-27-06(C)(3)(b);
- Mining, mineral rights, oil and gas well, and wetland documents as outlined in OAC 3745-27-06(C)(3)(c);
- A detailed description and analysis of the geology and hydrogeology under the proposed landfill, as outlined in OAC 3745-27-06(C)(3)(d);
- The site-specific groundwater quality of the uppermost aquifer system and all significant zones of saturation above, as outlined in OAC 3745-27-06(C)(3)(e);
- Subsurface investigation information, as outlined in OAC 3745-27-06(C)(3)(f); and,
- A detailed description of the subsurface investigation methodologies, as outlined in OAC 3745-27-06(C)(3)(g).

The *Hydrogeologic and Geotechnical Site Investigation Work Plan* (July 2, 2010) was designed for the collection of the data and information necessary to prepare the Hydrogeologic Site Investigation Report for the proposed Apex Landfill expansion. Information presented in this report consists of the definition of the regional hydrogeologic setting, the site-specific hydrogeologic setting and the water quality of the site-specific groundwater system.

In order to define the regional geology and hydrogeology, the regulations in OAC 3745-27-06(C)(3)(b) require identification and characterization of the regional aquifer, stratigraphy, structural geology and geomorphology. Information used in the characterization of the regional hydrogeologic setting consisted of the following:

- Ohio Department of Natural Resources and other published reports on the groundwater and geology of Jefferson County and the surrounding area;
- Public information from the Ohio Department of Natural Resources; and,
- Previous investigations for the Apex Landfill.

In order to define the site hydrogeologic setting, the regulations in OAC 3745-27-06(C)(3)(d) require characterization of the site stratigraphy, geomorphology, structural geology and the uppermost aquifer system (UAS) and any significant zone of saturation (SZS) above the UAS. To complete this characterization, a comprehensive review of previous investigations and CEC's field investigation was conducted to further characterize the expansion area of the Apex Landfill expansion area. The field investigations included drilling, rock coring, piezometer installation and hydraulic testing. The methods, procedures and equipment used in the most recent site investigation are described in detail along with a summary of past field investigations in Section (C)(3)(g). The comprehensive drilling and piezometer installation summary is presented in Table C3-1.

Subsequent to the drilling and piezometer installation programs associated with the investigation, piezometers were developed and selected piezometers were tested to evaluate the hydraulic characteristics of the subsurface zones in which the piezometers were installed. In addition, groundwater samples were collected from selected monitoring wells and piezometers to define the groundwater quality of the site-specific groundwater system, as outlined in OAC 3745-27-06(C)(3)(e).

(C)(3)(b) REGIONAL GEOLOGY AND HYDROGEOLOGY

The following sections present a description of the regional geology and hydrogeology of the site vicinity as required in OAC 3745-27-06(C)(3)(b). The following information is based on published literature, publicly available well records, and reports of previous investigations for the existing Apex Landfill.

(C)(3)(b) A description, based on publicly available information, of the regional geology and hydrogeology within one mile of the proposed sanitary landfill facility. This shall include, but is not limited to, the following:

(C)(3)(b)(i) The identification and average yield of the regional aquifer system(s).

The Ohio EPA defines a regional aquifer as "*...the aquifer used as a primary source of water to wells within one mile of the solid waste disposal facility"* (OAC Rule 3745-27-01). The existing landfill and proposed expansion area lies nearly on the border between Jefferson, Carroll and Harrison Counties. As such, regional groundwater information from these counties was utilized to determine characteristics of the regional aquifer system. The Groundwater Resources Map of Jefferson County (Walker, 1990) indicated that the site and surrounding vicinity is located in an area "in which yields seldom exceed 3 gallons per minute" from "thin beds of sandstone, shale, and limestone". The Harrison County (Crowell, 1980) and Carroll County (Walker, 1991) Groundwater Resources Maps corroborate the information provided on the Jefferson County map. The "thin beds of sandstone, shale, and limestone" referred to by the above referenced publications describes the Pennsylvanian System, and more specifically the Conemaugh Formation, underlying the region proximal to the landfill. The Conemaugh Formation is comprised of shales, siltstones, dirty sandstones, coal, and limestone. The Conemaugh is laterally extensive across the area and typically exhibits yields of less than five gallons per minute.

Ohio Department of Natural Resources (ODNR) logs of wells within one mile of the landfill site were reviewed to evaluate regional groundwater use and the yield of the regional aquifer. Drawing 2E provides the locations of the wells filed with ODNR. Further, the ODNR log information was used to gain an understanding of the historical use of water-bearing zones within one mile of the landfill. Results of the ODNR log review assisted in the definition of the Uppermost Aquifer System (UAS) at the landfill site. Appendix C3-B presents the ODNR well logs which were used to evaluate groundwater usage in the site vicinity. Table C3-2 summarizes the data contained on the logs used for the evaluation, including total depth, ~~year of installation,~~ formation screened, and yield ~~date~~ data (if available).

Of the 16~~42~~ wells reviewed, all were found to be yielding water from the consolidated bedrock in the region. The vast majority of the wells (13~~34~~ wells) were producing from the Connellsville-Morgantown Association. Of these 13~~34~~ wells, seven~~17~~ wells were producing form the Connellsville-Morgantown Association and 6~~17~~ were producing from a combination of

the Connellsville-Morgantown Association and the Birmingham-Gaysport-Ames Association. One~~5~~ well~~s~~ ~~were~~was producing from below the Connellsville-Morgantown Association in the Birmingham ~~-Gaysport-~~Ames Association. Only ~~three~~ two wells were found to be screened exclusively above the Connellsville unit in the Summerfield Association. The average regional yield calculated from ODNR well logs is *9.0*~~14.21~~ gallons per minute *(Table C3-2), which was determined using six of the 16 well logs that provide representative yield data.*

Based on the ODNR log information and findings of the subsurface investigations, CEC concludes that the regional aquifer within one mile of the landfill is the Connellsville-Morgantown bedrock units.

(C)(3)(b)(ii) The direction of ground water flow in the regional aquifer system(s).

The regional groundwater flow direction of the regional bedrock aquifer in the vicinity of the site can generally be expected to flow to the south-southeast, following the regional dip of the bedrock. However, as noted by Roth (1995), the rock strata are not horizontal or "regularly sloping" and local influences on the groundwater flow can be expected, based on topography.

In the 2001 HSI, BBC&M references the presence of a "syncline" underlying the region that influences the local groundwater flow direction. The presence of the "syncline" is noted on the structure contour maps of the Pittsburgh (#8) Coal (Slucher, 1996) and the Ames limestone (Swinford, 1997) in the region. CEC has reviewed the maps and agrees that a structure is present in the area, but hesitates to call the structure a syncline, as that implies a compressional force acted on the area after the deposition of the Pennsylvanian rock strata. CEC believes the structure is the result of differential compaction of the sediment during post deposition. As evidenced by previous investigations, the structure does influence the groundwater flow direction in the bedrock at the site and it is likely that the structure influences the bedrock groundwater flow direction on a regional level as well.

Regional groundwater flow in the limited unconsolidated material is expected to follow local topography. However, local groundwater flow will vary throughout the region as the area has been subjected to extensive strip mining. Mapping regional groundwater flow in the strip mined areas is difficult due to the unique and altered local drainage patterns associated with each individually mined area. Thus, local groundwater flow is significantly influenced by un-reclaimed mining excavations which have degraded to strip mining impoundments. These mining impoundments, where they exist, form localized recharge and discharge areas for both the shallow unconsolidated units as wells as shallow bedrock zones. Once on the surface, if an outlet drainage exists, water flows with the existing drainage pattern.

(C)(3)(b)(iii) The identification of recharge and discharge areas of the regional aquifer system(s).

Recharge to the regional bedrock aquifers occurs by infiltration of precipitation in areas where the bedrock outcrops or subcrops beneath relatively thin surficial deposits. Based on the general south-southeast dip of the bedrock underlying the region, the bedrock would be expected to outcrop/subcrop up dip to the north-northwest of the site. However, the presence of localized structures and strip mining impoundments also influence the recharge areas.

Recharge to the unconsolidated deposits occurs primarily by infiltration of precipitation falling on the regional topographic high points. A small amount of recharge may occur from the discharge of the bedrock aquifers which subcrop into the deposits.

Based on general regional dip of the bedrock, the presence of the above mentioned structural feature, the high relief common to the area, and the elevation of the aquifer, the regional discharge points are anticipated to be to the north into Goose Creek and its tributaries, northeast into Wolf Run, and southwest into Jefferson Creek.

Based on regional groundwater flow in the unconsolidated deposits, it is assumed that groundwater should discharge into one of the many named and unnamed streams in the area or areas of topographic lows. Locally, groundwater flow in the unconsolidated deposits appear to discharge into the surficial mine impoundments located in the areas where strip mining has occurred. Also, the surficial mine impoundments discharge water to the shallow unconsolidated and consolidated deposits. Surficial mined impoundment recharge and discharge is dependent on the localized topography and the dip of the bedrock underneath the specific impoundment. The impoundment may be receiving groundwater on the upper slope or at the higher bedrock elevation, but discharge groundwater to the lower slope or lower bedrock elevation.

(C)(3)(b)(iv) Regional stratigraphy, including any regional stratigraphic or structural features, such as the bedrock surface, bedrock dip, or joint systems that may influence the ground water flow system.

The regional stratigraphy consists of Quaternary-Age unconsolidated deposits underlain by the Pennsylvanian-Period Monongahela and Conemaugh Formation bedrock. These units are discussed below.

Unconsolidated Materials

Very little structure is associated with the unconsolidated deposits. The deposits consist of residual soils on the uplands and alluvial deposits in and near the valley bottoms. However, the area surrounding the landfill has been extensively strip mined, which has altered the native deposits and drainage patterns. This mining activity has displaced native deposits and restored them with reworked strip mine spoil deposits. These mine spoil deposits are composed of varying amounts of clay, silt, sand, and fragments of rock from the mining process.

Bedrock

Within the region, bedrock consists primarily of the Monongahela and Conemaugh groups of the Pennsylvanian Period. These groups are comprised of numerous cyclothem sequences. Each cyclothem consists of consolidated deposits with a distinctive sequence of marine and non-marine sedimentary members representing marine transgression and regression. The sequence of sedimentary members recognized in the Pottsville group in the region are coal, underclay, gray shale, sandstones, sedimentary iron ore, limestone, and black shale. Since alterations in lithology occur within an individual cyclothem, each lithologic unit will not be present in each sequence (Gray, 1961). Locally, the most frequent members found are gray and black shale, gray sandy shale, sandstone, and coal. It should also be noted that the thickness of the different members can vary greatly within a relatively short horizontal distance.

The region is located in the Appalachian Plateau physiographic province of eastern Ohio. According to Roth (1995), "the rock strata are not horizontal or regularly sloping, but the dip generally is in a south-southeasterly direction." The average dip is approximately 17 feet per mile for the Pittsburgh coal member.

(C)(3)(b)(v) A description of the regional geomorphology, including the location of surface water bodies, flood plains, etc. and a description of any topographic features that may influence the ground water flow system.

According to Roth, (1995), Jefferson County is located in the Unglaciated Allegheny Plateaus section of the Appalachian Plateau physiographic province. Jefferson County and the majority of surrounding counties are situated in primarily two physiographic regions, the Muskingum-Pittsburgh Plateau to the north and west and the Little Switzerland Plateau to the south and east. These regions are characterized by dissected to highly dissected plateaus exhibiting moderately high to high relief. Topographic relief is relatively high in the region of the landfill. Ground surface elevations range from approximately 1200 ft msl along ridge tops to approximately 960 ft msl at along portions of Yellow Creek.

The region has been extensively strip mined for the Pittsburgh #8 Coal. The mining operations in the region leave irregular topography when unreclaimed. Several high walls exist in the area and typically have ponds present at the base. Additionally, pit mining techniques were utilized on occasion. The pit mines fill with water creating additional surface water impoundments in the area.

As discussed in Section (C)(3)(b)(ii) above, the regional groundwater flow direction in the bedrock is generally south-southeast following the general dip of the bedrock. However, the presence of localized structural features do influence the local groundwater flow direction. Groundwater flow directions in the limited unconsolidated deposits can be expected to follow topography. However, locally, groundwater flow in the unconsolidated deposits is towards the mine spoil deposits and surface mining impoundments.

In the 2001 HSI, BBC&M summarized the surface water in the vicinity stating that the site and surrounding area are situated on a plateau that crosses the water drainage divide between Yellow Creek to the north and Cross Creek to the south. Both of these creeks are tributaries of the Ohio River approximately 15 miles east of the proposed expansion. Goose Creek, a tributary of Yellow Creek, is located approximately 700 feet east of the site and receives flow from the unnamed streams and creeks discharging from the northern portion of the site. Drainage from the southern portion of the site enters North Branch Cross Creek via several unnamed tributaries.

According to the Jefferson and Harrison County Soil Surveys, soils in the region consist mainly of those associated with the Morristown-Guernsey Association and the Morristown-Gilpin Association and where mining has occurred, mine spoils. The Morristown-Guernsey soils are "deep to very deep, nearly level to very steep, well drained to moderately well drained soils formed in material mixed by surface mining and in residuum and colluvium derived from shale, siltstone, and limestone." (Roth, 1998) The Morristown-Gilpin soils are "deep to very deep, nearly level to very steep, well drained soils formed in residuum and colluvium derived from siltstone, shale, limestone and sandstone and in material mixed by surface mining". (Roth et. al, 1995)

(C)(3)(c) DOCUMENTS

The following documentation is required per OAC Rule:

(C)(3)(c)(i) If any surface or underground mines were identified in accordance with paragraph (B)(2)(b)(ix) of this rule, a letter from the Ohio Department of Natural Resources, Division of Mines or other appropriate agency verifying type, mining method, location, depth, and status.

According to correspondence from Ms. Beth Wilson from the Ohio Department of Natural Resources, Mineral Resources Management (ODNR-MRM), dated January 12, 2011, there does not appear to be any current mining permits in the area of the proposed expansion. Two historic strip mine permits were issued in the vicinity of the proposed expansion including: permit # C-247 and permit # D881. According to the correspondence, permit D-881 was issued to mine the #8 coal. However, it is unclear if the mining actually occurred. Records regarding mining permit C-247 appear to have been lost. Additionally, the correspondence does not indicate whether there is a record of underground mining in the area stating that the information regarding permit numbers C-247 and D-881 is "all the information we could find". Based on the "shallow" occurrence of the #8 Pittsburgh Coal, no deep underground mines are thought to exist in the vicinity of the expansion area. The correspondence regarding the mines and a figure showing the permitted limits of disturbance allowed by each permit are presented in Appendix C3-A.

For the existing permitted landfill facility, Apex Energy Inc., holds a surface mine permit # IM-1164. The permit became effective July 13, 2002 and expires on July 12, 2017. ~~It is not anticipated that limestone mining operations will proceed into the proposed expansion area.~~ Documentation of this permit is provided in Appendix C3-A. New Drawing 3E-1 – Area of Limestone/Shallow Bedrock Removal, indicates that the Pittsburgh Limestone will be mined in the western portions of Phases 6 and 7 of the permitted landfill and from the proposed landfill expansion area. Apex Energy Inc, holds a surface mine permit # IM-1164, which became effective July 13, 2002 and expires on July 12, 2017. Apex will contract a licensed mining contractor registered in the State of Ohio to remove the Pittsburgh Limestone. Surface mine permit #IM-1164 will be updated and submitted to the Ohio Department of Natural Resources (ODNR) annually to shown the areas where the Pittsburgh Limestone has been removed. The mining permit application will indicate that the mined area will be used as a solid waste landfill following removal of the limestone.

(C)(3)(c)(ii) Documentation of who owns the mineral rights below the sanitary landfill facility.

The property deeds are included in Volume V Appendix C-10 of this permit application. Based on the purchases from previous owners, any mineral rights were transferred to Apex Landfill upon execution of the land title.

(C)(3)(c)(iii) If any oil or gas wells were identified in accordance with paragraph (B)(2)(b)(ix) of this rule, a letter from the Ohio Department of Natural Resources or other appropriate agency verifying type, location, depth and status.

According to correspondence from Ms. Beth Wilson from the Ohio Department of Natural Resources, Mineral Resources Management (ODNR-MRM), dated January 12, 2011, there does not appear to be any oil and gas wells in the area of the proposed expansion. This information and related correspondence are included in Appendix C3-A of this PTI Application.

(C)(3)(c)(iv) A letter from the Army Corps of Engineers agreeing with the wetland delineation, as depicted on the plan drawing with the information required by paragraph (B)(2)(a)(iv) of this rule, including if appropriate, that no wetlands are present, and if any wetlands are isolated.

Apex received a jurisdictional letter from the U.S. Army Corps of Engineers (COE). The letter is dated September 21, 2012, and has been included in Appendix C10-B in this revised PTI Application. ~~On behalf of Apex, CEC is in the process of preparing and submitting a wetland and stream delineation report to the Army Corps of Engineers. Therefore, the verification letter from the Army Corps agreeing the wetland delineation is currently pending. A copy of this letter will be provided once received.~~ Further discussions and correspondence regarding the wetland delineation and permitting are provided in Volume V Section (C)(10)(c) of the PTI Application, which is submitted under separate cover.

(C)(3)(d) SITE GEOLOGY AND HYDROGEOLOGY

A detailed description and analysis of the geology and hydrogeology under the proposed sanitary landfill facility. This description shall be based on data collected using appropriate subsurface investigatory methods such as borings, piezometers, monitoring wells, tensiometers, geophysical surveys, soil gas surveys, dutch cone penetrometers and test pits. The description and analysis shall include, but is not limited to, the following:

The site-specific hydrogeologic setting of the proposed Apex Landfill expansion has been defined from the results of the site investigation conducted, as documented in Section (C)(3)(f)

and (g). Included in this description of the site hydrogeology, as required by OAC 3745-27-06(C)(3)(d), are descriptions of the unconsolidated and consolidated stratigraphic units, the site geomorphology, the site structural geology, the uppermost aquifer system (UAS), and any significant zones of saturation (SZS) above the uppermost aquifer system.

The descriptions of the unconsolidated and consolidated stratigraphic units at the site are based on the results of the soil borings and bedrock coreholes drilled throughout both the existing and proposed landfill area through the course of this and previous investigations. The locations of the soil borings, rock coreholes and piezometers installed in selected borings and coreholes are shown on Drawing 3D. Drilling logs for the soil borings and coreholes as well as available completion diagrams for the piezometers are presented in Appendix C3-C. Drilling logs from previously drilled soil borings, piezometers, and monitoring wells surrounding the existing landfill area were used to supplement the results of the site investigation for the proposed expansion area. These logs are also presented in Appendix C3-C. Table C3-1 contains a summary of the borings, monitoring wells, piezometers, and test pits on the property.

In order to characterize the unconsolidated site stratigraphic units, the information presented on the drilling logs in Appendix C3-C was graphically presented in map form and on geologic cross-sections in the following drawings:

- Drawing 3D presents the soil boring, test pits, piezometer, and monitoring well location map
- Drawing 3E presents a contour map of the elevation of the top of bedrock surface
- Drawing 3F presents a contour map of the elevation of the uppermost aquifer system
- Drawing 3G and Drawing 3K present contour maps of the mine spoil potentiometric surface measured December 2010 and March 2011, respectively.
- Drawing 3H and Drawing 3L present contour maps of the shallow bedrock/limestone potentiometric surface measured December 2010 and March 2011, respectively.
- Drawing 3I and Drawing 3M present contour maps of the Bellaire/Summerfield units potentiometric surface measured December 2010 and March 2011, respectively.
- Drawing 3J and Drawing 3N present contour maps of the Connellsville/Morgantown potentiometric surface measured December 2010 and March 2011, respectively.

- Drawing 5A presents a map of the locations of the geologic cross-sections,
- Drawing 5B presents geologic cross-section A-A'
- Drawing 5C presents geologic cross-section B-B'
- Drawing 5D presents geologic cross-section C-C'
- Drawing 5E presents geologic cross-section D-D'
- Drawing 5F presents geologic cross-section E-E'
- Drawing 5G presents geologic cross-section F-F'

Unconsolidated sediments encountered beneath the expansion area are primarily reworked mine spoil deposits. The Apex Landfill is located on historic coal strip-mines. Where this strip mining activity has occurred, the geology of the overburden and underlying bedrock has been considerably altered.

For the unconsolidated unit, a total of 22 undisturbed Shelby Tube samples were submitted for geotechnical analysis. Because mine spoil comprises the majority of the site soils, there were no target horizons where a distribution of disturbed and undisturbed samples were required. Due to the heterogeneous mixture of soils and rock that comprise the mine spoil, the locations and depths of samples collected for geotechnical laboratory testing were chosen based on the results of Standard Penetration Tests, pocket penetrometer readings, and likelihood of sample recovery. Shelby Tube samples were collected mainly in the softer cohesive zones encountered, however representative samples were also collected in stiffer zones. The following is a summary of the samples analyzed, showing boring number, depth, sample type and classification.

Boring	Sample Depth (feet)	Sample Type	Classification
SB-3	11.5-13.5	Shelby Tube	CL
SB-4	28-30	Shelby Tube	CL
SB-6	8-9	Shelby Tube	Moisture Content Only
SB-6	9-10	Shelby Tube	GC
SB-8	2-4	Shelby Tube	CL
SB-14	10-12	Shelby Tube	CL
SB-14	25-25.5	Shelby Tube	MH
SB-14	26.5-27	Shelby Tube	CH
SB-16	0.5-2.5	Shelby Tube	CH
SB-16	1-3	Shelby Tube	CL
SB-17	16-18	Shelby Tube	SC
SB-17	18-20	Shelby Tube	SC
SB-18	10-12	Shelby Tube	CL
SB-18	22-24	Shelby Tube	GC
SB-19	11-13	Shelby Tube	CL
SB-20	16-18, 17-19	Shelby Tube	GC
SB-21	9-11	Shelby Tube	CL
TPE-17	12-14	Shelby Tube	CL
TPE-18	12-14	Shelby Tube	CL
TPE-18	18-19.7	Shelby Tube	SC
TPE-19	2-4	Shelby Tube	CL
TPE-21	2-4	Shelby Tube	CL

The soil samples were analyzed for some or all of the following characteristics: moisture content, grain size distribution, Atterberg Limits, wet and dry density, shear strength, and permeability. The geotechnical laboratory analytical results are presented in Appendix C3-D and summarized

on Table C3-3. Results pertaining to the consolidated hydrogeologic investigation are discussed below.

Consolidated material encountered beneath the site includes early Pennsylvanian cyclothem deposits which are specific sequences of stratigraphic units that represent a transgressive and regressive marine and non-marine environment. These sequences are attributable to mountain building activities that occurred with the collision of the North American and African plates, which resulted in the Appalachian Orogeny. Along the western boundary of this orogenic event, thin skinned deformation created a fold-and-thrust belt which formed the Appalachian Mountains with an associated foreland basin (Hatcher 1972). The foreland basin is found west of the deformed upper plate and extends into eastern Ohio. Sediments formed from the eroding Appalachian Mountains were shed onto this foreland basin (Meckel 1967). The Pennsylvanian Period was also affected by continental glaciations (Ninke and Evans, 2002). The results of repeated glacial advances were glacial-eustatic sea level changes and tectonic uplift produced repeated sequences of sedimentation due to migrating sea shores (Ninke and Evans, 2002). These repeated sequences of sedimentation are referred to as "cyclothems" and are composed of alternating marginal marine and continental facies. Each cyclothem consists of a specific sequence of stratigraphic units. An ideal cyclothem sequence generally consists of the following: coal, underclay, gray shale, sandstone, gray shale, sedimentary iron ore, limestone, and black shale. However, ideal cyclothem successions are rare and lateral and vertical changes in lithologic types occur frequently, thus it is nearly impossible to find a complete lithologic set within a single vertical section (Gray, 1961).

Rock units encountered beneath both the existing landfill and the proposed expansion consist of members of the Conemaugh Formation. The #8 Pittsburgh Coal is part of the Monongahela Formation, which was extensively strip mined from the area. Please note that not all members of these formations exist beneath the investigation area. The members which were specifically encounter beneath the investigation area are discussed in detail below.

As discussed earlier, the #8 Pittsburgh Coal was previously mined from the site. The Upper Pittsburgh Member occurs immediately beneath the #8 Pittsburgh Coal. The Upper Pittsburgh Member is mostly comprised of thin layers of shale overlying several feet of limestone which overlies shale. This member can also sometimes contain thin seams of poor quality coal. The limestone associated with this member can range from several inches think to several feet thick. In Jefferson County, the Pittsburgh Limestone varies from a few inches to eight feet in thickness with an average of two feet seven inches (Lamborn, 1930). Site specifically, the Pittsburgh limestone was found on average to be thicker than the average for Jefferson County.

Stratigraphically beneath the Upper Pittsburgh Member lies the Bellaire Member. The composition of the Bellaire varies across the site. The published literature represents this member as mostly sandstone, however, it goes on to state that in Jefferson County the sandstone is replaced over large areas by arenaceous shale (Lamborn, 1930). This shale replacement has occurred beneath the vast majority of the investigation area. Therefore, CEC defines the Bellaire Member to be generally comprised of shale with seams and lenses of siltstone and fine-grained sandstone.

Stratigraphically beneath the Bellaire Member lies the Summerfield Member, which is also known as the Lower Pittsburgh. This member is referred to as the Summerfield throughout this report, appendices, and drawings. The composition of this member varies greatly across the site, ranging from nearly continuous shale to siltstone, a few sandstone and limestone nodules and a few thin seams of poor quality coal. Generally the composition is predominantly shale with seams and lenses of siltstone.

Stratigraphically beneath the Summerfield Member lies the Connellsville Member. This member is generally comprised of fine to medium-grained sandstone and also contains minor discontinuous seams of siltstone, shale, limestone, and coal. Additionally, along higher ridges in Springfield Township, the Connellsville sandstone is replaced by sandy shale.

Stratigraphically beneath the Connellsville Member lies the Morgantown Member. This member is comprised of fine to medium-grained sandstone with several infrequent discontinuous seams of coal. In Springfield Township, the Morgantown sandstone has a variable thickness and ranges from 30 to 100 feet which has been confirmed during the subsurface investigation.

Stratigraphically beneath the Morgantown Member lies the Elk Lick Member. This member is comprised of a thin coal seam overlying limestone or calcareous shale. The Elk Lick is not present beneath the entire investigation area. Where it is not present, it has been replaced by the Birmingham Member. The lower Birmingham Member is comprised of predominantly shale, but grades to silty shale or siltstone in some locations.

(C)(3)(d)(i) The consolidated and unconsolidated stratigraphic units from the ground surface down to the base of the uppermost aquifer system including the following:
(*a*) Characteristics, composition and features including the following:
(*i*) For unconsolidated stratigraphic units, the textural classification using the "Unified Soil Classification System - USCS."
(*ii*) For consolidated stratigraphic units, the rock type(s) such as limestone, dolomite, coal, shale, siltstone, sandstone.
(*iii*) Color; moisture content; stratigraphic features such as layering, interbedding, or weathering; fracturing, jointing, and other types of secondary porosity; and any visible accessory minerals such as pyrite, calcite or gypsum.
(*iv*) Hydraulic conductivity.
(*b*) Thickness.
(*c*) Lateral extent.
(*d*) Depth and elevation.
***(e)* Variations in texture, saturation, stratigraphy, structure, or mineralogy exhibited by each stratigraphic unit that could influence the ground water flow or quality in the uppermost aquifer system or any overlying zones of saturation.**
(C)(3)(d)(i)(a)(*i*) and (*iii*): The Unified Soil Classification System (USCS) designations for the unconsolidated overburden sedimentary units submitted for analysis are based on the geotechnical analytical sampling results and the field visual descriptions of the soil samples, as reported on the drilling logs presented in Appendix C3-C. The unconsolidated overburden sediments can generally be divided into mine spoil and residual soil. The majority of the

expansion area has been extensively strip mined and the residual soil is limited to un-mined areas in valley bottoms. Therefore, these units have been referenced as the unconsolidated unit.

Unconsolidated Unit	USCS Designation
Mine Spoil	CH, CL, MH, SC, GC
Residual Soil	CH, CL, SC

The mine spoil and residual soil deposits identified during the hydrogeologic investigations are defined using the USCS ASTM Method D 2487. The mine spoil grain-size analysis was classified as CH (fat clay), Cl (lean clay), MH (elastic silt with sand), SC (clayey sand), and GC (clayey gravel). These varying grain-sizes identified are typical of mine spoil deposits. The residual soil grain-size analysis was classified as CH (fat clay), CL (lean clay), and SC (clayey sand), which are typical for undistributed residual soil deposits. These classifications are also based on the graphical comparison of the plasticity index to the liquid limit (referred to as the Plasticity Chart).

The water-bearing zones within the unconsolidated deposits vary in composition and are defined by several divisions within the USCS. In general the water-bearing zones have a clay matrix, but contain higher amount of sand and gravel allowing for the collection of perched water. The composition of these water-bearing zones is neither laterally nor vertically uniform, as observed from the sediments in the soil borings, and it is possible for a variety of soil types of deposits to be encountered in a single boring.

The complete soil testing results are summarized in Table C3-3 and the laboratory data sheets are presented in Appendix C3-D.

(C)(3)(d)(i)(a)(*ii*) and (*iii*): Below the unconsolidated unit are bedrock members belonging to the Conemaugh Formation of the Pennsylvanian geologic era. In general, the bedrock composition includes coal, limestone, shale, siltstone, and sandstone. The surface of the bedrock was encountered a few feet below ground surface to approximately 75 feet below ground surface in locations of thick mine spoil deposits. The surface of the bedrock when encountered has been weathered and fractured. The upper portion of the bedrock surface exhibits a higher permeability due to a greater fracture density and weathering. At depth, the permeability of the bedrock decreases and is controlled by the size and frequency of fractures.

For the specific color, moisture content, stratigraphic features such as layering, interbedding, or weathering, and fracturing please refer to the boring logs included as Appendix C3-C.

(C)(3)(d)(i)(a)(*iv*): The hydraulic conductivities (i.e., permeabilities) of the unconsolidated and consolidated deposits encountered on site have been assessed by both laboratory testing and in-situ testing. The horizontal hydraulic conductivity of the water-bearing zones of the unconsolidated and consolidated units were evaluated by pumping and in-situ testing, including packer tests and slug and recovery tests performed on monitoring wells and piezometers. The results are presented in Table C3-4 and Table C3-5 and the methodologies are presented in Section (C)(3)(g) below.

Hydraulic Conductivities – Slug Testing

The ranges of hydraulic conductivities of the consolidated and unconsolidated water-bearing zones noted during the slug testing are presented in the table below:

HYDRAULIC CONDUCTIVITIES – SLUG TESTING				
Zone	Number of Wells Tested	Minimum Hydraulic Conductivity (cm/sec)	Maximum Hydraulic Conductivity (cm/sec)	Geometric Mean Hydraulic Conductivity (cm/sec)
Mine Spoil SZS	3	$5.89x10^{-5}$	$1.09x10^{-2}$	$3.67x10^{-4}$
Limestone/ Shallow Bedrock SZS	6	$3.07x10^{-5}$	$2.10x10^{-2}$	$7.61x10^{-4}$
Bellaire/ Summerfield SZS	6	$5.47x10^{-7}$	$5.84x10^{-4}$	$3.50x10^{-5}$
Connellsville/Morgantown UAS	5	$4.44x10^{-5}$	$2.97x10^{-3}$	$9.61x10^{-4}$

Hydraulic Conductivities - Packer Testing

Dual packer testing was conducted in each deep boring (P-1, P-5, and P-9) prior to setting the UAS piezometer. Packer testing was conducted at ten foot intervals from the top of bedrock to the total depth of the respective boring. The coefficient of permeability was calculated from the pressure time/flow rate data which is presented in Table C3-5 and detailed below. Further discussions regarding the methodologies of the packer testing is included in Section (C)(3)(g)(iii).

Piezometer P-1 Packer Testing

Packer testing was conducted on the open bore hole prior to installing piezometer P-1. Packer testing was conducted from the termination depth of the bore hole (~270 feet bgs) to the bedrock surface (~85 feet bgs). A total of twenty-one (21) intervals were tested. Valid tests were completed for all 21 intervals, except a few tests where the packers failed, as noted within Table C3-5. The average of the hydraulic conductivity for the specific units tested are depicted on the table below.

PIEZOMETER P-1 – PACKER TEST RESULTS SUMMARY				
Zone	Number of 10-Foot Intervals Tested	Minimum Hydraulic Conductivity (cm/sec)	Maximum Hydraulic Conductivity (cm/sec)	Average Hydraulic Conductivity (cm/sec)
Limestone/ Shallow Bedrock SZS	2	0.0	2.28×10^{-3}	2.32×10^{-4}
Bellaire/ Summerfield SZS	9	0.0	1.17×10^{-3}	5.35×10^{-5}
Connellsville/ Morgantown UAS	10	0.0	1.08×10^{-3}	9.27×10^{-5}

Piezometer P-5 Packer Testing

Packer testing was conducted on the open bore hole prior to installing piezometer P-5. Packer testing was conducted from the termination depth of the bore hole (~189 feet bgs) to the bedrock surface (~29 feet bgs). A total of nineteen (19) intervals were tested. Valid tests were completed for all 19 intervals as noted on Table C3-5. The average of the hydraulic conductivity for the specific units tested are depicted on the table below.

PIEZOMETER P-5 – PACKER TEST RESULTS SUMMARY				
Zone	Number of 10-Foot Intervals Tested	Minimum Hydraulic Conductivity (cm/sec)	Maximum Hydraulic Conductivity (cm/sec)	Average Hydraulic Conductivity (cm/sec)
Limestone/ Shallow Bedrock SZS	2	2.55×10^{-5}	4.58×10^{-3}	3.23×10^{-4}
Bellaire/Summerfield SZS	7	0.0	7.22×10^{-4}	7.04×10^{-5}
Connellsville/Morgantown UAS	10	0.0	2.00×10^{-3}	6.52×10^{-5}

Piezometer P-9 Packer Testing

Packer testing was conducted on the open bore hole prior to installing piezometer P-9. Packer testing was conducted from the termination depth of the bore hole (~163 feet bgs) to the bedrock surface (~28 feet bgs). A total of eighteen (18) intervals were tested. Valid tests were completed for all 18 intervals, except a few tests where the packers failed, as noted within Table C3-5. The average of the hydraulic conductivity for the specific units tested are depicted on the table below.

PIEZOMETER P-9 – PACKER TEST RESULTS SUMMARY				
Zone	Number of 10-Foot Intervals Tested	Minimum Hydraulic Conductivity (cm/sec)	Maximum Hydraulic Conductivity (cm/sec)	Average Hydraulic Conductivity (cm/sec)
Limestone/ Shallow Bedrock SZS	2	$2.67x10^{-5}$	$4.49x10^{-3}$	$3.70x10^{-4}$
Bellaire/ Summerfield SZS	8	0.0	$1.37x10^{-3}$	$3.70x10^{-5}$
Connellsville/ Morgantown UAS	8	0.0	$1.61x10^{-3}$	$4.35x10^{-5}$

As noted on Table C3-5. Piezometer clusters P-1, P-5, and P-9 were generally installed within zones that yielded higher hydraulic conductivity values and/or zones which took more water during the packer testing. In addition, piezometer screened intervals were selected by examining the rock cores for fractures and visible oxidation from groundwater traveling through the bedrock. In some instances, a higher hydraulic conductivity value was reported during the packer test due to the nature of the fractured bedrock compared to the observations made during coring and groundwater yield estimate during drilling. In certain instances, a piezometer was not installed within the higher yield zone noted during the packer testing based on the other field observations during drilling which suggested that groundwater was not present within the interval.

The hydraulic conductivities (i.e., permeabilities) of the unconsolidated deposits encountered on site have been assessed by both laboratory testing and in-situ testing. "Undisturbed" tube samples were collected from the unconsolidated unit and the vertical permeability evaluated by laboratory testing using ASTM Testing Procedure D 5084-Method C. Soil samples tested for

hydraulic conductivity were not altered during the sampling process, nor compressed or remolded during laboratory testing. Thus, the permeability values are considered reflective of natural, in-situ vertical permeabilities. The unconsolidated unit at the facility consists of mine spoil and residual soil. The laboratory vertical hydraulic conductivity (K_v) for the nonconsolidated unit was determined and is summarized below.

Mine Spoil Unconsolidated Unit

Seven (7) undisturbed samples from the mine spoil deposits were subjected to falling head permeability tests throughout the course of investigation of the site. The hydraulic conductivities ranged from 7.10×10^{-8} to 3.70×10^{-5} centimeters per second, with a geometric mean of 5.35×10^{-7} cm/sec. Hydraulic conductivity values calculated through laboratory testing are summarized in Table C3-3.

Residual Soil Unconsolidated Unit

Two (2) undisturbed samples from the residual soil deposits were subjected to falling head permeability tests throughout the course of the investigation. The hydraulic conductivities were 3.80×10^{-6} and 5.70×10^{-6} cm/sec, with a geometric mean of 4.65×10^{-6} cm/sec. Hydraulic conductivity values calculated through laboratory testing are summarized in Table C3-3.

(C)(3)(d)(i)(b) Thickness

The total combined thickness of the unconsolidated unit is equivalent to the total overburden thickness at the site. The thickness of overburden ranges from a few feet below ground surface to 75 feet. The thickness of the unconsolidated units includes the mine spoil and residual soil deposits and is depicted graphically on the geologic cross section presented as Drawings 5B-5G.

The elevation of the bedrock surface is shown on Drawing 3E. As shown, the bedrock surface generally follows the existing undisturbed topography and the previously strip mined areas. The consolidated subsurface investigation was conducted from the top of bedrock to the base of the Connellsville/Morgantown UAS. The thicknesses of the consolidated units encountered at each boring location are depicted graphically on the geologic cross section presented as Drawings 5B-5G.

(C)(3)(d)(i)(c) Lateral Extent

Unconsolidated overburden, either mine spoil or residual soil, is present across the entire site, but the specific water-bearing units are generally isolated and discontinuous within this unit. The lateral extent of the unconsolidated overburden sediments is illustrated on the geologic cross-sections on Drawings 5B-5G.

The lateral extent of the Upper Pittsburgh Unit is not continuous across the entire site due to strip mining activities or it has been cut off by natural valleys or highwalls. Likewise, the later extent of the Bellaire/Summerfield unit is not continuous across the entire site. These units do not exist in the northwestern portion of the existing permitted facility where they pinches out and have been replaced by the lower units belonging to the Connellsville/Morgantown Members. The Connellsville/Morgantown units are below all of the existing and proposed expansion area and have been identified as the UAS.

(C)(3)(d)(i)(d) Depth and Elevation

The depth and elevation of the unconsolidated overburden sediments and consolidated bedrock units are illustrated on the geologic cross-sections on Drawings 5B-5G.

(C)(3)(d)(i)(e) Variations in texture, saturation, stratigraphy, structure, or mineralogy exhibited by each stratigraphic unit that could influence the groundwater flow or quality in the uppermost aquifer system or any overlying zones of saturation.

Textural and stratigraphic variation in addition to the discontinuous nature of the unconsolidated water bearing zones influence both inter and intra-zonal groundwater flow at the site. The surface water impoundments also create recharge and discharge points for the groundwater encountered within the unconsolidated and shallow bedrock units. The impoundments and natural valleys also create isolation points limiting the groundwater flow across the entire facility.

The shallow bedrock is typically weathered and exhibits frequent fracturing which adds to the permeability when saturated. The weathered upper portion of the shallow bedrock is anticipated to exhibit a higher permeability probably due to a greater fracture density, and weathering. At greater depth, the permeability of the bedrock will be controlled by the size and number of fractures and/or solution features encountered.

(C)(3)(D)(II) SITE GEOMORPHOLOGY DESCRIPTION

The local geomorphology at the proposed sanitary landfill facility including surface water bodies or topographic features that may influence the ground water flow in the uppermost aquifer system or any overlying significant zones of saturation.

The site lies in the unglaciated portion of Ohio and is part of the Appalachian Plateau. In the relatively recent geological past, this part of Ohio was reduced, topographically, to a nearly level plain. Over a period of time, the plan has been dissected by a system of gullies and streams. At present, the deepest stream valleys in the vicinity of the site lie about 150 feet below the hill tops.

The site lies on a high plateau immediately north of a water drainage divide between Yellow Creek to the north and Cross Creek to the South. These creeks are tributaries of the Ohio River, which lies approximately 15 miles east of the site. The streams and creeks discharging from the site flow into Goose Creek which in turn flows into Yellow Creek. Goose Creek originates approximately 700 feet east-southeast of the northeast corner of the existing landfill and flows generally north-northwest. The point where it discharges into Yellow Creek is approximately 2.5 miles north of the site. Drainage from the proposed expansion area, south of the existing landfill, enters North Branch Cross Creek via several unnamed tributaries approximately 2 miles south of the site. North Branch Cross Creek in turn flows into Cross Creek.

The majority of the site is located in former strip mine operations, portions of which have been reclaimed. The areas which have been reclaimed have been graded so that surface water drains into existing streams and are effectively drained in this manner with only minor evidence of ponding. The unreclaimed areas tend to have moderate to highly irregular surface topography. A near-vertical highwall is located along the western side of the proposed expansion area. This highwall has a pond at the base. Additionally, there are pit mines which have filled with water located within the southwestern portion of the proposed expansion area. Depending on the overall dip of the bedrock surface beneath the strip or pit mined pond, these surface water impoundments act as discharge and recharge points for the mine spoil and shallow bedrock units and influence groundwater flow as discussed below.

(C)(3)(D)(III) SITE STRUCTURAL GEOLOGY

Any local structural geology features under the proposed sanitary landfill facility that may influence the ground water flow in the uppermost aquifer system or any overlying significant zones of saturation.

The presence of the "syncline" is noted on the structure contour maps of the Pittsburgh (#8) Coal (Slucher, 1996) and the Ames limestone (Swinford, 1997) in the region. This "syncline" shaped structure is present in the area, but does not meet the definition of a syncline, which implies a compressional force acted on the area after the deposition of the Pennsylvanian rock strata. Rather the "syncline" shaped structure is the result of differential compaction of the sediment during and post deposition. ~~As evidenced by previous investigations, the structure does influence the groundwater flow direction in the bedrock at the site and it is likely that the structure influences the bedrock groundwater flow direction on a regional level as well.~~ The axis of this "syncline" shaped structure, which crosses the site, dips generally southwest at approximately 30 feet per mile (0.6 percent). Geologic cross sections included in the HSIR indicate that the base of the Connellsville and Morgantown units do not exhibit a consistent, site-wide dip direction. Due to the relatively low regional dip and the variable nature of the UAS structure based on the HSIR borings, it appears that geologic structure is not creating a significant influence on groundwater flow in the UAS. However, in valley areas where the UAS outcrops/subcrops it is expect that topographically-controlled groundwater divides exist.

(C)(3)(D)(IV) UPPERMOST AQUIFER SYSTEM

The uppermost aquifer system and all significant zones of saturation above the uppermost aquifer system. This description shall include the depth to, and lateral and vertical extent of, the uppermost aquifer system and all significant zones of saturation above the uppermost aquifer system.

As required, this description shall include the depth to, and the lateral and vertical extent of the uppermost aquifer system and all significant zones of saturation above the uppermost aquifer. The designations of the water-producing zones were established during the original landfill permitting process (BBC&M 1993), and further defined as part of the investigation for the expansion area. The designations of the water-producing zones utilized the now retired Ohio EPA Guidance's for aquifer systems and significant zones of saturation (SZS): DDAGW-02-05-100 (Ohio EPA, July 27, 1997) and GD0303.110 (Ohio EPA, August 5, 1991), respectively. Per those guidance documents, an aquifer system is one or more mappable geologic unit or formation that is wholly or partly saturated with water and are able to store, transmit and yield significant amounts of water to wells or springs. An SZS is a saturated hydrogeologic unit that possesses certain hydrologic properties that allow it to transmit groundwater at a faster rate than surrounding units away from the limits of waste placement. These zones do not have to be capable of yielding a significant amount of water to a well or spring.

The Ohio EPA guidance states that a zone is an aquifer system if it yields a "significant amount of water". What constitutes a significant amount in the Ohio EPA guidance is a yield greater than 0.1 gpm, except for the case when the yield is between 0.1 and 2.6 gpm (2-inch well) and less than 50% of the yield of wells in another zone of saturation beneath the property and is a likely source of potable water within one mile of the facility (i.e. the regional aquifer).

A program of drilling, subsurface sampling and coring, and well installation and testing was undertaken to collect the data necessary to characterize the subsurface stratigraphy, define the UAS and any encountered SZSs, and define the rate and direction of groundwater flow. The drilling locations for the hydrogeologic investigation are shown on Drawing 3D. The results of the drilling investigation identified four zones requiring groundwater classification; as such CEC has identified them as follows: Mine Spoil SZS, Limestone/Shallow Bedrock SZS and UAS (where saturated), Bellaire/Summerfield SZS, and the Connellsville/Morgantown UAS.

The previous hydrogeologic investigation for the existing permitted landfill to the north designated the Connellsville/Morgantown units as the UAS. The Connellsville/Morgantown unit is present beneath the entire proposed expansion area and will remain the UAS at the site. Additionally, some piezometers installed within the Limestone/Shallow Bedrock unit have been identified to yield a significant amount of water (>2.6 gpm); therefore, portions of the Limestone/Shallow Bedrock unit have been identified as a UAS. These higher yield Limestone/Shallow Bedrock piezometers are limited to the central portion of the expansion area and are not mappable across the entire expansion area. The top of UAS contour map, Drawing 3F, has been drawn to include the approximate horizontal and vertical limits of the isolated, higher yield shallow groundwater zone which will be removed during landfill construction. Based on additional limestone yield testing at piezometers P-13L, P-14L, and P-15, which were install in June and July, 2012, the limits of the higher yield limestone has been revised by contouring the average yield of all limestone piezometers, as shown on Drawing 3F-1 Limestone/Shallow Bedrock Average Yield Contours, to determine where the yield contours exceed 2.6 gpm, which is the adjusted sustained yield criteria for determination of a UAS. Once landfill construction removes this high yield Limestone/Shallow Bedrock zone, the deeper Connellsville/Morgantown unit will remain the UAS.

The unconsolidated Mine Spoil and consolidated (Limestone/Shallow Bedrock and Bellaire/Summerfield) units overlying the Connellsville/Morgantown units have been classified as a SZS. As noted above, some isolated portions of the Limestone/Shallow Bedrock unit have been identified as a UAS. Where present, each unit could be called a geologic unit, and each unit is wholly or partly saturated. In order to

determine which water-bearing zone or zones may qualify as an aquifer, each zone was evaluated with respect to its ability to "yield significant amounts of water" and be mappable beneath the site.

For piezometers and wells which produced an adequate flow rate to support pumping, the maximum flow rate was determined for each piezometer by conducting a modified step pumping test. The piezometer or well was pumped with a Grundfos Redi-Flo electric submersible pump for approximately two hours to determine the maximum flow rate. The maximum flow rate is defined as the flow rate noted at the maximum drawdown level. The maximum drawdown level is defined as the water level 1-3 feet above the pump intake. Specific piezometer and well yield date is summarized on Table C3-9 and discussed in detail below for each saturated zone.

Mine Spoil Significant Zone of Saturation

This hydrostratigraphic interval encompasses the unconsolidated deposits above bedrock and includes unconsolidated residual soil deposits which were not affected by strip mining operations. The vast majority of the proposed expansion area was extensively strip mined. Therefore, these unconsolidated soil units have been combined as the Mine Spoil SZS. The unconsolidated mine spoil deposits extend from ground surface down to the top of the bedrock. The unconsolidated deposits around the proposed expansion area vary widely due to the inconsistent nature of the Mine Spoil. The unit ranges from fat clays, lean clays with sand, to clayey gravel with sand. For a complete list of USCS classifications, refer to the Laboratory Test Results Summary, Table C3-3 and the boring logs included in Appendix C3-C. Perched groundwater was encountered within the Mine Spoil unit in ~~5~~6 of the 26 unconsolidated drilling locations, prompting the installation of piezometers P-1A, P-2A, P-3A, P-5A, P-7A, and P-8A.

Based on the 26 soil borings and numerous test pits within the mine spoil and residual soil, there are very few sporadic and isolated zones of saturation. Additionally, the mine spoil is only located in areas of the proposed expansion where strip mining occurred. The proposed landfill design will remove the majority of the mine spoil overburden, except where it will remain beneath the perimeter landfill berm. As such, the lack of potential saturation and aerial extent or mappability supports the conclusion that the mine spoil should remain a SZS. Potentiometric surface maps have been prepared for this unit, which are included as Drawings 3G and 3K. These maps have been drawn using available data to reflect the localized groundwater flow influenced by surface water bodies and mine cuts that drastically impact topographic relief.

Yield testing was conducted on newly installed Mine Spoil SZS piezometers P-1A, P-2A, P-3A, P-5A, P-7A, and P-8A. Due to a limited water column during yield testing efforts, no tests were conducted on Mine Spoil piezometers B-1A, B-2A, B-7A, B-401A, and B-402A. Piezometers P-1A, P-3A, P-5A, P-7A, and P-8A were bailed dry numerous times and would not support a submersible pump. The average yield of these piezometers was calculated by dividing the total time elapsed by the gallons removed as noted during the piezometer development. The yields were calculated at P-1A (0.07 gpm), P-3A (0.13 gpm), P-5A (0.08 gpm), P-7A (0.22 gpm), and P-8A (0.17 gpm). Piezometer P-2A exhibited relatively stable drawdowns during pumping; therefore, the maximum yield was determined to be 0.75 gpm. Pump testing forms are included as Appendix C3-F and results summarized on Table C3-9. The average of the yield data collected for the Mine Spoil SZS was 0.24 gpm.

The results of the yield testing of the Mine Spoil SZS are summarized in the table below. Additionally, the table depicts yields of the Mine Spoil piezometers compared to the yield of the Connellsville/Morgantown UAS in regards to the aquifer designation criteria discussed above and as noted in DDAGW-02-05-100 (Ohio EPA, July 29, 1997). Based on the discontinuous nature of the saturated portions of the Mine Spoil unit and the low yield data evaluation provided below, the Mine Spoil unit has been designated as a SZS beneath the proposed expansion.

Piezometer ID	Hydraulic Connectivity (cm/sec)	Average Yield (gpm)	Does Well Yield Greater Than 2.6 gpm[2]? (yes/no)	Yield Greater Than 50% of the Regional Aquifer~~2.26gpm~~[3]? (yes/no)
P-1A	Not Tested[1]	0.07	No	No
P-2A	1.09×10^{-2}	0.75	No	No
P-3A	7.71×10^{-5}	0.13	No	No
P-5A	Not Tested[1]	0.08	No	No
P-7A	5.89×10^{-5}	0.22	No	No
P-8A	Not Tested[1]	0.17	No	No
Average	3.68×10^{-3}	0.24	No	No

Notes:
1 = Not Tested due to limited water column in piezometer during yield testing effort.
2 = Per Ohio EPA guidance, an aquifer is defined as a well that yields greater than 3gpm (4-inch well) or 2.6gpm (2-inch well).
3 = Per Ohio EPA guidance, an aquifer is defined as a well that yields greater than 50% of yield of wells in another zone of saturation beneath the property. The average regional aquifer yield is *9.0*~~14.21~~ gpm.

50% of the regional aquifer is *4.5*~~7.11~~ gpm. ~~The 2.26 gpm represents the average yield of the Connellsville/Morgantown UAS.~~

Limestone / Shallow Bedrock Uppermost Aquifer System and Signification Zone of Saturation

This interval includes the consolidated units of the most shallow bedrock deposits encountered below the Mine Spoil unit. During the drilling program, groundwater was intermittently encountered within the upper 10 to 15 feet of the bedrock, which include portions of the Upper Pittsburgh Limestone. The limestone was encountered at varying thicknesses throughout the shallow bedrock and is not mappable across the expansion area. The vertical extent of this unit is considered to be the top of bedrock to approximately 10 to 15 feet below the top of bedrock. This interval has been determined based on the intermittent saturation found within the shallow bedrock. The Limestone/Shallow Bedrock unit consists of limestone, siltstone, and shale. The boring logs included in Appendix C3-C have detailed descriptions of the varying rock types encountered within this interval. Groundwater was encountered within 8 of the 10 consolidated drilling locations, prompting the installation of piezometers P-1L, P-2L, P-3L, P-4L, P-5L, P-6L, P-10L, and P-11L. The shallow bedrock beneath the mine spoil was not found to be saturated at drilling locations P-9 or P-12. Additionally, rock drilling was not conducted at piezometer locations P-7 and P-8; therefore, no shallow bedrock piezometers could be installed. However, mine spoil piezometers P-7A and P-8A were installed at these locations. Potentiometric surface maps have been prepared for this unit, which are included as Drawings 3H and 3L. These maps have been drawn using available data to reflect the localized groundwater flow and the influence of the surface water bodies, which will be removed during the future landfill expansion.

Yield testing was conducted on Limestone / Shallow Bedrock unit piezometers P-1L, P-2L, P-3L, P-4L, P-5L, P-6L, P-10L, P-11L, and monitoring well B-402S. Piezometers P-1L, P-5L, P-6L, and P-11L were bailed dry numerous times and would not yield sufficient groundwater to use a submersible pump. The average yield of these piezometers was calculated by dividing the total time elapsed by the gallons removed as noted during the piezometer development. The yields were calculated at P-1L (0.11 gpm), P-5L (0.15 gpm), P-6L (0.16 gpm), and P-11L (0.09 gpm). Piezometers P-2L, P-3L, and well B-402A exhibited relatively stable drawdowns during pumping; therefore, the maximum yield for these piezometers was determined 3.75 gpm, 0.65 gpm, and 1.65 gpm, respectively. The maximum flow rates noted in piezometers P-4L (5.0 gpm) and P-10L (4.5 gpm) were limited by the submersible pump. Based on the lack of drawdown noted during the pumping, the piezometers could potentially yield greater amount of water than 4.5 to 5.0 gpm. Pump testing forms are included as Appendix C3-F and results summarized on Table C3-9. The average of the yield data collected for the Limestone / Shallow Bedrock unit

was 1.78 gpm. As noted throughout this document, the higher yield piezometers have been identified as UAS and will be excavated during landfill construction.

Aquifer testing conducted on the Limestone / Shallow Bedrock unit is summarized in the table below. The table depicts yields of the Limestone/Shallow Bedrock piezometers compared to the yield of the Connellsville/Morgantown UAS in regards to the aquifer designation criteria discussed above and as noted in DDAGW-02-05-100 (Ohio EPA, July 29, 1997).

Piezometer ID	Hydraulic Connectivity (cm/sec)	Average Yield (gpm)	Does Well Yield Greater Than 2.6gpm[2]? (yes/no)	Yield Greater Than 50% of the Regional Aquifer~~2.26gpm~~[3]? (yes/no)
P-1L	Not Tested[1]	0.11	No	No
P-2L	**$2.23x10^{-3}$**	**3.75**	**Yes**	~~Yes~~No
P-3L	$1.83x10^{-4}$	0.65	No	No
P-4L	**$2.10x10^{-2}$**	**5.00**	**Yes**	~~Yes~~No*Yes*
P-5L	$1.54x10^{-4}$	0.15	No	No
P-6L	$3.07x10^{-5}$	0.16	No	No
P-10L	**$4.80x10^{-3}$**	**4.50**	**Yes**	~~Yes~~No
P-11L	Not Tested[1]	0.09	No	No
B-402A	**Not Tested[1]**	**1.65**	**No**	~~Yes~~No
Average	$4.73x10^{-3}$	1.78	No	~~Yes~~No

Notes:
1 = Not Tested due to limited water column in piezometer during yield testing effort.
2 = Per Ohio EPA guidance, an aquifer is defined as a well that yields greater than 3gpm (4-inch well) or 2.6gpm (2-inch well).
3 = Per Ohio EPA guidance, an aquifer is defined as a well that yields greater than 50% of yield of wells in another zone of saturation beneath the property. The average regional aquifer yield is *9.0*~~14.21~~ gpm, 50% of the regional aquifer is *4.5*~~7.11~~ gpm. ~~The 2.26 gpm represents the average yield of the Connellsville/Morgantown UAS.~~

Based on the above evaluation of the yield data collected, piezometers P-2L, P-4L, and P-10L~~ and monitoring well B-402A~~ yield a "significant" amount of water in regards to the definition of an aquifer. Piezometers P-4L and P-10L~~ and well B-402A~~ are located in the same general vicinity just south of the existing permitted limits of waste. Additionally, piezometer P-2L is located approximately 100 feet from a surface water body, which is contributing to the noted yield at P-2L. As documented in the engineering

section of this PTI and noted on the geologic cross-sections, this higher producing water bearing unit will be removed during the proposed landfill construction. The surface water body contributing to the yield noted at P-2L will also be removed. The removal of the Limestone/Shallow Bedrock unit will eliminate the groundwater noted within the vicinity; therefore, the unit where significant yields were encountered is considered a UAS that will be removed. Once this shallow unit is removed during landfill construction, the deeper Connellsville/Morgantown unit will remain the UAS for monitoring.

Additionally, Side Hill Aggregate Underdrain System (SHAUDS-3) is partially constructed along the southwestern section of the permitted limits of waste and will be extended during the construction of Phase 7. It is anticipated that SHAUDS-3 will likely began to dewater the Limestone/Shallow Bedrock in the vicinity prior to the proposed landfill expansion construction.

Bellaire / Summerfield Signification Zone of Saturation

This interval includes the consolidated units of the Bellaire/Summerfield deposits encountered below the Limestone/Shallow Bedrock unit. During the drilling program, groundwater was encountered within this unit to a limited extent. The unit was encountered beneath the entire expansion area, however it is not present beneath the northwestern portion of the permitted facility, therefore is not mappable across the entire facility. The vertical extent of this unit is considered to be the base of the Limestone/Shallow Bedrock unit (i.e. 10-15 feet into bedrock) to the top of the Connellsville/Morgantown UAS. The Bellaire/Summerfield unit consists of interbedded layers of limestone, siltstone, and shale. The boring logs included in Appendix C3-C have detailed descriptions of the varying rock types encountered within this interval. Groundwater was encountered within this unit at all drilling locations, prompting the installation of piezometers P-1S, P-2S, P-3S, P-5S, P-6S, P-9S, P-10S, and P-12S. It should be noted that the existing detection monitoring wells B-402S, B-405S, B-407S, and B-409S are often dry during semi-annual groundwater sampling events. Potentiometric surface maps have been prepared for this unit, which are included as Drawings 3I and 3M.

Yield testing was conducted on Bellaire / Summerfield SZS piezometers P-1S, P-2S, P-3S, P-5S, P-6S, P-9S, and P-10S. Piezometers P-1S, P-5S, and P-10S were bailed dry numerous times and would not yield sufficient groundwater to use a submersible pump. The average yield of these piezometers was calculated by dividing the total time elapsed by the gallons removed as noted during the piezometer development. The yields were calculated at P-1S (0.02 gpm), P-5S (0.13 gpm), and P-10S (0.22 gpm). Piezometers P-2S, P-3S, P-6S, and P-9S were yield tested with a submersible pump. Yields noted for piezometers P-3S (0.47 gpm), P-6S (0.45 gpm), P-9S (0.32

gpm) were determined while the piezometer was still showing a slight drawdown which suggests that the piezometer may not yield the respective gpm without going dry. Piezometer P-2S exhibited a relatively stable drawdown during pumping; therefore, the maximum yield for the piezometer was determined to be 0.75 gpm. Pump testing forms are included as Appendix C3-F and results summarized on Table C3-9. The average of the yield data collected for the Bellaire / Summerfield SZS was 0.34 gpm.

Aquifer testing conducted on the Bellaire/Summerfield piezometers P-1S, P-2S, P-3S, P-5S, P-6S, P-9S, and P-10S ~~and~~ is summarized in the table below. The table depicts yields of the piezometers compared to the yield of the Connellsville/Morgantown UAS in regards to the aquifer designation criteria discussed above and as noted in DDAGW-02-05-100 (Ohio EPA, July 27, 1997). Based on the yield data evaluation provided below, ~~and the fact that the unit does not exist beneath the entire facility,~~ the Bellaire/Summerfield unit has been designated as an SZS for the facility.

Piezometer ID	Hydraulic Connectivity (cm/sec)	Average Yield (gpm)	Does Well Yield Greater Than 2.6gpm[2]? (yes/no)	Yield Greater Than 50% of the Regional Aquifer ~~2.26gpm~~[3]? (yes/no)
P-1S	Not Tested[1]	0.02	No	No
P-2S	$3.74x10^{-4}$	0.75	No	No
P-3S	$5.84x10^{-4}$	0.47	No	No
P-5S	Not Tested[1]	0.13	No	No
P-6S	$1.97x10^{-5}$	0.45	No	No
P-9S	$3.63x10^{-5}$	0.32	No	No
P-10S	$2.16x10^{-5}$	0.22	No	No
Average	$2.07x10^{-4}$	0.34	No	No

Notes:
1 = Not Test due to limited water column in piezometer during yield testing effort.
2 = Per Ohio EPA guidance, an aquifer is defined as a well that yields greater than 3gpm (4-inch well) or 2.6gpm (2-inch well).
3 = Per Ohio EPA guidance, an aquifer is defined as a well that yields greater than 50% of yield of wells in another zone of saturation beneath the property. The average regional aquifer yield is *9.0*~~14.21~~ gpm, 50% of the regional aquifer is *4.5*~~7.11~~ gpm. ~~The 2.26 gpm represents the average yield of the Connellsville/Morgantown UAS.~~

Connellsville/Morgantown Uppermost Aquifer System

This interval includes the consolidated units of the Connellsville/Morgantown deposits encountered below the Bellaire/Summerfield unit. This interval is laterally continuous and was encountered in all of the deep boring locations. The vertical extent of the unit is considered to be the contact of the Bellaire/Summerfield unit to the top of the Birmingham or Elk Lick unit (where present). The Connellsville/Morgantown unit consists of mostly sandstone with interbedded layers of siltstone and shale with a few occurrences of thin coal and limestone seams. The boring logs included in Appendix C3-C have detailed descriptions of the rock types encountered within this interval. Groundwater was encountered within this unit at all proposed drilling locations, prompting the installation of piezometers P-1, P-5, P-9, and P-12. Borings and piezometers installed during previously site investigations were used to supplement this investigation. Potentiometric surface maps have been prepared for this unit, which are included as Drawings 3J and 3N.

Pump Testing was conducted on UAS piezometers P-1, P-5, P-9, and B-12. A Grundfos Redi-Flo electric submersible pump was installed to within 1-2 feet of the bottom of the piezometer. The piezometer was pumped at the maximum sustainable rate or the maximum rate of the submersible pump. Piezometer P-1 sustained a rate of 0.53 gpm, while piezometers P-5, P-9, and B-12 ranged from 2.5 to 3 gpm. The maximum flow rates noted in piezometers P-5, P-9, and B-12 were limited by the submersible pump. Based on the lack of drawdown noted during the pumping, the piezometers could potentially yield a far greater amount of water than 3 gpm. Pump testing forms are included as Appendix C3-F and results summarized on Table C3-9. The average of the yield data collected for the UAS was calculated to be 2.26 gpm.

Aquifer testing conducted on the Connellsville/Morgantown piezometers P-1, P-5, P-9, and B-12 and is summarized in the table below. Groundwater flow in the Connellsville/Morgantown unit is fracture dominated and observed yields during drilling exceed those of the shallower SZSs. Due to its geographic extent (mappability), yield observed, and source of potable water in the vicinity, the Connellsville/Morgantown unit is designated as the UAS. Although yields of a few Limestone/Shallow Bedrock piezometers were comparable to the Connellsville/Morgantown unit, the Limestone/Shallow Bedrock unit will be removed during landfill construction (as previously discussed).

Piezometer ID	Hydraulic Connectivity (cm/sec)	Average Yield (gpm)	Does Well Yield Greater Than 2.6gpm[2]? (yes/no)	Yield Greater Than 50% of the Regional Aquifer~~2.26gpm~~[3]? (yes/no)
P-1	$4.44x10^{-5}$	0.53	No	~~Not Applicable~~No
P-5	**$1.98x10^{-3}$**	**3.0**	**Yes**	~~Not Applicable~~No
P-9	**$2.62x10^{-3}$**	**3.0**	**Yes**	~~Not Applicable~~No
B-12	$2.97x10^{-3}$	2.5	No	~~Not Applicable~~No
Average	$1.90x10^{-3}$	2.26	No	~~Not Applicable~~No

Notes:
1 = Not Testing due to limited water column in piezometer during yield testing effort.
2 = Per Ohio EPA guidance, an aquifer is defined as a well that yields greater than 3gpm (4-inch well) or 2.6gpm (2-inch well).
3 = Per Ohio EPA guidance, an aquifer is defined as a well that yields greater than 50% of yield of wells in another zone of saturation beneath the property. The average regional aquifer yield is *9.0*~~14.21~~ gpm, 50% of the regional aquifer is *4.5*~~7.11~~ gpm. ~~Therefore, the 2.26 gpm represents the average yield of the Connellsville/Morgantown UAS.~~

(C)(3)(d)(iv)(*a*) Temporal fluctuations in ground water levels over a period of time to determine the seasonal effects on ground water flow directions.

Site-wide groundwater level measurement events, including the existing monitoring wells and expansion investigation wells, were conducted in October 2010, December 2010, ~~and~~ March 2011, November 2011, May 2012, and December 2012. The water levels are summarized on Table C3-6. Potentiometric maps for the Mine Spoil SZS, Limestone/Shallow Bedrock SZS/UAS, Bellaire/Summerfield SZS, and Connellsville/Morgantown UAS units from the December 2010, ~~and~~ March 2011 and December 2013 events are shown in Drawings 3G through 3R~~3N~~.

The groundwater levels are consistent over the period during which measurements were evaluated and it can be concluded that the groundwater flow regime in each zone does not change seasonally. In almost all cases, the groundwater levels in each well or piezometer increased or decreased consistently with each other. It is significant to note that Ohio experienced abnormally high precipitation amounts in March 2011 which accounts for a spike in water levels during that time. Groundwater elevations have since settled and consistent fluctuations have been observed during recent measurements. Inconsistencies, especially in the

shallower zones (Mine Spoil SZS and Limestone/Shallow Bedrock SZS) can generally be accounted for by precipitation and ongoing construction and de-watering activities toward the southern portion of the existing facility due to the underdrain systems.

(C)(3)(d)(iv)(*b*) An interpretation of the ground water flow system, including hydraulic conductivity, rate of flow, direction of flow, vertical and lateral components of flow, and interconnections between and within the uppermost aquifer system and any significant zones of saturation above the uppermost aquifer system. This interpretation shall be described in both narrative and map form.

Connellsville/Morgantown Uppermost Aquifer System

Drawings 3J, ~~and~~ 3N, and 3R present the potentiometric surface maps for the Connellsville/Morgantown aquifer based on measurements performed on December 6, 2010, ~~and~~ March 28, 2011 and December 10, 2012, respectively. The direction of groundwater flow within the Connellsville/Morgantown aquifer is consistent with historic flow patterns for the northern permitted facility. In general, the flow under the northern facility is from the south to northeast and northwest along the ridge on which the facility is located. The groundwater flow under the majority of the southern expansion area also flows toward the north; however, a divide is present in the southwestern portion of the expansion area. As noted on Connellsville/Morgantown potentiometric maps~~Drawing 3N~~, flow turns toward the south near piezometer B-12 toward the southwestern valley structure~~where it follows a large valley~~.

Two existing piezometers, B-7B and B-403 located south-southeast of the expansion area, exhibit water levels that are higher than surrounding piezometers and, thus, a potentiometric high is mapped in this vicinity of the UAS. As stated in the HSIR, the UAS dips to the north in the vicinity of these two piezometers. The observed potentiometric high at these two piezometers may be due to the structural dip.

It should be noted that along the eastern side of the expansion area, groundwater flows toward the north, which is opposite the valley. In general, this groundwater flow is caused by the northerly dip of the Connellsville/Morgantown unit in the vicinity.

Geologic cross sections included in the HSIR indicate that the base of the Connellsville and Morgantown units do not exhibit a consistent, site-wide dip direction. The variable nature of the UAS structure appears to influence groundwater flow directions in portions of the UAS. Also, in valley areas where the UAS outcrops/subcrops, it is expect that topographically-controlled groundwater divides exist. The

approximate location of the Connellsville/Morgantown subcrop has been added to Drawing 3R - Connellsville–Morgantown Potentiometric Map December 10, 2012 that is included in the revised PTI Application (HSIR). The UAS outcrop/subcrop, based on surface elevations in the southern valleys, is expected to be found more than 2,000 feet south of piezometer B-7B and is beyond the map area in Drawing 3R. Topographic influences that create a groundwater divide and discharge boundary this far south of the expansion apparently does not override the structural influence in the vicinity of B-7B and B-403. Apex believes the proposed UAS monitoring well network and designation of upgradient and downgradient wells is accurate based on existing information. As proposed monitoring wells for the expansion area are completed and water levels recorded, another evaluation of the UAS flow lines and adequacy of the monitoring well network will be completed and reported to Ohio EPA.

As noted on the potentiometric surface maps for March 28, 2011 (Drawing 3N), groundwater elevations beneath the western side of the existing landfill dropped 16.67 vertical feet over approximately 1880 lateral feet between B-414 and B-411, producing a hydraulic gradient of approximately 0.0089. Groundwater elevations beneath the eastern side of the existing landfill dropped 7.51 vertical feet over approximately 1810 lateral feet between B-405 and B-408, producing a hydraulic gradient of approximately 0.0041. Groundwater elevations beneath the eastern side of the proposed expansion area dropped 12.2 vertical feet over approximately 1590 lateral feet between B-7B and B-11, producing a hydraulic gradient of approximately 0.0077. Groundwater elevations beneath the west central portion of the proposed expansion area dropped 5.47 vertical feet over approximately 1130 lateral feet between B-401 and P-5, producing a hydraulic gradient of approximately 0.0048. The average of these hydraulic gradients is 0.0064.

The average linear groundwater flow rate in the Connellsville/Morgantown UAS is determined using the average hydraulic gradient of 0.0064, the geometric mean of the hydraulic conductivity testing of 9.61 x 10-4 cm/sec, as determined from the slug testing program, and an effective porosity of 35% (TGM 2006) in the following equation.

$$v = K\, i / ne$$

where: v = groundwater flow rate
K = hydraulic conductivity
i = hydraulic gradient
ne = effective porosity

The calculated groundwater flow rate for the UAS is thus 0.05 ft/day, or 18.3 ft/year. A spreadsheet for the groundwater flow rate is included as Table C3-7.

Based on the lack of piezometers installed within the lower Birmingham unit, it is assumed that the vertical component of flow within the Connellsville/Morgantown UAS is downward, which is consistent with the units found above.

Bellaire / Summerfield Signification Zone of Saturation

The Bellaire/Summerfield units have been classified as a SZS for the proposed expansion area and have previously been identified as a SZS for the existing permitted facility. This zone is only present beneath approximately two-thirds of the existing permitted facility and is present beneath the entire expansion area. Drawings 3I and 3M present the potentiometric surface map for the Bellaire/Summerfield unit based on measurements collected on December 6, 2010 and March 28, 2011, respectively. Groundwater flow within the unit generally follows topography and the dip of the bedrock units. Flow for the northern permitted facility is toward the east following a valley which was previously filled for construction of the landfill and also flows toward the south along the southeastern permitted limits of waste. Flow for the southern expansion area flows toward the southeast from a potentiometric high at piezometer P-12S and also exhibits a southerly flow following the valleys along the southern proposed waste limits. This flow direction may change over time as landfill construction activities develop in the southern portion of the permitted landfill footprint and additional underdrain systems are installed.

Hydraulic gradients for the Bellaire/Summerfield SZS have been calculated for the eastern, western, and southwestern portions of the expansion area. Gradients were not calculated for the northern permitted facility due to the unit not being present and subsequent lack of potentiometric data. As noted on the potentiometric surface maps for March 28, 2011 (Drawing 3M), groundwater elevations beneath the eastern side of the expansion area dropped 45.43 vertical feet over approximately 957 lateral feet between B-11S and B-403S, producing a hydraulic gradient of approximately 0.047. Groundwater elevations beneath the western side of the expansion area dropped 46.52 vertical feet over approximately 1270 lateral feet between P-12S and P-2S, producing a hydraulic gradient of approximately 0.037. Groundwater elevations beneath the southwestern side of the proposed expansion area dropped 22.74 vertical feet over approximately 720 lateral feet between P-2S and P-3S, producing a hydraulic gradient of approximately 0.032. The average of these hydraulic gradients is 0.039.

The average linear groundwater flow rate in the Bellaire/Summerfield SZS is determined using the average hydraulic gradient of 0.039, the geometric mean of the hydraulic conductivity testing of 3.50 x 10^{-5} cm/sec, as determined from the slug testing program, and an effective porosity of 6% (TGM 2006), using the equation listed above. The calculated groundwater flow rate for the Bellaire/Summerfield SZS is thus 0.065 ft/day, or 23.5 ft/year. A spreadsheet for the groundwater flow rate is included as Table C3-7.

Based on the potentiometric data collected during the hydrogeologic investigation and as depicted on the geologic cross-sections, the vertical component of flow for the Bellaire/Summerfield SZS is downward toward the Connellsville/Morgantown UAS.

Limestone / Shallow Bedrock SZS and UAS (to be removed)

The Limestone/Shallow Bedrock unit has been classified as a SZS and UAS where the unit yields a significant amount of groundwater and will be removed. This zone is present beneath the entire expansion area, however, is not present or has been removed during landfill construction from beneath the existing permitted facility. Although this unit is present beneath the entire expansion area because it has been identified as the first 10 to 15 feet of bedrock, it was only found to be saturated and yield a significant amount of water in the south central portion of the expansion area. Drawings 3H and 3L presents the potentiometric surface map for the Limestone/Shallow Bedrock unit based on measurements collected on December 6, 2010 and March 28, 2011, respectively. Groundwater flow within the unit generally follows topography and the top of bedrock surface and is toward the south. As previously discussed, portions of this unit which have been identified as UAS and yield a significant amount of water will be removed during landfill construction. The portion of this unit to be removed is identified on geologic cross-sections B-B (Drawing 5C) and D-D' (Drawing 5E) and plan Drawing 3E-1.

Hydraulic gradients have been calculated for the unit utilizing piezometers located within the central portion of the area identified to yield the greatest amount of groundwater. As noted on the potentiometric surface maps for March 28, 2011 (Drawing 3L), groundwater elevations beneath the central portion of this area dropped 21.07 vertical feet over approximately 1230 lateral feet between P-10L and P-5L, producing a hydraulic gradient of approximately 0.017. Groundwater elevations within the eastern portion of the area dropped 10.18 vertical feet over approximately 1080 lateral feet between P-6L and P-5L, producing a hydraulic gradient of approximately 0.009. Groundwater elevations within the western portion of the area dropped 12.47 vertical feet over approximately 1310 lateral feet between P-3L and

P-5L, producing a hydraulic gradient of approximately 0.010. The average of these hydraulic gradients is 0.012.

The average linear groundwater flow rate in the Limestone/Shallow Bedrock unit is determined using the average hydraulic gradient of 0.012, the geometric mean of the hydraulic conductivity testing of 7.61 x 10^{-4} cm/sec, as determined from the slug testing program, and an effective porosity of 30% (TGM 2006), using the equation listed above. The calculated groundwater flow rate for the Limestone/Shallow Bedrock is thus 0.086 ft/day, or 31.5 ft/year. A spreadsheet for the groundwater flow rate is included as Table C3-7.

Based on the potentiometric data collected during the hydrogeologic investigation and as depicted on the geologic cross-sections, the vertical component of flow for the Limestone/Shallow Bedrock unit is downward toward the Bellaire/Summerfield SZS.

Mine Spoil Significant Zone of Saturation (Unconsolidated)

The Mine Spoil SZS consists of mine spoil and residual soil in unmined areas. The majority of the site consists of mine spoil; therefore, the unconsolidated deposits are referred to as the Mine Spoil SZS. The Mine Spoil SZS is present beneath the entire expansion area, however, is not present or has been removed during landfill construction from beneath the permitted facility. Drawings 3G and 3K present the potentiometric surface map for the Mine Spoil unit based on measurements collected on December 6, 2010 and March 28, 2011, respectively. Groundwater flow within the unit generally follows topography and the top of bedrock surface. Flow in the northwestern portion of the expansion area is to the north/northeast toward the valley. Flow in the eastern portion of the expansion area follows topography and is toward the northeast and south. Flow in the southeastern portion of the expansion area also follows topography and is to the south. It should be noted that the underdrain (SHAUDS-3) is partially installed along the southern permitted limits of waste and has begun to affect groundwater flow within the mine spoil unit. This underdrain directs flow toward the northwest following the existing topography of the valley. Additionally, it is anticipated that landfill construction activities will require the installation of permanent underdrain systems, which will likely alter groundwater flow directions and likely dewater areas of the mine spoil unit.

Hydraulic gradients have been calculated for the unit utilizing piezometers located within the northwestern, eastern, and western portions of the expansion area. As noted on the potentiometric surface map for March 28, 2011 (Drawing 3K), groundwater elevations beneath the northwestern portion of the

expansion area dropped 6.91 vertical feet over approximately 290 lateral feet between P-1A and B-1A, producing a hydraulic gradient of approximately 0.024. Groundwater elevations within the eastern portion of the expansion area dropped 11.16 vertical feet over approximately 1150 lateral feet between P-7A and B-7A, producing a hydraulic gradient of approximately 0.010. Groundwater elevations within the western portion of the area dropped 2.69 vertical feet over approximately 730 lateral feet between P-2A and P-3A, producing a hydraulic gradient of approximately 0.004. The average of these hydraulic gradients is 0.013.

The average linear groundwater flow rate in the Mine Spoil unit is determined using the average hydraulic gradient of 0.013, the geometric mean of the hydraulic conductivity testing of 3.67×10^{-4} cm/sec, as determined from the slug testing program, and an effective porosity of 0.32 (TGM 2006 for Sandy Clay), using the equation listed above. The calculated groundwater flow rate for the Mine Spoil SZS is thus 0.042 ft/day, or 15.4 ft/year. A spreadsheet for the groundwater flow rate is included as Table C3-7.

Based on the potentiometric data collected during the hydrogeologic investigation and as depicted on the geologic cross-sections, the vertical component of flow for the Mine Spoil unit is downward toward the Limestone/Shallow Bedrock unit.

Vertical Component of Flow

Hydraulic relationships of the water-bearing zones in the vicinity of the expansion area exhibit a downward gradient. This downward gradient is noted at piezometers installed with clusters at locations P-1, P-2, P-3, P-5, P-6, and P-9. Groundwater elevations collected on March 28, 2011 have also been depicted on the geologic cross-sections (Drawing 5B through 5G), which also depict this downward gradient.

(C)(3)(d)(iv)(*c*) Identification and characterization of recharge and discharge areas within the boundaries of the proposed sanitary landfill facility. This shall include any relationships of ground water with seeps, springs, streams, and other surface water features.

Generally speaking, a downward vertical gradient exists between each of the unconsolidated and consolidated water-bearing zones down to and including the bedrock UAS. Therefore each water-bearing zone receives recharge from the zone directly above. Principal recharge for the UAS at the site occurs via downward infiltration of surface water and leakage from saturated

consolidated and unconsolidated deposits above the aquifer. Discharge from the UAS is primarily through seeps and springs located near the base of the ridges on which the existing and proposed landfill are located. In valley areas where the bedrock units outcrop/subcrop, it is expect that topographically-controlled groundwater divides exist. Groundwater discharge from the bedrock units is expected to occur along these outcrop/subcrop positions.

Recharge for the Bellaire/Summerfield and Limestone/Shallow Bedrock units is believed to be infiltration of surface water and water contained within the mine spoil. The surface water impoundments noted within the expansion area have a significant influence on the groundwater encountered within the shallow bedrock. A pond gauge (PG-1) was installed within the impoundment nearest shallow bedrock piezometer P-2L and Bellaire/Summerfield piezometer P-2S. When comparing groundwater elevation between PG-1, P-2L, and P-2S, a downward gradient exists, which suggests that the surface water impoundment is recharging the shallow bedrock. Construction activities for the proposed landfill units will remove the surface water impoundments and underdrain systems will be installed to control shallow groundwater. These activities will limit recharge from the top down and alter flow and quality of groundwater over time, as demonstrated at the existing landfill. Discharge from these units occurs as leakage to the underlying Connellsville/Morgantown UAS and seeps down-slope of the recharge areas.

The estimated locations of the combined Bellaire/Summerfield outcrop/subcrop are shown on Drawing 3Q Bellaire–Summerfield Potentiometric Map, December 10, 2012, which depicts both the top and bottom of the outcrop/subcrop positions. The presence of the subcrop positions along the valley side slopes and man-made cuts represent groundwater discharge boundaries and appear to have created several groundwater divides in the Bellaire/Summerfield unit. Flow lines presented on Drawing 3Q emanate from these divides.

Recharge for the unconsolidated mine spoil unit is from precipitation and infiltration of surface water as well as hydraulic connection with surface water impoundments. The surface water impoundments noted within the expansion area have a significant influence on the groundwater encountered within the mine spoil unit. As discussed above, PG-1 and piezometer P-2A exhibit a downward gradient which suggests that the surface water impoundment is recharging the mine spoil unit. As construction progresses and the surface water impoundments are removed, recharge to the mine spoil will be limited over time. Additionally, underdrains will be installed within the unconsolidated unit and will further dewater this shallow zone. Discharge from mine

spoil occurs as leakage to the underlying shallow bedrock and seeps down-slope of the recharge areas following topography.

CEC completed a field reconnaissance on April 23, 2013 to map seeps and springs at the Apex facility. The reconnaissance covered valleys to the south, east and northwest of the facility. Wetlands were observed at the locations shown on the December 10, 2012 potentiometric maps and appeared to be groundwater discharge features. Significant surface water flow was observed in the wetland areas and in the valley channels in the southeast, southwest and northwest valleys. Side-slope seeps/springs were observed to flow only in the southern valleys and were mapped using hand-held GPS instruments. A total of 12 groundwater seeps were identified along the side slopes of these valleys. The seeps are numbered Seep-2 through Seep-12 in the December 10, 2012 potentiometric maps. An error occurred in determining the GPS location of Seep-1, thus, this seep is not included on the drawings.

The mapped seep locations are shown on Drawing 3Q Bellaire – Summerfield Potentiometric Map, December 10, 2012, Drawing 3P Limestone/Shallow Bedrock Potentiometric Map, December 10, 2012, Drawing 3O Mine Spoil Potentiometric Map, December 10, 2012, 3K Mine Spoil Potentiometric Map, March 28, 2011, Drawing 3G Mine Spoil Potentiometric Map, December 6, 2010, and the Drawing 3E Top of Bedrock Map. Table C-10 presents a summary of the seep elevations compared to the top of bedrock elevations. Based on seep elevations compared to potentiometric contours and top of bedrock contours, it appears that the source of the seeps is from the Mine Spoil and/or the Limestone/Shallow Bedrock unit(s). CEC believes the permeability contrast between the Mine Spoil and the competent top of bedrock causes groundwater to daylight as seeps and springs along valley side slopes and in existing drainage swales.

At the operating landfill, underdrains have been constructed in excavations to control shallow groundwater beneath the recompacted soil liner (RSL). The underdrains have been constructed to discharge to valley structures that existed prior to mining at the site. If underdrains are needed for the expansion area, these drains will also daylight into the pre-existing valleys to the south, northwest and east of the expansion area. The need for these underdrains will be made as discussed in Section C7 of the revised PTI Application.

(C)(3)(d)(iv)(*d*) Yield of any significant zones of saturation and of the uppermost aquifer system(s).

Yield of the UAS and SZS are presented in Section (C)(3)(d)(iv).

(C)(3)(d)(*v*) If the applicant chooses, site specific justification that an unconsolidated aquifer system capable of sustaining a yield of one-hundred gallons per minute for a twenty-four-hour period (based on evidence gathered in accordance with paragraph (C)(3)(b) of this rule), is not located beneath the facility.

This section is not applicable. The site investigation and scientific literature provide evidence that the unconsolidated material underlying the area is not capable of producing 100 gallons per minute for a 24 hour period.

(C)(3)(e) GROUND WATER QUALITY

A description and quantification of the ground water quality of the uppermost aquifer system and all significant zones of saturation above the uppermost aquifer system. The description and quantification of the ground water quality shall describe and quantify the rate extent, and concentration of any ground water contamination located under the facility.

In October 2010, CEC sampled the newly installed piezometers within the proposed expansion area for OAC 3745-27-10 Appendix I parameters (1-78) to characterize the groundwater quality. Additionally, existing detection monitoring network wells that are located within the expansion area were sampled during the December 2010 semi-annual monitoring event and the data are presented herein. A summary of the analytical results are provided in Table C3-8.

CEC conducted sampling on newly installed piezometers P-2A, P-2L, P-2S, P-3L, P-4L, P-5, P-5S, P-6S, P-7A, P-9, and P-10L on October 28-29, 2010. Please note that P-4L was erroneously identified as P-4A within the laboratory analytical report provided in Appendix C3-E. On December 8-9, 2010, CEC collected samples from existing detection monitoring network wells B-401, B-401A, B-401S, B-402, B-402A, B-403, and B-403S in conjunction with the second 2010 semi-annual sampling event at the existing permitted facility. Sampling was conducted in accordance with the sampling procedures presented in the facility's Groundwater Detection Monitoring Plan, most recently revised by CEC in October 2009. Information regarding sample collection is shown on the Field Information Forms in Appendix C3-E. After collection, each sample was placed on ice in secure containers and then picked up by courier for delivery to the analytical laboratory. Chains of custody were maintained and are included with the laboratory analytical report (Appendix C3-E). Geochemical Testing of Somerset, Pennsylvania completed the analyses. As summarized on Table C3-8, concentrations for each detected parameter are reported if the level exceeds the laboratory's practical quantitation limit (PQL), otherwise the result is reported as less than the parameter's respective PQL. The PQL is defined as the lowest analyte concentration in a given matrix that the laboratory can consistently determine on a routine basis.

The groundwater data evaluated for this HSI includes samples collected and analyzed from each of the saturated zones present beneath the proposed expansion area. The relative percentages of the major ionic constituents (magnesium, calcium, sodium, potassium, chloride, sulfate, and bicarbonate) detected in the groundwater samples can be used to classify and differentiate waters with respect to the different saturated zones. As such, the ionic composition of the groundwater samples have been compared using Stiff and Piper Diagrams. These Stiff and Piper diagrams are provided as a visual means of evaluating the ionic compositions and are included within Appendix C3-E.

A Stiff Diagram is a graphical representation where the size and shape represent the relative proportion and concentration of the ionic composition of the sample. The larger the area of the polygonal shape; the greater the concentrations of the various ions. The polygonal shape is created from four parallel horizontal axes extending on either side of a vertical zero axis. Cations and anions are plotted on either side of the zero axis in milliequivalents per liter (meg/L). As shown on the Stiff Diagrams, groundwater chemistry of the Mine Spoil and Shallow Bedrock / Limestone units are typically higher in ionic constituents such as calcium, sulfate, and magnesium, while the deeper saturated zones of the Bellaire / Summerfield and Connellsville / Morgantown units have lower concentrations of calcium, sulfate, and magnesium ions. This suggests that the shallower groundwater is influenced by increased mineralization due to mixing and percolation of precipitation through the mine spoil overburden. Deeper groundwater is not subjected to this mineralization and accelerated recharge and has increased residence times within the groundwater flow regime.

One exception to the characterization can be noted at UAS well B-401. Well B-401 is located in an area that produces a significant amount of groundwater within the Shallow Bedrock / Limestone unit. This area also corresponds to the thickest and most saturated portions of the mine spoil which directly overlays the Shallow Bedrock / Limestone unit. The Stiff Diagram for well B-401 plots very similar to Mine Spoil well B-401A and Shallow Bedrock / Limestone piezometer P-10L. This coincidence suggest that UAS well B-401 is likely receiving recharge from the Mine Spoil and Shallow Bedrock / Limestone units such that the groundwater geochemistry of these units are similar.

A Piper (trilinear) Diagram is another visual method of evaluating the cation and anion concentrations. A Piper Diagram was constructed by converting the analytical results of each sample to total milliequivalents per liter (meq/L) and then plotting these results as percentages of their respective totals in two triangles (cation and anion). The cation and anion relative percentages in each triangle are then projected into a quadrilateral polygon that describes water type or hydrochemical facies. The Piper Diagram reinforces the conclusions made during the above analysis of the Stiff Diagrams. It is worth noting that data from several different piezometers installed within the same unit show a scattering of data points across several hydrochemical facies which suggests temporal and spatial variability and groundwater mixing, which is a good justification for using intra-well statistical analyses as proposed in the Groundwater Detection Monitoring plan for the facility.

Volatile organic compounds (VOCs) included as part of the Appendix I parameter list were also analyzed as part of the characterization samples. No VOCs were detected above the laboratory's PQLs.

(C)(3)(f) SUBSURFACE INVESTIGATION

The following information will be used to prepare the site investigation report narrative required in paragraphs (C)(3)(b), (C)(3)(d) and (C)(3)(e) of this rule and the stability analyses required in paragraph (C)(4) of this rule. All submitted information shall be adequate to satisfy the performance standards of paragraphs (C)(3)(a) and (C)(4) of this rule. At a minimum the information shall include the following:

(i) publicly available information collected and used to prepare the site investigation report narrative required in paragraph (C)(3)(b) of this rule and the plan sheets required in paragraph (B)(2) of this rule. For the purposes of this rule, "publicly available Information" means written or published information from public or private sources that is reasonably available to the public, and includes but is not limited to visual surveys from public right-of-ways and public lands of the area surrounding the proposed sanitary landfill facility and/or written or oral surveys of the landowners around the proposed sanitary landfill facility. At a minimum, the publicly available information includes the following:

(a) **All well logs, and, where applicable, the decommissioning records, for public and private water supply wells within one mile of the proposed sanitary landfill facility.**

(C)(3)(f)(i)(*a*) A search of well logs was undertaken to identify both private and public groundwater users located within one mile of the proposed landfill. Well log locations are identified on Drawing 2E, included in the engineering portion of the PTI application, and summarized in Table C3-2 included herein. Copies of the well logs are included in Appendix C3-B.

***(b)* The Ohio Department of Natural Resources Division of Water County Ground Water Resource Maps or other appropriate regional hydrogeological data.**

***(c)* Other publicly available information.**

(C)(3)(f)(i)(*b*) and (*c*) See the Reference Section at the end of this narrative for a listing of the documents used.

(C)(3)(f)(ii) Information collected at the site for each stratigraphic unit from the surface to the bottom of the uppermost aquifer system or to one hundred and fifty feet below the proposed composite liner system, whichever is shallower. The information will be used to prepare the site investigation report narrative required in paragraph (C)(3)(d) of this rule. This information shall be presented on logs appropriate for the subsurface investigatory method used. At a minimum the information shall include the following:

(*a*) Location of the subsurface investigation site (northing and easting location coordinates).

(*b*) Surface elevation surveyed to the nearest tenth of a foot (0.1).

(C)(3)(f)(ii)(*a*) and (*b*) Table C3-1 and the boring logs included in Appendix C3-C summarize the well, piezometer, test pit, and boring information, including the available site coordinates and elevations.

(*c*) Depth interval for each stratigraphic unit.

(*d*) Field descriptions of the consolidated and unconsolidated units. At a minimum the information shall include the following:

***(i)* Textural classification for each unconsolidated stratigraphic unit using the "Unified Soil Classification System."**

***(ii)* Color.**

***(iii)* Moisture content.**

***(iv)* Stratigraphic features such as layering, interbedding, or weathering.**

***(v)* Structural features such as fracturing or jointing.**

***(vi) V*isible accessory minerals such as pyrite, calcite or gypsum.**

***(vii) R*ock type such as limestone, dolomite, coal, shale, siltstone or sandstone.**

(viii) **Thickness.**

(ix) **Variations in texture, saturation, stratigraphy, structure or mineralogy in each stratigraphic unit.**

(*e*) Depth to saturation.

(C)(3)(f)(ii)(*c*), (*d*) and (*e*) The above information is presented in Section (C)(3)(d).

(f) **Hydraulic conductivity, including the following:**

(i) **For saturated unconsolidated stratigraphic units, at least one field measurement of hydraulic conductivity per saturated unconsolidated unit and one additional measurement per saturated unconsolidated unit for each twenty acres.**

(C)(3)(f)(ii)(*f*)(*i*) In-situ hydraulic conductivity testing was conducted on piezometers and wells completed in the ~~consolidated and~~ unconsolidated water-bearing deposits encountered on site. The horizontal hydraulic conductivities were determined by in-situ testing of the piezometer and monitoring wells, including slug, recovery, and pumping tests. The results of this testing are presented in Section (C)(3)(d)(i)(a)(iv) and summarized in Table C3-4. The methodologies are described below. The test data and associated calculations are presented in Appendix C3-F. The horizontal hydraulic conductivities from slug testing ranged from 5.89 x 10-5 to 1.09 x 10-2 centimeters per second (cm/sec) with a geometric mean of 3.67 x 10-4 cm/sec. Lower values were observed in vertical hydraulic conductivities from laboratory testing with values ranging from 7.10 x 10-8 to 3.70 x 10-5 cm/sec, with a geometric mean of 5.60 x 10-6 cm/sec. Laboratory permeability results are presented on Table C3-3. Additionally, packer testing was conducted on piezometers P-1, P-5, and P-9 which is discussed in detail in Section (C)(3)(d)(i)(a)(iv) and summarized on Table C3-5.

(ii) **For unconsolidated stratigraphic units, from which an undisturbed sample can be collected, at least one laboratory measurement of vertical hydraulic conductivity per unconsolidated unit and one additional measurement per unconsolidated unit for each twenty acres.**

(C)(3)(f)(ii)(*f*)(*ii*) A total of nine permeability tests were conducted on the unconsolidated mine spoil and residual soil samples and are presented in Appendix C3-D. The average of the permeability tests performed on the nine samples was 5.60 x 10^{-6} cm/s as summarized in Table C3-3.

***(iii)* For saturated consolidated stratigraphic units, at least one field measurement of hydraulic conductivity per saturated consolidated unit and one additional measurement per saturated consolidated unit for each twenty acres.**

(C)(3)(f)(ii)(*f*)(*iii*) The hydraulic conductivity of ~~the bedrock~~ each consolidated unit was determined using in-situ hydraulic conductivity testing as presented in Section (C)(3)(d)(i)(a)(iv). In compliance with the rule, a minimum of nine hydraulic conductivity tests were performed on each saturated consolidated unit. A total of six slug tests were performed on both the Limestone/Shallow Bedrock and Bellaire/Summerfield units, and five tests were conducted on the Connellsville/Morgantown unit. Additionally, packer testing was conducted on piezometers P-1, P-5, and P-9 which is discussed in detail in Section (C)(3)(d)(i)(a)(iv). Packer testing concluded with six tests within the Limestone/Shallow Bedrock unit, 24 tests within the Bellaire/Summerfield unit, and 28 tests within the Connellsville/Morgantown unit.

***(g)* Yield of any significant zones of saturation and of the uppermost aquifer.**

(C)(3)(f)(ii)(*g*) The observed yields of the SZS and UAS are presented in Section (C)(3)(d)(iv).

***(h)* If an unconsolidated aquifer system capable of sustaining a yield of one hundred gallons per minute for a twenty-four-hour period is suspected beneath the facility based on evidence gathered in accordance with paragraph (C)(4)(b) of this rule, and the applicant proposes to revise that finding, the applicant must provide adequate site-specific information on the suspected aquifer system to justify any requested revision, including but not limited to the yield of any aquifer systems below the uppermost aquifer system.**

(C)(3)(f)(ii)(*h*) No unconsolidated aquifer system is capable of a sustained yield of 100 gallons per minute. This information is provided in (C)(3)(d)(v).

(C)(3)(f)(iii) Construction diagrams of all monitoring wells and piezometers. At a minimum the diagrams shall include the following:

***(a)* The top-of-casing elevation used for water level measurement reference surveyed to the nearest hundredth foot.**

***(b)* The boring diameter and the inside diameter of the well casing.**

***(c)* The total depth of the boring and the total depth of the well.**

***(d)* The screened interval depth and elevation, and the screen slot size.**

***(e)* A description of all construction materials and depth intervals for all construction materials.**

This information is provided on Table C3-1 and in the well construction logs included in Appendix C3-C.

(C)(3)(f)(iv) Data gathered by sampling and analyzing the ground water from the uppermost aquifer system and all significant zones of saturation above the uppermost aquifer system. These samples shall, at a minimum, be analyzed for compounds 1 to 78 listed in Appendix I of rule 3745-27-10 of the Administrative Code.

This information is presented in Section (C)(3)(e).

(C)(3)(f)(v) Information collected at the site and used to prepare the stability analysis required in paragraph (C)(4) of this rule. This information shall be presented on logs appropriate for the subsurface investigatory method used. The subsurface investigatory method(s) and frequency must be adequate to find the unconsolidated stratigraphic units susceptible to bearing capacity failure, static stability failure, seismic stability failure, or settlement, at the site. The information shall be collected for each unconsolidated stratigraphic unit under the facility down to fifty feet below the proposed depths of excavation. At a minimum the information shall include the following:

(*a*) Northing and easting location coordinates.

(*b*) Surface elevation surveyed to the nearest tenth of a foot (0.1).

(*c*) Depth interval for each stratigraphic unit.

(*d*) Field descriptions of the unconsolidated units. At a minimum the information shall include the following:

(i) **Textural classification for each unconsolidated stratigraphic unit using the "Unified Soil Classification System."**

(ii) **Color.**

iii) **Moisture content.**

(iv) **Stratigraphic features such as layering, interbedding, or weathering.**

(v) **For fine-grained unconsolidated units (e.g. silts and clays), field descriptions of consistency and plasticity or dilatancy.**

(vi) **Thickness.**

(vii) **Variations in texture, saturation, stratigraphy, structure or mineralogy in each stratigraphic unit.**

(C)(3)(f)(v)(*a*) through (*d*) This information is summarized in Section (C)(3)(d)(i) of this PTI application.

(e) **Identification of the depth interval of any samples collected including those submitted for laboratory testing.**

(C)(3)(f)(v)(*e*) This information is summarized in Table C3-3 of this PTI application.

(f) **Depth to phreatic and piezometric surfaces.**

(C)(3)(f)(v)(*f*) The depth to the water table varies between the Mine Spoil SZS and the underlying bedrock. The majority of the proposed expansion consists of mine spoil where the water table is discovered in areally limited areas, specifically in the northwestern, northeastern, and central portions of the expansion footprint. In areas where either the mine spoil is not saturated or where piezometers are installed beyond the limits of mine spoil, saturated areas of the uppermost bedrock units are representative of water table conditions. However, there is no evidence that there is a significant hydraulic interconnection between the mine spoil and the upper most bedrock units at the site. Thus, water table mapping is limited to the mine spoil unit. Drawing 3O - Mine Spoil Potentiometric Map, December 10, 2012 and Drawings 3G-R and 3K-R present the approximate limits of mine spoil, which represents a discharge boundary for groundwater flow in the mine spoil unit. ~~This~~ Additional information is summarized in Sections (C)(3)(d)(i) and (C)(3)(d)(iv) of this PTI application.

(g) **Results from penetration testing following ASTM D1586-99, plus the corrected and normalized standard penetration number, or results from mechanical cone penetration testing following ASTM D3441-98.**

(C)(3)(f)(v)(*g*) This information is summarized in Sections (C)(3)(d) of this PTI application.

(h) **If Appendix I of rule 3745-27-08 of the Administrative Code will be used, the vertical hydraulic conductivity of each unsaturated stratigraphic unit.**

(C)(3)(f)(v)(*h*) The vertical hydraulic conductivity of each unconsolidated unit is presented and summarized in tabular format in Table C3-3 and the calculations for liner thickness are presented in Section (C)(5)(b) in this PTI application (Volume IV).

(vi) Laboratory analysis on representative samples of all the unconsolidated stratigraphic units under the facility down to a minimum of fifty feet below the proposed depths of excavation. The information is used to prepare the stability analysis required in paragraph (C)(4) of this rule. At a minimum the information shall include the following:

(a) **Grain size distribution (sieve and hydrometer curves).**

(*b*) **Atterberg limits.**

(*c*) **Specific gravity.**

(*d*) **In-situ unit weight.**

(*e*) **In-situ moisture content.**

(*f*) **Dry unit weight.**

(C)(3)(f)(vi)(*a*) through (*f*) The soil testing results are provided in Appendix C3-D. A summary of the Atterberg Limit and Grain Size Distribution results is presented below. Samples were collected from selected locations throughout the entire thickness of the unconsolidated units.

Atterberg Limits

Thirty-eight (38) unconsolidated samples were analyzed for Atterberg Limits. Average, minimum and maximum values for liquid limit, plastic limit and plasticity index for these samples are presented below.

	Average	Minimum	Maximum
Liquid Limit	42	30	81
Plastic Limit	20	10	48
Plasticity Index	21	11	34

Grain Size Distribution

Soil samples were extracted from the unconsolidated unit via soil borings. Soils were extracted using the split spoon and Shelby tube sampling methods.

A total of thirty-nine (39) soil samples were submitted to the laboratory for geotechnical testing. Each of the samples was tested for grain size distribution using ASTM Testing Procedure D-422. Average grain size percentages for unconsolidated samples are listed below.

- 16 percent for gravel (ranging from 0 to 54.1 percent).
- 23.2 percent for sand (ranging from 4.5 to 53.3 percent).
- 37.9 percent for silt (ranging from 16.1 to 74.1 percent).
- 23.1 percent for clay (ranging from 5.2 to 54.9 percent).

The complete soil testing results are summarized in Table C3-3 and the laboratory data sheets are presented in Appendix C3-D.

(g) **For unconsolidated stratigraphic units susceptible to bearing capacity failure, the effective drained or undrained peak shear strength parameters as appropriate using direct shear (ASTM D3080-98), unconsolidated undrained compression (ASTM D2850-95(1999)), or consolidated undrained triaxial compression (ASTM D6467-99).**

(h) **For unconsolidated stratigraphic units susceptible to static stability failure or seismic stability failure, the effective shear strength using ASTM D3080-98 (Direct Shear Test) or ASTM D4767-95 (Consolidated Undrained Triaxial Compression Test), or ASTM D6467-99 (Torsional Ring Shear Test).**

(i) **For unconsolidated stratigraphic units susceptible to static stability failure or seismic stability failure due to excessive increase in pore pressures from construction and operation activities, the undrained shear strength using fully saturated samples shall be determined using ASTM D2850-95(1999) (Unconsolidated-Undrained Triaxial Compression).**

(j) **For unconsolidated stratigraphic units susceptible to settlement, the following parameters:**

(i) **The coefficient of consolidation.**

(*ii*) **The over consolidation ratio.**

(*iii*) **The pre-consolidation pressure.**

(*iv*) **The compression index.**

(*v*) **The swelling index.**

(vi) **The in situ void ratio.**

(vii) **The effective porosity.**

(C)(3)(f)(vi)(*g*) through (*j*) The stability analysis is presented in Section (C)(4) (Volume III) of this PTI application and includes soil strength test results.

(vii) Any other data generated.

(C)(3)(f)(vii) No other relevant data was generated.

(C)(3)(g) PROCEDURES, EQUIPMENT AND METHODOLOGY

OAC 3745-27-06(C)(3)(g) requires that the Hydrogeologic Site Investigation Report include a detailed description of the field procedures utilized to conduct the site investigation, including drilling and sampling methods, soil and rock analytical methods, UAS and SZS characterization methods and groundwater quality characterization methods. The following section summarizes the procedures used while conducting the site investigation.

(C)(3)(g) A detailed description of how the subsurface investigation was conducted including the following:

(i) The subsurface investigatory and sampling methods used in characterizing the geologic and hydrogeologic properties of the consolidated and unconsolidated stratigraphic units at the proposed sanitary landfill facility and an explanation of why the particular subsurface investigatory method(s) was chosen.

The subsurface investigation of the Apex Landfill expansion area can be divided into four separate phases of work. The BBC&M May 2001 HSI drilling effort, the installation of the existing detection monitoring well network for the permitted landfill, the August 2010 Hydrogeologic Investigation for the proposed expansion, and the February 2011 Supplemental Hydrogeologic Investigation for the proposed expansion. Discussions of these four phases of work are presented below.

BBC&M May 2001 HSI Investigation

This HSI incorporates portions of a May 2001 HSI document prepared by BBC&M Engineering, Inc. (BBC&M) for the existing facility permit to install. This document provides comprehensive work characterizing the geology and hydrogeology underlying the Apex Landfill. Some of the hydrogeologic data collected during this portion of the investigation was collected near or within the proposed expansion area and therefore has been used to supplement this HSI. A brief summary of the methodologies used in the BBC&M May 2001 HSI are presented below.

Forty-five test pits (identified with a TP nomenclature) were completed during the exploration. In addition, soil borings B-1A, B-2A, B-7A, B-9A and B-9C were drilled using an all-terrain vehicle-mounted drilling rig. The soil borings were advanced using 4¼-inch Inner Diameter (ID) hollow stem augurs. Sampling was performed by driving a 2-inch Outer Diameter (OD)

split-barrel sampler by blows of a 140-pound hammer freely falling 30-inches. Bedrock exploration was completed at 36 locations. The borings were drilled with a truck-mounted drill rig using air rotary drilling methods. In ten borings, bedrock was cored using a PQM double-tube core barrel.

During the excavation of test pits, drilling of the soil boring, and drilling of the un-cored bedrock explorations, the field work was continuously supervised by a project geologist from BBC&M. During the drilling of bedrock explorations which were cored, the work was periodically monitored by BBC&M. The stratigraphy was identified by examining the exposed stratigraphy in test pits, examining samples obtained using a split-barrel sampler, examining rock cores, and examining cuttings returned to the surface during drilling operations. Strata changes, when not observed in the samples, were estimated based on drill stem behavior and cutting returned to the surface.

Field measurements of hydraulic conductivities of the bedrock formations and mine spoils were completed using slug tests and packer tests. Slug tests were performed in wells B-5, B-6, B-7B, B-11, B-7A, and B-9A and packer tests were completed in boring B-13, B-14, and B-15. The results of the slug and packer testing for the work conducted by BBC&M can be found in the May 2001 PTI application.

Detection Monitoring Well Network Installation

The Groundwater Detection Monitoring Program (GWDMP) for the existing landfill was implemented prior to any waste being placed in the facility. The detection monitoring wells are identified with a B-400 series nomenclature. In accordance with the current GWDMP, monitoring wells were installed along the perimeter berm of the landfill as the landfill was constructed. Some of these detection monitoring wells were installed within or close to the proposed expansion area and have been used to supplement this HSI. A summary of the methodologies used to install the monitoring well network are presented below.

During installation of the detection monitoring wells, a CEC geologist was on site to supervise and direct the drilling activities. The boreholes were advanced using air rotary drilling techniques. Steel casing was installed through the overburden soils into competent bedrock. Boring logs and monitoring well construction diagrams were completed as drilling and well installation activities progressed. Drilling details are as follows:

- A 9 7/8-inch tri-cone roller bit was using to drill through the overburden soils, which consisted of mine spoil or residual soil, into the bedrock. Once reaching bedrock, the tri-cone bit was removed from the borehole and 6-inch steel casing was installed from ground surface to within bedrock. The casing was sealed in place using bentonite chips which were hydrated in lifts of approximately 2-3 feet as they were placed.

- Drilling continued through the steel casing using either a 5 7/8-inch tri-cone roller bit or a NX split barrel wire line rock coring system. In some cases, continuous rock coring was not completed and drilling cuttings were logged as the boreholes were advanced. Once the desired depth was reached using the tri-cone bit, continuous rock coring was initiated to identify lithology of the screened interval for monitoring well placement. The more recently installed monitoring wells utilized continuous rock core sampling from below the surface case to the desired total depth.

- Upon reaching total depth, the borehole was then reamed with a 5 7/8-inch tri-cone roller bit to provide a larger diameter borehole for monitoring well installation. Monitoring well installation details are discussed below in Section (C)(3)(g)(iii)(a).

August 2010 Hydrogeologic Investigation for the Proposed Expansion

The initial field portion of this HSI for the proposed expansion was completed from August 3, 2010 to October 1, 2010. Subsurface exploratory locations installed during the HSI were identified with a P for piezometer, SB for a soil boring (with continuous soil sampling), RB for a rock boring (without continuous sampling), and TPE for a test pit conducted for the expansion area.

Two drilling companies were utilized to conduct the drilling, sampling, and rock coring under the direct supervision of a CEC geologist. Geotechnical drilling was conducted through the overburden by Test Boring Services, Inc. of Scenery Hill, PA, while the bedrock drilling was conducted by Frontz Drilling Company of Wooster, OH.

The geotechnical drilling was conducted by Test Boring Services, Inc. using a 55 CME 300M Carrier Track Unit equipped with 4¼-inch ID hollow stem augers to drill through the residual soil and mine spoil sediments until reaching bedrock. While drilling the unconsolidated

sediments, soil samples were collected continuously using a two-foot split spoon sampler. Split-spoon sampling was performed according to ASTM D 1586. Split spoon samples were collected with a 2-inch OD split spoon sampler, 24 inches in length. The sampler was driven with a 140-pound slide hammer. Blow counts were counted for every six inches the split spoon sampler was advanced and were recorded on the boring logs. Soil samples collected as the borings were advanced were described and recorded on a boring log. Boring logs for the project are included in Appendix C3-C, along with well completion diagrams. The description on the boring logs includes sample color, composition, moisture content, density/cohesiveness and any other notable features. Soil samples (i.e. Shelby Tubes) were collected at selected depths for testing of geotechnical properties. These sample depths were determined in the field by the supervising geologist and were based on the lithology encountered. Geotechnical samples were submitted to a laboratory for testing of the moisture content, particle size distribution, Atterberg Limits, densities and permeability. Geotechnical testing laboratory reports are included in Appendix C3-D.

The bedrock drilling was conducted by Frontz Drilling Co., using an Ingersoll Rand TH-60. The boreholes were advanced using air rotary drilling techniques. Steel casing was installed through the overburden soils into bedrock. A 9 7/8-inch tri-cone roller bit was used to drill through the overburden soils into bedrock. Once reaching bedrock, the tri-cone bit was removed from the borehole and 6-inch steel casing was installed from ground surface to the total depth of the borehole in competent bedrock. The casing was sealed using bentonite chips which were hydrated in lifts of approximately 2-3 feet as they were placed. Rock coring was completed using a NX core with a 10-foot continuous barrel sampler. Ten-foot coring runs were conducted where possible. Rock coring was conducted from the base of the steel casing to the bottom of the UAS. Coring logs were kept which included the length of core run, recovery percentage, sample description, and rock quality designation (RQD). Copies of the boring logs are included in Appendix C3-C. Core samples were labeled, boxed and retained on site for future reference. Upon reaching total depth, the monitoring wells were installed. Monitoring well installation details are discussed below in Section (C)(3)(g)(iii)(a).

Both the geotechnical and bedrock borings were either completed as shallow overburden piezometers, bedrock piezometers, or were abandoned. Abandonment was accomplished by either using an all bentonite slurry or bentonite chips. The bentonite slurry was placed by tremie

grouting the bore hole from the bottom of the boring upward. The bentonite chips were placed in the bore hole in lifts of 2-3 feet and hydrated when groundwater was not present.

Test pits (identified with a TPE nomenclature) were excavated using a backhoe at 14 locations spaced mostly around lowland areas near the strip mine ponds. Excavation depths of the test pits ranged from 3 to 19 feet bgs. Test pits were excavated to identify the top of rock and unconsolidated material near the strip mine ponds. Test pits allowed for examination and characterization of the soils, determination of the distribution and thickness of the soil types, and the collection of samples for geotechnical analysis. Soil types encountered within the test pits were characterized by the supervising geologist. Test pits logs are included in Appendix C3-C.

February 2011 Hydrogeologic Investigation for the Proposed Expansion

The second field portion of this HSI for the proposed expansion was completed from February 10 – 25, 2011. This drilling was conducted to further investigate the top of bedrock elevation and install an additional piezometer cluster at the P-12 location. Based on boulders encountered within the mine spoil, sonic drilling methods were utilized for the unconsolidated drilling in February 2011. Sonic drilling methods are capable of drilling though boulders within the mine spoil, while continuously collecting soil samples to accurately identify the top of bedrock elevation. Once reaching the top of bedrock, the bore hole was advanced using an HQ wire-line coring system.

Boart Longyear Drilling Company utilized two sonic drilling rigs to complete this work. Direction and oversight was provided by a CEC geologist. For the top of bedrock borings, a 600C Full Sonic Track rig was utilized. This rig was equipped with 4-inch and 6-inch tooling/casing to continuously collect soil samples through the mine spoil until reaching bedrock. While drilling the unconsolidated material, soil samples were collected continuously using the 4-inch casing, prior to drilling with the 6-inch override casing. Pocket penetrometer readings were collected for every foot of soil recovered. Soil samples collected as the borings were advanced were described and recorded on a boring log. Boring logs for the project are included in Appendix C3-C. The description on the boring logs include sample color, composition, moisture content, density/cohesiveness and any other notable features. Soil samples (i.e. Shelby Tubes) were collected at selected depths for testing of geotechnical properties. These sample depths were determined in the field by the supervising geologist and were based on the lithology encountered. Geotechnical samples were submitted to a laboratory for testing of the moisture

content, particle size distribution, Atterberg Limits, densities and permeability. Geotechnical testing laboratory reports are included in Appendix C3-D. The top of rock borings were abandoned using bentonite chips placed in the bore hole in lifts of 2-3 feet and hydrated when groundwater was not present.

For installation of the bedrock piezometers, Boart Longyear utilized a 200C Mini Sonic drilling rig which was also capable of completing wire line rock core sampling. Standard sonic drilling, as discussed above, was used to drill through the overburden to the top of bedrock. Once reaching bedrock, the 6-inch casing/tooling was utilized as temporary surface casing and the bedrock bore hole was advanced using HQ core with a 10-foot continuous barrel sampler. Ten-foot coring runs were conducted where possible. Rock coring was conducted from the base of the steel casing to the desired depth of the bore hole. Core logs were kept which included the length of core run, recovery percentage, sample description, and rock quality designation (RQD). Copies of the boring logs are included in Appendix C3-C. Core samples were labeled, boxed and retained on site for future reference. Upon reaching total depth of coring, the bore hole was reamed with the 4-inch and 6-inch drill casing to create a large diameter bore hole for the installation of the piezometers. Piezometer installation details are discussed below in Section (C)(3)(g)(iii)(a).

(C)(3)(g)(ii) The analytical procedures and methodology used to characterize the unconsolidated and consolidated materials obtained from test pits and borings.

(C)(3)(g)(ii) Shelby tube soil samples were collected at various depths and drilling and test pits locations across the proposed expansion for geotechnical analysis. The following geotechnical tests were performed on selected samples:

- ASTM D 422 - Particle-Size Analysis of Soils;
- ASTM D 4318 - Liquid Limit, Plastic Limit, and Plasticity Index of Soils;
- ASTM D 2487 - Classification of Soils for Engineering Purposes (Unified Soil Classification System);
- ASTM D 2216 - Laboratory Determination of Water (Moisture) Content of Soil, Rock, and Soil-Aggregate Mixtures;
- ASTM D 4767 - Consolidated-Undrained Compressive Strength of Cohesive Soils in Triaxial Compression;

- ASTM D 2937 - Test Method for Density of Soil In Place by the Drive-Cylinder Method.
- ASTM D854 - Specific Gravity

Soil laboratory analytical data for selected geotechnical samples are provided in Appendix C3-D and on Table C3-3.

(C)(3)(G)(III) THE METHODOLOGY, EQUIPMENT, AND PROCEDURES USED TO DEFINE THE UPPERMOST AQUIFER SYSTEM AND ALL SIGNIFICANT ZONES OF SATURATION ABOVE THE UPPERMOST AQUIFER SYSTEM, INCLUDING THE FOLLOWING:

(*a*) Well and piezometer construction specifications.

(C)(3)(g)(iii)(a) Piezometers and monitoring wells have been installed during multiple investigations as described in Section (C)(3)(g). All monitoring wells and piezometers were installed and developed in a manner consistent with those procedures outlined in the appropriate regulatory guideline for groundwater monitoring wells at sanitary landfill facilities at the time the wells were installed. These activities are described in detail below.

- 6-inch steel surface casing was placed from ground surface into competent bedrock. The use of 6-inch steel casing allows for the piezometers to be abandoned easily and provides a superior surficial seal preventing groundwater mixing.

- Piezometers were installed through the open borehole and steel casing, where applicable, and constructed of 2-inch ID, factory-machined 0.01-inch slotted polyvinyl chloride (PVC) screen (10 feet in length) and screw-type flush joint Schedule 40 PVC riser pipe.

- The annular space around the screen was backfilled with a clean silica sand (#5) filter pack to minimize the passage of formation materials into the well. The filter pack was installed to a depth approximately four feet above the top of the screen.

- A 2-3 feet thick bentonite chip seal was placed on top of the sand pack. Bentonite chips were used for a large portion of the seal placement in an attempt to minimize bentonite grout from migrating into the screen through fractures in the surrounding rock. The bentonite chips were hydrated when placement was above the water column. The

remaining annular space above the bentonite chip seal was filled with bentonite grout slurry.

- At the surface, the well was completed in a 6-inch-diameter steel protective casing and fitted with a keyed alike lock. The casing was anchored with a 2-foot x 2-foot concrete pad. The annular space between the protective casing and the PVC riser was filled with coarse sand to approximately three inches below the top of the PVC.

- A weep hole was drilled into the protective casing to prevent accumulation of water between the PVC casing and the protective casing. Each well was labeled for easy identification.

- Survey information including top of casing elevation (TOC), ground elevation, and northing and easting coordinates were measured on the monitoring well and are included on the boring logs included in Appendix C3-C.

Limited description of methodology, equipment, or procedures is available for the initial site characterization performed by BBC&M in 1990. Based on lithologic logs, the wells were installed using mostly air rotary and air coring techniques. All available information is presented on the boring logs in Appendix C3-C.

Piezometer Development

Piezometers installed during this HSI were developed subsequent to installation activities. The purpose of development is to arrange the granular filter pack around the screen to minimize passage of fine-grained formation materials into the piezometer. Development was initiated by surging the piezometer with a disposable bailer to remove heavy sediments. A submersible pump or stainless steel bailer was then used to purge the piezometer. To the extent possible, piezometer development was performed until the temperature, pH and conductivity stabilized. Pumping rates, purge volumes, and water levels were also recorded during the development process. Development water was discharged to the ground surface. The pump and hose were decontaminated between successive locations by pumping potable water through the pump intake and discharge lines. Stainless steel bailers were decontaminated between locations by rinsing the bailer with deionized water. Development data sheets are included in Appendix C3-F.

IN-SITU PERMEABILITY TESTING

Slug Tests

Slug tests were performed at selected piezometers installed for the current investigation and selected monitoring wells previously installed at the facility to test the hydraulic properties of the screened intervals. In those piezometers where the recovery was extremely slow, measurements were collected by hand after a disposable bailer was introduced into each well and a specific volume of water was removed or "slugged out." The resulting changes in head as the well recovered were measured and recorded over time. Data points were gathered for each well using a stopwatch to monitor specific time intervals. The rising head was monitored until the groundwater level stabilized or until 90 percent of the initial static water level was reached.

For monitoring wells and piezometers with sufficiently rapid recovery, the slug tests were conducted by installing a transducer into the piezometer, which is capable of detecting and recording the change in water levels to the nearest one-hundredth of a foot. A four-foot stainless steel slug was rapidly inserted into the water column and the change in water level was recorded by the transducer. This slug test is referred to as the “slug in” or “falling head” test. The falling head test was terminated after the water level returned to the original static water level with the slug still within the water column. After returning to static, the slug was rapidly removed and the change in water level was recorded by the transducer. This slug test is referred to as the “slug out” or “rising head” test. The rising head test was terminated after the water level returned to static. Transducer data were downloaded in the field to ensure accurate and quality data were collected. If questionable data were collected during the slug test, both the falling and rising head tests were repeated until usable and accurate data were collected. The data collected during the slug testing were analyzed using the Bouwer and Rice method (Bouwer and Rice, 1976) for determining hydraulic conductivity. Hydraulic conductivity values are presented on Table C3-4, while the results and calculations are included in Appendix C3-F.

The solid slug was decontaminated between use in each well by rinsing multiple times with distilled water. The polyethylene rope used to raise and lower the slug were also decontaminated between use in each well by rinsing with distilled water.

Packer Testing

Dual packer testing was conducted by Frontz Drilling Company with oversight and guidance provided by CEC in each deep boring (P-1, P-5, and P-9) prior to setting the UAS piezometer. Each test consisted of using specialized drill rods that hold the packers in place and allow water to be introduced between the packers. Tests were conducted by inflating packers followed by injecting water at a constant pressure for a specified period of time into an isolated ten foot test interval. Packer testing was conducted at the ten foot interval from the top of bedrock to the total depth of the respective boring. The test in each isolated interval was repeated several times at higher pressures; 10, 20, 30, and 40 psi. The flow rate was recorded during the test intervals and the test continued until a constant flow rate was observed. The coefficient of permeability was calculated from the pressure time/flow rate data which is presented Table C3-5. The results of the packer testing are included in Section (C)(3)(d)(i)(a)(iv).

Pump Testing

During this HSI, specific monitoring well and piezometer yields were determined during development and additional pump testing of selected piezometers based on the data collected during the development. The majority of the shallow piezometers yielded a low volume of water and would not sustain pumping. Therefore, the yield of these piezometers was determined by averaging the total volume removed prior to the piezometer going dry divided by the total time. Specific piezometer and well yield data are summarized on Table C3-9.

For piezometers and wells which produced an adequate flow rate to support pumping, the maximum flow rate was determined for each piezometer by conducting a modified step pumping test. The piezometer or well was pumped with a Grundfos Redi-Flo electric submersible pump for approximately two hours to determine the maximum flow rate. The maximum flow rate is defined as the flow rate noted at the maximum drawdown level. The maximum drawdown level is defined as the water level 1-3 feet above the pump intake. Specific piezometer and well yield data are summarized on Table C3-9.

(C)(3)(g)(iii)(b) Water level measurement procedures.

The following summarizes water level measurements conducted during the investigation:

Three separate, site-wide groundwater measurement events took place over the course of this HSI. These events were completed on October 25, 2010, December 6, 2010, and

March 28, 2011. The depth to water was measured from a survey mark on the top of PVC casing. An electronic water level indicator was used for the depth to water measurements with each measurement recorded to the nearest one-hundredth of a foot. The depth to water measurement was then subtracted from the elevation of the reference point to calculate the groundwater elevation. A summary of the water levels is shown in Table C3-6. Potentiometric surface maps for each of the water bearing zones as recorded during the December 6, 2010 and March 28, 2011 events are shown in Drawings 3G through 3N.

(C)(3)(g)(iv) The methodology, equipment, and procedures used to determine the ground water quality in the uppermost aquifer system and any significant zones of saturation above the uppermost aquifer system, including the following:

Groundwater quality sampling was performed in accordance with the methods presented below.

*(*a*) Detection of Immiscible Layers.*

(C)(3)(g)(iv)(a) No organic vapors were detected using olfactory methods during purging and sampling activities, and no free product was observed in groundwater samples collected from the monitoring wells. Additionally, no organic compounds were detected above the laboratory's PQL in the groundwater samples collected. Therefore, the test for detection of immiscible layers in ground water was not conducted during this investigation.

(*b*) Collection of ground water samples, including the following:

Groundwater samples collected for site characterization followed standard industry procedures presented in the Ohio EPA DDAGW Technical Guidance Manual. Existing detection monitoring wells located within the expansion area were also sampled as part of the second semi-annual 2010 sampling event for the existing facility to supplement the proposed expansion area groundwater characterization. Samples collected for existing detection monitoring wells followed procedures documented in the Groundwater Detection Monitoring Plan (GWDMP), October, 2009. Details regarding the collection of groundwater samples are included below.

*(*i*) Well Evacuation.*

(C)(3)(g)(iv)(b)(i) All piezometers and monitoring wells were purged prior to sampling. Prior to purging, the volume of water in the well was calculated based on casing diameter, total depth of the piezometer/well and the water level. Expansion piezometers P-2A, P-2L, P-2S, P-3L, P-4L, P-5, P-9, and P-10L were purged using an electric submersible pump using low-flow purging

techniques. Because the submersible pump was used at multiple locations for evacuation purposes, the pump was decontaminated between uses by pumping deionized water through the pump. New disposable polyvinyl discharge tubing was used in each well. Expansion piezometers P-5S, P-6S, and P-7A were purged to dryness using disposable bailers due to the low yield. Existing detection monitoring wells B-401, B-401A, B-401S, B-402, B-402A, B-403, and B-403S were purged using dedicated QED bladder pumps and a disposable bailer (B-401S).

Groundwater levels were measured prior to and after the purging process to document any drawdown in the well. Field parameters (i.e. temperature, pH, specific conductivity, and turbidity) were also measured during the course of purging activities. Purging continued until the field parameter measurements stabilized or the piezometer/well was purged dry. Purge water was discharged to the ground surface.

*(*ii*) Sample Withdrawal.*

(C)(3)(g)(iv)(*b*)(*ii*) Groundwater samples were obtained using a non-dedicated electric submersible pump, dedicated bladder pump, or a disposable bailer. Sample containers were filled, preserved, and packaged according to U.S. Environmental Protection Agency (US EPA) protocols. Samples were analyzed for the Appendix I list of parameters (1-78) as outlined in OAC 3745-27-10. The sample chain-of-custody was maintained from the time of sample collection through the time of delivery at the analytical laboratory. Geochemical Testing of Somerset, Pennsylvania performed the laboratory analyses from the water quality samples. Water quality analytical reports are included in Appendix C3-E.

*(*iii*) Sample Containers and Handling.*

(C)(3)(g)(iv)(*b*)(*iii*) The groundwater samples were placed in appropriate containers, properly labeled, and delivered to the laboratory in protective coolers. Bagged ice was used to keep the samples at approximately 4˚C. Samples were shipped for overnight deliver to the laboratory via FedEx. Chain-of-custody forms were maintained as part of the project documentation, and have been included Appendix C3-E.

*(*iv*) Sample preservation.*

(C)(3)(g)(iv)(*b*)(*iv*) Multiple, pre-labeled containers were supplied by the laboratory for each sampling point. The appropriate preservatives were added to each container by the laboratory, as necessary, during sample bottle preparation. Samples were poured directly into the sample

bottles from the polyvinyl discharge tubing. VOC sample containers were filled to slightly more than capacity before placing the cap on the container to ensure that the headspace was free of air. The samples were placed in coolers with ice immediately after collection.

(*c*) Performance of field analysis, including the following:

(*i*) Procedures and forms for recording data and the exact location, time, and facility-specific considerations associated with the data acquisition.

(*ii*) Calibration of field devices.

(C)(3)(g)(iv)(*b*) Field Information Logs were employed as the primary method for recording field observations and information. Standardized Field Information Logs were utilized in this investigation. These forms listed dates, piezometer/sample numbers, personnel present, water level measurements, volume calculations, times for the start and end of purging, field parameter measurements, field meter calibration information, chain-of-custody information, and sample description. Field Information Logs are presented in Appendix C3-E.

Field measurements, conditions, calibrations, and observations were recorded in project logbooks, Field Data Sheets, or both. The logbooks contained notes on personnel present, working times and conditions, and tasks accomplished. The field meters were calibrated to the specifications of the manufacturers and at least once daily.

(*d*) Decontamination of equipment.

(C)(3)(g)(iv)(*d*) The submersible pump used for purging the piezometers was decontaminated between uses by pumping distilled water through the pump intake and discharge. Dedicated polyvinyl tubing was used at each piezometer sampled. Decontamination of field meters was performed by rinsing the meter probes with distilled water between uses.

(*e*) Analysis of ground water samples.

(C)(3)(g)(iv)(*e*) Groundwater samples were analyzed in accordance with standard methods by Geochemical Testing, Inc. The samples were analyzed for OAC 3745-27-10 Appendix I parameters (1-78).

(*f*) Chain-of-custody control, including the following:

(*i*) Standardized field tracking reporting forms to record sample custody in the field prior to and during shipment.

(C)(3)(g)(iv)(*f*)(*i*) Chain-of-custody forms were completed for all samples obtained in the field. These forms included project name, names of field personnel, date and time of sample collection, required analyses, shipping and courier data, and signatures documenting changes in sample custody. Copies of the chain-of-custody forms are presented in Appendix C3-E.

(*ii*) Sample labels indicating a unique sample number, date, time, sample media, sample type, analytical methods, any preservatives, and any other information necessary for effective sample tracking.

(C)(3)(g)(iv)(*f*)(*ii*) Each groundwater sample was placed in appropriate containers and labeled at the time of collection. The sample number, date, time, preservatives, analytical requirements, as well as any special testing or handling data, were marked on each label.

(*g*) Field and laboratory quality assurance and quality control including the following, the number of which shall be enough to adequately demonstrate the accuracy of the analysis results:

(C)(3)(g)(iv)(*g*) QA/QC procedures for replicate samples, blanks, and interferences are discussed below.

(*i*) Collection of duplicate samples.

(C)(3)(g)(iv)(*g*)(*i*) Duplicate samples were collected at a rate of one per 10 site samples. Therefore, two duplicate samples were collected for the investigation (Field Dup and Dup-2). These samples were collected simultaneously with the sample it was to replicate (P-5 and B-401), and the bottles were filled at the same time as the original samples. The purpose of duplicate is to identify general interferences from either the sampling/shipping methods or laboratory procedures. The duplicate analytical results are included on Table C3-8 and are within the acceptable range of precision when compared to the results of piezometers P-5 and B-401 as depicted.

(*ii*) Submission of field-bias blanks.

One trip blank was collected for this investigation. Trip blanks were prepared by Geochemical Testing at the laboratory and accompanied the coolers / sample bottles throughout shipping and throughout the groundwater sampling event. The trip blanks were analyzed for the volatile organic compounds listed in the Appendix 1 parameter list (1-78). The results are included on Table C3-8 and no volatile organic compounds were detected in the trip blanks. All blanks were

numbered and/or labeled to avoid confusion with the actual ground water samples or other QA/QC samples.

*(*iii*) Potential interferences.*

(C)(3)(g)(iv)(*g*)(*iii*) Possible potential field and laboratory interferences were monitored and minimized by following the prescribed QA/QC procedures described above. This includes proper equipment decontamination, the collection of blank samples and the laboratory following their internal QA/QC guidelines.

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TABLES

TABLE C3-1
SUMMARY OF MONITORING WELL AND PIEZOMETER INSTALLATION DATA
APEX LANDFILL LATERAL EXPANSION

Well No.	Date Installed	Date Abandoned	Stratigraphic Unit	Ground Elevation (ft. MSL)	Boring Total Depth (ft. BGS)	Top of Casing Elevation (ft. MSL)	Screen Interval (ft MSL)		Screen Interval (ft BGS)		Well Diameter (in.)	Comments
							Top	Bottom	Top	Bottom		
Uppermost Aquifer Monitoring Wells and Piezometers												
B-2B	Jun-91	TBD	Summerfield/Connellsville	1265.9	159.0	1268.23	1142.50	1133.50	123.4	132.4	4	-----
B-3*	Jul-91	Oct-04	Morgantown/Birmingham	1228.3	155.0	1230.83	1085.40	1076.40	142.9	151.9	4	Abandoned
B-4	Jun-91	TBD	Birmingham	1205.3	143.0	1207.75	1083.80	1074.80	121.5	130.5	4	7' of filter pack
B-5	Jun-91	TBD	Morgantown/Birmingham	1174.2	96.0	1176.74	1093.70	1084.70	80.5	89.5	4	-----
B-6	Jun-91	TBD	Morgantown	1247.9	133.0	1250.41	1159.90	1150.90	88	97.0	4	4' of filter pack
B-7B	Jul-91	TBD	Morgantown	1244	130.0	1246.53	1130.00	1121.00	114	123.0	4	7' of filter pack
B-8	Jul-91	TBD	Connellsville/Morgantown	1172.4	52.0	1174.92	1134.90	1125.90	37.5	46.5	4	9' filter pack
B-9B*	Sep-91	Sep-08	Morgantown	1256.9	157.0	1259.42	1132.90	1123.90	124	133.0	4	Abandoned
B-11	Jul-91	TBD	Morgantown	1243.9	141.0	1246.36	1140.70	1131.60	103.2	112.3	4	9' filter pack
B-12	Aug-91	TBD	Morgantown	1282.3	193.0	1284.83	1109.10	1100.10	173.2	182.2	4	18.5 of filter pack
B-13*	May-92	1992	Unknown	1249	180.0	Unknown						Exploratory boring. No well installed
B-14*	May-92	1992	Unknown	1262	206.0	Unknown						Abandoned
B-15*	May-92	TBD	Unknown	1240	180.0	Unknown						Abandoned
B-101*	Sep-94	Sep-08	Morgantown	1193.6	120.0	1194.66	1119.30	1109.90	74.3	83.7	4	Abandoned
B-102*	Aug-94	Oct-04	Morgantown	1204.8	118.5	1206.79	1111.50	1097.10	93.3	107.7	4	Abandoned
B-103*	Aug-94	Oct-04	Morgantown	1206	113.0	1208.07	1117.80	1108.30	88.2	97.7	4	Abandoned
B-104*	Aug-94	Oct-04	Morgantown	1221.1	133.0	1221.96	1131.70	1117.40	89.4	103.7	4	Abandoned
B-105	Aug-94	TBD	Morgantown	1227.3	140.0	1229.12	1108.80	1099.30	118.5	128.0	4	4' of filter pack
B-106*	Aug-94	Jan-06	Morgantown	1165	85.0	1166.76	1096.50	1087.00	68.5	78.0	4	Abandoned
B-401	Jun-05	-----	Connellsville/Morgantown	1262.95	145.0	1265.63	1130.23	1120.23	132.72	142.72	2	Upgradient Monitoring Well
B-402	Jun-05	-----	Connellsville/Morgantown	1263.12	155.0	1266.19	1118.66	1108.66	144.46	154.46	2	Upgradient Monitoring Well
B-403	Jun-05	-----	Connellsville/Morgantown	1224.47	118.0	1226.84	1116.55	1106.55	107.92	117.92	2	Upgradient Monitoring Well
B-405	Dec-10	-----	Connellsville/Morgantown	1231.11	152.0	1234.20	1116.48	1106.48	114.63	124.63	2	-----
B-406	Feb-08	-----	Connellsville/Morgantown	1227.47	144.0	1230.13	1102.16	1092.16	125.31	135.31	2	Downgradient Monitoring Well
B-407	Jul-06	-----	Connellsville/Morgantown	1233.15	150.0	1235.74	1108.19	1098.19	124.96	134.96	2	Downgradient Monitoring Well
B-408	Jul-06	-----	Connellsville/Morgantown	1238.07	138.0	1240.71	1118.76	1108.76	119.31	129.31	2	Downgradient Monitoring Well
B-409	Jul-06	-----	Connellsville/Morgantown	1245.12	127.5	1247.57	1143.37	1133.37	101.75	111.75	2	Downgradient Monitoring Well
B-410	Jun-05	-----	Connellsville/Morgantown	1242.79	137.0	1245.32	1132.00	1123.00	110.79	119.79	2	Downgradient Monitoring Well
B-411	Aug-05	-----	Connellsville/Morgantown	1237.07	139.0	1240.13	1121.50	1111.50	115.57	125.57	2	Downgradient Monitoring Well
B-412	Sep-05	-----	Connellsville/Morgantown	1233.74	128.0	1236.38	1115.96	1105.96	117.78	127.78	2	Downgradient Monitoring Well
B-413	Feb-08	-----	Connellsville/Morgantown	1240.11	107.0	1242.11	1148.12	1138.12	91.99	101.99	2	Downgradient Monitoring Well
B-413R	May-09	-----	Connellsville/Morgantown	1238.88	146.0	1241.61	1115.34	1105.34	123.54	133.54	2	Downgradient Monitoring Well
B-414	Aug-09	-----	Connellsville/Morgantown	1229.42	125.0	1231.50	1121.20	1111.20	108.22	118.22	2	Downgradient Monitoring Well
P-1	Sep-10	TBD	Connellsville/Morgantown	1327.11	270.0	1329.37	1138.72	1128.72	188.39	198.39	2	-----
P-5	Sep-10	TBD	Connellsville/Morgantown	1240.98	189.0	1243.49	1127.49	1117.49	113.49	123.49	2	-----
P-9	Sep-10	TBD	Connellsville/Morgantown	1256.94	163.0	1259.50	1122.70	1112.70	134.24	144.24	2	-----
P-12	Feb-11	TBD	Connellsville/Morgantown	1300.36	141.0	1303.25	1176.69	1166.69	123.67	133.67	2	-----
Bellaire / Summerfield Significant Zone of Saturation Monitoring Wells and Piezometers												
B-4S	Jun-91	TBD	Summerfield	1205.8	36.0	1206.81	1181.40	1172.00	24.4	33.8	2	-----
B-11S	Apr-95	TBD	Bellaire/Summerfield	1244.3	60.0	1246.63	1195.20	1185.80	49.1	58.5	2	6' of filter pack
B-101S*	Sep-94	Sep-08	Summerfield	1193.7	49.0	1196.44	1151.10	1146.40	42.6	47.3	2	Abandoned
B-104S*	Aug-94	Oct-04	Summerfield	1221.2	35.0	1223.22	1192.90	1188.60	28.3	32.6	2	Abandoned
B-105S	Sep-94	TBD	Bellaire	1227.7	44.6	1228.37	1198.30	1183.80	29.4	43.9	2	14.5' of screen; 4' of filter pack
B-106S*	Sep-94	Jan-06	Summerfield	1164.7	28.6	1166.36	1146.20	1136.70	18.5	28.0	2	Abandoned
B-201	Apr-95	TBD	Summerfield	1209.3	40.0	1210.63	1180.20	1170.80	29.1	38.5	2	-----
B-202	Apr-95	TBD	Summerfield	1201.1	31.5	1201.63	1179.70	1170.30	21.8	30.8	2	-----
B-203*	Apr-95	Jun-05	Bellaire	1213.7	40.0	1215.33	1194.90	1185.50	18.8	28.2	2	Abandoned
B-204*	Apr-95	Jul-07	Summerfield	1196.8	50.3	1198.25	1167.80	1158.40	29	38.4	2	-----
B-301*	Aug-95	Jan-06	Summerfield	1163.9	31.0	1166.37	1138.50	1134.20	25.4	29.7	2	Abandoned
B-302*	Aug-95	Jan-06	Bellaire	1173	22.0	1174.43	1164.00	1154.60	9	18.4	2	Abandoned
B-303*	Aug-95	Jul-07	Bellaire/Summerfield	1190.2	25.0	1192.12	1181.70	1172.30	8.5	17.9	2	-----
B-304*	Aug-95	Jul-07	Bellaire/Summerfield	1215.93	50.5	1218.13	1187.90	1178.00	27.7	37.6	2	-----
B-305*	Aug-95	Jul-07	Summerfield	1216.74	87.0	1218.43	1177.60	1167.70	38.3	48.2	2	4' of filter pack
B-306*	Aug-95	Jan-06	Bellaire/Summerfield	1201.4	30.3	1202.99	1182.60	1172.70	18.8	28.7	2	Abandoned

TABLE C3-1
SUMMARY OF MONITORING WELL AND PIEZOMETER INSTALLATION DATA
APEX LANDFILL LATERAL EXPANSION

Well No.	Date Installed	Date Abandoned	Stratigraphic Unit	Ground Elevation (ft. MSL)	Boring Total Depth (ft. BGS)	Top of Casing Elevation (ft. MSL)	Screen Interval (ft MSL)		Screen Interval (ft BGS)		Well Diameter (in.)	Comments
							Top	Bottom	Top	Bottom		
Bellaire / Summerfield Significant Zone of Saturation Monitoring Wells and Piezometers (Continued)												
B-307*	Unknown	Jul-07	Summerfield	1216.56	45.0	1218.96	1181.00	1171.60	34.00	44.00	2	-----
B-308	Unknown	TBD	Bellaire	Unknown		1220.84	1198.40	1189.00	Unknown		2	-----
B-309	Unknown	TBD	Summerfield	Unknown		1214.63	1190.30	1180.90	Unknown		2	-----
B-310	Unknown	TBD	Summerfield	Unknown		1254.20	1146.30	1137.00	Unknown		2	-----
B-311	Unknown	TBD	Summerfield	Unknown		1233.87	1145.80	1136.40	Unknown		2	-----
B-312*	May-96	Jul-07	Bellaire	1215.00	40.0	1217.00	1187.80	1177.90	27.20	36.70	2	-----
B-313*	May-96	Jul-07	Summerfield	1178.30	20.0	1179.84	1169.40	1159.50	8.90	18.80	2	-----
B-401S	Jun-05	-----	Bellaire/Summerfield	1275.52	115.0	1278.27	1170.20	1160.20	105.32	115.32	2	Downgradient Monitoring Well
B-402S	Jun-05	-----	Bellaire/Summerfield	1257.59	90.0	1258.61	1178.25	1168.25	79.34	89.34	2	Downgradient Monitoring Well
B-403S	Jun-05	-----	Bellaire/Summerfield	1275.55	134.5	1277.75	1150.92	1140.92	124.63	134.63	2	Downgradient Monitoring Well
B-405S	Dec-10	-----	Bellaire/Summerfield	1230.41	58.0	1233.55	1190.47	1180.47	39.94	49.94	2	-----
B-406S	Feb-08	-----	Bellaire/Summerfield	1227.54	73.0	1230.24	1169.92	1159.92	57.62	67.62	2	Downgradient Monitoring Well
B-407S	Jul-07	-----	Bellaire/Summerfield	1232.74	72.0	1235.55	1170.25	1165.25	62.49	67.49	2	Downgradient Monitoring Well
B-408S	Jul-06	-----	Bellaire/Summerfield	1238.80	60.0	1241.40	1193.49	1183.49	45.31	55.31	2	Downgradient Monitoring Well
B-408SS	Jul-06	-----	Fill	1238.80	32.0	1241.37	1213.55	1208.55	25.25	30.25	2	Downgradient Monitoring Well
B-409S	Jul-06	-----	Bellaire/Summerfield	1245.09	68.0	1247.55	1194.80	1184.80	50.29	60.29	2	Downgradient Monitoring Well
P-1S	Sep-10	TBD	Bellaire/Summerfield	1326.50	150.0	1329.18	1200.95	1190.95	125.55	135.55	2	-----
P-2S	Sep-10	TBD	Bellaire/Summerfield	1236.44	90.0	1238.75	1183.16	1173.16	53.28	63.28	2	-----
P-3S	Sep-10	TBD	Bellaire/Summerfield	1278.33	127.0	1281.02	1174.26	1164.26	104.07	114.07	2	-----
P-5S	Sep-10	TBD	Bellaire/Summerfield	1242.01	72.0	1244.40	1187.37	1177.37	54.64	64.64	2	-----
P-6S	Sep-10	TBD	Bellaire/Summerfield	1244.12	100.0	1246.75	1173.92	1163.92	70.20	80.20	2	-----
P-9S	Sep-10	TBD	Bellaire/Summerfield	1257.81	98.0	1260.76	1187.56	1177.56	70.25	80.25	2	-----
P-10S	Aug-10	TBD	Bellaire/Summerfield	1201.78	42.1	1204.05	1181.71	1176.71	20.07	25.07	2	-----
P-12S	Feb-11	TBD	Bellaire/Summerfield	1300.58	82.0	1303.04	1229.34	1219.34	71.24	81.24	2	-----
Mine Spoil Significant Zone of Saturation Monitoring Wells and Piezometers												
B-401A	Jul-06	-----	Mine Spoil	1266.75	50.0	1269.45	1226.15	1221.15	40.60	45.60	2	TBD
B-402A	Jul-06	-----	Mine Spoil	1258.03	60.0	1260.50	1232.62	1222.62	25.41	35.41	2	TBD
B-1A	Jul-91	TBD	Mine Spoil	1293.90	64.0	1296.4	1235.40	1231.40	58.50	62.50	2	4' of filter pack
B-2A	Jul-91	TBD	Mine Spoil	1265.50	46.0	1268.04	1226.50	1222.50	39.00	43.00	2	4' of filter pack
B-7A	Jul-91	TBD	Mine Spoil	1243.70	21.3	1246.18	1228.20	1224.20	15.50	19.50	2	-----
B-9A*	Jul-91	Sep-08	Mine Spoil	1256.50	26.0	1258.97	1235.50	1231.50	21.00	25.00	2	Abandoned
B-9C	Jul-91	NA	Mine Spoil	1261.80	26.0	NA	NA	NA	NA	NA	NA	Monitoring Well Never Installed
P-1A	Aug-10	TBD	Mine Spoil	1287.61	47.6	1290.04	1245.09	1240.09	42.52	47.52	2	-----
P-2A	Aug-10	TBD	Mine Spoil	1236.68	14.0	1239.05	1228.26	1223.26	8.42	13.42	2	-----
P-3A	Aug-10	TBD	Mine Spoil	1278.34	55.9	1280.87	1233.94	1223.94	44.40	54.40	2	-----
P-5A	Aug-10	TBD	Mine Spoil/Residual Soil	1241.24	28.4	1243.60	1225.09	1220.09	16.15	21.15	2	-----
P-7A	Aug-10	TBD	Mine Spoil	1263.93	42.1	1266.64	1231.15	1226.15	32.78	37.78	2	-----
P-8A	Aug-10	TBD	Mine Spoil/Residual Soil	1209.50	22.2	1211.20	1199.59	1194.59	9.91	14.91	2	-----
Limestone / Shallow Bedrock Significant Zone of Saturation Monitoring Wells and Piezometers												
P-1L	Sep-10	TBD	Limestone/Shallow Bedrock	1327.18	101.0	1330.30	1238.99	1228.99	88.19	98.19	2	-----
P-2L	Sep-10	TBD	Limestone/Shallow Bedrock	1236.62	32.0	1238.64	1215.62	1205.62	21.00	31.00	2	-----
P-3L	Sep-10	TBD	Limestone/Shallow Bedrock	1277.28	87.0	1279.00	1213.96	1203.96	63.32	73.32	2	-----
P-4L	Aug-10	TBD	Limestone/Shallow Bedrock	1260.88	54.1	1263.34	1218.47	1208.47	42.41	52.41	2	-----
P-5L	Sep-10	TBD	Limestone/Shallow Bedrock	1240.08	39.0	1242.43	1177.39	1167.39	62.69	72.69	2	-----
P-6L	Sep-10	TBD	Limestone/Shallow Bedrock	1243.35	37.0	1246.18	1216.18	1206.18	27.17	37.17	2	-----
P-10L	Sep-10	TBD	Limestone/Shallow Bedrock	1266.43	84.0	1268.83	1216.19	1206.19	50.24	60.24	2	-----
P-11L	Oct-10	TBD	Limestone/Shallow Bedrock	1257.31	53.0	1259.54	1215.85	1205.85	41.46	51.46	2	-----
Miscellaneous Wells												
B-103S*	Sep-94	Oct-04	Connellsville	1206.10	33.3	1208.17	1177.90	1173.40	28.20	32.70	2	Abandoned
B-1B	Jul-91	TBD	Birmingham/Gaysport	1293.50	193.0	1295.96	1129.50	1120.50	164.00	173.00	4	-----
B-10*	Jul-91	Jul-07	Gaysport	1254.80	207.0	1257.28	1069.60	1060.60	185.20	194.20	4	12' of filter pack

Notes:

* Abandoned Monitoring Well

TBD=To Be Determined

TABLE C3-1
SUMMARY OF SOIL BORING AND TEST PIT INSTALLATION DATA
APEX LANDFILL LATERAL EXPANSION

Soil Boring No.	Date Installed	Stratigraphic Unit	Ground Elevation (ft. MSL)	Boring Total Depth (ft. BGS)	Depth to Bedrock (ft. BGS)	Bedrock Elevation (ft. msl)	Comments
RB-1	8/4/2010	Mine Spoil	1244.84	39.5	39.2	1205.64	Abandoned
RB-2	8/4/2010	Mine Spoil / Residual Soil	1267.57	30.0	29.7	1237.87	Abandoned
RB-3	8/6/2010	Mine Spoil / Residual Soil	1288.49	49.5	49.1	1239.39	Abandoned
RB-4	8/5/2010	Residual Soil	1228.58	24.5	24.5	1204.08	Abandoned
RB-5	8/4/2010	Mine Spoil	1256.50	20.0	19.5	1237.00	Abandoned
RB-6	8/27/2010	Mine Spoil	1268.91	20.0	20.0	1248.91	Abandoned
RB-7	8/27/2010	Mine Spoil	1271.60	38.0	25.0	1246.60	Abandoned
RB-8	8/30/2010	Residual Soil	1248.16	27.8	27.5	1220.66	Abandoned
SB-01	8/10/2010	Mine Spoil	1326.69	74.1	74.0	1252.69	Abandoned
SB-02	8/6/2010	Mine Spoil	1299.77	25.1	22.0	1277.77	Abandoned
SB-03	8/3/2010	Mine Spoil	1281.21	46.1	42.0	1239.21	Abandoned
SB-04	8/26/2010	Mine Spoil	1287.61	47.6	47.5	1240.11	Converted to Piezometer P-1A
SB-05	8/3/2010	Mine Spoil	1282.17	31.2	20.0	1262.17	Abandoned
SB-06	8/2/2010	Mine Spoil	1278.34	55.9	42.0	1236.34	Converted to Piezometer P-3A
SB-07	8/4/2010	Mine Spoil	1236.68	14.0	13.8	1222.88	Converted to Piezometer P-2A
SB-08	8/25/2010	Residual Soil	1192.29	20.1	9.0	1183.29	Abandoned
SB-09	8/25/2010	Residual Soil	1201.13	19.0	7.0	1194.13	Abandoned
SB-10	8/11/2010	Mine Spoil	1260.88	54.1	44.0	1216.88	Converted to Piezometer P-4A
SB-11	8/24/2010	Mine Spoil	1266.09	41.0	36.8	1229.29	Abandoned
SB-12	8/19/2010	Mine Spoil / Residual Soil	1241.24	28.4	28.0	1213.24	Converted to Piezometer P-5A
SB-13	8/18/2010	Mine Spoil	1263.93	42.1	39.0	1224.93	Converted to Piezometer P-7A
SB-14	8/23/2010	Mine Spoil	1252.23	32.3	32.0	1220.23	Abandoned
SB-15	8/16/2010	Mine Spoil / Residual Soil	1201.78	42.1	17.0	1184.78	Converted to Piezometer P-6A
SB-16	8/17/2010	Residual Soil	1224.28	10.2	8.0	1216.28	Abandoned
SB-17	8/12/2010	Mine Spoil	1270.75	30.6	30.1	1240.65	Abandoned
SB-18	8/12/2010	Mine Spoil	1259.64	34.2	32.2	1227.44	Abandoned
SB-19	8/16/2010	Mine Spoil	1262.06	38.9	29.5	1232.56	Abandoned
SB-20	8/13/2010	Mine Spoil	1258.15	28.4	25.2	1232.95	Abandoned
SB-21	8/18/2010	Mine Spoil / Residual Soil	1209.50	22.2	14.0	1195.50	Converted to Piezometer P-8A
SB-22	8/25/2010	Mine Spoil / Residual Soil	1224.21	15.1	15.0	1209.21	Abandoned
SB-23	2/11/2011	Mine Spoil	1282.38	65.0	55.5	1226.88	Abandoned
SB-24	2/15/2011	Mine Spoil	1271.29	55.0	47.0	1224.29	Abandoned
SB-25	2/15/2011	Mine Spoil	1287.50	65.0	54.7	1232.80	Abandoned
SB-26	2/14/2011	Mine Spoil	1256.65	50.0	36.1	1220.55	Abandoned
New Test Pits for Expansion (TPE Only)							
TPE-2	9/23/2010	Mine Spoil	1249.21	11.0	7.5	1241.71	Back Filled Test Pit
TPE-3	9/23/2010	Topsoil	1244.63	3.0	1.0	1243.63	Back Filled Test Pit
TPE-4	9/23/2010	Minespoil	1249.13	11.5	11.0	1238.13	Back Filled Test Pit
TPE-5	9/23/2010	Minespoil	1265.53	12.0	NA	NA	Back Filled Test Pit
TPE-15	9/20/2010	Mine Spoil	1234.81	19.0	17.5	1217.31	Back Filled Test Pit
TPE-16	9/20/2010	Mine Spoil	1226.02	8.5	8.0	1218.02	Back Filled Test Pit
TPE-17	9/20/2010	Mine Spoil / Residual Soil	1212.81	17.0	16.0	1196.81	Back Filled Test Pit
TPE-18	9/21/2010	Mine Spoil / Residual Soil	1231.70	18.5	15.0	1216.70	Back Filled Test Pit
TPE-19	9/21/2010	Residual Soil	1210.02	8.5	8.0	1202.02	Back Filled Test Pit
TPE-20	9/21/2010	Mine Spoil / Residual Soil	1224.49	16.0	6.0	1218.49	Back Filled Test Pit
TPE-21	9/22/2010	Mine Spoil / Residual Soil	1219.66	10.0	4.0	1215.66	Back Filled Test Pit
TPE-22	9/22/2010	Residual Soil	1231.85	13.0	4.0	1227.85	Back Filled Test Pit
TPE-23/24	9/22/2010	Residual Soil	1220.98	12.0	1.5	1219.48	Back Filled Test Pit
TPE-25	9/22/2010	Residual Soil	1206.75	10.0	5.0	1201.75	Back Filled Test Pit

TABLE C3-2
SUMMARY OF ODNR WELL LOG CONSTRUCTION INFORMATION
REGIONAL WELLS WITHIN ONE MILE OF THE SITE
APEX LANDFILL LATERAL EXPANSION

ODNR Well No.	Estimated Formation Members	Approximate Ground Elevation (ft. msl)	Approximate Static Groundwater Elevation (ft. msl)	Depth to Water (Feet)	Total Well Depth (Feet)	Test Pumping Rate (GPM)	Test Duration (hours)	Observed Drawdown (S) (Feet)	Available Drawdown (S') (Feet)	Estimated Yield (GPM)
15	Connellsville / Morgantown	1160	ND	ND	80	30	0.5	ND	ND	ND
79	Connellsville / Morgantown	1140	1082	58	124	2.0	48.0	124	66	ND
81	Morgantown	1265	1150	114.5	163	15.0	0.5	6	49	121.3
82	Summerfield / Morgantown	1300	1179	121	170	12.5	2.0	49	49	12.5
83	Connellsville / Gaysport	1260	1150	110	172	6.0	2.0	60	62	6.2
92	Connellsville / Morgantown	1220	1131	89	155	ND	ND	ND	66	ND
93A	Summerfield	1220	1185	35	50	9.0	1.0	ND	15	ND
94	Summerfield	1215	1188	27	39	18.0	1.0	14	12	15.4
95	Connellsville / Morgantown	1230	1170	60	157	ND	ND	ND	97	ND
96	Connellsville / Morgantown	1250	1182	68	155	10.0	1.0	26	87	33.5
97	Connellsville / Morgantown	1240	1180	60	120	12.0	2.0	ND	60	ND
98	Connellsville / Morgantown	1250	1150	100	146	20.0	2.0	10	46	92.0
99	Summerfield / Morgantown	1250	1183	67	157	11.0	2.0	90	90	11.0
115	Birmingham / Ames	1195	1133	62	129	2.0	1.0	20	67	6.7
992542 [1]	Morgantown / Birmingham	1289	1169	120	245	50.0	4.0	200	125	ND
992543 [1]	Morgantown/Birmingham/Bloomfield	1107	1072	35	185	1.5	4.0	100	150	2.3
Average Regional Yield						14.21	Average Estimated Yield (GPM):			33.4

Notes

Average Estimated Yield (GPM) without wells 81, 96 & 98: 9.0

S = Drawdown from Well Log Data

S' = Total Depth of Well - Static Water Level

Y = Pumping Rate (GPM) x ((Available Drawdown S')/(Drawdown S))

Not used in estimated yield calculation because observed drawdown exceeded available drawdown

Not used in average estimated yield calculation because estimated yield considerably higher than other calculated yields

ND = No Data Available

1 = Apex Landfill Water Supply Wells

* = Assumed 1 foot of drawdown to calculate the specific capacity

ODNR well log records identified within approximately one mile of the facility.

TABLE C3-3
LABORATORY TEST RESULTS SUMMARY
APEX LANDFILL LATERAL EXPANSION
APEX ENVIRONMENTAL, LLC

Origin	Boring/Test Pit Number	Sample Depth (ft)	Sample Number	Moisture Content (%)	Specific Gravity	Atterberg Limits		USDA Classification				% Passing 2" Sieve (%)	% Passing 3/4" Sieve (%)	% Passing No. 200 Sieve (%)	USCS Symbol	USCS Description	In-Situ Wet Density (pcf)	In-Situ Dry Density (pcf)	Optimum Moisture Content (%)	Maximum Dry Density (pcf)	Effective Stress		Total Stress		Effective Stress		Unconfined Compressive Strength (psf)	Average Hydraulic Conductivity (cm/sec)
						Liquid Limit (%)	Plastic Limit (%)	Gravel (%)	Sand (%)	Silt (%)	Clay (%)										Cohesion (psf)	Angle of Friction (degrees)	Cohesion (psf)	Angle of Friction (degrees)	Cohesion (psf)	Angle of Friction (degrees)		
				ASTM D 2216	ASTM D 854	ASTM D 4318		ASTM D 422									ASTM D 2937		ASTM D 698		ASTM D 4767				ASTM D 3080		ASTM D 2166	ASTM D 5084
Mine Spoil	RB-1	14 - 19	B-1	22.5	--	43	18	3.60	17.40	48.00	31.00	100.00	99.70	84.50	CL	Lean Clay With Sand	--	--	17.1	103.1	158	29.3	173	14.6	--	--	--	--
Residual	RB-3	20 - 24	B-1	12.9	2.69	37	14	10.10	26.00	36.20	27.70	100.00	99.10	68.00	CL	Sandy Lean Clay	--	--	13.9	111.5	--	--	--	--	--	--	--	--
Residual	RB-4	19 - 24	B-1	27.4	2.56	45	19	6.30	18.40	37.50	37.80	100.00	99.80	79.30	CL	Lean Clay With Sand	--	--	21.1	98.4	--	--	--	--	--	--	--	--
Residual	RB-8	23 - 27	B-1	35.6	--	56	24	3.40	10.70	41.80	44.20	100.00	99.30	90.20	CH	Fat Clay	--	--	18.4	94.1	144	26.6	58	15.8	--	--	--	--
Mine Spoil	SB-1	26 - 28	SS-13	6.2	--	33	20	5.10	19.20	55.10	20.60	100.00	100.00	82.00	CL	Lean Clay With Sand	--	--	--	--	--	--	--	--	--	--	--	--
Mine Spoil	SB-1	58 - 66	B-1	12.9	--	40	18	21.20	19.80	32.70	26.30	100.00	98.70	62.90	CL	Sandy Lean Clay	--	--	14.2	113.1	173	25.7	317	13.8	--	--	--	--
Mine Spoil	SB-2	22 - 24	SS-12	12.6	--	33	19	45.70	15.40	28.00	10.90	100.00	86.70	41.40	GC	Clayey Gravel With Sand	--	--	--	--	--	--	--	--	--	--	--	--
Mine Spoil	SB-3	11.5 - 13.5	ST-1	10.5	--	38	18	0.00	9.80	74.10	16.10	100.00	100.00	97.60	CL	Lean Clay	141.4	128.0	--	--	--	--	--	--	1,094	29.3	--	--
Mine Spoil	SB-4	28 - 30	ST-1	9.1	--	37	19	11.40	25.70	39.50	23.40	100.00	96.80	66.10	CL	Sandy Lean Clay	121.6	111.4	--	--	--	--	--	--	14	29.1	--	2.00E-07
Mine Spoil	SB-5	6 - 8	SS-4	12.3	--	37	19	54.10	24.50	16.10	5.20	100.00	71.40	25.10	GC	Clayey Gravel With Sand	--	--	--	--	--	--	--	--	--	--	--	--
Mine Spoil	SB-6	8 - 9	ST-1	8.2	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Mine Spoil	SB-6	9 - 10	ST-2	9.5	2.72	34	19	44.90	25.10	21.70	8.30	100.00	85.20	32.60	GC	Clayey Gravel With Sand	130.7	119.3	--	--	--	--	--	--	--	--	--	7.40E-08
Mine Spoil	SB-6	30 - 32	SS-15	14.7	--	37	19	25.60	31.30	26.20	16.80	100.00	100.00	45.40	SC	Clayey Sand	--	--	--	--	--	--	--	--	--	--	--	--
Mine Spoil	SB-8	2 - 4	ST-1	15.4	--	35	21	5.20	27.00	51.90	15.80	100.00	100.00	74.10	CL	Lean Clay With Sand	130.8	113.4	--	--	--	--	--	--	173	32.2	--	3.70E-05
Mine Spoil	SB-8	6 - 8	SS-3	10.6	--	30	19	18.70	32.10	35.20	14.00	100.00	92.50	53.70	CL	Sandy Lean Clay	--	--	--	--	--	--	--	--	--	--	--	--
Residual	SB-9	0 - 2	SS-1	14.7	--	46	22	12.70	20.00	39.80	27.50	100.00	100.00	70.00	CL	Lean Clay With Sand	--	--	--	--	--	--	--	--	--	--	--	--
Mine Spoil	SB-11	14 - 16	SS-8	13.4	--	40	21	9.40	26.30	42.00	22.30	100.00	100.00	70.30	CL	Lean Clay With Sand	--	--	--	--	--	--	--	--	--	--	--	--
Mine Spoil	SB-12	16 - 18	SS-9	23.6	--	50	25	0.00	(1)	(1)	(1)	100.00	100.00	79.10	CH	Fat Clay With Sand	--	--	--	--	--	34.8	28.8	23.1	--	--	--	--
Mine Spoil	SB-14	10 - 12	ST-1	21.6	--	48	22	14.40	28.50	38.70	18.40	100.00	93.80	60.80	CL	Sandy Lean Clay	125.9	103.5	--	--	--	--	--	--	--	--	--	1.70E-07
Mine Spoil	SB-14	16 - 20	B-1	24.9	--	46	19	6.70	15.40	40.6	37.4	100.00	99.80	81.50	CL	Lean Clay With Sand	--	--	20.3	102.4	274	26.2	302	13.1	--	--	--	--
Mine Spoil	SB-14	25 - 25.5	ST-2	38.1	--	81	48	0.00	37.40	36.20	26.50	100.00	100.00	72.50	MH	Elastic Silt With Sand	87.1	52.8	--	--	--	--	--	--	158	34.1	238	--
Mine Spoil	SB-14	26.5 - 27	ST-2	65.0	--	54	23	0.00	4.50	46.70	48.80	100.00	100.00	96.90	CH	Fat Clay	106.1	76.8	--	--	--	--	--	--	274	23.8	--	--
Mine Spoil	SB-16	0.5 - 2.5	ST-1	21.9	2.70	60	26	0.00	4.70	40.50	54.90	100.00	100.00	98.00	CH	Fat Clay	118.4	97.1	--	--	--	--	--	--	734	20.9	--	--
Mine Spoil	SB-16	1 - 3	ST-1	20.9	--	42	20	0.00	20.30	41.30	38.50	100.00	100.00	82.70	CL	Lean Clay With Sand	126.1	104.3	--	--	187	26.3	518	15.0	--	--	--	--
Residual	SB-15	4 - 6	SS-3	13.6	--	36	11	10.50	26.70	27.50	35.30	100.00	100.00	65.20	CL	Sandy Lean Clay	--	--	--	--	--	--	--	--	--	--	--	--
Mine Spoil	SB-17	6 - 8	SS-4	13.9	--	38	10	13.60	(1)	(1)	(1)	100.00	100.00	54.70	CL	Sandy Lean Clay	--	--	--	--	--	--	--	--	--	--	--	--
Mine Spoil	SB-17	16 - 18	ST-1	16.4	2.70	40	21	34.90	21.10	28.10	16.00	100.00	85.50	46.10	SC	Clayey Sand	114.8	98.6	--	--	--	--	--	--	--	--	--	--
Mine Spoil	SB-17	18 - 20	ST-2	10.1	--	37	18	25.90	27.50	31.20	15.30	100.00	93.90	49.80	SC	Clayey Sand With Gravel	125.7	114.2	--	--	--	--	--	--	--	--	--	7.10E-08
Mine Spoil	SB-18	10 - 12	ST-1	17.9	2.71	42	21	21.30	23.40	34.40	21.00	100.00	97.10	57.60	CL	Sandy Lean Clay With Gravel	132.3	112.2	--	--	--	--	--	--	--	--	--	--
Mine Spoil	SB-18	22 - 24	ST-3	15.4	--	39	22	31.00	23.60	32.70	12.70	100.00	85.90	47.90	GC	Clayey Gravel With Sand	126.1	109.2	--	--	--	--	--	--	--	--	--	7.00E-07
Mine Spoil	SB-18	28 - 30	SS-11	17.3	--	41	20	41.70	(1)	(1)	(1)	100.00	100.00	38.20	GC	Clayey Gravel With Sand	--	--	--	--	--	--	--	--	--	--	--	--
Mine Spoil	SB-19	11 - 13	ST-1	16.1	--	41	19	8.80	23.40	41.0	26.8	100.00	100.00	70.60	CL	Lean Clay With Sand	128.6	110.8	--	--	--	--	--	--	--	--	--	2.70E-06
Mine Spoil	SB-20	16 - 18, 17 - 19	ST-1, ST-2	20.3	--	35	17	48.20	21.60	18.30	11.90	82.30	76.20	31.50	GC	Clayey Gravel With Sand	138.5	115.2	--	--	259	27.7	274	14.3	--	--	--	--
Residual	SB-21	9 - 11	ST-1	13.4	2.77	42	20	17.70	14.60	42.60	25.10	100.00	98.50	74.20	CL	Lean Clay With Gravel	137.2	121.0	--	--	--	--	--	--	--	--	--	--
Residual	TPE-17	12 - 14	ST-1	14.9	--	32	17	12.20	35.00	38.90	14.00	100.00	98.50	58.10	CL	Sandy Lean Clay	138.0	120.1	--	--	720	28.4	1195	12.7	--	--	--	--
Residual	TPE-18	12 - 14	ST-1	22.4	2.77	42	20	11.80	22.30	41.50	24.30	100.00	99.00	69.10	CL	Sandy Lean Clay	128.1	104.6	--	--	--	--	--	--	--	--	--	--
Residual	TPE-18	18 - 19.7	ST-2	11.9	--	32	19	24.50	37.80	30.10	7.60	100.00	100.00	44.40	SC	Clayey Sand With Gravel	137.1	122.5	--	--	--	--	--	--	--	--	--	5.70E-06
Residual	TPE-19	2 - 4	ST-1	14.6	--	41	23	7.10	21.10	51.00	20.70	100.00	100.00	75.90	CL	Lean Clay With Sand	140.2	122.3	--	--	230	32.6	202	21.4	--	--	--	--
Residual	TPE-21	2 - 4	ST-1	21.8	--	44	23	0.40	53.30	39.40	6.80	100.00	100.00	53.20	CL	Sandy Lean Clay	133.3	109.5	--	--	--	--	--	--	--	--	--	3.80E-06
HIGHEST VALUE				65.0	2.77	81	48	54.10	53.30	74.10	54.90	100.00	100.00	98.00	--	--	141.4	128.0	21.1	113.1	720	34.8	1195	23.1	1094	34.1	--	3.70E-05
LOWEST VALUE				6.2	2.56	30	10	0.00	4.50	16.10	5.20	82.30	71.40	25.10	--	--	87.1	52.8	13.9	94.1	144	25.7	29	12.7	14	20.9	--	7.10E-08
AVERAGE				18.1	2.70	42	20	16.00	23.17	37.90	23.14	99.53	96.25	64.51	--	--	127.0	107.9	17.5	103.8	268	28.6	341	16.0	408	28.2	--	5.60E-06

Notes:

1. Hydrometer was unable to be performed due to lack of material

TABLE C3-4
SUMMARY OF HYDRAULIC CONDUCTIVITY TEST RESULTS (SINGLE WELL SLUG TEST)
APEX LANDFILL LATERAL EXPANSION

Well / Boring ID	Total Depth (ft. bgs)	TOC Elevation (ft. msl)	Screened Interval[1] (ft. msl)		K Value (cm/sec)	K Value (ft/sec)	K Value (ft/day)	K Value (m/day)	K Value (gpd/ft^2)
			Top	Bottom					
Morgantown/Connersville Uppermost Aquifer Monitoring Wells									
P-1	198.39	1329.37	1139.54	1129.54	4.44E-05	1.45E-06	1.26E-01	3.83E-02	9.37E-01
P-5	123.49	1243.49	1127.98	1117.98	1.98E-03	6.50E-05	5.61E+00	1.71E+00	4.19E+01
P-9	144.24	1259.50	1122.94	1112.94	2.62E-03	8.57E-05	7.40E+00	2.26E+00	5.52E+01
B-12	182.20	1284.83	1110.10	1100.10	2.97E-03	9.73E-05	8.41E+00	2.56E+00	6.27E+01
B-401	142.72	1265.63	1130.95	1120.95	1.20E-03	3.92E-05	3.38E+00	1.03E+00	2.53E+01
Max	na	na	na	na	2.97E-03	9.73E-05	8.41E+00	2.56E+00	6.27E+01
Min	na	na	na	na	4.44E-05	1.45E-06	1.26E-01	3.83E-02	9.37E-01
Geo. Mean	na	na	na	na	9.61E-04	3.15E-05	2.72E+00	8.28E-01	2.03E+01
Bellaire/Summerfield Significant Saturated Zone Monitoring Wells									
B-11S	58.50	1246.63	1195.80	1185.80	5.47E-07	1.79E-08	1.55E-03	4.72E-04	1.16E-02
P-2S	63.28	1238.75	1183.44	1173.44	3.74E-04	1.22E-05	1.06E+00	3.23E-01	7.89E+00
P-3S	114.07	1281.02	1184.33	1174.33	5.84E-04	1.91E-05	1.65E+00	5.04E-01	1.23E+01
P-6S	80.20	1246.75	1174.12	1164.12	1.97E-05	6.47E-07	5.59E-02	1.70E-02	4.17E-01
P-9S	80.25	1260.76	1187.81	1177.81	3.63E-05	1.19E-06	1.03E-01	3.13E-02	7.66E-01
P-10S	25.07	1204.05	1181.78	1176.78	2.16E-05	7.07E-07	6.11E-02	1.86E-02	4.56E-01
Max	na	na	na	na	5.84E-04	1.91E-05	1.65E+00	5.04E-01	1.23E+01
Min	na	na	na	na	5.47E-07	1.79E-08	1.55E-03	4.72E-04	1.16E-02
Geo. Mean	na	na	na	na	3.50E-05	1.15E-06	9.92E-02	3.02E-02	7.40E-01
Mine Spoil Significant Saturated Zone Monitoring Wells									
P-2A	13.42	1239.05	1228.13	1223.13	1.09E-02	3.57E-04	3.08E+01	9.40E+00	2.30E+02
P-3A	54.40	1280.87	1251.34	1223.94	7.71E-05	2.52E-06	2.18E-01	6.65E-02	1.63E+00
P-7A	37.78	1266.64	1230.93	1225.93	5.89E-05	1.93E-06	1.67E-01	5.09E-02	1.24E+00
Max	na	na	na	na	1.09E-02	3.57E-04	3.08E+01	9.40E+00	2.30E+02
Min	na	na	na	na	5.89E-05	1.93E-06	1.67E-01	5.09E-02	1.24E+00
Geo. Mean	na	na	na	na	3.67E-04	1.20E-05	1.04E+00	3.17E-01	7.75E+00
Limestone/Shallow Bedrock Significant Saturated Zone Monitoring Wells									
P-2L	31.00	1238.64	1210.72	1205.62	2.23E-03	7.31E-05	6.32E+00	1.93E+00	4.71E+01
P-3L	73.32	1279.00	1214.28	1204.38	1.83E-04	5.99E-06	5.18E-01	1.58E-01	3.87E+00
P-4L	52.41	1263.34	1217.38	1207.38	2.10E-02	6.87E-04	5.94E+01	1.81E+01	4.43E+02
P-5L	72.69	1242.43	1207.58	1202.58	1.54E-04	5.04E-06	4.35E-01	1.33E-01	3.25E+00
P-6L	37.17	1246.18	1211.35	1208.65	3.07E-05	1.01E-06	8.68E-02	2.65E-02	6.48E-01
P-10L	60.24	1268.83	1216.43	1206.43	4.80E-03	1.57E-04	1.36E+01	4.14E+00	1.01E+02
Max	na	na	na	na	2.10E-02	6.87E-04	5.94E+01	1.81E+01	4.43E+02
Min	na	na	na	na	3.07E-05	1.01E-06	8.68E-02	2.65E-02	6.48E-01
Geo. Mean	na	na	na	na	7.61E-04	2.49E-05	2.15E+00	6.57E-01	1.61E+01

Notes:

[1] - Screened interval includes the sand pack above and if present, below the screen.

TABLE C3-5
PIEZOMETER P-1
HYDRAULIC CONDUCTIVITY RESULTS FROM PACKER TESTING
APEX LANDFILL LATERAL EXPANSION

PACKER TESTS

Boring:	P-1	Length of Packer (ft):	3
Date:	9/28/2010	Packer inflation pressure (psi):	200
Depth of Boring:	270	Length of test section (feet):	10
Bore Hole Size:	5	Distance pressure gauge is above ground:	5
Water Level (bgs ft):	178.9	Height of water swivel above ground:	5

Test Interval	Water level in 6" ID Cylinder	Drop in water level (feet)	Conversion to ft^3	Water Take (gal)	Pressure of Test (psi)	Time Lapse (min)	Flow Rate (ft^3/min)	H (ft)	k ft/min	k ft/day	k ft/year	k cm/sec	Sceen Zone	Comments
85-95	29.00	Start Test												
	23.65	5.35	1.073	8.02	10	1	1.073	118.1	5.60E-04	8.06E-01	294.3	2.28E-03	YES P-1L	Complete Water Loss
95-105	29.20	Start Test												
	28.50	0.70	0.140	1.05	10	1	0.140	128.1	6.75E-05	9.73E-02	35.5	2.75E-04		Limestone / Shallow Bedrock
	28.31	0.19	0.038	0.28	10	2	0.038	128.1	1.83E-05	2.64E-02	9.6	7.47E-05		Limestone / Shallow Bedrock
	28.10	0.21	0.042	0.31	10	3	0.042	128.1	2.03E-05	2.92E-02	10.7	8.26E-05		Limestone / Shallow Bedrock
	27.92	0.18	0.036	0.27	10	4	0.036	128.1	1.74E-05	2.50E-02	9.1	7.08E-05		Limestone / Shallow Bedrock
	27.78	0.14	0.028	0.21	10	5	0.028	128.1	1.35E-05	1.95E-02	7.1	5.51E-05		Limestone / Shallow Bedrock
	27.52	0.26	0.052	0.39	10	6	0.052	128.1	2.51E-05	3.61E-02	13.2	1.02E-04		Limestone / Shallow Bedrock
	26.90	Start Test												
	26.56	0.34	0.068	0.51	20	7	0.068	151.2	2.78E-05	4.00E-02	14.6	1.13E-04		Limestone / Shallow Bedrock
	26.30	0.26	0.052	0.39	20	8	0.052	151.2	2.13E-05	3.06E-02	11.2	8.66E-05		Limestone / Shallow Bedrock
	26.00	0.30	0.060	0.45	20	9	0.060	151.2	2.45E-05	3.53E-02	12.9	9.99E-05		Limestone / Shallow Bedrock
	25.71	0.29	0.058	0.43	20	10	0.058	151.2	2.37E-05	3.41E-02	12.5	9.66E-05		Limestone / Shallow Bedrock
	29.50	Start Test												
	28.15	1.35	0.271	2.02	30	13	0.271	174.3	9.57E-05	1.38E-01	50.3	3.90E-04		Limestone / Shallow Bedrock
	27.81	0.34	0.068	0.51	30	14	0.068	174.3	2.41E-05	3.47E-02	12.7	9.83E-05		Limestone / Shallow Bedrock
	27.48	0.33	0.066	0.49	30	15	0.066	174.3	2.34E-05	3.37E-02	12.3	9.54E-05		Limestone / Shallow Bedrock
	27.12	0.36	0.072	0.54	30	16	0.072	174.3	2.55E-05	3.68E-02	13.4	1.04E-04		Limestone / Shallow Bedrock
	26.60	Start Test												
	26.14	0.46	0.092	0.69	40	18	0.092	197.4	2.88E-05	4.15E-02	15.1	1.17E-04		Limestone / Shallow Bedrock
	25.66	0.48	0.096	0.72	40	19	0.096	197.4	3.01E-05	4.33E-02	15.8	1.22E-04		Limestone / Shallow Bedrock
	25.10	0.56	0.112	0.84	40	20	0.112	197.4	3.51E-05	5.05E-02	18.4	1.43E-04		Limestone / Shallow Bedrock
	25.10	0.00	0.000	0.00	40	21	0.000	197.4	0.00E+00	0.00E+00	0.0	0.00E+00		Limestone / Shallow Bedrock
105-115	28.50	Start Test												
	28.45	0.05	0.010	0.07	10	1	0.010	138.1	4.48E-06	6.44E-03	2.4	1.82E-05		Bellaire / Summersfield
	28.43	0.02	0.004	0.03	10	2	0.004	138.1	1.79E-06	2.58E-03	0.9	7.30E-06		Bellaire / Summersfield
	28.41	0.02	0.004	0.03	10	3	0.004	138.1	1.79E-06	2.58E-03	0.9	7.30E-06		Bellaire / Summersfield
	28.39	0.02	0.004	0.03	10	4	0.004	138.1	1.79E-06	2.58E-03	0.9	7.30E-06		Bellaire / Summersfield
	28.37	0.02	0.004	0.03	10	5	0.004	138.1	1.79E-06	2.58E-03	0.9	7.30E-06		Bellaire / Summersfield
	28.17	Start Test												
	28.15	0.02	0.004	0.03	20	7	0.004	161.2	1.53E-06	2.21E-03	0.8	6.25E-06		Bellaire / Summersfield
	28.12	0.03	0.006	0.04	20	8	0.006	161.2	2.30E-06	3.31E-03	1.2	9.37E-06		Bellaire / Summersfield
	28.10	0.02	0.004	0.03	20	9	0.004	161.2	1.53E-06	2.21E-03	0.8	6.25E-06		Bellaire / Summersfield
	28.08	0.02	0.004	0.03	20	10	0.004	161.2	1.53E-06	2.21E-03	0.8	6.25E-06		Bellaire / Summersfield
	27.88	Start Test												
	27.86	0.02	0.004	0.03	30	12	0.004	184.3	1.34E-06	1.93E-03	0.7	5.47E-06		Bellaire / Summersfield
	27.83	0.03	0.006	0.04	30	13	0.006	184.3	2.01E-06	2.90E-03	1.1	8.20E-06		Bellaire / Summersfield
	27.80	0.03	0.006	0.04	30	14	0.006	184.3	2.01E-06	2.90E-03	1.1	8.20E-06		Bellaire / Summersfield
	27.77	0.03	0.006	0.04	30	15	0.006	184.3	2.01E-06	2.90E-03	1.1	8.20E-06		Bellaire / Summersfield
	27.63	Start Test												
	27.60	0.03	0.006	0.04	40	17	0.006	207.4	1.79E-06	2.57E-03	0.9	7.29E-06		Bellaire / Summersfield
	27.55	0.05	0.010	0.07	40	18	0.010	207.4	2.98E-06	4.29E-03	1.6	1.21E-05		Bellaire / Summersfield
	27.51	0.04	0.008	0.06	40	19	0.008	207.4	2.38E-06	3.43E-03	1.3	9.72E-06		Bellaire / Summersfield
	27.45	0.06	0.012	0.09	40	20	0.012	207.4	3.58E-06	5.15E-03	1.9	1.46E-05		Bellaire / Summersfield

TABLE C3-5
PIEZOMETER P-1
HYDRAULIC CONDUCTIVITY RESULTS FROM PACKER TESTING
APEX LANDFILL LATERAL EXPANSION

Test Interval	Water level in 6" ID Cylinder	Drop in water level (feet)	Conversion to ft^3	Water Take (gal)	Pressure of Test (psi)	Time Lapse (min)	Flow Rate (ft^3/min)	H (ft)	k ft/min	k ft/day	k ft/year	k cm/sec	Sceen Zone	Comments
115-125	29.12	Start Test												
	29.09	0.03	0.006	0.04	10	1	0.006	148.1	2.50E-06	3.61E-03	1.3	1.02E-05		Bellaire / Summersfield
	29.08	0.01	0.002	0.01	10	2	0.002	148.1	8.35E-07	1.20E-03	0.4	3.40E-06		Bellaire / Summersfield
	29.08	0.00	0.000	0.00	10	3	0.000	148.1	0.00E+00	0.00E+00	0.0	0.00E+00		Bellaire / Summersfield
	29.08	0.00	0.000	0.00	10	4	0.000	148.1	0.00E+00	0.00E+00	0.0	0.00E+00		Bellaire / Summersfield
	29.08	0.00	0.000	0.00	10	5	0.000	148.1	0.00E+00	0.00E+00	0.0	0.00E+00		Bellaire / Summersfield
	28.62	Start Test												
	28.62	0.00	0.000	0.00	20	7	0.000	171.2	0.00E+00	0.00E+00	0.0	0.00E+00		Bellaire / Summersfield
	28.62	0.00	0.000	0.00	20	8	0.000	171.2	0.00E+00	0.00E+00	0.0	0.00E+00		Bellaire / Summersfield
	28.61	0.01	0.002	0.01	20	9	0.002	171.2	7.22E-07	1.04E-03	0.4	2.94E-06		Bellaire / Summersfield
	28.61	0.00	0.000	0.00	20	10	0.000	171.2	0.00E+00	0.00E+00	0.0	0.00E+00		Bellaire / Summersfield
	28.38	Start Test												
	28.37	0.01	0.002	0.01	30	12	0.002	194.3	6.36E-07	9.16E-04	0.3	2.59E-06		Bellaire / Summersfield
	28.36	0.01	0.002	0.01	30	13	0.002	194.3	6.36E-07	9.16E-04	0.3	2.59E-06		Bellaire / Summersfield
	28.35	0.01	0.002	0.01	30	14	0.002	194.3	6.36E-07	9.16E-04	0.3	2.59E-06		Bellaire / Summersfield
	28.34	0.01	0.002	0.01	30	15	0.002	194.3	6.36E-07	9.16E-04	0.3	2.59E-06		Bellaire / Summersfield
	28.20	Start Test												
	28.18	0.02	0.004	0.03	40	17	0.004	217.4	1.14E-06	1.64E-03	0.6	4.63E-06		Bellaire / Summersfield
	28.16	0.02	0.004	0.03	40	18	0.004	217.4	1.14E-06	1.64E-03	0.6	4.63E-06		Bellaire / Summersfield
	28.15	0.01	0.002	0.01	40	19	0.002	217.4	5.69E-07	8.19E-04	0.3	2.32E-06		Bellaire / Summersfield
	28.14	0.01	0.002	0.01	40	20	0.002	217.4	5.69E-07	8.19E-04	0.3	2.32E-06		Bellaire / Summersfield
125-135	29.10	Start Test												
	25.42	3.68	0.738	5.52	10	1	0.738	158.1	2.88E-04	4.14E-01	151.2	1.17E-03	YES	P-1S Screened Interval
	24.50	0.92	0.184	1.38	10	2	0.184	158.1	7.19E-05	1.04E-01	37.8	2.93E-04	YES	~122-136
	23.65	0.85	0.170	1.27	10	3	0.170	158.1	6.65E-05	9.57E-02	34.9	2.71E-04	YES	Complete Water Loss
135-145	28.78	Start Test												
	28.75	0.03	0.006	0.04	10	1	0.006	168.1	2.21E-06	3.18E-03	1.2	8.99E-06		Bellaire / Summersfield
	28.74	0.01	0.002	0.01	10	2	0.002	168.1	7.35E-07	1.06E-03	0.4	3.00E-06		Bellaire / Summersfield
	28.73	0.01	0.002	0.01	10	3	0.002	168.1	7.35E-07	1.06E-03	0.4	3.00E-06		Bellaire / Summersfield
	28.73	0.00	0.000	0.00	10	4	0.000	168.1	0.00E+00	0.00E+00	0.0	0.00E+00		Bellaire / Summersfield
	28.73	0.00	0.000	0.00	10	5	0.000	168.1	0.00E+00	0.00E+00	0.0	0.00E+00		Bellaire / Summersfield
	28.32	Start Test												
	28.32	0.00	0.000	0.00	20	7	0.000	191.2	0.00E+00	0.00E+00	0.0	0.00E+00		Bellaire / Summersfield
	28.31	0.01	0.002	0.01	20	8	0.002	191.2	6.46E-07	9.31E-04	0.3	2.63E-06		Bellaire / Summersfield
	28.30	0.01	0.002	0.01	20	9	0.002	191.2	6.46E-07	9.31E-04	0.3	2.63E-06		Bellaire / Summersfield
	28.29	0.01	0.002	0.01	20	10	0.002	191.2	6.46E-07	9.31E-04	0.3	2.63E-06		Bellaire / Summersfield
	28.01	Start Test												
	28.00	0.01	0.002	0.01	30	12	0.002	214.3	5.77E-07	8.31E-04	0.3	2.35E-06		Bellaire / Summersfield
	27.99	0.01	0.002	0.01	30	13	0.002	214.3	5.77E-07	8.31E-04	0.3	2.35E-06		Bellaire / Summersfield
	27.97	0.02	0.004	0.03	30	14	0.004	214.3	1.15E-06	1.66E-03	0.6	4.70E-06		Bellaire / Summersfield
	27.92	0.05	0.010	0.07	30	15	0.010	214.3	2.88E-06	4.15E-03	1.5	1.18E-05		Bellaire / Summersfield
	25.50	Start Test												
	23.65	1.85	0.371	2.77	40	17	0.371	237.4	9.63E-05	1.39E-01	50.6	3.93E-04		Complete Water Loss
145-155	28.12	Start Test												
	28.00	0.12	0.024	0.18	10	1	0.024	178.1	8.33E-06	1.20E-02	4.4	3.39E-05		Bellaire / Summersfield
	27.99	0.01	0.002	0.01	10	2	0.002	178.1	6.94E-07	9.99E-04	0.4	2.83E-06		Bellaire / Summersfield
	27.99	0.00	0.000	0.00	10	3	0.000	178.1	0.00E+00	0.00E+00	0.0	0.00E+00		Bellaire / Summersfield
	27.99	0.00	0.000	0.00	10	4	0.000	178.1	0.00E+00	0.00E+00	0.0	0.00E+00		Bellaire / Summersfield
	27.99	0.00	0.000	0.00	10	5	0.000	178.1	0.00E+00	0.00E+00	0.0	0.00E+00		Bellaire / Summersfield
	27.60	Start Test												
	27.11	0.49	0.098	0.73	20	7	0.098	201.2	3.01E-05	4.33E-02	15.8	1.23E-04		Bellaire / Summersfield
	27.11	0.00	0.000	0.00	20	8	0.000	201.2	0.00E+00	0.00E+00	0.0	0.00E+00		Bellaire / Summersfield
	27.11	0.00	0.000	0.00	20	9	0.000	201.2	0.00E+00	0.00E+00	0.0	0.00E+00		Bellaire / Summersfield
	27.11	0.00	0.000	0.00	20	10	0.000	201.2	0.00E+00	0.00E+00	0.0	0.00E+00		Bellaire / Summersfield

TABLE C3-5
PIEZOMETER P-1
HYDRAULIC CONDUCTIVITY RESULTS FROM PACKER TESTING
APEX LANDFILL LATERAL EXPANSION

Test Interval	Water level in 6" ID Cylinder	Drop in water level (feet)	Conversion to ft^3	Water Take (gal)	Pressure of Test (psi)	Time Lapse (min)	Flow Rate (ft^3/min)	H (ft)	k ft/min	k ft/day	k ft/year	k cm/sec	Sceen Zone	Comments
145-155	29.23	Start Test												
	25.56	3.67	0.736	5.50	30	12	0.736	224.3	2.02E-04	2.91E-01	106.3	8.24E-04		Bellaire / Summersfield
	25.56	0.00	0.000	0.00	30	13	0.000	224.3	0.00E+00	0.00E+00	0.0	0.00E+00		Bellaire / Summersfield
	25.56	0.00	0.000	0.00	30	14	0.000	224.3	0.00E+00	0.00E+00	0.0	0.00E+00		Bellaire / Summersfield
	25.55	0.01	0.002	0.01	30	15	0.002	224.3	5.51E-07	7.94E-04	0.3	2.25E-06		Bellaire / Summersfield
	25.54	0.01	0.002	0.01	30	16	0.002	224.3	5.51E-07	7.94E-04	0.3	2.25E-06		Bellaire / Summersfield
	25.52	0.02	0.004	0.03	30	17	0.004	224.3	1.10E-06	1.59E-03	0.6	4.49E-06		Bellaire / Summersfield
	25.51	0.01	0.002	0.01	30	18	0.002	224.3	5.51E-07	7.94E-04	0.3	2.25E-06		Bellaire / Summersfield
	25.50	0.01	0.002	0.01	30	19	0.002	224.3	5.51E-07	7.94E-04	0.3	2.25E-06		Bellaire / Summersfield
	29.05	Start Test												
	27.86	1.19	0.239	1.78	40	21	0.239	247.4	5.95E-05	8.56E-02	31.3	2.42E-04		Bellaire / Summersfield
	27.83	0.03	0.006	0.04	40	22	0.006	247.4	1.50E-06	2.16E-03	0.8	6.11E-06		Bellaire / Summersfield
	27.80	0.03	0.006	0.04	40	23	0.006	247.4	1.50E-06	2.16E-03	0.8	6.11E-06		Bellaire / Summersfield
	27.77	0.03	0.006	0.04	40	24	0.006	247.4	1.50E-06	2.16E-03	0.8	6.11E-06		Bellaire / Summersfield
	27.74	0.03	0.006	0.04	40	25	0.006	247.4	1.50E-06	2.16E-03	0.8	6.11E-06		Bellaire / Summersfield
155-165	29.04	Start Test												
	28.10	0.94	0.188	1.41	10	1	0.188	188.1	6.18E-05	8.90E-02	32.5	2.52E-04		Bellaire / Summersfield
	28.06	0.04	0.008	0.06	10	2	0.008	188.1	2.63E-06	3.79E-03	1.4	1.07E-05		Bellaire / Summersfield
	28.05	0.01	0.002	0.01	10	3	0.002	188.1	6.57E-07	9.46E-04	0.3	2.68E-06		Bellaire / Summersfield
	28.04	0.01	0.002	0.01	10	4	0.002	188.1	6.57E-07	9.46E-04	0.3	2.68E-06		Bellaire / Summersfield
	28.02	0.02	0.004	0.03	10	5	0.004	188.1	1.31E-06	1.89E-03	0.7	5.36E-06		Bellaire / Summersfield
	28.00	0.02	0.004	0.03	10	6	0.004	188.1	1.31E-06	1.89E-03	0.7	5.36E-06		Bellaire / Summersfield
	27.69	Start Test												
	27.67	0.02	0.004	0.03	20	8	0.004	211.2	1.17E-06	1.69E-03	0.6	4.77E-06		Bellaire / Summersfield
	27.64	0.03	0.006	0.04	20	9	0.006	211.2	1.76E-06	2.53E-03	0.9	7.16E-06		Bellaire / Summersfield
	27.60	0.04	0.008	0.06	20	10	0.008	211.2	2.34E-06	3.37E-03	1.2	9.54E-06		Bellaire / Summersfield
	27.59	0.01	0.002	0.01	20	11	0.002	211.2	5.85E-07	8.43E-04	0.3	2.39E-06		Bellaire / Summersfield
	27.57	0.02	0.004	0.03	20	12	0.004	211.2	1.17E-06	1.69E-03	0.6	4.77E-06		Bellaire / Summersfield
	27.39	Start Test												
	27.35	0.04	0.008	0.06	30	14	0.008	234.3	2.11E-06	3.04E-03	1.1	8.60E-06		Bellaire / Summersfield
	27.32	0.03	0.006	0.04	30	15	0.006	234.3	1.58E-06	2.28E-03	0.8	6.45E-06		Bellaire / Summersfield
	27.28	0.04	0.008	0.06	30	16	0.008	234.3	2.11E-06	3.04E-03	1.1	8.60E-06		Bellaire / Summersfield
	27.25	0.03	0.006	0.04	30	17	0.006	234.3	1.58E-06	2.28E-03	0.8	6.45E-06		Bellaire / Summersfield
	27.21	0.04	0.008	0.06	30	18	0.008	234.3	2.11E-06	3.04E-03	1.1	8.60E-06		Bellaire / Summersfield
	27.05	Start Test												
	27.03	0.02	0.004	0.03	40	20	0.004	257.4	9.60E-07	1.38E-03	0.5	3.91E-06		Bellaire / Summersfield
	26.97	0.06	0.012	0.09	40	21	0.012	257.4	2.88E-06	4.15E-03	1.5	1.17E-05		Bellaire / Summersfield
	26.90	0.07	0.014	0.10	40	22	0.014	257.4	3.36E-06	4.84E-03	1.8	1.37E-05		Bellaire / Summersfield
	26.86	0.04	0.008	0.06	40	23	0.008	257.4	1.92E-06	2.77E-03	1.0	7.83E-06		Bellaire / Summersfield
165-175	29.12	Start Test												
	25.11	4.01	0.804	6.01	10	1	0.804	198.1	2.50E-04	3.60E-01	131.5	1.02E-03		Bellaire / Summersfield
	24.70	0.41	0.082	0.61	10	2	0.082	198.1	2.56E-05	3.68E-02	13.4	1.04E-04		Bellaire / Summersfield
	23.65	1.05	0.211	1.57	10	3	0.211	198.1	6.55E-05	9.43E-02	34.4	2.67E-04		Complete Water Loss
175-185	29.18	Start Test												
	29.18	0.00	0.000	0.00	10	1	0.000	208.1	0.00E+00	0.00E+00	0.0	0.00E+00		Bellaire / Summersfield
	29.18	0.00	0.000	0.00	10	2	0.000	208.1	0.00E+00	0.00E+00	0.0	0.00E+00		Bellaire / Summersfield
	29.18	0.00	0.000	0.00	10	3	0.000	208.1	0.00E+00	0.00E+00	0.0	0.00E+00		Bellaire / Summersfield
	29.18	0.00	0.000	0.00	10	4	0.000	208.1	0.00E+00	0.00E+00	0.0	0.00E+00		Bellaire / Summersfield
	29.18	0.00	0.000	0.00	10	5	0.000	208.1	0.00E+00	0.00E+00	0.0	0.00E+00		Bellaire / Summersfield

TABLE C3-5
PIEZOMETER P-1
HYDRAULIC CONDUCTIVITY RESULTS FROM PACKER TESTING
APEX LANDFILL LATERAL EXPANSION

Test Interval	Water level in 6" ID Cylinder	Drop in water level (feet)	Conversion to ft^3	Water Take (gal)	Pressure of Test (psi)	Time Lapse (min)	Flow Rate (ft^3/min)	H (ft)	k ft/min	k ft/day	k ft/year	k cm/sec	Sceen Zone	Comments
175-185	28.53	Start Test												
	28.53	0.00	0.000	0.00	20	7	0.000	231.2	0.00E+00	0.00E+00	0.0	0.00E+00		Connellsville / Morgantown
	28.53	0.00	0.000	0.00	20	8	0.000	231.2	0.00E+00	0.00E+00	0.0	0.00E+00		Connellsville / Morgantown
	28.53	0.00	0.000	0.00	20	9	0.000	231.2	0.00E+00	0.00E+00	0.0	0.00E+00		Connellsville / Morgantown
	28.53	0.00	0.000	0.00	20	10	0.000	231.2	0.00E+00	0.00E+00	0.0	0.00E+00		Connellsville / Morgantown
	28.23	Start Test												
	28.22	0.01	0.002	0.01	30	12	0.002	254.3	4.86E-07	7.00E-04	0.3	1.98E-06		Connellsville / Morgantown
	28.22	0.00	0.000	0.00	30	13	0.000	254.3	0.00E+00	0.00E+00	0.0	0.00E+00		Connellsville / Morgantown
	28.21	0.01	0.002	0.01	30	14	0.002	254.3	4.86E-07	7.00E-04	0.3	1.98E-06		Connellsville / Morgantown
	28.21	0.00	0.000	0.00	30	15	0.000	254.3	0.00E+00	0.00E+00	0.0	0.00E+00		Connellsville / Morgantown
	28.02	Start Test												
	28.00	0.02	0.004	0.03	40	17	0.004	277.4	8.91E-07	1.28E-03	0.5	3.63E-06		Connellsville / Morgantown
	27.92	0.08	0.016	0.12	40	18	0.016	277.4	3.56E-06	5.13E-03	1.9	1.45E-05		Connellsville / Morgantown
	27.79	0.13	0.026	0.19	40	19	0.026	277.4	5.79E-06	8.34E-03	3.0	2.36E-05		Connellsville / Morgantown
	27.49	0.30	0.060	0.45	40	20	0.060	277.4	1.34E-05	1.93E-02	7.0	5.45E-05		Connellsville / Morgantown
	27.27	0.22	0.044	0.33	40	21	0.044	277.4	9.80E-06	1.41E-02	5.2	4.00E-05		Connellsville / Morgantown
185-195	29.19	Start Test												
	26.70	2.49	0.499	3.73	10	1	0.499	218.1	1.41E-04	2.03E-01	74.2	5.75E-04	YES	P-1 Screened Interval
	25.75	0.95	0.190	1.42	10	2	0.190	218.1	5.38E-05	7.75E-02	28.3	2.19E-04	YES	~185-199
	24.85	0.90	0.180	1.35	10	3	0.180	218.1	5.10E-05	7.35E-02	26.8	2.08E-04	YES	Connellsville / Morgantown
	23.65	1.20	0.241	1.80	10	4	0.241	218.1	6.80E-05	9.79E-02	35.7	2.77E-04	YES	Complete Water Loss
	29.18	Start Test												
	26.75	2.43	0.487	3.64	20	5	0.487	241.2	1.25E-04	1.79E-01	65.5	5.07E-04	YES	Connellsville / Morgantown
	25.65	1.10	0.221	1.65	20	6	0.221	241.2	5.64E-05	8.12E-02	29.6	2.30E-04	YES	Connellsville / Morgantown
	24.50	1.15	0.231	1.72	20	7	0.231	241.2	5.89E-05	8.49E-02	31.0	2.40E-04	YES	Connellsville / Morgantown
	23.65	0.85	0.170	1.27	20	8	0.170	241.2	4.36E-05	6.27E-02	22.9	1.78E-04	YES	Complete Water Loss
	29.24	Start Test												
	26.10	3.14	0.630	4.71	30	10	0.630	264.3	1.47E-04	2.11E-01	77.2	5.98E-04	YES	Connellsville / Morgantown
	25.75	0.35	0.070	0.52	30	11	0.070	264.3	1.64E-05	2.36E-02	8.6	6.67E-05	YES	Connellsville / Morgantown
	24.60	1.15	0.231	1.72	30	12	0.231	264.3	5.38E-05	7.74E-02	28.3	2.19E-04	YES	Connellsville / Morgantown
	23.65	0.95	0.190	1.42	30	13	0.190	264.3	4.44E-05	6.40E-02	23.4	1.81E-04	YES	Complete Water Loss
	29.18	Start Test												
	26.65	2.53	0.507	3.79	40	15	0.507	287.4	1.09E-04	1.57E-01	57.2	4.43E-04	YES	Connellsville / Morgantown
	25.15	1.50	0.301	2.25	40	16	0.301	287.4	6.45E-05	9.29E-02	33.9	2.63E-04	YES	Connellsville / Morgantown
	23.65	1.50	0.301	2.25	40	17	0.301	287.4	6.45E-05	9.29E-02	33.9	2.63E-04	YES	Complete Water Loss
195-205	29.15	Start Test												
	28.74	0.41	0.082	0.61	10	1	0.082	228.1	2.22E-05	3.20E-02	11.7	9.05E-05		Connellsville / Morgantown
	28.49	0.25	0.050	0.37	10	2	0.050	228.1	1.35E-05	1.95E-02	7.1	5.52E-05		Connellsville / Morgantown
	28.35	0.14	0.028	0.21	10	3	0.028	228.1	7.59E-06	1.09E-02	4.0	3.09E-05		Connellsville / Morgantown
	28.15	0.20	0.040	0.30	10	4	0.040	228.1	1.08E-05	1.56E-02	5.7	4.42E-05		Connellsville / Morgantown
	27.36	Start Test												
	27.22	0.14	0.028	0.21	20	5	0.028	251.2	6.89E-06	9.92E-03	3.6	2.81E-05		Connellsville / Morgantown
	27.00	0.22	0.044	0.33	20	6	0.044	251.2	1.08E-05	1.56E-02	5.7	4.41E-05		Connellsville / Morgantown
	26.76	0.24	0.048	0.36	20	7	0.048	251.2	1.18E-05	1.70E-02	6.2	4.81E-05		Connellsville / Morgantown
	26.66	0.10	0.020	0.15	20	8	0.020	251.2	4.92E-06	7.09E-03	2.6	2.01E-05		Connellsville / Morgantown
	26.46	0.20	0.040	0.30	20	9	0.040	251.2	9.84E-06	1.42E-02	5.2	4.01E-05		Connellsville / Morgantown
	26.31	0.15	0.030	0.22	20	10	0.030	251.2	7.38E-06	1.06E-02	3.9	3.01E-05		Connellsville / Morgantown
	25.60	Start Test												
	25.30	0.30	0.060	0.45	30	12	0.060	274.3	1.35E-05	1.95E-02	7.1	5.51E-05		Connellsville / Morgantown
	25.03	0.27	0.054	0.40	30	13	0.054	274.3	1.22E-05	1.75E-02	6.4	4.96E-05		Connellsville / Morgantown
	24.73	0.30	0.060	0.45	30	14	0.060	274.3	1.35E-05	1.95E-02	7.1	5.51E-05		Connellsville / Morgantown
	23.65	1.08	0.217	1.62	30	15	0.217	274.3	4.87E-05	7.01E-02	25.6	1.98E-04		Complete Water Loss
	29.13	Start Test												
	28.66	0.47	0.094	0.70	40	17	0.094	297.4	1.95E-05	2.81E-02	10.3	7.96E-05		Connellsville / Morgantown
	28.30	0.36	0.072	0.54	40	18	0.072	297.4	1.50E-05	2.15E-02	7.9	6.10E-05		Connellsville / Morgantown
	28.00	0.30	0.060	0.45	40	19	0.060	297.4	1.25E-05	1.80E-02	6.6	5.08E-05		Connellsville / Morgantown
	27.74	0.26	0.052	0.39	40	20	0.052	297.4	1.08E-05	1.56E-02	5.7	4.40E-05		Connellsville / Morgantown
	27.45	0.29	0.058	0.43	40	21	0.058	297.4	1.21E-05	1.74E-02	6.3	4.91E-05		Connellsville / Morgantown

TABLE C3-5
PIEZOMETER P-1
HYDRAULIC CONDUCTIVITY RESULTS FROM PACKER TESTING
APEX LANDFILL LATERAL EXPANSION

Test Interval	Water level in 6" ID Cylinder	Drop in water level (feet)	Conversion to ft^3	Water Take (gal)	Pressure of Test (psi)	Time Lapse (min)	Flow Rate (ft^3/min)	H (ft)	k ft/min	k ft/day	k ft/year	k cm/sec	Sceen Zone	Comments
205-215	27.30	Start Test												
	23.65	3.65	0.732	5.47	10	1	0.732	238.1	1.89E-04	2.73E-01	99.6	7.72E-04		Complete Water Loss
215-225	29.09	Start Test												
	28.15	0.94	0.188	1.41	10	1	0.188	248.1	4.68E-05	6.74E-02	24.6	1.91E-04		Connellsville / Morgantown
	28.06	0.09	0.018	0.13	10	2	0.018	248.1	4.48E-06	6.46E-03	2.4	1.83E-05		Connellsville / Morgantown
	27.99	0.07	0.014	0.10	10	3	0.014	248.1	3.49E-06	5.02E-03	1.8	1.42E-05		Connellsville / Morgantown
	27.92	0.07	0.014	0.10	10	4	0.014	248.1	3.49E-06	5.02E-03	1.8	1.42E-05		Connellsville / Morgantown
	27.85	0.07	0.014	0.10	10	5	0.014	248.1	3.49E-06	5.02E-03	1.8	1.42E-05		Connellsville / Morgantown
	27.37	Start Test												
	27.30	0.07	0.014	0.10	20	7	0.014	271.2	3.19E-06	4.59E-03	1.7	1.30E-05		Connellsville / Morgantown
	27.22	0.08	0.016	0.12	20	8	0.016	271.2	3.65E-06	5.25E-03	1.9	1.49E-05		Connellsville / Morgantown
	27.13	0.09	0.018	0.13	20	9	0.018	271.2	4.10E-06	5.91E-03	2.2	1.67E-05		Connellsville / Morgantown
	27.09	0.04	0.008	0.06	20	10	0.008	271.2	1.82E-06	2.63E-03	1.0	7.43E-06		Connellsville / Morgantown
	26.97	0.12	0.024	0.18	20	11	0.024	271.2	5.47E-06	7.88E-03	2.9	2.23E-05		Connellsville / Morgantown
	26.88	0.09	0.018	0.13	20	12	0.018	271.2	4.10E-06	5.91E-03	2.2	1.67E-05		Connellsville / Morgantown
	26.55	Start Test												
	26.45	0.10	0.020	0.15	30	14	0.020	294.3	4.20E-06	6.05E-03	2.2	1.71E-05		Connellsville / Morgantown
	26.33	0.12	0.024	0.18	30	15	0.024	294.3	5.04E-06	7.26E-03	2.6	2.05E-05		Connellsville / Morgantown
	26.24	0.09	0.018	0.13	30	16	0.018	294.3	3.78E-06	5.44E-03	2.0	1.54E-05		Connellsville / Morgantown
	26.15	0.09	0.018	0.13	30	17	0.018	294.3	3.78E-06	5.44E-03	2.0	1.54E-05		Connellsville / Morgantown
	25.97	0.18	0.036	0.27	30	18	0.036	294.3	7.56E-06	1.09E-02	4.0	3.08E-05		Connellsville / Morgantown
	25.74	Start Test												
	25.66	0.08	0.016	0.12	40	20	0.016	317.4	3.12E-06	4.49E-03	1.6	1.27E-05		Connellsville / Morgantown
	25.54	0.12	0.024	0.18	40	21	0.024	317.4	4.67E-06	6.73E-03	2.5	1.90E-05		Connellsville / Morgantown
	25.46	0.08	0.016	0.12	40	22	0.016	317.4	3.12E-06	4.49E-03	1.6	1.27E-05		Connellsville / Morgantown
	25.35	0.11	0.022	0.16	40	23	0.022	317.4	4.28E-06	6.17E-03	2.3	1.75E-05		Connellsville / Morgantown
	25.25	0.10	0.020	0.15	40	24	0.020	317.4	3.89E-06	5.61E-03	2.0	1.59E-05		Connellsville / Morgantown
225-235	29.18	Start Test												
	23.65	5.53	1.109	8.29	10	1	1.109	258.1	2.65E-04	3.81E-01	139.2	1.08E-03		Complete Water Loss
235-245	29.18	Start Test												
	25.70	3.48	0.698	5.22	10	1	0.698	268.1	1.60E-04	2.31E-01	84.3	6.54E-04		Connellsville / Morgantown
	23.65	2.05	0.411	3.07	10	15	0.411	268.1	9.45E-05	1.36E-01	49.7	3.85E-04		Complete Water Loss
	29.25	Start Test												
	23.65	5.60	1.123	8.40	20	1	1.123	291.2	2.38E-04	3.42E-01	124.9	9.69E-04		Complete Water Loss
245-255	29.15	Start Test												
	28.43	0.72	0.144	1.08	10	1	0.144	278.1	3.20E-05	4.61E-02	16.8	1.30E-04		Connellsville / Morgantown
	28.27	0.16	0.032	0.24	10	2	0.032	278.1	7.11E-06	1.02E-02	3.7	2.90E-05		Connellsville / Morgantown
	28.10	0.17	0.034	0.25	10	3	0.034	278.1	7.56E-06	1.09E-02	4.0	3.08E-05		Connellsville / Morgantown
	27.85	0.25	0.050	0.37	10	4	0.050	278.1	1.11E-05	1.60E-02	5.8	4.53E-05		Connellsville / Morgantown
	27.68	0.17	0.034	0.25	10	5	0.034	278.1	7.56E-06	1.09E-02	4.0	3.08E-05		Connellsville / Morgantown
	27.55	0.13	0.026	0.19	10	6	0.026	278.1	5.78E-06	8.32E-03	3.0	2.35E-05		Connellsville / Morgantown
	27.10	Start Test												
	26.88	0.22	0.044	0.33	20	8	0.044	301.2	9.03E-06	1.30E-02	4.7	3.68E-05		Connellsville / Morgantown
	26.70	0.18	0.036	0.27	20	9	0.036	301.2	7.39E-06	1.06E-02	3.9	3.01E-05		Connellsville / Morgantown
	26.47	0.23	0.046	0.34	20	10	0.046	301.2	9.44E-06	1.36E-02	5.0	3.85E-05		Connellsville / Morgantown
	26.25	0.22	0.044	0.33	20	11	0.044	301.2	9.03E-06	1.30E-02	4.7	3.68E-05		Connellsville / Morgantown
	25.10	1.15	0.231	1.72	20	12	0.231	301.2	4.72E-05	6.80E-02	24.8	1.92E-04		Connellsville / Morgantown
	25.85	Start Test												
	25.63	0.22	0.044	0.33	30	14	0.044	324.3	8.39E-06	1.21E-02	4.4	3.42E-05		Connellsville / Morgantown
	25.46	0.17	0.034	0.25	30	15	0.034	324.3	6.48E-06	9.33E-03	3.4	2.64E-05		Connellsville / Morgantown
	25.32	0.14	0.028	0.21	30	16	0.028	324.3	5.34E-06	7.68E-03	2.8	2.17E-05		Connellsville / Morgantown
	25.19	0.13	0.026	0.19	30	17	0.026	324.3	4.96E-06	7.14E-03	2.6	2.02E-05		Connellsville / Morgantown
	24.94	Start Test												
	24.85	0.09	0.018	0.13	40	19	0.018	347.4	3.20E-06	4.61E-03	1.7	1.31E-05		Connellsville / Morgantown
	24.68	0.17	0.034	0.25	40	20	0.034	347.4	6.05E-06	8.71E-03	3.2	2.47E-05		Connellsville / Morgantown
	24.52	0.16	0.032	0.24	40	21	0.032	347.4	5.69E-06	8.20E-03	3.0	2.32E-05		Connellsville / Morgantown
	24.35	0.17	0.034	0.25	40	22	0.034	347.4	6.05E-06	8.71E-03	3.2	2.47E-05		Connellsville / Morgantown

TABLE C3-5
PIEZOMETER P-1
HYDRAULIC CONDUCTIVITY RESULTS FROM PACKER TESTING
APEX LANDFILL LATERAL EXPANSION

Test Interval	Water level in 6" ID Cylinder	Drop in water level (feet)	Conversion to ft^3	Water Take (gal)	Pressure of Test (psi)	Time Lapse (min)	Flow Rate (ft^3/min)	H (ft)	k ft/min	k ft/day	k ft/year	k cm/sec	Sceen Zone	Comments
255-265	29.18	Start Test												
	28.49	0.69	0.138	1.03	10	1	0.138	288.1	2.96E-05	4.26E-02	15.6	1.21E-04		Connellsville / Morgantown
	28.23	0.26	0.052	0.39	10	2	0.052	288.1	1.12E-05	1.61E-02	5.9	4.55E-05		Connellsville / Morgantown
	28.10	0.13	0.026	0.19	10	3	0.026	288.1	5.58E-06	8.03E-03	2.9	2.27E-05		Connellsville / Morgantown
	27.98	0.12	0.024	0.18	10	4	0.024	288.1	5.15E-06	7.41E-03	2.7	2.10E-05		Connellsville / Morgantown
	27.88	0.10	0.020	0.15	10	5	0.020	288.1	4.29E-06	6.18E-03	2.3	1.75E-05		Connellsville / Morgantown
	27.76	0.12	0.024	0.18	10	6	0.024	288.1	5.15E-06	7.41E-03	2.7	2.10E-05		Connellsville / Morgantown
	27.07	Start Test												
	26.87	0.20	0.040	0.30	20	8	0.040	311.2	7.94E-06	1.14E-02	4.2	3.24E-05		Connellsville / Morgantown
	26.74	0.13	0.026	0.19	20	9	0.026	311.2	5.16E-06	7.44E-03	2.7	2.10E-05		Connellsville / Morgantown
	26.55	0.19	0.038	0.28	20	10	0.038	311.2	7.55E-06	1.09E-02	4.0	3.08E-05		Connellsville / Morgantown
	26.40	0.15	0.030	0.22	20	11	0.030	311.2	5.96E-06	8.58E-03	3.1	2.43E-05		Connellsville / Morgantown
	26.33	0.07	0.014	0.10	20	12	0.014	311.2	2.78E-06	4.00E-03	1.5	1.13E-05		Connellsville / Morgantown
	25.95	Start Test												
	25.87	0.08	0.016	0.12	30	14	0.016	334.3	2.96E-06	4.26E-03	1.6	1.21E-05		Connellsville / Morgantown
	25.60	0.27	0.054	0.40	30	15	0.054	334.3	9.98E-06	1.44E-02	5.2	4.07E-05		Connellsville / Morgantown
	25.47	0.13	0.026	0.19	30	16	0.026	334.3	4.81E-06	6.92E-03	2.5	1.96E-05		Connellsville / Morgantown
	25.30	0.17	0.034	0.25	30	17	0.034	334.3	6.29E-06	9.05E-03	3.3	2.56E-05		Connellsville / Morgantown
	25.13	0.17	0.034	0.25	30	18	0.034	334.3	6.29E-06	9.05E-03	3.3	2.56E-05		Connellsville / Morgantown
	24.87	Start Test												
	24.79	0.08	0.016	0.12	40	20	0.016	357.4	2.77E-06	3.98E-03	1.5	1.13E-05		Connellsville / Morgantown
	24.70	0.09	0.018	0.13	40	21	0.018	357.4	3.11E-06	4.48E-03	1.6	1.27E-05		Connellsville / Morgantown
	24.52	0.18	0.036	0.27	40	22	0.036	357.4	6.23E-06	8.96E-03	3.3	2.54E-05		Connellsville / Morgantown
	24.36	0.16	0.032	0.24	40	23	0.032	357.4	5.53E-06	7.97E-03	2.9	2.26E-05		Connellsville / Morgantown
	24.21	0.15	0.030	0.22	40	24	0.030	357.4	5.19E-06	7.47E-03	2.7	2.11E-05		Connellsville / Morgantown
265-270	29.18	Start Test												
	28.40	0.78	0.156	1.17	10	1	0.156	295.6	3.26E-05	4.70E-02	17.1	1.33E-04		Connellsville / Morgantown
	28.25	0.15	0.030	0.22	10	2	0.030	295.6	6.27E-06	9.03E-03	3.3	2.56E-05		Connellsville / Morgantown
	28.12	0.13	0.026	0.19	10	3	0.026	295.6	5.44E-06	7.83E-03	2.9	2.22E-05		Connellsville / Morgantown
	28.01	0.11	0.022	0.16	10	4	0.022	295.6	4.60E-06	6.62E-03	2.4	1.87E-05		Connellsville / Morgantown
	27.90	0.11	0.022	0.16	10	5	0.022	295.6	4.60E-06	6.62E-03	2.4	1.87E-05		Connellsville / Morgantown
	27.36	Start Test												
	27.27	0.09	0.018	0.13	20	7	0.018	318.7	3.49E-06	5.03E-03	1.8	1.42E-05		Connellsville / Morgantown
	27.10	0.17	0.034	0.25	20	8	0.034	318.7	6.59E-06	9.49E-03	3.5	2.69E-05		Connellsville / Morgantown
	26.97	0.13	0.026	0.19	20	9	0.026	318.7	5.04E-06	7.26E-03	2.7	2.05E-05		Connellsville / Morgantown
	26.84	0.13	0.026	0.19	20	10	0.026	318.7	5.04E-06	7.26E-03	2.7	2.05E-05		Connellsville / Morgantown
	26.70	0.14	0.028	0.21	20	11	0.028	318.7	5.43E-06	7.82E-03	2.9	2.21E-05		Connellsville / Morgantown
	26.24	Start Test												
	26.03	0.21	0.042	0.31	30	13	0.042	341.8	7.59E-06	1.09E-02	4.0	3.09E-05		Connellsville / Morgantown
	25.90	0.13	0.026	0.19	30	14	0.026	341.8	4.70E-06	6.77E-03	2.5	1.92E-05		Connellsville / Morgantown
	25.72	0.18	0.036	0.27	30	15	0.036	341.8	6.51E-06	9.37E-03	3.4	2.65E-05		Connellsville / Morgantown
	25.28	0.44	0.088	0.66	30	16	0.088	341.8	1.59E-05	2.29E-02	8.4	6.48E-05		Connellsville / Morgantown
	25.42	-0.14												Test Void
	25.15	Start Test												
	25.00	0.15	0.030	0.22	40	19	0.030	364.9	5.08E-06	7.32E-03	2.7	2.07E-05		Connellsville / Morgantown
	25.81	-0.81												Test Void
	24.66	1.15	0.231	1.72	40	21	0.231	364.9	3.90E-05	5.61E-02	20.5	1.59E-04		Connellsville / Morgantown
	24.50	0.16	0.032	0.24	40	22	0.032	364.9	5.42E-06	7.80E-03	2.8	2.21E-05		Connellsville / Morgantown
	24.35	0.15	0.030	0.22	40	23	0.030	364.9	5.08E-06	7.32E-03	2.7	2.07E-05		Connellsville / Morgantown

TABLE C3-5
PIEZOMETER P-5
HYDRAULIC CONDUCTIVITY RESULTS FROM PACKER TESTING
APEX LANDFILL LATERAL EXPANSION

PACKER TESTS

Boring:	P-5	Length of Packer (ft):	3
Date:	9/21/2010	Packer inflation pressure (psi)	200
Depth of Boring:	189	Length of test section (feet):	10
Bore Hole Size:	5	Distance pressure gauge is above ground:	5
Water Level (bgs ft):	91.53	Height of water swivel above ground:	5

Test Interval	Water level in 6" ID Cylinder	Drop in water level (feet)	Conversion to ft^3	Water Take (gal)	Pressure of Test (psi)	Time Lapse (min)	Flow Rate (ft^3/min)	H (ft)	k ft/min	k ft/day	k ft/year	k cm/sec	Sceen Zone	Comments
29-39	29.30	Start Test												
	23.65	5.65	1.133	8.47	10	1	1.133	62.1	1.12E-03	1.62E+00	591.1	4.58E-03	YES P-5L	Complete Water Loss
39-49	29.30	Start Test												
	29.18	0.12	0.024	0.18	10	1	0.024	72.1	2.06E-05	2.96E-02	10.8	8.38E-05		Estimated Drop in Water Level
	29.06	0.12	0.024	0.18	10	2	0.024	72.1	2.06E-05	2.96E-02	10.8	8.38E-05		Estimated Drop in Water Level
	28.94	0.12	0.024	0.18	10	3	0.024	72.1	2.06E-05	2.96E-02	10.8	8.38E-05		Estimated Drop in Water Level
	28.82	0.12	0.024	0.18	10	4	0.024	72.1	2.06E-05	2.96E-02	10.8	8.38E-05		Estimated Drop in Water Level
	28.70	0.12	0.024	0.18	10	5	0.024	72.1	2.06E-05	2.96E-02	10.8	8.38E-05		Limestone / Shallow Bedrock
	28.64	Start Test												
	28.58	0.06	0.012	0.09	20	7	0.012	95.2	7.79E-06	1.12E-02	4.1	3.17E-05		Estimated Drop in Water Level
	28.52	0.06	0.012	0.09	20	8	0.012	95.2	7.79E-06	1.12E-02	4.1	3.17E-05		Estimated Drop in Water Level
	28.46	0.06	0.012	0.09	20	9	0.012	95.2	7.79E-06	1.12E-02	4.1	3.17E-05		Estimated Drop in Water Level
	28.40	0.06	0.012	0.09	20	10	0.012	95.2	7.79E-06	1.12E-02	4.1	3.17E-05		Estimated Drop in Water Level
	28.34	Start Test												
	28.28	0.06	0.012	0.09	30	12	0.012	118.3	6.27E-06	9.03E-03	3.3	2.55E-05		Estimated Drop in Water Level
	28.20	0.08	0.016	0.12	30	13	0.016	118.3	8.36E-06	1.20E-02	4.4	3.41E-05		Limestone / Shallow Bedrock
	28.05	0.15	0.030	0.22	30	14	0.030	118.3	1.57E-05	2.26E-02	8.2	6.39E-05		Limestone / Shallow Bedrock
	27.91	0.14	0.028	0.21	30	15	0.028	118.3	1.46E-05	2.11E-02	7.7	5.96E-05		Limestone / Shallow Bedrock
	27.68	Start Test												
	27.05	0.63	0.126	0.94	40	17	0.126	141.4	5.51E-05	7.93E-02	28.9	2.24E-04		Limestone / Shallow Bedrock
	26.78	0.27	0.054	0.40	40	18	0.054	141.4	2.36E-05	3.40E-02	12.4	9.62E-05		Limestone / Shallow Bedrock
	26.51	0.27	0.054	0.40	40	19	0.054	141.4	2.36E-05	3.40E-02	12.4	9.62E-05		Limestone / Shallow Bedrock
	26.25	0.26	0.052	0.39	40	20	0.052	141.4	2.27E-05	3.27E-02	11.9	9.26E-05		Limestone / Shallow Bedrock
49-59	29.20	Start Test												
	29.20	0.00	0.000	0.00	10	1	0.000	82.1	0.00E+00	0.00E+00	0.0	0.00E+00	YES	P-5S Screened interval ~51-65
	29.20	0.00	0.000	0.00	10	2	0.000	82.1	0.00E+00	0.00E+00	0.0	0.00E+00	YES	Bellaire / Summerfield
	29.20	0.00	0.000	0.00	10	3	0.000	82.1	0.00E+00	0.00E+00	0.0	0.00E+00	YES	Bellaire / Summerfield
	29.20	0.00	0.000	0.00	10	4	0.000	82.1	0.00E+00	0.00E+00	0.0	0.00E+00	YES	Bellaire / Summerfield
	29.20	0.00	0.000	0.00	10	5	0.000	82.1	0.00E+00	0.00E+00	0.0	0.00E+00	YES	Bellaire / Summerfield
	28.89	Start Test												
	28.85	0.04	0.008	0.06	20	7	0.008	105.2	4.70E-06	6.77E-03	2.5	1.92E-05	YES	Bellaire / Summerfield
	28.84	0.01	0.002	0.01	20	8	0.002	105.2	1.18E-06	1.69E-03	0.6	4.79E-06	YES	Bellaire / Summerfield
	28.81	0.03	0.006	0.04	20	9	0.006	105.2	3.53E-06	5.08E-03	1.9	1.44E-05	YES	Bellaire / Summerfield
	28.77	0.04	0.008	0.06	20	10	0.008	105.2	4.70E-06	6.77E-03	2.5	1.92E-05	YES	Bellaire / Summerfield
	28.51	Start Test												
	28.51	0.00	0.000	0.00	30	12	0.000	128.3	0.00E+00	0.00E+00	0.0	0.00E+00	YES	Bellaire / Summerfield
	28.47	0.04	0.008	0.06	30	13	0.008	128.3	3.85E-06	5.55E-03	2.0	1.57E-05	YES	Bellaire / Summerfield
	28.41	0.06	0.012	0.09	30	14	0.012	128.3	5.78E-06	8.32E-03	3.0	2.36E-05	YES	Bellaire / Summerfield
	28.32	0.09	0.018	0.13	30	15	0.018	128.3	8.67E-06	1.25E-02	4.6	3.53E-05	YES	Bellaire / Summerfield
	28.10	Start Test												
	28.02	0.08	0.016	0.12	40	17	0.016	151.4	6.53E-06	9.41E-03	3.4	2.66E-05	YES	Bellaire / Summerfield
	27.97	0.05	0.010	0.07	40	18	0.010	151.4	4.08E-06	5.88E-03	2.1	1.66E-05	YES	Bellaire / Summerfield
	27.89	0.08	0.016	0.12	40	19	0.016	151.4	6.53E-06	9.41E-03	3.4	2.66E-05	YES	Bellaire / Summerfield
	27.81	0.08	0.016	0.12	40	20	0.016	151.4	6.53E-06	9.41E-03	3.4	2.66E-05	YES	Bellaire / Summerfield

TABLE C3-5
PIEZOMETER P-5
HYDRAULIC CONDUCTIVITY RESULTS FROM PACKER TESTING
APEX LANDFILL LATERAL EXPANSION

Test Interval	Water level in 6" ID Cylinder	Drop in water level (feet)	Conversion to ft^3	Water Take (gal)	Pressure of Test (psi)	Time Lapse (min)	Flow Rate (ft^3/min)	H (ft)	k ft/min	k ft/day	k ft/year	k cm/sec	Sceen Zone	Comments
59-69	29.10	Start Test												
	29.00	0.10	0.020	0.15	10	1	0.020	92.1	1.34E-05	1.93E-02	7.1	5.47E-05	YES	Bellaire / Summerfield
	28.91	0.09	0.018	0.13	10	2	0.018	92.1	1.21E-05	1.74E-02	6.3	4.92E-05	YES	Bellaire / Summerfield
	28.91	0.00	0.000	0.00	10	3	0.000	92.1	0.00E+00	0.00E+00	0.0	0.00E+00	YES	Bellaire / Summerfield
	28.91	0.00	0.000	0.00	10	4	0.000	92.1	0.00E+00	0.00E+00	0.0	0.00E+00	YES	Bellaire / Summerfield
	28.91	0.00	0.000	0.00	10	5	0.000	92.1	0.00E+00	0.00E+00	0.0	0.00E+00	YES	Bellaire / Summerfield
	28.59	Start Test												
	28.57	0.02	0.004	0.03	20	7	0.004	115.2	2.15E-06	3.09E-03	1.1	8.75E-06	YES	Bellaire / Summerfield
	28.56	0.01	0.002	0.01	20	8	0.002	115.2	1.07E-06	1.55E-03	0.6	4.37E-06	YES	Bellaire / Summerfield
	28.53	0.03	0.006	0.04	20	9	0.006	115.2	3.22E-06	4.64E-03	1.7	1.31E-05	YES	Bellaire / Summerfield
	28.50	0.03	0.006	0.04	20	10	0.006	115.2	3.22E-06	4.64E-03	1.7	1.31E-05	YES	Bellaire / Summerfield
	28.29	Start Test												
	28.26	0.03	0.006	0.04	30	12	0.006	138.3	2.68E-06	3.86E-03	1.4	1.09E-05	YES	Bellaire / Summerfield
	28.20	0.06	0.012	0.09	30	13	0.012	138.3	5.36E-06	7.72E-03	2.8	2.19E-05	YES	Bellaire / Summerfield
	28.15	0.05	0.010	0.07	30	14	0.010	138.3	4.47E-06	6.44E-03	2.3	1.82E-05	YES	Bellaire / Summerfield
	28.10	0.05	0.010	0.07	30	15	0.010	138.3	4.47E-06	6.44E-03	2.3	1.82E-05	YES	Bellaire / Summerfield
	27.96	Start Test												
	27.94	0.02	0.004	0.03	40	17	0.004	161.4	1.53E-06	2.21E-03	0.8	6.24E-06	YES	Bellaire / Summerfield
	27.91	0.03	0.006	0.04	40	18	0.006	161.4	2.30E-06	3.31E-03	1.2	9.36E-06	YES	Bellaire / Summerfield
	27.89	0.02	0.004	0.03	40	19	0.004	161.4	1.53E-06	2.21E-03	0.8	6.24E-06	YES	Bellaire / Summerfield
	27.88	0.01	0.002	0.01	40	20	0.002	161.4	7.66E-07	1.10E-03	0.4	3.12E-06	YES	Bellaire / Summerfield
69-79	28.79	Start Test												
	28.71	0.08	0.016	0.12	10	1	0.016	102.1	9.69E-06	1.39E-02	5.1	3.95E-05		Bellaire / Summerfield
	28.66	0.05	0.010	0.07	10	2	0.010	102.1	6.05E-06	8.72E-03	3.2	2.47E-05		Bellaire / Summerfield
	28.59	0.07	0.014	0.10	10	3	0.014	102.1	8.47E-06	1.22E-02	4.5	3.45E-05		Bellaire / Summerfield
	28.50	0.09	0.018	0.13	10	4	0.018	102.1	1.09E-05	1.57E-02	5.7	4.44E-05		Bellaire / Summerfield
	28.45	0.05	0.010	0.07	10	5	0.010	102.1	6.05E-06	8.72E-03	3.2	2.47E-05		Bellaire / Summerfield
	28.03	Start Test												
	27.87	0.16	0.032	0.24	20	7	0.032	125.2	1.58E-05	2.27E-02	8.3	6.44E-05		Bellaire / Summerfield
	27.82	0.05	0.010	0.07	20	8	0.010	125.2	4.94E-06	7.11E-03	2.6	2.01E-05		Bellaire / Summerfield
	27.69	0.13	0.026	0.19	20	9	0.026	125.2	1.28E-05	1.85E-02	6.7	5.23E-05		Bellaire / Summerfield
	27.52	0.17	0.034	0.25	20	10	0.034	125.2	1.68E-05	2.42E-02	8.8	6.84E-05		Bellaire / Summerfield
	27.39	Start Test												
	27.09	0.30	0.060	0.45	30	12	0.060	148.3	2.50E-05	3.60E-02	13.1	1.02E-04		Bellaire / Summerfield
	26.84	0.25	0.050	0.37	30	13	0.050	148.3	2.08E-05	3.00E-02	11.0	8.49E-05		Bellaire / Summerfield
	26.50	0.34	0.068	0.51	30	14	0.068	148.3	2.83E-05	4.08E-02	14.9	1.15E-04		Bellaire / Summerfield
	26.20	0.30	0.060	0.45	30	15	0.060	148.3	2.50E-05	3.60E-02	13.1	1.02E-04		Bellaire / Summerfield
	26.07	Start Test												
	25.85	0.22	0.044	0.33	40	17	0.044	171.4	1.59E-05	2.28E-02	8.3	6.47E-05		Bellaire / Summerfield
	25.61	0.24	0.048	0.36	40	18	0.048	171.4	1.73E-05	2.49E-02	9.1	7.05E-05		Bellaire / Summerfield
	25.41	0.20	0.040	0.30	40	19	0.040	171.4	1.44E-05	2.08E-02	7.6	5.88E-05		Bellaire / Summerfield
	25.24	0.17	0.034	0.25	40	20	0.034	171.4	1.23E-05	1.77E-02	6.4	5.00E-05		Bellaire / Summerfield
79-89	29.22	Start Test												
	28.63	0.59	0.118	0.88	10	1	0.118	112.1	6.51E-05	9.37E-02	34.2	2.65E-04		Estimated Drop in Water Level
	28.04	0.59	0.118	0.88	10	2	0.118	112.1	6.51E-05	9.37E-02	34.2	2.65E-04		Bellaire / Summerfield
	28.03	0.01	0.002	0.01	10	3	0.002	112.1	1.10E-06	1.59E-03	0.6	4.49E-06		Bellaire / Summerfield
	28.03	0.00	0.000	0.00	10	4	0.000	112.1	0.00E+00	0.00E+00	0.0	0.00E+00		Bellaire / Summerfield
	28.00	0.03	0.006	0.04	10	5	0.006	112.1	3.31E-06	4.76E-03	1.7	1.35E-05		Bellaire / Summerfield
	27.66	Start Test												
	27.60	0.06	0.012	0.09	20	7	0.012	135.2	5.49E-06	7.90E-03	2.9	2.24E-05		Bellaire / Summerfield
	27.55	0.05	0.010	0.07	20	8	0.010	135.2	4.57E-06	6.58E-03	2.4	1.86E-05		Bellaire / Summerfield
	27.49	0.06	0.012	0.09	20	9	0.012	135.2	5.49E-06	7.90E-03	2.9	2.24E-05		Bellaire / Summerfield
	27.42	0.07	0.014	0.10	20	10	0.014	135.2	6.40E-06	9.22E-03	3.4	2.61E-05		Bellaire / Summerfield
	27.22	Start Test												
	27.14	0.08	0.016	0.12	30	12	0.016	158.3	6.25E-06	9.00E-03	3.3	2.55E-05		Bellaire / Summerfield
	27.06	0.08	0.016	0.12	30	13	0.016	158.3	6.25E-06	9.00E-03	3.3	2.55E-05		Bellaire / Summerfield
	26.98	0.08	0.016	0.12	30	14	0.016	158.3	6.25E-06	9.00E-03	3.3	2.55E-05		Bellaire / Summerfield
	26.83	0.15	0.030	0.22	30	15	0.030	158.3	1.17E-05	1.69E-02	6.2	4.77E-05		Bellaire / Summerfield
	26.75	0.08	0.016	0.12	30	16	0.016	158.3	6.25E-06	9.00E-03	3.3	2.55E-05		Bellaire / Summerfield
	26.68	0.07	0.014	0.10	30	17	0.014	158.3	5.47E-06	7.87E-03	2.9	2.23E-05		Bellaire / Summerfield
	26.66	0.02	0.004	0.03	30	18	0.004	158.3	1.56E-06	2.25E-03	0.8	6.36E-06		Bellaire / Summerfield
	26.54	0.12	0.024	0.18	30	19	0.024	158.3	9.37E-06	1.35E-02	4.9	3.82E-05		Bellaire / Summerfield
	26.45	0.09	0.018	0.13	30	20	0.018	158.3	7.03E-06	1.01E-02	3.7	2.86E-05		Bellaire / Summerfield

TABLE C3-5
PIEZOMETER P-5
HYDRAULIC CONDUCTIVITY RESULTS FROM PACKER TESTING
APEX LANDFILL LATERAL EXPANSION

Test Interval	Water level in 6" ID Cylinder	Drop in water level (feet)	Conversion to ft^3	Water Take (gal)	Pressure of Test (psi)	Time Lapse (min)	Flow Rate (ft^3/min)	H (ft)	k ft/min	k ft/day	k ft/year	k cm/sec	Sceen Zone	Comments
79-89	26.26	Start Test												
	26.19	0.07	0.014	0.10	40	22	0.014	181.4	4.77E-06	6.87E-03	2.5	1.94E-05		Bellaire / Summerfield
	26.10	0.09	0.018	0.13	40	23	0.018	181.4	6.13E-06	8.83E-03	3.2	2.50E-05		Bellaire / Summerfield
	26.02	0.08	0.016	0.12	40	24	0.016	181.4	5.45E-06	7.85E-03	2.9	2.22E-05		Bellaire / Summerfield
	25.95	0.07	0.014	0.10	40	25	0.014	181.4	4.77E-06	6.87E-03	2.5	1.94E-05		Bellaire / Summerfield
89-99	29.12	Start Test												
	29.10	0.02	0.004	0.03	10	1	0.004	122.1	2.02E-06	2.92E-03	1.1	8.25E-06		Bellaire / Summerfield
	27.35	1.75	0.351	2.62	10	2	0.351	122.1	1.77E-04	2.55E-01	93.1	7.22E-04		Bellaire / Summerfield
	27.11	0.24	0.048	0.36	10	3	0.048	122.1	2.43E-05	3.50E-02	12.8	9.90E-05		Bellaire / Summerfield
	27.00	0.11	0.022	0.16	10	4	0.022	122.1	1.11E-05	1.60E-02	5.9	4.54E-05		Bellaire / Summerfield
	26.86	0.14	0.028	0.21	10	5	0.028	122.1	1.42E-05	2.04E-02	7.4	5.78E-05		Bellaire / Summerfield
	26.41	Start Test												
	26.21	0.20	0.040	0.30	20	7	0.040	145.2	1.70E-05	2.45E-02	8.9	6.94E-05		Bellaire / Summerfield
	26.09	0.12	0.024	0.18	20	8	0.024	145.2	1.02E-05	1.47E-02	5.4	4.16E-05		Bellaire / Summerfield
	25.90	0.19	0.038	0.28	20	9	0.038	145.2	1.62E-05	2.33E-02	8.5	6.59E-05		Bellaire / Summerfield
	25.77	0.13	0.026	0.19	20	10	0.026	145.2	1.11E-05	1.59E-02	5.8	4.51E-05		Bellaire / Summerfield
	25.34	Start Test												
	25.09	0.25	0.050	0.37	30	12	0.050	168.3	1.84E-05	2.64E-02	9.7	7.48E-05		Bellaire / Summerfield
	24.89	0.20	0.040	0.30	30	13	0.040	168.3	1.47E-05	2.12E-02	7.7	5.99E-05		Bellaire / Summerfield
	24.69	0.20	0.040	0.30	30	14	0.040	168.3	1.47E-05	2.12E-02	7.7	5.99E-05		Bellaire / Summerfield
	24.43	0.26	0.052	0.39	30	15	0.052	168.3	1.91E-05	2.75E-02	10.0	7.78E-05		Bellaire / Summerfield
	29.04	Start Test												
	27.98	1.06	0.213	1.59	40	17	0.213	191.4	6.85E-05	9.86E-02	36.0	2.79E-04		Bellaire / Summerfield
	27.69	0.29	0.058	0.43	40	18	0.058	191.4	1.87E-05	2.70E-02	9.8	7.63E-05		Bellaire / Summerfield
	27.39	0.30	0.060	0.45	40	19	0.060	191.4	1.94E-05	2.79E-02	10.2	7.90E-05		Bellaire / Summerfield
	27.12	0.27	0.054	0.40	40	20	0.054	191.4	1.74E-05	2.51E-02	9.2	7.11E-05		Bellaire / Summerfield
99-109	29.05	Start Test												
	27.45	1.60	0.321	2.40	10	1	0.321	132.1	1.50E-04	2.16E-01	78.7	6.10E-04		Bellaire / Summerfield
	27.19	0.26	0.052	0.39	10	2	0.052	132.1	2.43E-05	3.50E-02	12.8	9.91E-05		Bellaire / Summerfield
	26.82	0.37	0.074	0.55	10	3	0.074	132.1	3.46E-05	4.99E-02	18.2	1.41E-04		Bellaire / Summerfield
	26.41	0.41	0.082	0.61	10	4	0.082	132.1	3.84E-05	5.52E-02	20.2	1.56E-04		Bellaire / Summerfield
	26.10	0.31	0.062	0.46	10	5	0.062	132.1	2.90E-05	4.18E-02	15.2	1.18E-04		Bellaire / Summerfield
	29.06	Start Test												
	27.75	1.31	0.263	1.96	20	7	0.263	155.2	1.04E-04	1.50E-01	54.8	4.25E-04		Bellaire / Summerfield
	27.34	0.41	0.082	0.61	20	8	0.082	155.2	3.27E-05	4.70E-02	17.2	1.33E-04		Bellaire / Summerfield
	26.85	0.49	0.098	0.73	20	9	0.098	155.2	3.90E-05	5.62E-02	20.5	1.59E-04		Bellaire / Summerfield
	26.45	0.40	0.080	0.60	20	10	0.080	155.2	3.19E-05	4.59E-02	16.7	1.30E-04		Bellaire / Summerfield
	25.96	Start Test												
	25.58	0.38	0.076	0.57	30	12	0.076	178.3	2.63E-05	3.79E-02	13.8	1.07E-04		Bellaire / Summerfield
	25.12	0.46	0.092	0.69	30	13	0.092	178.3	3.19E-05	4.59E-02	16.8	1.30E-04		Bellaire / Summerfield
	24.72	0.40	0.080	0.60	30	14	0.080	178.3	2.77E-05	3.99E-02	14.6	1.13E-04		Bellaire / Summerfield
	24.28	0.44	0.088	0.66	30	15	0.088	178.3	3.05E-05	4.39E-02	16.0	1.24E-04		Bellaire / Summerfield
	29.10	Start Test												
	27.95	1.15	0.231	1.72	40	17	0.231	201.4	7.06E-05	1.02E-01	37.1	2.88E-04		Bellaire / Summerfield
	27.23	0.72	0.144	1.08	40	18	0.144	201.4	4.42E-05	6.36E-02	23.2	1.80E-04		Bellaire / Summerfield
	26.79	0.44	0.088	0.66	40	19	0.088	201.4	2.70E-05	3.89E-02	14.2	1.10E-04		Bellaire / Summerfield
	26.29	0.50	0.100	0.75	40	20	0.100	201.4	3.07E-05	4.42E-02	16.1	1.25E-04		Bellaire / Summerfield
109-119	29.30	Start Test												
	23.65	5.65	1.133	8.47	10	1	1.133	142.1	4.91E-04	7.08E-01	258.3	2.00E-03	YES	Complete Water Loss
119-129	29.20	Start Test												
	29.17	0.03	0.006	0.04	10	1	0.006	152.1	2.44E-06	3.51E-03	1.3	9.94E-06	YES	P-5 Screened Interval ~110-124
	29.12	0.05	0.010	0.07	10	2	0.010	152.1	4.06E-06	5.85E-03	2.1	1.66E-05	YES	Connellsville / Morgantown
	29.11	0.01	0.002	0.01	10	3	0.002	152.1	8.13E-07	1.17E-03	0.4	3.31E-06	YES	Connellsville / Morgantown
	29.05	0.06	0.012	0.09	10	4	0.012	152.1	4.88E-06	7.02E-03	2.6	1.99E-05	YES	Connellsville / Morgantown
	29.04	0.01	0.002	0.01	10	5	0.002	152.1	8.13E-07	1.17E-03	0.4	3.31E-06	YES	Connellsville / Morgantown
	28.66	Start Test												
	28.63	0.03	0.006	0.04	20	7	0.006	175.2	2.12E-06	3.05E-03	1.1	8.63E-06	YES	Connellsville / Morgantown
	28.61	0.02	0.004	0.03	20	8	0.004	175.2	1.41E-06	2.03E-03	0.7	5.75E-06	YES	Connellsville / Morgantown
	28.58	0.03	0.006	0.04	20	9	0.006	175.2	2.12E-06	3.05E-03	1.1	8.63E-06	YES	Connellsville / Morgantown
	28.54	0.04	0.008	0.06	20	10	0.008	175.2	2.82E-06	4.06E-03	1.5	1.15E-05	YES	Connellsville / Morgantown

TABLE C3-5
PIEZOMETER P-5
HYDRAULIC CONDUCTIVITY RESULTS FROM PACKER TESTING
APEX LANDFILL LATERAL EXPANSION

Test Interval	Water level in 6" ID Cylinder	Drop in water level (feet)	Conversion to ft^3	Water Take (gal)	Pressure of Test (psi)	Time Lapse (min)	Flow Rate (ft^3/min)	H (ft)	k ft/min	k ft/day	k ft/year	k cm/sec	Sceen Zone	Comments
119-129	28.24	Start Test												
	28.19	0.05	0.010	0.07	30	12	0.010	198.3	3.12E-06	4.49E-03	1.6	1.27E-05	YES	Connellsville / Morgantown
	28.15	0.04	0.008	0.06	30	13	0.008	198.3	2.49E-06	3.59E-03	1.3	1.02E-05	YES	Connellsville / Morgantown
	28.11	0.04	0.008	0.06	30	14	0.008	198.3	2.49E-06	3.59E-03	1.3	1.02E-05	YES	Connellsville / Morgantown
	28.02	0.09	0.018	0.13	30	15	0.018	198.3	5.61E-06	8.08E-03	2.9	2.29E-05	YES	Connellsville / Morgantown
	27.84	Start Test												
	27.79	0.05	0.010	0.07	40	17	0.010	221.4	2.79E-06	4.02E-03	1.5	1.14E-05	YES	Connellsville / Morgantown
	27.70	0.09	0.018	0.13	40	18	0.018	221.4	5.02E-06	7.24E-03	2.6	2.05E-05	YES	Connellsville / Morgantown
	27.65	0.05	0.010	0.07	40	19	0.010	221.4	2.79E-06	4.02E-03	1.5	1.14E-05	YES	Connellsville / Morgantown
	27.60	0.05	0.010	0.07	40	20	0.010	221.4	2.79E-06	4.02E-03	1.5	1.14E-05	YES	Connellsville / Morgantown
129-139	29.20	Start Test												
	28.50	0.70	0.140	1.05	10	1	0.140	162.1	5.34E-05	7.69E-02	28.1	2.18E-04		Connellsville / Morgantown
	28.25	0.25	0.050	0.37	10	2	0.050	162.1	1.91E-05	2.75E-02	10.0	7.77E-05		Connellsville / Morgantown
	28.00	0.25	0.050	0.37	10	3	0.050	162.1	1.91E-05	2.75E-02	10.0	7.77E-05		Connellsville / Morgantown
	27.89	0.11	0.022	0.16	10	4	0.022	162.1	8.39E-06	1.21E-02	4.4	3.42E-05		Connellsville / Morgantown
	27.57	0.32	0.064	0.48	10	5	0.064	162.1	2.44E-05	3.51E-02	12.8	9.94E-05		Connellsville / Morgantown
	26.90	Start Test												
	26.54	0.36	0.072	0.54	20	7	0.072	185.2	2.40E-05	3.46E-02	12.6	9.79E-05		Connellsville / Morgantown
	26.20	0.34	0.068	0.51	20	8	0.068	185.2	2.27E-05	3.27E-02	11.9	9.25E-05		Connellsville / Morgantown
	25.91	0.29	0.058	0.43	20	9	0.058	185.2	1.94E-05	2.79E-02	10.2	7.89E-05		Connellsville / Morgantown
	25.64	0.27	0.054	0.40	20	10	0.054	185.2	1.80E-05	2.60E-02	9.5	7.34E-05		Connellsville / Morgantown
	29.08	Start Test												
	26.62	2.46	0.493	3.69	30	12	0.493	208.3	1.46E-04	2.10E-01	76.7	5.95E-04		Connellsville / Morgantown
	26.25	0.37	0.074	0.55	30	13	0.074	208.3	2.20E-05	3.16E-02	11.5	8.95E-05		Connellsville / Morgantown
	25.48	0.77	0.154	1.15	30	14	0.154	208.3	4.57E-05	6.58E-02	24.0	1.86E-04		Connellsville / Morgantown
	25.30	0.18	0.036	0.27	30	15	0.036	208.3	1.07E-05	1.54E-02	5.6	4.35E-05		Connellsville / Morgantown
	29.14	Start Test												
	27.69	1.45	0.291	2.17	40	17	0.291	231.4	7.75E-05	1.12E-01	40.7	3.16E-04		Connellsville / Morgantown
	27.26	0.43	0.086	0.64	40	18	0.086	231.4	2.30E-05	3.31E-02	12.1	9.36E-05		Connellsville / Morgantown
	26.81	0.45	0.090	0.67	40	19	0.090	231.4	2.40E-05	3.46E-02	12.6	9.80E-05		Connellsville / Morgantown
	26.45	0.36	0.072	0.54	40	20	0.072	231.4	1.92E-05	2.77E-02	10.1	7.84E-05		Connellsville / Morgantown
139-149	29.16	Start Test												
	29.10	0.06	0.012	0.09	10	1	0.012	172.1	4.31E-06	6.21E-03	2.3	1.76E-05		Connellsville / Morgantown
	29.10	0.00	0.000	0.00	10	2	0.000	172.1	0.00E+00	0.00E+00	0.0	0.00E+00		Connellsville / Morgantown
	29.10	0.00	0.000	0.00	10	3	0.000	172.1	0.00E+00	0.00E+00	0.0	0.00E+00		Connellsville / Morgantown
	29.10	0.00	0.000	0.00	10	4	0.000	172.1	0.00E+00	0.00E+00	0.0	0.00E+00		Connellsville / Morgantown
	29.10	0.00	0.000	0.00	10	5	0.000	172.1	0.00E+00	0.00E+00	0.0	0.00E+00		Connellsville / Morgantown
	28.76	Start Test												
	28.76	0.00	0.000	0.00	20	7	0.000	195.2	0.00E+00	0.00E+00	0.0	0.00E+00		Connellsville / Morgantown
	28.76	0.00	0.000	0.00	20	8	0.000	195.2	0.00E+00	0.00E+00	0.0	0.00E+00		Connellsville / Morgantown
	28.75	0.01	0.002	0.01	20	9	0.002	195.2	6.33E-07	9.12E-04	0.3	2.58E-06		Connellsville / Morgantown
	28.74	0.01	0.002	0.01	20	10	0.002	195.2	6.33E-07	9.12E-04	0.3	2.58E-06		Connellsville / Morgantown
	28.52	Start Test												
	28.52	0.00	0.000	0.00	30	12	0.000	218.3	0.00E+00	0.00E+00	0.0	0.00E+00		Connellsville / Morgantown
	28.52	0.00	0.000	0.00	30	13	0.000	218.3	0.00E+00	0.00E+00	0.0	0.00E+00		Connellsville / Morgantown
	28.51	0.01	0.002	0.01	30	14	0.002	218.3	5.66E-07	8.15E-04	0.3	2.31E-06		Connellsville / Morgantown
	28.50	0.01	0.002	0.01	30	15	0.002	218.3	5.66E-07	8.15E-04	0.3	2.31E-06		Connellsville / Morgantown
	28.35	Start Test												
	28.35	0.00	0.000	0.00	40	17	0.000	241.4	0.00E+00	0.00E+00	0.0	0.00E+00		Connellsville / Morgantown
	28.35	0.00	0.000	0.00	40	18	0.000	241.4	0.00E+00	0.00E+00	0.0	0.00E+00		Connellsville / Morgantown
	28.34	0.01	0.002	0.01	40	19	0.002	241.4	5.12E-07	7.37E-04	0.3	2.09E-06		Connellsville / Morgantown
	28.33	0.01	0.002	0.01	40	20	0.002	241.4	5.12E-07	7.37E-04	0.3	2.09E-06		Connellsville / Morgantown
149-159	28.05	Start Test												
	27.60	0.45	0.090	0.67	10	1	0.090	182.1	3.05E-05	4.40E-02	16.1	1.24E-04		Connellsville / Morgantown
	27.60	0.00	0.000	0.00	10	2	0.000	182.1	0.00E+00	0.00E+00	0.0	0.00E+00		Connellsville / Morgantown
	27.60	0.00	0.000	0.00	10	3	0.000	182.1	0.00E+00	0.00E+00	0.0	0.00E+00		Connellsville / Morgantown
	27.60	0.00	0.000	0.00	10	4	0.000	182.1	0.00E+00	0.00E+00	0.0	0.00E+00		Connellsville / Morgantown
	27.59	0.01	0.002	0.01	10	5	0.002	182.1	6.79E-07	9.77E-04	0.4	2.77E-06		Connellsville / Morgantown

TABLE C3-5
PIEZOMETER P-5
HYDRAULIC CONDUCTIVITY RESULTS FROM PACKER TESTING
APEX LANDFILL LATERAL EXPANSION

Test Interval	Water level in 6" ID Cylinder	Drop in water level (feet)	Conversion to ft^3	Water Take (gal)	Pressure of Test (psi)	Time Lapse (min)	Flow Rate (ft^3/min)	H (ft)	k ft/min	k ft/day	k ft/year	k cm/sec	Sceen Zone	Comments
149-159	27.23	Start Test												
	27.22	0.01	0.002	0.01	20	7	0.002	205.2	6.02E-07	8.67E-04	0.3	2.45E-06		Connellsville / Morgantown
	27.21	0.01	0.002	0.01	20	8	0.002	205.2	6.02E-07	8.67E-04	0.3	2.45E-06		Connellsville / Morgantown
	27.20	0.01	0.002	0.01	20	9	0.002	205.2	6.02E-07	8.67E-04	0.3	2.45E-06		Connellsville / Morgantown
	27.19	0.01	0.002	0.01	20	10	0.002	205.2	6.02E-07	8.67E-04	0.3	2.45E-06		Connellsville / Morgantown
	26.98	Start Test												
	26.95	0.03	0.006	0.04	30	12	0.006	228.3	1.62E-06	2.34E-03	0.9	6.62E-06		Connellsville / Morgantown
	26.91	0.04	0.008	0.06	30	13	0.008	228.3	2.17E-06	3.12E-03	1.1	8.83E-06		Connellsville / Morgantown
	26.89	0.02	0.004	0.03	30	14	0.004	228.3	1.08E-06	1.56E-03	0.6	4.41E-06		Connellsville / Morgantown
	26.88	0.01	0.002	0.01	30	15	0.002	228.3	5.41E-07	7.80E-04	0.3	2.21E-06		Connellsville / Morgantown
	26.79	Start Test												
	26.78	0.01	0.002	0.01	40	17	0.002	251.4	4.92E-07	7.08E-04	0.3	2.00E-06		Connellsville / Morgantown
	26.77	0.01	0.002	0.01	40	18	0.002	251.4	4.92E-07	7.08E-04	0.3	2.00E-06		Connellsville / Morgantown
	26.75	0.02	0.004	0.03	40	19	0.004	251.4	9.83E-07	1.42E-03	0.5	4.01E-06		Connellsville / Morgantown
	26.73	0.02	0.004	0.03	40	20	0.004	251.4	9.83E-07	1.42E-03	0.5	4.01E-06		Connellsville / Morgantown
159-169	29.10	Start Test												
	29.10	0.00	0.000	0.00	10	1	0.000	192.1	0.00E+00	0.00E+00	0.0	0.00E+00		Connellsville / Morgantown
	28.92	0.18	0.036	0.27	10	2	0.036	192.1	1.16E-05	1.67E-02	6.1	4.72E-05		Connellsville / Morgantown
	28.86	0.06	0.012	0.09	10	3	0.012	192.1	3.86E-06	5.56E-03	2.0	1.57E-05		Connellsville / Morgantown
	28.78	0.08	0.016	0.12	10	4	0.016	192.1	5.15E-06	7.41E-03	2.7	2.10E-05		Connellsville / Morgantown
	28.69	0.09	0.018	0.13	10	5	0.018	192.1	5.79E-06	8.34E-03	3.0	2.36E-05		Connellsville / Morgantown
	28.62	Start Test												
	28.15	0.47	0.094	0.70	20	7	0.094	215.2	2.70E-05	3.89E-02	14.2	1.10E-04		Connellsville / Morgantown
	28.05	0.10	0.020	0.15	20	8	0.020	215.2	5.74E-06	8.27E-03	3.0	2.34E-05		Connellsville / Morgantown
	27.94	0.11	0.022	0.16	20	9	0.022	215.2	6.32E-06	9.10E-03	3.3	2.57E-05		Connellsville / Morgantown
	27.81	0.13	0.026	0.19	20	10	0.026	215.2	7.47E-06	1.08E-02	3.9	3.04E-05		Connellsville / Morgantown
	27.69	Start Test												
	27.40	0.29	0.058	0.43	30	12	0.058	238.3	1.50E-05	2.17E-02	7.9	6.13E-05		Connellsville / Morgantown
	27.27	0.13	0.026	0.19	30	13	0.026	238.3	6.74E-06	9.71E-03	3.5	2.75E-05		Connellsville / Morgantown
	27.05	0.22	0.044	0.33	30	14	0.044	238.3	1.14E-05	1.64E-02	6.0	4.65E-05		Connellsville / Morgantown
	26.90	0.15	0.030	0.22	30	15	0.030	238.3	7.78E-06	1.12E-02	4.1	3.17E-05		Connellsville / Morgantown
	26.50	Start Test												
	26.30	0.20	0.040	0.30	40	17	0.040	261.4	9.46E-06	1.36E-02	5.0	3.85E-05		Connellsville / Morgantown
	26.00	0.30	0.060	0.45	40	18	0.060	261.4	1.42E-05	2.04E-02	7.5	5.78E-05		Connellsville / Morgantown
	25.89	0.11	0.022	0.16	40	19	0.022	261.4	5.20E-06	7.49E-03	2.7	2.12E-05		Connellsville / Morgantown
	25.75	0.14	0.028	0.21	40	20	0.028	261.4	6.62E-06	9.53E-03	3.5	2.70E-05		Connellsville / Morgantown
169-179	29.23	Start Test												
	29.00	0.23	0.046	0.34	10	1	0.046	202.1	1.41E-05	2.03E-02	7.4	5.73E-05		Connellsville / Morgantown
	28.99	0.01	0.002	0.01	10	2	0.002	202.1	6.12E-07	8.81E-04	0.3	2.49E-06		Connellsville / Morgantown
	28.98	0.01	0.002	0.01	10	3	0.002	202.1	6.12E-07	8.81E-04	0.3	2.49E-06		Connellsville / Morgantown
	28.97	0.01	0.002	0.01	10	4	0.002	202.1	6.12E-07	8.81E-04	0.3	2.49E-06		Connellsville / Morgantown
	28.96	0.01	0.002	0.01	10	5	0.002	202.1	6.12E-07	8.81E-04	0.3	2.49E-06		Connellsville / Morgantown
	28.66	Start Test												
	28.64	0.02	0.004	0.03	20	7	0.004	225.2	1.10E-06	1.58E-03	0.6	4.47E-06		Connellsville / Morgantown
	28.62	0.02	0.004	0.03	20	8	0.004	225.2	1.10E-06	1.58E-03	0.6	4.47E-06		Connellsville / Morgantown
	28.59	0.03	0.006	0.04	20	9	0.006	225.2	1.65E-06	2.37E-03	0.9	6.71E-06		Connellsville / Morgantown
	28.57	0.02	0.004	0.03	20	10	0.004	225.2	1.10E-06	1.58E-03	0.6	4.47E-06		Connellsville / Morgantown
	28.37	Start Test												
	28.35	0.02	0.004	0.03	30	12	0.004	248.3	9.96E-07	1.43E-03	0.5	4.06E-06		Connellsville / Morgantown
	28.34	0.01	0.002	0.01	30	13	0.002	248.3	4.98E-07	7.17E-04	0.3	2.03E-06		Connellsville / Morgantown
	28.32	0.02	0.004	0.03	30	14	0.004	248.3	9.96E-07	1.43E-03	0.5	4.06E-06		Connellsville / Morgantown
	28.30	0.02	0.004	0.03	30	15	0.004	248.3	9.96E-07	1.43E-03	0.5	4.06E-06		Connellsville / Morgantown
	28.15	Start Test												
	28.12	0.03	0.006	0.04	40	17	0.006	271.4	1.37E-06	1.97E-03	0.7	5.57E-06		Connellsville / Morgantown
	28.10	0.02	0.004	0.03	40	18	0.004	271.4	9.11E-07	1.31E-03	0.5	3.71E-06		Connellsville / Morgantown
	28.07	0.03	0.006	0.04	40	19	0.006	271.4	1.37E-06	1.97E-03	0.7	5.57E-06		Connellsville / Morgantown
	28.04	0.03	0.006	0.04	40	20	0.006	271.4	1.37E-06	1.97E-03	0.7	5.57E-06		Connellsville / Morgantown
179-189	29.10	Start Test												
	23.65	5.45	1.093	8.17	10	1	1.093	212.1	3.18E-04	4.57E-01	166.9	1.29E-03		Complete Water Loss

TABLE C3-5
PIEZOMETER P-9
HYDRAULIC CONDUCTIVITY RESULTS FROM PACKER TESTING
APEX LANDFILL LATERAL EXPANSION

PACKER TESTS

Boring:	P-9	Length of Packer (ft):	3
Date:	9/23/2010	Packer inflation pressure (psi):	200
Depth of Boring:	163	Length of test section (feet):	10
Bore Hole Size:	5	Distance pressure gauge is above ground:	5
Water Level (bgs ft):	80.10	Height of water swivel above ground:	5

Test Interval	Water level in 6" ID Cylinder	Drop in water level (feet)	Conversion to ft^3	Water Take (gal)	Pressure of Test (psi)	Time Lapse (min)	Flow Rate (ft^3/min)	H (ft)	k ft/min	k ft/day	k ft/year	k cm/sec	Sceen Zone	Comments
28-38	29.10	Start Test												
	23.65	5.45	1.093	8.17	10	1	1.093	61.1	1.10E-03	1.59E+00	579.5	4.49E-03		Complete Water Loss
38-48	29.23	Start Test												
	28.00	1.23	0.247	1.84	10	1	0.247	71.1	2.14E-04	3.08E-01	112.4	8.71E-04		Limestone / Shallow Bedrock
	27.38	0.62	0.124	0.93	10	2	0.124	71.1	1.08E-04	1.55E-01	56.7	4.39E-04		Limestone / Shallow Bedrock
	27.27	0.11	0.022	0.16	10	3	0.022	71.1	1.91E-05	2.75E-02	10.1	7.79E-05		Limestone / Shallow Bedrock
	27.15	0.12	0.024	0.18	10	4	0.024	71.1	2.09E-05	3.00E-02	11.0	8.50E-05		Limestone / Shallow Bedrock
	27.05	0.10	0.020	0.15	10	5	0.020	71.1	1.74E-05	2.50E-02	9.1	7.08E-05		Limestone / Shallow Bedrock
	26.97	Start Test												
	26.92	0.05	0.010	0.07	20	7	0.010	94.2	6.56E-06	9.45E-03	3.4	2.67E-05		Limestone / Shallow Bedrock
	26.83	0.09	0.018	0.13	20	8	0.018	94.2	1.18E-05	1.70E-02	6.2	4.81E-05		Limestone / Shallow Bedrock
	26.73	0.10	0.020	0.15	20	9	0.020	94.2	1.31E-05	1.89E-02	6.9	5.35E-05		Limestone / Shallow Bedrock
	26.64	0.09	0.018	0.13	20	10	0.018	94.2	1.18E-05	1.70E-02	6.2	4.81E-05		Limestone / Shallow Bedrock
	26.48	Start Test												
	26.36	0.12	0.024	0.18	30	12	0.024	117.3	1.26E-05	1.82E-02	6.6	5.15E-05		Limestone / Shallow Bedrock
	26.20	0.16	0.032	0.24	30	13	0.032	117.3	1.69E-05	2.43E-02	8.9	6.87E-05		Limestone / Shallow Bedrock
	26.09	0.11	0.022	0.16	30	14	0.022	117.3	1.16E-05	1.67E-02	6.1	4.72E-05		Limestone / Shallow Bedrock
	26.00	0.09	0.018	0.13	30	15	0.018	117.3	9.48E-06	1.37E-02	5.0	3.86E-05		Limestone / Shallow Bedrock
	25.82	Start Test												
	25.67	0.15	0.030	0.22	40	17	0.030	140.4	1.32E-05	1.90E-02	6.9	5.38E-05		Limestone / Shallow Bedrock
	25.44	0.23	0.046	0.34	40	18	0.046	140.4	2.02E-05	2.92E-02	10.6	8.25E-05		Limestone / Shallow Bedrock
	25.26	0.18	0.036	0.27	40	19	0.036	140.4	1.58E-05	2.28E-02	8.3	6.46E-05		Limestone / Shallow Bedrock
	25.14	0.12	0.024	0.18	40	20	0.024	140.4	1.06E-05	1.52E-02	5.6	4.31E-05		Limestone / Shallow Bedrock
48-58	29.00	Start Test												
	29.00	0.00	0.000	0.00	10	1	0.000	81.1	0.00E+00	0.00E+00	0.0	0.00E+00		Bellaire / Summerfield
	29.00	0.00	0.000	0.00	10	2	0.000	81.1	0.00E+00	0.00E+00	0.0	0.00E+00		Bellaire / Summerfield
	29.00	0.00	0.000	0.00	10	3	0.000	81.1	0.00E+00	0.00E+00	0.0	0.00E+00		Bellaire / Summerfield
	29.00	0.00	0.000	0.00	10	4	0.000	81.1	0.00E+00	0.00E+00	0.0	0.00E+00		Bellaire / Summerfield
	29.00	0.00	0.000	0.00	10	5	0.000	81.1	0.00E+00	0.00E+00	0.0	0.00E+00		Bellaire / Summerfield
	28.62	Start Test												
	28.62	0.00	0.000	0.00	20	7	0.000	104.2	0.00E+00	0.00E+00	0.0	0.00E+00		Bellaire / Summerfield
	28.62	0.00	0.000	0.00	20	8	0.000	104.2	0.00E+00	0.00E+00	0.0	0.00E+00		Bellaire / Summerfield
	28.62	0.00	0.000	0.00	20	9	0.000	104.2	0.00E+00	0.00E+00	0.0	0.00E+00		Bellaire / Summerfield
	28.62	0.00	0.000	0.00	20	10	0.000	104.2	0.00E+00	0.00E+00	0.0	0.00E+00		Bellaire / Summerfield
	28.38	Start Test												
	28.35	0.03	0.006	0.04	30	12	0.006	127.3	2.91E-06	4.19E-03	1.5	1.19E-05		Bellaire / Summerfield
	28.33	0.02	0.004	0.03	30	13	0.004	127.3	1.94E-06	2.80E-03	1.0	7.91E-06		Bellaire / Summerfield
	28.30	0.03	0.006	0.04	30	14	0.006	127.3	2.91E-06	4.19E-03	1.5	1.19E-05		Bellaire / Summerfield
	28.28	0.02	0.004	0.03	30	15	0.004	127.3	1.94E-06	2.80E-03	1.0	7.91E-06		Bellaire / Summerfield
	28.15	Start Test												
	28.12	0.03	0.006	0.04	40	17	0.006	150.4	2.47E-06	3.55E-03	1.3	1.00E-05		Bellaire / Summerfield
	28.09	0.03	0.006	0.04	40	18	0.006	150.4	2.47E-06	3.55E-03	1.3	1.00E-05		Bellaire / Summerfield
	28.06	0.03	0.006	0.04	40	19	0.006	150.4	2.47E-06	3.55E-03	1.3	1.00E-05		Bellaire / Summerfield
	28.02	0.04	0.008	0.06	40	20	0.008	150.4	3.29E-06	4.73E-03	1.7	1.34E-05		Bellaire / Summerfield

TABLE C3-5
PIEZOMETER P-9
HYDRAULIC CONDUCTIVITY RESULTS FROM PACKER TESTING
APEX LANDFILL LATERAL EXPANSION

Test Interval	Water level in 6" ID Cylinder	Drop in water level (feet)	Conversion to ft^3	Water Take (gal)	Pressure of Test (psi)	Time Lapse (min)	Flow Rate (ft^3/min)	H (ft)	k ft/min	k ft/day	k ft/year	k cm/sec	Sceen Zone	Comments
58-68	29.10	Start Test												
	29.10	0.00	0.000	0.00	10	1	0.000	91.1	0.00E+00	0.00E+00	0.0	0.00E+00		Bellaire / Summerfield
	29.10	0.00	0.000	0.00	10	2	0.000	91.1	0.00E+00	0.00E+00	0.0	0.00E+00		Bellaire / Summerfield
	29.10	0.00	0.000	0.00	10	3	0.000	91.1	0.00E+00	0.00E+00	0.0	0.00E+00		Bellaire / Summerfield
	29.10	0.00	0.000	0.00	10	4	0.000	91.1	0.00E+00	0.00E+00	0.0	0.00E+00		Bellaire / Summerfield
	29.10	0.00	0.000	0.00	10	5	0.000	91.1	0.00E+00	0.00E+00	0.0	0.00E+00		Bellaire / Summerfield
	28.75	Start Test												
	28.75	0.00	0.000	0.00	20	7	0.000	114.2	0.00E+00	0.00E+00	0.0	0.00E+00		Bellaire / Summerfield
	28.75	0.00	0.000	0.00	20	8	0.000	114.2	0.00E+00	0.00E+00	0.0	0.00E+00		Bellaire / Summerfield
	28.75	0.00	0.000	0.00	20	9	0.000	114.2	0.00E+00	0.00E+00	0.0	0.00E+00		Bellaire / Summerfield
	28.75	0.00	0.000	0.00	20	10	0.000	114.2	0.00E+00	0.00E+00	0.0	0.00E+00		Bellaire / Summerfield
	28.54	Start Test												
	28.54	0.00	0.000	0.00	30	12	0.000	137.3	0.00E+00	0.00E+00	0.0	0.00E+00		Bellaire / Summerfield
	28.54	0.00	0.000	0.00	30	13	0.000	137.3	0.00E+00	0.00E+00	0.0	0.00E+00		Bellaire / Summerfield
	28.54	0.00	0.000	0.00	30	14	0.000	137.3	0.00E+00	0.00E+00	0.0	0.00E+00		Bellaire / Summerfield
	28.54	0.00	0.000	0.00	30	15	0.000	137.3	0.00E+00	0.00E+00	0.0	0.00E+00		Bellaire / Summerfield
	28.40	Start Test												
	28.40	0.00	0.000	0.00	40	17	0.000	160.4	0.00E+00	0.00E+00	0.0	0.00E+00		Bellaire / Summerfield
	28.39	0.01	0.002	0.01	40	18	0.002	160.4	7.71E-07	1.11E-03	0.4	3.14E-06		Bellaire / Summerfield
	28.38	0.01	0.002	0.01	40	19	0.002	160.4	7.71E-07	1.11E-03	0.4	3.14E-06		Bellaire / Summerfield
	28.37	0.01	0.002	0.01	40	20	0.002	160.4	7.71E-07	1.11E-03	0.4	3.14E-06		Bellaire / Summerfield
68-78	28.87	Start Test												
	28.87	0.00	0.000	0.00	10	1	0.000	101.1	0.00E+00	0.00E+00	0.0	0.00E+00	YES	P-9S Screened Interval
	28.87	0.00	0.000	0.00	10	2	0.000	101.1	0.00E+00	0.00E+00	0.0	0.00E+00	YES	~67-81
	28.87	0.00	0.000	0.00	10	3	0.000	101.1	0.00E+00	0.00E+00	0.0	0.00E+00	YES	Bellaire / Summerfield
	28.87	0.00	0.000	0.00	10	4	0.000	101.1	0.00E+00	0.00E+00	0.0	0.00E+00	YES	Bellaire / Summerfield
	28.87	0.00	0.000	0.00	10	5	0.000	101.1	0.00E+00	0.00E+00	0.0	0.00E+00	YES	Bellaire / Summerfield
	28.75	Start Test												
	28.75	0.00	0.000	0.00	20	7	0.000	124.2	0.00E+00	0.00E+00	0.0	0.00E+00	YES	Bellaire / Summerfield
	28.75	0.00	0.000	0.00	20	8	0.000	124.2	0.00E+00	0.00E+00	0.0	0.00E+00	YES	Bellaire / Summerfield
	28.75	0.00	0.000	0.00	20	9	0.000	124.2	0.00E+00	0.00E+00	0.0	0.00E+00	YES	Bellaire / Summerfield
	28.75	0.00	0.000	0.00	20	10	0.000	124.2	0.00E+00	0.00E+00	0.0	0.00E+00	YES	Bellaire / Summerfield
	29.50	Start Test												
	28.99	0.51	0.102	0.76	30	12	0.102	147.3	4.28E-05	6.16E-02	22.5	1.74E-04	YES	Bellaire / Summerfield
	24.98	4.01	0.804	6.01	30	13	0.804	147.3	3.37E-04	4.85E-01	176.9	1.37E-03	YES	Bellaire / Summerfield
	24.98	0.00	0.000	0.00	30	14	0.000	147.3	0.00E+00	0.00E+00	0.0	0.00E+00	YES	Bellaire / Summerfield
	24.98	0.00	0.000	0.00	30	15	0.000	147.3	0.00E+00	0.00E+00	0.0	0.00E+00	YES	Bellaire / Summerfield
	28.66	Start Test												
	28.68	-0.02											YES	Test Void
	28.69	-0.01											YES	Test Void
	28.69	0.00	0.000	0.00	40	19	0.000	170.4	0.00E+00	0.00E+00	0.0	0.00E+00	YES	Bellaire / Summerfield
	28.69	0.00	0.000	0.00	40	20	0.000	170.4	0.00E+00	0.00E+00	0.0	0.00E+00	YES	Bellaire / Summerfield

TABLE C3-5
PIEZOMETER P-9
HYDRAULIC CONDUCTIVITY RESULTS FROM PACKER TESTING
APEX LANDFILL LATERAL EXPANSION

Test Interval	Water level in 6" ID Cylinder	Drop in water level (feet)	Conversion to ft^3	Water Take (gal)	Pressure of Test (psi)	Time Lapse (min)	Flow Rate (ft^3/min)	H (ft)	k ft/min	k ft/day	k ft/year	k cm/sec	Sceen Zone	Comments
78-88	29.24	Start Test												
	29.23	0.01	0.002	0.01	10	1	0.002	111.1	1.11E-06	1.60E-03	0.6	4.53E-06		Bellaire / Summerfield
	29.23	0.00	0.000	0.00	10	2	0.000	111.1	0.00E+00	0.00E+00	0.0	0.00E+00		Bellaire / Summerfield
	29.23	0.00	0.000	0.00	10	3	0.000	111.1	0.00E+00	0.00E+00	0.0	0.00E+00		Bellaire / Summerfield
	29.23	0.00	0.000	0.00	10	4	0.000	111.1	0.00E+00	0.00E+00	0.0	0.00E+00		Bellaire / Summerfield
	29.23	0.00	0.000	0.00	10	5	0.000	111.1	0.00E+00	0.00E+00	0.0	0.00E+00		Bellaire / Summerfield
	28.95	Start Test												
	28.95	0.00	0.000	0.00	20	7	0.000	134.2	0.00E+00	0.00E+00	0.0	0.00E+00		Bellaire / Summerfield
	28.95	0.00	0.000	0.00	20	8	0.000	134.2	0.00E+00	0.00E+00	0.0	0.00E+00		Bellaire / Summerfield
	28.95	0.00	0.000	0.00	20	9	0.000	134.2	0.00E+00	0.00E+00	0.0	0.00E+00		Bellaire / Summerfield
	28.95	0.00	0.000	0.00	20	10	0.000	134.2	0.00E+00	0.00E+00	0.0	0.00E+00		Bellaire / Summerfield
	28.77	Start Test												
	28.77	0.00	0.000	0.00	30	12	0.000	157.3	0.00E+00	0.00E+00	0.0	0.00E+00		Bellaire / Summerfield
	28.77	0.00	0.000	0.00	30	13	0.000	157.3	0.00E+00	0.00E+00	0.0	0.00E+00		Bellaire / Summerfield
	28.77	0.00	0.000	0.00	30	14	0.000	157.3	0.00E+00	0.00E+00	0.0	0.00E+00		Bellaire / Summerfield
	28.77	0.00	0.000	0.00	30	15	0.000	157.3	0.00E+00	0.00E+00	0.0	0.00E+00		Bellaire / Summerfield
	28.63	Start Test												
	28.63	0.00	0.000	0.00	40	22	0.000	180.4	0.00E+00	0.00E+00	0.0	0.00E+00		Bellaire / Summerfield
	28.63	0.00	0.000	0.00	40	23	0.000	180.4	0.00E+00	0.00E+00	0.0	0.00E+00		Bellaire / Summerfield
	28.63	0.00	0.000	0.00	40	24	0.000	180.4	0.00E+00	0.00E+00	0.0	0.00E+00		Bellaire / Summerfield
	28.63	0.00	0.000	0.00	40	25	0.000	180.4	0.00E+00	0.00E+00	0.0	0.00E+00		Bellaire / Summerfield
88-98	29.04	Start Test												
	28.30	0.74	0.148	1.11	10	1	0.148	121.1	7.55E-05	1.09E-01	39.7	3.08E-04		Bellaire / Summerfield
	28.10	0.20	0.040	0.30	10	2	0.040	121.1	2.04E-05	2.94E-02	10.7	8.32E-05		Bellaire / Summerfield
	27.78	0.32	0.064	0.48	10	3	0.064	121.1	3.27E-05	4.70E-02	17.2	1.33E-04		Bellaire / Summerfield
	27.61	0.17	0.034	0.25	10	4	0.034	121.1	1.74E-05	2.50E-02	9.1	7.07E-05		Bellaire / Summerfield
	27.39	0.22	0.044	0.33	10	5	0.044	121.1	2.25E-05	3.23E-02	11.8	9.15E-05		Bellaire / Summerfield
	26.92	Start Test												
	26.59	0.33	0.066	0.49	20	7	0.066	144.2	2.83E-05	4.07E-02	14.9	1.15E-04		Bellaire / Summerfield
	26.35	0.24	0.048	0.36	20	8	0.048	144.2	2.06E-05	2.96E-02	10.8	8.38E-05		Bellaire / Summerfield
	26.13	0.22	0.044	0.33	20	9	0.044	144.2	1.89E-05	2.72E-02	9.9	7.69E-05		Bellaire / Summerfield
	25.84	0.29	0.058	0.43	20	10	0.058	144.2	2.49E-05	3.58E-02	13.1	1.01E-04		Bellaire / Summerfield
	25.39	Start Test												
	25.22	0.17	0.034	0.25	30	12	0.034	167.3	1.26E-05	1.81E-02	6.6	5.12E-05		Bellaire / Summerfield
	25.10	0.12	0.024	0.18	30	13	0.024	167.3	8.87E-06	1.28E-02	4.7	3.61E-05		Bellaire / Summerfield
	24.82	0.28	0.056	0.42	30	14	0.056	167.3	2.07E-05	2.98E-02	10.9	8.43E-05		Bellaire / Summerfield
	24.23	0.59	0.118	0.88	30	15	0.118	167.3	4.36E-05	6.28E-02	22.9	1.78E-04		Bellaire / Summerfield
	29.20	Start Test												
	28.00	1.20	0.241	1.80	40	17	0.241	190.4	7.79E-05	1.12E-01	40.9	3.17E-04		Bellaire / Summerfield
	27.62	0.38	0.076	0.57	40	18	0.076	190.4	2.47E-05	3.55E-02	13.0	1.01E-04		Bellaire / Summerfield
	27.36	0.26	0.052	0.39	40	19	0.052	190.4	1.69E-05	2.43E-02	8.9	6.88E-05		Bellaire / Summerfield
	27.02	0.34	0.068	0.51	40	20	0.068	190.4	2.21E-05	3.18E-02	11.6	9.00E-05		Bellaire / Summerfield
98-108	29.10	Start Test												
	29.20	-0.10												Test Void
	29.20	0.00	0.000	0.00	10	2	0.000	131.1	0.00E+00	0.00E+00	0.0	0.00E+00		Bellaire / Summerfield
	29.20	0.00	0.000	0.00	10	3	0.000	131.1	0.00E+00	0.00E+00	0.0	0.00E+00		Bellaire / Summerfield

TABLE C3-5
PIEZOMETER P-9
HYDRAULIC CONDUCTIVITY RESULTS FROM PACKER TESTING
APEX LANDFILL LATERAL EXPANSION

Test Interval	Water level in 6" ID Cylinder	Drop in water level (feet)	Conversion to ft^3	Water Take (gal)	Pressure of Test (psi)	Time Lapse (min)	Flow Rate (ft^3/min)	H (ft)	k ft/min	k ft/day	k ft/year	k cm/sec	Sceen Zone	Comments
98-108	29.20	0.00	0.000	0.00	10	4	0.000	131.1	0.00E+00	0.00E+00	0.0	0.00E+00		Bellaire / Summerfield
	29.20	0.00	0.000	0.00	10	5	0.000	131.1	0.00E+00	0.00E+00	0.0	0.00E+00		Bellaire / Summerfield
	28.67	Start Test												
	28.67	0.00	0.000	0.00	20	7	0.000	154.2	0.00E+00	0.00E+00	0.0	0.00E+00		Bellaire / Summerfield
	28.66	0.01	0.002	0.01	20	8	0.002	154.2	8.02E-07	1.15E-03	0.4	3.27E-06		Bellaire / Summerfield
	28.65	0.01	0.002	0.01	20	9	0.002	154.2	8.02E-07	1.15E-03	0.4	3.27E-06		Bellaire / Summerfield
	28.64	0.01	0.002	0.01	20	10	0.002	154.2	8.02E-07	1.15E-03	0.4	3.27E-06		Bellaire / Summerfield
	28.52	Start Test												
	28.51	0.01	0.002	0.01	30	12	0.002	177.3	6.97E-07	1.00E-03	0.4	2.84E-06		Bellaire / Summerfield
	28.50	0.01	0.002	0.01	30	13	0.002	177.3	6.97E-07	1.00E-03	0.4	2.84E-06		Bellaire / Summerfield
	28.50	0.00	0.000	0.00	30	14	0.000	177.3	0.00E+00	0.00E+00	0.0	0.00E+00		Bellaire / Summerfield
	28.49	0.01	0.002	0.01	30	15	0.002	177.3	6.97E-07	1.00E-03	0.4	2.84E-06		Bellaire / Summerfield
	28.42	Start Test												
	28.41	0.01	0.002	0.01	40	17	0.002	200.4	6.17E-07	8.88E-04	0.3	2.51E-06		Bellaire / Summerfield
	28.40	0.01	0.002	0.01	40	18	0.002	200.4	6.17E-07	8.88E-04	0.3	2.51E-06		Bellaire / Summerfield
	28.39	0.01	0.002	0.01	40	19	0.002	200.4	6.17E-07	8.88E-04	0.3	2.51E-06		Bellaire / Summerfield
	28.38	0.01	0.002	0.01	40	20	0.002	200.4	6.17E-07	8.88E-04	0.3	2.51E-06		Bellaire / Summerfield
108-118	29.25	Start Test												
	29.02	0.23	0.046	0.34	10	1	0.046	141.1	2.01E-05	2.90E-02	10.6	8.21E-05		Connellsville / Morgantown
	28.99	0.03	0.006	0.04	10	2	0.006	141.1	2.63E-06	3.78E-03	1.4	1.07E-05		Connellsville / Morgantown
	28.88	0.11	0.022	0.16	10	3	0.022	141.1	9.64E-06	1.39E-02	5.1	3.93E-05		Connellsville / Morgantown
	28.85	0.03	0.006	0.04	10	4	0.006	141.1	2.63E-06	3.78E-03	1.4	1.07E-05		Connellsville / Morgantown
	28.78	0.07	0.014	0.10	10	5	0.014	141.1	6.13E-06	8.83E-03	3.2	2.50E-05		Connellsville / Morgantown
	28.50	Start Test												
	28.45	0.05	0.010	0.07	20	7	0.010	164.2	3.76E-06	5.42E-03	2.0	1.53E-05		Connellsville / Morgantown
	28.37	0.08	0.016	0.12	20	8	0.016	164.2	6.02E-06	8.67E-03	3.2	2.45E-05		Connellsville / Morgantown
	28.30	0.07	0.014	0.10	20	9	0.014	164.2	5.27E-06	7.59E-03	2.8	2.15E-05		Connellsville / Morgantown
	28.23	0.07	0.014	0.10	20	10	0.014	164.2	5.27E-06	7.59E-03	2.8	2.15E-05		Connellsville / Morgantown
	28.05	Start Test												
	27.98	0.07	0.014	0.10	30	12	0.014	187.3	4.62E-06	6.65E-03	2.4	1.88E-05		Connellsville / Morgantown
	27.90	0.08	0.016	0.12	30	13	0.016	187.3	5.28E-06	7.60E-03	2.8	2.15E-05		Connellsville / Morgantown
	27.83	0.07	0.014	0.10	30	14	0.014	187.3	4.62E-06	6.65E-03	2.4	1.88E-05		Connellsville / Morgantown
	27.75	0.08	0.016	0.12	30	15	0.016	187.3	5.28E-06	7.60E-03	2.8	2.15E-05		Connellsville / Morgantown
	27.50	Start Test												
	27.42	0.08	0.016	0.12	40	17	0.016	210.4	4.70E-06	6.77E-03	2.5	1.92E-05		Connellsville / Morgantown
	27.37	0.05	0.010	0.07	40	18	0.010	210.4	2.94E-06	4.23E-03	1.5	1.20E-05		Connellsville / Morgantown
	27.30	0.07	0.014	0.10	40	19	0.014	210.4	4.11E-06	5.92E-03	2.2	1.68E-05		Connellsville / Morgantown
	27.20	0.10	0.020	0.15	40	20	0.020	210.4	5.88E-06	8.46E-03	3.1	2.39E-05		Connellsville / Morgantown
118-128	29.10	Start Test												
	28.67	0.43	0.086	0.64	10	1	0.086	151.1	3.52E-05	5.07E-02	18.5	1.43E-04		Connellsville / Morgantown
	28.52	0.15	0.030	0.22	10	2	0.030	151.1	1.23E-05	1.77E-02	6.4	5.00E-05		Connellsville / Morgantown
	28.40	0.12	0.024	0.18	10	3	0.024	151.1	9.82E-06	1.41E-02	5.2	4.00E-05		Connellsville / Morgantown
	28.26	0.14	0.028	0.21	10	4	0.028	151.1	1.15E-05	1.65E-02	6.0	4.67E-05		Connellsville / Morgantown
	28.11	0.15	0.030	0.22	10	5	0.030	151.1	1.23E-05	1.77E-02	6.4	5.00E-05		Connellsville / Morgantown

TABLE C3-5
PIEZOMETER P-9
HYDRAULIC CONDUCTIVITY RESULTS FROM PACKER TESTING
APEX LANDFILL LATERAL EXPANSION

Test Interval	Water level in 6" ID Cylinder	Drop in water level (feet)	Conversion to ft^3	Water Take (gal)	Pressure of Test (psi)	Time Lapse (min)	Flow Rate (ft^3/min)	H (ft)	k ft/min	k ft/day	k ft/year	k cm/sec	Sceen Zone	Comments
118-128	27.68	Start Test												
	27.50	0.18	0.036	0.27	20	7	0.036	174.2	1.28E-05	1.84E-02	6.7	5.21E-05		Connellsville / Morgantown
	27.32	0.18	0.036	0.27	20	8	0.036	174.2	1.28E-05	1.84E-02	6.7	5.21E-05		Connellsville / Morgantown
	27.13	0.19	0.038	0.28	20	9	0.038	174.2	1.35E-05	1.94E-02	7.1	5.49E-05		Connellsville / Morgantown
	26.96	0.17	0.034	0.25	20	10	0.034	174.2	1.21E-05	1.74E-02	6.3	4.92E-05		Connellsville / Morgantown
	26.57	Start Test												
	26.34	0.23	0.046	0.34	30	12	0.046	197.3	1.44E-05	2.07E-02	7.6	5.87E-05		Connellsville / Morgantown
	26.15	0.19	0.038	0.28	30	13	0.038	197.3	1.19E-05	1.71E-02	6.3	4.85E-05		Connellsville / Morgantown
	25.97	0.18	0.036	0.27	30	14	0.036	197.3	1.13E-05	1.62E-02	5.9	4.60E-05		Connellsville / Morgantown
	25.74	0.23	0.046	0.34	30	15	0.046	197.3	1.44E-05	2.07E-02	7.6	5.87E-05		Connellsville / Morgantown
	25.44	Start Test												
	25.30	0.14	0.028	0.21	40	17	0.028	220.4	7.85E-06	1.13E-02	4.1	3.20E-05		Connellsville / Morgantown
	25.14	0.16	0.032	0.24	40	18	0.032	220.4	8.97E-06	1.29E-02	4.7	3.66E-05		Connellsville / Morgantown
	24.99	0.15	0.030	0.22	40	19	0.030	220.4	8.41E-06	1.21E-02	4.4	3.43E-05		Connellsville / Morgantown
	24.77	0.22	0.044	0.33	40	20	0.044	220.4	1.23E-05	1.78E-02	6.5	5.03E-05		Connellsville / Morgantown
128-138	29.02	Start Test												
	28.79	0.23	0.046	0.34	10	1	0.046	161.1	1.76E-05	2.54E-02	9.3	7.19E-05	YES	P-9 Screened Interval
	28.59	0.20	0.040	0.30	10	2	0.040	161.1	1.53E-05	2.21E-02	8.1	6.25E-05	YES	~131-144
	28.50	0.09	0.018	0.13	10	3	0.018	161.1	6.91E-06	9.94E-03	3.6	2.81E-05	YES	Connellsville / Morgantown
	28.41	0.09	0.018	0.13	10	4	0.018	161.1	6.91E-06	9.94E-03	3.6	2.81E-05	YES	Connellsville / Morgantown
	28.33	0.08	0.016	0.12	10	5	0.016	161.1	6.14E-06	8.84E-03	3.2	2.50E-05	YES	Connellsville / Morgantown
	27.87	Start Test												
	27.76	0.11	0.022	0.16	20	7	0.022	184.2	7.38E-06	1.06E-02	3.9	3.01E-05	YES	Connellsville / Morgantown
	27.70	0.06	0.012	0.09	20	8	0.012	184.2	4.03E-06	5.80E-03	2.1	1.64E-05	YES	Connellsville / Morgantown
	27.59	0.11	0.022	0.16	20	9	0.022	184.2	7.38E-06	1.06E-02	3.9	3.01E-05	YES	Connellsville / Morgantown
	27.47	0.12	0.024	0.18	20	10	0.024	184.2	8.05E-06	1.16E-02	4.2	3.28E-05	YES	Connellsville / Morgantown
	27.15	Start Test												
	27.00	0.15	0.030	0.22	30	12	0.030	207.3	8.94E-06	1.29E-02	4.7	3.64E-05	YES	Connellsville / Morgantown
	26.86	0.14	0.028	0.21	30	13	0.028	207.3	8.35E-06	1.20E-02	4.4	3.40E-05	YES	Connellsville / Morgantown
	26.73	0.13	0.026	0.19	30	14	0.026	207.3	7.75E-06	1.12E-02	4.1	3.16E-05	YES	Connellsville / Morgantown
	26.59	0.14	0.028	0.21	30	15	0.028	207.3	8.35E-06	1.20E-02	4.4	3.40E-05	YES	Connellsville / Morgantown
	26.33	Start Test												
	26.12	0.21	0.042	0.31	40	17	0.042	230.4	1.13E-05	1.62E-02	5.9	4.59E-05	YES	Connellsville / Morgantown
	26.00	0.12	0.024	0.18	40	18	0.024	230.4	6.44E-06	9.27E-03	3.4	2.62E-05	YES	Connellsville / Morgantown
	25.86	0.14	0.028	0.21	40	19	0.028	230.4	7.51E-06	1.08E-02	3.9	3.06E-05	YES	Connellsville / Morgantown
	25.69	0.17	0.034	0.25	40	20	0.034	230.4	9.12E-06	1.31E-02	4.8	3.72E-05	YES	Connellsville / Morgantown
138-148	29.13	Start Test												
	23.65	5.48	1.099	8.22	10	1	1.099	171.1	3.96E-04	5.70E-01	208.1	1.61E-03	YES	Complete Water Loss
148-158	29.11	Start Test												
	28.99	0.12	0.024	0.18	10	1	0.024	181.1	8.19E-06	1.18E-02	4.3	3.34E-05		Connellsville / Morgantown
	28.97	0.02	0.004	0.03	10	2	0.004	181.1	1.37E-06	1.97E-03	0.7	5.56E-06		Connellsville / Morgantown
	28.97	0.00	0.000	0.00	10	3	0.000	181.1	0.00E+00	0.00E+00	0.0	0.00E+00		Connellsville / Morgantown
	28.97	0.00	0.000	0.00	10	4	0.000	181.1	0.00E+00	0.00E+00	0.0	0.00E+00		Connellsville / Morgantown
	28.96	0.01	0.002	0.01	10	5	0.002	181.1	6.83E-07	9.83E-04	0.4	2.78E-06		Connellsville / Morgantown

TABLE C3-5
PIEZOMETER P-9
HYDRAULIC CONDUCTIVITY RESULTS FROM PACKER TESTING
APEX LANDFILL LATERAL EXPANSION

Test Interval	Water level in 6" ID Cylinder	Drop in water level (feet)	Conversion to ft^3	Water Take (gal)	Pressure of Test (psi)	Time Lapse (min)	Flow Rate (ft^3/min)	H (ft)	k ft/min	k ft/day	k ft/year	k cm/sec	Sceen Zone	Comments
148-158	28.59	Start Test												
	28.59	0.00	0.000	0.00	20	7	0.000	204.2	0.00E+00	0.00E+00	0.0	0.00E+00		Connellsville / Morgantown
	28.59	0.00	0.000	0.00	20	8	0.000	204.2	0.00E+00	0.00E+00	0.0	0.00E+00		Connellsville / Morgantown
	28.58	0.01	0.002	0.01	20	9	0.002	204.2	6.05E-07	8.72E-04	0.3	2.47E-06		Connellsville / Morgantown
	28.57	0.01	0.002	0.01	20	10	0.002	204.2	6.05E-07	8.72E-04	0.3	2.47E-06		Connellsville / Morgantown
	28.27	Start Test												
	28.25	0.02	0.004	0.03	30	12	0.004	227.3	1.09E-06	1.57E-03	0.6	4.43E-06		Connellsville / Morgantown
	28.23	0.02	0.004	0.03	30	13	0.004	227.3	1.09E-06	1.57E-03	0.6	4.43E-06		Connellsville / Morgantown
	28.20	0.03	0.006	0.04	30	14	0.006	227.3	1.63E-06	2.35E-03	0.9	6.65E-06		Connellsville / Morgantown
	28.18	0.02	0.004	0.03	30	15	0.004	227.3	1.09E-06	1.57E-03	0.6	4.43E-06		Connellsville / Morgantown
	28.02	Start Test												
	27.98	0.04	0.008	0.06	40	17	0.008	250.4	1.97E-06	2.84E-03	1.0	8.05E-06		Connellsville / Morgantown
	27.96	0.02	0.004	0.03	40	18	0.004	250.4	9.87E-07	1.42E-03	0.5	4.02E-06		Connellsville / Morgantown
	27.93	0.03	0.006	0.04	40	19	0.006	250.4	1.48E-06	2.13E-03	0.8	6.04E-06		Connellsville / Morgantown
	27.91	0.02	0.004	0.03	40	20	0.004	250.4	9.87E-07	1.42E-03	0.5	4.02E-06		Connellsville / Morgantown
158-163	29.15	Start Test												
	28.90	0.25	0.050	0.37	10	1	0.050	188.6	1.64E-05	2.36E-02	8.6	6.68E-05		Connellsville / Morgantown
	28.90	0.00	0.000	0.00	10	2	0.000	188.6	0.00E+00	0.00E+00	0.0	0.00E+00		Connellsville / Morgantown
	28.90	0.00	0.000	0.00	10	3	0.000	188.6	0.00E+00	0.00E+00	0.0	0.00E+00		Connellsville / Morgantown
	28.88	0.02	0.004	0.03	10	4	0.004	188.6	1.31E-06	1.89E-03	0.7	5.34E-06		Connellsville / Morgantown
	28.87	0.01	0.002	0.01	10	5	0.002	188.6	6.55E-07	9.44E-04	0.3	2.67E-06		Connellsville / Morgantown
	28.45	Start Test												
	28.44	0.01	0.002	0.01	20	7	0.002	211.7	5.84E-07	8.41E-04	0.3	2.38E-06		Connellsville / Morgantown
	28.42	0.02	0.004	0.03	20	8	0.004	211.7	1.17E-06	1.68E-03	0.6	4.76E-06		Connellsville / Morgantown
	28.40	0.02	0.004	0.03	20	9	0.004	211.7	1.17E-06	1.68E-03	0.6	4.76E-06		Connellsville / Morgantown
	28.38	0.02	0.004	0.03	20	10	0.004	211.7	1.17E-06	1.68E-03	0.6	4.76E-06		Connellsville / Morgantown
	28.20	Start Test												
	28.18	0.02	0.004	0.03	30	12	0.004	234.8	1.05E-06	1.52E-03	0.6	4.29E-06		Connellsville / Morgantown
	28.16	0.02	0.004	0.03	30	13	0.004	234.8	1.05E-06	1.52E-03	0.6	4.29E-06		Connellsville / Morgantown
	28.14	0.02	0.004	0.03	30	14	0.004	234.8	1.05E-06	1.52E-03	0.6	4.29E-06		Connellsville / Morgantown
	28.11	0.03	0.006	0.04	30	15	0.006	234.8	1.58E-06	2.27E-03	0.8	6.44E-06		Connellsville / Morgantown
	27.95	Start Test												
	27.92	0.03	0.006	0.04	40	17	0.006	257.9	1.44E-06	2.07E-03	0.8	5.86E-06		Connellsville / Morgantown
	27.87	0.05	0.010	0.07	40	18	0.010	257.9	2.40E-06	3.45E-03	1.3	9.77E-06		Connellsville / Morgantown
	27.85	0.02	0.004	0.03	40	19	0.004	257.9	9.59E-07	1.38E-03	0.5	3.91E-06		Connellsville / Morgantown
	27.83	0.02	0.004	0.03	40	20	0.004	257.9	9.59E-07	1.38E-03	0.5	3.91E-06		Connellsville / Morgantown

TABLE C3-6
GROUNDWATER ELEVATION SUMMARY
APEX LANDFILL LATERAL EXPANSION

Well / Boring ID	Ground Surface Elevation (ft. msl)	TOC Elevation (ft. msl)	Total Depth (ft. below TOC)[2]	October 25, 2010		December 6, 2010		March 28, 2011		November 8, 2011		May 22, 2012		December 10, 2012	
				DTW	Elevation	DTW	Elevation	DTW	Elevation	DTW	Elevation	DTW	Elevation	DTW	Elevation
Mine Spoil Piezometers															
P-1A	1287.61	1290.04	49.95	46.36	1243.68	45.98	1244.06	45.80	1244.24	49.96	1240.08	45.87	1244.17	46.15	1243.89
P-2A	1236.68	1239.05	15.79	9.48	1229.57	8.31	1230.74	5.69	1233.36	10.98	1228.07	10.89	1228.16	10.87	1228.18
P-3A	1278.34	1280.87	56.39	51.23	1229.64	50.74	1230.13	50.20	1230.67	50.68	1230.19	50.71	1230.16	51.17	1229.70
P-5A	1241.24	1243.60	23.51	19.46	1224.14	19.23	1224.37	14.75	1228.85	18.53	1225.07	18.79	1224.81	18.82	1224.78
P-7A	1263.93	1266.64	40.49	31.63	1235.01	27.04	1239.60	24.75	1241.89	29.08	1237.56	27.87	1238.77	29.78	1236.86
P-8A	1209.50	1211.20	16.61	16.16	1195.04	12.09	1199.11	6.99	1204.21	11.32	1199.88	11.35	1199.85	10.37	1200.83
B-1A	1293.90	1296.40	66.00	60.97	1235.43	60.98	1235.42	59.07	1237.33	60.91	1235.49	60.32	1236.08	60.70	1235.70
B-2A	1265.50	1268.04	46.50	45.10	1222.94	45.11	1222.93	36.58	1231.46	44.60	1223.44	43.65	1224.39	45.57	1222.47
B-7A	1243.70	1246.18	23.00	19.90	1226.28	18.06	1228.12	15.45	1230.73	18.19	1227.99	17.48	1228.70	18.07	1228.11
B-401A	1266.75	1269.45	45.60	BTOP	BTOP	BTOP	BTOP	37.94	1231.51	BTOP	BTOP	BTOP	BTOP	BTOP	BTOP
B-402A	1258.03	1260.50	35.41	32.96	1227.54	30.99	1229.51	29.30	1231.20	32.64	1227.86	32.87	1227.63	32.78	1227.72
B-408A	1238.80	1241.37	32.85	31.78	1209.59	25.32	1216.05	24.72	1216.65	27.70	1213.67	Converted to B-408SS			
Limestone / Shallow Bedrock Piezometers															
P-1L	1327.18	1330.30	101.31	96.68	1233.62	95.55	1234.75	87.79	1242.51	87.80	1242.50	89.08	1241.22	90.74	1239.56
P-2L	1236.62	1238.64	33.02	14.36	1224.28	14.12	1224.52	14.11	1224.53	17.53	1221.11	18.56	1220.08	19.03	1219.61
P-3L	1277.28	1279.00	75.04	57.93	1221.07	57.83	1221.17	56.32	1222.68	57.99	1221.01	57.93	1221.07	58.99	1220.01
P-4L	1260.88	1263.34	54.97	40.36	1222.98	40.39	1222.95	31.81	1231.53	39.84	1223.50	38.86	1224.48	41.13	1222.21
P-5L	1240.08	1242.43	40.26	35.24	1207.19	34.85	1207.58	32.22	1210.21	34.21	1208.22	34.58	1207.85	33.60	1208.83
P-6L	1243.35	1246.18	40.00	32.58	1213.60	30.42	1215.76	25.79	1220.39	29.63	1216.55	31.05	1215.13	30.15	1216.03
P-10L	1266.43	1268.83	62.64	46.12	1222.71	46.14	1222.69	37.55	1231.28	45.59	1223.24	44.59	1224.24	46.87	1221.96
P-11L	1257.31	1259.54	53.69	47.15	1212.39	33.83	1225.71	29.56	1229.98	33.31	1226.23	33.49	1226.05	34.21	1225.33
P-13L	1260.40	1262.65	57.11	Not Installed										38.65	1224.00
P-14L	1230.06	1232.80	10.89	Not Installed										7.17	1225.63
P-15L	1285.30	1287.35	63.98	Not Installed										51.92	1235.43
Bellaire / Summerfield SZS Piezometers															
P-1S	1326.50	1329.18	138.23	137.63	1191.55	137.57	1191.61	137.45	1191.73	137.39	1191.79	137.39	1191.79	137.42	1191.76
P-2S	1236.44	1238.75	65.59	51.10	1187.65	50.10	1188.65	48.66	1190.09	49.46	1189.29	49.19	1189.56	48.77	1189.98
P-3S	1278.33	1281.02	116.76	112.54	1168.48	113.77	1167.25	113.67	1167.35	113.58	1167.44	113.56	1167.46	113.57	1167.45
P-5S	1242.01	1244.40	67.03	63.92	1180.48	60.85	1183.55	55.49	1188.91	58.31	1186.09	59.40	1185.00	59.66	1184.74
P-6S	1244.12	1246.75	82.83	63.66	1183.09	60.63	1186.12	56.33	1190.42	59.64	1187.11	60.63	1186.12	62.22	1184.53
P-9S	1257.81	1260.76	83.20	78.60	1182.16	79.46	1181.30	79.38	1181.38	79.74	1181.02	79.42	1181.34	79.54	1181.22
P-10S	1201.78	1204.05	27.34	19.29	1184.76	13.38	1190.67	10.78	1193.27	15.31	1188.74	16.30	1187.75	10.89	1193.16
P-12S	1300.58	1303.04	82.00	Not Installed				66.43	1236.61	67.73	1235.31	67.67	1235.37	67.64	1235.40
B-4S	1205.8	1206.81	36.44	NM	NM	29.76	1177.05	29.51	1177.30	29.78	1177.03	29.90	1176.91	29.37	1177.44
B-11S	1244.3	1246.63	60.40	44.95	1201.68	44.60	1202.03	42.35	1204.28	43.91	1202.72	43.87	1202.76	44.04	1202.59
B-105S	1227.7	1228.37	45.51	NM	NM	31.92	1196.45	29.49	1198.88	30.61	1197.76	31.09	1197.28	31.27	1197.10
B-201	1209.3	1210.63	40.12	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY
B-202	1201.1	1201.63	30.80	Well Blocked											
B-308	NM	1220.84	33.70	NM	NM	NA	NM	11.07	1209.77	Unable to Locate / Damaged by Construction Activities					
B-309	NM	1214.63	NA	Could Not Locate						17.03	1197.60	Abandoned February 27, 2012			
B-310	NM	1256.27	116.74	NM	NM	96.69	1159.58	89.38	1166.89	91.83	1164.44	92.96	1163.31	92.82	1163.45
B-311	NM	1233.87	98.20	95.75	1138.12	56.08	1177.79	53.54	1180.33	54.22	1179.65	55.53	1178.34	56.18	1177.69
B-401S	1275.52	1278.27	118.09	111.89	1166.38	112.48	1165.79	106.13	1172.14	108.98	1169.29	101.60	1176.67	112.66	1165.61
B-402S	1257.59	1260.64	92.49	91.71	1168.93	91.78	1168.86	91.74	1168.90	91.83	1168.81	92.09	1168.55	DRY	DRY
B-403S	1275.55	1277.75	134.63	122.48	1155.27	121.99	1155.76	118.90	1158.85	119.80	1157.95	121.03	1156.72	121.85	1155.90
B-404S	1242.26	1245.09	81.33	Not Installed										DRY	DRY
B-405S	1230.41	1233.55	53.41	ND	ND	51.72	1181.83	51.69	1181.86	52.32	1181.23	52.03	1181.52	51.06	1182.49
B-405SR	1230.44	1232.94	82.94	Not Installed										82.58	1150.36
B-406S	1227.54	1230.24	67.00	DRY	DRY	60.83	1169.41	DRY	DRY	60.25	1169.99	62.52	1167.72	63.79	1166.45
B-407S	1232.74	1235.24	70.10	69.80	1165.44	68.70	1166.54	65.72	1169.52	67.85	1167.39	68.61	1166.63	67.59	1167.65
B-408S	1238.80	1238.80	57.96	47.86	1190.94	46.15	1192.65	41.19	1197.61	44.15	1194.65	45.83	1192.97	46.55	1192.25
B-408SS	1238.80	1241.37	32.85	Well Converted from B-408A								30.71	1210.66	26.97	1214.40
B-409S	1245.09	1247.55	62.83	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY
Uppermost Aquifer System Piezometers															
P-1	1327.11	1329.37	200.65	178.63	1150.74	177.55	1151.82	175.32	1154.05	176.45	1152.92	176.18	1153.19	177.03	1152.34
P-5	1240.98	1243.49	126.00	91.62	1151.87	90.16	1153.33	87.82	1155.67	89.33	1154.16	89.60	1153.89	90.03	1153.46
P-9	1256.94	1259.50	146.80	106.18	1153.32	103.96	1155.54	101.23	1158.27	102.75	1156.75	104.24	1155.26	104.54	1154.96
P-12	1300.66	1303.25	141.00	Not Installed				DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY[1]
B-2B	1265.9	1268.23	135.70	111.88	1156.35	110.61	1157.62	107.14	1161.09	108.68	1159.55	109.17	1159.06	109.63	1158.60
B-4	1205.3	1207.75	130.50	NM	NM	72.94	1134.81	71.07	1136.68	71.63	1136.12	71.86	1135.89	72.44	1135.31
B-5	NA	NA	94.35	NM	NM	NM	NM	53.88	NA	54.58	NA	55.65	NA	54.21	NA
B-6	CANNOT LOCATE WELL														
B-7B	1244	1246.53	133.70	80.59	1165.94	78.81	1167.72	77.53	1169.00	78.59	1167.94	79.41	1167.12	78.78	1167.75
B-8	1172.4	1174.92	50.00	NM	NM	NM	NM	19.89	1155.03	21.22	1153.70	21.32	1153.60	21.16	1153.76
B-11	1243.9	1246.36	115.80	94.38	1151.98	92.13	1154.23	89.56	1156.80	91.09	1155.27	92.65	1153.71	93.18	1153.18
B-12	1282.3	1284.83	185.70	133.98	1150.85	132.81	1152.02	130.70	1154.13	132.21	1152.62	132.24	1152.59	132.98	1151.85
B-105	1227.3	1229.12	158.51	NM	NM	81.72	1147.40	80.49	1148.63	81.55	1147.57	82.62	1146.50	82.95	1146.17
B-401	1262.95	1265.63	146.00	109.07	1156.56	107.12	1158.51	104.49	1161.14	105.57	1160.06	106.77	1158.86	106.79	1158.84
B-402	1263.12	1266.19	155.00	113.03	1153.16	111.42	1154.77	108.88	1157.31	110.10	1156.09	111.35	1154.84	111.71	1154.48
B-403	1224.47	1226.84	118.00	68.41	1158.43	66.90	1159.94	64.53	1162.31	65.83	1161.01	67.06	1159.78	67.45	1159.39
B-404	1243.07	1246.17	123.11	Not Installed										93.09	1153.08
B-405	1231.11	1234.20	127.72	ND	ND	80.46	1153.74	77.69	1156.51	79.17	1155.03	80.74	1153.46	81.30	1152.90
B-406	1227.47	1230.13	135.31	83.42	1146.71	81.29	1148.84	78.65	1151.48	79.81	1150.32	81.16	1148.97	82.18	1147.95
B-407	1233.15	1235.74	134.96	92.78	1142.96	91.04	1144.70	89.75	1145.99	90.15	1145.59	91.06	1144.68	91.20	1144.54
B-408	1238.07	1240.71	129.31	95.90	1144.81	95.16	1145.55	91.71	1149.00	92.96	1147.75	93.99	1146.72	94.42	1146.29
B-409	1245.12	1247.57	111.75	98.91	1148.66	96.29	1151.28	94.49	1153.08	95.81	1151.76	97.08	1150.49	97.71	1149.86
B-410	1242.79	1245.32	119.79	106.85	1138.47	102.49	1142.83	100.24	1145.08	101.02	1144.30	102.33	1142.99	103.52	1141.80
B-411	1237.07	1239.87	125.57	117.25	1122.62	116.50	1123.37	116.17	1123.70	116.58	1123.29	116.86	1123.01	116.69	1123.18
B-412	1233.74	1236.38	127.78	104.23	1132.15	100.29	1136.09	99.76	1136.62	100.78	1135.60	101.10	1135.28	100.27	1136.11
B-413	1240.11	1242.96	101.99	103.07	1139.89	97.15	1145.81	96.34	1146.62	97.70	1145.26	99.31	1143.65	97.35	1145.61
B-413R	1238.88	1241.61	133.54	100.77	1140.84	95.90	1145.71	94.95	1146.66	97.04	1144.57	98.00	1143.61	96.29	1145.32
B-414	1229.42	1231.50	118.22	97.58	1133.92	94.42	1137.08	91.13	1140.37	93.50	1138.00	93.84	1137.66	94.69	1136.81
Birmingham (Below Uppermost Aquifer)															
B-1B	1293.50	1295.96	176.50	136.32	1159.64	135.75	1160.21	132.25	1163.71	134.00	1161.96	133.31	1162.65	135.48	1160.48
Pond Gauge															
PG-1	NM	1234.04	NA	ND	ND	2.90	1231.14	1.00*	1235.04	DRY[1]	DRY[1]	DRY[1]	DRY[1]	DRY[1]	DRY[1]

Notes:

NA = Not Available

NM = Not Measured

ND = No data. Well Not Installed

BTOP = Below Top of Pump

* Water above gauge in pond

[1] Water receeded from pond gauge

[2] Total Depths updated from May 22, 2012 sampling event

TABLE C3-7
GROUNDWATER VELOCITY CALCUATIONS
APEX LANDFILL LATERAL EXPANSION

Civil & Environmental Consultants, Inc.

PROJECT	Apex Landfill Lateral Expansion	PROJECT NO.	101-049
	Groundwater Velocity Calculations	PAGE	1 OF 2

MADE BY	DWC	DATE	4-12-11	CHECKED BY	JMD	DATE	4-26-11

INTRODUCTION Calculate the Mean Groundwater Flow Rates

METHOD A derivation of Darcy's Equation.

CALCULATION

$$V = (K) \times (dh/dl)/n_e$$

Where: V = Mean Groundwater Flow Rate
K = Hydraulic Conductivity
dh/dl = Hydraulic Gradient
n_e = Effective Porosity

Connellsville/Morgantown UAS

K = 9.61×10^{-4} cm/sec (geometric mean of the K-testing)
dh/dl = 0.0064 ft/ft (average hydraulic gradient observed)
n_e = 0.35 (Sandstone - OEPA Technical Guidance Manual, 2006)

V = (9.61×10^{-4} cm/sec)(0.0064 ft/ft)/(0.35) = 1.76×10^{-5} cm/sec
= 5.77×10^{-7} ft / sec
= 0.05 ft/day
= 18.3 ft/year

Bellaire/Summerfield SZS

K = 3.50×10^{-5} cm/sec (geometric mean of the K-testing)
dh/dl = 0.039 ft/ft (average hydraulic gradient observed)
n_e = 0.06 (Shale - OEPA Technical Guidance Manual, 2006)

V = (3.50×10^{-5} cm/sec)(0.039 ft/ft)/(0.06) = 2.28×10^{-5} cm/sec
= 7.46×10^{-7} ft / sec
= 0.065 ft/day
= 23.5 ft/year

TABLE C3-7
GROUNDWATER VELOCITY CALCUATIONS
APEX LANDFILL LATERAL EXPANSION

Civil & Environmental Consultants, Inc.

PROJECT	Apex Landfill Lateral Expansion	PROJECT NO.	101-049
	Groundwater Velocity Calculations	PAGE	2 OF 2
MADE BY	DWC DATE 4-12-11	CHECKED BY	JMD DATE 4-26-11

Limestone/Shallow Bedrock SZS and UAS

K = 7.61 x 10^{-4} cm/sec (geometric mean of the K-testing)
dh/dl = 0.012 ft/ft (average hydraulic gradient observed)
n_e = 0.30 (Limestone - OEPA Technical Guidance Manual, 2006)

V = (7.61x10^{-4} cm/sec)(0.012 ft/ft)/(0.30) = 3.04 x 10^{-5} cm/sec
= 9.97 x 10^{-6} ft / sec
= 0.086 ft/day
= 31.5 ft/year

Mine Spoil SZS

K = 3.67 x 10^{-4} cm/sec (geometric mean of the K-testing)
dh/dl = 0.013 ft/ft (average hydraulic gradient observed)
n_e = 0.32 (Sandy Clay - OEPA Technical Guidance Manual, 2006)

V = (3.67x10^{-4} cm/sec)(0.013 ft/ft)/(0.32) = 1.49 x 10^{-5} cm/sec
= 4.89 x 10^{-7} ft / sec
= 0.042 ft/day
= 15.4 ft/year

TABLE C3-8
WATER QUALITY SAMPLING RESULTS SUMMARY - OCTOBER & DECEMBER 2010
APEX LANDFILL LATERAL EXPANSION

		Lateral Expansion Piezometers													Detection Monitoring Wells							
Parameter / Date	Unit	P-2A 10/28/10	P-2L 10/28/10	P-2S 10/28/10	P-3L 10/29/10	P-4L/P-4A[1] 10/28/10	P-5 10/28/10	FIELD DUP 10/28/10	P-5S 10/29/10	P-6S 10/29/10	P-7A 10/29/10	P-9 10/28/10	P-10L 10/28/10	Trip Blank	B-401 12/9/10	DUP-2 12/9/10	B-401A 12/9/10	B-401S 12/8/10	B-402 12/9/10	B-402A 12/9/10	B-403 12/9/10	B-403S 12/9/10
1,1,1,2-Tetrachloroethane	µg/L	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
1,1,1-Trichloroethane	µg/L	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
1,1,2,2-Tetrachloroethane	µg/L	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
1,1,2-Trichloroethane	µg/L	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
1,1-Dichloroethane	µg/L	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
1,1-Dichloroethene	µg/L	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
1,2,3-Trichloropropane	µg/L	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
1,2-Dibromo-3-chloropropane	µg/L	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04
1,2-Dibromoethane	µg/L	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04
1,2-Dichlorobenzene	µg/L	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
1,2-Dichloroethane	µg/L	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
1,2-Dichloropropane	µg/L	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
1,4-Dichlorobenzene	µg/L	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
2-Hexanone	µg/L	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5
4-Methyl-2-Pentanone	µg/L	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
Acetone	µg/L	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10
Acrylonitrile	µg/L	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5
Alkalinity to pH 4.5	mg/L CaCO3	287	268	272	272	319	299	297	295	281	615	292	348	NA	389	386	325	372	272	427	259	533
Ammonia Nitrogen	mg/L as N	0.061	0.24	0.65	1.65	0.08J	0.78	0.77	0.43	0.54	2.33	0.31	0.16	NA	0.12	0.21	0.061	0.38	0.6	0.22	0.12	0.3
Antimony	µg/L	<1	<1	<1	<1	<1	1.1	1.1	<1	<1	<1	<1	<1	NA	<1	<1	<1	<1	<1	<1	<1	<1
Arsenic	µg/L	<1	<1	<1	<1	<2	13	13.7	<1	<1	15	12.4	1.0J	NA	<1	<1	<1	1.4	8	2.1	<1	0.9J
Barium	mg/L	0.026	0.024	0.021	0.017	0.025	0.023	0.023	0.034	0.043	0.055	0.037	0.013	NA	0.023	0.025	0.01	0.069	0.042	0.013	0.033	0.058
Benzene	µg/L	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
Beryllium	mg/L	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	NA	<0.001	<0.001	<0.001	<0.001	0.0006J	<0.001	<0.001	<0.001
Bromochloromethane	µg/L	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
Bromoform	µg/L	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
Bromomethane	µg/L	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
Cadmium	mg/L	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	NA	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002
Calcium	mg/L	361	358	232	370	564	216	225	285	439	678	207	581	NA	695	666	676	420	89.9	349	227	5.61
Carbon Disulfide	µg/L	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
Carbon Tetrachloride	µg/L	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
Chloride	mg/L	4J	8	4J	6	6	4J	4J	2J	2J	13	<5	5	NA	8	7	3J	5	<5	155	<5	3J
Chlorobenzene	µg/L	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
Chlorodibromomethane	µg/L	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
Chloroethane	µg/L	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
Chloroform	µg/L	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
Chloromethane	µg/L	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
Chromium	mg/L	<0.01	<0.01	<0.01	<0.01	0.006J	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	NA	<0.01	<0.01	<0.01	0.007J	<0.01	<0.01	<0.01	<0.01
cis-1,2-Dichloroethene	µg/L	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
cis-1,3-Dichloropropene	µg/L	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
Cobalt	mg/L	0.014	0.026	<0.005	<0.005	0.007	0.009	0.008	<0.005	<0.005	0.003J	0.006	0.007	NA	0.002J	0.003J	0.002J	0.007	<0.005	<0.005	<0.005	<0.005
Copper	mg/L	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	NA	<0.01	<0.01	<0.01	0.013	<0.01	<0.01	<0.01	<0.01
Dibromomethane	µg/L	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
Dichlorobromomethane	µg/L	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
Ethylbenzene	µg/L	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
Iodomethane	µg/L	<5	<5	<5	<5	<5	<5	<5	0.7J	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5
Iron	mg/L	0.91	0.32	0.26	3.04	3.01	0.05	0.05	0.3	0.47	84.6	0.19	2.32	NA	0.08	0.09	0.12	6.7	0.12	2.55	0.13	<0.05
Lead	µg/L	0.4J	<1	<1	<1	2	<1	<1	0.9J	1.7	2.7	0.4J	<1	NA	<1	<1	<1	5.3	<1	<1	<1	<1
Magnesium	mg/L	81.5	88	60.8	137	206	62.6	65.7	86.5	121	244	49	231	NA	116	119	261	161	29	129	71.8	1.29
Manganese	mg/L	4.04	8.27	0.269	0.304	0.574	0.604	0.62	0.47	0.771	10.8	0.545	0.882	NA	3.18	3.31	0.181	1.37	0.083	0.195	0.037	0.018
Methyl Ethyl Ketone	µg/L	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5
Methylene Chloride	µg/L	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
Nickel	mg/L	0.017	0.046	<0.01	<0.01	0.019	0.01	0.01	<0.01	<0.01	0.017	0.006J	0.015	NA	<0.01	<0.01	0.014	0.019	<0.01	0.006J	<0.01	<0.01
Nitrate - Nitrite	mg/L as N	<0.05	0.02J	0.05	<0.05	<0.05	<0.05	0.02J	0.35	0.03J	0.05	<0.05	<0.05	NA	<0.05	<0.05	0.05J	0.81	0.1	<0.05	0.29	0.08
pH (Field)	S U	7.08	6.65	7.45	7.19	7.21	7.52	NA	7.19	7.25	7.34	7.41	7.18	NA	6.8	6.8	6.82	6.47	8.31	6.84	7.6	8.34
Potassium	mg/L	2.3	2.9	5.1	9.1	7.5	3.4	3.6	6	5.2	30.2	3.3	7.2	NA	3.6	3.7	7.4	9.5	4.2	7.8	4.8	2.2
Selenium	µg/L	<1	<1	<1	<1	<2	<1	<1	0.8J	<1	1.3	<1	0.6J	NA	0.7J	<1	1.5	0.6J	<1	2.6	<1	<1
Silver	mg/L	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	NA	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Sodium	mg/L	5.9	7.8	33	130	10.2	58.5	60.2	40.2	32.5	53.4	53.8	8.8	NA	19.2	19.6	7	43.5	64.9	34.5	58.4	332
Specific Conductance (Field)	umhos/cm	1781	1784	1373	3500	4010	1458	NA	1717	3020	5030	1325	4300	NA	3050	3050	3490	2900	595	1766	1219	1038
Styrene	µg/L	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
Sulfate	mg/L	728	697	389	1260	1690	577	571	726	1210	1990	490	1560	NA	1320	1380	1810	1390	166	719	514	148
Temperature (Field)	deg C	14.5	12.4	14.2	13.1	13	13.4	NA	8.7	9.3	8.7	12.5	12.6	NA	9.4	9.4	9.4	9.3	8	10.1	8.2	8.3
Tetrachloroethene	µg/L	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
Thallium	µg/L	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	1	<0.2	<0.2	NA	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
Toluene	µg/L	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
Total dissolved solids	mg/L	1600	1680	1130	2230	3070	1220	1200	1430	2090	3830	1050	2960	NA	2430	2470	2980	2330	456	1540	1110	754
Total Xylene	µg/L	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2
trans-1,2-Dichloroethene	µg/L	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
trans-1,3-Dichloropropene	µg/L	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
trans-1,4-Dichloro-2-butene	µg/L	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2
Trichloroethene	µg/L	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
Trichlorofluoromethane	µg/L	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
Turbidity (Field)	NTU	21.4	1.19	2.09	11.5	163	2.36	NA	7.59	25.4	62	6.2	2.87	NA	0.52	0.52	2.36	>1000	1.24	1.24	2.87	0.76
Vanadium	mg/L	0.003J	0.005J	<0.005	<0.005	0.004J	<0.005	<0.005	<0.005	<0.005	0.008	<0.005	<0.005	NA	<0.005	<0.005	<0.005	0.006	<0.005	<0.005	<0.005	<0.005
Vinyl Acetate	µg/L	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
Vinyl Chloride	µg/L	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
Zinc	mg/L	0.004J	0.012	<0.01	<0.01	0.015	<0.01	<0.01	0.012	0.010J	0.042	<0.01	0.007J	NA	<0.01	<0.01	0.006J	0.139	<0.01	0.005J	0.005J	<0.01

Notes

NA = Not Analyzed

Bold values represent detections above there PQL or field parameters

Field Duplicate collected at P-5

J - Data qualifier indicates a detection above the MDL, but below the PQL

1 - Well P-4L is identified as P-4A within the laboratory analytical report

TABLE C3-9
SUMMARY OF GROUNDWATER YIELD DATA
APEX LANDFILL LATERAL EXPANSION

Hydrogeologic Zone	Piezometer ID	Activity / Method of Purging	Total Well Depth from Top of PVC (Feet)	Static Water Level from Top of PVC (Feet)	Flow Rate During Development or Yield Test (GPM)	Approximate Drawdown Observed at Flow Rate (Feet)	Average Yield (GPM)	Does Well Yield Greater Than Average Regional Yield of 9.0 GPM? (yes/no)	Does Well Yield Greater Than 2.6 GPM? (yes/no)	**Average** Yield Greater Than 50% of the Average Regional Yield? (yes/no)	Comments
Uppermost Aquifer System	P-1	Well Development / Grundfos Pump	200.65	178.18	0.25 to 0.8	11.56	0.53	No	No	No	Average yield calculated over development period. Water Level stable at 189.74 at 0.25 gpm.
	P-5	Well Development / Grundfos Pump	127.70	92.53	3.00	7.00	3.00	Unknown	**Yes**	NA[1]	Flow rate limited by Grundfos Pump. Pump maxed out at 3.0 gpm with only 7 feet of drawdown. Well produces greater than 3 gpm.
		Yield Test / Grundfos Pump	127.70	90.48	3.00	8.63	3.00	Unknown			Flow rate limited by Grundfos Pump. Pump maxed out at 3.0 gpm with only 8.63 feet of drawdown. Well produces greater than 3 gpm. No Change in observation piezometers P-5S or P-5A during pump test.
	P-9	Well Development / Grundfos Pump	146.80	105.81	3.00	5.44	3.00	Unknown	**Yes**	NA[1]	Flow rate limited by Grundfos Pump. Pump maxed out at 3.0 gpm with only 5.44 feet of drawdown. Well produces greater than 3 gpm.
		Yield Test / Grundfos Pump	146.80	104.35	3.00	4.10	3.00	Unknown			Flow rate limited by Grundfos Pump. Pump maxed out at 3.0 gpm with only 4.10 feet of drawdown. Well produces greater than 3 gpm. No Change in observation piezometer P-9S during pump test.
	B-12	Yield Test / Grundfos Pump	195.00	133.27	2.50	0.85	2.50	Unknown	**Yes**	NA[1]	Flow rate limited by Grundfos Pump. Pump maxed out at 2.5 gpm with only 0.85 feet of drawdown. Well produces greater than 3 gpm. No Change in observation piezometer P-3A, P-3L, or P-3S during pump test.
						Average Yield of Uppermost Aquifer System >	**2.26**			**50% of 9.0 = 4.5**	Based on the limitations of the Grundfos pump and 2-inch piezometers. The UAS yields greater than the 2.26 gpm average.
Bellaire / Summerfield - Significant Zone of Saturation	P-1S	Well Development / Bailer	138.23	135.96	NA	Purged Dry	0.02	No	No	No	Average yield calculated during development with a bailer by dividing gallons removed by total time elapsed. Average includes multiple purging and recover periods.
	P-2S	Well Development / Grundfos Pump	65.59	51.32	0.25 to 0.5	5.43	0.50	No	No	No	Water level was relatively stable at 0.50 gpm. See yield test of P-2S below for more information.
		Yield Test / Grundfos Pump	65.59	49.12	0.75	13.78	0.75	No			Water level approximately stable at 13.78 feet of drawdown at 0.75 gpm. No Change in observation piezometers P-2A or P-2L during pump test.
	P-3S	Well Development / Grundfos Pump	116.76	88.87	0.30 to 0.63	Purged Dry	0.47	No	No	No	Average yield calculated on purging rate prior to well going dry. Well would likely not support the 0.47 gpm flow rate without going dry.
	P-5S	Well Development / Bailer	67.03	63.50	NA	Purged Dry	0.13	No	No	No	Average yield calculated during development with a bailer by dividing total time elapsed by gallons removed. Average only calculated on 2nd bailing period on 10/14/10.
	P-6S	Well Development / Grundfos Pump	82.83	62.51	0.21 to 0.56	Purged Dry	0.45	No	No	No	Average yield calculated on purging rate prior to well going dry. Well would likely not support the 0.45 gpm flow rate without going dry.
	P-9S	Well Development / Grundfos Pump	83.20	69.73	0.5 to 0.13	Purged Dry	0.32	No	No	No	Average yield calculated on purging rate prior to well going dry. Well would likely not support the 0.32 gpm flow rate without going dry.
	P-10S	Well Development / Bailer	27.34	19.09	NA	Purged Dry	0.22	No	No	No	Average yield calculated during development with a bailer by dividing gallons removed by total time elapsed. Average calculated over 2 development periods where the well was purged dry.
						Average Yield of Bellaire / Summerfield - Significant Zone of Saturation =	**0.34**			**50% of 9.0 = 4.5**	
Limestone / Shallow Bedrock - Significant Zone of Saturation	P-1L	Well Development / Bailer	101.31	95.89	NA	Purged Dry	0.11	No	No	No	Average yield calculated during development with a bailer by dividing gallons removed by total time elapsed. Average calculated over the 1st and 3rd development periods where the well was purged dry.
	P-2L	Well Development / Grundfos Pump	33.02	14.27	0.56 to 1.25	16.54	1.25	No	**Yes**	**NA[1]**	Average yield calculated over development period. Water Level relatively stable at 1.25 gpm with 16.54 feet of drawdown.
		Yield Test / Grundfos Pump	33.02	15.18	3.75	15.39	3.75	No			Water level relatively stable, but exhibited slight drawdown at 3.75. No Change in observation piezometers P-2A or P-2S during pump test.
	P-3L	Well Development / Grundfos Pump	75.04	57.78	0.38 to 1.0	10.38	0.50	No	No	No	Average yield calculated over development period. Water Level relatively stable at 0.5 gpm with 10.38 feet of drawdown.
		Yield Test / Grundfos Pump	75.07	58.11	0.65	13.81	0.65	No			Water level stable at 0.65 gpm with 13.81 feet of drawdown. No change in observation piezometers P-3A, P-3S, or B-12.
	P-4L	Well Dev / Grundfos Pump and Bailer	54.97	40.07	0.3 with Bailer / 5.0 with Pump	0.13	5.00	Unknown	**Yes**	**NA[1]**	Flow rate limited by Grundfos Pump. Pump maxed out at 5.0 gpm with only 0.13 feet of drawdown. Well produces greater than 5 gpm.
		Yield Test / Grundfos Pump	54.97	39.81	4.25	0.10	4.25	Unknown			Flow rate limited by Grundfos Pump. Pump maxed out at 4.25 gpm with only 0.10 feet of drawdown. Well produces greater than 4.25 gpm. No Change in observation piezometers B-401, B-402A, B-402S, or P-10L during pump test.
	P-5L	Well Development / Bailer	40.26	35.19	0.14 to 0.18	Purged Dry	0.15	No	No	No	Average yield calculated during development with a bailer by dividing gallons removed by total time elapsed. Average calculated over 3 development periods where the well was purged dry.
	P-6L	Well Development / Bailer	40.00	32.52	0.10 to 0.21	Purged Dry	0.16	No	No	No	Average yield calculated during development with a bailer by dividing gallons removed by total time elapsed. Average calculated over 2 development periods where the well was purged dry.
	P-10L	Well Development / Grundfos Pump	62.64	46.89	1.67 to 5.0	1.26	4.00	Unknown	**Yes**	**NA[1]**	Water level not stable during development at 4.0 gpm. See below for additional yield test data on P-10L.
		Yield Test / Grundfos Pump	62.67	45.57	4.5	4.54	4.50	Unknown			Flow rate limited by Grundfos Pump. Pump maxed out at 4.5 gpm with 4.54 feet of drawdown. Well produces greater than 4.5 gpm. No change in observation piezometers B-401, B-401A, B-2A, B-2B, or P-4A.
	P-11L	Well Development / Bailer	53.69	50.96	0.013 to 0.17	Purged Dry	0.09	No	No	No	Average yield calculated during development with a bailer by dividing gallons removed by total time elapsed. Average calculated over 2 development periods where the well was purged dry.
	P-13L	Well Development / Bailer & Grundfos Pump	57.11	40.11	0.23 to 0.42	Purged Dry	0.30	No	No	No	Average yield calculated during development with a bailer and/or Grundfos Pump by dividing gallons removed by total time elapsed. Average calculated over 3 development periods where the well was purged dry.
		Recovery Test / Bailer	57.11	40.11	0.03	Purged Dry	0.03	No			Test conducted by purging the well dry and measuring its recovery. Average yield calculated by dividing the gallons of recharge by total time elapsed during recovery.
	P-14L	Well Development / Bailer	10.89	5.57	0.05 to 0.35	Purged Dry	0.20	No	No	No	Average yield calculated during development with a bailer by dividing gallons removed by total time elapsed. Average calculated over 2 development periods where the well was purged dry.
		Recovery Test / Bailer	10.89	7.94	<0.01	Purged Dry	<0.01	No			Test conducted by purging the well dry and measuring its recovery. Average yield calculated by dividing the gallons of recharge by total time elapsed during recovery.
	P-15L	Well Development / Bailer & Grundfos Pump	63.98	51.99	0.16 to 0.23	Purged Dry	0.21	No	No	No	Average yield calculated during development with a bailer and/or Grundfos Pump by dividing gallons removed by total time elapsed. Average calculated over 4 development periods where the well was purged dry.
		Recovery Test / Bailer	63.98	53.24	0.03	Purged Dry	0.03	No			Test conducted by purging the well dry and measuring its recovery. Average yield calculated by dividing the gallons of recharge by total time elapsed during recovery.
						Average Yield of Limestone / Shallow Bedrock - Significant Zone of Saturation >	**1.37**			**50% of 9.0 = 4.5**	
Mine Spoil - Significant Zone of Saturation	P-1A	Well Development / Bailer	49.95	46.32	0.08 to 0.06	Purged Dry	0.07	No	No	No	Average yield calculated during development with a bailer by dividing total time elapsed by gallons removed. Average calculated over 2 development periods where the well was purged dry.
	P-2A	Well Dev / Grundfos Pump and Bailer	15.79	9.25	0.18 with Bailer / 0.25 with Pump	1.60	0.25	No	No	No	Average yield calculated off development with Grundfos Pump. See below for additional yield data from P-2A
		Yield Test / Grundfos Pump	15.80	8.63	0.75	4.36	0.75	No			Water level stable at 0.75 gpm with 4.36 feet of drawdown. No change in observation piezometers P-2L or P-2S.
	P-3A	Well Development / Bailer	56.39	51.14	0.09 to 0.16	Purged Dry	0.13	No	No	No	Average yield calculated during development with a bailer by dividing total time elapsed by gallons removed. Average calculated on 2 development periods where well was purged dry.
	P-5A	Well Development / Bailer	23.51	19.41	0.07 to 0.08	Purged Dry	0.08	No	No	No	Average yield calculated during development with a bailer by dividing total time elapsed by gallons removed. Average calculated on 2 development periods where well was purged dry.
	P-7A	Well Development / Bailer	40.49	31.63	0.14 to 0.29	Purged Dry	0.22	No	No	No	Average yield calculated during development with a bailer by dividing total time elapsed by gallons removed. Average calculated on 2 development periods where well was purged dry.
	P-8A	Well Development / Bailer	16.61	15.41	0.17	Purged Dry	0.17	No	No	No	Average yield calculated during development with a bailer by dividing total time elapsed by gallons removed. Average calculated on 1 development period where well was purged dry. Very limited intial amount of water in the well.
						Average Yield of Mine Spoil / Significant Zone of Saturation =	**0.23**			**50% of 9.0 = 4.5**	

Note:

NA[1] When average yield is greater tht 2.6 gpm (for a 2 inch diameter well), then the yield criteria for a UAS is met at that well location. A comparison to the regional yield is not required in this case.

TABLE C3-10
SUMMARY OF GROUNDWATER SEEPS
APEX LANDFILL LATERAL EXPANSION

Seep Identification Number	Approximate Groundwater Seep Elevation (ft. msl)	Approximate Top of Bedrock Elevation (ft. msl)	Comments / Nearby Piezometers
1	1140	ND	Saturated Mine Spoil / Residual Soil
2	1190	1185	Saturated Mine Spoil / Residual Soil
3	1225	1215	Saturated Mine Spoil (piezometer P-5A located approximately 300 feet from seep)
4	1220	1200	Saturated Mine Spoil / Residual Soil
5	1200	1190	Saturated Mine Spoil / Residual Soil
6	1195	1190	Saturated Mine Spoil / Residual Soil
7	1265	1225	Saturated Mine Spoil (piezometer B-7A located approximately 300 feet from seep)
8	1220	1215	Saturated Mine Spoil / Residual Soil (boring RB-8 exhibited sturated residual soil - located approximately 225 feet from seep)
9	1225	1215	Saturated Mine Spoil / Residual Soil
10	1230	1215	Saturated Mine Spoil / Residual Soil
11	1185	1185	Saturated at Top of Bedrock (piezometer P-10S located approximately 225 feet from seep)
12	1195	1190	Saturated Mine Spoil / Residual Soil

Notes:

ND = No Data Available

DRAWINGS

(ROLL)

APPENDIX C3-A

DOCUMENTS AND CORRESPONDENCE

January 5, 2011

Ms. Beth Wilson
Division of Mineral Resources Management
Ohio Department of Natural Resources
2045 Morse Road, Bldg. H3
Columbus, Ohio 43229-6693

SUBJECT: Proposed PTI Application
Apex Landfill
Amsterdam, Ohio
CEC Project 101-049

Dear Ms. Wilson:

Apex Environmental, LLC, is proposing to submit a Permit to Install (PTI) Application for the expansion of the Apex Landfill in Jefferson County, Ohio. The proposed expansion will add additional acreage to the existing landfill. The landfill is located in Springfield Township, Jefferson County, Ohio. A copy of a United States Geological Survey map segment for the site is attached.

In accordance with Ohio Administrative Code 3745-27-06(C)(3)(c), we are requesting a letter from the Ohio Department of Natural Resources, Division of Mineral resources Management verifying the type, mining methods, location, depth, and status of any surface or underground mines in the area. Additionally, we are also requesting a letter verifying location, depth, and operating status of any oil or gas wells in the vicinity of the landfill.

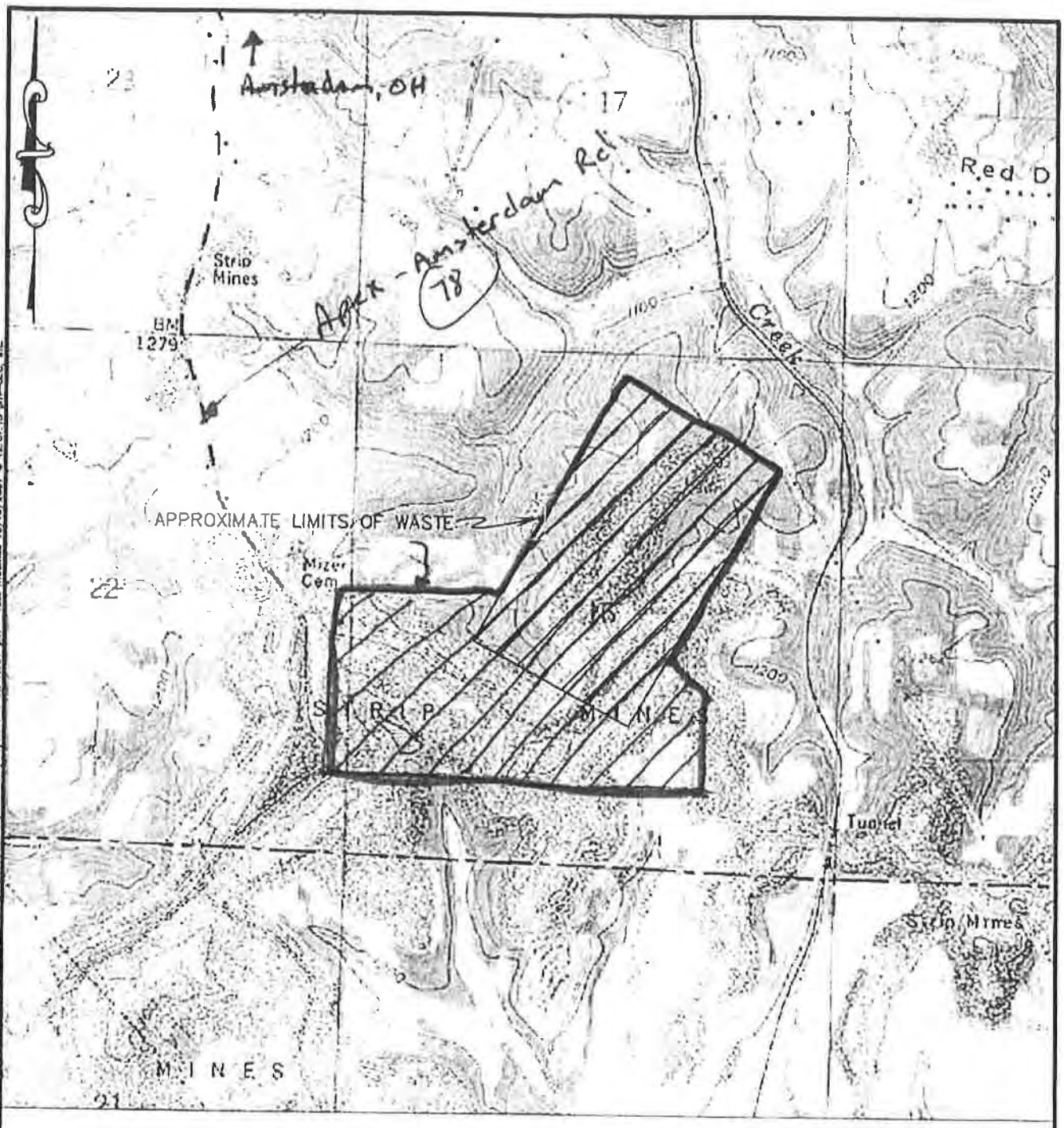
We request a letter transmitting the information in your files concerning any information as outlined above. Thank you for your assistance.

Sincerely,

CIVIL AND ENVIRONMENTAL CONSULTANTS, INC.

Matthew Barnett, P.G.
Project Manager

Attachment



REFERENCE:

U.S.G.S. 7.5 MINUTE TOPOGRAPHIC QUADRANGLE MAP
AMSTERDAM, OHIO; DATED 1976.

SCALE IN FEET

0 1500 3000

Civil & Environmental Consultants, Inc.
Columbus, OH
(614) 540-6633 • (888) 598-6808
Cincinnati, OH • Pittsburgh, PA • Indianapolis, IN • Nashville, TN

SITE LOCATION MAP
APEX ENVIRONMENTAL LLC.
JEFFERSON COUNTY, OHIO

DWN. BY: KMAC	SCALE:	DATE:	PROJECT NO.:	
CHKD. BY: DWC	1"=1500'	May 2006	042-021	Figure 1

\\cd-archive\Projects\2004\042021 Apex Landfill\Drawings\Site Location\042021 SITE LOCATION Figure 1.dwg, by:boardman, plotted 01/04/2011 @ 02:42:37 pm ~ last modified 10/10/2007 @ 12:01:13 pm~CEC, Inc.

Crayne, David

From: Wilson, Beth [Beth.Wilson@dnr.state.oh.us]
Sent: Wednesday, January 12, 2011 10:50 AM
To: Barnett, Matt
Subject: FW: Data request
Attachments: CEC maps.pdf

Follow Up Flag: Follow up
Flag Status: Flagged

Re: Additional information about both oil/gas wells and mining operations for a location in Springfield Twp, Jefferson Co.

Mr. Barnett,

Attached please find the information you requested.

Our records show two permits located in the area of interest. C-247 and D-881 were both surface mines. D-881 was proposing to mine the #8 coal (elevation 1242) but looking at the scanned map, I'm not sure if they actually mined the coal. I tried to bring up the scanned map for C-247 but was unable to. Attached are a couple of maps showing the limits of the two mines (red = C-247 and yellow = D-881). This is all the information we could find.

There are no known oil and gas wells in section 16 (S), Springfield Township, Jefferson County.

If we can be of assistance to you in the future, please contact us.

Beth Wilson, Public Information
Ohio Department of Natural Resources
Division of Mineral Resources Management
614-265-6901
www.dnr.state.oh.us/mineral/tabid/10352/Default.aspx

-----Original Message-----
From: Barnett, Matt [mailto:mbarnett@cecinc.com]
Sent: Wednesday, January 05, 2011 3:23 PM
To: minerals
Subject: Data request

Dear Ms. Wilson,

Pursuant to our telephone conversation yesterday, I am forwarding you a data request. Please contact me with any questions. Thank you for your assistance.

Matthew Barnett, P.G.
Civil & Environmental Consultants, Inc.
8740 Orion Place, Suite 100 · Columbus, Ohio 43240

Toll-Free: 888-598-6808 · Direct: 614-310-2073 · Fax: 614-540-6638
Mobile: (614)214-6879 · http://www.cecinc.com
Senior Leadership · Integrated Services · Personal Business Relationships

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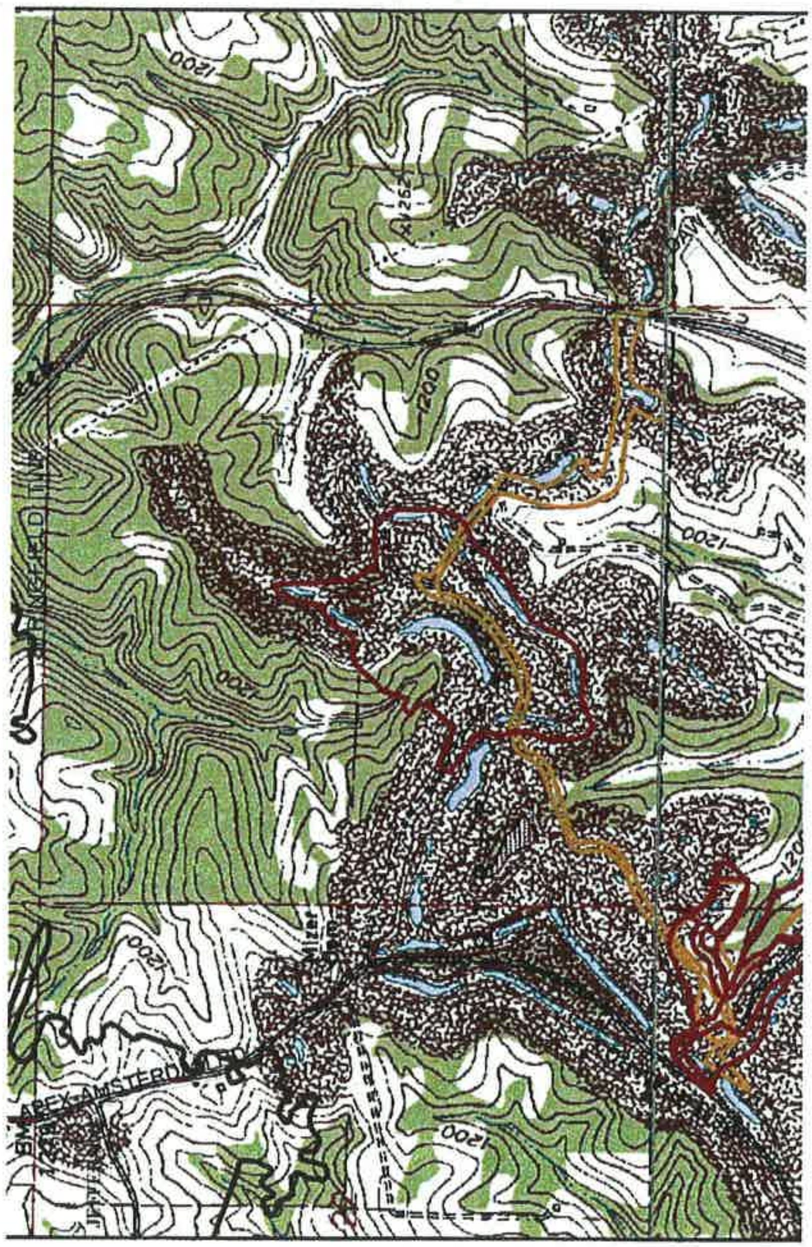

1200

284 RD

SURFACE MINE RENEWAL PERMIT

Under the authority of Chapter 1514 of the Revised Code, the Chief of the Division of Mineral Resources Management hereby orders and grants a renewal to Ohio Surface Mine Permit: IM-1164.

Issued To: K C C I
PO Box 24
MORRISTOWN, OH 43759

Telephone: (740) 782-1087

Permit Number: IM-1164
Application Number IMR-1164-1
Acreage: 356.60
Effective: 07/13/2002
Expires: 07/12/2017

Type of Operation: Surface
Mineral Types: Limestone

CONDITIONS

CONDITION TYPE	DESCRIPTION
Various	No dewatering may occur until all groundwater modelling provisions, as outlined in section 1514.13 of ORC, are submitted to and approved by the Division of Mineral Resources Management.

LOCATION OF PERMIT AREA

NAME OF LANDOWNERS	T	R	SECTION	LOTS	TOWNSHIP	COUNTY
Apex Energy, Inc.	11	4	16		SPRINGFIELD	JEFFERSON

The issuance of this permit means only that the application to conduct a surface mining operation meets the requirements of Chapter 1514 of the Revised Code, and as such DOES NOT RELIEVE the operator of any obligation to meet other federal, state or local requirements

This permit is conditioned upon the compliance of the permittee with Chapter 1514 of the Revised Code and rules adopted pursuant thereto, and performance of the measures set forth in the Mining and Reclamation Plan in a timely manner, and upon the right of the Chief, division inspectors, or other authorized representatives of the Chief to enter upon the premises at reasonable times for the purposes of determining whether or not there is compliance with Chapter 1514 of the Revised Code.

Signature: Michael V Sponsler by RV Date: 06/19/2003
Chief, Mineral Resources Management

OPERATOR

Form IM-1
4/95

OHIO DEPARTMENT OF NATURAL RESOURCES
DIVISION OF RECLAMATION

SURFACE MINING PERMIT APPLICATION

DIVISION O
MINERAL RESOURCES MGM

To Be Completed and Submitted By The Applicant

I, DAVID KRULOCK, on behalf of K.C.C.I., do hereby submit a Surface Mining Permit Application including the required attachments listed below. All information and data provided on this application, maps, and attachments thereto are true and correct to the best of my knowledge. Comments made about this application are to be directed to me. I can be reached at (740) 782-1087.

Area Code/Phone Number

OPERATOR

LIST OF REQUIRED ATTACHMENTS

X (1) A surface mining permit application which has been prepared in accordance with section 1514.02 (A) of the Revised Code and in accordance with rules adopted by the Chief pursuant to section 1514.08 of the Revised Code.

X (2) An application map which has been prepared in accordance with section 1514.02(A)(10) & (11) of the Revised Code and in accordance with rules adopted by the Chief pursuant to section 1514.08 of the Revised Code.

X (3) Cross sections which depict the existing and proposed land form. (See surface mine rule 1501:14-4-02). **PREVIOUSLY SUBMITTED.**

X (4) One copy of the Geological Data Report. All information included in this report shall be kept confidential and not made a matter of public record, except that the information may be disclosed by the Chief in any legal action in which the truthfulness of the information is material. (Form IM-2) **PREVIOUSLY SUBMITTED.**

X (5) One copy of a Certificate of Public Liability Insurance in accordance with section 1514.02 (A) (11) of the Revised Code. (Form IM-3 or ACORD Form)

X (6) One copy of the actual deed, lease, or Lease/Deed Affidavit form for each surface owner listed on the application other than the applicant, which documents the right of entry upon the land proposed to be mined. (Form IM-15)

__ (7) If applicable, a 50' Consent - Public Road form with original signature, authorizing land to be affected closer than fifty (50) feet to the right of way of any public road. (Form IM-19)

__ (8) If applicable, a 50' Consent - Adjacent Property form, with original signature, authorizing land to be affected closer than fifty (50) feet of an adjacent property. (Form IM-20)

NOTE: X Three (3) copies of all documents, unless otherwise stated, are required for final submission.

X Any supplemental information that accompanies this application should be submitted on 8 ½" x 11" paper and should identify the page number and question to which it pertains.

X Submit this application to the Ohio Department of Natural Resources, Division of Reclamation, 1855 Fountain Square Court, Bldg. H, Columbus, Ohio 43224-1327.

Form IM-1

Ohio Department of Natural Resources
Division of Reclamation

SURFACE MINING PERMIT APPLICATION
(To Be Filed In Triplicate)

FOR DIVISION USE ONLY	
Date Revised	
Application No.	R-1164-1
District	SA
Permit No.	IM-1164

☐ NEW ■ RENEWAL IM-1164

GENERAL INFORMATION

OPERATOR

(1) **Name of Applicant:**
Business Name K.C.C.I.
Mailing Address P.O. BOX 24
City MORRISTOWN State OHIO Zip Code 43759
Business Telephone 740/782-1087

(2) **Business Structure:**
☐ Sole Proprietorship ☐ Partnership ■ Corporation ☐ Other _____

(3) **List the name of owners, partners, all corporate officers, directors, or other persons who have a right to control or in fact control the management of the applicant or the selection of officers, directors, or managers of the applicant.**

Name DAVID KRULOCK Title PRESIDENT Address P.O. BOX 24 City MORRISTOWN State OH Zip 43759	Name DAN KRULOCK Title VICE - PRESIDENT Address P.O. BOX 24 City MORRISTOWN State OH Zip 43759
Name _____ Title _____ Address _____ City _____ State _____ Zip _____	Name _____ Title _____ Address _____ City _____ State _____ Zip _____

IF ADDITIONAL PERSONS ARE TO BE SHOWN, LIST ON SEPARATE SHEET

FOR DIVISION USE ONLY

This application is hereby Approved by the Chief, Division of Reclamation.

Date June 19, 2003 Signed _____
Chief, Division of Reclamation

The applicant is hereby informed that upon receipt of a filing fee of $_____, the acreage fee of $_____, and a bond of $_____ for _____ acres estimated to be affected during the current year of operation, a permit or renewal to surface mine will be issued by the Division of Reclamation.

(4) **List below the names of additional persons duly authorized to sign for the applicant with regard to the administrative paperwork required by the Division of Reclamation.**

TIMOTHY H. LINN

(5) **If the business structure is a corporation, give the name, address, and telephone of the statutory agent.**

Name DAVID KRULOCK Telephone 740/782-1087

Mailing Address P.O. BOX 24

City MORRISTOWN State OH Zip 43759

(6) **Identify the appropriate permit number of any other surface mining and/or coal mining permits now held by applicant in this state.**

D-0840

(7) **Has the applicant, any partner if the applicant is a partnership, any officer or director if the applicant is a corporation, or any other person who has a right to control or in fact controls the management of the applicant or the selection of officers, directors or managers of the applicant ever had a surface mining permit or strip mining permit/license issued by this or any other state suspended or revoked or ever forfeited a surface or strip mining bond, cash, or a security deposit in lieu of bond?**

☐ Yes ■ No (If "Yes," explain circumstances of any suspension, revocation or forfeiture on attached sheet as supplemental information.)

SURFACE INFORMATION

(8) List each mineral to be produced and the estimated annual rate of production.

One Mineral per Line	Estimated Production Rate (in short tons)
LIMESTONE	100,000

(9) **List the name and address of the owners of surface rights in all the land upon which the applicant proposes to surface mine. If surface rights in the land are not owned by the applicant, submit a copy of the deed, lease, or Lease/Deed Affidavit Form which documents the right of entry upon such land by the applicant or his agents.**

SURFACE OWNERS	TOWNSHIP AND RANGE (T- , R-)	SECTION/ LOT/VMS	TOWNSHIP	COUNTY	MUNICIPAL CORP.
Name APEX ENERGY, INC. Address P.O. BOX 1298 City STEUBENVILLE State OHIO Zip 43701	T-11-N; R-4-W	SEC: 16 LOT: VMS:	SPRINGFIELD	JEFFERSON	N/A
Name _____ Address _____ City _____ State _____ Zip _____		SEC: LOT: VMS:			
Name _____ Address _____ City _____ State _____ Zip _____		SEC: LOT: VMS:			
Name _____ Address _____ City _____ State _____ Zip _____		SEC: LOT: VMS:			
Name _____ Address _____ City _____ State _____ Zip _____		SEC: LOT: VMS:			

(10) Provide the following acreage information.

(a) Total acres included in the permit area: 356.6

(b) Number of separate and distinct mining areas in the permit area: 3
(mining areas must be identified by name or number and shown on the attached map)

(c) Total acres proposed to be affected during current year of operation: 63.1

BLASTING

(11) Will explosives be used during mining? ■ Yes ☐ No

(a) If "Yes," list the following information for a **typical** blasting plan:

(1) Type of explosives used: AMMONIUM NITRATE
(2) Delay interval, in milliseconds, between detonations: 8
(3) Delay interval, in milliseconds, between holes: 60
(4) Delay interval, in milliseconds, between rows: 120
(5) Number of holes detonated per delay: 1
(6) Typical explosive weight per hole: 200 LBS
(7) Total explosive weight per delay: 200 LBS
(8) Total weight of explosives per blast: 3,000-15,000 LBS
(9) Depth of stemming: 7'
(10) Depth of hole 30 FT. Diameter of hole 3 IN.
(11) Typical burden 28 ft. Typical spacing 12 ft.

(b) Will the weight of explosives used be in compliance with the formula $W = (D/50)^2$ {W=explosive weight/delay; D=distance to nearest structure; 50 = scaled distance constant]? ■ Yes ☐ No

(c) If "No," supply seismographic evidence per surface mine rule 1501:14-3-04(B) to support a modified scaled distance constant.

GROUNDWATER

(12) How will contamination of underground water supplies be prevented? ANY TOXIC MATERIAL ENCOUNTERED WILL BE BURIED AND COVERED WITH AT LEAST 3 FEET OF NON-TOXIC MATERIAL. LIMESTONE HAS A NATURAL NEUTRALIZING AND BUFFERING CAPACITY WHICH WILL PRECLUDE GROUNDWATER CONTAMINATION.

(13) Do deep mines exist within or under any proposed mining area? ☐ Yes ■ No
If "Yes," answer the following:
Describe practices to be employed to permanently seal opened works when they are intercepted by mining to prevent contamination of underground water supplies. _____

(14) Do acid forming strata exist within the permit area? ☐ Yes ■ No
If "Yes," list the acid forming strata to be affected in the permit area. Describe the specific practices to be employed during mining and reclamation, including any treatment procedures and facilities, to minimize acid water drainage and the accumulation of acid water, and to prevent damage to adjoining property resulting from such drainage or accumulation.

(a) Strata: _____

(b) Practices: IF ANY ACID PRODUCING MATERIAL IS ENCOUNTERED, IT WILL BE PLACED IN A LOCATION SO AS TO MINIMIZE CONTACT WITH WATER AND THEN COVERED WITH AT LEAST 3 FEET OF NON-TOXIC MATERIAL.

MINING METHOD/EQUIPMENT

(15) Indicate proposed mining method and equipment to be used.

(a) Mining Method (Dry equates to mining above existing water level)

Open Pit	Quarry	Other
Wet _____	Wet _____	_____
Dry XX	Dry _____	_____

(b)

Equipment	Capacity
dragline	N/A cubic yards _____ maximum vertical depth
shovel (power)	N/A cubic yards
bulldozer	XX model # CAT D-9
front end loader	2.5 cubic yards
scrapers (pans)	12 cubic yards
dredge	N/A tons per hour ___ maximum vertical depth
pump size	_____ gallons/minute
other: N/A	

DRAINAGE CONTROLS

(16) **Indicate the methods to be used to control surface drainage to prevent soil erosion, sedimentation, flooding, landslides, and flood hazards during mining and reclamation.**

(a) Sediment Ponds■ Locate on map and identify by name or number. Give dimensions (length, width, and depth) and capacity. (Attach plan views or cross sections when needed as supplemental information.)

REFER TO RENEWAL MAP. POND DATA SHEETS ARE TAKEN DIRECTLY FROM THE APPROVED ORIGINAL IM-1164, IM-1164-1 AND IM-1164-2 APPLICATIONS.

IM-1164

K.C.C.I.
MINING AND RECLAMATION SUPPLEMENT, PAGE 7, ITEM 6(B).

DESCRIPTION	POND NO. 001	002	003	004	005	006
Total watershed, (acre)	8.9	16.8	25.2	36.5	16.9	60.3
Disturbed watershed (acre)	6.2	16.8	25.2	36.5	16.9	57.4
Sediment Storage (ac.ft.)	1.3	3.4	5.0	7.4	3.4	11.5
Pond Surface Area						
Bottom	0.11	0.22	0.27	0.40	0.22	0.55
Principal Spillway	0.46	0.68	0.79	1.15	0.67	1.90
Elevations						
Bottom	100.0	100.0	100.0	100.0	100.0	100.0
Principal Spillway	105.0	108.0	110.0	110.0	108.0	110.0
Emergency Spillway	107.5	111.0	113.0	113.0	111.0	114.0
Top of Embankment	110.0	113.0	116.0	116.0	113.0	117.0
Principal Spillway						
Diameter	12"	18"	24"	24"	18"	36"
Length	60'	80'	100'	100'	80'	120'
Type	CMP	CMP	CMP	CMP	CMP	CMP
Emergency Spillway						
Width	12'	12'	15'	15'	12'	15'
(R)ip Rap/(V)egetated	V	V	R	R	V	R

IM-21

Ohio Department of Natural Resources
Division of Reclamation
Industrial Minerals

Permit No. _____
or
Applic. No. 1164-1

DISCHARGE DATA SHEET FOR PERMANENT IMPOUNDMENTS

Applicant's Name K.C.C.I. Pond # 007

Type of impoundment EMBANKMENT Permanent ____, Temporary XX

1. POND DRAINAGE AREA DATA:
   a) Drainage area: 9.5 acres
   b) Disturbed area: 9.5 acres
   c) Ave. land slope: 15 %
   d) Hydraulic length: 1,300 feet

2. DESIGN STORM CRITERIA:
   a) Method:
      1) Design method(s) including computer programs: SEDCAD+
      2) SCS curve number 80
   b) County: JEFFERSON

3. POND SIZE:
   a) Dimensions:
      1) Dam width: 12 ft.
      2) Dam downstream slope: 50 %
      3) Dam upstream slope: 50 %
   b) Sediment storage volume 1.93 ac.ft. is provided below the 108.0 foot elevation.
   c) Stage/Area Data:

	Elevation ft.	Surface Area ac.	Volume ac.ft.
1) Bottom of pond	100.0	0.10	0.00
2) Streambed at upstream toe:	100.0	0.10	0.00
3) Principal spillway inlet:	108.0	0.42	1.93
4) Emergency spillway crest:	111.0	0.50	2.83
5) Top of embankment:	114.0	0.60	4.96

(Volume calculated using Conic Method.)

4. PRINCIPAL SPILLWAY:
   a) Pipe length: 60 ft.
   b) Pipe diameter: 18 in.
   c) Pipe slope: 10.0 %
   d) Riser diameter: N/A in.
   e) Riser height: N/A ft.
   f) Type of pipe: HDPE, n = 0.012

5. EMERGENCY SPILLWAY/EXIT CHANNEL:
   a) Base width: 12 ft.
   b) Exit slope: 15 %
   c) Side slopes: 2:1 ft.
   d) Channel lining: LIMESTONE RIP RAP
   e) Length of level control section: 35 ft.

6. IMPOUNDMENT:
   a) Permanent: _____
   b) Temporary: XX

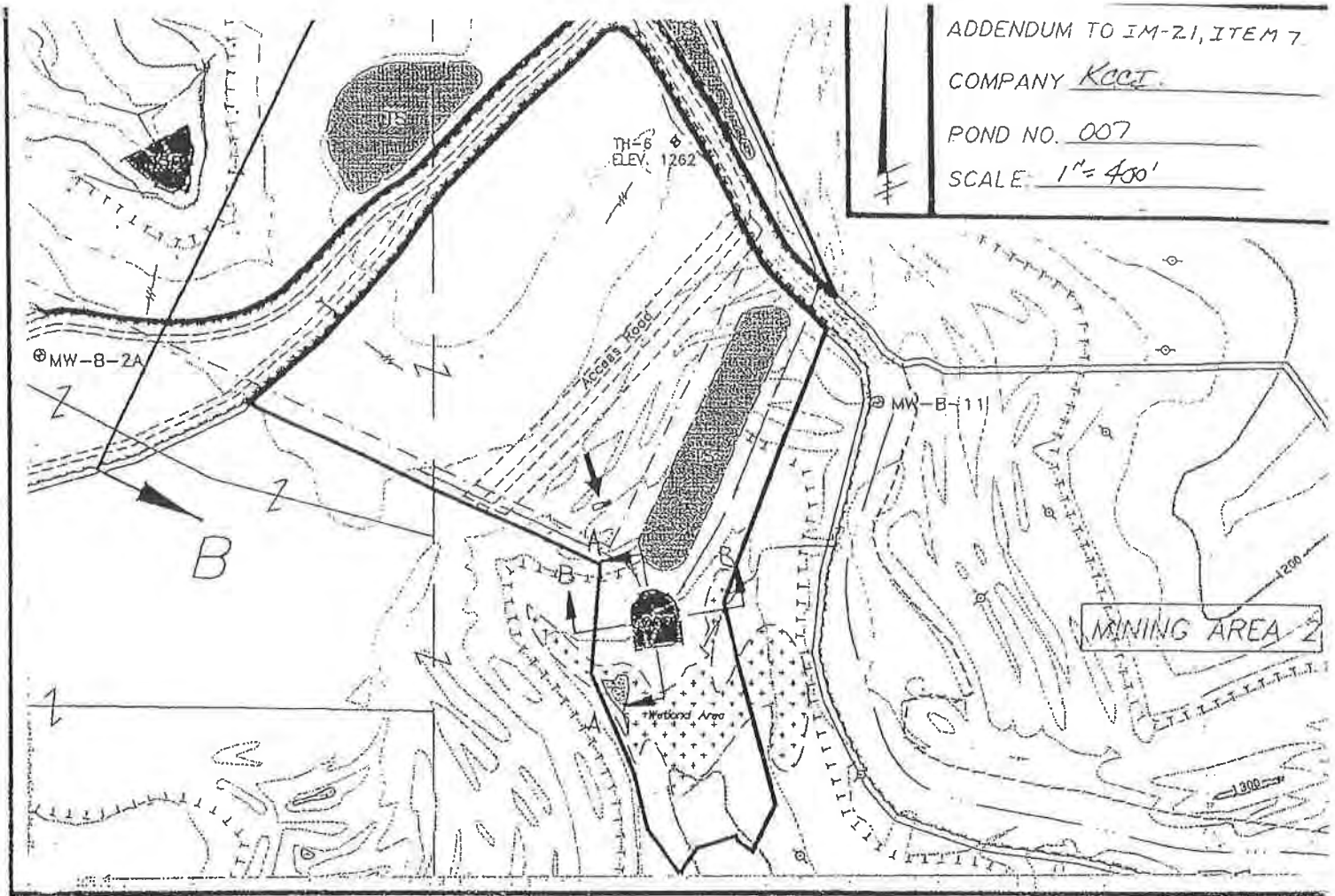
PROVIDE AS AN ADDENDUM TO THIS STATEMENT A DETAILED PLAN VIEW OR 2 PERPENDICULAR CROSS SECTIONS OF THE IMPOUNDMENT.

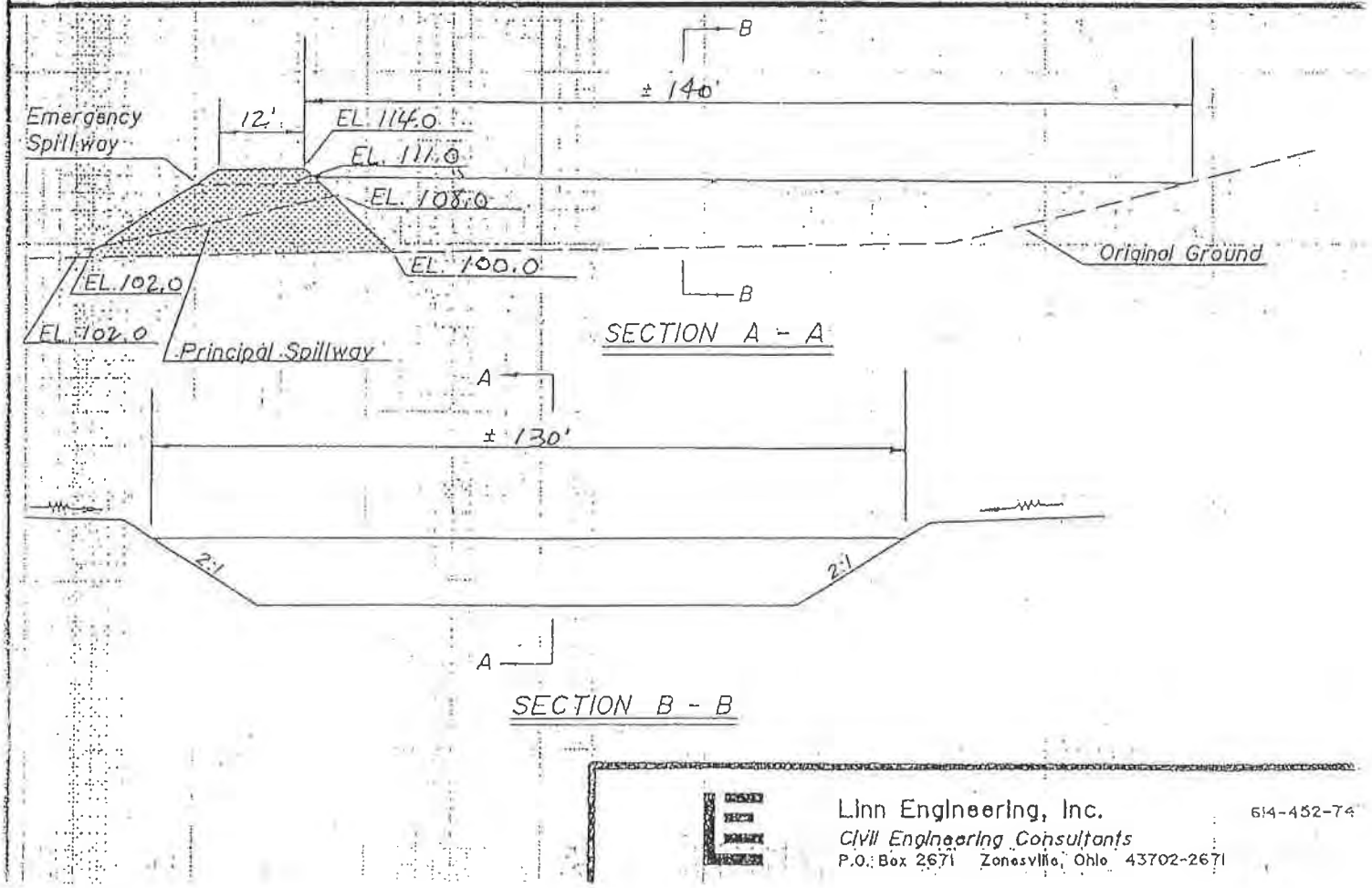
ADDENDUM TO IM-21, ITEM 7

COMPANY KCCT

POND NO. 007

SCALE 1" = 400'





Linn Engineering, Inc.
Civil Engineering Consultants
P.O. Box 2671 Zanesville, Ohio 43702-2671
614-452-74

IM-21

Ohio Department of Natural Resources
Division of Reclamation
Industrial Minerals

Permit No. _____
or
Applic. No. 1164-1

DISCHARGE DATA SHEET FOR PERMANENT IMPOUNDMENTS

Applicant's Name K.C.C.I. Pond # 008

Type of impoundment EMBANKMENT Permanent ____, Temporary XX

1. POND DRAINAGE AREA DATA:
   a) Drainage area: 49.4 acres b) Disturbed area: 46.8 acres
   c) Ave. land slope: 24 % d) Hydraulic length: 2,000 feet

2. DESIGN STORM CRITERIA:
   a) Method:
      1) Design method(s) including computer programs: SEDCAD+
      2) SCS curve number 80
   b) County: JEFFERSON

3. POND SIZE:
   a) Dimensions:
      1) Dam width: 15 ft. 2) Dam downstream slope: 50 %
      3) Dam upstream slope: 50 %
   b) Sediment storage volume 9.50 ac.ft. is provided below the 113.0 foot elevation.
   c) Stage/Area Data:

		Elevation ft.	Surface Area ac.	Volume ac.ft.
1)	Bottom of pond	100.0	0.30	0.00
2)	Streambed at upstream toe:	103.0	0.45	1.12
3)	Principal spillway inlet:	113.0	1.30	9.50
4)	Emergency spillway crest:	117.0	1.60	15.29
5)	Top of embankment:	120.0	1.75	20.31

(Volume calculated using Conis Method.)

4. PRINCIPAL SPILLWAY:
   a) Pipe length: 80 ft. b) Pipe diameter: 30 in.
   c) Pipe slope: 16.3 % d) Riser diameter: N/A in.
   e) Riser height: N/A ft. f) Type of pipe: HDPE, n = 0.012

5. EMERGENCY SPILLWAY/EXIT CHANNEL:
   a) Base width: 15 ft. b) Exit slope: 15 %
   c) Side slopes: 2:1 ft. d) Channel lining: LIMESTONE RIP RAP
   e) Length of level control section: 40 ft.

6. IMPOUNDMENT:
   a) Permanent: _____ b) Temporary: XX

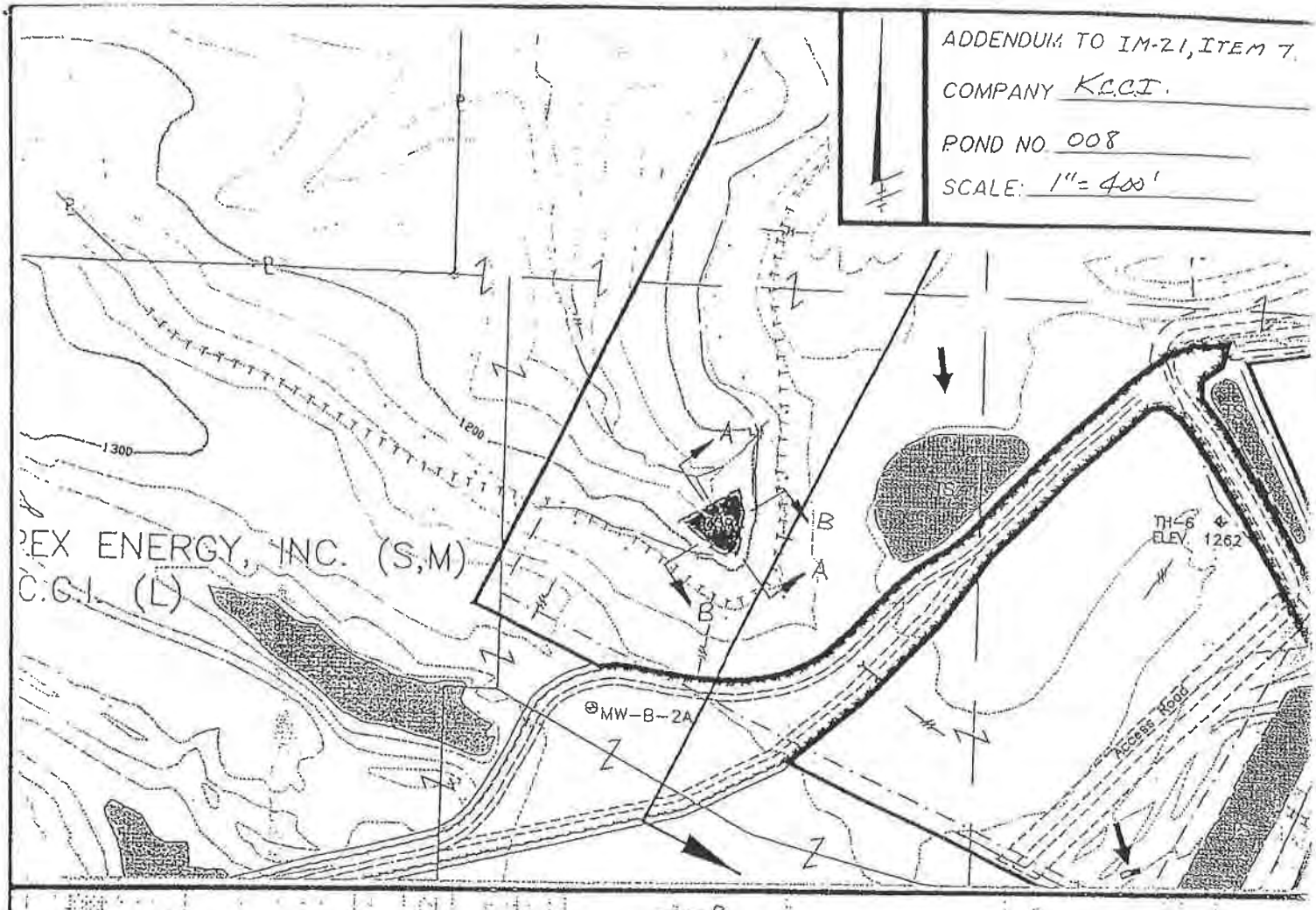
7. PROVIDE AS AN ADDENDUM TO THIS STATEMENT A DETAILED PLAN VIEW OR 2 PERPENDICULAR CROSS SECTIONS OF THE IMPOUNDMENT.

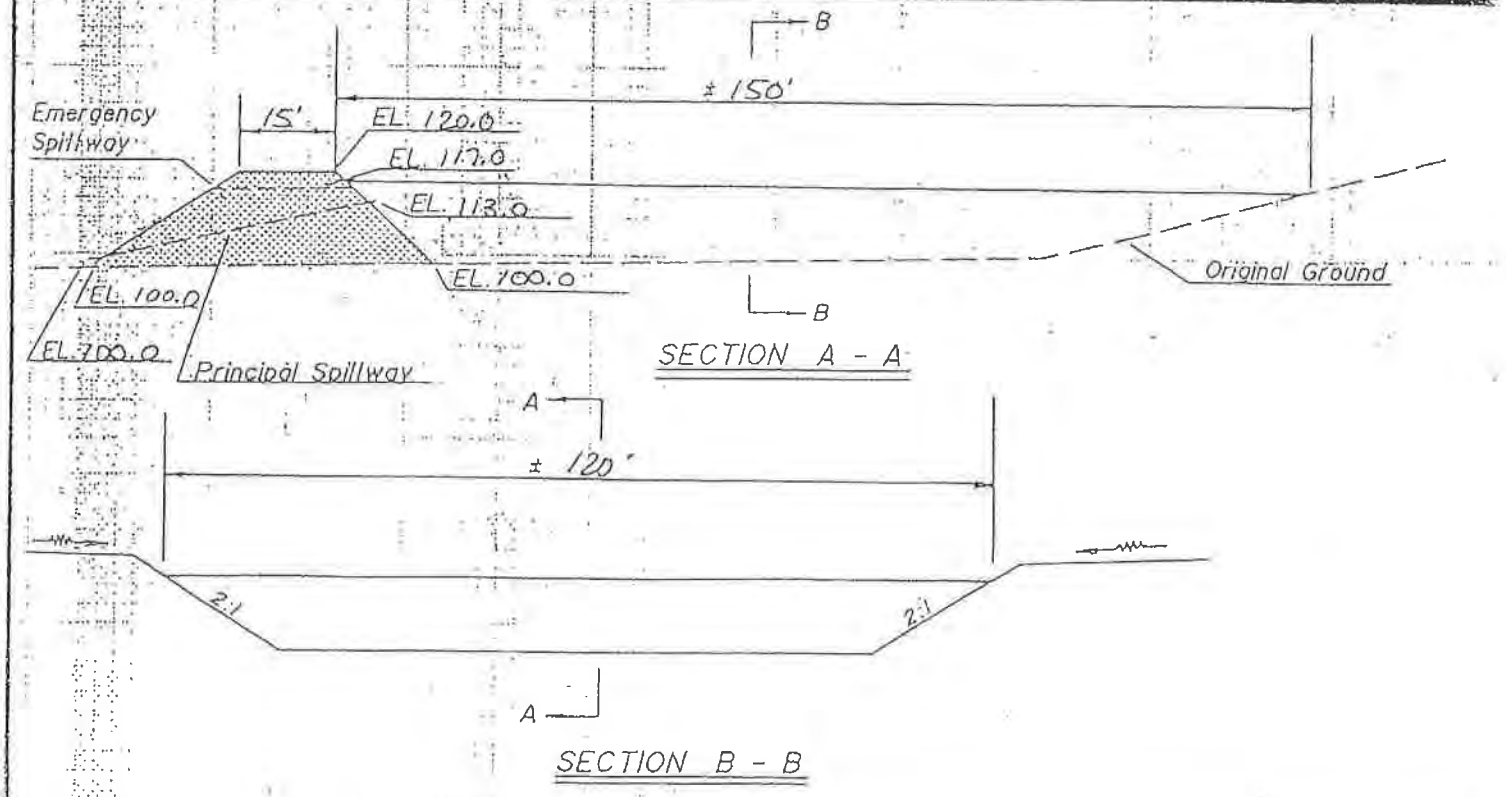
ADDENDUM TO IM-21, ITEM 7

COMPANY K.C.C.I.

POND NO. 008

SCALE: 1" = 400'





SECTION A - A

SECTION B - B

Linn Engineering, Inc.
Civil Engineering Consultants
P.O. Box 2671 Zanesville, Ohio 43702-2671
614-452-74

IM-21

Ohio Department of Natural Resources
Division of Reclamation
Industrial Minerals

Permit No. _____
or
Applic. No. 1164-1

DISCHARGE DATA SHEET FOR PERMANENT IMPOUNDMENTS

Applicant's Name K.C.C.I. Pond # 009

Type of impoundment EMBANKMENT Permanent ____, Temporary XX

1. POND DRAINAGE AREA DATA:
   a) Drainage area: 64.2 acres b) Disturbed area: 63.7 acres
   c) Ave. land slope: 15 % d) Hydraulic length: 1,800 feet

2. DESIGN STORM CRITERIA:
   a) Method:
      1) Design method(s) including computer programs: SEDCAD+
      2) SCS curve number 80
   b) County: JEFFERSON

3. POND SIZE:
   a) Dimensions:
      1) Dam width: 15 ft. 2) Dam downstream slope: 50 %
      3) Dam upstream slope: 50 %
   b) Sediment storage volume 12.81 ac.ft. is provided below the 114.0 foot elevation.
   c) Stage/Area Data:

		Elevation ft.	Surface Area ac.	Volume ac.ft.
1)	Bottom of pond	100.0	0.45	0.00
2)	Streambed at upstream toe:	104.0	0.70	4.67
3)	Principal spillway inlet:	114.0	1.45	12.81
4)	Emergency spillway crest:	118.0	1.75	19.20
5)	Top of embankment:	121.0	2.00	24.82

(Volume was calculated using Conic Method.)

4. PRINCIPAL SPILLWAY:
   a) Pipe length: 80 ft. b) Pipe diameter: 36 in.
   c) Pipe slope: 17.5 % d) Riser diameter: N/A in.
   e) Riser height: N/A ft. f) Type of pipe: HDPE, n = 0.012

5. EMERGENCY SPILLWAY/EXIT CHANNEL:
   a) Base width: 15 ft. b) Exit slope: 15 %
   c) Side slopes: 2:1 ft. d) Channel lining: LIMESTONE RIP RAP
   e) Length of level control section: 40 ft.

6. IMPOUNDMENT:
   a) Permanent: _____ b) Temporary: XX

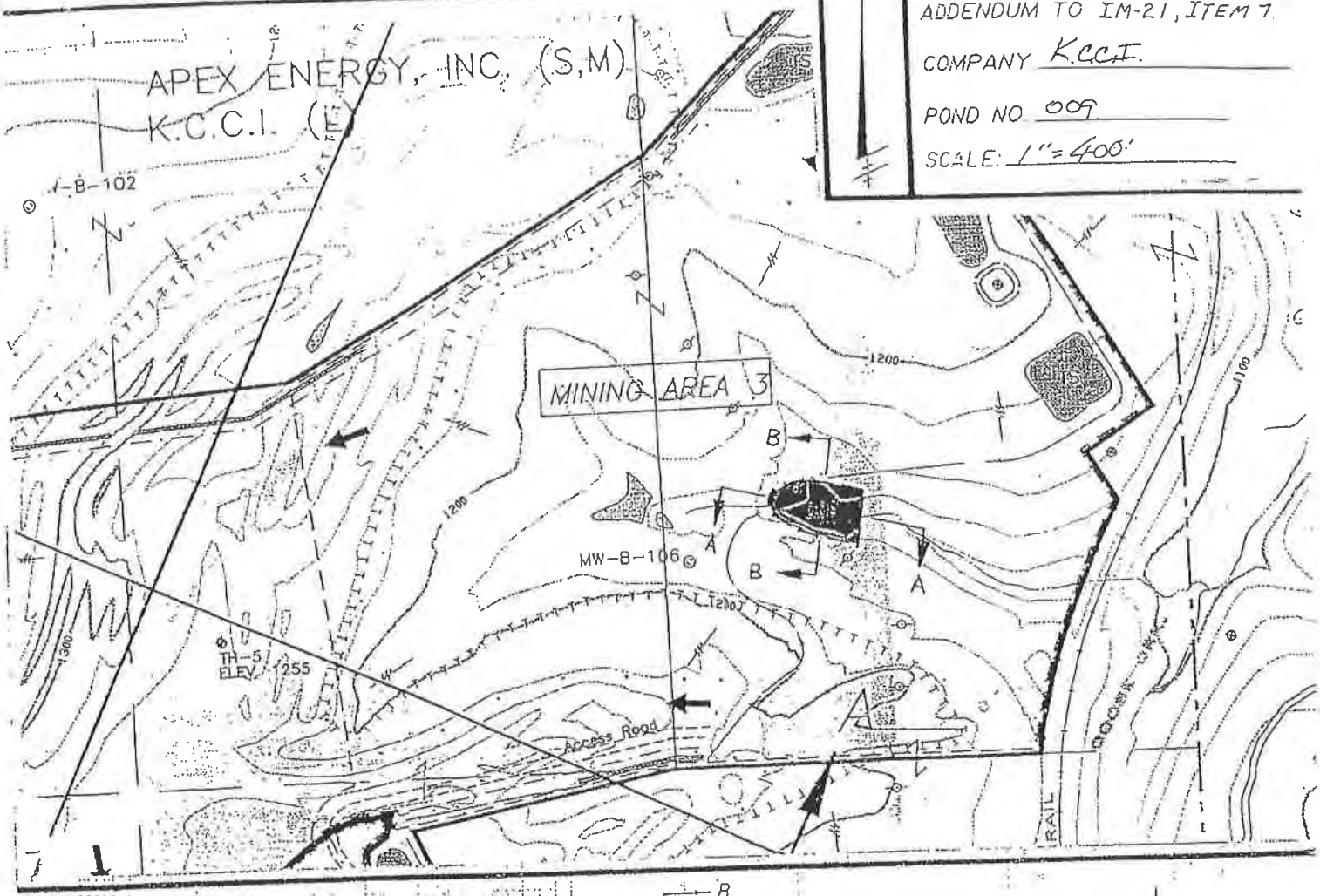
PROVIDE AS AN ADDENDUM TO THIS STATEMENT A DETAILED PLAN VIEW OR 2 PERPENDICULAR CROSS SECTIONS OF THE IMPOUNDMENT.

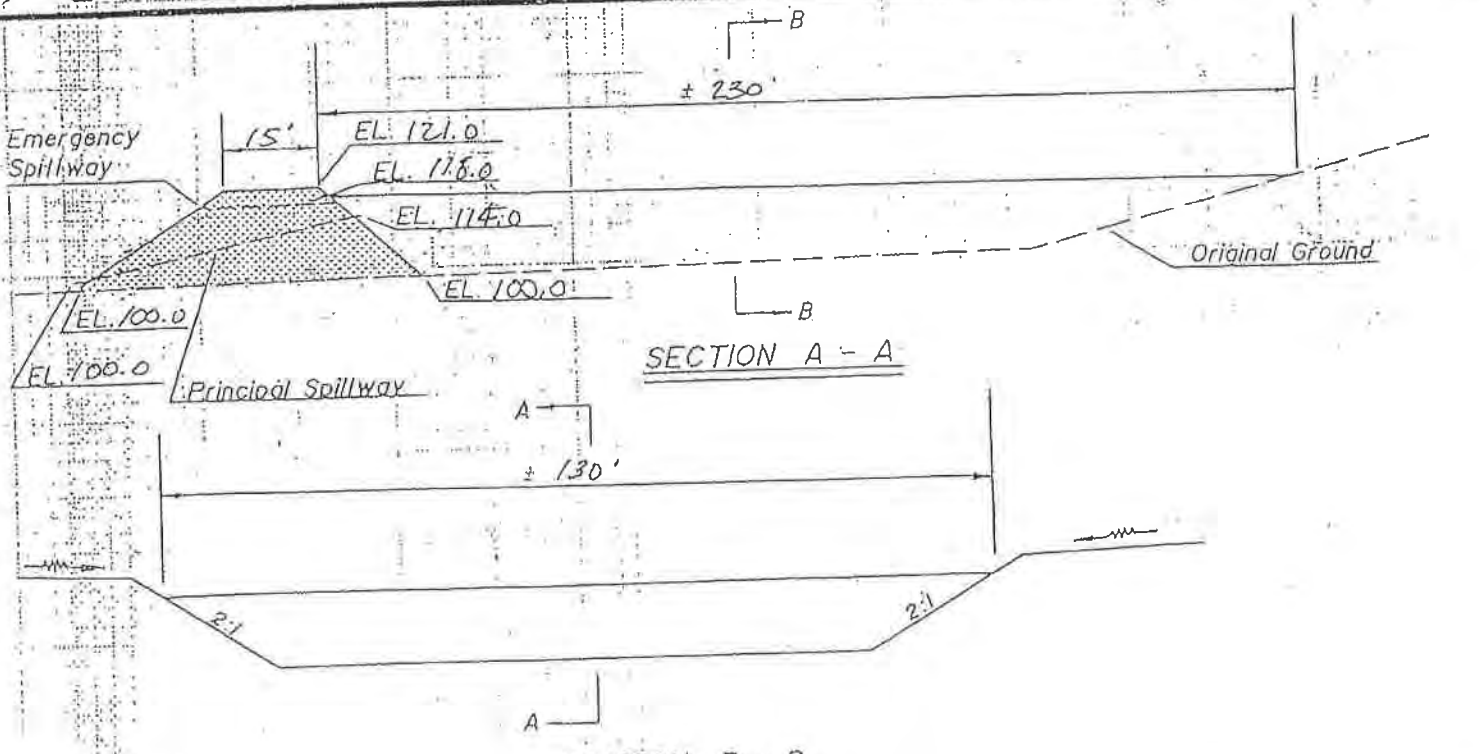
ADDENDUM TO IM-21, ITEM 7

COMPANY K.C.C.I.

POND NO 009

SCALE: 1"=400'





Linn Engineering, Inc.
Civil Engineering Consultants
P.O. Box 2671 Zanesville, Ohio 43702-2671
614-452-7

IM-1164-1

MINING AND RECLAMATION SUPPLEMENT, PAGE 7 ITEM 6(A)

DRAINAGE CONTROL PLAN: The amendment area will either have drainage control dikes or diversions around its perimeter to control drainage. All drainage will be routed by diversion or flow naturally to Ponds 007, 008, and 009. (See amendment map for viewing.) All ponds are proposed as temporary and will not be removed until the ponds for the proposed sanitary landfill are in place. Mining will commence in the northeast and proceed southwesterly toward proposed Pond 007. See Form(s) IM-21 for the three ponds and Addendum to Page 7, Item 6(b) for typical dike X-Section.

IM-1164-2

MINING AND RECLAMATION SUPPLEMENT, PAGE 7 ITEM 6a

RAINAGE CONTROL PLAN: All drainage will be routed by diversion or flow naturally to Pond 010. Diversion will be constructed according the originally approved permit application. The proposed pond is temporary. Refer to the amendment map for plan view.

POND 010: (temporary)

Amendment Area = 24.8 Ac.
Req'd Sediment Capacity = 4.96 Acft.

Surface Area = 0.62 Ac.
Depth = 10 Ft.
Capacity = 5.4 Acft

SURFACE INFORMATION

(8) List each mineral to be produced and the estimated annual rate of production.

One Mineral per Line	Estimated Production Rate (in short tons)
Limestone	97,000 TONS
DAL	3,000 TONS

(b) Diversions ■ Locate on map and identify by plan views or cross sections.
DIVERSION DATA SHEET IS TAKEN FROM THE APPROVED ORIGINAL IM-1164 APPLICATION.

(c) Protective cover ☐ Temporary Vegetation Species Pounds/acre

☐ Mulch

(d) Dikes ■ Locate on map and give dimensions. (Attach plan views or cross sections when needed as supplemental information.)
DIKE DATA SHEET IS TAKEN FROM THE APPROVED ORIGINAL IM-1164 APPLICATION.

(e) Other ■ Describe DRAINAGE IS COLLECTED IN THE PIT THEN PUMPED TO A SEDIMENT POND.

LAND USE/RECLAMATION PLAN

(17) Does a zoning plan and/or other comprehensive plan governing land uses or the construction of public improvements or utilities apply to the permit area: ☐ Yes ■ No

If "Yes," answer the following:

(a) Indicate the date such plan was adopted.

(b) Identify the governmental unit administering the zoning or comprehensive plan.

(c) List the sections of the plan which are applicable to the permit area.

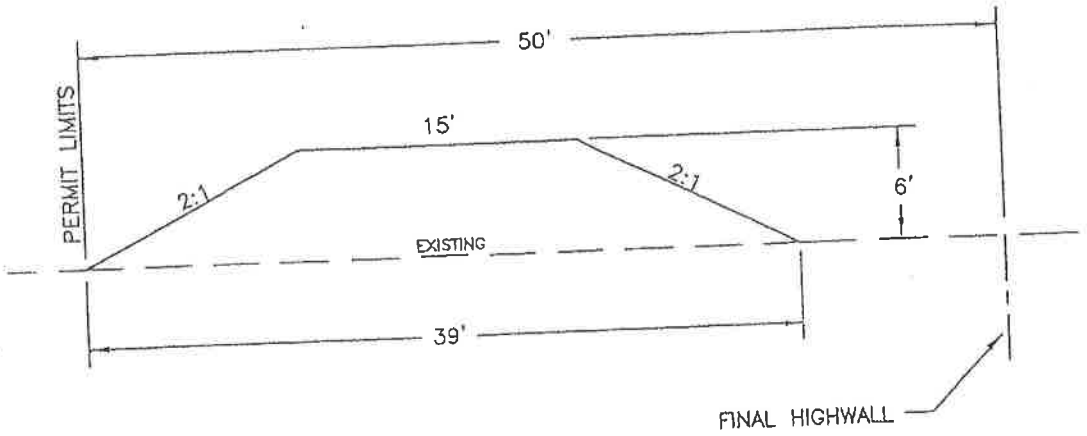
(d) List the uses designated by the zoning or comprehensive plan.

(e) Does the future intended use (or uses) of any part of the permit area conflict with the zoning or comprehensive plan for the same area? ☐ Yes ☐ No

If "Yes," explain.

K.C.C.I.
APPLICATION NO. IM-1164-1
ADDENDUM TO PAGE 7, ITEM 6(b)

PERIMETER DRAINAGE CONTROL DIKE



TYPICAL SECTION

SCALE

H – 1" = 10'
V – 1" = 1'

THE DIKE WILL BE CONSTRUCTED WITH MATERIAL (SUBSOIL) THAT IS ADEQUATE OF SUSTAINING VEGETATIVE GROWTH. IT WILL BE SEEDED AND MULCHED AFTER ITS COMPLETION AND WILL BE REMOVED WHEN MINING IS COMPLETED.

TIMOTHY H. LINN 9/20/95
DATE

IM-1164

C.I.
PPLICATION NO. 1276
NG AND RECLAMATION SUPPLEMENT TO PAGE 7, ITEM 6(b)
RSION DESIGN

ersion: TYPICAL Temp. XX Perm. ____

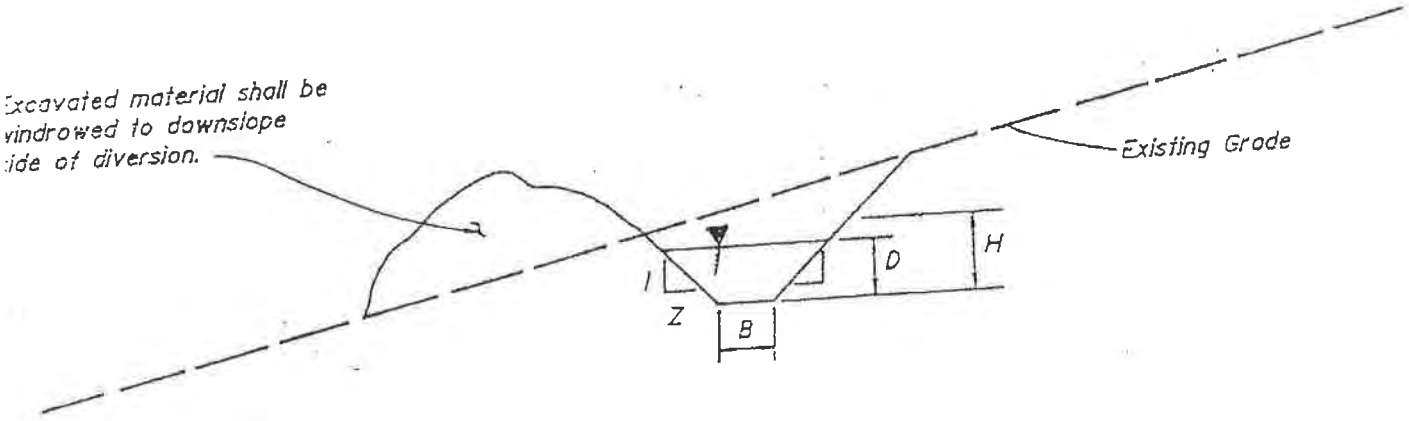
rologic Data

ign storm: 2 Yr. 24 Hr.
ershed: 14.5 acres
. land slope: 22 %
ve number: 80
k flowrate: 9.1 cfs

Construction Specifications

flow depth, D 0.8 ft.
channel depth, H 2.0 ft.
side slopes, z 2
bottom width, b 2.0 ft.
channel slope 1 %
velocity 3.1 fps
erosion protection
VEGETATED

ument:
; DATA AND SPECIFICATIONS GIVEN ABOVE APPLY SPECIFICALLY TO THE SOUTH SIDE
POND NO. 003. SINCE THIS DIVERSION WILL CARRY THE GREATEST VOLUME OF FLOW
ANY DIVERSION, ITS CONSTRUCTION SPECIFICATIONS SHALL APPLY TO ALL
MPORARY DIVERSIONS.



(18) Indicate the post mining land use for the permit area. If more than one future use is proposed, explain in detail for each mining area. Include a general description if any structures of facilities to be constructed.

MINING AREAS 2 AND 3 WILL HAVE A FUTURE USE OF A MUNICIPAL SOLID WASTE LANDFILL. OHIO EPA HAS ISSUED DRAFT PERMIT #06-6219 FOR THE LANDFILL. MINING AREA 1 WILL HAVE A FUTURE USE OF GRAZINGLAND.

(19) For each mining area, describe the sequence of steps, mining through reclamation, that will be used to prepare the land for its future intended used and achieve soil stability, control landslides, erosion and sedimentation. (Address use of overburden, backfilling, grading, terracing, contouring, degree of final slopes, etc.)

MINING WILL CONTINUE USING THE SAME METHODS AS ARE CURRENTLY BEING USED - THAT IS TOPSOIL WILL BE STOCKPILED FOR LATER RE-DISTRIBUTION, SPOIL WILL BE PLACED IN THE INACTIVE PIT OR GRADED FOR THE POST MINING LAND USE. DISTURBED AREAS WILL BE RESOILED. PIT IMPOUNDMENT(S) WILL REMAIN IN AREAS WHERE THERE IS INSUFFICIENT SPOIL TO COMPLETELY BACKFILL THE PIT.

(20) Include typical cross sections of existing and final land forms for each mining area and identify by name or number. Submit additional cross sections for any significant dissimilar final land configurations.

SUBMITTED WITH ORIGINAL PERMIT APPLICATION.

(21) Schedule for reclamation.

(a) The approximate time frame between completion of mining and the completion of grading and planting on any mining area. GRADING AND PLANTING WILL COMMENCE AT THE EARLIEST POSSIBLE TIME PRIOR TO THE NEXT APPROPRIATE PLANTING SEASON.

(b) The approximate time frame between the completion of grading and planting and the establishment of the permanent vegetative cover on any mining area.

ONE YEAR

PERMANENT IMPOUNDMENTS

(22) Will permanent impoundments be included in the final land form? ■ Yes ☐ No

If "Yes," identify by name or number and supply the following information for each impoundment..

REFER TO PREVIOUSLY APPROVED IMPOUNDMENT INFORMATION.

(a) Indicate the estimated elevation of the high water mark for each impoundment. _____

(b) Indicate the minimum and maximum depth of each impoundment.

Minimum_____Ft. Maximum _____Ft.

(c) Indicate the estimated surface area of each impoundment in acres. _____

(d) What is the major contributing source of water for each impoundment?
☐ Ground Water ■ Surface Water

(e) How will contamination of water in the impoundment be prevented?

THE LIMESTONE AND ITS OVERBURDEN HAVE A NATURAL NEUTRALIZING CAPACITY FOR ANY ACIDIC MATERIALS WHICH MAY BE ENCOUNTERED.

(f) To provide for public safety, what measures will be taken to:

1. Restrict access where access is not required by the intended future use? THE MAIN HAUL ROAD WILL BE GATED AND LOCKED WHEN NOT IN USE.

2. Provide egress from the impoundment? THE HAUL ROAD FROM THE PIT WILL REMAIN AFTER MINING.

3. Insure public safety due to particular site conditions? THERE ARE NO PARTICULAR SITE CONDITIONS REQUIRING SPECIAL CONSIDERATION.

4. Construct access areas for recreational use? RECREATIONAL USE IS NOT PROPOSED.

(g) Is the impoundment designed to discharge? ■ Yes ☐ No

If "Yes," complete Form IM-21 Discharge Data Sheet for Permanent Impoundments.

RESOILING / PLANTING PLAN

(24) What materials will be used for resoiling the permanent seedbed?

(a) Average depth of topsoil on permit area. 3 INCHES

(b) Average depth of subsoil on permit area. 5 FEET

(c) To what depth will topsoil be redistributed for reclamation? 3 INCHES (MIN.)

(d) To what depth will subsoil be redistributed for reclamation? 8 INCHES (MIN.)

(e) If sufficient quantities of topsoil and subsoil do not exist for reclamation, what substitute resoiling material will be utilized. (Identify stratum or mixture to be utilized and include evidence that the substitute resoiling material will support vegetation capable of self-regeneration and plant succession.) SUFFICIENT QUANTITIES OF TOPSOIL AND SUBSOIL SHOULD BE AVAILABLE ON SITE WITH CAREFUL PLANNING AND MANAGEMENT FOR RECLAMATION MATERIAL.

(f) Describe the plan for removal, storage and redistribution of topsoil, subsoil or alternate resoiling material. ALL TOPSOIL WILL BE REMOVED AHEAD OF THE ACTIVE MINING AREA AND STORED ON STABLE GROUND. TOPSOIL STOCKPILES WILL BE SEEDED AND MULCHED AND WILL NOT BE DISTURBED UNTIL REDISTRIBUTION.

(g) Describe how the seedbed will be prepared, planted and protected. (Include: equipment, lime and fertilizer to be used per soil test results, moisture retention and erosion control methods to be employed.) AFTER FINAL GRADING AND RESOILING, ALL AREAS WILL BE DISCED AND HARROWED BEFORE PLANTING. ALL SEEDBEDS WILL BE TESTED TO DETERMINE LIME AND FERTILIZER REQUIREMENTS TO BE ADDED.

(25) Identify the species and list the amounts of grasses, legumes, and nurse crop that will be utilized for revegetation of the affected area per the intended future use:

(a) Grasses (specify species)	Pounds Per Acre
PERENNIAL RYEGRASS	8
ORCHARD GRASS	8
TIMOTHY	8
(b) Legumes (specify species)	**Pounds Per Acre**
RED CLOVER	4
WHITE CLOVER	4
ALFALFA	10
(c) Nurse Crop (fast growing annual grass or grain)	**Bushels/Pounds Per Acre**
WHEAT OR OATS	2 BU/AC

(26) **Will trees or shrubs be planted?** ☐ **Yes** ■ **No If "Yes," specify species and spacing.**

Species	Spacing	Acreage of Area Planted

(27) **Will other agricultural crops be planted on the permit area?** ☐ **Yes** ■ **No**
If "Yes," specify species and amounts to be planted.

ALL INFORMATION AND DATA PROVIDED ON THIS APPLICATION, EXHIBITS, AND ATTACHMENTS THERETO ARE TRUE AND CORRECT TO THE BEST OF MY KNOWLEDGE. [Note: Signature required below must be an individual listed in the response to Question (3) of this application.]

Signed this 10th Day of JUNE, 20 02

Signed David Krulock

Printed Name DAVID KRULOCK

Title PRESIDENT

PLEASE RESPOND TO THE FOLLOWING QUESTIONS
AND RETURN THIS PAGE AND THE RESPONSES
WITH THE RENEWAL APPLICATION

Surface Mining Permit Application, Groundwater Section:

1. Will your operation be dewatered in order to facilitate mining? (If "yes," respond to questions 2 through 5.) Rule 1501:14-1-01 defines dewatering as "the withdrawal of groundwater from an aquifer or saturated zone which may result in the lowering of the water level within the aquifer or saturated zone, or a decline of the potentiometric surface within that aquifer or saturated zone." Aquifer is defined as "a consolidated or unconsolidated geologic formation or series of formations that are hydraulically interconnected and that have ability to receive, store, or transmit water." Groundwater is defined as "all water occurring in an aquifer."

   YES

2. What will be the lowest elevation in feet above mean sea level to which dewatering will occur (including the lowest water elevation in sumps used for dewatering purposes)?

   APPROX. 1193 MSL.

3. What will be the estimated discharge in gallons per year from the dewatering of the mining operation?

   5,000,000

4. Describe the components of your dewatering plan, including but not limited to, dewatering methods, retention ponds, discharge sites for the water, etc.

   A ZONE OF SATURATION EXISTS IN THE NO. 8 COAL. THE LIMESTONE IS LOCATED BELOW THE COAL AND THE IM PERMIT ALLOWS FOR REMOVAL OF INCIDENTAL COAL. SEEPAGE FROM THE SATURATED ZONE WILL COLLECT IN THE PIT AND THEN BE PUMPED TO A SEDIMENT POND. THE HYDROGEOLOGIC STUDY FOR THE LANDFILL INDICATES THAT THE VOLUME OF WATER IN THE SATURATED ZONE IS NOT SIGNIFICANT AND CAN BE CONTROLLED BY PUMPING.

5. Which of the following measures will be taken to prevent damage to adjoining property and to protect and/or restore surface-water or ground-water supplies impacted by the operation?

   -altering mining plan (describe)
   -deepening an existing well
   ★-drilling a new well
   -constructing a cistern
   -connecting to public water
   -repairing/replacing an impoundment
   ★-providing temporary water until installation of a permanent replacement
   -other (describe)

Ohio Department of Natural Resources
Division of Reclamation
Industrial Minerals

Permit No.
or
Applic. No.

CERTIFICATE OF INSURANCE

Issued by Oklok-Criss & Associates, P.O. Box 98, Steubenville, Ohio 43952

THIS CERTIFICATE OF INSURANCE NEITHER AFFIRMATIVELY NOR NEGATIVELY AMENDS, EXTENDS OR ALTERS THE COVERAGE AFFORDED BY ANY POLICY DESCRIBED HEREIN.

This is to Certify, that policies in the name of:

Name of Insured and Complete Address*

Apex Energy, Inc.
Krulock Coal Co., Inc. (KCC)
P.O. Box 1298
Steubenville, OH 43952

*Include Street, P.O. Box, City, State, Zip Code

Issued at request of:

State of Ohio
Department of Natural Resources
Division of Reclamation
Industrial Minerals Section

are in force at the date hereof, as follows:

Type of Insurance	Policy Number	Policy Period	Coverage	Coverage
General Liability Bodily Injury	3710-31-36	07/29/2002 – 07/29/2003	Each Person $1,000,000	Each Person $1,000,000
General Liability Property Damage	3710-31-36	07/29/2002 – 07/29/2003	Each Occurrence $1,000,000	Aggregate $2,000,000
Pollution Liability	7315-77-02	01/31/2002 – 01/31/2003	Each Occurrence $1,000,000	Aggregate $1,000,000

If the name of the insured is other than permitted operation, list below the approved operator=s name for which the coverage is provided:

RECEIVED
DIVISION OF
MINERAL RESOURCES MGMT

NOTE: If approved names are not available, individual mining permit numbers will suffice.

The above designated polices apply to all surface mining operations of the insured in the State of Ohio.
Yes ____ No X

Ohio Administrative Code 1501:14-1-08 requires ten days prior notice in the event of cancellation or non-renewal of the insurance. Such notice should be directed to the Ohio Department of Natural Resources, Division of Reclamation, Industrial Minerals Section, 1855 Fountain Square Ct., Building 2, Columbus, Ohio 43224.

Date November 5, 2002

By
Authorized Representative

Form IM-15 9/93
State of Ohio
Department of Natural Resources
Division of Reclamation

Permit No. IM-1164
or
Applic. No. _____

INDUSTRIAL MINERALS
LEASE/DEED AFFIDAVIT

Applicant/Operator K.C.C.I.

Pursuant to 1514.02, O.R.C., I (We) TIMOTHY H. LINN as authorized representative of K.C.C.I. (company) attest to the fact that I(We) have consent to mine the following minerals on the following location by virtue of a lease or deed or other document that is available for submission to ODNR, if requested.

PROPERTY LOCATION:

COUNTY	TOWNSHIP	SECTION	LOT	T-, R-	ACRES
JEFFERSON	SPRINGFIELD	10,16,22		11N, 4W	928.58
HARRISON	GERMAN	14,15,21		11N, 4W	817.05

Mineral Owners of Property: Name: APEX ENERGY, INC.
Address: P.O. BOX 1298, STEUBENVILLE, OH 43952

Surface Owners of Property: Name: APEX ENERGY, INC.
Address: P.O. BOX 1298, STEUBENVILLE, OH 43952

Minerals to be Mined: LIMESTONE

Further Description of Property: JEFFERSON CO.- DEED BK. REF. 17, PG. 28.
HARRISON CO. - DEED BK. REF. 232, PGS. 201-204

Mining Rights Authorized by Virtue of:

Lease ____ Dated _____ for a period of _____ years beginning _____
and ending _____. Is lease assignable? ____ Yes ____ No

Deed ____ Dated _____

Other XX Describe: DAVID KRULOCK IS PRESIDENT OF K.C.C.I. AND A MAJOR STOCKHOLDER OF APEX ENERGY, INC.

Signature of Affiant

CONSULTANT
Title

6/10/02
Date

Sworn to before me and subscribed in my presence this

10th day of JUNE, 2002

Tara C Weiser
Notary Public

TARA C. WEISER
Notary Public, State of Ohio
My Commission Expires
April 20, 2003

16.5 Regulatory Records Documentation

OhioEPA

State of Ohio Environmental Protection Agency

Permit to Install
Terms and Conditions

Application No. 17-1407
APS Premise No. 1707100211
Permit Fee: $1500.00

Name of Facility: K.C.C.I.

Person to Contact: GEORGE KEVLOCK

Address: PO BOX 24
MORRISTOWN, OH 43906

Location of proposed source(s): 17 D-0 TWP RD 264
AMSTERDAM, OHIO

Description of proposed source(s):
PORTABLE LIMESTONE CRUSHING AND SCREENING PLANT.

Date of Issuance: January 18, 1996

Effective Date: January 18, 1996

The above named entity is hereby granted a permit to install for the above described source(s) pursuant to Chapter 3745-31 of the Ohio Administrative Code. Issuance of this permit does not constitute expressed or implied approval or agreement that, if constructed or modified in accordance with the plans included in the application, the above described source(s) of environmental pollutants will operate in compliance with applicable State and Federal laws and regulations, and does not constitute expressed or implied assurance that if constructed or modified in accordance with those plans and specifications, the above described source(s) of pollutants will be granted the necessary permits to operate (air) or NPDES permits as applicable.

This permit is granted subject to the conditions attached hereto.

Ohio Environmental Protection Agency

Donald R Schregardus

Director

K.C.C.I.
Application No. 17-1407
Page 2 of 8
January 18, 1996

TERMINATION OF PERMIT TO INSTALL

Substantial construction for installation must take place within 18 months of the effective date of this permit. This deadline may be extended by up to 12 months if application is made to the Director within a reasonable time before the termination date and the party shows good cause for any such extension.

NOTICE OF INSPECTION

The Director of the Ohio Environmental Protection Agency, or his authorized representatives, may enter upon the premises of the above-named applicant during construction and operation at any reasonable time for the purpose of making inspections, conducting tests, or to examine records or reports pertaining to the construction, modification or installation of the source(s) of environmental pollutants identified within this permit.

CONSTRUCTION OF NEW SOURCES

The proposed source(s) shall be constructed in strict accordance with the plans and application submitted for this permit to the Director of the Ohio Environmental Protection Agency. There may be no deviation from the approved plans without the express, written approval of the Agency. Any deviations from the approved plans or the above conditions may lead to such sanctions and penalties as provided under Ohio law. Approval of these plans does not constitute an assurance that the proposed facilities will operate in compliance with all Ohio laws and regulations. Additional facilities shall be installed upon orders of the Ohio Environmental Protection Agency if the proposed sources are inadequate or cannot meet applicable standards.

If the construction of the proposed source(s) has already begun or has been completed prior to the date the Director of the Environmental Protection Agency approves the permit application and plans, the approval does not constitute expressed or implied assurance that the proposed facility has been constructed in accordance with the approved plans. The action of beginning and/or completing construction prior to obtaining the Director's approval constitutes a violation of Ohio Administrative Code (OAC) Rule 3745-31-02. Furthermore, issuance of the Permit to Install does not constitute an assurance that the proposed source will operate in compliance with all Ohio laws and regulations. Approval of the plans in any case is not to be construed as an approval of the facility as constructed and/or completed. Moreover, issuance of the Permit to Install is not to be construed as a waiver of any rights that the Ohio Environmental Protection Agency (or other persons)

may have against the applicant for starting construction prior to the effective date of the permit. Additional facilities shall be installed upon orders of the Ohio Environmental Protection Agency if the proposed facilities prove to be inadequate or cannot meet applicable standards.

PERMIT TO INSTALL FEE

In accordance with Ohio Revised Code 3745.11, the specified Permit to Install fee must be remitted within 30 days of the effective date of this permit to install.

PUBLIC DISCLOSURE

The facility is hereby notified that this permit, and all agency records concerning the operation of this permitted source, are subject to public disclosure in accordance with OAC Rule 3745-49-03.

APPLICABILITY

This Permit to Install is applicable only to the contaminant sources identified. Separate application must be made to the Director for the installation or modification of any other contaminant sources.

BEST AVAILABLE TECHNOLOGY

As specified in OAC Rule 3745-31-05, all new sources must employ Best Available Technology (BAT). Compliance with the terms and conditions of this permit will fulfill this requirement.

PERMIT TO OPERATE APPLICATION

A Permit to Operate application must be submitted to the appropriate field office for each air contaminant source in this Permit to Install. In accordance with OAC Rule 3745-35-02, the application shall be filed no later than thirty days after commencement of operation.

SOURCE OPERATION AFTER COMPLETION OF CONSTRUCTION

This facility is permitted to operate each source described by this permit to install for a period of up to one year from the date the source commenced operation. This permission to operate is granted only if the facility complies with all requirements contained in this permit and all applicable air pollution laws, regulations, and policies.

K.C.C.I.
Application No. 17-1407
Page 4 of 8
January 18, 1996

AIR EMISSION SUMMARY

The air contaminant sources listed below comprise the Permit to Install for K.C.C.I. located in Jefferson County. The sources listed below shall not exceed the emission limits/control requirements contained in the table. This condition in no way limits the applicability of any other state or federal regulations. Additionally, this condition does not limit the applicability of additional special terms and conditions of this permit.

Ohio EPA Source Number	Source Identification Description	BAT Determination	Applicable Federal & OAC Rules	Permit Allowable Mass Emissions and/or Control/Usage Requirements
B001	Diesel electric generator	Diesel fuel <0.5% sulfur	3745-31-05 3745-17-10 3745-17-07 3745-17-06 3745-15-07	PM: 0.25 lb/ 10^6 BTU and 0.27 ton/yr SO_2: 0.23 lb/ 10^6 BTU and 0.25 ton/yr HC: 0.28 lb/ 10^6 BTU and 0.3 ton/yr NO_x: 3.47 lb/ 10^6 BTU and 3.75 ton/yr CO: 0.76 lb/ 10^6 BTU and 0.82 ton/yr
F001	Unpaved roads and parking area	Dust suppression/water truck, speed reduction resurface with aggregate spill cleanup	3745-31-05 3745-17-08 (B) 3745-15-06 3745-15-07	PM: 0.55 ton/yr minimize or eliminate fugitive particulate emission and compliance with reported visible emission standard
F002	Aggregate storage piles	Water truck good operating practice	3745-31-05 3745-17-08 3745-15-06 3745-15-07	PM: 2.88 tons/yr minimize or eliminate fugitive particulate emission and compliance with reported visible emission standard

K.C.C.I.
Application No. 17-1407
Page 5 of 8
January 18, 1996

F003	Aggregate processing	Spray bars, good operating practice damp material	3745-31-05 3745-17-08 3745-15-06 3745-15-07 40 CFR part 60 subpart 000	PM: .495 ton/yr minimize or eliminate fugitive particulate emission and compliance with reported visible emission standard

SUMMARY
TOTAL PERMIT TO INSTALL ALLOWABLE EMISSIONS

Pollutant	Tons/Year
PM	4.195
SO_2	0.25
HC	0.30
NO_x	3.75
CO	0.82

NSPS REQUIREMENTS

The following sources are subject to the applicable provisions of the New Source Performance Standards (NSPS) as promulgated by the United States Environmental Protection Agency, 40 CFR Part 60.

Source No.	Source Description	NSPS Regulation (Subpart)
F003	Limestone/crushing screening, transferring activities	00

The application and enforcement of these standards are delegated to the Ohio EPA. The requirements of 40 CFR Part 60 are also federally enforceable.

Pursuant to the NSPS, the source owner/operator is hereby advised of the requirement to report the following at the appropriate times:

a. construction date (no later than 30 days after such date);
b. anticipated start-up date (not more than 60 days or less than 30 days prior to such date);
c. actual start-up date (within 15 days after such date); and
d. date of performance testing (If required, at least 30 days prior to testing).

K.C.C.I.
Application No. 17-1407
Page 6 of 8
January 18, 1996

Reports are to be sent to:

Ohio Environmental Protection Agency
DAPC - Permit Management Unit
P.O. Box 163669
Columbus, OH 43216-3669

and North Ohio Valley Air Authority
814 Adams
Steubenville, Ohio 43952

MAINTENANCE OF EQUIPMENT

This source and its associated air pollution control system(s) shall be maintained regularly in accordance with good engineering practices and the recommendations of the respective manufacturers in order to minimize air contaminant emissions.

MALFUNCTION/ABATEMENT

In accordance with OAC RULE 3745-15-06, any malfunction of the source(s) or associated air pollution control system(s) shall be reported immediately to the North Ohio Valley Air Authority, 814 Adams, Steubenville, Ohio 43952.

Except as provided by OAC Rule 3745-15-06(A)(3), scheduled maintenance of air pollution control equipment that requires the shutdown or bypassing of air pollution control system(s) must be accompanied by the shutdown of the associated air pollution sources.

AIR POLLUTION NUISANCES PROHIBITED

The air contaminant source(s) identified in this permit may not cause a public nuisance in violation of OAC Rule 3745-15-07.

NINETY DAY OPERATING PERIOD

The facility will be permitted to operate during a 90-day period in accordance with OAC Rule 3745-35-02(C)(4)(b). The purpose of this period of operation is to fulfill the performance tests conditions used in the determination of compliance with the provisions of this Permit to Install or other applicable Ohio EPA rules.

K.C.C.I.
Application No. 17-1407
Page 7 of 8
January 18, 1996

CONSTRUCTION COMPLIANCE CERTIFICATION

The applicant shall provide Ohio EPA with a written certification (see enclosed form) that the facility has been constructed in accordance with the Permit to Install application and the terms and conditions of the Permit to Install. The certification shall be provided to Ohio EPA upon completion of construction but prior to startup of the source.

ADDITIONAL SPECIAL TERMS AND CONDITIONS

1. F001 - Unpaved Roads and Parking Areas

In order to control emissions of fugitive dust, this facility shall implement the following control measures:

A. this facility shall apply water or suitable dust suppression chemicals as often as necessary on all unpaved roads and parking areas in order to minimize or prevent visible emissions of fugitive dust;

B. speed zones of no more than 15 miles per hour shall be established, posted and enforced by the owner or operator for all vehicles operating within the facility or facility controlled access roads;

C. this facility shall operate and maintain a truck mounted spray system to distribute water and/or dust suppression solution in order to minimize or eliminate visible emissions of fugitive dust generated by vehicle traffic on unpaved roadways and parking areas; and

D. paved roadways shall be maintained free of gross quantities of mud or dust to prevent tracking of materials onto public roadways and to minimize dust emissions from the facility roadways.

Visible Emission Limitations for Roadways and Parking Areas

There shall be no visible particulate emissions from any paved roadway or parking area except for a period of time not to exceed one minute during any sixty-minute observation period as determined by Method 22 of 40 CFR Part 60.

There shall be no visible particulate emission from any unpaved road or parking area except for a period of time not to exceed three minutes during any sixty-minute observation period as determined by Method 22 of 40 CFR Part 60.

2. F002 - Aggregate Storage Piles

All aggregate storage piles shall contain sufficient moisture so as to minimize or eliminate visible emissions caused by wind erosion.

There shall be no visible particulate emission from the material storage piles except for a period of time not to exceed one minute during any sixty-minute observation period.

During the unloading onto or removal from the aggregate storage piles, the drop height of the front-end loader shall be minimized in order to minimize or eliminate visible emissions of fugitive dust.

3. **F003 - Aggregate Plant Operations**

K.C.I.I. shall maintain and employ, as needed, properly sized spray bar system processing adequate volume and pressure to wet the limestone material sufficiently to minimize or eliminate at all times fugitive dust. The front end loader operators shall be instructed and required to reduce the bucket drop height to the extent possible in order to minimize or eliminate fugitive dust. There shall be no visible particulate emission that exceed ten percent opacity as a six-minute average as determined by Method 9 of 40 CFR Part 60.

4. **B001 - Diesel Generator**

In accordance with the requirements of OAC Rule 3745-31-05 K.C.I.I. shall use only diesel fuel having 0.5 weight percent or lower sulfur content.

APPENDIX C3-B

ODNR WELL LOGS

ONR-7802.03
TYPE OR USE PEN
SELF TRANSCRIBING
PRESS HARD

WELL LOG AND DRILLING REPORT

Ohio Department of Natural Resources
Division of Water, 1939 Fountain Square Drive
Columbus, Ohio 43224-9971 Voice (614) 265-6740 Fax (614) 265-6767

992543

WELL LOCATION

County Jefferson Township Springfield

Owner/Builder (Circle One or Both) Apex Sanitary Landfill (First / Last)

Address of Well Location Apex Rd. (Number / Street Name)

City Amsterdam Zip Code +4 43903

Permit No. 2005-029 Section/Lot No. (Circle One or Both) 16

Location of Well in State Plane coordinates, if available: Use of Well building

N ☐ X 40°25.942 N ____ +/- ____ ft. or m

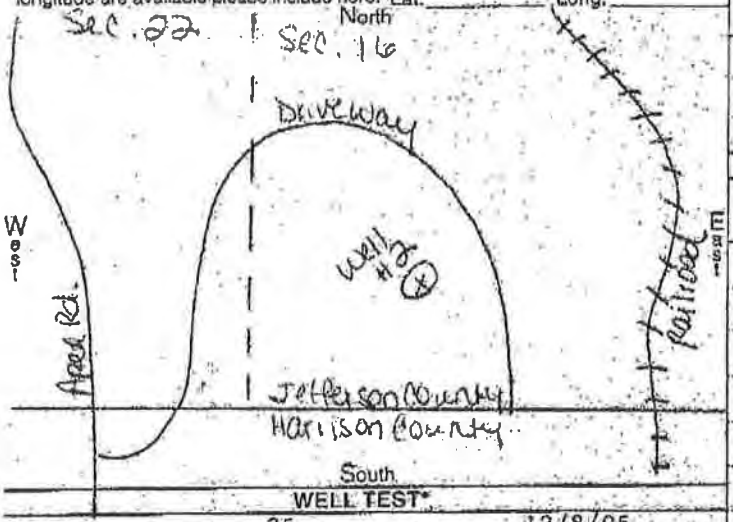
S ☐ Y 080°54.579 W ____ +/- ____ ft. or m

Elevation of Well 1107' ____ +/- ____ ft. or m

Datum Plain: ☐ NAD27 ☐ NAD83 Elevation Source ____

Source of Coordinates: ☒ GPS ☐ Survey ☐ Other ____

Sketch a map showing distance well lies from numbered state highways, street intersections, county roads, buildings or other notable landmarks. If latitude and longitude are available please include here: Lat: ____ Long: ____



WELL TEST*

Pre-Pumping Static Level 35 ft. Date 12/8/05

Measured from: ☒ Top of Casing ☐ Ground Level ☐ Other ____

☐ Air ☒ Bailing ☐ Pumping ☐ Other ____

Test Rate 1½ gpm Duration of Test 4 hrs.

Feet of Drawdown 100 ft. Sustainable Yield 1 gpm

*(Attach a copy of the pumping test record, per section 1521.05, ORC)

Is Copy Attached? ☐ Yes ☐ No Flowing Well? ☐ Yes ☒ No

Quality clear

PUMP/PITLESS

Type of pump ____ Capacity ____ gpm

Pump set at ____ ft. Pitless Type ____

Pump installed by Install at later date

I hereby certify the information given is accurate and correct to the best of my knowledge

Drilling Firm McKay & Gould Drilling, Inc.

Address 267 Taggart Rd.

City, State, Zip Darlington, PA 16115

Signed Lynn Gould (CS) Date 12/16/05

ODH Registration Number 0145

CONSTRUCTION DETAILS

☒ Rotary ☐ Cable ☐ Augered ☐ Driven ☐ Other ____

BOREHOLE/CASING (measured from ground surface)

1 ☒ Borehole Diameter 12 3/4 inches Depth 0-31½ ft.

Casing Diameter 8 in. Length 33 ft. Thickness .280 in.

2 ☒ Borehole Diameter 8 inches Depth 31½-185 ft.

Casing Diameter ____ in. Length ____ ft. Thickness ____ in.

Casing Height Above Ground 18" ft.

Type 1 ☒ Steel 1 ☐ Galv 1 ☐ PVC 1 ☐ 2 ☐ 2 ☐ 2 ☐ 2 ☐ Other ____

Joints 1 ☒ Threaded 1 ☐ Welded 1 ☐ Solvent 1 ☐ 2 ☐ 2 ☐ 2 ☐ 2 ☐ Other ____

SCREEN

Diameter ____ Slot Size ____ Screen Length ____ ft.

Type ____ Material ____

Set Between ____ ft. and ____ ft.

GRAVEL PACK (Filter Pack)

Material/Size ____ Volume/Weight Used ____

Method of Installation ____

Depth: Placed FROM ____ ft. TO ____ ft.

GROUT

Material Bentonite Volume/Weight Used 1000#

Method of Installation dry pour

Depth: Placed FROM 31½ ft. TO 0 ft.

DRILLING LOG*

INDICATE DEPTH(S) AT WHICH WATER IS ENCOUNTERED. Show color, texture, hardness, and formation: sandstone, shale, limestone, gravel, clay, sand, etc.	From	To
Broken sandstone	0	2
Sandstone water 35-40' 1½gpm	2	51
Shale	51	59
Limestone	59	62
Sandy shale w/lime bands	62	70
Red shale	70	75
Shale w/lime bands	75	138
Coal	138	140
Clay	140	146
Lime shale	146	162
Red & gr. clay shale	162	185

*(If more space is needed to complete drilling log, use next consecutively numbered form.)

Date of Well Completion 12/8/05 Total Depth of Well 185 ft.

Completion of this form is required by section 1521.05, Ohio Revised Code - file within 30 days after completion of drilling.

ORIGINAL COPY TO - ODNR, DIVISION OF WATER, 1939 FOUNTAIN SQ. DRIVE, COLS., OHIO 43224-9971

Blue - Customer's copy; Pink - Driller's copy; Green - Local Health Dept. copy

ODNR 7002.03
TYPE OR USE PEN
SELF TRANSCRIBING
PRESS HARD

WELL LOG AND DRILLING REPORT

Ohio Department of Natural Resources
Division of Water, 1939 Fountain Square Drive
Columbus, Ohio 43224-9971 Voice (614) 265-6740 Fax (614) 265-6767

992542

WELL LOCATION

County Jefferson Township Springfield

Owner/Builder (Circle One or Both) Apex Sanitary Landfill (First / Last)

Address of Well Location Apex Rd. (Number / Street Name)

City Amsterdam Zip Code +4 43903

Permit No. 2005-029 Section/Lot No. (Circle One or Both) 22

Location of Well in State Plane coordinates, if available: Use of Well building

N ☐ X 40°25.586 N . ____ +/- ____ ft. or m

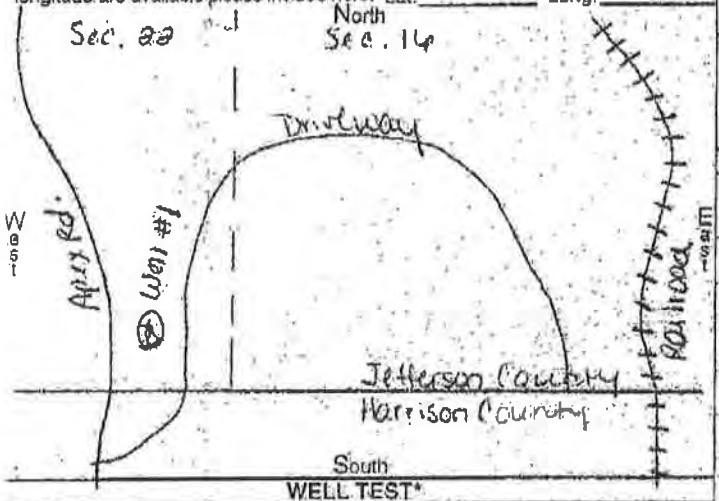
S ☐ Y 080°55.629 W . ____ +/- ____ ft. or m

Elevation of Well 1289' . ____ +/- ____ ft. or m

Datum Plain: ☐ NAD27 ☐ NAD83 Elevation Source ____

Source of Coordinates: ☒ GPS ☐ Survey ☐ Other ____

Sketch a map showing distance well lies from numbered state highways, street intersections, county roads, buildings or other notable landmarks. If latitude and longitude are available please include here: Lat: ____ Long: ____



WELL TEST*

Pre-Pumping Static Level 120 ft. Date 12/2/05

Measured from: ☒ Top of Casing ☐ Ground Level ☐ Other ____

☐ Air ☐ Bailing ☐ Pumping* ☐ Other ____

Test Rate 50 gpm Duration of Test 4 hrs.

Feet of Drawdown 200 ft. Sustainable Yield 25 gpm

(Attach a copy of the pumping test record, per section 1521.05, ORC)

Log Copy Attached? ☐ Yes ☐ No Flowing Well? ☐ Yes ☒ No

Quality clear

PUMP/PITLESS

Type of pump submersible/10LS10422 Capacity 10 gpm

Pump set at 220 ft. Pitless Type Dickens/JRS-10/screwed on

Pump installed by McKay & Gould Drilling, Inc.

I hereby certify the information given is accurate and correct to the best of my knowledge.

Drilling Firm McKay & Gould Drilling, Inc.

Address 267 Taggart Rd.

City, State, Zip Darlington, PA 16115

Signed [signature] Date 12/16/05

ODH Registration Number 0145

CONSTRUCTION DETAILS

☒ Rotary ☐ Cable ☐ Augered ☐ Driven ☐ Other ____

BOREHOLE/CASING (measured from ground surface)

1 ☒ Borehole Diameter 12 3/4 inches Depth 0-70.5 ft.

Casing Diameter 8 in. Length 72 ft. Thickness .280 in.

2 ☒ Borehole Diameter 8 inches Depth 70.5-245 ft.

Casing Diameter 4"PLASTIC in. Length 235 ft. Thickness .237 in.

Casing Height Above Ground 18" ft.

Type 1 ☒ Steel 1 ☐ Galv. 1 ☐ PVC 1 ☐ 2 ☐ 2 ☐ 2 ☒ 2 ☐ Other ____

Joints 1 ☒ Threaded 1 ☐ Welded 1 ☐ Solvent 1 ☐ 2 ☐ 2 ☐ 2 ☒ 2 ☐ Other ____

SCREEN

Diameter ____ Slot Size ____ Screen Length ____ ft.

Type ____ Material ____

Set Between ____ ft. and ____ ft.

GRAVEL PACK (Filter Pack)

Material/Size ____ Volume/Weight Used ____

Method of Installation ____

Depth: Placed FROM ____ ft. TO ____ ft.

GROUT

Material Bentonite Volume/Weight Used 1900#

Method of Installation dry pour

Depth: Placed FROM 70± ft. TO 0 ft.

DRILLING LOG*

INDICATE DEPTH(S) AT WHICH WATER IS ENCOUNTERED. Show color, texture, hardness, and formation: sandstone, shale, limestone, gravel, clay, sand, etc.	From	To
Spoil	0	64±
Limestone	64±	66±
Sandstone	66±	70
Sandstone w/shale bds.	70	140
Sandy shale w/sandstone bds.	140	185
Sandstone water 50gpm	185	185
Sandy shale w/sandstone bds.	185	218
Shale	218	221
Sandy shale w/sandstone bds.	221	245

*(If more space is needed to complete drilling log, use next consecutively numbered form.)

Date of Well Completion 12/7/05 Total Depth of Well 245 ft.

Completion of this form is required by section 1521.05, Ohio Revised Code - file within 30 days after completion of drilling.

ORIGINAL COPY TO - ODNR, DIVISION OF WATER, 1939 FOUNTAIN SQ. DRIVE, COLS., OHIO 43224-9971

Blue - Customer's copy, Pink - Driller's copy, Green - Local Health Dept. copy

WELL LOG AND DRILLING REPORT

ORIGINAL

NO CARBON PAPER NECESSARY— SELF-TRANSCRIBING

State of Ohio
DEPARTMENT OF NATURAL RESOURCES
Division of Water
65 S. Front St., Rm. 815 Phone (614) 469-2646
Columbus, Ohio 43215

No. 390899

County Harrison Township Green Section of Township

Owner Carole Lolich Address Dennison, Ohio 44621

Location of property 3 miles East of Dennison on RT 646

CONSTRUCTION DETAILS

Casing diameter 6" Length of casing 17

Type of screen Length of screen

Type of pump

Capacity of pump

Depth of pump setting

Date of completion

BAILING OR PUMPING TEST
(Specify one by circling)

Test Rate 30 G.P.M. Duration of test ½ hrs.

Drawdown ft. Date 9/11/72

Static level-depth to water ft.

Quality (clear, cloudy, taste, odor)

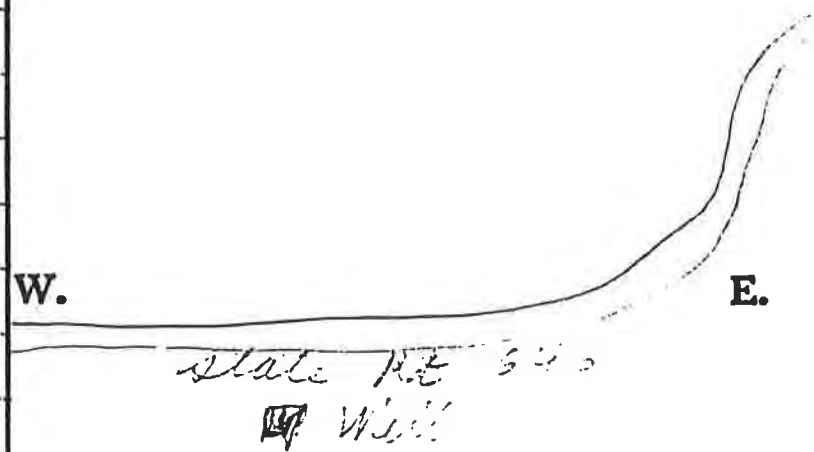
Pump installed by

WELL LOG*

Formations Sandstone, shale, limestone, gravel and clay	From	To
Clay	0 Feet	1 Ft.
Sandstone	1	59
Shale	59	58
Water		

SKETCH SHOWING LOCATION

Locate in reference to numbered State Highways, St. Intersections, County roads, etc.



Drilling Firm Unger Drilling Date 9/11/72

Address RD #1 Dennison O Signed D. Unger Unger Jr.

*If additional space is needed to complete well log, use next consecutive numbered form.

(15)

Plate A-6

WELL LOG AND DRILLING REPORT

NO CARBON PAPER NECESSARY— SELF-TRANSCRIBING

State of Ohio
DEPARTMENT OF NATURAL RESOURCES
Division of Water
65 S. Front St., Rm. 815 Phone (614) 469-2646
Columbus, Ohio 43215

No. 378735

County Jefferson Township Springfield Section of Township

Owner Henry Dooley Address R.D. #1, Amsterdam Ohio

Location of property Before entering Amsterdam, on Rt. #43, going northwest, ~~make left on first township road, first farm~~ on right.

CONSTRUCTION DETAILS

Casing diameter 6 5/4" Length of casing 29' 4"

Type of screen — Length of screen —

Type of pump submersible

Capacity of pump 4 gpm.

Depth of pump setting 120'

Date of completion 7-9-69

BAILING OR PUMPING TEST
(Specify one by circling)

Test Rate 2 G.P.M. Duration of test 2 hours

Drawdown dry ft. Date 7-5-69

Static level-depth to water 58 ft.

Quality (clear, cloudy, taste, odor) clear

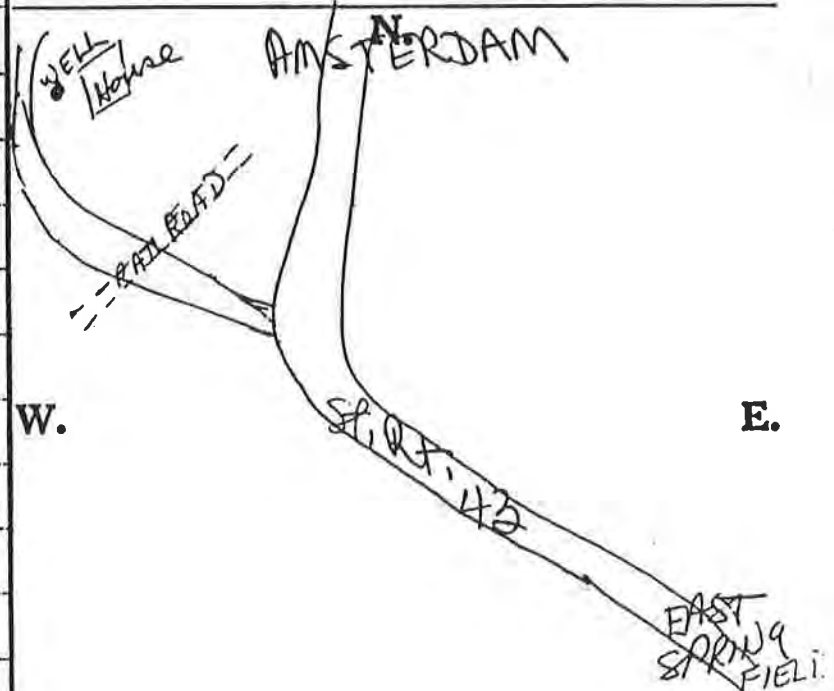
Pump installed by Driller

WELL LOG*

Formations Sandstone, shale, limestone, gravel and clay	From	To
Soil	0 Feet	1 Ft.
Soft Sandrock Shale	1	19
Brown Sandrock	19	27
White Sandrock	27	80
Sandrock	80	115
Coal	115	119
Limestone	119	124
Water 65'		

SKETCH SHOWING LOCATION

Locate in reference to numbered State Highways, St. Intersections, County roads, etc.



Drilling Firm Bonecutter Drilling Co. Date 7-21-69

Address RD #1, Bloomingdale, Ohio Signed Carl H. Bonecutter

*If additional space is needed to complete well log, use next consecutive numbered form.

79

Plate A-23

WE' LOG AND DRILLING REPORT

NO CARBON PAPER NECESSARY– SELF-TRANSCRIBING

State of Ohio
DEPARTMENT OF NATURAL RESOURCES
Division of Water
Fountain Square
Columbus, Ohio 43224

(3) 609568

COUNTY Jefferson TOWNSHIP Springfield SECTION OF TOWNSHIP 23

OWNER David Miller ADDRESS Amsterdam, Oh

LOCATION OF PROPERTY Co 78 @ Co 267

CONSTRUCTION DETAILS

Casing diameter 6" Length of casing 26'

Type of screen — Length of screen —

Type of pump —

Capacity of pump —

Depth of pump setting —

Date of completion —

BAILING OR PUMPING TEST
(specify one by circling)

Test rate 15 gpm Duration of test ½ hrs

Drawdown 6' ft Date 12-7-81

Static level (depth to water) 114½ ft

Quality (clear, cloudy, taste, odor) cloudy

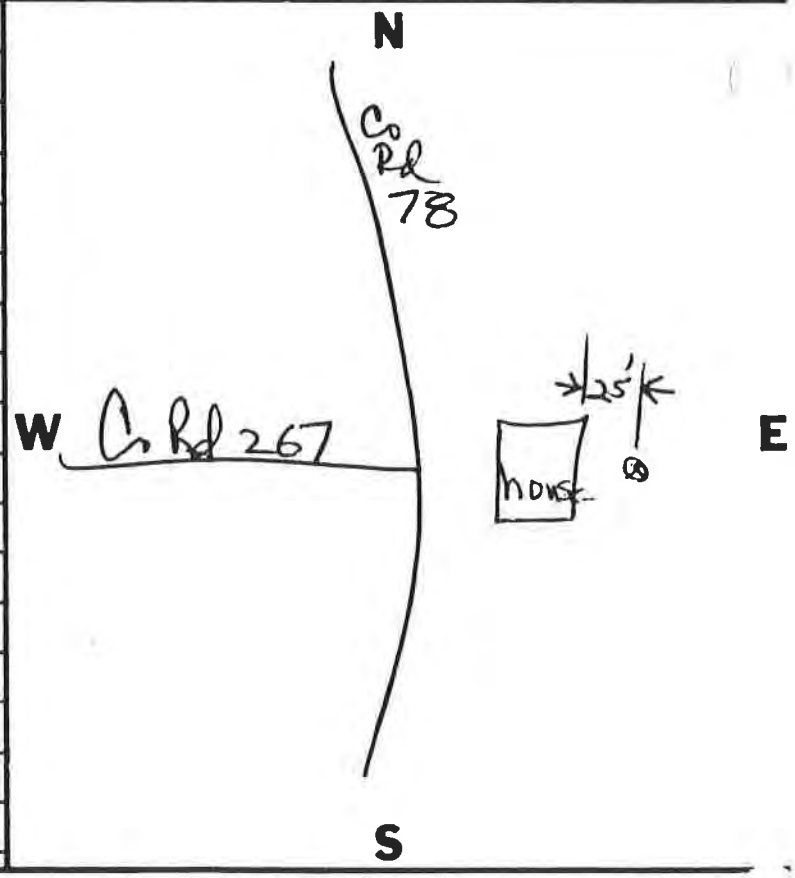
Pump installed by —

WELL LOG*

Formations: sandstone, shale, limestone, gravel, clay	From	To
Clay	0 ft	10 ft
Sandstone	10	15
Clay	15	25
Clay w/sand	25	45
Redrock Clay	45	50
Clay w/shale	50	72
Sandstone	72	77
Clay w/shale	77	105
Shale	105	120
Sandstone	120	163

SKETCH SHOWING LOCATION

Locate in reference to numbered state highways, street intersections, county roads, etc.



DRILLING FIRM Curry Drilling DATE 12-7-81

ADDRESS 6180 Beaver, Amsterdam Oh SIGNED Jim Curry

*If additional space is needed to complete well log, use next consecutive numbered form.

ORIGINAL COPY - ODNR, DIVISION OF WATER, FOUNTAIN SQ., COLS OHIO 43224

(81)

WE' LOG AND DRILLING RE'ORT

(2)

ORIGINAL

NO CARBON PAPER NECESSARY– SELF-TRANSCRIBING

State of Ohio
DEPARTMENT OF NATURAL RESOURCES
Division of Water
Fountain Square
Columbus, Ohio 43224

514501

COUNTY Jefferson TOWNSHIP Springfield SECTION OF TOWNSHIP 23

OWNER Ed Crace ADDRESS R-1 Amsterdam, Ohio 43903

LOCATION OF PROPERTY @ 2½mi South West of Amsterdam on Co Rd 75

CONSTRUCTION DETAILS

Casing diameter 6 ⅝" C.D. Length of casing 47'

Type of screen — Length of screen —

Type of pump —

Capacity of pump —

Depth of pump setting —

Date of completion 4-9-77

BAILING OR PUMPING TEST
(specify one by circling)

Test rate 12+ gpm Duration of test 2 hrs

Drawdown 49' ft Date 4-9-77

Static level (depth to water) 121' ft

Quality (clear, cloudy, taste, odor) Cloudy

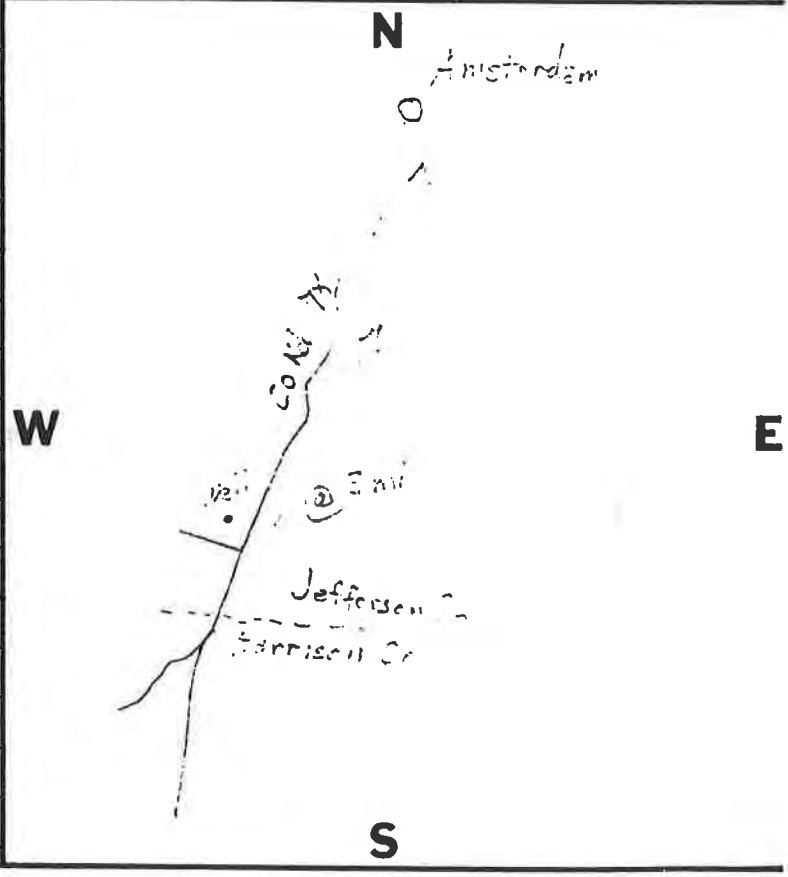
Pump installed by —

WELL LOG*

Formations: sandstone, shale, limestone, gravel, clay	From	To
Fill Dirt	0 ft	25 ft
Limestone	25'	33'
Soft Gray Shale	33'	40'
Hard " Shale	40'	50'
Pink rock	50'	55'
Hard Gray Shale	55'	72'
Hard Dark Shale	72'	97'
Limestone	97'	100'
Hard Dark Gray Shale	100'	135'
Gray Sandy Shale	135'	142'
Sand w/shale Strimmers	142'	155'
Sand (white)	155'	170'
		T.D.

SKETCH SHOWING LOCATION

Locate in reference to numbered state highways, street intersections, county roads, etc.



DRILLING FIRM Speed Drilling Co

ADDRESS Carrollton, Ohio

DATE 4-10-77

SIGNED [illegible]

*If additional space is needed to complete well log, use next consecutive numbered form.

Plate A-26

WE' LOG AND DRILLING RE'ORT

ORIGINAL

NO CARBON PAPER NECESSARY– SELF-TRANSCRIBING

State of Ohio
DEPARTMENT OF NATURAL RESOURCES
Division of Water
Fountain Square
Columbus, Ohio 43224

1
514505

COUNTY Jefferson TOWNSHIP Springfield SECTION OF TOWNSHIP 23

OWNER Louis Ciacci ADDRESS Rt 1, Amsterdam, Ohio 43903

LOCATION OF PROPERTY @ 2½ mi south of Amsterdam on Co Rd 78

CONSTRUCTION DETAILS

Casing diameter 6 5/8" O.D. Length of casing 50'

Type of screen — Length of screen —

Type of pump —

Capacity of pump —

Depth of pump setting —

Date of completion 4-27-77

BAILING OR PUMPING TEST
(specify one by circling)

Test rate 6 gpm Duration of test 2 hrs

Drawdown 60' ft Date 4-26-77

Static level (depth to water) 110' ft

Quality (clear, cloudy, taste, odor) Cloudy

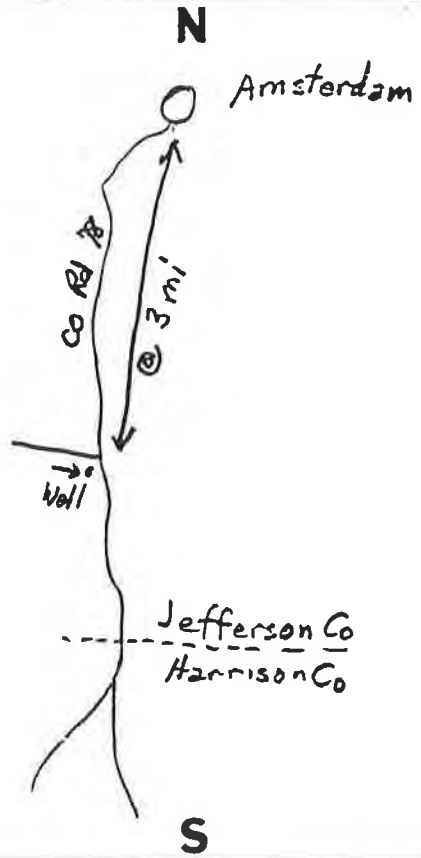
Pump installed by —

WELL LOG*

Formations: sandstone, shale, limestone, gravel, clay	From	To
Surface Soil	0 ft	2' ft
Clay	2'	10'
Broken Limestone	10'	20'
Soft Gray Shale	20'	45'
Gray Sandy Shale	45'	58'
Dark Gray Shale	58'	103'
Sand	103'	115'
Soft Shale	115'	120'
Sandy Shale	120'	125'
Sand	125'	135'
Soft Dark Shale	135'	142'
Sand w/shale stringers	142'	172'
		T.D.

SKETCH SHOWING LOCATION

Locate in reference to numbered state highways, street intersections, county roads, etc.



DRILLING FIRM Speedy Drilling Co DATE 4-26-77

ADDRESS Carrollton, Ohio SIGNED Glenn T. Speedy

*If additional space is needed to complete well log, use next consecutive numbered form.

Plate A-27

(83)

WELL LOG AND DRILLING REPORT

State of Ohio
DEPARTMENT OF NATURAL RESOURCES
Division of Water
1500 Dublin Road
Columbus, Ohio

No. 222333

County Perry Township Springfield Section of Township 11

Owner Harry Repella Address Amsterdam

Location of property South of 43

CONSTRUCTION DETAILS

Casing diameter 6 Length of casing 28

Type of screen ..... Length of screen .....

Type of pump .....

Capacity of pump .....

Depth of pump setting .....

Date of completion .....

BAILING OR PUMPING TEST

Pumping rate ..... G.P.M. Duration of test ..... hrs.

Drawdown ..... ft. Date .....

Developed capacity .....

Static level—depth to water 89 ft.

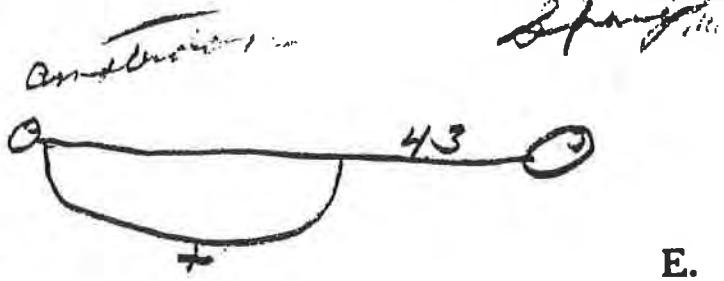
Pump installed by .....

WELL LOG

Formations Sandstone, shale, limestone, gravel and clay	From	To
	0 Feet	..... Ft.
Shale & Lime		24
Grey slate	24	70
Sand	70	150
Slate	150	165 W.
Water 145		

SKETCH SHOWING LOCATION

Locate in reference to numbered State Highways, St. Intersections, County roads, etc.



See reverse side for instructions

Drilling Firm John Sapp Date Oct 1959

Address Richmond, Signed .....

92

Plate A-33

WELL LOG AND DRILLING REPORT

ORIGINAL

State of Ohio
DEPARTMENT OF NATURAL RESOURCES
Division of Water
Columbus, Ohio

No 141335

County Jefferson Township Springfield Section of Township or Lot Number Sec 11 T 11 R 4

Owner Frank Fowler Address Cunningham Ohio Rt 1

Location of property 3 mi south of Cunningham

CONSTRUCTION DETAILS

Casing diameter 6 Length of casing 21-6

Type of screen None Length of screen —

Type of pump Gravel

Capacity of pump 1 - 30

Depth of pump setting 37

PUMPING TEST

Pumping rate 9 G.P.M. Duration of test 1 hrs.

Drawdown 0 ft. Date Dec 12-56

Developed capacity 9 G. P. M.

Static level—depth to water 35 ft.

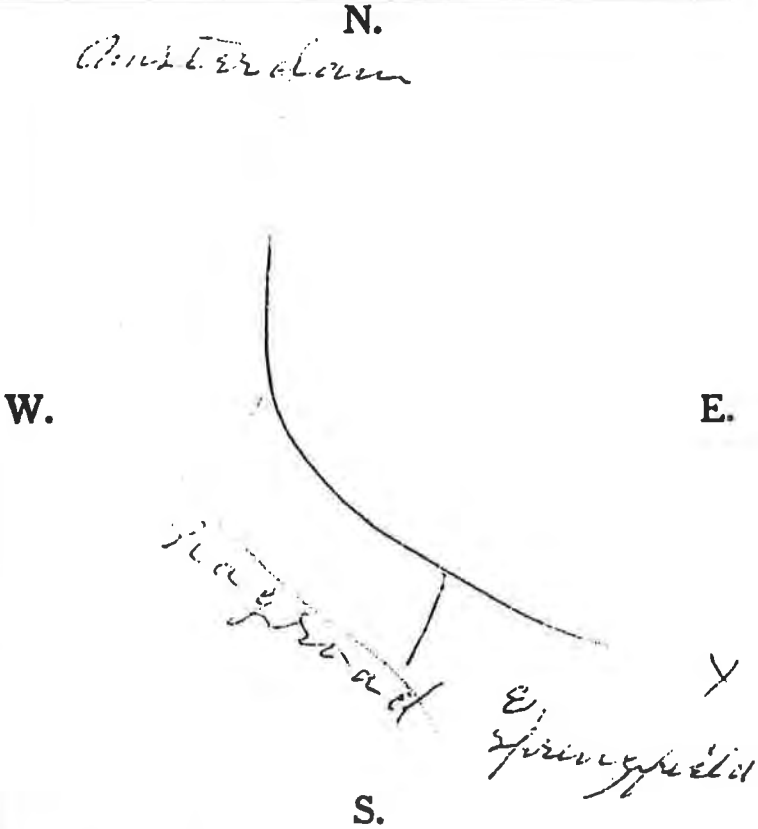
Pump installed by Miller

WELL LOG

Formations Sandstone, shale, limestone, gravel and clay	From	To
Clay	0 Feet	12 Ft.
Sand Stone	12	20
Brown shale	20	30
Blue shale	30	50
Water at 35.		

SKETCH SHOWING LOCATION

Locate in reference to numbered State Highways, St. Intersections, County roads, etc.



See reverse side for instructions

Drilling Firm Lawrence Miller Date Dec 12 - 1956

Address Cunningham Ohio Signed Frank Lawrence

Plate A-34

93A

WELL LOG AND DRILLING REPORT

ORIGINAL

State of Ohio
DEPARTMENT OF NATURAL RESOURCES
Division of Water
Columbus, Ohio

No 141334

County Jefferson Township Springfield or Lot Number Sec 11 Tp 11 – R 4

Owner Oscar Pafini Address Cunningham R.F.D. #1

Location of property 2 mi West of E. Springfield

CONSTRUCTION DETAILS

Casing diameter 6 Length of casing 19

Type of screen None Length of screen

Type of pump None

Capacity of pump

Depth of pump setting

PUMPING TEST

Pumping rate 15 G.P.M. Duration of test 1 hrs.

Drawdown 17 ft. Date 11 – 21 – 36

Developed capacity 16

Static level—depth to water 27 ft.

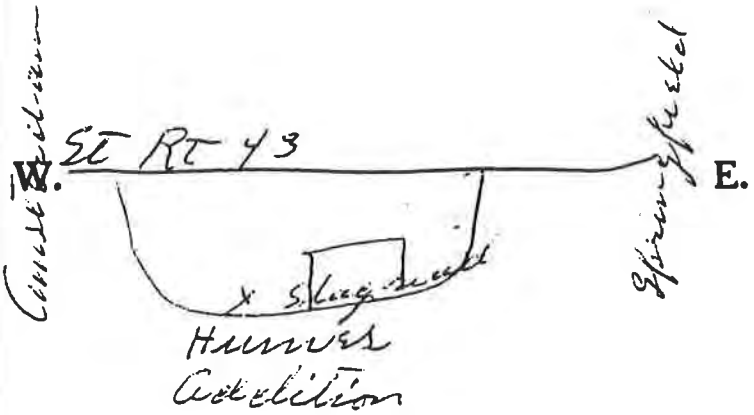
Pump installed by Pump not installed

WELL LOG

Formations Sandstone, shale, limestone, gravel and clay	From	To
Clay	0 Feet	14 Ft.
Sand stone	14	30
Slate	30	39
Water at 32		

SKETCH SHOWING LOCATION

Locate in reference to numbered State Highways, St. Intersections, County roads, etc.



See reverse side for instructions

Drilling Firm Laurence & McCorkle Date Nov 24 – 1936

Address Cunningham Ohio Signed Frank Laurence

Plate A-36

94

WELL LOG AND DRILLING REPORT

ORIGINAL

NO CARBON PAPER NECESSARY— SELF-TRANSCRIBING

State of Ohio
DEPARTMENT OF NATURAL RESOURCES
Division of Water
65 S. Front St., Rm. 815 Phone (614) 469-2646
Columbus, Ohio 43215

455863

County Jeff Township Springfield Section of Township 11

Owner Kenny Dorsey Address Amsterdam, Ohio

Location of property Red Dog Road, off 43

CONSTRUCTION DETAILS

Casing diameter 6 ¼ Length of casing 21

Type of screen Length of screen

Type of pump

Capacity of pump

Depth of pump setting

Date of completion

BAILING OR PUMPING TEST
(Specify one by circling)

Test Rate G.P.M. Duration of test hrs.

Drawdown ft. Date

Static level-depth to water 60' ft.

Quality (clear, cloudy, taste, odor) Clear

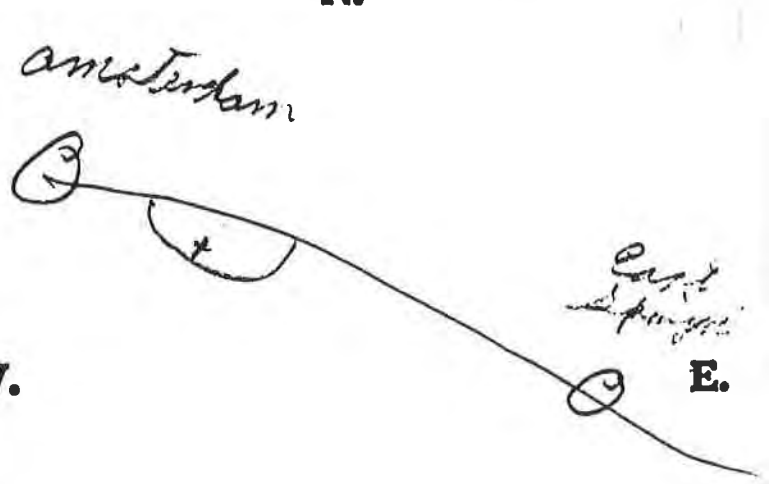
Pump installed by

WELL LOG*

Formations Sandstone, shale, limestone, gravel and clay	From	To
Lime & shale	0 Feet	30 Ft.
Gray shale	30	70
Gray sand	70	155
Gray shale	155	157
Water 95		
145		
Hard		

SKETCH SHOWING LOCATION

Locate in reference to numbered State Highways, St. Intersections, County roads, etc.



Drilling Firm John Sapp Date 1975

Address Richmond, Ohio Signed John Sapp

*If additional space is needed to complete well log, use next consecutive numbered form.

Plate A-37

(95)

X= -, 117, 000
Y= 288,200 N

State of Ohio
DEPARTMENT OF NATURAL RESOURCES
Division of Water
Columbus, Ohio

No 95901

County Jefferson Township Springfield Section of Township or Lot Number

Owner Vernon Palen Address Cadiz Route #1 O.

Location of property 2½ mile South of Cadiz

CONSTRUCTION DETAILS

Casing diameter 6" Length of casing 20'

Type of screen None Length of screen

Type of pump None

Capacity of pump "

Depth of pump setting "

PUMPING TEST

Pumping rate G.P.M. Duration of test Bailer Test 1 hrs.

Drawdown 26 ft. Date Aug 10-1951

Developed capacity 10 G.P.M.

Static level—depth to water 65 ft.

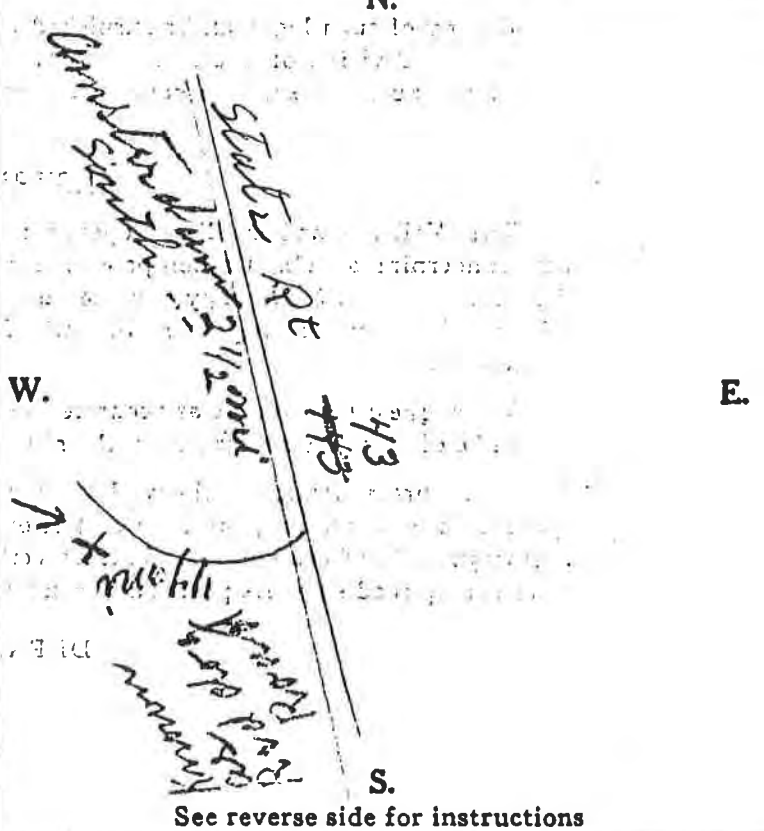
Pump installed by None

WELL LOG

Formations Sandstone, shale, limestone, gravel and clay	From	To
	0 Feet	Ft.
Clay		5
Limestone	5	8
Clay	8	20
Hard Limestone	20	28
Clay & Blue shale	28	40
Limestone	40	54
Clay & State dark	54	60
State dark Sand Water	60	75
Sand rock Gray	75	95
Sandrock "	95	141
Fine Stone	141	142
State dark	142	155
Water at 148		

SKETCH SHOWING LOCATION

Locate in reference to numbered State Highways, St. Intersections, County roads, etc.



See reverse side for instructions

Drilling Firm Lawrence & McCorkle Date April 10 1952

Address Cadiz Ohio Signed Frank Lawrence

Plate A-38

96

WELL LOG AND DRILLING REPORT

ORIGINAL

NO CARBON PAPER NECESSARY— ELF-TRANSCRIBING

State of Ohio
DEPARTMENT OF NATURAL RESOURCES
Division of Water
65 S. Front St., Rm. 815 Phone (614) 469-2646
Columbus, Ohio 43215

464198

County Jefferson Township Springfield Section of Township

Owner Richard McDonald Address Rt 1 Wintersville

Location of property N. Side Road Route 267 & SR 43

CONSTRUCTION DETAILS

Casing diameter 6 5/8 00 Length of casing 35

Type of screen Length of screen

Type of pump

Capacity of pump

Depth of pump setting

Date of completion

BAILING OR PUMPING TEST
(Specify one by circling)

Test Rate 12 G.P.M. Duration of test 2 hrs.

Drawdown ft. Date 9-7-74

Static level-depth to water 60 ft.

Quality (clear, cloudy, taste, odor) O K

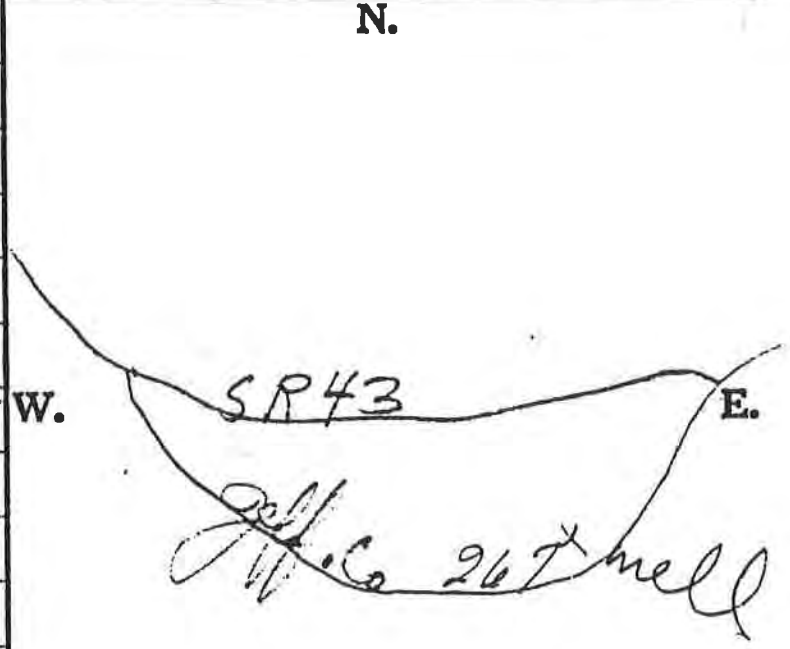
Pump installed by

WELL LOG*

Formations Sandstone, shale, limestone, gravel and clay	From	To
Soil	0 Feet	4 Ft.
Limestone Shale	4	20
Shale	20	30
Lime	30	40
Shale	40	60
Brown Sand Rock	60	75
White Sand	75	115
Limey Sand	115	120

SKETCH SHOWING LOCATION

Locate in reference to numbered State Highways, St. Intersections, County roads, etc.



Drilling Firm Speedy Drilling

Address Carrollton O

Date Sept 7 1974

Signed Ben B. Speedy

*If additional space is needed to complete well log, use next consecutive numbered form.

WELL LOG AND DRILLING REPORT

ORIGINAL

NO CARBON PAPER NECESSARY– SELF-TRANSCRIBING

State of Ohio
DEPARTMENT OF NATURAL RESOURCES
Division of Geological Survey
Fountain Square
Columbus, Ohio 43224 Phone (614) 466-5344

480445

COUNTY Jefferson TOWNSHIP Stingy Ridge SECTION OF TOWNSHIP OR LOT NUMBER 11

OWNER Richard Krogar ADDRESS Rd. #1 Amsterdam Ohio

LOCATION OF PROPERTY 1 mi from St 43 on Twp 207

CONSTRUCTION DETAILS

Casing diameter 7" Od. Length of casing 93'
Type of screen NONE Length of screen
Type of pump Deep well sub
Capacity of pump 4 gpm
Depth of pump setting 135'
Date of completion 12/4/76

BAILING OR PUMPING TEST
(specify one by circling)

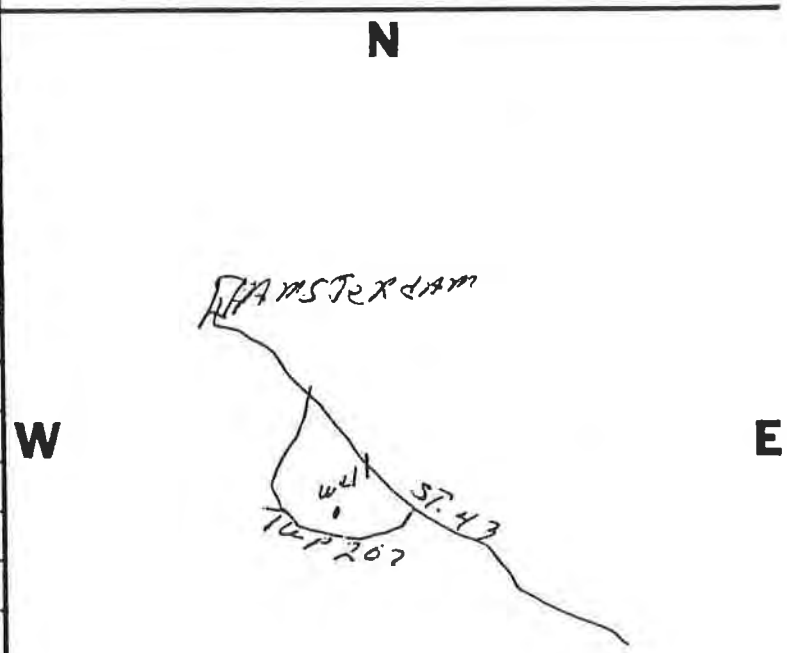
Test rate 20 gpm Duration of test 2 hrs
Drawdown 10 ft Date 12/4/76
Static level (depth to water) 100' ft
Quality (clear, cloudy, taste, odor) cloudy
Pump installed by Jerry Nichols

WELL LOG*

Formations: sandstone, shale, limestone, gravel, clay	From	To
CLAY & SHALE	0 ft	10' ft
LIMESTONE	10'	14'
CLAY	14'	40'
SHALE & CLAY	40	90'
SANDSTONE	90'	94'
SHALE	94	123'
SANDSTONE	123'	135'
SHALE & CLAY	135	145'
WATER AT 130'		

SKETCH SHOWING LOCATION

Locate in reference to numbered state highways, street intersections, county roads, etc.



DRILLING FIRM Jerry Nichols well Drilling DATE 12/4/76
ADDRESS 1661 Kensington Rd. NE - Carrollton, Ohio SIGNED Jerry Nichols

*If additional space is needed to complete well log, use next consecutive numbered form.

Plate A-40

98

WE[illegible] LOG AND DRILLING RE[illegible]ORT

ORIGINAL

NO CARBON PAPER NECESSARY – SELF-TRANSCRIBING

State of Ohio
DEPARTMENT OF NATURAL RESOURCES
Division of Water
Fountain Square
Columbus, Ohio 43224

522405

COUNTY JEFFERSON TOWNSHIP SPRINGFIELD SECTION OF TOWNSHIP _____

OWNER JERRY WARNER ADDRESS 8295 BEARD RD AMSTERDAM

LOCATION OF PROPERTY ON TWP RD 267 1/2 MI WEST OF SR 43

CONSTRUCTION DETAILS

Casing diameter 6" Length of casing 39 FT.

Type of screen _____ Length of screen _____

Type of pump _____

Capacity of pump _____

Depth of pump setting _____

Date of completion _____

BAILING OR PUMPING TEST
(specify one by circling)

Test rate 11 gpm Duration of test 2 hrs

Drawdown 90 ft Date 6-24-77

Static level (depth to water) 67 ft

Quality (clear, cloudy, taste, odor) CLEAR

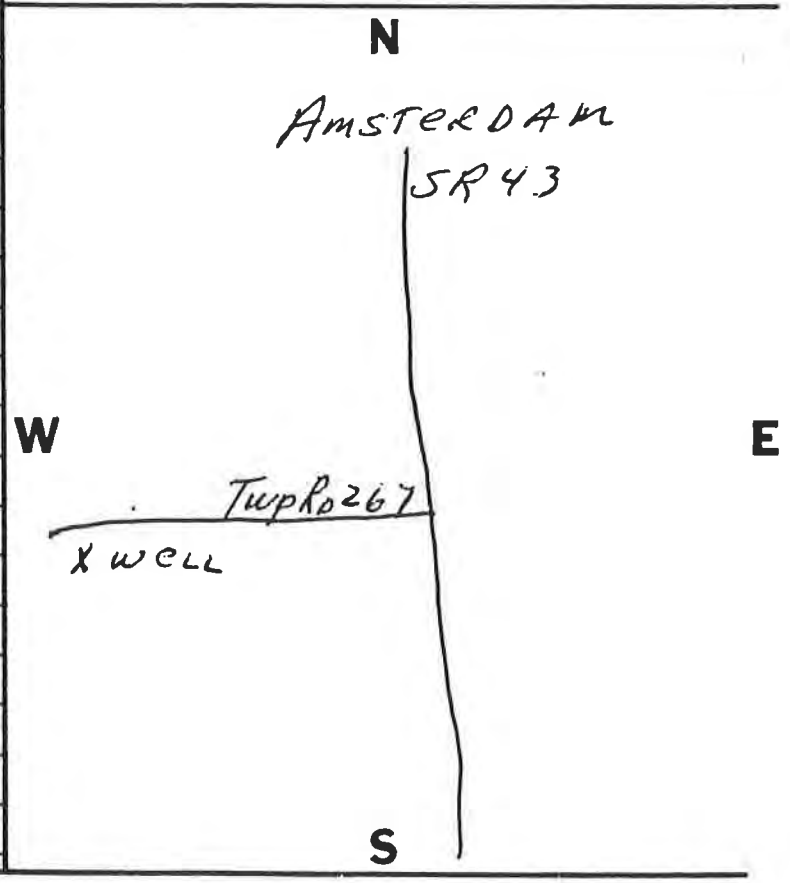
Pump installed by OWNER

WELL LOG*

Formations: sandstone, shale, limestone, gravel, clay	From	To
CLAY	0 ft	20 ft
SHALE + limestone	20	45
shale	45	50
limestone	50	55
hard rock	55	75
sandy shale	75	85
limestone	85	90
shale + lime shells	90	120
sandy shale	120	130
hard rock	130	150
limey	150	157
some H20 at 75 ft and increased at 152 Ft		

SKETCH SHOWING LOCATION

Locate in reference to numbered state highways, street intersections, county roads, etc.



DRILLING FIRM Speedy Well Drilling DATE 6-27-77

ADDRESS Carrollton, Ohio SIGNED Jack E. Speedy

*If additional space is needed to complete well log, use next consecutive numbered form.

Plate A-41

99

X= 286,600N

State of Ohio
DEPARTMENT OF NATURAL RESOURCES
Division of Water
Columbus, Ohio

No 95907

County Jefferson Township Springfield Section of Township or Lot Number 4-11-10-2C

Owner Frank Crawford Address Union Port R. D.

Location of property about 500 ft from old Davidson School

CONSTRUCTION DETAILS

Casing diameter 6 Length of casing 20'

Type of screen Length of screen

Type of pump Hand power

Capacity of pump

Depth of pump setting

PUMPING TEST

Pumping rate 2 G.P.M. Duration of test 1 hrs.

Drawdown 20 ft. Date 7-11-1952

Developed capacity 2 G. P. M.

Static level—depth to water 62 ft.

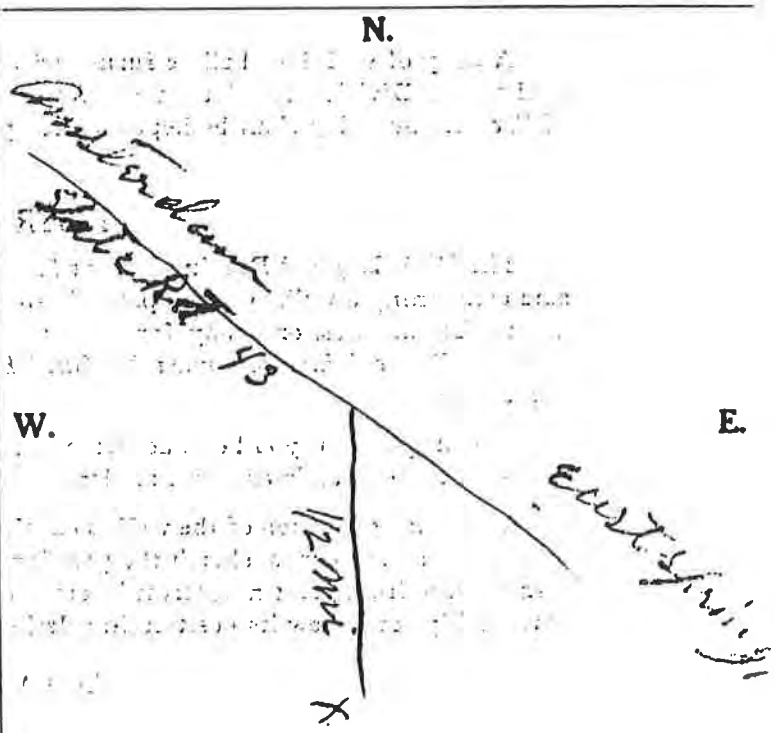
Pump installed by Not installed

WELL LOG

Formations Sandstone, shale, limestone, gravel and clay	From	To
Sand rock	0 Feet	35 Ft.
Slate rock	35	45
White stone	45	52
Slate & clay	52	63
Lime rock	63	67
Shale	67	76
Blue rock	76	82
Clay & Slate	82	92
Hard clay & slate	92	102
Gray Clay & slate	102	110
Lime	110	113
Slate	113	117
Hard rock	117	126
Red rock	126	127
Some water at 92 and 117	127	129

SKETCH SHOWING LOCATION

Locate in reference to numbered State Highways, St. Intersections, County roads, etc.



See reverse side for instructions

Drilling Firm Lawrence & McCorkle Date July 14 - 1952

Address Cadiz Ohio Signed Frank Lawrence

115

Plate A-44

APPENDIX C3-C

SOIL BORING LOGS, WELL CONSTRUCTION LOGS, TEST PITS LOGS

LOG OF BORING NO B-15 — Sheet 4 of 4 Sheets

Apex Solid Waste Disposal Facility
Jefferson and Harrison Counties, Ohio

LOCATION: See Plan Sheets 3D-1 and 3D-2 — ELEVATION: 1240 — DATE: May, 1992

SAMPLER(S): PXM Core-barrel

DRILLING METHOD: Air Rotary — COMPLETION DEPTH: 180.0'

DEPTH, FEET	SAMPLE NUMBER	SAMPLES	SAMPLING EFFORT	DESCRIPTION	TEST RESULTS
150			PXM	-Continued- Hard light-gray fine to medium sandstone, nearly horizontally bedded, well-cemented, 1" to 15" layers, partly calcareous. -From 157.1' to 159.7': Contains many nodules of dark-gray shale and limestone.	
	15		REC --- 99%		K=8.3 E-4 cm/sec (150'-160')
160				Very-soft to medium-hard light-gray calcareous shale, interbedded with medium-hard to hard argillaceous limestone, nearly horizontally bedded, many diagonal and vertical fractures, partly similar to hard soil.	
	16		REC --- 50%		K=3.6 E-4 cm/sec (160'-170')
170				Medium-hard gray shale, nearly horizontally bedded, 1" to 12" layers, occasional diagonal fractures.	
	17		REC --- 100%	From 179.8' to 180.0': Red-brown color.	
180					
190					
200					

NATURAL CONSISTENCY INDEX
NATURAL MOISTURE CONTENT
PLASTIC LIMIT — LIQUID LIMIT
10 20 30 40

WATER LEVEL: 80.0'
DATE: 06/04

SYMBOLS USED TO INDICATE TEST RESULTS

G - GRADATION
O - UNCONFINED COMPR.
T - TRIAXIAL COMPR.
C - CONSOLIDATION
} SEE SEPARATE CURVES

H - PENETROMETER (tsf)
W - UNIT DRY WEIGHT (pcf)
D - RELATIVE DENSITY (%)

BBC&E ENGINEERING, INC. JOB: 3850

Plate B-102

LOG OF BORING NO. B-101
APEX SLF
JEFFERSON COUNTY, OHIO

LOCATION: See Plan Sheets 3D-1 and 3D-2 ELEVATION: 1193.6 DATE: 8/30/94 9/1/94

DRILLING METHOD: 6-3/4" T icone Bit COMPLETION DEPTH: 120.0'

SAMPLER(S): PXM Core Barrel

DEPTH, FEET	SAMPLE NUMBER	SAMPLE EFFORT	DESCRIPTION	NATURAL CONSISTENCY INDEX / NATURAL MOISTURE CONTENT (PLASTIC LIMIT — LIQUID LIMIT; 10 20 30 40)	TEST RESULTS
0			TOPSOIL - 12 INCHES		
			Soft with seams of medium-hard brown with gray shale, nearly horizontally bedded, many horizoutal fractures.		
5					
10		REC			RQD
15	1	83%			31%
			Medium-hard brown and gray fine-grained sandstone, nearly horizontally bedded, many horizontally fractures, few 3-inch seams of shale.		
20					
			Medium-hard with seams of soft, dark-gray, gray, and brown, interbedded shale and fine-grained sandstone, nearly horizontally bedded, many horizontally fractures, 2-inch to 4-inch beds.		
25	2	89%			95%
30					
35	3	87%	-From 34.2' to 35.4': Highly fractured.		46%
40					
			-From 41.8' to 44.2': Seepage in fractures.		
45	4	100%			83%
			DESCRIPTION ON NEXT PAGE		
50					

WATER LEVEL: ▽ 72.4 ▽ ▽

WATER NOTE:

DATE: 09/01/94

SYMBOLS USED TO INDICATE TEST RESULTS

G - GRADATION, Q - UNCONFINED COMPR, T - TRIAXIAL COMPR, C - CONSOLIDATION } SEE SEPARATE CURVES

H - PENETROMETER (tsf)
W - UNIT DRY WEIGHT (pcf)
D - RELATIVE DENSITY (%)

JOB: 38502

-CONTINUED-

BBC&M

LOG OF BORING NO. B-101
APEX SLF
JEFFERSON COUNTY, OHIO

LOCATION: See Plan Sheets 3D-1 and 3D-2 ELEVATION: 1193.6 DATE: 8/30/94 9/1/94

DRILLING METHOD: 6-3/4" Tricone Bit COMPLETION DEPTH: 120.0'

SAMPLER(S): PXM Core Barrel

DEPTH, FEET	SAMPLE NUMBER	SAMPLE SAMPLE EFFORT	DESCRIPTION - CONTINUED	TEST RESULTS
50			Medium-hard gray fine to medium-grained sandstone, nearly horizontally bedded, many horizontal fractures, 7-inch to 8-inch layers, occasional diagonal fractures, many partings less than 1/16 inch shale, minor cross bedding, micaceous.	
55	5	100%		60%
60			- From 63.0' to 70.2': Few horizontal fractures.	
65	6	96%		81%
70			Soft to medium-hard dark-gray carbonaceous shale, nearly horizontally bedded, highly fractured.	
75	7	93%	Medium-hard gray fine to medium-grained sandstone, nearly horizontally bedded, many horizontal fractures, many seams less than 2 inches of shale to 77.0'. - Encountered water in fractures below 73.0'.	68%
80				
85	8	100%	- From 85.2' to 105.9': Few horizontal fractures.	74%
90			- From 91.3' to 92.5': Medium-hard gray silty shale.	
95	9	91%		91%
100				

NATURAL CONSISTENCY INDEX
NATURAL MOISTURE CONTENT
PLASTIC LIMIT LIQUID LIMIT
10 20 30 40

WATER LEVEL: ▽ 72.4 ▼ ▼
WATER NOTE:
DATE: 09/01/94

SYMBOLS USED TO INDICATE TEST RESULTS

G - GRADATION
Q - UNCONFINED COMPR
T - TRIAXIAL COMPR
C - CONSOLIDATION
SEE SEPARATE CURVES
H - PENETROMETER (tsf)
W - UNIT DRY WEIGHT (pcf)
D - RELATIVE DENSITY (%)

JOB: 38502

-CONTINUED-

Plate B-104

BBC&M

LOG OF BORING NO. B-101
APEX SLF
JEFFERSON COUNTY, OHIO

LOCATION: See Plan Sheets 3D-1 and 3D-2 ELEVATION: 1193.6 DATE: 8/30/94 9/1/94

DRILLING METHOD: 6-3/4" Tricone Bit COMPLETION DEPTH: 120.0'

SAMPLER(S): PXM Core Barrel

DEPTH, FEET	SAMPLE NUMBER	SAMPLE	SAMPLE EFFORT	DESCRIPTION - CONTINUED	NATURAL CONSISTENCY INDEX / NATURAL MOISTURE CONTENT (PLASTIC LIMIT, LIQUID LIMIT; 10, 20, 30, 40)	TEST RESULTS
100				Medium-hard gray fine to medium-grained sandstone, nearly horizontally bedded, many horizontal fractures.		
105	10		100%			89%
110						
				Medium-hard dark gray siltstone, nearly horizontally bedded, many horizontal fractures, minor cross beds.		
115	11		100%			83%
120						
125						
130						
135						
140						
145						
150						

WATER LEVEL: ▽ 72.4 ▽ ▽
WATER NOTE:
DATE: 09/01/94

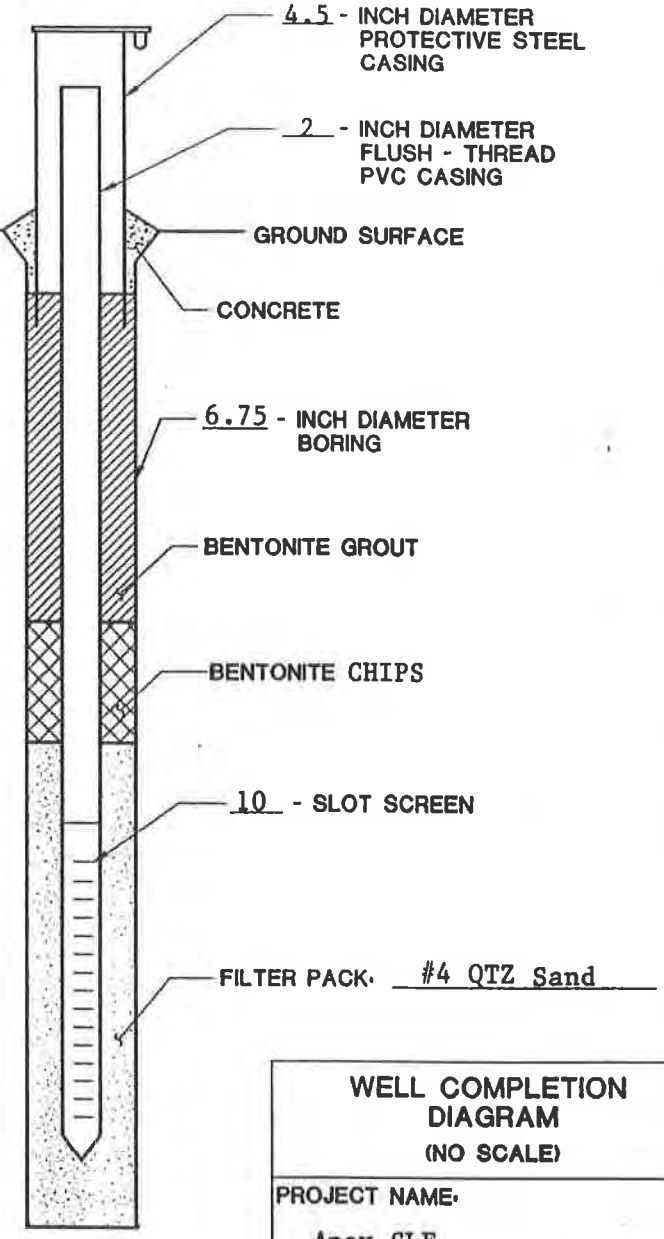
SYMBOLS USED TO INDICATE TEST RESULTS

G - GRADATION
Q - UNCONFINED COMPR
T - TRIAXIAL COMPR
C - CONSOLIDATION
} SEE SEPARATE CURVES

H - PENETROMETER (tsf)
W - UNIT DRY WEIGHT (pcf)
D - RELATIVE DENSITY (%)

JOB: 38502

ELEV. #	DEPTH BELOW GROUND SURFACE (FEET)	
1194.86	1.3	TOP OF COVER
1194.66	1.1	TOP OF PVC
1193.6	0.0	GROUND SURFACE
1189.4	4.2	TOP OF GROUT
1130.9	62.7	TOP OF BENTONITE
1128.3	65.3	TOP OF FILTER PACK
1146.0	47.6	TOP OF AQUIFER
1119.3	74.3	TOP OF SCREEN OPENINGS
1109.9	83.7	BOTTOM OF SCREEN OPENINGS
1109.3	84.3	BOTTOM OF WELL
1081.5	112.1	BOTTOM OF AQUIFER
1073.6	120.0	BORING DEPTH



WELL COMPLETION DIAGRAM
(NO SCALE)

PROJECT NAME: Apex SLF

BORING: B-101

STATIC WATER LEVEL #	1131.87	1130.69		
DATE:	9/12/94	9/14/94		

DATE WELL INSTALLED: 9/1/94

BBC & M PROJECT NO: 3850.2

WELL DEVELOPMENT: 9/12/94- Bailed 4 gallons (DRY) in 17 minutes with 21.9 feet of drawdown.

9/14/94- Bailed 3.75 gallons (DRY) in 14 minutes with 20.68 feet of drawdown. Water slightly silty at completion.

FEET ABOVE MSL

BBC&M ENGINEERING, INC.

Plate B-146

BBC&M

LOG OF BORING NO. B-101S
APEX SLF
JEFFERSON COUNTY, OHIO

LOCATION: See Plan Sheets 3D-1 and 3D-2 ELEVATION: 1193.7 DATE: 9/1/94

DRILLING METHOD: 6-3/4" Tricone Bit COMPLETION DEPTH: 49.0'

SAMPLER(S): N/A

DEPTH, FEET	SAMPLE NUMBER	SAMPLE	SAMPLE EFFORT	DESCRIPTION	NATURAL CONSISTENCY INDEX — NATURAL MOISTURE CONTENT — PLASTIC LIMIT — LIQUID LIMIT (10 20 30 40)	TEST RESULTS
0				See Log of B-101		
5						
10						
15						
20						
25						
30						
35						
40						
45						
50						

WATER LEVEL: ▽ "Dry" ▼ ▼

WATER NOTE:

DATE: 09/01/94

SYMBOLS USED TO INDICATE TEST RESULTS

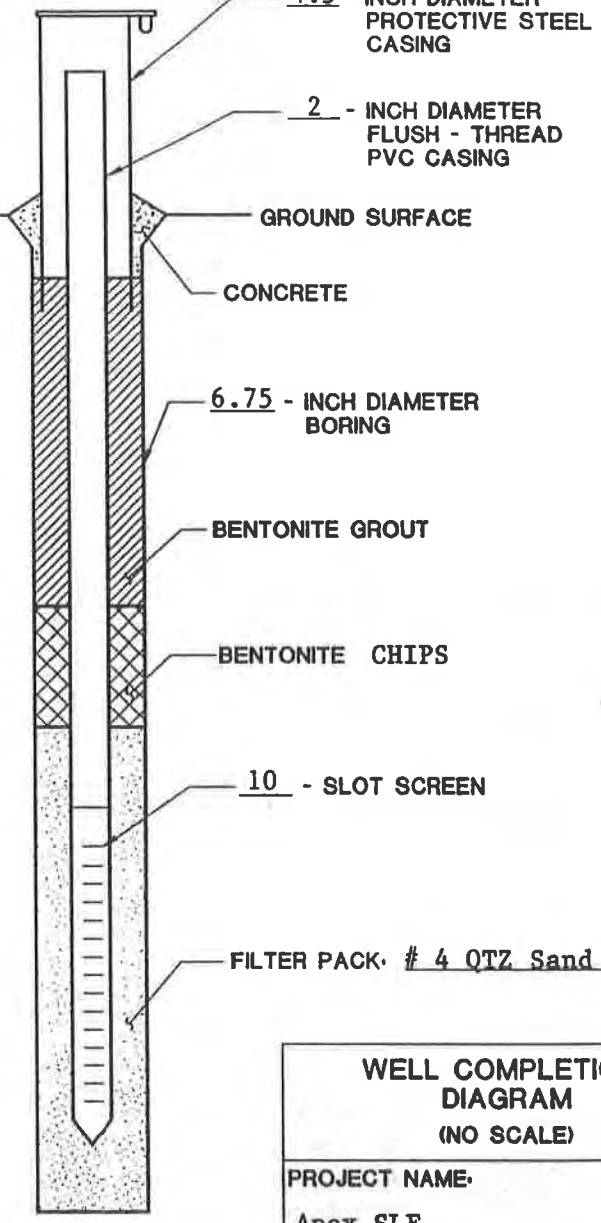
G - GRADATION
Q - UNCONFINED COMPR
T - TRIAXIAL COMPR
C - CONSOLIDATION
} SEE SEPARATE CURVES

H - PENETROMETER (tsf)
W - UNIT DRY WEIGHT (pcf)
D - RELATIVE DENSITY (%)

JOB: 38502

Plate B-106

ELEV. #	DEPTH BELOW GROUND SURFACE (FEET)	
1196.70	3.0	TOP OF COVER
1196.44	2.7	TOP OF PVC
1193.7	0.0	GROUND SURFACE
1193.0	0.7	TOP OF GROUT
1154.2	39.5	TOP OF BENTONITE
1152.4	41.3	TOP OF FILTER PACK
1151.1	42.6	TOP OF SCREEN OPENINGS
1146.4	47.3	BOTTOM OF SCREEN OPENINGS
1146.1	47.6	BOTTOM OF WELL
1144.7	49.0	BORING DEPTH



WELL COMPLETION DIAGRAM
(NO SCALE)

PROJECT NAME: Apex SLF

BORING: B-101 S

DATE WELL INSTALLED: 9/1/94

BBC & M PROJECT NO: 3850.2

STATIC WATER LEVEL #	DRY	DRY		
DATE:	9/12/94	9/14/94		

WELL DEVELOPMENT:

FEET ABOVE MSL

BBC&M ENGINEERING, INC.

Plate B-147

BBC&M

LOG OF BORING NO. B-102
APEX SLF
JEFFERSON COUNTY, OHIO

LOCATION: See Plan Sheets 3D-1 and 3D-2 ELEVATION: 1204.8 DATE: 8/27/94 8/30/94

DRILLING METHOD: 6-3/4" Tricone Bit COMPLETION DEPTH: 118.5'

SAMPLER(S): PXM Core Barrel

DEPTH, FEET	SAMPLE NUMBER	SAMPLE	SAMPLE EFFORT	DESCRIPTION	NATURAL CONSISTENCY INDEX / NATURAL MOISTURE CONTENT (PLASTIC LIMIT, LIQUID LIMIT; 10 20 30 40)	TEST RESULTS
0				RESIDUAL SOIL		
5				Medium-hard brown with streaks of gray fine to fine to medium-grained sandstone, nearly horizontally bedded, few horizontal fractures, few diagonal fractures, minor cross bedding.		
10			REC			RQD
15	1		98%			85%
20				Medium-hard gray with layers of brown fine-grained shaley sandstone, nearly horizontally bedded, few horizontal fractures.		
25	2		100%	- At 25.4': Small void.		100%
30				- At 30.9': 1-inch void. - From 32.0' to 36.4': Few limestone inclusions.		
35	3		97%	- From 37.0' to 37.4': Many small voids.		85%
40				- From 41.2' to 50.3': Many horizontal fractures, 3-inch to 5-inch layers.		
45	4		100%	- Encountered seepage in fractures below 45.0'.		59%
50						

WATER LEVEL: ▽ 77.3 ▽ ▽
WATER NOTE:
DATE: 08/31/94

SYMBOLS USED TO INDICATE TEST RESULTS

G - GRADATION
Q - UNCONFINED COMPR
T - TRIAXIAL COMPR
C - CONSOLIDATION
} SEE SEPARATE CURVES

H - PENETROMETER (tsf)
W - UNIT DRY WEIGHT (pcf)
D - RELATIVE DENSITY (%)

JOB: 38502

-CONTINUED-

BBC&M

LOG OF BORING NO. B-102
APEX SLF
JEFFERSON COUNTY, OHIO

LOCATION: See Plan Sheets 3D-1 and 3D-2 ELEVATION: 1204.8 DATE: 8/27/94 8/30/94

DRILLING METHOD: 6-3/4" Tricone Bit COMPLETION DEPTH: 118.5'

SAMPLER(S): PXM Core Barrel

DEPTH, FEET	SAMPLE NUMBER	SAMPLE	SAMPLE EFFORT	DESCRIPTION - CONTINUED	TEST RESULTS
50				Medium-hard gray with layers of brown fine-grained shaley sandstone, nearly horizontally bedded, few horizontal fractures.	
55	5		100%	- From 56.2' to 60.8': Many horizontal fractures, 7-inch to 8-inch layers.	89%
60					
65	6		100%	- From 66.2' to 74.3': Many horizontal fractures, 7-inch to 8-inch layers.	94%
70					
75	7		93%	- From 76.8' to 79.2': Numerous diagonal fractures.	50%
80				Medium-hard gray fine to medium-grained massive sandstone, nearly horizontally bedded, micaceous, minor x-beds.	
85	8		100%	- From 88.3' to 91.0': Few horizontal fractures. - Encountered water from 89.1' to 91.0'. - From 89.7' to 91.0': Vertical fracture.	97%
90				Medium-hard gray and brown conglomerate interbedded with siltstone, nearly horizontally bedded.	
95	9		92%	Medium-hard gray fine to coarse-grained sandstone, nearly horizontally bedded, few horizontal fractures.	78%
100					

NATURAL CONSISTENCY INDEX
NATURAL MOISTURE CONTENT
PLASTIC LIMIT LIQUID LIMIT
10 20 30 40

WATER LEVEL: ▽ 77.3 ▼ ▼
WATER NOTE:
DATE: 08/31/94

SYMBOLS USED TO INDICATE TEST RESULTS

G - GRADATION
Q - UNCONFINED COMPR
T - TRIAXIAL COMPR
C - CONSOLIDATION
} SEE SEPARATE CURVES

H - PENETROMETER (tsf)
W - UNIT DRY WEIGHT (pcf)
D - RELATIVE DENSITY (%)

JOB: 38502

-CONTINUED-

Plate B-108

BBC&M

LOG OF BORING NO. B-102
APEX SLF
JEFFERSON COUNTY, OHIO

LOCATION: See Plan Sheets 3D-1 and 3D-2 ELEVATION: 1204.8 DATE: 8/27/94 8/30/94

DRILLING METHOD: 6-3/4" Tricone Bit COMPLETION DEPTH: 118.5'

SAMPLER(S): PXM Core Barrel

DEPTH, FEET	SAMPLE NUMBER	SAMPLE	SAMPLE EFFORT	DESCRIPTION - CONTINUED	NATURAL CONSISTENCY INDEX / NATURAL MOISTURE CONTENT (PLASTIC LIMIT — LIQUID LIMIT; 10 20 30 40)	TEST RESULTS
100				Medium-hard gray fine to coarse-grained sandstone, nearly horizontally bedded, few horizontal fractures.		
105	10		97%	- Encountered water in fractures from 105.1' to 105.4'.		92%
110						
	11		85%	~1090.8 Medium-hard gray silty shale, nearly horizontally bedded, many horizontal fractures. - At 114.1': 1" coal.		82%
115						
120						
125						
130						
135						
140						
145						
150						

WATER LEVEL: ▽ 77.3 ▽ ▽

WATER NOTE:

DATE: 08/31/94

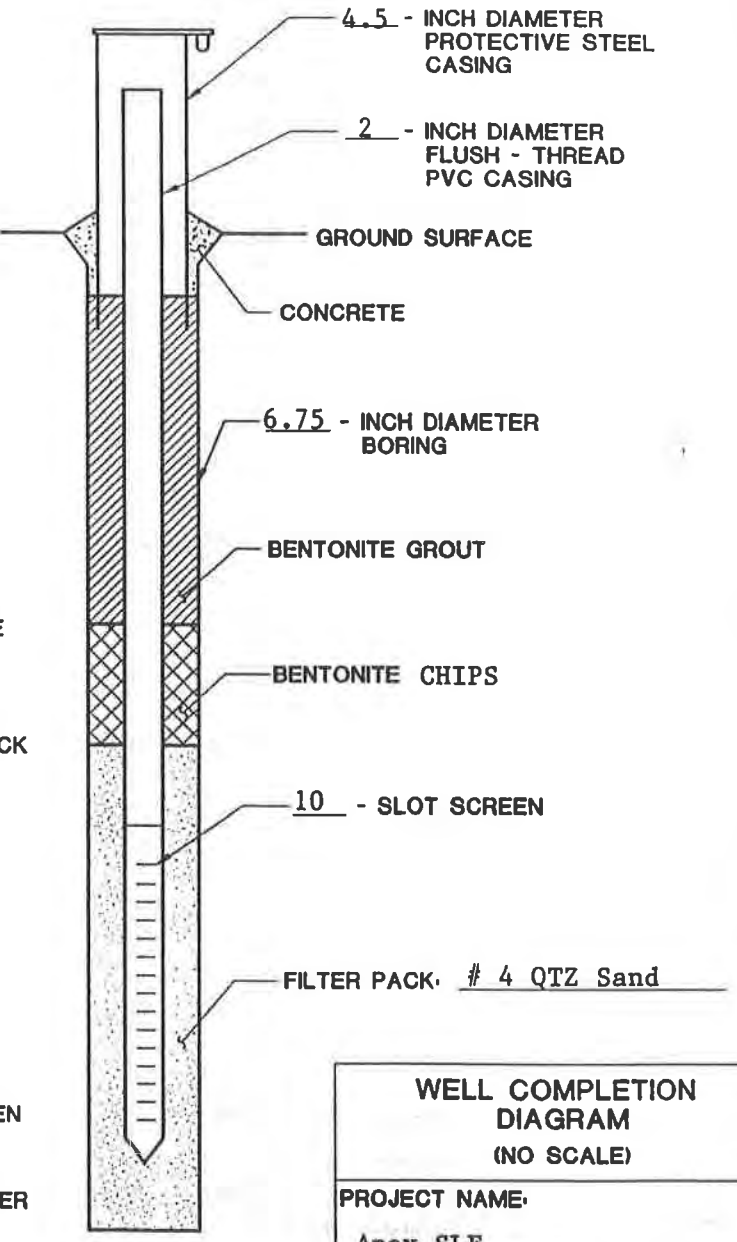
SYMBOLS USED TO INDICATE TEST RESULTS

G - GRADATION
Q - UNCONFINED COMPR
T - TRIAXIAL COMPR
C - CONSOLIDATION
} SEE SEPARATE CURVES

H - PENETROMETER (tsf)
W - UNIT DRY WEIGHT (pcf)
D - RELATIVE DENSITY (%)

JOB: 38502

ELEV. #	DEPTH BELOW GROUND SURFACE (FEET)	
1207.00	2.2	TOP OF COVER
1206.79	2.0	TOP OF PVC
1204.8	0.0	GROUND SURFACE
1196.2	8.6	TOP OF GROUT
1118.4	86.4	TOP OF BENTONITE
1115.5	89.3	TOP OF FILTER PACK
1201.8	3.0	TOP OF AQUIFER
1111.5	93.3	TOP OF SCREEN OPENINGS
1097.1	107.7	BOTTOM OF SCREEN OPENINGS
1096.5	108.3	BOTTOM OF WELL
1090.7	114.1	BOTTOM OF AQUIFER
1086.3	118.5	BORING DEPTH



WELL COMPLETION DIAGRAM
(NO SCALE)

PROJECT NAME: Apex SLF

BORING: B-102

STATIC WATER LEVEL #	1126.25	1125.79			DATE WELL INSTALLED: 8/31/94
DATE:	9/12/94	9/14/94			BBC & M PROJECT NO: 3850.2

WELL DEVELOPMENT: 9/12- Bailed 15 gallons in 80 minutes with 7.3 feet of of drawdown.

9/14- Bailed 5 gallons in 22 minutes with 4.52 feet of drawdown. Water slightly silty at conpletion.

FEET ABOVE MSL

BBC&M ENGINEERING, INC.

Plate B-148

BBC&M

LOG OF BORING NO. B-103
APEX SLF
JEFFERSON COUNTY, OHIO

LOCATION: See Plan Sheets 3D-1 and 3D-2 ELEVATION: 1206.0 DATE: 8/25/94 8/27/94

DRILLING METHOD: 6-3/4" Tricone Bit COMPLETION DEPTH: 113.0'

SAMPLER(S): PXM Core Barrel

DEPTH, FEET	SAMPLE NUMBER	SAMPLE	SAMPLE EFFORT	DESCRIPTION	TEST RESULTS
0				RESIDUAL SOIL	
10			REC	Medium-hard brown fine to fine to medium-grained sandstone, nearly horizontally bedded, many horizontal fractures, occasional diagonal fracture, few cross bedded zones.	RQD
15	1		90%		55%
20					
25	2		92%	Medium-hard gray with brown fine-grained sandstone, nearly horizontally bedded, few horizontal fractures, minor cross bedding.	90%
30					
35	3		94%	- Encountered slight seepage in fractures below 37.0'.	87%
40					
45				- From 44.5' to 52.2': Many horizontal fractures.	
50					82%

NATURAL CONSISTENCY INDEX
NATURAL MOISTURE CONTENT
PLASTIC LIMIT LIQUID LIMIT
10 20 30 40

WATER LEVEL: ▽ 83.8 ▼ ▼
WATER NOTE:
DATE: 08/29/94

SYMBOLS USED TO INDICATE TEST RESULTS

G - GRADATION
Q - UNCONFINED COMPR
T - TRIAXIAL COMPR
C - CONSOLIDATION
} SEE SEPARATE CURVES

H - PENETROMETER (tsf)
W - UNIT DRY WEIGHT (pcf)
D - RELATIVE DENSITY (%)

JOB: 38502

-CONTINUED-

Plate B-110

BBC&M

LOG OF BORING NO. B-103
APEX SLF
JEFFERSON COUNTY, OHIO

LOCATION: See Plan Sheets 3D-1 and 3D-2 ELEVATION: 1206.0 DATE: 8/25/94 8/27/94

DRILLING METHOD: 6-3/4" Tricone Bit COMPLETION DEPTH: 113.0'

SAMPLER(S): PXM Core Barrel

DEPTH, FEET	SAMPLE NUMBER	SAMPLE SAMPLE EFFORT	DESCRIPTION - CONTINUED	NATURAL CONSISTENCY INDEX / NATURAL MOISTURE CONTENT (PLASTIC LIMIT, LIQUID LIMIT; 10 20 30 40)	TEST RESULTS
50	4	99%	Medium-hard gray with brown fine-grained sandstone, nearly horizontally bedded, few horizontal fractures, minor cross beds.		
55			Medium-hard gray limestone, nearly horizontally bedded. -From 54.1' to 54.4': Vuggy.		
60	5	97%	Medium-hard gray fine to fine to medium-grained sandstone, nearly horizontally bedded, many horizontal fractures, micaceous, trace fossiles. - Encountered seepage in fractures below 56.5'. - From 58.8' to 59.3': Highly fractured, brown.		33%
65					
70	6	99%			74%
75			- From 74.5' to 75.7': Highly fractured, brown.		
80	7	100%			77%
85			- From 85.2' to 86.0': Few fractures.		
90	8	96%			81%
95					
100	9	88%			65%

WATER LEVEL: ▽ 83.8 ▼ ▼

WATER NOTE:

DATE: 08/29/94

SYMBOLS USED TO INDICATE TEST RESULTS

G - GRADATION
Q - UNCONFINED COMPR
T - TRIAXIAL COMPR
C - CONSOLIDATION
} SEE SEPARATE CURVES

H - PENETROMETER (tsf)
W - UNIT DRY WEIGHT (pcf)
D - RELATIVE DENSITY (%)

JOB: 38502

-CONTINUED-

BBC&M

LOG OF BORING NO. B-103
APEX SLF
JEFFERSON COUNTY, OHIO

LOCATION: See Plan Sheets 3D-1 and 3D-2 ELEVATION: 1206.0 DATE: 8/25/94 8/27/94

DRILLING METHOD: 6-3/4" Tricone Bit COMPLETION DEPTH: 113.0'

SAMPLER(S): PXM Core Barrel

DEPTH, FEET	SAMPLE NUMBER	SAMPLE	SAMPLE EFFORT	DESCRIPTION - CONTINUED	NATURAL CONSISTENCY INDEX / NATURAL MOISTURE CONTENT (PLASTIC LIMIT — LIQUID LIMIT; 10 20 30 40)	TEST RESULTS
100				Medium-hard gray fine to fine to medium-grained sandstone, nearly horizontally bedded, many horizontal fractures, micaceous, trace fossiles.		
105				Medium-hard black coal.		
	10		100%	Medium-hard gray shale, nearly horizontally bedded, many horizontal fractures.		71%
110				- Below 110.4': Many limestone inclusions.		
115						
120						
125						
130						
135						
140						
145						
150						

WATER LEVEL: ▽ 83.8 ▼ ▼

WATER NOTE:

DATE: 08/29/94

SYMBOLS USED TO INDICATE TEST RESULTS

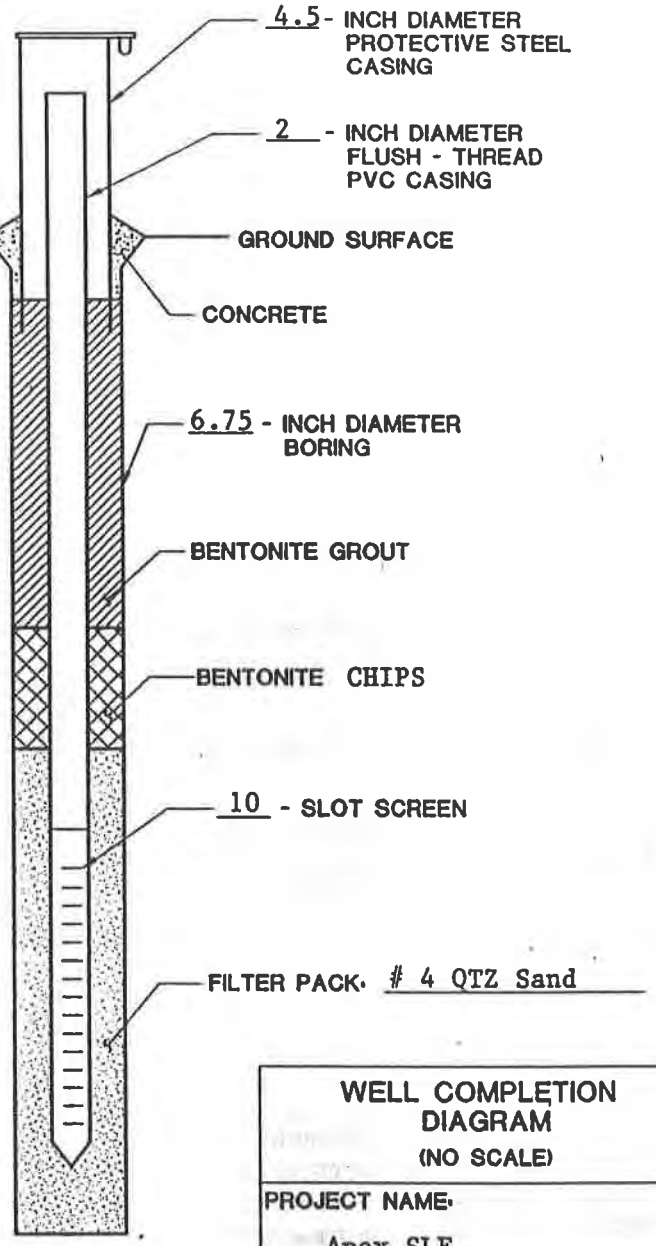
G - GRADATION
Q - UNCONFINED COMPR
T - TRIAXIAL COMPR
C - CONSOLIDATION
} SEE SEPARATE CURVES

H - PENETROMETER (tsf)
W - UNIT DRY WEIGHT (pcf)
D - RELATIVE DENSITY (%)

JOB: 38502

Plate B-112

ELEV. #	DEPTH BELOW GROUND SURFACE (FEET)	
1208.19	2.2	TOP OF COVER
1208.07	2.1	TOP OF PVC
1206.0	0.0	GROUND SURFACE
1202.9	3.1	TOP OF GROUT
1123.6	82.4	TOP OF BENTONITE
1120.0	86.0	TOP OF FILTER PACK
1198.0	8.0	TOP OF AQUIFER
1117.8	88.2	TOP OF SCREEN OPENINGS
1108.3	97.7	BOTTOM OF SCREEN OPENINGS
1107.8	98.2	BOTTOM OF WELL
1100.5	105.5	BOTTOM OF AQUIFER
1093.0	113.0	BORING DEPTH



WELL COMPLETION DIAGRAM
(NO SCALE)

PROJECT NAME: Apex SLF

BORING: B-103

DATE WELL INSTALLED: 8/30/94 & 8/31/94

BBC & M PROJECT NO: 3850.2

STATIC WATER LEVEL #	1124.73	1117.79	1114.71
DATE:	8/31/94	9/12/94	9/14/94

WELL DEVELOPMENT: 9/12- Bailed 4 gallons (DRY) in 20 minutes with 7.4 feet of drawdown.

9/14- Bailed 1.25 gallons (DRY) in 7 minutes with 5.94 feet of drawdown. Water very silty at completion.

FEET ABOVE MSL

BBC&M ENGINEERING, INC.

Plate B-149

BBC&M

LOG OF BORING NO. B-103S
APEX SLF
JEFFERSON COUNTY, OHIO

LOCATION: See Plan Sheets 3D-1 and 3D-2 ELEVATION: 1206.1 DATE: 9/22/94

DRILLING METHOD: 6-3/4" Tricone Bit COMPLETION DEPTH: 33.3'

SAMPLER(S): N/A

DEPTH, FEET	SAMPLE NUMBER	SAMPLE	SAMPLE EFFORT	DESCRIPTION	NATURAL CONSISTENCY INDEX — NATURAL MOISTURE CONTENT — PLASTIC LIMIT — LIQUID LIMIT (10 20 30 40)	TEST RESULTS
0				See Log of B-103		
5						
10						
15						
20						
25						
30						
35						
40						
45						
50						

WATER LEVEL: ▽ "Dry" ▼ ▼

WATER NOTE:

DATE: 09/22/94

SYMBOLS USED TO INDICATE TEST RESULTS

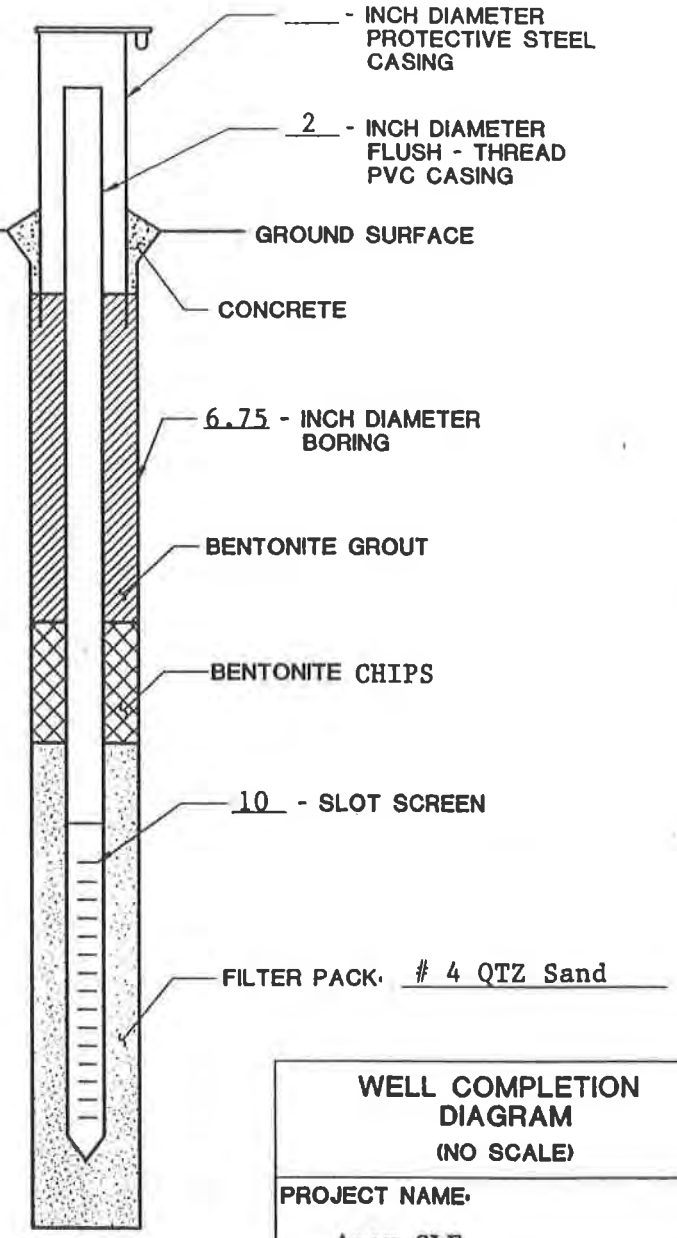
G - GRADATION
Q - UNCONFINED COMPR
T - TRIAXIAL COMPR
C - CONSOLIDATION
} SEE SEPARATE CURVES

H - PENETROMETER (tsf)
W - UNIT DRY WEIGHT (pcf)
D - RELATIVE DENSITY (%)

JOB: 38502

Plate B-113

ELEV. #	DEPTH BELOW GROUND SURFACE (FEET)	
		TOP OF COVER
1208.17	2.1	TOP OF PVC
1206.1	0.0	GROUND SURFACE
1206.1	0.0	TOP OF GROUT
1183.3	22.8	TOP OF BENTONITE
1180.5	25.6	TOP OF FILTER PACK
1177.9	28.2	TOP OF SCREEN OPENINGS
1173.4	32.7	BOTTOM OF SCREEN OPENINGS
1172.8	33.3	BOTTOM OF WELL
1172.8	33.3	BORING DEPTH



WELL COMPLETION DIAGRAM
(NO SCALE)

PROJECT NAME: Apex SLF

BORING: B-103 S

DATE WELL INSTALLED: 9/28/94

BBC & M PROJECT NO: 3850.2

STATIC WATER LEVEL #	DRY	DRY		
DATE:	9/28/94	10/5/94		

WELL DEVELOPMENT:

FEET ABOVE MSL

BBC&M ENGINEERING, INC.

Plate B-150

BBC&M

LOG OF BORING NO. B-104
APEX SLF
JEFFERSON COUNTY, OHIO

LOCATION: See Plan Sheets 3D-1 and 3D-2 ELEVATION: 1221.1 DATE: 8/22/94 8/24/94

DRILLING METHOD: 6-3/4" Tricone Bit COMPLETION DEPTH: 133.0'

SAMPLER(S): PXM Core Barrel

DEPTH, FEET	SAMPLE NUMBER	SAMPLE	SAMPLE EFFORT	DESCRIPTION	NATURAL CONSISTENCY INDEX / NATURAL MOISTURE CONTENT (PLASTIC LIMIT, LIQUID LIMIT; 10 20 30 40)	TEST RESULTS
0				RESIDUAL SOIL		
5				Interbedded medium-hard brown fine-grained sandstone and soft brown shale, nearly horizontally bedded, many horizontal and diagonal fractures, 3-inch to 12-inch layers.		
10			REC			RQD
15	1		95%			33%
20				Medium-hard brown with orange-brown staining siltstone, nearly horizontally bedded, many horizontal fractures.		
25	2		99%			50%
30				Soft to medium-hard gray with seams of dark-gray silty shale, nearly horizontally bedded, many horizontal and diagonal fractures, occasional seam less than 5 inches of siltstone.		
35	3		83%	Medium-hard gray siltstone to fine-grained sandstone, nearly horizontally bedded, many horizontal fractures, few sub-diagonal fractures, occasional seam less than 3 inches of shale.		38%
40				- Encountered seepage from 41.0' to 42.3'.		
45	4		96%	Medium-hard gray fine-grained sandstone, nearly horizontally bedded, few horizontal fractures.		43%
50				- From 47.0' to 50.7': Many fractures.		

WATER LEVEL: ▽ 81.3 ▽ ▽

WATER NOTE:

DATE: 08/26/94

SYMBOLS USED TO INDICATE TEST RESULTS

G - GRADATION
Q - UNCONFINED COMPR
T - TRIAXIAL COMPR
C - CONSOLIDATION
} SEE SEPARATE CURVES

H - PENETROMETER (tsf)
W - UNIT DRY WEIGHT (pcf)
D - RELATIVE DENSITY (%)

JOB:. 38502

Plate B-114

-CONTINUED-

LOG OF BORING NO. B-104
APEX SLF
JEFFERSON COUNTY, OHIO

LOCATION: See Plan Sheets 3D-1 and 3D-2 ELEVATION: 1221.1 DATE: 8/22/94 8/24/94

DRILLING METHOD: 6-3/4" Tricone Bit COMPLETION DEPTH: 133.0'

SAMPLER(S): PXM Core Barrel

DEPTH, FEET	SAMPLE NUMBER	SAMPLE EFFORT	DESCRIPTION - CONTINUED	TEST RESULTS
50			DESCRIPTION ON PREVIOUS PAGE	
			Medium-hard dark-gray shale, nearly horizontally bedded.	
	5	100%	- Encountered seepage from 51.4' to 52.5'.	66%
55			Medium-hard gray fine to medium-grained sandstone, nearly horizontally bedded, few horizontal fractures, micaceous.	
60				
	6	100%		85%
65			- From 64.0' to 67.5': Many horizontal fractures.	
70			Medium-hard gray fine-grained massive sandstone, nearly horizontally bedded.	
	7	100%		97%
75				
80			Medium-hard gray fine to medium-grained sandstone, nearly horizontally bedded, few horizontal fractures, micaceous, minor cross bedding.	
			- Below 77.7': Brown staining at fractures.	
	8	76%		68%
85				
			- From 87.5' to 89.6': Highly fractured.	
90			- Encountered water from 87.9' to 89.6'.	
	9	100%		97%
95				
			- Encountered seepage in sandstone from 98.0' to 124.2'.	
100				

NATURAL CONSISTENCY INDEX
NATURAL MOISTURE CONTENT
PLASTIC LIMIT LIQUID LIMIT
10 20 30 40

WATER LEVEL: ▽ 81.3 ▼ ▼
WATER NOTE:
DATE: 08/26/94

SYMBOLS USED TO INDICATE TEST RESULTS

G - GRADATION
Q - UNCONFINED COMPR
T - TRIAXIAL COMPR
C - CONSOLIDATION
} SEE SEPARATE CURVES

H - PENETROMETER (tsf)
W - UNIT DRY WEIGHT (pcf)
D - RELATIVE DENSITY (%)

JOB: 38502

-CONTINUED-

BBC&M

LOG OF BORING NO. B-104
APEX SLF
JEFFERSON COUNTY, OHIO

LOCATION: See Plan Sheets 3D-1 and 3D-2 ELEVATION: 1221.1 DATE: 8/22/94 8/24/94

DRILLING METHOD: 6-3/4" Tricone Bit COMPLETION DEPTH: 133.0'

SAMPLER(S): PXM Core Barrel

DEPTH, FEET	SAMPLE NUMBER	SAMPLE SAMPLE EFFORT	DESCRIPTION - CONTINUED	NATURAL CONSISTENCY INDEX / NATURAL MOISTURE CONTENT (PLASTIC LIMIT — LIQUID LIMIT; 10 20 30 40)	TEST RESULTS
100			Medium-hard gray fine to medium-grained sandstone, nearly horizontally bedded, few horizontal fractures, micaceous, minor cross bedding.		
			- Encountered water from 100.3' to 103.7'.		
105	10	100%	- From 103.0' to 103.7': Many diagonal fractures.		94%
			- Below 104.0': Few limestone inclusions.		
110					
115	11	100%			100%
120			- From 119.6' to 120.8': Numerous limestone inclusions.		
			- From 122.0' to 124.2': Many horizontal fractures.		
125			Medium-hard black coal.		
			Very-soft to soft gray shale.		
	12	100%	Medium-hard gray silty shale, nearly horizontally bedded, many horizontal fractures.		54%
130					
135					
140					
145					
150					

WATER LEVEL: ▽ 81.3 ▽ ▽

WATER NOTE:

DATE: 08/26/94

SYMBOLS USED TO INDICATE TEST RESULTS

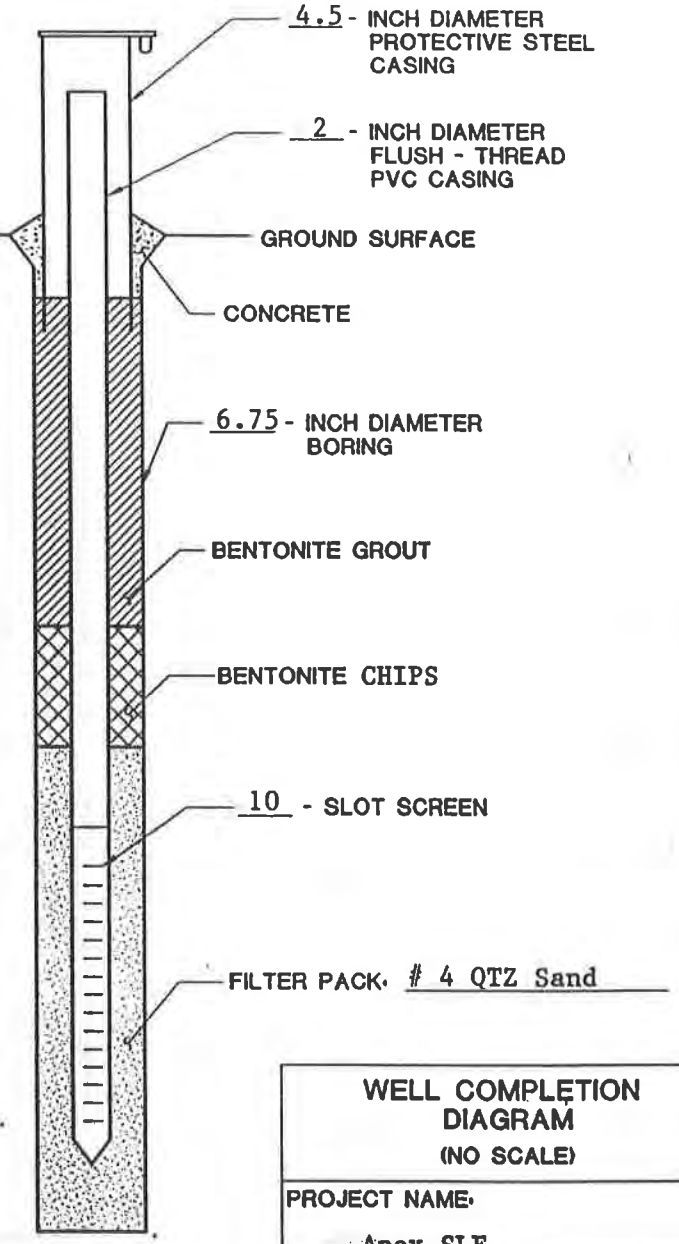
G - GRADATION
Q - UNCONFINED COMPR
T - TRIAXIAL COMPR
C - CONSOLIDATION
} SEE SEPARATE CURVES

H - PENETROMETER (tsf)
W - UNIT DRY WEIGHT (pcf)
D - RELATIVE DENSITY (%)

JOB: 38502

Plate B-116

ELEV. #	DEPTH BELOW GROUND SURFACE (FEET)	
1222.11	1.1	TOP OF COVER
1221.96	0.9	TOP OF PVC
1221.1	0.0	GROUND SURFACE
1214.9	6.2	TOP OF GROUT
1137.9	83.2	TOP OF BENTONITE
1135.0	86.1	TOP OF FILTER PACK
1168.7	52.4	TOP OF AQUIFER
1131.7	89.4	TOP OF SCREEN OPENINGS
1117.4	103.7	BOTTOM OF SCREEN OPENINGS
1116.7	104.4	BOTTOM OF WELL
1097.0	124.1	BOTTOM OF AQUIFER
1088.1	133.0	BORING DEPTH



WELL COMPLETION DIAGRAM
(NO SCALE)

PROJECT NAME: Apex SLF

BORING: B-104

STATIC WATER LEVEL #	1140.37	1140.29	1140.22	
DATE:	8/30/94	9/12/94	9/14/94	

DATE WELL INSTALLED: 8/26/94 & 8/30/94

BBC & M PROJECT NO: 3850.2

WELL DEVELOPMENT: 9/12- Bailed 10 gallons in 53 minutes with 0.23 feet of drawdown.

9/14- Bailed 5 gallons in 19 minutes with 0.11 feet of drawdown. Water cloudy at completion.

FEET ABOVE MSL

BBC&M ENGINEERING, INC.

Plate B-151

BBC&M

LOG OF BORING NO. B-104S
APEX SLF
JEFFERSON COUNTY, OHIO

LOCATION: See Plan Sheets 3D-1 and 3D-2 ELEVATION: 1221.2 DATE: 8/30/94

DRILLING METHOD: 6-3/4" Tricone Bit COMPLETION DEPTH: 35.0'

SAMPLER(S): N/A

DEPTH, FEET	SAMPLE NUMBER	SAMPLE	SAMPLE EFFORT	DESCRIPTION	NATURAL CONSISTENCY INDEX / NATURAL MOISTURE CONTENT (PLASTIC LIMIT — LIQUID LIMIT; 10 20 30 40)	TEST RESULTS
0				See Log of B-104		
5						
10						
15						
20						
25						
30						
35						
40						
45						
50						

WATER LEVEL: ▽ "Dry" ▼ 24.0 ▼

WATER NOTE:

DATE: 08/30/94 08/31/94

SYMBOLS USED TO INDICATE TEST RESULTS

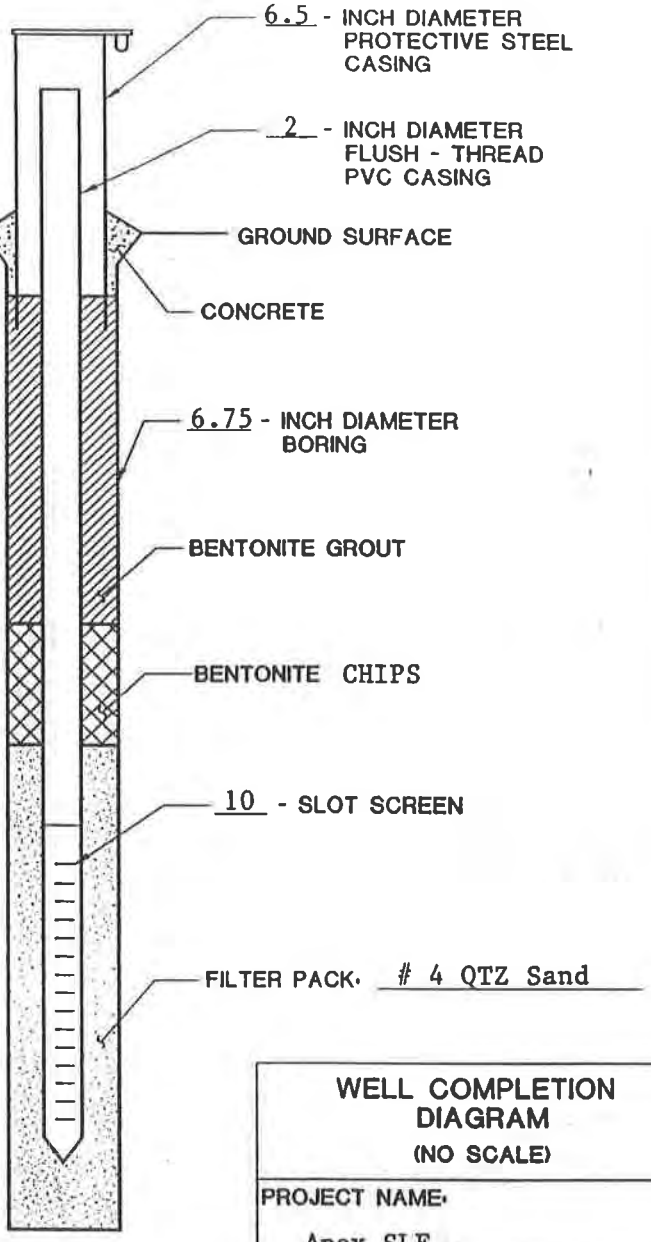
G - GRADATION
Q - UNCONFINED COMPR
T - TRIAXIAL COMPR
C - CONSOLIDATION
} SEE SEPARATE CURVES

H - PENETROMETER (tsf)
W - UNIT DRY WEIGHT (pcf)
D - RELATIVE DENSITY (%)

JOB: 38502

Plate B-117

ELEV. #	DEPTH BELOW GROUND SURFACE (FEET)	
1223.62	2.4	TOP OF COVER
1223.22	2.0	TOP OF PVC
1221.2	0.0	GROUND SURFACE
1218.6	2.6	TOP OF GROUT
1198.4	22.8	TOP OF BENTONITE
1195.1	26.1	TOP OF FILTER PACK
1198.0	23.2	TOP OF SAT. ZONE
1192.9	28.3	TOP OF SCREEN OPENINGS
1188.6	32.6	BOTTOM OF SCREEN OPENINGS
1187.9	33.3	BOTTOM OF WELL
1187.8	33.4	BOTTOM OF SAT. ZONE
1186.2	35.0	BORING DEPTH



WELL COMPLETION DIAGRAM
(NO SCALE)

PROJECT NAME: Apex SLF

BORING: B-104 S

DATE WELL INSTALLED: 8/31/94

BBC & M PROJECT NO: 3850.2

STATIC WATER LEVEL #	1197.41	1197.83	1197.86
DATE:	9/1/94	9/12/94	9/14/94

WELL DEVELOPMENT: 9/12- Bailed 10 gallons in 27 minutes with 1.8 feet of drawdown.

9/14- Bailed 5 gallons in 9 minutes with 3.31 feet of drawdown. Water slightly silty at completion.

FEET ABOVE MSL

BBC&M ENGINEERING INC

Plate B-152

BBC&M

LOG OF BORING NO. B-105
APEX SLF
JEFFERSON COUNTY, OHIO

LOCATION: See Plan Sheets 3D-1 and 3D-2 ELEVATION: 1227.3 DATE: 8/17/94 8/22/94

DRILLING METHOD: 6-3/4" Tricone Bit COMPLETION DEPTH: 150.0'

SAMPLER(S): PXM Core Barrel

DEPTH, FEET	SAMPLE NUMBER	SAMPLE	SAMPLE EFFORT	DESCRIPTION	TEST RESULTS
0				RESIDUAL SOIL	
10			REC	Medium-hard brown siltstone, nearly horizontally bedded, highly fractured.	RQD
				Soft to medium-hard dark-brown shale, nearly horizontally bedded, numerous horizontal fractures.	
15	1		48%	Very-soft to soft gray shale, nearly horizontally bedded, highly fractured.	12%
				Medium-hard gray to dark-gray limestone, nearly horizontally bedded, many shale partings, many horizontal fractures.	
20				Soft to medium-hard gray shale, nearly horizontally bedded, many horizontal fractures, few seams less than 6 inches of medium-hard siltstone.	
25	2		62%		34%
30					
35	3		98%		31%
40					
45	4		96%	- From 43.9'to 44.7': Vertical fracture with oxidation. - From 47.9' to 48.3': Soft gray shale.	61%
				Medium-hard gray with streaks of dark-gray fine-grained sandstone to siltstone, nearly horizontally bedded, few horizontal fractures.	
50					

NATURAL CONSISTENCY INDEX
NATURAL MOISTURE CONTENT
PLASTIC LIMIT LIQUID LIMIT
10 20 30 40

WATER LEVEL: ▽ 81.0 ▼ ▼
WATER NOTE:
DATE: 08/24/94

SYMBOLS USED TO INDICATE TEST RESULTS

G - GRADATION
Q - UNCONFINED COMPR
T - TRIAXIAL COMPR
C - CONSOLIDATION
} SEE SEPARATE CURVES

H - PENETROMETER (tsf)
W - UNIT DRY WEIGHT (pcf)
D - RELATIVE DENSITY (%)

JOB: 38502

-CONTINUED-

LOG OF BORING NO. B-105
APEX SLF
JEFFERSON COUNTY, OHIO

LOCATION: See Plan Sheets 3D-1 and 3D-2 ELEVATION: 1227.3 DATE: 8/17/94 8/22/94

DRILLING METHOD: 6-3/4" Tricone Bit COMPLETION DEPTH: 150.0'

SAMPLER(S): PXM Core Barrel

DEPTH, FEET	SAMPLE NUMBER	SAMPLE	SAMPLE EFFORT	DESCRIPTION - CONTINUED	TEST RESULTS
50				Medium-hard gray shale, nearly horizontally bedded, many horizontal fractures, silty to 50.2', occasional vertical fracture. - Encountered seepage from 50.3' to 53.5'.	
55	5		96%	Medium-hard gray shaley siltstone.	50%
				Medium-hard gray shale, nearly horizontally bedded, many horizontal fractures.	
60				Medium-hard gray fine-grained sandstone, nearly horizontally bedded, occasional shale seam less than 2 inches, many horizontal fractures. - Encountered seepage from 60.7' to 62.7'.	
65	6		99%	- Encountered seepage from 64.9' to 66.2'.	40%
70				Medium-hard gray fine to medium-grained sandstone, nearly horizontally bedded, minor cross bedding, few horizontal fractures, occasional shale parting, micaceous, occasional seam less than 4 inches of siltstone, slight seepage in sandstone.	
75	7		100%		80%
80					
85	8		100%	- From 83.5 to 84.5': Highly fractured.	71%
90				-From 90.5' to 96.7': Many fractures with seepage.	
95	9		100%		62%
100					

NATURAL CONSISTENCY INDEX
NATURAL MOISTURE CONTENT
PLASTIC LIMIT — LIQUID LIMIT
10 20 30 40

WATER LEVEL: ▽ 81.0 ▼ ▼
WATER NOTE:
DATE: 08/24/94

SYMBOLS USED TO INDICATE TEST RESULTS

G - GRADATION
Q - UNCONFINED COMPR
T - TRIAXIAL COMPR
C - CONSOLIDATION
} SEE SEPARATE CURVES

H - PENETROMETER (tsf)
W - UNIT DRY WEIGHT (pcf)
D - RELATIVE DENSITY (%)

JOB: 38502

-CONTINUED-

Plate B-119

BBC&M

LOG OF BORING NO. B-105
APEX SLF
JEFFERSON COUNTY, OHIO

LOCATION: See Plan Sheets 3D-1 and 3D-2 ELEVATION: 1227.3 DATE: 8/17/94 8/22/94

DRILLING METHOD: 6-3/4" Tricone Bit COMPLETION DEPTH: 150.0'

SAMPLER(S): PXM Core Barrel

DEPTH, FEET	SAMPLE NUMBER	SAMPLE	SAMPLE EFFORT	DESCRIPTION - CONTINUED	NATURAL CONSISTENCY INDEX / NATURAL MOISTURE CONTENT (PLASTIC LIMIT — LIQUID LIMIT; 10 20 30 40)	TEST RESULTS
100				Medium-hard gray fine to medium-grained sandstone, nearly horizontally bedded, minor cross bedding, few horizontal fractures, occasional shale parting, micaceous, occasional seam less than 4 inches of siltstone, slight seepage in sandstone.		
105	10		73%	-From 101.5' to 113.1': Many fractures with seepage.		65%
110						
115	11		90%			88%
120				-From 120.0' to 134.1': Numerous horizontal fractures with seepage.		
125	12		98%			38%
130						
135	13		93%	Medium- hard gray limestone.		40%
				Medium-hard gray siltstone, nearly horizontally bedded, many horizontal fractures.		
140				Medium-hard gray with few seams of red brown silty shale, nearly horizontally bedded, many horizontal fractures, occasional diagonal fracture.		
145	14		84%			39%
150						

WATER LEVEL: ▽ 81.0 ▽ ▽

WATER NOTE:

DATE: 08/24/94

SYMBOLS USED TO INDICATE TEST RESULTS

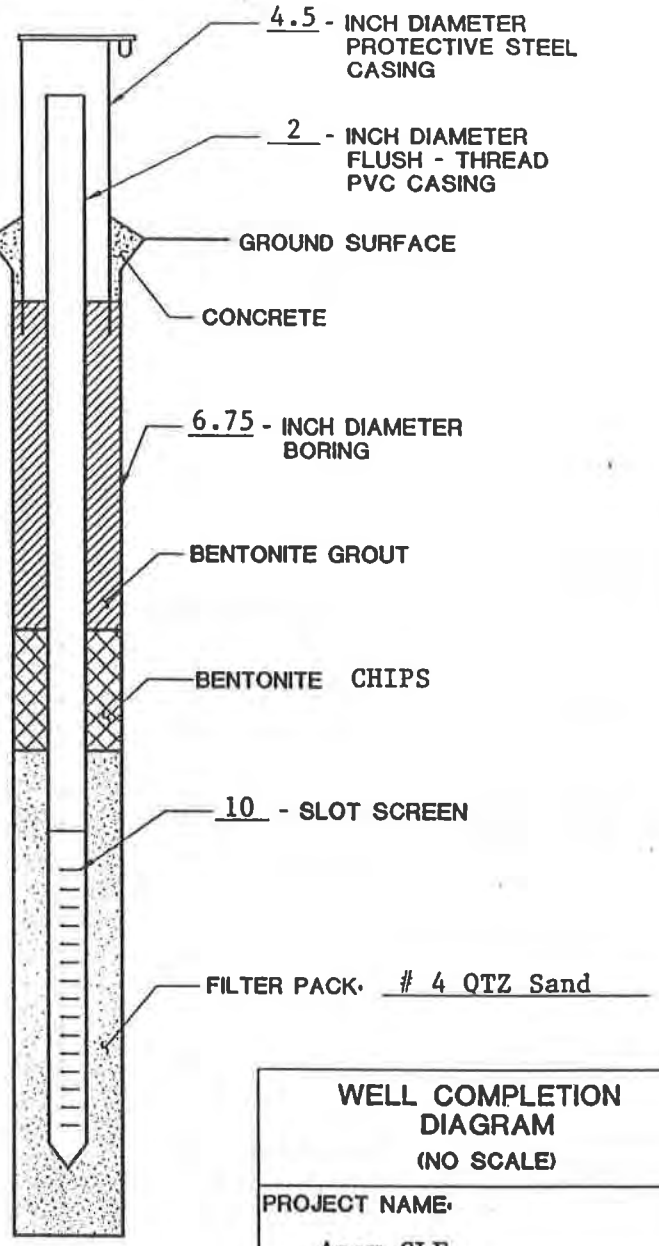
G - GRADATION
Q - UNCONFINED COMPR
T - TRIAXIAL COMPR
C - CONSOLIDATION
} SEE SEPARATE CURVES

H - PENETROMETER (tsf)
W - UNIT DRY WEIGHT (pcf)
D - RELATIVE DENSITY (%)

JOB: 3850?

Plate B-120

ELEV. #	DEPTH BELOW GROUND SURFACE (FEET)	
1229.22	1.9	TOP OF COVER
1229.12	1.8	TOP OF PVC
1227.3	0.0	GROUND SURFACE
1219.9	7.4	TOP OF GROUT
1115.9	111.4	TOP OF BENTONITE
1112.7	114.6	TOP OF FILTER PACK
1167.9	59.4	TOP OF AQUIFER
1108.8	118.5	TOP OF SCREEN OPENINGS
1099.3	128.0	BOTTOM OF SCREEN OPENINGS
1078.8	148.5	BOTTOM OF WELL
1093.2	134.1	BOTTOM OF AQUIFER
1087.3	140.0	BORING DEPTH



WELL COMPLETION DIAGRAM
(NO SCALE)

PROJECT NAME: Apex SLF

BORING: B-105

STATIC WATER LEVEL #	1144.77	1145.20	1145.10
DATE:	8/26/94	9/9/94	9/14/94

DATE WELL INSTALLED: 8/25/94 & 8/26/94

BBC & M PROJECT NO: 3850.2

WELL DEVELOPMENT: 9/9- Bailed 10 gallons in 47 minutes with 5.7 feet of drawdown.

9/14- Bailed 5 gallons in 21 minutes with 4.80 feet of drawdown. Water nearly clear at completion.

FEET ABOVE MSL

BBC&M ENGINEERING, INC.

Plate B-153

BBC&M

LOG OF BORING NO. B-105S
APEX SLF
JEFFERSON COUNTY, OHIO

LOCATION: See Plan Sheets 3D-1 and 3D-2 ELEVATION: 1227.7 DATE: 9/30/94

DRILLING METHOD: 6-3/4" Tricone Bit COMPLETION DEPTH: 44.6'

SAMPLER(S): N/A

DEPTH, FEET	SAMPLE NUMBER	SAMPLE	SAMPLE EFFORT	DESCRIPTION	NATURAL CONSISTENCY INDEX / NATURAL MOISTURE CONTENT (PLASTIC LIMIT — LIQUID LIMIT; 10 20 30 40)	TEST RESULTS
0				See Log of B-105		
5						
10						
15						
20						
25						
30						
35						
40						
45						
50						

WATER LEVEL: ▽ "Dry" ▽ ▽

WATER NOTE:

DATE: 09/30/94

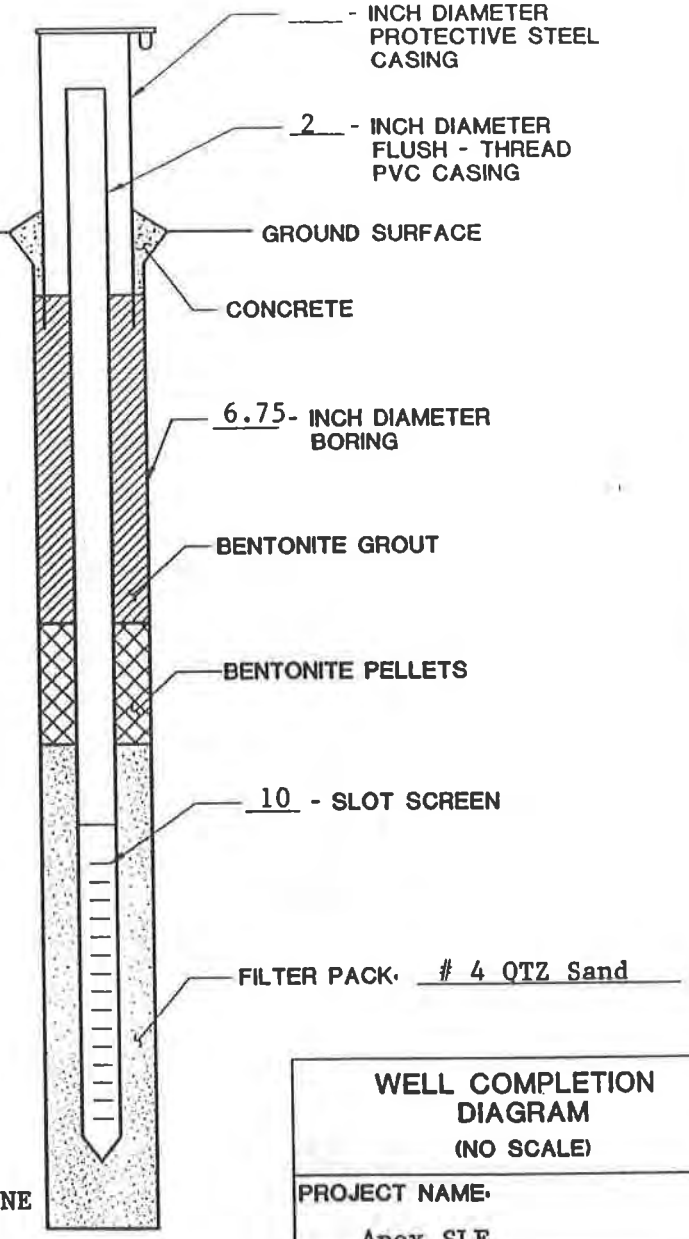
SYMBOLS USED TO INDICATE TEST RESULTS

G - GRADATION
Q - UNCONFINED COMPR
T - TRIAXIAL COMPR
C - CONSOLIDATION
} SEE SEPARATE CURVES

H - PENETROMETER (tsf)
W - UNIT DRY WEIGHT (pcf)
D - RELATIVE DENSITY (%)

JOB: 38502

ELEV. #	DEPTH BELOW GROUND SURFACE (FEET)	
		TOP OF COVER
1228.37	0.7	TOP OF PVC
1227.7	0.0	GROUND SURFACE
1221.3	6.4	TOP OF GROUT
1205.0	22.7	TOP OF BENTONITE
1202.4	25.3	TOP OF FILTER PACK
1187.0	40.7	TOP OF SAT. ZONE
1198.3	29.4	TOP OF SCREEN OPENINGS
1183.8	43.9	BOTTOM OF SCREEN OPENINGS
1183.1	44.6	BOTTOM OF WELL
1181.3	46.4	BOTTOM OF SAT. ZONE
1183.1	44.6	BORING DEPTH



WELL COMPLETION DIAGRAM
(NO SCALE)

PROJECT NAME: Apex SLF

BORING: B-105 S

STATIC WATER LEVEL #	"DRY"	1186.74			DATE WELL INSTALLED: 9/30/94
DATE:	9/30/94	10/5/94			BBC & M PROJECT NO: 3850.2

WELL DEVELOPMENT: 10/5- Bailed 2 gallons in 6 minutes (DRY) 3.7' of drawdown, water silty at completion.

FEET ABOVE MSL

BBC&M ENGINEERING, INC

Plate B-154

LOG OF BORING NO. B-106
APEX SLF
JEFFERSON COUNTY, OHIO

LOCATION: See Plan Sheets 3D-1 and 3D-2 ELEVATION: 1165.0 DATE: 8/14/94 8/15/94

DRILLING METHOD: 6-3/4" Tricone Bit COMPLETION DEPTH: 85.0'

SAMPLER(S): PXM Core Barrel

DEPTH, FEET	SAMPLE NUMBER	SAMPLE	SAMPLE EFFORT	DESCRIPTION	TEST RESULTS
0				MINE SPOIL / FILL	
5					
				Medium-hard brown with gray and orange brown shaley siltstone, nearly horizontally bedded, few seams less than 4 inches of shale, highly fractured.	
10			REC		RQD
15	1		98%	Medium-hard gray with orange brown staining at joints siltstone, nearly horziontally bedded, many horizontal fractures, few seams less than 2 inches of shale.	13%
20				- Encountered water at 20.0'.	
25	2		37%		0%
				Soft to medium-hard interbedded siltstone and shale, nearly horizontally bedded, many horizontal fractures, occasional vertical fracture, beds 1 to 10 inches thick.	
30					
35	3		100%		69%
				Medium-hard dark gray shale, nearly horizontally bedded, few horizontal fractures.	
40				Medium-hard gray with dark-gray fine to medium-grained sandstone, nearly horizontally bedded, few horizontal fractures, occasional seam less than 1/8 inch of shale.	
45	4		98%		92%
50					

NATURAL CONSISTENCY INDEX
NATURAL MOISTURE CONTENT
PLASTIC LIMIT LIQUID LIMIT
10 20 30 40

WATER LEVEL: ▽ 13.3 ▼ ▽
WATER NOTE:
DATE: 08/19/94

SYMBOLS USED TO INDICATE TEST RESULTS

G - GRADATION
Q - UNCONFINED COMPR
T - TRIAXIAL COMPR
C - CONSOLIDATION
} SEE SEPARATE CURVES

H - PENETROMETER (tsf)
W - UNIT DRY WEIGHT (pcf)
D - RELATIVE DENSITY (%)

JOB: 38502

-CONTINUED-

BBC&M

LOG OF BORING NO. B-106
APEX SLF
JEFFERSON COUNTY, OHIO

LOCATION: See Plan Sheets 3D-1 and 3D-2 ELEVATION: 1165.0 DATE: 8/14/94 8/15/94

DRILLING METHOD: 6-3/4" Tricone Bit COMPLETION DEPTH: 85.0'

SAMPLER(S): PXM Core Barrel

DEPTH, FEET	SAMPLE NUMBER	SAMPLE SAMPLE EFFORT	DESCRIPTION - CONTINUED	NATURAL CONSISTENCY INDEX / NATURAL MOISTURE CONTENT (PLASTIC LIMIT — LIQUID LIMIT; 10 20 30 40)	TEST RESULTS
50			DESCRIPTION ON PREVIOUS PAGE		
			Medium-hard gray fine-grained sandstone, nearly horizontally bedded, occasional seams less than 7 inches of siltstone, massive.		
55	5	92%			91%
60					
65	6	98%			89%
			Medium-hard gray with dark gray fine to medium-grained sandstone, nearly horizontally bedded, many horizontal fractures, few seams less than 2 inches of shale, micaceous, minor cross beds.		
70			- Encountered water at 68.4'.		
75	7	98%	- At 76.5': 1" of coal.		67%
			Medium-hard dark gray carbonaceous shale, nearly horizontally bedded, highly fractured, silty in partings.		
80					
	8	98%			24%
85					
90					
95					
100					

WATER LEVEL: ▽ 13.3 ▽ ▽
WATER NOTE:
DATE: 08/19/94

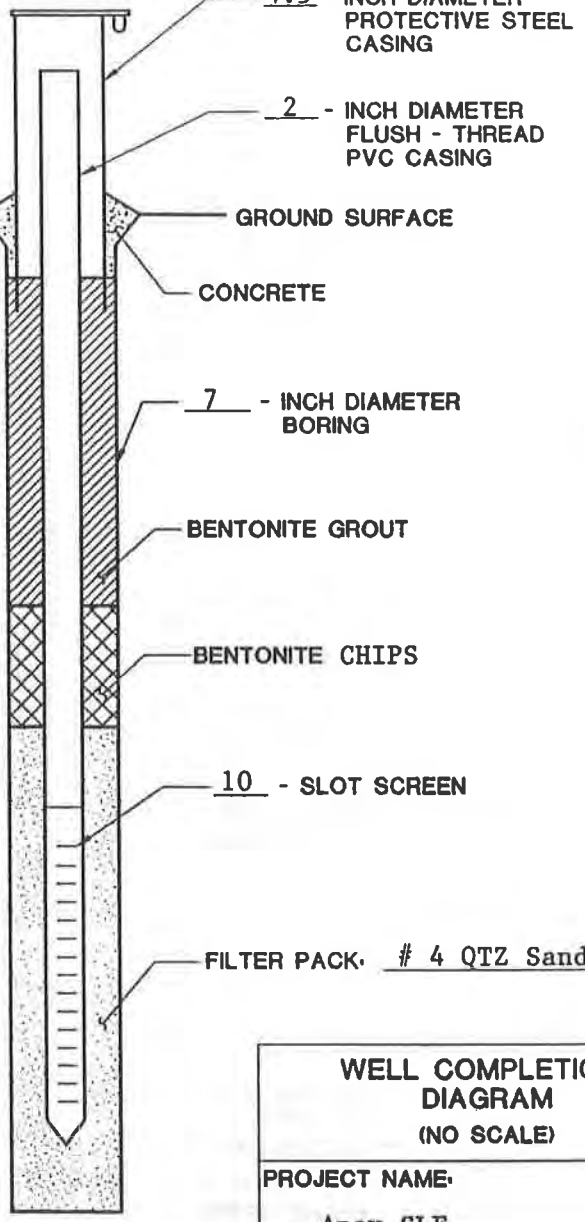
SYMBOLS USED TO INDICATE TEST RESULTS

G - GRADATION
Q - UNCONFINED COMPR
T - TRIAXIAL COMPR
C - CONSOLIDATION
} SEE SEPARATE CURVES

H - PENETROMETER (tsf)
W - UNIT DRY WEIGHT (pcf)
D - RELATIVE DENSITY (%)

JOB: 38502

ELEV. #	DEPTH BELOW GROUND SURFACE (FEET)	
1166.91	1.9	TOP OF COVER
1166.76	1.8	TOP OF PVC
1165.0	0.0	GROUND SURFACE
1160.2	4.8	TOP OF GROUT
1102.1	62.9	TOP OF BENTONITE
1099.2	65.8	TOP OF FILTER PACK
1125.0	68.4	TOP OF AQUIFER
1096.5	68.5	TOP OF SCREEN OPENINGS
1087.0	78.0	BOTTOM OF SCREEN OPENINGS
1081.5	83.5	BOTTOM OF WELL
1086.8	78.2	BOTTOM OF AQUIFER
1080.0	85.0	BORING DEPTH



WELL COMPLETION DIAGRAM
(NO SCALE)

PROJECT NAME: Apex SLF

BORING: B-106

STATIC WATER LEVEL #	1149.34	1148.44	1146.04
DATE:	8/25/94	9/12/94	9/14/94

DATE WELL INSTALLED: 8/24/94 & 8/25/94

BBC & M PROJECT NO: 3850.2

WELL DEVELOPMENT: 9/12- Bailed 15 gallons in 43 minutes with 53.5 feet of drawdown.

9/14- Bailed 5 gallons in 11 minutes with 25.27 feet of drawdown. Water nearly clear at completion.

FEET ABOVE MSL

BBC&M ENGINEERING INC.

Plate B-155

BBC&M

LOG OF BORING NO. B-106S
APEX SLF
JEFFERSON COUNTY, OHIO

LOCATION: See Plan Sheets 3D-1 and 3D-2 ELEVATION: 1164.7 DATE: 9/1/94

DRILLING METHOD: 6-3/4" Tricone Bit COMPLETION DEPTH: 28.6'

SAMPLER(S): N/A

DEPTH, FEET	SAMPLE NUMBER	SAMPLE	SAMPLE EFFORT	DESCRIPTION	NATURAL CONSISTENCY INDEX / NATURAL MOISTURE CONTENT (PLASTIC LIMIT — LIQUID LIMIT; 10 20 30 40)	TEST RESULTS
0				See Log of B-106		
5						
10						
15						
20						
▽						
25						
30						
35						
40						
45						
50						

WATER LEVEL: ▽ 23.4 ▽ ▽

WATER NOTE:

DATE: 09/01/94

SYMBOLS USED TO INDICATE TEST RESULTS

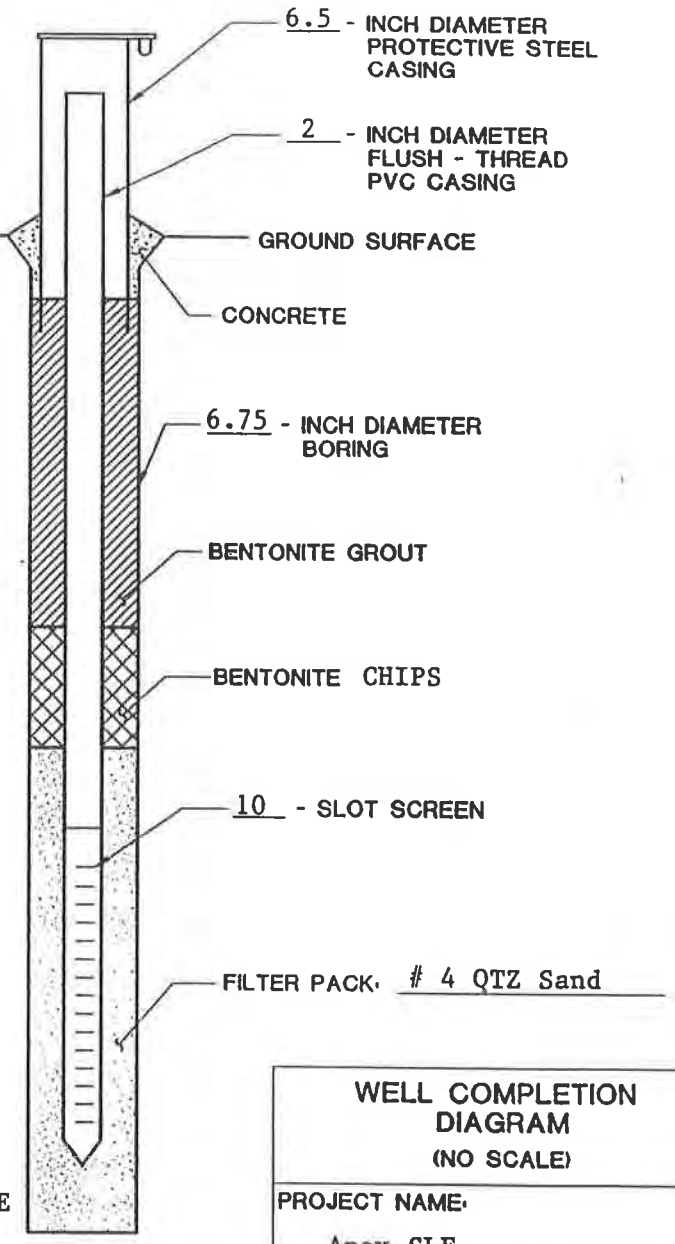
G - GRADATION
Q - UNCONFINED COMPR
T - TRIAXIAL COMPR
C - CONSOLIDATION
} SEE SEPARATE CURVES

H - PENETROMETER (tsf)
W - UNIT DRY WEIGHT (pcf)
D - RELATIVE DENSITY (%)

JOB: 38502

Plate B-124

ELEV. #	DEPTH BELOW GROUND SURFACE (FEET)	
1166.50	1.8	TOP OF COVER
1166.36	1.7	TOP OF PVC
1164.7	0.0	GROUND SURFACE
1164.7	0.0	TOP OF GROUT
12.7	14.4	TOP OF BENTONITE
1147.9	16.8	TOP OF FILTER PACK
1156.0	8.7	TOP OF SAT. ZONE
1146.2	18.5	TOP OF SCREEN OPENINGS
1136.7	28.0	BOTTOM OF SCREEN OPENINGS
1136.1	28.6	BOTTOM OF WELL
1137.7	27.0	BOTTOM OF SAT. ZONE
1136.1	28.6	BORING DEPTH



WELL COMPLETION DIAGRAM
(NO SCALE)

PROJECT NAME: Apex SLF

BORING: B-106 S

DATE WELL INSTALLED: 9/1/94

BBC & M PROJECT NO: 3850.2

STATIC WATER LEVEL #	1156.05	1155.63		
DATE:	9/12/94	9/14/94		

WELL DEVELOPMENT: 9/12- Bailed 22 gallons (DRY) in 39 minutes with 18.2 feet of drawdown.

9/14- Bailed 5 gallons in 9 minutes with 10.36 feet of drawdown. Water silty at completion.

FEET ABOVE MSL

BBC&M ENGINEERING INC

Plate B-156

BBC&M

LOG OF BORING NO. B-201
APEX SOLID WASTE DISPOSAL FACILITY
JEFFERSON COUNTY, OHIO

LOCATION: See Plan Sheets 3D-1 and 3D-2 ELEVATION: 1209.3 DATE: 4/19/95

DRILLING METHOD: COMPLETION DEPTH: 40.0'

SAMPLER(S): Air Rotary, 6-3/4" Tricone

DEPTH, FEET	SAMPLE NUMBER	SAMPLE	SAMPLE EFFORT	DESCRIPTION	NATURAL CONSISTENCY INDEX (NATURAL MOISTURE CONTENT; PLASTIC LIMIT — LIQUID LIMIT; 10 20 30 40)	TEST RESULTS
0				TOPSOIL - 5 INCHES		
				Medium-hard brown siltstone, contains fine grained sandstone.		
5						
				Soft to medium-hard brown with gray silty shale, few thin seams of siltstone.		
10						
15						
				Soft to medium-hard gray with brown shale.		
20						
25						
				Medium-hard brown with gray siltstone.		
30						
				Medium-hard gray silty shale.		
35						
				Medium-hard brown with gray siltstone.		
40				- Encountered no water. BORING CONVERTED TO TEMPORARY PIEZOMETER		
45						
50						
55						
60						
65						

WATER LEVEL:	▽ "Dry"	▼ "Dry"	▼ "Dry"
WATER NOTE:			
DATE:	04/19/95	04/20/95	05/01/95

SYMBOLS USED TO INDICATE TEST RESULTS

G - GRADATION
Q - UNCONFINED COMPR
T - TRIAXIAL COMPR
C - CONSOLIDATION
} SEE SEPARATE CURVES

H - PENETROMETER (tsf)
W - UNIT DRY WEIGHT (pcf)
D - RELATIVE DENSITY (%)

JOB: 38503

Plate B-125

BBC&M

LOG OF BORING NO. B-202
APEX SOLID WASTE DISPOSAL FACILITY
JEFFERSON COUNTY, OHIO

LOCATION: See Plan Sheets 3D-1 and 3D-2 ELEVATION: 1201.1 DATE: 4/20/95

DRILLING METHOD: COMPLETION DEPTH: 31.5'

SAMPLER(S): Air Rotary, 6-3/4" Tricone

DEPTH, FEET	SAMPLE NUMBER	SAMPLE	SAMPLE EFFORT	DESCRIPTION	NATURAL CONSISTENCY INDEX / NATURAL MOISTURE CONTENT / PLASTIC LIMIT / LIQUID LIMIT (10 20 30 40)	TEST RESULTS
0				TOPSOIL - 5 INCHES		
				Brown clayey silt, little fine to coarse sand, trace fine to coarse gravel. ML		
5				Brown mottled gray silty clay, little fine to coarse sand, trace fine to coarse gravel. CL		
				Medium-hard brown with gray siltstone.		
				Very-soft to soft red-brown shale.		
10				Soft gray shale.		
				Medium-hard brown silty shale, few thin seams fine to medium grained sandstone, few thin seams siltstone.		
15						
20						
	▼					
25						
30						
				- Encountered no water. BORING CONVERTED TO TEMPORARY PIEZOMETER		
35						
40						
45						
50						
55						
60						
65						

WATER LEVEL:	▼ "Dry"	▼ 23.5	▼
WATER NOTE:			
DATE:	04/20/95	05/01/95	

SYMBOLS USED TO INDICATE TEST RESULTS

G - GRADATION
Q - UNCONFINED COMPR
T - TRIAXIAL COMPR
C - CONSOLIDATION
} SEE SEPARATE CURVES

H - PENETROMETER (tsf)
W - UNIT DRY WEIGHT (pcf)
D - RELATIVE DENSITY (%)

JOB: 38503

Plate B-126

BBC&M

LOG OF BORING NO. B-203
APEX SOLID WASTE DISPOSAL FACILITY
JEFFERSON COUNTY, OHIO

LOCATION: See Plan Sheets 3D-1 and 3D-2 ELEVATION: 1213.7 DATE: 4/19/95

DRILLING METHOD: COMPLETION DEPTH: 40.0'

SAMPLER(S): Air Rotary, 6-3/4" Tricone

DEPTH, FEET	SAMPLE NUMBER	SAMPLE	SAMPLE EFFORT	DESCRIPTION	NATURAL CONSISTENCY INDEX / NATURAL MOISTURE CONTENT / PLASTIC LIMIT / LIQUID LIMIT (10 20 30 40)	TEST RESULTS
0				FILL: Loose gray fine to coarse gravel, some fine to coarse sand, some silty clay. GW		
5				Medium-hard brown and gray limestone. - From 5.0' to 6.0': Brown shale.		
10				Soft gray with brown silty shale.		
15				Medium-hard gray siltstone.		
20				Hard gray limestone. Soft to medium-hard dark-gray shale, many seams of siltstone to fine grained sandstone to 27 feet.		
25						
30						
35						
40				- Encountered seepage from 17.5' to 27.0'. BORING CONVERTED TO GROUNDWATER MONITORING WELL (See Well Completion Diagram).		
45						
50						
55						
60						
65						

WATER LEVEL:	▽ 22.0	▼ 14.8	▼ 16.4
WATER NOTE:			
DATE:	04/19/95	04/20/95	05/01/95

SYMBOLS USED TO INDICATE TEST RESULTS

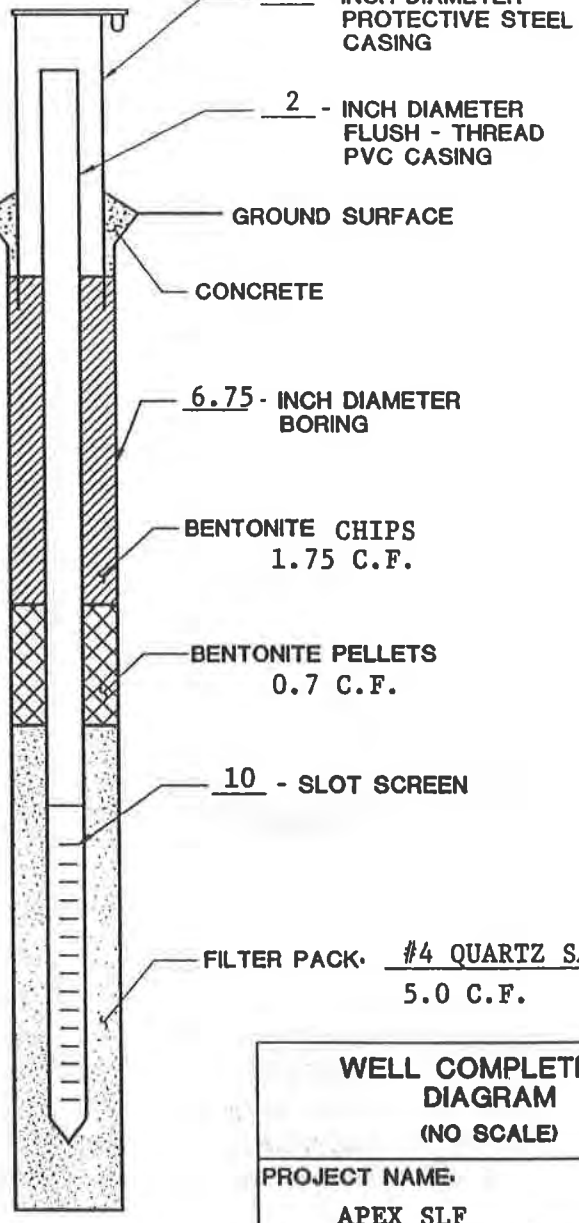
G - GRADATION
Q - UNCONFINED COMPR
T - TRIAXIAL COMPR
C - CONSOLIDATION
} SEE SEPARATE CURVES

H - PENETROMETER (tsf)
W - UNIT DRY WEIGHT (pcf)
D - RELATIVE DENSITY (%)

JOB: 38503

Plate B-127

ELEV. #	DEPTH BELOW GROUND SURFACE (FEET)	
1215.50	1.8	TOP OF COVER
1215.33	1.6	TOP OF PVC
1213.7	0.0	GROUND SURFACE
1209.8	3.9	TOP OF GROUT
1200.9	12.8	TOP OF BENTONITE
1197.2	16.5	TOP OF FILTER PACK
1196.2	17.5	TOP OF SAT. ZONE
1194.9	18.8	TOP OF SCREEN OPENINGS
1185.5	28.2	BOTTOM OF SCREEN OPENINGS
1185.0	28.7	BOTTOM OF WELL
1186.7	27.0	BOTTOM OF SAT. ZONE
1173.7	40.0	BORING DEPTH



WELL COMPLETION DIAGRAM
(NO SCALE)

PROJECT NAME: APEX SLF

BORING: B-203

DATE WELL INSTALLED: April 20, 1995

BBC & M PROJECT NO: 3850-3

STATIC WATER LEVEL #	1197.92	1197.80	1197.34	1197.34
DATE:	4/26/95	4/27/95	5/1/95	5/7/95

WELL DEVELOPMENT: 4/26 - Hand bailed 8 gallons; water slightly silty at completion.

FEET ABOVE MSL

BBC&M ENGINEERING INC

Plate B-157

BBC&M

LOG OF BORING NO. B-204
APEX SOLID WASTE DISPOSAL FACILITY
JEFFERSON COUNTY, OHIO

LOCATION: See Plan Sheets 3D-1 and 3D-2 ELEVATION: 1196.8 DATE: 4/20/95

DRILLING METHOD: COMPLETION DEPTH: 50.3'

SAMPLER(S): Air Rotary, 6-3/4" Tricone

DEPTH, FEET	SAMPLE NUMBER	SAMPLE EFFORT	DESCRIPTION	NATURAL CONSISTENCY INDEX / NATURAL MOISTURE CONTENT / PLASTIC LIMIT / LIQUID LIMIT (10 20 30 40)	TEST RESULTS
0			MINE SPOIL: Brown and Black silty clay, intermixed with coal fragments. CL		
			Brown silty clay, little fine to coarse sand. CL		
5			Soft brown shale.		
			Medium-hard brown siltstone.		
10			Soft to medium-hard brown silty shale.		
			Medium-hard gray siltstone.		
15			Medium-hard gray shale, few seams of siltstone.		
20					
25					
30					
35					
40					
			Medium-hard gray siltstone to fine grained sandstone.		
45					
50					
			- Encountered water from 35.0' to 42.0'.		
			BORING CONVERTED TO GROUNDWATER MONITORING WELL (See Well Completion Diagram).		
55					
60					
65					

WATER LEVEL:	▽ 45.2	▼ 23.1	▽
WATER NOTE:			
DATE:	04/20/95	05/01/95	

SYMBOLS USED TO INDICATE TEST RESULTS

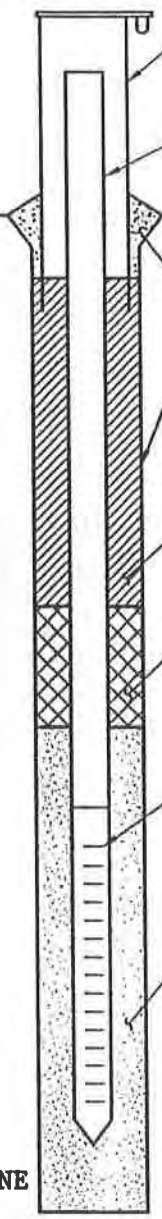
G - GRADATION
Q - UNCONFINED COMPR
T - TRIAXIAL COMPR
C - CONSOLIDATION
} SEE SEPARATE CURVES

H - PENETROMETER (tsf)
W - UNIT DRY WEIGHT (pcf)
D - RELATIVE DENSITY (%)

JOB: 3850

Plate B-128

ELEV. #	DEPTH BELOW GROUND SURFACE (FEET)	
1198.42	1.6	TOP OF COVER
1198.25	1.4	TOP OF PVC
1196.8	0.0	GROUND SURFACE
1192.5	4.3	TOP OF GROUT
1172.3	24.5	TOP OF BENTONITE
1168.9	27.9	TOP OF FILTER PACK
1176.0	20.8	TOP OF SAT. ZONE
1167.8	29.0	TOP OF SCREEN OPENINGS
1158.4	38.4	BOTTOM OF SCREEN OPENINGS
1157.9	38.9	BOTTOM OF WELL
1154.8	42.0	BOTTOM OF SAT. ZONE
1146.5	50.3	BORING DEPTH



4 - INCH DIAMETER PROTECTIVE STEEL CASING

2 - INCH DIAMETER FLUSH - THREAD PVC CASING

GROUND SURFACE

CONCRETE

6.75- INCH DIAMETER BORING

BENTONITE CHIPS
4.2 C.F.

BENTONITE PELLETS
0.7 C.F.

10 - SLOT SCREEN

FILTER PACK: #4 QUARTZ SAND
5.0 C.F.

WELL COMPLETION DIAGRAM
(NO SCALE)

PROJECT NAME: APEX SLF

BORING: B-204

DATE WELL INSTALLED: April 20, 1995

BBC & M PROJECT NO: 3850-3

STATIC WATER LEVEL #	1175.11	1175.31	1173.72
DATE:	4/26/95	4/27/95	5/1/95

WELL DEVELOPMENT: 4/26 - Hand bailed 10 gallons
5/1 - Hand bailed 10 gallons; water silty at completion.

FEET ABOVE MSL

BBC&M ENGINEERING INC.

Plate B-158

BBC&M

LOG OF BORING NO. B-301
APEX SLF
JEFFERSON COUNTY, OHIO

LOCATION: See Plate 1 ELEVATION: 1163.9 DATE: 8/21/95

DRILLING METHOD: 5-3/4" Tricone Bit - Air Rotary COMPLETION DEPTH: 31.0'

SAMPLER(S):

DEPTH, FEET	SAMPLE NUMBER	SAMPLE	SAMPLE EFFORT	DESCRIPTION	NATURAL CONSISTENCY INDEX (NATURAL MOISTURE CONTENT; PLASTIC LIMIT; LIQUID LIMIT) 10 20 30 40	TEST RESULTS
0				MINE SPOIL: Dark-gray coal and shale fragments.		
5						
10						
15						
20				Brown silty clay, little fine to coarse sand.		
25				Soft to medium-hard gray shale.		
30				Medium-hard gray siltstone, many shale seams.		
35				- Encountered water at 21.5'. - Boring converted to groundwater monitoring well. See well completion diagram.		
40						

WATER LEVEL:	▽ 25.2	▼ 19.0	▼ 19.0
WATER NOTE:			
DATE:	08/21/95	08/22/95	08/23/95

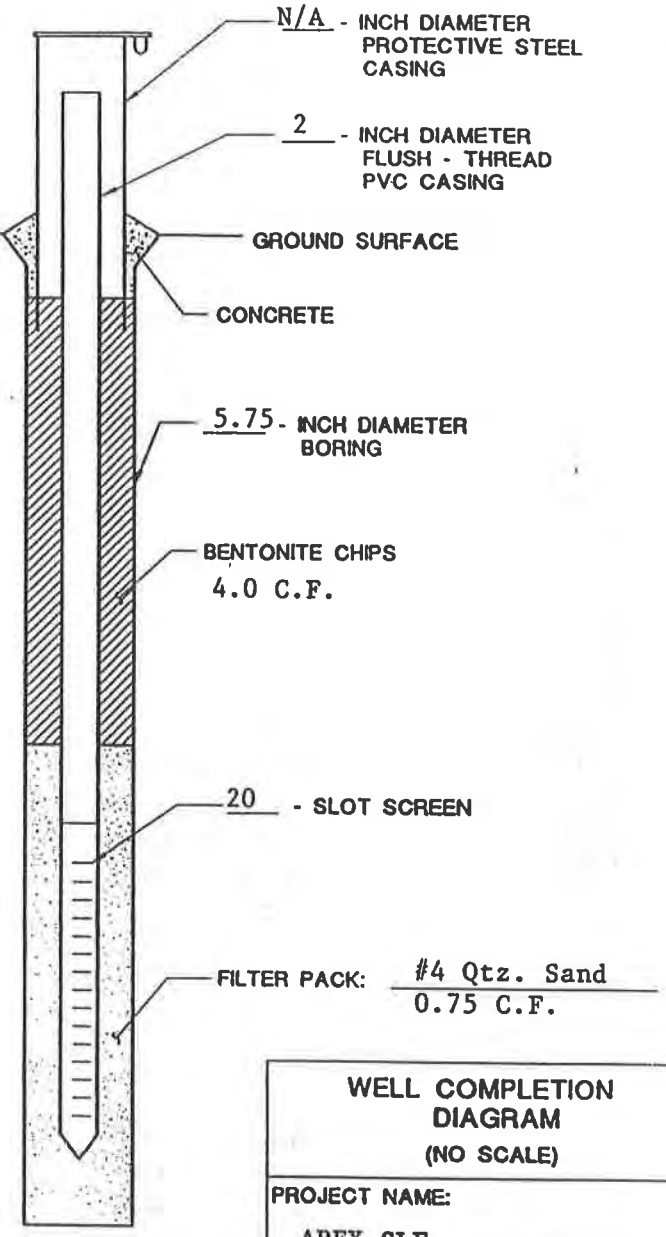
SYMBOLS USED TO INDICATE TEST RESULTS

G - GRADATION
Q - UNCONFINED COMPR
T - TRIAXIAL COMPR
C - CONSOLIDATION
} SEE SEPARATE CURVES

H - PENETROMETER (tsf)
W - UNIT DRY WEIGHT (pcf)
D - RELATIVE DENSITY (%)

JOB: 38504

ELEV. #	DEPTH BELOW GROUND SURFACE (FEET)	
–	N/A	TOP OF COVER
1166.37	2.5	TOP OF PVC
1163.9	0.0	GROUND SURFACE
1163.9	0.0	TOP OF BENTONITE
1139.1	24.8	TOP OF FILTER PACK
1138.5	25.4	TOP OF AQUIFER TOP OF SCREEN OPENINGS
1134.2	29.7	BOTTOM OF SCREEN OPENINGS
1133.7	30.2	BOTTOM OF WELL
1132.9	31.0	BOTTOM OF AQUIFER BORING DEPTH



WELL COMPLETION DIAGRAM
(NO SCALE)

PROJECT NAME: APEX SLF

BORING: B-301

DATE WELL INSTALLED: 8/22/95

BBC & M PROJECT NO: 3850-4

STATIC WATER LEVEL #	8/23			
DATE:	1144.93			

WELL DEVELOPMENT:
8/22 Hand bailed 15 gallons, water silty
8/23 Hand bailed 6 gallons, water slightly silty.

FEET ABOVE MSL

BBC&M ENGINEERING INC.

Plate 14

BBC&M

LOG OF BORING NO. B-302
APEX SLF
JEFFERSON COUNTY, OHIO

LOCATION: See Plate 1 ELEVATION: 1173.0 DATE: 8/21/95

DRILLING METHOD: 5-3/4" Tricone Bit - Air Rotary COMPLETION DEPTH: 22.0'

SAMPLER(S):

DEPTH, FEET	SAMPLE NUMBER	SAMPLE	SAMPLE EFFORT	DESCRIPTION	NATURAL CONSISTENCY INDEX / NATURAL MOISTURE CONTENT / PLASTIC LIMIT / LIQUID LIMIT (10 20 30 40)	TEST RESULTS
0				FILL: Brown clayey silt intermixed with silty clay, little fine to coarse sand.		
				TOPSOIL - 12 INCHES		
				Brown silty clay, little fine to coarse sand, trace fine to coarse gravel.		
5				Soft brown silty shale.		
10						
				Medium-hard gray siltstone, many seams of soft brown shale.		
15						
20						
				- Encountered water at 10.5'.		
25				- Boring converted to groundwater monitoring well. See well completion diagram.		
30						
35						
40						

WATER LEVEL:	▽ 13.5	▼ 2.6	▼ 2.6
WATER NOTE:			
DATE:	08/21/95	08/22/95	08/23/95

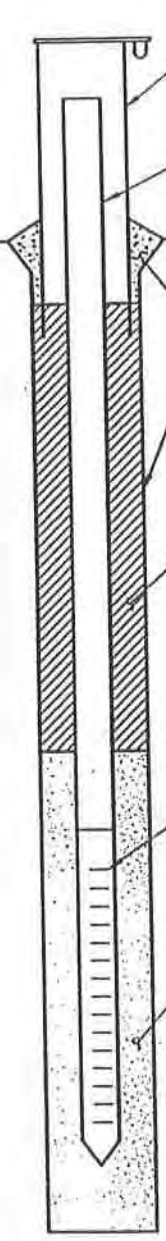
SYMBOLS USED TO INDICATE TEST RESULTS

G - GRADATION
Q - UNCONFINED COMPR
T - TRIAXIAL COMPR
C - CONSOLIDATION
} SEE SEPARATE CURVES

H - PENETROMETER (tsf)
W - UNIT DRY WEIGHT (pcf)
D - RELATIVE DENSITY (%)

JOB: 38504

ELEV. #	DEPTH BELOW GROUND SURFACE (FEET)	
–	N/A	TOP OF COVER
1174.43	1.4	TOP OF PVC
1173.0	0.0	GROUND SURFACE
1173.0	0.0	TOP OF BENTONITE
1164.7	8.3	TOP OF FILTER PACK
		TOP OF AQUIFER
1164.0	9.0	TOP OF SCREEN OPENINGS
1154.6	18.4	BOTTOM OF SCREEN OPENINGS
1153.9	19.1	BOTTOM OF WELL
1151.0	22.0	BOTTOM OF AQUIFER BORING DEPTH



N/A INCH DIAMETER PROTECTIVE STEEL CASING

2 - INCH DIAMETER FLUSH - THREAD PVC CASING

GROUND SURFACE

CONCRETE

5.75 INCH DIAMETER BORING

BENTONITE CHIPS
1.4 C.F.

20 - SLOT SCREEN

FILTER PACK: #4 Qtz. Sand
2.0 C.F.

WELL COMPLETION DIAGRAM
(NO SCALE)

PROJECT NAME: APEX SLF

BORING: B-302

DATE WELL INSTALLED: 8/22/95

BBC & M PROJECT NO: 3850-4

STATIC WATER LEVEL #	1170.35				
DATE:	8/23				

WELL DEVELOPMENT: 8/22 Hand bailed 15 gallons, water slightly silty.
8/23 Hand bailed 9 gallons, water nearly clear.

FEET ABOVE MSL

BBC&M ENGINEERING INC.

TCAMWEL2

BBC&M

LOG OF BORING NO. B-303
APEX SLF
JEFFERSON COUNTY, OHIO

LOCATION: See Plate 1 ELEVATION: 1190.2 DATE: 8/21/95

DRILLING METHOD: 5-3/4" Tricone Bit - Air Rotary COMPLETION DEPTH: 25.0'

SAMPLER(S):

DEPTH, FEET	SAMPLE NUMBER	SAMPLE	SAMPLE EFFORT	DESCRIPTION	NATURAL CONSISTENCY INDEX / NATURAL MOISTURE CONTENT / PLASTIC LIMIT / LIQUID LIMIT (10 20 30 40)	TEST RESULTS
0				FILL: Brown silty clay, little fine to coarse sand.		
5				TOPSOIL - 12 INCHES Brown silty clay, some fine to coarse sand.		
				Soft to medium-hard gray shale.		
10				Medium-hard dark-brown siltstone.		
				Soft to medium-hard brown and gray shale, many seams of siltstone.		
15						
20				Medium-hard gray with seams of brown siltstone, many seams of shale.		
25				- Boring converted to groundwater monitoring well. See well completion diagram.		
30						
35						
40						

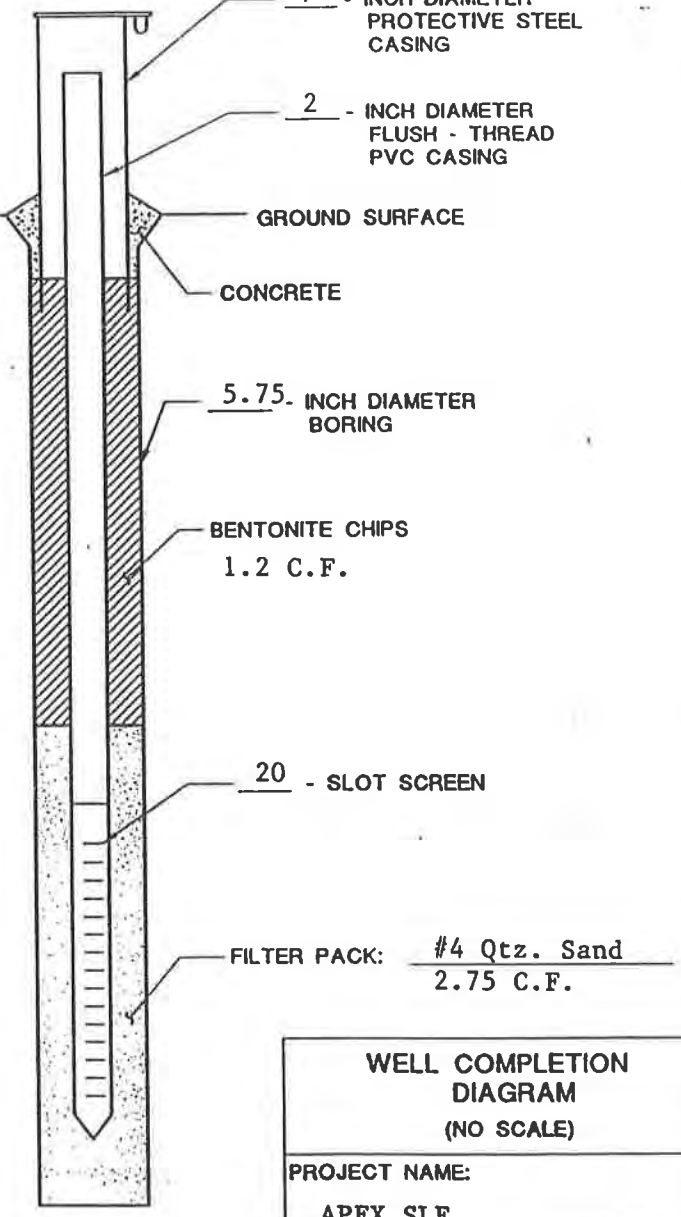
WATER LEVEL:	▽ 21.6	▼ 9.7	▼ 9.8
WATER NOTE:			
DATE:	08/21/95	08/22/96	08/23/95

SYMBOLS USED TO INDICATE TEST RESULTS

G - GRADATION
Q - UNCONFINED COMPR
T - TRIAXIAL COMPR
C - CONSOLIDATION
} SEE SEPARATE CURVES

H - PENETROMETER (tsf)
W - UNIT DRY WEIGHT (pcf)
D - RELATIVE DENSITY (%)

ELEV. #	DEPTH BELOW GROUND SURFACE (FEET)	
–	N/A	TOP OF COVER
1192.12	1.9	TOP OF PVC
1190.2	0.0	GROUND SURFACE
1190.2	0.0	TOP OF BENTONITE
1182.2	8.0	TOP OF FILTER PACK
1181.7	8.5	TOP OF AQUIFER TOP OF SCREEN OPENINGS
1172.3	17.9	BOTTOM OF SCREEN OPENINGS
1171.8	18.4	BOTTOM OF WELL
1165.2	25.0	BOTTOM OF AQUIFER BORING DEPTH



WELL COMPLETION DIAGRAM
(NO SCALE)

PROJECT NAME: APEX SLF

BORING: B-303

DATE WELL INSTALLED: 8/22/95

BBC & M PROJECT NO: 3850-4

STATIC WATER LEVEL #	1180.39	
DATE:	8/23	

WELL DEVELOPMENT:
8/22 Hand bailed 13 gallons (Dry), water nearly clear.
8/23 Hand bailed 4.5 gallons, water nearly clear.

FEET ABOVE MSL

BBC&M ENGINEERING INC.

Plate 16

BBC&M

LOG OF BORING NO. B-304
APEX SLF
JEFFERSON COUNTY, OHIO

LOCATION: See Plate 1 ELEVATION: 1215.6 DATE: 8/21/95

DRILLING METHOD: 5-3/4" Tricone Bit - Air Rotary COMPLETION DEPTH: 50.5'

SAMPLER(S):

DEPTH, FEET	SAMPLE NUMBER	SAMPLE	SAMPLE EFFORT	DESCRIPTION	NATURAL CONSISTENCY INDEX / NATURAL MOISTURE CONTENT (PLASTIC LIMIT — LIQUID LIMIT; 10 20 30 40)	TEST RESULTS
0				MINE SPOIL: Coal fragments.		
				MINE SPOIL: Brown silty clay, some fine to coarse sand (coal fragments), little fine to coarse gravel.		
5				Very-soft brown shale.		
				Soft to medium-hard brown shale.		
10						
15				Medium-hard brown with streaks of gray silty shale.		
20						
				Medium-hard brown and gray interbedded shale and siltstone.		
25						
30						
				Medium-hard brown with gray siltstone.		
35						
				Medium-hard gray siltstone.		
40						

WATER LEVEL:	▽ 50.1	▽ 29.4	▽ 30.0
WATER NOTE:			
DATE:	08/21/95	08/22/95	08/23/95

SYMBOLS USED TO INDICATE TEST RESULTS

G - GRADATION
Q - UNCONFINED COMPR
T - TRIAXIAL COMPR
C - CONSOLIDATION
} SEE SEPARATE CURVES

H - PENETROMETER (tsf)
W - UNIT DRY WEIGHT (pcf)
D - RELATIVE DENSITY (%)

JOB: 38504

-CONTINUED-

BBC&M

LOG OF BORING NO. B-304
APEX SLF
JEFFERSON COUNTY, OHIO

LOCATION: See Plate 1 ELEVATION: 1215.6 DATE: 8/21/95

DRILLING METHOD: 5-3/4" Tricone Bit - Air Rotary COMPLETION DEPTH: 50.5'

SAMPLER(S):

DEPTH, FEET	SAMPLE NUMBER	SAMPLE	SAMPLE EFFORT	DESCRIPTION - CONTINUED	NATURAL CONSISTENCY INDEX (NATURAL MOISTURE CONTENT; PLASTIC LIMIT — LIQUID LIMIT; 10 20 30 40)	TEST RESULTS
40				Medium-hard gray siltstone.		
45						
50				- Encountered slight seepage at 32.0' to 50.5'. - Boring converted to groundwater monitoring well. See well completion diagram.		
55						
60						
65						
70						
75						
80						

WATER LEVEL: ▽ 50.1 ▼ 29.4 ▼ 30.0

WATER NOTE:

DATE: 08/21/95 08/22/95 08/23/95

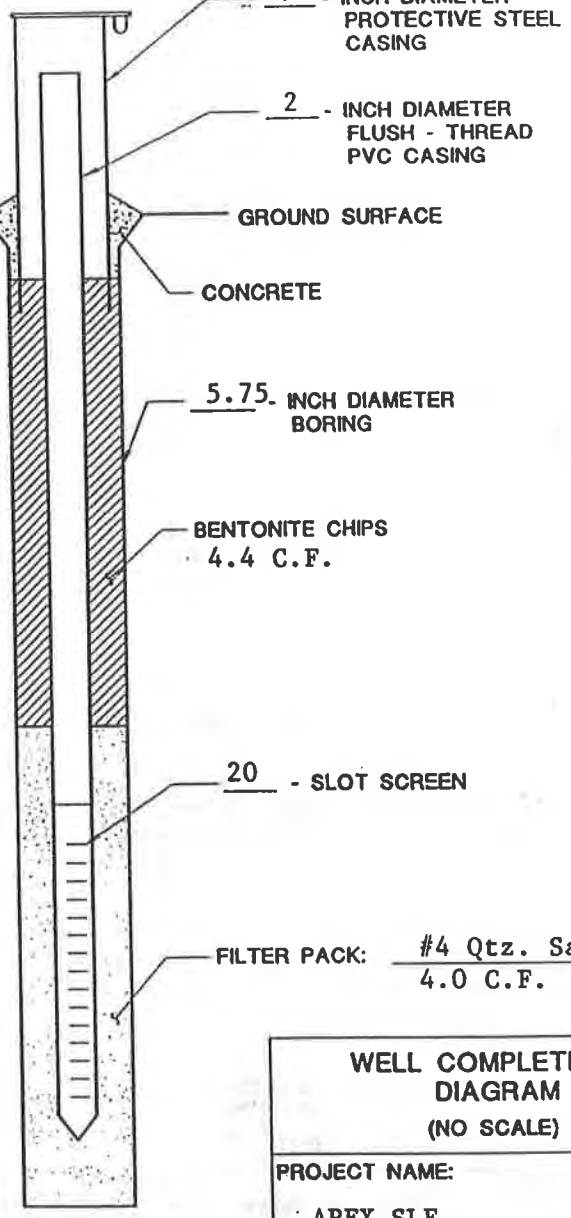
SYMBOLS USED TO INDICATE TEST RESULTS

G - GRADATION
Q - UNCONFINED COMPR
T - TRIAXIAL COMPR
C - CONSOLIDATION
} SEE SEPARATE CURVES

H - PENETROMETER (tsf)
W - UNIT DRY WEIGHT (pcf)
D - RELATIVE DENSITY (%)

JOB: 38504

ELEV. #	DEPTH BELOW GROUND SURFACE (FEET)	
–	N/A	TOP OF COVER
1218.30	2.7	TOP OF PVC
1215.6	0.0	GROUND SURFACE
1215.6	0.0	TOP OF BENTONITE
1189.8	25.8	TOP OF FILTER PACK
		TOP OF AQUIFER
1187.9	27.7	TOP OF SCREEN OPENINGS
1178.5	37.1	BOTTOM OF SCREEN OPENINGS
1178.0	37.6	BOTTOM OF WELL
		BOTTOM OF AQUIFER
1165.1	50.5	BORING DEPTH



WELL COMPLETION DIAGRAM
(NO SCALE)

PROJECT NAME: APEX SLF

BORING: B-304

DATE WELL INSTALLED: 8/22/95

BBC & M PROJECT NO: 3850-4

STATIC WATER LEVEL #	1185.55			
DATE:	8/23			

WELL DEVELOPMENT:
8/22 Hand bailed 9 gallons (dry), water silty.
8/23 Hand bailed 4.5 gallons, water slightly silty.

FEET ABOVE MSL

BBC&M ENGINEERING INC

TCAMWEL2

BBC&M

LOG OF BORING NO. B-305
APEX SLF
JEFFERSON COUNTY, OHIO

LOCATION: See Plate 1 ELEVATION: 1215.9 DATE: 8/21/95

DRILLING METHOD: 5-3/4" Tricone Bit - Air Rotary COMPLETION DEPTH: 87.0'

SAMPLER(S):

DEPTH, FEET	SAMPLE NUMBER	SAMPLE	SAMPLE EFFORT	DESCRIPTION	NATURAL CONSISTENCY INDEX / NATURAL MOISTURE CONTENT (PLASTIC LIMIT, LIQUID LIMIT)	TEST RESULTS
0				MINE SPOIL: Loose dark-gray to brown fine to coarse gravel (coal), some fine to coarse sand (coal), trace clayey silt.	10 20 30 40	
5				MINE SPOIL: Brown silty clay mixed with coal fragments.		
10				Hard gray limestone.		
				Very-soft brown shale, similar to soil.		
15				Medium-hard gray with brown siltstone, many shale seams.		
				Very-soft brown shale.		
20				Soft to medium-hard brown silty shale, many seams of siltstone.		
25						
30				Hard gray limestone.		
				Medium-hard brown with gray siltstone.		
35				Medium-hard brown and gray silty shale.		
40						

WATER LEVEL:	▽ "Dry"	▼ 42.9	▼ 40.7
WATER NOTE:			
DATE:	08/21/95	08/22/95	08/23/95

SYMBOLS USED TO INDICATE TEST RESULTS

G - GRADATION, Q - UNCONFINED COMPR, T - TRIAXIAL COMPR, C - CONSOLIDATION } SEE SEPARATE CURVES

H - PENETROMETER (tsf), W - UNIT DRY WEIGHT (pcf), D - RELATIVE DENSITY (%)

JOB: 38504

-CONTINUED-

BBC&M

LOG OF BORING NO. B-305
APEX SLF
JEFFERSON COUNTY, OHIO

LOCATION: See Plate 1 ELEVATION: 1215.9 DATE: 8/21/95

DRILLING METHOD: 5-3/4" Tricone Bit - Air Rotary COMPLETION DEPTH: 87.0'

SAMPLER(S):

DEPTH, FEET	SAMPLE NUMBER	SAMPLE	SAMPLE EFFORT	DESCRIPTION - CONTINUED	NATURAL CONSISTENCY INDEX / NATURAL MOISTURE CONTENT (PLASTIC LIMIT, LIQUID LIMIT; 10 20 30 40)	TEST RESULTS
40				Medium-hard brown and gray silty shale.		
45				Medium-hard gray with brown siltstone, few seams of shale.		
50						
55				Medium-hard gray shale.		
60						
65				Medium-hard gray siltstone.		
70						
75						
80						

WATER LEVEL:	▽ "Dry"	▼ 42.9	▼ 40.7
WATER NOTE:			
DATE:	08/21/95	08/22/95	08/23/95

SYMBOLS USED TO INDICATE TEST RESULTS

G - GRADATION
Q - UNCONFINED COMPR
T - TRIAXIAL COMPR
C - CONSOLIDATION
} SEE SEPARATE CURVES

H - PENETROMETER (tsf)
W - UNIT DRY WEIGHT (pcf)
D - RELATIVE DENSITY (%)

JOB: 38504

-CONTINUED-

BBC&M

LOG OF BORING NO. B-305
APEX SLF
JEFFERSON COUNTY, OHIO

LOCATION: See Plate 1 ELEVATION: 1215.9 DATE: 8/21/95

DRILLING METHOD: 5-3/4" Tricone Bit - Air Rotary COMPLETION DEPTH: 87.0'

SAMPLER(S):

DEPTH, FEET	SAMPLE NUMBER	SAMPLE	SAMPLE EFFORT	DESCRIPTION - CONTINUED	NATURAL CONSISTENCY INDEX / NATURAL MOISTURE CONTENT (PLASTIC LIMIT — LIQUID LIMIT; 10 20 30 40)	TEST RESULTS
80				Medium-hard gray siltstone.		
85				- Encountered no water.		
90				- Boring converted to groundwater monitoring well. See well completion diagram.		
95						
100						
105						
110						
115						
120						

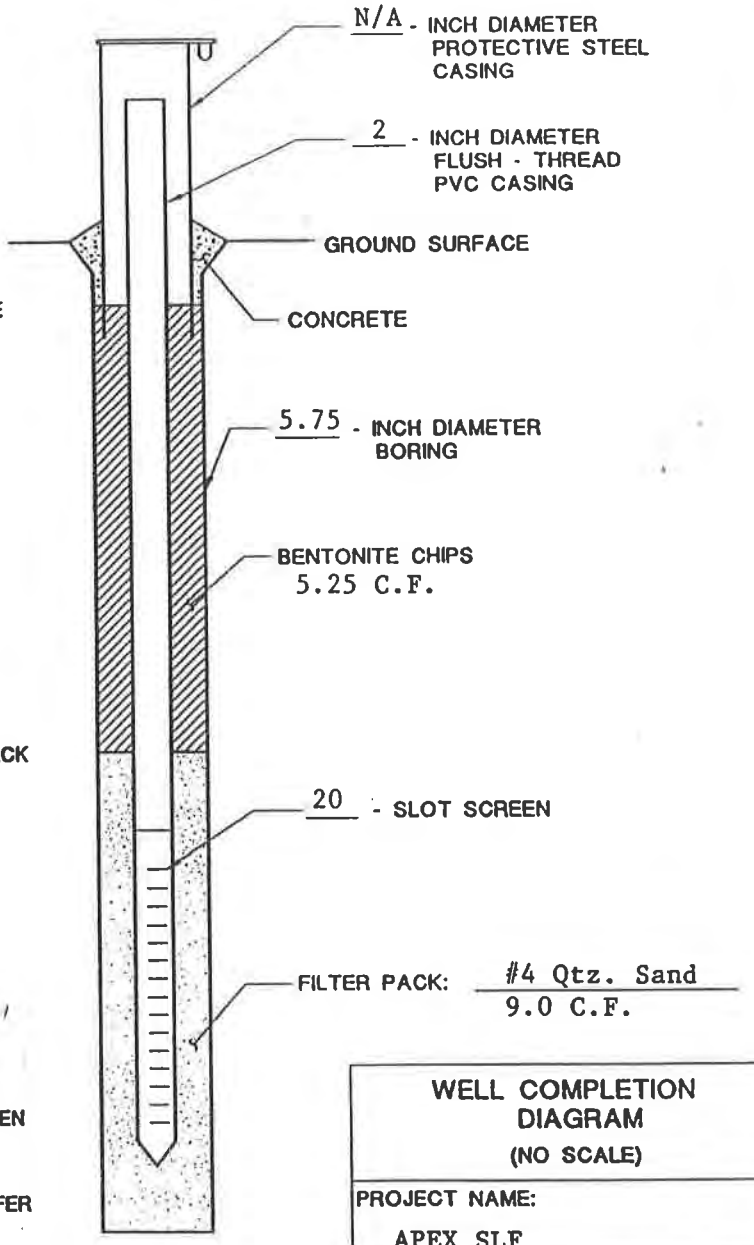
WATER LEVEL:	▽ "Dry"	▼ 42.9	▼ 40.7
WATER NOTE:			
DATE:	08/21/95	08/22/95	08/23/95

SYMBOLS USED TO INDICATE TEST RESULTS

G - GRADATION, Q - UNCONFINED COMPR, T - TRIAXIAL COMPR, C - CONSOLIDATION — SEE SEPARATE CURVES

H - PENETROMETER (tsf)
W - UNIT DRY WEIGHT (pcf)
D - RELATIVE DENSITY (%)

ELEV. #	DEPTH BELOW GROUND SURFACE (FEET)	
–	N/A	TOP OF COVER
1217.97	2.1	TOP OF PVC
1215.9	0.0	GROUND SURFACE
1215.9	0.0	TOP OF BENTONITE
1181.3	34.6	TOP OF FILTER PACK
1177.6	38.3	TOP OF AQUIFER TOP OF SCREEN OPENINGS
1168.2	47.7	BOTTOM OF SCREEN OPENINGS
1167.7	48.2	BOTTOM OF WELL
1128.9	87.0	BOTTOM OF AQUIFER BORING DEPTH



WELL COMPLETION DIAGRAM
(NO SCALE)

PROJECT NAME: APEX SLF

BORING: B-305

DATE WELL INSTALLED: 8/22/95

BBC & M PROJECT NO: 3805-4

STATIC WATER LEVEL #	1175.18			
DATE:	8/23			

WELL DEVELOPMENT:
8/22 Hand bailed 8 gallons (dry), water very silty.
8/23 Hand bailed 4.5 gallons, water silty.

FEET ABOVE MSL

BBC&M ENGINEERING, INC.

BBC&M

LOG OF BORING NO. B-306
APEX SLF
JEFFERSON COUNTY, OHIO

LOCATION: See Plate 1 ELEVATION: 1201.4 DATE: 8/21/95

DRILLING METHOD: 6-3/4" Tricone Bit - Air Rotary COMPLETION DEPTH: 30.3'

SAMPLER(S):

DEPTH, FEET	SAMPLE NUMBER	SAMPLE	SAMPLE EFFORT	DESCRIPTION	NATURAL CONSISTENCY INDEX (NATURAL MOISTURE CONTENT; PLASTIC LIMIT; LIQUID LIMIT) 10 20 30 40	TEST RESULTS
0				TOPSOIL - 6 INCHES		
				Brown silty clay, little fine to coarse sand.		
5				Very-soft brown shale.		
				Medium-hard gray and dark-gray shale.		
10				Very-soft to soft brown and gray shale.		
15				Soft to medium-hard gray with dark-gray shale, silty in parts.		
20				Medium-hard dark-gray carbonaceous shale.		
25				Medium-hard brown coal.		
				Medium-hard dark-gray carbonaceous shale.		
				Medium-hard gray siltstone.		
30				- Encountered water at 27.0'.		
				- Boring converted to groundwater monitoring well. See well completion diagram.		
35						
40						

WATER LEVEL:	▽ 26.3	▽ 19.0	▽ 19.2
WATER NOTE:			
DATE:	08/21/95	08/22/95	08/23/95

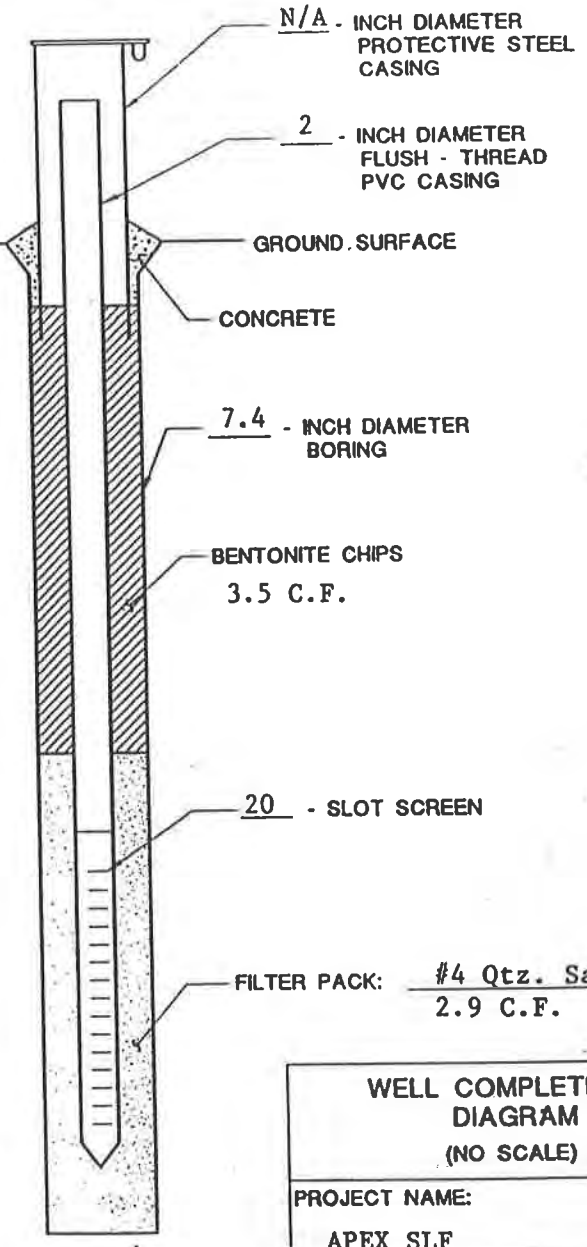
SYMBOLS USED TO INDICATE TEST RESULTS

G - GRADATION
Q - UNCONFINED COMPR
T - TRIAXIAL COMPR
C - CONSOLIDATION
} SEE SEPARATE CURVES

H - PENETROMETER (tsf)
W - UNIT DRY WEIGHT (pcf)
D - RELATIVE DENSITY (%)

JOB: 38504

ELEV. #	DEPTH BELOW GROUND SURFACE (FEET)	
0.0	N/A	TOP OF COVER
1202.99	1.6	TOP OF PVC
1201.4	0.0	GROUND SURFACE
1201.1	0.3	TOP OF BENTONITE
1182.7	18.7	TOP OF FILTER PACK
		TOP OF AQUIFER
1182.6	18.8	TOP OF SCREEN OPENINGS
1173.2	28.2	BOTTOM OF SCREEN OPENINGS
1172.7	28.7	BOTTOM OF WELL
		BOTTOM OF AQUIFER
1171.1	30.3	BORING DEPTH



WELL COMPLETION DIAGRAM
(NO SCALE)

PROJECT NAME: APEX SLF

BORING: B-306

DATE WELL INSTALLED: 8/22/95

BBC & M PROJECT NO: 3850-4

STATIC WATER LEVEL #	1182.18				
DATE:	8/23				

WELL DEVELOPMENT: 8/22 Hand bailed 10 gallons, water silty.

FEET ABOVE MSL

TCAMWEL2

CIVIL & ENVIRONMENTAL CONSULTANTS, INC

8740 Orion Pl., Suite 100
Columbus, OH 43240

Phone 614-540-6633 Fax 614-540-6638

BOREHOLE LOG

BOREHOLE/WELL NO.: **B-401**

TOTAL DEPTH (BGS): **146 feet**

PROJECT INFORMATION		DRILLING INFORMATION	
PROJECT:	Apex Sanitary Landfill	DRILLING CO./DRILLER:	Duncan Bros. Drilling Inc.
SITE LOCATION:	Amsterdam, OH	DRILLING RIG/METHOD:	Air Rotary / NX Air Core
PROJECT NO.:	042-021	BOREHOLE DIAMETER:	9 7/8" & 6 1/8" Tri-cone Bits
FIELD GEOLOGIST:	D. Crayne	WELL DIAMETER:	2"
DATES DRILLED:	6/10/05 to 6/15/05	GROUND/TOC ELEVATION:	1262.95 / 1265.63 ft amsl

⧗ Water level during drilling ⧗ Water Level After Development

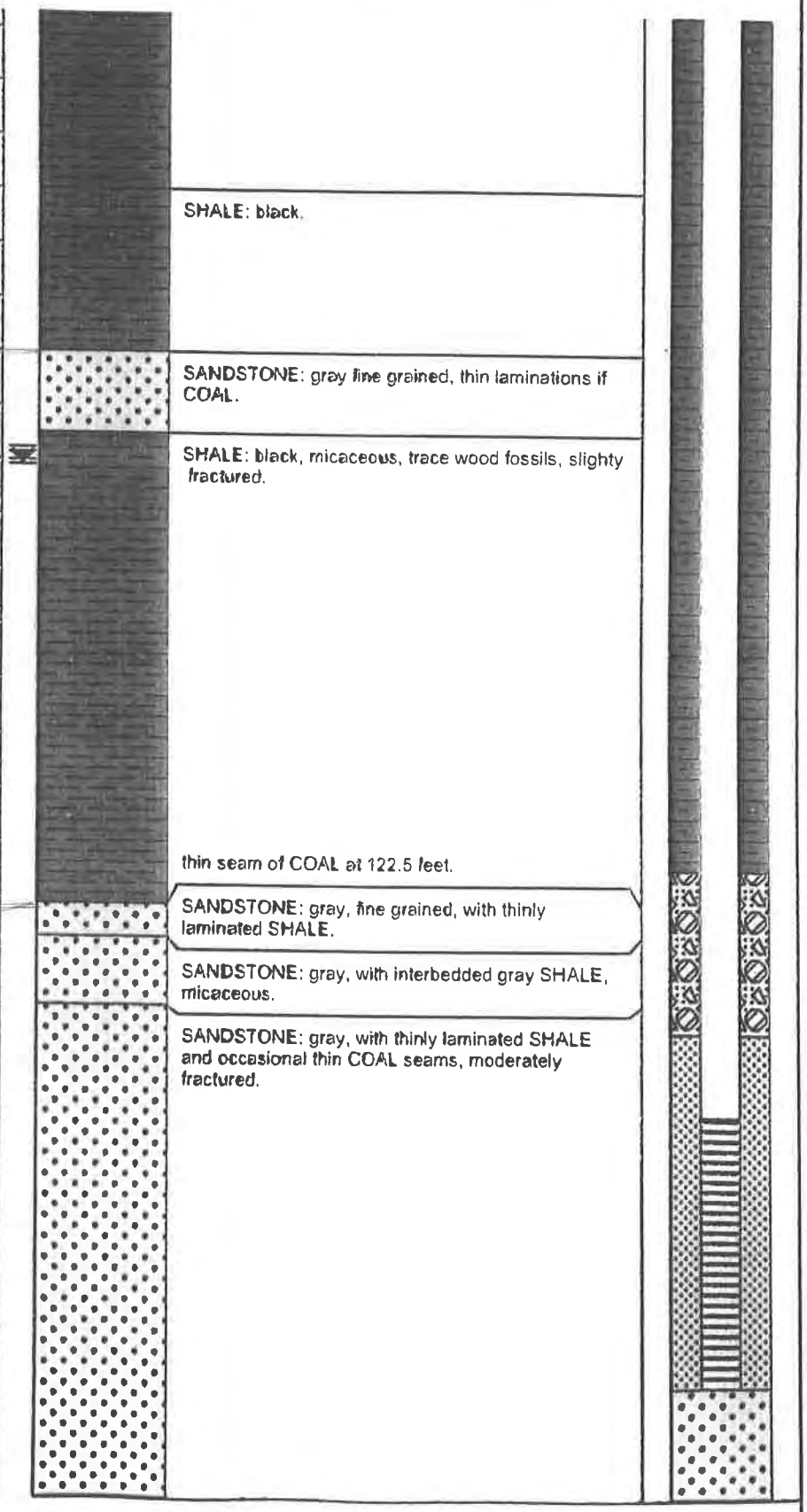
SAMPLE/ CORE NO.	SAMPLE INTERVAL	SAMPLE RECOVERY (ft' in")	RQD (%)	%Recovery	DEPTH	SOIL SYMBOLS	LITHOLOGY	WELL COMPLETION
	9 7/8" Tri-cone Log Cuttings				0		MINE SPOIL: brown with rock fragment	
					18		LIMESTONE: boulder.	
					20		MINE SPOIL: brown, dry.	

OBSERVATIONS:
9 7/8" Tri-cone to 60' set 7" casing. 6 1/8" Tri-cone to 105'. Core from 105' to 146'.

SAMPLE/ CORE NO.	SAMPLE INTERVAL	SAMPLE RECOVERY (ft' in")	RQD (%)	%Recovery	DEPTH	SOIL SYMBOLS	LITHOLOGY	WELL COMPLETION
	6 1/8" Tri-cone Log Cuttings				38–90		LIMESTONE: gray, weak, with SHALE fragments, wet @ 47 feet.	
					52		COAL: seam, wet, estimated thickness.	
					54–70		SHALE: black, trace pyrite, black water return. Above contact is approximate	
					70–74		SILTSTONE: with some SHALE cutting, gray.	
					74–78		SHALE: black.	
					78–80		SILTSTONE: with SHALE interbeds.	
					80–86		SHALE: black, with few SILTSTONE interbeds.	
					86–90		SILTSTONE: gray, with trace black SHALE cuttings.	
					90		SHALE: black, with few interbeds of gray SHALE.	

OBSERVATIONS:
9 7/8" Tri-cone to 60' set 7" casing. 6 1/8" Tri-cone to 105'. Core from 105' to 146'.

SAMPLE/ CORE NO.	SAMPLE INTERVAL	SAMPLE RECOVERY (ft' in")	RQD (%)	%Recovery
CR#1	105'-110'	4'2"	75%	83%
CR#2	110'-119'	8'10"	84%	98%
CR#3	119'-128'	8'5"	60%	94%
CR#4	128'-137'	8'	43%	89%
CR#5	137'-146'	9'3"	50%	100%



OBSERVATIONS:
9 7/8" Tri-cone to 60' set 7" casing. 6 1/8" Tri-cone to 105'. Core from 105' to 146'.

WELL CONSTRUCTION LOG	PROJECT	PROJECT NUMBER	
	Apex Sanitary Landfill	042-021	B-401
COORDINATES	GROUND SURFACE ELEVATION	TOP OF PVC ELEVATION	
N 281493.54 E 2409466.83	1262.95 feet amsl	1265.63 feet amsl	

CITY & STATE:
Amsterdam, OH
COUNTY: Jefferson County
INSTALLATION DATE:
6/10/05 to 6/15/05

DRILLING METHOD: Air Rotary / NX Air Core
DRILLING CONTRACTOR:
Duncan Bros. Drilling Inc.

DELEVOPED BY: DWC
DATE: 7/7/05

DEVELOPMENT TECHNIQUE(S):
Grundfos Pump and Bailer

WATER REMOVED DURING DEVELOPMENT:
35 gallons

DEPTH to WATER: 109.93

SOUNDED DEPTH FROM TOC:
145.40 feet

SCREENED INTERVAL ELEVATION: 1130.23'-1120.23'

COMMENTS:
9 7/8" Tri-cone to 60' set 7" casing. 6 1/8" Tri-cone to 105'. Core from 105' to 146'.

7" Surface Casing to 60'

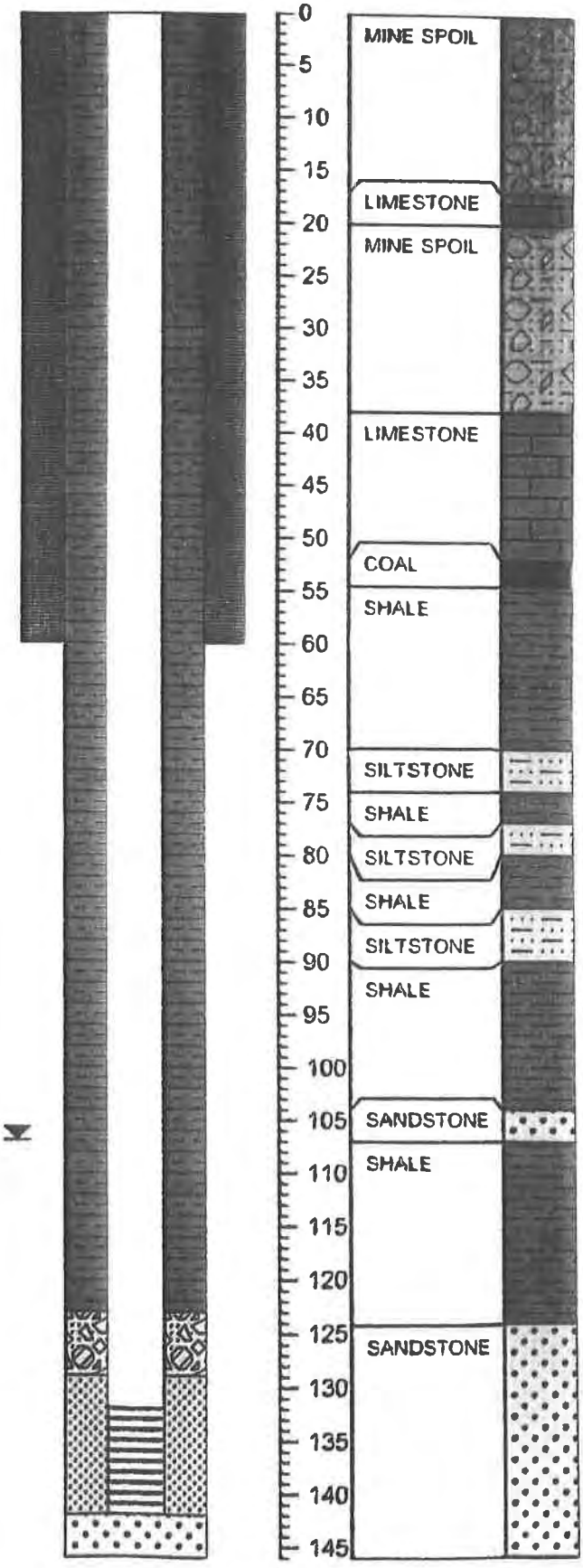
Sealed using bentonite clay slurry

2" Well Diameter

6" Borehole Diameter

Hole Plug

No. 7 Fine Sand



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BOREHOLE LOG

BOREHOLE/WELL NO.: B-401S

TOTAL DEPTH (BGS): 115 feet

PROJECT INFORMATION

PROJECT:	Apex Sanitary Landfill
SITE LOCATION:	Amsterdam, OH
PROJECT NO.:	042-021
FIELD GEOLOGIST:	D. Crayne
DATES DRILLED:	6/16/05 to 6/17/05

DRILLING INFORMATION

DRILLING CO./DRILLER:	Duncan Bros. Drilling Inc.
DRILLING RIG/METHOD:	Air Rotary / NX Air Core
BOREHOLE DIAMETER:	9 7/8" & 6 1/8" Tri-cone Bits
WELL DIAMETER:	2"
GROUND/TOC ELEVATION:	1275.52 / 1278.27 ft amsl

⊻ Water level during drilling

⊻ Water Level After Development

SAMPLE/ CORE NO.	SAMPLE INTERVAL	SAMPLE RECOVERY (ft' in")	RQD (%)	%Recovery	DEPTH	SOIL SYMBOLS	LITHOLOGY	WELL COMPLETION
	9 7/8" Tri-cone Log Cuttings				0		MINE SPOIL: brown to gray, with CLAY and rock fragments.	
					2			
					4			
					6			
					8			
					10			
					12			
					14			
					16			
					18			
					20			
					22			
					24			
					26		LIMESTONE: boulder.	
					28		MINE SPOIL: brown to gray, with CLAY and rock	

OBSERVATIONS:
9 7/8" Tri-cone to 69' set 7" casing. 6 1/8" Tri-cone to 75'. Core from 75' to 115'.

SAMPLE/ CORE NO.	SAMPLE INTERVAL	SAMPLE RECOVERY (ft. in.)	RQD (%)	%Recovery	DEPTH	SOIL SYMBOLS	LITHOLOGY	WELL COMPLETION
					30		fragments.	
					32			
					34			
					36			
					38			
					40			
					42			
					44		LIMESTONE: boulder.	
					46		Lost cutting return.	
					48		Below contact is approximate.	
					50		LIMESTONE: with SHALE fragments	
					52			
					54			
					56			
					58			
					60			
					62			
					64			
					66		Approximate top of competent rock at 67 feet., Wet.	
					68		SANDSTONE: gray, fine grained.	
					70			
					72		SHALE: gray.	

6 1/8" Tri-cone Log Cuttings

OBSERVATIONS:
9 7/8" Tri-cone to 69' set 7" casing. 6 1/8" Tri-cone to 75'. Core from 75' to 115'.

SAMPLE/ CORE NO.	SAMPLE INTERVAL	SAMPLE RECOVERY (ft' in")	RQD (%)	%Recovery	DEPTH	SOIL SYMBOLS	LITHOLOGY	WELL COMPLETION
CR#1	75'-85'	8'3"	37%	83%	74			
					76		SHALE: black, intensely fractured.	
					78			
					80		SILTSTONE: dark gray, highly weathered, moderately fractured.	
					82		Vertical fracture at 83 feet.	
CR#2	85'-94'	5'10"	36%	65%	84			
					86			
					88			
					90			
					92			
					94		SHALE: black, laminated COAL, highly weathered, intensely fractured.	
CR#3	94'-103'	6'4"	40%	70%	96			
					98			
					100		SILTSTONE: gray, moderately fractured, horizontal and vertical.	
					102			
CR#4	103'-109'	6'3"	5%	100%	104		SILTSTONE: gray, intensely fractured, horizontal.	
					106			
					108			
CR#5	109'-115'	5'6"	12%	92%	110			
					112			
					114			

OBSERVATIONS:
9 7/8" Tri-cone to 69' set 7" casing. 6 1/8" Tri-cone to 75'. Core from 75' to 115'.

WELL CONSTRUCTION LOG

PROJECT	PROJECT NUMBER	
Apex Sanitary Landfill	042-021	B-401S

COORDINATES	GROUND SURFACE ELEVATION	TOP OF PVC ELEVATION
N 281703.01 E 2409401.50	1275.52 feet amsl	1278.27 feet amsl

CITY & STATE:
Amsterdam, OH

COUNTY: Jefferson County

INSTALLATION DATE:
6/16/05 to 6/17/05

DRILLING METHOD: Air Rotary / NX Air Core

DRILLING CONTRACTOR:
Duncan Bros. Drilling Inc.

DELEVOPED BY: DWC

DATE: 7/7/05

DEVELOPMENT TECHNIQUE(S):
Grundfos Pump and Bailer

WATER REMOVED DURING DEVELOPMENT:
5 gallons and DRY

DEPTH to WATER: DRY

SOUNDED DEPTH FROM TOC:
118.07 feet

SCREENED INTERVAL ELEVATION: 1170.20'-1160.20'

COMMENTS:
9 7/8" Tri-cone to 69' set 7" casing. 6 1/8" Tri-cone to 75'. Core from 75' to 115'.

7" Surface Casing to 69'

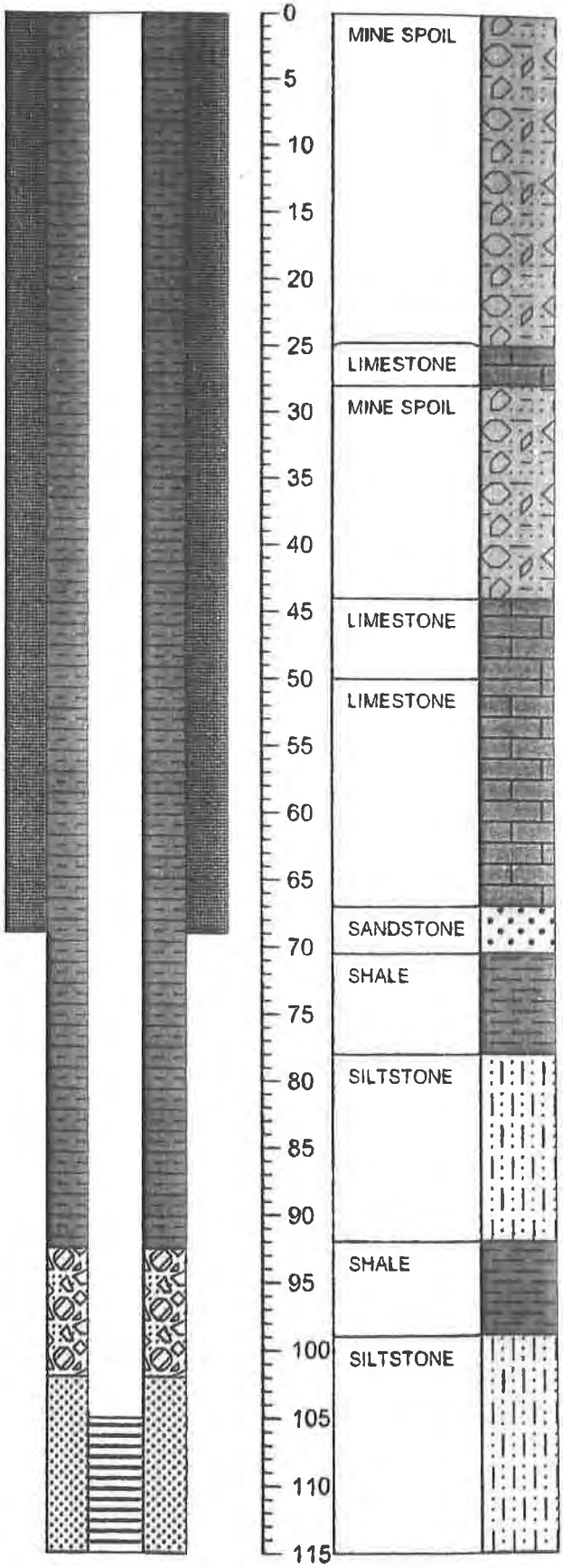
Sealed using bentonite clay slurry

2" Well Diameter

6" Borehole Diameter

Hole Plug

No. 7 Fine Sand



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BOREHOLE LOG

BOREHOLE/WELL NO.: **B-401A**

TOTAL DEPTH (BGS): **50 feet**

PROJECT INFORMATION

PROJECT:	Apex Sanitary Landfill
SITE LOCATION:	Amsterdam, OH
PROJECT NO.:	042-021
FIELD GEOLOGIST:	D. Crayne
DATES DRILLED:	8/3/06

DRILLING INFORMATION

DRILLING CO./DRILLER:	Duncan Bros. Drilling Inc.
DRILLING RIG/METHOD:	Air Rotary
BOREHOLE DIAMETER:	6 1/8" Tri-cone
WELL DIAMETER:	2"
GROUND/TOC ELEVATION:	1266.75 / 1269.45ft amsl

▼ Water level during drilling

▼ Water Level After Development

SAMPLE/ CORE NO.	SAMPLE INTERVAL	SAMPLE RECOVERY (ft' in")	RQD (%)	%Recovery	DEPTH	SOIL SYMBOLS	LITHOLOGY	WELL COMPLETION
	Log Cuttings				0–50		MINE SPOIL: Brown to gray, some rock fragment. Loose/easy drilling. (0–24') LIMESTONE: Boulder gray (24–26') MINE SPOIL: Brown to gray, some rock fragment. Loose/easy drilling. (26–28') LIMESTONE: Boulder, gray (28–32') MINE SPOIL: Brown to gray, some boulders. Drilling becomes very hard from 35'-37.5'. Broke through after 37.5'. Picked up some water and lost cutting return at 42'. Drilling becomes very rough and broken up. (32–50')	

OBSERVATIONS:
Blind drill with 6 1/8" tri-cone

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BOREHOLE LOG

BOREHOLE/WELL NO.: **B-402**

TOTAL DEPTH (BGS): **155 feet**

PROJECT INFORMATION		DRILLING INFORMATION	
PROJECT:	Apex Sanitary Landfill	DRILLING CO./DRILLER:	Duncan Bros. Drilling Inc.
SITE LOCATION:	Amsterdam, OH	DRILLING RIG/METHOD:	Air Rotary / NX Air Core
PROJECT NO.:	042-021	BOREHOLE DIAMETER:	9 7/8" & 6 1/8" Tri-cone Bits
FIELD GEOLOGIST:	D. Crayne	WELL DIAMETER:	2"
DATES DRILLED:	6/8/05 to 6/9/05	GROUND/TOC ELEVATION:	1263.12 / 1266.19 ft amsl

⧖ Water level during drilling ⧖ Water Level After Development

SAMPLE/ CORE NO.	SAMPLE INTERVAL	SAMPLE RECOVERY (ft. in.)	RQD (%)	%Recovery	DEPTH	SOIL SYMBOLS	LITHOLOGY	WELL COMPLETION
9 7/8" Tri-cone Log Cuttings					0 2 4 6 8 10 12 14 16 18 20 22 24 26 28 30 32 34 36 38		MINE SPOIL: brown, with CLAY and rock fragments. wet at 36 feet.	

OBSERVATIONS:
9 7/8" Tri-cone to 44' set 7" casing. 6 1/8" Tri-cone to 110'. Core from 110' to 155'.

SAMPLE/ CORE NO.	SAMPLE INTERVAL	SAMPLE RECOVERY (ft' in")	RQD (%)	%Recovery	DEPTH	SOIL SYMBOLS	LITHOLOGY	WELL COMPLETION
	6 1/8" Tri-cone Log Cuttings				40		LIMESTONE: gray, with some SHALE cuttings.	
					42			
					44			
					46		wet @ 45 feet.	
					48			
					50			
					52			
					54			
					56			
					58			
					60			
					62			
					64			
					66			
					68			
					70			
					72		SILTSTONE: gray, with some SHALE interbeds.	
					74			
					76			
					78			
					80			
					82			
					84			
					86			
					88			
					90			
					92			
					94			
					96			

OBSERVATIONS:
9 7/8" Tri-cone to 44' set 7" casing. 6 1/8" Tri-cone to 110'. Core from 110' to 155'.

SAMPLE/ CORE NO.	SAMPLE INTERVAL	SAMPLE RECOVERY (ft' in")	RQD (%)	%Recovery	DEPTH	SOIL SYMBOLS	LITHOLOGY	WELL COMPLETION
CR#1	110'-120'	7'10"	83%	78%	98, 100, 102, 104, 106, 108, 110, 112, 114, 116, 118, 120, 122, 124, 126, 128, 130, 132, 134, 136, 138, 140, 142, 144, 146, 148, 150, 152, 154		SILTSTONE: gray, few organic fossils, trace lenses of SANDSTONE, few seams of SHALE, moderately fractured	
CR#2	120'-128'	7'10"	45%	98%				
CR#3	128'-137'	8'4"	55%	93%			SILTSTONE: with interbedded SHALE, few organic fossils, intensely fractured.	
CR#4	137'-146'	9'4"	78%	100%			SANDSTONE: gray, medium grained, thin laminations of COAL and SHALE at fractures, moderately fractured.	
CR#5	146'-155'	9'6"	88%	100%				

OBSERVATIONS:
9 7/8" Tri-cone to 44' set 7" casing. 6 1/8" Tri-cone to 110'. Core from 110' to 155'.

WELL CONSTRUCTION LOG	PROJECT	PROJECT NUMBER	B-401A
	Apex Sanitary Landfill	042-021	
COORDINATES	GROUND SURFACE ELEVATION	TOP OF PVC ELEVATION	
N 281586.96 E 2409294.44	1266.75 feet amsl	1269.45 feet amsl	

CITY & STATE:
Amsterdam, OH

COUNTY: Jefferson County

INSTALLATION DATE:
8/3/2006

DRILLING METHOD: 6 1/8"
Tri-cone w/ Air Rotary

DRILLING CONTRACTOR:
Duncan Bros. Drilling Inc.

DELEVOPED BY: DWC/JK
DATE: 8/17/06

DEVELOPMENT TECHNIQUE(S):
Grundfos Pump and SS Bailer

WATER REMOVED DURING DEVELOPMENT:
151 gallons

Depth to WATER: 44.54 feet

SOUNDED DEPTH FROM TOC:
48.30 feet

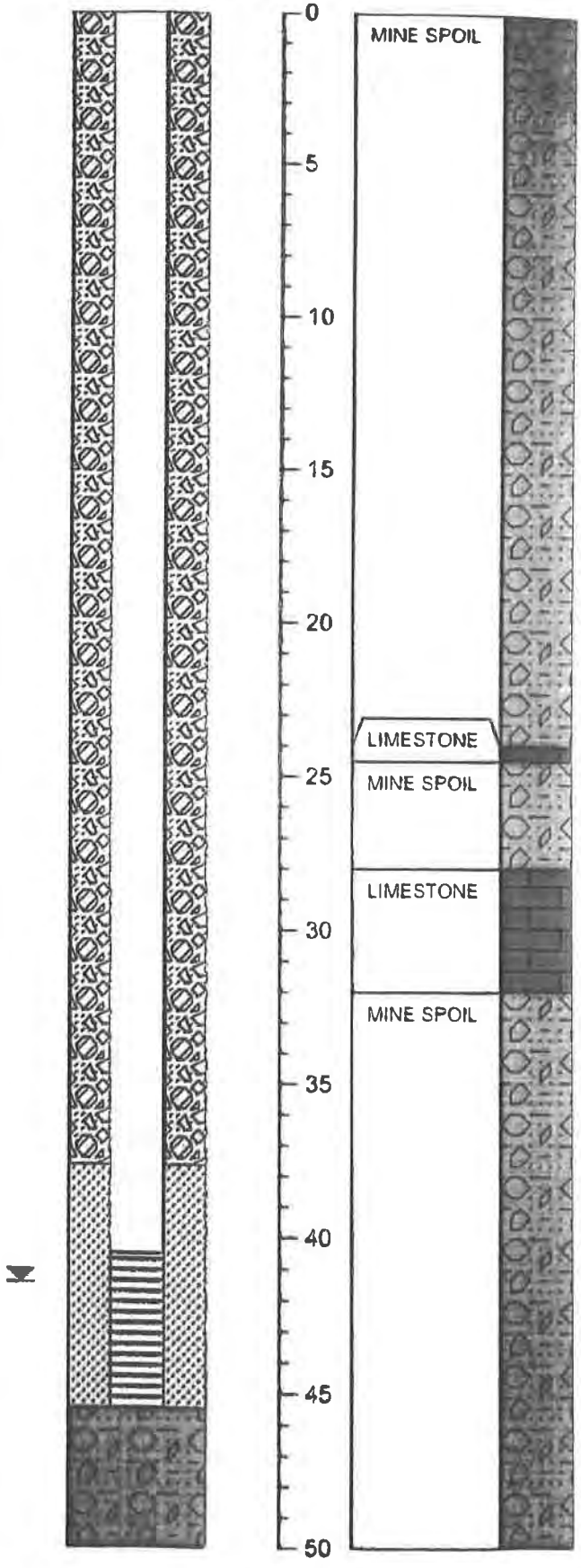
SCREENED INTERVAL ELEVATION: '- '

COMMENTS:

6" Borehole Diameter

2" Well Diameter

No. 4 Fine Sand



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WELL CONSTRUCTION LOG

PROJECT	PROJECT NUMBER	
Apex Sanitary Landfill	042-021	B-402

COORDINATES	GROUND SURFACE ELEVATION	TOP OF PVC ELEVATION
N 281126.81 E 2410084.67	1263.12 feet amsl	1266.19 feet amsl

CITY & STATE:
Amsterdam, OH
COUNTY: Jefferson County
INSTALLATION DATE:
6/8/05 to 6/9/05

DRILLING METHOD: Air Rotary / NX Air Core
DRILLING CONTRACTOR:
Duncan Bros. Drilling Inc.

DELEVOPED BY: DWC
DATE: 7/6 & 7/7/05

DEVELOPMENT TECHNIQUE(S):
Grundfos Pump and Bailer

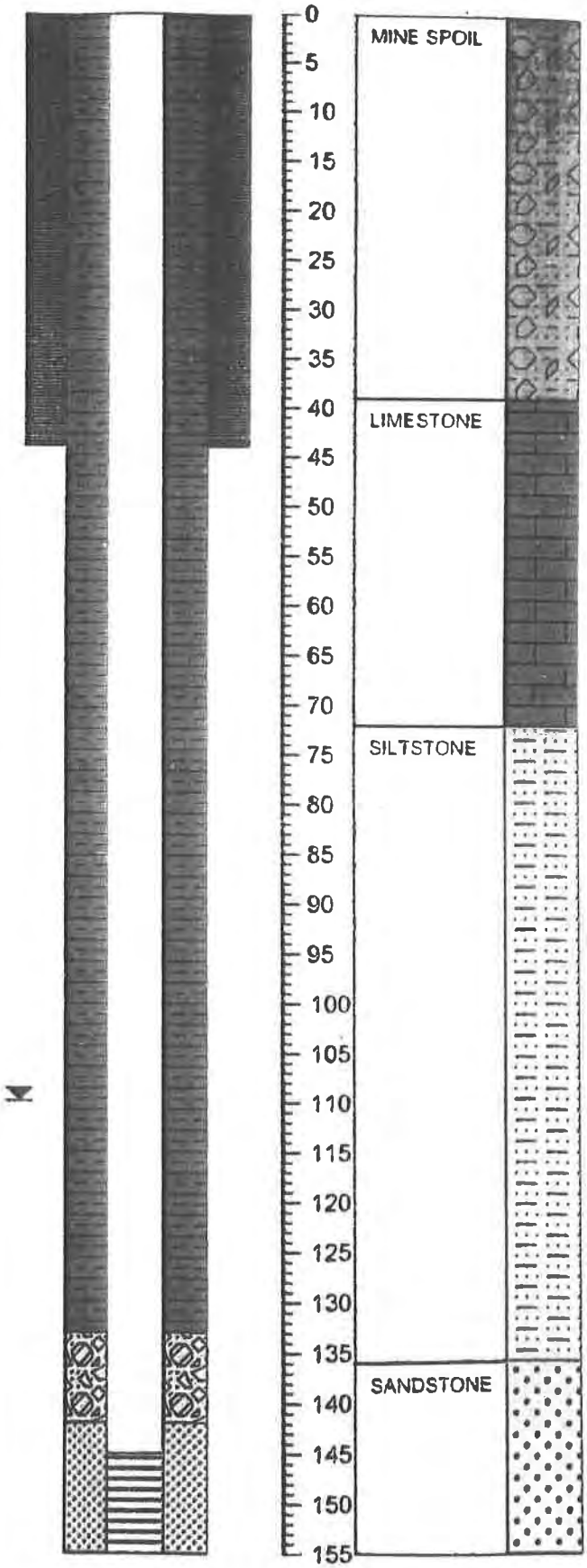
WATER REMOVED DURING DEVELOPMENT:
24 gallons

DEPTH to WATER: 112.53

SOUNDED DEPTH FROM TOC:
157.53 feet

SCREENED INTERVAL ELEVATION: 1118.66'-1108.66'

COMMENTS:
9 7/8" Tri-cone to 44' set 7" casing. 6 1/8" Tri-cone to 110'. Core from 110' to 155'.



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BOREHOLE LOG

BOREHOLE/WELL NO.: **B-402S**

TOTAL DEPTH (BGS): **90 feet**

PROJECT INFORMATION

PROJECT:	**Apex Sanitary Landfill**
SITE LOCATION:	**Amsterdam, OH**
PROJECT NO.:	**042-021**
FIELD GEOLOGIST:	**D. Crayne**
DATES DRILLED:	**6/6/05 to 6/7/05**

DRILLING INFORMATION

DRILLING CO./DRILLER:	**Duncan Bros. Drilling Inc.**
DRILLING RIG/METHOD:	**Air Rotary / NX Air Core**
BOREHOLE DIAMETER:	**9 7/8" & 6 1/8" Tri-cone Bits**
WELL DIAMETER:	**2"**
GROUND/TOC ELEVATION:	**1257.59 / 1260.64 ft amsl**

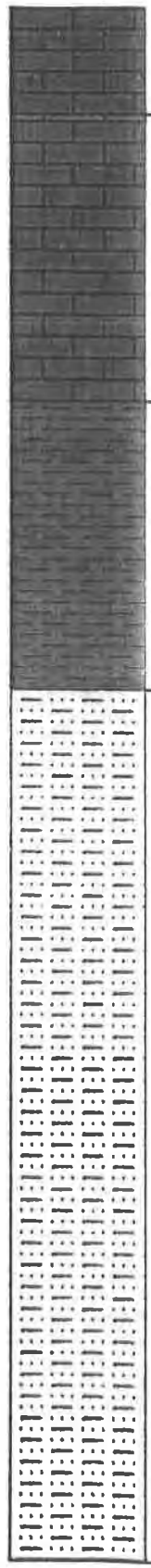
⧗ Water level during drilling

⧗ Water Level After Development

SAMPLE/ CORE NO.	SAMPLE INTERVAL	SAMPLE RECOVERY (ft. in.)	RQD (%)	%Recovery	DEPTH	SOIL SYMBOLS	LITHOLOGY	WELL COMPLETION
	9 7/8" Tri-cone Log Cuttings				0		MINE SPOIL: gray, with CLAY and rock fragments, hit water @ 23 feet.	
					24		LIMESTONE: gray trace SHALE fragments.	
	6 1/8" Tri-cone Log Cuttings				32 ⧗			
					36			

OBSERVATIONS:
9 7/8" Tri-cone to 27' set 7" casing. 6 1/8" Tri-cone to 40'. Core from 40' to 90'.

SAMPLE/ CORE NO.	SAMPLE INTERVAL	SAMPLE RECOVERY (ft' in")	RQD (%)	%Recovery
CR#1	40'-50'	9'2"	48%	92%
CR#2	50'-59'	6'5"	32%	71%
CR#3	59'-68'	9'3"	58%	100%
CR#4	68'-77'	8'7"	96%	95%
CR#5	77'-86'	9'7"	83%	100%
CR#6	86'-90'	3'7"	81%	90%



LIMESTONE: gray to black with some Sandstone lenses and Siltstone lenses

SHALE: very weak, poor RQD, some Clay lenses.

SILTSTONE: gray, micaceous, lenses of Sandstone, trace organic fossils

OBSERVATIONS:
9 7/8" Tri-cone to 27' set 7" casing. 6 1/8" Tri-cone to 40'. Core from 40' to 90'.

WELL CONSTRUCTION LOG

PROJECT	PROJECT NUMBER	
Apex Sanitary Landfill	042-021	B-402S

COORDINATES	GROUND SURFACE ELEVATION	TOP OF PVC ELEVATION
N 281453.23 E 2409947.60	1257.59 feet amsl	1260.64 feet amsl

CITY & STATE:
Amsterdam, OH

COUNTY: Jefferson County

INSTALLATION DATE:
6/6/05 to 6/7/05

DRILLING METHOD: Air Rotary / NX Air Core

DRILLING CONTRACTOR:
Duncan Bros. Drilling Inc.

DELEVOPED BY: DWC

DATE: 7/6 & 7/7/05

DEVELOPMENT TECHNIQUE(S):
Grundfos Pump and Bailer

WATER REMOVED DURING DEVELOPMENT:
17 gallons and DRY

DEPTH to WATER: DRY

SOUNDED DEPTH FROM TOC:
92.39 feet

SCREENED INTERVAL ELEVATION: 1178.25'-1168.25'

7" Surface Casing to 27'

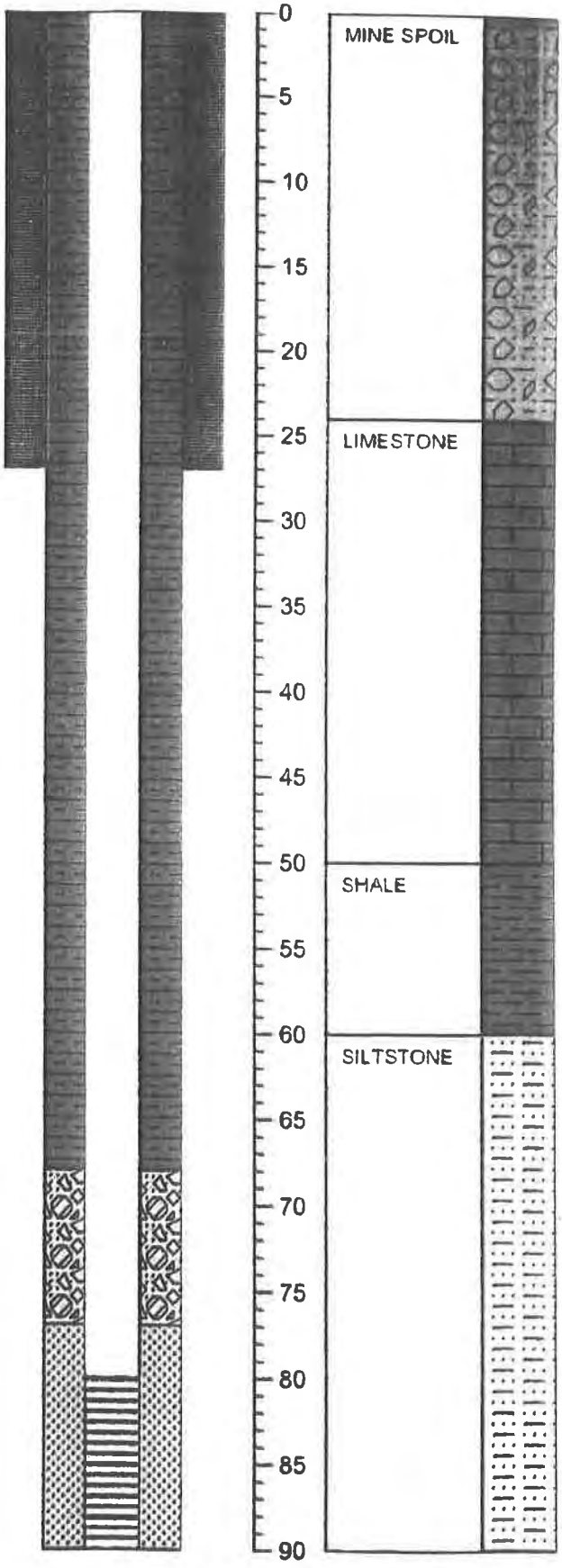
2" Well Diameter

6" Borehole Diameter

Sealed using bentonite clay slurry

Hole Plug

No. 7 Fine Sand



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BOREHOLE LOG

BOREHOLE/WELL NO.: **B-402A**

TOTAL DEPTH (BGS): **60 feet**

PROJECT INFORMATION

PROJECT:	**Apex Sanitary Landfill**
SITE LOCATION:	**Amsterdam, OH**
PROJECT NO.:	**042-021**
FIELD GEOLOGIST:	**D. Crayne**
DATES DRILLED:	**8/2/06**

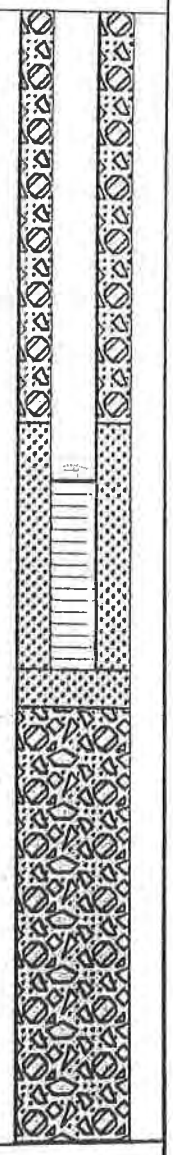
DRILLING INFORMATION

DRILLING CO./DRILLER:	**Duncan Bros. Drilling Inc.**
DRILLING RIG/METHOD:	**Air Rotary**
BOREHOLE DIAMETER:	**6 1/8" Tri-cone Bit**
WELL DIAMETER:	**2"**
GROUND/TOC ELEVATION:	**1258.03 / 1260.50ft amsl**

▽ Water level during drilling

▽ Water Level After Development

SAMPLE/ CORE NO.	SAMPLE INTERVAL	SAMPLE RECOVERY (ft. in.)	RQD (%)	%Recovery	DEPTH	SOIL SYMBOLS	LITHOLOGY	WELL COMPLETION
	Log Cuttings				0		TOPSOIL: brown	
					2			
					4		MINE SPOIL: brown to gray, some rock fragments. Water seepage at bottom of mine spoil.	
					6			
					8			
					10			
					12			
					14			
					16			
					18			
					20			
					22			
					24			
					26			
					28	▽		
	Log from B-402S				30		SHALE: black to gray, dry.	
					32			
					34			
					36		LIMESTONE: gray trace SHALE fragments	
					38			
					40			
					42		LIMESTONE: gray to black with some Sandstone lenses and Siltstone lenses	
					44			
					46			
					48			
					50			
					52		SHALE: very weak, poor RQD, some Clay lenses.	
					54			
					56			
					58			
					60			



OBSERVATIONS:
Blind drill with 6 1/8" tri-cone

WELL CONSTRUCTION LOG

PROJECT	PROJECT NUMBER	
Apex Sanitary Landfill	042-021	B-402A

COORDINATES	GROUND SURFACE ELEVATION	TOP OF PVC ELEVATION
N 281447.40 E 2409956.70	1258.03 feet amsl	1260.50 feet amsl

CITY & STATE:
Amsterdam, OH

COUNTY: Jefferson County

INSTALLATION DATE:
8/2/2006

DRILLING METHOD: 6 1/8"
Tri-cone w/ Air Rotary

DRILLING CONTRACTOR:
Duncan Bros. Drilling Inc.

DELEVOPED BY: DWC/JK
DATE: 8/16/06

DEVELOPMENT TECHNIQUE(S):
Grundfos Pump and SS Bailer

WATER REMOVED DURING DEVELOPMENT:
24 gallons
Depth to WATER: 32.79 feet

SOUNDED DEPTH FROM TOC:
37.88 feet
SCREENED INTERVAL ELEVATION: '- '

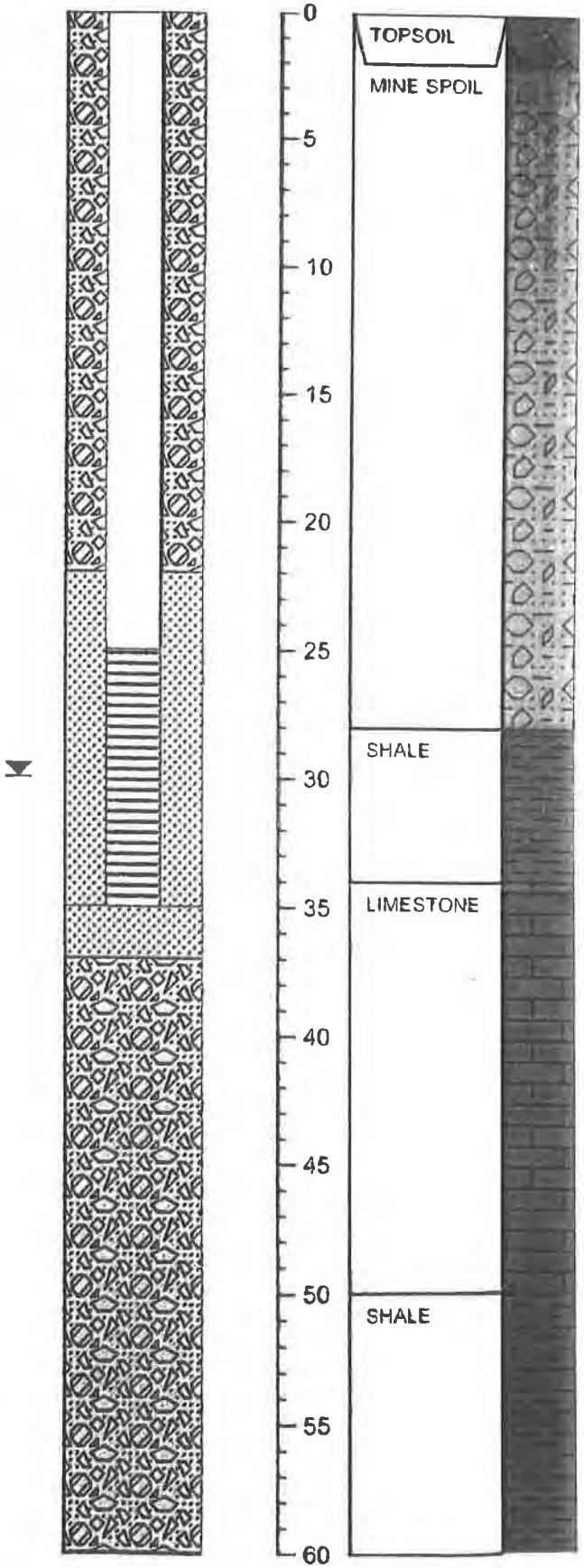
COMMENTS:

6" Borehole Diameter

2" Well Diameter

No. 4 Fine Sand

Hole Plug



CIVIL & ENVIRONMENTAL CONSULTANTS, INC.

CIVIL & ENVIRONMENTAL CONSULTANTS, INC

8740 Orion Pl., Suite 100
Columbus, OH 43240

Phone 614-540-6633 Fax 614-540-6638

BOREHOLE LOG

BOREHOLE/WELL NO.: **B-403**

TOTAL DEPTH (BGS): **118 feet**

PROJECT INFORMATION

PROJECT:	**Apex Sanitary Landfill**
SITE LOCATION:	**Amsterdam, OH**
PROJECT NO.:	**042-021**
FIELD GEOLOGIST:	**D. Crayne**
DATES DRILLED:	**6/21/05**

DRILLING INFORMATION

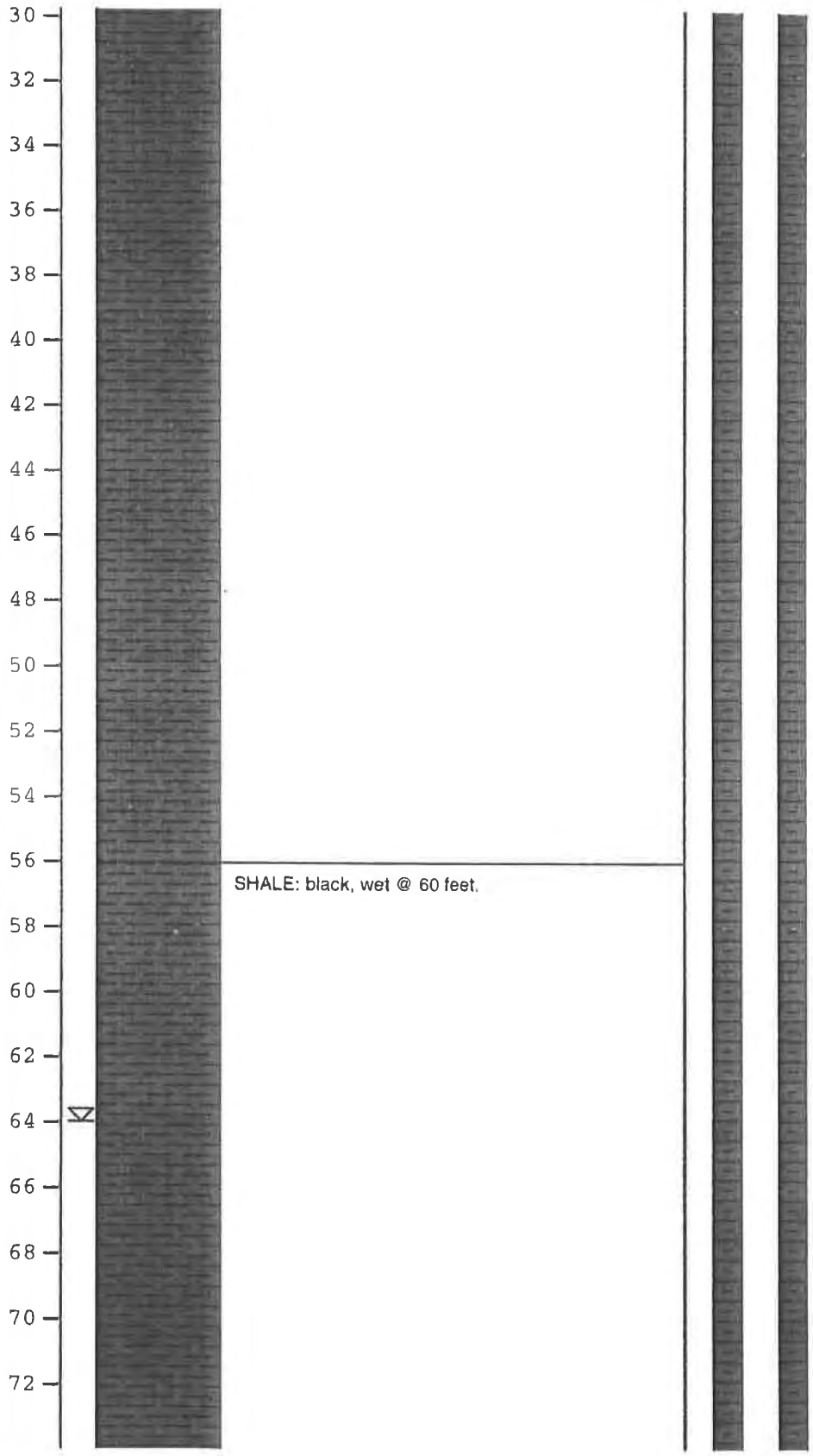
DRILLING CO./DRILLER:	**Duncan Bros. Drilling Inc.**
DRILLING RIG/METHOD:	**Air Rotary / NX Air Core**
BOREHOLE DIAMETER:	**9 7/8" & 6 1/8" Tri-cone Bits**
WELL DIAMETER:	**2"**
GROUND/TOC ELEVATION:	**1224.47 / 1226.84 ft amsl**

▼ Water level during drilling ▼ Water Level After Development

SAMPLE/ CORE NO.	SAMPLE INTERVAL	SAMPLE RECOVERY (ft' in")	RQD (%)	%Recovery	DEPTH	SOIL SYMBOLS	LITHOLOGY	WELL COMPLETION
	9 7/8" Tri-cone Log Cuttings				0		MINE SPOIL: brown, with some SHALE and LIMESTONE fragments.	
					2			
					4			
					6			
					8			
					10			
					12		LEAN CLAY: turns gray, with shale and limestone fragment.	
					14		LIMESTONE: gray, weak, wet.	
					16			
					18		SHALE: with limestone fragment	
					20			
	6 1/8" Tri-cone Log Cuttings				22		LIMESTONE: with SHALE fragments	
					24			
					26			
					28		SHALE: black to dark gray	

OBSERVATIONS:
9 7/8" Tri-cone to 22' set 7" casing. 6 1/8" Tri-cone to 90'. Core from 90' to 118'.

SAMPLE/ CORE NO.	SAMPLE INTERVAL	SAMPLE RECOVERY (ft' in")	RQD (%)	%Recovery	DEPTH	SOIL SYMBOLS	LITHOLOGY	WELL COMPLETION



OBSERVATIONS:
9 7/8" Tri-cone to 22' set 7" casing. 6 1/8" Tri-cone to 90'. Core from 90' to 118'.

SAMPLE/ CORE NO.	SAMPLE INTERVAL	SAMPLE RECOVERY (ft' in")	RQD (%)	%Recovery	DEPTH	SOIL SYMBOLS	LITHOLOGY	WELL COMPLETION
					74			
					76			
					78			
					80			
					82			
					84			
					86		SILTSTONE: and SHALE fragments.	
					88			
CR#1	90'-100'	9'8"	49%	97%	90		SANDSTONE: gray, fine grained, with laminations of SILTSTONE.	
					92		SILTSTONE: black, slightly fractured.	
					94		SANDSTONE: gray, fine grained, moderately fractured.	
					96			
					98		SILTSTONE: gray to black, intensely fractured	
CR#2	100'-109'	9'1"	41%	100%	100		SANDSTONE: gray, fine grained.	
					102		SILTSTONE: black	
					104		SANDSTONE: gray fine grained, intensely fractured.	
					106			
					108			
CR#3	109'-118'	9'3"	13%	100%	110		SANDSTONE: gray, fine grained, with thin laminations of SILTSTONE, intensely fractured.	
					112			
					114			
					116		SANDSTONE: gray, fine grained with thinly bedded SILTSTONE, moderately fractured.	
					118			

OBSERVATIONS:
9 7/8" Tri-cone to 22' set 7" casing. 6 1/8" Tri-cone to 90'. Core from 90' to 118'.

WELL CONSTRUCTION LOG	PROJECT Apex Sanitary Landfill	PROJECT NUMBER 042-021	B-403
COORDINATES N 281075.51 E 2410797.63	GROUND SURFACE ELEVATION 1224.47 feet amsl	TOP OF PVC ELEVATION 1226.84 feet amsl	

CITY & STATE:
Amsterdam, OH

COUNTY: Jefferson County

INSTALLATION DATE:
6/21/05

DRILLING METHOD: Air Rotary / NX Air Core

DRILLING CONTRACTOR:
Duncan Bros. Drilling Inc.

DELEVOPED BY: DWC

DATE: 7/6 & 7/7/05

DEVELOPMENT TECHNIQUE(S):
Grundfos Pump and Bailer

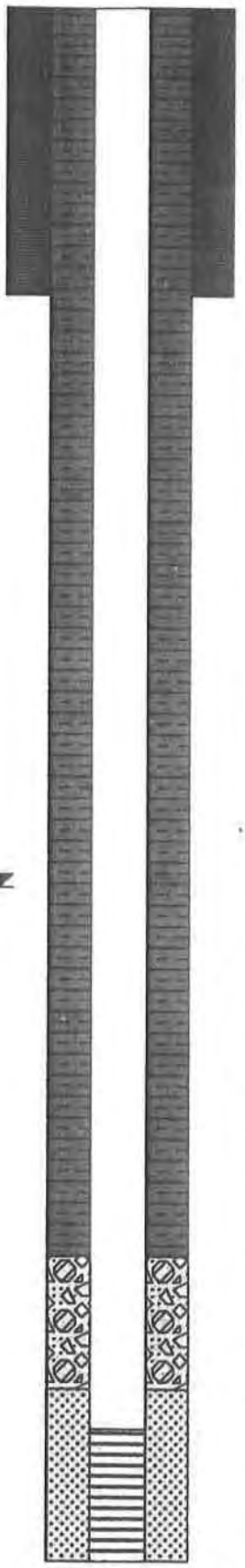
WATER REMOVED DURING DEVELOPMENT:
25 gallons

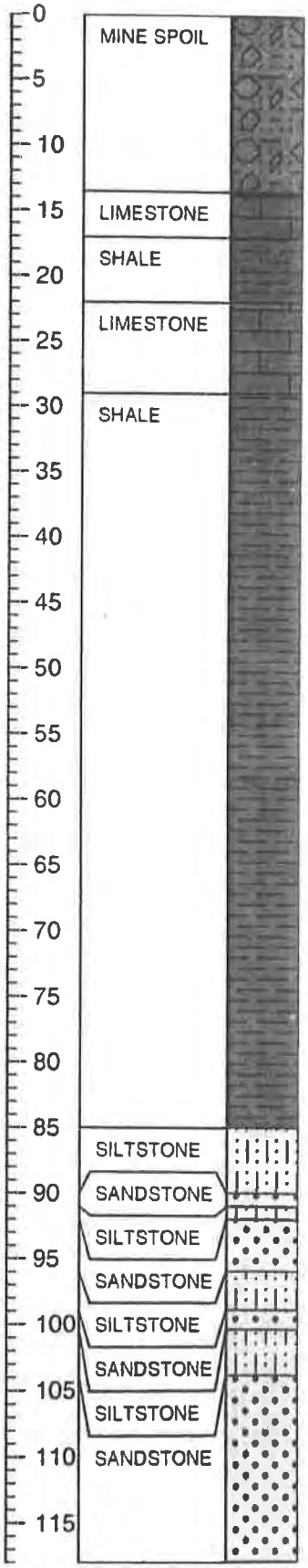
DEPTH to WATER: 67.07

SOUNDED DEPTH FROM TOC:
120.29 feet

SCREENED INTERVAL ELEVATION: 1116.55'-1106.55'

COMMENTS:
9 7/8" Tri-cone to 22' set 7" casing. 6 1/8" Tri-cone to 90'. Core from 90' to 118'.





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Phone 614-540-6633 Fax 614-540-6638

BOREHOLE LOG

BOREHOLE/WELL NO.: **B-403S**

TOTAL DEPTH (BGS): **134.5 feet**

PROJECT INFORMATION

PROJECT:	**Apex Sanitary Landfill**
SITE LOCATION:	**Amsterdam, OH**
PROJECT NO.:	**042-021**
FIELD GEOLOGIST:	**D. Crayne**
DATES DRILLED:	**6/22/05 to 6/23/05**

DRILLING INFORMATION

DRILLING CO./DRILLER:	**Duncan Bros. Drilling Inc.**
DRILLING RIG/METHOD:	**Air Rotary / NX Air Core**
BOREHOLE DIAMETER:	**9 7/8" & 6 1/8" Tri-cone Bits**
WELL DIAMETER:	**2"**
GROUND/TOC ELEVATION:	**1275.55 / 1277.75 ft amsl**

⧗ Water level during drilling

⧗ Water Level After Development

SAMPLE/ CORE NO.	SAMPLE INTERVAL	SAMPLE RECOVERY (ft, in")	RQD (%)	%Recovery	DEPTH	SOIL SYMBOLS	LITHOLOGY	WELL COMPLETION
	9 7/8" Tri-cone Log Cuttings				0 – 32		MINE SPOIL: brown to gray, clay and rock fragments, DRY.	

OBSERVATIONS:
9 7/8" Tri-cone to 64' set 7" casing. 6 1/8" Tri-cone to 70'. Core from 70' to 134.5'.

SAMPLE/ CORE NO.	SAMPLE INTERVAL	SAMPLE RECOVERY (FEET, in.)	RQD (%)	%Recovery	DEPTH	SOIL SYMBOLS	LITHOLOGY	WELL COMPLETION
					34			
					36		LIMESTONE: Boulder	
					38		MINE SPOIL: brown, rock fragments, DRY	
					40			
					42			
					44			
					46			
					48			
					50			
					52		LIMESTONE: and SHALE cuttings, wet. Lost cutting return @ 53 feet. set casing to 64 feet.	
					54			
					56			
					58			
					60			
					62			
	6 1/8" Tri-cone Log Cuttings				64			
					66			
					68		SHALE: gray to black cuttings	
CR#1	70'-80'	8'6"	45%	94%	70		SILTSTONE: gray, moderately fractured	
					72			
					74		SHALE: gray, intensely fractured, micaceous	
					76			
					78			
CR#2	79'-88.5'	9'4"	36%	98%	80			
					82			
					84			

OBSERVATIONS:
9 7/8" Tri-cone to 64' set 7" casing. 6 1/8" Tri-cone to 70'. Core from 70' to 134.5'.

SAMPLE/ CORE NO.	SAMPLE INTERVAL	SAMPLE RECOVERY (ft' in")	RQD (%)	%Recovery	DEPTH	SOIL SYMBOLS	LITHOLOGY	WELL COMPLETION
CR#3	88.5'-98'	9'3"	42%	96%	86, 88, 90, 92, 94, 96, 98		SANDSTONE: fine grained, with thinly bedded SHALE, intensely fractured.	
							SILTSTONE: gray, moderately fractured	
CR#4	98'-107.5'	9'4"	18%	98%	100, 102, 104, 106		SHALE: gray with a few thin interbeds of gray fine grained SANDSTONE, intensely fractured.	
'#5	107.5'-117'	7'8"	15%	81%	108, 110, 112, 114, 116		SHALE: gray, dry in some places, intensely to moderately fractured.	
CR#6	117'-125'	7'	37%	88%	118, 120, 122, 124		SHALE: gray, with thinly bedded SILTSTONE, thin SANDSTONE layer @ 119 feet. Thin Laminations of COAL.	
CR#6	125'-134.5'	9'2"	16%	96%	126, 128, 130, 132, 134			

OBSERVATIONS:
9 7/8" Tri-cone to 64' set 7" casing. 6 1/8" Tri-cone to 70'. Core from 70' to 134.5'.

WELL CONSTRUCTION LOG

PROJECT	PROJECT NUMBER	
Apex Sanitary Landfill	042-021	B-403S

COORDINATES	GROUND SURFACE ELEVATION	TOP OF PVC ELEVATION
N 281221.66 E 2410383.66	1275.55 feet amsl	1277.75 feet amsl

CITY & STATE:
Amsterdam, OH
COUNTY: Jefferson County
INSTALLATION DATE:
6/22/05 to 6/23/05

DRILLING METHOD: Air Rotary / NX Air Core
DRILLING CONTRACTOR:
Duncan Bros. Drilling Inc.

DELEVOPED BY: DWC
DATE: 7/6 & 7/8/05

DEVELOPMENT TECHNIQUE(S):
Grundfos Pump and Bailer

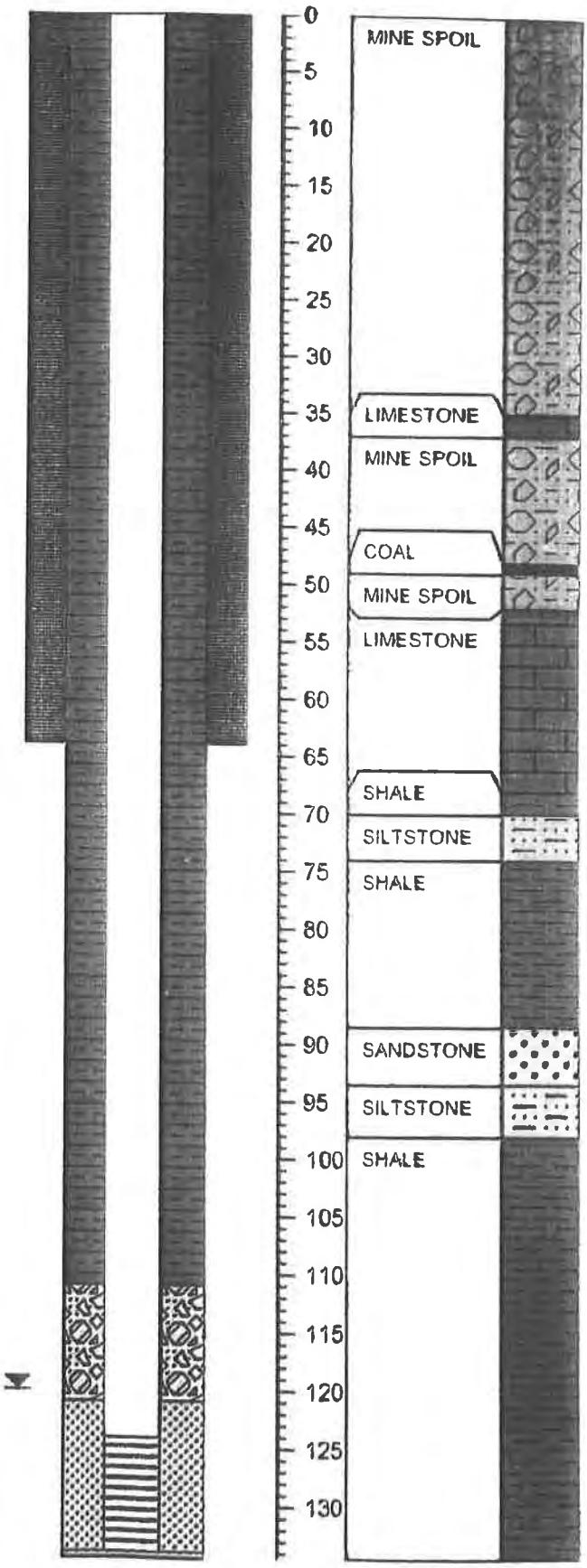
WATER REMOVED DURING DEVELOPMENT:
15 gallons and DRY

DEPTH to WATER: 123.23

SOUNDED DEPTH FROM TOC:
136.83 feet

SCREENED INTERVAL ELEVATION: 1150.92'-1140.92'

COMMENTS:
9 7/8" Tri-cone to 64' set 7" casing. 6 1/8" Tri-cone to 70'. Core from 70' to 134.5'.



CIVIL & ENVIRONMENTAL CONSULTANTS, INC.

Civil & Environmental Consultants, Inc.
8740 Orion Place, Suite 100
Columbus, Ohio 43240

BORING NUMBER B-405

CLIENT Apex Environmental, LLC
PROJECT NAME Apex Sanitary Landfill
CEC PROJECT NUMBER 100-804
PROJECT LOCATION Amsterdam, OH
DATE STARTED 11/30/10 **COMPLETED** 12/1/10
GROUND ELEVATION 1231.11 ft **HOLE SIZE** 8" / 5"
DRILLINGCONTRACTOR Frontz Drilling, Inc.
TOP OF PVC ELEVATION 1234.20 ft
DRILLING METHOD Air Rotary & HQ Core
GROUND WATER LEVELS:
LOGGED BY BRB **CHECKED BY** DWC
▼ **AT END OF DRILLING** 80.8 ft / Elev 1150.3 ft
LOCATION Apex Sanitary Landfill

DEPTH (ft)	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	GRAPHIC LOG	MATERIAL DESCRIPTION	WELL DIAGRAM
0				Structural Fill; clay and rock fragments Blind drilled from 0' - 8' and set 6" steel surface casing. Top of rock = 6'.	6-Inch Steel Surface Casing
6.0					1225.1
8.0				SHALE; gray to dark gray, moderate-strong, silty, trace limestone note: logged rock cuttings from 8' - 15'	1223.1
15.0					1216.1
17.5				SHALE; gray, moderate-strong, intense fracturing w/ moderate weathering	1213.6
18.4	RC 1	60 (46)		LIMESTONE; dark gray, very strong, high reaction to HCl SHALE; gray, very weak, high weathering	1212.7
23.0					1208.1
26.2	RC 2	69 (57)		NO RECOVERY; assuming highly weathered shale	1204.9
30.3				LIMESTONE; light gray, very strong, high reaction to HCl note: horizontal fracture @ 28.9'	1200.8
31.4				LIMESTONE/ SHALE; interbedded limestone and shale, dark gray, weak, moderate reaction to HCl	1199.7
33.0				SHALE; dark gray, weak, some limestone inclusions note: horizontal fracture w/ moderate weathering @ 33.8'	1198.1
35.0					1196.1

Bentonite Grout

2-Inch Solid PVC Riser

GENERAL BH / TP / WELL APEX_BEDROCK_PIEZOMETERS.GPJ GOOD TEMPLATE.GDT 1/5/11

(Continued Next Page)

Civil & Environmental Consultants, Inc.
8740 Orion Place, Suite 100
Columbus, Ohio 43240

BORING NUMBER B-405

CLIENT Apex Environmental, LLC **PROJECT NAME** Apex Sanitary Landfill

CEC PROJECT NUMBER 100-804 **PROJECT LOCATION** Amsterdam, OH

DEPTH (ft)	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	GRAPHIC LOG	MATERIAL DESCRIPTION	WELL DIAGRAM
35					
	RC 3	102 (97)		SHALE; dark gray, moderate-strong to weak, some limestone inclusions note: horizontal fracture w/ slight weathering @ 35.0' and 36.1' note: horizontal fracture w/ slight weathering @ 40.9'	
40					
				43.0 1188.1	
	RC 4	100 (90)		SHALE; dark gray, moderate-strong, some sandstone laminations, few limestone inclusions note: horizontal fracture w/ brown oxidized staining @ 44.3' note: diagonal fracture @ 44.5' note: horizontal fracture w/ brown oxidized staining @ 45.8', 46.3', and 46.6' note: broken w/ brown oxidized staining from 48.9' - 49.4' note: diagonal fracture @ 51.6'	Bentonite Grout
45					
50					
				53.0 1178.1	
	RC 5	84 (63)		SHALE; dark gray to black, moderate-strong, some plant fossils, trace limestone inclusions note: horizontal fracture @ 54.4' note: intense horizontal fracturing w/ high weathering from 55.3' - 57.4' note: horizontal fracturing w/ slight weathering @ 58.6' and 59.2'	2-Inch Solid PVC Riser
55					
60					
				63.0 1168.1	
	RC 6	88 (85)		SHALE; dark gray, strong, some plant fossils, few sandstone laminations, few calcite inclusions note: horizontal fracture @ 64.3', 65.6', and 66.1' note: horizontal fracture @ 68.7', 70.6', and 71.2'	
65					
70					
				73.0 1158.1	
75					

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BORING NUMBER B-405

CLIENT Apex Environmental, LLC **PROJECT NAME** Apex Sanitary Landfill

CEC PROJECT NUMBER 100-804 **PROJECT LOCATION** Amsterdam, OH

DEPTH (ft)	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	GRAPHIC LOG	MATERIAL DESCRIPTION	WELL DIAGRAM
75	RC 7	93 (88)		SHALE; dark gray to black, moderate-strong, some plant fossils, trace sandstone laminations, trace calcite inclusions, micaceous note: horizontal fracture w/ slight weathering @ 73.8' and 76.5'	
80				note: horizontal fracture w/ slight weathering @ 79.0' and 79.9' *(continued)*	
				83.0 — 1148.1	
85	RC 8	87 (83)		SHALE; dark gray to black, moderate-strong, few plant fossils, trace sandstone laminations, micaceous note: horizontal fracture @ 85.6'	Bentonite Grout
90				note: diagonal fracture @ 89.4' note: horizontal fracture @ 90.4'	
				93.0 — 1138.1	
95	RC 9	84 (82)		SHALE; gray, strong, trace plant fossils, micaceous note: horizontal fracture w/ slight weathering @ 93.5' and 95.6'	2-Inch Solid PVC Riser
100				note: horizontal fracture @ 97.5' note: horizontal fracture w/ moderate weathering @ 99.3'	
				100.9 — 1130.2	
				102.0 — SHALE/ SANDSTONE; interbedded shale and sandstone, dark gray, strong, few coal inclusions, micaceous — 1129.1	
				103.4 — SHALE; dark gray, weak, micaceous, intensely fractured w/ moderate weathering — 1127.7	
105	RC 10	101 (94)		SANDSTONE; gray, very strong, fine to medium-grained, micaceous note: horizontal fracture @ 106.5'	Bentonite Chips
110					#3 Filter Sand
					0.010-Inch Slotted Screen
115				115.0 — 1116.1	

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BORING NUMBER B-405

CLIENT Apex Environmental, LLC **PROJECT NAME** Apex Sanitary Landfill

CEC PROJECT NUMBER 100-804 **PROJECT LOCATION** Amsterdam, OH

DEPTH (ft)	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	GRAPHIC LOG	MATERIAL DESCRIPTION	WELL DIAGRAM
115					
	RC 11	99 (98)		SANDSTONE; gray, very strong, fine to medium-grained, micaceous note: broken w/ moderate weathering from 113.3' - 113.6' note: horizontal fracture w/ brown oxidized staining @ 114.6' note: horizontal fracture @ 116.7'	0.010-Inch Slotted Screen
120					
				122.0 1109.1	
				SANDSTONE; gray, very strong, fine to medium-grained, micaceous	#3 Filter Sand
125	RC 12	101 (100)		note: horizontal fracture @ 126.9' and 128.9'	
130					
				132.0 1099.1	
				SANDSTONE; gray, very strong, fine to medium-grained, micaceous	
135	RC 13	93 (92)		note: horizontal fracture w/ slight weathering @ 137.7'	Bentonite Chips
				138.2 1092.9	
140				SANDSTONE/ SHALE; interbedded gray sandstone with black shale, moderate-strong, micaceous note: horizontal fracture w/ slight weathering @ 138.3', 140.0', 140.5', and 141.2' note: broken and crumbled from 142.6' - 143.1'	
				143.1 1088.0	
				SHALE; dark gray to black, moderate-strong, no reaction to HCl	
145	RC 14	57 (44)		note: intense horizontal fracturing w/ moderate weathering from 145.9' - 152'	
150					
				152.0 1079.1	
				Bottom of hole at 152.0 feet	

GENERAL BH / TP / WELL APEX_BEDROCK_PIEZOMETERS.GPJ GOOD TEMPLATE.GDT 1/5/11

Civil & Environmental Consultants, Inc.
8740 Orion Place, Suite 100
Columbus, Ohio 43240

BORING NUMBER B-405S

CLIENT Apex Environmental, LLC
PROJECT NAME Apex Sanitary Landfill
CEC PROJECT NUMBER 100-804
PROJECT LOCATION Amsterdam, OH
DATE STARTED 12/2/10 **COMPLETED** 12/2/10
GROUND ELEVATION 1230.41 ft **HOLE SIZE** 8" / 5"
DRILLINGCONTRACTOR Frontz Drilling, Inc.
TOP OF PVC ELEVATION 1233.55 ft
DRILLING METHOD Air Rotary & HQ Core
GROUND WATER LEVELS:
LOGGED BY BRB **CHECKED BY** DWC
▼ **AT END OF DRILLING** 43.6 ft / Elev 1186.8 ft
LOCATION Apex Sanitary Landfill

DEPTH (ft)	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	GRAPHIC LOG	MATERIAL DESCRIPTION	WELL DIAGRAM
0				Structural Fill; clay and rock fragments Blind drilled from 0' - 11' and set 6" steel surface casing. Top of rock = 8'. See B-405 for description.	
8.0					1222.4
11.0				Blind drilled from 11' - 38'. See B-405 for description.	1219.4

6-Inch Steel Surface Casimg

Bentonite Grout

2-Inch Solid PVC Riser

GENERAL BH / TP / WELL APEX_BEDROCK_PIEZOMETERS.GPJ GOOD TEMPLATE.GDT 1/5/11

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BORING NUMBER B-405S

CLIENT Apex Environmental, LLC
PROJECT NAME Apex Sanitary Landfill
CEC PROJECT NUMBER 100-804
PROJECT LOCATION Amsterdam, OH

DEPTH (ft)	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	GRAPHIC LOG	MATERIAL DESCRIPTION	WELL DIAGRAM
35				Blind drilled from 11' - 38'. See B-405 for description. *(continued)*	Bentonite Chips; 2-Inch Solid PVC Riser
				38.0 1192.4	
40	RC 1	76 (68)		SHALE; dark gray, moderate-strong, few limestone inclusions, trace sandstone laminations note: horizontal fracture w/ slight brown oxidized staining @ 38.8' note: horizontal fracture @ 39.4' and 39.9' note: horizontal fracture w/ high weathering @ 41.3' note: intense horizontal and vertical fracturing from 42.1' - 43.1'	#3 Filter Sand
45				note: horizontal fracture w/ brown oxidized staining @ 45.5' note: bottom 2' (46' - 48') not recovered, assuming its highly weathered shale	0.010-Inch Slotted Screen
				48.0 1182.4	
50	RC 2	93 (88)		SHALE; dark gray, moderate-strong, few limestone inclusions note: intense horizontal fracturing from 49.0' - 49.8'	#3 Filter Sand
55				note: horizontal fracture @ 54.6'	Bentonite Chips
				58.0 1172.4	
				Bottom of hole at 58.0 feet	

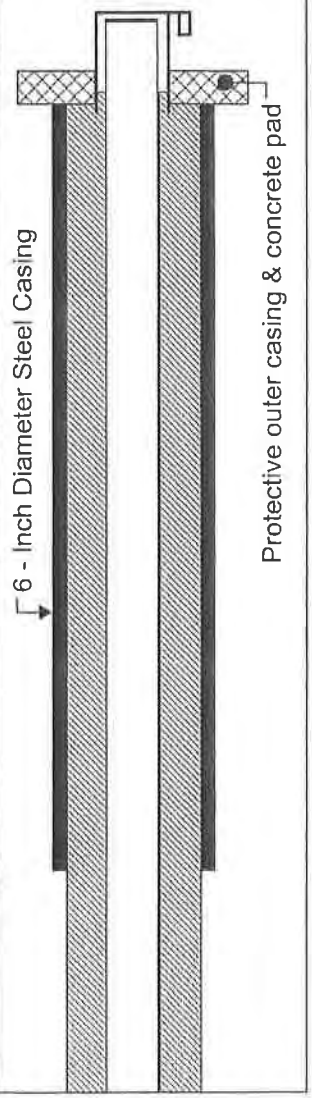
GENERAL BH / TP / WELL APEX_BEDROCK_PIEZOMETERS.GPJ GOOD TEMPLATE.GDT 1/5/11

Civil & Environmental Consultants, Inc.

Chicago Cincinnati Columbus Export Detroit Indianapolis Nashville Pittsburgh St. Louis

Project Name: Apex Sanitary Landfill Amsterdam, OH	Borehole/Well ID: B-406
	Northing: 283002.51
	Easting: 2411520.65
	Casing Elevation: 1230.13
Project No.: 042-021	Ground Elevation: 1227.47
Date Started: 2-6-08 Completed: 2-8-08	Groundwater Elevation: 1151.79 Date: 3-24-08 Time: 1629
Drilling Company: Duncan Bros. Drilling Inc.	Sample Information: 9 7/8 tri-cone to 37', set 6"steel casing to 37'. NX core from 20'-144'. See boring log B-406S for description from 20'-37'.
Driller: Dave	
CEC Representative: D. Crayne	
Drilling Method: Air Rotary	Comments/Problems: 6" tri-cone to 135' to set well.
Bore Hole: 9 7/8" & 6" / Core Size: NX	
Well Installed: ☑	
Screened Interval:	

Sample No./ Core Run	Recovery (feet)	Blow Counts/ RQD	Pocket Pen.	Sample Type	Depth (feet)	Material Description and Comments	Graphic Log	Elevation (feet, msl)	Well Diagram
					-3				
					-1	Ground Surface		1227.5	
					1	brown to gray LEAN CLAY, moist (FILL)			
					3				
					5				
					7				
					9				
					11				
					13				
					15			1211.0	
					17	gray SHALE, very weak, moist			
					19			1207.0	
					21			1205.0	
1	2	67%		NX	23	gray LIMESTONE, non-fractured, strong reaction to HCL. dry			
					25				
					27	brown to gray SHALE, moist. Very low recovery because weak shale is blowing out of core barrel.			
					29				
2	.8	0%		NX	31				
					33				
					35				
					37			1190.0	
					39	brown SANDSTONE, dry			
3	9	41%		NX	41	brown weak SHALE with few siltstone inclusions (1-3 inches thick), weathered to highly weathered, intensely fractured, no reaction to HCL.			
					43				
					45			1181.5	

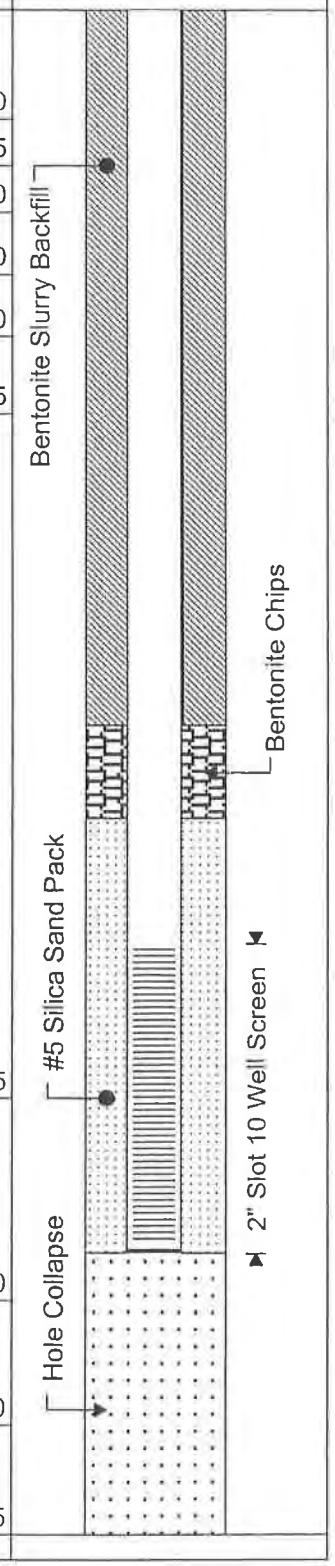


Civil & Environmental Consultants, Inc.	Project Name: Apex Sanitary Landfill Project No.: 042-021	Borehole/Well ID: B-406

Sample No./ Core Run	Recovery	Blow Counts/ RQD	Pocket Pen.	Sample Type	Depth (feet)	Material Description and Comments	Graphic Log	Elevation (feet, msl)	Well Diagram
4	7.5	36%		NX	48–54	brown to gray weak SHALE, weathered, intensely fractured, some brown water staining at horizontal fractures at 49, 50, & 51.		1172.5	
5	8.9	55%		NX	56–64	gray weak SHALE, micaceous, laminated, weathered, some brown water staining every foot from 55-64. highly weathered and stained brown from 63-64 and at 66		1163.5	
6	9	70%		NX	64–72	gray SHALE, moderate strength, micaceous, no reaction to HCL, slightly weathered, slightly fractured brown water staining at fractures at 64, 65, 67, & 69.5			Bentonite Slurry Backfill
7	9	66%		NX	74–80	brown water staining at 75, 78, & 79			
8	9	70%		NX	82–90	brown water staining at 83 & 88			
9		80%			92–94	brown water staining at 94.5 &			

Civil & Environmental Consultants, Inc.	Project Name: Apex Sanitary Landfill Project No.: 042-021	Borehole/Well ID: B-406

Sample No./ Core Run	Recovery	Blow Counts/ RQD	Pocket Pen.	Sample Type	Depth (feet)	Material Description and Comments	Graphic Log	Elevation (feet, msl)	Well Diagram
9	8.6	80%		NX	97			1129.0	
					99	gray SHALE same as above with some laminated sandstone inclusions.		1127.5	
10	8.3	86%		NX	101			1126.0	
					103	black SHALE, micaceous, intensely fractured.		1124.0	
					105	gray SANDSTONE with some laminated shale, slightly fractured		1122.0	
					107			1119.5	
11	9	100%		NX	109	black SHALE, trace laminated sandstone, intensely fractured, wet			
					111	gray SANDSTONE, strong, trace black bark fossils.			
					113	gray SANDSTONE, trace shale inclusions, massive bedding.			
					115				
					117				
12	9	100%		NX	119				
					121				
					123				
					125				
					127				
13	9.3	65%		NX	129			1097.5	
					131	gray SANDSTONE, highly fractured, brown water staining at fractures, some laminated shale.			
					133				
					135			1091.0	
14	7.6	44%		NX	137	gray to black weak SHALE, laminated, highly fractured, no reaction to HCL			
					139			1087.0	
					141	gray weak LIMESTONE, moderate fractured, strong reaction to HCL.			
					143	BOB = 144 feet		1083.5	

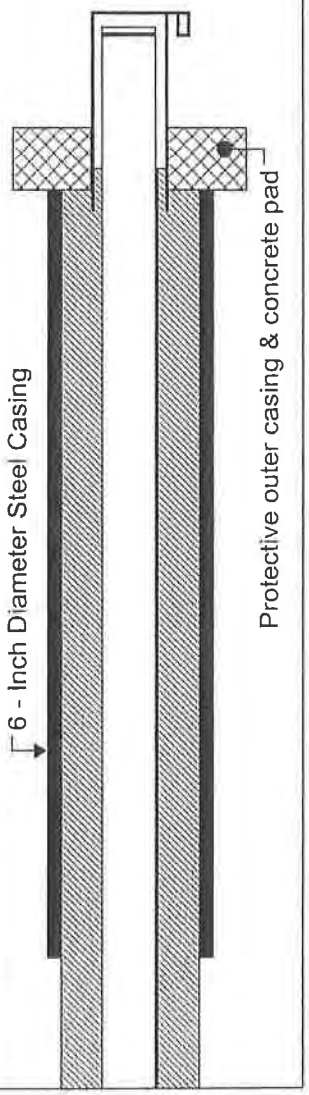


Civil & Environmental Consultants, Inc.

Chicago Cincinnati Columbus Export Detroit Indianapolis Nashville Pittsburgh St. Louis

Project Name: Apex Sanitary Landfill Amsterdam, OH	Borehole/Well ID: B-406S
	Northing: 282995.2
	Easting: 2411518.19
	Casing Elevation: 1230.24
Project No.: 042-021	Ground Elevation: 1227.54
Date Started: 2-12-08 Completed: 2-12-08	Groundwater Elevation: 1178.68 Date: 3-24-08 Time: 1112
Drilling Company: Duncan Bros. Drilling Inc.	Sample Information: 9 7/8 tri-cone to 20', set 6"steel casing to 20'. NX core from 20'-38'. 6 inch tri-cone from 38'-67'.
Driller: Dave	
CEC Representative: D. Crayne	
Drilling Method: Air Rotary	Comments/Problems: Description taken from boring B-406 for 38-73'.
Bore Hole: 9 7/8" & 6" / Core Size: NX	
Well Installed: ☑	
Screened Interval:	

Sample No./ Core Run	Recovery (feet)	Blow Counts/ RQD	Pocket Pen.	Sample Type	Depth (feet)	Material Description and Comments	Graphic Log	Elevation (feet, msl)	Well Diagram
					-3				
					-1	Ground Surface		1227.5	
					1	brown to gray LEAN CLAY, moist (FILL)			
					3				
					5				
					7				
					9				
					11				
					13				
					15				
					17			1211.0	
					19	gray SHALE, very weak, moist, logged cuttings			
					21			1207.0	
						gray LIMESTONE, non-fractured, strong reaction to HCL. dry		1205.0	

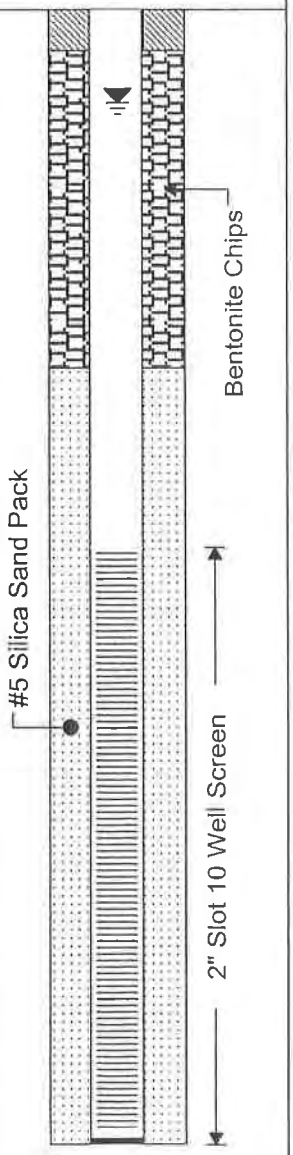


Civil & Environmental Consultants, Inc.	Project Name: Apex Sanitary Landfill Project No.: 042-021	Borehole/Well ID: B-406S

Sample No./ Core Run	Recovery	Blow Counts/ RQD	Pocket Pen.	Sample Type	Depth (feet)	Material Description and Comments	Graphic Log	Elevation (feet, msl)	Well Diagram
1	2	67%		NX	24	brown to gray SHALE, moist. Very low recovery because weak shale is blowing out of core barrel.			Bentonite Slurry Backfill
					26				
					28				
2	.8	0%		NX	30				
					32				
					34				
					36			1190.0	
					38	brown SANDSTONE, dry		1189.5	
						brown weak SHALE with few siltstone inclusions (1-3 inches thick), weathered to highly weathered, intensely fractured, no reaction to HCL.			
3	9	41%		NX	40				
					42				
					44				
					46			1181.5	
					48				

Civil & Environmental Consultants, Inc.	Project Name: Apex Sanitary Landfill Project No.: 042-021	Borehole/Well ID: B-406S

Sample No./ Core Run	Recovery	Blow Counts/ RQD	Pocket Pen.	Sample Type	Depth (feet)	Material Description and Comments	Graphic Log	Elevation (feet, msl)	Well Diagram
4	7.5	36%		NX	50 52 54	brown to gray weak SHALE, weathered, intensely fractured, some brown water staining at horizontal fractures at 49, 50, & 51.		1172.5	
5	8.9	55%		NX	56 58 60 62 64	gray weak SHALE, micaceous, laminated, weathered, some brown water staining every foot from 55-64. highly weathered and stained brown from 63-64 and at 66		1163.5	
6	9	70%		NX	66 68 70 72	gray SHALE, moderate strength, micaceous, no reaction to HCL, slightly weathered, slightly fractured Used 6 inch tri-cone to drill to 67 feet and set 406S. Description taken from B-406 BOB = 67 feet for B-406S.		1154.5	



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8740 Orion Pl., Suite 100
Columbus, OH 43240

Phone 614-540-6633 Fax 614-540-6638

BOREHOLE LOG

BOREHOLE/WELL NO.: **B-407**

TOTAL DEPTH (BGS): **150 feet**

PROJECT INFORMATION		DRILLING INFORMATION	
PROJECT:	Apex Sanitary Landfill	DRILLING CO./DRILLER:	Duncan Bros. Drilling Inc.
SITE LOCATION:	Amsterdam, OH	DRILLING RIG/METHOD:	Air Rotary / NX Air Core
PROJECT NO.:	042-021	BOREHOLE DIAMETER:	12 3/4" & 6 1/8" Tri-cone Bits
FIELD GEOLOGIST:	D. Crayne	WELL DIAMETER:	2"
DATES DRILLED:	7/18/06	GROUND/TOC ELEVATION:	1233.15 / 1235.74ft amsl

⧗ Water level during drilling ⧗ Water Level After Development

SAMPLE/ CORE NO.	SAMPLE INTERVAL	SAMPLE RECOVERY (ft' in")	RQD (%)	%Recovery	DEPTH	SOIL SYMBOLS	LITHOLOGY	WELL COMPLETION
	12 3/4" Tri-cone Log Cuttings				0 – 38		STRUCTURAL FILL: brown to gray, with some rock fragment, some clayey soil form 43'-55'.	

OBSERVATIONS:
12 3/4" Reamer Tri-cone to 80' set 7" casing. 6 1/8" Tri-cone to 90'. Core from 90' to 150'.

SAMPLE/ CORE NO.	SAMPLE INTERVAL	SAMPLE RECOVERY (ft' in")	RQD (%)	%Recovery	DEPTH	SOIL SYMBOLS	LITHOLOGY	WELL COMPLETION
					40			
					42			
					44			
					46			
					48			
					50			
					52			
					54			
					56			
					58			
					60		SHALE: & SILTSTONE, contact estimated because of drilling with 12 3/4" reamer tri-cone bit. Could not set casing in very soft material at base of structural fill.	
					62			
					64			
					66			
					68			
					70			
					72			
					74			
					76		SANDSTONE: brown, more competent rock, set casing to 79.5'	
					78			
	6 1/8" Tri-cone Log Cuttings				80		SANDSTONE: gray fine to grained with some black shale cuttings.	
					82			
					84			
					86			
					88			
CR#1	90'-100'	9'10"	92%	98%	90		SANDSTONE: gray fine to medium grained, black thinly laminated shale @ 99', brown staining @ 90' and 91.5' in horizontal fractures.	
					92			
					94			

OBSERVATIONS:
12 3/4" Reamer Tri-cone to 80' set 7" casing. 6 1/8" Tri-cone to 90'. Core from 90' to 150'.

SAMPLE/ CORE NO.	SAMPLE INTERVAL	SAMPLE RECOVERY (ft' in")	RQD (%)	%Recovery	DEPTH	SOIL SYMBOLS	LITHOLOGY	WELL COMPLETION
					96			
					98			
CR#2	100'-110'	10'	87%	100%	100		SANDSTONE: SAA, black shale @ 100.5' and 106', picked up water during coring 100'-110'	
					102			
					104			
					106			
					108			
CR#3	110'-120'	9'11"	81%	99%	110		SANDSTONE: SAA, un-fractured from 110'-116'.5 black coal stringers at 120'	
					112			
					114			
					116			
					118			
CR#4	120'-130'	10'2"	52%	102%	120		SANDSTONE: SAA, black SHALE from 122.5'-123', micaceous, seepage.	
					122			
					124			
					126			
					128			
CR#5	130'-140'	10'1"	74%	101%	130		SANDSTONE: SAA, some black laminated shale and coal stringers, moderately fractured.	
					132			
					134			
					136			
					138			
CR#6	140'-150'	9'8"	83%	97%	140		SHALE: gray, highly fractured	
					142		SANDSTONE: gray fine to medium grained, trace laminated shale.	
					144			
					146		SILTSTONE: gray, medium hard moderately fractured.	
					148			
					150			

OBSERVATIONS:
12 3/4" Reamer Tri-cone to 80' set 7" casing. 6 1/8" Tri-cone to 90'. Core from 90' to 150'.

WELL CONSTRUCTION LOG	PROJECT	PROJECT NUMBER	B-407
	Apex Sanitary Landfill	042-021	
COORDINATES	GROUND SURFACE ELEVATION	TOP OF PVC ELEVATION	
N 283612.12 E 2411818.30	1233.15 feet amsl	1235.74 feet amsl	

CITY & STATE:
Amsterdam, OH
COUNTY: Jefferson County

INSTALLATION DATE:
7/18/06

DRILLING METHOD: Air Rotary / NX Air Core

DRILLING CONTRACTOR:
Duncan Bros. Drilling Inc.

DELEVOPED BY: DWC/JK
DATE: 8/16/06

DEVELOPMENT TECHNIQUE(S):
Grundfos Pump and SS Bailer

WATER REMOVED DURING DEVELOPMENT:
22 gallons

Depth to WATER: 95.09 feet

SOUNDED DEPTH FROM TOC:
137.55 feet

SCREENED INTERVAL ELEVATION: '- '

COMMENTS: 12 3/4" Reamer Tri-cone to 80' set 7" casing. 6 1/8" Tri-cone to 90'. Core from 90' to 150'.

12 3/4" Borehole Diameter

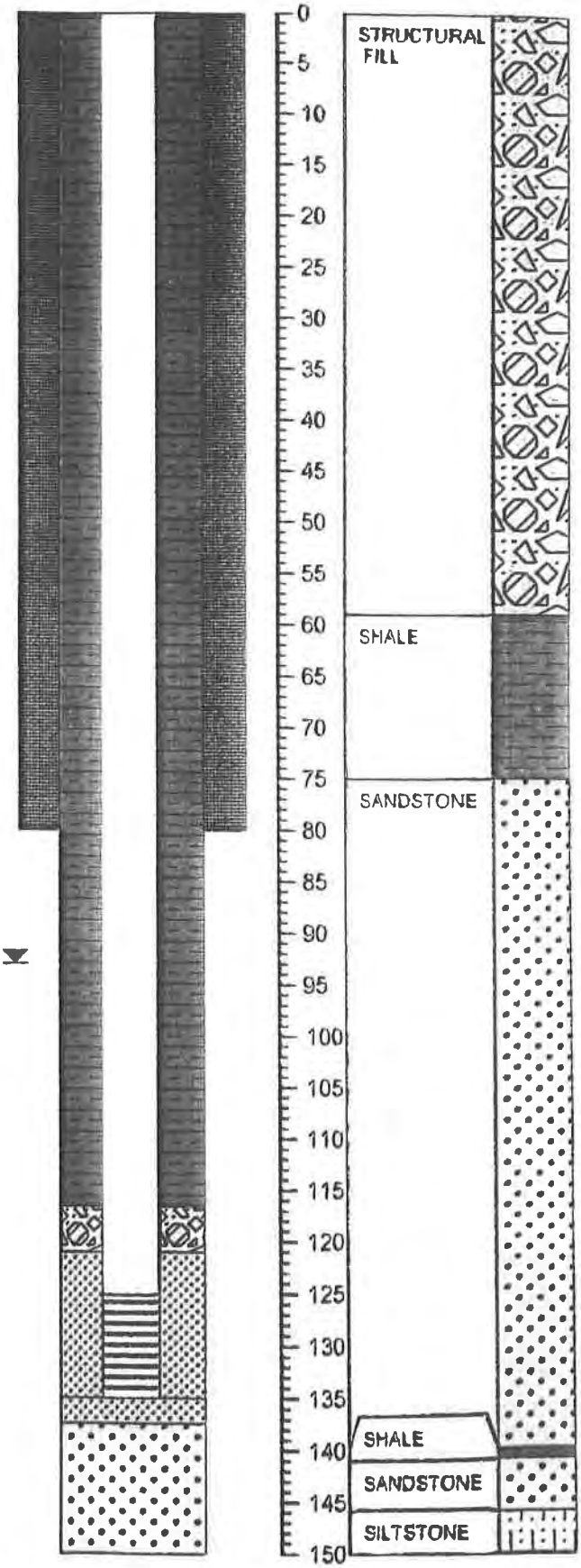
7" Surface Casing to 80'

6" Borehole Diameter Sealed using bentonite clay slurry

2" Well Diameter

Hole Plug

No. 4 Fine Sand



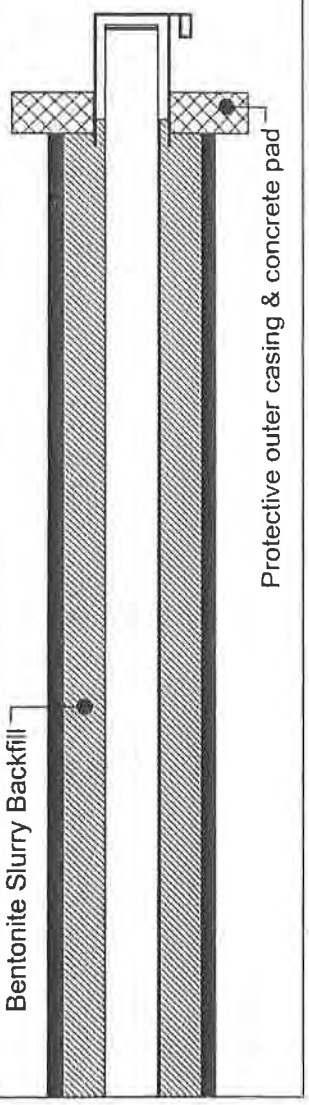
CIVIL & ENVIRONMENTAL CONSULTANTS, INC.

Civil & Environmental Consultants, Inc.

Chicago Cincinnati Columbus Export Detroit Indianapolis Nashville Pittsburgh St. Louis

Project Name: Apex Sanitary Landfill Amsterdam, OH	Borehole/Well ID: B-407S
	Northing: 283619.69
	Easting: 2411822.89
	Casing Elevation: 1235.24
Project No.: 042-021	Ground Elevation: 1232.74
Date Started: 7-16-07 Completed: 7-16-07	Groundwater Elevation: DRY Date: Time:
Drilling Company: Duncan Bros. Drilling Inc.	Sample Information: 9 7/8 tri-cone to 59', set 7" temporary steel casing. PQ core from 59'-72'
Driller: Dave	
CEC Representative: D. Crayne	
Drilling Method: Air Rotary	Comments/Problems:
Bore Hole: 9 7/8 & 6 1/8 Core Size: PQ	
Well Installed: ☑	
Screened Interval:	

Sample No./ Core Run	Recovery (feet)	Blow Counts/ RQD	Pocket Pen.	Sample Type	Depth (feet)	Material Description and Comments	Graphic Log	Elevation (feet, msl)	Well Diagram
					-3				
					-1	Ground Surface		1232.7	
					1	FILL brown to gray LEAN CLAY, some shale fragments, few small boulders,dry			
					3				
					5				
					7				
					9				
					11				
					13				
					15				
					17				
					19				
					21				
					23				
					25				
					27				
					29				
					31				
					33				
					35				



Civil & Environmental Consultants, Inc.	Project Name: Apex Sanitary Landfill Project No.: 042-021	Borehole/Well ID: B-407S

Sample No./ Core Run	Recovery	Blow Counts/ RQD	Pocket Pen.	Sample Type	Depth (feet)	Material Description and Comments	Graphic Log	Elevation (feet, msl)	Well Diagram
					37 39 41 43 45 47 49 51 53 55 57 59	FILL brown to gray LEAN CLAY, some shale fragments, few small boulders,dry		1172.7	7 - Inch Diameter Temporary Steel Casing Bentonite Chips
1	4	0%		PQ	61	brown LEAN CLAY, trace sand, low plasticity, moist, gray mottling from 62-63.		1169.7	Silica Sand Pack
					63	brown-gray SHALE, highly weathered, moist		1168.7	
2	3.5	0%		PQ	65 67	brown SILTSTONE, some sandstone lenses, few clay at fractures, trace black oxidation at fractures		1163.7	Bentonite Chips 2" Slot 10 Well Screen
3	2.5	0%		PQ	69 71	gray SANDSTONE, brown staining at fractures, trace plant fossils BOB = 72 feet		1160.7	
					73				

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8740 Orion Pl., Suite 100
Columbus, OH 43240

Phone 614-540-6633 Fax 614-540-6638

BOREHOLE LOG

BOREHOLE/WELL NO.: B-408

TOTAL DEPTH (BGS): 138 feet

PROJECT INFORMATION

PROJECT:	**Apex Sanitary Landfill**
SITE LOCATION:	**Amsterdam, OH**
PROJECT NO.:	**042-021**
FIELD GEOLOGIST:	**D. Crayne**
DATES DRILLED:	**7/20/06**

DRILLING INFORMATION

DRILLING CO./DRILLER:	**Duncan Bros. Drilling Inc.**
DRILLING RIG/METHOD:	**Air Rotary / NX Air Core**
BOREHOLE DIAMETER:	**9 7/8" & 6 1/8" Tri-cone Bits**
WELL DIAMETER:	**2"**
GROUND/TOC ELEVATION:	**1238.07 / 1240.71ft amsl**

▼ Water level during drilling

▼ Water Level After Development

SAMPLE/ CORE NO.	SAMPLE INTERVAL	SAMPLE RECOVERY (ft' in")	RQD (%)	%Recovery	DEPTH	SOIL SYMBOLS	LITHOLOGY	WELL COMPLETION
	9 7/8" Tri-cone Log Cuttings				0		STRUCTURAL FILL: brown to gray, frequent boulders.	
					2			
					4			
					6			
					8		SILTY CLAY: residual soil, with some rock fragments.	
					10			
					12		structural fill?	
					14			
					16			
					18			
					20			
					22			
					24			
					26		SHALE: gray, picked up water at 30', set 7" casing to 33' to seal off water.	
					28			
					30			
					32			
	6 1/8" Tri-cone				34			

OBSERVATIONS:
9 7/8" Reamer Tri-cone to 33' set 7" casing. 6 1/8" Tri-cone to 99'. Core from 99' to 138'.

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Phone 614-540-6633 Fax 614-540-6638

BOREHOLE LOG

BOREHOLE/WELL NO.: **B-408**

TOTAL DEPTH (BGS): **138 feet**

PROJECT INFORMATION

PROJECT:	**Apex Sanitary Landfill**
SITE LOCATION:	**Amsterdam, OH**
PROJECT NO.:	**042-021**
FIELD GEOLOGIST:	**D. Crayne**
DATES DRILLED:	**7/20/06**

DRILLING INFORMATION

DRILLING CO./DRILLER:	**Duncan Bros. Drilling Inc.**
DRILLING RIG/METHOD:	**Air Rotary / NX Air Core**
BOREHOLE DIAMETER:	**9 7/8" & 6 1/8" Tri-cone Bits**
WELL DIAMETER:	**2"**
GROUND/TOC ELEVATION:	**1238.07 / 1240.71ft amsl**

⧗ Water level during drilling

⧗ Water Level After Development

SAMPLE/ CORE NO.	SAMPLE INTERVAL	SAMPLE RECOVERY (ft, in")	RQD (%)	%Recovery	DEPTH	SOIL SYMBOLS	LITHOLOGY	WELL COMPLETION
	9 7/8" Tri-cone Log Cuttings				0–34		STRUCTURAL FILL: brown to gray, frequent boulders. (0–8) SILTY CLAY: residual soil, with some rock fragments. (8–26) SHALE: gray, picked up water at 30', set 7" casing to 33' to seal off water. (26–34) 6 1/8" Tri-cone	

OBSERVATIONS:
9 7/8" Reamer Tri-cone to 33' set 7" casing. 6 1/8" Tri-cone to 99'. Core from 99' to 138'.

SAMPLE/ CORE NO.	SAMPLE INTERVAL	SAMPLE RECOVERY (ft. in.)	RQD (%)	%Recovery	DEPTH	SOIL SYMBOLS	LITHOLOGY	WELL COMPLETION
	Log Cuttings				36		SILTSTONE: gray, medium soft, moderately fractured some clay at fractures, no oxidation. Rock description from 35'-60' taken from coring B-408S.	
					38			
					40			
					42		SILTSTONE: gray weak siltstone with some medium interbeds of gray fine to medium grained sandstone. brown oxidized horizontal fractures at 43.5'	
					44			
					46		SILTSTONE: gray weak siltstone with brown oxidized fractures from 45'-49'	
					48			
					50		SANDSTONE: gray, hard, fine grained sandstone with laminated shale. Slight oxidation from 51'-52'	
					52		SHALE: moderately hard, gray, with little laminated fine grained sandstone. No oxidation at fractures.	
					54			
					56			
					58		SANDSTONE: hard gray, fine grained sandstone with laminated shale, no oxidation at fractures, hole still drilling dry.	
					60		SANDSTONE: brown to gray, picks up a little moisture at 74'-78'	
					62			
					64			
					66			
					68			
					70			
					72			
					74			
					76			
					78			
					80			
					82			
					84			
					86			

OBSERVATIONS:
9 7/8" Reamer Tri-cone to 33' set 7" casing. 6 1/8" Tri-cone to 99'. Core from 99' to 138'.

SAMPLE/ CORE NO.	SAMPLE INTERVAL	SAMPLE RECOVERY (ft' in")	RQD (%)	%Recovery	DEPTH	SOIL SYMBOLS	LITHOLOGY	WELL COMPLETION
CR#1	99'-109'	10'	74%	100%	88, 90, 92, 94, 96, 98, 100, 102, 104, 106, 108		SANDSTONE: gray, fine to medium grained, some laminated shale. 2" thick coal seam at 108.5'. Water stained fractures at 99.5' and 102'	
CR#2	109'-119'	9'8"	47%	97%	110, 112		SHALE: gray to black, highly fractured	
					114, 116		SANDSTONE: gray, with some laminated shale, moderately fractured.	
CR#3	119'-128'	9'1"	51%	101%	118, 120, 122, 124, 126		SANDSTONE: gray, fine to medium grained, some inclusions of black shale and dark gray sandstone, highly fractured from 120'-121', 122'-124.5', and 125'-126.5'. Producing a lot of water (approx. 8 gpm) during drilling.	
CR#4	128'-138'	9'6"	95%	95%	128, 130, 132, 134, 136, 138		SANDSTONE: gray fine to medium grained, with little laminated shale, micaceous, slightly fractured.	

OBSERVATIONS:
9 7/8" Reamer Tri-cone to 33' set 7" casing. 6 1/8" Tri-cone to 99'. Core from 99' to 138'.

WELL CONSTRUCTION LOG

PROJECT	PROJECT NUMBER	
Apex Sanitary Landfill	042-021	B-408

COORDINATES	GROUND SURFACE ELEVATION	TOP OF PVC ELEVATION
N 284104.43 E 2412045.93	1238.07 feet amsl	1240.71 feet amsl

CITY & STATE:
Amsterdam, OH
COUNTY: Jefferson County

INSTALLATION DATE:
7/20/06

DRILLING METHOD: Air Rotary / NX Air Core

DRILLING CONTRACTOR:
Duncan Bros. Drilling Inc.

DELEVOPED BY: DWC/JK
DATE: 8/16/06

DEVELOPMENT TECHNIQUE(S):
Grundfos Pump and SS Bailer

WATER REMOVED DURING DEVELOPMENT:
87 gallons

Depth to WATER: 98.26 feet

SOUNDED DEPTH FROM TOC:
131.95 feet

SCREENED INTERVAL ELEVATION: '- '

COMMENTS: 9 7/8" Reamer Tri-cone to 33' set 7" casing. 6 1/8" Tri-cone to 99'. Core from 99' to 138'.

9 7/8" Borehole Diameter

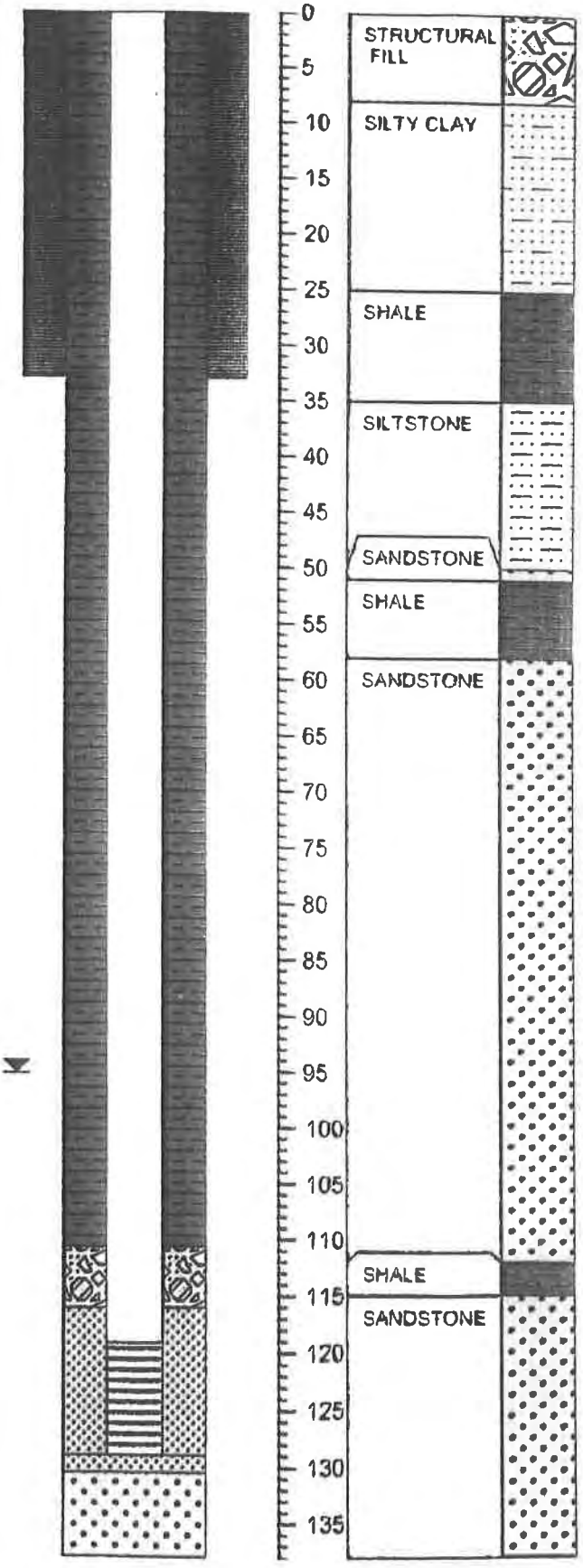
7" Surface Casing to 33'

6" Borehole Diameter Sealed using bentonite clay slurry

2" Well Diameter

Mole Plug

No. 4 Fine Sand



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Phone 614-540-6633 Fax 614-540-6638

BOREHOLE LOG

BOREHOLE/WELL NO.: **B-408S**

TOTAL DEPTH (BGS): **60 feet**

PROJECT INFORMATION

PROJECT:	**Apex Sanitary Landfill**
SITE LOCATION:	**Amsterdam, OH**
PROJECT NO.:	**042-021**
FIELD GEOLOGIST:	**D. Crayne**
DATES DRILLED:	**7/31/06**

DRILLING INFORMATION

DRILLING CO./DRILLER:	**Duncan Bros. Drilling Inc.**
DRILLING RIG/METHOD:	**Air Rotary**
BOREHOLE DIAMETER:	**9 7/8" & 6 1/8" Tri-cone Bits**
WELL DIAMETER:	**2"**
GROUND/TOC ELEVATION:	**1238.80 / 1241.40ft amsl**

▼ Water level during drilling

▼ Water Level After Development

SAMPLE/ CORE NO.	SAMPLE INTERVAL	SAMPLE RECOVERY (ft' in")	RQD (%)	%Recovery	DEPTH	SOIL SYMBOLS	LITHOLOGY	WELL COMPLETION
	9 7/8" Tri-cone Log Cuttings				0		STRUCTURAL FILL: brown to gray, frequent boulders.	
					2			
					4			
					6			
					8		SILTY CLAY: soil, with some rock fragments.	
					10			
					12			
					14			
					16			
					18			
					20			
					22			
					24			

OBSERVATIONS:
9 7/8" Reamer Tri-cone to 34' set 7" casing. 6 1/8" Tri-cone to 35'. Core from 35' to 60'.

SAMPLE/ CORE NO.	SAMPLE INTERVAL	SAMPLE RECOVERY (ft' in")	RQD (%)	%Recovery
	6 1/8" Tri-cone Log Cuttings			
CR#1	35'-40'	4'4"	25%	87%
CR#2	40'-45'	4'8"	34%	93%
CR#3	45'-50'	3'7"	37%	72%
CR#4	50'-60'	8'9"	55%	88%

DEPTH: 26, 28, 30, 32, 34, 36, 38, 40, 42, 44, 46, 48, 50, 52, 54, 56, 58, 60

SOIL SYMBOLS / LITHOLOGY

- SHALE: gray, picked up water at 30', set 7" casing to 34' to seal off water.
- SILTSTONE: gray, medium soft, moderately fractured some clay at fractures, no oxidation.
- SILTSTONE: gray weak siltstone with some medium interbeds of gray fine to medium grained sandstone brown oxidized horizontal fractures at 43.5'
- SILTSTONE: gray weak siltstone with brown oxidized fractures from 45'-49'
- SANDSTONE: gray, hard, fine grained sandstone with laminated shale. Slight oxidation from 51'-52'.
- SHALE: moderately hard, gray, with little laminated fine grained sandstone. No oxidation at fractures.
- SANDSTONE: hard gray, fine grained sandstone with laminated shale, no oxidation at fractures, hole still drilling dry.

WELL COMPLETION

OBSERVATIONS:
9 7/8" Reamer Tri-cone to 34' set 7" casing. 6 1/8" Tri-cone to 35'. Core from 35' to 60'.

WELL CONSTRUCTION LOG	PROJECT	PROJECT NUMBER	
	Apex Sanitary Landfill	042-021	B-408S
COORDINATES	GROUND SURFACE ELEVATION	TOP OF PVC ELEVATION	
N 284113.85 E 2412045.35	1238.80 feet amsl	1241.40 feet amsl	

CITY & STATE:
Amsterdam, OH

COUNTY: Jefferson County

INSTALLATION DATE:
7/31/06

DRILLING METHOD: Air Rotary / NX Air Core

DRILLING CONTRACTOR:
Duncan Bros. Drilling Inc.

DELEVOPED BY: DWC/JK

DATE: 8/16/06

DEVELOPMENT TECHNIQUE(S):
SS Bailer

WATER REMOVED DURING DEVELOPMENT:
10 gallons

Depth to WATER: 45.69'

SOUNDED DEPTH FROM TOC:
57.91 feet

SCREENED INTERVAL ELEVATION: '-'

COMMENTS: 9 7/8" Reamer Tri-cone to 34' set 7" casing. 6 1/8" Tri-cone to 35'. Core from 35' to 50'.

9 7/8" Borehole Diameter

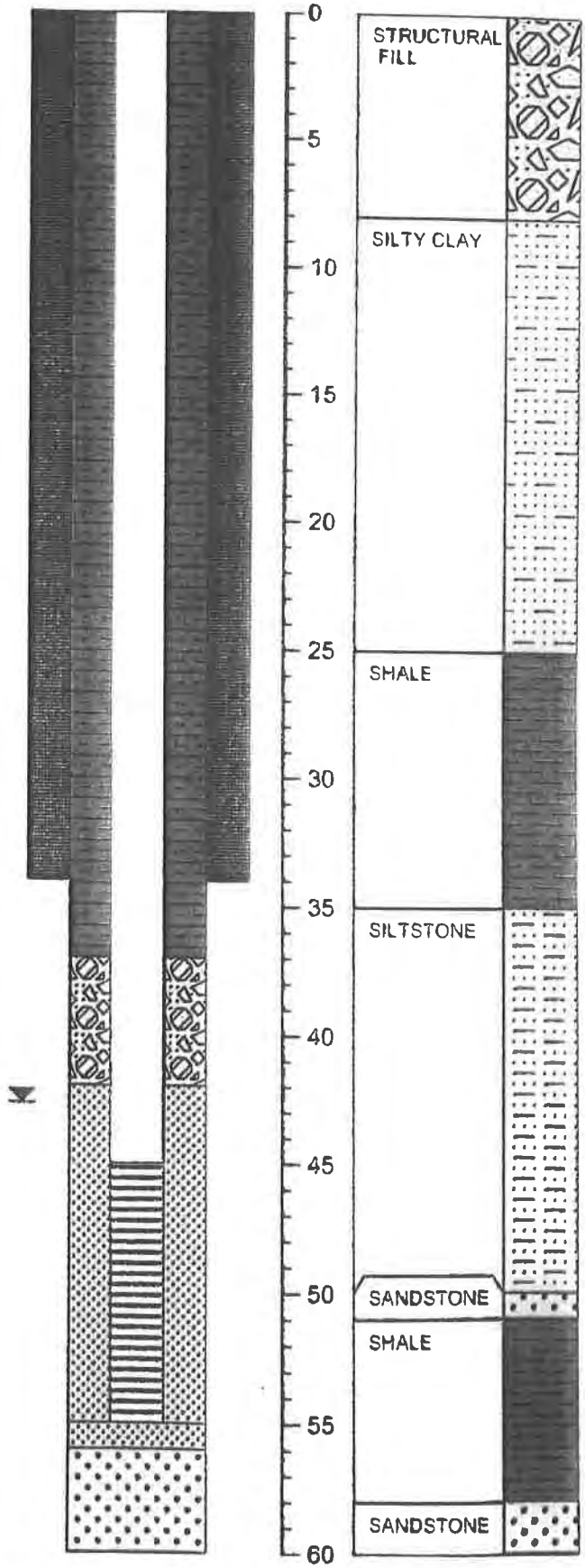
6" Borehole Diameter
Sealed using bentonite clay slurry

7" Surface Casing to 34'

Hole Plug

2" Well Diameter

No. 4 Fine Sand



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BOREHOLE LOG

BOREHOLE/WELL NO.: **B-408A**

TOTAL DEPTH (BGS): **32 feet**

PROJECT INFORMATION

PROJECT:	**Apex Sanitary Landfill**
SITE LOCATION:	**Amsterdam, OH**
PROJECT NO.:	**042-021**
FIELD GEOLOGIST:	**D. Crayne**
DATES DRILLED:	**8/1/06**

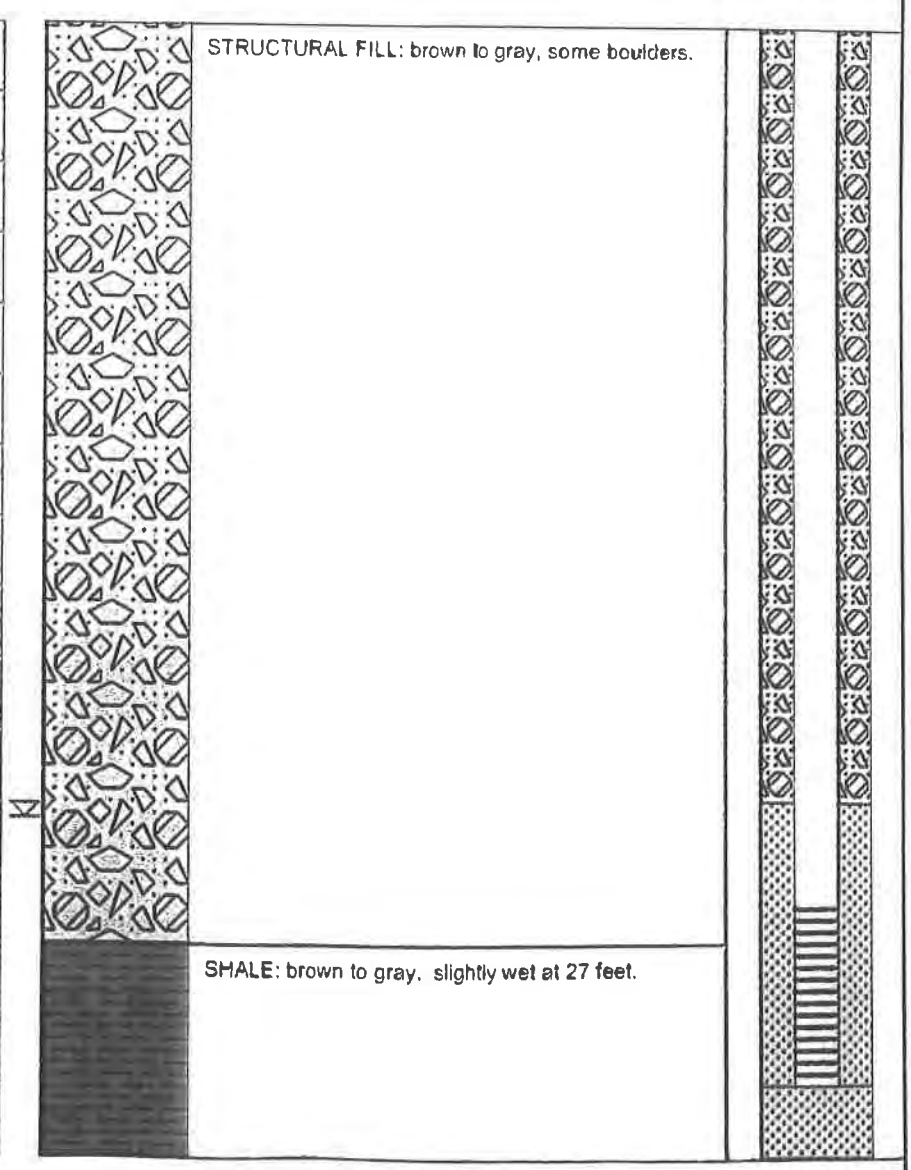
DRILLING INFORMATION

DRILLING CO./DRILLER:	**Duncan Bros. Drilling Inc.**
DRILLING RIG/METHOD:	**Air Rotary**
BOREHOLE DIAMETER:	**6 1/8" Tri-cone Bit**
WELL DIAMETER:	**2"**
GROUND/TOC ELEVATION:	**1238.80 / 1241.37 ft amsl**

⧗ Water level during drilling

⧗ Water Level After Development

SAMPLE/ CORE NO.	SAMPLE INTERVAL	SAMPLE RECOVERY (ft. in")	RQD (%)	%Recovery	DEPTH	SOIL SYMBOLS	LITHOLOGY	WELL COMPLETION
	log cuttings				0 2 4 6 8 10 12 14 16 18 20 22 24 26 28 30 32		STRUCTURAL FILL: brown to gray, some boulders.	
							SHALE: brown to gray, slightly wet at 27 feet.	



OBSERVATIONS:

WELL CONSTRUCTION LOG	PROJECT	PROJECT NUMBER	B-408A
	Apex Sanitary Landfill	042-021	
COORDINATES	GROUND SURFACE ELEVATION	TOP OF PVC ELEVATION	
N 284123.40 E 2412042.73	1238.80 feet amsl	1241.37 feet amsl	

CITY & STATE:
Amsterdam, OH

COUNTY: Jefferson County

INSTALLATION DATE:
8/1/2006

DRILLING METHOD: 6 1/8"
Tri-cone w/ Air Rotary

DRILLING CONTRACTOR:
Duncan Bros. Drilling Inc.

DELEVOPED BY: DWC/JK

DATE: 8/1/06 & 8/16/06

DEVELOPMENT
TECHNIQUE(S):
SS Bailer

WATER REMOVED
DURING DEVELOPMENT:
10 gallons

Depth to WATER: 26.90 feet

SOUNDED DEPTH FROM
TOC:
32.82 feet

SCREENED INTERVAL
ELEVATION: '-'

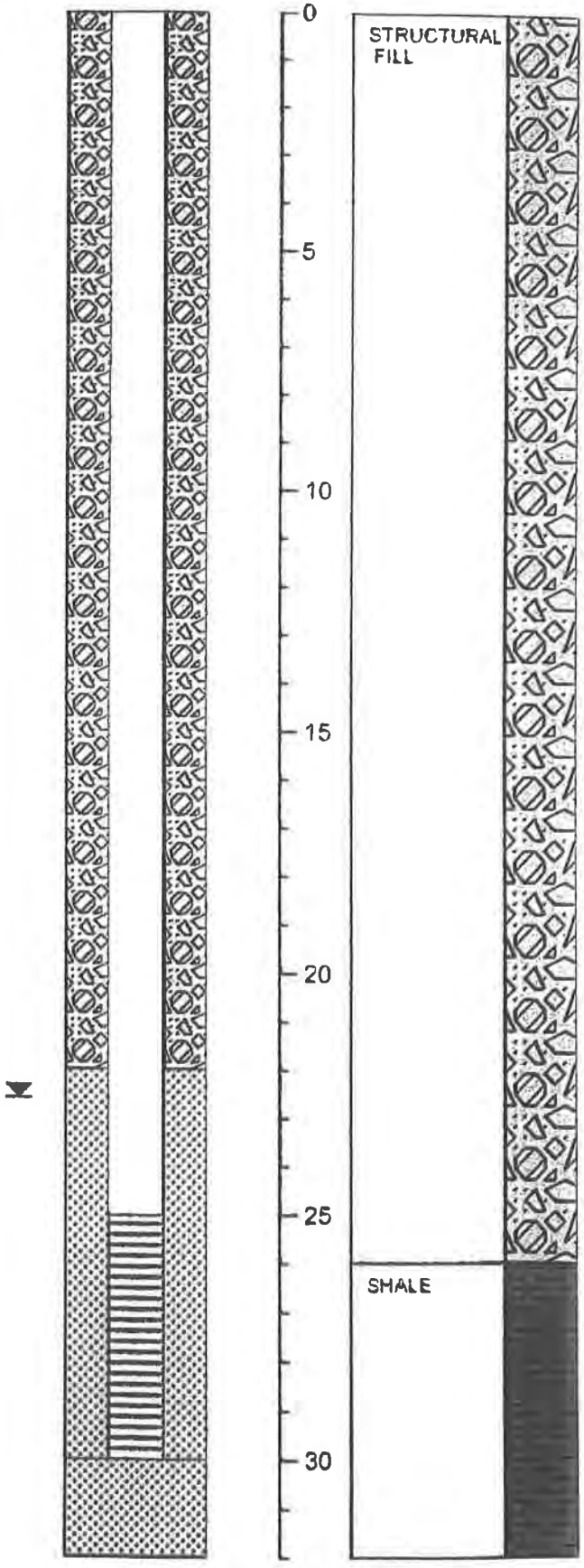
COMMENTS:

Hole Plug

6" Borehole Diameter

2" Well Diameter

No. 4 Fine Sand



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BOREHOLE LOG

BOREHOLE/WELL NO.: **B-409**

TOTAL DEPTH (BGS): **127.5 feet**

PROJECT INFORMATION

PROJECT:	**Apex Sanitary Landfill**
SITE LOCATION:	**Amsterdam, OH**
PROJECT NO.:	**042-021**
FIELD GEOLOGIST:	**D. Crayne**
DATES DRILLED:	**7/24/06**

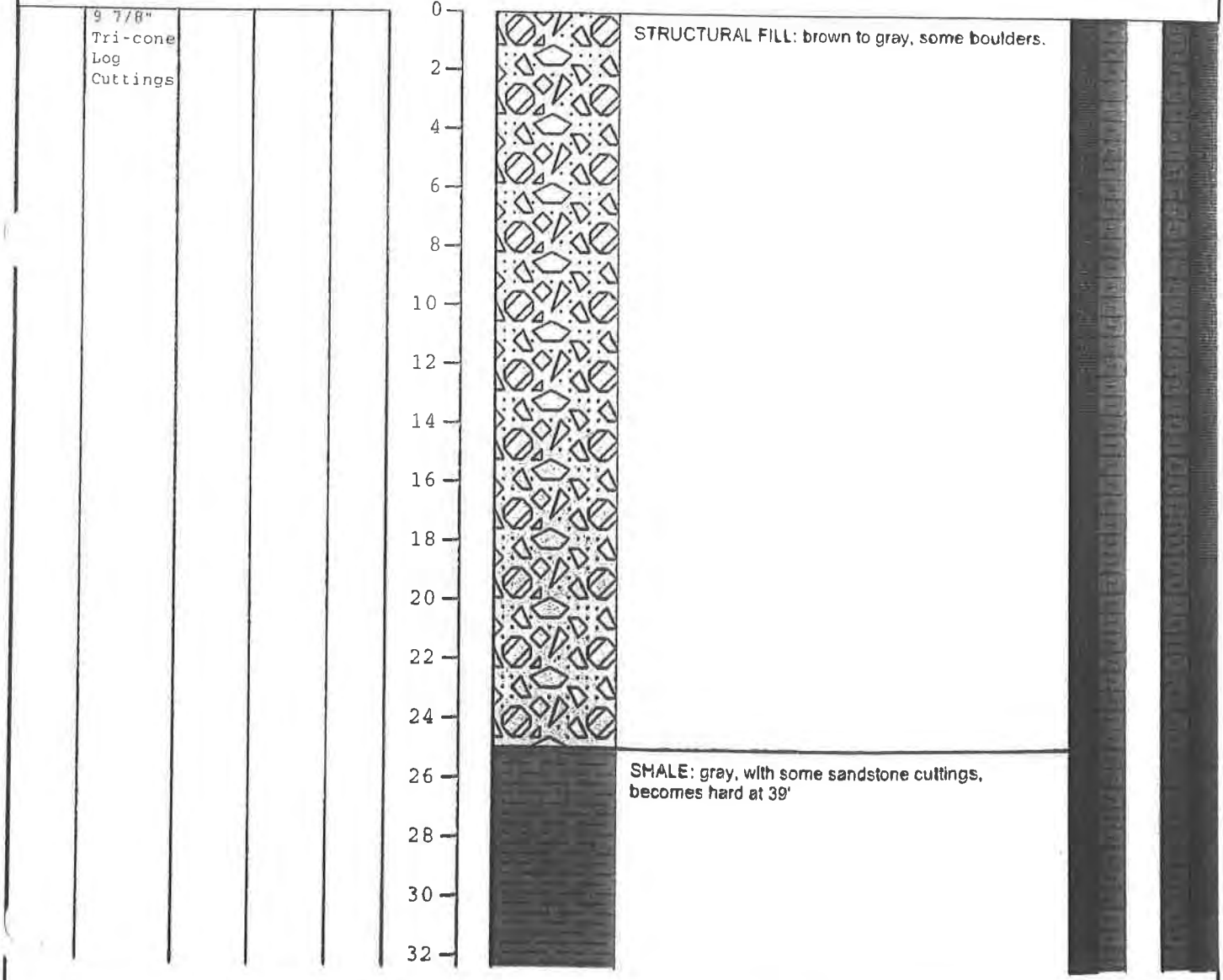
DRILLING INFORMATION

DRILLING CO./DRILLER:	**Duncan Bros. Drilling Inc.**
DRILLING RIG/METHOD:	**Air Rotary / NX Air Core**
BOREHOLE DIAMETER:	**9 7/8" & 6 1/8" Tri-cone Bits**
WELL DIAMETER:	**2"**
GROUND/TOC ELEVATION:	**1245.12 / 1247.57 ft amsl**

▼ Water level during drilling

▼ Water Level After Development

SAMPLE/ CORE NO.	SAMPLE INTERVAL	SAMPLE RECOVERY (ft' in")	RQD (%)	%Recovery	DEPTH	SOIL SYMBOLS	LITHOLOGY	WELL COMPLETION
	9 7/8" Tri-cone Log Cuttings				0		STRUCTURAL FILL: brown to gray, some boulders.	
					24		SHALE: gray, with some sandstone cuttings, becomes hard at 39'	



OBSERVATIONS:

9 7/8" Reamer Tri-cone to 39.5' set 7" casing. 6 1/8" Tri-cone to 90'. Core from 90' to 127.5'.

SAMPLE/ CORE NO.	SAMPLE INTERVAL	SAMPLE RECOVERY (ft in.)	RQD (%)	%Recovery	DEPTH	SOIL SYMBOLS	LITHOLOGY	WELL COMPLETION
	6 1/8" Tri-cone Log Cuttings				34 36 38 40 42 44 46 48 50 52 54 56 58 60 62 64 66 68 70 72 74 76 78 80		SILTSTONE: gray, medium soft, near vertical fracture at 42.5'-43' with brown oxidation. Rock description from 40'-68' from boring B-409S SHALE: very little recovery, pulverizing soft black shale during coring from 43'-50' SHALE: black, highly fractured, little coal stringers at 56', no oxidation at fractures, still drilling dry. SILTSTONE: gray, medium soft, moderately fractured, slightly micaceous, boring still dry. SANDSTONE: Gray, turns brown denoting water at 74' and 80'	

OBSERVATIONS:

9 7/8" Reamer Tri-cone to 39.5' set 7" casing. 6 1/8" Tri-cone to 90'. Core from 90' to 127.5'.

SAMPLE/ CORE NO.	SAMPLE INTERVAL	SAMPLE RECOVERY (ft' in")	RQD (%)	%Recovery	DEPTH	SOIL SYMBOLS	LITHOLOGY	WELL COMPLETION
CR#1	90'-100'	9'10"	25%	98%	82, 84, 86, 88, 90, 92, 94, 96, 98, 100		SANDSTONE: gray to black, with some shale, intensely fractured, micaceous, dry, no staining or oxidation.	
							SANDSTONE: gray with some laminated shale, moderately fractured, micaceous shale.	
CR#2	100'-109.5'	8'4"	53%	88%	100, 102, 104, 106, 108		SHALE: black, with some laminated gray sandstone, highly fractured.	
							SANDSTONE: gray fine to medium grained, some laminated shale at fractures, brown water staining from 104'-105', with 6" near vertical fracture.	
CR#3	109.5'-118.5'	8'3"	93%	92%	110, 112, 114, 116, 118		SANDSTONE: gray, with brown water staining at horizontal fracture.	
							SANDSTONE: gray fine to medium grained with little inclusions of brown sandstone, almost unfractured.	
CR#4	118.5'-127.5'	10'2"	98%	113%	120, 122, 124, 126		SANDSTONE: gray fine to medium grained, unfractured except at 125.5', brown water staining at 3" horizontal fracture, produced more water when drilling.	

OBSERVATIONS:

9 7/8" Reamer Tri-cone to 39.5' set 7" casing. 6 1/8" Tri-cone to 90'. Core from 90' to 127.5'.

WELL CONSTRUCTION LOG	PROJECT	PROJECT NUMBER	B-409
	Apex Sanitary Landfill	042-021	
COORDINATES	GROUND SURFACE ELEVATION	TOP OF PVC ELEVATION	
N 284430.49 E 2411502.07	1245.12 feet amsl	1247.57 feet amsl	

CITY & STATE:
Amsterdam, OH
COUNTY: Jefferson County

INSTALLATION DATE:
7/24/06

DRILLING METHOD: Air Rotary / NX Air Core

DRILLING CONTRACTOR:
Duncan Bros. Drilling Inc.

DELEVOPED BY: DWC/JK

DATE: 8/17/06

DEVELOPMENT TECHNIQUE(S):
Grundfos Pump and SS Bailer

WATER REMOVED DURING DEVELOPMENT:
52.5 gallons

Depth to WATER: 103.02 feet

SOUNDED DEPTH FROM TOC:
114.20 feet

SCREENED INTERVAL ELEVATION: '- '

COMMENTS: 9 7/8" Reamer Tri-cone to 39.5' set 7" casing. 6 1/8" Tri-cone to 90'. Core from 90' to 127.5'.

9 7/8" Borehole Diarneter

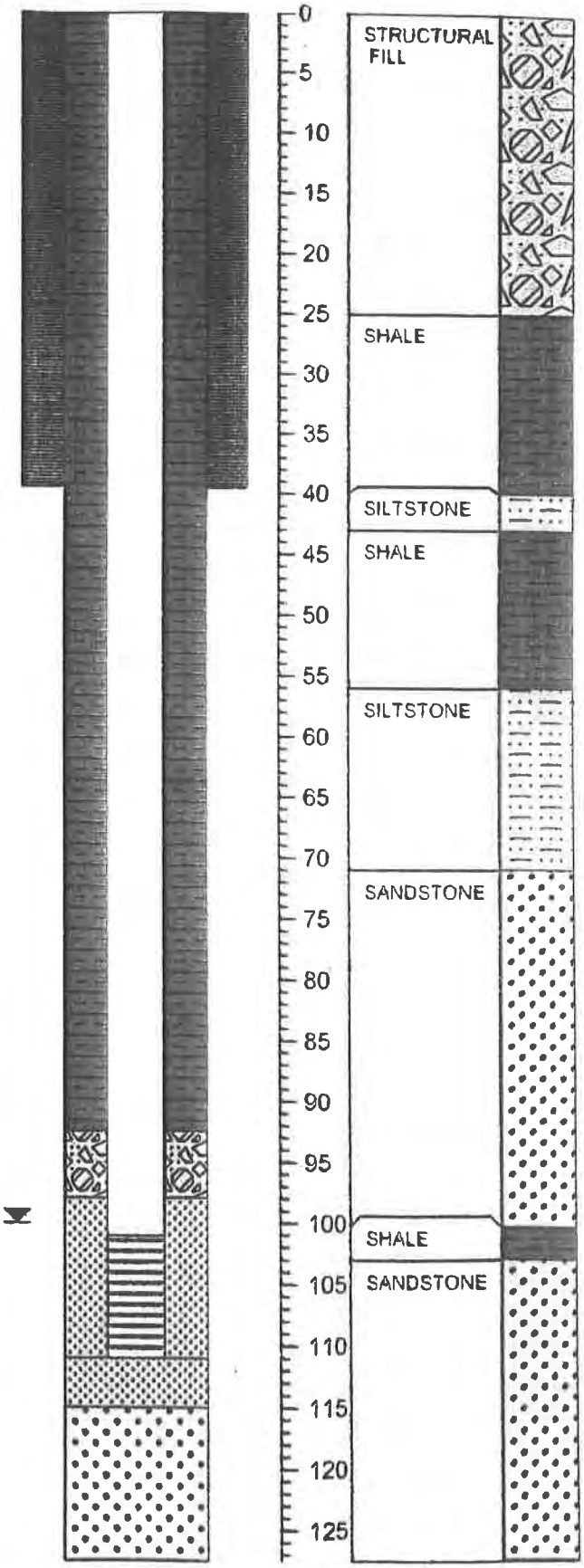
7" Surface Casing to 39.5'

6" Borehole Diameter Sealed using bentonite clay slurry

2" Well Diameter

Hole Plug

No. 4 Fine Sand



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BOREHOLE LOG

BOREHOLE/WELL NO.: **B-409S**

TOTAL DEPTH (BGS): **68 feet**

PROJECT INFORMATION

PROJECT:	**Apex Sanitary Landfill**
SITE LOCATION:	**Amsterdam, OH**
PROJECT NO.:	**042-021**
FIELD GEOLOGIST:	**D. Crayne**
DATES DRILLED:	**7/27/06**

DRILLING INFORMATION

DRILLING CO./DRILLER:	**Duncan Bros. Drilling Inc.**
DRILLING RIG/METHOD:	**Air Rotary / NX Air Core**
BOREHOLE DIAMETER:	**9 7/8" & 6 1/8" Tri-cone Bits**
WELL DIAMETER:	**2"**
GROUND/TOC ELEVATION:	**1245.09 / 1247.55ft amsl**

⧗ Water level during drilling

⧗ Water Level After Development

SAMPLE/ CORE NO.	SAMPLE INTERVAL	SAMPLE RECOVERY (ft. in")	RQD (%)	%Recovery	DEPTH	SOIL SYMBOLS	LITHOLOGY	WELL COMPLETION
	9 7/8" Tri-cone Log Cuttings				0		STRUCTURAL FILL: brown to gray, some boulders.	
					2			
					4			
					6			
					8			
					10			
					12			
					14			
					16			
					18			
					20			
					22			
					24			
					26		SHALE: gray, with some sandstone cuttings, becomes hard at 39'	

OBSERVATIONS:
9 7/8" Reamer Tri-cone to 39.5' set 7" casing. 6 1/8" Tri-cone to 40'. Core from 40' to 68'.

SAMPLE/ CORE NO.	SAMPLE INTERVAL	SAMPLE RECOVERY (ft' in")	RQD (%)	%Recovery	DEPTH	SOIL SYMBOLS	LITHOLOGY	WELL COMPLETION
	6 1/8" Tri-cone Log Cuttings				28			
					30			
					32			
					34			
					36			
					38			
CR#1	40'-50'	3'	39%	30%	40		SILTSTONE: gray, medium soft, near vertical fracture at 42.5'-43' with brown oxidation.	
					42			
					44		SHALE: very little recovery, pulverizing soft black shale during coring from 43'-50'	
					46			
					48			
CR#2	50'-56'	4'6"	7%	75%	50		SHALE: black, highly fractured, little coal stringers at 56', no oxidation at fractures, still drilling dry.	
					52			
					54			
CR#3	56'-62'	4'	42%	67%	56		SILTSTONE: gray, medium soft, moderately fractured, slightly micaceous, boring still dry.	
					58			
					60			
CR#4	62'-68'	5'7"	58%	81%	62			
					64			
					66			
					68			

OBSERVATIONS:
9 7/8" Reamer Tri-cone to 39.5' set 7" casing. 6 1/8" Tri-cone to 40'. Core from 40' to 68'.

WELL CONSTRUCTION LOG

PROJECT	PROJECT NUMBER	
Apex Sanitary Landfill	042-021	B-409S

COORDINATES	GROUND SURFACE ELEVATION	TOP OF PVC ELEVATION
N 284430.49 E 2411502.07	1245.12 feet amsl	1247.57 feet amsl

CITY & STATE:
Amsterdam, OH

COUNTY: Jefferson County

INSTALLATION DATE:
7/27/06

DRILLING METHOD: Air Rotary / NX Air Core

DRILLING CONTRACTOR:
Duncan Bros. Drilling Inc.

DELEVOPED BY: DWC/JK

DATE: 8/17/06

DEVELOPMENT TECHNIQUE(S):
SS Bailer

WATER REMOVED DURING DEVELOPMENT:
Removed 1.3 gallons of water added to hydrate hole plug, and DRY

Depth to WATER: DRY

SOUNDED DEPTH FROM TOC:
62.75 feet

SCREENED INTERVAL ELEVATION: '-'

COMMENTS: 9 7/8" Reamer Tri-cone to 39.5' set 7" casing. 6 1/8" Tri-cone to 40'. Core from 40' to 68'.

9 7/8" Borehole Diameter

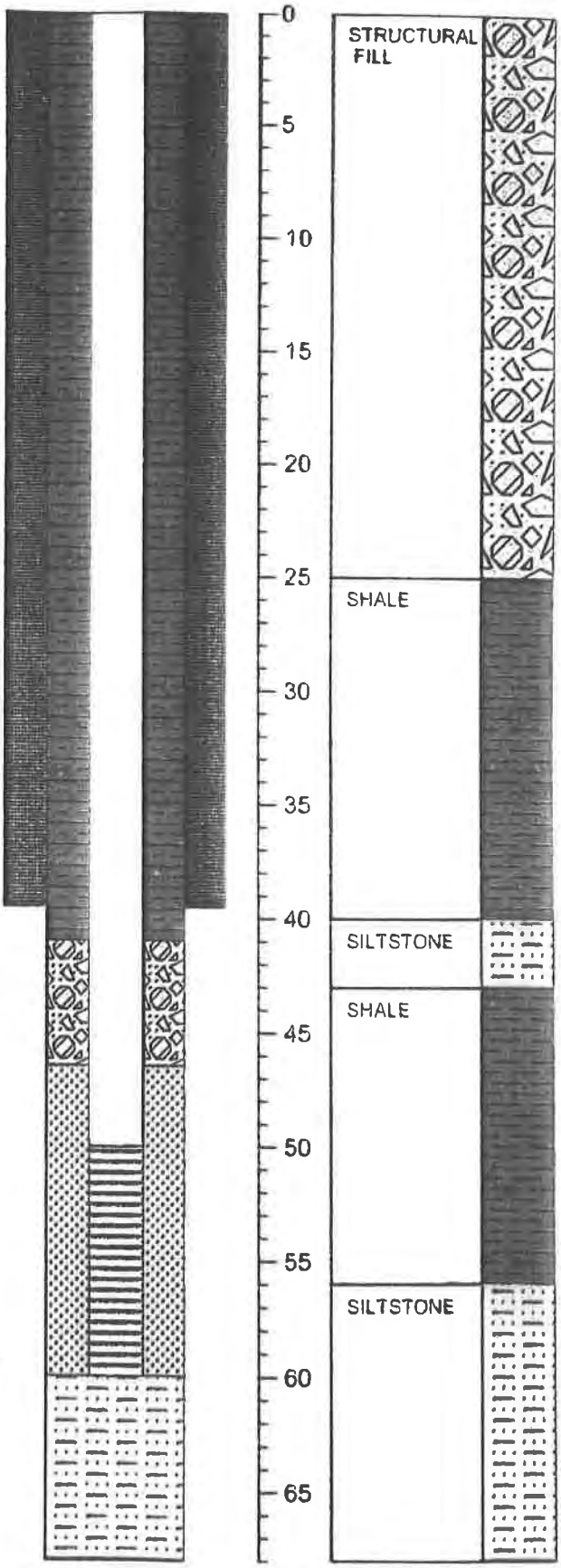
6" Borehole Diameter
Sealed using bentonite clay slurry

7" Surface Casing to 39.5'

Hole Plug

2" Well Diameter

No. 4 Fine Sand



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BOREHOLE LOG

BOREHOLE/WELL NO.: **B-410**

TOTAL DEPTH (BGS): **137 feet**

PROJECT INFORMATION

PROJECT:	**Apex Sanitary Landfill**
SITE LOCATION:	**Amsterdam, OH**
PROJECT NO.:	**042-021**
FIELD GEOLOGIST:	**D. Crayne**
DATES DRILLED:	**6/27/05 to 6/28/05**

DRILLING INFORMATION

DRILLING CO./DRILLER:	**Duncan Bros. Drilling Inc.**
DRILLING RIG/METHOD:	**Air Rotary / NX Air Core**
BOREHOLE DIAMETER:	**9 7/8" & 6 1/8" Tri-cone Bits**
WELL DIAMETER:	**2"**
GROUND/TOC ELEVATION:	**1242.79 / 1245.32 ft amsl**

⧗ Water level during drilling

⧗ Water Level After Development

SAMPLE/ CORE NO.	SAMPLE INTERVAL	SAMPLE RECOVERY (ft. in.)	RQD (%)	%Recovery	DEPTH	SOIL SYMBOLS	LITHOLOGY	WELL COMPLETION
	9 7/8" Tri-cone Log Cuttings				0		STRUCTURAL FILL: re-compacted FILL brown, trace rock fragment.	
					2			
					4			
					6			
					8			
					10		turns gray @ 10 feet.	
					12			
					14			
					16		LIMESTONE: boulder, gray	
					18			
					20		STRUCTURAL FILL: re-compacted FILL, brown.	
					22			
					24			
					26			
					28			
					30			
					32			
					34			

OBSERVATIONS:
9 7/8" Tri-cone to 50' set 7" casing. 6 1/8" Tri-cone to 80'. Core from 80' to 137'.

SAMPLE/ CORE NO.	SAMPLE INTERVAL	SAMPLE RECOVERY (ft' in')	RQD (%)	%Recovery	DEPTH	SOIL SYMBOLS	LITHOLOGY	WELL COMPLETION
					36		SANDSTONE: brown to gray, with some SHALE fragments	
					38			
					40			
					42			
					44			
					46			
					48		SHALE: gray, dry	
	6 1/8" Tri-cone Log Cuttings				50		SANDSTONE: gray, fine grained, dry.	
					52			
					54			
					56			
					58			
					60			
					62			
					64			
					66			
					68			
					70			
					72			
					74			
					76			
					78			
CR#1	80'-90'	10'1"	78%	100%	80		SANDSTONE: gray fine to medium grained, horizontal bedding, intensely fractured, wet.	
					82		SANDSTONE: brown water stained vertical fracture.	
					84		SANDSTONE: gray fine to medium grained, with SILTSTONE lenses, slightly fractured.	

OBSERVATIONS:
9 7/8" Tri-cone to 50' set 7" casing. 6 1/8" Tri-cone to 80'. Core from 80' to 137'.

SAMPLE/ CORE NO.	SAMPLE INTERVAL	SAMPLE RECOVERY (ft' in")	RQD (%)	%Recovery	DEPTH	SOIL SYMBOLS	LITHOLOGY	WELL COMPLETION
CR#2	90'-100'	9'11"	97%	99%	86, 88, 90, 92, 94, 96, 98, 100		SANDSTONE: brown fine to medium grained, with SILTSTONE lenses, moderately fractured, wet.	
							SANDSTONE: SAA, near vertical fracture.	
CR#3	100'-110'	9'7"	79%	96%	102, 104, 106, 108		SANDSTONE: gray, fine to medium grained, with some brown staining at fractures. Wet, but not producing water during drilling.	
#4	110'-119'	6'6"	53%	72%	110, 112, 114, 116, 118		SANDSTONE: gray, fine to medium grained, with some brown staining at fractures. Wet, but not producing water during drilling Core barrel jamed during Core Run (CR # 4) Let boring sit open over night to obtain water level during drilling (static water level) noted on the left.	
CR#5	119'-128'	9'2"	92%	100%	120, 122, 124, 126			
CR#6	128'-137'	9'6"	65%	100%	128, 130, 132, 134		SANDSTONE: gray, with thin laminations of COAL.	
					136			

OBSERVATIONS:
9 7/8" Tri-cone to 50' set 7" casing. 6 1/8" Tri-cone to 80'. Core from 80' to 137'.

WELL CONSTRUCTION LOG

PROJECT	PROJECT NUMBER	
Apex Sanitary Landfill	042-021	B-410

COORDINATES	GROUND SURFACE ELEVATION	TOP OF PVC ELEVATION
N 284690.00 E 2410966.53	1242.79 feet amsl	1245.32 feet amsl

CITY & STATE:
Amsterdam, OH
COUNTY: Jefferson County
INSTALLATION DATE:
6/27/05 to 6/28/05

DRILLING METHOD: Air Rotary / NX Air Core
DRILLING CONTRACTOR:
Duncan Bros. Drilling Inc.

DELEVOPED BY: DWC
DATE: 7/7 & 7/8/05

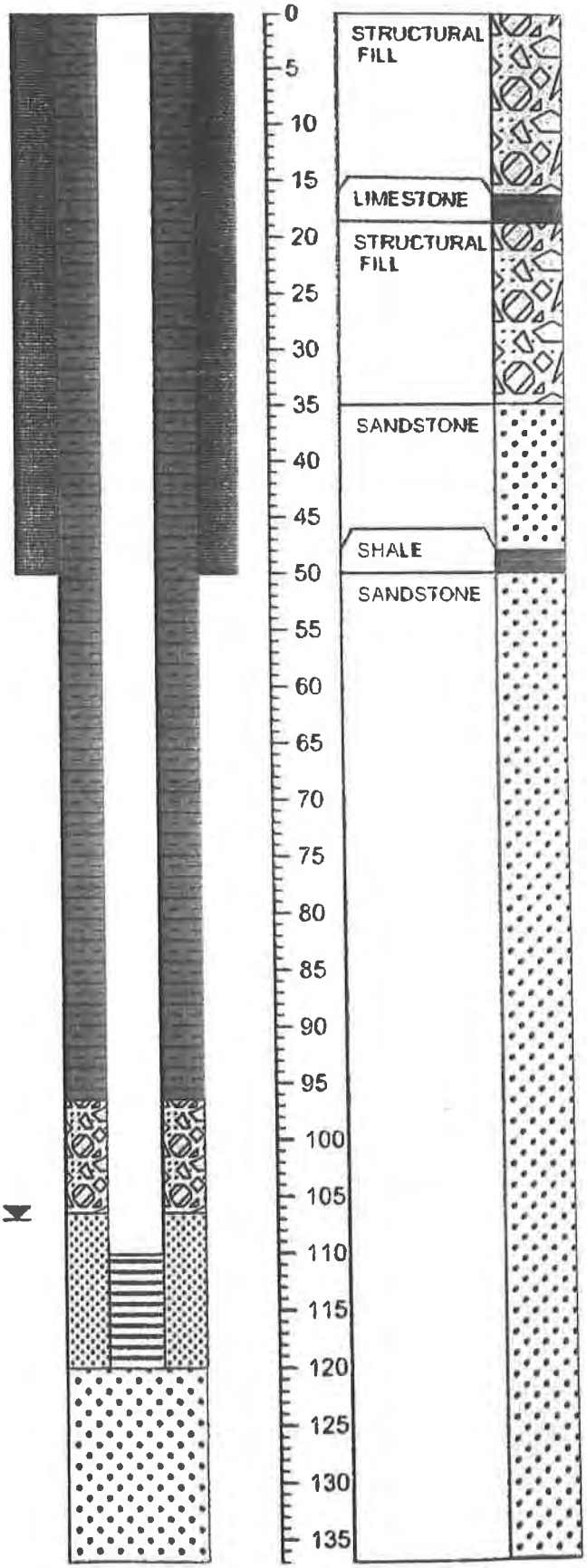
DEVELOPMENT TECHNIQUE(S):
Grundfos Pump and Bailer

WATER REMOVED DURING DEVELOPMENT:
16 gallons

Depth to WATER: 110.29 feet
SOUNDED DEPTH FROM TOC:
122.32 feet

SCREENED INTERVAL ELEVATION: 1133.00'-1123.00 '

COMMENTS:
9 7/8" Tri-cone to 50' set 7" casing. 6 1/8" Tri-cone to 80'. Core from 80' to 137'.



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BOREHOLE LOG

BOREHOLE/WELL NO.: **B-411-rev**

TOTAL DEPTH (BGS): **139 feet**

PROJECT INFORMATION

PROJECT:	**Apex Sanitary Landfill**
SITE LOCATION:	**Amsterdam, OH**
PROJECT NO.:	**042-021**
FIELD GEOLOGIST:	**D. Crayne**
DATES DRILLED:	**8/29/05 to 8/30/05**

DRILLING INFORMATION

DRILLING CO./DRILLER:	**Duncan Bros. Drilling Inc.**
DRILLING RIG/METHOD:	**Air Rotary / NX Air Core**
BOREHOLE DIAMETER:	**9 7/8" & 6 1/8" Tri-cone Bits**
WELL DIAMETER:	**2"**
GROUND/TOC ELEVATION:	**1237.07 / 1239.87 ft amsl**

⧗ Water level during drilling

⧗ Water Level After Development

SAMPLE/ CORE NO.	SAMPLE INTERVAL	SAMPLE RECOVERY (ft' in")	RQD (%)	%Recovery	DEPTH	SOIL SYMBOLS	LITHOLOGY	WELL COMPLETION
	9 7/8" Tri-cone Log Cuttings				0		STRUCTURAL FILL: Compacted fill material brown to gray. occasional Limestone boulder	
					30		STRUCTURAL FILL: brown to gray. some Limestone and rock fragment.	

OBSERVATIONS:
9 7/8" Tri-cone to 89' set 7" casing. 6 1/8" Tri-cone to 90'. Core from 90' to 139'.

SAMPLE/ CORE NO.	SAMPLE INTERVAL	SAMPLE RECOVERY (ft' in")	RQD (%)	%Recovery	DEPTH	SOIL SYMBOLS	LITHOLOGY	WELL COMPLETION
					36			
					38			
					40			
					42			
					44			
					46			
					48			
					50			
					52			
					54			
					56			
					58			
					60		lost circulation @ 60 feet, regained @ 65 feet.	
					62			
					64		picked up a little moisture @ 65 feet.	
					66			
					68			
					70			
					72			
					74			
					76			
					78			
					80			
					82			
					84		SANDSTONE: brown, highly weathered, weak, fine to medium grained.	
					86			

OBSERVATIONS:
9 7/8" Tri-cone to 89' set 7" casing. 6 1/8" Tri-cone to 90'. Core from 90' to 139'.

SAMPLE/ CORE NO.	SAMPLE INTERVAL	SAMPLE RECOVERY (ft' in")	RQD (%)	%Recovery	DEPTH	SOIL SYMBOLS	LITHOLOGY	WELL COMPLETION
	6 1/8" Tri-cone 1 foot				88			
CR#1	90'-100'	10'1"	57%	>100%	90		SANDSTONE: gray medium grained, with few horizontal fractures with brown water staining.	
					92			
					94			
					96			
					98			
CR#2	100'-110'	6'5"	62%	64%	100			
					102			
					104			
					106			
					108			
CR#3	110'-116'	9'9"	73%	>100%	110		SANDSTONE: gray medium grained, unfractured.	
					112			
					114		SANDSTONE: brown medium grained slight horizontal fractures with brown water staining.	
CR#4	116'-125'	7'	69%	67%	116		SANDSTONE: gray medium grained, moderately to intensely fractured with some brown water staining at fractures.	
					118			
					120			
					122			
					124			
CR#5	125'-130'	4'	50%	80%	126			
					128		SANDSTONE: gray with some COAL stringers	
CR#6	130'-139'	7'6"	30%	83%	130		SHALE: gray, intensely fractured, no water staining, Birmingham formation.	
					132			
					134			
					136			
					138			

OBSERVATIONS:
9 7/8" Tri-cone to 89' set 7" casing. 6 1/8" Tri-cone to 90'. Core from 90' to 139'.

WELL CONSTRUCTION LOG	PROJECT Apex Sanitary Landfill	PROJECT NUMBER 042-021	B-411-rev
COORDINATES N 284634.20 E 2410335.01	GROUND SURFACE ELEVATION 1237.07feet amsl	TOP OF PVC ELEVATION 1240.13 feet amsl	

CITY & STATE:
Amsterdam, OH
COUNTY: Jefferson County
INSTALLATION DATE:
8/29/05 to 8/30/05

DRILLING METHOD: Air Rotary / NX Air Core
DRILLING CONTRACTOR:
Duncan Bros. Drilling Inc.

DELEVOPED BY: DWC
DATE: 9/2 & 9/22/05

DEVELOPMENT TECHNIQUE(S):
Grundfos Pump and Bailer

WATER REMOVED DURING DEVELOPMENT:
15 gallons

DEPTH to WATER: 118.67

SOUNDED DEPTH FROM TOC:
128.37 feet

SCREENED INTERVAL ELEVATION: 1121.50'-1111.50 '

COMMENTS:
9 7/8" Tri-cone to 89' set 7" casing. 6 1/8" Tri-cone to 90'. Core from 90' to 139'.

7" Surface Casing to 89'

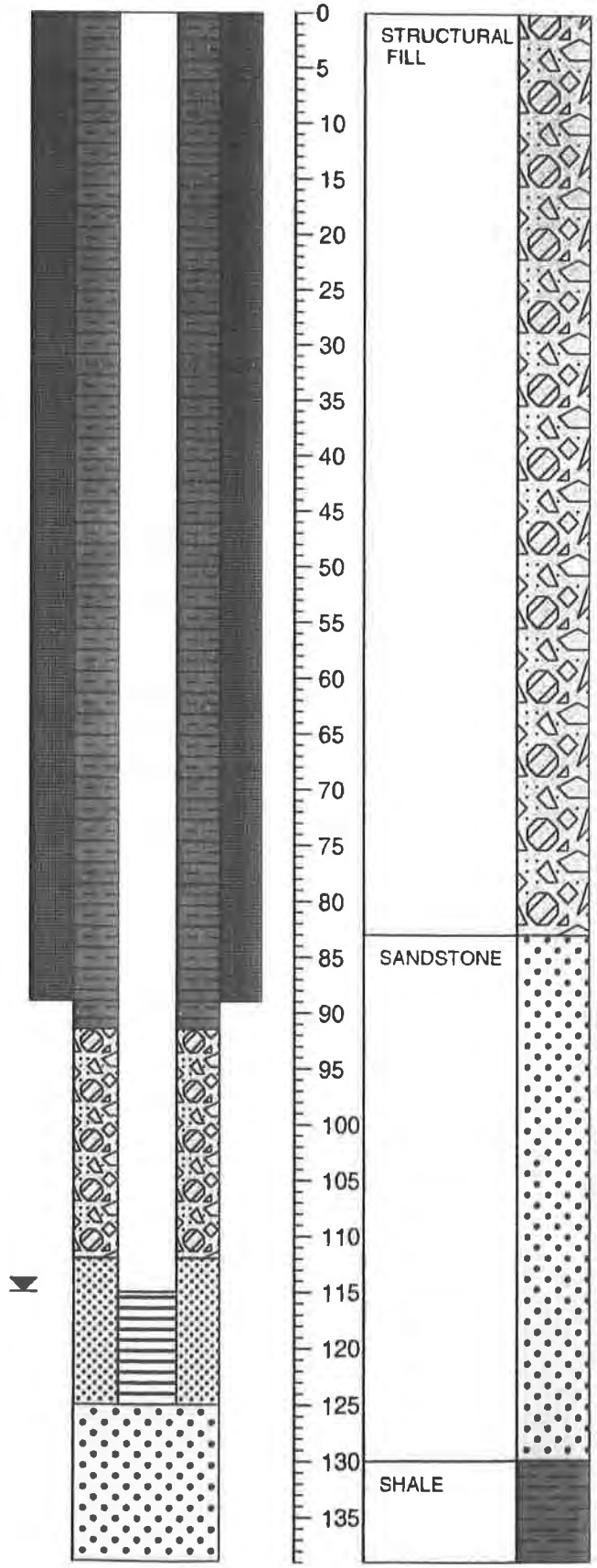
Sealed using bentonite clay slurry

2" Well Diameter

6" Borehole Diameter

Hole Plug

No. 7 Fine Sand



CIVIL & ENVIRONMENTAL CONSULTANTS, INC.

CIVIL & ENVIRONMENTAL CONSULTANTS, INC

8740 Orion Pl., Suite 100
Columbus, OH 43240

Phone 614-540-6633 Fax 614-540-6638

BOREHOLE LOG

BOREHOLE/WELL NO.: **B-412-rev**

TOTAL DEPTH (BGS): **128 feet**

PROJECT INFORMATION

PROJECT:	**Apex Sanitary Landfill**
SITE LOCATION:	**Amsterdam, OH**
PROJECT NO.:	**042-021**
FIELD GEOLOGIST:	**D. Crayne**
DATES DRILLED:	**9/1/05**

DRILLING INFORMATION

DRILLING CO./DRILLER:	**Duncan Bros. Drilling Inc.**
DRILLING RIG/METHOD:	**Air Rotary / NX Air Core**
BOREHOLE DIAMETER:	**9 7/8" & 6 1/8" Tri-cone Bits**
WELL DIAMETER:	**2"**
GROUND/TOC ELEVATION:	**1233.74 / 1236.38 ft amsl**

⧖ Water level during drilling

⧗ Water Level After Development

SAMPLE/ CORE NO.	SAMPLE INTERVAL	SAMPLE RECOVERY (ft' in")	RQD (%)	%Recovery	DEPTH	SOIL SYMBOLS	LITHOLOGY	WELL COMPLETION
	9 7/8" Tri-cone Log Cuttings				0		STRUCTURAL FILL: brown to gray, occasional limestone boulder	
					20		SANDSTONE: brown, weak, not solid enough for casing.	

OBSERVATIONS:
9 7/8" Tri-cone to 41' set 7" casing. 6 1/8" Tri-cone to 80'. Core from 80' to 128'.

SAMPLE/ CORE NO.	SAMPLE INTERVAL	SAMPLE RECOVERY (ft' in")	RQD (%)	%Recovery	DEPTH	SOIL SYMBOLS	LITHOLOGY	WELL COMPLETION
	6 1/8" Tri-cone Log Cuttings				34 36 38 40 42 44 46 48 50 52 54 56 58 60 62 64 66 68 70 72 74 76 78 80		SHALE: brown to gray. SANDSTONE: gray medium grained sandstone with occasional seams of brown water stained cuttings. Drilling very dry and dusty to 80 feet.	

OBSERVATIONS:
9 7/8" Tri-cone to 41' set 7" casing. 6 1/8" Tri-cone to 80'. Core from 80' to 128'.

SAMPLE/ CORE NO.	SAMPLE INTERVAL	SAMPLE RECOVERY (ft' in")	RQD (%)	%Recovery	DEPTH	SOIL SYMBOLS	LITHOLOGY	WELL COMPLETION
CR#1	80'-90'	9'11"	77%	99%	82		SANDSTONE: gray with verticle fractures and brown water staining at fractures.	
					84			
					86		SANDSTONE: gray medium grained, unfractured.	
					88			
CR#2	90'-100'	9'6"	26%	95%	90			
					92		SANDSTONE: brown to gray. Core very broken due to the loss of the core down hole. Two attempts made to retrieve the 10 foot core run.	
					94			
					96			
					98			
CR#3	100'-109'	8'5"	81%	94%	100			
					102		SANDSTONE: gray, medium grained, with two brown horizontal fractures @ 103' and 107'	
					104			
					106			
					108			
CR#4	109'-118'	9'9"	100%	100%	110		SANDSTONE: gray with SILTSTONE lenses, unfractured.	
					112			
					114			
					116			
CR#5	118'-128'	9'10"	58%	98%	118		SANDSTONE: gray with a few COAL stringers. 10 inch near vertical fracture @ 121', brown staining.	
					120			
					122			
					124			
					126			
					128			

OBSERVATIONS:
9 7/8" Tri-cone to 41' set 7" casing. 6 1/8" Tri-cone to 80'. Core from 80' to 128'.

WELL CONSTRUCTION LOG	PROJECT Apex Sanitary Landfill	PROJECT NUMBER 042-021	B-412-rev
COORDINATES N 284220.02 E 2410143.72	GROUND SURFACE ELEVATION 1233.74 feet amsl	TOP OF PVC ELEVATION 1236.38 feet amsl	

CITY & STATE:
Amsterdam, OH

COUNTY: Jefferson County

INSTALLATION DATE:
9/1/05

DRILLING METHOD: Air Rotary / NX Air Core

DRILLING CONTRACTOR:
Duncan Bros. Drilling Inc.

DELEVOPED BY: DWC

DATE: 9/2 & 9/22/05

DEVELOPMENT TECHNIQUE(S):
Grundfos Pump and Bailer

WATER REMOVED DURING DEVELOPMENT:
19 gallons

DEPTH to WATER: 109.29

SOUNDED DEPTH FROM TOC:
130.42 feet

SCREENED INTERVAL ELEVATION: 1115.96'-1105.96 '

COMMENTS:
9 7/8" Tri-cone to 41' set 7" casing. 6 1/8" Tri-cone to 80'. Core from 80' to 128'.

7" Surface Casing to 41'

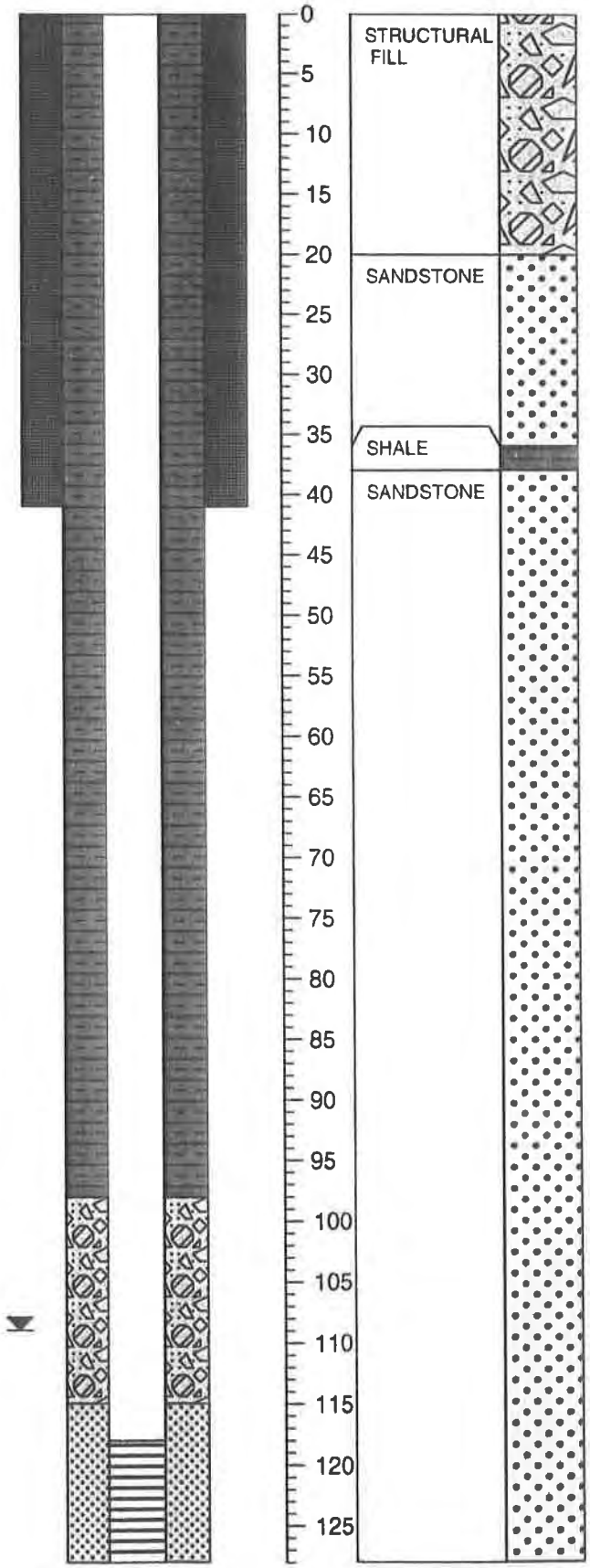
Sealed using bentonite clay slurry

2" Well Diameter

6" Borehole Diameter

Hole Plug

No. 7 Fine Sand



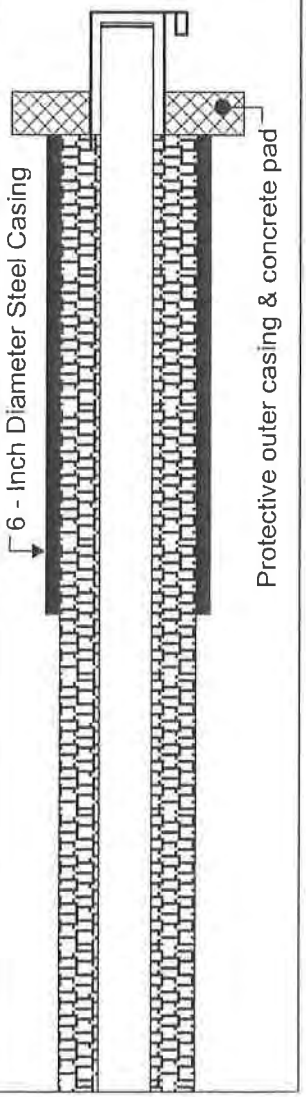
CIVIL & ENVIRONMENTAL CONSULTANTS, INC.

Civil & Environmental Consultants, Inc.

Chicago Cincinnati Columbus Export Detroit Indianapolis Nashville Pittsburgh St. Louis

Project Name: Apex Sanitary Landfill Amsterdam, OH	Borehole/Well ID: B-413
	Northing: 283549.12
	Easting: 2409818.42
	Casing Elevation: 1242.96
Project No.: 042-021	Ground Elevation: 1240.11
Date Started: 2-13-08 Completed: 2-13-08	Groundwater Elevation: 1147.65 Date: 3-24-08 Time: 1448
Drilling Company: Duncan Bros. Drilling Inc.	Sample Information: 9 7/8 tri-cone to 18'. Set 6" steel casing to 18.3'. 6 inch tri-cone from 18'-80'. NX core from 80'-107'. 6 inch tri-cone 80'-100' to
Driller: Dave	
CEC Representative: D. Crayne	
Drilling Method: Air Rotary	Comments/Problems:
Bore Hole: 9 7/8" & 6" / Core Size: NX	
Well Installed: ☑	
Screened Interval:	

Sample No./ Core Run	Recovery (feet)	Blow Counts/ RQD	Pocket Pen.	Sample Type	Depth (feet)	Material Description and Comments	Graphic Log	Elevation (feet, msl)	Well Diagram
					-3				
					-1	Ground Surface		1240.1	
					1	brown to gray LEAN CLAY, moist (FILL)		1237.1	
					3	brown to gray weak SHALE, dry			
					5				
					7				
					9				
					11				
					13				
					15			1224.6	
					17	gray LIMESTONE (15.5-15.9) strong reaction to HCL, dry.			
					19	brown SHALE, dry.			
					21				
					23				
					25				
					27				
					29				
					31				
					33			1207.1	
						gray SHALE, dry			

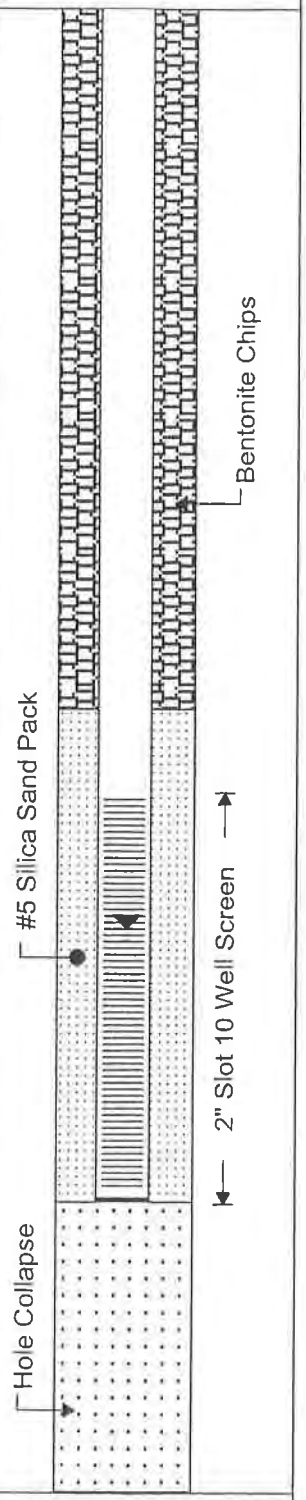


Civil & Environmental Consultants, Inc.	Project Name: Apex Sanitary Landfill Project No.: 042-021	Borehole/Well ID: B-413

Sample No./ Core Run	Recovery	Blow Counts/ RQD	Pocket Pen.	Sample Type	Depth (feet)	Material Description and Comments	Graphic Log	Elevation (feet, msl)	Well Diagram
					36 38 40 42 44 46 48			1192.1	Bentonite Chips
						black SHALE, trace coal, dry		1191.1	
					50 52	alternating brown to gray SHALE, dry		1187.1	
					54 56 58 60	gray SANDSTONE, very hard, dry		1179.1	
					62	brown SANDSTONE, dust died down a little, possibly a little water		1176.1	
					64 66 68 70	gray SANDSTONE, dry			

Civil & Environmental Consultants, Inc.	Project Name: Apex Sanitary Landfill Project No.: 042-021	Borehole/Well ID: B-413

Sample No./ Core Run	Recovery	Blow Counts/ RQD	Pocket Pen.	Sample Type	Depth (feet)	Material Description and Comments	Graphic Log	Elevation (feet, msl)	Well Diagram
					73 75 77 79			1160.1	
1	8.8	94%		NX	81 83 85 87	gray hard SANDSTONE, trace black fossils, non-fractured, massive bedding		1152.1	
2	8.8	90%		NX	89 91 93 95 97	brown SANDSTONE, oxidized fracture at 88.7', wet gray fine SANDSTONE, trace brown fine sandstone inclusions, slightly fractured, hard. brown 6 inch diagonal fracture with oxidation, wet.		1149.1	
3	7.4	97%		NX	99 101 103 105 107	brown oxidized fracture at 98.5, wet brown oxidized fracture at 101.75, wet probably lost recovery to fractures. BOB = 107 feet		1133.1	



Civil & Environmental Consultants, Inc.

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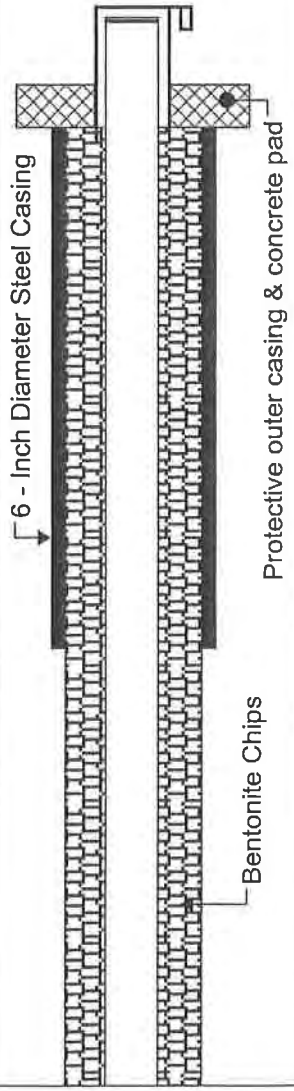
Project Name: Apex Sanitary Landfill Amsterdam, OH	Borehole/Well ID: B-413R
	Northing: 283575.05
	Easting: 2409823.98
	Casing Elevation: 1241.61
Project No.: 081-898.413A	Ground Elevation: 1238.88
Date Started: 5-5-09 Completed: 5-8-09	Groundwater Elevation: 1142.64 Date: 5-20-09 Time: 1500
Drilling Company: Double J Drilling, Inc.	Sample Information: Drilled 6 1/4" augers to 20'. Set 6" steel casing to 20'. Drilled 5 7/8" tri-cone from 20' to 100". Cored with NQ (1 7/8") from 100'-146'. Reamed boring with 5 7/8" tri-cone from 100' to 134'. Set well screen from 123' to 133'.
Driller: Cliff	
CEC Representative: D. Crayne	
Drilling Method: Air Rotary & HSA for surface casing	Comments/Problems: Sealed well with all bentonite chips from top of sand pack at 118' to ground surface. Hydrated chips to activate. Sealed surface casing with all bentonite chips, hydrated to activate. All drilling was completed with air. No water used.
Bore Hole: 5 7/8" Core Size: NQ (1 7/8")	
Well Installed: ☑	
Screened Interval: 123'-133'	

Sample No./ Core Run	Recovery (feet)	Blow Counts/ RQD	Pocket Pen.	Sample Type	Depth (feet)	Material Description and Comments	Graphic Log	Elevation (feet, msl)	Well Diagram
					-3				
					-1	Ground Surface		1238.9	
					1	brown to gray LEAN CLAY, moist (FILL)			
					3				
					5			1233.9	
					7	brown to gray weathered SHALE, dry			
					9				
					11			1227.9	
					13	gray LIMESTONE (approx.11-11.8) strong reaction to HCL, dry.		1224.9	
					15	brown SHALE, dry.			
					17	alternating brown to gray SHALE, dry			
					19				
					21				
					23				
					25				
					27				
					29				
					31				
					33				



Civil & Environmental Consultants, Inc.	Project Name: Apex Sanitary Landfill Project No.: 081-898.413A	Borehole/Well ID: B-413R

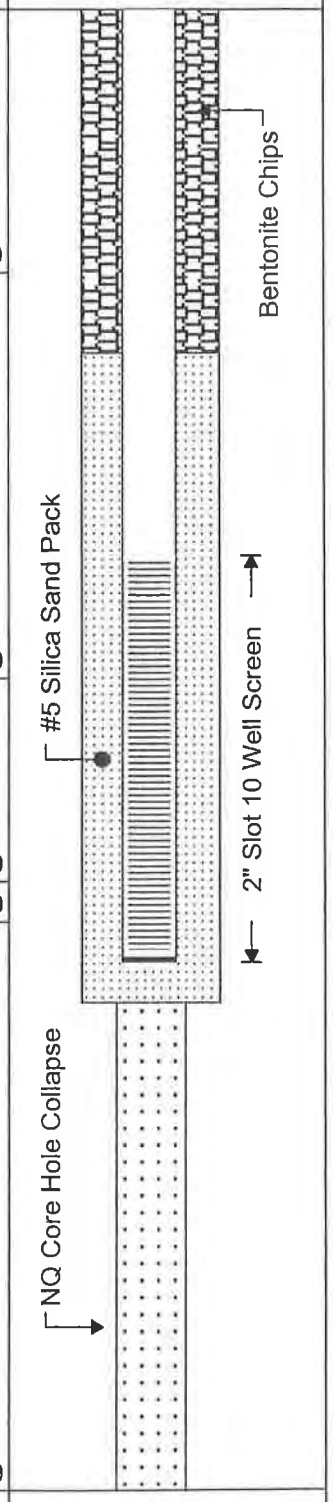
Sample No./ Core Run	Recovery	Blow Counts/ RQD	Pocket Pen.	Sample Type	Depth (feet)	Material Description and Comments	Graphic Log	Elevation (feet, msl)	Well Diagram
					36	Log cuttings, same as above.			
					38				
					40				
					42				
					44				
					46			1191.9	
					48	brown SANDSTONE, very hard, dry			
					50				
					52				
					54			1183.9	Bentonite Chips
					56	gray SANDSTONE, dry.			
					58				
					60				
					62				
					64				
					66				
					68				
					70				
					72				

Civil & Environmental Consultants, Inc.	Project Name: Apex Sanitary Landfill Project No.: 081-898.413A	Borehole/Well ID: B-413R

Sample No./ Core Run	Recovery	Blow Counts/ RQD	Pocket Pen.	Sample Type	Depth (feet)	Material Description and Comments	Graphic Log	Elevation (feet, msl)	Well Diagram
					74	Log cuttings, same as above.			
					76				
					78				
					80				
					82				
					84				
					86				
					88				Bentonite Chips
					90				
					92				
					94	Dust died down a little during drilling, possibly a little water around approx. 94 feet.			
					96				
					98	Start NQ coring at 99.5 feet.		1139.4	
1	4.8	0%		NQ	100	gray SANDSTONE, fine to medium grained, dry, Poor RQD due to rod chatter.			
					102				
					104				
					106				
					108	brown oxidized fractures from 107.5' to 108'.			

Civil & Environmental Consultants, Inc.	Project Name: Apex Sanitary Landfill Project No.: 081-898.413A	Borehole/Well ID: B-413R

Sample No./ Core Run	Recovery	Blow Counts/ RQD	Pocket Pen.	Sample Type	Depth (feet)	Material Description and Comments	Graphic Log	Elevation (feet, msl)
2	9.6	40%		NQ	111 113 115	brown oxidized fracture at 115.7'.		1122.9
3	6	0%		NQ	117 119 121 123 125	gray SANDSTONE, fine grained, Poor RQD due to rod chatter. brown oxidized staining from 117.8' to 118.1". brown oxidized staining from 119.7' to 120.3'. small amount of brown staining at 126'.		1112.9
4	4.4	20%		NQ	127 129 131	gray SANDSTONE, fine grained, Poor RQD due to rod chatter.		1107.9 1106.9
5	5	30%		NQ	133 135	(131-132) gray fine grained SANDSTONE, brown oxidized fracture at 132.5, few limestone inclusions (conglomeritic). Limestone has strong reaction with HCl. Highly fractured.		
6	3.8	0%		NQ	137 139	gray fine grained SANDSTONE, some laminated shale partings. Shale is micaceous.		
7	3.7	0%		NQ	141 143 145	Poor RQD's due to rod chatter mechanically breaking cores		1092.9
					147	BOB = 146 feet		



Civil & Environmental Consultants, Inc.

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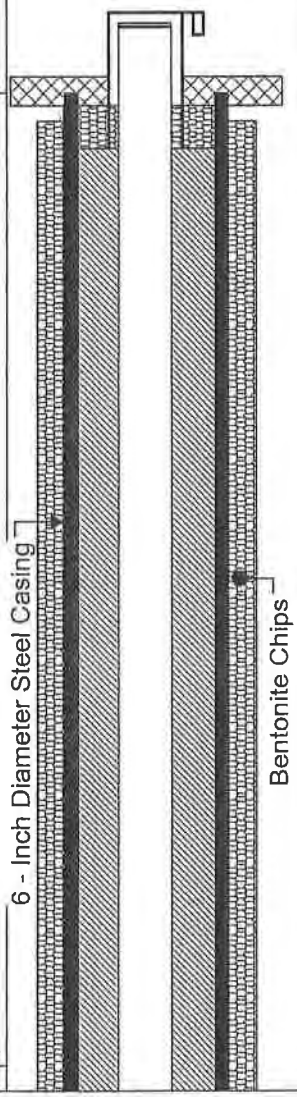
Project Name: Apex Sanitary Landfill Amsterdam, OH	Borehole/Well ID: B-414
	Northing: 282957.72
	Easting: 2409494.13
	Casing Elevation: 1231.50
Project No.: 081-898	Ground Elevation: 1229.42
Date Started: 8/11/2009 Completed: 8/12/2009	Groundwater Elevation: 1137.51 Date: 8/18/09 Time: -
Drilling Company: Duncan Bros. Drilling Inc.	Sample Information: 9 7/8 tri-cone to 40'. Set 6" steel casing to 40'. 5 7/8 inch tri-cone from 40'-85'. 94mm core from 85'-125'. 6 inch tri-cone 85'-118' to set well.
Driller: Mark Duncan	
CEC Representative: J. Kennedy	
Drilling Method: Air Rotary	Comments/Problems:
Bore Hole: 9 7/8" & 6" / Core Size: 94 mm	
Well Installed: ☑	
Screened Interval: 108-118 ft bgs	

Sample No./ Core Run	Recovery (feet)	Blow Counts/ RQD	Pocket Pen.	Sample Type	Depth (feet)	Material Description and Comments	Graphic Log	Elevation (feet, msl)	Well Diagram
					-3				
					-1	Ground Surface		1229.4	
					1	Fill Brown and gray, Lean CLAY, moist.			
					3				
					5				
					7				
					9				
					11				
					13				
					15				
					17				
					19				
					21				
					23				
					25				
					27				
					29				
					31				
					33			1195.4	



Civil & Environmental Consultants, Inc.	Project Name: Apex Sanitary Landfill Project No.: 081-898	Borehole/Well ID: B-414

Sample No./ Core Run	Recovery	Blow Counts/ RQD	Pocket Pen.	Sample Type	Depth (feet)	Material Description and Comments	Graphic Log	Elevation (feet, msl)	Well Diagram
					36 38 40 42 44 46 48 50 52	Brown SHALE, dry.			
					54	Gray SHALE, dry.		1176.4 1173.4	
					56 58	Gray SANDSTONE, moist,weathered, soft.		1171.4	
					60 62	Gray to black SHALE, dry,.		1166.4	
					64	Brown SHALE, dry.		1165.4	
					66 68 70	Gray, SHALE, dry.			Bentonite Grout

Civil & Environmental Consultants, Inc.	Project Name: Apex Sanitary Landfill Project No.: 081-898	Borehole/Well ID: B-414

Sample No./ Core Run	Recovery	Blow Counts/ RQD	Pocket Pen.	Sample Type	Depth (feet)	Material Description and Comments	Graphic Log	Elevation (feet, msl)	Well Diagram
					73 75 77 79			1150.4	
					81	Brown, Sandy SHALE, dry.		1148.4	
					83	Gray, SANDSTONE, moist.		1146.4	
					85	Brown, SHALE, dry.		1145.4	
C1	3.5	73%		HQ	87 89	Gray, SANDSTONE, fine to medium grained, hard, slight shale interbedding, moderately fractured, some black staining/weathering, moist.			
C2	5.0	14%		HQ	91 93				
C3	0.9	0%		HQ	95 97 99 101				
C4	1.9	100%		HQ	103			1124.4	
					105 107				

Bentonite Chips

Civil & Environmental Consultants, Inc.	Project Name: Apex Sanitary Landfill Project No.: 081-898	Borehole/Well ID: B-414

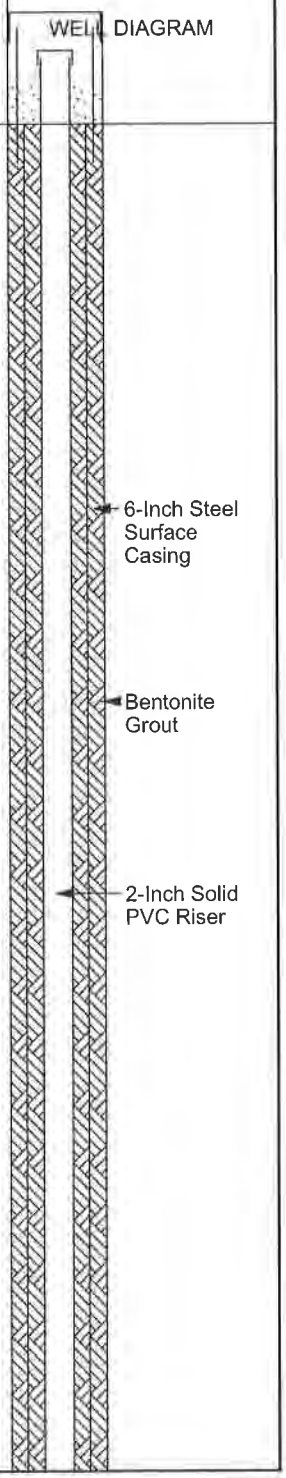
Sample No./ Core Run	Recovery	Blow Counts/ RQD	Pocket Pen.	Sample Type	Depth (feet)	Material Description and Comments	Graphic Log	Elevation (feet, msl)	Well Diagram
C5	7.9	61%		HQ	110 112			1117.4	
C6	6.7	71%		HQ	114 116 118 120	Gray, SANDSTONE, hard, slightly weathered, slightly fractured, wet. Significant oxidation on fracture at 114.7.		1109.4	#5 Silica Sand Pack 2" Slot 10 Well Screen
C7	4.9	86%		HQ	122 124	Gray, SANDSTONE, becoming fine grained, hard, unweathered, massive, wet.		1104.4	Hole Collapse
					126 128 130 132 134 136 138 140 142 144	End of Boring - 125'			

Civil & Environmental Consultants, Inc.
8740 Orion Place, Suite 100
Columbus, Ohio 43240

BORING NUMBER P-1

CLIENT Apex Environmental, LLC
PROJECT NAME Apex Sanitary Landfill
CEC PROJECT NUMBER 101-049
PROJECT LOCATION Amsterdam, OH
DATE STARTED 9/14/10 **COMPLETED** 9/28/10
GROUND ELEVATION 1327.11 ft **HOLE SIZE** 8" / 5"
DRILLING CONTRACTOR Frontz Drilling, Inc.
GROUND WATER LEVELS:
DRILLING METHOD Air Rotary & HQ Core
AT TIME OF DRILLING ---
LOGGED BY BRB **CHECKED BY** DWC
AT END OF DRILLING 178.9 ft / Elev 1148.2 ft
LOCATION Northing: 282316.10 Easting: 2407947.91
24hrs AFTER DRILLING 177.4 ft / Elev 1149.7 ft

DEPTH (ft)	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	GRAPHIC LOG	MATERIAL DESCRIPTION	WELL DIAGRAM
0				Blind drilled from 0' - 85' and set 6" steel surface casing. See SB-1 for description Top of rock = 83'.	



5
10
15
20
25
30
35

GENERAL BH / TP / WELL APEX_BEDROCK_PIEZOMETERS.GPJ GOOD TEMPLATE.GDT 3/31/11

(Continued Next Page)

Civil & Environmental Consultants, Inc.
8740 Orion Place, Suite 100
Columbus, Ohio 43240

BORING NUMBER P-1

CLIENT Apex Environmental, LLC
PROJECT NAME Apex Sanitary Landfill
CEC PROJECT NUMBER 101-049
PROJECT LOCATION Amsterdam, OH

DEPTH (ft)	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	GRAPHIC LOG	MATERIAL DESCRIPTION	WELL DIAGRAM
35				Blind drilled from 0' - 85' and set 6" steel surface casing. See SB-1 for description Top of rock = 83'. *(continued)*	
40					
45					6-Inch Steel Surface Casing
50					
55					Bentonite Grout
60					
65					2-Inch Solid PVC Riser
70					
75					

(Continued Next Page)

Civil & Environmental Consultants, Inc.
8740 Orion Place, Suite 100
Columbus, Ohio 43240

BORING NUMBER P-1

CLIENT Apex Environmental, LLC
PROJECT NAME Apex Sanitary Landfill
CEC PROJECT NUMBER 101-049
PROJECT LOCATION Amsterdam, OH

DEPTH (ft)	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	GRAPHIC LOG	MATERIAL DESCRIPTION	WELL DIAGRAM
75				Blind drilled from 0' - 85' and set 6" steel surface casing. See SB-1 for description Top of rock = 83'. *(continued)*	
80					
				83.0 — 1244.1	
85				85.0 — 1242.1	End of Steel Surface Casing
				85.9 LIMESTONE; dark gray, strong, intense horizontal fracturing w/ moderate weathering and brown oxidized staining, high reaction to HCl — 1241.2	
	RC 1	90 (58)		LIMESTONE; light gray, very strong, high reaction to HCl note: horizontal fracture w/ moderate weathering and brown oxidized staining @ 87.6' note: broken w/ slight weathering from 88.5' - 90.0' note: crumbled w/ very high weathering from 90.3' - 90.8'	
90				90.3 — 1236.8	
				SILTSTONE; gray, strong, micaceous, sandstone laminations	
				92.1 — 1235.0	
				SANDSTONE; gray, very strong, medium-grained note: diagonal fracture @ 93.2'	
				93.6 — 1233.5	
95				SILTSTONE; gray, strong, micaceous, sandstone laminations	
	RC 2	73 (59)		94.6 note: crumbled w/ high weathering from 93.6' - 94.4' — 1232.5	2-Inch Solid PVC Riser
				LIMESTONE; light gray, very strong, high reaction to HCl	
100					
				note: medium band of sandstone from 101.5' - 102.0'	
				102.4 — 1224.7	
				SHALE; dark gray, weak, few limestone inclusions note: horizontal fracture w/ high weathering and brown oxidized staining @ 103.7' and 103.9'	
105	RC 3	98 (87)		note: horizontal fracture w/ high weathering @ 104.6'	Bentonite Grout
				107.9 — 1219.2	
				SILTSTONE; gray, strong, micaceous, sandstone laminations	
110				note: horizontal fracture w/ moderate weathering from @ 111.7', 112.2', and 112.8'	
				111.6 — 1215.5	
115	RC	93			

(Continued Next Page)

GENERAL BH / TP / WELL APEX_BEDROCK_PIEZOMETERS.GPJ GOOD TEMPLATE.GDT 3/31/11

Civil & Environmental Consultants, Inc.
8740 Orion Place, Suite 100
Columbus, Ohio 43240

BORING NUMBER P-1

CLIENT Apex Environmental, LLC
PROJECT NAME Apex Sanitary Landfill
CEC PROJECT NUMBER 101-049
PROJECT LOCATION Amsterdam, OH

DEPTH (ft)	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	GRAPHIC LOG	MATERIAL DESCRIPTION	WELL DIAGRAM
115	4	(84)		SHALE; dark gray, weak, some calcite inclusions, few limestone inclusions note: horizontal fracture w/ very high weathering @ 114.5' note: horizontal fracture w/ high weathering @ 115.0', 116.1', and 116.3'	
120				note: horizontal fracture w/ moderate weathering @ 120.7' note: horizontal fracture w/ high weathering @ 123.1'	
125	RC 5	52 (39)		note: broken and crumbled w/ high weathering from 123.9' - 129.5' *(continued)*	2-Inch Solid PVC Riser
130				129.5 1197.6 SHALE; dark gray to black, moderate-strong, few pyrite inclusions note: horizontal fracture @ 130.4'	
135	RC 6	100 (98)		note: horizontal fracture w/ slight weathering @ 135.2', 137.0', and 138.1'	
140				140.0 1187.1 SHALE; dark gray to black, moderate-strong, few pyrite inclusions, few plant fossils, trace sandstone laminations note: intense horizontal fracturing from 140.3' - 141.3'	Bentonite Grout
145	RC 7	87 (77)		note: horizontal fracture @ 146.5' note: horizontal fracture w/ moderate weathering @ 48.0' note: horizontal fracture @ 148.6'	
150				150.0 1177.1 SHALE; dark gray to black, moderate-strong, trace pyrite inclusions, some plant fossils, some sandstone laminations note: horizontal fracture @ 150.7' note: horizontal fracture w/ moderate weathering @ 151.1'	
155	RC	100			

(Continued Next Page)

Civil & Environmental Consultants, Inc.
8740 Orion Place, Suite 100
Columbus, Ohio 43240

BORING NUMBER P-1

CLIENT Apex Environmental, LLC **PROJECT NAME** Apex Sanitary Landfill

CEC PROJECT NUMBER 101-049 **PROJECT LOCATION** Amsterdam, OH

DEPTH (ft)	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	GRAPHIC LOG	MATERIAL DESCRIPTION	WELL DIAGRAM
155	8	(95)		SHALE; dark gray to black, moderate-strong, trace pyrite inclusions, some plant fossils, some sandstone laminations note: horizontal fracture @ 150.7' note: horizontal fracture w/ moderate weathering @ 151.1' *(continued)*	
160				160.0 1167.1	2-Inch Solid PVC Riser
				SHALE; dark gray to black, moderate-strong, some plant fossils note: horizontal fracture @ 161.4' note: horizontal fracture @ 163.5' note: medium band of sandstone from 164.1' - 164.5' and 164.6' - 164.9'	
165	RC 9	91 (90)			
170				170.0 1157.1	Bentonite Grout
				SHALE; dark gray to black, moderate-strong, trace plant fossils, some sandstone laminations note: diagonal fracture w/ moderate weathering @ 172.3' note: diagonal fracture w/ slight weathering @ 174.8'	
175	RC 10	103 (93)		note: horizontal fracture w/ high weathering @ 176.4' and 176.8' note: vertical fracture w/ slight weathering from 176.8' - 177.5' note: horizontal fracture w/ high weathering @ 177.5'	
				note: horizontal fracture w/ very high weathering @ 179.8'	
180				note: broken from 180.9' - 184.2'	
				184.2 1142.9	Bentonite Chips
185	RC 11	78 (64)		SANDSTONE; gray, very strong, micaceous, medium-grained, black shale laminations 185.4 1141.7 note: horizontal fracture w/ brown oxidized staining @ 185.4' and 185.6'	
				SHALE; dark gray to black, moderate-strong, micaceous, sandstone laminations note: horizontal fracture w/ brown oxidized staining @ 187.6', 188.6', and 188.9'	#3 Filter Sand
				188.9 1138.2	
190				189.4 1137.7 SANDSTONE / SHALE; interbedded sandstone and shale, brown oxidized staining, vertically fractured	0.010-Inch Slotted Screen
195	RC	103			

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GENERAL BH / TP / WELL APEX_BEDROCK_PIEZOMETERS.GPJ GOOD TEMPLATE.GDT 3/31/11

Civil & Environmental Consultants, Inc.
8740 Orion Place, Suite 100
Columbus, Ohio 43240

BORING NUMBER P-1

CLIENT Apex Environmental, LLC
PROJECT NAME Apex Sanitary Landfill
CEC PROJECT NUMBER 101-049
PROJECT LOCATION Amsterdam, OH

DEPTH (ft)	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	GRAPHIC LOG	MATERIAL DESCRIPTION	WELL DIAGRAM
195	12	(101)		note: horizontal fracture w/ brown oxidized staining @ 189.4' note: vertical fracture w/ brown oxidized staining from 189.4' - 189.8' note: horizontal fracture w/ brown oxidized staining @ 189.8', 190.2', and 192.2' note: diagonal fracture w/ moderate weathering @ 193.7' SANDSTONE; gray, very strong, micaceous, fine to medium-grained, some black shale laminations, few coal laminations	0.010-Inch Slotted Screen #3 Filter Sand
200				note: horizontal fracture @ 205.0'	
205	RC 13	83 (82)		note: medium band of black shale from 208.0' - 208.3' *(continued)*	
210				210.0 1117.1	Bentonite Chips
				SANDSTONE; gray, very strong, micaceous, fine to medium-grained, some coal laminations w/ trace pyrite	
215	RC 14	103 (102)		note: horizontal fracture @ 214.7'	
220				220.0 1107.1	
				SANDSTONE; gray, very strong, micaceous, fine to medium-grained, few coal laminations	
225	RC 15	98 (98)			
230				230.0 1097.1	
235	RC	103			

GENERAL BH / TP / WELL APEX_BEDROCK_PIEZOMETERS.GPJ GOOD TEMPLATE.GDT 3/31/11

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Civil & Environmental Consultants, Inc.
8740 Orion Place, Suite 100
Columbus, Ohio 43240

BORING NUMBER P-1

CLIENT Apex Environmental, LLC
PROJECT NAME Apex Sanitary Landfill
CEC PROJECT NUMBER 101-049
PROJECT LOCATION Amsterdam, OH

DEPTH (ft)	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	GRAPHIC LOG	MATERIAL DESCRIPTION	WELL DIAGRAM
235	16	(100)		SANDSTONE; gray, very strong, micaceous, fine to medium-grained, some coal laminations	
240				240.0 1087.1 note: horizontal fracture w/ high weathering @ 234.4' and 236.1' *(continued)* SANDSTONE; gray, very strong, micaceous, fine to medium-grained, few coal laminations note: horizontal fracture @ 241.5'	
245	RC 17	103 (103)			
250				250.0 1077.1 SANDSTONE; gray, very strong, micaceous, fine to medium-grained, trace coal laminations	Bentonite Chips
255	RC 18	102 (102)			
260				263.6 1063.5	
265	RC 19	92 (87)		SHALE; black, moderate-strong, smooth note: horizontal fracture w/ moderate weathering @ 266.7'	
270				267.5 1059.6 LIMESTONE; dark gray to tan, very strong, some interbedded shale, some calcite inclusions, high reaction to HCl 270.0 1057.1 Bottom of hole at 270.0 feet	

GENERAL BH / TP / WELL APEX_BEDROCK_PIEZOMETERS.GPJ GOOD TEMPLATE.GDT 3/31/11

Civil & Environmental Consultants, Inc.
8740 Orion Place, Suite 100
Columbus, Ohio 43240

BORING NUMBER SB-04 / P-1A

CLIENT Apex Environmental, LLC
PROJECT NAME Apex Lateral Expansion
CEC PROJECT NUMBER 101-049
PROJECT LOCATION Amsterdam, Ohio
DATE STARTED 8/26/10 **COMPLETED** 8/26/10
GROUND ELEVATION 1287.61 ft **HOLE SIZE** 8"
DRILLING CONTRACTOR Test Boring Services, Inc.
GROUND WATER LEVELS:
DRILLING METHOD Auger/SS
AT TIME OF DRILLING Not Applicable
LOGGED BY LRW **CHECKED BY** JMN
AT END OF DRILLING 47.0 ft / Elev 1240.6 ft
LOCATION Northing: 282280.18 Easting: 2407366.15
AFTER DRILLING Immediately Backfilled

ELEVATION (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	DEPTH (ft)	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	POCKET PEN (tsf) T=Torvane
		(TOPSOIL)	0.0				
		Brown SAND, and silt, dry, medium stiff, **(MINE SPOIL)**		SS S-1	8	2-3-4-4 (7)	
		Gray to brown CLAY, and sand, some coal, dry, medium stiff, **(MINE SPOIL)**					
		Gray and brown silty CLAY, and shale fragments, dry, stiff, **(MINE SPOIL)** **Bag sample collected from 3 to 8 ft**		SS S-2	8	9-7-5-4 (12)	
		Gray and orange silty CLAY, some sandstone fragments, dry, medium stiff, **(MINE SPOIL)**	5.0	SS S-3	8	4-5-2-4 (7)	
		Gray silty CLAY, with siltstone fragments, some sand, dry, soft, **(MINE SPOIL)**		SS S-4	7	5-5-2-2 (7)	
		Tan and gray sandy CLAY, with siltstone fragments, some sand, dry, very stiff, **(MINE SPOIL)**		SS S-5	5	5-7-6-10 (13)	
		Tan and gray silty CLAY, some sand, trace coal, dry, stiff, **(MINE SPOIL)**	10.0	SS S-6	8	12-8-9-6 (17)	
		Tan and gray silty CLAY, some sand, some sandstone fragments, dry, stiff, micaceous, **(MINE SPOIL)**		SS S-7	7	7-6-6-5 (12)	
		Gray, tan and orange CLAY, trace silt, trace coal, dry, hard, micaceous on bottom, **(MINE SPOIL)**	15.0	SS S-8	5	8-8-50 (58)	
				SS S-9	8	13-34-12-14 (46)	
		Tan and gray silty CLAY, some sand, some sandstone fragments, dry, very stiff, **(MINE SPOIL)**		SS S-10	8	8-15-11-14 (26)	
		Gray LIMESTONE, dry, dense to medium dense, **(MINE SPOIL)**	20.0	SS S-11	1	29-35-19-9 (54)	
				SS S-12	2	12-10-8-6 (18)	
		Gray, tan and brown CLAY, some sand, some coal, dry, stiff, **(MINE SPOIL)**	25.0	SS		9-5-8-5	

WELL DIAGRAM

Bentonite Chips

2-Inch Solid PVC Riser

CEC CUSTOM LOG 2 APEX_SHALLOW_PIEZOMETERS.GPJ GOOD TEMPLATE.GDT 3/31/11

Civil & Environmental Consultants, Inc.
8740 Orion Place, Suite 100
Columbus, Ohio 43240

BORING NUMBER SB-04 / P-1A

CLIENT Apex Environmental, LLC
PROJECT NAME Apex Lateral Expansion
CEC PROJECT NUMBER 101-049
PROJECT LOCATION Amsterdam, Ohio

ELEVATION (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	DEPTH (ft)	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	POCKET PEN. (tsf) T=Torvane	WELL DIAGRAM
			25.0					
		Gray, tan and brown CLAY, some sand, some coal, dry, stiff, **(MINE SPOIL)***(continued)*		S-13	7	(13)		
		Gray, tan and orange sandy CLAY, some shale fragments, dry, stiff, **(MINE SPOIL)**		SS S-14	8	10-5-8-4 (13)		
		Shelby Tube collected from 28 to 30 ft. Recovery 1.6 ft	30.0	ST S-15		Pushed		
				SS S-16	8	5-5-5-4 (10)		
		Brown and gray silty CLAY, and limestone fragments, and sandstone fragments, dry, very stiff, **(MINE SPOIL)**		SS S-17	8	11-18-26-12 (44)		
		Gray sandy SHALE, dry, hard, micaceous, **(MINE SPOIL)**						
		Tan and gray CLAY, trace sandstone fragments, dry, very stiff, micaceous on bottom, **(MINE SPOIL)**	35.0	SS S-18	8	10-8-8-9 (16)		
		Gray, tan and orange sandy CLAY, and sandstone fragments, and coal, dry, stiff, micaceous in middle, **(MINE SPOIL)**		SS S-19	8	7-6-7-8 (13)		
			40.0	SS S-20	7	7-7-4-6 (11)		
				SS S-21	6	5-14-10-22 (24)		10/20 Sand
		Gray, tan and orange sandy CLAY, some limestone fragments, some coal, dry, stiff to hard, **(MINE SPOIL)**		SS S-22	7	12-29-29-36 (58)		
		Gray, tan and orange sandy CLAY, some limestone fragments, some sandstone fragments, wet, hard, **(MINE SPOIL)**	45.0	SS S-23	6	21-23-14-42 (37)		0.010-Inch Slotted Screen
		Gray SHALE, and limestone fragments, and sandstone fragments, wet, hard, **(MINE SPOIL)**		SS S-24	2	50		
		Gray LIMESTONE, wet, very dense, auger refusal, **(BEDROCK)**		SS S-25	8	50/1"		
		Bottom of hole at 47.6 feet.						

CEC CUSTOM LOG 2 APEX_SHALLOW_PIEZOMETERS.GPJ GOOD TEMPLATE.GDT 3/31/11

Civil & Environmental Consultants, Inc.
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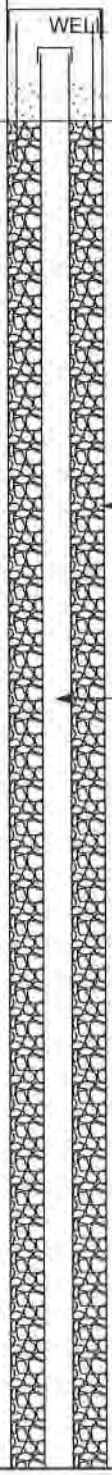
Columbus, Ohio 43240

BORING NUMBER P-1L

CLIENT Apex Environmental, LLC
PROJECT NAME Apex Sanitary Landfill
CEC PROJECT NUMBER 101-049
PROJECT LOCATION Amsterdam, OH
DATE STARTED 9/16/10 **COMPLETED** 9/20/10
GROUND ELEVATION 1327.18 ft **HOLE SIZE** 8" / 5"
DRILLING CONTRACTOR Frontz Drilling, Inc.
GROUND WATER LEVELS:
DRILLING METHOD Air Rotary & HQ Core
AT TIME OF DRILLING ---
LOGGED BY BRB **CHECKED BY** DWC
AT END OF DRILLING 96.8 ft / Elev 1230.4 ft
LOCATION Northing: 282308.95 Easting: 2407965.25
1hrs AFTER DRILLING 95.1 ft / Elev 1232.1 ft

DEPTH (ft)	SAMPLE TYPE NUMBER	GRAPHIC LOG	MATERIAL DESCRIPTION	WELL DIAGRAM
0			Blind drilled from 0' - 80' and set temporary 6" steel surface casing. See SB-1 and P-1 for description. Top of rock = 80'	



5
10
15
20
25
30
35

GENERAL BH / TP / WELL APEX_BEDROCK_PIEZOMETERS.GPJ GOOD TEMPLATE.GDT 3/31/11

(Continued Next Page)

Civil & Environmental Consultants, Inc.
8740 Orion Place, Suite 100
Columbus, Ohio 43240

BORING NUMBER P-1L

CLIENT Apex Environmental, LLC **PROJECT NAME** Apex Sanitary Landfill

CEC PROJECT NUMBER 101-049 **PROJECT LOCATION** Amsterdam, OH

DEPTH (ft)	SAMPLE TYPE NUMBER	GRAPHIC LOG	MATERIAL DESCRIPTION	WELL DIAGRAM
35			Blind drilled from 0' - 80' and set temporary 6" steel surface casing. See SB-1 and P-1 for description. Top of rock = 80'. *(continued)*	
40				Hydrated Bentonite Chips
45				
50				2-Inch Solid PVC Riser
55				
60				
65				
70				
75				

GENERAL BH / TP / WELL APEX_BEDROCK_PIEZOMETERS.GPJ GOOD TEMPLATE.GDT 3/31/11

(Continued Next Page)

Civil & Environmental Consultants, Inc.
8740 Orion Place, Suite 100
Columbus, Ohio 43240

BORING NUMBER P-1L

CLIENT Apex Environmental, LLC
PROJECT NAME Apex Sanitary Landfill
CEC PROJECT NUMBER 101-049
PROJECT LOCATION Amsterdam, OH

DEPTH (ft)	SAMPLE TYPE NUMBER	GRAPHIC LOG	MATERIAL DESCRIPTION	WELL DIAGRAM
75			Blind drilled from 0' - 80' and set temporary 6" steel surface casing. See SB-1 and P-1 for description. Top of rock = 80'. *(continued)*	Hydrated Bentonite Chips
80			80.0 / 1247.2 — Blind drilled from 80' - 101'. See P-1 for description.	2-Inch Solid PVC Riser
85				#3 Filter Sand
90			90.3 / 1236.9	
			92.1 / 1235.1	
			93.6 / 1233.6	0.010-Inch Slotted Screen
95			94.6 / 1232.6	
100			101.0 / 1226.2	
			Bottom of hole at 101.0 feet	

GENERAL BH / TP / WELL APEX_BEDROCK_PIEZOMETERS.GPJ GOOD TEMPLATE.GDT 3/31/11

Civil & Environmental Consultants, Inc.
8740 Orion Place, Suite 100
Columbus, Ohio 43240

BORING NUMBER P-1S

CLIENT Apex Environmental, LLC
PROJECT NAME Apex Sanitary Landfill
CEC PROJECT NUMBER 101-049
PROJECT LOCATION Amsterdam, OH
DATE STARTED 9/20/10 **COMPLETED** 9/28/10
GROUND ELEVATION 1326.50 ft **HOLE SIZE** 8" / 5"
DRILLING CONTRACTOR Frontz Drilling, Inc.
GROUND WATER LEVELS:
DRILLING METHOD Air Rotary & HQ Core
AT TIME OF DRILLING ---
LOGGED BY BRB **CHECKED BY** DWC
AT END OF DRILLING 128.0 ft / Elev 1198.5 ft
LOCATION Northing: 282297.81 Easting: 2407950.80
168hrs AFTER DRILLING 130.5 ft / Elev 1196.0 ft

DEPTH (ft)	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	GRAPHIC LOG	MATERIAL DESCRIPTION	WELL DIAGRAM
0				Blind drilled from 0' - 86' and set 6" steel surface casing. See SB-1 and P-1 for description. Top of rock = 83' (from P-1).	6-Inch Steel Surface Casing; 2-Inch Solid PVC Riser; Bentonite Grout
5					
10					
15					
20					
25					
30					
35					

GENERAL BH / TP / WELL APEX_BEDROCK_PIEZOMETERS.GPJ GOOD TEMPLATE.GDT 3/31/11

(Continued Next Page)

Civil & Environmental Consultants, Inc
8740 Orion Place, Suite 100
Columbus, Ohio 43240

BORING NUMBER P-1S

CLIENT Apex Environmental, LLC **PROJECT NAME** Apex Sanitary Landfill

CEC PROJECT NUMBER 101-049 **PROJECT LOCATION** Amsterdam, OH

DEPTH (ft)	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	GRAPHIC LOG	MATERIAL DESCRIPTION	WELL DIAGRAM
35				Blind drilled from 0' - 86' and set 6" steel surface casing. See SB-1 and P-1 for description. Top of rock = 83' (from P-1). *(continued)*	
40					6-Inch Steel Surface Casing
45					2-Inch Solid PVC Riser
50					Bentonite Grout
55					
60					
65					
70					
75					

GENERAL BH / TP / WELL APEX_BEDROCK_PIEZOMETERS.GPJ GOOD TEMPLATE.GDT 3/31/11

(Continued Next Page)

Civil & Environmental Consultants, Inc.
8740 Orion Place, Suite 100
Columbus, Ohio 43240

BORING NUMBER P-1S

CLIENT Apex Environmental, LLC
PROJECT NAME Apex Sanitary Landfill
CEC PROJECT NUMBER 101-049
PROJECT LOCATION Amsterdam, OH

DEPTH (ft)	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	GRAPHIC LOG	MATERIAL DESCRIPTION	WELL DIAGRAM
75				Blind drilled from 0' - 86' and set 6" steel surface casing. See SB-1 and P-1 for description. Top of rock = 83' (from P-1). *(continued)*	
83.0					1243.5
86.0				Blind drilled from 86' - 120'. See P-1 for description.	1240.5
90.3					1236.2
92.1					1234.4
93.6					1232.9
94.6					1231.9
102.4					1224.1
107.9					1218.6
111.6					1214.9
115					

End of 6-Inch Steel Surface Casing

2-Inch Solid PVC Riser

Bentonite Grout

GENERAL BH / TP / WELL APEX_BEDROCK_PIEZOMETERS.GPJ GOOD TEMPLATE.GDT 3/31/11

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Civil & Environmental Consultants, Inc.
8740 Orion Place, Suite 100
Columbus, Ohio 43240

BORING NUMBER P-1S

CLIENT Apex Environmental, LLC
PROJECT NAME Apex Sanitary Landfill
CEC PROJECT NUMBER 101-049
PROJECT LOCATION Amsterdam, OH

DEPTH (ft)	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	GRAPHIC LOG	MATERIAL DESCRIPTION	WELL DIAGRAM
115					
120				120.0 — 1206.5 SHALE; dark gray, weak, some limestone inclusions, few calcite inclusions note: intense horizontal fracturing from 120.0' - 122.3'	Bentonite Chips
				note: horizontal fracture @ 123.5'	
125	RC 1	91 (82)		note: horizontal fracture w/ high weathering @ 126.6' note: diagonal fracture @ 127.1' note: horizontal fracture w/ high weathering @ 127.6'	0.010-Inch Slotted Screen
				127.6 — 1198.9 SHALE; dark gray to black, moderate-strong, few plant fossils	
130					#3 Filter Sand
				note: horizontal fracture @ 132.1'	
135	RC 2	94 (87)		note: vertical and horizontal fractures w/ high weathering from 135.8' - 136.0'	
				note: horizontal fracture @ 137.3'	
				note: horizontal fracture w/ high weathering @ 138.9'	
140					Bentonite Chips
				note: horizontal fracture w/ slight weathering @ 140.5' and 141.3'	
145	RC 3	75 (74)			
				note: sandstone laminations from 148.5' - 149.0'	
150				150.0 — 1176.5 Bottom of hole at 150.0 feet	

GENERAL BH / TP / WELL APEX_BEDROCK_PIEZOMETERS.GPJ GOOD TEMPLATE.GDT 3/31/11

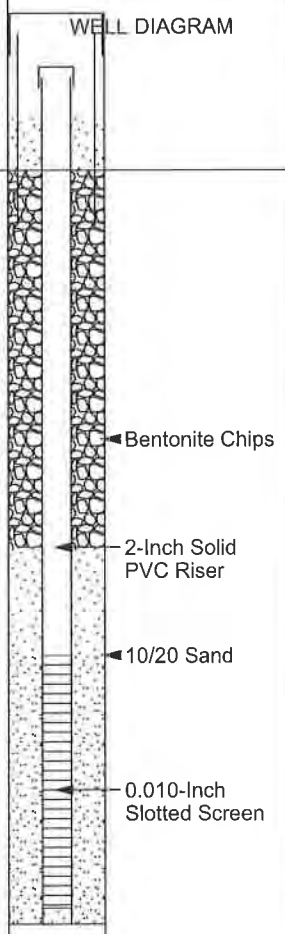
Civil & Environmental Consultants, Inc.
8740 Orion Place, Suite 100
Columbus, Ohio 43240

BORING NUMBER SB-07 / P-2A

CLIENT Apex Environmental, LLC
PROJECT NAME Apex Lateral Expansion
CEC PROJECT NUMBER 101-049
PROJECT LOCATION Amsterdam, Ohio
DATE STARTED 8/4/10 **COMPLETED** 8/4/10
GROUND ELEVATION 1236.68 ft **HOLE SIZE** 8"
DRILLING CONTRACTOR Test Boring Services, Inc.
GROUND WATER LEVELS:
DRILLING METHOD Auger/SS
AT TIME OF DRILLING Not Applicable
LOGGED BY LRW **CHECKED BY** JMN
AT END OF DRILLING Dry
LOCATION Northing: 281145.14 Easting: 2408480.03
AFTER DRILLING Immediately Backfilled

ELEVATION (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	DEPTH (ft)	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	POCKET PEN. (tsf) T=Torvane
		Gray gravelly SAND, some silt, dry, medium dense, **(MINE SPOIL)**	0.0	SS S-1	8	4-10-9-4 (19)	
		Orangish tan silty CLAY, some sand, dry, **(MINE SPOIL)**					
		Dark brown SILT, and coal, dry, very stiff, **(MINE SPOIL)**		SS S-2	7	15-15-6-4 (21)	
		Orangish tan and gray CLAY, some sand, trace coal, dry, medium stiff to stiff, **(MINE SPOIL)**	5.0	SS S-3	8	4-3-4-6 (7)	
				SS S-4	8	6-6-6-8 (12)	
		Orangish tan and gray CLAY, some sand, moist-, stiff, **(MINE SPOIL)**		SS S-5	8	7-7-4-8 (11)	
		Reddish brown clayey SAND, moist-, very stiff, **(MINE SPOIL)**	10.0	SS S-6	8	6-9-13-13 (22)	
		Orangish tan CLAY, some sand, dry, soft, **(MINE SPOIL)**		SS S-7	8	2-2-2-50 (4)	
		Gray LIMESTONE, dry, very dense, Auger Refusal, **(BEDROCK)**					
		Bottom of hole at 14.0 feet.					

WELL DIAGRAM



CEC CUSTOM LOG 2 APEX_SHALLOW_PIEZOMETERS.GPJ GOOD TEMPLATE.GDT 3/31/11

Civil & Environmental Consultants, Inc.
8740 Orion Place, Suite 100
Columbus, Ohio 43240

BORING NUMBER P-2L

CLIENT Apex Environmental, LLC
PROJECT NAME Apex Sanitary Landfill
CEC PROJECT NUMBER 101-049
PROJECT LOCATION Amsterdam, OH
DATE STARTED 9/23/10 **COMPLETED** 9/23/10
GROUND ELEVATION 1236.62 ft **HOLE SIZE** 8" / 5"
DRILLING CONTRACTOR Frontz Drilling, Inc.
GROUND WATER LEVELS:
DRILLING METHOD Air Rotary & HQ Core
AT TIME OF DRILLING ---
LOGGED BY BRB **CHECKED BY** DWC
AT END OF DRILLING ---
LOCATION Northing: 281153.56 Easting: 2408509.37
1hrs AFTER DRILLING 15.4 ft / Elev 1221.2 ft

DEPTH (ft)	MATERIAL DESCRIPTION	WELL DIAGRAM
0	Blind drilled from 0' - 12' and set temporary 6" steel surface casing. See SB-7 for description. Top of rock = 14' (from SB-7).	
12.0 (1224.6)	Blind drilled from 12' - 32'. See SB-7 and P-2S for description.	Bentonite Grout; 2-Inch Solid PVC Riser
14.0 (1222.6)		
19.3 (1217.3)		Bentonite Chips; #3 Filter Sand
25.9 (1210.7)		0.010-Inch Slotted Screen
32.0 (1204.6)	Bottom of hole at 32.0 feet	

GENERAL BH / TP / WELL APEX_BEDROCK_PIEZOMETERS.GPJ GOOD TEMPLATE.GDT 3/31/11

Civil & Environmental Consultants, Inc.
8740 Orion Place, Suite 100
Columbus, Ohio 43240

BORING NUMBER P-2S

CLIENT Apex Environmental, LLC
PROJECT NAME Apex Sanitary Landfill
CEC PROJECT NUMBER 101-049
PROJECT LOCATION Amsterdam, OH
DATE STARTED 9/22/10 **COMPLETED** 9/23/10
GROUND ELEVATION 1236.44 ft **HOLE SIZE** 8" / 5"
DRILLING CONTRACTOR Frontz Drilling, Inc.
GROUND WATER LEVELS:
DRILLING METHOD Air Rotary & HQ Core
AT TIME OF DRILLING ---
LOGGED BY BRB **CHECKED BY** DWC
AT END OF DRILLING ---
LOCATION Northing: 281149.67 Easting: 2408495.21
1hrs AFTER DRILLING 37.6 ft / Elev 1198.8 ft

DEPTH (ft)	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	GRAPHIC LOG	MATERIAL DESCRIPTION
0				Blind drilled from 0' - 18' and set 6" steel surface casing. See SB-7 for description. Top of rock = 14' (from SB-7).
14.0				1222.4
18.0				1218.4 SANDSTONE; gray, very strong, micaceous, medium-grained
19.3				1217.1 note: intense horizontal fracturing w/ brown oxidized staining from 19.1' - 20.9'
				SHALE; dark gray, very weak
	RC 1	46 (24)		note: crumbled w/ high weathering from 20.9' - 25.9'
25.9				1210.5 LIMESTONE; dark gray, strong, high reaction to HCl note: vertical fracture w/ brown oxidized staining from 26.3' - 26.6' note: crumbled w/ brown oxidized staining from 27.5' - 28.0' note: intense horizontal fracturing from 28.0' - 30.0'
	RC 2	58 (17)		
30.0				1206.4 LIMESTONE; dark gray to black, weak to strong, high reaction to HCl note: broken w/ brown oxidized staining from 30.0' - 32.1' note: intense horizontal fracturing w/ brown oxidized staining from 32.1' - 34.1'
34.1				1202.3
35	RC	58		SHALE; dark gray, very weak, high weathering, trace interbedded limestone

WELL DIAGRAM

- 6-Inch Steel Surface Casing
- Bentonite Grout
- 2-Inch Solid PVC Riser
- End of Steel Surface Casing

GENERAL BH / TP / WELL APEX_BEDROCK_PIEZOMETERS.GPJ GOOD TEMPLATE.GDT 3/31/11

(Continued Next Page)

Civil & Environmental Consultants, Inc.
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Columbus, Ohio 43240

BORING NUMBER P-2S

CLIENT Apex Environmental, LLC
PROJECT NAME Apex Sanitary Landfill
CEC PROJECT NUMBER 101-049
PROJECT LOCATION Amsterdam, OH

DEPTH (ft)	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	GRAPHIC LOG	MATERIAL DESCRIPTION	WELL DIAGRAM
35	3	(46)		SHALE; dark gray, very weak, high weathering, trace interbedded limestone *(continued)*	Bentonite Grout
40				40.0 / 1196.4	
				SHALE; dark gray, weak to moderate-strong	2-Inch Solid PVC Riser
45	RC 4	83 (75)		note: horizontal fracture @ 42.6' and 43.4' note: horizontal fracture w/ moderate weathering @ 44.1' note: horizontal fracture w/ very high weathering @ 45.0' note: horizontal fracture w/ moderate weathering @ 45.7' and 47.7'	
50				50.0 / 1186.4	Bentonite Chips
				SHALE; dark gray, weak to moderate-strong, few sandstone laminations	
55	RC 5	95 (90)		note: horizontal fracture @ 50.9' and 52.1' note: horizontal fracture w/ moderate weathering @ 53.9' note: horizontal fracture w/ brown oxidized staining @ 54.2' note: horizontal fracture w/ high weathering @ 55.0' note: diagonal fracture w/ brown oxidized staining @ 56.6'	#3 Filter Sand
60				note: horizontal fracture w/ high weathering @ 58.3' 59.8 / 1176.6	0.010-Inch Slotted Screen
				SANDSTONE; gray, very strong, micaceous, medium-grained, few shale laminations	
				62.0 / 1174.4	
65	RC 6	98 (94)		SHALE; dark gray to black, moderate-strong to strong, micaceous note: horizontal fracture w/ brown oxidized staining @ 62.8'	
70				note: diagonal fracture w/ moderate weathering @68.9' 70.0 / 1166.4	Bentonite Chips
				SHALE; dark gray to black, moderate-strong to strong, micaceous, sandstone laminations	
75	RC	100		note: horizontal fracture @ 76.7', 77.1', and 78.9' note: horizontal fracture w/ moderate weathering @ 79.8'	

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GENERAL BH / TP / WELL APEX_BEDROCK_PIEZOMETERS.GPJ GOOD TEMPLATE.GDT 3/31/11

Civil & Environmental Consultants, Inc.
8740 Orion Place, Suite 100
Columbus, Ohio 43240

BORING NUMBER P-2S

CLIENT Apex Environmental, LLC **PROJECT NAME** Apex Sanitary Landfill

CEC PROJECT NUMBER 101-049 **PROJECT LOCATION** Amsterdam, OH

DEPTH (ft)	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	GRAPHIC LOG	MATERIAL DESCRIPTION	WELL DIAGRAM
75					
	7	(97)		SHALE; dark gray to black, moderate-strong to strong, micaceous, sandstone laminations note: horizontal fracture @ 76.7', 77.1', and 78.9' note: horizontal fracture w/ moderate weathering @ 79.8' *(continued)*	
80					Bentonite Chips
				81.4 1155.0	
	RC 8	93 (92)		SANDSTONE; gray, very strong, micaceous, fine to medium-grained, some shale inclusions, few coal laminations	
85					
90				90.0 1146.4	
				Bottom of hole at 90.0 feet	

GENERAL BH / TP / WELL APEX_BEDROCK_PIEZOMETERS.GPJ GOOD TEMPLATE.GDT 3/31/11

Civil & Environmental Consultants, Inc.
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BORING NUMBER SB-06 / P-3A

CLIENT Apex Environmental, LLC
PROJECT NAME Apex Lateral Expansion
CEC PROJECT NUMBER 101-049
PROJECT LOCATION Amsterdam, Ohio
DATE STARTED 8/2/10 **COMPLETED** 8/2/10
GROUND ELEVATION 1278.34 ft **HOLE SIZE** 8"
DRILLING CONTRACTOR Test Boring Services, Inc.
GROUND WATER LEVELS:
DRILLING METHOD Auger/SS
AT TIME OF DRILLING Not Applicable
LOGGED BY LRW **CHECKED BY** JMN
AT END OF DRILLING Dry
LOCATION Northing: 280514.28 Easting: 2408121.68
AFTER DRILLING Immediately Backfilled

ELEVATION (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	DEPTH (ft)	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	POCKET PEN. (tsf) T=Torvane
		Brown to gray sandy CLAY, and silt, some shale fragments, moist to dry, medium stiff to stiff, **(MINE SPOIL)**	0.0	SS 1	75	3-6-0 (6)	
				SS 2	75	1-1-1-1 (2)	
		Brown and gray clayey SILT, trace rock fragments, dry, hard, **(MINE SPOIL)**	5.0	SS 3	75	2-3-1-5 (4)	
		Brown and gray clayey SAND, dry, loose, **(MINE SPOIL)**		SS 4	100	1-4-50 (54)	
				ST 1	100	Pushed	
			10.0	ST 2	100	Pushed	
		Gray and white silty CLAY, some shale fragments, some rock fragments, dry, medium stiff, **(MINE SPOIL)**		SS 5	65	4-4-4-3 (8)	
		Gray and brown silty CLAY, some shale fragments, some sand, moist-. medium stiff, **(MINE SPOIL)**		SS 6	90	3-3-3-2 (6)	
		Gray and brown silty CLAY, some rock fragments, moist-, medium stiff, **(MINE SPOIL)**	15.0	SS 7	80	5-11-8-5 (19)	
		Gray and brown silty CLAY, some sand, some rock fragments, moist-, stiff to medium stiff, **(MINE SPOIL)**		SS 8	95	4-5-7-7 (12)	
			20.0	SS 9	80	1-2-4-3 (6)	
		Gray and brown sandy CLAY, some shale fragments, some rock fragments, moist-, stiff, **(MINE SPOIL)**		SS 10	85	3-6-6-6 (12)	
		Gray and brown clayey SAND, some rock fragments, trace coal, dry, medium dense, **(MINE SPOIL)**		SS 11	75	1-18-18-10 (36)	
		Gray and brown sandy SILTSTONE, some clay, some coal, dry, medium dense, **(MINE SPOIL)**	25.0	SS		4-4-5-8	

WELL DIAGRAM

2-Inch Solid PVC Riser

Bentonite Chips

CEC CUSTOM LOG 2 APEX SHALLOW PIEZOMETERS.GPJ GOOD TEMPLATE.GDT 3/31/11

Civil & Environmental Consultants, Inc.
8740 Orion Place, Suite 100
Columbus, Ohio 43240

BORING NUMBER SB-06 / P-3A

CLIENT Apex Environmental, LLC
PROJECT NAME Apex Lateral Expansion
CEC PROJECT NUMBER 101-049
PROJECT LOCATION Amsterdam, Ohio

ELEVATION (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	DEPTH (ft)	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	POCKET PEN (tsf) T=Torvane	WELL DIAGRAM
		Gray and brown sandy SILTSTONE, some clay, some coal, dry, medium dense, **(MINE SPOIL)***(continued)*	25.0	12	100	(9)		
		Brown and orange sandy CLAY, some shale fragments, dry, very stiff, **(MINE SPOIL)**		SS 13	45	4-8-7-9 (15)		
				SS 14	55	1-9-10-13 (19)		
		Gray CLAY, and sand, dry, very stiff, **(MINE SPOIL)**	30.0	SS 15	55	6-16-9-7 (25)		
				SS 16	85	1-9-9-9 (18)		
		Gray CLAY, and sand, trace coal, dry, very stiff, **(MINE SPOIL)**	35.0	SS 17	55	17-15-8-9 (23)		
		Brown to gray sandy CLAY, and shale fragments, dry, hard, **(MINE SPOIL)**		SS 18	100	7-7-13-28 (20)		
		Gray clayey SANDSTONE, with clay, dry, very stiff, **(MINE SPOIL)**	40.0	SS 19	100	1-12-12-9 (24)		10/20 Sand
		Orangish gray sandy CLAY, dry, hard, **(MINE SPOIL)**		SS 20	60	50		
		Gray SILTSTONE, dry, hard, **(BEDROCK)**		SS 21	100	21-50		
			45.0	SS 22	100	50		
		VOID(46.0'-49.5' Rods dropped under weight of hammer)		SS 23	100	0-0-0-0 (0)		0.010-Inch Slotted Screen
		Black CARBONACEOUS SHALE, and coal, dry, hard, **(BEDROCK)**	50.0	SS 24	75	4-8-14-18 (22)		
				SS 25	2	5-12-50 (62)		

CEC CUSTOM LOG 2 APEX_SHALLOW_PIEZOMETERS.GPJ GOOD TEMPLATE.GDT 3/31/11

Civil & Environmental Consultants, Inc.
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Columbus, Ohio 43240

BORING NUMBER SB-06 / P-3A

CLIENT Apex Environmental, LLC
PROJECT NAME Apex Lateral Expansion
CEC PROJECT NUMBER 101-049
PROJECT LOCATION Amsterdam, Ohio

ELEVATION (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	DEPTH (ft)	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	POCKET PEN (tsf) T=Torvane	WELL DIAGRAM
		Dark gray SHALE, trace coal, dry, hard, **(BEDROCK)** *(continued)*	55.0	SS 26	3	21-50		
		Dark gray SILTSTONE, dry, hard, auger refusal, **(BEDROCK)**		SS 27	13	50/2"		
		Bottom of hole at 55.9 feet.						

Civil & Environmental Consultants, Inc.
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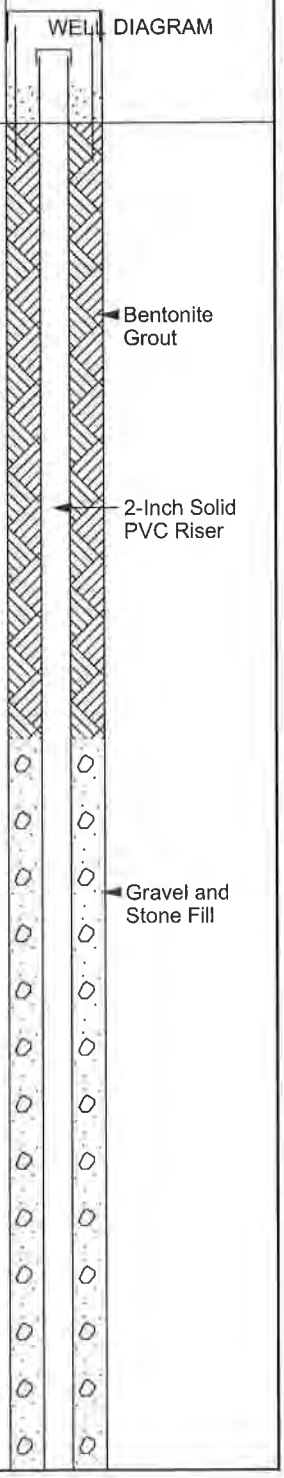
Columbus, Ohio 43240

BORING NUMBER P-3L

CLIENT Apex Environmental, LLC
PROJECT NAME Apex Sanitary Landfill
CEC PROJECT NUMBER 101-049
PROJECT LOCATION Amsterdam, OH
DATE STARTED 9/24/10 **COMPLETED** 9/27/10
GROUND ELEVATION 1277.28 ft **HOLE SIZE** 8" / 5"
DRILLING CONTRACTOR Frontz Drilling, Inc.
GROUND WATER LEVELS:
DRILLING METHOD Air Rotary & HQ Core
AT TIME OF DRILLING —
LOGGED BY BRB **CHECKED BY** DWC
AT END OF DRILLING 61.27'
LOCATION Northing: 280505.41 Easting: 2408134.26
1hrs AFTER DRILLING 55.3 ft / Elev 1222.0 ft

DEPTH (ft)	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	GRAPHIC LOG	MATERIAL DESCRIPTION	WELL DIAGRAM
0				Blind drilled from 0' - 42.5' and set temporary 6" steel surface casing. Blind drilled from 42.5' - 43'. See SB-6 for description.	



GENERAL BH / TP / WELL APEX_BEDROCK_PIEZOMETERS.GPJ GOOD TEMPLATE.GDT 3/31/11

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Civil & Environmental Consultants, Inc.
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BORING NUMBER P-3L

CLIENT Apex Environmental, LLC
PROJECT NAME Apex Sanitary Landfill
CEC PROJECT NUMBER 101-049
PROJECT LOCATION Amsterdam, OH

DEPTH (ft)	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	GRAPHIC LOG	MATERIAL DESCRIPTION	WELL DIAGRAM
35				Blind drilled from 0' - 42.5' and set temporary 6" steel surface casing. Blind drilled from 42.5' - 43'. See SB-6 for description. *(continued)*	
40					2-Inch Solid PVC Riser
				43.0 — 1234.3	
				MINESPOIL; gray claystone interbedded w/ orange-brown silty clay, very strong, some interbedded shale, few limestone boulders.	
45					Bentonite Chips
	RC 1	21 (21)		note: 7.9' not recovered in rock core #1	
50					
				53.0 — 1224.3	
				Removed temporary 6" steel surface casing and blind drilled from 53' - 57'.	
55				Re-set 6" steel surface casing from 0' - 57'.	
				57.0 — 1220.3	
				MINESPOIL; gray claystone interbedded w/ orange-brown silty clay, very strong, some interbedded shale, few limestone boulders.	
				59.5 — 1217.8	
60				LIMESTONE; dark gray, strong, high reaction to HCl	
				60.9 — note: horizontal fracture w/ high weathering @ 60.7' — 1216.4	
	RC 2	78 (69)		SHALE; gray, moderate-strong, some calcite inclusions	#3 Filter Sand
65				note: horizontal fracture @ 64.4' and 65.5'	
				67.7 — 1209.6	
				LIMESTONE; dark gray, strong, high reaction to HCl	0.010-Inch Slotted Screen
70				note: diagonal fracture @ 68.7'	
				note: horizontal fracture @ 69.3'	
	RC 3	66 (59)		note: horizontal fracture w/ high weathering @ 69.9'	
				72.9 — 1204.4	
75					

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GENERAL BH / TP / WELL APEX_BEDROCK_PIEZOMETERS.GPJ GOOD TEMPLATE.GDT 3/31/11

Civil & Environmental Consultants, Inc.
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Columbus, Ohio 43240

BORING NUMBER P-3L

CLIENT Apex Environmental, LLC
PROJECT NAME Apex Sanitary Landfill
CEC PROJECT NUMBER 101-049
PROJECT LOCATION Amsterdam, OH

DEPTH (ft)	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	GRAPHIC LOG	MATERIAL DESCRIPTION	WELL DIAGRAM
75				SHALE; gray, moderate-strong, some calcite inclusions	
				note: horizontal fracture @ 78.5'	
80	RC 4	102 (98)			Bentonite Chips
85				note: horizontal fracture w/ slight weathering @ 85.5' *(continued)*	
				87.0 1190.3 Bottom of hole at 87.0 feet	

GENERAL BH / TP / WELL APEX_BEDROCK_PIEZOMETERS.GPJ GOOD TEMPLATE.GDT 3/31/11

Civil & Environmental Consultants, Inc.
8740 Orion Place, Suite 100
Columbus, Ohio 43240

BORING NUMBER P-3S

CLIENT Apex Environmental, LLC
PROJECT NAME Apex Sanitary Landfill
CEC PROJECT NUMBER 101-049
PROJECT LOCATION Amsterdam, OH
DATE STARTED 9/29/10 **COMPLETED** 9/29/10
GROUND ELEVATION 1278.33 ft **HOLE SIZE** 8" / 5"
DRILLING CONTRACTOR Frontz Drilling, Inc.
GROUND WATER LEVELS:
DRILLING METHOD Air Rotary & HQ Core
AT TIME OF DRILLING —
LOGGED BY BRB **CHECKED BY** DWC
AT END OF DRILLING —
LOCATION Northing: 280524.47 Easting: 2408132.84
2hrs AFTER DRILLING 81.8 ft / Elev 1196.6 ft

DEPTH (ft)	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	GRAPHIC LOG	MATERIAL DESCRIPTION	WELL DIAGRAM
0				Blind drilled from 0' - 55' and set 6" steel surface casing. See SB-6 for description. Top of rock = 59.5' (from P-3L).	
5					
10					
15					6-Inch Steel Surface Casing
20					
25					2-Inch Solid PVC Riser
30					
35					

GENERAL BH / TP / WELL APEX_BEDROCK_PIEZOMETERS.GPJ GOOD TEMPLATE.GDT 3/31/11

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BORING NUMBER P-3S

CLIENT Apex Environmental, LLC **PROJECT NAME** Apex Sanitary Landfill

CEC PROJECT NUMBER 101-049 **PROJECT LOCATION** Amsterdam, OH

DEPTH (ft)	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	GRAPHIC LOG	MATERIAL DESCRIPTION	WELL DIAGRAM
35				Blind drilled from 0' - 55' and set 6" steel surface casing. See SB-6 for description. Top of rock = 59.5' (from P-3L). *(continued)*	
55				55.0 / 1223.3 Blind drilled from 55' - 87'	End of Steel Surface Casing
60				59.5 / 1218.8	
				60.9 / 1217.4	
65				67.7 / 1210.6	
70				72.9 / 1205.4	
75					

GENERAL BH / TP / WELL APEX_BEDROCK_PIEZOMETERS.GPJ GOOD TEMPLATE.GDT 3/31/11

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Civil & Environmental Consultants, Inc.
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BORING NUMBER P-3S

CLIENT Apex Environmental, LLC
PROJECT NAME Apex Sanitary Landfill
CEC PROJECT NUMBER 101-049
PROJECT LOCATION Amsterdam, OH

DEPTH (ft)	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	GRAPHIC LOG	MATERIAL DESCRIPTION	WELL DIAGRAM
75					
80				▼	
85					
				87.0 / 1191.3	
90	RC 1	96 (88)		SHALE; dark gray, moderate-strong, few calcite inclusions note: horizontal fracture @ 88.7' note: horizontal fracture w/ moderate weathering @ 90.6' note: horizontal fracture @ 91.0' note: horizontal fracture w/ high weathering @ 91.5'	
95				note: horizontal fracture @ 93.3'	
				97.0 / 1181.3	
100	RC 2	100 (93)		SHALE; dark gray, moderate-strong, some calcite inclusions, few sandstone laminations note: horizontal fracture @ 98.7' note: horizontal fracture @ 101.4' note: horizontal fracture w/ moderate weathering @ 101.8' and 103.2'	Bentonite Chips
105				note: horizontal fracture @ 106.3'	
				107.0 / 1171.3	
110	RC 3	98 (96)		SHALE; dark gray, strong, few calcite inclusions, some sandstone laminations note: horizontal fracture @ 108.2' note: diagonal fracture w/ high weathering @ 109.1' note: horizontal fracture @ 110.0'	0.010-Inch Slotted Screen #3 Filter Sand
115				note: diagonal fracture w/ moderate weathering @ 113.2' note: diagonal fracture @ 114.8'	
				115.0 / 1163.3	

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Civil & Environmental Consultants, Inc.
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BORING NUMBER P-3S

CLIENT Apex Environmental, LLC
PROJECT NAME Apex Sanitary Landfill
CEC PROJECT NUMBER 101-049
PROJECT LOCATION Amsterdam, OH

DEPTH (ft)	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	GRAPHIC LOG	MATERIAL DESCRIPTION	WELL DIAGRAM
115					
120	RC 4	102 (98)		note: horizontal fracture @ 117.8', 118.1', and 120.2' note: horizontal fracture w/ moderate weathering @ 121.5' note: diagonal fracture w/ moderate weathering @ 123.1'	Bentonite Chips
				123.6 — 1154.7 SANDSTONE / SHALE; interbedded dark gray shale with gray sandstone, strong, micaceous	
125				125.1 — 1153.2 note: horizontal fracture @ 124.8' and 125.9' SANDSTONE; gray, very strong, micaceous, fine to medium-grained	
				127.0 — 1151.3 Bottom of hole at 127.0 feet	

GENERAL BH / TP / WELL APEX_BEDROCK_PIEZOMETERS.GPJ GOOD TEMPLATE.GDT 3/31/11

Civil & Environmental Consultants, Inc.
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Columbus, Ohio 43240

BORING NUMBER SB-10 / P-4L

CLIENT Apex Environmental, LLC
PROJECT NAME Apex Lateral Expansion
CEC PROJECT NUMBER 101-049
PROJECT LOCATION Amsterdam, Ohio
DATE STARTED 8/10/10 **COMPLETED** 8/11/10
GROUND ELEVATION 1260.88 ft **HOLE SIZE** 8"
DRILLING CONTRACTOR Test Boring Services, Inc.
GROUND WATER LEVELS:
DRILLING METHOD Auger/SS
AT TIME OF DRILLING Not Applicable
LOGGED BY LRW **CHECKED BY** JMN
AT END OF DRILLING 45.0 ft / Elev 1215.9 ft
LOCATION Northing: 281515.11 Easting: 2409500.09
AFTER DRILLING Immediately Backfilled

ELEVATION (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	DEPTH (ft)	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	POCKET PEN. (tsf) T=Torvane	WELL DIAGRAM
		Gray SAND, and gravel, dry, medium dense, **(MINE SPOIL)**	0.0	SS S-1	3	2-5-10-15 (15)		
		Gray LIMESTONE, some silt, dry, medium dense, **(MINE SPOIL)**		SS S-2	1	39-15-14-20 (29)		
		Gray sandy CLAY, and rock fragments, trace coal, dry, very stiff, **(MINE SPOIL)**	5.0	SS S-3	6	17-21-15-6 (36)		
		Gray LIMESTONE, some silt, dry, medium dense, **(MINE SPOIL)**		SS S-4	1	8-7-9-10 (16)		
		Gray sandy CLAY, and shale fragments, some rock fragments, dry, stiff, **(MINE SPOIL)**	10.0	SS S-5	5	2-4-4-5 (8)		
		Gray CLAY, and rock fragments, and silt, dry, very stiff, **(MINE SPOIL)**		SS S-6	5	6-13-11-11 (24)		
		Gray to brown CLAY, and rock fragments, and silt, dry, stiff, **(MINE SPOIL)**		SS S-7	7	4-7-9-6 (16)		
			15.0	SS S-8	8	3-4-3-8 (7)		Bentonite Chips
		Brown SAND, some clay, some rock fragments, moist, dense, **(MINE SPOIL)**		SS S-9	5	4-19-28-18 (47)		
		Gray LIMESTONE, dry, medium dense, some Chattering, **(MINE SPOIL)**	20.0	SS S-10	1	18-8-4-4 (12)		
		Brown to gray CLAY, some shale fragments, some rock fragments, dry, stiff, **(MINE SPOIL)**		SS S-11	5	6-5-6-8 (11)		
		Gray LIMESTONE, dry, medium dense, **(MINE SPOIL)**		SS S-12	1	8-10-10-9 (20)		
			25.0	SS		6-6-21-10		

CEC CUSTOM LOG 2 APEX_SHALLOW_PIEZOMETERS.GPJ GOOD TEMPLATE.GDT 3/31/11

Civil & Environmental Consultants, Inc.
8740 Orion Place, Suite 100
Columbus, Ohio 43240

BORING NUMBER SB-10 / P-4L

CLIENT Apex Environmental, LLC
PROJECT NAME Apex Lateral Expansion
CEC PROJECT NUMBER 101-049
PROJECT LOCATION Amsterdam, Ohio

ELEVATION (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	DEPTH (ft)	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	POCKET PEN (tsf) T=Torvane	WELL DIAGRAM
		Gray LIMESTONE, dry, medium dense, **(MINE SPOIL)** *(continued)*	25.0	S-13	1	(27)		2-Inch Solid PVC Riser
		Gray silty CLAY, some rock fragments, dry, hard, **(MINE SPOIL)**		SS S-14	2	3-50		
		NO RECOVERY. Chattering Hard	30.0	SS S-15	0	6-11-17-19 (28)		
		Dark gray CARBONACEOUS SHALE, and shale fragments, trace coal, dry, stiff, **(MINE SPOIL)**		SS S-16	8	6-6-5-6 (11)		
		Brown, tan and black sandy CLAY, and carbonaceous shale, dry, stiff, **(MINE SPOIL)**						
		Gray and brown silty CLAY, some sand, some carbonaceous shale, dry, stiff, **(MINE SPOIL)**		SS S-17	6	5-7-7-6 (14)		
		Olive green SAND, dry, very stiff, **(MINE SPOIL)**	35.0	SS S-18	8	6-19-9-7 (28)		
		Dark gray SHALE, some silt, dry, very stiff, **(MINE SPOIL)**						
		Black CARBONACEOUS SHALE, some coal, wet, stiff, some olive green sand bands., **(MINE SPOIL)**		SS S-19	6	6-7-5-4 (12)		
		Gray, tan and orange sandy CLAY, and shale fragments, some coal, dry to wet, medium stiff, **(MINE SPOIL)**	40.0	SS S-20	8	6-3-3-9 (6)		
		Tan, orange and black silty CLAY, and carbonaceous shale, some coal, dry, stiff, **(MINE SPOIL)**		SS S-21	5	4-6-7-7 (13)		
		Tan and gray silty CLAY, moist+, hard, **(MINE SPOIL)**		SS S-22	5	7-10-50 (60)		
		Gray LIMESTONE, wet, very dense, **(WEATHERED BEDROCK)**	45.0	SS S-23	0	50		10/20 Sand
		Tan, gray, white and black SHALE, and shale fragments, wet, stiff, **(WEATHERED BEDROCK)**		SS S-24	5	3-6-5-9 (11)		
		Whitish gray, tan and black silty SHALE, some coal, wet, stiff, **(WEATHERED BEDROCK)**		SS S-25	7	5-7-5-7 (12)		0.010-Inch Slotted Screen
			50.0	SS S-26	6	7-7-13-9 (20)		
		COAL, wet, very dense, **(BEDROCK)**		SS S-27	6	7-7-50 (57)		Bottom Cap

CEC CUSTOM LOG 2 APEX SHALLOW PIEZOMETERS.GPJ GOOD TEMPLATE.GDT 3/31/11

Civil & Environmental Consultants, Inc.
8740 Orion Place, Suite 100
Columbus, Ohio 43240

BORING NUMBER SB-10 / P-4L

CLIENT Apex Environmental, LLC
PROJECT NAME Apex Lateral Expansion
CEC PROJECT NUMBER 101-049
PROJECT LOCATION Amsterdam, Ohio

ELEVATION (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	DEPTH (ft)	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	POCKET PEN. (tsf) T=Torvane	WELL DIAGRAM
		Black CARBONACEOUS SHALE, wet, hard, **(BEDROCK)**		SS S-28	8	50/1"		
		Bottom of hole at 54.1 feet.						

CEC CUSTOM LOG 2 APEX_SHALLOW_PIEZOMETERS.GPJ GOOD TEMPLATE.GDT 3/31/11

Civil & Environmental Consultants, Inc.
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Columbus, Ohio 43240

BORING NUMBER P-5

CLIENT Apex Environmental, LLC
PROJECT NAME Apex Sanitary Landfill
CEC PROJECT NUMBER 101-049
PROJECT LOCATION Amsterdam, OH
DATE STARTED 8/31/10 **COMPLETED** 9/21/10
GROUND ELEVATION 1240.98 ft **HOLE SIZE** 8" / 5"
DRILLING CONTRACTOR Frontz Drilling, Inc.
GROUND WATER LEVELS:
DRILLING METHOD Air Rotary & HQ Core
AT TIME OF DRILLING ---
LOGGED BY BRB **CHECKED BY** DWC
AT END OF DRILLING ---
LOCATION Northing: 280367.78 Easting: 2409429.11
2hrs AFTER DRILLING 91.6 ft / Elev 1149.4 ft

DEPTH (ft)	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	GRAPHIC LOG	MATERIAL DESCRIPTION	WELL DIAGRAM
0				Blind drilled from 0' - 29' and set 6" steel surface casing. See SB-12 for description. Top of rock = 21' (from SB-12).	
5					6-Inch Steel Surface Casing
10					2-Inch Solid PVC Riser
15					Bentonite Grout
20					
21.0 / 1220.0					
25					
29.0 / 1212.0					
29.5 / 1211.5				SILTSTONE; gray, strong, intensely fractured w/ brown oxidized staining	End of Steel Surface Casing
30				LIMESTONE; gray, strong, trace black shale inclusions, trace calcite inclusions, high reaction to HCl	
	RC 1	56 (34)		note: broken from 32.5' - 33.0'	
35 / 1206.0					

GENERAL BH / TP / WELL APEX_BEDROCK_PIEZOMETERS.GPJ GOOD TEMPLATE.GDT 3/31/11

(Continued Next Page)

Civil & Environmental Consultants, Inc.
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BORING NUMBER P-5

CLIENT Apex Environmental, LLC
PROJECT NAME Apex Sanitary Landfill
CEC PROJECT NUMBER 101-049
PROJECT LOCATION Amsterdam, OH

DEPTH (ft)	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	GRAPHIC LOG	MATERIAL DESCRIPTION	WELL DIAGRAM
35				LIMESTONE; gray, strong, trace black shale inclusions, trace calcite inclusions, high reaction to HCl	
40				41.0 1200.0	2-Inch Solid PVC Riser
	RC 2	86 (51)		41.7 SILTSTONE; gray, weak, broken 1199.3	
45				LIMESTONE; gray, strong, trace black shale inclusions, trace calcite inclusions, high reaction to HCl	
				note: horizontal fracture @ 47.5'	
	RC 3	86 (73)		47.7 1193.3 SILTSTONE; gray, strong, micaceous, few calcite inclusions	
50					
55					Bentonite Grout
	RC 4	100 (78)		note: horizontal fracture w/ brown oxidized staining @ 58.0'	
60					
				note: sandstone laminations from 62.0' - 63.0'	
65				note: horizontal fracture w/ brown oxidized staining 65.0'	
	RC 5	100 (97)		65.0 1176.0 SHALE; dark gray, strong, micaceous, trace plant fossils	
70				note: horizontal fracture w/ brown oxidized staining @ 70.5'	
				note: sandstone laminations from 72.0' - 75.0'	
75				75.0 1166.0	

GENERAL BH / TP / WELL APEX_BEDROCK_PIEZOMETERS.GPJ GOOD TEMPLATE.GDT 3/31/11

(Continued Next Page)

Civil & Environmental Consultants, Inc.
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Columbus, Ohio 43240

BORING NUMBER P-5

CLIENT Apex Environmental, LLC **PROJECT NAME** Apex Sanitary Landfill

CEC PROJECT NUMBER 101-049 **PROJECT LOCATION** Amsterdam, OH

DEPTH (ft)	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	GRAPHIC LOG	MATERIAL DESCRIPTION	WELL DIAGRAM
75					
	RC 6	95 (95)		SHALE; dark gray, strong, micaceous, trace plant fossils	
80					2-Inch Solid PVC Riser
85	RC 7	94 (93)		85.0 1156.0 SHALE / SANDSTONE; interbedded black shale and gray sandstone note: horizontal fracture @ 87.1'	
90				90.0 1151.0 SHALE; gray, strong, micaceous, some sandstone laminations, trace plant fossils note: horizontal fracture @ 90.9', 91.8', and 92.8'	Bentonite Grout
95	RC 8	100 (91)		note: intense fracturing w/ high weathering from 97.4' - 98.0'	
100					
105	RC 9	101 (87)		note: horizontal fracture @ 104.2' note: horizontal fracture @ 106.7'	Bentonite Chips
110				note: horizontal fracture @ 108.2' note: thin band of sandstone from 108.0' - 108.4' 110.0 1131.0 SANDSTONE; gray, strong, medium-grained, dark gray shale laminations, intensely fractured.	
				112.0 1129.0 SANDSTONE; gray, very strong, micaceous, medium-grained	#3 Filter Sand
115	RC	100		115.0 1126.0	0.010-Inch Slotted

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GENERAL BH / TP / WELL APEX_BEDROCK_PIEZOMETERS.GPJ GOOD TEMPLATE.GDT 3/31/11

Civil & Environmental Consultants, Inc.
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Columbus, Ohio 43240

BORING NUMBER P-5

CLIENT Apex Environmental, LLC **PROJECT NAME** Apex Sanitary Landfill

CEC PROJECT NUMBER 101-049 **PROJECT LOCATION** Amsterdam, OH

DEPTH (ft)	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	GRAPHIC LOG	MATERIAL DESCRIPTION	WELL DIAGRAM
115	10	(88)		SANDSTONE; gray, very strong, micaceous, medium-grained	Screen
120					0.010-Inch Slotted Screen
					#3 Filter Sand
125	RC 11	101 (99)		note: intense horizontal fracturing from 123.3' - 123.5'	
130				note: horizontal fracture @ 131.1'	
135	RC 12	103 (95)		note: intense horizontal fracturing from 136.2' - 136.8'	
140				note: horizontal fracture @ 139.7'	Bentonite Chips
145	RC 13	70 (70)		note: horizontal fracture @ 144.9'	
150					
155	RC 14	104 (104)			

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GENERAL BH / TP / WELL APEX_BEDROCK_PIEZOMETERS.GPJ GOOD TEMPLATE.GDT 3/31/11

Civil & Environmental Consultants, Inc.
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Columbus, Ohio 43240

BORING NUMBER P-5

CLIENT Apex Environmental, LLC
PROJECT NAME Apex Sanitary Landfill
CEC PROJECT NUMBER 101-049
PROJECT LOCATION Amsterdam, OH

DEPTH (ft)	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	GRAPHIC LOG	MATERIAL DESCRIPTION	WELL DIAGRAM
155				159.0 1082.0	
160	RC 15	93 (93)		SANDSTONE; gray, very strong, micaceous, medium-grained, black shale laminations note: horizontal fracture @ 159.5'	
165				note: diagonal fracture @ 164.6' and 165.8'	
				note: thin seam of black shale from 169.0' - 169.2'	
				169.2 1071.8	
170	RC 16	101 (99)		SANDSTONE; gray, very strong, micaceous, medium-grained	Bentonite Chips
175				note: horizontal fracture @ 173.7'	
				179.3 1061.7	
180	RC 17	99 (66)		SHALE; black, moderate-strong, sandstone laminations, intensely fractured note: diagonal fracture @ 182'	
				182.0 1059.0	
				SANDSTONE; gray, very strong, micaceous, medium-grained, trace black shale laminations	
				184.0 1057.0	
185				SHALE; black, moderate-strong, trace sandstone laminations	
				189.0 1052.0	
				Bottom of hole at 189.0 feet	

GENERAL BH / TP / WELL APEX_BEDROCK_PIEZOMETERS.GPJ GOOD TEMPLATE.GDT 3/31/11

Civil & Environmental Consultants, Inc.
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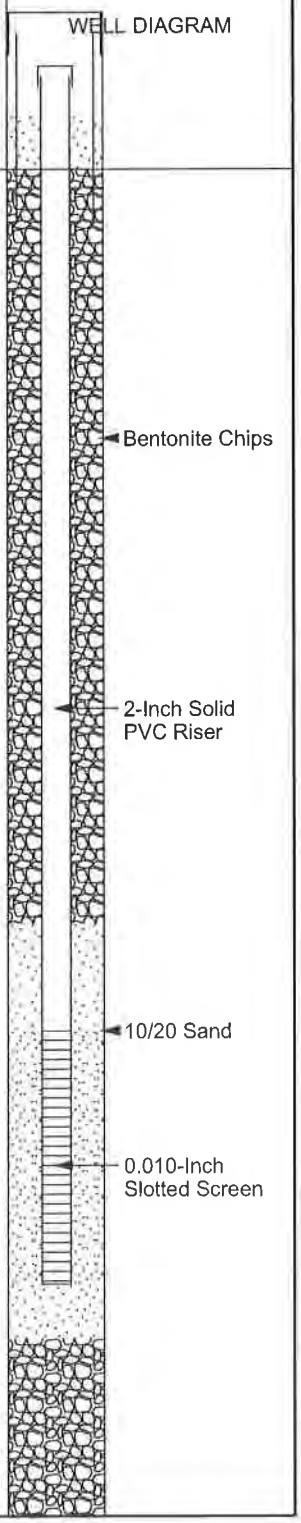
BORING NUMBER SB-12 / P-5A

CLIENT Apex Environmental, LLC
PROJECT NAME Apex Lateral Expansion
CEC PROJECT NUMBER 101-049
PROJECT LOCATION Amsterdam, Ohio
DATE STARTED 8/19/10 **COMPLETED** 8/19/10
GROUND ELEVATION 1241.24 ft **HOLE SIZE** 8"
DRILLING CONTRACTOR Test Boring Services, Inc.
GROUND WATER LEVELS:
DRILLING METHOD Auger/SS
AT TIME OF DRILLING Not Applicable
LOGGED BY LRW **CHECKED BY** JMN
AT END OF DRILLING Dry
LOCATION Northing: 280361.08 Easting: 2409442.45
AFTER DRILLING Immediately Backfilled

ELEVATION (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	DEPTH (ft)	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	POCKET PEN. (tsf) T=Torvane
			0.0				
		Tan clayey SAND, some coal, dry, medium stiff, **(MINE SPOIL)**		SS S-1	6	2-2-3-4 (5)	
		Tan and gray sandy CLAY, some shale fragments, some coal, dry, medium stiff, **(MINE SPOIL)**		SS S-2	8	6-3-2-2 (5)	
		Tan and gray CLAY, dry, stiff, plastic intervals, **(MINE SPOIL)**	5.0	SS S-3	8	3-5-5-5 (10)	
		Reddish brown and gray CLAY, dry, medium stiff, medium plasticity, **(MINE SPOIL)**		SS S-4	8	4-4-4-7 (8)	
		Gray to reddish brown sandy CLAY, trace limestone fragments, dry, medium stiff, **(MINE SPOIL)**	10.0	SS S-5	7	3-4-3-5 (7)	
		Reddish brown and gray CLAY, some sand, dry, medium stiff, medium plasticity, **(MINE SPOIL)**		SS S-6	7	3-3-4-6 (7)	
		Reddish brown and gray silty CLAY, some sand, trace rock fragments, dry, very stiff, micaceous, **(MINE SPOIL)**		SS S-7	7	15-11-5-5 (16)	
		Gray, tan and black silty CLAY, trace coal, dry, stiff, **(MINE SPOIL)**	15.0	SS S-8	8	4-6-8-10 (14)	
		Tan SILT, some sand, some coal, dry, stiff, micaceous, **(MINE SPOIL)**		SS S-9	6	5-7-7-11 (14)	
		Tan and orange silty CLAY, trace coal, dry, hard, medium plasticity, **(MINE SPOIL)**	20.0	SS S-10	8	8-23-8-8 (31)	
		Gray and orange silty CLAY, and siltstone fragments, wet to dry, hard, **(MINE SPOIL)**		SS S-11	7	8-11-36-50 (47)	
		White sandy SHALE, dry, hard, micaceous, **(RESIDUAL SOIL)**		SS S-12	1	50	
		Light tan SHALE, dry, hard, micaceous, **(RESIDUAL SOIL)**	25.0	SS			

WELL DIAGRAM



CEC CUSTOM LOG 2 APEX_SHALLOW_PIEZOMETERS.GPJ GOOD TEMPLATE.GDT 3/31/11

Civil & Environmental Consultants, Inc.
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Columbus, Ohio 43240

BORING NUMBER SB-12 / P-5A

CLIENT Apex Environmental, LLC
PROJECT NAME Apex Lateral Expansion
CEC PROJECT NUMBER 101-049
PROJECT LOCATION Amsterdam, Ohio

ELEVATION (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	DEPTH (ft)	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	POCKET PEN. (tsf) T=Torvane	WELL DIAGRAM
		Light tan SHALE, dry, hard, micaceous, **(RESIDUAL SOIL)** *(continued)*	25.0	S-13	1	50		Bentonite Backfill
		White shaley SANDSTONE, dry, hard, micaceous, **(RESIDUAL SOIL)**		SS S-14	1	50		
		NO RECOVERY. Auger Refusal, **(BEDROCK)** Bottom of hole at 28.4 feet.		SS S-15	0	50/1"		

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BORING NUMBER P-5L

CLIENT Apex Environmental, LLC
PROJECT NAME Apex Sanitary Landfill
CEC PROJECT NUMBER 101-049
PROJECT LOCATION Amsterdam, OH
DATE STARTED 9/3/10 **COMPLETED** 9/3/10
GROUND ELEVATION 1240.08 ft **HOLE SIZE** 8" / 5"
DRILLING CONTRACTOR Frontz Drilling, Inc.
GROUND WATER LEVELS:
DRILLING METHOD Air Rotary & HQ Core
AT TIME OF DRILLING ---
LOGGED BY BRB **CHECKED BY** DWC
AT END OF DRILLING ---
LOCATION Northing: 280351.32 Easting: 2409431.08
1hrs AFTER DRILLING 32.6 ft / Elev 1207.5 ft

DEPTH (ft)	SAMPLE TYPE NUMBER	GRAPHIC LOG	MATERIAL DESCRIPTION	WELL DIAGRAM
0			Blind drilled from 0' - 27' and set temporary 6" steel surface casing. See SB-12 and P-5 for description. Top of rock = 27'.	
27.0				1213.1
			Blind drilled from 27' - 39'. See P-5 for description	
29.5				1210.6

Bentonite Grout
2-Inch Solid PVC Riser
Bentonite Chips
#3 Filter Sand
0.010-Inch Slotted Screen

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GENERAL BH / TP / WELL APEX BEDROCK PIEZOMETERS.GPJ GOOD TEMPLATE.GDT 3/31/11

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BORING NUMBER P-5L

CLIENT Apex Environmental, LLC
PROJECT NAME Apex Sanitary Landfill
CEC PROJECT NUMBER 101-049
PROJECT LOCATION Amsterdam, OH

DEPTH (ft)	SAMPLE TYPE NUMBER	GRAPHIC LOG	MATERIAL DESCRIPTION	WELL DIAGRAM
35				
			39.0 1201.1 Bottom of hole at 39.0 feet	0.010-Inch Slotted Screen #3 Filter Sand

GENERAL BH / TP / WELL APEX_BEDROCK_PIEZOMETERS.GPJ GOOD TEMPLATE.GDT 3/31/11

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BORING NUMBER P-5S

CLIENT Apex Environmental, LLC
PROJECT NAME Apex Sanitary Landfill
CEC PROJECT NUMBER 101-049
PROJECT LOCATION Amsterdam, OH
DATE STARTED 9/1/10 **COMPLETED** 9/2/10
GROUND ELEVATION 1242.01 ft **HOLE SIZE** 8" / 5"
DRILLING CONTRACTOR Frontz Drilling, Inc.
GROUND WATER LEVELS:
DRILLING METHOD Air Rotary & HQ Core
AT TIME OF DRILLING ---
LOGGED BY BRB **CHECKED BY** DWC
AT END OF DRILLING 44.2 ft / Elev 1197.8 ft
LOCATION Northing: 280376.38 Easting: 2409440.65
48hrs AFTER DRILLING 63.3 ft / Elev 1178.8 ft

DEPTH (ft)	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	GRAPHIC LOG	MATERIAL DESCRIPTION	WELL DIAGRAM
0				Blind drilled from 0' - 29' and set 6" steel surface casing. See SB-12 for description. Top of rock = 21' (from SB-12).	6-Inch Steel Surface Casing; Bentonite Grout; 2-Inch Solid PVC Riser
21.0					1221.0
29.5				Blind drilled from 29' to 52'. See P-5 for description.	1212.5 End of Steel Surface Casing

GENERAL BH / TP / WELL APEX_BEDROCK_PIEZOMETERS.GPJ GOOD TEMPLATE.GDT 3/31/11

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Civil & Environmental Consultants, Inc.
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BORING NUMBER P-5S

CLIENT Apex Environmental, LLC
PROJECT NAME Apex Sanitary Landfill
CEC PROJECT NUMBER 101-049
PROJECT LOCATION Amsterdam, OH

DEPTH (ft)	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	GRAPHIC LOG	MATERIAL DESCRIPTION	WELL DIAGRAM
35				Blind drilled from 29' to 52'. See P-5 for description. *(continued)*	Bentonite Grout
40				41.0 / 1201.0	
				41.7 / 1200.3	2-Inch Solid PVC Riser
45				▼	
				47.7 / 1194.3	
50					Bentonite Chips
				52.0 / 1190.0	
				SILTSTONE; gray, strong, micaceous, few calcite inclusions	#3 Filter Sand
55				note: intense horizontal fracturing w/ brown oxidized staining from 54.9' - 55.1'	
	RC 1	102 (98)		note: diagonal fracture w/ brown oxidized staining @ 55.6'	
60				note: horizontal fracture, high weathering w/ brown oxidized staining @ 60.4'	0.010-Inch Slotted Screen
				note: diagonal fracture @ 62.3'	
				note: brown oxidized staining @ 63.8'	
				▼ 63.8 / 1178.2	
65				SHALE; gray, strong, micaceous	
	RC 2	81 (63)			
70				note: horizontal fracture @ 69.5'	Bentonite Chips
				72.0 / 1170.0	
				Bottom of hole at 72.0 feet	

GENERAL BH / TP / WELL APEX_BEDROCK_PIEZOMETERS.GPJ GOOD TEMPLATE.GDT 3/31/11

Civil & Environmental Consultants, Inc.
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Columbus, Ohio 43240

BORING NUMBER P-6L

CLIENT Apex Environmental, LLC
PROJECT NAME Apex Sanitary Landfill
CEC PROJECT NUMBER 101-049
PROJECT LOCATION Amsterdam, OH
DATE STARTED 9/8/10 **COMPLETED** 9/8/10
GROUND ELEVATION 1243.35 ft **HOLE SIZE** 8" / 5"
DRILLING CONTRACTOR Frontz Drilling, Inc.
GROUND WATER LEVELS:
DRILLING METHOD Air Rotary & HQ Core
AT TIME OF DRILLING ---
LOGGED BY BRB **CHECKED BY** DWC
AT END OF DRILLING 35.9 ft / Elev 1207.5 ft
LOCATION Northing: 280123.20 Easting: 2410482.10
1hrs AFTER DRILLING 34.8 ft / Elev 1208.6 ft

DEPTH (ft)	SAMPLE TYPE NUMBER	GRAPHIC LOG	MATERIAL DESCRIPTION	WELL DIAGRAM
0			Blind drilled from 0' - 27' and set temporary 6" steel surface casing. See B-7A and P-6S for description. Top of rock = 26.7' (from P-6S)	
18.0				1225.4
19.4				1224.0
26.7				1216.7
			Blind drilled from 27' - 37'. See P-6S for description.	
28.0				1215.4
34.7				1208.7

Bentonite Chips
2-Inch Solid PVC Riser
#3 Filter Sand
0.010-Inch Slotted Screen

GENERAL BH / TP / WELL APEX_BEDROCK_PIEZOMETERS.GPJ GOOD TEMPLATE.GDT 3/31/11

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Civil & Environmental Consultants, Inc.
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Columbus, Ohio 43240

BORING NUMBER P-6L

CLIENT Apex Environmental, LLC
PROJECT NAME Apex Sanitary Landfill
CEC PROJECT NUMBER 101-049
PROJECT LOCATION Amsterdam, OH

DEPTH (ft)	SAMPLE TYPE NUMBER	GRAPHIC LOG	MATERIAL DESCRIPTION	WELL DIAGRAM
35				
			▼	#3 Filter Sand
			37.0 1206.4	0.010-Inch Slotted Screen
			Bottom of hole at 37.0 feet	

GENERAL BH / TP / WELL APEX_BEDROCK_PIEZOMETERS.GPJ GOOD TEMPLATE.GDT 3/31/11

BORING NUMBER P-6S

Civil & Environmental Consultants, Inc.
8740 Orion Place, Suite 100
Columbus, Ohio 43240

CLIENT Apex Environmental, LLC
PROJECT NAME Apex Sanitary Landfill
CEC PROJECT NUMBER 101-049
PROJECT LOCATION Amsterdam, OH
DATE STARTED 9/7/10 **COMPLETED** 9/8/10
GROUND ELEVATION 1244.12 ft **HOLE SIZE** 8" / 5"
DRILLING CONTRACTOR Frontz Drilling, Inc.
GROUND WATER LEVELS:
DRILLING METHOD Air Rotary & HQ Core
AT TIME OF DRILLING ---
LOGGED BY BRB **CHECKED BY** DWC
AT END OF DRILLING 35.3 ft / Elev 1208.8 ft
LOCATION Northing: 280121.77 Easting: 2410467.43
1hrs AFTER DRILLING 32.3 ft / Elev 1211.9 ft

DEPTH (ft)	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	GRAPHIC LOG	MATERIAL DESCRIPTION	WELL DIAGRAM
0				Blind drill from 0' - 18' and set 6" steel surface casing. See B-7B for description Top of rock = 16' (from B-7B)	6-Inch Steel Surface Casing
16.0				1228.1	
18.0				1226.1	End of Steel Surface Casing
19.4				LIMESTONE; gray to dark gray, moderate-hard, thin shale seams, trace calcite inclusions, high reaction to HCl, intensely fractured note: brown oxidized staining @ 19.2' 1224.7	2-Inch Solid PVC Riser
20	RC 1	27 (16)		No recovery due to mine spoil	Bentonite Grout
25					
26.7				1217.4	
28.0				SANDSTONE; gray, moderate-strong to weak, micaceous, medium-grained note: diagonal fracture from 26.7' - 27.3' 1216.1	
30				Blind drilled from 28' - 30' and re-set surface casing. Top of rock = 26.7'.	
30.0				1214.1	
35	RC 2	67 (61)		LIMESTONE; gray to dark gray, moderate-strong, high reaction to HCl note: diagonal fracture w/ brown oxidized staining @ 31.1' note: brown oxidized staining from 32.0' - 32.2' note: intensely fractured from 33.0' - 34.7' note: horizontal fracture w/ brown oxidized staining @ 33.3' note: diagonal fracture @ 34.7'	
34.7				1209.4	

GENERAL BH / TP / WELL APEX_BEDROCK_PIEZOMETERS.GPJ GOOD TEMPLATE.GDT 3/31/11

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Civil & Environmental Consultants, Inc.
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Columbus, Ohio 43240

BORING NUMBER P-6S

CLIENT Apex Environmental, LLC
PROJECT NAME Apex Sanitary Landfill
CEC PROJECT NUMBER 101-049
PROJECT LOCATION Amsterdam, OH

DEPTH (ft)	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	GRAPHIC LOG	MATERIAL DESCRIPTION	WELL DIAGRAM
35				35.0 (1209.1) SHALE; gray, strong, micaceous, sandstone laminations, interbedded limestone, moderate reaction to HCl note: intense horizontal fracturing w/ brown oxidized staining from 35.6' - 36.8'	
40	RC 3	90 (76)			Bentonite Grout
45	RC 4	93 (83)		41.2 (1202.9) SANDSTONE; gray, very strong, micaceous, fine to medium-grained 44.4 (1199.7) SHALE; dark gray, weak, intense horizontal fracturing, high weathering 45.4 (1198.7) SILTSTONE; gray, strong, few limestone inclusions, sandstone laminations	
50				50.0 (1194.1) SILTSTONE; gray, strong, some limestone inclusions, sandstone laminations note: horizontal fracture @ 51.0' and 51.6'	2-Inch Solid PVC Riser
55	RC 5	102 (98)			
60				note: horizontal fracture @ 60.2' and 61.2'	
65	RC 6	101 (98)		note: horizontal fracture w/ high weathering @ 62.4' note: high weathering from 65.4' - 65.7'	Bentonite Chips
70				note: horizontal fracture w/ brown oxidized staining @ 69.1'	#3 Filter Sand
75	RC	103		72.8 (1171.3) 75.0 (1169.1)	0.010-Inch Slotted Screen

GENERAL BH / TP / WELL APEX_BEDROCK_PIEZOMETERS.GPJ GOOD TEMPLATE.GDT 3/31/11

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Civil & Environmental Consultants, Inc.
8740 Orion Place, Suite 100
Columbus, Ohio 43240

BORING NUMBER P-6S

CLIENT Apex Environmental, LLC
PROJECT NAME Apex Sanitary Landfill
CEC PROJECT NUMBER 101-049
PROJECT LOCATION Amsterdam, OH

DEPTH (ft)	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	GRAPHIC LOG	MATERIAL DESCRIPTION	WELL DIAGRAM
75	7	(98)		SHALE; dark gray, strong, micaceous, sandstone laminations note: horizontal fracture w/ brown oxidized staining @ 75.4' note: diagonal fracture w/ brown oxidized staining from 75.4' - 75.8' note: diagonal fracture w/ brown oxidized staining @ 76.5'	0.010-Inch Slotted Screen
80				note: horizontal fracture w/ brown oxidized staining @ 79.3' and 80.9'	#3 Filter Sand
85	RC 8	99 (97)			
90				note: horizontal fracture w/ brown oxidized staining @ 87.6'	
				90.0 — 1154.1	Bentonite Chips
				SHALE; dark gray to black, strong, micaceous, sandstone laminations note: horizontal fracture w/ brown oxidized staining @ 91.8'	
95	RC 9	98 (95)		note: thin band of sandstone from 94.0' - 94.1'	
				96.5 — 1147.6	
				SANDSTONE; gray, very strong, micaceous, medium-grained, black shale laminations note: thin seam of black shale @ 97.2'	
100				100.0 — 1144.1	
				Bottom of hole at 100.0 feet	

GENERAL BH / TP / WELL APEX_BEDROCK_PIEZOMETERS.GPJ GOOD TEMPLATE.GDT 3/31/11

Civil & Environmental Consultants, Inc.
8740 Orion Place, Suite 100
Columbus, Ohio 43240

BORING NUMBER SB-13 / P-7A

CLIENT Apex Environmental, LLC
PROJECT NAME Apex Lateral Expansion
CEC PROJECT NUMBER 101-049
PROJECT LOCATION Amsterdam, Ohio
DATE STARTED 8/18/10 **COMPLETED** 8/18/10
GROUND ELEVATION 1263.93 ft **HOLE SIZE** 8"
DRILLING CONTRACTOR Test Boring Services, Inc.
GROUND WATER LEVELS:
DRILLING METHOD Auger/SS
AT TIME OF DRILLING Not Applicable
LOGGED BY LRW **CHECKED BY** JMN
AT END OF DRILLING Dry
LOCATION Northing: 281270.43 Easting: 2410288.36
AFTER DRILLING Immediately Backfilled

ELEVATION (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	DEPTH (ft)	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	POCKET PEN (tsf) T=Torvane	WELL DIAGRAM
		Brown silty CLAY, and shale fragments, some sand, dry, stiff, **(MINE SPOIL)**	0.0	SS S-1	8	2-2-9-16 (11)		
		Gray and orange sandy CLAY, some siltstone fragments, dry, stiff, micaceous, **(MINE SPOIL)**		SS S-2	8	11-9-5-4 (14)		
		Gray sandy SHALE, and limestone fragments, dry, very stiff, micaceous, **(MINE SPOIL)**	5.0	SS S-3	3	16-10-6-8 (16)		
		Dark gray SHALE, dry, very stiff, **(MINE SPOIL)**		SS S-4	8	10-5-12-18 (17)		
		Dark gray and tan SHALE, dry, very stiff, with sand intervals. Micaceous, **(MINE SPOIL)**	10.0	SS S-5	8	14-14-10-10 (24)		
				SS S-6	8	10-9-8-7 (17)		
		Dark gray and tan SHALE, dry, stiff to very stiff, with sand intervals. Micaceous, **(MINE SPOIL)**		SS S-7	8	4-4-7-9 (11)		
		BAG SAMPLE COLLECTED AT 14'-20'	15.0	SS S-8	8	8-11-10-14 (21)		Bentonite Chips
		Dark gray and tan SHALE, dry, very stiff to stiff, with sand intervals. Micaceous, **(MINE SPOIL)**		SS S-9	8	9-10-6-7 (16)		
				SS S-10	8	5-5-5-7 (10)		
		SHELBY TUBE COLLECTED AT 20'-22' Recovery 2.0', **(MINE SPOIL)**	20.0	ST		Pushed		
		Gray, tan and black sandy CLAY, some shale fragments, dry, stiff, **(MINE SPOIL)**		SS S-11	8	7-4-5-7 (9)		
		Gray, tan and brown sandy CLAY, and shale fragments, dry, stiff, **(MINE SPOIL)**	25.0	SS		4-4-5-10		

CEC CUSTOM LOG 2 APEX_SHALLOW_PIEZOMETERS.GPJ GOOD TEMPLATE.GDT 3/31/11

Civil & Environmental Consultants, Inc.
8740 Orion Place, Suite 100
Columbus, Ohio 43240

BORING NUMBER SB-13 / P-7A

CLIENT Apex Environmental, LLC
PROJECT NAME Apex Lateral Expansion
CEC PROJECT NUMBER 101-049
PROJECT LOCATION Amsterdam, Ohio

ELEVATION (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	DEPTH (ft)	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	POCKET PEN (tsf) T=Torvane
		Gray, tan and brown sandy CLAY, and shale fragments, dry, stiff, **(MINE SPOIL)***(continued)*	25.0	S-12	8	(9)	
		Gray, tan and brown sandy CLAY, some shale fragments, dry, stiff, micaceous at bottom, **(MINE SPOIL)**		SS S-13	8	6-7-8-6 (15)	
		Black and gray CLAY, some sand, trace coal, dry, medium stiff, included wood fragment, **(MINE SPOIL)**	30.0	SS S-14	6	4-2-4-6 (6)	
		Black and gray CLAY, some sand, trace coal, dry to wet, medium stiff, included railroad tie fragment, **(MINE SPOIL)**		SS S-15	8	7-4-4-4 (8)	
		Gray, tan and brown CLAY, some shale fragments, trace coal, dry, stiff, low plasticity, **(MINE SPOIL)**		SS S-16	8	2-4-5-8 (9)	
		Black COAL, some clay, some sand, wet, stiff, **(MINE SPOIL)**	35.0	SS S-17	8	5-4-6-5 (10)	
		Tan and gray sandy CLAY, some shale fragments, moist-, stiff, low plasticity, **(MINE SPOIL)**		SS S-18	5	4-4-5-8 (9)	
		Gray silty CLAY, some limestone fragments, dry, very stiff, **(MINE SPOIL)**		SS S-19	6	3-27-50 (77)	
		Gray sandy SHALE, dry, hard, **(WEATHERED BEDROCK)**	40.0	SS S-20	0	50	
		Gray LIMESTONE, dry, very dense, Auger Refusal, **(BEDROCK)** Bottom of hole at 42.1 feet.		SS S-21	8	50/1"	

WELL DIAGRAM: 2-Inch Solid PVC Riser; 10/20 Sand; 0.010-Inch Slotted Screen; Bentonite Backfill

CEC CUSTOM LOG 2_APEX_SHALLOW_PIEZOMETERS.GPJ GOOD TEMPLATE.GDT 3/31/11

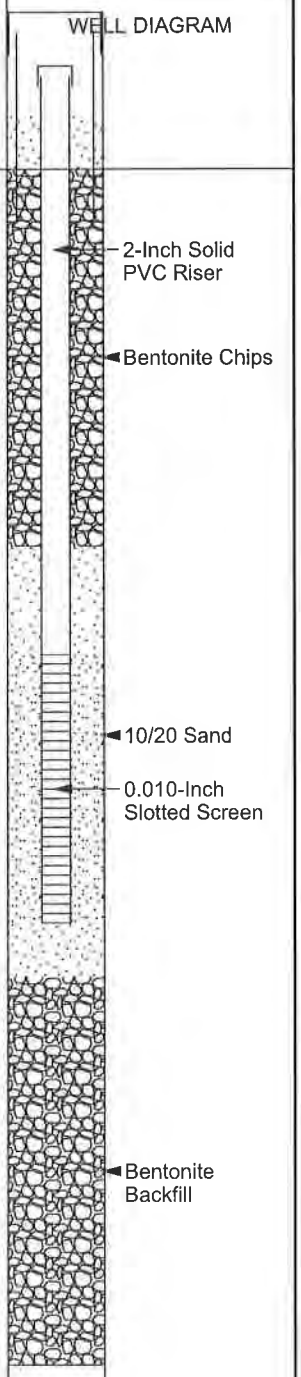
Civil & Environmental Consultants, Inc.
8740 Orion Place, Suite 100
Columbus, Ohio 43240

BORING NUMBER SB-21 / P-8A

CLIENT Apex Environmental, LLC
PROJECT NAME Apex Lateral Expansion
CEC PROJECT NUMBER 101-049
PROJECT LOCATION Amsterdam, Ohio
DATE STARTED 8/18/10 **COMPLETED** 8/18/10
GROUND ELEVATION 1209.50 ft **HOLE SIZE** 8"
DRILLING CONTRACTOR Test Boring Services, Inc.
GROUND WATER LEVELS:
DRILLING METHOD Auger/SS
AT TIME OF DRILLING Not Applicable
LOGGED BY LRW **CHECKED BY** JMN
AT END OF DRILLING Dry
LOCATION Northing: 281947.98 Easting: 2411756.63
AFTER DRILLING Immediately Backfilled

ELEVATION (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	DEPTH (ft)	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	POCKET PEN (tsf) T=Torvane
		(TOPSOIL)	0.0				
		Tan silty CLAY, trace coal, dry, stiff, **BAG SAMPLE COLLECTED AT 0.5'-10' (MINE SPOIL)**		SS S-1	7	2-4-6-7 (10)	
		Gray, tan and orange sandy CLAY, some coal, dry, stiff, **(MINE SPOIL)**		SS S-2	8	4-5-9-11 (14)	
		Tan and orange sandy SHALE, dry, hard to very stiff, micaceous, **(RESIDUAL SOIL)**	5.0	SS S-3	8	10-8-15-19 (23)	
				SS S-4	8	14-15-10-12 (25)	
		Gray, tan and orange SAND, and siltstone fragments, moist- to dry, stiff, **SHELBY TUBE COLLECTED AT 9'-11'** Recovery 2.0', **(RESIDUAL SOIL)**		ST S-5	8	Pushed	
			10.0	SS S-6	8	6-6-9-9 (15)	
		Light tan decomposed CLAYSTONE, dry, stiff, **(RESIDUAL SOIL)**		SS S-7	8	6-3-9-50 (12)	
		SANDSTONE FRAGMENTS, wet, medium dense, **(RESIDUAL SOIL)**					
		Tan sandy CLAYSTONE, dry, stiff, micaceous, **(RESIDUAL SOIL)**					
		NO RECOVERY, **(BEDROCK)**	15.0	SS S-8	0	50	
		Gray and orange CLAYSTONE, some silt, dry, hard, **(BEDROCK)**		SS S-9	3	40-50	
		Gray CLAYSTONE, some silt, dry, hard, **(BEDROCK)**		SS S-10	0	50	
			20.0	SS S-11	0	50	
		Bottom of hole at 22.2 feet.		SS S-12	16	50/1"	

WELL DIAGRAM



CEC CUSTOM LOG 2 APEX_SHALLOW_PIEZOMETERS.GPJ GOOD TEMPLATE.GDT 3/31/11

Civil & Environmental Consultants, Inc.
8740 Orion Place, Suite 100
Columbus, Ohio 43240

BORING NUMBER P-9

CLIENT Apex Environmental, LLC
PROJECT NAME Apex Sanitary Landfill
CEC PROJECT NUMBER 101-049
PROJECT LOCATION Amsterdam, OH
DATE STARTED 9/9/10 **COMPLETED** 9/23/10
GROUND ELEVATION 1256.94 ft **HOLE SIZE** 8" / 5"
DRILLING CONTRACTOR Frontz Drilling, Inc.
GROUND WATER LEVELS:
DRILLING METHOD Air Rotary & HQ Core
AT TIME OF DRILLING ---
LOGGED BY BRB **CHECKED BY** DWC
AT END OF DRILLING 80.1 ft / Elev 1176.8 ft
LOCATION Northing: 280679.82 Easting: 2411624.18
AFTER DRILLING ---

DEPTH (ft)	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	GRAPHIC LOG	MATERIAL DESCRIPTION	WELL DIAGRAM
0				Blind drilled from 0' - 28' and set 6" steel surface casing. See SB-20 for description. Top of rock = 28' (from SB-20)	6-Inch Steel Surface Casing; Bentonite Grout; 2-Inch Solid PVC Riser; End of Steel Surface Casing
28.0				1228.9	
28.3				SANDSTONE; gray, very hard, micaceous, fine to medium-grained 1228.6	
				SHALE; dark gray, moderate-strong, trace plant fossils, trace sandstone laminations note: horizontal fracture w/ high weathering @ 29.1' and 29.4'	
33.2	RC 1	99 (97)		1223.7	
34.2				LIMESTONE; gray, strong, high reaction to HCl 1222.7 note: horizontal fracture w/ high weathering @ 33.2' note: diagonal fracture @ 33.8'	

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GENERAL BH / TP / WELL APEX_BEDROCK_PIEZOMETERS.GPJ GOOD TEMPLATE.GDT 3/31/11

Civil & Environmental Consultants, Inc.
8740 Orion Place, Suite 100
Columbus, Ohio 43240

BORING NUMBER P-9

CLIENT Apex Environmental, LLC
PROJECT NAME Apex Sanitary Landfill
CEC PROJECT NUMBER 101-049
PROJECT LOCATION Amsterdam, OH

DEPTH (ft)	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	GRAPHIC LOG	MATERIAL DESCRIPTION	WELL DIAGRAM
35				LIMESTONE / SHALE; interbedded limestone and shale, gray to dark gray, moderate-strong, low reaction to HCl note: diagonal fracture @ 36.4' note: horizontal fracture w/ slight weathering @ 37.8' *(continued)*	
				37.8 — 1219.1	
				SANDSTONE; gray, very strong, micaceous, fine-grained	
40				note: horizontal fracture @ 41.4'	
				41.4 — 1215.5	
				SHALE; gray, very hard, sandstone laminations	
				42.4 — 1214.5	
	RC 2	88 (84)		LIMESTONE; gray to dark gray, moderate-strong, high reaction to HCl note: crumbled w/ high weathering from 44.4' - 44.8'	
45					Bentonite Chips
				46.5 — 1210.4	
				LIMESTONE / SHALE; interbedded limestone and shale, gray to dark gray, moderate-strong, low reaction to HCl	
50					
				50.9 — 1206.0	
	RC 3	103 (102)		SHALE; gray, strong, some limestone inclusions, trace sandstone laminations note: horizontal fracture w/ brown oxidized staining @ 52.2' note: horizontal fracture w/ brown oxidized staining @ 54.5'	
55				note: horizontal fracture w/ moderate weathering @ 57.0' and 58.1'	2-Inch Solid PVC Riser
				58.0 — 1198.9	
				SHALE; gray, strong, few limestone inclusions, sandstone laminations	
60					
	RC 4	101 (99)		note: horizontal fracture w/ moderate weathering @ 63.7'	
65					
				note: horizontal fracture @ 68.6'	
				68.6 — 1188.3	
				SILTSTONE; gray, weak, micaceous, sandstone laminations	
70				note: horizontal fracture w/ high weathering, brown oxidized staining @ 71.4' and 71.6'	
				72.3 — note: horizontal fracture @ 72.2' — 1184.6	
	RC 5	92 (89)		SHALE; dark gray, strong, sandstone laminations	
75				note: horizontal fracture w/ coal and pyrite inclusions @ 74.9'	
				75.0 — 1181.9	

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GENERAL BH / TP / WELL APEX_BEDROCK_PIEZOMETERS.GPJ GOOD TEMPLATE.GDT 3/31/11

Civil & Environmental Consultants, Inc.
8740 Orion Place, Suite 100
Columbus, Ohio 43240

BORING NUMBER P-9

CLIENT Apex Environmental, LLC **PROJECT NAME** Apex Sanitary Landfill

CEC PROJECT NUMBER 101-049 **PROJECT LOCATION** Amsterdam, OH

DEPTH (ft)	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	GRAPHIC LOG	MATERIAL DESCRIPTION	WELL DIAGRAM
75				SHALE; dark gray, strong, sandstone laminations	
				78.0 1178.9	
				SHALE; dark gray, moderate-strong, some sandstone laminations, trace pyrite	
80				▼	
	RC 6	94 (92)		note: horizontal fracture w/ slight weathering @ 83.3'	
85				85.0 1171.9	Bentonite Chips
				SHALE; dark gray, moderate-strong, micaceous, sandstone laminations note: horizontal fracture w/ brown oxidized staining @ 85.1' note: horizontal fracture w/ moderate weathering @ 86.1', 86.5', and 87.7' note: vertical fracture from 87.9' - 88.5' note: horizontal fracture @ 88.5'	
90	RC 7	103 (97)		note: diagonal fracture w/ slight weathering @ 90.2' note: horizontal fracture w/ high weathering @ 93.6' note: horizontal fracture w/ moderate weathering @ 95.0'	
95				95.0 1161.9	2-Inch Solid PVC Riser
				SHALE; dark gray, moderate-strong, micaceous, few sandstone laminations note: diagonal fracture @ 95.7'	
100	RC 8	101 (100)		note: horizontal fracture @ 99.1'	
				note: diagonal fracture w/ high weathering @ 103.0'	
105	RC 9	101 (100)			
				109.3 1147.6	
110				SILTSTONE; dark gray, moderate-strong, thin sandstone bands	
				112.6 note: horizontal fracture w/ brown oxidized staining @ 112.8' 1144.3	
115					

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GENERAL BH / TP / WELL APEX_BEDROCK_PIEZOMETERS.GPJ GOOD TEMPLATE.GDT 3/31/11

Civil & Environmental Consultants, Inc.
8740 Orion Place, Suite 100
Columbus, Ohio 43240

BORING NUMBER P-9

CLIENT Apex Environmental, LLC **PROJECT NAME** Apex Sanitary Landfill

CEC PROJECT NUMBER 101-049 **PROJECT LOCATION** Amsterdam, OH

DEPTH (ft)	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	GRAPHIC LOG	MATERIAL DESCRIPTION	WELL DIAGRAM
115	RC 10	102 (101)		SANDSTONE; gray to dark gray, very strong, medium-grained, thin shale bands note: horizontal fracture @ 119.8' *(continued)*	
120				120.5 — 1136.4 SANDSTONE; gray, very strong, micaceous, medium-grained	
125	RC 11	102 (102)			
130					Bentonite Chips
				note: horizontal fracture w/ brown oxidized staining @ 132.4'	#3 Filter Sand
				133.0 — 1123.9 SANDSTONE; gray, very strong, micaceous, medium-grained, black shale laminations note: medium band of black shale from 134.2' - 134.8'	
135					
140	RC 12	99 (96)		note: broken w/ high weathering from 137.6' - 137.7' note: horizontal fracture w/ brown oxidized staining @ 138.3' and 140.5'	0.010-Inch Slotted Screen
				143.0 — 1113.9 SANDSTONE; gray, very strong, micaceous, medium-grained, few black shale laminations note: horizontal fracture @ 143.6'	
145					
150	RC 13	102 (98)		note: horizontal fracture w/ brown oxidized staining @ 150.4'	Bentonite Chips
				note: horizontal fracture @ 152.6'	
155					

GENERAL BH / TP / WELL APEX_BEDROCK_PIEZOMETERS.GPJ GOOD TEMPLATE.GDT 3/31/11

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Civil & Environmental Consultants, Inc.
8740 Orion Place, Suite 100
Columbus, Ohio 43240

BORING NUMBER P-9

CLIENT Apex Environmental, LLC
PROJECT NAME Apex Sanitary Landfill
CEC PROJECT NUMBER 101-049
PROJECT LOCATION Amsterdam, OH

DEPTH (ft)	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	GRAPHIC LOG	MATERIAL DESCRIPTION	WELL DIAGRAM
155	RC 14	99 (99)		158.6 1098.3 SANDSTONE; gray, very strong, micaceous, medium-grained, some limestone inclusions	Bentonite Chips
160				160.5 1096.4 SHALE; dark gray, strong, sandstone laminations	
				163.0 1093.9 Bottom of hole at 163.0 feet	

GENERAL BH / TP / WELL APEX_BEDROCK_PIEZOMETERS.GPJ GOOD TEMPLATE.GDT 3/31/11

Civil & Environmental Consultants, Inc.
8740 Orion Place, Suite 100
Columbus, Ohio 43240

BORING NUMBER P-9S

CLIENT Apex Environmental, LLC
PROJECT NAME Apex Sanitary Landfill
CEC PROJECT NUMBER 101-049
PROJECT LOCATION Amsterdam, OH
DATE STARTED 9/10/10 **COMPLETED** 9/13/10
GROUND ELEVATION 1257.81 ft **HOLE SIZE** 8" / 5"
DRILLING CONTRACTOR Frontz Drilling, Inc.
GROUND WATER LEVELS:
DRILLING METHOD Air Rotary & HQ Core
AT TIME OF DRILLING ---
LOGGED BY BRB **CHECKED BY** DWC
AT END OF DRILLING 85.7 ft / Elev 1172.1 ft
LOCATION Northing: 280665.04 Easting: 2411633.74
2hrs AFTER DRILLING 65.6 ft / Elev 1192.2 ft

DEPTH (ft)	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	GRAPHIC LOG	MATERIAL DESCRIPTION	WELL DIAGRAM
0				Blind drilled from 0' - 28' and set 6" steel surface casing. See SB-20 for description. Top of rock = 28' (from SB-20)	6-Inch Steel Surface Casing
5					
10					2-Inch Solid PVC Riser
15					Bentonite Grout
20					
25					
28.0 / 1229.8				Blind drilled from 28' - 67'. See P-9 for description	End of Steel Surface Casing
28.3 / 1229.5					
30					
33.2 / 1224.6					
35					

GENERAL BH / TP / WELL APEX_BEDROCK_PIEZOMETERS.GPJ GOOD TEMPLATE.GDT 3/31/11

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Civil & Environmental Consultants, Inc.
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Columbus, Ohio 43240

BORING NUMBER P-9S

CLIENT Apex Environmental, LLC
PROJECT NAME Apex Sanitary Landfill
CEC PROJECT NUMBER 101-049
PROJECT LOCATION Amsterdam, OH

DEPTH (ft)	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	GRAPHIC LOG	MATERIAL DESCRIPTION	WELL DIAGRAM
35					
				37.8 — 1220.0	Bentonite Grout
40				41.4 — 1216.4	
				42.4 — 1215.4	
45					
50				50.9 — 1206.9	2-Inch Solid PVC Riser
55					
60					
65				▼	Bentonite Chips
				67.0 — 1190.8	
70	RC 1	70 (61)		SILTSTONE; gray, weak to moderate-strong, micaceous, few limestone inclusions, sandstone laminations note: horizontal fracture w/ moderate weathering @ 67.7' note: diagonal fracture w/ moderate weathering @ 68.6' note: horizontal fracture w/ moderate weathering @ 69.7', 70.1', 70.6', and 71.8'	#3 Filter Sand
75				75.0 — 1182.8	0.010-Inch Slotted Screen

GENERAL BH / TP / WELL APEX_BEDROCK_PIEZOMETERS.GPJ GOOD TEMPLATE.GDT 3/31/11

(Continued Next Page)

Civil & Environmental Consultants, Inc.
8740 Orion Place, Suite 100
Columbus, Ohio 43240

BORING NUMBER P-9S

CLIENT Apex Environmental, LLC
PROJECT NAME Apex Sanitary Landfill
CEC PROJECT NUMBER 101-049
PROJECT LOCATION Amsterdam, OH

DEPTH (ft)	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	GRAPHIC LOG	MATERIAL DESCRIPTION	WELL DIAGRAM
75				SILTSTONE; gray, weak to moderate-strong, micaceous, few limestone inclusions, sandstone laminations note: broken w/ very high weathering from 74.8' - 78.8'	0.010-Inch Slotted Screen
	RC 2	68 (58)		78.8 / 1179.0 SHALE; dark gray, strong, sandstone laminations	#3 Filter Sand
80				note: horizontal fracture @ 80.1', 82.6', and 83.2'	
				84.0 / 1173.8 SHALE; dark gray, strong, sandstone laminations	
85				▼	
	RC 3	103 (101)			
90				note: horizontal fracture @ 90.7' and 91.2' note: thin sandstone band from 92.2' - 92.4' note: horizontal fracture w/ moderate weathering @ 93.1' note: diagonal fracture w/ moderate weathering @ 93.8'	Bentonite Chips
				94.0 / 1163.8 SHALE; dark gray, strong, sandstone laminations	
95	RC 4	108 (104)		note: horizontal fracture @ 95.5' @ 96'	
				98.0 / 1159.8 Bottom of hole at 98.0 feet	

GENERAL BH / TP / WELL APEX_BEDROCK_PIEZOMETERS.GPJ GOOD TEMPLATE.GDT 3/31/11

Civil & Environmental Consultants, Inc.
8740 Orion Place, Suite 100
Columbus, Ohio 43240

BORING NUMBER P-10L

CLIENT Apex Environmental, LLC
PROJECT NAME Apex Sanitary Landfill
CEC PROJECT NUMBER 101-049
PROJECT LOCATION Amsterdam, OH
DATE STARTED 9/30/10 **COMPLETED** 9/30/10
GROUND ELEVATION 1266.43 ft **HOLE SIZE** 8" / 5"
DRILLING CONTRACTOR Frontz Drilling, Inc.
GROUND WATER LEVELS:
DRILLING METHOD Air Rotary & HQ Core
AT TIME OF DRILLING ---
LOGGED BY BRB **CHECKED BY** DWC
AT END OF DRILLING ---
LOCATION Northing: 281570.13 Easting: 2409307.15
2hrs AFTER DRILLING 45.71'

DEPTH (ft)	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	GRAPHIC LOG	MATERIAL DESCRIPTION	WELL DIAGRAM
0				Blind drilled from 0' - 44' and set temporary 6" steel surface casing. See B-401A for description. Top of rock = 44' (from B-401A)	
5					
10					Hydrated Bentonite Chips
15					
20					2-Inch Solid PVC Riser
25					
30					
35					

GENERAL BH / TP / WELL APEX_BEDROCK_PIEZOMETERS.GPJ GOOD TEMPLATE.GDT 3/31/11

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Civil & Environmental Consultants, Inc.
8740 Orion Place, Suite 100
Columbus, Ohio 43240

BORING NUMBER P-10L

CLIENT Apex Environmental, LLC
PROJECT NAME Apex Sanitary Landfill
CEC PROJECT NUMBER 101-049
PROJECT LOCATION Amsterdam, OH

DEPTH (ft)	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	GRAPHIC LOG	MATERIAL DESCRIPTION	WELL DIAGRAM
35				Blind drilled from 0' - 44' and set temporary 6" steel surface casing. See B-401A for description. Top of rock = 44' (from B-401A) *(continued)*	
40				44.0 / 1222.4	
45				LIMESTONE; gray, very strong, high reaction to HCl	
50	RC 1	76 (70)		note: horizontal fracture w/ high weathering @ 49.4'	#3 Filter Sand
				49.4 / 1217.0	
				LIMESTONE; dark gray to black, strong, high reaction to HCl note: horizontal fracture w/ high weathering @ 49.8' and 50.9'	
55				54.0 / 1212.4	
				LIMESTONE; gry to dark gray, strong to very strong, high reaction to HCl note: broken from 54.8' - 55.4'	0.010-Inch Slotted Screen
60	RC 2	87 (83)		60.6 / 1205.8	
				SHALE; dark gray, moderate-strong, few calcite inclusions, trace laminated sandstone	
65				64.0 / 1202.4	
				SHALE; dark gray, moderate-strong, some calcite inclusions, few limestone inclusions, laminated sandstone note: horizontal fracture @ 66.3' and 67.4'	
70	RC 3	102 (94)		note: horizontal fracture w/ high weathering @ 68.9'	Bentonite Chips
				69.9 / 1196.5	
				LIMESTONE; dark gray to black, weak to strong, high reaction to HCl note: horizontal fracture @ 72.7' note: horizontal fracture w/ high weathering @ 73.9'	
				74.0 / 1192.4	
75					

GENERAL BH / TP / WELL APEX_BEDROCK_PIEZOMETERS.GPJ GOOD TEMPLATE.GDT 3/31/11

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Civil & Environmental Consultants, Inc.
8740 Orion Place, Suite 100
Columbus, Ohio 43240

BORING NUMBER P-10L

CLIENT Apex Environmental, LLC
PROJECT NAME Apex Sanitary Landfill
CEC PROJECT NUMBER 101-049
PROJECT LOCATION Amsterdam, OH

DEPTH (ft)	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	GRAPHIC LOG	MATERIAL DESCRIPTION	WELL DIAGRAM
75				SHALE; dark gray to black, weak, slight reaction to HCl note: intense horizontal fracturing from 74' - 75.4' *(continued)*	
				76.5 — 1189.9	
				LIMESTONE; dark gray to black, weak to strong, high reaction to HCl	
	RC 4	86 (74)			
80				79.7 — 1186.7	
				SHALE; dark gray to black, weak	
				84.0 — 1182.4	
				Bottom of hole at 84.0 feet	

GENERAL BH / TP / WELL APEX_BEDROCK_PIEZOMETERS.GPJ GOOD TEMPLATE.GDT 3/31/11

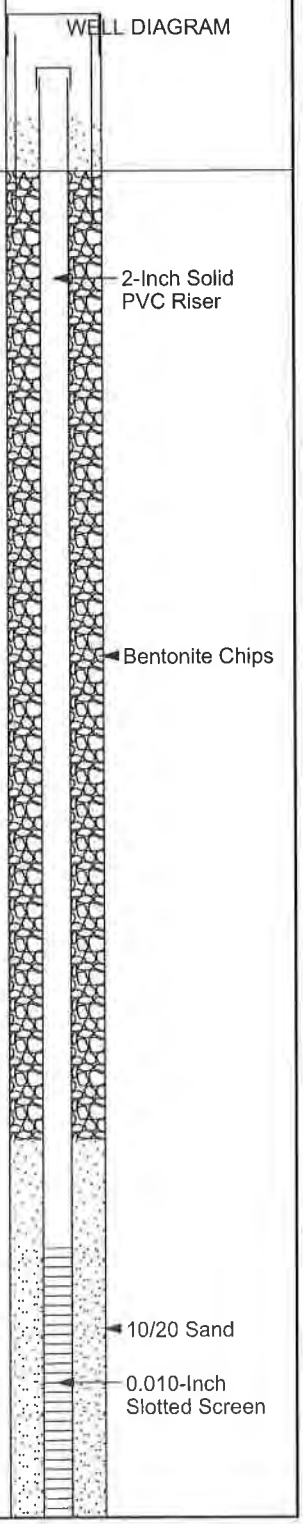
Civil & Environmental Consultants, Inc.
8740 Orion Place, Suite 100
Columbus, Ohio 43240

BORING NUMBER SB-15 / P-10S

CLIENT Apex Environmental, LLC
PROJECT NAME Apex Lateral Expansion
CEC PROJECT NUMBER 101-049
PROJECT LOCATION Amsterdam, Ohio
DATE STARTED 8/16/10 **COMPLETED** 8/16/10
GROUND ELEVATION 1201.78 ft **HOLE SIZE** 8"
DRILLING CONTRACTOR Test Boring Services, Inc.
GROUND WATER LEVELS:
DRILLING METHOD Auger/SS
AT TIME OF DRILLING Not Applicable
LOGGED BY LRW **CHECKED BY** JMN
AT END OF DRILLING Dry
LOCATION Northing: 280002.73 Easting: 2411119.49
AFTER DRILLING Immediately Backfilled

ELEVATION (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	DEPTH (ft)	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	POCKET PEN (tsf) T=Torvane
		(TOPSOIL)	0.0				
		Tan, orange and black CLAY, some coal, dry, stiff to very stiff, **(MINE SPOIL)**		SS S-1	8	1-3-7-7 (10)	
				SS S-2	8	6-11-9-9 (20)	
		Tan and orange CLAY, some sand, trace rock fragments, dry, very stiff, **(RESIDUAL SOIL)**	5.0	SS S-3	8	11-12-13-14 (25)	
		Tan and orange sandy CLAY, some shale fragments, dry, stiff, **(RESIDUAL SOIL)**		SS S-4	8	7-7-7-5 (14)	
		Tan and orange decomposed SHALE, dry, very stiff, micaceous. **BAG COLLECTED AT 10'-14'(RESIDUAL SOIL)**	10.0	SS S-5	8	7-10-8-5 (18)	
				SS S-6	8	8-10-18-12 (28)	
		Tan and orange decomposed CLAYSTONE, dry, very stiff, some sand intervals, **(RESIDUAL SOIL)**		SS S-7	8	6-7-14-15 (21)	
		Tan and orange decomposed CLAYSTONE, dry, hard, micaceous, **(RESIDUAL SOIL)**	15.0	SS S-8	8	27-33-35-45 (68)	
		Tan and orange to gray decomposed CLAYSTONE, some sand, dry, hard, micaceous, **(RESIDUAL SOIL)**		SS S-9	3	45-50	
		Tan sandy SHALE, and clay, dry, hard, **(BEDROCK)**		SS S-10	1	50	
		Gray sandy SHALE, dry, hard, damp between beds, **(BEDROCK)**	20.0	SS S-11	1	50	
		Gray SHALE, wet to dry, hard, micaceous, **(BEDROCK)**		SS S-12	1	50	
		Dark gray SHALE, some silt, wet to dry, hard, micaceous, **(BEDROCK)**	25.0	SS			

WELL DIAGRAM



CEC CUSTOM LOG 2 APEX_SHALLOW_PIEZOMETERS.GPJ GOOD TEMPLATE.GDT 3/31/11

Civil & Environmental Consultants, Inc
8740 Orion Place, Suite 100
Columbus, Ohio 43240

BORING NUMBER SB-15 / P-10S

CLIENT Apex Environmental, LLC
PROJECT NAME Apex Lateral Expansion
CEC PROJECT NUMBER 101-049
PROJECT LOCATION Amsterdam, Ohio

ELEVATION (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	DEPTH (ft)	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	POCKET PEN (tsf) T=Torvane	WELL DIAGRAM
		Dark gray SHALE, some silt, wet to dry, hard, micaceous, **(BEDROCK)***(continued)*	25.0	S-13	1	50		
				SS S-14	0	50		
				SS S-15	0	50		
		Dark gray sandy SHALE, dry, hard, micaceous, **(BEDROCK)**	30.0	SS S-16	0	50		Bentonite Backfill
				SS S-17	0	50		
			35.0	SS S-18	0	50		
				SS S-19	0	50		Bentonite Backfill
				SS S-20	1	50		
			40.0	SS S-21	0	50		
		Bottom of hole at 42.1 feet.		SS S-22	8	50/1"		

CEC CUSTOM LOG 2 APEX_SHALLOW_PIEZOMETERS.GPJ GOOD TEMPLATE.GDT 3/31/11

Civil & Environmental Consultants, Inc.
8740 Orion Place, Suite 100
Columbus, Ohio 43240

BORING NUMBER P-11L

CLIENT Apex Environmental, LLC
PROJECT NAME Apex Sanitary Landfill
CEC PROJECT NUMBER 101-049
PROJECT LOCATION Amsterdam, OH
DATE STARTED 10/1/10 **COMPLETED** 10/1/10
GROUND ELEVATION 1257.31 ft **HOLE SIZE** 8" / 5"
DRILLING CONTRACTOR Frontz Drilling, Inc.
GROUND WATER LEVELS:
DRILLING METHOD Air Rotary & HQ Core
AT TIME OF DRILLING ---
LOGGED BY BRB **CHECKED BY** DWC
AT END OF DRILLING DRY
LOCATION Northing: 281438.57 Easting: 2409970.24
1hrs AFTER DRILLING DRY

DEPTH (ft)	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	GRAPHIC LOG	MATERIAL DESCRIPTION	WELL DIAGRAM
0				Blind drilled from 0' - 33' and set 6" steel surface casing. See B-402A for description.	6-Inch Steel Surface Casing
26.0				1231.3 note: encountered coal during blind drilling @ 26'	Bentonite Grout
32.0				1225.3 note: top of rock (shale) = 32'	2-Inch Solid PVC Riser
33.0				1224.3	

GENERAL BH / TP / WELL APEX_BEDROCK_PIEZOMETERS.GPJ GOOD TEMPLATE.GDT 3/31/11

(Continued Next Page)

Civil & Environmental Consultants, Inc.
8740 Orion Place, Suite 100
Columbus, Ohio 43240

BORING NUMBER P-11L

CLIENT Apex Environmental, LLC
PROJECT NAME Apex Sanitary Landfill
CEC PROJECT NUMBER 101-049
PROJECT LOCATION Amsterdam, OH

DEPTH (ft)	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	GRAPHIC LOG	MATERIAL DESCRIPTION	WELL DIAGRAM
35	RC 1	72 (61)		LIMESTONE; gray to dark gray, strong to very strong, high reaction to HCl note: intense horizontal fracturing w/ high weathering from 34' - 34.3' note: highly weathered zone / no recovery from 36' - 37.5' note: diagonal fracture @ 38'	Bentonite Chips
40				note: horizontal fracture w/ moderate weathering @ 40.5' note: intense horizontal fracturing w/ high weathering from 42.1' - 42.4'	#3 Filter Sand
				42.1 — 1215.2	
				SHALE; dark gray, very weak, no reaction to HCl	
				43.0 — 1214.3	
45	RC 2	100 (97)		SILTSTONE; dark gray, strong, micaceous, interbedded sandstone laminations note: sandstone seam from 44.7' - 45' note: horizontal fracture @ 44.3', 45.4', and 46.3'	0.010-Inch Slotted Screen
				note: horizontal fracture w/ moderate weathering @ 47.8' note: horizontal fracture w/ high weathering @ 48.6' and 49'	
				49.1 — 1208.2	
50				LIMESTONE; dark gray, strong, high react to HCl	
				50.9 — 1206.4	
				SHALE; dark gray, weak, no reaction to HCl	
				53.0 — 1204.3	Bentonite Chips
				Bottom of hole at 53.0 feet	

GENERAL BH / TP / WELL APEX_BEDROCK_PIEZOMETERS.GPJ GOOD TEMPLATE.GDT 3/31/11

Civil & Environmental Consultants, Inc.
8740 Orion Place, Suite 100
Columbus, Ohio 43240

BORING NUMBER P-12

CLIENT Apex Environmental, LLC
PROJECT NAME Apex Sanitary Landfill
CEC PROJECT NUMBER 101-049
PROJECT LOCATION Amsterdam, OH
DATE STARTED 2/16/11 **COMPLETED** 2/24/11
GROUND ELEVATION 1300.66 ft **HOLE SIZE** 6" / 4"
DRILLINGCONTRACTOR Boart Longyear
TOP OF PVC ELEVATION 1303.25 ft
DRILLING METHOD Sonic & HQ Core
GROUND WATER LEVELS:
LOGGED BY BRB **CHECKED BY** DWC
▼ **AT END OF DRILLING** 103.6 ft / Elev 1197.1 ft
LOCATION Northing: 281889.18 Easting: 2407454.58

DEPTH (ft)	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	POCKET PENETROMETER	GRAPHIC LOG	MATERIAL DESCRIPTION	WELL DIAGRAM
0						
			4.5		MINESPOIL; brown clayey SILT, few coal fragments, few shale fragments, low plasticity, dry, very stiff to hard	
			3.6		2.3 1298.4	
			2.5		MINESPOIL; orange-brown silty SAND, some coal, some shale, no plasticity, dry, very stiff	
			2.4		4.4 1296.3	
5	SONIC 1	44	3.1		MINESPOIL; no recovery	
10					10.0 1290.7	2-Inch Solid PVC Riser
			4.2		MINESPOIL; brown silty CLAY, some coal, medium plasticity, dry, very stiff to hard	
			3.5		11.9 1288.8	
			2.6		MINESPOIL; orange-brown silty SAND, some coal, some rock fragments, no plasticity, dry, stiff	
			0.5		13.4 1287.3	
15	SONIC 2	51	1.2		MINESPOIL; gray SILT, no plasticity, dry, soft to stiff	
			3.1		14.7 1286.0	
					MINESPOIL; orange-brown silty SAND, some coal, some shale, no plasticity, dry, very stiff, no recovery from 15.1' - 20'	
20					20.0 1280.7	
			>4.5		MINESPOIL; gray LIMESTONE, some tan silty clay, low plasticity, dry, hard	
					21.0 1279.7	
			1.0		MINESPOIL; tan silty CLAY and gray LIMESTONE, low plasticity, dry, stiff	
					22.0 1278.7	
					MINESPOIL; no recovery	Bentonite Chips
25	SONIC 3	20				
30					30.0 1270.7	
			1.4		MINESPOIL; tan sandy CLAY, few coal fragments, low plasticity, dry, stiff	
					30.4 1270.3	
			>4.5		MINESPOIL; highly weathered gray SHALE, some coal, some tan sandy clay, low plasticity, dry, hard	
					31.9 1268.8	
					MINESPOIL; no recovery	
35	SONIC					

(Continued Next Page)

P-12 TEMPLATE P-12_P-12S.GPJ GOOD TEMPLATE.GDT 3/31/11

Civil & Environmental Consultants, Inc.
8740 Orion Place, Suite 100
Columbus, Ohio 43240

BORING NUMBER P-12

CLIENT Apex Environmental, LLC **PROJECT NAME** Apex Sanitary Landfill

CEC PROJECT NUMBER 101-049 **PROJECT LOCATION** Amsterdam, OH

DEPTH (ft)	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	POCKET PENETROMETER	GRAPHIC LOG	MATERIAL DESCRIPTION	WELL DIAGRAM
35	4	19			MINESPOIL; no recovery *(continued)*	
40					40.0 / 1260.7	
			0.4		40.4 / 1260.3 MINESPOIL; orange-brown silty CLAY, some highly weathered shale, low plasticity, dry, stiff	
			1.8		MINESPOIL; highly weathered gray SHALE and orange silty CLAY, high plasticity, dry, stiff to very stiff	
			3.7		42.8 / 1257.9 MINESPOIL; no recovery	
45	SONIC 5	28				2-Inch Solid PVC Riser
50					50.0 / 1250.7	
	SONIC 6	38	4.2		MINESPOIL; encountered LIMESTONE BOULDER, continued through soft minespoil from 50.5' - 53.7', no recovery	
			>4.5		53.7 / 1247.0 MINESPOIL; black COAL, hard	
55			>4.5		55.2 / 1245.5 LIMESTONE; dark gray to brown, strong, high reaction to HCl, dry	
					56.3 / 1244.4 SHALE; gray, very weak, highly weathered	
	RC 1	82 (68)			57.0 / 1243.7 LIMESTONE; gray, very strong, high reaction to HCl, moderate fracturing w/ high weathering, dry	
60					61.0 / 1239.7	Bentonite Chips
	RC 2	98 (92)			LIMESTONE; gray, very strong, high reaction to HCl, dry note: horizontal fracture w/ moderate weathering @ 64.1' & 64.7'	
65					64.7 / 1236.0 SHALE; dark gray, weak, few limestone inclusions 66.0 / 1234.7 note: horizontal fracture w/ high weathering @ 65.1' and 65.5'	
	RC 3	100 (95)			SHALE; dark gray, strong, micaceous, trace limestone inclusions note: horizontal fracture w/ high weathering @ 69.5'	
70					69.8 / 1230.9 70.1 / 1230.6 SHALE; dark gray, highly weathered, weak	
					SHALE; dark gray to black, strong, micaceous, trace limestone inclusions 71.9 / 1228.8	
	RC 4	95 (87)			72.7 / 1228.0 LIMESTONE; dark gray, very strong, high reaction to HCl SHALE; dark gray, moderate to strong, some limestone inclusions note: horizontal fracture w/ moderate weathering @ 71.1', 71.6', 72.7', 73.5', and 75.6'	
75					75.0 / 1225.7	

(Continued Next Page)

P-12 TEMPLATE P-12_P-12S.GPJ GOOD TEMPLATE.GDT 3/31/11

Civil & Environmental Consultants, Inc.
8740 Orion Place, Suite 100
Columbus, Ohio 43240

BORING NUMBER P-12

CLIENT Apex Environmental, LLC
PROJECT NAME Apex Sanitary Landfill
CEC PROJECT NUMBER 101-049
PROJECT LOCATION Amsterdam, OH

DEPTH (ft)	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	POCKET PENETROMETER	GRAPHIC LOG	MATERIAL DESCRIPTION	WELL DIAGRAM
75					76.0 SHALE; dark gray, moderate to strong, some limestone inclusions 1224.7	
80	RC 5	90 (73)			SHALE; dark gray to black, strong, few limestone inclusions, trace calcite inclusions note: intense horizontal fracturing w/ high weathering from 76.0' - 78.2' note: horizontal fracture w/ high weathering @ 78.9', 79.5', 80.6', and 80.8'	
85	RC 6	100 (95)			81.0 1219.7 SHALE; dark gray, strong, some limestone inclusions note: horizontal fracture w/ high weathering @ 81.2' note: horizontal fracture w/ slight weathering @ 83.9'	2-Inch Solid PVC Riser
90	RC 7	87 (82)			86.0 1214.7 SHALE; dark gray, strong, some limestone inclusions, some sandstone laminations note: horizontal fracture w/ moderate weathering @ 87.9', 88.3', 89.0', and 90.1'	
95	RC 8	77 (62)			91.0 1209.7 SHALE; dark gray, strong, some limestone inclusions note: broken and highly weathered from 91.1' - 91.5' and from 92.4' - 92.7' note: diagonal fracture w/ slight weathering @ 93.8'	
100	RC 9	97 (88)			note: horizontal fracture @ 96.8' and 98.0'	Bentonite Chips
105	RC 10	92 (87)			note: horizontal fracture @ 101.7' note: horizontal fracture w/ slight weathering @ 103.0' and 104.9'	
110	RC 11	98 (93)			106.0 1194.7 SHALE; dark gray, strong, some limestone inclusions, few sandstone laminations note: horizontal fracture w/ high weathering @ 110.6'	
115	RC 12	103 (102)			111.0 1189.7 SHALE; dark gray, strong, micaceous, some limestone inclusions, few sandstone laminations note: horizontal fracture w/ moderate weathering @ 113.9'	

(Continued Next Page)

P-12 TEMPLATE P-12_P-12S.GPJ GOOD TEMPLATE.GDT 3/31/11

Civil & Environmental Consultants, Inc.
8740 Orion Place, Suite 100
Columbus, Ohio 43240

BORING NUMBER P-12

CLIENT Apex Environmental, LLC
PROJECT NAME Apex Sanitary Landfill
CEC PROJECT NUMBER 101-049
PROJECT LOCATION Amsterdam, OH

DEPTH (ft)	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	POCKET PENETROMETER	GRAPHIC LOG	MATERIAL DESCRIPTION	WELL DIAGRAM
115					116.0 1184.7	2-Inch Solid PVC Riser
	RC 13	95 (92)			SHALE; dark gray, strong, micaceous, few limestone inclusions, few calcite inclusions, laminated sandstone note: horizontal fracture @ 116.2' 118.2 1182.5	Bentonite Chips
120					SANDSTONE; dark gray, strong, fine to medium-grained, micaceous, some shale laminations note: horizontal fracture @ 120.3' and 121.4'	#3 Filter Sand
	RC 14	102 (100)			note: horizontal fracture w/ moderate weathering @ 123.4'	
125					note: horizontal fracture @ 126.7' 126.0 1174.7	
	RC 15	98 (97)			SANDSTONE; dark gray, strong, fine to medium-grained, micaceous, some shale laminations, few coal laminations note: horizontal fracture w/ moderate weathering @129.0'	0.010-Inch Slotted Screen
130					131.0 1169.7	
	RC 16	105 (102)			SANDSTONE; dark gray, strong, fine to medium-grained, micaceous, some coal laminations, few shale laminations note: horizontal fracture @ 132.3' and 133.5'	#3 Filter Sand
135					136.0 1164.7	
	RC 17	102 (100)			SANDSTONE; dark gray, strong, fine to medium-grained, micaceous, some coal laminations note: horizontal fracture @ 140.4'	Bentonite Chips
140					141.0 1159.7	
					Bottom of hole at 141.0 feet	

Civil & Environmental Consultants, Inc.
8740 Orion Place, Suite 100
Columbus, Ohio 43240

BORING NUMBER P-12S

CLIENT Apex Environmental, LLC
PROJECT NAME Apex Sanitary Landfill
CEC PROJECT NUMBER 101-049
PROJECT LOCATION Amsterdam, OH
DATE STARTED 2/25/11 **COMPLETED** 2/25/11
GROUND ELEVATION 1300.58 ft **HOLE SIZE** 6" / 4"
DRILLINGCONTRACTOR Boart Longyear
TOP OF PVC ELEVATION 1303.04 ft
DRILLING METHOD Sonic
GROUND WATER LEVELS:
LOGGED BY BRB **CHECKED BY** DWC
▼ **AT END OF DRILLING** 66.8 ft / Elev 1233.8 ft
LOCATION Northing: 281889.33 Easting: 2407469.65

DEPTH (ft)	SAMPLE TYPE NUMBER	GRAPHIC LOG	MATERIAL DESCRIPTION		WELL DIAGRAM
0			--- ALL MATERIAL DESCRIPTIONS ARE BASED UPON P-12 LOG ---		
			MINESPOIL; brown clayey SILT, low plasticity, dry, very stiff to hard	1298.3	
			2.3 MINESPOIL; orange-brown silty SAND, some coal, some shale, no plasticity, dry, very stiff		
			4.4	1296.2	
5	SONIC 1		MINESPOIL; no recovery		
10			10.0	1290.6	2-Inch Solid PVC Riser
			MINESPOIL; brown silty CLAY, some coal, medium plasticity, dry, very stiff to hard		
			11.9	1288.7	
			MINESPOIL; orange-brown silty SAND, some coal, some rock fragments, no plasticity, dry, stiff		
			13.4	1287.2	
			MINESPOIL; gray SILT, no plasticity, dry, soft to stiff		
15	SONIC 2		14.7	1285.9	
			MINESPOIL; orange-brown silty SAND, some coal, some shale, no plasticity, dry, very stiff, no recovery from 15.1' - 20'		
20			20.0	1280.6	
			MINESPOIL; gray LIMESTONE, some tan silty clay, low plasticity, dry, hard		
			21.0	1279.6	
			MINESPOIL; tan silty CLAY and gray LIMESTONE, low plasticity, dry, stiff		
			22.0	1278.6	
			MINESPOIL; no recovery		Bentonite Chips
25	SONIC 3				
30			30.0	1270.6	
			30.4 MINESPOIL; tan sandy CLAY, few coal fragments, low plasticity, dry, stiff	1270.2	
			MINESPOIL; highly weathered gray SHALE, some coal, some tan sandy clay, low		
			31.9 plasticity, dry, hard	1268.7	
			MINESPOIL; no recovery		
35	SONIC				

P-12S TEMPLATE P-12_P-12S.GPJ GOOD TEMPLATE.GDT 3/31/11

(Continued Next Page)

Civil & Environmental Consultants, Inc.
8740 Orion Place, Suite 100
Columbus, Ohio 43240

BORING NUMBER P-12S

CLIENT Apex Environmental, LLC **PROJECT NAME** Apex Sanitary Landfill

CEC PROJECT NUMBER 101-049 **PROJECT LOCATION** Amsterdam, OH

DEPTH (ft)	SAMPLE TYPE NUMBER	GRAPHIC LOG	MATERIAL DESCRIPTION		WELL DIAGRAM
35	4		MINESPOIL; no recovery *(continued)*		
40			40.0	1260.6	
			40.4 MINESPOIL; orange-brown silty CLAY, some highly weathered shale, low plasticity, dry stiff	1260.2	
			MINESPOIL; highly weathered gray SHALE and orange silty CLAY, high plasticity, dry, stiff to very stiff		
			42.8	1257.8	
45	SONIC 5		MINESPOIL; no recovery		2-Inch Solid PVC Riser
50			50.0	1250.6	
	SONIC 6		MINESPOIL; encountered LIMESTONE BOULDER, continued through soft minespoil from 50.5' - 53.7', no recovery		
			53.7	1246.9	
55			MINESPOIL; black COAL, hard		
			55.2	1245.4	
			LIMESTONE; dark gray to brown, strong, high reaction to HCl, dry		
			56.3	1244.3	
			57.0 SHALE; gray, very weak, highly weathered	1243.6	
60	SONIC 7		LIMESTONE; gray, very strong, high reaction to HCl, moderate fracturing w/ high weathering, dry		Bentonite Chips
			61.0	1239.6	
			LIMESTONE; gray, very strong, high reaction to HCl, dry note: horizontal fracture w/ moderate weathering @ 64.1' & 64.7'		
65			64.7	1235.9	
			SHALE; dark gray, weak, few limestone inclusions 66.0 note: horizontal fracture w/ high weathering @ 65.1' and 65.5'	1234.6	
	SONIC 8		SHALE; dark gray, strong, micaceous, trace limestone inclusions note: horizontal fracture w/ high weathering @ 69.5'		
70			69.8	1230.8	#3 Filter Sand
			70.1 SHALE; dark gray, highly weathered, weak	1230.5	
			SHALE; dark gray to black, strong, micaceous, trace limestone inclusions		
			71.9	1228.7	
			72.7 LIMESTONE; dark gray, very strong, high reaction to HCl	1227.9	0.010-Inch Slotted Screen
			SHALE; dark gray, moderate to strong, some limestone inclusions note: horizontal fracture w/ moderate weathering @ 71.1', 71.6', 72.7', 73.5', and 75.6'		
75			75.0	1225.6	

(Continued Next Page)

Civil & Environmental Consultants, Inc.
8740 Orion Place, Suite 100
Columbus, Ohio 43240

BORING NUMBER P-12S

CLIENT Apex Environmental, LLC
PROJECT NAME Apex Sanitary Landfill
CEC PROJECT NUMBER 101-049
PROJECT LOCATION Amsterdam, OH

DEPTH (ft)	SAMPLE TYPE NUMBER	GRAPHIC LOG	MATERIAL DESCRIPTION	WELL DIAGRAM
75			76.0 SHALE; dark gray, moderate to strong, some limestone inclusions 1224.6	
	SONIC 9		SHALE; dark gray to black, strong, few limestone inclusions, trace calcite inclusions note: intense horizontal fracturing w/ high weathering from 76.0' - 78.2' note: horizontal fracture w/ high weathering @ 78.9', 79.5', 80.6', and 80.8'	0.010-Inch Slotted Screen
80			81.0 1219.6	
			82.0 SHALE; dark gray, strong, some limestone inclusions 1218.6	#3 Filter Sand
			Bottom of hole at 82.0 feet	

LOG OF TEST PIT NO. TP-1

Apex Solid Waste Disposal Facility

Jefferson and Harrison Counties, Ohio

TYPE: Backhoe LOCATION: See Plan Sheet 3D-1 and 3D-2

COMPLETION DEPTH: 7.2' ELEVATION: 1222.6 DATE: 06/06/91

DEPTH, FEET	SAMPLE NO	SAMPLES	SAMPLING EFFORT	HAND PENE-TROMETER (tsf)	MOISTURE CONTENT (%)	LIQUID LIMIT (%)	PLASTIC LIMIT (%)	DESCRIPTION
0								TOPSOIL - 7 INCHES
								Very-stiff red-brown mottled with gray clay, little silt, trace fine to coarse sand, trace fine gravel, few roots. CH
	1		* **	2.4-3.9	22	75	24	
2				2.7-3.1				
				2.4-4.5+				Very-stiff to hard light-gray mottled with red-brown silty clay, little with pockets of some fine to coarse sand, trace fine to coarse gravel, occasional cobble CL
4				3.2-4.5+				
	2		* **	4.5+	10	32	18	
6								Soft to medium-hard light-brown mottled with orange-brown staining siltstone, contains nodules of hard limestone.
	3							
8								Encountered no water.
								Pit did not cave.
								*Bag sample also obtained.
10								**See gradation curve.
12								
14								
16								

WATER LEVEL: "DRY"

DATE: 06/06

Plate B-7

LOG OF TEST PIT NO. TP-2

Apex Solid Waste Disposal Facility

Jefferson and Harrison Counties, Ohio

TYPE: Backhoe LOCATION: See Plan Sheets 3B-1 and 3D-2

COMPLETION DEPTH: 4.9' ELEVATION: 1234.7 DATE: 06/06/91

DEPTH, FEET	SAMPLE NO.	SAMPLES	SAMPLING EFFORT	HAND PENE-TROMETER tsf	MOISTURE CONTENT %	LIQUID LIMIT %	PLASTIC LIMIT %	DESCRIPTION
0								TOPSOIL - 8 INCHES
2	1		* **	4.5+	21	51	25	Hard brown silty clay, little fine to coarse sand, trace fine to coarse gravel, few roots. **CH**
4	2		* **	2.3-3.0	23	52	24	Very-stiff gray mottled with brown silty clay, little fine to coarse sand, trace fine gravel. **CH**
	3							Medium-hard light-brown fine to medium-grained sandstone, nearly horizontally bedded, poorly cemented.
6								Encountered no water.
								Pit did not cave.
								*Bag sample also obtained.
8								**See gradation curve.
10								
12								
14								
16								

WATER LEVEL: "DRY"

DATE: 06/06

JOB: 4850 NCAF
BERGER ENGINEERING, INC.

Plate B-8

LOG OF TEST PIT NO. TP-3

Apex Solid Waste Disposal Facility

Jefferson and Harrison Counties, Ohio

TYPE: Backhoe LOCATION: See Plan Sheets 3D-1 and 3D-2

COMPLETION DEPTH: 2.1' ELEVATION: 1245.5 DATE: 06/06/91

DEPTH, FEET	SAMPLE NO	SAMPLES	SAMPLING EFFORT	HAND PENE-TROMETER (tsf)	MOISTURE CONTENT (%)	LIQUID LIMIT (%)	PLASTIC LIMIT (%)	DESCRIPTION
0								MINE SPOIL - 3 INCHES
								Shale and coal fragments.GP
								Very-soft to soft gray stained orange-brown shale, nearly horizontally bedded.
	1							Soft with seams of medium-hard gray shale, nearly horizontally bedded.
2								Backhoe refusal on hard gray limestone at 2.1'
								Encountered no water.
								Pit did not cave.
4								
6								
8								
10								
12								
14								
16								

WATER LEVEL: "DRY"

DATE: 06/06

LOG OF TEST PIT NO. TP-4

Apex Solid Waste Disposal Facility

Jefferson and Harrison Counties, Ohio

TYPE: Backhoe LOCATION: See Plan Sheets 3D-1 and 3D-2

COMPLETION DEPTH: 12.0' ELEVATION: 1277.0 DATE: 06/05/91

DEPTH, FEET	SAMPLE NO.	SAMPLES	SAMPLING EFFORT	HAND PENE-TROMETER tsf	MOISTURE CONTENT %	LIQUID LIMIT %	PLASTIC LIMIT %	DESCRIPTION
0								TOPSOIL - 6 INCHES
	1			3.6-4.5+				MINE SPOIL Very-stiff to hard gray mottled with orange-brown silty clay, little fine to coarse sand, trace fine to coarse gravel, trace coal, few roots. CL
2								
4								MINE SPOIL Medium-dense brown, gray and orange-brown fine to coarse gravel, some fine to coarse sand, little to some silty clay, many cobbles, occasional boulder, trace coal. GC
6	2							
8								
10								
12	3							Encountered no water. Pit did not cave.
14								
16								

WATER LEVEL: "DRY"

DATE: 06/05

JOB: 3000 ENGINEERING, INC.

Plate B-10

LOG OF TEST PIT NO. TP-5

Apex Solid Waste Disposal Facility

Jefferson and Harrison Counties, Ohio

TYPE: Backhoe LOCATION: See Plan Shee 3D-1 and 3D-2

COMPLETION DEPTH: 6.0' ELEVATION: 1260.1 DATE: 06/05/91

DEPTH, FEET	SAMPLE NO.	SAMPLES	SAMPLING EFFORT	HAND PENE-TROMETER (tsf)	MOISTURE CONTENT (%)	LIQUID LIMIT (%)	PLASTIC LIMIT (%)	DESCRIPTION
0								TOPSOIL - 8 INCHES
2								MINE SPOIL Loose gray limestone coarse gravel and cobbles, little fine gravel, little fine to coarse sand, trace to little clayey silt, many boulders. GP
4								MINE SPOIL Loose gray fine to coarse sand, "and" silty clay, little fine to coarse gravel, many limestone cobbles. SC
6	1							Backhoe refusal on limestone boulder greater than 3' in diameter. Encountered no water. Pit caved slightly from 0.7' to 3.5'
8								
10								
12								
14								
16								

WATER LEVEL: "DRY"

DATE: 06/05

DUGAN ENGINEERING, INC. JOB 3030

LOG OF TEST PIT NO. TP-6

Apex Solid Waste Disposal Facility

Jefferson and Harrison Counties, Ohio

TYPE: Backhoe LOCATION: See Plan Sheets 3D-1 and 3D-2

COMPLETION DEPTH: 12.2' ELEVATION: 1221.2 DATE: 06/06/91

DEPTH, FEET	SAMPLE NO.	SAMPLES	SAMPLING EFFORT	HAND PENE-TROMETER (tsf)	MOISTURE CONTENT (%)	LIQUID LIMIT (%)	PLASTIC LIMIT (%)	DESCRIPTION
0								MINE SPOIL Soft dark-brown clayey silt, "and" fine to coarse sand, little fine to coarse gravel, trace coal. ML
	1							MINE SPOIL Medium-dense dark-brown and black fine to coarse gravel (coal fragments), some fine to coarse sand, some silty clay, few cobbles. CL
2				1.6-3.2				MINE SPOIL Medium-stiff to very-stiff orange-brown mottled with brown and gray silty clay, some fine to coarse sand, trace fine to coarse gravel, trace coal, occasional cobble. CL
	2		* ** ***	0.8-2.6	22	41	25	
4				1.2-1.4				
								MINE SPOIL Medium-dense brown and gray cobbles, some fine to coarse gravel, some silty clay, little fine to coarse sand, few boulders. CL
6								MINE SPOIL Medium-stiff to stiff brown mottled with gray and orange-brown silty clay, "and" fine to coarse sand, little fine to coarse gravel, many cobbles, trace coal. CL
8	3			0.7-1.1				
10								MINE SPOIL Medium-stiff to stiff light-brown mottled with gray silty clay, little fine to coarse sand, trace fine to coarse gravel. CL
12	4							
								Encountered no water. Pit did not cave. *Bag sample also obtained. **See gradation curve. ***See Constant Head permeability test.
14								
16								

WATER LEVEL: "DRY"

DATE: 06/06

Plate B-12

LOG OF TEST PIT NO. TP-7

Apex Solid Waste Disposal Facility

Jefferson and Harrison Counties, Ohio

TYPE: Backhoe LOCATION: See Plan Shee 3D-1 and 3D-2

COMPLETION DEPTH: 8.8' ELEVATION: 1300.8 DATE: 06/06/91

DEPTH, FEET	SAMPLE NO.	SAMPLES	SAMPLING EFFORT	HAND PENE-TROMETER (tsf)	MOISTURE CONTENT (%)	LIQUID LIMIT (%)	PLASTIC LIMIT (%)	DESCRIPTION
0								TOPSOIL - 2 INCHES MINE SPOIL Dense gray and brown limestone and shale cobbles, some fine to coarse gravel, little fine to coarse sand, little silty clay, trace coal, few boulders, few roots GP
2								
4								
6								
8								
10								Backhoe refusal on boulders. Encountered no water. Pit did not cave.
12								
14								
16								

WATER LEVEL: "DRY"

DATE: 06/06

DOUGLAS ENGINEERING, INC. JOB: 3000

LOG OF TEST PIT NO. TP-8

Apex Solid Waste Disposal Facility

Jefferson and Harrison Counties, Ohio

TYPE: Backhoe LOCATION: See Plan Sheets 3D-1 and 3D-2

COMPLETION DEPTH: 6.5' ELEVATION: 1244.8 DATE: 06/05/91

DEPTH, FEET	SAMPLE NO	SAMPLES	SAMPLING EFFORT	HAND PENE-TROMETER (tsf)	MOISTURE CONTENT (%)	LIQUID LIMIT (%)	PLASTIC LIMIT (%)	DESCRIPTION
0								MINE SPOIL Coal fragments.
2				0.6-1.2 1.3-1.4				MINE SPOIL Medium-stiff to stiff gray mottled with orange-brown silty clay, some fine to coarse gravel, little fine to coarse sand, trace coal, few cobbles, occasional boulder. CL
4	1			0.5-0.7 0.7-1.2				
6	2							Very-soft to soft with seams of medium-hard shale, nearly horizontally bedded.
8								Backhoe refusal on limestone. Encountered seepage from 5.0' to 5.4'. Pit did not cave.
10								
12								
14								
16								

WATER LEVEL: "DRY"

DATE: 06/05

JOB: 3830

BROWN ENGINEERING, INC.

Plate B-14

LOG OF TEST PIT NO. TP-9

Apex Solid Waste Disposal Facility

Jefferson and Harrison Counties, Ohio

TYPE: Backhoe LOCATION: See Plan Shee 3D-1 and 3D-2

COMPLETION DEPTH: 2.4' ELEVATION: 1328.6 DATE: 06/04/91

DEPTH, FEET	SAMPLE NO.	SAMPLES	SAMPLING EFFORT	HAND PENE-TROMETER (tsf)	MOISTURE CONTENT (%)	LIQUID LIMIT (%)	PLASTIC LIMIT (%)	DESCRIPTION
0								TOPSOIL - 4 INCHES
	1	■		3.3-4.5+				Hard brown silty clay, little fine to coarse sand, little fine to coarse gravel, few cobbles. CL
2	2	■						Soft brown shale, nearly horizontally bedded, silty.
								Encountered no water
								Pit did not cave.
16								

WATER LEVEL: "DRY"

DATE: 06/04

DOLAN ENGINEERING, INC. JOB: 3030

LOG OF TEST PIT NO. TP-10

Apex Solid Waste Disposal Facility

Jefferson and Harrison Counties, Ohio

TYPE: Backhoe LOCATION: See Plan Sheets 3D-1 and 3D-2

COMPLETION DEPTH: 9.8' ELEVATION: 1262.3 DATE: 06/04/91

DEPTH, FEET	SAMPLE NO	SAMPLES	SAMPLING EFFORT	HAND PENE-TROMETER (tsf)	MOISTURE CONTENT (%)	LIQUID LIMIT (%)	PLASTIC LIMIT (%)	DESCRIPTION
0								TOPSOIL AND SOD - 14 INCHES
2								MINE SPOIL Medium-dense gray with brown fine to coarse sand, some fine to coarse gravel, "and" silty clay, numerous cobbles, occasional boulders. SC
4								
6	1							
8								
10	2							
12								Encountered no water Pit did not cave.
14								
16								

WATER LEVEL: "DRY"

DATE: 06/04

DOUGH ENGINEERING, INC. JOB: 3830

Plate B-16

LOG OF TEST PIT NO. TP-11

Apex Solid Waste Disposal Facility

Jefferson and Harrison Counties, Ohio

TYPE: Backhoe LOCATION: See Plan Sheet 3D-1 and 3D-2

COMPLETION DEPTH: 10.0' ELEVATION: 1274.6 DATE: 06/04/91

DEPTH, FEET	SAMPLE NO	SAMPLES	SAMPLING EFFORT	HAND PENE-TROMETER (tsf)	MOISTURE CONTENT (%)	LIQUID LIMIT (%)	PLASTIC LIMIT (%)	DESCRIPTION
0								TOPSOIL - 11 INCHES
1	1							MINE SPOIL Dense brown mottled with gray fine to coarse gravel, some fine to coarse sand, little clayey silt, few cobbles. SC
2								
4	2							MINE SPOIL Dense dark-gray fine to coarse gravel, little fine to coarse sand, little silty clay, numerous cobbles, occasional boulder. GC
6								
8								MINE SPOIL Medium-dense brown fine to coarse gravel, some fine to coarse sand, some clayey silt, few cobbles. GC
10	3							Encountered no water. Pit did not cove.
12								
14								
16								

WATER LEVEL: "DRY"

DATE: 06/04

Plate B-17

LOG OF TEST PIT NO. TP-12

Apex Solid Waste Disposal Facility

Jefferson and Harrison Counties, Ohio

TYPE: Backhoe LOCATION: See Plan Sheets 3D-1 and 3D-2

COMPLETION DEPTH: 10.3' ELEVATION: 1269.6 DATE: 06/05/91

DEPTH, FEET	SAMPLE NO.	SAMPLES	SAMPLING EFFORT	HAND PENE-TROMETER (tsf)	MOISTURE CONTENT (%)	LIQUID LIMIT (%)	PLASTIC LIMIT (%)	DESCRIPTION
0								MINE SPOIL Medium-dense orange-brown, gray and black fine to coarse gravel, some fine to coarse sand, some silty clay, trace coal, many cobbles, occasional boulder. GC
2								
4	1							
6								
8								
10	2							
12								Encountered no water. Pit did not cave
14								
16								

WATER LEVEL: "DRY"

DATE: 06/05

Plate B-18

LOG OF TEST PIT NO. TP-13

Apex Solid Waste Disposal Facility

Jefferson and Harrison Counties, Ohio

TYPE: Backhoe LOCATION: See Plan She 3D-1 and 3D-2

COMPLETION DEPTH: 5.5' ELEVATION: 1159.7 DATE: 06/06/91

DEPTH, FEET	SAMPLE NO.	SAMPLES	SAMPLING EFFORT	HAND PENE-TROMETER (tsf)	MOISTURE CONTENT (%)	LIQUID LIMIT (%)	PLASTIC LIMIT (%)	DESCRIPTION
0								TOPSOIL - 10 INCHES
2	1			1.5-4.5+				Stiff to very-stiff light-brown clayey silt, some fine to coarse sand, little becoming some fine to coarse gravel, few becoming many cobbles. CL
4								Soft to medium-hard light-brown fine to medium-grained sandstone, nearly horizontally bedded, poorly cemented.
6	2							Encountered no water. Pit did not cave.
8								
10								
12								
14								
16								

WATER LEVEL: "DRY"

DATE: 06/06

Plate B-19

LOG OF TEST PIT NO. TP-14

Apex Solid Waste Disposal Facility

Jefferson and Harrison Counties, Ohio

TYPE: Backhoe

LOCATION: See Plan Sheets 3D-1 and 3D-2

COMPLETION DEPTH: 2.6' ELEVATION: 1238.5 DATE: 06/04/91

DEPTH, FEET	SAMPLE NO	SAMPLES	SAMPLING EFFORT	HAND PENE-TROMETER (tsf)	MOISTURE CONTENT (%)	LIQUID LIMIT (%)	PLASTIC LIMIT (%)	DESCRIPTION
0	1							MINE SPOIL Loose orange-brown fine to coarse gravel (shale fragments), some clayey silt, some fine to coarse sand, few cobbles. GC
	2		*					Very-soft to soft gray and dark-gray shale, nearly horizontally bedded.
2								
4								
6								
8								
10								
12								
14								
16								

Encountered seepage from 0.0' to 2.6'.

Pit did not cave.

*Bag sample also obtained.

WATER LEVEL: 2.4'

DATE: 06/04

Plate B-20

LOG OF TEST PIT NO. TP-15

Apex Solid Waste Disposal Facility

Jefferson and Harrison Counties, Ohio

TYPE: Backhoe LOCATION: See Plan Sheet 3D-1 and 3D-2

COMPLETION DEPTH: 7.4' ELEVATION: 1261.0 DATE: 06/04/91

DEPTH, FEET	SAMPLE NO	SAMPLES	SAMPLING EFFORT	HAND PENE-TROMETER (tsf)	MOISTURE CONTENT (%)	LIQUID LIMIT (%)	PLASTIC LIMIT (%)	DESCRIPTION
0								MINE SPOIL Medium-dense gray, dark-gray, orange-gray and brown fine to coarse gravel, some fine to coarse sand, little silty clay, numerous cobbles (predominately shale with minor limestone), few boulders, few pockets of sand and silty clay. GC
2	1							
4								
6	2							
8								
10								
12								
14								
16								

Encountered two 3' diameter limestone boulders at 6.3'.

Encountered no water.

Pit did not cave.

WATER LEVEL: "DRY"

DATE: 06/04

BBC&M ENGINEERING, INC. JOB: 3850

Plate B-21

LOG OF TEST PIT NO. TP-16

Apex Solid Waste Disposal Facility

Jefferson and Harrison Counties, Ohio

TYPE: Backhoe LOCATION: See Plan Sheets 3D-1 and 3D-2

COMPLETION DEPTH: 10.1' ELEVATION: 1252.6 DATE: 06/04/91

DEPTH, FEET	SAMPLE NO.	SAMPLES	SAMPLING EFFORT	HAND PENE-TROMETER (tsf)	MOISTURE CONTENT (%)	LIQUID LIMIT (%)	PLASTIC LIMIT (%)	DESCRIPTION
0								MINE SPOIL Very-stiff to hard brown with gray and dark-gray silty clay, some with pockets of "and" fine to coarse sand, little fine to coarse gravel, trace coal, few cobbles. **CL**
				3.2-4.5+				
2				4.5+				
	1			4.1-4.5+				
4				4.5+				
				4.5+				
6								
8								MINE SPOIL Medium-dense brown with gray fine to coarse sand, "and" fine to coarse gravel, little silty clay, few cobbles. **SC**
10	2							
12								Encountered no water. Pit did not cave.
14								
16								

WATER LEVEL: "DRY"

DATE: 06/04

JOB: 3830
BROWN ENGINEERING, INC.

LOG OF TEST PIT NO. TP-17

Apex Solid Waste Disposal Facility

Jefferson and Harrison Counties, Ohio

TYPE: Backhoe LOCATION: See Plan Shee 3D-1 and 3D-2

COMPLETION DEPTH: 11.5' ELEVATION: 1253.9 DATE: 06/04/91

DEPTH, FEET	SAMPLE NO	SAMPLES	SAMPLING EFFORT	HAND PENE-TROMETER tsf	MOISTURE CONTENT %	LIQUID LIMIT %	PLASTIC LIMIT %	DESCRIPTION
0								TOPSOIL - 6 INCHES
								MINE SPOIL - 9.75 FEET Very-stiff to hard brown mottled with gray silty clay, some fine to coarse sand, little fine to coarse gravel, few cobbles, few boulders, trace coal. CL
				4.2-4.5+				
2								
	1			3.2-4.5+				
				4.5+				
4								MINE SPOIL - 3.7 FEET Medium-stiff to stiff light-brown mottled with gray silty clay, little fine to coarse sand, trace fine to coarse gravel, trace coal. CL
			* ** *** **** *****					
	2			0.6-1.4	23	43	23	
6								
				0.8-1.0				
8								MINE SPOIL - 3.7 FEET Medium-stiff gray mottled with brown silty clay, some fine to coarse sand, trace fine to coarse gravel, occasional cobble, occasional boulder, trace coal. CL
10								
	3			0.5-0.8				
12								
								Encountered no water. Pit did not cave. *Bag sample also obtained. **See Gradation Curve ***See Constant Head permeability test. ****See Standard Proctor Curve. *****See Remolded permeability test.
14								
16								

WATER LEVEL: "DRY"

DATE: 06/04

DOUGH ENGINEERING, INC. JOB. 3030

LOG OF TEST PIT NO. TP-18

Apex Solid Waste Disposal Facility

Jefferson and Harrison Counties, Ohio

TYPE: Backhoe LOCATION: See Plan Sheets 3D-1 and 3D-2

COMPLETION DEPTH: 11.4' ELEVATION: 1234.5 DATE: 06/04/91

DEPTH, FEET	SAMPLE NO.	SAMPLES	SAMPLING EFFORT	HAND PENE-TROMETER (tsf)	MOISTURE CONTENT (%)	LIQUID LIMIT (%)	PLASTIC LIMIT (%)	DESCRIPTION
0								TOPSOIL - 12 INCHES
								MINE SPOIL Hard brown, black and gray silty clay, some with pockets of "and" fine to coarse sand, trace fine to coarse gravel, trace coal. CL
	1			4.5+				
2								
	2			1.1-1.7				MINE SPOIL Stiff light-brown mottled with gray silty clay, little fine to coarse sand, trace fine gravel. CL
4								MINE SPOIL Medium-stiff to stiff brown, black and gray intermixed silty clay and coal fragments, little fine to coarse sand, little fine to coarse gravel. CL
				1.2-1.4				
	3			0.7-1.1				
6								
	4			1.4-2.2				MINE SPOIL Stiff to very-stiff brown mottled with gray silty clay, some fine to coarse sand, trace fine to coarse gravel. CL
8								
	5							MINE SPOIL Loose gray fine to coarse sand, "and" silty clay, little fine to coarse gravel. SC
10								
	6							MINE SPOIL Loose coal fragments. SP
	7		* ** *** ****	4.5+				Very-soft to soft gray shale, nearly horizontally bedded.
12								
14								
16								

Encountered no water.

Pit did not cave.

*Bag sample also obtained.

**See Constant Head permeability test.

***See Standard Proctor Curve.

****See Remolded permeability test.

WATER LEVEL: "DRY"

DATE: 06/04

JUB: JBSU

BRUCE ENGINEERING, INC.

LOG OF TEST PIT NO. TP-101

APEX SANITARY LANDFILL

JEFFERSON AND HARRISON COUNTIES

TYPE: TEST PIT — LOCATION: See Plan Shee
APEX B/H — 3D-1 and 3D-2
24" BUCKET - DANNY
COMPLETION DEPTH: 13.5' — ELEVATION: 1165 — DATE: 02/10/93

DEPTH, FEET	SAMPLE NO.	SAMPLES	SAMPLING EFFORT	HAND PENE-TROMETER (tsf)	MOISTURE CONTENT (%)	LIQUID LIMIT (%)	PLASTIC LIMIT (%)	DESCRIPTION
0								MINE SPOIL: Loose to medium-dense black with gray, fine to coarse gravel (coal), some fine to coarse sand (coal), little silt (coal dust), few cobbles (coal), contains pockets of carbonaceous shale and very-soft gray shale (gob pile). GW
2	1							
4	2*							
6								
8								
10	3							MINE SPOIL: Very-soft orange-brown and reddish-brown shale fragments, fine to coarse gravel, similar to soft silty clay, some silty clay, some fine to coarse sand, few cobbles. GC
12	4							MINE SPOIL: Loose reddish-brown fine to coarse gravel (medium-hard shale fragments), some fine to coarse sand (shale fragments), little silt, trace coal fragments. GC
14								Did not cave. No seepage or water encountered. *Gradation curve on plate 16.
16								

WATER LEVEL: "Dry"
DATE: 02/10

DOUGH ENGINEERING, INC. JOB: 9391

LOG OF TEST PIT NO. TP-102

APEX SANITARY LANDFILL

JEFFERSON AND HARRISON COUNTIES

TYPE: TEST PIT — LOCATION: See Plan Sheets

APEX B/H — 3D-1 and 3D-2

24" BUCKET - DANNY

COMPLETION DEPTH: 5.5' — ELEVATION: 1169 — DATE: 02/10/93

DEPTH, FEET	SAMPLE NO.	SAMPLES	SAMPLING EFFORT	HAND PENE-TROMETER (tsf)	MOISTURE CONTENT (%)	LIQUID LIMIT (%)	PLASTIC LIMIT (%)	DESCRIPTION
0								TOPSOIL = 6 INCHES
	1			1.2-2.2	19	30	17	Stiff to very-stiff brown silty clay, little fine to coarse sand, trace fine to coarse gravel, few roots. CL
2								
	2							Soft to medium-hard greenish-gray and brown silty shale, nearly horizontally bedded, many horizontal fractures with silty clay filling.
4								
	3							
6								No seepage or water encountered.
8								
10								
12								
14								
16								

WATER LEVEL: "Dry"

DATE: 02/10

Plate B-26

LOG OF TEST PIT NO. TP-103

APEX SANITARY LANDFILL

JEFFERSON AND HARRISON COUNTIES

TYPE: TEST PIT
APEX B/H
24" BUCKET - DANNY

LOCATION: See Plan She 3D-1 and 3D-2

COMPLETION DEPTH: 5.5' ELEVATION: 1127 DATE: 02/10/93

DEPTH, FEET	SAMPLE NO.	SAMPLES	SAMPLING EFFORT	HAND PENE-TROMETER (tsf)	MOISTURE CONTENT (%)	LIQUID LIMIT (%)	PLASTIC LIMIT (%)	DESCRIPTION
0								TOPSOIL = 4 INCHES
	1			1.5-2.5	19	25	18	Stiff to very-stiff brown clayey silt, some fine to coarse sand, trace fine to coarse gravel, few roots, occasional cobble. CL
2								
	2							Medium-hard (well cemented) dark-brown fine to medium grained sandstone, nearly horizontally bedded, numerous fractures.
4								
	3							Medium-hard (well cemented) brown fine to medium grained sandstone, nearly horizontally bedded, many fractures, micaceous.
6								No seepage or water encountered.
8								
10								
12								
14								
16								

WATER LEVEL: "Dry"

DATE: 02/10

JOB: 4341

BBC&M ENGINEERING, INC.

Plate B-27

LOG OF TEST PIT NO. TP-104
APEX SANITARY LANDFILL
JEFFERSON AND HARRISON COUNTIES

TYPE: TEST PIT
APEX B/H
24" BUCKET - DANNY
LOCATION: See Plan Sheets 3D-1 and 3D-2
COMPLETION DEPTH: 11.5' ELEVATION: 1224 DATE: 02/10/93

DEPTH, FEET	SAMPLE NO.	SAMPLES	SAMPLING EFFORT	HAND PENE-TROMETER tsf	MOISTURE CONTENT %	LIQUID LIMIT %	PLASTIC LIMIT %	DESCRIPTION
0								TOPSOIL = 2 INCHES
								Hard brown mottled with orange-brown silty clay, trace fine to coarse sand, trace fine to coarse gravel, occasional cobble, trace coal blossom. CL
	1			4.5+				
2								
	2			4.5+	18	46	22	Hard light-brown and light-gray silty clay, trace fine to coarse sand, trace fine to coarse gravel, few cobbles. CL
4								
	3			4.5+				Hard brown with black silty clay, some fine to coarse sand (coal blossom), little fine to coarse gravel, occasional cobble. CL
6	4							Soft greenish-gray silty shale, nearly horizontally bedded, many horizontal partings with silty clay filling.
8								
	5							Very-soft light-gray shale, nearly horizontally bedded, similar to hard silty clay, highly fractured with silty clay filling.
10								
	6							Soft gray shale, nearly horizontally bedded.
12								No seepage or water encountered.
14								
16								

WATER LEVEL: "Dry"
DATE: 02/10

JOB: 4341

BBC&M ENGINEERING, INC.

Plate B-28

LOG OF TEST PIT NO. TP-105

APEX SANITARY LANDFILL

JEFFERSON AND HARRISON COUNTIES

TYPE: TEST PIT
APEX B/H
24" BUCKET - DANNY

LOCATION: See Plan Sheet 3D-1 and 3D-2

COMPLETION DEPTH: 5.5' ELEVATION: 1157 DATE: 02/10/93

DEPTH, FEET	SAMPLE NO.	SAMPLES	SAMPLING EFFORT	HAND PENE-TROMETER (tsf)	MOISTURE CONTENT (%)	LIQUID LIMIT (%)	PLASTIC LIMIT (%)	DESCRIPTION
0								TOPSOIL = 10 INCHES
	1							Loose brown fine to medium sand, some silt, fractured coarse sand, little fine to coarse gravel, few cobbles. SM
2								*Loose brown fine to coarse gravel, some fine to coarse sand, little silt. GM
4								Soft to medium-hard (poorly to moderately-well cemented) brown and orange-brown fine to medium grained sandstone, nearly horizontally bedded, highly fractured, few thin seams of soft greenish-gray shale.
	2							
6								Difficult digging below 4.0'.
								No seepage or water encountered.
								*Gradation curve on plate 17.
8								
10								
12								
14								
16								

WATER LEVEL: "Dry"

DATE: 02/10

BBC&M ENGINEERING, INC. JOB: 4341

LOG OF TEST PIT NO. TP-106

APEX SANITARY LANDFILL

JEFFERSON AND HARRISON COUNTIES

TYPE: TEST PIT
APEX B/H
24" BUCKET - DANNY

LOCATION: See Plan Sheets 3D-1 and 3D-2

COMPLETION DEPTH: 6.0' ELEVATION: 1165 DATE: 02/10/93

DEPTH, FEET	SAMPLE NO.	SAMPLES	SAMPLING EFFORT	HAND PENE-TROMETER (tsf)	MOISTURE CONTENT (%)	LIQUID LIMIT (%)	PLASTIC LIMIT (%)	DESCRIPTION
0								TOPSOIL = 6 INCHES
	1			1.3-1.8	29	43	26	Stiff brown silty clay, little fine to coarse sand, trace fine to coarse gravel, occasional cobble, few roots. CL
2	2			1.1-2.5				Stiff to very-stiff brown silty clay, some fine to coarse sand, little fine to coarse gravel, few cobbles. CL
4	3							Medium-hard (moderately well cemented) dark-brown fine to medium grained sandstone, nearly horizontally bedded, micaceous.
	4							Very-soft (very-poorly cemented) light-brown fine to medium grained sandstone, nearly horizontally bedded, micaceous, similar to medium-dense fine to medium sand, some silty clay.
6	5							Medium-hard (well cemented) brown and dark-brown fine to medium grained sandstone, nearly horizontally bedded, micaceous.
8								No seepage or water encountered.
10								
12								
14								
16								

WATER LEVEL: "Dry"
DATE: 02/10

JOB: 4341

BBC&M ENGINEERING, INC

Plate B-30

LOG OF TEST PIT NO. TP-107

APEX SANITARY LANDFILL

JEFFERSON AND HARRISON COUNTIES

TYPE: TEST PIT
APEX B/H
24" BUCKET - DANNY

LOCATION: See Plan She
3D-1 and 3D-2

COMPLETION DEPTH: 7.5' ELEVATION: 1130 DATE: 02/10/93

DEPTH, FEET	SAMPLE NO.	SAMPLES	SAMPLING EFFORT	HAND PENE-TROMETER (tsf)	MOISTURE CONTENT (%)	LIQUID LIMIT (%)	PLASTIC LIMIT (%)	DESCRIPTION
0								TOPSOIL = 4 INCHES
								Loose brown fine to medium sand, some silty clay, little fine to coarse gravel. SC
2	1							Weathered upper bedrock, medium-hard brown fine to medium grained sandstone, highly fractured strata similar to fine to coarse gravel, some fine to coarse sand, trace silt, gravel and coal pieces are sub-angular (slightly rounded).
4								
6	2							Less weathered bedrock, medium-hard greenish-gray fine to medium grained sandstone, nearly horizontally bedded, fractured, micaceous, strata is predominately slab, cobbles.
8	3							Medium-hard (well cemented) greenish-gray and brown fine to medium grained sandstone, nearly horizontally bedded, few horizontal fractures, micaceous.
10								No seepage or water encountered.
12								
14								
16								

WATER LEVEL: "Dry"
DATE: 02/10

JOB: 4341

BBC&M ENGINEERING, INC.

Plate B-31

LOG OF TEST PIT NO. TP-108

APEX SANITARY LANDFILL

JEFFERSON AND HARRISON COUNTIES

TYPE: TEST PIT
APEX B/H
24" BUCKET - DANNY

LOCATION: See Plan Sheets 3D-1 and D3-2

COMPLETION DEPTH: 10.0' ELEVATION: 1085 DATE: 02/10/93

DEPTH, FEET	SAMPLE NO.	SAMPLES	SAMPLING EFFORT	HAND PENE-TROMETER tsf	MOISTURE CONTENT %	LIQUID LIMIT %	PLASTIC LIMIT %	DESCRIPTION
0								TOPSOIL = 7 INCHES
	1			1.0-1.6	28	40	28	Stiff brown clayey silt, little fine to coarse sand, trace fine to coarse gravel, few roots, occasional cobble. ML
2								Very-soft brown shale interbedded with soft to medium-hard reddish-brown fine to medium granular sandstone, nearly horizontally bedded, shale bed, sandstone beds.
	2							
4								
6	3							Very-soft light-gray and light-brown shale, nearly horizontally bedded, similar to very-stiff to hard silty clay.
8								
	4							Very-soft to medium-hard brown fine to medium granular sandstone, nearly horizontally bedded, micaceous.
10								No seepage or water encountered.
12								
14								
16								

WATER LEVEL: "Dry"

DATE: 02/10

JUB: RNF 1995

BROWN ENGINEERING, INC.

Plate B-32

LOG OF TEST PIT NO. TP-109

APEX SANITARY LANDFILL

JEFFERSON AND HARRISON COUNTIES

TYPE: TEST PIT
APEX B/H
24" BUCKET - DANNY

LOCATION See Plan Shee
3D-1 and 3D-2

COMPLETION DEPTH: 7.5' ELEVATION: 1180 DATE: 02/10/93

DEPTH, FEET	SAMPLE NO.	SAMPLES	SAMPLING EFFORT	HAND PENE-TROMETER (tsf)	MOISTURE CONTENT (%)	LIQUID LIMIT (%)	PLASTIC LIMIT (%)	DESCRIPTION
0								TOPSOIL = 7 INCHES
	1			0.9-1.2	24	28	25	Medium-stiff to stiff brown silt, little fine to coarse sand, trace fine to coarse gravel, few roots. ML
2								Very-soft to soft brown shale, nearly horizontally bedded, simular to hard silty clay, highly fractured.
4	2							
6								
	3							Medium-hard brown with orange-brown siltstone, trace fine grained sandstone, nearly horizontally bedded.
8								No seepage or water encountered.
10								
12								
14								
16								

WATER LEVEL: "Dry"
DATE: 02/10

BROWN ENGINEERING, INC.

JOB: 4341

LOG OF TEST PIT NO. TP-110

APEX SANITARY LANDFILL

JEFFERSON AND HARRISON COUNTIES

TYPE: TEST PIT — LOCATION: See Plan Sheets

APEX B/H — 3D-1 and 3D-2

24" BUCKET - DANNY

COMPLETION DEPTH: 7.0' — ELEVATION: 1145 — DATE: 02/10/93

DEPTH, FEET	SAMPLE NO.	SAMPLES	SAMPLING EFFORT	HAND PENE-TROMETER (tsf)	MOISTURE CONTENT (%)	LIQUID LIMIT (%)	PLASTIC LIMIT (%)	DESCRIPTION
0								TOPSOIL = 5 INCHES
	1*							Very-loose brown fine to medium sand, "and" clayey silt, trace coarse sand, little fine to coarse gravel, few roots. SC
2								
	2							Very-soft to soft (very-poorly to poorly cemented) fine to medium grained sandstone, nearly horizontally bedded, micaceous.
4								
								Medium-hard (well cemented) greenish-gray fine grained sandstone, nearly horizontally bedded, highly fractured with sand filling fractures.
6	3							
8								No seepage or water encountered.
								*Gradation curve on plate 18.
10								
12								
14								
16								

WATER LEVEL: "Dry"

DATE: 02/10

JOB: TJTL

Plate B-34

LOG OF TEST PIT NO. TP-.111

APEX SANITARY LANDFILL

JEFFERSON AND HARRISON COUNTIES

TYPE: TEST PIT
APEX B/H
24" BUCKET - DANNY

LOCATION See Plan Shee 3D-1 and 3D-2

COMPLETION DEPTH: 8.3' ELEVATION: 1122 DATE: 02/10/93

DEPTH, FEET	SAMPLE NO.	SAMPLES	SAMPLING EFFORT	HAND PENE-TROMETER tsf	MOISTURE CONTENT %	LIQUID LIMIT %	PLASTIC LIMIT %	DESCRIPTION
0								TOPSOIL = 13 INCHES
2	1			0.0				Very-soft dark-gray and brown clayey silt, mixed with organic material and coal dust, trace fine to coarse sand, roots. CL
4	2							Loose brown fine to coarse sand, some fine to coarse gravel, some clayey silt, few cobbles. SC
6	3							Very-soft (very-poorly cemented) dark gray fine to medium grained sandstone.
8	4							Soft to medium-hard dark gray with gray and orange-brown fine to medium grained sandstone, nearly horizontally bedded, few horizontal fractures.
	5							Medium-hard (well cemented) light-brown sandstone, nearly horizontally bedded.
10								Backhoe refusal at 8.3'.
								No seepage or water encountered.
12								
14								
16								

WATER LEVEL: "Dry"
DATE: 02/10

BROWN ENGINEERING, INC JOB: 9391

LOG OF TEST PIT NO. TP-112

APEX SANITARY LANDFILL

JEFFERSON AND HARRISON COUNTIES

TYPE: TEST PIT
APEX B/H
24" BUCKET - DANNY

LOCATION: See Plan Sheets 3D-1 and 3D-2

COMPLETION DEPTH: 9.0' ELEVATION: 1213 DATE: 02/10/93

DEPTH, FEET	SAMPLE NO.	SAMPLES	SAMPLING EFFORT	HAND PENE-TROMETER tsf	MOISTURE CONTENT %	LIQUID LIMIT %	PLASTIC LIMIT %	DESCRIPTION
0								TOPSOIL = 4 INCHES
								Stiff brown clayey silt, trace fine to coarse sand, trace fine gravel, few roots. CL
	1			1.6-1.9				
2								
	2							Medium-dense orange-brown fine to coarse sand, some fine to coarse gravel, some silty clay. SC
								Hard orange-brown mottled with brown and dark-gray silty clay, trace fine to coarse sand, trace fine to coarse gravel, similar to very-soft shale. CL
4				4.5+				
	3			4.5+				
6								
	4			0.6-1.7				Medium-stiff to stiff dark-gray mottled with brown silty clay, trace fine to coarse sand, trace fine to coarse gravel, similar to very-soft shale. CL
	5							Very-soft to soft dark-gray and dark-brown shale, nearly horizontally bedded.
8								Very-soft to soft gray shale, nearly horizontally bedded.
								No seepage or water encountered.
10								
12								
14								
16								

WATER LEVEL: "Dry"
DATE: 02/10

JOB: 7371

DUGAN ENGINEERING, INC.

Plate B-36

BBC&M ENGINEERING, INC.

LOG OF TEST PIT NO. TP-201
APEX SOLID WASTE DISPOSAL FACILITY
JEFFERSON COUNTY, OHIO

TYPE: Backhoe LOCATION: See Plan Sheets 3D-1 and 3D-2

COMPLETION DEPTH: 9.3' ELEVATION: 1215.9 DATE: 4/26/95

DEPTH, FEET	SAMPLE NO.	SAMPLES	SAMPLING EFFORT	HAND PENE-TROMETER tsf	MOISTURE CONTENT %	LIQUID LIMIT %	PLASTIC LIMIT %	DESCRIPTION
0								MINE SPOIL: Dark-gray and black fine to coarse gravel (carbonaceous shale and coal), little fine to coarse sand, little clayey silt. CL
2								
4								MINE SPOIL: Light-gray silty clay (degraded shale), some fine to coarse sand, little fine to coarse gravel. CL
6								Very-soft brown and gray shale, nearly horizontally bedded. CL
	1		*					
8								
								Medium-hard to hard gray limestone.
10								- Encountered water from 3.8' to 6.0'.
								* Sample 1A - As excavated
12								Sample 1B - Crushed
								Sample 1C - Crushed and milled
14								See gradation curves, compaction tests and permeability tests.
16								

WATER LEVEL:	▽ 7.2	▽	▽	▽	▽	▽
WATER NOTE:						
DATE:	04/26/95					

JOB: 38503

Plate B-37

BBC&M ENGINEERING, INC.

LOG OF TEST PIT NO. TP-202
APEX SOLID WASTE DISPOSAL FACILITY
JEFFERSON COUNTY, OHIO

TYPE: Backhoe LOCATION: See Plan Sheets 3D-1 and 3D-2

COMPLETION DEPTH: 12.6' ELEVATION: 1205.6 DATE: 4/26/95

DEPTH, FEET	SAMPLE NO.	SAMPLES	SAMPLING EFFORT	HAND PENE-TROMETER (tsf)	MOISTURE CONTENT (%)	LIQUID LIMIT (%)	PLASTIC LIMIT (%)	DESCRIPTION
0								TOPSOIL - 5 INCHES
	1		*			52	25	Orange-brown silty clay, little fine to coarse sand. CH
2								
4								Very-soft brown and gray shale, nearly horizontally bedded.
6								
8								
10								
12								
14								- Encountered no water.
16								* See gradation curve.

WATER LEVEL: ▽ "Dry"
WATER NOTE:
DATE: 04/26/95

JOB: 38503

Plate B-38

BBC&M ENGINEERING, INC.

LOG OF TEST PIT NO. TP-203
APEX SOLID WASTE DISPOSAL FACILITY
JEFFERSON COUNTY, OHIO

TYPE: Backhoe LOCATION: See Plan Sheets 3D-1 and 3D-2

COMPLETION DEPTH: 4.3' ELEVATION: 1223.5 DATE: 4/27/95

DEPTH, FEET	SAMPLE NO.	SAMPLES	SAMPLING EFFORT	HAND PENE-TROMETER (tsf)	MOISTURE CONTENT (%)	LIQUID LIMIT (%)	PLASTIC LIMIT (%)	DESCRIPTION
0								TOPSOIL - 11 INCHES
2	1		*			37	20	Brown silty clay, little fine to coarse sand, trace fine to coarse gravel. CL
4								Dark-brown clayey silt, little fine to coarse sand, trace fine to coarse gravel, few cobbles, medium limestone. ML
								Hard gray limestone.
6								- Encountered no water.
								* See gradation curve, compaction test and permeability test.
8								
10								
12								
14								
16								

WATER LEVEL: ▽ "Dry"
WATER NOTE:
DATE: 04/27/95

JOB: 38503

Plate B-39

BBC&M ENGINEERING, INC.

LOG OF TEST PIT NO. TP-204
APEX SOLID WASTE DISPOSAL FACILITY
JEFFERSON COUNTY, OHIO

TYPE: Backhoe LOCATION: See Plan Sheets 3D-1 and 3D-2

COMPLETION DEPTH: 2.8' ELEVATION: 1245.1 DATE: 4/26/95

DEPTH, FEET	SAMPLE NO.	SAMPLES	SAMPLING EFFORT	HAND PENE-TROMETER tsf	MOISTURE CONTENT %	LIQUID LIMIT %	PLASTIC LIMIT %	DESCRIPTION
0								MINE SPOIL - 5 INCHES
			*					Soft-gray shale, nearly horizontally bedded.
	1							
2								
								Hard gray limestone.
4								- Encountered no water.
								* Sample 1A - As excavated
6								Sample 1B - Crushed
								Sample 1C - Crushed and milled.
8								See gradation curve, compaction tests and permeability tests.
10								
12								
14								
16								

WATER LEVEL: ▽ "Dry" ▽ ▽ ▽ ▽ ▽

WATER NOTE:

DATE: 04/26/95

JOB: 38503

Plate B-40

TEST PITS TP-205 THROUGH TP-214
EXPLORATIONS IN MINE SPOIL
FOR POTENTIAL GEOLOGIC FILL MATERIAL

Job No. 3850-3

Subject: Apex SLF

EXPLORATION	GROUND ELEVATION	COMPLETION DEPTH	UNPROCESSED MINE SPOIL	MATERIAL AFTER CRUSHING
TP-205 *	1261.2	10.5'	Orange-brown, brown and gray fine to coarse gravel, "and" silty clay, some fine to coarse sand, many cobbles and boulders. GC	Sandy lean clay. CL
TP-206	1260.5	11.0'	Brown silty clay, little fine to coarse sand, little fine to coarse gravel, few cobbles. CL	Lean clay. CL
TP-207 *	1256.9	8.6'	Brown silty clay, "and" fine to coarse gravel, some fine to coarse sand, few cobbles. CL	Sandy lean clay with gravel. CL
TP-208	1299.4	9.3'	Brown and gray fine to coarse gravel, little fine to coarse sand, little silty clay, many cobbles, few boulders. GC	Clayey sand with gravel. SC
TP-209 *	1268.2	10.0'	Brown, orange-brown, gray and dark-gray silty clay, some fine to coarse gravel, little fine to coarse sand. CL	Sandy lean clay. CL
TP-210	1256.4	5.0'	Gray cobbles and boulders, some fine to coarse gravel, little fine to coarse sand, little silty clay. GC	Clayey sand with gravel.
TP-211 *	1282.3	7.7'	Black, brown and gray fine to coarse gravel, "and" silty clay, some fine to coarse sand, many cobbles, occasional boulder. GC	Sandy lean clay. CL
TP-212	1267.3	6.2'	Orange-brown and gray silty clay, some fine to coarse gravel, little fine to coarse sand, few cobbles. CL	Sandy lean clay. CL
TP-213 *	1264.7	5.4'	Brown and gray fine to coarse gravel, some fine to coarse sand, little silty clay, many cobbles, occasional boulder. GC	Clayey sand with gravel. SC
TP-214	1259.4	5.2'	Gray and brown fine to coarse gravel, some fine to coarse sand, little silty clay, many cobbles, few boulders. GC	Silty sand with gravel. SM

* Compaction test and remolded permeability test completed

NOTES: - All samples are composite samples of all material excavated.
- All analysis was performed on samples after they were crushed.
- Atterberg limits and gradation analysis performed on all samples.

BBC&M ENGINEERING, INC.

LOG OF TEST PIT NO. TP-215
APEX SOLID WASTE DISPOSAL FACILITY
JEFFERSON COUNTY, OHIO

TYPE: Backhoe LOCATION: See Plan Sheets 3D-1 and 3D-2

COMPLETION DEPTH: 10.7' ELEVATION: 1245.5 DATE: 4/27/95

DEPTH, FEET	SAMPLE NO.	SAMPLES	SAMPLING EFFORT	HAND PENE-TROMETER (tsf)	MOISTURE CONTENT (%)	LIQUID LIMIT (%)	PLASTIC LIMIT (%)	DESCRIPTION
0								TOPSOIL - 8 INCHES
2								Orange-brown mottled gray silty clay, some fine to coarse sand, little fine to coarse gravel, few cobbles. CL
4	1		*			50	25	Very-soft brown to orange-brown and gray shale, nearly horizontally bedded, similar to soil. CL
6								Very-soft gray shale, nearly horizontally bedded.
8								Very-soft orange-brown and gray shale, nearly horizontally bedded, similar to soil.
10								Hard gray limestone.
12								- Encountered no water.
14								* See gradation curve, compaction test and permeability test.
16								

WATER LEVEL: ▽ "Dry" ▽ ▽ ▽ ▽ ▽

WATER NOTE:

DATE: 04/27/95

JOB: 38503

Plate B-42

Civil & Environmental Consultants, Inc.
333 Baldwin Road
Pittsburgh, PA 15205

TEST PIT NUMBER TPE-2

CLIENT Apex Environmental, LLC
PROJECT NAME Apex Lateral Expansion
PROJECT NUMBER 101-049
PROJECT LOCATION Amsterdam, Ohio
DATE STARTED 9/23/10 **COMPLETED** 9/23/10
GROUND ELEVATION 1249.21 ft **BACKFILL** Excavated Material
EXCAVATION CONTRACTOR Test Boring Services, Inc.
GROUND WATER LEVELS:
EXCAVATION METHOD Excavator
BEFORE CORING Not Applicable
CEC REP JMN **CHECKED BY** LRW
AT END OF EXCAVATION 7.5 ft / Elev 1241.7 ft
NOTES Northing: 282134.30 Easting: 2407343.71
24hrs AFTER EXCAVATION Immediately Backfilled

ELEVATION (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	DEPTH (ft)	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	POCKET PEN. (tsf)	▲ SPT N VALUE ▲ 20 40 60 80 / PL MC LL 20 40 60 80 / ☐ FINES CONTENT (%) ☐ 20 40 60 80
		TOPSOIL	0					
		Brown and gray sandy CLAY, some rock fragments, some coal fragments, moist, **(MINE SPOIL)**						
		-- MATERIAL WAS LOGGED BASED ON AUGER CUTTINGS --						
1245			5					
		Black COAL, wet, **(BEDROCK)**						
1240			10					
		Bottom of test pit at 11.0 feet.						

CEC CUSTOM LOG APEX EXPANSION.GPJ CEC.GDT 4/4/11

Civil & Environmental Consultants, Inc.
333 Baldwin Road
Pittsburgh, PA 15205

TEST PIT NUMBER TPE-3

CLIENT Apex Environmental, LLC
PROJECT NAME Apex Lateral Expansion
PROJECT NUMBER 101-049
PROJECT LOCATION Amsterdam, Ohio
DATE STARTED 9/23/10 **COMPLETED** 9/23/10
GROUND ELEVATION 1244.63 ft **BACKFILL** Excavated Material
EXCAVATION CONTRACTOR Test Boring Services, Inc.
GROUND WATER LEVELS:
EXCAVATION METHOD Excavator
BEFORE CORING Not Applicable
CEC REP JMN **CHECKED BY** LRW
AT END OF EXCAVATION Dry
NOTES Northing: 282063.42 Easting: 2407992.52
24hrs AFTER EXCAVATION Immediately Backfilled

ELEVATION (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	DEPTH (ft)	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	POCKET PEN. (tsf)	▲ SPT N VALUE ▲ 20 40 60 80 / PL MC LL 20 40 60 80 / ☐ FINES CONTENT (%) ☐ 20 40 60 80
		TOPSOIL	0					
		-- MATERIAL WAS LOGGED BASED ON AUGER CUTTINGS --						
		Gray and brown decomposed SHALE, dry, **(BEDROCK)**						
		becomes hard at 3.0 ft						
		Bottom of test pit at 3.0 feet.						

CEC CUSTOM LOG APEX EXPANSION.GPJ CEC.GDT 4/4/11

Civil & Environmental Consultants, Inc.
333 Baldwin Road
Pittsburgh, PA 15205

TEST PIT NUMBER TPE-4

CLIENT Apex Environmental, LLC
PROJECT NAME Apex Lateral Expansion
PROJECT NUMBER 101-049
PROJECT LOCATION Amsterdam, Ohio
DATE STARTED 9/23/10 **COMPLETED** 9/23/10
GROUND ELEVATION 1249.13 ft **BACKFILL** Excavated Material
EXCAVATION CONTRACTOR Test Boring Services, Inc.
GROUND WATER LEVELS:
EXCAVATION METHOD Excavator
BEFORE CORING Not Applicable
CEC REP JMN **CHECKED BY** LRW
AT END OF EXCAVATION Dry
NOTES Northing: 281940.41 Easting: 2408263.19
24hrs AFTER EXCAVATION Immediately Backfilled

ELEVATION (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	DEPTH (ft)	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	POCKET PEN. (tsf)	▲ SPT N VALUE ▲ 20 40 60 80 / PL MC LL 20 40 60 80 / ☐ FINES CONTENT (%) ☐ 20 40 60 80
		TOPSOIL	0					
		Gray and brown sandy CLAY, some rock fragments, trace boulders, moist to wet, **(MINE SPOIL)**						
		-- MATERIAL WAS LOGGED BASED ON AUGER CUTTINGS --						
1245			5					
1240			10					
		Gray and brown decomposed SHALE, **(BEDROCK)**						
		becomes hard at 11.5 ft						
		Bottom of test pit at 11.5 feet.						

CEC CUSTOM LOG APEX EXPANSION.GPJ CEC.GDT 4/4/11

TEST PIT NUMBER TPE-5

Civil & Environmental Consultants, Inc.
333 Baldwin Road
Pittsburgh, PA 15205

CLIENT Apex Environmental, LLC
PROJECT NAME Apex Lateral Expansion
PROJECT NUMBER 101-049
PROJECT LOCATION Amsterdam, Ohio
DATE STARTED 9/23/10 **COMPLETED** 9/23/10
GROUND ELEVATION 1265.53 ft **BACKFILL** Excavated Material
EXCAVATION CONTRACTOR Test Boring Services, Inc.
GROUND WATER LEVELS:
EXCAVATION METHOD Excavator
BEFORE CORING Not Applicable
CEC REP JMN **CHECKED BY** LRW
AT END OF EXCAVATION Dry
NOTES Northing: 281723.33 Easting: 2408845.53
24hrs AFTER EXCAVATION Immediately Backfilled

ELEVATION (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	DEPTH (ft)	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	POCKET PEN. (tsf)	▲ SPT N VALUE ▲ 20 40 60 80 / PL MC LL 20 40 60 80 / ☐ FINES CONTENT (%) ☐ 20 40 60 80
1265		TOPSOIL	0					
		Brown and gray sandy CLAY, some rock fragments, dry, **(MINE SPOIL)**						
		-- MATERIAL WAS LOGGED BASED ON AUGER CUTTINGS --	5					
1260								
			10					
1255								
		Bottom of test pit at 12.0 feet.						

CEC CUSTOM LOG APEX EXPANSION GPJ CEC GDT 4/4/11

TEST PIT NUMBER TPE-15

Civil & Environmental Consultants, Inc.
333 Baldwin Road
Pittsburgh, PA 15205

CLIENT Apex Environmental, LLC
PROJECT NAME Apex Lateral Expansion
PROJECT NUMBER 101-049
PROJECT LOCATION Amsterdam, Ohio
DATE STARTED 9/20/10 **COMPLETED** 9/20/10
GROUND ELEVATION 1234.81 ft **BACKFILL** Excavated Material
EXCAVATION CONTRACTOR Test Boring Services, Inc.
GROUND WATER LEVELS:
EXCAVATION METHOD Excavator
BEFORE CORING Not Applicable
CEC REP JMN **CHECKED BY** LRW
AT END OF EXCAVATION 17.5 ft / Elev 1217.3 ft
NOTES Northing: 280556.65 Easting: 2408463.98
24hrs AFTER EXCAVATION Immediately Backfilled

ELEVATION (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	DEPTH (ft)	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	POCKET PEN. (tsf)	▲ SPT N VALUE ▲ 20 40 60 80 / PL MC LL 20 40 60 80 / ☐ FINES CONTENT (%) ☐ 20 40 60 80
		TOPSOIL	0					
		Brown silty CLAY, some sand, rock fragments, moist, **(MINE SPOIL)**						
		-- MATERIAL WAS LOGGED BASED ON AUGER CUTTINGS --						
1230			5					
		Brown and gray CLAY, moist, **(MINE SPOIL)**						
1225			10					
		Tan and gray CLAY, trace rock fragments, moist, mottled, **(MINE SPOIL)**						
		Shelby tube collected from 13.5 to 15 ft. Recovery 1.5 ft		ST 1	100			
1220			15					
		Black COAL, moist to wet, **(BEDROCK)**						
		Bottom of test pit at 19.0 feet.						

Civil & Environmental Consultants, Inc.
333 Baldwin Road
Pittsburgh, PA 15205

TEST PIT NUMBER TPE-16

CLIENT Apex Environmental, LLC
PROJECT NAME Apex Lateral Expansion
PROJECT NUMBER 101-049
PROJECT LOCATION Amsterdam, Ohio
DATE STARTED 9/20/10 **COMPLETED** 9/20/10
GROUND ELEVATION 1226.02 ft **BACKFILL** Excavated Material
EXCAVATION CONTRACTOR Test Boring Services, Inc.
GROUND WATER LEVELS:
EXCAVATION METHOD Excavator
BEFORE CORING Not Applicable
CEC REP JMN **CHECKED BY** LRW
AT END OF EXCAVATION 8.5 ft / Elev 1217.5 ft
NOTES Northing: 280957.41 Easting: 2408332.48
24hrs AFTER EXCAVATION Immediately Backfilled

ELEVATION (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	DEPTH (ft)	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	POCKET PEN. (tsf)	▲ SPT N VALUE ▲ 20 40 60 80 / PL MC LL 20 40 60 80 / ☐ FINES CONTENT (%) ☐ 20 40 60 80
1225		TOPSOIL	0					
		Brown sandy CLAY, some boulders, moist, **(MINE SPOIL)**						
		-- MATERIAL WAS LOGGED BASED ON AUGER CUTTINGS --	5					
1220								
		Black COAL, moist to wet, **(BEDROCK)**						
		Bottom of test pit at 8.5 feet.						

CEC CUSTOM LOG APEX EXPANSION.GPJ CEC GDT 4/4/11

Civil & Environmental Consultants, Inc.
333 Baldwin Road
Pittsburgh, PA 15205

TEST PIT NUMBER TPE-17

CLIENT Apex Environmental, LLC
PROJECT NAME Apex Lateral Expansion
PROJECT NUMBER 101-049
PROJECT LOCATION Amsterdam, Ohio
DATE STARTED 9/20/10 **COMPLETED** 9/20/10
GROUND ELEVATION 1212.81 ft **BACKFILL** Excavated Material
EXCAVATION CONTRACTOR Test Boring Services, Inc.
GROUND WATER LEVELS:
EXCAVATION METHOD Excavator
BEFORE CORING Not Applicable
CEC REP JMN **CHECKED BY** LRW
AT END OF EXCAVATION Dry
NOTES Northing: 280585.80 Easting: 2408798.71
24hrs AFTER EXCAVATION Immediately Backfilled

ELEVATION (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	DEPTH (ft)	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	POCKET PEN. (tsf)	▲ SPT N VALUE ▲ 20 40 60 80 / PL MC LL 20 40 60 80 / ☐ FINES CONTENT (%) ☐ 20 40 60 80
		TOPSOIL	0					
1210		Brown clayey SAND, some rock fragments, some coal fragments, dry to moist, **(MINE SPOIL)** -- MATERIAL WAS LOGGED BASED ON AUGER CUTTINGS --	5					
1205		Tan and gray CLAY, trace sand, trace rock fragments, moist, **(RESIDUAL SOIL)** *Water seeping into excavation at 8 to 8.5 feet*	10					
1200		**Shelby Tube collected from 12 to 14 ft. Recovery 2.0 ft**		ST 1	100			
		Brownish gray SHALE, dry to moist, **(BEDROCK)**	15					
		Bottom of test pit at 17.0 feet.						

TEST PIT NUMBER TPE-18

Civil & Environmental Consultants, Inc.
333 Baldwin Road
Pittsburgh, PA 15205

CLIENT Apex Environmental, LLC
PROJECT NAME Apex Lateral Expansion
PROJECT NUMBER 101-049
PROJECT LOCATION Amsterdam, Ohio
DATE STARTED 9/21/10 **COMPLETED** 9/21/10
GROUND ELEVATION 1231.70 ft **BACKFILL** Excavated Material
EXCAVATION CONTRACTOR Test Boring Services, Inc.
GROUND WATER LEVELS:
EXCAVATION METHOD Excavator
BEFORE CORING Not Applicable
CEC REP JMN **CHECKED BY** LRW
AT END OF EXCAVATION Dry
NOTES Northing: 280253.97 Easting: 2409341.71
24hrs AFTER EXCAVATION Immediately Backfilled

ELEVATION (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	DEPTH (ft)	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	POCKET PEN. (tsf)	▲ SPT N VALUE ▲ 20 40 60 80 / PL MC LL 20 40 60 80 / ☐ FINES CONTENT (%) ☐ 20 40 60 80
		TOPSOIL	0					
1230		Brown and gray sandy CLAY, some rock fragments, dry, **(MINE SPOIL)** -- MATERIAL WAS LOGGED BASED ON AUGER CUTTINGS --	5					
1225			10					
1220		Dark gray CLAY, some rock fragments, some roots, moist to wet, **(RESIDUAL SOIL)** Grayish brown CLAY, moist to wet, **(RESIDUAL SOIL)** **Shelby Tube collected from 12 to 14 ft. Recovery 1.7 ft**	15	ST 1	85			
1215		Tan and gray CLAYSTONE, moist to wet, mottled, **(BEDROCK)** **Shelby Tube collected from 18 to 19.5 ft. Recovery 1.7 ft** Light gray CLAYSTONE, some sand, moist, **(RESIDUAL SOIL)** Bottom of test pit at 18.5 feet.		ST 2	100			

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TEST PIT NUMBER TPE-19

CLIENT Apex Environmental, LLC
PROJECT NAME Apex Lateral Expansion
PROJECT NUMBER 101-049
PROJECT LOCATION Amsterdam, Ohio
DATE STARTED 9/21/10 **COMPLETED** 9/21/10
GROUND ELEVATION 1210.02 ft **BACKFILL** Excavated Material
EXCAVATION CONTRACTOR Test Boring Services, Inc.
GROUND WATER LEVELS:
EXCAVATION METHOD Excavator
BEFORE CORING Not Applicable
CEC REP JMN **CHECKED BY** LRW
AT END OF EXCAVATION Dry
NOTES Northing: 280443.80 Easting: 2410751.41
24hrs AFTER EXCAVATION Immediately Backfilled

ELEVATION (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	DEPTH (ft)	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	POCKET PEN. (tsf)	▲ SPT N VALUE ▲ 20 40 60 80 / PL MC LL 20 40 60 80 / ☐ FINES CONTENT (%) ☐ 20 40 60 80
1210		TOPSOIL	0					
		Brown silty FINE SAND, trace clay, some rock fragments, dry to moist, **(RESIDUAL SOIL)**						
		Shelby Tube collected from 2 to 4 ft. Recovery 1.7 ft		ST 1	85			
		-- MATERIAL WAS LOGGED BASED ON AUGER CUTTINGS --						
1205			5					
		Brown SHALY SANDSTONE, trace clay, dry to moist, **(BEDROCK)**						
		Bottom of test pit at 8.5 feet.						

CEC CUSTOM LOG APEX EXPANSION.GPJ CEC GDT 4/4/11

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TEST PIT NUMBER TPE-20

CLIENT Apex Environmental, LLC
PROJECT NAME Apex Lateral Expansion
PROJECT NUMBER 101-049
PROJECT LOCATION Amsterdam, Ohio
DATE STARTED 9/21/10 **COMPLETED** 9/21/10
GROUND ELEVATION 1224.49 ft **BACKFILL** Excavated Material
EXCAVATION CONTRACTOR Test Boring Services, Inc.
GROUND WATER LEVELS:
EXCAVATION METHOD Excavator
BEFORE CORING Not Applicable
CEC REP JMN **CHECKED BY** LRW
AT END OF EXCAVATION Dry
NOTES Northing: 280444.13 Easting: 2410673.77
24hrs AFTER EXCAVATION Immediately Backfilled

ELEVATION (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	DEPTH (ft)	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	POCKET PEN. (tsf)	▲ SPT N VALUE ▲ 20 40 60 80 / PL MC LL 20 40 60 80 / ☐ FINES CONTENT (%) ☐ 20 40 60 80
		TOPSOIL	0					
		Brown sandy CLAY, some rock fragments, some coal fragments, dry to moist, **(MINE SPOIL)** -- MATERIAL WAS LOGGED BASED ON AUGER CUTTINGS --						
1220		Brown clayey FINE SAND, some rock fragments, dry to moist, **(RESIDUAL SOIL)**	5					
		Dark gray to black decomposed COAL AND SHALE FRAGMENTS, dry, **(BEDROCK)** Tan and gray CLAYSTONE, moist, **(BEDROCK)**						
1215		Reddish brown clayey SHALE, some sand, some clay, moist to wet, **(BEDROCK)**	10					
		Brownish gray clayey SHALE, some clay, moist to wet, **(BEDROCK)**						
1210			15					
		Bottom of test pit at 16.0 feet.						

CEC CUSTOM LOG APEX EXPANSION.GPJ CEC.GDT 4/4/11

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TEST PIT NUMBER TPE-21

CLIENT Apex Environmental, LLC
PROJECT NAME Apex Lateral Expansion
PROJECT NUMBER 101-049
PROJECT LOCATION Amsterdam, Ohio
DATE STARTED 9/22/10 **COMPLETED** 9/22/10
GROUND ELEVATION 1219.66 ft **BACKFILL** Excavated Material
EXCAVATION CONTRACTOR Test Boring Services, Inc.
GROUND WATER LEVELS:
EXCAVATION METHOD Excavator
BEFORE CORING Not Applicable
CEC REP JMN **CHECKED BY** LRW
AT END OF EXCAVATION 10.0 ft / Elev 1209.7 ft
NOTES Northing: 280942.89 Easting: 2410704.30
24hrs AFTER EXCAVATION Immediately Backfilled

ELEVATION (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	DEPTH (ft)	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	POCKET PEN (tsf)	▲ SPT N VALUE ▲ 20 40 60 80 / PL MC LL 20 40 60 80 / ☐ FINES CONTENT (%) ☐ 20 40 60 80
		TOPSOIL	0					
		Reddish brown and tan CLAY, some boulders, moist, **(MINE SPOIL)**						
		Tan and gray CLAY, moist, **(RESIDUAL SOIL)**		ST 1	100			
		Shelby Tube collected from 2 to 4 ft. Recovery 2.0 ft						
1215		Reddish brown clayey SHALE, some sand, some clay, moist to wet, **(BEDROCK)**	5					
		Brownish gray clayey SHALE, some clay, moist to wet, **(BEDROCK)**						
		-- MATERIAL WAS LOGGED BASED ON AUGER CUTTINGS --						
1210		▼ Brownish gray SHALE, dry to moist, **(BEDROCK)**	10					
		Bottom of test pit at 10.0 feet.						

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TEST PIT NUMBER TPE-22

CLIENT Apex Environmental, LLC
PROJECT NAME Apex Lateral Expansion
PROJECT NUMBER 101-049
PROJECT LOCATION Amsterdam, Ohio
DATE STARTED 9/22/10 **COMPLETED** 9/22/10
GROUND ELEVATION 1231.85 ft **BACKFILL** Excavated Material
EXCAVATION CONTRACTOR Test Boring Services, Inc.
GROUND WATER LEVELS:
EXCAVATION METHOD Excavator
BEFORE CORING Not Applicable
CEC REP JMN **CHECKED BY** LRW
AT END OF EXCAVATION Dry
NOTES Northing: 281164.84 Easting: 2410911.54
24hrs AFTER EXCAVATION Immediately Backfilled

ELEVATION (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	DEPTH (ft)	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	POCKET PEN (tsf)	▲ SPT N VALUE ▲ 20 40 60 80 / PL MC LL 20 40 60 80 / ☐ FINES CONTENT (%) ☐ 20 40 60 80
		TOPSOIL	0					
1230		Brown clayey FINE SAND, trace rock fragments, dry to moist, **(RESIDUAL SOIL)**						
		Bag sample collected from 2.0 to 3.0 ft						
		Tan and light gray CLAY, some sand, moist, **(RESIDUAL SOIL)**						
		Brown SHALY SANDSTONE, moist to dry, **(BEDROCK)**	5					
		Brown clayey SHALE, moist to wet, **(BEDROCK)**						
1225		*water seeping into test pit at 6.5 feet*						
		Reddish brown clayey SHALE, moist to wet, **(BEDROCK)**						
		Brownish gray clayey SHALE, moist to wet, **(BEDROCK)**	10					
		Tan and gray clayey LIMESTONE, moist to wet, **(BEDROCK)**						
1220		-- MATERIAL WAS LOGGED BASED ON AUGER CUTTINGS --						
		Bottom of test pit at 13.0 feet.						

CEC CUSTOM LOG APEX EXPANSION GPJ CEC GDT 4/4/11

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TEST PIT NUMBER TPE-23/24

CLIENT Apex Environmental, LLC
PROJECT NAME Apex Lateral Expansion
PROJECT NUMBER 101-049
PROJECT LOCATION Amsterdam, Ohio
DATE STARTED 9/22/10 **COMPLETED** 9/22/10
GROUND ELEVATION 1220.98 ft **BACKFILL** Excavated Material
EXCAVATION CONTRACTOR Test Boring Services, Inc.
GROUND WATER LEVELS:
EXCAVATION METHOD Excavator
BEFORE CORING Not Applicable
CEC REP JMN **CHECKED BY** LRW
AT END OF EXCAVATION 12.0 ft / Elev 1209.0 ft
NOTES Northing: 280657.59 Easting: 2411065.31
24hrs AFTER EXCAVATION Immediately Backfilled

ELEVATION (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	DEPTH (ft)	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	POCKET PEN. (tsf)	▲ SPT N VALUE ▲ 20 40 60 80 / PL MC LL 20 40 60 80 / ☐ FINES CONTENT (%) ☐ 20 40 60 80
		TOPSOIL	0					
1220		Brown clayey FINE SAND, some rock fragments, dry, **(RESIDUAL SOIL)**						
		Reddish brown clayey SHALE, moist to wet, **(BEDROCK)**						
		Brownish gray clayey SHALE, moist to wet, **(BEDROCK)**	5					
		-- MATERIAL WAS LOGGED BASED ON AUGER CUTTINGS --						
1215								
			10					
1210								
		becomes medium hard at 12.0 ft						
		Bottom of test pit at 12.0 feet.						

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TEST PIT NUMBER TPE-25

CLIENT Apex Environmental, LLC
PROJECT NAME Apex Lateral Expansion
PROJECT NUMBER 101-049
PROJECT LOCATION Amsterdam, Ohio
DATE STARTED 9/22/10 **COMPLETED** 9/22/10
GROUND ELEVATION 1206.75 ft **BACKFILL** Excavated Material
EXCAVATION CONTRACTOR Test Boring Services, Inc.
GROUND WATER LEVELS:
EXCAVATION METHOD Excavator
BEFORE CORING Not Applicable
CEC REP JMN **CHECKED BY** LRW
AT END OF EXCAVATION Dry
NOTES Northing: 280230.14 Easting: 2411100.26
24hrs AFTER EXCAVATION Immediately Backfilled

ELEVATION (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	DEPTH (ft)	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	POCKET PEN. (tsf)	▲ SPT N VALUE ▲ 20 40 60 80 / PL MC LL 20 40 60 80 / ☐ FINES CONTENT (%) ☐ 20 40 60 80
		TOPSOIL	0					
1205		Brown clayey FINE SAND, some rock fragments, dry to moist, **(RESIDUAL SOIL)**						
		Bag sample collected from 2.0 to 2.5 ft						
		-- MATERIAL WAS LOGGED BASED ON AUGER CUTTINGS --	5					
		Brown clayey SANDY SHALE, dry to moist, **(BEDROCK)**						
1200								
		Black SHALY SANDSTONE, dry, **(BEDROCK)**	10					
		Bottom of test pit at 10.0 feet.						

CEC CUSTOM LOG APEX EXPANSION.GPJ CEC.GDT 4/4/11

BORING NUMBER RB-1

Civil & Environmental Consultants, Inc.
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Pittsburgh, PA 15205

CLIENT Apex Environmental, LLC
PROJECT NAME Apex Lateral Expansion
PROJECT NUMBER 101-049
PROJECT LOCATION Amsterdam, Ohio
DATE STARTED 8/4/10 **COMPLETED** 8/4/10
GROUND ELEVATION 1244.84 ft **BACKFILL** bentonite
DRILLING CONTRACTOR Test Boring Services, Inc.
GROUND WATER LEVELS:
DRILLING METHOD Hollow Stem Auger
BEFORE CORING Not Applicable
CEC REP LRW **CHECKED BY** JMN
AT END OF DRILLING Dry
NOTES Northing: 281021.15 Easting: 2408146.67
AFTER DRILLING Immediately Backfilled

ELEVATION (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	DEPTH (ft)	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	POCKET PEN. (tsf)	▲ SPT N VALUE ▲ 20 40 60 80 / PL MC LL 20 40 60 80 / ☐ FINES CONTENT (%) ☐ 20 40 60 80
		-- MATERIAL WAS LOGGED BASED ON AUGER CUTTINGS --	0					
		Gray SAND, and gravel, dry, **(MINE SPOIL)**						
1240			5					
		Gray CLAY, some coal, dry, **(MINE SPOIL)**						
		Tan and black CLAY, dry, **(MINE SPOIL)**						
1235			10					
		Tan CLAY, some sand, dry, **(MINE SPOIL)**						
1230			15					
		Bag sample (B-1) collected from 14 to 19 ft						
		Tan silty CLAY, moist, **(MINE SPOIL)**						
1225			20	AU				
		Tan CLAY, moist, **(MINE SPOIL)**						
		Tan CLAY, dry, **(MINE SPOIL)**						
		boulders / cobbles from 24 to 29 ft						
1220			25					

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CEC CUSTOM LOG APEX EXPANSION.GPJ CEC.GDT 4/4/11

Civil & Environmental Consultants, Inc.
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BORING NUMBER RB-1

CLIENT Apex Environmental, LLC **PROJECT NAME** Apex Lateral Expansion

PROJECT NUMBER 101-049 **PROJECT LOCATION** Amsterdam, Ohio

ELEVATION (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	DEPTH (ft)	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	POCKET PEN. (tsf)	▲ SPT N VALUE ▲ 20 40 60 80 / PL MC LL 20 40 60 80 / ☐ FINES CONTENT (%) ☐ 20 40 60 80
		Tan CLAY, dry, **(MINE SPOIL)***(continued)*	25					
1215		Tan CLAY, some sand, trace shale fragments, dry, **(MINE SPOIL)**	30					
		Brown CLAY, dry, **(MINE SPOIL)**						
1210		Brown sandy CLAY, dry, low return, **(MINE SPOIL)**	35					
		Gray CLAY, dry, **(MINE SPOIL)**						
		boulders / cobbles						
		augers scratching at 39 ft						
		Gray LIMESTONE, dry, auger refusal, **(BEDROCK)**						
		Bottom of boring at 39.5 feet.						

CEC CUSTOM LOG APEX EXPANSION GPJ CEC GDT 4/4/11

Civil & Environmental Consultants, Inc.
333 Baldwin Road
Pittsburgh, PA 15205

BORING NUMBER RB-2

CLIENT Apex Environmental, LLC
PROJECT NAME Apex Lateral Expansion
PROJECT NUMBER 101-049
PROJECT LOCATION Amsterdam, Ohio
DATE STARTED 8/4/10 **COMPLETED** 8/4/10
GROUND ELEVATION 1267.57 ft **BACKFILL** bentonite
DRILLING CONTRACTOR Test Boring Services, Inc.
GROUND WATER LEVELS:
DRILLING METHOD Hollow Stem Auger
BEFORE CORING Not Applicable
CEC REP LRW **CHECKED BY** JMN
AT END OF DRILLING Dry
NOTES Northing: 280741.50 Easting: 2407926.19
AFTER DRILLING Immediately Backfilled

ELEVATION (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	DEPTH (ft)	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	POCKET PEN. (tsf)	▲ SPT N VALUE ▲ 20 40 60 80 / PL MC LL 20 40 60 80 / ☐ FINES CONTENT (%) ☐ 20 40 60 80
		-- MATERIAL WAS LOGGED BASED ON AUGER CUTTINGS --	0					
1265		Brown CLAY, some silt, dry, **(MINE SPOIL)**	5					
1260			10					
1255			15	AU				
1250			20					
1245			25					

CEC CUSTOM LOG APEX EXPANSION.GPJ CEC.GDT 4/4/11

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Civil & Environmental Consultants, Inc.
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BORING NUMBER RB-2

CLIENT Apex Environmental, LLC
PROJECT NAME Apex Lateral Expansion
PROJECT NUMBER 101-049
PROJECT LOCATION Amsterdam, Ohio

ELEVATION (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	DEPTH (ft)	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	POCKET PEN. (tsf)	▲ SPT N VALUE ▲ 20 40 60 80 / PL MC LL 20 40 60 80 / ☐ FINES CONTENT (%) ☐ 20 40 60 80
1240		Brown CLAY, some silt, dry, **(MINE SPOIL)**	25					
		Gray LIMESTONE, dry, **(RESIDUAL SOIL)**						
		Gray LIMESTONE, dry, auger refusal, **(BEDROCK)**	30					
		Bottom of boring at 30.0 feet.						

CEC CUSTOM LOG APEX EXPANSION GPJ CEC GDT 4/4/11

Civil & Environmental Consultants, Inc.
333 Baldwin Road
Pittsburgh, PA 15205

BORING NUMBER RB-3

CLIENT Apex Environmental, LLC
PROJECT NAME Apex Lateral Expansion
PROJECT NUMBER 101-049
PROJECT LOCATION Amsterdam, Ohio
DATE STARTED 8/6/10 **COMPLETED** 8/6/10
GROUND ELEVATION 1288.49 ft **BACKFILL** bentonite
DRILLING CONTRACTOR Test Boring Services, Inc.
GROUND WATER LEVELS:
DRILLING METHOD Hollow Stem Auger
BEFORE CORING Not Applicable
CEC REP LRW **CHECKED BY** JMN
AT END OF DRILLING Dry
NOTES Northing: 281535.77 Easting: 2408495.14
AFTER DRILLING Immediately Backfilled

ELEVATION (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	DEPTH (ft)	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	POCKET PEN. (tsf)	▲ SPT N VALUE ▲ 20 40 60 80 / PL MC LL 20 40 60 80 / ☐ FINES CONTENT (%) ☐ 20 40 60 80
		-- MATERIAL WAS LOGGED BASED ON AUGER CUTTINGS --	0					
		Brown gravelly CLAY, some silt, some limestone, dry, **(MINE SPOIL)**						
1285			5					
1280			10					
1275			15					
		Brown CLAY, dry, **(RESIDUAL SOIL)**						
1270		Gray sandy CLAY, dry, **(RESIDUAL SOIL)**	20					
1265		**Bag sample (B-1) collected from 20 to 24 ft**						
		Low return to 25 ft	25	AU				

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CEC CUSTOM LOG APEX EXPANSION.GPJ CEC.GDT 4/4/11

Civil & Environmental Consultants, Inc.
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BORING NUMBER RB-3

CLIENT Apex Environmental, LLC **PROJECT NAME** Apex Lateral Expansion

PROJECT NUMBER 101-049 **PROJECT LOCATION** Amsterdam, Ohio

ELEVATION (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	DEPTH (ft)	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	POCKET PEN. (tsf)	▲ SPT N VALUE ▲ 20 40 60 80 / PL MC LL 20 40 60 80 / ☐ FINES CONTENT (%) ☐ 20 40 60 80
		Brown silty CLAY, trace limestone fragments, moist, **(RESIDUAL SOIL)**	25					
		Gray SHALE, trace limestone fragments, dry, **(RESIDUAL SOIL)**						
1260			30					
1255			35					
		Brown silty CLAY, dry, **(RESIDUAL SOIL)**						
1250		Gray SHALE, dry, **(RESIDUAL SOIL)**	40					
		Gray SHALE, some limestone fragments, dry, **(RESIDUAL SOIL)**						
1245		*Noticed no sand or silt*						
		Low return at 45 ft	45					
		Gray SHALE, some sand, moist, **(RESIDUAL SOIL)**						
		Gray LIMESTONE, dry, **(RESIDUAL SOIL)**						
1240								
		Gray LIMESTONE, dry, auger refusal, **(BEDROCK)**						
		Bottom of boring at 49.5 feet.						

CEC CUSTOM LOG APEX EXPANSION.GPJ CEC.GDT 4/4/11

Civil & Environmental Consultants, Inc.
333 Baldwin Road
Pittsburgh, PA 15205

BORING NUMBER RB-4

CLIENT Apex Environmental, LLC
PROJECT NAME Apex Lateral Expansion
PROJECT NUMBER 101-049
PROJECT LOCATION Amsterdam, Ohio
DATE STARTED 8/5/10 **COMPLETED** 8/5/10
GROUND ELEVATION 1228.58 ft **BACKFILL** bentonite
DRILLING CONTRACTOR Test Boring Services, Inc.
GROUND WATER LEVELS:
DRILLING METHOD Hollow Stem Auger
BEFORE CORING Not Applicable
CEC REP LRW **CHECKED BY** JMN
AT END OF DRILLING 24.5 ft / Elev 1204.1 ft
NOTES Northing: 280669.39 Easting: 2408867.52
AFTER DRILLING Immediately Backfilled

ELEVATION (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	DEPTH (ft)	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	POCKET PEN. (tsf)	▲ SPT N VALUE ▲ 20 40 60 80 / PL MC LL 20 40 60 80 / ☐ FINES CONTENT (%) ☐ 20 40 60 80
		-- MATERIAL WAS LOGGED BASED ON AUGER CUTTINGS --	0					
		Brown CLAY, some silt, some sand, moist, possible residual, **(RESIDUAL SOIL)**						
1225			5					
1220			10	AU				
1215			15					
1210		Gray CLAY, some sand, dry to wet, medium plasticity, **(RESIDUAL SOIL)**	20					
1205		**Bag sample (B-1) collected from 19 to 24 ft**						
		▼ Auger refusal						
		Bottom of boring at 24.5 feet.						

CEC CUSTOM LOG APEX EXPANSION.GPJ CEC.GDT 4/4/11

Civil & Environmental Consultants, Inc.
333 Baldwin Road
Pittsburgh, PA 15205

BORING NUMBER RB-5

CLIENT Apex Environmental, LLC
PROJECT NAME Apex Lateral Expansion
PROJECT NUMBER 101-049
PROJECT LOCATION Amsterdam, Ohio
DATE STARTED 8/4/10 **COMPLETED** 8/4/10
GROUND ELEVATION 1256.50 ft **BACKFILL** bentonite
DRILLING CONTRACTOR Test Boring Services, Inc.
GROUND WATER LEVELS:
DRILLING METHOD Hollow Stem Auger
BEFORE CORING Not Applicable
CEC REP LRW **CHECKED BY** JMN
AT END OF DRILLING Dry
NOTES Northing: 281373.78 Easting: 2409105.92
AFTER DRILLING Immediately Backfilled

ELEVATION (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	DEPTH (ft)	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	POCKET PEN. (tsf)	▲ SPT N VALUE ▲ 20 40 60 80 / PL MC LL 20 40 60 80 / ☐ FINES CONTENT (%) ☐ 20 40 60 80
		-- MATERIAL WAS LOGGED BASED ON AUGER CUTTINGS --	0					
1255		Tan clayey SILT, some sand, some shale fragments, dry, **(MINE SPOIL)**						
		Gray CLAY, and shale fragments, dry, **(MINE SPOIL)**	5					
1250								
			10	AU				
1245								
			15					
1240		*Augers Scratching. No Return. Possible weathered limestone.*						
		Gray LIMESTONE, dry, auger refusal, **(BEDROCK)**	20					
		Bottom of boring at 20.0 feet.						

CEC CUSTOM LOG APEX EXPANSION.GPJ CEC.GDT 4/4/11

Civil & Environmental Consultants, Inc.
333 Baldwin Road
Pittsburgh, PA 15205

BORING NUMBER RB-6

CLIENT Apex Environmental, LLC
PROJECT NAME Apex Lateral Expansion
PROJECT NUMBER 101-049
PROJECT LOCATION Amsterdam, Ohio
DATE STARTED 8/27/10 **COMPLETED** 8/27/10
GROUND ELEVATION 1268.91 ft **BACKFILL** bentonite
DRILLING CONTRACTOR Test Boring Services, Inc.
GROUND WATER LEVELS:
DRILLING METHOD Hollow Stem Auger
BEFORE CORING Not Applicable
CEC REP LRW **CHECKED BY** JMN
AT END OF DRILLING Dry
NOTES Northing: 280895.78 Easting: 2409701.34
AFTER DRILLING Immediately Backfilled

ELEVATION (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	DEPTH (ft)	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	POCKET PEN. (tsf)	▲ SPT N VALUE ▲ 20 40 60 80 / PL MC LL 20 40 60 80 / ☐ FINES CONTENT (%) ☐ 20 40 60 80
		-- MATERIAL WAS LOGGED BASED ON AUGER CUTTINGS --	0					
		Gray SAND, and gravel, dry, **(MINE SPOIL)**						
1265		Gray LIMESTONE, dry, **(MINE SPOIL)**						
		Brown silty SAND, trace gravel, dry, **(MINE SPOIL)**	5					
1260								
		Bag sample (B-1) collected from 10 to 13 ft	10	AU				
		Gray SAND, and silt, some gravel, dry, **(MINE SPOIL)**						
1255			15					
		Gray LIMESTONE, dry, **(MINE SPOIL)**						
1250		SAND, dry, **(MINE SPOIL)**						
		Gray LIMESTONE, dry, auger refusal, **(MINE SPOIL)**	20					
		Bottom of boring at 20.0 feet.						

CEC CUSTOM LOG APEX EXPANSION.GPJ CEC.GDT 4/4/11

Civil & Environmental Consultants, Inc.
333 Baldwin Road
Pittsburgh, PA 15205

BORING NUMBER RB-7

CLIENT Apex Environmental, LLC
PROJECT NAME Apex Lateral Expansion
PROJECT NUMBER 101-049
PROJECT LOCATION Amsterdam, Ohio
DATE STARTED 8/27/10 **COMPLETED** 8/27/10
GROUND ELEVATION 1271.60 ft **BACKFILL** bentonite
DRILLING CONTRACTOR Test Boring Services, Inc.
GROUND WATER LEVELS:
DRILLING METHOD Hollow Stem Auger
BEFORE CORING Not Applicable
CEC REP LRW **CHECKED BY** JMN
AT END OF DRILLING Dry
NOTES Northing: 280651.16 Easting: 2409475.82
AFTER DRILLING Immediately Backfilled

ELEVATION (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	DEPTH (ft)	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	POCKET PEN. (tsf)	▲ SPT N VALUE ▲ 20 40 60 80 / PL MC LL 20 40 60 80 / ☐ FINES CONTENT (%) ☐ 20 40 60 80
		Dry, **(TOPSOIL)**	0					
1270		Brown silty SAND, dry, **(MINE SPOIL)**						
		Gray LIMESTONE, dry, **(MINE SPOIL)**						
		Grayish brown to gray SAND, some silt, some gravel, dry, **(MINE SPOIL)**	5					
1265		-- MATERIAL WAS LOGGED BASED ON AUGER CUTTINGS --						
			10					
1260		*Difficult augering from 12 to 14 ft*						
			15					
1255		**Bag sample (B-1) collected from 15 to 20 ft**		AU				
		Increases in silt content as boring progresses	20					
1250								
			25					

(Continued Next Page)

Civil & Environmental Consultants, Inc.
333 Baldwin Road
Pittsburgh, PA 15205

BORING NUMBER RB-7

CLIENT Apex Environmental, LLC **PROJECT NAME** Apex Lateral Expansion

PROJECT NUMBER 101-049 **PROJECT LOCATION** Amsterdam, Ohio

ELEVATION (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	DEPTH (ft)	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	POCKET PEN. (tsf)	▲ SPT N VALUE ▲ 20 40 60 80 / PL MC LL 20 40 60 80 / ☐ FINES CONTENT (%) ☐ 20 40 60 80
		Grayish brown to gray SAND, and silt, some gravel, dry, **(BEDROCK)**	25					
1245			30					
1240			35					
1235		Grayish brown SAND, and gravel, dry, **(BEDROCK)**						
		Gray LIMESTONE, dry, auger refusal, **(BEDROCK)**						
		Bottom of boring at 38.0 feet.						

Civil & Environmental Consultants, Inc.
333 Baldwin Road
Pittsburgh, PA 15205

BORING NUMBER RB-8

CLIENT Apex Environmental, LLC
PROJECT NAME Apex Lateral Expansion
PROJECT NUMBER 101-049
PROJECT LOCATION Amsterdam, Ohio
DATE STARTED 8/30/10 **COMPLETED** 8/30/10
GROUND ELEVATION 1248.16 ft **BACKFILL** bentonite
DRILLING CONTRACTOR Test Boring Services, Inc.
GROUND WATER LEVELS:
DRILLING METHOD Hollow Stem Auger
BEFORE CORING Not Applicable
CEC REP LRW **CHECKED BY** JMN
AT END OF DRILLING 22.0 ft / Elev 1226.2 ft
NOTES Northing: 280700.29 Easting: 2410495.51
AFTER DRILLING Immediately Backfilled

ELEVATION (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	DEPTH (ft)	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	POCKET PEN (tsf)
		(TOPSOIL)	0				
		-- MATERIAL WAS LOGGED BASED ON AUGER CUTTINGS --					
1245		Brown silty CLAY, trace sand, trace rock fragments, dry, **(RESIDUAL SOIL)**	5				
1240							
		Brown silty CLAY, some sandstone fragments, some siltstone fragments, dry, **(RESIDUAL SOIL)**	10				
1235		Brown CLAY, moist-, **(RESIDUAL SOIL)**		AU			
			15				
		Tan CLAY, dry, medium plasticity, **(RESIDUAL SOIL)**					
1230							
		Black COAL, dry, **(RESIDUAL SOIL)**	20				
		Gray to brown FAT CLAY, wet, highly plastic, **(RESIDUAL SOIL)**					
1225		**Bag sample (B-1) collected from 23 to 27 ft**					
			25				

▲ SPT N VALUE ▲
20 40 60 80
PL MC LL
20 40 60 80
☐ FINES CONTENT (%) ☐
20 40 60 80

CEC CUSTOM LOG APEX EXPANSION GPJ CEC GDT 4/4/11

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Civil & Environmental Consultants, Inc.
333 Baldwin Road
Pittsburgh, PA 15205

BORING NUMBER RB-8

CLIENT Apex Environmental, LLC

PROJECT NAME Apex Lateral Expansion

PROJECT NUMBER 101-049

PROJECT LOCATION Amsterdam, Ohio

ELEVATION (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	DEPTH (ft)	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	POCKET PEN. (tsf)	▲ SPT N VALUE ▲ 20 40 60 80 / PL MC LL 20 40 60 80 / ☐ FINES CONTENT (%) ☐ 20 40 60 80
			25					
		Gray LIMESTONE, wet, chattering, augering hard, **(RESIDUAL SOIL)**						
		Gray LIMESTONE, wet, auger refusal, **(BEDROCK)**						
		Bottom of boring at 27.8 feet.						

Civil & Environmental Consultants, Inc.
333 Baldwin Road
Pittsburgh, PA 15205

BORING NUMBER SB-1

CLIENT Apex Environmental, LLC
PROJECT NAME Apex Lateral Expansion
PROJECT NUMBER 101-049
PROJECT LOCATION Amsterdam, Ohio
DATE STARTED 8/6/10 **COMPLETED** 8/10/10
GROUND ELEVATION 1326.69 ft **BACKFILL** bentonite
DRILLING CONTRACTOR Test Boring Services, Inc.
GROUND WATER LEVELS:
DRILLING METHOD Auger/SS
BEFORE CORING Not Applicable
CEC REP LRW **CHECKED BY** JMN
AT END OF DRILLING Dry
NOTES Northing: 282307.37 Easting: 2407944.82
AFTER DRILLING Immediately Backfilled

ELEVATION (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	DEPTH (ft)	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	POCKET PEN. (tsf)
		Gray and brown silty CLAY, and siltstone fragments, and coal, dry, stiff, **(MINE SPOIL)**	0	SS 1	75	6-16-10-4 (26)	
1325				SS 2	35	4-3-6-4 (9)	
		Brown and orange silty CLAY, and siltstone fragments, and coal, dry, stiff, **(MINE SPOIL)**	5	SS 3	85	3-2-3-7 (5)	
1320				SS 4	100	1-2-4-9 (6)	
		Brown and gray CLAY, some sand, trace coal, dry, stiff, **(MINE SPOIL)**		SS 5	100	3-3-4-5 (7)	
			10	SS 6	100	5-5-7-8 (12)	
1315				SS 7	60	2-1-7-7 (8)	
		Brown and orange CLAY, and rock fragments, some coal, dry, stiff, includes wood chips. Medium plasticity., **(MINE SPOIL)**	15	SS 8	100	7-10-4-6 (14)	
1310		**Attempted Shelby Tube. No recovery.**		ST 1	0		
		Brown sandy CLAYSTONE, and shale fragments, trace wood fragments, dry, very stiff, **(MINE SPOIL)**	20	SS 9	50	6-17-16-6 (33)	
		Brown SAND, and coal, some clay, dry, medium stiff, **(MINE SPOIL)**		SS 10	100	2-3-4-4 (7)	
1305		Brown and gray sandy CLAY, some rock fragments, some coal, dry, stiff, **(MINE SPOIL)**		SS 11	65	1-1-4-9 (5)	
			25	SS		10-9-9-11	

▲ SPT N VALUE ▲
20 40 60 80
PL MC LL
20 40 60 80
☐ FINES CONTENT (%) ☐
20 40 60 80

CEC CUSTOM LOG APEX EXPANSION.GPJ CEC.GDT 4/4/11

(Continued Next Page)

Civil & Environmental Consultants, Inc.
333 Baldwin Road
Pittsburgh, PA 15205

BORING NUMBER SB-1

CLIENT Apex Environmental, LLC **PROJECT NAME** Apex Lateral Expansion

PROJECT NUMBER 101-049 **PROJECT LOCATION** Amsterdam, Ohio

ELEVATION (ft)	MATERIAL DESCRIPTION	DEPTH (ft)	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	POCKET PEN (tsf)
	Brown and gray sandy CLAY, some rock fragments, some coal, dry, stiff, **(MINE SPOIL)***(continued)*	25	SS 12	100	(18)	
1300	Brown and gray silty SHALE, some sand, dry, very stiff to stiff, micaceous, **(MINE SPOIL)**		SS 13	100	9-3-10-12 (13)	
		30	SS 14	100	10-8-5-8 (13)	
1295			SS 15	100	4-6-7-7 (13)	
	Gray and orange silty SHALE, some sand, dry, stiff, **(MINE SPOIL)**		SS 16	100	2-1-6-9 (7)	
	Gray, brown and yellow silty CLAY, and shale fragments, trace coal, dry, very stiff, **(MINE SPOIL)**	35	SS 17	100	4-7-9-11 (16)	
1290	Gray SILT, and decomposed siltstone, trace coal, dry, very stiff, **(MINE SPOIL)**		SS 18	100	5-7-17-11 (24)	
	Grayish brown silty CLAY, dry, very stiff, **(MINE SPOIL)**		SS 19	15	1-7-10-11 (17)	
	Gray, brown and orange silty CLAY, trace siltstone fragments, trace coal, dry, stiff to medium stiff, **(MINE SPOIL)**	40	SS 20	100	10-9-8-7 (17)	
1285			SS 21	70	1-1-1-5 (2)	
	Grayish brown silty CLAY, some sand, trace coal, dry, very stiff, **(MINE SPOIL)**	45	SS 22	15	6-13-14-13 (27)	
1280			SS 23	85	13-33-20-16 (53)	
	Gray, brown and orange CLAY, some sand, dry, hard to very stiff, **(MINE SPOIL)**		SS 24	80	6-21-15-22 (36)	
		50	SS 25	100	19-10-11-9 (21)	
1275						
	Gray and brown sandy CLAY, dry, very stiff, **(MINE SPOIL)**		SS 26	90	13-13-9-8 (22)	

▲ SPT N VALUE ▲
20 40 60 80
PL MC LL
20 40 60 80
☐ FINES CONTENT (%) ☐
20 40 60 80

CEC CUSTOM LOG APEX EXPANSION GPJ CEC GDT 4/4/11

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Civil & Environmental Consultants, Inc.
333 Baldwin Road
Pittsburgh, PA 15205

BORING NUMBER SB-1

CLIENT Apex Environmental, LLC **PROJECT NAME** Apex Lateral Expansion

PROJECT NUMBER 101-049 **PROJECT LOCATION** Amsterdam, Ohio

ELEVATION (ft)	MATERIAL DESCRIPTION	DEPTH (ft)	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	POCKET PEN. (tsf)
	Gray, brown and orange SHALE, some sand, some coal, dry, very stiff, **(MINE SPOIL)**	55	SS 27	100	8-9-9-9 (18)	
1270	**No recovery**		SS 28		50/0	
	Gray and brown sandy CLAY, trace coal fragments, dry, stiff to very stiff, **(MINE SPOIL)**		SS 29	100	7-9-7-8 (16)	
	Bag sample (B-1) collected from 58 to 66 ft	60	SS 30	100	10-11-10-19 (21)	
1265			SS 31	100	12-9-9-12 (18)	
		65	SS 32	85	1-1-2-24 (3)	
1260	Gray, brown and orange silty CLAY, trace limestone fragments, dry, hard, **(MINE SPOIL)**		SS 33	100	29-25-37-47 (62)	
	Gray and orange silty CLAY, dry, hard, **(MINE SPOIL)**		SS 34	90	1-1-19-45 (20)	
	Gray SAND, and sandstone fragments, dry, hard, micaceous, **(MINE SPOIL)**	70	SS 35	35	1-10-20-23 (30)	
1255			SS 36	100	50/0.1	
	Gray LIMESTONE, dry, very dense, Auger Refusal, **(BEDROCK)**		SS 37	100	50/0.1	
	Bottom of boring at 74.1 feet.					

▲ SPT N VALUE ▲
20 40 60 80
PL MC LL
20 40 60 80
☐ FINES CONTENT (%) ☐
20 40 60 80

50/0

50/0.1

50/0.1

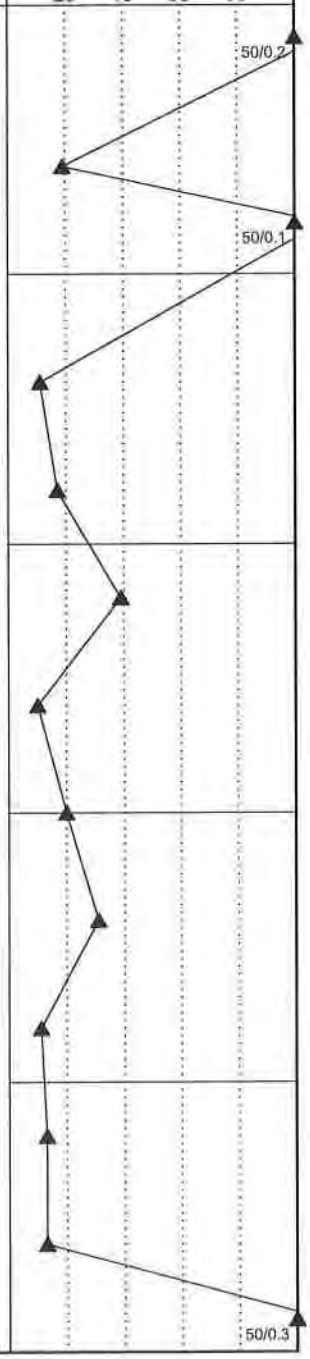
BORING NUMBER SB-2

Civil & Environmental Consultants, Inc.
333 Baldwin Road
Pittsburgh, PA 15205

CLIENT Apex Environmental, LLC
PROJECT NAME Apex Lateral Expansion
PROJECT NUMBER 101-049
PROJECT LOCATION Amsterdam, Ohio
DATE STARTED 8/6/10 **COMPLETED** 8/6/10
GROUND ELEVATION 1299.77 ft **BACKFILL** Bentonite
DRILLING CONTRACTOR Test Boring Services, Inc.
GROUND WATER LEVELS:
DRILLING METHOD Auger/SS
BEFORE CORING Not Applicable
CEC REP LRW **CHECKED BY** JMN
AT END OF DRILLING Dry
NOTES Northing: 281896.89 Easting: 2407470.79
AFTER DRILLING Immediately Backfilled

ELEVATION (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	DEPTH (ft)	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	POCKET PEN. (tsf)
		(TOPSOIL)	0				
		Tan clayey SILT, some rock fragments, some dry, hard, **(MINE SPOIL)**		SS 1	100	1-5-50/0.2	
		Brown and gray CLAY, trace rock fragments, dry, very stiff, **(MINE SPOIL)**		SS 2	70	7-11-8-17 (19)	
1295		Gray LIMESTONE, dry, very dense, auger refusal. Offset boring 5.0' south and augered to 6.0', **(MINE SPOIL)**		SS 3	100	50/0.1	
		Tan CLAY, some shale fragments, some sandstone fragments, dry, stiff, **(MINE SPOIL)**	5	SS 4	80	2-6-5-5 (11)	
		Tan and gray CLAY, some limestone fragments, some coal, dry, very stiff to hard, **(MINE SPOIL)**		SS 5	70	8-9-8-7 (17)	
1290			10	SS 6	85	10-25-14-15 (39)	
		Tan and gray sandy CLAY, some rock fragments, some coal, dry, stiff, **(MINE SPOIL)**		SS 7	90	8-5-5-4 (10)	
1285		Gray and orange silty CLAY, dry, very stiff, **(MINE SPOIL)**	15	SS 8	100	5-8-12-19 (20)	
		Gray to brown silty CLAY, some coal, dry, hard to stiff, **(MINE SPOIL)**		SS 9	100	16-9-22-14 (31)	
1280			20	SS 10	100	3-5-6-5 (11)	
		Orangish brown sandy CLAY, some coal, dry, stiff, **(MINE SPOIL)**		SS 11	100	4-5-8-7 (13)	
		Brown and gray CLAYSTONE, dry, stiff to hard, auger refusal, **(MINE SPOIL)**		SS 12	85	8-7-6-13 (13)	
1275			25	SS 13	100	7-50/0.3	

▲ SPT N VALUE ▲ 20 40 60 80
PL MC LL 20 40 60 80
☐ FINES CONTENT (%) ☐ 20 40 60 80



CEC CUSTOM LOG APEX EXPANSION.GPJ CEC.GDT 4/4/11

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Civil & Environmental Consultants, Inc.
333 Baldwin Road
Pittsburgh, PA 15205

BORING NUMBER SB-2

CLIENT Apex Environmental, LLC
PROJECT NAME Apex Lateral Expansion
PROJECT NUMBER 101-049
PROJECT LOCATION Amsterdam, Ohio

ELEVATION (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	DEPTH (ft)	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	POCKET PEN. (tsf)	▲ SPT N VALUE ▲ 20 40 60 80 / PL MC LL 20 40 60 80 / ☐ FINES CONTENT (%) ☐ 20 40 60 80
			25					
		Bottom of boring at 25.1 feet.		SS 14	100	50/0.1		50/0.1

Civil & Environmental Consultants, Inc.
333 Baldwin Road
Pittsburgh, PA 15205

BORING NUMBER SB-3

CLIENT Apex Environmental, LLC
PROJECT NAME Apex Lateral Expansion
PROJECT NUMBER 101-049
PROJECT LOCATION Amsterdam, Ohio
DATE STARTED 8/3/10 **COMPLETED** 8/3/10
GROUND ELEVATION 1281.21 ft **BACKFILL** Bentonite
DRILLING CONTRACTOR Test Boring Services, Inc.
GROUND WATER LEVELS:
DRILLING METHOD Auger/SS
BEFORE CORING Not Applicable
CEC REP LRW **CHECKED BY** JMN
AT END OF DRILLING 46.0 ft / Elev 1235.2 ft
NOTES Northing: 280631.12 Easting: 2407396.42
AFTER DRILLING Immediately Backfilled

ELEVATION (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	DEPTH (ft)	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	POCKET PEN (tsf)
			0				
1280		Gray and brown silty CLAY, some rock fragments, dry, very stiff to stiff, **(MINE SPOIL)**		SS 1	80	1-1-2-19 (3)	
				SS 2	100	27-10-7-5 (17)	
		Gray, brown and orange CLAY, some silt, some coal, dry, very stiff, **(MINE SPOIL)**	5	SS 3	75	9-14-8-9 (22)	
1275		Gray CLAY, and silt, trace rock fragments, dry, stiff, **(MINE SPOIL)**		SS 4	10	3-4-5-10 (9)	
		Dark gray CLAY, dry, stiff, **(MINE SPOIL)**		SS 5	20	5-4-2-7 (6)	
			10				
1270		Gray, brown and black silty CLAY, and shale fragments, trace coal, dry, medium stiff, **(MINE SPOIL)**		SS 6	80	13-4-5-3 (9)	
		Shelby Tube (ST-1) collected from 11.5 to 13.5 from off-set boring. Recovery 1.7 ft		SS 7	65	2-2-3-2 (5)	
			15	SS 8	100	5-4-5-10 (9)	
1265		Gray and brown sandy CLAY, and shale fragments, trace coal, dry, very stiff, **(MINE SPOIL)**		SS 9	100	11-10-13-13 (23)	
				SS 10	100	4-5-5-10 (10)	
			20				
1260		Gray and brown CLAY, and shale fragments, trace coal, dry, stiff, **(MINE SPOIL)**		SS 11	100	10-4-6-3 (10)	
		Bag sample (B-1) obtained from 20 to 34 ft		SS 12	60	14-6-4-6 (10)	
			25	SS		3-20-21-6	

▲ SPT N VALUE ▲
20 40 60 80
PL MC LL
20 40 60 80
☐ FINES CONTENT (%) ☐
20 40 60 80

CEC CUSTOM LOG APEX EXPANSION.GPJ CEC.GDT 4/4/11

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Civil & Environmental Consultants, Inc.
333 Baldwin Road
Pittsburgh, PA 15205

BORING NUMBER SB-3

CLIENT Apex Environmental, LLC **PROJECT NAME** Apex Lateral Expansion

PROJECT NUMBER 101-049 **PROJECT LOCATION** Amsterdam, Ohio

ELEVATION (ft)	MATERIAL DESCRIPTION	DEPTH (ft)	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	POCKET PEN. (tsf)
	Gray SHALE, dry, very stiff, **(MINE SPOIL)**	25	SS 13	100	(41)	
1255			SS 14	0	50/0.1	
	Brown to gray silty SHALE, some clay, trace coal, dry, very stiff, **(MINE SPOIL)**		SS 15	100	10-16-8-19 (24)	
	Gray, tan and orange CLAY, and shale fragments, trace coal, dry, hard, **(MINE SPOIL)**	30	SS 16	100	10-16-50/0.3	
1250	Tan and gray sandy CLAY, and shale fragments, dry, stiff, **(MINE SPOIL)**		SS 17	100	4-4-4-7 (8)	
	Gray, tan and orange sandy CLAY, and shale fragments, trace coal, dry, very stiff, **(MINE SPOIL)**	35	SS 18	100	14-19-10-10 (29)	
1245			SS 19	100	11-13-50 (63)	
		40	SS 20	85	12-8-7-8 (15)	
	Gray LIMESTONE, dry, dense, **(MINE SPOIL)**		SS 21	65	6-11-13-24 (24)	
1240	Gray SHALE, dry, very stiff to hard, **(WEATHERED BEDROCK)**		SS 22	55	1-1-9-16 (10)	
			SS 23	100	37-50/0	
		45				
	Gray LIMESTONE, dry, very dense, auger refusal, **(BEDROCK)** Bottom of boring at 46.1 feet.		SS 24	100	50/0.1	

▲ SPT N VALUE ▲ 20 40 60 80

PL MC LL 20 40 60 80

☐ FINES CONTENT (%) ☐ 20 40 60 80

50/0.1 50/0.3 50/0 50/0.1

CEC CUSTOM LOG APEX EXPANSION.GPJ CEC.GDT 4/4/11

Civil & Environmental Consultants, Inc.
333 Baldwin Road
Pittsburgh, PA 15205

BORING NUMBER SB-4

CLIENT Apex Environmental, LLC
PROJECT NAME Apex Lateral Expansion
PROJECT NUMBER 101-049
PROJECT LOCATION Amsterdam, Ohio
DATE STARTED 8/26/10 **COMPLETED** 8/26/10
GROUND ELEVATION 1287.61 ft **BACKFILL** Bentonite
DRILLING CONTRACTOR Test Boring Services, Inc.
GROUND WATER LEVELS:
DRILLING METHOD Auger/SS
BEFORE CORING Not Applicable
CEC REP LRW **CHECKED BY** JMN
AT END OF DRILLING 47.0 ft / Elev 1240.6 ft
NOTES Northing: 282280.18 Easting: 2407366.15
AFTER DRILLING Immediately Backfilled

ELEVATION (ft)	MATERIAL DESCRIPTION	DEPTH (ft)	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	POCKET PEN (tsf)
	(TOPSOIL)	0				
	Brown SAND, some silt, dry, medium stiff, **(MINE SPOIL)**		SS 1	95	2-3-4-4 (7)	
	Gray to brown CLAY, some sand, some coal, dry, medium stiff, **(MINE SPOIL)**					
1285	Gray and brown silty CLAY, some shale fragments, dry, stiff, **(MINE SPOIL)** **Bag sample collected from 3 to 8 ft**		SS 2	90	9-7-5-4 (12)	
	Gray and orange silty CLAY, some sandstone fragments, dry, medium stiff, **(MINE SPOIL)**	5	SS 3	90	4-5-2-4 (7)	
1280	Gray silty CLAY, with siltstone fragments, some sand, dry, soft, **(MINE SPOIL)**		SS 4	85	5-5-2-2 (7)	
	Tan and gray sandy CLAY, with siltstone fragments, some sand, dry, very stiff, **(MINE SPOIL)**	10	SS 5	65	5-7-6-10 (13)	
	Tan and gray silty CLAY, some sand, trace coal, dry, stiff, **(MINE SPOIL)**		SS 6	90	12-8-9-6 (17)	
1275	Tan and gray silty CLAY, some sand, some sandstone fragments, dry, stiff, micaceous, **(MINE SPOIL)**		SS 7	80	7-6-6-5 (12)	
	Gray, tan and orange CLAY, trace silt, trace coal, dry, hard, micaceous on bottom., **(MINE SPOIL)**	15	SS 8	100	8-8-50/0.2	
1270			SS 9	100	13-34-12-14 (46)	
	Tan and gray silty CLAY, some sand, some sandstone fragments, dry, very stiff, **(MINE SPOIL)**	20	SS 10	95	8-15-11-14 (26)	
	Gray LIMESTONE, dry, dense to medium dense, **(MINE SPOIL)**		SS 11	15	29-35-19-9 (54)	
1265			SS 12	25	12-10-8-6 (18)	
	Gray, tan and brown CLAY, some sand, some coal, dry, stiff, **(MINE SPOIL)**	25	SS		9-5-8-5	

▲ SPT N VALUE ▲
20 40 60 80
PL MC LL
20 40 60 80
☐ FINES CONTENT (%) ☐
20 40 60 80

50/0.2

CEC CUSTOM LOG APEX EXPANSION GPJ CEC GDT 4/4/11

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Civil & Environmental Consultants, Inc.
333 Baldwin Road
Pittsburgh, PA 15205

BORING NUMBER SB-4

CLIENT Apex Environmental, LLC **PROJECT NAME** Apex Lateral Expansion

PROJECT NUMBER 101-049 **PROJECT LOCATION** Amsterdam, Ohio

ELEVATION (ft)	MATERIAL DESCRIPTION	DEPTH (ft)	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	POCKET PEN. (tsf)
	Gray, tan and brown CLAY, some sand, some coal, dry, stiff, **(MINE SPOIL)***(continued)*	25	SS 13	85	(13)	
1260	Gray, tan and orange sandy CLAY, some rock fragments, dry, stiff, **(MINE SPOIL)**		SS 14	95	10-5-8-4 (13)	
	Shelby Tube collected from 28 to 30 ft. Recovery 1.6 ft	30	ST 1	75		
			SS 15	100	5-5-5-4 (10)	
1255	Brown and gray silty CLAY, some limestone fragments, some sandstone fragments, dry, very stiff, **(MINE SPOIL)**		SS 16	100	11-18-26-12 (44)	
	Gray sandy SHALE, dry, hard, micaceous, **(MINE SPOIL)**					
	Tan and gray CLAY, trace sandstone fragments, dry, very stiff, micaceous on bottom., **(MINE SPOIL)**	35	SS 17	100	10-8-8-9 (16)	
	Gray, tan and orange sandy CLAY, some sandstone fragments, some coal, dry, stiff, micaceous in middle., **(MINE SPOIL)**		SS 18	100	7-6-7-8 (13)	
1250			SS 19	80	7-7-4-6 (11)	
		40	SS 20	75	5-14-10-22 (24)	
1245	Gray, tan and orange sandy CLAY, some limestone fragments, some coal, dry, stiff to hard, **(MINE SPOIL)**		SS 21	80	12-29-29-36 (58)	
	Gray, tan and orange sandy CLAY, some limestone fragments, some sandstone fragments, wet, hard, **(MINE SPOIL)**	45	SS 22	75	21-23-14-42 (37)	
	Gray SHALE, some limestone fragments, some sandstone fragments, wet, hard, **(MINE SPOIL)**		SS 23	20	50	
	Gray LIMESTONE, wet, very dense, auger refusal, **(BEDROCK)**		SS 24	100	50/0.1	
	Bottom of boring at 47.6 feet.					

▲ SPT N VALUE ▲ (20 40 60 80)

PL MC LL (20 40 60 80)

☐ FINES CONTENT (%) ☐ (20 40 60 80)

50/0.1

CEC CUSTOM LOG APEX EXPANSION GPJ CEC GDT 4/4/11

Civil & Environmental Consultants, Inc.
333 Baldwin Road
Pittsburgh, PA 15205

BORING NUMBER SB-5

CLIENT Apex Environmental, LLC
PROJECT NAME Apex Lateral Expansion
PROJECT NUMBER 101-049
PROJECT LOCATION Amsterdam, Ohio
DATE STARTED 8/3/10 **COMPLETED** 8/3/10
GROUND ELEVATION 1282.17 ft **BACKFILL** Bentonite
DRILLING CONTRACTOR Test Boring Services, Inc.
GROUND WATER LEVELS:
DRILLING METHOD Auger/SS
BEFORE CORING Not Applicable
CEC REP LRW **CHECKED BY** JMN
AT END OF DRILLING Dry
NOTES Northing: 280225.62 Easting: 2407611.22
AFTER DRILLING Immediately Backfilled

ELEVATION (ft)	MATERIAL DESCRIPTION	DEPTH (ft)	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	POCKET PEN. (tsf)
	Brown SAND, and silt, dry, loose, **(MINE SPOIL)**	0	SS 1	70	2-3-3-5 (6)	
1280	Tan silty CLAY, some sand, some coal, dry, very stiff, **(MINE SPOIL)**		SS 2	100	13-10-7-7 (17)	
		5	SS 3	100	6-6-12-8 (18)	
	Gray and orange decomposed SILTSTONE, trace sand, dry, stiff, micaceous, **(MINE SPOIL)**		SS 4	80	4-5-5-6 (10)	
1275			SS 5	90	6-8-5-5 (13)	
		10	SS 6	100	6-50/0.3	
	Gray and orange clayey SILT, some sand, trace coal, dry, hard, **(MINE SPOIL)**					
1270	Brown clayey SAND, some shale fragments, some rock fragments, dry, dense, **(MINE SPOIL)**		SS 7	100	48-14-23-40 (37)	
	Gray LIMESTONE, dry, very dense, **(MINE SPOIL)**					
	Gray, brown and black CLAY, some sand, trace coal, dry, very stiff to hard, **(MINE SPOIL)**	15	SS 8	80	6-6-8-8 (14)	
1265			SS 9	100	6-5-18-50 (23)	
	Gray sandy CLAYSTONE, and siltstone fragments, dry, hard, **(MINE SPOIL)**	20	SS 10	100	28-41-37-50 (78)	
	Gray decomposed SILTSTONE, and decomposed sandstone, dry, very dense, **(RESIDUAL SOIL)**		SS 11	5	50	
1260	Gray SANDSTONE, dry, medium dense, micaceous, **(RESIDUAL SOIL)**		SS 12	10	7-6-5-5 (11)	
	Gray SILTSTONE, dry, very dense, **(BEDROCK)**	25	SS 13	100	50/0.1	

▲ SPT N VALUE ▲
20 40 60 80
PL MC LL
20 40 60 80
☐ FINES CONTENT (%) ☐
20 40 60 80

50/0.3

50/0.1

CEC CUSTOM LOG APEX EXPANSION.GPJ CEC.GDT 4/4/11

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Civil & Environmental Consultants, Inc.
333 Baldwin Road
Pittsburgh, PA 15205

BORING NUMBER SB-5

CLIENT Apex Environmental, LLC
PROJECT NAME Apex Lateral Expansion
PROJECT NUMBER 101-049
PROJECT LOCATION Amsterdam, Ohio

ELEVATION (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	DEPTH (ft)	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	POCKET PEN. (tsf)	▲ SPT N VALUE ▲ 20 40 60 80 / PL MC LL 20 40 60 80 / ☐ FINES CONTENT (%) ☐ 20 40 60 80
		Gray SILTSTONE, dry, very dense, **(BEDROCK)***(continued)*	25					
1255				SS 14	0	50/0.1		50/0.1
		Gray LIMESTONE, dry, very dense, **(BEDROCK)**		SS 15	100	50/0.4		50/0.4
			30					
		Tan and orange decomposed CLAYSTONE, some shale fragments, dry, very stiff, **(BEDROCK)**		SS 16	100	8-10-50/0.2		50/0.2
		Gray SILTSTONE, dry, very dense, auger refusal, **(BEDROCK)**						
		Bottom of boring at 31.2 feet.						

CEC CUSTOM LOG APEX EXPANSION GPJ CEC GDT 4/4/11

Civil & Environmental Consultants, Inc.
333 Baldwin Road
Pittsburgh, PA 15205

BORING NUMBER SB-6

CLIENT Apex Environmental, LLC
PROJECT NAME Apex Lateral Expansion
PROJECT NUMBER 101-049
PROJECT LOCATION Amsterdam, Ohio
DATE STARTED 8/2/10 **COMPLETED** 8/2/10
GROUND ELEVATION 1278.34 ft **BACKFILL** Bentonite
DRILLING CONTRACTOR Test Boring Services, Inc.
GROUND WATER LEVELS:
DRILLING METHOD Auger/SS
BEFORE CORING Not Applicable
CEC REP LRW **CHECKED BY** JMN
AT END OF DRILLING Dry
NOTES Northing: 280514.28 Easting: 2408121.68
AFTER DRILLING Immediately Backfilled

ELEVATION (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	DEPTH (ft)	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	POCKET PEN (tsf)
		Brown to gray sandy CLAY, and silt, some shale fragments, moist to dry, medium stiff to stiff, **(MINE SPOIL)**	0	SS 1	75	3-6-0 (6)	
1275				SS 2	75	1-1-1-1 (2)	
		Brown and gray clayey SILT, trace rock fragments, dry, hard, **(MINE SPOIL)**	5	SS 3	75	2-3-1-5 (4)	
		Brown and gray clayey ROCK FRAGMENTS, some sand, dry, loose, **(MINE SPOIL)**		SS 4	100	1-4-50 (54)	
1270				ST 1	100		
			10	ST 2	100		
		Gray and white silty CLAY, some shale fragments, some rock fragments, dry, medium stiff, **(MINE SPOIL)**		SS 5	65	4-4-4-3 (8)	
		Gray and brown silty CLAY, some shale fragments, some sand, moist, medium stiff, **(MINE SPOIL)**		SS 6	90	3-3-3-2 (6)	
1265		Gray and brown silty CLAY, some rock fragments, moist, medium stiff, **(MINE SPOIL)**	15	SS 7	80	5-11-8-5 (19)	
		Gray and brown silty CLAY, some sand, some rock fragments, moist, stiff to medium stiff, **(MINE SPOIL)**		SS 8	95	4-5-7-7 (12)	
1260				SS 9	80	1-2-4-3 (6)	
		Gray and brown sandy CLAY, some shale fragments, some rock fragments, moist, stiff, **(MINE SPOIL)**	20	SS 10	85	3-6-6-6 (12)	
		Gray and brown clayey SAND, some rock fragments, trace coal, dry, medium dense, **(MINE SPOIL)**		SS 11	75	1-18-18-10 (36)	
1255		Gray and brown sandy SILTSTONE, some clay, some coal, dry, medium dense, **(MINE SPOIL)**	25	SS		4-4-5-8	

▲ SPT N VALUE ▲
20 40 60 80
PL MC LL
20 40 60 80
☐ FINES CONTENT (%) ☐
20 40 60 80

(Continued Next Page)

CEC CUSTOM LOG APEX EXPANSION.GPJ CEC.GDT 4/4/11

Civil & Environmental Consultants, Inc.
333 Baldwin Road
Pittsburgh, PA 15205

BORING NUMBER SB-6

CLIENT Apex Environmental, LLC
PROJECT NAME Apex Lateral Expansion
PROJECT NUMBER 101-049
PROJECT LOCATION Amsterdam, Ohio

ELEVATION (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	DEPTH (ft)	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	POCKET PEN. (tsf)
		Gray and brown sandy SILTSTONE, some clay, some coal, dry, medium dense, **(MINE SPOIL)***(continued)*	25	12	100	(9)	
1250		Brown and orange sandy CLAY, some shale fragments, dry, very stiff, **(MINE SPOIL)**		SS 13	45	4-8-7-9 (15)	
				SS 14	55	1-9-10-13 (19)	
		Gray clayey SAND, dry, medium dense, **(MINE SPOIL)**	30	SS 15	85	6-16-9-7 (25)	
1245				SS 16	55	1-9-9-9 (18)	
		Gray CLAY, and sand, trace coal, dry, very stiff, **(MINE SPOIL)**	35	SS 17	100	17-15-8-9 (23)	
		Brown to gray sandy CLAY, and shale fragments, dry, hard, **(MINE SPOIL)**		SS 18	100	7-7-13-28 (20)	
1240		Gray clayey SANDSTONE, with clay, dry, very stiff, **(MINE SPOIL)**		SS 19	60	1-12-12-9 (24)	
		Orangish gray sandy CLAY, dry, hard, **(MINE SPOIL)**	40	SS 20	100	50/0.1	
		Gray SILTSTONE, dry, hard, **(BEDROCK)**		SS 21	100	21-50/0.1	
1235				SS 22	100	50/0.1	
		VOID(46.0'-49.5' Rods dropped under weight of hammer)	45				
1230							
		Black CARBONACEOUS SHALE, and coal, dry, hard, **(BEDROCK)**	50	SS 23	75	4-8-14-18 (22)	
				SS 24	29	5-12-50/0.4	
1225							

▲ SPT N VALUE ▲
20 40 60 80
PL MC LL
20 40 60 80
☐ FINES CONTENT (%) ☐
20 40 60 80

50/0.1
50/0.1
50/0.1
50/0.4

CEC CUSTOM LOG APEX EXPANSION GPJ CEC GDT 4/4/11

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Civil & Environmental Consultants, Inc.
333 Baldwin Road
Pittsburgh, PA 15205

BORING NUMBER SB-6

CLIENT Apex Environmental, LLC
PROJECT NAME Apex Lateral Expansion
PROJECT NUMBER 101-049
PROJECT LOCATION Amsterdam, Ohio

ELEVATION (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	DEPTH (ft)	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	POCKET PEN (tsf)	▲ SPT N VALUE ▲ 20 40 60 80 / PL MC LL 20 40 60 80 / ☐ FINES CONTENT (%) ☐ 20 40 60 80
		Dark gray SHALE, trace coal, dry, hard, **(BEDROCK)** *(continued)*		SS 25	100	21-50/0.1		50/0.1
			55					
		Dark gray SILTSTONE, dry, hard, auger refusal, **(BEDROCK)**		SS 26	100	50/0.2		50/0.2
		Bottom of boring at 55.9 feet.						

CEC CUSTOM LOG APEX EXPANSION GPJ CEC GDT 4/4/11

Civil & Environmental Consultants, Inc.
333 Baldwin Road
Pittsburgh, PA 15205

BORING NUMBER SB-7

CLIENT Apex Environmental, LLC
PROJECT NAME Apex Lateral Expansion
PROJECT NUMBER 101-049
PROJECT LOCATION Amsterdam, Ohio
DATE STARTED 8/4/10 **COMPLETED** 8/4/10
GROUND ELEVATION 1236.68 ft **BACKFILL** Bentonite
DRILLING CONTRACTOR Test Boring Services, Inc.
GROUND WATER LEVELS:
DRILLING METHOD Auger/SS
BEFORE CORING Not Applicable
CEC REP LRW **CHECKED BY** JMN
AT END OF DRILLING Dry
NOTES Northing: 281145.14 Easting: 2408480.03
AFTER DRILLING Immediately Backfilled

ELEVATION (ft)	MATERIAL DESCRIPTION	DEPTH (ft)	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	POCKET PEN. (tsf)
	Gray gravelly SAND, some silt, dry, medium dense, **(MINE SPOIL)**	0	SS 1	100	4-10-9-4 (19)	
1235	Orangish tan silty CLAY, some sand, dry, **(MINE SPOIL)**					
	Dark brown SILT, and coal, dry, very stiff, **(MINE SPOIL)**		SS 2	85	15-15-6-4 (21)	
	Orangish tan and gray CLAY, some sand, trace coal, dry, medium stiff to stiff, **(MINE SPOIL)**	5	SS 3	100	4-3-4-6 (7)	
1230			SS 4	100	6-6-6-8 (12)	
	Orangish tan and gray CLAY, some sand, moist, stiff, **(MINE SPOIL)**		SS 5	100	7-7-4-8 (11)	
	Reddish brown clayey SAND, moist, very stiff, **(MINE SPOIL)**	10	SS 6	100	6-9-13-13 (22)	
1225	Orangish tan CLAY, some sand, dry, soft, **(MINE SPOIL)**		SS 7	100	2-2-2-50 (4)	
	Gray LIMESTONE, dry, very dense, auger refusal, **(BEDROCK)**					
	Bottom of boring at 14.0 feet.					

▲ SPT N VALUE ▲
20 40 60 80
PL MC LL
20 40 60 80
☐ FINES CONTENT (%) ☐
20 40 60 80

Civil & Environmental Consultants, Inc.
333 Baldwin Road
Pittsburgh, PA 15205

BORING NUMBER SB-8

CLIENT Apex Environmental, LLC
PROJECT NAME Apex Lateral Expansion
PROJECT NUMBER 101-049
PROJECT LOCATION Amsterdam, Ohio
DATE STARTED 8/25/20 **COMPLETED** 8/25/20
GROUND ELEVATION 1192.29 ft **BACKFILL** Bentonite
DRILLING CONTRACTOR Test Boring Services, Inc.
GROUND WATER LEVELS:
DRILLING METHOD Auger/SS
BEFORE CORING Not Applicable
CEC REP LRW **CHECKED BY** JMN
AT END OF DRILLING Dry
NOTES Northing: 282667.69 Easting: 2408832.86
AFTER DRILLING Immediately Backfilled

ELEVATION (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	DEPTH (ft)	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	POCKET PEN. (tsf)
		Brown SILT, dry, medium stiff, **(RESIDUAL SOIL)**	0				
1190		Tan CLAY, some sand, dry, stiff to very stiff, **(RESIDUAL SOIL)** **Shelby Tube collected from 1 to 3 ft. Recovery 2.0.**		SS 1	100	2-6-6-5 (12)	
				SS 2	100	7-8-11-11 (19)	
		Tan silty CLAY, some sandstone fragments, dry, hard, **(RESIDUAL SOIL)**	5	SS 3	100	14-16-50 (66)	
1185		Gray and orange sandy CLAY, some sandstone fragments, dry, hard, micaceous, **(RESIDUAL SOIL)**		SS 4	100	37-30-22-19 (52)	
				SS 5	100	12-44-50/0.1	
		Gray SANDSTONE, dry, very dense, shaley, micaceous, **(BEDROCK)**	10				
				SS 6	10	50	
1180		Gray SANDSTONE, dry, very dense, micaceous, **(BEDROCK)**		SS 7	5	50	
			15	SS 8	100	22-50/0.3	
		Gray SHALE, some sandstone fragments, dry, very dense, **(BEDROCK)**		SS 9	100	48-50/0.1	
1175		Gray SANDSTONE, dry, very dense, **(BEDROCK)**		SS 10	100	50/0.1	
			20	SS 11	100	50/0.1	
		Bottom of boring at 20.1 feet.					

▲ SPT N VALUE ▲
20 40 60 80
PL MC LL
20 40 60 80
☐ FINES CONTENT (%) ☐
20 40 60 80

50/0.1
50/0.3
50/0.1
50/0.1
50/0.1

CEC CUSTOM LOG APEX EXPANSION.GPJ CEC.GDT 4/4/11

Civil & Environmental Consultants, Inc.
333 Baldwin Road
Pittsburgh, PA 15205

BORING NUMBER SB-9

CLIENT Apex Environmental, LLC
PROJECT NAME Apex Lateral Expansion
PROJECT NUMBER 101-049
PROJECT LOCATION Amsterdam, Ohio
DATE STARTED 8/25/10 **COMPLETED** 8/25/10
GROUND ELEVATION 1201.13 ft **BACKFILL** Bentonite
DRILLING CONTRACTOR Test Boring Services, Inc.
GROUND WATER LEVELS:
DRILLING METHOD Auger/SS
BEFORE CORING Not Applicable
CEC REP LRW **CHECKED BY** JMN
AT END OF DRILLING Dry
NOTES Northing: 280349.10 Easting: 2408825.30
AFTER DRILLING Immediately Backfilled

ELEVATION (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	DEPTH (ft)	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	POCKET PEN (tsf)
			0				
1200		Tan CLAY, some sand, trace rock fragments, dry, stiff, **(RESIDUAL SOIL)**		SS 1	75	4-7-7-7 (14)	
		Tan to gray CLAY, some silt, dry, stiff, **(RESIDUAL SOIL)**		SS 2	70	10-8-7-9 (15)	
		Whitish tan CLAY, some sand, dry, very stiff, **(RESIDUAL SOIL)**	5	SS 3	65	7-10-10-12 (20)	
1195				SS 4	75	3-8-9-12 (17)	
		Whitish gray CLAY, some interbedded limestone, dry, hard, **(WEATHERED BEDROCK)**		SS 5	75	18-28-18-25 (46)	
			10	SS 6	100	44-50	
1190		Whitish gray CLAY, some interbedded limestone, dry, very dense, **(BEDROCK)**		SS 7	100	14-50/0.4	
		Whitish gray and orange CLAYSTONE, dry, hard, **(BEDROCK)**					
			15	SS 8	100	25-45-50/0.4	
1185		Whitish gray CLAYSTONE, some sand, dry, hard, **(BEDROCK)**		SS 9	100	16-18-17-50 (35)	
				SS 10	100	50/0.3	
		Auger refusal					
		Bottom of boring at 19.0 feet.					

▲ SPT N VALUE ▲
20 40 60 80
PL MC LL
20 40 60 80
☐ FINES CONTENT (%) ☐
20 40 60 80

50/0.4
50/0.4
50/0.3

CEC CUSTOM LOG APEX EXPANSION GPJ CEC GDT 4/4/11

Civil & Environmental Consultants, Inc.
333 Baldwin Road
Pittsburgh, PA 15205

BORING NUMBER SB-10

CLIENT Apex Environmental, LLC
PROJECT NAME Apex Lateral Expansion
PROJECT NUMBER 101-049
PROJECT LOCATION Amsterdam, Ohio
DATE STARTED 8/10/10 **COMPLETED** 8/11/10
GROUND ELEVATION 1260.88 ft **BACKFILL** Bentonite
DRILLING CONTRACTOR Test Boring Services, Inc.
GROUND WATER LEVELS:
DRILLING METHOD Auger/SS
BEFORE CORING Not Applicable
CEC REP LRW **CHECKED BY** JMN
AT END OF DRILLING 45.0 ft / Elev 1215.9 ft
NOTES Northing: 281515.11 Easting: 2409500.09
AFTER DRILLING Immediately Backfilled

ELEVATION (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	DEPTH (ft)	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	POCKET PEN. (tsf)
			0				
1260		Gray SAND, some gravel, dry, medium dense, **(MINE SPOIL)**		SS 1	35	2-5-10-15 (15)	
		Gray LIMESTONE, some silt, dry, medium dense, **(MINE SPOIL)**		SS 2	15	39-15-14-20 (29)	
		Gray sandy CLAY, some rock fragments, trace coal, dry, very stiff, **(MINE SPOIL)**	5	SS 3	70	17-21-15-6 (36)	
1255		Gray LIMESTONE, some silt, dry, medium dense, **(MINE SPOIL)**		SS 4	10	8-7-9-10 (16)	
		Gray sandy CLAY, some shale fragments, some rock fragments, dry, stiff, **(MINE SPOIL)**		SS 5	55	2-4-4-5 (8)	
			10				
1250		Gray CLAY, some rock fragments, and silt, dry, very stiff, **(MINE SPOIL)**		SS 6	55	6-13-11-11 (24)	
		Gray to brown CLAY, some rock fragments, and silt, dry, stiff, **(MINE SPOIL)**		SS 7	85	4-7-9-6 (16)	
			15	SS 8	90	3-4-3-8 (7)	
1245		Brown SAND, some clay, some rock fragments, moist, dense, **(MINE SPOIL)**		SS 9	55	4-19-28-18 (47)	
		Gray LIMESTONE, dry, medium dense, some chattering, **(MINE SPOIL)**		SS 10	10	18-8-4-4 (12)	
			20				
1240		Brown to gray CLAY, some shale fragments, some rock fragments, dry, stiff, **(MINE SPOIL)**		SS 11	65	6-5-6-8 (11)	
		Gray LIMESTONE, dry, medium dense, **(MINE SPOIL)**		SS 12	15	8-10-10-9 (20)	
			25	SS		6-6-21-10	

▲ SPT N VALUE ▲
20 40 60 80
PL MC LL
20 40 60 80
☐ FINES CONTENT (%) ☐
20 40 60 80

CEC CUSTOM LOG APEX EXPANSION GPJ CEC.GDT 4/4/11

(Continued Next Page)

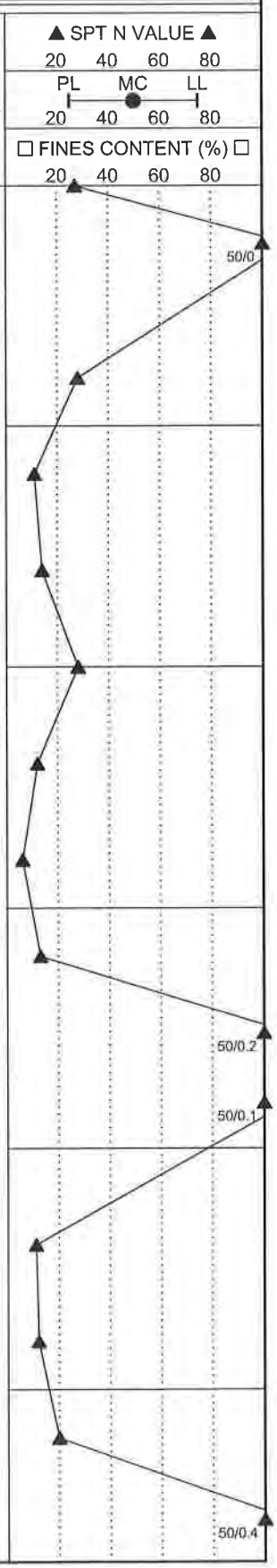
Civil & Environmental Consultants, Inc.
333 Baldwin Road
Pittsburgh, PA 15205

BORING NUMBER SB-10

CLIENT Apex Environmental, LLC **PROJECT NAME** Apex Lateral Expansion

PROJECT NUMBER 101-049 **PROJECT LOCATION** Amsterdam, Ohio

ELEVATION (ft)	MATERIAL DESCRIPTION	DEPTH (ft)	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	POCKET PEN. (tsf)
		25				
1235	Gray LIMESTONE, dry, medium dense, **(MINE SPOIL)** *(continued)*		13	10	(27)	
	Gray silty CLAY, some rock fragments, dry, hard, **(MINE SPOIL)**		SS 14	100	3-50/0	
	Drilling difficult at 28 ft		SS 15	0	6-11-17-19 (28)	
		30				
1230	Dark gray CARBONACEOUS SHALE, some shale fragments, trace coal, dry, stiff, **(MINE SPOIL)**		SS 16	100	6-6-5-6 (11)	
	Brown, tan and black sandy CLAY, some carbonaceous shale, dry, stiff, **(MINE SPOIL)**					
	Gray and brown silty CLAY, some sand, some carbonaceous shale, dry, stiff, **(MINE SPOIL)**		SS 17	75	5-7-7-6 (14)	
	Olive green SAND, dry, very stiff, **(MINE SPOIL)**	35	SS 18	100	6-19-9-7 (28)	
1225	Dark gray SHALE, some silt, dry, very stiff, **(MINE SPOIL)**					
	Black CARBONACEOUS SHALE, some coal, wet, stiff, some olive green sand bands., **(MINE SPOIL)**		SS 19	75	6-7-5-4 (12)	
	Gray, tan and orange sandy CLAY, some shale fragments, some coal, dry to wet, medium stiff, **(MINE SPOIL)**		SS 20	100	6-3-3-9 (6)	
		40				
1220	Tan, orange and black silty CLAY, some carbonaceous shale, some coal, dry, stiff, **(MINE SPOIL)**		SS 21	65	4-6-7-7 (13)	
	Tan and gray silty CLAY, moist, hard, **(MINE SPOIL)**		SS 22	100	7-10-50/0.2	
	Gray LIMESTONE, wet, very dense, **(WEATHERED BEDROCK)**		SS 23	100	50/0.1	
		45				
1215	Tan, gray, white and black SHALE, some shale fragments, wet, stiff, **(WEATHERED BEDROCK)**		SS 24	60	3-6-5-9 (11)	
	Whitish gray, tan and black silty SHALE, some coal, wet, stiff, **(WEATHERED BEDROCK)**		SS 25	85	5-7-5-7 (12)	
		50				
1210			SS 26	75	7-7-13-9 (20)	
	COAL, wet, very dense, **(BEDROCK)**		SS 27	100	7-7-50/0.4	



CEC CUSTOM LOG APEX EXPANSION.GPJ CEC.GDT 4/4/11

(Continued Next Page)

Civil & Environmental Consultants, Inc.
333 Baldwin Road
Pittsburgh, PA 15205

BORING NUMBER SB-10

CLIENT Apex Environmental, LLC **PROJECT NAME** Apex Lateral Expansion

PROJECT NUMBER 101-049 **PROJECT LOCATION** Amsterdam, Ohio

ELEVATION (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	DEPTH (ft)	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	POCKET PEN. (tsf)	▲ SPT N VALUE ▲ 20 40 60 80 / PL MC LL 20 40 60 80 / ☐ FINES CONTENT (%) ☐ 20 40 60 80
		Black CARBONACEOUS SHALE, wet, hard, **(BEDROCK)**		SS 28	100	50/0.1		50/0.1
		Bottom of boring at 54.1 feet.						

Civil & Environmental Consultants, Inc.
333 Baldwin Road
Pittsburgh, PA 15205

BORING NUMBER SB-11

CLIENT Apex Environmental, LLC
PROJECT NAME Apex Lateral Expansion
PROJECT NUMBER 101-049
PROJECT LOCATION Amsterdam, Ohio
DATE STARTED 8/24/20 **COMPLETED** 8/24/10
GROUND ELEVATION 1266.09 ft **BACKFILL** Bentonite
DRILLING CONTRACTOR Test Boring Services, Inc.
GROUND WATER LEVELS:
DRILLING METHOD Auger/SS
BEFORE CORING Not Applicable
CEC REP LRW **CHECKED BY** JMN
AT END OF DRILLING Dry
NOTES Northing: 280172.61 Easting: 2409963.32
AFTER DRILLING Immediately Backfilled

ELEVATION (ft)	MATERIAL DESCRIPTION	DEPTH (ft)	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	POCKET PEN (tsf)
		0				
1265	Gray silty CLAY, some siltstone fragments, trace coal, dry, medium stiff, **(MINE SPOIL)**		SS 1	60	4-3-2-3 (5)	
	Yellowish tan and gray CLAY, some silt, some limestone fragments, dry, very stiff, Relocated boring ~4' North., **(MINE SPOIL)**		SS 2	30	6-8-14-42 (22)	
	White and orange CLAY, trace coal, trace limestone fragments, dry, stiff, **(MINE SPOIL)**	5	SS 3	75	21-9-6-22 (15)	
1260	Tan to gray CLAY, some coal, dry, very stiff, **(MINE SPOIL)**		SS 4	55	5-11-9-13 (20)	
	Tan to gray CLAY, trace coal, trace limestone fragments, dry, hard, **(MINE SPOIL)**		SS 5	100	11-13-35-50 (48)	
		10				
1255	Gray LIMESTONE, dry, very dense, **(MINE SPOIL)**		SS 6	100	50/0.1	
	Gray SHALE, some sandstone fragments, dry, stiff, Relocated Drill Rig ~30' North., **(MINE SPOIL)**		SS 7	75	17-5-5-3 (10)	
	Tan and gray CLAY, some shale fragments, trace coal, dry, stiff, **(MINE SPOIL)**	15	SS 8	75	4-4-6-3 (10)	
1250	Tan silty CLAY, some rock fragments, trace coal, dry, very stiff, **(MINE SPOIL)**		SS 9	75	10-17-7-9 (24)	
	Grayish brown CLAY, trace coal, dry, stiff, **(MINE SPOIL)**		SS 10	75	10-11-5-5 (16)	
		20				
1245	Brown silty CLAY, some limestone fragments, dry, medium stiff, **(MINE SPOIL)**		SS 11	35	5-4-3-3 (7)	
	Gray and orange CLAY, some sand, dry, very stiff, **(MINE SPOIL)**		SS 12	65	3-12-6-5 (18)	
	Gray to whitish gray CLAY, some siltstone fragments, trace coal, dry, very stiff to stiff, **(MINE SPOIL)**	25	SS		5-12-14-10	

▲ SPT N VALUE ▲
20 40 60 80
PL MC LL
20 40 60 80
☐ FINES CONTENT (%) ☐
20 40 60 80

50/0.1

(Continued Next Page)

CEC CUSTOM LOG APEX EXPANSION.GPJ CEC.GDT 4/4/11

Civil & Environmental Consultants, Inc.
333 Baldwin Road
Pittsburgh, PA 15205

BORING NUMBER SB-11

CLIENT Apex Environmental, LLC **PROJECT NAME** Apex Lateral Expansion

PROJECT NUMBER 101-049 **PROJECT LOCATION** Amsterdam, Ohio

ELEVATION (ft)	MATERIAL DESCRIPTION	DEPTH (ft)	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	POCKET PEN. (tsf)
	Gray to whitish gray CLAY, some siltstone fragments, trace coal, dry, very stiff to stiff, **(MINE SPOIL)***(continued)*	25	13	75	(26)	
1240			SS 14	75	9-8-7-5 (15)	
	Bag sample (B-1) collected from 28 to 30 ft		SS 15	75	2-4-6-6 (10)	
	Brown SILT, trace rock fragments, dry, stiff, **(MINE SPOIL)**	30	SS 16	75	7-8-6-5 (14)	
1235	Yellowish tan and gray CLAY, some siltstone fragments, some limestone fragments, wet, medium stiff, **(MINE SPOIL)**		SS 17	60	7-4-3-4 (7)	
	Tan SAND, some gravel, wet, very stiff, **(MINE SPOIL)**	35	SS 18	50	44-9-14-7 (23)	
1230	Black COAL, wet, **(MINE SPOIL)**		SS 19	100	5-24-50/0.2	
	Gray limy CLAY, some limestone fragments, some sand, wet, hard, augering hard, **(WEATHERED BEDROCK)**		SS 20	100	7-50/0.2	
	Gray limy SHALE, wet, hard, auger refusal, **(BEDROCK)**	40	SS 21	100	50/0.3	
	Bottom of boring at 41.0 feet.					

▲ SPT N VALUE ▲ 20 40 60 80

PL MC LL 20 40 60 80

☐ FINES CONTENT (%) ☐ 20 40 60 80

50/0.2 50/0.2 50/0.3

CEC CUSTOM LOG APEX EXPANSION.GPJ CEC.GDT 4/4/11

Civil & Environmental Consultants, Inc.
333 Baldwin Road
Pittsburgh, PA 15205

BORING NUMBER SB-12

CLIENT Apex Environmental, LLC
PROJECT NAME Apex Lateral Expansion
PROJECT NUMBER 101-049
PROJECT LOCATION Amsterdam, Ohio
DATE STARTED 8/19/10 **COMPLETED** 8/19/10
GROUND ELEVATION 1241.24 ft **BACKFILL** Bentonite
DRILLING CONTRACTOR Test Boring Services, Inc.
GROUND WATER LEVELS:
DRILLING METHOD Auger/SS
BEFORE CORING Not Applicable
CEC REP LRW **CHECKED BY** JMN
AT END OF DRILLING Dry
NOTES Northing: 280361.08 Easting: 2409442.45
AFTER DRILLING Immediately Backfilled

ELEVATION (ft)	MATERIAL DESCRIPTION	DEPTH (ft)	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	POCKET PEN (tsf)
	Tan clayey SAND, some coal, dry, medium stiff, **(MINE SPOIL)**	0	SS 1	75	2-2-3-4 (5)	
1240	Tan and gray sandy CLAY, some shale fragments, some coal, dry, medium stiff, **(MINE SPOIL)**		SS 2	100	6-3-2-2 (5)	
	Tan and gray CLAY, dry, stiff, plastic intervals, **(MINE SPOIL)**	5	SS 3	100	3-5-5-5 (10)	
1235	Reddish brown and gray CLAY, dry, medium stiff, medium plasticity, **(MINE SPOIL)**		SS 4	100	4-4-4-7 (8)	
	Gray to reddish brown sandy CLAY, trace limestone fragments, dry, medium stiff, **(MINE SPOIL)**	10	SS 5	80	3-4-3-5 (7)	
1230	Reddish brown and gray CLAY, some sand, dry, medium stiff, medium plasticity, **(MINE SPOIL)**		SS 6	85	3-3-4-6 (7)	
	Reddish brown and gray silty CLAY, some sand, trace rock fragments, dry, very stiff, micaceous, **(MINE SPOIL)**		SS 7	80	15-11-5-5 (16)	
	Gray, tan and black silty CLAY, trace coal, dry, stiff, **(MINE SPOIL)**	15	SS 8	100	4-6-8-10 (14)	
1225	Tan fat CLAY, some sand, trace coal, dry, stiff, micaceous, **(MINE SPOIL)**		SS 9	70	5-7-7-11 (14)	
	Tan and orange silty CLAY, trace coal, dry, hard, medium plasticity, **(MINE SPOIL)**		SS 10	100	8-23-8-8 (31)	
	Gray and orange silty CLAY, some siltstone fragments, wet to dry, hard, **(MINE SPOIL)**	20	SS 11	100	8-11-36-50 (47)	
1220	White sandy SHALE, dry, hard, micaceous, **(RESIDUAL SOIL)**		SS 12	100	50/0.2	
	Light tan SHALE, dry, hard, micaceous, **(RESIDUAL SOIL)**	25	SS 13	100	50/0.2	

▲ SPT N VALUE ▲
20 40 60 80
PL MC LL
20 40 60 80
☐ FINES CONTENT (%) ☐
20 40 60 80

50/0.2
50/0.2

CEC CUSTOM LOG APEX EXPANSION GPJ CEC GDT 4/4/11

(Continued Next Page)

Civil & Environmental Consultants, Inc.
333 Baldwin Road
Pittsburgh, PA 15205

BORING NUMBER SB-12

CLIENT Apex Environmental, LLC **PROJECT NAME** Apex Lateral Expansion

PROJECT NUMBER 101-049 **PROJECT LOCATION** Amsterdam, Ohio

ELEVATION (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	DEPTH (ft)	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	POCKET PEN. (tsf)	▲ SPT N VALUE ▲ 20 40 60 80 / PL MC LL 20 40 60 80 / ☐ FINES CONTENT (%) ☐ 20 40 60 80
		Light tan SHALE, dry, hard, micaceous, **(RESIDUAL SOIL)** *(continued)*	25					
1215		White shaly SANDSTONE, dry, hard, micaceous, **(RESIDUAL SOIL)**		SS 14	100	50/0.3		50/0.3
		Auger refusal		SS 15	0	50/0.1		50/0.1
		Bottom of boring at 28.4 feet.						

Civil & Environmental Consultants, Inc.
333 Baldwin Road
Pittsburgh, PA 15205

BORING NUMBER SB-12-1

CLIENT Apex Environmental, LLC
PROJECT NAME Apex Lateral Expansion
PROJECT NUMBER 101-049
PROJECT LOCATION Amsterdam, Ohio
DATE STARTED 2/15/11 **COMPLETED** 2/15/11
GROUND ELEVATION 1241.24 ft **BACKFILL** Bentonite
DRILLING CONTRACTOR Boart Longyear
GROUND WATER LEVELS:
DRILLING METHOD Sonic
BEFORE CORING Not Applicable
CEC REP BRB **CHECKED BY** DWC
AT END OF DRILLING Dry
NOTES Northing: 280361.08 Easting: 2409442.45
AFTER DRILLING Immediately Backfilled

ELEVATION (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	DEPTH (ft)	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	POCKET PEN. (tsf)
1240		Brown clayey SAND, few coal fragments, no plasticity, dry	0				0.5
		Brown CLAY, some coal, few limestone fragments, low plasticity, dry					2.0
							3.2
		Assuming brown CLAY (See SB-12 for description), no recovery					2.7
			5				2.6
1235				SONIC 1	27		
			10				
1230							
			15				
		Used water to blow out hole, no recovery					
1225		Brown CLAY, collected SHELBY TUBE (21" of recovery)		ST 2	88		
		Bottom of boring at 18.0 feet.					

▲ SPT N VALUE ▲
20 40 60 80
PL MC LL
20 40 60 80
☐ FINES CONTENT (%) ☐
20 40 60 80

CEC CUSTOM LOG APEX EXPANSION.GPJ CEC.GDT 4/4/11

Civil & Environmental Consultants, Inc.
333 Baldwin Road
Pittsburgh, PA 15205

BORING NUMBER SB-13

CLIENT Apex Environmental, LLC
PROJECT NAME Apex Lateral Expansion
PROJECT NUMBER 101-049
PROJECT LOCATION Amsterdam, Ohio
DATE STARTED 8/18/10 **COMPLETED** 8/18/10
GROUND ELEVATION 1263.93 ft **BACKFILL** Bentonite
DRILLING CONTRACTOR Test Boring Services, Inc.
GROUND WATER LEVELS:
DRILLING METHOD Auger/SS
BEFORE CORING Not Applicable
CEC REP LRW **CHECKED BY** JMN
AT END OF DRILLING Dry
NOTES Northing: 281270.43 Easting: 2410288.36
AFTER DRILLING Immediately Backfilled

ELEVATION (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	DEPTH (ft)	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	POCKET PEN. (tsf)
		Brown silty CLAY, some shale fragments, some sand, dry, stiff, **(MINE SPOIL)**	0	SS 1	100	2-2-9-16 (11)	
		Gray and orange sandy CLAY, some siltstone fragments, dry, stiff, micaceous, **(MINE SPOIL)**		SS 2	100	11-9-5-4 (14)	
1260		Gray sandy SHALE, some limestone fragments, dry, very stiff, micaceous, **(MINE SPOIL)**	5	SS 3	35	16-10-6-8 (16)	
				SS 4	100	10-5-12-18 (17)	
		Dark gray SHALE, dry, very stiff, **(MINE SPOIL)**					
1255		Dark gray and tan SHALE, dry, very stiff, with sand intervals. Micaceous, **(MINE SPOIL)**		SS 5	100	14-14-10-10 (24)	
			10	SS 6	100	10-9-8-7 (17)	
		Dark gray and tan SHALE, dry, stiff to very stiff, with sand intervals. Micaceous, **(MINE SPOIL)**		SS 7	100	4-4-7-9 (11)	
1250		**Bag sample (B-1) collected from 14 to 20 ft**	15	SS 8	100	8-11-10-14 (21)	
		Dark gray and tan SHALE, dry, very stiff to stiff, with sand intervals. Micaceous, **(MINE SPOIL)**		SS 9	100	9-10-6-7 (16)	
1245				SS 10	100	5-5-5-7 (10)	
		Shelby Tube (ST-1) collected from 20 to 22 ft. Recovery 2.0	20	ST 1	100		
		Gray, tan and black sandy CLAY, some shale fragments, dry, stiff, **(MINE SPOIL)**		SS 11	100	7-4-5-7 (9)	
1240		Gray, tan and brown sandy CLAY, some shale fragments, dry, stiff, **(MINE SPOIL)**	25	SS		4-4-5-10	

▲ SPT N VALUE ▲
20 40 60 80
PL MC LL
20 40 60 80
☐ FINES CONTENT (%) ☐
20 40 60 80

(Continued Next Page)

CEC CUSTOM LOG APEX EXPANSION.GPJ CEC.GDT 4/4/11

Civil & Environmental Consultants, Inc.
333 Baldwin Road
Pittsburgh, PA 15205

BORING NUMBER SB-13

CLIENT Apex Environmental, LLC **PROJECT NAME** Apex Lateral Expansion

PROJECT NUMBER 101-049 **PROJECT LOCATION** Amsterdam, Ohio

ELEVATION (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	DEPTH (ft)	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	POCKET PEN (tsf)
		Gray, tan and brown sandy CLAY, some shale fragments, dry, stiff, **(MINE SPOIL)***(continued)*	25	12	100	(9)	
		Gray, tan and brown sandy CLAY, some shale fragments, dry, stiff, micaceous at bottom, **(MINE SPOIL)**		SS 13	100	6-7-8-6 (15)	
1235		Black and gray CLAY, some sand, trace coal, dry, medium stiff, included wood fragment, **(MINE SPOIL)**	30	SS 14	75	4-2-4-6 (6)	
		Black and gray CLAY, some sand, trace coal, dry to wet, medium stiff, included railroad tie fragment, **(MINE SPOIL)**		SS 15	100	7-4-4-4 (8)	
1230		Gray, tan and brown CLAY, some shale fragments, trace coal, dry, stiff, low plasticity, **(MINE SPOIL)**		SS 16	100	2-4-5-8 (9)	
		Black COAL, some clay, some sand, wet, stiff, **(MINE SPOIL)**	35	SS 17	100	5-4-6-5 (10)	
		Tan and gray sandy CLAY, some shale fragments, moist, stiff, low plasticity, **(MINE SPOIL)**		SS 18	60	4-4-5-8 (9)	
1225		Gray silty CLAY, some limestone fragments, dry, very stiff, **(MINE SPOIL)**		SS 19	100	3-27-50/0.4	
		Gray sandy SHALE, dry, hard, **(WEATHERED BEDROCK)**	40	SS 20	100	50/0.1	
		Gray LIMESTONE, dry, very dense, Auger Refusal, **(BEDROCK)**		SS 21	100	50/0.1	
		Bottom of boring at 42.1 feet.					

▲ SPT N VALUE ▲
20 40 60 80
PL MC LL
20 40 60 80
☐ FINES CONTENT (%) ☐
20 40 60 80

50/0.4
50/0.1
50/0.1

CEC CUSTOM LOG APEX EXPANSION.GPJ CEC.GDT 4/4/11

Civil & Environmental Consultants, Inc.
333 Baldwin Road
Pittsburgh, PA 15205

BORING NUMBER SB-14

CLIENT Apex Environmental, LLC
PROJECT NAME Apex Lateral Expansion
PROJECT NUMBER 101-049
PROJECT LOCATION Amsterdam, Ohio
DATE STARTED 8/23/10 **COMPLETED** 8/23/10
GROUND ELEVATION 1252.23 ft **BACKFILL** Bentonite
DRILLING CONTRACTOR Test Boring Services, Inc.
GROUND WATER LEVELS:
DRILLING METHOD Auger/SS
BEFORE CORING Not Applicable
CEC REP LRW **CHECKED BY** JMN
AT END OF DRILLING 32.0 ft / Elev 1220.2 ft
NOTES Northing: 280306.10 Easting: 2410584.25
AFTER DRILLING Immediately Backfilled

ELEVATION (ft)	DEPTH (ft)	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	POCKET PEN. (tsf)
	0	Brown SILT, some clay, dry, stiff, **(MINE SPOIL)**				
		Tan and gray silty CLAY, trace rock fragments, trace coal, dry, medium stiff, **(MINE SPOIL)**	SS 1	100	6-4-4-7 (8)	
1250		Tan and gray silty CLAY, some sand, trace coal, dry, stiff, **(MINE SPOIL)**	SS 2	75	1-5-4-4 (9)	
	5	Tan and gray silty CLAY, some sand, trace coal, dry, very stiff to medium stiff, **(MINE SPOIL)**	SS 3	75	4-7-9-11 (16)	
1245			SS 4	100	4-4-4-7 (8)	
		Reddish brown and gray CLAY, some sand, trace coal, dry, stiff, low plasticity, **(MINE SPOIL)**	SS 5	100	3-5-4-3 (9)	
	10	**Shelby Tube (ST-2) was collected from 11 to 13 ft in adjacent boring. Recovery 2.0 ft.**	ST 1	75		
1240		Gray, tan and brown silty CLAY, some sand, trace rock fragments, dry, stiff, **(MINE SPOIL)**	SS 6	75	3-4-5-4 (9)	
		Yellowish tan CLAY, some sand, trace coal, dry, stiff, **(MINE SPOIL)**	SS 7	90	3-4-8-8 (12)	
	15	Yellowish tan and gray CLAY, some sand, trace coal, dry, stiff, low plasticity, **(MINE SPOIL)**	SS 8	65	7-5-5-17 (10)	
1235		**Bag sample (B-1) collected from 16 to 20 ft**				
		Gray and brown CLAY, some silt, dry, stiff, **(MINE SPOIL)**	SS 9	100	4-7-7-9 (14)	
	20	Yellowish brown and gray CLAY, some sand, dry, stiff, **(MINE SPOIL)**	SS 10	100	8-10-14-12 (24)	
		Black CARBONACEOUS SHALE, some coal, dry, very stiff, **(MINE SPOIL)**	SS 11	100	12-9-10-15 (19)	
1230		Yellowish brown and gray CLAY, some coal, dry, very stiff, **(MINE SPOIL)**				
		Tan and black SILT, some coal fragments, dry, very stiff, **(MINE SPOIL)**	SS		6-8-9-8	
	25					

▲ SPT N VALUE ▲
20 40 60 80
PL MC LL
20 40 60 80
☐ FINES CONTENT (%) ☐
20 40 60 80

(Continued Next Page)

CEC CUSTOM LOG APEX EXPANSION.GPJ CEC.GDT 4/4/11

Civil & Environmental Consultants, Inc.
333 Baldwin Road
Pittsburgh, PA 15205

BORING NUMBER SB-14

CLIENT Apex Environmental, LLC
PROJECT NAME Apex Lateral Expansion
PROJECT NUMBER 101-049
PROJECT LOCATION Amsterdam, Ohio

ELEVATION (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	DEPTH (ft)	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	POCKET PEN (tsf)
		Gray and brown FAT CLAY, trace rock fragments, dry to moist, medium stiff, **(MINE SPOIL)**	25	12	100	(17)	
1225		**Shelby Tube (ST-3) collected from 25 to 27 ft in adjacent boring. Recovery 2.0**		SS 16	100	4-4-4-13 (8)	
		Tan and black sandy CLAY, some carbonaceous shale, wet, very soft, **(MINE SPOIL)**	30	SS 14	40	3-1-1-4 (2)	
		Yellow to gray CLAY, some silt, wet, stiff, **(MINE SPOIL)**		SS 15	65	1-5-6-17 (11)	
1220		Gray LIMESTONE, wet, very dense, auger refusal, **(BEDROCK)**		SS 16	100	50/0.2	
		Bottom of boring at 32.3 feet.					

▲ SPT N VALUE ▲
20 40 60 80
PL MC LL
20 40 60 80
☐ FINES CONTENT (%) ☐
20 40 60 80

50/0.2

CEC CUSTOM LOG APEX EXPANSION GPJ CEC GDT 4/4/11

BORING NUMBER SB-15

Civil & Environmental Consultants, Inc.
333 Baldwin Road
Pittsburgh, PA 15205

CLIENT Apex Environmental, LLC
PROJECT NAME Apex Lateral Expansion
PROJECT NUMBER 101-049
PROJECT LOCATION Amsterdam, Ohio
DATE STARTED 8/16/10 **COMPLETED** 8/16/10
GROUND ELEVATION 1201.78 ft **BACKFILL** Bentonite
DRILLING CONTRACTOR Test Boring Services, Inc.
GROUND WATER LEVELS:
DRILLING METHOD Auger/SS
BEFORE CORING Not Applicable
CEC REP LRW **CHECKED BY** JMN
AT END OF DRILLING Dry
NOTES Northing: 280002.73 Easting: 2411119.49
AFTER DRILLING Immediately Backfilled

ELEVATION (ft)	DEPTH (ft)	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	POCKET PEN. (tsf)
	0	**(TOPSOIL)**				
1200		Tan, orange and black CLAY, some coal, dry, stiff to very stiff, **(MINE SPOIL)**	SS 1	100	1-3-7-7 (10)	
			SS 2	100	6-11-9-9 (20)	
		Tan and orange sandy CLAY, some rock fragments, dry, stiff to very stiff, **(RESIDUAL SOIL)**	SS 3	100	11-12-13-14 (25)	
1195	5		SS 4	100	7-7-7-5 (14)	
		Tan and orange decomposed SHALE, dry, very stiff, micaceous., **(RESIDUAL SOIL)**	SS 5	100	7-10-8-5 (18)	
	10	**Bag Sample (B-1) collected from 10 to 14 ft**	SS 6	100	8-10-18-12 (28)	
1190		Tan and orange decomposed CLAYSTONE, dry, very stiff, some sand intervals, **(RESIDUAL SOIL)**	SS 7	100	6-7-14-15 (21)	
		Tan and orange decomposed CLAYSTONE, dry, hard, micaceous, **(RESIDUAL SOIL)**	SS 8	100	27-33-35-45 (68)	
	15					
1185		Tan and orange to gray decomposed CLAYSTONE, some sand, dry, hard, micaceous, **(RESIDUAL SOIL)**	SS 9	100	45-50/0.2	
		Tan sandy SHALE, some clay, dry, hard, **(BEDROCK)**	SS 10	100	50/0.2	
	20					
		Gray sandy SHALE, dry, hard, damp between beds, **(BEDROCK)**	SS 11	100	50/0.2	
1180						
		Gray SHALE, wet to dry, hard, micaceous, **(BEDROCK)**	SS 12	100	50/0.2	
		Dark gray SHALE, some silt, wet to dry, hard, micaceous, **(BEDROCK)**	SS 13	100	50/0.2	
	25					

▲ SPT N VALUE ▲
20 40 60 80
PL MC LL
20 40 60 80
☐ FINES CONTENT (%) ☐
20 40 60 80

50/0.2
50/0.2
50/0.2
50/0.2
50/0.2

CEC CUSTOM LOG APEX EXPANSION.GPJ CEC.GDT 4/4/11

(Continued Next Page)

Civil & Environmental Consultants, Inc.
333 Baldwin Road
Pittsburgh, PA 15205

BORING NUMBER SB-15

CLIENT Apex Environmental, LLC
PROJECT NAME Apex Lateral Expansion
PROJECT NUMBER 101-049
PROJECT LOCATION Amsterdam, Ohio

ELEVATION (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	DEPTH (ft)	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	POCKET PEN. (tsf)	▲ SPT N VALUE ▲ 20 40 60 80 / PL MC LL 20 40 60 80 / ☐ FINES CONTENT (%) ☐ 20 40 60 80
		Dark gray SHALE, some silt, wet to dry, hard, micaceous, **(BEDROCK)***(continued)*	25	SS 14	100	50/0.1		50/0.1
1175				SS 15	100	50/0.1		50/0.1
		Dark gray sandy SHALE, dry, hard, micaceous, **(BEDROCK)**	30	SS 16	100	50/0.1		50/0.1
1170				SS 17	100	50/0.1		50/0.1
				SS 18	100	50/0.1		50/0.1
			35	SS 19	100	50/0.1		50/0.1
1165				SS 20	100	50/0.2		50/0.2
			40	SS 21	100	50/0.1		50/0.1
1160		Bottom of boring at 42.1 feet.		SS 22	100	50/0.1		50/0.1

CEC CUSTOM LOG APEX EXPANSION GPJ CEC GDT 4/4/11

Civil & Environmental Consultants, Inc.
333 Baldwin Road
Pittsburgh, PA 15205

BORING NUMBER SB-16

CLIENT Apex Environmental, LLC
PROJECT NAME Apex Lateral Expansion
PROJECT NUMBER 101-049
PROJECT LOCATION Amsterdam, Ohio
DATE STARTED 8/17/10 **COMPLETED** 8/17/10
GROUND ELEVATION 1224.28 ft **BACKFILL** Bentonite
DRILLING CONTRACTOR Test Boring Services, Inc.
GROUND WATER LEVELS:
DRILLING METHOD Auger/SS
BEFORE CORING Not Applicable
CEC REP LRW **CHECKED BY** JMN
AT END OF DRILLING Dry
NOTES Northing: 280311.70 Easting: 2411271.33
AFTER DRILLING Immediately Backfilled

ELEVATION (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	DEPTH (ft)	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	POCKET PEN. (tsf)
		(TOPSOIL)	0				
		Brown to tan and gray FAT CLAY, some sand, dry, medium stiff, **(RESIDUAL SOIL)** **Shelby Tubes (ST-1 and ST-2) collected from 0.5 to 2.5 ft and 1 to 3 ft in adjacent boring. Recovery 1.0 and 1.0 ft, respectively**		SS 1	85	3-3-3-4 (6)	
		Tan and gray to orange FAT CLAY, dry, stiff, micaceous on bottom, **(RESIDUAL SOIL)**		SS 2	80	3-4-7-7 (11)	
1220		Gray, tan, brown and orange CLAY, some shale fragments, dry, stiff, **(RESIDUAL SOIL)**	5	SS 3	100	6-7-6-8 (13)	
		Gray, tan and orange CLAY, dry, stiff, **(RESIDUAL SOIL)**		SS 4	100	3-4-5-8 (9)	
		Tan silty CLAYSTONE, dry, hard, **(WEATHERED BEDROCK)**		SS 5	100	7-24-50/0.4	
1215			10				
		Gray LIMESTONE, dry, very dense, auger refusal, **(BEDROCK)** Bottom of boring at 10.2 feet.		SS 6	100	50/0.1	

▲ SPT N VALUE ▲
20 40 60 80
PL MC LL
20 40 60 80
☐ FINES CONTENT (%) ☐
20 40 60 80

50/0.4
50/0.1

CEC CUSTOM LOG APEX EXPANSION GPJ CEC GDT 4/4/11

BORING NUMBER SB-17

Civil & Environmental Consultants, Inc.
333 Baldwin Road
Pittsburgh, PA 15205

CLIENT Apex Environmental, LLC
PROJECT NAME Apex Lateral Expansion
PROJECT NUMBER 101-049
PROJECT LOCATION Amsterdam, Ohio
DATE STARTED 8/12/10 **COMPLETED** 8/12/10
GROUND ELEVATION 1270.75 ft **BACKFILL** Bentonite
DRILLING CONTRACTOR Test Boring Services, Inc.
GROUND WATER LEVELS:
DRILLING METHOD Auger/SS
BEFORE CORING Not Applicable
CEC REP LRW **CHECKED BY** JMN
AT END OF DRILLING Dry
NOTES Northing: 281886.46 Easting: 2411238.23
AFTER DRILLING Immediately Backfilled

ELEVATION (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	DEPTH (ft)	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	POCKET PEN. (tsf)
1270		Light brown CLAY, some rock fragments, dry, stiff, **(MINE SPOIL)**	0	SS 1	100	1-3-9-7 (12)	
		Orange, brown and gray CLAY, some rock fragments, trace coal, dry, medium stiff, **(MINE SPOIL)**		SS 2	90	9-4-2-4 (6)	
1265			5	SS 3	100	3-5-3-3 (8)	
		Brown sandy CLAY, dry, stiff, **(MINE SPOIL)**		SS 4	20	8-8-6-3 (14)	
		Gray and yellow sandy CLAY, trace coal, dry, medium stiff, **(MINE SPOIL)**	10	SS 5	80	2-3-5-3 (8)	
1260		Yellow to gray decomposed SANDSTONE, some shale fragments, dry, soft, **(MINE SPOIL)**		SS 6	100	2-2-2-4 (4)	
		Gray and brown silty CLAY, some shale fragments, some sand and rock fragments, dry, medium stiff, **(MINE SPOIL)**		SS 7	100	2-3-3-4 (6)	
		Gray and yellow silty CLAY, some shale fragments, trace sand and coal fragments, dry, soft, **(MINE SPOIL)**	15	SS 8	100	1-2-2-3 (4)	
1255		Gray clayey SAND, trace rock fragments, **(MINE SPOIL)**		ST 1	50		
		Shelby Tube collected from 16 to 18 ft. Recovery 1.0 ft.					
		Shelby Tube collected from 18 to 20 ft. Recovery 1.2 ft	20	ST 2	60		
1250		Gray and yellow silty CLAY, some shale fragments, some sand and coal fragments, dry, medium stiff, low plasticity, **(MINE SPOIL)**		SS 9	100	2-3-3-5 (6)	
				SS 10	100	3-2-4-10 (6)	
		Gray CLAY, some shale fragments, some sand, dry, very stiff, medium plasticity, **(MINE SPOIL)**	25	SS		33-22-5-7	

▲ SPT N VALUE ▲
20 40 60 80
PL MC LL
20 40 60 80
☐ FINES CONTENT (%) ☐
20 40 60 80

(Continued Next Page)

CEC CUSTOM LOG APEX EXPANSION.GPJ CEC.GDT 4/4/11

Civil & Environmental Consultants, Inc.
333 Baldwin Road
Pittsburgh, PA 15205

BORING NUMBER SB-17

CLIENT Apex Environmental, LLC **PROJECT NAME** Apex Lateral Expansion

PROJECT NUMBER 101-049 **PROJECT LOCATION** Amsterdam, Ohio

ELEVATION (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	DEPTH (ft)	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	POCKET PEN. (tsf)
1245		Gray CLAY, some shale fragments, some sand, dry, very stiff, medium plasticity, **(MINE SPOIL)***(continued)*	25	11	80	(27)	
		Bag sample collected from 24 to 28 ft					
		Gray CLAY, some shale fragments, some sand and rock fragments, dry, medium stiff, augering harder, **(MINE SPOIL)**		SS 12	90	5-2-4-5 (6)	
		Gray, black and yellow silty CLAY, some shale fragments, some sand and rock fragments, dry, stiff, chattering, **(MINE SPOIL)**	30	SS 13	100	1-5-5-26 (10)	
		Gray LIMESTONE, dry, hard, **(BEDROCK)**		SS 14	67	45-50/0.1	
		Bottom of boring at 30.6 feet.					

▲ SPT N VALUE ▲
20 40 60 80
PL MC LL
20 40 60 80
☐ FINES CONTENT (%) ☐
20 40 60 80

50/0.1

BORING NUMBER SB-18

Civil & Environmental Consultants, Inc.
333 Baldwin Road
Pittsburgh, PA 15205

CLIENT Apex Environmental, LLC
PROJECT NAME Apex Lateral Expansion
PROJECT NUMBER 101-049
PROJECT LOCATION Amsterdam, Ohio
DATE STARTED 8/12/10 **COMPLETED** 8/12/10
GROUND ELEVATION 1259.64 ft **BACKFILL** Bentonite
DRILLING CONTRACTOR Test Boring Services, Inc.
GROUND WATER LEVELS:
DRILLING METHOD Auger/SS
BEFORE CORING Not Applicable
CEC REP LRW **CHECKED BY** JMN
AT END OF DRILLING Dry
NOTES Northing: 281589.89 Easting: 2411361.90
AFTER DRILLING Immediately Backfilled

ELEVATION (ft)	DEPTH (ft)	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	POCKET PEN. (tsf)
	0	Gray and orange CLAY, some carbonaceous shale, some sand, dry, stiff, **(MINE SPOIL)**	SS 1	70	5-5-7-7 (12)	
		Gray, brown and orange CLAY, some sand, trace coal, dry, very stiff, **(MINE SPOIL)**	SS 2	45	14-10-7-6 (17)	
1255	5	Gray to tan and yellow silty CLAY, some sand, some coal, dry, hard, **(MINE SPOIL)**	SS 3	100	12-10-50 (60)	
		Dark gray sandy SHALE, dry, hard, **(MINE SPOIL)**	SS 4	100	50/0.1	
		Gray, yellow and black sandy CLAY, some coal, some rock fragments, dry, stiff, **(MINE SPOIL)**	SS 5	90	1-4-5-5 (9)	
1250	10	Gray, yellow and black sandy CLAY, trace coal, trace rock fragments, dry, medium stiff, **(MINE SPOIL)** **Shelby Tube (ST-1) collected from 10 to 12 ft in adjacent boring. Recovery 1.5 ft**	SS 6	85	3-5-3-3 (8)	
			SS 7	100	3-3-50/0.4	
		Shelby Tube (ST-2) collected from 12 to 14 ft in adjacent boring. Recovery 1.5 ft				
1245	15	Gray sandy CLAY, trace rock fragments, dry, medium stiff to hard, **(MINE SPOIL)**	SS 8	50	3-2-4-6 (6)	
			SS 9	100	5-50/0.1	
		Gray sandy CLAY, trace limestone fragments, trace carbonaceous shale, dry, stiff to very stiff, **(MINE SPOIL)**	SS 10	100	3-8-6-7 (14)	
1240	20		SS 11	100	4-21-9-13 (30)	
		Gray clayey ROCK FRAGMENTS, some sand, moist, stiff, medium plasticity, **(MINE SPOIL)**	SS 12	100	4-5-5-5 (10)	
1235		**Shelby Tubes (ST-3 and ST-4) collected from 22 to 24 and 24 to 26 ft in adjacent boring. Recovery 1.5 and 1.1, respectively**				
	25		SS		4-4-11-17	

▲ SPT N VALUE ▲
20 40 60 80
PL MC LL
20 40 60 80
☐ FINES CONTENT (%) ☐
20 40 60 80

50/0.1
50/0.4
50/0.1

(Continued Next Page)

CEC CUSTOM LOG APEX EXPANSION.GPJ CEC.GDT 4/4/11

Civil & Environmental Consultants, Inc.
333 Baldwin Road
Pittsburgh, PA 15205

BORING NUMBER SB-18

CLIENT Apex Environmental, LLC **PROJECT NAME** Apex Lateral Expansion

PROJECT NUMBER 101-049 **PROJECT LOCATION** Amsterdam, Ohio

ELEVATION (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	DEPTH (ft)	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	POCKET PEN. (tsf)
		Gray clayey ROCK FRAGMENTS, some sand, moist, stiff, medium plasticity, **(MINE SPOIL)***(continued)*	25	13	85	(15)	
		Gray sandy CLAY, some rock fragments, dry, stiff, **(MINE SPOIL)**		SS 14	55	3-3-10-10 (13)	
		Gray ROCK FRAGMENTS, some clay, dry, medium dense, **(MINE SPOIL)**					
		Gray clayey ROCK FRAGMENTS, some sand, dry, stiff, **(MINE SPOIL)**		SS 15	100	4-6-8-8 (14)	
1230		Gray, tan and orange silty CLAY, some sand, some shale fragments, dry, soft, low plasticity, **(MINE SPOIL)**	30	SS 16	100	4-5-7-50 (12)	
		Light gray SHALE, dry, hard, **(WEATHERED BEDROCK)**		SS 17	100	24-35-50/0.3	
		Gray LIMESTONE, dry, very dense, auger refusal, **(BEDROCK)**		SS 18	100	50/0.2	
		Bottom of boring at 34.2 feet.					

▲ SPT N VALUE ▲
20 40 60 80
PL MC LL
20 40 60 80
☐ FINES CONTENT (%) ☐
20 40 60 80

50/0.3

50/0.2

CEC CUSTOM LOG APEX EXPANSION.GPJ CEC.GDT 4/4/11

BORING NUMBER SB-19

Civil & Environmental Consultants, Inc.
333 Baldwin Road
Pittsburgh, PA 15205

CLIENT Apex Environmental, LLC
PROJECT NAME Apex Lateral Expansion
PROJECT NUMBER 101-049
PROJECT LOCATION Amsterdam, Ohio
DATE STARTED 8/16/10 **COMPLETED** 8/16/10
GROUND ELEVATION 1262.06 ft **BACKFILL** Bentonite
DRILLING CONTRACTOR Test Boring Services, Inc.
GROUND WATER LEVELS:
DRILLING METHOD Auger/SS
BEFORE CORING Not Applicable
CEC REP LRW **CHECKED BY** JMN
AT END OF DRILLING Dry
NOTES Northing: 280892.63 Easting: 2411670.87
AFTER DRILLING Immediately Backfilled

ELEVATION (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	DEPTH (ft)	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	POCKET PEN. (tsf)
		(TOPSOIL)	0				
1260		Gray, tan and orange silty CLAY, trace coal, trace rock fragments, dry, stiff, **(MINE SPOIL)**		SS 1	65	1-5-7-10 (12)	
				SS 2	80	12-8-5-4 (13)	
		Gray, brown and orange CLAY, some sand, dry, medium stiff, **(MINE SPOIL)**	5	SS 3	20	3-3-3-6 (6)	
1255		Gray, brown and orange CLAY, some silt, trace coal, dry, stiff, **(MINE SPOIL)**		SS 4	100	4-5-9-16 (14)	
		Brown and orange CLAY, some carbonaceous shale, trace rock fragments, dry, medium stiff, **(MINE SPOIL)**		SS 5	90	2-2-4-4 (6)	
		Brown and orange CLAY, trace carbonaceous shale fragments, trace rock fragments, dry, medium stiff, **(MINE SPOIL)**	10	SS 6	55	2-4-2-3 (6)	
1250		**Shelby Tube (ST-1) collected from 11 to 13 ft in adjacent boring. Recovery 1.0 ft**					
		Shelby Tube collected from 13 to 15 ft. No recovery due to damaged tube		SS 7	85	1-4-3-3 (7)	
		Grayish brown CLAY, some shale fragments, some rock fragments, dry, stiff, includes wood fragment. Has black oily substance, **(MINE SPOIL)**	15	SS 8	35	18-5-6-6 (11)	
1245		Gray, brown and orange CLAY, some sand, trace coal, dry, medium stiff, **(MINE SPOIL)**		SS 9	90	3-3-4-5 (7)	
				SS 10	90	1-4-3-8 (7)	
		Gray, brown and orange silty CLAY, some shale fragments, some rock fragments, dry, stiff, includes plant fossil, **(MINE SPOIL)**	20	SS 11	80	3-6-6-8 (12)	
1240		Gray, brown and orange silty CLAY, some sand, some shale fragments, dry, stiff, **(MINE SPOIL)**		SS 12	100	6-8-7-9 (15)	
			25	SS		4-5-5-8	

▲ SPT N VALUE ▲
20 40 60 80
PL MC LL
20 40 60 80
☐ FINES CONTENT (%) ☐
20 40 60 80

CEC CUSTOM LOG APEX EXPANSION GPJ CEC GDT 4/4/11

(Continued Next Page)

Civil & Environmental Consultants, Inc.
333 Baldwin Road
Pittsburgh, PA 15205

BORING NUMBER SB-19

CLIENT Apex Environmental, LLC **PROJECT NAME** Apex Lateral Expansion

PROJECT NUMBER 101-049 **PROJECT LOCATION** Amsterdam, Ohio

ELEVATION (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	DEPTH (ft)	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	POCKET PEN. (tsf)
		Gray, brown and orange silty CLAY, some sand, some shale fragments, dry, stiff, **(MINE SPOIL)***(continued)*	25	13	100	(10)	
1235		Gray, brown and orange silty CLAY, some sand, trace coal, dry, stiff to hard, limestone fragments on bottom, **(MINE SPOIL)**		SS 14	100	4-4-5-7 (9)	
				SS 15	100	4-9-50/0.2	
		Gray decomposed SILTSTONE, some sand, dry, very dense, **(WEATHERED BEDROCK)**	30	SS 16	100	50/0.2	
1230				SS 17	100	50/0.1	
		Gray decomposed CLAYSTONE, some sand, dry, hard, **(WEATHERED BEDROCK)**	35	SS 18	100	50/0.1	
		Gray decomposed SHALE, dry, hard, augers chattering, **(WEATHERED BEDROCK)**		SS 19	100	50/0.1	
1225				SS 20	100	50/0.2	
		Auger refusal					
		Bottom of boring at 38.9 feet.					

▲ SPT N VALUE ▲
20 40 60 80
PL MC LL
20 40 60 80
☐ FINES CONTENT (%) ☐
20 40 60 80

50/0.2
50/0.2
50/0.1
50/0.1
50/0.1
50/0.2

CEC CUSTOM LOG APEX EXPANSION GPJ CEC GDT 4/4/11

BORING NUMBER SB-20

Civil & Environmental Consultants, Inc.
333 Baldwin Road
Pittsburgh, PA 15205

CLIENT Apex Environmental, LLC
PROJECT NAME Apex Lateral Expansion
PROJECT NUMBER 101-049
PROJECT LOCATION Amsterdam, Ohio
DATE STARTED 8/13/10 **COMPLETED** 8/13/10
GROUND ELEVATION 1258.15 ft **BACKFILL** Bentonite
DRILLING CONTRACTOR Test Boring Services, Inc.
GROUND WATER LEVELS:
DRILLING METHOD Auger/SS
BEFORE CORING Not Applicable
CEC REP LRW **CHECKED BY** JMN
AT END OF DRILLING Dry
NOTES Northing: 280665.62 Easting: 2411634.72
AFTER DRILLING Immediately Backfilled

ELEVATION (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	DEPTH (ft)	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	POCKET PEN. (tsf)
		Tan and orange silty CLAY, some sand, trace coal, dry, stiff to very stiff, **(MINE SPOIL)**	0	SS 1	95	1-4-11-11 (15)	
1255				SS 2	85	25-12-8-14 (20)	
		Gray LIMESTONE, dry, very dense, **(MINE SPOIL)**	5	SS 3	90	43-12-10-10 (22)	
		Orange sandy CLAY, wet, very stiff, **(MINE SPOIL)**					
		Gray silty CLAY, some rock fragments, some carbonaceous shale, wet, stiff, **(MINE SPOIL)**		SS 4	20	4-5-8-9 (13)	
1250		Orange and gray clayey SAND, some rock fragments, wet, medium dense, **(MINE SPOIL)**		SS 5	75	4-8-6-6 (14)	
		Gray, brown and orange CLAY, some shale fragments, some sand, moist, medium stiff, low plasticity, **(MINE SPOIL)**	10	SS 6	100	3-2-3-5 (5)	
		Gray and orange CLAY, trace carbonaceous shale, wet, stiff, medium plasticity, **(MINE SPOIL)**		SS 7	100	3-3-5-4 (8)	
1245		Gray, brown and orange sandy CLAY, wet to dry, stiff, spoon wet to dry. sampled mat'l dry, **(MINE SPOIL)**	15	SS 8	100	3-5-4-7 (9)	
		Gray, brown and orange sandy CLAY, wet, soft, stopped drilling, **(MINE SPOIL)**		SS 9	65	2-1-2-3 (3)	
1240		**Shelby Tubes (ST-1 and ST-2) collected from 16 to 18 ft and 17 to 20 ft in adjacent boring. Recovery 1.1 and 0.9 ft, respectively**					
		Gray, brown and orange sandy CLAY, some shale fragments, wet to dry, soft, **(MINE SPOIL)** **Bag sample (B-1) collected from 18 to 22 ft**	20	SS 10	40	1-2-1-2 (3)	
		Gray silty CLAY, some limestone fragments, dry, stiff, **(MINE SPOIL)**		SS 11	35	1-3-9-13 (12)	
		Gray LIMESTONE FRAGMENTS, some clay, some sand, wet, medium dense, **(MINE SPOIL)**		SS 12	55	5-7-5-7 (12)	
1235			25	SS		8-8-6-13	

▲ SPT N VALUE ▲
20 40 60 80
PL MC LL
20 40 60 80
☐ FINES CONTENT (%) ☐
20 40 60 80

CEC CUSTOM LOG APEX EXPANSION GPJ CEC.GDT 4/4/11

(Continued Next Page)

Civil & Environmental Consultants, Inc.
333 Baldwin Road
Pittsburgh, PA 15205

BORING NUMBER SB-20

CLIENT Apex Environmental, LLC **PROJECT NAME** Apex Lateral Expansion

PROJECT NUMBER 101-049 **PROJECT LOCATION** Amsterdam, Ohio

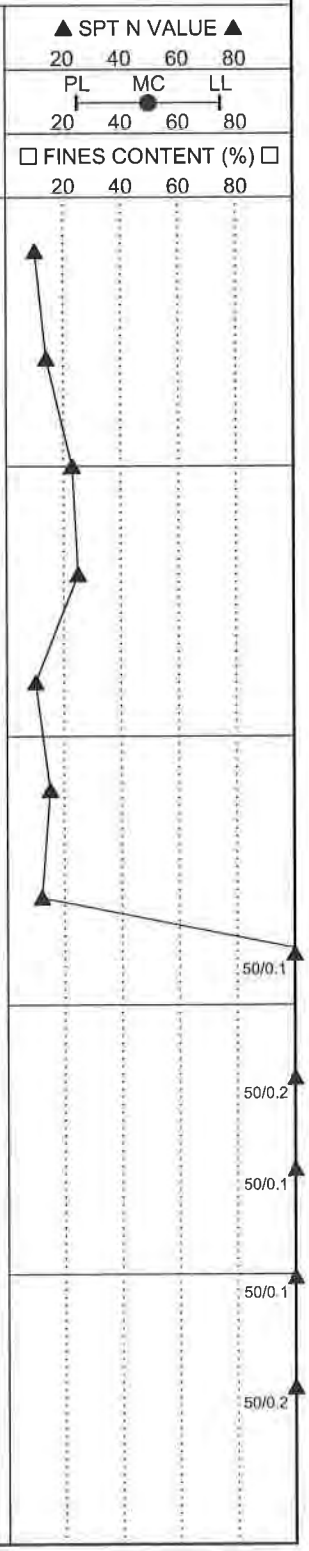
ELEVATION (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	DEPTH (ft)	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	POCKET PEN. (tsf)	▲ SPT N VALUE ▲ 20 40 60 80 / PL MC LL 20 40 60 80 / ☐ FINES CONTENT (%) ☐ 20 40 60 80
		Gray decomposed CLAYSTONE, dry, hard, **(RESIDUAL SOIL)**	25	SS 13	55	(14)		
		Gray limy CLAYSTONE, dry, hard, **(BEDROCK)**		SS 14	100	11-50/0.1		50/0.1
1230				SS 15	100	50/0.4		50/0.4
		Bottom of boring at 28.4 feet.						

Civil & Environmental Consultants, Inc.
333 Baldwin Road
Pittsburgh, PA 15205

BORING NUMBER SB-21

CLIENT Apex Environmental, LLC
PROJECT NAME Apex Lateral Expansion
PROJECT NUMBER 101-049
PROJECT LOCATION Amsterdam, Ohio
DATE STARTED 8/18/10 **COMPLETED** 8/18/10
GROUND ELEVATION 1209.50 ft **BACKFILL** Bentonite
DRILLING CONTRACTOR Test Boring Services, Inc.
GROUND WATER LEVELS:
DRILLING METHOD Auger/SS
BEFORE CORING Not Applicable
CEC REP LRW **CHECKED BY** JMN
AT END OF DRILLING Dry
NOTES Northing: 281947.98 Easting: 2411756.63
AFTER DRILLING Immediately Backfilled

ELEVATION (ft)	MATERIAL DESCRIPTION	DEPTH (ft)	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	POCKET PEN. (tsf)
	(TOPSOIL)	0				
	Tan silty CLAY, trace coal, dry, stiff, **(MINE SPOIL)** **Bag sample (B-1) collected from 0.5 to 10 ft**		SS 1	85	2-4-6-7 (10)	
	Gray, tan and orange sandy CLAY, some coal, dry, stiff, **(MINE SPOIL)**		SS 2	100	4-5-9-11 (14)	
1205	Tan and orange sandy SHALE, dry, hard to very stiff, micaceous, **(RESIDUAL SOIL)**	5	SS 3	100	10-8-15-19 (23)	
			SS 4	100	14-15-10-12 (25)	
	Olive and brown CLAY, some gravel, stiff, **(RESIDUAL SOIL)**		SS 5	100	8-6-4-7 (10)	
1200	**Shelby Tube (ST-1) collected from 9 to 11 ft in adjacent boring. Recovery 2.0 ft**	10				
	Gray, tan and orange SAND, some siltstone fragments, moist to dry, stiff, **(RESIDUAL SOIL)**		SS 6	100	6-6-9-9 (15)	
	Light tan decomposed CLAYSTONE, dry, stiff, **(RESIDUAL SOIL)**		SS 7	100	6-3-9-50 (12)	
	SANDSTONE FRAGMENTS, wet, medium dense, **(RESIDUAL SOIL)**					
1195	Tan sandy CLAYSTONE, dry, stiff, micaceous, **(RESIDUAL SOIL)**		SS 8	0	50/0.1	
	Gray and orange CLAYSTONE, some silt, dry, hard, **(BEDROCK)**	15	SS 9	100	40-50/0.2	
	Gray CLAYSTONE, some silt, dry, hard, **(BEDROCK)**		SS 10	100	50/0.1	
1190		20	SS 11	100	50/0.1	
			SS 12	100	50/0.2	
	Bottom of boring at 22.2 feet.					



CEC CUSTOM LOG APEX EXPANSION.GPJ CEC.GDT 4/4/11

Civil & Environmental Consultants, Inc.
333 Baldwin Road
Pittsburgh, PA 15205

BORING NUMBER SB-22

CLIENT Apex Environmental, LLC
PROJECT NAME Apex Lateral Expansion
PROJECT NUMBER 101-049
PROJECT LOCATION Amsterdam, Ohio
DATE STARTED 8/25/10 **COMPLETED** 8/25/10
GROUND ELEVATION 1224.21 ft **BACKFILL** Bentonite
DRILLING CONTRACTOR Test Boring Services, Inc.
GROUND WATER LEVELS:
DRILLING METHOD Auger/SS
BEFORE CORING Not Applicable
CEC REP LRW **CHECKED BY** JMN
AT END OF DRILLING Dry
NOTES Northing: 279864.36 Easting: 2408472.37
AFTER DRILLING Immediately Backfilled

ELEVATION (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	DEPTH (ft)	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	POCKET PEN (tsf)
		Brown to tan CLAY, trace silt, trace coal, dry, medium stiff, **(MINE SPOIL)**	0	SS 1	75	3-3-3-4 (6)	
		Tan, brown and black silty CLAY, some carbonaceous shale, dry, stiff, **(MINE SPOIL)**		SS 2	75	4-6-5-4 (11)	
1220		Tan, brown and black CLAY, some silt, some carbonaceous shale, dry, stiff, **(MINE SPOIL)**	5	SS 3	75	4-4-6-6 (10)	
		Tan and gray CLAY, some sandstone fragments, trace sand, dry, stiff, **(MINE SPOIL)**		SS 4	50	3-4-5-6 (9)	
1215		Tan CLAY, some sand, trace carbonaceous shale, dry, medium stiff, **(MINE SPOIL)** **Bag sample (B-1) collected from 8 to 12 ft**	10	SS 5	75	4-3-4-5 (7)	
		Yellow decomposed SANDSTONE, some clay, dry, very dense, micaceous on bottom, **(RESIDUAL SOIL)**		SS 6	75	6-7-47-23 (54)	
		Gray decomposed LIMESTONE, dry, **(RESIDUAL SOIL)** Yellowish gray limy CLAYSTONE, some sand, dry, very stiff, **(RESIDUAL SOIL)**		SS 7	75	7-20-8-19 (28)	
1210		Yellowish gray CLAY, dry, hard, **(RESIDUAL SOIL)**	15	SS 8	70	10-50/0.5	
		Gray LIMESTONE, dry, very dense, **(BEDROCK)** Bottom of boring at 15.1 feet.		SS 9	100	50/0.1	

▲ SPT N VALUE ▲
20 40 60 80
PL MC LL
20 40 60 80
☐ FINES CONTENT (%) ☐
20 40 60 80

50/0.5
50/0.1

CEC CUSTOM LOG APEX EXPANSION GPJ CEC GDT 4/4/11

BORING NUMBER SB-23

Civil & Environmental Consultants, Inc.
333 Baldwin Road
Pittsburgh, PA 15205

CLIENT Apex Environmental, LLC
PROJECT NAME Apex Lateral Expansion
PROJECT NUMBER 101-049
PROJECT LOCATION Amsterdam, Ohio
DATE STARTED 2/10/11 **COMPLETED** 2/11/11
GROUND ELEVATION 1282.38 ft **BACKFILL** Bentonite
DRILLING CONTRACTOR Boart Longyear
GROUND WATER LEVELS:
DRILLING METHOD Sonic
BEFORE CORING Not Applicable
CEC REP BRB **CHECKED BY** DWC
AT END OF DRILLING Dry
NOTES Northing: 280238.92 Easting: 2407602.27
AFTER DRILLING Immediately Backfilled

ELEVATION (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	DEPTH (ft)	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	POCKET PEN. (tsf)
			0				
		Brown silty CLAY, some coarse gravel, few shale fragments, medium plasticity, dry, stiff, **(MINE SPOIL)**					1.8
1280							3.1
				SONIC 1	52		
		No recovrey, **(MINE SPOIL)**					2.6
			5				
		Orangish brown clayey SILT, some coarse gravel, few limestone fragments, medium plasticity, dry, medium stiff, **(MINE SPOIL)**					0.7
		Orangish brown to gray clayey SILT, few, shale fragments, low plasticity, dry, medium stiff to very stiff, **(MINE SPOIL)**					2.0
1275				SONIC 2	70		2.1
		No recovery, **(MINE SPOIL)**					0.9
			10				
		Gray to brown sandy SILT, some coarse gravel, no plasticity, dry, very stiff to hard, **(MINE SPOIL)**					2.6
							4.1
1270		Gray to brown sandy SILT, some coarse gravel, few shale fragments, low plasticity, dry, very stiff to hard, **(MINE SPOIL)**					3.9
		Encountered LIMESTONE BOULDER, continued through soft minespoil, no recovery, **(MINE SPOIL)**					4.2
			15	SONIC 3	34		
1265							
			20				
		Gray to brown silty CLAY, trace shale fragments, medium plasticity, dry, very stiff, **(MINE SPOIL)**					2.9
		Gray sandy SILT, some siltstone fragments, no plasticity, dry, very soft, **(MINE SPOIL)**					0.3
1260							0
		Gray to brown silty CLAY, trace shale fragments, medium plasticity, dry, very stiff, **(MINE SPOIL)**					3.4
		Gray sandy SILT, some siltstone fragments, no plasticity, dry, very soft, **(MINE SPOIL)**	25	SONIC			

▲ SPT N VALUE ▲
20 40 60 80
PL MC LL
20 40 60 80
☐ FINES CONTENT (%) ☐
20 40 60 80

(Continued Next Page)

CEC CUSTOM LOG APEX EXPANSION.GPJ CEC.GDT 4/4/11

Civil & Environmental Consultants, Inc.
333 Baldwin Road
Pittsburgh, PA 15205

BORING NUMBER SB-23

CLIENT Apex Environmental, LLC **PROJECT NAME** Apex Lateral Expansion

PROJECT NUMBER 101-049 **PROJECT LOCATION** Amsterdam, Ohio

ELEVATION (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	DEPTH (ft)	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	POCKET PEN. (tsf)
		Encountered LIMESTONE BOULDER, continued through soft minespoil, no recovery, **(MINE SPOIL)***(continued)*	25	4	42		0.2
1255			30				
		Gray SILT, few coal fragments, no plasticity, dry, hard, **(MINE SPOIL)**					>4.5
		Black COAL, highly weathered, soft to medium stiff, **(MINE SPOIL)**					1.1
1250		Orangish brown clayey SILT, trace shale fragments, medium plasticity, dry, very stiff, **(MINE SPOIL)**					2.7
		Orangish brown sandy SILT, some coarse gravel, few shale fragments, no plasticity, dry, hard, **(MINE SPOIL)**					>4.5
		Encountered LIMESTONE BOULDER, continued through soft minespoil, no recovery, **(MINE SPOIL)**	35	SONIC 5	36		
1245			40				
		Gray SILT, with decomposed shale, low plasticity, dry, soft to medium stiff, **(MINE SPOIL)**					0.9
1240							2.0
		Encountered LIMESTONE BOULDER, continued through soft minespoil, no recovery, **(MINE SPOIL)**					0.3
			45	SONIC 6	22		
1235			50				
		Encountered LIMESTONE BOULDER, continued through soft minespoil, no recovery, **(MINE SPOIL)**					
1230							

▲ SPT N VALUE ▲
20 40 60 80
PL MC LL
20 40 60 80
☐ FINES CONTENT (%) ☐
20 40 60 80

(Continued Next Page)

Civil & Environmental Consultants, Inc.
333 Baldwin Road
Pittsburgh, PA 15205

BORING NUMBER SB-23

CLIENT Apex Environmental, LLC **PROJECT NAME** Apex Lateral Expansion

PROJECT NUMBER 101-049 **PROJECT LOCATION** Amsterdam, Ohio

ELEVATION (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	DEPTH (ft)	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	POCKET PEN. (tsf)	▲ SPT N VALUE ▲ 20 40 60 80 / PL MC LL 20 40 60 80 / ☐ FINES CONTENT (%) ☐ 20 40 60 80
		Encountered LIMESTONE BOULDER, continued through soft minespoil, no recovery, **(MINE SPOIL)***(continued)*	55	SONIC 7	25			
1225		Dark gray SHALE, hard, no reaction to HCl, **(BEDROCK)**					>4.5 >4.5 >4.5 >4.5	
		Dark gray SHALE, hard, low reaction to HCl, **(BEDROCK)**	60					
1220		Dark gray LIMESTONE, highly weathered, weak, high reaction to HCl, **(BEDROCK)**		SONIC 8	58		>4.5 >4.5 >4.5 >4.5 >4.5	
		Brown LIMESTONE, very strong, high reaction to HCl, **(BEDROCK)**	65					
		Bottom of boring at 65.0 feet.						

Civil & Environmental Consultants, Inc.
333 Baldwin Road
Pittsburgh, PA 15205

BORING NUMBER SB-24

CLIENT Apex Environmental, LLC
PROJECT NAME Apex Lateral Expansion
PROJECT NUMBER 101-049
PROJECT LOCATION Amsterdam, Ohio
DATE STARTED 2/15/11 **COMPLETED** 2/15/11
GROUND ELEVATION 1271.29 ft **BACKFILL** Bentonite
DRILLING CONTRACTOR Boart Longyear
GROUND WATER LEVELS:
DRILLING METHOD Sonic
BEFORE CORING Not Applicable
CEC REP BRB **CHECKED BY** DWC
AT END OF DRILLING Dry
NOTES Northing: 280654.79 Easting: 2409482.24
AFTER DRILLING Immediately Backfilled

ELEVATION (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	DEPTH (ft)	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	POCKET PEN (tsf)
		Brown silty SAND, some coal fragments, low plasticity, dry, moderate stiff, **(MINE SPOIL)**	0				1.1
1270		Gray LIMESTONE BOULDER, very strong, high reaction to HCl, **(MINE SPOIL)**					>4.5
		Encountered LIMESTONE BOULDER, continued through soft minespoil, no recovery, **(MINE SPOIL)**		SONIC 1	30		
			5				
		Gray LIMESTONE BOULDER, very strong, high reaction to HCl, **(MINE SPOIL)**					>4.5
1265							>4.5
		Encountered LIMESTONE BOULDER, continued through soft minespoil, no recovery, **(MINE SPOIL)**		SONIC 2	36		
			10				
		Brown silty SAND, few limestone fragments, few coal fragments, no plasticity, dry, soft, **(MINE SPOIL)**					0.2
1260		Gray LIMESTONE BOULDER, very strong, high reaction to HCl, **(MINE SPOIL)**					0.3
		Encountered LIMESTONE BOULDER from 12.5' - 15.0', continued through soft minespoil, no recovery, **(MINE SPOIL)**					>4.5
			15	SONIC 3	25		
1255							
			20				
		Brown to gray silty SAND, some coal fragments, trace coarse gravel, low plasticity, dry, soft to moderate stiff, **(MINE SPOIL)**					0.6
1250		Gray LIMESTONE BOULDER, very strong, high reaction to HCl, **(MINE SPOIL)**					1.0
		Encountered LIMESTONE BOULDER from 22.3' - 24' and 26'-27', continued through soft minespoil, no recovery, **(MINE SPOIL)**					>4.5
			25	SONIC			

▲ SPT N VALUE ▲
20 40 60 80
PL MC LL
20 40 60 80
☐ FINES CONTENT (%) ☐
20 40 60 80

(Continued Next Page)

CEC CUSTOM LOG APEX EXPANSION.GPJ CEC.GDT 4/4/11

Civil & Environmental Consultants, Inc.
333 Baldwin Road
Pittsburgh, PA 15205

BORING NUMBER SB-24

CLIENT Apex Environmental, LLC **PROJECT NAME** Apex Lateral Expansion

PROJECT NUMBER 101-049 **PROJECT LOCATION** Amsterdam, Ohio

ELEVATION (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	DEPTH (ft)	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	POCKET PEN. (tsf)
			25	4	23		
1245		Encountered LIMESTONE BOULDER from 22.3' - 24' and 26'-27', continued through soft minespoil, no recovery, **(MINE SPOIL)** *(continued)*	30				
1240		Gray to brown silty SAND, some coal fragments, few coarse gravel pieces, low plasticity, dry, stiff, **(MINE SPOIL)**					1.1
		Gray to brown sandy SILT, and gravel, low plasticity, dry, very stiff, **(MINE SPOIL)**					2.2
		Gray LIMESTONE BOULDER, very strong, high reaction to HCl, **(MINE SPOIL)**		SONIC 5	43		3.7
1235		Encountered LIMESTONE BOULDER, continued through soft minespoil, no recovery, **(MINE SPOIL)**	35				
		LIMESTONE BOULDER, no recovery, **(MINE SPOIL)**		SONIC 6	0		
1230			40				
		LIMESTONE BOULDER and brown to gray sandy SILT, some siltstone fragments, low plasticity, dry, stiff, **(MINE SPOIL)**					1.6
		Brown to gray sandy SILT, and siltstone, few limestone fragments, low plasticity, dry, very stiff to hard, **(MINE SPOIL)**	45	SONIC 7	48		3.9
1225		Dark gray SILTSTONE, hard, no reaction to HCl, **(BEDROCK)**					>4.5
		Gray LIMESTONE, very hard, trace calcite inclusions, high reaction to HCl, **(BEDROCK)**					>4.5
			50				>4.5
1220				SONIC 8	40		>4.5
							>4.5
							>4.5

▲ SPT N VALUE ▲ 20 40 60 80

PL MC LL 20 40 60 80

☐ FINES CONTENT (%) ☐ 20 40 60 80

CEC CUSTOM LOG APEX EXPANSION GPJ CEC GDT 4/4/11

(Continued Next Page)

Civil & Environmental Consultants, Inc.
333 Baldwin Road
Pittsburgh, PA 15205

BORING NUMBER SB-24

CLIENT Apex Environmental, LLC **PROJECT NAME** Apex Lateral Expansion

PROJECT NUMBER 101-049 **PROJECT LOCATION** Amsterdam, Ohio

ELEVATION (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	DEPTH (ft)	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	POCKET PEN. (tsf)	▲ SPT N VALUE ▲ 20 40 60 80 / PL MC LL 20 40 60 80 / ☐ FINES CONTENT (%) ☐ 20 40 60 80
		Gray LIMESTONE, very hard, trace calcite inclusions, high reaction to HCl, **(BEDROCK)***(continued)*	55				>4.5	
		Bottom of boring at 55.0 feet.						

Civil & Environmental Consultants, Inc.
333 Baldwin Road
Pittsburgh, PA 15205

BORING NUMBER SB-25

CLIENT Apex Environmental, LLC
PROJECT NAME Apex Lateral Expansion
PROJECT NUMBER 101-049
PROJECT LOCATION Amsterdam, Ohio
DATE STARTED 2/15/11 **COMPLETED** 2/15/11
GROUND ELEVATION 1287.50 ft **BACKFILL** Bentonite
DRILLING CONTRACTOR Boart Longyear
GROUND WATER LEVELS:
DRILLING METHOD Sonic
BEFORE CORING Not Applicable
CEC REP BRB **CHECKED BY** DWC
AT END OF DRILLING Dry
NOTES Northing: 281535.86 Easting: 2408500.90
AFTER DRILLING Immediately Backfilled

ELEVATION (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	DEPTH (ft)	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	POCKET PEN. (tsf)
		Gray to brown silty SAND, some micaceous siltstone, no plasticity, dry, stiff	0				1.1
		Gray to brown silty SAND, and coal, some micaceous siltstone, no plasticity, dry, very stiff					3.1
1285		Assuming soft minespoil, no recovery					3.0
			5	SONIC 1	24		
1280			10				
		Brown sandy SILT, few coal fragments, medium plasticity, dry, soft to stiff					2.0
1275		Highly weathered SHALE and brown to gray SILT, few coal fragments, low plasticity, dry, stiff					0.9
		Assuming soft minespoil, no recovery					2.0
			15	SONIC 2	24		
1270			20				
		Highly weathered SHALE and orangish brown silt, low plasticity, dry, moderate stiff to stiff					0.8
1265							1.4
		Orangish brown silty SAND, some coal, few shale fragments, no plasticity, dry, stiff					1.4
		Assuming soft minespoil, no recovery	25	SONIC			1.6

▲ SPT N VALUE ▲
20 40 60 80
PL MC LL
20 40 60 80
☐ FINES CONTENT (%) ☐
20 40 60 80

CEC CUSTOM LOG APEX EXPANSION.GPJ CEC.GDT 4/4/11

(Continued Next Page)

Civil & Environmental Consultants, Inc.
333 Baldwin Road
Pittsburgh, PA 15205

BORING NUMBER SB-25

CLIENT Apex Environmental, LLC **PROJECT NAME** Apex Lateral Expansion

PROJECT NUMBER 101-049 **PROJECT LOCATION** Amsterdam, Ohio

ELEVATION (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	DEPTH (ft)	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	POCKET PEN. (tsf)	▲ SPT N VALUE ▲ 20 40 60 80 / PL MC LL 20 40 60 80 / ☐ FINES CONTENT (%) ☐ 20 40 60 80
		Assuming soft minespoil, no recovery *(continued)*	25	3	44		1.8	
1260			30					
		Orangish brown silty SAND, some coal, some rock fragments, no plasticity, dry, very stiff to hard					3.8	
1255							4.0	
		Assuming soft minespoil, no recovery					4.5	
			35	SONIC 4	28			
1250								
			40					
		Tan to gray sandy SILT, some coal, few rock fragments, low plasticity, dry, very stiff					3.0	
1245							2.0	
		Gray to brown silty SAND, some rock fragments, no plasticity, dry, hard					1.6	
							4.4	
			45	SONIC 5	49		4.5	
		Assuming soft minespoil, no recovery						
1240								
			50					
		Orangish brown clayey SILT, some coal, low plasticity, dry, stiff					1.1	
1235							1.7	
							1.4	

(Continued Next Page)

Civil & Environmental Consultants, Inc.
333 Baldwin Road
Pittsburgh, PA 15205

BORING NUMBER SB-25

CLIENT Apex Environmental, LLC **PROJECT NAME** Apex Lateral Expansion

PROJECT NUMBER 101-049 **PROJECT LOCATION** Amsterdam, Ohio

ELEVATION (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	DEPTH (ft)	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	POCKET PEN. (tsf)	▲ SPT N VALUE ▲ 20 40 60 80 / PL MC LL 20 40 60 80 / ☐ FINES CONTENT (%) ☐ 20 40 60 80
		Orangish brown clayey SILT, some coal, low plasticity, dry, stiff *(continued)*		SONIC 6	80		1.4	
		Gray LIMESTONE, very hard, high reaction to HCl	55				>4.5	
		Gray to dark gray LIMESTONE, very hard, high reaction to HCl					>4.5	
1230							>4.5	
		Gray SHALE, highly weathered, no reaction to HCl					>4.5	
		Gray SILTSTONE, moderate stiff to hard, slight reaction to HCl	60				>4.5	
				SONIC 7	79		>4.5	
1225							>4.5	
							>4.5	
			65				>4.5	
		Bottom of boring at 65.0 feet.						

CEC CUSTOM LOG APEX EXPANSION GPJ CEC GDT 4/4/11

Civil & Environmental Consultants, Inc.
333 Baldwin Road
Pittsburgh, PA 15205

BORING NUMBER SB-26

CLIENT Apex Environmental, LLC
PROJECT NAME Apex Lateral Expansion
PROJECT NUMBER 101-049
PROJECT LOCATION Amsterdam, Ohio
DATE STARTED 2/11/11 **COMPLETED** 2/14/11
GROUND ELEVATION 1256.65 ft **BACKFILL** Bentonite
DRILLING CONTRACTOR Boart Longyear
GROUND WATER LEVELS:
DRILLING METHOD Sonic
BEFORE CORING Not Applicable
CEC REP BRB **CHECKED BY** DWC
AT END OF DRILLING Dry
NOTES Northing: 281373.57 Easting: 2409105.58
AFTER DRILLING Immediately Backfilled

ELEVATION (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	DEPTH (ft)	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	POCKET PEN. (tsf)
		Brown to gray silty CLAY, some micaceous siltstone, high plasticity, dry, hard	0				>4.5
1255		Gray sandy SILT, few micaceous siltstone fragments, no plasticity, dry, soft		SONIC 1	58		>4.5
		Assuming soft minespoil, no recovery	5				0.7
		Gray sandy SILT, some micaceous siltstone, no plasticity, dry, soft					0.5
1250		Brown SAND, few micaceous siltstone fragments, low plasticity, dry, very stiff		SONIC 2	40		2.6
		Assuming soft minespoil, no recovery	10				
		Brown SAND, few micaceous siltstone fragments, low plasticity, dry, very stiff					4.0
1245		Brown SAND, and gravel, no plasticity, dry, soft to hard		SONIC 3	92		0.8
		Gray LIMESTONE BOULDER, very strong, high reaction to HCl	15				>4.5
				SONIC 4	100		>4.5
1240		LIMESTONE BOULDER, no recovery		SONIC 5	0		>4.5
			20				
		Gray LIMESTONE BOULDER, very strong, high reaction to HCl					>4.5
1235		Brown clayey SILT, some limestone fragments, low plasticity, dry, very stiff		SONIC 6	78		2.2
		Gray LIMESTONE BOULDER, very strong, high reaction to HCl					2.3
		LIMESTONE BOULDER, no recovery	25				>4.5

▲ SPT N VALUE ▲
20 40 60 80
PL MC LL
20 40 60 80
☐ FINES CONTENT (%) ☐
20 40 60 80

(Continued Next Page)

CEC CUSTOM LOG APEX EXPANSION.GPJ CEC.GDT 4/4/11

Civil & Environmental Consultants, Inc.
333 Baldwin Road
Pittsburgh, PA 15205

BORING NUMBER SB-26

CLIENT Apex Environmental, LLC
PROJECT NAME Apex Lateral Expansion
PROJECT NUMBER 101-049
PROJECT LOCATION Amsterdam, Ohio

ELEVATION (ft)	MATERIAL DESCRIPTION	DEPTH (ft)	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	POCKET PEN. (tsf)
	LIMESTONE BOULDER, no recovery *(continued)*	25				
1230	Possible void or very soft minespoil, no recovery	30	SONIC 7	0		
1225	Brown sandy SILT, some limestone fragments, trace coal fragments, low plasticity, dry, soft		SONIC 8	103		0.5
	Brown sandy SILT, and coal, low plasticity, dry, soft					0.6
	Black COAL, dry					>4.5
	Encountered LIMESTONE BOULDER, continued through soft minespoil, no recovery	35	SONIC 9	48		
1220	Dark gray SHALE, few plant fossils, hard					>4.5
						>4.5
						>4.5
	Dark gray LIMESTONE, very hard, high reaction to HCl	40				>4.5
1215	Gray LIMESTONE, very hard, high reaction to HCl		SONIC 10	96		>4.5
						>4.5
						>4.5
		45				>4.5
1210			SONIC 11	20		>4.5
						>4.5
						>4.5
		50				>4.5
	Bottom of boring at 50.0 feet.					

▲ SPT N VALUE ▲
20 40 60 80
PL MC LL
20 40 60 80
☐ FINES CONTENT (%) ☐
20 40 60 80

CEC CUSTOM LOG APEX EXPANSION.GPJ CEC.GDT 4/4/11

LOG OF BORING NO B-1A — Sheet 1 of 2 Sheets

Apex Solid Waste Disposal Facility
Jefferson and Harrison Counties, Ohio

LOCATION: **See Plan Sheets 3D-1 and 3D-2** ELEVATION: 1293.9 DATE: 07/17-23/91

SAMPLER(S) 2" O.D. Split-Barrel

DRILLING METHOD: Hollow-stem Auger, Air Rotary, 5-1/4" Tricone COMPLETION DEPTH: 64.0'

DEPTH, FEET	SAMPLE NUMBER	SAMPLES	SAMPLING EFFORT	DESCRIPTION	NATURAL CONSISTENCY INDEX (NATURAL MOISTURE CONTENT; PLASTIC LIMIT; LIQUID LIMIT)	TEST RESULTS
0				MINE SPOIL Loose gray intermixed with brown fine to coarse gravel (shale fragments), some fine to coarse sand (shale fragments), some silty clay, few coal fragments, few cobbles and boulders. GC	10 20 30 40	
	1		5/2/5			
	2		8/7/7			
10	3		10/10/14			
	4		4/8/7			
				MINE SPOIL Cobbles and boulders, sandstone and limestone. GC		
20				MINE SPOIL Brown fine to coarse sand, some gravel, little clayey silt. SP		
				MINE SPOIL Limestone boulders. GP		
				MINE SPOIL Brown with gray fine to coarse gravel (shale fragments), some fine to coarse sand, little silty clay, many cobbles and boulders, contains zones up to 5' of cobbles and boulders. GC		
30						
40						
50				-Continued-		

WATER LEVEL: 60.5'
DATE: 07/23

SYMBOLS USED TO INDICATE TEST RESULTS

G - GRADATION O - UNCONFINED COMPR. T - TRIAXIAL COMPR. C - CONSOLIDATION	SEE SEPARATE CURVES	H - PENETROMETER (tsf) W - UNIT DRY WEIGHT (pcf) D - RELATIVE DENSITY (%)

BOLAIR ENGINEERING, INC. JOB: 3850

Plate B-43

LOG OF BORING NO. B-1A

Apex Solid Waste Disposal Facility
Jefferson and Harrison Counties, Ohio

LOCATION: See Plan Sheets 3D-1 and 3D-2 ELEVATION: 1293.9 DATE: 07/17-23/91

SAMPLER(S): 2" O.D. Split-Barrel

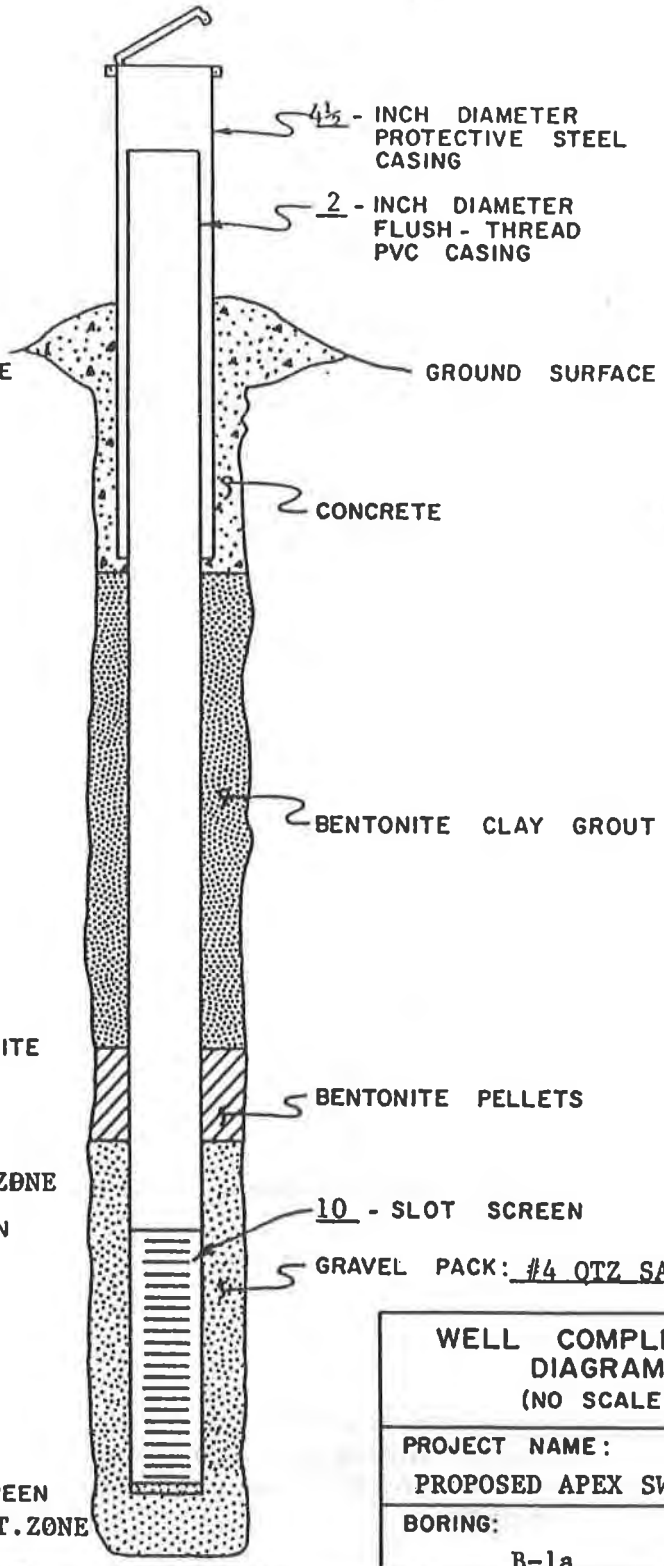
DRILLING METHOD: Hollow-stem Auger, Air Rotary, 5-1/4" Tricone COMPLETION DEPTH: 64.0'

DEPTH, FEET	SAMPLE NUMBER	SAMPLES	SAMPLING EFFORT	DESCRIPTION	NATURAL CONSISTENCY INDEX (Natural Moisture Content; Plastic Limit; Liquid Limit) 10 20 30 40	TEST RESULTS
50				-Continued- MINE SPOIL Brown with gray fine to coarse gravel (shale fragments), some fine to coarse sand, little silty clay, many cobbles and boulders, contains zones up to 5' of cobbles and boulders. GC		
60						
				Encountered seepage from 60.0' to 64.0'		
				Encountered shale bedrock at 64.0'.		
70						
80						
90						
100						

WATER LEVEL: 60.5'
DATE: 07/23

SYMBOLS USED TO INDICATE TEST RESULTS
G - GRADATION
U - UNCONFINED COMPR.
T - TRIAXIAL COMPR.
C - CONSOLIDATION
SEE SEPARATE CURVES
H - PENETROMETER (tsf)
W - UNIT DRY WEIGHT (pcf)
D - RELATIVE DENSITY (%)

ELEV. *	DEPTH BELOW GROUND SURFACE (FEET)	
1296.53	+2.6	TOP OF COVER
1296.40	+2.5	TOP OF PVC
1293.9	0.0	GROUND SURFACE
1251.8	42.1	TOP OF GROUT
1241.4	52.5	TOP OF BENTONITE
1239.3	54.6	TOP OF GRAVEL
1235.0	58.9	TOP OF SAT. ZONE
1235.4	58.5	TOP OF SCREEN
1231.4	62.5	BOTTOM OF SCREEN
1229.9	64.0	BOTTOM OF SAT. ZONE
1229.9	64.0	BORING DEPTH



WELL COMPLETION DIAGRAM
(NO SCALE)

PROJECT NAME: PROPOSED APEX SWDF

BORING: B-1a

STATIC WATER ELEVATION: *	1233.88	1234.85	1235.1	1233.62
DATE:	7/24	7/29	8/5	8/8

DATE WELL INSTALLED: 7/22/91

BBC&M PROJECT NO: 3850

* FEET ABOVE MSL

WELL DEVELOPMENT: BAILED 3 GALLONS OVER 2 DAYS. WATER VERY SILTY AT COMPLETION.

BBC&M ENGINEERING, INC.

Plate B-120

LOG OF BORING NO. B-1B — Sheet 1 of 3 Sheets

Apex Solid Waste Disposal Facility
Jefferson and Harrison Counties, Ohio

LOCATION: **See Plan Sheets 3D-1 and 3D-2** ELEVATION: 1293.5 DATE: 07/05-12/91

SAMPLER(S):

DRILLING METHOD: Air Rotary, 6-1/4" Tricone COMPLETION DEPTH: 193.0'

DEPTH, FEET	SAMPLE NUMBER	SAMPLES	SAMPLING EFFORT	DESCRIPTION	NATURAL CONSISTENCY INDEX (NATURAL MOISTURE CONTENT; PLASTIC LIMIT X — X LIQUID LIMIT; 10 20 30 40)	TEST RESULTS
50				MINE SPOIL: 0.0' - 64.0' See Log B-1A		
60				Soft gray shale.		
				Hard gray limestone.		
70				Soft to medium-hard gray shale.		
80				From 78.5' to 79.0' and 82.0' to 82.5'; Hard gray limestone		
90				Medium-hard dark-gray shale, contains thin seams of siltstone		
100				-Continued-		

WATER LEVEL: 148.8
DATE: 07/12

SYMBOLS USED TO INDICATE TEST RESULTS

G - GRADATION
O - UNCONFINED COMPR
T - TRIAXIAL COMPR.
C - CONSOLIDATION
} SEE SEPARATE CURVES

H - PENETROMETER (tsf)
W - UNIT DRY WEIGHT (pcf)
D - RELATIVE DENSITY (%)

DOUGLAS ENGINEERING, INC. JOB 3000

LOG OF BORING NO. B-1B — Sheet 2 of 3 Sheets

Apex Solid Waste Disposal Facility
Jefferson and Harrison Counties, Ohio

LOCATION: See Plan Sheets 3D-1 and 3D-2 — ELEVATION: 1293.5 — DATE: 07/05-12/91

SAMPLER(S):

DRILLING METHOD: Air Rotary, 6-1/4" Tricone — COMPLETION DEPTH: 193.0'

DEPTH, FEET	SAMPLE NUMBER	SAMPLES	SAMPLING EFFORT	DESCRIPTION	NATURAL CONSISTENCY INDEX / NATURAL MOISTURE CONTENT (PLASTIC LIMIT – LIQUID LIMIT)	TEST RESULTS
100				-Continued- Medium-hard dark-gray shale, contains thin seams of siltstone.	10 20 30 40	
110				From 118.0' to 119.0'; Medium-hard black coal.		
120				Soft to medium-hard gray sandstone, fine to medium grained.		
130						
140				From 141.0' to 144.0'; Medium-hard dark-gray shale interbedded with hard gray limestone.		
150				-Continued-		

WATER LEVEL: 148.8'
DATE: 07/12

SYMBOLS USED TO INDICATE TEST RESULTS

G - GRADATION
Q - UNCONFINED COMPR.
T - TRIAXIAL COMPR.
C - CONSOLIDATION
} SEE SEPARATE CURVES

H - PENETROMETER (tsf)
W - UNIT DRY WEIGHT (pcf)
D - RELATIVE DENSITY (%)

Plate B-46

LOG OF BORING NO. B-1B — Sheet 3 of 3 Sheets

Apex Solid Waste Disposal Facility
Jefferson and Harrison Counties, Ohio

LOCATION: See Plan Sheets 3D-1 and 3D-2 — ELEVATION: 1293.5 — DATE: 07/05-12/91

SAMPLER(S):

DRILLING METHOD: Air Rotary, 6-1/4" Tricone — COMPLETION DEPTH: 193.0'

DEPTH, FEET	SAMPLE NUMBER	SAMPLES	SAMPLING EFFORT	DESCRIPTION	NATURAL CONSISTENCY INDEX / NATURAL MOISTURE CONTENT (PLASTIC LIMIT X — LIQUID LIMIT X; 10 20 30 40)	TEST RESULTS
150				-Continued- Medium-hard gray fine to medium-grained sandstone		
				Soft to medium-hard dark-gray shale, contains seams of siltstone.		
160						
170						
180						
190				Encountered water at 165.0'.		
200						

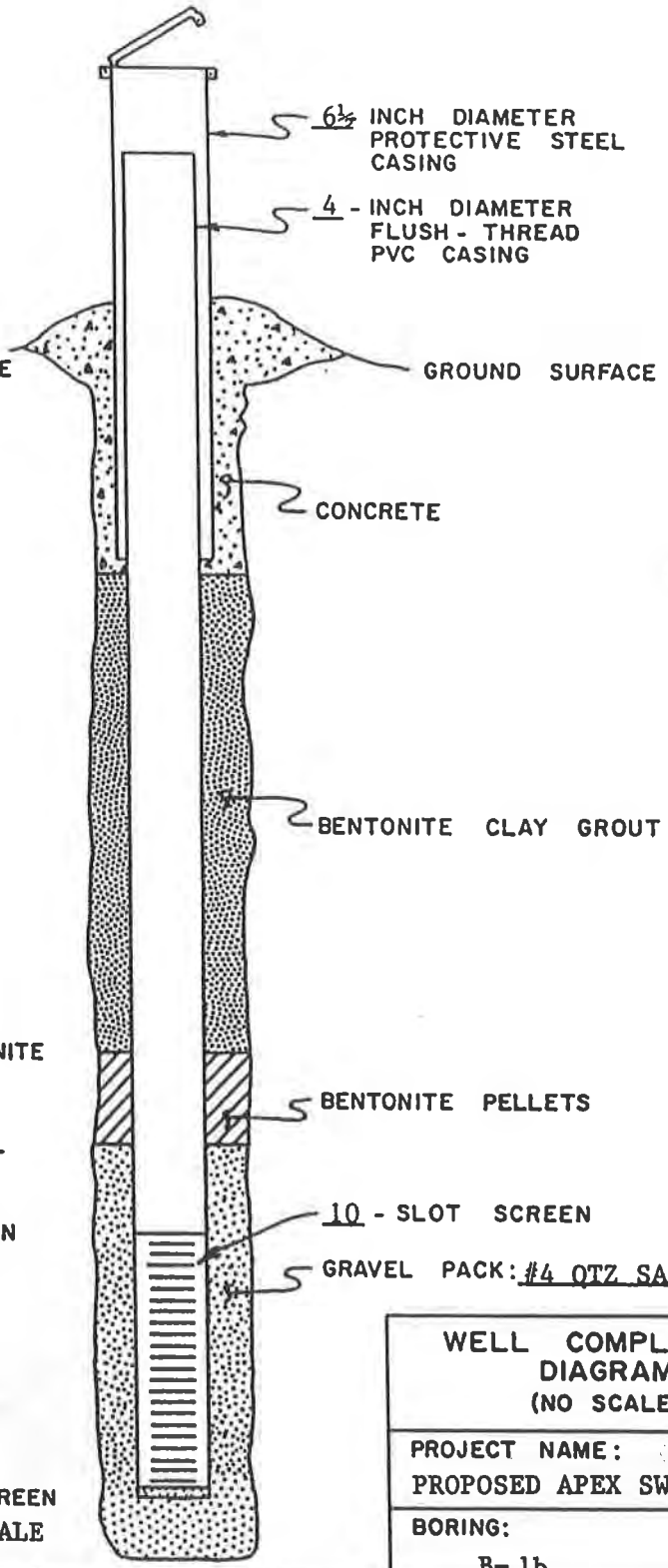
WATER LEVEL: 148.8'
DATE: 07/12

SYMBOLS USED TO INDICATE TEST RESULTS

G - GRADATION
O - UNCONFINED COMPR.
T - TRIAXIAL COMPR.
C - CONSOLIDATION
} SEE SEPARATE CURVES

H - PENETROMETER (tsf)
W - UNIT DRY WEIGHT (pcf)
D - RELATIVE DENSITY (%)

ELEV. *	DEPTH BELOW GROUND SURFACE (FEET)	
1296.17	+2.7	TOP OF COVER
1295.96	+2.5	TOP OF PVC
1293.5	0.0	GROUND SURFACE
1251.1	42.4	TOP OF GROUT
1134.0	159.5	TOP OF BENTONITE
1132.0	161.5	TOP OF GRAVEL
1138.5	155.0	TOP OF SHALE
1129.5	164.0	TOP OF SCREEN
1120.5	173.0	BOTTOM OF SCREEN
–	–	BOTTOM OF SHALE
1100.5	193.0	BORING DEPTH



WELL COMPLETION DIAGRAM
(NO SCALE)

PROJECT NAME: PROPOSED APEX SWDF

BORING: B-1b

STATIC WATER ELEVATION: *	1152.1	1162.7	1161.9	1162.0
DATE:	7/16	7/29	8/5	8/8

DATE WELL INSTALLED: 7/12/91

BBC&M PROJECT NO: 3850

* FEET ABOVE MSL

WELL DEVELOPMENT: PUMPED 90 GALLONS OVER 2 DAYS. WATER SLIGHTLY CLOUDY AT COMPLETION. WELL YIELDING APPROXIMATELY 0.3 GALLONS PER MINUTE.

BBC&M ENGINEERING, INC.

Plate B-130

LOG OF BORING NO. B-2A

Apex Solid Waste Disposal Facility
Jefferson and Harrison Counties, Ohio

LOCATION: See Plan Sheets 3D-1 and 3D-2 ELEVATION: 1265 5 DATE: 07/05-19/91

SAMPLER(S): 2" O.D. Split-Barrel

DRILLING METHOD: Hollow-stem Auger, Air Rotary, 5-1/4" Tricone COMPLETION DEPTH: 46.0'

DEPTH, FEET	SAMPLE NUMBER	SAMPLES	SAMPLING EFFORT	DESCRIPTION	TEST RESULTS
0				**MINE SPOIL** Very-soft to soft brown and gray shale fragments, intermixed with fine to medium sandstone fragments, contains coal fragments. GP	
	1		42/50R		H=4.5+
				MINE SPOIL Very-soft to medium-hard brown and gray shale fragments, partly similar to hard silty clay, few coal fragments (few boulder-sized). GP	
	2		10/8/6		
10	3		8/4/5		
				MINE SPOIL Very-soft to medium hard brown and gray shale fragments, partly similar to hard soil, many cobbles and bolders sizes, few coal fragments, few hard limestone fragments. GP	
	4		11/8/7		
				MINE SPOIL Very-soft to soft gray and brown shale fragments, partly similar to silty clay, few coal and limestone fragments. GP	
20	5		6/10/9		
				MINE SPOIL Very-soft to medium-hard gray and brown limestone fragments, intermixed with shale fragments, few coal fragments, occational cobbles. GP	
	6		42/22/16		
				MINE SPOIL Very-soft brown and gray shale fragments intermixed with medium-hard gray shale and limestone fragments, few coal fragments, few cobbles and bolders, partly simular to very hard soil. GP	
30	7		10/13/21		
	8		6/8/7		
				MINE SPOIL Medium-hard gray and brown limestone boulders.	
40				Soft to medium-hard gray shale.	
				Encountered water from 39.0' to 44.5'.	
50					

NATURAL CONSISTENCY INDEX
NATURAL MOISTURE CONTENT
PLASTIC LIMIT — LIQUID LIMIT
10 20 30 40

WATER LEVEL: 40.7'
DATE: 07/19

SYMBOLS USED TO INDICATE TEST RESULTS

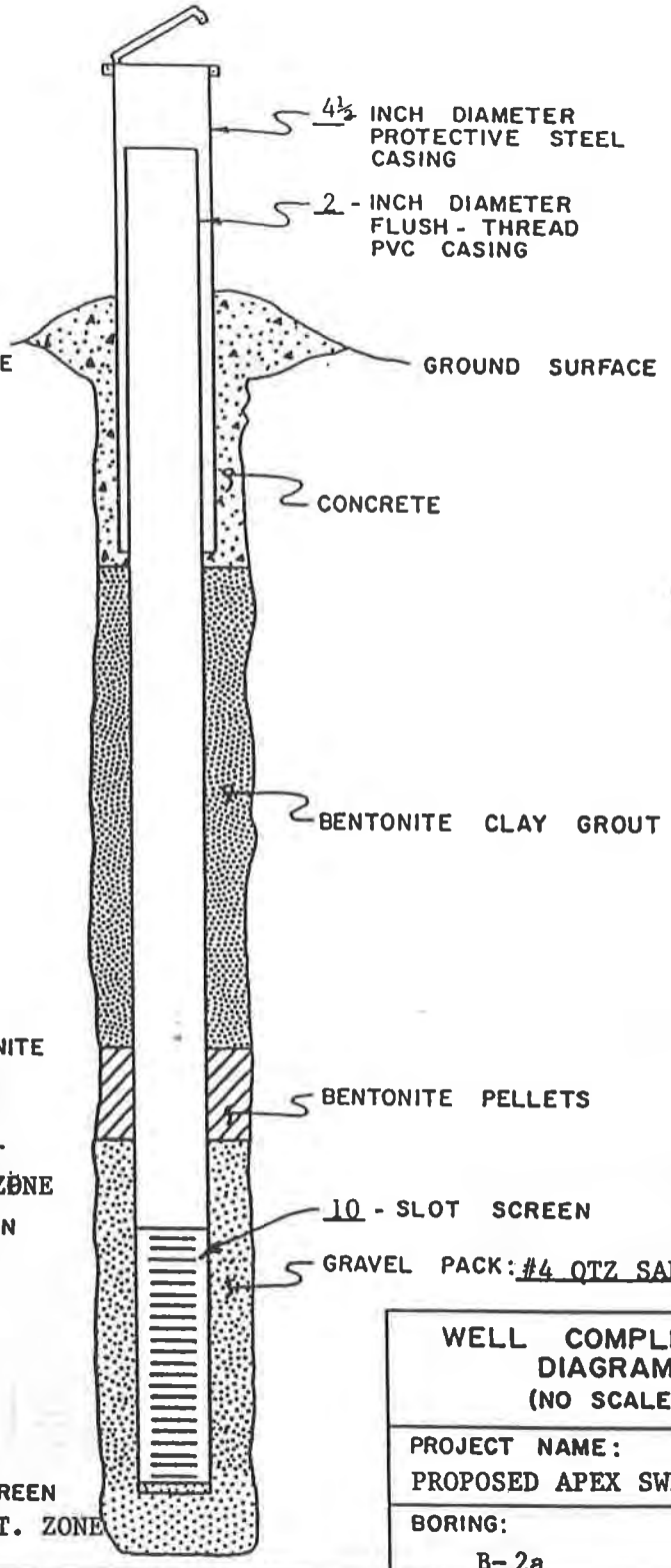
G - GRADATION
O - UNCONFINED COMPR.
T - TRIAXIAL COMPR.
C - CONSOLIDATION
} SEE SEPARATE CURVES

H - PENETROMETER (tsf)
W - UNIT DRY WEIGHT (pcf)
D - RELATIVE DENSITY (%)

BOLAR ENGINEERING, INC JOB 3000

Plate B-48

ELEV. *	DEPTH BELOW GROUND SURFACE (FEET)	
1268.21	+2.7	TOP OF COVER
1268.04	+2.5	TOP OF PVC
1265.5	0.0	GROUND SURFACE
1265.1	0.4	TOP OF GROUT
1231.9	33.6	TOP OF BENTONITE
1230.5	35.0	TOP OF GRAVEL
1225.0	40.5	TOP OF SAT. ZONE
1226.5	39.0	TOP OF SCREEN
1222.5	43.0	BOTTOM OF SCREEN
1221.0	44.5	BOTTOM OF SAT. ZONE
1219.5	46.0	BORING DEPTH



WELL COMPLETION DIAGRAM
(NO SCALE)

PROJECT NAME: PROPOSED APEX SWDF

BORING: B-2a

DATE WELL INSTALLED: 7/19/91

BBC&M PROJECT NO: 3850

STATIC WATER ELEVATION: *	1224.74	1224.57	1224.44	1224.38
DATE:	7/22	7/29	8/5	8/8

* FEET ABOVE MSL

WELL DEVELOPMENT: BAILED 50 GALLONS OVER 2 DAYS. WATER CLOUDY AT COMPLETION.

BBC&M ENGINEERING, INC.

Plate B-131

LOG OF BORING NO: B-2B

Sheet 1 of 4 Sheets

Apex Solid Waste Disposal Facility
Jefferson and Harrison Counties, Ohio

LOCATION **See Plan Sheets 3D-1 and 3D-2** ELEVATION: 1265.9 DATE: 06/20-25/91

SAMPLER(S) PQM Core Barrel

DRILLING METHOD: Air Rotary, 6-1/4" Tricone COMPLETION DEPTH: 159.0'

DEPTH, FEET	SAMPLE NUMBER	SAMPLES	SAMPLING EFFORT	DESCRIPTION	NATURAL CONSISTENCY INDEX (NATURAL MOISTURE CONTENT; PLASTIC LIMIT; LIQUID LIMIT) 10 20 30 40	TEST RESULTS
0				MINE SPOIL: 0.0' - 41.5' SEE LOG B-2A		
10						
20						
30						
40				Soft to medium-hard gray shale.		
50				Hard gray limestone. -Continued-		

WATER LEVEL: 40.3'
DATE: 06/25

SYMBOLS USED TO INDICATE TEST RESULTS

G - GRADATION
O - UNCONFINED COMPR.
T - TRIAXIAL COMPR.
C - CONSOLIDATION
} SEE SEPARATE CURVES

H - PENETROMETER (tsf)
W - UNIT DRY WEIGHT (pcf)
D - RELATIVE DENSITY (%)

BBL&M ENGINEERING, INC JOB: 3850

LOG OF BORING NO B-2B — Sheet 2 of 4 Sheets

Apex Solid Waste Disposal Facility
Jefferson and Harrison Counties, Ohio

LOCATION: **See Plan Sheets 3D-1 and 3D-2** ELEVATION: 1265.9 DATE: 06/20-25-91

SAMPLER(S): PQM Core Barrel

DRILLING METHOD: Air Rotary, 6-1/4" Tricone COMPLETION DEPTH: 159.0'

DEPTH, FEET	SAMPLE NUMBER	SAMPLES	SAMPLING EFFORT	DESCRIPTION	NATURAL CONSISTENCY INDEX (NATURAL MOISTURE CONTENT; PLASTIC LIMIT; LIQUID LIMIT; 10 20 30 40)	TEST RESULTS
50				-Continued- Hard gray limestone.		
				Medium-hard with seams of soft gray shale, nearly horizontally bedded, many horizontal fractures and partings, occasional diagonal fracture, contains few thin seams of siltstone.		
60			PQM			
	1		REC --- 100%	66.4' to 66.6'; Completed vertical permeability test See test results.		ROD --- 65%
70						
80				Medium-hard gray siltstone, nearly horizontally bedded, many horizontal fractures, occasional vertical and diagonal fractures, occasional thin seam of shale.		
			PQM			
90	2		REC --- 95%	94.3' to 94.5'; Completed vertical permeability test See test results.		ROD --- 82%
100				-Continued-		

WATER LEVEL: 40.3'
DATE: 06/25

SYMBOLS USED TO INDICATE TEST RESULTS

G - GRADATION
Q - UNCONFINED COMPR.
T - TRIAXIAL COMPR.
C - CONSOLIDATION
} SEE SEPARATE CURVES

H - PENETROMETER (tsf)
W - UNIT DRY WEIGHT (pcf)
D - RELATIVE DENSITY (%)

BOUCHER ENGINEERING, INC. JOB 3830

Plate B-50

LOG OF BORING NO. B-2B — Sheet 3 of 4 Sheets

Apex Solid Waste Disposal Facility
Jefferson and Harrison Counties, Ohio

LOCATION: See Plan Sheets 3D-1 and 3D-2 — ELEVATION: 1265.9 — DATE: 06/20-25/91

SAMPLER(S): PQM Core Barrel

DRILLING METHOD: Air Rotary, 6-1/4" Tricone — COMPLETION DEPTH: 159.0'

DEPTH, FEET	SAMPLE NUMBER	SAMPLES	SAMPLING EFFORT	DESCRIPTION	TEST RESULTS
100				-Continued-	
				Medium-hard dark-gray silty shale, nearly horizontally bedded, few horizontal fractures, few seams of limestone.	
				108.0' to 108.2'; Completed vertical permeability test. See test results.	
			PQM	109.4' to 109.6'; Completed horizontal permeability test. See test results.	
110			REC --- 99%		ROD --- 87%
	3			Medium-hard light-gray fine-grained sandstone, nearly horizontally bedded, few shale partings, micaceous, few horizontal and occasional diagonal fractures.	
				111.5' to 111.7'; Completed vertical permeability test.	
				111.8' to 112.0'; Completed horizontal permeability test.	
				114.0' to 114.2'; Completed vertical permeability test. (See test results.)	
120				Soft to medium-hard gray shale	
			PQM	Medium-hard light-gray with streaks of dark-gray fine to medium-grained sandstone, nearly horizontally bedded, many thin seams of shale, occasional thin seam of coal, micaceous.	
130			REC --- 95%	129.6' to 129.8'; Completed vertical permeability test. See test results.	ROD --- 88%
	4				
140					
			PQM		
			REC --- 98%	From 146.5' to 148.0'; Medium-hard dark-gray siltstone	ROD --- 93%
150	5			151.0' to 151.2'; Completed vertical permeability test See test results.	
				-Continued-	

NATURAL CONSISTENCY INDEX — NATURAL MOISTURE CONTENT — PLASTIC LIMIT — LIQUID LIMIT — 10 20 30 40

WATER LEVEL: 40.3'
DATE: 06/25

SYMBOLS USED TO INDICATE TEST RESULTS

G - GRADATION
O - UNCONFINED COMPR.
T - TRIAXIAL COMPR.
C - CONSOLIDATION
} SEE SEPARATE CURVES

H - PENETROMETER (tsf)
W - UNIT DRY WEIGHT (pcf)
D - RELATIVE DENSITY (%)

DOLAN ENGINEERING, INC. JOB: 3DDU

Plate B-51

LOG OF BORING NO. B-2B — Sheet 4 of 4 Sheets

Apex Solid Waste Disposal Facility
Jefferson and Harrison Counties, Ohio

LOCATION: See Plan Sheets 3D-1 and 3D-2 ELEVATION: 1265.9 DATE: 06/20-25/91

SAMPLER(S): PQM Core Barrel

DRILLING METHOD: Air Rotary, 6-1/4" Tricone COMPLETION DEPTH: 159.0'

DEPTH, FEET	SAMPLE NUMBER	SAMPLES	SAMPLING EFFORT	DESCRIPTION	NATURAL CONSISTENCY INDEX (NATURAL MOISTURE CONTENT; PLASTIC LIMIT; LIQUID LIMIT)	TEST RESULTS
150				-Continued-	10 20 30 40	
	5		PQM REC --- 98%	Medium-hard light-gray with streaks of dark-gray fine to medium-grained sandstone, nearly horizontally bedded, many thin seams of shale, occasional thin seam of coal, micaceous.		RQD --- 93%
160				Medium-hard gray siltstone, nearly horizontally bedded, few horizontal fractures, sandy.		
				Encountered water from 126.0' to 158.5'		
170						
180						
190						
200						

WATER LEVEL: 40.3'
DATE: 06/25

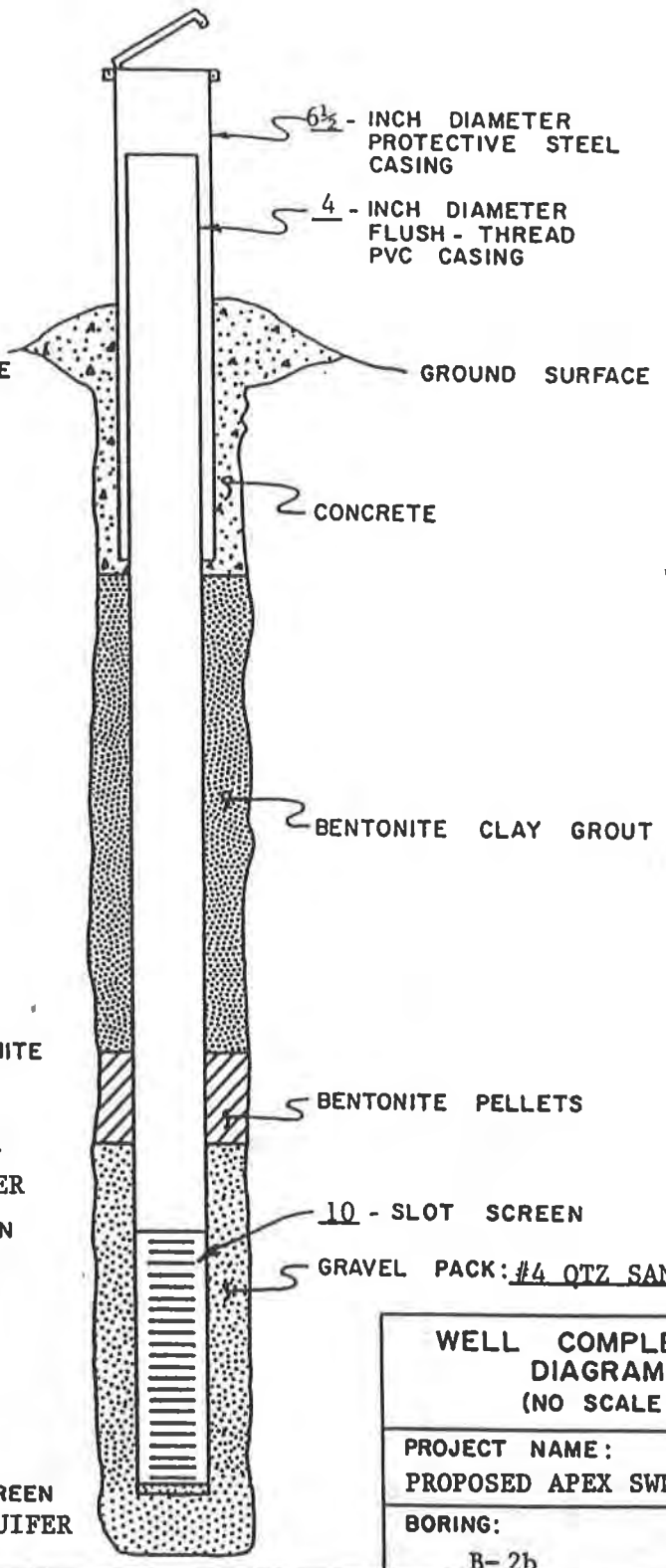
SYMBOLS USED TO INDICATE TEST RESULTS

G - GRADATION
Q - UNCONFINED COMPR
T - TRIAXIAL COMPR
C - CONSOLIDATION
} SEE SEPARATE CURVES

H - PENETROMETER (tsf)
W - UNIT DRY WEIGHT (pcf)
D - RELATIVE DEN (%)

Plate B-52

ELEV. *	DEPTH BELOW GROUND SURFACE (FEET)	
1268.44	+2.5	TOP OF COVER
1268.23	+2.3	TOP OF PVC
1265.9	0.0	GROUND SURFACE
1216.2	49.7	TOP OF GROUT
1143.9	122.0	TOP OF BENTONITE
1141.6	124.3	TOP OF GRAVEL
1139.9	126.0	TOP OF AQUIFER
1142.5	123.4	TOP OF SCREEN
1133.5	132.4	BOTTOM OF SCREEN
1108.3	157.6	BOTTOM OF AQUIFER
1106.9	159.0	BORING DEPTH



WELL COMPLETION DIAGRAM
(NO SCALE)

PROJECT NAME: PROPOSED APEX SWDF

BORING: B-2b

STATIC WATER ELEVATION: *	1160.4	1160.2	1159.9	1158.7
DATE:	6/28	7/8	7/10	7/29

DATE WELL INSTALLED: 6/25/91

BBC&M PROJECT NO: 3850

* FEET ABOVE MSL

WELL DEVELOPMENT: BAILED OR PUMPED 65 GALLONS OVER 2 DAYS WATER CLOUDY AT COMPLETION. WELL YIELDING APPROXIMATELY 4 GALLONS PER HOUR.

BBC&M ENGINEERING, INC.

Plate B-132

LOG OF BORING NO. B-3 — Sheet 1 of 4 Sheets

Apex Solid Waste Disposal Facility
Jefferson and Harrison Counties, Ohio

LOCATION: **See Plan Sheets 3D-1 and 3D-2** ELEVATION: 1228.3 DATE: 07/16-17/91

SAMPLER(S):

DRILLING METHOD: Air Rotary, 6-1/4" Tricone COMPLETION DEPTH: 155.0'

DEPTH, FEET	SAMPLE NUMBER	SAMPLES	SAMPLING EFFORT	DESCRIPTION	NATURAL CONSISTENCY INDEX (NATURAL MOISTURE CONTENT, PLASTIC LIMIT, LIQUID LIMIT)	TEST RESULTS
0				TOPSOIL = 12 INCHES	10 20 30 40	
				Brown silty clay.		
				Hard gray limestone.		
				Very-soft gray-brown shale.		
				Soft to medium-hard brown shale.		
10						
20				Below 20.0'; Becomes gray.		
				26.5' to 31.0'; Soft to medium-hard dark-gray shale.		
30						
	36			Medium-hard brown fine-grained sandstone.		
40						
				Soft to medium-hard gray fine-grained sandstone, occasional thin seam of shale.		
				-Continued-		
50						

WATER LEVEL: 125.4'
DATE: 07/17

SYMBOLS USED TO INDICATE TEST RESULTS

G - GRADATION
Q - UNCONFINED COMPR.
T - TRIAXIAL COMPR.
C - CONSOLIDATION
} SEE SEPARATE CURVES

H - PENETROMETER (tsf)
W - UNIT DRY WEIGHT (pcf)
D - RELATIVE DENSITY (%)

BBC&M ENGINEERING, INC JOB: 3850

Plate B-53

LOG OF BORING NO. B-3 Sheet 2 of 4 Sheets

Apex Solid Waste Disposal Facility
Jefferson and Harrison Counties, Ohio

LOCATION: See Plan Sheets 3D-1 and 3D-2 ELEVATION: 1228.3 DATE: 07/16-17/91

SAMPLER(S):

DRILLING METHOD: Air Rotary, 6-1/4" Tricone COMPLETION DEPTH: 155.0'

DEPTH, FEET	SAMPLE NUMBER	SAMPLES	SAMPLING EFFORT	DESCRIPTION	NATURAL CONSISTENCY INDEX (NATURAL MOISTURE CONTENT; PLASTIC LIMIT; LIQUID LIMIT)	TEST RESULTS
50				-Continued- Soft to medium-hard gray fine-grained sandstone, occasional thin seam of shale.	10 20 30 40	
				Soft to medium-hard interbedded gray fine-grained sandstone and medium-hard brown siltstone.		
60						
70						
				Soft to medium-hard gray fine grained sandstone		
80						
				From 94.0' to 97.5'; Brown.		
90						
100				-Continued-		

WATER LEVEL: 125.4'
DATE: 07/17

SYMBOLS USED TO INDICATE TEST RESULTS

G - GRADATION
O - UNCONFINED COMPR.
T - TRIAXIAL COMPR.
C - CONSOLIDATION
} SEE SEPARATE CURVES

H - PENETROMETER (tsf)
W - UNIT DRY WEIGHT (pcf)
D - RELATIVE DENSITY (%)

BBL&E ENGINEERING, INC. JOB: 3850

Plate B-54

LOG OF BORING NO. B-3

Apex Solid Waste Disposal Facility
Jefferson and Harrison Counties, Ohio

LOCATION: See Plan Sheets 3D-1 and 3D-2 ELEVATION: 1228.3 DATE: 07/16-17/91

SAMPLER(S):

DRILLING METHOD: Air Rotary, 6-1/4" Tricone COMPLETION DEPTH: 155.0'

DEPTH, FEET	SAMPLE NUMBER	SAMPLES	SAMPLING EFFORT	DESCRIPTION	NATURAL CONSISTENCY INDEX (NATURAL MOISTURE CONTENT; PLASTIC LIMIT; LIQUID LIMIT) 10 20 30 40	TEST RESULTS
100				-Continued- Soft to medium-hard gray fine-grained sandstone.		
				From 105.0' to 106.5'; Medium-hard brown siltstone		
110						
				From 115.5' to 116.0'; Medium-hard brown sandstone		
120						
130				From 131.0' to 132.0'; Medium-hard brown siltstone From 132.0' to 132.5'; Medium-hard black coal.		
140						
				Medium-hard gray shale.		
150				-Continued-		

WATER LEVEL: 125.4'
DATE: 07/17

SYMBOLS USED TO INDICATE TEST RESULTS
G - GRADATION
Q - UNCONFINED COMPR.
T - TRIAXIAL COMPR.
C - CONSOLIDATION
SEE SEPARATE CURVES
H - PENETROMETER (tsf)
W - UNIT DRY WEIGHT (pcf)
D - RELATIVE DENSITY (%)

LOG OF BORING NO. B-3 Sheet 4 of 4 Sheets

Apex Solid Waste Disposal Facility
Jefferson and Harrison Counties, Ohio

LOCATION: See Plan Sheets 3D-1 and 3D-2 ELEVATION: 1228.3 DATE: 07/16-17/91

SAMPLER(S):

DRILLING METHOD: Air Rotary, 6-1/4" Tricone COMPLETION DEPTH: 155.0'

DEPTH, FEET	SAMPLE NUMBER	SAMPLES	SAMPLING EFFORT	DESCRIPTION	NATURAL CONSISTENCY INDEX (NATURAL MOISTURE CONTENT; PLASTIC LIMIT; LIQUID LIMIT)	TEST RESULTS
150				Medium-hard gray shale.	10 20 30 40	
				Soft to medium-hard red-brown shale.		
				Encountered water from 144.0' to 154.0'		
160						
170						
180						
190						
200						

WATER LEVEL: 125.4'
DATE: 07/17

SYMBOLS USED TO INDICATE TEST RESULTS

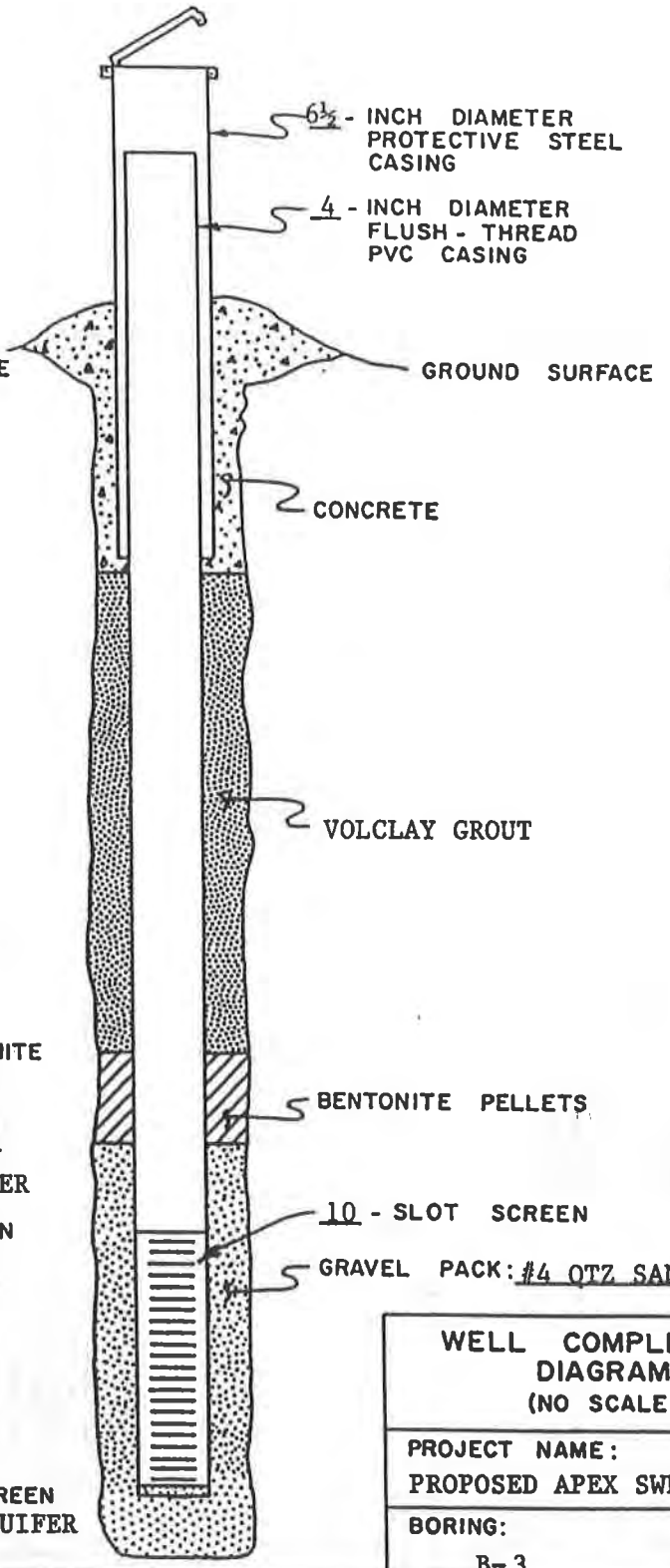
G - GRADATION
Q - UNCONFINED COMPR.
T - TRIAXIAL COMPR.
C - CONSOLIDATION
} SEE SEPARATE CURVES

H - PENETROMETER (tsf)
W - UNIT DRY WEIGHT (pcf)
D - RELATIVE DENSITY (%)

DBUA ENGINEERING, INC. JOB 3031

Plate B-56

ELEV. *	DEPTH BELOW GROUND SURFACE (FEET)	
1231.05	+2.7	TOP OF COVER
1230.83	+2.5	TOP OF PVC
1228.3	0.0	GROUND SURFACE
1227.8	0.5	TOP OF GROUT
1090.8	137.5	TOP OF BENTONITE
1089.0	139.3	TOP OF GRAVEL
1153.3	75.0	TOP OF AQUIFER
1085.4	142.9	TOP OF SCREEN
1076.4	151.9	BOTTOM OF SCREEN
1084.3	144.0	BOTTOM OF AQUIFER
1073.3	155.0	BORING DEPTH



WELL COMPLETION DIAGRAM
(NO SCALE)

PROJECT NAME: PROPOSED APEX SWDF

BORING: B-3

DATE WELL INSTALLED: 7/17/91

BBC&M PROJECT NO: 3850

STATIC WATER ELEVATION: *	1130.9	1128.2	1127.2	1127.0
DATE:	7/18	7/29	8/5	8/8

* FEET ABOVE MSL

WELL DEVELOPMENT: PUMPED 165 GALLONS OVER 3 DAYS. WATER NEARLY CLEAR AT COMPLETION. WELL YIELDING APPROXIMATELY 0.3 GALLONS PER MINUTE.

BBC&M ENGINEERING, INC.

Plate B-133

LOG OF BORING NO. B-4 Sheet 1 of 3 Sheets

Apex Solid Waste Disposal Facility
Jefferson and Harrison Counties, Ohio

LOCATION: See Plan Sheets 3D-1 and 3D-2 ELEVATION: 1205.3 DATE: 06/18-19/91

SAMPLER(S)

DRILLING METHOD: Air Rotary, 6-1/4" Tricone COMPLETION DEPTH: 143.0'

DEPTH, FEET	SAMPLE NUMBER	SAMPLES	SAMPLING EFFORT	DESCRIPTION	NATURAL CONSISTENCY INDEX — NATURAL MOISTURE CONTENT — PLASTIC LIMIT — LIQUID LIMIT (10 20 30 40)	TEST RESULTS
0				TOPSOIL = 12 INCHES		
				Brown silty clay.		
				Brown silty clay, some sand.		
				Medium-hard brown fine-grained sandstone.		
10						
				Medium-hard brown siltstone, few shale seams.		
20						
				Medium-hard gray fine to medium-grained sandstone.		
30						
				Soft to medium-hard dark-gray shale.		
40				Medium-hard gray and brown fine to medium-grained sandstone, few thin shale seams.		
50				-Continued-		

WATER LEVEL: 88.3'
DATE: 06/19

SYMBOLS USED TO INDICATE TEST RESULTS

G - GRADATION
O - UNCONFINED COMPR.
T - TRIAXIAL COMPR.
C - CONSOLIDATION
} SEE SEPARATE CURVES

H - PENETROMETER (tsf)
W - UNIT DRY WEIGHT (pcf)
D - RELATIVE DENSITY (%)

DOUGHTY ENGINEERING, INC. JOB: 3DDJ PAGE

Plate B-57

LOG OF BORING NO. B-4 Sheet 2 of 3 Sheets

Apex Solid Waste Disposal Facility

Jefferson and Harrison Counties, Ohio

LOCATION: See Plan Sheets 3D-1 and 3D-2 ELEVATION: 1205.3 DATE: 06/18-19/91

SAMPLER(S)

DRILLING METHOD: Air Rotary, 6-1/4" Tricone COMPLETION DEPTH: 143.0'

DEPTH, FEET	SAMPLE NUMBER	SAMPLES	SAMPLING EFFORT	DESCRIPTION	NATURAL CONSISTENCY INDEX (NATURAL MOISTURE CONTENT; PLASTIC LIMIT; LIQUID LIMIT)	TEST RESULTS
50				-Continued- Medium-hard gray and brown fine to medium-grained sandstone, few thin shale seams.	10 20 30 40	
60				Medium-hard interbedded brown and gray siltstone, and fine to medium-grained sandstone.		
70						
80						
90						
100				-Continued-		

WATER LEVEL: 88.3'

DATE: 06/19

SYMBOLS USED TO INDICATE TEST RESULTS

G - GRADATION
Q - UNCONFINED COMPR.
T - TRIAXIAL COMPR.
C - CONSOLIDATION
} SEE SEPARATE CURVES

H - PENETROMETER (tsf)
W - UNIT DRY WEIGHT (pcf)
D - RELATIVE DENSITY (%)

Plate B-58

LOG OF BORING NO. B-4 — Sheet 3 of 3 Sheets

Apex Solid Waste Disposal Facility
Jefferson and Harrison Counties, Ohio

LOCATION: **See Plan Sheets 3D-1 and 3D-2** ELEVATION: 1205.3 DATE: 06/18-19/91

SAMPLER(S)

DRILLING METHOD: Air Rotary, 6-1/4" Tricone COMPLETION DEPTH: 143.0'

DEPTH, FEET	SAMPLE NUMBER	SAMPLES	SAMPLING EFFORT	DESCRIPTION	NATURAL CONSISTENCY INDEX — NATURAL MOISTURE CONTENT (X) PLASTIC LIMIT (X) LIQUID LIMIT (10 20 30 40)	TEST RESULTS
100				-Continued-		
				From 107.0' to 108.0'; Seam of medium-hard black coal.		
				Soft to medium-hard gray shale.		
110						
120						
130						
140				Hard gray limestone.		
				Very-soft to soft brown-gray shale.		
				Encountered water from 120.0' to 140.3'.		
150						

WATER LEVEL: 88.3'
DATE: 06/19

SYMBOLS USED TO INDICATE TEST RESULTS

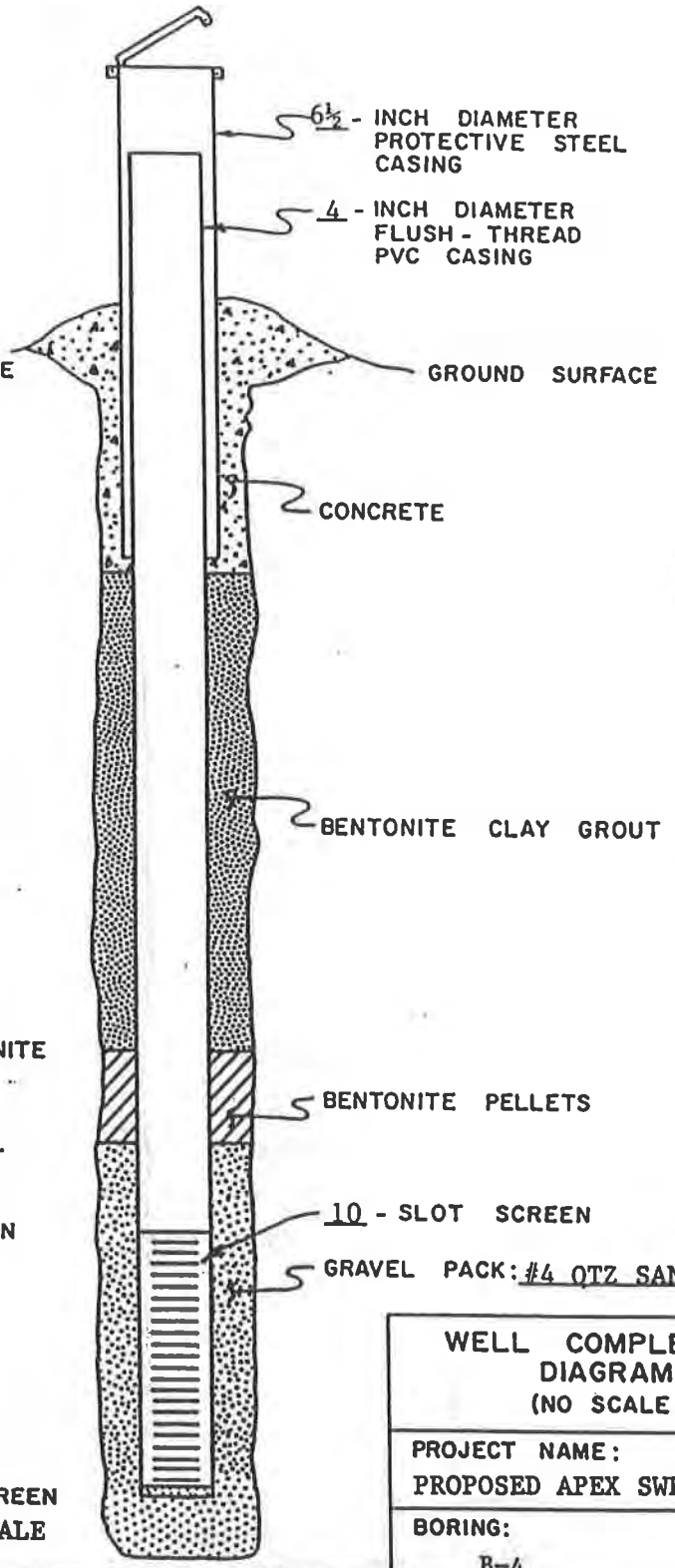
G - GRADATION
O - UNCONFINED COMPR.
T - TRIAXIAL COMPR.
C - CONSOLIDATION
} SEE SEPARATE CURVES

H - PENETROMETER (tsf)
W - UNIT DRY WEIGHT (pcf)
D - RELATIVE DENSITY (%)

DBUAH ENGINEERING, INC. JOB 3000

Plate B-59

ELEV. *	DEPTH BELOW GROUND SURFACE (FEET)	
1207.97	+2.7	TOP OF COVER
1207.75	+2.5	TOP OF PVC
1205.3	0.0	GROUND SURFACE
1200.2	5.1	TOP OF GROUT
1092.2	113.1	TOP OF BENTONITE
1090.6	114.7	TOP OF GRAVEL
1098.3	107.0	TOP OF SHALE
1083.8	121.5	TOP OF SCREEN
1074.8	130.5	BOTTOM OF SCREEN
—	—	BOTTOM OF SHALE
1062.3	143.0	BORING DEPTH



WELL COMPLETION DIAGRAM
(NO SCALE)

PROJECT NAME: PROPOSED APEX SWDF

BORING: B-4

DATE WELL INSTALLED: 6/19/91

BBC&M PROJECT NO: 3850

STATIC WATER ELEVATION: *	1132.16	1145.02	1128.98	1132.16
DATE:	6/21	6/25	7/8	7/21

* FEET ABOVE MSL

WELL DEVELOPMENT: PUMPED 76 GALLONS OVER 3 DAYS. WATER CLOUDY AT COMPLETION. WELL YIELDING APPROXIMATELY 0.6 GALLONS PER HOUR.

BBC&M ENGINEERING, INC.

Plate B-134

BBC&M

LOG OF BORING NO. B-4S
APEX SOLID WASTE DISPOSAL FACILITY
JEFFERSON COUNTY, OHIO

LOCATION: See Plan Sheets 3D-1 and 3D-2 ELEVATION: 1205.8 DATE: 4/19/95

DRILLING METHOD: COMPLETION DEPTH: 36.0'

SAMPLER(S): Air Rotary, 6-3/4" Tricone

DEPTH, FEET	SAMPLE NUMBER	SAMPLE	SAMPLE EFFORT	DESCRIPTION	NATURAL CONSISTENCY INDEX / NATURAL MOISTURE CONTENT (PLASTIC LIMIT — LIQUID LIMIT)	TEST RESULTS
0				SEE LOG OF BORING B-4 BORING CONVERTED TO TEMPORARY PIEZOMETER	10 20 30 40	
5						
10						
15						
20						
25						
30						
35						
40						
45						
50						
55						
60						
65						

WATER LEVEL:	▽ "Dry"	▼ 35.5	▼ 31.5
WATER NOTE:			
DATE:	04/19/95	04/20/95	05/01/95

SYMBOLS USED TO INDICATE TEST RESULTS

G - GRADATION
Q - UNCONFINED COMPR
T - TRIAXIAL COMPR
C - CONSOLIDATION
} SEE SEPARATE CURVES

H - PENETROMETER (tsf)
W - UNIT DRY WEIGHT (pcf)
D - RELATIVE DENSITY (%)

JOB: 38503

Plate B-60

LOG OF BORING NO B-5 Sheet 1 of 2 Sheets

Apex Solid Waste Disposal Facility
Jefferson and Harrison Counties, Ohio

LOCATION: See Plan Sheets 3D-1 and 3D-2 ELEVATION: 1174.2 DATE: 06/19-20/91

SAMPLER(S):

DRILLING METHOD: Air Rotary, 6-1/4" Tricone COMPLETION DEPTH: 96.0'

DEPTH, FEET	SAMPLE NUMBER	SAMPLES	SAMPLING EFFORT	DESCRIPTION	NATURAL CONSISTENCY INDEX (NATURAL MOISTURE CONTENT, PLASTIC LIMIT, LIQUID LIMIT) 10 20 30 40	TEST RESULTS
0				TOPSOIL = 12 INCHES		
				Brown silty clay, "and" sand.		
				Soft brown fine-grained sandstone.		
10				Below 11.5'; Becomes medium-hard		
20						
30						
				Soft to medium-hard interbedded gray and brown shale, sandstone and siltstone.		
40						
				Medium-hard gray fine to medium-grained sandstone, micaceous.		
50				-Continued-		

WATER LEVEL: 56.9'
DATE: 06/20

SYMBOLS USED TO INDICATE TEST RESULTS

G - GRADATION
Q - UNCONFINED COMPR.
T - TRIAXIAL COMPR.
C - CONSOLIDATION
} SEE SEPARATE CURVES

H - PENETROMETER (tsf)
W - UNIT DRY WEIGHT (pcf)
D - RELATIVE DENSITY (%)

BBL&H ENGINEERING, LTD. JOB: 3800

Plate B-61

LOG OF BORING NO B-5 Sheet 2 of 2 Sheets

Apex Solid Waste Disposal Facility

Jefferson and Harrison Counties, Ohio

LOCATION: See Plan Sheets 3D-1 and 3D-2 ELEVATION: 1174.2 DATE: 06/19-20/91

SAMPLER(S):

DRILLING METHOD: Air Rotary, 6-1/4" Tricone COMPLETION DEPTH: 96.0'

DEPTH FEET	SAMPLE NUMBER	SAMPLES	SAMPLING EFFORT	DESCRIPTION	NATURAL CONSISTENCY INDEX / NATURAL MOISTURE CONTENT / PLASTIC LIMIT / LIQUID LIMIT (10 20 30 40)	TEST RESULTS
50				-Continued- Medium-hard gray fine to medium-grained sandstone, micaceous.		
				From 55.0' to 57.0'; Medium-hard brown siltstone.		
60						
				From 68.0' to 69.0'; Medium-hard brown siltstone. From 69.0' to 70.0'; Soft dark-gray shale. From 70.0' to 71.0'; Medium-hard black coal.		
70						
80				Soft to medium-hard dark-gray shale.		
90				Hard gray limestone. Soft green-gray shale.		
100				Encountered water from 85.0' to 90.0'.		

WATER LEVEL: 56.9'

DATE: 06/20

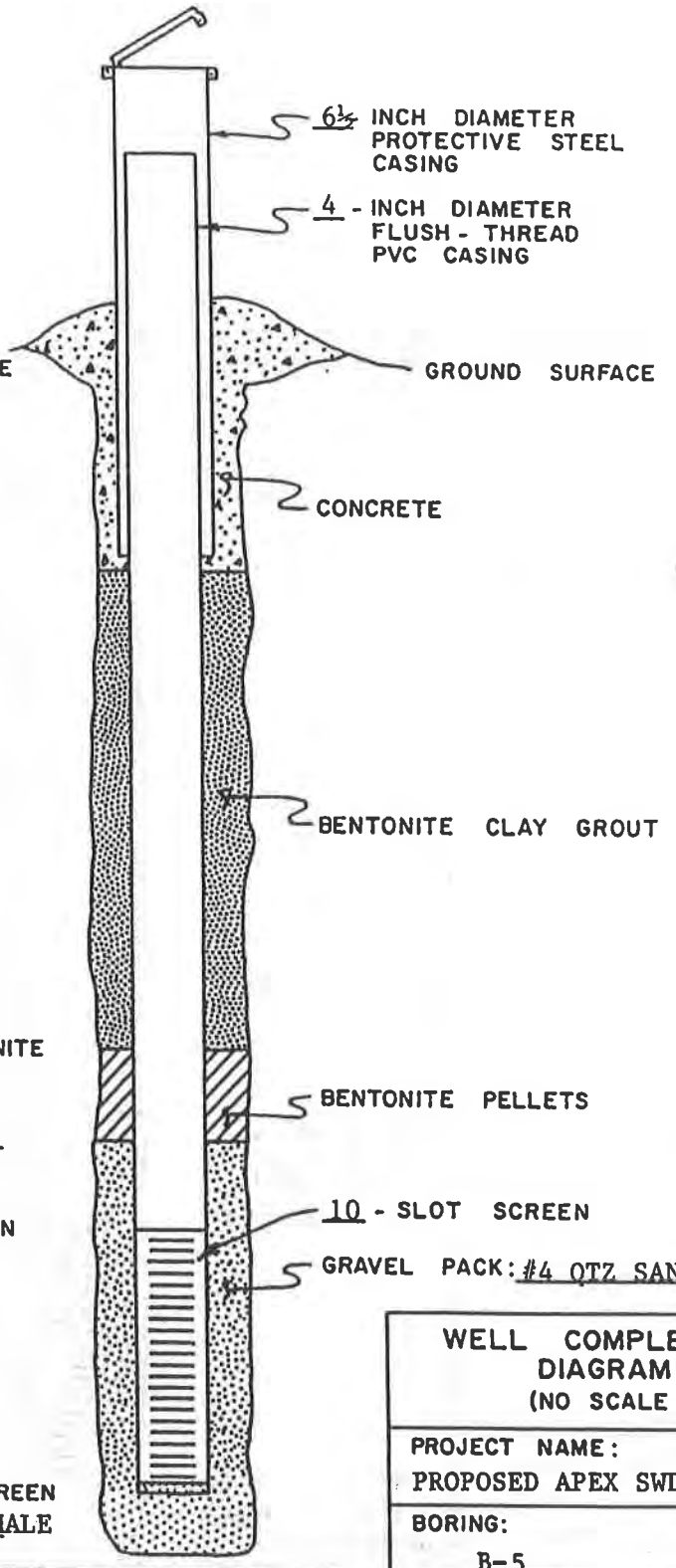
SYMBOLS USED TO INDICATE TEST RESULTS

G - GRADATION
O - UNCONFINED COMPR.
T - TRIAXIAL COMPR.
C - CONSOLIDATION
} SEE SEPARATE CURVES

H - PENETROMETER (tsf)
W - UNIT DRY WEIGHT (pcf)
D - RELATIVE DENSITY (%)

Plate B-62

ELEV. *	DEPTH BELOW GROUND SURFACE (FEET)	
1176.96	+2.7	TOP OF COVER
1176.74	+2.5	TOP OF PVC
1174.2	0.0	GROUND SURFACE
1173.8	0.4	TOP OF GROUT
1097.1	77.1	TOP OF BENTONITE
1095.5	78.7	TOP OF GRAVEL
1093.7	80.5	TOP OF SHALE
1093.7	80.5	TOP OF SCREEN
1084.7	89.5	BOTTOM OF SCREEN
—	—	BOTTOM OF SHALE
1078.2	96.0	BORING DEPTH



WELL COMPLETION DIAGRAM
(NO SCALE)

PROJECT NAME: PROPOSED APEX SWDF

BORING: B-5

DATE WELL INSTALLED: 6/20/91

BBC&M PROJECT NO: 3850

STATIC WATER ELEVATION: *	1119.24	1119.59	1118.55	1119.24
DATE:	6/21	6/24	7/8	7/21

* FEET ABOVE MSL

WELL DEVELOPMENT: PUMPED 692 GALLONS OVER 2 DAYS. WATER SLIGHTLY CLOUDY AT COMPLETION. WELL YIELDING APPROXIMATELY 3 GALLONS PER MINUTE.

BBC&M ENGINEERING, INC.

LOG OF BORING NO. B-6 — Sheet 1 of 3 Sheets

Apex Solid Waste Disposal Facility
Jefferson and Harrison Counties, Ohio

LOCATION: **See Plan Sheets 3D-1 and 3D-2** ELEVATION: 1247.9 DATE: 06/14-17/91

SAMPLER(S):

DRILLING METHOD: Air Rotary, 6-1/4" Tricone COMPLETION DEPTH: 133.0'

DEPTH, FEET	SAMPLE NUMBER	SAMPLES	SAMPLING EFFORT	DESCRIPTION	NATURAL CONSISTENCY INDEX — NATURAL MOISTURE CONTENT; PLASTIC LIMIT; LIQUID LIMIT (10 20 30 40)	TEST RESULTS
0				MINE SPOIL Shale and coal fragments.		
				Soft to medium-hard gray shale.		
				Hard gray limestone. From 6.2' to 6.4'; Medium-hard gray shale.		
10				Soft to medium-hard dark-gray shale, few seams of siltstone.		
20				Medium-hard gray fine-grained sandstone.		
				Soft to medium-hard gray shale. From 34.0' to 42.0'; Many seams of siltstone.		
40				From 42.0' to 43.5'; Hard gray limestone.		
50				-Continued-		

WATER LEVEL: 65.8'
DATE: 06/17

SYMBOLS USED TO INDICATE TEST RESULTS

G - GRADATION Q - UNCONFINED COMPR. T - TRIAXIAL COMPR. C - CONSOLIDATION	SEE SEPARATE CURVES	H - PENETROMETER (tsf) W - UNIT DRY WEIGHT (pcf) D - RELATIVE DENSITY (%)

BRUCE & MERRILL ENGINEERING, INC. JOB: 4857

Plate B-63

LOG OF BORING NO. B-6 — Sheet 2 of 3 Sheets

Apex Solid Waste Disposal Facility
Jefferson and Harrison Counties, Ohio

LOCATION: See Plan Sheets 3D-1 and 3D-2 ELEVATION: 1247.9 DATE: 06/14-17/91

SAMPLER(S)

DRILLING METHOD: Air Rotary, 6-1/4" Tricone COMPLETION DEPTH: 133.0'

DEPTH, FEET	SAMPLE NUMBER	SAMPLES	SAMPLING EFFORT	DESCRIPTION	NATURAL CONSISTENCY INDEX — NATURAL MOISTURE CONTENT (X PLASTIC LIMIT, X LIQUID LIMIT) 10 20 30 40	TEST RESULTS
50				-Continued- Soft to medium-hard gray shale.		
60				From 59.5' to 60.0'; Medium-hard black coal. From 60.0' to 61.0'; Very-soft light-gray clayey shale		
70				Medium-hard gray siltstone/fine-grained sandstone, trace pyrite, contains seams of fine to medium-grained sandstone.		
80						
90				Medium-hard light-gray fine to medium-grained sandstone		
100						

WATER LEVEL: 65.8'
DATE: 06/17

SYMBOLS USED TO INDICATE TEST RESULTS

G - GRADATION
O - UNCONFINED COMPR.
T - TRIAXIAL COMPR.
C - CONSOLIDATION
} SEE SEPARATE CURVES

H - PENETROMETER (tsf)
W - UNIT DRY WEIGHT (pcf)
D - RELATIVE DENSITY (%)

Plate B-64

LOG OF BORING NO. B-6 Sheet 3 of 3 Sheets

Apex Solid Waste Disposal Facility
Jefferson and Harrison Counties, Ohio

LOCATION: **See Plan Sheets 3D-1 and 3D-2** ELEVATION: 1247.9 DATE: 06/14-17/91

SAMPLER(S):

DRILLING METHOD: Air Rotary, 6-1/4" Tricone COMPLETION DEPTH: 133.0'

DEPTH, FEET	SAMPLE NUMBER	SAMPLES	SAMPLING EFFORT	DESCRIPTION	NATURAL CONSISTENCY INDEX (NATURAL MOISTURE CONTENT; PLASTIC LIMIT; LIQUID LIMIT) 10 20 30 40	TEST RESULTS
100				-Continued- Medium-hard light-gray fine to medium-grained sandstone.		
				Medium-hard dark-gray siltstone.		
110				Soft to medium-hard dark-brown shale.		
				From 113.0' to 115.5'; Medium-hard light-brown limestone.^		
120						
130						
				Encountered water from 85.0' to 102.0'		
140						
150						

WATER LEVEL: 65.8'
DATE: 06/17

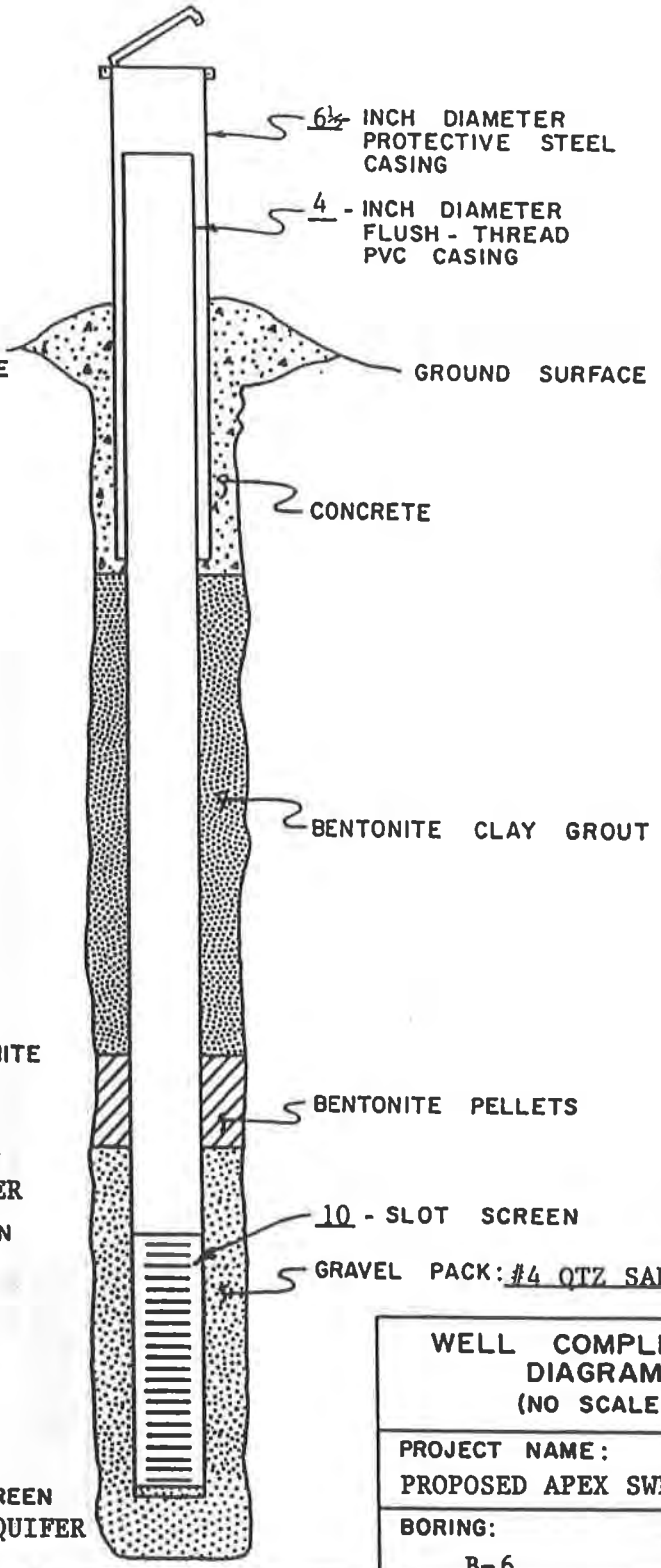
SYMBOLS USED TO INDICATE TEST RESULTS

G - GRADATION
O - UNCONFINED COMPR.
T - TRIAXIAL COMPR.
C - CONSOLIDATION
} SEE SEPARATE CURVES

H - PENETROMETER (tsf)
W - UNIT DRY WEIGHT (pcf)
D - RELATIVE DENSITY (%)

Plate B-65

ELEV. *	DEPTH BELOW GROUND SURFACE (FEET)	
1250.62	+2.7	TOP OF COVER
1250.41	+2.5	TOP OF PVC
1247.9	0.0	GROUND SURFACE
1247.5	0.4	TOP OF GROUT
1166.4	81.5	TOP OF BENTONITE
1164.3	83.6	TOP OF GRAVEL
1159.9	88.0	TOP OF AQUIFER TOP OF SCREEN
1150.9	97.0	BOTTOM OF SCREEN
1145.9	102.0	BOTTOM OF AQUIFER
1114.9	133.0	BORING DEPTH



WELL COMPLETION DIAGRAM
(NO SCALE)

PROJECT NAME: PROPOSED APEX SWDF

BORING: B-6

DATE WELL INSTALLED: 6/17/91

BBC&M PROJECT NO: 3850

STATIC WATER ELEVATION: *	1178.02	1176.72	1177.32	1178.02
DATE:	6/17	6/18	7/8	7/18

* FEET ABOVE MSL

WELL DEVELOPMENT: PUMPED 113 GALLONS OVER 2 DAYS. WATER SLIGHTLY CLOUDY AT COMPLETION. WELL YIELDING APPROXIMATELY 5 GALLONS PER HOUR.

BBC&M ENGINEERING, INC.

LOG OF BORING NO. B-7A

Apex Solid Waste Disposal Facility

Jefferson and Harrison Counties, Ohio

LOCATION See Plan Sheets 3D-1 and 3D-2 ELEVATION: 1243.7 DATE: 07/17/91

SAMPLER(S) 2" O.D. Split-Barrel, 3" O.D. Shelby tube

DRILLING METHOD: Hollow-stem Auger, Air Rotary, 5-1/4" Tricone COMPLETION DEPTH: 21.3'

DEPTH, FEET	SAMPLE NUMBER	SAMPLES	SAMPLING EFFORT	DESCRIPTION	NATURAL CONSISTENCY INDEX (NATURAL MOISTURE CONTENT, PLASTIC LIMIT, LIQUID LIMIT)	TEST RESULTS
0				**MINE SPOIL** Medium-stiff to very-stiff brown mixed with gray silty clay; "and" fine to coarse sand, little fine to coarse gravel, contains coal fragments, few roots. CL	10 20 30 40	
	1		2/2/2/3			H=0.5-1.5
	5A					H=0.5-0.8
	*		3/4/4/4			
	5B					H=1.1-2.6
	2					
10	3		2/3/2/6/			H=0.8-1.4
	4A		2/2/50R-0.3	**MINE SPOIL** Medium-stiff to stiff dark-gray mixed with gray and brown silty clay, some fine to coarse sand, trace fine gravel, few coal fragments. CL		H=0.8-1.3
	4B					H=1.8-2.0
	4C					
20				Stiff to very-stiff brown mottled with gray silty clay, trace fine to coarse sand. CL		
				Very-soft to soft gray shale.		
				Hard gray limestone.		
30				Encountered water at 17.5'		
				*Shelby tube		
40						
50						

WATER LEVEL 17.6'

DATE: 07/17

SYMBOLS USED TO INDICATE TEST RESULTS

G - GRADATION, O - UNCONFINED COMPR., T - TRIAXIAL COMPR., C - CONSOLIDATION } SEE SEPARATE CURVES

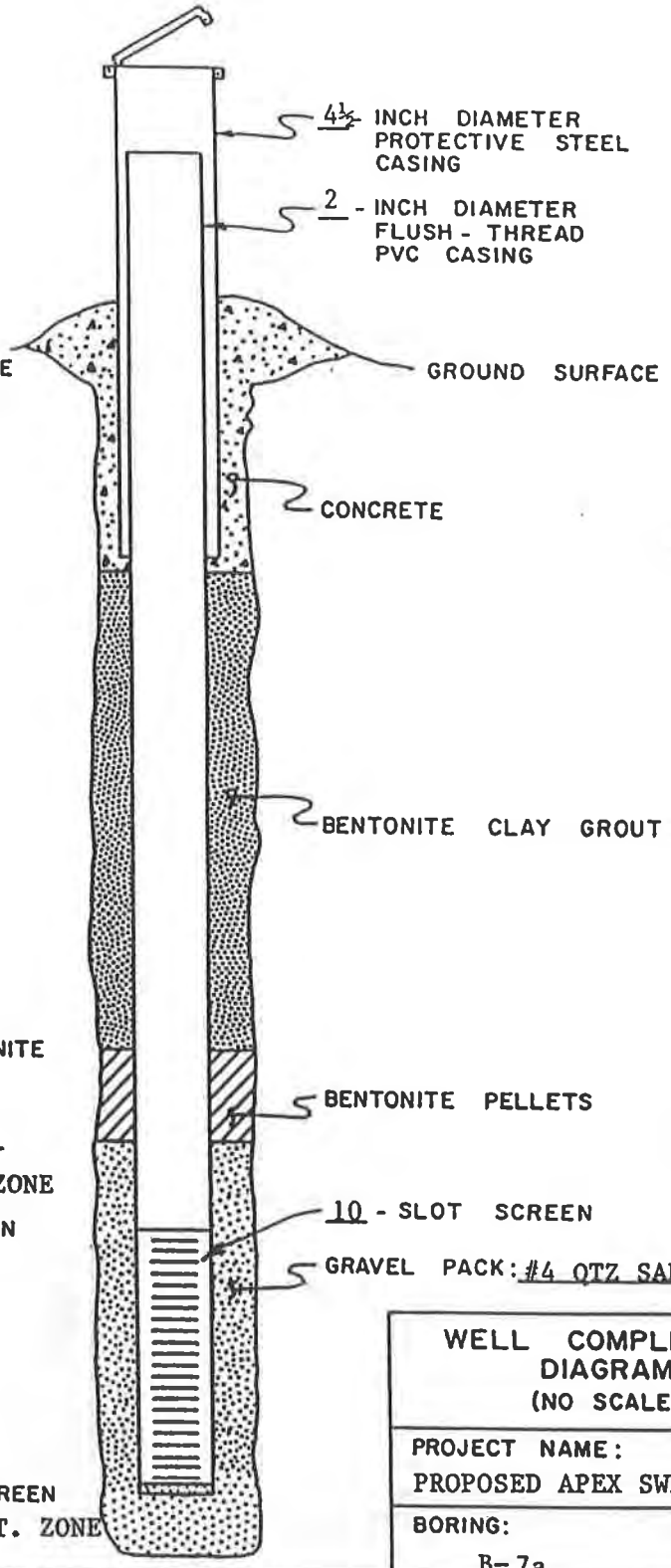
H - PENETROMETER (tsf)

W - UNIT DRY WEIGHT (pcf)

D - RELATIVE DENSITY (%)

Plate B-66

ELEV. *	DEPTH BELOW GROUND SURFACE (FEET)	
1246.34	+2.7	TOP OF COVER
1246.18	+2.5	TOP OF PVC
1243.7	0.0	GROUND SURFACE
1243.4	0.3	TOP OF GROUT
1233.6	10.1	TOP OF BENTONITE
1231.5	12.2	TOP OF GRAVEL
1227.5	16.2	TOP OF SAT. ZONE
1228.2	15.5	TOP OF SCREEN
1224.2	19.5	BOTTOM OF SCREEN
1225.7	18.0	BOTTOM OF SAT. ZONE
1222.4	21.3	BORING DEPTH



WELL COMPLETION DIAGRAM
(NO SCALE)

PROJECT NAME: PROPOSED APEX SWDF

BORING: B-7a

DATE WELL INSTALLED: 7/17/91

BBC&M PROJECT NO: 3850

STATIC WATER ELEVATION: *	1227.25	1227.28	1227.12	1226.91
DATE:	7/19	7/21	7/29	8/5

* FEET ABOVE MSL

WELL DEVELOPMENT: BAILED 41 GALLONS OVER 2 DAYS. WATER SLIGHTLY CLOUDY AT COMPLETION.

BBC&M ENGINEERING, INC.

Plate B-137

LOG OF BORING NO. B-7B

Sheet 1 of 3 Sheets

Apex Solid Waste Disposal Facility
Jefferson and Harrison Counties, Ohio

LOCATION: See Plan Sheets 3D-1 and 3D-2 ELEVATION: 1244.0 DATE: 07/01/91

SAMPLER(S):

DRILLING METHOD: Air Rotary, 6-1/4" Tricone COMPLETION DEPTH: 130.0'

DEPTH, FEET	SAMPLE NUMBER	SAMPLES	SAMPLING EFFORT	DESCRIPTION	NATURAL CONSISTENCY INDEX (NATURAL MOISTURE CONTENT; PLASTIC LIMIT; LIQUID LIMIT) 10 20 30 40	TEST RESULTS
0				MINE SPOIL FROM 0.0' TO 16.0' SEE LOG OF BORING NO. B-7A		
10						
				Soft to medium-hard gray shale.		
				Medium-hard gray limestone, contains thin seams of shale.		
20						
				Soft to medium-hard gray shale.		
30				From 30.0' to 30.5'; Hard gray limestone.		
				Medium-hard gray fine to medium-grained sandstone.		
40						
				Medium-hard gray siltstone.		
50				Soft gray shale.		
				-Continued-		

WATER LEVEL: 40.9'
DATE: 07/01

SYMBOLS USED TO INDICATE TEST RESULTS

G - GRADATION
O - UNCONFINED COMPR.
T - TRIAXIAL COMPR.
C - CONSOLIDATION
} SEE SEPARATE CURVES

H - PENETROMETER (tsf)
W - UNIT DRY WEIGHT (pcf)
D - RELATIVE DENSITY (%)

Plate B-67

LOG OF BORING NO B-7B — Sheet 2 of 3 Sheets

Apex Solid Waste Disposal Facility
Jefferson and Harrison Counties, Ohio

LOCATION: See Plan Sheets 3D-1 and 3D-2 — ELEVATION: 1244.0 — DATE: 07/01/91

SAMPLER(S):

DRILLING METHOD: Air Rotary, 6-1/4" Tricone — COMPLETION DEPTH: 130.0'

DEPTH, FEET	SAMPLE NUMBER	SAMPLES	SAMPLING EFFORT	DESCRIPTION	NATURAL CONSISTENCY INDEX (NATURAL MOISTURE CONTENT; PLASTIC LIMIT; LIQUID LIMIT)	TEST RESULTS
50				-Continued- Soft gray shale.	10 20 30 40	
				Medium-hard gray siltstone, contains thin shale seams From 58.5' to 61.0'; Medium-hard gray sandstone.		
60						
70				From 70.0' to 70.5'; Medium-hard black coal.		
80				From 82.0' to 82.5'; Medium-hard black coal.		
90						
				From 99.5' to 100.0'; Medium-hard black coal.		
100				Medium-hard gray fine to medium-grained sandstone, contains seams of gray shale. -Continued-		

WATER LEVEL: 40.9'
DATE: 07/01

SYMBOLS USED TO INDICATE TEST RESULTS

G - GRADATION
O - UNCONFINED COMPR
T - TRIAXIAL COMPR.
C - CONSOLIDATION
} SEE SEPARATE CURVES

H - PENETROMETER (tsf)
W - UNIT DRY WEIGHT (pcf)
D - RELATIVE DENSITY (%)

LOG OF BORING NO. B-7B — Sheet 3 of 3 Sheets

Apex Solid Waste Disposal Facility
Jefferson and Harrison Counties, Ohio

LOCATION: **See Plan Sheets 3D-1 and 3D-2** ELEVATION: 1244.0 DATE: 07/01/91

SAMPLER(S)

DRILLING METHOD: Air Rotary, 6-1/4" Tricone COMPLETION DEPTH: 130.0'

DEPTH, FEET	SAMPLE NUMBER	SAMPLES	SAMPLING EFFORT	DESCRIPTION	NATURAL CONSISTENCY INDEX — NATURAL MOISTURE CONTENT (X) — PLASTIC LIMIT — LIQUID LIMIT (X) — 10 20 30 40	TEST RESULTS
100				-Continued- Medium-hard gray fine to medium-grained sandstone, contains seams of gray shale.		
110				From 111.0' to 112.0'; Medium-hard black coal From 112.0' to 114.0'; Soft gray shale		
120				Soft to medium-hard gray shale, occasional thin seam of limestone		
130				Encountered water from 114.0' to 122.0'		
140						
150						

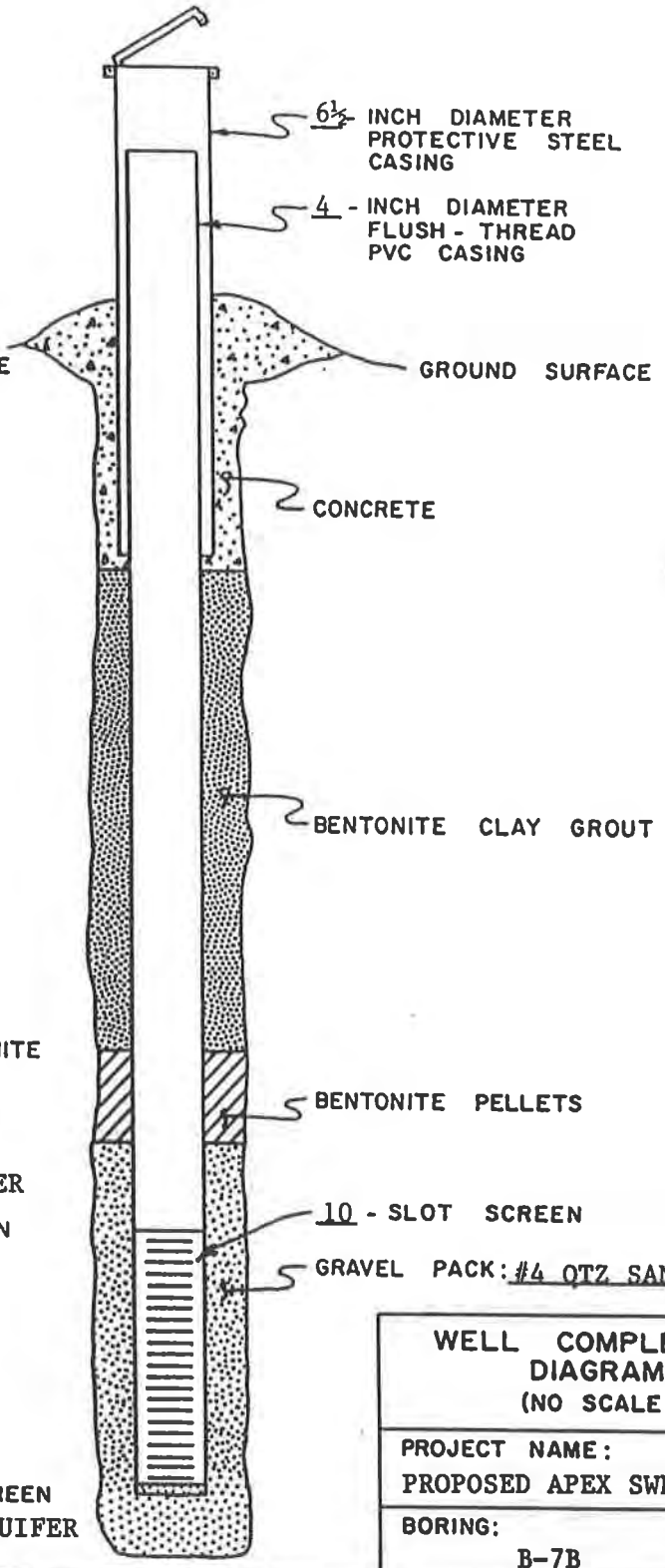
WATER LEVEL: 40.9'
DATE: 07/01

SYMBOLS USED TO INDICATE TEST RESULTS

G - GRADATION
O - UNCONFINED COMPR.
T - TRIAXIAL COMPR.
C - CONSOLIDATION
} SEE SEPARATE CURVES

H - PENETROMETER (tsf)
W - UNIT DRY WEIGHT (pcf)
D - RELATIVE DENSITY (%)

ELEV. *	DEPTH BELOW GROUND SURFACE (FEET)	
1246.74	+2.7	TOP OF COVER
1246.53	+2.5	TOP OF PVC
1244.0	0.0	GROUND SURFACE
1243.7	0.3	TOP OF GROUT
1136.6	107.4	TOP OF BENTONITE
1134.3	109.7	TOP OF GRAVEL
1144.0	100.0	TOP OF AQUIFER
1130.0	114.0	TOP OF SCREEN
1121.0	123.0	BOTTOM OF SCREEN
1122.0	122.0	BOTTOM OF AQUIFER
1114.0	130.0	BORING DEPTH



WELL COMPLETION DIAGRAM
(NO SCALE)

PROJECT NAME: PROPOSED APEX SWDF

BORING: B-7B

DATE WELL INSTALLED: 7/1/91

BBC&M PROJECT NO: 3850

STATIC WATER ELEVATION: *	1167.87	1167.29	1166.78	1166.61
DATE:	7/2	7/8	7/29	8/5

* FEET ABOVE MSL

WELL DEVELOPMENT: PUMPED 289 GALLONS OVER 4 DAYS. WATER CLOUDY AT COMPLETION. WELL YIELDING APPROXIMATELY 1 GALLON PER MINUTE.

BBC&M ENGINEERING, INC.

Plate B-138

LOG OF BORING NO. B-8

Apex Solid Waste Disposal Facility
Jefferson and Harrison Counties, Ohio

LOCATION: See Plan Sheets 3D-1 and 3D-2 ELEVATION: 1172.4 DATE: 07/16/91

SAMPLER(S):

DRILLING METHOD: Air Rotary, 6-1/4" Tricone COMPLETION DEPTH: 52.0'

DEPTH, FEET	SAMPLE NUMBER	SAMPLES	SAMPLING EFFORT	DESCRIPTION	NATURAL CONSISTENCY INDEX (NATURAL MOISTURE CONTENT; PLASTIC LIMIT; LIQUID LIMIT)	TEST RESULTS
0				TOPSOIL = 12 INCHES	10 20 30 40	
				Brown silty clay.		
				Light-brown fine to coarse sand, some silty clay.		
10				Soft to medium-hard brown fine-grained sandstone, contains thin seams of siltstone.		
20				Medium-hard gray fine to medium-grained sandstone, micaceous, contains thin seams of brown siltstone.		
30				Encountered water from 35.0' to 50.0'.		
40				From 42.0' to 42.5'; Medium-hard black coal.		
50				Hard gray limestone.		
				Soft to medium-hard gray shale.		

WATER LEVEL: 16.0'
DATE: 07/16

SYMBOLS USED TO INDICATE TEST RESULTS

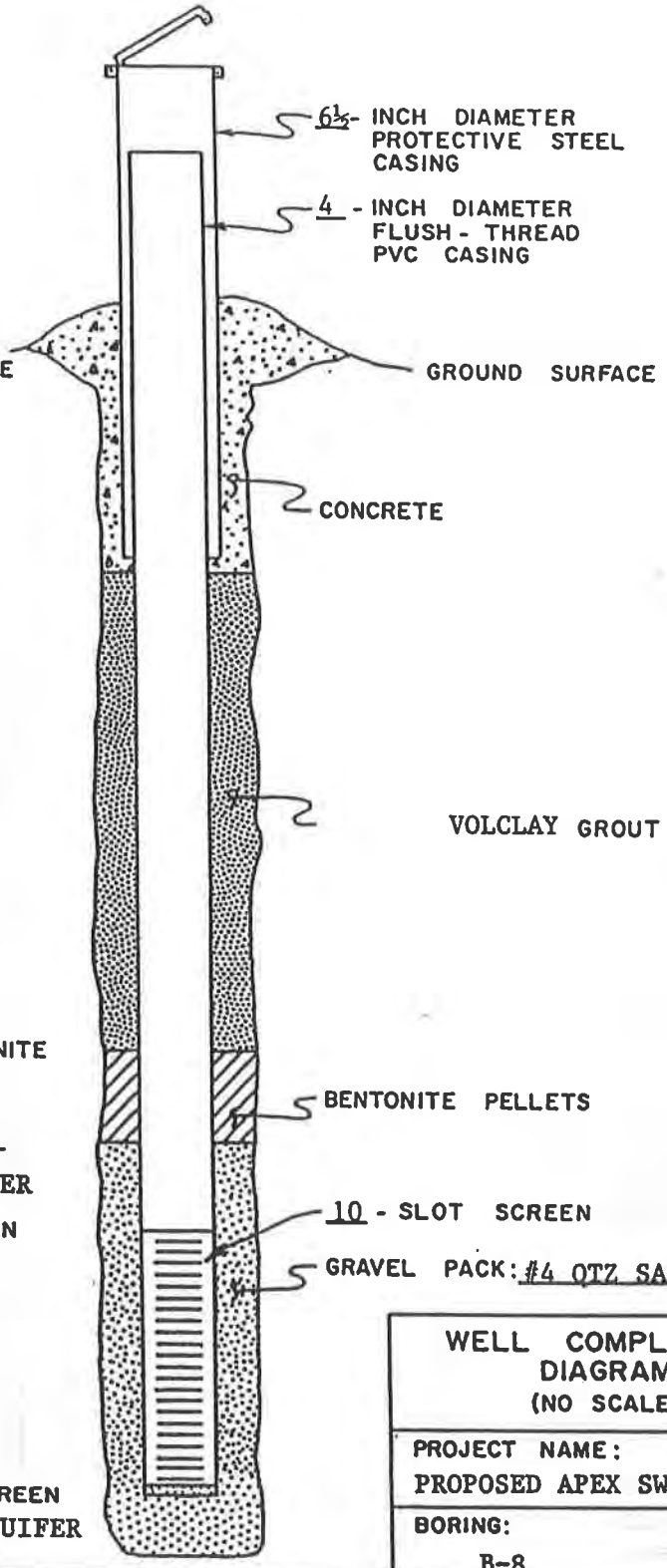
G - GRADATION
Q - UNCONFINED COMPR.
T - TRIAXIAL COMPR.
C - CONSOLIDATION
} SEE SEPARATE CURVES

H - PENETROMETER (tsf)
W - UNIT DRY WEIGHT (pcf)
D - RELATIVE DENSITY (%)

BBU&E ENGINEERING, INC JOB: 3850

Plate B-70

ELEV. *	DEPTH BELOW GROUND SURFACE (FEET)	
1175.16	+2.7	TOP OF COVER
1174.92	+2.5	TOP OF PVC
1172.4	0.0	GROUND SURFACE
1172.0	0.4	TOP OF GROUT
1146.0	26.4	TOP OF BENTONITE
1144.1	28.3	TOP OF GRAVEL
1152.4	20.0	TOP OF AQUIFER
1134.9	37.5	TOP OF SCREEN
1125.9	46.5	BOTTOM OF SCREEN
1122.4	50.0	BOTTOM OF AQUIFER
1120.4	52.0	BORING DEPTH



WELL COMPLETION DIAGRAM
(NO SCALE)

PROJECT NAME: PROPOSED APEX SWDF

BORING: B-8

DATE WELL INSTALLED: 7/16/91

BBC&M PROJECT NO: 3850

STATIC WATER ELEVATION: *	1156.14	1156.03	1155.71	1155.52
DATE:	7/17	7/24	7/29	8/5

* FEET ABOVE MSL

WELL DEVELOPMENT: PUMPED 209 GALLONS IN ONE DAY. WATER NEARLY CLEAR AT COMPLETION. WELL YIELDING APPROXIMATELY 2 GALLONS PER MINUTE.

BBC&M ENGINEERING, INC.

LOG OF BORING NO. B-9A

Apex Solid Waste Disposal Facility

Jefferson and Harrison Counties, Ohio

LOCATION: See Plan Sheets 3D-1 and 3D-2 ELEVATION: 1256.5 DATE: 09/19/91

SAMPLER(S):

DRILLING METHOD: Air Rotary, 5-1/4" Tricone COMPLETION DEPTH: 26.0'

DEPTH, FEET	SAMPLE NUMBER	SAMPLES	SAMPLING EFFORT	DESCRIPTION	NATURAL CONSISTENCY INDEX / NATURAL MOISTURE CONTENT (PLASTIC LIMIT, LIQUID LIMIT)	TEST RESULTS
0				TOPSOIL	10 20 30 40	
				MINE SPOIL Brown silty clay, some to "and" fine to coarse sand, little fine to coarse gravel, many cobbles. CL		
				MINE SPOIL Brown and gray fine to coarse sand, some fine to coarse gravel, little silty clay, few cobbles. SC		
10				MINE SPOIL Gray fine to coarse gravel, some fine to coarse sand, little silty clay, many cobbles. GC		
				MINE SPOIL Sandstone and limestone cobbles and boulders. GP		
20				Soft gray shale.		
				Medium-hard to hard gray limestone.		
30				Encountered water from 18.0' to 23.5'		
40						
50						

WATER LEVEL: 17.3'

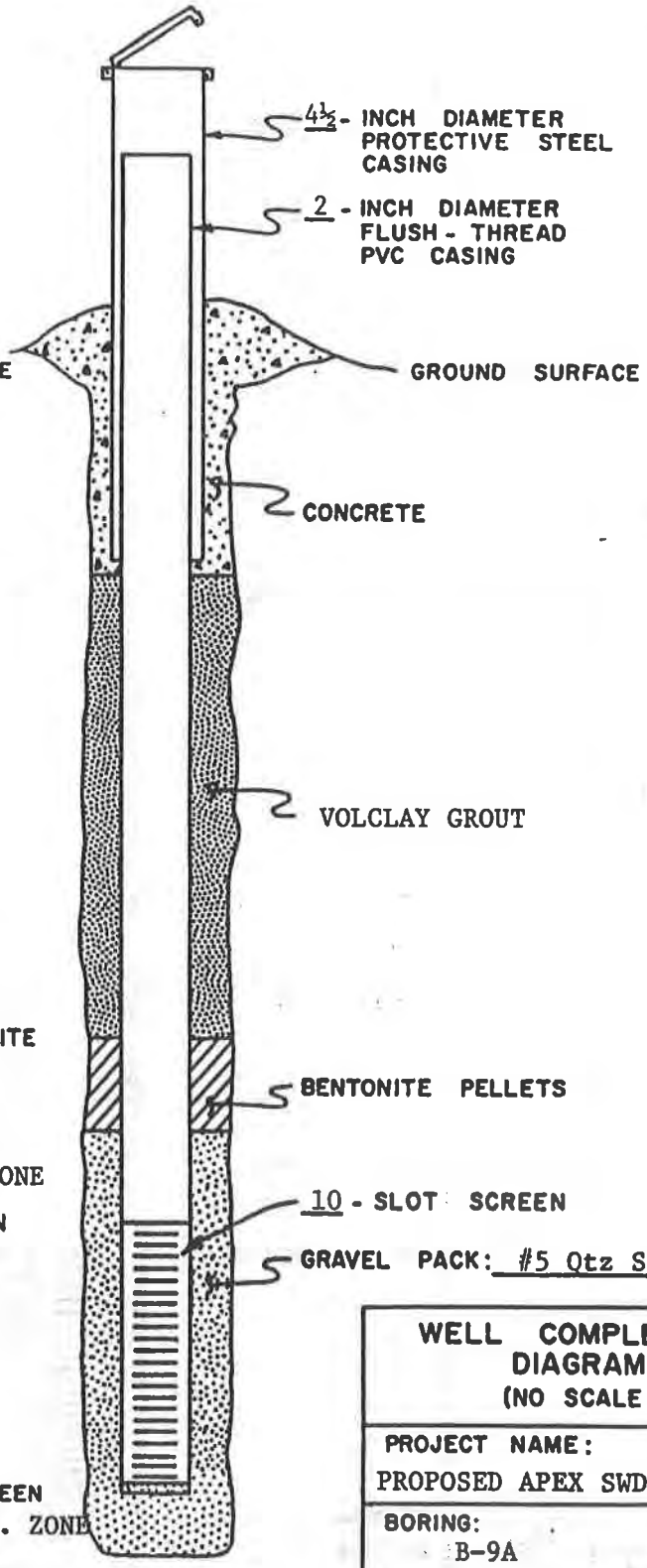
DATE: 09/19

SYMBOLS USED TO INDICATE TEST RESULTS

G - GRADATION
O - UNCONFINED COMPR.
T - TRIAXIAL COMPR.
C - CONSOLIDATION
} SEE SEPARATE CURVES

H - PENETROMETER (tsf)
W - UNIT DRY WEIGHT (pcf)
D - RELATIVE DENSITY (%)

ELEV. *	DEPTH BELOW GROUND SURFACE (FEET)	
1259.13	2.7	TOP OF COVER
1258.97	2.5	TOP OF PVC
1256.5	0.0	GROUND SURFACE
1255.7	0.8	TOP OF GROUT
1240.1	16.4	TOP OF BENTONITE
1236.9	19.6	TOP OF GRAVEL
1239.0	26.5	TOP OF SAT. ZONE
1235.5	21.0	TOP OF SCREEN
1231.5	25.0	BOTTOM OF SCREEN
1233.0	23.5	BOTTOM OF SAT. ZONE
1230.5	26.0	BORING DEPTH



WELL COMPLETION DIAGRAM
(NO SCALE)

PROJECT NAME: PROPOSED APEX SWDF

BORING: B-9A

STATIC WATER ELEVATION: *	1238.83	1238.48		
DATE:	10/9	11/6		

DATE WELL INSTALLED: 9/19/91

BBC&M PROJECT NO: 3850

* FEET ABOVE MSL

WELL DEVELOPMENT: Bailed 15 gallons over 2 days. Water silty @ completion.

BBC&M ENGINEERING, INC.

Plate B-140

LOG OF BORING NO. B-9B — Sheet 1 of 4 Sheets

Apex Solid Waste Disposal Facility
Jefferson and Harrison Counties, Ohio

LOCATION: **See Plan Sheets 3D-1 and 3D-2** ELEVATION: 1256.9 DATE: 09/16-18/91

SAMPLER(S)

DRILLING METHOD: Air Rotary, 6-1/4" Tricone COMPLETION DEPTH: 157.0'

DEPTH, FEET	SAMPLE NUMBER & SAMPLES	SAMPLING EFFORT	DESCRIPTION	NATURAL CONSISTENCY INDEX (NATURAL MOISTURE CONTENT; PLASTIC LIMIT; LIQUID LIMIT)	TEST RESULTS
0			MINE SPOIL: 0.0' to 24.0' See log of Boring No. B-9A	10 20 30 40	
10					
20					
			Soft gray shale.		
			Medium-hard to hard gray limestone, few thin seams of shale		
30					
			Soft gray shale.		
40			From 46.0' to 47.0': Hard gray limestone.		
50			-Continued-		

WATER LEVEL: 26.9'
DATE: 09/18

SYMBOLS USED TO INDICATE TEST RESULTS

G - GRADATION
O - UNCONFINED COMPR
T - TRIAXIAL COMPR.
C - CONSOLIDATION
} SEE SEPARATE CURVES

H - PENETROMETER (tsf)
W - UNIT DRY WEIGHT (pcf)
D - RELATIVE DENSITY (%)

LOG OF BORING NO. B-9B — Sheet 2 of 4 Sheets

Apex Solid Waste Disposal Facility
Jefferson and Harrison Counties, Ohio

LOCATION See Plan Sheets 3D-1 and 3D-2 ELEVATION: 1256.9 DATE: 09/16-18/91

SAMPLER(S)

DRILLING METHOD: Air Rotary, 6-1/4" Tricone COMPLETION DEPTH: 157.0'

DEPTH, FEET	SAMPLE NUMBER	SAMPLES	SAMPLING EFFORT	DESCRIPTION	NATURAL CONSISTENCY INDEX — NATURAL MOISTURE CONTENT; PLASTIC LIMIT; LIQUID LIMIT (10 20 30 40)	TEST RESULTS
50				-Continued-		
				Soft gray shale.		
60				From 64.0' to 80.0'; Very-soft to medium-hard dark-gray shale.		
70						
80				From 80.0' to 92.0'; Few thin seams of siltstone.		
90				From 92.0' to 93.0'; Medium-hard black coal.		
				Soft to medium-hard gray fine-grained sandstone.		
100				-Continued-		

WATER LEVEL: 26.9'
DATE: 09/18

SYMBOLS USED TO INDICATE TEST RESULTS

G - GRADATION
O - UNCONFINED COMPR.
T - TRIAXIAL COMPR.
C - CONSOLIDATION
} SEE SEPARATE CURVES

H - PENETROMETER (tsf)
W - UNIT DRY WEIGHT (pcf)
D - RELATIVE DENSITY (%)

Plate B-73

LOG OF BORING NO. B-9B — Sheet 3 of 4 Sheets

Apex Solid Waste Disposal Facility
Jefferson and Harrison Counties, Ohio

LOCATION: See Plan Sheets 3D-1 and 3D-2 — ELEVATION: 1256.9 — DATE: 09/16-18/91

SAMPLER(S)

DRILLING METHOD: Air Rotary, 6-1/4" Tricone — COMPLETION DEPTH: 157.0'

DEPTH, FEET	SAMPLE NUMBER	SAMPLES	SAMPLING EFFORT	DESCRIPTION	NATURAL CONSISTENCY INDEX — NATURAL MOISTURE CONTENT — PLASTIC LIMIT — LIQUID LIMIT (10 20 30 40)	TEST RESULTS
100				-Continued- Soft to medium-hard gray sandstone.		
				Soft to medium-hard gray shale.		
110				From 112.0' to 114.0': Hard gray-brown limestone.		
				Soft to medium-hard gray fine to medium-grained sandstone.		
120						
130						
140				From 143.0' to 144.0': Medium-hard black coal.		
				Soft to medium-hard gray shale.		
150				-Continued-		

WATER LEVEL: 26.9'
DATE: 09/18

SYMBOLS USED TO INDICATE TEST RESULTS

G - GRADATION
O - UNCONFINED COMPR.
T - TRIAXIAL COMPR.
C - CONSOLIDATION
} SEE SEPARATE CURVES

H - PENETROMETER (tsf)
W - UNIT DRY WEIGHT (pcf)
D - RELATIVE DENSITY (%)

BBC&M ENGINEERING, INC. JOB: 3ASU

Plate B-74

LOG OF BORING NO B-9B — Sheet 4 of 4 Sheets

Apex Solid Waste Disposal Facility
Jefferson and Harrison Counties, Ohio

LOCATION: **See Plan Sheets 3D-1 and 3D-2** ELEVATION: 1256.9 DATE: 09/16-18/91

SAMPLER(S)

DRILLING METHOD: Air Rotary, 6-1/4" Tricone COMPLETION DEPTH: 157.0'

DEPTH, FEET	SAMPLE NUMBER	SAMPLES	SAMPLING EFFORT	DESCRIPTION	NATURAL CONSISTENCY INDEX — NATURAL MOISTURE CONTENT (PLASTIC LIMIT X … X LIQUID LIMIT)	TEST RESULTS
150				-Continued- Soft to medium-hard gray shale.	10 20 30 40	
160				Encountered water from 22.0' to 24.0'. Encountered water from 125.0' to 141.0'.		
170						
180						
190						
200						

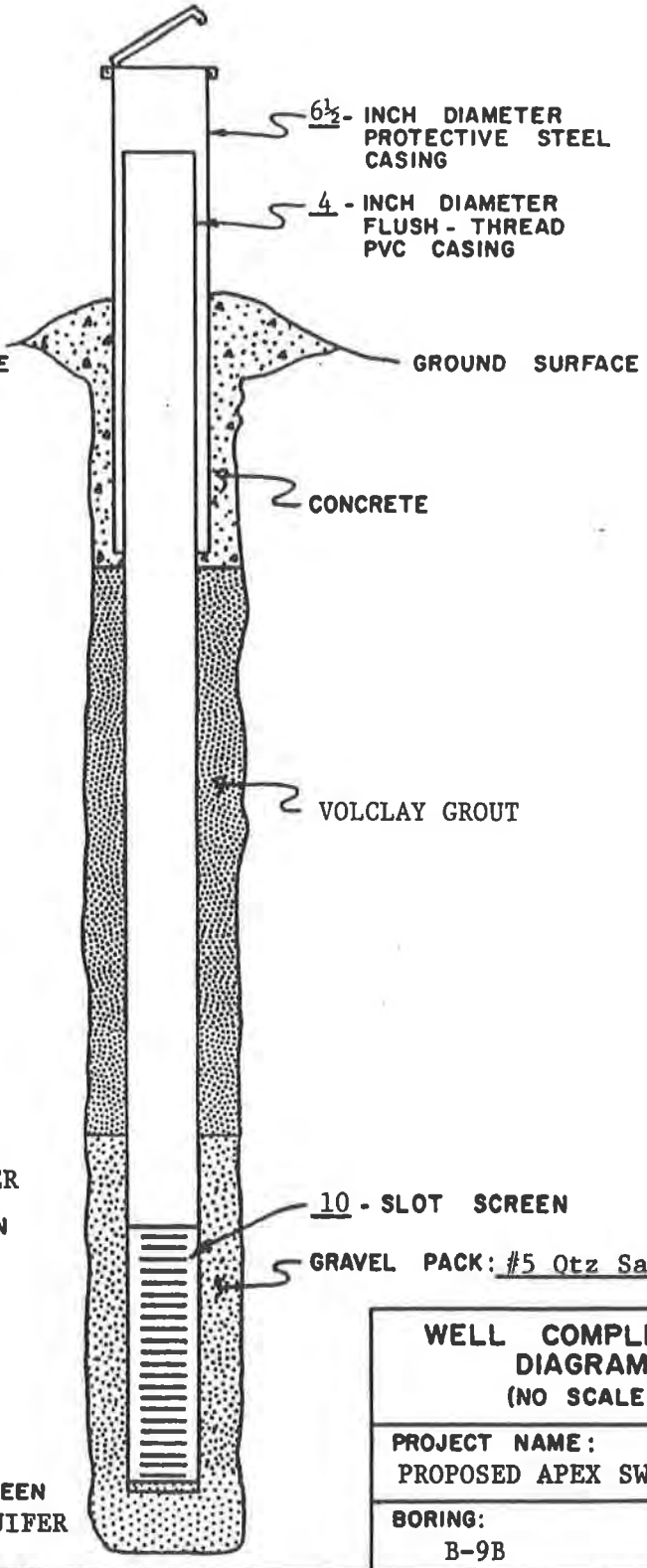
WATER LEVEL: 26.9'
DATE: 09/18

SYMBOLS USED TO INDICATE TEST RESULTS

G - GRADATION
O - UNCONFINED COMPR.
T - TRIAXIAL COMPR.
C - CONSOLIDATION
} SEE SEPARATE CURVES

H - PENETROMETER (tsf)
W - UNIT DRY WEIGHT (pcf)
D - RELATIVE DENSITY (%)

ELEV. *	DEPTH BELOW GROUND SURFACE (FEET)	
1259.63	2.7	TOP OF COVER
1259.42	2.5	TOP OF PVC
1256.9	0.0	GROUND SURFACE
1235.5	21.4	TOP OF GROUT
1145.1	111.8	TOP OF GRAVEL
1163.9	93.0	TOP OF AQUIFER
1132.9	124.0	TOP OF SCREEN
1123.9	133.0	BOTTOM OF SCREEN
1112.9	144.0	BOTTOM OF AQUIFER
1099.9	157.0	BORING DEPTH



WELL COMPLETION DIAGRAM
(NO SCALE)

PROJECT NAME: PROPOSED APEX SWDF

BORING: B-9B

DATE WELL INSTALLED: 9/18/91

BBC&M PROJECT NO: 3850

STATIC WATER ELEVATION: *	1137.7	1127.0	1126.7	
DATE:	9/19	10/9	11/6	

* FEET ABOVE MSL

WELL DEVELOPMENT: Bailed 21 gallons water. Silty at completion. Well yielding approximately 0.5 gallons per hour.

BBC&M ENGINEERING, INC.

Plate B-141

LOG OF BORING NO. B-9C

Apex Solid Waste Disposal Facility

Jefferson and Harrison Counties, Ohio

LOCATION See Plan Sheets 3D-1 and 3D-2 ELEVATION 1261.8 DATE: 07/16/91

SAMPLER(S) 2" O.D. Split-Barrel, 3' O.D. Shelby tube

DRILLING METHOD 4-1/4" I.D. Hollow-stem Auger COMPLETION DEPTH: 26.0'

DEPTH, FEET	SAMPLE NUMBER	SAMPLES	SAMPLING EFFORT	DESCRIPTION	TEST RESULTS
0				**MINE SPOIL** Brown silty claysome fine to coarse sand, little fine to coarse gravel, few coal fragments, highly weathered shale. SP	
	1		32/18/14/15	**MINE SPOIL** Medium-dense to dense black coal fragments, few seams of very-soft brown and gray shale. GP	
	2		5/7/7		
	7A *7B			**MINE SPOIL** Very-soft to soft brown intermixed with gray shale fragments, contains coal fragments, similar to hard silty shale. GP	
10	3		6/13/9		H=2.5-3.8
	4		7/4/4	**MINE SPOIL** Loose black coal fragments, intermixed with very-soft to medium-hard gray shale fragments. GP	
	5		7/2/4		
20	6A 6B		27-60R	Very-soft to soft gray and dark-gray shale.	
30				Encountered water at 22.0'	
				*Shelby tube	
40					
50					

NATURAL CONSISTENCY INDEX

NATURAL MOISTURE CONTENT

PLASTIC LIMIT X X LIQUID LIMIT

10 20 30 40

WATER LEVEL 21.9'

DATE: 07/16

SYMBOLS USED TO INDICATE TEST RESULTS

G - GRADATION
Q - UNCONFINED COMPR.
T - TRIAXIAL COMPR.
C - CONSOLIDATION
} SEE SEPARATE CURVES

H - PENETROMETER (tsf)
W - UNIT DRY WEIGHT (pcf)
D - RELATIVE DENSITY (%)

late B-76

LOG OF BORING NO. B-10 — Sheet 1 of 5 Sheets

Apex Solid Waste Disposal Facility
Jefferson and Harrison Counties, Ohio

LOCATION: See Plan Sheets 3D-1 and 3D-2 — ELEVATION: 1254.8 — DATE: 07/27-29/91

SAMPLER(S): — COMPLETION DEPTH: 207.0'

DRILLING METHOD: Air Rotary, 6-1/4" Tricone

DEPTH, FEET	SAMPLE NUMBER	SAMPLES	SAMPLING EFFORT	DESCRIPTION
0				TOPSOIL
				MINE SPOIL Brown with gray fine to coarse gravel, some fine to coarse sand, little silty clay
				MINE SPOIL Brown silty clay, some fine to coarse gravel, little fine to coarse sand.
10				MINE SPOIL Brown with gray fine to coarse gravel, some fine to coarse sand, little silty clay.
				MINE SPOIL Brown silty clay, little fine to coarse sand, trace fine to coarse gravel.
				MINE SPOIL Brown fine to coarse sand, some fine to coarse gravel, little silty clay.
20				MINE SPOIL Limestone cobbles and boulders.
				MINE SPOIL Brown and gray with black fine to coarse gravel, some fine to coarse sand, trace silty clay, few coal fragments.
				Medium-hard black coal.
				Very-soft to soft light-gray shale.
30				Medium-hard to hard gray limestone. From 28.3' to 29.0'; Soft to medium-hard gray shale. From 31.0' to 31.3'; Soft to medium-hard gray shale.
				Soft to medium-hard gray shale, few thin seams of siltstone and limestone.
40				From 39.0' to 46.0'; Soft to medium-hard dark-gray shale.
50				-Continued-

NATURAL CONSISTENCY INDEX
NATURAL MOISTURE CONTENT
PLASTIC LIMIT — LIQUID LIMIT
10 20 30 40

TEST RESULTS

WATER LEVEL: 185.3'
DATE: 07/29

SYMBOLS USED TO INDICATE TEST RESULTS

G - GRADATION
O - UNCONFINED COMPR.
T - TRIAXIAL COMPR.
C - CONSOLIDATION
} SEE SEPARATE CURVES

H - PENETROMETER (tsf)
W - UNIT DRY WEIGHT (pcf)
D - RELATIVE DENSITY (%)

JUB: 3830
ENGINEERING, INC.
BBLAH

Plate B-

LOG OF BORING NO. B-10 Sheet 2 of 5 Sheets

Apex Solid Waste Disposal Facility
Jefferson and Harrison Counties, Ohio

LOCATION: See Plan Sheets 3D-1 and 3D-2 ELEVATION: 1254.8 DATE: 07/27-29/91

SAMPLER(S)

DRILLING METHOD: Air Rotary, 6-1/4" Tricone COMPLETION DEPTH: 207.0'

DEPTH, FEET	SAMPLE NUMBER	SAMPLES	SAMPLING EFFORT	DESCRIPTION	NATURAL CONSISTENCY INDEX / NATURAL MOISTURE CONTENT (PLASTIC LIMIT X — X LIQUID LIMIT) 10 20 30 40	TEST RESULTS
50				-Continued- Soft to medium-hard gray shale, few thin seams of siltstone and limestone.		
60						
70						
80						
90				Medium-hard gray fine-grained sandstone, contains thin seams of dark-gray siltstone. From 99.0' to 99.5'; Medium-hard black coal. From 99.5' to 101.0'; Medium-hard gray limestone.		
100				-Continued-		

WATER LEVEL 185.3'
DATE: 07/29

SYMBOLS USED TO INDICATE TEST RESULTS

G - GRADATION
Q - UNCONFINED COMPR.
T - TRIAXIAL COMPR.
C - CONSOLIDATION
} SEE SEPARATE CURVES

H - PENETROMETER (tsf)
W - UNIT DRY WEIGHT (pcf)
D - RELATIVE DENSITY (%)

DOUGHERTY ENGINEERING, INC. JOB: 3DDJ

Plate B-78

LOG OF BORING NO. B-10 Sheet 3 of 5 Sheets

Apex Solid Waste Disposal Facility

Jefferson and Harrison Counties, Ohio

LOCATION: **See Plan Sheets 3D-1 and 3D-2** ELEVATION: 1254.8 DATE: 07/27-29/91

SAMPLER(S):

DRILLING METHOD: Air Rotary, 6-1/4" Tricone COMPLETION DEPTH: 207.0'

DEPTH, FEET	SAMPLE NUMBER	SAMPLES	SAMPLING EFFORT	DESCRIPTION	NATURAL CONSISTENCY INDEX (NATURAL MOISTURE CONTENT; PLASTIC LIMIT; LIQUID LIMIT) 10 20 30 40	TEST RESULTS
100				-Continued-		
				Medium-hard dark-gray siltstone, contains many thin seams of gray sandstone.		
110				From 115.0' to 115.5': Medium-hard black coal		
				Medium-hard gray fine-grained sandstone, micaceous, occasional thin seam of medium-hard dark-gray siltstone.		
120						
130						
140						
150				-Continued-		

WATER LEVEL: 185.3'

DATE: 07/29

SYMBOLS USED TO INDICATE TEST RESULTS

G - GRADATION; Q - UNCONFINED COMPR.; T - TRIAXIAL COMPR.; C - CONSOLIDATION } SEE SEPARATE CURVES

H - PENETROMETER (tsf)

W - UNIT DRY WEIGHT (pcf)

D - RELATIVE DENSITY (%)

Plate B-79

LOG OF BORING NO. B-10 — Sheet 4 of 5 Sheets

Apex Solid Waste Disposal Facility
Jefferson and Harrison Counties, Ohio

LOCATION: See Plan Sheets 3D-1 and 3D-2 — ELEVATION: 1254.8 — DATE: 07/27-29/91

SAMPLER(S)

DRILLING METHOD: Air Rotary, 6-1/4" Tricone — COMPLETION DEPTH: 207.0'

DEPTH, FEET	SAMPLE NUMBER	SAMPLES	SAMPLING EFFORT	DESCRIPTION	NATURAL CONSISTENCY INDEX (NATURAL MOISTURE CONTENT; PLASTIC LIMIT; LIQUID LIMIT)	TEST RESULTS
150				-Continued- Medium-hard gray sandstone, micaceous, occasional thin seam of medium-hard dark-gray siltstone.	10 20 30 40	
				Medium-hard gray shale.		
				From 156.0' to 157.0'; Very-soft light-brown shale.		
				From 157.0' to 158.0'; Medium-hard to hard light-brown limestone.		
160						
170				From 173.0' to 176.0'; Medium-hard red-brown shale.		
180						
190						
				Medium-hard light-gray limestone.		
200				Medium-hard gray shale. -Continued-		

WATER LEVEL: 185.3'
DATE: 07/29

SYMBOLS USED TO INDICATE TEST RESULTS

G - GRADATION Q - UNCONFINED COMPR. T - TRIAXIAL COMPR. C - CONSOLIDATION	SEE SEPARATE CURVES	H - PENETROMETER (tsf) W - UNIT DRY WEIGHT(pcf) D - RELATIVE DENSITY (%)

BBC&M ENGINEERING, INC. JOB: 385 .GPJ

Plate B-80

LOG OF BORING NO. B-10 Sheet 5 of 5 Sheets

Apex Solid Waste Disposal Facility
Jefferson and Harrison Counties, Ohio

LOCATION: See Plan Sheets 3D-1 and 3D-2 ELEVATION: 1254.8 DATE: 07/27-29/91

SAMPLER(S):

DRILLING METHOD: Air Rotary, 6-1/4" Tricone COMPLETION DEPTH: 207.0'

DEPTH, FEET	SAMPLE NUMBER	SAMPLES	SAMPLING EFFORT	DESCRIPTION	NATURAL CONSISTENCY INDEX (NATURAL MOISTURE CONTENT; PLASTIC LIMIT; LIQUID LIMIT)	TEST RESULTS
200				-Continued- Medium-hard gray shale	10 20 30 40	
210				Encountered water from 176.0' to 198.0'		
220						
230						
240						
250						

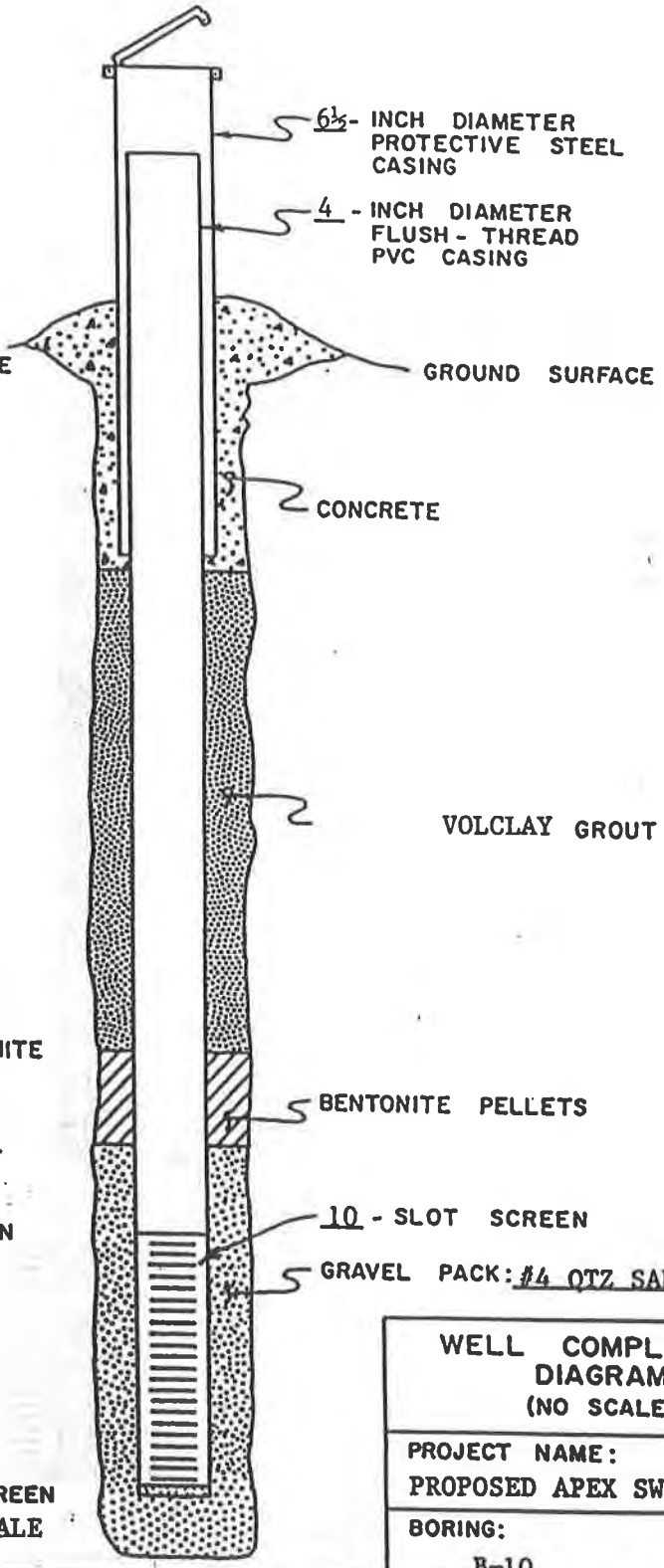
WATER LEVEL: 185.30'
DATE: 07/29

SYMBOLS USED TO INDICATE TEST RESULTS

G - GRADATION
Q - UNCONFINED COMPR.
T - TRIAXIAL COMPR.
C - CONSOLIDATION
} SEE SEPARATE CURVES

H - PENETROMETER (tsf)
W - UNIT DRY WEIGHT (pcf)
D - RELATIVE DENSITY (%)

ELEV. *	DEPTH BELOW GROUND SURFACE (FEET)	
1257.47	+2.7	TOP OF COVER
1257.28	+2.5	TOP OF PVC
1254.8	0.0	GROUND SURFACE
1242.6	12.2	TOP OF GROUT
1083.8	171.0	TOP OF BENTONITE
1081.8	173.0	TOP OF GRAVEL
1100.8	154.0	TOP OF SHALE
1069.6	185.2	TOP OF SCREEN
1060.6	194.2	BOTTOM OF SCREEN
—	—	
1047.8	207.0	BOTTOM OF SHALE BORING DEPTH



WELL COMPLETION DIAGRAM
(NO SCALE)

PROJECT NAME: PROPOSED APEX SWDF

BORING: B-10

DATE WELL INSTALLED: 7/29/91

BBC&M PROJECT NO: 3850

STATIC WATER ELEVATION: *	1077.2	1081.1	1068.8	1070.5
DATE:	8/2	8/5	8/8	8/14

* FEET ABOVE MSL

WELL DEVELOPMENT: BAILED OR PUMPED 29 GALLONS OVER 4 DAYS. WATER SILTY AT COMPLETION. WELL YIELDING APPROXIMATELY 0.5 GALLONS PER HOUR.

BBC&M ENGINEERING, INC.

Plate B-142

LOG OF BORING NO. B-11 Sheet 1 of 3 Sheets

Apex Solid Waste Disposal Facility
Jefferson and Harrison Counties, Ohio

LOCATION: See Plan Sheets 3D-1 and 3D-2 ELEVATION: 1243.9 DATE: 07/18/91

SAMPLER(S):

DRILLING METHOD: Air Rotary, 6-1/4" Tricone COMPLETION DEPTH: 141.0'

DEPTH, FEET	SAMPLE NUMBER	SAMPLES	SAMPLING EFFORT	DESCRIPTION	NATURAL CONSISTENCY INDEX / NATURAL MOISTURE CONTENT (PLASTIC LIMIT — LIQUID LIMIT; 10 20 30 40)	TEST RESULTS
0				MINE SPOIL Topsoil mixed with silty clay.		
				MINE SPOIL Black fine to coarse gravel (coal and shale).		
				MINE SPOIL Brown silty clay.		
				MINE SPOIL Brown with black fine to coarse sand (shale and coal).		
10				MINE SPOIL Brown silty clay.		
				Soft gray shale.		
				Medium-hard to hard gray limestone. From 9.5' to 10.0'; Soft gray shale. From 11.7' to 12.0'; Soft gray shale.		
				Soft to medium-hard gray shale, contains thin seams of limestone. From 18.0' to 19.5'; Medium-hard gray siltstone. From 20.0' to 21.5'; Hard gray limestone.		
20						
30						
40						
50				-Continued-		

WATER LEVEL: 92.5'
DATE: 07/18

SYMBOLS USED TO INDICATE TEST RESULTS

G - GRADATION
Q - UNCONFINED COMPR.
T - TRIAXIAL COMPR.
C - CONSOLIDATION
} SEE SEPARATE CURVES

H - PENETROMETER (tsf)
W - UNIT DRY WEIGHT (pcf)
D - RELATIVE DENSITY (%)

Plate B-82

LOG OF BORING NO. B-11 — Sheet 2 of 3 Sheets

Apex Solid Waste Disposal Facility
Jefferson and Harrison Counties, Ohio

LOCATION: See Plan Sheets 3D-1 and 3D-2 — ELEVATION: 1243.9 — DATE: 07/18/91

SAMPLER(S):

DRILLING METHOD: Air Rotary, 6-1/4" Tricone — COMPLETION DEPTH: 141.0'

DEPTH, FEET	SAMPLE NUMBER	SAMPLES	SAMPLING EFFORT	DESCRIPTION	NATURAL CONSISTENCY INDEX / NATURAL MOISTURE CONTENT (PLASTIC LIMIT X — LIQUID LIMIT X)	TEST RESULTS
50				-Continued- Soft to medium-hard gray shale, contains thin seams of limestone.	10 20 30 40	
				Medium-hard dark-gray shale.		
60				Medium-hard light-gray fine-grained sandstone.		
				Medium-hard interbedded gray fine-grained sandstone and dark-gray siltstone.		
70						
80						
90				Soft to medium-hard gray fine-grained sandstone.		
100				-Continued-		

WATER LEVEL: 92.5'
DATE: 07/18

SYMBOLS USED TO INDICATE TEST RESULTS

G - GRADATION O - UNCONFINED COMPR. T - TRIAXIAL COMPR. C - CONSOLIDATION	SEE SEPARATE CURVES	H - PENETROMETER (tsf) W - UNIT DRY WEIGHT(pcf) D - RELATIVE DENSITY (%)

LOG OF BORING NO. B-11 — Sheet 3 of 3 Sheets

Apex Solid Waste Disposal Facility
Jefferson and Harrison Counties, Ohio

LOCATION: See Plan Sheets 3D-1 and 3D-2 — ELEVATION: 1243.9 — DATE: 07/18/91

SAMPLER(S):

DRILLING METHOD: Air Rotary, 6-1/4" Tricone — COMPLETION DEPTH: 141.0'

DEPTH, FEET	SAMPLE NUMBER	SAMPLES	SAMPLING EFFORT	DESCRIPTION	NATURAL CONSISTENCY INDEX (NATURAL MOISTURE CONTENT; PLASTIC LIMIT; LIQUID LIMIT)	TEST RESULTS
100				-Continued- Soft to medium-hard gray fine-grained sandstone. From 101.0' to 103.0'; Medium-hard dark-gray siltstone.	10 20 30 40	
110						
120				From 122.0' to 124.0'; Medium-hard gray siltstone.		
				Medium-hard brown limestone.		
130				Medium-hard gray shale.		
140				Encountered seepage from 94.0' to 101.0'. Encountered water from 117.0' to 126.0'.		
150						

WATER LEVEL: 92.5'
DATE: 07/18

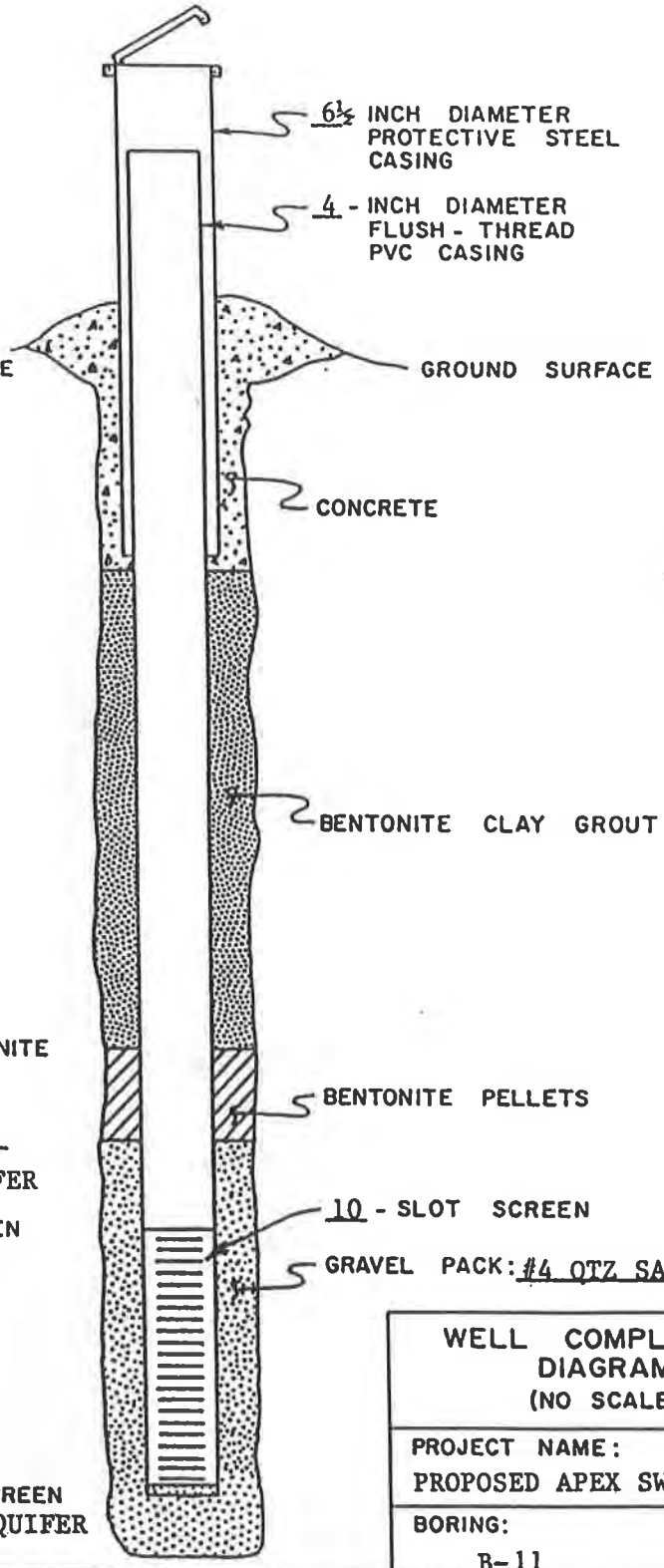
SYMBOLS USED TO INDICATE TEST RESULTS

G - GRADATION
Q - UNCONFINED COMPR.
T - TRIAXIAL COMPR.
C - CONSOLIDATION
} SEE SEPARATE CURVES

H - PENETROMETER (tsf)
W - UNIT DRY WEIGHT (pcf)
D - RELATIVE DENSITY (%)

Plate B-84

ELEV. *	DEPTH BELOW GROUND SURFACE (FEET)	
1246.61	+2.7	TOP OF COVER
1246.36	+2.5	TOP OF PVC
1243.9	0.0	GROUND SURFACE
1243.4	0.5	TOP OF GROUT
1150.9	93.0	TOP OF BENTONITE
1149.5	94.4	TOP OF GRAVEL
1153.9	90.0	TOP OF AQUIFER
1140.7	103.2	TOP OF SCREEN
1131.6	112.3	BOTTOM OF SCREEN
1117.9	126.0	BOTTOM OF AQUIFER
1102.9	141.0	BORING DEPTH



WELL COMPLETION DIAGRAM
(NO SCALE)

PROJECT NAME: PROPOSED APEX SWDF

BORING: B-11

DATE WELL INSTALLED: 7/18/91

BBC&M PROJECT NO: 3850

STATIC WATER ELEVATION: *	1156.62	1156.24	1156.19	1156.06
DATE:	7/29	8/5	8/8	8/14

* FEET ABOVE MSL

WELL DEVELOPMENT: PUMPED 103 GALLONS OVER 3 DAYS. WATEI SILTY AT COMPLETION. WELL YIELDING APPROXIMATELY 4 GALLONS PER HOUR.

BBC&M ENGINEERING, INC.

BBC&M

LOG OF BORING NO. B-11S
APEX SOLID WASTE DISPOSAL FACILITY
JEFFERSON COUNTY, OHIO

LOCATION: See Plan Sheets 3D-1 and 3D-2 ELEVATION: 1244.3 DATE: 4/19/95

DRILLING METHOD: COMPLETION DEPTH: 60.0'

SAMPLER(S): Air Rotary, 6-3/4" Tricone

DEPTH, FEET	SAMPLE NUMBER	SAMPLE	SAMPLE EFFORT	DESCRIPTION	NATURAL CONSISTENCY INDEX / NATURAL MOISTURE CONTENT / PLASTIC LIMIT / LIQUID LIMIT (10 20 30 40)	TEST RESULTS
0				SEE LOG OF BORING B-11 BORING CONVERTED TO GROUNDWATER MONITORING WELL (See Well Completion Diagram)		
5						
10						
15						
20						
25						
30						
35						
40						
45						
50						
55						
60						
65						

WATER LEVEL:	▽ 54.2	▼ 4.6	▽ 52.0
WATER NOTE:			
DATE:	04/19/95	04/20/95	05/01/95

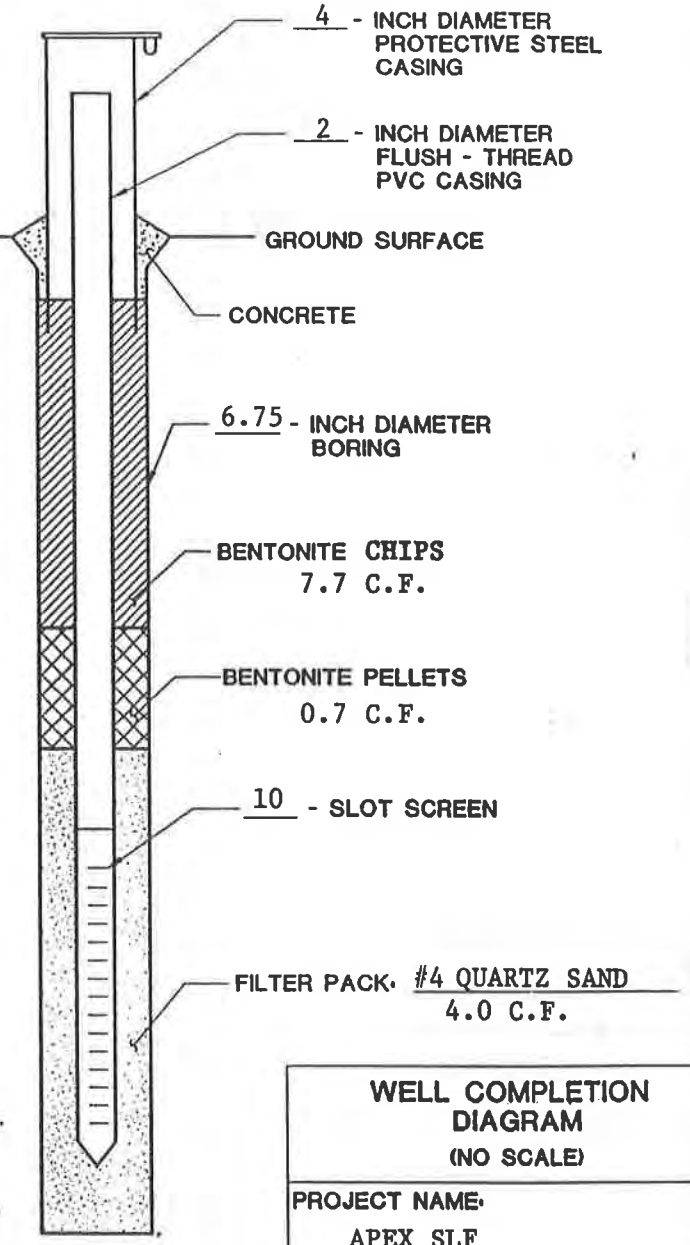
SYMBOLS USED TO INDICATE TEST RESULTS

G - GRADATION
Q - UNCONFINED COMPR
T - TRIAXIAL COMPR
C - CONSOLIDATION
} SEE SEPARATE CURVES

H - PENETROMETER (tsf)
W - UNIT DRY WEIGHT (pcf)
D - RELATIVE DENSITY (%)

JOB: 38503

ELEV. #	DEPTH BELOW GROUND SURFACE (FEET)	
1246.83	2.5	TOP OF COVER
1246.63	2.3	TOP OF PVC
1244.3	0.0	GROUND SURFACE
1240.9	3.4	TOP OF GROUT
1204.3	40.0	TOP OF BENTONITE
1200.9	43.4	TOP OF FILTER PACK
1195.2	49.1	TOP OF SCREEN OPENINGS
1185.8	58.5	BOTTOM OF SCREEN OPENINGS
1186.2	58.1	BOTTOM OF WELL
1184.3	60.0	BORING DEPTH



WELL COMPLETION DIAGRAM
(NO SCALE)

PROJECT NAME: APEX SLF

BORING: B-11 S

DATE WELL INSTALLED: April 20, 1995

BBC & M PROJECT NO: 3850-3

STATIC WATER LEVEL #	1210.14	1191.18	1192.31	1195.58
DATE:	4/26/95	4/27/95	5/1/95	5/5/95

WELL DEVELOPMENT: 4/26 - Hand bailed 9.5 gallons (dry)
4/27 - Hand bailed 1.25 gallons (dry)
5/1 - Hand bailed 1.5 gallons (dry); water silty at completion.

FEET ABOVE MSL

BBC&M ENGINEERING INC

Plate B-144

LOG OF BORING NO. B-12 Sheet 1 of 4 Sheets

Apex Solid Waste Disposal Facility

Jefferson and Harrison Counties, Ohio

LOCATION: See Plan Sheets 3D-1 and 3D-2 ELEVATION: 1282.3 DATE: 07/30-08/02/9

SAMPLER(S):

DRILLING METHOD: Air Rotary, 5-7/8" Tricone COMPLETION DEPTH: 193.0'

DEPTH, FEET	SAMPLE NUMBER	SAMPLES	SAMPLING EFFORT	DESCRIPTION	NATURAL CONSISTENCY INDEX (NATURAL MOISTURE CONTENT; PLASTIC LIMIT; LIQUID LIMIT)	TEST RESULTS
0				TOPSOIL	10 20 30 40	
				MINE SPOIL Brown fine to coarse sand, some silty clay, little fine to coarse gravel.		
				MINE SPOIL Gray shale boulder.		
				MINE SPOIL Brown fine to coarse gravel, some fine to coarse sand, little silty clay.		
10				MINE SPOIL Dark-brown clayey silt (topsoil).		
				MINE SPOIL Brown silty clay, some fine to coarse sand, little fine to coarse gravel.		
				MINE SPOIL Brown and gray fine to coarse sand, some fine to coarse gravel, little clayey silt, few cobbles, occasional boulders.		
20				MINE SPOIL Limestone cobbles and boulders.		
				MINE SPOIL Gray sand and gravel (shale fragments).		
				MINE SPOIL Limestone boulder.		
				MINE SPOIL Brown fine to coarse sand, some silty clay, little fine to coarse gravel, trace coal, few cobbles and boulders.		
30						
40				MINE SPOIL Gray fine to coarse gravel, some fine to coarse sand, little silty clay.		
				MINE SPOIL Brown and gray fine to coarse sand, some silty clay, little fine to coarse gravel, few cobbles and boulders.		
50				MINE SPOIL Limestone boulders. -Continued-		

WATER LEVEL: 128.8'

DATE: 08/02

SYMBOLS USED TO INDICATE TEST RESULTS

G - GRADATION
Q - UNCONFINED COMPR.
T - TRIAXIAL COMPR.
C - CONSOLIDATION
} SEE SEPARATE CURVES

H - PENETROMETER (tsf)
W - UNIT DRY WEIGHT(pcf)
D - RELATIVE DENSITY (%)

LOG OF BORING NO. B-12 — Sheet 2 of 4 Sheets

Apex Solid Waste Disposal Facility
Jefferson and Harrison Counties, Ohio

LOCATION: See Plan Sheets 3D-1 and 3D-2 ELEVATION: 1282.3 DATE: 07/30-8/02/9

SAMPLER(S):

DRILLING METHOD: Air Rotary, 5-7/8" Tricone COMPLETION DEPTH: 193.0'

DEPTH, FEET	SAMPLE NUMBER	SAMPLES	SAMPLING EFFORT	DESCRIPTION	NATURAL CONSISTENCY INDEX (NATURAL MOISTURE CONTENT, PLASTIC LIMIT, LIQUID LIMIT)	TEST RESULTS
50				-Continued- MINE SPOIL Brown and gray fine to coarse sand, some silty clay, little fine to coarse gravel, few cobbles and boulders.	10 20 30 40	
				MINE SPOIL Limestone boulders.		
				VOID		
				Soft gray shale.		
60				Hard gray limestone, few thin shale seams.		
				Soft to medium-hard gray shale, few thin seams of siltstone.		
70				From 71.0' to 72.0'; Hard gray limestone.		
				From 72.0' to 76.0'; Soft to medium-hard dark-gray shale.		
80						
90				Medium-hard gray siltstone.		
				Soft to medium-hard gray shale.		
100				-Continued-		

WATER LEVEL: 128.8'
DATE: 08/02

SYMBOLS USED TO INDICATE TEST RESULTS

G - GRADATION
O - UNCONFINED COMPR.
T - TRIAXIAL COMPR.
C - CONSOLIDATION
} SEE SEPARATE CURVES

H - PENETROMETER (tsf)
W - UNIT DRY WEIGHT (pcf)
D - RELATIVE DENSITY (%)

DUKE ENGINEERING, INC. JOB 3000

LOG OF BORING NO. B-12 — Sheet 3 of 4 Sheets

Apex Solid Waste Disposal Facility
Jefferson and Harrison Counties, Ohio

LOCATION: See Plan Sheets 3D-1 and 3D-2 — ELEVATION: 1282.3 — DATE: 07/30-8/02/91

SAMPLER(S):

DRILLING METHOD: Air Rotary, 5-7/8" Tricone — COMPLETION DEPTH: 193.0'

DEPTH, FEET	SAMPLE NUMBER	SAMPLES	SAMPLING EFFORT	DESCRIPTION	NATURAL CONSISTENCY INDEX (NATURAL MOISTURE CONTENT; PLASTIC LIMIT; LIQUID LIMIT)	TEST RESULTS
100				-Continued- Soft to medium-hard gray shale.	10 20 30 40	
				Medium-hard dark-gray siltstone, contains few seams of soft gray shale.		
110						
120				From 126.5' to 127.0'; Medium-hard black coal. From 127.0' to 129.0'; Medium-hard gray limestone.		
130				Soft to medium-hard gray fine-grained sandstone, few thin seams of dark-gray siltstone.		
140						
150				-Continued-		

WATER LEVEL: 128.8'
DATE: 08/02

SYMBOLS USED TO INDICATE TEST RESULTS

G - GRADATION
Q - UNCONFINED COMPR.
T - TRIAXIAL COMPR.
C - CONSOLIDATION
} SEE SEPARATE CURVES

H - PENETROMETER (tsf)
W - UNIT DRY WEIGHT (pcf)
D - RELATIVE DENSITY (%)

DOUGLAS ENGINEERING, INC JOB 3000

Plate B-88

LOG OF BORING NO. B-12 — Sheet 4 of 4 Sheets

Apex Solid Waste Disposal Facility
Jefferson and Harrison Counties, Ohio

LOCATION: **See Plan Sheets 3D-1 and 3D-2** ELEVATION: 1282.3 DATE: 07/30-8/02/91

SAMPLER(S)

DRILLING METHOD: Air Rotary, 5-7/8" Tricone COMPLETION DEPTH: 193.0'

DEPTH, FEET	SAMPLE NUMBER	SAMPLES	SAMPLING EFFORT	DESCRIPTION	NATURAL CONSISTENCY INDEX (NATURAL MOISTURE CONTENT; PLASTIC LIMIT; LIQUID LIMIT)	TEST RESULTS
150				-Continued- Soft to medium-hard gray fine-grained sandstone, few thin seams of dark-gray siltstone. From 153.0' to 154.0'; Medium-hard black coal.	10 20 30 40	
				From 154.0' to 158.0'; Medium-hard dark-gray siltstone.		
160						
170						
180				From 187.0' to 188.0'; Medium-hard black coal		
				Medium-hard gray limestone.		
190				Medium-hard dark-gray siltstone.		
				Encountered water at 165.0'.		
				Encountered strong flow of water from 175.0' to 188.0'.		
200						

WATER LEVEL: 128.8'
DATE: 08/02

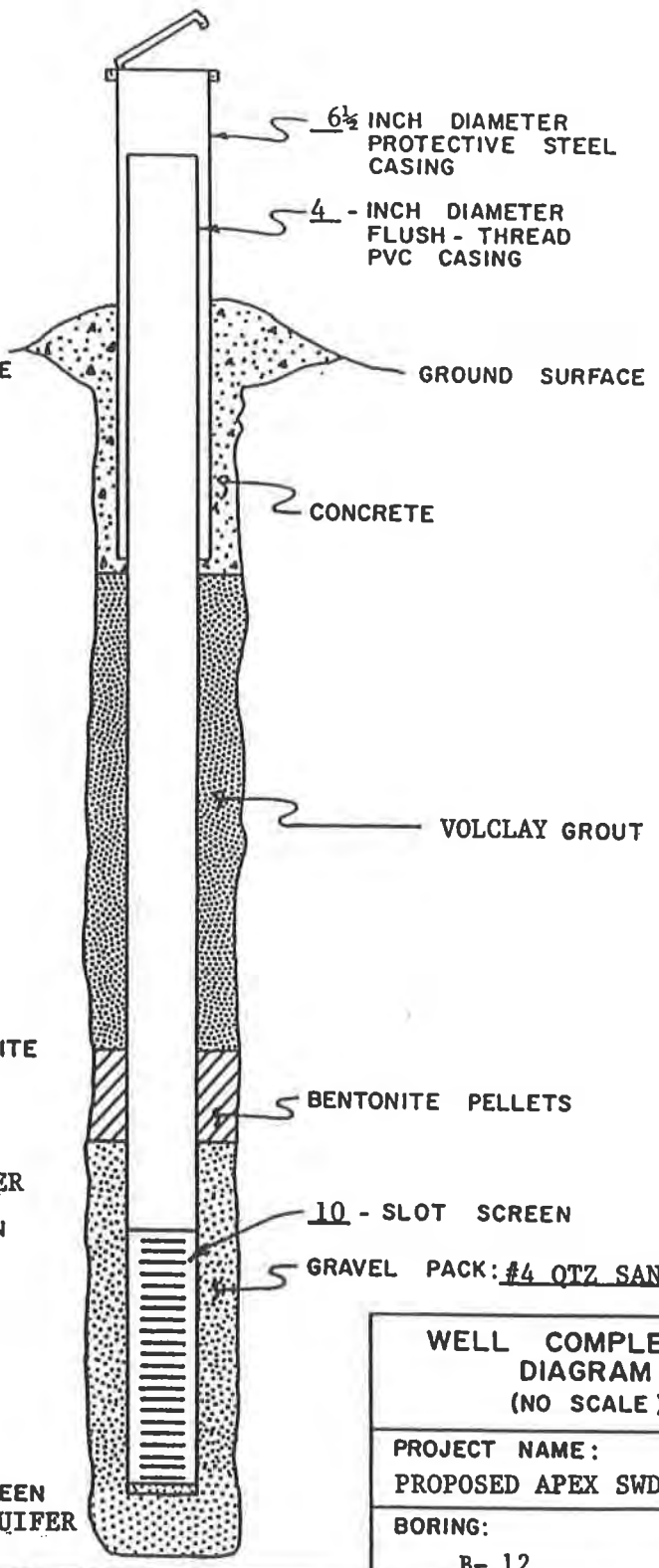
SYMBOLS USED TO INDICATE TEST RESULTS

G - GRADATION
O - UNCONFINED COMPR.
T - TRIAXIAL COMPR.
C - CONSOLIDATION
} SEE SEPARATE CURVES

H - PENETROMETER (tsf)
W - UNIT DRY WEIGHT (pcf)
D - RELATIVE DENSITY (%)

Plate B-89

ELEV. *	DEPTH BELOW GROUND SURFACE (FEET)	
1284.97	+2.6	TOP OF COVER
1284.83	+2.5	TOP OF PVC
1282.3	0.0	GROUND SURFACE
1276.0	6.3	TOP OF GROUT
1130.2	152.1	TOP OF BENTONITE
1127.5	154.8	TOP OF GRAVEL
1153.3	129.0	TOP OF AQUIFER
1109.1	173.2	TOP OF SCREEN
1100.1	182.2	BOTTOM OF SCREEN
1095.3	187.0	BOTTOM OF AQUIFER
1089.3	193.0	BORING DEPTH



WELL COMPLETION DIAGRAM
(NO SCALE)

PROJECT NAME: PROPOSED APEX SWDF

BORING: B- 12

DATE WELL INSTALLED: 8/2/91

BBC&M PROJECT NO: 3850

STATIC WATER ELEVATION: *	1153.4	1153.4	1153.2	1153.1
DATE:	8/5	8/8	8/14	9/16

* FEET ABOVE MSL

WELL DEVELOPMENT: PUMPED 295 GALLONS IN ONE DAY. WATER NEARLY CLEAR AT COMPLETION. WELL YIELDING APPROXIMATELY 5 GALLONS PER MINUTE.

BBC&M ENGINEERING, INC.

LOG OF BORING NO B-13 Sheet 1 of 4 Sheets

Apex Solid Waste Disposal Facility
Jefferson and Harrison Counties, Ohio

LOCATION: See Plan Sheets 3D-1 and 3D-2 ELEVATION: 1249 DATE: May, 1992

SAMPLER(S): PXM Core-barrel

DRILLING METHOD: Air Rotary COMPLETION DEPTH: 180.0'

DEPTH, FEET	SAMPLE NUMBER	SAMPLES	SAMPLING EFFORT	DESCRIPTION	NATURAL CONSISTENCY INDEX / NATURAL MOISTURE CONTENT (PLASTIC LIMIT X — X LIQUID LIMIT)	TEST RESULTS
0				NO SAMPLING PERFORMED	10 20 30 40	
10	1		PXM REC --- 100%	Medium-hard to hard light-gray argillaceous limestone, nearly horizontally bedded, 1" to 14" layers. -from 14.7' to 16.7': Soft to medium-hard gray shale.		
20	2		REC --- 82%	Soft gray shale, nearly horizontally bedded, fissile, few diagonal fractures. -From 21.0' to 23.2': Few slickensides.		
30	3		REC --- 87%	Medium-hard gray argillaceous, arenaceous limestone, nearly horizontally bedded, 5" to 40" layers.		
40	4		REC --- 100%	Interbedded medium-hard to hard gray shale and siltstone, nearly horizontally bedded, 1" to 10" layers, few seams of fine sandstone.		K=2.2 E-5 cm/sec (40'-50')
50	5		REC --- 92%	-Continued-		

WATER LEVEL: 38.0'
DATE: 06/04

SYMBOLS USED TO INDICATE TEST RESULTS

G - GRADATION
Q - UNCONFINED COMPR.
T - TRIAXIAL COMPR.
C - CONSOLIDATION
} SEE SEPARATE CURVES

H - PENETROMETER (tsf)
W - UNIT DRY WEIGHT (pcf)
D - RELATIVE DENSITY (%)

JUB ENGINEERING, INC.

Plate B-90

LOG OF BORING NO. B-13 Sheet 2 of 4 Sheets

Apex Solid Waste Disposal Facility

Jefferson and Harrison Counties, Ohio

LOCATION: See Plan Sheets 3D-1 and 3D-2 ELEVATION: 1249 DATE: May, 1992

SAMPLER(S): PXM Core-barrel

DRILLING METHOD: Air Rotary COMPLETION DEPTH: 180.0'

DEPTH, FEET	SAMPLE NUMBER	SAMPLES	SAMPLING EFFORT	DESCRIPTION	NATURAL CONSISTENCY INDEX / NATURAL MOISTURE CONTENT (PLASTIC LIMIT X — X LIQUID LIMIT; 10 20 30 40)	TEST RESULTS
50			PXM	-Continued- Interbedded medium-hard to hard gray shale and siltstone, nearly horizontally bedded, 1" to 10" layers, few seams of fine sandstone.		
	5		REC --- 92%			K=3.4 E-8 cm/sec (50'-60')
60						
	6		REC --- 97%	-From 65.5' to 66.0': Few limestone nodules		K=2.6 E-7 cm/sec (60'-70')
70						
	7		REC --- 100%	Medium-hard to hard gray fine and fine to medium sandstone, nearly horizontally bedded, 1" to 40" layers.		
80						
	8		REC --- 100%	-From 86.3' to 88.0': Brown staining		K=2.2 E-6 cm/sec (80'-90')
90						
	9		REC --- 100%	-From 99.1' to 100.0': Contains limestone nodules		K=5.8 E-7 cm/sec (90'-100')
100						
	10		REC --- 100%	-Continued-		

WATER LEVEL: 38.0'

DATE: 06/04

SYMBOLS USED TO INDICATE TEST RESULTS

G - GRADATION, O - UNCONFINED COMPR, T - TRIAXIAL COMPR., C - CONSOLIDATION } SEE SEPARATE CURVES

H - PENETROMETER (tsf)
W - UNIT DRY WEIGHT (pcf)
D - RELATIVE DENSITY (%)

DRUGAN ENGINEERING, INC. JOB: 3850-T

LOG OF BORING NO. B-13 Sheet 3 of 4 Sheets

Apex Solid Waste Disposal Facility
Jefferson and Harrison Counties, Ohio

LOCATION: See Plan Sheets 3D-1 and 3D-2 ELEVATION: 1249 DATE: May, 1992

SAMPLER(S): PXM Core-barrel

DRILLING METHOD: Air Rotary COMPLETION DEPTH: 180.0'

DEPTH, FEET	SAMPLE NUMBER	SAMPLES	SAMPLING EFFORT	DESCRIPTION	NATURAL CONSISTENCY INDEX / NATURAL MOISTURE CONTENT (PLASTIC LIMIT — LIQUID LIMIT; 10 20 30 40)	TEST RESULTS
100			PXM	-Continued- Medium-hard to hard gray fine and fine to medium sandstone, nearly horizontally bedded, 1" to 40" layers.		
	10		REC --- 100%			K=8.4 E-7 cm/sec (100'-110')
110						
	11		REC --- 97%			K=7.9 E-7 cm/sec (110'-120')
120				-From 121.7' to 123.1': Many thin seams of micaceous siltstone.		
	12		REC --- 100%			K=1.4 E-6 cm/sec (120'-130')
130						
	13		REC --- 100%			K=3.6 E-7 cm/sec (130'-140')
140						
	14		REC --- 100%			K=6.8 E-8 cm/sec (140'-150')
150			REC			
	15		--- 100%	-Continued-		

WATER LEVEL: 38.0'
DATE: 06/04

SYMBOLS USED TO INDICATE TEST RESULTS

G - GRADATION
O - UNCONFINED COMPR.
T - TRIAXIAL COMPR.
C - CONSOLIDATION
} SEE SEPARATE CURVES

H - PENETROMETER (tsf)
W - UNIT DRY WEIGHT (pcf)
D - RELATIVE DENSITY (%)

LOG OF BORING NO. B-13 Sheet 4 of 4 Sheets

Apex Solid Waste Disposal Facility
Jefferson and Harrison Counties, Ohio

LOCATION: **See Plan Sheets 3D-1 and 3D-2** ELEVATION: 1249 DATE: May, 1992

SAMPLER(S): PXM Core-barrel

DRILLING METHOD: Air Rotary COMPLETION DEPTH: 180.0'

DEPTH, FEET	SAMPLE NUMBER	SAMPLES	SAMPLING EFFORT	DESCRIPTION	TEST RESULTS
150			PXM	-Continued- Medium-hard to hard gray fine and fine to medium sandstone, nearly horizontally bedded, 1" to 40" layers	
	15		REC --- 100%		K=8.1 E-8 cm/sec (150'-160')
160				Medium-hard to hard dark-gray argillaceous limestone, nearly horizontally bedded, 1" to 5" layers, many 1" to 3" seams of broken and clay-filled limestone. -From 160.8' to 161.0': Broken zone with clay filling. -From 167.5' to 170.0': Very-broken. -From 170.0' to 174.5': Intergrading between arenaceous limestone and calcareous shale.	
	16		REC --- 79%		
170					
	17		REC --- 100%	Medium-hard gray shale, nearly horizontally bedded, 2" to 3" layers.	
180					
190					
200					

NATURAL CONSISTENCY INDEX
NATURAL MOISTURE CONTENT
PLASTIC LIMIT X X LIQUID LIMIT
10 20 30 40

WATER LEVEL: 38.0'
DATE: 06/04

SYMBOLS USED TO INDICATE TEST RESULTS

G - GRADATION Q - UNCONFINED COMPR. T - TRIAXIAL COMPR. C - CONSOLIDATION	SEE SEPARATE CURVES	H - PENETROMETER (tsf) W - UNIT DRY WEIGHT (pcf) D - RELATIVE DENSITY (%)

DOUGH ENGINEERING, INC. JOB: T-ASAF

LOG OF BORING NO. B-14 Sheet 1 of 5 Sheets

Apex Solid Waste Disposal Facility
Jefferson and Harrison Counties, Ohio

LOCATION: See Plan Sheets 3D-1 and 3D-2 ELEVATION: 1262 DATE: May, 1992

SAMPLER(S): PXM Core-barrel

DRILLING METHOD: Air Rotary COMPLETION DEPTH: 206.0'

DEPTH, FEET	SAMPLE NUMBER	SAMPLES	SAMPLING EFFORT	DESCRIPTION	NATURAL CONSISTENCY INDEX (NATURAL MOISTURE CONTENT; PLASTIC LIMIT; LIQUID LIMIT)	TEST RESULTS
0				FROM 0.0' TO 37.0': MINE SPOIL NO SAMPLING PERFORMED	10 20 30 40	
10						
20						
30						
40						
			PXM			
	47.5			Soft to medium-hard gray calcareous shale, nearly horizontally bedded, 1/4" to 4" layers.		
			REC			
50	1 49.5		---	Medium-hard to hard gray argillaceous limestone, nearly horizontally bedded, 1" to 5" layers.		
			75%	From 50.2' to 52.0': Soft to medium-hard gray calcareous shale.		

-Continued-

WATER LEVEL: 103.4
DATE: 06/02/92

SYMBOLS USED TO INDICATE TEST RESULTS

G - GRADATION
O - UNCONFINED COMPR.
T - TRIAXIAL COMPR.
C - CONSOLIDATION
} SEE SEPARATE CURVES

H - PENETROMETER (tsf)
W - UNIT DRY WEIGHT (pcf)
D - RELATIVE DENSITY (%)

Plate B-94

LOG OF BORING NO. B-14 — Sheet 2 of 5 Sheets

Apex Solid Waste Disposal Facility
Jefferson and Harrison Counties, Ohio

LOCATION: **See Plan Sheets 3D-1 and 3D-2** ELEVATION: 1262 DATE: May, 1992

SAMPLER(S): PXM Core-barrel

DRILLING METHOD: Air Rotary COMPLETION DEPTH: 206.0'

DEPTH, FEET	SAMPLE NUMBER	SAMPLES	SAMPLING EFFORT	DESCRIPTION	NATURAL CONSISTENCY INDEX (NATURAL MOISTURE CONTENT; PLASTIC LIMIT; LIQUID LIMIT)	TEST RESULTS
50			PXM	-Continued-	10 20 30 40	
	1		REC --- 75%	Medium-hard to hard gray argillaceous limestone, nearly horizontally bedded, 1" to 5" layers. -from 54.1' to 54.6': Very-soft shale, similar to soil.		
			REC --- 100%			
60	2			Soft to medium-hard gray shale, nearly horizontally bedded, 1/2" to 5" layers, partly calcareous to 67.0'.		K=3.3 E -8 cm/sec (61'-66')
			REC --- 100%			
70	3					
			REC --- 94%			
80	4					
			REC --- 100%			
90	5					
			REC --- 97%			
100	6			-Continued-		

WATER LEVEL: 103.4'
DATE: 06/02

SYMBOLS USED TO INDICATE TEST RESULTS

G - GRADATION Q - UNCONFINED COMPR. T - TRIAXIAL COMPR. C - CONSOLIDATION	SEE SEPARATE CURVES	H - PENETROMETER (tsf) W - UNIT DRY WEIGHT (pcf) D - RELATIVE DENSITY (%)

LOG OF BORING NO. B-14 Sheet 3 of 5 Sheets

Apex Solid Waste Disposal Facility
Jefferson and Harrison Counties, Ohio

LOCATION: See Plan Sheets 3D-1 and 3D-2 ELEVATION: 1262 DATE: May, 1992

SAMPLER(S): PXM Core-barrel

DRILLING METHOD: Air Rotary COMPLETION DEPTH: 206.0'

DEPTH, FEET	SAMPLE NUMBER	SAMPLES	SAMPLING EFFORT	DESCRIPTION	NATURAL CONSISTENCY INDEX (NATURAL MOISTURE CONTENT; PLASTIC LIMIT; LIQUID LIMIT; 10 20 30 40)	TEST RESULTS
100			PQM	-Continued-		
	6		REC --- 97%	Soft to medium-hard gray shale, nearly horizontally bedded, 1/2" to 5" layers.		K=3.7 E -8 cm/sec (101'-106')
110	7		REC --- 100%			
120	8		REC --- 100%			K=4.1 E -8 cm/sec (118'-123')
						K=4.2 E -8 cm/sec (123'-128')
130	9		REC --- 100%	-From 130.5' to 133.0': Many low-angle diagonal fractures with slickensides.		K=1.1 E -5 cm/sec (128'-133')
				-From 135.0' to 143.6': Contains seams of very-soft or broken shale, few slickensides in diagonal fractures		K=4.5 E -8 cm/sec (133'-138')
140	10		REC --- 66%			K=4.6 E -8 cm/sec (138'-143')
				-From 143.6' to 145.6': Layer of hard gray arenaceous shale, contains few limestone nodules.		K=4.8 E -8 cm/sec (143'-148')
				-From 145.6' to 150.5': Medium-hard to hard black becoming gray shale.		
150	11		REC --- 94%	-Continued-		K=2.4 E -6 cm/sec (148'-153')

WATER LEVEL: 103.9'
DATE: 06/02

SYMBOLS USED TO INDICATE TEST RESULTS

G - GRADATION
Q - UNCONFINED COMPR.
T - TRIAXIAL COMPR.
C - CONSOLIDATION
} SEE SEPARATE CURVES

H - PENETROMETER (tsf)
W - UNIT DRY WEIGHT (pcf)
D - RELATIVE DENSITY (%)

Plate B-96

LOG OF BORING NO. B-14

Apex Solid Waste Disposal Facility
Jefferson and Harrison Counties, Ohio

LOCATION: See Plan Sheets 3D-1 and 3D-2 ELEVATION: 1262 DATE: May, 1992
SAMPLER(S): PXM Core-barrel
DRILLING METHOD: Air Rotary COMPLETION DEPTH: 206.0'

DEPTH, FEET	SAMPLE NUMBER	SAMPLING EFFORT	DESCRIPTION	TEST RESULTS
150		PXM	-Continued-	
	11	REC --- 94%	Medium-hard to hard gray argillaceous fine to medium sandstone, well cemented, nearly horizontally bedded, 1" to 120" layers. -From 150.2' to 152.3': Contains lenses and nodules of medium-hard black shale.	K=5.9 E -4 cm/sec (153'-158')
160	12	REC --- 100%		K=5.4 E -8 cm/sec (161'-166')
170	13	REC --- 100%	-From 169.5' to 170.3' and 171.0' to 172.0': Contains many limestone nodules.	K=3.1 E -8 cm/sec (168'-173')
			Soft to medium hard gray shale, nearly horizontally bedded, 1" to 36" layers.	
180	14	REC --- 97%	-From 175.0' to 194.5': Contains 1" to 12" zones of broken rock, clay-filled seams, few seams of very-soft shale similar to hard soil.	K=4.3 E -5 cm/sec (176'-181')
190	15	REC --- 80%	Calcareous to 191.0'.	
	16	REC --- 100%		
200	17	REC --- 100%	-Continued-	

NATURAL CONSISTENCY INDEX: NATURAL MOISTURE CONTENT; PLASTIC LIMIT; LIQUID LIMIT (scale 10, 20, 30, 40)

WATER LEVEL: 103.4'
DATE: 06/02

SYMBOLS USED TO INDICATE TEST RESULTS
G - GRADATION
Q - UNCONFINED COMPR.
T - TRIAXIAL COMPR.
C - CONSOLIDATION
SEE SEPARATE CURVES
H - PENETROMETER (tsf)
W - UNIT DRY WEIGHT (pcf)
D - RELATIVE DENSITY (%)

LOG OF BORING NO. B-14 Sheet 5 of 5 Sheets

Apex Solid Waste Disposal Facility
Jefferson and Harrison Counties, Ohio

LOCATION: **See Plan Sheets 3D-1 and 3D-2** ELEVATION: 1262 DATE: May, 1992

SAMPLER(S): PXM Core-barrel

DRILLING METHOD: Air Rotary COMPLETION DEPTH: 206.0'

DEPTH, FEET	SAMPLE NUMBER	SAMPLES	SAMPLING EFFORT	DESCRIPTION	NATURAL CONSISTENCY INDEX / NATURAL MOISTURE CONTENT (PLASTIC LIMIT, LIQUID LIMIT)	TEST RESULTS
200	17		PXM REC --- 100%	-Continued- Soft to medium-hard gray shale, nearly horizontally bedded, 1" to 36" layers. -From 205.4' to 206.0': Red-brown in color.	10 20 30 40	
210						
220						
230						
240						
250						

WATER LEVEL: 103.4'
DATE: 06/02

SYMBOLS USED TO INDICATE TEST RESULTS

G - GRADATION
Q - UNCONFINED COMPR
T - TRIAXIAL COMPR.
C - CONSOLIDATION
} SEE SEPARATE CURVES

H - PENETROMETER (tsf)
W - UNIT DRY WEIGHT (pcf)
D - RELATIVE DENSITY (%)

Plate B-98

LOG OF BORING NO. B-15

Apex Solid Waste Disposal Facility
Jefferson and Harrison Counties, Ohio

LOCATION: See Plan Sheets 3D-1 and 3D-2 ELEVATION: 1240 DATE: May, 1992

SAMPLER(S): PXM Core-barrel

DRILLING METHOD: Air Rotary COMPLETION DEPTH: 180.0'

DEPTH, FEET	SAMPLE NUMBER	SAMPLES	SAMPLING EFFORT	DESCRIPTION	TEST RESULTS
0				NO SAMPLING PERFORMED	
10					
			PXM	Medium-hard light-gray calcareous siltstone, nearly horizontally bedded, 1" to 10" layers.	
20	1		REC --- 95%	Soft to medium-hard gray shale, nearly orizontally bedded, 1/2" to 5" layers, few diagonal fractures.	
				From 21.9' to 22.1': Very-soft to soft, broken. From 21.9' to 29.6': Black to dark-gray color.	K=8.0 E-4 cm/sec (20'-30')
30	2		REC --- 98%		
				Very-soft to soft gray shale, nearly horizontally bedded, 1" to 9" layers, partly calcareous, few diagonal fractures, few linestone inclusions.	K=6.0 E-4 cm/sec (30'-40')
	3		REC --- 72%		
40				Soft to medium-hard gray shale, interbedded with siltstone, nearly horizontally bedded, 1" to 8" layers, few diagonal fractures.	
	4		REC --- 100%		K=6.5 E-6 cm/sec (40'-50')
50				-Continued-	
	5		REC --- 100%		

NATURAL CONSISTENCY INDEX
NATURAL MOISTURE CONTENT
PLASTIC LIMIT — LIQUID LIMIT
10 20 30 40

WATER LEVEL: 80.0'
DATE: 06/04

SYMBOLS USED TO INDICATE TEST RESULTS

G - GRADATION
Q - UNCONFINED COMPR.
T - TRIAXIAL COMPR.
C - CONSOLIDATION
} SEE SEPARATE CURVES

H - PENETROMETER (tsf)
W - UNIT DRY WEIGHT (pcf)
D - RELATIVE DENSITY (%)

JOB: 3001-1 DUGGAL ENGINEERING, INC.

LOG OF BORING NO B-15 Sheet 2 of 4 Sheets

Apex Solid Waste Disposal Facility
Jefferson and Harrison Counties, Ohio

LOCATION See Plan Sheets 3D-1 and 3D-2 ELEVATION: 1240 DATE: May, 1992

SAMPLER(S) PXM Core-barrel

DRILLING METHOD Air Rotary COMPLETION DEPTH 180.0'

DEPTH, FEET	SAMPLE NUMBER	SAMPLES	SAMPLING EFFORT	DESCRIPTION	NATURAL CONSISTENCY INDEX / NATURAL MOISTURE CONTENT (PLASTIC LIMIT, LIQUID LIMIT)	TEST RESULTS
50				-Continued-	10 20 30 40	
	5		PXM REC --- 100%	Soft to medium-hard gray shale, interbedded with siltstone, nearly horizontally bedded, 1" to 8" layers, few diagonal fractures		K=2.3 E-6 cm/sec (50'-60')
60						
	6		REC --- 99%	-From 65.4' to 79.6': Contains few seams of medium-hard to hard fine sandstone.		K=8.6 E-6 cm/sec (60'-70')
70						
	7		REC --- 100%			K=3.4 E-7 cm/sec (70'-80')
80				Medium-hard to hard gray fine and fine to medium sandstone, well cemented, nearly horizontally bedded, 4" to 54" layers. -From 80.4' to 80.6' and 82.9' to 93.8': Many thin seams of mica, fissile.		
	8		REC --- 100%			
90				-From 90.0' to 90.3': Contains limestone nodules.		
	9		REC --- 94%			
100						
	10		REC --- 100%	-Continued-		

WATER LEVEL: 80.0'
DATE: 06/04

SYMBOLS USED TO INDICATE TEST RESULTS

G - GRADATION
O - UNCONFINED COMPR
T - TRIAXIAL COMPR.
C - CONSOLIDATION
} SEE SEPARATE CURVES

H - PENETROMETER (tsf)
W - UNIT DRY WEIGHT (pcf)
D - RELATIVE DENSITY (%)

BBL&M ENGINEERING, INC JOB: 3850-1

Plate B-100

LOG OF BORING NO B-15 — Sheet 3 of 4 Sheets

Apex Solid Waste Disposal Facility
Jefferson and Harrison Counties, Ohio

LOCATION See Plan Sheets 3D-1 and 3D-2 — ELEVATION: 1240 — DATE: May, 1992

SAMPLER(S) PXM Core-barrel

DRILLING METHOD Air Rotary — COMPLETION DEPTH: 180.0'

DEPTH, FEET	SAMPLE NUMBER	SAMPLES	SAMPLING EFFORT	DESCRIPTION	TEST RESULTS
100				-Continued-	
			PXM	Medium-hard to hard gray fine and fine to medium sandstone, well cemented, nearly horizontally bedded, 4" to 54" layers	
			REC		
	10		---		
			100%	-From 100.0' to 100.9': Contains limestone nodules	K=2.7 E-5 cm/sec (100'-110')
				-From 100.9' to 103.4': Contains seams of soft to medium-hard shale and siltstone	
110				-From 103.9' to 110.0': Contains occasional thin streaks of coal.	
			REC		
	11		---	-From 110.0' to 114.0': Contains seams of siltstone	K=1.5 E-4 cm/sec (110'-120')
			85%		
120				Interbedded medium-hard to hard light-gray and dark-gray fine sandstone, siltstone, and shale, nearly horizontally bedded, 1" to 10" layers, few diagonal fractures, partly cross-bedded, contains 1" to 3" zones of broken rock.	
			REC		
	12		---		K=8.8 E-4 cm/sec (120'-130')
			76%		
130				-From 132.0' to 133.0': Few limestone nodules	
			REC	Hard light-gray fine to medium sandstone, nearly horizontally bedded, well-cemented, 1" to 15" layers, partly calcareous.	
	13		---		K=1.7 E-4 cm/sec (130'-140')
			100%		
140					
			REC		
	14		---		K=7.7 E-8 cm/sec (140'-150')
			97%		
150					
			REC		
	15		---	-Continued-	
			99%		

NATURAL CONSISTENCY INDEX
NATURAL MOISTURE CONTENT
PLASTIC LIMIT — LIQUID LIMIT
10 20 30 40

WATER LEVEL: 80.0'
DATE: 06/04

SYMBOLS USED TO INDICATE TEST RESULTS

G - GRADATION O - UNCONFINED COMPR. T - TRIAXIAL COMPR C - CONSOLIDATION	SEE SEPARATE CURVES	H - PENETROMETER (tsf) W - UNIT DRY WEIGHT (pcf) D - RELATIVE DENSITY (%)

BBC&M ENGINEERING, INC JOB 3850-1

APPENDIX C3-D

GEOTECHNICAL LABORATORY REPORT (DATA CD)

SPECIFIC GRAVITY OF SOILS - ASTM D854

Client	Civil & Environmental Consultants, Inc.
Client Project	091-867 Apex Landfill Expansion
Project No.	30598

Boring	SB-21	TPE-18	SB-6	RB-3	RB-4
Depth	9'-11'	12'-14'	9'-10'	20'-24'	19'-24'
Sample	ST-1	ST-1	ST-2	B-1	B-1
Lab. Sample No.	30598011	30598012	30598014	30598026	30598027

TEST PARAMETERS											
Procedure / Water	Test Method B / Distilled Water										
Replicate No.	1	2	1	2	1	2	1	2	1	2	
Material Used	- #4 Sieve	- #4 Sieve	- #4 Sieve	- #4 Sieve	- #4 Sieve	- #4 Sieve	- #4 Sieve	- #4 Sieve	- #4 Sieve	- #4 Sieve	
Percent Passing #4 Sieve	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	
Pycnometer Identification	X	M	R	M	W	R	R	L	K	T	
Wt. Pycnometer+Soil+Water, gm - Mb (at Tb)	711.8	692.78	696.15	695.62	705.86	706.3	706.88	706.22	725.44	726.31	
Wt. Pycnometer+Water at Test Temp, gm - Ma (at Tb)	679.38	660.61	661.24	660.36	661.29	661.52	661.03	662.11	682.95	683.58	
Test Temperature, *C - Tb	17.4	17.9	20.4	20.4	17.7	17.5	22.3	22.3	22.3	22.5	
Test Water Density, gm/ml	0.99872	0.99863	0.99814	0.99814	0.99867	0.99871	0.99773	0.99773	0.99773	0.99768	
Tare No.	507	519	302	823	709	517	937	302	805	509	
Wt. of Tare + Dry Soil, gm	153.64	153.31	154.91	158.57	167.99	174.7	172.32	170.42	172.21	172.51	
Wt. of Tare, gm	102.97	102.87	100.41	103.32	97.61	103.86	99.56	100.14	102.34	102.72	
Wt. of Dry Soil, gm - Mo	50.67	50.44	54.5	55.25	70.38	70.84	72.76	70.28	69.87	69.79	
CALIBRATION PARAMETERS											
Wt. Dry Pycnometer, gm - Mf	180.412	161.87	162.81	161.87	162.54	162.81	162.81	163.88	184.26	185.15	
Wt. Dry Pycnometer + Water, gm - Ma	678.91	660.18	661.32	660.18	661.13	661.32	661.32	662.12	683.26	683.61	
Calibration Water Temperature, *C - Ta	22.1	22.1	19.6	22.1	19.4	19.6	19.6	22.2	19.4	22.2	
Calibration Water Density, gm/ml	0.99777	0.99777	0.99831	0.99777	0.99835	0.99831	0.99831	0.99775	0.99835	0.99775	
SPECIFIC GRAVITY AT TEMPERATURE T											
Specific Gravity of Soil At Temp. Tb	2.776	2.761	2.783	2.763	2.727	2.718	2.704	2.686	2.552	2.580	
Conversion Factor For Temp. Tb - K	1.00049	1.00040	0.99991	0.99991	1.00044	1.00048	0.99950	0.99950	0.99950	0.99945	
SPECIFIC GRAVITY AT 20* C											
Specific Gravity of Soil at 20* C	2.777	2.762	2.782	2.763	2.728	2.720	2.702	2.684	2.551	2.578	
Average	**2.77**		**2.77**		**2.72**		**2.69**		**2.56**		

Input Validation: Reviewed By: Date 12/1/2010

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SPECIFIC GRAVITY OF SOILS - ASTM D854

Client	Civil & Environmental Consultants, Inc.
Client Project	091-867 Apex Landfill Expansion
Project No.	30598

Boring	SB-16	SB-17	SB-18
Depth	0.5'-2.5'	16'-18'	10'-12'
Sample	ST-1	ST-1	ST-1
Lab. Sample No.	30598008	30598009	30598010

TEST PARAMETERS										
Procedure / Water	Test Method B / Distilled Water									
Pycnometer Identification	M	X	W							
Wt. Pycnometer+Soil+Water, gm - Mb (at Tb)	703.72	725.43	704.88							
Wt. Pycnometer+Water at Test Temp, gm - Ma (at Tb)	660.17	678.89	660.82							
Test Temperature, *C - Tb	22.2	22.3	22.3							
Test Water Density, gm/ml	0.99775	0.99773	0.99773							
Wt. of Dry Soil, gm - Mo	69.2	73.89	69.82							
CALIBRATION PARAMETERS										
Wt. Dry Pycnometer, gm - Mf	161.874	180.412	162.542							
Wt. Dry Pycnometer + Water, gm - Ma	660.18	678.91	661.13							
Calibration Water Temperature, *C - Ta	22.1	22.1	19.4							
Calibration Water Density, gm/ml	0.99777	0.99777	0.99835							
SPECIFIC GRAVITY AT TEMPERATURE T										
Specific Gravity of Soil At Temp. Tb	2.698	2.702	2.710							
Conversion Factor For Temp. Tb - K	0.99952	0.99950	0.99950							
SPECIFIC GRAVITY AT 20* C										
Specific Gravity of Soil at 20* C	2.70	2.70	2.71							

Input Validation: 12/1/2010

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DENSITY DETERMINATIONS

Client: Civil & Environmental Consultants, Inc.
Project: 091-867 Apex Landfill Expansion
Project No.: 30598

Boring Number	SB-3	SB-14	SB-20	SB-16	TPE-17	TPE-19	SB-14
Depth	11.5'-13.5'	25'-27'	16'-18', 17'-19	1'-3'	12'-14'	2'-4'	25' - 27'
Sample	ST-1	ST-2 TOP	ST-1, ST-2	ST-1	ST-1	ST-1	ST-2 Bottom
Lab Sample No.	30598001	30598002	30598003	30598004	30598005	30598006	30598039
Water Contents							
Tare Number	A10	Z2	A10	A23	A17	Z12	A45
Wt. Tare & WS, gm	76.94	144.79	100.8	134.52	183.36	233.45	94.14
Wt. Tare & DS, gm	70.55	136.26	85.43	112.93	160.83	219.41	70.66
Wt. Tare, gm	9.53	123.14	9.53	9.43	9.54	123.25	9.06
Water Content, %	**10.5%**	**65.0%**	**20.3%**	**20.9%**	**14.9%**	**14.6%**	**38.1%**
Direct Measurement Method							
Wt. Of WS., gm	1437.09	869.73	1402.42	1279.3	1425.36	1456.47	1099.3
Length 1, in	6.002	5.983	5.954	5.977	6.05	6.052	6.039
Length 2, in	5.943	5.99	5.915	5.893	6.034	6.049	6.051
Length 3, in	5.928	6.005	5.937	5.88	6.027	6.119	6.055
Top Diameter, in	2.873	2.84	2.878	2.895	2.881	2.881	2.881
Middle Diameter, in	2.877	2.837	2.873	2.909	2.88	2.88	2.879
Bottom Diameter, in	2.879	2.851	2.876	2.847	2.88	2.879	2.884
Sample Volume, cc	634.37	623.25	631.70	633.23	644.61	648.34	646.27
Water Content ,%	10.5%	65.0%	20.3%	20.9%	14.9%	14.6%	38.1%
Unit Wet Wt., gm/cc	2.27	1.40	2.22	2.02	2.21	2.25	1.70
Unit Wet Wt., pcf	141.4	87.1	138.5	126.1	138.0	140.2	106.1
Unit Dry Wt., pcf	**128.0**	**52.8**	**115.2**	**104.3**	**120.1**	**122.3**	**76.8**
Unit Dry Wt., gm/cc	2.05	0.85	1.85	1.67	1.92	1.96	1.23
Specific Gravity, Assumed	2.7	2.7	2.7	2.7	2.7	2.7	2.7
Void Ratio,e	0.32	2.19	0.46	0.62	0.40	0.38	1.19
Porosity, n	0.24	0.69	0.32	0.38	0.29	0.27	0.54
Saturation, %	89.3%	80.1%	118.2%	91.5%	99.8%	104.5%	86.3%

Input Validation Reviewed By: Date: 12/1/2010

DENSITY DETERMINATIONS

Client: Civil & Environmental Consultants, Inc.
Project: 091-867 Apex Landfill Expansion
Project No.: 30598

Boring Number	SB-16	SB-17	SB-18	SB-21	TPE-18	SB-6
Depth	0.5'-2.5'	16'-18'	10'-12'	9'-11'	12'-14'	9'-10'
Sample	ST-1	ST-1	ST-1	ST-1	ST-1	ST-2
Lab Sample No.	30598008	30598009	30598010	30598011	30598012	30598014
Water Contents						
Tare Number	A45	A23	A12	A42	Z13	A12
Wt. Tare & WS, gm	91.82	78.88	121.92	125.9	241.96	257.57
Wt. Tare & DS, gm	76.93	69.11	104.87	112.18	220.12	235.97
Wt. Tare, gm	9.06	9.42	9.53	9.49	122.82	9.53
Water Content, %	**21.9%**	**16.4%**	**17.9%**	**13.4%**	**22.4%**	**9.5%**
Direct Measurement Method						
Wt. Of WS., gm	1222.51	1188.1	1377.45	1433.65	1324.1	1356.49
Length 1, in	6.032	6.067	6.118	6.082	6.055	6.085
Length 2, in	6.035	6.068	6.109	6.063	6.026	6.079
Length 3, in	6.032	6.062	6.112	6.069	6.033	6.067
Top Diameter, in	2.885	2.877	2.873	2.89	2.881	2.884
Middle Diameter, in	2.878	2.875	2.875	2.892	2.882	2.877
Bottom Diameter, in	2.877	2.877	2.874	2.885	2.881	2.871
Sample Volume, cc	644.03	645.87	649.86	652.18	645.17	647.53
Water Content ,%	21.9%	16.4%	17.9%	13.4%	22.4%	9.5%
Unit Wet Wt., gm/cc	1.90	1.84	2.12	2.20	2.05	2.09
Unit Wet Wt., pcf	118.4	114.8	132.3	137.2	128.1	130.7
Unit Dry Wt., pcf	**97.1**	**98.6**	**112.2**	**121.0**	**104.6**	**119.3**
Unit Dry Wt., gm/cc	1.56	1.58	1.80	1.94	1.68	1.91
Specific Gravity, Measured	2.70	2.70	2.71	2.77	2.77	2.72
Void Ratio,e	0.73	0.71	0.51	0.43	0.65	0.42
Porosity, n	0.42	0.41	0.34	0.30	0.39	0.30
Saturation, %	80.7%	62.4%	95.6%	86.4%	95.3%	61.4%

Input Validation Reviewed By: Date: 12/1/2010

DENSITY DETERMINATIONS

Client: Civil & Environmental Consultants, Inc.
Project: 091-867 Apex Landfill Expansion
Project No.: 30598

Boring Number	SB-4	SB-8	SB-14	SB-17	SB-18	SB-19	TPE-18	TPE-21
Depth	28'-30'	2'-4'	10'-12'	18'-20'	22'-24'	11'-13'	18'-19.7'	2'-4'
Sample	ST-1	ST-1	ST-1	ST-2	ST-3	ST-1	ST-2	ST-1
Lab Sample No.	30598013	30598015	30598016	30598017	30598018	30598019	30598020	30598021
Water Contents								
Tare Number	A34	A37	A45	A10	A18	A23	A10	A7
Wt. Tare & WS, gm	260.56	246.62	193.31	233.21	262.22	247.18	76.24	218.78
Wt. Tare & DS, gm	239.59	215.08	160.57	212.65	228.43	214.13	69.14	181.38
Wt. Tare, gm	9.91	9.67	9.07	9.56	9.46	9.42	9.53	9.45
Water Content, %	**9.1%**	**15.4%**	**21.6%**	**10.1%**	**15.4%**	**16.1%**	**11.9%**	**21.8%**
Direct Measurement Method								
Wt. Of WS., gm	1271.41	1354.15	1300.67	1242.22	1356.74	1314.72	1406.73	1383.55
Length 1, in	6.078	6.049	6.053	5.995	6.081	5.999	6.031	6.082
Length 2, in	6.074	6.046	6.035	6.043	6.149	6.012	5.98	6.053
Length 3, in	6.078	6.061	6.048	6.077	6.082	5.998	6.055	6.067
Top Diameter, in	2.892	2.879	2.881	2.993	2.892	2.867	2.872	2.881
Middle Diameter, in	2.89	2.879	2.879	2.838	2.984	2.873	2.877	2.881
Bottom Diameter, in	2.882	2.881	2.877	2.618	2.894	2.879	2.873	2.879
Sample Volume, cc	652.31	645.91	644.90	616.42	671.37	637.72	640.18	647.85
Water Content ,%	9.1%	15.4%	21.6%	10.1%	15.4%	16.1%	11.9%	21.8%
Unit Wet Wt., gm/cc	1.95	2.10	2.02	2.02	2.02	2.06	2.20	2.14
Unit Wet Wt., pcf	121.6	130.8	125.9	125.7	126.1	128.6	137.1	133.3
Unit Dry Wt., pcf	**111.4**	**113.4**	**103.5**	**114.2**	**109.2**	**110.8**	**122.5**	**109.5**
Unit Dry Wt., gm/cc	1.79	1.82	1.66	1.83	1.75	1.78	1.96	1.75
Specific Gravity, Assumed	2.7	2.7	2.7	2.7	2.7	2.7	2.7	2.7
Void Ratio,e	0.51	0.49	0.63	0.48	0.54	0.52	0.38	0.54
Porosity, n	0.34	0.33	0.39	0.32	0.35	0.34	0.27	0.35
Saturation, %	48.2%	85.4%	92.9%	57.5%	76.8%	83.7%	85.7%	108.9%

Input Validation

Reviewed By:

Date: 12/1/2010

MEASUREMENT OF HYDRAULIC CONDUCTIVITY OF SATURATED POROUS MATERIALS USING A FLEXIBLE WALL PERMEAMETER

ASTM D5084-00 Method F; Mercury U-Tube Permometer - Inflow Volume = Outflow Volume

Client	Civil & Environmental Consultants, Inc.	Boring	SB-4
Client Project	091-867 Apex Landfill Expansion	Depth	28-30
Project No.	30598	Sample	ST-1
Visual Description	DARK GRAYISH BROWN SANDY LEAN CLAY	Lab Sample No.	30598013
Sample Condition	Undisturbed		

SAMPLE CONDITIONS		
Sample Status	Initial	Final
Tare Number	A34	117
Wt. Tare & WS, gm	260.56	656.45
Wt. Tare & DS, gm	239.59	565.21
Wt. Tare, gm	9.91	83.51
Moisture Content, %	9.1%	18.9%
Wt. Tube & WS., gm	562.2	NA
Wt. Of Tube, gm	0	NA
Wt. Of WS., gm	562.2	612.7
Length 1, in	2.671	2.709
Length 2, in	2.703	2.708
Length 3, in	2.631	2.671
Top Diameter, in	2.847	2.861
Middle Diameter, in	2.879	2.885
Bottom Diameter, in	2.869	2.871
Average Length, **L**, cm	6.78	6.85
Average Area, **A**, cm^2	41.59	41.80
Sample Volume, cc	281.9	286.3
Unit Wet Wt., gm/cc	1.99	2.14
Unit Wet Wt., pcf	124.4	133.6
Unit Dry Wt., pcf	114.0	112.3
Unit Dry Wt., gm/cc	1.83	1.80
Specific Gravity, Assumed	2.7	2.7
Void Ratio, e	0.477	0.500
Porosity, n	0.323	0.334
Pore Volume, cc	91.10	95.48
Saturation, %	51.6%	

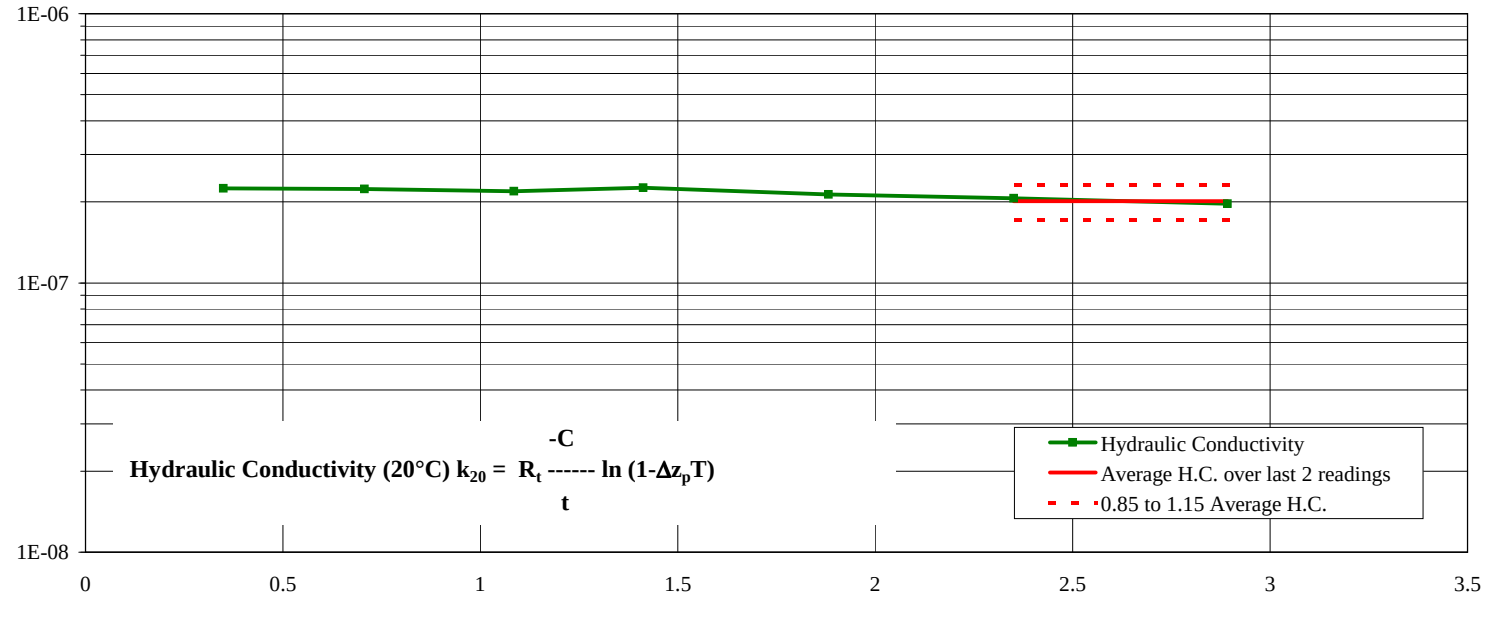
TEST CONSTANTS & EQUATIONS	
Pipette Area, a_p - cm^2	0.031416
Annulus Area, a_a, cm^2	0.76712
Manometer Constant, $M_1 = a_a a_p/(a_a+a_p)$, cm^2	0.03018
Manometer Constant, $M_2 = 1 + a_p/a_a$	1.0410
Sample Constant, $S = L/A$, cm^{-1}	0.164
Specific Gravity, $\delta = \delta_{hg} - \delta_w$, gm/cc	12.562
Test Constant, $C = M_1 S/\delta$	3.94E-04
Mercury Level at Equilibrium, R_{eq}, cm	2.2
Mercury Level of Pipette at t=0, R_{p0}, cm	10.7
Initial Head Difference, $z_1 = (R_{p0}-R_{eq})M_2$, cm	8.85
Trial Constant, $T = M_2 / z_1$, cm	0.1176
Temperature Correction for 20°C, R_t	1.009

SAMPLE SUMMARY	
Avg. Hydraulic Conductivity, k_{20}, cm/sec	**2.0E-07**
Initial Water Content, %	9.1%
Initial Dry Density, pcf	114.0
% Compaction	NA
Sample Status	Undisturbed
B Parameter	99
Permeant	Deaired Water
Cell Pressure, psi	83
Back Pressure, psi	80
Avg.(Mid-Height) Confining Stress, psi	3
Maximum Gradient	16.2
Average Test Temperature, °C	19.6

TEST DATA

t_i Elapsed Time *min*	R_{pt} Mercury Height *cm*	Δz_p R_{p0}-R_{pt} *cm*	i Gradient *cm / cm*	H_t Head *cm*	ΔH_t Percent of Initial Head from t=0 *%*	σ'_{max} Effective Stress Max *psi*	σ'_{min} Effective Stress Min *psi*	k_{20} **Hydraulic Conductivity** *cm/sec*
0.00	10.7	0	16.2	111.1	100.0%	3.79	2.21	NA
0.35	10.6	0.1	16.0	109.8	98.8%	3.78	2.22	2.24E-07
0.71	10.5	0.2	15.8	108.5	97.6%	3.77	2.23	2.23E-07
1.08	10.4	0.3	15.7	107.2	96.5%	3.76	2.24	2.19E-07
1.41	10.3	0.4	15.5	105.9	95.3%	3.75	2.25	2.26E-07
1.88	10.2	0.5	15.3	104.6	94.1%	3.74	2.26	2.13E-07
2.35	10.1	0.6	15.1	103.3	92.9%	3.73	2.27	2.06E-07
2.89	10	0.7	14.9	102.0	91.8%	3.73	2.27	1.97E-07

ELAPSED TIME vs. HYDRAULIC CONDUCTIVITY



Input Validation: Reviewed By: Date Tested: 12/2/2010

Note: The average Hydraulic Conductivity is calculated using the average of the last 4 determinations where all requisite flow and Hydraulic Conductivity conditions are achieved!

Prerequisits: Inflow / Outflow Ratio = 1 by definition of test procedure. Final Hydraulic Conductivity = +-25% of average Hydraulic Conductivity when k > 1E-8 cm/sec and +-50% when k < 1E-8 cm/sec.

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MEASUREMENT OF HYDRAULIC CONDUCTIVITY OF SATURATED POROUS MATERIALS USING A FLEXIBLE WALL PERMEAMETER

ASTM D5084-00 Method F; Mercury U-Tube Permometer - Inflow Volume = Outflow Volume

Client	Civil & Environmental Consultants, Inc.	Boring	SB-6
Client Project	091-867 Apex Landfill Expansion	Depth	9'-10'
Project No.	30598	Sample	ST-2
Visual Description	GRAYISH BROWN CLAYEY GRAVEL WITH SAND	Lab Sample No.	30598014
Sample Condition	Undisturbed		

SAMPLE CONDITIONS		
Sample Status	Initial	Final
Tare Number	A12	B07
Wt. Tare & WS, gm	257.57	692.7
Wt. Tare & DS, gm	235.97	613.64
Wt. Tare, gm	9.53	84.31
Moisture Content, %	9.5%	14.9%
Wt. Tube & WS., gm	599.1	NA
Wt. Of Tube, gm	0	NA
Wt. Of WS., gm	599.1	628.6
Length 1, in	2.696	2.731
Length 2, in	2.679	2.745
Length 3, in	2.683	2.601
Top Diameter, in	2.865	2.871
Middle Diameter, in	2.863	2.862
Bottom Diameter, in	2.868	2.87
Average Length, **L**, cm	6.82	6.84
Average Area, **A**, cm^2	41.60	41.67
Sample Volume, cc	283.8	285.0
Unit Wet Wt., gm/cc	2.11	2.21
Unit Wet Wt., pcf	131.7	137.7
Unit Dry Wt., pcf	120.2	119.8
Unit Dry Wt., gm/cc	1.93	1.92
Specific Gravity, Assumed	2.7	2.7
Void Ratio, e	0.401	0.407
Porosity, n	0.286	0.289
Pore Volume, cc	81.25	82.39
Saturation, %	64.2%	

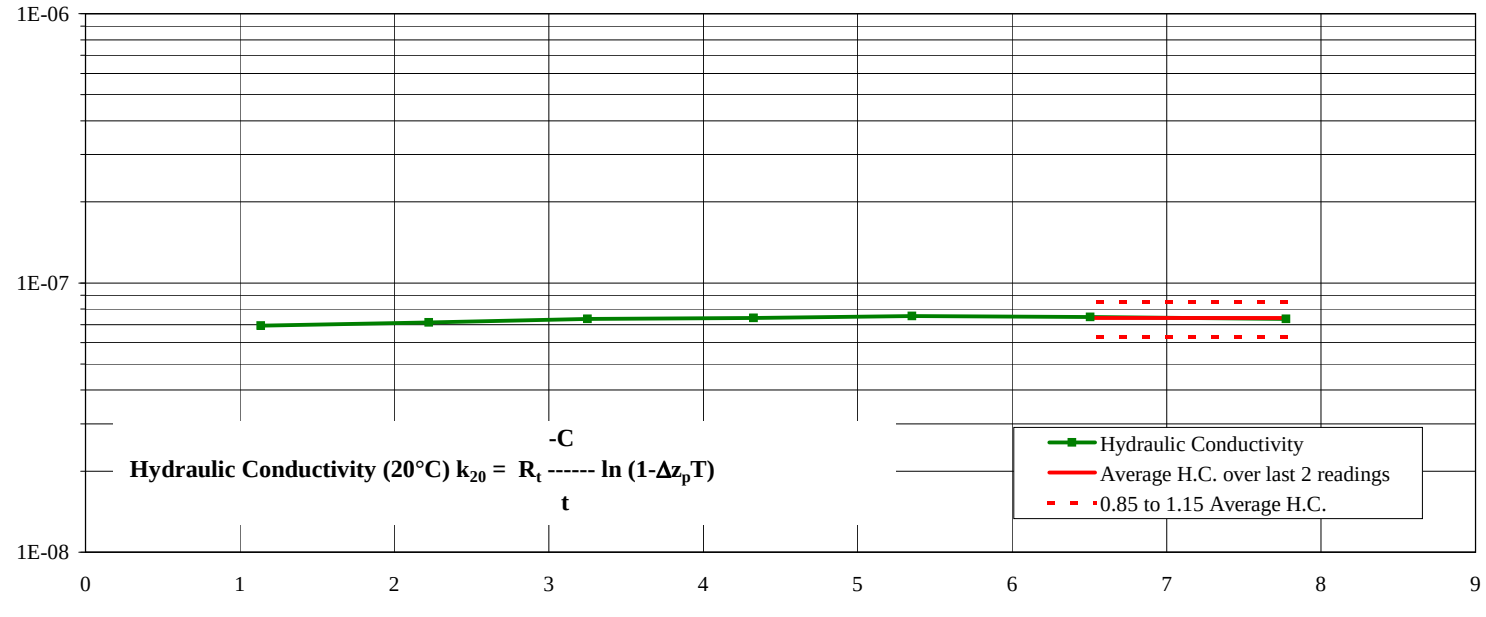
TEST CONSTANTS & EQUATIONS	
Pipette Area, a_p - cm^2	0.031416
Annulus Area, a_a, cm^2	0.76712
Manometer Constant, $M_1 = a_a a_p/(a_a+a_p)$, cm^2	0.03018
Manometer Constant, $M_2 = 1 + a_p/a_a$	1.0410
Sample Constant, $S = L/A$, cm^{-1}	0.164
Specific Gravity, $\delta = \delta_{hg} - \delta_w$, gm/cc	12.562
Test Constant, $C = M_1 S/\delta$	3.94E-04
Mercury Level at Equilibrium, R_{eq}, cm	2.3
Mercury Level of Pipette at t=0, R_{p0}, cm	10.8
Initial Head Difference, $z_1 = (R_{p0}-R_{eq})M_2$, cm	8.85
Trial Constant, $T = M_2 / z_1$, cm	0.1176
Temperature Correction for 20°C, R_t	1.012

SAMPLE SUMMARY	
Avg. Hydraulic Conductivity, k_{20}, cm/sec	**7.4E-08**
Initial Water Content, %	9.5%
Initial Dry Density, pcf	120.2
% Compaction	NA
Sample Status	Undisturbed
B Parameter	100
Permeant	Deaired Water
Cell Pressure, psi	83
Back Pressure, psi	80
Avg.(Mid-Height) Confining Stress, psi	3
Maximum Gradient	16.3
Average Test Temperature, °C	19.5

TEST DATA

t_i Elapsed Time *min*	R_{pt} Mercury Height *cm*	Δz_p R_{p0}-R_{pt} *cm*	i Gradient *cm / cm*	H_t Head *cm*	ΔH_t Percent of Initial Head from t=0 *%*	σ'_{max} Effective Stress Max *psi*	σ'_{min} Effective Stress Min *psi*	k_{20} Hydraulic Conductivity *cm/sec*
0.00	10.8	0	16.3	111.1	100.0%	3.79	2.21	NA
1.14	10.7	0.1	16.1	109.8	98.8%	3.78	2.22	6.93E-08
2.22	10.6	0.2	15.9	108.5	97.6%	3.77	2.23	7.12E-08
3.25	10.5	0.3	15.7	107.2	96.5%	3.76	2.24	7.35E-08
4.33	10.4	0.4	15.5	105.9	95.3%	3.75	2.25	7.41E-08
5.35	10.3	0.5	15.3	104.6	94.1%	3.74	2.26	7.53E-08
6.51	10.2	0.6	15.1	103.3	92.9%	3.73	2.27	7.48E-08
7.77	10.1	0.7	14.9	102.0	91.8%	3.73	2.27	7.35E-08

ELAPSED TIME vs. HYDRAULIC CONDUCTIVITY



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Note: The average Hydraulic Conductivity is calculated using the average of the last 4 determinations where all requisite flow and Hydraulic Conductivity conditions are achieved!

Prerequisits: Inflow / Outflow Ratio = 1 by definition of test procedure. Final Hydraulic Conductivity = +-25% of average Hydraulic Conductivity when k > 1E-8 cm/sec and +-50% when k < 1E-8 cm/sec.

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MEASUREMENT OF HYDRAULIC CONDUCTIVITY OF SATURATED POROUS MATERIALS USING A FLEXIBLE WALL PERMEAMETER

ASTM D5084-00 Method F; Mercury U-Tube Permometer - Inflow Volume = Outflow Volume

Client	Civil & Environmental Consultants, Inc.	Boring	SB-8
Client Project	091-867 Apex Landfill Expansion	Depth	2'-4'
Project No.	30598	Sample	ST-1
Visual Description	YELLOWISH BROWN LEAN CLAY WITH SAND	Lab Sample No.	30598015
Sample Condition	Undisturbed		

SAMPLE CONDITIONS		
Sample Status	Initial	Final
Tare Number	A37	102
Wt. Tare & WS, gm	246.62	795.3
Wt. Tare & DS, gm	215.08	677.93
Wt. Tare, gm	9.67	84.7
Moisture Content, %	15.4%	19.8%
Wt. Tube & WS., gm	676.2	NA
Wt. Of Tube, gm	0	NA
Wt. Of WS., gm	676.2	702.2
Length 1, in	3.214	3.214
Length 2, in	3.184	3.205
Length 3, in	3.236	3.249
Top Diameter, in	2.824	2.826
Middle Diameter, in	2.821	2.822
Bottom Diameter, in	2.831	2.831
Average Length, **L**, cm	8.16	8.19
Average Area, **A**, cm^2	40.45	40.48
Sample Volume, cc	329.9	331.3
Unit Wet Wt., gm/cc	2.05	2.12
Unit Wet Wt., pcf	127.9	132.3
Unit Dry Wt., pcf	110.9	110.4
Unit Dry Wt., gm/cc	1.78	1.77
Specific Gravity, Assumed	2.7	2.7
Void Ratio, e	0.520	0.526
Porosity, n	0.342	0.345
Pore Volume, cc	112.80	114.20
Saturation, %	79.8%	

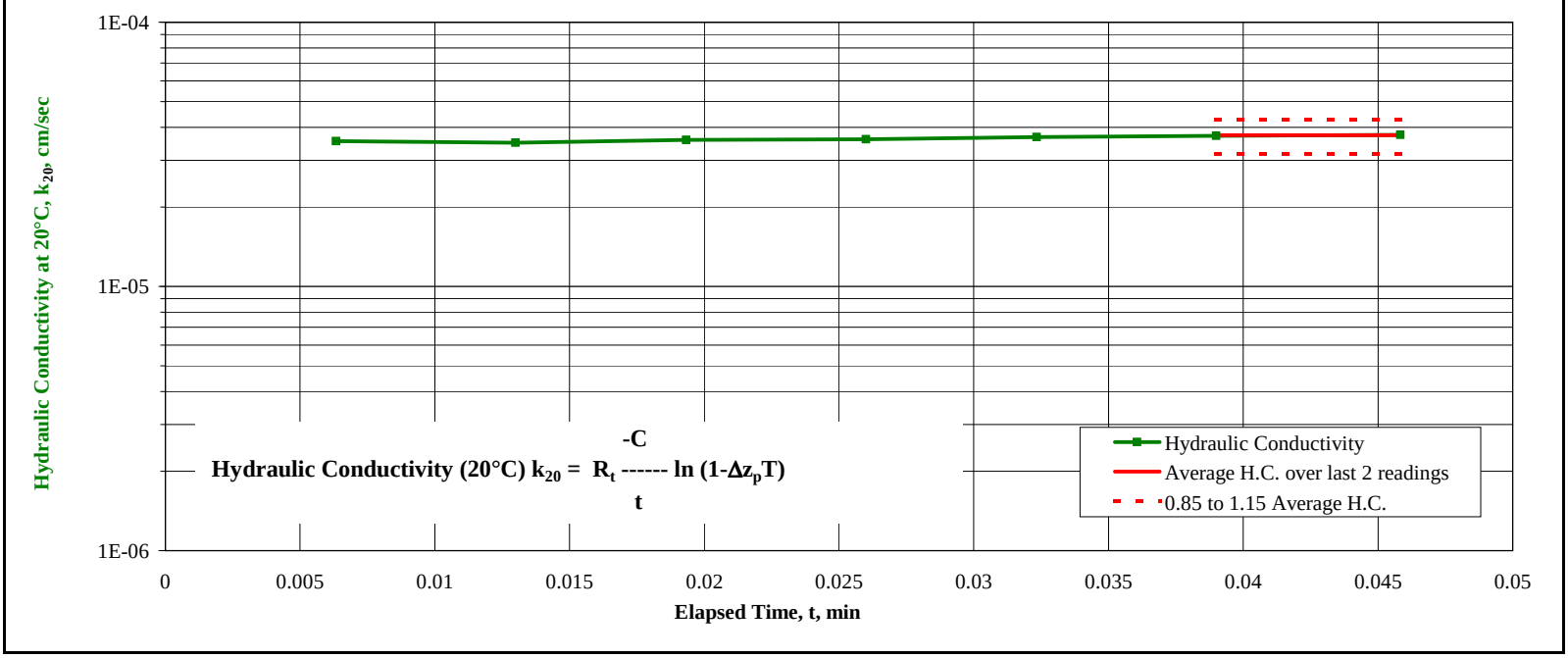
TEST CONSTANTS & EQUATIONS	
Pipette Area, $\mathbf{a_p}$ - cm^2	0.031416
Annulus Area, $\mathbf{a_a}$, cm^2	0.76712
Manometer Constant, $\mathbf{M_1} = a_a a_p/(a_a+a_p)$, cm^2	0.03018
Manometer Constant, $\mathbf{M_2} = 1 + a_p/a_a$	1.0410
Sample Constant, $\mathbf{S} = L/A$, cm^{-1}	0.202
Specific Gravity, $\boldsymbol{\delta} = \delta_{hg} - \delta_w$, gm/cc	12.562
Test Constant, $\mathbf{C} = M_1 S/\delta$	4.86E-04
Mercury Level at Equilibrium, $\mathbf{R_{eq}}$, cm	2.3
Mercury Level of Pipette at t=0, $\mathbf{R_{p0}}$, cm	6
Initial Head Difference, $\mathbf{z_1} = (R_{p0}-R_{eq})M_2$, cm	3.85
Trial Constant, $\mathbf{T} = M_2 / z_1$, cm	0.2703
Temperature Correction for 20°C, $\mathbf{R_t}$	1.012

SAMPLE SUMMARY	
Avg. Hydraulic Conductivity, k_{20}, cm/sec	**3.7E-05**
Initial Water Content, %	15.4%
Initial Dry Density, pcf	110.9
% Compaction	NA
Sample Status	Undisturbed
B Parameter	100
Permeant	Deaired Water
Cell Pressure, psi	83
Back Pressure, psi	80
Avg.(Mid-Height) Confining Stress, psi	3
Maximum Gradient	5.9
Average Test Temperature, °C	19.5

TEST DATA

t_i Elapsed Time	R_{pt} Mercury Height	Δz_p R_{p0}-R_{pt}	i Gradient	H_t Head	ΔH_t Percent of Initial Head from t=0	σ'_{max} Effective Stress Max	σ'_{min} Effective Stress Min	k_{20} Hydraulic Conductivity
min	*cm*	*cm*	*cm / cm*	*cm*	*%*	*psi*	*psi*	*cm/sec*
0.00	6	0	5.9	48.4	100.0%	3.34	2.66	NA
0.01	5.9	0.1	5.8	47.1	97.3%	3.33	2.67	3.54E-05
0.01	5.8	0.2	5.6	45.8	94.6%	3.33	2.67	3.50E-05
0.02	5.7	0.3	5.4	44.5	91.9%	3.32	2.68	3.58E-05
0.03	5.6	0.4	5.3	43.2	89.2%	3.31	2.69	3.61E-05
0.03	5.5	0.5	5.1	41.8	86.5%	3.30	2.70	3.68E-05
0.04	5.4	0.6	5.0	40.5	83.8%	3.29	2.71	3.72E-05
0.05	5.3	0.7	4.8	39.2	81.1%	3.28	2.72	3.75E-05

ELAPSED TIME vs. HYDRAULIC CONDUCTIVITY



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Note: The average Hydraulic Conductivity is calculated using the average of the last 4 determinations where all requisite flow and Hydraulic Conductivity conditions are achieved!

Prerequisits: Inflow / Outflow Ratio = 1 by definition of test procedure. Final Hydraulic Conductivity = +-25% of average Hydraulic Conductivity when k > 1E-8 cm/sec and +-50% when k < 1E-8 cm/sec.

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MEASUREMENT OF HYDRAULIC CONDUCTIVITY OF SATURATED POROUS MATERIALS USING A FLEXIBLE WALL PERMEAMETER

ASTM D5084-00 Method F; Mercury U-Tube Permometer - Inflow Volume = Outflow Volume

Client	Civil & Environmental Consultants, Inc.	Boring	SB-14
Client Project	091-867 Apex Landfill Expansion	Depth	10'-12'
Project No.	30598	Sample	ST-1
Visual Description	DARK GRAYISH BROWN SANDY LEAN CLAY	Lab Sample No.	30598016
Sample Condition	Undisturbed		

SAMPLE CONDITIONS		
Sample Status	Initial	Final
Tare Number	A45	18
Wt. Tare & WS, gm	193.31	728.09
Wt. Tare & DS, gm	160.57	584.22
Wt. Tare, gm	9.07	81.33
Moisture Content, %	21.6%	28.6%
Wt. Tube & WS., gm	638.3	NA
Wt. Of Tube, gm	0	NA
Wt. Of WS., gm	638.3	675.0
Length 1, in	3.079	3.075
Length 2, in	3.082	3.088
Length 3, in	3.034	3.041
Top Diameter, in	2.875	2.873
Middle Diameter, in	2.864	2.863
Bottom Diameter, in	2.871	2.879
Average Length, **L**, cm	7.79	7.79
Average Area, **A**, cm^2	41.74	41.79
Sample Volume, cc	324.9	325.6
Unit Wet Wt., gm/cc	1.96	2.07
Unit Wet Wt., pcf	122.6	129.4
Unit Dry Wt., pcf	100.8	100.6
Unit Dry Wt., gm/cc	1.62	1.61
Specific Gravity, Assumed	2.7	2.7
Void Ratio, e	0.671	0.675
Porosity, n	0.402	0.403
Pore Volume, cc	130.53	131.22
Saturation, %	86.9%	

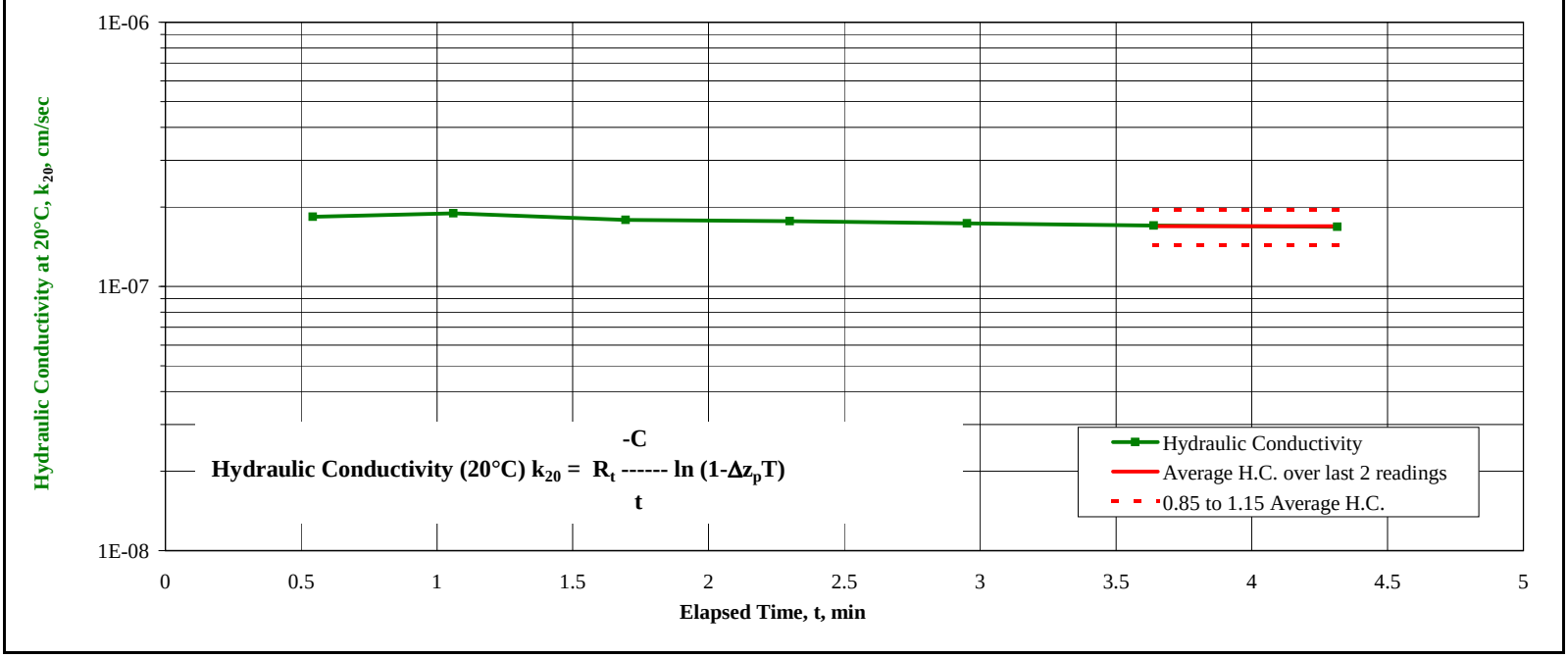
TEST CONSTANTS & EQUATIONS	
Pipette Area, a_p - cm^2	0.031416
Annulus Area, a_a, cm^2	0.76712
Manometer Constant, $M_1 = a_a a_p/(a_a+a_p)$, cm^2	0.03018
Manometer Constant, $M_2 = 1 + a_p/a_a$	1.0410
Sample Constant, $S = L/A$, cm^{-1}	0.186
Specific Gravity, $\delta = \delta_{hg} - \delta_w$, gm/cc	12.561
Test Constant, $C = M_1 S/\delta$	4.48E-04
Mercury Level at Equilibrium, R_{eq}, cm	2.2
Mercury Level of Pipette at t=0, R_{p0}, cm	10
Initial Head Difference, $z_1 = (R_{p0}-R_{eq})M_2$, cm	8.12
Trial Constant, $T = M_2 / z_1$, cm	0.1282
Temperature Correction for 20°C, R_t	1.034

SAMPLE SUMMARY	
Avg. Hydraulic Conductivity, k_{20}, cm/sec	**1.7E-07**
Initial Water Content, %	21.6%
Initial Dry Density, pcf	100.8
% Compaction	NA
Sample Status	Undisturbed
B Parameter	96
Permeant	Deaired Water
Cell Pressure, psi	73
Back Pressure, psi	70
Avg.(Mid-Height) Confining Stress, psi	3
Maximum Gradient	13.1
Average Test Temperature, °C	18.6

TEST DATA

t_i Elapsed Time *min*	R_{pt} Mercury Height *cm*	Δz_p R_{p0}-R_{pt} *cm*	i Gradient *cm / cm*	H_t Head *cm*	ΔH_t Percent of Initial Head from t=0 *%*	σ'_{max} Effective Stress Max *psi*	σ'_{min} Effective Stress Min *psi*	k_{20} Hydraulic Conductivity *cm/sec*
0.00	10	0	13.1	102.0	100.0%	3.73	2.27	NA
0.54	9.9	0.1	12.9	100.7	98.7%	3.72	2.28	1.84E-07
1.06	9.8	0.2	12.8	99.4	97.4%	3.71	2.29	1.89E-07
1.70	9.7	0.3	12.6	98.1	96.2%	3.70	2.30	1.79E-07
2.30	9.6	0.4	12.4	96.8	94.9%	3.69	2.31	1.77E-07
2.95	9.5	0.5	12.2	95.5	93.6%	3.68	2.32	1.73E-07
3.64	9.4	0.6	12.1	94.1	92.3%	3.67	2.33	1.70E-07
4.31	9.3	0.7	11.9	92.8	91.0%	3.66	2.34	1.68E-07

ELAPSED TIME vs. HYDRAULIC CONDUCTIVITY



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Note: The average Hydraulic Conductivity is calculated using the average of the last 4 determinations where all requisite flow and Hydraulic Conductivity conditions are achieved!

Prerequisits: Inflow / Outflow Ratio = 1 by definition of test procedure. Final Hydraulic Conductivity = +-25% of average Hydraulic Conductivity when k > 1E-8 cm/sec and +-50% when k < 1E-8 cm/sec.

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MEASUREMENT OF HYDRAULIC CONDUCTIVITY OF SATURATED POROUS MATERIALS USING A FLEXIBLE WALL PERMEAMETER

ASTM D5084-00 Method F; Mercury U-Tube Permometer - Inflow Volume = Outflow Volume

Client	Civil & Environmental Consultants, Inc.	Boring	SB-17
Client Project	091-867 Apex Landfill Expansion	Depth	18-20
Project No.	30598	Sample	ST-2
Visual Description	GRAY CLAYEY SAND WITH GRAVEL	Lab Sample No.	30598017
Sample Condition	Undisturbed		

SAMPLE CONDITIONS		
Sample Status	Initial	Final
Tare Number	A10	448
Wt. Tare & WS, gm	233.21	572.78
Wt. Tare & DS, gm	212.65	497.93
Wt. Tare, gm	9.56	83.89
Moisture Content, %	10.1%	18.1%
Wt. Tube & WS., gm	474.1	NA
Wt. Of Tube, gm	0	NA
Wt. Of WS., gm	474.1	508.3
Length 1, in	2.41	2.429
Length 2, in	2.394	2.394
Length 3, in	2.404	2.406
Top Diameter, in	2.91	2.914
Middle Diameter, in	2.808	2.858
Bottom Diameter, in	2.56	2.568
Average Length, **L**, cm	6.10	6.12
Average Area, **A**, cm^2	38.58	39.16
Sample Volume, cc	235.4	239.7
Unit Wet Wt., gm/cc	2.01	2.12
Unit Wet Wt., pcf	125.6	132.3
Unit Dry Wt., pcf	114.1	112.1
Unit Dry Wt., gm/cc	1.83	1.80
Specific Gravity, Assumed	2.7	2.7
Void Ratio, e	0.477	0.503
Porosity, n	0.323	0.335
Pore Volume, cc	76.00	80.24
Saturation, %	57.3%	

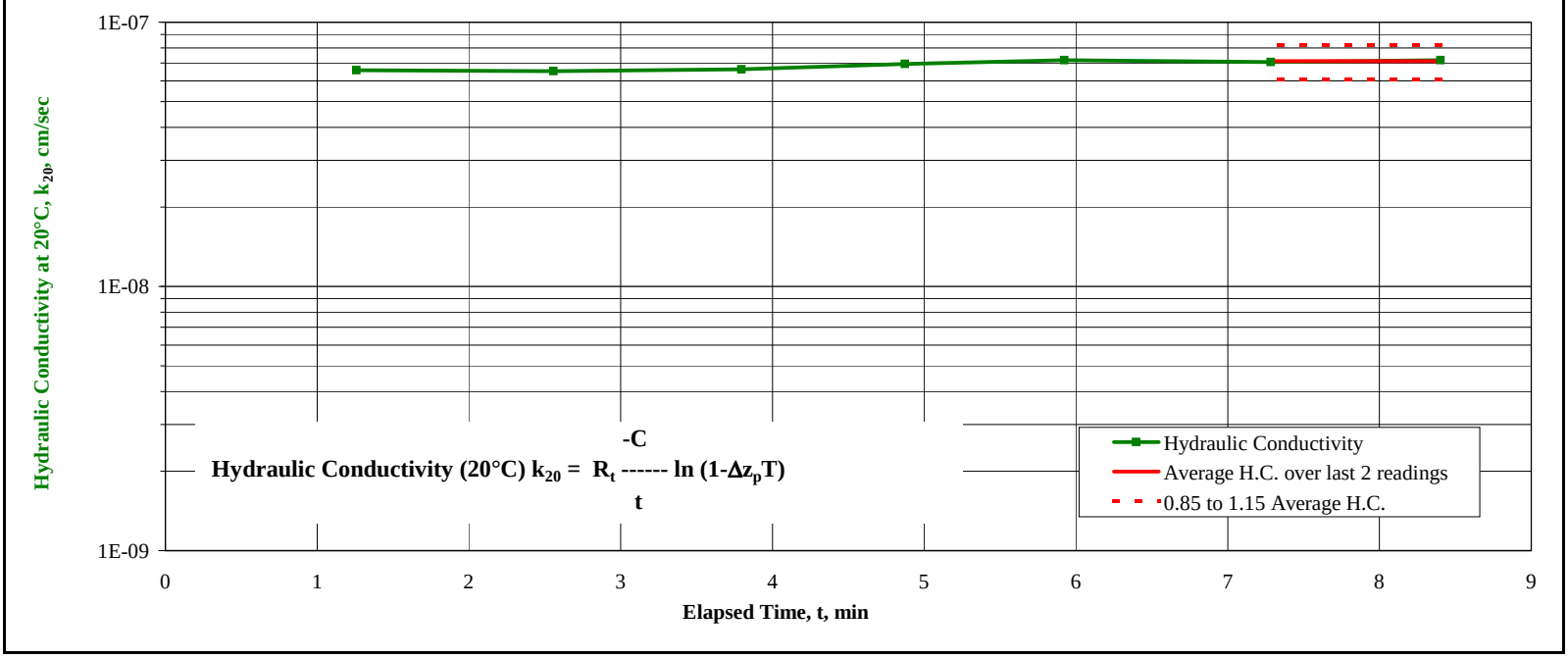
TEST CONSTANTS & EQUATIONS	
Pipette Area, $\mathbf{a_p}$ - cm^2	0.031416
Annulus Area, $\mathbf{a_a}$, cm^2	0.76712
Manometer Constant, $\mathbf{M_1} = a_a a_p/(a_a+a_p)$, cm^2	0.03018
Manometer Constant, $\mathbf{M_2} = 1 + a_p/a_a$	1.0410
Sample Constant, $\mathbf{S} = L/A$, cm^{-1}	0.156
Specific Gravity, $\boldsymbol{\delta} = \delta_{hg} - \delta_w$, gm/cc	12.562
Test Constant, $\mathbf{C} = M_1 S/\delta$	3.76E-04
Mercury Level at Equilibrium, $\mathbf{R_{eq}}$, cm	2.2
Mercury Level of Pipette at t=0, $\mathbf{R_{p0}}$, cm	10
Initial Head Difference, $\mathbf{z_1} = (R_{p0}-R_{eq})M_2$, cm	8.12
Trial Constant, $\mathbf{T} = M_2 / z_1$, cm	0.1282
Temperature Correction for 20°C, $\mathbf{R_t}$	1.027

SAMPLE SUMMARY	
Avg. Hydraulic Conductivity, k_{20}, cm/sec	**7.1E-08**
Initial Water Content, %	10.1%
Initial Dry Density, pcf	114.1
% Compaction	NA
Sample Status	Undisturbed
B Parameter	97
Permeant	Deaired Water
Cell Pressure, psi	73
Back Pressure, psi	70
Avg.(Mid-Height) Confining Stress, psi	3
Maximum Gradient	16.7
Average Test Temperature, °C	18.9

TEST DATA

t_i Elapsed Time *min*	R_{pt} Mercury Height *cm*	Δz_p R_{p0}-R_{pt} *cm*	i Gradient *cm / cm*	H_t Head *cm*	ΔH_t Percent of Initial Head from t=0 *%*	σ'_{max} Effective Stress Max *psi*	σ'_{min} Effective Stress Min *psi*	k_{20} Hydraulic Conductivity *cm/sec*
0.00	10	0	16.7	102.0	100.0%	3.73	2.27	NA
1.26	9.9	0.1	16.5	100.7	98.7%	3.72	2.28	6.59E-08
2.56	9.8	0.2	16.2	99.4	97.4%	3.71	2.29	6.52E-08
3.80	9.7	0.3	16.0	98.1	96.2%	3.70	2.30	6.64E-08
4.87	9.6	0.4	15.8	96.8	94.9%	3.69	2.31	6.94E-08
5.92	9.5	0.5	15.6	95.5	93.6%	3.68	2.32	7.19E-08
7.28	9.4	0.6	15.4	94.1	92.3%	3.67	2.33	7.06E-08
8.40	9.3	0.7	15.2	92.8	91.0%	3.66	2.34	7.19E-08

ELAPSED TIME vs. HYDRAULIC CONDUCTIVITY



Input Validation: Reviewed By: Date Tested: 12/2/2010

Note: The average Hydraulic Conductivity is calculated using the average of the last 4 determinations where all requisite flow and Hydraulic Conductivity conditions are achieved!

Prerequisits: Inflow / Outflow Ratio = 1 by definition of test procedure. Final Hydraulic Conductivity = +-25% of average Hydraulic Conductivity when k > 1E-8 cm/sec and +-50% when k < 1E-8 cm/sec.

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MEASUREMENT OF HYDRAULIC CONDUCTIVITY OF SATURATED POROUS MATERIALS USING A FLEXIBLE WALL PERMEAMETER

ASTM D5084-00 Method F; Mercury U-Tube Permometer - Inflow Volume = Outflow Volume

Client	Civil & Environmental Consultants, Inc.	Boring	SB-18
Client Project	091-867 Apex Landfill Expansion	Depth	22-24
Project No.	30598	Sample	ST-3
Visual Description	DARK GRAYISH BROWN CLAYEY GRAVEL WITH S/	Lab Sample No.	30598018
Sample Condition	Undisturbed		

SAMPLE CONDITIONS		
Sample Status	Initial	Final
Tare Number	A18	40
Wt. Tare & WS, gm	262.22	764.69
Wt. Tare & DS, gm	228.43	663.74
Wt. Tare, gm	9.46	82.49
Moisture Content, %	15.4%	17.4%
Wt. Tube & WS., gm	656.5	NA
Wt. Of Tube, gm	0	NA
Wt. Of WS., gm	656.5	667.6
Length 1, in	3.202	3.158
Length 2, in	3.189	3.217
Length 3, in	3.229	3.196
Top Diameter, in	2.83	2.826
Middle Diameter, in	2.838	2.835
Bottom Diameter, in	2.847	2.836
Average Length, **L**, cm	8.14	8.10
Average Area, **A**, cm^2	40.82	40.65
Sample Volume, cc	332.5	329.4
Unit Wet Wt., gm/cc	1.97	2.03
Unit Wet Wt., pcf	123.2	126.5
Unit Dry Wt., pcf	106.7	107.7
Unit Dry Wt., gm/cc	1.71	1.73
Specific Gravity, Assumed	2.7	2.7
Void Ratio, e	0.578	0.564
Porosity, n	0.366	0.360
Pore Volume, cc	121.83	118.74
Saturation, %	72.0%	

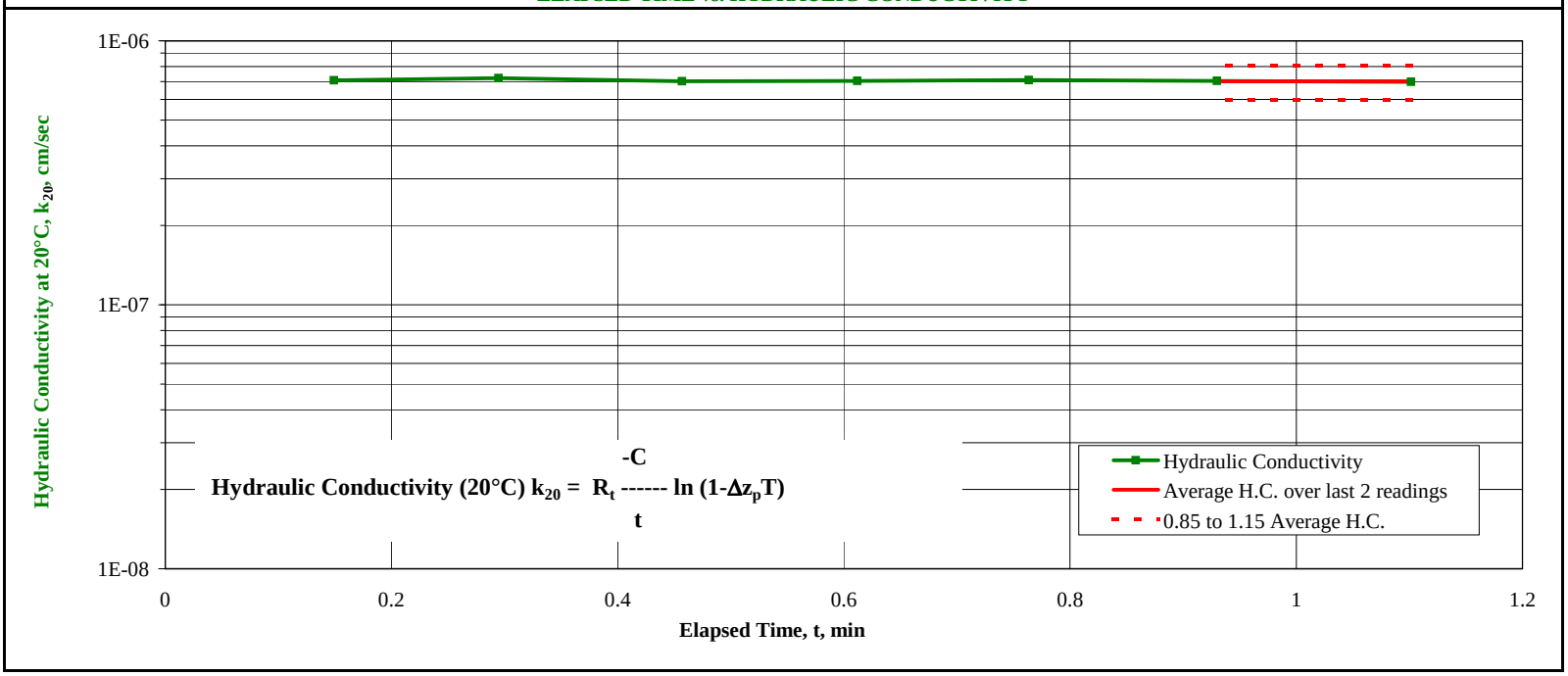
TEST CONSTANTS & EQUATIONS	
Pipette Area, $\mathbf{a_p}$ - cm^2	0.031416
Annulus Area, $\mathbf{a_a}$, cm^2	0.76712
Manometer Constant, $\mathbf{M_1} = a_a a_p/(a_a+a_p)$, cm^2	0.03018
Manometer Constant, $\mathbf{M_2} = 1 + a_p/a_a$	1.0410
Sample Constant, $\mathbf{S} = L/A$, cm^{-1}	0.199
Specific Gravity, $\boldsymbol{\delta} = \delta_{hg} - \delta_w$, gm/cc	12.562
Test Constant, $\mathbf{C} = M_1 S/\delta$	4.79E-04
Mercury Level at Equilibrium, $\mathbf{R_{eq}}$, cm	2.2
Mercury Level of Pipette at t=0, $\mathbf{R_{p0}}$, cm	10
Initial Head Difference, $\mathbf{z_1} = (R_{p0}-R_{eq})M_2$, cm	8.12
Trial Constant, $\mathbf{T} = M_2 / z_1$, cm	0.1282
Temperature Correction for 20°C, $\mathbf{R_t}$	1.027

SAMPLE SUMMARY	
Avg. Hydraulic Conductivity, k_{20}, cm/sec	**7.0E-07**
Initial Water Content, %	15.4%
Initial Dry Density, pcf	106.7
% Compaction	NA
Sample Status	Undisturbed
B Parameter	97
Permeant	Deaired Water
Cell Pressure, psi	73
Back Pressure, psi	70
Avg.(Mid-Height) Confining Stress, psi	3
Maximum Gradient	12.6
Average Test Temperature, °C	18.9

TEST DATA

t_i Elapsed Time *min*	R_{pt} Mercury Height *cm*	Δz_p R_{p0}-R_{pt} *cm*	i Gradient *cm / cm*	H_t Head *cm*	ΔH_t Percent of Initial Head from t=0 *%*	σ'_{max} Effective Stress Max *psi*	σ'_{min} Effective Stress Min *psi*	k_{20} Hydraulic Conductivity *cm/sec*
0.00	10	0	12.6	102.0	100.0%	3.73	2.27	NA
0.15	9.9	0.1	12.4	100.7	98.7%	3.72	2.28	7.09E-07
0.29	9.8	0.2	12.3	99.4	97.4%	3.71	2.29	7.22E-07
0.46	9.7	0.3	12.1	98.1	96.2%	3.70	2.30	7.04E-07
0.61	9.6	0.4	11.9	96.8	94.9%	3.69	2.31	7.05E-07
0.76	9.5	0.5	11.8	95.5	93.6%	3.68	2.32	7.11E-07
0.93	9.4	0.6	11.6	94.1	92.3%	3.67	2.33	7.05E-07
1.10	9.3	0.7	11.5	92.8	91.0%	3.66	2.34	7.00E-07

ELAPSED TIME vs. HYDRAULIC CONDUCTIVITY



Input Validation: Reviewed By: Date Tested: 12/2/2010

Note: The average Hydraulic Conductivity is calculated using the average of the last 4 determinations where all requisite flow and Hydraulic Conductivity conditions are achieved!

Prerequisits: Inflow / Outflow Ratio = 1 by definition of test procedure. Final Hydraulic Conductivity = +-25% of average Hydraulic Conductivity when k > 1E-8 cm/sec and +-50% when k < 1E-8 cm/sec.

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MEASUREMENT OF HYDRAULIC CONDUCTIVITY OF SATURATED POROUS MATERIALS USING A FLEXIBLE WALL PERMEAMETER

ASTM D5084-00 Method F; Mercury U-Tube Permometer - Inflow Volume = Outflow Volume

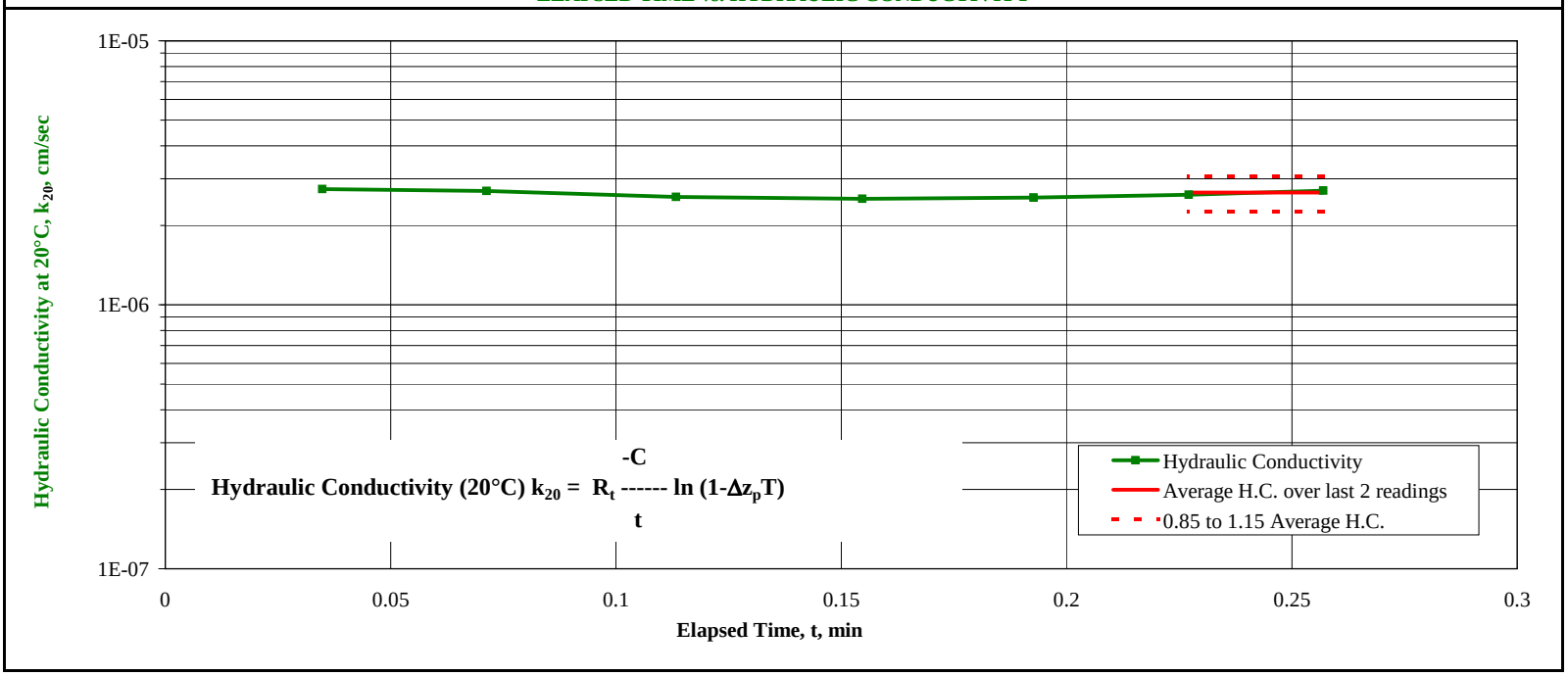
Client	Civil & Environmental Consultants, Inc.	Boring	SB-19
Client Project	091-867 Apex Landfill Expansion	Depth	11'-13'
Project No.	30598	Sample	ST-1
Visual Description	LIGHT OLIVE BROWN LEAN CLAY WITH SAND	Lab Sample No.	30598019
Sample Condition	Undisturbed		

SAMPLE CONDITIONS			TEST CONSTANTS & EQUATIONS		SAMPLE SUMMARY	
Sample Status	Initial	Final	Pipette Area, a_p - cm^2	0.031416	**Avg. Hydraulic Conductivity, k_{20}, cm/sec**	**2.7E-06**
Tare Number	A23	47	Annulus Area, a_a, cm^2	0.76712	Initial Water Content, %	16.1%
Wt. Tare & WS, gm	247.18	730.11	Manometer Constant, $M_1 = a_a a_p/(a_a+a_p)$, cm^2	0.03018	Initial Dry Density, pcf	104.6
Wt. Tare & DS, gm	214.13	623.25	Manometer Constant, $M_2 = 1 + a_p/a_a$	1.0410	% Compaction	NA
Wt. Tare, gm	9.42	83.93	Sample Constant, $S = L/A$, cm^{-1}	0.181	Sample Status	Undisturbed
Moisture Content, %	16.1%	19.8%	Specific Gravity, $\delta = \delta_{hg} - \delta_w$, gm/cc	12.562	B Parameter	97
Wt. Tube & WS., gm	628.1	NA	Test Constant, $C = M_1 S/\delta$	4.34E-04	Permeant	Deaired Water
Wt. Of Tube, gm	0	NA	Mercury Level at Equilibrium, R_{eq}, cm	2.3	Cell Pressure, psi	83
Wt. Of WS., gm	628.1	647.9	Mercury Level of Pipette at t=0, R_{p0}, cm	10	Back Pressure, psi	80
Length 1, in	2.999	3.005	Initial Head Difference, $z_1 = (R_{p0}-R_{eq})M_2$, cm	8.02	Avg.(Mid-Height) Confining Stress, psi	3
Length 2, in	3.023	3.031	Trial Constant, $T = M_2 / z_1$, cm	0.1299	Maximum Gradient	13.2
Length 3, in	2.985	3.001	Temperature Correction for 20°C, R_t	1.009	Average Test Temperature, °C	19.6
Top Diameter, in	2.882	2.885				
Middle Diameter, in	2.889	2.888				
Bottom Diameter, in	2.899	2.899				
Average Length, **L**, cm	7.63	7.65				
Average Area, **A**, cm^2	42.32	42.34				

TEST DATA

t_i Elapsed Time	R_{pt} Mercury Height	Δz_p $R_{p0}-R_{pt}$	i Gradient	H_t Head	ΔH_t Percent of Initial Head from t=0	σ'_{max} Effective Stress Max	σ'_{min} Effective Stress Min	k_{20} Hydraulic Conductivity
min	*cm*	*cm*	*cm / cm*	*cm*	*%*	*psi*	*psi*	*cm/sec*
0.00	10	0	13.2	100.7	100.0%	3.72	2.28	NA
0.03	9.9	0.1	13.0	99.4	98.7%	3.71	2.29	2.74E-06
0.07	9.8	0.2	12.8	98.1	97.4%	3.70	2.30	2.69E-06
0.11	9.7	0.3	12.6	96.8	96.1%	3.69	2.31	2.56E-06
0.15	9.6	0.4	12.5	95.5	94.8%	3.68	2.32	2.52E-06
0.19	9.5	0.5	12.3	94.1	93.5%	3.67	2.33	2.55E-06
0.23	9.4	0.6	12.1	92.8	92.2%	3.66	2.34	2.61E-06
0.26	9.3	0.7	12.0	91.5	90.9%	3.65	2.35	2.71E-06

ELAPSED TIME vs. HYDRAULIC CONDUCTIVITY



Input Validation: Reviewed By: Date Tested: 12/2/2010

Note: The average Hydraulic Conductivity is calculated using the average of the last 4 determinations where all requisite flow and Hydraulic Conductivity conditions are achieved!

Prerequisits: Inflow / Outflow Ratio = 1 by definition of test procedure. Final Hydraulic Conductivity = +-25% of average Hydraulic Conductivity when k > 1E-8 cm/sec and +-50% when k < 1E-8 cm/sec.

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MEASUREMENT OF HYDRAULIC CONDUCTIVITY OF SATURATED POROUS MATERIALS USING A FLEXIBLE WALL PERMEAMETER

ASTM D5084-00 Method F; Mercury U-Tube Permometer - Inflow Volume = Outflow Volume

Client	Civil & Environmental Consultants, Inc.	Boring	TPE-18
Client Project	091-867 Apex Landfill Expansion	Depth	18-19.7
Project No.	30598	Sample	ST-2
Visual Description	LIGHT OLIVE BROWN CLAYEY SAND WITH GRAVE	Lab Sample No.	30598020
Sample Condition	Undisturbed		

SAMPLE CONDITIONS		
Sample Status	Initial	Final
Tare Number	A7	449
Wt. Tare & WS, gm	129.87	770.01
Wt. Tare & DS, gm	117.52	655.65
Wt. Tare, gm	9.46	84.24
Moisture Content, %	11.4%	20.0%
Wt. Tube & WS., gm	670.2	NA
Wt. Of Tube, gm	0	NA
Wt. Of WS., gm	670.2	721.9
Length 1, in	3.132	3.138
Length 2, in	3.1	3.104
Length 3, in	3.052	3.055
Top Diameter, in	2.871	2.877
Middle Diameter, in	2.88	2.882
Bottom Diameter, in	2.878	2.891
Average Length, **L**, cm	7.86	7.87
Average Area, **A**, cm^2	41.92	42.13
Sample Volume, cc	329.5	331.6
Unit Wet Wt., gm/cc	2.03	2.18
Unit Wet Wt., pcf	126.9	135.8
Unit Dry Wt., pcf	113.9	113.2
Unit Dry Wt., gm/cc	1.83	1.81
Specific Gravity, Assumed	2.7	2.7
Void Ratio, e	0.479	0.488
Porosity, n	0.324	0.328
Pore Volume, cc	106.75	108.82
Saturation, %	64.4%	

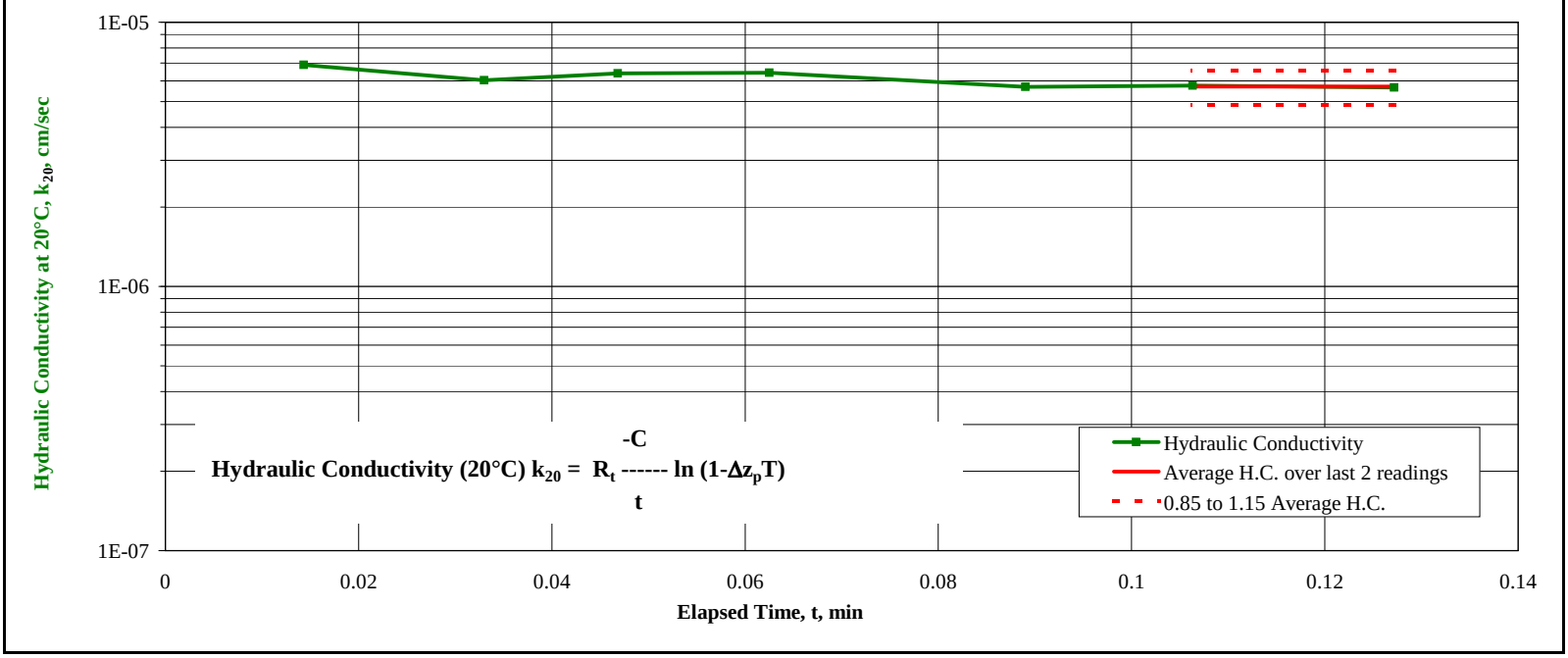
TEST CONSTANTS & EQUATIONS	
Pipette Area, $\mathbf{a_p}$ - cm^2	0.031416
Annulus Area, $\mathbf{a_a}$, cm^2	0.76712
Manometer Constant, $\mathbf{M_1} = a_a a_p/(a_a+a_p)$, cm^2	0.03018
Manometer Constant, $\mathbf{M_2} = 1 + a_p/a_a$	1.0410
Sample Constant, $\mathbf{S} = L/A$, cm^{-1}	0.187
Specific Gravity, $\boldsymbol{\delta} = \delta_{hg} - \delta_w$, gm/cc	12.562
Test Constant, $\mathbf{C} = M_1 S/\delta$	4.49E-04
Mercury Level at Equilibrium, $\mathbf{R_{eq}}$, cm	2.3
Mercury Level of Pipette at t=0, $\mathbf{R_{p0}}$, cm	10
Initial Head Difference, $\mathbf{z_1} = (R_{p0}-R_{eq})M_2$, cm	8.02
Trial Constant, $\mathbf{T} = M_2 / z_1$, cm	0.1299
Temperature Correction for 20°C, $\mathbf{R_t}$	1.009

SAMPLE SUMMARY	
Avg. Hydraulic Conductivity, k_{20}, cm/sec	**5.7E-06**
Initial Water Content, %	11.4%
Initial Dry Density, pcf	113.9
% Compaction	NA
Sample Status	Undisturbed
B Parameter	100
Permeant	Deaired Water
Cell Pressure, psi	83
Back Pressure, psi	80
Avg.(Mid-Height) Confining Stress, psi	3
Maximum Gradient	12.8
Average Test Temperature, °C	19.6

TEST DATA

t_i Elapsed Time	R_{pt} Mercury Height	Δz_p $R_{p0}-R_{pt}$	i Gradient	H_t Head	ΔH_t Percent of Initial Head from t=0	σ'_{max} Effective Stress Max	σ'_{min} Effective Stress Min	k_{20} Hydraulic Conductivity
min	*cm*	*cm*	*cm / cm*	*cm*	*%*	*psi*	*psi*	*cm/sec*
0.00	10	0	12.8	100.7	100.0%	3.72	2.28	NA
0.01	9.9	0.1	12.6	99.4	98.7%	3.71	2.29	6.89E-06
0.03	9.8	0.2	12.5	98.1	97.4%	3.70	2.30	6.02E-06
0.05	9.7	0.3	12.3	96.8	96.1%	3.69	2.31	6.41E-06
0.06	9.6	0.4	12.1	95.5	94.8%	3.68	2.32	6.45E-06
0.09	9.5	0.5	12.0	94.1	93.5%	3.67	2.33	5.70E-06
0.11	9.4	0.6	11.8	92.8	92.2%	3.66	2.34	5.76E-06
0.13	9.3	0.7	11.6	91.5	90.9%	3.65	2.35	5.66E-06

ELAPSED TIME vs. HYDRAULIC CONDUCTIVITY



Input Validation: Reviewed By: Date Tested: 12/2/2010

Note: The average Hydraulic Conductivity is calculated using the average of the last 4 determinations where all requisite flow and Hydraulic Conductivity conditions are achieved!

Prerequisits: Inflow / Outflow Ratio = 1 by definition of test procedure. Final Hydraulic Conductivity = +-25% of average Hydraulic Conductivity when k > 1E-8 cm/sec and +-50% when k < 1E-8 cm/sec.

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MEASUREMENT OF HYDRAULIC CONDUCTIVITY OF SATURATED POROUS MATERIALS USING A FLEXIBLE WALL PERMEAMETER

ASTM D5084-00 Method F; Mercury U-Tube Permometer - Inflow Volume = Outflow Volume

Client	Civil & Environmental Consultants, Inc.	Boring	TPE-21
Client Project	091-867 Apex Landfill Expansion	Depth	2'-4'
Project No.	30598	Sample	ST-1
Visual Description	LIGHT OLIVE BROWN SANDY LEAN CLAY	Lab Sample No.	30598021
Sample Condition	Undisturbed		

SAMPLE CONDITIONS		
Sample Status	Initial	Final
Tare Number	A7	103
Wt. Tare & WS, gm	218.78	750.16
Wt. Tare & DS, gm	181.38	644.9
Wt. Tare, gm	9.45	83.99
Moisture Content, %	21.8%	18.8%
Wt. Tube & WS., gm	656.1	NA
Wt. Of Tube, gm	0	NA
Wt. Of WS., gm	656.1	640.0
Length 1, in	2.985	2.992
Length 2, in	3.013	3.015
Length 3, in	2.947	2.955
Top Diameter, in	2.879	2.881
Middle Diameter, in	2.875	2.879
Bottom Diameter, in	2.879	2.883
Average Length, **L**, cm	7.57	7.59
Average Area, **A**, cm^2	41.96	42.06
Sample Volume, cc	317.8	319.1
Unit Wet Wt., gm/cc	2.06	2.01
Unit Wet Wt., pcf	128.8	125.1
Unit Dry Wt., pcf	105.8	105.4
Unit Dry Wt., gm/cc	1.70	1.69
Specific Gravity, Assumed	2.7	2.7
Void Ratio, e	0.592	0.599
Porosity, n	0.372	0.375
Pore Volume, cc	118.21	119.55
Saturation, %	99.2%	

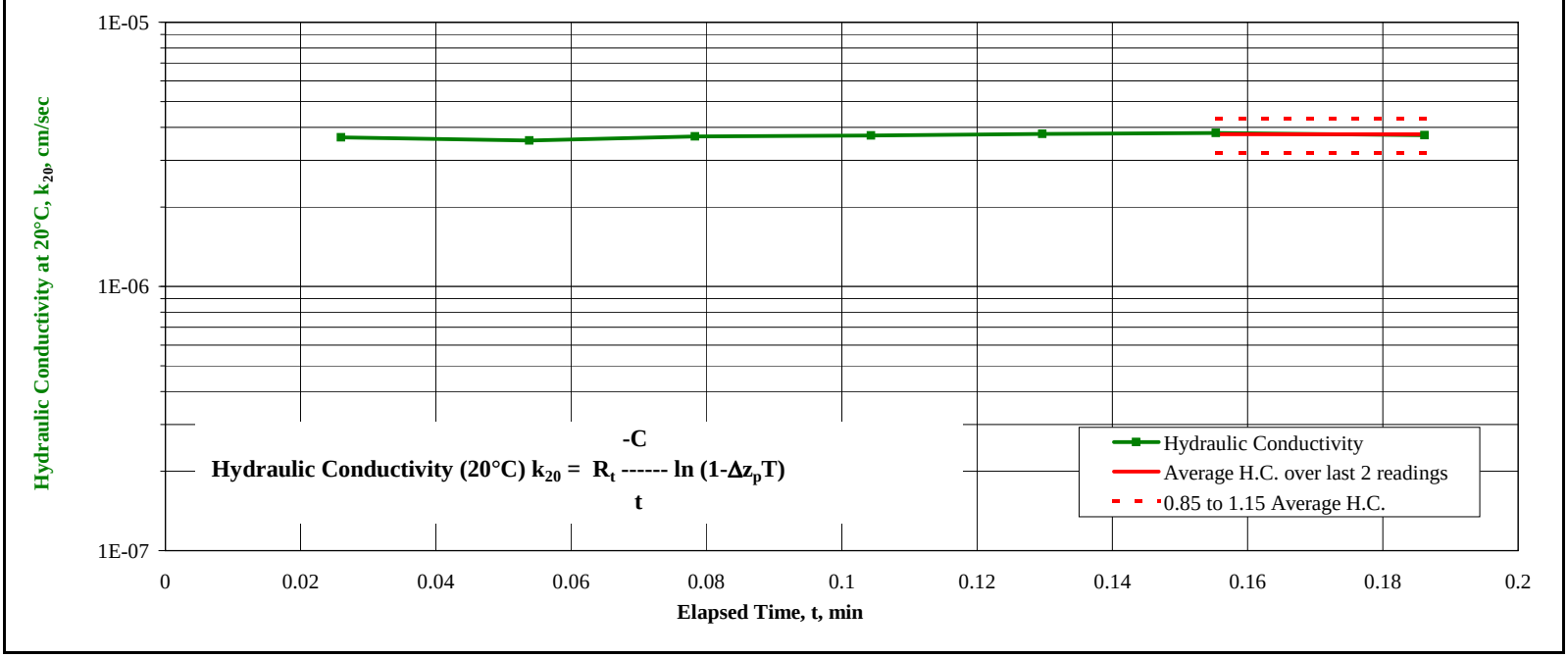
TEST CONSTANTS & EQUATIONS	
Pipette Area, $\mathbf{a_p}$ - cm^2	0.031416
Annulus Area, $\mathbf{a_a}$, cm^2	0.76712
Manometer Constant, $\mathbf{M_1} = a_a a_p/(a_a+a_p)$, cm^2	0.03018
Manometer Constant, $\mathbf{M_2} = 1 + a_p/a_a$	1.0410
Sample Constant, $\mathbf{S} = L/A$, cm^{-1}	0.180
Specific Gravity, $\boldsymbol{\delta} = \delta_{hg} - \delta_w$, gm/cc	12.562
Test Constant, $\mathbf{C} = M_1 S/\delta$	4.33E-04
Mercury Level at Equilibrium, $\mathbf{R_{eq}}$, cm	2.3
Mercury Level of Pipette at t=0, $\mathbf{R_{p0}}$, cm	10
Initial Head Difference, $\mathbf{z_1} = (R_{p0}-R_{eq})M_2$, cm	8.02
Trial Constant, $\mathbf{T} = M_2 / z_1$, cm	0.1299
Temperature Correction for 20°C, $\mathbf{R_t}$	1.009

SAMPLE SUMMARY	
Avg. Hydraulic Conductivity, k_{20}, cm/sec	**3.8E-06**
Initial Water Content, %	21.8%
Initial Dry Density, pcf	105.8
% Compaction	NA
Sample Status	Undisturbed
B Parameter	100
Permeant	Deaired Water
Cell Pressure, psi	83
Back Pressure, psi	80
Avg.(Mid-Height) Confining Stress, psi	3
Maximum Gradient	13.3
Average Test Temperature, °C	19.6

TEST DATA

t_i Elapsed Time	R_{pt} Mercury Height	Δz_p $R_{p0}-R_{pt}$	i Gradient	H_t Head	ΔH_t Percent of Initial Head from t=0	σ'_{max} Effective Stress Max	σ'_{min} Effective Stress Min	k_{20} Hydraulic Conductivity
min	*cm*	*cm*	*cm / cm*	*cm*	*%*	*psi*	*psi*	*cm/sec*
0.00	10	0	13.3	100.7	100.0%	3.72	2.28	NA
0.03	9.9	0.1	13.1	99.4	98.7%	3.71	2.29	3.67E-06
0.05	9.8	0.2	12.9	98.1	97.4%	3.70	2.30	3.57E-06
0.08	9.7	0.3	12.8	96.8	96.1%	3.69	2.31	3.70E-06
0.10	9.6	0.4	12.6	95.5	94.8%	3.68	2.32	3.73E-06
0.13	9.5	0.5	12.4	94.1	93.5%	3.67	2.33	3.78E-06
0.16	9.4	0.6	12.2	92.8	92.2%	3.66	2.34	3.81E-06
0.19	9.3	0.7	12.1	91.5	90.9%	3.65	2.35	3.73E-06

ELAPSED TIME vs. HYDRAULIC CONDUCTIVITY



Input Validation: Reviewed By: Date Tested: 12/2/2010

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PARTICLE-SIZE ANALYSIS OF SOILS
ASTM D 422

Client	Civil & Environmental Consultants, I	Boring	SB-3
Client Project	091-867 Apex Landfill Expansion	Depth	11.5'-13.5'
Project No.	30598	Sample	ST-1
		Lab Sample No.	30598001

USCS Description **LIGHT GRAY LEAN CLAY**
USCS Group Symbol **CL** AASHTO: **A-6 (20)**
USDA Description **SILT LOAM**

MECHANICAL SIEVE ANALYSIS

As-Received Representative Sample Size Split or Material Submitted Used	
Representable Wet Wt, gm	868.5
+#4 Grnd., Washed DS., gm	0.0
-#4 Wet Wt., gm	868.5
-#4 Water Content, %	7.2
-#4 Dry Wt., gm	810.0
Representable Dry Wt, gm	**810.0**
** Note: Percentages +#4 are based on total Dry representable sample.*	
Split Sample, -#4 washed over #200	
Tare No.	808
Tare + WS., gm	204.58
Tare + DS., gm	197.67
Tare, gm	101.96
Wt. of DS., gm	95.71
Water Content -#4, %	7.2
Wt. of +#200 Sample, gm	2.3

US Std. Sieve Size	Sieve Opening (mm)	Wt. of Soil Retained (gm)	Percent Retained (%)*	Cumulative Percent Retained	Percent Finer (%)	Final Percent Finer
3"	75	0	0.0	0.0	100.0	100.0
2 1/2"	62.5	0	0.0	0.0	100.0	100.0
2"	50	0	0.0	0.0	100.0	100.0
1 1/2"	37.5	0	0.0	0.0	100.0	100.0
1"	25	0	0.0	0.0	100.0	100.0
3/4"	19	0	0.0	0.0	100.0	100.0
1/2"	12.5	0	0.0	0.0	100.0	100.0
3/8"	9.5	0	0.0	0.0	100.0	100.0
#4	4.75	0	0.0	0.0	100.0	100.0
#10	2	0.04	0.0	0.0	100.0	100.0
#20	0.85	0.28	0.3	0.3	99.7	99.7
#40	0.425	0.54	0.6	0.9	99.1	99.1
#60	0.25	0.66	0.7	1.6	98.4	98.4
#140	0.106	0.53	0.6	2.1	97.9	97.9
#200	0.075	0.2	0.2	2.4	97.6	97.6
-#200 / Pan		93.5	97.6	100.0	-	-

The final percent finer combines the gradation of the plus #4 and minus #4 material.

HYDROMETER ANALYSIS (-#200)

Hydrometer Sample Weight (-#200)	
Tare No.	511
Wt. Tare + DS., gm	132.25
Wt. Tare, gm	103.3
Wt. Dispers., gm	5
Wt. Dry Soil, gm	23.95
-#10 Dispersed 1min in Hamilton Beach Mixer	
K Factor	0.0138
Composite Correction	7.5
a Factor	0.99
Average Test Temp, °C	18.3
Specific Gravity, Assumed	2.7

Elapsed Time (min.)	R Measured	Composite Correction	R Corrected	Percent Finer (%)	Particle Diameter (mm)	Adjusted % Finer (%)
0	NA	NA	NA	NA	NA	NA
2	28	7.5	20.5	84.6	0.0332	82.7
5	26	7.5	18.5	76.4	0.0213	74.6
15	24.5	7.5	17	70.2	0.0124	68.5
30	22	7.5	14.5	59.9	0.0089	58.5
60	19	7.5	11.5	47.5	0.0064	46.4
250	13.5	7.5	6	24.8	0.0033	24.2
1440	10	7.5	2.5	10.3	0.0014	10.1

The adjusted percent finer is corrected for the percent passing the -#200 sieve.

D 422 / USCS SOIL CLASSIFICATION

Corrected For 100% Passing a 3" Sieve

% Gravel (-3" & +#4)	**0.0**	Silt=59.2%	Clay=38.2%
Coarse=0; Fine=0		D60, mm	NA
% Sand (-#4 & +#200)	**2.4**	D30, mm	NA
Coa.=0; Med.=0.9; Fine=1.5		D10, mm	NA
% Fines (-#200)	**97.6**	Cc	NA
% Plus #200 (-3")	**2.4**	Cu	NA

USCS Description
LEAN CLAY

USCS Group Symbol	Atterberg Limits Group Symbol
CL	**CL, LL=38, PL=18, PI=20**

Auxiliary Information	Wt Ret, gm	% Retained	% Finer
12" Sieve - 300 mm	0	0.0	100.0
6" Sieve - 150 mm	0	0.0	100.0
3" Sieve - 75 mm	0	0.0	100.0

USDA CLASSIFICATION

Particle Size (mm)	Percent Finer (%)	Percent of Each Component (Material)	(%)	Corrected Percent of -2.0 mm Material for USDA
100	100			
		Gravel	0.0	0
2	100.0			
		Sand	9.8	9.8
0.05	90.2			
		Silt	74.1	74.1
0.002	16.1			
		Clay	16.1	16.1

USDA Classification
SILT LOAM

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LIQUID LIMIT, PLASTIC LIMIT, AND PLASTICITY INDEX OF SOILS
ASTM D 4318

Client	Civil & Environmental Consultants, I	Boring No.	SB-3
Client Project	091-867 Apex Landfill Expansion	Depth(ft)	11.5'-13.5'
Project No.	30598	Sample No.	ST-1
		Lab Sample No.	30598001

Soil Description: LIGHT GRAY LEAN CLAY
(-#40 Fraction)

AS-RECEIVED W.C.

Tare Number	808
Wt. Tare & WS, gm	204.58
Wt. Tare & DS, gm	197.67
Wt. Water, gm	6.91
Wt. Tare, gm	101.96
Wt. DS, gm	95.71
Water Content, %	7.2

SAMPLE SUMMARY

Liquid Limit (LL), %	38
Plastic Limit (PL), %	18
Plasticity Index (PI)	20
USCS Symbol (-#40 Fraction)	CL
Sample Preparation:	Wet Method
Liquidity Index, %	-53.9%
Clay Fraction (% 2 microns)	NA
Skempton's Activity (A)	NA

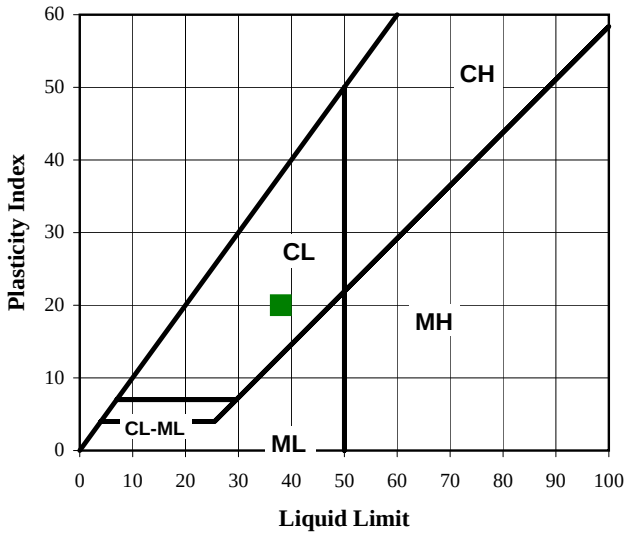
PLASTIC LIMIT

Test Number	1	2	3
Tare Number	412	496	512
Wt. Tare & WS, gm	17.60	17.32	17.57
Wt. Tare & DS, gm	16.55	16.33	16.57
Wt. Water, gm	1.05	0.99	1.00
Wt. Tare, gm	10.74	10.79	10.73
Wt. DS, gm	5.81	5.54	5.84
Water Content, %	18.1	17.9	17.1

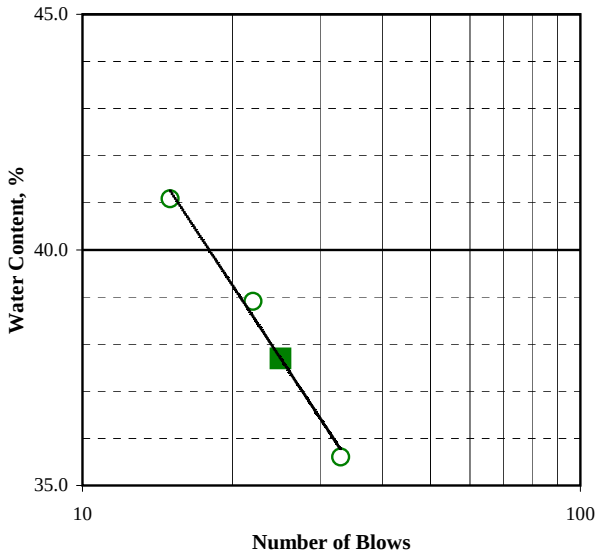
LIQUID LIMIT

	1	2	3
Tare Number	429	436	400
Wt. Tare & WS, gm	18.69	18.68	18.74
Wt. Tare & DS, gm	16.34	16.47	16.65
Wt. Water, gm	2.35	2.21	2.09
Wt. Tare, gm	10.62	10.79	10.78
Wt. DS, gm	5.72	5.68	5.87
Water Content, %	41.1	38.9	35.6
# of Blows	15	22	33

PLASTICITY CHART



FLOW CURVE



Input Validation: Reviewed By: Date Tested: 12/1/2010

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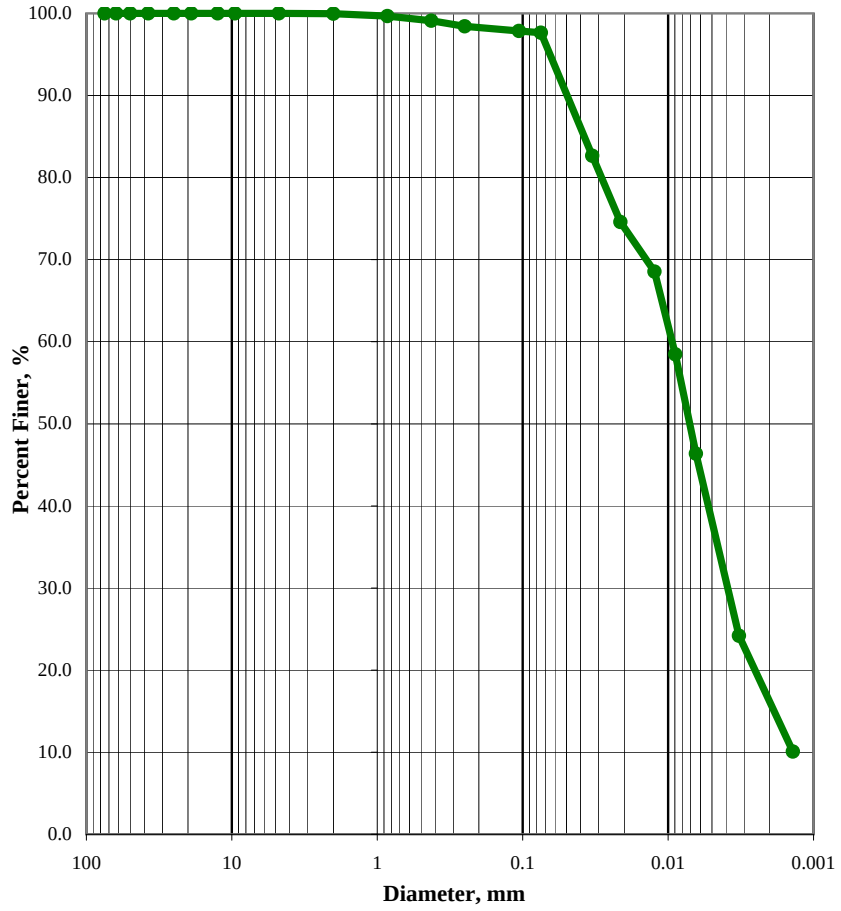
PARTICLE-SIZE ANALYSIS OF SOILS

Client	Civil & Environmental Consultants, I	Boring	SB-3
Client Project	091-867 Apex Landfill Expansion	Depth	11.5'-13.5'
Project No.	30598	Sample	ST-1
		Lab Sample No.	30598001

USCS Description **LIGHT GRAY LEAN CLAY**
USCS Group Symbol **CL** AASHTO: **A-6 (20)**
USDA Description **SILT LOAM**



US Std. Sieve Size	Particle Diameter (mm)	Percent Finer (%)
3"	75	100.0
2 1/2"	62.5	100.0
2"	50	100.0
1 1/2"	37.5	100.0
1"	25	100.0
3/4"	19	100.0
1/2"	12.5	100.0
3/8"	9.5	100.0
#4	4.75	100.0
#10	2	100.0
#20	0.85	99.7
#40	0.425	99.1
#60	0.25	98.4
#140	0.106	97.9
#200	0.075	97.6
NA	0.0332	82.7
NA	0.0213	74.6
NA	0.0124	68.5
NA	0.0089	58.5
NA	0.0064	46.4
NA	0.0033	24.2
NA	0.0014	10.1

USCS SOIL CLASSIFICATION

Corrected For 100% Passing a 3" Sieve

% Gravel (-3" & +#4)	**0.0**	Silt=59.2% Clay=38.2%	
Coarse=0; Fine=0		D60, mm	NA
% Sand (-#4 & +#200)	**2.4**	D30, mm	NA
Coa.=0; Med.=0.9; Fine=1.5		D10, mm	NA
% Fines (-#200)	**97.6**	Cc	NA
% Plus #200 (-3")	**2.4**	Cu	NA

USCS Description
LEAN CLAY

USCS Group Symbol	Atterberg Limits Group Symbol		
CL	**CL, LL=38, PL=18, PI=20**		
Auxiliary Information	Wt Ret, gm	% Retained	% Finer
12" Sieve - 300 mm	0	0.0	100.0
6" Sieve - 150 mm	0	0.0	100.0
3" Sieve - 75 mm	0	0.0	100.0

USDA CLASSIFICATION

Particle Size (mm)	Percent Finer (%)	Percent of Each Component (Material)	(%)	Corrected Percent of -2.0 mm Material for USDA
100	100			
		Gravel	0.0	0
2	100.0			
		Sand	9.8	9.8
0.05	90.2			
		Silt	74.1	74.1
0.002	16.1			
		Clay	16.1	16.1

USDA Classification
SILT LOAM

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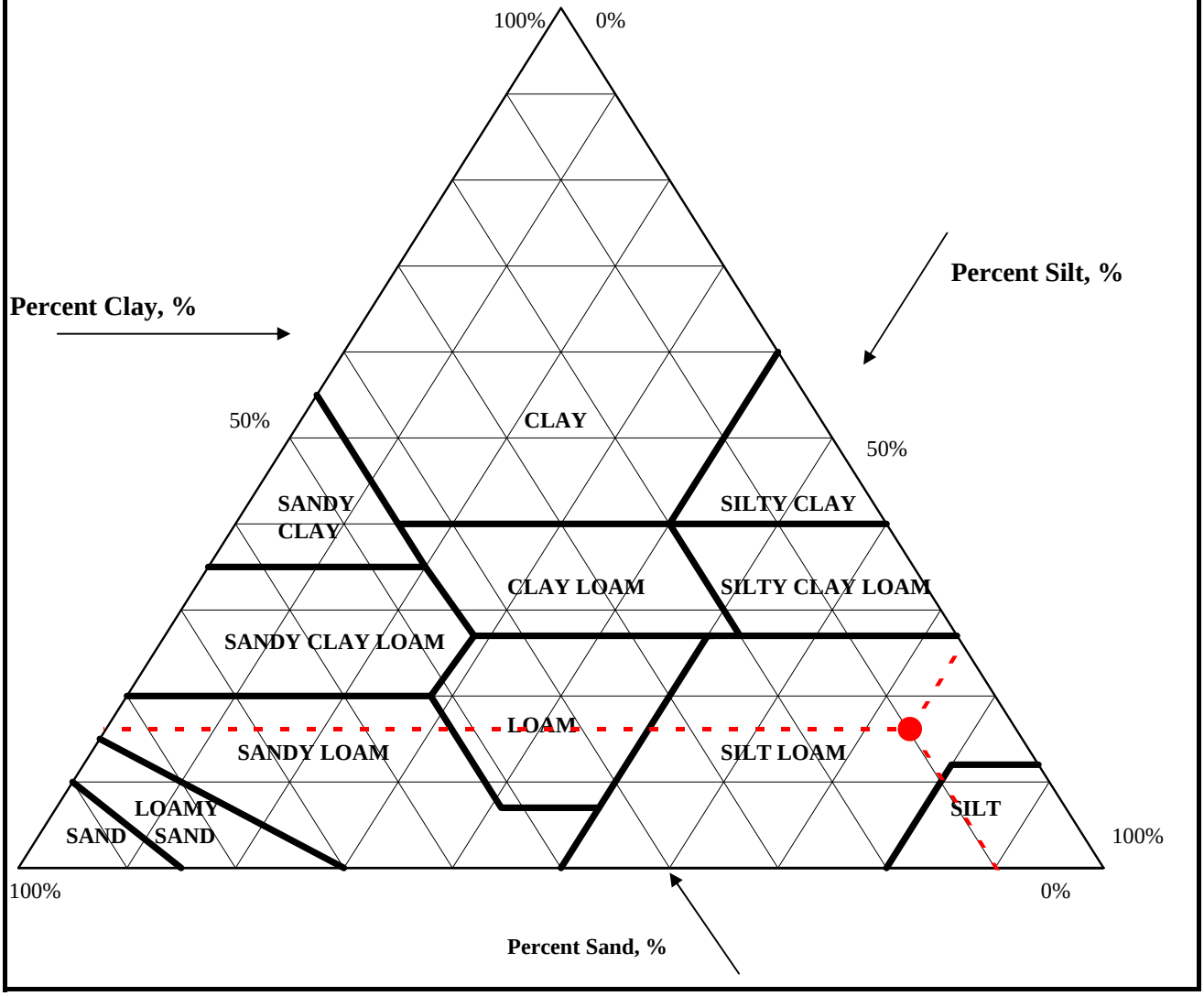
USDA CLASSIFICATION CHART

Client	Civil & Environmental Consultants, I	Boring	SB-3
Client Project	091-867 Apex Landfill Expansion	Depth	11.5'-13.5'
Project No.	30598	Sample	ST-1
		Lab Sample No.	30598001
USCS Description	**LIGHT GRAY LEAN CLAY**		
USCS Group Symbol	**CL**	AASHTO Classification	**A-6 (20)**
USDA Description	**SILT LOAM**		

Corrected for 0% gravel	
Percent Gravel, %	0.0
Percent Sand, %	9.8
Percent Silt, %	74.1
Percent Clay, %	16.1

Sand Subsizes Corrected Percentages	
Very Coarse Sand; 2-1	0.2
Coarse Sand; 1-0.5	0.5
Medium Sand; 0.5-0.25	0.8
Fine Sand; 0.25-0.1	0.6
Very Fine Sand; 0.1-0.05	7.6
Total	**9.8**



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PARTICLE-SIZE ANALYSIS OF SOILS
ASTM D 422

Client	Civil & Environmental Consultants, I	Boring	SB-14
Client Project	091-867 Apex Landfill Expansion	Depth	25'-27'
Project No.	30598	Sample	ST-2 TOP (Mine Spoil)
		Lab Sample No.	30598002
USCS Description	**BLACK ELASTIC SILT WITH SAND**		
USCS Group Symbol	**MH**	AASHTO:	**A-7-5 (28)**
USDA Description	**LOAM**		

MECHANICAL SIEVE ANALYSIS

As-Received Representative Sample Size Split or Material Submitted Used	
Representable Wet Wt, gm	512.9
+#4 Grnd., Washed DS., gm	0.0
-#4 Wet Wt., gm	512.9
-#4 Water Content, %	51.7
-#4 Dry Wt., gm	338.0
Representable Dry Wt, gm	**338.0**
** Note: Percentages +#4 are based on total Dry representable sample.*	
Split Sample, -#4 washed over #200	
Tare No.	523
Tare + WS., gm	228.37
Tare + DS., gm	186.07
Tare, gm	104.33
Wt. of DS., gm	81.74
Water Content -#4, %	51.7
Wt. of +#200 Sample, gm	22.4

US Std. Sieve Size	Sieve Opening (mm)	Wt. of Soil Retained (gm)	Percent Retained (%)*	Cumulative Percent Retained	Percent Finer (%)	Final Percent Finer
3"	75	0	0.0	0.0	100.0	100.0
2 1/2"	62.5	0	0.0	0.0	100.0	100.0
2"	50	0	0.0	0.0	100.0	100.0
1 1/2"	37.5	0	0.0	0.0	100.0	100.0
1"	25	0	0.0	0.0	100.0	100.0
3/4"	19	0	0.0	0.0	100.0	100.0
1/2"	12.5	0	0.0	0.0	100.0	100.0
3/8"	9.5	0	0.0	0.0	100.0	100.0
#4	4.75	0	0.0	0.0	100.0	100.0
#10	2	0	0.0	0.0	100.0	100.0
#20	0.85	0.08	0.1	0.1	99.9	99.9
#40	0.425	0.35	0.4	0.5	99.5	99.5
#60	0.25	0.55	0.7	1.2	98.8	98.8
#140	0.106	9	11.0	12.2	87.8	87.8
#200	0.075	12.46	15.2	27.5	72.5	72.5
-#200 / Pan		59.3	72.5	100.0	-	-

The final percent finer combines the gradation of the plus #4 and minus #4 material.

HYDROMETER ANALYSIS (-#200)

Hydrometer Sample Weight (-#200)	
Tare No.	946
Wt. Tare + DS., gm	121.1
Wt. Tare, gm	98.75
Wt. Dispers., gm	5
Wt. Dry Soil, gm	17.35
-#10 Dispersed 1min in Hamilton Beach Mixer	
K Factor	0.0137
Composite Correction	7.5
a Factor	0.99
Average Test Temp, °C	18.6
Specific Gravity, Assumed	2.7

Elapsed Time (min.)	R Measured	Composite Correction	R Corrected	Percent Finer (%)	Particle Diameter (mm)	Adjusted % Finer (%)
0	NA	NA	NA	NA	NA	NA
2	20.5	7.5	13	74.1	0.0348	53.8
5	20	7.5	12.5	71.2	0.0221	51.7
15	19	7.5	11.5	65.5	0.0128	47.6
30	18	7.5	10.5	59.8	0.0091	43.4
60	17	7.5	9.5	54.1	0.0065	39.3
250	15	7.5	7.5	42.7	0.0032	31.0
1440	13	7.5	5.5	31.3	0.0014	22.7

The adjusted percent finer is corrected for the percent passing the -#200 sieve.

D 422 / USCS SOIL CLASSIFICATION

Corrected For 100% Passing a 3" Sieve

% Gravel (-3" & +#4)	**0.0**	Silt=36% Clay=36.2%	
Coarse=0; Fine=0		D60, mm	NA
% Sand (-#4 & +#200)	**27.5**	D30, mm	NA
Coa.=0; Med.=0.5; Fine=26.9		D10, mm	NA
% Fines (-#200)	**72.5**	Cc	NA
% Plus #200 (-3")	**27.5**	Cu	NA

USCS Description

ELASTIC SILT WITH SAND

USCS Group Symbol	Atterberg Limits Group Symbol
MH	**MH, LL=81, PL=48, PI=33**

Auxiliary Information	Wt Ret, gm	% Retained	% Finer
12" Sieve - 300 mm	0	0.0	100.0
6" Sieve - 150 mm	0	0.0	100.0
3" Sieve - 75 mm	0	0.0	100.0

USDA CLASSIFICATION

Particle Size (mm)	Percent Finer (%)	Percent of Each Component (Material)	(%)	Corrected Percent of -2.0 mm Material for USDA
100	100			
		Gravel	0.0	0
2	100.0			
		Sand	37.4	37.4
0.05	62.6			
		Silt	36.2	36.2
0.002	26.5			
		Clay	26.5	26.5

USDA Classification

LOAM

Input Validation: Reviewed By: Date Tested: 12/1/2010

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LIQUID LIMIT, PLASTIC LIMIT, AND PLASTICITY INDEX OF SOILS
ASTM D 4318

Client	Civil & Environmental Consultants, I	Boring No.	SB-14
Client Project	091-867 Apex Landfill Expansion	Depth(ft)	25'-27'
Project No.	30598	Sample No.	ST-2 TOP (Mine Spoil)
		Lab Sample No.	30598002

Soil Description: BLACK ELASTIC SILT
(-#40 Fraction)

AS-RECEIVED W.C.

Tare Number	523
Wt. Tare & WS, gm	228.37
Wt. Tare & DS, gm	186.07
Wt. Water, gm	42.30
Wt. Tare, gm	104.33
Wt. DS, gm	81.74
Water Content, %	51.7

SAMPLE SUMMARY

Liquid Limit (LL), %	81
Plastic Limit (PL), %	48
Plasticity Index (PI)	33
USCS Symbol (-#40 Fraction)	MH
Sample Preparation:	Wet Method
Liquidity Index, %	11.4%
Clay Fraction (% 2 microns)	NA
Skempton's Activity (A)	NA

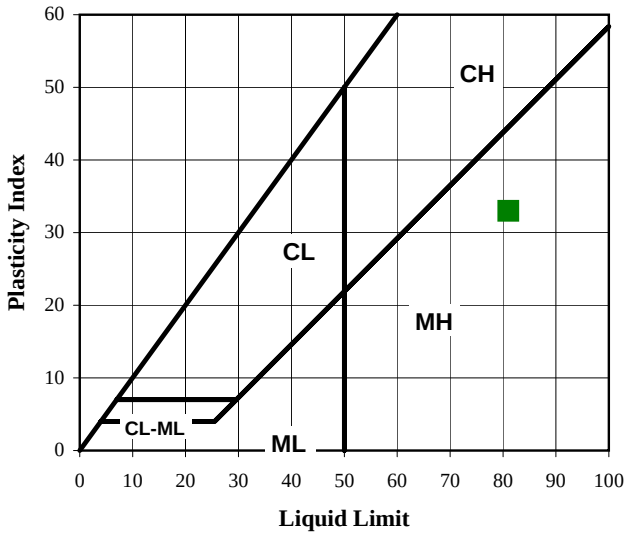
PLASTIC LIMIT

Test Number	1	2	3
Tare Number	486	499	402
Wt. Tare & WS, gm	18.23	17.57	18.90
Wt. Tare & DS, gm	15.78	15.34	16.29
Wt. Water, gm	2.45	2.23	2.61
Wt. Tare, gm	10.78	10.76	10.77
Wt. DS, gm	5.00	4.58	5.52
Water Content, %	49.0	48.7	47.3

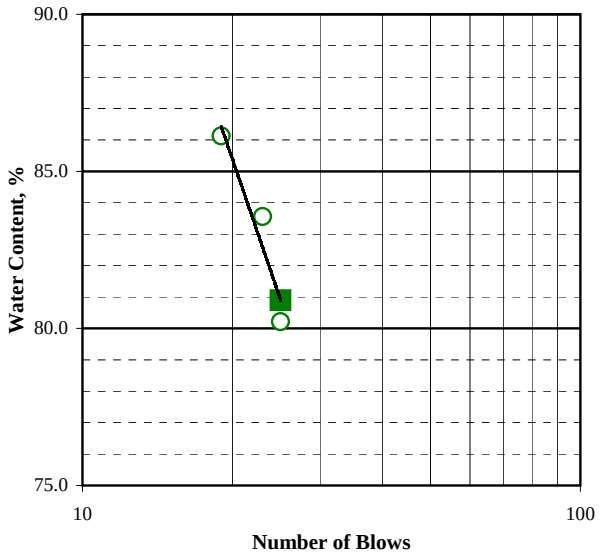
LIQUID LIMIT

	1	2	3
Tare Number	461	493	506
Wt. Tare & WS, gm	17.12	17.42	15.77
Wt. Tare & DS, gm	14.14	14.37	13.54
Wt. Water, gm	2.98	3.05	2.23
Wt. Tare, gm	10.68	10.72	10.76
Wt. DS, gm	3.46	3.65	2.78
Water Content, %	86.1	83.6	80.2
# of Blows	19	23	25

PLASTICITY CHART



FLOW CURVE



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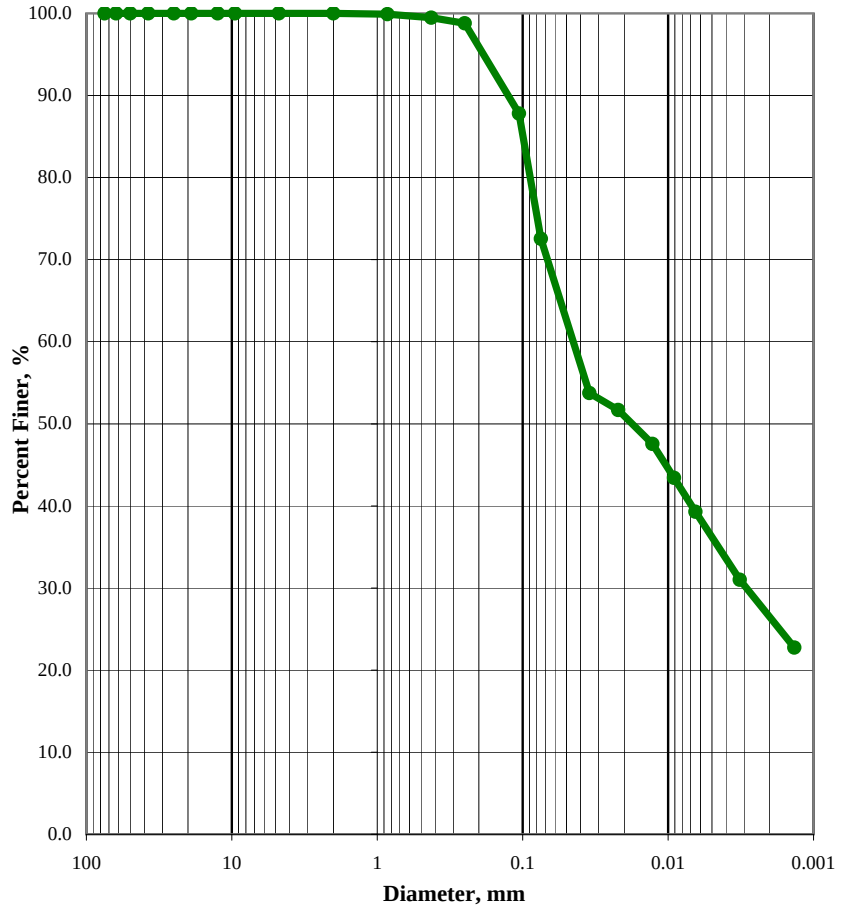
PARTICLE-SIZE ANALYSIS OF SOILS

Client	Civil & Environmental Consultants, I	Boring	SB-14
Client Project	091-867 Apex Landfill Expansion	Depth	25'-27'
Project No.	30598	Sample	ST-2 TOP (Mine Spoil)
		Lab Sample No.	30598002

USCS Description **BLACK ELASTIC SILT WITH SAND**
USCS Group Symbol **MH** AASHTO: **A-7-5 (28)**
USDA Description **LOAM**



US Std. Sieve Size	Particle Diameter (mm)	Percent Finer (%)
3"	75	100.0
2 1/2"	62.5	100.0
2"	50	100.0
1 1/2"	37.5	100.0
1"	25	100.0
3/4"	19	100.0
1/2"	12.5	100.0
3/8"	9.5	100.0
#4	4.75	100.0
#10	2	100.0
#20	0.85	99.9
#40	0.425	99.5
#60	0.25	98.8
#140	0.106	87.8
#200	0.075	72.5
NA	0.0348	53.8
NA	0.0221	51.7
NA	0.0128	47.6
NA	0.0091	43.4
NA	0.0065	39.3
NA	0.0032	31.0
NA	0.0014	22.7

USCS SOIL CLASSIFICATION

Corrected For 100% Passing a 3" Sieve

% Gravel (-3" & +#4)	**0.0**	Silt=36% Clay=36.2%	
Coarse=0; Fine=0		D60, mm	NA
% Sand (-#4 & +#200)	**27.5**	D30, mm	NA
Coa.=0; Med.=0.5; Fine=26.9		D10, mm	NA
% Fines (-#200)	**72.5**	Cc	NA
% Plus #200 (-3")	**27.5**	Cu	NA

USCS Description
ELASTIC SILT WITH SAND

USCS Group Symbol	Atterberg Limits Group Symbol		
MH	**MH, LL=81, PL=48, PI=33**		
Auxiliary Information	Wt Ret, gm	% Retained	% Finer
12" Sieve - 300 mm	0	0.0	100.0
6" Sieve - 150 mm	0	0.0	100.0
3" Sieve - 75 mm	0	0.0	100.0

USDA CLASSIFICATION

Particle Size (mm)	Percent Finer (%)	Percent of Each Component (Material)	(%)	Corrected Percent of -2.0 mm Material for USDA
100	100			
		Gravel	0.0	0
2	100.0			
		Sand	37.4	37.4
0.05	62.6			
		Silt	36.2	36.2
0.002	26.5			
		Clay	26.5	26.5

USDA Classification
LOAM

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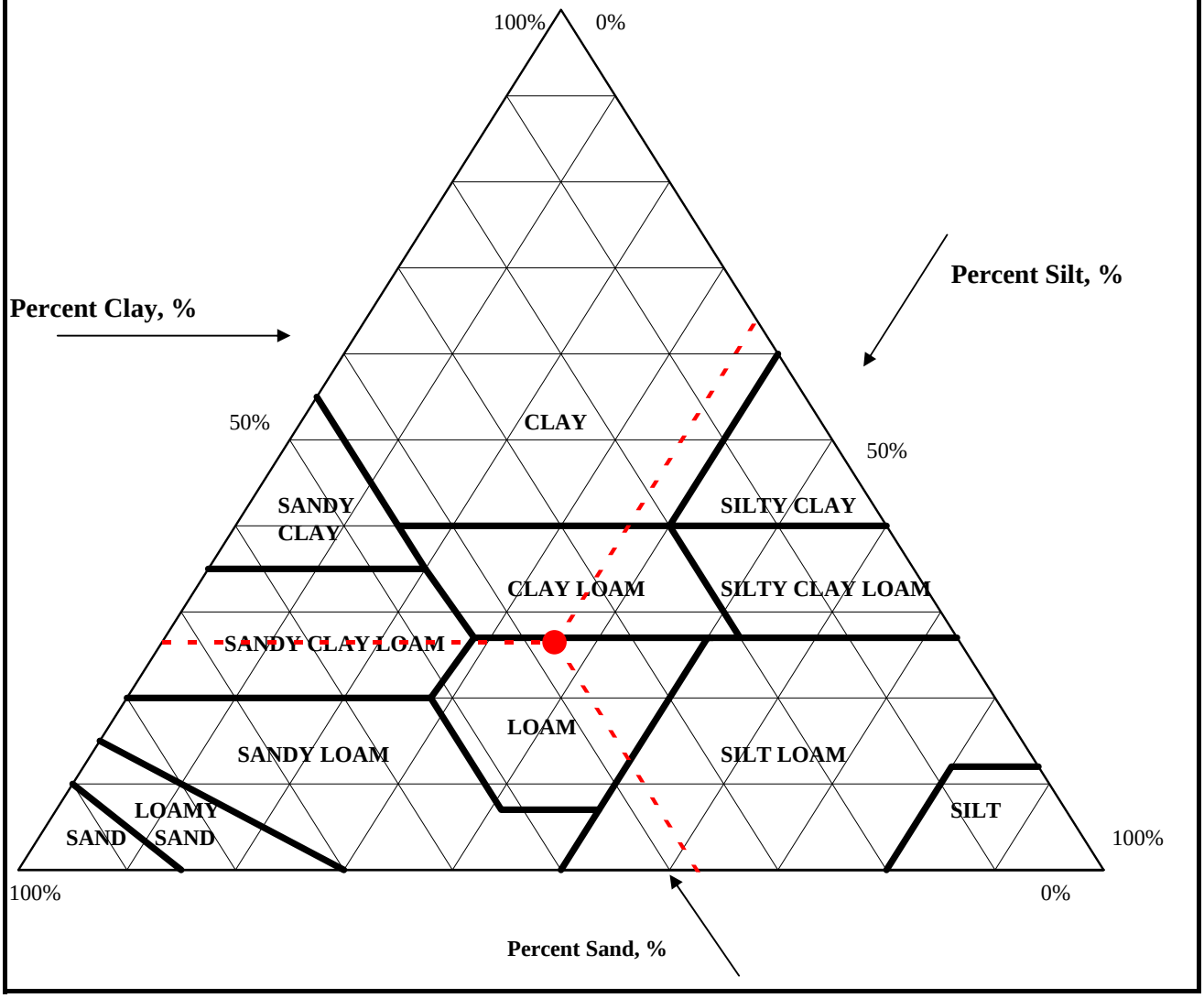
USDA CLASSIFICATION CHART

Client	Civil & Environmental Consultants, I	Boring	SB-14
Client Project	091-867 Apex Landfill Expansion	Depth	25'-27'
Project No.	30598	Sample	ST-2 TOP (Mine Spoil)
		Lab Sample No.	30598002
USCS Description	**BLACK ELASTIC SILT WITH SAND**		
USCS Group Symbol	**MH**	AASHTO Classification	**A-7-5 (28)**
USDA Description	**LOAM**		

Corrected for 0% gravel	
Percent Gravel, %	0.0
Percent Sand, %	37.4
Percent Silt, %	36.2
Percent Clay, %	26.5

Sand Subsizes Corrected Percentages	
Very Coarse Sand; 2-1	0.1
Coarse Sand; 1-0.5	0.3
Medium Sand; 0.5-0.25	0.8
Fine Sand; 0.25-0.1	13.6
Very Fine Sand; 0.1-0.05	22.6
Total	**37.4**



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PARTICLE-SIZE ANALYSIS OF SOILS
ASTM D 422

Client	Civil & Environmental Consultants, I	Boring	SB-16
Client Project	091-867 Apex Landfill Expansion	Depth	1'-3'
Project No.	30598	Sample	ST-1
		Lab Sample No.	30598004

USCS Description **LIGHT YELLOWISH BROWN LEAN CLAY WITH SAND**
USCS Group Symbol **CL** AASHTO: **A-7-6 (18)**
USDA Description **CLAY LOAM**

MECHANICAL SIEVE ANALYSIS

As-Received Representative Sample Size Split or Material Submitted Used	
Representable Wet Wt, gm	1288.0
+#4 Grnd., Washed DS., gm	0.0
-#4 Wet Wt., gm	1288.0
-#4 Water Content, %	19.2
-#4 Dry Wt., gm	1080.8
Representable Dry Wt, gm	**1080.8**
** Note: Percentages +#4 are based on total Dry representable sample.*	
Split Sample, -#4 washed over #200	
Tare No.	904
Tare + WS., gm	278.17
Tare + DS., gm	249.35
Tare, gm	98.99
Wt. of DS., gm	150.36
Water Content -#4, %	19.2
Wt. of +#200 Sample, gm	26.0

US Std. Sieve Size	Sieve Opening (mm)	Wt. of Soil Retained (gm)	Percent Retained (%)*	Cumulative Percent Retained	Percent Finer (%)	Final Percent Finer
3"	75	0	0.0	0.0	100.0	100.0
2 1/2"	62.5	0	0.0	0.0	100.0	100.0
2"	50	0	0.0	0.0	100.0	100.0
1 1/2"	37.5	0	0.0	0.0	100.0	100.0
1"	25	0	0.0	0.0	100.0	100.0
3/4"	19	0	0.0	0.0	100.0	100.0
1/2"	12.5	0	0.0	0.0	100.0	100.0
3/8"	9.5	0	0.0	0.0	100.0	100.0
#4	4.75	0	0.0	0.0	100.0	100.0
#10	2	0	0.0	0.0	100.0	100.0
#20	0.85	0.12	0.1	0.1	99.9	99.9
#40	0.425	0.33	0.2	0.3	99.7	99.7
#60	0.25	0.23	0.2	0.5	99.5	99.5
#140	0.106	11.49	7.6	8.1	91.9	91.9
#200	0.075	13.79	9.2	17.3	82.7	82.7
-#200 / Pan		124.4	82.7	100.0	-	-

The final percent finer combines the gradation of the plus #4 and minus #4 material.

HYDROMETER ANALYSIS (-#200)

Hydrometer Sample Weight (-#200)	
Tare No.	303
Wt. Tare + DS., gm	144.95
Wt. Tare, gm	100.52
Wt. Dispers., gm	5
Wt. Dry Soil, gm	39.43
-#10 Dispersed 1min in Hamilton Beach Mixer	
K Factor	0.0137
Composite Correction	7.5
a Factor	0.99
Average Test Temp, °C	18.6
Specific Gravity, Assumed	2.7

Elapsed Time (min.)	R Measured	Composite Correction	R Corrected	Percent Finer (%)	Particle Diameter (mm)	Adjusted % Finer (%)
0	NA	NA	NA	NA	NA	NA
2	44	7.5	36.5	91.5	0.0291	75.7
5	43	7.5	35.5	89.0	0.0186	73.7
15	41	7.5	33.5	84.0	0.0109	69.5
30	39	7.5	31.5	79.0	0.0078	65.4
60	35.5	7.5	28	70.2	0.0057	58.1
250	29.5	7.5	22	55.2	0.0029	45.6
1440	22	7.5	14.5	36.4	0.0013	30.1

The adjusted percent finer is corrected for the percent passing the -#200 sieve.

D 422 / USCS SOIL CLASSIFICATION

Corrected For 100% Passing a 3" Sieve

% Gravel (-3" & +#4)	**0.0**	Silt=27% Clay=55.6%	
Coarse=0; Fine=0		D60, mm	NA
% Sand (-#4 & +#200)	**17.3**	D30, mm	NA
Coa.=0; Med.=0.3; Fine=17		D10, mm	NA
% Fines (-#200)	**82.7**	Cc	NA
% Plus #200 (-3")	**17.3**	Cu	NA

USCS Description
LEAN CLAY WITH SAND

USCS Group Symbol	Atterberg Limits Group Symbol
CL	**CL, LL=42, PL=20, PI=22**

Auxiliary Information	Wt Ret, gm	% Retained	% Finer
12" Sieve - 300 mm	0	0.0	100.0
6" Sieve - 150 mm	0	0.0	100.0
3" Sieve - 75 mm	0	0.0	100.0

USDA CLASSIFICATION

Particle Size (mm)	Percent Finer (%)	Percent of Each Component (Material)	(%)	Corrected Percent of -2.0 mm Material for USDA
100	100			
		Gravel	0.0	0
2	100.0			
		Sand	20.3	20.3
0.05	79.7			
		Silt	41.3	41.3
0.002	38.5			
		Clay	38.5	38.5

USDA Classification
CLAY LOAM

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LIQUID LIMIT, PLASTIC LIMIT, AND PLASTICITY INDEX OF SOILS
ASTM D 4318

Client	Civil & Environmental Consultants, I	Boring No.	SB-16
Client Project	091-867 Apex Landfill Expansion	Depth(ft)	1'-3'
Project No.	30598	Sample No.	ST-1
		Lab Sample No.	30598004

Soil Description: LIGHT YELLOWISH BROWN LEAN CLAY
(-#40 Fraction)

AS-RECEIVED W.C.

Tare Number	904
Wt. Tare & WS, gm	278.17
Wt. Tare & DS, gm	249.35
Wt. Water, gm	28.82
Wt. Tare, gm	98.99
Wt. DS, gm	150.36
Water Content, %	19.2

SAMPLE SUMMARY

Liquid Limit (LL), %	42
Plastic Limit (PL), %	20
Plasticity Index (PI)	22
USCS Symbol (-#40 Fraction)	CL
Sample Preparation:	Wet Method
Liquidity Index, %	-3.8%
Clay Fraction (% 2 microns)	NA
Skempton's Activity (A)	NA

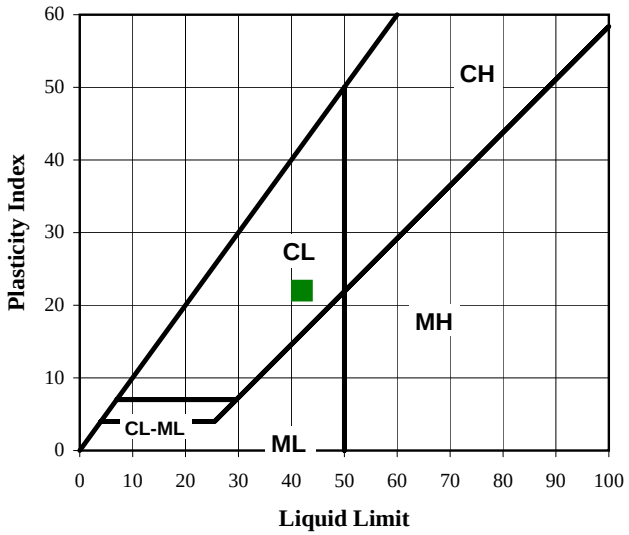
PLASTIC LIMIT

Test Number	1	2	3
Tare Number	461	416	500
Wt. Tare & WS, gm	19.45	19.09	17.87
Wt. Tare & DS, gm	17.99	17.71	16.70
Wt. Water, gm	1.46	1.38	1.17
Wt. Tare, gm	10.67	10.80	10.75
Wt. DS, gm	7.32	6.91	5.95
Water Content, %	19.9	20.0	19.7

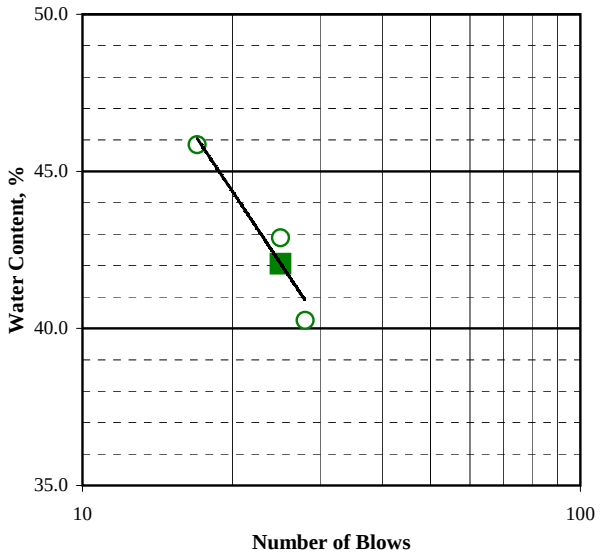
LIQUID LIMIT

	1	2	3
	427	491	499
	21.16	18.95	19.47
	17.90	16.51	16.97
	3.26	2.44	2.50
	10.79	10.82	10.76
	7.11	5.69	6.21
	45.9	42.9	40.3
# of Blows	17	25	28

PLASTICITY CHART



FLOW CURVE



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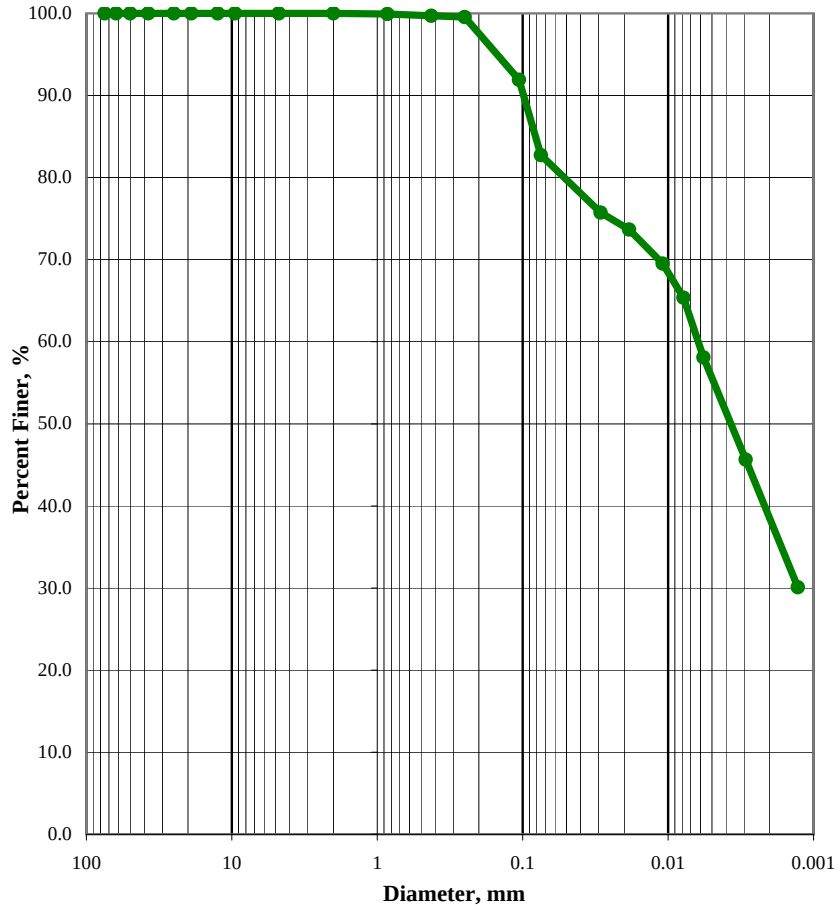
PARTICLE-SIZE ANALYSIS OF SOILS

Client	Civil & Environmental Consultants, I	Boring	SB-16
Client Project	091-867 Apex Landfill Expansion	Depth	1'-3'
Project No.	30598	Sample	ST-1
		Lab Sample No.	30598004

USCS Description **LIGHT YELLOWISH BROWN LEAN CLAY WITH SAND**
USCS Group Symbol **CL** AASHTO: **A-7-6 (18)**
USDA Description **CLAY LOAM**



US Std. Sieve Size	Particle Diameter (mm)	Percent Finer (%)
3"	75	100.0
2 1/2"	62.5	100.0
2"	50	100.0
1 1/2"	37.5	100.0
1"	25	100.0
3/4"	19	100.0
1/2"	12.5	100.0
3/8"	9.5	100.0
#4	4.75	100.0
#10	2	100.0
#20	0.85	99.9
#40	0.425	99.7
#60	0.25	99.5
#140	0.106	91.9
#200	0.075	82.7
NA	0.0291	75.7
NA	0.0186	73.7
NA	0.0109	69.5
NA	0.0078	65.4
NA	0.0057	58.1
NA	0.0029	45.6
NA	0.0013	30.1

USCS SOIL CLASSIFICATION

Corrected For 100% Passing a 3" Sieve

% Gravel (-3" & +#4)	**0.0**	Silt=27% Clay=55.6%	
Coarse=0; Fine=0		D60, mm	NA
% Sand (-#4 & +#200)	**17.3**	D30, mm	NA
Coa.=0; Med.=0.3; Fine=17		D10, mm	NA
% Fines (-#200)	**82.7**	Cc	NA
% Plus #200 (-3")	**17.3**	Cu	NA

USCS Description
LEAN CLAY WITH SAND

USCS Group Symbol	Atterberg Limits Group Symbol		
CL	**CL, LL=42, PL=20, PI=22**		
Auxiliary Information	Wt Ret, gm	% Retained	% Finer
12" Sieve - 300 mm	0	0.0	100.0
6" Sieve - 150 mm	0	0.0	100.0
3" Sieve - 75 mm	0	0.0	100.0

USDA CLASSIFICATION

Particle Size (mm)	Percent Finer (%)	Percent of Each Component (Material)	(%)	Corrected Percent of -2.0 mm Material for USDA
100	100			
		Gravel	0.0	0
2	100.0			
		Sand	20.3	20.3
0.05	79.7			
		Silt	41.3	41.3
0.002	38.5			
		Clay	38.5	38.5

USDA Classification
CLAY LOAM

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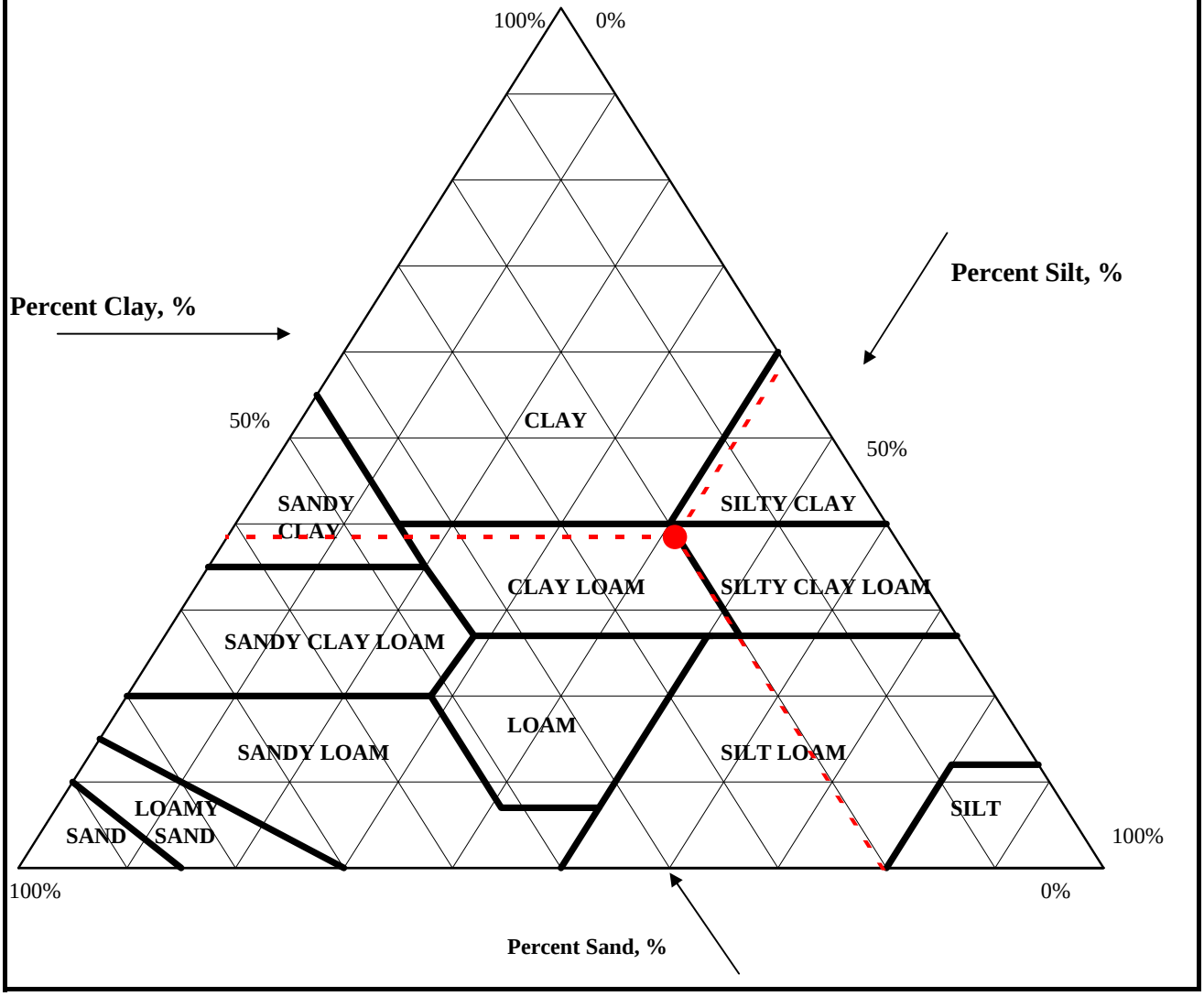
USDA CLASSIFICATION CHART

Client	Civil & Environmental Consultants, I	Boring	SB-16
Client Project	091-867 Apex Landfill Expansion	Depth	1'-3'
Project No.	30598	Sample	ST-1
		Lab Sample No.	30598004
USCS Description	**LIGHT YELLOWISH BROWN LEAN CLAY WITH SAND**		
USCS Group Symbol	**CL**	AASHTO Classification	**A-7-6 (18)**
USDA Description	**CLAY LOAM**		

Corrected for 0% gravel	
Percent Gravel, %	0.0
Percent Sand, %	20.3
Percent Silt, %	41.3
Percent Clay, %	38.5

Sand Subsizes Corrected Percentages	
Very Coarse Sand; 2-1	0.1
Coarse Sand; 1-0.5	0.2
Medium Sand; 0.5-0.25	0.2
Fine Sand; 0.25-0.1	9.2
Very Fine Sand; 0.1-0.05	10.6
Total	**20.3**



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PARTICLE-SIZE ANALYSIS OF SOILS
ASTM D 422

Client	Civil & Environmental Consultants, I	Boring	TPE-17
Client Project	091-867 Apex Landfill Expansion	Depth	12'-14'
Project No.	30598	Sample	ST-1
		Lab Sample No.	30598005
USCS Description	**YELLOWISH BROWN SANDY LEAN CLAY**		
USCS Group Symbol	**CL**	AASHTO:	**A-6 (6)**
USDA Description	**LOAM**		

MECHANICAL SIEVE ANALYSIS

As-Received Representative Sample Size Split or Material Submitted Used	
Representable Wet Wt, gm	1425.4
+#4 Grnd., Washed DS., gm	36.4
-#4 Wet Wt., gm	1389.1
-#4 Water Content, %	15.5
-#4 Dry Wt., gm	1202.9
Representable Dry Wt, gm	**1239.3**
** Note: Percentages +#4 are based on total Dry representable sample.*	
Split Sample, -#4 washed over #200	
Tare No.	810
Tare + WS., gm	388.99
Tare + DS., gm	350.59
Tare, gm	102.42
Wt. of DS., gm	248.17
Water Content -#4, %	15.5
Wt. of +#200 Sample, gm	99.7

US Std. Sieve Size	Sieve Opening (mm)	Wt. of Soil Retained (gm)	Percent Retained (%)*	Cumulative Percent Retained	Percent Finer (%)	Final Percent Finer
3"	75	0	0.0	0.0	100.0	100.0
2 1/2"	62.5	0	0.0	0.0	100.0	100.0
2"	50	0	0.0	0.0	100.0	100.0
1 1/2"	37.5	0	0.0	0.0	100.0	100.0
1"	25	0	0.0	0.0	100.0	100.0
3/4"	19	18.83	1.5	1.5	98.5	98.5
1/2"	12.5	7.6	0.6	2.1	97.9	97.9
3/8"	9.5	3.86	0.3	2.4	97.6	97.6
#4	4.75	6.06	0.5	2.9	97.1	97.1
#10	2	23.59	9.5	9.5	90.5	87.8
#20	0.85	29.64	11.9	21.4	78.6	76.2
#40	0.425	14.42	5.8	27.3	72.7	70.6
#60	0.25	8.64	3.5	30.7	69.3	67.2
#140	0.106	14.15	5.7	36.4	63.6	61.7
#200	0.075	9.24	3.7	40.2	59.8	58.1
-#200 / Pan		148.5	59.8	100.0	-	-

The final percent finer combines the gradation of the plus #4 and minus #4 material.

HYDROMETER ANALYSIS (-#200)

Hydrometer Sample Weight (-#200)	
Tare No.	508
Wt. Tare + DS., gm	142.36
Wt. Tare, gm	104.99
Wt. Dispers., gm	5
Wt. Dry Soil, gm	32.37
-#10 Dispersed 1min in Hamilton Beach Mixer	
K Factor	0.0137
Composite Correction	7.5
a Factor	0.99
Average Test Temp, °C	18.6
Specific Gravity, Assumed	2.7

Elapsed Time (min.)	R Measured	Composite Correction	R Corrected	Percent Finer (%)	Particle Diameter (mm)	Adjusted % Finer (%)
0	NA	NA	NA	NA	NA	NA
2	34	7.5	26.5	81.0	0.0316	47.0
5	30.5	7.5	23	70.3	0.0205	40.8
15	26.5	7.5	19	58.0	0.0122	33.7
30	24	7.5	16.5	50.4	0.0088	29.3
60	22	7.5	14.5	44.3	0.0063	25.7
250	17	7.5	9.5	29.0	0.0032	16.9
1440	14	7.5	6.5	19.9	0.0013	11.5

The adjusted percent finer is corrected for the percent passing the -#200 sieve.

D 422 / USCS SOIL CLASSIFICATION

Corrected For 100% Passing a 3" Sieve

% Gravel (-3" & +#4)	**2.9**	Silt=35.2%	Clay=22.7%
Coarse=1.5; Fine=1.4		D60, mm	NA
% Sand (-#4 & +#200)	**39.0**	D30, mm	NA
Coa.=9.2; Med.=17.2; Fine=12.5		D10, mm	NA
% Fines (-#200)	**58.1**	Cc	NA
% Plus #200 (-3")	**41.9**	Cu	NA

USCS Description

SANDY LEAN CLAY

USCS Group Symbol	Atterberg Limits Group Symbol
CL	**CL, LL=32, PL=17, PI=15**

Auxiliary Information	Wt Ret, gm	% Retained	% Finer
12" Sieve - 300 mm	0	0.0	100.0
6" Sieve - 150 mm	0	0.0	100.0
3" Sieve - 75 mm	0	0.0	100.0

USDA CLASSIFICATION

Particle Size (mm)	Percent Finer (%)	Percent of Each Component (Material)	(%)	Corrected Percent of -2.0 mm Material for USDA
100	100			
		Gravel	12.2	0
2	87.8			
		Sand	35.0	39.8
0.05	52.9			
		Silt	38.9	44.3
0.002	14.0			
		Clay	14.0	15.9

USDA Classification

LOAM

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LIQUID LIMIT, PLASTIC LIMIT, AND PLASTICITY INDEX OF SOILS
ASTM D 4318

Client	Civil & Environmental Consultants, I	Boring No.	TPE-17
Client Project	091-867 Apex Landfill Expansion	Depth(ft)	12'-14'
Project No.	30598	Sample No.	ST-1
		Lab Sample No.	30598005

Soil Description: YELLOWISH BROWN LEAN CLAY
(-#40 Fraction)

AS-RECEIVED W.C.

Tare Number	810
Wt. Tare & WS, gm	388.99
Wt. Tare & DS, gm	350.59
Wt. Water, gm	38.40
Wt. Tare, gm	102.42
Wt. DS, gm	248.17
Water Content, %	15.5

SAMPLE SUMMARY

Liquid Limit (LL), %	32
Plastic Limit (PL), %	17
Plasticity Index (PI)	15
USCS Symbol (-#40 Fraction)	CL
Sample Preparation:	Wet Method
Liquidity Index, %	-10.2%
Clay Fraction (% 2 microns)	NA
Skempton's Activity (A)	NA

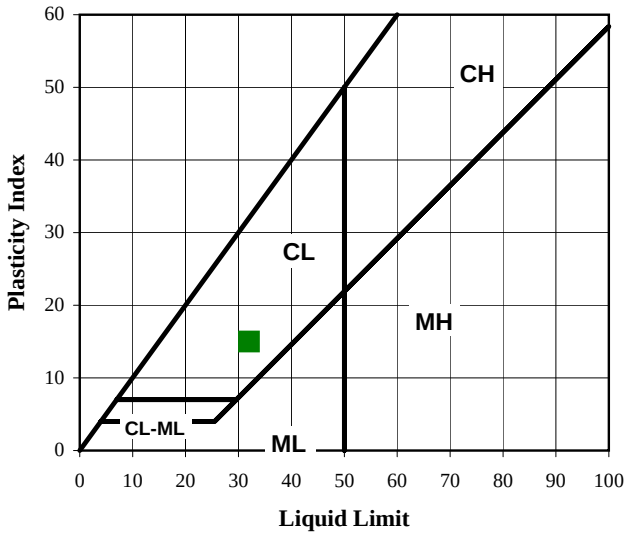
PLASTIC LIMIT

Test Number	1	2	3
Tare Number	476	486	400
Wt. Tare & WS, gm	22.40	25.47	23.52
Wt. Tare & DS, gm	20.70	23.29	21.64
Wt. Water, gm	1.70	2.18	1.88
Wt. Tare, gm	10.82	10.79	10.78
Wt. DS, gm	9.88	12.50	10.86
Water Content, %	17.2	17.4	17.3

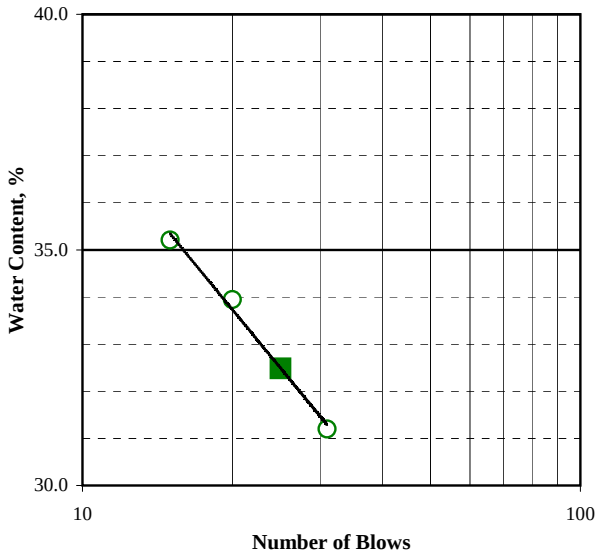
LIQUID LIMIT

	1	2	3
Tare Number	449	490	510
Wt. Tare & WS, gm	18.17	18.09	22.28
Wt. Tare & DS, gm	16.23	16.24	19.55
Wt. Water, gm	1.94	1.85	2.73
Wt. Tare, gm	10.72	10.79	10.80
Wt. DS, gm	5.51	5.45	8.75
Water Content, %	35.2	33.9	31.2
# of Blows	15	20	31

PLASTICITY CHART



FLOW CURVE



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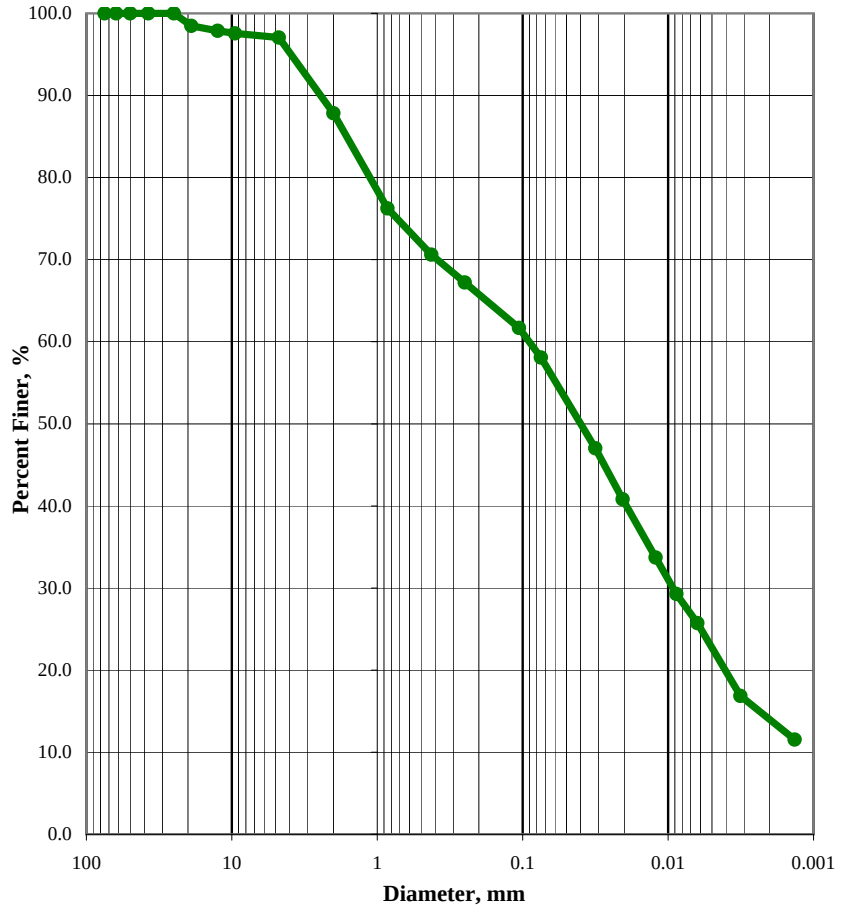
PARTICLE-SIZE ANALYSIS OF SOILS

Client	Civil & Environmental Consultants, I	Boring	TPE-17
Client Project	091-867 Apex Landfill Expansion	Depth	12'-14'
Project No.	30598	Sample	ST-1
		Lab Sample No.	30598005
USCS Description	**YELLOWISH BROWN SANDY LEAN CLAY**		
USCS Group Symbol	**CL**	AASHTO:	**A-6 (6)**
USDA Description	**LOAM**		



US Std. Sieve Size	Particle Diameter (mm)	Percent Finer (%)
3"	75	100.0
2 1/2"	62.5	100.0
2"	50	100.0
1 1/2"	37.5	100.0
1"	25	100.0
3/4"	19	98.5
1/2"	12.5	97.9
3/8"	9.5	97.6
#4	4.75	97.1
#10	2	87.8
#20	0.85	76.2
#40	0.425	70.6
#60	0.25	67.2
#140	0.106	61.7
#200	0.075	58.1
NA	0.0316	47.0
NA	0.0205	40.8
NA	0.0122	33.7
NA	0.0088	29.3
NA	0.0063	25.7
NA	0.0032	16.9
NA	0.0013	11.5

USCS SOIL CLASSIFICATION

Corrected For 100% Passing a 3" Sieve

% Gravel (-3" & +#4)	**2.9**	Silt=35.2% Clay=22.7%	
Coarse=1.5; Fine=1.4		D60, mm	NA
% Sand (-#4 & +#200)	**39.0**	D30, mm	NA
Coa.=9.2; Med.=17.2; Fine=12.5		D10, mm	NA
% Fines (-#200)	**58.1**	Cc	NA
% Plus #200 (-3")	**41.9**	Cu	NA

USCS Description
SANDY LEAN CLAY

USCS Group Symbol	Atterberg Limits Group Symbol		
CL	**CL, LL=32, PL=17, PI=15**		
Auxiliary Information	Wt Ret, gm	% Retained	% Finer
12" Sieve - 300 mm	0	0.0	100.0
6" Sieve - 150 mm	0	0.0	100.0
3" Sieve - 75 mm	0	0.0	100.0

USDA CLASSIFICATION

Particle Size (mm)	Percent Finer (%)	Percent of Each Component (Material)	(%)	Corrected Percent of -2.0 mm Material for USDA
100	100			
		Gravel	12.2	0
2	87.8			
		Sand	35.0	39.8
0.05	52.9			
		Silt	38.9	44.3
0.002	14.0			
		Clay	14.0	15.9

USDA Classification
LOAM

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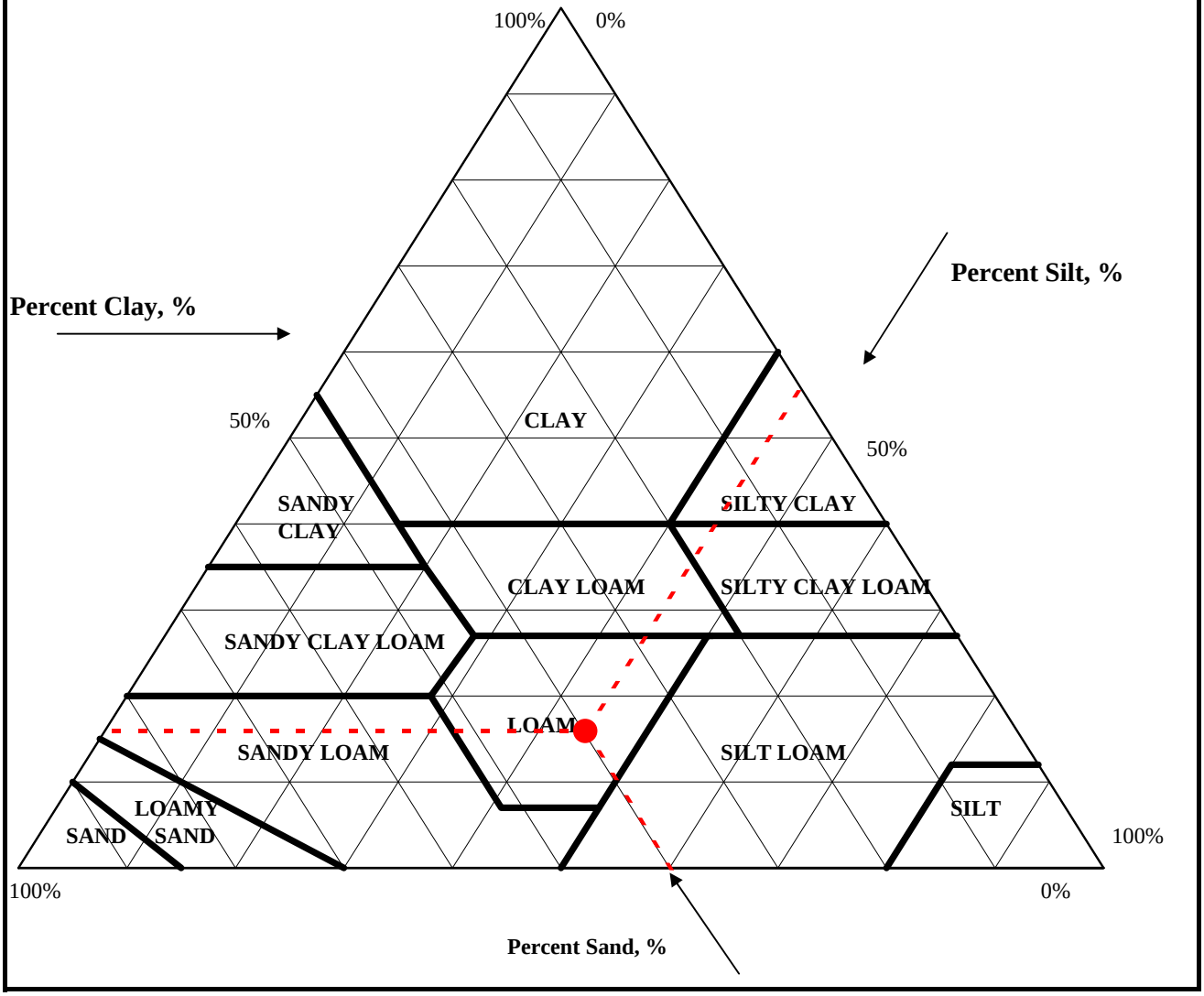
USDA CLASSIFICATION CHART

Client	Civil & Environmental Consultants, I	Boring	TPE-17
Client Project	091-867 Apex Landfill Expansion	Depth	12'-14'
Project No.	30598	Sample	ST-1
		Lab Sample No.	30598005
USCS Description	**YELLOWISH BROWN SANDY LEAN CLAY**		
USCS Group Symbol	**CL**	AASHTO Classification	**A-6 (6)**
USDA Description	**LOAM**		

Corrected for 0% gravel	
Percent Gravel, %	0.0
Percent Sand, %	39.8
Percent Silt, %	44.3
Percent Clay, %	15.9

Sand Subsizes Corrected Percentages	
Very Coarse Sand; 2-1	10.7
Coarse Sand; 1-0.5	7.4
Medium Sand; 0.5-0.25	5.4
Fine Sand; 0.25-0.1	7.0
Very Fine Sand; 0.1-0.05	9.3
Total	**39.8**



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PARTICLE-SIZE ANALYSIS OF SOILS
ASTM D 422

Client	Civil & Environmental Consultants, I	Boring	TPE-19
Client Project	091-867 Apex Landfill Expansion	Depth	2'-4'
Project No.	30598	Sample	ST-1
		Lab Sample No.	30598006
USCS Description	**DARK YELLOWISH BROWN LEAN CLAY WITH SAND**		
USCS Group Symbol	**CL**	AASHTO:	**A-7-6 (13)**
USDA Description	**SILT LOAM**		

MECHANICAL SIEVE ANALYSIS

As-Received Representative Sample Size Split or Material Submitted Used	
Representable Wet Wt, gm	1353.3
+#4 Grnd., Washed DS., gm	40.6
-#4 Wet Wt., gm	1312.7
-#4 Water Content, %	19.7
-#4 Dry Wt., gm	1096.5
Representable Dry Wt, gm	**1137.0**
** Note: Percentages +#4 are based on total Dry representable sample.*	
Split Sample, -#4 washed over #200	
Tare No.	21
Tare + WS., gm	177.9
Tare + DS., gm	162.05
Tare, gm	81.68
Wt. of DS., gm	80.37
Water Content -#4, %	19.7
Wt. of +#200 Sample, gm	17.1

US Std. Sieve Size	Sieve Opening (mm)	Wt. of Soil Retained (gm)	Percent Retained (%)*	Cumulative Percent Retained	Percent Finer (%)	Final Percent Finer
3"	75	0	0.0	0.0	100.0	100.0
2 1/2"	62.5	0	0.0	0.0	100.0	100.0
2"	50	0	0.0	0.0	100.0	100.0
1 1/2"	37.5	0	0.0	0.0	100.0	100.0
1"	25	0	0.0	0.0	100.0	100.0
3/4"	19	0	0.0	0.0	100.0	100.0
1/2"	12.5	8.82	0.8	0.8	99.2	99.2
3/8"	9.5	13.26	1.2	1.9	98.1	98.1
#4	4.75	18.48	1.6	3.6	96.4	96.4
#10	2	2.95	3.7	3.7	96.3	92.9
#20	0.85	4.01	5.0	8.7	91.3	88.1
#40	0.425	2.48	3.1	11.7	88.3	85.1
#60	0.25	1.98	2.5	14.2	85.8	82.7
#140	0.106	3.56	4.4	18.6	81.4	78.5
#200	0.075	2.12	2.6	21.3	78.7	75.9
-#200 / Pan		63.3	78.7	100.0	-	-

The final percent finer combines the gradation of the plus #4 and minus #4 material.

HYDROMETER ANALYSIS (-#200)

Hydrometer Sample Weight (-#200)	
Tare No.	901
Wt. Tare + DS., gm	147.62
Wt. Tare, gm	99.55
Wt. Dispers., gm	5
Wt. Dry Soil, gm	43.07
-#10 Dispersed 1min in Hamilton Beach Mixer	
K Factor	0.0139
Composite Correction	8
a Factor	0.99
Average Test Temp, °C	17.4
Specific Gravity, Assumed	2.7

Elapsed Time (min.)	R Measured	Composite Correction	R Corrected	Percent Finer (%)	Particle Diameter (mm)	Adjusted % Finer (%)
0	NA	NA	NA	NA	NA	NA
2	46	8	38	87.2	0.0290	66.2
5	42	8	34	78.1	0.0190	59.3
15	35	8	27	62.0	0.0116	47.1
30	31	8	23	52.8	0.0085	40.1
60	27	8	19	43.6	0.0062	33.1
250	22	8	14	32.1	0.0031	24.4
1440	18	8	10	23.0	0.0013	17.4

The adjusted percent finer is corrected for the percent passing the -#200 sieve.

D 422 / USCS SOIL CLASSIFICATION

Corrected For 100% Passing a 3" Sieve

% Gravel (-3" & +#4)	**3.6**	Silt=45.4%	Clay=30.4%
Coarse=0; Fine=3.6		D60, mm	NA
% Sand (-#4 & +#200)	**20.5**	D30, mm	NA
Coa.=3.5; Med.=7.8; Fine=9.2		D10, mm	NA
% Fines (-#200)	**75.9**	Cc	NA
% Plus #200 (-3")	**24.1**	Cu	NA

USCS Description

LEAN CLAY WITH SAND

USCS Group Symbol	Atterberg Limits Group Symbol
CL	**CL, LL=41, PL=23, PI=18**

Auxiliary Information	Wt Ret, gm	% Retained	% Finer
12" Sieve - 300 mm	0	0.0	100.0
6" Sieve - 150 mm	0	0.0	100.0
3" Sieve - 75 mm	0	0.0	100.0

USDA CLASSIFICATION

Particle Size (mm)	Percent Finer (%)	Percent of Each Component (Material)	(%)	Corrected Percent of -2.0 mm Material for USDA
100	100			
		Gravel	7.1	0
2	92.9			
		Sand	21.1	22.7
0.05	71.8			
		Silt	51.0	55.0
0.002	20.7			
		Clay	20.7	22.3

USDA Classification

SILT LOAM

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LIQUID LIMIT, PLASTIC LIMIT, AND PLASTICITY INDEX OF SOILS
ASTM D 4318

Client	Civil & Environmental Consultants, I	Boring No.	TPE-19
Client Project	091-867 Apex Landfill Expansion	Depth(ft)	2'-4'
Project No.	30598	Sample No.	ST-1
		Lab Sample No.	30598006

Soil Description: DARK YELLOWISH BROWN LEAN CLAY
(-#40 Fraction)

AS-RECEIVED W.C.

Tare Number	21
Wt. Tare & WS, gm	177.90
Wt. Tare & DS, gm	162.05
Wt. Water, gm	15.85
Wt. Tare, gm	81.68
Wt. DS, gm	80.37
Water Content, %	19.7

SAMPLE SUMMARY

Liquid Limit (LL), %	41
Plastic Limit (PL), %	23
Plasticity Index (PI)	18
USCS Symbol (-#40 Fraction)	CL
Sample Preparation:	Wet Method
Liquidity Index, %	-18.2%
Clay Fraction (% 2 microns)	NA
Skempton's Activity (A)	NA

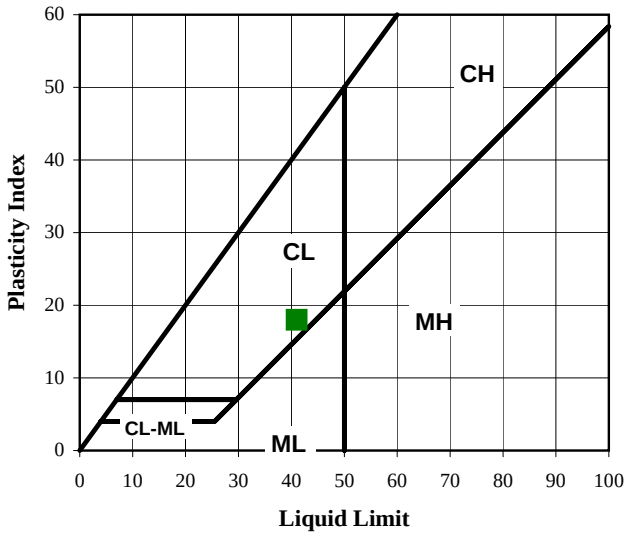
PLASTIC LIMIT

Test Number	1	2	3
Tare Number	419	444	510
Wt. Tare & WS, gm	16.87	17.89	17.90
Wt. Tare & DS, gm	15.73	16.58	16.59
Wt. Water, gm	1.14	1.31	1.31
Wt. Tare, gm	10.71	10.72	10.81
Wt. DS, gm	5.02	5.86	5.78
Water Content, %	22.7	22.4	22.7

LIQUID LIMIT

	1	2	3
Tare Number	421	434	451
Wt. Tare & WS, gm	18.47	19.62	18.17
Wt. Tare & DS, gm	16.12	17.00	16.07
Wt. Water, gm	2.35	2.62	2.10
Wt. Tare, gm	10.74	10.79	10.79
Wt. DS, gm	5.38	6.21	5.28
Water Content, %	43.7	42.2	39.8
# of Blows	19	22	27

PLASTICITY CHART



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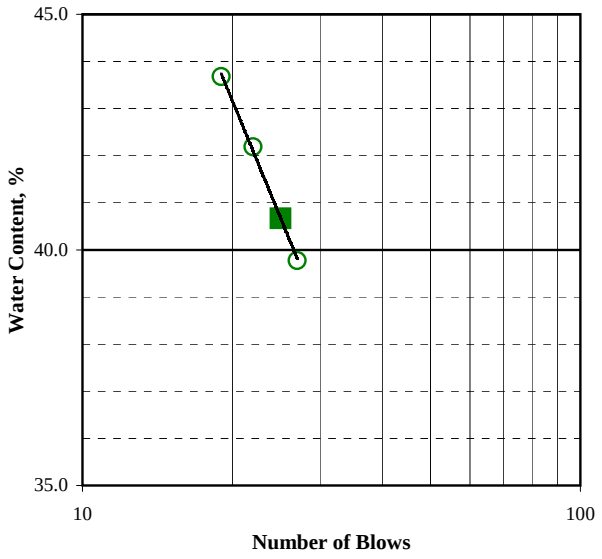

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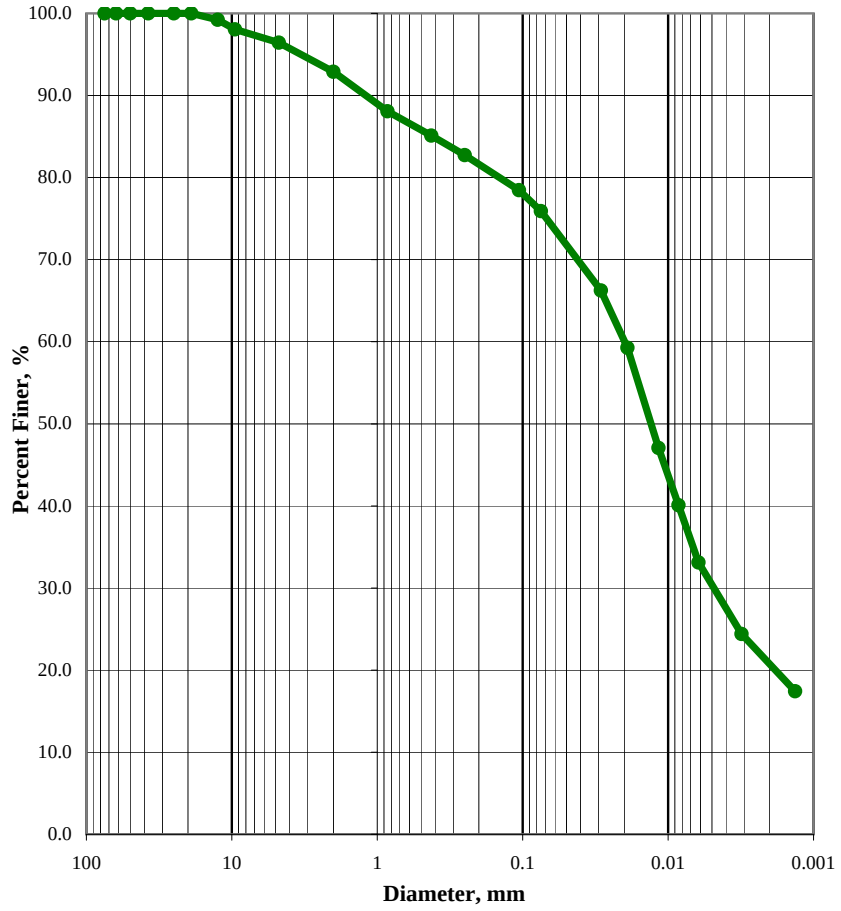
PARTICLE-SIZE ANALYSIS OF SOILS

Client	Civil & Environmental Consultants, I	Boring	TPE-19
Client Project	091-867 Apex Landfill Expansion	Depth	2'-4'
Project No.	30598	Sample	ST-1
		Lab Sample No.	30598006
USCS Description	**DARK YELLOWISH BROWN LEAN CLAY WITH SAND**		
USCS Group Symbol	**CL**	AASHTO:	**A-7-6 (13)**
USDA Description	**SILT LOAM**		



US Std. Sieve Size	Particle Diameter (mm)	Percent Finer (%)
3"	75	100.0
2 1/2"	62.5	100.0
2"	50	100.0
1 1/2"	37.5	100.0
1"	25	100.0
3/4"	19	100.0
1/2"	12.5	99.2
3/8"	9.5	98.1
#4	4.75	96.4
#10	2	92.9
#20	0.85	88.1
#40	0.425	85.1
#60	0.25	82.7
#140	0.106	78.5
#200	0.075	75.9
NA	0.0290	66.2
NA	0.0190	59.3
NA	0.0116	47.1
NA	0.0085	40.1
NA	0.0062	33.1
NA	0.0031	24.4
NA	0.0013	17.4

USCS SOIL CLASSIFICATION

Corrected For 100% Passing a 3" Sieve

% Gravel (-3" & +#4)	**3.6**	Silt=45.4%	Clay=30.4%
Coarse=0; Fine=3.6		D60, mm	NA
% Sand (-#4 & +#200)	**20.5**	D30, mm	NA
Coa.=3.5; Med.=7.8; Fine=9.2		D10, mm	NA
% Fines (-#200)	**75.9**	Cc	NA
% Plus #200 (-3")	**24.1**	Cu	NA

USCS Description
LEAN CLAY WITH SAND

USCS Group Symbol	Atterberg Limits Group Symbol		
CL	**CL, LL=41, PL=23, PI=18**		
Auxiliary Information	Wt Ret, gm	% Retained	% Finer
12" Sieve - 300 mm	0	0.0	100.0
6" Sieve - 150 mm	0	0.0	100.0
3" Sieve - 75 mm	0	0.0	100.0

USDA CLASSIFICATION

Particle Size (mm)	Percent Finer (%)	Percent of Each Component (Material)	(%)	Corrected Percent of -2.0 mm Material for USDA
100	100			
		Gravel	7.1	0
2	92.9			
		Sand	21.1	22.7
0.05	71.8			
		Silt	51.0	55.0
0.002	20.7			
		Clay	20.7	22.3

USDA Classification
SILT LOAM

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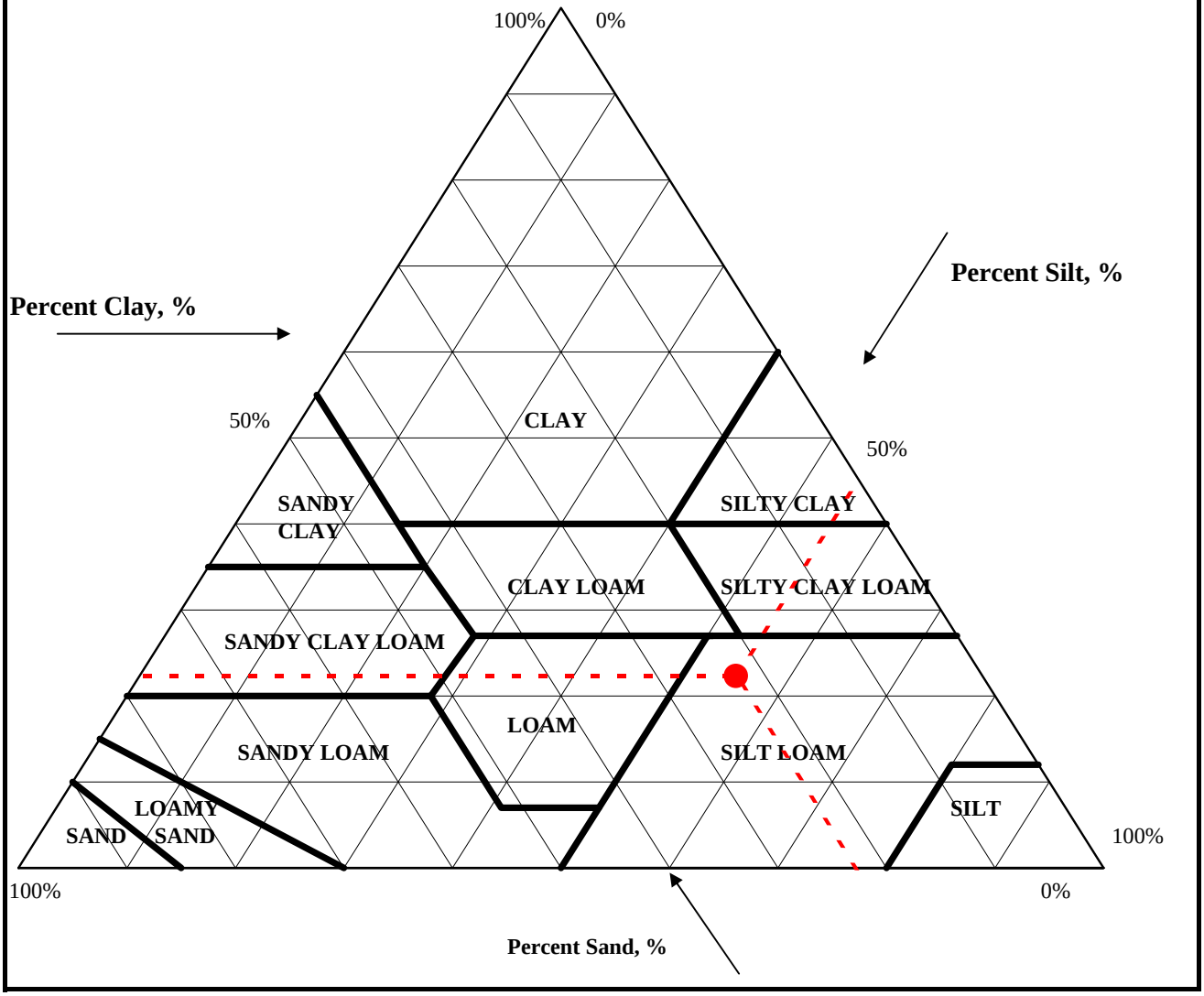
USDA CLASSIFICATION CHART

Client	Civil & Environmental Consultants, I	Boring	TPE-19
Client Project	091-867 Apex Landfill Expansion	Depth	2'-4'
Project No.	30598	Sample	ST-1
		Lab Sample No.	30598006
USCS Description	**DARK YELLOWISH BROWN LEAN CLAY WITH SAND**		
USCS Group Symbol	**CL**	AASHTO Classification	**A-7-6 (13)**
USDA Description	**SILT LOAM**		

Corrected for 0% gravel	
Percent Gravel, %	0.0
Percent Sand, %	22.7
Percent Silt, %	55.0
Percent Clay, %	22.3

Sand Subsizes Corrected Percentages	
Very Coarse Sand; 2-1	4.2
Coarse Sand; 1-0.5	3.4
Medium Sand; 0.5-0.25	3.3
Fine Sand; 0.25-0.1	5.1
Very Fine Sand; 0.1-0.05	6.7
Total	**22.7**



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PARTICLE-SIZE ANALYSIS OF SOILS
ASTM D 422

Client	Civil & Environmental Consultants, I	Boring	SB-16
Client Project	091-867 Apex Landfill Expansion	Depth	0.5'-2.5'
Project No.	30598	Sample	ST-1
		Lab Sample No.	30598008

USCS Description **LIGHT OLIVE BROWN FAT CLAY**
USCS Group Symbol **CH** AASHTO: **A-7-6 (39)**
USDA Description **SILTY CLAY**

MECHANICAL SIEVE ANALYSIS

As-Received Representative Sample Size Split or Material Submitted Used	
Representable Wet Wt, gm	760.4
+#4 Grnd., Washed DS., gm	0.0
-#4 Wet Wt., gm	760.4
-#4 Water Content, %	23.0
-#4 Dry Wt., gm	618.2
Representable Dry Wt, gm	**618.2**
** Note: Percentages +#4 are based on total Dry representable sample.*	
Split Sample, -#4 washed over #200	
Tare No.	935
Tare + WS., gm	217.76
Tare + DS., gm	195.55
Tare, gm	99.03
Wt. of DS., gm	96.52
Water Content -#4, %	23.0
Wt. of +#200 Sample, gm	1.9

US Std. Sieve Size	Sieve Opening (mm)	Wt. of Soil Retained (gm)	Percent Retained (%)*	Cumulative Percent Retained	Percent Finer (%)	Final Percent Finer
3"	75	0	0.0	0.0	100.0	100.0
2 1/2"	62.5	0	0.0	0.0	100.0	100.0
2"	50	0	0.0	0.0	100.0	100.0
1 1/2"	37.5	0	0.0	0.0	100.0	100.0
1"	25	0	0.0	0.0	100.0	100.0
3/4"	19	0	0.0	0.0	100.0	100.0
1/2"	12.5	0	0.0	0.0	100.0	100.0
3/8"	9.5	0	0.0	0.0	100.0	100.0
#4	4.75	0	0.0	0.0	100.0	100.0
#10	2	0.03	0.0	0.0	100.0	100.0
#20	0.85	0.13	0.1	0.2	99.8	99.8
#40	0.425	0.14	0.1	0.3	99.7	99.7
#60	0.25	0.19	0.2	0.5	99.5	99.5
#140	0.106	0.79	0.8	1.3	98.7	98.7
#200	0.075	0.66	0.7	2.0	98.0	98.0
-#200 / Pan		94.6	98.0	100.0	-	-

The final percent finer combines the gradation of the plus #4 and minus #4 material.

HYDROMETER ANALYSIS (-#200)

Hydrometer Sample Weight (-#200)	
Tare No.	702
Wt. Tare + DS., gm	164.06
Wt. Tare, gm	97.89
Wt. Dispers., gm	5
Wt. Dry Soil, gm	61.17
-#10 Dispersed 1min in Hamilton Beach Mixer	
K Factor	0.0134
Composite Correction	7
a Factor	0.99
Average Test Temp, °C	20.4
Specific Gravity, Assumed	2.7

Elapsed Time (min.)	R Measured	Composite Correction	R Corrected	Percent Finer (%)	Particle Diameter (mm)	Adjusted % Finer (%)
0	NA	NA	NA	NA	NA	NA
30	58.5	7	51.5	83.3	0.0063	81.6
45	56	7	49	79.2	0.0053	77.6
60	54	7	47	76.0	0.0047	74.5
120	50	7	43	69.5	0.0035	68.1
180	47	7	40	64.7	0.0029	63.4
250	44	7	37	59.8	0.0025	58.6
1440	36	7	29	46.9	0.0011	45.9

The adjusted percent finer is corrected for the percent passing the -#200 sieve.

D 422 / USCS SOIL CLASSIFICATION

Corrected For 100% Passing a 3" Sieve

% Gravel (-3" & +#4)	**0.0**	Silt=21.8%	Clay=76.1%
Coarse=0; Fine=0		D60, mm	NA
% Sand (-#4 & +#200)	**2.0**	D30, mm	NA
Coa.=0; Med.=0.3; Fine=1.7		D10, mm	NA
% Fines (-#200)	**98.0**	Cc	NA
% Plus #200 (-3")	**2.0**	Cu	NA

USCS Description
FAT CLAY

USCS Group Symbol	Atterberg Limits Group Symbol
CH	**CH, LL=60, PL=26, PI=34**

Auxiliary Information	Wt Ret, gm	% Retained	% Finer
12" Sieve - 300 mm	0	0.0	100.0
6" Sieve - 150 mm	0	0.0	100.0
3" Sieve - 75 mm	0	0.0	100.0

USDA CLASSIFICATION

Particle Size (mm)	Percent Finer (%)	Percent of Each Component (Material)	(%)	Corrected Percent of -2.0 mm Material for USDA
100	100			
		Gravel	0.0	0
2	100.0			
		Sand	4.7	4.7
0.05	95.3			
		Silt	40.5	40.5
0.002	54.8			
		Clay	54.8	54.9

USDA Classification
SILTY CLAY

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LIQUID LIMIT, PLASTIC LIMIT, AND PLASTICITY INDEX OF SOILS
ASTM D 4318

Client	Civil & Environmental Consultants, I	Boring No.	SB-16
Client Project	091-867 Apex Landfill Expansion	Depth(ft)	0.5'-2.5'
Project No.	30598	Sample No.	ST-1
		Lab Sample No.	30598008

Soil Description: LIGHT OLIVE BROWN FAT CLAY
(-#40 Fraction)

AS-RECEIVED W.C.

Tare Number	935
Wt. Tare & WS, gm	217.76
Wt. Tare & DS, gm	195.55
Wt. Water, gm	22.21
Wt. Tare, gm	99.03
Wt. DS, gm	96.52
Water Content, %	23.0

SAMPLE SUMMARY

Liquid Limit (LL), %	60
Plastic Limit (PL), %	26
Plasticity Index (PI)	34
USCS Symbol (-#40 Fraction)	CH
Sample Preparation:	Wet Method
Liquidity Index, %	-8.8%
Clay Fraction (% 2 microns)	NA
Skempton's Activity (A)	NA

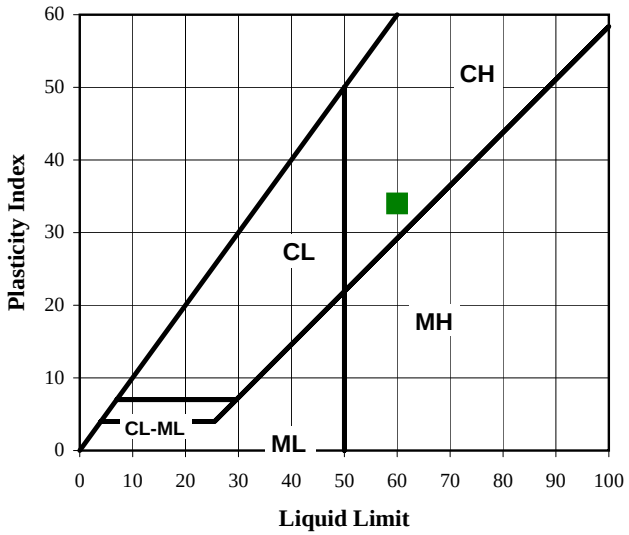
PLASTIC LIMIT

Test Number	1	2	3
Tare Number	456	463	458
Wt. Tare & WS, gm	20.57	18.72	20.01
Wt. Tare & DS, gm	18.60	17.09	18.11
Wt. Water, gm	1.97	1.63	1.90
Wt. Tare, gm	10.89	10.72	10.79
Wt. DS, gm	7.71	6.37	7.32
Water Content, %	25.6	25.6	26.0

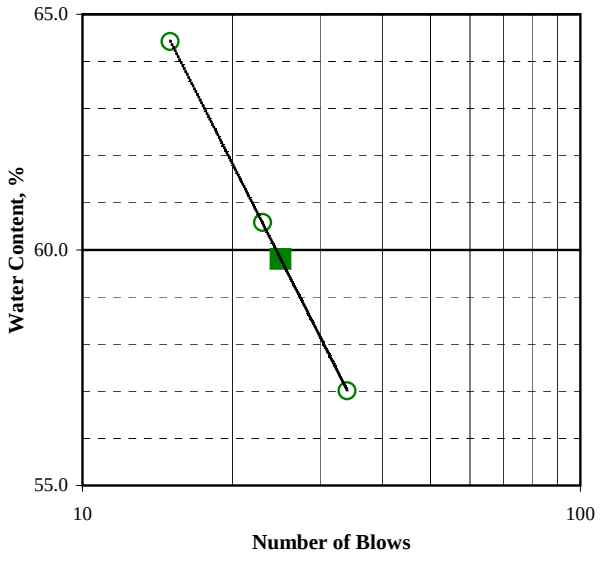
LIQUID LIMIT

	1	2	3
Tare Number	437	441	447
Wt. Tare & WS, gm	17.45	17.28	17.58
Wt. Tare & DS, gm	14.77	14.79	15.10
Wt. Water, gm	2.68	2.49	2.48
Wt. Tare, gm	10.61	10.68	10.75
Wt. DS, gm	4.16	4.11	4.35
Water Content, %	64.4	60.6	57.0
# of Blows	15	23	34

PLASTICITY CHART



FLOW CURVE



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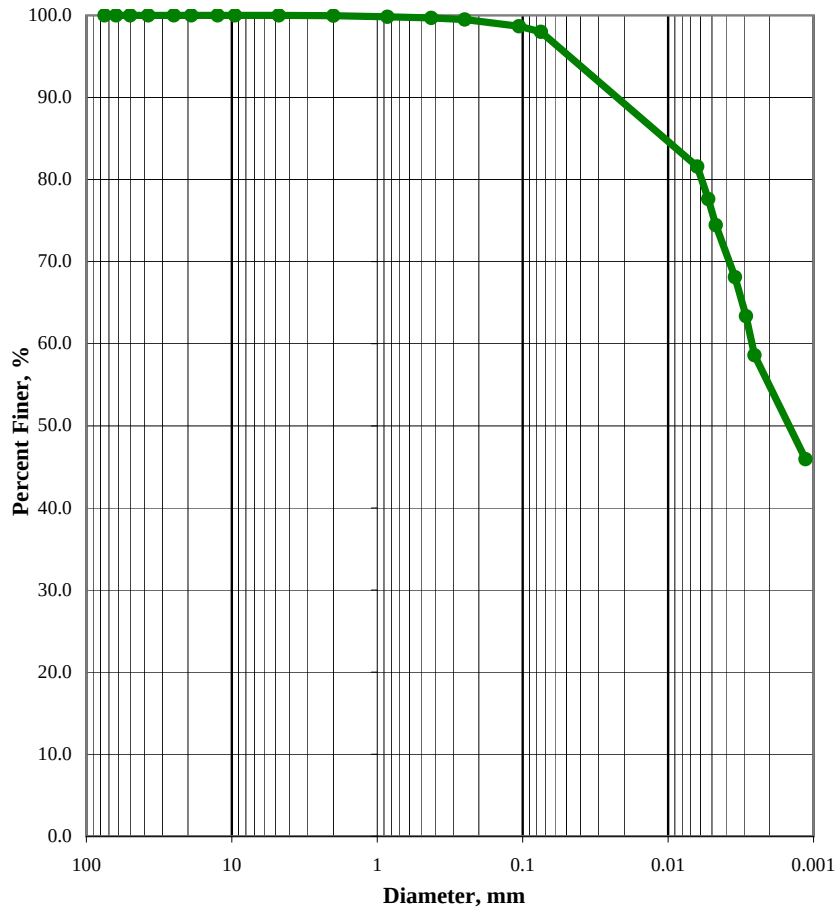
PARTICLE-SIZE ANALYSIS OF SOILS

Client	Civil & Environmental Consultants, I	Boring	SB-16
Client Project	091-867 Apex Landfill Expansion	Depth	0.5'-2.5'
Project No.	30598	Sample	ST-1
		Lab Sample No.	30598008

USCS Description **LIGHT OLIVE BROWN FAT CLAY**
USCS Group Symbol **CH** AASHTO: **A-7-6 (39)**
USDA Description **SILTY CLAY**



US Std. Sieve Size	Particle Diameter (mm)	Percent Finer (%)
3"	75	100.0
2 1/2"	62.5	100.0
2"	50	100.0
1 1/2"	37.5	100.0
1"	25	100.0
3/4"	19	100.0
1/2"	12.5	100.0
3/8"	9.5	100.0
#4	4.75	100.0
#10	2	100.0
#20	0.85	99.8
#40	0.425	99.7
#60	0.25	99.5
#140	0.106	98.7
#200	0.075	98.0
NA	0.0063	81.6
NA	0.0053	77.6
NA	0.0047	74.5
NA	0.0035	68.1
NA	0.0029	63.4
NA	0.0025	58.6
NA	0.0011	45.9

USCS SOIL CLASSIFICATION

Corrected For 100% Passing a 3" Sieve

% Gravel (-3" & +#4)	**0.0**	Silt=21.8% Clay=76.1%	
Coarse=0; Fine=0		D60, mm	NA
% Sand (-#4 & +#200)	**2.0**	D30, mm	NA
Coa.=0; Med.=0.3; Fine=1.7		D10, mm	NA
% Fines (-#200)	**98.0**	Cc	NA
% Plus #200 (-3")	**2.0**	Cu	NA

USCS Description
FAT CLAY

USCS Group Symbol	Atterberg Limits Group Symbol
CH	**CH, LL=60, PL=26, PI=34**

Auxiliary Information	Wt Ret, gm	% Retained	% Finer
12" Sieve - 300 mm	0	0.0	100.0
6" Sieve - 150 mm	0	0.0	100.0
3" Sieve - 75 mm	0	0.0	100.0

USDA CLASSIFICATION

Particle Size (mm)	Percent Finer (%)
100	100
2	100.0
0.05	95.3
0.002	54.8

Percent of Each Component (Material)	(%)	Corrected Percent of -2.0 mm Material for USDA
Gravel	0.0	0
Sand	4.7	4.7
Silt	40.5	40.5
Clay	54.8	54.9

USDA Classification
SILTY CLAY

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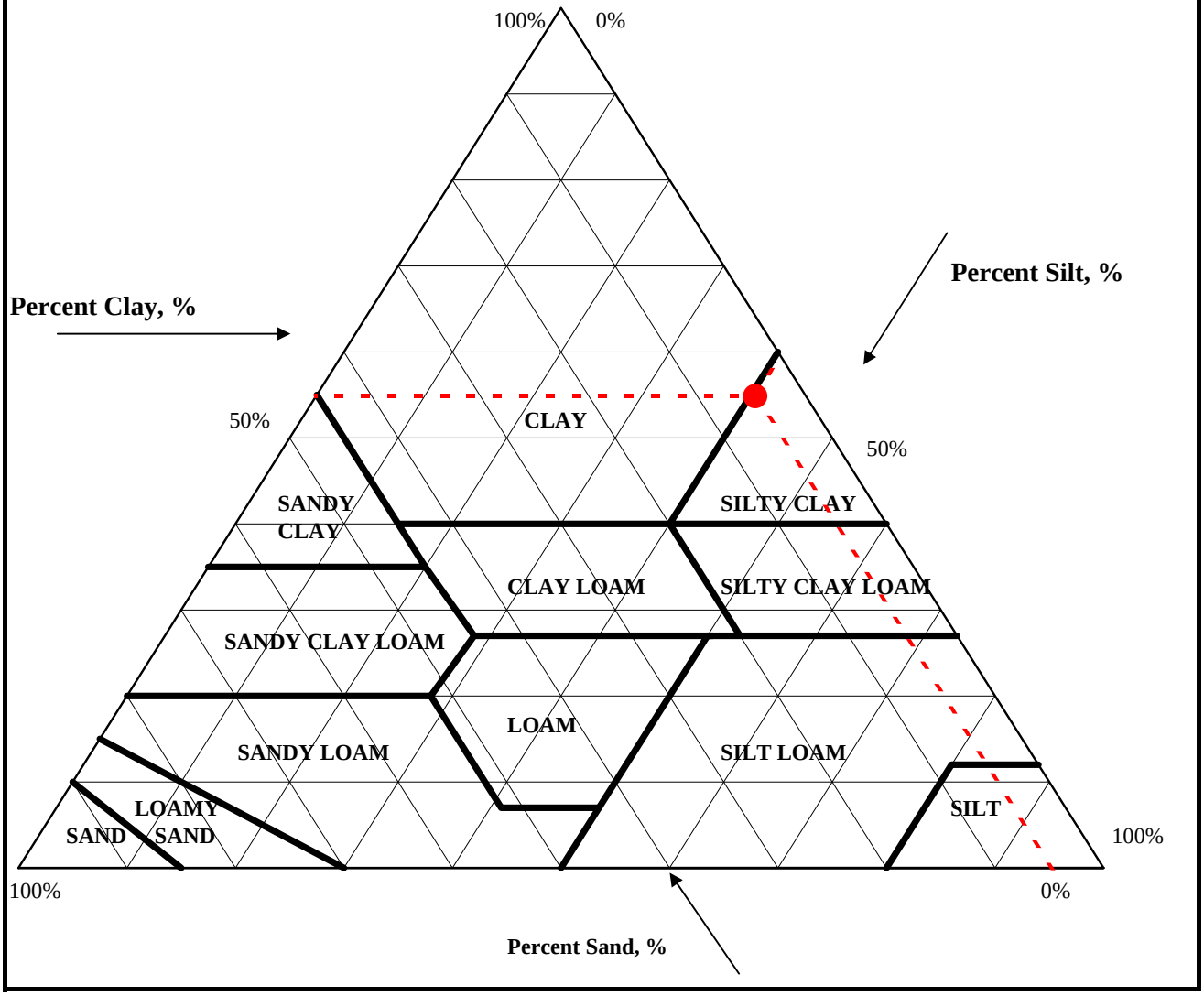
USDA CLASSIFICATION CHART

Client	Civil & Environmental Consultants, I	Boring	SB-16
Client Project	091-867 Apex Landfill Expansion	Depth	0.5'-2.5'
Project No.	30598	Sample	ST-1
		Lab Sample No.	30598008
USCS Description	**LIGHT OLIVE BROWN FAT CLAY**		
USCS Group Symbol	**CH**	AASHTO Classification	**A-7-6 (39)**
USDA Description	**SILTY CLAY**		

Corrected for 0% gravel	
Percent Gravel, %	0.0
Percent Sand, %	4.7
Percent Silt, %	40.5
Percent Clay, %	54.9

Sand Subsizes Corrected Percentages	
Very Coarse Sand; 2-1	0.1
Coarse Sand; 1-0.5	0.1
Medium Sand; 0.5-0.25	0.2
Fine Sand; 0.25-0.1	0.9
Very Fine Sand; 0.1-0.05	3.3
Total	**4.7**



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PARTICLE-SIZE ANALYSIS OF SOILS
ASTM D 422

Client	Civil & Environmental Consultants, I	Boring	SB-17
Client Project	091-867 Apex Landfill Expansion	Depth	16'-18'
Project No.	30598	Sample	ST-1
		Lab Sample No.	30598009

USCS Description **GRAY CLAYEY SAND**
USCS Group Symbol **SC** AASHTO: **A-2-7 (0)**
USDA Description **SANDY LOAM**

MECHANICAL SIEVE ANALYSIS

As-Received Representative Sample Size Split or Material Submitted Used	
Representable Wet Wt, gm	465.7
+#4 Grnd., Washed DS., gm	122.5
-#4 Wet Wt., gm	343.2
-#4 Water Content, %	14.0
-#4 Dry Wt., gm	301.1
Representable Dry Wt, gm	**423.6**
** Note: Percentages +#4 are based on total Dry representable sample.*	
Split Sample, -#4 washed over #200	
Tare No.	A33
Tare + WS., gm	168.62
Tare + DS., gm	149.13
Tare, gm	9.74
Wt. of DS., gm	139.39
Water Content -#4, %	14.0
Wt. of +#200 Sample, gm	48.9

US Std. Sieve Size	Sieve Opening (mm)	Wt. of Soil Retained (gm)	Percent Retained (%)*	Cumulative Percent Retained	Percent Finer (%)	Final Percent Finer
3"	75	0	0.0	0.0	100.0	100.0
2 1/2"	62.5	0	0.0	0.0	100.0	100.0
2"	50	0	0.0	0.0	100.0	100.0
1 1/2"	37.5	0	0.0	0.0	100.0	100.0
1"	25	33.14	7.8	7.8	92.2	92.2
3/4"	19	28.15	6.6	14.5	85.5	85.5
1/2"	12.5	21.41	5.1	19.5	80.5	80.5
3/8"	9.5	11.2	2.6	22.2	77.8	77.8
#4	4.75	28.63	6.8	28.9	71.1	71.1
#10	2	11.65	8.4	8.4	91.6	65.1
#20	0.85	13.88	10.0	18.3	81.7	58.1
#40	0.425	8.55	6.1	24.4	75.6	53.7
#60	0.25	5.38	3.9	28.3	71.7	51.0
#140	0.106	6.59	4.7	33.0	67.0	47.6
#200	0.075	2.84	2.0	35.1	64.9	46.1
-#200 / Pan		90.5	64.9	100.0	-	-

The final percent finer combines the gradation of the plus #4 and minus #4 material.

HYDROMETER ANALYSIS (-#200)

Hydrometer Sample Weight (-#200)	
Tare No.	1
Wt. Tare + DS., gm	137.29
Wt. Tare, gm	103.79
Wt. Dispers., gm	5
Wt. Dry Soil, gm	28.5
-#10 Dispersed 1min in Hamilton Beach Mixer	
K Factor	0.0135
Composite Correction	7
a Factor	0.99
Average Test Temp, °C	20.1
Specific Gravity, Assumed	2.7

Elapsed Time (min.)	R Measured	Composite Correction	R Corrected	Percent Finer (%)	Particle Diameter (mm)	Adjusted % Finer (%)
0	NA	NA	NA	NA	NA	NA
2	33	7	26	90.2	0.0313	41.6
5	31	7	24	83.3	0.0201	38.4
15	28.5	7	21.5	74.6	0.0118	34.4
30	26.5	7	19.5	67.7	0.0085	31.2
60	24	7	17	59.0	0.0061	27.2
250	19	7	12	41.6	0.0031	19.2
1440	15	7	8	27.8	0.0013	12.8

The adjusted percent finer is corrected for the percent passing the -#200 sieve.

D 422 / USCS SOIL CLASSIFICATION

Corrected For 100% Passing a 3" Sieve

% Gravel (-3" & +#4)	**28.9**	Silt=21.2%	Clay=24.9%
Coarse=14.5; Fine=14.5		D60, mm	NA
% Sand (-#4 & +#200)	**24.9**	D30, mm	NA
Coa.=5.9; Med.=11.4; Fine=7.6		D10, mm	NA
% Fines (-#200)	**46.1**	Cc	NA
% Plus #200 (-3")	**53.9**	Cu	NA

USCS Description
CLAYEY SAND

USCS Group Symbol	Atterberg Limits Group Symbol
SC	**CH, LL=40, PL=21, PI=19**

Auxiliary Information	Wt Ret, gm	% Retained	% Finer
12" Sieve - 300 mm	0	0.0	100.0
6" Sieve - 150 mm	0	0.0	100.0
3" Sieve - 75 mm	0	0.0	100.0

USDA CLASSIFICATION

Particle Size (mm)	Percent Finer (%)	Percent of Each Component (Material)	(%)	Corrected Percent of -2.0 mm Material for USDA
100	100			
		Gravel	34.9	0
2	65.1			
		Sand	21.1	32.4
0.05	44.1			
		Silt	28.1	43.1
0.002	16.0			
		Clay	16.0	24.5

USDA Classification
SANDY LOAM

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LIQUID LIMIT, PLASTIC LIMIT, AND PLASTICITY INDEX OF SOILS
ASTM D 4318

Client	Civil & Environmental Consultants, I	Boring No.	SB-17
Client Project	091-867 Apex Landfill Expansion	Depth(ft)	16'-18'
Project No.	30598	Sample No.	ST-1
		Lab Sample No.	30598009

Soil Description: GRAY FAT CLAY
(-#40 Fraction)

AS-RECEIVED W.C.

Tare Number	A33
Wt. Tare & WS, gm	168.62
Wt. Tare & DS, gm	149.13
Wt. Water, gm	19.49
Wt. Tare, gm	9.74
Wt. DS, gm	139.39
Water Content, %	14.0

SAMPLE SUMMARY

Liquid Limit (LL), %	40
Plastic Limit (PL), %	21
Plasticity Index (PI)	19
USCS Symbol (-#40 Fraction)	CH
Sample Preparation:	Wet Method
Liquidity Index, %	-36.9%
Clay Fraction (% 2 microns)	NA
Skempton's Activity (A)	NA

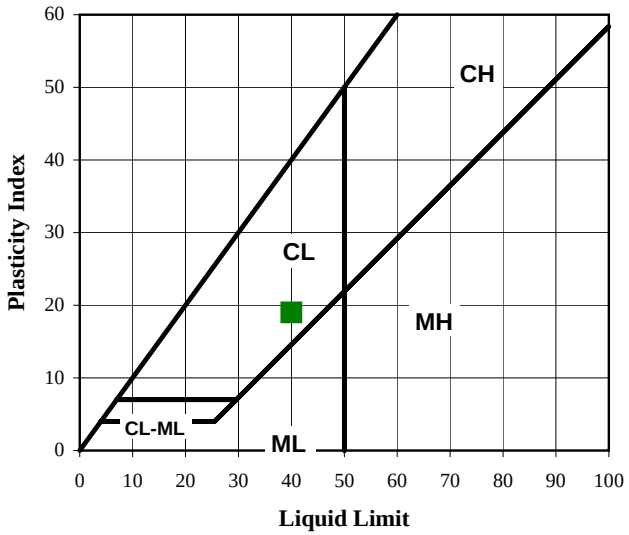
PLASTIC LIMIT

Test Number	1	2	3
Tare Number	421	510	417
Wt. Tare & WS, gm	18.16	20.15	19.65
Wt. Tare & DS, gm	16.88	18.55	18.13
Wt. Water, gm	1.28	1.60	1.52
Wt. Tare, gm	10.74	10.81	10.71
Wt. DS, gm	6.14	7.74	7.42
Water Content, %	20.8	20.7	20.5

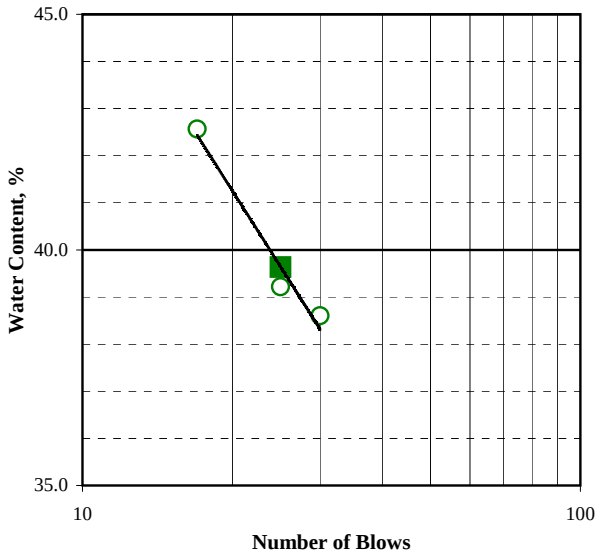
LIQUID LIMIT

	1	2	3
Tare Number	405	409	491
Wt. Tare & WS, gm	18.88	17.79	19.14
Wt. Tare & DS, gm	16.39	15.79	16.82
Wt. Water, gm	2.49	2.00	2.32
Wt. Tare, gm	10.54	10.69	10.81
Wt. DS, gm	5.85	5.10	6.01
Water Content, %	42.6	39.2	38.6
# of Blows	17	25	30

PLASTICITY CHART



FLOW CURVE



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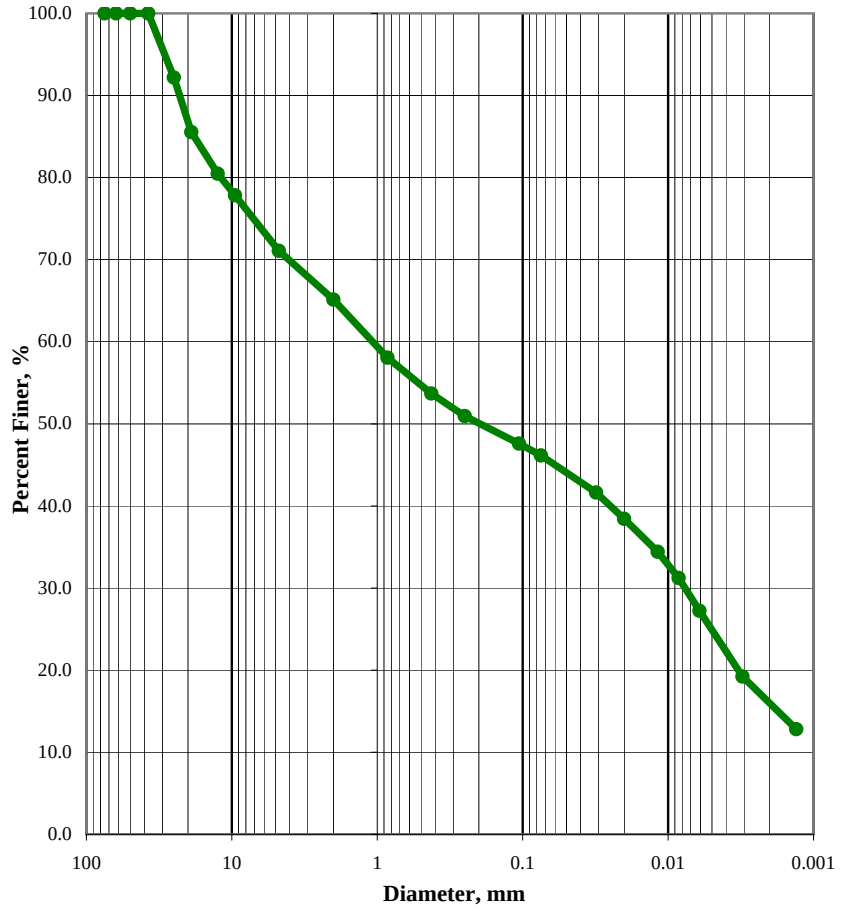
PARTICLE-SIZE ANALYSIS OF SOILS

Client	Civil & Environmental Consultants, I	Boring	SB-17
Client Project	091-867 Apex Landfill Expansion	Depth	16'-18'
Project No.	30598	Sample	ST-1
		Lab Sample No.	30598009

USCS Description **GRAY CLAYEY SAND**
USCS Group Symbol **SC** AASHTO: **A-2-7 (0)**
USDA Description **SANDY LOAM**



US Std. Sieve Size	Particle Diameter (mm)	Percent Finer (%)
3"	75	100.0
2 1/2"	62.5	100.0
2"	50	100.0
1 1/2"	37.5	100.0
1"	25	92.2
3/4"	19	85.5
1/2"	12.5	80.5
3/8"	9.5	77.8
#4	4.75	71.1
#10	2	65.1
#20	0.85	58.1
#40	0.425	53.7
#60	0.25	51.0
#140	0.106	47.6
#200	0.075	46.1
NA	0.0313	41.6
NA	0.0201	38.4
NA	0.0118	34.4
NA	0.0085	31.2
NA	0.0061	27.2
NA	0.0031	19.2
NA	0.0013	12.8

USCS SOIL CLASSIFICATION

Corrected For 100% Passing a 3" Sieve

% Gravel (-3" & +#4)	**28.9**	Silt=21.2% Clay=24.9%	
Coarse=14.5; Fine=14.5		D60, mm	NA
% Sand (-#4 & +#200)	**24.9**	D30, mm	NA
Coa.=5.9; Med.=11.4; Fine=7.6		D10, mm	NA
% Fines (-#200)	**46.1**	Cc	NA
% Plus #200 (-3")	**53.9**	Cu	NA

USCS Description
CLAYEY SAND

USCS Group Symbol	Atterberg Limits Group Symbol
SC	**CH, LL=40, PL=21, PI=19**

Auxiliary Information	Wt Ret, gm	% Retained	% Finer
12" Sieve - 300 mm	0	0.0	100.0
6" Sieve - 150 mm	0	0.0	100.0
3" Sieve - 75 mm	0	0.0	100.0

USDA CLASSIFICATION

Particle Size (mm)	Percent Finer (%)
100	100
2	65.1
0.05	44.1
0.002	16.0

Percent of Each Component (Material)	(%)	Corrected Percent of -2.0 mm Material for USDA
Gravel	34.9	0
Sand	21.1	32.4
Silt	28.1	43.1
Clay	16.0	24.5

USDA Classification
SANDY LOAM

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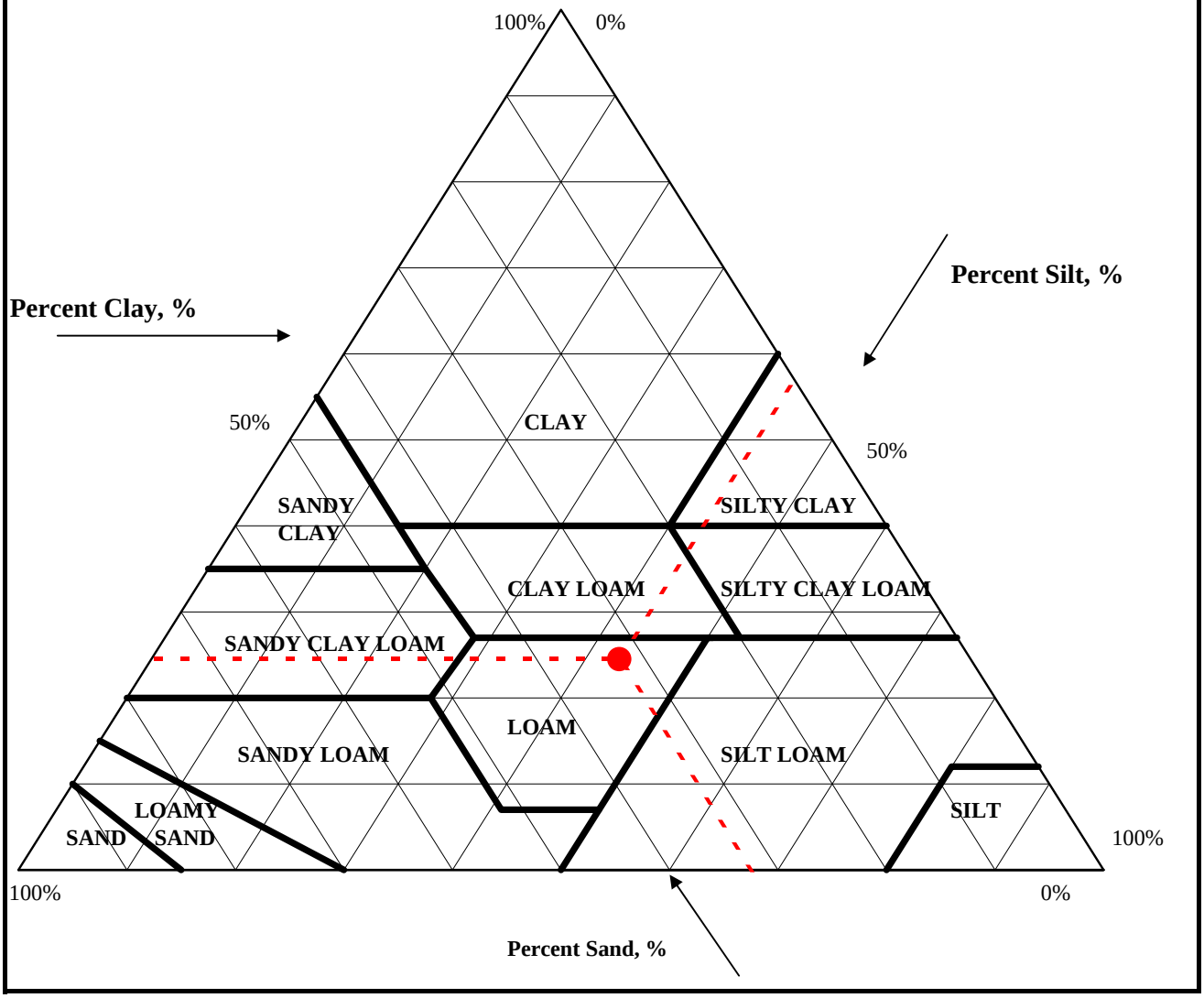
USDA CLASSIFICATION CHART

Client	Civil & Environmental Consultants, I	Boring	SB-17
Client Project	091-867 Apex Landfill Expansion	Depth	16'-18'
Project No.	30598	Sample	ST-1
		Lab Sample No.	30598009
USCS Description	**GRAY CLAYEY SAND**		
USCS Group Symbol	**SC**	AASHTO Classification	**A-2-7 (0)**
USDA Description	**SANDY LOAM**		

Corrected for 0% gravel	
Percent Gravel, %	0.0
Percent Sand, %	32.4
Percent Silt, %	43.1
Percent Clay, %	24.5

Sand Subsizes Corrected Percentages	
Very Coarse Sand; 2-1	8.8
Coarse Sand; 1-0.5	7.2
Medium Sand; 0.5-0.25	5.8
Fine Sand; 0.25-0.1	5.5
Very Fine Sand; 0.1-0.05	5.1
Total	**32.4**



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PARTICLE-SIZE ANALYSIS OF SOILS
ASTM D 422

Client	Civil & Environmental Consultants, I	Boring	SB-18
Client Project	091-867 Apex Landfill Expansion	Depth	10-12
Project No.	30598	Sample	ST-1
		Lab Sample No.	30598010

USCS Description **DARK GRAYISH BROWN SANDY LEAN CLAY WITH GRAVEL**
USCS Group Symbol **CL** AASHTO: **A-7-6 (9)**
USDA Description **LOAM**

MECHANICAL SIEVE ANALYSIS

As-Received Representative Sample Size Split or Material Submitted Used	
Representable Wet Wt, gm	929.8
+#4 Grnd., Washed DS., gm	142.1
-#4 Wet Wt., gm	787.7
-#4 Water Content, %	18.3
-#4 Dry Wt., gm	665.7
Representable Dry Wt, gm	**807.8**
** Note: Percentages +#4 are based on total Dry representable sample.*	
Split Sample, -#4 washed over #200	
Tare No.	950
Tare + WS., gm	227.24
Tare + DS., gm	207.25
Tare, gm	98.14
Wt. of DS., gm	109.11
Water Content -#4, %	18.3
Wt. of +#200 Sample, gm	32.9

US Std. Sieve Size	Sieve Opening (mm)	Wt. of Soil Retained (gm)	Percent Retained (%)*	Cumulative Percent Retained	Percent Finer (%)	Final Percent Finer
3"	75	0	0.0	0.0	100.0	100.0
2 1/2"	62.5	0	0.0	0.0	100.0	100.0
2"	50	0	0.0	0.0	100.0	100.0
1 1/2"	37.5	0	0.0	0.0	100.0	100.0
1"	25	0	0.0	0.0	100.0	100.0
3/4"	19	23.47	2.9	2.9	97.1	97.1
1/2"	12.5	35.6	4.4	7.3	92.7	92.7
3/8"	9.5	18.34	2.3	9.6	90.4	90.4
#4	4.75	64.72	8.0	17.6	82.4	82.4
#10	2	4.89	4.5	4.5	95.5	78.7
#20	0.85	9.11	8.3	12.8	87.2	71.8
#40	0.425	7.16	6.6	19.4	80.6	66.4
#60	0.25	4.54	4.2	23.6	76.4	63.0
#140	0.106	5.18	4.7	28.3	71.7	59.1
#200	0.075	2	1.8	30.1	69.9	57.6
-#200 / Pan		76.2	69.9	100.0	-	-

The final percent finer combines the gradation of the plus #4 and minus #4 material.

HYDROMETER ANALYSIS (-#200)

Hydrometer Sample Weight (-#200)	
Tare No.	517
Wt. Tare + DS., gm	145.61
Wt. Tare, gm	103.65
Wt. Dispers., gm	5
Wt. Dry Soil, gm	36.96
-#10 Dispersed 1min in Hamilton Beach Mixer	
K Factor	0.0134
Composite Correction	7
a Factor	0.99
Average Test Temp, °C	20.3
Specific Gravity, Assumed	2.7

Elapsed Time (min.)	R Measured	Composite Correction	R Corrected	Percent Finer (%)	Particle Diameter (mm)	Adjusted % Finer (%)
0	NA	NA	NA	NA	NA	NA
2	41	7	34	91.0	0.0293	52.4
5	39	7	32	85.6	0.0188	49.3
15	35.5	7	28.5	76.3	0.0112	43.9
30	33	7	26	69.6	0.0081	40.1
60	30	7	23	61.5	0.0058	35.4
250	23	7	16	42.8	0.0030	24.6
1440	18	7	11	29.4	0.0013	16.9

The adjusted percent finer is corrected for the percent passing the -#200 sieve.

D 422 / USCS SOIL CLASSIFICATION

Corrected For 100% Passing a 3" Sieve

% Gravel (-3" & +#4)	**17.6**	Silt=24.6%	Clay=32.9%
Coarse=2.9; Fine=14.7		D60, mm	NA
% Sand (-#4 & +#200)	**24.8**	D30, mm	NA
Coa.=3.7; Med.=12.3; Fine=8.9		D10, mm	NA
% Fines (-#200)	**57.6**	Cc	NA
% Plus #200 (-3")	**42.4**	Cu	NA

USCS Description
SANDY LEAN CLAY WITH GRAVEL

USCS Group Symbol	Atterberg Limits Group Symbol
CL	**CL, LL=42, PL=21, PI=21**

Auxiliary Information	Wt Ret, gm	% Retained	% Finer
12" Sieve - 300 mm	0	0.0	100.0
6" Sieve - 150 mm	0	0.0	100.0
3" Sieve - 75 mm	0	0.0	100.0

USDA CLASSIFICATION

Particle Size (mm)	Percent Finer (%)	Percent of Each Component (Material)	(%)	Corrected Percent of -2.0 mm Material for USDA
100	100			
		Gravel	21.3	0
2	78.7			
		Sand	23.4	29.7
0.05	55.3			
		Silt	34.4	43.7
0.002	21.0			
		Clay	21.0	26.6

USDA Classification
LOAM

Input Validation: Reviewed By: Date Tested: 12/1/2010

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LIQUID LIMIT, PLASTIC LIMIT, AND PLASTICITY INDEX OF SOILS
ASTM D 4318

Client	Civil & Environmental Consultants, I	Boring No.	SB-18
Client Project	091-867 Apex Landfill Expansion	Depth(ft)	10-12
Project No.	30598	Sample No.	ST-1
		Lab Sample No.	30598010

Soil Description: DARK GRAYISH BROWN LEAN CLAY
(-#40 Fraction)

AS-RECEIVED W.C.

Tare Number	950
Wt. Tare & WS, gm	227.24
Wt. Tare & DS, gm	207.25
Wt. Water, gm	19.99
Wt. Tare, gm	98.14
Wt. DS, gm	109.11
Water Content, %	18.3

SAMPLE SUMMARY

Liquid Limit (LL), %	42
Plastic Limit (PL), %	21
Plasticity Index (PI)	21
USCS Symbol (-#40 Fraction)	CL
Sample Preparation:	Wet Method
Liquidity Index, %	-12.8%
Clay Fraction (% 2 microns)	NA
Skempton's Activity (A)	NA

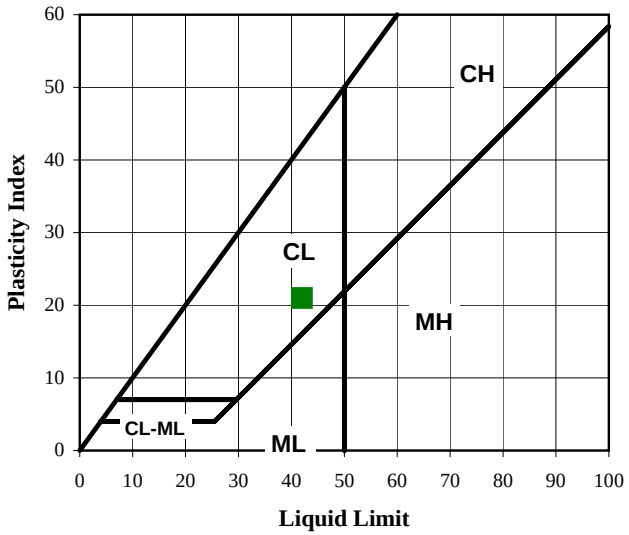
PLASTIC LIMIT

Test Number	1	2	3
Tare Number	476	426	462
Wt. Tare & WS, gm	18.87	18.75	20.17
Wt. Tare & DS, gm	17.49	17.39	18.57
Wt. Water, gm	1.38	1.36	1.60
Wt. Tare, gm	10.81	10.71	10.77
Wt. DS, gm	6.68	6.68	7.80
Water Content, %	20.7	20.4	20.5

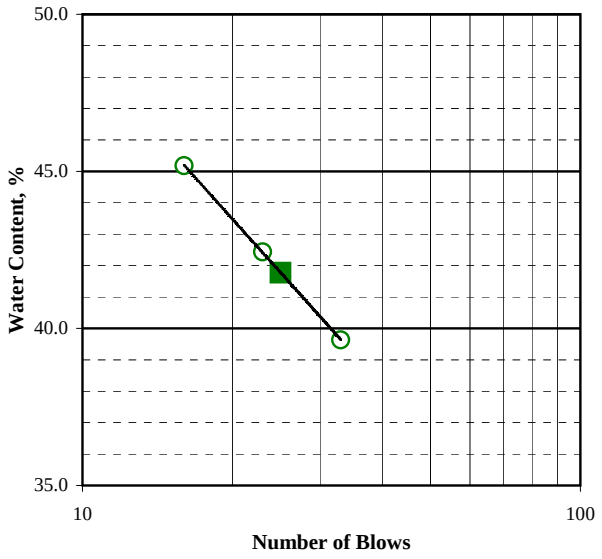
LIQUID LIMIT

	1	2	3
Tare Number	475	477	487
Wt. Tare & WS, gm	18.41	18.92	20.50
Wt. Tare & DS, gm	16.02	16.48	17.69
Wt. Water, gm	2.39	2.44	2.81
Wt. Tare, gm	10.73	10.73	10.60
Wt. DS, gm	5.29	5.75	7.09
Water Content, %	45.2	42.4	39.6
# of Blows	16	23	33

PLASTICITY CHART



FLOW CURVE



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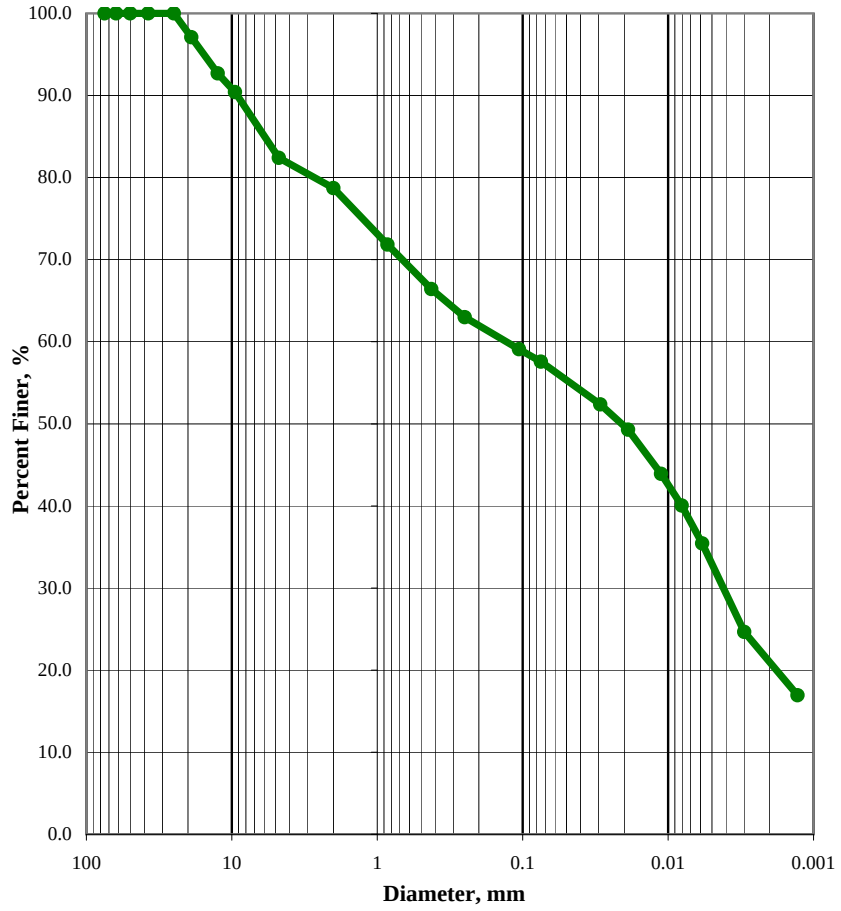
PARTICLE-SIZE ANALYSIS OF SOILS

Client	Civil & Environmental Consultants, I	Boring	SB-18
Client Project	091-867 Apex Landfill Expansion	Depth	10-12
Project No.	30598	Sample	ST-1
		Lab Sample No.	30598010

USCS Description **DARK GRAYISH BROWN SANDY LEAN CLAY WITH GRAVEL**
USCS Group Symbol **CL** AASHTO: **A-7-6 (9)**
USDA Description **LOAM**



US Std. Sieve Size	Particle Diameter (mm)	Percent Finer (%)
3"	75	100.0
2 1/2"	62.5	100.0
2"	50	100.0
1 1/2"	37.5	100.0
1"	25	100.0
3/4"	19	97.1
1/2"	12.5	92.7
3/8"	9.5	90.4
#4	4.75	82.4
#10	2	78.7
#20	0.85	71.8
#40	0.425	66.4
#60	0.25	63.0
#140	0.106	59.1
#200	0.075	57.6
NA	0.0293	52.4
NA	0.0188	49.3
NA	0.0112	43.9
NA	0.0081	40.1
NA	0.0058	35.4
NA	0.0030	24.6
NA	0.0013	16.9

USCS SOIL CLASSIFICATION

Corrected For 100% Passing a 3" Sieve

% Gravel (-3" & +#4)	**17.6**	Silt=24.6%	Clay=32.9%
Coarse=2.9; Fine=14.7		D60, mm	NA
% Sand (-#4 & +#200)	**24.8**	D30, mm	NA
Coa.=3.7; Med.=12.3; Fine=8.9		D10, mm	NA
% Fines (-#200)	**57.6**	Cc	NA
% Plus #200 (-3")	**42.4**	Cu	NA

USCS Description
SANDY LEAN CLAY WITH GRAVEL

USCS Group Symbol	Atterberg Limits Group Symbol
CL	**CL, LL=42, PL=21, PI=21**

Auxiliary Information	Wt Ret, gm	% Retained	% Finer
12" Sieve - 300 mm	0	0.0	100.0
6" Sieve - 150 mm	0	0.0	100.0
3" Sieve - 75 mm	0	0.0	100.0

USDA CLASSIFICATION

Particle Size (mm)	Percent Finer (%)	Percent of Each Component (Material)	(%)	Corrected Percent of -2.0 mm Material for USDA
100	100			
		Gravel	21.3	0
2	78.7			
		Sand	23.4	29.7
0.05	55.3			
		Silt	34.4	43.7
0.002	21.0			
		Clay	21.0	26.6

USDA Classification
LOAM

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USDA CLASSIFICATION CHART

Client	Civil & Environmental Consultants, I	Boring	SB-18
Client Project	091-867 Apex Landfill Expansion	Depth	10-12
Project No.	30598	Sample	ST-1
		Lab Sample No.	30598010

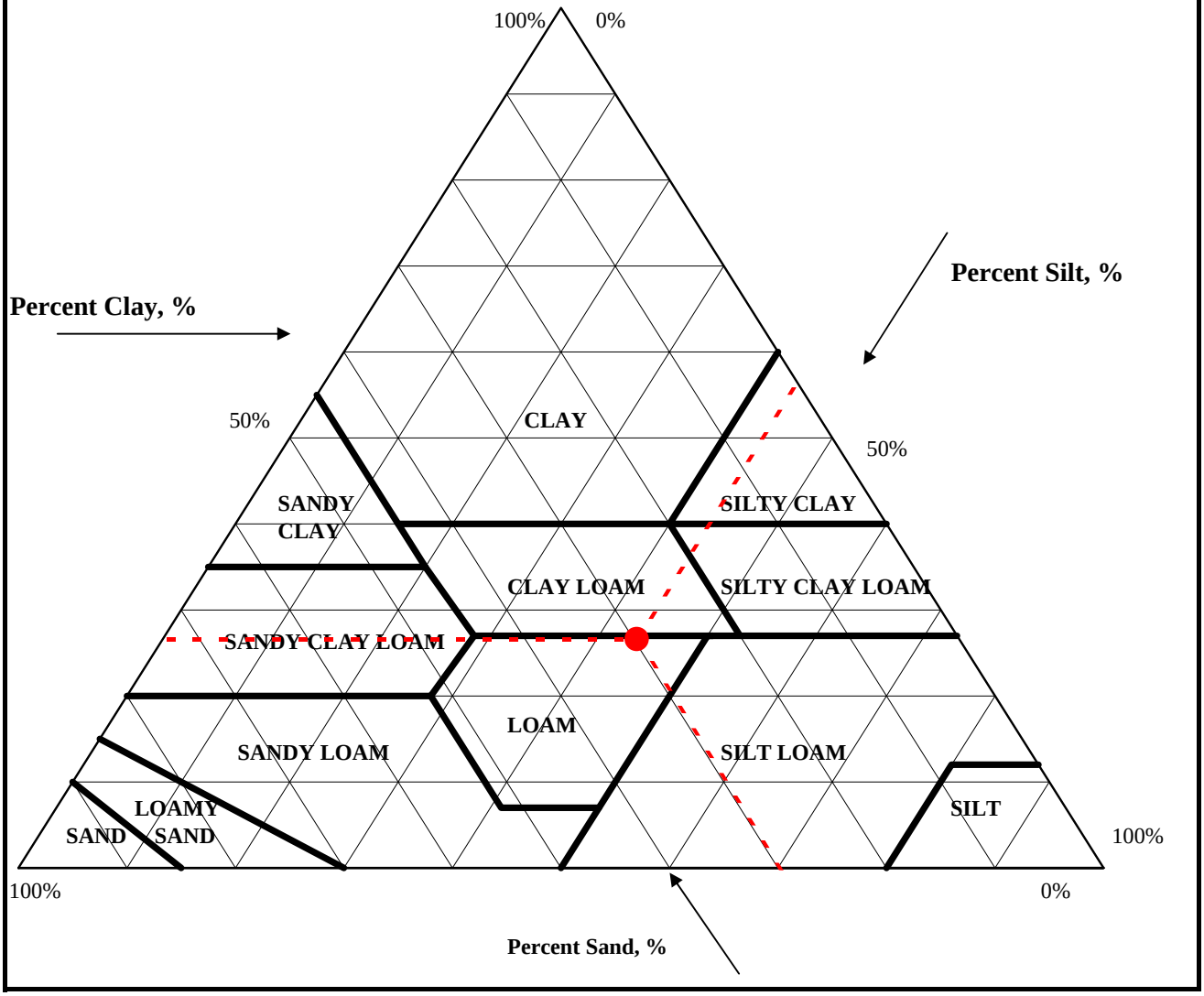
USCS Description **DARK GRAYISH BROWN SANDY LEAN CLAY WITH GRAVEL**

USCS Group Symbol **CL** AASHTO Classification **A-7-6 (9)**

USDA Description **LOAM**

Corrected for 0% gravel	
Percent Gravel, %	0.0
Percent Sand, %	29.7
Percent Silt, %	43.7
Percent Clay, %	26.6

Sand Subsizes Corrected Percentages	
Very Coarse Sand; 2-1	7.1
Coarse Sand; 1-0.5	6.9
Medium Sand; 0.5-0.25	6.0
Fine Sand; 0.25-0.1	5.3
Very Fine Sand; 0.1-0.05	4.4
Total	**29.7**



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PARTICLE-SIZE ANALYSIS OF SOILS
ASTM D 422

Client	Civil & Environmental Consultants, I	Boring	SB-21
Client Project	091-867 Apex Landfill Expansion	Depth	9'-11'
Project No.	30598	Sample	ST-1
		Lab Sample No.	30598011

USCS Description **LIGHT OLIVE BROWN LEAN CLAY WITH GRAVEL**
USCS Group Symbol **CL** AASHTO: **A-7-6 (15)**
USDA Description **SILTY CLAY LOAM**

MECHANICAL SIEVE ANALYSIS

As-Received Representative Sample Size Split or Material Submitted Used	
Representable Wet Wt, gm	1235.5
+#4 Grnd., Washed DS., gm	169.3
-#4 Wet Wt., gm	1066.2
-#4 Water Content, %	15.2
-#4 Dry Wt., gm	925.5
Representable Dry Wt, gm	**1094.8**
** Note: Percentages +#4 are based on total Dry representable sample.*	
Split Sample, -#4 washed over #200	
Tare No.	4
Tare + WS., gm	365.33
Tare + DS., gm	331.19
Tare, gm	106.61
Wt. of DS., gm	224.58
Water Content -#4, %	15.2
Wt. of +#200 Sample, gm	27.5

US Std. Sieve Size	Sieve Opening (mm)	Wt. of Soil Retained (gm)	Percent Retained (%)*	Cumulative Percent Retained	Percent Finer (%)	Final Percent Finer
3"	75	0	0.0	0.0	100.0	100.0
2 1/2"	62.5	0	0.0	0.0	100.0	100.0
2"	50	0	0.0	0.0	100.0	100.0
1 1/2"	37.5	0	0.0	0.0	100.0	100.0
1"	25	0	0.0	0.0	100.0	100.0
3/4"	19	16.81	1.5	1.5	98.5	98.5
1/2"	12.5	21.43	2.0	3.5	96.5	96.5
3/8"	9.5	34.24	3.1	6.6	93.4	93.4
#4	4.75	96.83	8.8	15.5	84.5	84.5
#10	2	5.82	2.6	2.6	97.4	82.3
#20	0.85	10.68	4.8	7.3	92.7	78.3
#40	0.425	5.44	2.4	9.8	90.2	76.3
#60	0.25	1.82	0.8	10.6	89.4	75.6
#140	0.106	1.81	0.8	11.4	88.6	74.9
#200	0.075	1.91	0.9	12.2	87.8	74.2
-#200 / Pan		197.1	87.8	100.0	-	-

The final percent finer combines the gradation of the plus #4 and minus #4 material.

HYDROMETER ANALYSIS (-#200)

Hydrometer Sample Weight (-#200)	
Tare No.	941
Wt. Tare + DS., gm	129.45
Wt. Tare, gm	99.79
Wt. Dispers., gm	5
Wt. Dry Soil, gm	24.66
-#10 Dispersed 1min in Hamilton Beach Mixer	
K Factor	0.0134
Composite Correction	7
a Factor	0.99
Average Test Temp, °C	20.3
Specific Gravity, Assumed	2.7

Elapsed Time (min.)	R Measured	Composite Correction	R Corrected	Percent Finer (%)	Particle Diameter (mm)	Adjusted % Finer (%)
0	NA	NA	NA	NA	NA	NA
2	27.5	7	20.5	82.2	0.0325	61.0
5	26	7	19	76.2	0.0208	56.5
15	24	7	17	68.2	0.0122	50.6
30	22	7	15	60.2	0.0087	44.6
60	20.5	7	13.5	54.1	0.0062	40.2
250	17	7	10	40.1	0.0031	29.8
1440	14	7	7	28.1	0.0013	20.8

The adjusted percent finer is corrected for the percent passing the -#200 sieve.

D 422 / USCS SOIL CLASSIFICATION

Corrected For 100% Passing a 3" Sieve

% Gravel (-3" & +#4)	**15.5**	Silt=37.1%	Clay=36.9%
Coarse=1.5; Fine=13.9		D60, mm	NA
% Sand (-#4 & +#200)	**10.3**	D30, mm	NA
Coa.=2.2; Med.=6.1; Fine=2.1		D10, mm	NA
% Fines (-#200)	**74.2**	Cc	NA
% Plus #200 (-3")	**25.8**	Cu	NA

USCS Description
LEAN CLAY WITH GRAVEL

USCS Group Symbol	Atterberg Limits Group Symbol
CL	**CL, LL=42, PL=20, PI=22**

Auxiliary Information	Wt Ret, gm	% Retained	% Finer
12" Sieve - 300 mm	0	0.0	100.0
6" Sieve - 150 mm	0	0.0	100.0
3" Sieve - 75 mm	0	0.0	100.0

USDA CLASSIFICATION

Particle Size (mm)	Percent Finer (%)	Percent of Each Component (Material)	(%)	Corrected Percent of -2.0 mm Material for USDA
100	100			
		Gravel	17.7	0
2	82.3			
		Sand	14.6	17.7
0.05	67.8			
		Silt	42.6	51.8
0.002	25.1			
		Clay	25.1	30.5

USDA Classification
SILTY CLAY LOAM

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LIQUID LIMIT, PLASTIC LIMIT, AND PLASTICITY INDEX OF SOILS
ASTM D 4318

Client	Civil & Environmental Consultants, I	Boring No.	SB-21
Client Project	091-867 Apex Landfill Expansion	Depth(ft)	9'-11'
Project No.	30598	Sample No.	ST-1
		Lab Sample No.	30598011

Soil Description: LIGHT OLIVE BROWN LEAN CLAY
(-#40 Fraction)

AS-RECEIVED W.C.

Tare Number	4
Wt. Tare & WS, gm	365.33
Wt. Tare & DS, gm	331.19
Wt. Water, gm	34.14
Wt. Tare, gm	106.61
Wt. DS, gm	224.58
Water Content, %	15.2

SAMPLE SUMMARY

Liquid Limit (LL), %	42
Plastic Limit (PL), %	20
Plasticity Index (PI)	22
USCS Symbol (-#40 Fraction)	CL
Sample Preparation:	Wet Method
Liquidity Index, %	-21.8%
Clay Fraction (% 2 microns)	NA
Skempton's Activity (A)	NA

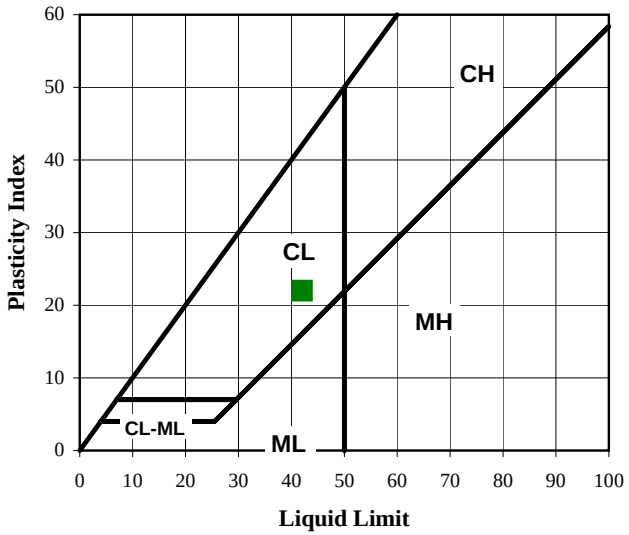
PLASTIC LIMIT

Test Number	1	2	3
Tare Number	403	460	498
Wt. Tare & WS, gm	18.42	17.98	17.44
Wt. Tare & DS, gm	17.12	16.78	16.33
Wt. Water, gm	1.30	1.20	1.11
Wt. Tare, gm	10.75	10.75	10.72
Wt. DS, gm	6.37	6.03	5.61
Water Content, %	20.4	19.9	19.8

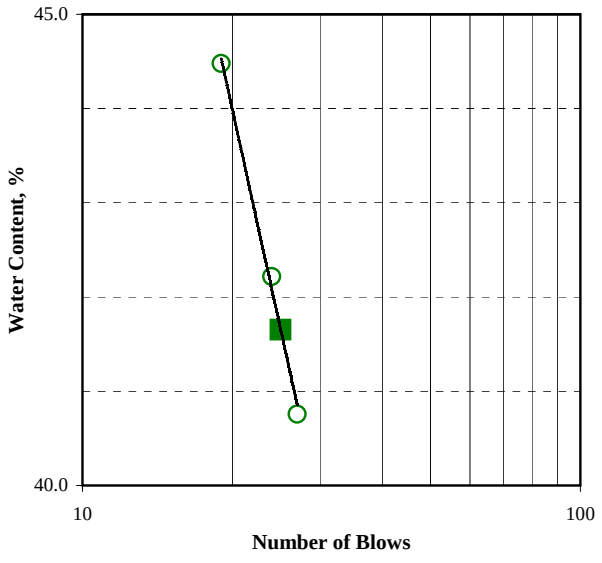
LIQUID LIMIT

	1	2	3
Tare Number	449	451	459
Wt. Tare & WS, gm	20.12	18.08	20.09
Wt. Tare & DS, gm	17.22	15.91	17.40
Wt. Water, gm	2.90	2.17	2.69
Wt. Tare, gm	10.70	10.77	10.80
Wt. DS, gm	6.52	5.14	6.60
Water Content, %	44.5	42.2	40.8
# of Blows	19	24	27

PLASTICITY CHART



FLOW CURVE



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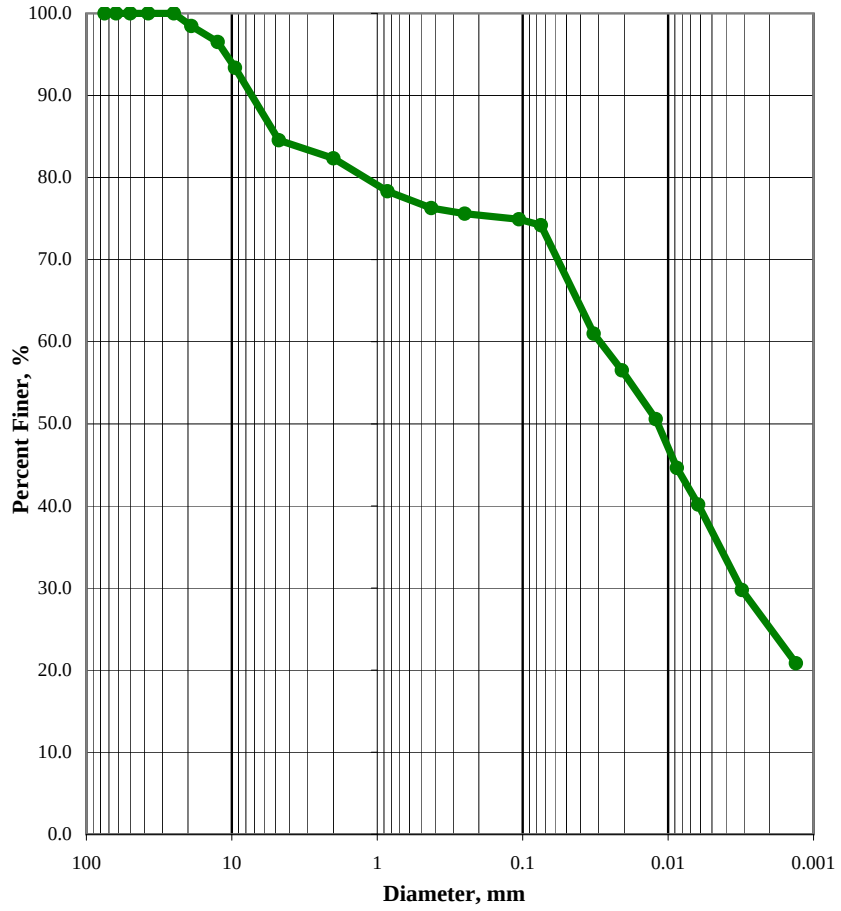
PARTICLE-SIZE ANALYSIS OF SOILS

Client	Civil & Environmental Consultants, I	Boring	SB-21
Client Project	091-867 Apex Landfill Expansion	Depth	9'-11'
Project No.	30598	Sample	ST-1
		Lab Sample No.	30598011

USCS Description **LIGHT OLIVE BROWN LEAN CLAY WITH GRAVEL**

USCS Group Symbol **CL** AASHTO: **A-7-6 (15)**

USDA Description **SILTY CLAY LOAM**



US Std. Sieve Size	Particle Diameter (mm)	Percent Finer (%)
3"	75	100.0
2 1/2"	62.5	100.0
2"	50	100.0
1 1/2"	37.5	100.0
1"	25	100.0
3/4"	19	98.5
1/2"	12.5	96.5
3/8"	9.5	93.4
#4	4.75	84.5
#10	2	82.3
#20	0.85	78.3
#40	0.425	76.3
#60	0.25	75.6
#140	0.106	74.9
#200	0.075	74.2
NA	0.0325	61.0
NA	0.0208	56.5
NA	0.0122	50.6
NA	0.0087	44.6
NA	0.0062	40.2
NA	0.0031	29.8
NA	0.0013	20.8

USCS SOIL CLASSIFICATION

Corrected For 100% Passing a 3" Sieve

% Gravel (-3" & +#4)	**15.5**	Silt=37.1% Clay=36.9%	
Coarse=1.5; Fine=13.9		D60, mm	NA
% Sand (-#4 & +#200)	**10.3**	D30, mm	NA
Coa.=2.2; Med.=6.1; Fine=2.1		D10, mm	NA
% Fines (-#200)	**74.2**	Cc	NA
% Plus #200 (-3")	**25.8**	Cu	NA

USCS Description
LEAN CLAY WITH GRAVEL

USCS Group Symbol	Atterberg Limits Group Symbol
CL	**CL, LL=42, PL=20, PI=22**

Auxiliary Information	Wt Ret, gm	% Retained	% Finer
12" Sieve - 300 mm	0	0.0	100.0
6" Sieve - 150 mm	0	0.0	100.0
3" Sieve - 75 mm	0	0.0	100.0

USDA CLASSIFICATION

Particle Size (mm)	Percent Finer (%)
100	100
2	82.3
0.05	67.8
0.002	25.1

Percent of Each Component (Material)	(%)	Corrected Percent of -2.0 mm Material for USDA
Gravel	17.7	0
Sand	14.6	17.7
Silt	42.6	51.8
Clay	25.1	30.5

USDA Classification
SILTY CLAY LOAM

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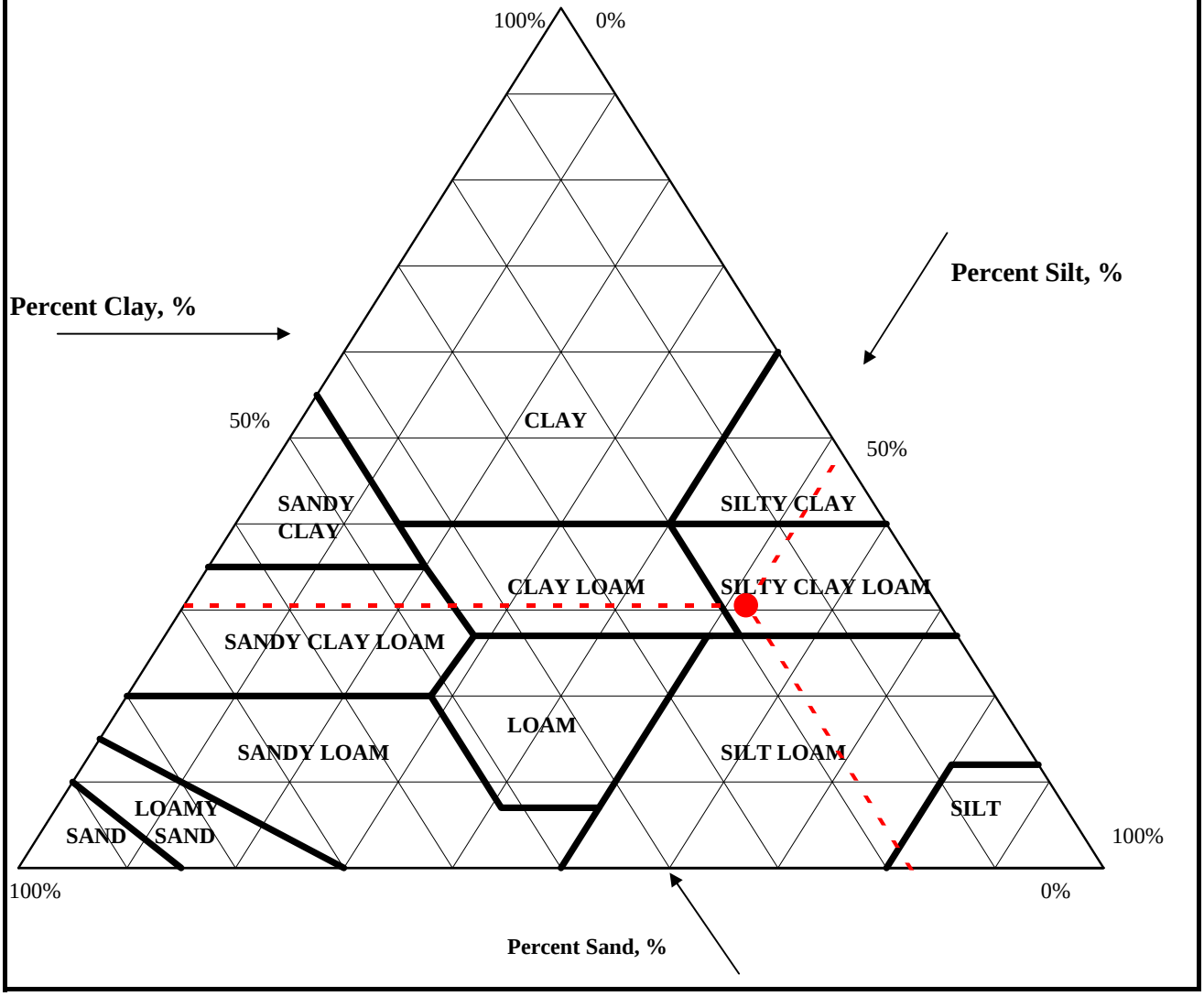
USDA CLASSIFICATION CHART

Client	Civil & Environmental Consultants, I	Boring	SB-21
Client Project	091-867 Apex Landfill Expansion	Depth	9'-11'
Project No.	30598	Sample	ST-1
		Lab Sample No.	30598011
USCS Description	**LIGHT OLIVE BROWN LEAN CLAY WITH GRAVEL**		
USCS Group Symbol	**CL**	AASHTO Classification	**A-7-6 (15)**
USDA Description	**SILTY CLAY LOAM**		

Corrected for 0% gravel	
Percent Gravel, %	0.0
Percent Sand, %	17.7
Percent Silt, %	51.8
Percent Clay, %	30.5

Sand Subsizes Corrected Percentages	
Very Coarse Sand; 2-1	4.0
Coarse Sand; 1-0.5	2.8
Medium Sand; 0.5-0.25	1.4
Fine Sand; 0.25-0.1	1.0
Very Fine Sand; 0.1-0.05	8.5
Total	**17.7**



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PARTICLE-SIZE ANALYSIS OF SOILS
ASTM D 422

Client	Civil & Environmental Consultants, I	Boring	SB-4
Client Project	091-867 Apex Landfill Expansion	Depth	28'-30'
Project No.	30598	Sample	ST-1
		Lab Sample No.	30598013
USCS Description	**DARK GRAYISH BROWN SANDY LEAN CLAY**		
USCS Group Symbol	**CL**	AASHTO:	**A-6 (10)**
USDA Description	**LOAM**		

MECHANICAL SIEVE ANALYSIS

As-Received Representative Sample Size Split or Material Submitted Used	
Representable Wet Wt, gm	1260.1
+#4 Grnd., Washed DS., gm	70.2
-#4 Wet Wt., gm	1189.9
-#4 Water Content, %	17.2
-#4 Dry Wt., gm	1015.1
Representable Dry Wt, gm	**1085.3**
** Note: Percentages +#4 are based on total Dry representable sample.*	
Split Sample, -#4 washed over #200	
Tare No.	701
Tare + WS., gm	255.2
Tare + DS., gm	232.3
Tare, gm	99.33
Wt. of DS., gm	132.97
Water Content -#4, %	17.2
Wt. of +#200 Sample, gm	39.0

US Std. Sieve Size	Sieve Opening (mm)	Wt. of Soil Retained (gm)	Percent Retained (%)*	Cumulative Percent Retained	Percent Finer (%)	Final Percent Finer
3"	75	0	0.0	0.0	100.0	100.0
2 1/2"	62.5	0	0.0	0.0	100.0	100.0
2"	50	0	0.0	0.0	100.0	100.0
1 1/2"	37.5	0	0.0	0.0	100.0	100.0
1"	25	34.49	3.2	3.2	96.8	96.8
3/4"	19	0	0.0	3.2	96.8	96.8
1/2"	12.5	4.81	0.4	3.6	96.4	96.4
3/8"	9.5	7.15	0.7	4.3	95.7	95.7
#4	4.75	23.77	2.2	6.5	93.5	93.5
#10	2	7.03	5.3	5.3	94.7	88.6
#20	0.85	9.12	6.9	12.1	87.9	82.2
#40	0.425	6.47	4.9	17.0	83.0	77.6
#60	0.25	4.54	3.4	20.4	79.6	74.4
#140	0.106	7.48	5.6	26.1	73.9	69.2
#200	0.075	4.34	3.3	29.3	70.7	66.1
-#200 / Pan		94.0	70.7	100.0	-	-

The final percent finer combines the gradation of the plus #4 and minus #4 material.

HYDROMETER ANALYSIS (-#200)

Hydrometer Sample Weight (-#200)	
Tare No.	904
Wt. Tare + DS., gm	141.23
Wt. Tare, gm	98.89
Wt. Dispers., gm	5
Wt. Dry Soil, gm	37.34
-#10 Dispersed 1min in Hamilton Beach Mixer	
K Factor	0.0134
Composite Correction	7
a Factor	0.99
Average Test Temp, °C	20.2
Specific Gravity, Assumed	2.7

Elapsed Time (min.)	R Measured	Composite Correction	R Corrected	Percent Finer (%)	Particle Diameter (mm)	Adjusted % Finer (%)
0	NA	NA	NA	NA	NA	NA
2	40.5	7	33.5	88.7	0.0294	58.7
5	38	7	31	82.1	0.0190	54.3
15	34	7	27	71.5	0.0113	47.3
30	31	7	24	63.6	0.0082	42.0
60	29	7	22	58.3	0.0059	38.5
250	23	7	16	42.4	0.0030	28.0
1440	17.5	7	10.5	27.8	0.0013	18.4

The adjusted percent finer is corrected for the percent passing the -#200 sieve.

D 422 / USCS SOIL CLASSIFICATION

Corrected For 100% Passing a 3" Sieve

% Gravel (-3" & +#4)	**6.5**	Silt=30%	Clay=36%
Coarse=3.2; Fine=3.3		D60, mm	NA
% Sand (-#4 & +#200)	**27.4**	D30, mm	NA
Coa.=4.9; Med.=11; Fine=11.5		D10, mm	NA
% Fines (-#200)	**66.1**	Cc	NA
% Plus #200 (-3")	**33.9**	Cu	NA

USCS Description

SANDY LEAN CLAY

USCS Group Symbol	Atterberg Limits Group Symbol
CL	**CL, LL=37, PL=19, PI=18**

Auxiliary Information	Wt Ret, gm	% Retained	% Finer
12" Sieve - 300 mm	0	0.0	100.0
6" Sieve - 150 mm	0	0.0	100.0
3" Sieve - 75 mm	387.2	26.3	73.7

USDA CLASSIFICATION

Particle Size (mm)	Percent Finer (%)	Percent of Each Component (Material)	(%)	Corrected Percent of -2.0 mm Material for USDA
100	100			
		Gravel	11.4	0
2	88.6			
		Sand	25.7	29.0
0.05	62.9			
		Silt	39.5	44.6
0.002	23.4			
		Clay	23.4	26.4

USDA Classification

LOAM

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LIQUID LIMIT, PLASTIC LIMIT, AND PLASTICITY INDEX OF SOILS
ASTM D 4318

Client	Civil & Environmental Consultants, I	Boring No.	SB-4
Client Project	091-867 Apex Landfill Expansion	Depth(ft)	28'-30'
Project No.	30598	Sample No.	ST-1
		Lab Sample No.	30598013

Soil Description: DARK GRAYISH BROWN LEAN CLAY
(-#40 Fraction)

AS-RECEIVED W.C.

Tare Number	701
Wt. Tare & WS, gm	255.20
Wt. Tare & DS, gm	232.30
Wt. Water, gm	22.90
Wt. Tare, gm	99.33
Wt. DS, gm	132.97
Water Content, %	17.2

SAMPLE SUMMARY

Liquid Limit (LL), %	37
Plastic Limit (PL), %	19
Plasticity Index (PI)	18
USCS Symbol (-#40 Fraction)	CL
Sample Preparation:	Wet Method
Liquidity Index, %	-9.9%
Clay Fraction (% 2 microns)	NA
Skempton's Activity (A)	NA

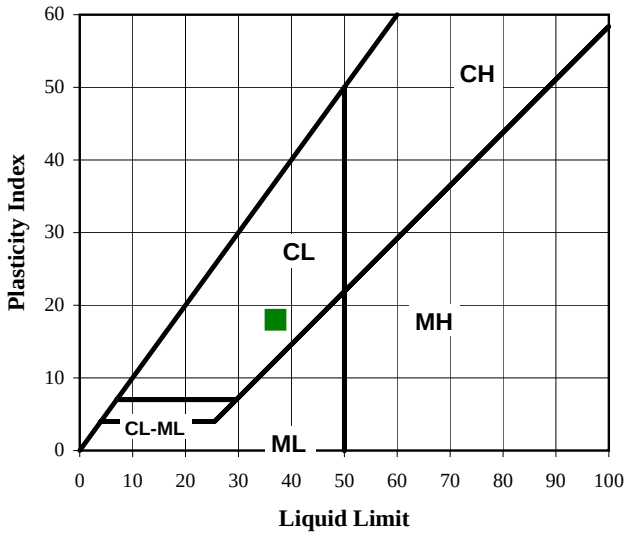
PLASTIC LIMIT

Test Number	1	2	3
Tare Number	453	459	503
Wt. Tare & WS, gm	17.15	17.01	17.19
Wt. Tare & DS, gm	16.12	16.02	16.14
Wt. Water, gm	1.03	0.99	1.05
Wt. Tare, gm	10.78	10.80	10.62
Wt. DS, gm	5.34	5.22	5.52
Water Content, %	19.3	19.0	19.0

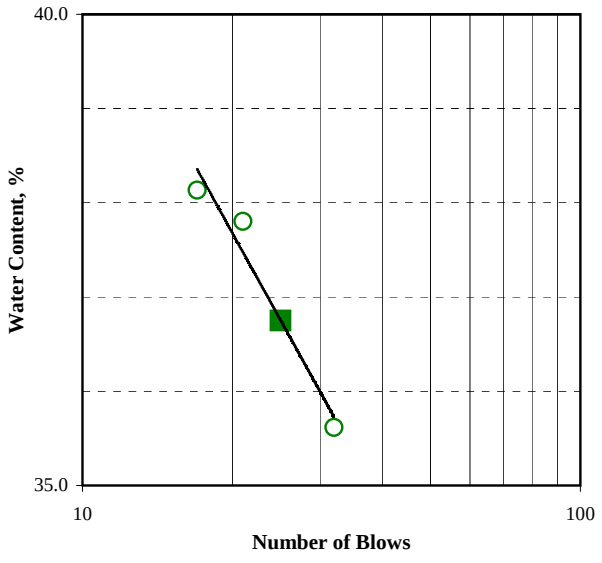
LIQUID LIMIT

	1	2	3
Tare Number	411	446	472
Wt. Tare & WS, gm	19.12	20.33	18.74
Wt. Tare & DS, gm	16.79	17.68	16.66
Wt. Water, gm	2.33	2.65	2.08
Wt. Tare, gm	10.68	10.67	10.82
Wt. DS, gm	6.11	7.01	5.84
Water Content, %	38.1	37.8	35.6
# of Blows	17	21	32

PLASTICITY CHART



FLOW CURVE



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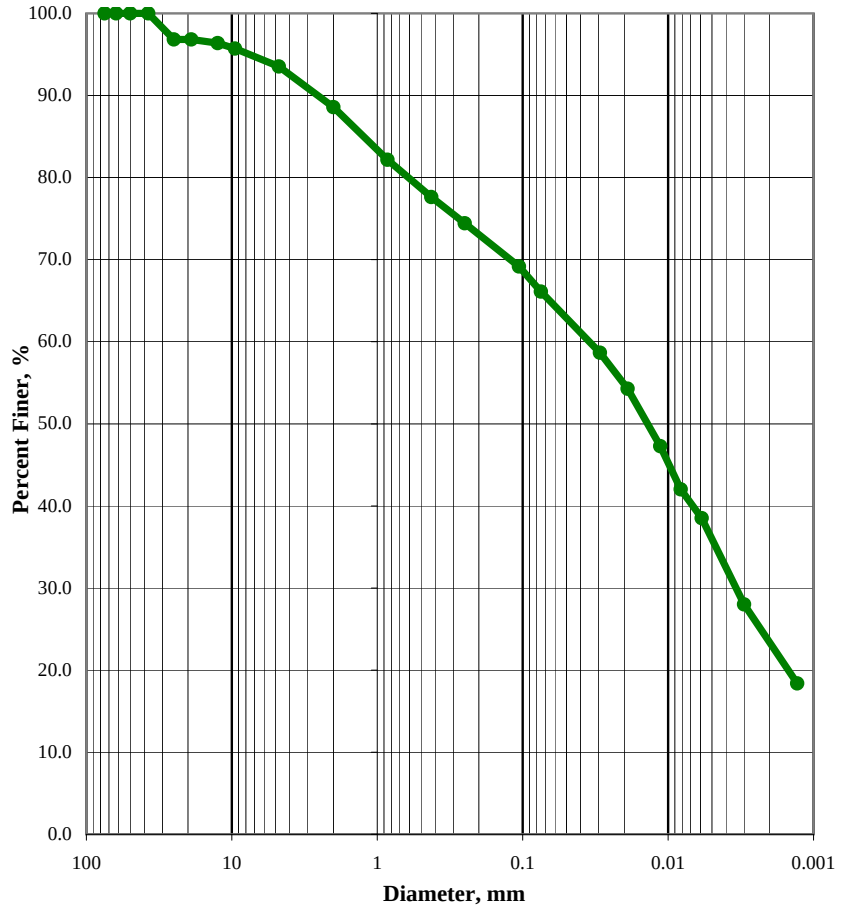
PARTICLE-SIZE ANALYSIS OF SOILS

Client	Civil & Environmental Consultants, I	Boring	SB-4
Client Project	091-867 Apex Landfill Expansion	Depth	28'-30'
Project No.	30598	Sample	ST-1
		Lab Sample No.	30598013
USCS Description	**DARK GRAYISH BROWN SANDY LEAN CLAY**		
USCS Group Symbol	**CL**	AASHTO:	**A-6 (10)**
USDA Description	**LOAM**		



US Std. Sieve Size	Particle Diameter (mm)	Percent Finer (%)
3"	75	100.0
2 1/2"	62.5	100.0
2"	50	100.0
1 1/2"	37.5	100.0
1"	25	96.8
3/4"	19	96.8
1/2"	12.5	96.4
3/8"	9.5	95.7
#4	4.75	93.5
#10	2	88.6
#20	0.85	82.2
#40	0.425	77.6
#60	0.25	74.4
#140	0.106	69.2
#200	0.075	66.1
NA	0.0294	58.7
NA	0.0190	54.3
NA	0.0113	47.3
NA	0.0082	42.0
NA	0.0059	38.5
NA	0.0030	28.0
NA	0.0013	18.4

USCS SOIL CLASSIFICATION

Corrected For 100% Passing a 3" Sieve

% Gravel (-3" & +#4)	**6.5**	Silt=30% Clay=36%	
Coarse=3.2; Fine=3.3		D60, mm	NA
% Sand (-#4 & +#200)	**27.4**	D30, mm	NA
Coa.=4.9; Med.=11; Fine=11.5		D10, mm	NA
% Fines (-#200)	**66.1**	Cc	NA
% Plus #200 (-3")	**33.9**	Cu	NA

USCS Description
SANDY LEAN CLAY

USCS Group Symbol	Atterberg Limits Group Symbol		
CL	**CL, LL=37, PL=19, PI=18**		
Auxiliary Information	Wt Ret, gm	% Retained	% Finer
12" Sieve - 300 mm	0	0.0	100.0
6" Sieve - 150 mm	0	0.0	100.0
3" Sieve - 75 mm	387.2	26.3	73.7

USDA CLASSIFICATION

Particle Size (mm)	Percent Finer (%)	Percent of Each Component (Material)	(%)	Corrected Percent of -2.0 mm Material for USDA
100	100			
		Gravel	11.4	0
2	88.6			
		Sand	25.7	29.0
0.05	62.9			
		Silt	39.5	44.6
0.002	23.4			
		Clay	23.4	26.4

USDA Classification
LOAM

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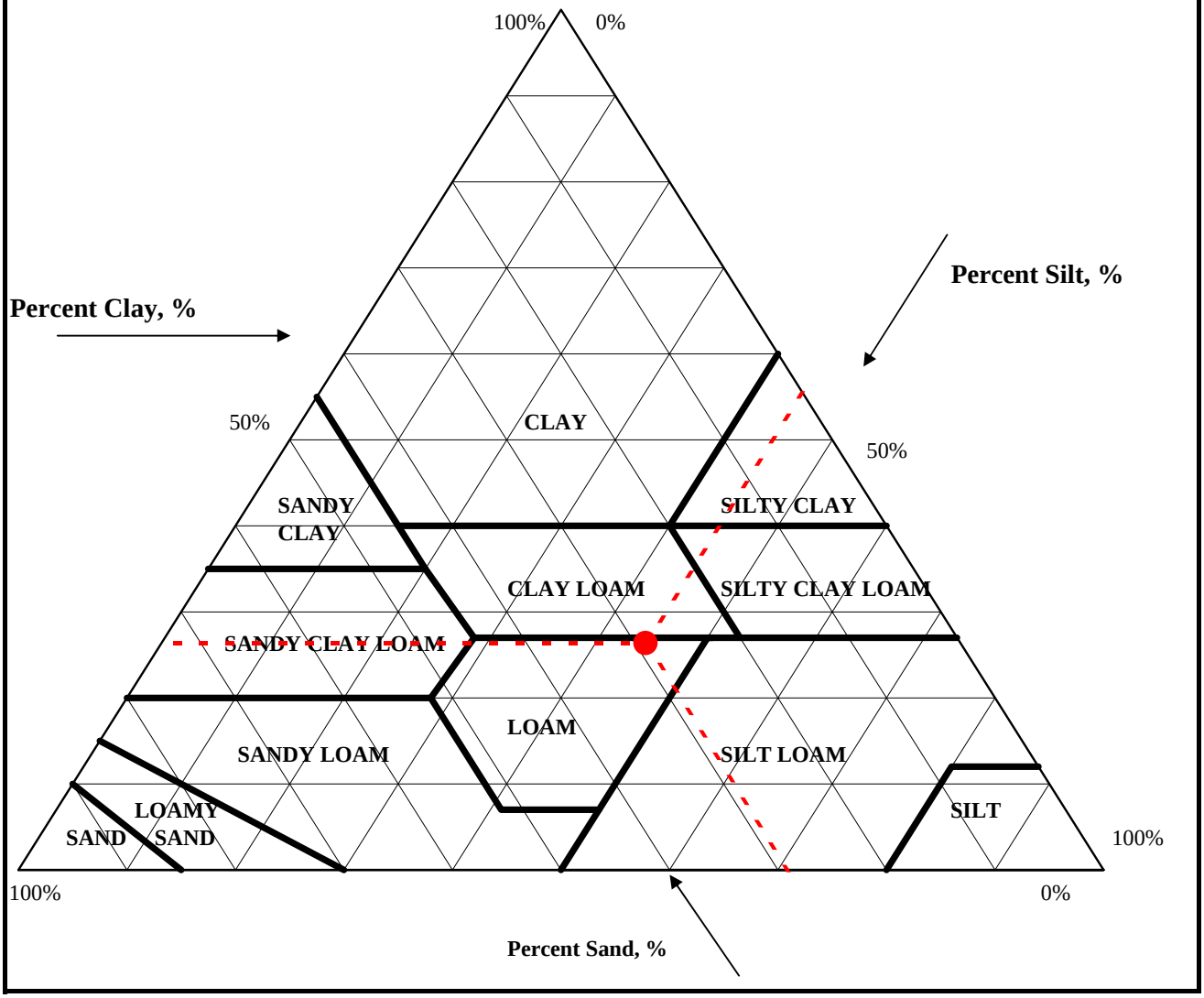
USDA CLASSIFICATION CHART

Client	Civil & Environmental Consultants, I	Boring	SB-4
Client Project	091-867 Apex Landfill Expansion	Depth	28'-30'
Project No.	30598	Sample	ST-1
		Lab Sample No.	30598013
USCS Description	**DARK GRAYISH BROWN SANDY LEAN CLAY**		
USCS Group Symbol	**CL**	AASHTO Classification	**A-6 (10)**
USDA Description	**LOAM**		

Corrected for 0% gravel	
Percent Gravel, %	0.0
Percent Sand, %	29.0
Percent Silt, %	44.6
Percent Clay, %	26.4

Sand Subsizes Corrected Percentages	
Very Coarse Sand; 2-1	5.9
Coarse Sand; 1-0.5	5.3
Medium Sand; 0.5-0.25	4.8
Fine Sand; 0.25-0.1	6.5
Very Fine Sand; 0.1-0.05	6.5
Total	**29.0**



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PARTICLE-SIZE ANALYSIS OF SOILS
ASTM D 422

Client	Civil & Environmental Consultants, I	Boring	SB-6
Client Project	091-867 Apex Landfill Expansion	Depth	9'-10'
Project No.	30598	Sample	ST-2
		Lab Sample No.	30598014

USCS Description **GRAYISH BROWN CLAYEY GRAVEL WITH SAND**
USCS Group Symbol **GC** AASHTO: **A-2-6 (1)**
USDA Description **LOAM**

MECHANICAL SIEVE ANALYSIS

As-Received Representative Sample Size Split or Material Submitted Used	
Representable Wet Wt, gm	743.8
+#4 Grnd., Washed DS., gm	277.8
-#4 Wet Wt., gm	466.0
-#4 Water Content, %	11.3
-#4 Dry Wt., gm	418.5
Representable Dry Wt, gm	**696.3**
** Note: Percentages +#4 are based on total Dry representable sample.*	
Split Sample, -#4 washed over #200	
Tare No.	7
Tare + WS., gm	220.3
Tare + DS., gm	208.62
Tare, gm	105.68
Wt. of DS., gm	102.94
Water Content -#4, %	11.3
Wt. of +#200 Sample, gm	47.1

US Std. Sieve Size	Sieve Opening (mm)	Wt. of Soil Retained (gm)	Percent Retained (%)*	Cumulative Percent Retained	Percent Finer (%)	Final Percent Finer
3"	75	0	0.0	0.0	100.0	100.0
2 1/2"	62.5	0	0.0	0.0	100.0	100.0
2"	50	0	0.0	0.0	100.0	100.0
1 1/2"	37.5	0	0.0	0.0	100.0	100.0
1"	25	67.68	9.7	9.7	90.3	90.3
3/4"	19	35.31	5.1	14.8	85.2	85.2
1/2"	12.5	70.17	10.1	24.9	75.1	75.1
3/8"	9.5	25.77	3.7	28.6	71.4	71.4
#4	4.75	78.84	11.3	39.9	60.1	60.1
#10	2	8.61	8.4	8.4	91.6	55.1
#20	0.85	14.44	14.0	22.4	77.6	46.6
#40	0.425	8.09	7.9	30.3	69.7	41.9
#60	0.25	5.03	4.9	35.1	64.9	39.0
#140	0.106	6.8	6.6	41.7	58.3	35.0
#200	0.075	4.16	4.0	45.8	54.2	32.6
-#200 / Pan		55.8	54.2	100.0	-	-

The final percent finer combines the gradation of the plus #4 and minus #4 material.

HYDROMETER ANALYSIS (-#200)

Hydrometer Sample Weight (-#200)	
Tare No.	523
Wt. Tare + DS., gm	140.81
Wt. Tare, gm	104.07
Wt. Dispers., gm	5
Wt. Dry Soil, gm	31.74
-#10 Dispersed 1min in Hamilton Beach Mixer	
K Factor	0.0134
Composite Correction	7
a Factor	0.99
Average Test Temp, °C	20.3
Specific Gravity, Assumed	2.7

Elapsed Time (min.)	R Measured	Composite Correction	R Corrected	Percent Finer (%)	Particle Diameter (mm)	Adjusted % Finer (%)
0	NA	NA	NA	NA	NA	NA
2	33.5	7	26.5	82.6	0.0311	26.9
5	31	7	24	74.8	0.0200	24.4
15	28	7	21	65.4	0.0118	21.3
30	25	7	18	56.1	0.0085	18.3
60	23	7	16	49.9	0.0061	16.2
250	17.5	7	10.5	32.7	0.0031	10.7
1440	13	7	6	18.7	0.0013	6.1

The adjusted percent finer is corrected for the percent passing the -#200 sieve.

D 422 / USCS SOIL CLASSIFICATION

Corrected For 100% Passing a 3" Sieve

% Gravel (-3" & +#4)	**39.9**	Silt=17.9%	Clay=14.6%
Coarse=14.8; Fine=25.1		D60, mm	NA
% Sand (-#4 & +#200)	**27.5**	D30, mm	NA
Coa.=5; Med.=13.2; Fine=9.3		D10, mm	NA
% Fines (-#200)	**32.6**	Cc	NA
% Plus #200 (-3")	**67.4**	Cu	NA

USCS Description
CLAYEY GRAVEL WITH SAND

USCS Group Symbol	Atterberg Limits Group Symbol
GC	**CL, LL=34, PL=19, PI=15**

Auxiliary Information	Wt Ret, gm	% Retained	% Finer
12" Sieve - 300 mm	0	0.0	100.0
6" Sieve - 150 mm	0	0.0	100.0
3" Sieve - 75 mm	0	0.0	100.0

USDA CLASSIFICATION

Particle Size (mm)	Percent Finer (%)	Percent of Each Component (Material)	(%)	Corrected Percent of -2.0 mm Material for USDA
100	100			
		Gravel	44.9	0
2	55.1			
		Sand	25.1	45.6
0.05	30.0			
		Silt	21.7	39.4
0.002	8.3			
		Clay	8.3	15.1

USDA Classification
LOAM

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LIQUID LIMIT, PLASTIC LIMIT, AND PLASTICITY INDEX OF SOILS
ASTM D 4318

Client	Civil & Environmental Consultants, I	Boring No.	SB-6
Client Project	091-867 Apex Landfill Expansion	Depth(ft)	9'-10'
Project No.	30598	Sample No.	ST-2
		Lab Sample No.	30598014

Soil Description: GRAYISH BROWN LEAN CLAY
(-#40 Fraction)

AS-RECEIVED W.C.

Tare Number	7
Wt. Tare & WS, gm	220.30
Wt. Tare & DS, gm	208.62
Wt. Water, gm	11.68
Wt. Tare, gm	105.68
Wt. DS, gm	102.94
Water Content, %	11.3

SAMPLE SUMMARY

Liquid Limit (LL), %	34
Plastic Limit (PL), %	19
Plasticity Index (PI)	15
USCS Symbol (-#40 Fraction)	CL
Sample Preparation:	Wet Method
Liquidity Index, %	-51.0%
Clay Fraction (% 2 microns)	NA
Skempton's Activity (A)	NA

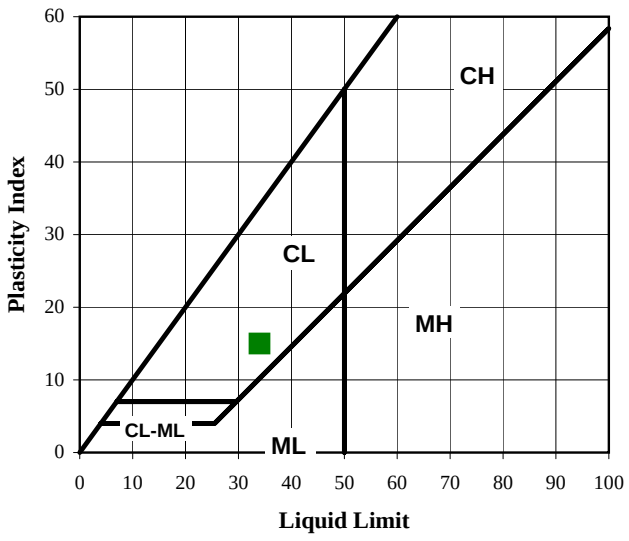
PLASTIC LIMIT

Test Number	1	2	3
Tare Number	499	497	461
Wt. Tare & WS, gm	17.52	21.15	19.39
Wt. Tare & DS, gm	16.45	19.46	17.99
Wt. Water, gm	1.07	1.69	1.40
Wt. Tare, gm	10.75	10.74	10.66
Wt. DS, gm	5.70	8.72	7.33
Water Content, %	18.8	19.4	19.1

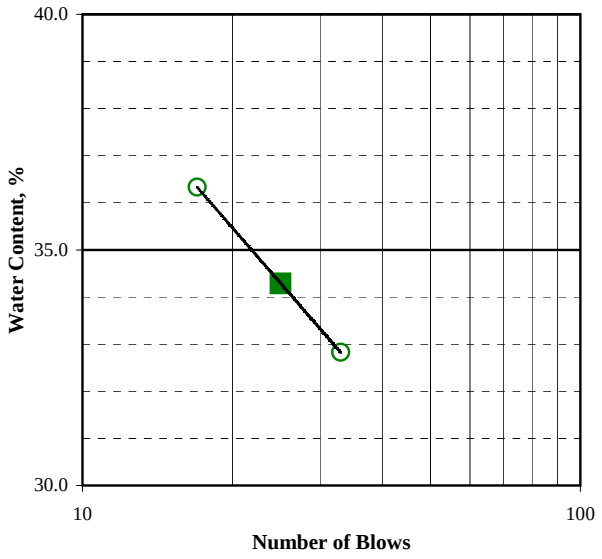
LIQUID LIMIT

	1	2	3
	443	453	488
	18.80	17.43	19.65
	16.66	15.73	17.48
	2.14	1.70	2.17
	10.77	10.77	10.87
	5.89	4.96	6.61
	36.3	34.3	32.8
# of Blows	17	25	33

PLASTICITY CHART



FLOW CURVE



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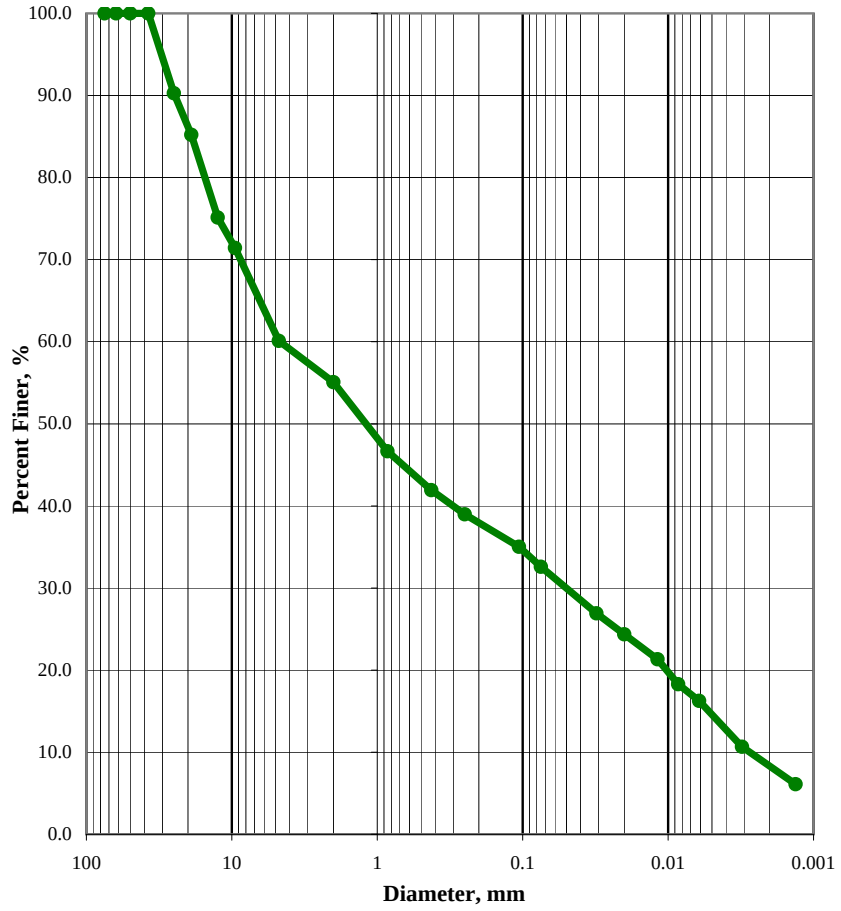
PARTICLE-SIZE ANALYSIS OF SOILS

Client	Civil & Environmental Consultants, I	Boring	SB-6
Client Project	091-867 Apex Landfill Expansion	Depth	9'-10'
Project No.	30598	Sample	ST-2
		Lab Sample No.	30598014
USCS Description	**GRAYISH BROWN CLAYEY GRAVEL WITH SAND**		
USCS Group Symbol	**GC**	AASHTO:	**A-2-6 (1)**
USDA Description	**LOAM**		



US Std. Sieve Size	Particle Diameter (mm)	Percent Finer (%)
3"	75	100.0
2 1/2"	62.5	100.0
2"	50	100.0
1 1/2"	37.5	100.0
1"	25	90.3
3/4"	19	85.2
1/2"	12.5	75.1
3/8"	9.5	71.4
#4	4.75	60.1
#10	2	55.1
#20	0.85	46.6
#40	0.425	41.9
#60	0.25	39.0
#140	0.106	35.0
#200	0.075	32.6
NA	0.0311	26.9
NA	0.0200	24.4
NA	0.0118	21.3
NA	0.0085	18.3
NA	0.0061	16.2
NA	0.0031	10.7
NA	0.0013	6.1

USCS SOIL CLASSIFICATION

Corrected For 100% Passing a 3" Sieve

% Gravel (-3" & +#4)	**39.9**	Silt=17.9% Clay=14.6%	
Coarse=14.8; Fine=25.1		D60, mm	NA
% Sand (-#4 & +#200)	**27.5**	D30, mm	NA
Coa.=5; Med.=13.2; Fine=9.3		D10, mm	NA
% Fines (-#200)	**32.6**	Cc	NA
% Plus #200 (-3")	**67.4**	Cu	NA

USCS Description
CLAYEY GRAVEL WITH SAND

USCS Group Symbol	Atterberg Limits Group Symbol		
GC	**CL, LL=34, PL=19, PI=15**		
Auxiliary Information	Wt Ret, gm	% Retained	% Finer
12" Sieve - 300 mm	0	0.0	100.0
6" Sieve - 150 mm	0	0.0	100.0
3" Sieve - 75 mm	0	0.0	100.0

USDA CLASSIFICATION

Particle Size (mm)	Percent Finer (%)	Percent of Each Component (Material)	(%)	Corrected Percent of -2.0 mm Material for USDA
100	100			
		Gravel	44.9	0
2	55.1			
		Sand	25.1	45.6
0.05	30.0			
		Silt	21.7	39.4
0.002	8.3			
		Clay	8.3	15.1

USDA Classification
LOAM

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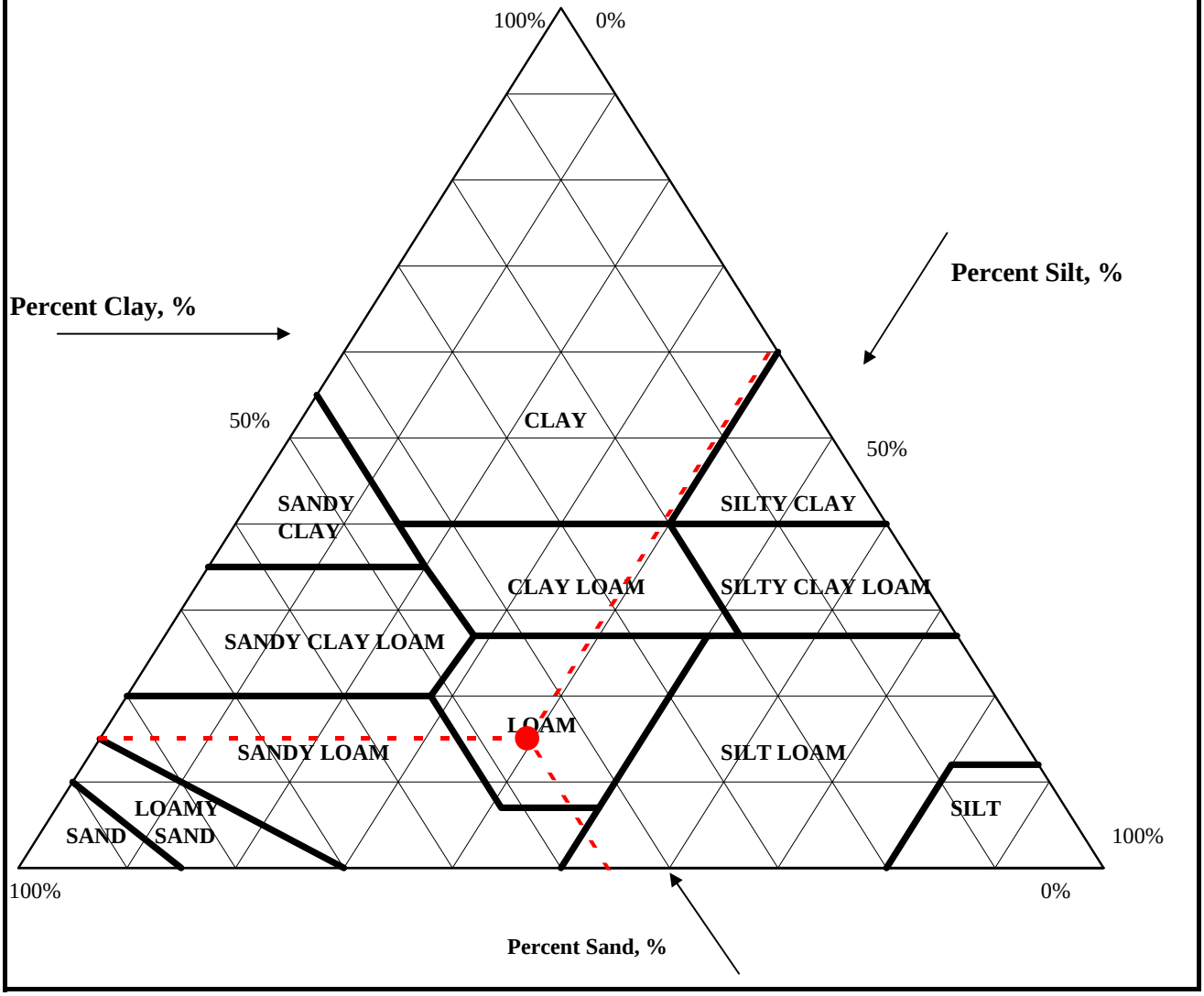
USDA CLASSIFICATION CHART

Client	Civil & Environmental Consultants, I	Boring	SB-6
Client Project	091-867 Apex Landfill Expansion	Depth	9'-10'
Project No.	30598	Sample	ST-2
		Lab Sample No.	30598014
USCS Description	**GRAYISH BROWN CLAYEY GRAVEL WITH SAND**		
USCS Group Symbol	**GC**	AASHTO Classification	**A-2-6 (1)**
USDA Description	**LOAM**		

Corrected for 0% gravel	
Percent Gravel, %	0.0
Percent Sand, %	45.6
Percent Silt, %	39.4
Percent Clay, %	15.1

Sand Subsizes Corrected Percentages	
Very Coarse Sand; 2-1	12.4
Coarse Sand; 1-0.5	9.5
Medium Sand; 0.5-0.25	7.3
Fine Sand; 0.25-0.1	8.0
Very Fine Sand; 0.1-0.05	8.4
Total	**45.6**



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PARTICLE-SIZE ANALYSIS OF SOILS
ASTM D 422

Client	Civil & Environmental Consultants, I	Boring	SB-8
Client Project	091-867 Apex Landfill Expansion	Depth	2'-4'
Project No.	30598	Sample	ST-1
		Lab Sample No.	30598015

USCS Description **YELLOWISH BROWN LEAN CLAY WITH SAND**
USCS Group Symbol **CL** AASHTO: **A-6 (9)**
USDA Description **SILT LOAM**

MECHANICAL SIEVE ANALYSIS

As-Received Representative Sample Size Split or Material Submitted Used	
Representable Wet Wt, gm	1313.4
+#4 Grnd., Washed DS., gm	0.0
-#4 Wet Wt., gm	1313.4
-#4 Water Content, %	14.2
-#4 Dry Wt., gm	1150.0
Representable Dry Wt, gm	**1150.0**
** Note: Percentages +#4 are based on total Dry representable sample.*	
Split Sample, -#4 washed over #200	
Tare No.	947
Tare + WS., gm	298.19
Tare + DS., gm	273.36
Tare, gm	98.62
Wt. of DS., gm	174.74
Water Content -#4, %	14.2
Wt. of +#200 Sample, gm	45.3

US Std. Sieve Size	Sieve Opening (mm)	Wt. of Soil Retained (gm)	Percent Retained (%)*	Cumulative Percent Retained	Percent Finer (%)	Final Percent Finer
3"	75	0	0.0	0.0	100.0	100.0
2 1/2"	62.5	0	0.0	0.0	100.0	100.0
2"	50	0	0.0	0.0	100.0	100.0
1 1/2"	37.5	0	0.0	0.0	100.0	100.0
1"	25	0	0.0	0.0	100.0	100.0
3/4"	19	0	0.0	0.0	100.0	100.0
1/2"	12.5	0	0.0	0.0	100.0	100.0
3/8"	9.5	0	0.0	0.0	100.0	100.0
#4	4.75	0	0.0	0.0	100.0	100.0
#10	2	9.08	5.2	5.2	94.8	94.8
#20	0.85	16.13	9.2	14.4	85.6	85.6
#40	0.425	8.56	4.9	19.3	80.7	80.7
#60	0.25	3.82	2.2	21.5	78.5	78.5
#140	0.106	4.07	2.3	23.8	76.2	76.2
#200	0.075	3.62	2.1	25.9	74.1	74.1
-#200 / Pan		129.5	74.1	100.0	-	-

The final percent finer combines the gradation of the plus #4 and minus #4 material.

HYDROMETER ANALYSIS (-#200)

Hydrometer Sample Weight (-#200)	
Tare No.	946
Wt. Tare + DS., gm	140.13
Wt. Tare, gm	98.46
Wt. Dispers., gm	5
Wt. Dry Soil, gm	36.67
-#10 Dispersed 1min in Hamilton Beach Mixer	
K Factor	0.0135
Composite Correction	7
a Factor	0.99
Average Test Temp, °C	20.1
Specific Gravity, Assumed	2.7

Elapsed Time (min.)	R Measured	Composite Correction	R Corrected	Percent Finer (%)	Particle Diameter (mm)	Adjusted % Finer (%)
0	NA	NA	NA	NA	NA	NA
2	37	7	30	80.9	0.0303	59.9
5	33.5	7	26.5	71.5	0.0197	52.9
15	29	7	22	59.3	0.0118	44.0
30	25.5	7	18.5	49.9	0.0085	37.0
60	23	7	16	43.1	0.0061	32.0
250	17	7	10	27.0	0.0031	20.0
1440	13	7	6	16.2	0.0013	12.0

The adjusted percent finer is corrected for the percent passing the -#200 sieve.

D 422 / USCS SOIL CLASSIFICATION

Corrected For 100% Passing a 3" Sieve

% Gravel (-3" & +#4)	**0.0**	Silt=45.5%	Clay=28.4%
Coarse=0; Fine=0		D60, mm	NA
% Sand (-#4 & +#200)	**25.9**	D30, mm	NA
Coa.=5.2; Med.=14.1; Fine=6.6		D10, mm	NA
% Fines (-#200)	**74.1**	Cc	NA
% Plus #200 (-3")	**25.9**	Cu	NA

USCS Description
LEAN CLAY WITH SAND

USCS Group Symbol	Atterberg Limits Group Symbol
CL	**CL, LL=35, PL=21, PI=14**

Auxiliary Information	Wt Ret, gm	% Retained	% Finer
12" Sieve - 300 mm	0	0.0	100.0
6" Sieve - 150 mm	0	0.0	100.0
3" Sieve - 75 mm	0	0.0	100.0

USDA CLASSIFICATION

Particle Size (mm)	Percent Finer (%)	Percent of Each Component (Material)	(%)	Corrected Percent of -2.0 mm Material for USDA
100	100			
		Gravel	5.2	0
2	94.8			
		Sand	27.0	28.5
0.05	67.8			
		Silt	51.9	54.8
0.002	15.8			
		Clay	15.8	16.7

USDA Classification
SILT LOAM

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LIQUID LIMIT, PLASTIC LIMIT, AND PLASTICITY INDEX OF SOILS
ASTM D 4318

Client	Civil & Environmental Consultants, I	Boring No.	SB-8
Client Project	091-867 Apex Landfill Expansion	Depth(ft)	2'-4'
Project No.	30598	Sample No.	ST-1
		Lab Sample No.	30598015

Soil Description: YELLOWISH BROWN LEAN CLAY
(-#40 Fraction)

AS-RECEIVED W.C.

Tare Number	947
Wt. Tare & WS, gm	298.19
Wt. Tare & DS, gm	273.36
Wt. Water, gm	24.83
Wt. Tare, gm	98.62
Wt. DS, gm	174.74
Water Content, %	14.2

SAMPLE SUMMARY

Liquid Limit (LL), %	35
Plastic Limit (PL), %	21
Plasticity Index (PI)	14
USCS Symbol (-#40 Fraction)	CL
Sample Preparation:	Wet Method
Liquidity Index, %	-48.5%
Clay Fraction (% 2 microns)	NA
Skempton's Activity (A)	NA

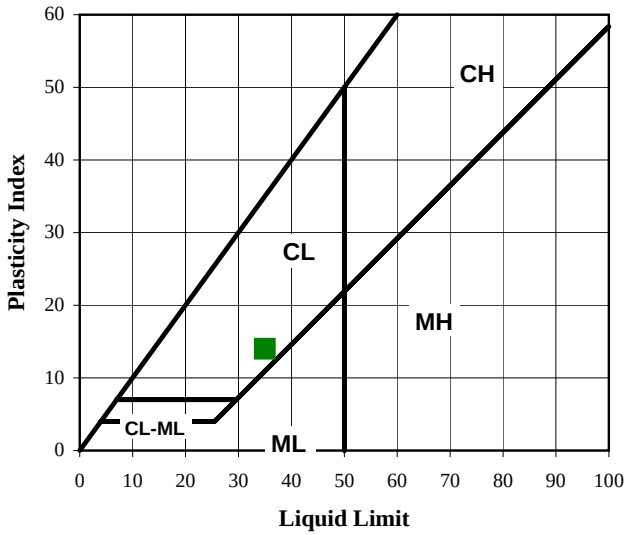
PLASTIC LIMIT

Test Number	1	2	3
Tare Number	427	416	491
Wt. Tare & WS, gm	23.64	23.30	21.85
Wt. Tare & DS, gm	21.47	21.13	19.96
Wt. Water, gm	2.17	2.17	1.89
Wt. Tare, gm	10.80	10.81	10.83
Wt. DS, gm	10.67	10.32	9.13
Water Content, %	20.3	21.0	20.7

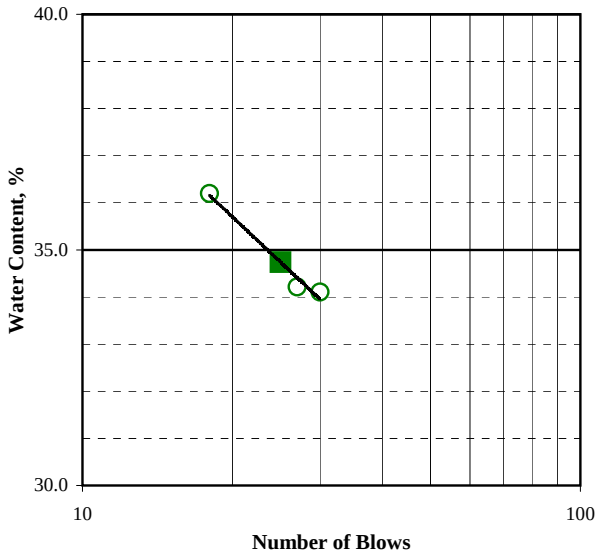
LIQUID LIMIT

	1	2	3
Tare Number	416	470	503
Wt. Tare & WS, gm	18.90	19.84	21.03
Wt. Tare & DS, gm	16.75	17.51	18.38
Wt. Water, gm	2.15	2.33	2.65
Wt. Tare, gm	10.81	10.70	10.61
Wt. DS, gm	5.94	6.81	7.77
Water Content, %	36.2	34.2	34.1
# of Blows	18	27	30

PLASTICITY CHART



FLOW CURVE



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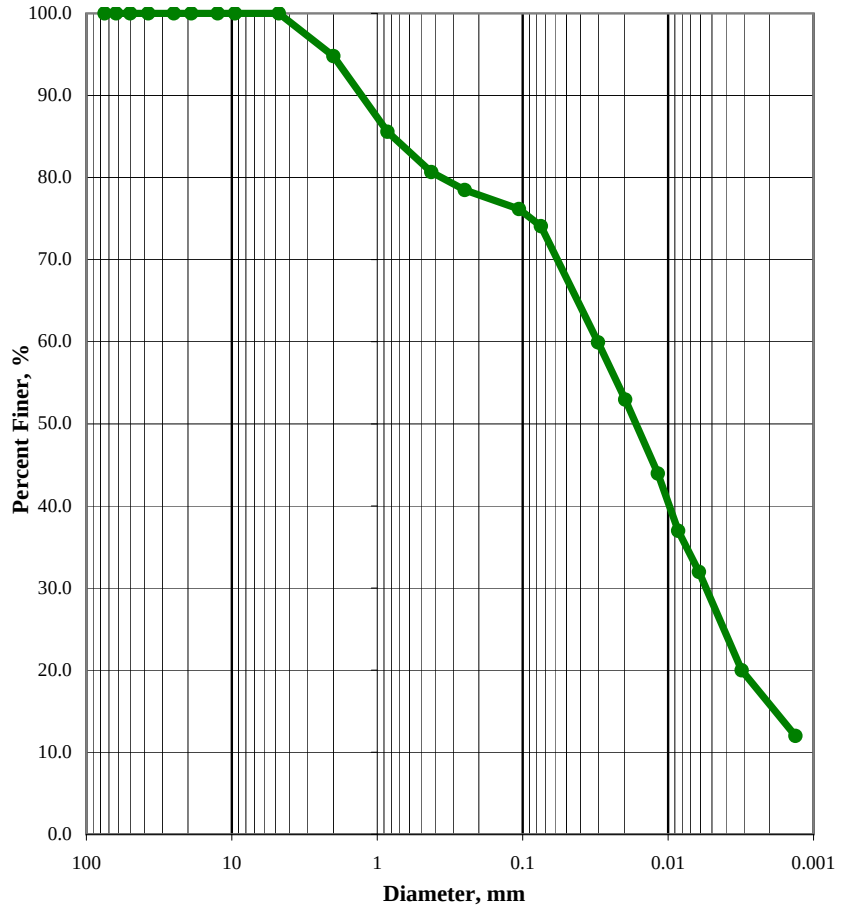
PARTICLE-SIZE ANALYSIS OF SOILS

Client	Civil & Environmental Consultants, I	Boring	SB-8
Client Project	091-867 Apex Landfill Expansion	Depth	2'-4'
Project No.	30598	Sample	ST-1
		Lab Sample No.	30598015
USCS Description	**YELLOWISH BROWN LEAN CLAY WITH SAND**		
USCS Group Symbol	**CL**	AASHTO:	**A-6 (9)**
USDA Description	**SILT LOAM**		



US Std. Sieve Size	Particle Diameter (mm)	Percent Finer (%)
3"	75	100.0
2 1/2"	62.5	100.0
2"	50	100.0
1 1/2"	37.5	100.0
1"	25	100.0
3/4"	19	100.0
1/2"	12.5	100.0
3/8"	9.5	100.0
#4	4.75	100.0
#10	2	94.8
#20	0.85	85.6
#40	0.425	80.7
#60	0.25	78.5
#140	0.106	76.2
#200	0.075	74.1
NA	0.0303	59.9
NA	0.0197	52.9
NA	0.0118	44.0
NA	0.0085	37.0
NA	0.0061	32.0
NA	0.0031	20.0
NA	0.0013	12.0

USCS SOIL CLASSIFICATION

Corrected For 100% Passing a 3" Sieve

% Gravel (-3" & +#4)	**0.0**	Silt=45.5% Clay=28.4%	
Coarse=0; Fine=0		D60, mm	NA
% Sand (-#4 & +#200)	**25.9**	D30, mm	NA
Coa.=5.2; Med.=14.1; Fine=6.6		D10, mm	NA
% Fines (-#200)	**74.1**	Cc	NA
% Plus #200 (-3")	**25.9**	Cu	NA

USCS Description
LEAN CLAY WITH SAND

USCS Group Symbol	Atterberg Limits Group Symbol
CL	**CL, LL=35, PL=21, PI=14**

Auxiliary Information	Wt Ret, gm	% Retained	% Finer
12" Sieve - 300 mm	0	0.0	100.0
6" Sieve - 150 mm	0	0.0	100.0
3" Sieve - 75 mm	0	0.0	100.0

USDA CLASSIFICATION

Particle Size (mm)	Percent Finer (%)	Percent of Each Component (Material)	(%)	Corrected Percent of -2.0 mm Material for USDA
100	100			
		Gravel	5.2	0
2	94.8			
		Sand	27.0	28.5
0.05	67.8			
		Silt	51.9	54.8
0.002	15.8			
		Clay	15.8	16.7

USDA Classification
SILT LOAM

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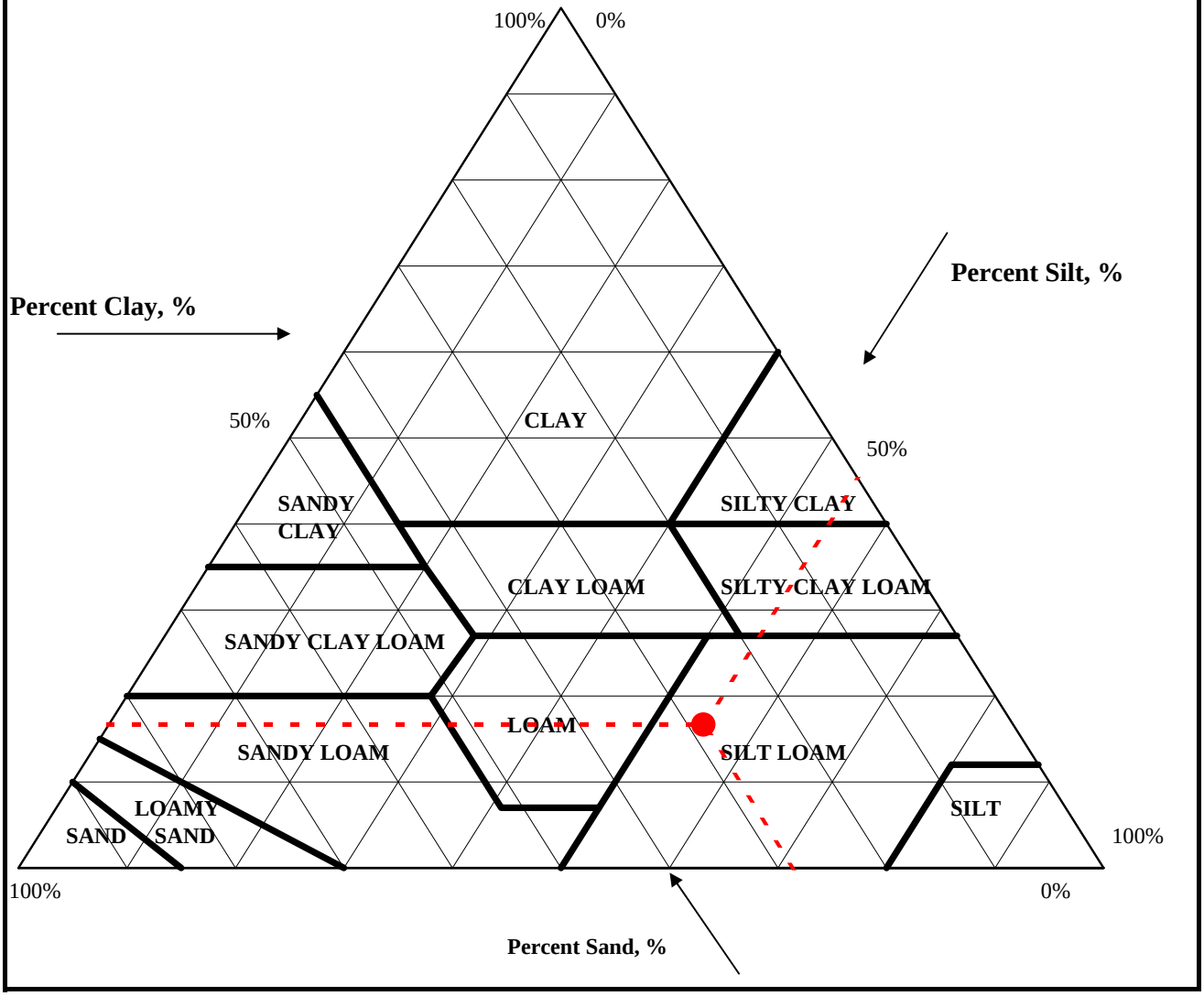
USDA CLASSIFICATION CHART

Client	Civil & Environmental Consultants, I	Boring	SB-8
Client Project	091-867 Apex Landfill Expansion	Depth	2'-4'
Project No.	30598	Sample	ST-1
		Lab Sample No.	30598015
USCS Description	**YELLOWISH BROWN LEAN CLAY WITH SAND**		
USCS Group Symbol	**CL**	AASHTO Classification	**A-6 (9)**
USDA Description	**SILT LOAM**		

Corrected for 0% gravel	
Percent Gravel, %	0.0
Percent Sand, %	28.5
Percent Silt, %	54.8
Percent Clay, %	16.7

Sand Subsizes Corrected Percentages	
Very Coarse Sand; 2-1	7.9
Coarse Sand; 1-0.5	5.8
Medium Sand; 0.5-0.25	3.5
Fine Sand; 0.25-0.1	2.8
Very Fine Sand; 0.1-0.05	8.5
Total	**28.5**



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PARTICLE-SIZE ANALYSIS OF SOILS
ASTM D 422

Client	Civil & Environmental Consultants, I	Boring	SB-14
Client Project	091-867 Apex Landfill Expansion	Depth	10'-12'
Project No.	30598	Sample	ST-1
		Lab Sample No.	30598016
USCS Description	**DARK GRAYISH BROWN SANDY LEAN CLAY**		
USCS Group Symbol	**CL**	AASHTO:	**A-7-6 (14)**
USDA Description	**LOAM**		

MECHANICAL SIEVE ANALYSIS

As-Received Representative Sample Size Split or Material Submitted Used	
Representable Wet Wt, gm	643.0
+#4 Grnd., Washed DS., gm	68.4
-#4 Wet Wt., gm	574.6
-#4 Water Content, %	22.0
-#4 Dry Wt., gm	470.8
Representable Dry Wt, gm	**539.2**
** Note: Percentages +#4 are based on total Dry representable sample.*	
Split Sample, -#4 washed over #200	
Tare No.	832
Tare + WS., gm	253.35
Tare + DS., gm	226.29
Tare, gm	103.55
Wt. of DS., gm	122.74
Water Content -#4, %	22.0
Wt. of +#200 Sample, gm	37.2

US Std. Sieve Size	Sieve Opening (mm)	Wt. of Soil Retained (gm)	Percent Retained (%)*	Cumulative Percent Retained	Percent Finer (%)	Final Percent Finer
3"	75	0	0.0	0.0	100.0	100.0
2 1/2"	62.5	0	0.0	0.0	100.0	100.0
2"	50	0	0.0	0.0	100.0	100.0
1 1/2"	37.5	0	0.0	0.0	100.0	100.0
1"	25	0	0.0	0.0	100.0	100.0
3/4"	19	33.46	6.2	6.2	93.8	93.8
1/2"	12.5	0	0.0	6.2	93.8	93.8
3/8"	9.5	8.52	1.6	7.8	92.2	92.2
#4	4.75	26.44	4.9	12.7	87.3	87.3
#10	2	2.43	2.0	2.0	98.0	85.6
#20	0.85	12.33	10.0	12.0	88.0	76.8
#40	0.425	8.29	6.8	18.8	81.2	70.9
#60	0.25	5.15	4.2	23.0	77.0	67.3
#140	0.106	6.14	5.0	28.0	72.0	62.9
#200	0.075	2.9	2.4	30.3	69.7	60.8
-#200 / Pan		85.5	69.7	100.0	-	-

The final percent finer combines the gradation of the plus #4 and minus #4 material.

HYDROMETER ANALYSIS (-#200)

Hydrometer Sample Weight (-#200)	
Tare No.	941
Wt. Tare + DS., gm	137.17
Wt. Tare, gm	99.56
Wt. Dispers., gm	5
Wt. Dry Soil, gm	32.61
-#10 Dispersed 1min in Hamilton Beach Mixer	
K Factor	0.0135
Composite Correction	7
a Factor	0.99
Average Test Temp, °C	20.0
Specific Gravity, Assumed	2.7

Elapsed Time (min.)	R Measured	Composite Correction	R Corrected	Percent Finer (%)	Particle Diameter (mm)	Adjusted % Finer (%)
0	NA	NA	NA	NA	NA	NA
2	35.5	7	28.5	86.4	0.0307	52.6
5	34	7	27	81.9	0.0197	49.8
15	31	7	24	72.8	0.0116	44.3
30	27.5	7	20.5	62.2	0.0084	37.8
60	25	7	18	54.6	0.0061	33.2
250	19.5	7	12.5	37.9	0.0031	23.1
1440	14.5	7	7.5	22.7	0.0013	13.8

The adjusted percent finer is corrected for the percent passing the -#200 sieve.

D 422 / USCS SOIL CLASSIFICATION

Corrected For 100% Passing a 3" Sieve

% Gravel (-3" & +#4)	**12.7**	Silt=30.4%	Clay=30.3%
Coarse=6.2; Fine=6.5		D60, mm	NA
% Sand (-#4 & +#200)	**26.5**	D30, mm	NA
Coa.=1.7; Med.=14.7; Fine=10.1		D10, mm	NA
% Fines (-#200)	**60.8**	Cc	NA
% Plus #200 (-3")	**39.2**	Cu	NA

USCS Description

SANDY LEAN CLAY

USCS Group Symbol	Atterberg Limits Group Symbol
CL	**CL, LL=48, PL=22, PI=26**

Auxiliary Information	Wt Ret, gm	% Retained	% Finer
12" Sieve - 300 mm	0	0.0	100.0
6" Sieve - 150 mm	0	0.0	100.0
3" Sieve - 75 mm	0	0.0	100.0

USDA CLASSIFICATION

Particle Size (mm)	Percent Finer (%)	Percent of Each Component (Material)	(%)	Corrected Percent of -2.0 mm Material for USDA
100	100			
		Gravel	14.4	0
2	85.6			
		Sand	28.5	33.3
0.05	57.1			
		Silt	38.7	45.2
0.002	18.4			
		Clay	18.4	21.5

USDA Classification

LOAM

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LIQUID LIMIT, PLASTIC LIMIT, AND PLASTICITY INDEX OF SOILS
ASTM D 4318

Client	Civil & Environmental Consultants, I	Boring No.	SB-14
Client Project	091-867 Apex Landfill Expansion	Depth(ft)	10'-12'
Project No.	30598	Sample No.	ST-1
		Lab Sample No.	30598016

Soil Description: DARK GRAYISH BROWN LEAN CLAY
(-#40 Fraction)

AS-RECEIVED W.C.

Tare Number	832
Wt. Tare & WS, gm	253.35
Wt. Tare & DS, gm	226.29
Wt. Water, gm	27.06
Wt. Tare, gm	103.55
Wt. DS, gm	122.74
Water Content, %	22.0

SAMPLE SUMMARY

Liquid Limit (LL), %	48
Plastic Limit (PL), %	22
Plasticity Index (PI)	26
USCS Symbol (-#40 Fraction)	CL
Sample Preparation:	Wet Method
Liquidity Index, %	0.2%
Clay Fraction (% 2 microns)	NA
Skempton's Activity (A)	NA

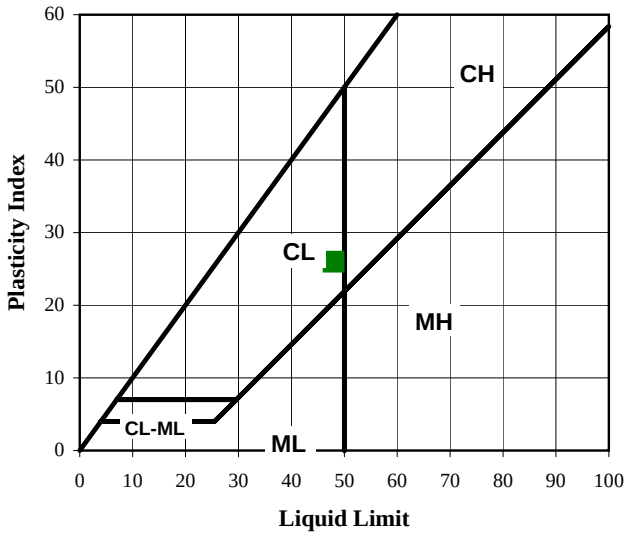
PLASTIC LIMIT

Test Number	1	2	3
Tare Number	405	424	466
Wt. Tare & WS, gm	18.74	20.31	19.11
Wt. Tare & DS, gm	17.26	18.59	17.61
Wt. Water, gm	1.48	1.72	1.50
Wt. Tare, gm	10.55	10.77	10.82
Wt. DS, gm	6.71	7.82	6.79
Water Content, %	22.1	22.0	22.1

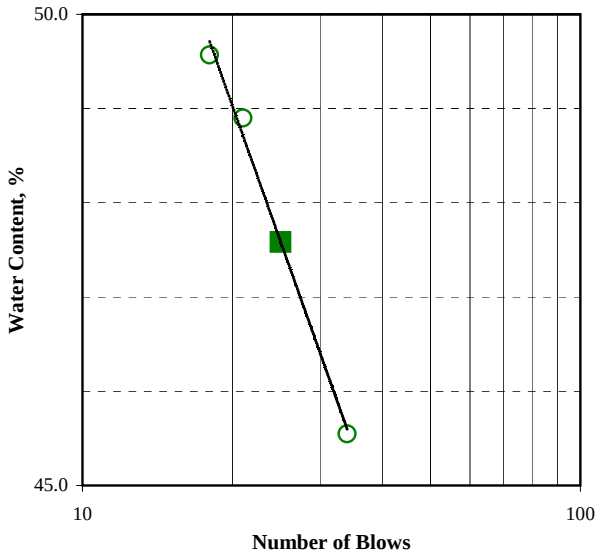
LIQUID LIMIT

	1	2	3
Tare Number	433	451	467
Wt. Tare & WS, gm	19.38	19.57	20.56
Wt. Tare & DS, gm	16.51	16.68	17.49
Wt. Water, gm	2.87	2.89	3.07
Wt. Tare, gm	10.72	10.77	10.75
Wt. DS, gm	5.79	5.91	6.74
Water Content, %	49.6	48.9	45.5
# of Blows	18	21	34

PLASTICITY CHART



FLOW CURVE



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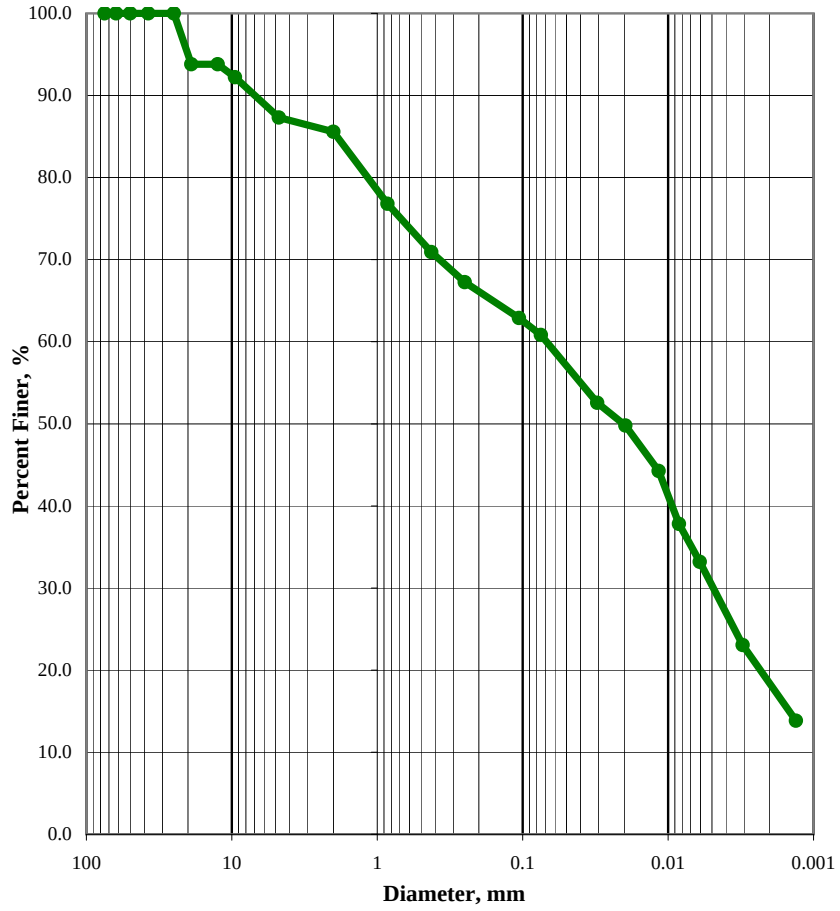
PARTICLE-SIZE ANALYSIS OF SOILS

Client	Civil & Environmental Consultants, I	Boring	SB-14
Client Project	091-867 Apex Landfill Expansion	Depth	10'-12'
Project No.	30598	Sample	ST-1
		Lab Sample No.	30598016
USCS Description	**DARK GRAYISH BROWN SANDY LEAN CLAY**		
USCS Group Symbol	**CL**	AASHTO:	**A-7-6 (14)**
USDA Description	**LOAM**		



US Std. Sieve Size	Particle Diameter (mm)	Percent Finer (%)
3"	75	100.0
2 1/2"	62.5	100.0
2"	50	100.0
1 1/2"	37.5	100.0
1"	25	100.0
3/4"	19	93.8
1/2"	12.5	93.8
3/8"	9.5	92.2
#4	4.75	87.3
#10	2	85.6
#20	0.85	76.8
#40	0.425	70.9
#60	0.25	67.3
#140	0.106	62.9
#200	0.075	60.8
NA	0.0307	52.6
NA	0.0197	49.8
NA	0.0116	44.3
NA	0.0084	37.8
NA	0.0061	33.2
NA	0.0031	23.1
NA	0.0013	13.8

USCS SOIL CLASSIFICATION

Corrected For 100% Passing a 3" Sieve

% Gravel (-3" & +#4)	**12.7**	Silt=30.4%	Clay=30.3%
Coarse=6.2; Fine=6.5		D60, mm	NA
% Sand (-#4 & +#200)	**26.5**	D30, mm	NA
Coa.=1.7; Med.=14.7; Fine=10.1		D10, mm	NA
% Fines (-#200)	**60.8**	Cc	NA
% Plus #200 (-3")	**39.2**	Cu	NA

USCS Description
SANDY LEAN CLAY

USCS Group Symbol	Atterberg Limits Group Symbol
CL	**CL, LL=48, PL=22, PI=26**

Auxiliary Information	Wt Ret, gm	% Retained	% Finer
12" Sieve - 300 mm	0	0.0	100.0
6" Sieve - 150 mm	0	0.0	100.0
3" Sieve - 75 mm	0	0.0	100.0

USDA CLASSIFICATION

Particle Size (mm)	Percent Finer (%)	Percent of Each Component (Material)	(%)	Corrected Percent of -2.0 mm Material for USDA
100	100			
		Gravel	14.4	0
2	85.6			
		Sand	28.5	33.3
0.05	57.1			
		Silt	38.7	45.2
0.002	18.4			
		Clay	18.4	21.5

USDA Classification
LOAM

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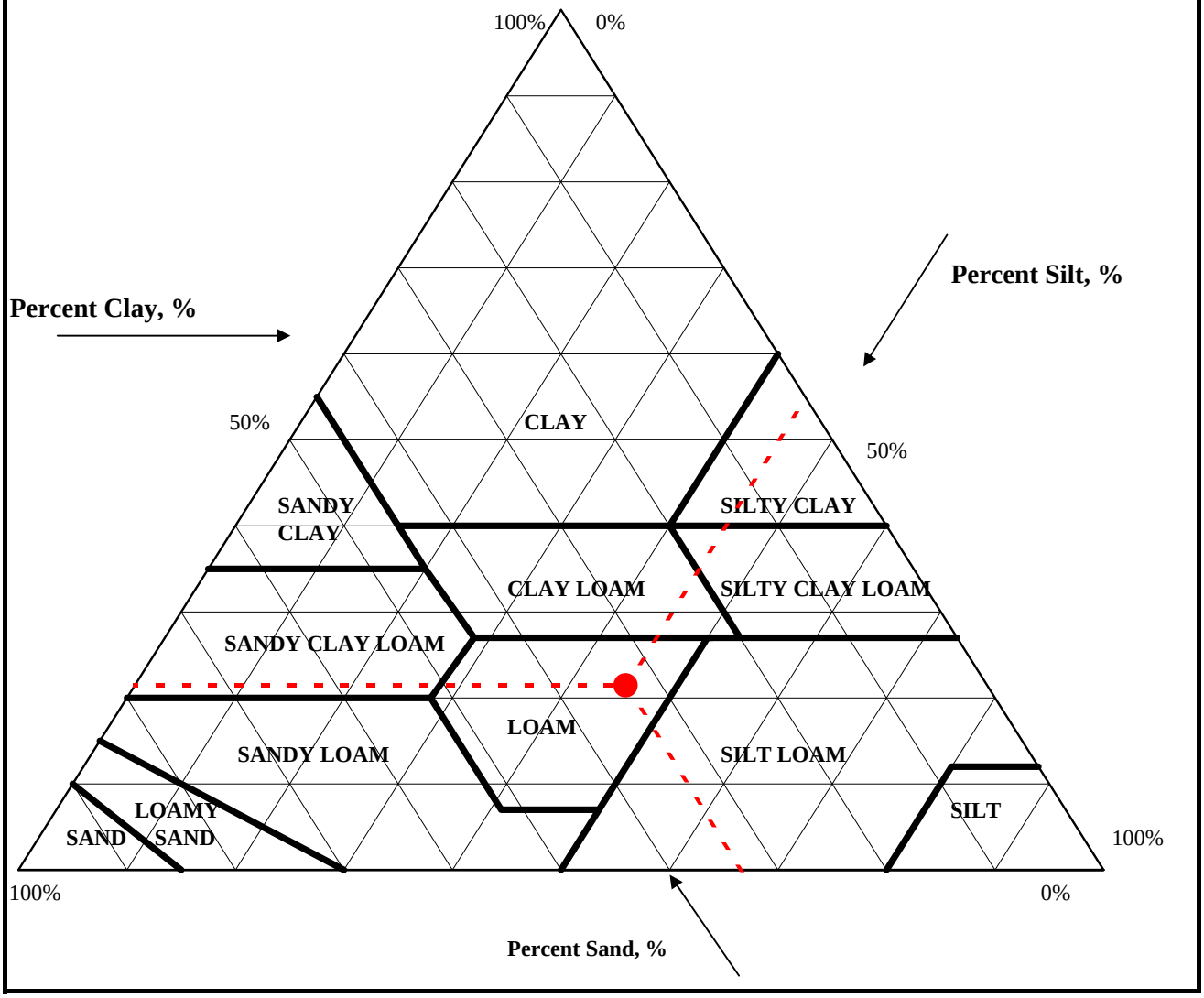
USDA CLASSIFICATION CHART

Client	Civil & Environmental Consultants, I	Boring	SB-14
Client Project	091-867 Apex Landfill Expansion	Depth	10'-12'
Project No.	30598	Sample	ST-1
		Lab Sample No.	30598016
USCS Description	**DARK GRAYISH BROWN SANDY LEAN CLAY**		
USCS Group Symbol	**CL**	AASHTO Classification	**A-7-6 (14)**
USDA Description	**LOAM**		

Corrected for 0% gravel	
Percent Gravel, %	0.0
Percent Sand, %	33.3
Percent Silt, %	45.2
Percent Clay, %	21.5

Sand Subsizes Corrected Percentages	
Very Coarse Sand; 2-1	8.3
Coarse Sand; 1-0.5	7.2
Medium Sand; 0.5-0.25	5.9
Fine Sand; 0.25-0.1	5.5
Very Fine Sand; 0.1-0.05	6.4
Total	**33.3**



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PARTICLE-SIZE ANALYSIS OF SOILS
ASTM D 422

Client	Civil & Environmental Consultants, I	Boring	SB-17
Client Project	091-867 Apex Landfill Expansion	Depth	18'-20'
Project No.	30598	Sample	ST-2
		Lab Sample No.	30598017
USCS Description	**GRAY CLAYEY SAND WITH GRAVEL**		
USCS Group Symbol	**SC**	AASHTO:	**A-6 (6)**
USDA Description	**LOAM**		

MECHANICAL SIEVE ANALYSIS

As-Received Representative Sample Size Split or Material Submitted Used	
Representable Wet Wt, gm	766.9
+#4 Grnd., Washed DS., gm	151.1
-#4 Wet Wt., gm	615.8
-#4 Water Content, %	14.3
-#4 Dry Wt., gm	538.6
Representable Dry Wt, gm	**689.7**
** Note: Percentages +#4 are based on total Dry representable sample.*	
Split Sample, -#4 washed over #200	
Tare No.	804
Tare + WS., gm	236.45
Tare + DS., gm	219.65
Tare, gm	102.4
Wt. of DS., gm	117.25
Water Content -#4, %	14.3
Wt. of +#200 Sample, gm	42.5

US Std. Sieve Size	Sieve Opening (mm)	Wt. of Soil Retained (gm)	Percent Retained (%)*	Cumulative Percent Retained	Percent Finer (%)	Final Percent Finer
3"	75	0	0.0	0.0	100.0	100.0
2 1/2"	62.5	0	0.0	0.0	100.0	100.0
2"	50	0	0.0	0.0	100.0	100.0
1 1/2"	37.5	0	0.0	0.0	100.0	100.0
1"	25	12.35	1.8	1.8	98.2	98.2
3/4"	19	29.42	4.3	6.1	93.9	93.9
1/2"	12.5	28.81	4.2	10.2	89.8	89.8
3/8"	9.5	25.77	3.7	14.0	86.0	86.0
#4	4.75	54.75	7.9	21.9	78.1	78.1
#10	2	6.05	5.2	5.2	94.8	74.1
#20	0.85	13.3	11.3	16.5	83.5	65.2
#40	0.425	8.09	6.9	23.4	76.6	59.8
#60	0.25	4.97	4.2	27.6	72.4	56.5
#140	0.106	6.66	5.7	33.3	66.7	52.1
#200	0.075	3.38	2.9	36.2	63.8	49.8
-#200 / Pan		74.8	63.8	100.0	-	-

The final percent finer combines the gradation of the plus #4 and minus #4 material.

HYDROMETER ANALYSIS (-#200)

Hydrometer Sample Weight (-#200)	
Tare No.	810
Wt. Tare + DS., gm	135.93
Wt. Tare, gm	102.21
Wt. Dispers., gm	5
Wt. Dry Soil, gm	28.72
-#10 Dispersed 1min in Hamilton Beach Mixer	
K Factor	0.0135
Composite Correction	7
a Factor	0.99
Average Test Temp, °C	20.1
Specific Gravity, Assumed	2.7

Elapsed Time (min.)	R Measured	Composite Correction	R Corrected	Percent Finer (%)	Particle Diameter (mm)	Adjusted % Finer (%)
0	NA	NA	NA	NA	NA	NA
2	32	7	25	86.1	0.0315	42.9
5	30	7	23	79.2	0.0202	39.5
15	28	7	21	72.3	0.0118	36.0
30	25.5	7	18.5	63.7	0.0085	31.7
60	23	7	16	55.1	0.0061	27.4
250	18	7	11	37.9	0.0031	18.9
1440	14	7	7	24.1	0.0013	12.0

The adjusted percent finer is corrected for the percent passing the -#200 sieve.

D 422 / USCS SOIL CLASSIFICATION

Corrected For 100% Passing a 3" Sieve

% Gravel (-3" & +#4)	**21.9**	Silt=24.8%	Clay=24.9%
Coarse=6.1; Fine=15.9		D60, mm	NA
% Sand (-#4 & +#200)	**28.3**	D30, mm	NA
Coa.=4; Med.=14.2; Fine=10		D10, mm	NA
% Fines (-#200)	**49.8**	Cc	NA
% Plus #200 (-3")	**50.2**	Cu	NA

USCS Description

CLAYEY SAND WITH GRAVEL

USCS Group Symbol	Atterberg Limits Group Symbol
SC	**CL, LL=37, PL=18, PI=19**

Auxiliary Information	Wt Ret, gm	% Retained	% Finer
12" Sieve - 300 mm	0	0.0	100.0
6" Sieve - 150 mm	0	0.0	100.0
3" Sieve - 75 mm	0	0.0	100.0

USDA CLASSIFICATION

Particle Size (mm)	Percent Finer (%)	Percent of Each Component (Material)	(%)	Corrected Percent of -2.0 mm Material for USDA
100	100			
		Gravel	25.9	0
2	74.1			
		Sand	27.5	37.1
0.05	46.6			
		Silt	31.2	42.2
0.002	15.3			
		Clay	15.3	20.7

USDA Classification

LOAM

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LIQUID LIMIT, PLASTIC LIMIT, AND PLASTICITY INDEX OF SOILS
ASTM D 4318

Client	Civil & Environmental Consultants, I	Boring No.	SB-17
Client Project	091-867 Apex Landfill Expansion	Depth(ft)	18'-20'
Project No.	30598	Sample No.	ST-2
		Lab Sample No.	30598017

Soil Description: GRAY LEAN CLAY
(-#40 Fraction)

AS-RECEIVED W.C.

Tare Number	804
Wt. Tare & WS, gm	236.45
Wt. Tare & DS, gm	219.65
Wt. Water, gm	16.80
Wt. Tare, gm	102.40
Wt. DS, gm	117.25
Water Content, %	14.3

SAMPLE SUMMARY

Liquid Limit (LL), %	37
Plastic Limit (PL), %	18
Plasticity Index (PI)	19
USCS Symbol (-#40 Fraction)	CL
Sample Preparation:	Wet Method
Liquidity Index, %	-19.3%
Clay Fraction (% 2 microns)	NA
Skempton's Activity (A)	NA

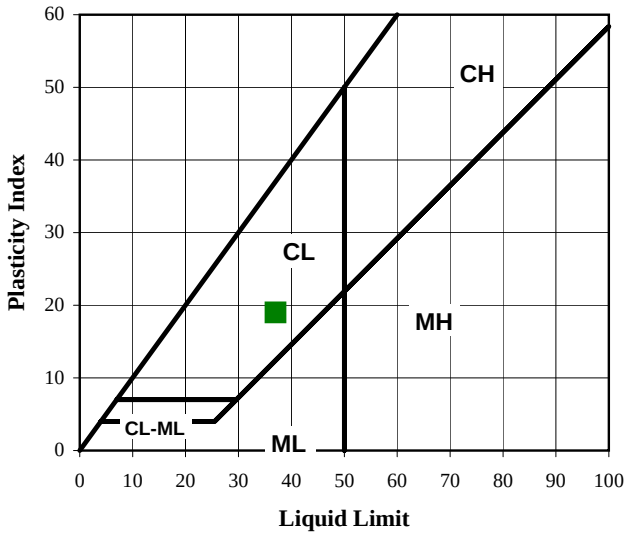
PLASTIC LIMIT

Test Number	1	2	3
Tare Number	500	421	414
Wt. Tare & WS, gm	19.71	19.09	19.52
Wt. Tare & DS, gm	18.32	17.83	18.13
Wt. Water, gm	1.39	1.26	1.39
Wt. Tare, gm	10.75	10.73	10.75
Wt. DS, gm	7.57	7.10	7.38
Water Content, %	18.4	17.7	18.8

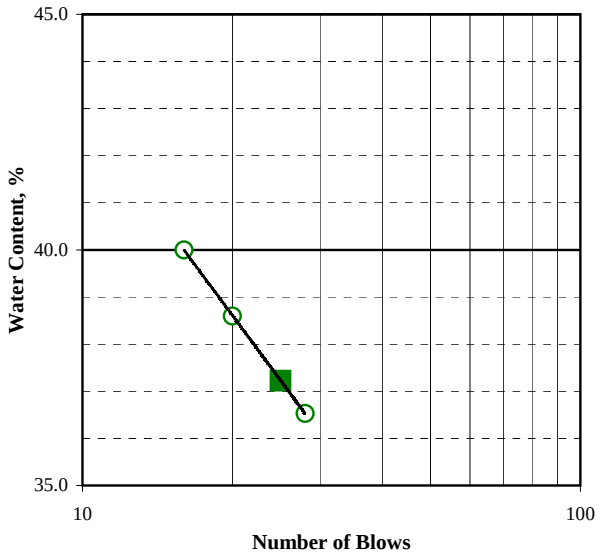
LIQUID LIMIT

	1	2	3
Tare Number	406	469	505
Wt. Tare & WS, gm	20.24	20.24	17.61
Wt. Tare & DS, gm	17.52	17.60	15.78
Wt. Water, gm	2.72	2.64	1.83
Wt. Tare, gm	10.72	10.76	10.77
Wt. DS, gm	6.80	6.84	5.01
Water Content, %	40.0	38.6	36.5
# of Blows	16	20	28

PLASTICITY CHART



FLOW CURVE



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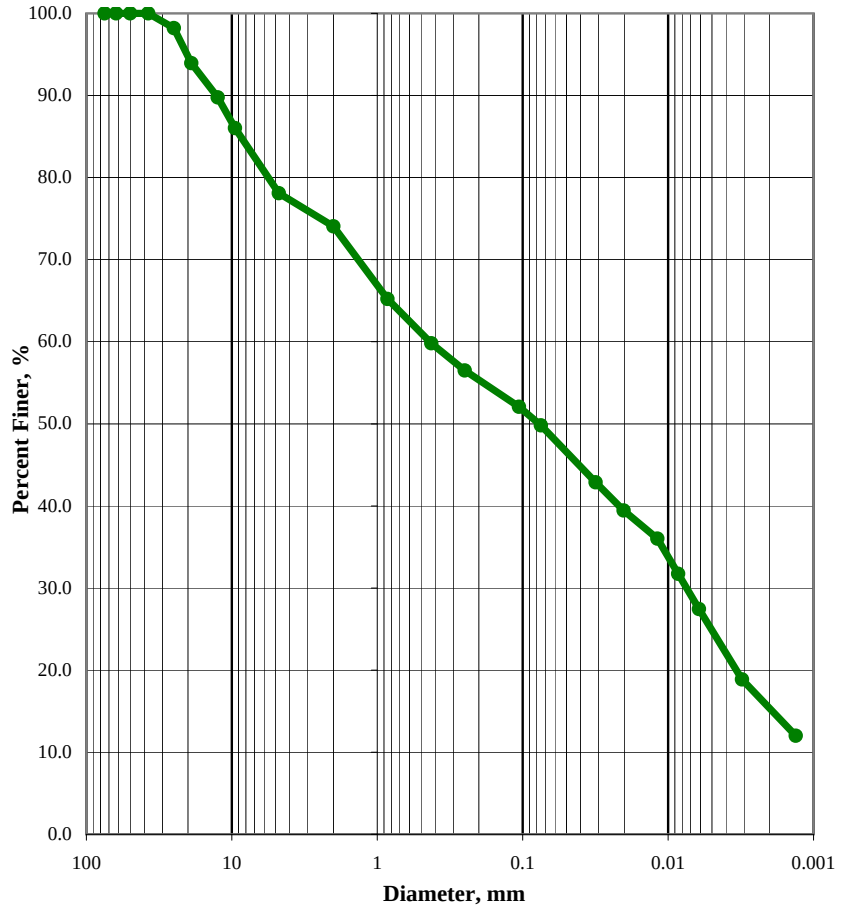
PARTICLE-SIZE ANALYSIS OF SOILS

Client	Civil & Environmental Consultants, I	Boring	SB-17
Client Project	091-867 Apex Landfill Expansion	Depth	18'-20'
Project No.	30598	Sample	ST-2
		Lab Sample No.	30598017

USCS Description **GRAY CLAYEY SAND WITH GRAVEL**
USCS Group Symbol **SC** AASHTO: **A-6 (6)**
USDA Description **LOAM**



US Std. Sieve Size	Particle Diameter (mm)	Percent Finer (%)
3"	75	100.0
2 1/2"	62.5	100.0
2"	50	100.0
1 1/2"	37.5	100.0
1"	25	98.2
3/4"	19	93.9
1/2"	12.5	89.8
3/8"	9.5	86.0
#4	4.75	78.1
#10	2	74.1
#20	0.85	65.2
#40	0.425	59.8
#60	0.25	56.5
#140	0.106	52.1
#200	0.075	49.8
NA	0.0315	42.9
NA	0.0202	39.5
NA	0.0118	36.0
NA	0.0085	31.7
NA	0.0061	27.4
NA	0.0031	18.9
NA	0.0013	12.0

USCS SOIL CLASSIFICATION

Corrected For 100% Passing a 3" Sieve

% Gravel (-3" & +#4)	**21.9**	Silt=24.8% Clay=24.9%	
Coarse=6.1; Fine=15.9		D60, mm	NA
% Sand (-#4 & +#200)	**28.3**	D30, mm	NA
Coa.=4; Med.=14.2; Fine=10		D10, mm	NA
% Fines (-#200)	**49.8**	Cc	NA
% Plus #200 (-3")	**50.2**	Cu	NA

USCS Description
CLAYEY SAND WITH GRAVEL

USCS Group Symbol	Atterberg Limits Group Symbol		
SC	**CL, LL=37, PL=18, PI=19**		
Auxiliary Information	Wt Ret, gm	% Retained	% Finer
12" Sieve - 300 mm	0	0.0	100.0
6" Sieve - 150 mm	0	0.0	100.0
3" Sieve - 75 mm	0	0.0	100.0

USDA CLASSIFICATION

Particle Size (mm)	Percent Finer (%)	Percent of Each Component (Material)	(%)	Corrected Percent of -2.0 mm Material for USDA
100	100			
		Gravel	25.9	0
2	74.1			
		Sand	27.5	37.1
0.05	46.6			
		Silt	31.2	42.2
0.002	15.3			
		Clay	15.3	20.7

USDA Classification
LOAM

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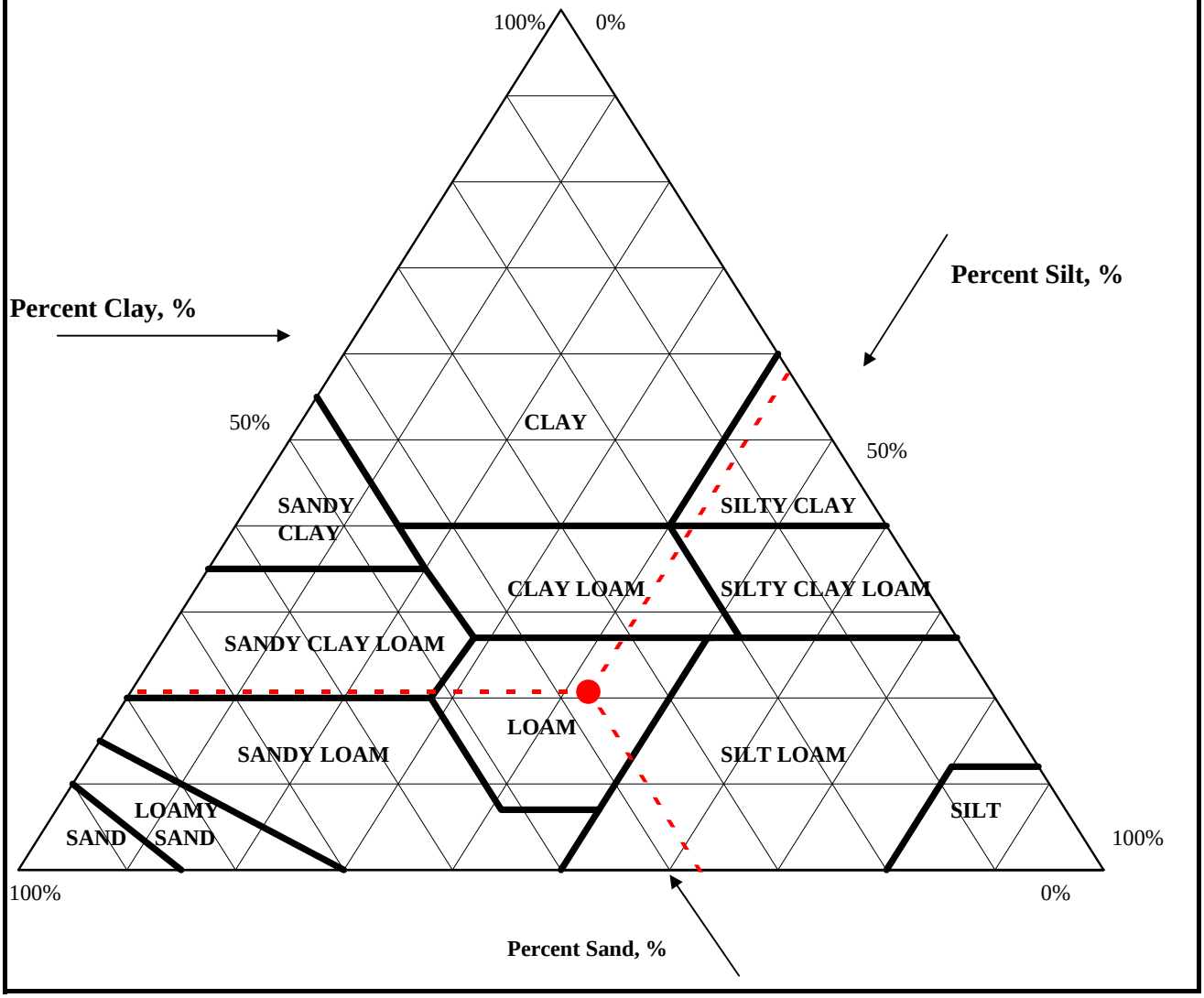
USDA CLASSIFICATION CHART

Client	Civil & Environmental Consultants, I	Boring	SB-17
Client Project	091-867 Apex Landfill Expansion	Depth	18'-20'
Project No.	30598	Sample	ST-2
		Lab Sample No.	30598017
USCS Description	**GRAY CLAYEY SAND WITH GRAVEL**		
USCS Group Symbol	**SC**	AASHTO Classification	**A-6 (6)**
USDA Description	**LOAM**		

Corrected for 0% gravel	
Percent Gravel, %	0.0
Percent Sand, %	37.1
Percent Silt, %	42.2
Percent Clay, %	20.7

Sand Subsizes Corrected Percentages	
Very Coarse Sand; 2-1	9.7
Coarse Sand; 1-0.5	7.8
Medium Sand; 0.5-0.25	6.2
Fine Sand; 0.25-0.1	6.5
Very Fine Sand; 0.1-0.05	6.9
Total	**37.1**



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PARTICLE-SIZE ANALYSIS OF SOILS
ASTM D 422

Client	Civil & Environmental Consultants, I	Boring	SB-18
Client Project	091-867 Apex Landfill Expansion	Depth	22'-24'
Project No.	30598	Sample	ST-3
		Lab Sample No.	30598018

USCS Description **DARK GRAYISH BROWN CLAYEY GRAVEL WITH SAND**
USCS Group Symbol **GC** AASHTO: **A-6 (5)**
USDA Description **LOAM**

MECHANICAL SIEVE ANALYSIS

As-Received Representative Sample Size Split or Material Submitted Used	
Representable Wet Wt, gm	670.8
+#4 Grnd., Washed DS., gm	161.9
-#4 Wet Wt., gm	509.0
-#4 Water Content, %	14.0
-#4 Dry Wt., gm	446.6
Representable Dry Wt, gm	**608.5**
** Note: Percentages +#4 are based on total Dry representable sample.*	
Split Sample, -#4 washed over #200	
Tare No.	829
Tare + WS., gm	218.61
Tare + DS., gm	204.42
Tare, gm	102.83
Wt. of DS., gm	101.59
Water Content -#4, %	14.0
Wt. of +#200 Sample, gm	35.3

US Std. Sieve Size	Sieve Opening (mm)	Wt. of Soil Retained (gm)	Percent Retained (%)*	Cumulative Percent Retained	Percent Finer (%)	Final Percent Finer
3"	75	0	0.0	0.0	100.0	100.0
2 1/2"	62.5	0	0.0	0.0	100.0	100.0
2"	50	0	0.0	0.0	100.0	100.0
1 1/2"	37.5	0	0.0	0.0	100.0	100.0
1"	25	48.88	8.0	8.0	92.0	92.0
3/4"	19	36.63	6.0	14.1	85.9	85.9
1/2"	12.5	26.86	4.4	18.5	81.5	81.5
3/8"	9.5	14.47	2.4	20.8	79.2	79.2
#4	4.75	35.03	5.8	26.6	73.4	73.4
#10	2	6.08	6.0	6.0	94.0	69.0
#20	0.85	9.25	9.1	15.1	84.9	62.3
#40	0.425	7.13	7.0	22.1	77.9	57.2
#60	0.25	4.83	4.8	26.9	73.1	53.7
#140	0.106	5.73	5.6	32.5	67.5	49.5
#200	0.075	2.32	2.3	34.8	65.2	47.9
-#200 / Pan		66.3	65.2	100.0	-	-

The final percent finer combines the gradation of the plus #4 and minus #4 material.

HYDROMETER ANALYSIS (-#200)

Hydrometer Sample Weight (-#200)	
Tare No.	825
Wt. Tare + DS., gm	144.44
Wt. Tare, gm	102.5
Wt. Dispers., gm	5
Wt. Dry Soil, gm	36.94
-#10 Dispersed 1min in Hamilton Beach Mixer	
K Factor	0.0135
Composite Correction	7
a Factor	0.99
Average Test Temp, °C	20.1
Specific Gravity, Assumed	2.7

Elapsed Time (min.)	R Measured	Composite Correction	R Corrected	Percent Finer (%)	Particle Diameter (mm)	Adjusted % Finer (%)
0	NA	NA	NA	NA	NA	NA
2	40	7	33	88.3	0.0296	42.3
5	38	7	31	83.0	0.0190	39.7
15	35	7	28	75.0	0.0112	35.9
30	32	7	25	66.9	0.0081	32.0
60	29	7	22	58.9	0.0059	28.2
250	22.5	7	15.5	41.5	0.0030	19.9
1440	11.5	7	4.5	12.0	0.0013	5.8

The adjusted percent finer is corrected for the percent passing the -#200 sieve.

D 422 / USCS SOIL CLASSIFICATION

Corrected For 100% Passing a 3" Sieve

% Gravel (-3" & +#4)	**26.6**	Silt=21.6%	Clay=26.2%
Coarse=14.1; Fine=12.5		D60, mm	NA
% Sand (-#4 & +#200)	**25.5**	D30, mm	NA
Coa.=4.4; Med.=11.8; Fine=9.3		D10, mm	NA
% Fines (-#200)	**47.9**	Cc	NA
% Plus #200 (-3")	**52.1**	Cu	NA

USCS Description
CLAYEY GRAVEL WITH SAND

USCS Group Symbol	Atterberg Limits Group Symbol
GC	**CL, LL=39, PL=22, PI=17**

Auxiliary Information	Wt Ret, gm	% Retained	% Finer
12" Sieve - 300 mm	0	0.0	100.0
6" Sieve - 150 mm	0	0.0	100.0
3" Sieve - 75 mm	0	0.0	100.0

USDA CLASSIFICATION

Particle Size (mm)	Percent Finer (%)	Percent of Each Component (Material)	(%)	Corrected Percent of -2.0 mm Material for USDA
100	100			
		Gravel	31.0	0
2	69.0			
		Sand	23.6	34.2
0.05	45.4			
		Silt	32.7	47.4
0.002	12.7			
		Clay	12.7	18.4

USDA Classification
LOAM

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LIQUID LIMIT, PLASTIC LIMIT, AND PLASTICITY INDEX OF SOILS
ASTM D 4318

Client	Civil & Environmental Consultants, I	Boring No.	SB-18
Client Project	091-867 Apex Landfill Expansion	Depth(ft)	22'-24'
Project No.	30598	Sample No.	ST-3
		Lab Sample No.	30598018

Soil Description: DARK GRAYISH BROWN LEAN CLAY
(-#40 Fraction)

AS-RECEIVED W.C.

Tare Number	829
Wt. Tare & WS, gm	218.61
Wt. Tare & DS, gm	204.42
Wt. Water, gm	14.19
Wt. Tare, gm	102.83
Wt. DS, gm	101.59
Water Content, %	14.0

SAMPLE SUMMARY

Liquid Limit (LL), %	39
Plastic Limit (PL), %	22
Plasticity Index (PI)	17
USCS Symbol (-#40 Fraction)	CL
Sample Preparation:	Wet Method
Liquidity Index, %	-47.2%
Clay Fraction (% 2 microns)	NA
Skempton's Activity (A)	NA

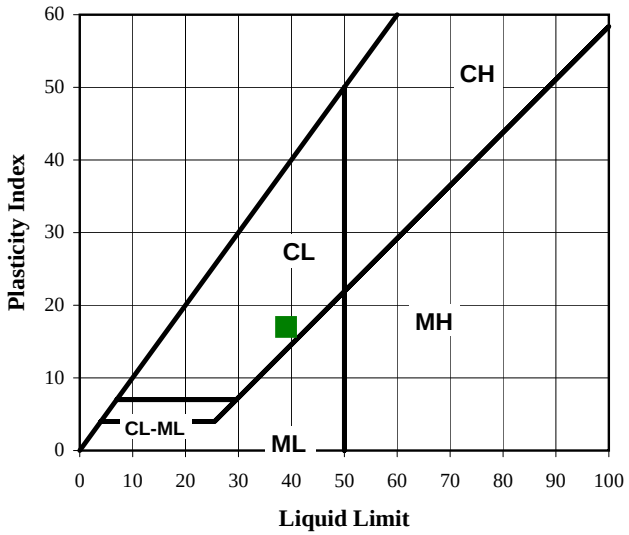
PLASTIC LIMIT

Test Number	1	2	3
Tare Number	404	412	498
Wt. Tare & WS, gm	17.07	16.89	16.9
Wt. Tare & DS, gm	15.92	15.80	15.78
Wt. Water, gm	1.15	1.09	1.12
Wt. Tare, gm	10.76	10.74	10.72
Wt. DS, gm	5.16	5.06	5.06
Water Content, %	22.3	21.5	22.1

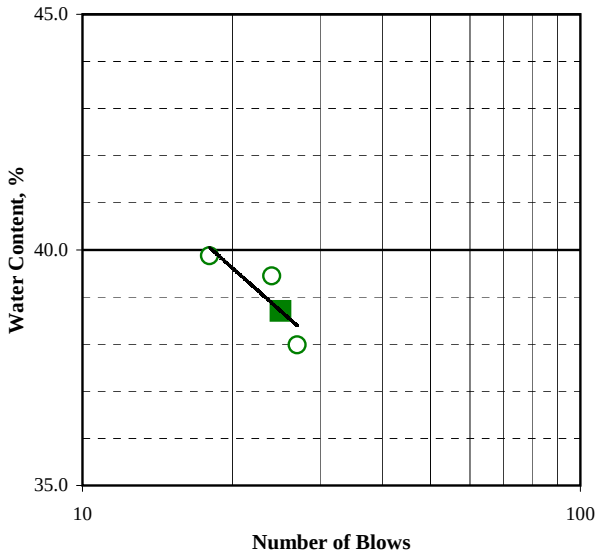
LIQUID LIMIT

	1	2	3
Tare Number	459	434	471
Wt. Tare & WS, gm	19.92	18.37	18.98
Wt. Tare & DS, gm	17.32	16.22	16.72
Wt. Water, gm	2.60	2.15	2.26
Wt. Tare, gm	10.80	10.77	10.77
Wt. DS, gm	6.52	5.45	5.95
Water Content, %	39.9	39.4	38.0
# of Blows	18	24	27

PLASTICITY CHART



FLOW CURVE



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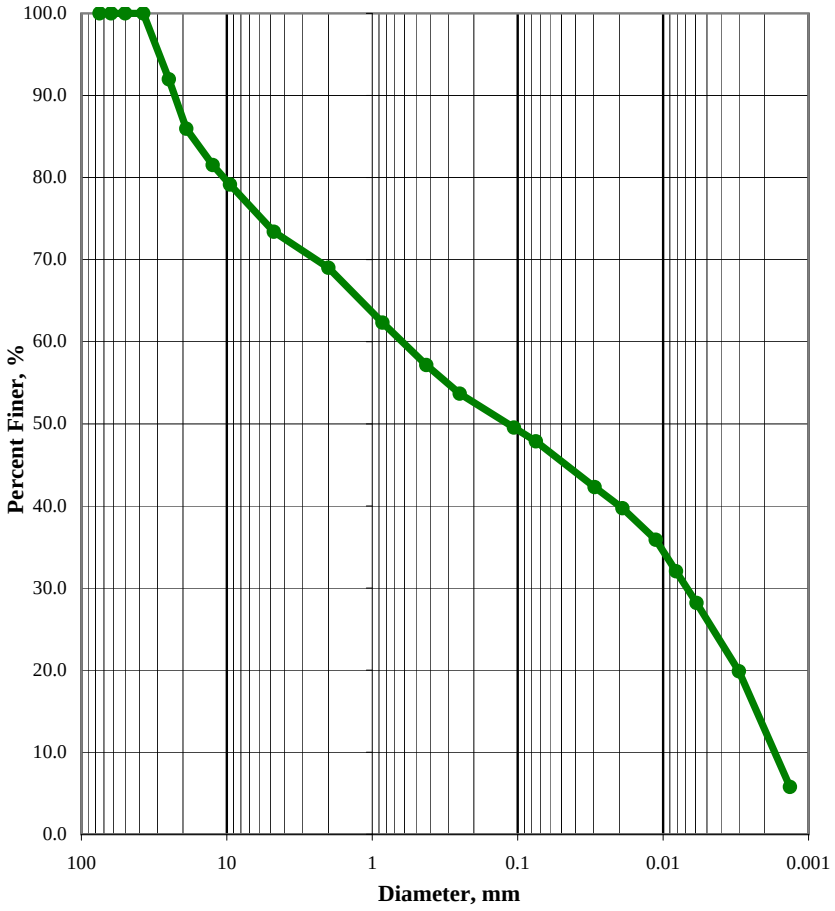
PARTICLE-SIZE ANALYSIS OF SOILS

Client	Civil & Environmental Consultants, I	Boring	SB-18
Client Project	091-867 Apex Landfill Expansion	Depth	22'-24'
Project No.	30598	Sample	ST-3
		Lab Sample No.	30598018

USCS Description **DARK GRAYISH BROWN CLAYEY GRAVEL WITH SAND**
USCS Group Symbol **GC** AASHTO: **A-6 (5)**
USDA Description **LOAM**



US Std. Sieve Size	Particle Diameter (mm)	Percent Finer (%)
3"	75	100.0
2 1/2"	62.5	100.0
2"	50	100.0
1 1/2"	37.5	100.0
1"	25	92.0
3/4"	19	85.9
1/2"	12.5	81.5
3/8"	9.5	79.2
#4	4.75	73.4
#10	2	69.0
#20	0.85	62.3
#40	0.425	57.2
#60	0.25	53.7
#140	0.106	49.5
#200	0.075	47.9
NA	0.0296	42.3
NA	0.0190	39.7
NA	0.0112	35.9
NA	0.0081	32.0
NA	0.0059	28.2
NA	0.0030	19.9
NA	0.0013	5.8

USCS SOIL CLASSIFICATION

Corrected For 100% Passing a 3" Sieve

% Gravel (-3" & +#4)	**26.6**	Silt=21.6%	Clay=26.2%
Coarse=14.1; Fine=12.5		D60, mm	NA
% Sand (-#4 & +#200)	**25.5**	D30, mm	NA
Coa.=4.4; Med.=11.8; Fine=9.3		D10, mm	NA
% Fines (-#200)	**47.9**	Cc	NA
% Plus #200 (-3")	**52.1**	Cu	NA

USCS Description
CLAYEY GRAVEL WITH SAND

USCS Group Symbol	Atterberg Limits Group Symbol		
GC	**CL, LL=39, PL=22, PI=17**		
Auxiliary Information	Wt Ret, gm	% Retained	% Finer
12" Sieve - 300 mm	0	0.0	100.0
6" Sieve - 150 mm	0	0.0	100.0
3" Sieve - 75 mm	0	0.0	100.0

USDA CLASSIFICATION

Particle Size (mm)	Percent Finer (%)	Percent of Each Component (Material)	(%)	Corrected Percent of -2.0 mm Material for USDA
100	100			
		Gravel	31.0	0
2	69.0			
		Sand	23.6	34.2
0.05	45.4			
		Silt	32.7	47.4
0.002	12.7			
		Clay	12.7	18.4

USDA Classification
LOAM

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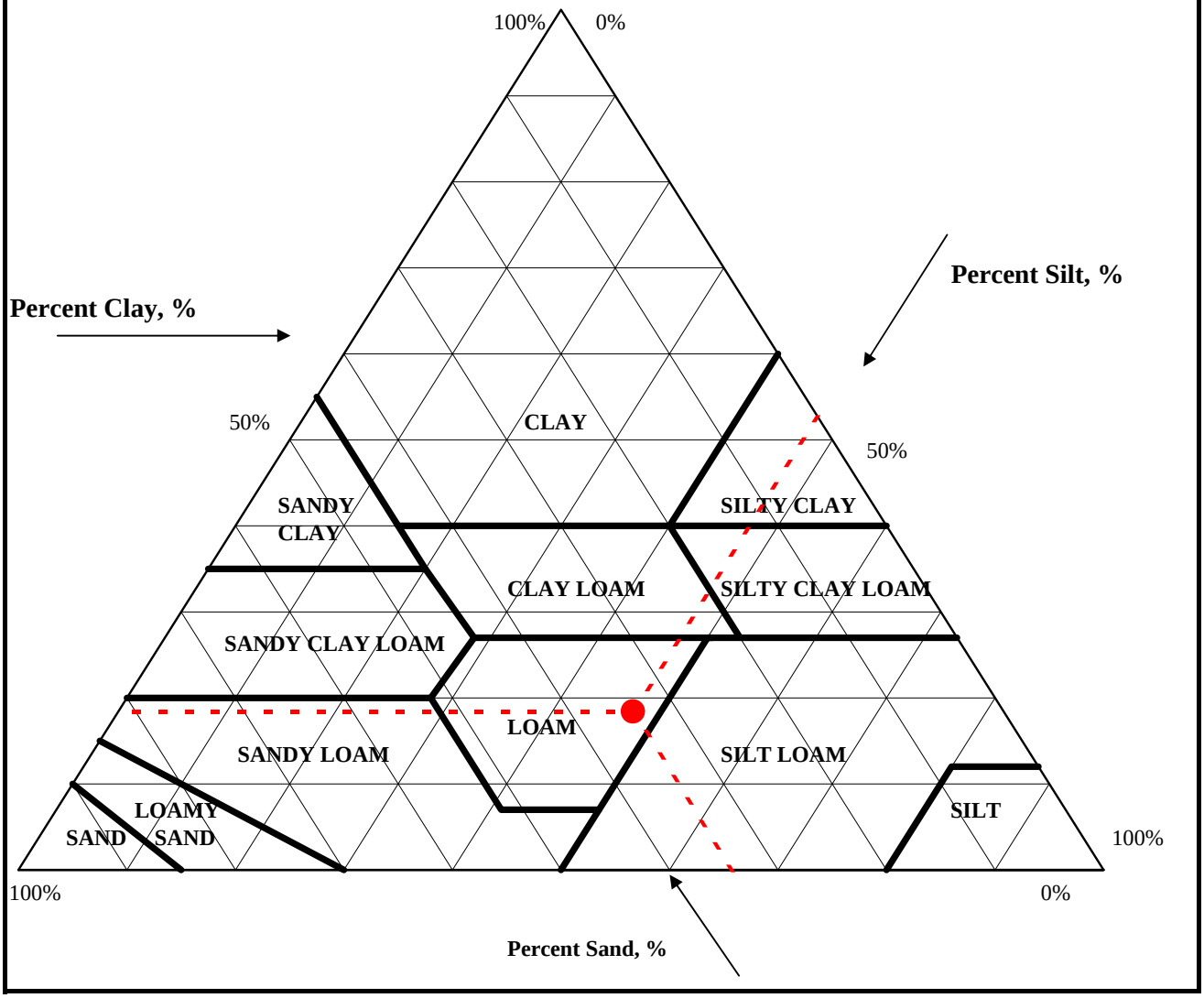
USDA CLASSIFICATION CHART

Client	Civil & Environmental Consultants, I	Boring	SB-18
Client Project	091-867 Apex Landfill Expansion	Depth	22'-24'
Project No.	30598	Sample	ST-3
		Lab Sample No.	30598018
USCS Description	**DARK GRAYISH BROWN CLAYEY GRAVEL WITH SAND**		
USCS Group Symbol	**GC**	AASHTO Classification	**A-6 (5)**
USDA Description	**LOAM**		

Corrected for 0% gravel	
Percent Gravel, %	0.0
Percent Sand, %	34.2
Percent Silt, %	47.4
Percent Clay, %	18.4

Sand Subsizes Corrected Percentages	
Very Coarse Sand; 2-1	7.8
Coarse Sand; 1-0.5	7.6
Medium Sand; 0.5-0.25	6.8
Fine Sand; 0.25-0.1	6.4
Very Fine Sand; 0.1-0.05	5.5
Total	**34.2**



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PARTICLE-SIZE ANALYSIS OF SOILS
ASTM D 422

Client	Civil & Environmental Consultants, I	Boring	SB-19
Client Project	091-867 Apex Landfill Expansion	Depth	11'-13'
Project No.	30598	Sample	ST-1
		Lab Sample No.	30598019

USCS Description **LIGHT OLIVE BROWN LEAN CLAY WITH SAND**
USCS Group Symbol **CL** AASHTO: **A-7-6 (14)**
USDA Description **CLAY LOAM**

MECHANICAL SIEVE ANALYSIS

As-Received Representative Sample Size Split or Material Submitted Used	
Representable Wet Wt, gm	658.6
+#4 Grnd., Washed DS., gm	31.9
-#4 Wet Wt., gm	626.7
-#4 Water Content, %	18.7
-#4 Dry Wt., gm	527.9
Representable Dry Wt, gm	**559.9**
** Note: Percentages +#4 are based on total Dry representable sample.*	
Split Sample, -#4 washed over #200	
Tare No.	843
Tare + WS., gm	287.54
Tare + DS., gm	258.79
Tare, gm	105.1
Wt. of DS., gm	153.69
Water Content -#4, %	18.7
Wt. of +#200 Sample, gm	38.6

US Std. Sieve Size	Sieve Opening (mm)	Wt. of Soil Retained (gm)	Percent Retained (%)*	Cumulative Percent Retained	Percent Finer (%)	Final Percent Finer
3"	75	0	0.0	0.0	100.0	100.0
2 1/2"	62.5	0	0.0	0.0	100.0	100.0
2"	50	0	0.0	0.0	100.0	100.0
1 1/2"	37.5	0	0.0	0.0	100.0	100.0
1"	25	0	0.0	0.0	100.0	100.0
3/4"	19	0	0.0	0.0	100.0	100.0
1/2"	12.5	5.64	1.0	1.0	99.0	99.0
3/8"	9.5	6.57	1.2	2.2	97.8	97.8
#4	4.75	19.73	3.5	5.7	94.3	94.3
#10	2	5.04	3.3	3.3	96.7	91.2
#20	0.85	10.41	6.8	10.1	89.9	84.8
#40	0.425	8.05	5.2	15.3	84.7	79.9
#60	0.25	5.53	3.6	18.9	81.1	76.5
#140	0.106	6.85	4.5	23.3	76.7	72.3
#200	0.075	2.67	1.7	25.1	74.9	70.6
-#200 / Pan		115.1	74.9	100.0	-	-

The final percent finer combines the gradation of the plus #4 and minus #4 material.

HYDROMETER ANALYSIS (-#200)

Hydrometer Sample Weight (-#200)	
Tare No.	709
Wt. Tare + DS., gm	137.76
Wt. Tare, gm	97.44
Wt. Dispers., gm	5
Wt. Dry Soil, gm	35.32
-#10 Dispersed 1min in Hamilton Beach Mixer	
K Factor	0.0135
Composite Correction	7
a Factor	0.99
Average Test Temp, °C	19.8
Specific Gravity, Assumed	2.7

Elapsed Time (min.)	R Measured	Composite Correction	R Corrected	Percent Finer (%)	Particle Diameter (mm)	Adjusted % Finer (%)
0	NA	NA	NA	NA	NA	NA
2	39.5	7	32.5	91.0	0.0298	64.3
5	38	7	31	86.8	0.0191	61.3
15	35.5	7	28.5	79.8	0.0112	56.4
30	32	7	25	70.0	0.0082	49.4
60	29	7	22	61.6	0.0059	43.5
250	23	7	16	44.8	0.0030	31.6
1440	18	7	11	30.8	0.0013	21.8

The adjusted percent finer is corrected for the percent passing the -#200 sieve.

D 422 / USCS SOIL CLASSIFICATION

Corrected For 100% Passing a 3" Sieve

% Gravel (-3" & +#4)	**5.7**	Silt=30% Clay=40.6%	
Coarse=0; Fine=5.7		D60, mm	NA
% Sand (-#4 & +#200)	**23.7**	D30, mm	NA
Coa.=3.1; Med.=11.3; Fine=9.2		D10, mm	NA
% Fines (-#200)	**70.6**	Cc	NA
% Plus #200 (-3")	**29.4**	Cu	NA

USCS Description
LEAN CLAY WITH SAND

USCS Group Symbol	Atterberg Limits Group Symbol
CL	**CL, LL=41, PL=19, PI=22**

Auxiliary Information	Wt Ret, gm	% Retained	% Finer
12" Sieve - 300 mm	0	0.0	100.0
6" Sieve - 150 mm	0	0.0	100.0
3" Sieve - 75 mm	0	0.0	100.0

USDA CLASSIFICATION

Particle Size (mm)	Percent Finer (%)	Percent of Each Component (Material)	(%)	Corrected Percent of -2.0 mm Material for USDA
100	100			
		Gravel	8.8	0
2	91.2			
		Sand	23.4	25.6
0.05	67.8			
		Silt	41.0	45.0
0.002	26.8			
		Clay	26.8	29.4

USDA Classification
CLAY LOAM

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LIQUID LIMIT, PLASTIC LIMIT, AND PLASTICITY INDEX OF SOILS
ASTM D 4318

Client	Civil & Environmental Consultants, I	Boring No.	SB-19
Client Project	091-867 Apex Landfill Expansion	Depth(ft)	11'-13'
Project No.	30598	Sample No.	ST-1
		Lab Sample No.	30598019

Soil Description: LIGHT OLIVE BROWN LEAN CLAY
(-#40 Fraction)

AS-RECEIVED W.C.

Tare Number	843
Wt. Tare & WS, gm	287.54
Wt. Tare & DS, gm	258.79
Wt. Water, gm	28.75
Wt. Tare, gm	105.10
Wt. DS, gm	153.69
Water Content, %	18.7

SAMPLE SUMMARY

Liquid Limit (LL), %	41
Plastic Limit (PL), %	19
Plasticity Index (PI)	22
USCS Symbol (-#40 Fraction)	CL
Sample Preparation:	Wet Method
Liquidity Index, %	-1.3%
Clay Fraction (% 2 microns)	NA
Skempton's Activity (A)	NA

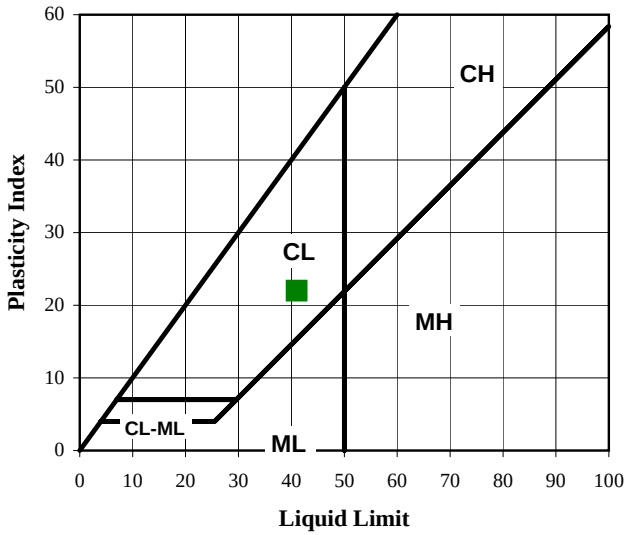
PLASTIC LIMIT

Test Number	1	2	3
Tare Number	492	472	481
Wt. Tare & WS, gm	21.35	23.67	22.48
Wt. Tare & DS, gm	19.58	21.63	20.57
Wt. Water, gm	1.77	2.04	1.91
Wt. Tare, gm	10.77	10.80	10.73
Wt. DS, gm	8.81	10.83	9.84
Water Content, %	20.1	18.8	19.4

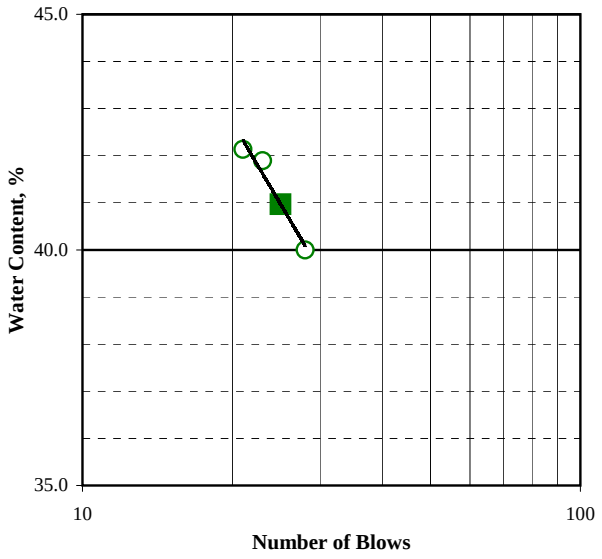
LIQUID LIMIT

	1	2	3
Tare Number	402	403	422
Wt. Tare & WS, gm	20.63	19.15	19.38
Wt. Tare & DS, gm	17.71	16.67	16.94
Wt. Water, gm	2.92	2.48	2.44
Wt. Tare, gm	10.78	10.75	10.84
Wt. DS, gm	6.93	5.92	6.10
Water Content, %	42.1	41.9	40.0
# of Blows	21	23	28

PLASTICITY CHART



FLOW CURVE



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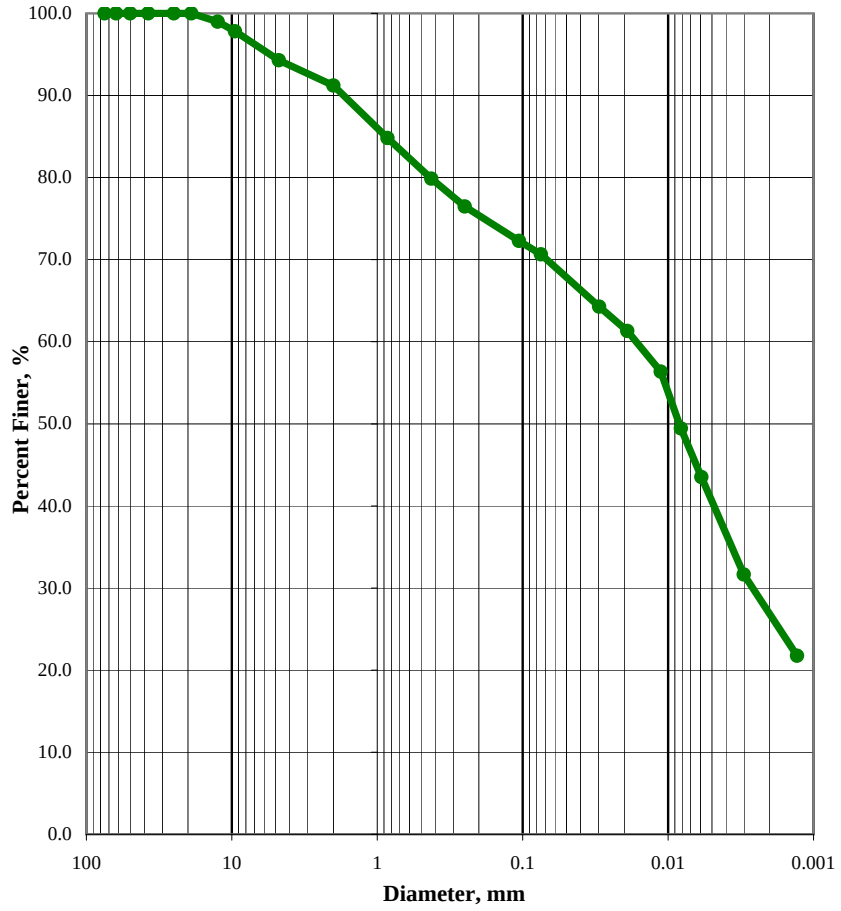
PARTICLE-SIZE ANALYSIS OF SOILS

Client	Civil & Environmental Consultants, I	Boring	SB-19
Client Project	091-867 Apex Landfill Expansion	Depth	11'-13'
Project No.	30598	Sample	ST-1
		Lab Sample No.	30598019
USCS Description	**LIGHT OLIVE BROWN LEAN CLAY WITH SAND**		
USCS Group Symbol	**CL**	AASHTO:	**A-7-6 (14)**
USDA Description	**CLAY LOAM**		



US Std. Sieve Size	Particle Diameter (mm)	Percent Finer (%)
3"	75	100.0
2 1/2"	62.5	100.0
2"	50	100.0
1 1/2"	37.5	100.0
1"	25	100.0
3/4"	19	100.0
1/2"	12.5	99.0
3/8"	9.5	97.8
#4	4.75	94.3
#10	2	91.2
#20	0.85	84.8
#40	0.425	79.9
#60	0.25	76.5
#140	0.106	72.3
#200	0.075	70.6
NA	0.0298	64.3
NA	0.0191	61.3
NA	0.0112	56.4
NA	0.0082	49.4
NA	0.0059	43.5
NA	0.0030	31.6
NA	0.0013	21.8

USCS SOIL CLASSIFICATION

Corrected For 100% Passing a 3" Sieve

% Gravel (-3" & +#4)	**5.7**	Silt=30% Clay=40.6%	
Coarse=0; Fine=5.7		D60, mm	NA
% Sand (-#4 & +#200)	**23.7**	D30, mm	NA
Coa.=3.1; Med.=11.3; Fine=9.2		D10, mm	NA
% Fines (-#200)	**70.6**	Cc	NA
% Plus #200 (-3")	**29.4**	Cu	NA

USCS Description
LEAN CLAY WITH SAND

USCS Group Symbol	Atterberg Limits Group Symbol
CL	**CL, LL=41, PL=19, PI=22**

Auxiliary Information	Wt Ret, gm	% Retained	% Finer
12" Sieve - 300 mm	0	0.0	100.0
6" Sieve - 150 mm	0	0.0	100.0
3" Sieve - 75 mm	0	0.0	100.0

USDA CLASSIFICATION

Particle Size (mm)	Percent Finer (%)	Percent of Each Component (Material)	(%)	Corrected Percent of -2.0 mm Material for USDA
100	100			
		Gravel	8.8	0
2	91.2			
		Sand	23.4	25.6
0.05	67.8			
		Silt	41.0	45.0
0.002	26.8			
		Clay	26.8	29.4

USDA Classification
CLAY LOAM

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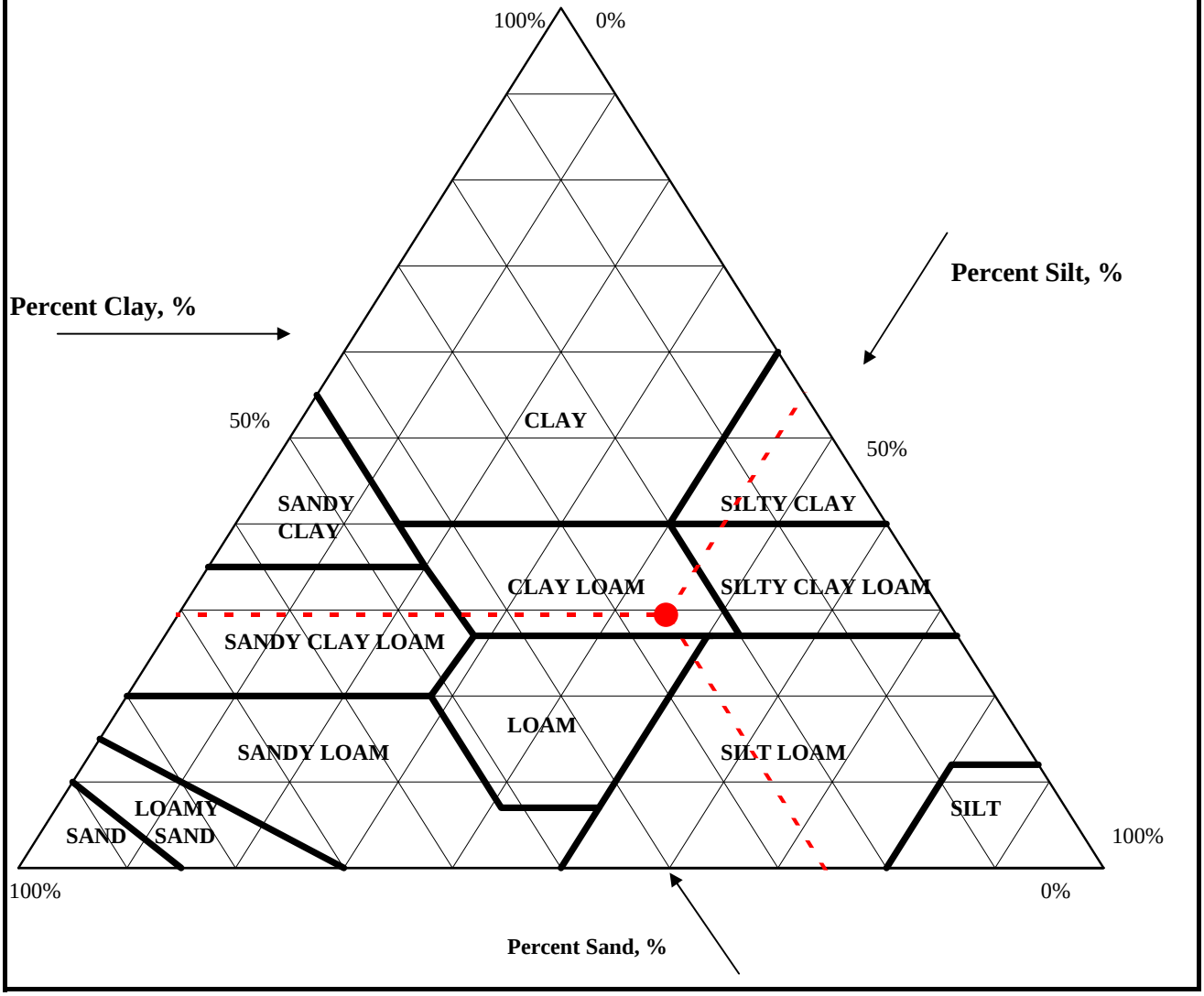
USDA CLASSIFICATION CHART

Client	Civil & Environmental Consultants, I	Boring	SB-19
Client Project	091-867 Apex Landfill Expansion	Depth	11'-13'
Project No.	30598	Sample	ST-1
		Lab Sample No.	30598019
USCS Description	**LIGHT OLIVE BROWN LEAN CLAY WITH SAND**		
USCS Group Symbol	**CL**	AASHTO Classification	**A-7-6 (14)**
USDA Description	**CLAY LOAM**		

Corrected for 0% gravel	
Percent Gravel, %	0.0
Percent Sand, %	25.6
Percent Silt, %	45.0
Percent Clay, %	29.4

Sand Subsizes Corrected Percentages	
Very Coarse Sand; 2-1	5.7
Coarse Sand; 1-0.5	5.5
Medium Sand; 0.5-0.25	5.0
Fine Sand; 0.25-0.1	4.9
Very Fine Sand; 0.1-0.05	4.6
Total	**25.6**



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PARTICLE-SIZE ANALYSIS OF SOILS
ASTM D 422

Client	Civil & Environmental Consultants, I	Boring	TPE-18
Client Project	091-867 Apex Landfill Expansion	Depth	18'-19.7'
Project No.	30598	Sample	ST-2
		Lab Sample No.	30598020
USCS Description	**LIGHT OLIVE BROWN CLAYEY SAND WITH GRAVEL**		
USCS Group Symbol	**SC**	AASHTO:	**A-6 (2)**
USDA Description	**LOAM**		

MECHANICAL SIEVE ANALYSIS

As-Received Representative Sample Size Split or Material Submitted Used	
Representable Wet Wt, gm	571.1
+#4 Grnd., Washed DS., gm	125.7
-#4 Wet Wt., gm	445.4
-#4 Water Content, %	12.6
-#4 Dry Wt., gm	395.5
Representable Dry Wt, gm	**521.2**
** Note: Percentages +#4 are based on total Dry representable sample.*	
Split Sample, -#4 washed over #200	
Tare No.	803
Tare + WS., gm	230.06
Tare + DS., gm	215.88
Tare, gm	103.59
Wt. of DS., gm	112.29
Water Content -#4, %	12.6
Wt. of +#200 Sample, gm	46.6

US Std. Sieve Size	Sieve Opening (mm)	Wt. of Soil Retained (gm)	Percent Retained (%)*	Cumulative Percent Retained	Percent Finer (%)	Final Percent Finer
3"	75	0	0.0	0.0	100.0	100.0
2 1/2"	62.5	0	0.0	0.0	100.0	100.0
2"	50	0	0.0	0.0	100.0	100.0
1 1/2"	37.5	0	0.0	0.0	100.0	100.0
1"	25	0	0.0	0.0	100.0	100.0
3/4"	19	0	0.0	0.0	100.0	100.0
1/2"	12.5	29.58	5.7	5.7	94.3	94.3
3/8"	9.5	25.96	5.0	10.7	89.3	89.3
#4	4.75	70.16	13.5	24.1	75.9	75.9
#10	2	0.63	0.6	0.6	99.4	75.5
#20	0.85	10.59	9.4	10.0	90.0	68.3
#40	0.425	6.99	6.2	16.2	83.8	63.6
#60	0.25	5.5	4.9	21.1	78.9	59.9
#140	0.106	11.2	10.0	31.1	68.9	52.3
#200	0.075	11.69	10.4	41.5	58.5	44.4
-#200 / Pan		65.7	58.5	100.0	-	-

The final percent finer combines the gradation of the plus #4 and minus #4 material.

HYDROMETER ANALYSIS (-#200)

Hydrometer Sample Weight (-#200)	
Tare No.	718
Wt. Tare + DS., gm	126.67
Wt. Tare, gm	99.08
Wt. Dispers., gm	5
Wt. Dry Soil, gm	22.59
-#10 Dispersed 1min in Hamilton Beach Mixer	
K Factor	0.0135
Composite Correction	7
a Factor	0.99
Average Test Temp, °C	20.1
Specific Gravity, Assumed	2.7

Elapsed Time (min.)	R Measured	Composite Correction	R Corrected	Percent Finer (%)	Particle Diameter (mm)	Adjusted % Finer (%)
0	NA	NA	NA	NA	NA	NA
2	23	7	16	70.0	0.0336	31.1
5	20	7	13	56.9	0.0217	25.3
15	18	7	11	48.2	0.0127	21.4
30	16.5	7	9.5	41.6	0.0090	18.5
60	15	7	8	35.0	0.0064	15.5
250	12	7	5	21.9	0.0032	9.7
1440	10	7	3	13.1	0.0014	5.8

The adjusted percent finer is corrected for the percent passing the -#200 sieve.

D 422 / USCS SOIL CLASSIFICATION

Corrected For 100% Passing a 3" Sieve

% Gravel (-3" & +#4)	**24.1**	Silt=30.8%	Clay=13.4%
Coarse=0; Fine=24.1		D60, mm	NA
% Sand (-#4 & +#200)	**31.5**	D30, mm	NA
Coa.=0.4; Med.=11.9; Fine=19.2		D10, mm	NA
% Fines (-#200)	**44.4**	Cc	NA
% Plus #200 (-3")	**55.6**	Cu	NA

USCS Description

CLAYEY SAND WITH GRAVEL

USCS Group Symbol	Atterberg Limits Group Symbol
SC	**CL, LL=32, PL=19, PI=13**

Auxiliary Information	Wt Ret, gm	% Retained	% Finer
12" Sieve - 300 mm	0	0.0	100.0
6" Sieve - 150 mm	0	0.0	100.0
3" Sieve - 75 mm	0	0.0	100.0

USDA CLASSIFICATION

Particle Size (mm)	Percent Finer (%)	Percent of Each Component (Material)	(%)	Corrected Percent of -2.0 mm Material for USDA
100	100			
		Gravel	24.5	0
2	75.5			
		Sand	37.8	50.1
0.05	37.7			
		Silt	30.1	39.9
0.002	7.6			
		Clay	7.6	10.0

USDA Classification

LOAM

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LIQUID LIMIT, PLASTIC LIMIT, AND PLASTICITY INDEX OF SOILS
ASTM D 4318

Client	Civil & Environmental Consultants, I	Boring No.	TPE-18
Client Project	091-867 Apex Landfill Expansion	Depth(ft)	18'-19.7'
Project No.	30598	Sample No.	ST-2
		Lab Sample No.	30598020

Soil Description: LIGHT OLIVE BROWN LEAN CLAY
(-#40 Fraction)

AS-RECEIVED W.C.

Tare Number	803
Wt. Tare & WS, gm	230.06
Wt. Tare & DS, gm	215.88
Wt. Water, gm	14.18
Wt. Tare, gm	103.59
Wt. DS, gm	112.29
Water Content, %	12.6

SAMPLE SUMMARY

Liquid Limit (LL), %	32
Plastic Limit (PL), %	19
Plasticity Index (PI)	13
USCS Symbol (-#40 Fraction)	CL
Sample Preparation:	Wet Method
Liquidity Index, %	-49.0%
Clay Fraction (% 2 microns)	NA
Skempton's Activity (A)	NA

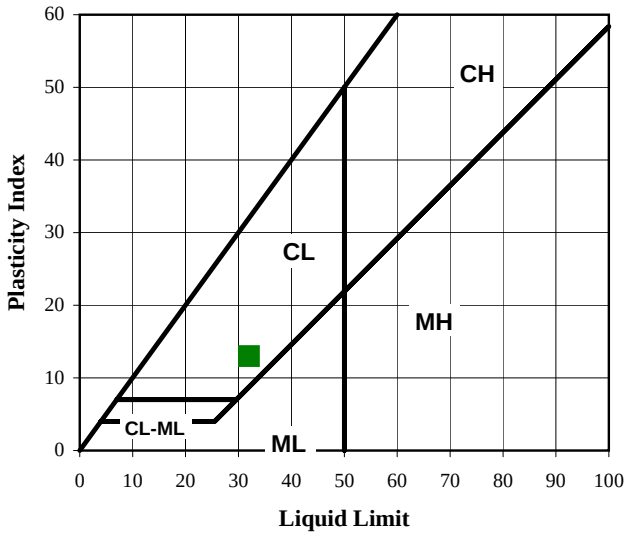
PLASTIC LIMIT

Test Number	1	2	3
Tare Number	409	419	497
Wt. Tare & WS, gm	17.51	17.34	17.54
Wt. Tare & DS, gm	16.43	16.30	16.47
Wt. Water, gm	1.08	1.04	1.07
Wt. Tare, gm	10.69	10.71	10.75
Wt. DS, gm	5.74	5.59	5.72
Water Content, %	18.8	18.6	18.7

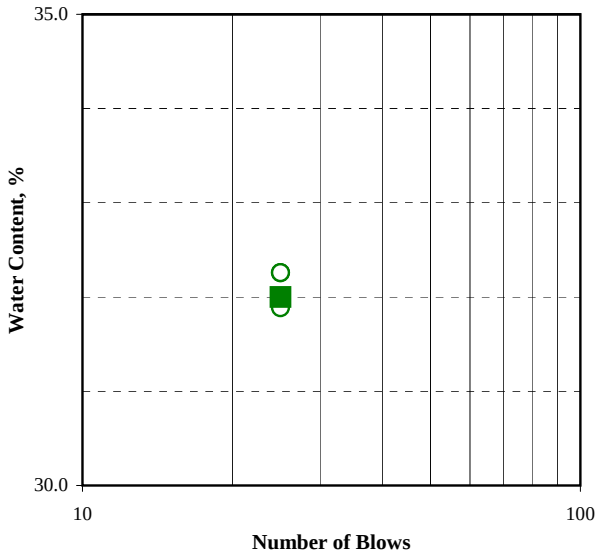
LIQUID LIMIT

	1	2
Tare Number	426	430
Wt. Tare & WS, gm	23.17	23.88
Wt. Tare & DS, gm	20.16	20.68
Wt. Water, gm	3.01	3.20
Wt. Tare, gm	10.72	10.76
Wt. DS, gm	9.44	9.92
Water Content, %	31.9	32.3
# of Blows	25	25

PLASTICITY CHART



FLOW CURVE



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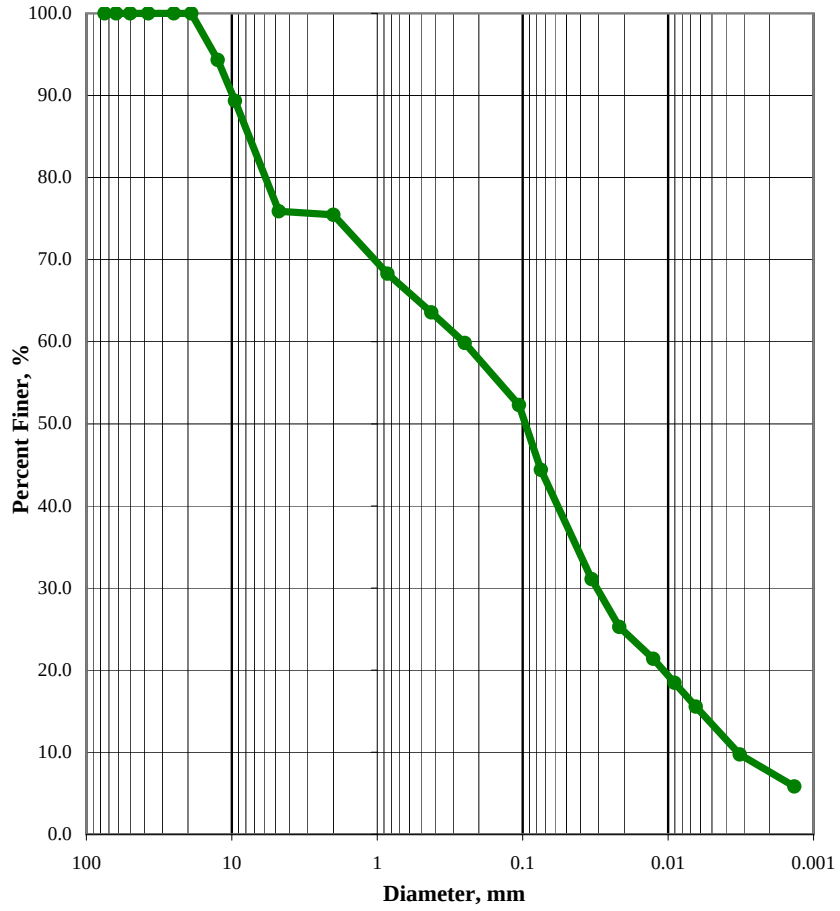
PARTICLE-SIZE ANALYSIS OF SOILS

Client	Civil & Environmental Consultants, I	Boring	TPE-18
Client Project	091-867 Apex Landfill Expansion	Depth	18'-19.7'
Project No.	30598	Sample	ST-2
		Lab Sample No.	30598020
USCS Description	**LIGHT OLIVE BROWN CLAYEY SAND WITH GRAVEL**		
USCS Group Symbol	**SC**	AASHTO:	**A-6 (2)**
USDA Description	**LOAM**		



US Std. Sieve Size	Particle Diameter (mm)	Percent Finer (%)
3"	75	100.0
2 1/2"	62.5	100.0
2"	50	100.0
1 1/2"	37.5	100.0
1"	25	100.0
3/4"	19	100.0
1/2"	12.5	94.3
3/8"	9.5	89.3
#4	4.75	75.9
#10	2	75.5
#20	0.85	68.3
#40	0.425	63.6
#60	0.25	59.9
#140	0.106	52.3
#200	0.075	44.4
NA	0.0336	31.1
NA	0.0217	25.3
NA	0.0127	21.4
NA	0.0090	18.5
NA	0.0064	15.5
NA	0.0032	9.7
NA	0.0014	5.8

USCS SOIL CLASSIFICATION

Corrected For 100% Passing a 3" Sieve

% Gravel (-3" & +#4)	**24.1**	Silt=30.8%	Clay=13.4%
Coarse=0; Fine=24.1		D60, mm	NA
% Sand (-#4 & +#200)	**31.5**	D30, mm	NA
Coa.=0.4; Med.=11.9; Fine=19.2		D10, mm	NA
% Fines (-#200)	**44.4**	Cc	NA
% Plus #200 (-3")	**55.6**	Cu	NA

USCS Description
CLAYEY SAND WITH GRAVEL

USCS Group Symbol	Atterberg Limits Group Symbol		
SC	**CL, LL=32, PL=19, PI=13**		
Auxiliary Information	Wt Ret, gm	% Retained	% Finer
12" Sieve - 300 mm	0	0.0	100.0
6" Sieve - 150 mm	0	0.0	100.0
3" Sieve - 75 mm	0	0.0	100.0

USDA CLASSIFICATION

Particle Size (mm)	Percent Finer (%)
100	100
2	75.5
0.05	37.7
0.002	7.6

Percent of Each Component (Material)	(%)	Corrected Percent of -2.0 mm Material for USDA
Gravel	24.5	0
Sand	37.8	50.1
Silt	30.1	39.9
Clay	7.6	10.0

USDA Classification
LOAM

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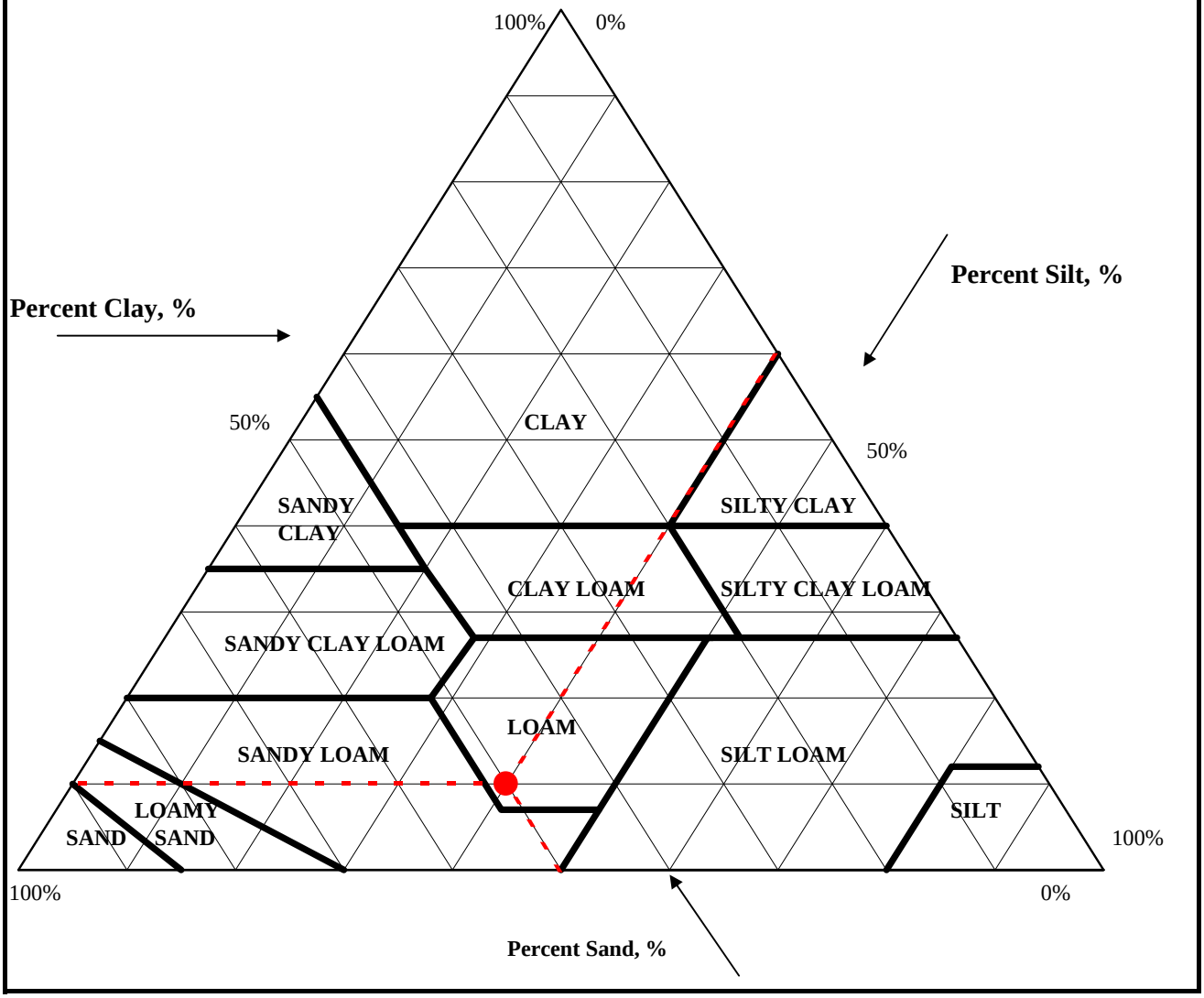
USDA CLASSIFICATION CHART

Client	Civil & Environmental Consultants, I	Boring	TPE-18
Client Project	091-867 Apex Landfill Expansion	Depth	18'-19.7'
Project No.	30598	Sample	ST-2
		Lab Sample No.	30598020
USCS Description	**LIGHT OLIVE BROWN CLAYEY SAND WITH GRAVEL**		
USCS Group Symbol	**SC**	AASHTO Classification	**A-6 (2)**
USDA Description	**LOAM**		

Corrected for 0% gravel	
Percent Gravel, %	0.0
Percent Sand, %	50.1
Percent Silt, %	39.9
Percent Clay, %	10.0

Sand Subsizes Corrected Percentages	
Very Coarse Sand; 2-1	7.7
Coarse Sand; 1-0.5	6.6
Medium Sand; 0.5-0.25	6.4
Fine Sand; 0.25-0.1	11.8
Very Fine Sand; 0.1-0.05	17.6
Total	**50.1**



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PARTICLE-SIZE ANALYSIS OF SOILS
ASTM D 422

Client	Civil & Environmental Consultants, I	Boring	TPE-21
Client Project	091-867 Apex Landfill Expansion	Depth	2'-4'
Project No.	30598	Sample	ST-1
		Lab Sample No.	30598021
USCS Description	**LIGHT OLIVE BROWN SANDY LEAN CLAY**		
USCS Group Symbol	**CL**	AASHTO:	**A-7-6 (8)**
USDA Description	**SANDY LOAM**		

MECHANICAL SIEVE ANALYSIS

As-Received Representative Sample Size Split or Material Submitted Used	
Representable Wet Wt, gm	714.6
+#4 Grnd., Washed DS., gm	0.0
-#4 Wet Wt., gm	714.6
-#4 Water Content, %	18.5
-#4 Dry Wt., gm	602.9
Representable Dry Wt, gm	**602.9**
** Note: Percentages +#4 are based on total Dry representable sample.*	
Split Sample, -#4 washed over #200	
Tare No.	836
Tare + WS., gm	246.68
Tare + DS., gm	224.35
Tare, gm	103.79
Wt. of DS., gm	120.56
Water Content -#4, %	18.5
Wt. of +#200 Sample, gm	56.4

US Std. Sieve Size	Sieve Opening (mm)	Wt. of Soil Retained (gm)	Percent Retained (%)*	Cumulative Percent Retained	Percent Finer (%)	Final Percent Finer
3"	75	0	0.0	0.0	100.0	100.0
2 1/2"	62.5	0	0.0	0.0	100.0	100.0
2"	50	0	0.0	0.0	100.0	100.0
1 1/2"	37.5	0	0.0	0.0	100.0	100.0
1"	25	0	0.0	0.0	100.0	100.0
3/4"	19	0	0.0	0.0	100.0	100.0
1/2"	12.5	0	0.0	0.0	100.0	100.0
3/8"	9.5	0	0.0	0.0	100.0	100.0
#4	4.75	0	0.0	0.0	100.0	100.0
#10	2	0.54	0.4	0.4	99.6	99.6
#20	0.85	24.59	20.4	20.8	79.2	79.2
#40	0.425	14.58	12.1	32.9	67.1	67.1
#60	0.25	6.92	5.7	38.7	61.3	61.3
#140	0.106	7.55	6.3	44.9	55.1	55.1
#200	0.075	2.2	1.8	46.8	53.2	53.2
-#200 / Pan		64.2	53.2	100.0	-	-

The final percent finer combines the gradation of the plus #4 and minus #4 material.

HYDROMETER ANALYSIS (-#200)

Hydrometer Sample Weight (-#200)	
Tare No.	814
Wt. Tare + DS., gm	121.37
Wt. Tare, gm	101.88
Wt. Dispers., gm	5
Wt. Dry Soil, gm	14.49
-#10 Dispersed 1min in Hamilton Beach Mixer	
K Factor	0.0135
Composite Correction	7
a Factor	0.99
Average Test Temp, °C	20.0
Specific Gravity, Assumed	2.7

Elapsed Time (min.)	R Measured	Composite Correction	R Corrected	Percent Finer (%)	Particle Diameter (mm)	Adjusted % Finer (%)
0	NA	NA	NA	NA	NA	NA
2	18	7	11	75.1	0.0347	40.0
5	17	7	10	68.2	0.0221	36.3
15	15.5	7	8.5	58.0	0.0129	30.9
30	14.5	7	7.5	51.2	0.0092	27.2
60	13	7	6	40.9	0.0065	21.8
250	10	7	3	20.5	0.0033	10.9
1440	8	7	1	6.8	0.0014	3.6

The adjusted percent finer is corrected for the percent passing the -#200 sieve.

D 422 / USCS SOIL CLASSIFICATION

Corrected For 100% Passing a 3" Sieve

% Gravel (-3" & +#4)	**0.0**	Silt=35.4%	Clay=17.6%
Coarse=0; Fine=0		D60, mm	NA
% Sand (-#4 & +#200)	**46.8**	D30, mm	NA
Coa.=0.4; Med.=32.5; Fine=13.8		D10, mm	NA
% Fines (-#200)	**53.2**	Cc	NA
% Plus #200 (-3")	**46.8**	Cu	NA

USCS Description
SANDY LEAN CLAY

USCS Group Symbol	Atterberg Limits Group Symbol
CL	**CL, LL=44, PL=23, PI=21**

Auxiliary Information	Wt Ret, gm	% Retained	% Finer
12" Sieve - 300 mm	0	0.0	100.0
6" Sieve - 150 mm	0	0.0	100.0
3" Sieve - 75 mm	0	0.0	100.0

USDA CLASSIFICATION

Particle Size (mm)	Percent Finer (%)	Percent of Each Component (Material)	(%)	Corrected Percent of -2.0 mm Material for USDA
100	100			
		Gravel	0.4	0
2	99.6			
		Sand	53.3	53.5
0.05	46.3			
		Silt	39.4	39.6
0.002	6.8			
		Clay	6.8	6.8

USDA Classification
SANDY LOAM

Input Validation: Reviewed By: Date Tested: 12/1/2010

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LIQUID LIMIT, PLASTIC LIMIT, AND PLASTICITY INDEX OF SOILS
ASTM D 4318

Client	Civil & Environmental Consultants, I	Boring No.	TPE-21
Client Project	091-867 Apex Landfill Expansion	Depth(ft)	2'-4'
Project No.	30598	Sample No.	ST-1
		Lab Sample No.	30598021

Soil Description: LIGHT OLIVE BROWN LEAN CLAY
(-#40 Fraction)

AS-RECEIVED W.C.

Tare Number	836
Wt. Tare & WS, gm	246.68
Wt. Tare & DS, gm	224.35
Wt. Water, gm	22.33
Wt. Tare, gm	103.79
Wt. DS, gm	120.56
Water Content, %	18.5

SAMPLE SUMMARY

Liquid Limit (LL), %	44
Plastic Limit (PL), %	23
Plasticity Index (PI)	21
USCS Symbol (-#40 Fraction)	CL
Sample Preparation:	Wet Method
Liquidity Index, %	-21.3%
Clay Fraction (% 2 microns)	NA
Skempton's Activity (A)	NA

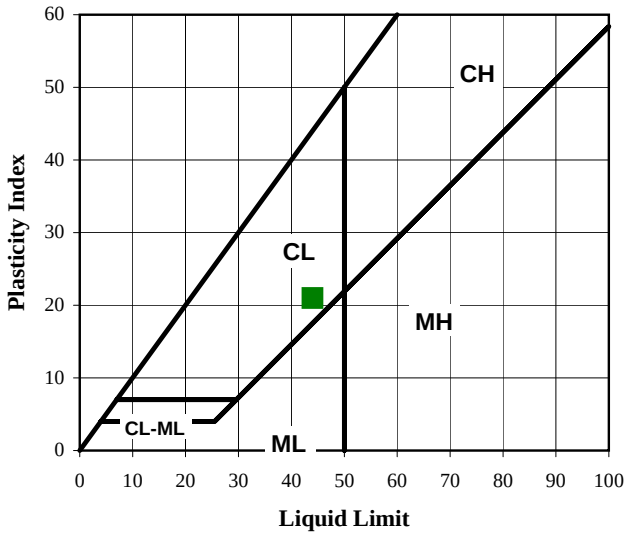
PLASTIC LIMIT

Test Number	1	2	3
Tare Number	411	444	455
Wt. Tare & WS, gm	16.90	16.91	17.17
Wt. Tare & DS, gm	15.68	15.76	15.97
Wt. Water, gm	1.22	1.15	1.20
Wt. Tare, gm	10.69	10.73	10.73
Wt. DS, gm	4.99	5.03	5.24
Water Content, %	24.4	22.9	22.9

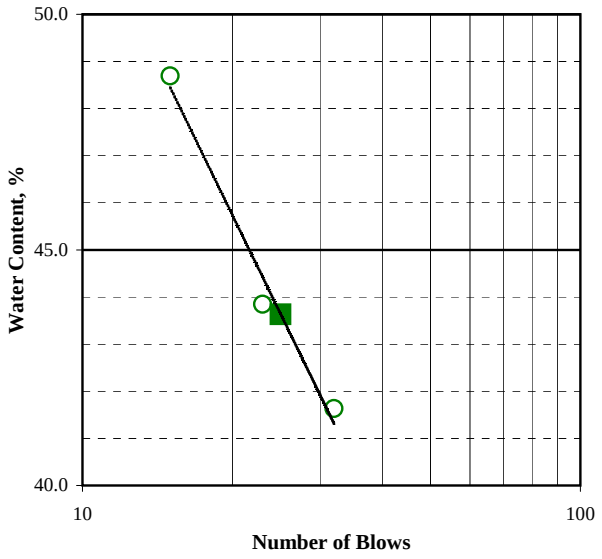
LIQUID LIMIT

	1	2	3
Tare Number	480	485	489
Wt. Tare & WS, gm	18.05	18.30	17.85
Wt. Tare & DS, gm	15.63	16.02	15.71
Wt. Water, gm	2.42	2.28	2.14
Wt. Tare, gm	10.66	10.82	10.57
Wt. DS, gm	4.97	5.20	5.14
Water Content, %	48.7	43.8	41.6
# of Blows	15	23	32

PLASTICITY CHART



FLOW CURVE



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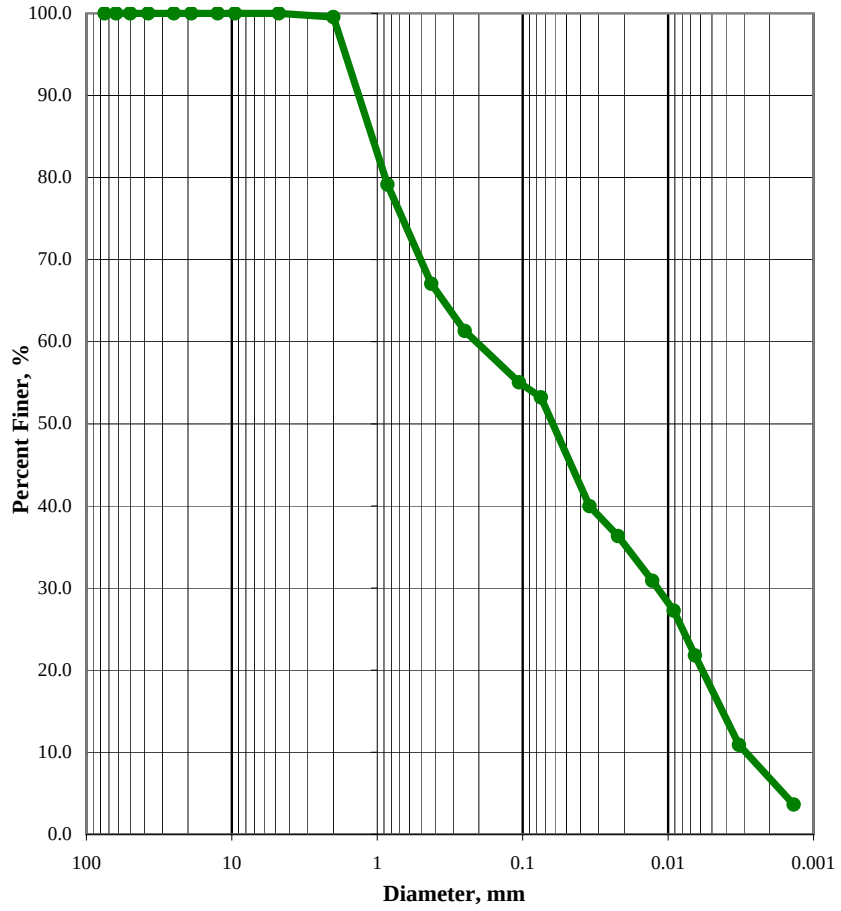
PARTICLE-SIZE ANALYSIS OF SOILS

Client	Civil & Environmental Consultants, I	Boring	TPE-21
Client Project	091-867 Apex Landfill Expansion	Depth	2'-4'
Project No.	30598	Sample	ST-1
		Lab Sample No.	30598021

USCS Description **LIGHT OLIVE BROWN SANDY LEAN CLAY**
USCS Group Symbol **CL** AASHTO: **A-7-6 (8)**
USDA Description **SANDY LOAM**



US Std. Sieve Size	Particle Diameter (mm)	Percent Finer (%)
3"	75	100.0
2 1/2"	62.5	100.0
2"	50	100.0
1 1/2"	37.5	100.0
1"	25	100.0
3/4"	19	100.0
1/2"	12.5	100.0
3/8"	9.5	100.0
#4	4.75	100.0
#10	2	99.6
#20	0.85	79.2
#40	0.425	67.1
#60	0.25	61.3
#140	0.106	55.1
#200	0.075	53.2
NA	0.0347	40.0
NA	0.0221	36.3
NA	0.0129	30.9
NA	0.0092	27.2
NA	0.0065	21.8
NA	0.0033	10.9
NA	0.0014	3.6

USCS SOIL CLASSIFICATION

Corrected For 100% Passing a 3" Sieve

% Gravel (-3" & +#4)	**0.0**	Silt=35.4% Clay=17.6%	
Coarse=0; Fine=0		D60, mm	NA
% Sand (-#4 & +#200)	**46.8**	D30, mm	NA
Coa.=0.4; Med.=32.5; Fine=13.8		D10, mm	NA
% Fines (-#200)	**53.2**	Cc	NA
% Plus #200 (-3")	**46.8**	Cu	NA

USCS Description
SANDY LEAN CLAY

USCS Group Symbol	Atterberg Limits Group Symbol
CL	**CL, LL=44, PL=23, PI=21**

Auxiliary Information	Wt Ret, gm	% Retained	% Finer
12" Sieve - 300 mm	0	0.0	100.0
6" Sieve - 150 mm	0	0.0	100.0
3" Sieve - 75 mm	0	0.0	100.0

USDA CLASSIFICATION

Particle Size (mm)	Percent Finer (%)	Percent of Each Component (Material)	(%)	Corrected Percent of -2.0 mm Material for USDA
100	100			
		Gravel	0.4	0
2	99.6			
		Sand	53.3	53.5
0.05	46.3			
		Silt	39.4	39.6
0.002	6.8			
		Clay	6.8	6.8

USDA Classification
SANDY LOAM

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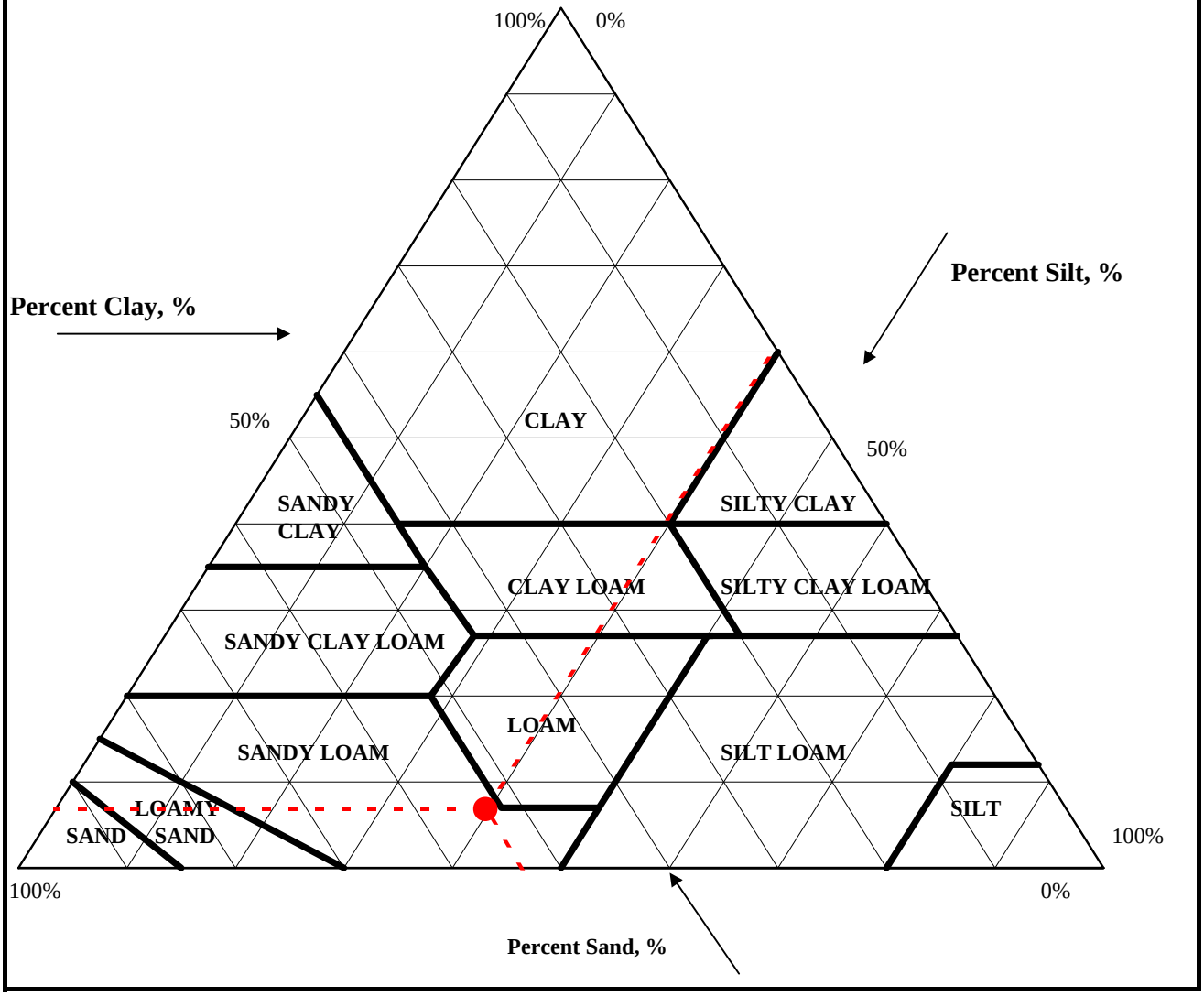
USDA CLASSIFICATION CHART

Client	Civil & Environmental Consultants, I	Boring	TPE-21
Client Project	091-867 Apex Landfill Expansion	Depth	2'-4'
Project No.	30598	Sample	ST-1
		Lab Sample No.	30598021
USCS Description	**LIGHT OLIVE BROWN SANDY LEAN CLAY**		
USCS Group Symbol	**CL**	AASHTO Classification	**A-7-6 (8)**
USDA Description	**SANDY LOAM**		

Corrected for 0% gravel	
Percent Gravel, %	0.0
Percent Sand, %	53.5
Percent Silt, %	39.6
Percent Clay, %	6.8

Sand Subsizes Corrected Percentages	
Very Coarse Sand; 2-1	16.6
Coarse Sand; 1-0.5	13.2
Medium Sand; 0.5-0.25	8.6
Fine Sand; 0.25-0.1	6.6
Very Fine Sand; 0.1-0.05	8.5
Total	**53.5**



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PARTICLE-SIZE ANALYSIS OF SOILS
ASTM D 422

Client	Civil & Environmental Consultants, I	Boring	SB-1
Client Project	091-867 Apex Landfill Expansion	Depth	26'-28'
Project No.	30598	Sample	SS-13
		Lab Sample No.	30598028

USCS Description **DARK GRAY LEAN CLAY WITH SAND**
USCS Group Symbol **CL** AASHTO: **A-6 (10)**
USDA Description **SILT LOAM**

MECHANICAL SIEVE ANALYSIS

As-Received Representative Sample Size Split or Material Submitted Used	
Representable Wet Wt, gm	258.5
+#4 Grnd., Washed DS., gm	1.1
-#4 Wet Wt., gm	257.4
-#4 Water Content, %	6.2
-#4 Dry Wt., gm	242.5
Representable Dry Wt, gm	**243.5**
** Note: Percentages +#4 are based on total Dry representable sample.*	
Split Sample, -#4 washed over #200	
Tare No.	842
Tare + WS., gm	249.57
Tare + DS., gm	242.23
Tare, gm	123.32
Wt. of DS., gm	118.91
Water Content -#4, %	6.2
Wt. of +#200 Sample, gm	21.0

US Std. Sieve Size	Sieve Opening (mm)	Wt. of Soil Retained (gm)	Percent Retained (%)*	Cumulative Percent Retained	Percent Finer (%)	Final Percent Finer
3"	75	0	0.0	0.0	100.0	100.0
2 1/2"	62.5	0	0.0	0.0	100.0	100.0
2"	50	0	0.0	0.0	100.0	100.0
1 1/2"	37.5	0	0.0	0.0	100.0	100.0
1"	25	0	0.0	0.0	100.0	100.0
3/4"	19	0	0.0	0.0	100.0	100.0
1/2"	12.5	0	0.0	0.0	100.0	100.0
3/8"	9.5	1.06	0.4	0.4	99.6	99.6
#4	4.75	0	0.0	0.4	99.6	99.6
#10	2	5.59	4.7	4.7	95.3	94.9
#20	0.85	6.03	5.1	9.8	90.2	89.8
#40	0.425	2.62	2.2	12.0	88.0	87.6
#60	0.25	1.43	1.2	13.2	86.8	86.4
#140	0.106	2.83	2.4	15.6	84.4	84.1
#200	0.075	2.51	2.1	17.7	82.3	82.0
-#200 / Pan		97.9	82.3	100.0	-	-

The final percent finer combines the gradation of the plus #4 and minus #4 material.

HYDROMETER ANALYSIS (-#200)

Hydrometer Sample Weight (-#200)	
Tare No.	302
Wt. Tare + DS., gm	149.05
Wt. Tare, gm	100.08
Wt. Dispers., gm	5
Wt. Dry Soil, gm	43.97
-#10 Dispersed 1min in Hamilton Beach Mixer	
K Factor	0.0137
Composite Correction	7.5
a Factor	0.99
Average Test Temp, °C	18.8
Specific Gravity, Assumed	2.7

Elapsed Time (min.)	R Measured	Composite Correction	R Corrected	Percent Finer (%)	Particle Diameter (mm)	Adjusted % Finer (%)
0	NA	NA	NA	NA	NA	NA
2	44	7.5	36.5	82.1	0.0290	67.3
5	40	7.5	32.5	73.1	0.0190	59.9
15	35.5	7.5	28	63.0	0.0114	51.6
30	32	7.5	24.5	55.1	0.0083	45.2
60	28	7.5	20.5	46.1	0.0060	37.8
250	21	7.5	13.5	30.4	0.0031	24.9
1440	16.5	7.5	9	20.2	0.0013	16.6

The adjusted percent finer is corrected for the percent passing the -#200 sieve.

D 422 / USCS SOIL CLASSIFICATION

Corrected For 100% Passing a 3" Sieve

% Gravel (-3" & +#4)	**0.4**	Silt=47.6%	Clay=34.2%
Coarse=0; Fine=0.4		D60, mm	NA
% Sand (-#4 & +#200)	**17.6**	D30, mm	NA
Coa.=4.7; Med.=7.2; Fine=5.7		D10, mm	NA
% Fines (-#200)	**82.0**	Cc	NA
% Plus #200 (-3")	**18.0**	Cu	NA

USCS Description
LEAN CLAY WITH SAND

USCS Group Symbol	Atterberg Limits Group Symbol
CL	**CL, LL=33, PL=20, PI=13**

Auxiliary Information	Wt Ret, gm	% Retained	% Finer
12" Sieve - 300 mm	0	0.0	100.0
6" Sieve - 150 mm	0	0.0	100.0
3" Sieve - 75 mm	0	0.0	100.0

USDA CLASSIFICATION

Particle Size (mm)	Percent Finer (%)	Percent of Each Component (Material)	(%)	Corrected Percent of -2.0 mm Material for USDA
100	100			
		Gravel	5.1	0
2	94.9			
		Sand	19.2	20.2
0.05	75.7			
		Silt	55.1	58.1
0.002	20.6			
		Clay	20.6	21.7

USDA Classification
SILT LOAM

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LIQUID LIMIT, PLASTIC LIMIT, AND PLASTICITY INDEX OF SOILS
ASTM D 4318

Client	Civil & Environmental Consultants, I	Boring No.	SB-1
Client Project	091-867 Apex Landfill Expansion	Depth(ft)	26'-28'
Project No.	30598	Sample No.	SS-13
		Lab Sample No.	30598028

Soil Description: DARK GRAY LEAN CLAY
(-#40 Fraction)

AS-RECEIVED W.C.

Tare Number	842
Wt. Tare & WS, gm	249.57
Wt. Tare & DS, gm	242.23
Wt. Water, gm	7.34
Wt. Tare, gm	123.32
Wt. DS, gm	118.91
Water Content, %	6.2

SAMPLE SUMMARY

Liquid Limit (LL), %	33
Plastic Limit (PL), %	20
Plasticity Index (PI)	13
USCS Symbol (-#40 Fraction)	CL
Sample Preparation:	Wet Method
Liquidity Index, %	-106.4%
Clay Fraction (% 2 microns)	NA
Skempton's Activity (A)	NA

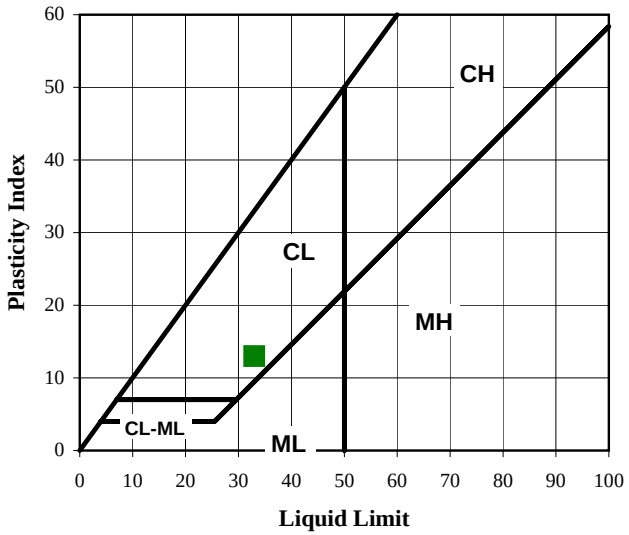
PLASTIC LIMIT

Test Number	1	2	3
Tare Number	433		
Wt. Tare & WS, gm	16.86		
Wt. Tare & DS, gm	15.83		
Wt. Water, gm	1.03		
Wt. Tare, gm	10.80		
Wt. DS, gm	5.03		
Water Content, %	20.5		

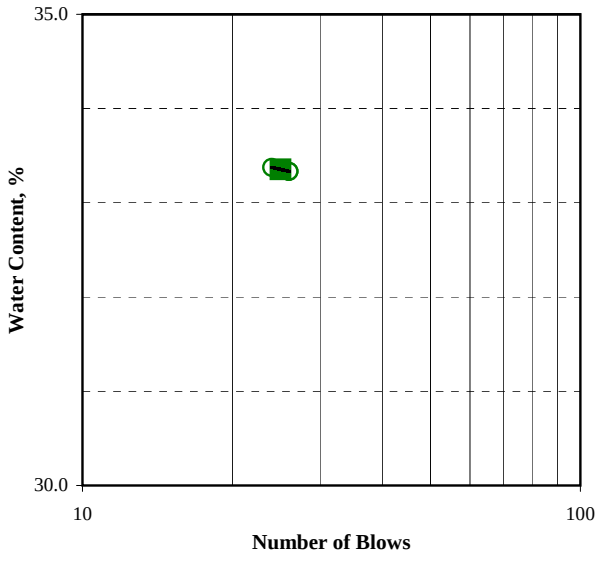
LIQUID LIMIT

	1	2
Tare Number	400	443
Wt. Tare & WS, gm	21.29	20.02
Wt. Tare & DS, gm	18.68	17.71
Wt. Water, gm	2.61	2.31
Wt. Tare, gm	10.86	10.78
Wt. DS, gm	7.82	6.93
Water Content, %	33.4	33.3
# of Blows	24	26

PLASTICITY CHART



FLOW CURVE



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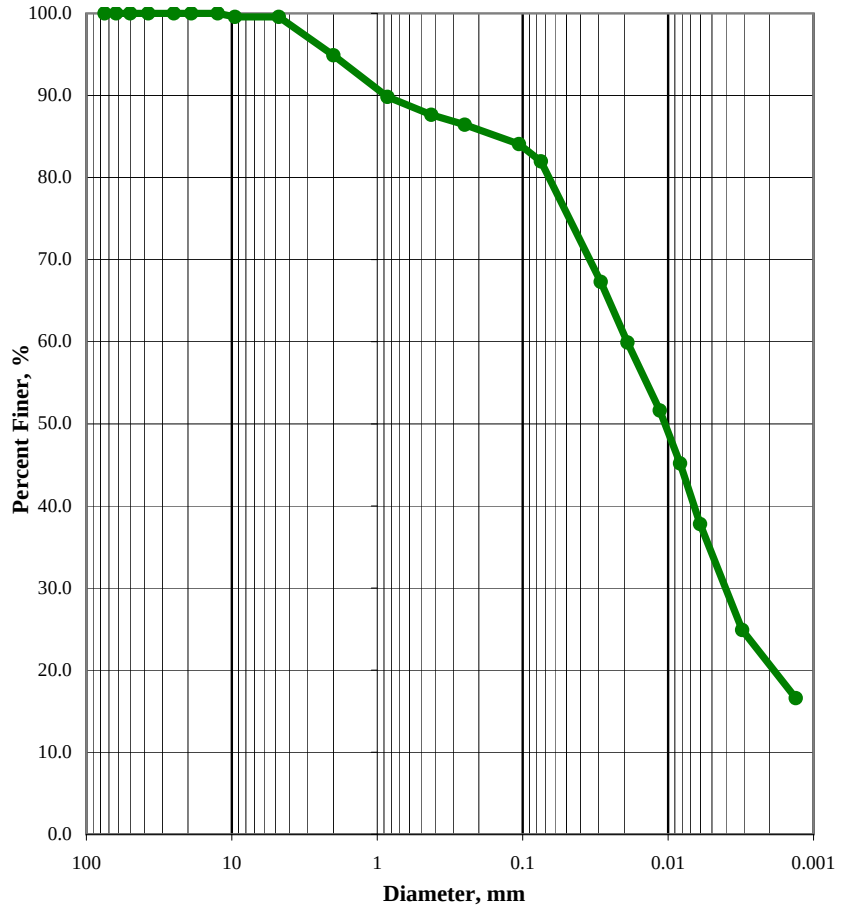
PARTICLE-SIZE ANALYSIS OF SOILS

Client	Civil & Environmental Consultants, I	Boring	SB-1
Client Project	091-867 Apex Landfill Expansion	Depth	26'-28'
Project No.	30598	Sample	SS-13
		Lab Sample No.	30598028
USCS Description	**DARK GRAY LEAN CLAY WITH SAND**		
USCS Group Symbol	**CL**	AASHTO:	**A-6 (10)**
USDA Description	**SILT LOAM**		



US Std. Sieve Size	Particle Diameter (mm)	Percent Finer (%)
3"	75	100.0
2 1/2"	62.5	100.0
2"	50	100.0
1 1/2"	37.5	100.0
1"	25	100.0
3/4"	19	100.0
1/2"	12.5	100.0
3/8"	9.5	99.6
#4	4.75	99.6
#10	2	94.9
#20	0.85	89.8
#40	0.425	87.6
#60	0.25	86.4
#140	0.106	84.1
#200	0.075	82.0
NA	0.0290	67.3
NA	0.0190	59.9
NA	0.0114	51.6
NA	0.0083	45.2
NA	0.0060	37.8
NA	0.0031	24.9
NA	0.0013	16.6

USCS SOIL CLASSIFICATION

Corrected For 100% Passing a 3" Sieve

% Gravel (-3" & +#4)	**0.4**	Silt=47.6% Clay=34.2%	
Coarse=0; Fine=0.4		D60, mm	NA
% Sand (-#4 & +#200)	**17.6**	D30, mm	NA
Coa.=4.7; Med.=7.2; Fine=5.7		D10, mm	NA
% Fines (-#200)	**82.0**	Cc	NA
% Plus #200 (-3")	**18.0**	Cu	NA

USCS Description
LEAN CLAY WITH SAND

USCS Group Symbol	Atterberg Limits Group Symbol		
CL	**CL, LL=33, PL=20, PI=13**		
Auxiliary Information	Wt Ret, gm	% Retained	% Finer
12" Sieve - 300 mm	0	0.0	100.0
6" Sieve - 150 mm	0	0.0	100.0
3" Sieve - 75 mm	0	0.0	100.0

USDA CLASSIFICATION

Particle Size (mm)	Percent Finer (%)	Percent of Each Component (Material)	(%)	Corrected Percent of -2.0 mm Material for USDA
100	100			
		Gravel	5.1	0
2	94.9			
		Sand	19.2	20.2
0.05	75.7			
		Silt	55.1	58.1
0.002	20.6			
		Clay	20.6	21.7

USDA Classification
SILT LOAM

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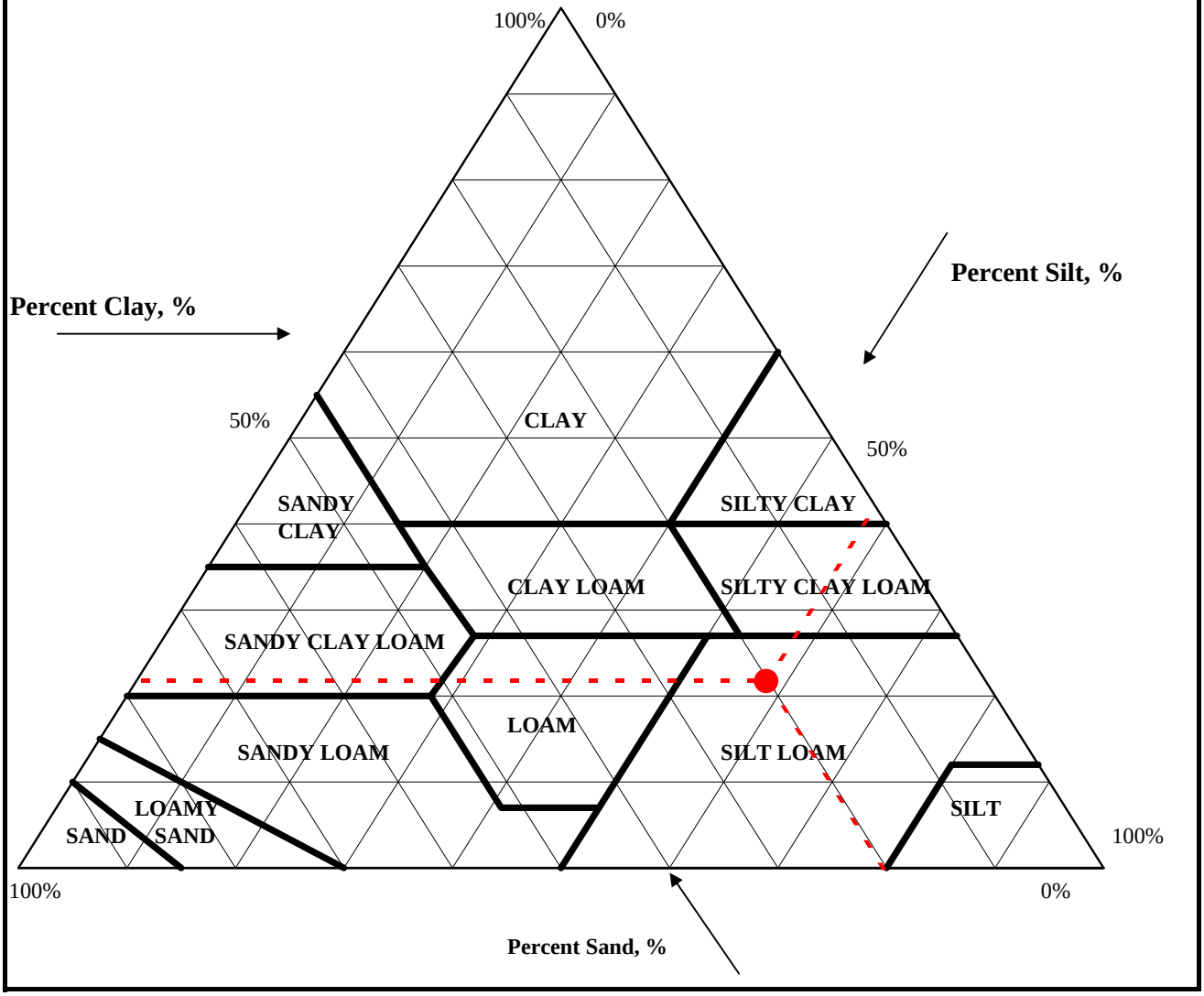
USDA CLASSIFICATION CHART

Client	Civil & Environmental Consultants, I	Boring	SB-1
Client Project	091-867 Apex Landfill Expansion	Depth	26'-28'
Project No.	30598	Sample	SS-13
		Lab Sample No.	30598028
USCS Description	**DARK GRAY LEAN CLAY WITH SAND**		
USCS Group Symbol	**CL**	AASHTO Classification	**A-6 (10)**
USDA Description	**SILT LOAM**		

Corrected for 0% gravel	
Percent Gravel, %	0.0
Percent Sand, %	20.2
Percent Silt, %	58.1
Percent Clay, %	21.7

Sand Subsizes Corrected Percentages	
Very Coarse Sand; 2-1	4.3
Coarse Sand; 1-0.5	2.8
Medium Sand; 0.5-0.25	1.8
Fine Sand; 0.25-0.1	2.9
Very Fine Sand; 0.1-0.05	8.5
Total	**20.2**



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PARTICLE-SIZE ANALYSIS OF SOILS
ASTM D 422

Client	Civil & Environmental Consultants, I	Boring	SB-2
Client Project	091-867 Apex Landfill Expansion	Depth	22'-24'
Project No.	30598	Sample	SS-12
		Lab Sample No.	30598029
USCS Description	**DARK GRAY CLAYEY GRAVEL WITH SAND**		
USCS Group Symbol	**GC**	AASHTO:	**A-6 (2)**
USDA Description	**SILT LOAM**		

MECHANICAL SIEVE ANALYSIS

As-Received Representative Sample Size Split or Material Submitted Used	
Representable Wet Wt, gm	229.8
+#4 Grnd., Washed DS., gm	84.9
-#4 Wet Wt., gm	144.9
-#4 Water Content, %	12.6
-#4 Dry Wt., gm	128.7
Representable Dry Wt, gm	**213.5**
** Note: Percentages +#4 are based on total Dry representable sample.*	
Split Sample, -#4 washed over #200	
Tare No.	839
Tare + WS., gm	193.65
Tare + DS., gm	185.77
Tare, gm	123.44
Wt. of DS., gm	62.33
Water Content -#4, %	12.6
Wt. of +#200 Sample, gm	19.6

US Std. Sieve Size	Sieve Opening (mm)	Wt. of Soil Retained (gm)	Percent Retained (%)*	Cumulative Percent Retained	Percent Finer (%)	Final Percent Finer
3"	75	0	0.0	0.0	100.0	100.0
2 1/2"	62.5	0	0.0	0.0	100.0	100.0
2"	50	0	0.0	0.0	100.0	100.0
1 1/2"	37.5	0	0.0	0.0	100.0	100.0
1"	25	17.41	8.2	8.2	91.8	91.8
3/4"	19	10.91	5.1	13.3	86.7	86.7
1/2"	12.5	24.94	11.7	24.9	75.1	75.1
3/8"	9.5	8.29	3.9	28.8	71.2	71.2
#4	4.75	23.33	10.9	39.7	60.3	60.3
#10	2	6.15	9.9	9.9	90.1	54.3
#20	0.85	5.14	8.2	18.1	81.9	49.3
#40	0.425	2.98	4.8	22.9	77.1	46.5
#60	0.25	1.87	3.0	25.9	74.1	44.6
#140	0.106	2.39	3.8	29.7	70.3	42.3
#200	0.075	1.02	1.6	31.4	68.6	41.4
-#200 / Pan		42.8	68.6	100.0	-	-

The final percent finer combines the gradation of the plus #4 and minus #4 material.

HYDROMETER ANALYSIS (-#200)

Hydrometer Sample Weight (-#200)	
Tare No.	805
Wt. Tare + DS., gm	135.95
Wt. Tare, gm	102.16
Wt. Dispers., gm	5
Wt. Dry Soil, gm	28.79
-#10 Dispersed 1min in Hamilton Beach Mixer	
K Factor	0.0137
Composite Correction	7.5
a Factor	0.99
Average Test Temp, °C	18.7
Specific Gravity, Assumed	2.7

Elapsed Time (min.)	R Measured	Composite Correction	R Corrected	Percent Finer (%)	Particle Diameter (mm)	Adjusted % Finer (%)
0	NA	NA	NA	NA	NA	NA
2	33	7.5	25.5	87.6	0.0318	36.2
5	30	7.5	22.5	77.3	0.0206	32.0
15	26	7.5	18.5	63.5	0.0122	26.3
30	23	7.5	15.5	53.2	0.0088	22.0
60	20.5	7.5	13	44.7	0.0063	18.5
250	16	7.5	8.5	29.2	0.0032	12.1
1440	14.5	7.5	7	24.0	0.0013	9.9

The adjusted percent finer is corrected for the percent passing the -#200 sieve.

D 422 / USCS SOIL CLASSIFICATION

Corrected For 100% Passing a 3" Sieve

% Gravel (-3" & +#4)	**39.7**	Silt=25%	Clay=16.3%
Coarse=13.3; Fine=26.5		D60, mm	NA
% Sand (-#4 & +#200)	**18.9**	D30, mm	NA
Coa.=5.9; Med.=7.8; Fine=5.1		D10, mm	NA
% Fines (-#200)	**41.4**	Cc	NA
% Plus #200 (-3")	**58.6**	Cu	NA

USCS Description

CLAYEY GRAVEL WITH SAND

USCS Group Symbol	Atterberg Limits Group Symbol
GC	**CL, LL=33, PL=19, PI=14**

Auxiliary Information	Wt Ret, gm	% Retained	% Finer
12" Sieve - 300 mm	0	0.0	100.0
6" Sieve - 150 mm	0	0.0	100.0
3" Sieve - 75 mm	0	0.0	100.0

USDA CLASSIFICATION

Particle Size (mm)	Percent Finer (%)	Percent of Each Component (Material)	(%)	Corrected Percent of -2.0 mm Material for USDA
100	100			
		Gravel	45.7	0
2	54.3			
		Sand	15.4	28.3
0.05	38.9			
		Silt	28.0	51.6
0.002	10.9			
		Clay	10.9	20.1

USDA Classification

SILT LOAM

Input Validation: Reviewed By: Date Tested: 12/1/2010

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LIQUID LIMIT, PLASTIC LIMIT, AND PLASTICITY INDEX OF SOILS
ASTM D 4318

Client	Civil & Environmental Consultants, I	Boring No.	SB-2
Client Project	091-867 Apex Landfill Expansion	Depth(ft)	22'-24'
Project No.	30598	Sample No.	SS-12
		Lab Sample No.	30598029

Soil Description: DARK GRAY LEAN CLAY
(-#40 Fraction)

AS-RECEIVED W.C.

Tare Number	839
Wt. Tare & WS, gm	193.65
Wt. Tare & DS, gm	185.77
Wt. Water, gm	7.88
Wt. Tare, gm	123.44
Wt. DS, gm	62.33
Water Content, %	12.6

SAMPLE SUMMARY

Liquid Limit (LL), %	33
Plastic Limit (PL), %	19
Plasticity Index (PI)	14
USCS Symbol (-#40 Fraction)	CL
Sample Preparation:	Wet Method
Liquidity Index, %	-45.4%
Clay Fraction (% 2 microns)	NA
Skempton's Activity (A)	NA

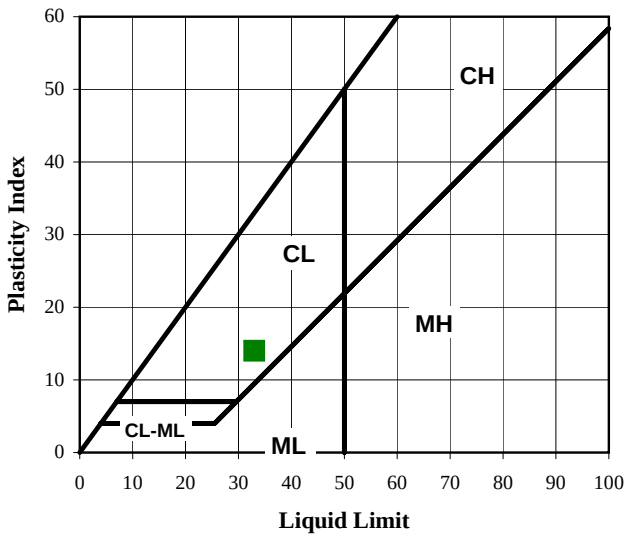
PLASTIC LIMIT

Test Number	1	2	3
Tare Number	466	476	
Wt. Tare & WS, gm	17.38	18.16	
Wt. Tare & DS, gm	16.34	17.00	
Wt. Water, gm	1.04	1.16	
Wt. Tare, gm	10.78	10.88	
Wt. DS, gm	5.56	6.12	
Water Content, %	18.7	19.0	

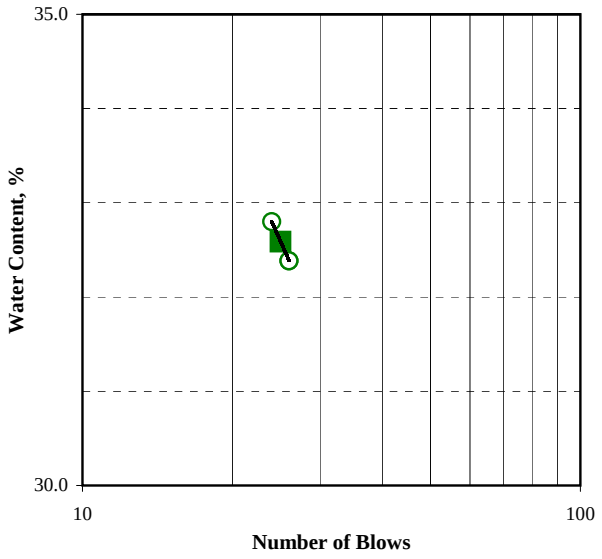
LIQUID LIMIT

	1	2	3
Tare Number	449	443	
Wt. Tare & WS, gm	19.57	19.93	
Wt. Tare & DS, gm	17.41	17.68	
Wt. Water, gm	2.16	2.25	
Wt. Tare, gm	10.74	10.82	
Wt. DS, gm	6.67	6.86	
Water Content, %	32.4	32.8	
# of Blows	26	24	

PLASTICITY CHART



FLOW CURVE



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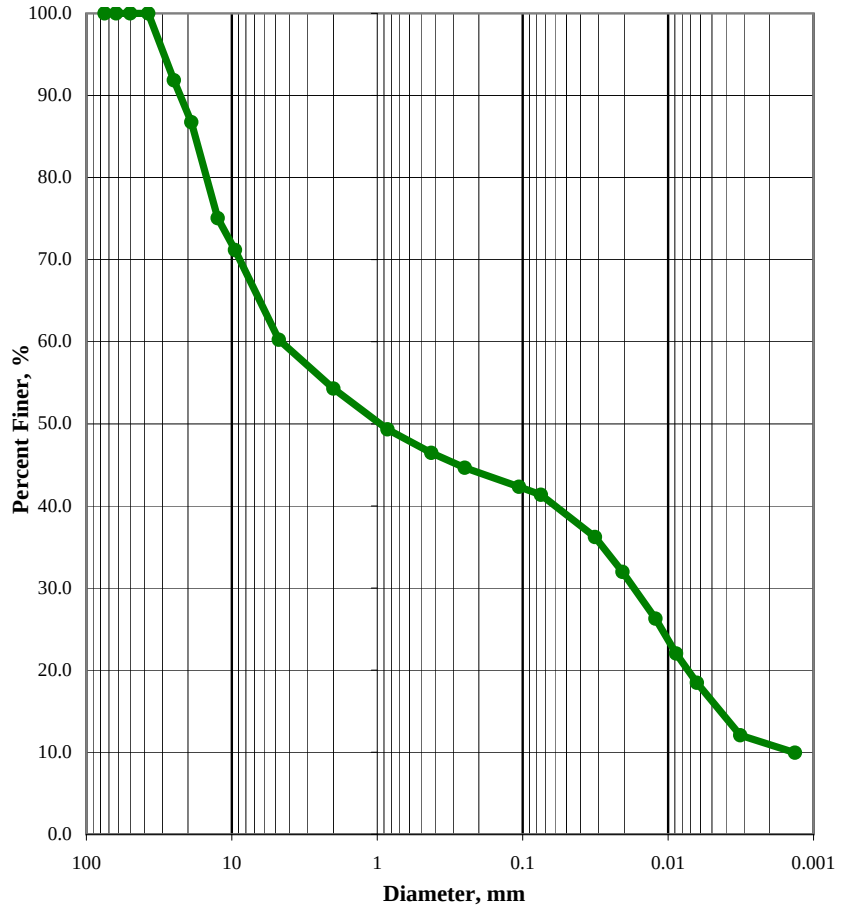
PARTICLE-SIZE ANALYSIS OF SOILS

Client	Civil & Environmental Consultants, I	Boring	SB-2
Client Project	091-867 Apex Landfill Expansion	Depth	22'-24'
Project No.	30598	Sample	SS-12
		Lab Sample No.	30598029
USCS Description	**DARK GRAY CLAYEY GRAVEL WITH SAND**		
USCS Group Symbol	**GC**	AASHTO:	**A-6 (2)**
USDA Description	**SILT LOAM**		



US Std. Sieve Size	Particle Diameter (mm)	Percent Finer (%)
3"	75	100.0
2 1/2"	62.5	100.0
2"	50	100.0
1 1/2"	37.5	100.0
1"	25	91.8
3/4"	19	86.7
1/2"	12.5	75.1
3/8"	9.5	71.2
#4	4.75	60.3
#10	2	54.3
#20	0.85	49.3
#40	0.425	46.5
#60	0.25	44.6
#140	0.106	42.3
#200	0.075	41.4
NA	0.0318	36.2
NA	0.0206	32.0
NA	0.0122	26.3
NA	0.0088	22.0
NA	0.0063	18.5
NA	0.0032	12.1
NA	0.0013	9.9

USCS SOIL CLASSIFICATION

Corrected For 100% Passing a 3" Sieve

% Gravel (-3" & +#4)	**39.7**	Silt=25% Clay=16.3%	
Coarse=13.3; Fine=26.5		D60, mm	NA
% Sand (-#4 & +#200)	**18.9**	D30, mm	NA
Coa.=5.9; Med.=7.8; Fine=5.1		D10, mm	NA
% Fines (-#200)	**41.4**	Cc	NA
% Plus #200 (-3")	**58.6**	Cu	NA

USCS Description
CLAYEY GRAVEL WITH SAND

USCS Group Symbol	Atterberg Limits Group Symbol		
GC	**CL, LL=33, PL=19, PI=14**		
Auxiliary Information	Wt Ret, gm	% Retained	% Finer
12" Sieve - 300 mm	0	0.0	100.0
6" Sieve - 150 mm	0	0.0	100.0
3" Sieve - 75 mm	0	0.0	100.0

USDA CLASSIFICATION

Particle Size (mm)	Percent Finer (%)	Percent of Each Component (Material)	(%)	Corrected Percent of -2.0 mm Material for USDA
100	100			
		Gravel	45.7	0
2	54.3			
		Sand	15.4	28.3
0.05	38.9			
		Silt	28.0	51.6
0.002	10.9			
		Clay	10.9	20.1

USDA Classification
SILT LOAM

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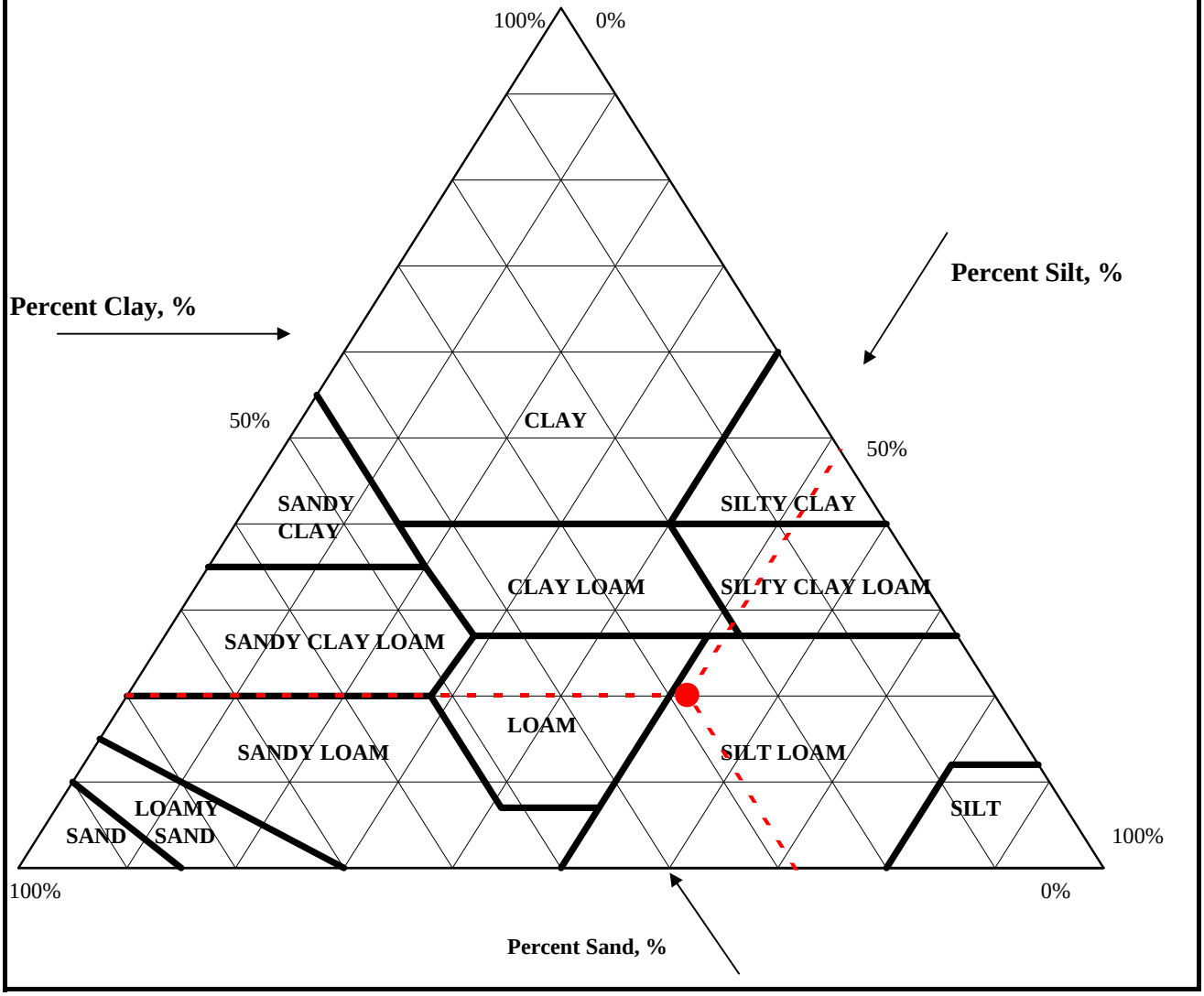
USDA CLASSIFICATION CHART

Client	Civil & Environmental Consultants, I	Boring	SB-2
Client Project	091-867 Apex Landfill Expansion	Depth	22'-24'
Project No.	30598	Sample	SS-12
		Lab Sample No.	30598029
USCS Description	**DARK GRAY CLAYEY GRAVEL WITH SAND**		
USCS Group Symbol	**GC**	AASHTO Classification	**A-6 (2)**
USDA Description	**SILT LOAM**		

Corrected for 0% gravel	
Percent Gravel, %	0.0
Percent Sand, %	28.3
Percent Silt, %	51.6
Percent Clay, %	20.1

Sand Subsizes Corrected Percentages	
Very Coarse Sand; 2-1	7.4
Coarse Sand; 1-0.5	5.8
Medium Sand; 0.5-0.25	4.6
Fine Sand; 0.25-0.1	4.6
Very Fine Sand; 0.1-0.05	6.0
Total	**28.3**



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PARTICLE-SIZE ANALYSIS OF SOILS
ASTM D 422

Client	Civil & Environmental Consultants, I	Boring	SB-5
Client Project	091-867 Apex Landfill Expansion	Depth	6'-8'
Project No.	30598	Sample	SS-4
		Lab Sample No.	30598030

USCS Description **DARK GRAY CLAYEY GRAVEL WITH SAND**
USCS Group Symbol **GC** AASHTO: **A-2-6 (1)**
USDA Description **SANDY LOAM**

MECHANICAL SIEVE ANALYSIS

As-Received Representative Sample Size Split or Material Submitted Used	
Representable Wet Wt, gm	262.2
+#4 Grnd., Washed DS., gm	107.7
-#4 Wet Wt., gm	154.5
-#4 Water Content, %	12.3
-#4 Dry Wt., gm	137.5
Representable Dry Wt, gm	**245.3**
** Note: Percentages +#4 are based on total Dry representable sample.*	
Split Sample, -#4 washed over #200	
Tare No.	800
Tare + WS., gm	204.42
Tare + DS., gm	195.51
Tare, gm	123.25
Wt. of DS., gm	72.26
Water Content -#4, %	12.3
Wt. of +#200 Sample, gm	40.0

US Std. Sieve Size	Sieve Opening (mm)	Wt. of Soil Retained (gm)	Percent Retained (%)*	Cumulative Percent Retained	Percent Finer (%)	Final Percent Finer
3"	75	0	0.0	0.0	100.0	100.0
2 1/2"	62.5	0	0.0	0.0	100.0	100.0
2"	50	0	0.0	0.0	100.0	100.0
1 1/2"	37.5	0	0.0	0.0	100.0	100.0
1"	25	54.67	22.3	22.3	77.7	77.7
3/4"	19	15.51	6.3	28.6	71.4	71.4
1/2"	12.5	15.77	6.4	35.0	65.0	65.0
3/8"	9.5	19.47	7.9	43.0	57.0	57.0
#4	4.75	2.3	0.9	43.9	56.1	56.1
#10	2	13.18	18.2	18.2	81.8	45.9
#20	0.85	11.52	15.9	34.2	65.8	36.9
#40	0.425	5.03	7.0	41.1	58.9	33.0
#60	0.25	2.92	4.0	45.2	54.8	30.7
#140	0.106	4.33	6.0	51.2	48.8	27.4
#200	0.075	2.99	4.1	55.3	44.7	25.1
-#200 / Pan		32.3	44.7	100.0	-	-

The final percent finer combines the gradation of the plus #4 and minus #4 material.

HYDROMETER ANALYSIS (-#200)

Hydrometer Sample Weight (-#200)	
Tare No.	307
Wt. Tare + DS., gm	122.48
Wt. Tare, gm	98.86
Wt. Dispers., gm	5
Wt. Dry Soil, gm	18.62
-#10 Dispersed 1min in Hamilton Beach Mixer	
K Factor	0.0137
Composite Correction	7.5
a Factor	0.99
Average Test Temp, °C	18.9
Specific Gravity, Assumed	2.7

Elapsed Time (min.)	R Measured	Composite Correction	R Corrected	Percent Finer (%)	Particle Diameter (mm)	Adjusted % Finer (%)
0	NA	NA	NA	NA	NA	NA
2	21	7.5	13.5	71.7	0.0346	18.0
5	19	7.5	11.5	61.1	0.0221	15.3
15	17	7.5	9.5	50.5	0.0129	12.6
30	16	7.5	8.5	45.1	0.0092	11.3
60	14	7.5	6.5	34.5	0.0066	8.7
250	12	7.5	4.5	23.9	0.0033	6.0
1440	11	7.5	3.5	18.6	0.0014	4.7

The adjusted percent finer is corrected for the percent passing the -#200 sieve.

D 422 / USCS SOIL CLASSIFICATION

Corrected For 100% Passing a 3" Sieve

% Gravel (-3" & +#4)	**43.9**	Silt=17.3% Clay=7.6%	
Coarse=28.6; Fine=15.3		D60, mm	NA
% Sand (-#4 & +#200)	**31.0**	D30, mm	NA
Coa.=10.2; Med.=12.8; Fine=7.9		D10, mm	NA
% Fines (-#200)	**25.1**	Cc	NA
% Plus #200 (-3")	**74.9**	Cu	NA

USCS Description
CLAYEY GRAVEL WITH SAND

USCS Group Symbol	Atterberg Limits Group Symbol
GC	**CL, LL=37, PL=19, PI=18**

Auxiliary Information	Wt Ret, gm	% Retained	% Finer
12" Sieve - 300 mm	0	0.0	100.0
6" Sieve - 150 mm	0	0.0	100.0
3" Sieve - 75 mm	0	0.0	100.0

USDA CLASSIFICATION

Particle Size (mm)	Percent Finer (%)	Percent of Each Component (Material)	(%)	Corrected Percent of -2.0 mm Material for USDA
100	100			
		Gravel	54.1	0
2	45.9			
		Sand	24.5	53.4
0.05	21.3			
		Silt	16.1	35.1
0.002	5.2			
		Clay	5.2	11.4

USDA Classification
SANDY LOAM

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LIQUID LIMIT, PLASTIC LIMIT, AND PLASTICITY INDEX OF SOILS
ASTM D 4318

Client	Civil & Environmental Consultants, I	Boring No.	SB-5
Client Project	091-867 Apex Landfill Expansion	Depth(ft)	6'-8'
Project No.	30598	Sample No.	SS-4
		Lab Sample No.	30598030

Soil Description: DARK GRAY LEAN CLAY
(-#40 Fraction)

AS-RECEIVED W.C.

Tare Number	800
Wt. Tare & WS, gm	204.42
Wt. Tare & DS, gm	195.51
Wt. Water, gm	8.91
Wt. Tare, gm	123.25
Wt. DS, gm	72.26
Water Content, %	12.3

SAMPLE SUMMARY

Liquid Limit (LL), %	37
Plastic Limit (PL), %	19
Plasticity Index (PI)	18
USCS Symbol (-#40 Fraction)	CL
Sample Preparation:	Wet Method
Liquidity Index, %	-37.1%
Clay Fraction (% 2 microns)	NA
Skempton's Activity (A)	NA

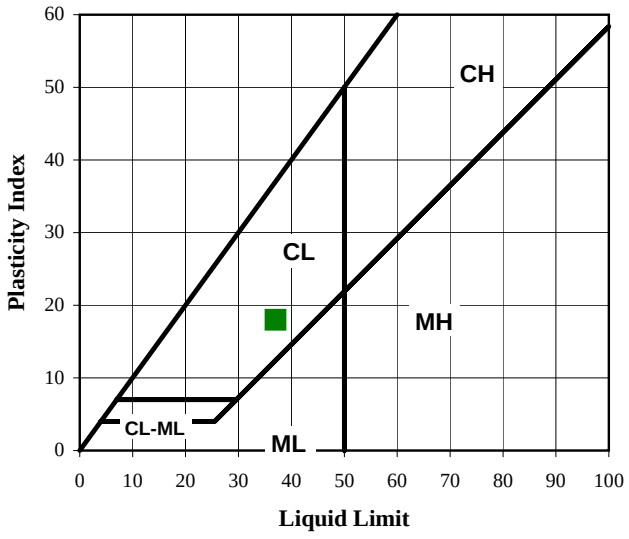
PLASTIC LIMIT

Test Number	1	2	3
Tare Number	414	458	
Wt. Tare & WS, gm	19.77	18.34	
Wt. Tare & DS, gm	18.35	17.15	
Wt. Water, gm	1.42	1.19	
Wt. Tare, gm	10.81	10.81	
Wt. DS, gm	7.54	6.34	
Water Content, %	18.8	18.8	

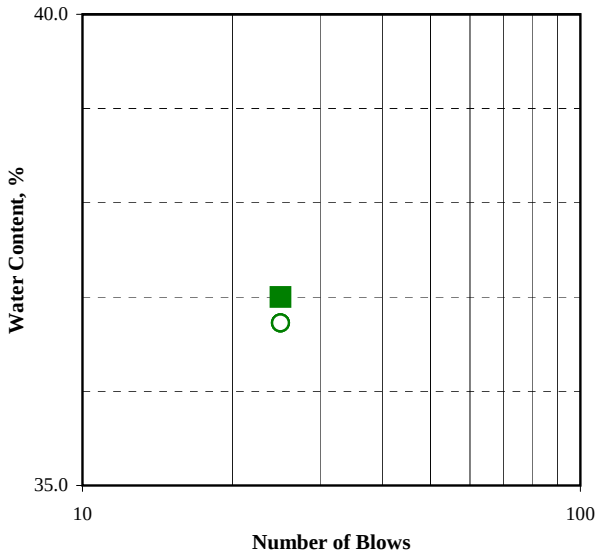
LIQUID LIMIT

	1	2	3
Tare Number	508		
Wt. Tare & WS, gm	18.74		
Wt. Tare & DS, gm	16.61		
Wt. Water, gm	2.13		
Wt. Tare, gm	10.81		
Wt. DS, gm	5.80		
Water Content, %	36.7		
# of Blows	25		

PLASTICITY CHART



FLOW CURVE



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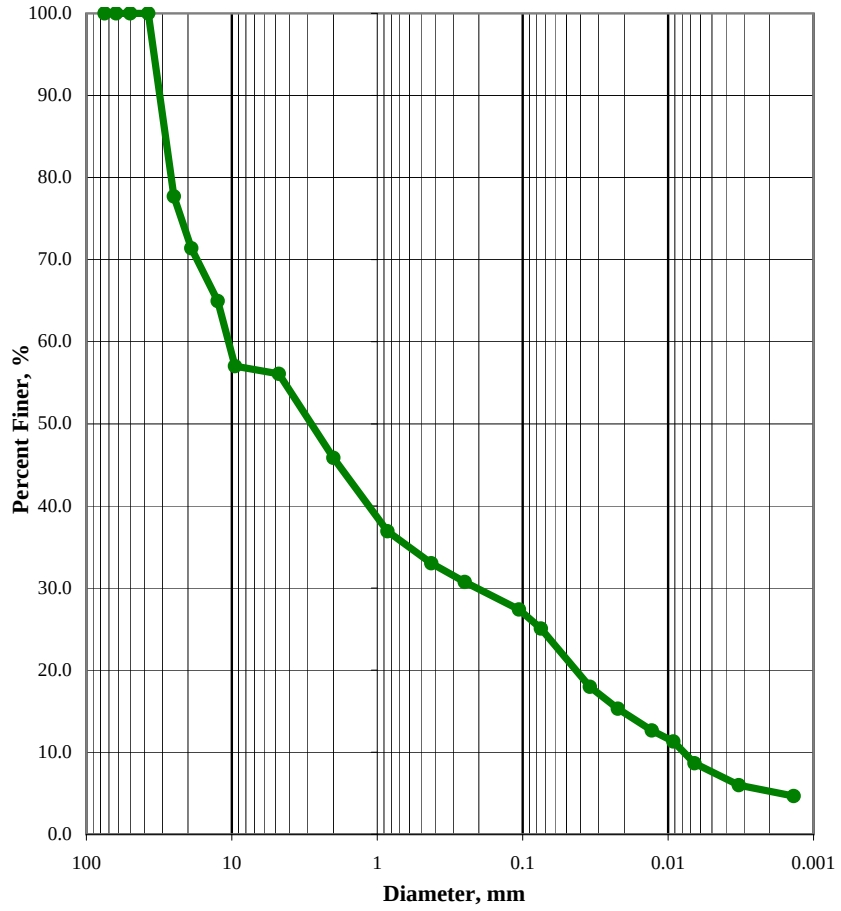
PARTICLE-SIZE ANALYSIS OF SOILS

Client	Civil & Environmental Consultants, I	Boring	SB-5
Client Project	091-867 Apex Landfill Expansion	Depth	6'-8'
Project No.	30598	Sample	SS-4
		Lab Sample No.	30598030
USCS Description	**DARK GRAY CLAYEY GRAVEL WITH SAND**		
USCS Group Symbol	**GC**	AASHTO:	**A-2-6 (1)**
USDA Description	**SANDY LOAM**		



US Std. Sieve Size	Particle Diameter (mm)	Percent Finer (%)
3"	75	100.0
2 1/2"	62.5	100.0
2"	50	100.0
1 1/2"	37.5	100.0
1"	25	77.7
3/4"	19	71.4
1/2"	12.5	65.0
3/8"	9.5	57.0
#4	4.75	56.1
#10	2	45.9
#20	0.85	36.9
#40	0.425	33.0
#60	0.25	30.7
#140	0.106	27.4
#200	0.075	25.1
NA	0.0346	18.0
NA	0.0221	15.3
NA	0.0129	12.6
NA	0.0092	11.3
NA	0.0066	8.7
NA	0.0033	6.0
NA	0.0014	4.7

USCS SOIL CLASSIFICATION

Corrected For 100% Passing a 3" Sieve

% Gravel (-3" & +#4)	**43.9**	Silt=17.3% Clay=7.6%	
Coarse=28.6; Fine=15.3		D60, mm	NA
% Sand (-#4 & +#200)	**31.0**	D30, mm	NA
Coa.=10.2; Med.=12.8; Fine=7.9		D10, mm	NA
% Fines (-#200)	**25.1**	Cc	NA
% Plus #200 (-3")	**74.9**	Cu	NA

USCS Description
CLAYEY GRAVEL WITH SAND

USCS Group Symbol	Atterberg Limits Group Symbol		
GC	**CL, LL=37, PL=19, PI=18**		
Auxiliary Information	Wt Ret, gm	% Retained	% Finer
12" Sieve - 300 mm	0	0.0	100.0
6" Sieve - 150 mm	0	0.0	100.0
3" Sieve - 75 mm	0	0.0	100.0

USDA CLASSIFICATION

Particle Size (mm)	Percent Finer (%)	Percent of Each Component (Material)	(%)	Corrected Percent of -2.0 mm Material for USDA
100	100			
		Gravel	54.1	0
2	45.9			
		Sand	24.5	53.4
0.05	21.3			
		Silt	16.1	35.1
0.002	5.2			
		Clay	5.2	11.4

USDA Classification
SANDY LOAM

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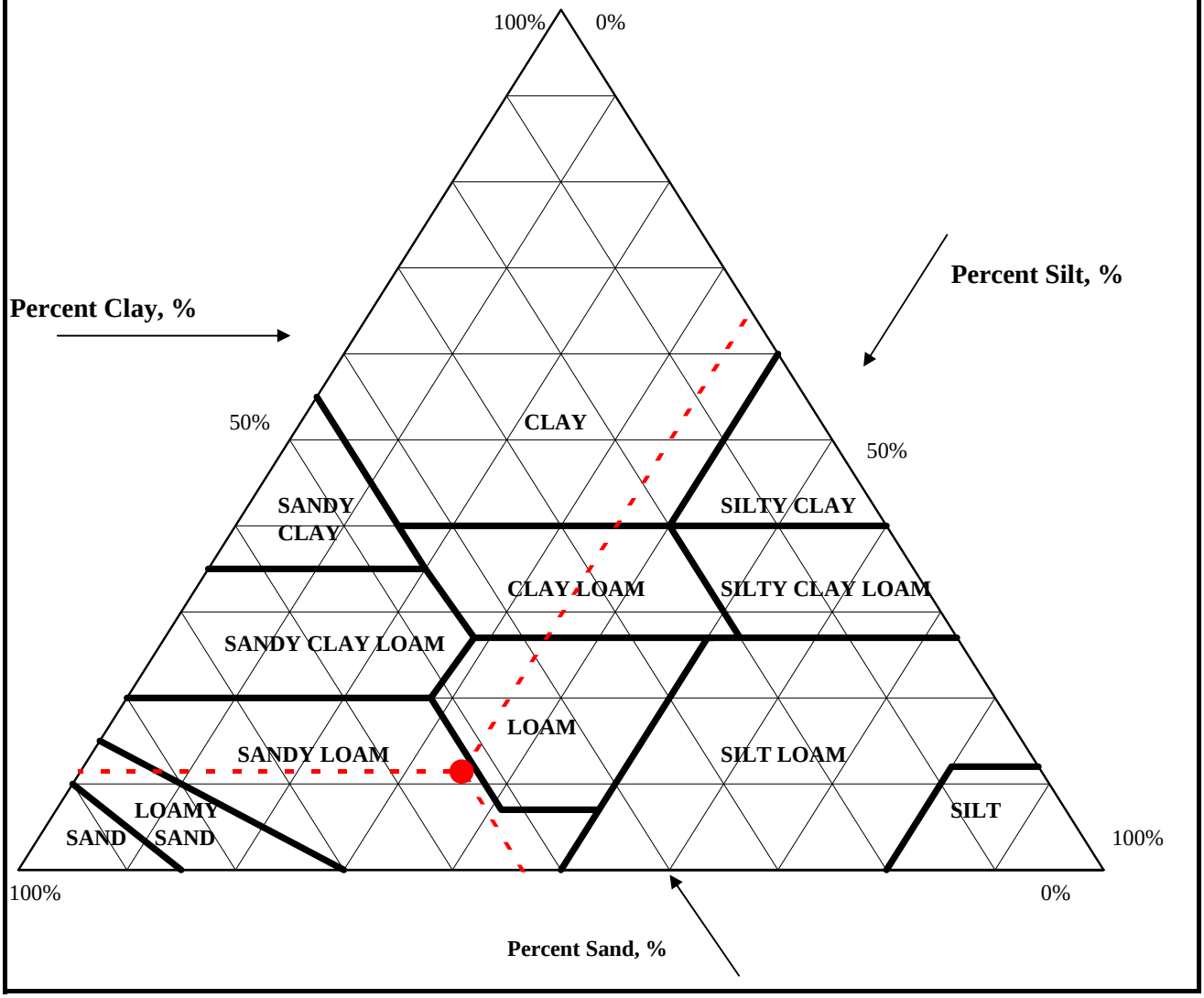
USDA CLASSIFICATION CHART

Client	Civil & Environmental Consultants, I	Boring	SB-5
Client Project	091-867 Apex Landfill Expansion	Depth	6'-8'
Project No.	30598	Sample	SS-4
		Lab Sample No.	30598030
USCS Description	**DARK GRAY CLAYEY GRAVEL WITH SAND**		
USCS Group Symbol	**GC**	AASHTO Classification	**A-2-6 (1)**
USDA Description	**SANDY LOAM**		

Corrected for 0% gravel	
Percent Gravel, %	0.0
Percent Sand, %	53.4
Percent Silt, %	35.1
Percent Clay, %	11.4

Sand Subsizes Corrected Percentages	
Very Coarse Sand; 2-1	15.8
Coarse Sand; 1-0.5	10.2
Medium Sand; 0.5-0.25	6.9
Fine Sand; 0.25-0.1	8.2
Very Fine Sand; 0.1-0.05	12.3
Total	**53.4**



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PARTICLE-SIZE ANALYSIS OF SOILS
ASTM D 422

Client	Civil & Environmental Consultants, I	Boring	SB-6
Client Project	091-867 Apex Landfill Expansion	Depth	30'-32'
Project No.	30598	Sample	SS-15
		Lab Sample No.	30598031

USCS Description **DARK GRAY CLAYEY SAND**
USCS Group Symbol **SC** AASHTO: **A-6 (4)**
USDA Description **LOAM**

MECHANICAL SIEVE ANALYSIS

As-Received Representative Sample Size Split or Material Submitted Used	
Representable Wet Wt, gm	210.1
+#4 Grnd., Washed DS., gm	22.0
-#4 Wet Wt., gm	188.0
-#4 Water Content, %	14.7
-#4 Dry Wt., gm	163.9
Representable Dry Wt, gm	**185.9**
** Note: Percentages +#4 are based on total Dry representable sample.*	
Split Sample, -#4 washed over #200	
Tare No.	902
Tare + WS., gm	213.01
Tare + DS., gm	201.49
Tare, gm	123.38
Wt. of DS., gm	78.11
Water Content -#4, %	14.7
Wt. of +#200 Sample, gm	37.9

US Std. Sieve Size	Sieve Opening (mm)	Wt. of Soil Retained (gm)	Percent Retained (%)*	Cumulative Percent Retained	Percent Finer (%)	Final Percent Finer
3"	75	0	0.0	0.0	100.0	100.0
2 1/2"	62.5	0	0.0	0.0	100.0	100.0
2"	50	0	0.0	0.0	100.0	100.0
1 1/2"	37.5	0	0.0	0.0	100.0	100.0
1"	25	0	0.0	0.0	100.0	100.0
3/4"	19	0	0.0	0.0	100.0	100.0
1/2"	12.5	6.41	3.4	3.4	96.6	96.6
3/8"	9.5	5.76	3.1	6.5	93.5	93.5
#4	4.75	9.86	5.3	11.9	88.1	88.1
#10	2	12.22	15.6	15.6	84.4	74.4
#20	0.85	11.29	14.5	30.1	69.9	61.6
#40	0.425	5.84	7.5	37.6	62.4	55.0
#60	0.25	3.09	4.0	41.5	58.5	51.5
#140	0.106	3.76	4.8	46.3	53.7	47.3
#200	0.075	1.72	2.2	48.5	51.5	45.4
-#200 / Pan		40.2	51.5	100.0	-	-

The final percent finer combines the gradation of the plus #4 and minus #4 material.

HYDROMETER ANALYSIS (-#200)

Hydrometer Sample Weight (-#200)	
Tare No.	828
Wt. Tare + DS., gm	134.88
Wt. Tare, gm	102.72
Wt. Dispers., gm	5
Wt. Dry Soil, gm	27.16
-#10 Dispersed 1min in Hamilton Beach Mixer	
K Factor	0.0137
Composite Correction	7.5
a Factor	0.99
Average Test Temp, °C	18.7
Specific Gravity, Assumed	2.7

Elapsed Time (min.)	R Measured	Composite Correction	R Corrected	Percent Finer (%)	Particle Diameter (mm)	Adjusted % Finer (%)
0	NA	NA	NA	NA	NA	NA
2	32	7.5	24.5	89.2	0.0321	40.5
5	31	7.5	23.5	85.6	0.0204	38.8
15	28	7.5	20.5	74.6	0.0121	33.9
30	26	7.5	18.5	67.4	0.0086	30.6
60	23.5	7.5	16	58.3	0.0062	26.4
250	19	7.5	11.5	41.9	0.0031	19.0
1440	16.5	7.5	9	32.8	0.0013	14.9

The adjusted percent finer is corrected for the percent passing the -#200 sieve.

D 422 / USCS SOIL CLASSIFICATION

Corrected For 100% Passing a 3" Sieve

% Gravel (-3" & +#4)	**11.9**	Silt=21.2%	Clay=24.1%
Coarse=0; Fine=11.9		D60, mm	NA
% Sand (-#4 & +#200)	**42.8**	D30, mm	NA
Coa.=13.8; Med.=19.3; Fine=9.7		D10, mm	NA
% Fines (-#200)	**45.4**	Cc	NA
% Plus #200 (-3")	**54.6**	Cu	NA

USCS Description
CLAYEY SAND

USCS Group Symbol	Atterberg Limits Group Symbol
SC	**CL, LL=37, PL=19, PI=18**

Auxiliary Information	Wt Ret, gm	% Retained	% Finer
12" Sieve - 300 mm	0	0.0	100.0
6" Sieve - 150 mm	0	0.0	100.0
3" Sieve - 75 mm	0	0.0	100.0

USDA CLASSIFICATION

Particle Size (mm)	Percent Finer (%)	Percent of Each Component (Material)	(%)	Corrected Percent of -2.0 mm Material for USDA
100	100			
		Gravel	25.6	0
2	74.4			
		Sand	31.3	42.1
0.05	43.0			
		Silt	26.2	35.2
0.002	16.8			
		Clay	16.8	22.6

USDA Classification
LOAM

Input Validation: Reviewed By: Date Tested: 12/1/2010

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LIQUID LIMIT, PLASTIC LIMIT, AND PLASTICITY INDEX OF SOILS
ASTM D 4318

Client	Civil & Environmental Consultants, I	Boring No.	SB-6
Client Project	091-867 Apex Landfill Expansion	Depth(ft)	30'-32'
Project No.	30598	Sample No.	SS-15
		Lab Sample No.	30598031

Soil Description: DARK GRAY LEAN CLAY
(-#40 Fraction)

AS-RECEIVED W.C.

Tare Number	902
Wt. Tare & WS, gm	213.01
Wt. Tare & DS, gm	201.49
Wt. Water, gm	11.52
Wt. Tare, gm	123.38
Wt. DS, gm	78.11
Water Content, %	14.7

SAMPLE SUMMARY

Liquid Limit (LL), %	37
Plastic Limit (PL), %	19
Plasticity Index (PI)	18
USCS Symbol (-#40 Fraction)	CL
Sample Preparation:	Wet Method
Liquidity Index, %	-23.6%
Clay Fraction (% 2 microns)	NA
Skempton's Activity (A)	NA

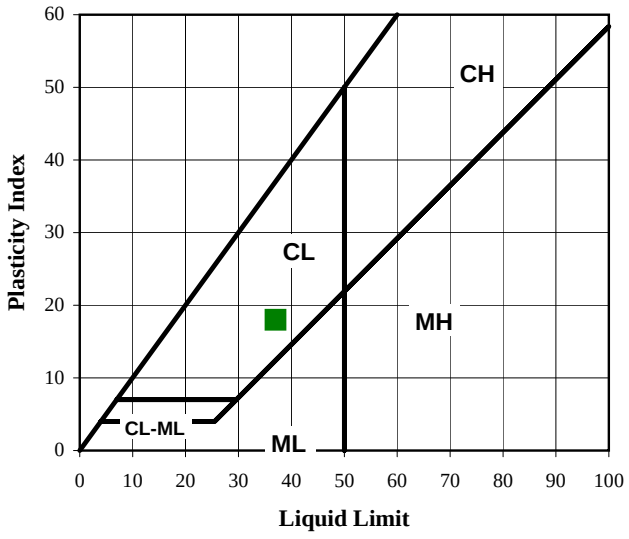
PLASTIC LIMIT

Test Number	1	2	3
Tare Number	430	491	
Wt. Tare & WS, gm	17.73	16.99	
Wt. Tare & DS, gm	16.59	16.04	
Wt. Water, gm	1.14	0.95	
Wt. Tare, gm	10.82	10.83	
Wt. DS, gm	5.77	5.21	
Water Content, %	19.8	18.2	

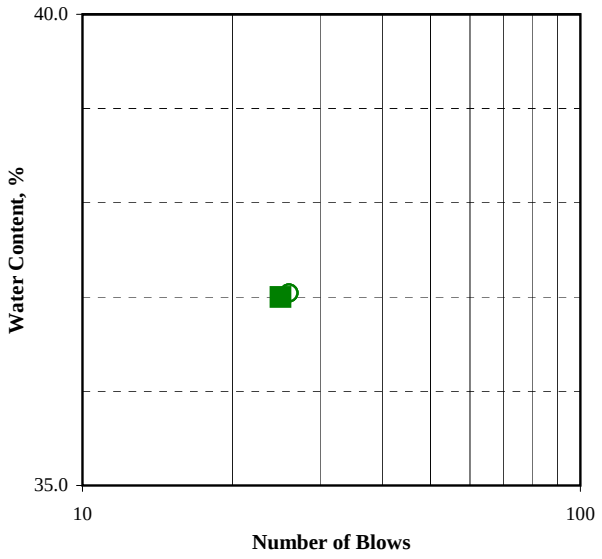
LIQUID LIMIT

	1	2	3
	433		
	19.34		
	17.01		
	2.33		
	10.72		
	6.29		
	37.0		
# of Blows	26		

PLASTICITY CHART



FLOW CURVE



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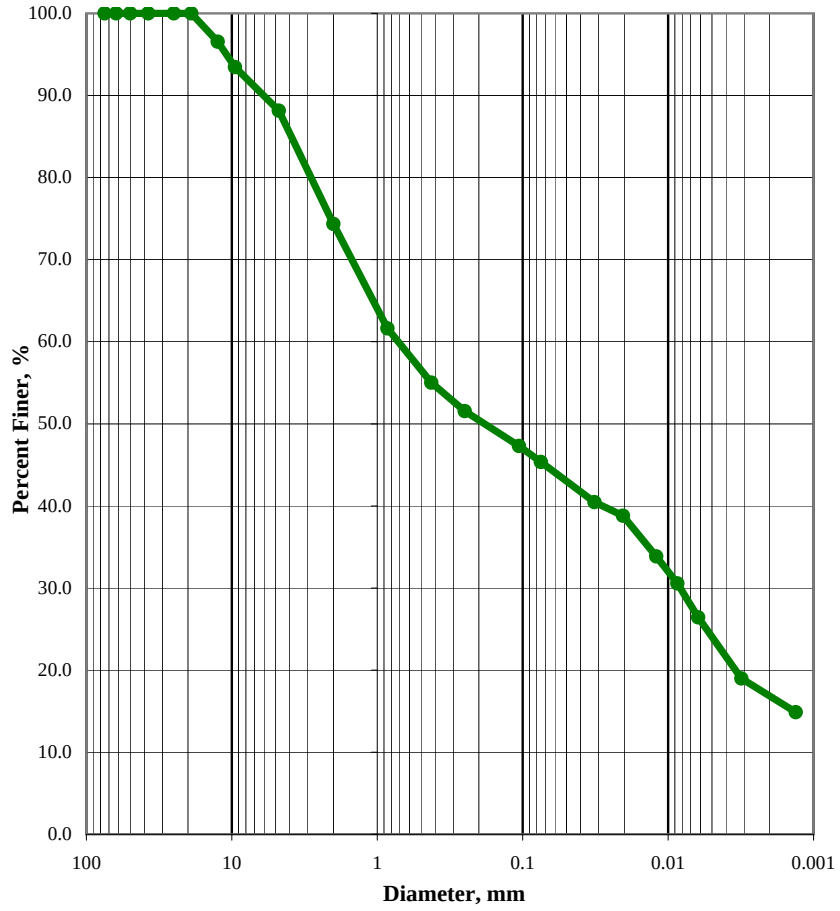
PARTICLE-SIZE ANALYSIS OF SOILS

Client	Civil & Environmental Consultants, I	Boring	SB-6
Client Project	091-867 Apex Landfill Expansion	Depth	30'-32'
Project No.	30598	Sample	SS-15
		Lab Sample No.	30598031
USCS Description	**DARK GRAY CLAYEY SAND**		
USCS Group Symbol	**SC**	AASHTO:	**A-6 (4)**
USDA Description	**LOAM**		



US Std. Sieve Size	Particle Diameter (mm)	Percent Finer (%)
3"	75	100.0
2 1/2"	62.5	100.0
2"	50	100.0
1 1/2"	37.5	100.0
1"	25	100.0
3/4"	19	100.0
1/2"	12.5	96.6
3/8"	9.5	93.5
#4	4.75	88.1
#10	2	74.4
#20	0.85	61.6
#40	0.425	55.0
#60	0.25	51.5
#140	0.106	47.3
#200	0.075	45.4
NA	0.0321	40.5
NA	0.0204	38.8
NA	0.0121	33.9
NA	0.0086	30.6
NA	0.0062	26.4
NA	0.0031	19.0
NA	0.0013	14.9

USCS SOIL CLASSIFICATION

Corrected For 100% Passing a 3" Sieve

% Gravel (-3" & +#4)	**11.9**	Silt=21.2% Clay=24.1%	
Coarse=0; Fine=11.9		D60, mm	NA
% Sand (-#4 & +#200)	**42.8**	D30, mm	NA
Coa.=13.8; Med.=19.3; Fine=9.7		D10, mm	NA
% Fines (-#200)	**45.4**	Cc	NA
% Plus #200 (-3")	**54.6**	Cu	NA

USCS Description
CLAYEY SAND

USCS Group Symbol	Atterberg Limits Group Symbol
SC	**CL, LL=37, PL=19, PI=18**

Auxiliary Information	Wt Ret, gm	% Retained	% Finer
12" Sieve - 300 mm	0	0.0	100.0
6" Sieve - 150 mm	0	0.0	100.0
3" Sieve - 75 mm	0	0.0	100.0

USDA CLASSIFICATION

Particle Size (mm)	Percent Finer (%)
100	100
2	74.4
0.05	43.0
0.002	16.8

Percent of Each Component (Material)	(%)	Corrected Percent of -2.0 mm Material for USDA
Gravel	25.6	0
Sand	31.3	42.1
Silt	26.2	35.2
Clay	16.8	22.6

USDA Classification
LOAM

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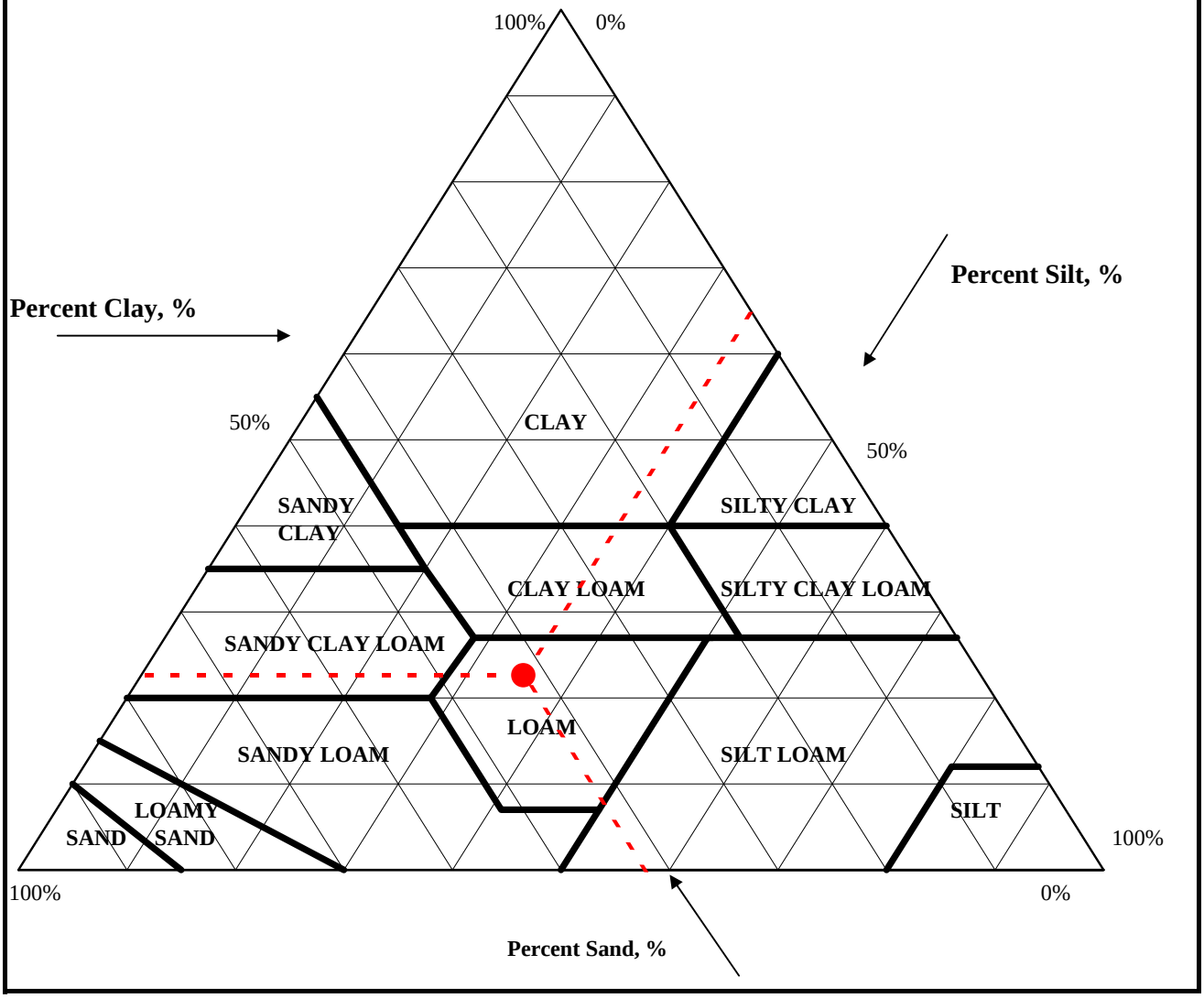
USDA CLASSIFICATION CHART

Client	Civil & Environmental Consultants, I	Boring	SB-6
Client Project	091-867 Apex Landfill Expansion	Depth	30'-32'
Project No.	30598	Sample	SS-15
		Lab Sample No.	30598031
USCS Description	**DARK GRAY CLAYEY SAND**		
USCS Group Symbol	**SC**	AASHTO Classification	**A-6 (4)**
USDA Description	**LOAM**		

Corrected for 0% gravel	
Percent Gravel, %	0.0
Percent Sand, %	42.1
Percent Silt, %	35.2
Percent Clay, %	22.6

Sand Subsizes Corrected Percentages	
Very Coarse Sand; 2-1	13.9
Coarse Sand; 1-0.5	10.0
Medium Sand; 0.5-0.25	6.8
Fine Sand; 0.25-0.1	6.1
Very Fine Sand; 0.1-0.05	5.3
Total	**42.1**



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PARTICLE-SIZE ANALYSIS OF SOILS
ASTM D 422

Client	Civil & Environmental Consultants, I	Boring	SB-8
Client Project	091-867 Apex Landfill Expansion	Depth	6'-8'
Project No.	30598	Sample	SS-3
		Lab Sample No.	30598032

USCS Description **BROWN SANDY LEAN CLAY**
USCS Group Symbol **CL** AASHTO: **A-6 (3)**
USDA Description **LOAM**

MECHANICAL SIEVE ANALYSIS

As-Received Representative Sample Size Split or Material Submitted Used	
Representable Wet Wt, gm	223.0
+#4 Grnd., Washed DS., gm	21.4
-#4 Wet Wt., gm	201.6
-#4 Water Content, %	10.6
-#4 Dry Wt., gm	182.3
Representable Dry Wt, gm	**203.7**
** Note: Percentages +#4 are based on total Dry representable sample.*	
Split Sample, -#4 washed over #200	
Tare No.	906
Tare + WS., gm	223.06
Tare + DS., gm	213.53
Tare, gm	123.45
Wt. of DS., gm	90.08
Water Content -#4, %	10.6
Wt. of +#200 Sample, gm	36.1

US Std. Sieve Size	Sieve Opening (mm)	Wt. of Soil Retained (gm)	Percent Retained (%)*	Cumulative Percent Retained	Percent Finer (%)	Final Percent Finer
3"	75	0	0.0	0.0	100.0	100.0
2 1/2"	62.5	0	0.0	0.0	100.0	100.0
2"	50	0	0.0	0.0	100.0	100.0
1 1/2"	37.5	0	0.0	0.0	100.0	100.0
1"	25	0	0.0	0.0	100.0	100.0
3/4"	19	15.2	7.5	7.5	92.5	92.5
1/2"	12.5	0	0.0	7.5	92.5	92.5
3/8"	9.5	1.45	0.7	8.2	91.8	91.8
#4	4.75	4.75	2.3	10.5	89.5	89.5
#10	2	8.28	9.2	9.2	90.8	81.3
#20	0.85	4.4	4.9	14.1	85.9	76.9
#40	0.425	2.39	2.7	16.7	83.3	74.5
#60	0.25	1.97	2.2	18.9	81.1	72.6
#140	0.106	11.53	12.8	31.7	68.3	61.1
#200	0.075	7.49	8.3	40.0	60.0	53.7
-#200 / Pan		54.0	60.0	100.0	-	-

The final percent finer combines the gradation of the plus #4 and minus #4 material.

HYDROMETER ANALYSIS (-#200)

Hydrometer Sample Weight (-#200)	
Tare No.	830
Wt. Tare + DS., gm	135.87
Wt. Tare, gm	102.69
Wt. Dispers., gm	5
Wt. Dry Soil, gm	28.18
-#10 Dispersed 1min in Hamilton Beach Mixer	
K Factor	0.0137
Composite Correction	7.5
a Factor	0.99
Average Test Temp, °C	18.8
Specific Gravity, Assumed	2.7

Elapsed Time (min.)	R Measured	Composite Correction	R Corrected	Percent Finer (%)	Particle Diameter (mm)	Adjusted % Finer (%)
0	NA	NA	NA	NA	NA	NA
2	31	7.5	23.5	82.5	0.0323	44.3
5	28.5	7.5	21	73.7	0.0208	39.6
15	25.5	7.5	18	63.2	0.0123	33.9
30	23	7.5	15.5	54.4	0.0088	29.2
60	20	7.5	12.5	43.9	0.0064	23.5
250	16	7.5	8.5	29.8	0.0032	16.0
1440	14	7.5	6.5	22.8	0.0013	12.2

The adjusted percent finer is corrected for the percent passing the -#200 sieve.

D 422 / USCS SOIL CLASSIFICATION

Corrected For 100% Passing a 3" Sieve

% Gravel (-3" & +#4)	**10.5**	Silt=32.6%	Clay=20.9%
Coarse=7.5; Fine=3		D60, mm	NA
% Sand (-#4 & +#200)	**35.8**	D30, mm	NA
Coa.=8.2; Med.=6.7; Fine=20.9		D10, mm	NA
% Fines (-#200)	**53.7**	Cc	NA
% Plus #200 (-3")	**46.3**	Cu	NA

USCS Description
SANDY LEAN CLAY

USCS Group Symbol	Atterberg Limits Group Symbol
CL	**CL, LL=30, PL=19, PI=11**

Auxiliary Information	Wt Ret, gm	% Retained	% Finer
12" Sieve - 300 mm	0	0.0	100.0
6" Sieve - 150 mm	0	0.0	100.0
3" Sieve - 75 mm	0	0.0	100.0

USDA CLASSIFICATION

Particle Size (mm)	Percent Finer (%)	Percent of Each Component (Material)	(%)	Corrected Percent of -2.0 mm Material for USDA
100	100			
		Gravel	18.7	0
2	81.3			
		Sand	32.1	39.5
0.05	49.1			
		Silt	35.2	43.3
0.002	14.0			
		Clay	14.0	17.2

USDA Classification
LOAM

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LIQUID LIMIT, PLASTIC LIMIT, AND PLASTICITY INDEX OF SOILS
ASTM D 4318

Client	Civil & Environmental Consultants, I	Boring No.	SB-8
Client Project	091-867 Apex Landfill Expansion	Depth(ft)	6'-8'
Project No.	30598	Sample No.	SS-3
		Lab Sample No.	30598032

Soil Description: BROWN LEAN CLAY
(-#40 Fraction)

AS-RECEIVED W.C.

Tare Number	906
Wt. Tare & WS, gm	223.06
Wt. Tare & DS, gm	213.53
Wt. Water, gm	9.53
Wt. Tare, gm	123.45
Wt. DS, gm	90.08
Water Content, %	10.6

SAMPLE SUMMARY

Liquid Limit (LL), %	30
Plastic Limit (PL), %	19
Plasticity Index (PI)	11
USCS Symbol (-#40 Fraction)	CL
Sample Preparation:	Wet Method
Liquidity Index, %	-76.6%
Clay Fraction (% 2 microns)	NA
Skempton's Activity (A)	NA

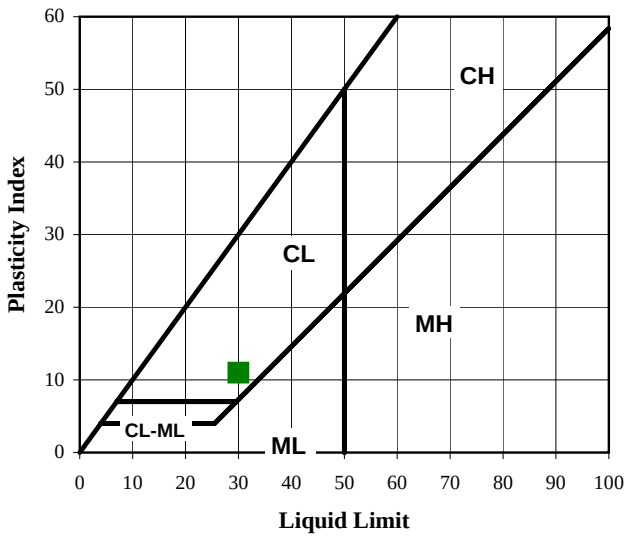
PLASTIC LIMIT

Test Number	1	2	3
Tare Number	498		
Wt. Tare & WS, gm	17.60		
Wt. Tare & DS, gm	16.51		
Wt. Water, gm	1.09		
Wt. Tare, gm	10.76		
Wt. DS, gm	5.75		
Water Content, %	19.0		

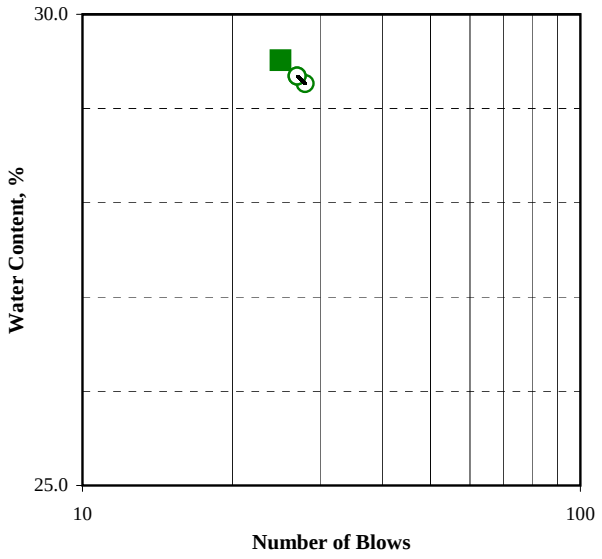
LIQUID LIMIT

	1	2	3
Tare Number	450	508	
Wt. Tare & WS, gm	21.24	23.24	
Wt. Tare & DS, gm	18.89	20.42	
Wt. Water, gm	2.35	2.82	
Wt. Tare, gm	10.86	10.81	
Wt. DS, gm	8.03	9.61	
Water Content, %	29.3	29.3	
# of Blows	28	27	

PLASTICITY CHART



FLOW CURVE



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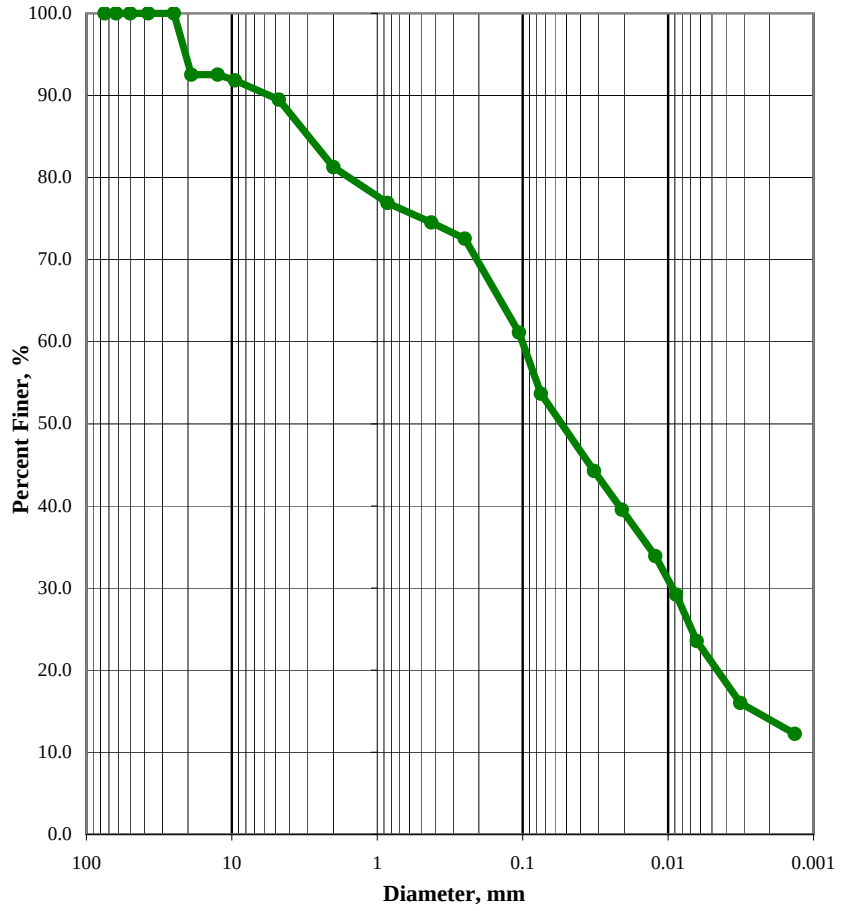
PARTICLE-SIZE ANALYSIS OF SOILS

Client	Civil & Environmental Consultants, I	Boring	SB-8
Client Project	091-867 Apex Landfill Expansion	Depth	6'-8'
Project No.	30598	Sample	SS-3
		Lab Sample No.	30598032

USCS Description **BROWN SANDY LEAN CLAY**
USCS Group Symbol **CL** AASHTO: **A-6 (3)**
USDA Description **LOAM**



US Std. Sieve Size	Particle Diameter (mm)	Percent Finer (%)
3"	75	100.0
2 1/2"	62.5	100.0
2"	50	100.0
1 1/2"	37.5	100.0
1"	25	100.0
3/4"	19	92.5
1/2"	12.5	92.5
3/8"	9.5	91.8
#4	4.75	89.5
#10	2	81.3
#20	0.85	76.9
#40	0.425	74.5
#60	0.25	72.6
#140	0.106	61.1
#200	0.075	53.7
NA	0.0323	44.3
NA	0.0208	39.6
NA	0.0123	33.9
NA	0.0088	29.2
NA	0.0064	23.5
NA	0.0032	16.0
NA	0.0013	12.2

USCS SOIL CLASSIFICATION

Corrected For 100% Passing a 3" Sieve

% Gravel (-3" & +#4)	**10.5**	Silt=32.6% Clay=20.9%	
Coarse=7.5; Fine=3		D60, mm	NA
% Sand (-#4 & +#200)	**35.8**	D30, mm	NA
Coa.=8.2; Med.=6.7; Fine=20.9		D10, mm	NA
% Fines (-#200)	**53.7**	Cc	NA
% Plus #200 (-3")	**46.3**	Cu	NA

USCS Description
SANDY LEAN CLAY

USCS Group Symbol	Atterberg Limits Group Symbol		
CL	**CL, LL=30, PL=19, PI=11**		
Auxiliary Information	Wt Ret, gm	% Retained	% Finer
12" Sieve - 300 mm	0	0.0	100.0
6" Sieve - 150 mm	0	0.0	100.0
3" Sieve - 75 mm	0	0.0	100.0

USDA CLASSIFICATION

Particle Size (mm)	Percent Finer (%)	Percent of Each Component (Material)	(%)	Corrected Percent of -2.0 mm Material for USDA
100	100			
		Gravel	18.7	0
2	81.3			
		Sand	32.1	39.5
0.05	49.1			
		Silt	35.2	43.3
0.002	14.0			
		Clay	14.0	17.2

USDA Classification
LOAM

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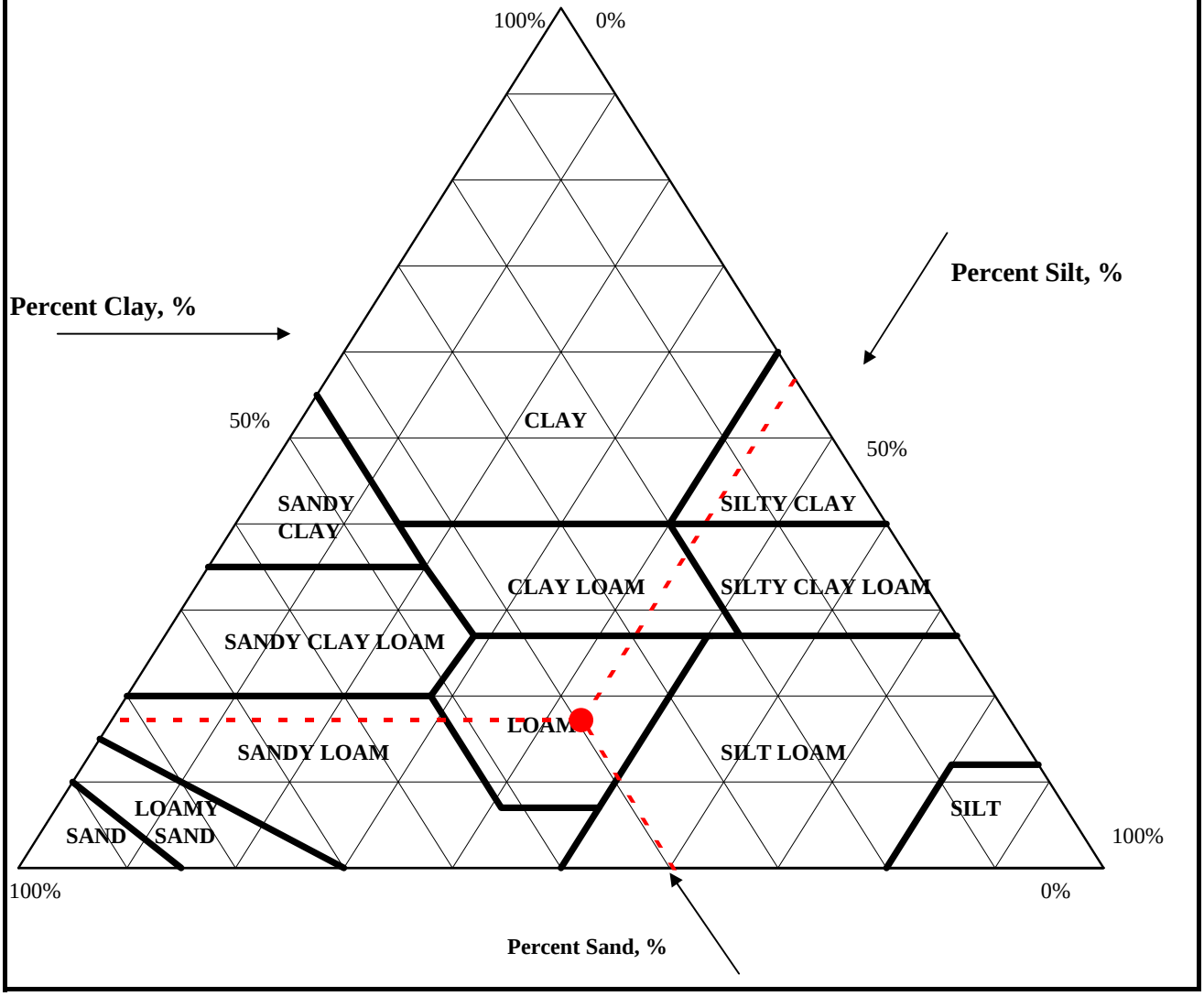
USDA CLASSIFICATION CHART

Client	Civil & Environmental Consultants, I	Boring	SB-8
Client Project	091-867 Apex Landfill Expansion	Depth	6'-8'
Project No.	30598	Sample	SS-3
		Lab Sample No.	30598032
USCS Description	**BROWN SANDY LEAN CLAY**		
USCS Group Symbol	**CL**	AASHTO Classification	**A-6 (3)**
USDA Description	**LOAM**		

Corrected for 0% gravel	
Percent Gravel, %	0.0
Percent Sand, %	39.5
Percent Silt, %	43.3
Percent Clay, %	17.2

Sand Subsizes Corrected Percentages	
Very Coarse Sand; 2-1	4.4
Coarse Sand; 1-0.5	3.3
Medium Sand; 0.5-0.25	3.1
Fine Sand; 0.25-0.1	15.6
Very Fine Sand; 0.1-0.05	13.2
Total	**39.5**



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PARTICLE-SIZE ANALYSIS OF SOILS
ASTM D 422

Client	Civil & Environmental Consultants, I	Boring	SB-9
Client Project	091-867 Apex Landfill Expansion	Depth	0'-2'
Project No.	30598	Sample	SS-1
		Lab Sample No.	30598033

USCS Description **YELLOWISH BROWN LEAN CLAY WITH SAND**
USCS Group Symbol **CL** AASHTO: **A-7-6 (16)**
USDA Description **CLAY LOAM**

MECHANICAL SIEVE ANALYSIS

As-Received Representative Sample Size Split or Material Submitted Used	
Representable Wet Wt, gm	205.5
+#4 Grnd., Washed DS., gm	8.0
-#4 Wet Wt., gm	197.4
-#4 Water Content, %	14.7
-#4 Dry Wt., gm	172.2
Representable Dry Wt, gm	**180.2**
** Note: Percentages +#4 are based on total Dry representable sample.*	
Split Sample, -#4 washed over #200	
Tare No.	222
Tare + WS., gm	218.62
Tare + DS., gm	206.38
Tare, gm	123
Wt. of DS., gm	83.38
Water Content -#4, %	14.7
Wt. of +#200 Sample, gm	22.3

US Std. Sieve Size	Sieve Opening (mm)	Wt. of Soil Retained (gm)	Percent Retained (%)*	Cumulative Percent Retained	Percent Finer (%)	Final Percent Finer
3"	75	0	0.0	0.0	100.0	100.0
2 1/2"	62.5	0	0.0	0.0	100.0	100.0
2"	50	0	0.0	0.0	100.0	100.0
1 1/2"	37.5	0	0.0	0.0	100.0	100.0
1"	25	0	0.0	0.0	100.0	100.0
3/4"	19	0	0.0	0.0	100.0	100.0
1/2"	12.5	0	0.0	0.0	100.0	100.0
3/8"	9.5	3.18	1.8	1.8	98.2	98.2
#4	4.75	4.86	2.7	4.5	95.5	95.5
#10	2	7.18	8.6	8.6	91.4	87.3
#20	0.85	5.97	7.2	15.8	84.2	80.5
#40	0.425	2.82	3.4	19.2	80.8	77.2
#60	0.25	1.72	2.1	21.2	78.8	75.3
#140	0.106	3.01	3.6	24.8	75.2	71.8
#200	0.075	1.57	1.9	26.7	73.3	70.0
-#200 / Pan		61.1	73.3	100.0	-	-

The final percent finer combines the gradation of the plus #4 and minus #4 material.

HYDROMETER ANALYSIS (-#200)

Hydrometer Sample Weight (-#200)	
Tare No.	705
Wt. Tare + DS., gm	139.24
Wt. Tare, gm	99.63
Wt. Dispers., gm	5
Wt. Dry Soil, gm	34.61
-#10 Dispersed 1min in Hamilton Beach Mixer	
K Factor	0.0137
Composite Correction	7.5
a Factor	0.99
Average Test Temp, °C	18.7
Specific Gravity, Assumed	2.7

Elapsed Time (min.)	R Measured	Composite Correction	R Corrected	Percent Finer (%)	Particle Diameter (mm)	Adjusted % Finer (%)
0	NA	NA	NA	NA	NA	NA
2	39.5	7.5	32	91.4	0.0302	64.0
5	38	7.5	30.5	87.1	0.0193	61.0
15	34.5	7.5	27	77.1	0.0115	54.0
30	32	7.5	24.5	70.0	0.0083	49.0
60	28	7.5	20.5	58.6	0.0060	41.0
250	22.5	7.5	15	42.9	0.0031	30.0
1440	20	7.5	12.5	35.7	0.0013	25.0

The adjusted percent finer is corrected for the percent passing the -#200 sieve.

D 422 / USCS SOIL CLASSIFICATION

Corrected For 100% Passing a 3" Sieve

% Gravel (-3" & +#4)	**4.5**	Silt=32%	Clay=38%
Coarse=0; Fine=4.5		D60, mm	NA
% Sand (-#4 & +#200)	**25.5**	D30, mm	NA
Coa.=8.2; Med.=10.1; Fine=7.2		D10, mm	NA
% Fines (-#200)	**70.0**	Cc	NA
% Plus #200 (-3")	**30.0**	Cu	NA

USCS Description
LEAN CLAY WITH SAND

USCS Group Symbol	Atterberg Limits Group Symbol
CL	**CL, LL=46, PL=22, PI=24**

Auxiliary Information	Wt Ret, gm	% Retained	% Finer
12" Sieve - 300 mm	0	0.0	100.0
6" Sieve - 150 mm	0	0.0	100.0
3" Sieve - 75 mm	0	0.0	100.0

USDA CLASSIFICATION

Particle Size (mm)	Percent Finer (%)	Percent of Each Component (Material)	(%)	Corrected Percent of -2.0 mm Material for USDA
100	100			
		Gravel	12.7	0
2	87.3			
		Sand	20.0	22.9
0.05	67.3			
		Silt	39.8	45.6
0.002	27.5			
		Clay	27.5	31.5

USDA Classification
CLAY LOAM

Input Validation: Reviewed By: Date Tested: 12/1/2010

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LIQUID LIMIT, PLASTIC LIMIT, AND PLASTICITY INDEX OF SOILS
ASTM D 4318

Client	Civil & Environmental Consultants, I	Boring No.	SB-9
Client Project	091-867 Apex Landfill Expansion	Depth(ft)	0'-2'
Project No.	30598	Sample No.	SS-1
		Lab Sample No.	30598033

Soil Description: YELLOWISH BROWN LEAN CLAY
(-#40 Fraction)

AS-RECEIVED W.C.

Tare Number	222
Wt. Tare & WS, gm	218.62
Wt. Tare & DS, gm	206.38
Wt. Water, gm	12.24
Wt. Tare, gm	123.00
Wt. DS, gm	83.38
Water Content, %	14.7

SAMPLE SUMMARY

Liquid Limit (LL), %	46
Plastic Limit (PL), %	22
Plasticity Index (PI)	24
USCS Symbol (-#40 Fraction)	CL
Sample Preparation:	Wet Method
Liquidity Index, %	-30.5%
Clay Fraction (% 2 microns)	NA
Skempton's Activity (A)	NA

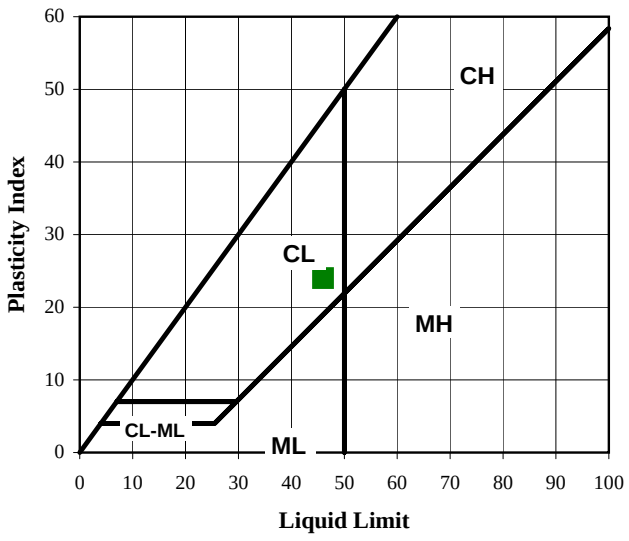
PLASTIC LIMIT

Test Number	1	2	3
Tare Number	506	455	
Wt. Tare & WS, gm	17.39	16.89	
Wt. Tare & DS, gm	16.18	15.78	
Wt. Water, gm	1.21	1.11	
Wt. Tare, gm	10.78	10.77	
Wt. DS, gm	5.40	5.01	
Water Content, %	22.4	22.2	

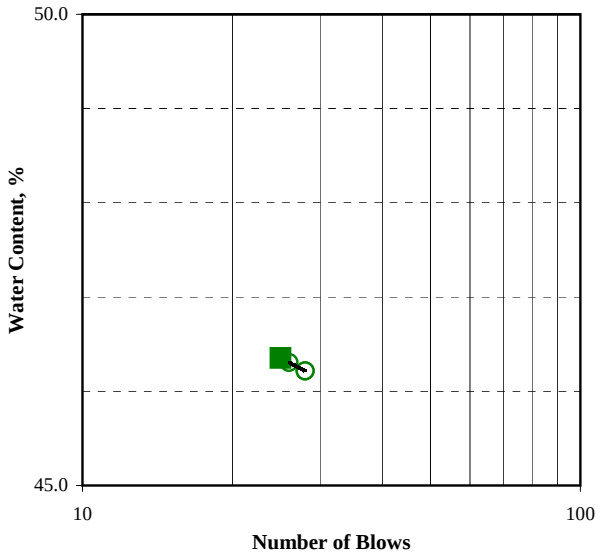
LIQUID LIMIT

	1	2	3
Tare Number	498	450	
Wt. Tare & WS, gm	18.09	19.76	
Wt. Tare & DS, gm	15.77	16.94	
Wt. Water, gm	2.32	2.82	
Wt. Tare, gm	10.75	10.85	
Wt. DS, gm	5.02	6.09	
Water Content, %	46.2	46.3	
# of Blows	28	26	

PLASTICITY CHART



FLOW CURVE



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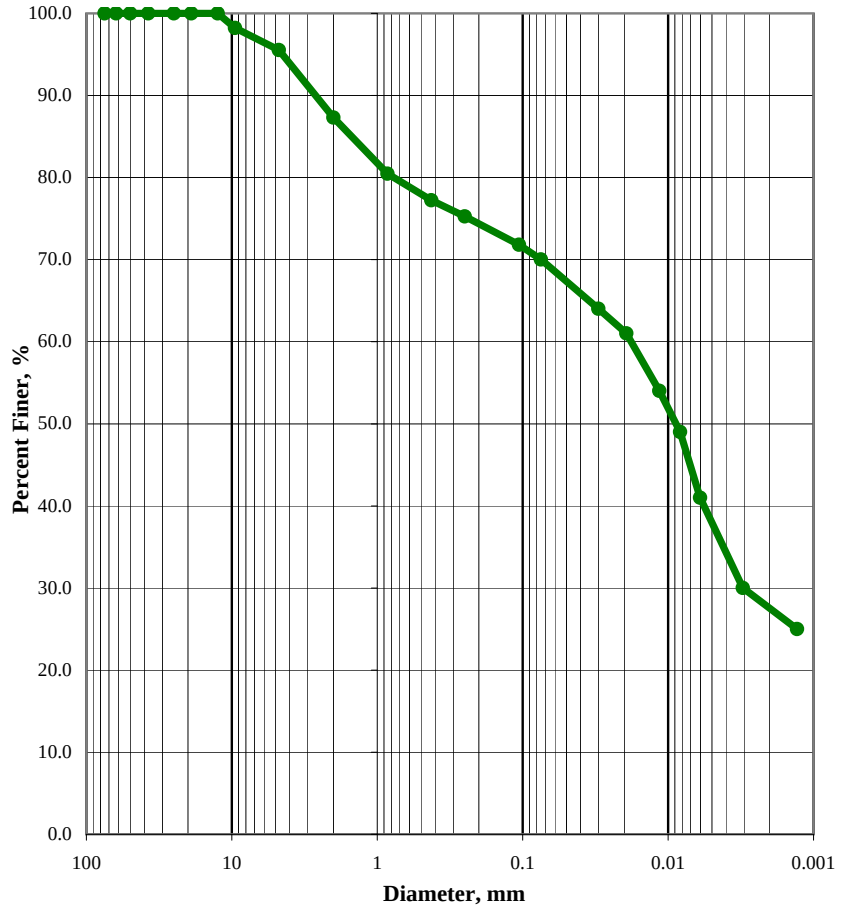
PARTICLE-SIZE ANALYSIS OF SOILS

Client	Civil & Environmental Consultants, I	Boring	SB-9
Client Project	091-867 Apex Landfill Expansion	Depth	0'-2'
Project No.	30598	Sample	SS-1
		Lab Sample No.	30598033

USCS Description **YELLOWISH BROWN LEAN CLAY WITH SAND**

USCS Group Symbol **CL** AASHTO: **A-7-6 (16)**

USDA Description **CLAY LOAM**



US Std. Sieve Size	Particle Diameter (mm)	Percent Finer (%)
3"	75	100.0
2 1/2"	62.5	100.0
2"	50	100.0
1 1/2"	37.5	100.0
1"	25	100.0
3/4"	19	100.0
1/2"	12.5	100.0
3/8"	9.5	98.2
#4	4.75	95.5
#10	2	87.3
#20	0.85	80.5
#40	0.425	77.2
#60	0.25	75.3
#140	0.106	71.8
#200	0.075	70.0
NA	0.0302	64.0
NA	0.0193	61.0
NA	0.0115	54.0
NA	0.0083	49.0
NA	0.0060	41.0
NA	0.0031	30.0
NA	0.0013	25.0

USCS SOIL CLASSIFICATION

Corrected For 100% Passing a 3" Sieve

% Gravel (-3" & +#4)	**4.5**	Silt=32% Clay=38%	
Coarse=0; Fine=4.5		D60, mm	NA
% Sand (-#4 & +#200)	**25.5**	D30, mm	NA
Coa.=8.2; Med.=10.1; Fine=7.2		D10, mm	NA
% Fines (-#200)	**70.0**	Cc	NA
% Plus #200 (-3")	**30.0**	Cu	NA

USCS Description
LEAN CLAY WITH SAND

USCS Group Symbol	Atterberg Limits Group Symbol		
CL	**CL, LL=46, PL=22, PI=24**		
Auxiliary Information	Wt Ret, gm	% Retained	% Finer
12" Sieve - 300 mm	0	0.0	100.0
6" Sieve - 150 mm	0	0.0	100.0
3" Sieve - 75 mm	0	0.0	100.0

USDA CLASSIFICATION

Particle Size (mm)	Percent Finer (%)	Percent of Each Component (Material)	(%)	Corrected Percent of -2.0 mm Material for USDA
100	100			
		Gravel	12.7	0
2	87.3			
		Sand	20.0	22.9
0.05	67.3			
		Silt	39.8	45.6
0.002	27.5			
		Clay	27.5	31.5

USDA Classification
CLAY LOAM

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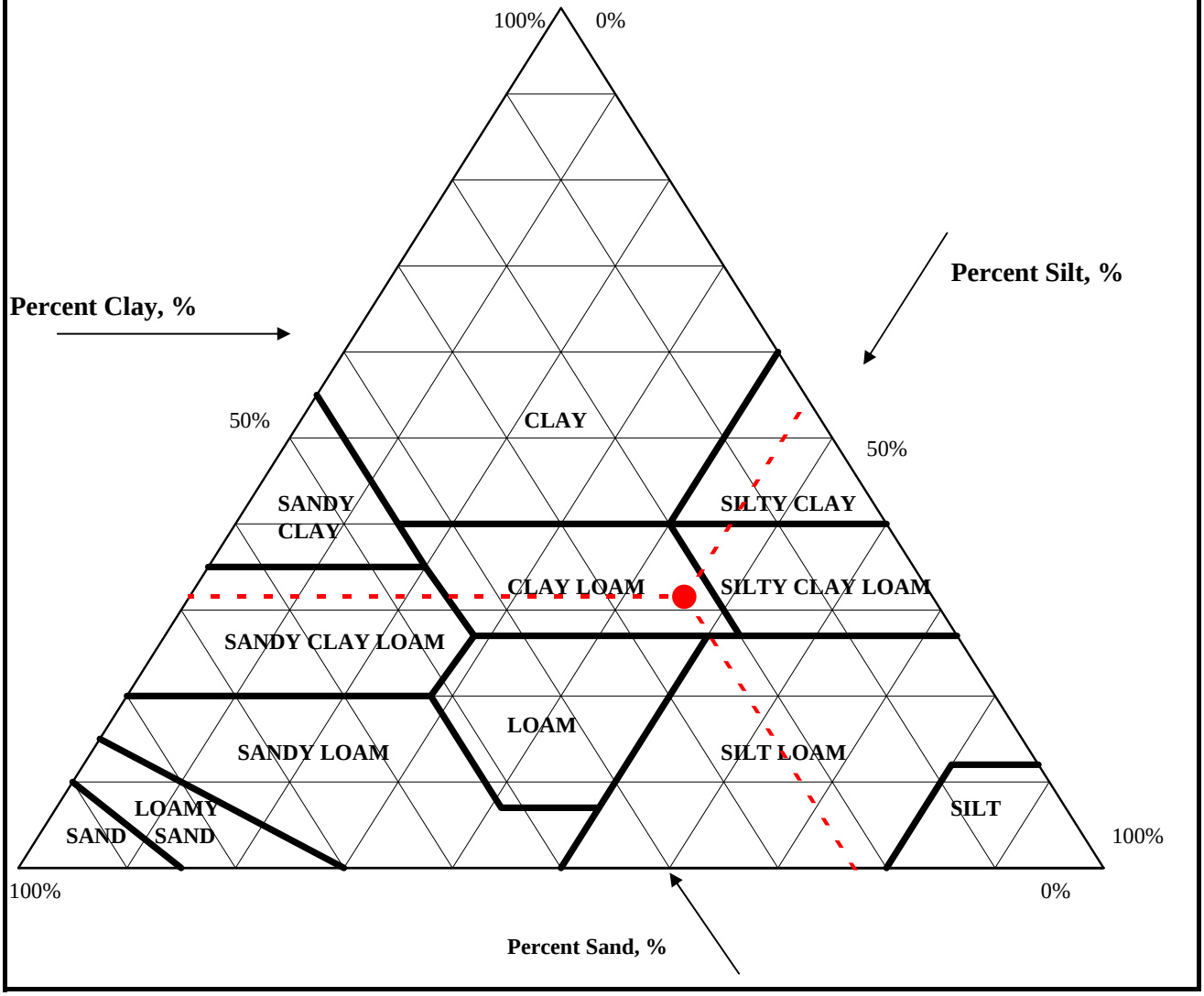
USDA CLASSIFICATION CHART

Client	Civil & Environmental Consultants, I	Boring	SB-9
Client Project	091-867 Apex Landfill Expansion	Depth	0'-2'
Project No.	30598	Sample	SS-1
		Lab Sample No.	30598033
USCS Description	**YELLOWISH BROWN LEAN CLAY WITH SAND**		
USCS Group Symbol	**CL**	AASHTO Classification	**A-7-6 (16)**
USDA Description	**CLAY LOAM**		

Corrected for 0% gravel	
Percent Gravel, %	0.0
Percent Sand, %	22.9
Percent Silt, %	45.6
Percent Clay, %	31.5

Sand Subsizes Corrected Percentages	
Very Coarse Sand; 2-1	6.3
Coarse Sand; 1-0.5	4.3
Medium Sand; 0.5-0.25	3.1
Fine Sand; 0.25-0.1	4.3
Very Fine Sand; 0.1-0.05	4.8
Total	**22.9**



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PARTICLE-SIZE ANALYSIS OF SOILS
ASTM D 422

Client	Civil & Environmental Consultants, I	Boring	SB-11
Client Project	091-867 Apex Landfill Expansion	Depth	14'-16'
Project No.	30598	Sample	SS-8
		Lab Sample No.	30598034
USCS Description	**DARK GRAY LEAN CLAY WITH SAND**		
USCS Group Symbol	**CL**	AASHTO:	**A-6 (12)**
USDA Description	**LOAM**		

MECHANICAL SIEVE ANALYSIS

As-Received Representative Sample Size Split or Material Submitted Used	
Representable Wet Wt, gm	210.6
+#4 Grnd., Washed DS., gm	0.0
-#4 Wet Wt., gm	210.6
-#4 Water Content, %	13.4
-#4 Dry Wt., gm	185.7
Representable Dry Wt, gm	**185.7**
** Note: Percentages +#4 are based on total Dry representable sample.*	
Split Sample, -#4 washed over #200	
Tare No.	520
Tare + WS., gm	197.48
Tare + DS., gm	188.71
Tare, gm	123.28
Wt. of DS., gm	65.43
Water Content -#4, %	13.4
Wt. of +#200 Sample, gm	19.4

US Std. Sieve Size	Sieve Opening (mm)	Wt. of Soil Retained (gm)	Percent Retained (%)*	Cumulative Percent Retained	Percent Finer (%)	Final Percent Finer
3"	75	0	0.0	0.0	100.0	100.0
2 1/2"	62.5	0	0.0	0.0	100.0	100.0
2"	50	0	0.0	0.0	100.0	100.0
1 1/2"	37.5	0	0.0	0.0	100.0	100.0
1"	25	0	0.0	0.0	100.0	100.0
3/4"	19	0	0.0	0.0	100.0	100.0
1/2"	12.5	0	0.0	0.0	100.0	100.0
3/8"	9.5	0	0.0	0.0	100.0	100.0
#4	4.75	0	0.0	0.0	100.0	100.0
#10	2	6.17	9.4	9.4	90.6	90.6
#20	0.85	6.11	9.3	18.8	81.2	81.2
#40	0.425	2.81	4.3	23.1	76.9	76.9
#60	0.25	1.4	2.1	25.2	74.8	74.8
#140	0.106	1.83	2.8	28.0	72.0	72.0
#200	0.075	1.12	1.7	29.7	70.3	70.3
-#200 / Pan		46.0	70.3	100.0	-	-

The final percent finer combines the gradation of the plus #4 and minus #4 material.

HYDROMETER ANALYSIS (-#200)

Hydrometer Sample Weight (-#200)	
Tare No.	817
Wt. Tare + DS., gm	127.93
Wt. Tare, gm	102.07
Wt. Dispers., gm	5
Wt. Dry Soil, gm	20.86
-#10 Dispersed 1min in Hamilton Beach Mixer	
K Factor	0.0137
Composite Correction	7.5
a Factor	0.99
Average Test Temp, °C	18.8
Specific Gravity, Assumed	2.7

Elapsed Time (min.)	R Measured	Composite Correction	R Corrected	Percent Finer (%)	Particle Diameter (mm)	Adjusted % Finer (%)
0	NA	NA	NA	NA	NA	NA
2	25	7.5	17.5	83.0	0.0337	58.3
5	23.5	7.5	16	75.9	0.0215	53.3
15	21.5	7.5	14	66.4	0.0126	46.7
30	20	7.5	12.5	59.3	0.0090	41.7
60	18	7.5	10.5	49.8	0.0064	35.0
250	15	7.5	7.5	35.6	0.0032	25.0
1440	13.5	7.5	6	28.4	0.0013	20.0

The adjusted percent finer is corrected for the percent passing the -#200 sieve.

D 422 / USCS SOIL CLASSIFICATION

Corrected For 100% Passing a 3" Sieve

% Gravel (-3" & +#4)	**0.0**	Silt=38.7%	Clay=31.4%
Coarse=0; Fine=0		D60, mm	NA
% Sand (-#4 & +#200)	**29.7**	D30, mm	NA
Coa.=9.4; Med.=13.6; Fine=6.6		D10, mm	NA
% Fines (-#200)	**70.3**	Cc	NA
% Plus #200 (-3")	**29.7**	Cu	NA

USCS Description

LEAN CLAY WITH SAND

USCS Group Symbol	Atterberg Limits Group Symbol
CL	**CL, LL=40, PL=21, PI=19**

Auxiliary Information	Wt Ret, gm	% Retained	% Finer
12" Sieve - 300 mm	0	0.0	100.0
6" Sieve - 150 mm	0	0.0	100.0
3" Sieve - 75 mm	0	0.0	100.0

USDA CLASSIFICATION

Particle Size (mm)	Percent Finer (%)	Percent of Each Component (Material)	(%)	Corrected Percent of -2.0 mm Material for USDA
100	100			
		Gravel	9.4	0
2	90.6			
		Sand	26.3	29.1
0.05	64.2			
		Silt	42.0	46.3
0.002	22.3			
		Clay	22.3	24.6

USDA Classification

LOAM

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LIQUID LIMIT, PLASTIC LIMIT, AND PLASTICITY INDEX OF SOILS
ASTM D 4318

Client	Civil & Environmental Consultants, I	Boring No.	SB-11
Client Project	091-867 Apex Landfill Expansion	Depth(ft)	14'-16'
Project No.	30598	Sample No.	SS-8
		Lab Sample No.	30598034

Soil Description: DARK GRAY LEAN CLAY
(-#40 Fraction)

AS-RECEIVED W.C.

Tare Number	520
Wt. Tare & WS, gm	197.48
Wt. Tare & DS, gm	188.71
Wt. Water, gm	8.77
Wt. Tare, gm	123.28
Wt. DS, gm	65.43
Water Content, %	13.4

SAMPLE SUMMARY

Liquid Limit (LL), %	40
Plastic Limit (PL), %	21
Plasticity Index (PI)	19
USCS Symbol (-#40 Fraction)	CL
Sample Preparation:	Wet Method
Liquidity Index, %	-40.0%
Clay Fraction (% 2 microns)	NA
Skempton's Activity (A)	NA

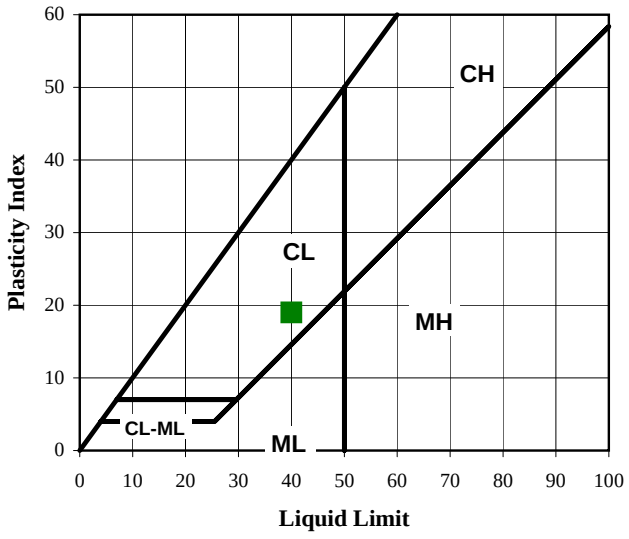
PLASTIC LIMIT

Test Number	1	2	3
Tare Number	413	512	
Wt. Tare & WS, gm	16.88	17.31	
Wt. Tare & DS, gm	15.85	16.15	
Wt. Water, gm	1.03	1.16	
Wt. Tare, gm	10.82	10.76	
Wt. DS, gm	5.03	5.39	
Water Content, %	20.5	21.5	

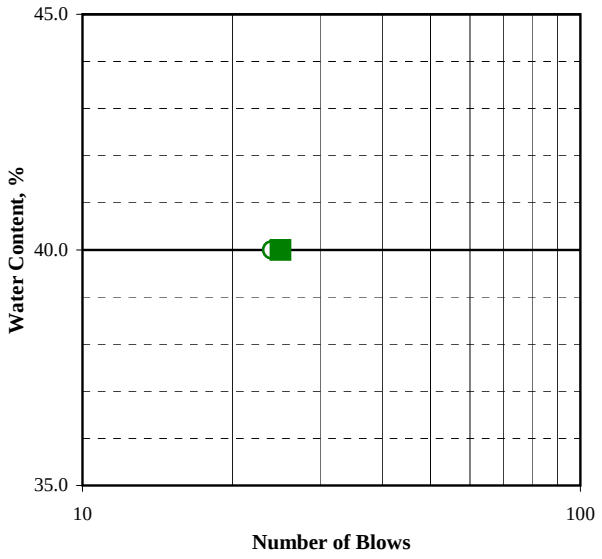
LIQUID LIMIT

	1	2	3
Tare Number	400		
Wt. Tare & WS, gm	19.82		
Wt. Tare & DS, gm	17.26		
Wt. Water, gm	2.56		
Wt. Tare, gm	10.86		
Wt. DS, gm	6.40		
Water Content, %	40.0		
# of Blows	24		

PLASTICITY CHART



FLOW CURVE



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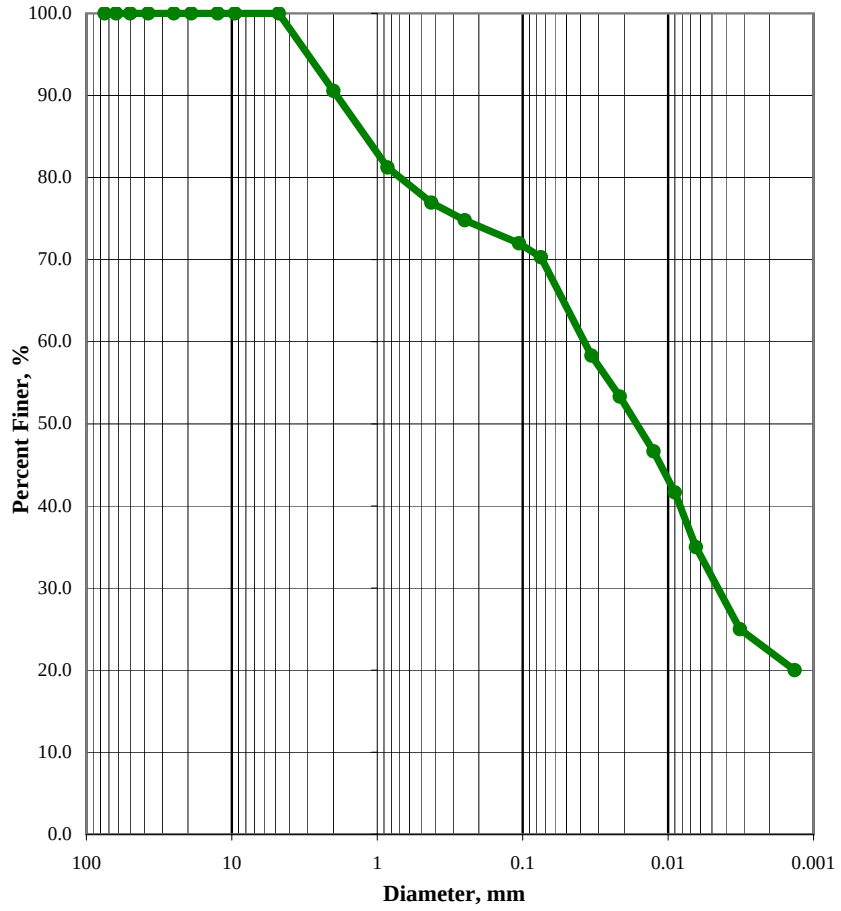
PARTICLE-SIZE ANALYSIS OF SOILS

Client	Civil & Environmental Consultants, I	Boring	SB-11
Client Project	091-867 Apex Landfill Expansion	Depth	14'-16'
Project No.	30598	Sample	SS-8
		Lab Sample No.	30598034
USCS Description	**DARK GRAY LEAN CLAY WITH SAND**		
USCS Group Symbol	**CL**	AASHTO:	**A-6 (12)**
USDA Description	**LOAM**		



US Std. Sieve Size	Particle Diameter (mm)	Percent Finer (%)
3"	75	100.0
2 1/2"	62.5	100.0
2"	50	100.0
1 1/2"	37.5	100.0
1"	25	100.0
3/4"	19	100.0
1/2"	12.5	100.0
3/8"	9.5	100.0
#4	4.75	100.0
#10	2	90.6
#20	0.85	81.2
#40	0.425	76.9
#60	0.25	74.8
#140	0.106	72.0
#200	0.075	70.3
NA	0.0337	58.3
NA	0.0215	53.3
NA	0.0126	46.7
NA	0.0090	41.7
NA	0.0064	35.0
NA	0.0032	25.0
NA	0.0013	20.0

USCS SOIL CLASSIFICATION

Corrected For 100% Passing a 3" Sieve

% Gravel (-3" & +#4)	**0.0**	Silt=38.7% Clay=31.4%	
Coarse=0; Fine=0		D60, mm	NA
% Sand (-#4 & +#200)	**29.7**	D30, mm	NA
Coa.=9.4; Med.=13.6; Fine=6.6		D10, mm	NA
% Fines (-#200)	**70.3**	Cc	NA
% Plus #200 (-3")	**29.7**	Cu	NA

USCS Description
LEAN CLAY WITH SAND

USCS Group Symbol	Atterberg Limits Group Symbol		
CL	**CL, LL=40, PL=21, PI=19**		
Auxiliary Information	Wt Ret, gm	% Retained	% Finer
12" Sieve - 300 mm	0	0.0	100.0
6" Sieve - 150 mm	0	0.0	100.0
3" Sieve - 75 mm	0	0.0	100.0

USDA CLASSIFICATION

Particle Size (mm)	Percent Finer (%)	Percent of Each Component (Material)	(%)	Corrected Percent of -2.0 mm Material for USDA
100	100			
		Gravel	9.4	0
2	90.6			
		Sand	26.3	29.1
0.05	64.2			
		Silt	42.0	46.3
0.002	22.3			
		Clay	22.3	24.6

USDA Classification
LOAM

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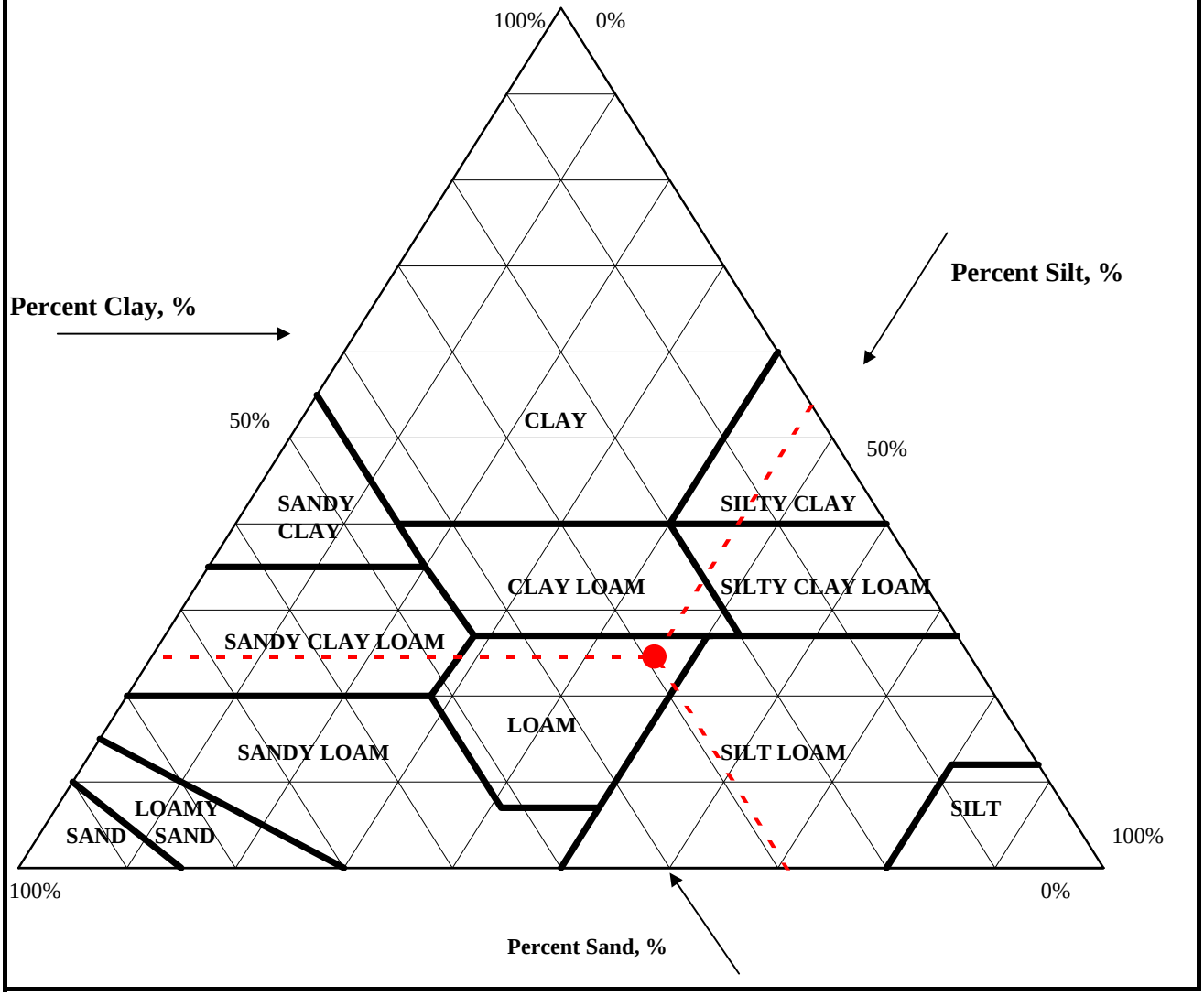
USDA CLASSIFICATION CHART

Client	Civil & Environmental Consultants, I	Boring	SB-11
Client Project	091-867 Apex Landfill Expansion	Depth	14'-16'
Project No.	30598	Sample	SS-8
		Lab Sample No.	30598034
USCS Description	**DARK GRAY LEAN CLAY WITH SAND**		
USCS Group Symbol	**CL**	AASHTO Classification	**A-6 (12)**
USDA Description	**LOAM**		

Corrected for 0% gravel	
Percent Gravel, %	0.0
Percent Sand, %	29.1
Percent Silt, %	46.3
Percent Clay, %	24.6

Sand Subsizes Corrected Percentages	
Very Coarse Sand; 2-1	8.4
Coarse Sand; 1-0.5	5.6
Medium Sand; 0.5-0.25	3.5
Fine Sand; 0.25-0.1	3.4
Very Fine Sand; 0.1-0.05	8.3
Total	**29.1**



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PARTICLE-SIZE ANALYSIS OF SOILS
ASTM D 422

Client	Civil & Environmental Consultants, I	Boring	SB-15
Client Project	091-867 Apex Landfill Expansion	Depth	4'-6'
Project No.	30598	Sample	SS-3
		Lab Sample No.	30598036
USCS Description	**LIGHT YELLOWISH BROWN SANDY LEAN CLAY**		
USCS Group Symbol	**CL**	AASHTO:	**A-6 (13)**
USDA Description	**CLAY LOAM**		

MECHANICAL SIEVE ANALYSIS

As-Received Representative Sample Size Split or Material Submitted Used	
Representable Wet Wt, gm	232.8
+#4 Grnd., Washed DS., gm	10.6
-#4 Wet Wt., gm	222.2
-#4 Water Content, %	13.6
-#4 Dry Wt., gm	195.6
Representable Dry Wt, gm	**206.1**
** Note: Percentages +#4 are based on total Dry representable sample.*	
Split Sample, -#4 washed over #200	
Tare No.	F5
Tare + WS., gm	230.93
Tare + DS., gm	218.01
Tare, gm	123.15
Wt. of DS., gm	94.86
Water Content -#4, %	13.6
Wt. of +#200 Sample, gm	29.6

US Std. Sieve Size	Sieve Opening (mm)	Wt. of Soil Retained (gm)	Percent Retained (%)*	Cumulative Percent Retained	Percent Finer (%)	Final Percent Finer
3"	75	0	0.0	0.0	100.0	100.0
2 1/2"	62.5	0	0.0	0.0	100.0	100.0
2"	50	0	0.0	0.0	100.0	100.0
1 1/2"	37.5	0	0.0	0.0	100.0	100.0
1"	25	0	0.0	0.0	100.0	100.0
3/4"	19	0	0.0	0.0	100.0	100.0
1/2"	12.5	3.42	1.7	1.7	98.3	98.3
3/8"	9.5	1.43	0.7	2.4	97.6	97.6
#4	4.75	5.7	2.8	5.1	94.9	94.9
#10	2	5.38	5.7	5.7	94.3	89.5
#20	0.85	8.24	8.7	14.4	85.6	81.3
#40	0.425	4.82	5.1	19.4	80.6	76.4
#60	0.25	3.23	3.4	22.8	77.2	73.2
#140	0.106	4.92	5.2	28.0	72.0	68.3
#200	0.075	3.04	3.2	31.2	68.8	65.2
-#200 / Pan		65.2	68.8	100.0	-	-

The final percent finer combines the gradation of the plus #4 and minus #4 material.

HYDROMETER ANALYSIS (-#200)

Hydrometer Sample Weight (-#200)	
Tare No.	832
Wt. Tare + DS., gm	176.36
Wt. Tare, gm	103.33
Wt. Dispers., gm	5
Wt. Dry Soil, gm	68.03
-#10 Dispersed 1min in Hamilton Beach Mixer	
K Factor	0.0135
Composite Correction	7
a Factor	0.99
Average Test Temp, °C	19.9
Specific Gravity, Assumed	2.7

Elapsed Time (min.)	R Measured	Composite Correction	R Corrected	Percent Finer (%)	Particle Diameter (mm)	Adjusted % Finer (%)
0	NA	NA	NA	NA	NA	NA
60	58	7	51	74.1	0.0045	48.4
90	55	7	48	69.8	0.0038	45.5
120	53	7	46	66.9	0.0034	43.6
150	50.5	7	43.5	63.2	0.0031	41.3
180	49	7	42	61.1	0.0029	39.8
250	47	7	40	58.1	0.0025	37.9
1440	37	7	30	43.6	0.0011	28.5

The adjusted percent finer is corrected for the percent passing the -#200 sieve.

D 422 / USCS SOIL CLASSIFICATION

Corrected For 100% Passing a 3" Sieve

% Gravel (-3" & +#4)	**5.1**	Silt=16.2% Clay=49%	
Coarse=0; Fine=5.1		D60, mm	NA
% Sand (-#4 & +#200)	**29.6**	D30, mm	NA
Coa.=5.4; Med.=13.1; Fine=11.2		D10, mm	NA
% Fines (-#200)	**65.2**	Cc	NA
% Plus #200 (-3")	**34.8**	Cu	NA

USCS Description

SANDY LEAN CLAY

USCS Group Symbol	Atterberg Limits Group Symbol
CL	**CL, LL=36, PL=11, PI=25**

Auxiliary Information	Wt Ret, gm	% Retained	% Finer
12" Sieve - 300 mm	0	0.0	100.0
6" Sieve - 150 mm	0	0.0	100.0
3" Sieve - 75 mm	0	0.0	100.0

USDA CLASSIFICATION

Particle Size (mm)	Percent Finer (%)	Percent of Each Component (Material)	(%)	Corrected Percent of -2.0 mm Material for USDA
100	100			
		Gravel	10.5	0
2	89.5			
		Sand	26.7	29.8
0.05	62.8			
		Silt	27.5	30.7
0.002	35.3			
		Clay	35.3	39.4

USDA Classification

CLAY LOAM

Input Validation: Reviewed By: Date Tested: 12/1/2010

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LIQUID LIMIT, PLASTIC LIMIT, AND PLASTICITY INDEX OF SOILS
ASTM D 4318

Client	Civil & Environmental Consultants, I	Boring No.	SB-15
Client Project	091-867 Apex Landfill Expansion	Depth(ft)	4'-6'
Project No.	30598	Sample No.	SS-3
		Lab Sample No.	30598036

Soil Description: LIGHT YELLOWISH BROWN LEAN CLAY
(-#40 Fraction)

AS-RECEIVED W.C.

Tare Number	F5
Wt. Tare & WS, gm	230.93
Wt. Tare & DS, gm	218.01
Wt. Water, gm	12.92
Wt. Tare, gm	123.15
Wt. DS, gm	94.86
Water Content, %	13.6

SAMPLE SUMMARY

Liquid Limit (LL), %	36
Plastic Limit (PL), %	11
Plasticity Index (PI)	25
USCS Symbol (-#40 Fraction)	CL
Sample Preparation:	Wet Method
Liquidity Index, %	10.5%
Clay Fraction (% 2 microns)	NA
Skempton's Activity (A)	NA

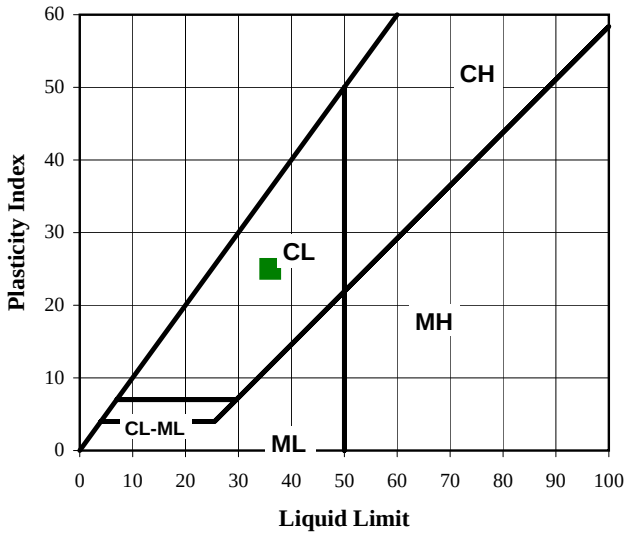
PLASTIC LIMIT

Test Number	1	2	3
Tare Number	404	499	488
Wt. Tare & WS, gm	18.64	18.93	17.93
Wt. Tare & DS, gm	17.90	18.16	17.24
Wt. Water, gm	0.74	0.77	0.69
Wt. Tare, gm	10.76	10.76	10.87
Wt. DS, gm	7.14	7.40	6.37
Water Content, %	10.4	10.4	10.8

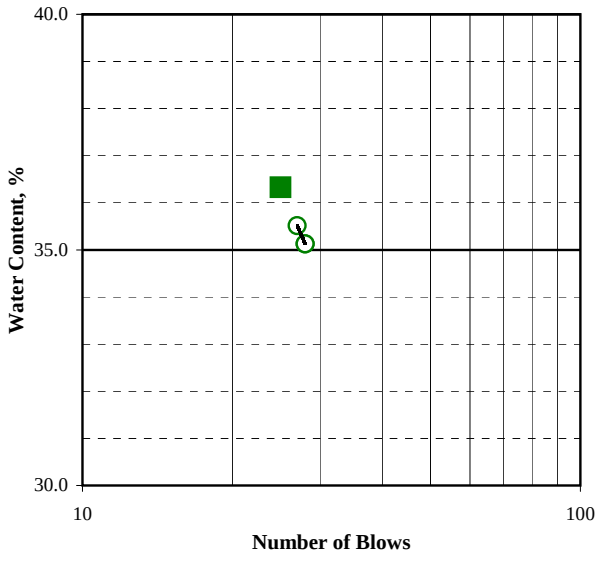
LIQUID LIMIT

	1	2	3
Tare Number	463	417	
Wt. Tare & WS, gm	21.31	19.30	
Wt. Tare & DS, gm	18.54	17.08	
Wt. Water, gm	2.77	2.22	
Wt. Tare, gm	10.74	10.76	
Wt. DS, gm	7.80	6.32	
Water Content, %	35.5	35.1	
# of Blows	27	28	

PLASTICITY CHART



FLOW CURVE



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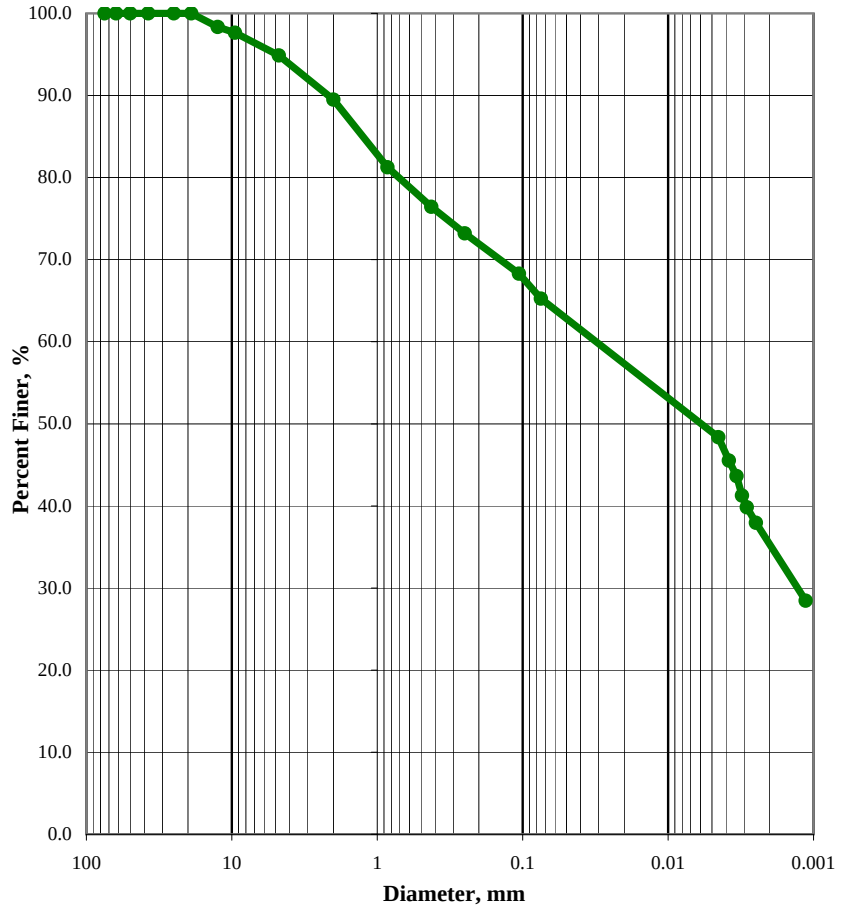
PARTICLE-SIZE ANALYSIS OF SOILS

Client	Civil & Environmental Consultants, I	Boring	SB-15
Client Project	091-867 Apex Landfill Expansion	Depth	4'-6'
Project No.	30598	Sample	SS-3
		Lab Sample No.	30598036

USCS Description **LIGHT YELLOWISH BROWN SANDY LEAN CLAY**
USCS Group Symbol **CL** AASHTO: **A-6 (13)**
USDA Description **CLAY LOAM**



US Std. Sieve Size	Particle Diameter (mm)	Percent Finer (%)
3"	75	100.0
2 1/2"	62.5	100.0
2"	50	100.0
1 1/2"	37.5	100.0
1"	25	100.0
3/4"	19	100.0
1/2"	12.5	98.3
3/8"	9.5	97.6
#4	4.75	94.9
#10	2	89.5
#20	0.85	81.3
#40	0.425	76.4
#60	0.25	73.2
#140	0.106	68.3
#200	0.075	65.2
NA	0.0045	48.4
NA	0.0038	45.5
NA	0.0034	43.6
NA	0.0031	41.3
NA	0.0029	39.8
NA	0.0025	37.9
NA	0.0011	28.5

USCS SOIL CLASSIFICATION

Corrected For 100% Passing a 3" Sieve

% Gravel (-3" & +#4)	**5.1**	Silt=16.2% Clay=49%	
Coarse=0; Fine=5.1		D60, mm	NA
% Sand (-#4 & +#200)	**29.6**	D30, mm	NA
Coa.=5.4; Med.=13.1; Fine=11.2		D10, mm	NA
% Fines (-#200)	**65.2**	Cc	NA
% Plus #200 (-3")	**34.8**	Cu	NA

USCS Description
SANDY LEAN CLAY

USCS Group Symbol	Atterberg Limits Group Symbol		
CL	**CL, LL=36, PL=11, PI=25**		
Auxiliary Information	Wt Ret, gm	% Retained	% Finer
12" Sieve - 300 mm	0	0.0	100.0
6" Sieve - 150 mm	0	0.0	100.0
3" Sieve - 75 mm	0	0.0	100.0

USDA CLASSIFICATION

Particle Size (mm)	Percent Finer (%)	Percent of Each Component (Material)	(%)	Corrected Percent of -2.0 mm Material for USDA
100	100			
		Gravel	10.5	0
2	89.5			
		Sand	26.7	29.8
0.05	62.8			
		Silt	27.5	30.7
0.002	35.3			
		Clay	35.3	39.4

USDA Classification
CLAY LOAM

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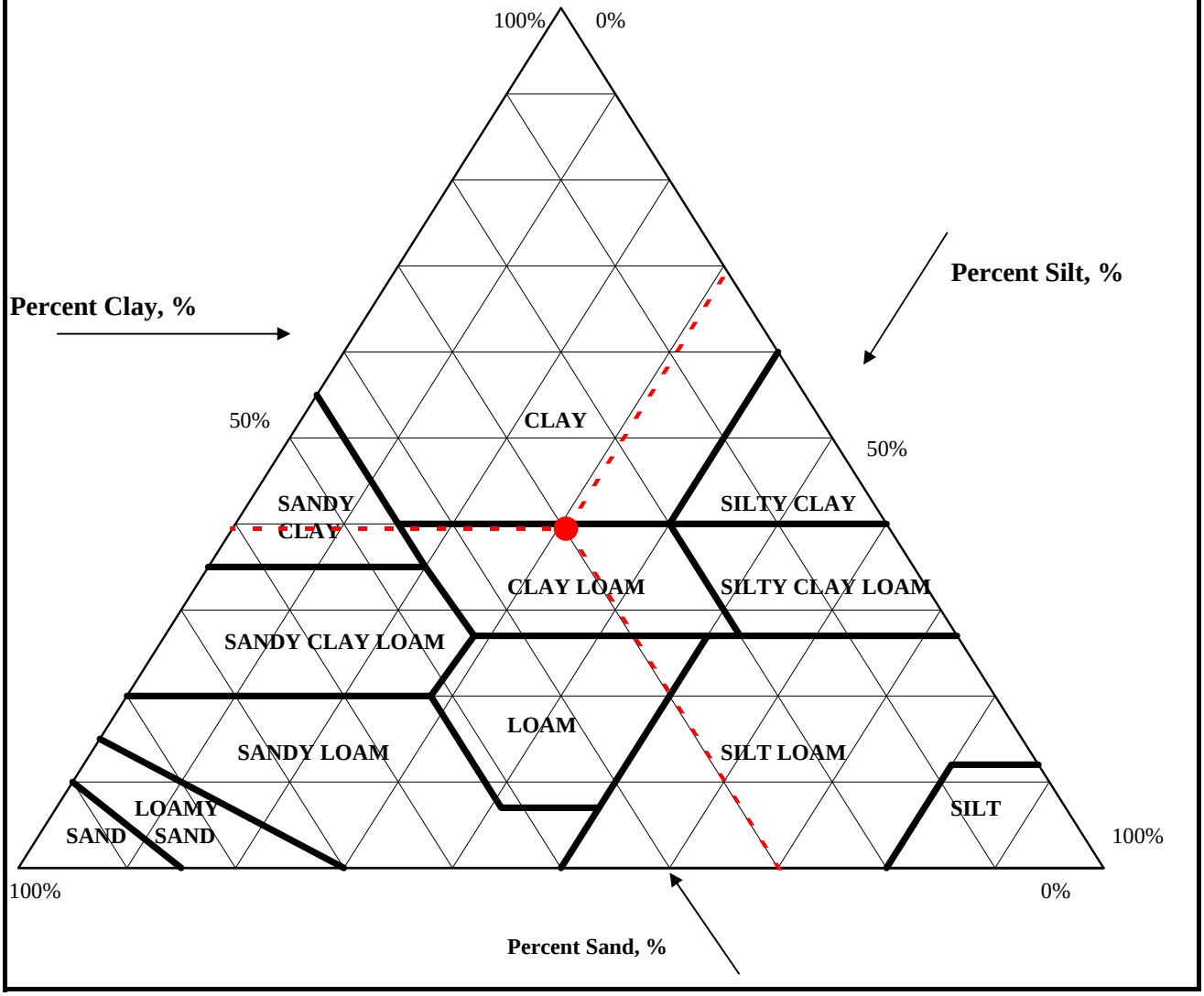
USDA CLASSIFICATION CHART

Client	Civil & Environmental Consultants, I	Boring	SB-15
Client Project	091-867 Apex Landfill Expansion	Depth	4'-6'
Project No.	30598	Sample	SS-3
		Lab Sample No.	30598036
USCS Description	**LIGHT YELLOWISH BROWN SANDY LEAN CLAY**		
USCS Group Symbol	**CL**	AASHTO Classification	**A-6 (13)**
USDA Description	**CLAY LOAM**		

Corrected for 0% gravel	
Percent Gravel, %	0.0
Percent Sand, %	29.8
Percent Silt, %	30.7
Percent Clay, %	39.4

Sand Subsizes Corrected Percentages	
Very Coarse Sand; 2-1	7.5
Coarse Sand; 1-0.5	5.9
Medium Sand; 0.5-0.25	4.9
Fine Sand; 0.25-0.1	6.1
Very Fine Sand; 0.1-0.05	5.5
Total	**29.8**



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PARTICLE-SIZE ANALYSIS OF SOILS
ASTM D 422

Client	Civil & Environmental Consultants, I	Boring	SB-14
Client Project	091-867 Apex Landfill Expansion	Depth	25' - 27'
Project No.	30598	Sample	ST-2 Bottom
		Lab Sample No.	30598039

USCS Description **GRAYISH BROWN FAT CLAY**
USCS Group Symbol **CH** AASHTO: **A-7-6 (34)**
USDA Description **SILTY CLAY**

MECHANICAL SIEVE ANALYSIS

As-Received Representative Sample Size Split or Material Submitted Used	
Representable Wet Wt, gm	362.4
+#4 Grnd., Washed DS., gm	0.0
-#4 Wet Wt., gm	362.4
-#4 Water Content, %	24.3
-#4 Dry Wt., gm	291.4
Representable Dry Wt, gm	**291.4**
** Note: Percentages +#4 are based on total Dry representable sample.*	
Split Sample, -#4 washed over #200	
Tare No.	515
Tare + WS., gm	232.44
Tare + DS., gm	207.17
Tare, gm	103.3
Wt. of DS., gm	103.87
Water Content -#4, %	24.3
Wt. of +#200 Sample, gm	3.2

US Std. Sieve Size	Sieve Opening (mm)	Wt. of Soil Retained (gm)	Percent Retained (%)*	Cumulative Percent Retained	Percent Finer (%)	Final Percent Finer
3"	75	0	0.0	0.0	100.0	100.0
2 1/2"	62.5	0	0.0	0.0	100.0	100.0
2"	50	0	0.0	0.0	100.0	100.0
1 1/2"	37.5	0	0.0	0.0	100.0	100.0
1"	25	0	0.0	0.0	100.0	100.0
3/4"	19	0	0.0	0.0	100.0	100.0
1/2"	12.5	0	0.0	0.0	100.0	100.0
3/8"	9.5	0	0.0	0.0	100.0	100.0
#4	4.75	0	0.0	0.0	100.0	100.0
#10	2	0.03	0.0	0.0	100.0	100.0
#20	0.85	0.48	0.5	0.5	99.5	99.5
#40	0.425	0.71	0.7	1.2	98.8	98.8
#60	0.25	0.65	0.6	1.8	98.2	98.2
#140	0.106	0.93	0.9	2.7	97.3	97.3
#200	0.075	0.37	0.4	3.1	96.9	96.9
-#200 / Pan		100.7	96.9	100.0	-	-

The final percent finer combines the gradation of the plus #4 and minus #4 material.

HYDROMETER ANALYSIS (-#200)

Hydrometer Sample Weight (-#200)	
Tare No.	720
Wt. Tare + DS., gm	155.78
Wt. Tare, gm	97.14
Wt. Dispers., gm	5
Wt. Dry Soil, gm	53.64
-#10 Dispersed 1min in Hamilton Beach Mixer	
K Factor	0.0137
Composite Correction	7.5
a Factor	0.99
Average Test Temp, °C	18.6
Specific Gravity, Assumed	2.7

Elapsed Time (min.)	R Measured	Composite Correction	R Corrected	Percent Finer (%)	Particle Diameter (mm)	Adjusted % Finer (%)
0	NA	NA	NA	NA	NA	NA
2	59.5	7.5	52	95.9	0.0246	92.9
5	58	7.5	50.5	93.1	0.0159	90.3
15	55	7.5	47.5	87.6	0.0095	84.9
30	51	7.5	43.5	80.2	0.0070	77.7
60	47	7.5	39.5	72.8	0.0052	70.6
250	38.5	7.5	31	57.2	0.0027	55.4
1440	29	7.5	21.5	39.6	0.0012	38.4

The adjusted percent finer is corrected for the percent passing the -#200 sieve.

D 422 / USCS SOIL CLASSIFICATION

Corrected For 100% Passing a 3" Sieve

% Gravel (-3" & +#4)	**0.0**	Silt=27.1%	Clay=69.8%
Coarse=0; Fine=0		D60, mm	NA
% Sand (-#4 & +#200)	**3.1**	D30, mm	NA
Coa.=0; Med.=1.1; Fine=1.9		D10, mm	NA
% Fines (-#200)	**96.9**	Cc	NA
% Plus #200 (-3")	**3.1**	Cu	NA

USCS Description
FAT CLAY

USCS Group Symbol	Atterberg Limits Group Symbol
CH	**CH, LL=54, PL=23, PI=31**

Auxiliary Information	Wt Ret, gm	% Retained	% Finer
12" Sieve - 300 mm	0	0.0	100.0
6" Sieve - 150 mm	0	0.0	100.0
3" Sieve - 75 mm	0	0.0	100.0

USDA CLASSIFICATION

Particle Size (mm)	Percent Finer (%)	Percent of Each Component (Material)	(%)	Corrected Percent of -2.0 mm Material for USDA
100	100			
		Gravel	0.0	0
2	100.0			
		Sand	4.5	4.5
0.05	95.5			
		Silt	46.7	46.7
0.002	48.8			
		Clay	48.8	48.8

USDA Classification
SILTY CLAY

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LIQUID LIMIT, PLASTIC LIMIT, AND PLASTICITY INDEX OF SOILS
ASTM D 4318

Client	Civil & Environmental Consultants, I	Boring No.	SB-14
Client Project	091-867 Apex Landfill Expansion	Depth(ft)	25' - 27'
Project No.	30598	Sample No.	ST-2 Bottom
		Lab Sample No.	30598039

Soil Description: GRAYISH BROWN FAT CLAY
(-#40 Fraction)

AS-RECEIVED W.C.

Tare Number	515
Wt. Tare & WS, gm	232.44
Wt. Tare & DS, gm	207.17
Wt. Water, gm	25.27
Wt. Tare, gm	103.30
Wt. DS, gm	103.87
Water Content, %	24.3

SAMPLE SUMMARY

Liquid Limit (LL), %	54
Plastic Limit (PL), %	23
Plasticity Index (PI)	31
USCS Symbol (-#40 Fraction)	CH
Sample Preparation:	Wet Method
Liquidity Index, %	4.3%
Clay Fraction (% 2 microns)	NA
Skempton's Activity (A)	NA

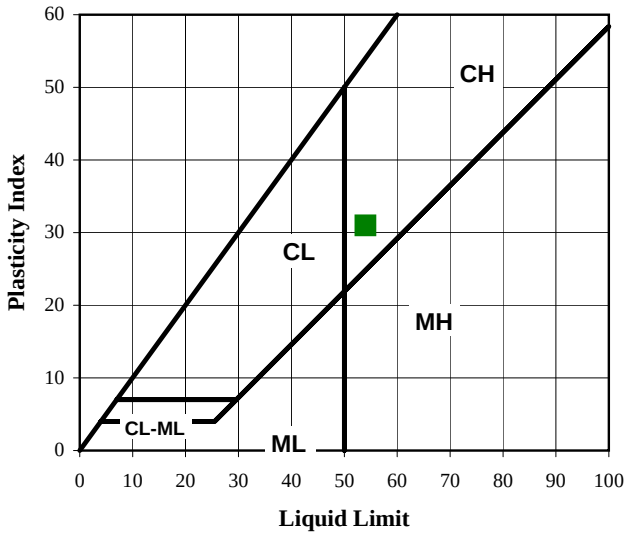
PLASTIC LIMIT

Test Number	1	2	3
Tare Number	490	492	505
Wt. Tare & WS, gm	17.98	17.70	18.21
Wt. Tare & DS, gm	16.68	16.44	16.80
Wt. Water, gm	1.30	1.26	1.41
Wt. Tare, gm	10.88	10.78	10.77
Wt. DS, gm	5.80	5.66	6.03
Water Content, %	22.4	22.3	23.4

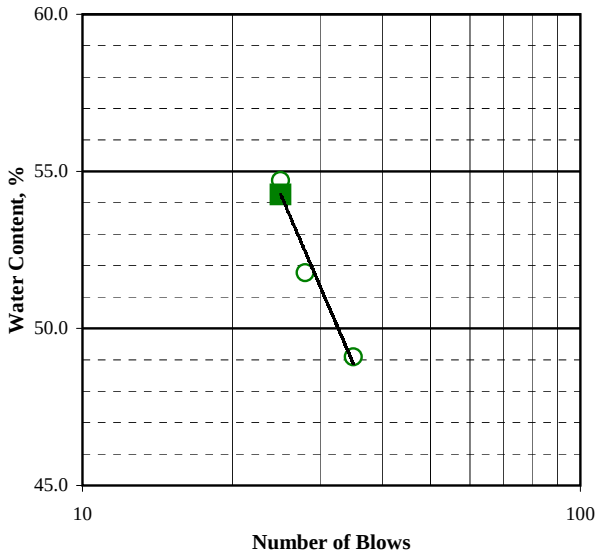
LIQUID LIMIT

	1	2	3
Tare Number	404	406	452
Wt. Tare & WS, gm	18.48	18.83	19.08
Wt. Tare & DS, gm	15.75	16.06	16.37
Wt. Water, gm	2.73	2.77	2.71
Wt. Tare, gm	10.76	10.71	10.85
Wt. DS, gm	4.99	5.35	5.52
Water Content, %	54.7	51.8	49.1
# of Blows	25	28	35

PLASTICITY CHART



FLOW CURVE



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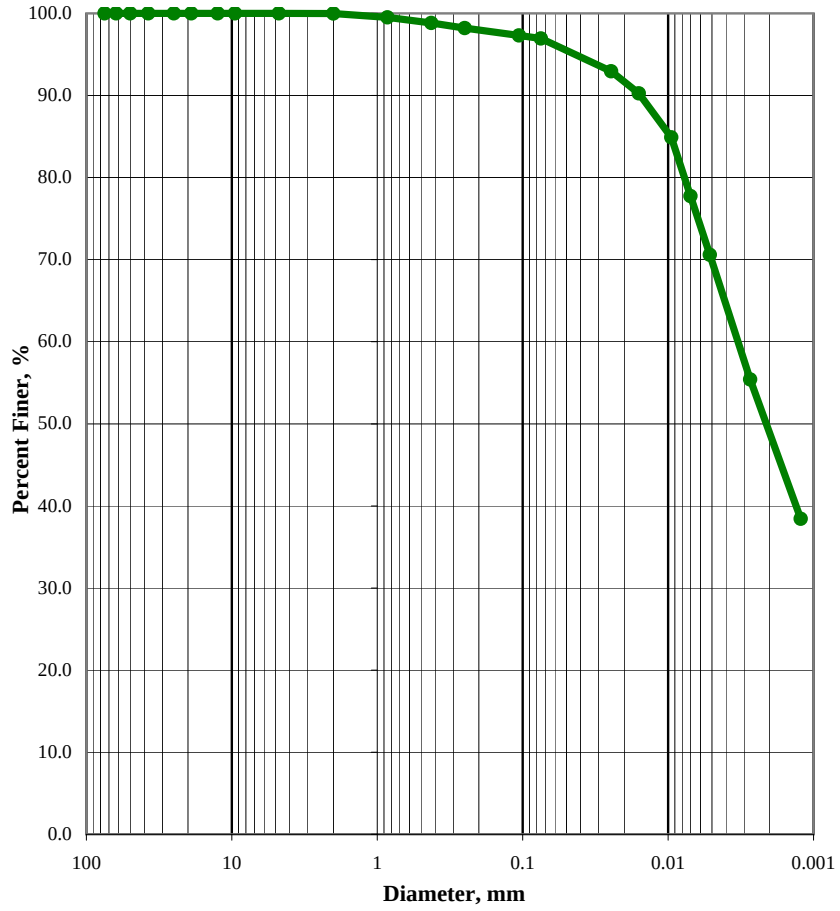
PARTICLE-SIZE ANALYSIS OF SOILS

Client	Civil & Environmental Consultants, I	Boring	SB-14
Client Project	091-867 Apex Landfill Expansion	Depth	25' - 27'
Project No.	30598	Sample	ST-2 Bottom
		Lab Sample No.	30598039

USCS Description **GRAYISH BROWN FAT CLAY**
USCS Group Symbol **CH** AASHTO: **A-7-6 (34)**
USDA Description **SILTY CLAY**



US Std. Sieve Size	Particle Diameter (mm)	Percent Finer (%)
3"	75	100.0
2 1/2"	62.5	100.0
2"	50	100.0
1 1/2"	37.5	100.0
1"	25	100.0
3/4"	19	100.0
1/2"	12.5	100.0
3/8"	9.5	100.0
#4	4.75	100.0
#10	2	100.0
#20	0.85	99.5
#40	0.425	98.8
#60	0.25	98.2
#140	0.106	97.3
#200	0.075	96.9
NA	0.0246	92.9
NA	0.0159	90.3
NA	0.0095	84.9
NA	0.0070	77.7
NA	0.0052	70.6
NA	0.0027	55.4
NA	0.0012	38.4

USCS SOIL CLASSIFICATION

Corrected For 100% Passing a 3" Sieve

% Gravel (-3" & +#4)	**0.0**	Silt=27.1% Clay=69.8%	
Coarse=0; Fine=0		D60, mm	NA
% Sand (-#4 & +#200)	**3.1**	D30, mm	NA
Coa.=0; Med.=1.1; Fine=1.9		D10, mm	NA
% Fines (-#200)	**96.9**	Cc	NA
% Plus #200 (-3")	**3.1**	Cu	NA

USCS Description
FAT CLAY

USCS Group Symbol	Atterberg Limits Group Symbol
CH	**CH, LL=54, PL=23, PI=31**

Auxiliary Information	Wt Ret, gm	% Retained	% Finer
12" Sieve - 300 mm	0	0.0	100.0
6" Sieve - 150 mm	0	0.0	100.0
3" Sieve - 75 mm	0	0.0	100.0

USDA CLASSIFICATION

Particle Size (mm)	Percent Finer (%)
100	100
2	100.0
0.05	95.5
0.002	48.8

Percent of Each Component (Material)	(%)	Corrected Percent of -2.0 mm Material for USDA
Gravel	0.0	0
Sand	4.5	4.5
Silt	46.7	46.7
Clay	48.8	48.8

USDA Classification
SILTY CLAY

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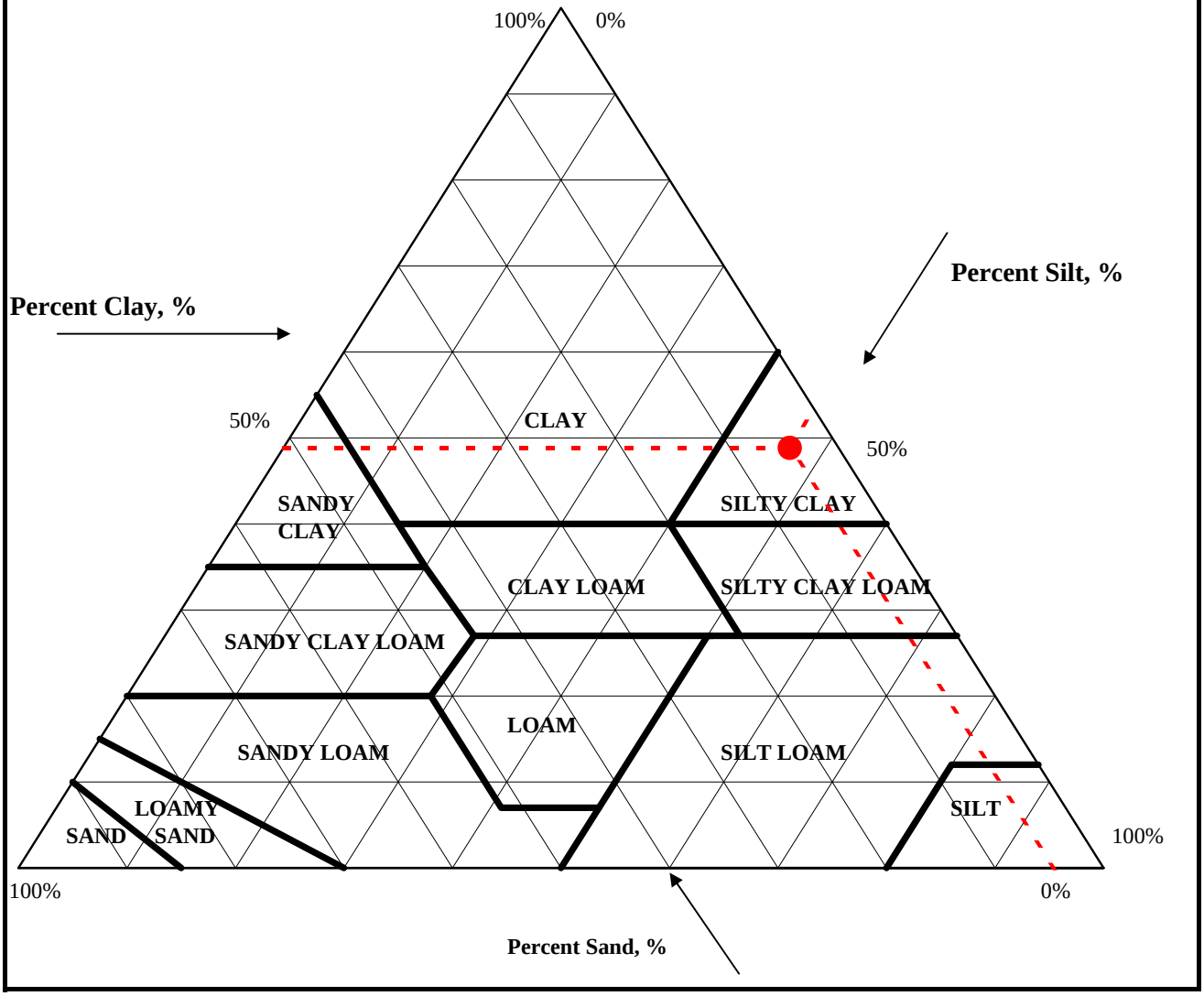
USDA CLASSIFICATION CHART

Client	Civil & Environmental Consultants, I	Boring	SB-14
Client Project	091-867 Apex Landfill Expansion	Depth	25' - 27'
Project No.	30598	Sample	ST-2 Bottom
		Lab Sample No.	30598039
USCS Description	**GRAYISH BROWN FAT CLAY**		
USCS Group Symbol	**CH**	AASHTO Classification	**A-7-6 (34)**
USDA Description	**SILTY CLAY**		

Corrected for 0% gravel	
Percent Gravel, %	0.0
Percent Sand, %	4.5
Percent Silt, %	46.7
Percent Clay, %	48.8

Sand Subsizes Corrected Percentages	
Very Coarse Sand; 2-1	0.4
Coarse Sand; 1-0.5	0.6
Medium Sand; 0.5-0.25	0.8
Fine Sand; 0.25-0.1	1.0
Very Fine Sand; 0.1-0.05	1.8
Total	**4.5**



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PARTICLE-SIZE ANALYSIS OF SOILS
ASTM D 422

Client	Civil & Environmental Consultants, I	Boring	SB-20
Client Project	091-867 Apex Landfill Expansion	Depth	16'-18', 17'-19'
Project No.	30598	Sample	ST-1, ST-2
		Lab Sample No.	30598003
USCS Description	**GRAY CLAYEY GRAVEL WITH SAND**		
USCS Group Symbol	**GC**	AASHTO:	**A-2-6 (1)**
USDA Description	**LOAM**		

MECHANICAL SIEVE ANALYSIS

As-Received Sample	
Correction For Split Samples (J-Factor)	
+3/4" Air Dry Wt, gm	289.5
-3/4 Wet Wt., gm	1061.4
-3/4 Dry Wt., gm	924.3
Total Sample Dry Wt, gm	1213.8
Passing -3/4" (J-Factor)	0.76
Split Sample, -3/4"	
Tare No.	1
Wt. Tare + WS., gm	663.43
Wt. Tare + DS., gm	591.18
Wt. Tare, gm	103.96
Wt. of DS., gm	487.22
Water Content, %	14.8
Wt. of +#200 Sample, gm	285.5
Wt. of -#200 Sample, gm	201.7

US Std. Sieve Size	Sieve Opening (mm)	Wt. of Soil Retained (gm)	Percent Retained (%)	Cumulative Percent Retained	Percent Finer (%)	Final Percent Finer
3"	75	0	0.0	0.0	100.0	100.0
2 1/2"	62.5	0	0.0	0.0	100.0	100.0
2"	50	214.33	17.7	17.7	82.3	82.3
1 1/2"	37.5	0	0.0	17.7	82.3	82.3
1"	25	0	0.0	17.7	82.3	82.3
3/4"	19	75.13	6.2	23.8	76.2	76.2
1/2"	12.5	39.09	8.0	8.0	92.0	70.0
3/8"	9.5	25.82	5.3	13.3	86.7	66.0
#4	4.75	51.88	10.6	24.0	76.0	57.9
#10	2	38.8	8.0	31.9	68.1	51.8
#20	0.85	29.96	6.1	38.1	61.9	47.2
#40	0.425	15.65	3.2	41.3	58.7	44.7
#60	0.25	11.18	2.3	43.6	56.4	43.0
#140	0.106	46.78	9.6	53.2	46.8	35.6
#200	0.075	26.38	5.4	58.6	41.4	31.5
Pan	-	201.7	41.4	100.0	-	-

The final percent finer combines the gradation of the plus 3/4" and minus 3/4" material.

HYDROMETER ANALYSIS

Hydrometer Sample Weight	
Tare No.	825
Wt. Tare + DS., gm	143.03
Wt. Tare, gm	102.62
Wt. Dispers., gm	5
Wt. Dry Soil, gm	35.41
-#10 Dispersed 1min in Hamilton Beach Mixer	
K Factor	0.0137
Composite Correction	7.5
a Factor	0.99
Average Test Temp, °C	18.6
Specific Gravity, Assumed	2.7

Elapsed Time (min.)	R Measured	Composite Correction	R Corrected	Percent Finer (%)	Particle Diameter (mm)	Adjusted % Finer (%)
0	NA	NA	NA	NA	NA	NA
2	40	7.5	32.5	90.8	0.0301	28.6
5	38	7.5	30.5	85.2	0.0194	26.9
15	35.5	7.5	28	78.2	0.0114	24.6
30	33	7.5	25.5	71.2	0.0082	22.4
60	30	7.5	22.5	62.8	0.0060	19.8
250	24	7.5	16.5	46.1	0.0030	14.5
1440	18	7.5	10.5	29.3	0.0013	9.2

The adjusted percent finer is corrected for the percent passing the -#200 sieve.

USCS SOIL CLASSIFICATION

Corrected For 100% Passing a 3" Sieve

% Gravel (-3" & +#4)	**42.1**	Silt=13% Clay=18.4%	
Coarse=23.8; Fine=18.3		D60, mm	NA
% Sand (-#4 & +#200)	**26.4**	D30, mm	NA
Coa.=6.1; Med.=7.1; Fine=13.2		D10, mm	NA
% Fines (-#200)	**31.5**	Cc	NA
% Plus #200 (-3")	**68.5**	Cu	NA

USCS Description

CLAYEY GRAVEL WITH SAND

USCS Group Symbol	Atterberg Limits Group Symbol
GC	**CL, LL=35, PL=17, PI=18**

Auxiliary Information	Wt Ret, gm	% Retained	% Finer
12" Sieve - 300 mm	0	0.0	100.0
6" Sieve - 150 mm	0	0.0	100.0
3" Sieve - 75 mm	0	0.0	100.0

USDA CLASSIFICATION

Particle Size (mm)	Percent Finer (%)
100	100
2	51.8
0.05	30.2
0.002	11.9

Percent of Each Component (Material)	(%)	Corrected Percent of -2.0 mm Material for USDA
Gravel	48.2	0
Sand	21.6	41.7
Silt	18.3	35.4
Clay	11.9	22.9

USDA Classification

LOAM

Input Validation: Reviewed By: Date Tested: 12/1/2010

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LIQUID LIMIT, PLASTIC LIMIT, AND PLASTICITY INDEX OF SOILS
ASTM D 4318

Client	Civil & Environmental Consultants, I	Boring No.	SB-20
Client Project	091-867 Apex Landfill Expansion	Depth(ft)	16'-18', 17'-19'
Project No.	30598	Sample No.	ST-1, ST-2
		Lab Sample No.	30598003

Soil Description: GRAY LEAN CLAY
(-#40 Fraction)

AS-RECEIVED W.C.

Tare Number	1
Wt. Tare & WS, gm	663.43
Wt. Tare & DS, gm	591.18
Wt. Water, gm	72.25
Wt. Tare, gm	103.96
Wt. DS, gm	487.22
Water Content, %	14.8

SAMPLE SUMMARY

Liquid Limit (LL), %	35
Plastic Limit (PL), %	17
Plasticity Index (PI)	18
USCS Symbol (-#40 Fraction)	CL
Sample Preparation:	Wet Method
Liquidity Index, %	-12.1%
Clay Fraction (% 2 microns)	NA
Skempton's Activity (A)	NA

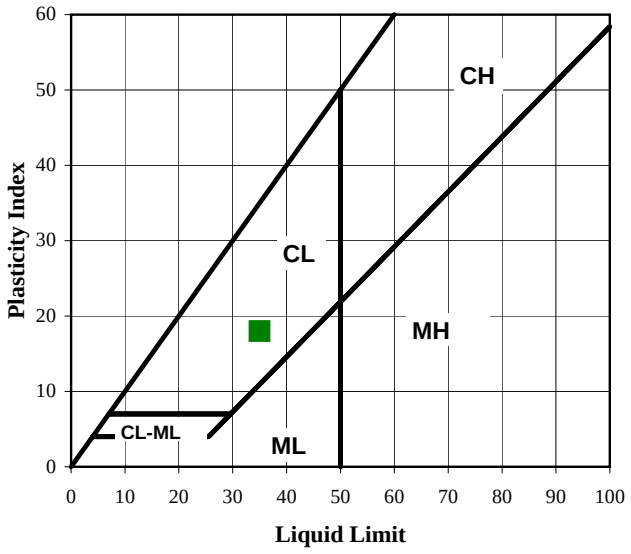
PLASTIC LIMIT

Test Number	1	2	3
Tare Number	414	466	493
Wt. Tare & WS, gm	17.09	19.02	18.54
Wt. Tare & DS, gm	16.20	17.86	17.4
Wt. Water, gm	0.89	1.16	1.14
Wt. Tare, gm	10.77	10.83	10.72
Wt. DS, gm	5.43	7.03	6.68
Water Content, %	16.4	16.5	17.1

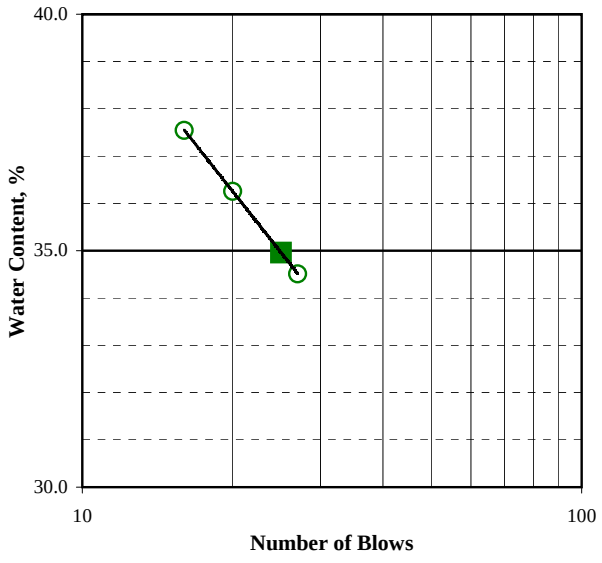
LIQUID LIMIT

	1	2	3
Tare Number	417	464	509
Wt. Tare & WS, gm	18.44	19.96	19.10
Wt. Tare & DS, gm	16.33	17.52	16.95
Wt. Water, gm	2.11	2.44	2.15
Wt. Tare, gm	10.71	10.79	10.72
Wt. DS, gm	5.62	6.73	6.23
Water Content, %	37.5	36.3	34.5
# of Blows	16	20	27

PLASTICITY CHART



FLOW CURVE



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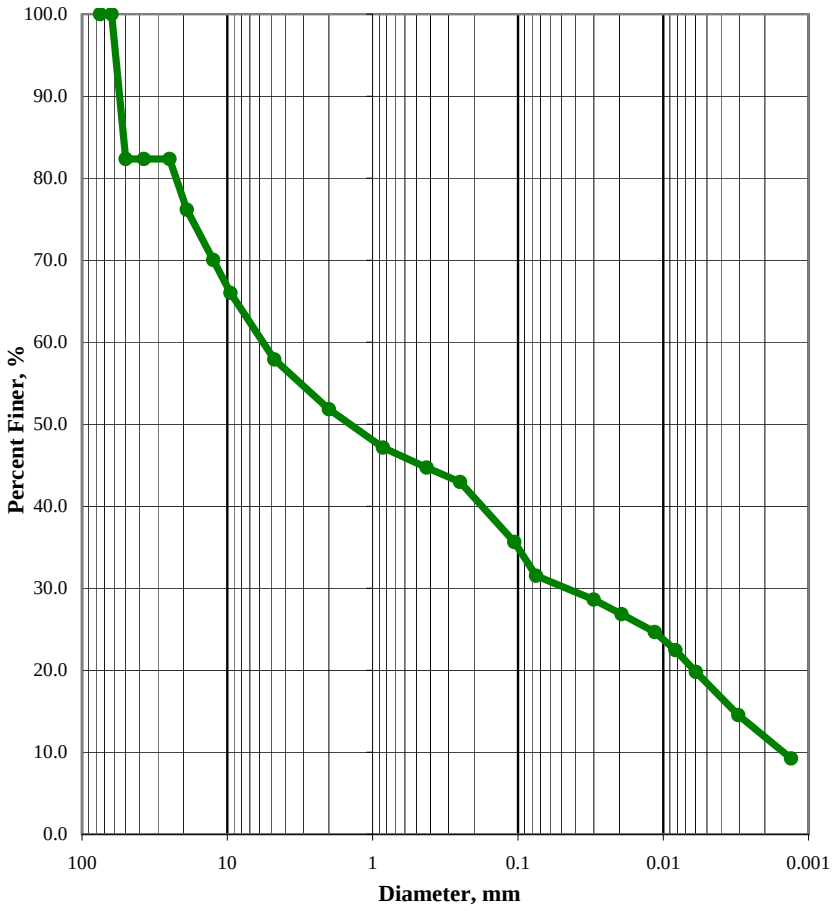
PARTICLE-SIZE ANALYSIS OF SOILS

Client	Civil & Environmental Consultants, I	Boring	SB-20
Client Project	091-867 Apex Landfill Expansion	Depth	16'-18', 17'-19'
Project No.	30598	Sample	ST-1, ST-2
		Lab Sample No.	30598003

USCS Description **GRAY CLAYEY GRAVEL WITH SAND**
USCS Group Symbol **GC** AASHTO: **A-2-6 (1)**
USDA Description **LOAM**



US Std. Sieve Size	Particle Diameter (mm)	Percent Finer (%)
3"	75	100.0
2 1/2"	62.5	100.0
2"	50	82.3
1 1/2"	37.5	82.3
1"	25	82.3
3/4"	19	76.2
1/2"	12.5	70.0
3/8"	9.5	66.0
#4	4.75	57.9
#10	2	51.8
#20	0.85	47.2
#40	0.425	44.7
#60	0.25	43.0
#140	0.106	35.6
#200	0.075	31.5
NA	0.0301	28.6
NA	0.0194	26.9
NA	0.0114	24.6
NA	0.0082	22.4
NA	0.0060	19.8
NA	0.0030	14.5
NA	0.0013	9.2

USCS SOIL CLASSIFICATION

Corrected For 100% Passing a 3" Sieve

% Gravel (-3" & +#4)	**42.1**	Silt=13% Clay=18.4%	
Coarse=23.8; Fine=18.3		D60, mm	NA
% Sand (-#4 & +#200)	**26.4**	D30, mm	NA
Coa.=6.1; Med.=7.1; Fine=13.2		D10, mm	NA
% Fines (-#200)	**31.5**	Cc	NA
% Plus #200 (-3")	**68.5**	Cu	NA

USCS Description
CLAYEY GRAVEL WITH SAND

USCS Group Symbol	Atterberg Limits Group Symbol
GC	**CL, LL=35, PL=17, PI=18**

Auxiliary Information	Wt Ret, gm	% Retained	% Finer
12" Sieve - 300 mm	0	0.0	100.0
6" Sieve - 150 mm	0	0.0	100.0
3" Sieve - 75 mm	0	0.0	100.0

USDA CLASSIFICATION

Particle Size (mm)	Percent Finer (%)
100	100
2	51.8
0.05	30.2
0.002	11.9

Percent of Each Component (Material)	(%)	Corrected Percent of -2.0 mm Material for USDA
Gravel	48.2	0
Sand	21.6	41.7
Silt	18.3	35.4
Clay	11.9	22.9

USDA Classification
LOAM

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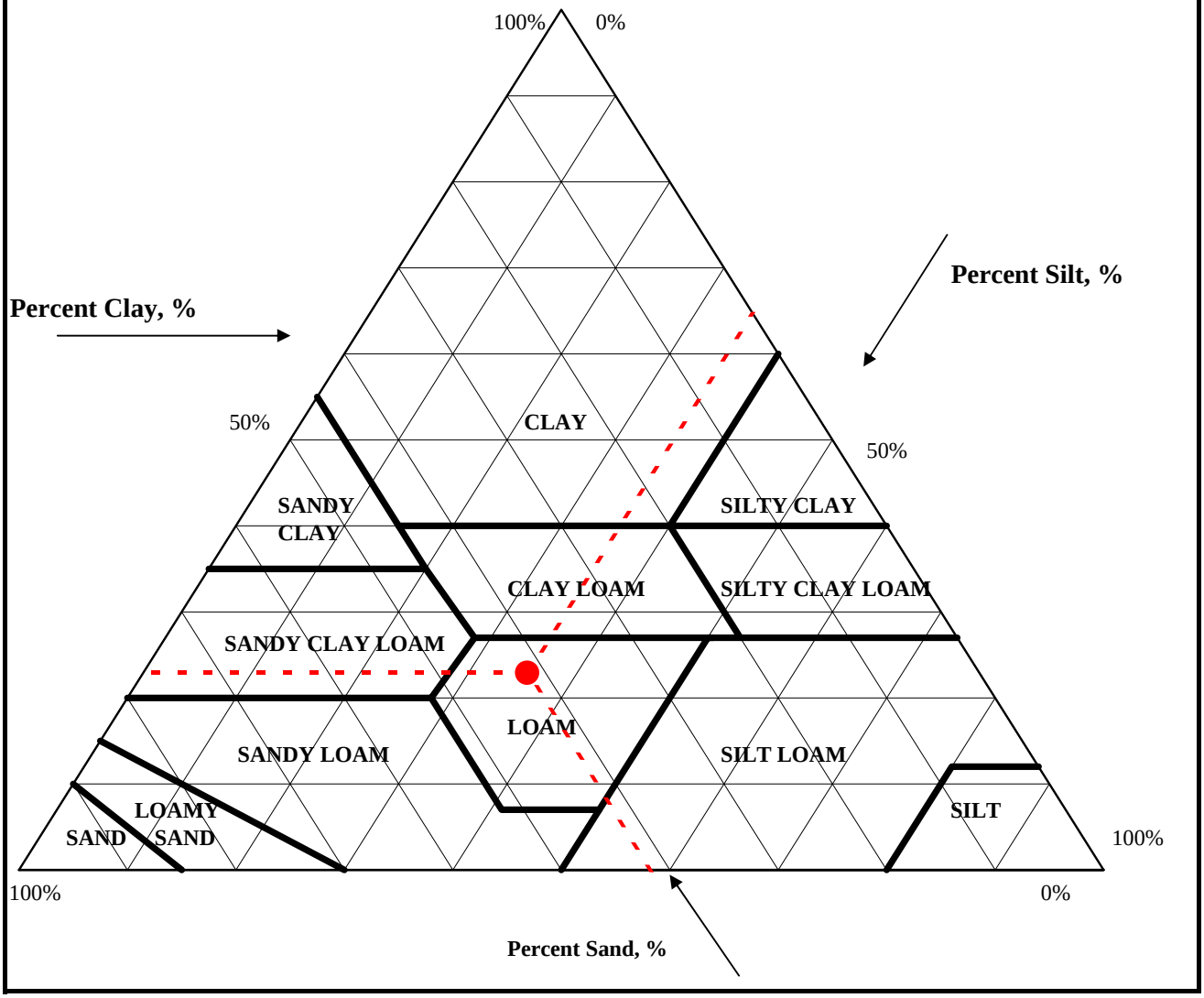
USDA CLASSIFICATION CHART

Client	Civil & Environmental Consultants, I	Boring	SB-20
Client Project	091-867 Apex Landfill Expansion	Depth	16'-18', 17'-19'
Project No.	30598	Sample	ST-1, ST-2
		Lab Sample No.	30598003
USCS Description	**GRAY CLAYEY GRAVEL WITH SAND**		
USCS Group Symbol	**GC**	AASHTO Classification	**A-2-6 (1)**
USDA Description	**LOAM**		

Corrected for 0% gravel	
Percent Gravel, %	0.0
Percent Sand, %	41.7
Percent Silt, %	35.4
Percent Clay, %	22.9

Sand Subsizes Corrected Percentages	
Very Coarse Sand; 2-1	7.3
Coarse Sand; 1-0.5	5.3
Medium Sand; 0.5-0.25	4.5
Fine Sand; 0.25-0.1	15.4
Very Fine Sand; 0.1-0.05	9.1
Total	**41.7**



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PARTICLE-SIZE ANALYSIS OF SOILS
ASTM D 422

Client	Civil & Environmental Consultants, I	Boring	TPE-18
Client Project	091-867 Apex Landfill Expansion	Depth	12'-14'
Project No.	30598	Sample	ST-1
		Lab Sample No.	30598012
USCS Description	**YELLOWISH BROWN SANDY LEAN CLAY**		
USCS Group Symbol	**CL**	AASHTO:	**A-7-6 (14)**
USDA Description	**CLAY LOAM**		

MECHANICAL SIEVE ANALYSIS

As-Received Sample	
Correction For Split Samples (J-Factor)	
+3/4" Air Dry Wt, gm	8.5
-3/4 Wet Wt., gm	969.1
-3/4 Dry Wt., gm	808.5
Total Sample Dry Wt, gm	817.1
Passing -3/4" (J-Factor)	0.99
Split Sample, -3/4"	
Tare No.	702
Wt. Tare + WS., gm	454.83
Wt. Tare + DS., gm	395.72
Wt. Tare, gm	98.11
Wt. of DS., gm	297.61
Water Content, %	19.9
Wt. of +#200 Sample, gm	89.9
Wt. of -#200 Sample, gm	207.7

US Std. Sieve Size	Sieve Opening (mm)	Wt. of Soil Retained (gm)	Percent Retained (%)	Cumulative Percent Retained	Percent Finer (%)	Final Percent Finer
3"	75	0	0.0	0.0	100.0	100.0
2 1/2"	62.5	0	0.0	0.0	100.0	100.0
2"	50	0	0.0	0.0	100.0	100.0
1 1/2"	37.5	0	0.0	0.0	100.0	100.0
1"	25	0	0.0	0.0	100.0	100.0
3/4"	19	8.54	1.0	1.0	99.0	99.0
1/2"	12.5	3.77	1.3	1.3	98.7	97.7
3/8"	9.5	4.24	1.4	2.7	97.3	96.3
#4	4.75	9.81	3.3	6.0	94.0	93.0
#10	2	14.66	4.9	10.9	89.1	88.2
#20	0.85	16.42	5.5	16.4	83.6	82.7
#40	0.425	10.67	3.6	20.0	80.0	79.1
#60	0.25	8.32	2.8	22.8	77.2	76.4
#140	0.106	13.88	4.7	27.5	72.5	71.8
#200	0.075	8.15	2.7	30.2	69.8	69.1
Pan	-	207.7	69.8	100.0	-	-

The final percent finer combines the gradation of the plus 3/4" and minus 3/4" material.

HYDROMETER ANALYSIS

Hydrometer Sample Weight	
Tare No.	718
Wt. Tare + DS., gm	143.35
Wt. Tare, gm	99.05
Wt. Dispers., gm	5
Wt. Dry Soil, gm	39.3
-#10 Dispersed 1min in Hamilton Beach Mixer	
K Factor	0.0138
Composite Correction	7.5
a Factor	0.99
Average Test Temp, °C	18.4
Specific Gravity, Assumed	2.7

Elapsed Time (min.)	R Measured	Composite Correction	R Corrected	Percent Finer (%)	Particle Diameter (mm)	Adjusted % Finer (%)
0	NA	NA	NA	NA	NA	NA
2	43	7.5	35.5	89.3	0.0294	61.7
5	40	7.5	32.5	81.8	0.0191	56.5
15	36	7.5	28.5	71.7	0.0114	49.5
30	33	7.5	25.5	64.2	0.0083	44.3
60	30	7.5	22.5	56.6	0.0060	39.1
250	24	7.5	16.5	41.5	0.0030	28.7
1440	19	7.5	11.5	28.9	0.0013	20.0

The adjusted percent finer is corrected for the percent passing the -#200 sieve.

USCS SOIL CLASSIFICATION

Corrected For 100% Passing a 3" Sieve

% Gravel (-3" & +#4)	**7.0**	Silt=32.6%	Clay=36.4%
Coarse=1; Fine=5.9		D60, mm	NA
% Sand (-#4 & +#200)	**24.0**	D30, mm	NA
Coa.=4.9; Med.=9; Fine=10.1		D10, mm	NA
% Fines (-#200)	**69.1**	Cc	NA
% Plus #200 (-3")	**30.9**	Cu	NA

USCS Description

SANDY LEAN CLAY

USCS Group Symbol	Atterberg Limits Group Symbol
CL	**CL, LL=42, PL=20, PI=22**

Auxiliary Information	Wt Ret, gm	% Retained	% Finer
12" Sieve - 300 mm	0	0.0	100.0
6" Sieve - 150 mm	0	0.0	100.0
3" Sieve - 75 mm	0	0.0	100.0

USDA CLASSIFICATION

Particle Size (mm)	Percent Finer (%)	Percent of Each Component (Material)	(%)	Corrected Percent of -2.0 mm Material for USDA
100	100			
		Gravel	11.8	0
2	88.2			
		Sand	22.3	25.3
0.05	65.9			
		Silt	41.5	47.1
0.002	24.3			
		Clay	24.3	27.6

USDA Classification

CLAY LOAM

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LIQUID LIMIT, PLASTIC LIMIT, AND PLASTICITY INDEX OF SOILS
ASTM D 4318

Client	Civil & Environmental Consultants, I	Boring No.	TPE-18
Client Project	091-867 Apex Landfill Expansion	Depth(ft)	12'-14'
Project No.	30598	Sample No.	ST-1
		Lab Sample No.	30598012

Soil Description: YELLOWISH BROWN LEAN CLAY
(-#40 Fraction)

AS-RECEIVED W.C.

Tare Number	702
Wt. Tare & WS, gm	454.83
Wt. Tare & DS, gm	395.72
Wt. Water, gm	59.11
Wt. Tare, gm	98.11
Wt. DS, gm	297.61
Water Content, %	19.9

SAMPLE SUMMARY

Liquid Limit (LL), %	42
Plastic Limit (PL), %	20
Plasticity Index (PI)	22
USCS Symbol (-#40 Fraction)	CL
Sample Preparation:	Wet Method
Liquidity Index, %	-0.6%
Clay Fraction (% 2 microns)	NA
Skempton's Activity (A)	NA

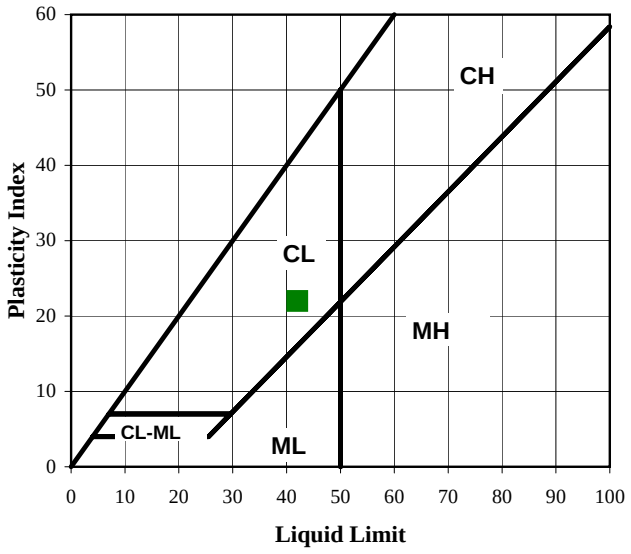
PLASTIC LIMIT

Test Number	1	2	3
Tare Number	455	509	419
Wt. Tare & WS, gm	18.99	19.56	19.41
Wt. Tare & DS, gm	17.59	18.07	17.97
Wt. Water, gm	1.40	1.49	1.44
Wt. Tare, gm	10.73	10.72	10.71
Wt. DS, gm	6.86	7.35	7.26
Water Content, %	20.4	20.3	19.8

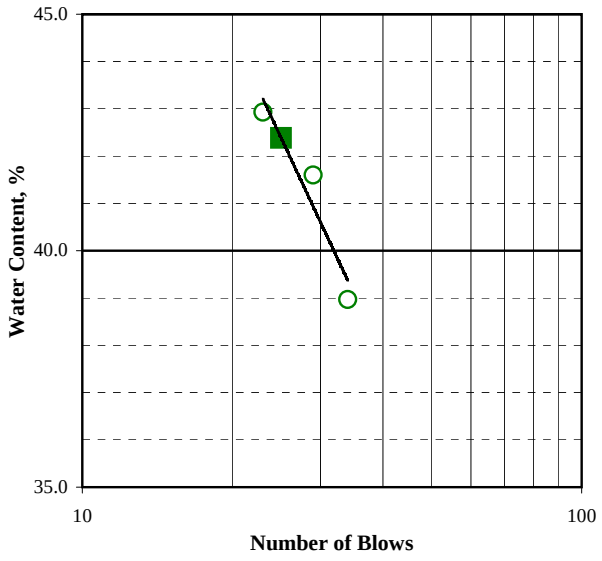
LIQUID LIMIT

	1	2	3
Tare Number	430	464	471
Wt. Tare & WS, gm	19.25	19.62	20.47
Wt. Tare & DS, gm	16.70	17.02	17.75
Wt. Water, gm	2.55	2.60	2.72
Wt. Tare, gm	10.76	10.77	10.77
Wt. DS, gm	5.94	6.25	6.98
Water Content, %	42.9	41.6	39.0
# of Blows	23	29	34

PLASTICITY CHART



FLOW CURVE



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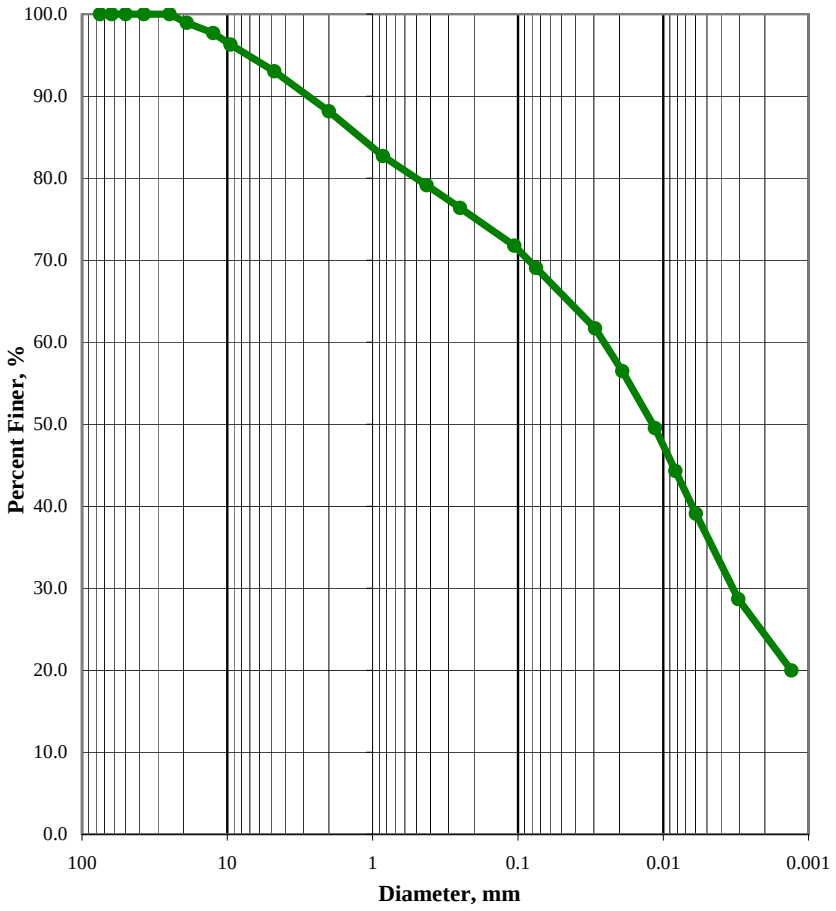
PARTICLE-SIZE ANALYSIS OF SOILS

Client	Civil & Environmental Consultants, I	Boring	TPE-18
Client Project	091-867 Apex Landfill Expansion	Depth	12'-14'
Project No.	30598	Sample	ST-1
		Lab Sample No.	30598012

USCS Description **YELLOWISH BROWN SANDY LEAN CLAY**
USCS Group Symbol **CL** AASHTO: **A-7-6 (14)**
USDA Description **CLAY LOAM**



US Std. Sieve Size	Particle Diameter (mm)	Percent Finer (%)
3"	75	100.0
2 1/2"	62.5	100.0
2"	50	100.0
1 1/2"	37.5	100.0
1"	25	100.0
3/4"	19	99.0
1/2"	12.5	97.7
3/8"	9.5	96.3
#4	4.75	93.0
#10	2	88.2
#20	0.85	82.7
#40	0.425	79.1
#60	0.25	76.4
#140	0.106	71.8
#200	0.075	69.1
NA	0.0294	61.7
NA	0.0191	56.5
NA	0.0114	49.5
NA	0.0083	44.3
NA	0.0060	39.1
NA	0.0030	28.7
NA	0.0013	20.0

USCS SOIL CLASSIFICATION

Corrected For 100% Passing a 3" Sieve

% Gravel (-3" & +#4)	**7.0**	Silt=32.6% Clay=36.4%	
Coarse=1; Fine=5.9		D60, mm	NA
% Sand (-#4 & +#200)	**24.0**	D30, mm	NA
Coa.=4.9; Med.=9; Fine=10.1		D10, mm	NA
% Fines (-#200)	**69.1**	Cc	NA
% Plus #200 (-3")	**30.9**	Cu	NA

USCS Description
SANDY LEAN CLAY

USCS Group Symbol	Atterberg Limits Group Symbol		
CL	**CL, LL=42, PL=20, PI=22**		
Auxiliary Information	Wt Ret, gm	% Retained	% Finer
12" Sieve - 300 mm	0	0.0	100.0
6" Sieve - 150 mm	0	0.0	100.0
3" Sieve - 75 mm	0	0.0	100.0

USDA CLASSIFICATION

Particle Size (mm)	Percent Finer (%)	Percent of Each Component (Material)	(%)	Corrected Percent of -2.0 mm Material for USDA
100	100			
		Gravel	11.8	0
2	88.2			
		Sand	22.3	25.3
0.05	65.9			
		Silt	41.5	47.1
0.002	24.3			
		Clay	24.3	27.6

USDA Classification
CLAY LOAM

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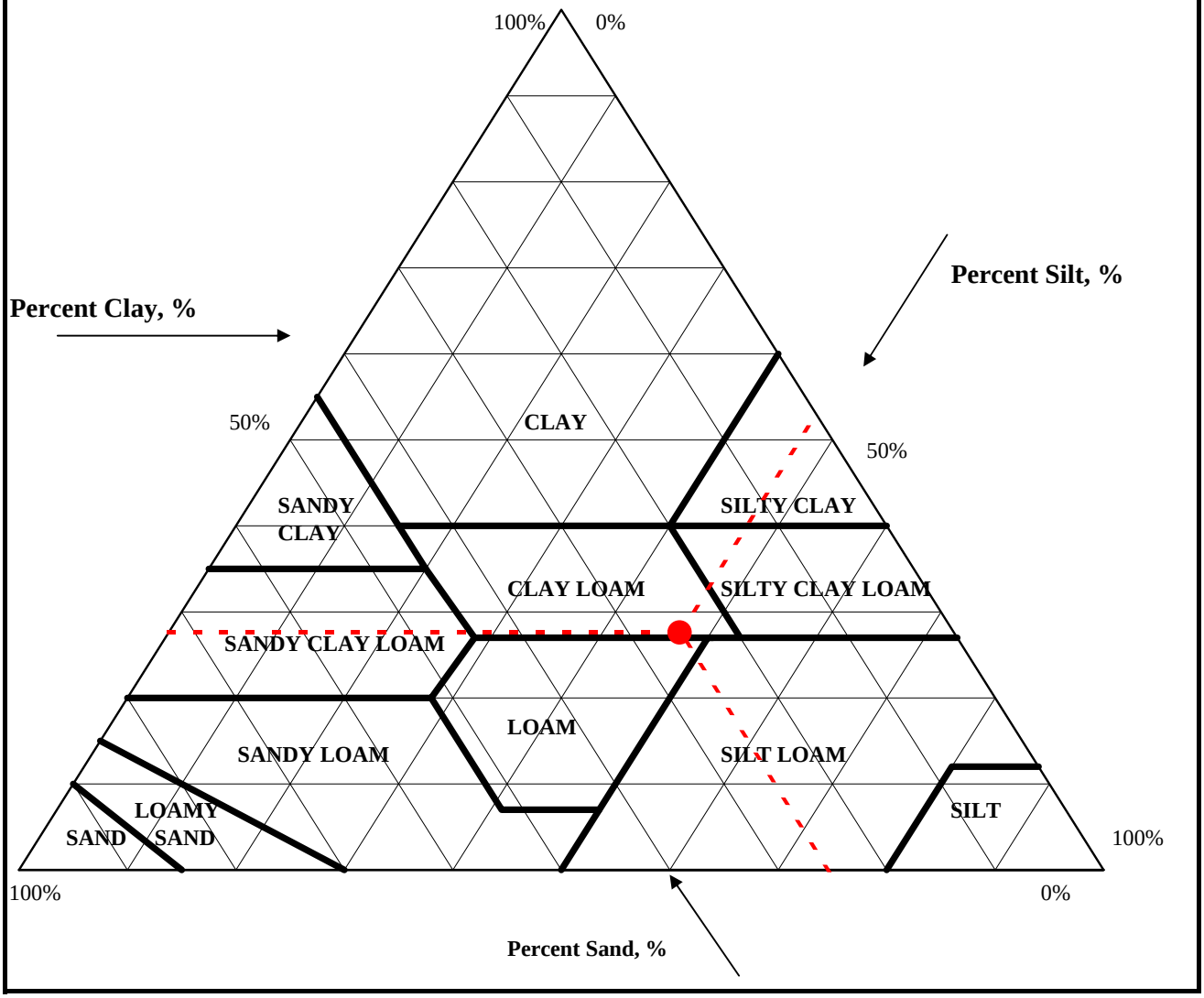
USDA CLASSIFICATION CHART

Client	Civil & Environmental Consultants, I	Boring	TPE-18
Client Project	091-867 Apex Landfill Expansion	Depth	12'-14'
Project No.	30598	Sample	ST-1
		Lab Sample No.	30598012
USCS Description	**YELLOWISH BROWN SANDY LEAN CLAY**		
USCS Group Symbol	**CL**	AASHTO Classification	**A-7-6 (14)**
USDA Description	**CLAY LOAM**		

Corrected for 0% gravel	
Percent Gravel, %	0.0
Percent Sand, %	25.3
Percent Silt, %	47.1
Percent Clay, %	27.6

Sand Subsizes Corrected Percentages	
Very Coarse Sand; 2-1	5.0
Coarse Sand; 1-0.5	4.3
Medium Sand; 0.5-0.25	4.1
Fine Sand; 0.25-0.1	5.8
Very Fine Sand; 0.1-0.05	6.2
Total	**25.3**



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PARTICLE-SIZE ANALYSIS OF SOILS
ASTM D 422

Client	Civil & Environmental Consultants, I	Boring	RB-1
Client Project	091-867 Apex Landfill Expansion	Depth	14'-19'
Project No.	30598	Sample	B-1
		Lab Sample No.	30598022
USCS Description	**OLIVE BROWN LEAN CLAY WITH SAND**		
USCS Group Symbol	**CL**	AASHTO:	**A-7-6 (21)**
USDA Description	**SILTY CLAY LOAM**		

MECHANICAL SIEVE ANALYSIS

As-Received Sample	
Correction For Split Samples (J-Factor)	
+3/4" Air Dry Wt, gm	37.1
-3/4 Wet Wt., gm	17083
-3/4 Dry Wt., gm	13940.9
Total Sample Dry Wt, gm	13978.0
Passing -3/4" (J-Factor)	1.00
Split Sample, -3/4"	
Tare No.	505
Wt. Tare + WS., gm	1186.1
Wt. Tare + DS., gm	987
Wt. Tare, gm	103.6
Wt. of DS., gm	883.4
Water Content, %	22.5
Wt. of +#200 Sample, gm	134.6
Wt. of -#200 Sample, gm	748.8

US Std. Sieve Size	Sieve Opening (mm)	Wt. of Soil Retained (gm)	Percent Retained (%)	Cumulative Percent Retained	Percent Finer (%)	Final Percent Finer
3"	75	0	0.0	0.0	100.0	100.0
2 1/2"	62.5	0	0.0	0.0	100.0	100.0
2"	50	0	0.0	0.0	100.0	100.0
1 1/2"	37.5	0	0.0	0.0	100.0	100.0
1"	25	0	0.0	0.0	100.0	100.0
3/4"	19	37.05	0.3	0.3	99.7	99.7
1/2"	12.5	0	0.0	0.0	100.0	99.7
3/8"	9.5	0	0.0	0.0	100.0	99.7
#4	4.75	9.26	1.0	1.0	99.0	98.7
#10	2	20.4	2.3	3.4	96.6	96.4
#20	0.85	25.25	2.9	6.2	93.8	93.5
#40	0.425	19.16	2.2	8.4	91.6	91.4
#60	0.25	14.7	1.7	10.0	90.0	89.7
#140	0.106	27.02	3.1	13.1	86.9	86.7
#200	0.075	18.84	2.1	15.2	84.8	84.5
Pan	-	748.8	84.8	100.0	-	-

The final percent finer combines the gradation of the plus 3/4" and minus 3/4" material.

HYDROMETER ANALYSIS

Hydrometer Sample Weight	
Tare No.	720
Wt. Tare + DS., gm	144.52
Wt. Tare, gm	96.91
Wt. Dispers., gm	5
Wt. Dry Soil, gm	42.61
-#10 Dispersed 1min in Hamilton Beach Mixer	
K Factor	0.0137
Composite Correction	7.5
a Factor	0.99
Average Test Temp, °C	18.7
Specific Gravity, Assumed	2.7

Elapsed Time (min.)	R Measured	Composite Correction	R Corrected	Percent Finer (%)	Particle Diameter (mm)	Adjusted % Finer (%)
0	NA	NA	NA	NA	NA	NA
2	44	7.5	36.5	84.7	0.0290	71.6
5	41	7.5	33.5	77.7	0.0189	65.7
15	35.5	7.5	28	65.0	0.0114	54.9
30	32.5	7.5	25	58.0	0.0082	49.0
60	30	7.5	22.5	52.2	0.0059	44.1
250	24.5	7.5	17	39.5	0.0030	33.4
1440	22	7.5	14.5	33.7	0.0013	28.4

The adjusted percent finer is corrected for the percent passing the -#200 sieve.

USCS SOIL CLASSIFICATION

Corrected For 100% Passing a 3" Sieve

% Gravel (-3" & +#4)	**1.3**	Silt=43% Clay=41.4%	
Coarse=0.3; Fine=1		D60, mm	NA
% Sand (-#4 & +#200)	**14.2**	D30, mm	NA
Coa.=2.3; Med.=5; Fine=6.8		D10, mm	NA
% Fines (-#200)	**84.5**	Cc	NA
% Plus #200 (-3")	**15.5**	Cu	NA

USCS Description

LEAN CLAY WITH SAND

USCS Group Symbol	Atterberg Limits Group Symbol
CL	**CL, LL=43, PL=18, PI=25**

Auxiliary Information	Wt Ret, gm	% Retained	% Finer
12" Sieve - 300 mm	0	0.0	100.0
6" Sieve - 150 mm	0	0.0	100.0
3" Sieve - 75 mm	0	0.0	100.0

USDA CLASSIFICATION

Particle Size (mm)	Percent Finer (%)	Percent of Each Component (Material)	(%)	Corrected Percent of -2.0 mm Material for USDA
100	100			
		Gravel	3.6	0
2	96.4			
		Sand	17.4	18.0
0.05	79.0			
		Silt	48.0	49.8
0.002	31.0			
		Clay	31.0	32.2

USDA Classification

SILTY CLAY LOAM

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LIQUID LIMIT, PLASTIC LIMIT, AND PLASTICITY INDEX OF SOILS
ASTM D 4318

Client	Civil & Environmental Consultants, I	Boring No.	RB-1
Client Project	091-867 Apex Landfill Expansion	Depth(ft)	14'-19'
Project No.	30598	Sample No.	B-1
		Lab Sample No.	30598022

Soil Description: OLIVE BROWN LEAN CLAY
(-#40 Fraction)

AS-RECEIVED W.C.

Tare Number	505
Wt. Tare & WS, gm	1186.10
Wt. Tare & DS, gm	987.00
Wt. Water, gm	199.10
Wt. Tare, gm	103.60
Wt. DS, gm	883.40
Water Content, %	22.5

SAMPLE SUMMARY

Liquid Limit (LL), %	43
Plastic Limit (PL), %	18
Plasticity Index (PI)	25
USCS Symbol (-#40 Fraction)	CL
Sample Preparation:	Wet Method
Liquidity Index, %	18.2%
Clay Fraction (% 2 microns)	NA
Skempton's Activity (A)	NA

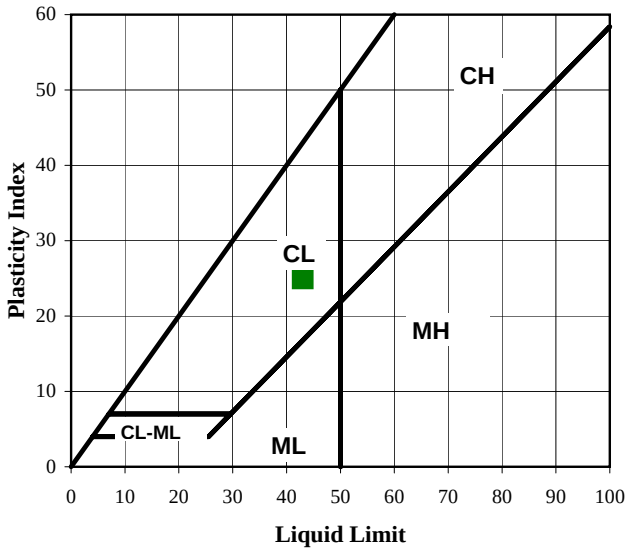
PLASTIC LIMIT

Test Number	1	2	3
Tare Number	409	492	493
Wt. Tare & WS, gm	17.97	18.91	19.13
Wt. Tare & DS, gm	16.87	17.63	17.82
Wt. Water, gm	1.10	1.28	1.31
Wt. Tare, gm	10.69	10.78	10.72
Wt. DS, gm	6.18	6.85	7.10
Water Content, %	17.8	18.7	18.5

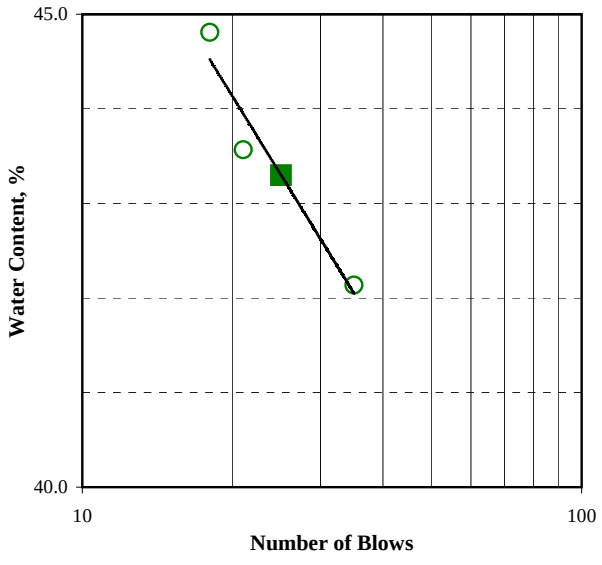
LIQUID LIMIT

	1	2	3
Tare Number	490	505	458
Wt. Tare & WS, gm	19.26	19.13	18.12
Wt. Tare & DS, gm	16.67	16.59	15.95
Wt. Water, gm	2.59	2.54	2.17
Wt. Tare, gm	10.89	10.76	10.80
Wt. DS, gm	5.78	5.83	5.15
Water Content, %	44.8	43.6	42.1
# of Blows	18	21	35

PLASTICITY CHART



FLOW CURVE



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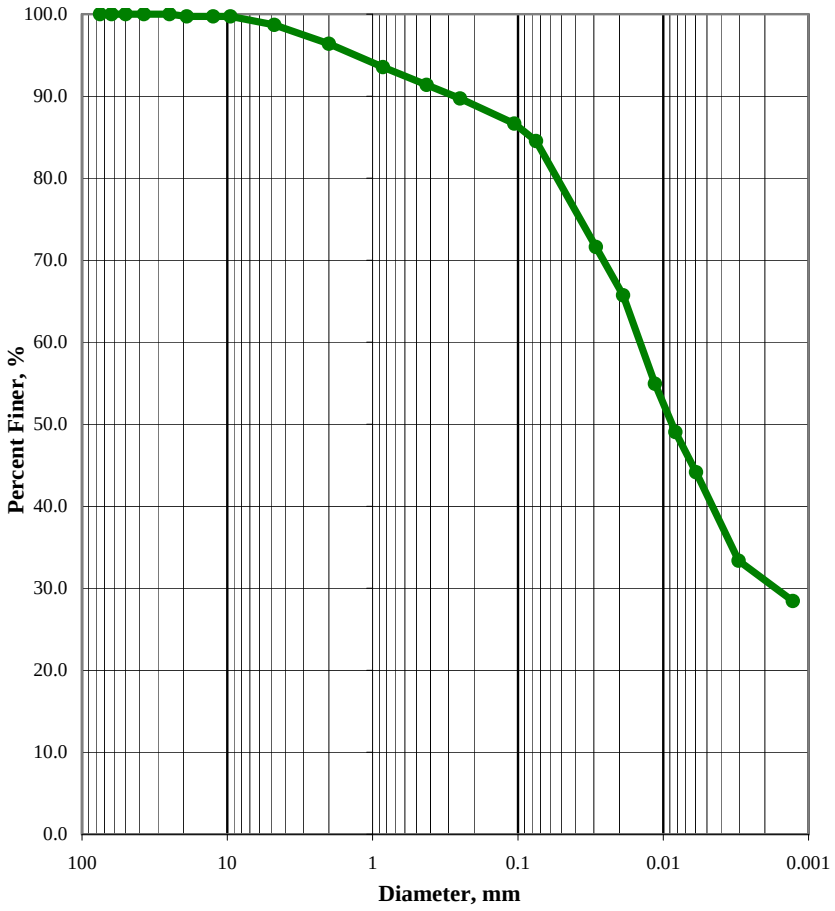
PARTICLE-SIZE ANALYSIS OF SOILS

Client	Civil & Environmental Consultants, I	Boring	RB-1
Client Project	091-867 Apex Landfill Expansion	Depth	14'-19'
Project No.	30598	Sample	B-1
		Lab Sample No.	30598022

USCS Description **OLIVE BROWN LEAN CLAY WITH SAND**
USCS Group Symbol **CL** AASHTO: **A-7-6 (21)**
USDA Description **SILTY CLAY LOAM**



US Std. Sieve Size	Particle Diameter (mm)	Percent Finer (%)
3"	75	100.0
2 1/2"	62.5	100.0
2"	50	100.0
1 1/2"	37.5	100.0
1"	25	100.0
3/4"	19	99.7
1/2"	12.5	99.7
3/8"	9.5	99.7
#4	4.75	98.7
#10	2	96.4
#20	0.85	93.5
#40	0.425	91.4
#60	0.25	89.7
#140	0.106	86.7
#200	0.075	84.5
NA	0.0290	71.6
NA	0.0189	65.7
NA	0.0114	54.9
NA	0.0082	49.0
NA	0.0059	44.1
NA	0.0030	33.4
NA	0.0013	28.4

USCS SOIL CLASSIFICATION

Corrected For 100% Passing a 3" Sieve

% Gravel (-3" & +#4)	**1.3**	Silt=43% Clay=41.4%	
Coarse=0.3; Fine=1		D60, mm	NA
% Sand (-#4 & +#200)	**14.2**	D30, mm	NA
Coa.=2.3; Med.=5; Fine=6.8		D10, mm	NA
% Fines (-#200)	**84.5**	Cc	NA
% Plus #200 (-3")	**15.5**	Cu	NA

USCS Description
LEAN CLAY WITH SAND

USCS Group Symbol	Atterberg Limits Group Symbol		
CL	**CL, LL=43, PL=18, PI=25**		
Auxiliary Information	Wt Ret, gm	% Retained	% Finer
12" Sieve - 300 mm	0	0.0	100.0
6" Sieve - 150 mm	0	0.0	100.0
3" Sieve - 75 mm	0	0.0	100.0

USDA CLASSIFICATION

Particle Size (mm)	Percent Finer (%)	Percent of Each Component (Material)	(%)	Corrected Percent of -2.0 mm Material for USDA
100	100			
		Gravel	3.6	0
2	96.4			
		Sand	17.4	18.0
0.05	79.0			
		Silt	48.0	49.8
0.002	31.0			
		Clay	31.0	32.2

USDA Classification
SILTY CLAY LOAM

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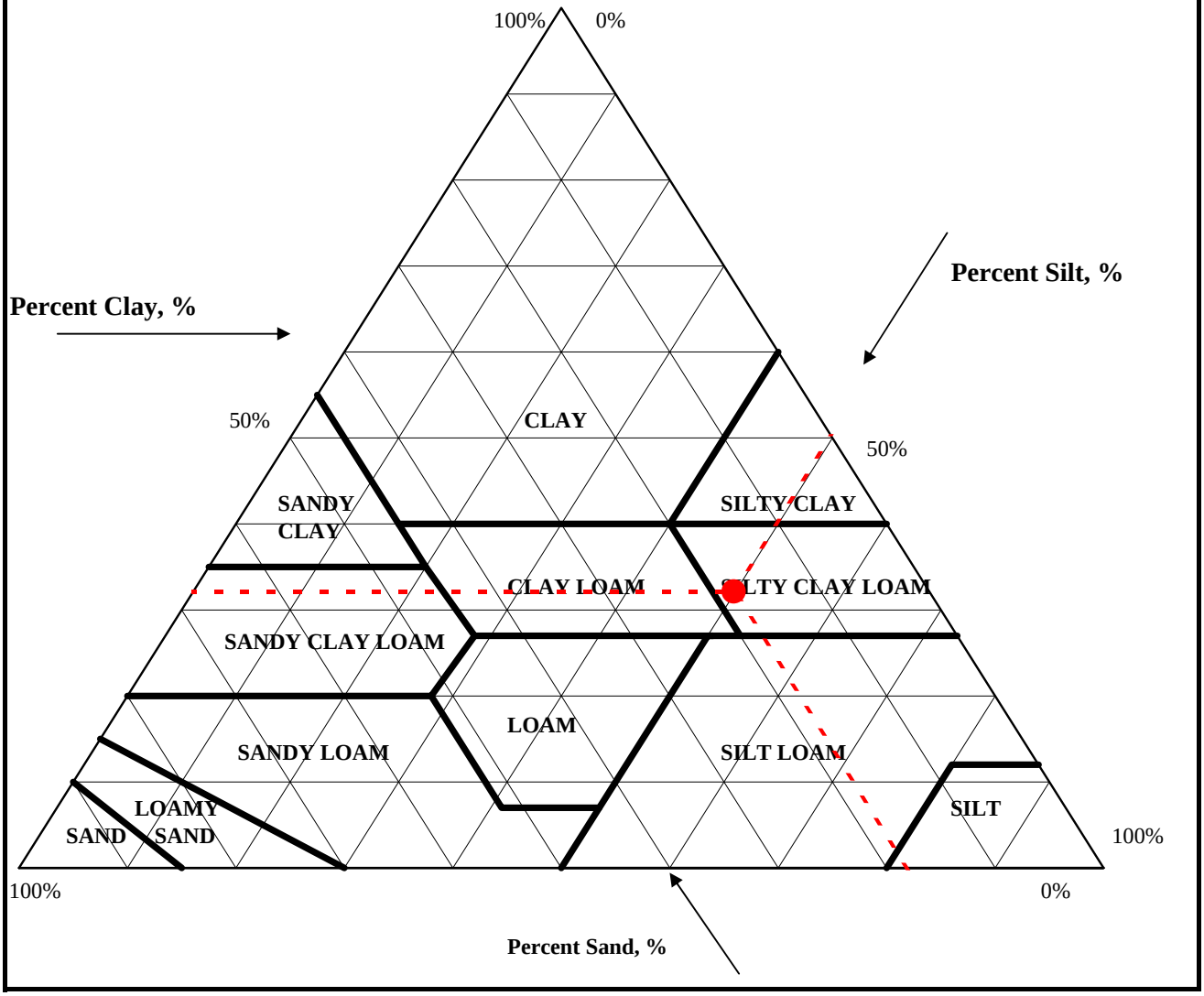
USDA CLASSIFICATION CHART

Client	Civil & Environmental Consultants, I	Boring	RB-1
Client Project	091-867 Apex Landfill Expansion	Depth	14'-19'
Project No.	30598	Sample	B-1
		Lab Sample No.	30598022
USCS Description	**OLIVE BROWN LEAN CLAY WITH SAND**		
USCS Group Symbol	**CL**	AASHTO Classification	**A-7-6 (21)**
USDA Description	**SILTY CLAY LOAM**		

Corrected for 0% gravel	
Percent Gravel, %	0.0
Percent Sand, %	18.0
Percent Silt, %	49.8
Percent Clay, %	32.2

Sand Subsizes Corrected Percentages	
Very Coarse Sand; 2-1	2.4
Coarse Sand; 1-0.5	2.3
Medium Sand; 0.5-0.25	2.2
Fine Sand; 0.25-0.1	3.5
Very Fine Sand; 0.1-0.05	7.6
Total	**18.0**



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PARTICLE-SIZE ANALYSIS OF SOILS
ASTM D 422

Client	Civil & Environmental Consultants, I	Boring	RB-8
Client Project	091-867 Apex Landfill Expansion	Depth	23'-27'
Project No.	30598	Sample	B-1
		Lab Sample No.	30598023

USCS Description **DARK GRAY FAT CLAY**
USCS Group Symbol **CH** AASHTO: **A-7-6 (32)**
USDA Description **SILTY CLAY**

MECHANICAL SIEVE ANALYSIS

As-Received Sample	
Correction For Split Samples (J-Factor)	
+3/4" Air Dry Wt, gm	68.3
-3/4 Wet Wt., gm	13031.8
-3/4 Dry Wt., gm	9609.9
Total Sample Dry Wt, gm	9678.1
Passing -3/4" (J-Factor)	0.99
Split Sample, -3/4"	
Tare No.	713
Wt. Tare + WS., gm	1111.2
Wt. Tare + DS., gm	845.6
Wt. Tare, gm	99.7
Wt. of DS., gm	745.9
Water Content, %	35.6
Wt. of +#200 Sample, gm	68.5
Wt. of -#200 Sample, gm	677.4

US Std. Sieve Size	Sieve Opening (mm)	Wt. of Soil Retained (gm)	Percent Retained (%)	Cumulative Percent Retained	Percent Finer (%)	Final Percent Finer
3"	75	0	0.0	0.0	100.0	100.0
2 1/2"	62.5	0	0.0	0.0	100.0	100.0
2"	50	0	0.0	0.0	100.0	100.0
1 1/2"	37.5	51.94	0.5	0.5	99.5	99.5
1"	25	16.31	0.2	0.7	99.3	99.3
3/4"	19	0	0.0	0.7	99.3	99.3
1/2"	12.5	0	0.0	0.0	100.0	99.3
3/8"	9.5	5.48	0.7	0.7	99.3	98.6
#4	4.75	6.92	0.9	1.7	98.3	97.6
#10	2	7.51	1.0	2.7	97.3	96.6
#20	0.85	8.72	1.2	3.8	96.2	95.5
#40	0.425	8.59	1.2	5.0	95.0	94.3
#60	0.25	7.82	1.0	6.0	94.0	93.3
#140	0.106	14.24	1.9	7.9	92.1	91.4
#200	0.075	9.21	1.2	9.2	90.8	90.2
Pan	-	677.4	90.8	100.0	-	-

The final percent finer combines the gradation of the plus 3/4" and minus 3/4" material.

HYDROMETER ANALYSIS

Hydrometer Sample Weight	
Tare No.	509
Wt. Tare + DS., gm	149.78
Wt. Tare, gm	102.52
Wt. Dispers., gm	5
Wt. Dry Soil, gm	42.26
-#10 Dispersed 1min in Hamilton Beach Mixer	
K Factor	0.0137
Composite Correction	7.5
a Factor	0.99
Average Test Temp, °C	18.6
Specific Gravity, Assumed	2.7

Elapsed Time (min.)	R Measured	Composite Correction	R Corrected	Percent Finer (%)	Particle Diameter (mm)	Adjusted % Finer (%)
0	NA	NA	NA	NA	NA	NA
2	45.5	7.5	38	88.9	0.0287	80.2
5	44	7.5	36.5	85.4	0.0184	77.0
15	42	7.5	34.5	80.7	0.0108	72.8
30	39	7.5	31.5	73.7	0.0079	66.5
60	35.5	7.5	28	65.5	0.0057	59.1
250	30	7.5	22.5	52.7	0.0029	47.5
1440	26.5	7.5	19	44.5	0.0012	40.1

The adjusted percent finer is corrected for the percent passing the -#200 sieve.

USCS SOIL CLASSIFICATION

Corrected For 100% Passing a 3" Sieve

% Gravel (-3" & +#4)	**2.4**	Silt=33.2%	Clay=56.8%
Coarse=0.7; Fine=1.7		D60, mm	NA
% Sand (-#4 & +#200)	**7.5**	D30, mm	NA
Coa.=1; Med.=2.3; Fine=4.2		D10, mm	NA
% Fines (-#200)	**90.2**	Cc	NA
% Plus #200 (-3")	**9.8**	Cu	NA

USCS Description
FAT CLAY

USCS Group Symbol	Atterberg Limits Group Symbol
CH	**CH, LL=56, PL=24, PI=32**

Auxiliary Information	Wt Ret, gm	% Retained	% Finer
12" Sieve - 300 mm	0	0.0	100.0
6" Sieve - 150 mm	0	0.0	100.0
3" Sieve - 75 mm	0	0.0	100.0

USDA CLASSIFICATION

Particle Size (mm)	Percent Finer (%)	Percent of Each Component (Material)	(%)	Corrected Percent of -2.0 mm Material for USDA
100	100			
		Gravel	3.4	0
2	96.6			
		Sand	10.7	11.1
0.05	86.0			
		Silt	41.8	43.2
0.002	44.2			
		Clay	44.2	45.7

USDA Classification
SILTY CLAY

Input Validation: Reviewed By: Date Tested: 12/1/2010

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LIQUID LIMIT, PLASTIC LIMIT, AND PLASTICITY INDEX OF SOILS
ASTM D 4318

Client	Civil & Environmental Consultants, I	Boring No.	RB-8
Client Project	091-867 Apex Landfill Expansion	Depth(ft)	23'-27'
Project No.	30598	Sample No.	B-1
		Lab Sample No.	30598023

Soil Description: DARK GRAY FAT CLAY
(-#40 Fraction)

AS-RECEIVED W.C.

Tare Number	713
Wt. Tare & WS, gm	1111.20
Wt. Tare & DS, gm	845.60
Wt. Water, gm	265.60
Wt. Tare, gm	99.70
Wt. DS, gm	745.90
Water Content, %	35.6

SAMPLE SUMMARY

Liquid Limit (LL), %	56
Plastic Limit (PL), %	24
Plasticity Index (PI)	32
USCS Symbol (-#40 Fraction)	CH
Sample Preparation:	Wet Method
Liquidity Index, %	36.3%
Clay Fraction (% 2 microns)	NA
Skempton's Activity (A)	NA

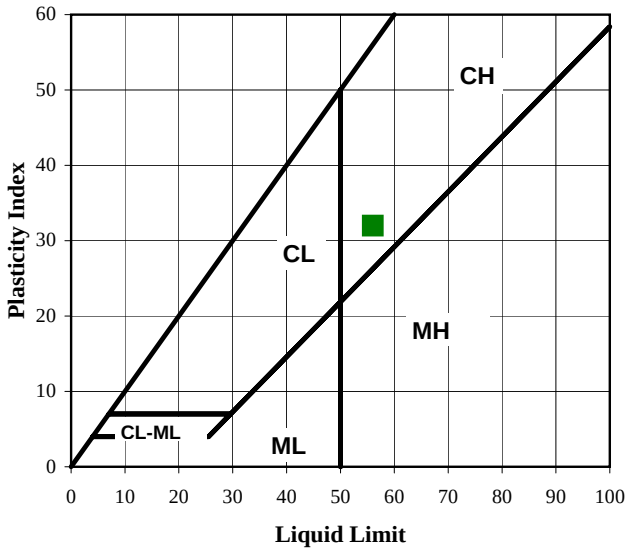
PLASTIC LIMIT

Test Number	1	2	3
Tare Number	408	422	433
Wt. Tare & WS, gm	17.21	17.15	17.41
Wt. Tare & DS, gm	15.88	15.92	16.14
Wt. Water, gm	1.33	1.23	1.27
Wt. Tare, gm	10.53	10.84	10.72
Wt. DS, gm	5.35	5.08	5.42
Water Content, %	24.9	24.2	23.4

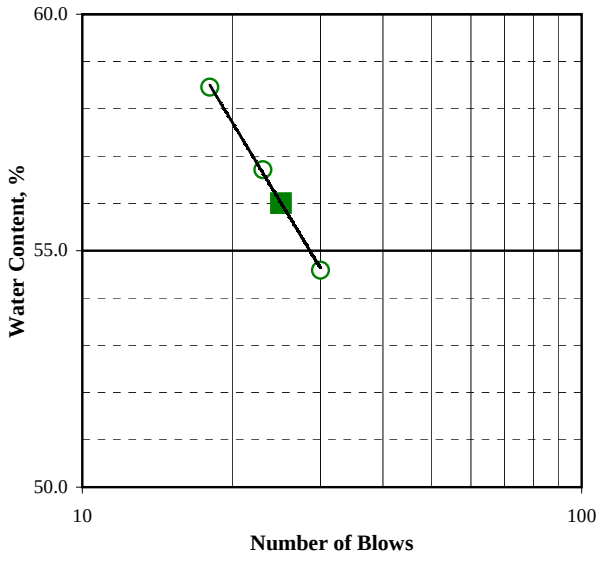
LIQUID LIMIT

	1	2	3
Tare Number	427	450	456
Wt. Tare & WS, gm	18.17	18.63	17.80
Wt. Tare & DS, gm	15.44	15.80	15.36
Wt. Water, gm	2.73	2.83	2.44
Wt. Tare, gm	10.77	10.81	10.89
Wt. DS, gm	4.67	4.99	4.47
Water Content, %	58.5	56.7	54.6
# of Blows	18	23	30

PLASTICITY CHART



FLOW CURVE



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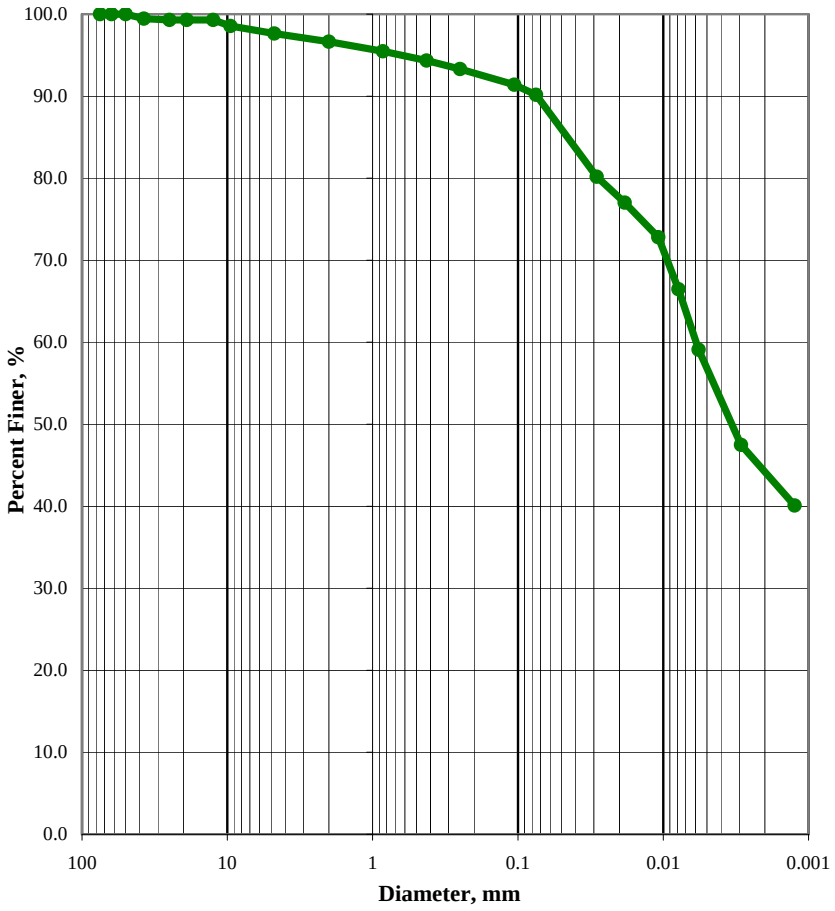
PARTICLE-SIZE ANALYSIS OF SOILS

Client	Civil & Environmental Consultants, I	Boring	RB-8
Client Project	091-867 Apex Landfill Expansion	Depth	23'-27'
Project No.	30598	Sample	B-1
		Lab Sample No.	30598023

USCS Description **DARK GRAY FAT CLAY**
USCS Group Symbol **CH** AASHTO: **A-7-6 (32)**
USDA Description **SILTY CLAY**



US Std. Sieve Size	Particle Diameter (mm)	Percent Finer (%)
3"	75	100.0
2 1/2"	62.5	100.0
2"	50	100.0
1 1/2"	37.5	99.5
1"	25	99.3
3/4"	19	99.3
1/2"	12.5	99.3
3/8"	9.5	98.6
#4	4.75	97.6
#10	2	96.6
#20	0.85	95.5
#40	0.425	94.3
#60	0.25	93.3
#140	0.106	91.4
#200	0.075	90.2
NA	0.0287	80.2
NA	0.0184	77.0
NA	0.0108	72.8
NA	0.0079	66.5
NA	0.0057	59.1
NA	0.0029	47.5
NA	0.0012	40.1

USCS SOIL CLASSIFICATION

Corrected For 100% Passing a 3" Sieve

% Gravel (-3" & +#4)	**2.4**	Silt=33.2% Clay=56.8%	
Coarse=0.7; Fine=1.7		D60, mm	NA
% Sand (-#4 & +#200)	**7.5**	D30, mm	NA
Coa.=1; Med.=2.3; Fine=4.2		D10, mm	NA
% Fines (-#200)	**90.2**	Cc	NA
% Plus #200 (-3")	**9.8**	Cu	NA

USCS Description
FAT CLAY

USCS Group Symbol	Atterberg Limits Group Symbol
CH	**CH, LL=56, PL=24, PI=32**

Auxiliary Information	Wt Ret, gm	% Retained	% Finer
12" Sieve - 300 mm	0	0.0	100.0
6" Sieve - 150 mm	0	0.0	100.0
3" Sieve - 75 mm	0	0.0	100.0

USDA CLASSIFICATION

Particle Size (mm)	Percent Finer (%)
100	100
2	96.6
0.05	86.0
0.002	44.2

Percent of Each Component (Material)	(%)	Corrected Percent of -2.0 mm Material for USDA
Gravel	3.4	0
Sand	10.7	11.1
Silt	41.8	43.2
Clay	44.2	45.7

USDA Classification
SILTY CLAY

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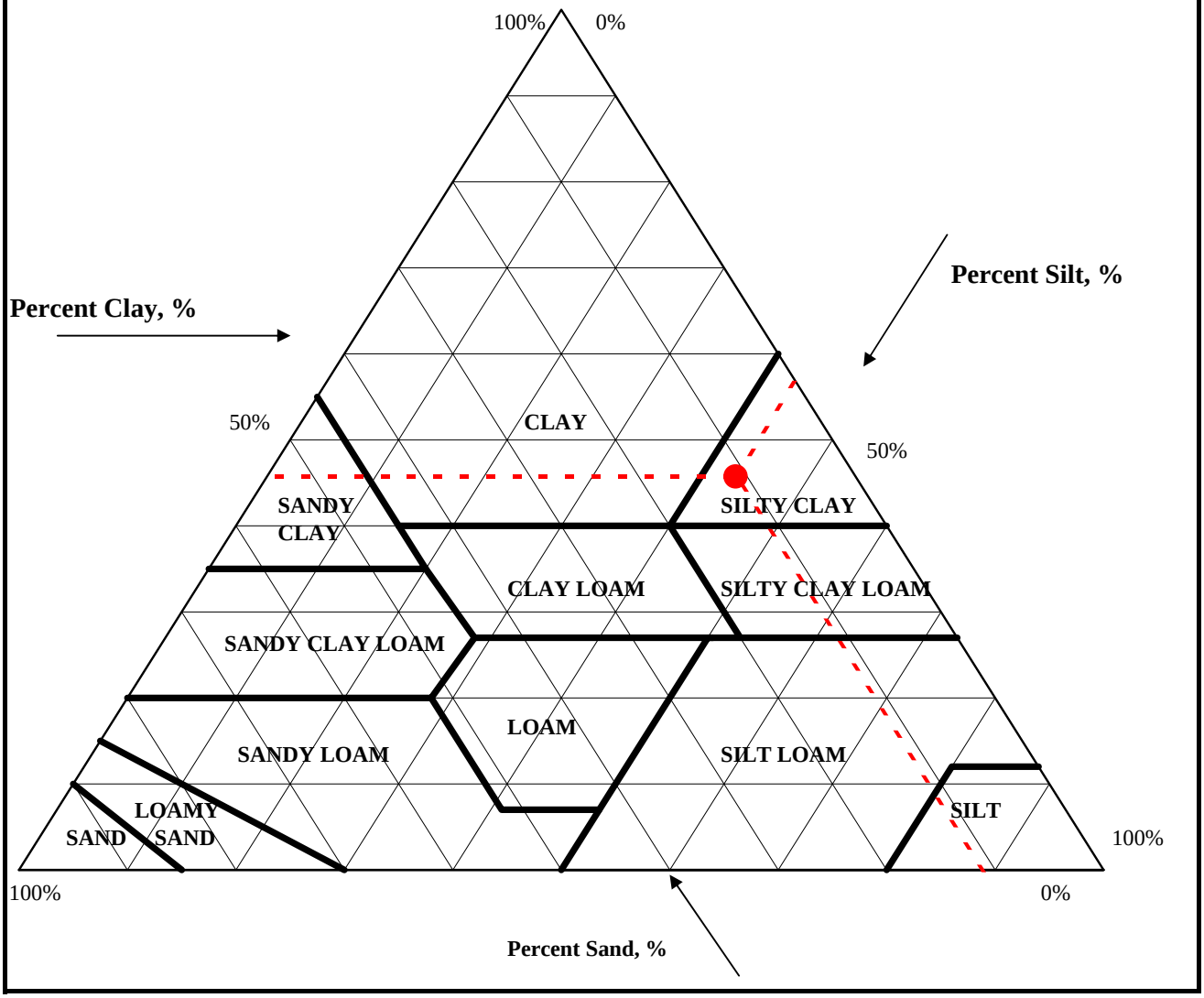
USDA CLASSIFICATION CHART

Client	Civil & Environmental Consultants, I	Boring	RB-8
Client Project	091-867 Apex Landfill Expansion	Depth	23'-27'
Project No.	30598	Sample	B-1
		Lab Sample No.	30598023
USCS Description	**DARK GRAY FAT CLAY**		
USCS Group Symbol	**CH**	AASHTO Classification	**A-7-6 (32)**
USDA Description	**SILTY CLAY**		

Corrected for 0% gravel	
Percent Gravel, %	0.0
Percent Sand, %	11.1
Percent Silt, %	43.2
Percent Clay, %	45.7

Sand Subsizes Corrected Percentages	
Very Coarse Sand; 2-1	1.0
Coarse Sand; 1-0.5	1.1
Medium Sand; 0.5-0.25	1.4
Fine Sand; 0.25-0.1	2.2
Very Fine Sand; 0.1-0.05	5.4
Total	**11.1**



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PARTICLE-SIZE ANALYSIS OF SOILS
ASTM D 422

Client	Civil & Environmental Consultants, I	Boring	SB-1
Client Project	091-867 Apex Landfill Expansion	Depth	58'-66'
Project No.	30598	Sample	B-1
		Lab Sample No.	30598024
USCS Description	**GRAYISH BROWN SANDY LEAN CLAY**		
USCS Group Symbol	**CL**	AASHTO:	**A-6 (11)**
USDA Description	**CLAY LOAM**		

MECHANICAL SIEVE ANALYSIS

As-Received Sample	
Correction For Split Samples (J-Factor)	
+3/4" Air Dry Wt, gm	196.3
-3/4 Wet Wt., gm	16553.7
-3/4 Dry Wt., gm	14667.3
Total Sample Dry Wt, gm	14863.7
Passing -3/4" (J-Factor)	0.99
Split Sample, -3/4"	
Tare No.	501
Wt. Tare + WS., gm	1237.9
Wt. Tare + DS., gm	1108.7
Wt. Tare, gm	104.1
Wt. of DS., gm	1004.6
Water Content, %	12.9
Wt. of +#200 Sample, gm	364.5
Wt. of -#200 Sample, gm	640.1

US Std. Sieve Size	Sieve Opening (mm)	Wt. of Soil Retained (gm)	Percent Retained (%)	Cumulative Percent Retained	Percent Finer (%)	Final Percent Finer
3"	75	0	0.0	0.0	100.0	100.0
2 1/2"	62.5	0	0.0	0.0	100.0	100.0
2"	50	0	0.0	0.0	100.0	100.0
1 1/2"	37.5	0	0.0	0.0	100.0	100.0
1"	25	71.89	0.5	0.5	99.5	99.5
3/4"	19	124.43	0.8	1.3	98.7	98.7
1/2"	12.5	13.42	1.3	1.3	98.7	97.4
3/8"	9.5	14.84	1.5	2.8	97.2	95.9
#4	4.75	70.04	7.0	9.8	90.2	89.0
#10	2	104.5	10.4	20.2	79.8	78.8
#20	0.85	60.39	6.0	26.2	73.8	72.8
#40	0.425	25.45	2.5	28.7	71.3	70.3
#60	0.25	15.7	1.6	30.3	69.7	68.8
#140	0.106	36.61	3.6	33.9	66.1	65.2
#200	0.075	23.53	2.3	36.3	63.7	62.9
Pan	-	640.1	63.7	100.0	-	-

The final percent finer combines the gradation of the plus 3/4" and minus 3/4" material.

HYDROMETER ANALYSIS

Hydrometer Sample Weight	
Tare No.	937
Wt. Tare + DS., gm	152.17
Wt. Tare, gm	99.39
Wt. Dispers., gm	5
Wt. Dry Soil, gm	47.78
-#10 Dispersed 1min in Hamilton Beach Mixer	
K Factor	0.0137
Composite Correction	7.5
a Factor	0.99
Average Test Temp, °C	18.6
Specific Gravity, Assumed	2.7

Elapsed Time (min.)	R Measured	Composite Correction	R Corrected	Percent Finer (%)	Particle Diameter (mm)	Adjusted % Finer (%)
0	NA	NA	NA	NA	NA	NA
2	48.5	7.5	41	84.9	0.0279	53.4
5	45.5	7.5	38	78.6	0.0181	49.5
15	43	7.5	35.5	73.5	0.0107	46.2
30	39	7.5	31.5	65.2	0.0078	41.0
60	36	7.5	28.5	59.0	0.0057	37.1
250	29.5	7.5	22	45.5	0.0029	28.6
1440	25.5	7.5	18	37.3	0.0013	23.4

The adjusted percent finer is corrected for the percent passing the -#200 sieve.

USCS SOIL CLASSIFICATION

Corrected For 100% Passing a 3" Sieve

% Gravel (-3" & +#4)	**11.0**	Silt=27.3% Clay=35.5%	
Coarse=1.3; Fine=9.7		D60, mm	NA
% Sand (-#4 & +#200)	**26.1**	D30, mm	NA
Coa.=10.3; Med.=8.4; Fine=7.4		D10, mm	NA
% Fines (-#200)	**62.9**	Cc	NA
% Plus #200 (-3")	**37.1**	Cu	NA

USCS Description
SANDY LEAN CLAY

USCS Group Symbol	Atterberg Limits Group Symbol
CL	**CL, LL=40, PL=18, PI=22**

Auxiliary Information	Wt Ret, gm	% Retained	% Finer
12" Sieve - 300 mm	0	0.0	100.0
6" Sieve - 150 mm	0	0.0	100.0
3" Sieve - 75 mm	0	0.0	100.0

USDA CLASSIFICATION

Particle Size (mm)	Percent Finer (%)	Percent of Each Component (Material)	(%)	Corrected Percent of -2.0 mm Material for USDA
100	100			
		Gravel	21.2	0
2	78.8			
		Sand	19.8	25.1
0.05	59.0			
		Silt	32.7	41.5
0.002	26.3			
		Clay	26.3	33.4

USDA Classification
CLAY LOAM

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LIQUID LIMIT, PLASTIC LIMIT, AND PLASTICITY INDEX OF SOILS
ASTM D 4318

Client	Civil & Environmental Consultants, I	Boring No.	SB-1
Client Project	091-867 Apex Landfill Expansion	Depth(ft)	58'-66'
Project No.	30598	Sample No.	B-1
		Lab Sample No.	30598024

Soil Description: GRAYISH BROWN LEAN CLAY
(-#40 Fraction)

AS-RECEIVED W.C.

Tare Number	501
Wt. Tare & WS, gm	1237.90
Wt. Tare & DS, gm	1108.70
Wt. Water, gm	129.20
Wt. Tare, gm	104.10
Wt. DS, gm	1004.60
Water Content, %	12.9

SAMPLE SUMMARY

Liquid Limit (LL), %	40
Plastic Limit (PL), %	18
Plasticity Index (PI)	22
USCS Symbol (-#40 Fraction)	CL
Sample Preparation:	Wet Method
Liquidity Index, %	-23.4%
Clay Fraction (% 2 microns)	NA
Skempton's Activity (A)	NA

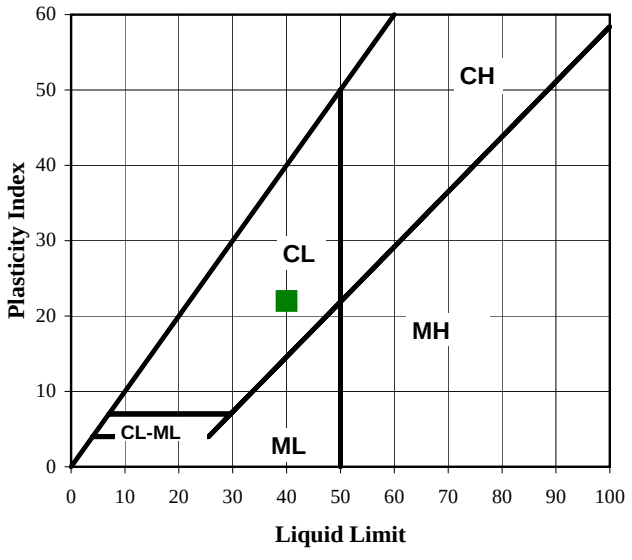
PLASTIC LIMIT

Test Number	1	2	3
Tare Number	469	467	434
Wt. Tare & WS, gm	18.04	20.17	18.74
Wt. Tare & DS, gm	16.92	18.71	17.5
Wt. Water, gm	1.12	1.46	1.24
Wt. Tare, gm	10.77	10.75	10.78
Wt. DS, gm	6.15	7.96	6.72
Water Content, %	18.2	18.3	18.5

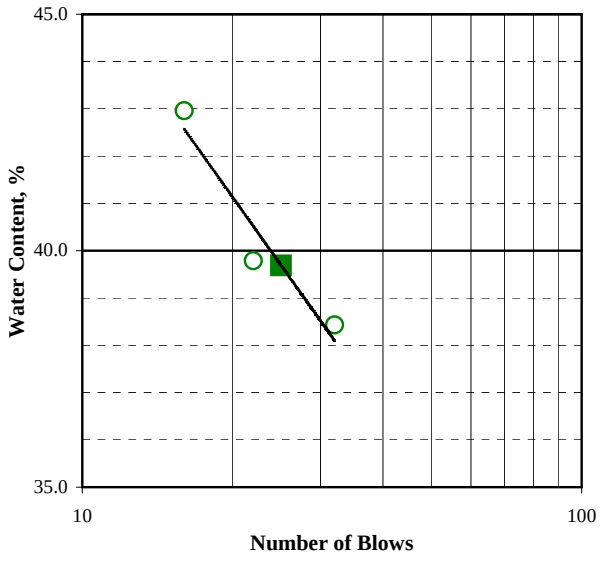
LIQUID LIMIT

	1	2	3
Tare Number	427	444	450
Wt. Tare & WS, gm	18.71	18.58	21.04
Wt. Tare & DS, gm	16.33	16.34	18.20
Wt. Water, gm	2.38	2.24	2.84
Wt. Tare, gm	10.79	10.71	10.81
Wt. DS, gm	5.54	5.63	7.39
Water Content, %	43.0	39.8	38.4
# of Blows	16	22	32

PLASTICITY CHART



FLOW CURVE



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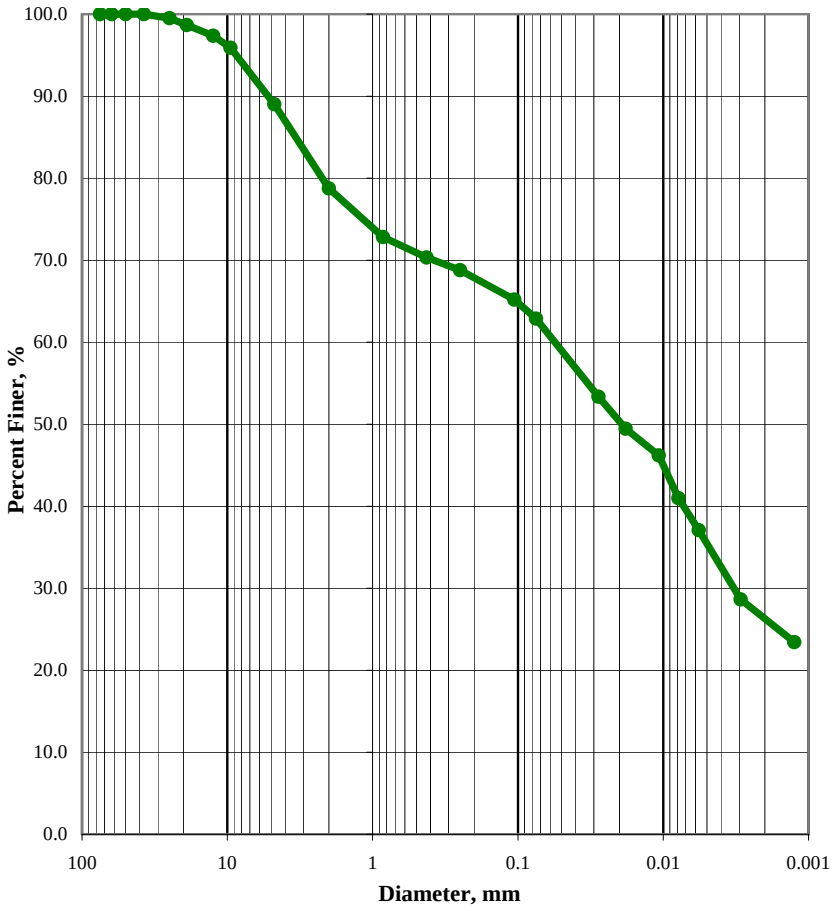
PARTICLE-SIZE ANALYSIS OF SOILS

Client	Civil & Environmental Consultants, I	Boring	SB-1
Client Project	091-867 Apex Landfill Expansion	Depth	58'-66'
Project No.	30598	Sample	B-1
		Lab Sample No.	30598024

USCS Description **GRAYISH BROWN SANDY LEAN CLAY**
USCS Group Symbol **CL** AASHTO: **A-6 (11)**
USDA Description **CLAY LOAM**



US Std. Sieve Size	Particle Diameter (mm)	Percent Finer (%)
3"	75	100.0
2 1/2"	62.5	100.0
2"	50	100.0
1 1/2"	37.5	100.0
1"	25	99.5
3/4"	19	98.7
1/2"	12.5	97.4
3/8"	9.5	95.9
#4	4.75	89.0
#10	2	78.8
#20	0.85	72.8
#40	0.425	70.3
#60	0.25	68.8
#140	0.106	65.2
#200	0.075	62.9
NA	0.0279	53.4
NA	0.0181	49.5
NA	0.0107	46.2
NA	0.0078	41.0
NA	0.0057	37.1
NA	0.0029	28.6
NA	0.0013	23.4

USCS SOIL CLASSIFICATION

Corrected For 100% Passing a 3" Sieve

% Gravel (-3" & +#4)	**11.0**	Silt=27.3% Clay=35.5%	
Coarse=1.3; Fine=9.7		D60, mm	NA
% Sand (-#4 & +#200)	**26.1**	D30, mm	NA
Coa.=10.3; Med.=8.4; Fine=7.4		D10, mm	NA
% Fines (-#200)	**62.9**	Cc	NA
% Plus #200 (-3")	**37.1**	Cu	NA

USCS Description
SANDY LEAN CLAY

USCS Group Symbol	Atterberg Limits Group Symbol
CL	**CL, LL=40, PL=18, PI=22**

Auxiliary Information	Wt Ret, gm	% Retained	% Finer
12" Sieve - 300 mm	0	0.0	100.0
6" Sieve - 150 mm	0	0.0	100.0
3" Sieve - 75 mm	0	0.0	100.0

USDA CLASSIFICATION

Particle Size (mm)	Percent Finer (%)	Percent of Each Component (Material)	(%)	Corrected Percent of -2.0 mm Material for USDA
100	100			
		Gravel	21.2	0
2	78.8			
		Sand	19.8	25.1
0.05	59.0			
		Silt	32.7	41.5
0.002	26.3			
		Clay	26.3	33.4

USDA Classification
CLAY LOAM

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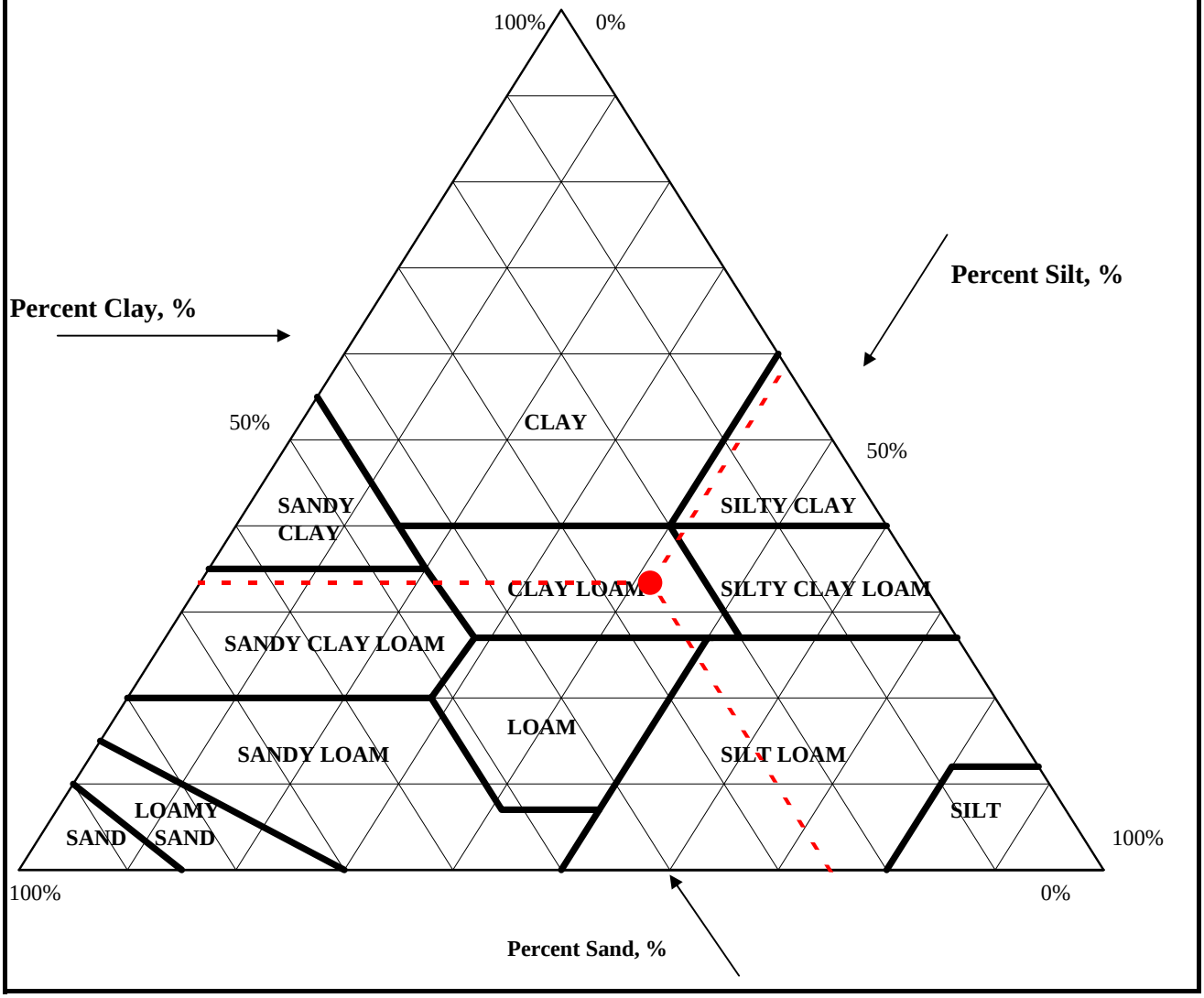
USDA CLASSIFICATION CHART

Client	Civil & Environmental Consultants, I	Boring	SB-1
Client Project	091-867 Apex Landfill Expansion	Depth	58'-66'
Project No.	30598	Sample	B-1
		Lab Sample No.	30598024
USCS Description	**GRAYISH BROWN SANDY LEAN CLAY**		
USCS Group Symbol	**CL**	AASHTO Classification	**A-6 (11)**
USDA Description	**CLAY LOAM**		

Corrected for 0% gravel	
Percent Gravel, %	0.0
Percent Sand, %	25.1
Percent Silt, %	41.5
Percent Clay, %	33.4

Sand Subsizes Corrected Percentages	
Very Coarse Sand; 2-1	6.1
Coarse Sand; 1-0.5	3.9
Medium Sand; 0.5-0.25	2.7
Fine Sand; 0.25-0.1	5.1
Very Fine Sand; 0.1-0.05	7.4
Total	**25.1**



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PARTICLE-SIZE ANALYSIS OF SOILS
ASTM D 422

Client	Civil & Environmental Consultants, I	Boring	SB-14
Client Project	091-867 Apex Landfill Expansion	Depth	16'-20'
Project No.	30598	Sample	B-1
		Lab Sample No.	30598025
USCS Description	**DARK GRAYISH BROWN LEAN CLAY WITH SAND**		
USCS Group Symbol	**CL**	AASHTO:	**A-7-6 (22)**
USDA Description	**SILTY CLAY**		

MECHANICAL SIEVE ANALYSIS

As-Received Sample	
Correction For Split Samples (J-Factor)	
+3/4" Air Dry Wt, gm	22.5
-3/4 Wet Wt., gm	17447.5
-3/4 Dry Wt., gm	13968.0
Total Sample Dry Wt, gm	13990.5
Passing -3/4" (J-Factor)	1.00
Split Sample, -3/4"	
Tare No.	522
Wt. Tare + WS., gm	1116.5
Wt. Tare + DS., gm	914.5
Wt. Tare, gm	103.6
Wt. of DS., gm	810.9
Water Content, %	24.9
Wt. of +#200 Sample, gm	148.6
Wt. of -#200 Sample, gm	662.3

US Std. Sieve Size	Sieve Opening (mm)	Wt. of Soil Retained (gm)	Percent Retained (%)	Cumulative Percent Retained	Percent Finer (%)	Final Percent Finer
3"	75	0	0.0	0.0	100.0	100.0
2 1/2"	62.5	0	0.0	0.0	100.0	100.0
2"	50	0	0.0	0.0	100.0	100.0
1 1/2"	37.5	0	0.0	0.0	100.0	100.0
1"	25	22.52	0.2	0.2	99.8	99.8
3/4"	19	0	0.0	0.2	99.8	99.8
1/2"	12.5	4.33	0.5	0.5	99.5	99.3
3/8"	9.5	2.31	0.3	0.8	99.2	99.0
#4	4.75	19.53	2.4	3.2	96.8	96.6
#10	2	27.03	3.3	6.6	93.4	93.3
#20	0.85	25.65	3.2	9.7	90.3	90.1
#40	0.425	18.07	2.2	12.0	88.0	87.9
#60	0.25	13.7	1.7	13.6	86.4	86.2
#140	0.106	23.39	2.9	16.5	83.5	83.3
#200	0.075	14.57	1.8	18.3	81.7	81.5
Pan	-	662.3	81.7	100.0	-	-

The final percent finer combines the gradation of the plus 3/4" and minus 3/4" material.

HYDROMETER ANALYSIS

Hydrometer Sample Weight	
Tare No.	811
Wt. Tare + DS., gm	146.15
Wt. Tare, gm	102.63
Wt. Dispers., gm	5
Wt. Dry Soil, gm	38.52
-#10 Dispersed 1min in Hamilton Beach Mixer	
K Factor	0.0138
Composite Correction	7.5
a Factor	0.99
Average Test Temp, °C	18.3
Specific Gravity, Assumed	2.7

Elapsed Time (min.)	R Measured	Composite Correction	R Corrected	Percent Finer (%)	Particle Diameter (mm)	Adjusted % Finer (%)
0	NA	NA	NA	NA	NA	NA
2	42.5	7.5	35	89.9	0.0296	73.3
5	40	7.5	32.5	83.4	0.0191	68.0
15	37	7.5	29.5	75.7	0.0113	61.8
30	35	7.5	27.5	70.6	0.0081	57.6
60	31.5	7.5	24	61.6	0.0059	50.2
250	27	7.5	19.5	50.1	0.0030	40.8
1440	23.5	7.5	16	41.1	0.0013	33.5

The adjusted percent finer is corrected for the percent passing the -#200 sieve.

USCS SOIL CLASSIFICATION

Corrected For 100% Passing a 3" Sieve

% Gravel (-3" & +#4)	**3.4**	Silt=33.5%	Clay=47.9%
Coarse=0.2; Fine=3.2		D60, mm	NA
% Sand (-#4 & +#200)	**15.1**	D30, mm	NA
Coa.=3.3; Med.=5.4; Fine=6.4		D10, mm	NA
% Fines (-#200)	**81.5**	Cc	NA
% Plus #200 (-3")	**18.5**	Cu	NA

USCS Description

LEAN CLAY WITH SAND

USCS Group Symbol	Atterberg Limits Group Symbol
CL	**CL, LL=46, PL=19, PI=27**

Auxiliary Information	Wt Ret, gm	% Retained	% Finer
12" Sieve - 300 mm	0	0.0	100.0
6" Sieve - 150 mm	0	0.0	100.0
3" Sieve - 75 mm	0	0.0	100.0

USDA CLASSIFICATION

Particle Size (mm)	Percent Finer (%)	Percent of Each Component (Material)	(%)	Corrected Percent of -2.0 mm Material for USDA
100	100			
		Gravel	6.7	0
2	93.3			
		Sand	15.4	16.5
0.05	77.9			
		Silt	40.6	43.5
0.002	37.4			
		Clay	37.4	40.1

USDA Classification

SILTY CLAY

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LIQUID LIMIT, PLASTIC LIMIT, AND PLASTICITY INDEX OF SOILS
ASTM D 4318

Client	Civil & Environmental Consultants, I	Boring No.	SB-14
Client Project	091-867 Apex Landfill Expansion	Depth(ft)	16'-20'
Project No.	30598	Sample No.	B-1
		Lab Sample No.	30598025

Soil Description: DARK GRAYISH BROWN LEAN CLAY
(-#40 Fraction)

AS-RECEIVED W.C.

Tare Number	522
Wt. Tare & WS, gm	1116.50
Wt. Tare & DS, gm	914.50
Wt. Water, gm	202.00
Wt. Tare, gm	103.60
Wt. DS, gm	810.90
Water Content, %	24.9

SAMPLE SUMMARY

Liquid Limit (LL), %	46
Plastic Limit (PL), %	19
Plasticity Index (PI)	27
USCS Symbol (-#40 Fraction)	CL
Sample Preparation:	Wet Method
Liquidity Index, %	21.9%
Clay Fraction (% 2 microns)	NA
Skempton's Activity (A)	NA

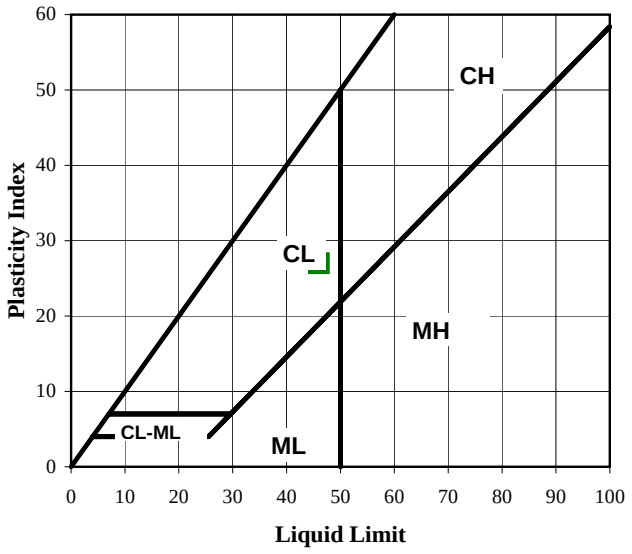
PLASTIC LIMIT

Test Number	1	2	3
Tare Number	423	506	488
Wt. Tare & WS, gm	17.07	17.77	20.62
Wt. Tare & DS, gm	16.09	16.64	19.08
Wt. Water, gm	0.98	1.13	1.54
Wt. Tare, gm	10.74	10.76	10.87
Wt. DS, gm	5.35	5.88	8.21
Water Content, %	18.3	19.2	18.8

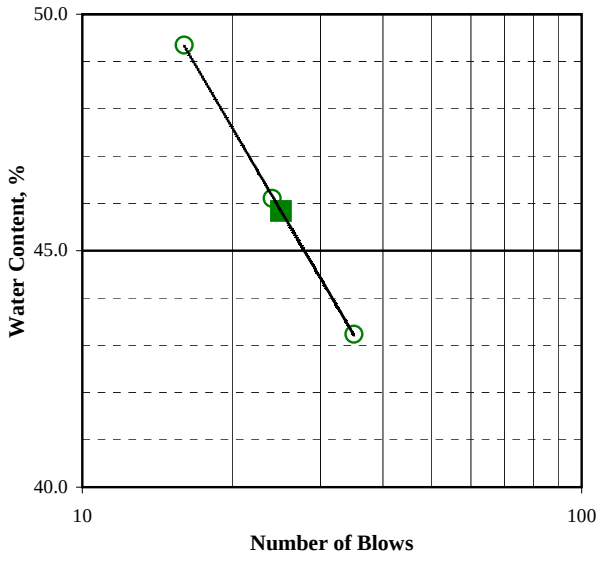
LIQUID LIMIT

	1	2	3
	444	466	472
	17.57	18.07	19.50
	15.30	15.76	16.88
	2.27	2.31	2.62
	10.70	10.75	10.82
	4.60	5.01	6.06
	49.3	46.1	43.2
# of Blows	16	24	35

PLASTICITY CHART



FLOW CURVE



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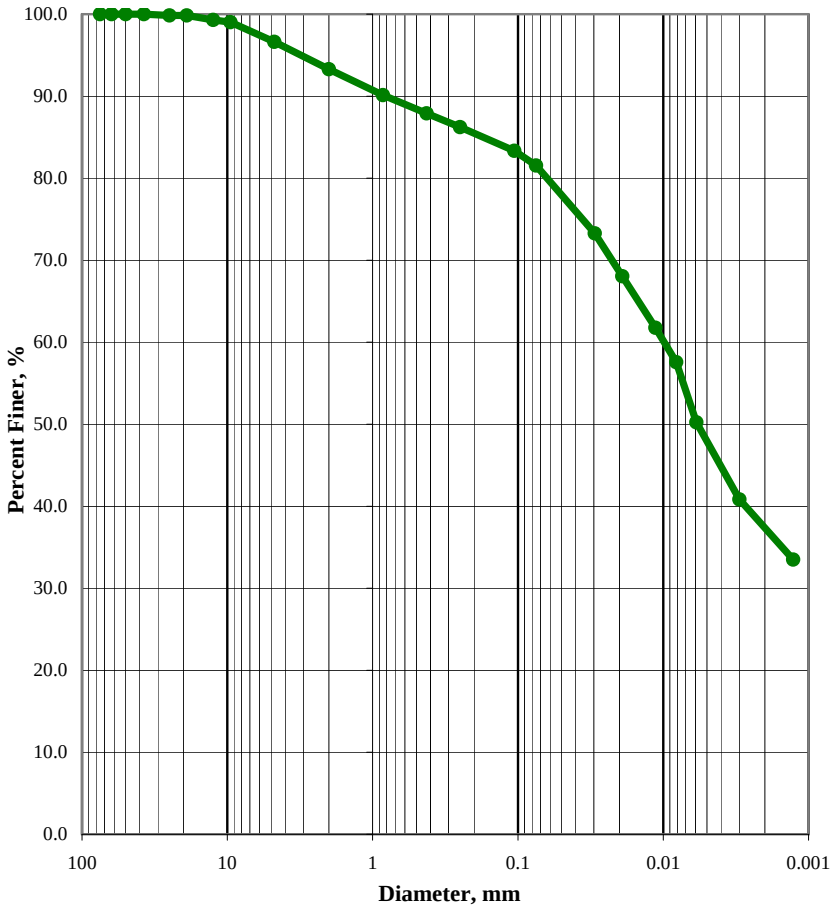
PARTICLE-SIZE ANALYSIS OF SOILS

Client	Civil & Environmental Consultants, I	Boring	SB-14
Client Project	091-867 Apex Landfill Expansion	Depth	16'-20'
Project No.	30598	Sample	B-1
		Lab Sample No.	30598025
USCS Description	**DARK GRAYISH BROWN LEAN CLAY WITH SAND**		
USCS Group Symbol	**CL**	AASHTO:	**A-7-6 (22)**
USDA Description	**SILTY CLAY**		



US Std. Sieve Size	Particle Diameter (mm)	Percent Finer (%)
3"	75	100.0
2 1/2"	62.5	100.0
2"	50	100.0
1 1/2"	37.5	100.0
1"	25	99.8
3/4"	19	99.8
1/2"	12.5	99.3
3/8"	9.5	99.0
#4	4.75	96.6
#10	2	93.3
#20	0.85	90.1
#40	0.425	87.9
#60	0.25	86.2
#140	0.106	83.3
#200	0.075	81.5
NA	0.0296	73.3
NA	0.0191	68.0
NA	0.0113	61.8
NA	0.0081	57.6
NA	0.0059	50.2
NA	0.0030	40.8
NA	0.0013	33.5

USCS SOIL CLASSIFICATION

Corrected For 100% Passing a 3" Sieve

% Gravel (-3" & +#4)	**3.4**	Silt=33.5% Clay=47.9%	
Coarse=0.2; Fine=3.2		D60, mm	NA
% Sand (-#4 & +#200)	**15.1**	D30, mm	NA
Coa.=3.3; Med.=5.4; Fine=6.4		D10, mm	NA
% Fines (-#200)	**81.5**	Cc	NA
% Plus #200 (-3")	**18.5**	Cu	NA

USCS Description

LEAN CLAY WITH SAND

USCS Group Symbol	Atterberg Limits Group Symbol
CL	**CL, LL=46, PL=19, PI=27**

Auxiliary Information	Wt Ret, gm	% Retained	% Finer
12" Sieve - 300 mm	0	0.0	100.0
6" Sieve - 150 mm	0	0.0	100.0
3" Sieve - 75 mm	0	0.0	100.0

USDA CLASSIFICATION

Particle Size (mm)	Percent Finer (%)
100	100
2	93.3
0.05	77.9
0.002	37.4

Percent of Each Component (Material)	(%)	Corrected Percent of -2.0 mm Material for USDA
Gravel	6.7	0
Sand	15.4	16.5
Silt	40.6	43.5
Clay	37.4	40.1

USDA Classification

SILTY CLAY

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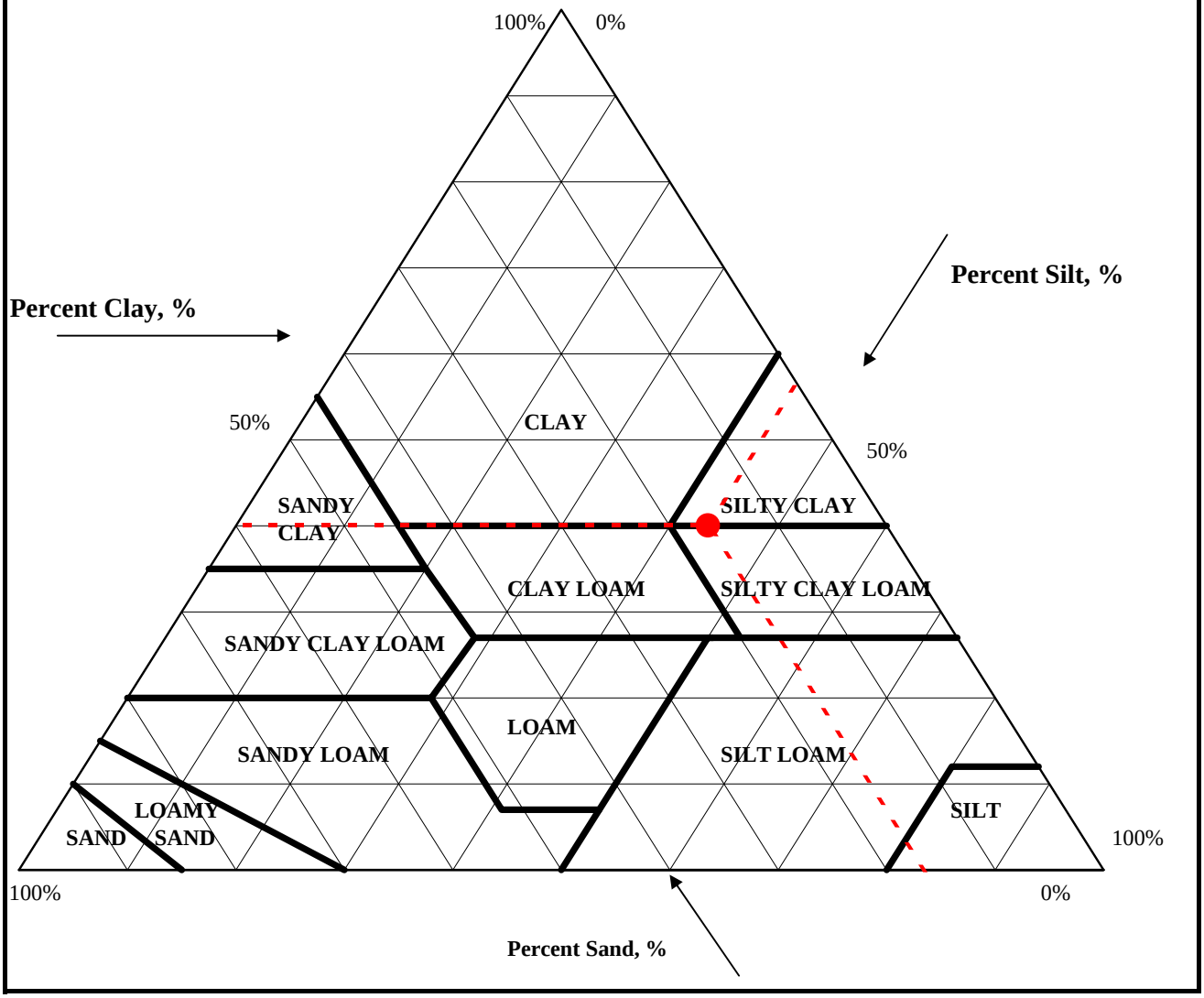
USDA CLASSIFICATION CHART

Client	Civil & Environmental Consultants, I	Boring	SB-14
Client Project	091-867 Apex Landfill Expansion	Depth	16'-20'
Project No.	30598	Sample	B-1
		Lab Sample No.	30598025
USCS Description	**DARK GRAYISH BROWN LEAN CLAY WITH SAND**		
USCS Group Symbol	**CL**	AASHTO Classification	**A-7-6 (22)**
USDA Description	**SILTY CLAY**		

Corrected for 0% gravel	
Percent Gravel, %	0.0
Percent Sand, %	16.5
Percent Silt, %	43.5
Percent Clay, %	40.1

Sand Subsizes Corrected Percentages	
Very Coarse Sand; 2-1	2.7
Coarse Sand; 1-0.5	2.5
Medium Sand; 0.5-0.25	2.4
Fine Sand; 0.25-0.1	3.4
Very Fine Sand; 0.1-0.05	5.5
Total	**16.5**



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PARTICLE-SIZE ANALYSIS OF SOILS
ASTM D 422

Client	Civil & Environmental Consultants, I	Boring	RB-3
Client Project	091-867 Apex Landfill Expansion	Depth	20'-24'
Project No.	30598	Sample	B-1
		Lab Sample No.	30598026
USCS Description	**DARK GRAY SANDY LEAN CLAY**		
USCS Group Symbol	**CL**	AASHTO:	**A-6 (13)**
USDA Description	**CLAY LOAM**		

MECHANICAL SIEVE ANALYSIS

As-Received Sample	
Correction For Split Samples (J-Factor)	
+3/4" Air Dry Wt, gm	109.2
-3/4 Wet Wt., gm	14370.8
-3/4 Dry Wt., gm	12728.1
Total Sample Dry Wt, gm	12837.3
Passing -3/4" (J-Factor)	0.99
Split Sample, -3/4"	
Tare No.	802
Wt. Tare + WS., gm	1139
Wt. Tare + DS., gm	1020.5
Wt. Tare, gm	102.3
Wt. of DS., gm	918.2
Water Content, %	12.9
Wt. of +#200 Sample, gm	288.4
Wt. of -#200 Sample, gm	629.8

US Std. Sieve Size	Sieve Opening (mm)	Wt. of Soil Retained (gm)	Percent Retained (%)	Cumulative Percent Retained	Percent Finer (%)	Final Percent Finer
3"	75	0	0.0	0.0	100.0	100.0
2 1/2"	62.5	0	0.0	0.0	100.0	100.0
2"	50	0	0.0	0.0	100.0	100.0
1 1/2"	37.5	0	0.0	0.0	100.0	100.0
1"	25	0	0.0	0.0	100.0	100.0
3/4"	19	109.2	0.9	0.9	99.1	99.1
1/2"	12.5	5.97	0.7	0.7	99.3	98.5
3/8"	9.5	4.55	0.5	1.1	98.9	98.0
#4	4.75	25.04	2.7	3.9	96.1	95.3
#10	2	50.3	5.5	9.4	90.6	89.9
#20	0.85	55.86	6.1	15.4	84.6	83.8
#40	0.425	37.01	4.0	19.5	80.5	79.8
#60	0.25	25.21	2.7	22.2	77.8	77.1
#140	0.106	51.38	5.6	27.8	72.2	71.6
#200	0.075	33.09	3.6	31.4	68.6	68.0
Pan	-	629.8	68.6	100.0	-	-

The final percent finer combines the gradation of the plus 3/4" and minus 3/4" material.

HYDROMETER ANALYSIS

Hydrometer Sample Weight	
Tare No.	303
Wt. Tare + DS., gm	146.09
Wt. Tare, gm	100.31
Wt. Dispers., gm	5
Wt. Dry Soil, gm	40.78
-#10 Dispersed 1min in Hamilton Beach Mixer	
K Factor	0.0137
Composite Correction	7.5
a Factor	0.99
Average Test Temp, °C	18.4
Specific Gravity, Assumed	2.7

Elapsed Time (min.)	R Measured	Composite Correction	R Corrected	Percent Finer (%)	Particle Diameter (mm)	Adjusted % Finer (%)
0	NA	NA	NA	NA	NA	NA
2	43	7.5	35.5	86.1	0.0294	58.5
5	40.5	7.5	33	80.0	0.0190	54.4
15	37	7.5	29.5	71.5	0.0113	48.6
30	35.5	7.5	28	67.9	0.0081	46.2
60	32	7.5	24.5	59.4	0.0059	40.4
250	26	7.5	18.5	44.9	0.0030	30.5
1440	22.5	7.5	15	36.4	0.0013	24.7

The adjusted percent finer is corrected for the percent passing the -#200 sieve.

USCS SOIL CLASSIFICATION

Corrected For 100% Passing a 3" Sieve

% Gravel (-3" & +#4)	**4.7**	Silt=29.9% Clay=38%	
Coarse=0.9; Fine=3.8		D60, mm	NA
% Sand (-#4 & +#200)	**27.3**	D30, mm	NA
Coa.=5.4; Med.=10; Fine=11.8		D10, mm	NA
% Fines (-#200)	**68.0**	Cc	NA
% Plus #200 (-3")	**32.0**	Cu	NA

USCS Description

SANDY LEAN CLAY

USCS Group Symbol	Atterberg Limits Group Symbol
CL	**CL, LL=37, PL=14, PI=23**

Auxiliary Information	Wt Ret, gm	% Retained	% Finer
12" Sieve - 300 mm	0	0.0	100.0
6" Sieve - 150 mm	0	0.0	100.0
3" Sieve - 75 mm	0	0.0	100.0

USDA CLASSIFICATION

Particle Size (mm)	Percent Finer (%)	Percent of Each Component (Material)	(%)	Corrected Percent of -2.0 mm Material for USDA
100	100			
		Gravel	10.1	0
2	89.9			
		Sand	26.0	28.9
0.05	63.9			
		Silt	36.2	40.2
0.002	27.7			
		Clay	27.7	30.9

USDA Classification

CLAY LOAM

Input Validation: Reviewed By: Date Tested: 12/1/2010

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LIQUID LIMIT, PLASTIC LIMIT, AND PLASTICITY INDEX OF SOILS
ASTM D 4318

Client	Civil & Environmental Consultants, I	Boring No.	RB-3
Client Project	091-867 Apex Landfill Expansion	Depth(ft)	20'-24'
Project No.	30598	Sample No.	B-1
		Lab Sample No.	30598026

Soil Description: DARK GRAY LEAN CLAY
(-#40 Fraction)

AS-RECEIVED W.C.

Tare Number	802
Wt. Tare & WS, gm	1139.00
Wt. Tare & DS, gm	1020.50
Wt. Water, gm	118.50
Wt. Tare, gm	102.30
Wt. DS, gm	918.20
Water Content, %	12.9

SAMPLE SUMMARY

Liquid Limit (LL), %	37
Plastic Limit (PL), %	14
Plasticity Index (PI)	23
USCS Symbol (-#40 Fraction)	CL
Sample Preparation:	Wet Method
Liquidity Index, %	-4.8%
Clay Fraction (% 2 microns)	NA
Skempton's Activity (A)	NA

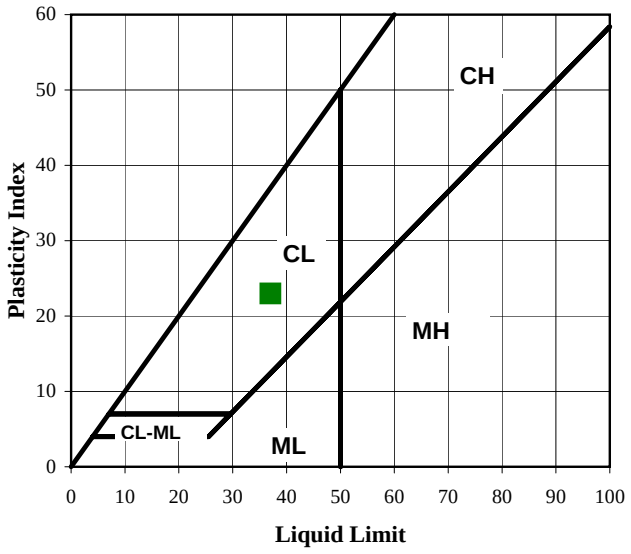
PLASTIC LIMIT

Test Number	1	2	3
Tare Number	510	430	419
Wt. Tare & WS, gm	19.40	19.74	16.91
Wt. Tare & DS, gm	18.32	18.67	16.12
Wt. Water, gm	1.08	1.07	0.79
Wt. Tare, gm	10.81	10.76	10.72
Wt. DS, gm	7.51	7.91	5.40
Water Content, %	14.4	13.5	14.6

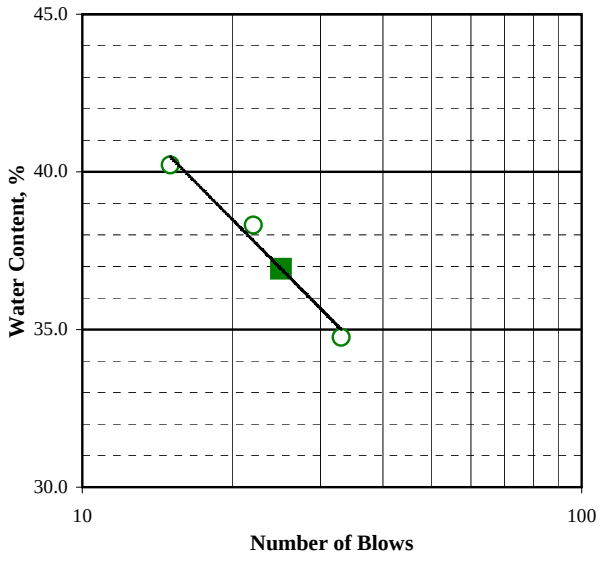
LIQUID LIMIT

	1	2	3
Tare Number	402	441	486
Wt. Tare & WS, gm	18.44	17.87	19.00
Wt. Tare & DS, gm	16.24	15.87	16.88
Wt. Water, gm	2.20	2.00	2.12
Wt. Tare, gm	10.77	10.65	10.78
Wt. DS, gm	5.47	5.22	6.10
Water Content, %	40.2	38.3	34.8
# of Blows	15	22	33

PLASTICITY CHART



FLOW CURVE



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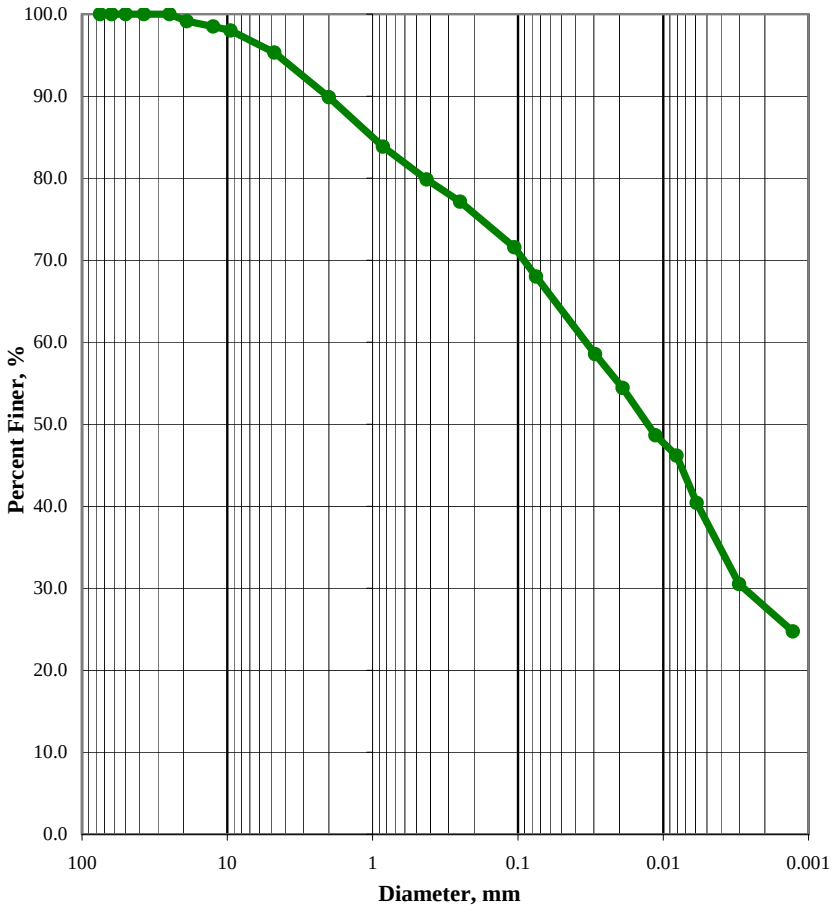
PARTICLE-SIZE ANALYSIS OF SOILS

Client	Civil & Environmental Consultants, I	Boring	RB-3
Client Project	091-867 Apex Landfill Expansion	Depth	20'-24'
Project No.	30598	Sample	B-1
		Lab Sample No.	30598026

USCS Description **DARK GRAY SANDY LEAN CLAY**
USCS Group Symbol **CL** AASHTO: **A-6 (13)**
USDA Description **CLAY LOAM**



US Std. Sieve Size	Particle Diameter (mm)	Percent Finer (%)
3"	75	100.0
2 1/2"	62.5	100.0
2"	50	100.0
1 1/2"	37.5	100.0
1"	25	100.0
3/4"	19	99.1
1/2"	12.5	98.5
3/8"	9.5	98.0
#4	4.75	95.3
#10	2	89.9
#20	0.85	83.8
#40	0.425	79.8
#60	0.25	77.1
#140	0.106	71.6
#200	0.075	68.0
NA	0.0294	58.5
NA	0.0190	54.4
NA	0.0113	48.6
NA	0.0081	46.2
NA	0.0059	40.4
NA	0.0030	30.5
NA	0.0013	24.7

USCS SOIL CLASSIFICATION

Corrected For 100% Passing a 3" Sieve

% Gravel (-3" & +#4)	**4.7**	Silt=29.9% Clay=38%	
Coarse=0.9; Fine=3.8		D60, mm	NA
% Sand (-#4 & +#200)	**27.3**	D30, mm	NA
Coa.=5.4; Med.=10; Fine=11.8		D10, mm	NA
% Fines (-#200)	**68.0**	Cc	NA
% Plus #200 (-3")	**32.0**	Cu	NA

USCS Description
SANDY LEAN CLAY

USCS Group Symbol	Atterberg Limits Group Symbol		
CL	**CL, LL=37, PL=14, PI=23**		
Auxiliary Information	Wt Ret, gm	% Retained	% Finer
12" Sieve - 300 mm	0	0.0	100.0
6" Sieve - 150 mm	0	0.0	100.0
3" Sieve - 75 mm	0	0.0	100.0

USDA CLASSIFICATION

Particle Size (mm)	Percent Finer (%)	Percent of Each Component (Material)	(%)	Corrected Percent of -2.0 mm Material for USDA
100	100			
		Gravel	10.1	0
2	89.9			
		Sand	26.0	28.9
0.05	63.9			
		Silt	36.2	40.2
0.002	27.7			
		Clay	27.7	30.9

USDA Classification
CLAY LOAM

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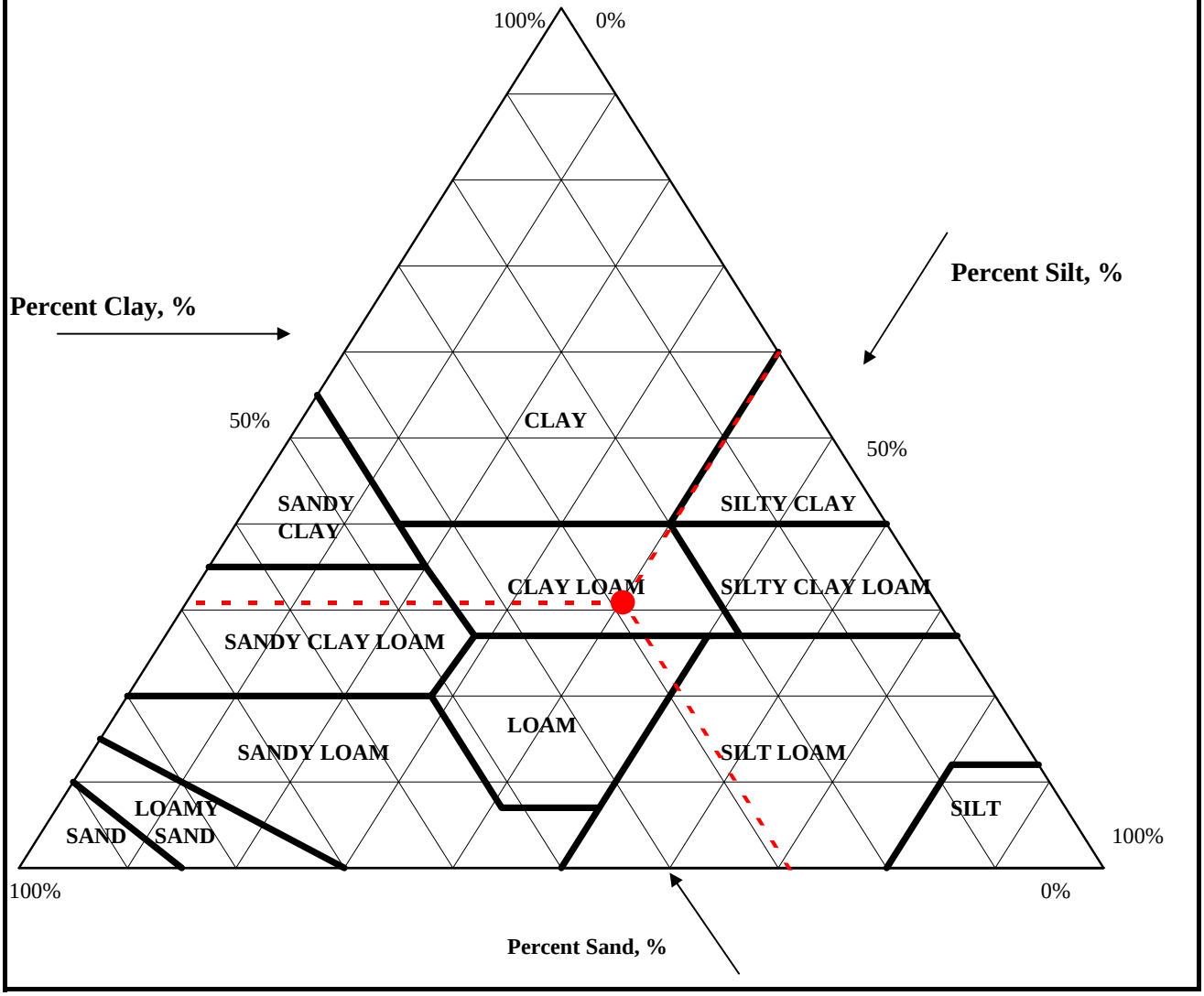
USDA CLASSIFICATION CHART

Client	Civil & Environmental Consultants, I	Boring	RB-3
Client Project	091-867 Apex Landfill Expansion	Depth	20'-24'
Project No.	30598	Sample	B-1
		Lab Sample No.	30598026
USCS Description	**DARK GRAY SANDY LEAN CLAY**		
USCS Group Symbol	**CL**	AASHTO Classification	**A-6 (13)**
USDA Description	**CLAY LOAM**		

Corrected for 0% gravel	
Percent Gravel, %	0.0
Percent Sand, %	28.9
Percent Silt, %	40.2
Percent Clay, %	30.9

Sand Subsizes Corrected Percentages	
Very Coarse Sand; 2-1	5.4
Coarse Sand; 1-0.5	4.7
Medium Sand; 0.5-0.25	4.1
Fine Sand; 0.25-0.1	6.8
Very Fine Sand; 0.1-0.05	7.9
Total	**28.9**



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PARTICLE-SIZE ANALYSIS OF SOILS
ASTM D 422

Client	Civil & Environmental Consultants, I	Boring	RB-4
Client Project	091-867 Apex Landfill Expansion	Depth	19'-24'
Project No.	30598	Sample	B-1
		Lab Sample No.	30598027

USCS Description **OLIVE BROWN LEAN CLAY WITH SAND**
USCS Group Symbol **CL** AASHTO: **A-7-6 (20)**
USDA Description **CLAY**

MECHANICAL SIEVE ANALYSIS

As-Received Sample	
Correction For Split Samples (J-Factor)	
+3/4" Air Dry Wt, gm	27.0
-3/4 Wet Wt., gm	14173.0
-3/4 Dry Wt., gm	11123.3
Total Sample Dry Wt, gm	11150.3
Passing -3/4" (J-Factor)	1.00
Split Sample, -3/4"	
Tare No.	806
Wt. Tare + WS., gm	1120.2
Wt. Tare + DS., gm	901.3
Wt. Tare, gm	102.9
Wt. of DS., gm	798.4
Water Content, %	27.4
Wt. of +#200 Sample, gm	163.9
Wt. of -#200 Sample, gm	634.5

US Std. Sieve Size	Sieve Opening (mm)	Wt. of Soil Retained (gm)	Percent Retained (%)	Cumulative Percent Retained	Percent Finer (%)	Final Percent Finer
3"	75	0	0.0	0.0	100.0	100.0
2 1/2"	62.5	0	0.0	0.0	100.0	100.0
2"	50	0	0.0	0.0	100.0	100.0
1 1/2"	37.5	0	0.0	0.0	100.0	100.0
1"	25	10.99	0.1	0.1	99.9	99.9
3/4"	19	16	0.1	0.2	99.8	99.8
1/2"	12.5	2.54	0.3	0.3	99.7	99.4
3/8"	9.5	3.66	0.5	0.8	99.2	99.0
#4	4.75	17.42	2.2	3.0	97.0	96.8
#10	2	24.76	3.1	6.1	93.9	93.7
#20	0.85	31.54	4.0	10.0	90.0	89.8
#40	0.425	25.04	3.1	13.1	86.9	86.6
#60	0.25	17.17	2.2	15.3	84.7	84.5
#140	0.106	28.18	3.5	18.8	81.2	81.0
#200	0.075	13.55	1.7	20.5	79.5	79.3
Pan	-	634.5	79.5	100.0	-	-

The final percent finer combines the gradation of the plus 3/4" and minus 3/4" material.

HYDROMETER ANALYSIS

Hydrometer Sample Weight	
Tare No.	834
Wt. Tare + DS., gm	141.7
Wt. Tare, gm	104.52
Wt. Dispers., gm	5
Wt. Dry Soil, gm	32.18
-#10 Dispersed 1min in Hamilton Beach Mixer	
K Factor	0.0138
Composite Correction	7.5
a Factor	0.99
Average Test Temp, °C	18.4
Specific Gravity, Assumed	2.7

Elapsed Time (min.)	R Measured	Composite Correction	R Corrected	Percent Finer (%)	Particle Diameter (mm)	Adjusted % Finer (%)
0	NA	NA	NA	NA	NA	NA
2	36.5	7.5	29	89.1	0.0311	70.7
5	35	7.5	27.5	84.5	0.0199	67.0
15	33	7.5	25.5	78.4	0.0117	62.1
30	31.5	7.5	24	73.8	0.0084	58.5
60	29	7.5	21.5	66.1	0.0060	52.4
250	24.5	7.5	17	52.2	0.0030	41.4
1440	21.5	7.5	14	43.0	0.0013	34.1

The adjusted percent finer is corrected for the percent passing the -#200 sieve.

USCS SOIL CLASSIFICATION

Corrected For 100% Passing a 3" Sieve

% Gravel (-3" & +#4)	**3.2**	Silt=29.7%	Clay=49.4%
Coarse=0.2; Fine=3		D60, mm	NA
% Sand (-#4 & +#200)	**17.5**	D30, mm	NA
Coa.=3.1; Med.=7.1; Fine=7.4		D10, mm	NA
% Fines (-#200)	**79.3**	Cc	NA
% Plus #200 (-3")	**20.7**	Cu	NA

USCS Description
LEAN CLAY WITH SAND

USCS Group Symbol	Atterberg Limits Group Symbol
CL	**CL, LL=45, PL=19, PI=26**

Auxiliary Information	Wt Ret, gm	% Retained	% Finer
12" Sieve - 300 mm	0	0.0	100.0
6" Sieve - 150 mm	0	0.0	100.0
3" Sieve - 75 mm	0	0.0	100.0

USDA CLASSIFICATION

Particle Size (mm)	Percent Finer (%)	Percent of Each Component (Material)	(%)	Corrected Percent of -2.0 mm Material for USDA
100	100			
		Gravel	6.3	0
2	93.7			
		Sand	18.4	19.6
0.05	75.3			
		Silt	37.5	40.0
0.002	37.8			
		Clay	37.8	40.4

USDA Classification
CLAY

Input Validation: Reviewed By: Date Tested: 12/1/2010

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LIQUID LIMIT, PLASTIC LIMIT, AND PLASTICITY INDEX OF SOILS
ASTM D 4318

Client	Civil & Environmental Consultants, I	Boring No.	RB-4
Client Project	091-867 Apex Landfill Expansion	Depth(ft)	19'-24'
Project No.	30598	Sample No.	B-1
		Lab Sample No.	30598027

Soil Description: OLIVE BROWN LEAN CLAY
(-#40 Fraction)

AS-RECEIVED W.C.

Tare Number	806
Wt. Tare & WS, gm	1120.20
Wt. Tare & DS, gm	901.30
Wt. Water, gm	218.90
Wt. Tare, gm	102.90
Wt. DS, gm	798.40
Water Content, %	27.4

SAMPLE SUMMARY

Liquid Limit (LL), %	45
Plastic Limit (PL), %	19
Plasticity Index (PI)	26
USCS Symbol (-#40 Fraction)	CL
Sample Preparation:	Wet Method
Liquidity Index, %	32.4%
Clay Fraction (% 2 microns)	NA
Skempton's Activity (A)	NA

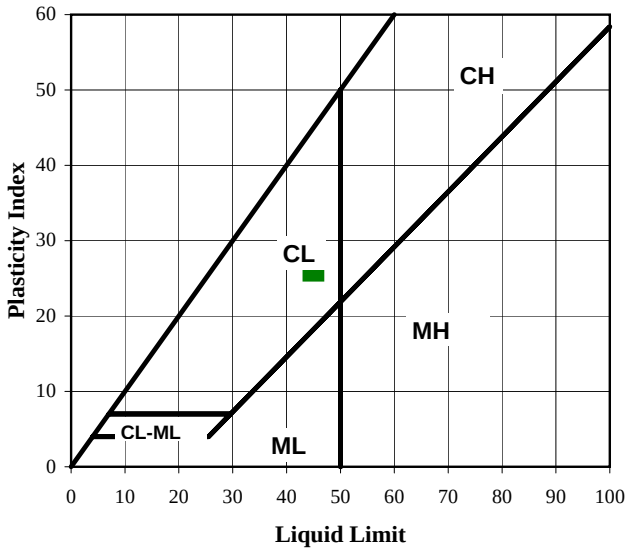
PLASTIC LIMIT

Test Number	1	2	3
Tare Number	463	506	510
Wt. Tare & WS, gm	17.90	17.58	17.12
Wt. Tare & DS, gm	16.72	16.49	16.14
Wt. Water, gm	1.18	1.09	0.98
Wt. Tare, gm	10.77	10.78	10.82
Wt. DS, gm	5.95	5.71	5.32
Water Content, %	19.8	19.1	18.4

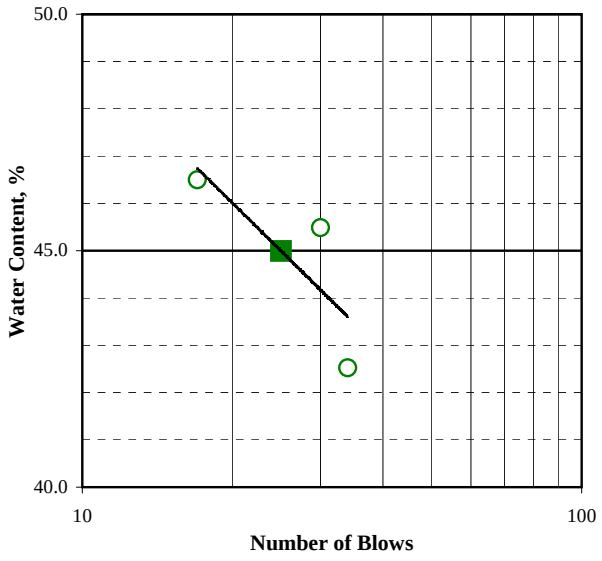
LIQUID LIMIT

	1	2	3
Tare Number	447	453	503
Wt. Tare & WS, gm	18.92	19.17	19.76
Wt. Tare & DS, gm	16.33	16.55	17.03
Wt. Water, gm	2.59	2.62	2.73
Wt. Tare, gm	10.76	10.79	10.61
Wt. DS, gm	5.57	5.76	6.42
Water Content, %	46.5	45.5	42.5
# of Blows	17	30	34

PLASTICITY CHART



FLOW CURVE



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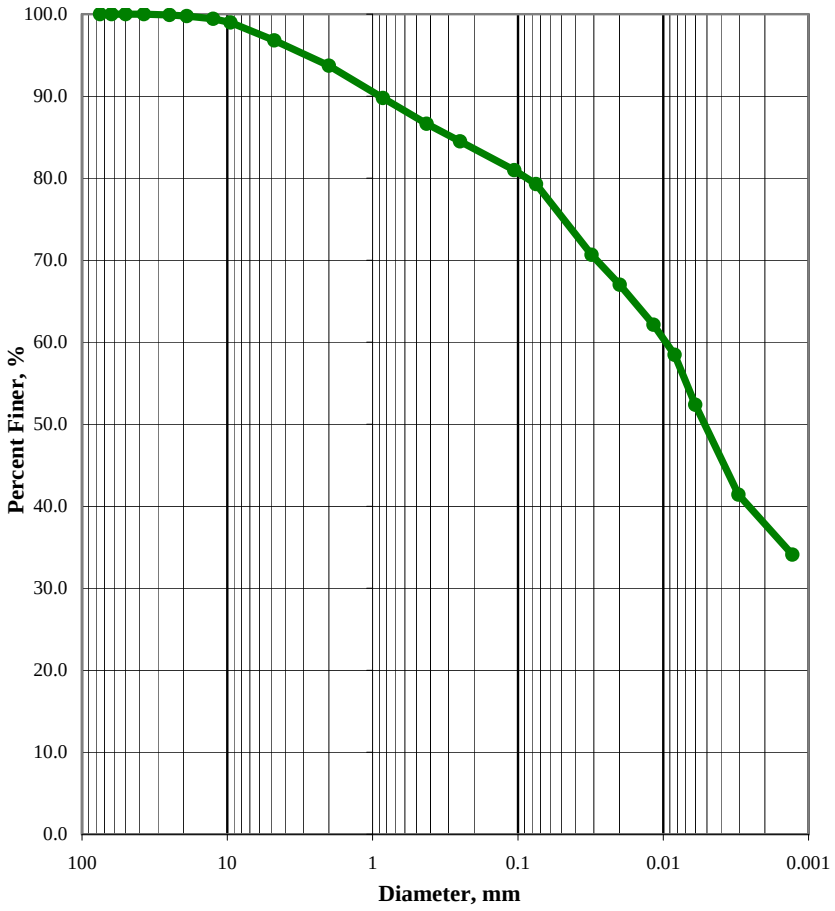
PARTICLE-SIZE ANALYSIS OF SOILS

Client	Civil & Environmental Consultants, I	Boring	RB-4
Client Project	091-867 Apex Landfill Expansion	Depth	19'-24'
Project No.	30598	Sample	B-1
		Lab Sample No.	30598027

USCS Description **OLIVE BROWN LEAN CLAY WITH SAND**
USCS Group Symbol **CL** AASHTO: **A-7-6 (20)**
USDA Description **CLAY**



US Std. Sieve Size	Particle Diameter (mm)	Percent Finer (%)
3"	75	100.0
2 1/2"	62.5	100.0
2"	50	100.0
1 1/2"	37.5	100.0
1"	25	99.9
3/4"	19	99.8
1/2"	12.5	99.4
3/8"	9.5	99.0
#4	4.75	96.8
#10	2	93.7
#20	0.85	89.8
#40	0.425	86.6
#60	0.25	84.5
#140	0.106	81.0
#200	0.075	79.3
NA	0.0311	70.7
NA	0.0199	67.0
NA	0.0117	62.1
NA	0.0084	58.5
NA	0.0060	52.4
NA	0.0030	41.4
NA	0.0013	34.1

USCS SOIL CLASSIFICATION

Corrected For 100% Passing a 3" Sieve

% Gravel (-3" & +#4)	**3.2**	Silt=29.7% Clay=49.4%	
Coarse=0.2; Fine=3		D60, mm	NA
% Sand (-#4 & +#200)	**17.5**	D30, mm	NA
Coa.=3.1; Med.=7.1; Fine=7.4		D10, mm	NA
% Fines (-#200)	**79.3**	Cc	NA
% Plus #200 (-3")	**20.7**	Cu	NA

USCS Description
LEAN CLAY WITH SAND

USCS Group Symbol	Atterberg Limits Group Symbol		
CL	**CL, LL=45, PL=19, PI=26**		
Auxiliary Information	Wt Ret, gm	% Retained	% Finer
12" Sieve - 300 mm	0	0.0	100.0
6" Sieve - 150 mm	0	0.0	100.0
3" Sieve - 75 mm	0	0.0	100.0

USDA CLASSIFICATION

Particle Size (mm)	Percent Finer (%)
100	100
2	93.7
0.05	75.3
0.002	37.8

Percent of Each Component (Material)	(%)	Corrected Percent of -2.0 mm Material for USDA
Gravel	6.3	0
Sand	18.4	19.6
Silt	37.5	40.0
Clay	37.8	40.4

USDA Classification
CLAY

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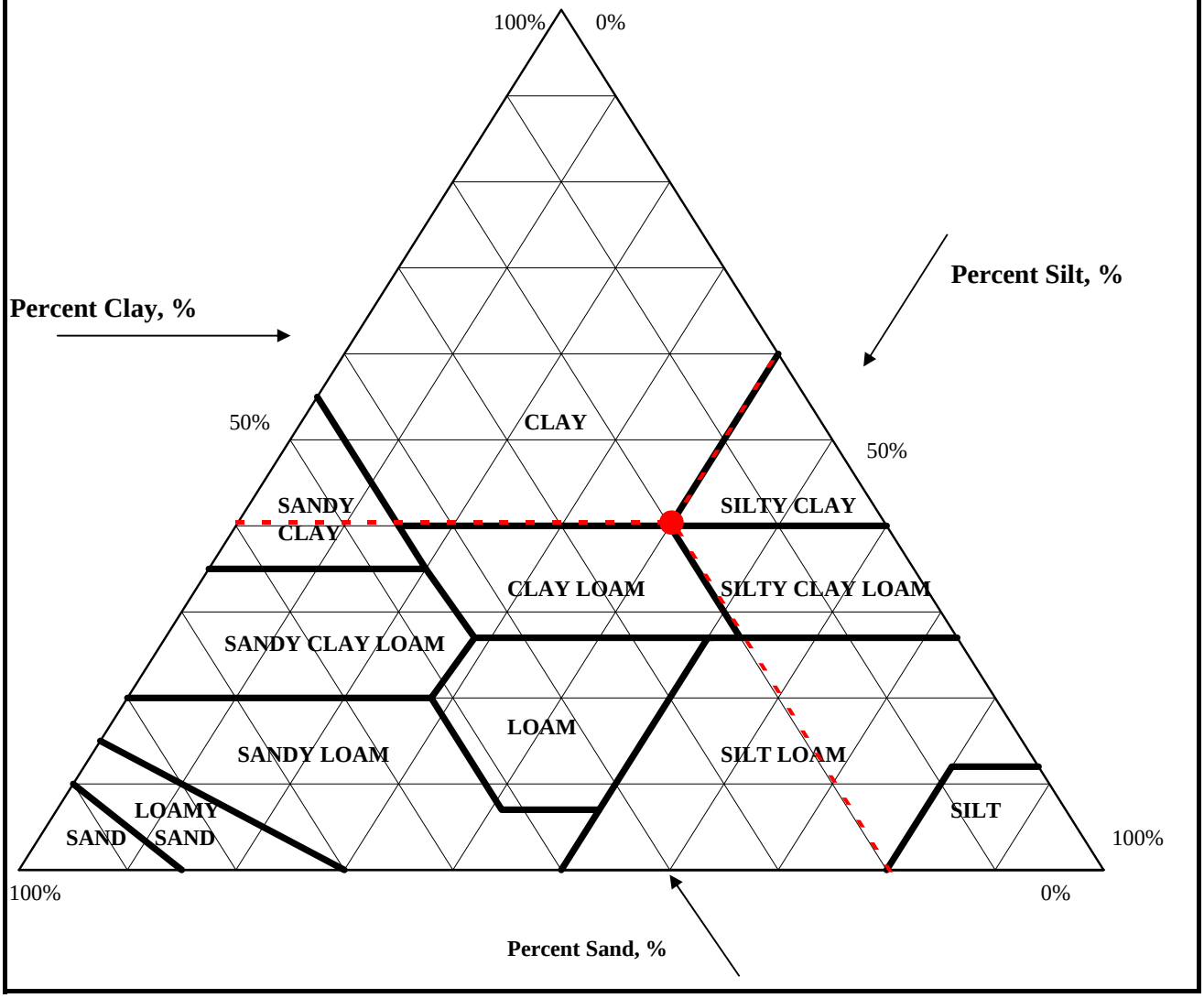
USDA CLASSIFICATION CHART

Client	Civil & Environmental Consultants, I	Boring	RB-4
Client Project	091-867 Apex Landfill Expansion	Depth	19'-24'
Project No.	30598	Sample	B-1
		Lab Sample No.	30598027
USCS Description	**OLIVE BROWN LEAN CLAY WITH SAND**		
USCS Group Symbol	**CL**	AASHTO Classification	**A-7-6 (20)**
USDA Description	**CLAY**		

Corrected for 0% gravel	
Percent Gravel, %	0.0
Percent Sand, %	19.6
Percent Silt, %	40.0
Percent Clay, %	40.4

Sand Subsizes Corrected Percentages	
Very Coarse Sand; 2-1	3.4
Coarse Sand; 1-0.5	3.4
Medium Sand; 0.5-0.25	3.1
Fine Sand; 0.25-0.1	4.1
Very Fine Sand; 0.1-0.05	5.7
Total	**19.6**



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LABORATORY DETERMINATION OF WATER (MOISTURE) CONTENT OF SOIL AND ROCK

ASTM D 2216-05

Client: Civil & Environmental Consultants, Inc.
Client Project: 091-867 Apex Landfill Expansion
Project No.: 30598

Lab Sample No.	Boring	Depth	Sample	Tare Number	Tare Weight + Wet Soil gm	Tare Weight + Dry Soil gm	Tare Weight gm	Water Content		~Maximum Particle Tested	Any + Sizes Omitted?	Could Minimum Mass be met	Method A or B
								Method B %	Method A %				
30598001	SB-3	11.5'-13.5'	ST-1	A10	76.94	70.55	9.53	10.5	10	-3/4	Yes	No	A
30598002	SB-14	25'-27'	ST-2 BOTTOM	Z2	144.79	136.26	123.14	65.0	65	-3/4	Yes	No	A
30598002(39	SB-14	25'-27'	ST-2 TOP	A45	94.14	70.66	9.06	38.1	38	-3/4	Yes	No	A
30598003	SB-20	16'-18', 17'-19'	ST-1, ST-2	A10	100.8	85.43	9.53	20.3	20	-3/4	No	No	A
30598004	SB-16	1'-3'	ST-1	A23	134.52	112.93	9.43	20.9	21	-3/4	No	No	A
30598005	TPE-17	12'-14'	ST-1	A17	183.36	160.83	9.54	14.9	15	-3/4	No	No	A
30598006	TPE-19	2'-4'	ST-1	Z12	233.45	219.41	123.25	14.6	15	-3/4	NA	No	A
30598007	SB-6	8'-9'	ST-1	917	217	208.07	99.57	8.2	8	-3/4	Yes	No	A
30598008	SB-16	0.5'-2.5'	ST-1	A45	91.82	76.93	9.06	21.9	22	-3/4	Yes	No	A
30598009	SB-17	16'-18'	ST-1	A23	78.88	69.11	9.42	16.4	16	-3/4	No	No	A
30598010	SB-18	10'-12'	ST-1	A12	121.92	104.87	9.53	17.9	18	-3/4	No	No	A
30598011	SB-21	9'-11'	ST-1	A42	125.9	112.18	9.49	13.4	13	-3/4	No	No	A
30598012	TPE-18	12'-14'	ST-1	Z13	241.96	220.12	122.82	22.4	22	-3/4	No	No	A
30598013	SB-4	28'-30'	ST-1	A34	260.56	239.59	9.91	9.1	9	-3/4	No	Yes	A
30598014	SB-6	9'-10'	ST-2	A12	257.57	235.97	9.53	9.5	10	-3/4	No	No	A
30598015	SB-8	2'-4'	ST-1	A37	246.62	215.08	9.67	15.4	15	-3/4	Yes	No	A
30598016	SB-14	10'-12'	ST-1	A45	193.31	160.57	9.07	21.6	22	-3/4	No	No	A
30598017	SB-17	18'-20'	ST-2	A10	233.21	212.65	9.56	10.1	10	-3/4	No	No	A
30598018	SB-18	22'-24'	ST-3	A18	262.22	228.43	9.46	15.4	15	-3/4	No	Yes	A
30598019	SB-19	11'-13'	ST-1	A23	247.18	214.13	9.42	16.1	16	-3/4	Yes	No	A
30598020	TPE-18	18'-19.7'	ST-2	A10	76.24	69.14	9.53	11.9	12	-3/4	Yes	No	A
30598021	TPE-21	2'-4'	ST-1	A7	218.78	181.38	9.45	21.8	22	-3/4	Yes	No	A

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Note: Both Methods A & B are presented for instances where additional significant digits are required for other calculations.

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LABORATORY DETERMINATION OF WATER (MOISTURE) CONTENT OF SOIL AND ROCK

ASTM D 2216-05

Client: Civil & Environmental Consultants, Inc.
Client Project: 091-867 Apex Landfill Expansion
Project No.: 30598

Lab Sample No.	Boring	Depth	Sample	Tare Number	Tare Weight + Wet Soil gm	Tare Weight + Dry Soil gm	Tare Weight gm	Water Content		~Maximum Particle Tested	Any + Sizes Omitted?	Could Minimum Mass be met	Method A or B
								Method B %	Method A %				
30598022	RB-1	14'-19'	B-1	505	1186.1	987	103.6	22.5	23	-3/8	NA	NA	NA
30598023	RB-8	23'-27'	B-1	713	1111.2	845.6	99.7	35.6	36	-#4	NA	NA	NA
30598024	SB-1	58'-66'	B-1	501	1237.9	1108.7	104.1	12.9	13	-#10	NA	NA	NA
30598025	SB-14	16'-20'	B-1	522	1116.5	914.5	103.6	24.9	25	NA	NA	NA	NA
30598026	RB-3	20'-24'	B-1	802	1139	1020.5	102.3	12.9	13	NA	NA	NA	NA
30598027	RB-4	19'-24'	B-1	806	1120.2	901.3	102.9	27.4	27	NA	NA	NA	NA
30598028	SB-1	26'-28'	SS-13	842	249.57	242.23	123.32	6.2	6	NA	NA	NA	NA
30598029	SB-2	22'-24'	SS-12	839	193.65	185.77	123.44	12.6	13	NA	NA	NA	NA
30598030	SB-5	6'-8'	SS-4	800	204.42	195.51	123.25	12.3	12	NA	NA	NA	NA
30598031	SB-6	30'-32'	SS-15	902	213.01	201.49	123.38	14.7	15	NA	NA	NA	NA
30598032	SB-8	6'-8'	SS-3	906	223.06	213.53	123.45	10.6	11	NA	NA	NA	NA
30598033	SB-9	0'-2'	SS-1	222	218.62	206.38	123	14.7	15	NA	NA	NA	NA
30598034	SB-11	14'-16'	SS-8	520	197.48	188.71	123.28	13.4	13	NA	NA	NA	NA
30598035	SB-12	16-'18'	SS-9	G4	203.06	187.94	123.82	23.6	24	NA	NA	NA	NA
30598036	SB-15	4'-6'	SS-3	F5	230.93	218.01	123.15	13.6	14	NA	NA	NA	NA
30598037	SB-17	6'-8'	SS-4	C2	208.28	197.9	123.17	13.9	14	NA	NA	NA	NA
30598038	SB-18	28'-30'	SS-11	446	154.13	143.7	83.31	17.3	17	NA	NA	NA	NA

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Note: Both Methods A & B are presented for instances where additional significant digits are required for other calculations.

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LABORATORY COMPACTION CHARACTERISTICS OF SOIL USING STANDARD EFFORT - D698

Client	Civil & Environmental Consu	Boring	RB-1
Client Project	091-867 Apex Landfill Expar	Depth	14-19
Project No.	30598	Sample	B-1
		Lab Sample No.	30598022
Visual Description:	OLIVE BROWN LEAN CLAY WITH SAND		

WET DENSITY

Compaction Point #	1	2	3	4	5
Wt. Mold & WS, gm.	5993.2	6114	6181.6	6218.4	6200.6
Wt. Mold, gm.	4381	4381	4381	4381	4381
Wt. WS, gm.	1612.2	1733	1800.6	1837.4	1819.6
Mold Volume, cc	941.62	941.62	941.62	941.62	941.62
Wet Density, gm./cc	1.71	1.84	1.91	1.95	1.93
Wet Density, pcf	106.8	114.8	119.3	121.8	120.6

WATER CONTENT

Tare Number	23	946	523	709	718
Wt. Tare & WS, gm.	728.9	674.1	789.6	803.8	855.5
Wt. Tare & DS, gm.	672.2	605.5	695.5	691.4	714.7
Wt. Tare, gm.	103.4	98.6	104.1	97.6	99.2
Water Content, %	10.0	13.5	15.9	18.9	22.9

DRY DENSITY vs. WATER CONTENT

LABORATORY TEST VALUES

Water Content, %	10.0	13.5	15.9	18.9	22.9
Dry Density, pcf	97.2	101.2	102.9	102.4	98.1

TEST SUMMARY

Compaction Effort	Standard
Test Procedure	B
Mold Diameter, in	4
Compacted Layers	3
Blows Per Layer	25
Rammer Weight / Fall	5.5 lbs / 12 in.
Size of Material Used	-3/8" Sieve
Mold Volume, cc	941.62
Wt. of Mold, gm.	4381

OVERSIZE PARTICLE CORRECTION

Percent Retained on 3/4" Sieve, %	<5%
Percent Retained on 3/8" Sieve, %	NA
Percent Retained on #4 Sieve, %	NA

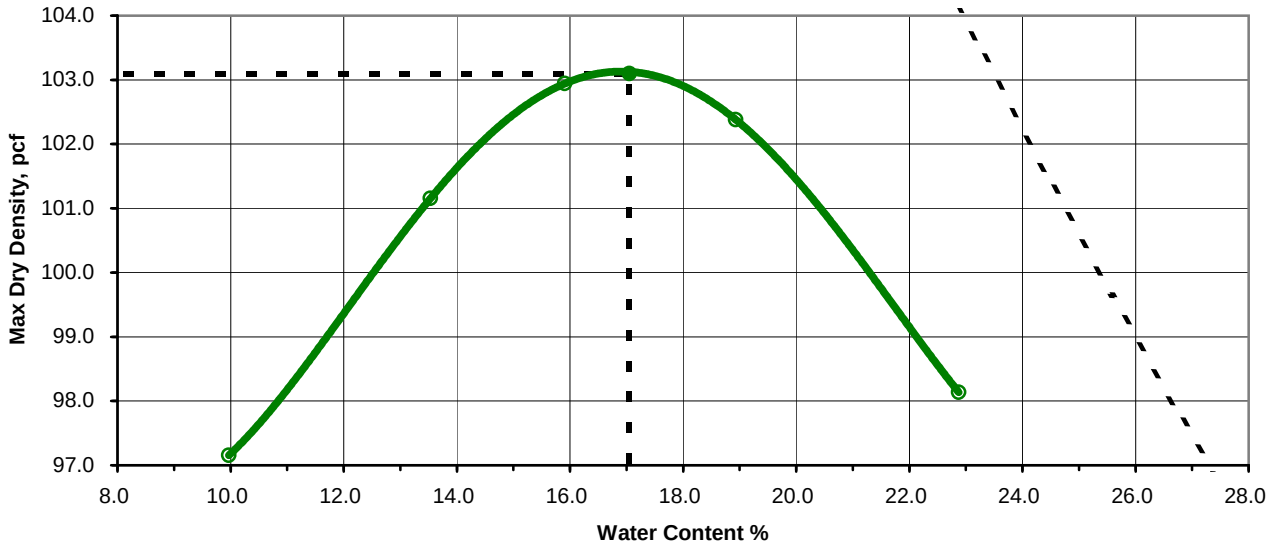
(Based on As Received Screening)

No Oversize Correction Needed

SAMPLE SUMMARY

As-Received Water Content, %	NA
Lab Optimum Water Content, %	***17.1***
Lab Maximum Dry Density, pcf	***103.1***

Note: Maximum Density and Optimum Water Content reported from estimated best fit smooth curve!



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LABORATORY COMPACTION CHARACTERISTICS OF SOIL USING STANDARD EFFORT - D698

Client	Civil & Environmental Consu	Boring	RB-8
Client Project	091-867 Apex Landfill Expar	Depth	23'-27'
Project No.	30598	Sample	B-1
		Lab Sample No.	30598023

Visual Description: DARK GRAY FAT CLAY

WET DENSITY

Compaction Point #	1	2	3	4
Wt. Mold & WS, gm.	5946.6	6032.2	6074	6070.4
Wt. Mold, gm.	4381	4381	4381	4381
Wt. WS, gm.	1565.6	1651.2	1693	1689.4
Mold Volume, cc	941.62	941.62	941.62	941.62
Wet Density, gm./cc	1.66	1.75	1.80	1.79
Wet Density, pcf	103.8	109.4	112.2	112.0

WATER CONTENT

Tare Number	828	830	31	519
Wt. Tare & WS, gm.	606.1	617.5	595.6	738.3
Wt. Tare & DS, gm.	542.03	542.9	511	627.9
Wt. Tare, gm.	102.9	103	84	103
Water Content, %	14.6	17.0	19.8	21.0

DRY DENSITY vs. WATER CONTENT

LABORATORY TEST VALUES

Water Content, %	14.6	17.0	19.8	21.0
Dry Density, pcf	90.5	93.6	93.6	92.5

TEST SUMMARY

Compaction Effort	Standard
Test Procedure	B
Mold Diameter, in	4
Compacted Layers	3
Blows Per Layer	25
Rammer Weight / Fall	5.5 lbs / 12 in.
Size of Material Used	-3/8" Sieve
Mold Volume, cc	941.62
Wt. of Mold, gm.	4381

OVERSIZE PARTICLE CORRECTION

Percent Retained on 3/4" Sieve, %	<5%
Percent Retained on 3/8" Sieve, %	NA
Percent Retained on #4 Sieve, %	NA

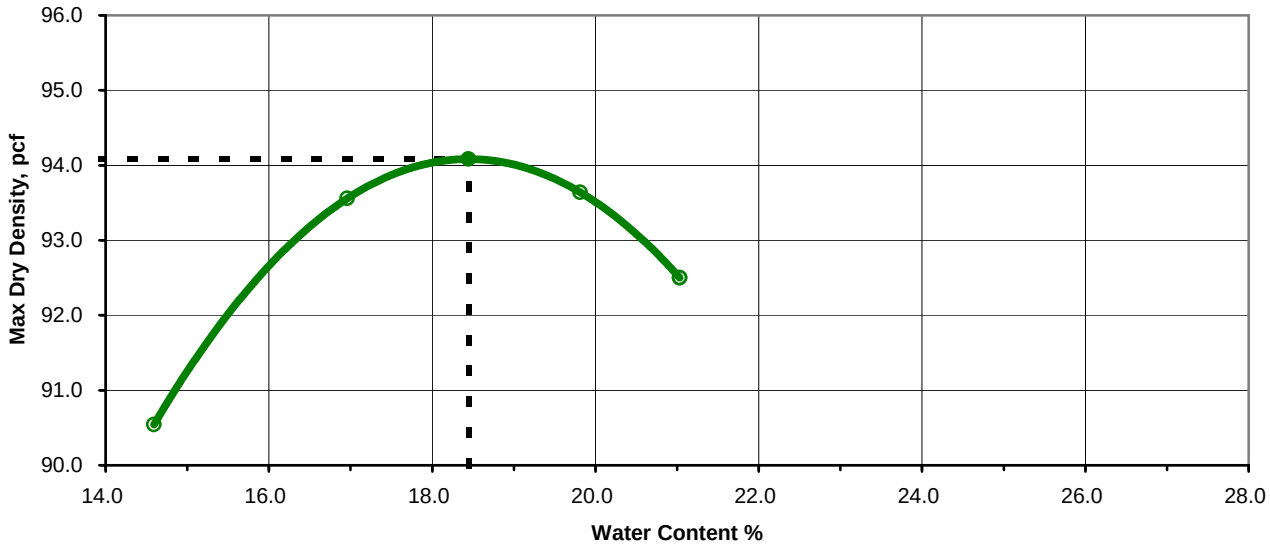
(Based on As Received Screening)

No Oversize Correction Needed

SAMPLE SUMMARY

As-Received Water Content, %	NA
Lab Optimum Water Content, %	***18.4***
Lab Maximum Dry Density, pcf	***94.1***

Note: Maximum Density and Optimum Water Content reported from estimated best fit smooth curve!



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LABORATORY COMPACTION CHARACTERISTICS OF SOIL USING STANDARD EFFORT - D698

Client	Civil & Environmental Consu	Boring	SB-1
Client Project	091-867 Apex Landfill Expar	Depth	58-66
Project No.	30598	Sample	B-1
		Lab Sample No.	30598024
Visual Description:	GRAYISH BROWN SANDY LEAN CLAY		

WET DENSITY

Compaction Point #	1	2	3	4
Wt. Mold & WS, gm.	10011.5	10122	10249	10131
Wt. Mold, gm.	5823.3	5823.3	5823.3	5823.3
Wt. WS, gm.	4188.2	4298.7	4425.7	4307.7
Mold Volume, cc	2121.4	2121.4	2121.4	2121.4
Wet Density, gm./cc	1.97	2.03	2.09	2.03
Wet Density, pcf	123.2	126.4	130.2	126.7

WATER CONTENT

Tare Number	709	516	43	814
Wt. Tare & WS, gm.	674.1	678.2	629	804.9
Wt. Tare & DS, gm.	621.6	615.5	555.9	694.8
Wt. Tare, gm.	97.1	104.9	82.9	101.8
Water Content, %	10.0	12.3	15.5	18.6

DRY DENSITY vs. WATER CONTENT

LABORATORY TEST VALUES

Water Content, %	10.0	12.3	15.5	18.6
Dry Density, pcf	112.0	112.6	112.8	106.9

TEST SUMMARY

Compaction Effort	Standard
Test Procedure	C
Mold Diameter, in	6
Compacted Layers	3
Blows Per Layer	56
Rammer Weight / Fall	5.5 lbs / 12 in.
Size of Material Used	-3/4" Sieve
Mold Volume, cc	2121.4
Wt. of Mold, gm.	5823.3

OVERSIZE PARTICLE CORRECTION

Percent Retained on 3/4" Sieve, %	<5%
Percent Retained on 3/8" Sieve, %	NA
Percent Retained on #4 Sieve, %	NA

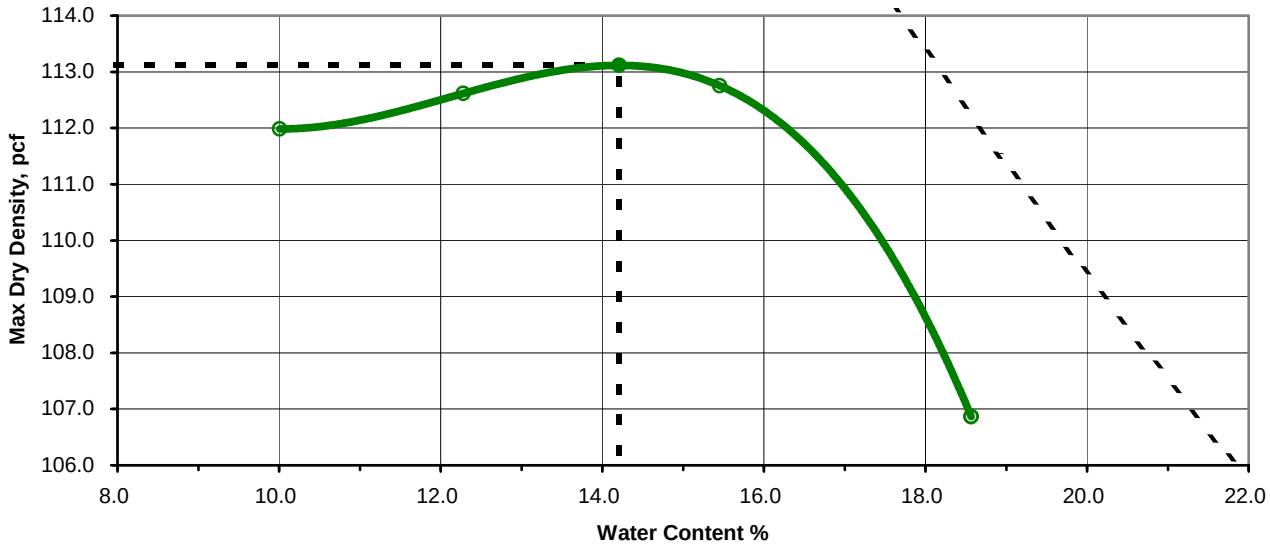
(Based on As Received Screening)

No Oversize Correction Needed

SAMPLE SUMMARY

As-Received Water Content, %	NA
Lab Optimum Water Content, %	***14.2***
Lab Maximum Dry Density, pcf	***113.1***

Note: Maximum Density and Optimum Water Content reported from estimated best fit smooth curve!



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LABORATORY COMPACTION CHARACTERISTICS OF SOIL USING STANDARD EFFORT - D698

Client	Civil & Environmental Consu	Boring	SB-14
Client Project	091-867 Apex Landfill Expar	Depth	16-20
Project No.	30598	Sample	B-1
		Lab Sample No.	30598025

Visual Description: DARK GRAYISH BROWN LEAN CLAY WITH SAND

WET DENSITY

Compaction Point #	1	2	3	4	
Wt. Mold & WS, gm.	6156.2	6192.8	6245.4	6240.4	
Wt. Mold, gm.	4381	4381	4381	4381	
Wt. WS, gm.	1775.2	1811.8	1864.4	1859.4	
Mold Volume, cc	941.62	941.62	941.62	941.62	
Wet Density, gm./cc	1.89	1.92	1.98	1.97	
Wet Density, pcf	117.6	120.1	123.6	123.2	

WATER CONTENT

Tare Number	814	21	21	11	
Wt. Tare & WS, gm.	752.4	738.7	730.1	826.4	
Wt. Tare & DS, gm.	657.4	637	618.7	689.4	
Wt. Tare, gm.	101.9	81.7	82.1	81.8	
Water Content, %	17.1	18.3	20.8	22.5	

DRY DENSITY vs. WATER CONTENT

LABORATORY TEST VALUES

Water Content, %	17.1	18.3	20.8	22.5	
Dry Density, pcf	100.5	101.5	102.3	100.5	

TEST SUMMARY

Compaction Effort	Standard
Test Procedure	B
Mold Diameter, in	4
Compacted Layers	3
Blows Per Layer	25
Rammer Weight / Fall	5.5 lbs / 12 in.
Size of Material Used	-3/8" Sieve
Mold Volume, cc	941.62
Wt. of Mold, gm.	4381

OVERSIZE PARTICLE CORRECTION

Percent Retained on 3/4" Sieve, %	<5%
Percent Retained on 3/8" Sieve, %	NA
Percent Retained on #4 Sieve, %	NA

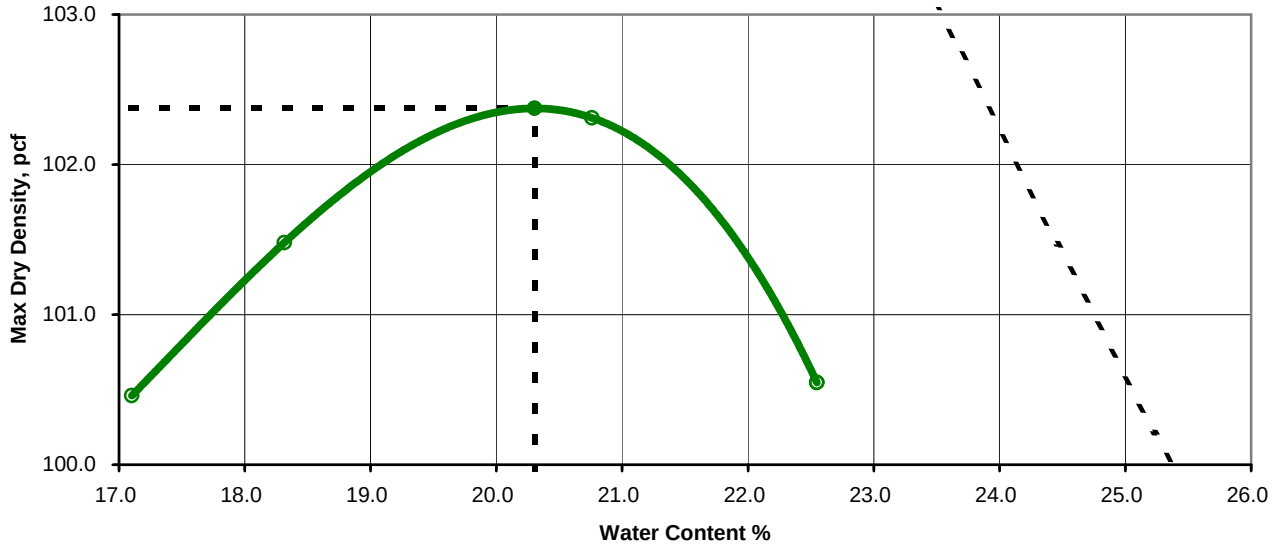
(Based on As Received Screening)

No Oversize Correction Needed

SAMPLE SUMMARY

As-Received Water Content, %	NA
Lab Optimum Water Content, %	***20.3***
Lab Maximum Dry Density, pcf	***102.4***

Note: Maximum Density and Optimum Water Content reported from estimated best fit smooth curve!



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LABORATORY COMPACTION CHARACTERISTICS OF SOIL USING STANDARD EFFORT - D698

Client	Civil & Environmental Consu	Boring	RB-3
Client Project	091-867 Apex Landfill Expar	Depth	20-24
Project No.	30598	Sample	B-1
		Lab Sample No.	30598026

Visual Description: DARK GRAY SANDY LEAN CLAY

WET DENSITY

Compaction Point #	1	2	3	4	
Wt. Mold & WS, gm.	6084	6224.8	6298.6	6273.6	
Wt. Mold, gm.	4381	4381	4381	4381	
Wt. WS, gm.	1703	1843.8	1917.6	1892.6	
Mold Volume, cc	941.62	941.62	941.62	941.62	
Wet Density, gm./cc	1.81	1.96	2.04	2.01	
Wet Density, pcf	112.9	122.2	127.1	125.4	

WATER CONTENT

Tare Number	518	301	916	312	
Wt. Tare & WS, gm.	820.6	622.9	677.7	808.4	
Wt. Tare & DS, gm.	768.8	569.2	606.9	705.7	
Wt. Tare, gm.	104.3	97.6	100.7	99.4	
Water Content, %	7.8	11.4	14.0	16.9	

DRY DENSITY vs. WATER CONTENT

LABORATORY TEST VALUES

Water Content, %	7.8	11.4	14.0	16.9	
Dry Density, pcf	104.7	109.7	111.5	107.3	

TEST SUMMARY

Compaction Effort	Standard
Test Procedure	B
Mold Diameter, in	4
Compacted Layers	3
Blows Per Layer	25
Rammer Weight / Fall	5.5 lbs / 12 in.
Size of Material Used	-3/8" Sieve
Mold Volume, cc	941.62
Wt. of Mold, gm.	4381

OVERSIZE PARTICLE CORRECTION

Percent Retained on 3/4" Sieve, %	<5%
Percent Retained on 3/8" Sieve, %	NA
Percent Retained on #4 Sieve, %	NA

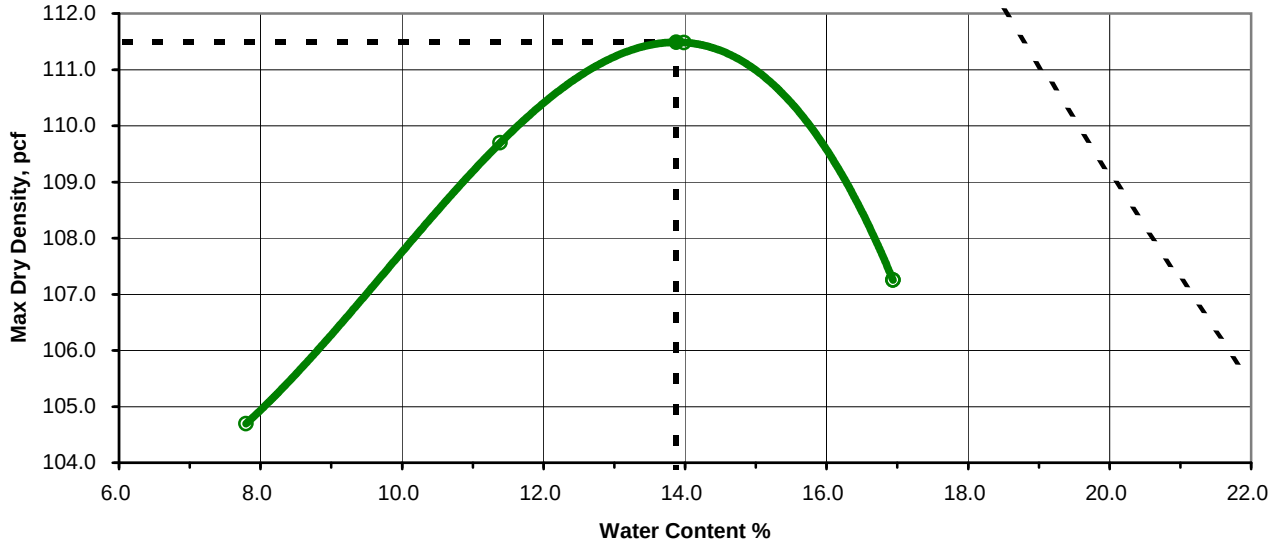
(Based on As Received Screening)

No Oversize Correction Needed

SAMPLE SUMMARY

As-Received Water Content, %	NA
Lab Optimum Water Content, %	***13.9***
Lab Maximum Dry Density, pcf	***111.5***

Note: Maximum Density and Optimum Water Content reported from estimated best fit smooth curve!



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LABORATORY COMPACTION CHARACTERISTICS OF SOIL USING STANDARD EFFORT - D698

Client	Civil & Environmental Consu	Boring	RB-4
Client Project	091-867 Apex Landfill Expar	Depth	19-24
Project No.	30598	Sample	B-1
		Lab Sample No.	30598027
Visual Description:	OLIVE BROWN LEAN CLAY WITH SAND		

WET DENSITY

Compaction Point #	1	2	3	4	5
Wt. Mold & WS, gm.	6038	6160.2	6180.8	6154.8	6124
Wt. Mold, gm.	4381	4381	4381	4381	4381
Wt. WS, gm.	1657	1779.2	1799.8	1773.8	1743
Mold Volume, cc	941.62	941.62	941.62	941.62	941.62
Wet Density, gm./cc	1.76	1.89	1.91	1.88	1.85
Wet Density, pcf	109.8	117.9	119.3	117.5	115.5

WATER CONTENT

Tare Number	903	810	511	503	23
Wt. Tare & WS, gm.	789.3	864.3	726.9	775.2	1828.2
Wt. Tare & DS, gm.	689.9	736.5	617.6	640.4	1470.5
Wt. Tare, gm.	100.6	102.1	102.9	103.4	104.3
Water Content, %	16.9	20.1	21.2	25.1	26.2

DRY DENSITY vs. WATER CONTENT

LABORATORY TEST VALUES

Water Content, %	16.9	20.1	21.2	25.1	26.2
Dry Density, pcf	94.0	98.1	98.4	94.0	91.5

TEST SUMMARY

Compaction Effort	Standard
Test Procedure	B
Mold Diameter, in	4
Compacted Layers	3
Blows Per Layer	25
Rammer Weight / Fall	5.5 lbs / 12 in.
Size of Material Used	-3/8" Sieve
Mold Volume, cc	941.62
Wt. of Mold, gm.	4381

OVERSIZE PARTICLE CORRECTION

Percent Retained on 3/4" Sieve, %	<5%
Percent Retained on 3/8" Sieve, %	NA
Percent Retained on #4 Sieve, %	NA

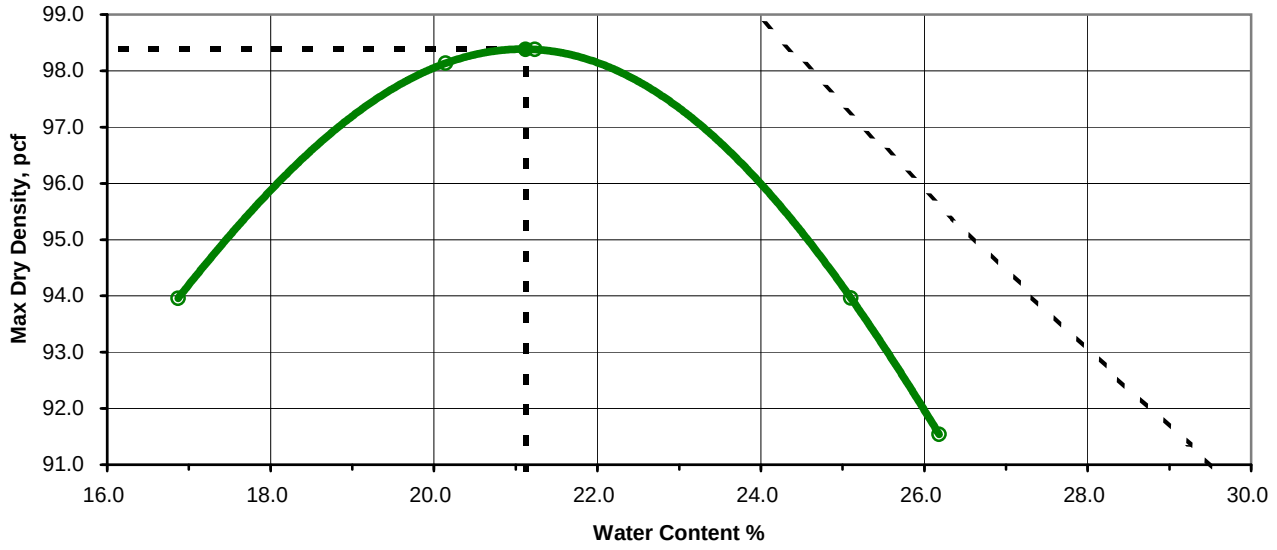
(Based on As Received Screening)

No Oversize Correction Needed

SAMPLE SUMMARY

As-Received Water Content, %	NA
Lab Optimum Water Content, %	***21.1***
Lab Maximum Dry Density, pcf	***98.4***

Note: Maximum Density and Optimum Water Content reported from estimated best fit smooth curve!



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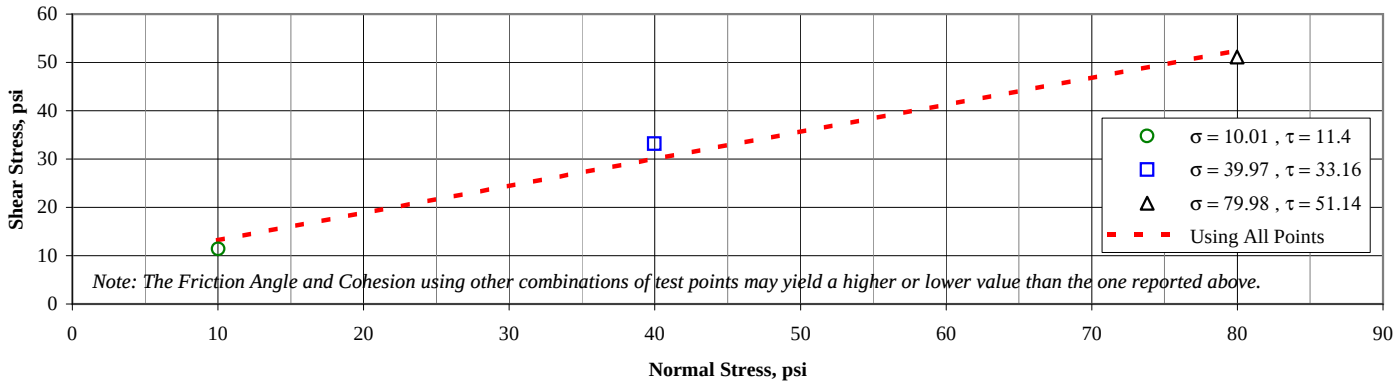
DIRECT SHEAR TEST OF SOILS UNDER CONSOLIDATED DRAINED CONDITIONS

Client	Civil & Environmental Consultants, Inc.	Boring	SB-3
Client Project	091-867 Apex Landfill Expansion	Depth	11.5'-13.5'
Project No.	30598	Sample	ST-1
		Lab No.	30598001

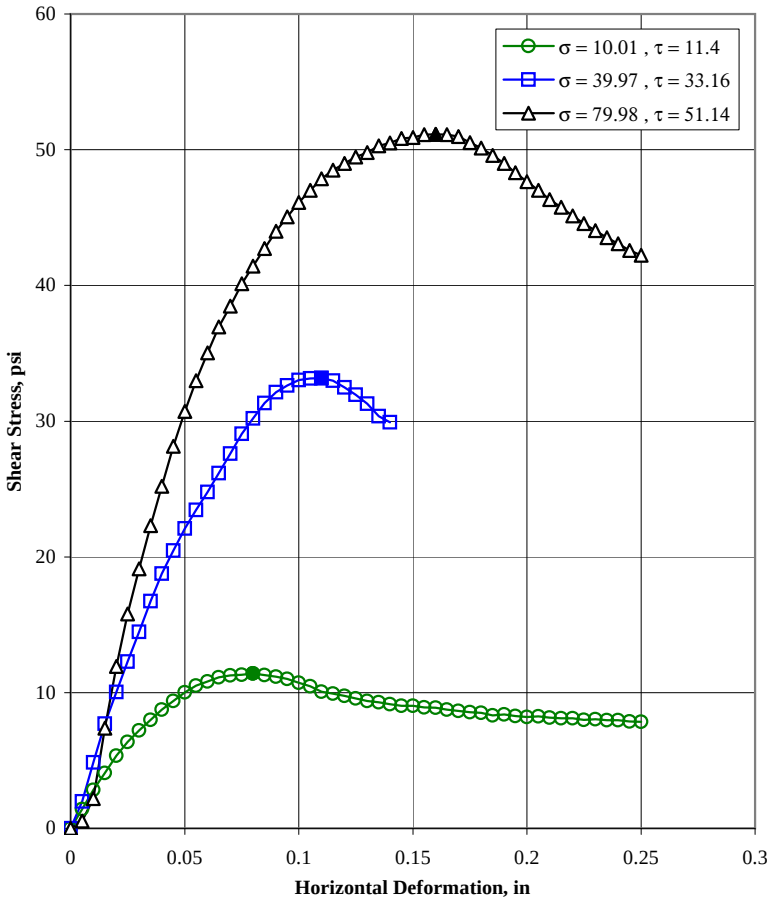
Visual Description	LIGHT GRAY LEAN CLAY
Sample Condition	Undisturbed

NORMAL STRESS vs. SHEAR STRESS

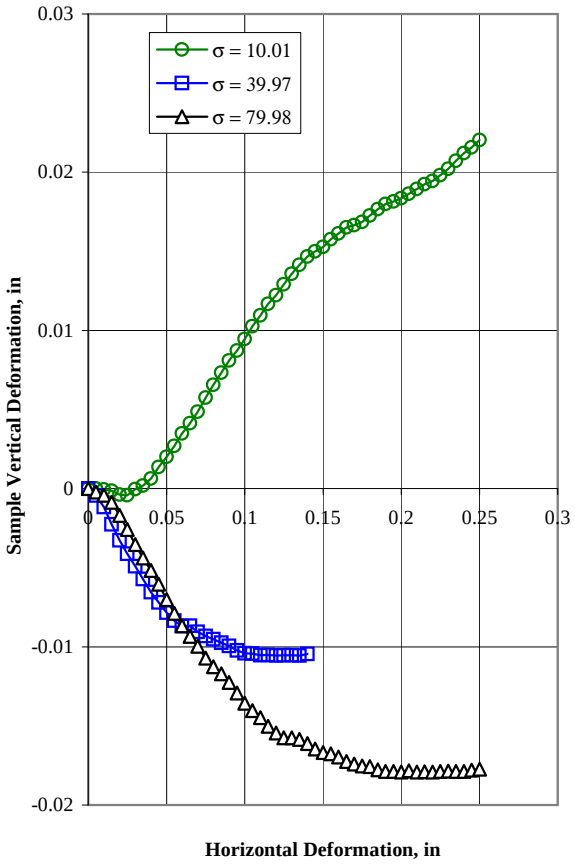
ϕ = 29.3° c = 7.6 psi



HORIZONTAL DEFORMATION vs. SHEAR STRESS



HORIZONTAL DEFORMATION vs. SAMPLE HEIGHT



Note: The calculations performed and the parameters presented herein are for preliminary purposes only. GTS only accepts responsibility for the raw data obtained from the direct shear tests. This data may be interpreted differently by others. It is the responsibility of the user to determine the appropriateness and accuracy of the computed values.

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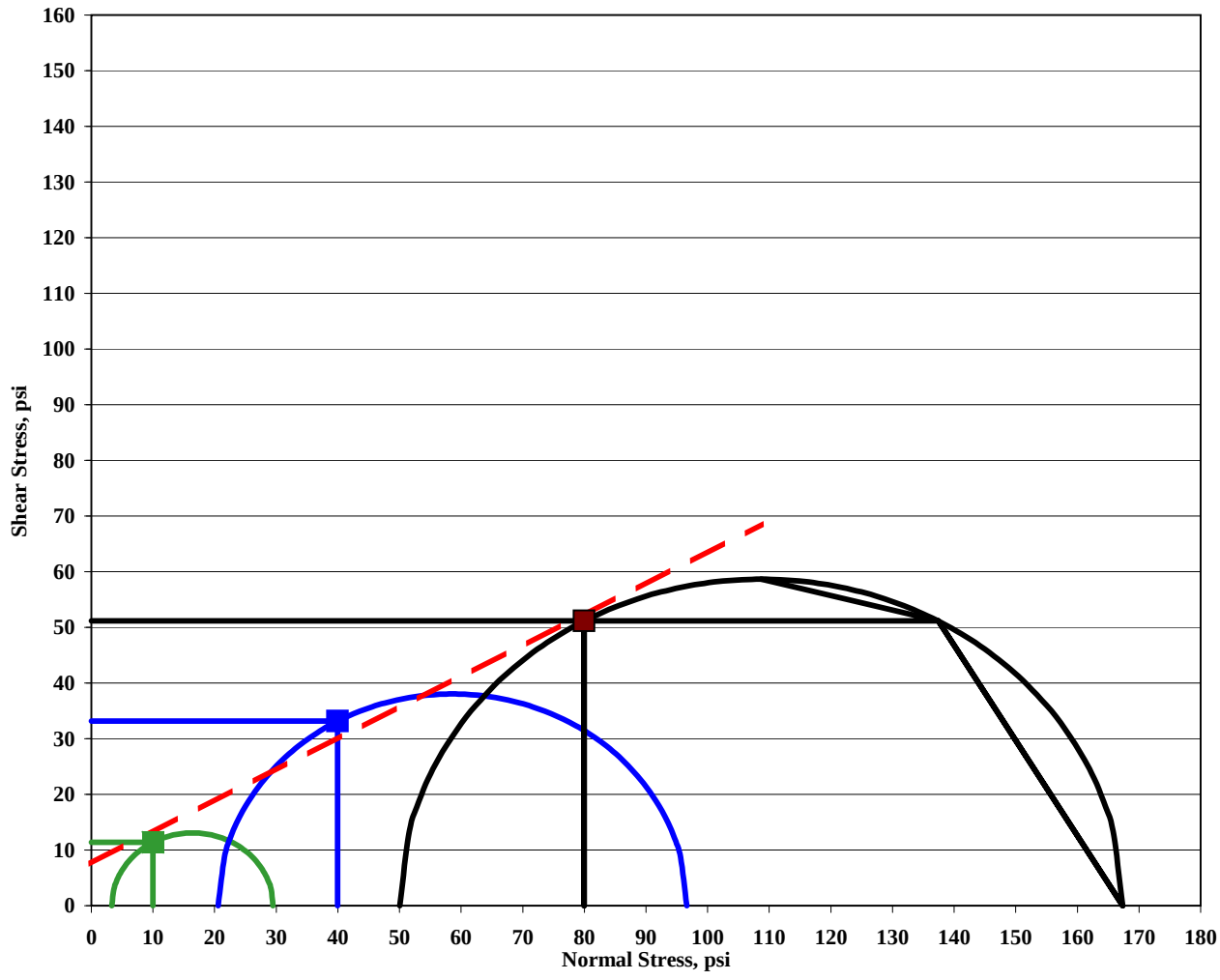
DIRECT SHEAR TEST OF SOILS
UNDER CONSOLIDATED, DRAINED CONDITIONS
MOHRS'S CIRCLE AND FAILURE PARAMETERS

Client:	Civil & Environmental Consultants, Inc.	Boring:	SB-3
Client Project	091-867 Apex Landfill Expansion	Depth:	11.5'-13.5'
Project No.	30598	Sample:	ST-1
		Lab Sample ID	30598001
Material:	LIGHT GRAY LEAN CLAY		
Condition	Undisturbed		

Average Friction Angle, ϕ, deg.		**29.3**	**Using All Points**
Average Cohesion, c, psi		**7.6**	**Using All Points**
Sample Condition		Undisturbed	
Normal Stress, psi	10.01	39.97	79.98
Shear Stress at Failure, psi	11.40	33.16	51.14
Mohr's Circle Radius, psi	13.1	38.0	58.7
Mohr's Circle Origin, psi	16.4	58.6	108.7
(Origin - Normal Stress), psi	6.4	18.6	28.7
Minor Principal Stress σ3, psi	3.3	20.6	50.0
Major Principal Stress σ1, psi	29.5	96.6	167.3
Principal Stress Difference, σ1–σ3, psi	26.1	76.1	117.3
Normal Stress Pole Coordinate, X, psi	22.8	77.2	137.4
Shear Stress Pole Coordinate, Y, psi	11.4	33.2	51.1
Assumed Failure Plane, deg	0 - Horizontal	0 - Horizontal	0 - Horizontal
Major Principal Failure Plane Angle, deg	59.7	59.7	59.7
Minor Principal Failure Plane Angle, deg	30.3	30.3	30.3
Maximum Shear Stress, psi	13.1	38.0	58.7
Maximum Shear Failure Plane Angle, deg	14.7	14.7	14.7
Initial Water Content, %	**10.5%**	**10.5%**	**10.5%**
Initial Dry Density, pcf	**130.0**	**124.3**	**123.4**



DIRECT SHEAR TEST OF SOILS UNDER CONSOLIDATED DRAINED CONDITIONS - ASTM D 3080

Client	Civil & Environmental Consultant	Boring	SB-3
Client Project	091-867 Apex Landfill Expansion	Depth	11.5'-13.5'
Project No.	30598	Sample	ST-1
		Lab No.	30598001
Visual Description	LIGHT GRAY LEAN CLAY		
Sample Condition	Undisturbed		

SAMPLE CONDITIONS

Test No.	1			2			3		
	Initial	**After Consol.**	**Final**	**Initial**	**After Consol.**	**Final**	**Initial**	**After Consol.**	**Final**
Tare I.D.	A10	-	A8	A10	-	53	A10	-	A12
Wt. Wet Soil & Tare, gm	76.94	-	195.49	76.94	-	267.54	76.94	-	181.88
Wt. Dry Soil & Tare, gm	70.55	-	174.28	70.55	-	246.98	70.55	-	161.41
Wt. Tare, gm	9.53	-	9.66	9.53	-	84.64	9.53	-	9.54
Water Content, %	10.5%	-	12.9%	10.5%	-	12.7%	10.5%	-	13.5%
Wt. of Wet Soil & Mold, gr	337.4	-	-	328.08	-	-	327.72	-	-
Wt. of Mold, gm	152.31	-	-	151.07	-	-	151.99	-	-
Wt. of Wet Soil, gm	185.09	-	-	177.01	-	-	175.73	-	-
Sample Height, in	1	0.9829	1.0050	1	0.9433	0.9328	1	0.9216	0.9039
Sample Diameter, in	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5
Sample Area, in^2	4.9	4.9	4.9	4.9	4.9	4.9	4.9	4.9	4.9
Sample Volume, cc	80.44	79.07	80.84	80.44	75.88	75.04	80.44	74.13	72.71
Wet Density, pcf	143.6	NA	146.0	137.3	NA	150.1	136.3	NA	154.9
Dry Density, pcf	130.0	NA	129.3	124.3	NA	133.2	123.4	NA	136.5

DEFORMATION RATE CALCULATIONS

t_{90}, min. (Sqrt. Method)	0.29	0.33	0.37
Equivalent t_{50}, min. (Sqrt.)	0.07	0.08	0.09
t_{50}, min. (Log Method)	0.09	0.07	0.10
Selected t_{50}, min. (Max.)	0.09	0.08	0.10
Calc. Disp. Rate, in./min.	0.0178	0.0290	0.0320

TEST DATA AND SUMMARY

Test No.	1		2		3	
Normal Stress, psi	**10.01**		**39.97**		**79.98**	
Shear Stress at Failure, psi	**11.4**	**Peak**	**33.2**	**Peak**	**51.1**	**Peak**
Shear Disp. at Failure, in	**0.080**		**0.110**		**0.160**	
Displacement Rate, in/min	**0.0020**		**0.0020**		**0.0020**	

Horizontal Displacement in	Shear Force lb.	Shear Stress psi	Vertical Deformation in	Shear Force lb.	Shear Stress psi	Vertical Deformation in	Shear Force lb.	Shear Stress psi	Vertical Deformation in
0	0.0	0.0	0.000	0.0	0.0	0.000	0.0	0.0	0.000
0.005	7.0	1.4	0.000	9.8	2.0	0.000	2.7	0.6	0.000
0.010	13.9	2.8	0.000	23.8	4.8	-0.001	10.8	2.2	0.000
0.015	20.1	4.1	0.000	37.8	7.7	-0.002	36.2	7.4	-0.001
0.020	26.2	5.3	0.000	49.3	10.0	-0.003	58.6	11.9	-0.002
0.025	31.3	6.4	0.000	60.3	12.3	-0.004	77.6	15.8	-0.003
0.030	35.4	7.2	0.000	71.1	14.5	-0.005	93.9	19.1	-0.004
0.035	39.3	8.0	0.000	82.2	16.7	-0.006	109.4	22.3	-0.004
0.040	42.9	8.7	0.001	92.1	18.8	-0.007	123.7	25.2	-0.005
0.045	46.1	9.4	0.001	100.5	20.5	-0.007	138.2	28.1	-0.006
0.050	49.2	10.0	0.002	108.5	22.1	-0.008	150.8	30.7	-0.007
0.055	51.6	10.5	0.003	115.2	23.5	-0.008	161.9	33.0	-0.008
0.060	53.1	10.8	0.003	121.6	24.8	-0.009	172.0	35.0	-0.009
0.065	54.6	11.1	0.004	128.4	26.2	-0.009	181.3	36.9	-0.009
0.070	55.4	11.3	0.005	135.5	27.6	-0.009	188.9	38.5	-0.010

Horizontal Displacement in	Shear Force lb.	Shear Stress psi	Vertical Deformation in	Shear Force lb.	Shear Stress psi	Vertical Deformation in	Shear Force lb.	Shear Stress psi	Vertical Deformation in
0.075	55.6	11.3	0.006	142.7	29.1	-0.009	197.0	40.1	-0.011
0.080	56.0	11.4	0.007	148.3	30.2	-0.010	203.4	41.4	-0.011
0.085	55.4	11.3	0.007	153.8	31.3	-0.010	209.7	42.7	-0.012
0.090	54.9	11.2	0.008	157.7	32.1	-0.010	215.9	44.0	-0.012
0.095	54.1	11.0	0.009	160.2	32.6	-0.010	221.2	45.1	-0.013
0.100	52.7	10.7	0.009	162.1	33.0	-0.010	226.3	46.1	-0.014
0.105	51.4	10.5	0.010	162.7	33.1	-0.010	230.8	47.0	-0.014
0.110	49.4	10.1	0.011	162.8	33.2	-0.011	235.0	47.9	-0.014
0.115	48.8	9.9	0.012	161.9	33.0	-0.011	238.0	48.5	-0.015
0.120	47.9	9.8	0.012	159.5	32.5	-0.011	240.5	49.0	-0.015
0.125	46.9	9.6	0.013	156.8	31.9	-0.011	242.8	49.5	-0.016
0.130	46.1	9.4	0.014	153.6	31.3	-0.011	244.4	49.8	-0.016
0.135	45.5	9.3	0.014	149.1	30.4	-0.011	246.9	50.3	-0.016
0.140	44.9	9.2	0.015	146.9	29.9	-0.010	247.9	50.5	-0.016
0.145	44.3	9.0	0.015				249.5	50.8	-0.016
0.150	44.3	9.0	0.015				249.8	50.9	-0.017
0.155	43.7	8.9	0.016				250.9	51.1	-0.017
0.160	43.6	8.9	0.016				251.0	51.1	-0.017
0.165	43.0	8.8	0.016				250.9	51.1	-0.017
0.170	42.5	8.7	0.017				250.2	51.0	-0.017
0.175	42.0	8.6	0.017				248.0	50.5	-0.018
0.180	41.8	8.5	0.017				246.0	50.1	-0.018
0.185	40.9	8.3	0.018				243.4	49.6	-0.018
0.190	41.2	8.4	0.018				240.5	49.0	-0.018
0.195	40.7	8.3	0.018				237.1	48.3	-0.018
0.200	40.3	8.2	0.018				233.9	47.7	-0.018
0.205	40.5	8.2	0.019				230.8	47.0	-0.018
0.210	40.0	8.2	0.019				227.4	46.3	-0.018
0.215	39.8	8.1	0.019				224.6	45.8	-0.018
0.220	39.8	8.1	0.019				221.5	45.1	-0.018
0.225	39.2	8.0	0.020				218.8	44.6	-0.018
0.230	39.4	8.0	0.020				216.1	44.0	-0.018
0.235	39.2	8.0	0.021				213.6	43.5	-0.018
0.240	39.1	8.0	0.021				211.4	43.1	-0.018
0.245	38.7	7.9	0.022				209.0	42.6	-0.018
0.250	38.5	7.8	0.022				207.2	42.2	-0.018

Input Validation: Reviewed By:

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ONE DIMENSIONAL CONSOLIDATION TEST

Client	Civil & Environmental Consultant	Boring	SB-3	**Final Test Load, psi**	**10.01**
Client Project	091-867 Apex Landfill Expansion	Depth	11.5'-13.5'		
Project No.	30598	Sample	ST-1		
		Lab ID#	30598001		
Description	LIGHT GRAY LEAN CLAY				
Test Conditions:	Undisturbed				

Increment Start Date and Time: 12/08/10

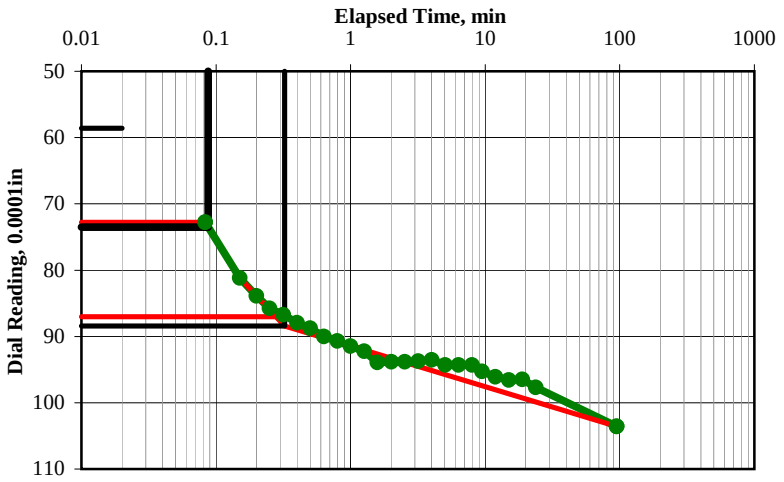
Elapsed Time (min)	Sqrt Time ($min^{1/2}$)	Dial Reading (0.0001in)	Sample Height (in)
0	0	0	1.0000
Corrections*		67	0.0067
Adjusted Sample Height			
0.08	0.29	72.8	0.9994
0.15	0.39	81.2	0.9986
0.20	0.45	83.9	0.9983
0.25	0.50	85.8	0.9981
0.32	0.56	86.7	0.9980
0.40	0.63	87.9	0.9979
0.50	0.71	88.8	0.9978
0.63	0.80	90.0	0.9977
0.80	0.89	90.7	0.9976
1.00	1.00	91.5	0.9976
1.27	1.13	92.2	0.9975
1.58	1.26	93.9	0.9973
2.02	1.42	93.8	0.9973
2.53	1.59	93.8	0.9973
3.18	1.78	93.7	0.9973
4.02	2.00	93.5	0.9973
5.05	2.25	94.3	0.9973
6.37	2.52	94.3	0.9973
8.02	2.83	94.3	0.9973
9.47	3.08	95.3	0.9972
11.92	3.45	96.1	0.9971
15.02	3.88	96.6	0.9970
18.92	4.35	96.5	0.9971
23.83	4.88	97.7	0.9969
95.03	9.75	103.6	0.9829

Machine Deflection

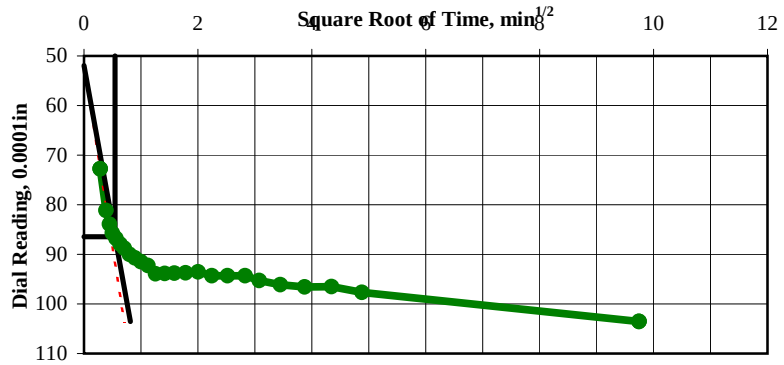
Applied Deflection Correction to Sample Height, 0.0001in 67

**Correction is applied to all dial readings.*

Log of Elapsed Time vs. Dial Reading



Square Root of Elapsed Time vs. Dial Reading



Sqrt. of Elapsed Time vs Dial Reading

T0 = 0 min.	D0 = 52 div.		
T90 = 0.292 min	D90 = 86.5 div.		
T100 = NA min	D100 = 90.3 div.		
Height at: D90 = 0.9847, D100 = 0.9843			
Average Sample Height, in	0.9915		
Average Drainage Height, in	0.4957		
T (Time Factor for T90)	0.848		
Coef. of Consol., C_v, in^2/min	0.703		

Log of Elapsed Time vs Dial Reading

T0 = 0 min.	D0 = 58.6 div.		
T50 = 0.09 min.	D50 = 73.5 div.		
T100 = 0.32 min.	D100 = 88.4 div.		
Height at: D50 = 0.986, D100 = 0.9845			
Average Sample Height, in	0.9915		
Average Drainage Height, in	0.4957		
T (Time Factor for T50)	0.197		
Coef. of Consol., C_v, in^2/min	0.538		

Load Summary

Initial Sample Height, in	1.0000
Final Sample Height, in	0.9829
Incremental Strain, %	1.71%
Loading Duration, min	95

Input Validation: Reviewed By: Date 12/8/2010

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ONE DIMENSIONAL CONSOLIDATION TEST

Client	Civil & Environmental Consultant	Boring	SB-3	**Final Test Load, psi**	**39.97**
Client Project	091-867 Apex Landfill Expansion	Depth	11.5'-13.5'		
Project No.	30598	Sample	ST-1		
		Lab ID#	30598001		
Description	LIGHT GRAY LEAN CLAY				
Test Conditions:	Undisturbed				

Increment Start Date: 12/08/10

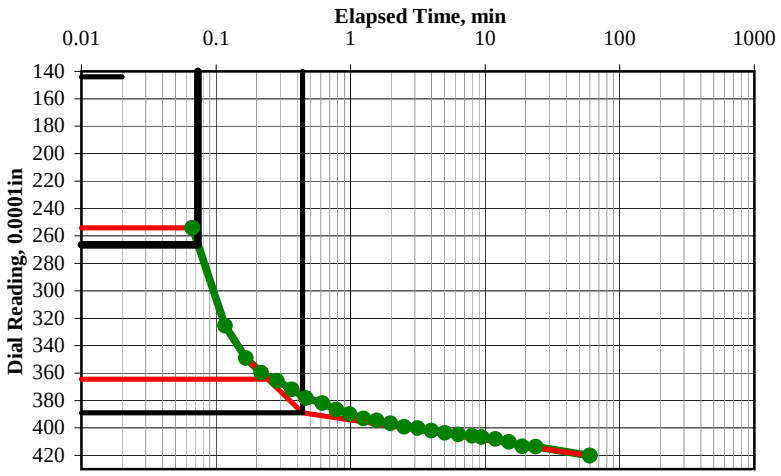
Elapsed Time (min)	Sqrt Time ($min^{1/2}$)	Dial Reading (0.0001in)	Sample Height (in)
0	0	0	1.0000
Corrections*		147	0.0147
Adjusted Sample Height			
0.07	0.26	254.2	0.9893
0.12	0.34	325.4	0.9822
0.17	0.41	349.0	0.9798
0.22	0.47	359.9	0.9787
0.28	0.53	365.6	0.9781
0.37	0.61	371.9	0.9775
0.47	0.68	378.1	0.9769
0.62	0.79	382.0	0.9765
0.78	0.89	386.6	0.9760
0.98	0.99	389.9	0.9757
1.25	1.12	393.2	0.9754
1.57	1.25	394.6	0.9752
1.98	1.41	396.7	0.9750
2.50	1.58	399.1	0.9748
3.15	1.77	400.1	0.9747
3.98	2.00	402.0	0.9745
5.02	2.24	403.7	0.9743
6.33	2.52	404.8	0.9742
8.00	2.83	405.6	0.9741
9.45	3.07	406.7	0.9740
11.90	3.45	408.1	0.9739
15.00	3.87	410.1	0.9737
18.90	4.35	413.5	0.9734
23.82	4.88	413.7	0.9733
60.00	7.75	420.3	0.9433

Machine Deflection

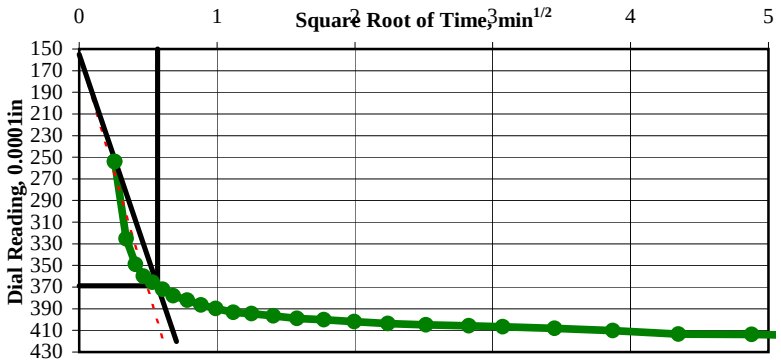
Applied Deflection Correction to Sample Height, 0.0001in 147

**Correction is applied to all dial readings.*

Log of Elapsed Time vs. Dial Reading



Square Root of Elapsed Time vs. Dial Reading



Sqrt. of Elapsed Time vs Dial Reading

T0 = 0 min.	D0 = 155 div.		
T90 = 0.325 min	D90 = 368.8 div.		
T100 = NA min	D100 = 392.6 div.		
Height at: D90 = 0.9484, D100 = 0.946			
Average Sample Height, in	0.9716		
Average Drainage Height, in	0.4858		
T (Time Factor for T90)	0.848		
Coef. of Consol., C_v, in^2/min	0.618		

Log of Elapsed Time vs Dial Reading

T0 = 0 min.	D0 = 144 div.		
T50 = 0.07 min.	D50 = 266.5 div.		
T100 = 0.44 min.	D100 = 389 div.		
Height at: D50 = 0.9587, D100 = 0.9464			
Average Sample Height, in	0.9716		
Average Drainage Height, in	0.4858		
T (Time Factor for T50)	0.197		
Coef. of Consol., C_v, in^2/min	0.664		

Load Summary

Initial Sample Height, in	1.0000
Final Sample Height, in	0.9433
Incremental Strain, %	5.67%
Loading Duration, min	60

Input Validation: Reviewed By: Date 12/8/2010

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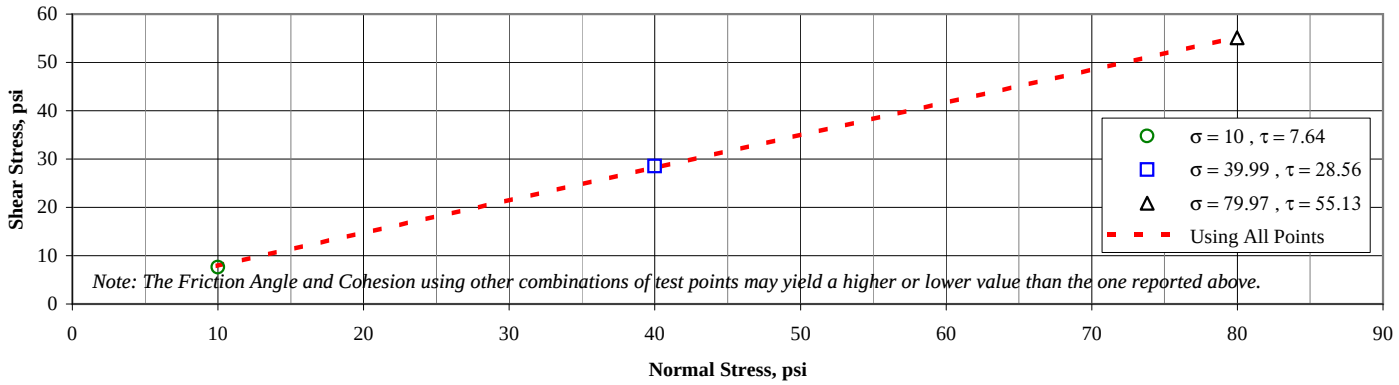
DIRECT SHEAR TEST OF SOILS UNDER CONSOLIDATED DRAINED CONDITIONS

Client	Civil & Environmental Consultants, Inc.	Boring	SB-14
Client Project	091-867 Apex Landfill Expansion	Depth	25'-27'
Project No.	30598	Sample	ST-2 TOP
		Lab No.	30598002

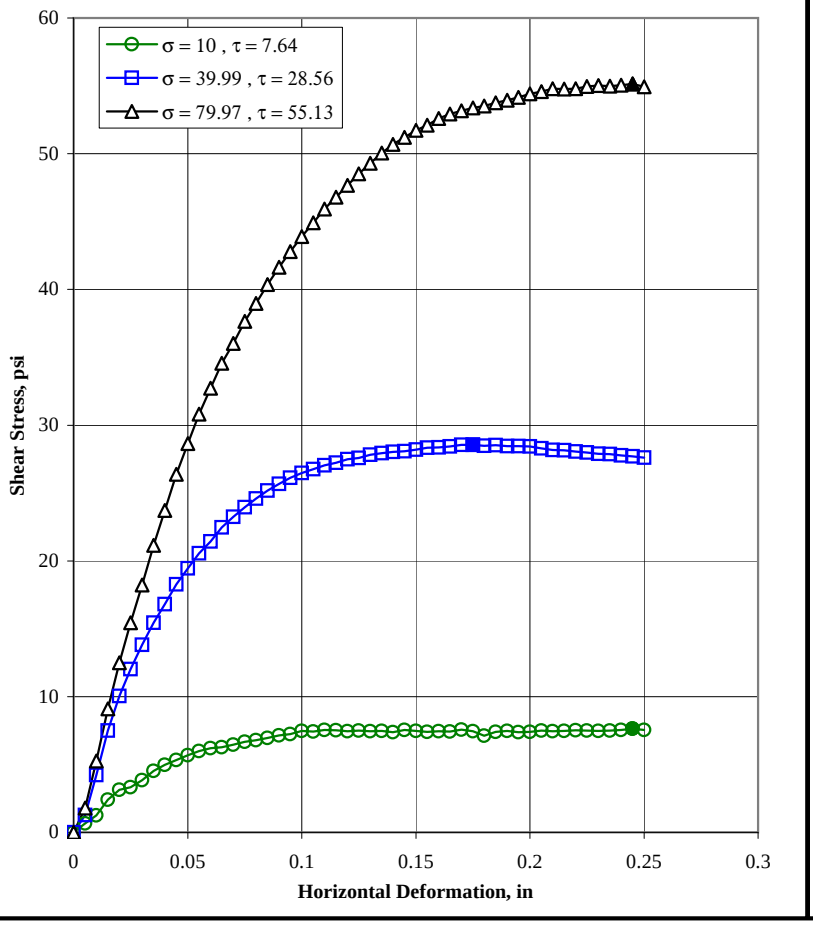
Visual Description	Black Mine Spoil
Sample Condition	Undisturbed

NORMAL STRESS vs. SHEAR STRESS

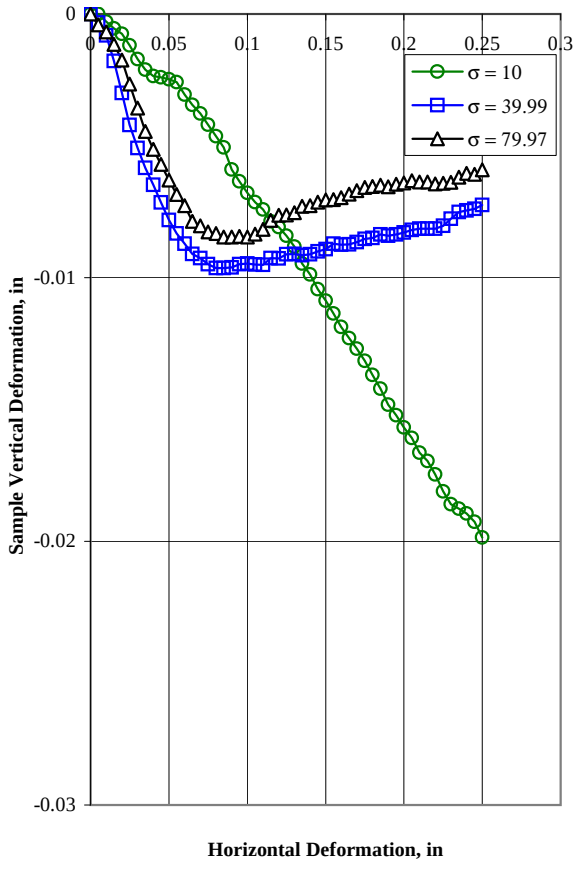
ϕ = 34.1° c = 1.1 psi



HORIZONTAL DEFORMATION vs. SHEAR STRESS



HORIZONTAL DEFORMATION vs. SAMPLE HEIGHT



Note: The calculations performed and the parameters presented herein are for preliminary purposes only. GTS only accepts responsibility for the raw data obtained from the direct shear tests. This data may be interpreted differently by others. It is the responsibility of the user to determine the appropriateness and accuracy of the computed values.

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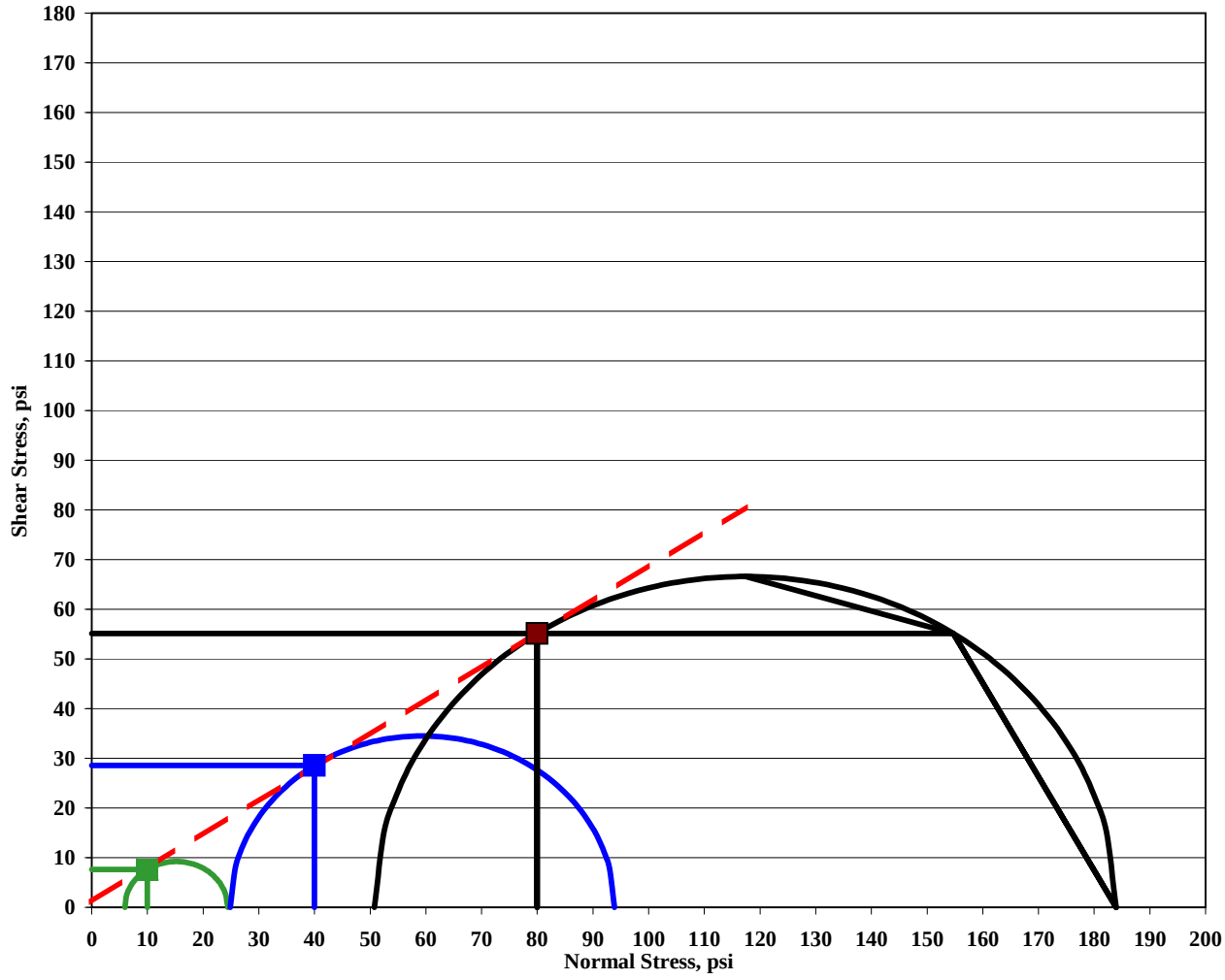
DIRECT SHEAR TEST OF SOILS
UNDER CONSOLIDATED, DRAINED CONDITIONS
MOHRS'S CIRCLE AND FAILURE PARAMETERS

Client:	Civil & Environmental Consultants, Inc.	Boring:	SB-14
Client Project	091-867 Apex Landfill Expansion	Depth:	25'-27'
Project No.	30598	Sample:	ST-2 TOP
		Lab Sample ID	30598002
Material:	Black Mine Spoil		
Condition	Undisturbed		

Average Friction Angle, ϕ, deg.		**34.1**	**Using All Points**
Average Cohesion, c, psi		**1.1**	**Using All Points**
Sample Condition		Undisturbed	
Normal Stress, psi	10.00	39.99	79.97
Shear Stress at Failure, psi	7.64	28.56	55.13
Mohr's Circle Radius, psi	9.2	34.5	66.6
Mohr's Circle Origin, psi	15.2	59.4	117.3
(Origin - Normal Stress), psi	5.2	19.4	37.4
Minor Principal Stress σ3, psi	5.9	24.8	50.7
Major Principal Stress σ1, psi	24.4	93.9	184.0
Principal Stress Difference, σ1–σ3, psi	18.5	69.0	133.2
Normal Stress Pole Coordinate, X, psi	20.4	78.7	154.7
Shear Stress Pole Coordinate, Y, psi	7.6	28.6	55.1
Assumed Failure Plane, deg	0 - Horizontal	0 - Horizontal	0 - Horizontal
Major Principal Failure Plane Angle, deg	62.1	62.1	62.1
Minor Principal Failure Plane Angle, deg	27.9	27.9	27.9
Maximum Shear Stress, psi	9.2	34.5	66.6
Maximum Shear Failure Plane Angle, deg	17.1	17.1	17.1
Initial Water Content, %	**65.0%**	**65.0%**	**65.0%**
Initial Dry Density, pcf	**47.7**	**49.3**	**49.5**



DIRECT SHEAR TEST OF SOILS UNDER CONSOLIDATED DRAINED CONDITIONS - ASTM D 3080

Client	Civil & Environmental Consultant	Boring	SB-14
Client Project	091-867 Apex Landfill Expansion	Depth	25'-27'
Project No.	30598	Sample	ST-2 TOP
		Lab No.	30598002

Visual Description: Black Mine Spoil
Sample Condition: Undisturbed

SAMPLE CONDITIONS

Test No.	1			2			3		
	Initial	**After Consol.**	**Final**	**Initial**	**After Consol.**	**Final**	**Initial**	**After Consol.**	**Final**
Tare I.D.	Z2	-	Z10	Z2	-	Z11	Z2	-	Z15
Wt. Wet Soil & Tare, gm	144.79	-	226.35	144.79	-	227.58	144.79	-	229.63
Wt. Dry Soil & Tare, gm	136.26	-	182.74	136.26	-	186.76	136.26	-	188
Wt. Tare, gm	123.14	-	123.04	123.14	-	122.89	123.14	-	122.86
Water Content, %	65.0%	-	73.0%	65.0%	-	63.9%	65.0%	-	63.9%
Wt. of Wet Soil & Mold, gr	253.84	-	-	255.99	-	-	257.25	-	-
Wt. of Mold, gm	152.31	-	-	151.07	-	-	151.99	-	-
Wt. of Wet Soil, gm	101.53	-	-	104.92	-	-	105.26	-	-
Sample Height, in	1	0.9782	0.9584	1	0.9278	0.9205	1	0.9195	0.9136
Sample Diameter, in	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5
Sample Area, in^2	4.9	4.9	4.9	4.9	4.9	4.9	4.9	4.9	4.9
Sample Volume, cc	80.44	78.69	77.09	80.44	74.63	74.05	80.44	73.96	73.49
Wet Density, pcf	78.8	NA	86.2	81.4	NA	87.8	81.7	NA	88.8
Dry Density, pcf	47.7	NA	49.8	49.3	NA	53.6	49.5	NA	54.2

DEFORMATION RATE CALCULATIONS

	1	2	3
t_{90}, min. (Sqrt. Method)	0.38	0.31	0.38
Equivalent t_{50}, min. (Sqrt.)	0.09	0.07	0.09
t_{50}, min. (Log Method)	0.30	0.07	0.11
Selected t_{50}, min. (Max.)	0.30	0.07	0.11
Calc. Disp. Rate, in./min.	0.0163	0.0477	0.0445

TEST DATA AND SUMMARY

Test No.	1		2		3	
Normal Stress, psi	**10.01**		**40.00**		**79.98**	
Shear Stress at Failure, psi	**7.6**	**Peak**	**28.6**	**Peak**	**55.1**	**Peak**
Shear Disp. at Failure, in	**0.245**		**0.175**		**0.245**	
Displacement Rate, in/min	**0.0020**		**0.0020**		**0.0020**	

Horizontal Displacement in	Shear Force lb.	Shear Stress psi	Vertical Deformation in	Shear Force lb.	Shear Stress psi	Vertical Deformation in	Shear Force lb.	Shear Stress psi	Vertical Deformation in
0	0.0	0.0	0.000	0.0	0.0	0.000	0.0	0.0	0.000
0.005	3.2	0.7	0.000	6.3	1.3	0.000	8.8	1.8	0.000
0.010	6.1	1.2	0.000	20.7	4.2	-0.001	25.8	5.3	-0.001
0.015	11.8	2.4	-0.001	36.8	7.5	-0.002	44.7	9.1	-0.001
0.020	15.4	3.1	-0.001	49.3	10.0	-0.003	61.4	12.5	-0.002
0.025	16.3	3.3	-0.001	59.0	12.0	-0.004	75.7	15.4	-0.003
0.030	18.9	3.9	-0.002	67.8	13.8	-0.005	89.5	18.2	-0.004
0.035	22.2	4.5	-0.002	75.8	15.5	-0.006	103.8	21.1	-0.004
0.040	24.4	5.0	-0.002	82.5	16.8	-0.006	116.4	23.7	-0.005
0.045	26.1	5.3	-0.002	89.7	18.3	-0.007	129.5	26.4	-0.006
0.050	27.9	5.7	-0.002	95.4	19.4	-0.008	140.6	28.7	-0.006
0.055	29.4	6.0	-0.003	100.9	20.6	-0.008	151.3	30.8	-0.007
0.060	30.4	6.2	-0.003	105.2	21.4	-0.009	160.7	32.7	-0.007
0.065	30.8	6.3	-0.003	110.3	22.5	-0.009	169.7	34.6	-0.008
0.070	31.8	6.5	-0.004	114.1	23.3	-0.009	176.9	36.0	-0.008

Horizontal Displacement in	Shear Force lb.	Shear Stress psi	Vertical Deformation in	Shear Force lb.	Shear Stress psi	Vertical Deformation in	Shear Force lb.	Shear Stress psi	Vertical Deformation in
0.075	32.8	6.7	-0.004	117.6	23.9	-0.009	184.8	37.6	-0.008
0.080	33.3	6.8	-0.005	120.7	24.6	-0.010	191.3	39.0	-0.008
0.085	34.2	7.0	-0.005	123.6	25.2	-0.010	198.2	40.4	-0.008
0.090	35.0	7.1	-0.006	126.0	25.7	-0.010	204.3	41.6	-0.008
0.095	35.6	7.2	-0.006	128.3	26.1	-0.009	210.0	42.8	-0.008
0.100	36.7	7.5	-0.007	130.0	26.5	-0.009	215.5	43.9	-0.008
0.105	36.4	7.4	-0.007	131.4	26.8	-0.009	220.5	44.9	-0.008
0.110	37.0	7.5	-0.007	132.8	27.1	-0.010	225.4	45.9	-0.008
0.115	36.9	7.5	-0.008	133.7	27.2	-0.009	229.7	46.8	-0.008
0.120	36.6	7.5	-0.008	135.0	27.5	-0.009	234.0	47.7	-0.008
0.125	36.8	7.5	-0.008	135.4	27.6	-0.009	238.1	48.5	-0.008
0.130	36.6	7.4	-0.009	136.6	27.8	-0.009	242.0	49.3	-0.008
0.135	36.7	7.5	-0.009	137.1	27.9	-0.009	245.7	50.1	-0.007
0.140	36.2	7.4	-0.010	137.6	28.0	-0.009	248.8	50.7	-0.007
0.145	37.1	7.5	-0.010	137.8	28.1	-0.009	251.4	51.2	-0.007
0.150	36.7	7.5	-0.011	138.4	28.2	-0.009	253.9	51.7	-0.007
0.155	36.3	7.4	-0.011	139.1	28.3	-0.009	255.7	52.1	-0.007
0.160	36.6	7.5	-0.012	139.3	28.4	-0.009	258.2	52.6	-0.007
0.165	36.4	7.4	-0.012	139.6	28.4	-0.009	259.7	52.9	-0.007
0.170	37.1	7.6	-0.013	140.1	28.5	-0.009	260.9	53.2	-0.007
0.175	36.6	7.4	-0.013	140.2	28.6	-0.009	262.0	53.4	-0.007
0.180	34.9	7.1	-0.014	139.7	28.5	-0.008	262.7	53.5	-0.007
0.185	36.4	7.4	-0.014	140.0	28.5	-0.008	263.8	53.7	-0.006
0.190	36.7	7.5	-0.015	139.7	28.5	-0.008	264.8	54.0	-0.007
0.195	36.3	7.4	-0.015	139.6	28.4	-0.008	265.8	54.2	-0.006
0.200	36.4	7.4	-0.016	139.6	28.4	-0.008	267.1	54.4	-0.006
0.205	36.8	7.5	-0.016	138.9	28.3	-0.008	267.9	54.6	-0.006
0.210	36.6	7.5	-0.017	138.3	28.2	-0.008	268.9	54.8	-0.006
0.215	36.7	7.5	-0.017	138.2	28.2	-0.008	268.8	54.8	-0.006
0.220	36.9	7.5	-0.017	137.7	28.1	-0.008	268.9	54.8	-0.006
0.225	36.8	7.5	-0.018	137.4	28.0	-0.008	269.7	54.9	-0.006
0.230	36.7	7.5	-0.019	136.9	27.9	-0.008	270.1	55.0	-0.006
0.235	36.8	7.5	-0.019	136.8	27.9	-0.008	269.9	55.0	-0.006
0.240	37.1	7.6	-0.019	136.3	27.8	-0.007	270.3	55.1	-0.006
0.245	37.5	7.6	-0.019	135.9	27.7	-0.007	270.7	55.1	-0.006
0.250	37.1	7.5	-0.020	135.5	27.6	-0.007	269.7	54.9	-0.006

Input Validation: Reviewed By:

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ONE DIMENSIONAL CONSOLIDATION TEST

Client	Civil & Environmental Consultant	Boring	SB-14	**Final Test Load, psi**	**10.01**
Client Project	091-867 Apex Landfill Expansion	Depth	25'-27'		
Project No.	30598	Sample	ST-2 TOP		
		Lab ID#	30598002		
Description	Black Mine Spoil				
Test Conditions:	Undisturbed				

Increment Start Date and Time: 12/10/10

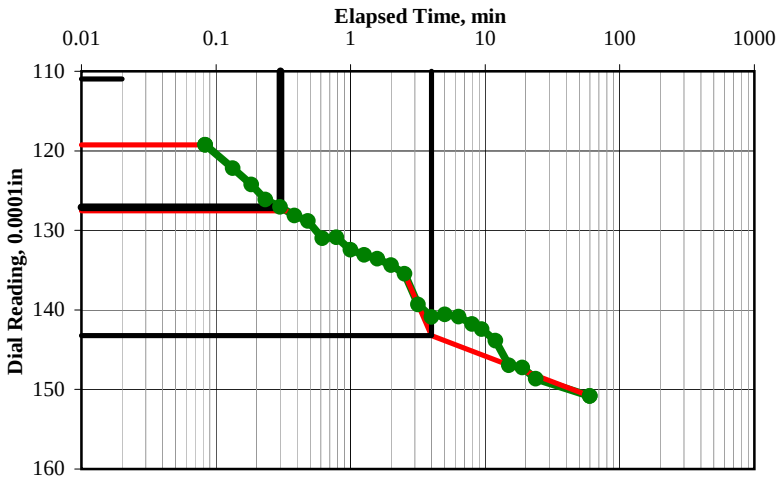
Elapsed Time (min)	Sqrt Time ($min^{1/2}$)	Dial Reading (0.0001in)	Sample Height (in)
0	0	0	1.0000
Corrections*		67	0.0067
Adjusted Sample Height			
0.08	0.29	119.2	0.9948
0.13	0.37	122.2	0.9945
0.18	0.43	124.2	0.9943
0.23	0.48	126.1	0.9941
0.30	0.55	127.1	0.9940
0.38	0.62	128.1	0.9939
0.48	0.70	128.8	0.9938
0.62	0.79	131.0	0.9936
0.78	0.89	130.9	0.9936
1.00	1.00	132.4	0.9935
1.27	1.13	133.1	0.9934
1.58	1.26	133.6	0.9933
2.00	1.41	134.4	0.9933
2.52	1.59	135.4	0.9932
3.17	1.78	139.3	0.9928
4.00	2.00	140.9	0.9926
5.03	2.24	140.6	0.9926
6.35	2.52	140.9	0.9926
8.00	2.83	141.8	0.9925
9.45	3.07	142.4	0.9925
11.92	3.45	143.9	0.9923
15.02	3.88	147.0	0.9920
18.92	4.35	147.3	0.9920
23.83	4.88	148.6	0.9918
60.03	7.75	150.8	0.9782

Machine Deflection

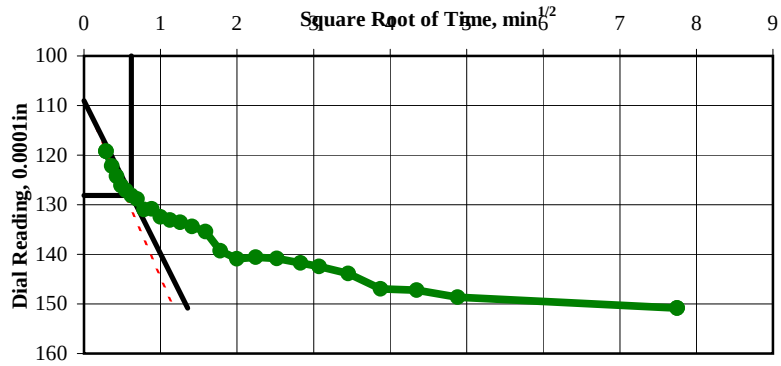
Applied Deflection Correction to Sample Height, 0.0001in 67

**Correction is applied to all dial readings.*

Log of Elapsed Time vs. Dial Reading



Square Root of Elapsed Time vs. Dial Reading



Sqrt. of Elapsed Time vs Dial Reading

T0 = 0 min.	D0 = 109.1 div.		
T90 = 0.384 min	D90 = 128.1 div.		
T100 = NA min	D100 = 130.2 div.		
Height at: D90 = 0.9805, D100 = 0.9803			
Average Sample Height, in	0.9891		
Average Drainage Height, in	0.4946		
T (Time Factor for T90)	0.848		
Coef. of Consol., C_v, in^2/min	0.543		

Log of Elapsed Time vs Dial Reading

T0 = 0 min.	D0 = 111 div.		
T50 = 0.3 min.	D50 = 127.1 div.		
T100 = 3.99 min.	D100 = 143.2 div.		
Height at: D50 = 0.9806, D100 = 0.979			
Average Sample Height, in	0.9891		
Average Drainage Height, in	0.4946		
T (Time Factor for T50)	0.197		
Coef. of Consol., C_v, in^2/min	0.161		

Load Summary

Initial Sample Height, in	1.0000
Final Sample Height, in	0.9782
Incremental Strain, %	2.18%
Loading Duration, min	60

Input Validation: Reviewed By: Date 12/10/2010

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ONE DIMENSIONAL CONSOLIDATION TEST

Client	Civil & Environmental Consultant	Boring	SB-14	**Final Test Load, psi**	**40.00**
Client Project	091-867 Apex Landfill Expansion	Depth	25'-27'		
Project No.	30598	Sample	ST-2 TOP		
		Lab ID#	30598002		
Description	Black Mine Spoil				
Test Conditions:	Undisturbed				

Increment Start Date: 12/10/10

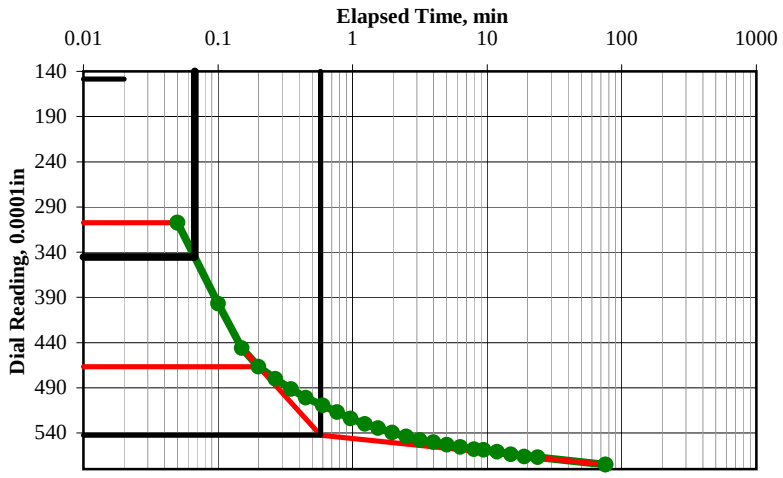
Elapsed Time (min)	Sqrt Time ($min^{1/2}$)	Dial Reading (0.0001in)	Sample Height (in)
0	0	0	1.0000
Corrections*		147	0.0147
Adjusted Sample Height			
0.05	0.22	307.5	0.9839
0.10	0.32	397.0	0.9750
0.15	0.39	446.1	0.9701
0.20	0.45	466.6	0.9680
0.27	0.52	480.3	0.9667
0.35	0.59	491.6	0.9655
0.45	0.67	501.0	0.9646
0.60	0.77	509.7	0.9637
0.77	0.88	517.2	0.9630
0.97	0.98	524.1	0.9623
1.23	1.11	530.0	0.9617
1.55	1.24	534.7	0.9612
1.97	1.40	539.8	0.9607
2.50	1.58	544.0	0.9603
3.15	1.77	547.6	0.9599
3.98	2.00	550.3	0.9597
5.02	2.24	553.2	0.9594
6.33	2.52	555.6	0.9591
7.98	2.83	557.9	0.9589
9.43	3.07	558.7	0.9588
11.88	3.45	560.8	0.9586
14.98	3.87	563.7	0.9583
18.88	4.35	566.1	0.9581
23.80	4.88	566.9	0.9580
76.00	8.72	575.2	0.9278

Machine Deflection

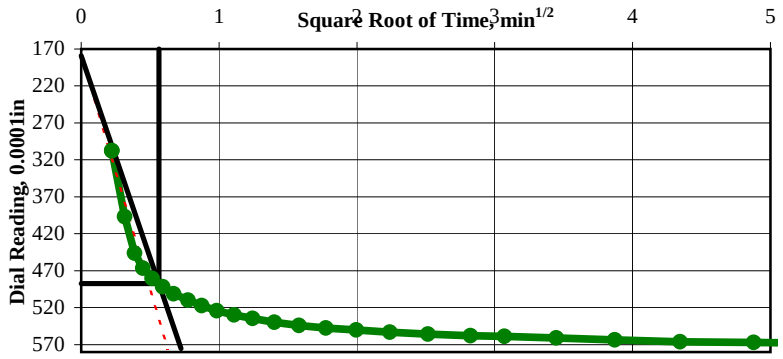
Applied Deflection Correction to Sample Height, 0.0001in 147

**Correction is applied to all dial readings.*

Log of Elapsed Time vs. Dial Reading



Square Root of Elapsed Time vs. Dial Reading



Sqrt. of Elapsed Time vs Dial Reading

T0 = 0 min.	D0 = 179.2 div.		
T90 = 0.314 min	D90 = 487.4 div.		
T100 = NA min	D100 = 521.6 div.		
Height at: D90 = 0.9366, D100 = 0.9331			
Average Sample Height, in	0.9639		
Average Drainage Height, in	0.4819		
T (Time Factor for T90)	0.848		
Coef. of Consol., C_v, in^2/min	0.620		

Log of Elapsed Time vs Dial Reading

T0 = 0 min.	D0 = 148.4 div.		
T50 = 0.07 min.	D50 = 345.4 div.		
T100 = 0.58 min.	D100 = 542.4 div.		
Height at: D50 = 0.9508, D100 = 0.9311			
Average Sample Height, in	0.9639		
Average Drainage Height, in	0.4819		
T (Time Factor for T50)	0.197		
Coef. of Consol., C_v, in^2/min	0.654		

Load Summary

Initial Sample Height, in	1.0000
Final Sample Height, in	0.9278
Incremental Strain, %	7.22%
Loading Duration, min	76

Input Validation: Reviewed By: Date 12/10/2010

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ONE DIMENSIONAL CONSOLIDATION TEST

Client	Civil & Environmental Consultant	Boring	SB-3	**Final Test Load, psi**	**79.98**
Client Project	091-867 Apex Landfill Expansion	Depth	11.5'-13.5'		
Project No.	30598	Sample	ST-1		
		Lab ID#	30598001		
Description	LIGHT GRAY LEAN CLAY				
Test Conditions:	Undisturbed				

Increment Start Date: 12/07/10

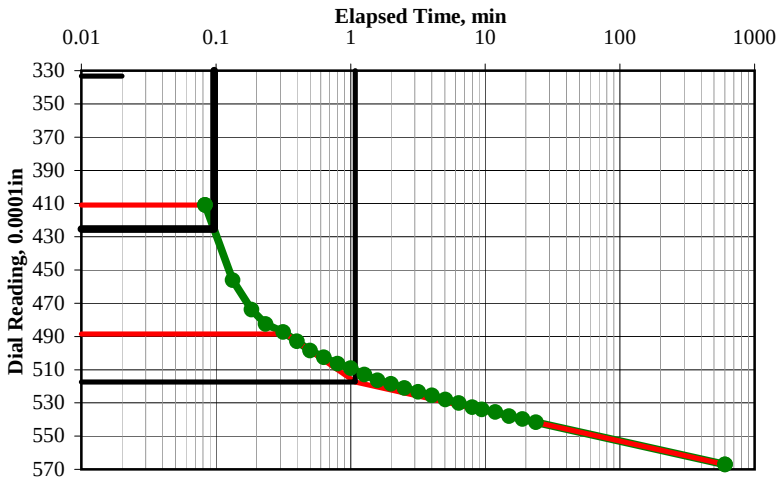
Elapsed Time (min)	Sqrt Time ($min^{1/2}$)	Dial Reading (0.0001in)	Sample Height (in)
0	0	0	1.0000
Corrections*		217	0.0217
Adjusted Sample Height			
0.08	0.29	410.9	0.9806
0.13	0.37	456.1	0.9761
0.18	0.43	473.9	0.9743
0.23	0.48	482.5	0.9735
0.32	0.56	487.3	0.9730
0.40	0.63	493.0	0.9724
0.50	0.71	498.4	0.9719
0.63	0.80	502.6	0.9714
0.80	0.89	506.4	0.9711
1.00	1.00	509.2	0.9708
1.27	1.13	513.0	0.9704
1.58	1.26	516.5	0.9701
2.00	1.41	518.5	0.9699
2.52	1.59	521.0	0.9696
3.18	1.78	523.3	0.9694
4.02	2.00	525.4	0.9692
5.05	2.25	528.0	0.9689
6.37	2.52	530.1	0.9687
8.02	2.83	532.6	0.9684
9.47	3.08	534.1	0.9683
11.92	3.45	535.5	0.9682
15.02	3.88	538.0	0.9679
18.92	4.35	539.8	0.9677
23.83	4.88	541.8	0.9675
603.05	24.56	567.0	0.9216

Machine Deflection

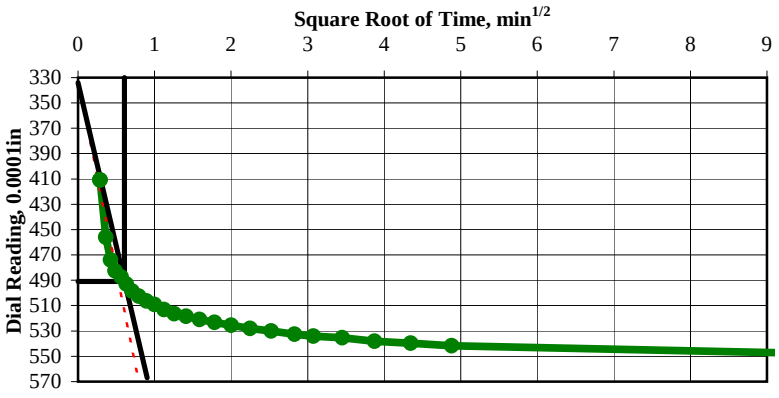
Applied Deflection Correction to Sample Height, 0.0001in 217

**Correction is applied to all dial readings.*

Log of Elapsed Time vs. Dial Reading



Square Root of Elapsed Time vs. Dial Reading



Sqrt. of Elapsed Time vs Dial Reading

T0 = 0 min.	D0 = 334 div.		
T90 = 0.372 min	D90 = 491 div.		
T100 = NA min	D100 = 508.4 div.		
Height at: D90 = 0.9292, D100 = 0.9275			
Average Sample Height, in	0.9608		
Average Drainage Height, in	0.4804		
T (Time Factor for T90)	0.848		
Coef. of Consol., C_v, in^2/min	0.530		

Log of Elapsed Time vs Dial Reading

T0 = 0 min.	D0 = 333.4 div.		
T50 = 0.1 min.	D50 = 425.4 div.		
T100 = 1.08 min.	D100 = 517.4 div.		
Height at: D50 = 0.9358, D100 = 0.9266			
Average Sample Height, in	0.9608		
Average Drainage Height, in	0.4804		
T (Time Factor for T50)	0.197		
Coef. of Consol., C_v, in^2/min	0.455		

Load Summary

Initial Sample Height, in	1.0000
Final Sample Height, in	0.9216
Incremental Strain, %	7.84%
Loading Duration, min	603

Input Validation: Reviewed By: Date 12/7/2010

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ONE DIMENSIONAL CONSOLIDATION TEST

Client	Civil & Environmental Consultant	Boring	SB-14	**Final Test Load, psi**	**79.98**
Client Project	091-867 Apex Landfill Expansion	Depth	25'-27'		
Project No.	30598	Sample	ST-2 TOP		
		Lab ID#	30598002		
Description	Black Mine Spoil				
Test Conditions:	Undisturbed				

Increment Start Date: 12/13/10

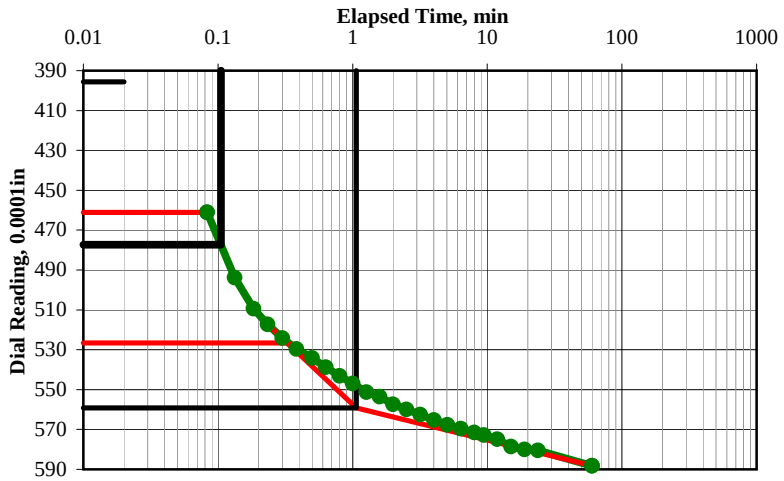
Elapsed Time (min)	Sqrt Time ($min^{1/2}$)	Dial Reading (0.0001in)	Sample Height (in)
0	0	0	1.0000
Corrections*		217	0.0217
Adjusted Sample Height			
0.08	0.29	461.1	0.9756
0.13	0.37	493.8	0.9723
0.18	0.43	509.3	0.9708
0.23	0.48	517.3	0.9700
0.30	0.55	524.2	0.9693
0.38	0.62	529.6	0.9687
0.50	0.71	534.2	0.9683
0.63	0.80	538.7	0.9678
0.80	0.89	543.1	0.9674
1.00	1.00	546.9	0.9670
1.27	1.13	551.2	0.9666
1.58	1.26	553.5	0.9663
2.00	1.41	557.3	0.9660
2.52	1.59	560.0	0.9657
3.18	1.78	562.6	0.9654
4.02	2.00	565.3	0.9652
5.05	2.25	567.7	0.9649
6.37	2.52	569.5	0.9647
8.02	2.83	571.6	0.9645
9.47	3.08	572.8	0.9644
11.92	3.45	574.9	0.9642
15.02	3.88	578.5	0.9638
18.92	4.35	580.0	0.9637
23.83	4.88	580.5	0.9637
60.03	7.75	588.2	0.9195

Machine Deflection

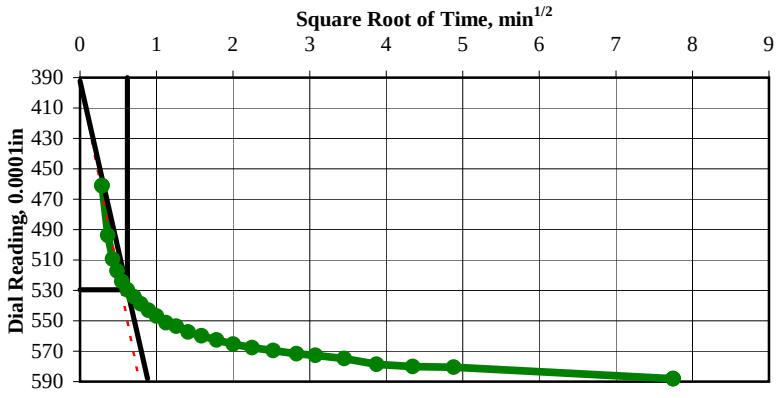
Applied Deflection Correction to Sample Height, 0.0001in 217

**Correction is applied to all dial readings.*

Log of Elapsed Time vs. Dial Reading



Square Root of Elapsed Time vs. Dial Reading



Sqrt. of Elapsed Time vs Dial Reading

T0 = 0 min.	D0 = 392.4 div.
T90 = 0.384 min	D90 = 529.6 div.
T100 = NA min	D100 = 544.8 div.
Height at: D90 = 0.9253, D100 = 0.9238	
Average Sample Height, in	0.9597
Average Drainage Height, in	0.4799
T (Time Factor for T90)	0.848
Coef. of Consol., C_v, in^2/min	0.510

Log of Elapsed Time vs Dial Reading

T0 = 0 min.	D0 = 395.7 div.
T50 = 0.11 min.	D50 = 477.4 div.
T100 = 1.06 min.	D100 = 559.1 div.
Height at: D50 = 0.9306, D100 = 0.9224	
Average Sample Height, in	0.9597
Average Drainage Height, in	0.4799
T (Time Factor for T50)	0.197
Coef. of Consol., C_v, in^2/min	0.412

Load Summary

Initial Sample Height, in	1.0000
Final Sample Height, in	0.9195
Incremental Strain, %	8.05%
Loading Duration, min	60

Input Validation: Reviewed By: Date 12/13/2010

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UNCONFINED COMPRESSIVE STRENGTH OF COHESIVE SOIL - ASTM D 2166

Client	Civil & Environmental Consultants, Inc.	Boring	SB-14
Client No.	091-867 Apex Landfill Expansion	Depth	25'-27'
Project No.	30598	Sample	ST-2 TOP
		Lab Sample No.	30598002

Visual Description: Black Refuse
Sample Condition Undisturbed

SAMPLE CONDITIONS	
Tare Number	943
Wt. Tare & WS, gm	873.62
Wt. Tare & DS, gm	624.94
Wt. Tare, gm	99.98
Moisture Content, %	47.4%
Wt. Tube & WS., gm	1257.2
Wt. Of Tube, gm	424.85
Wt. Of WS., gm	832.35
Length 1, in	6.039
Length 2, in	6.025
Length 3, in	6.033
Top Diameter, in	2.879
Middle Diameter, in	2.873
Bottom Diameter, in	2.874
Average Length, in	6.032
Average Area, in^2	6.493
Sample Volume, cc	641.9
Unit Wet Wt., gm/cc	1.30
Unit Wet Wt., pcf	80.9
Unit Dry Wt., pcf	54.9
Unit Dry Wt., gms/cc	0.88
Specific Gravity, Assumed	2.70
Void Ratio, e	2.07
Porosity, n	0.67
Pore Volume, cc	432.7
Saturation, %	61.8%
Length to Diameter Ratio	2.1

SAMPLE SUMMARY	
Confining Stress (σ_3), psi	**0.0**
UC Strength (q_u), psi	**3.3**
Shear Strength (S_u), psi	**1.6**
Strain at Failure (ε_f), %	**1.4%**
Avg. Displ. Rate, in/min	**0.05**
Average Strain Rate	**0.86%**
Failure Type	**Bulge**

SHEAR DATA						
Axial Deformation in	**Axial Load lb.**	**Axial Strain %**	**Deviator Stress psi**	**Major Principal Stress, psi**	**Stress Path Mohrs Circle Center**	**Radius**
δ	**P**	**ε**	**$\sigma_1-\sigma_3$**	**σ_1**	**p**	**q**
0.000	2.3	0.00%	0.00	0.00	0.00	0.00
0.003	6.3	0.06%	0.62	0.62	0.31	0.31
0.009	10.9	0.14%	1.32	1.32	0.66	0.66
0.014	13.4	0.23%	1.72	1.72	0.86	0.86
0.019	14.8	0.31%	1.93	1.93	0.96	0.96
0.024	16.1	0.40%	2.13	2.13	1.06	1.06
0.029	17.6	0.49%	2.35	2.35	1.18	1.18
0.035	18.7	0.57%	2.52	2.52	1.26	1.26
0.040	19.6	0.66%	2.65	2.65	1.33	1.33
0.045	20.6	0.74%	2.80	2.80	1.40	1.40
0.050	21.3	0.83%	2.91	2.91	1.46	1.46
0.055	22.1	0.91%	3.03	3.03	1.52	1.52
0.060	22.6	1.00%	3.10	3.10	1.55	1.55
0.065	23.1	1.08%	3.18	3.18	1.59	1.59
0.070	23.4	1.16%	3.22	3.22	1.61	1.61
0.075	23.6	1.25%	3.25	3.25	1.62	1.62
0.081	23.8	1.33%	3.27	3.27	1.63	1.63
0.086	23.9	1.42%	3.28	3.28	1.64	1.64
0.091	23.8	1.51%	3.27	3.27	1.64	1.64
0.096	23.6	1.59%	3.23	3.23	1.62	1.62
0.101	23.6	1.67%	3.23	3.23	1.62	1.62
0.106	23.1	1.76%	3.15	3.15	1.57	1.57
0.112	22.8	1.85%	3.10	3.10	1.55	1.55
0.117	22.5	1.94%	3.05	3.05	1.53	1.53
0.122	22.1	2.02%	2.99	2.99	1.49	1.49
0.127	21.8	2.10%	2.95	2.95	1.47	1.47
0.132	21.7	2.19%	2.93	2.93	1.47	1.47
0.137	21.4	2.27%	2.88	2.88	1.44	1.44
0.142	21.1	2.35%	2.84	2.84	1.42	1.42
0.147	20.6	2.43%	2.76	2.76	1.38	1.38
0.152	20.6	2.52%	2.76	2.76	1.38	1.38
0.157	20.5	2.60%	2.73	2.73	1.37	1.37
0.162	20.0	2.68%	2.67	2.67	1.33	1.33
0.167	19.6	2.77%	2.59	2.59	1.30	1.30
0.172	19.4	2.85%	2.56	2.56	1.28	1.28
0.177	19.2	2.94%	2.53	2.53	1.26	1.26
0.182	19.0	3.02%	2.50	2.50	1.25	1.25
0.187	18.8	3.10%	2.47	2.47	1.23	1.23
0.192	18.5	3.19%	2.43	2.43	1.21	1.21
0.197	18.5	3.27%	2.42	2.42	1.21	1.21

0.202	18.3	3.35%	2.39	2.39	1.19	1.19
0.207	18.0	3.44%	2.34	2.34	1.17	1.17
0.212	17.7	3.52%	2.29	2.29	1.15	1.15
0.217	17.4	3.60%	2.25	2.25	1.13	1.13
0.222	17.5	3.67%	2.26	2.26	1.13	1.13
0.227	17.4	3.76%	2.24	2.24	1.12	1.12
0.232	17.1	3.84%	2.20	2.20	1.10	1.10
0.236	16.9	3.92%	2.16	2.16	1.08	1.08
0.241	16.8	4.00%	2.15	2.15	1.08	1.08
0.246	16.4	4.08%	2.09	2.09	1.04	1.04
0.251	16.2	4.16%	2.06	2.06	1.03	1.03

Input Validation: Reviewed By: Date Tested: 2/9/2011

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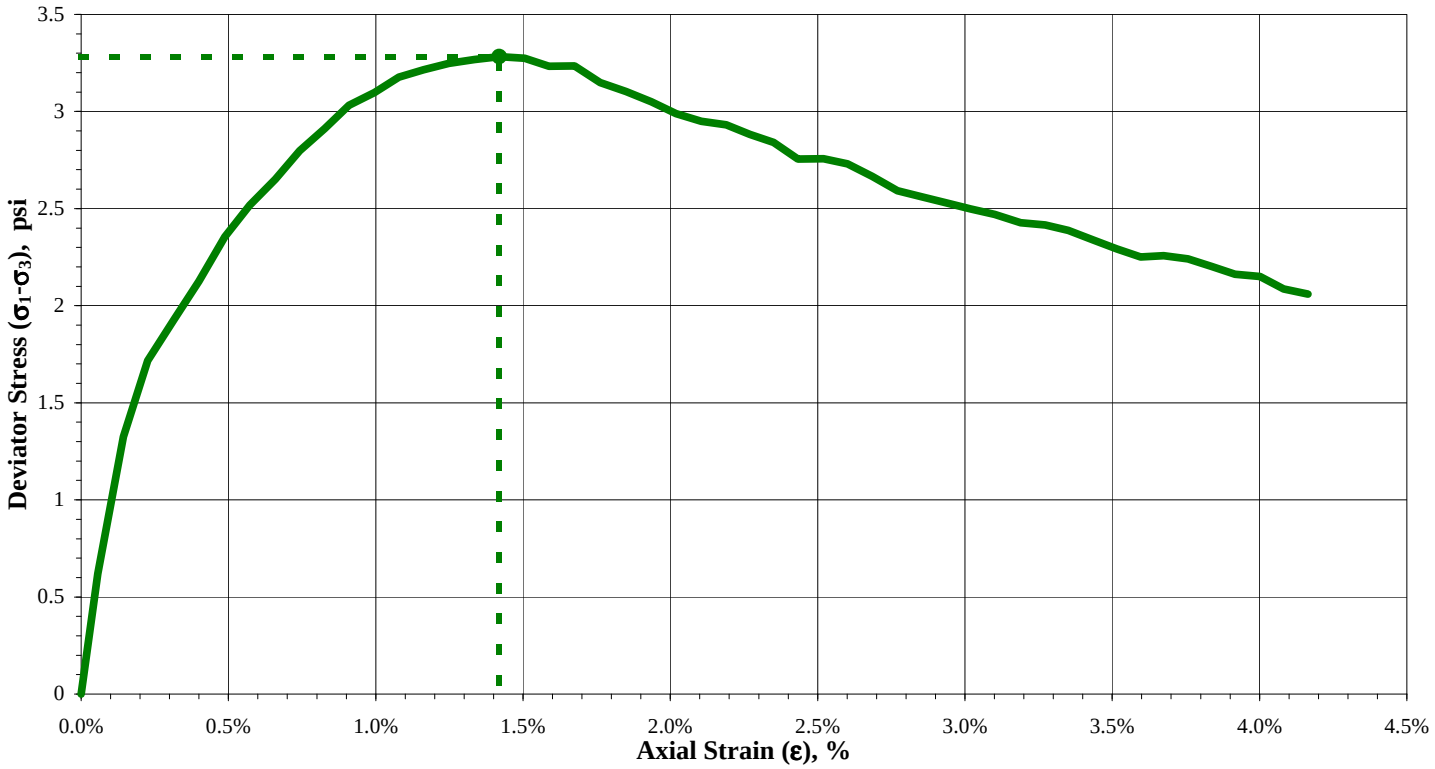
UNCONFINED COMPRESSIVE STRENGTH OF COHESIVE SOIL - ASTM D 2166

Client	Civil & Environmental Consultants, Inc	Boring	SB-14	*Confining Stress (σ_3), psi*	0.0
Client No.	091-867 Apex Landfill Expansion	Depth	25'-27'	UC Strength (q_u), psi	3.3
Project No.	30598	Sample	ST-2 TOP	Shear Strength (S_u), psi	1.6
		Lab ID No.	30598002	Strain at Failure (ε_f), %	1.4%

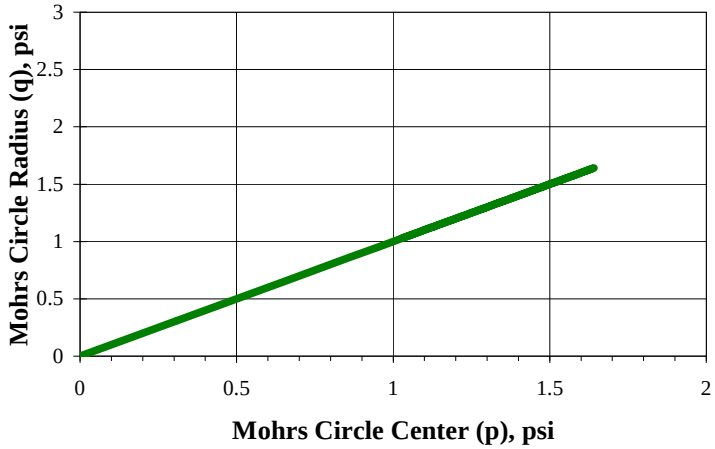
Visual Description: Black Refuse

Sample Condition Undisturbed

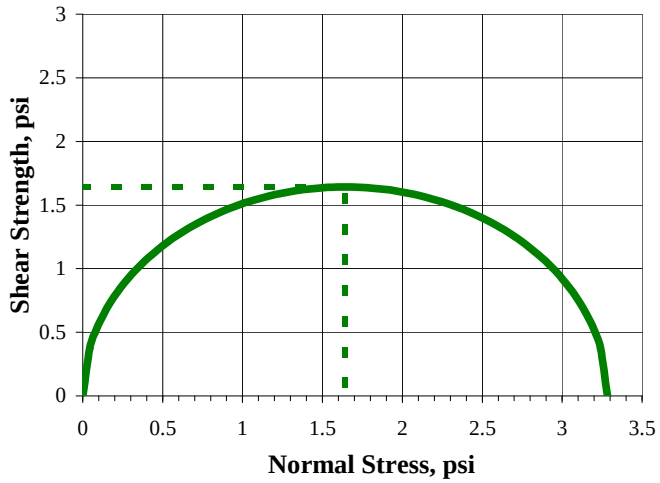
STRESS VS. STRAIN



STRESS PATHS



MOHRS CIRCLE



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CONSOLIDATED-UNDRAINED TRIAXIAL COMPRESSION TEST ON COHESIVE SOILS ASTM D 4767

Client	Civil & Environmental Consultants, Inc.	Boring	SB-20
Client Project	091-867 Apex Landfill Expansion	Depth	16'-18', 17'-19'
Project No.	30598	Sample	ST-1, ST-2
Test No.	1	Lab Sample No.	30598003
USCS Description:	GRAY CLAYEY GRAVEL WITH SAND	Test Conditions:	Undisturbed - Side And Double Drained

SAMPLE CONDITIONS

	Initial	After Consol.	Final
Tare Number	A10	NA	01
Wt. Tare & WS, gm	100.80	NA	663.43
Wt. Tare & DS, gm	85.43	NA	591.18
Wt. Tare, gm	9.53	NA	103.96
Water Content, %	20.3	14.8	14.8
Wt. Tube & WS., gm	1819.9	NA	
Wt. Of Tube, gm	417.5	NA	
Wt. Of WS., gm	1402.4	1339.2	
Length 1, in	5.954	NA	
Length 2, in	5.915	NA	
Length 3, in	5.937	NA	
Top Diameter, in	2.878	NA	
Middle Diameter, in	2.873	NA	
Bottom Diameter, in	2.876	NA	
Average Length, in	5.935	5.857	
Average Diameter, in	2.876	2.850	
Average Area, in^2	6.49	6.38	
Sample Volume, in^3	38.55	37.71	
Unit Dry Wt., gms/cc	1.85	1.89	
Unit Dry Wt., pcf	115.2	117.8	
Specific Gravity, Assume	2.70	2.70	
Volume of Solids, cc	431.94	431.94	
Void Ratio, e	0.46	0.43	
Porosity, n	0.32	0.30	
Pore Volume, cc	12.19	11.35	
Saturation, %	118.2	93.0	

TEST CONDITIONS

Cell Pressure, psi	49.58	
Back Pressure, psi	40.32	
Effective Consolidating Pressure, psi	9.26	σ_3
Pore Pressure Parameter (B), %	95	

SATURATION AND CONSOLIDATION VOLUME CHANGES

Height Change, mils	Reading	Change	Consolidation	
Initial Reading	6.708	0	Volume Change, ml	13.7
After Saturation	6.69	18	Volume Change, in^3	0.84
After Consolidation	6.63	78	Saturation Method:	Wet

STRAIN RATE CALCULATIONS

Calc. Strain Rate, %/min (t50=34.87)	0.0001	Strain Rate Used, %/min	0.0001
Calc. Deformation Rate, in/min	0.0007	Deformation Rate Used	0.0005

EFFECTIVE FAILURE SUMMARY

Failure Conditions	Max σ_1'/σ_3'	15% ε	
Effective Consolidating Pressure, psi	9.26	9.26	σ_3
1St. Maximum Effective Principal Stress Ratio	3.934	3.78	σ_1'/σ_3'
Deviator Stress at Failure, psi	11.94	16.75	$\sigma_1-\sigma_3$
Axial Strain at Failure, %	4.59	15.00	ε
Effective Minor Principal Stress at Failure, psi	4.07	6.02	σ_3'
Effective Major Principal Stress at Failure, psi	16.02	22.77	σ_1'
Mohr's Circle Stress Path (Origin of Circle), psi	10.04	14.39	p'
Mohr's Circle Stress Path (Radius of Circle), psi	5.97	8.38	q

TOTAL FAILURE SUMMARY

Failure Conditions	Max σ_1'/σ_3'	15% ε	
Deviator Stress at Failure, psi	11.94	16.75	$\sigma_1-\sigma_3$
Axial Strain at Failure, %	4.59	15.00	ε
Total Minor Principal Stress at Failure, psi	9.26	9.26	σ_3
Total Major Principal Stress at Failure, psi	21.20	26.01	σ_1

TEST DATA

Axial Load	Axial Deformation	Total Pore Water Pressure	Axial Strain	Principal Stress Difference (Deviator Stress)	Induced Pore Water Pressure	Effective Major Principal Stress	Effective Minor Principal Stress	Effective Principal Stress Ratio	A-Bar	Mohr's Circle Stress Paths	
										Origin of Circle	Radius of Circle
lb.	mils	psi	%	psi	psi	psi	psi			psi	psi
P	ΔH	U	ε	$\sigma_1-\sigma_3$	ΔU	σ_1'	σ_3'	σ_1'/σ_3'	A'	p'	q
10.6	0	40.3	0	0	NA	NA	NA	NA	NA	9.26	0
35.9	5	42.0	0.09	3.95	1.70	11.51	7.56	1.522	0.45	9.54	1.97
43.0	11	42.9	0.19	5.07	2.59	11.73	6.66	1.761	0.54	9.20	2.54
47.8	17	43.5	0.30	5.81	3.21	11.86	6.05	1.960	0.58	8.96	2.90
51.4	23	44.0	0.40	6.37	3.64	11.98	5.62	2.133	0.60	8.80	3.18
54.6	29	44.3	0.50	6.85	4.00	12.11	5.26	2.303	0.61	8.69	3.43
56.9	35	44.6	0.60	7.21	4.26	12.21	4.99	2.444	0.62	8.60	3.61
59.1	43	44.8	0.73	7.55	4.48	12.33	4.78	2.579	0.62	8.55	3.77
61.2	49	45.0	0.83	7.85	4.65	12.46	4.61	2.705	0.62	8.53	3.93
62.5	54	45.1	0.93	8.06	4.80	12.51	4.46	2.807	0.63	8.49	4.03
64.2	60	45.2	1.03	8.31	4.92	12.64	4.34	2.917	0.62	8.49	4.15
65.1	67	45.3	1.14	8.45	5.02	12.68	4.23	2.995	0.63	8.46	4.22
66.3	72	45.4	1.23	8.62	5.11	12.77	4.15	3.077	0.62	8.46	4.31
69.4	89	45.6	1.52	9.08	5.30	13.04	3.96	3.293	0.61	8.50	4.54

72.5	107	45.7	1.83	9.51	5.39	13.38	3.87	3.461	0.60	8.62	4.76
74.6	126	45.8	2.15	9.81	5.44	13.63	3.82	3.572	0.58	8.72	4.91
77.4	144	45.8	2.45	10.20	5.47	13.99	3.79	3.693	0.56	8.89	5.10
79.0	161	45.8	2.75	10.42	5.46	14.22	3.80	3.745	0.55	9.01	5.21
81.2	179	45.8	3.05	10.72	5.43	14.56	3.83	3.799	0.53	9.19	5.36
83.2	197	45.7	3.37	11.00	5.39	14.87	3.87	3.843	0.52	9.37	5.50
85.3	216	45.7	3.68	11.28	5.35	15.18	3.91	3.886	0.50	9.55	5.64
87.0	234	45.6	3.99	11.50	5.29	15.47	3.97	3.893	0.48	9.72	5.75
88.5	251	45.6	4.29	11.69	5.25	15.70	4.01	3.913	0.47	9.86	5.84
90.5	269	45.5	4.59	11.94	5.19	16.02	4.07	3.934	0.46	10.04	5.97
91.9	288	45.4	4.92	12.11	5.11	16.26	4.15	3.917	0.44	10.21	6.06
93.8	305	45.4	5.22	12.35	5.06	16.55	4.20	3.943	0.43	10.37	6.18
95.0	324	45.3	5.53	12.50	5.00	16.76	4.26	3.932	0.42	10.51	6.25
96.1	341	45.2	5.82	12.62	4.92	16.96	4.34	3.909	0.41	10.65	6.31
97.9	359	45.2	6.12	12.84	4.88	17.22	4.38	3.933	0.40	10.80	6.42
99.7	377	45.1	6.44	13.06	4.79	17.54	4.47	3.921	0.39	11.01	6.53
101.0	395	45.1	6.75	13.22	4.73	17.74	4.53	3.920	0.38	11.13	6.61
102.4	413	45.0	7.05	13.37	4.68	17.95	4.58	3.921	0.37	11.26	6.69
104.1	430	44.9	7.35	13.57	4.60	18.23	4.65	3.916	0.36	11.44	6.79
105.4	449	44.9	7.66	13.71	4.55	18.43	4.71	3.909	0.35	11.57	6.86
107.0	467	44.8	7.98	13.91	4.48	18.69	4.78	3.911	0.34	11.73	6.95
108.1	485	44.7	8.28	14.01	4.42	18.85	4.84	3.895	0.33	11.85	7.01
109.1	503	44.7	8.58	14.11	4.36	19.00	4.90	3.880	0.33	11.95	7.05
110.3	520	44.6	8.88	14.24	4.29	19.20	4.97	3.867	0.32	12.08	7.12
112.0	539	44.6	9.20	14.43	4.25	19.43	5.01	3.882	0.31	12.22	7.21
113.5	557	44.5	9.51	14.59	4.19	19.66	5.07	3.877	0.30	12.36	7.29
114.5	575	44.5	9.81	14.69	4.13	19.82	5.13	3.864	0.30	12.47	7.34
115.7	592	44.4	10.11	14.81	4.09	19.98	5.17	3.862	0.29	12.58	7.40
117.1	610	44.4	10.41	14.95	4.03	20.18	5.23	3.857	0.28	12.71	7.47
118.5	629	44.3	10.73	15.09	3.95	20.40	5.31	3.843	0.28	12.86	7.55
120.0	647	44.2	11.04	15.26	3.91	20.60	5.35	3.852	0.27	12.98	7.63
121.2	664	44.2	11.34	15.36	3.85	20.77	5.41	3.840	0.26	13.09	7.68
122.1	683	44.1	11.66	15.44	3.79	20.90	5.46	3.826	0.26	13.18	7.72
123.8	700	44.1	11.96	15.62	3.74	21.14	5.52	3.831	0.25	13.33	7.81
125.3	719	44.0	12.27	15.76	3.66	21.36	5.60	3.817	0.24	13.48	7.88
126.5	737	44.0	12.58	15.88	3.64	21.51	5.62	3.826	0.24	13.56	7.94
127.8	754	43.9	12.87	16.01	3.59	21.68	5.67	3.823	0.24	13.67	8.00
128.6	772	43.8	13.18	16.06	3.52	21.80	5.74	3.797	0.23	13.77	8.03
130.5	791	43.8	13.51	16.25	3.49	22.02	5.77	3.815	0.23	13.90	8.12
131.7	809	43.7	13.82	16.36	3.42	22.19	5.84	3.803	0.22	14.01	8.18
132.2	826	43.7	14.10	16.37	3.39	22.24	5.87	3.788	0.22	14.05	8.18
133.8	844	43.6	14.41	16.53	3.32	22.47	5.94	3.781	0.21	14.21	8.26
134.9	863	43.6	14.73	16.61	3.30	22.58	5.96	3.787	0.21	14.27	8.31
136.6	881	43.6	15.04	16.77	3.24	22.79	6.02	3.784	0.20	14.41	8.39
137.8	899	43.5	15.35	16.87	3.21	22.93	6.05	3.788	0.20	14.49	8.44
138.5	917	43.5	15.65	16.90	3.14	23.02	6.12	3.764	0.20	14.57	8.45
139.6	934	43.4	15.94	17.00	3.10	23.16	6.16	3.760	0.19	14.66	8.50
141.0	952	43.4	16.26	17.12	3.04	23.34	6.22	3.751	0.19	14.78	8.56
142.7	971	43.3	16.58	17.27	3.00	23.53	6.26	3.759	0.18	14.90	8.64
143.9	989	43.3	16.88	17.36	2.96	23.66	6.30	3.756	0.18	14.98	8.68
144.4	1005	43.2	17.16	17.37	2.90	23.72	6.35	3.734	0.18	15.04	8.69
146.0	1024	43.2	17.49	17.51	2.87	23.90	6.39	3.740	0.17	15.14	8.75
147.2	1042	43.1	17.79	17.60	2.82	24.04	6.44	3.735	0.17	15.24	8.80
148.1	1061	43.1	18.11	17.64	2.77	24.13	6.49	3.719	0.17	15.31	8.82

Input Validation: Reviewed By: Date Tested: 12/09/10

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CONSOLIDATED-UNDRAINED TRIAXIAL COMPRESSION TEST ON COHESIVE SOILS ASTM D 4767

Client	Civil & Environmental Consultants, Inc.	Boring	SB-20
Client Project	091-867 Apex Landfill Expansion	Depth	16'-18', 17'-19'
Project No.	30598	Sample	ST-1, ST-2
Test No.	2	Lab Sample No.	30598003
USCS Description:	GRAY CLAYEY GRAVEL WITH SAND	Test Conditions:	Undisturbed - Side And Double Drained

SAMPLE CONDITIONS

	Initial	After Consol.	Final
Tare Number	A10	NA	943
Wt. Tare & WS, gm	100.8	NA	1249.78
Wt. Tare & DS, gm	85.43	NA	1078.83
Wt. Tare, gm	9.53	NA	98.03
Water Content, %	20.3	17.4	17.4
Wt. Tube & WS., gm	1690.2	NA	
Wt. Of Tube, gm	423.8	NA	
Wt. Of WS., gm	1266.4	1236.7	
Length 1, in	5.98	NA	
Length 2, in	5.99	NA	
Length 3, in	6.015	NA	
Top Diameter, in	2.871	NA	
Middle Diameter, in	2.884	NA	
Bottom Diameter, in	2.891	NA	
Average Length, in	5.995	5.787	
Average Diameter, in	2.882	2.807	
Average Area, in^2	6.52	6.19	
Sample Volume, in^3	39.11	36.07	
Unit Dry Wt., gms/cc	1.64	1.78	
Unit Dry Wt., pcf	102.5	111.2	
Specific Gravity, Assume	2.70	2.70	
Volume of Solids, cc	390.04	390.04	
Void Ratio, e	0.64	0.52	
Porosity, n	0.39	0.34	
Pore Volume, cc	15.31	12.27	
Saturation, %	85.0	91.3	

TEST CONDITIONS

Cell Pressure, psi	79.59	
Back Pressure, psi	40.24	
Effective Consolidating Pressure, psi	39.35	σ_3
Pore Pressure Parameter (B), %	96	

SATURATION AND CONSOLIDATION VOLUME CHANGES

Height Change, mils	Reading	Change	Consolidation	
Initial Dial Reading	6.774	0	Volume Change, ml	49.8
After Saturation	6.761	13	Volume Change, in^3	3.04
After Consolidation	6.566	208	Saturation Method:	Wet

STRAIN RATE CALCULATIONS

Calc. Strain Rate, %/min (t50=47.87)	0.0001	Strain Rate Used, %/min	0.0001
Calc. Deformation Rate, in/min	0.0005	Deformation Rate Used	0.0005

EFFECTIVE FAILURE SUMMARY

Failure Conditions	Max σ_1'/σ_3'	15% ε	
Effective Consolidating Pressure, psi	39.35	39.35	σ_3
1St. Maximum Effective Principal Stress Ratio	3.343	3.32	σ_1'/σ_3'
Deviator Stress at Failure, psi	29.02	31.32	$\sigma_1-\sigma_3$
Axial Strain at Failure, %	5.51	15.00	ε
Effective Minor Principal Stress at Failure, psi	12.38	13.53	σ_3'
Effective Major Principal Stress at Failure, psi	41.41	44.85	σ_1'
Mohr's Circle Stress Path (Origin of Circle), psi	26.90	29.19	p'
Mohr's Circle Stress Path (Radius of Circle), psi	14.51	15.66	q

TOTAL FAILURE SUMMARY

Failure Conditions	Max σ_1'/σ_3'	15% ε	
Deviator Stress at Failure, psi	29.02	31.32	$\sigma_1-\sigma_3$
Axial Strain at Failure, %	5.51	15.00	ε
Total Minor Principal Stress at Failure, psi	39.35	39.35	σ_3
Total Major Principal Stress at Failure, psi	68.37	70.67	σ_1

TEST DATA

Axial Load	Axial Deformation	Total Pore Water Pressure	Axial Strain	Principal Stress Difference (Deviator Stress)	Induced Pore Water Pressure	Effective Major Principal Stress	Effective Minor Principal Stress	Effective Principal Stress Ratio	A-Bar	Mohr's Circle Stress Paths	
										Origin of Circle	Radius of Circle
lb.	mils	psi	%	psi	psi	psi	psi			psi	psi
P	ΔH	U	ε	$\sigma_1-\sigma_3$	ΔU	σ_1'	σ_3'	σ_1'/σ_3'	A'	p'	q
13.1	0	40.2	0	0.00	0	NA	NA	NA	NA	39.35	0
41.2	3	42.7	0.06	4.53	2.48	41.40	36.87	1.123	0.57	39.13	2.26
69.9	9	46.1	0.16	9.16	5.86	42.65	33.49	1.274	0.67	38.07	4.58
92.1	15	49.4	0.25	12.73	9.16	42.92	30.19	1.422	0.75	36.55	6.37
107.4	20	52.0	0.35	15.18	11.80	42.72	27.55	1.551	0.81	35.13	7.59
118.7	26	54.2	0.44	16.98	13.96	42.37	25.39	1.669	0.86	33.88	8.49
127.7	31	56.0	0.54	18.41	15.72	42.04	23.63	1.779	0.89	32.84	9.20
135.1	38	57.4	0.65	19.58	17.15	41.78	22.20	1.882	0.91	31.99	9.79
140.9	43	58.6	0.73	20.49	18.36	41.47	20.98	1.976	0.93	31.23	10.24
145.5	49	59.6	0.84	21.21	19.39	41.17	19.96	2.063	0.95	30.56	10.61
149.5	55	60.5	0.95	21.83	20.26	40.91	19.09	2.144	0.97	30.00	10.91
153.3	62	61.3	1.07	22.40	21.04	40.71	18.31	2.223	0.98	29.51	11.20
156.2	68	61.9	1.18	22.84	21.70	40.49	17.65	2.294	0.99	29.07	11.42
164.9	85	63.5	1.48	24.15	23.23	40.27	16.11	2.499	1.00	28.19	12.08

170.7	103	64.5	1.78	25.01	24.31	40.06	15.04	2.663	1.01	27.55	12.51
175.0	120	65.3	2.08	25.60	25.06	39.89	14.29	2.792	1.02	27.09	12.80
179.1	138	65.9	2.39	26.17	25.62	39.90	13.73	2.906	1.02	26.82	13.09
182.0	158	66.3	2.73	26.54	26.05	39.84	13.30	2.995	1.02	26.57	13.27
185.1	175	66.6	3.03	26.94	26.33	39.97	13.02	3.069	1.02	26.49	13.47
187.9	193	66.8	3.33	27.30	26.57	40.08	12.78	3.136	1.01	26.43	13.65
189.5	211	67.0	3.65	27.46	26.76	40.06	12.59	3.181	1.01	26.33	13.73
192.8	229	67.1	3.95	27.88	26.87	40.36	12.47	3.235	1.00	26.42	13.94
194.0	248	67.2	4.28	27.98	26.93	40.40	12.42	3.253	1.00	26.41	13.99
195.6	265	67.2	4.59	28.12	26.98	40.49	12.37	3.274	1.00	26.43	14.06
197.4	282	67.2	4.87	28.32	27.00	40.67	12.35	3.292	0.99	26.51	14.16
200.3	300	67.2	5.19	28.67	26.99	41.03	12.36	3.319	0.98	26.69	14.33
203.2	319	67.2	5.51	29.02	26.96	41.41	12.38	3.343	0.97	26.90	14.51
203.2	337	67.2	5.83	28.92	26.95	41.32	12.40	3.333	0.97	26.86	14.46
204.4	353	67.2	6.10	29.01	26.93	41.43	12.42	3.335	0.97	26.93	14.50
206.7	371	67.1	6.41	29.27	26.89	41.72	12.46	3.349	0.96	27.09	14.63
209.6	389	67.1	6.73	29.61	26.86	42.10	12.49	3.371	0.94	27.30	14.81
210.7	408	67.1	7.06	29.67	26.83	42.19	12.52	3.370	0.94	27.35	14.83
210.6	426	67.0	7.36	29.56	26.79	42.12	12.56	3.353	0.94	27.34	14.78
212.3	443	67.0	7.65	29.72	26.76	42.31	12.59	3.360	0.94	27.45	14.86
213.9	461	66.9	7.96	29.85	26.70	42.50	12.65	3.360	0.93	27.57	14.93
216.4	479	66.9	8.28	30.13	26.66	42.82	12.69	3.374	0.92	27.75	15.06
217.4	498	66.9	8.60	30.16	26.61	42.90	12.74	3.368	0.92	27.82	15.08
218.5	515	66.8	8.90	30.22	26.58	43.00	12.77	3.366	0.92	27.88	15.11
219.7	533	66.7	9.21	30.30	26.50	43.15	12.85	3.358	0.91	28.00	15.15
221.5	551	66.6	9.52	30.46	26.40	43.41	12.95	3.352	0.90	28.18	15.23
223.7	569	66.6	9.83	30.68	26.34	43.69	13.01	3.359	0.89	28.35	15.34
224.5	587	66.5	10.14	30.69	26.29	43.75	13.06	3.350	0.89	28.40	15.34
224.6	605	66.5	10.45	30.60	26.21	43.73	13.13	3.330	0.89	28.43	15.30
226.2	622	66.4	10.75	30.73	26.19	43.89	13.16	3.335	0.89	28.53	15.37
228.2	641	66.4	11.08	30.90	26.17	44.08	13.18	3.345	0.88	28.63	15.45
229.5	659	66.4	11.39	30.98	26.14	44.19	13.21	3.346	0.88	28.70	15.49
229.4	677	66.3	11.70	30.86	26.11	44.10	13.24	3.331	0.88	28.67	15.43
230.7	694	66.3	11.99	30.94	26.09	44.20	13.26	3.333	0.88	28.73	15.47
232.5	712	66.3	12.30	31.08	26.06	44.37	13.29	3.338	0.87	28.83	15.54
233.6	730	66.3	12.61	31.13	26.02	44.45	13.32	3.336	0.87	28.89	15.56
234.6	749	66.2	12.95	31.15	26.01	44.49	13.34	3.335	0.87	28.92	15.58
234.6	766	66.2	13.24	31.05	25.97	44.43	13.38	3.320	0.87	28.91	15.53
235.6	783	66.2	13.53	31.08	25.94	44.49	13.41	3.318	0.87	28.95	15.54
238.7	802	66.1	13.86	31.40	25.91	44.84	13.44	3.336	0.86	29.14	15.70
239.1	821	66.1	14.19	31.33	25.91	44.77	13.44	3.331	0.86	29.10	15.66
239.3	839	66.1	14.49	31.25	25.88	44.71	13.47	3.321	0.86	29.09	15.62
240.5	856	66.1	14.79	31.30	25.86	44.79	13.49	3.321	0.86	29.14	15.65
241.6	874	66.0	15.10	31.34	25.80	44.88	13.54	3.314	0.86	29.21	15.67
243.0	893	66.0	15.42	31.42	25.77	45.00	13.58	3.313	0.85	29.29	15.71
244.3	911	66.0	15.74	31.47	25.75	45.07	13.60	3.315	0.85	29.33	15.74
244.2	928	66.0	16.04	31.34	25.73	44.96	13.62	3.302	0.86	29.29	15.67
245.2	946	65.9	16.34	31.37	25.70	45.02	13.65	3.298	0.85	29.33	15.68
247.0	964	65.9	16.66	31.49	25.64	45.20	13.71	3.297	0.85	29.45	15.74
248.0	982	65.9	16.97	31.51	25.62	45.23	13.73	3.295	0.85	29.48	15.75
247.7	1001	65.8	17.30	31.34	25.61	45.08	13.74	3.281	0.85	29.41	15.67
247.2	1018	65.8	17.59	31.16	25.54	44.97	13.81	3.257	0.85	29.39	15.58
248.8	1035	65.7	17.89	31.26	25.50	45.11	13.85	3.257	0.85	29.48	15.63
251.7	1054	65.7	18.21	31.53	25.50	45.37	13.85	3.277	0.84	29.61	15.76

Input Validation: Reviewed By: Date Tested: 12/09/10

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CONSOLIDATED-UNDRAINED TRIAXIAL COMPRESSION TEST ON COHESIVE SOILS ASTM D 4767

Client	Civil & Environmental Consultants, Inc.	Boring	SB-20
Client Project	091-867 Apex Landfill Expansion	Depth	16'-18', 17'-19'
Project No.	30598	Sample	ST-1, ST-2
Test No.	3	Lab Sample No.	30598003
USCS Description:	GRAY CLAYEY GRAVEL WITH SAND	Test Conditions:	Undisturbed - Side And Double Drained

SAMPLE CONDITIONS

	Initial	After Consol.	Final
Tare Number	A10	NA	805
Wt. Tare & WS, gm	100.8	NA	1321.98
Wt. Tare & DS, gm	85.43	NA	1134.79
Wt. Tare, gm	9.53	NA	102.31
Water Content, %	20.3	18.1	18.1
Wt. Tube & WS., gm	1691.8	NA	
Wt. Of Tube, gm	419.8	NA	
Wt. Of WS., gm	1272.0	1249.6	
Length 1, in	5.981	NA	
Length 2, in	5.953	NA	
Length 3, in	5.957	NA	
Top Diameter, in	2.967	NA	
Middle Diameter, in	2.968	NA	
Bottom Diameter, in	2.975	NA	
Average Length, in	5.964	5.717	
Average Diameter, in	2.970	2.840	
Average Area, in^2	6.93	6.34	
Sample Volume, in^3	41.32	38.17	
Unit Dry Wt., gms/cc	1.56	1.69	
Unit Dry Wt., pcf	97.5	105.5	
Specific Gravity, Assume	2.70	2.70	
Volume of Solids, cc	391.77	391.77	
Void Ratio, e	0.73	0.60	
Porosity, n	0.42	0.37	
Pore Volume, cc	17.41	14.27	
Saturation, %	75.1	82.0	

TEST CONDITIONS

Cell Pressure, psi	120.04	
Back Pressure, psi	40.04	
Effective Consolidating Pressure, psi	79.99	σ_3
Pore Pressure Parameter (B), %	96	

SATURATION AND CONSOLIDATION VOLUME CHANGES

Height Change, mils	Reading	Change	Consolidation	
Initial Dial Reading	7.163	0	Volume Change, ml	51.5
After Saturation	7.069	94	Volume Change, in^3	3.14
After Consolidation	6.916	247	Saturation Method:	Wet

STRAIN RATE CALCULATIONS

Calc. Strain Rate, %/min (t50=14.02)	0.0003	Strain Rate Used, %/min	0.0001
Calc. Deformation Rate, in/min	0.0016	Deformation Rate Used	0.0005

EFFECTIVE FAILURE SUMMARY

Failure Conditions	Max σ_1'/σ_3'	15% ε	
Effective Consolidating Pressure, psi	79.99	79.99	σ_3
1St. Maximum Effective Principal Stress Ratio	2.914	2.81	σ_1'/σ_3'
Deviator Stress at Failure, psi	58.16	63.54	$\sigma_1-\sigma_3$
Axial Strain at Failure, %	6.54	15.00	ε
Effective Minor Principal Stress at Failure, psi	30.38	35.15	σ_3'
Effective Major Principal Stress at Failure, psi	88.54	98.69	σ_1'
Mohr's Circle Stress Path (Origin of Circle), psi	59.46	66.92	p'
Mohr's Circle Stress Path (Radius of Circle), psi	29.08	31.77	q

TOTAL FAILURE SUMMARY

Failure Conditions	Max σ_1'/σ_3'	15% ε	
Deviator Stress at Failure, psi	58.16	63.54	$\sigma_1-\sigma_3$
Axial Strain at Failure, %	6.54	15.00	ε
Total Minor Principal Stress at Failure, psi	79.99	79.99	σ_3
Total Major Principal Stress at Failure, psi	138.15	143.54	σ_1

TEST DATA

Axial Load	Axial Deformation	Total Pore Water Pressure	Axial Strain	Principal Stress Difference (Deviator Stress)	Induced Pore Water Pressure	Effective Major Principal Stress	Effective Minor Principal Stress	Effective Principal Stress Ratio	A-Bar	Mohr's Circle Stress Paths	
										Origin of Circle	Radius of Circle
lb.	mils	psi	%	psi	psi	psi	psi			psi	psi
P	ΔH	U	ε	$\sigma_1-\sigma_3$	ΔU	σ_1'	σ_3'	σ_1'/σ_3'	A'	p'	q
16.9	0	40.0	0	0	0	NA	NA	NA	NA	79.99	0
76.4	5	45.1	0.08	9.37	5.02	84.34	74.97	1.125	0.56	79.66	4.69
127.7	11	50.9	0.18	17.45	10.82	86.62	69.17	1.252	0.65	77.90	8.73
157.3	16	55.4	0.28	22.09	15.33	86.75	64.67	1.342	0.72	75.71	11.04
179.9	22	59.1	0.39	25.62	19.02	86.59	60.98	1.420	0.77	73.78	12.81
197.9	29	62.1	0.51	28.41	22.02	86.38	57.97	1.490	0.81	72.18	14.21
213.5	35	64.9	0.61	30.84	24.82	86.01	55.17	1.559	0.84	70.59	15.42
226.9	41	67.2	0.72	32.91	27.19	85.71	52.80	1.623	0.86	69.26	16.45
238.4	47	69.3	0.82	34.67	29.22	85.44	50.77	1.683	0.88	68.10	17.33
248.2	53	71.0	0.92	36.16	30.98	85.17	49.01	1.738	0.89	67.09	18.08
257.4	58	72.7	1.02	37.57	32.63	84.93	47.37	1.793	0.90	66.15	18.78
264.7	63	74.1	1.11	38.67	34.02	84.64	45.97	1.841	0.92	65.31	19.33
271.9	69	75.4	1.20	39.76	35.34	84.41	44.65	1.890	0.93	64.53	19.88
290.5	87	78.6	1.52	42.53	38.53	83.99	41.46	2.026	0.94	62.72	21.26

305.9	105	81.1	1.83	44.78	41.03	83.74	38.96	2.149	0.95	61.35	22.39
319.0	124	83.1	2.17	46.64	43.06	83.57	36.93	2.263	0.96	60.25	23.32
330.2	141	84.6	2.47	48.22	44.56	83.65	35.43	2.361	0.96	59.54	24.11
339.1	158	85.9	2.76	49.44	45.82	83.61	34.18	2.447	0.97	58.89	24.72
347.4	176	86.8	3.08	50.55	46.76	83.78	33.24	2.521	0.96	58.51	25.27
355.4	194	87.6	3.40	51.61	47.57	84.03	32.42	2.592	0.96	58.23	25.80
362.8	213	88.1	3.72	52.56	48.02	84.53	31.97	2.644	0.95	58.25	26.28
369.4	230	88.7	4.03	53.39	48.64	84.74	31.35	2.703	0.95	58.05	26.69
375.2	247	89.0	4.32	54.11	48.94	85.16	31.06	2.742	0.94	58.11	27.05
380.9	266	89.2	4.65	54.77	49.18	85.59	30.82	2.777	0.94	58.20	27.39
386.7	284	89.5	4.97	55.45	49.45	86.00	30.54	2.816	0.93	58.27	27.73
392.4	303	89.3	5.30	56.12	49.29	86.82	30.70	2.828	0.91	58.76	28.06
396.8	319	89.6	5.57	56.61	49.58	87.02	30.41	2.862	0.91	58.71	28.30
401.4	336	89.6	5.88	57.11	49.58	87.52	30.41	2.878	0.90	58.96	28.55
406.3	355	89.6	6.21	57.63	49.60	88.02	30.39	2.896	0.90	59.21	28.82
411.2	374	89.7	6.54	58.16	49.61	88.54	30.38	2.914	0.89	59.46	29.08
415.6	391	89.3	6.85	58.61	49.27	89.33	30.72	2.908	0.88	60.03	29.30
419.3	408	89.5	7.13	58.98	49.45	89.52	30.54	2.931	0.87	60.03	29.49
423.0	426	89.3	7.45	59.31	49.30	90.00	30.69	2.933	0.87	60.35	29.65
427.1	444	89.2	7.77	59.71	49.16	90.54	30.83	2.936	0.86	60.69	29.85
431.4	462	89.1	8.09	60.13	49.04	91.08	30.95	2.943	0.85	61.02	30.07
434.2	480	88.7	8.39	60.34	48.64	91.69	31.35	2.924	0.84	61.52	30.17
437.7	498	88.7	8.70	60.63	48.70	91.92	31.29	2.938	0.84	61.61	30.32
440.7	516	88.6	9.02	60.85	48.53	92.32	31.46	2.934	0.83	61.89	30.43
445.1	534	88.4	9.35	61.26	48.34	92.91	31.65	2.935	0.82	62.28	30.63
448.1	552	88.2	9.65	61.48	48.18	93.29	31.82	2.932	0.82	62.55	30.74
451.4	569	87.9	9.95	61.74	47.81	93.93	32.19	2.918	0.81	63.06	30.87
453.6	587	87.8	10.27	61.84	47.76	94.08	32.23	2.919	0.80	63.15	30.92
457.3	606	87.6	10.59	62.14	47.60	94.53	32.40	2.918	0.80	63.46	31.07
460.4	624	87.4	10.91	62.36	47.33	95.02	32.67	2.909	0.79	63.84	31.18
463.3	641	87.2	11.22	62.54	47.13	95.41	32.86	2.903	0.78	64.13	31.27
465.1	658	86.9	11.51	62.59	46.90	95.69	33.09	2.891	0.78	64.39	31.30
467.3	677	86.8	11.84	62.67	46.74	95.92	33.25	2.885	0.78	64.59	31.34
470.5	695	86.7	12.15	62.89	46.65	96.23	33.34	2.886	0.77	64.79	31.44
473.8	712	86.5	12.46	63.12	46.48	96.63	33.51	2.884	0.77	65.07	31.56
476.0	730	86.3	12.77	63.19	46.25	96.94	33.75	2.873	0.76	65.34	31.60
477.3	748	86.1	13.09	63.15	46.08	97.06	33.91	2.862	0.76	65.49	31.58
480.0	766	85.9	13.40	63.29	45.86	97.42	34.13	2.854	0.75	65.78	31.64
482.2	785	85.7	13.72	63.36	45.66	97.69	34.34	2.845	0.75	66.01	31.68
485.0	803	85.6	14.04	63.51	45.58	97.92	34.41	2.846	0.75	66.16	31.75
486.5	820	85.3	14.34	63.48	45.21	98.27	34.78	2.825	0.74	66.53	31.74
488.4	838	85.2	14.65	63.50	45.20	98.29	34.79	2.825	0.74	66.54	31.75
490.3	856	84.9	14.97	63.53	44.86	98.67	35.14	2.808	0.74	66.90	31.76
493.4	875	84.8	15.30	63.70	44.72	98.97	35.27	2.806	0.73	67.12	31.85
496.4	891	84.5	15.59	63.88	44.49	99.38	35.51	2.799	0.73	67.44	31.94
#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
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Input Validation: Reviewed By: Date Tested: 12/09/10

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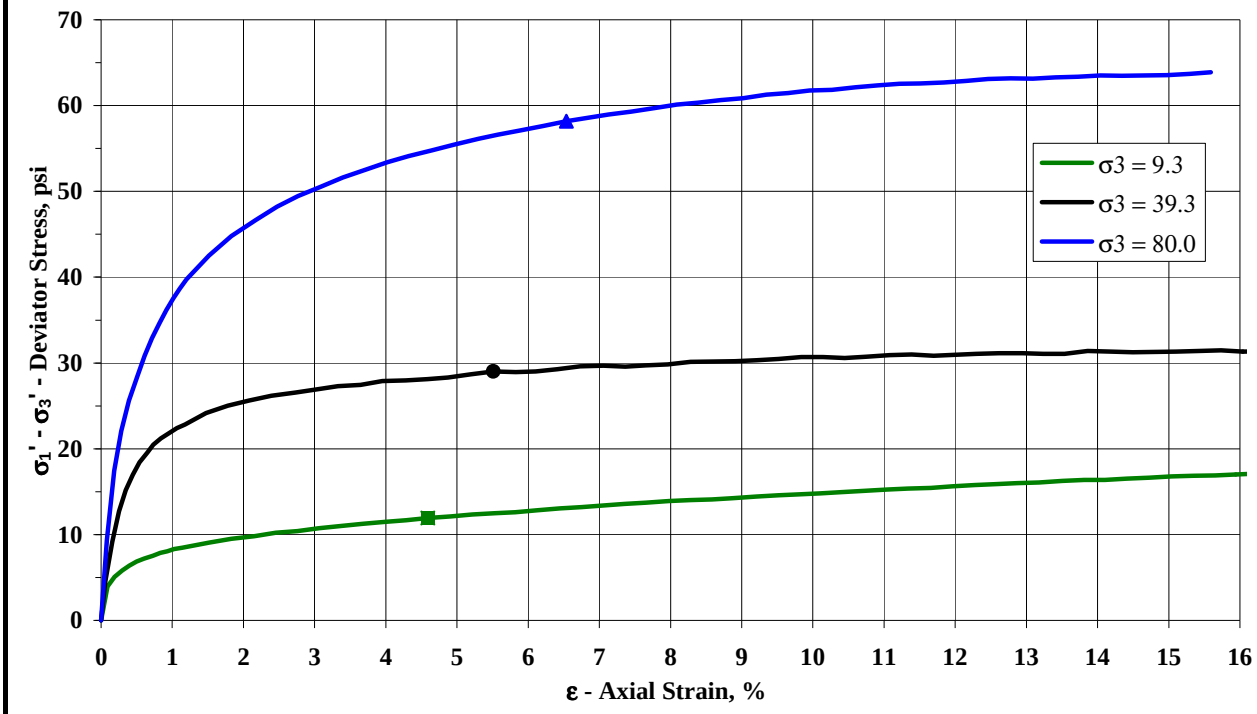
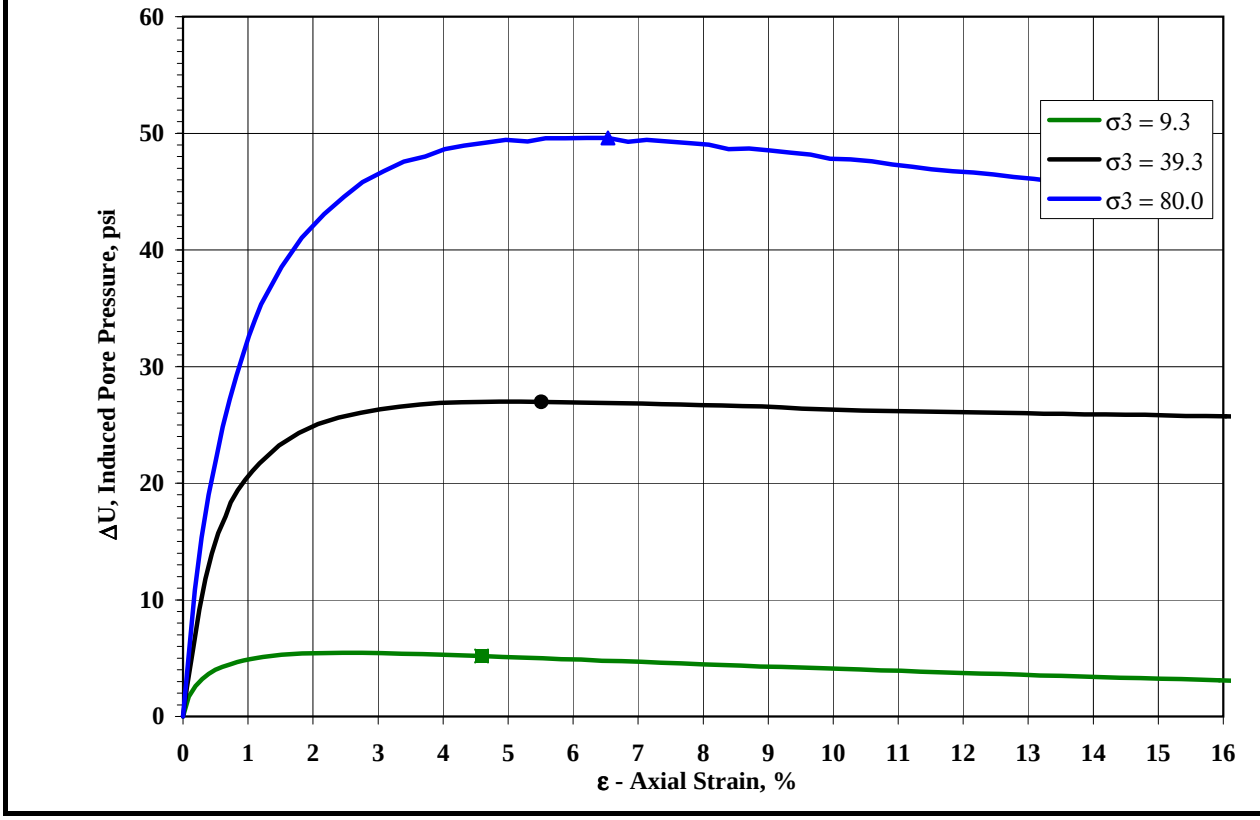
CONSOLIDATED-UNDRAINED TRIAXIAL COMPRESSION TEST ON COHESIVE SOILS ASTM D 4767

Client	Civil & Environmental Consultants, Inc.	Boring	SB-20
Client Project	091-867 Apex Landfill Expansion	Depth	16'-18', 17'-19'
Project No.	30598	Sample	ST-1, ST-2
Test Conditions:	Undisturbed - Side And Double Drained	Lab Sample No.	30598003
USCS Description:	GRAY CLAYEY GRAVEL WITH SAND		

AXIAL STRAIN vs. DEVIATOR STRESS



AXIAL STRAIN vs. INDUCED PORE-WATER PRESSURE



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CONSOLIDATED-UNDRAINED TRIAXIAL COMPRESSION TEST ON COHESIVE SOILS ASTM D 476

Client	Civil & Environmental Consultants, In	Boring	SB-20
Client Project	091-867 Apex Landfill Expansion	Depth	16'-18', 17'-19'
Project No.	30598	Sample	ST-1, ST-2
		Lab Sample No.	30598003
USCS Description:	GRAY CLAYEY GRAVEL WITH SAND		
Test Conditions:	Undisturbed - Side And Double Drained		

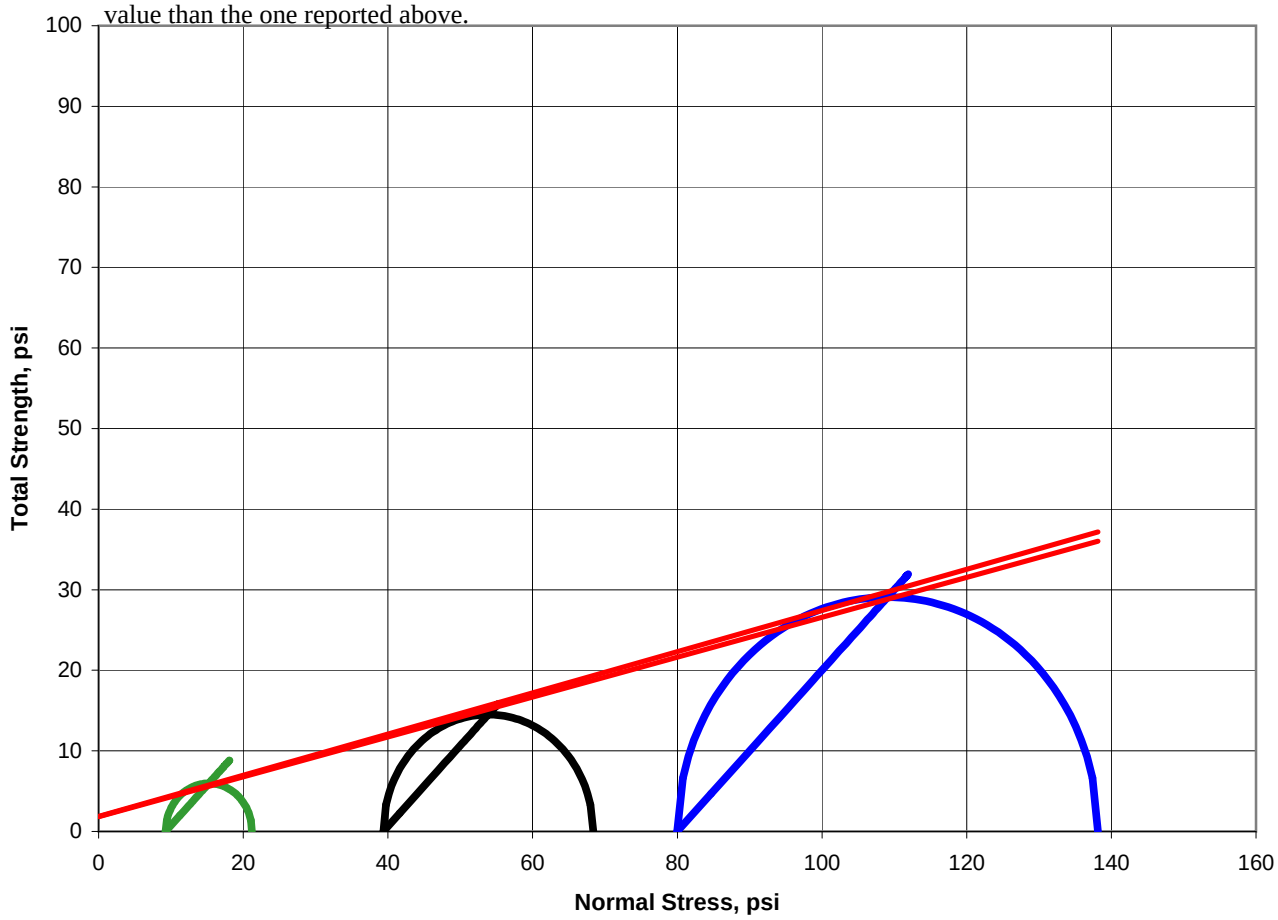
TOTAL STRESS

FAILURE CONDITION: 1st. MAX. EFFECTIVE PRINCIPAL STRESS RATIO

Test No.	Deviator Stress	Major Principal Stress	Minor Principal Stress	Strain at Failure	Mohr's Circle Stress Path		Failure Angle	
	$\sigma1-\sigma3$	$\sigma1$	$\sigma3$	ε	$(\sigma1+\sigma3)/2$	$(\sigma1-\sigma3)/2$		
	psi	psi	psi	%	psi	psi	α, deg	13.9
Test 1	11.94	21.20	9.26	4.59	15.23	5.97	a, psi	1.8
Test 2	29.02	68.37	39.35	5.51	53.86	14.51	Φ, deg	14.3
Test 3	58.16	138.15	79.99	6.54	109.07	29.08	C, psi	1.9

Calculations based on: Test 1 Test 2 Test 3

Note: The Friction Angle and Cohesion using other combinations of test points may yield a higher or lower value than the one reported above.



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CONSOLIDATED-UNDRAINED TRIAXIAL COMPRESSION TEST ON COHESIVE SOILS ASTM D 476

Client	Civil & Environmental Consultants, In	Boring	SB-20
Client Project	091-867 Apex Landfill Expansion	Depth	16'-18', 17'-19'
Project No.	30598	Sample	ST-1, ST-2
		Lab Sample No.	30598003
USCS Description:	GRAY CLAYEY GRAVEL WITH SAND		
Test Conditions:	Undisturbed - Side And Double Drained		

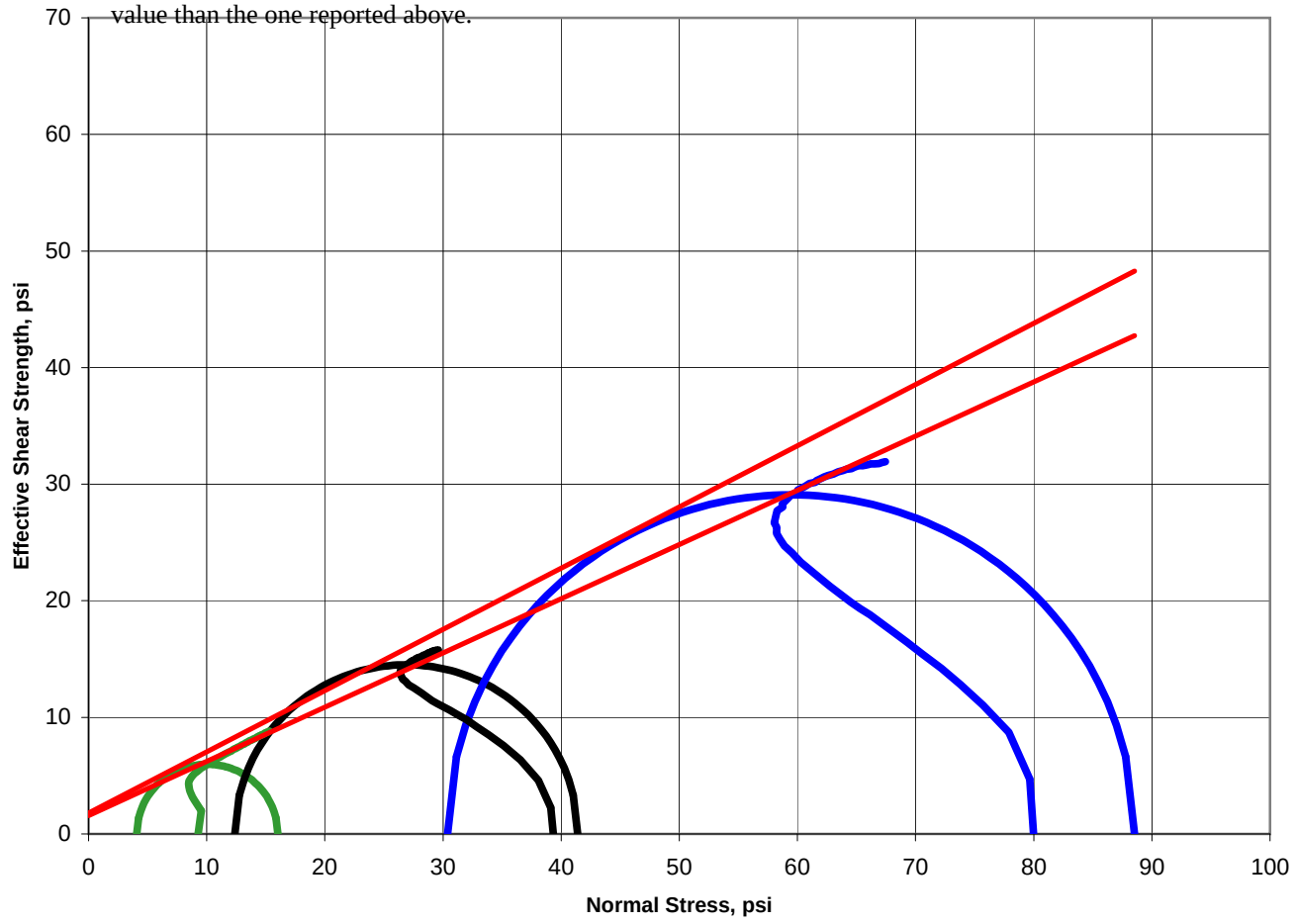
EFFECTIVE STRESS

FAILURE CONDITION: 1st. MAX. EFFECTIVE PRINCIPAL STRESS RATIO

Test No.	Deviator Stress	Major Principal Stress	Minor Principal Stress	Strain at Failure	Mohr's Circle Stress Path		Failure Angle	
	$\sigma 1-\sigma 3$	$\sigma' 1$	$\sigma' 3$	ε	p'	q		
	psi	psi	psi	%	psi	psi	α', deg	24.9
Test 1	11.94	16.02	4.07	4.59	10.04	5.97	a', psi	1.6
Test 2	29.02	41.41	12.38	5.51	26.90	14.51	Φ', deg	27.7
Test 3	58.16	88.54	30.38	6.54	59.46	29.08	C', psi	1.8

Calculations based on: Test 1 Test 2 Test 3

Note: The Friction Angle and Cohesion using other combinations of test points may yield a higher or lower value than the one reported above.



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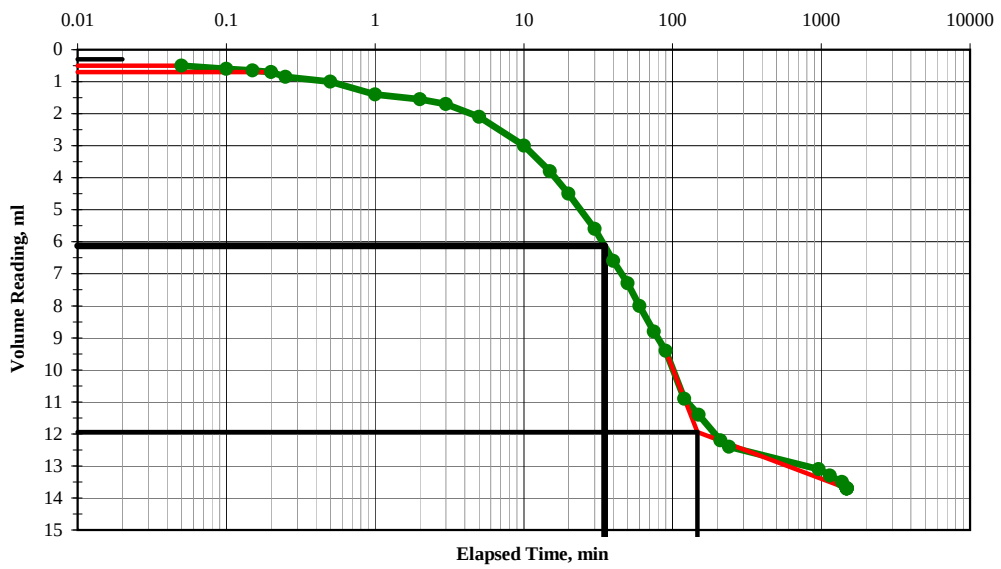
THREE DIMENSIONAL TRIAXIAL CONSOLIDATION TEST

Client	Civil & Environmental Consultants, Inc	Boring	SB-20	**Staged Consolidation**	
Client Project	091-867 Apex Landfill Expansion	Depth	16'-18', 17'-19'	Consolidation Plot Stress, psi	6.3
Project No.	30598	Sample	ST-1, ST-2	**Final Test Pressures**	
		Lab Sample	30598003	Cell Pressure, psi	49.6
USCS Description:	GRAY CLAYEY GRAVEL WITH SAND			Back Pressure, psi	40.3
Test Conditions:	Undisturbed - Side And Double Drained			Effective Consol., psi	9.3
				Additional Consol. Volume, ml	0.0

Consol. Start Date: 12/9/2010

Elapsed Time (min)	Sqrt Time ($min^{1/2}$)	Volume Reading ml
0	0	0.0
0.05	0.22	0.5
0.10	0.32	0.6
0.15	0.39	0.6
0.20	0.45	0.7
0.25	0.50	0.9
0.50	0.71	1.0
1.00	1.00	1.4
2.00	1.41	1.6
3.00	1.73	1.7
5.00	2.24	2.1
10.00	3.16	3.0
15.00	3.87	3.8
20.00	4.47	4.5
30.00	5.48	5.6
40.00	6.32	6.6
50.00	7.07	7.3
60.00	7.75	8.0
75.00	8.66	8.8
90.00	9.49	9.4
120.00	10.95	10.9
150.00	12.25	11.4
210.00	14.49	12.2
240.00	15.49	12.4
960.00	30.98	13.1
1140.00	33.76	13.3
1380.00	37.15	13.5
1485.00	38.54	13.7

Log of Elapsed Time vs. Volume Reading



Square Root of Elapsed Time vs. Volume Reading

Sqrt. of Elapsed Time vs Volume		Log of Elapsed Time vs Volume		Consolidation Summary	
T0 = 0 min.	V0 = 0.2 ml.	T0 = 0 min.	V0 = 0.3 ml.	Initial Volume Reading, ml	0.0
T90 = 188.8 min	V90 = 11.9 ml.	T50 = 34.9 min.	V50 = 6.1 ml.	Final Volume Reading, ml	13.7
T100 = NA min	V100 = 13.2 ml.	T100 = 146.6 min.	V100 = 11.9 ml.	Total Volume Change, ml	13.7

Input Validation: Reviewed By: Date 12/9/2010

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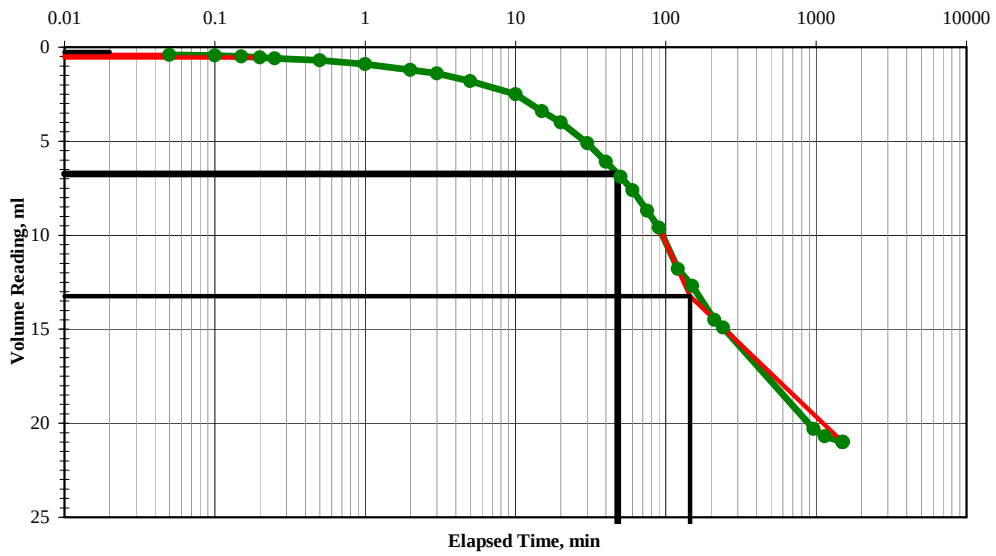
THREE DIMENSIONAL TRIAXIAL CONSOLIDATION TEST

Client	Civil & Environmental Consultants, Inc	Boring	SB-20	**Staged Consolidation**	
Client Project	091-867 Apex Landfill Expansion	Depth	16'-18', 17'-19'	Consolidation Plot Stress, psi	6.3
Project No.	30598	Sample	ST-1, ST-2	**Final Test Pressures**	
		Lab Sample	30598003	Cell Pressure, psi	79.6
USCS Description:	GRAY CLAYEY GRAVEL WITH SAND			Back Pressure, psi	40.2
Test Conditions:	Undisturbed - Side And Double Drained			Effective Consol., psi	39.3
				Additional Consol. Volume, ml	28.8

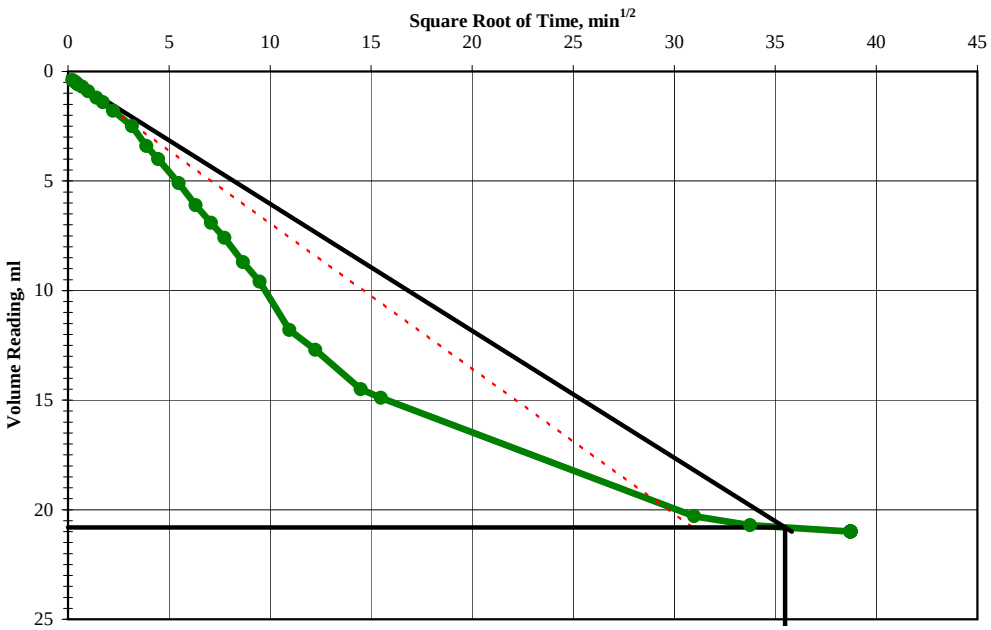
Consol. Start Date: 12/9/2010

Elapsed Time (min)	Sqrt Time ($min^{1/2}$)	Volume Reading ml
0	0	0.0
0.05	0.22	0.4
0.10	0.32	0.4
0.15	0.39	0.5
0.20	0.45	0.6
0.25	0.50	0.6
0.50	0.71	0.7
1.00	1.00	0.9
2.00	1.41	1.2
3.00	1.73	1.4
5.00	2.24	1.8
10.00	3.16	2.5
15.00	3.87	3.4
20.00	4.47	4.0
30.00	5.48	5.1
40.00	6.32	6.1
50.00	7.07	6.9
60.00	7.75	7.6
75.00	8.66	8.7
90.00	9.49	9.6
120.00	10.95	11.8
150.00	12.25	12.7
210.00	14.49	14.5
240.00	15.49	14.9
960.00	30.98	20.3
1140.00	33.76	20.7
1500.00	38.73	21.0

Log of Elapsed Time vs. Volume Reading



Square Root of Elapsed Time vs. Volume Reading



Sqrt. of Elapsed Time vs Volume		Log of Elapsed Time vs Volume		Consolidation Summary	
T0 = 0 min.	V0 = 0.2 ml.	T0 = 0 min.	V0 = 0.2 ml.	Initial Volume Reading, ml	0.0
T90 = 1,258.8 min	V90 = 20.8 ml.	T50 = 47.9 min.	V50 = 6.7 ml.	Final Volume Reading, ml	21.0
T100 = NA min	V100 = 23.1 ml.	T100 = 144.8 min.	V100 = 13.2 ml.	Total Volume Change, ml	49.8

Input Validation: Reviewed By: Date 12/9/2010

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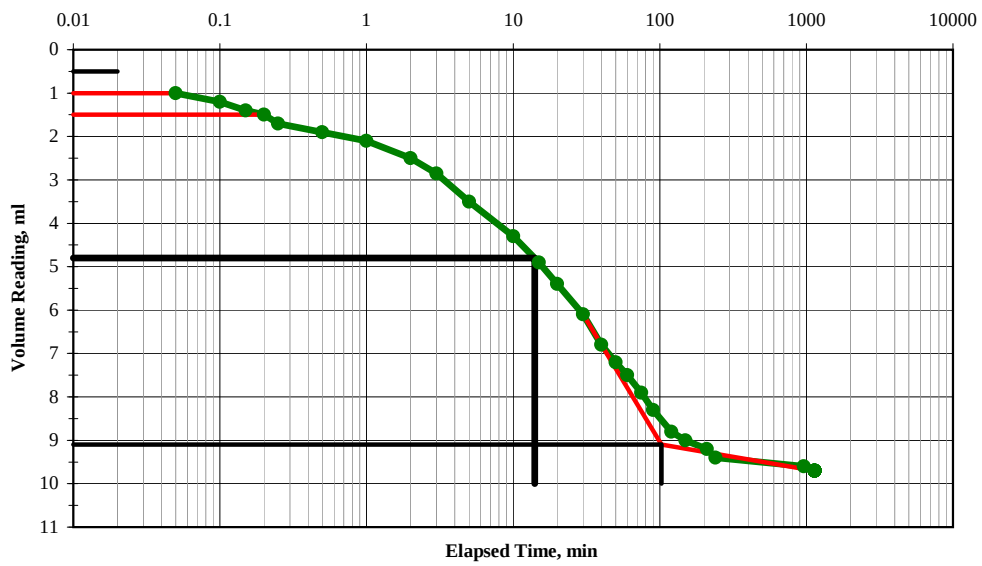
THREE DIMENSIONAL TRIAXIAL CONSOLIDATION TEST

Client	Civil & Environmental Consultants, Inc	Boring	SB-20	**Staged Consolidation**	
Client Project	091-867 Apex Landfill Expansion	Depth	16'-18', 17'-19'	Consolidation Plot Stress, psi	6.3
Project No.	30598	Sample	ST-1, ST-2	**Final Test Pressures**	
		Lab Sample I	30598003	Cell Pressure, psi	120.0
USCS Description:	GRAY CLAYEY GRAVEL WITH SAND			Back Pressure, psi	40.0
Test Conditions:	Undisturbed - Side And Double Drained			Effective Consol., psi	80.0
				Additional Consol. Volume, m	41.8

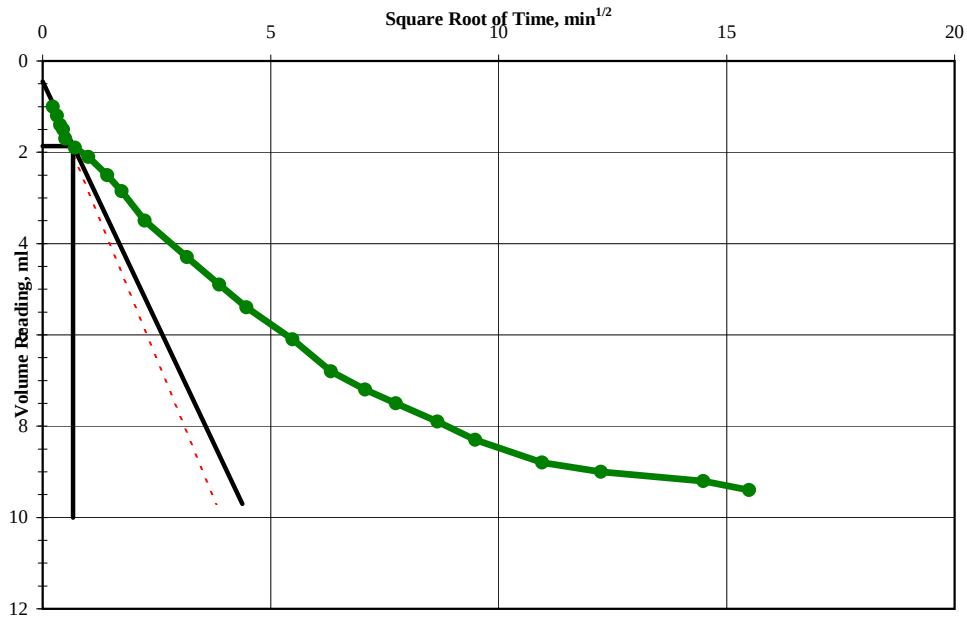
Consol. Start Date: 12/9/2010

Elapsed Time (min)	Sqrt Time ($min^{1/2}$)	Volume Reading ml
0	0	0.0
0.05	0.22	1.0
0.10	0.32	1.2
0.15	0.39	1.4
0.20	0.45	1.5
0.25	0.50	1.7
0.50	0.71	1.9
1.00	1.00	2.1
2.00	1.41	2.5
3.00	1.73	2.9
5.00	2.24	3.5
10.00	3.16	4.3
15.00	3.87	4.9
20.00	4.47	5.4
30.00	5.48	6.1
40.00	6.32	6.8
50.00	7.07	7.2
60.00	7.75	7.5
75.00	8.66	7.9
90.00	9.49	8.3
120.00	10.95	8.8
150.00	12.25	9.0
210.00	14.49	9.2
240.00	15.49	9.4
960.00	30.98	9.6
1140.00	33.76	9.7

Log of Elapsed Time vs. Volume Reading



Square Root of Elapsed Time vs. Volume Reading



Sqrt. of Elapsed Time vs Volume		Log of Elapsed Time vs Volume		Consolidation Summary	
T0 = 0 min.	V0 = 0.4 ml.	T0 = 0 min.	V0 = 0.5 ml.	Initial Volume Reading, ml	0.0
T90 = 0.4 min	V90 = 1.9 ml.	T50 = 14.0 min.	V50 = 4.8 ml.	Final Volume Reading, ml	9.7
T100 = NA min	V100 = 2.0 ml.	T100 = 103.0 min.	V100 = 9.1 ml.	Total Volume Change, ml	51.5

Input Validation: Reviewed By: Date 12/9/2010

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CONSOLIDATED-UNDRAINED TRIAXIAL COMPRESSION TEST ON COHESIVE SOILS ASTM D 4767

Client	Civil & Environmental Consultants, Inc.	Boring	SB-16
Client Project	091-867 Apex Landfill Expansion	Depth	1'-3'
Project No.	30598	Sample	ST-1
Test No.	1	Lab Sample No.	30598004
USCS Description:	Light Yellowish Brown Lean Clay With Sand	Test Conditions:	Undisturbed - Side And Double Drained

SAMPLE CONDITIONS

	Initial	After Consol.	Final
Tare Number	A23	NA	904
Wt. Tare & WS, gm	134.52	NA	278.17
Wt. Tare & DS, gm	112.93	NA	249.35
Wt. Tare, gm	9.43	NA	98.99
Water Content, %	20.9	19.2	19.2
Wt. Tube & WS., gm	1279.3	NA	
Wt. Of Tube, gm	0.0	NA	
Wt. Of WS., gm	1279.3	1261.4	
Length 1, in	5.977	NA	
Length 2, in	5.893	NA	
Length 3, in	5.88	NA	
Top Diameter, in	2.895	NA	
Middle Diameter, in	2.909	NA	
Bottom Diameter, in	2.847	NA	
Average Length, in	5.917	5.890	
Average Diameter, in	2.884	2.872	
Average Area, in^2	6.53	6.48	
Sample Volume, in^3	38.64	38.17	
Unit Dry Wt., gms/cc	1.67	1.69	
Unit Dry Wt., pcf	104.3	105.6	
Specific Gravity, Assume	2.70	2.70	
Volume of Solids, cc	392.04	392.04	
Void Ratio, e	0.62	0.60	
Porosity, n	0.38	0.37	
Pore Volume, cc	14.72	14.24	
Saturation, %	91.5	86.9	

TEST CONDITIONS

Cell Pressure, psi	59.89	
Back Pressure, psi	50.00	
Effective Consolidating Pressure, psi	9.88	σ_3
Pore Pressure Parameter (B), %	95	

SATURATION AND CONSOLIDATION VOLUME CHANGES

Height Change, mils	Reading	Change	Consolidation	
Initial Reading	6.725	0	Volume Change, ml	7.8
After Saturation	6.725	0	Volume Change, in^3	0.48
After Consolidation	6.698	27	Saturation Method:	Wet

STRAIN RATE CALCULATIONS

Calc. Strain Rate, %/min (t50=19.13)	0.0002	Strain Rate Used, %/min	0.0001
Calc. Deformation Rate, in/min	0.0012	Deformation Rate Used	0.0005

EFFECTIVE FAILURE SUMMARY

Failure Conditions	Max σ_1'/σ_3'	15% ε	
Effective Consolidating Pressure, psi	9.88	9.88	σ_3
1St. Maximum Effective Principal Stress Ratio	3.268	2.37	σ_1'/σ_3'
Deviator Stress at Failure, psi	15.03	18.35	$\sigma_1-\sigma_3$
Axial Strain at Failure, %	3.73	15.00	ε
Effective Minor Principal Stress at Failure, psi	6.63	13.42	σ_3'
Effective Major Principal Stress at Failure, psi	21.66	31.77	σ_1'
Mohr's Circle Stress Path (Origin of Circle), psi	14.14	22.59	p'
Mohr's Circle Stress Path (Radius of Circle), psi	7.52	9.18	q

TOTAL FAILURE SUMMARY

Failure Conditions	Max σ_1'/σ_3'	15% ε	
Deviator Stress at Failure, psi	15.03	18.35	$\sigma_1-\sigma_3$
Axial Strain at Failure, %	3.73	15.00	ε
Total Minor Principal Stress at Failure, psi	9.88	9.88	σ_3
Total Major Principal Stress at Failure, psi	24.92	28.23	σ_1

TEST DATA

Axial Load	Axial Deformation	Total Pore Water Pressure	Axial Strain	Principal Stress Difference (Deviator Stress)	Induced Pore Water Pressure	Effective Major Principal Stress	Effective Minor Principal Stress	Effective Principal Stress Ratio	A-Bar	Mohr's Circle Stress Paths	
										Origin of Circle	Radius of Circle
lb.	mils	psi	%	psi	psi	psi	psi			psi	psi
P	ΔH	U	ε	$\sigma_1-\sigma_3$	ΔU	σ_1'	σ_3'	σ_1'/σ_3'	A'	p'	q
16.2	0	50.0	0	0	NA	NA	NA	NA	NA	9.88	0
38.4	5	51.9	0.09	3.41	1.91	11.39	7.98	1.428	0.59	9.68	1.71
44.0	11	52.4	0.19	4.29	2.44	11.73	7.45	1.576	0.60	9.59	2.14
48.0	17	52.8	0.29	4.90	2.80	11.98	7.08	1.692	0.60	9.53	2.45
52.1	23	53.1	0.39	5.52	3.08	12.33	6.81	1.810	0.59	9.57	2.76
56.0	29	53.3	0.49	6.11	3.29	12.70	6.59	1.928	0.57	9.64	3.06
59.6	35	53.5	0.60	6.65	3.47	13.07	6.42	2.037	0.55	9.74	3.32
63.0	42	53.6	0.71	7.16	3.62	13.43	6.26	2.144	0.53	9.85	3.58
65.8	48	53.7	0.81	7.59	3.74	13.73	6.14	2.236	0.52	9.93	3.79
68.8	53	53.9	0.90	8.04	3.85	14.08	6.04	2.332	0.50	10.06	4.02
71.6	59	53.9	1.00	8.47	3.92	14.43	5.96	2.420	0.49	10.20	4.23
73.6	65	54.0	1.10	8.76	4.00	14.64	5.88	2.490	0.48	10.26	4.38
76.4	71	54.1	1.21	9.17	4.06	15.00	5.82	2.575	0.47	10.41	4.59
83.9	90	54.2	1.53	10.29	4.15	16.02	5.73	2.794	0.42	10.88	5.14

91.0	108	54.2	1.84	11.32	4.15	17.06	5.74	2.973	0.39	11.40	5.66
98.0	127	54.1	2.15	12.34	4.07	18.16	5.81	3.123	0.35	11.98	6.17
102.7	145	54.0	2.46	13.01	3.95	18.94	5.93	3.194	0.32	12.44	6.51
106.0	164	53.8	2.78	13.47	3.80	19.56	6.09	3.212	0.30	12.82	6.73
109.6	183	53.6	3.11	13.96	3.62	20.22	6.26	3.229	0.27	13.24	6.98
113.8	201	53.5	3.42	14.55	3.45	20.98	6.43	3.262	0.25	13.71	7.27
117.4	220	53.3	3.73	15.03	3.26	21.66	6.63	3.268	0.23	14.14	7.52
118.2	238	53.1	4.04	15.10	3.06	21.92	6.82	3.214	0.21	14.37	7.55
120.5	256	52.9	4.35	15.39	2.88	22.40	7.01	3.196	0.20	14.71	7.70
123.6	275	52.7	4.68	15.79	2.66	23.02	7.22	3.187	0.18	15.12	7.90
126.4	293	52.5	4.98	16.15	2.47	23.57	7.42	3.179	0.16	15.49	8.08
130.0	311	52.3	5.28	16.63	2.27	24.24	7.62	3.183	0.14	15.93	8.31
130.5	329	52.1	5.58	16.65	2.06	24.47	7.83	3.127	0.13	16.15	8.32
132.1	346	51.9	5.88	16.84	1.87	24.85	8.02	3.101	0.12	16.43	8.42
134.8	364	51.6	6.18	17.16	1.64	25.41	8.25	3.081	0.10	16.83	8.58
137.8	382	51.5	6.48	17.55	1.47	25.96	8.42	3.085	0.09	17.19	8.77
139.6	399	51.3	6.77	17.75	1.27	26.36	8.61	3.061	0.08	17.49	8.87
140.3	416	51.1	7.07	17.79	1.05	26.63	8.83	3.014	0.06	17.73	8.90
142.6	434	50.9	7.37	18.06	0.86	27.08	9.02	3.002	0.05	18.05	9.03
144.5	452	50.7	7.67	18.28	0.65	27.51	9.23	2.980	0.04	18.37	9.14
146.7	469	50.5	7.97	18.53	0.45	27.97	9.44	2.963	0.03	18.70	9.26
147.5	487	50.3	8.26	18.59	0.26	28.22	9.62	2.932	0.01	18.92	9.30
149.2	504	50.0	8.56	18.76	0.04	28.61	9.84	2.906	0.00	19.22	9.38
151.0	522	49.8	8.87	18.96	-0.16	29.00	10.04	2.888	-0.01	19.52	9.48
151.4	540	49.6	9.17	18.94	-0.38	29.20	10.26	2.846	-0.02	19.73	9.47
154.2	558	49.4	9.47	19.27	-0.61	29.77	10.50	2.836	-0.03	20.13	9.64
154.2	575	49.2	9.77	19.21	-0.82	29.91	10.70	2.796	-0.04	20.31	9.61
155.9	594	49.0	10.08	19.39	-1.00	30.27	10.88	2.782	-0.05	20.57	9.69
157.3	612	48.8	10.39	19.52	-1.22	30.62	11.10	2.758	-0.07	20.86	9.76
158.2	630	48.6	10.70	19.57	-1.39	30.84	11.27	2.736	-0.07	21.05	9.78
158.8	647	48.4	10.99	19.59	-1.56	31.03	11.44	2.712	-0.08	21.24	9.79
158.2	665	48.2	11.29	19.44	-1.76	31.08	11.64	2.670	-0.10	21.36	9.72
158.8	683	48.1	11.60	19.45	-1.93	31.26	11.81	2.647	-0.10	21.53	9.72
159.7	701	47.9	11.91	19.50	-2.15	31.53	12.03	2.621	-0.12	21.78	9.75
160.2	719	47.7	12.21	19.51	-2.30	31.69	12.18	2.602	-0.12	21.94	9.76
160.5	736	47.5	12.50	19.48	-2.46	31.83	12.35	2.577	-0.13	22.09	9.74
160.4	754	47.4	12.80	19.41	-2.63	31.92	12.52	2.550	-0.14	22.22	9.70
158.7	772	47.2	13.11	19.10	-2.77	31.76	12.66	2.509	-0.15	22.21	9.55
158.7	790	47.1	13.41	19.04	-2.93	31.85	12.82	2.485	-0.16	22.33	9.52
158.1	808	46.9	13.71	18.89	-3.06	31.83	12.94	2.459	-0.17	22.39	9.44
157.4	825	46.8	14.01	18.74	-3.16	31.78	13.04	2.436	-0.18	22.41	9.37
156.8	843	46.7	14.32	18.59	-3.29	31.76	13.17	2.412	-0.19	22.47	9.30
156.7	861	46.6	14.63	18.51	-3.39	31.79	13.28	2.394	-0.19	22.53	9.25
156.2	879	46.5	14.93	18.38	-3.51	31.77	13.39	2.372	-0.20	22.58	9.19
155.9	897	46.4	15.22	18.27	-3.61	31.76	13.49	2.355	-0.21	22.63	9.14
155.4	915	46.3	15.53	18.15	-3.72	31.75	13.60	2.334	-0.22	22.67	9.07
155.0	933	46.2	15.84	18.02	-3.76	31.67	13.65	2.320	-0.22	22.66	9.01
154.2	951	46.2	16.14	17.85	-3.85	31.59	13.73	2.300	-0.23	22.66	8.93
154.8	969	46.1	16.45	17.87	-3.91	31.66	13.80	2.295	-0.23	22.73	8.93
154.3	987	46.0	16.75	17.74	-4.00	31.62	13.88	2.278	-0.24	22.75	8.87
154.6	1005	45.9	17.06	17.71	-4.08	31.67	13.96	2.268	-0.24	22.81	8.85
154.7	1023	45.9	17.37	17.65	-4.14	31.68	14.02	2.259	-0.25	22.85	8.83
154.8	1041	45.8	17.68	17.60	-4.23	31.71	14.11	2.248	-0.25	22.91	8.80
154.4	1059	45.7	17.97	17.49	-4.30	31.67	14.18	2.234	-0.26	22.93	8.75

Input Validation: Reviewed By: Date Tested: 12/09/10

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CONSOLIDATED-UNDRAINED TRIAXIAL COMPRESSION TEST ON COHESIVE SOILS ASTM D 4767

Client	Civil & Environmental Consultants, Inc.	Boring	SB-16
Client Project	091-867 Apex Landfill Expansion	Depth	1'-3'
Project No.	30598	Sample	ST-1
Test No.	2	Lab Sample No.	30598004
USCS Description:	Light Yellowish Brown Lean Clay With Sand	Test Conditions:	Undisturbed - Side And Double Drained

SAMPLE CONDITIONS

	Initial	After Consol.	Final
Tare Number	A23	NA	901
Wt. Tare & WS, gm	134.52	NA	1369.03
Wt. Tare & DS, gm	112.93	NA	1164.19
Wt. Tare, gm	9.43	NA	99.68
Water Content, %	20.9	19.2	19.2
Wt. Tube & WS., gm	1693.8	NA	
Wt. Of Tube, gm	419.3	NA	
Wt. Of WS., gm	1274.6	1257.5	
Length 1, in	5.951	NA	
Length 2, in	6.007	NA	
Length 3, in	5.971	NA	
Top Diameter, in	2.874	NA	
Middle Diameter, in	2.873	NA	
Bottom Diameter, in	2.873	NA	
Average Length, in	5.976	5.873	
Average Diameter, in	2.873	2.816	
Average Area, in^2	6.48	6.23	
Sample Volume, in^3	38.75	36.67	
Unit Dry Wt., gms/cc	1.66	1.75	
Unit Dry Wt., pcf	103.6	109.5	
Specific Gravity, Assume	2.70	2.70	
Volume of Solids, cc	390.59	390.59	
Void Ratio, e	0.63	0.54	
Porosity, n	0.38	0.35	
Pore Volume, cc	14.92	12.84	
Saturation, %	90.0	96.5	

TEST CONDITIONS

Cell Pressure, psi	109.42	
Back Pressure, psi	69.58	
Effective Consolidating Pressure, psi	39.84	σ_3
Pore Pressure Parameter (B), %	98	

SATURATION AND CONSOLIDATION VOLUME CHANGES

Height Change, mils	Reading	Change	Consolidation	
Initial Dial Reading	7.267	0	Volume Change, ml	34.1
After Saturation	7.262	5	Volume Change, in^3	2.08
After Consolidation	7.164	103	Saturation Method:	Wet

STRAIN RATE CALCULATIONS

Calc. Strain Rate, %/min (t50=4.56)	0.0009	Strain Rate Used, %/min	0.0001
Calc. Deformation Rate, in/min	0.005	Deformation Rate Used	0.0005

EFFECTIVE FAILURE SUMMARY

Failure Conditions	Max σ_1'/σ_3'	15% ε	
Effective Consolidating Pressure, psi	39.84	39.84	σ_3
1St. Maximum Effective Principal Stress Ratio	2.758	2.28	σ_1'/σ_3'
Deviator Stress at Failure, psi	39.26	38.24	$\sigma_1-\sigma_3$
Axial Strain at Failure, %	6.88	15.00	ε
Effective Minor Principal Stress at Failure, psi	22.33	29.77	σ_3'
Effective Major Principal Stress at Failure, psi	61.59	68.02	σ_1'
Mohr's Circle Stress Path (Origin of Circle), psi	41.96	48.90	p'
Mohr's Circle Stress Path (Radius of Circle), psi	19.63	19.12	q

TOTAL FAILURE SUMMARY

Failure Conditions	Max σ_1'/σ_3'	15% ε	
Deviator Stress at Failure, psi	39.26	38.24	$\sigma_1-\sigma_3$
Axial Strain at Failure, %	6.88	15.00	ε
Total Minor Principal Stress at Failure, psi	39.84	39.84	σ_3
Total Major Principal Stress at Failure, psi	79.10	78.08	σ_1

TEST DATA

Axial Load	Axial Deformation	Total Pore Water Pressure	Axial Strain	Principal Stress Difference (Deviator Stress)	Induced Pore Water Pressure	Effective Major Principal Stress	Effective Minor Principal Stress	Effective Principal Stress Ratio	A-Bar	Mohr's Circle Stress Paths	
										Origin of Circle	Radius of Circle
lb.	mils	psi	%	psi	psi	psi	psi			psi	psi
P	ΔH	U	ε	$\sigma_1-\sigma_3$	ΔU	σ_1'	σ_3'	σ_1'/σ_3'	A'	p'	q
18.4	0	69.6	0	0.00	0	NA	NA	NA	NA	39.84	0
54.3	5	71.5	0.08	5.77	1.96	43.65	37.88	1.152	0.35	40.77	2.88
80.0	11	74.0	0.19	9.88	4.46	45.25	35.38	1.279	0.46	40.31	4.94
95.8	17	75.7	0.28	12.39	6.16	46.06	33.68	1.368	0.51	39.87	6.19
107.7	22	77.1	0.38	14.28	7.48	46.64	32.36	1.441	0.53	39.50	7.14
116.8	28	78.2	0.47	15.73	8.62	46.94	31.22	1.504	0.56	39.08	7.86
125.2	33	79.2	0.57	17.05	9.57	47.32	30.27	1.563	0.57	38.79	8.53
132.8	39	80.0	0.66	18.24	10.43	47.66	29.41	1.620	0.58	38.54	9.12
139.6	44	80.8	0.75	19.32	11.21	47.95	28.63	1.675	0.59	38.29	9.66
145.7	50	81.5	0.85	20.27	11.89	48.21	27.95	1.725	0.60	38.08	10.13
151.9	56	82.1	0.95	21.23	12.49	48.58	27.35	1.777	0.60	37.96	10.62
157.7	61	82.7	1.05	22.14	13.08	48.89	26.75	1.827	0.60	37.82	11.07
163.0	67	83.2	1.15	22.95	13.57	49.22	26.27	1.874	0.60	37.74	11.47
177.3	85	84.5	1.45	25.15	14.87	50.12	24.97	2.007	0.60	37.54	12.58

189.8	103	85.5	1.76	27.04	15.89	50.99	23.95	2.129	0.60	37.47	13.52
202.5	120	86.3	2.04	28.96	16.68	52.12	23.16	2.251	0.59	37.64	14.48
210.3	137	86.8	2.34	30.10	17.27	52.67	22.57	2.333	0.59	37.62	15.05
215.9	156	87.3	2.65	30.88	17.71	53.01	22.13	2.395	0.59	37.57	15.44
222.5	174	87.6	2.96	31.80	18.04	53.61	21.80	2.459	0.58	37.70	15.90
229.2	192	87.8	3.27	32.74	18.26	54.32	21.58	2.517	0.57	37.95	16.37
234.6	209	88.0	3.55	33.48	18.39	54.93	21.45	2.561	0.56	38.19	16.74
240.3	227	88.0	3.86	34.26	18.41	55.69	21.43	2.598	0.55	38.56	17.13
244.0	245	88.1	4.17	34.72	18.47	56.09	21.37	2.625	0.54	38.73	17.36
249.2	263	88.1	4.48	35.39	18.48	56.75	21.36	2.657	0.53	39.06	17.70
253.3	281	88.0	4.78	35.92	18.46	57.31	21.38	2.680	0.52	39.34	17.96
258.4	298	88.0	5.07	36.59	18.39	58.04	21.45	2.706	0.51	39.75	18.29
262.2	316	87.9	5.38	37.05	18.31	58.58	21.53	2.721	0.50	40.05	18.53
265.6	334	87.8	5.68	37.44	18.19	59.10	21.65	2.729	0.50	40.37	18.72
270.5	352	87.6	5.98	38.06	18.04	59.86	21.80	2.746	0.48	40.83	19.03
274.5	368	87.5	6.27	38.55	17.88	60.51	21.96	2.756	0.47	41.24	19.28
277.8	386	87.3	6.57	38.91	17.70	61.05	22.14	2.758	0.46	41.59	19.46
281.0	404	87.1	6.88	39.26	17.51	61.59	22.33	2.758	0.46	41.96	19.63
284.3	422	86.9	7.18	39.63	17.29	62.18	22.55	2.757	0.45	42.36	19.81
288.6	440	86.7	7.49	40.14	17.08	62.91	22.76	2.764	0.43	42.83	20.07
291.6	457	86.4	7.78	40.46	16.83	63.48	23.01	2.758	0.42	43.25	20.23
293.8	475	86.2	8.09	40.64	16.57	63.91	23.27	2.747	0.42	43.59	20.32
297.2	493	85.9	8.39	41.01	16.29	64.56	23.55	2.741	0.41	44.05	20.50
299.2	511	85.6	8.71	41.17	16.01	65.00	23.83	2.728	0.40	44.42	20.59
301.5	529	85.3	9.00	41.36	15.72	65.48	24.12	2.715	0.39	44.80	20.68
305.0	547	85.0	9.31	41.73	15.40	66.17	24.44	2.708	0.38	45.31	20.87
307.0	565	84.7	9.62	41.89	15.09	66.64	24.75	2.692	0.37	45.70	20.94
307.6	583	84.3	9.93	41.83	14.75	66.92	25.09	2.667	0.36	46.01	20.91
308.4	601	84.0	10.24	41.81	14.41	67.23	25.43	2.644	0.35	46.33	20.90
309.8	619	83.7	10.53	41.86	14.07	67.63	25.77	2.625	0.34	46.70	20.93
310.9	637	83.3	10.84	41.87	13.73	67.98	26.11	2.604	0.33	47.04	20.94
310.9	655	83.0	11.15	41.73	13.41	68.16	26.43	2.579	0.33	47.30	20.86
310.0	673	82.6	11.45	41.46	13.06	68.23	26.78	2.548	0.32	47.51	20.73
309.8	690	82.3	11.76	41.29	12.74	68.40	27.10	2.524	0.31	47.75	20.65
309.7	708	82.0	12.05	41.14	12.44	68.54	27.40	2.501	0.31	47.97	20.57
309.9	726	81.7	12.36	41.03	12.15	68.72	27.69	2.481	0.30	48.21	20.51
309.2	743	81.4	12.66	40.79	11.84	68.79	28.00	2.457	0.30	48.40	20.39
308.1	761	81.1	12.96	40.50	11.50	68.84	28.34	2.429	0.29	48.59	20.25
307.4	779	80.9	13.26	40.26	11.28	68.82	28.56	2.409	0.29	48.69	20.13
306.2	796	80.6	13.56	39.95	11.05	68.74	28.79	2.387	0.28	48.77	19.98
304.9	814	80.4	13.87	39.62	10.83	68.64	29.01	2.366	0.28	48.82	19.81
302.9	832	80.2	14.17	39.21	10.63	68.42	29.21	2.342	0.28	48.81	19.60
300.9	850	80.0	14.47	38.80	10.42	68.22	29.42	2.319	0.27	48.82	19.40
299.9	868	79.8	14.77	38.52	10.23	68.13	29.61	2.301	0.27	48.87	19.26
298.1	886	79.6	15.08	38.14	10.01	67.97	29.83	2.279	0.27	48.90	19.07
296.6	904	79.4	15.39	37.80	9.79	67.84	30.05	2.258	0.26	48.95	18.90
293.7	923	79.1	15.71	37.26	9.55	67.55	30.29	2.230	0.26	48.92	18.63
291.8	941	78.9	16.02	36.87	9.31	67.40	30.53	2.208	0.26	48.97	18.43
288.8	959	78.7	16.33	36.33	9.08	67.10	30.76	2.181	0.25	48.93	18.17
285.5	977	78.4	16.64	35.75	8.86	66.73	30.98	2.154	0.25	48.86	17.87
282.1	996	78.2	16.96	35.17	8.61	66.39	31.23	2.126	0.25	48.81	17.58
265.2	1001	77.7	17.04	32.88	8.12	64.60	31.72	2.037	0.25	48.16	16.44
261.9	1001	77.8	17.04	32.44	8.23	64.06	31.61	2.026	0.26	47.83	16.22
260.0	1001	77.8	17.04	32.18	8.24	63.77	31.60	2.018	0.26	47.69	16.09

Input Validation: Reviewed By: Date Tested: 12/14/10

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CONSOLIDATED-UNDRAINED TRIAXIAL COMPRESSION TEST ON COHESIVE SOILS ASTM D 4767

Client	Civil & Environmental Consultants, Inc.	Boring	SB-16
Client Project	091-867 Apex Landfill Expansion	Depth	1'-3'
Project No.	30598	Sample	ST-1
Test No.	3	Lab Sample No.	30598004
USCS Description:	Light Yellowish Brown Lean Clay With Sand	Test Conditions:	Undisturbed - Side And Double Drained

SAMPLE CONDITIONS

	Initial	After Consol.	Final
Tare Number	A23	NA	307
Wt. Tare & WS, gm	134.52	NA	1295.07
Wt. Tare & DS, gm	112.93	NA	1086.15
Wt. Tare, gm	9.43	NA	98.77
Water Content, %	20.9	21.2	21.2
Wt. Tube & WS., gm	1640.3	NA	
Wt. Of Tube, gm	418.4	NA	
Wt. Of WS., gm	1222.0	1225.0	
Length 1, in	5.96	NA	
Length 2, in	5.971	NA	
Length 3, in	5.932	NA	
Top Diameter, in	2.874	NA	
Middle Diameter, in	2.875	NA	
Bottom Diameter, in	2.877	NA	
Average Length, in	5.954	5.772	
Average Diameter, in	2.875	2.783	
Average Area, in^2	6.49	6.08	
Sample Volume, in^3	38.66	35.48	
Unit Dry Wt., gms/cc	1.60	1.74	
Unit Dry Wt., pcf	99.6	108.5	
Specific Gravity, Assume	2.70	2.70	
Volume of Solids, cc	374.46	374.46	
Void Ratio, e	0.69	0.55	
Porosity, n	0.41	0.36	
Pore Volume, cc	15.81	12.63	
Saturation, %	81.4	103.4	

TEST CONDITIONS

Cell Pressure, psi	119.64	
Back Pressure, psi	39.79	
Effective Consolidating Pressure, psi	79.84	σ_3
Pore Pressure Parameter (B), %	95	

SATURATION AND CONSOLIDATION VOLUME CHANGES

Height Change, mils	Reading	Change	Consolidation	
Initial Dial Reading	7.012	0	Volume Change, ml	52.2
After Saturation	6.993	19	Volume Change, in^3	3.19
After Consolidation	6.83	182	Saturation Method:	Wet

STRAIN RATE CALCULATIONS

Calc. Strain Rate, %/min (t50=3.29)	0.0012	Strain Rate Used, %/min	0.0001
Calc. Deformation Rate, in/min	0.007	Deformation Rate Used	0.0005

EFFECTIVE FAILURE SUMMARY

Failure Conditions	Max σ_1'/σ_3'	15% ε	
Effective Consolidating Pressure, psi	79.84	79.84	σ_3
1St. Maximum Effective Principal Stress Ratio	2.711	2.40	σ_1'/σ_3'
Deviator Stress at Failure, psi	64.13	61.71	$\sigma_1-\sigma_3$
Axial Strain at Failure, %	7.95	15.00	ε
Effective Minor Principal Stress at Failure, psi	37.48	44.19	σ_3'
Effective Major Principal Stress at Failure, psi	101.61	105.90	σ_1'
Mohr's Circle Stress Path (Origin of Circle), psi	69.55	75.05	p'
Mohr's Circle Stress Path (Radius of Circle), psi	32.06	30.85	q

TOTAL FAILURE SUMMARY

Failure Conditions	Max σ_1'/σ_3'	15% ε	
Deviator Stress at Failure, psi	64.13	61.71	$\sigma_1-\sigma_3$
Axial Strain at Failure, %	7.95	15.00	ε
Total Minor Principal Stress at Failure, psi	79.84	79.84	σ_3
Total Major Principal Stress at Failure, psi	143.97	141.55	σ_1

TEST DATA

Axial Load	Axial Deformation	Total Pore Water Pressure	Axial Strain	Principal Stress Difference (Deviator Stress)	Induced Pore Water Pressure	Effective Major Principal Stress	Effective Minor Principal Stress	Effective Principal Stress Ratio	A-Bar	Mohr's Circle Stress Paths	
										Origin of Circle	Radius of Circle
lb.	mils	psi	%	psi	psi	psi	psi			psi	psi
P	ΔH	U	ε	$\sigma_1-\sigma_3$	ΔU	σ_1'	σ_3'	σ_1'/σ_3'	A'	p'	q
21.3	0	39.8	0	0	0	NA	NA	NA	NA	79.84	0
90.8	4	46.3	0.07	11.42	6.50	84.76	73.35	1.156	0.60	79.05	5.71
128.9	9	51.3	0.16	17.65	11.54	85.96	68.30	1.258	0.69	77.13	8.83
153.1	15	55.1	0.26	21.60	15.33	86.12	64.51	1.335	0.75	75.31	10.80
172.4	21	58.1	0.36	24.75	18.34	86.25	61.50	1.402	0.78	73.88	12.37
188.5	27	60.7	0.46	27.36	20.92	86.28	58.92	1.464	0.81	72.60	13.68
202.4	33	62.8	0.57	29.61	23.05	86.40	56.79	1.521	0.82	71.60	14.80
215.1	39	64.8	0.67	31.64	24.96	86.52	54.88	1.576	0.83	70.70	15.82
226.3	44	66.5	0.77	33.44	26.67	86.61	53.17	1.629	0.84	69.89	16.72
236.6	50	68.0	0.87	35.09	28.17	86.76	51.67	1.679	0.85	69.21	17.54
246.5	57	69.2	0.98	36.66	29.45	87.05	50.39	1.727	0.85	68.72	18.33
255.0	63	70.5	1.09	38.00	30.69	87.15	49.15	1.773	0.85	68.15	19.00
263.4	69	71.6	1.19	39.33	31.77	87.40	48.08	1.818	0.85	67.74	19.66
284.6	87	74.2	1.51	42.63	34.40	88.08	45.45	1.938	0.85	66.76	21.32

302.5	105	76.3	1.82	45.38	36.48	88.75	43.36	2.047	0.85	66.06	22.69
317.3	123	77.8	2.13	47.62	38.05	89.41	41.80	2.139	0.84	65.60	23.81
330.3	141	79.1	2.45	49.55	39.31	90.09	40.53	2.223	0.84	65.31	24.78
342.0	160	80.1	2.77	51.26	40.27	90.83	39.57	2.295	0.83	65.20	25.63
352.2	178	80.8	3.08	52.73	41.03	91.54	38.81	2.359	0.82	65.18	26.36
362.0	195	81.5	3.39	54.12	41.70	92.27	38.14	2.419	0.81	65.20	27.06
370.2	213	81.9	3.68	55.25	42.12	92.97	37.72	2.465	0.80	65.35	27.63
377.9	231	82.3	3.99	56.28	42.53	93.59	37.31	2.508	0.80	65.45	28.14
385.0	249	82.6	4.31	57.21	42.83	94.23	37.02	2.546	0.79	65.62	28.61
391.7	266	82.7	4.61	58.09	42.94	94.99	36.90	2.574	0.78	65.94	29.04
398.2	283	82.9	4.91	58.92	43.12	95.64	36.72	2.605	0.77	66.18	29.46
404.4	301	83.0	5.21	59.70	43.20	96.35	36.65	2.629	0.76	66.50	29.85
409.9	319	83.0	5.52	60.35	43.23	96.97	36.61	2.648	0.75	66.79	30.18
415.6	336	82.9	5.83	61.04	43.14	97.75	36.71	2.663	0.74	67.23	30.52
420.9	353	82.9	6.12	61.68	43.08	98.44	36.77	2.678	0.74	67.61	30.84
425.8	371	82.9	6.42	62.22	43.08	98.99	36.76	2.692	0.73	67.88	31.11
430.5	388	82.8	6.72	62.75	42.99	99.60	36.86	2.702	0.72	68.23	31.37
434.6	406	82.6	7.04	63.16	42.84	100.17	37.01	2.707	0.71	68.59	31.58
438.9	424	82.4	7.34	63.62	42.60	100.86	37.24	2.708	0.70	69.05	31.81
442.9	441	82.2	7.65	64.02	42.42	101.44	37.42	2.711	0.70	69.43	32.01
445.0	459	82.2	7.95	64.13	42.36	101.61	37.48	2.711	0.70	69.55	32.06
447.5	477	81.9	8.26	64.27	42.11	102.00	37.73	2.704	0.69	69.87	32.14
451.2	495	81.8	8.58	64.62	42.04	102.42	37.80	2.709	0.68	70.11	32.31
453.8	513	81.6	8.89	64.78	41.84	102.79	38.01	2.705	0.68	70.40	32.39
455.2	531	81.4	9.19	64.78	41.64	102.98	38.20	2.696	0.68	70.59	32.39
456.0	548	81.3	9.50	64.68	41.46	103.06	38.39	2.685	0.67	70.72	32.34
457.8	567	81.0	9.82	64.72	41.24	103.32	38.60	2.676	0.67	70.96	32.36
459.3	585	80.8	10.13	64.71	40.99	103.56	38.85	2.666	0.67	71.20	32.35
461.0	603	80.5	10.44	64.74	40.73	103.86	39.12	2.655	0.66	71.49	32.37
462.0	619	80.3	10.73	64.68	40.47	104.05	39.37	2.643	0.66	71.71	32.34
463.1	637	80.0	11.04	64.61	40.23	104.23	39.62	2.631	0.66	71.92	32.30
464.1	655	79.7	11.35	64.53	39.89	104.48	39.95	2.615	0.65	72.22	32.27
464.9	673	79.4	11.66	64.43	39.56	104.70	40.28	2.599	0.65	72.49	32.21
465.5	690	79.1	11.96	64.29	39.29	104.84	40.55	2.585	0.64	72.69	32.14
466.1	708	78.8	12.27	64.16	38.96	105.04	40.89	2.569	0.64	72.97	32.08
466.9	726	78.5	12.58	64.04	38.68	105.21	41.17	2.556	0.64	73.19	32.02
466.5	744	78.1	12.89	63.75	38.31	105.28	41.53	2.535	0.63	73.41	31.88
466.8	761	77.8	13.19	63.58	37.96	105.46	41.88	2.518	0.63	73.67	31.79
466.2	779	77.3	13.50	63.27	37.50	105.62	42.34	2.494	0.62	73.98	31.64
465.4	797	76.8	13.80	62.94	37.05	105.74	42.80	2.471	0.62	74.27	31.47
465.4	815	76.4	14.12	62.70	36.64	105.90	43.20	2.451	0.62	74.55	31.35
464.0	833	76.0	14.43	62.27	36.22	105.90	43.62	2.428	0.61	74.76	31.14
464.2	851	75.7	14.74	62.08	35.86	106.07	43.99	2.411	0.61	75.03	31.04
462.6	869	75.4	15.05	61.64	35.61	105.87	44.23	2.393	0.61	75.05	30.82
460.5	887	75.1	15.37	61.11	35.30	105.66	44.54	2.372	0.61	75.10	30.56
457.4	905	74.7	15.68	60.45	34.95	105.34	44.89	2.347	0.61	75.12	30.23
453.9	923	74.4	15.99	59.76	34.64	104.96	45.20	2.322	0.61	75.08	29.88
452.0	940	74.2	16.29	59.27	34.36	104.75	45.48	2.303	0.61	75.11	29.63
451.1	958	74.0	16.60	58.93	34.17	104.60	45.67	2.290	0.61	75.14	29.47
448.8	976	73.8	16.92	58.40	33.99	104.25	45.85	2.274	0.61	75.05	29.20
445.9	994	73.6	17.22	57.78	33.81	103.81	46.03	2.255	0.62	74.92	28.89
442.6	1012	73.4	17.53	57.13	33.65	103.32	46.19	2.237	0.62	74.75	28.56
441.0	1029	73.3	17.83	56.69	33.47	103.06	46.37	2.223	0.62	74.72	28.34
438.8	1047	73.1	18.14	56.18	33.34	102.68	46.50	2.208	0.62	74.59	28.09

Input Validation: Reviewed By: Date Tested: 12/14/10

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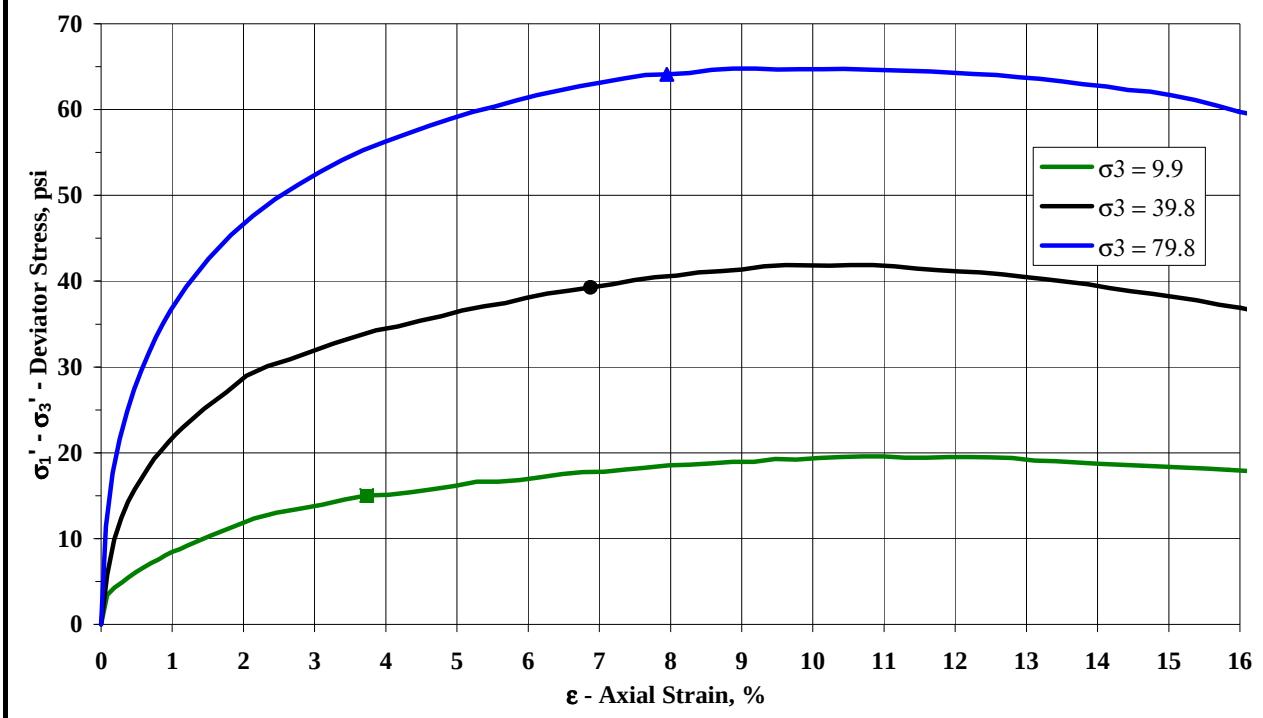
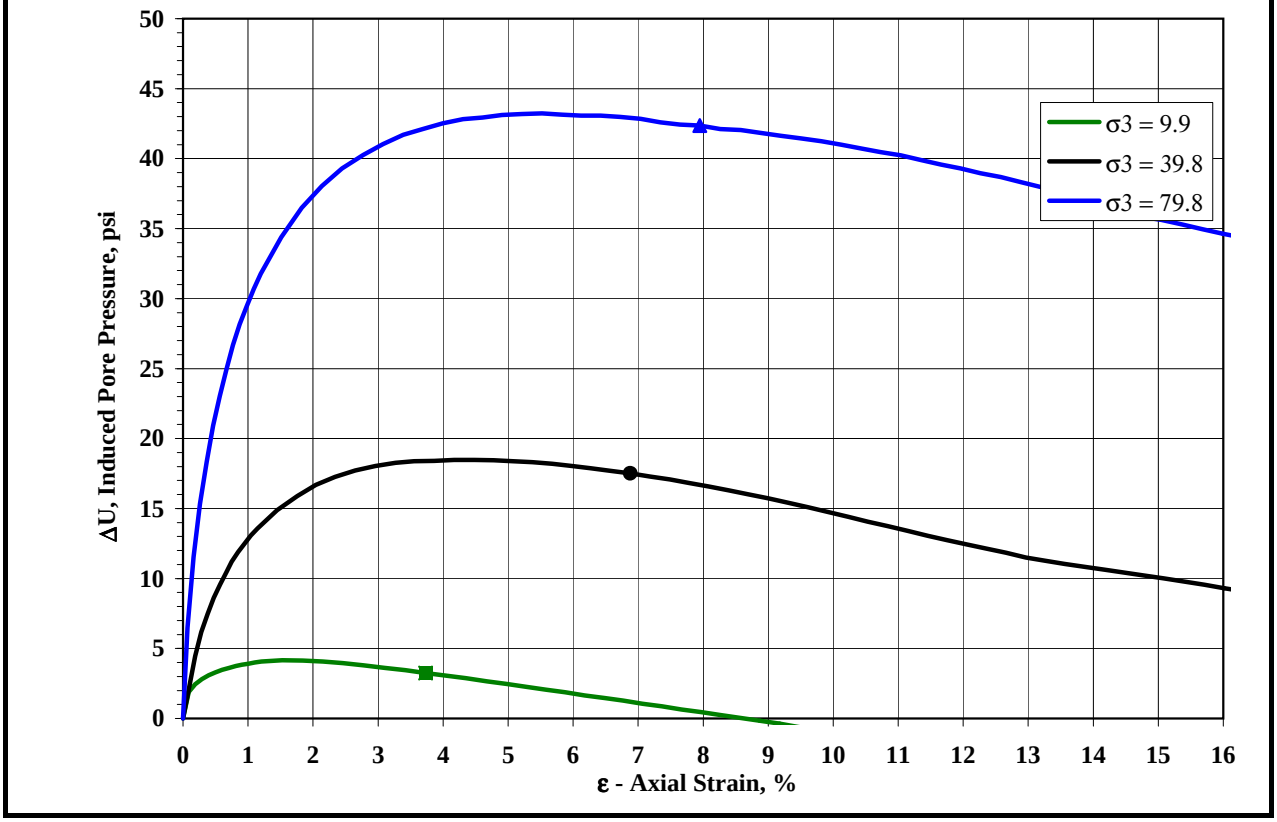
CONSOLIDATED-UNDRAINED TRIAXIAL COMPRESSION TEST ON COHESIVE SOILS ASTM D 4767

Client	Civil & Environmental Consultants, Inc.	Boring	SB-16
Client Project	091-867 Apex Landfill Expansion	Depth	1'-3'
Project No.	30598	Sample	ST-1
Test Conditions:	Undisturbed - Side And Double Drained	Lab Sample No.	30598004
USCS Description:	Light Yellowish Brown Lean Clay With Sand		

AXIAL STRAIN vs. DEVIATOR STRESS



AXIAL STRAIN vs. INDUCED PORE-WATER PRESSURE



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CONSOLIDATED-UNDRAINED TRIAXIAL COMPRESSION TEST ON COHESIVE SOILS ASTM D 476

Client	Civil & Environmental Consultants, In	Boring	SB-16
Client Project	091-867 Apex Landfill Expansion	Depth	1'-3'
Project No.	30598	Sample	ST-1
		Lab Sample No.	30598004
USCS Description:	Light Yellowish Brown Lean Clay With Sand		
Test Conditions:	Undisturbed - Side And Double Drained		

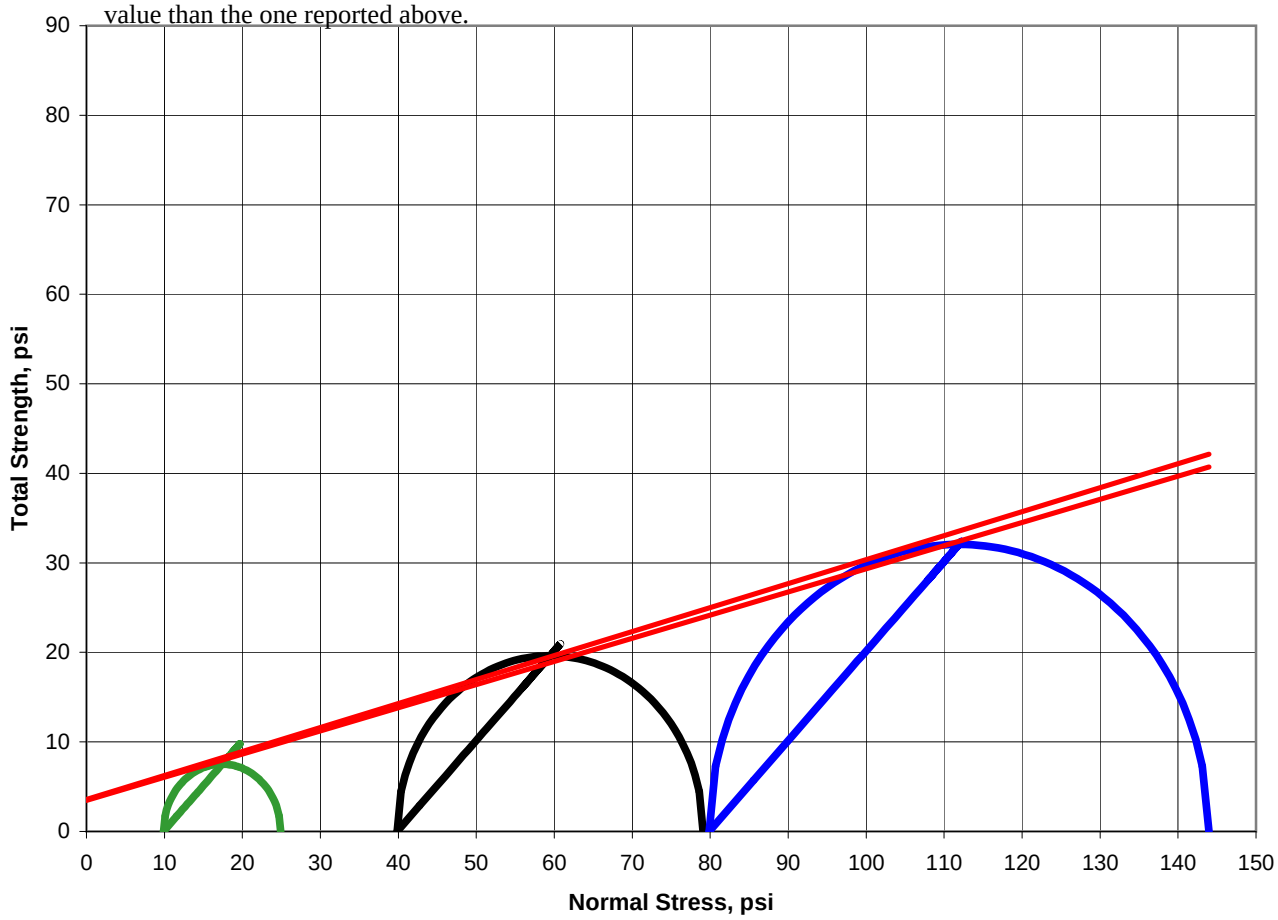
TOTAL STRESS

FAILURE CONDITION: 1st. MAX. EFFECTIVE PRINCIPAL STRESS RATIO

Test No.	Deviator Stress	Major Principal Stress	Minor Principal Stress	Strain at Failure	Mohr's Circle Stress Path		Failure Angle	
	$\sigma1-\sigma3$	$\sigma1$	$\sigma3$	ε	$(\sigma1+\sigma3)/2$	$(\sigma1-\sigma3)/2$		
	psi	psi	psi	%	psi	psi	α, deg	14.5
Test 1	15.03	24.92	9.88	3.73	17.40	7.52	a, psi	3.5
Test 2	39.26	79.10	39.84	6.88	59.47	19.63	Φ, deg	15.0
Test 3	64.13	143.97	79.84	7.95	111.91	32.06	C, psi	3.6

Calculations based on: Test 1 Test 2 Test 3

Note: The Friction Angle and Cohesion using other combinations of test points may yield a higher or lower value than the one reported above.



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CONSOLIDATED-UNDRAINED TRIAXIAL COMPRESSION TEST ON COHESIVE SOILS ASTM D 476

Client	Civil & Environmental Consultants, In	Boring	SB-16
Client Project	091-867 Apex Landfill Expansion	Depth	1'-3'
Project No.	30598	Sample	ST-1
		Lab Sample No.	30598004
USCS Description:	Light Yellowish Brown Lean Clay With Sand		
Test Conditions:	Undisturbed - Side And Double Drained		

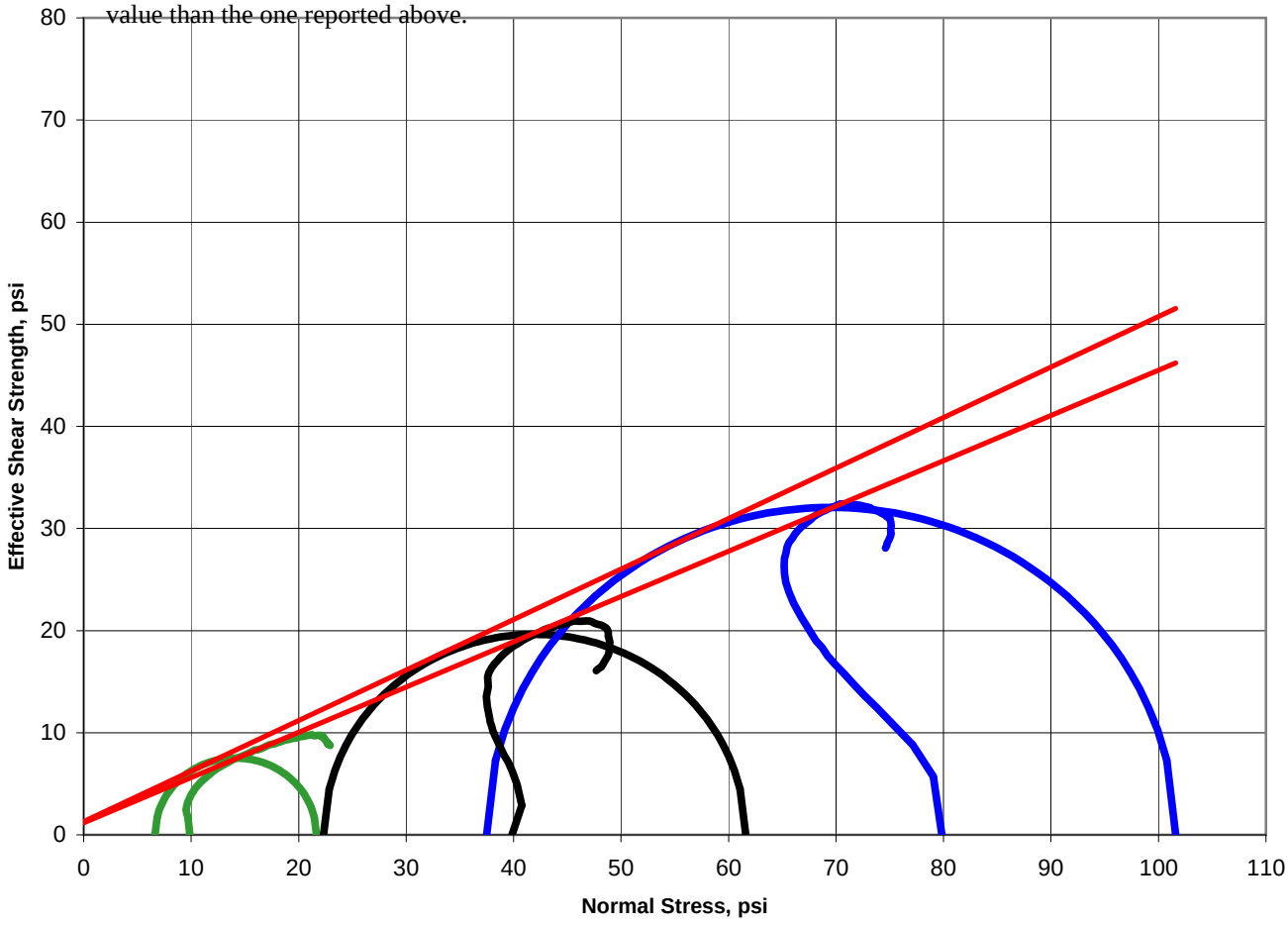
EFFECTIVE STRESS

FAILURE CONDITION: 1st. MAX. EFFECTIVE PRINCIPAL STRESS RATIO

Test No.	Deviator Stress	Major Principal Stress	Minor Principal Stress	Strain at Failure	Mohr's Circle Stress Path		Failure Angle	
	$\sigma 1-\sigma 3$	$\sigma' 1$	$\sigma' 3$	ε	p'	q		
	psi	psi	psi	%	psi	psi	α', deg	23.9
Test 1	15.03	21.66	6.63	3.73	14.14	7.52	a', psi	1.2
Test 2	39.26	61.59	22.33	6.88	41.96	19.63	Φ', deg	26.3
Test 3	64.13	101.61	37.48	7.95	69.55	32.06	C', psi	1.3

Calculations based on: Test 1 Test 2 Test 3

Note: The Friction Angle and Cohesion using other combinations of test points may yield a higher or lower value than the one reported above.



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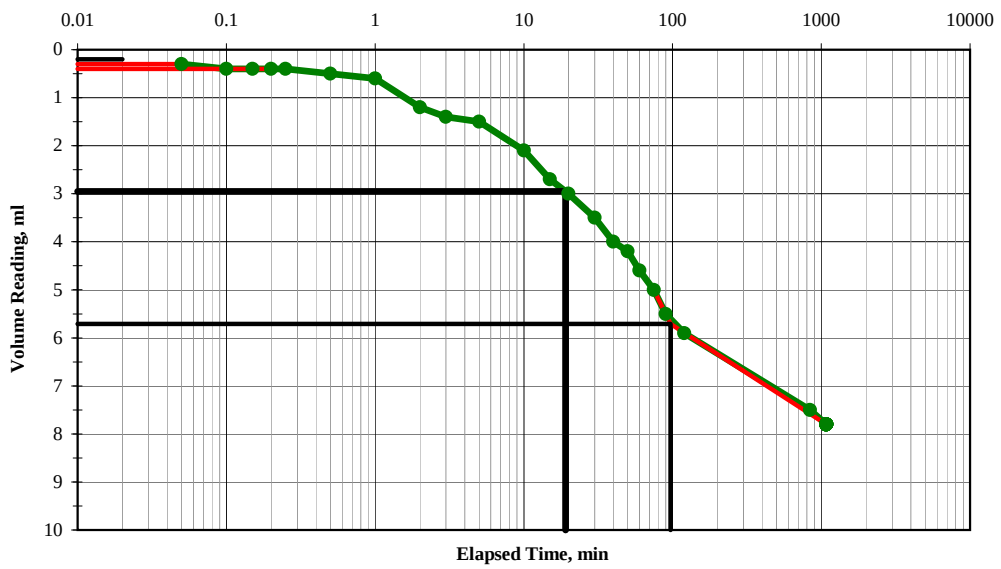
THREE DIMENSIONAL TRIAXIAL CONSOLIDATION TEST

Client	Civil & Environmental Consultants, Inc	Boring	SB-16	**Staged Consolidation**	
Client Project	091-867 Apex Landfill Expansion	Depth	1'-3'	Consolidation Plot Stress, psi	6.9
Project No.	30598	Sample	ST-1	**Final Test Pressures**	
		Lab Sample	30598004	Cell Pressure, psi	59.9
USCS Description:	Light Yellowish Brown Lean Clay With Sand			Back Pressure, psi	50.0
Test Conditions:	Undisturbed - Side And Double Drained			Effective Consol., psi	9.9
				Additional Consol. Volume, ml	0.0

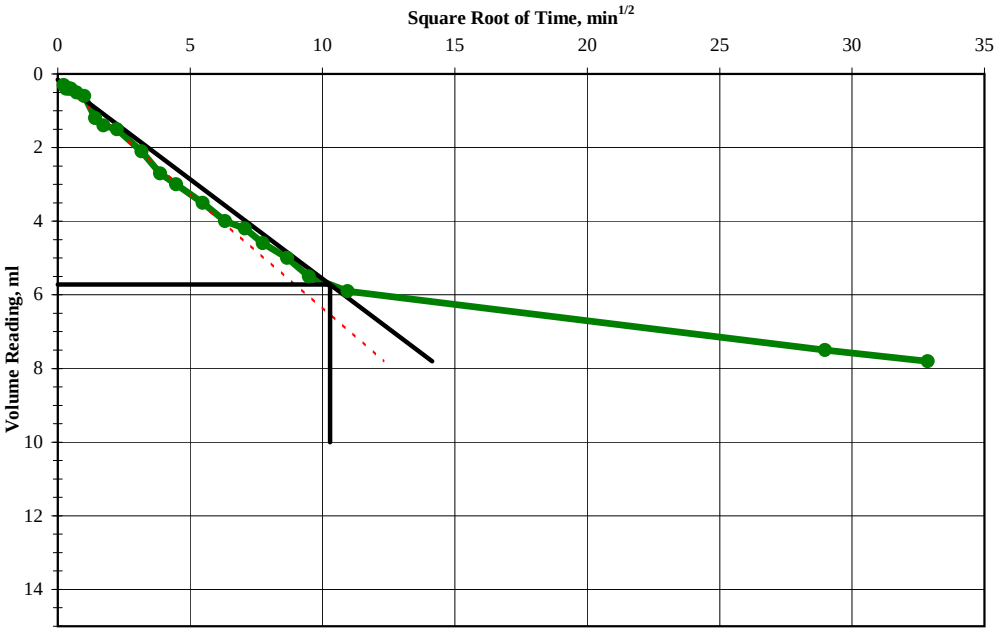
Consol. Start Date: 12/9/2010

Elapsed Time (min)	Sqrt Time ($min^{1/2}$)	Volume Reading ml
0	0	0.0
0.05	0.22	0.3
0.10	0.32	0.4
0.15	0.39	0.4
0.20	0.45	0.4
0.25	0.50	0.4
0.50	0.71	0.5
1.00	1.00	0.6
2.00	1.41	1.2
3.00	1.73	1.4
5.00	2.24	1.5
10.00	3.16	2.1
15.00	3.87	2.7
20.00	4.47	3.0
30.00	5.48	3.5
40.00	6.32	4.0
50.00	7.07	4.2
60.00	7.75	4.6
75.00	8.66	5.0
90.00	9.49	5.5
120.00	10.95	5.9
840.00	28.98	7.5
1080.00	32.86	7.8

Log of Elapsed Time vs. Volume Reading



Square Root of Elapsed Time vs. Volume Reading



Sqrt. of Elapsed Time vs Volume		Log of Elapsed Time vs Volume		Consolidation Summary	
T0 = 0 min.	V0 = 0.2 ml.	T0 = 0 min.	V0 = 0.2 ml.	Initial Volume Reading, ml	0.0
T90 = 105.9 min	V90 = 5.7 ml.	T50 = 19.1 min.	V50 = 3.0 ml.	Final Volume Reading, ml	7.8
T100 = NA min	V100 = 6.3 ml.	T100 = 97.1 min.	V100 = 5.7 ml.	Total Volume Change, ml	7.8

Input Validation: Reviewed By: Date 12/9/2010

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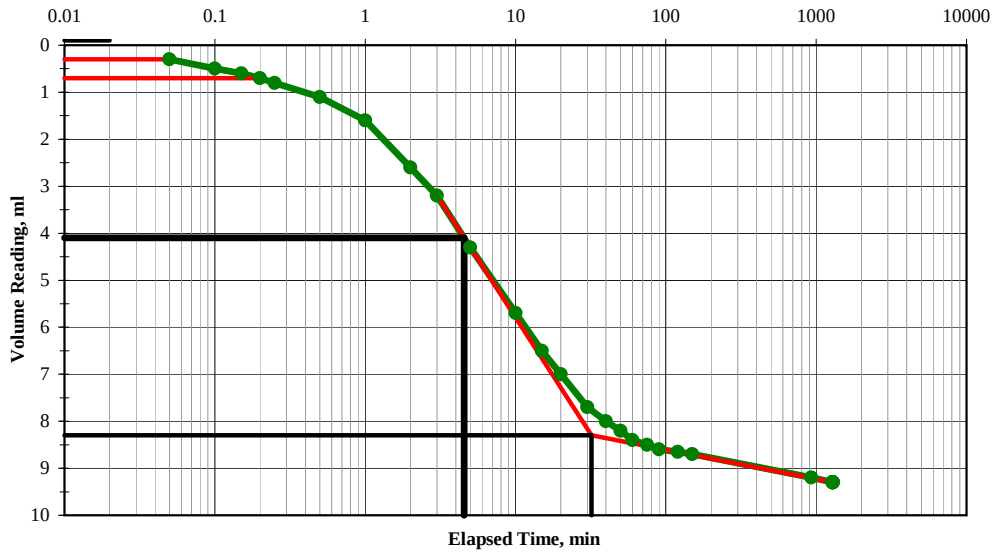
THREE DIMENSIONAL TRIAXIAL CONSOLIDATION TEST

Client	Civil & Environmental Consultants, Inc	Boring	SB-16	**Staged Consolidation**	
Client Project	091-867 Apex Landfill Expansion	Depth	1'-3'	Consolidation Plot Stress, psi	6.9
Project No.	30598	Sample	ST-1	**Final Test Pressures**	
		Lab Sample	30598004	Cell Pressure, psi	109.4
USCS Description:	Light Yellowish Brown Lean Clay With Sand			Back Pressure, psi	69.6
Test Conditions:	Undisturbed - Side And Double Drained			Effective Consol., psi	39.8
				Additional Consol. Volume, ml	24.8

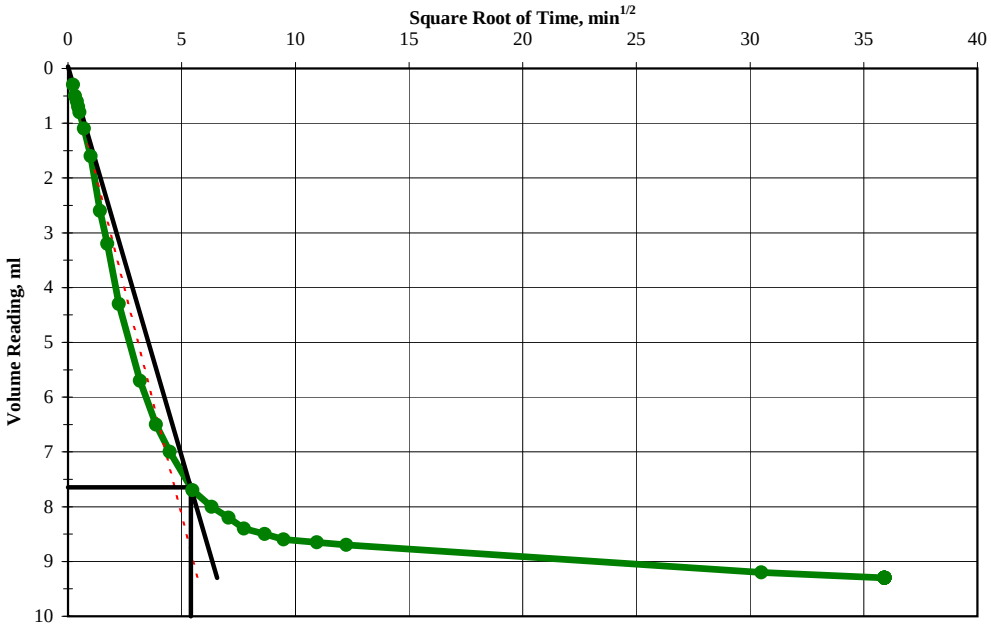
Consol. Start Date: 12/14/2010

Elapsed Time (min)	Sqrt Time ($min^{1/2}$)	Volume Reading ml
0	0	0.0
0.05	0.22	0.3
0.10	0.32	0.5
0.15	0.39	0.6
0.20	0.45	0.7
0.25	0.50	0.8
0.50	0.71	1.1
1.00	1.00	1.6
2.00	1.41	2.6
3.00	1.73	3.2
5.00	2.24	4.3
10.00	3.16	5.7
15.00	3.87	6.5
20.00	4.47	7.0
30.00	5.48	7.7
40.00	6.32	8.0
50.00	7.07	8.2
60.00	7.75	8.4
75.00	8.66	8.5
90.00	9.49	8.6
120.00	10.95	8.7
150.00	12.25	8.7
930.00	30.50	9.2
1290.00	35.92	9.3

Log of Elapsed Time vs. Volume Reading



Square Root of Elapsed Time vs. Volume Reading



Sqrt. of Elapsed Time vs Volume		Log of Elapsed Time vs Volume		Consolidation Summary	
T0 = 0 min.	V0 = 0.0 ml.	T0 = 0 min.	V0 = -0.1 ml.	Initial Volume Reading, ml	0.0
T90 = 29.2 min	V90 = 7.6 ml.	T50 = 4.6 min.	V50 = 4.1 ml.	Final Volume Reading, ml	9.3
T100 = NA min	V100 = 8.5 ml.	T100 = 32.0 min.	V100 = 8.3 ml.	Total Volume Change, ml	34.1

Input Validation: Reviewed By: Date 12/14/2010

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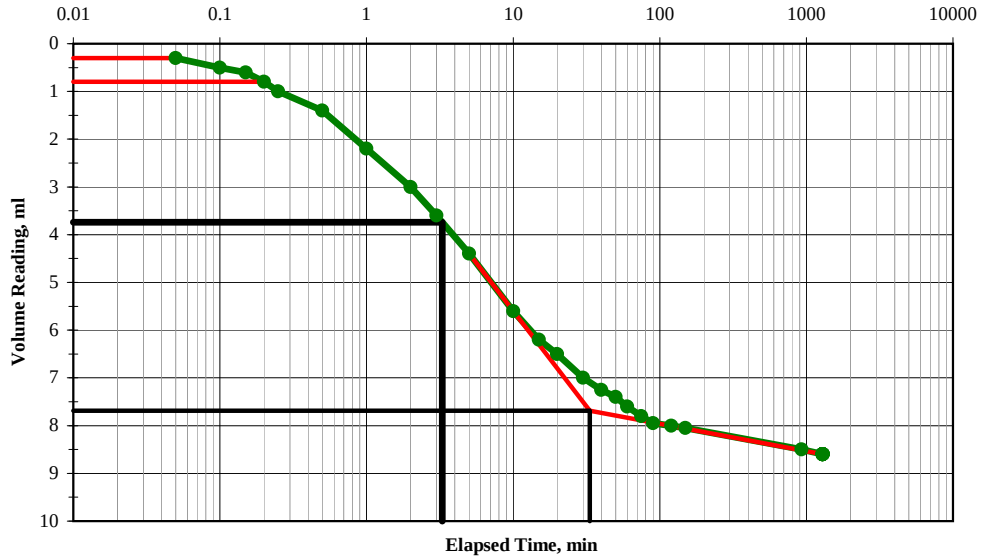
THREE DIMENSIONAL TRIAXIAL CONSOLIDATION TEST

Client	Civil & Environmental Consultants, Inc	Boring	SB-16	**Staged Consolidation**	
Client Project	091-867 Apex Landfill Expansion	Depth	1'-3'	Consolidation Plot Stress, psi	6.9
Project No.	30598	Sample	ST-1	**Final Test Pressures**	
		Lab Sample	30598004	Cell Pressure, psi	119.6
USCS Description:	Light Yellowish Brown Lean Clay With Sand			Back Pressure, psi	39.8
Test Conditions:	Undisturbed - Side And Double Drained			Effective Consol., psi	79.8
				Additional Consol. Volume, m	43.6

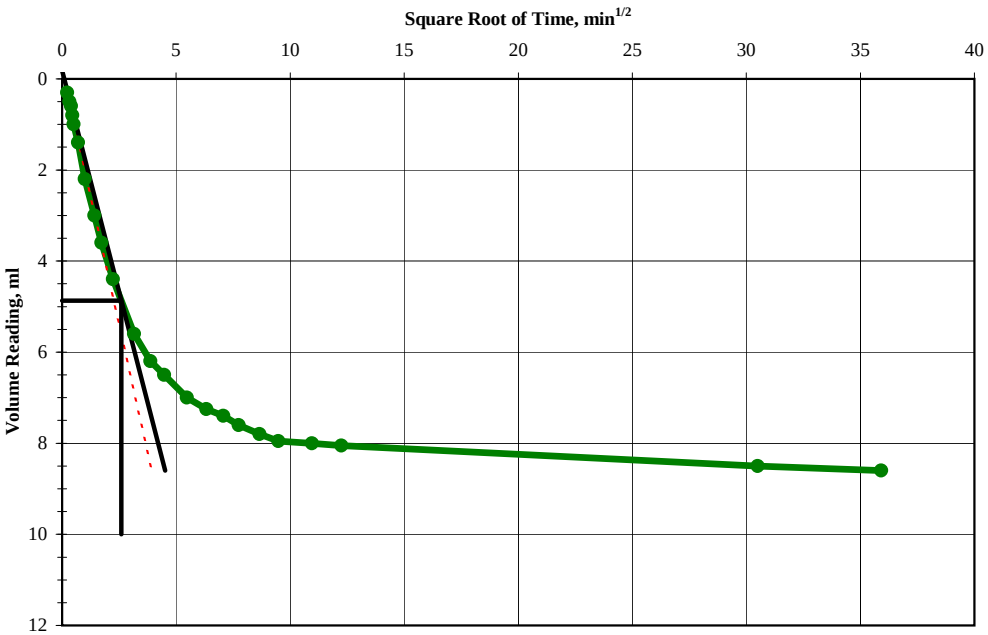
Consol. Start Date: 12/14/2010

Elapsed Time (min)	Sqrt Time ($min^{1/2}$)	Volume Reading ml
0	0	0.0
0.05	0.22	0.3
0.10	0.32	0.5
0.15	0.39	0.6
0.20	0.45	0.8
0.25	0.50	1.0
0.50	0.71	1.4
1.00	1.00	2.2
2.00	1.41	3.0
3.00	1.73	3.6
5.00	2.24	4.4
10.00	3.16	5.6
15.00	3.87	6.2
20.00	4.47	6.5
30.00	5.48	7.0
40.00	6.32	7.3
50.00	7.07	7.4
60.00	7.75	7.6
75.00	8.66	7.8
90.00	9.49	8.0
120.00	10.95	8.0
150.00	12.25	8.1
930.00	30.50	8.5
1290.00	35.92	8.6

Log of Elapsed Time vs. Volume Reading



Square Root of Elapsed Time vs. Volume Reading



Sqrt. of Elapsed Time vs Volume		Log of Elapsed Time vs Volume		Consolidation Summary	
T0 = 0 min.	V0 = -0.2 ml.	T0 = 0 min.	V0 = -0.2 ml.	Initial Volume Reading, ml	0.0
T90 = 6.8 min	V90 = 4.9 ml.	T50 = 3.3 min.	V50 = 3.7 ml.	Final Volume Reading, ml	8.6
T100 = NA min	V100 = 5.4 ml.	T100 = 33.4 min.	V100 = 7.7 ml.	Total Volume Change, ml	52.2

Input Validation: Reviewed By: Date 12/14/2010

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CONSOLIDATED-UNDRAINED TRIAXIAL COMPRESSION TEST ON COHESIVE SOILS ASTM D 4767

Client	Civil & Environmental Consultants, Inc.	Boring	TPE-17
Client Project	091-867 Apex Landfill Expansion	Depth	12'-14'
Project No.	30598	Sample	ST-1
Test No.	1	Lab Sample No.	30598005
USCS Description:	YELLOWISH SANDY LEAN CLAY	Test Conditions:	Undisturbed - Side And Double Drained

SAMPLE CONDITIONS

	Initial	After Consol.	Final
Tare Number	A17	NA	810
Wt. Tare & WS, gm	183.36	NA	389.99
Wt. Tare & DS, gm	160.83	NA	350.59
Wt. Tare, gm	9.54	NA	102.42
Water Content, %	14.9	15.9	15.9
Wt. Tube & WS., gm	1844.0	NA	
Wt. Of Tube, gm	418.6	NA	
Wt. Of WS., gm	1425.4	1437.6	
Length 1, in	6.05	NA	
Length 2, in	6.034	NA	
Length 3, in	6.027	NA	
Top Diameter, in	2.881	NA	
Middle Diameter, in	2.88	NA	
Bottom Diameter, in	2.88	NA	
Average Length, in	6.037	5.970	
Average Diameter, in	2.880	2.844	
Average Area, in^2	6.52	6.35	
Sample Volume, in^3	39.34	38.96	
Unit Dry Wt., gms/cc	1.92	1.94	
Unit Dry Wt., pcf	120.1	121.2	
Specific Gravity, Assume	2.70	2.70	
Volume of Solids, cc	459.48	459.48	
Void Ratio, e	0.40	0.39	
Porosity, n	0.29	0.28	
Pore Volume, cc	11.30	10.92	
Saturation, %	99.8	110.0	

TEST CONDITIONS

Cell Pressure, psi	60.08	
Back Pressure, psi	50.27	
Effective Consolidating Pressure, psi	9.81	σ_3
Pore Pressure Parameter (B), %	95	

SATURATION AND CONSOLIDATION VOLUME CHANGES

Height Change, mils	Reading	Change	Consolidation	
Initial Reading	7.167	0	Volume Change, ml	6.1
After Saturation	7.114	53	Volume Change, in^3	0.37
After Consolidation	7.1	67	Saturation Method:	Wet

STRAIN RATE CALCULATIONS

Calc. Strain Rate, %/min (t50=9.75)	0.0004	Strain Rate Used, %/min	0.0003
Calc. Deformation Rate, in/min	0.0024	Deformation Rate Used	0.002

EFFECTIVE FAILURE SUMMARY

Failure Conditions	Max σ_1'/σ_3'	15% ε	
Effective Consolidating Pressure, psi	9.81	9.81	σ_3
1St. Maximum Effective Principal Stress Ratio	5.085	3.98	σ_1'/σ_3'
Deviator Stress at Failure, psi	22.52	40.25	$\sigma_1-\sigma_3$
Axial Strain at Failure, %	2.33	15.00	ε
Effective Minor Principal Stress at Failure, psi	5.51	13.52	σ_3'
Effective Major Principal Stress at Failure, psi	28.04	53.77	σ_1'
Mohr's Circle Stress Path (Origin of Circle), psi	16.77	33.65	p'
Mohr's Circle Stress Path (Radius of Circle), psi	11.26	20.13	q

TOTAL FAILURE SUMMARY

Failure Conditions	Max σ_1'/σ_3'	15% ε	
Deviator Stress at Failure, psi	22.52	40.25	$\sigma_1-\sigma_3$
Axial Strain at Failure, %	2.33	15.00	ε
Total Minor Principal Stress at Failure, psi	9.81	9.81	σ_3
Total Major Principal Stress at Failure, psi	32.33	50.06	σ_1

TEST DATA

Axial Load	Axial Deformation	Total Pore Water Pressure	Axial Strain	Principal Stress Difference (Deviator Stress)	Induced Pore Water Pressure	Effective Major Principal Stress	Effective Minor Principal Stress	Effective Principal Stress Ratio	A-Bar	Mohr's Circle Stress Paths	
										Origin of Circle	Radius of Circle
lb.	mils	psi	%	psi	psi	psi	psi			psi	psi
P	ΔH	U	ε	$\sigma_1-\sigma_3$	ΔU	σ_1'	σ_3'	σ_1'/σ_3'	A'	p'	q
8.2	0	50.3	0	0	NA	NA	NA	NA	NA	9.81	0
33.0	5	51.7	0.08	3.90	1.38	12.33	8.42	1.463	0.37	10.38	1.95
50.5	11	53.2	0.18	6.66	2.88	13.58	6.92	1.961	0.46	10.25	3.33
61.3	17	54.0	0.28	8.33	3.71	14.43	6.10	2.367	0.47	10.26	4.17
69.8	22	54.5	0.38	9.67	4.28	15.20	5.53	2.749	0.47	10.37	4.84
77.1	29	54.9	0.48	10.79	4.64	15.96	5.16	3.089	0.45	10.56	5.40
83.7	35	55.2	0.58	11.82	4.90	16.73	4.91	3.406	0.44	10.82	5.91
89.7	41	55.3	0.68	12.75	5.07	17.49	4.74	3.690	0.42	11.11	6.37
95.4	46	55.5	0.78	13.62	5.18	18.24	4.62	3.946	0.40	11.43	6.81
100.6	52	55.5	0.87	14.43	5.26	18.97	4.54	4.175	0.38	11.76	7.21
105.5	58	55.6	0.97	15.16	5.28	19.69	4.52	4.351	0.37	12.11	7.58
110.3	64	55.6	1.07	15.90	5.30	20.41	4.51	4.527	0.35	12.46	7.95
114.7	70	55.6	1.17	16.57	5.28	21.10	4.53	4.662	0.34	12.81	8.29
126.4	86	55.4	1.45	18.34	5.13	23.02	4.68	4.920	0.29	13.85	9.17

137.1	104	55.2	1.74	19.94	4.88	24.87	4.93	5.048	0.26	14.90	9.97
145.8	121	54.9	2.03	21.23	4.60	26.43	5.21	5.077	0.23	15.82	10.61
154.7	139	54.6	2.33	22.52	4.29	28.04	5.51	5.085	0.20	16.77	11.26
161.9	156	54.2	2.61	23.57	3.96	29.42	5.85	5.027	0.18	17.64	11.78
169.7	173	53.9	2.90	24.68	3.61	30.88	6.20	4.979	0.15	18.54	12.34
176.1	191	53.5	3.20	25.59	3.26	32.14	6.55	4.908	0.13	19.35	12.80
181.3	209	53.2	3.50	26.30	2.91	33.19	6.89	4.814	0.12	20.04	13.15
186.2	226	52.9	3.79	26.97	2.60	34.17	7.20	4.743	0.10	20.69	13.48
192.0	243	52.6	4.08	27.75	2.29	35.27	7.52	4.692	0.09	21.39	13.87
197.5	261	52.3	4.38	28.49	1.99	36.31	7.82	4.644	0.07	22.07	14.25
202.0	280	52.0	4.68	29.08	1.69	37.19	8.12	4.582	0.06	22.66	14.54
205.7	297	51.7	4.98	29.54	1.40	37.95	8.41	4.514	0.05	23.18	14.77
210.6	315	51.4	5.28	30.18	1.13	38.85	8.67	4.480	0.04	23.76	15.09
215.9	333	51.1	5.57	30.88	0.88	39.81	8.93	4.459	0.03	24.37	15.44
220.1	351	50.9	5.88	31.40	0.63	40.58	9.18	4.419	0.02	24.88	15.70
223.9	369	50.6	6.18	31.86	0.38	41.29	9.43	4.379	0.01	25.36	15.93
227.0	387	50.4	6.48	32.22	0.16	41.86	9.65	4.339	0.01	25.76	16.11
230.9	405	50.2	6.78	32.69	-0.11	42.60	9.91	4.297	0.00	26.26	16.34
235.6	422	50.0	7.07	33.27	-0.30	43.37	10.10	4.292	-0.01	26.74	16.63
239.4	440	49.8	7.37	33.72	-0.50	44.02	10.31	4.271	-0.02	27.17	16.86
242.7	458	49.6	7.67	34.08	-0.69	44.58	10.50	4.245	-0.02	27.54	17.04
244.7	476	49.4	7.97	34.27	-0.88	44.95	10.68	4.208	-0.03	27.82	17.13
249.0	493	49.2	8.26	34.77	-1.05	45.64	10.86	4.201	-0.03	28.25	17.39
252.6	511	49.0	8.56	35.18	-1.22	46.21	11.03	4.189	-0.04	28.62	17.59
255.6	529	48.9	8.86	35.49	-1.40	46.71	11.21	4.165	-0.04	28.96	17.75
257.9	546	48.7	9.15	35.72	-1.53	47.05	11.33	4.151	-0.04	29.19	17.86
260.6	564	48.6	9.45	35.98	-1.68	47.47	11.49	4.132	-0.05	29.48	17.99
265.1	581	48.5	9.74	36.50	-1.82	48.13	11.63	4.139	-0.05	29.88	18.25
267.6	599	48.3	10.04	36.74	-1.95	48.50	11.76	4.124	-0.06	30.13	18.37
270.2	617	48.2	10.34	36.99	-2.08	48.87	11.89	4.111	-0.06	30.38	18.49
271.9	635	48.0	10.64	37.09	-2.23	49.14	12.04	4.080	-0.06	30.59	18.55
274.9	653	47.9	10.93	37.39	-2.33	49.53	12.14	4.081	-0.07	30.83	18.70
278.9	671	47.8	11.23	37.83	-2.45	50.09	12.26	4.086	-0.07	31.17	18.91
281.3	689	47.7	11.54	38.03	-2.56	50.39	12.36	4.075	-0.07	31.38	19.01
283.6	707	47.6	11.84	38.22	-2.68	50.70	12.48	4.061	-0.07	31.59	19.11
285.3	725	47.5	12.14	38.33	-2.78	50.92	12.59	4.044	-0.08	31.75	19.16
289.3	743	47.4	12.44	38.74	-2.89	51.44	12.70	4.051	-0.08	32.07	19.37
292.2	761	47.3	12.74	39.01	-3.01	51.83	12.82	4.043	-0.08	32.33	19.51
294.3	779	47.2	13.05	39.17	-3.10	52.08	12.91	4.033	-0.08	32.50	19.58
294.7	797	47.1	13.35	39.08	-3.20	52.09	13.01	4.005	-0.09	32.55	19.54
298.3	814	47.0	13.64	39.44	-3.30	52.55	13.11	4.009	-0.09	32.83	19.72
302.0	832	46.9	13.93	39.81	-3.39	53.01	13.20	4.017	-0.09	33.10	19.91
303.7	850	46.8	14.23	39.90	-3.48	53.19	13.29	4.002	-0.09	33.24	19.95
306.0	868	46.7	14.53	40.07	-3.57	53.44	13.38	3.995	-0.09	33.41	20.03
307.3	885	46.6	14.83	40.10	-3.67	53.58	13.48	3.975	-0.10	33.53	20.05
310.2	903	46.5	15.12	40.36	-3.75	53.91	13.56	3.977	-0.10	33.73	20.18
313.2	920	46.4	15.42	40.61	-3.82	54.24	13.63	3.979	-0.10	33.93	20.30
315.2	938	46.4	15.72	40.74	-3.92	54.46	13.73	3.968	-0.10	34.09	20.37
317.0	956	46.3	16.01	40.83	-3.99	54.63	13.80	3.958	-0.10	34.21	20.41
317.7	974	46.2	16.31	40.77	-4.08	54.66	13.88	3.937	-0.11	34.27	20.39
321.2	991	46.1	16.60	41.10	-4.18	55.09	13.99	3.937	-0.11	34.54	20.55
324.5	1009	46.0	16.90	41.37	-4.23	55.41	14.04	3.946	-0.11	34.73	20.69
326.2	1027	46.0	17.20	41.45	-4.31	55.56	14.12	3.936	-0.11	34.84	20.72
305.9	1037	46.0	17.37	38.73	-4.24	52.77	14.05	3.757	-0.12	33.41	19.36

Input Validation: Reviewed By: Date Tested: 12/13/10

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CONSOLIDATED-UNDRAINED TRIAXIAL COMPRESSION TEST ON COHESIVE SOILS ASTM D 4767

Client	Civil & Environmental Consultants, Inc.	Boring	TPE-17
Client Project	091-867 Apex Landfill Expansion	Depth	12'-14'
Project No.	30598	Sample	ST-1
Test No.	2	Lab Sample No.	30598005
USCS Description:	YELLOWISH SANDY LEAN CLAY	Test Conditions:	Undisturbed - Side And Double Drained

SAMPLE CONDITIONS

	Initial	After Consol.	Final
Tare Number	A17	NA	805
Wt. Tare & WS, gm	183.36	NA	1493.31
Wt. Tare & DS, gm	160.83	NA	1318.21
Wt. Tare, gm	9.54	NA	102.35
Water Content, %	14.9	14.4	14.4
Wt. Tube & WS., gm	1822.1	NA	
Wt. Of Tube, gm	417.2	NA	
Wt. Of WS., gm	1404.8	1398.8	
Length 1, in	6.027	NA	
Length 2, in	6.035	NA	
Length 3, in	6.012	NA	
Top Diameter, in	2.875	NA	
Middle Diameter, in	2.875	NA	
Bottom Diameter, in	2.878	NA	
Average Length, in	6.025	5.961	
Average Diameter, in	2.876	2.840	
Average Area, in^2	6.50	6.34	
Sample Volume, in^3	39.14	38.08	
Unit Dry Wt., gms/cc	1.91	1.96	
Unit Dry Wt., pcf	119.0	122.3	
Specific Gravity, Assume	2.70	2.70	
Volume of Solids, cc	452.86	452.86	
Void Ratio, e	0.42	0.38	
Porosity, n	0.29	0.27	
Pore Volume, cc	11.50	10.45	
Saturation, %	96.6	102.9	

TEST CONDITIONS

Cell Pressure, psi	89.40	
Back Pressure, psi	49.69	
Effective Consolidating Pressure, psi	39.71	$\sigma 3$
Pore Pressure Parameter (B), %	97	

SATURATION AND CONSOLIDATION VOLUME CHANGES

Height Change, mils	Reading	Change	Consolidation	
Initial Dial Reading	7.49	0	Volume Change, ml	17.3
After Saturation	7.474	16	Volume Change, in^3	1.06
After Consolidation	7.426	64	Saturation Method:	Wet

STRAIN RATE CALCULATIONS

Calc. Strain Rate, %/min (t50=4.32)	0.0009	Strain Rate Used, %/min	0.0003
Calc. Deformation Rate, in/min	0.0055	Deformation Rate Used	0.002

EFFECTIVE FAILURE SUMMARY

Failure Conditions	Max σ_1'/σ_3'	15% ε	
Effective Consolidating Pressure, psi	39.71	39.71	σ_3
1St. Maximum Effective Principal Stress Ratio	4.756	4.29	σ_1'/σ_3'
Deviator Stress at Failure, psi	50.62	62.44	$\sigma_1-\sigma_3$
Axial Strain at Failure, %	4.20	15.00	ε
Effective Minor Principal Stress at Failure, psi	13.48	18.96	σ_3'
Effective Major Principal Stress at Failure, psi	64.10	81.40	σ_1'
Mohr's Circle Stress Path (Origin of Circle), psi	38.79	50.18	p'
Mohr's Circle Stress Path (Radius of Circle), psi	25.31	31.22	q

TOTAL FAILURE SUMMARY

Failure Conditions	Max σ_1'/σ_3'	15% ε	
Deviator Stress at Failure, psi	50.62	62.44	$\sigma_1-\sigma_3$
Axial Strain at Failure, %	4.20	15.00	ε
Total Minor Principal Stress at Failure, psi	39.71	39.71	σ_3
Total Major Principal Stress at Failure, psi	90.33	102.15	σ_1

TEST DATA

Axial Load	Axial Deformation	Total Pore Water Pressure	Axial Strain	Principal Stress Difference (Deviator Stress)	Induced Pore Water Pressure	Effective Major Principal Stress	Effective Minor Principal Stress	Effective Principal Stress Ratio	A-Bar	Mohr's Circle Stress Paths	
										Origin of Circle	Radius of Circle
lb.	mils	psi	%	psi	psi	psi	psi			psi	psi
P	ΔH	U	ε	$\sigma_1-\sigma_3$	ΔU	σ_1'	σ_3'	σ_1'/σ_3'	A'	p'	q
11.2	0	49.7	0	0.00	0	NA	NA	NA	NA	39.71	0
80.2	4	54.6	0.07	10.88	4.87	45.72	34.84	1.312	0.46	40.28	5.44
124.8	9	60.0	0.15	17.89	10.28	47.32	29.43	1.608	0.59	38.37	8.95
155.0	14	63.9	0.24	22.63	14.17	48.17	25.54	1.886	0.65	36.85	11.31
177.5	20	66.7	0.34	26.15	16.97	48.89	22.74	2.150	0.67	35.81	13.07
195.4	26	68.7	0.44	28.94	19.04	49.61	20.67	2.400	0.68	35.14	14.47
209.7	32	70.3	0.53	31.16	20.62	50.25	19.09	2.632	0.68	34.67	15.58
221.8	38	71.5	0.63	33.03	21.83	50.91	17.88	2.847	0.68	34.39	16.51
232.2	44	72.5	0.74	34.61	22.82	51.50	16.89	3.049	0.68	34.20	17.31
241.1	50	73.3	0.84	35.97	23.59	52.09	16.12	3.231	0.68	34.10	17.98
249.2	56	73.9	0.94	37.21	24.21	52.70	15.50	3.401	0.67	34.10	18.60
256.0	62	74.4	1.04	38.23	24.72	53.21	14.99	3.551	0.67	34.10	19.11
262.0	68	74.8	1.14	39.13	25.14	53.70	14.57	3.686	0.66	34.13	19.56
277.0	86	75.7	1.45	41.34	25.99	55.06	13.73	4.012	0.65	34.39	20.67

288.7	104	76.1	1.75	43.02	26.45	56.28	13.26	4.246	0.63	34.77	21.51
298.8	123	76.4	2.06	44.45	26.68	57.48	13.03	4.411	0.62	35.25	22.22
307.1	142	76.5	2.37	45.58	26.79	58.50	12.92	4.527	0.61	35.71	22.79
314.7	160	76.5	2.68	46.61	26.81	59.51	12.90	4.613	0.59	36.20	23.31
321.9	178	76.5	2.98	47.57	26.77	60.51	12.94	4.675	0.58	36.73	23.78
328.5	196	76.4	3.29	48.43	26.67	61.47	13.04	4.714	0.57	37.25	24.22
334.8	215	76.2	3.60	49.22	26.55	62.39	13.16	4.740	0.56	37.77	24.61
340.3	232	76.1	3.90	49.91	26.39	63.23	13.32	4.747	0.55	38.28	24.95
346.0	251	75.9	4.20	50.62	26.23	64.10	13.48	4.756	0.53	38.79	25.31
351.3	268	75.8	4.49	51.26	26.06	64.91	13.65	4.755	0.52	39.28	25.63
356.9	285	75.6	4.79	51.93	25.86	65.78	13.85	4.750	0.51	39.82	25.97
362.0	303	75.4	5.09	52.54	25.70	66.55	14.01	4.750	0.50	40.28	26.27
366.8	321	75.2	5.39	53.10	25.53	67.27	14.18	4.745	0.50	40.73	26.55
371.8	338	75.1	5.68	53.67	25.37	68.02	14.34	4.741	0.49	41.18	26.84
376.5	356	74.9	5.97	54.21	25.17	68.75	14.54	4.727	0.48	41.65	27.10
380.9	374	74.7	6.27	54.69	24.97	69.43	14.74	4.711	0.47	42.08	27.34
385.3	391	74.5	6.56	55.17	24.79	70.08	14.92	4.698	0.46	42.50	27.58
389.4	409	74.3	6.86	55.58	24.61	70.68	15.10	4.681	0.46	42.89	27.79
393.0	426	74.1	7.14	55.95	24.42	71.24	15.29	4.658	0.45	43.27	27.97
397.3	443	73.9	7.44	56.40	24.22	71.89	15.49	4.640	0.44	43.69	28.20
401.6	462	73.7	7.74	56.84	24.04	72.50	15.67	4.628	0.44	44.08	28.42
405.1	479	73.6	8.04	57.17	23.89	72.99	15.82	4.613	0.43	44.41	28.58
408.7	497	73.4	8.34	57.50	23.73	73.48	15.98	4.599	0.43	44.73	28.75
412.4	514	73.3	8.63	57.85	23.59	73.97	16.12	4.589	0.42	45.05	28.93
415.8	532	73.2	8.93	58.15	23.46	74.40	16.25	4.578	0.42	45.32	29.07
419.6	550	73.0	9.24	58.49	23.32	74.88	16.39	4.569	0.41	45.63	29.25
422.9	568	72.9	9.54	58.77	23.17	75.31	16.54	4.554	0.41	45.92	29.39
426.4	586	72.7	9.83	59.09	23.02	75.77	16.69	4.540	0.40	46.23	29.54
429.6	604	72.6	10.13	59.33	22.88	76.17	16.83	4.525	0.40	46.50	29.67
432.6	622	72.4	10.44	59.56	22.69	76.59	17.02	4.498	0.39	46.81	29.78
435.7	640	72.3	10.74	59.80	22.57	76.93	17.14	4.489	0.39	47.04	29.90
438.9	658	72.1	11.03	60.05	22.45	77.30	17.26	4.479	0.39	47.28	30.02
442.0	675	72.0	11.33	60.28	22.32	77.67	17.39	4.466	0.38	47.53	30.14
445.1	693	71.9	11.62	60.52	22.18	78.05	17.53	4.451	0.38	47.79	30.26
448.3	711	71.7	11.93	60.75	22.04	78.42	17.67	4.438	0.37	48.04	30.37
450.5	729	71.6	12.22	60.86	21.91	78.66	17.80	4.419	0.37	48.23	30.43
453.3	746	71.5	12.52	61.03	21.78	78.96	17.93	4.404	0.37	48.45	30.52
456.6	764	71.3	12.81	61.28	21.64	79.36	18.07	4.390	0.36	48.72	30.64
459.3	782	71.2	13.11	61.44	21.50	79.66	18.21	4.373	0.36	48.93	30.72
462.4	799	71.0	13.41	61.65	21.34	80.02	18.37	4.356	0.36	49.20	30.83
465.0	817	71.0	13.71	61.79	21.27	80.23	18.44	4.351	0.35	49.34	30.90
468.0	834	70.9	14.00	61.99	21.16	80.54	18.55	4.342	0.35	49.55	31.00
470.8	852	70.7	14.30	62.15	21.03	80.83	18.68	4.327	0.35	49.75	31.07
473.3	871	70.6	14.61	62.27	20.91	81.07	18.80	4.312	0.35	49.94	31.14
476.0	889	70.5	14.91	62.42	20.79	81.34	18.92	4.298	0.34	50.13	31.21
478.3	906	70.4	15.21	62.50	20.66	81.54	19.05	4.281	0.34	50.29	31.25
481.5	924	70.2	15.50	62.71	20.54	81.87	19.17	4.272	0.34	50.52	31.35
484.7	942	70.1	15.81	62.91	20.42	82.19	19.29	4.261	0.33	50.74	31.45
487.1	961	70.0	16.12	63.00	20.31	82.40	19.40	4.247	0.33	50.90	31.50
489.9	978	69.8	16.42	63.14	20.16	82.69	19.55	4.229	0.33	51.12	31.57
492.4	996	69.8	16.71	63.25	20.07	82.89	19.64	4.221	0.33	51.26	31.63
495.9	1014	69.6	17.01	63.47	19.95	83.23	19.76	4.211	0.32	51.50	31.73
499.2	1032	69.5	17.32	63.68	19.84	83.55	19.87	4.204	0.32	51.71	31.84
501.5	1050	69.4	17.62	63.74	19.74	83.71	19.97	4.192	0.32	51.84	31.87

Input Validation: Reviewed By: Date Tested: 12/13/10

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CONSOLIDATED-UNDRAINED TRIAXIAL COMPRESSION TEST ON COHESIVE SOILS ASTM D 4767

Client	Civil & Environmental Consultants, Inc.	Boring	TPE-17
Client Project	091-867 Apex Landfill Expansion	Depth	12'-14'
Project No.	30598	Sample	ST-1
Test No.	3	Lab Sample No.	30598005
USCS Description:	YELLOWISH SANDY LEAN CLAY	Test Conditions:	Undisturbed - Side And Double Drained

SAMPLE CONDITIONS

	Initial	After Consol.	Final
Tare Number	A17	NA	307
Wt. Tare & WS, gm	183.36	NA	1398.71
Wt. Tare & DS, gm	160.83	NA	1193.80
Wt. Tare, gm	9.54	NA	98.77
Water Content, %	14.9	18.7	18.7
Wt. Tube & WS., gm	1750.7	NA	
Wt. Of Tube, gm	419.9	NA	
Wt. Of WS., gm	1330.8	1375.1	
Length 1, in	6.075	NA	
Length 2, in	6.054	NA	
Length 3, in	6.071	NA	
Top Diameter, in	2.879	NA	
Middle Diameter, in	2.881	NA	
Bottom Diameter, in	2.886	NA	
Average Length, in	6.067	5.930	
Average Diameter, in	2.882	2.828	
Average Area, in^2	6.52	6.28	
Sample Volume, in^3	39.58	37.41	
Unit Dry Wt., gms/cc	1.79	1.89	
Unit Dry Wt., pcf	111.5	117.9	
Specific Gravity, Assume	2.70	2.70	
Volume of Solids, cc	429.01	429.01	
Void Ratio, e	0.51	0.43	
Porosity, n	0.34	0.30	
Pore Volume, cc	13.40	11.23	
Saturation, %	78.6	117.8	

TEST CONDITIONS

Cell Pressure, psi	119.75	
Back Pressure, psi	39.99	
Effective Consolidating Pressure, psi	79.76	σ_3
Pore Pressure Parameter (B), %	97	

SATURATION AND CONSOLIDATION VOLUME CHANGES

Height Change, mils	Reading	Change	Consolidation	
Initial Dial Reading	7.223	0	Volume Change, ml	35.5
After Saturation	7.215	8	Volume Change, in^3	2.17
After Consolidation	7.086	137	Saturation Method:	Wet

STRAIN RATE CALCULATIONS

Calc. Strain Rate, %/min (t50=8.11)	0.0005	Strain Rate Used, %/min	0.0003
Calc. Deformation Rate, in/min	0.0029	Deformation Rate Used	0.002

EFFECTIVE FAILURE SUMMARY

Failure Conditions	Max σ_1'/σ_3'	15% ε	
Effective Consolidating Pressure, psi	79.76	79.76	σ_3
1St. Maximum Effective Principal Stress Ratio	3.251	2.72	σ_1'/σ_3'
Deviator Stress at Failure, psi	61.96	54.00	$\sigma_1-\sigma_3$
Axial Strain at Failure, %	3.87	15.00	ε
Effective Minor Principal Stress at Failure, psi	27.52	31.46	σ_3'
Effective Major Principal Stress at Failure, psi	89.49	85.46	σ_1'
Mohr's Circle Stress Path (Origin of Circle), psi	58.50	58.46	p'
Mohr's Circle Stress Path (Radius of Circle), psi	30.98	27.00	q

TOTAL FAILURE SUMMARY

Failure Conditions	Max σ_1'/σ_3'	15% ε	
Deviator Stress at Failure, psi	61.96	54.00	$\sigma_1-\sigma_3$
Axial Strain at Failure, %	3.87	15.00	ε
Total Minor Principal Stress at Failure, psi	79.76	79.76	σ_3
Total Major Principal Stress at Failure, psi	141.73	133.77	σ_1

TEST DATA

Axial Load	Axial Deformation	Total Pore Water Pressure	Axial Strain	Principal Stress Difference (Deviator Stress)	Induced Pore Water Pressure	Effective Major Principal Stress	Effective Minor Principal Stress	Effective Principal Stress Ratio	A-Bar	Mohr's Circle Stress Paths	
										Origin of Circle	Radius of Circle
lb.	mils	psi	%	psi	psi	psi	psi			psi	psi
P	ΔH	U	ε	$\sigma_1-\sigma_3$	ΔU	σ_1'	σ_3'	σ_1'/σ_3'	A'	p'	q
18.6	0	40.0	0	0	0	NA	NA	NA	NA	79.76	0
80.2	5	44.2	0.09	9.79	4.25	85.31	75.52	1.130	0.45	80.41	4.90
152.6	10	52.5	0.17	21.28	12.47	88.58	67.29	1.316	0.60	77.93	10.64
198.6	16	59.1	0.26	28.57	19.10	89.23	60.66	1.471	0.69	74.95	14.28
230.6	22	64.3	0.37	33.62	24.28	89.11	55.49	1.606	0.74	72.30	16.81
255.0	28	68.4	0.47	37.45	28.45	88.76	51.31	1.730	0.78	70.03	18.72
275.7	34	71.9	0.57	40.68	31.94	88.50	47.82	1.851	0.81	68.16	20.34
291.6	39	74.8	0.66	43.15	34.82	88.10	44.94	1.960	0.83	66.52	21.58
305.5	44	77.3	0.75	45.33	37.27	87.82	42.49	2.067	0.85	65.16	22.66
317.3	50	79.3	0.84	47.15	39.31	87.60	40.45	2.166	0.86	64.02	23.57
327.6	56	81.0	0.94	48.72	41.02	87.47	38.75	2.257	0.87	63.11	24.36
336.4	62	82.6	1.04	50.05	42.57	87.24	37.19	2.346	0.88	62.22	25.03
344.8	68	83.9	1.14	51.32	43.88	87.21	35.89	2.430	0.88	61.55	25.66
364.5	86	86.8	1.45	54.26	46.85	87.17	32.92	2.648	0.89	60.05	27.13

379.8	104	88.8	1.75	56.48	48.84	87.40	30.92	2.827	0.89	59.16	28.24
391.7	122	90.2	2.06	58.16	50.21	87.72	29.55	2.968	0.89	58.64	29.08
400.4	139	91.0	2.35	59.33	51.05	88.04	28.71	3.067	0.89	58.38	29.67
407.0	156	91.6	2.64	60.19	51.60	88.36	28.16	3.137	0.88	58.26	30.10
412.9	176	92.0	2.97	60.89	51.97	88.69	27.80	3.191	0.88	58.24	30.45
417.8	194	92.2	3.27	61.47	52.16	89.07	27.60	3.227	0.87	58.33	30.73
421.2	212	92.2	3.58	61.79	52.26	89.30	27.51	3.246	0.87	58.40	30.89
423.6	229	92.2	3.87	61.96	52.24	89.49	27.52	3.251	0.87	58.50	30.98
425.6	247	92.2	4.17	62.08	52.18	89.66	27.58	3.251	0.87	58.62	31.04
428.7	266	92.1	4.48	62.34	52.10	90.00	27.66	3.254	0.86	58.83	31.17
430.1	284	92.0	4.80	62.35	51.97	90.14	27.79	3.243	0.86	58.97	31.17
431.5	301	91.7	5.07	62.38	51.75	90.39	28.02	3.227	0.86	59.21	31.19
432.3	318	91.6	5.37	62.30	51.65	90.42	28.12	3.216	0.85	59.27	31.15
434.2	337	91.5	5.69	62.38	51.52	90.62	28.24	3.209	0.85	59.43	31.19
436.0	355	91.4	5.99	62.46	51.38	90.84	28.38	3.201	0.85	59.61	31.23
437.5	373	91.2	6.29	62.48	51.24	91.01	28.53	3.190	0.85	59.77	31.24
438.3	390	91.1	6.57	62.41	51.07	91.11	28.69	3.175	0.84	59.90	31.21
440.2	408	90.9	6.88	62.49	50.93	91.32	28.84	3.167	0.84	60.08	31.24
441.1	427	90.8	7.20	62.40	50.76	91.40	29.00	3.152	0.84	60.20	31.20
441.8	445	90.6	7.50	62.31	50.60	91.48	29.17	3.136	0.84	60.32	31.15
441.0	463	90.4	7.81	61.98	50.44	91.30	29.33	3.113	0.84	60.32	30.99
441.4	480	90.2	8.09	61.85	50.20	91.41	29.56	3.092	0.84	60.48	30.92
440.0	499	90.1	8.41	61.43	50.14	91.05	29.62	3.074	0.84	60.34	30.71
438.1	517	90.0	8.71	60.95	50.00	90.72	29.77	3.048	0.85	60.24	30.47
435.8	535	89.8	9.02	60.41	49.86	90.31	29.90	3.020	0.85	60.11	30.21
431.9	552	89.7	9.31	59.65	49.73	89.69	30.03	2.986	0.86	59.86	29.83
426.5	570	89.6	9.62	58.67	49.59	88.85	30.17	2.945	0.87	59.51	29.34
422.2	588	89.4	9.92	57.86	49.45	88.18	30.31	2.909	0.88	59.25	28.93
419.6	607	89.4	10.23	57.29	49.40	87.66	30.37	2.887	0.89	59.01	28.65
417.7	625	89.3	10.54	56.82	49.35	87.23	30.41	2.869	0.90	58.82	28.41
416.7	643	89.3	10.84	56.50	49.29	86.97	30.47	2.854	0.90	58.72	28.25
415.4	660	89.2	11.13	56.12	49.17	86.72	30.60	2.834	0.90	58.66	28.06
414.2	679	89.2	11.45	55.75	49.18	86.34	30.58	2.823	0.91	58.46	27.88
409.2	697	89.0	11.76	54.87	49.03	85.59	30.73	2.785	0.92	58.16	27.43
408.7	714	88.9	12.05	54.61	48.95	85.42	30.81	2.772	0.92	58.11	27.30
410.0	732	88.8	12.35	54.60	48.86	85.50	30.90	2.767	0.92	58.20	27.30
409.2	750	88.8	12.65	54.31	48.76	85.31	31.00	2.752	0.93	58.15	27.15
408.6	769	88.7	12.96	54.02	48.67	85.11	31.09	2.738	0.93	58.10	27.01
408.5	786	88.6	13.26	53.83	48.59	85.00	31.17	2.727	0.93	58.09	26.92
408.6	804	88.4	13.56	53.66	48.46	84.96	31.30	2.714	0.93	58.13	26.83
410.9	822	88.4	13.87	53.77	48.45	85.09	31.31	2.717	0.93	58.20	26.89
413.2	841	88.3	14.18	53.90	48.28	85.38	31.48	2.712	0.92	58.43	26.95
414.8	859	88.3	14.49	53.92	48.29	85.40	31.48	2.713	0.92	58.44	26.96
416.0	876	88.3	14.78	53.90	48.32	85.34	31.45	2.714	0.92	58.39	26.95
418.5	894	88.3	15.08	54.04	48.30	85.50	31.46	2.718	0.92	58.48	27.02
422.6	912	88.2	15.39	54.40	48.24	85.92	31.52	2.726	0.91	58.72	27.20
427.6	931	88.2	15.70	54.88	48.24	86.40	31.52	2.741	0.91	58.96	27.44
429.0	948	88.2	15.99	54.88	48.22	86.42	31.54	2.740	0.91	58.98	27.44
431.7	966	88.2	16.29	55.04	48.20	86.61	31.57	2.744	0.90	59.09	27.52
435.9	984	88.2	16.59	55.40	48.21	86.95	31.55	2.756	0.90	59.25	27.70
439.0	1002	88.2	16.90	55.61	48.18	87.19	31.58	2.761	0.89	59.39	27.80
442.6	1021	88.1	17.22	55.86	48.07	87.55	31.69	2.763	0.89	59.62	27.93
443.9	1038	88.1	17.51	55.84	48.11	87.49	31.65	2.764	0.89	59.57	27.92
446.3	1056	88.1	17.80	55.96	48.11	87.62	31.66	2.768	0.89	59.64	27.98

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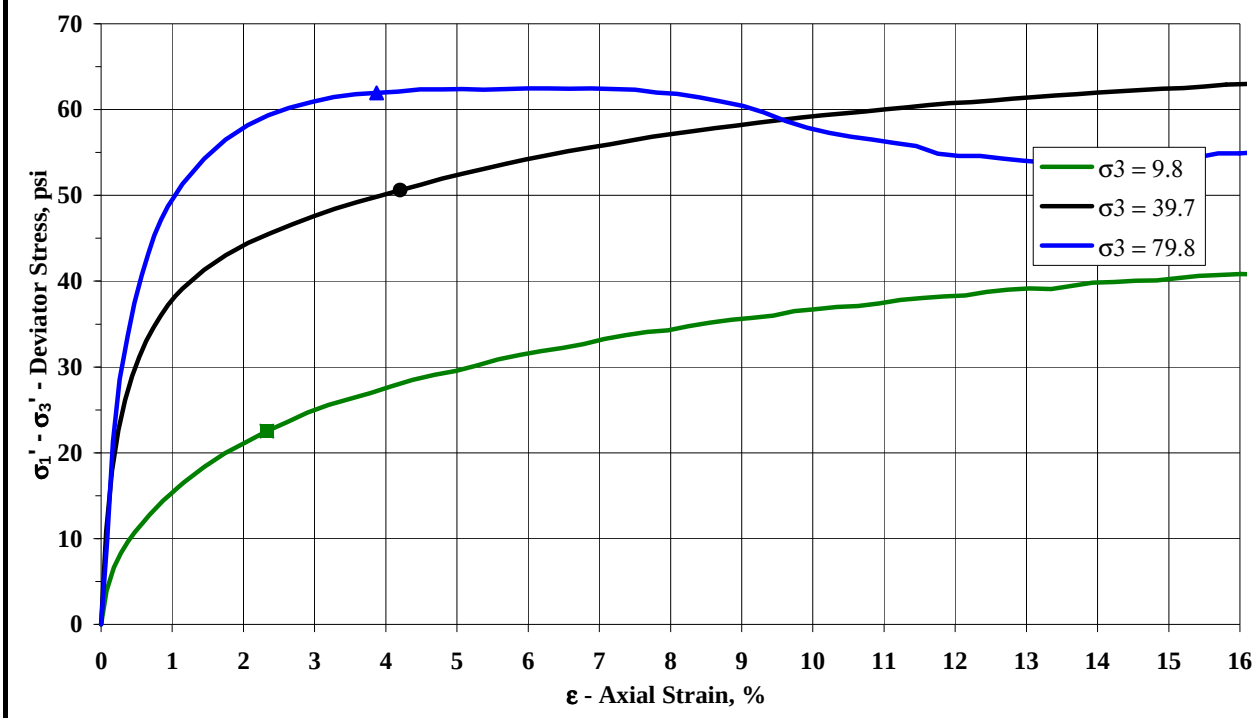
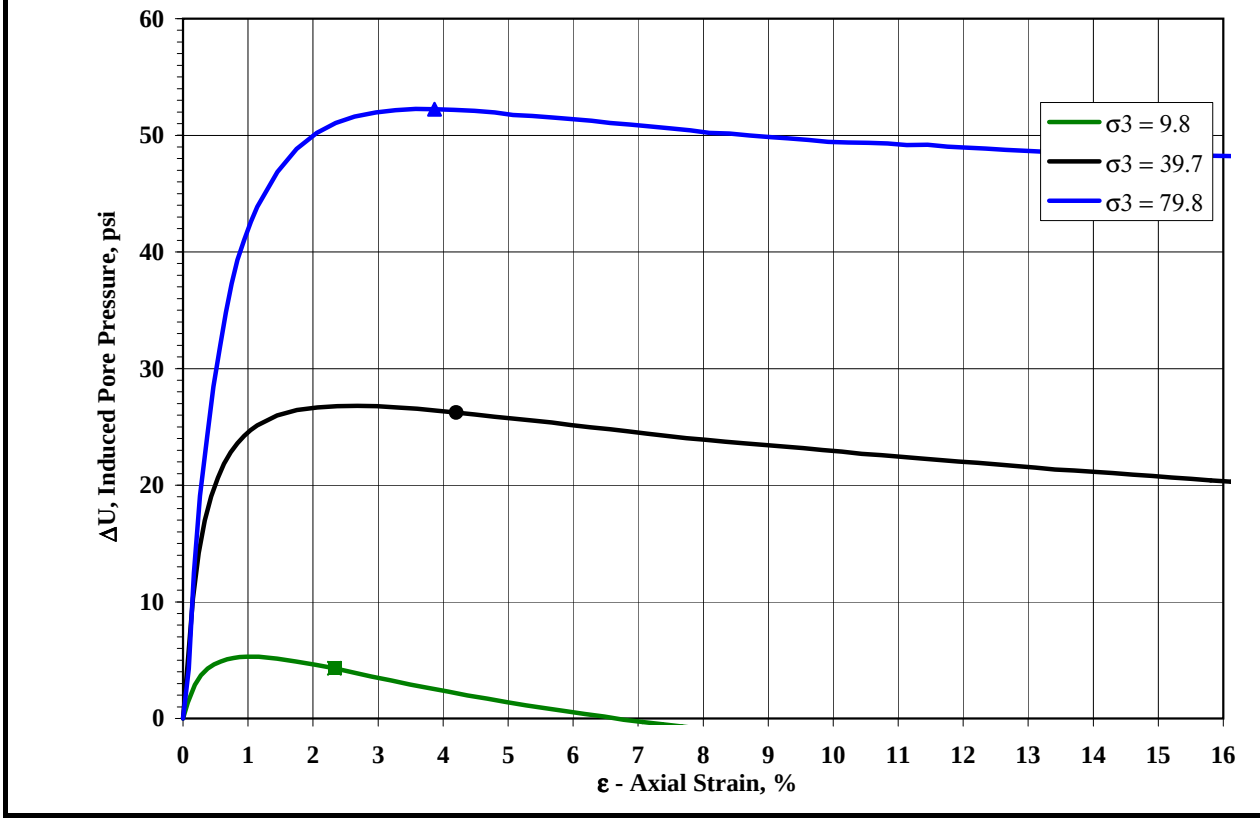
CONSOLIDATED-UNDRAINED TRIAXIAL COMPRESSION TEST ON COHESIVE SOILS ASTM D 4767

Client	Civil & Environmental Consultants, Inc.	Boring	TPE-17
Client Project	091-867 Apex Landfill Expansion	Depth	12'-14'
Project No.	30598	Sample	ST-1
Test Conditions:	Undisturbed - Side And Double Drained	Lab Sample No.	30598005
USCS Description:	YELLOWISH SANDY LEAN CLAY		

AXIAL STRAIN vs. DEVIATOR STRESS



AXIAL STRAIN vs. INDUCED PORE-WATER PRESSURE



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CONSOLIDATED-UNDRAINED TRIAXIAL COMPRESSION TEST ON COHESIVE SOILS ASTM D 476

Client	Civil & Environmental Consultants, In	Boring	TPE-17
Client Project	091-867 Apex Landfill Expansion	Depth	12'-14'
Project No.	30598	Sample	ST-1
		Lab Sample No.	30598005
USCS Description:	YELLOWISH SANDY LEAN CLAY		
Test Conditions:	Undisturbed - Side And Double Drained		

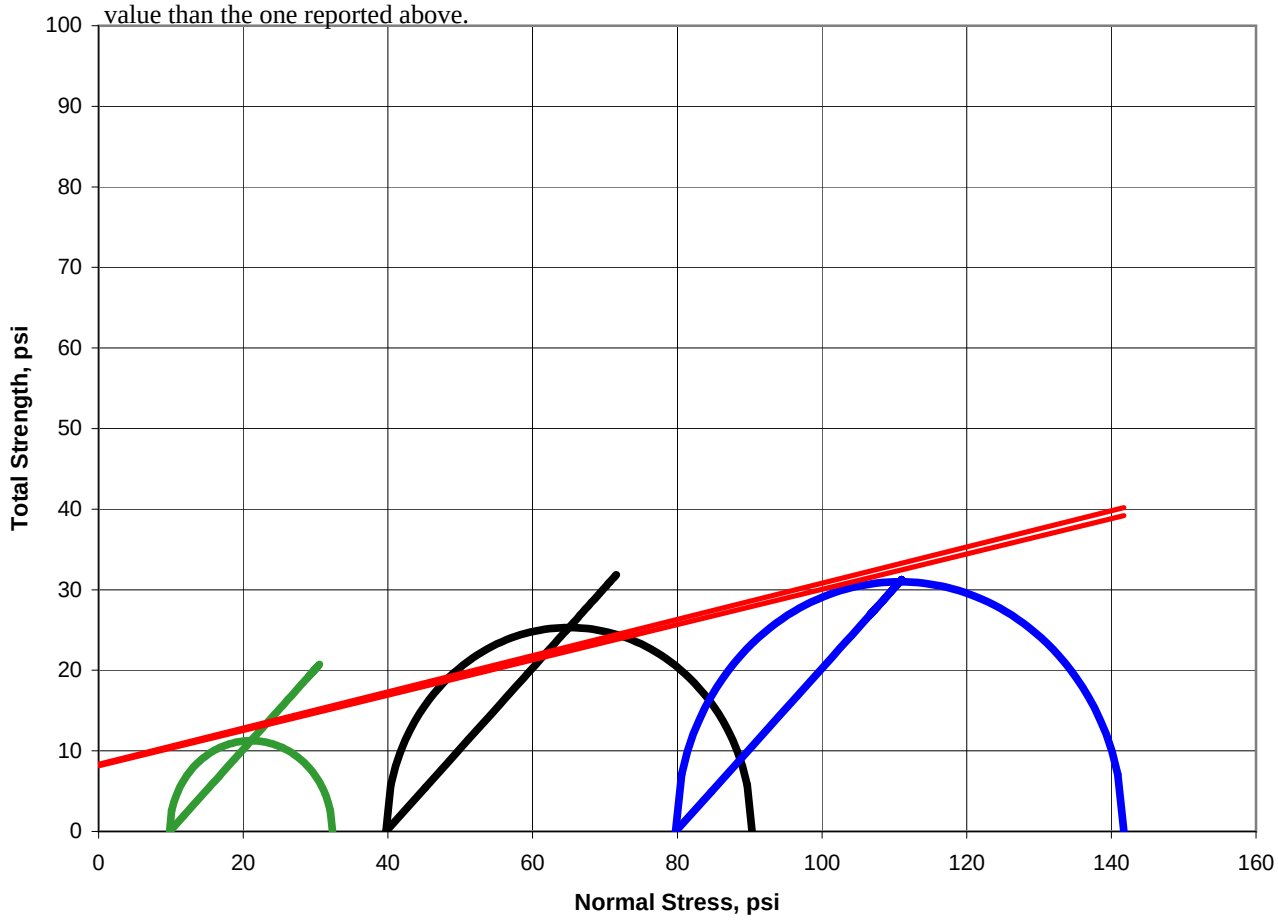
TOTAL STRESS

FAILURE CONDITION: 1st. MAX. EFFECTIVE PRINCIPAL STRESS RATIO

Test No.	Deviator Stress	Major Principal Stress	Minor Principal Stress	Strain at Failure	Mohr's Circle Stress Path		Failure Angle	
	$\sigma1-\sigma3$	$\sigma1$	$\sigma3$	ε	$(\sigma1+\sigma3)/2$	$(\sigma1-\sigma3)/2$		
	psi	psi	psi	%	psi	psi	α, deg	12.4
Test 1	22.52	32.33	9.81	2.33	21.07	11.26	a, psi	8.1
Test 2	50.62	90.33	39.71	4.20	65.02	25.31	Φ, deg	12.7
Test 3	61.96	141.73	79.76	3.87	110.75	30.98	C, psi	8.3

Calculations based on: Test 1 Test 2 Test 3

Note: The Friction Angle and Cohesion using other combinations of test points may yield a higher or lower value than the one reported above.



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CONSOLIDATED-UNDRAINED TRIAXIAL COMPRESSION TEST ON COHESIVE SOILS ASTM D 476

Client	Civil & Environmental Consultants, In	Boring	TPE-17
Client Project	091-867 Apex Landfill Expansion	Depth	12'-14'
Project No.	30598	Sample	ST-1
		Lab Sample No.	30598005
USCS Description:	YELLOWISH SANDY LEAN CLAY		
Test Conditions:	Undisturbed - Side And Double Drained		

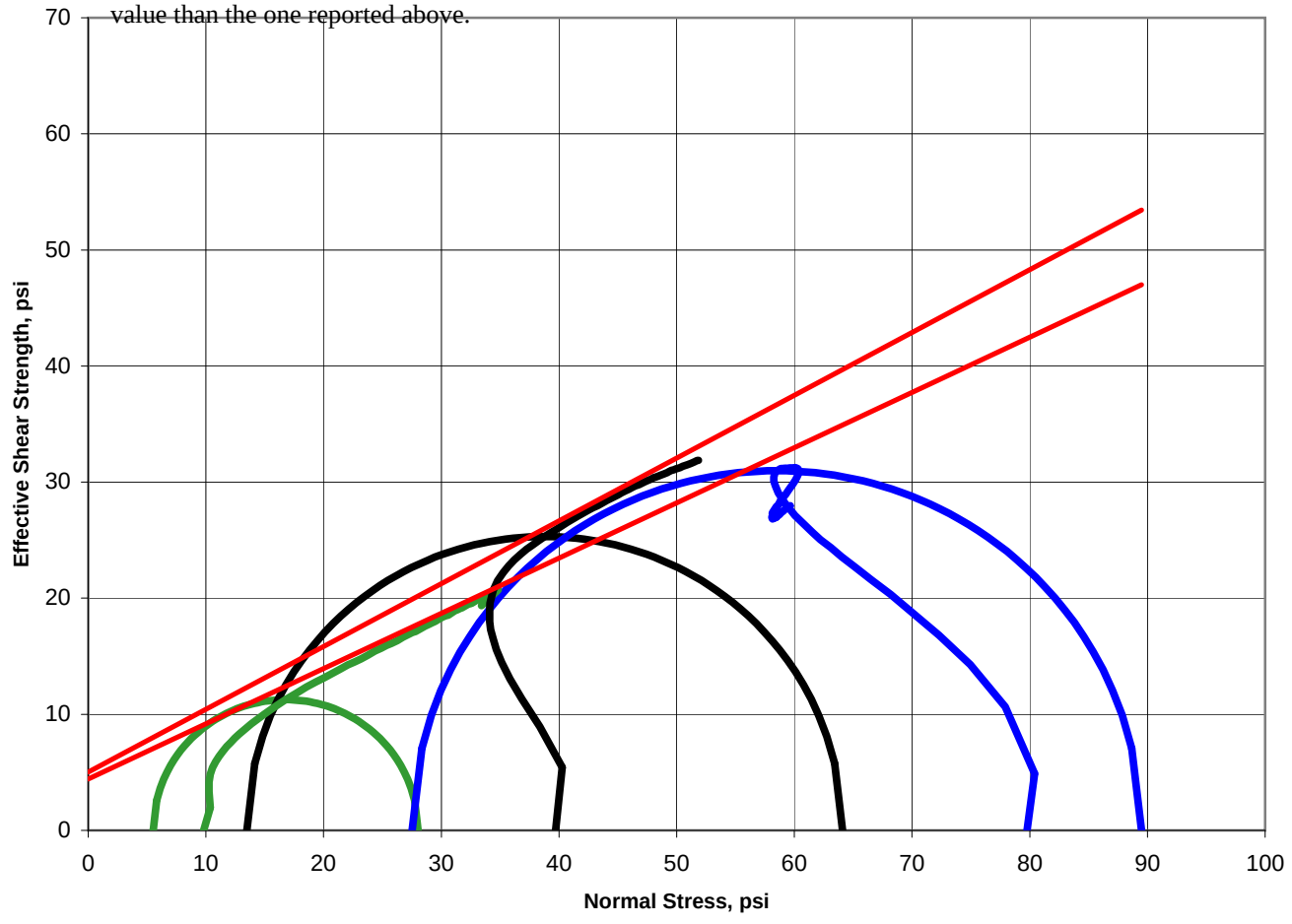
EFFECTIVE STRESS

FAILURE CONDITION: 1st. MAX. EFFECTIVE PRINCIPAL STRESS RATIO

Test No.	Deviator Stress	Major Principal Stress	Minor Principal Stress	Strain at Failure	Mohr's Circle Stress Path		Failure Angle	
	$\sigma 1-\sigma 3$	$\sigma' 1$	$\sigma' 3$	ε	p'	q		
	psi	psi	psi	%	psi	psi	α', deg	25.4
Test 1	22.52	28.04	5.51	2.33	16.77	11.26	a', psi	4.4
Test 2	50.62	64.10	13.48	4.20	38.79	25.31	Φ', deg	28.4
Test 3	61.96	89.49	27.52	3.87	58.50	30.98	C', psi	5.0

Calculations based on: Test 1 Test 2 Test 3

Note: The Friction Angle and Cohesion using other combinations of test points may yield a higher or lower value than the one reported above.



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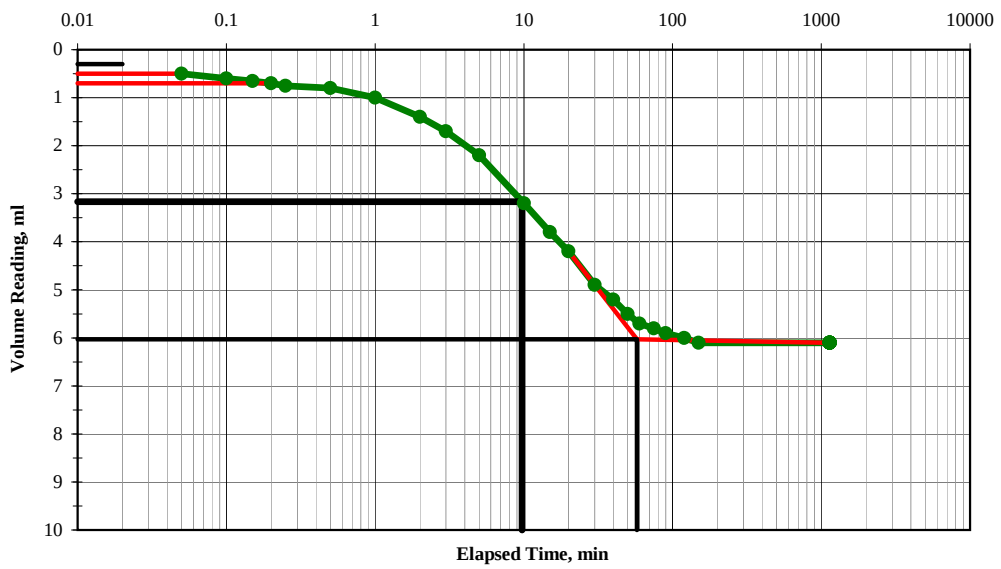
THREE DIMENSIONAL TRIAXIAL CONSOLIDATION TEST

Client	Civil & Environmental Consultants, Inc	Boring	TPE-17	**Staged Consolidation**	
Client Project	091-867 Apex Landfill Expansion	Depth	12'-14'	Consolidation Plot Stress, psi	6.8
Project No.	30598	Sample	ST-1	**Final Test Pressures**	
		Lab Sample	30598005	Cell Pressure, psi	60.1
USCS Description:	YELLOWISH SANDY LEAN CLAY			Back Pressure, psi	50.3
Test Conditions:	Undisturbed - Side And Double Drained			Effective Consol., psi	9.8
				Additional Consol. Volume, ml	0.0

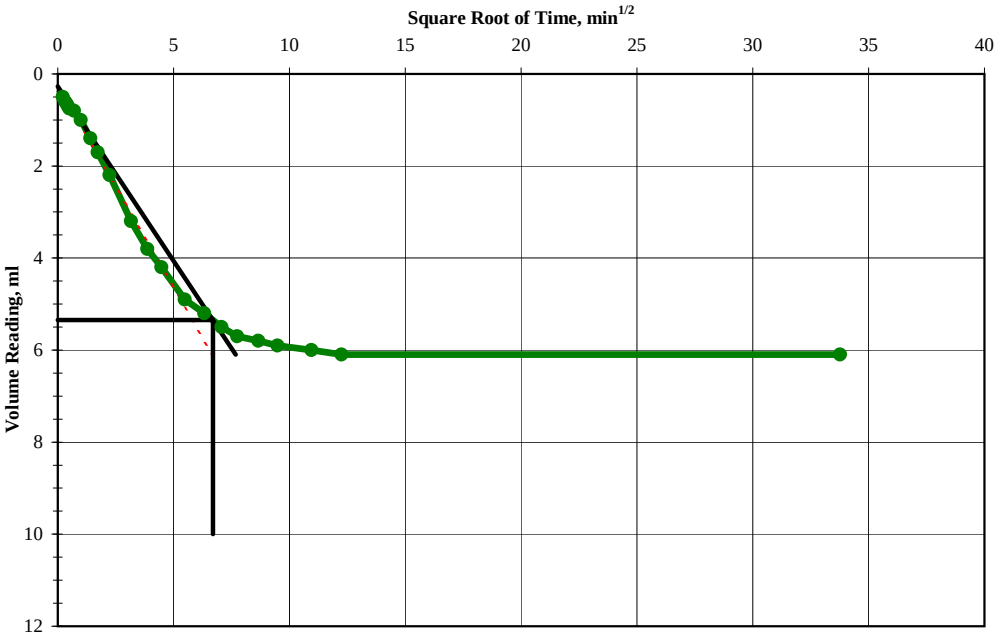
Consol. Start Date: 12/13/2010

Elapsed Time (min)	Sqrt Time ($min^{1/2}$)	Volume Reading ml
0	0	0.0
0.05	0.22	0.5
0.10	0.32	0.6
0.15	0.39	0.6
0.20	0.45	0.7
0.25	0.50	0.8
0.50	0.71	0.8
1.00	1.00	1.0
2.00	1.41	1.4
3.00	1.73	1.7
5.00	2.24	2.2
10.00	3.16	3.2
15.00	3.87	3.8
20.00	4.47	4.2
30.00	5.48	4.9
40.00	6.32	5.2
50.00	7.07	5.5
60.00	7.75	5.7
75.00	8.66	5.8
90.00	9.49	5.9
120.00	10.95	6.0
150.00	12.25	6.1
1140.00	33.76	6.1

Log of Elapsed Time vs. Volume Reading



Square Root of Elapsed Time vs. Volume Reading



Sqrt. of Elapsed Time vs Volume		Log of Elapsed Time vs Volume		Consolidation Summary	
T0 = 0 min.	V0 = 0.3 ml.	T0 = 0 min.	V0 = 0.3 ml.	Initial Volume Reading, ml	0.0
T90 = 44.8 min	V90 = 5.3 ml.	T50 = 9.8 min.	V50 = 3.2 ml.	Final Volume Reading, ml	6.1
T100 = NA min	V100 = 5.9 ml.	T100 = 57.6 min.	V100 = 6.0 ml.	Total Volume Change, ml	6.1

Input Validation: Reviewed By: Date 12/13/2010

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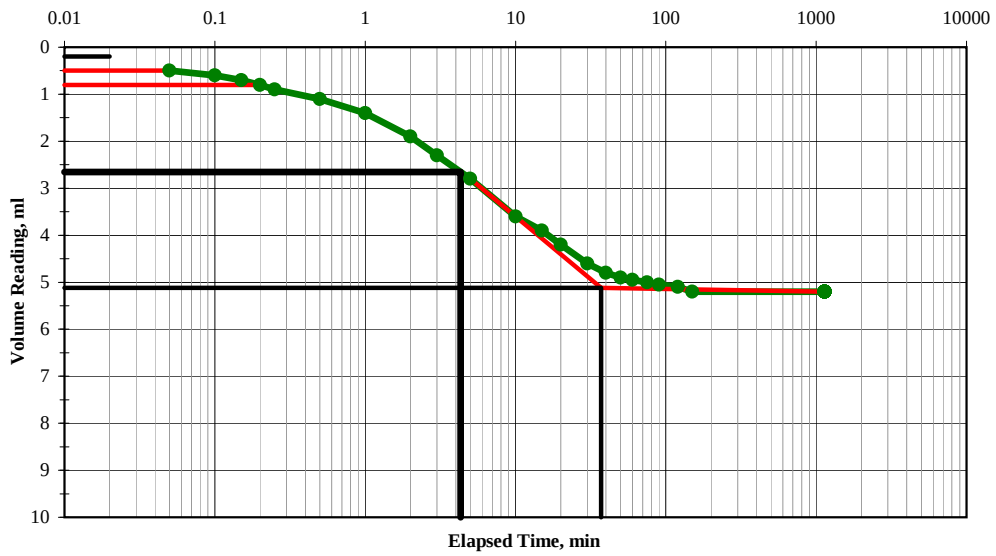
THREE DIMENSIONAL TRIAXIAL CONSOLIDATION TEST

Client	Civil & Environmental Consultants, Inc	Boring	TPE-17	**Staged Consolidation**	
Client Project	091-867 Apex Landfill Expansion	Depth	12'-14'	Consolidation Plot Stress, psi	6.8
Project No.	30598	Sample	ST-1	**Final Test Pressures**	
		Lab Sample	30598005	Cell Pressure, psi	89.4
USCS Description:	YELLOWISH SANDY LEAN CLAY			Back Pressure, psi	49.7
Test Conditions:	Undisturbed - Side And Double Drained			Effective Consol., psi	39.7
				Additional Consol. Volume, ml	12.1

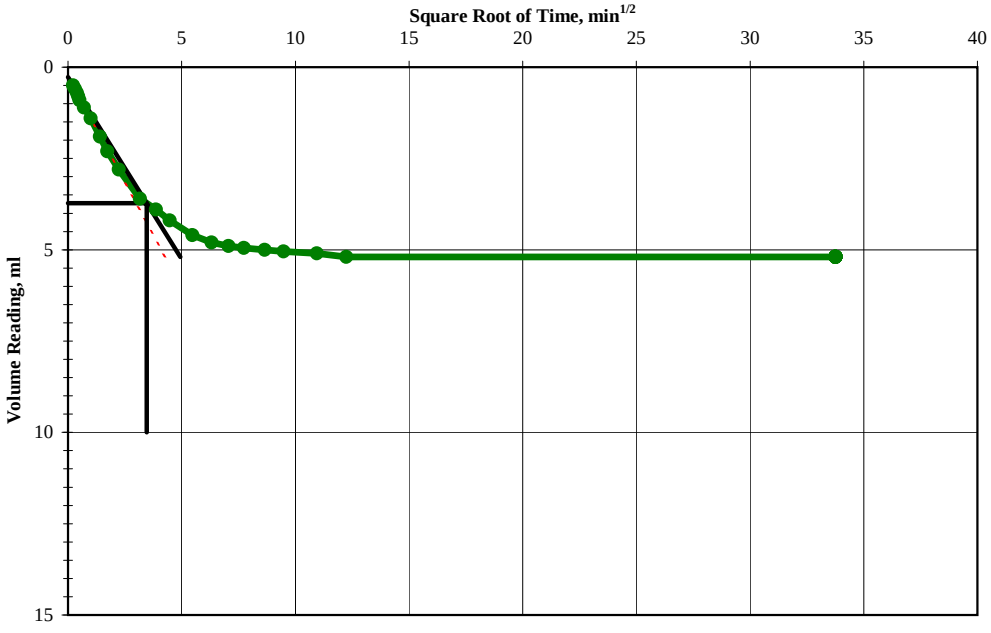
Consol. Start Date: 12/13/2010

Elapsed Time (min)	Sqrt Time ($min^{1/2}$)	Volume Reading ml
0	0	0.0
0.05	0.22	0.5
0.10	0.32	0.6
0.15	0.39	0.7
0.20	0.45	0.8
0.25	0.50	0.9
0.50	0.71	1.1
1.00	1.00	1.4
2.00	1.41	1.9
3.00	1.73	2.3
5.00	2.24	2.8
10.00	3.16	3.6
15.00	3.87	3.9
20.00	4.47	4.2
30.00	5.48	4.6
40.00	6.32	4.8
50.00	7.07	4.9
60.00	7.75	5.0
75.00	8.66	5.0
90.00	9.49	5.1
120.00	10.95	5.1
150.00	12.25	5.2
1140.00	33.76	5.2

Log of Elapsed Time vs. Volume Reading



Square Root of Elapsed Time vs. Volume Reading



Sqrt. of Elapsed Time vs Volume		Log of Elapsed Time vs Volume		Consolidation Summary	
T0 = 0 min.	V0 = 0.3 ml.	T0 = 0 min.	V0 = 0.2 ml.	Initial Volume Reading, ml	0.0
T90 = 12.0 min	V90 = 3.7 ml.	T50 = 4.3 min.	V50 = 2.7 ml.	Final Volume Reading, ml	5.2
T100 = NA min	V100 = 4.1 ml.	T100 = 37.2 min.	V100 = 5.1 ml.	Total Volume Change, ml	17.3

Input Validation: Reviewed By: Date 12/13/2010

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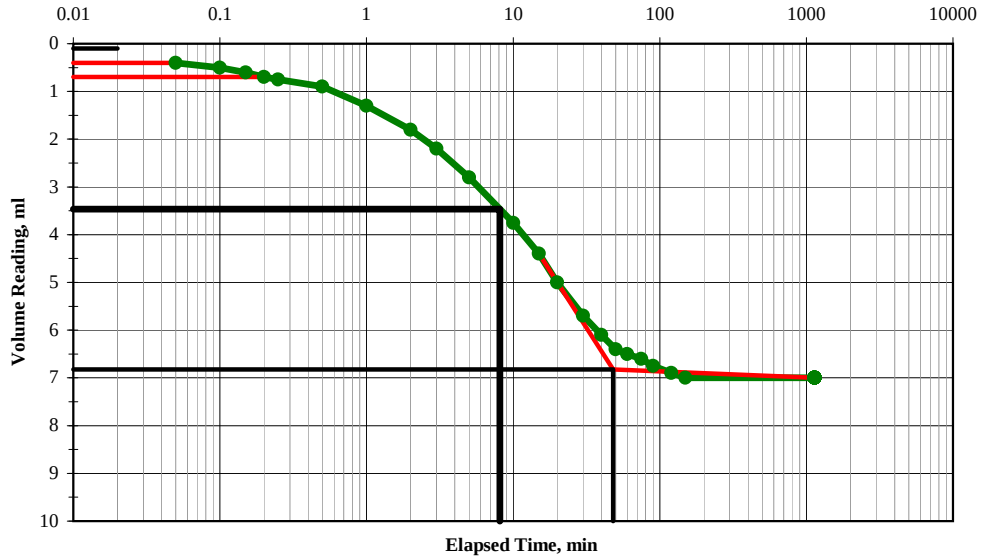
THREE DIMENSIONAL TRIAXIAL CONSOLIDATION TEST

Client	Civil & Environmental Consultants, Inc	Boring	TPE-17	**Staged Consolidation**	
Client Project	091-867 Apex Landfill Expansion	Depth	12'-14'	Consolidation Plot Stress, psi	6.8
Project No.	30598	Sample	ST-1	**Final Test Pressures**	
		Lab Sample	30598005	Cell Pressure, psi	119.8
USCS Description:	YELLOWISH SANDY LEAN CLAY			Back Pressure, psi	40.0
Test Conditions:	Undisturbed - Side And Double Drained			Effective Consol., psi	79.8
				Additional Consol. Volume, m	28.5

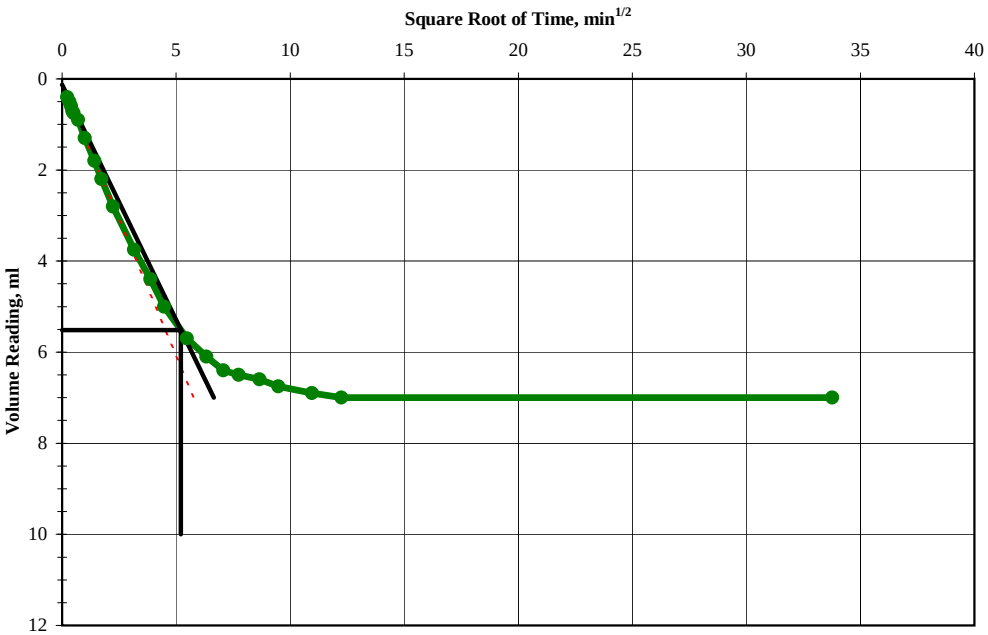
Consol. Start Date: 12/13/2010

Elapsed Time (min)	Sqrt Time ($min^{1/2}$)	Volume Reading ml
0	0	0.0
0.05	0.22	0.4
0.10	0.32	0.5
0.15	0.39	0.6
0.20	0.45	0.7
0.25	0.50	0.8
0.50	0.71	0.9
1.00	1.00	1.3
2.00	1.41	1.8
3.00	1.73	2.2
5.00	2.24	2.8
10.00	3.16	3.8
15.00	3.87	4.4
20.00	4.47	5.0
30.00	5.48	5.7
40.00	6.32	6.1
50.00	7.07	6.4
60.00	7.75	6.5
75.00	8.66	6.6
90.00	9.49	6.8
120.00	10.95	6.9
150.00	12.25	7.0
1140.00	33.76	7.0

Log of Elapsed Time vs. Volume Reading



Square Root of Elapsed Time vs. Volume Reading



Sqrt. of Elapsed Time vs Volume		Log of Elapsed Time vs Volume		Consolidation Summary	
T0 = 0 min.	V0 = 0.1 ml.	T0 = 0 min.	V0 = 0.1 ml.	Initial Volume Reading, ml	0.0
T90 = 27.1 min	V90 = 5.5 ml.	T50 = 8.1 min.	V50 = 3.5 ml.	Final Volume Reading, ml	7.0
T100 = NA min	V100 = 6.1 ml.	T100 = 48.0 min.	V100 = 6.8 ml.	Total Volume Change, ml	35.5

Input Validation: Reviewed By: Date 12/13/2010

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CONSOLIDATED-UNDRAINED TRIAXIAL COMPRESSION TEST ON COHESIVE SOILS ASTM D 4767

Client	Civil & Environmental Consultants, Inc.	Boring	TPE-19
Client Project	091-867 Apex Landfill Expansion	Depth	2'-4'
Project No.	30598	Sample	ST-1
Test No.	1	Lab Sample No.	30598006
USCS Description:	DARK YELLOWISH BROWN LEAN CLAY WIT	Test Conditions:	Undisturbed - Side And Double Drained

SAMPLE CONDITIONS

	Initial	After Consol.	Final
Tare Number	Z12	NA	512
Wt. Tare & WS, gm	233.45	NA	755.17
Wt. Tare & DS, gm	219.41	NA	656.48
Wt. Tare, gm	123.25	NA	104.61
Water Content, %	14.6	17.9	17.9
Wt. Tube & WS., gm	1717.5	NA	
Wt. Of Tube, gm	412.7	NA	
Wt. Of WS., gm	1304.8	1342.1	
Length 1, in	5.991	NA	
Length 2, in	6.021	NA	
Length 3, in	6.024	NA	
Top Diameter, in	2.876	NA	
Middle Diameter, in	2.855	NA	
Bottom Diameter, in	2.866	NA	
Average Length, in	6.012	6.005	
Average Diameter, in	2.866	2.856	
Average Area, in^2	6.45	6.41	
Sample Volume, in^3	38.78	38.51	
Unit Dry Wt., gms/cc	1.79	1.80	
Unit Dry Wt., pcf	111.8	112.6	
Specific Gravity, Assume	2.70	2.70	
Volume of Solids, cc	421.68	421.68	
Void Ratio, e	0.51	0.50	
Porosity, n	0.34	0.33	
Pore Volume, cc	13.04	12.77	
Saturation, %	77.8	97.3	

TEST CONDITIONS

Cell Pressure, psi	89.22	
Back Pressure, psi	79.22	
Effective Consolidating Pressure, psi	10.00	σ_3
Pore Pressure Parameter (B), %	95	

SATURATION AND CONSOLIDATION VOLUME CHANGES

Height Change, mils	Reading	Change	Consolidation	
Initial Reading	6.738	0	Volume Change, ml	4.4
After Saturation	6.736	2	Volume Change, in^3	0.27
After Consolidation	6.731	7	Saturation Method:	Wet

STRAIN RATE CALCULATIONS

Calc. Strain Rate, %/min (t50=.19)	0.0211	Strain Rate Used, %/min	0.0003
Calc. Deformation Rate, in/min	0.126	Deformation Rate Used	0.002

EFFECTIVE FAILURE SUMMARY

Failure Conditions	Max σ_1'/σ_3'	15% ε	
Effective Consolidating Pressure, psi	10.00	10.00	σ_3
1St. Maximum Effective Principal Stress Ratio	4.820	3.55	σ_1'/σ_3'
Deviator Stress at Failure, psi	17.94	28.21	$\sigma_1-\sigma_3$
Axial Strain at Failure, %	1.15	15.00	ε
Effective Minor Principal Stress at Failure, psi	4.70	11.05	σ_3'
Effective Major Principal Stress at Failure, psi	22.64	39.26	σ_1'
Mohr's Circle Stress Path (Origin of Circle), psi	13.67	25.16	p'
Mohr's Circle Stress Path (Radius of Circle), psi	8.97	14.10	q

TOTAL FAILURE SUMMARY

Failure Conditions	Max σ_1'/σ_3'	15% ε	
Deviator Stress at Failure, psi	17.94	28.21	$\sigma_1-\sigma_3$
Axial Strain at Failure, %	1.15	15.00	ε
Total Minor Principal Stress at Failure, psi	10.00	10.00	σ_3
Total Major Principal Stress at Failure, psi	27.95	38.21	σ_1

TEST DATA

Axial Load	Axial Deformation	Total Pore Water Pressure	Axial Strain	Principal Stress Difference (Deviator Stress)	Induced Pore Water Pressure	Effective Major Principal Stress	Effective Minor Principal Stress	Effective Principal Stress Ratio	A-Bar	Mohr's Circle Stress Paths	
										Origin of Circle	Radius of Circle
lb.	mils	psi	%	psi	psi	psi	psi			psi	psi
P	ΔH	U	ε	$\sigma_1-\sigma_3$	ΔU	σ_1'	σ_3'	σ_1'/σ_3'	A'	p'	q
16.4	0	79.2	0	0	NA	NA	NA	NA	NA	10.00	0
35.5	5	80.2	0.09	2.98	0.95	12.04	9.06	1.329	0.33	10.55	1.49
64.2	10	82.1	0.17	7.46	2.86	14.60	7.14	2.044	0.40	10.87	3.73
79.8	17	83.1	0.28	9.87	3.84	16.03	6.16	2.601	0.41	11.10	4.94
91.0	23	83.6	0.38	11.61	4.43	17.19	5.57	3.083	0.40	11.38	5.81
100.4	27	84.0	0.45	13.07	4.82	18.25	5.19	3.519	0.39	11.72	6.53
108.1	33	84.3	0.55	14.24	5.07	19.17	4.93	3.888	0.37	12.05	7.12
115.0	39	84.5	0.64	15.30	5.24	20.06	4.76	4.216	0.36	12.41	7.65
120.5	45	84.6	0.74	16.13	5.34	20.80	4.66	4.459	0.35	12.73	8.07
124.7	51	84.6	0.84	16.77	5.38	21.39	4.62	4.627	0.34	13.01	8.39
128.1	56	84.6	0.93	17.28	5.38	21.90	4.62	4.742	0.33	13.26	8.64
130.8	62	84.6	1.04	17.67	5.36	22.32	4.65	4.803	0.32	13.48	8.84
132.7	69	84.5	1.15	17.94	5.30	22.64	4.70	4.820	0.31	13.67	8.97
135.7	88	84.3	1.46	18.36	5.12	23.24	4.88	4.763	0.29	14.06	9.18

137.7	105	84.2	1.75	18.61	4.95	23.66	5.05	4.685	0.28	14.36	9.31
139.8	122	84.0	2.02	18.88	4.79	24.09	5.21	4.625	0.27	14.65	9.44
142.6	140	83.9	2.33	19.25	4.64	24.62	5.36	4.589	0.25	14.99	9.63
144.8	159	83.7	2.65	19.52	4.50	25.03	5.51	4.546	0.24	15.27	9.76
146.9	178	83.6	2.96	19.78	4.35	25.42	5.65	4.502	0.23	15.54	9.89
148.5	194	83.4	3.23	19.97	4.21	25.76	5.79	4.446	0.22	15.78	9.98
150.9	212	83.3	3.52	20.26	4.06	26.20	5.94	4.410	0.21	16.07	10.13
153.2	230	83.1	3.83	20.54	3.92	26.62	6.08	4.377	0.20	16.35	10.27
155.3	249	83.0	4.14	20.78	3.78	27.00	6.22	4.342	0.19	16.61	10.39
157.0	267	82.9	4.44	20.98	3.64	27.34	6.36	4.300	0.18	16.85	10.49
159.3	283	82.7	4.71	21.27	3.51	27.77	6.50	4.274	0.17	17.13	10.63
161.8	301	82.6	5.02	21.56	3.37	28.20	6.63	4.251	0.16	17.42	10.78
164.1	320	82.5	5.32	21.83	3.23	28.60	6.77	4.226	0.16	17.68	10.91
165.9	339	82.3	5.64	22.03	3.07	28.97	6.93	4.177	0.15	17.95	11.02
167.6	355	82.2	5.92	22.20	2.95	29.26	7.06	4.147	0.14	18.16	11.10
170.1	373	82.0	6.22	22.51	2.81	29.70	7.19	4.130	0.13	18.45	11.25
172.5	391	81.9	6.52	22.79	2.68	30.12	7.33	4.111	0.12	18.72	11.40
175.1	410	81.8	6.83	23.09	2.55	30.54	7.45	4.098	0.12	18.99	11.54
176.0	428	81.6	7.13	23.15	2.41	30.74	7.59	4.048	0.11	19.17	11.57
178.5	445	81.5	7.41	23.43	2.27	31.17	7.73	4.031	0.10	19.45	11.72
180.7	462	81.4	7.69	23.67	2.15	31.53	7.85	4.014	0.10	19.69	11.84
182.9	481	81.2	8.00	23.92	2.01	31.91	7.99	3.993	0.09	19.95	11.96
184.9	499	81.1	8.32	24.12	1.88	32.24	8.13	3.967	0.08	20.19	12.06
186.2	517	81.0	8.61	24.23	1.73	32.49	8.27	3.930	0.08	20.38	12.11
188.3	534	80.8	8.89	24.45	1.60	32.85	8.40	3.910	0.07	20.63	12.22
190.7	552	80.7	9.19	24.71	1.46	33.25	8.54	3.894	0.06	20.89	12.35
192.8	571	80.5	9.50	24.93	1.33	33.60	8.68	3.874	0.06	21.14	12.46
194.8	589	80.4	9.80	25.13	1.20	33.93	8.80	3.855	0.05	21.37	12.56
196.1	606	80.3	10.10	25.23	1.06	34.17	8.94	3.822	0.04	21.56	12.62
198.2	624	80.1	10.39	25.44	0.93	34.52	9.08	3.803	0.04	21.80	12.72
200.6	642	80.0	10.69	25.69	0.80	34.89	9.20	3.792	0.03	22.05	12.85
202.5	661	79.9	11.00	25.86	0.66	35.20	9.34	3.768	0.03	22.27	12.93
204.3	679	79.8	11.30	26.02	0.54	35.48	9.46	3.750	0.02	22.47	13.01
206.1	696	79.6	11.58	26.19	0.41	35.77	9.59	3.731	0.02	22.68	13.09
208.2	713	79.5	11.88	26.39	0.27	36.12	9.73	3.712	0.01	22.93	13.20
210.6	732	79.4	12.19	26.62	0.14	36.49	9.86	3.699	0.01	23.17	13.31
212.5	750	79.2	12.49	26.80	0.01	36.79	9.99	3.683	0.00	23.39	13.40
213.9	768	79.1	12.79	26.89	-0.10	37.00	10.11	3.661	0.00	23.55	13.45
216.0	785	79.0	13.08	27.08	-0.24	37.33	10.24	3.644	-0.01	23.78	13.54
218.3	803	78.8	13.38	27.30	-0.37	37.68	10.37	3.633	-0.01	24.02	13.65
220.5	822	78.7	13.69	27.50	-0.50	38.00	10.50	3.620	-0.02	24.25	13.75
222.1	840	78.6	13.98	27.63	-0.63	38.26	10.63	3.598	-0.02	24.45	13.81
223.4	858	78.5	14.29	27.71	-0.76	38.46	10.76	3.575	-0.03	24.61	13.85
225.5	875	78.3	14.57	27.90	-0.89	38.79	10.89	3.561	-0.03	24.84	13.95
228.1	893	78.2	14.87	28.13	-1.00	39.13	11.00	3.557	-0.04	25.07	14.07
230.3	912	78.1	15.19	28.32	-1.13	39.46	11.14	3.544	-0.04	25.30	14.16
231.4	929	78.0	15.47	28.38	-1.25	39.63	11.25	3.521	-0.05	25.44	14.19
232.8	946	77.8	15.76	28.47	-1.38	39.85	11.39	3.500	-0.05	25.62	14.23
235.3	965	77.7	16.07	28.68	-1.51	40.19	11.51	3.492	-0.06	25.85	14.34
237.4	984	77.6	16.38	28.86	-1.63	40.48	11.63	3.482	-0.06	26.06	14.43
239.1	1002	77.5	16.69	28.97	-1.75	40.72	11.75	3.465	-0.06	26.23	14.48
240.2	1019	77.4	16.97	29.01	-1.87	40.88	11.87	3.444	-0.07	26.37	14.50
241.7	1037	77.2	17.28	29.10	-1.99	41.09	11.99	3.427	-0.07	26.54	14.55
244.1	1055	77.1	17.57	29.30	-2.11	41.41	12.11	3.420	-0.08	26.76	14.65

Input Validation: Reviewed By: Date Tested: 12/21/10

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CONSOLIDATED-UNDRAINED TRIAXIAL COMPRESSION TEST ON COHESIVE SOILS ASTM D 4767

Client	Civil & Environmental Consultants, Inc.	Boring	TPE-19
Client Project	091-867 Apex Landfill Expansion	Depth	2'-4'
Project No.	30598	Sample	ST-1
Test No.	2	Lab Sample No.	30598006
USCS Description:	DARK YELLOWISH BROWN LEAN CLAY WIT	Test Conditions:	Undisturbed - Side And Double Drained

SAMPLE CONDITIONS

	Initial	After Consol.	Final
Tare Number	Z12	NA	901
Wt. Tare & WS, gm	233.45	NA	1498.95
Wt. Tare & DS, gm	219.41	NA	1279.74
Wt. Tare, gm	123.25	NA	99.65
Water Content, %	14.6	18.6	18.6
Wt. Tube & WS., gm	1759.2	NA	
Wt. Of Tube, gm	412.6	NA	
Wt. Of WS., gm	1346.6	1393.3	
Length 1, in	6.046	NA	
Length 2, in	6.029	NA	
Length 3, in	6.014	NA	
Top Diameter, in	2.882	NA	
Middle Diameter, in	2.883	NA	
Bottom Diameter, in	2.885	NA	
Average Length, in	6.030	5.997	
Average Diameter, in	2.883	2.853	
Average Area, in^2	6.53	6.39	
Sample Volume, in^3	39.37	38.42	
Unit Dry Wt., gms/cc	1.82	1.87	
Unit Dry Wt., pcf	113.7	116.4	
Specific Gravity, Assume	2.70	2.70	
Volume of Solids, cc	435.21	435.21	
Void Ratio, e	0.48	0.45	
Porosity, n	0.33	0.31	
Pore Volume, cc	12.81	11.87	
Saturation, %	81.7	112.2	

TEST CONDITIONS

Cell Pressure, psi	117.39	
Back Pressure, psi	79.23	
Effective Consolidating Pressure, psi	38.16	σ_3
Pore Pressure Parameter (B), %	96	

SATURATION AND CONSOLIDATION VOLUME CHANGES

Height Change, mils	Reading	Change	Consolidation	
Initial Dial Reading	7.417	0	Volume Change, ml	15.5
After Saturation	7.413	4	Volume Change, in^3	0.95
After Consolidation	7.384	33	Saturation Method:	Wet

STRAIN RATE CALCULATIONS

Calc. Strain Rate, %/min (t50=.87)	0.0046	Strain Rate Used, %/min	0.0003
Calc. Deformation Rate, in/min	0.028	Deformation Rate Used	0.002

EFFECTIVE FAILURE SUMMARY

Failure Conditions	Max σ_1'/σ_3'	15% ε	
Effective Consolidating Pressure, psi	38.16	38.16	σ_3
1St. Maximum Effective Principal Stress Ratio	3.588	3.25	σ_1'/σ_3'
Deviator Stress at Failure, psi	44.16	59.38	$\sigma_1-\sigma_3$
Axial Strain at Failure, %	4.14	15.00	ε
Effective Minor Principal Stress at Failure, psi	17.07	26.37	σ_3'
Effective Major Principal Stress at Failure, psi	61.23	85.76	σ_1'
Mohr's Circle Stress Path (Origin of Circle), psi	39.15	56.07	p'
Mohr's Circle Stress Path (Radius of Circle), psi	22.08	29.69	q

TOTAL FAILURE SUMMARY

Failure Conditions	Max σ_1'/σ_3'	15% ε	
Deviator Stress at Failure, psi	44.16	59.38	$\sigma_1-\sigma_3$
Axial Strain at Failure, %	4.14	15.00	ε
Total Minor Principal Stress at Failure, psi	38.16	38.16	σ_3
Total Major Principal Stress at Failure, psi	82.32	97.54	σ_1

TEST DATA

Axial Load	Axial Deformation	Total Pore Water Pressure	Axial Strain	Principal Stress Difference (Deviator Stress)	Induced Pore Water Pressure	Effective Major Principal Stress	Effective Minor Principal Stress	Effective Principal Stress Ratio	A-Bar	Mohr's Circle Stress Paths	
										Origin of Circle	Radius of Circle
lb.	mils	psi	%	psi	psi	psi	psi			psi	psi
P	ΔH	U	ε	$\sigma_1-\sigma_3$	ΔU	σ_1'	σ_3'	σ_1'/σ_3'	A'	p'	q
22.6	0	79.2	0	0.00	0	NA	NA	NA	NA	38.16	0
61.2	5	81.6	0.08	6.03	2.40	41.79	35.75	1.169	0.42	38.77	3.02
115.2	9	86.7	0.16	14.46	7.43	45.19	30.73	1.471	0.54	37.96	7.23
145.1	16	89.9	0.26	19.11	10.65	46.61	27.50	1.695	0.58	37.06	9.55
167.9	22	92.1	0.36	22.65	12.91	47.89	25.25	1.897	0.59	36.57	11.32
185.6	27	93.9	0.44	25.38	14.66	48.88	23.50	2.080	0.60	36.19	12.69
199.7	33	95.2	0.55	27.56	16.00	49.71	22.15	2.244	0.60	35.93	13.78
211.5	39	96.3	0.64	29.36	17.08	50.44	21.08	2.393	0.61	35.76	14.68
221.2	45	97.2	0.76	30.82	17.96	51.01	20.19	2.526	0.61	35.60	15.41
228.9	52	97.9	0.86	31.98	18.71	51.43	19.44	2.645	0.61	35.44	15.99
235.5	57	98.6	0.96	32.99	19.32	51.82	18.83	2.751	0.61	35.33	16.49
240.7	63	99.0	1.05	33.75	19.80	52.10	18.35	2.839	0.61	35.23	16.87
245.6	69	99.5	1.15	34.48	20.25	52.38	17.90	2.926	0.61	35.14	17.24
257.3	86	100.3	1.44	36.18	21.07	53.27	17.08	3.118	0.61	35.18	18.09

266.4	104	100.8	1.73	37.47	21.59	54.03	16.56	3.262	0.60	35.30	18.73
275.0	122	101.1	2.03	38.68	21.85	54.98	16.30	3.373	0.59	35.64	19.34
281.8	141	101.2	2.35	39.59	21.95	55.80	16.21	3.442	0.58	36.00	19.79
288.2	158	101.2	2.63	40.44	21.94	56.66	16.22	3.494	0.57	36.44	20.22
294.3	175	101.1	2.92	41.25	21.83	57.57	16.33	3.526	0.55	36.95	20.62
300.8	193	100.9	3.22	42.11	21.69	58.57	16.46	3.558	0.54	37.52	21.05
305.9	213	100.8	3.55	42.74	21.52	59.38	16.63	3.570	0.52	38.00	21.37
312.0	231	100.6	3.85	43.53	21.32	60.36	16.84	3.585	0.51	38.60	21.76
317.2	248	100.3	4.14	44.16	21.09	61.23	17.07	3.588	0.50	39.15	22.08
321.8	265	100.1	4.42	44.72	20.83	62.05	17.32	3.582	0.49	39.68	22.36
327.9	283	99.8	4.72	45.50	20.61	63.04	17.54	3.594	0.47	40.29	22.75
333.2	302	99.5	5.04	46.13	20.25	64.03	17.91	3.576	0.46	40.97	23.06
337.8	320	99.3	5.33	46.66	20.02	64.80	18.14	3.573	0.45	41.47	23.33
342.6	337	99.0	5.62	47.24	19.78	65.62	18.38	3.571	0.44	42.00	23.62
347.6	354	98.8	5.91	47.82	19.52	66.46	18.63	3.567	0.43	42.55	23.91
352.8	374	98.5	6.23	48.43	19.24	67.34	18.91	3.561	0.41	43.13	24.21
357.2	392	98.2	6.54	48.90	18.94	68.11	19.21	3.546	0.40	43.66	24.45
361.7	409	97.9	6.82	49.42	18.66	68.91	19.50	3.535	0.39	44.20	24.71
366.1	426	97.6	7.11	49.90	18.36	69.69	19.79	3.521	0.38	44.74	24.95
371.2	444	97.3	7.41	50.48	18.10	70.54	20.06	3.517	0.37	45.30	25.24
375.7	463	97.1	7.73	50.96	17.82	71.30	20.33	3.506	0.36	45.81	25.48
379.9	482	96.7	8.03	51.39	17.51	72.04	20.64	3.490	0.35	46.34	25.70
383.6	498	96.5	8.31	51.77	17.23	72.70	20.93	3.474	0.35	46.81	25.88
388.5	516	96.2	8.61	52.30	17.01	73.44	21.15	3.473	0.34	47.30	26.15
392.9	535	95.9	8.92	52.75	16.63	74.28	21.53	3.450	0.33	47.90	26.37
397.5	553	95.7	9.23	53.22	16.42	74.96	21.73	3.449	0.32	48.34	26.61
401.1	572	95.4	9.53	53.56	16.19	75.52	21.97	3.438	0.31	48.75	26.78
404.1	588	95.1	9.81	53.81	15.91	76.06	22.24	3.419	0.31	49.15	26.91
409.1	607	94.9	10.12	54.33	15.65	76.83	22.50	3.414	0.30	49.66	27.16
413.8	624	94.7	10.41	54.82	15.42	77.55	22.73	3.411	0.29	50.14	27.41
417.6	643	94.4	10.72	55.15	15.15	78.15	23.00	3.397	0.29	50.58	27.57
420.9	660	94.1	11.01	55.43	14.92	78.67	23.24	3.385	0.28	50.95	27.72
424.4	678	93.9	11.30	55.74	14.65	79.25	23.51	3.371	0.27	51.38	27.87
428.5	696	93.6	11.61	56.11	14.41	79.85	23.75	3.363	0.27	51.80	28.05
432.6	715	93.4	11.92	56.47	14.18	80.45	23.98	3.355	0.26	52.21	28.24
436.1	733	93.2	12.23	56.76	13.93	80.99	24.22	3.344	0.26	52.60	28.38
439.1	749	92.9	12.50	56.99	13.68	81.47	24.48	3.329	0.25	52.97	28.50
442.6	767	92.6	12.80	57.29	13.40	82.04	24.76	3.314	0.24	53.40	28.64
447.4	786	92.4	13.11	57.74	13.20	82.69	24.96	3.313	0.24	53.83	28.87
450.8	804	92.2	13.40	57.99	12.94	83.21	25.22	3.300	0.23	54.22	29.00
454.4	822	92.0	13.71	58.27	12.77	83.65	25.38	3.296	0.23	54.52	29.14
457.3	839	91.8	14.00	58.47	12.54	84.09	25.62	3.282	0.22	54.86	29.24
461.3	857	91.5	14.30	58.80	12.28	84.69	25.88	3.272	0.22	55.28	29.40
465.0	876	91.3	14.61	59.08	12.06	85.18	26.10	3.264	0.21	55.64	29.54
468.5	895	91.1	14.92	59.34	11.85	85.64	26.30	3.256	0.21	55.97	29.67
471.2	911	90.8	15.20	59.50	11.61	86.04	26.54	3.242	0.20	56.29	29.75
474.2	930	90.6	15.50	59.68	11.40	86.44	26.75	3.231	0.20	56.59	29.84
478.3	948	90.4	15.80	60.01	11.17	86.99	26.98	3.224	0.19	56.99	30.01
481.4	966	90.2	16.11	60.19	10.96	87.39	27.20	3.213	0.19	57.30	30.10
485.6	983	90.0	16.40	60.53	10.78	87.91	27.38	3.211	0.19	57.65	30.27
488.4	1001	89.7	16.68	60.69	10.46	88.39	27.70	3.191	0.18	58.04	30.35
491.9	1018	89.5	16.98	60.93	10.28	88.81	27.88	3.186	0.18	58.34	30.46
495.3	1037	89.3	17.29	61.15	10.09	89.22	28.06	3.179	0.17	58.64	30.58
498.7	1055	89.1	17.60	61.35	9.90	89.61	28.25	3.171	0.17	58.93	30.68

Input Validation: Reviewed By: Date Tested: 12/21/10

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CONSOLIDATED-UNDRAINED TRIAXIAL COMPRESSION TEST ON COHESIVE SOILS ASTM D 4767

Client	Civil & Environmental Consultants, Inc.	Boring	TPE-19
Client Project	091-867 Apex Landfill Expansion	Depth	2'-4'
Project No.	30598	Sample	ST-1
Test No.	3	Lab Sample No.	30598006
USCS Description:	DARK YELLOWISH BROWN LEAN CLAY WIT	Test Conditions:	Undisturbed - Side And Double Drained

SAMPLE CONDITIONS

	Initial	After Consol.	Final
Tare Number	Z12	NA	519
Wt. Tare & WS, gm	233.45	NA	1576.40
Wt. Tare & DS, gm	219.41	NA	1400.15
Wt. Tare, gm	123.25	NA	102.71
Water Content, %	14.6	13.6	13.6
Wt. Tube & WS., gm	1873.1	NA	
Wt. Of Tube, gm	416.7	NA	
Wt. Of WS., gm	1456.5	1443.6	
Length 1, in	6.052	NA	
Length 2, in	6.049	NA	
Length 3, in	6.119	NA	
Top Diameter, in	2.881	NA	
Middle Diameter, in	2.88	NA	
Bottom Diameter, in	2.879	NA	
Average Length, in	6.073	5.983	
Average Diameter, in	2.880	2.812	
Average Area, in^2	6.51	6.21	
Sample Volume, in^3	39.56	37.26	
Unit Dry Wt., gms/cc	1.96	2.08	
Unit Dry Wt., pcf	122.3	129.9	
Specific Gravity, Assume	2.70	2.70	
Volume of Solids, cc	470.71	470.71	
Void Ratio, e	0.38	0.30	
Porosity, n	0.27	0.23	
Pore Volume, cc	10.84	8.54	
Saturation, %	104.5	123.4	

TEST CONDITIONS

Cell Pressure, psi	120.24	
Back Pressure, psi	40.03	
Effective Consolidating Pressure, psi	80.21	σ_3
Pore Pressure Parameter (B), %	95	

SATURATION AND CONSOLIDATION VOLUME CHANGES

Height Change, mils	Reading	Change	Consolidation	
Initial Dial Reading	7.249	0	Volume Change, ml	37.7
After Saturation	7.243	6	Volume Change, in^3	2.30
After Consolidation	7.159	90	Saturation Method:	Wet

STRAIN RATE CALCULATIONS

Calc. Strain Rate, %/min (t50=41.29)	0.0001	Strain Rate Used, %/min	0.0003
Calc. Deformation Rate, in/min	0.001	Deformation Rate Used	0.002

EFFECTIVE FAILURE SUMMARY

Failure Conditions	Max σ_1'/σ_3'	15% ε	
Effective Consolidating Pressure, psi	80.21	80.21	σ_3
1St. Maximum Effective Principal Stress Ratio	3.496	3.05	σ_1'/σ_3'
Deviator Stress at Failure, psi	97.75	146.56	$\sigma_1-\sigma_3$
Axial Strain at Failure, %	2.90	15.00	ε
Effective Minor Principal Stress at Failure, psi	39.16	71.38	σ_3'
Effective Major Principal Stress at Failure, psi	136.91	217.94	σ_1'
Mohr's Circle Stress Path (Origin of Circle), psi	88.03	144.66	p'
Mohr's Circle Stress Path (Radius of Circle), psi	48.87	73.28	q

TOTAL FAILURE SUMMARY

Failure Conditions	Max σ_1'/σ_3'	15% ε	
Deviator Stress at Failure, psi	97.75	146.56	$\sigma_1-\sigma_3$
Axial Strain at Failure, %	2.90	15.00	ε
Total Minor Principal Stress at Failure, psi	80.21	80.21	σ_3
Total Major Principal Stress at Failure, psi	177.95	226.76	σ_1

TEST DATA

Axial Load	Axial Deformation	Total Pore Water Pressure	Axial Strain	Principal Stress Difference (Deviator Stress)	Induced Pore Water Pressure	Effective Major Principal Stress	Effective Minor Principal Stress	Effective Principal Stress Ratio	A-Bar	Mohr's Circle Stress Paths	
										Origin of Circle	Radius of Circle
lb.	mils	psi	%	psi	psi	psi	psi			psi	psi
P	ΔH	U	ε	$\sigma_1-\sigma_3$	ΔU	σ_1'	σ_3'	σ_1'/σ_3'	A'	p'	q
20.8	0	40.0	0	0	0	NA	NA	NA	NA	80.21	0
106.1	5	48.2	0.08	13.73	8.21	85.72	72.00	1.191	0.63	78.86	6.86
172.6	10	56.8	0.17	24.41	16.74	87.88	63.47	1.385	0.72	75.67	12.20
217.8	16	62.8	0.27	31.63	22.72	89.12	57.49	1.550	0.76	73.30	15.82
253.0	22	67.1	0.36	37.26	27.09	90.38	53.12	1.701	0.77	71.75	18.63
282.2	27	70.5	0.46	41.90	30.46	91.65	49.75	1.842	0.77	70.70	20.95
308.2	33	73.2	0.55	46.03	33.14	93.10	47.07	1.978	0.76	70.08	23.02
331.8	39	75.3	0.65	49.75	35.31	94.65	44.90	2.108	0.75	69.77	24.88
353.2	45	77.1	0.75	53.14	37.09	96.25	43.11	2.232	0.73	69.68	26.57
373.5	51	78.6	0.85	56.33	38.60	97.94	41.61	2.354	0.72	69.77	28.16
392.5	56	79.9	0.94	59.30	39.84	99.67	40.36	2.469	0.71	70.02	29.65
410.6	62	80.9	1.04	62.13	40.85	101.49	39.36	2.579	0.69	70.43	31.07
428.9	68	81.7	1.13	64.99	41.65	103.54	38.56	2.685	0.67	71.05	32.49
475.7	85	83.4	1.43	72.23	43.33	109.10	36.87	2.959	0.63	72.99	36.11

517.7	103	84.0	1.72	78.65	43.99	114.86	36.21	3.172	0.59	75.53	39.32
556.5	121	83.9	2.02	84.54	43.90	120.84	36.30	3.329	0.55	78.57	42.27
589.7	139	83.3	2.32	89.50	43.28	126.42	36.92	3.424	0.51	81.67	44.75
620.8	157	82.3	2.62	94.10	42.31	132.00	37.89	3.483	0.47	84.95	47.05
645.8	174	81.1	2.90	97.75	41.05	136.91	39.16	3.496	0.44	88.03	48.87
668.3	192	79.7	3.20	100.94	39.68	141.47	40.52	3.491	0.41	90.99	50.47
688.9	209	78.3	3.50	103.83	38.27	145.77	41.94	3.476	0.39	93.86	51.92
707.8	227	76.9	3.80	106.44	36.85	149.79	43.35	3.455	0.36	96.57	53.22
725.1	245	75.5	4.10	108.79	35.46	153.54	44.75	3.431	0.34	99.14	54.40
743.6	262	74.1	4.38	111.31	34.07	157.44	46.13	3.413	0.32	101.79	55.66
760.1	280	72.8	4.68	113.49	32.81	160.89	47.40	3.394	0.30	104.14	56.75
774.8	298	71.6	4.98	115.40	31.57	164.03	48.63	3.373	0.29	106.33	57.70
787.3	316	70.4	5.27	116.95	30.39	166.76	49.81	3.348	0.27	108.29	58.48
802.4	333	69.3	5.56	118.89	29.25	169.84	50.95	3.333	0.26	110.40	59.45
816.5	350	68.2	5.85	120.66	28.17	172.70	52.04	3.319	0.25	112.37	60.33
829.1	368	67.2	6.15	122.18	27.14	175.25	53.07	3.302	0.23	114.16	61.09
840.7	386	66.1	6.45	123.54	26.10	177.65	54.10	3.284	0.22	115.87	61.77
851.3	403	65.2	6.74	124.75	25.21	179.75	55.00	3.268	0.21	117.37	62.37
865.0	420	64.3	7.03	126.42	24.28	182.34	55.92	3.261	0.20	119.13	63.21
877.3	438	63.4	7.32	127.86	23.40	184.66	56.80	3.251	0.19	120.73	63.93
887.5	456	62.6	7.62	128.95	22.56	186.60	57.65	3.237	0.18	122.13	64.48
897.7	473	61.8	7.91	130.06	21.78	188.48	58.42	3.226	0.18	123.45	65.03
908.7	491	61.0	8.20	131.28	21.01	190.48	59.20	3.218	0.17	124.84	65.64
920.3	509	60.2	8.50	132.56	20.20	192.57	60.00	3.209	0.16	126.28	66.28
928.1	527	59.6	8.80	133.26	19.57	193.89	60.63	3.198	0.15	127.26	66.63
938.3	545	58.9	9.10	134.33	18.89	195.65	61.31	3.191	0.15	128.48	67.17
947.1	562	58.3	9.40	135.18	18.24	197.15	61.96	3.182	0.14	129.56	67.59
956.4	580	57.6	9.70	136.08	17.58	198.71	62.63	3.173	0.14	130.67	68.04
964.6	598	57.0	10.00	136.82	16.97	200.05	63.24	3.164	0.13	131.65	68.41
975.9	616	56.4	10.30	137.99	16.37	201.82	63.83	3.162	0.12	132.83	68.99
984.1	634	55.9	10.59	138.72	15.88	203.04	64.32	3.157	0.12	133.68	69.36
990.8	651	55.4	10.88	139.23	15.34	204.09	64.86	3.147	0.12	134.47	69.61
998.9	669	54.8	11.18	139.94	14.73	205.41	65.48	3.137	0.11	135.44	69.97
1010.5	687	54.2	11.48	141.11	14.19	207.13	66.02	3.137	0.11	136.58	70.56
1018.9	704	53.7	11.77	141.84	13.63	208.41	66.57	3.131	0.10	137.49	70.92
1026.9	722	53.2	12.07	142.50	13.17	209.54	67.04	3.126	0.10	138.29	71.25
1033.9	739	52.7	12.36	143.01	12.67	210.54	67.53	3.118	0.09	139.03	71.50
1041.1	757	52.2	12.66	143.54	12.20	211.54	68.00	3.111	0.09	139.77	71.77
1047.0	775	51.8	12.96	143.87	11.74	212.33	68.46	3.102	0.09	140.40	71.94
1050.5	793	51.3	13.25	143.88	11.30	212.79	68.91	3.088	0.08	140.85	71.94
1058.8	810	50.9	13.54	144.55	10.88	213.87	69.33	3.085	0.08	141.60	72.27
1064.6	828	50.5	13.84	144.86	10.45	214.61	69.75	3.077	0.08	142.18	72.43
1066.8	846	50.1	14.13	144.66	10.04	214.82	70.17	3.062	0.07	142.49	72.33
1074.3	864	49.7	14.43	145.19	9.62	215.77	70.58	3.057	0.07	143.18	72.60
1084.2	881	49.3	14.73	146.05	9.23	217.02	70.97	3.058	0.07	144.00	73.02
1092.0	899	48.8	15.03	146.61	8.78	218.03	71.42	3.053	0.06	144.72	73.30
1097.7	917	48.5	15.33	146.87	8.48	218.59	71.72	3.048	0.06	145.16	73.43
1092.0	935	48.1	15.63	145.55	8.06	217.70	72.15	3.017	0.06	144.92	72.78
1098.6	953	47.8	15.93	145.93	7.72	218.42	72.49	3.013	0.06	145.46	72.97
1103.5	971	47.4	16.23	146.08	7.34	218.95	72.86	3.005	0.05	145.91	73.04
1109.7	989	47.1	16.53	146.39	7.04	219.56	73.17	3.001	0.05	146.36	73.20
1120.5	1007	46.8	16.83	147.31	6.72	220.80	73.49	3.005	0.05	147.14	73.66
1116.6	1025	46.4	17.13	146.26	6.34	220.13	73.86	2.980	0.05	147.00	73.13
1111.0	1043	45.7	17.43	144.99	5.63	219.57	74.58	2.944	0.04	147.07	72.50

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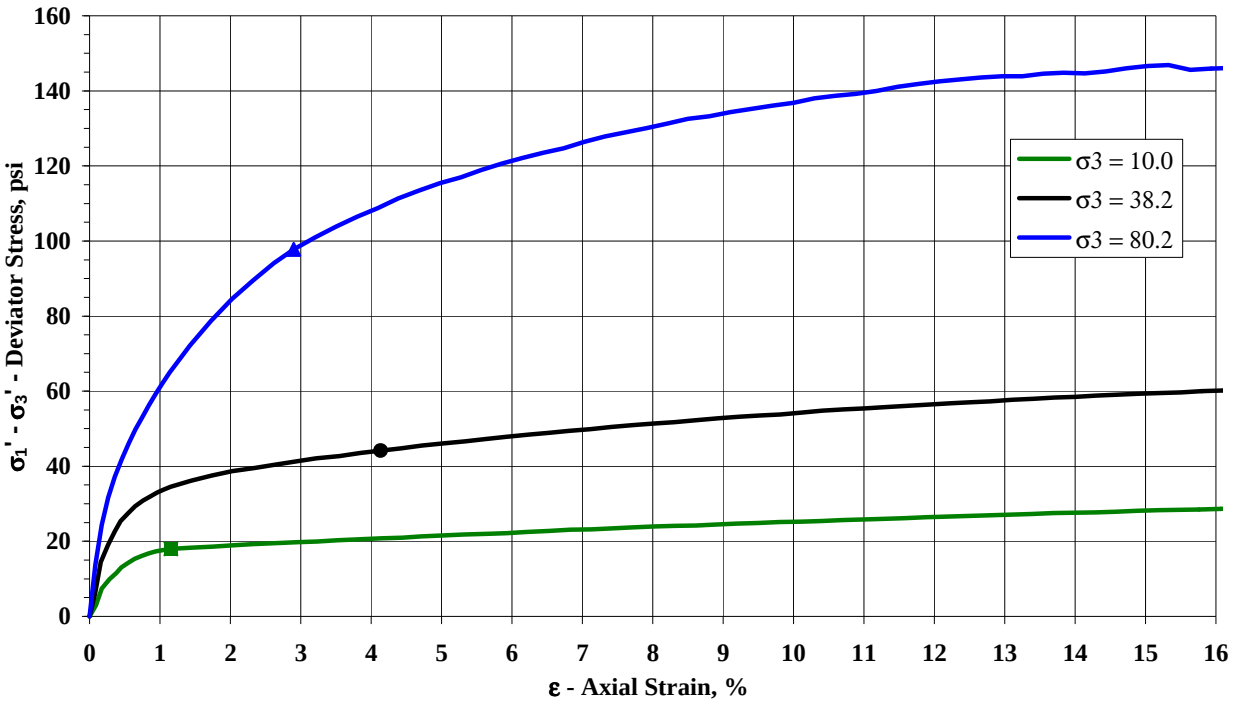
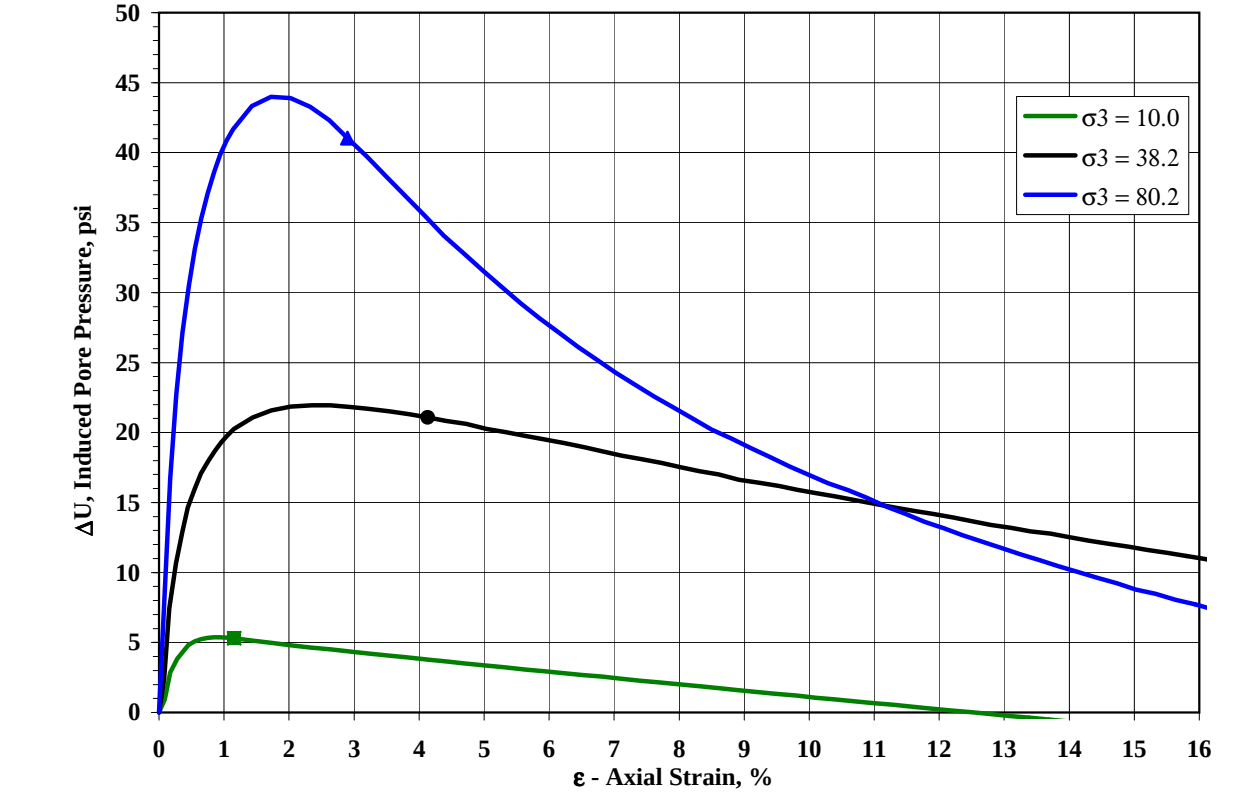
CONSOLIDATED-UNDRAINED TRIAXIAL COMPRESSION TEST ON COHESIVE SOILS ASTM D 4767

Client	Civil & Environmental Consultants, Inc.	Boring	TPE-19
Client Project	091-867 Apex Landfill Expansion	Depth	2'-4'
Project No.	30598	Sample	ST-1
Test Conditions:	Undisturbed - Side And Double Drained	Lab Sample No.	30598006
USCS Description:	DARK YELLOWISH BROWN LEAN CLAY WITH SAND		

AXIAL STRAIN vs. DEVIATOR STRESS



AXIAL STRAIN vs. INDUCED PORE-WATER PRESSURE



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CONSOLIDATED-UNDRAINED TRIAXIAL COMPRESSION TEST ON COHESIVE SOILS ASTM D 476

Client	Civil & Environmental Consultants, In	Boring	TPE-19
Client Project	091-867 Apex Landfill Expansion	Depth	2'-4'
Project No.	30598	Sample	ST-1
		Lab Sample No.	30598006
USCS Description:	DARK YELLOWISH BROWN LEAN CLAY WITH SAND		
Test Conditions:	Undisturbed - Side And Double Drained		

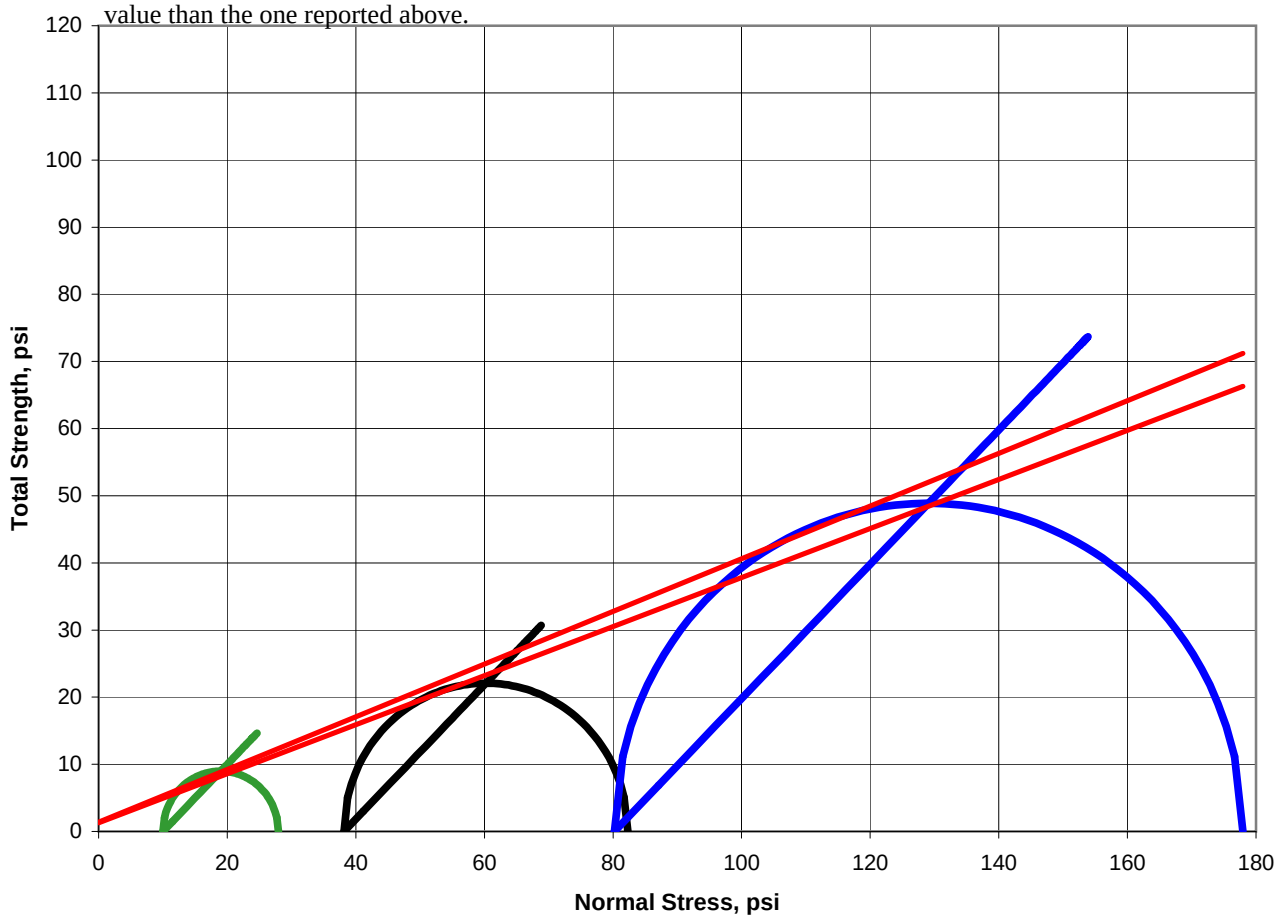
TOTAL STRESS

FAILURE CONDITION: 1st. MAX. EFFECTIVE PRINCIPAL STRESS RATIO

Test No.	Deviator Stress	Major Principal Stress	Minor Principal Stress	Strain at Failure	Mohr's Circle Stress Path		Failure Angle	
	$\sigma1-\sigma3$	$\sigma1$	$\sigma3$	ε	$(\sigma1+\sigma3)/2$	$(\sigma1-\sigma3)/2$		
	psi	psi	psi	%	psi	psi	α, deg	20.1
Test 1	17.94	27.95	10.00	1.15	18.97	8.97	a, psi	1.3
Test 2	44.16	82.32	38.16	4.14	60.24	22.08	Φ, deg	21.4
Test 3	97.75	177.95	80.21	2.90	129.08	48.87	C, psi	1.4

Calculations based on: Test 1 Test 2 Test 3

Note: The Friction Angle and Cohesion using other combinations of test points may yield a higher or lower value than the one reported above.



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CONSOLIDATED-UNDRAINED TRIAXIAL COMPRESSION TEST ON COHESIVE SOILS ASTM D 476

Client	Civil & Environmental Consultants, In	Boring	TPE-19
Client Project	091-867 Apex Landfill Expansion	Depth	2'-4'
Project No.	30598	Sample	ST-1
		Lab Sample No.	30598006
USCS Description:	DARK YELLOWISH BROWN LEAN CLAY WITH SAND		
Test Conditions:	Undisturbed - Side And Double Drained		

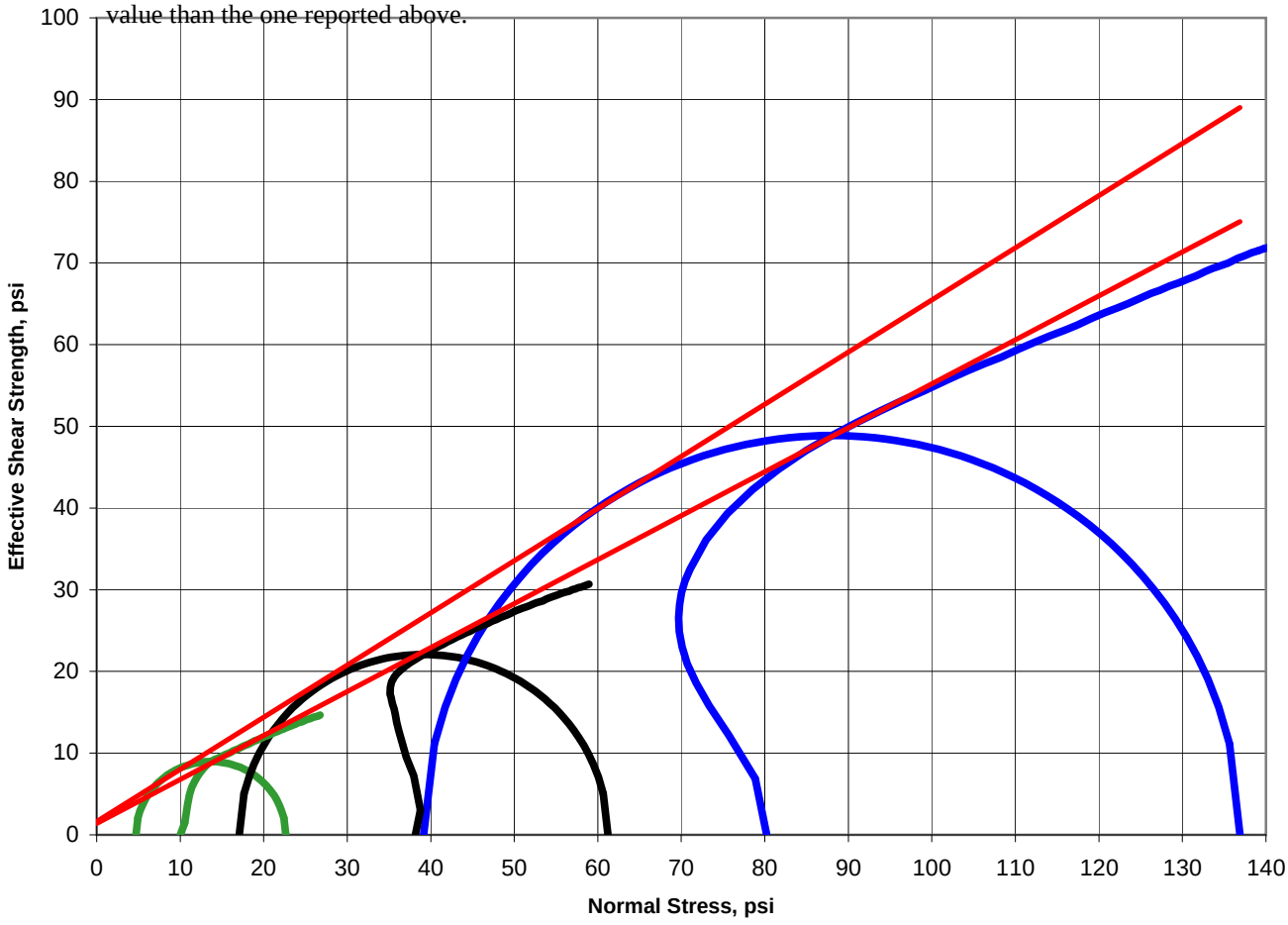
EFFECTIVE STRESS

FAILURE CONDITION: 1st. MAX. EFFECTIVE PRINCIPAL STRESS RATIO

Test No.	Deviator Stress	Major Principal Stress	Minor Principal Stress	Strain at Failure	Mohr's Circle Stress Path		Failure Angle	
	$\sigma 1-\sigma 3$	$\sigma' 1$	$\sigma' 3$	ε	p'	q		
	psi	psi	psi	%	psi	psi	α', deg	28.3
Test 1	17.94	22.64	4.70	1.15	13.67	8.97	a', psi	1.4
Test 2	44.16	61.23	17.07	4.14	39.15	22.08	Φ', deg	32.6
Test 3	97.75	136.91	39.16	2.90	88.03	48.87	C', psi	1.6

Calculations based on: Test 1 Test 2 Test 3

Note: The Friction Angle and Cohesion using other combinations of test points may yield a higher or lower value than the one reported above.



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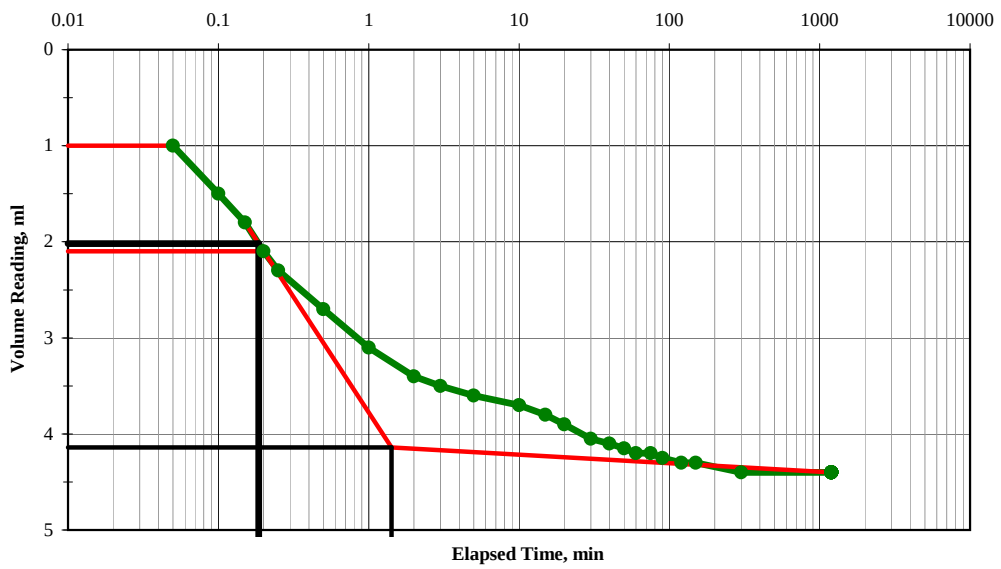
THREE DIMENSIONAL TRIAXIAL CONSOLIDATION TEST

Client	Civil & Environmental Consultants, Inc	Boring	TPE-19	**Staged Consolidation**	
Client Project	091-867 Apex Landfill Expansion	Depth	2'-4'	Consolidation Plot Stress, psi	7.0
Project No.	30598	Sample	ST-1	**Final Test Pressures**	
		Lab Sample	30598006	Cell Pressure, psi	89.2
USCS Description:	DARK YELLOWISH BROWN LEAN CLAY WITH SAND			Back Pressure, psi	79.2
Test Conditions:	Undisturbed - Side And Double Drained			Effective Consol., psi	10.0
				Additional Consol. Volume, ml	0.0

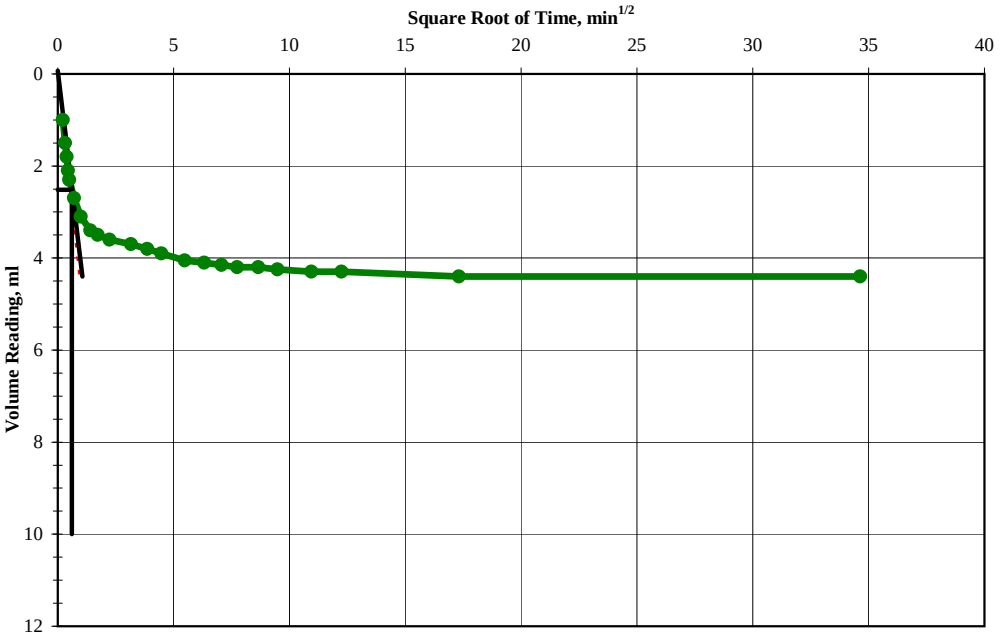
Consol. Start Date: 12/21/2010

Elapsed Time (min)	Sqrt Time ($min^{1/2}$)	Volume Reading ml
0	0	0.0
0.05	0.22	1.0
0.10	0.32	1.5
0.15	0.39	1.8
0.20	0.45	2.1
0.25	0.50	2.3
0.50	0.71	2.7
1.00	1.00	3.1
2.00	1.41	3.4
3.00	1.73	3.5
5.00	2.24	3.6
10.00	3.16	3.7
15.00	3.87	3.8
20.00	4.47	3.9
30.00	5.48	4.1
40.00	6.32	4.1
50.00	7.07	4.2
60.00	7.75	4.2
75.00	8.66	4.2
90.00	9.49	4.3
120.00	10.95	4.3
150.00	12.25	4.3
300.00	17.32	4.4
1200.00	34.64	4.4

Log of Elapsed Time vs. Volume Reading



Square Root of Elapsed Time vs. Volume Reading



Sqrt. of Elapsed Time vs Volume		Log of Elapsed Time vs Volume		Consolidation Summary	
T0 = 0 min.	V0 = -0.1 ml.	T0 = 0 min.	V0 = -0.1 ml.	Initial Volume Reading, ml	0.0
T90 = 0.4 min	V90 = 2.5 ml.	T50 = 0.2 min.	V50 = 2.0 ml.	Final Volume Reading, ml	4.4
T100 = NA min	V100 = 2.8 ml.	T100 = 1.4 min.	V100 = 4.1 ml.	Total Volume Change, ml	4.4

Input Validation: Reviewed By: Date 12/21/2010

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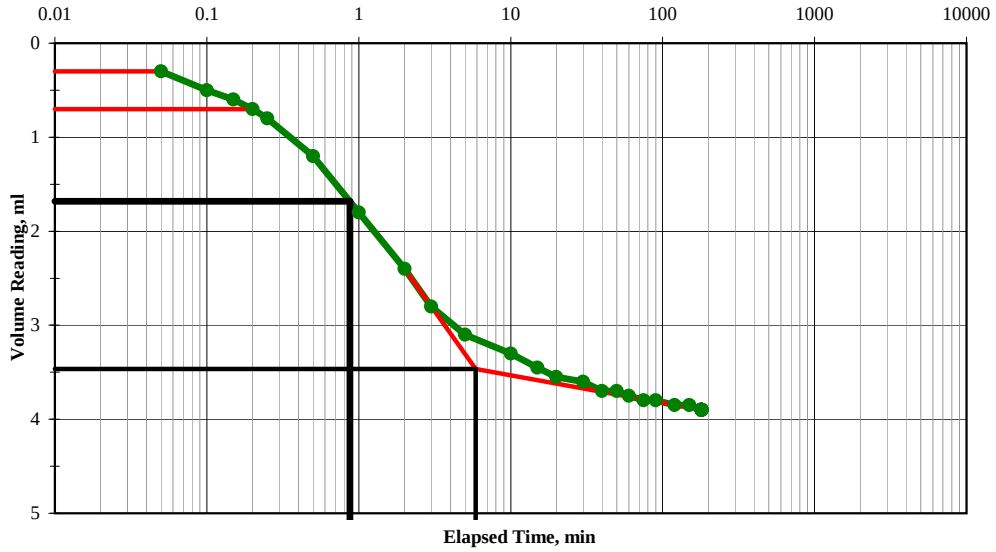
THREE DIMENSIONAL TRIAXIAL CONSOLIDATION TEST

Client	Civil & Environmental Consultants, Inc	Boring	TPE-19	**Staged Consolidation**	
Client Project	091-867 Apex Landfill Expansion	Depth	2'-4'	Consolidation Plot Stress, psi	7.0
Project No.	30598	Sample	ST-1	**Final Test Pressures**	
		Lab Sample	30598006	Cell Pressure, psi	117.4
USCS Description:	DARK YELLOWISH BROWN LEAN CLAY WITH SAND			Back Pressure, psi	79.2
Test Conditions:	Undisturbed - Side And Double Drained			Effective Consol., psi	38.2
				Additional Consol. Volume, ml	11.6

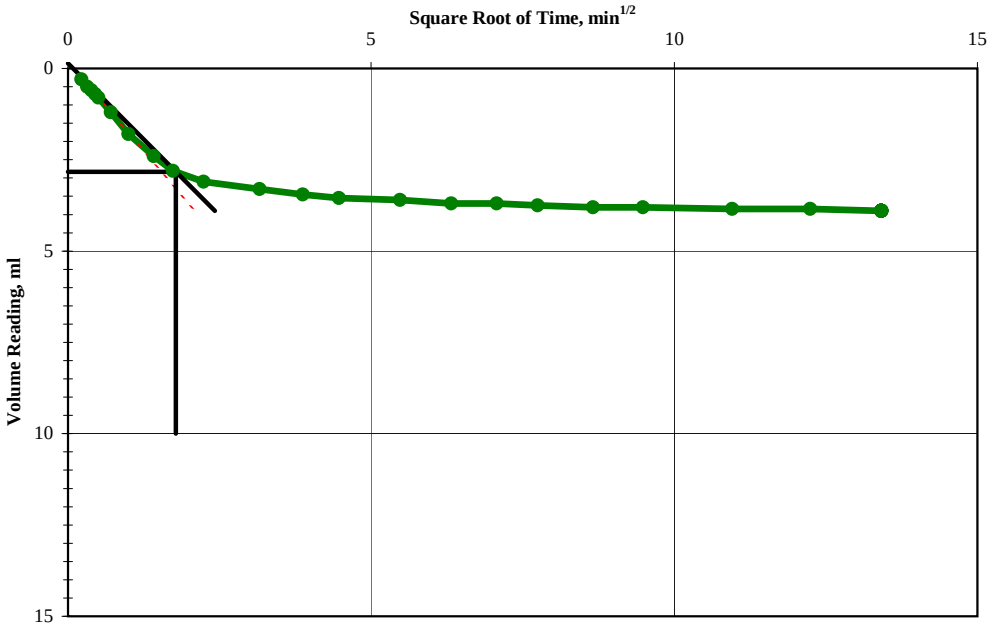
Consol. Start Date: 12/21/2010

Elapsed Time (min)	Sqrt Time ($min^{1/2}$)	Volume Reading ml
0	0	0.0
0.05	0.22	0.3
0.10	0.32	0.5
0.15	0.39	0.6
0.20	0.45	0.7
0.25	0.50	0.8
0.50	0.71	1.2
1.00	1.00	1.8
2.00	1.41	2.4
3.00	1.73	2.8
5.00	2.24	3.1
10.00	3.16	3.3
15.00	3.87	3.5
20.00	4.47	3.6
30.00	5.48	3.6
40.00	6.32	3.7
50.00	7.07	3.7
60.00	7.75	3.8
75.00	8.66	3.8
90.00	9.49	3.8
120.00	10.95	3.9
150.00	12.25	3.9
180.00	13.42	3.9

Log of Elapsed Time vs. Volume Reading



Square Root of Elapsed Time vs. Volume Reading



Sqrt. of Elapsed Time vs Volume		Log of Elapsed Time vs Volume		Consolidation Summary	
T0 = 0 min.	V0 = -0.1 ml.	T0 = 0 min.	V0 = -0.1 ml.	Initial Volume Reading, ml	0.0
T90 = 3.2 min	V90 = 2.8 ml.	T50 = 0.9 min.	V50 = 1.7 ml.	Final Volume Reading, ml	3.9
T100 = NA min	V100 = 3.2 ml.	T100 = 5.9 min.	V100 = 3.5 ml.	Total Volume Change, ml	15.5

Input Validation: Reviewed By: Date 12/21/2010

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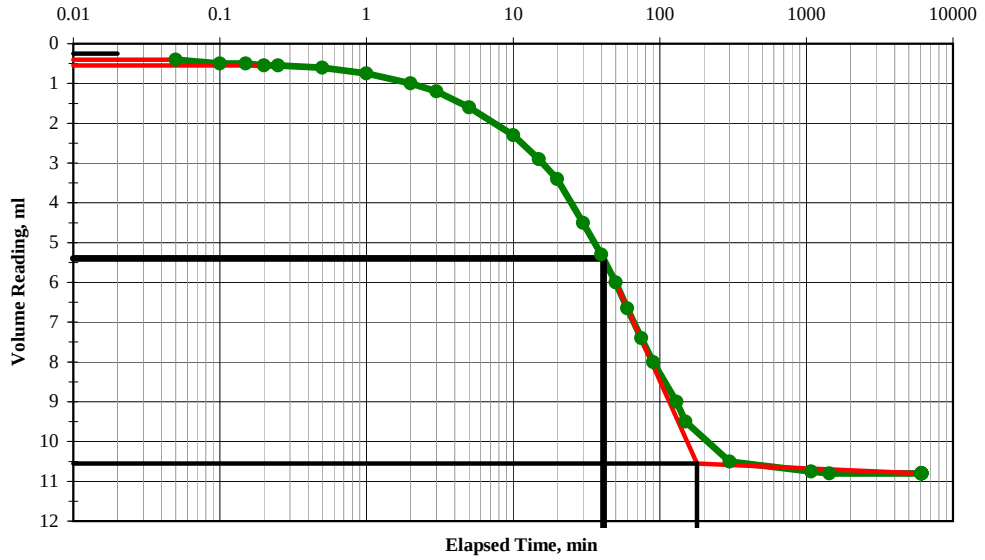
THREE DIMENSIONAL TRIAXIAL CONSOLIDATION TEST

Client	Civil & Environmental Consultants, Inc	Boring	TPE-19	**Staged Consolidation**	
Client Project	091-867 Apex Landfill Expansion	Depth	2'-4'	Consolidation Plot Stress, psi	7.0
Project No.	30598	Sample	ST-1	**Final Test Pressures**	
		Lab Sample	30598006	Cell Pressure, psi	120.2
USCS Description:	DARK YELLOWISH BROWN LEAN CLAY WITH SAND			Back Pressure, psi	40.0
Test Conditions:	Undisturbed - Side And Double Drained			Effective Consol., psi	80.2
				Additional Consol. Volume, m	26.9

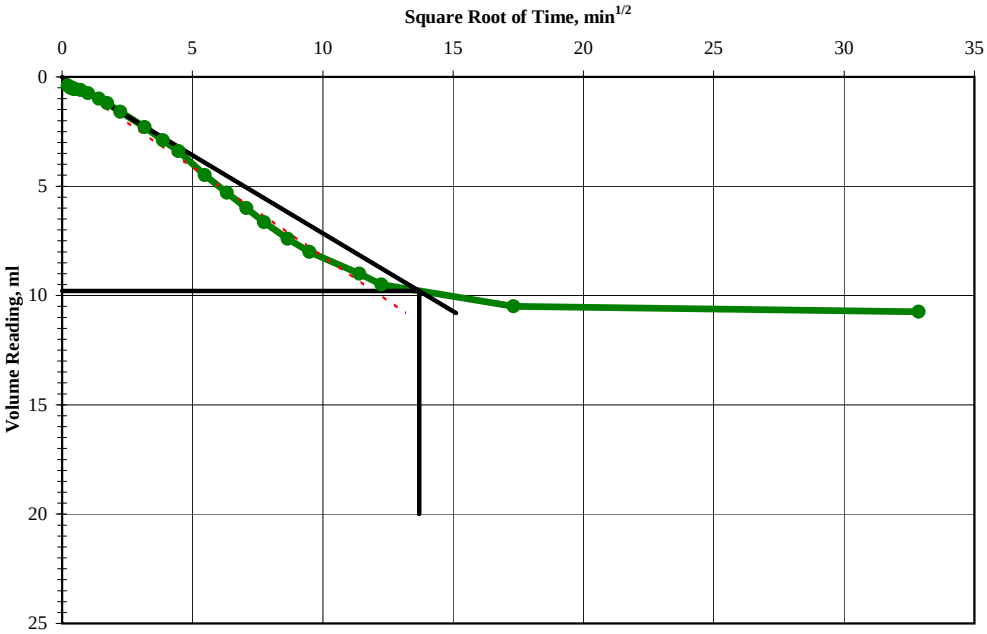
Consol. Start Date: 12/29/2010

Elapsed Time (min)	Sqrt Time ($min^{1/2}$)	Volume Reading ml
0	0	0.0
0.05	0.22	0.4
0.10	0.32	0.5
0.15	0.39	0.5
0.20	0.45	0.6
0.25	0.50	0.6
0.50	0.71	0.6
1.00	1.00	0.8
2.00	1.41	1.0
3.00	1.73	1.2
5.00	2.24	1.6
10.00	3.16	2.3
15.00	3.87	2.9
20.00	4.47	3.4
30.00	5.48	4.5
40.00	6.32	5.3
50.00	7.07	6.0
60.00	7.75	6.7
75.00	8.66	7.4
90.00	9.49	8.0
130.00	11.40	9.0
150.00	12.25	9.5
300.00	17.32	10.5
1080.00	32.86	10.8
1440.00	37.95	10.8
6120.00	78.23	10.8

Log of Elapsed Time vs. Volume Reading



Square Root of Elapsed Time vs. Volume Reading



Sqrt. of Elapsed Time vs Volume		Log of Elapsed Time vs Volume		Consolidation Summary	
T0 = 0 min.	V0 = 0.0 ml.	T0 = 0 min.	V0 = 0.2 ml.	Initial Volume Reading, ml	0.0
T90 = 187.7 min	V90 = 9.8 ml.	T50 = 41.3 min.	V50 = 5.4 ml.	Final Volume Reading, ml	10.8
T100 = NA min	V100 = 10.9 ml.	T100 = 179.1 min.	V100 = 10.5 ml.	Total Volume Change, ml	37.7

Input Validation: Reviewed By: Date 12/29/2010

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ONE-DIMENSIONAL CONSOLIDATION PROPERTIES OF SOILS
ASTM D 2435

Client	Civil & Environmental Consultant	Boring	SB-16
Client Project	091-867 Apex Landfill Expansion	Depth	0.5'-2.5'
Project No.	30598	Sample	ST-1
		Lab Sample No.	30598008

Visual Description: Light Olive Brown Fat Clay
Sample Conditions: Undisturbed, Inundated, and Double Drained
Machine Deflection Correction: Applied

SAMPLE PROPERTIES		
	Initial	Final
Tare Number	A23	Z13
Wt. Tare & WS, gm	98.22	277.35
Wt. Tare & DS, gm	81.05	251.7
Wt. Tare, gm	9.45	122.82
Water Content, %	24.0%	19.9%
Sample Diameter, in	2.5	2.5
Sample Height, in	1.004	0.9011
Sample Volume, in^3	4.9265	4.4234
Wt. WS + Ring, gm	272.59	267.73
Wt. of Ring, gm	112.08	112.08
Wt. of WS, gm	160.51	155.65
Wet Density, pcf	124.06	133.99
Wet Density, g/cc	1.988	2.147
Water Content, %	24.0%	19.9%
Wt. of DS, gm	129.46	129.81
Dry Density, pcf	100.07	111.75
Dry Density, g/cc	1.604	1.791
Void Ratio, e	0.6837	0.5076
Saturation, %	94.7%	
Specific Gravity	2.7	Measured
Height of Solids, in	0.5961	0.5961

TEST DATA SUMMARY

Applied Pressure tsf	Load Duration min	Final Height in	Vertical Strain %	Dry Density g/cc	Void Ratio e	a_v ft^2/ton	Incremental C_c	Incremental C_r
Seating	NA	1.0036	0.00	1.6036	0.6837	NA	NA	NA
0.25	120	1.0036	0.00%	1.6036	0.6837	0.00E+00	NA	NA
0.5	380	1.0018	0.18%	1.6066	0.6806	1.24E-02	0.010	NA
1	955	0.9946	0.90%	1.6182	0.6685	2.42E-02	0.040	NA
2	1,514	0.9792	2.44%	1.6437	0.6427	2.58E-02	0.086	NA
4	1,203	0.9573	4.62%	1.6813	0.6059	1.84E-02	0.122	NA
1	380	0.9685	3.50%	1.6618	0.6247	6.26E-03	NA	NA
0.25	955	0.9846	1.90%	1.6347	0.6517	3.60E-02	NA	NA
0.5	955	0.9830	2.05%	1.6372	0.6491	1.04E-02	NA	0.009
1	1,203	0.9778	2.57%	1.6460	0.6404	1.74E-02	NA	0.029
2	955	0.9682	3.53%	1.6623	0.6243	1.61E-02	NA	0.053
4	380	0.9544	4.90%	1.6863	0.6011	1.16E-02	NA	0.077
8	955	0.9293	7.40%	1.7318	0.5590	1.05E-02	0.140	NA
16	302	0.9011	10.21%	1.7860	0.5117	5.91E-03	0.157	NA

Note: The calculations performed and the parameters presented herein are for preliminary purposes only. GTS only accepts responsibility for the raw data obtained from the consolidation tests. This data may be interpreted differently by others. It is the responsibility of the user to determine the appropriateness and accuracy of the computed values.

Input Validation | Reviewed By: | Date Tested: 12/3/2010 |

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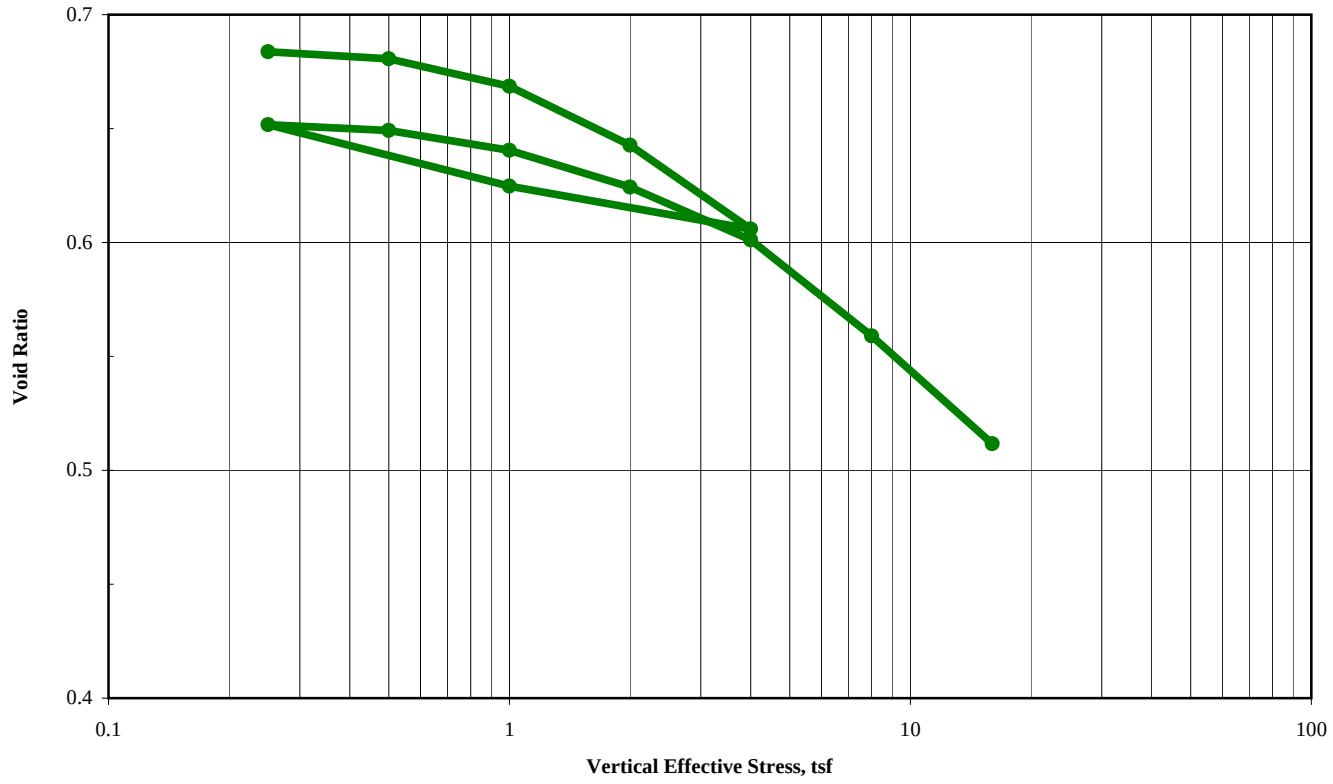
ONE-DIMENSIONAL CONSOLIDATION PROPERTIES OF SOILS
ASTM D 2435

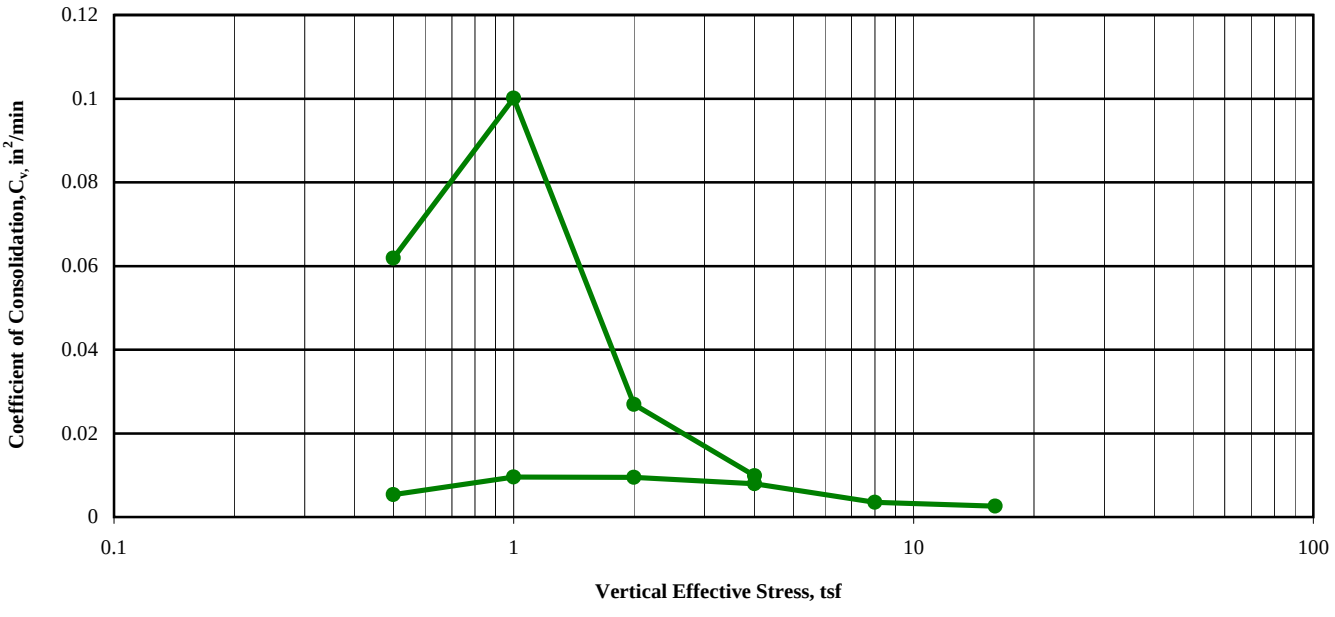
Client	Civil & Environmental Consultants, Inc.	Boring	SB-16
Client Project	091-867 Apex Landfill Expansion	Depth	0.5'-2.5'
Project No.	30598	Sample	ST-1
		Lab Sample No.	30598008

Visual Description: Light Olive Brown Fat Clay
Sample Conditions: Undisturbed, Inundated, and Double Drained
Machine Deflection Correction: Applied

Void Ratio (Final Height) vs Vertical Effective Consolidation Stress



Coeffieicent of Consolidation (log. method) vs. Vertical Effective Consolidation Stress



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ONE-DIMENSIONAL CONSOLIDATION PROPERTIES OF SOILS
ASTM D 2435

Client	Civil & Environmental Consultant	Boring	SB-16	**Test Load, tsf**	**0-0.25**
Client Project	091-867 Apex Landfill Expansion	Depth	0.5'-2.5'		Load 1 of 13
Project No.	30598	Sample	ST-1		
		Lab ID#	30598008		
Visual Description	Light Olive Brown Fat Clay				
Test Conditions:	Undisturbed, Inundated, and Double Drained				

Time Vs. Dial Reading

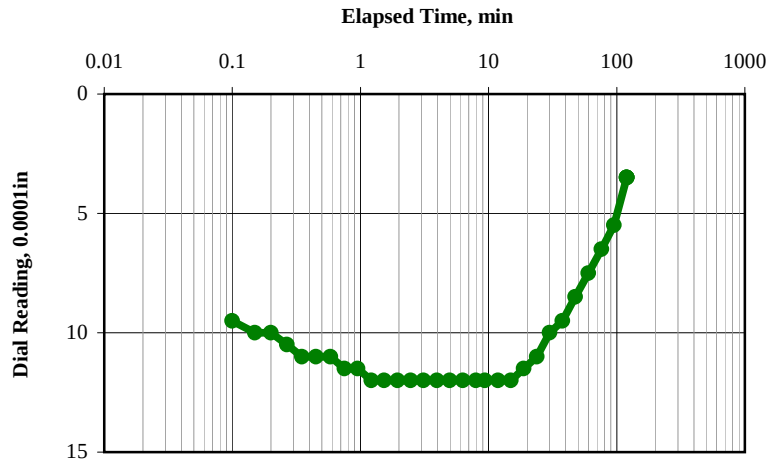
Elapsed Time (min)	Sqrt Time ($min^{1/2}$)	Dial Reading (0.0001in)	Sample Height (in)	Void Ratio
0	0	0	1.0036	0.6837
Corrections*		-3.5	-0.00035	-0.0006
Adjusted Sample Height & Void Ratio				
0.10	0.32	9.5	1.0030	0.6827
0.15	0.39	10.0	1.0030	0.6826
0.20	0.45	10.0	1.0030	0.6826
0.27	0.52	10.5	1.0029	0.6825
0.35	0.59	11.0	1.0029	0.6824
0.45	0.67	11.0	1.0029	0.6824
0.58	0.76	11.0	1.0029	0.6824
0.75	0.87	11.5	1.0028	0.6823
0.95	0.97	11.5	1.0028	0.6823
1.22	1.10	12.0	1.0028	0.6822
1.53	1.24	12.0	1.0028	0.6822
1.95	1.40	12.0	1.0028	0.6822
2.47	1.57	12.0	1.0028	0.6822
3.12	1.77	12.0	1.0028	0.6822
3.95	1.99	12.0	1.0028	0.6822
4.98	2.23	12.0	1.0028	0.6822
6.30	2.51	12.0	1.0028	0.6822
7.97	2.82	12.0	1.0028	0.6822
9.40	3.07	12.0	1.0028	0.6822
11.85	3.44	12.0	1.0028	0.6822
14.95	3.87	12.0	1.0028	0.6822
18.85	4.34	11.5	1.0028	0.6823
23.77	4.88	11.0	1.0029	0.6824
29.95	5.47	10.0	1.0030	0.6826
37.75	6.14	9.5	1.0030	0.6827
47.57	6.90	8.5	1.0031	0.6828
59.95	7.74	7.5	1.0032	0.6830
75.95	8.71	6.5	1.0033	0.6832
94.95	9.74	5.5	1.0034	0.6833
119.95	10.95	3.5	1.0036	0.6837

Machine Deflection

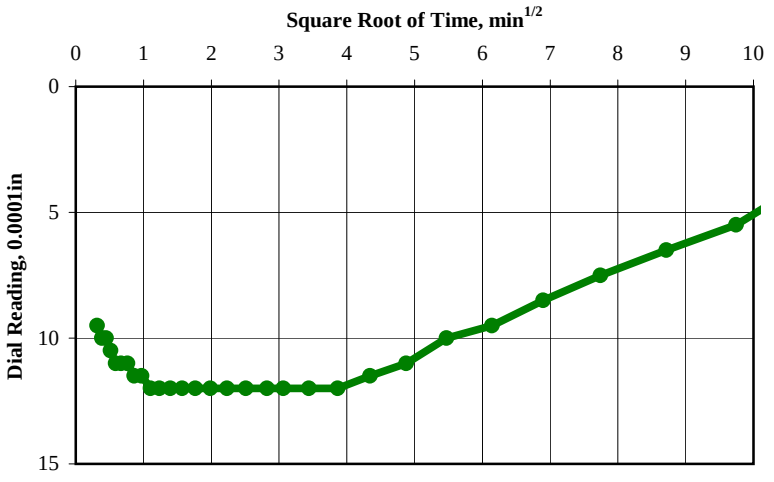
Applied Deflection Correction to Sample Height, 0.0001in -3.5

**Correction is applied to all dial readings.*

Log of Elapsed Time vs. Dial Reading



Square Root of Elapsed Time vs. Dial Reading



Sqrt. of Elapsed Time vs Dial Reading

Specimen Swelled

Log of Elapsed Time vs Dial Reading

Load Summary

Initial Sample Height, in	1.0036
Initial Sample Void Ratio	0.6837
Final Sample Height, in	1.0036
Final Sample Void Ratio	0.6837
Incremental Strain, %	0.00%
Loading Duration, min	119.95

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ONE-DIMENSIONAL CONSOLIDATION PROPERTIES OF SOILS
ASTM D 2435

Client	Civil & Environmental Consultant	Boring	SB-16	**Test Load, tsf**	**0.25-0.5**
Client Project	091-867 Apex Landfill Expansion	Depth	0.5'-2.5'		Load 2 of 13
Project No.	30598	Sample	ST-1		
		Lab ID#	30598008		

Visual Description: Light Olive Brown Fat Clay
Test Conditions: Undisturbed, Inundated, and Double Drained

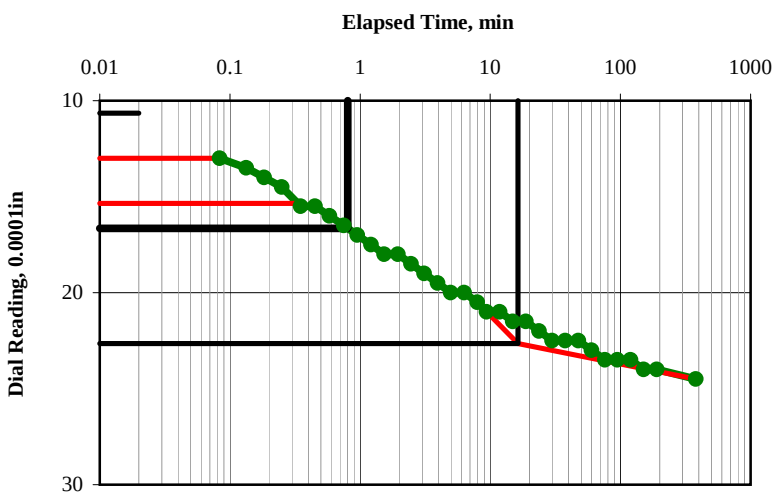
Time Vs. Dial Reading

Elapsed Time (min)	Sqrt Time ($min^{1/2}$)	Dial Reading (0.0001in)	Sample Height (in)	Void Ratio
0	0	3.5	1.0036	0.6837
Corrections*		-2.5	-0.00025	-0.0004
Adjusted Sample Height & Void Ratio				
0.08	0.29	13.0	1.0029	0.6825
0.13	0.37	13.5	1.0029	0.6824
0.18	0.43	14.0	1.0028	0.6823
0.25	0.50	14.5	1.0028	0.6822
0.35	0.59	15.5	1.0027	0.6821
0.45	0.67	15.5	1.0027	0.6821
0.58	0.76	16.0	1.0026	0.6820
0.75	0.87	16.5	1.0026	0.6819
0.95	0.97	17.0	1.0025	0.6818
1.22	1.10	17.5	1.0025	0.6817
1.53	1.24	18.0	1.0024	0.6817
1.95	1.40	18.0	1.0024	0.6817
2.47	1.57	18.5	1.0024	0.6816
3.12	1.77	19.0	1.0023	0.6815
3.95	1.99	19.5	1.0023	0.6814
4.98	2.23	20.0	1.0022	0.6813
6.30	2.51	20.0	1.0022	0.6813
7.95	2.82	20.5	1.0022	0.6812
9.40	3.07	21.0	1.0021	0.6812
11.85	3.44	21.0	1.0021	0.6812
14.95	3.87	21.5	1.0021	0.6811
18.85	4.34	21.5	1.0021	0.6811
23.77	4.88	22.0	1.0020	0.6810
29.95	5.47	22.5	1.0020	0.6809
37.75	6.14	22.5	1.0020	0.6809
47.57	6.90	22.5	1.0020	0.6809
59.95	7.74	23.0	1.0019	0.6808
75.95	8.71	23.5	1.0019	0.6807
94.95	9.74	23.5	1.0019	0.6807
119.95	10.95	23.5	1.0019	0.6807
150.95	12.29	24.0	1.0018	0.6807
189.95	13.78	24.0	1.0018	0.6807
379.95	19.49	24.5	1.0018	0.6806

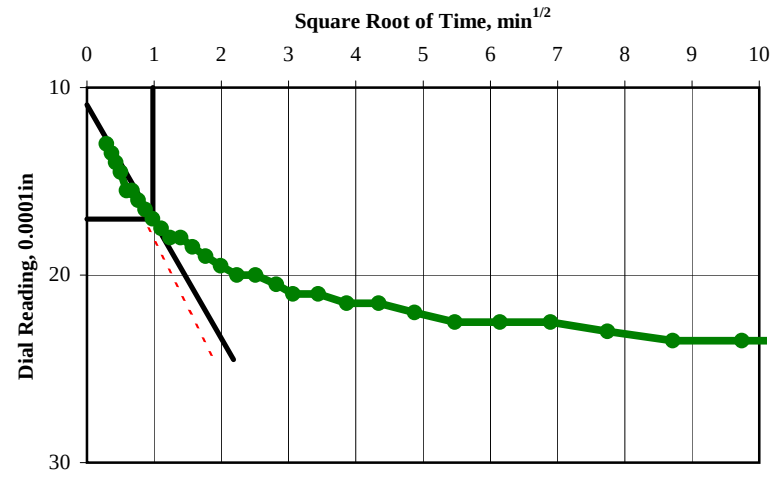
Machine Deflection

Applied Deflection Correction to Sample Height, 0.0001in: -2.5
**Correction is applied to all dial readings.*

Log of Elapsed Time vs. Dial Reading



Square Root of Elapsed Time vs. Dial Reading



Sqrt. of Elapsed Time vs Dial Reading

T0 = 0 min.	D0 = 10.9 div.		
T90 = 0.96 min	D90 = 17 div.		
T100 = NA min	D100 = 17.7 div.		
Height at: D90 = 1.0025, D100 = 1.0025			
Average Sample Height, in	1.0027		
Average Drainage Height, in	0.5014		
T (Time Factor for T90)	0.848		
Coef. of Consol., C_v, in^2/min	0.222		

Log of Elapsed Time vs Dial Reading

T0 = 0 min.	D0 = 10.6 div.		
T50 = 0.8 min.	D50 = 16.6 div.		
T100 = 16.31 min.	D100 = 22.6 div.		
Height at: D50 = 1.0026, D100 = 1.002			
Average Sample Height, in	1.0027		
Average Drainage Height, in	0.5014		
T (Time Factor for T50)	0.197		
Coef. of Consol., C_v, in^2/min	0.062		

Load Summary

Initial Sample Height, in	1.0036
Initial Sample Void Ratio	0.6837
Final Sample Height, in	1.0018
Final Sample Void Ratio	0.6806
Incremental Strain, %	0.18%
Loading Duration, min	379.95

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ONE-DIMENSIONAL CONSOLIDATION PROPERTIES OF SOILS
ASTM D 2435

Client	Civil & Environmental Consultant	Boring	SB-16	**Test Load, tsf**	**0.5-1**
Client Project	091-867 Apex Landfill Expansion	Depth	0.5'-2.5'		Load 3 of 13
Project No.	30598	Sample	ST-1		
		Lab ID#	30598008		

Visual Description: Light Olive Brown Fat Clay
Test Conditions: Undisturbed, Inundated, and Double Drained

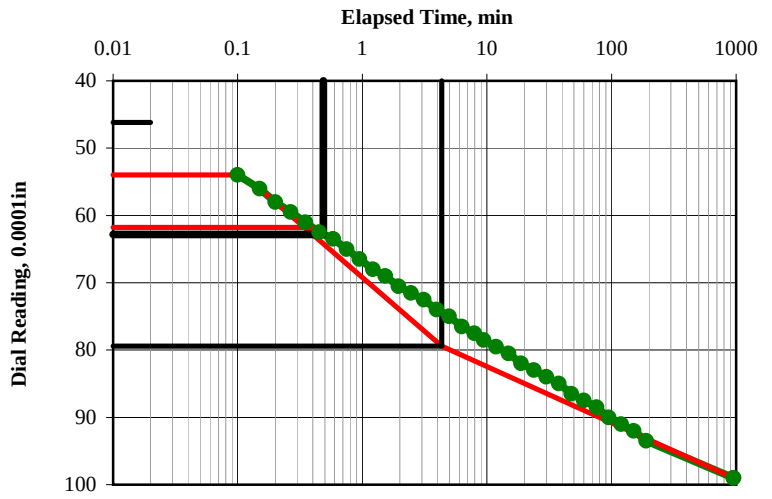
Time Vs. Dial Reading

Elapsed Time (min)	Sqrt Time ($min^{1/2}$)	Dial Reading (0.0001in)	Sample Height (in)	Void Ratio
0	0	24.5	1.0018	0.6806
Corrections*		-2.5	-0.00025	-0.0004
Adjusted Sample Height & Void Ratio				
0.10	0.32	54.0	0.9991	0.6760
0.15	0.39	56.0	0.9989	0.6757
0.20	0.45	58.0	0.9987	0.6754
0.27	0.52	59.5	0.9985	0.6751
0.35	0.59	61.0	0.9984	0.6749
0.45	0.67	62.5	0.9982	0.6746
0.58	0.76	63.5	0.9981	0.6744
0.75	0.87	65.0	0.9980	0.6742
0.95	0.97	66.5	0.9978	0.6739
1.22	1.10	68.0	0.9977	0.6737
1.53	1.24	69.0	0.9976	0.6735
1.95	1.40	70.5	0.9974	0.6733
2.47	1.57	71.5	0.9973	0.6731
3.12	1.77	72.5	0.9972	0.6729
3.95	1.99	74.0	0.9971	0.6727
4.98	2.23	75.0	0.9970	0.6725
6.30	2.51	76.5	0.9968	0.6723
7.95	2.82	77.5	0.9967	0.6721
9.40	3.07	78.5	0.9966	0.6719
11.85	3.44	79.5	0.9965	0.6718
14.95	3.87	80.5	0.9964	0.6716
18.85	4.34	82.0	0.9963	0.6713
23.77	4.88	83.0	0.9962	0.6712
29.95	5.47	84.0	0.9961	0.6710
37.75	6.14	85.0	0.9960	0.6708
47.57	6.90	86.5	0.9958	0.6706
59.95	7.74	87.5	0.9957	0.6704
75.95	8.71	88.5	0.9956	0.6703
94.95	9.74	90.0	0.9955	0.6700
119.95	10.95	91.0	0.9954	0.6698
150.95	12.29	92.0	0.9953	0.6697
189.95	13.78	93.5	0.9951	0.6694
954.95	30.90	99.0	0.9946	0.6685

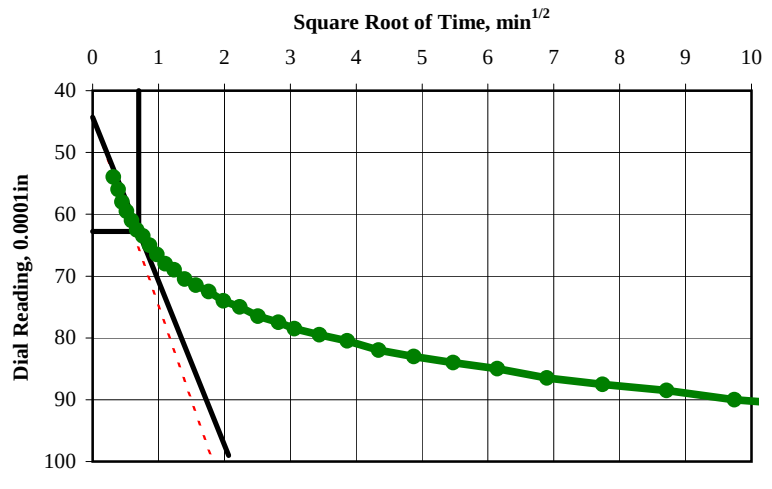
Machine Deflection

Applied Deflection Correction to Sample Height, 0.0001in: -2.5
**Correction is applied to all dial readings.*

Log of Elapsed Time vs. Dial Reading



Square Root of Elapsed Time vs. Dial Reading



Sqrt. of Elapsed Time vs Dial Reading

T0 = 0 min.	D0 = 44.3 div.
T90 = 0.49 min	D90 = 62.8 div.
T100 = NA min	D100 = 64.8 div.
Height at: D90 = 0.9982, D100 = 0.998	
Average Sample Height, in	0.9982
Average Drainage Height, in	0.4991
T (Time Factor for T90)	0.848
Coef. of Consol., C_v, in^2/min	0.435

Log of Elapsed Time vs Dial Reading

T0 = 0 min.	D0 = 46.2 div.
T50 = 0.49 min.	D50 = 62.8 div.
T100 = 4.34 min.	D100 = 79.4 div.
Height at: D50 = 0.9982, D100 = 0.9965	
Average Sample Height, in	0.9982
Average Drainage Height, in	0.4991
T (Time Factor for T50)	0.197
Coef. of Consol., C_v, in^2/min	0.100

Load Summary

Initial Sample Height, in	1.0018
Initial Sample Void Ratio	0.6806
Final Sample Height, in	0.9946
Final Sample Void Ratio	0.6685
Incremental Strain, %	0.72%
Loading Duration, min	954.95

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ONE-DIMENSIONAL CONSOLIDATION PROPERTIES OF SOILS
ASTM D 2435

Client	Civil & Environmental Consultant	Boring	SB-16	**Test Load, tsf**	**1-2**
Client Project	091-867 Apex Landfill Expansion	Depth	0.5'-2.5'		Load 4 of 13
Project No.	30598	Sample	ST-1		
		Lab ID#	30598008		

Visual Description: Light Olive Brown Fat Clay
Test Conditions: Undisturbed, Inundated, and Double Drained

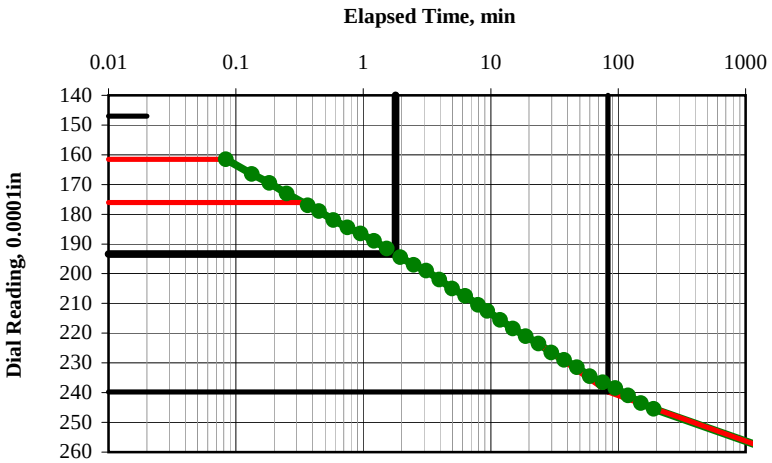
Time Vs. Dial Reading

Elapsed Time (min)	Sqrt Time ($min^{1/2}$)	Dial Reading (0.0001in)	Sample Height (in)	Void Ratio
0	0	99.0	0.9946	0.6685
Corrections*		-6	-0.0006	-0.001
Adjusted Sample Height & Void Ratio				
0.08	0.29	161.5	0.9889	0.6590
0.13	0.37	166.5	0.9884	0.6582
0.18	0.43	169.5	0.9881	0.6577
0.25	0.50	173.0	0.9878	0.6571
0.37	0.61	177.0	0.9874	0.6564
0.45	0.67	179.0	0.9872	0.6561
0.58	0.76	182.0	0.9869	0.6556
0.75	0.87	184.5	0.9866	0.6552
0.95	0.97	186.5	0.9864	0.6548
1.22	1.10	189.0	0.9862	0.6544
1.53	1.24	191.5	0.9859	0.6540
1.95	1.40	194.5	0.9856	0.6535
2.48	1.58	197.0	0.9854	0.6531
3.12	1.77	199.0	0.9852	0.6527
3.95	1.99	202.0	0.9849	0.6522
4.98	2.23	205.0	0.9846	0.6517
6.30	2.51	207.5	0.9843	0.6513
7.95	2.82	210.5	0.9840	0.6508
9.40	3.07	212.5	0.9838	0.6505
11.85	3.44	215.5	0.9835	0.6500
14.95	3.87	218.5	0.9832	0.6494
18.85	4.34	221.0	0.9830	0.6490
23.77	4.88	223.5	0.9827	0.6486
29.95	5.47	226.5	0.9824	0.6481
37.75	6.14	229.0	0.9822	0.6477
47.57	6.90	231.5	0.9819	0.6473
59.95	7.74	234.5	0.9816	0.6468
75.95	8.71	236.5	0.9814	0.6464
94.95	9.74	238.5	0.9812	0.6461
119.95	10.95	241.0	0.9810	0.6457
150.95	12.29	243.5	0.9807	0.6453
189.95	13.78	245.5	0.9805	0.6449
1513.95	38.91	259.0	0.9792	0.6427

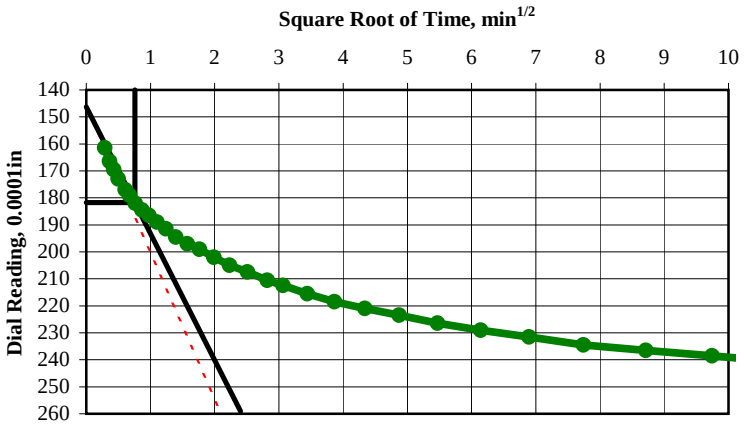
Machine Deflection

Applied Deflection Correction to Sample Height, 0.0001in: -6
**Correction is applied to all dial readings.*

Log of Elapsed Time vs. Dial Reading



Square Root of Elapsed Time vs. Dial Reading



Sqrt. of Elapsed Time vs Dial Reading

T0 = 0 min.	D0 = 146.3 div.
T90 = 0.578 min	D90 = 181.8 div.
T100 = NA min	D100 = 185.7 div.
Height at: D90 = 0.9869, D100 = 0.9865	
Average Sample Height, in	0.9869
Average Drainage Height, in	0.4934
T (Time Factor for T90)	0.848
Coef. of Consol., C_v, in^2/min	0.361

Log of Elapsed Time vs Dial Reading

T0 = 0 min.	D0 = 147 div.
T50 = 1.78 min.	D50 = 193.4 div.
T100 = 83.42 min.	D100 = 239.8 div.
Height at: D50 = 0.9857, D100 = 0.9811	
Average Sample Height, in	0.9869
Average Drainage Height, in	0.4934
T (Time Factor for T50)	0.197
Coef. of Consol., C_v, in^2/min	0.027

Load Summary

Initial Sample Height, in	0.9946
Initial Sample Void Ratio	0.6685
Final Sample Height, in	0.9792
Final Sample Void Ratio	0.6427
Incremental Strain, %	1.55%
Loading Duration, min	1513.95

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ONE-DIMENSIONAL CONSOLIDATION PROPERTIES OF SOILS
ASTM D 2435

Client	Civil & Environmental Consultant	Boring	SB-16	**Test Load, tsf**	**2-4**
Client Project	091-867 Apex Landfill Expansion	Depth	0.5'-2.5'		Load 5 of 13
Project No.	30598	Sample	ST-1		
		Lab ID#	30598008		

Visual Description: Light Olive Brown Fat Clay
Test Conditions: Undisturbed, Inundated, and Double Drained

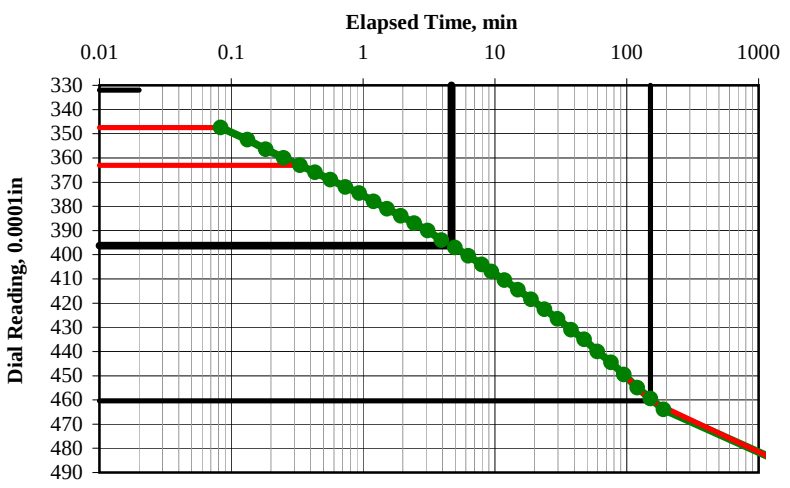
Time Vs. Dial Reading

Elapsed Time (min)	Sqrt Time ($min^{1/2}$)	Dial Reading (0.0001in)	Sample Height (in)	Void Ratio
0	0	259.0	0.9792	0.6427
Corrections*		-5.5	-0.00055	-0.0009
Adjusted Sample Height & Void Ratio				
0.08	0.29	347.5	0.9709	0.6287
0.13	0.37	352.5	0.9704	0.6279
0.18	0.43	356.5	0.9700	0.6272
0.25	0.50	360.0	0.9696	0.6266
0.33	0.58	363.0	0.9693	0.6261
0.43	0.66	366.0	0.9690	0.6256
0.57	0.75	369.0	0.9687	0.6251
0.73	0.86	372.0	0.9684	0.6246
0.93	0.97	374.5	0.9682	0.6242
1.20	1.10	378.0	0.9678	0.6236
1.52	1.23	381.0	0.9675	0.6231
1.93	1.39	384.0	0.9672	0.6226
2.45	1.57	387.0	0.9669	0.6221
3.10	1.76	390.0	0.9666	0.6216
3.93	1.98	394.0	0.9662	0.6209
4.97	2.23	397.0	0.9659	0.6204
6.28	2.51	400.5	0.9656	0.6198
7.93	2.82	404.0	0.9652	0.6193
9.38	3.06	407.0	0.9649	0.6187
11.83	3.44	410.5	0.9646	0.6182
14.93	3.86	414.5	0.9642	0.6175
18.83	4.34	418.5	0.9638	0.6168
23.75	4.87	422.5	0.9634	0.6161
29.93	5.47	426.5	0.9630	0.6155
37.73	6.14	431.0	0.9625	0.6147
47.55	6.90	435.0	0.9621	0.6141
59.93	7.74	440.0	0.9616	0.6132
75.93	8.71	444.5	0.9612	0.6125
94.93	9.74	449.5	0.9607	0.6116
119.93	10.95	455.0	0.9601	0.6107
150.93	12.29	459.5	0.9597	0.6099
189.93	13.78	464.0	0.9592	0.6092
1202.93	34.68	483.5	0.9573	0.6059

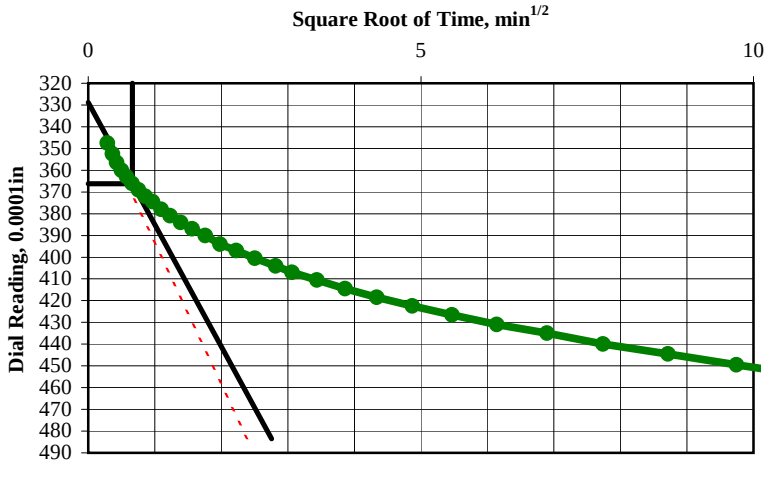
Machine Deflection

Applied Deflection Correction to Sample Height, 0.0001in: -5.5
**Correction is applied to all dial readings.*

Log of Elapsed Time vs. Dial Reading



Square Root of Elapsed Time vs. Dial Reading



Sqrt. of Elapsed Time vs Dial Reading

T0 = 0 min.	D0 = 328.9 div.		
T90 = 0.449 min	D90 = 366.2 div.		
T100 = NA min	D100 = 370.4 div.		
Height at: D90 = 0.969, D100 = 0.9686			
Average Sample Height, in	0.9682		
Average Drainage Height, in	0.4841		
T (Time Factor for T90)	0.848		
Coef. of Consol., C_v, in^2/min	0.449		

Log of Elapsed Time vs Dial Reading

T0 = 0 min.	D0 = 332 div.		
T50 = 4.67 min.	D50 = 396.2 div.		
T100 = 150.93 min.	D100 = 460.4 div.		
Height at: D50 = 0.966, D100 = 0.9596			
Average Sample Height, in	0.9682		
Average Drainage Height, in	0.4841		
T (Time Factor for T50)	0.197		
Coef. of Consol., C_v, in^2/min	0.010		

Load Summary

Initial Sample Height, in	0.9792
Initial Sample Void Ratio	0.6427
Final Sample Height, in	0.9573
Final Sample Void Ratio	0.6059
Incremental Strain, %	2.24%
Loading Duration, min	1202.9333

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ONE-DIMENSIONAL CONSOLIDATION PROPERTIES OF SOILS
ASTM D 2435

Client	Civil & Environmental Consultant	Boring	SB-16	**Test Load, tsf**	**4-1**
Client Project	091-867 Apex Landfill Expansion	Depth	0.5'-2.5'		Load 6 of 13
Project No.	30598	Sample	ST-1		
		Lab ID#	30598008		

Visual Description: Light Olive Brown Fat Clay
Test Conditions: Undisturbed, Inundated, and Double Drained

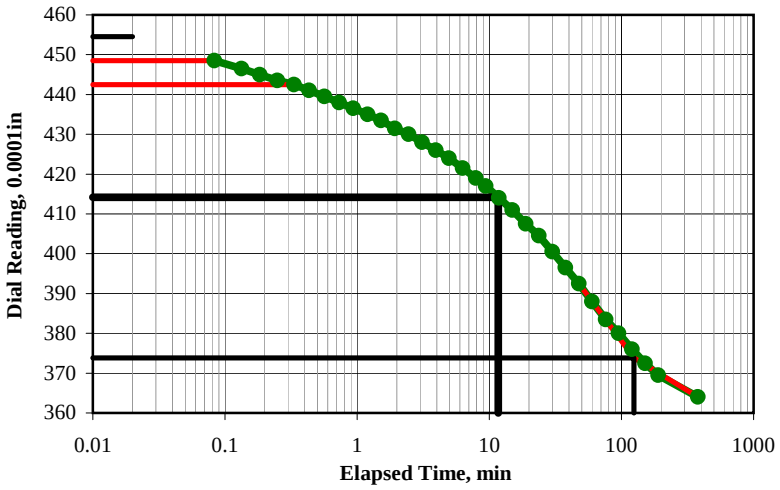
Time Vs. Dial Reading

Elapsed Time (min)	Sqrt Time ($min^{1/2}$)	Dial Reading (0.0001in)	Sample Height (in)	Void Ratio
0	0	483.5	0.9573	0.6059
Corrections*		7.5	0.00075	0.00126
Adjusted Sample Height & Void Ratio				
0.08	0.29	448.5	0.9600	0.6105
0.13	0.37	446.5	0.9602	0.6109
0.18	0.43	445.0	0.9604	0.6111
0.25	0.50	443.5	0.9605	0.6114
0.33	0.58	442.5	0.9606	0.6115
0.43	0.66	441.0	0.9608	0.6118
0.57	0.75	439.5	0.9609	0.6120
0.73	0.86	438.0	0.9611	0.6123
0.93	0.97	436.5	0.9612	0.6125
1.20	1.10	435.0	0.9614	0.6128
1.52	1.23	433.5	0.9615	0.6130
1.93	1.39	431.5	0.9617	0.6134
2.45	1.57	430.0	0.9619	0.6136
3.10	1.76	428.0	0.9621	0.6140
3.93	1.98	426.0	0.9623	0.6143
4.97	2.23	424.0	0.9625	0.6146
6.28	2.51	421.5	0.9627	0.6151
7.93	2.82	419.0	0.9630	0.6155
9.38	3.06	417.0	0.9632	0.6158
11.83	3.44	414.0	0.9635	0.6163
14.93	3.86	411.0	0.9638	0.6168
18.83	4.34	407.5	0.9641	0.6174
23.75	4.87	404.5	0.9644	0.6179
29.93	5.47	400.5	0.9648	0.6186
37.73	6.14	396.5	0.9652	0.6193
47.55	6.90	392.5	0.9656	0.6199
59.93	7.74	388.0	0.9661	0.6207
75.93	8.71	383.5	0.9665	0.6214
94.93	9.74	380.0	0.9669	0.6220
119.93	10.95	376.0	0.9673	0.6227
150.93	12.29	372.5	0.9676	0.6233
189.93	13.78	369.5	0.9679	0.6238
379.93	19.49	364.0	0.9685	0.6247

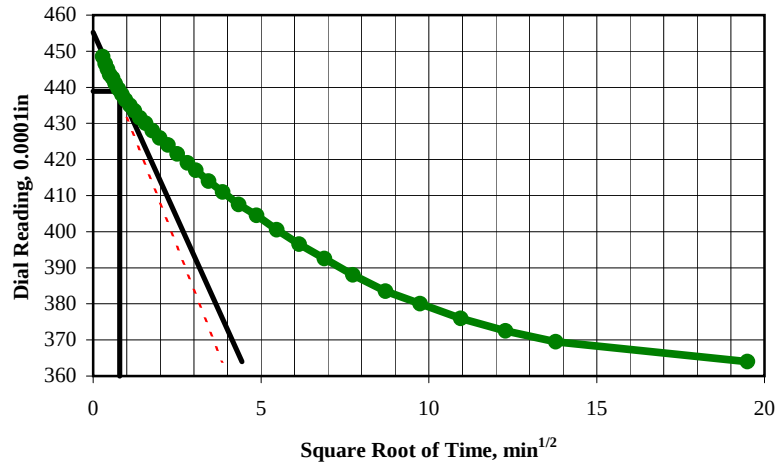
Machine Deflection

Applied Deflection Correction to Sample Height, 0.0001in 7.5
**Correction is applied to all dial readings.*

Log of Elapsed Time vs. Dial Reading



Square Root of Elapsed Time vs. Dial Reading



Sqrt. of Elapsed Time vs Dial Reading

T0 = 0 min.	D0 = 455.2 div.
T90 = 0.624 min	D90 = 438.9 div.
T100 = NA min	D100 = 437.1 div.
Height at: D90 = 0.961, D100 = 0.9612	
Average Sample Height, in	0.9629
Average Drainage Height, in	0.4814
T (Time Factor for T90)	0.848
Coef. of Consol., C_v, in^2/min	0.314

Log of Elapsed Time vs Dial Reading

T0 = 0 min.	D0 = 454.5 div.
T50 = 11.69 min.	D50 = 414.2 div.
T100 = 124.25 min.	D100 = 373.8 div.
Height at: D50 = 0.9635, D100 = 0.9675	
Average Sample Height, in	0.9629
Average Drainage Height, in	0.4814
T (Time Factor for T50)	0.197
Coef. of Consol., C_v, in^2/min	0.004

Load Summary

Initial Sample Height, in	0.9573
Initial Sample Void Ratio	0.6059
Final Sample Height, in	0.9685
Final Sample Void Ratio	0.6247
Incremental Strain, %	-1.17%
Loading Duration, min	379.93333

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ONE-DIMENSIONAL CONSOLIDATION PROPERTIES OF SOILS
ASTM D 2435

Client	Civil & Environmental Consultant	Boring	SB-16	**Test Load, tsf**	**1-0.25**
Client Project	091-867 Apex Landfill Expansion	Depth	0.5'-2.5'		Load 7 of 13
Project No.	30598	Sample	ST-1		
		Lab ID#	30598008		

Visual Description: Light Olive Brown Fat Clay
Test Conditions: Undisturbed, Inundated, and Double Drained

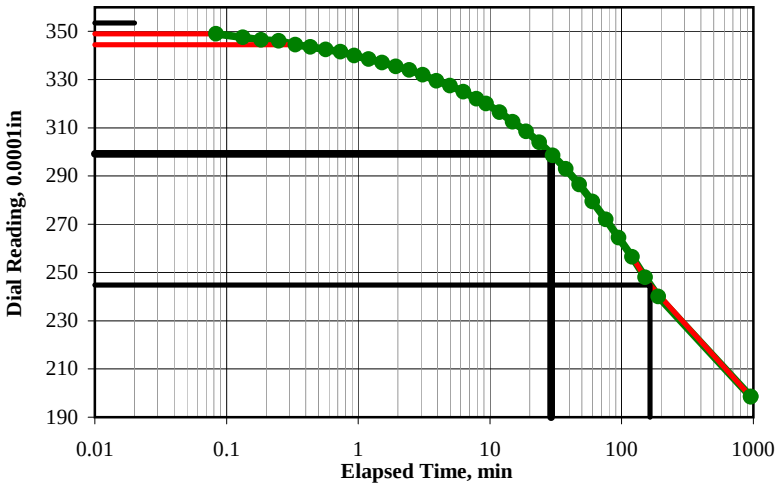
Time Vs. Dial Reading

Elapsed Time (min)	Sqrt Time ($min^{1/2}$)	Dial Reading (0.0001in)	Sample Height (in)	Void Ratio
0	0	364.0	0.9685	0.6247
Corrections*		4.5	0.00045	0.00075
Adjusted Sample Height & Void Ratio				
0.08	0.29	349.0	0.9695	0.6265
0.13	0.37	347.5	0.9697	0.6267
0.18	0.43	346.5	0.9698	0.6269
0.25	0.50	346.0	0.9698	0.6270
0.33	0.58	344.5	0.9700	0.6272
0.43	0.66	343.5	0.9701	0.6274
0.57	0.75	342.5	0.9702	0.6276
0.73	0.86	341.5	0.9703	0.6277
0.93	0.97	340.0	0.9704	0.6280
1.20	1.10	338.5	0.9706	0.6282
1.52	1.23	337.0	0.9707	0.6285
1.93	1.39	335.5	0.9709	0.6287
2.45	1.57	334.0	0.9710	0.6290
3.10	1.76	332.0	0.9712	0.6293
3.93	1.98	329.5	0.9715	0.6297
4.97	2.23	327.5	0.9717	0.6301
6.28	2.51	325.0	0.9719	0.6305
7.93	2.82	322.0	0.9722	0.6310
9.38	3.06	320.0	0.9724	0.6313
11.83	3.44	316.5	0.9728	0.6319
14.93	3.86	312.5	0.9732	0.6326
18.83	4.34	308.5	0.9736	0.6333
23.75	4.87	304.0	0.9740	0.6340
29.93	5.47	298.5	0.9746	0.6349
37.73	6.14	293.0	0.9751	0.6359
47.55	6.90	286.5	0.9758	0.6370
59.93	7.74	279.5	0.9765	0.6381
75.93	8.71	272.0	0.9772	0.6394
94.93	9.74	264.5	0.9780	0.6406
119.93	10.95	256.5	0.9788	0.6420
150.93	12.29	248.0	0.9796	0.6434
189.93	13.78	240.0	0.9804	0.6448
954.93	30.90	198.5	0.9846	0.6517

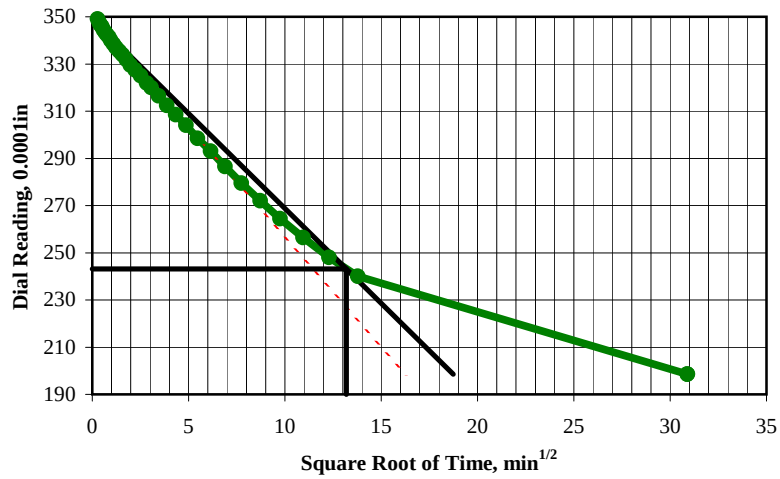
Machine Deflection

Applied Deflection Correction to Sample Height, 0.0001in 4.5
**Correction is applied to all dial readings.*

Log of Elapsed Time vs. Dial Reading



Square Root of Elapsed Time vs. Dial Reading



Sqrt. of Elapsed Time vs Dial Reading

T0 = 0 min.	D0 = 349.2 div.
T90 = 173.712 min	D90 = 243.2 div.
T100 = NA min	D100 = 231.4 div.
Height at: D90 = 0.9801, D100 = 0.9813	
Average Sample Height, in	0.9765
Average Drainage Height, in	0.4883
T (Time Factor for T90)	0.848
Coef. of Consol., C_v, in^2/min	0.001

Log of Elapsed Time vs Dial Reading

T0 = 0 min.	D0 = 353.5 div.
T50 = 29.1 min.	D50 = 299.2 div.
T100 = 164.38 min.	D100 = 244.8 div.
Height at: D50 = 0.9745, D100 = 0.9799	
Average Sample Height, in	0.9765
Average Drainage Height, in	0.4883
T (Time Factor for T50)	0.197
Coef. of Consol., C_v, in^2/min	0.002

Load Summary

Initial Sample Height, in	0.9685
Initial Sample Void Ratio	0.6247
Final Sample Height, in	0.9846
Final Sample Void Ratio	0.6517
Incremental Strain, %	-1.66%
Loading Duration, min	954.93333

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ONE-DIMENSIONAL CONSOLIDATION PROPERTIES OF SOILS
ASTM D 2435

Client	Civil & Environmental Consultant	Boring	SB-16	**Test Load, tsf**	**0.25-0.5**
Client Project	091-867 Apex Landfill Expansion	Depth	0.5'-2.5'		Load 8 of 13
Project No.	30598	Sample	ST-1		
		Lab ID#	30598008		

Visual Description: Light Olive Brown Fat Clay
Test Conditions: Undisturbed, Inundated, and Double Drained

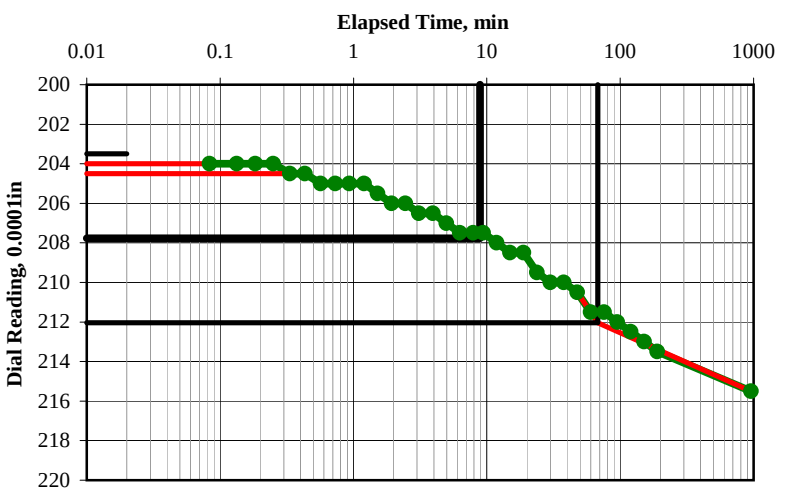
Time Vs. Dial Reading

Elapsed Time (min)	Sqrt Time ($min^{1/2}$)	Dial Reading (0.0001in)	Sample Height (in)	Void Ratio
0	0	198.5	0.9846	0.6517
Corrections*		-1.5	-0.00015	-0.0003
Adjusted Sample Height & Void Ratio				
0.08	0.29	204.0	0.9842	0.6510
0.13	0.37	204.0	0.9842	0.6510
0.18	0.43	204.0	0.9842	0.6510
0.25	0.50	204.0	0.9842	0.6510
0.33	0.58	204.5	0.9841	0.6510
0.43	0.66	204.5	0.9841	0.6510
0.57	0.75	205.0	0.9841	0.6509
0.73	0.86	205.0	0.9841	0.6509
0.93	0.97	205.0	0.9841	0.6509
1.20	1.10	205.0	0.9841	0.6509
1.52	1.23	205.5	0.9840	0.6508
1.93	1.39	206.0	0.9840	0.6507
2.45	1.57	206.0	0.9840	0.6507
3.10	1.76	206.5	0.9839	0.6506
3.95	1.99	206.5	0.9839	0.6506
4.97	2.23	207.0	0.9839	0.6505
6.28	2.51	207.5	0.9838	0.6505
7.93	2.82	207.5	0.9838	0.6505
9.38	3.06	207.5	0.9838	0.6505
11.83	3.44	208.0	0.9838	0.6504
14.93	3.86	208.5	0.9837	0.6503
18.83	4.34	208.5	0.9837	0.6503
23.75	4.87	209.5	0.9836	0.6501
29.93	5.47	210.0	0.9836	0.6500
37.73	6.14	210.0	0.9836	0.6500
47.55	6.90	210.5	0.9835	0.6500
59.93	7.74	211.5	0.9834	0.6498
75.93	8.71	211.5	0.9834	0.6498
94.93	9.74	212.0	0.9834	0.6497
119.93	10.95	212.5	0.9833	0.6496
150.93	12.29	213.0	0.9833	0.6495
189.93	13.78	213.5	0.9832	0.6494
954.93	30.90	215.5	0.9830	0.6491

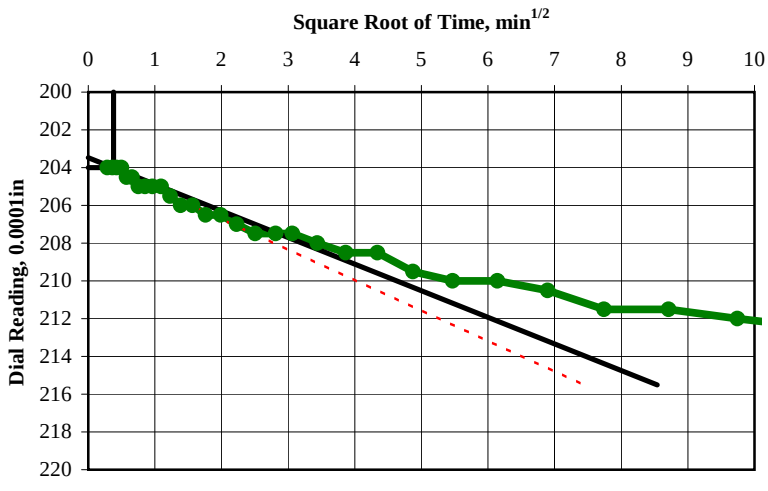
Machine Deflection

Applied Deflection Correction to Sample Height, 0.0001in: -1.5
**Correction is applied to all dial readings.*

Log of Elapsed Time vs. Dial Reading



Square Root of Elapsed Time vs. Dial Reading



Sqrt. of Elapsed Time vs Dial Reading

T0 = 0 min.	D0 = 203.5 div.
T90 = 0.144 min	D90 = 204 div.
T100 = NA min	D100 = 204.1 div.
Height at: D90 = 0.9842, D100 = 0.9842	
Average Sample Height, in	0.9838
Average Drainage Height, in	0.4919
T (Time Factor for T90)	0.848
Coef. of Consol., C_v, in^2/min	1.440

Log of Elapsed Time vs Dial Reading

T0 = 0 min.	D0 = 203.5 div.
T50 = 8.88 min.	D50 = 207.8 div.
T100 = 68.02 min.	D100 = 212 div.
Height at: D50 = 0.9838, D100 = 0.9834	
Average Sample Height, in	0.9838
Average Drainage Height, in	0.4919
T (Time Factor for T50)	0.197
Coef. of Consol., C_v, in^2/min	0.005

Load Summary

Initial Sample Height, in	0.9846
Initial Sample Void Ratio	0.6517
Final Sample Height, in	0.9830
Final Sample Void Ratio	0.6491
Incremental Strain, %	0.16%
Loading Duration, min	954.93333

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ONE-DIMENSIONAL CONSOLIDATION PROPERTIES OF SOILS
ASTM D 2435

Client	Civil & Environmental Consultant	Boring	SB-16	**Test Load, tsf**	**0.5-1**
Client Project	091-867 Apex Landfill Expansion	Depth	0.5'-2.5'		Load 9 of 13
Project No.	30598	Sample	ST-1		
		Lab ID#	30598008		

Visual Description: Light Olive Brown Fat Clay
Test Conditions: Undisturbed, Inundated, and Double Drained

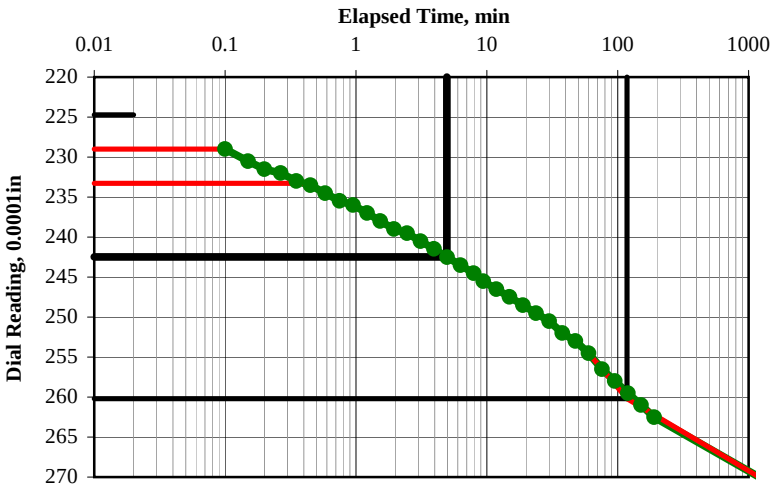
Time Vs. Dial Reading

Elapsed Time (min)	Sqrt Time ($min^{1/2}$)	Dial Reading (0.0001in)	Sample Height (in)	Void Ratio
0	0	215.5	0.9830	0.6491
Corrections*		-2.5	-0.00025	-0.0004
Adjusted Sample Height & Void Ratio				
0.10	0.32	229.0	0.9819	0.6473
0.15	0.39	230.5	0.9818	0.6470
0.20	0.45	231.5	0.9817	0.6468
0.27	0.52	232.0	0.9816	0.6468
0.35	0.59	233.0	0.9815	0.6466
0.45	0.67	233.5	0.9815	0.6465
0.58	0.76	234.5	0.9814	0.6463
0.75	0.87	235.5	0.9813	0.6462
0.95	0.97	236.0	0.9812	0.6461
1.22	1.10	237.0	0.9811	0.6459
1.53	1.24	238.0	0.9810	0.6458
1.95	1.40	239.0	0.9809	0.6456
2.47	1.57	239.5	0.9809	0.6455
3.12	1.77	240.5	0.9808	0.6453
3.95	1.99	241.5	0.9807	0.6452
4.98	2.23	242.5	0.9806	0.6450
6.30	2.51	243.5	0.9805	0.6448
7.95	2.82	244.5	0.9804	0.6447
9.40	3.07	245.5	0.9803	0.6445
11.85	3.44	246.5	0.9802	0.6443
14.95	3.87	247.5	0.9801	0.6442
18.85	4.34	248.5	0.9800	0.6440
23.77	4.88	249.5	0.9799	0.6438
29.95	5.47	250.5	0.9798	0.6437
37.75	6.14	252.0	0.9796	0.6434
47.57	6.90	253.0	0.9795	0.6432
59.95	7.74	254.5	0.9794	0.6430
75.95	8.71	256.5	0.9792	0.6427
94.95	9.74	258.0	0.9790	0.6424
119.95	10.95	259.5	0.9789	0.6422
150.95	12.29	261.0	0.9787	0.6419
189.95	13.78	262.5	0.9786	0.6416
1202.95	34.68	270.0	0.9778	0.6404

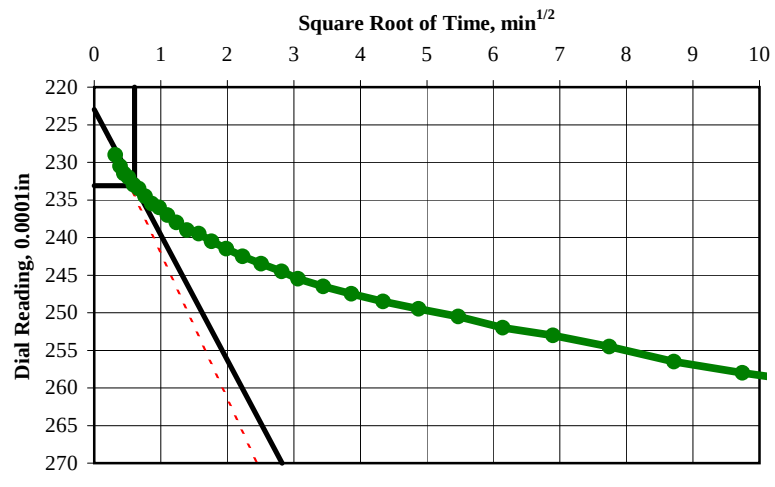
Machine Deflection

Applied Deflection Correction to Sample Height, 0.0001in: -2.5
**Correction is applied to all dial readings.*

Log of Elapsed Time vs. Dial Reading



Square Root of Elapsed Time vs. Dial Reading



Sqrt. of Elapsed Time vs Dial Reading

T0 = 0 min.	D0 = 223 div.		
T90 = 0.372 min	D90 = 233.1 div.		
T100 = NA min	D100 = 234.2 div.		
Height at: D90 = 0.9815, D100 = 0.9814			
Average Sample Height, in	0.9804		
Average Drainage Height, in	0.4902		
T (Time Factor for T90)	0.848		
Coef. of Consol., C_v, in^2/min	0.553		

Log of Elapsed Time vs Dial Reading

T0 = 0 min.	D0 = 224.7 div.		
T50 = 4.94 min.	D50 = 242.5 div.		
T100 = 117.48 min.	D100 = 260.2 div.		
Height at: D50 = 0.9806, D100 = 0.9788			
Average Sample Height, in	0.9804		
Average Drainage Height, in	0.4902		
T (Time Factor for T50)	0.197		
Coef. of Consol., C_v, in^2/min	0.010		

Load Summary

Initial Sample Height, in	0.9830
Initial Sample Void Ratio	0.6491
Final Sample Height, in	0.9778
Final Sample Void Ratio	0.6404
Incremental Strain, %	0.53%
Loading Duration, min	1202.95

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ONE-DIMENSIONAL CONSOLIDATION PROPERTIES OF SOILS
ASTM D 2435

Client	Civil & Environmental Consultant	Boring	SB-16	**Test Load, tsf**	**1-2**
Client Project	091-867 Apex Landfill Expansion	Depth	0.5'-2.5'		Load 10 of 13
Project No.	30598	Sample	ST-1		
		Lab ID#	30598008		

Visual Description: Light Olive Brown Fat Clay
Test Conditions: Undisturbed, Inundated, and Double Drained

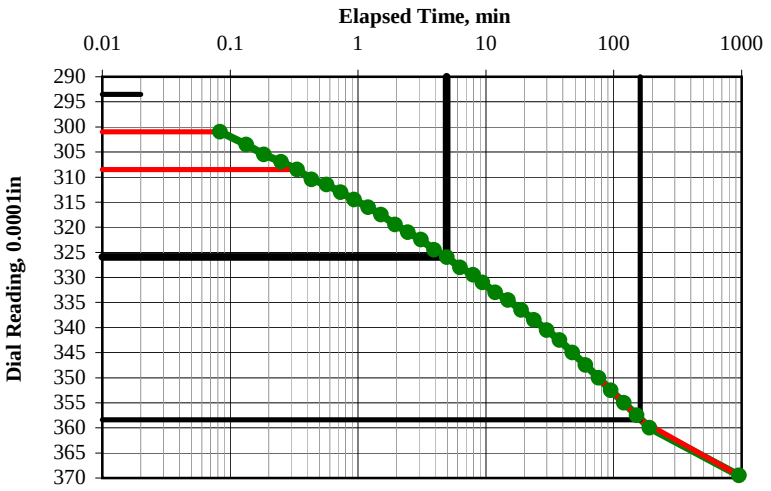
Time Vs. Dial Reading

Elapsed Time (min)	Sqrt Time ($min^{1/2}$)	Dial Reading (0.0001in)	Sample Height (in)	Void Ratio
0	0	270.0	0.9778	0.6404
Corrections*		-3.5	-0.00035	-0.0006
Adjusted Sample Height & Void Ratio				
0.08	0.29	301.0	0.9751	0.6358
0.13	0.37	303.5	0.9748	0.6354
0.18	0.43	305.5	0.9746	0.6350
0.25	0.50	307.0	0.9745	0.6348
0.33	0.58	308.5	0.9743	0.6345
0.43	0.66	310.5	0.9741	0.6342
0.57	0.75	311.5	0.9740	0.6340
0.73	0.86	313.0	0.9739	0.6338
0.93	0.97	314.5	0.9737	0.6335
1.20	1.10	316.0	0.9736	0.6333
1.52	1.23	317.5	0.9734	0.6330
1.95	1.40	319.5	0.9732	0.6327
2.45	1.57	321.0	0.9731	0.6324
3.10	1.76	322.5	0.9729	0.6322
3.93	1.98	324.5	0.9727	0.6318
4.97	2.23	326.0	0.9726	0.6316
6.28	2.51	328.0	0.9724	0.6312
7.93	2.82	329.5	0.9722	0.6310
9.38	3.06	331.0	0.9721	0.6307
11.83	3.44	333.0	0.9719	0.6304
14.93	3.86	334.5	0.9717	0.6302
18.83	4.34	336.5	0.9715	0.6298
23.75	4.87	338.5	0.9713	0.6295
29.93	5.47	340.5	0.9711	0.6291
37.73	6.14	342.5	0.9709	0.6288
47.55	6.90	345.0	0.9707	0.6284
59.93	7.74	347.5	0.9704	0.6280
75.93	8.71	350.0	0.9702	0.6276
94.93	9.74	352.5	0.9699	0.6271
119.93	10.95	355.0	0.9697	0.6267
150.93	12.29	357.5	0.9694	0.6263
189.93	13.78	360.0	0.9692	0.6259
954.93	30.90	369.5	0.9682	0.6243

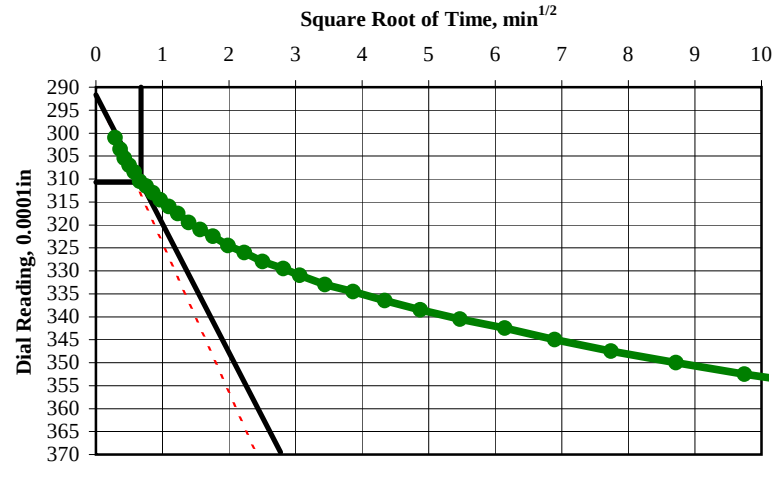
Machine Deflection

Applied Deflection Correction to Sample Height, 0.0001in: -3.5
**Correction is applied to all dial readings.*

Log of Elapsed Time vs. Dial Reading



Square Root of Elapsed Time vs. Dial Reading



Sqrt. of Elapsed Time vs Dial Reading

T0 = 0 min.	D0 = 291.7 div.
T90 = 0.462 min	D90 = 310.7 div.
T100 = NA min	D100 = 312.8 div.
Height at: D90 = 0.9741, D100 = 0.9739	
Average Sample Height, in	0.9730
Average Drainage Height, in	0.4865
T (Time Factor for T90)	0.848
Coef. of Consol., C_v, in^2/min	0.438

Log of Elapsed Time vs Dial Reading

T0 = 0 min.	D0 = 293.5 div.
T50 = 4.92 min.	D50 = 325.9 div.
T100 = 160.53 min.	D100 = 358.4 div.
Height at: D50 = 0.9726, D100 = 0.9693	
Average Sample Height, in	0.9730
Average Drainage Height, in	0.4865
T (Time Factor for T50)	0.197
Coef. of Consol., C_v, in^2/min	0.009

Load Summary

Initial Sample Height, in	0.9778
Initial Sample Void Ratio	0.6404
Final Sample Height, in	0.9682
Final Sample Void Ratio	0.6243
Incremental Strain, %	0.98%
Loading Duration, min	954.93333

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ONE-DIMENSIONAL CONSOLIDATION PROPERTIES OF SOILS
ASTM D 2435

Client	Civil & Environmental Consultant	Boring	SB-16	**Test Load, tsf**	**2-4**
Client Project	091-867 Apex Landfill Expansion	Depth	0.5'-2.5'		Load 11 of 13
Project No.	30598	Sample	ST-1		
		Lab ID#	30598008		

Visual Description: Light Olive Brown Fat Clay
Test Conditions: Undisturbed, Inundated, and Double Drained

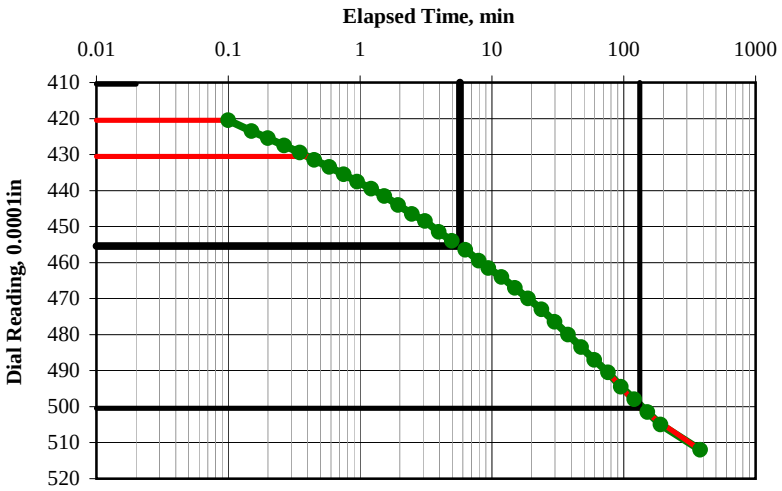
Time Vs. Dial Reading

Elapsed Time (min)	Sqrt Time ($min^{1/2}$)	Dial Reading (0.0001in)	Sample Height (in)	Void Ratio
0	0	369.5	0.9682	0.6243
Corrections*		-4.5	-0.00045	-0.0008
Adjusted Sample Height & Void Ratio				
0.10	0.32	420.5	0.9636	0.6165
0.15	0.39	423.5	0.9633	0.6160
0.20	0.45	425.5	0.9631	0.6156
0.27	0.52	427.5	0.9629	0.6153
0.35	0.59	429.5	0.9627	0.6150
0.45	0.67	431.5	0.9625	0.6146
0.58	0.76	433.5	0.9623	0.6143
0.75	0.87	435.5	0.9621	0.6140
0.95	0.97	437.5	0.9619	0.6136
1.22	1.10	439.5	0.9617	0.6133
1.53	1.24	441.5	0.9615	0.6130
1.95	1.40	444.0	0.9612	0.6125
2.47	1.57	446.5	0.9610	0.6121
3.12	1.77	448.5	0.9608	0.6118
3.95	1.99	451.5	0.9605	0.6113
4.98	2.23	454.0	0.9602	0.6109
6.30	2.51	456.5	0.9600	0.6104
7.95	2.82	459.5	0.9597	0.6099
9.40	3.07	461.5	0.9595	0.6096
11.85	3.44	464.0	0.9592	0.6092
14.95	3.87	467.0	0.9589	0.6087
18.85	4.34	470.0	0.9586	0.6082
23.77	4.88	473.0	0.9583	0.6077
29.95	5.47	476.5	0.9580	0.6071
37.75	6.14	480.0	0.9576	0.6065
47.57	6.90	483.5	0.9573	0.6059
59.95	7.74	487.0	0.9569	0.6053
75.95	8.71	490.5	0.9566	0.6047
94.95	9.74	494.5	0.9562	0.6041
119.95	10.95	498.0	0.9558	0.6035
150.95	12.29	501.5	0.9555	0.6029
189.95	13.78	505.0	0.9551	0.6023
379.95	19.49	512.0	0.9544	0.6011

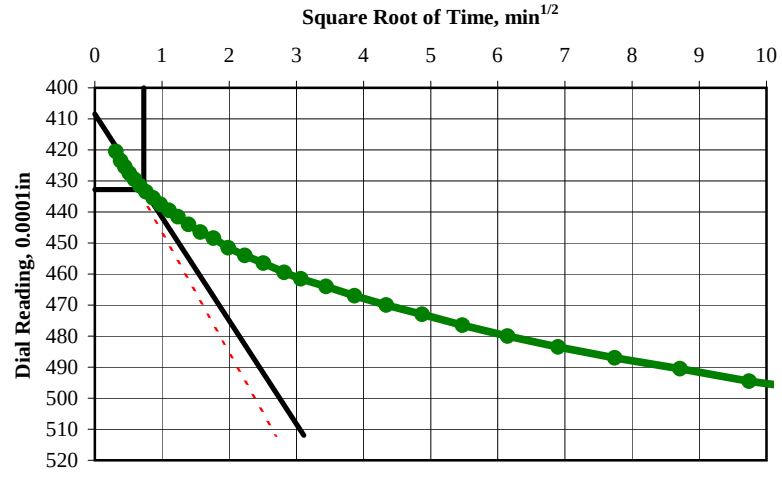
Machine Deflection

Applied Deflection Correction to Sample Height, 0.0001in: -4.5
**Correction is applied to all dial readings.*

Log of Elapsed Time vs. Dial Reading



Square Root of Elapsed Time vs. Dial Reading



Sqrt. of Elapsed Time vs Dial Reading

T0 = 0 min.	D0 = 408.5 div.
T90 = 0.533 min	D90 = 432.7 div.
T100 = NA min	D100 = 435.4 div.
Height at: D90 = 0.9624, D100 = 0.9621	
Average Sample Height, in	0.9613
Average Drainage Height, in	0.4807
T (Time Factor for T90)	0.848
Coef. of Consol., C_v, in^2/min	0.369

Log of Elapsed Time vs Dial Reading

T0 = 0 min.	D0 = 410.4 div.
T50 = 5.71 min.	D50 = 455.4 div.
T100 = 132.4 min.	D100 = 500.5 div.
Height at: D50 = 0.9601, D100 = 0.9556	
Average Sample Height, in	0.9613
Average Drainage Height, in	0.4807
T (Time Factor for T50)	0.197
Coef. of Consol., C_v, in^2/min	0.008

Load Summary

Initial Sample Height, in	0.9682
Initial Sample Void Ratio	0.6243
Final Sample Height, in	0.9544
Final Sample Void Ratio	0.6011
Incremental Strain, %	1.43%
Loading Duration, min	379.95

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ONE-DIMENSIONAL CONSOLIDATION PROPERTIES OF SOILS
ASTM D 2435

Client	Civil & Environmental Consultant	Boring	SB-16	**Test Load, tsf**	**4-8**
Client Project	091-867 Apex Landfill Expansion	Depth	0.5'-2.5'		Load 12 of 13
Project No.	30598	Sample	ST-1		
		Lab ID#	30598008		

Visual Description: Light Olive Brown Fat Clay
Test Conditions: Undisturbed, Inundated, and Double Drained

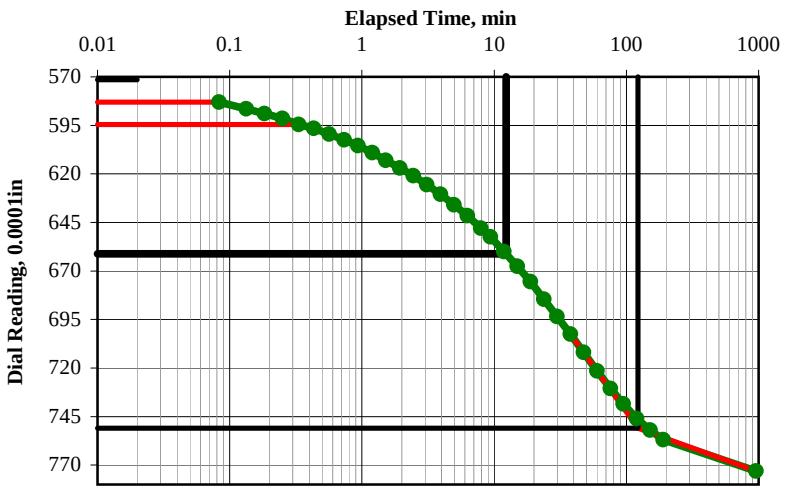
Time Vs. Dial Reading

Elapsed Time (min)	Sqrt Time ($min^{1/2}$)	Dial Reading (0.0001in)	Sample Height (in)	Void Ratio
0	0	512.0	0.9544	0.6011
Corrections*		-10	-0.001	-0.0017
Adjusted Sample Height & Void Ratio				
0.08	0.29	583.0	0.9483	0.5909
0.13	0.37	586.5	0.9480	0.5903
0.18	0.43	589.0	0.9477	0.5899
0.25	0.50	591.5	0.9475	0.5895
0.33	0.58	594.5	0.9472	0.5890
0.43	0.66	596.5	0.9470	0.5886
0.57	0.75	599.5	0.9467	0.5881
0.73	0.86	602.5	0.9464	0.5876
0.93	0.97	605.5	0.9461	0.5871
1.20	1.10	609.0	0.9457	0.5865
1.52	1.23	613.0	0.9453	0.5859
1.93	1.39	617.0	0.9449	0.5852
2.45	1.57	621.0	0.9445	0.5845
3.10	1.76	625.5	0.9441	0.5838
3.93	1.98	630.5	0.9436	0.5829
4.97	2.23	636.0	0.9430	0.5820
6.28	2.51	641.5	0.9425	0.5811
7.93	2.82	648.0	0.9418	0.5800
9.38	3.06	652.5	0.9414	0.5792
11.83	3.44	660.0	0.9406	0.5780
14.93	3.86	667.5	0.9399	0.5767
18.83	4.34	675.5	0.9391	0.5754
23.75	4.87	684.5	0.9382	0.5739
29.93	5.47	693.5	0.9373	0.5724
37.73	6.14	702.5	0.9364	0.5709
47.55	6.90	712.0	0.9354	0.5693
59.93	7.74	721.5	0.9345	0.5677
75.93	8.71	730.5	0.9336	0.5662
94.93	9.74	738.5	0.9328	0.5648
119.93	10.95	746.0	0.9320	0.5636
150.93	12.29	752.0	0.9314	0.5625
189.93	13.78	757.0	0.9309	0.5617
954.93	30.90	773.0	0.9293	0.5590

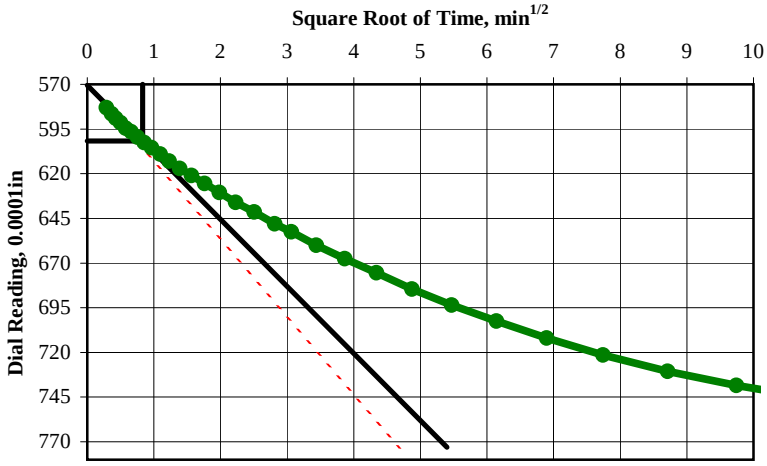
Machine Deflection

Applied Deflection Correction to Sample Height, 0.0001in: -10
**Correction is applied to all dial readings.*

Log of Elapsed Time vs. Dial Reading



Square Root of Elapsed Time vs. Dial Reading



Sqrt. of Elapsed Time vs Dial Reading

T0 = 0 min.	D0 = 570.6 div.
T90 = 0.689 min	D90 = 601.8 div.
T100 = NA min	D100 = 605.2 div.
Height at: D90 = 0.9464, D100 = 0.9461	
Average Sample Height, in	0.9419
Average Drainage Height, in	0.4709
T (Time Factor for T90)	0.848
Coef. of Consol., C_v, in^2/min	0.273

Log of Elapsed Time vs Dial Reading

T0 = 0 min.	D0 = 571.5 div.
T50 = 12.29 min.	D50 = 661.2 div.
T100 = 122.62 min.	D100 = 750.9 div.
Height at: D50 = 0.9405, D100 = 0.9315	
Average Sample Height, in	0.9419
Average Drainage Height, in	0.4709
T (Time Factor for T50)	0.197
Coef. of Consol., C_v, in^2/min	0.004

Load Summary

Initial Sample Height, in	0.9544
Initial Sample Void Ratio	0.6011
Final Sample Height, in	0.9293
Final Sample Void Ratio	0.5590
Incremental Strain, %	2.63%
Loading Duration, min	954.93333

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ONE-DIMENSIONAL CONSOLIDATION PROPERTIES OF SOILS
ASTM D 2435

Client	Civil & Environmental Consultant	Boring	SB-16	**Test Load, tsf**	**8-16**
Client Project	091-867 Apex Landfill Expansion	Depth	0.5'-2.5'		Load 13 of 13
Project No.	30598	Sample	ST-1		
		Lab ID#	30598008		

Visual Description: Light Olive Brown Fat Clay
Test Conditions: Undisturbed, Inundated, and Double Drained

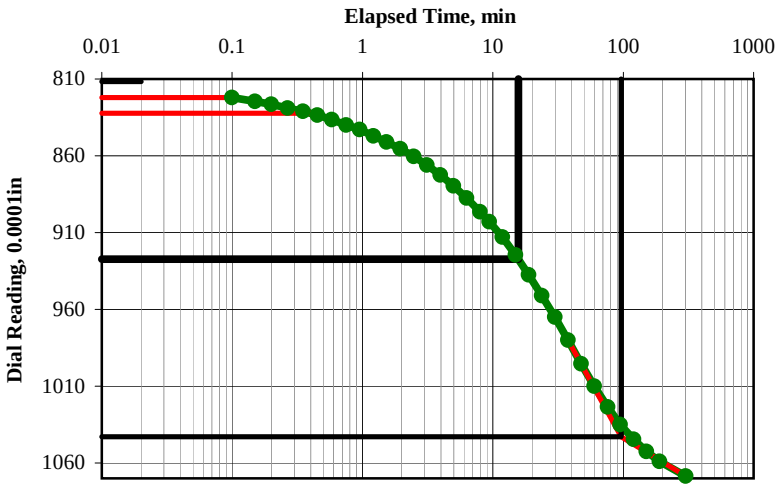
Time Vs. Dial Reading

Elapsed Time (min)	Sqrt Time ($min^{1/2}$)	Dial Reading (0.0001in)	Sample Height (in)	Void Ratio
0	0	773.0	0.9293	0.5590
Corrections*		-13.5	-0.00135	-0.0023
Adjusted Sample Height & Void Ratio				
0.10	0.32	822.0	0.9258	0.5531
0.15	0.39	824.5	0.9255	0.5527
0.20	0.45	826.5	0.9253	0.5523
0.27	0.52	829.0	0.9251	0.5519
0.35	0.59	831.0	0.9249	0.5516
0.45	0.67	833.5	0.9246	0.5511
0.58	0.76	836.5	0.9243	0.5506
0.75	0.87	840.0	0.9240	0.5501
0.95	0.97	843.0	0.9237	0.5495
1.22	1.10	847.0	0.9233	0.5489
1.53	1.24	851.0	0.9229	0.5482
1.95	1.40	855.5	0.9224	0.5475
2.47	1.57	860.5	0.9219	0.5466
3.12	1.77	866.0	0.9214	0.5457
3.95	1.99	872.5	0.9207	0.5446
4.98	2.23	879.5	0.9200	0.5434
6.30	2.51	887.5	0.9192	0.5421
7.95	2.82	896.5	0.9183	0.5406
9.40	3.07	903.0	0.9177	0.5395
11.85	3.44	913.0	0.9167	0.5378
14.95	3.87	924.5	0.9155	0.5359
18.85	4.34	937.5	0.9142	0.5337
23.77	4.88	951.0	0.9129	0.5314
29.95	5.47	965.0	0.9115	0.5291
37.75	6.14	980.0	0.9100	0.5266
47.57	6.90	995.5	0.9084	0.5240
59.95	7.74	1010.0	0.9070	0.5215
75.95	8.71	1023.5	0.9056	0.5193
94.95	9.74	1035.0	0.9045	0.5173
119.95	10.95	1044.5	0.9035	0.5157
150.95	12.29	1052.5	0.9027	0.5144
189.95	13.78	1059.0	0.9021	0.5133
301.95	17.38	1068.5	0.9011	0.5117

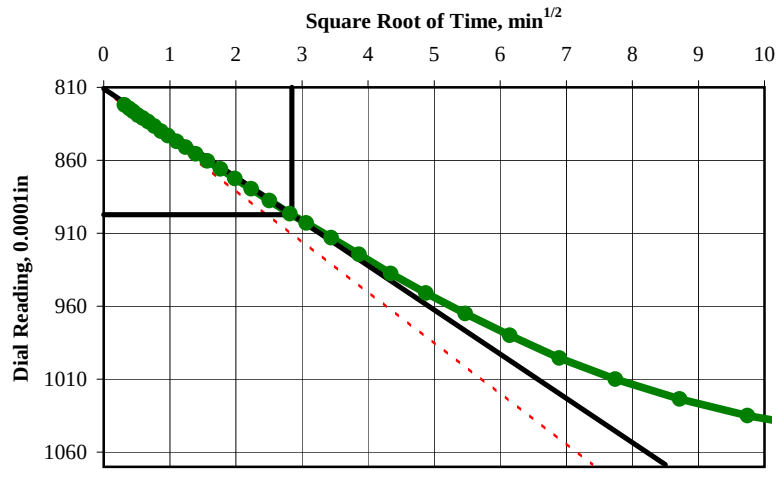
Machine Deflection

Applied Deflection Correction to Sample Height, 0.0001in: -13.5
**Correction is applied to all dial readings.*

Log of Elapsed Time vs. Dial Reading



Square Root of Elapsed Time vs. Dial Reading



Sqrt. of Elapsed Time vs Dial Reading

T0 = 0 min.	D0 = 811 div.
T90 = 8.123 min	D90 = 897.2 div.
T100 = NA min	D100 = 906.8 div.
Height at: D90 = 0.9183, D100 = 0.9173	
Average Sample Height, in	0.9152
Average Drainage Height, in	0.4576
T (Time Factor for T90)	0.848
Coef. of Consol., C_v, in^2/min	0.022

Log of Elapsed Time vs Dial Reading

T0 = 0 min.	D0 = 811.7 div.
T50 = 15.7 min.	D50 = 927.2 div.
T100 = 96.32 min.	D100 = 1042.8 div.
Height at: D50 = 0.9153, D100 = 0.9037	
Average Sample Height, in	0.9152
Average Drainage Height, in	0.4576
T (Time Factor for T50)	0.197
Coef. of Consol., C_v, in^2/min	0.003

Load Summary

Initial Sample Height, in	0.9293
Initial Sample Void Ratio	0.5590
Final Sample Height, in	0.9011
Final Sample Void Ratio	0.5117
Incremental Strain, %	3.03%
Loading Duration, min	301.95

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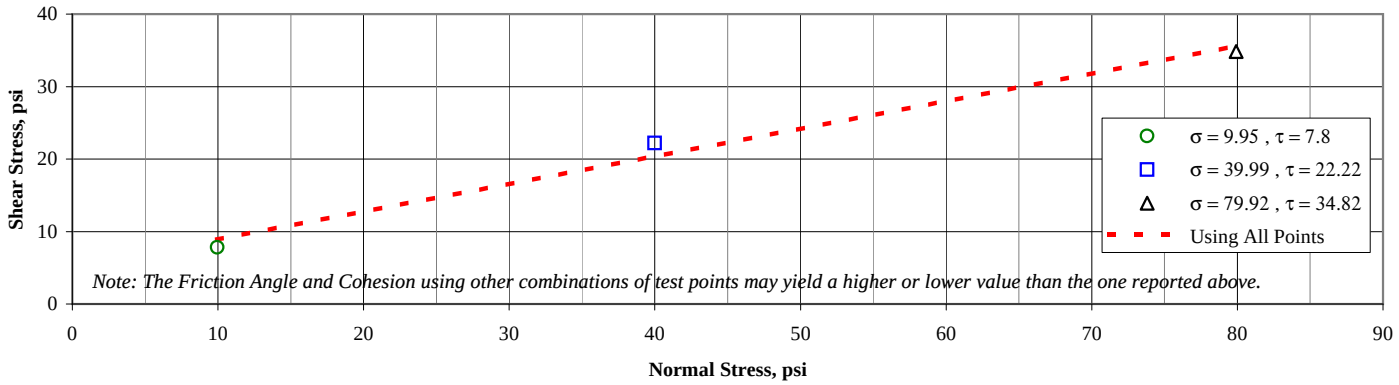
DIRECT SHEAR TEST OF SOILS UNDER CONSOLIDATED DRAINED CONDITIONS

Client	Civil & Environmental Consultants, Inc.	Boring	SB-16
Client Project	091-867 Apex Landfill Expansion	Depth	0.5'-2.5'
Project No.	30598	Sample	ST-1
		Lab No.	30598008

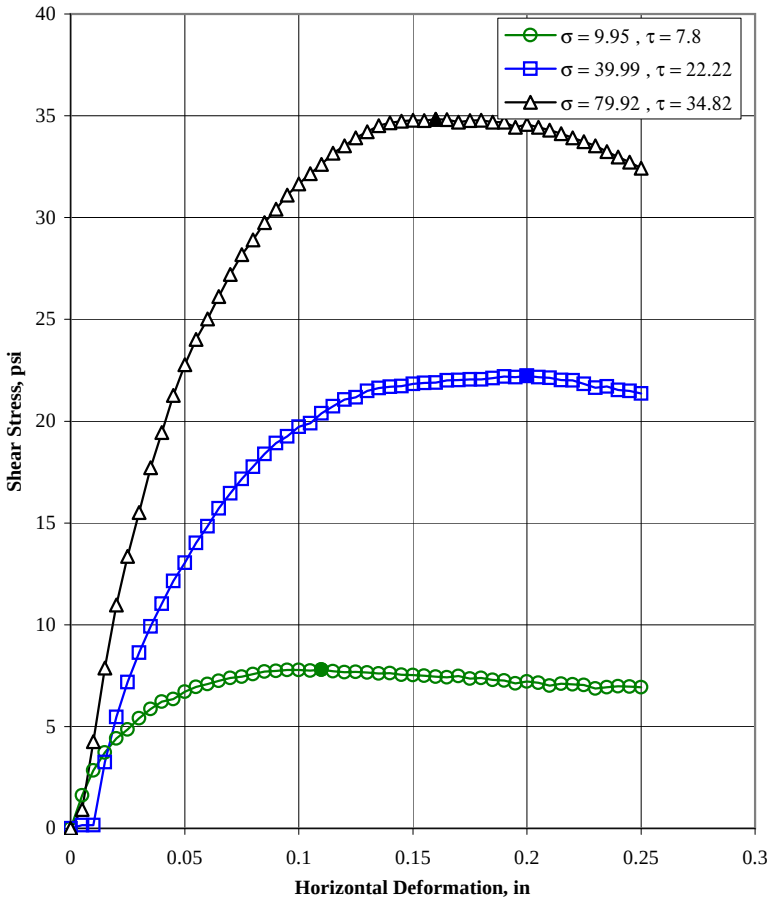
Visual Description	Light Olive Brown Fat Clay
Sample Condition	Undisturbed

NORMAL STRESS vs. SHEAR STRESS

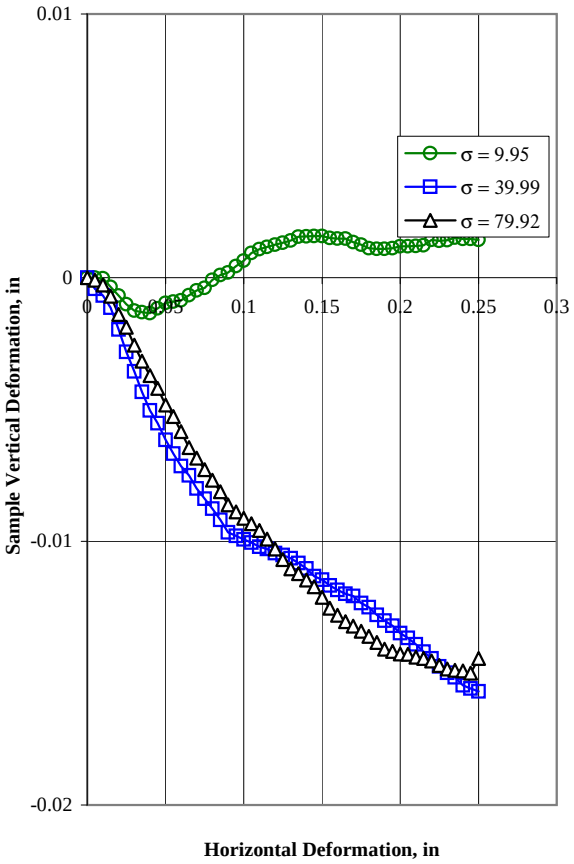
ϕ = 20.9° c = 5.1 psi



HORIZONTAL DEFORMATION vs. SHEAR STRESS



HORIZONTAL DEFORMATION vs. SAMPLE HEIGHT



Note: The calculations performed and the parameters presented herein are for preliminary purposes only. GTS only accepts responsibility for the raw data obtained from the direct shear tests. This data may be interpreted differently by others. It is the responsibility of the user to determine the appropriateness and accuracy of the computed values.

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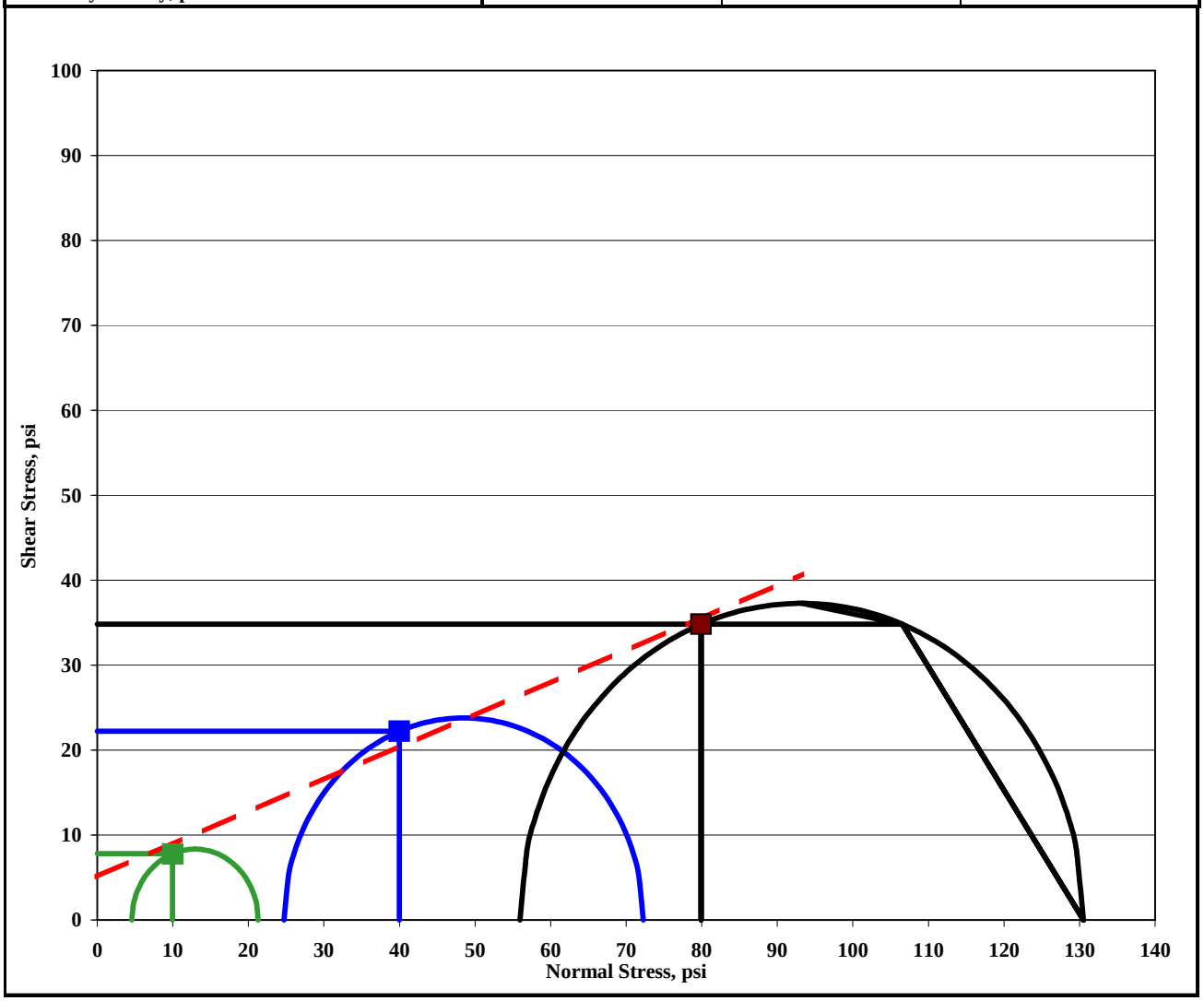
DIRECT SHEAR TEST OF SOILS
UNDER CONSOLIDATED, DRAINED CONDITIONS
MOHRS'S CIRCLE AND FAILURE PARAMETERS

Client:	Civil & Environmental Consultants, Inc.	Boring:	SB-16
Client Project	091-867 Apex Landfill Expansion	Depth:	0.5'-2.5'
Project No.	30598	Sample:	ST-1
		Lab Sample ID	30598008
Material:	Light Olive Brown Fat Clay		
Condition	Undisturbed		

Average Friction Angle, ϕ, deg.		**20.9**	**Using All Points**
Average Cohesion, c, psi		**5.1**	**Using All Points**
Sample Condition		Undisturbed	
Normal Stress, psi	9.95	39.99	79.92
Shear Stress at Failure, psi	7.80	22.22	34.82
Mohr's Circle Radius, psi	8.4	23.8	37.3
Mohr's Circle Origin, psi	12.9	48.5	93.2
(Origin - Normal Stress), psi	3.0	8.5	13.3
Minor Principal Stress σ3, psi	4.6	24.7	56.0
Major Principal Stress σ1, psi	21.3	72.3	130.5
Principal Stress Difference, σ1–σ3, psi	16.7	47.6	74.6
Normal Stress Pole Coordinate, X, psi	15.9	57.0	106.5
Shear Stress Pole Coordinate, Y, psi	7.8	22.2	34.8
Assumed Failure Plane, deg	0 - Horizontal	0 - Horizontal	0 - Horizontal
Major Principal Failure Plane Angle, deg	55.5	55.5	55.5
Minor Principal Failure Plane Angle, deg	34.5	34.5	34.5
Maximum Shear Stress, psi	8.4	23.8	37.3
Maximum Shear Failure Plane Angle, deg	10.5	10.5	10.5
Initial Water Content, %	**23.4%**	**23.4%**	**23.4%**
Initial Dry Density, pcf	**96.4**	**96.3**	**96.4**



DIRECT SHEAR TEST OF SOILS UNDER CONSOLIDATED DRAINED CONDITIONS - ASTM D 3080

Client	Civil & Environmental Consultant	Boring	SB-16
Client Project	091-867 Apex Landfill Expansion	Depth	0.5'-2.5'
Project No.	30598	Sample	ST-1
		Lab No.	30598008
Visual Description	Light Olive Brown Fat Clay		
Sample Condition	Undisturbed		

SAMPLE CONDITIONS

Test No.	1			2			3		
	Initial	**After Consol.**	**Final**	**Initial**	**After Consol.**	**Final**	**Initial**	**After Consol.**	**Final**
Tare I.D.	Z5	-	A30	Z5	-	Z7	Z5	-	E4
Wt. Wet Soil & Tare, gm	330.94	-	164.51	330.94	-	276.45	330.94	-	273.76
Wt. Dry Soil & Tare, gm	291.46	-	132.64	291.46	-	247.54	291.46	-	246.1
Wt. Tare, gm	123.02	-	9.1	123.02	-	122.96	123.02	-	122.92
Water Content, %	23.4%	-	25.8%	23.4%	-	23.2%	23.4%	-	22.5%
Wt. of Wet Soil & Mold, gr	304.31	-	-	304.24	-	-	305.36	-	-
Wt. of Mold, gm	150.95	-	-	150.94	-	-	151.98	-	-
Wt. of Wet Soil, gm	153.36	-	-	153.3	-	-	153.38	-	-
Sample Height, in	1	0.9708	0.9722	1	0.9343	0.9186	1	0.8884	0.8740
Sample Diameter, in	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5
Sample Area, in^2	4.9	4.9	4.9	4.9	4.9	4.9	4.9	4.9	4.9
Sample Volume, cc	80.44	78.09	78.20	80.44	75.16	73.89	80.44	71.47	70.30
Wet Density, pcf	119.0	NA	124.7	118.9	NA	129.2	119.0	NA	135.0
Dry Density, pcf	96.4	NA	99.1	96.3	NA	104.9	96.4	NA	110.3

DEFORMATION RATE CALCULATIONS

	1	2	3
t_{90}, min. (Sqrt. Method)	0.33	0.35	0.41
Equivalent t_{50}, min. (Sqrt.)	0.08	0.08	0.10
t_{50}, min. (Log Method)	0.25	0.11	0.40
Selected t_{50}, min. (Max.)	0.25	0.11	0.40
Calc. Disp. Rate, in./min.	0.0088	0.0364	0.0080

TEST DATA AND SUMMARY

Test No.	1		2		3	
Normal Stress, psi	**9.96**		**40.00**		**79.92**	
Shear Stress at Failure, psi	**7.8**	**Peak**	**22.2**	**Peak**	**34.8**	**Peak**
Shear Disp. at Failure, in	**0.110**		**0.200**		**0.160**	
Displacement Rate, in/min	**0.0020**		**0.0020**		**0.0020**	

Horizontal Displacement in	Shear Force lb.	Shear Stress psi	Vertical Deformation in	Shear Force lb.	Shear Stress psi	Vertical Deformation in	Shear Force lb.	Shear Stress psi	Vertical Deformation in
0	0.0	0.0	0.000	0.0	0.0	0.000	0.0	0.0	0.000
0.005	7.9	1.6	0.000	0.8	0.2	0.000	4.6	0.9	0.000
0.010	13.9	2.8	0.000	0.8	0.2	-0.001	20.9	4.3	0.000
0.015	18.3	3.7	0.000	15.9	3.2	-0.001	38.7	7.9	-0.001
0.020	21.7	4.4	-0.001	26.8	5.5	-0.002	53.8	11.0	-0.001
0.025	23.9	4.9	-0.001	35.2	7.2	-0.003	65.6	13.4	-0.002
0.030	26.6	5.4	-0.001	42.3	8.6	-0.004	76.1	15.5	-0.003
0.035	28.8	5.9	-0.001	48.7	9.9	-0.004	86.9	17.7	-0.003
0.040	30.5	6.2	-0.001	54.2	11.0	-0.005	95.4	19.4	-0.004
0.045	31.2	6.3	-0.001	59.6	12.1	-0.006	104.4	21.3	-0.004
0.050	33.0	6.7	-0.001	64.1	13.0	-0.006	111.8	22.8	-0.005
0.055	34.1	6.9	-0.001	68.8	14.0	-0.007	117.9	24.0	-0.005
0.060	34.8	7.1	-0.001	72.8	14.8	-0.007	122.9	25.0	-0.006
0.065	35.6	7.2	-0.001	77.1	15.7	-0.008	128.2	26.1	-0.006
0.070	36.2	7.4	0.000	80.8	16.5	-0.008	133.6	27.2	-0.007

Horizontal Displacement in	Shear Force lb.	Shear Stress psi	Vertical Deformation in	Shear Force lb.	Shear Stress psi	Vertical Deformation in	Shear Force lb.	Shear Stress psi	Vertical Deformation in
0.075	36.5	7.4	0.000	84.2	17.2	-0.008	138.3	28.2	-0.007
0.080	37.2	7.6	0.000	87.2	17.8	-0.009	141.9	28.9	-0.008
0.085	37.8	7.7	0.000	90.2	18.4	-0.009	146.1	29.8	-0.008
0.090	37.9	7.7	0.000	92.9	18.9	-0.010	149.3	30.4	-0.009
0.095	38.2	7.8	0.000	94.5	19.2	-0.010	152.6	31.1	-0.009
0.100	38.2	7.8	0.001	96.8	19.7	-0.010	155.4	31.7	-0.009
0.105	38.1	7.8	0.001	97.7	19.9	-0.010	157.9	32.2	-0.009
0.110	38.3	7.8	0.001	100.1	20.4	-0.010	160.1	32.6	-0.010
0.115	37.9	7.7	0.001	101.8	20.7	-0.010	162.8	33.2	-0.010
0.120	37.7	7.7	0.001	103.4	21.1	-0.010	164.6	33.5	-0.010
0.125	37.7	7.7	0.001	103.9	21.2	-0.011	166.5	33.9	-0.011
0.130	37.6	7.7	0.001	105.5	21.5	-0.011	167.9	34.2	-0.011
0.135	37.3	7.6	0.002	106.1	21.6	-0.011	169.4	34.5	-0.011
0.140	37.4	7.6	0.002	106.5	21.7	-0.011	170.1	34.7	-0.011
0.145	37.0	7.5	0.002	106.6	21.7	-0.011	170.5	34.7	-0.012
0.150	36.9	7.5	0.002	107.2	21.8	-0.011	170.8	34.8	-0.012
0.155	36.8	7.5	0.001	107.4	21.9	-0.012	170.7	34.8	-0.013
0.160	36.6	7.5	0.001	107.5	21.9	-0.012	171.0	34.8	-0.013
0.165	36.4	7.4	0.001	108.0	22.0	-0.012	170.9	34.8	-0.013
0.170	36.8	7.5	0.001	108.1	22.0	-0.012	170.3	34.7	-0.013
0.175	36.1	7.4	0.001	108.3	22.1	-0.012	170.7	34.8	-0.013
0.180	36.2	7.4	0.001	108.2	22.1	-0.013	170.7	34.8	-0.014
0.185	35.8	7.3	0.001	108.5	22.1	-0.013	170.3	34.7	-0.014
0.190	35.6	7.3	0.001	109.0	22.2	-0.013	170.3	34.7	-0.014
0.195	34.9	7.1	0.001	108.8	22.2	-0.013	169.1	34.4	-0.014
0.200	35.4	7.2	0.001	109.1	22.2	-0.013	169.7	34.6	-0.014
0.205	35.1	7.1	0.001	108.8	22.2	-0.014	169.1	34.4	-0.014
0.210	34.4	7.0	0.001	108.6	22.1	-0.014	168.4	34.3	-0.014
0.215	34.9	7.1	0.001	108.1	22.0	-0.014	167.5	34.1	-0.014
0.220	34.7	7.1	0.001	108.0	22.0	-0.014	166.5	33.9	-0.015
0.225	34.6	7.0	0.001	107.1	21.8	-0.015	165.6	33.7	-0.015
0.230	33.7	6.9	0.001	106.3	21.6	-0.015	164.5	33.5	-0.015
0.235	34.0	6.9	0.002	106.6	21.7	-0.015	163.2	33.2	-0.015
0.240	34.3	7.0	0.001	105.7	21.5	-0.015	161.8	33.0	-0.015
0.245	34.2	7.0	0.001	105.5	21.5	-0.016	160.6	32.7	-0.015
0.250	34.0	6.9	0.001	104.9	21.4	-0.016	159.2	32.4	-0.014

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ONE DIMENSIONAL CONSOLIDATION TEST

Client	Civil & Environmental Consultant	Boring	SB-16	**Final Test Load, psi**	**9.96**
Client Project	091-867 Apex Landfill Expansion	Depth	0.5'-2.5'		
Project No.	30598	Sample	ST-1		
		Lab ID#	30598008		
Description	Light Olive Brown Fat Clay				
Test Conditions:	Undisturbed				

Increment Start Date and Time: 02/06/11

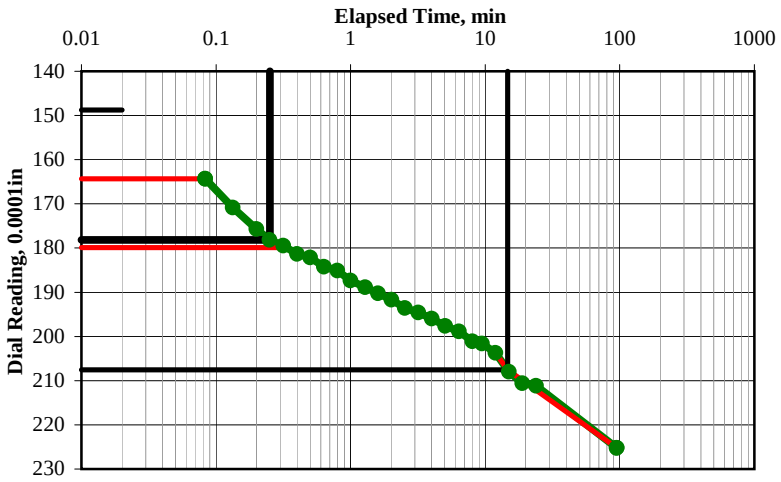
Elapsed Time (min)	Sqrt Time ($min^{1/2}$)	Dial Reading (0.0001in)	Sample Height (in)
0	0	0	1.0000
Corrections*		67	0.0067
Adjusted Sample Height			
0.08	0.29	164.3	0.9903
0.13	0.37	170.8	0.9896
0.20	0.45	175.7	0.9891
0.25	0.50	178.1	0.9889
0.32	0.56	179.5	0.9888
0.40	0.63	181.3	0.9886
0.50	0.71	182.1	0.9885
0.63	0.80	184.3	0.9883
0.80	0.89	185.1	0.9882
1.00	1.00	187.3	0.9880
1.28	1.13	188.9	0.9878
1.60	1.26	190.2	0.9877
2.02	1.42	191.7	0.9875
2.53	1.59	193.6	0.9873
3.18	1.78	194.6	0.9872
4.02	2.00	196.0	0.9871
5.05	2.25	197.7	0.9869
6.38	2.53	198.9	0.9868
8.03	2.83	201.1	0.9866
9.48	3.08	201.6	0.9865
11.93	3.45	203.7	0.9863
15.03	3.88	208.0	0.9859
18.93	4.35	210.6	0.9856
23.85	4.88	211.2	0.9856
95.05	9.75	225.2	0.9708

Machine Deflection

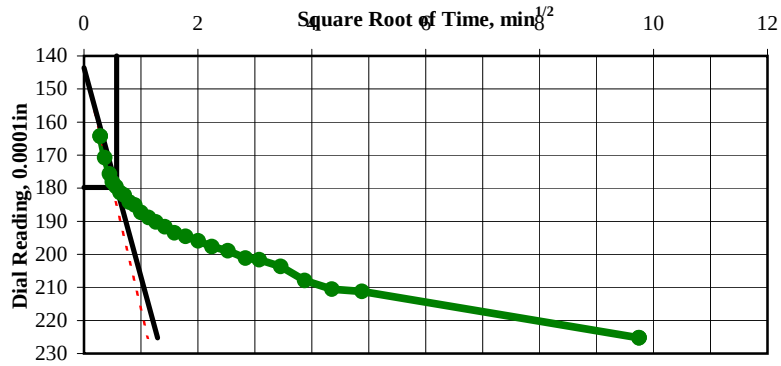
Applied Deflection Correction to Sample Height, 0.0001in: 67

**Correction is applied to all dial readings.*

Log of Elapsed Time vs. Dial Reading



Square Root of Elapsed Time vs. Dial Reading



Sqrt. of Elapsed Time vs Dial Reading

T0 = 0 min.	D0 = 143.5 div.		
T90 = 0.325 min	D90 = 179.8 div.		
T100 = NA min	D100 = 183.8 div.		
Height at: D90 = 0.9753, D100 = 0.9749			
Average Sample Height, in	0.9854		
Average Drainage Height, in	0.4927		
T (Time Factor for T90)	0.848		
Coef. of Consol., C_v, in^2/min	0.626		

Log of Elapsed Time vs Dial Reading

T0 = 0 min.	D0 = 148.8 div.		
T50 = 0.25 min.	D50 = 178.2 div.		
T100 = 14.7 min.	D100 = 207.6 div.		
Height at: D50 = 0.9755, D100 = 0.9725			
Average Sample Height, in	0.9854		
Average Drainage Height, in	0.4927		
T (Time Factor for T50)	0.197		
Coef. of Consol., C_v, in^2/min	0.191		

Load Summary

Initial Sample Height, in	1.0000
Final Sample Height, in	0.9708
Incremental Strain, %	2.92%
Loading Duration, min	95

Input Validation: Reviewed By: Date 2/6/2011

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ONE DIMENSIONAL CONSOLIDATION TEST

Client	Civil & Environmental Consultant	Boring	SB-16	**Final Test Load, psi**	**40.00**
Client Project	091-867 Apex Landfill Expansion	Depth	0.5'-2.5'		
Project No.	30598	Sample	ST-1		
		Lab ID#	30598008		
Description	Light Olive Brown Fat Clay				
Test Conditions:	Undisturbed				

Increment Start Date: 02/07/11

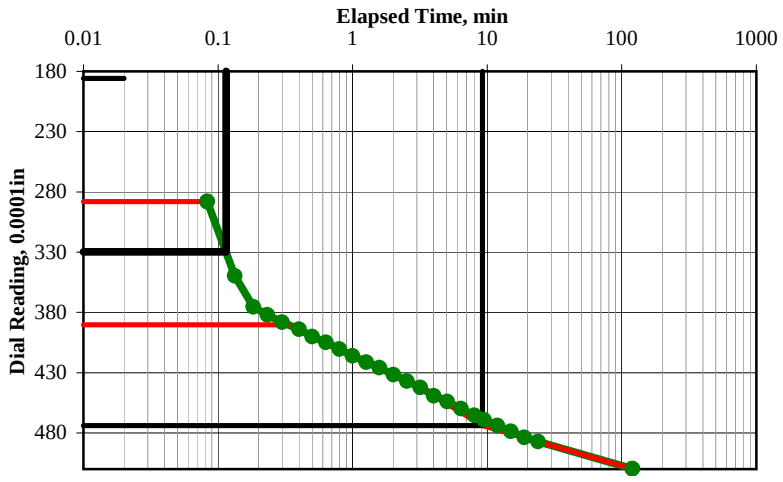
Elapsed Time (min)	Sqrt Time ($min^{1/2}$)	Dial Reading (0.0001in)	Sample Height (in)
0	0	0	1.0000
Corrections*		147	0.0147
Adjusted Sample Height			
0.08	0.29	288.1	0.9859
0.13	0.37	349.6	0.9797
0.18	0.43	375.3	0.9772
0.23	0.48	382.0	0.9765
0.30	0.55	388.1	0.9759
0.40	0.63	394.0	0.9753
0.50	0.71	400.0	0.9747
0.63	0.80	404.7	0.9742
0.80	0.89	410.4	0.9737
1.00	1.00	415.9	0.9731
1.27	1.13	421.3	0.9726
1.58	1.26	425.9	0.9721
2.02	1.42	431.8	0.9715
2.53	1.59	437.0	0.9710
3.18	1.78	442.2	0.9705
4.02	2.00	449.1	0.9698
5.05	2.25	453.9	0.9693
6.38	2.53	459.8	0.9687
8.03	2.83	465.3	0.9682
9.48	3.08	469.1	0.9678
11.93	3.45	473.8	0.9673
15.03	3.88	478.6	0.9668
18.93	4.35	483.8	0.9663
23.85	4.88	487.2	0.9660
120.05	10.96	509.7	0.9343

Machine Deflection

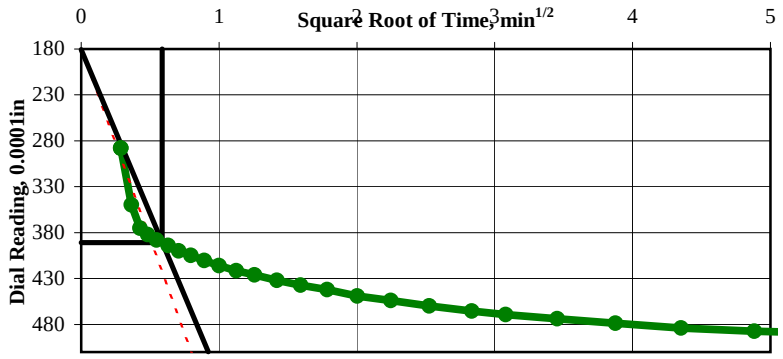
Applied Deflection Correction to Sample Height, 0.0001in 147

**Correction is applied to all dial readings.*

Log of Elapsed Time vs. Dial Reading



Square Root of Elapsed Time vs. Dial Reading



Sqrt. of Elapsed Time vs Dial Reading

T0 = 0 min.	D0 = 180.8 div.		
T90 = 0.348 min	D90 = 390.9 div.		
T100 = NA min	D100 = 414.3 div.		
Height at: D90 = 0.9462, D100 = 0.9439			
Average Sample Height, in	0.9672		
Average Drainage Height, in	0.4836		
T (Time Factor for T90)	0.848		
Coef. of Consol., C_v, in^2/min	0.573		

Log of Elapsed Time vs Dial Reading

T0 = 0 min.	D0 = 185.9 div.		
T50 = 0.11 min.	D50 = 329.9 div.		
T100 = 9.22 min.	D100 = 473.8 div.		
Height at: D50 = 0.9523, D100 = 0.9379			
Average Sample Height, in	0.9672		
Average Drainage Height, in	0.4836		
T (Time Factor for T50)	0.197		
Coef. of Consol., C_v, in^2/min	0.419		

Load Summary

Initial Sample Height, in	1.0000
Final Sample Height, in	0.9343
Incremental Strain, %	6.57%
Loading Duration, min	120

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ONE DIMENSIONAL CONSOLIDATION TEST

Client	Civil & Environmental Consultant	Boring	SB-16	**Final Test Load, psi**	**79.92**
Client Project	091-867 Apex Landfill Expansion	Depth	0.5'-2.5'		
Project No.	30598	Sample	ST-1		
		Lab ID#	30598008		
Description	Light Olive Brown Fat Clay				
Test Conditions:	Undisturbed				

Increment Start Date: 02/06/11

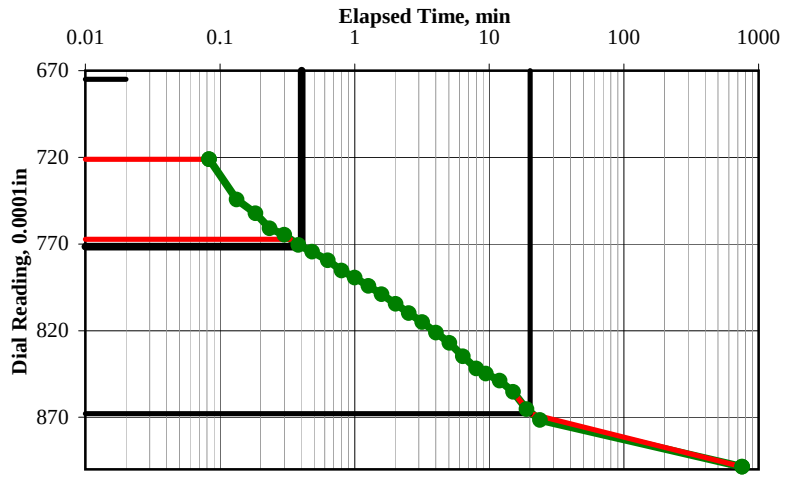
Elapsed Time (min)	Sqrt Time ($min^{1/2}$)	Dial Reading (0.0001in)	Sample Height (in)
0	0	0	1.0000
Corrections*		217	0.0217
Adjusted Sample Height			
0.08	0.29	721.1	0.9496
0.13	0.37	744.4	0.9473
0.18	0.43	752.3	0.9465
0.23	0.48	761.1	0.9456
0.30	0.55	764.7	0.9452
0.38	0.62	770.5	0.9446
0.48	0.70	774.5	0.9442
0.63	0.80	779.5	0.9437
0.80	0.89	785.4	0.9432
1.00	1.00	789.4	0.9428
1.27	1.13	794.2	0.9423
1.58	1.26	799.1	0.9418
2.02	1.42	804.6	0.9412
2.53	1.59	809.9	0.9407
3.18	1.78	815.1	0.9402
4.02	2.00	821.1	0.9396
5.05	2.25	827.0	0.9390
6.37	2.52	834.8	0.9382
8.02	2.83	841.8	0.9375
9.47	3.08	844.8	0.9372
11.93	3.45	848.9	0.9368
15.03	3.88	855.4	0.9362
18.93	4.35	865.3	0.9352
23.85	4.88	871.5	0.9345
758.07	27.53	898.6	0.8884

Machine Deflection

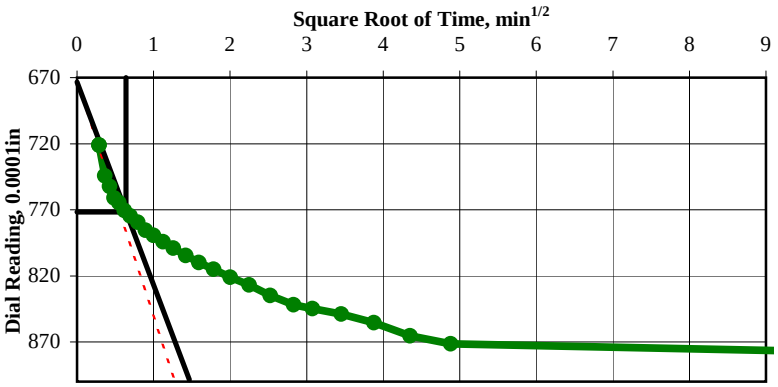
Applied Deflection Correction to Sample Height, 0.0001in 217

**Correction is applied to all dial readings.*

Log of Elapsed Time vs. Dial Reading



Square Root of Elapsed Time vs. Dial Reading



Sqrt. of Elapsed Time vs Dial Reading		Log of Elapsed Time vs Dial Reading		Load Summary	
T0 = 0 min.	D0 = 673.5 div.	T0 = 0 min.	D0 = 675 div.		
T90 = 0.41 min	D90 = 771.6 div.	T50 = 0.4 min.	D50 = 771.4 div.	Initial Sample Height, in	1.0000
T100 = NA min	D100 = 782.5 div.	T100 = 20.1 min.	D100 = 867.9 div.		
Height at: D90 = 0.9011, D100 = 0.9001		Height at: D50 = 0.9012, D100 = 0.8915		Final Sample Height, in	0.8884
Average Sample Height, in	0.9442	Average Sample Height, in	0.9442		
Average Drainage Height, in	0.4721	Average Drainage Height, in	0.4721	Incremental Strain, %	11.16%
T (Time Factor for T90)	0.848	T (Time Factor for T50)	0.197	Loading Duration, min	758
Coef. of Consol., C_v, in^2/min	0.462	Coef. of Consol., C_v, in^2/min	0.110		

Input Validation: Reviewed By: Date 2/6/2011

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ONE-DIMENSIONAL CONSOLIDATION PROPERTIES OF SOILS
ASTM D 2435

Client	Civil & Environmental Consultant	Boring	SB-17
Client Project	091-867 Apex Landfill Expansion	Depth	16'-18'
Project No.	30598	Sample	ST-1
		Lab Sample No.	30598009

Visual Description: Gray Clayey Sand
Sample Conditions: Undisturbed, Inundated, and Double Drained
Machine Deflection Correction: Applied

SAMPLE PROPERTIES		
	Initial	Final
Tare Number	A45	A33
Wt. Tare & WS, gm	114.76	168.62
Wt. Tare & DS, gm	99.5	147.41
Wt. Tare, gm	9.08	9.74
Water Content, %	16.9%	15.4%
Sample Diameter, in	2.5	2.5
Sample Height, in	1.007	0.8918
Sample Volume, in^3	4.9413	4.3778
Wt. WS + Ring, gm	271.29	270.71
Wt. of Ring, gm	110.92	110.92
Wt. of WS, gm	160.37	159.79
Wet Density, pcf	123.59	138.99
Wet Density, g/cc	1.981	2.227
Water Content, %	16.9%	15.4%
Wt. of DS, gm	137.21	138.46
Dry Density, pcf	105.74	120.43
Dry Density, g/cc	1.695	1.930
Void Ratio, e	0.5933	0.3989
Saturation, %	76.8%	
Specific Gravity	2.7	Measured
Height of Solids, in	0.6318	0.6318

TEST DATA SUMMARY

Applied Pressure tsf	Load Duration min	Final Height in	Vertical Strain %	Dry Density g/cc	Void Ratio e	a_v ft^2/ton	Incremental C_c	Incremental C_r
Seating	NA	1.0066	0.00	1.6946	0.5933	NA	NA	NA
0.25	120	1.0065	0.01%	1.6947	0.5932	6.66E-04	NA	NA
0.5	478	1.0041	0.25%	1.6988	0.5894	1.53E-02	0.013	NA
1	302	0.9966	1.00%	1.7116	0.5775	2.38E-02	0.040	NA
2	1,514	0.9755	3.09%	1.7486	0.5441	3.33E-02	0.111	NA
4	151	0.9475	5.87%	1.8002	0.4998	2.22E-02	0.147	NA
1	151	0.9513	5.50%	1.7931	0.5058	1.98E-03	NA	NA
0.25	120	0.9580	4.83%	1.7805	0.5164	1.42E-02	NA	NA
0.5	95	0.9572	4.91%	1.7820	0.5151	5.07E-03	NA	0.004
1	95	0.9554	5.09%	1.7855	0.5122	5.83E-03	NA	0.010
2	190	0.9512	5.50%	1.7932	0.5057	6.56E-03	NA	0.022
4	151	0.9427	6.35%	1.8094	0.4922	6.71E-03	NA	0.045
8	758	0.9181	8.79%	1.8579	0.4532	9.75E-03	0.130	NA
16	190	0.8918	11.40%	1.9127	0.4116	5.20E-03	0.138	NA

Note: The calculations performed and the parameters presented herein are for preliminary purposes only. GTS only accepts responsibility for the raw data obtained from the consolidation tests. This data may be interpreted differently by others. It is the responsibility of the user to determine the appropriateness and accuracy of the computed values.

Input Validation | Reviewed By: | Date Tested: 12/3/2010 |

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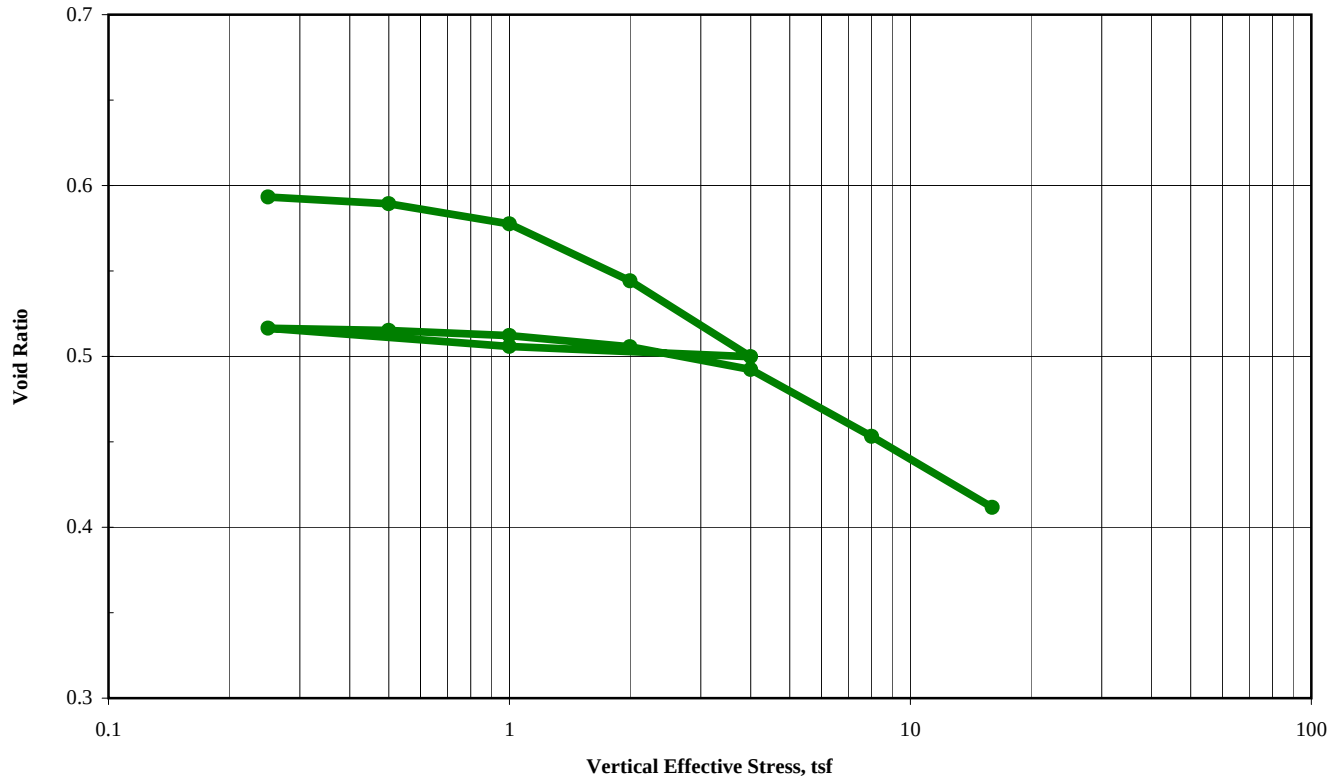
ONE-DIMENSIONAL CONSOLIDATION PROPERTIES OF SOILS
ASTM D 2435

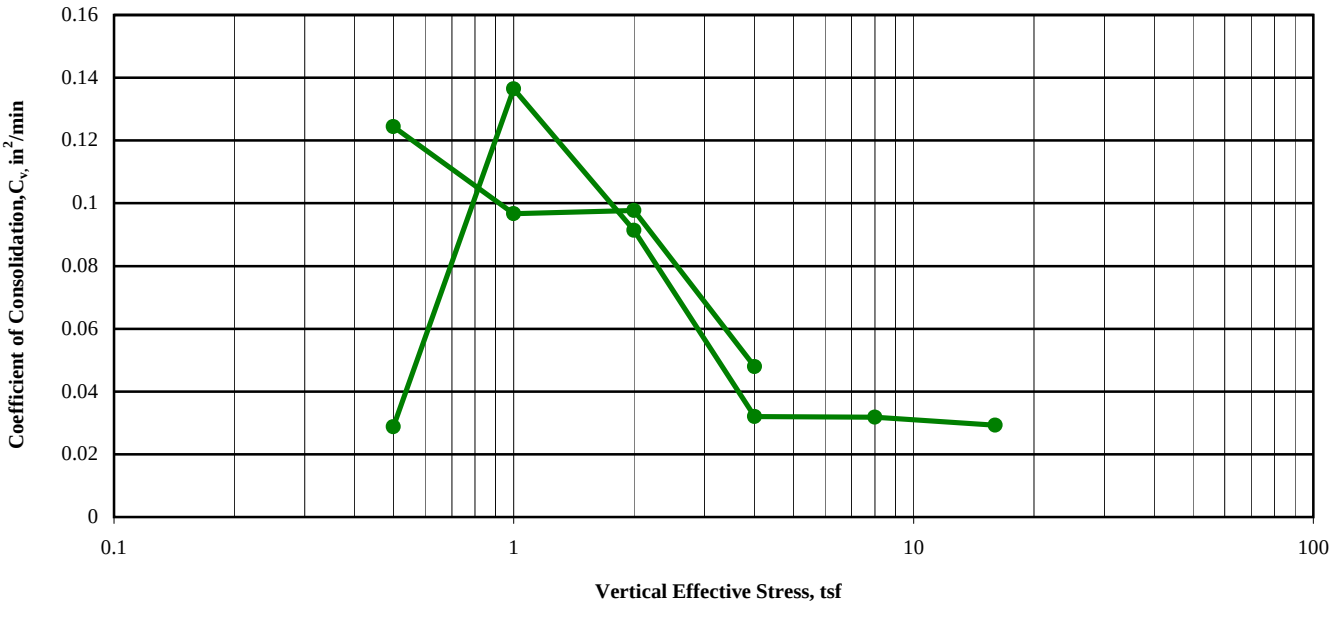
Client	Civil & Environmental Consultants, Inc.	Boring	SB-17
Client Project	091-867 Apex Landfill Expansion	Depth	16'-18'
Project No.	30598	Sample	ST-1
		Lab Sample No.	30598009

Visual Description: Gray Clayey Sand
Sample Conditions: Undisturbed, Inundated, and Double Drained
Machine Deflection Correction: Applied

Void Ratio (Final Height) vs Vertical Effective Consolidation Stress



Coeffieicent of Consolidation (log. method) vs. Vertical Effective Consolidation Stress



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ONE-DIMENSIONAL CONSOLIDATION PROPERTIES OF SOILS
ASTM D 2435

Client	Civil & Environmental Consultant	Boring	SB-17	**Test Load, tsf**	**0-0.25**
Client Project	091-867 Apex Landfill Expansion	Depth	16'-18'		Load 1 of 13
Project No.	30598	Sample	ST-1		
		Lab ID#	30598009		

Visual Description: Gray Clayey Sand
Test Conditions: Undisturbed, Inundated, and Double Drained

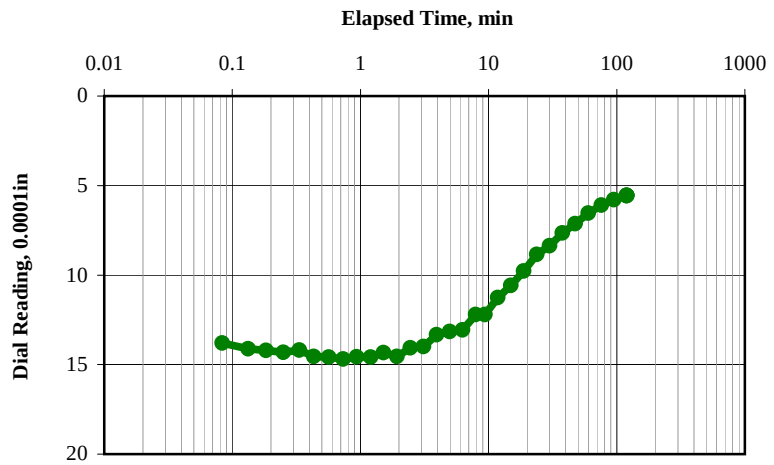
Time Vs. Dial Reading

Elapsed Time (min)	Sqrt Time ($min^{1/2}$)	Dial Reading (0.0001in)	Sample Height (in)	Void Ratio
0	0	0	1.0066	0.5933
Corrections*		-4.5	-0.00045	-0.0007
Adjusted Sample Height & Void Ratio				
0.08	0.29	13.8	1.0057	0.5919
0.13	0.37	14.1	1.0057	0.5918
0.18	0.43	14.2	1.0057	0.5918
0.25	0.50	14.3	1.0056	0.5918
0.33	0.58	14.2	1.0057	0.5918
0.43	0.66	14.5	1.0056	0.5917
0.57	0.75	14.6	1.0056	0.5917
0.73	0.86	14.7	1.0056	0.5917
0.93	0.97	14.6	1.0056	0.5917
1.20	1.10	14.6	1.0056	0.5917
1.52	1.23	14.3	1.0056	0.5918
1.93	1.39	14.5	1.0056	0.5917
2.45	1.57	14.1	1.0057	0.5918
3.10	1.76	14.0	1.0057	0.5918
3.93	1.98	13.3	1.0057	0.5919
4.97	2.23	13.1	1.0058	0.5920
6.28	2.51	13.1	1.0058	0.5920
7.93	2.82	12.2	1.0059	0.5921
9.38	3.06	12.2	1.0059	0.5921
11.83	3.44	11.3	1.0059	0.5923
14.93	3.86	10.6	1.0060	0.5924
18.83	4.34	9.8	1.0061	0.5925
23.75	4.87	8.8	1.0062	0.5926
29.93	5.47	8.4	1.0062	0.5927
37.73	6.14	7.7	1.0063	0.5928
47.55	6.90	7.1	1.0064	0.5929
59.93	7.74	6.5	1.0064	0.5930
75.93	8.71	6.1	1.0065	0.5931
94.93	9.74	5.8	1.0065	0.5931
119.93	10.95	5.6	1.0065	0.5932

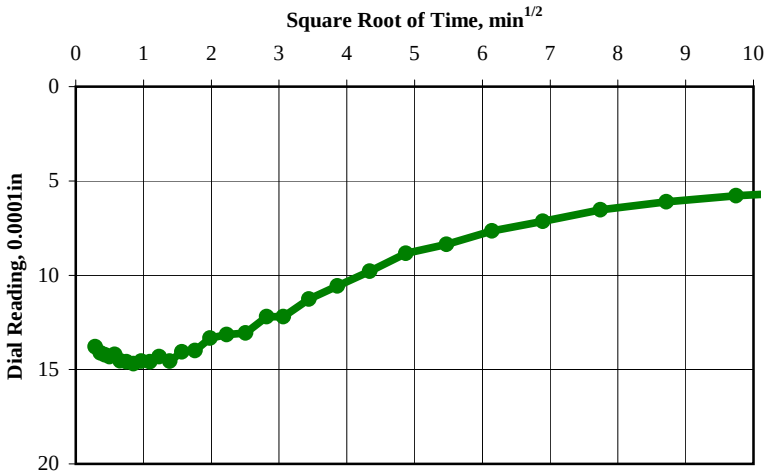
Machine Deflection

Applied Deflection Correction to Sample Height, 0.0001in -4.5
**Correction is applied to all dial readings.*

Log of Elapsed Time vs. Dial Reading



Square Root of Elapsed Time vs. Dial Reading



Sqrt. of Elapsed Time vs Dial Reading

Log of Elapsed Time vs Dial Reading

Specimen Swelled

Load Summary

Initial Sample Height, in	1.0066
Initial Sample Void Ratio	0.5933
Final Sample Height, in	1.0065
Final Sample Void Ratio	0.5932
Incremental Strain, %	0.01%
Loading Duration, min	119.93333

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ONE-DIMENSIONAL CONSOLIDATION PROPERTIES OF SOILS
ASTM D 2435

Client	Civil & Environmental Consultant	Boring	SB-17	**Test Load, tsf**	**0.25-0.5**
Client Project	091-867 Apex Landfill Expansion	Depth	16'-18'		Load 2 of 13
Project No.	30598	Sample	ST-1		
		Lab ID#	30598009		

Visual Description: Gray Clayey Sand
Test Conditions: Undisturbed, Inundated, and Double Drained

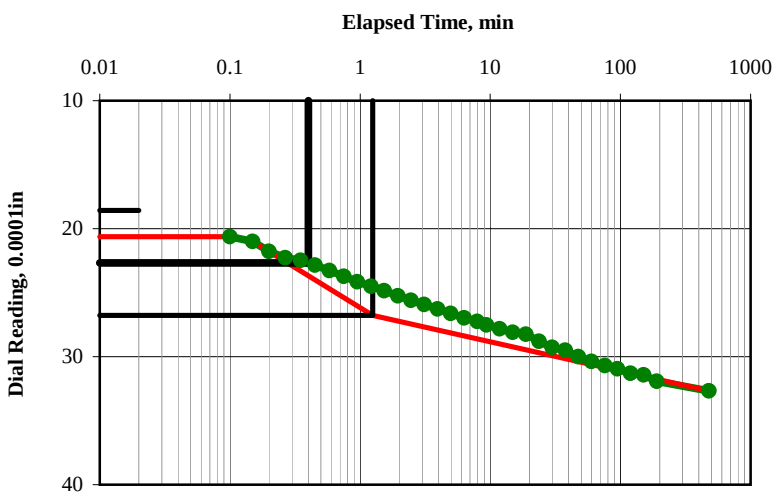
Time Vs. Dial Reading

Elapsed Time (min)	Sqrt Time ($min^{1/2}$)	Dial Reading (0.0001in)	Sample Height (in)	Void Ratio
0	0	5.6	1.0065	0.5932
Corrections*		-3	-0.0003	-0.0005
Adjusted Sample Height & Void Ratio				
0.10	0.32	20.6	1.0053	0.5913
0.15	0.39	21.0	1.0053	0.5912
0.20	0.45	21.8	1.0052	0.5911
0.27	0.52	22.3	1.0051	0.5910
0.35	0.59	22.5	1.0051	0.5910
0.45	0.67	22.8	1.0051	0.5909
0.58	0.76	23.3	1.0050	0.5908
0.75	0.87	23.7	1.0050	0.5908
0.95	0.97	24.2	1.0050	0.5907
1.22	1.10	24.5	1.0049	0.5906
1.53	1.24	24.8	1.0049	0.5906
1.95	1.40	25.3	1.0048	0.5905
2.47	1.57	25.6	1.0048	0.5905
3.12	1.77	25.9	1.0048	0.5904
3.95	1.99	26.3	1.0047	0.5904
4.98	2.23	26.6	1.0047	0.5903
6.30	2.51	27.0	1.0047	0.5903
7.95	2.82	27.2	1.0047	0.5902
9.40	3.07	27.5	1.0046	0.5902
11.85	3.44	27.8	1.0046	0.5901
14.95	3.87	28.1	1.0046	0.5901
18.85	4.34	28.3	1.0045	0.5901
23.77	4.88	28.8	1.0045	0.5900
29.95	5.47	29.3	1.0044	0.5899
37.75	6.14	29.5	1.0044	0.5899
47.57	6.90	30.0	1.0044	0.5898
59.95	7.74	30.4	1.0043	0.5897
75.95	8.71	30.7	1.0043	0.5897
94.95	9.74	31.0	1.0043	0.5896
119.95	10.95	31.3	1.0042	0.5896
150.95	12.29	31.4	1.0042	0.5895
189.95	13.78	31.9	1.0042	0.5895
477.95	21.86	32.7	1.0041	0.5894

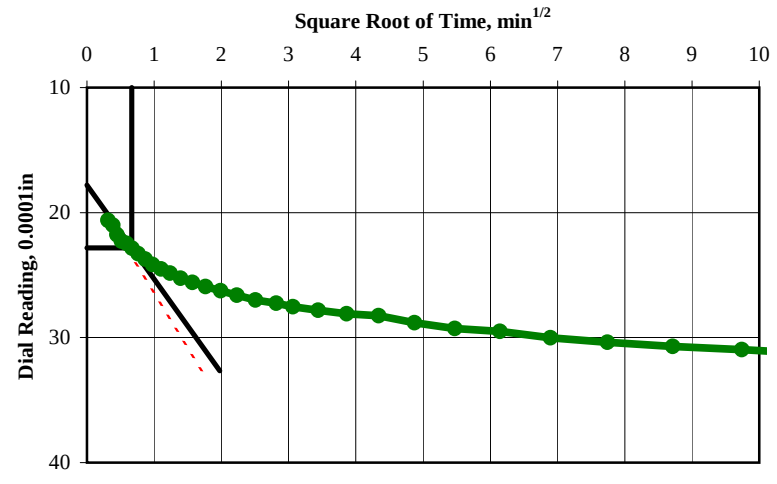
Machine Deflection

Applied Deflection Correction to Sample Height, 0.0001in: -3
**Correction is applied to all dial readings.*

Log of Elapsed Time vs. Dial Reading



Square Root of Elapsed Time vs. Dial Reading



Sqrt. of Elapsed Time vs Dial Reading

T0 = 0 min.	D0 = 17.8 div.		
T90 = 0.436 min	D90 = 22.8 div.		
T100 = NA min	D100 = 23.4 div.		
Height at: D90 = 1.0051, D100 = 1.005			
Average Sample Height, in	1.0053		
Average Drainage Height, in	0.5027		
T (Time Factor for T90)	0.848		
Coef. of Consol., C_v, in^2/min	0.486		

Log of Elapsed Time vs Dial Reading

T0 = 0 min.	D0 = 18.6 div.		
T50 = 0.4 min.	D50 = 22.7 div.		
T100 = 1.25 min.	D100 = 26.8 div.		
Height at: D50 = 1.0051, D100 = 1.0047			
Average Sample Height, in	1.0053		
Average Drainage Height, in	0.5027		
T (Time Factor for T50)	0.197		
Coef. of Consol., C_v, in^2/min	0.124		

Load Summary

Initial Sample Height, in	1.0065
Initial Sample Void Ratio	0.5932
Final Sample Height, in	1.0041
Final Sample Void Ratio	0.5894
Incremental Strain, %	0.24%
Loading Duration, min	477.95

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ONE-DIMENSIONAL CONSOLIDATION PROPERTIES OF SOILS
ASTM D 2435

Client	Civil & Environmental Consultant	Boring	SB-17	**Test Load, tsf**	**0.5-1**
Client Project	091-867 Apex Landfill Expansion	Depth	16'-18'		Load 3 of 13
Project No.	30598	Sample	ST-1		
		Lab ID#	30598009		

Visual Description: Gray Clayey Sand
Test Conditions: Undisturbed, Inundated, and Double Drained

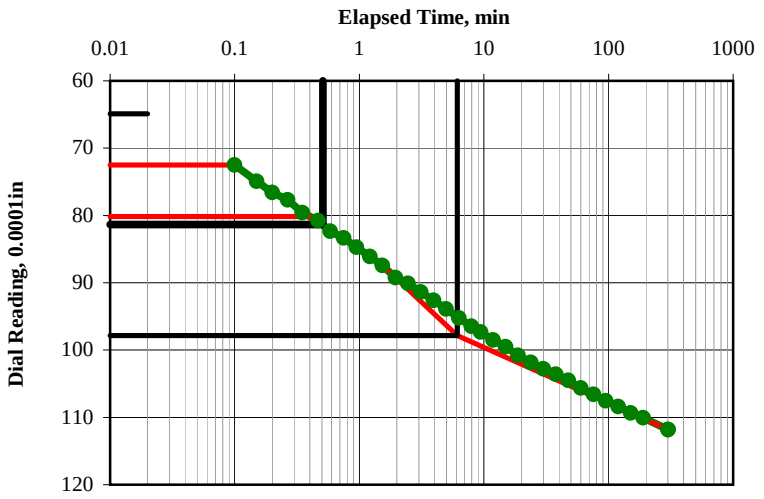
Time Vs. Dial Reading

Elapsed Time (min)	Sqrt Time ($min^{1/2}$)	Dial Reading (0.0001in)	Sample Height (in)	Void Ratio
0	0	32.7	1.0041	0.5894
Corrections*		-4	-0.0004	-0.0006
Adjusted Sample Height & Void Ratio				
0.10	0.32	72.5	1.0005	0.5837
0.15	0.39	75.0	1.0003	0.5833
0.20	0.45	76.6	1.0001	0.5830
0.27	0.52	77.7	1.0000	0.5829
0.35	0.59	79.6	0.9998	0.5826
0.47	0.68	80.8	0.9997	0.5824
0.58	0.76	82.3	0.9995	0.5821
0.75	0.87	83.4	0.9994	0.5820
0.95	0.97	84.7	0.9993	0.5817
1.22	1.10	86.1	0.9992	0.5815
1.53	1.24	87.4	0.9990	0.5813
1.95	1.40	89.2	0.9989	0.5810
2.47	1.57	90.1	0.9988	0.5809
3.12	1.77	91.4	0.9986	0.5807
3.95	1.99	92.6	0.9985	0.5805
4.98	2.23	93.9	0.9984	0.5803
6.30	2.51	95.2	0.9983	0.5801
7.95	2.82	96.4	0.9981	0.5799
9.40	3.07	97.3	0.9980	0.5798
11.85	3.44	98.5	0.9979	0.5796
14.95	3.87	99.5	0.9978	0.5794
18.85	4.34	100.8	0.9977	0.5792
23.77	4.88	101.9	0.9976	0.5790
29.95	5.47	102.8	0.9975	0.5789
37.75	6.14	103.6	0.9974	0.5788
47.57	6.90	104.5	0.9973	0.5786
59.95	7.74	105.6	0.9972	0.5784
75.95	8.71	106.6	0.9971	0.5783
94.95	9.74	107.5	0.9970	0.5781
119.95	10.95	108.4	0.9969	0.5780
150.95	12.29	109.4	0.9968	0.5778
189.95	13.78	110.1	0.9968	0.5777
301.95	17.38	111.8	0.9966	0.5775

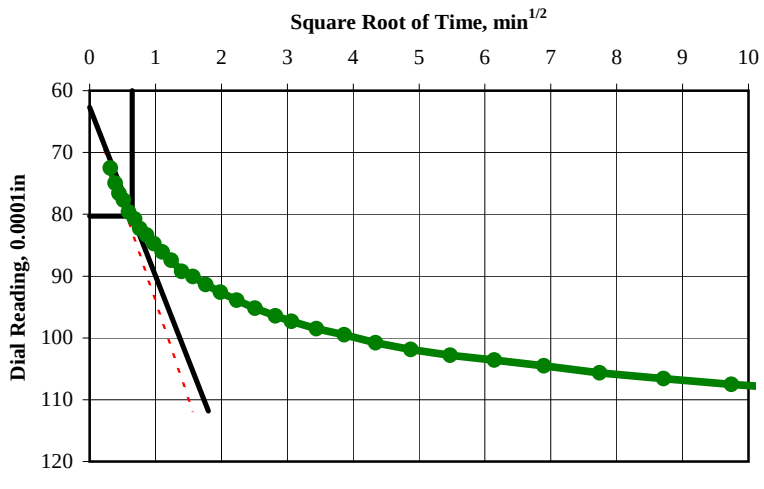
Machine Deflection

Applied Deflection Correction to Sample Height, 0.0001in: -4
**Correction is applied to all dial readings.*

Log of Elapsed Time vs. Dial Reading



Square Root of Elapsed Time vs. Dial Reading



Sqrt. of Elapsed Time vs Dial Reading

T0 = 0 min.	D0 = 62.7 div.
T90 = 0.423 min	D90 = 80.3 div.
T100 = NA min	D100 = 82.3 div.
Height at: D90 = 0.9997, D100 = 0.9995	
Average Sample Height, in	1.0004
Average Drainage Height, in	0.5002
T (Time Factor for T90)	0.848
Coef. of Consol., C_v, in^2/min	0.507

Log of Elapsed Time vs Dial Reading

T0 = 0 min.	D0 = 64.9 div.
T50 = 0.51 min.	D50 = 81.4 div.
T100 = 6.13 min.	D100 = 97.8 div.
Height at: D50 = 0.9996, D100 = 0.998	
Average Sample Height, in	1.0004
Average Drainage Height, in	0.5002
T (Time Factor for T50)	0.197
Coef. of Consol., C_v, in^2/min	0.097

Load Summary

Initial Sample Height, in	1.0041
Initial Sample Void Ratio	0.5894
Final Sample Height, in	0.9966
Final Sample Void Ratio	0.5775
Incremental Strain, %	0.75%
Loading Duration, min	301.95

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ONE-DIMENSIONAL CONSOLIDATION PROPERTIES OF SOILS
ASTM D 2435

Client	Civil & Environmental Consultant	Boring	SB-17	**Test Load, tsf**	**1-2**
Client Project	091-867 Apex Landfill Expansion	Depth	16'-18'		Load 4 of 13
Project No.	30598	Sample	ST-1		
		Lab ID#	30598009		

Visual Description: Gray Clayey Sand
Test Conditions: Undisturbed, Inundated, and Double Drained

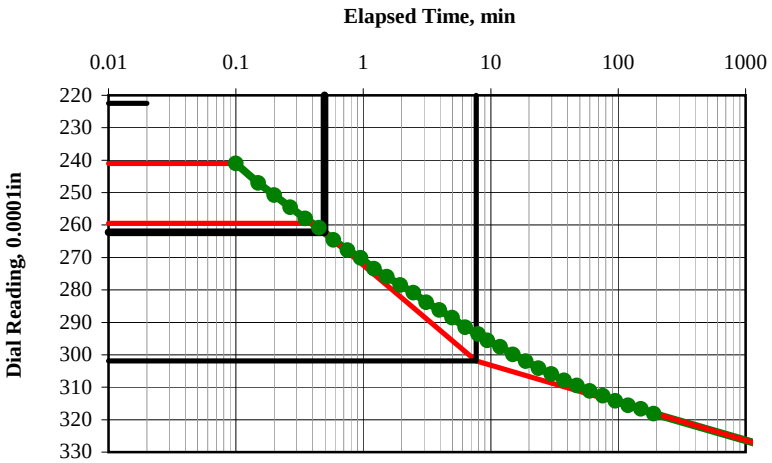
Time Vs. Dial Reading

Elapsed Time (min)	Sqrt Time ($min^{1/2}$)	Dial Reading (0.0001in)	Sample Height (in)	Void Ratio
0	0	111.8	0.9966	0.5775
Corrections*		-6	-0.0006	-0.0009
Adjusted Sample Height & Void Ratio				
0.10	0.32	241.0	0.9843	0.5580
0.15	0.39	247.0	0.9837	0.5570
0.20	0.45	250.8	0.9833	0.5564
0.27	0.52	254.5	0.9829	0.5558
0.35	0.59	258.0	0.9826	0.5553
0.45	0.67	260.8	0.9823	0.5548
0.58	0.76	264.6	0.9819	0.5542
0.75	0.87	267.7	0.9816	0.5537
0.95	0.97	270.2	0.9814	0.5533
1.22	1.10	273.5	0.9810	0.5528
1.53	1.24	276.0	0.9808	0.5524
1.95	1.40	278.5	0.9805	0.5520
2.47	1.57	280.9	0.9803	0.5516
3.12	1.77	283.8	0.9800	0.5512
3.95	1.99	286.2	0.9798	0.5508
4.98	2.23	288.6	0.9795	0.5504
6.30	2.51	291.5	0.9792	0.5500
7.95	2.82	293.6	0.9790	0.5496
9.40	3.07	295.6	0.9788	0.5493
11.85	3.44	297.6	0.9786	0.5490
14.95	3.87	299.9	0.9784	0.5486
18.85	4.34	302.0	0.9782	0.5483
23.77	4.88	304.1	0.9780	0.5480
29.95	5.47	305.9	0.9778	0.5477
37.75	6.14	307.9	0.9776	0.5474
47.57	6.90	309.4	0.9774	0.5471
59.95	7.74	311.1	0.9773	0.5469
75.95	8.71	312.7	0.9771	0.5466
94.95	9.74	314.2	0.9770	0.5464
119.95	10.95	315.6	0.9768	0.5462
150.95	12.29	316.7	0.9767	0.5460
189.95	13.78	318.2	0.9766	0.5457
1513.95	38.91	328.4	0.9755	0.5441

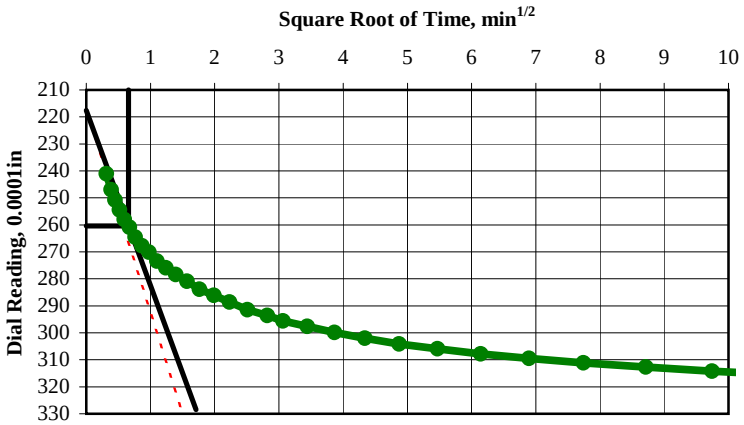
Machine Deflection

Applied Deflection Correction to Sample Height, 0.0001in: -6
**Correction is applied to all dial readings.*

Log of Elapsed Time vs. Dial Reading



Square Root of Elapsed Time vs. Dial Reading



Sqrt. of Elapsed Time vs Dial Reading

T0 = 0 min.	D0 = 217.6 div.		
T90 = 0.436 min	D90 = 260.4 div.		
T100 = NA min	D100 = 265.2 div.		
Height at: D90 = 0.9823, D100 = 0.9819			
Average Sample Height, in	0.9861		
Average Drainage Height, in	0.4930		
T (Time Factor for T90)	0.848		
Coef. of Consol., C_v, in^2/min	0.474		

Log of Elapsed Time vs Dial Reading

T0 = 0 min.	D0 = 222.5 div.		
T50 = 0.49 min.	D50 = 262.2 div.		
T100 = 7.68 min.	D100 = 301.9 div.		
Height at: D50 = 0.9822, D100 = 0.9782			
Average Sample Height, in	0.9861		
Average Drainage Height, in	0.4930		
T (Time Factor for T50)	0.197		
Coef. of Consol., C_v, in^2/min	0.098		

Load Summary

Initial Sample Height, in	0.9966
Initial Sample Void Ratio	0.5775
Final Sample Height, in	0.9755
Final Sample Void Ratio	0.5441
Incremental Strain, %	2.11%
Loading Duration, min	1513.95

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ONE-DIMENSIONAL CONSOLIDATION PROPERTIES OF SOILS
ASTM D 2435

Client	Civil & Environmental Consultant	Boring	SB-17	**Test Load, tsf**	**2-4**
Client Project	091-867 Apex Landfill Expansion	Depth	16'-18'		Load 5 of 13
Project No.	30598	Sample	ST-1		
		Lab ID#	30598009		

Visual Description: Gray Clayey Sand
Test Conditions: Undisturbed, Inundated, and Double Drained

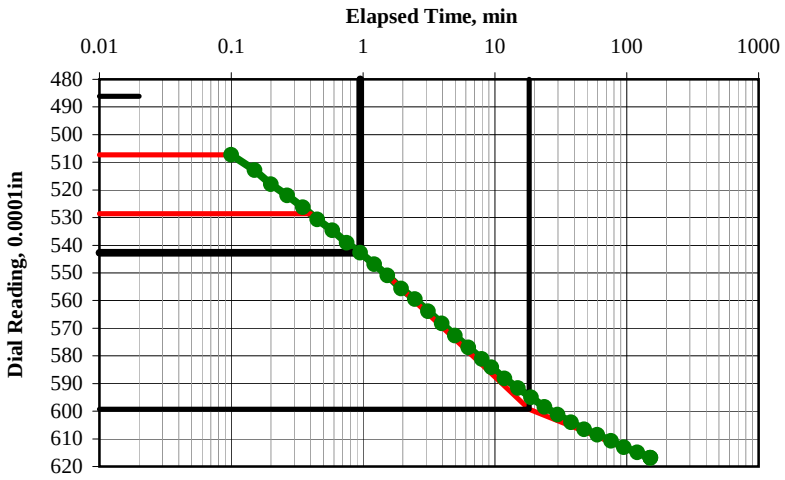
Time Vs. Dial Reading

Elapsed Time (min)	Sqrt Time ($min^{1/2}$)	Dial Reading (0.0001in)	Sample Height (in)	Void Ratio
0	0	328.4	0.9755	0.5441
Corrections*		-8.5	-0.00085	-0.0013
Adjusted Sample Height & Void Ratio				
0.10	0.32	507.4	0.9585	0.5171
0.15	0.39	512.9	0.9579	0.5163
0.20	0.45	517.9	0.9574	0.5155
0.27	0.52	522.0	0.9570	0.5148
0.35	0.59	526.2	0.9566	0.5142
0.45	0.67	530.7	0.9562	0.5135
0.58	0.76	534.6	0.9558	0.5128
0.75	0.87	539.1	0.9553	0.5121
0.95	0.97	542.7	0.9550	0.5116
1.22	1.10	546.9	0.9545	0.5109
1.53	1.24	551.0	0.9541	0.5102
1.95	1.40	555.7	0.9537	0.5095
2.47	1.57	559.5	0.9533	0.5089
3.12	1.77	563.8	0.9528	0.5082
3.95	1.99	568.3	0.9524	0.5075
4.98	2.23	572.6	0.9520	0.5068
6.30	2.51	577.0	0.9515	0.5061
7.95	2.82	581.1	0.9511	0.5055
9.40	3.07	584.1	0.9508	0.5050
11.85	3.44	588.2	0.9504	0.5044
14.95	3.87	591.6	0.9501	0.5038
18.85	4.34	595.1	0.9497	0.5033
23.77	4.88	598.4	0.9494	0.5027
29.95	5.47	601.2	0.9491	0.5023
37.75	6.14	604.0	0.9488	0.5018
47.57	6.90	606.6	0.9486	0.5014
59.95	7.74	608.6	0.9484	0.5011
75.95	8.71	610.7	0.9482	0.5008
94.95	9.74	613.0	0.9479	0.5004
119.95	10.95	614.9	0.9477	0.5001
150.95	12.29	616.9	0.9475	0.4998

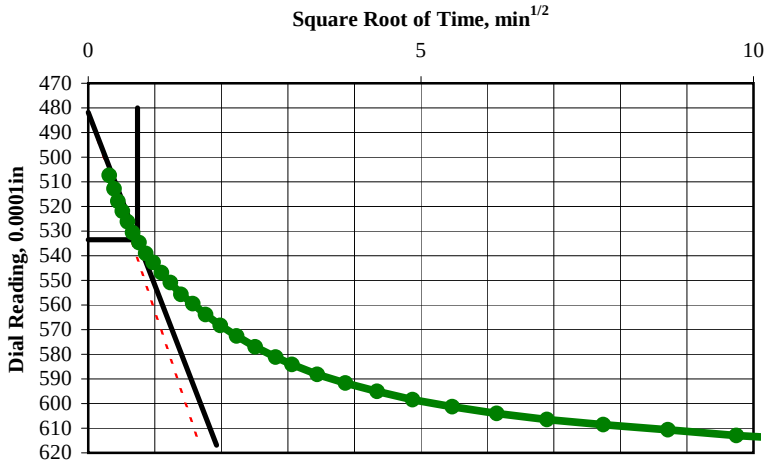
Machine Deflection

Applied Deflection Correction to Sample Height, 0.0001in: -8.5
**Correction is applied to all dial readings.*

Log of Elapsed Time vs. Dial Reading



Square Root of Elapsed Time vs. Dial Reading



Sqrt. of Elapsed Time vs Dial Reading

T0 = 0 min.	D0 = 481.8 div.
T90 = 0.548 min	D90 = 533.6 div.
T100 = NA min	D100 = 539.3 div.
Height at: D90 = 0.9559, D100 = 0.9553	
Average Sample Height, in	0.9615
Average Drainage Height, in	0.4808
T (Time Factor for T90)	0.848
Coef. of Consol., C_v, in^2/min	0.359

Log of Elapsed Time vs Dial Reading

T0 = 0 min.	D0 = 486.1 div.
T50 = 0.95 min.	D50 = 542.7 div.
T100 = 18.15 min.	D100 = 599.2 div.
Height at: D50 = 0.955, D100 = 0.9493	
Average Sample Height, in	0.9615
Average Drainage Height, in	0.4808
T (Time Factor for T50)	0.197
Coef. of Consol., C_v, in^2/min	0.048

Load Summary

Initial Sample Height, in	0.9755
Initial Sample Void Ratio	0.5441
Final Sample Height, in	0.9475
Final Sample Void Ratio	0.4998
Incremental Strain, %	2.87%
Loading Duration, min	150.95

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ONE-DIMENSIONAL CONSOLIDATION PROPERTIES OF SOILS
ASTM D 2435

Client	Civil & Environmental Consultant	Boring	SB-17	**Test Load, tsf**	**4-1**
Client Project	091-867 Apex Landfill Expansion	Depth	16'-18'		Load 6 of 13
Project No.	30598	Sample	ST-1		
		Lab ID#	30598009		

Visual Description: Gray Clayey Sand
Test Conditions: Undisturbed, Inundated, and Double Drained

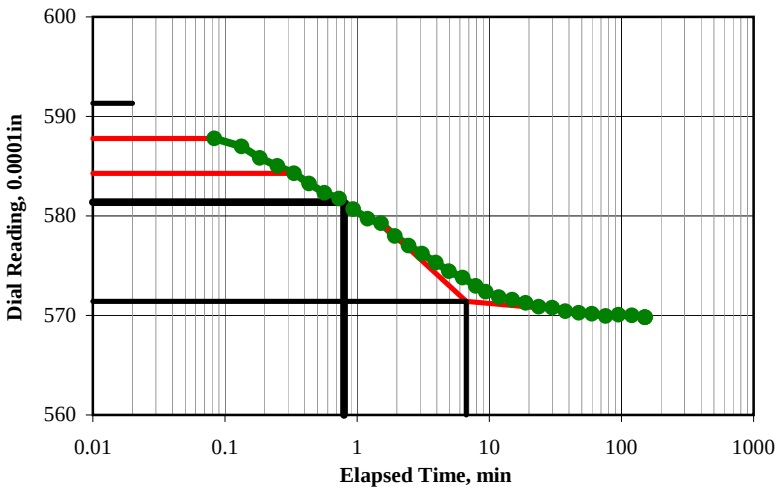
Time Vs. Dial Reading

Elapsed Time (min)	Sqrt Time ($min^{1/2}$)	Dial Reading (0.0001in)	Sample Height (in)	Void Ratio
0	0	616.9	0.9475	0.4998
Corrections*		9.5	0.00095	0.0015
Adjusted Sample Height & Void Ratio				
0.08	0.29	587.8	0.9495	0.5029
0.13	0.37	587.0	0.9496	0.5030
0.18	0.43	585.8	0.9497	0.5032
0.25	0.50	585.0	0.9498	0.5033
0.33	0.58	584.3	0.9498	0.5035
0.43	0.66	583.2	0.9500	0.5036
0.57	0.75	582.3	0.9500	0.5038
0.73	0.86	581.7	0.9501	0.5039
0.93	0.97	580.7	0.9502	0.5040
1.20	1.10	579.7	0.9503	0.5042
1.52	1.23	579.3	0.9503	0.5043
1.93	1.39	578.0	0.9505	0.5045
2.45	1.57	577.0	0.9506	0.5046
3.10	1.76	576.2	0.9507	0.5047
3.93	1.98	575.3	0.9507	0.5049
4.97	2.23	574.4	0.9508	0.5050
6.28	2.51	573.8	0.9509	0.5051
7.93	2.82	573.0	0.9510	0.5053
9.38	3.06	572.4	0.9510	0.5053
11.83	3.44	571.8	0.9511	0.5054
14.93	3.86	571.6	0.9511	0.5055
18.83	4.34	571.3	0.9511	0.5055
23.75	4.87	570.9	0.9512	0.5056
29.93	5.47	570.8	0.9512	0.5056
37.73	6.14	570.4	0.9512	0.5057
47.55	6.90	570.3	0.9512	0.5057
59.93	7.74	570.2	0.9513	0.5057
75.93	8.71	569.9	0.9513	0.5057
94.93	9.74	570.1	0.9513	0.5057
119.93	10.95	570.0	0.9513	0.5057
150.93	12.29	569.8	0.9513	0.5058

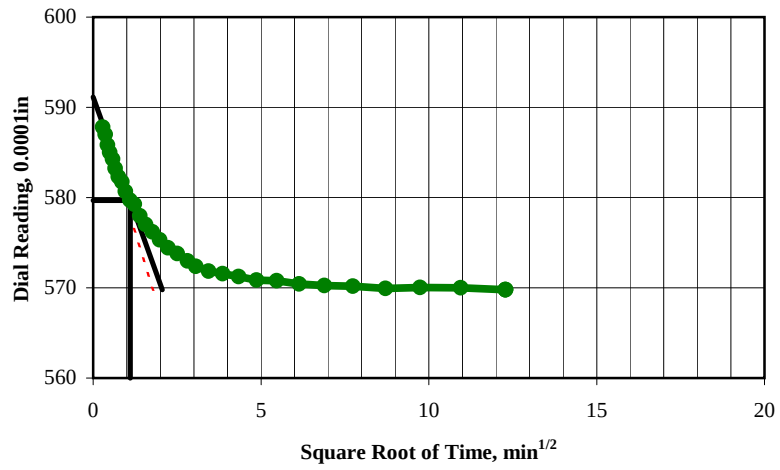
Machine Deflection

Applied Deflection Correction to Sample Height, 0.0001in 9.5
**Correction is applied to all dial readings.*

Log of Elapsed Time vs. Dial Reading



Square Root of Elapsed Time vs. Dial Reading



Sqrt. of Elapsed Time vs Dial Reading

T0 = 0 min.	D0 = 591.1 div.
T90 = 1.232 min	D90 = 579.7 div.
T100 = NA min	D100 = 578.4 div.
Height at: D90 = 0.9503, D100 = 0.9504	
Average Sample Height, in	0.9494
Average Drainage Height, in	0.4747
T (Time Factor for T90)	0.848
Coef. of Consol., C_v, in^2/min	0.156

Log of Elapsed Time vs Dial Reading

T0 = 0 min.	D0 = 591.3 div.
T50 = 0.8 min.	D50 = 581.4 div.
T100 = 6.71 min.	D100 = 571.4 div.
Height at: D50 = 0.9501, D100 = 0.9511	
Average Sample Height, in	0.9494
Average Drainage Height, in	0.4747
T (Time Factor for T50)	0.197
Coef. of Consol., C_v, in^2/min	0.055

Load Summary

Initial Sample Height, in	0.9475
Initial Sample Void Ratio	0.4998
Final Sample Height, in	0.9513
Final Sample Void Ratio	0.5058
Incremental Strain, %	-0.40%
Loading Duration, min	150.93333

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ONE-DIMENSIONAL CONSOLIDATION PROPERTIES OF SOILS
ASTM D 2435

Client	Civil & Environmental Consultant	Boring	SB-17	**Test Load, tsf**	**1-0.25**
Client Project	091-867 Apex Landfill Expansion	Depth	16'-18'		Load 7 of 13
Project No.	30598	Sample	ST-1		
		Lab ID#	30598009		

Visual Description: Gray Clayey Sand
Test Conditions: Undisturbed, Inundated, and Double Drained

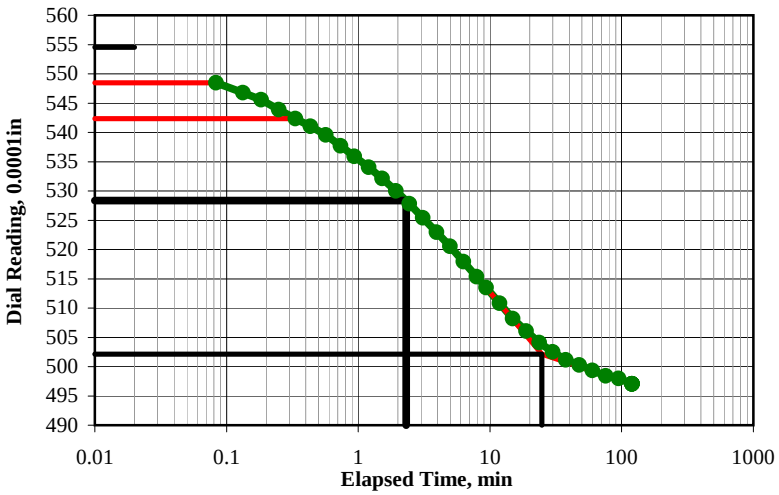
Time Vs. Dial Reading

Elapsed Time (min)	Sqrt Time ($min^{1/2}$)	Dial Reading (0.0001in)	Sample Height (in)	Void Ratio
0	0	569.8	0.9513	0.5058
Corrections*		5.5	0.00055	0.00087
Adjusted Sample Height & Void Ratio				
0.08	0.29	548.5	0.9529	0.5083
0.13	0.37	546.8	0.9530	0.5085
0.18	0.43	545.6	0.9532	0.5087
0.25	0.50	543.9	0.9533	0.5090
0.33	0.58	542.4	0.9535	0.5092
0.43	0.66	541.0	0.9536	0.5094
0.57	0.75	539.6	0.9538	0.5097
0.73	0.86	537.7	0.9540	0.5100
0.93	0.97	535.9	0.9541	0.5103
1.20	1.10	534.1	0.9543	0.5105
1.52	1.23	532.1	0.9545	0.5108
1.93	1.39	530.0	0.9547	0.5112
2.45	1.57	527.8	0.9549	0.5115
3.10	1.76	525.4	0.9552	0.5119
3.93	1.98	522.9	0.9554	0.5123
4.97	2.23	520.5	0.9557	0.5127
6.28	2.51	517.9	0.9559	0.5131
7.93	2.82	515.4	0.9562	0.5135
9.38	3.06	513.5	0.9564	0.5138
11.83	3.44	510.8	0.9566	0.5142
14.93	3.86	508.2	0.9569	0.5146
18.83	4.34	506.0	0.9571	0.5150
23.75	4.87	504.1	0.9573	0.5153
29.93	5.47	502.5	0.9575	0.5155
37.73	6.14	501.1	0.9576	0.5158
47.55	6.90	500.3	0.9577	0.5159
59.93	7.74	499.4	0.9578	0.5160
75.93	8.71	498.4	0.9579	0.5162
94.93	9.74	498.0	0.9579	0.5163
119.93	10.95	497.0	0.9580	0.5164

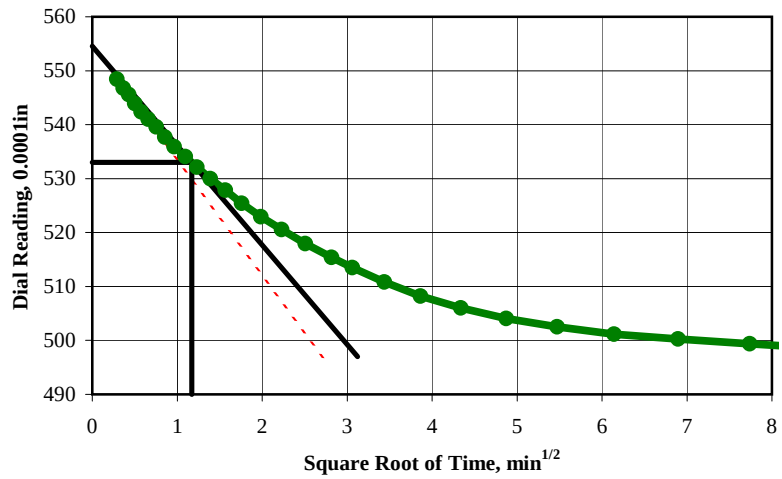
Machine Deflection

Applied Deflection Correction to Sample Height, 0.0001in 5.5
**Correction is applied to all dial readings.*

Log of Elapsed Time vs. Dial Reading



Square Root of Elapsed Time vs. Dial Reading



Sqrt. of Elapsed Time vs Dial Reading

T0 = 0 min.	D0 = 554.6 div.
T90 = 1.369 min	D90 = 533 div.
T100 = NA min	D100 = 530.6 div.
Height at: D90 = 0.9544, D100 = 0.9547	
Average Sample Height, in	0.9547
Average Drainage Height, in	0.4773
T (Time Factor for T90)	0.848
Coef. of Consol., C_v, in^2/min	0.141

Log of Elapsed Time vs Dial Reading

T0 = 0 min.	D0 = 554.6 div.
T50 = 2.31 min.	D50 = 528.3 div.
T100 = 24.82 min.	D100 = 502.1 div.
Height at: D50 = 0.9549, D100 = 0.9575	
Average Sample Height, in	0.9547
Average Drainage Height, in	0.4773
T (Time Factor for T50)	0.197
Coef. of Consol., C_v, in^2/min	0.019

Load Summary

Initial Sample Height, in	0.9513
Initial Sample Void Ratio	0.5058
Final Sample Height, in	0.9580
Final Sample Void Ratio	0.5164
Incremental Strain, %	-0.71%
Loading Duration, min	119.93333

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ONE-DIMENSIONAL CONSOLIDATION PROPERTIES OF SOILS
ASTM D 2435

Client	Civil & Environmental Consultant	Boring	SB-17	**Test Load, tsf**	**0.25-0.5**
Client Project	091-867 Apex Landfill Expansion	Depth	16'-18'		Load 8 of 13
Project No.	30598	Sample	ST-1		
		Lab ID#	30598009		

Visual Description: Gray Clayey Sand
Test Conditions: Undisturbed, Inundated, and Double Drained

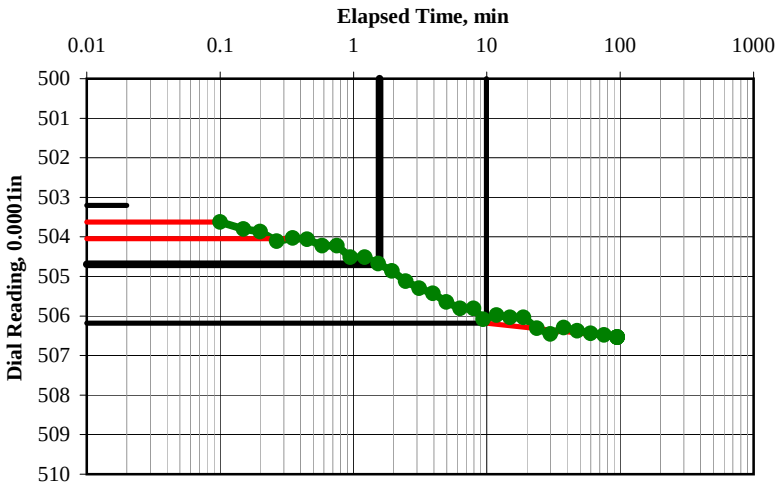
Time Vs. Dial Reading

Elapsed Time (min)	Sqrt Time ($min^{1/2}$)	Dial Reading (0.0001in)	Sample Height (in)	Void Ratio
0	0	497.0	0.9580	0.5164
Corrections*		-1.5	-0.00015	-0.0002
Adjusted Sample Height & Void Ratio				
0.10	0.32	503.6	0.9575	0.5156
0.15	0.39	503.8	0.9575	0.5156
0.20	0.45	503.9	0.9575	0.5156
0.27	0.52	504.1	0.9575	0.5155
0.35	0.59	504.0	0.9575	0.5155
0.45	0.67	504.1	0.9575	0.5155
0.58	0.76	504.2	0.9575	0.5155
0.75	0.87	504.2	0.9575	0.5155
0.95	0.97	504.5	0.9574	0.5155
1.22	1.10	504.5	0.9574	0.5155
1.53	1.24	504.7	0.9574	0.5154
1.95	1.40	504.9	0.9574	0.5154
2.47	1.57	505.1	0.9574	0.5154
3.12	1.77	505.3	0.9573	0.5153
3.95	1.99	505.4	0.9573	0.5153
4.98	2.23	505.6	0.9573	0.5153
6.30	2.51	505.8	0.9573	0.5153
7.95	2.82	505.8	0.9573	0.5153
9.40	3.07	506.1	0.9573	0.5152
11.85	3.44	506.0	0.9573	0.5152
14.95	3.87	506.0	0.9573	0.5152
18.85	4.34	506.0	0.9573	0.5152
23.77	4.88	506.3	0.9572	0.5152
29.95	5.47	506.5	0.9572	0.5152
37.75	6.14	506.3	0.9572	0.5152
47.57	6.90	506.4	0.9572	0.5152
59.95	7.74	506.4	0.9572	0.5152
75.95	8.71	506.5	0.9572	0.5151
94.95	9.74	506.5	0.9572	0.5151

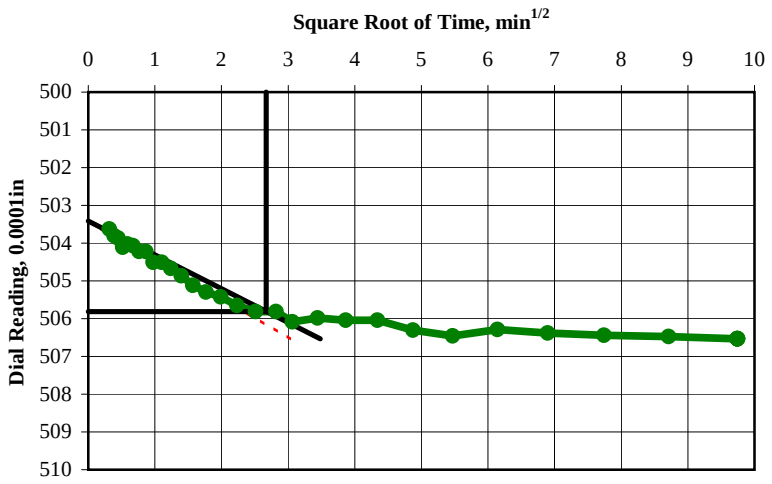
Machine Deflection

Applied Deflection Correction to Sample Height, 0.0001in: -1.5
**Correction is applied to all dial readings.*

Log of Elapsed Time vs. Dial Reading



Square Root of Elapsed Time vs. Dial Reading



Sqrt. of Elapsed Time vs Dial Reading

T0 = 0 min.	D0 = 503.4 div.
T90 = 7.129 min	D90 = 505.8 div.
T100 = NA min	D100 = 506.1 div.
Height at: D90 = 0.9573, D100 = 0.9573	
Average Sample Height, in	0.9576
Average Drainage Height, in	0.4788
T (Time Factor for T90)	0.848
Coef. of Consol., C_v, in^2/min	0.027

Log of Elapsed Time vs Dial Reading

T0 = 0 min.	D0 = 503.2 div.
T50 = 1.57 min.	D50 = 504.7 div.
T100 = 9.94 min.	D100 = 506.2 div.
Height at: D50 = 0.9574, D100 = 0.9573	
Average Sample Height, in	0.9576
Average Drainage Height, in	0.4788
T (Time Factor for T50)	0.197
Coef. of Consol., C_v, in^2/min	0.029

Load Summary

Initial Sample Height, in	0.9580
Initial Sample Void Ratio	0.5164
Final Sample Height, in	0.9572
Final Sample Void Ratio	0.5151
Incremental Strain, %	0.08%
Loading Duration, min	94.95

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ONE-DIMENSIONAL CONSOLIDATION PROPERTIES OF SOILS
ASTM D 2435

Client	Civil & Environmental Consultant	Boring	SB-17	**Test Load, tsf**	**0.5-1**
Client Project	091-867 Apex Landfill Expansion	Depth	16'-18'		Load 9 of 13
Project No.	30598	Sample	ST-1		
		Lab ID#	30598009		

Visual Description: Gray Clayey Sand
Test Conditions: Undisturbed, Inundated, and Double Drained

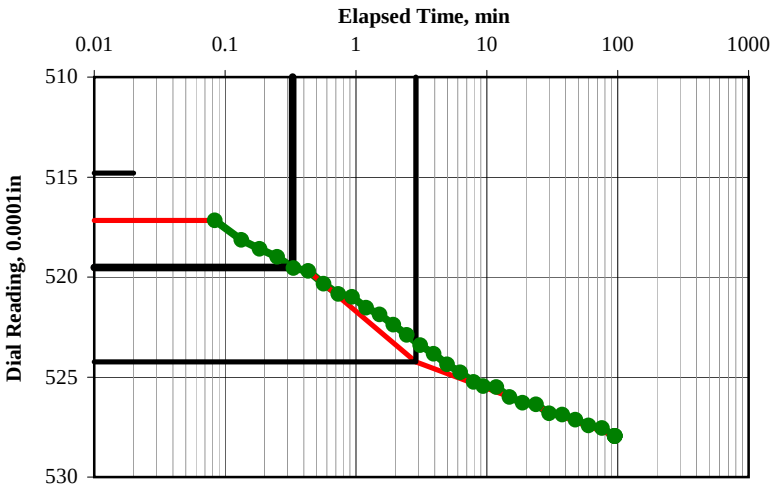
Time Vs. Dial Reading

Elapsed Time (min)	Sqrt Time ($min^{1/2}$)	Dial Reading (0.0001in)	Sample Height (in)	Void Ratio
0	0	506.5	0.9572	0.5151
Corrections*		-3	-0.0003	-0.0005
Adjusted Sample Height & Void Ratio				
0.08	0.29	517.2	0.9565	0.5139
0.13	0.37	518.1	0.9564	0.5138
0.18	0.43	518.6	0.9563	0.5137
0.25	0.50	519.0	0.9563	0.5136
0.33	0.58	519.6	0.9562	0.5136
0.43	0.66	519.7	0.9562	0.5135
0.57	0.75	520.3	0.9561	0.5134
0.73	0.86	520.8	0.9561	0.5133
0.93	0.97	521.0	0.9561	0.5133
1.20	1.10	521.5	0.9560	0.5132
1.52	1.23	521.9	0.9560	0.5132
1.93	1.39	522.4	0.9559	0.5131
2.45	1.57	522.9	0.9559	0.5130
3.10	1.76	523.4	0.9558	0.5129
3.93	1.98	523.8	0.9558	0.5129
4.97	2.23	524.4	0.9557	0.5128
6.28	2.51	524.8	0.9557	0.5127
7.93	2.82	525.2	0.9557	0.5127
9.38	3.06	525.5	0.9556	0.5126
11.83	3.44	525.5	0.9556	0.5126
14.93	3.86	526.0	0.9556	0.5125
18.83	4.34	526.3	0.9555	0.5125
23.75	4.87	526.4	0.9555	0.5125
29.93	5.47	526.8	0.9555	0.5124
37.73	6.14	526.9	0.9555	0.5124
47.55	6.90	527.1	0.9555	0.5124
59.93	7.74	527.4	0.9554	0.5123
75.93	8.71	527.6	0.9554	0.5123
94.93	9.74	528.0	0.9554	0.5122

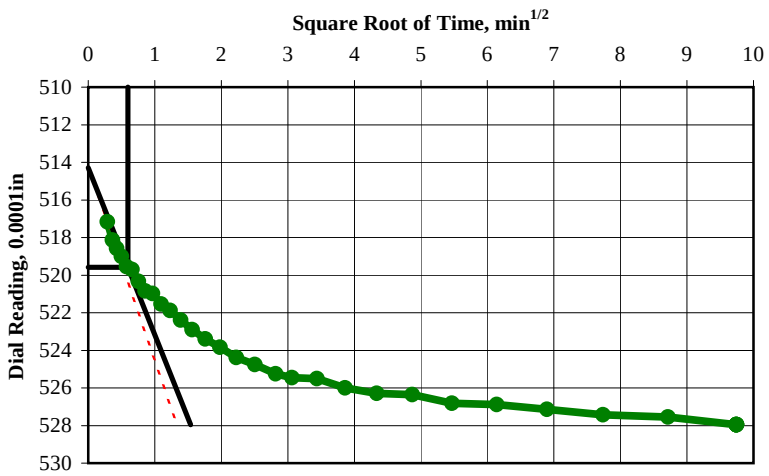
Machine Deflection

Applied Deflection Correction to Sample Height, 0.0001in: -3
**Correction is applied to all dial readings.*

Log of Elapsed Time vs. Dial Reading



Square Root of Elapsed Time vs. Dial Reading



Sqrt. of Elapsed Time vs Dial Reading

T0 = 0 min.	D0 = 514.3 div.		
T90 = 0.36 min	D90 = 519.6 div.		
T100 = NA min	D100 = 520.2 div.		
Height at: D90 = 0.9562, D100 = 0.9562			
Average Sample Height, in	0.9563		
Average Drainage Height, in	0.4782		
T (Time Factor for T90)	0.848		
Coef. of Consol., C_v, in^2/min	0.543		

Log of Elapsed Time vs Dial Reading

T0 = 0 min.	D0 = 514.8 div.		
T50 = 0.33 min.	D50 = 519.5 div.		
T100 = 2.87 min.	D100 = 524.2 div.		
Height at: D50 = 0.9562, D100 = 0.9558			
Average Sample Height, in	0.9563		
Average Drainage Height, in	0.4782		
T (Time Factor for T50)	0.197		
Coef. of Consol., C_v, in^2/min	0.136		

Load Summary

Initial Sample Height, in	0.9572
Initial Sample Void Ratio	0.5151
Final Sample Height, in	0.9554
Final Sample Void Ratio	0.5122
Incremental Strain, %	0.19%
Loading Duration, min	94.933333

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ONE-DIMENSIONAL CONSOLIDATION PROPERTIES OF SOILS
ASTM D 2435

Client	Civil & Environmental Consultant	Boring	SB-17	**Test Load, tsf**	**1-2**
Client Project	091-867 Apex Landfill Expansion	Depth	16'-18'		Load 10 of 13
Project No.	30598	Sample	ST-1		
		Lab ID#	30598009		

Visual Description: Gray Clayey Sand
Test Conditions: Undisturbed, Inundated, and Double Drained

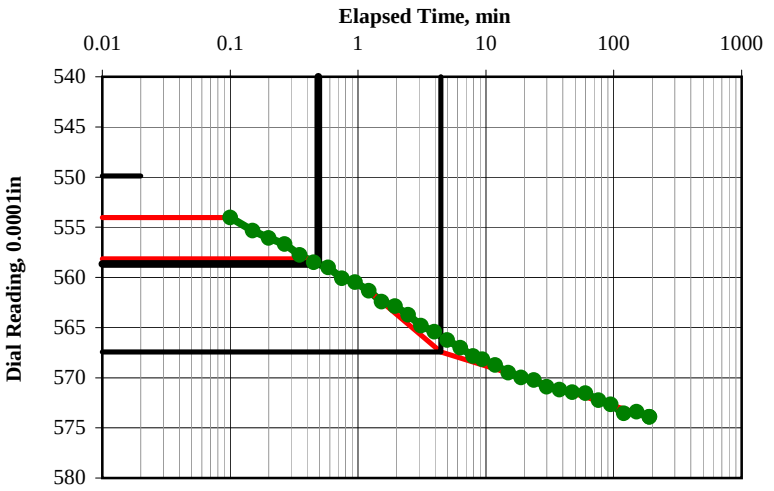
Time Vs. Dial Reading

Elapsed Time (min)	Sqrt Time ($min^{1/2}$)	Dial Reading (0.0001in)	Sample Height (in)	Void Ratio
0	0	528.0	0.9554	0.5122
Corrections*		-4.5	-0.00045	-0.0007
Adjusted Sample Height & Void Ratio				
0.10	0.32	554.0	0.9532	0.5088
0.15	0.39	555.3	0.9531	0.5086
0.20	0.45	556.1	0.9530	0.5085
0.27	0.52	556.7	0.9530	0.5084
0.35	0.59	557.8	0.9528	0.5082
0.45	0.67	558.5	0.9528	0.5081
0.58	0.76	559.0	0.9527	0.5080
0.75	0.87	560.1	0.9526	0.5078
0.95	0.97	560.5	0.9526	0.5078
1.22	1.10	561.4	0.9525	0.5076
1.53	1.24	562.4	0.9524	0.5075
1.95	1.40	562.9	0.9523	0.5074
2.47	1.57	563.7	0.9523	0.5073
3.12	1.77	564.8	0.9521	0.5071
3.95	1.99	565.4	0.9521	0.5070
4.98	2.23	566.3	0.9520	0.5069
6.30	2.51	567.0	0.9519	0.5068
7.95	2.82	567.8	0.9518	0.5066
9.40	3.07	568.2	0.9518	0.5066
11.85	3.44	568.7	0.9518	0.5065
14.95	3.87	569.5	0.9517	0.5064
18.85	4.34	570.0	0.9516	0.5063
23.77	4.88	570.2	0.9516	0.5062
29.95	5.47	570.9	0.9515	0.5061
37.75	6.14	571.2	0.9515	0.5061
47.57	6.90	571.4	0.9515	0.5061
59.95	7.74	571.6	0.9515	0.5060
75.95	8.71	572.3	0.9514	0.5059
94.95	9.74	572.7	0.9514	0.5059
119.95	10.95	573.5	0.9513	0.5057
150.95	12.29	573.4	0.9513	0.5057
189.95	13.78	573.9	0.9512	0.5057

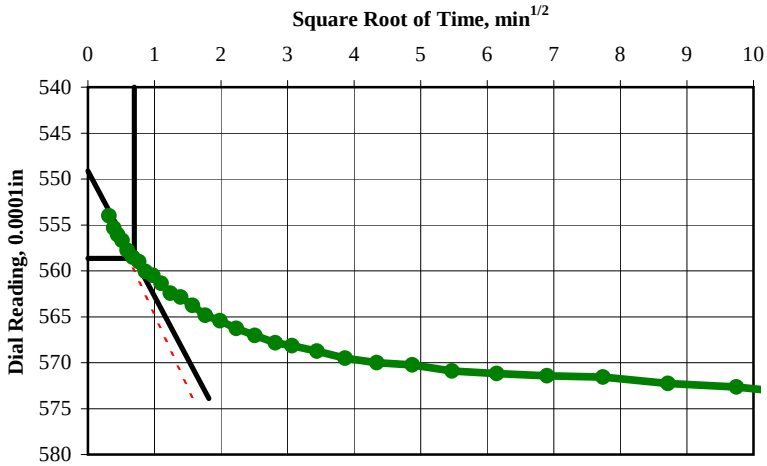
Machine Deflection

Applied Deflection Correction to Sample Height, 0.0001in: -4.5
**Correction is applied to all dial readings.*

Log of Elapsed Time vs. Dial Reading



Square Root of Elapsed Time vs. Dial Reading



Sqrt. of Elapsed Time vs Dial Reading

T0 = 0 min.	D0 = 549.1 div.
T90 = 0.49 min	D90 = 558.6 div.
T100 = NA min	D100 = 559.7 div.
Height at: D90 = 0.9528, D100 = 0.9527	
Average Sample Height, in	0.9533
Average Drainage Height, in	0.4767
T (Time Factor for T90)	0.848
Coef. of Consol., C_v, in^2/min	0.395

Log of Elapsed Time vs Dial Reading

T0 = 0 min.	D0 = 549.9 div.
T50 = 0.49 min.	D50 = 558.7 div.
T100 = 4.45 min.	D100 = 567.4 div.
Height at: D50 = 0.9528, D100 = 0.9519	
Average Sample Height, in	0.9533
Average Drainage Height, in	0.4767
T (Time Factor for T50)	0.197
Coef. of Consol., C_v, in^2/min	0.091

Load Summary

Initial Sample Height, in	0.9554
Initial Sample Void Ratio	0.5122
Final Sample Height, in	0.9512
Final Sample Void Ratio	0.5057
Incremental Strain, %	0.43%
Loading Duration, min	189.95

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ONE-DIMENSIONAL CONSOLIDATION PROPERTIES OF SOILS
ASTM D 2435

Client	Civil & Environmental Consultant	Boring	SB-17	**Test Load, tsf**	**2-4**
Client Project	091-867 Apex Landfill Expansion	Depth	16'-18'		Load 11 of 13
Project No.	30598	Sample	ST-1		
		Lab ID#	30598009		

Visual Description: Gray Clayey Sand
Test Conditions: Undisturbed, Inundated, and Double Drained

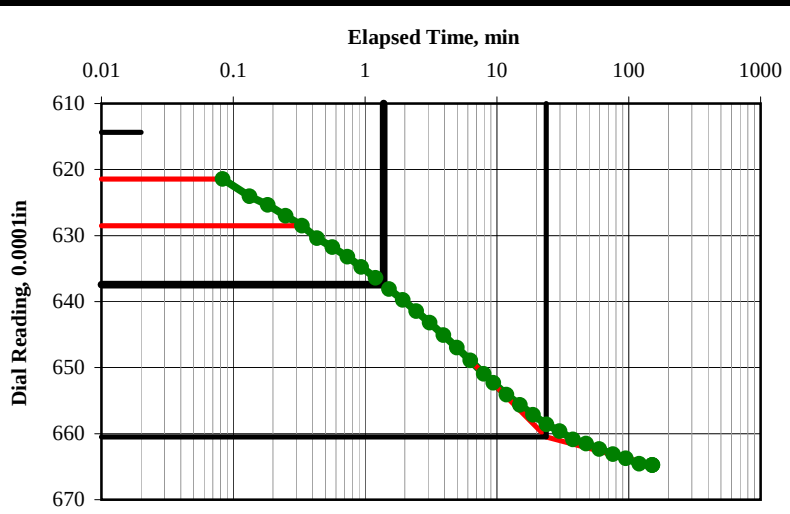
Time Vs. Dial Reading

Elapsed Time (min)	Sqrt Time ($min^{1/2}$)	Dial Reading (0.0001in)	Sample Height (in)	Void Ratio
0	0	573.9	0.9512	0.5057
Corrections*		-6	-0.0006	-0.0009
Adjusted Sample Height & Void Ratio				
0.08	0.29	621.4	0.9471	0.4991
0.13	0.37	624.1	0.9468	0.4987
0.18	0.43	625.4	0.9467	0.4985
0.25	0.50	627.0	0.9465	0.4982
0.33	0.58	628.5	0.9464	0.4980
0.43	0.66	630.4	0.9462	0.4977
0.57	0.75	631.7	0.9461	0.4975
0.73	0.86	633.2	0.9459	0.4972
0.93	0.97	634.8	0.9457	0.4970
1.20	1.10	636.4	0.9456	0.4967
1.52	1.23	638.1	0.9454	0.4965
1.93	1.39	639.7	0.9453	0.4962
2.45	1.57	641.5	0.9451	0.4959
3.10	1.76	643.2	0.9449	0.4956
3.93	1.98	645.1	0.9447	0.4953
4.97	2.23	647.0	0.9445	0.4950
6.28	2.51	648.9	0.9443	0.4947
7.93	2.82	651.0	0.9441	0.4944
9.38	3.06	652.3	0.9440	0.4942
11.83	3.44	654.1	0.9438	0.4939
14.93	3.86	655.7	0.9437	0.4937
18.83	4.34	657.1	0.9435	0.4934
23.75	4.87	658.6	0.9434	0.4932
29.93	5.47	659.6	0.9433	0.4930
37.73	6.14	660.9	0.9431	0.4928
47.55	6.90	661.5	0.9431	0.4927
59.93	7.74	662.3	0.9430	0.4926
75.93	8.71	663.1	0.9429	0.4925
94.93	9.74	663.8	0.9428	0.4924
119.93	10.95	664.6	0.9428	0.4923
150.93	12.29	664.8	0.9427	0.4922

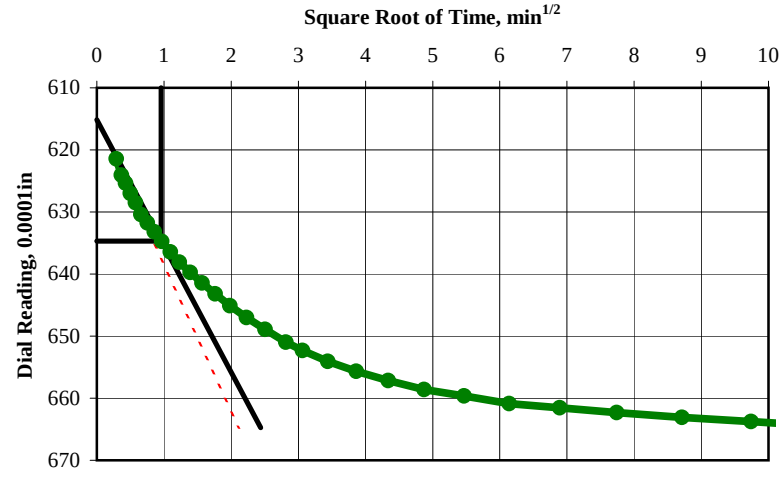
Machine Deflection

Applied Deflection Correction to Sample Height, 0.0001in: -6
**Correction is applied to all dial readings.*

Log of Elapsed Time vs. Dial Reading



Square Root of Elapsed Time vs. Dial Reading



Sqrt. of Elapsed Time vs Dial Reading

T0 = 0 min.	D0 = 615.1 div.
T90 = 0.922 min	D90 = 634.7 div.
T100 = NA min	D100 = 636.8 div.
Height at: D90 = 0.9458, D100 = 0.9455	
Average Sample Height, in	0.9470
Average Drainage Height, in	0.4735
T (Time Factor for T90)	0.848
Coef. of Consol., C_v, in^2/min	0.206

Log of Elapsed Time vs Dial Reading

T0 = 0 min.	D0 = 614.4 div.
T50 = 1.38 min.	D50 = 637.4 div.
T100 = 23.65 min.	D100 = 660.5 div.
Height at: D50 = 0.9455, D100 = 0.9432	
Average Sample Height, in	0.9470
Average Drainage Height, in	0.4735
T (Time Factor for T50)	0.197
Coef. of Consol., C_v, in^2/min	0.032

Load Summary

Initial Sample Height, in	0.9512
Initial Sample Void Ratio	0.5057
Final Sample Height, in	0.9427
Final Sample Void Ratio	0.4922
Incremental Strain, %	0.89%
Loading Duration, min	150.93333

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ONE-DIMENSIONAL CONSOLIDATION PROPERTIES OF SOILS
ASTM D 2435

Client	Civil & Environmental Consultant	Boring	SB-17	**Test Load, tsf**	**4-8**
Client Project	091-867 Apex Landfill Expansion	Depth	16'-18'		Load 12 of 13
Project No.	30598	Sample	ST-1		
		Lab ID#	30598009		

Visual Description: Gray Clayey Sand
Test Conditions: Undisturbed, Inundated, and Double Drained

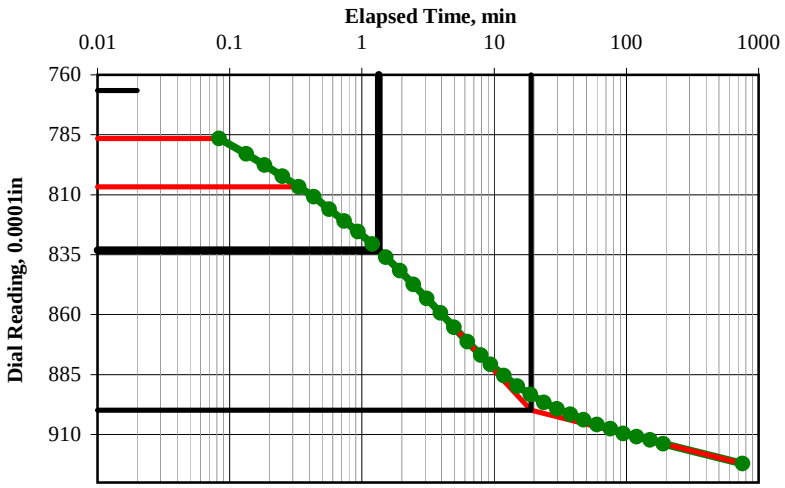
Time Vs. Dial Reading

Elapsed Time (min)	Sqrt Time ($min^{1/2}$)	Dial Reading (0.0001in)	Sample Height (in)	Void Ratio
0	0	664.8	0.9427	0.4922
Corrections*		-11	-0.0011	-0.0017
Adjusted Sample Height & Void Ratio				
0.08	0.29	786.6	0.9317	0.4747
0.13	0.37	793.0	0.9310	0.4737
0.18	0.43	797.6	0.9306	0.4730
0.25	0.50	802.3	0.9301	0.4722
0.33	0.58	806.7	0.9297	0.4715
0.43	0.66	810.8	0.9292	0.4709
0.57	0.75	816.0	0.9287	0.4700
0.73	0.86	821.0	0.9282	0.4692
0.93	0.97	825.4	0.9278	0.4685
1.20	1.10	830.6	0.9273	0.4677
1.52	1.23	836.1	0.9267	0.4669
1.93	1.39	841.7	0.9262	0.4660
2.45	1.57	847.4	0.9256	0.4651
3.10	1.76	853.3	0.9250	0.4641
3.93	1.98	859.3	0.9244	0.4632
4.97	2.23	865.3	0.9238	0.4622
6.28	2.51	871.3	0.9232	0.4613
7.93	2.82	876.9	0.9226	0.4604
9.38	3.06	880.8	0.9222	0.4598
11.83	3.44	885.5	0.9218	0.4590
14.93	3.86	889.8	0.9213	0.4584
18.83	4.34	893.4	0.9210	0.4578
23.75	4.87	896.6	0.9207	0.4573
29.93	5.47	899.3	0.9204	0.4568
37.73	6.14	901.6	0.9202	0.4565
47.55	6.90	903.8	0.9199	0.4561
59.93	7.74	905.9	0.9197	0.4558
75.93	8.71	907.6	0.9196	0.4555
94.93	9.74	909.6	0.9194	0.4552
119.93	10.95	911.0	0.9192	0.4550
150.93	12.29	912.2	0.9191	0.4548
189.93	13.78	913.9	0.9189	0.4545
757.93	27.53	922.1	0.9181	0.4532

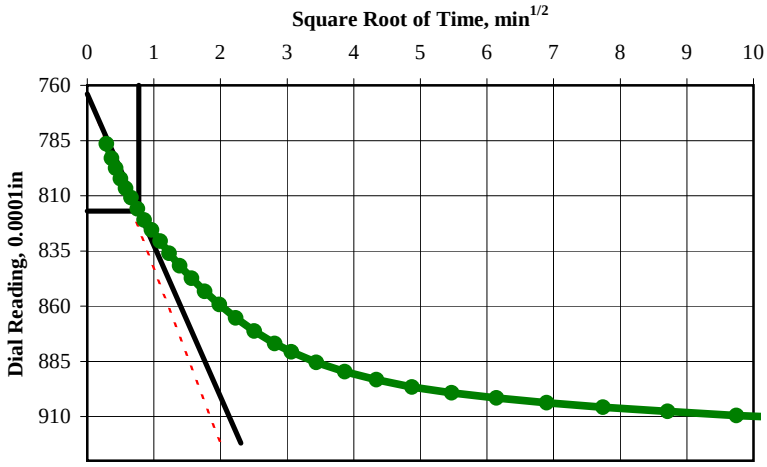
Machine Deflection

Applied Deflection Correction to Sample Height, 0.0001in: -11
**Correction is applied to all dial readings.*

Log of Elapsed Time vs. Dial Reading



Square Root of Elapsed Time vs. Dial Reading



Sqrt. of Elapsed Time vs Dial Reading

T0 = 0 min.	D0 = 763.9 div.		
T90 = 0.593 min	D90 = 817 div.		
T100 = NA min	D100 = 822.9 div.		
Height at: D90 = 0.9286, D100 = 0.928			
Average Sample Height, in	0.9304		
Average Drainage Height, in	0.4652		
T (Time Factor for T90)	0.848		
Coef. of Consol., C_v, in^2/min	0.307		

Log of Elapsed Time vs Dial Reading

T0 = 0 min.	D0 = 766.5 div.		
T50 = 1.34 min.	D50 = 833.2 div.		
T100 = 19.06 min.	D100 = 899.9 div.		
Height at: D50 = 0.927, D100 = 0.9203			
Average Sample Height, in	0.9304		
Average Drainage Height, in	0.4652		
T (Time Factor for T50)	0.197		
Coef. of Consol., C_v, in^2/min	0.032		

Load Summary

Initial Sample Height, in	0.9427
Initial Sample Void Ratio	0.4922
Final Sample Height, in	0.9181
Final Sample Void Ratio	0.4532
Incremental Strain, %	2.61%
Loading Duration, min	757.93333

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ONE-DIMENSIONAL CONSOLIDATION PROPERTIES OF SOILS
ASTM D 2435

Client	Civil & Environmental Consultant	Boring	SB-17	**Test Load, tsf**	**8-16**
Client Project	091-867 Apex Landfill Expansion	Depth	16'-18'		Load 13 of 13
Project No.	30598	Sample	ST-1		
		Lab ID#	30598009		

Visual Description: Gray Clayey Sand
Test Conditions: Undisturbed, Inundated, and Double Drained

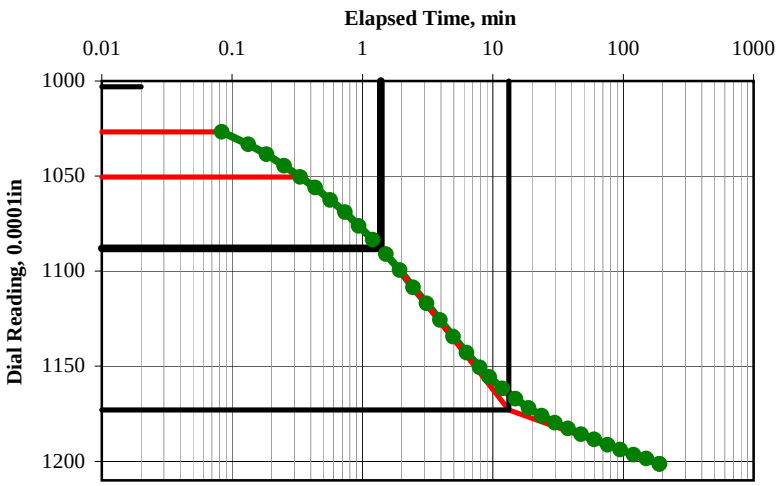
Time Vs. Dial Reading

Elapsed Time (min)	Sqrt Time ($min^{1/2}$)	Dial Reading (0.0001in)	Sample Height (in)	Void Ratio
0	0	922.1	0.9181	0.4532
Corrections*		-16.5	-0.00165	-0.0026
Adjusted Sample Height & Void Ratio				
0.08	0.29	1026.8	0.9093	0.4393
0.13	0.37	1033.4	0.9086	0.4382
0.18	0.43	1038.5	0.9081	0.4374
0.25	0.50	1044.7	0.9075	0.4365
0.33	0.58	1050.6	0.9069	0.4355
0.43	0.66	1056.0	0.9064	0.4347
0.57	0.75	1062.6	0.9057	0.4336
0.73	0.86	1069.0	0.9051	0.4326
0.93	0.97	1076.2	0.9044	0.4315
1.20	1.10	1083.4	0.9036	0.4303
1.52	1.23	1091.0	0.9029	0.4291
1.93	1.39	1099.4	0.9020	0.4278
2.45	1.57	1108.5	0.9011	0.4263
3.10	1.76	1116.9	0.9003	0.4250
3.93	1.98	1125.7	0.8994	0.4236
4.97	2.23	1134.4	0.8985	0.4222
6.28	2.51	1142.8	0.8977	0.4209
7.93	2.82	1150.5	0.8969	0.4197
9.38	3.06	1155.6	0.8964	0.4189
11.83	3.44	1161.7	0.8958	0.4179
14.93	3.86	1167.0	0.8953	0.4171
18.83	4.34	1171.9	0.8948	0.4163
23.75	4.87	1176.0	0.8944	0.4157
29.93	5.47	1179.7	0.8940	0.4151
37.73	6.14	1182.7	0.8937	0.4146
47.55	6.90	1185.8	0.8934	0.4141
59.93	7.74	1188.4	0.8931	0.4137
75.93	8.71	1191.4	0.8928	0.4132
94.93	9.74	1193.9	0.8926	0.4128
119.93	10.95	1196.5	0.8923	0.4124
150.93	12.29	1198.6	0.8921	0.4121
189.93	13.78	1201.4	0.8918	0.4116

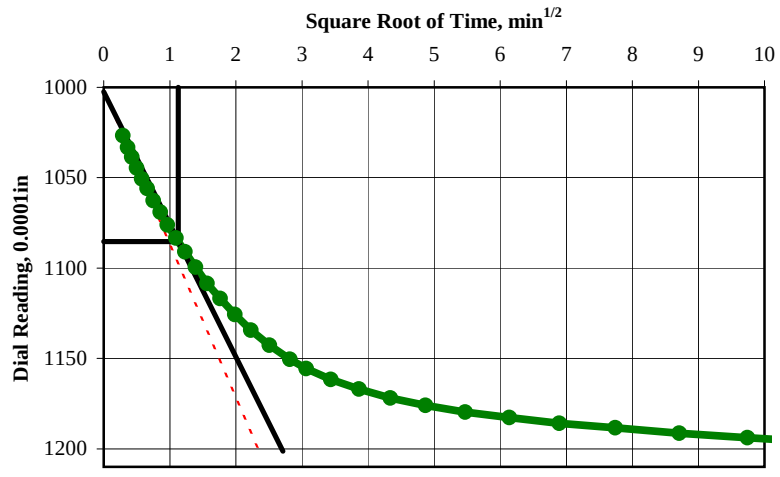
Machine Deflection

Applied Deflection Correction to Sample Height, 0.0001in: -16.5
**Correction is applied to all dial readings.*

Log of Elapsed Time vs. Dial Reading



Square Root of Elapsed Time vs. Dial Reading



Sqrt. of Elapsed Time vs Dial Reading

T0 = 0 min.	D0 = 1002.5 div.		
T90 = 1.277 min	D90 = 1085.4 div.		
T100 = NA min	D100 = 1094.6 div.		
Height at: D90 = 0.9034, D100 = 0.9025			
Average Sample Height, in	0.9050		
Average Drainage Height, in	0.4525		
T (Time Factor for T90)	0.848		
Coef. of Consol., C_v, in^2/min	0.136		

Log of Elapsed Time vs Dial Reading

T0 = 0 min.	D0 = 1003 div.		
T50 = 1.38 min.	D50 = 1088 div.		
T100 = 13.24 min.	D100 = 1173 div.		
Height at: D50 = 0.9032, D100 = 0.8947			
Average Sample Height, in	0.9050		
Average Drainage Height, in	0.4525		
T (Time Factor for T50)	0.197		
Coef. of Consol., C_v, in^2/min	0.029		

Load Summary

Initial Sample Height, in	0.9181
Initial Sample Void Ratio	0.4532
Final Sample Height, in	0.8918
Final Sample Void Ratio	0.4116
Incremental Strain, %	2.86%
Loading Duration, min	189.93333

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ONE-DIMENSIONAL CONSOLIDATION PROPERTIES OF SOILS
ASTM D 2435

Client	Civil & Environmental Consultant	Boring	SB-18
Client Project	091-867 Apex Landfill Expansion	Depth	10'-12'
Project No.	30598	Sample	ST-1
		Lab Sample No.	30598010

Visual Description: Dark Grayish Brown Sandy Clay with Gravel
Sample Conditions: Undisturbed, Inundated, and Double Drained
Machine Deflection Correction: Applied

SAMPLE PROPERTIES			*TEST DATA SUMMARY*								
	Initial	Final	**Applied**	**Load**	**Final**	**Vertical**	**Dry**	**Void**	**a_v**	**Incremental**	
Tare Number	A12	A9	**Pressure**	**Duration**	**Height**	**Strain**	**Density**	**Ratio**		**C_c**	**C_r**
Wt. Tare & WS, gm	121.92	161.44	**tsf**	**min**	**in**	**%**	**g/cc**	**e**	**ft^2/ton**		
Wt. Tare & DS, gm	104.87	138.68	Seating	NA	1.0170	0.00	1.6023	0.6913	NA	NA	NA
Wt. Tare, gm	9.53	9.8	0.25	240	1.0136	0.34%	1.6077	0.6856	2.30E-02	NA	NA
Water Content, %	17.9%	17.7%	0.5	955	1.0031	1.37%	1.6246	0.6681	6.98E-02	0.058	NA
			1	302	0.9846	3.19%	1.6551	0.6374	6.15E-02	0.102	NA
Sample Diameter, in	2.5	2.5	2	1,514	0.9569	5.91%	1.7029	0.5914	4.60E-02	0.153	NA
Sample Height, in	1.017	0.8731	4	151	0.9299	8.56%	1.7524	0.5465	2.25E-02	0.149	NA
Sample Volume, in^3	4.9922	4.2856	1	151	0.9364	7.93%	1.7403	0.5572	3.58E-03	NA	NA
Wt. WS + Ring, gm	268.2	265.74	0.25	120	0.9469	6.90%	1.7210	0.5747	2.33E-02	NA	NA
Wt. of Ring, gm	113.68	113.68	0.5	955	0.9458	7.00%	1.7229	0.5729	6.98E-03	NA	0.006
Wt. of WS, gm	154.52	152.06	1	95	0.9427	7.31%	1.7286	0.5678	1.03E-02	NA	0.017
Wet Density, pcf	117.86	135.11	2	190	0.9362	7.95%	1.7407	0.5569	1.09E-02	NA	0.036
Wet Density, g/cc	1.889	2.165	4	151	0.9252	9.03%	1.7614	0.5386	9.15E-03	NA	0.061
Water Content, %	17.9%	17.7%	8	758	0.9007	11.44%	1.8093	0.4978	1.02E-02	0.135	NA
Wt. of DS, gm	131.08	129.24	16	190	0.8731	14.15%	1.8665	0.4519	5.74E-03	0.152	NA
Dry Density, pcf	99.98	114.83									
Dry Density, g/cc	1.602	1.840									
Void Ratio, e	0.6913	0.4726									
Saturation, %	70.1%		*Note: The calculations performed and the parameters presented herein are for preliminary purposes only. GTS only accepts responsibility for the raw data obtained from the consolidation tests. This data may be interpreted differently by others. It is the responsibility of the user to determine the appropriateness and accuracy of the computed values.*								
Specific Gravity	2.71	Measured									
Height of Solids, in	0.6013	0.6013									

Input Validation | Reviewed By: | Date Tested: 12/3/2010 |

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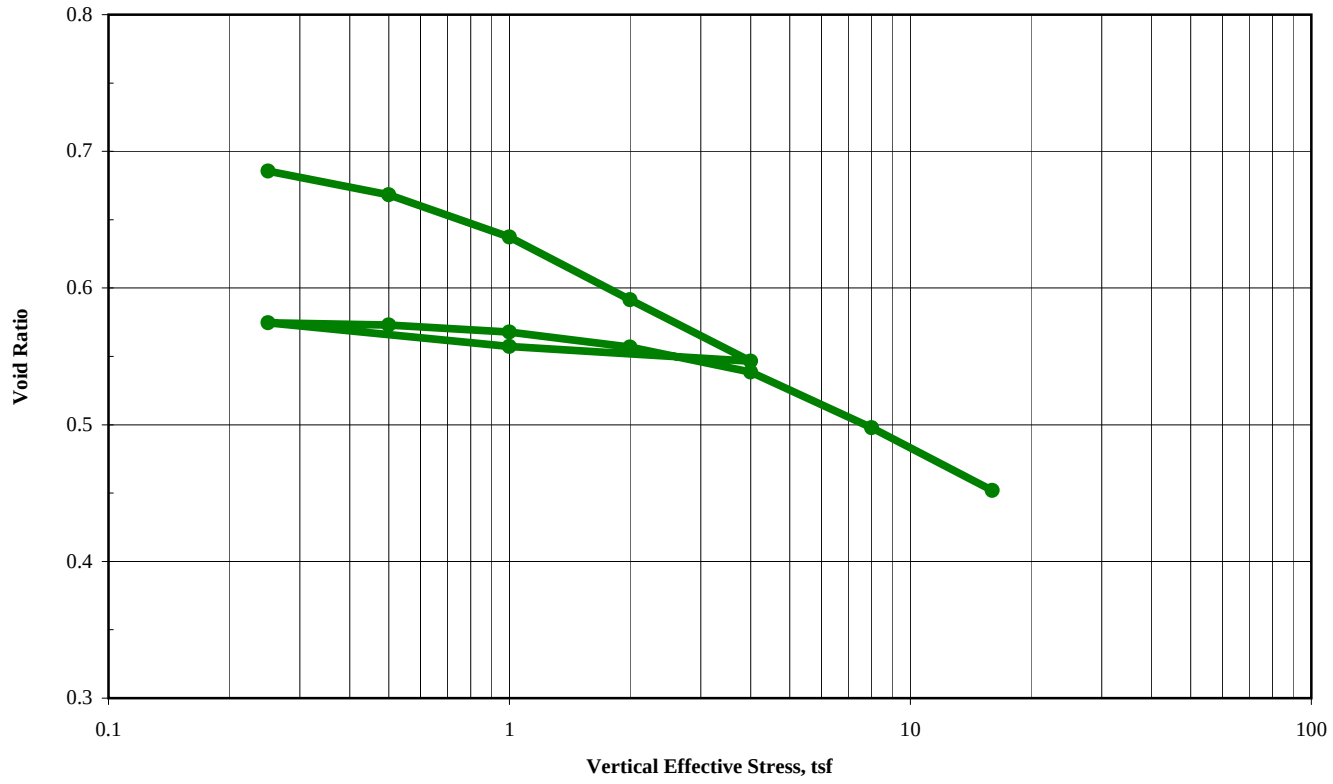
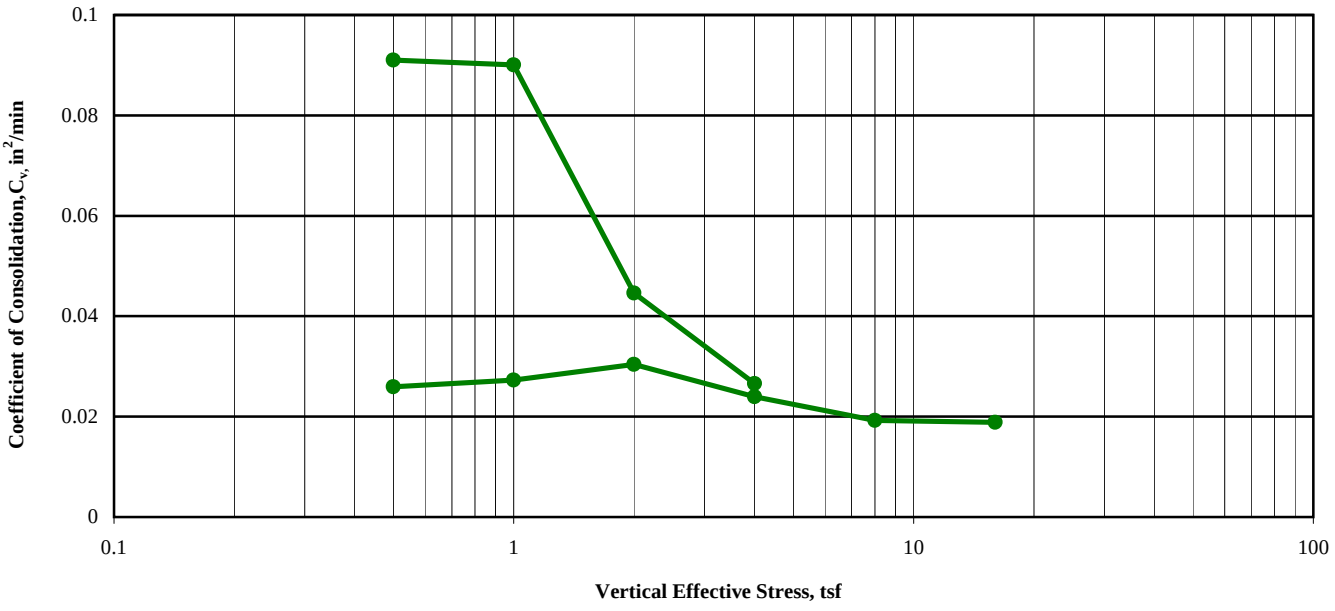
ONE-DIMENSIONAL CONSOLIDATION PROPERTIES OF SOILS
ASTM D 2435

Client	Civil & Environmental Consultants, Inc.	Boring	SB-18
Client Project	091-867 Apex Landfill Expansion	Depth	10'-12'
Project No.	30598	Sample	ST-1
		Lab Sample No.	30598010
Visual Description	Dark Grayish Brown Sandy Clay with Gravel		
Sample Conditions	Undisturbed, Inundated, and Double Drained		
Machine Deflection Correction:	Applied		

Void Ratio (Final Height) vs Vertical Effective Consolidation Stress



Coeffieicent of Consolidation (log. method) vs. Vertical Effective Consolidation Stress



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ONE-DIMENSIONAL CONSOLIDATION PROPERTIES OF SOILS
ASTM D 2435

Client	Civil & Environmental Consultant	Boring	SB-18	**Test Load, tsf**	**0-0.25**
Client Project	091-867 Apex Landfill Expansion	Depth	10'-12'		Load 1 of 13
Project No.	30598	Sample	ST-1		
		Lab ID#	30598010		
Visual Description	Dark Grayish Brown Sandy Clay with Gravel				
Test Conditions:	Undisturbed, Inundated, and Double Drained				

Time Vs. Dial Reading

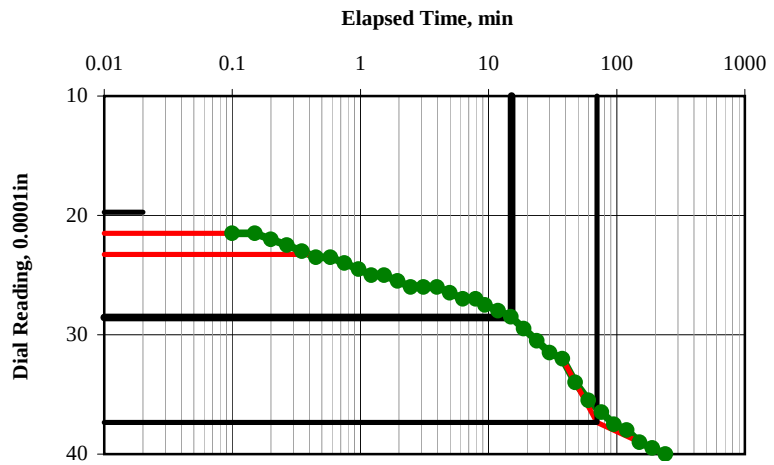
Elapsed Time (min)	Sqrt Time ($min^{1/2}$)	Dial Reading (0.0001in)	Sample Height (in)	Void Ratio
0	0	0	1.0170	0.6913
Corrections*		-5.5	-0.00055	-0.0009
Adjusted Sample Height & Void Ratio				
0.10	0.32	21.5	1.0154	0.6887
0.15	0.39	21.5	1.0154	0.6887
0.20	0.45	22.0	1.0154	0.6886
0.27	0.52	22.5	1.0153	0.6885
0.35	0.59	23.0	1.0153	0.6884
0.45	0.67	23.5	1.0152	0.6883
0.58	0.76	23.5	1.0152	0.6883
0.75	0.87	24.0	1.0152	0.6883
0.97	0.98	24.5	1.0151	0.6882
1.22	1.10	25.0	1.0151	0.6881
1.53	1.24	25.0	1.0151	0.6881
1.95	1.40	25.5	1.0150	0.6880
2.47	1.57	26.0	1.0150	0.6879
3.12	1.77	26.0	1.0150	0.6879
3.95	1.99	26.0	1.0150	0.6879
4.98	2.23	26.5	1.0149	0.6878
6.30	2.51	27.0	1.0149	0.6878
7.95	2.82	27.0	1.0149	0.6878
9.40	3.07	27.5	1.0148	0.6877
11.85	3.44	28.0	1.0148	0.6876
14.95	3.87	28.5	1.0147	0.6875
18.85	4.34	29.5	1.0146	0.6873
23.77	4.88	30.5	1.0145	0.6872
29.95	5.47	31.5	1.0144	0.6870
37.75	6.14	32.0	1.0144	0.6869
47.57	6.90	34.0	1.0142	0.6866
59.95	7.74	35.5	1.0140	0.6863
75.95	8.71	36.5	1.0139	0.6862
94.95	9.74	37.5	1.0138	0.6860
119.95	10.95	38.0	1.0138	0.6859
150.95	12.29	39.0	1.0137	0.6858
189.95	13.78	39.5	1.0136	0.6857
239.95	15.49	40.0	1.0136	0.6856

Machine Deflection

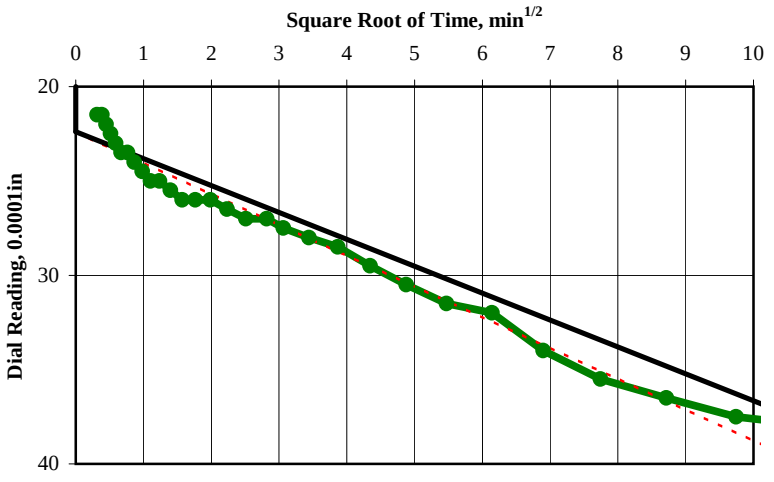
Applied Deflection Correction to Sample Height, 0.0001in -5.5

**Correction is applied to all dial readings.*

Log of Elapsed Time vs. Dial Reading



Square Root of Elapsed Time vs. Dial Reading



Sqrt. of Elapsed Time vs Dial Reading

T0 = 0 min.	D0 = 22.4 div.		
T90 = 0 min	D90 = 22.4 div.		
T100 = NA min	D100 = 22.4 div.		
Height at: D90 = 1.0153, D100 = 1.0153			
Average Sample Height, in	1.0153		
Average Drainage Height, in	0.5076		
T (Time Factor for T90)	0.848		
Coef. of Consol., C_v, in^2/min	#DIV/0!		

Log of Elapsed Time vs Dial Reading

T0 = 0 min.	D0 = 19.7 div.		
T50 = 15.09 min.	D50 = 28.5 div.		
T100 = 70 min.	D100 = 37.3 div.		
Height at: D50 = 1.0147, D100 = 1.0138			
Average Sample Height, in	1.0153		
Average Drainage Height, in	0.5076		
T (Time Factor for T50)	0.197		
Coef. of Consol., C_v, in^2/min	0.003		

Load Summary

Initial Sample Height, in	1.0170
Initial Sample Void Ratio	0.6913
Final Sample Height, in	1.0136
Final Sample Void Ratio	0.6856
Incremental Strain, %	0.34%
Loading Duration, min	239.95

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ONE-DIMENSIONAL CONSOLIDATION PROPERTIES OF SOILS
ASTM D 2435

Client	Civil & Environmental Consultant	Boring	SB-18	**Test Load, tsf**	**0.25-0.5**
Client Project	091-867 Apex Landfill Expansion	Depth	10'-12'		Load 2 of 13
Project No.	30598	Sample	ST-1		
		Lab ID#	30598010		
Visual Description	Dark Grayish Brown Sandy Clay with Gravel				
Test Conditions:	Undisturbed, Inundated, and Double Drained				

Time Vs. Dial Reading

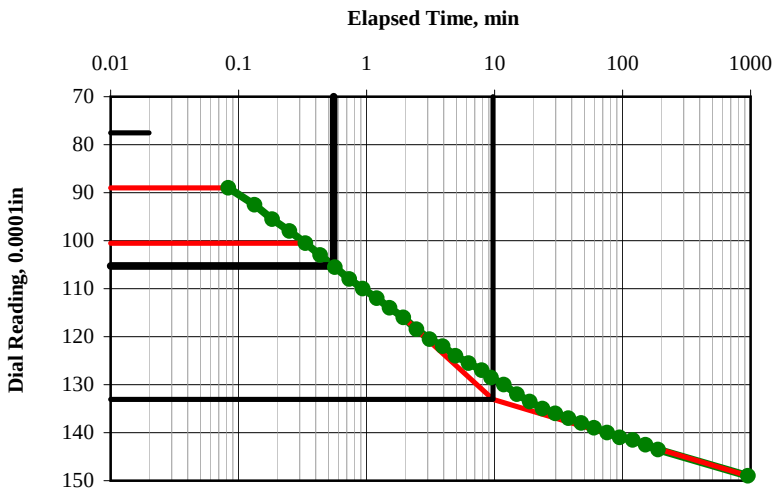
Elapsed Time (min)	Sqrt Time ($min^{1/2}$)	Dial Reading (0.0001in)	Sample Height (in)	Void Ratio
0	0	40.0	1.0136	0.6856
Corrections*		-4	-0.0004	-0.0007
Adjusted Sample Height & Void Ratio				
0.08	0.29	89.0	1.0091	0.6781
0.13	0.37	92.5	1.0087	0.6775
0.18	0.43	95.5	1.0084	0.6770
0.25	0.50	98.0	1.0082	0.6766
0.33	0.58	100.5	1.0079	0.6762
0.43	0.66	103.0	1.0077	0.6758
0.57	0.75	105.5	1.0074	0.6754
0.73	0.86	108.0	1.0072	0.6750
0.93	0.97	110.0	1.0070	0.6746
1.20	1.10	112.0	1.0068	0.6743
1.52	1.23	114.0	1.0066	0.6740
1.93	1.39	116.0	1.0064	0.6736
2.45	1.57	118.5	1.0061	0.6732
3.10	1.76	120.5	1.0059	0.6729
3.93	1.98	122.0	1.0058	0.6726
4.97	2.23	124.0	1.0056	0.6723
6.28	2.51	125.5	1.0054	0.6720
7.93	2.82	127.0	1.0053	0.6718
9.38	3.06	128.5	1.0051	0.6715
11.83	3.44	130.0	1.0050	0.6713
14.93	3.86	132.0	1.0048	0.6710
18.83	4.34	133.5	1.0046	0.6707
23.75	4.87	135.0	1.0045	0.6705
29.93	5.47	136.0	1.0044	0.6703
37.73	6.14	137.0	1.0043	0.6701
47.55	6.90	138.0	1.0042	0.6700
59.93	7.74	139.0	1.0041	0.6698
75.93	8.71	140.0	1.0040	0.6696
94.93	9.74	141.0	1.0039	0.6695
119.93	10.95	141.5	1.0038	0.6694
150.93	12.29	142.5	1.0037	0.6692
189.93	13.78	143.5	1.0036	0.6690
954.93	30.90	149.0	1.0031	0.6681

Machine Deflection

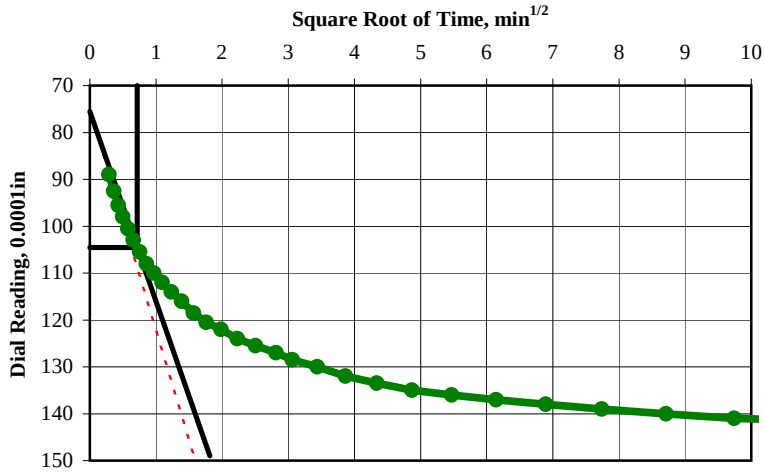
Applied Deflection Correction to Sample Height, 0.0001in -4

**Correction is applied to all dial readings.*

Log of Elapsed Time vs. Dial Reading



Square Root of Elapsed Time vs. Dial Reading



Sqrt. of Elapsed Time vs Dial Reading

T0 = 0 min.	D0 = 75.5 div.
T90 = 0.518 min	D90 = 104.5 div.
T100 = NA min	D100 = 107.7 div.
Height at: D90 = 1.0075, D100 = 1.0072	
Average Sample Height, in	1.0083
Average Drainage Height, in	0.5042
T (Time Factor for T90)	0.848
Coef. of Consol., C_v, in^2/min	0.421

Log of Elapsed Time vs Dial Reading

T0 = 0 min.	D0 = 77.5 div.
T50 = 0.55 min.	D50 = 105.3 div.
T100 = 9.72 min.	D100 = 133.1 div.
Height at: D50 = 1.0074, D100 = 1.0046	
Average Sample Height, in	1.0083
Average Drainage Height, in	0.5042
T (Time Factor for T50)	0.197
Coef. of Consol., C_v, in^2/min	0.091

Load Summary

Initial Sample Height, in	1.0136
Initial Sample Void Ratio	0.6856
Final Sample Height, in	1.0031
Final Sample Void Ratio	0.6681
Incremental Strain, %	1.04%
Loading Duration, min	954.93333

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ONE-DIMENSIONAL CONSOLIDATION PROPERTIES OF SOILS
ASTM D 2435

Client	Civil & Environmental Consultant	Boring	SB-18	**Test Load, tsf**	**0.5-1**
Client Project	091-867 Apex Landfill Expansion	Depth	10'-12'		Load 3 of 13
Project No.	30598	Sample	ST-1		
		Lab ID#	30598010		
Visual Description	Dark Grayish Brown Sandy Clay with Gravel				
Test Conditions:	Undisturbed, Inundated, and Double Drained				

Time Vs. Dial Reading

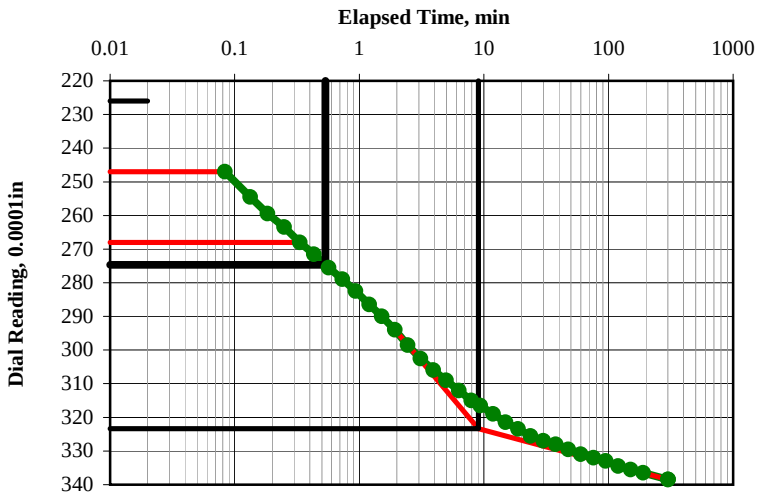
Elapsed Time (min)	Sqrt Time ($min^{1/2}$)	Dial Reading (0.0001in)	Sample Height (in)	Void Ratio
0	0	149.0	1.0031	0.6681
Corrections*		-4.5	-0.00045	-0.0007
Adjusted Sample Height & Void Ratio				
0.08	0.29	247.0	0.9937	0.6526
0.13	0.37	254.5	0.9930	0.6513
0.18	0.43	259.5	0.9925	0.6505
0.25	0.50	263.5	0.9921	0.6498
0.33	0.58	268.0	0.9916	0.6491
0.43	0.66	271.5	0.9913	0.6485
0.57	0.75	275.5	0.9909	0.6478
0.73	0.86	279.0	0.9905	0.6473
0.93	0.97	282.5	0.9902	0.6467
1.20	1.10	286.5	0.9898	0.6460
1.52	1.23	290.0	0.9894	0.6454
1.93	1.39	294.0	0.9890	0.6448
2.45	1.57	298.5	0.9886	0.6440
3.10	1.76	302.5	0.9882	0.6434
3.93	1.98	306.0	0.9878	0.6428
4.97	2.23	309.0	0.9875	0.6423
6.28	2.51	312.0	0.9872	0.6418
7.93	2.82	315.0	0.9869	0.6413
9.38	3.06	316.5	0.9868	0.6410
11.83	3.44	319.0	0.9865	0.6406
14.93	3.86	321.5	0.9863	0.6402
18.83	4.34	323.5	0.9861	0.6399
23.75	4.87	325.5	0.9859	0.6395
29.93	5.47	327.0	0.9857	0.6393
37.73	6.14	328.0	0.9856	0.6391
47.55	6.90	329.5	0.9855	0.6389
59.93	7.74	331.0	0.9853	0.6386
75.93	8.71	332.0	0.9852	0.6384
94.93	9.74	333.0	0.9851	0.6383
119.93	10.95	334.5	0.9850	0.6380
150.93	12.29	335.5	0.9849	0.6379
189.93	13.78	336.5	0.9848	0.6377
301.93	17.38	338.5	0.9846	0.6374

Machine Deflection

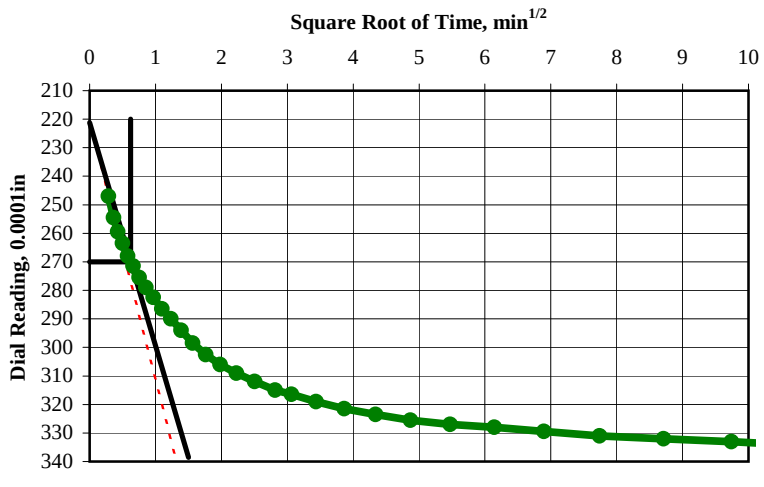
Applied Deflection Correction to Sample Height, 0.0001in -4.5

**Correction is applied to all dial readings.*

Log of Elapsed Time vs. Dial Reading



Square Root of Elapsed Time vs. Dial Reading



Sqrt. of Elapsed Time vs Dial Reading

T0 = 0 min.	D0 = 221.2 div.
T90 = 0.384 min	D90 = 270 div.
T100 = NA min	D100 = 275.4 div.
Height at: D90 = 0.9914, D100 = 0.9909	
Average Sample Height, in	0.9938
Average Drainage Height, in	0.4969
T (Time Factor for T90)	0.848
Coef. of Consol., C_v, in^2/min	0.538

Log of Elapsed Time vs Dial Reading

T0 = 0 min.	D0 = 226 div.
T50 = 0.54 min.	D50 = 274.7 div.
T100 = 9.05 min.	D100 = 323.3 div.
Height at: D50 = 0.9909, D100 = 0.9861	
Average Sample Height, in	0.9938
Average Drainage Height, in	0.4969
T (Time Factor for T50)	0.197
Coef. of Consol., C_v, in^2/min	0.090

Load Summary

Initial Sample Height, in	1.0031
Initial Sample Void Ratio	0.6681
Final Sample Height, in	0.9846
Final Sample Void Ratio	0.6374
Incremental Strain, %	1.84%
Loading Duration, min	301.93333

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ONE-DIMENSIONAL CONSOLIDATION PROPERTIES OF SOILS
ASTM D 2435

Client	Civil & Environmental Consultant	Boring	SB-18	**Test Load, tsf**	**1-2**
Client Project	091-867 Apex Landfill Expansion	Depth	10'-12'		Load 4 of 13
Project No.	30598	Sample	ST-1		
		Lab ID#	30598010		
Visual Description	Dark Grayish Brown Sandy Clay with Gravel				
Test Conditions:	Undisturbed, Inundated, and Double Drained				

Time Vs. Dial Reading

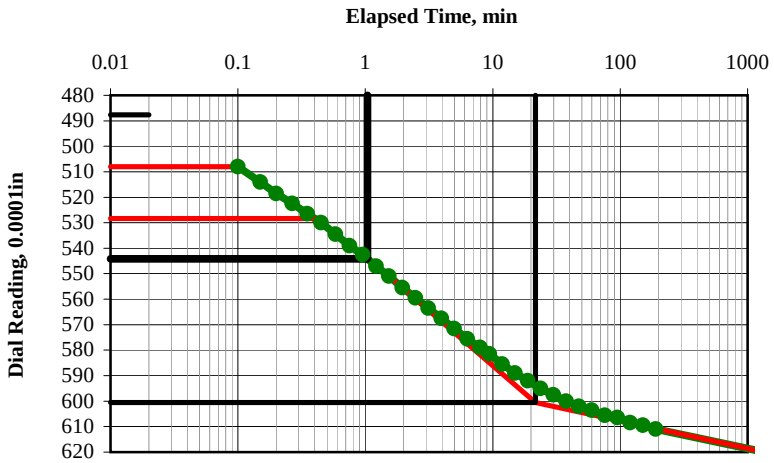
Elapsed Time (min)	Sqrt Time ($min^{1/2}$)	Dial Reading (0.0001in)	Sample Height (in)	Void Ratio
0	0	338.5	0.9846	0.6374
Corrections*		-5.5	-0.00055	-0.0009
Adjusted Sample Height & Void Ratio				
0.10	0.32	508.0	0.9682	0.6101
0.15	0.39	514.0	0.9676	0.6091
0.20	0.45	518.5	0.9671	0.6083
0.27	0.52	522.5	0.9667	0.6077
0.35	0.59	526.5	0.9663	0.6070
0.45	0.67	530.0	0.9660	0.6064
0.58	0.76	534.5	0.9655	0.6057
0.75	0.87	539.0	0.9651	0.6049
0.95	0.97	542.5	0.9647	0.6044
1.22	1.10	547.0	0.9643	0.6036
1.53	1.24	551.0	0.9639	0.6029
1.95	1.40	555.5	0.9634	0.6022
2.47	1.57	559.5	0.9630	0.6015
3.12	1.77	563.5	0.9626	0.6009
3.95	1.99	567.5	0.9622	0.6002
4.98	2.23	571.5	0.9618	0.5995
6.30	2.51	575.5	0.9614	0.5989
7.95	2.82	579.0	0.9611	0.5983
9.40	3.07	581.5	0.9608	0.5979
11.85	3.44	585.5	0.9604	0.5972
14.95	3.87	589.0	0.9601	0.5966
18.85	4.34	592.0	0.9598	0.5961
23.77	4.88	595.0	0.9595	0.5956
29.95	5.47	597.5	0.9592	0.5952
37.75	6.14	600.0	0.9590	0.5948
47.57	6.90	602.0	0.9588	0.5945
59.95	7.74	603.5	0.9586	0.5942
75.95	8.71	605.5	0.9584	0.5939
94.95	9.74	606.5	0.9583	0.5937
119.95	10.95	608.5	0.9581	0.5934
150.95	12.29	609.5	0.9580	0.5932
189.95	13.78	611.0	0.9579	0.5930
1513.95	38.91	620.5	0.9569	0.5914

Machine Deflection

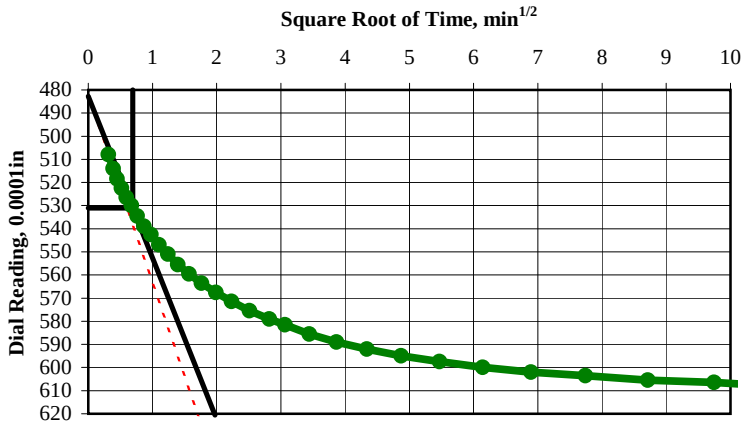
Applied Deflection Correction to Sample Height, 0.0001in -5.5

**Correction is applied to all dial readings.*

Log of Elapsed Time vs. Dial Reading



Square Root of Elapsed Time vs. Dial Reading



Sqrt. of Elapsed Time vs Dial Reading

T0 = 0 min.	D0 = 482.7 div.		
T90 = 0.476 min	D90 = 531 div.		
T100 = NA min	D100 = 536.4 div.		
Height at: D90 = 0.9659, D100 = 0.9653			
Average Sample Height, in	0.9707		
Average Drainage Height, in	0.4854		
T (Time Factor for T90)	0.848		
Coef. of Consol., C_v, in^2/min	0.417		

Log of Elapsed Time vs Dial Reading

T0 = 0 min.	D0 = 487.6 div.		
T50 = 1.04 min.	D50 = 544.1 div.		
T100 = 21.68 min.	D100 = 600.6 div.		
Height at: D50 = 0.9645, D100 = 0.9589			
Average Sample Height, in	0.9707		
Average Drainage Height, in	0.4854		
T (Time Factor for T50)	0.197		
Coef. of Consol., C_v, in^2/min	0.045		

Load Summary

Initial Sample Height, in	0.9846
Initial Sample Void Ratio	0.6374
Final Sample Height, in	0.9569
Final Sample Void Ratio	0.5914
Incremental Strain, %	2.81%
Loading Duration, min	1513.95

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ONE-DIMENSIONAL CONSOLIDATION PROPERTIES OF SOILS
ASTM D 2435

Client	Civil & Environmental Consultant	Boring	SB-18	**Test Load, tsf**	**2-4**
Client Project	091-867 Apex Landfill Expansion	Depth	10'-12'		Load 5 of 13
Project No.	30598	Sample	ST-1		
		Lab ID#	30598010		

Visual Description: Dark Grayish Brown Sandy Clay with Gravel
Test Conditions: Undisturbed, Inundated, and Double Drained

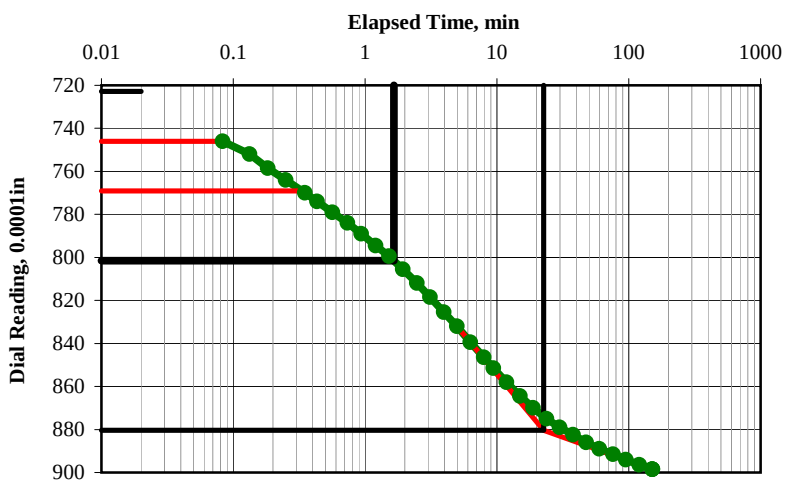
Time Vs. Dial Reading

Elapsed Time (min)	Sqrt Time ($min^{1/2}$)	Dial Reading (0.0001in)	Sample Height (in)	Void Ratio
0	0	620.5	0.9569	0.5914
Corrections*		-8	-0.0008	-0.0013
Adjusted Sample Height & Void Ratio				
0.08	0.29	746.0	0.9452	0.5718
0.13	0.37	752.0	0.9446	0.5708
0.18	0.43	758.5	0.9439	0.5698
0.25	0.50	764.0	0.9434	0.5688
0.35	0.59	770.0	0.9428	0.5679
0.43	0.66	774.0	0.9424	0.5672
0.57	0.75	779.0	0.9419	0.5664
0.73	0.86	784.0	0.9414	0.5655
0.93	0.97	789.0	0.9409	0.5647
1.20	1.10	794.5	0.9403	0.5638
1.52	1.23	799.5	0.9398	0.5629
1.93	1.39	805.5	0.9392	0.5619
2.47	1.57	812.0	0.9386	0.5609
3.12	1.77	818.5	0.9379	0.5598
3.95	1.99	825.5	0.9372	0.5586
4.98	2.23	832.0	0.9366	0.5575
6.30	2.51	839.5	0.9358	0.5563
7.95	2.82	846.5	0.9351	0.5551
9.40	3.07	851.5	0.9346	0.5543
11.85	3.44	858.0	0.9340	0.5532
14.95	3.87	864.5	0.9333	0.5521
18.85	4.34	870.0	0.9328	0.5512
23.77	4.88	875.0	0.9323	0.5504
29.95	5.47	879.0	0.9319	0.5497
37.75	6.14	882.5	0.9315	0.5491
47.57	6.90	886.0	0.9312	0.5486
59.95	7.74	889.0	0.9309	0.5481
75.95	8.71	891.5	0.9306	0.5476
94.95	9.74	894.0	0.9304	0.5472
119.95	10.95	896.5	0.9301	0.5468
150.95	12.29	898.5	0.9299	0.5465

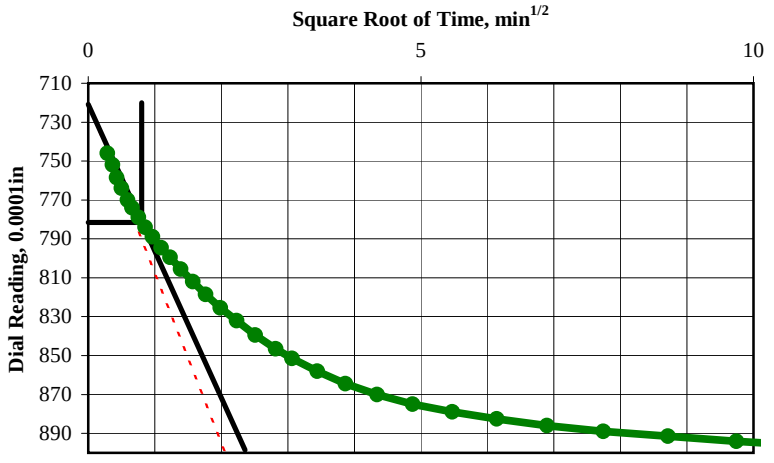
Machine Deflection

Applied Deflection Correction to Sample Height, 0.0001in: -8
**Correction is applied to all dial readings.*

Log of Elapsed Time vs. Dial Reading



Square Root of Elapsed Time vs. Dial Reading



Sqrt. of Elapsed Time vs Dial Reading

T0 = 0 min.	D0 = 720.9 div.
T90 = 0.656 min	D90 = 781.5 div.
T100 = NA min	D100 = 788.3 div.
Height at: D90 = 0.9416, D100 = 0.9409	
Average Sample Height, in	0.9434
Average Drainage Height, in	0.4717
T (Time Factor for T90)	0.848
Coef. of Consol., C_v, in^2/min	0.291

Log of Elapsed Time vs Dial Reading

T0 = 0 min.	D0 = 722.9 div.
T50 = 1.65 min.	D50 = 801.6 div.
T100 = 22.57 min.	D100 = 880.3 div.
Height at: D50 = 0.9396, D100 = 0.9317	
Average Sample Height, in	0.9434
Average Drainage Height, in	0.4717
T (Time Factor for T50)	0.197
Coef. of Consol., C_v, in^2/min	0.027

Load Summary

Initial Sample Height, in	0.9569
Initial Sample Void Ratio	0.5914
Final Sample Height, in	0.9299
Final Sample Void Ratio	0.5465
Incremental Strain, %	2.82%
Loading Duration, min	150.95

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ONE-DIMENSIONAL CONSOLIDATION PROPERTIES OF SOILS
ASTM D 2435

Client	Civil & Environmental Consultant	Boring	SB-18	**Test Load, tsf**	**4-1**
Client Project	091-867 Apex Landfill Expansion	Depth	10'-12'		Load 6 of 13
Project No.	30598	Sample	ST-1		
		Lab ID#	30598010		
Visual Description	Dark Grayish Brown Sandy Clay with Gravel				
Test Conditions:	Undisturbed, Inundated, and Double Drained				

Time Vs. Dial Reading

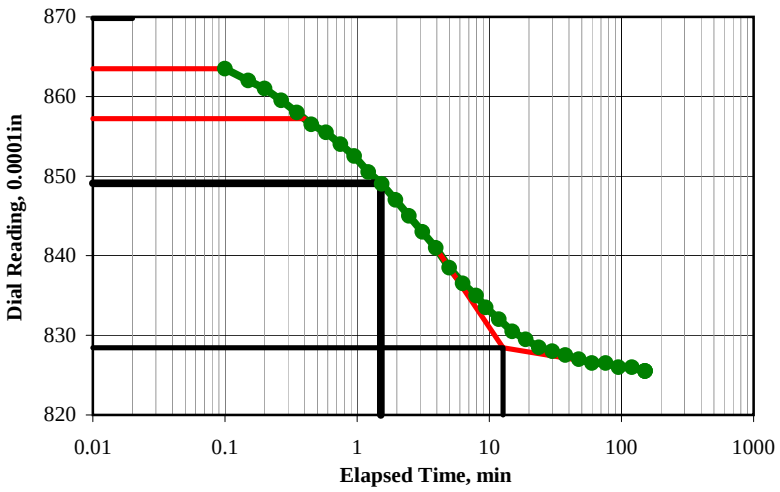
Elapsed Time (min)	Sqrt Time ($min^{1/2}$)	Dial Reading (0.0001in)	Sample Height (in)	Void Ratio
0	0	898.5	0.9299	0.5465
Corrections*		8.5	0.00085	0.00141
Adjusted Sample Height & Void Ratio				
0.10	0.32	863.5	0.9326	0.5509
0.15	0.39	862.0	0.9327	0.5511
0.20	0.45	861.0	0.9328	0.5513
0.27	0.52	859.5	0.9330	0.5516
0.35	0.59	858.0	0.9331	0.5518
0.45	0.67	856.5	0.9333	0.5521
0.58	0.76	855.5	0.9334	0.5522
0.75	0.87	854.0	0.9335	0.5525
0.95	0.97	852.5	0.9337	0.5527
1.22	1.10	850.5	0.9339	0.5530
1.53	1.24	849.0	0.9340	0.5533
1.95	1.40	847.0	0.9342	0.5536
2.47	1.57	845.0	0.9344	0.5540
3.12	1.77	843.0	0.9346	0.5543
3.95	1.99	841.0	0.9348	0.5546
4.98	2.23	838.5	0.9351	0.5550
6.30	2.51	836.5	0.9353	0.5554
7.95	2.82	835.0	0.9354	0.5556
9.40	3.07	833.5	0.9356	0.5559
11.85	3.44	832.0	0.9357	0.5561
14.95	3.87	830.5	0.9359	0.5564
18.85	4.34	829.5	0.9360	0.5565
23.77	4.88	828.5	0.9361	0.5567
29.95	5.47	828.0	0.9361	0.5568
37.75	6.14	827.5	0.9362	0.5569
47.57	6.90	827.0	0.9362	0.5570
59.95	7.74	826.5	0.9363	0.5570
75.95	8.71	826.5	0.9363	0.5570
94.95	9.74	826.0	0.9363	0.5571
119.95	10.95	826.0	0.9363	0.5571
150.95	12.29	825.5	0.9364	0.5572

Machine Deflection

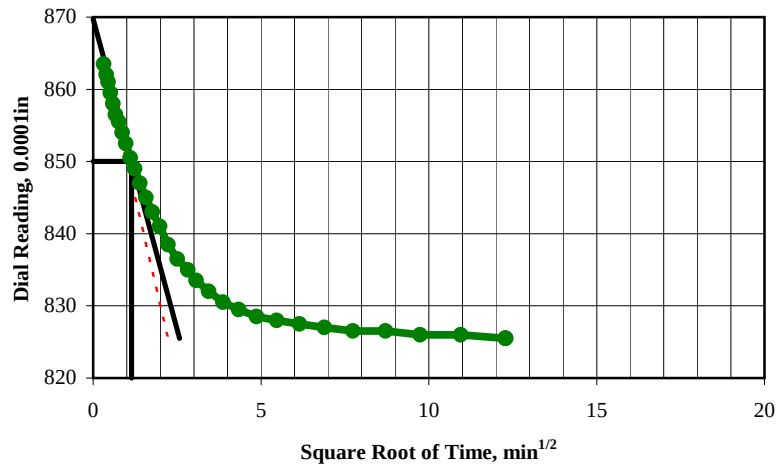
Applied Deflection Correction to Sample Height, 0.0001in 8.5

**Correction is applied to all dial readings.*

Log of Elapsed Time vs. Dial Reading



Square Root of Elapsed Time vs. Dial Reading



Sqrt. of Elapsed Time vs Dial Reading

T0 = 0 min.	D0 = 869.7 div.		
T90 = 1.323 min	D90 = 850 div.		
T100 = NA min	D100 = 847.8 div.		
Height at: D90 = 0.9339, D100 = 0.9341			
Average Sample Height, in	0.9331		
Average Drainage Height, in	0.4666		
T (Time Factor for T90)	0.848		
Coef. of Consol., C_v, in^2/min	0.140		

Log of Elapsed Time vs Dial Reading

T0 = 0 min.	D0 = 869.8 div.		
T50 = 1.51 min.	D50 = 849.1 div.		
T100 = 12.72 min.	D100 = 828.4 div.		
Height at: D50 = 0.934, D100 = 0.9361			
Average Sample Height, in	0.9331		
Average Drainage Height, in	0.4666		
T (Time Factor for T50)	0.197		
Coef. of Consol., C_v, in^2/min	0.028		

Load Summary

Initial Sample Height, in	0.9299
Initial Sample Void Ratio	0.5465
Final Sample Height, in	0.9364
Final Sample Void Ratio	0.5572
Incremental Strain, %	-0.69%
Loading Duration, min	150.95

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ONE-DIMENSIONAL CONSOLIDATION PROPERTIES OF SOILS
ASTM D 2435

Client	Civil & Environmental Consultant	Boring	SB-18	**Test Load, tsf**	**1-0.25**
Client Project	091-867 Apex Landfill Expansion	Depth	10'-12'		Load 7 of 13
Project No.	30598	Sample	ST-1		
		Lab ID#	30598010		
Visual Description	Dark Grayish Brown Sandy Clay with Gravel				
Test Conditions:	Undisturbed, Inundated, and Double Drained				

Time Vs. Dial Reading

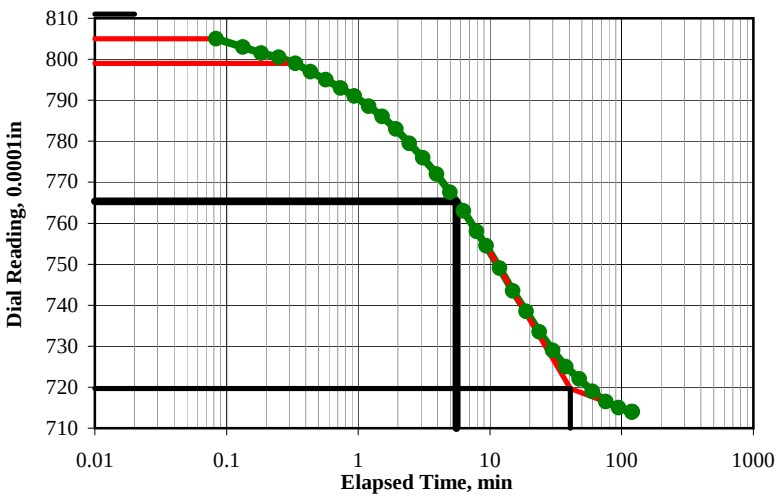
Elapsed Time (min)	Sqrt Time ($min^{1/2}$)	Dial Reading (0.0001in)	Sample Height (in)	Void Ratio
0	0	825.5	0.9364	0.5572
Corrections*		6.5	0.00065	0.00108
Adjusted Sample Height & Void Ratio				
0.08	0.29	805.0	0.9378	0.5595
0.13	0.37	803.0	0.9380	0.5599
0.18	0.43	801.5	0.9381	0.5601
0.25	0.50	800.5	0.9382	0.5603
0.33	0.58	799.0	0.9384	0.5605
0.43	0.66	797.0	0.9386	0.5609
0.57	0.75	795.0	0.9388	0.5612
0.73	0.86	793.0	0.9390	0.5615
0.93	0.97	791.0	0.9392	0.5619
1.20	1.10	788.5	0.9394	0.5623
1.52	1.23	786.0	0.9397	0.5627
1.93	1.39	783.0	0.9400	0.5632
2.45	1.57	779.5	0.9403	0.5638
3.10	1.76	776.0	0.9407	0.5644
3.93	1.98	772.0	0.9411	0.5650
4.97	2.23	767.5	0.9415	0.5658
6.28	2.51	763.0	0.9420	0.5665
7.93	2.82	758.0	0.9425	0.5674
9.38	3.06	754.5	0.9428	0.5679
11.83	3.44	749.0	0.9434	0.5688
14.93	3.86	743.5	0.9439	0.5698
18.83	4.34	738.5	0.9444	0.5706
23.75	4.87	733.5	0.9449	0.5714
29.93	5.47	729.0	0.9454	0.5722
37.73	6.14	725.0	0.9458	0.5728
47.55	6.90	722.0	0.9461	0.5733
59.93	7.74	719.0	0.9464	0.5738
75.93	8.71	716.5	0.9466	0.5743
94.93	9.74	715.0	0.9468	0.5745
119.93	10.95	714.0	0.9469	0.5747

Machine Deflection

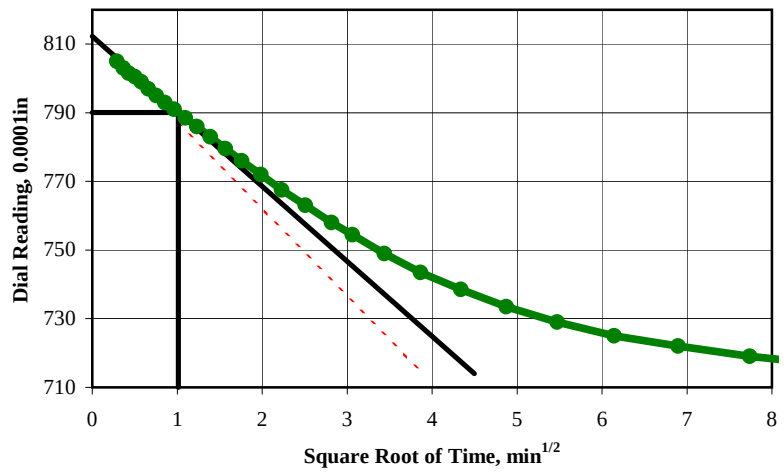
Applied Deflection Correction to Sample Height, 0.0001in 6.5

**Correction is applied to all dial readings.*

Log of Elapsed Time vs. Dial Reading



Square Root of Elapsed Time vs. Dial Reading



Sqrt. of Elapsed Time vs Dial Reading

T0 = 0 min.	D0 = 812.2 div.
T90 = 1.02 min	D90 = 790.1 div.
T100 = NA min	D100 = 787.6 div.
Height at: D90 = 0.9392, D100 = 0.9395	
Average Sample Height, in	0.9416
Average Drainage Height, in	0.4708
T (Time Factor for T90)	0.848
Coef. of Consol., C_v, in^2/min	0.183

Log of Elapsed Time vs Dial Reading

T0 = 0 min.	D0 = 811 div.
T50 = 5.56 min.	D50 = 765.3 div.
T100 = 40.77 min.	D100 = 719.7 div.
Height at: D50 = 0.9417, D100 = 0.9463	
Average Sample Height, in	0.9416
Average Drainage Height, in	0.4708
T (Time Factor for T50)	0.197
Coef. of Consol., C_v, in^2/min	0.008

Load Summary

Initial Sample Height, in	0.9364
Initial Sample Void Ratio	0.5572
Final Sample Height, in	0.9469
Final Sample Void Ratio	0.5747
Incremental Strain, %	-1.12%
Loading Duration, min	119.93333

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ONE-DIMENSIONAL CONSOLIDATION PROPERTIES OF SOILS
ASTM D 2435

Client	Civil & Environmental Consultant	Boring	SB-18	**Test Load, tsf**	**0.25-0.5**
Client Project	091-867 Apex Landfill Expansion	Depth	10'-12'		Load 8 of 13
Project No.	30598	Sample	ST-1		
		Lab ID#	30598010		
Visual Description	Dark Grayish Brown Sandy Clay with Gravel				
Test Conditions:	Undisturbed, Inundated, and Double Drained				

Time Vs. Dial Reading

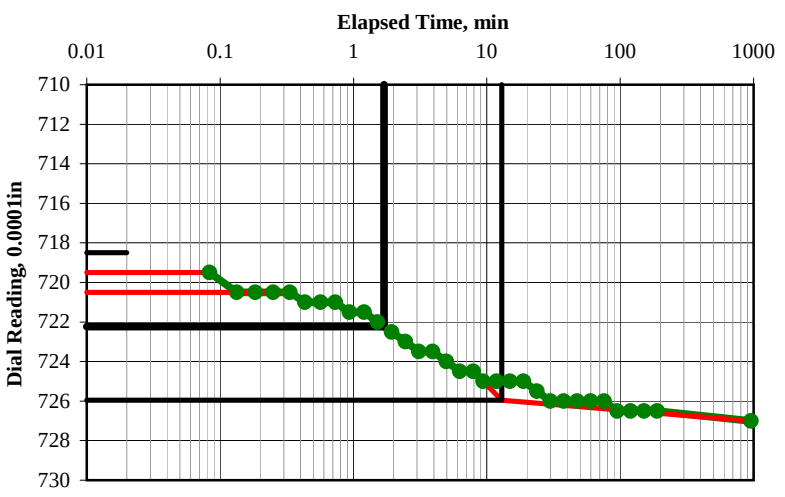
Elapsed Time (min)	Sqrt Time ($min^{1/2}$)	Dial Reading (0.0001in)	Sample Height (in)	Void Ratio
0	0	714.0	0.9469	0.5747
Corrections*		-2.5	-0.00025	-0.0004
Adjusted Sample Height & Void Ratio				
0.08	0.29	719.5	0.9466	0.5742
0.13	0.37	720.5	0.9465	0.5740
0.18	0.43	720.5	0.9465	0.5740
0.25	0.50	720.5	0.9465	0.5740
0.33	0.58	720.5	0.9465	0.5740
0.43	0.66	721.0	0.9464	0.5739
0.57	0.75	721.0	0.9464	0.5739
0.73	0.86	721.0	0.9464	0.5739
0.93	0.97	721.5	0.9464	0.5738
1.20	1.10	721.5	0.9464	0.5738
1.52	1.23	722.0	0.9463	0.5738
1.93	1.39	722.5	0.9463	0.5737
2.45	1.57	723.0	0.9462	0.5736
3.10	1.76	723.5	0.9462	0.5735
3.93	1.98	723.5	0.9462	0.5735
4.97	2.23	724.0	0.9461	0.5734
6.28	2.51	724.5	0.9461	0.5733
7.93	2.82	724.5	0.9461	0.5733
9.38	3.06	725.0	0.9460	0.5733
11.83	3.44	725.0	0.9460	0.5733
14.93	3.86	725.0	0.9460	0.5733
18.83	4.34	725.0	0.9460	0.5733
23.75	4.87	725.5	0.9460	0.5732
29.93	5.47	726.0	0.9459	0.5731
37.73	6.14	726.0	0.9459	0.5731
47.55	6.90	726.0	0.9459	0.5731
59.93	7.74	726.0	0.9459	0.5731
75.93	8.71	726.0	0.9459	0.5731
94.93	9.74	726.5	0.9459	0.5730
119.93	10.95	726.5	0.9459	0.5730
150.93	12.29	726.5	0.9459	0.5730
189.93	13.78	726.5	0.9459	0.5730
954.93	30.90	727.0	0.9458	0.5729

Machine Deflection

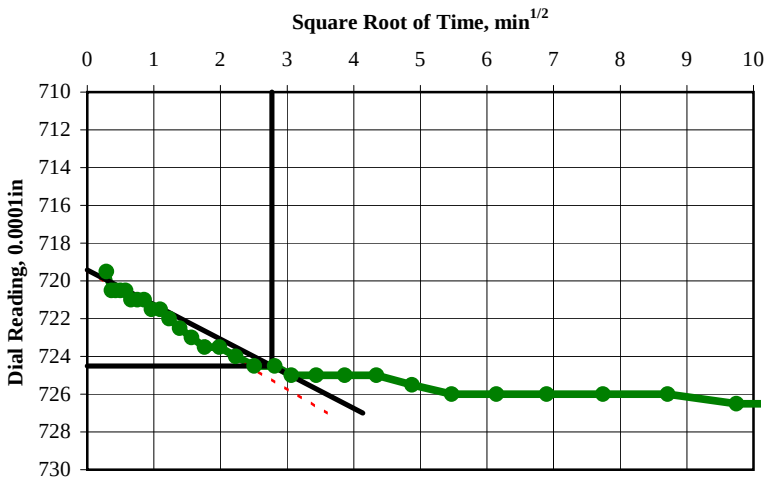
Applied Deflection Correction to Sample Height, 0.0001in -2.5

**Correction is applied to all dial readings.*

Log of Elapsed Time vs. Dial Reading



Square Root of Elapsed Time vs. Dial Reading



Sqrt. of Elapsed Time vs Dial Reading

T0 = 0 min.	D0 = 719.4 div.		
T90 = 7.673 min	D90 = 724.5 div.		
T100 = NA min	D100 = 725.1 div.		
Height at: D90 = 0.9461, D100 = 0.946			
Average Sample Height, in	0.9463		
Average Drainage Height, in	0.4732		
T (Time Factor for T90)	0.848		
Coef. of Consol., C_v, in^2/min	0.025		

Log of Elapsed Time vs Dial Reading

T0 = 0 min.	D0 = 718.5 div.		
T50 = 1.7 min.	D50 = 722.2 div.		
T100 = 12.95 min.	D100 = 726 div.		
Height at: D50 = 0.9463, D100 = 0.9459			
Average Sample Height, in	0.9463		
Average Drainage Height, in	0.4732		
T (Time Factor for T50)	0.197		
Coef. of Consol., C_v, in^2/min	0.026		

Load Summary

Initial Sample Height, in	0.9469
Initial Sample Void Ratio	0.5747
Final Sample Height, in	0.9458
Final Sample Void Ratio	0.5729
Incremental Strain, %	0.11%
Loading Duration, min	954.93333

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ONE-DIMENSIONAL CONSOLIDATION PROPERTIES OF SOILS
ASTM D 2435

Client	Civil & Environmental Consultant	Boring	SB-18	**Test Load, tsf**	**0.5-1**
Client Project	091-867 Apex Landfill Expansion	Depth	10'-12'		Load 9 of 13
Project No.	30598	Sample	ST-1		
		Lab ID#	30598010		
Visual Description	Dark Grayish Brown Sandy Clay with Gravel				
Test Conditions:	Undisturbed, Inundated, and Double Drained				

Time Vs. Dial Reading

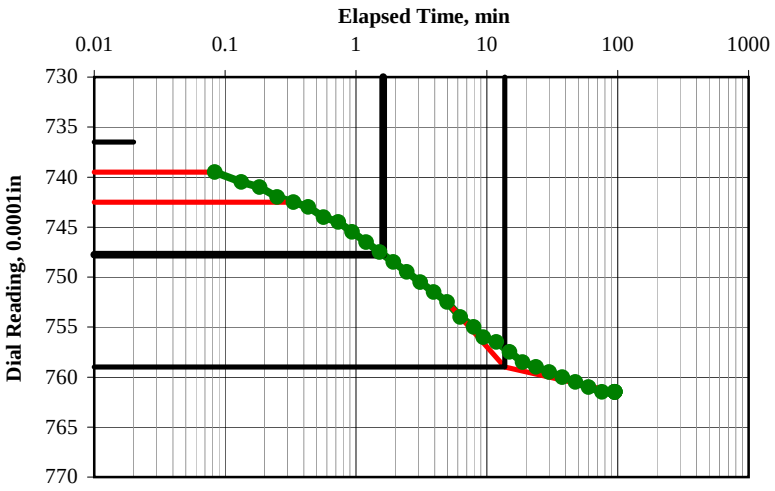
Elapsed Time (min)	Sqrt Time ($min^{1/2}$)	Dial Reading (0.0001in)	Sample Height (in)	Void Ratio
0	0	727.0	0.9458	0.5729
Corrections*		-3.5	-0.00035	-0.0006
Adjusted Sample Height & Void Ratio				
0.08	0.29	739.5	0.9449	0.5714
0.13	0.37	740.5	0.9448	0.5713
0.18	0.43	741.0	0.9448	0.5712
0.25	0.50	742.0	0.9447	0.5710
0.33	0.58	742.5	0.9446	0.5709
0.43	0.66	743.0	0.9446	0.5708
0.57	0.75	744.0	0.9445	0.5707
0.73	0.86	744.5	0.9444	0.5706
0.93	0.97	745.5	0.9443	0.5704
1.20	1.10	746.5	0.9442	0.5703
1.52	1.23	747.5	0.9441	0.5701
1.93	1.39	748.5	0.9440	0.5699
2.45	1.57	749.5	0.9439	0.5698
3.10	1.76	750.5	0.9438	0.5696
3.93	1.98	751.5	0.9437	0.5694
4.97	2.23	752.5	0.9436	0.5693
6.28	2.51	754.0	0.9435	0.5690
7.93	2.82	755.0	0.9434	0.5688
9.38	3.06	756.0	0.9433	0.5687
11.83	3.44	756.5	0.9432	0.5686
14.93	3.86	757.5	0.9431	0.5684
18.83	4.34	758.5	0.9430	0.5683
23.75	4.87	759.0	0.9430	0.5682
29.93	5.47	759.5	0.9429	0.5681
37.73	6.14	760.0	0.9429	0.5680
47.55	6.90	760.5	0.9428	0.5679
59.93	7.74	761.0	0.9428	0.5679
75.93	8.71	761.5	0.9427	0.5678
94.93	9.74	761.5	0.9427	0.5678

Machine Deflection

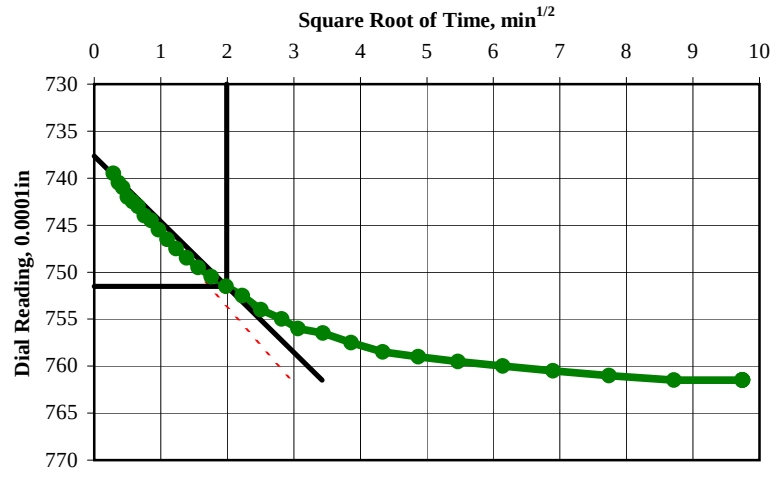
Applied Deflection Correction to Sample Height, 0.0001in -3.5

**Correction is applied to all dial readings.*

Log of Elapsed Time vs. Dial Reading



Square Root of Elapsed Time vs. Dial Reading



Sqrt. of Elapsed Time vs Dial Reading

T0 = 0 min.	D0 = 737.7 div.
T90 = 3.96 min	D90 = 751.5 div.
T100 = NA min	D100 = 753.1 div.
Height at: D90 = 0.9437, D100 = 0.9435	
Average Sample Height, in	0.9443
Average Drainage Height, in	0.4721
T (Time Factor for T90)	0.848
Coef. of Consol., C_v, in^2/min	0.048

Log of Elapsed Time vs Dial Reading

T0 = 0 min.	D0 = 736.5 div.
T50 = 1.61 min.	D50 = 747.7 div.
T100 = 13.74 min.	D100 = 759 div.
Height at: D50 = 0.9441, D100 = 0.943	
Average Sample Height, in	0.9443
Average Drainage Height, in	0.4721
T (Time Factor for T50)	0.197
Coef. of Consol., C_v, in^2/min	0.027

Load Summary

Initial Sample Height, in	0.9458
Initial Sample Void Ratio	0.5729
Final Sample Height, in	0.9427
Final Sample Void Ratio	0.5678
Incremental Strain, %	0.33%
Loading Duration, min	94.933333

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ONE-DIMENSIONAL CONSOLIDATION PROPERTIES OF SOILS
ASTM D 2435

Client	Civil & Environmental Consultant	Boring	SB-18	**Test Load, tsf**	**1-2**
Client Project	091-867 Apex Landfill Expansion	Depth	10'-12'		Load 10 of 13
Project No.	30598	Sample	ST-1		
		Lab ID#	30598010		
Visual Description	Dark Grayish Brown Sandy Clay with Gravel				
Test Conditions:	Undisturbed, Inundated, and Double Drained				

Time Vs. Dial Reading

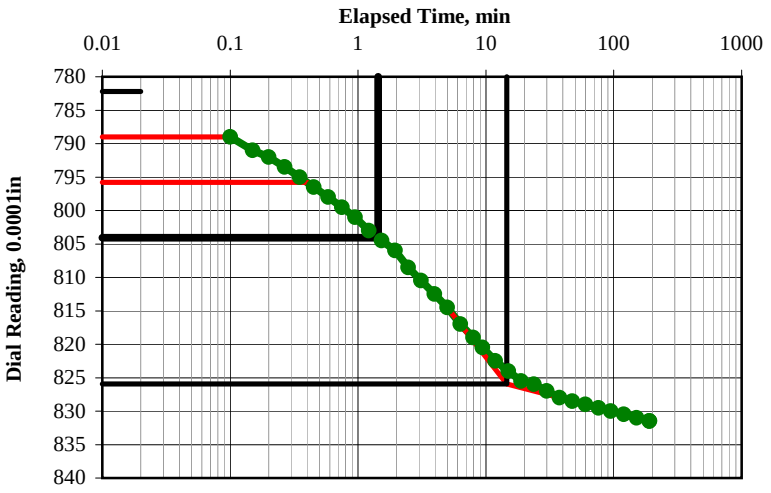
Elapsed Time (min)	Sqrt Time ($min^{1/2}$)	Dial Reading (0.0001in)	Sample Height (in)	Void Ratio
0	0	761.5	0.9427	0.5678
Corrections*		-4.5	-0.00045	-0.0007
Adjusted Sample Height & Void Ratio				
0.10	0.32	789.0	0.9404	0.5639
0.15	0.39	791.0	0.9402	0.5636
0.20	0.45	792.0	0.9401	0.5634
0.27	0.52	793.5	0.9400	0.5632
0.35	0.59	795.0	0.9398	0.5629
0.45	0.67	796.5	0.9397	0.5627
0.58	0.76	798.0	0.9395	0.5624
0.75	0.87	799.5	0.9394	0.5622
0.95	0.97	801.0	0.9392	0.5619
1.22	1.10	803.0	0.9390	0.5616
1.53	1.24	804.5	0.9389	0.5614
1.95	1.40	806.0	0.9387	0.5611
2.47	1.57	808.5	0.9385	0.5607
3.12	1.77	810.5	0.9383	0.5604
3.95	1.99	812.5	0.9381	0.5600
4.98	2.23	814.5	0.9379	0.5597
6.30	2.51	817.0	0.9376	0.5593
7.95	2.82	819.0	0.9374	0.5590
9.40	3.07	820.5	0.9373	0.5587
11.85	3.44	822.5	0.9371	0.5584
14.95	3.87	824.0	0.9369	0.5581
18.85	4.34	825.5	0.9368	0.5579
23.77	4.88	826.0	0.9367	0.5578
29.95	5.47	827.0	0.9366	0.5576
37.75	6.14	828.0	0.9365	0.5575
47.57	6.90	828.5	0.9365	0.5574
59.95	7.74	829.0	0.9364	0.5573
75.95	8.71	829.5	0.9364	0.5572
94.95	9.74	830.0	0.9363	0.5571
119.95	10.95	830.5	0.9363	0.5570
150.95	12.29	831.0	0.9362	0.5570
189.95	13.78	831.5	0.9362	0.5569

Machine Deflection

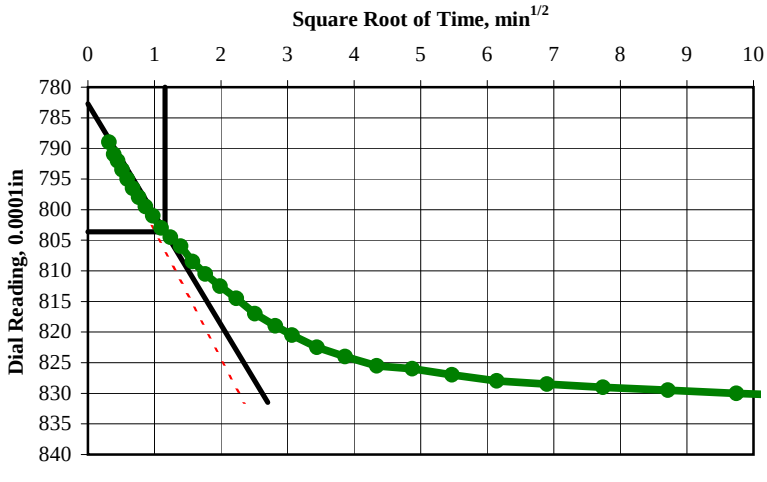
Applied Deflection Correction to Sample Height, 0.0001in -4.5

**Correction is applied to all dial readings.*

Log of Elapsed Time vs. Dial Reading



Square Root of Elapsed Time vs. Dial Reading



Sqrt. of Elapsed Time vs Dial Reading

T0 = 0 min.	D0 = 782.7 div.		
T90 = 1.346 min	D90 = 803.6 div.		
T100 = NA min	D100 = 806 div.		
Height at: D90 = 0.9389, D100 = 0.9387			
Average Sample Height, in	0.9394		
Average Drainage Height, in	0.4697		
T (Time Factor for T90)	0.848		
Coef. of Consol., C_v, in^2/min	0.139		

Log of Elapsed Time vs Dial Reading

T0 = 0 min.	D0 = 782.2 div.		
T50 = 1.43 min.	D50 = 804.1 div.		
T100 = 14.57 min.	D100 = 825.9 div.		
Height at: D50 = 0.9389, D100 = 0.9367			
Average Sample Height, in	0.9394		
Average Drainage Height, in	0.4697		
T (Time Factor for T50)	0.197		
Coef. of Consol., C_v, in^2/min	0.030		

Load Summary

Initial Sample Height, in	0.9427
Initial Sample Void Ratio	0.5678
Final Sample Height, in	0.9362
Final Sample Void Ratio	0.5569
Incremental Strain, %	0.69%
Loading Duration, min	189.95

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ONE-DIMENSIONAL CONSOLIDATION PROPERTIES OF SOILS
ASTM D 2435

Client	Civil & Environmental Consultant	Boring	SB-18	**Test Load, tsf**	**2-4**
Client Project	091-867 Apex Landfill Expansion	Depth	10'-12'		Load 11 of 13
Project No.	30598	Sample	ST-1		
		Lab ID#	30598010		
Visual Description	Dark Grayish Brown Sandy Clay with Gravel				
Test Conditions:	Undisturbed, Inundated, and Double Drained				

Time Vs. Dial Reading

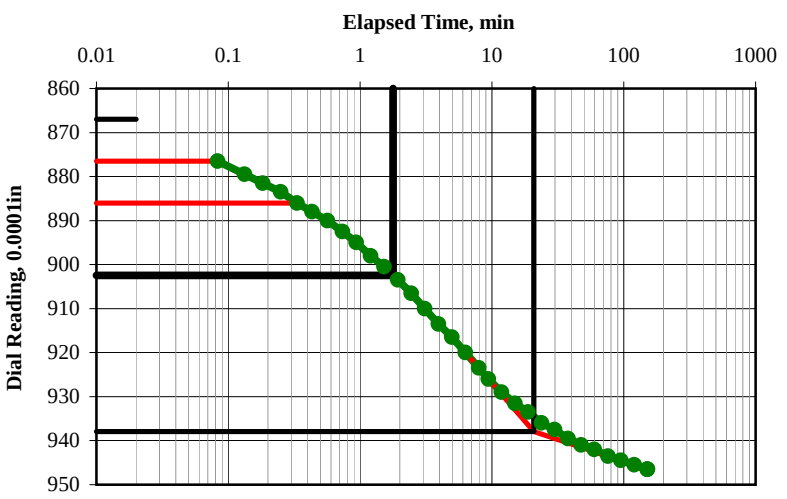
Elapsed Time (min)	Sqrt Time ($min^{1/2}$)	Dial Reading (0.0001in)	Sample Height (in)	Void Ratio
0	0	831.5	0.9362	0.5569
Corrections*		-5	-0.0005	-0.0008
Adjusted Sample Height & Void Ratio				
0.08	0.29	876.5	0.9322	0.5502
0.13	0.37	879.5	0.9319	0.5497
0.18	0.43	881.5	0.9317	0.5494
0.25	0.50	883.5	0.9315	0.5491
0.33	0.58	886.0	0.9312	0.5486
0.43	0.66	888.0	0.9310	0.5483
0.57	0.75	890.0	0.9308	0.5480
0.73	0.86	892.5	0.9306	0.5476
0.93	0.97	895.0	0.9303	0.5471
1.20	1.10	898.0	0.9300	0.5466
1.52	1.23	900.5	0.9298	0.5462
1.93	1.39	903.5	0.9295	0.5457
2.45	1.57	906.5	0.9292	0.5452
3.10	1.76	910.0	0.9288	0.5447
3.93	1.98	913.5	0.9285	0.5441
4.97	2.23	916.5	0.9282	0.5436
6.28	2.51	920.0	0.9278	0.5430
7.93	2.82	923.5	0.9275	0.5424
9.38	3.06	926.0	0.9272	0.5420
11.83	3.44	929.0	0.9269	0.5415
14.93	3.86	931.5	0.9267	0.5411
18.83	4.34	933.5	0.9265	0.5407
23.75	4.87	936.0	0.9262	0.5403
29.93	5.47	937.5	0.9261	0.5401
37.73	6.14	939.5	0.9259	0.5397
47.55	6.90	941.0	0.9257	0.5395
59.93	7.74	942.0	0.9256	0.5393
75.93	8.71	943.5	0.9255	0.5391
94.93	9.74	944.5	0.9254	0.5389
119.93	10.95	945.5	0.9253	0.5387
150.93	12.29	946.5	0.9252	0.5386

Machine Deflection

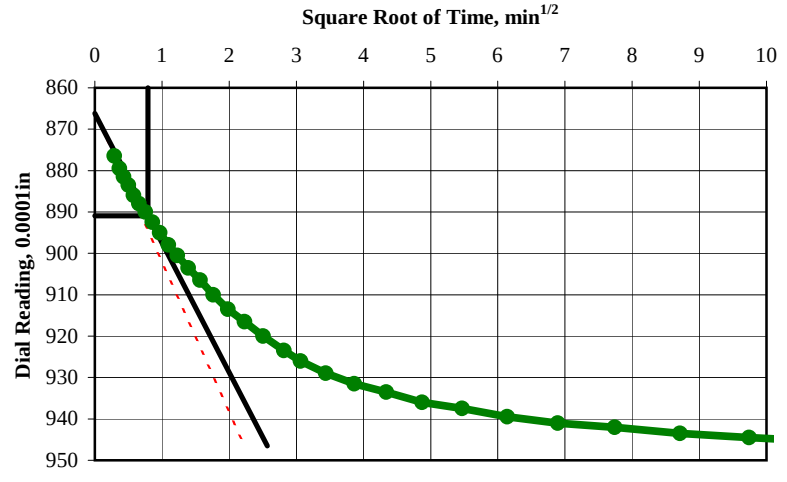
Applied Deflection Correction to Sample Height, 0.0001in -5

**Correction is applied to all dial readings.*

Log of Elapsed Time vs. Dial Reading



Square Root of Elapsed Time vs. Dial Reading



Sqrt. of Elapsed Time vs Dial Reading

T0 = 0 min.	D0 = 866.2 div.
T90 = 0.624 min	D90 = 890.9 div.
T100 = NA min	D100 = 893.6 div.
Height at: D90 = 0.9307, D100 = 0.9304	
Average Sample Height, in	0.9307
Average Drainage Height, in	0.4653
T (Time Factor for T90)	0.848
Coef. of Consol., C_v, in^2/min	0.294

Log of Elapsed Time vs Dial Reading

T0 = 0 min.	D0 = 867 div.
T50 = 1.78 min.	D50 = 902.5 div.
T100 = 20.75 min.	D100 = 937.9 div.
Height at: D50 = 0.9296, D100 = 0.926	
Average Sample Height, in	0.9307
Average Drainage Height, in	0.4653
T (Time Factor for T50)	0.197
Coef. of Consol., C_v, in^2/min	0.024

Load Summary

Initial Sample Height, in	0.9362
Initial Sample Void Ratio	0.5569
Final Sample Height, in	0.9252
Final Sample Void Ratio	0.5386
Incremental Strain, %	1.18%
Loading Duration, min	150.93333

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ONE-DIMENSIONAL CONSOLIDATION PROPERTIES OF SOILS
ASTM D 2435

Client	Civil & Environmental Consultant	Boring	SB-18	**Test Load, tsf**	**4-8**
Client Project	091-867 Apex Landfill Expansion	Depth	10'-12'		Load 12 of 13
Project No.	30598	Sample	ST-1		
		Lab ID#	30598010		
Visual Description	Dark Grayish Brown Sandy Clay with Gravel				
Test Conditions:	Undisturbed, Inundated, and Double Drained				

Time Vs. Dial Reading

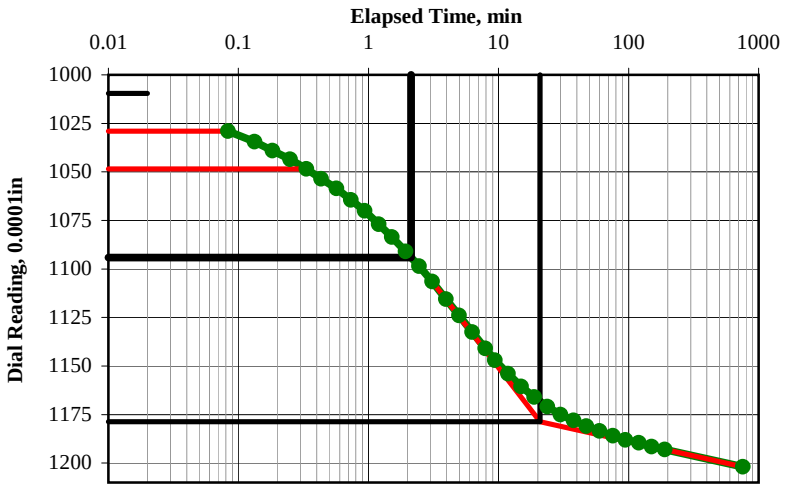
Elapsed Time (min)	Sqrt Time ($min^{1/2}$)	Dial Reading (0.0001in)	Sample Height (in)	Void Ratio
0	0	946.5	0.9252	0.5386
Corrections*		-10.5	-0.00105	-0.0017
Adjusted Sample Height & Void Ratio				
0.08	0.29	1029.0	0.9180	0.5266
0.13	0.37	1034.5	0.9174	0.5257
0.18	0.43	1039.0	0.9170	0.5249
0.25	0.50	1043.5	0.9165	0.5242
0.33	0.58	1048.5	0.9160	0.5234
0.43	0.66	1053.5	0.9155	0.5225
0.57	0.75	1058.5	0.9150	0.5217
0.73	0.86	1064.5	0.9144	0.5207
0.93	0.97	1070.0	0.9139	0.5198
1.20	1.10	1077.0	0.9132	0.5186
1.52	1.23	1083.5	0.9125	0.5175
1.93	1.39	1091.0	0.9118	0.5163
2.45	1.57	1098.5	0.9110	0.5150
3.10	1.76	1106.5	0.9102	0.5137
3.93	1.98	1115.5	0.9093	0.5122
4.97	2.23	1124.0	0.9085	0.5108
6.28	2.51	1132.5	0.9076	0.5094
7.93	2.82	1141.0	0.9068	0.5080
9.38	3.06	1147.0	0.9062	0.5070
11.83	3.44	1154.0	0.9055	0.5058
14.93	3.86	1160.5	0.9048	0.5047
18.83	4.34	1166.0	0.9043	0.5038
23.75	4.87	1171.0	0.9038	0.5030
29.93	5.47	1175.0	0.9034	0.5023
37.73	6.14	1178.0	0.9031	0.5018
47.55	6.90	1181.0	0.9028	0.5013
59.93	7.74	1183.5	0.9025	0.5009
75.93	8.71	1186.0	0.9023	0.5005
94.93	9.74	1188.0	0.9021	0.5002
119.93	10.95	1189.5	0.9019	0.4999
150.93	12.29	1191.5	0.9017	0.4996
189.93	13.78	1193.0	0.9016	0.4993
757.93	27.53	1202.0	0.9007	0.4978

Machine Deflection

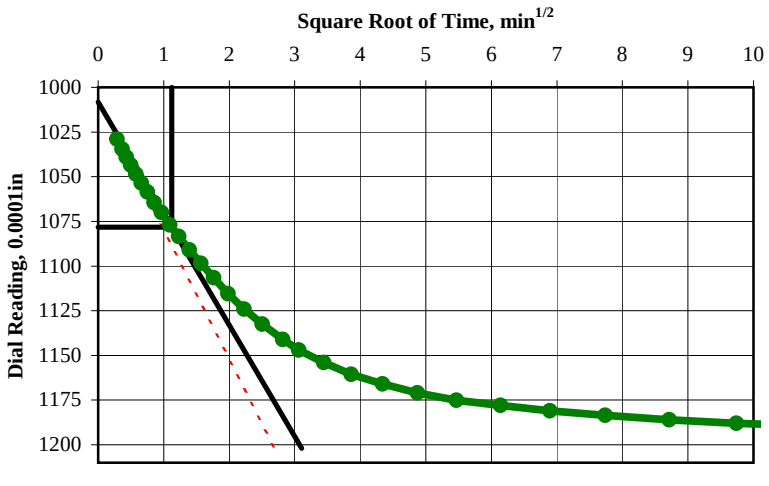
Applied Deflection Correction to Sample Height, 0.0001in -10.5

**Correction is applied to all dial readings.*

Log of Elapsed Time vs. Dial Reading



Square Root of Elapsed Time vs. Dial Reading



Sqrt. of Elapsed Time vs Dial Reading

T0 = 0 min.	D0 = 1008.3 div.
T90 = 1.254 min	D90 = 1078.3 div.
T100 = NA min	D100 = 1086.1 div.
Height at: D90 = 0.913, D100 = 0.9122	
Average Sample Height, in	0.9129
Average Drainage Height, in	0.4565
T (Time Factor for T90)	0.848
Coef. of Consol., C_v, in^2/min	0.140

Log of Elapsed Time vs Dial Reading

T0 = 0 min.	D0 = 1009.5 div.
T50 = 2.13 min.	D50 = 1094.1 div.
T100 = 20.9 min.	D100 = 1178.6 div.
Height at: D50 = 0.9114, D100 = 0.903	
Average Sample Height, in	0.9129
Average Drainage Height, in	0.4565
T (Time Factor for T50)	0.197
Coef. of Consol., C_v, in^2/min	0.019

Load Summary

Initial Sample Height, in	0.9252
Initial Sample Void Ratio	0.5386
Final Sample Height, in	0.9007
Final Sample Void Ratio	0.4978
Incremental Strain, %	2.65%
Loading Duration, min	757.93333

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ONE-DIMENSIONAL CONSOLIDATION PROPERTIES OF SOILS
ASTM D 2435

Client	Civil & Environmental Consultant	Boring	SB-18	**Test Load, tsf**	**8-16**
Client Project	091-867 Apex Landfill Expansion	Depth	10'-12'		Load 13 of 13
Project No.	30598	Sample	ST-1		
		Lab ID#	30598010		
Visual Description	Dark Grayish Brown Sandy Clay with Gravel				
Test Conditions:	Undisturbed, Inundated, and Double Drained				

Time Vs. Dial Reading

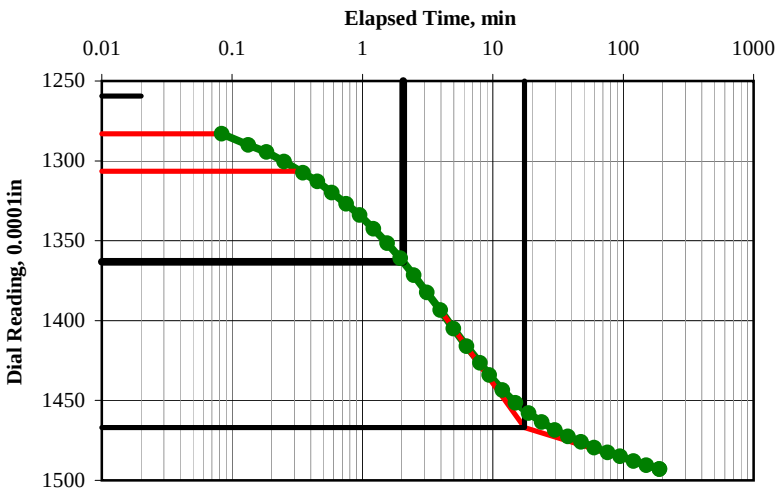
Elapsed Time (min)	Sqrt Time ($min^{1/2}$)	Dial Reading (0.0001in)	Sample Height (in)	Void Ratio
0	0	1202.0	0.9007	0.4978
Corrections*		-15	-0.0015	-0.0025
Adjusted Sample Height & Void Ratio				
0.08	0.29	1283.0	0.8941	0.4869
0.13	0.37	1290.0	0.8934	0.4857
0.18	0.43	1294.5	0.8929	0.4849
0.25	0.50	1300.5	0.8923	0.4839
0.35	0.59	1307.5	0.8916	0.4828
0.45	0.67	1313.0	0.8911	0.4819
0.58	0.76	1320.0	0.8904	0.4807
0.75	0.87	1327.0	0.8897	0.4795
0.95	0.97	1334.0	0.8890	0.4784
1.22	1.10	1342.5	0.8881	0.4770
1.55	1.24	1351.5	0.8872	0.4755
1.95	1.40	1361.0	0.8863	0.4739
2.47	1.57	1371.5	0.8852	0.4721
3.12	1.77	1382.5	0.8841	0.4703
3.95	1.99	1393.5	0.8830	0.4685
4.98	2.23	1405.0	0.8819	0.4666
6.30	2.51	1416.0	0.8808	0.4647
7.95	2.82	1426.5	0.8797	0.4630
9.40	3.07	1434.0	0.8790	0.4617
11.85	3.44	1443.5	0.8780	0.4602
14.95	3.87	1451.5	0.8772	0.4588
18.85	4.34	1458.0	0.8766	0.4578
23.77	4.88	1463.5	0.8760	0.4568
29.95	5.47	1468.5	0.8755	0.4560
37.75	6.14	1472.5	0.8751	0.4553
47.57	6.90	1476.0	0.8748	0.4548
59.95	7.74	1479.5	0.8744	0.4542
75.95	8.71	1482.5	0.8741	0.4537
94.95	9.74	1485.0	0.8739	0.4533
119.95	10.95	1488.0	0.8736	0.4528
150.95	12.29	1490.5	0.8733	0.4524
189.95	13.78	1493.0	0.8731	0.4519

Machine Deflection

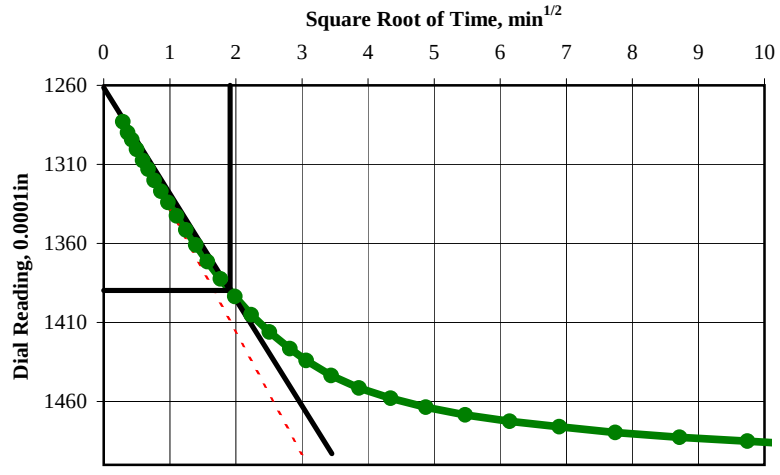
Applied Deflection Correction to Sample Height, 0.0001in -15

**Correction is applied to all dial readings.*

Log of Elapsed Time vs. Dial Reading



Square Root of Elapsed Time vs. Dial Reading



Sqrt. of Elapsed Time vs Dial Reading

T0 = 0 min.	D0 = 1261.4 div.		
T90 = 3.648 min	D90 = 1389.8 div.		
T100 = NA min	D100 = 1404.1 div.		
Height at: D90 = 0.8834, D100 = 0.8819			
Average Sample Height, in	0.8869		
Average Drainage Height, in	0.4434		
T (Time Factor for T90)	0.848		
Coef. of Consol., C_v, in^2/min	0.046		

Log of Elapsed Time vs Dial Reading

T0 = 0 min.	D0 = 1259.5 div.		
T50 = 2.05 min.	D50 = 1363.3 div.		
T100 = 17.46 min.	D100 = 1467 div.		
Height at: D50 = 0.886, D100 = 0.8757			
Average Sample Height, in	0.8869		
Average Drainage Height, in	0.4434		
T (Time Factor for T50)	0.197		
Coef. of Consol., C_v, in^2/min	0.019		

Load Summary

Initial Sample Height, in	0.9007
Initial Sample Void Ratio	0.4978
Final Sample Height, in	0.8731
Final Sample Void Ratio	0.4519
Incremental Strain, %	3.06%
Loading Duration, min	189.95

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ONE-DIMENSIONAL CONSOLIDATION PROPERTIES OF SOILS
ASTM D 2435

Client	Civil & Environmental Consultant	Boring	SB-21
Client Project	091-867 Apex Landfill Expansion	Depth	9'-11'
Project No.	30598	Sample	ST-1
		Lab Sample No.	30598011

Visual Description: LIGHT OLIVE BROWN LEAN CLAY WITH GRAVEL
Sample Conditions: Undisturbed, Inundated, and Double Drained
Machine Deflection Correction: Applied

SAMPLE PROPERTIES		
	Initial	Final
Tare Number	A42	Z12
Wt. Tare & WS, gm	125.9	295.85
Wt. Tare & DS, gm	112.18	275.69
Wt. Tare, gm	9.49	123.26
Water Content, %	13.4%	13.2%
Sample Diameter, in	2.5	2.5
Sample Height, in	1.004	0.9224
Sample Volume, in^3	4.9290	4.5279
Wt. WS + Ring, gm	289.21	287.23
Wt. of Ring, gm	113.68	113.68
Wt. of WS, gm	175.53	173.55
Wet Density, pcf	135.61	145.95
Wet Density, g/cc	2.173	2.339
Water Content, %	13.4%	13.2%
Wt. of DS, gm	154.84	153.28
Dry Density, pcf	119.62	128.90
Dry Density, g/cc	1.917	2.066
Void Ratio, e	0.4449	0.3409
Saturation, %	83.2%	
Specific Gravity	2.77	Measured
Height of Solids, in	0.6949	0.6949

TEST DATA SUMMARY

Applied Pressure tsf	**Load Duration** min	**Final Height** in	**Vertical Strain** %	**Dry Density** g/cc	**Void Ratio** e	**a_v** ft^2/ton	**Incremental** C_c	**Incremental** C_r
Seating	NA	1.0041	0.00	1.9170	0.4449	NA	NA	NA
0.25	24	1.0018	0.23%	1.9215	0.4416	1.35E-02	NA	NA
0.5	190	0.9998	0.43%	1.9253	0.4388	1.12E-02	0.009	NA
1	60	0.9940	1.01%	1.9365	0.4304	1.67E-02	0.028	NA
2	758	0.9837	2.04%	1.9569	0.4155	1.49E-02	0.049	NA
4	190	0.9698	3.42%	1.9849	0.3955	1.00E-02	0.066	NA
1	120	0.9795	2.45%	1.9653	0.4095	4.65E-03	NA	NA
0.25	190	0.9899	1.42%	1.9446	0.4244	2.00E-02	NA	NA
0.5	758	0.9886	1.54%	1.9471	0.4226	7.20E-03	NA	0.006
1	240	0.9852	1.89%	1.9539	0.4177	9.93E-03	NA	0.016
2	95	0.9781	2.59%	1.9681	0.4075	1.02E-02	NA	0.034
4	95	0.9676	3.64%	1.9895	0.3923	7.55E-03	NA	0.050
8	955	0.9475	5.64%	2.0315	0.3635	7.21E-03	0.096	NA
16	240	0.9224	8.14%	2.0868	0.3274	4.51E-03	0.120	NA

Note: The calculations performed and the parameters presented herein are for preliminary purposes only. GTS only accepts responsibility for the raw data obtained from the consolidation tests. This data may be interpreted differently by others. It is the responsibility of the user to determine the appropriateness and accuracy of the computed values.

Input Validation | Reviewed By: | Date Tested: 12/8/2010 |

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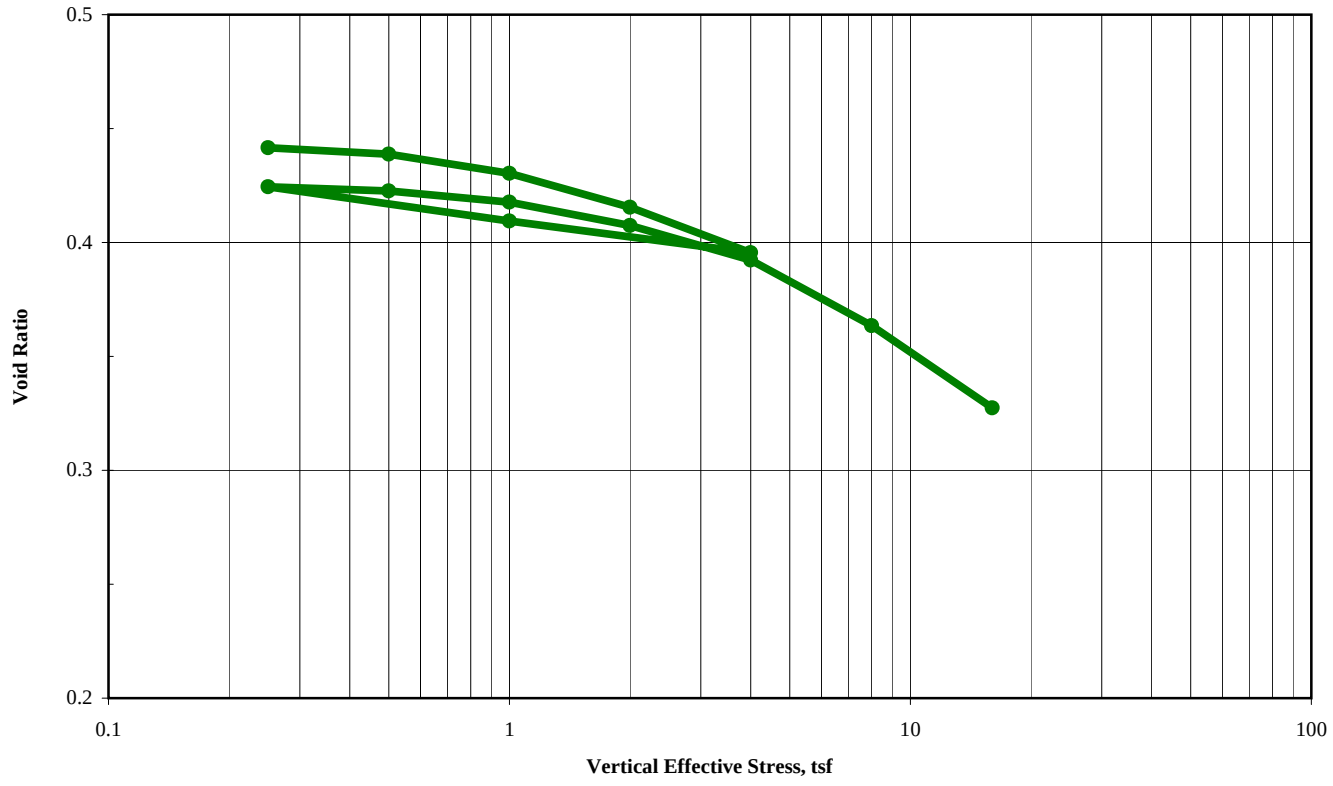
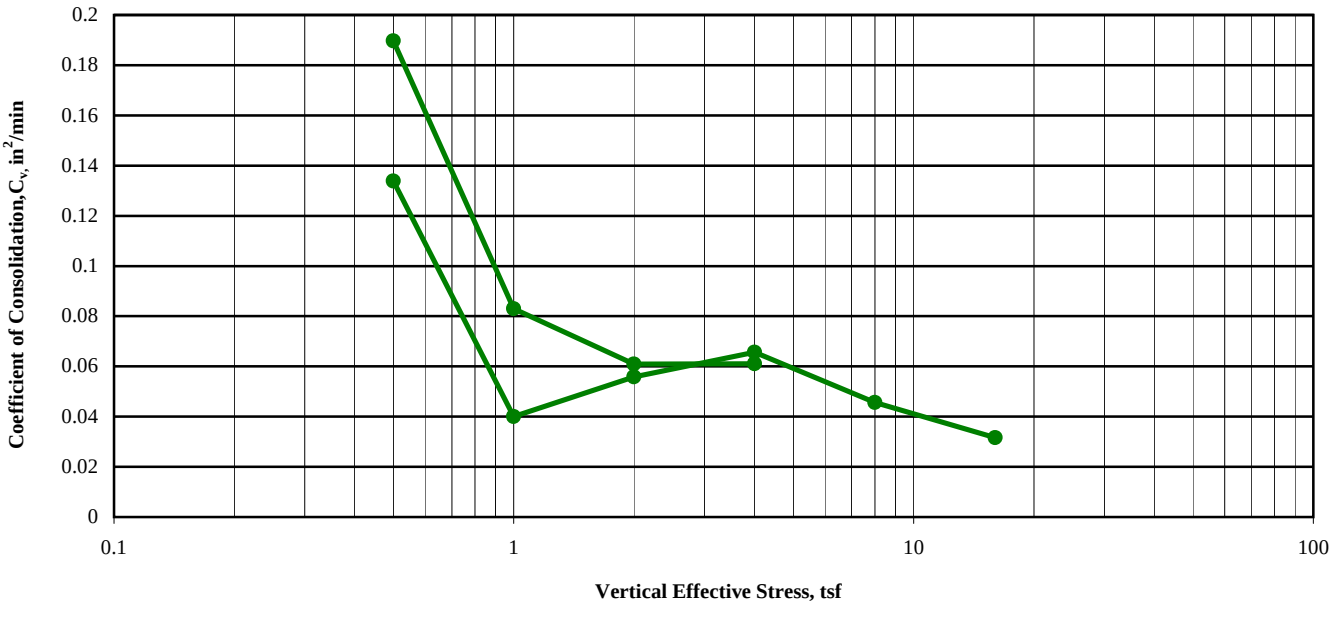
ONE-DIMENSIONAL CONSOLIDATION PROPERTIES OF SOILS
ASTM D 2435

Client	Civil & Environmental Consultants, Inc.	Boring	SB-21
Client Project	091-867 Apex Landfill Expansion	Depth	9'-11'
Project No.	30598	Sample	ST-1
		Lab Sample No.	30598011
Visual Description	LIGHT OLIVE BROWN LEAN CLAY WITH GRAVEL		
Sample Conditions	Undisturbed, Inundated, and Double Drained		
Machine Deflection Correction:	Applied		

Void Ratio (Final Height) vs Vertical Effective Consolidation Stress



Coeffieicent of Consolidation (log. method) vs. Vertical Effective Consolidation Stress



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ONE-DIMENSIONAL CONSOLIDATION PROPERTIES OF SOILS
ASTM D 2435

Client	Civil & Environmental Consultant	Boring	SB-21	**Test Load, tsf**	**0-0.25**
Client Project	091-867 Apex Landfill Expansion	Depth	9'-11'		Load 1 of 13
Project No.	30598	Sample	ST-1		
		Lab ID#	30598011		
Visual Description	LIGHT OLIVE BROWN LEAN CLAY WITH GRAVEL				
Test Conditions:	Undisturbed, Inundated, and Double Drained				

Time Vs. Dial Reading

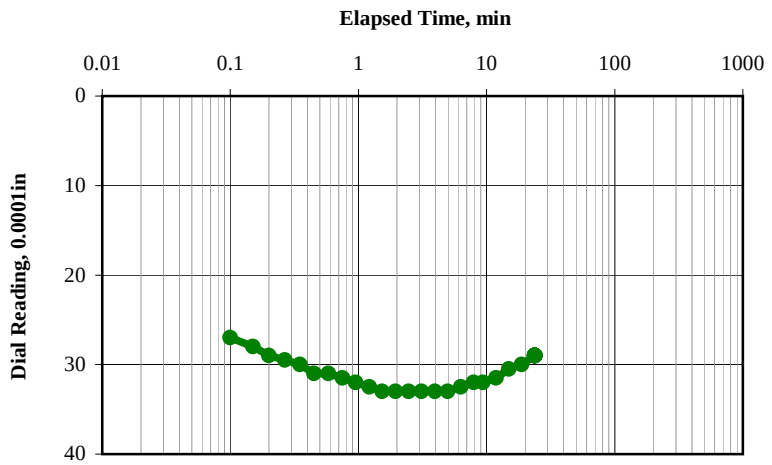
Elapsed Time (min)	Sqrt Time ($min^{1/2}$)	Dial Reading (0.0001in)	Sample Height (in)	Void Ratio
0	0	0	1.0041	0.4449
Corrections*		-5.5	-0.00055	-0.0008
Adjusted Sample Height & Void Ratio				
0.10	0.32	27.0	1.0020	0.4418
0.15	0.39	28.0	1.0019	0.4417
0.20	0.45	29.0	1.0018	0.4416
0.27	0.52	29.5	1.0017	0.4415
0.35	0.59	30.0	1.0017	0.4414
0.45	0.67	31.0	1.0016	0.4413
0.58	0.76	31.0	1.0016	0.4413
0.75	0.87	31.5	1.0015	0.4412
0.95	0.97	32.0	1.0015	0.4411
1.22	1.10	32.5	1.0014	0.4411
1.53	1.24	33.0	1.0014	0.4410
1.95	1.40	33.0	1.0014	0.4410
2.47	1.57	33.0	1.0014	0.4410
3.12	1.77	33.0	1.0014	0.4410
3.95	1.99	33.0	1.0014	0.4410
4.98	2.23	33.0	1.0014	0.4410
6.30	2.51	32.5	1.0014	0.4411
7.95	2.82	32.0	1.0015	0.4411
9.40	3.07	32.0	1.0015	0.4411
11.85	3.44	31.5	1.0015	0.4412
14.95	3.87	30.5	1.0016	0.4413
18.85	4.34	30.0	1.0017	0.4414
23.77	4.88	29.0	1.0018	0.4416

Machine Deflection

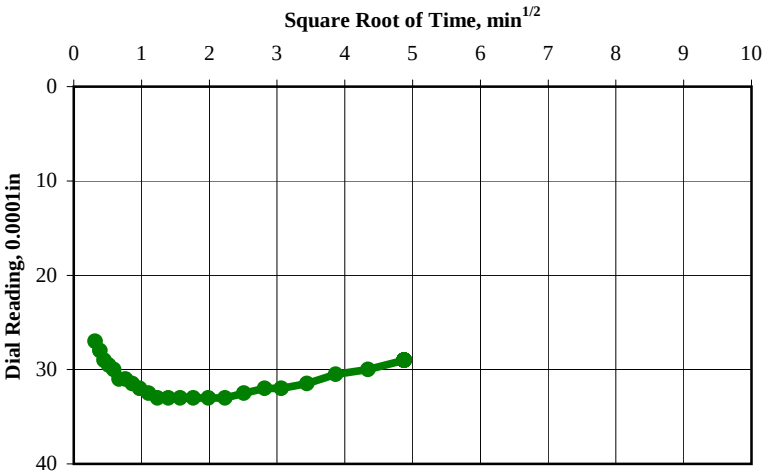
Applied Deflection Correction to Sample Height, 0.0001in -5.5

**Correction is applied to all dial readings.*

Log of Elapsed Time vs. Dial Reading



Square Root of Elapsed Time vs. Dial Reading



Sqrt. of Elapsed Time vs Dial Reading

Log of Elapsed Time vs Dial Reading

Specimen Swelled

Load Summary

Initial Sample Height, in	1.0041
Initial Sample Void Ratio	0.4449
Final Sample Height, in	1.0018
Final Sample Void Ratio	0.4416
Incremental Strain, %	0.23%
Loading Duration, min	23.766667

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ONE-DIMENSIONAL CONSOLIDATION PROPERTIES OF SOILS
ASTM D 2435

Client	Civil & Environmental Consultant	Boring	SB-21	**Test Load, tsf**	**0.25-0.5**
Client Project	091-867 Apex Landfill Expansion	Depth	9'-11'		Load 2 of 13
Project No.	30598	Sample	ST-1		
		Lab ID#	30598011		

Visual Description: LIGHT OLIVE BROWN LEAN CLAY WITH GRAVEL

Test Conditions: Undisturbed, Inundated, and Double Drained

Time Vs. Dial Reading

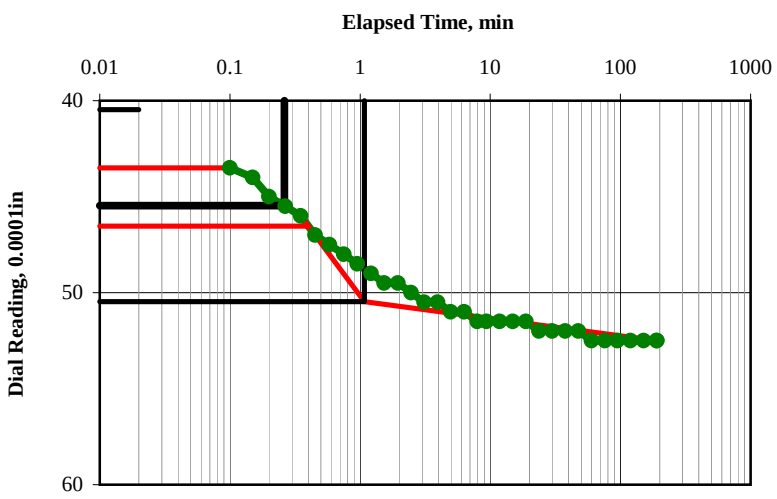
Elapsed Time (min)	Sqrt Time ($min^{1/2}$)	Dial Reading (0.0001in)	Sample Height (in)	Void Ratio
0	0	29.0	1.0018	0.4416
Corrections*		-4	-0.0004	-0.0006
Adjusted Sample Height & Void Ratio				
0.10	0.32	43.5	1.0007	0.4400
0.15	0.39	44.0	1.0007	0.4400
0.20	0.45	45.0	1.0006	0.4398
0.27	0.52	45.5	1.0005	0.4398
0.35	0.59	46.0	1.0005	0.4397
0.45	0.67	47.0	1.0004	0.4395
0.58	0.76	47.5	1.0003	0.4395
0.75	0.87	48.0	1.0003	0.4394
0.95	0.97	48.5	1.0002	0.4393
1.22	1.10	49.0	1.0002	0.4393
1.53	1.24	49.5	1.0001	0.4392
1.95	1.40	49.5	1.0001	0.4392
2.47	1.57	50.0	1.0001	0.4391
3.12	1.77	50.5	1.0000	0.4390
3.95	1.99	50.5	1.0000	0.4390
4.98	2.23	51.0	1.0000	0.4390
6.30	2.51	51.0	1.0000	0.4390
7.95	2.82	51.5	0.9999	0.4389
9.40	3.07	51.5	0.9999	0.4389
11.85	3.44	51.5	0.9999	0.4389
14.95	3.87	51.5	0.9999	0.4389
18.85	4.34	51.5	0.9999	0.4389
23.77	4.88	52.0	0.9999	0.4388
29.95	5.47	52.0	0.9999	0.4388
37.75	6.14	52.0	0.9999	0.4388
47.57	6.90	52.0	0.9999	0.4388
59.95	7.74	52.5	0.9998	0.4388
75.95	8.71	52.5	0.9998	0.4388
94.95	9.74	52.5	0.9998	0.4388
119.95	10.95	52.5	0.9998	0.4388
150.95	12.29	52.5	0.9998	0.4388
189.95	13.78	52.5	0.9998	0.4388

Machine Deflection

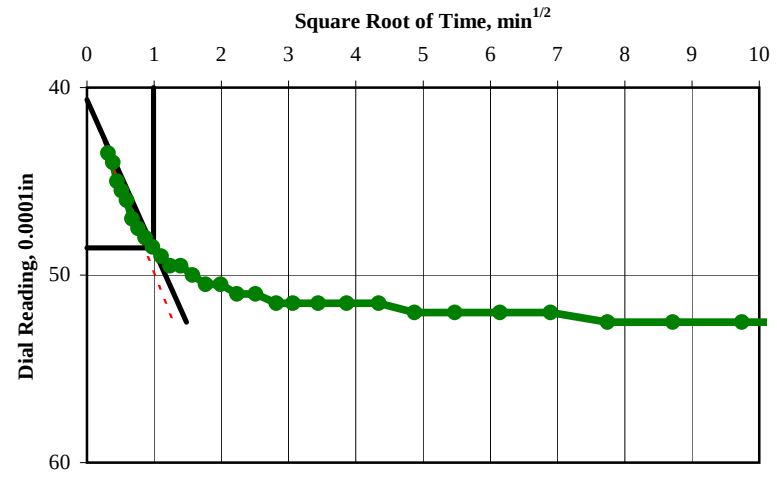
Applied Deflection Correction to Sample Height, 0.0001in: -4

**Correction is applied to all dial readings.*

Log of Elapsed Time vs. Dial Reading



Square Root of Elapsed Time vs. Dial Reading



Sqrt. of Elapsed Time vs Dial Reading

T0 = 0 min.	D0 = 40.6 div.
T90 = 0.98 min	D90 = 48.6 div.
T100 = NA min	D100 = 49.4 div.
Height at: D90 = 1.0002, D100 = 1.0001	
Average Sample Height, in	1.0008
Average Drainage Height, in	0.5004
T (Time Factor for T90)	0.848
Coef. of Consol., C_v, in^2/min	0.217

Log of Elapsed Time vs Dial Reading

T0 = 0 min.	D0 = 40.5 div.
T50 = 0.26 min.	D50 = 45.5 div.
T100 = 1.08 min.	D100 = 50.5 div.
Height at: D50 = 1.0005, D100 = 1	
Average Sample Height, in	1.0008
Average Drainage Height, in	0.5004
T (Time Factor for T50)	0.197
Coef. of Consol., C_v, in^2/min	0.190

Load Summary

Initial Sample Height, in	1.0018
Initial Sample Void Ratio	0.4416
Final Sample Height, in	0.9998
Final Sample Void Ratio	0.4388
Incremental Strain, %	0.19%
Loading Duration, min	189.95

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ONE-DIMENSIONAL CONSOLIDATION PROPERTIES OF SOILS
ASTM D 2435

Client	Civil & Environmental Consultant	Boring	SB-21	**Test Load, tsf**	**0.5-1**
Client Project	091-867 Apex Landfill Expansion	Depth	9'-11'		Load 3 of 13
Project No.	30598	Sample	ST-1		
		Lab ID#	30598011		

Visual Description: LIGHT OLIVE BROWN LEAN CLAY WITH GRAVEL
Test Conditions: Undisturbed, Inundated, and Double Drained

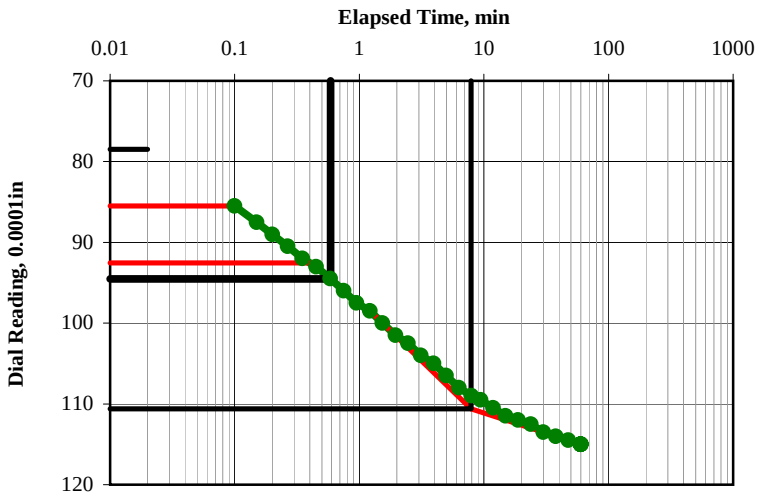
Time Vs. Dial Reading

Elapsed Time (min)	Sqrt Time ($min^{1/2}$)	Dial Reading (0.0001in)	Sample Height (in)	Void Ratio
0	0	52.5	0.9998	0.4388
Corrections*		-4.5	-0.00045	-0.0006
Adjusted Sample Height & Void Ratio				
0.10	0.32	85.5	0.9970	0.4346
0.15	0.39	87.5	0.9968	0.4344
0.20	0.45	89.0	0.9966	0.4341
0.27	0.52	90.5	0.9965	0.4339
0.35	0.59	92.0	0.9963	0.4337
0.45	0.67	93.0	0.9962	0.4336
0.58	0.76	94.5	0.9961	0.4334
0.75	0.87	96.0	0.9959	0.4331
0.95	0.97	97.5	0.9958	0.4329
1.22	1.10	98.5	0.9957	0.4328
1.53	1.24	100.0	0.9955	0.4326
1.95	1.40	101.5	0.9954	0.4323
2.47	1.57	102.5	0.9953	0.4322
3.12	1.77	104.0	0.9951	0.4320
3.95	1.99	105.0	0.9950	0.4318
4.98	2.23	106.5	0.9949	0.4316
6.30	2.51	108.0	0.9947	0.4314
7.95	2.82	109.0	0.9946	0.4313
9.40	3.07	109.5	0.9946	0.4312
11.85	3.44	110.5	0.9945	0.4311
14.95	3.87	111.5	0.9944	0.4309
18.85	4.34	112.0	0.9943	0.4308
23.77	4.88	112.5	0.9943	0.4308
29.95	5.47	113.5	0.9942	0.4306
37.75	6.14	114.0	0.9941	0.4305
47.57	6.90	114.5	0.9941	0.4305
59.95	7.74	115.0	0.9940	0.4304

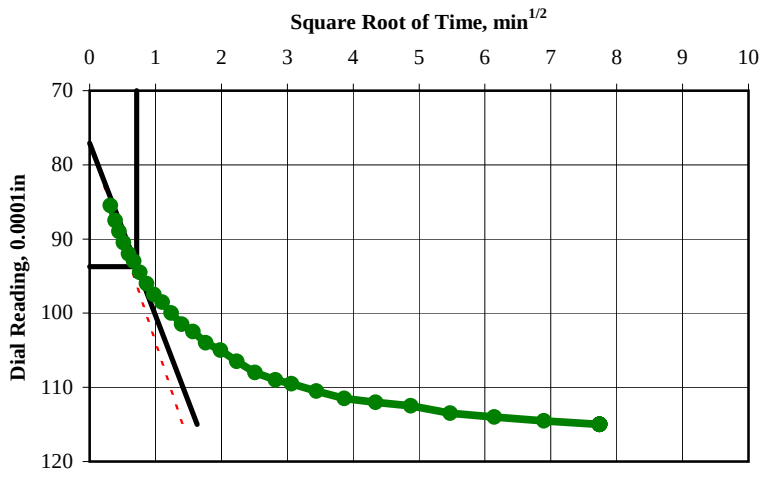
Machine Deflection

Applied Deflection Correction to Sample Height, 0.0001in: -4.5
**Correction is applied to all dial readings.*

Log of Elapsed Time vs. Dial Reading



Square Root of Elapsed Time vs. Dial Reading



Sqrt. of Elapsed Time vs Dial Reading

T0 = 0 min.	D0 = 77.1 div.
T90 = 0.518 min	D90 = 93.7 div.
T100 = NA min	D100 = 95.6 div.
Height at: D90 = 0.9962, D100 = 0.996	
Average Sample Height, in	0.9969
Average Drainage Height, in	0.4985
T (Time Factor for T90)	0.848
Coef. of Consol., C_v, in^2/min	0.411

Log of Elapsed Time vs Dial Reading

T0 = 0 min.	D0 = 78.5 div.
T50 = 0.59 min.	D50 = 94.5 div.
T100 = 7.88 min.	D100 = 110.6 div.
Height at: D50 = 0.9961, D100 = 0.9945	
Average Sample Height, in	0.9969
Average Drainage Height, in	0.4985
T (Time Factor for T50)	0.197
Coef. of Consol., C_v, in^2/min	0.083

Load Summary

Initial Sample Height, in	0.9998
Initial Sample Void Ratio	0.4388
Final Sample Height, in	0.9940
Final Sample Void Ratio	0.4304
Incremental Strain, %	0.58%
Loading Duration, min	59.95

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ONE-DIMENSIONAL CONSOLIDATION PROPERTIES OF SOILS
ASTM D 2435

Client	Civil & Environmental Consultant	Boring	SB-21	**Test Load, tsf**	**1-2**
Client Project	091-867 Apex Landfill Expansion	Depth	9'-11'		Load 4 of 13
Project No.	30598	Sample	ST-1		
		Lab ID#	30598011		

Visual Description: LIGHT OLIVE BROWN LEAN CLAY WITH GRAVEL
Test Conditions: Undisturbed, Inundated, and Double Drained

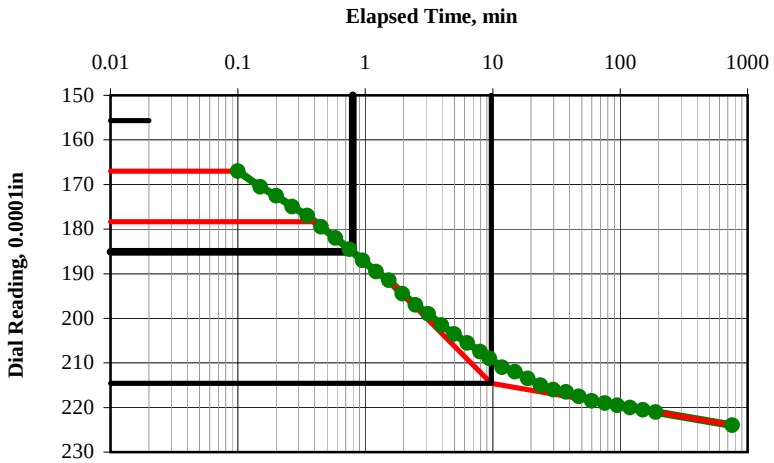
Time Vs. Dial Reading

Elapsed Time (min)	Sqrt Time ($min^{1/2}$)	Dial Reading (0.0001in)	Sample Height (in)	Void Ratio
0	0	115.0	0.9940	0.4304
Corrections*		-5.5	-0.00055	-0.0008
Adjusted Sample Height & Void Ratio				
0.10	0.32	167.0	0.9894	0.4237
0.15	0.39	170.5	0.9890	0.4232
0.20	0.45	172.5	0.9888	0.4229
0.27	0.52	175.0	0.9886	0.4226
0.35	0.59	177.0	0.9884	0.4223
0.45	0.67	179.5	0.9881	0.4219
0.58	0.76	182.0	0.9879	0.4216
0.75	0.87	184.5	0.9876	0.4212
0.95	0.97	187.0	0.9874	0.4208
1.22	1.10	189.5	0.9871	0.4205
1.53	1.24	191.5	0.9869	0.4202
1.95	1.40	194.5	0.9866	0.4198
2.47	1.57	197.0	0.9864	0.4194
3.12	1.77	199.0	0.9862	0.4191
3.95	1.99	201.5	0.9859	0.4187
4.98	2.23	203.5	0.9857	0.4185
6.30	2.51	205.5	0.9855	0.4182
7.95	2.82	207.5	0.9853	0.4179
9.40	3.07	209.0	0.9852	0.4177
11.85	3.44	211.0	0.9850	0.4174
14.95	3.87	212.0	0.9849	0.4172
18.85	4.34	213.5	0.9847	0.4170
23.77	4.88	215.0	0.9846	0.4168
29.95	5.47	216.0	0.9845	0.4167
37.75	6.14	216.5	0.9844	0.4166
47.57	6.90	217.5	0.9843	0.4164
59.95	7.74	218.5	0.9842	0.4163
75.95	8.71	219.0	0.9842	0.4162
94.95	9.74	219.5	0.9841	0.4162
119.95	10.95	220.0	0.9841	0.4161
150.95	12.29	220.5	0.9840	0.4160
189.95	13.78	221.0	0.9840	0.4159
757.95	27.53	224.0	0.9837	0.4155

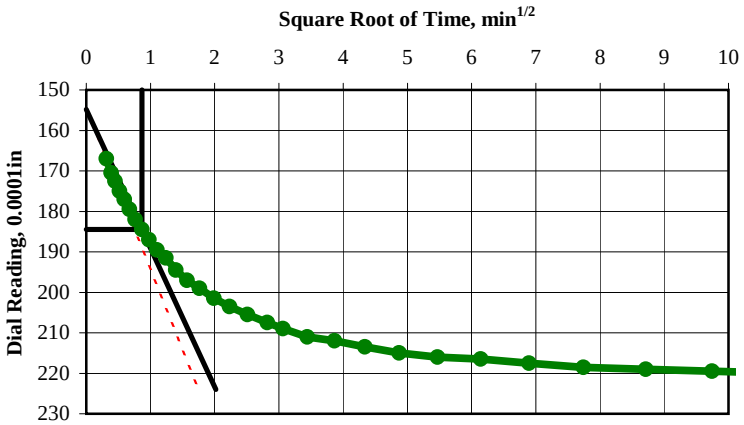
Machine Deflection

Applied Deflection Correction to Sample Height, 0.0001in: -5.5
**Correction is applied to all dial readings.*

Log of Elapsed Time vs. Dial Reading



Square Root of Elapsed Time vs. Dial Reading



Sqrt. of Elapsed Time vs Dial Reading

T0 = 0 min.	D0 = 154.8 div.
T90 = 0.74 min	D90 = 184.5 div.
T100 = NA min	D100 = 187.8 div.
Height at: D90 = 0.9876, D100 = 0.9873	
Average Sample Height, in	0.9889
Average Drainage Height, in	0.4944
T (Time Factor for T90)	0.848
Coef. of Consol., C_v, in^2/min	0.277

Log of Elapsed Time vs Dial Reading

T0 = 0 min.	D0 = 155.7 div.
T50 = 0.79 min.	D50 = 185.1 div.
T100 = 9.73 min.	D100 = 214.6 div.
Height at: D50 = 0.9876, D100 = 0.9846	
Average Sample Height, in	0.9889
Average Drainage Height, in	0.4944
T (Time Factor for T50)	0.197
Coef. of Consol., C_v, in^2/min	0.061

Load Summary

Initial Sample Height, in	0.9940
Initial Sample Void Ratio	0.4304
Final Sample Height, in	0.9837
Final Sample Void Ratio	0.4155
Incremental Strain, %	1.04%
Loading Duration, min	757.95

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ONE-DIMENSIONAL CONSOLIDATION PROPERTIES OF SOILS
ASTM D 2435

Client	Civil & Environmental Consultant	Boring	SB-21	**Test Load, tsf**	**2-4**
Client Project	091-867 Apex Landfill Expansion	Depth	9'-11'		Load 5 of 13
Project No.	30598	Sample	ST-1		
		Lab ID#	30598011		

Visual Description: LIGHT OLIVE BROWN LEAN CLAY WITH GRAVEL
Test Conditions: Undisturbed, Inundated, and Double Drained

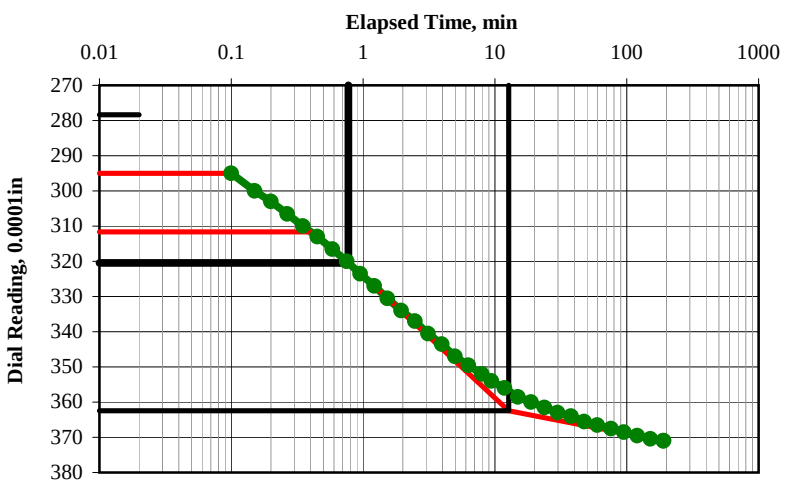
Time Vs. Dial Reading

Elapsed Time (min)	Sqrt Time ($min^{1/2}$)	Dial Reading (0.0001in)	Sample Height (in)	Void Ratio
0	0	224.0	0.9837	0.4155
Corrections*		-8	-0.0008	-0.0012
Adjusted Sample Height & Void Ratio				
0.10	0.32	295.0	0.9774	0.4064
0.15	0.39	300.0	0.9769	0.4057
0.20	0.45	303.0	0.9766	0.4053
0.27	0.52	306.5	0.9762	0.4048
0.35	0.59	310.0	0.9759	0.4043
0.45	0.67	313.0	0.9756	0.4039
0.58	0.76	316.5	0.9752	0.4034
0.75	0.87	320.0	0.9749	0.4028
0.95	0.97	323.5	0.9745	0.4023
1.22	1.10	327.0	0.9742	0.4018
1.53	1.24	330.5	0.9738	0.4013
1.95	1.40	334.0	0.9735	0.4008
2.47	1.57	337.0	0.9732	0.4004
3.12	1.77	340.5	0.9728	0.3999
3.95	1.99	343.5	0.9725	0.3995
4.98	2.23	347.0	0.9722	0.3990
6.30	2.51	349.5	0.9719	0.3986
7.95	2.82	352.0	0.9717	0.3982
9.40	3.07	354.0	0.9715	0.3980
11.85	3.44	356.0	0.9713	0.3977
14.95	3.87	358.5	0.9710	0.3973
18.85	4.34	360.0	0.9709	0.3971
23.77	4.88	361.5	0.9707	0.3969
29.95	5.47	363.0	0.9706	0.3967
37.75	6.14	364.0	0.9705	0.3965
47.57	6.90	365.5	0.9703	0.3963
59.95	7.74	366.5	0.9702	0.3962
75.95	8.71	367.5	0.9701	0.3960
94.95	9.74	368.5	0.9700	0.3959
119.95	10.95	369.5	0.9699	0.3957
150.95	12.29	370.5	0.9698	0.3956
189.95	13.78	371.0	0.9698	0.3955

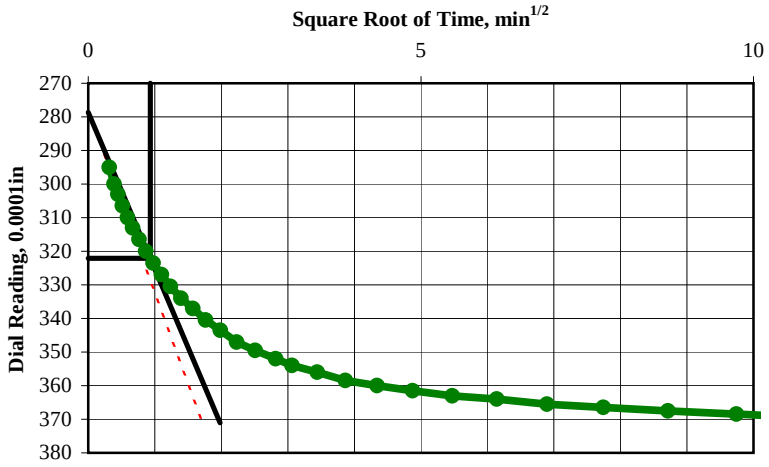
Machine Deflection

Applied Deflection Correction to Sample Height, 0.0001in: -8
**Correction is applied to all dial readings.*

Log of Elapsed Time vs. Dial Reading



Square Root of Elapsed Time vs. Dial Reading



Sqrt. of Elapsed Time vs Dial Reading

T0 = 0 min.	D0 = 278.7 div.		
T90 = 0.865 min	D90 = 322.1 div.		
T100 = NA min	D100 = 326.9 div.		
Height at: D90 = 0.9747, D100 = 0.9742			
Average Sample Height, in	0.9767		
Average Drainage Height, in	0.4884		
T (Time Factor for T90)	0.848		
Coef. of Consol., C_v, in^2/min	0.233		

Log of Elapsed Time vs Dial Reading

T0 = 0 min.	D0 = 278.4 div.		
T50 = 0.77 min.	D50 = 320.4 div.		
T100 = 12.7 min.	D100 = 362.5 div.		
Height at: D50 = 0.9748, D100 = 0.9706			
Average Sample Height, in	0.9767		
Average Drainage Height, in	0.4884		
T (Time Factor for T50)	0.197		
Coef. of Consol., C_v, in^2/min	0.061		

Load Summary

Initial Sample Height, in	0.9837
Initial Sample Void Ratio	0.4155
Final Sample Height, in	0.9698
Final Sample Void Ratio	0.3955
Incremental Strain, %	1.41%
Loading Duration, min	189.95

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ONE-DIMENSIONAL CONSOLIDATION PROPERTIES OF SOILS
ASTM D 2435

Client	Civil & Environmental Consultant	Boring	SB-21	**Test Load, tsf**	**4-1**
Client Project	091-867 Apex Landfill Expansion	Depth	9'-11'		Load 6 of 13
Project No.	30598	Sample	ST-1		
		Lab ID#	30598011		
Visual Description	LIGHT OLIVE BROWN LEAN CLAY WITH GRAVEL				
Test Conditions:	Undisturbed, Inundated, and Double Drained				

Time Vs. Dial Reading

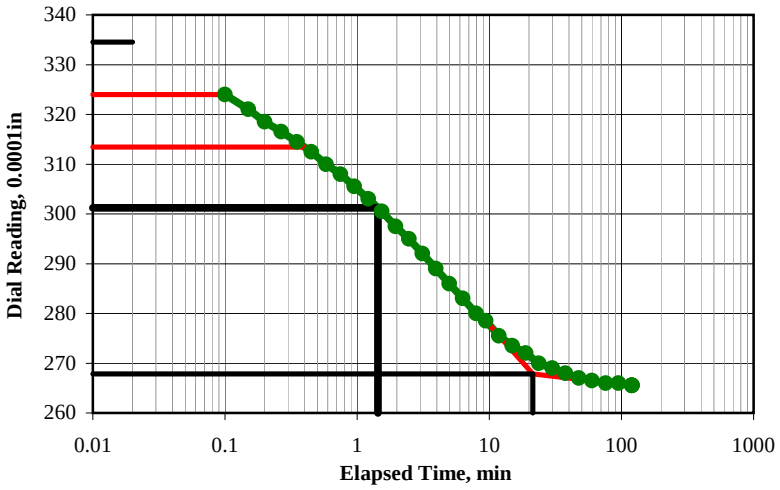
Elapsed Time (min)	Sqrt Time ($min^{1/2}$)	Dial Reading (0.0001in)	Sample Height (in)	Void Ratio
0	0	371.0	0.9698	0.3955
Corrections*		8.5	0.00085	0.00122
Adjusted Sample Height & Void Ratio				
0.10	0.32	324.0	0.9736	0.4010
0.15	0.39	321.0	0.9739	0.4015
0.20	0.45	318.5	0.9742	0.4018
0.27	0.52	316.5	0.9744	0.4021
0.35	0.59	314.5	0.9746	0.4024
0.45	0.67	312.5	0.9748	0.4027
0.58	0.76	310.0	0.9750	0.4031
0.75	0.87	308.0	0.9752	0.4034
0.95	0.97	305.5	0.9755	0.4037
1.22	1.10	303.0	0.9757	0.4041
1.53	1.24	300.5	0.9760	0.4044
1.95	1.40	297.5	0.9763	0.4049
2.47	1.57	295.0	0.9765	0.4052
3.12	1.77	292.0	0.9768	0.4057
3.95	1.99	289.0	0.9771	0.4061
4.98	2.23	286.0	0.9774	0.4065
6.30	2.51	283.0	0.9777	0.4069
7.95	2.82	280.0	0.9780	0.4074
9.40	3.07	278.5	0.9782	0.4076
11.85	3.44	275.5	0.9785	0.4080
14.95	3.87	273.5	0.9787	0.4083
18.85	4.34	272.0	0.9788	0.4085
23.77	4.88	270.0	0.9790	0.4088
29.95	5.47	269.0	0.9791	0.4090
37.75	6.14	268.0	0.9792	0.4091
47.57	6.90	267.0	0.9793	0.4093
59.95	7.74	266.5	0.9794	0.4093
75.95	8.71	266.0	0.9794	0.4094
94.95	9.74	266.0	0.9794	0.4094
119.95	10.95	265.5	0.9795	0.4095

Machine Deflection

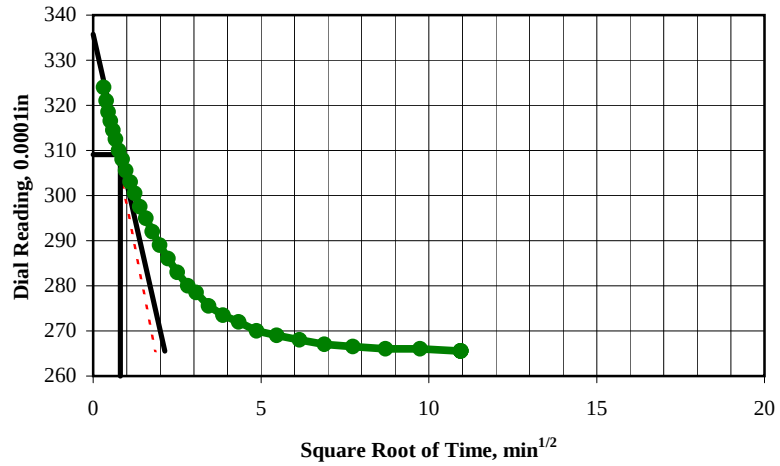
Applied Deflection Correction to Sample Height, 0.0001in 8.5

**Correction is applied to all dial readings.*

Log of Elapsed Time vs. Dial Reading



Square Root of Elapsed Time vs. Dial Reading



Sqrt. of Elapsed Time vs Dial Reading

T0 = 0 min.	D0 = 335.8 div.
T90 = 0.656 min	D90 = 309.1 div.
T100 = NA min	D100 = 306.1 div.
Height at: D90 = 0.9751, D100 = 0.9754	
Average Sample Height, in	0.9746
Average Drainage Height, in	0.4873
T (Time Factor for T90)	0.848
Coef. of Consol., C_v, in^2/min	0.306

Log of Elapsed Time vs Dial Reading

T0 = 0 min.	D0 = 334.6 div.
T50 = 1.43 min.	D50 = 301.2 div.
T100 = 21.35 min.	D100 = 267.9 div.
Height at: D50 = 0.9759, D100 = 0.9792	
Average Sample Height, in	0.9746
Average Drainage Height, in	0.4873
T (Time Factor for T50)	0.197
Coef. of Consol., C_v, in^2/min	0.033

Load Summary

Initial Sample Height, in	0.9698
Initial Sample Void Ratio	0.3955
Final Sample Height, in	0.9795
Final Sample Void Ratio	0.4095
Incremental Strain, %	-1.00%
Loading Duration, min	119.95

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ONE-DIMENSIONAL CONSOLIDATION PROPERTIES OF SOILS
ASTM D 2435

Client	Civil & Environmental Consultant	Boring	SB-21	**Test Load, tsf**	**1-0.25**
Client Project	091-867 Apex Landfill Expansion	Depth	9'-11'		Load 7 of 13
Project No.	30598	Sample	ST-1		
		Lab ID#	30598011		

Visual Description: LIGHT OLIVE BROWN LEAN CLAY WITH GRAVEL
Test Conditions: Undisturbed, Inundated, and Double Drained

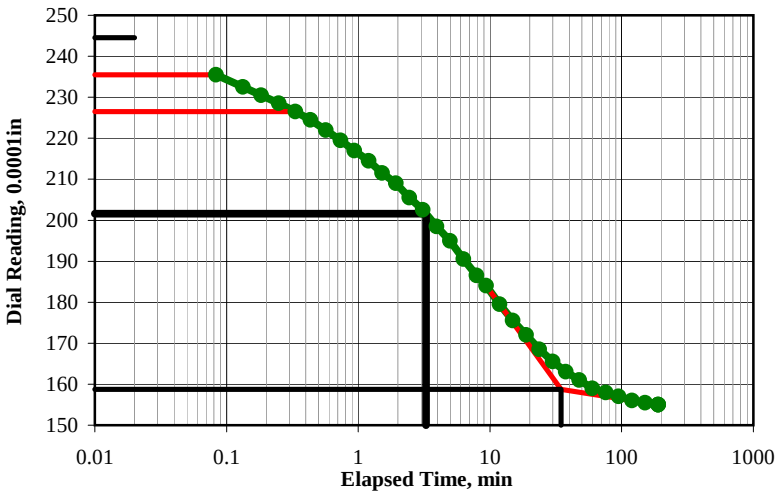
Time Vs. Dial Reading

Elapsed Time (min)	Sqrt Time ($min^{1/2}$)	Dial Reading (0.0001in)	Sample Height (in)	Void Ratio
0	0	265.5	0.9795	0.4095
Corrections*		6.5	0.00065	0.00094
Adjusted Sample Height & Void Ratio				
0.08	0.29	235.5	0.9818	0.4128
0.13	0.37	232.5	0.9821	0.4133
0.18	0.43	230.5	0.9823	0.4136
0.25	0.50	228.5	0.9825	0.4139
0.33	0.58	226.5	0.9827	0.4141
0.43	0.66	224.5	0.9829	0.4144
0.57	0.75	222.0	0.9832	0.4148
0.73	0.86	219.5	0.9834	0.4152
0.93	0.97	217.0	0.9837	0.4155
1.20	1.10	214.5	0.9839	0.4159
1.52	1.23	211.5	0.9842	0.4163
1.93	1.39	209.0	0.9845	0.4167
2.45	1.57	205.5	0.9848	0.4172
3.10	1.76	202.5	0.9851	0.4176
3.93	1.98	198.5	0.9855	0.4182
4.97	2.23	195.0	0.9859	0.4187
6.28	2.51	190.5	0.9863	0.4193
7.93	2.82	186.5	0.9867	0.4199
9.38	3.06	184.0	0.9870	0.4203
11.83	3.44	179.5	0.9874	0.4209
14.93	3.86	175.5	0.9878	0.4215
18.83	4.34	172.0	0.9882	0.4220
23.75	4.87	168.5	0.9885	0.4225
29.93	5.47	165.5	0.9888	0.4229
37.73	6.14	163.0	0.9891	0.4233
47.55	6.90	161.0	0.9893	0.4236
59.93	7.74	159.0	0.9895	0.4239
75.93	8.71	158.0	0.9896	0.4240
94.93	9.74	157.0	0.9897	0.4241
119.93	10.95	156.0	0.9898	0.4243
150.93	12.29	155.5	0.9898	0.4244
189.93	13.78	155.0	0.9899	0.4244

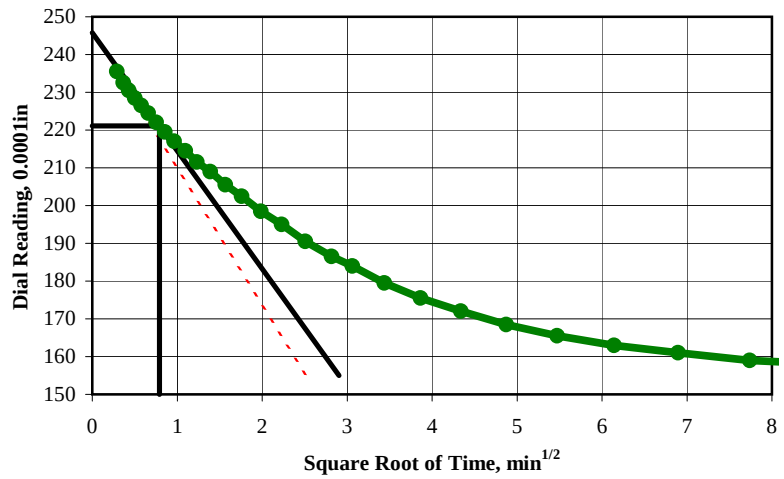
Machine Deflection

Applied Deflection Correction to Sample Height, 0.0001in 6.5
**Correction is applied to all dial readings.*

Log of Elapsed Time vs. Dial Reading



Square Root of Elapsed Time vs. Dial Reading



Sqrt. of Elapsed Time vs Dial Reading

T0 = 0 min.	D0 = 245.8 div.
T90 = 0.624 min	D90 = 221.1 div.
T100 = NA min	D100 = 218.4 div.
Height at: D90 = 0.9833, D100 = 0.9835	
Average Sample Height, in	0.9847
Average Drainage Height, in	0.4923
T (Time Factor for T90)	0.848
Coef. of Consol., C_v, in^2/min	0.330

Log of Elapsed Time vs Dial Reading

T0 = 0 min.	D0 = 244.5 div.
T50 = 3.27 min.	D50 = 201.6 div.
T100 = 34.57 min.	D100 = 158.7 div.
Height at: D50 = 0.9852, D100 = 0.9895	
Average Sample Height, in	0.9847
Average Drainage Height, in	0.4923
T (Time Factor for T50)	0.197
Coef. of Consol., C_v, in^2/min	0.015

Load Summary

Initial Sample Height, in	0.9795
Initial Sample Void Ratio	0.4095
Final Sample Height, in	0.9899
Final Sample Void Ratio	0.4244
Incremental Strain, %	-1.06%
Loading Duration, min	189.93333

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ASTM D 2435

Client	Civil & Environmental Consultant	Boring	SB-21	**Test Load, tsf**	**0.25-0.5**
Client Project	091-867 Apex Landfill Expansion	Depth	9'-11'		Load 8 of 13
Project No.	30598	Sample	ST-1		
		Lab ID#	30598011		

Visual Description: LIGHT OLIVE BROWN LEAN CLAY WITH GRAVEL

Test Conditions: Undisturbed, Inundated, and Double Drained

Time Vs. Dial Reading

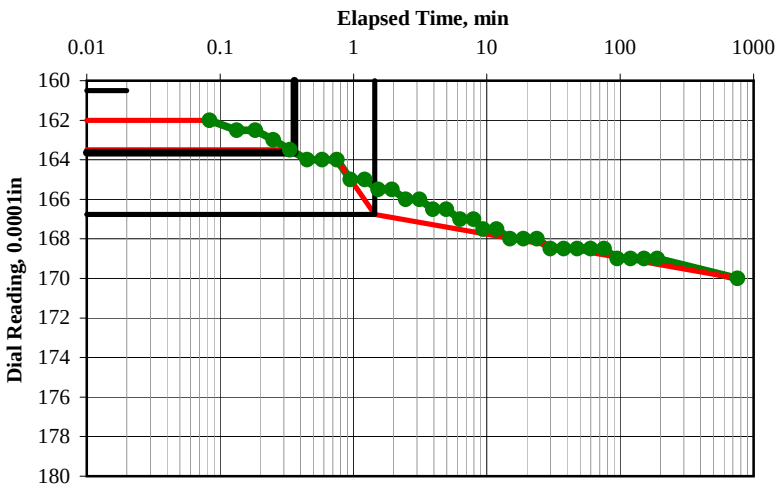
Elapsed Time (min)	Sqrt Time ($min^{1/2}$)	Dial Reading (0.0001in)	Sample Height (in)	Void Ratio
0	0	155.0	0.9899	0.4244
Corrections*		-2.5	-0.00025	-0.0004
Adjusted Sample Height & Void Ratio				
0.08	0.29	162.0	0.9894	0.4238
0.13	0.37	162.5	0.9894	0.4237
0.18	0.43	162.5	0.9894	0.4237
0.25	0.50	163.0	0.9893	0.4236
0.33	0.58	163.5	0.9893	0.4236
0.45	0.67	164.0	0.9892	0.4235
0.58	0.76	164.0	0.9892	0.4235
0.75	0.87	164.0	0.9892	0.4235
0.95	0.97	165.0	0.9891	0.4234
1.22	1.10	165.0	0.9891	0.4234
1.53	1.24	165.5	0.9891	0.4233
1.95	1.40	165.5	0.9891	0.4233
2.47	1.57	166.0	0.9890	0.4232
3.13	1.77	166.0	0.9890	0.4232
3.95	1.99	166.5	0.9890	0.4231
4.98	2.23	166.5	0.9890	0.4231
6.30	2.51	167.0	0.9889	0.4231
7.95	2.82	167.0	0.9889	0.4231
9.40	3.07	167.5	0.9889	0.4230
11.85	3.44	167.5	0.9889	0.4230
14.95	3.87	168.0	0.9888	0.4229
18.85	4.34	168.0	0.9888	0.4229
23.77	4.88	168.0	0.9888	0.4229
29.95	5.47	168.5	0.9888	0.4228
37.75	6.14	168.5	0.9888	0.4228
47.57	6.90	168.5	0.9888	0.4228
59.95	7.74	168.5	0.9888	0.4228
75.95	8.71	168.5	0.9888	0.4228
94.95	9.74	169.0	0.9887	0.4228
119.95	10.95	169.0	0.9887	0.4228
150.95	12.29	169.0	0.9887	0.4228
189.95	13.78	169.0	0.9887	0.4228
757.95	27.53	170.0	0.9886	0.4226

Machine Deflection

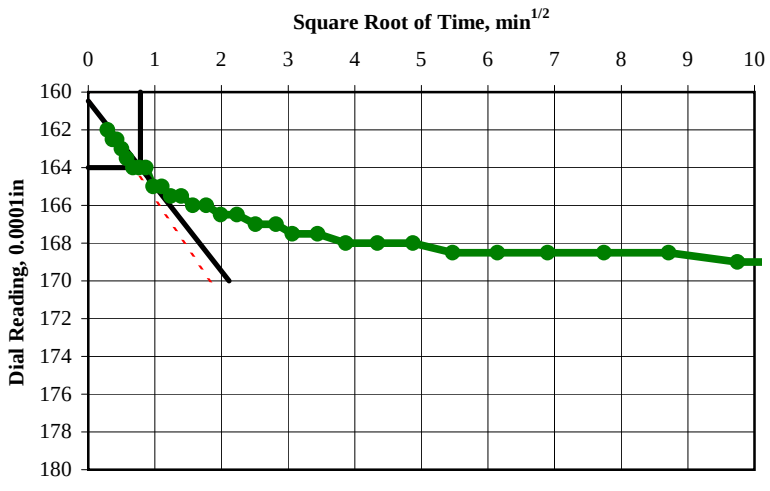
Applied Deflection Correction to Sample Height, 0.0001in: -2.5

**Correction is applied to all dial readings.*

Log of Elapsed Time vs. Dial Reading



Square Root of Elapsed Time vs. Dial Reading



Sqrt. of Elapsed Time vs Dial Reading

T0 = 0 min.	D0 = 160.5 div.		
T90 = 0.608 min	D90 = 164 div.		
T100 = NA min	D100 = 164.4 div.		
Height at: D90 = 0.9892, D100 = 0.9892			
Average Sample Height, in	0.9893		
Average Drainage Height, in	0.4946		
T (Time Factor for T90)	0.848		
Coef. of Consol., C_v, in^2/min	0.339		

Log of Elapsed Time vs Dial Reading

T0 = 0 min.	D0 = 160.5 div.		
T50 = 0.36 min.	D50 = 163.6 div.		
T100 = 1.44 min.	D100 = 166.8 div.		
Height at: D50 = 0.9893, D100 = 0.9889			
Average Sample Height, in	0.9893		
Average Drainage Height, in	0.4946		
T (Time Factor for T50)	0.197		
Coef. of Consol., C_v, in^2/min	0.134		

Load Summary

Initial Sample Height, in	0.9899
Initial Sample Void Ratio	0.4244
Final Sample Height, in	0.9886
Final Sample Void Ratio	0.4226
Incremental Strain, %	0.13%
Loading Duration, min	757.95

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ONE-DIMENSIONAL CONSOLIDATION PROPERTIES OF SOILS
ASTM D 2435

Client	Civil & Environmental Consultant	Boring	SB-21	**Test Load, tsf**	**0.5-1**
Client Project	091-867 Apex Landfill Expansion	Depth	9'-11'		Load 9 of 13
Project No.	30598	Sample	ST-1		
		Lab ID#	30598011		
Visual Description	LIGHT OLIVE BROWN LEAN CLAY WITH GRAVEL				
Test Conditions:	Undisturbed, Inundated, and Double Drained				

Time Vs. Dial Reading

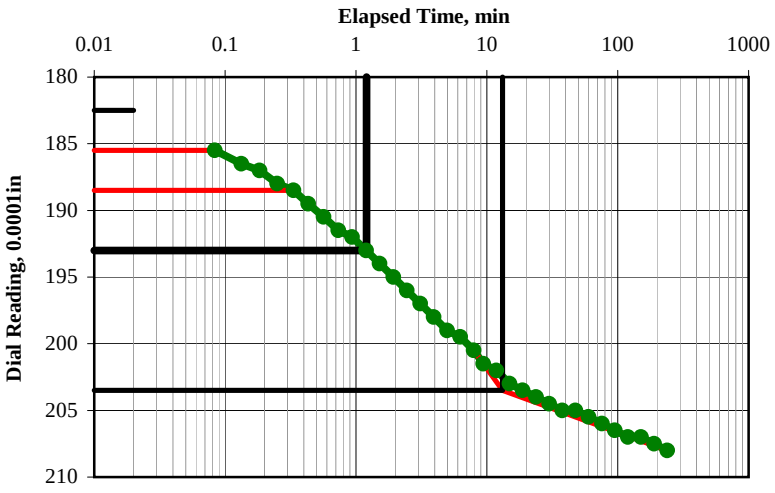
Elapsed Time (min)	Sqrt Time ($min^{1/2}$)	Dial Reading (0.0001in)	Sample Height (in)	Void Ratio
0	0	170.0	0.9886	0.4226
Corrections*		-3.5	-0.00035	-0.0005
Adjusted Sample Height & Void Ratio				
0.08	0.29	185.5	0.9874	0.4209
0.13	0.37	186.5	0.9873	0.4208
0.18	0.43	187.0	0.9873	0.4207
0.25	0.50	188.0	0.9872	0.4205
0.33	0.58	188.5	0.9871	0.4205
0.43	0.66	189.5	0.9870	0.4203
0.57	0.75	190.5	0.9869	0.4202
0.73	0.86	191.5	0.9868	0.4200
0.93	0.97	192.0	0.9868	0.4200
1.20	1.10	193.0	0.9867	0.4198
1.52	1.23	194.0	0.9866	0.4197
1.93	1.39	195.0	0.9865	0.4195
2.45	1.57	196.0	0.9864	0.4194
3.10	1.76	197.0	0.9863	0.4193
3.93	1.98	198.0	0.9862	0.4191
4.97	2.23	199.0	0.9861	0.4190
6.28	2.51	199.5	0.9860	0.4189
7.93	2.82	200.5	0.9859	0.4187
9.38	3.06	201.5	0.9858	0.4186
11.83	3.44	202.0	0.9858	0.4185
14.93	3.86	203.0	0.9857	0.4184
18.83	4.34	203.5	0.9856	0.4183
23.75	4.87	204.0	0.9856	0.4182
29.93	5.47	204.5	0.9855	0.4182
37.73	6.14	205.0	0.9855	0.4181
47.55	6.90	205.0	0.9855	0.4181
59.93	7.74	205.5	0.9854	0.4180
75.93	8.71	206.0	0.9854	0.4180
94.93	9.74	206.5	0.9853	0.4179
119.93	10.95	207.0	0.9853	0.4178
150.93	12.29	207.0	0.9853	0.4178
189.93	13.78	207.5	0.9852	0.4177
239.93	15.49	208.0	0.9852	0.4177

Machine Deflection

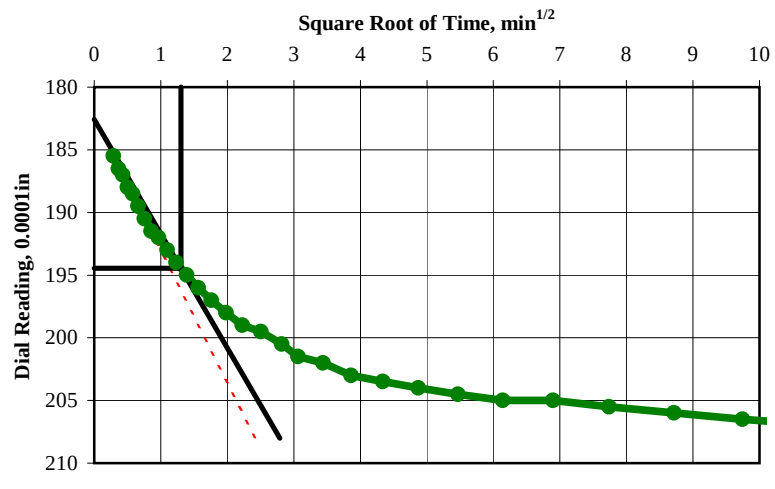
Applied Deflection Correction to Sample Height, 0.0001in -3.5

**Correction is applied to all dial readings.*

Log of Elapsed Time vs. Dial Reading



Square Root of Elapsed Time vs. Dial Reading



Sqrt. of Elapsed Time vs Dial Reading

T0 = 0 min.	D0 = 182.6 div.		
T90 = 1.69 min	D90 = 194.5 div.		
T100 = NA min	D100 = 195.8 div.		
Height at: D90 = 0.9865, D100 = 0.9864			
Average Sample Height, in	0.9869		
Average Drainage Height, in	0.4935		
T (Time Factor for T90)	0.848		
Coef. of Consol., C_v, in^2/min	0.121		

Log of Elapsed Time vs Dial Reading

T0 = 0 min.	D0 = 182.5 div.		
T50 = 1.2 min.	D50 = 193 div.		
T100 = 13.14 min.	D100 = 203.5 div.		
Height at: D50 = 0.9867, D100 = 0.9856			
Average Sample Height, in	0.9869		
Average Drainage Height, in	0.4935		
T (Time Factor for T50)	0.197		
Coef. of Consol., C_v, in^2/min	0.040		

Load Summary

Initial Sample Height, in	0.9886
Initial Sample Void Ratio	0.4226
Final Sample Height, in	0.9852
Final Sample Void Ratio	0.4177
Incremental Strain, %	0.35%
Loading Duration, min	239.93333

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Client	Civil & Environmental Consultant	Boring	SB-21	**Test Load, tsf**	**1-2**
Client Project	091-867 Apex Landfill Expansion	Depth	9'-11'		Load 10 of 13
Project No.	30598	Sample	ST-1		
		Lab ID#	30598011		

Visual Description: LIGHT OLIVE BROWN LEAN CLAY WITH GRAVEL
Test Conditions: Undisturbed, Inundated, and Double Drained

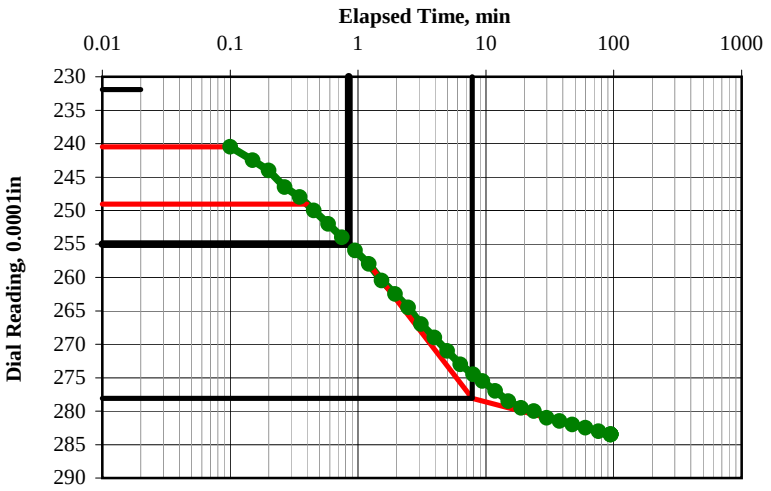
Time Vs. Dial Reading

Elapsed Time (min)	Sqrt Time ($min^{1/2}$)	Dial Reading (0.0001in)	Sample Height (in)	Void Ratio
0	0	208.0	0.9852	0.4177
Corrections*		-4.5	-0.00045	-0.0006
Adjusted Sample Height & Void Ratio				
0.10	0.32	240.5	0.9824	0.4136
0.15	0.39	242.5	0.9822	0.4134
0.20	0.45	244.0	0.9820	0.4131
0.27	0.52	246.5	0.9818	0.4128
0.35	0.59	248.0	0.9816	0.4126
0.45	0.67	250.0	0.9814	0.4123
0.58	0.76	252.0	0.9812	0.4120
0.75	0.87	254.0	0.9810	0.4117
0.95	0.97	256.0	0.9808	0.4114
1.22	1.10	258.0	0.9806	0.4111
1.53	1.24	260.5	0.9804	0.4108
1.95	1.40	262.5	0.9802	0.4105
2.47	1.57	264.5	0.9800	0.4102
3.12	1.77	267.0	0.9797	0.4098
3.95	1.99	269.0	0.9795	0.4095
4.98	2.23	271.0	0.9793	0.4093
6.30	2.51	273.0	0.9791	0.4090
7.95	2.82	274.5	0.9790	0.4087
9.40	3.07	275.5	0.9789	0.4086
11.85	3.44	277.0	0.9787	0.4084
14.95	3.87	278.5	0.9786	0.4082
18.85	4.34	279.5	0.9785	0.4080
23.77	4.88	280.0	0.9784	0.4080
29.95	5.47	281.0	0.9783	0.4078
37.75	6.14	281.5	0.9783	0.4077
47.57	6.90	282.0	0.9782	0.4077
59.95	7.74	282.5	0.9782	0.4076
75.95	8.71	283.0	0.9781	0.4075
94.95	9.74	283.5	0.9781	0.4075

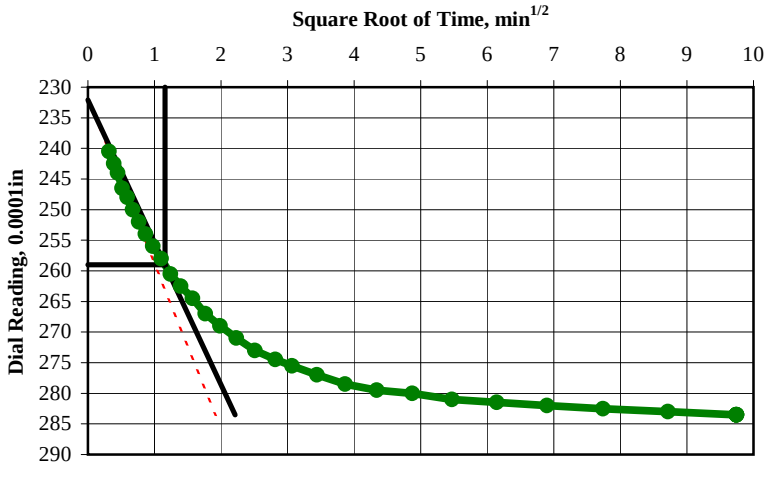
Machine Deflection

Applied Deflection Correction to Sample Height, 0.0001in: -4.5
**Correction is applied to all dial readings.*

Log of Elapsed Time vs. Dial Reading



Square Root of Elapsed Time vs. Dial Reading



Sqrt. of Elapsed Time vs Dial Reading

T0 = 0 min.	D0 = 232.1 div.
T90 = 1.346 min	D90 = 259 div.
T100 = NA min	D100 = 262 div.
Height at: D90 = 0.9805, D100 = 0.9802	
Average Sample Height, in	0.9816
Average Drainage Height, in	0.4908
T (Time Factor for T90)	0.848
Coef. of Consol., C_v, in^2/min	0.152

Log of Elapsed Time vs Dial Reading

T0 = 0 min.	D0 = 231.9 div.
T50 = 0.85 min.	D50 = 255 div.
T100 = 7.8 min.	D100 = 278.1 div.
Height at: D50 = 0.9809, D100 = 0.9786	
Average Sample Height, in	0.9816
Average Drainage Height, in	0.4908
T (Time Factor for T50)	0.197
Coef. of Consol., C_v, in^2/min	0.056

Load Summary

Initial Sample Height, in	0.9852
Initial Sample Void Ratio	0.4177
Final Sample Height, in	0.9781
Final Sample Void Ratio	0.4075
Incremental Strain, %	0.72%
Loading Duration, min	94.95

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ASTM D 2435

Client	Civil & Environmental Consultant	Boring	SB-21	**Test Load, tsf**	**2-4**
Client Project	091-867 Apex Landfill Expansion	Depth	9'-11'		Load 11 of 13
Project No.	30598	Sample	ST-1		
		Lab ID#	30598011		
Visual Description	LIGHT OLIVE BROWN LEAN CLAY WITH GRAVEL				
Test Conditions:	Undisturbed, Inundated, and Double Drained				

Time Vs. Dial Reading

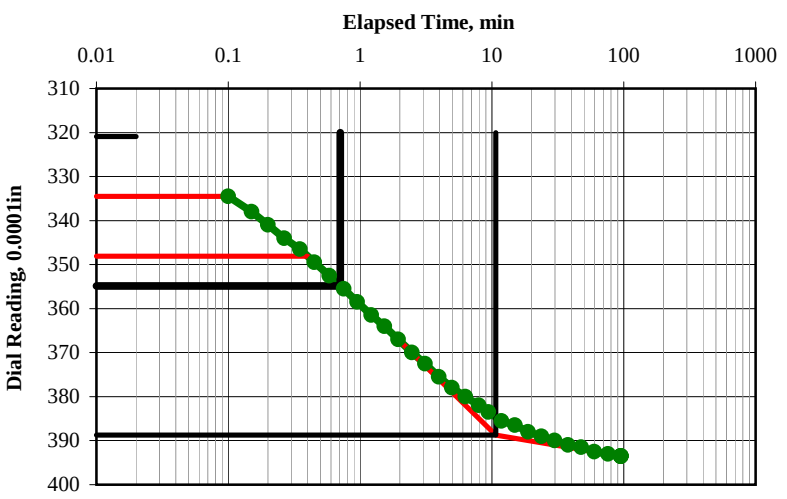
Elapsed Time (min)	Sqrt Time ($min^{1/2}$)	Dial Reading (0.0001in)	Sample Height (in)	Void Ratio
0	0	283.5	0.9781	0.4075
Corrections*		-5	-0.0005	-0.0007
Adjusted Sample Height & Void Ratio				
0.10	0.32	334.5	0.9735	0.4008
0.15	0.39	338.0	0.9731	0.4003
0.20	0.45	341.0	0.9728	0.3999
0.27	0.52	344.0	0.9725	0.3995
0.35	0.59	346.5	0.9723	0.3991
0.45	0.67	349.5	0.9720	0.3987
0.58	0.76	352.5	0.9717	0.3982
0.75	0.87	355.5	0.9714	0.3978
0.95	0.97	358.5	0.9711	0.3974
1.22	1.10	361.5	0.9708	0.3969
1.53	1.24	364.0	0.9705	0.3966
1.95	1.40	367.0	0.9702	0.3962
2.47	1.57	370.0	0.9699	0.3957
3.12	1.77	372.5	0.9697	0.3954
3.95	1.99	375.5	0.9694	0.3949
4.98	2.23	378.0	0.9691	0.3946
6.30	2.51	380.0	0.9689	0.3943
7.95	2.82	382.0	0.9687	0.3940
9.40	3.07	383.5	0.9686	0.3938
11.85	3.44	385.5	0.9684	0.3935
14.95	3.87	386.5	0.9683	0.3934
18.85	4.34	388.0	0.9681	0.3931
23.77	4.88	389.0	0.9680	0.3930
29.95	5.47	390.0	0.9679	0.3928
37.75	6.14	391.0	0.9678	0.3927
47.57	6.90	391.5	0.9678	0.3926
59.95	7.74	392.5	0.9677	0.3925
75.95	8.71	393.0	0.9676	0.3924
94.95	9.74	393.5	0.9676	0.3923

Machine Deflection

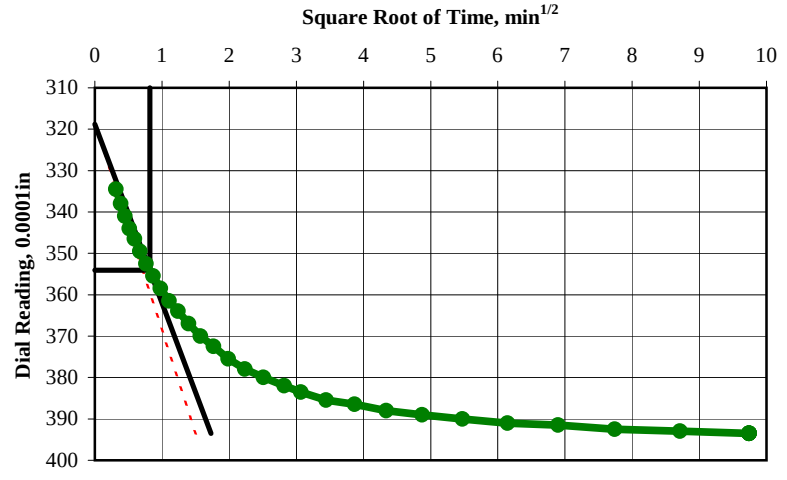
Applied Deflection Correction to Sample Height, 0.0001in -5

**Correction is applied to all dial readings.*

Log of Elapsed Time vs. Dial Reading



Square Root of Elapsed Time vs. Dial Reading



Sqrt. of Elapsed Time vs Dial Reading

T0 = 0 min.	D0 = 318.8 div.		
T90 = 0.672 min	D90 = 354.1 div.		
T100 = NA min	D100 = 358 div.		
Height at: D90 = 0.9715, D100 = 0.9711			
Average Sample Height, in	0.9728		
Average Drainage Height, in	0.4864		
T (Time Factor for T90)	0.848		
Coef. of Consol., C_v, in^2/min	0.300		

Log of Elapsed Time vs Dial Reading

T0 = 0 min.	D0 = 320.9 div.		
T50 = 0.71 min.	D50 = 354.8 div.		
T100 = 10.7 min.	D100 = 388.7 div.		
Height at: D50 = 0.9714, D100 = 0.9681			
Average Sample Height, in	0.9728		
Average Drainage Height, in	0.4864		
T (Time Factor for T50)	0.197		
Coef. of Consol., C_v, in^2/min	0.066		

Load Summary

Initial Sample Height, in	0.9781
Initial Sample Void Ratio	0.4075
Final Sample Height, in	0.9676
Final Sample Void Ratio	0.3923
Incremental Strain, %	1.07%
Loading Duration, min	94.95

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Client	Civil & Environmental Consultant	Boring	SB-21	**Test Load, tsf**	**4-8**
Client Project	091-867 Apex Landfill Expansion	Depth	9'-11'		Load 12 of 13
Project No.	30598	Sample	ST-1		
		Lab ID#	30598011		

Visual Description: LIGHT OLIVE BROWN LEAN CLAY WITH GRAVEL
Test Conditions: Undisturbed, Inundated, and Double Drained

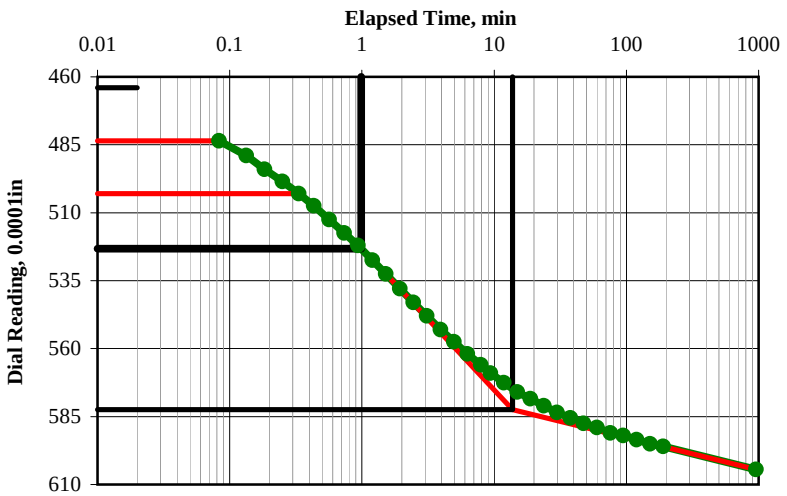
Time Vs. Dial Reading

Elapsed Time (min)	Sqrt Time ($min^{1/2}$)	Dial Reading (0.0001in)	Sample Height (in)	Void Ratio
0	0	393.5	0.9676	0.3923
Corrections*		-10.5	-0.00105	-0.0015
Adjusted Sample Height & Void Ratio				
0.08	0.29	483.5	0.9596	0.3809
0.13	0.37	489.0	0.9591	0.3801
0.18	0.43	494.0	0.9586	0.3794
0.25	0.50	498.5	0.9581	0.3787
0.33	0.58	503.0	0.9577	0.3781
0.43	0.66	507.5	0.9572	0.3774
0.57	0.75	512.5	0.9567	0.3767
0.73	0.86	517.5	0.9562	0.3760
0.93	0.97	522.0	0.9558	0.3754
1.20	1.10	527.5	0.9552	0.3746
1.52	1.23	532.5	0.9547	0.3739
1.93	1.39	538.0	0.9542	0.3731
2.45	1.57	543.0	0.9537	0.3723
3.10	1.76	548.0	0.9532	0.3716
3.93	1.98	553.0	0.9527	0.3709
4.97	2.23	557.5	0.9522	0.3703
6.28	2.51	562.0	0.9518	0.3696
7.93	2.82	566.0	0.9514	0.3690
9.38	3.06	569.0	0.9511	0.3686
11.83	3.44	572.5	0.9507	0.3681
14.93	3.86	576.0	0.9504	0.3676
18.83	4.34	578.5	0.9501	0.3672
23.75	4.87	581.0	0.9499	0.3669
29.93	5.47	583.5	0.9496	0.3665
37.73	6.14	585.5	0.9494	0.3662
47.55	6.90	587.5	0.9492	0.3659
59.93	7.74	589.0	0.9491	0.3657
75.93	8.71	591.0	0.9489	0.3654
94.93	9.74	592.0	0.9488	0.3653
119.93	10.95	593.5	0.9486	0.3651
150.93	12.29	595.0	0.9485	0.3649
189.93	13.78	596.0	0.9484	0.3647
954.93	30.90	604.5	0.9475	0.3635

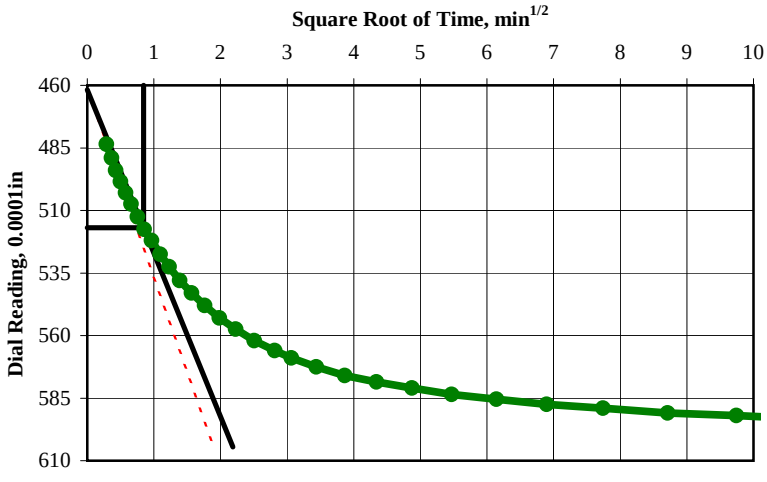
Machine Deflection

Applied Deflection Correction to Sample Height, 0.0001in: -10.5
**Correction is applied to all dial readings.*

Log of Elapsed Time vs. Dial Reading



Square Root of Elapsed Time vs. Dial Reading



Sqrt. of Elapsed Time vs Dial Reading

T0 = 0 min.	D0 = 461.7 div.
T90 = 0.723 min	D90 = 517 div.
T100 = NA min	D100 = 523.1 div.
Height at: D90 = 0.9563, D100 = 0.9557	
Average Sample Height, in	0.9576
Average Drainage Height, in	0.4788
T (Time Factor for T90)	0.848
Coef. of Consol., C_v, in^2/min	0.272

Log of Elapsed Time vs Dial Reading

T0 = 0 min.	D0 = 464 div.
T50 = 0.99 min.	D50 = 523.2 div.
T100 = 13.77 min.	D100 = 582.5 div.
Height at: D50 = 0.9557, D100 = 0.9497	
Average Sample Height, in	0.9576
Average Drainage Height, in	0.4788
T (Time Factor for T50)	0.197
Coef. of Consol., C_v, in^2/min	0.046

Load Summary

Initial Sample Height, in	0.9676
Initial Sample Void Ratio	0.3923
Final Sample Height, in	0.9475
Final Sample Void Ratio	0.3635
Incremental Strain, %	2.07%
Loading Duration, min	954.93333

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ONE-DIMENSIONAL CONSOLIDATION PROPERTIES OF SOILS
ASTM D 2435

Client	Civil & Environmental Consultant	Boring	SB-21	**Test Load, tsf**	**8-16**
Client Project	091-867 Apex Landfill Expansion	Depth	9'-11'		Load 13 of 13
Project No.	30598	Sample	ST-1		
		Lab ID#	30598011		
Visual Description	LIGHT OLIVE BROWN LEAN CLAY WITH GRAVEL				
Test Conditions:	Undisturbed, Inundated, and Double Drained				

Time Vs. Dial Reading

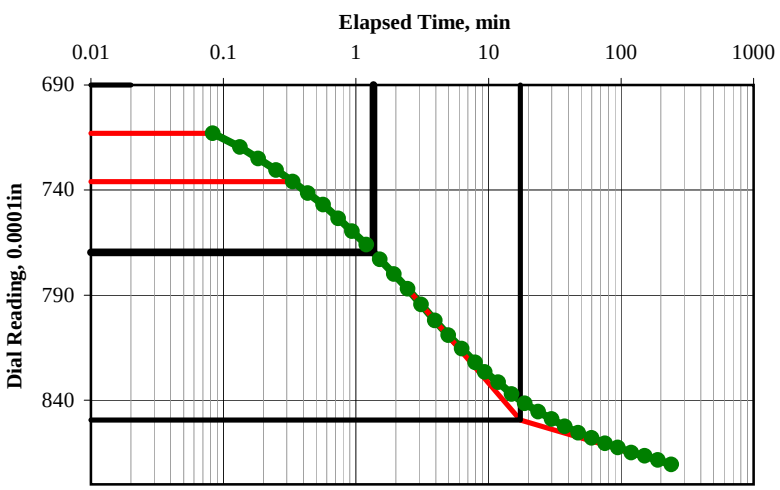
Elapsed Time (min)	Sqrt Time ($min^{1/2}$)	Dial Reading (0.0001in)	Sample Height (in)	Void Ratio
0	0	604.5	0.9475	0.3635
Corrections*		-15	-0.0015	-0.0022
Adjusted Sample Height & Void Ratio				
0.08	0.29	713.0	0.9382	0.3500
0.13	0.37	719.5	0.9375	0.3491
0.18	0.43	725.0	0.9370	0.3483
0.25	0.50	730.5	0.9364	0.3475
0.33	0.58	736.0	0.9359	0.3467
0.43	0.66	741.5	0.9353	0.3459
0.57	0.75	747.0	0.9348	0.3451
0.73	0.86	753.5	0.9341	0.3442
0.93	0.97	759.5	0.9335	0.3433
1.20	1.10	766.0	0.9329	0.3424
1.52	1.23	773.0	0.9322	0.3414
1.93	1.39	780.0	0.9315	0.3404
2.45	1.57	787.0	0.9308	0.3394
3.10	1.76	794.5	0.9300	0.3383
3.93	1.98	802.0	0.9293	0.3372
4.97	2.23	809.0	0.9286	0.3362
6.28	2.51	815.5	0.9279	0.3353
7.93	2.82	822.0	0.9273	0.3344
9.38	3.06	826.5	0.9268	0.3337
11.83	3.44	831.5	0.9263	0.3330
14.93	3.86	837.0	0.9258	0.3322
18.83	4.34	841.5	0.9253	0.3315
23.75	4.87	845.5	0.9249	0.3310
29.93	5.47	849.0	0.9246	0.3305
37.73	6.14	852.5	0.9242	0.3300
47.55	6.90	855.5	0.9239	0.3295
59.93	7.74	858.0	0.9237	0.3292
75.93	8.71	860.5	0.9234	0.3288
94.93	9.74	862.5	0.9232	0.3285
119.93	10.95	865.0	0.9230	0.3282
150.93	12.29	866.5	0.9228	0.3279
189.93	13.78	868.5	0.9226	0.3277
239.93	15.49	870.5	0.9224	0.3274

Machine Deflection

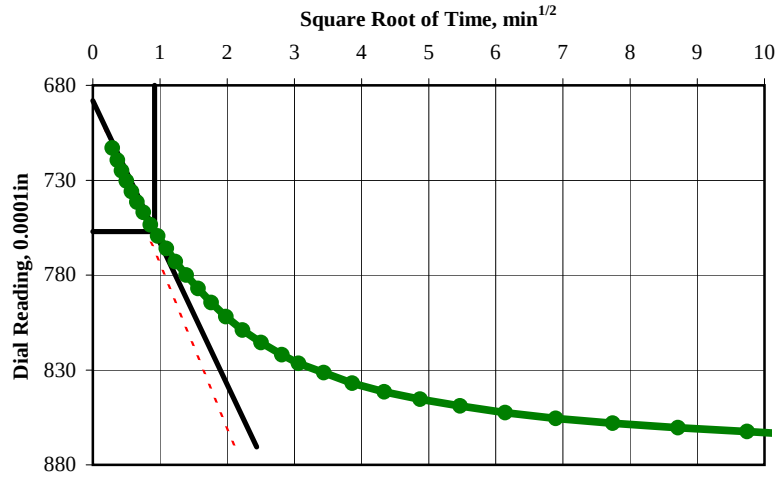
Applied Deflection Correction to Sample Height, 0.0001in -15

**Correction is applied to all dial readings.*

Log of Elapsed Time vs. Dial Reading



Square Root of Elapsed Time vs. Dial Reading



Sqrt. of Elapsed Time vs Dial Reading

T0 = 0 min.	D0 = 688.2 div.		
T90 = 0.846 min	D90 = 757.1 div.		
T100 = NA min	D100 = 764.7 div.		
Height at: D90 = 0.9338, D100 = 0.933			
Average Sample Height, in	0.9350		
Average Drainage Height, in	0.4675		
T (Time Factor for T90)	0.848		
Coef. of Consol., C_v, in^2/min	0.218		

Log of Elapsed Time vs Dial Reading

T0 = 0 min.	D0 = 690 div.		
T50 = 1.36 min.	D50 = 769.7 div.		
T100 = 17.34 min.	D100 = 849.4 div.		
Height at: D50 = 0.9325, D100 = 0.9245			
Average Sample Height, in	0.9350		
Average Drainage Height, in	0.4675		
T (Time Factor for T50)	0.197		
Coef. of Consol., C_v, in^2/min	0.032		

Load Summary

Initial Sample Height, in	0.9475
Initial Sample Void Ratio	0.3635
Final Sample Height, in	0.9224
Final Sample Void Ratio	0.3274
Incremental Strain, %	2.65%
Loading Duration, min	239.93333

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ONE-DIMENSIONAL CONSOLIDATION PROPERTIES OF SOILS
ASTM D 2435

Client	Civil & Environmental Consultant	Boring	TPE-18
Client Project	091-867 Apex Landfill Expansion	Depth	12'-14'
Project No.	30598	Sample	ST-1
		Lab Sample No.	30598012

Visual Description: Yellowish Brown Sandy Lean Clay
Sample Conditions: Undisturbed, Inundated, and Double Drained
Machine Deflection Correction: Applied

SAMPLE PROPERTIES		
	Initial	Final
Tare Number	Z13	Z7
Wt. Tare & WS, gm	241.96	279.74
Wt. Tare & DS, gm	220.12	253.3
Wt. Tare, gm	122.82	123.07
Water Content, %	22.4%	20.3%
Sample Diameter, in	2.5	2.5
Sample Height, in	1.004	0.9083
Sample Volume, in^3	4.9284	4.4584
Wt. WS + Ring, gm	276.25	271.01
Wt. of Ring, gm	113.65	113.65
Wt. of WS, gm	162.6	157.36
Wet Density, pcf	125.63	134.40
Wet Density, g/cc	2.013	2.154
Water Content, %	22.4%	20.3%
Wt. of DS, gm	132.79	130.80
Dry Density, pcf	102.60	111.72
Dry Density, g/cc	1.644	1.790
Void Ratio, e	0.6846	0.5472
Saturation, %	90.8%	
Specific Gravity	2.77	Measured
Height of Solids, in	0.5960	0.5960

TEST DATA SUMMARY

Applied Pressure tsf	**Load Duration** min	**Final Height** in	**Vertical Strain** %	**Dry Density** g/cc	**Void Ratio** e	**a_v** ft^2/ton	**Incremental** C_c	**Incremental** C_r
Seating	NA	1.0040	0.00	1.6443	0.6846	NA	NA	NA
0.25	24	1.0013	0.27%	1.6488	0.6800	1.85E-02	NA	NA
0.5	190	0.9970	0.70%	1.6558	0.6729	2.85E-02	0.024	NA
1	60	0.9903	1.37%	1.6671	0.6616	2.27E-02	0.038	NA
2	302	0.9782	2.57%	1.6877	0.6413	2.03E-02	0.067	NA
4	151	0.9602	4.37%	1.7194	0.6111	1.51E-02	0.100	NA
1	120	0.9674	3.65%	1.7066	0.6232	4.03E-03	NA	NA
0.25	240	0.9757	2.82%	1.6920	0.6371	1.86E-02	NA	NA
0.5	302	0.9747	2.92%	1.6937	0.6355	6.38E-03	NA	0.005
1	758	0.9718	3.21%	1.6987	0.6306	9.73E-03	NA	0.016
2	240	0.9664	3.75%	1.7082	0.6216	9.06E-03	NA	0.030
4	151	0.9573	4.66%	1.7246	0.6062	7.68E-03	NA	0.051
8	955	0.9347	6.90%	1.7662	0.5684	9.46E-03	0.126	NA
16	190	0.9083	9.54%	1.8176	0.5240	5.55E-03	0.147	NA

Note: The calculations performed and the parameters presented herein are for preliminary purposes only. GTS only accepts responsibility for the raw data obtained from the consolidation tests. This data may be interpreted differently by others. It is the responsibility of the user to determine the appropriateness and accuracy of the computed values.

Input Validation | Reviewed By: | Date Tested: 12/13/2010 |

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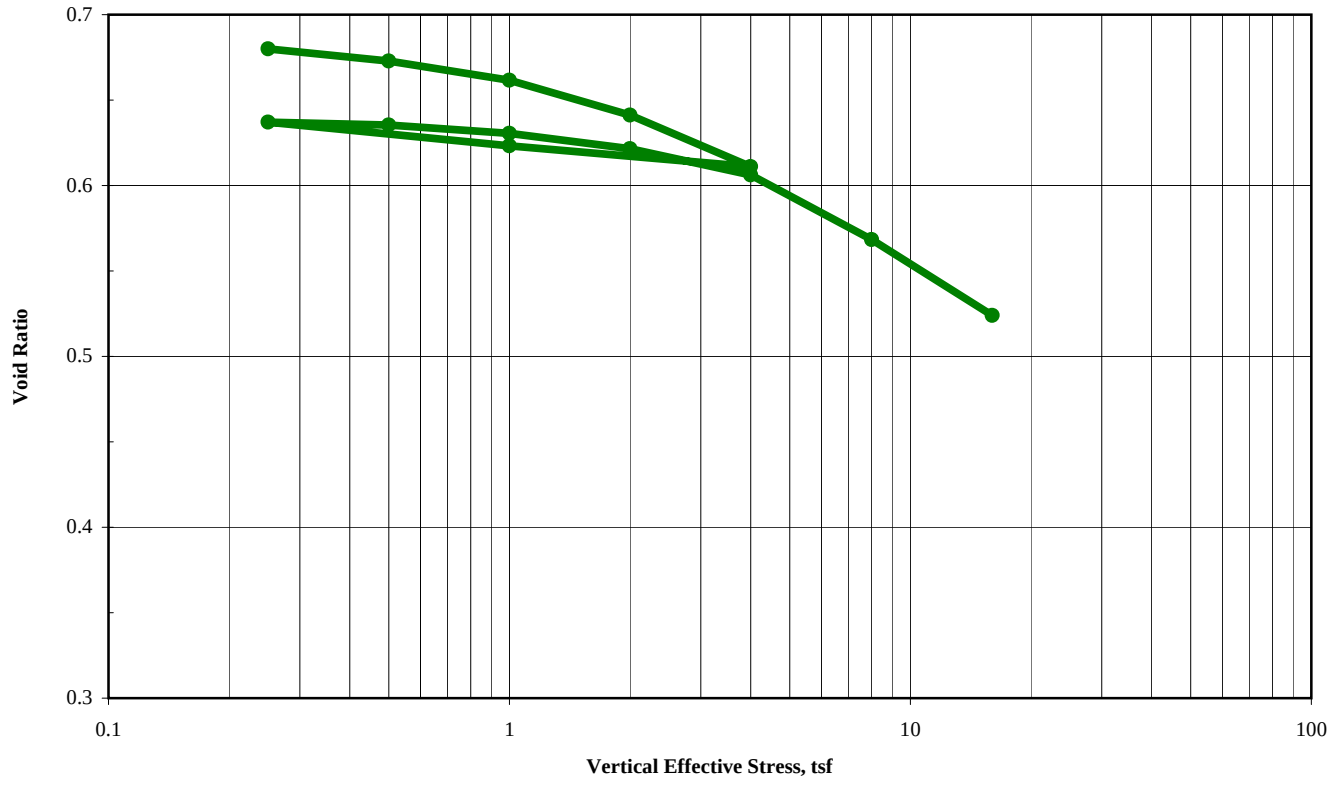
ONE-DIMENSIONAL CONSOLIDATION PROPERTIES OF SOILS
ASTM D 2435

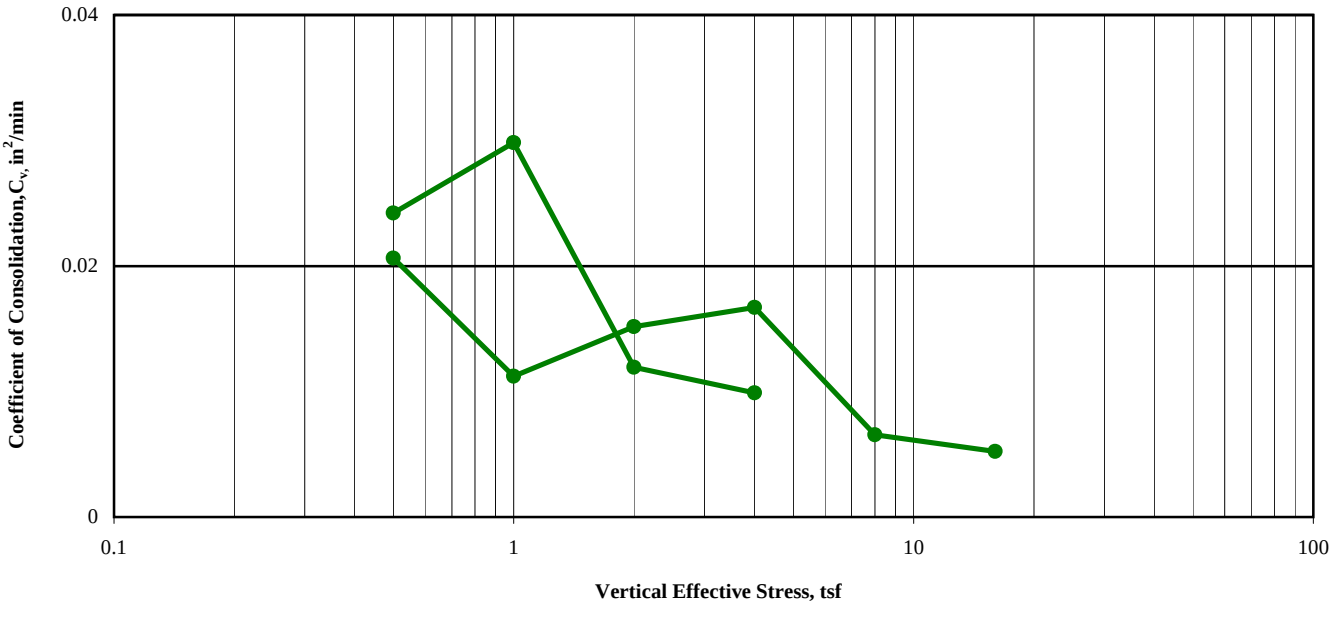
Client	Civil & Environmental Consultants, Inc.	Boring	TPE-18
Client Project	091-867 Apex Landfill Expansion	Depth	12'-14'
Project No.	30598	Sample	ST-1
		Lab Sample No.	30598012

Visual Description: Yellowish Brown Sandy Lean Clay
Sample Conditions: Undisturbed, Inundated, and Double Drained
Machine Deflection Correction: Applied

Void Ratio (Final Height) vs Vertical Effective Consolidation Stress



Coeffieicent of Consolidation (log. method) vs. Vertical Effective Consolidation Stress



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ONE-DIMENSIONAL CONSOLIDATION PROPERTIES OF SOILS
ASTM D 2435

Client	Civil & Environmental Consultant	Boring	TPE-18	**Test Load, tsf**	**0-0.25**
Client Project	091-867 Apex Landfill Expansion	Depth	12'-14'		Load 1 of 13
Project No.	30598	Sample	ST-1		
		Lab ID#	30598012		
Visual Description	Yellowish Brown Sandy Lean Clay				
Test Conditions:	Undisturbed, Inundated, and Double Drained				

Time Vs. Dial Reading

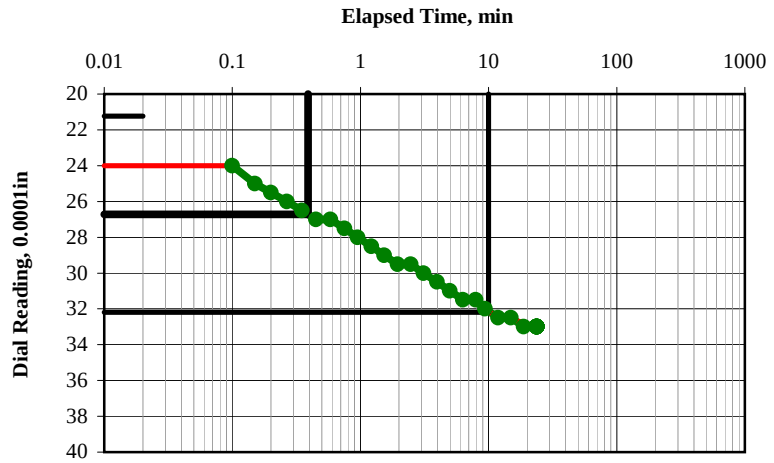
Elapsed Time (min)	Sqrt Time ($min^{1/2}$)	Dial Reading (0.0001in)	Sample Height (in)	Void Ratio
0	0	0	1.0040	0.6846
Corrections*		-5.5	-0.00055	-0.0009
Adjusted Sample Height & Void Ratio				
0.10	0.32	24.0	1.0022	0.6815
0.15	0.39	25.0	1.0021	0.6814
0.20	0.45	25.5	1.0020	0.6813
0.27	0.52	26.0	1.0020	0.6812
0.35	0.59	26.5	1.0019	0.6811
0.45	0.67	27.0	1.0019	0.6810
0.58	0.76	27.0	1.0019	0.6810
0.75	0.87	27.5	1.0018	0.6810
0.95	0.97	28.0	1.0018	0.6809
1.22	1.10	28.5	1.0017	0.6808
1.53	1.24	29.0	1.0017	0.6807
1.95	1.40	29.5	1.0016	0.6806
2.47	1.57	29.5	1.0016	0.6806
3.12	1.77	30.0	1.0016	0.6805
3.95	1.99	30.5	1.0015	0.6805
4.98	2.23	31.0	1.0015	0.6804
6.30	2.51	31.5	1.0014	0.6803
7.95	2.82	31.5	1.0014	0.6803
9.40	3.07	32.0	1.0014	0.6802
11.85	3.44	32.5	1.0013	0.6801
14.95	3.87	32.5	1.0013	0.6801
18.85	4.34	33.0	1.0013	0.6800
23.77	4.88	33.0	1.0013	0.6800

Machine Deflection

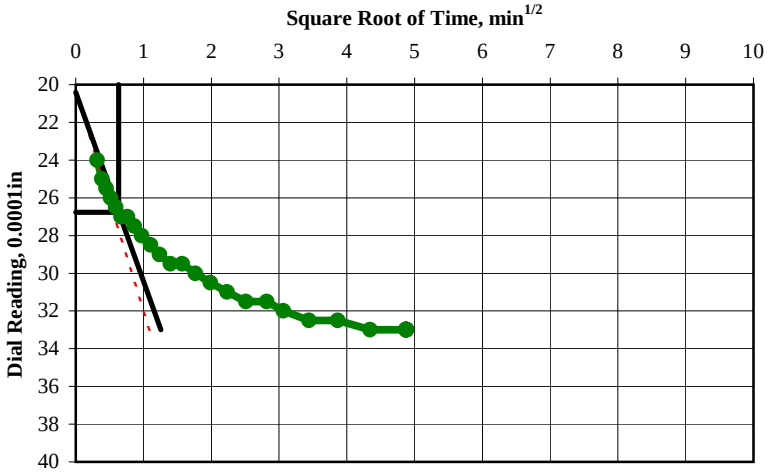
Applied Deflection Correction to Sample Height, 0.0001in -5.5

**Correction is applied to all dial readings.*

Log of Elapsed Time vs. Dial Reading



Square Root of Elapsed Time vs. Dial Reading



Sqrt. of Elapsed Time vs Dial Reading

T0 = 0 min.	D0 = 20.4 div.		
T90 = 0.397 min	D90 = 26.8 div.		
T100 = NA min	D100 = 27.5 div.		
Height at: D90 = 1.0019, D100 = 1.0018			
Average Sample Height, in	1.0026		
Average Drainage Height, in	0.5013		
T (Time Factor for T90)	0.848		
Coef. of Consol., C_v, in^2/min	0.530		

Log of Elapsed Time vs Dial Reading

T0 = 0 min.	D0 = 21.2 div.		
T50 = 0.39 min.	D50 = 26.7 div.		
T100 = 10.02 min.	D100 = 32.2 div.		
Height at: D50 = 1.0019, D100 = 1.0013			
Average Sample Height, in	1.0026		
Average Drainage Height, in	0.5013		
T (Time Factor for T50)	0.197		
Coef. of Consol., C_v, in^2/min	0.127		

Load Summary

Initial Sample Height, in	1.0040
Initial Sample Void Ratio	0.6846
Final Sample Height, in	1.0013
Final Sample Void Ratio	0.6800
Incremental Strain, %	0.27%
Loading Duration, min	23.766667

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ONE-DIMENSIONAL CONSOLIDATION PROPERTIES OF SOILS
ASTM D 2435

Client	Civil & Environmental Consultant	Boring	TPE-18	**Test Load, tsf**	**0.25-0.5**
Client Project	091-867 Apex Landfill Expansion	Depth	12'-14'		Load 2 of 13
Project No.	30598	Sample	ST-1		
		Lab ID#	30598012		

Visual Description: Yellowish Brown Sandy Lean Clay
Test Conditions: Undisturbed, Inundated, and Double Drained

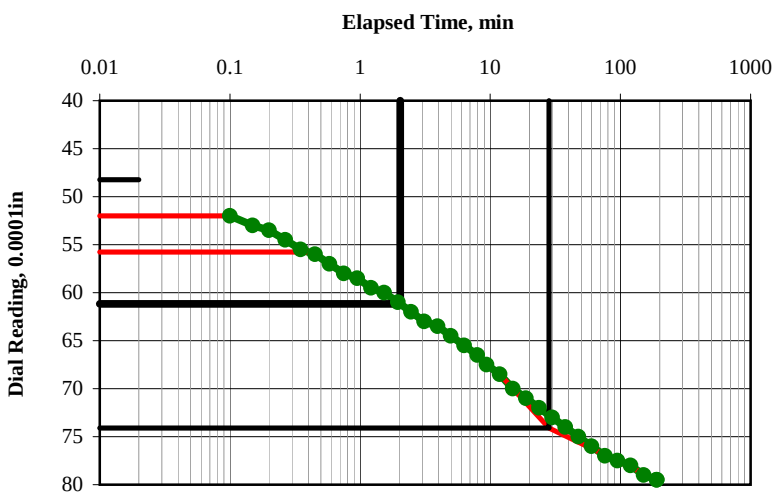
Time Vs. Dial Reading

Elapsed Time (min)	Sqrt Time ($min^{1/2}$)	Dial Reading (0.0001in)	Sample Height (in)	Void Ratio
0	0	33.0	1.0013	0.6800
Corrections*		-4	-0.0004	-0.0007
Adjusted Sample Height & Void Ratio				
0.10	0.32	52.0	0.9998	0.6775
0.15	0.39	53.0	0.9997	0.6773
0.20	0.45	53.5	0.9996	0.6773
0.27	0.52	54.5	0.9995	0.6771
0.35	0.59	55.5	0.9994	0.6769
0.45	0.67	56.0	0.9994	0.6768
0.58	0.76	57.0	0.9993	0.6767
0.75	0.87	58.0	0.9992	0.6765
0.95	0.97	58.5	0.9991	0.6764
1.22	1.10	59.5	0.9990	0.6763
1.53	1.24	60.0	0.9990	0.6762
1.95	1.40	61.0	0.9989	0.6760
2.47	1.57	62.0	0.9988	0.6758
3.12	1.77	63.0	0.9987	0.6757
3.95	1.99	63.5	0.9986	0.6756
4.98	2.23	64.5	0.9985	0.6754
6.30	2.51	65.5	0.9984	0.6752
7.95	2.82	66.5	0.9983	0.6751
9.40	3.07	67.5	0.9982	0.6749
11.85	3.44	68.5	0.9981	0.6747
14.95	3.87	70.0	0.9980	0.6745
18.85	4.34	71.0	0.9979	0.6743
23.77	4.88	72.0	0.9978	0.6742
29.95	5.47	73.0	0.9977	0.6740
37.75	6.14	74.0	0.9976	0.6738
47.57	6.90	75.0	0.9975	0.6737
59.95	7.74	76.0	0.9974	0.6735
75.95	8.71	77.0	0.9973	0.6733
94.95	9.74	77.5	0.9972	0.6732
119.95	10.95	78.0	0.9972	0.6732
150.95	12.29	79.0	0.9971	0.6730
189.95	13.78	79.5	0.9970	0.6729

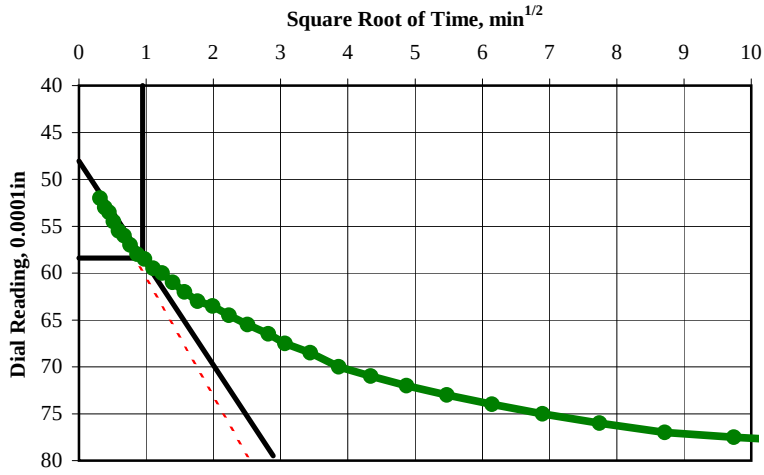
Machine Deflection

Applied Deflection Correction to Sample Height, 0.0001in: -4
**Correction is applied to all dial readings.*

Log of Elapsed Time vs. Dial Reading



Square Root of Elapsed Time vs. Dial Reading



Sqrt. of Elapsed Time vs Dial Reading

T0 = 0 min.	D0 = 48 div.		
T90 = 0.903 min	D90 = 58.4 div.		
T100 = NA min	D100 = 59.5 div.		
Height at: D90 = 0.9991, D100 = 0.999			
Average Sample Height, in	0.9991		
Average Drainage Height, in	0.4996		
T (Time Factor for T90)	0.848		
Coef. of Consol., C_v, in^2/min	0.235		

Log of Elapsed Time vs Dial Reading

T0 = 0 min.	D0 = 48.2 div.		
T50 = 2.03 min.	D50 = 61.2 div.		
T100 = 28.26 min.	D100 = 74.1 div.		
Height at: D50 = 0.9988, D100 = 0.9975			
Average Sample Height, in	0.9991		
Average Drainage Height, in	0.4996		
T (Time Factor for T50)	0.197		
Coef. of Consol., C_v, in^2/min	0.024		

Load Summary

Initial Sample Height, in	1.0013
Initial Sample Void Ratio	0.6800
Final Sample Height, in	0.9970
Final Sample Void Ratio	0.6729
Incremental Strain, %	0.42%
Loading Duration, min	189.95

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ONE-DIMENSIONAL CONSOLIDATION PROPERTIES OF SOILS
ASTM D 2435

Client	Civil & Environmental Consultant	Boring	TPE-18	**Test Load, tsf**	**0.5-1**
Client Project	091-867 Apex Landfill Expansion	Depth	12'-14'		Load 3 of 13
Project No.	30598	Sample	ST-1		
		Lab ID#	30598012		
Visual Description	Yellowish Brown Sandy Lean Clay				
Test Conditions:	Undisturbed, Inundated, and Double Drained				

Time Vs. Dial Reading

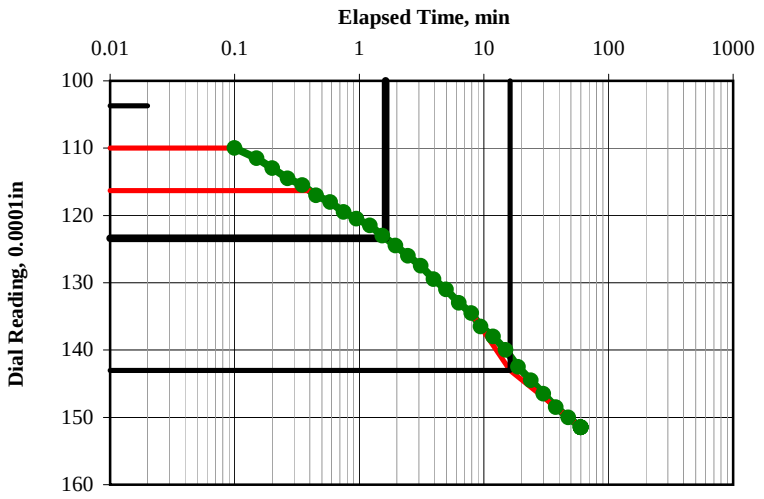
Elapsed Time (min)	Sqrt Time ($min^{1/2}$)	Dial Reading (0.0001in)	Sample Height (in)	Void Ratio
0	0	79.5	0.9970	0.6729
Corrections*		-4.5	-0.00045	-0.0008
Adjusted Sample Height & Void Ratio				
0.10	0.32	110.0	0.9944	0.6685
0.15	0.39	111.5	0.9943	0.6683
0.20	0.45	113.0	0.9941	0.6680
0.27	0.52	114.5	0.9940	0.6678
0.35	0.59	115.5	0.9939	0.6676
0.45	0.67	117.0	0.9937	0.6674
0.58	0.76	118.0	0.9936	0.6672
0.75	0.87	119.5	0.9935	0.6669
0.95	0.97	120.5	0.9934	0.6668
1.22	1.10	121.5	0.9933	0.6666
1.53	1.24	123.0	0.9931	0.6664
1.95	1.40	124.5	0.9930	0.6661
2.47	1.57	126.0	0.9928	0.6659
3.12	1.77	127.5	0.9927	0.6656
3.95	1.99	129.5	0.9925	0.6653
4.98	2.23	131.0	0.9923	0.6650
6.30	2.51	133.0	0.9921	0.6647
7.95	2.82	134.5	0.9920	0.6644
9.40	3.07	136.5	0.9918	0.6641
11.85	3.44	138.0	0.9916	0.6638
14.95	3.87	140.0	0.9914	0.6635
18.85	4.34	142.5	0.9912	0.6631
23.77	4.88	144.5	0.9910	0.6627
29.95	5.47	146.5	0.9908	0.6624
37.75	6.14	148.5	0.9906	0.6621
47.57	6.90	150.0	0.9904	0.6618
59.95	7.74	151.5	0.9903	0.6616

Machine Deflection

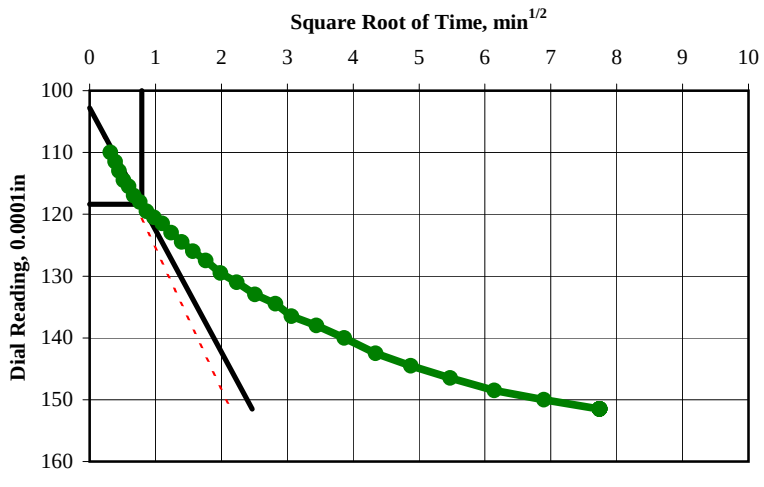
Applied Deflection Correction to Sample Height, 0.0001in -4.5

**Correction is applied to all dial readings.*

Log of Elapsed Time vs. Dial Reading



Square Root of Elapsed Time vs. Dial Reading



Sqrt. of Elapsed Time vs Dial Reading

T0 = 0 min.	D0 = 102.8 div.
T90 = 0.624 min	D90 = 118.4 div.
T100 = NA min	D100 = 120.1 div.
Height at: D90 = 0.9936, D100 = 0.9934	
Average Sample Height, in	0.9936
Average Drainage Height, in	0.4968
T (Time Factor for T90)	0.848
Coef. of Consol., C_v, in^2/min	0.335

Log of Elapsed Time vs Dial Reading

T0 = 0 min.	D0 = 103.7 div.
T50 = 1.63 min.	D50 = 123.4 div.
T100 = 16.25 min.	D100 = 143 div.
Height at: D50 = 0.9931, D100 = 0.9911	
Average Sample Height, in	0.9936
Average Drainage Height, in	0.4968
T (Time Factor for T50)	0.197
Coef. of Consol., C_v, in^2/min	0.030

Load Summary

Initial Sample Height, in	0.9970
Initial Sample Void Ratio	0.6729
Final Sample Height, in	0.9903
Final Sample Void Ratio	0.6616
Incremental Strain, %	0.68%
Loading Duration, min	59.95

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ONE-DIMENSIONAL CONSOLIDATION PROPERTIES OF SOILS
ASTM D 2435

Client	Civil & Environmental Consultant	Boring	TPE-18	**Test Load, tsf**	**1-2**
Client Project	091-867 Apex Landfill Expansion	Depth	12'-14'		Load 4 of 13
Project No.	30598	Sample	ST-1		
		Lab ID#	30598012		

Visual Description: Yellowish Brown Sandy Lean Clay
Test Conditions: Undisturbed, Inundated, and Double Drained

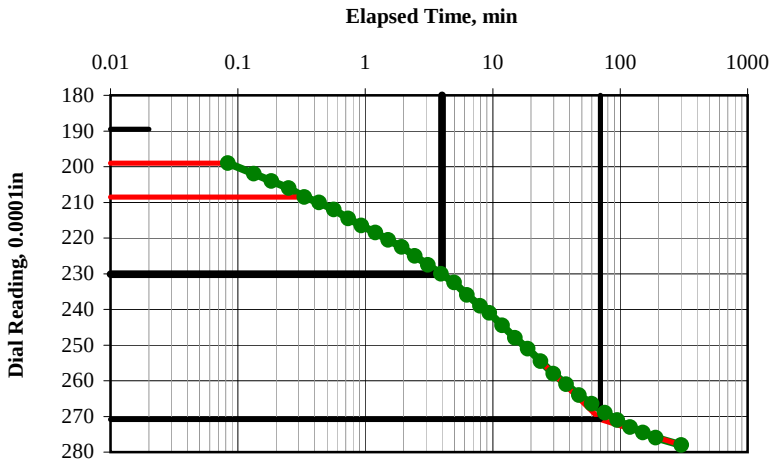
Time Vs. Dial Reading

Elapsed Time (min)	Sqrt Time ($min^{1/2}$)	Dial Reading (0.0001in)	Sample Height (in)	Void Ratio
0	0	151.5	0.9903	0.6616
Corrections*		-5.5	-0.00055	-0.0009
Adjusted Sample Height & Void Ratio				
0.08	0.29	199.0	0.9861	0.6545
0.13	0.37	202.0	0.9858	0.6540
0.18	0.43	204.0	0.9856	0.6537
0.25	0.50	206.0	0.9854	0.6534
0.33	0.58	208.5	0.9851	0.6529
0.43	0.66	210.0	0.9850	0.6527
0.57	0.75	212.0	0.9848	0.6523
0.73	0.86	214.5	0.9845	0.6519
0.93	0.97	216.5	0.9843	0.6516
1.20	1.10	218.5	0.9841	0.6513
1.52	1.23	220.5	0.9839	0.6509
1.93	1.39	222.5	0.9837	0.6506
2.45	1.57	225.0	0.9835	0.6502
3.10	1.76	227.5	0.9832	0.6497
3.93	1.98	230.0	0.9830	0.6493
4.97	2.23	232.5	0.9827	0.6489
6.28	2.51	236.0	0.9824	0.6483
7.93	2.82	239.0	0.9821	0.6478
9.38	3.06	241.0	0.9819	0.6475
11.83	3.44	244.5	0.9815	0.6469
14.93	3.86	248.0	0.9812	0.6463
18.83	4.34	251.0	0.9809	0.6458
23.75	4.87	254.5	0.9805	0.6452
29.93	5.47	258.0	0.9802	0.6446
37.73	6.14	261.0	0.9799	0.6441
47.55	6.90	264.0	0.9796	0.6436
59.93	7.74	266.5	0.9793	0.6432
75.93	8.71	269.0	0.9791	0.6428
94.93	9.74	271.0	0.9789	0.6424
119.93	10.95	273.0	0.9787	0.6421
150.93	12.29	274.5	0.9785	0.6419
189.93	13.78	276.0	0.9784	0.6416
301.93	17.38	278.0	0.9782	0.6413

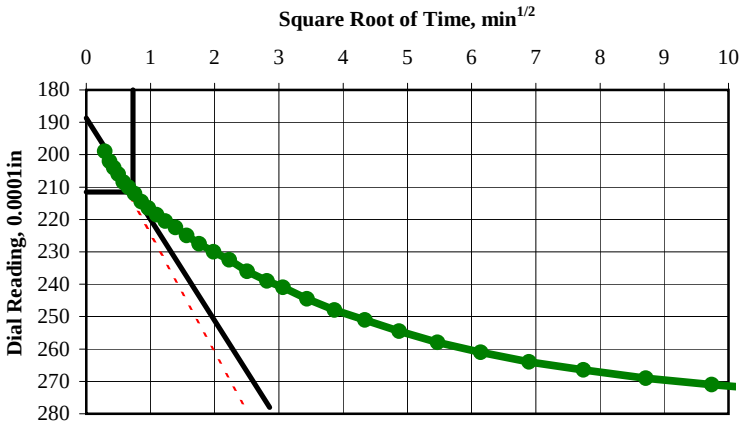
Machine Deflection

Applied Deflection Correction to Sample Height, 0.0001in: -5.5
**Correction is applied to all dial readings.*

Log of Elapsed Time vs. Dial Reading



Square Root of Elapsed Time vs. Dial Reading



Sqrt. of Elapsed Time vs Dial Reading

T0 = 0 min.	D0 = 188.7 div.
T90 = 0.533 min	D90 = 211.5 div.
T100 = NA min	D100 = 214 div.
Height at: D90 = 0.9848, D100 = 0.9845	
Average Sample Height, in	0.9842
Average Drainage Height, in	0.4921
T (Time Factor for T90)	0.848
Coef. of Consol., C_v, in^2/min	0.386

Log of Elapsed Time vs Dial Reading

T0 = 0 min.	D0 = 189.5 div.
T50 = 4 min.	D50 = 230.2 div.
T100 = 69.99 min.	D100 = 270.8 div.
Height at: D50 = 0.9829, D100 = 0.9789	
Average Sample Height, in	0.9842
Average Drainage Height, in	0.4921
T (Time Factor for T50)	0.197
Coef. of Consol., C_v, in^2/min	0.012

Load Summary

Initial Sample Height, in	0.9903
Initial Sample Void Ratio	0.6616
Final Sample Height, in	0.9782
Final Sample Void Ratio	0.6413
Incremental Strain, %	1.22%
Loading Duration, min	301.93333

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ONE-DIMENSIONAL CONSOLIDATION PROPERTIES OF SOILS
ASTM D 2435

Client	Civil & Environmental Consultant	Boring	TPE-18	**Test Load, tsf**	**2-4**
Client Project	091-867 Apex Landfill Expansion	Depth	12'-14'		Load 5 of 13
Project No.	30598	Sample	ST-1		
		Lab ID#	30598012		

Visual Description: Yellowish Brown Sandy Lean Clay
Test Conditions: Undisturbed, Inundated, and Double Drained

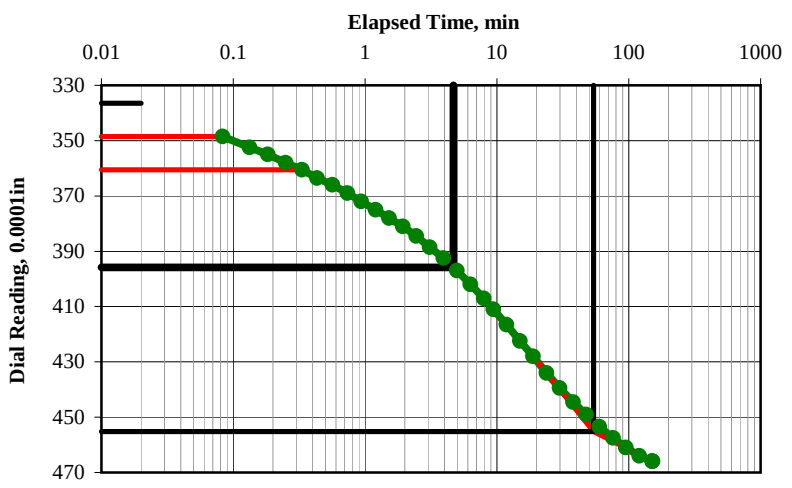
Time Vs. Dial Reading

Elapsed Time (min)	Sqrt Time ($min^{1/2}$)	Dial Reading (0.0001in)	Sample Height (in)	Void Ratio
0	0	278.0	0.9782	0.6413
Corrections*		-8	-0.0008	-0.0013
Adjusted Sample Height & Void Ratio				
0.08	0.29	348.5	0.9719	0.6308
0.13	0.37	352.5	0.9715	0.6301
0.18	0.43	355.0	0.9713	0.6297
0.25	0.50	358.0	0.9710	0.6292
0.33	0.58	360.5	0.9707	0.6288
0.43	0.66	363.5	0.9704	0.6283
0.57	0.75	366.0	0.9702	0.6278
0.73	0.86	369.0	0.9699	0.6273
0.93	0.97	372.0	0.9696	0.6268
1.20	1.10	375.0	0.9693	0.6263
1.52	1.23	378.0	0.9690	0.6258
1.93	1.39	381.0	0.9687	0.6253
2.45	1.57	384.5	0.9683	0.6247
3.10	1.76	388.5	0.9679	0.6241
3.93	1.98	392.5	0.9675	0.6234
4.97	2.23	397.0	0.9671	0.6226
6.28	2.51	402.0	0.9666	0.6218
7.93	2.82	407.0	0.9661	0.6210
9.38	3.06	411.0	0.9657	0.6203
11.83	3.44	416.5	0.9651	0.6194
14.93	3.86	422.5	0.9645	0.6184
18.83	4.34	428.0	0.9640	0.6174
23.75	4.87	434.0	0.9634	0.6164
29.93	5.47	439.5	0.9628	0.6155
37.73	6.14	444.5	0.9623	0.6147
47.55	6.90	449.0	0.9619	0.6139
59.93	7.74	453.5	0.9614	0.6132
75.93	8.71	457.5	0.9610	0.6125
94.93	9.74	461.0	0.9607	0.6119
119.93	10.95	464.0	0.9604	0.6114
150.93	12.29	466.0	0.9602	0.6111

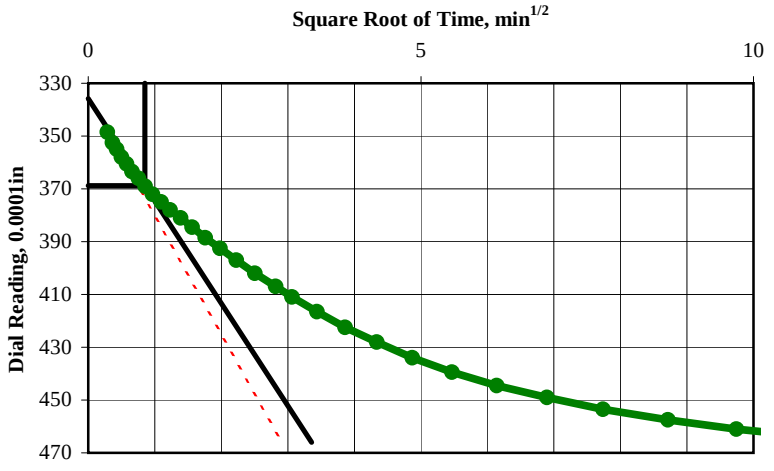
Machine Deflection

Applied Deflection Correction to Sample Height, 0.0001in: -8
**Correction is applied to all dial readings.*

Log of Elapsed Time vs. Dial Reading



Square Root of Elapsed Time vs. Dial Reading



Sqrt. of Elapsed Time vs Dial Reading

T0 = 0 min.	D0 = 335.9 div.
T90 = 0.723 min	D90 = 368.8 div.
T100 = NA min	D100 = 372.5 div.
Height at: D90 = 0.9699, D100 = 0.9695	
Average Sample Height, in	0.9692
Average Drainage Height, in	0.4846
T (Time Factor for T90)	0.848
Coef. of Consol., C_v, in^2/min	0.275

Log of Elapsed Time vs Dial Reading

T0 = 0 min.	D0 = 336.5 div.
T50 = 4.68 min.	D50 = 395.9 div.
T100 = 53.97 min.	D100 = 455.2 div.
Height at: D50 = 0.9672, D100 = 0.9612	
Average Sample Height, in	0.9692
Average Drainage Height, in	0.4846
T (Time Factor for T50)	0.197
Coef. of Consol., C_v, in^2/min	0.010

Load Summary

Initial Sample Height, in	0.9782
Initial Sample Void Ratio	0.6413
Final Sample Height, in	0.9602
Final Sample Void Ratio	0.6111
Incremental Strain, %	1.84%
Loading Duration, min	150.93333

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ONE-DIMENSIONAL CONSOLIDATION PROPERTIES OF SOILS
ASTM D 2435

Client	Civil & Environmental Consultant	Boring	TPE-18	**Test Load, tsf**	**4-1**
Client Project	091-867 Apex Landfill Expansion	Depth	12'-14'		Load 6 of 13
Project No.	30598	Sample	ST-1		
		Lab ID#	30598012		

Visual Description: Yellowish Brown Sandy Lean Clay
Test Conditions: Undisturbed, Inundated, and Double Drained

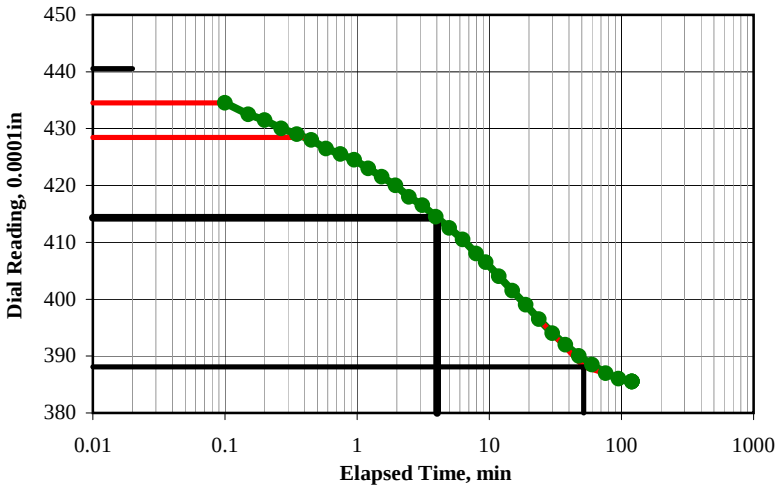
Time Vs. Dial Reading

Elapsed Time (min)	Sqrt Time ($min^{1/2}$)	Dial Reading (0.0001in)	Sample Height (in)	Void Ratio
0	0	466.0	0.9602	0.6111
Corrections*		8.5	0.00085	0.00143
Adjusted Sample Height & Void Ratio				
0.10	0.32	434.5	0.9625	0.6149
0.15	0.39	432.5	0.9627	0.6153
0.20	0.45	431.5	0.9628	0.6154
0.27	0.52	430.0	0.9629	0.6157
0.35	0.59	429.0	0.9630	0.6159
0.45	0.67	428.0	0.9631	0.6160
0.58	0.76	426.5	0.9633	0.6163
0.75	0.87	425.5	0.9634	0.6164
0.95	0.97	424.5	0.9635	0.6166
1.22	1.10	423.0	0.9636	0.6169
1.53	1.24	421.5	0.9638	0.6171
1.95	1.40	420.0	0.9639	0.6174
2.47	1.57	418.0	0.9641	0.6177
3.12	1.77	416.5	0.9643	0.6179
3.95	1.99	414.5	0.9645	0.6183
4.98	2.23	412.5	0.9647	0.6186
6.30	2.51	410.5	0.9649	0.6190
7.95	2.82	408.0	0.9651	0.6194
9.40	3.07	406.5	0.9653	0.6196
11.85	3.44	404.0	0.9655	0.6200
14.95	3.87	401.5	0.9658	0.6205
18.85	4.34	399.0	0.9660	0.6209
23.77	4.88	396.5	0.9663	0.6213
29.95	5.47	394.0	0.9665	0.6217
37.75	6.14	392.0	0.9667	0.6221
47.57	6.90	390.0	0.9669	0.6224
59.95	7.74	388.5	0.9671	0.6226
75.95	8.71	387.0	0.9672	0.6229
94.95	9.74	386.0	0.9673	0.6231
119.95	10.95	385.5	0.9674	0.6232

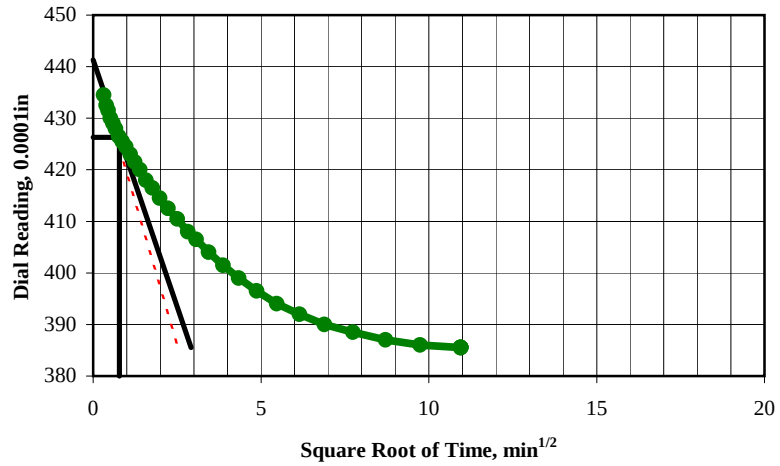
Machine Deflection

Applied Deflection Correction to Sample Height, 0.0001in 8.5
**Correction is applied to all dial readings.*

Log of Elapsed Time vs. Dial Reading



Square Root of Elapsed Time vs. Dial Reading



Sqrt. of Elapsed Time vs Dial Reading		Log of Elapsed Time vs Dial Reading		Load Summary	
T0 = 0 min.	D0 = 441.3 div.	T0 = 0 min.	D0 = 440.5 div.		
T90 = 0.608 min	D90 = 426.3 div.	T50 = 4.04 min.	D50 = 414.3 div.	Initial Sample Height, in	0.9602
T100 = NA min	D100 = 424.6 div.	T100 = 51.73 min.	D100 = 388.1 div.	Initial Sample Void Ratio	0.6111
Height at: D90 = 0.9633, D100 = 0.9634		Height at: D50 = 0.9645, D100 = 0.9671		Final Sample Height, in	0.9674
Average Sample Height, in	0.9638	Average Sample Height, in	0.9638	Final Sample Void Ratio	0.6232
Average Drainage Height, in	0.4819	Average Drainage Height, in	0.4819	Incremental Strain, %	-0.75%
T (Time Factor for T90)	0.848	T (Time Factor for T50)	0.197	Loading Duration, min	119.95
Coef. of Consol., C_v, in^2/min	0.321	Coef. of Consol., C_v, in^2/min	0.011		

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ONE-DIMENSIONAL CONSOLIDATION PROPERTIES OF SOILS
ASTM D 2435

Client	Civil & Environmental Consultant	Boring	TPE-18	**Test Load, tsf**	**1-0.25**
Client Project	091-867 Apex Landfill Expansion	Depth	12'-14'		Load 7 of 13
Project No.	30598	Sample	ST-1		
		Lab ID#	30598012		

Visual Description: Yellowish Brown Sandy Lean Clay
Test Conditions: Undisturbed, Inundated, and Double Drained

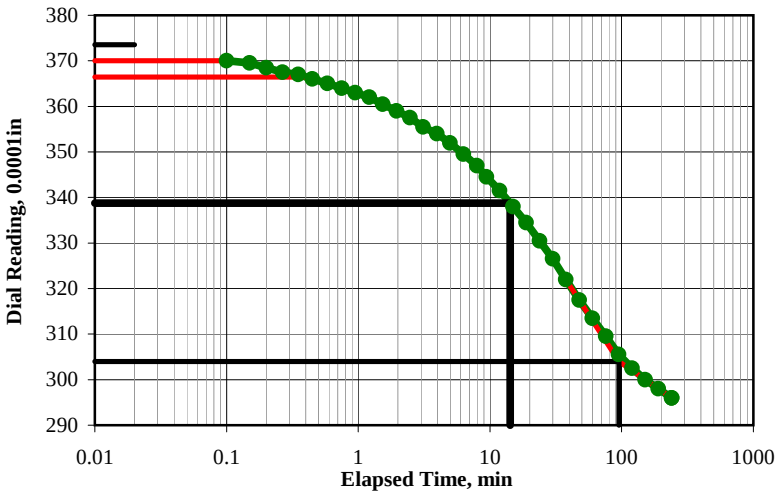
Time Vs. Dial Reading

Elapsed Time (min)	Sqrt Time ($min^{1/2}$)	Dial Reading (0.0001in)	Sample Height (in)	Void Ratio
0	0	385.5	0.9674	0.6232
Corrections*		6.5	0.00065	0.00109
Adjusted Sample Height & Void Ratio				
0.10	0.32	370.0	0.9683	0.6247
0.15	0.39	369.5	0.9683	0.6247
0.20	0.45	368.5	0.9684	0.6249
0.27	0.52	367.5	0.9685	0.6251
0.35	0.59	367.0	0.9686	0.6252
0.45	0.67	366.0	0.9687	0.6253
0.58	0.76	365.0	0.9688	0.6255
0.75	0.87	364.0	0.9689	0.6257
0.95	0.97	363.0	0.9690	0.6258
1.22	1.10	362.0	0.9691	0.6260
1.53	1.24	360.5	0.9692	0.6263
1.95	1.40	359.0	0.9694	0.6265
2.47	1.57	357.5	0.9695	0.6268
3.12	1.77	355.5	0.9697	0.6271
3.95	1.99	354.0	0.9699	0.6273
4.98	2.23	352.0	0.9701	0.6277
6.30	2.51	349.5	0.9703	0.6281
7.95	2.82	347.0	0.9706	0.6285
9.40	3.07	344.5	0.9708	0.6289
11.85	3.44	341.5	0.9711	0.6294
14.95	3.87	338.0	0.9715	0.6300
18.85	4.34	334.5	0.9718	0.6306
23.77	4.88	330.5	0.9722	0.6313
29.95	5.47	326.5	0.9726	0.6320
37.75	6.14	322.0	0.9731	0.6327
47.57	6.90	317.5	0.9735	0.6335
59.95	7.74	313.5	0.9739	0.6341
75.95	8.71	309.5	0.9743	0.6348
94.95	9.74	305.5	0.9747	0.6355
119.95	10.95	302.5	0.9750	0.6360
150.95	12.29	300.0	0.9753	0.6364
189.95	13.78	298.0	0.9755	0.6367
239.95	15.49	296.0	0.9757	0.6371

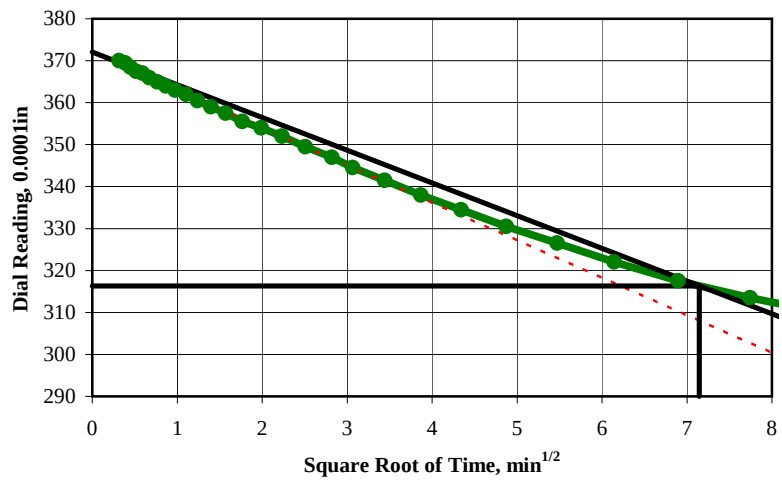
Machine Deflection

Applied Deflection Correction to Sample Height, 0.0001in 6.5
**Correction is applied to all dial readings.*

Log of Elapsed Time vs. Dial Reading



Square Root of Elapsed Time vs. Dial Reading



Sqrt. of Elapsed Time vs Dial Reading

T0 = 0 min.	D0 = 372.1 div.
T90 = 50.98 min	D90 = 316.3 div.
T100 = NA min	D100 = 310.1 div.
Height at: D90 = 0.9736, D100 = 0.9742	
Average Sample Height, in	0.9715
Average Drainage Height, in	0.4858
T (Time Factor for T90)	0.848
Coef. of Consol., C_v, in^2/min	0.004

Log of Elapsed Time vs Dial Reading

T0 = 0 min.	D0 = 373.5 div.
T50 = 14.23 min.	D50 = 338.7 div.
T100 = 95.4 min.	D100 = 304 div.
Height at: D50 = 0.9714, D100 = 0.9749	
Average Sample Height, in	0.9715
Average Drainage Height, in	0.4858
T (Time Factor for T50)	0.197
Coef. of Consol., C_v, in^2/min	0.003

Load Summary

Initial Sample Height, in	0.9674
Initial Sample Void Ratio	0.6232
Final Sample Height, in	0.9757
Final Sample Void Ratio	0.6371
Incremental Strain, %	-0.86%
Loading Duration, min	239.95

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ONE-DIMENSIONAL CONSOLIDATION PROPERTIES OF SOILS
ASTM D 2435

Client	Civil & Environmental Consultant	Boring	TPE-18	**Test Load, tsf**	**0.25-0.5**
Client Project	091-867 Apex Landfill Expansion	Depth	12'-14'		Load 8 of 13
Project No.	30598	Sample	ST-1		
		Lab ID#	30598012		
Visual Description	Yellowish Brown Sandy Lean Clay				
Test Conditions:	Undisturbed, Inundated, and Double Drained				

Time Vs. Dial Reading

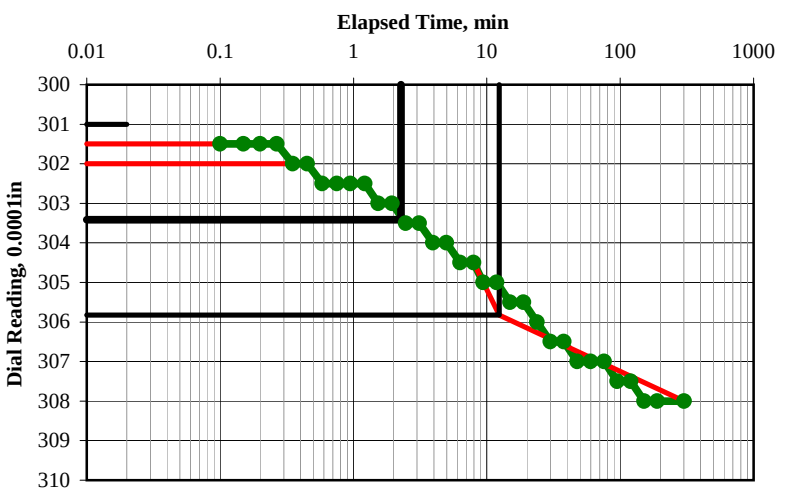
Elapsed Time (min)	Sqrt Time ($min^{1/2}$)	Dial Reading (0.0001in)	Sample Height (in)	Void Ratio
0	0	296.0	0.9757	0.6371
Corrections*		-2.5	-0.00025	-0.0004
Adjusted Sample Height & Void Ratio				
0.10	0.32	301.5	0.9754	0.6366
0.15	0.39	301.5	0.9754	0.6366
0.20	0.45	301.5	0.9754	0.6366
0.27	0.52	301.5	0.9754	0.6366
0.35	0.59	302.0	0.9753	0.6365
0.45	0.67	302.0	0.9753	0.6365
0.58	0.76	302.5	0.9753	0.6364
0.75	0.87	302.5	0.9753	0.6364
0.95	0.97	302.5	0.9753	0.6364
1.22	1.10	302.5	0.9753	0.6364
1.53	1.24	303.0	0.9752	0.6363
1.95	1.40	303.0	0.9752	0.6363
2.47	1.57	303.5	0.9752	0.6362
3.12	1.77	303.5	0.9752	0.6362
3.95	1.99	304.0	0.9751	0.6362
4.98	2.23	304.0	0.9751	0.6362
6.30	2.51	304.5	0.9751	0.6361
7.95	2.82	304.5	0.9751	0.6361
9.40	3.07	305.0	0.9750	0.6360
11.85	3.44	305.0	0.9750	0.6360
14.95	3.87	305.5	0.9750	0.6359
18.85	4.34	305.5	0.9750	0.6359
23.77	4.88	306.0	0.9749	0.6358
29.95	5.47	306.5	0.9749	0.6357
37.75	6.14	306.5	0.9749	0.6357
47.57	6.90	307.0	0.9748	0.6357
59.95	7.74	307.0	0.9748	0.6357
75.95	8.71	307.0	0.9748	0.6357
94.95	9.74	307.5	0.9748	0.6356
119.95	10.95	307.5	0.9748	0.6356
150.95	12.29	308.0	0.9747	0.6355
189.95	13.78	308.0	0.9747	0.6355
301.95	17.38	308.0	0.9747	0.6355

Machine Deflection

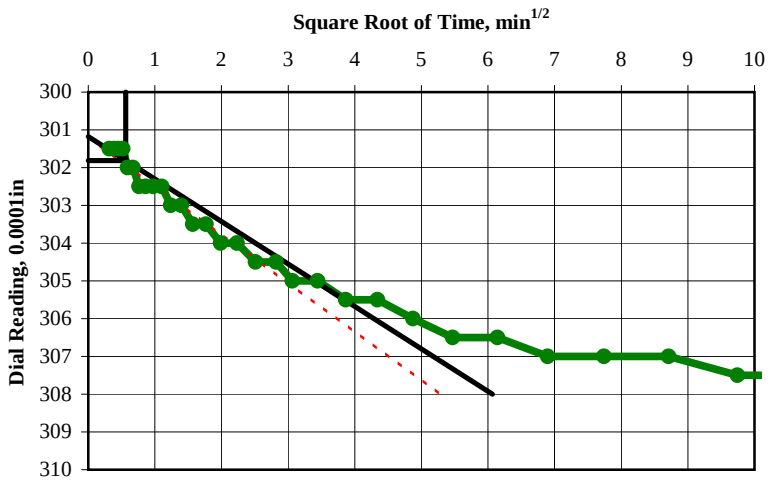
Applied Deflection Correction to Sample Height, 0.0001in -2.5

**Correction is applied to all dial readings.*

Log of Elapsed Time vs. Dial Reading



Square Root of Elapsed Time vs. Dial Reading



Sqrt. of Elapsed Time vs Dial Reading

T0 = 0 min.	D0 = 301.2 div.
T90 = 0.314 min	D90 = 301.8 div.
T100 = NA min	D100 = 301.9 div.
Height at: D90 = 0.9753, D100 = 0.9753	
Average Sample Height, in	0.9752
Average Drainage Height, in	0.4876
T (Time Factor for T90)	0.848
Coef. of Consol., C_v, in^2/min	0.636

Log of Elapsed Time vs Dial Reading

T0 = 0 min.	D0 = 301 div.
T50 = 2.27 min.	D50 = 303.4 div.
T100 = 12.38 min.	D100 = 305.8 div.
Height at: D50 = 0.9752, D100 = 0.9749	
Average Sample Height, in	0.9752
Average Drainage Height, in	0.4876
T (Time Factor for T50)	0.197
Coef. of Consol., C_v, in^2/min	0.021

Load Summary

Initial Sample Height, in	0.9757
Initial Sample Void Ratio	0.6371
Final Sample Height, in	0.9747
Final Sample Void Ratio	0.6355
Incremental Strain, %	0.10%
Loading Duration, min	301.95

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ONE-DIMENSIONAL CONSOLIDATION PROPERTIES OF SOILS
ASTM D 2435

Client	Civil & Environmental Consultant	Boring	TPE-18	**Test Load, tsf**	**0.5-1**
Client Project	091-867 Apex Landfill Expansion	Depth	12'-14'		Load 9 of 13
Project No.	30598	Sample	ST-1		
		Lab ID#	30598012		
Visual Description	Yellowish Brown Sandy Lean Clay				
Test Conditions:	Undisturbed, Inundated, and Double Drained				

Time Vs. Dial Reading

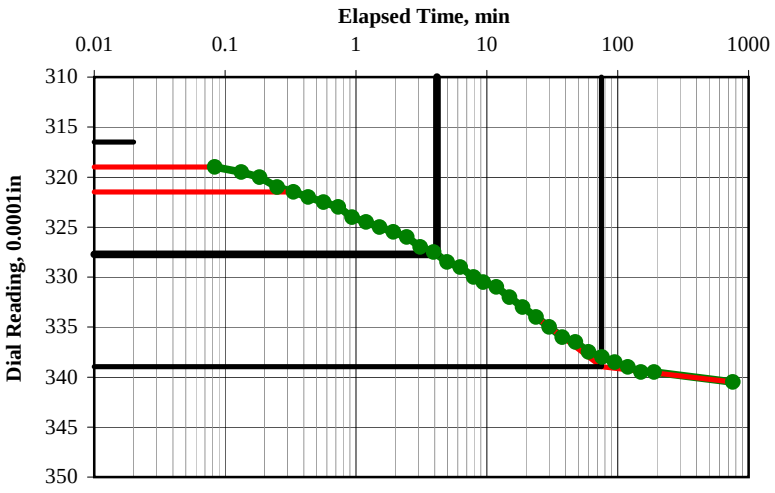
Elapsed Time (min)	Sqrt Time ($min^{1/2}$)	Dial Reading (0.0001in)	Sample Height (in)	Void Ratio
0	0	308.0	0.9747	0.6355
Corrections*		-3.5	-0.00035	-0.0006
Adjusted Sample Height & Void Ratio				
0.08	0.29	319.0	0.9740	0.6342
0.13	0.37	319.5	0.9739	0.6341
0.18	0.43	320.0	0.9739	0.6341
0.25	0.50	321.0	0.9738	0.6339
0.33	0.58	321.5	0.9737	0.6338
0.43	0.66	322.0	0.9737	0.6337
0.57	0.75	322.5	0.9736	0.6336
0.73	0.86	323.0	0.9736	0.6336
0.93	0.97	324.0	0.9735	0.6334
1.20	1.10	324.5	0.9734	0.6333
1.52	1.23	325.0	0.9734	0.6332
1.93	1.39	325.5	0.9733	0.6331
2.45	1.57	326.0	0.9733	0.6330
3.10	1.76	327.0	0.9732	0.6329
3.93	1.98	327.5	0.9731	0.6328
4.97	2.23	328.5	0.9730	0.6326
6.28	2.51	329.0	0.9730	0.6325
7.93	2.82	330.0	0.9729	0.6324
9.38	3.06	330.5	0.9728	0.6323
11.83	3.44	331.0	0.9728	0.6322
14.93	3.86	332.0	0.9727	0.6320
18.83	4.34	333.0	0.9726	0.6319
23.75	4.87	334.0	0.9725	0.6317
29.93	5.47	335.0	0.9724	0.6315
37.73	6.14	336.0	0.9723	0.6314
47.55	6.90	336.5	0.9722	0.6313
59.93	7.74	337.5	0.9721	0.6311
75.93	8.71	338.0	0.9721	0.6310
94.93	9.74	338.5	0.9720	0.6310
119.93	10.95	339.0	0.9720	0.6309
150.93	12.29	339.5	0.9719	0.6308
189.93	13.78	339.5	0.9719	0.6308
757.93	27.53	340.5	0.9718	0.6306

Machine Deflection

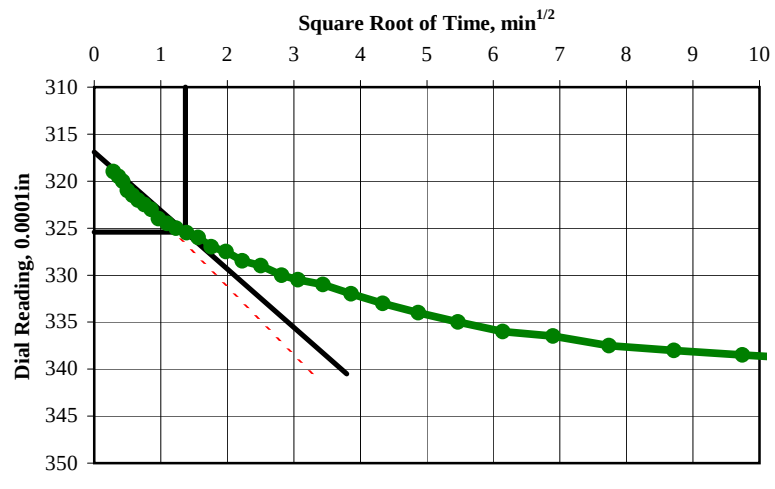
Applied Deflection Correction to Sample Height, 0.0001in -3.5

**Correction is applied to all dial readings.*

Log of Elapsed Time vs. Dial Reading



Square Root of Elapsed Time vs. Dial Reading



Sqrt. of Elapsed Time vs Dial Reading

T0 = 0 min.	D0 = 316.9 div.
T90 = 1.877 min	D90 = 325.4 div.
T100 = NA min	D100 = 326.4 div.
Height at: D90 = 0.9733, D100 = 0.9732	
Average Sample Height, in	0.9733
Average Drainage Height, in	0.4866
T (Time Factor for T90)	0.848
Coef. of Consol., C_v, in^2/min	0.107

Log of Elapsed Time vs Dial Reading

T0 = 0 min.	D0 = 316.5 div.
T50 = 4.16 min.	D50 = 327.7 div.
T100 = 75.05 min.	D100 = 339 div.
Height at: D50 = 0.9731, D100 = 0.972	
Average Sample Height, in	0.9733
Average Drainage Height, in	0.4866
T (Time Factor for T50)	0.197
Coef. of Consol., C_v, in^2/min	0.011

Load Summary

Initial Sample Height, in	0.9747
Initial Sample Void Ratio	0.6355
Final Sample Height, in	0.9718
Final Sample Void Ratio	0.6306
Incremental Strain, %	0.30%
Loading Duration, min	757.93333

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ONE-DIMENSIONAL CONSOLIDATION PROPERTIES OF SOILS
ASTM D 2435

Client	Civil & Environmental Consultant	Boring	TPE-18	**Test Load, tsf**	**1-2**
Client Project	091-867 Apex Landfill Expansion	Depth	12'-14'		Load 10 of 13
Project No.	30598	Sample	ST-1		
		Lab ID#	30598012		
Visual Description	Yellowish Brown Sandy Lean Clay				
Test Conditions:	Undisturbed, Inundated, and Double Drained				

Time Vs. Dial Reading

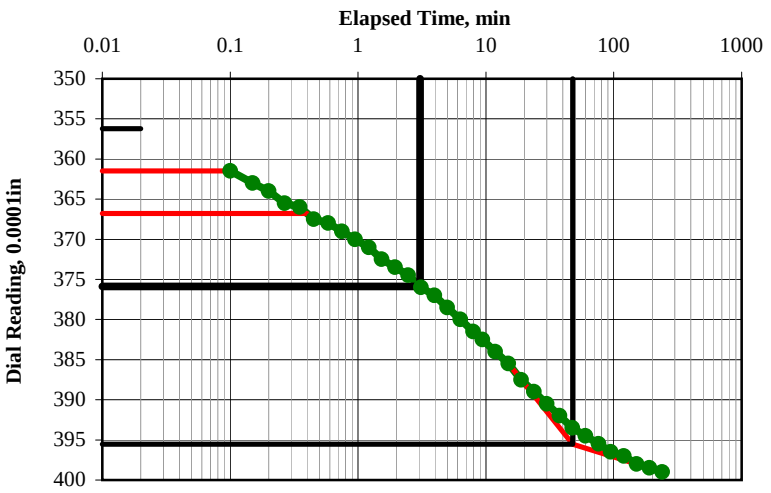
Elapsed Time (min)	Sqrt Time ($min^{1/2}$)	Dial Reading (0.0001in)	Sample Height (in)	Void Ratio
0	0	340.5	0.9718	0.6306
Corrections*		-4.5	-0.00045	-0.0008
Adjusted Sample Height & Void Ratio				
0.10	0.32	361.5	0.9702	0.6278
0.15	0.39	363.0	0.9700	0.6276
0.20	0.45	364.0	0.9699	0.6274
0.27	0.52	365.5	0.9698	0.6272
0.35	0.59	366.0	0.9697	0.6271
0.45	0.67	367.5	0.9696	0.6268
0.58	0.76	368.0	0.9695	0.6268
0.75	0.87	369.0	0.9694	0.6266
0.95	0.97	370.0	0.9693	0.6264
1.22	1.10	371.0	0.9692	0.6263
1.53	1.24	372.5	0.9691	0.6260
1.95	1.40	373.5	0.9690	0.6258
2.47	1.57	374.5	0.9689	0.6257
3.12	1.77	376.0	0.9687	0.6254
3.95	1.99	377.0	0.9686	0.6252
4.98	2.23	378.5	0.9685	0.6250
6.30	2.51	380.0	0.9683	0.6247
7.95	2.82	381.5	0.9682	0.6245
9.40	3.07	382.5	0.9681	0.6243
11.85	3.44	384.0	0.9679	0.6241
14.95	3.87	385.5	0.9678	0.6238
18.85	4.34	387.5	0.9676	0.6235
23.77	4.88	389.0	0.9674	0.6232
29.95	5.47	390.5	0.9673	0.6230
37.75	6.14	392.0	0.9671	0.6227
47.57	6.90	393.5	0.9670	0.6225
59.95	7.74	394.5	0.9669	0.6223
75.95	8.71	395.5	0.9668	0.6221
94.95	9.74	396.5	0.9667	0.6220
119.95	10.95	397.0	0.9666	0.6219
150.95	12.29	398.0	0.9665	0.6217
189.95	13.78	398.5	0.9665	0.6216
239.95	15.49	399.0	0.9664	0.6216

Machine Deflection

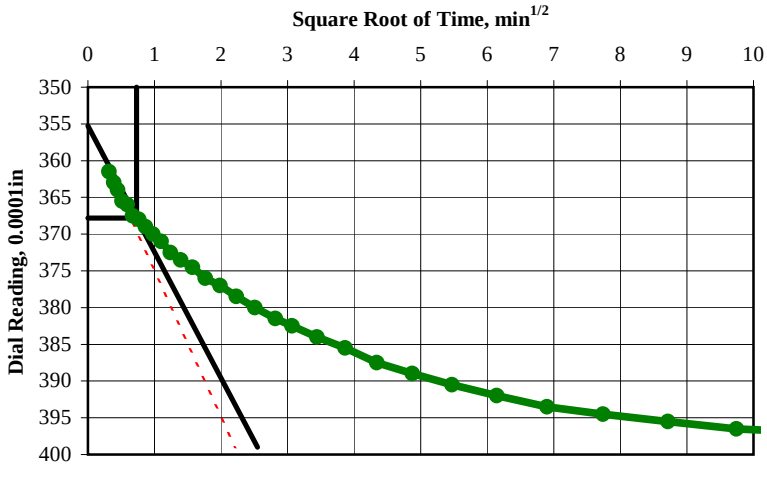
Applied Deflection Correction to Sample Height, 0.0001in -4.5

**Correction is applied to all dial readings.*

Log of Elapsed Time vs. Dial Reading



Square Root of Elapsed Time vs. Dial Reading



Sqrt. of Elapsed Time vs Dial Reading

T0 = 0 min.	D0 = 355.3 div.
T90 = 0.533 min	D90 = 367.8 div.
T100 = NA min	D100 = 369.2 div.
Height at: D90 = 0.9695, D100 = 0.9694	
Average Sample Height, in	0.9691
Average Drainage Height, in	0.4846
T (Time Factor for T90)	0.848
Coef. of Consol., C_v, in^2/min	0.372

Log of Elapsed Time vs Dial Reading

T0 = 0 min.	D0 = 356.2 div.
T50 = 3.05 min.	D50 = 375.9 div.
T100 = 47.74 min.	D100 = 395.5 div.
Height at: D50 = 0.9687, D100 = 0.9668	
Average Sample Height, in	0.9691
Average Drainage Height, in	0.4846
T (Time Factor for T50)	0.197
Coef. of Consol., C_v, in^2/min	0.015

Load Summary

Initial Sample Height, in	0.9718
Initial Sample Void Ratio	0.6306
Final Sample Height, in	0.9664
Final Sample Void Ratio	0.6216
Incremental Strain, %	0.56%
Loading Duration, min	239.95

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ONE-DIMENSIONAL CONSOLIDATION PROPERTIES OF SOILS
ASTM D 2435

Client	Civil & Environmental Consultant	Boring	TPE-18	**Test Load, tsf**	**2-4**
Client Project	091-867 Apex Landfill Expansion	Depth	12'-14'		Load 11 of 13
Project No.	30598	Sample	ST-1		
		Lab ID#	30598012		

Visual Description: Yellowish Brown Sandy Lean Clay
Test Conditions: Undisturbed, Inundated, and Double Drained

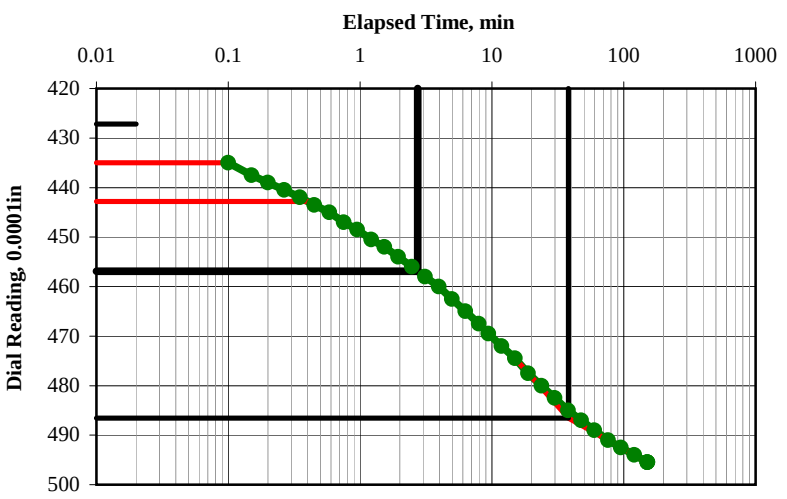
Time Vs. Dial Reading

Elapsed Time (min)	Sqrt Time ($min^{1/2}$)	Dial Reading (0.0001in)	Sample Height (in)	Void Ratio
0	0	399.0	0.9664	0.6216
Corrections*		-5	-0.0005	-0.0008
Adjusted Sample Height & Void Ratio				
0.10	0.32	435.0	0.9633	0.6164
0.15	0.39	437.5	0.9631	0.6159
0.20	0.45	439.0	0.9629	0.6157
0.27	0.52	440.5	0.9628	0.6154
0.35	0.59	442.0	0.9626	0.6152
0.45	0.67	443.5	0.9625	0.6149
0.58	0.76	445.0	0.9623	0.6147
0.75	0.87	447.0	0.9621	0.6143
0.95	0.97	448.5	0.9620	0.6141
1.22	1.10	450.5	0.9618	0.6138
1.53	1.24	452.0	0.9616	0.6135
1.95	1.40	454.0	0.9614	0.6132
2.47	1.57	456.0	0.9612	0.6128
3.12	1.77	458.0	0.9610	0.6125
3.95	1.99	460.0	0.9608	0.6122
4.98	2.23	462.5	0.9606	0.6117
6.30	2.51	465.0	0.9603	0.6113
7.95	2.82	467.5	0.9601	0.6109
9.40	3.07	469.5	0.9599	0.6106
11.85	3.44	472.0	0.9596	0.6101
14.95	3.87	474.5	0.9594	0.6097
18.85	4.34	477.5	0.9591	0.6092
23.77	4.88	480.0	0.9588	0.6088
29.95	5.47	482.5	0.9586	0.6084
37.75	6.14	485.0	0.9583	0.6080
47.57	6.90	487.0	0.9581	0.6076
59.95	7.74	489.0	0.9579	0.6073
75.95	8.71	491.0	0.9577	0.6070
94.95	9.74	492.5	0.9576	0.6067
119.95	10.95	494.0	0.9574	0.6065
150.95	12.29	495.5	0.9573	0.6062

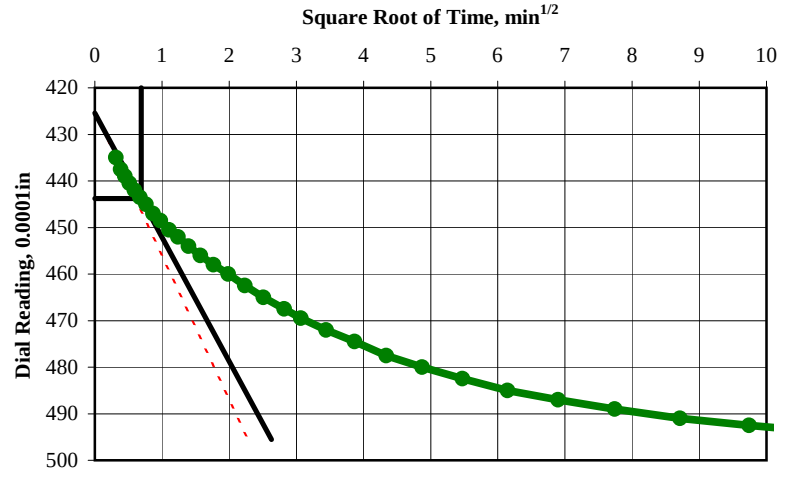
Machine Deflection

Applied Deflection Correction to Sample Height, 0.0001in: -5
**Correction is applied to all dial readings.*

Log of Elapsed Time vs. Dial Reading



Square Root of Elapsed Time vs. Dial Reading



Sqrt. of Elapsed Time vs Dial Reading

T0 = 0 min.	D0 = 425.4 div.
T90 = 0.476 min	D90 = 443.8 div.
T100 = NA min	D100 = 445.9 div.
Height at: D90 = 0.9624, D100 = 0.9622	
Average Sample Height, in	0.9618
Average Drainage Height, in	0.4809
T (Time Factor for T90)	0.848
Coef. of Consol., C_v, in^2/min	0.412

Log of Elapsed Time vs Dial Reading

T0 = 0 min.	D0 = 427.2 div.
T50 = 2.73 min.	D50 = 456.9 div.
T100 = 37.94 min.	D100 = 486.6 div.
Height at: D50 = 0.9611, D100 = 0.9581	
Average Sample Height, in	0.9618
Average Drainage Height, in	0.4809
T (Time Factor for T50)	0.197
Coef. of Consol., C_v, in^2/min	0.017

Load Summary

Initial Sample Height, in	0.9664
Initial Sample Void Ratio	0.6216
Final Sample Height, in	0.9573
Final Sample Void Ratio	0.6062
Incremental Strain, %	0.95%
Loading Duration, min	150.95

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ONE-DIMENSIONAL CONSOLIDATION PROPERTIES OF SOILS
ASTM D 2435

Client	Civil & Environmental Consultant	Boring	TPE-18	**Test Load, tsf**	**4-8**
Client Project	091-867 Apex Landfill Expansion	Depth	12'-14'		Load 12 of 13
Project No.	30598	Sample	ST-1		
		Lab ID#	30598012		

Visual Description: Yellowish Brown Sandy Lean Clay
Test Conditions: Undisturbed, Inundated, and Double Drained

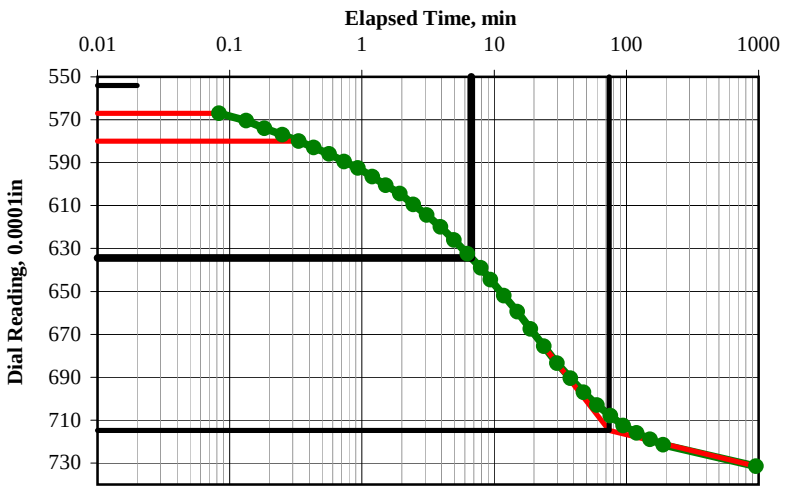
Time Vs. Dial Reading

Elapsed Time (min)	Sqrt Time ($min^{1/2}$)	Dial Reading (0.0001in)	Sample Height (in)	Void Ratio
0	0	495.5	0.9573	0.6062
Corrections*		-10.5	-0.00105	-0.0018
Adjusted Sample Height & Void Ratio				
0.08	0.29	567.0	0.9512	0.5960
0.13	0.37	570.5	0.9508	0.5954
0.18	0.43	574.0	0.9505	0.5948
0.25	0.50	577.0	0.9502	0.5943
0.33	0.58	580.0	0.9499	0.5938
0.43	0.66	583.0	0.9496	0.5933
0.57	0.75	586.0	0.9493	0.5928
0.73	0.86	589.5	0.9489	0.5922
0.93	0.97	592.5	0.9486	0.5917
1.20	1.10	596.5	0.9482	0.5910
1.52	1.23	600.5	0.9478	0.5903
1.93	1.39	604.5	0.9474	0.5897
2.45	1.57	609.5	0.9469	0.5888
3.10	1.76	614.5	0.9464	0.5880
3.93	1.98	620.0	0.9459	0.5871
4.97	2.23	626.0	0.9453	0.5861
6.28	2.51	632.5	0.9446	0.5850
7.93	2.82	639.0	0.9440	0.5839
9.38	3.06	644.5	0.9434	0.5830
11.83	3.44	652.0	0.9427	0.5817
14.93	3.86	659.5	0.9419	0.5804
18.83	4.34	667.5	0.9411	0.5791
23.75	4.87	675.5	0.9403	0.5778
29.93	5.47	683.5	0.9395	0.5764
37.73	6.14	690.5	0.9388	0.5752
47.55	6.90	697.0	0.9382	0.5742
59.93	7.74	703.0	0.9376	0.5731
75.93	8.71	708.0	0.9371	0.5723
94.93	9.74	712.5	0.9366	0.5716
119.93	10.95	716.0	0.9363	0.5710
150.93	12.29	719.0	0.9360	0.5705
189.93	13.78	721.5	0.9357	0.5700
954.93	30.90	731.5	0.9347	0.5684

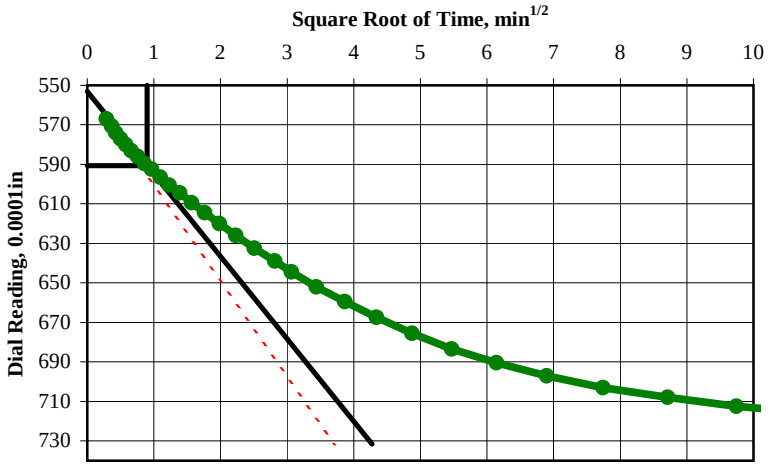
Machine Deflection

Applied Deflection Correction to Sample Height, 0.0001in: -10.5
**Correction is applied to all dial readings.*

Log of Elapsed Time vs. Dial Reading



Square Root of Elapsed Time vs. Dial Reading



Sqrt. of Elapsed Time vs Dial Reading

T0 = 0 min.	D0 = 553.1 div.		
T90 = 0.81 min	D90 = 590.7 div.		
T100 = NA min	D100 = 594.8 div.		
Height at: D90 = 0.9488, D100 = 0.9484			
Average Sample Height, in	0.9460		
Average Drainage Height, in	0.4730		
T (Time Factor for T90)	0.848		
Coef. of Consol., C_v, in^2/min	0.235		

Log of Elapsed Time vs Dial Reading

T0 = 0 min.	D0 = 554 div.		
T50 = 6.72 min.	D50 = 634.4 div.		
T100 = 73.99 min.	D100 = 714.8 div.		
Height at: D50 = 0.9444, D100 = 0.9364			
Average Sample Height, in	0.9460		
Average Drainage Height, in	0.4730		
T (Time Factor for T50)	0.197		
Coef. of Consol., C_v, in^2/min	0.007		

Load Summary

Initial Sample Height, in	0.9573
Initial Sample Void Ratio	0.6062
Final Sample Height, in	0.9347
Final Sample Void Ratio	0.5684
Incremental Strain, %	2.36%
Loading Duration, min	954.93333

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ONE-DIMENSIONAL CONSOLIDATION PROPERTIES OF SOILS
ASTM D 2435

Client	Civil & Environmental Consultant	Boring	TPE-18	**Test Load, tsf**	**8-16**
Client Project	091-867 Apex Landfill Expansion	Depth	12'-14'		Load 13 of 13
Project No.	30598	Sample	ST-1		
		Lab ID#	30598012		
Visual Description	Yellowish Brown Sandy Lean Clay				
Test Conditions:	Undisturbed, Inundated, and Double Drained				

Time Vs. Dial Reading

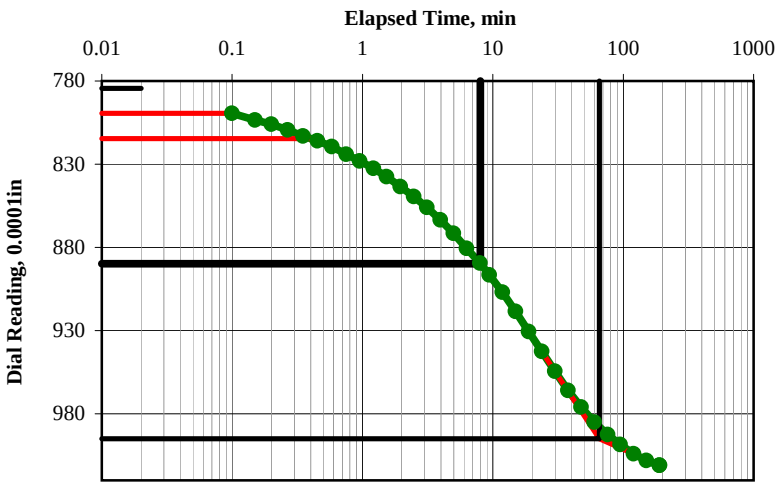
Elapsed Time (min)	Sqrt Time ($min^{1/2}$)	Dial Reading (0.0001in)	Sample Height (in)	Void Ratio
0	0	731.5	0.9347	0.5684
Corrections*		-15	-0.0015	-0.0025
Adjusted Sample Height & Void Ratio				
0.10	0.32	799.5	0.9294	0.5595
0.15	0.39	803.5	0.9290	0.5588
0.20	0.45	806.0	0.9288	0.5584
0.27	0.52	809.5	0.9284	0.5578
0.35	0.59	813.0	0.9281	0.5572
0.45	0.67	816.0	0.9278	0.5567
0.58	0.76	819.5	0.9274	0.5561
0.75	0.87	824.0	0.9270	0.5554
0.95	0.97	828.0	0.9266	0.5547
1.22	1.10	832.5	0.9261	0.5539
1.53	1.24	837.5	0.9256	0.5531
1.95	1.40	843.5	0.9250	0.5521
2.47	1.57	849.5	0.9244	0.5511
3.12	1.77	856.0	0.9238	0.5500
3.95	1.99	863.5	0.9230	0.5487
4.98	2.23	871.5	0.9222	0.5474
6.30	2.51	880.5	0.9213	0.5459
7.95	2.82	889.5	0.9204	0.5444
9.40	3.07	896.5	0.9197	0.5432
11.85	3.44	907.0	0.9187	0.5414
14.95	3.87	918.5	0.9175	0.5395
18.85	4.34	930.5	0.9163	0.5375
23.77	4.88	942.5	0.9151	0.5355
29.95	5.47	954.5	0.9139	0.5335
37.75	6.14	966.0	0.9128	0.5315
47.57	6.90	976.0	0.9118	0.5299
59.95	7.74	985.0	0.9109	0.5283
75.95	8.71	992.5	0.9101	0.5271
94.95	9.74	998.5	0.9095	0.5261
119.95	10.95	1004.0	0.9090	0.5252
150.95	12.29	1008.0	0.9086	0.5245
189.95	13.78	1011.0	0.9083	0.5240

Machine Deflection

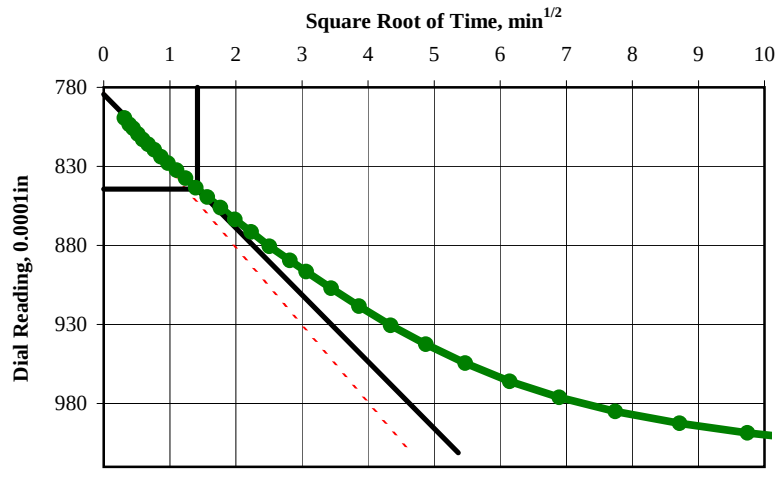
Applied Deflection Correction to Sample Height, 0.0001in -15

**Correction is applied to all dial readings.*

Log of Elapsed Time vs. Dial Reading



Square Root of Elapsed Time vs. Dial Reading



Sqrt. of Elapsed Time vs Dial Reading

T0 = 0 min.	D0 = 784.4 div.
T90 = 2.016 min	D90 = 844.3 div.
T100 = NA min	D100 = 850.9 div.
Height at: D90 = 0.9249, D100 = 0.9243	
Average Sample Height, in	0.9215
Average Drainage Height, in	0.4607
T (Time Factor for T90)	0.848
Coef. of Consol., C_v, in^2/min	0.089

Log of Elapsed Time vs Dial Reading

T0 = 0 min.	D0 = 784.4 div.
T50 = 8 min.	D50 = 889.7 div.
T100 = 65.47 min.	D100 = 995.1 div.
Height at: D50 = 0.9204, D100 = 0.9098	
Average Sample Height, in	0.9215
Average Drainage Height, in	0.4607
T (Time Factor for T50)	0.197
Coef. of Consol., C_v, in^2/min	0.005

Load Summary

Initial Sample Height, in	0.9347
Initial Sample Void Ratio	0.5684
Final Sample Height, in	0.9083
Final Sample Void Ratio	0.5240
Incremental Strain, %	2.83%
Loading Duration, min	189.95

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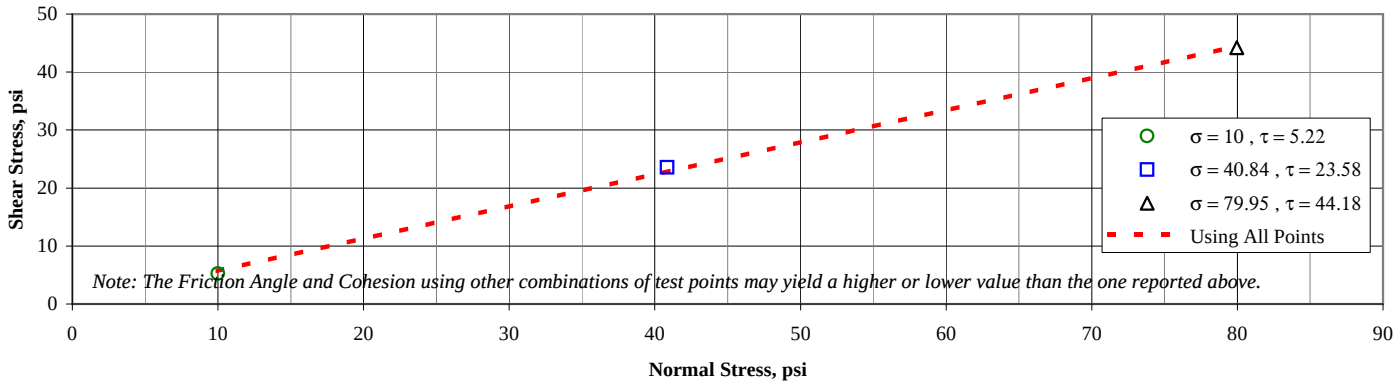
DIRECT SHEAR TEST OF SOILS UNDER CONSOLIDATED DRAINED CONDITIONS

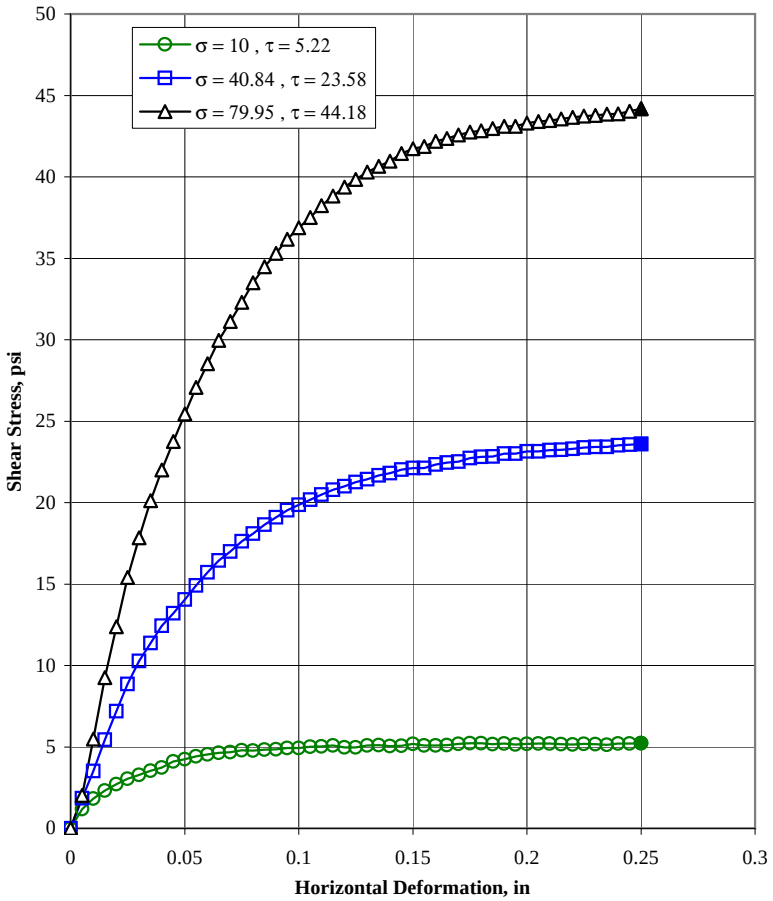
Client	Civil & Environmental Consultants, Inc.	Boring	SB-4
Client Project	091-867 Apex Landfill Expansion	Depth	28'-30'
Project No.	30598	Sample	ST-1
		Lab No.	30598013
Visual Description	DARK GRAYISH BROWN SANDY LEAN CLAY		
Sample Condition	Undisturbed (oversize material present)		

NORMAL STRESS vs. SHEAR STRESS

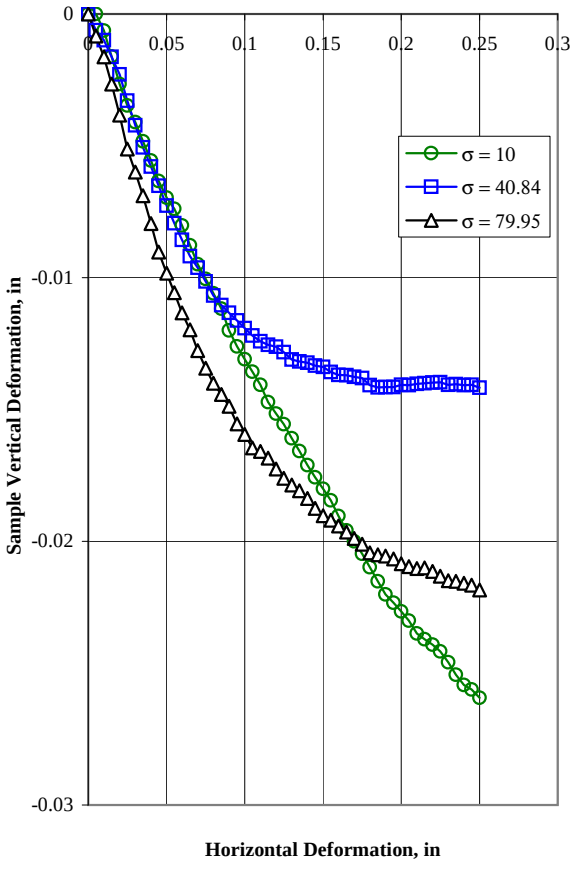
ϕ = 29.1° c = 0.1 psi



HORIZONTAL DEFORMATION vs. SHEAR STRESS



HORIZONTAL DEFORMATION vs. SAMPLE HEIGHT



Note: The calculations performed and the parameters presented herein are for preliminary purposes only. GTS only accepts responsibility for the raw data obtained from the direct shear tests. This data may be interpreted differently by others. It is the responsibility of the user to determine the appropriateness and accuracy of the computed values.

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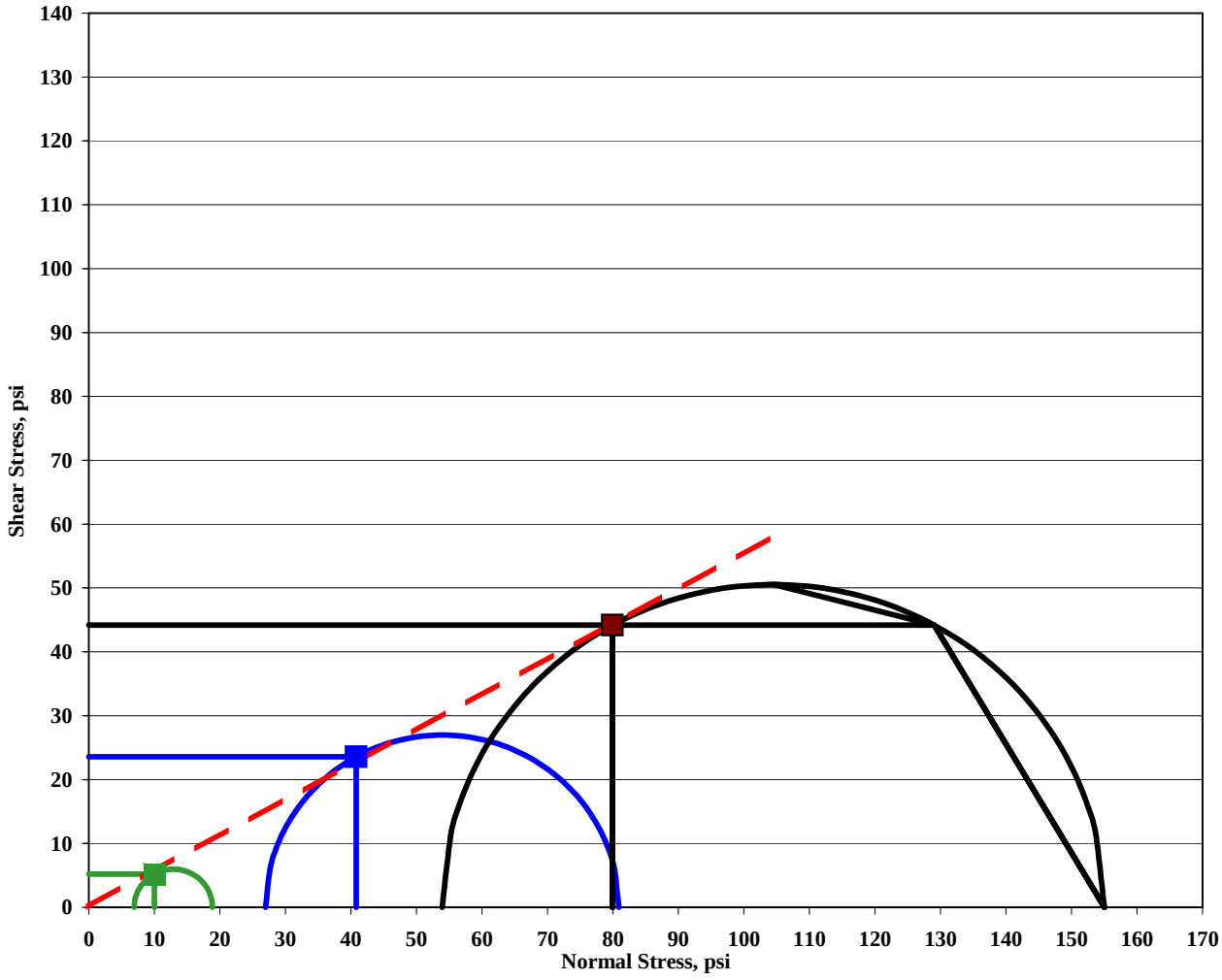
DIRECT SHEAR TEST OF SOILS
UNDER CONSOLIDATED, DRAINED CONDITIONS
MOHRS'S CIRCLE AND FAILURE PARAMETERS

Client:	Civil & Environmental Consultants, Inc.	Boring:	SB-4
Client Project	091-867 Apex Landfill Expansion	Depth:	28'-30'
Project No.	30598	Sample:	ST-1
		Lab Sample ID	30598013
Material:	DARK GRAYISH BROWN SANDY LEAN CLAY		
Condition	Undisturbed (oversize material present)		

Average Friction Angle, ϕ, deg.		**29.1**	**Using All Points**
Average Cohesion, c, psi		**0.1**	**Using All Points**
Sample Condition	Undisturbed (oversize material present)		
Normal Stress, psi	10.00	40.84	79.95
Shear Stress at Failure, psi	5.22	23.58	44.18
Mohr's Circle Radius, psi	6.0	27.0	50.5
Mohr's Circle Origin, psi	12.9	53.9	104.5
(Origin - Normal Stress), psi	2.9	13.1	24.5
Minor Principal Stress σ3, psi	6.9	27.0	54.0
Major Principal Stress σ1, psi	18.9	80.9	155.0
Principal Stress Difference, σ1–σ3, psi	11.9	54.0	101.1
Normal Stress Pole Coordinate, X, psi	15.8	67.0	129.0
Shear Stress Pole Coordinate, Y, psi	5.2	23.6	44.2
Assumed Failure Plane, deg	0 - Horizontal	0 - Horizontal	0 - Horizontal
Major Principal Failure Plane Angle, deg	59.5	59.5	59.5
Minor Principal Failure Plane Angle, deg	30.5	30.5	30.5
Maximum Shear Stress, psi	6.0	27.0	50.5
Maximum Shear Failure Plane Angle, deg	14.5	14.5	14.5
Initial Water Content, %	**9.1%**	**9.1%**	**9.1%**
Initial Dry Density, pcf	**111.4**	**111.4**	**111.4**



DIRECT SHEAR TEST OF SOILS UNDER CONSOLIDATED DRAINED CONDITIONS - ASTM D 3080

Client	Civil & Environmental Consultant	Boring	SB-4
Client Project	091-867 Apex Landfill Expansion	Depth	28'-30'
Project No.	30598	Sample	ST-1
		Lab No.	30598013
Visual Description	DARK GRAYISH BROWN SANDY LEAN CLAY		
Sample Condition	Undisturbed (oversize material present)		

SAMPLE CONDITIONS

Test No.	1			2			3		
	Initial	**After Consol.**	**Final**	**Initial**	**After Consol.**	**Final**	**Initial**	**After Consol.**	**Final**
Tare I.D.	A34	-	A24	A34	-	A7	A34	-	A37
Wt. Wet Soil & Tare, gm	260.56	-	167.23	260.56	-	161.31	260.56	-	157.83
Wt. Dry Soil & Tare, gm	239.59	-	137.96	239.59	-	137.23	239.59	-	136.68
Wt. Tare, gm	9.91	-	9.44	9.91	-	9.44	9.91	-	9.62
Water Content, %	9.1%	-	22.8%	9.1%	-	18.8%	9.1%	-	16.6%
Wt. of Wet Soil & Mold, gr	309.04	-	-	307.86	-	-	307.69	-	-
Wt. of Mold, gm	152.32	-	-	151.14	-	-	150.97	-	-
Wt. of Wet Soil, gm	156.72	-	-	156.72	-	-	156.72	-	-
Sample Height, in	1	0.9731	0.9472	1	0.9384	0.9243	1	0.8862	0.8643
Sample Diameter, in	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5
Sample Area, in^2	4.9	4.9	4.9	4.9	4.9	4.9	4.9	4.9	4.9
Sample Volume, cc	80.44	78.28	76.19	80.44	75.49	74.35	80.44	71.28	69.53
Wet Density, pcf	121.6	NA	144.4	121.6	NA	143.2	121.6	NA	150.3
Dry Density, pcf	111.4	NA	117.6	111.4	NA	120.5	111.4	NA	128.9

DEFORMATION RATE CALCULATIONS

t_{90}, min. (Sqrt. Method)	0.35	0.35	8.88
Equivalent t_{50}, min. (Sqrt.)	0.08	0.08	2.07
t_{50}, min. (Log Method)	0.11	0.46	0.50
Selected t_{50}, min. (Max.)	0.11	0.46	2.07
Calc. Disp. Rate, in./min.	0.0455	0.0109	0.0024

TEST DATA AND SUMMARY

Test No.	1		2		3	
Normal Stress, psi	**10.00**		**40.85**		**79.95**	
Shear Stress at Failure, psi	**5.2**	**10% Def**	**23.6**	**10% Def**	**44.2**	**10% Def**
Shear Disp. at Failure, in	**0.250**		**0.250**		**0.250**	
Displacement Rate, in/min	**0.0020**		**0.0020**		**0.0020**	

Horizontal Displacement in	Shear Force lb.	Shear Stress psi	Vertical Deformation in	Shear Force lb.	Shear Stress psi	Vertical Deformation in	Shear Force lb.	Shear Stress psi	Vertical Deformation in
0	0.0	0.0	0.000	0.0	0.0	0.000	0.0	0.0	0.000
0.005	5.8	1.2	0.000	9.1	1.9	-0.001	9.9	2.0	-0.001
0.010	8.9	1.8	-0.001	17.2	3.5	-0.001	26.9	5.5	-0.002
0.015	11.4	2.3	-0.002	26.7	5.4	-0.002	45.4	9.3	-0.003
0.020	13.3	2.7	-0.003	35.3	7.2	-0.002	60.8	12.4	-0.004
0.025	15.0	3.1	-0.003	43.5	8.9	-0.003	75.6	15.4	-0.005
0.030	16.1	3.3	-0.004	50.4	10.3	-0.004	87.6	17.8	-0.006
0.035	17.3	3.5	-0.005	55.9	11.4	-0.005	98.7	20.1	-0.007
0.040	18.3	3.7	-0.006	61.0	12.4	-0.006	108.0	22.0	-0.008
0.045	20.1	4.1	-0.006	64.8	13.2	-0.007	116.6	23.7	-0.009
0.050	20.9	4.2	-0.007	69.0	14.1	-0.007	124.9	25.4	-0.010
0.055	21.7	4.4	-0.007	73.2	14.9	-0.008	132.9	27.1	-0.011
0.060	22.2	4.5	-0.008	77.1	15.7	-0.009	140.0	28.5	-0.011
0.065	22.8	4.6	-0.009	80.7	16.4	-0.009	147.0	30.0	-0.012
0.070	22.9	4.7	-0.009	83.5	17.0	-0.010	152.7	31.1	-0.013

Horizontal Displacement in	Shear Force lb.	Shear Stress psi	Vertical Deformation in	Shear Force lb.	Shear Stress psi	Vertical Deformation in	Shear Force lb.	Shear Stress psi	Vertical Deformation in
0.075	23.5	4.8	-0.010	86.5	17.6	-0.010	158.5	32.3	-0.013
0.080	23.4	4.8	-0.011	88.9	18.1	-0.011	164.4	33.5	-0.014
0.085	23.7	4.8	-0.011	91.5	18.6	-0.011	169.2	34.5	-0.014
0.090	23.9	4.9	-0.012	93.7	19.1	-0.011	173.3	35.3	-0.015
0.095	24.2	4.9	-0.013	95.8	19.5	-0.012	177.5	36.2	-0.016
0.100	24.2	4.9	-0.013	97.5	19.9	-0.012	181.1	36.9	-0.016
0.105	24.6	5.0	-0.014	99.0	20.2	-0.012	184.1	37.5	-0.016
0.110	24.7	5.0	-0.014	100.6	20.5	-0.012	187.7	38.2	-0.017
0.115	25.0	5.1	-0.015	102.0	20.8	-0.013	190.5	38.8	-0.017
0.120	24.4	5.0	-0.015	103.1	21.0	-0.013	193.3	39.4	-0.017
0.125	24.4	5.0	-0.016	104.4	21.3	-0.013	195.5	39.8	-0.018
0.130	25.0	5.1	-0.016	105.3	21.4	-0.013	197.8	40.3	-0.018
0.135	25.0	5.1	-0.017	106.3	21.7	-0.013	199.5	40.6	-0.018
0.140	24.8	5.0	-0.017	107.0	21.8	-0.013	201.1	41.0	-0.018
0.145	24.9	5.1	-0.018	108.1	22.0	-0.013	203.4	41.4	-0.019
0.150	25.5	5.2	-0.018	108.6	22.1	-0.013	204.8	41.7	-0.019
0.155	25.0	5.1	-0.018	108.6	22.1	-0.014	205.6	41.9	-0.019
0.160	25.0	5.1	-0.019	109.7	22.3	-0.014	207.0	42.2	-0.019
0.165	25.0	5.1	-0.020	110.2	22.5	-0.014	207.9	42.4	-0.020
0.170	25.4	5.2	-0.020	110.5	22.5	-0.014	209.0	42.6	-0.020
0.175	25.6	5.2	-0.020	111.5	22.7	-0.014	209.8	42.7	-0.020
0.180	25.6	5.2	-0.021	111.9	22.8	-0.014	210.2	42.8	-0.020
0.185	25.4	5.2	-0.022	112.0	22.8	-0.014	210.9	43.0	-0.021
0.190	25.5	5.2	-0.022	113.0	23.0	-0.014	211.6	43.1	-0.021
0.195	25.2	5.1	-0.022	113.0	23.0	-0.014	211.6	43.1	-0.021
0.200	25.5	5.2	-0.023	113.6	23.1	-0.014	212.6	43.3	-0.021
0.205	25.6	5.2	-0.023	113.6	23.1	-0.014	213.0	43.4	-0.021
0.210	25.6	5.2	-0.023	114.0	23.2	-0.014	213.3	43.5	-0.021
0.215	25.4	5.2	-0.024	114.1	23.2	-0.014	213.8	43.6	-0.021
0.220	25.3	5.1	-0.024	114.4	23.3	-0.014	214.3	43.7	-0.021
0.225	25.5	5.2	-0.024	114.8	23.4	-0.014	214.7	43.7	-0.021
0.230	25.3	5.2	-0.025	115.0	23.4	-0.014	214.8	43.8	-0.021
0.235	25.2	5.1	-0.025	114.9	23.4	-0.014	215.3	43.9	-0.022
0.240	25.6	5.2	-0.025	115.4	23.5	-0.014	215.4	43.9	-0.022
0.245	25.5	5.2	-0.026	115.6	23.6	-0.014	216.1	44.0	-0.022
0.250	25.6	5.2	-0.026	115.8	23.6	-0.014	216.9	44.2	-0.022

Input Validation: Reviewed By:

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ONE DIMENSIONAL CONSOLIDATION TEST

Client	Civil & Environmental Consultant	Boring	SB-4	**Final Test Load, psi**	**10.00**
Client Project	091-867 Apex Landfill Expansion	Depth	28'-30'		
Project No.	30598	Sample	ST-1		
		Lab ID#	30598013		
Description	DARK GRAYISH BROWN SANDY LEAN CLAY				
Test Conditions:	Undisturbed (oversize material present)				

Increment Start Date and Time: 12/06/10

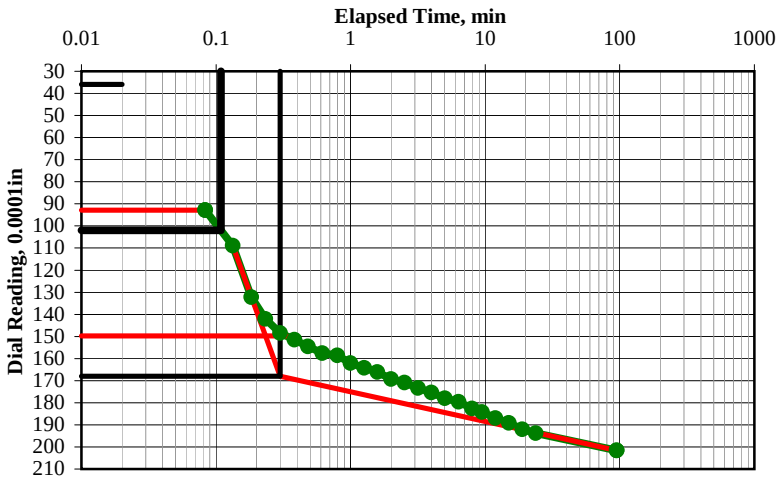
Elapsed Time (min)	Sqrt Time ($min^{1/2}$)	Dial Reading (0.0001in)	Sample Height (in)
0	0	0	1.0000
Corrections*		67	0.0067
Adjusted Sample Height			
0.08	0.29	92.9	0.9974
0.13	0.37	108.9	0.9958
0.18	0.43	132.2	0.9935
0.23	0.48	142.1	0.9925
0.30	0.55	148.5	0.9918
0.38	0.62	151.5	0.9915
0.48	0.70	154.6	0.9912
0.62	0.79	157.6	0.9909
0.80	0.89	158.6	0.9908
1.00	1.00	162.1	0.9905
1.27	1.13	164.2	0.9903
1.58	1.26	166.1	0.9901
2.00	1.41	169.4	0.9898
2.52	1.59	171.0	0.9896
3.17	1.78	173.4	0.9894
4.00	2.00	175.4	0.9892
5.03	2.24	178.0	0.9889
6.35	2.52	179.6	0.9887
8.00	2.83	182.6	0.9884
9.47	3.08	184.2	0.9883
11.92	3.45	187.0	0.9880
15.02	3.88	189.1	0.9878
18.92	4.35	192.0	0.9875
23.83	4.88	193.8	0.9873
95.03	9.75	201.6	0.9731

Machine Deflection

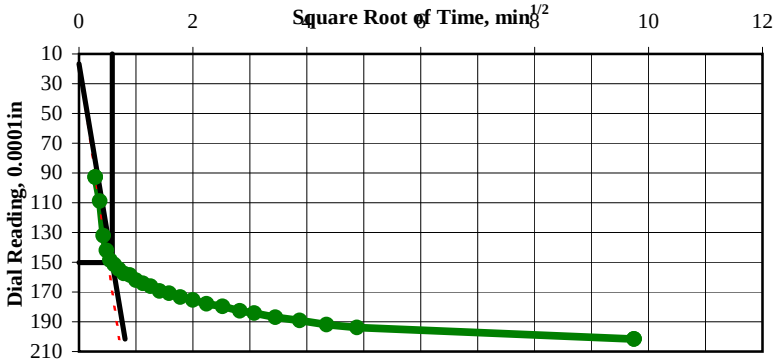
Applied Deflection Correction to Sample Height, 0.0001in 67

**Correction is applied to all dial readings.*

Log of Elapsed Time vs. Dial Reading



Square Root of Elapsed Time vs. Dial Reading



Sqrt. of Elapsed Time vs Dial Reading

T0 = 0 min.	D0 = 16.7 div.		
T90 = 0.348 min	D90 = 150.1 div.		
T100 = NA min	D100 = 164.9 div.		
Height at: D90 = 0.9783, D100 = 0.9768			
Average Sample Height, in	0.9866		
Average Drainage Height, in	0.4933		
T (Time Factor for T90)	0.848		
Coef. of Consol., C_v, in^2/min	0.601		

Log of Elapsed Time vs Dial Reading

T0 = 0 min.	D0 = 35.9 div.		
T50 = 0.11 min.	D50 = 102 div.		
T100 = 0.3 min.	D100 = 168 div.		
Height at: D50 = 0.9831, D100 = 0.9765			
Average Sample Height, in	0.9866		
Average Drainage Height, in	0.4933		
T (Time Factor for T50)	0.197		
Coef. of Consol., C_v, in^2/min	0.436		

Load Summary

Initial Sample Height, in	1.0000
Final Sample Height, in	0.9731
Incremental Strain, %	2.69%
Loading Duration, min	95

Input Validation: Reviewed By: Date 12/6/2010

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ONE DIMENSIONAL CONSOLIDATION TEST

Client	Civil & Environmental Consultant	Boring	SB-4	**Final Test Load, psi**	**40.85**
Client Project	091-867 Apex Landfill Expansion	Depth	28'-30'		
Project No.	30598	Sample	ST-1		
		Lab ID#	30598013		
Description	DARK GRAYISH BROWN SANDY LEAN CLAY				
Test Conditions:	Undisturbed (oversize material present)				

Increment Start Date: 12/06/10

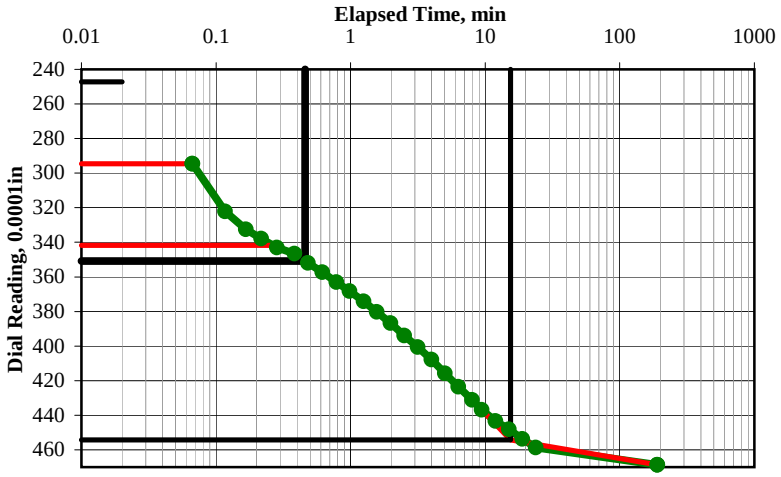
Elapsed Time (min)	Sqrt Time ($min^{1/2}$)	Dial Reading (0.0001in)	Sample Height (in)
0	0	0	1.0000
Corrections*		147	0.0147
Adjusted Sample Height			
0.07	0.26	294.6	0.9852
0.12	0.34	322.1	0.9825
0.17	0.41	332.6	0.9814
0.22	0.47	337.8	0.9809
0.28	0.53	343.0	0.9804
0.38	0.62	346.5	0.9801
0.48	0.70	351.9	0.9795
0.62	0.79	357.3	0.9790
0.78	0.89	363.0	0.9784
0.98	0.99	368.2	0.9779
1.25	1.12	374.2	0.9773
1.57	1.25	380.2	0.9767
1.98	1.41	386.7	0.9760
2.50	1.58	393.9	0.9753
3.15	1.77	400.7	0.9746
3.98	2.00	407.7	0.9739
5.02	2.24	415.7	0.9731
6.33	2.52	423.6	0.9723
8.00	2.83	431.1	0.9716
9.45	3.07	437.0	0.9710
11.90	3.45	443.4	0.9704
15.00	3.87	448.2	0.9699
18.90	4.35	453.7	0.9693
23.82	4.88	458.7	0.9688
190.03	13.79	468.6	0.9384

Machine Deflection

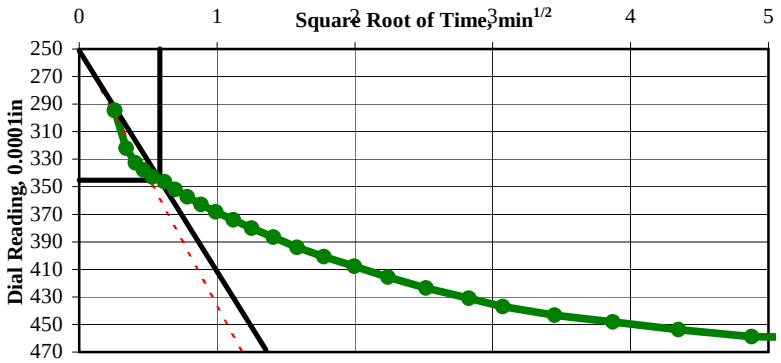
Applied Deflection Correction to Sample Height, 0.0001in 147

**Correction is applied to all dial readings.*

Log of Elapsed Time vs. Dial Reading



Square Root of Elapsed Time vs. Dial Reading



Sqrt. of Elapsed Time vs Dial Reading

T0 = 0 min.	D0 = 251.2 div.		
T90 = 0.348 min	D90 = 345.2 div.		
T100 = NA min	D100 = 355.6 div.		
Height at: D90 = 0.9508, D100 = 0.9497			
Average Sample Height, in	0.9692		
Average Drainage Height, in	0.4846		
T (Time Factor for T90)	0.848		
Coef. of Consol., C_v, in^2/min	0.580		

Log of Elapsed Time vs Dial Reading

T0 = 0 min.	D0 = 247.3 div.		
T50 = 0.46 min.	D50 = 350.8 div.		
T100 = 15.43 min.	D100 = 454.3 div.		
Height at: D50 = 0.9502, D100 = 0.9399			
Average Sample Height, in	0.9692		
Average Drainage Height, in	0.4846		
T (Time Factor for T50)	0.197		
Coef. of Consol., C_v, in^2/min	0.101		

Load Summary

Initial Sample Height, in	1.0000
Final Sample Height, in	0.9384
Incremental Strain, %	6.16%
Loading Duration, min	190

Input Validation: Reviewed By: Date 12/6/2010

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ONE DIMENSIONAL CONSOLIDATION TEST

Client	Civil & Environmental Consultant	Boring	SB-4	**Final Test Load, psi**	**79.95**
Client Project	091-867 Apex Landfill Expansion	Depth	28'-30'		
Project No.	30598	Sample	ST-1		
		Lab ID#	30598013		
Description	DARK GRAYISH BROWN SANDY LEAN CLAY				
Test Conditions:	Undisturbed (oversize material present)				

Increment Start Date: 12/07/10

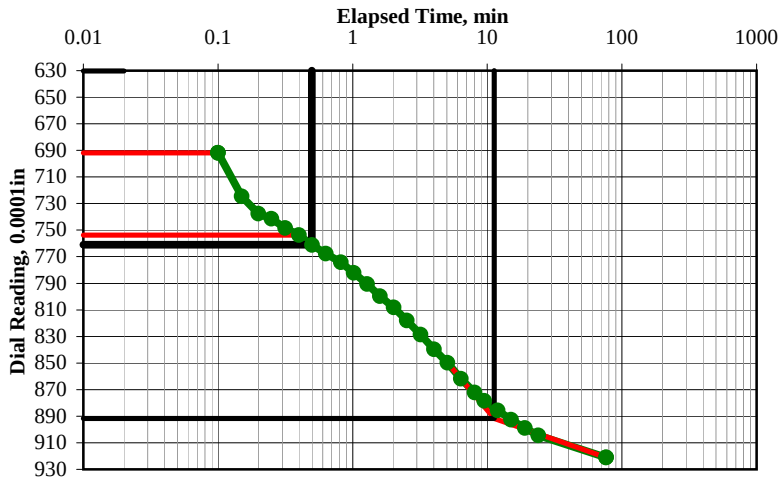
Elapsed Time (min)	Sqrt Time ($min^{1/2}$)	Dial Reading (0.0001in)	Sample Height (in)
0	0	0	1.0000
Corrections*		217	0.0217
Adjusted Sample Height			
0.10	0.32	692.0	0.9525
0.15	0.39	724.6	0.9492
0.20	0.45	737.7	0.9479
0.25	0.50	741.4	0.9476
0.32	0.56	748.4	0.9469
0.40	0.63	753.6	0.9463
0.50	0.71	761.3	0.9456
0.63	0.80	767.7	0.9449
0.82	0.90	774.1	0.9443
1.02	1.01	782.1	0.9435
1.28	1.13	790.7	0.9426
1.60	1.26	799.7	0.9417
2.02	1.42	808.1	0.9409
2.53	1.59	818.2	0.9399
3.20	1.79	828.7	0.9388
4.03	2.01	839.8	0.9377
5.07	2.25	849.8	0.9367
6.38	2.53	861.9	0.9355
8.05	2.84	872.3	0.9345
9.50	3.08	878.5	0.9339
11.95	3.46	885.6	0.9331
15.07	3.88	892.6	0.9324
18.98	4.36	898.9	0.9318
23.92	4.89	904.5	0.9312
76.23	8.73	921.1	0.8862

Machine Deflection

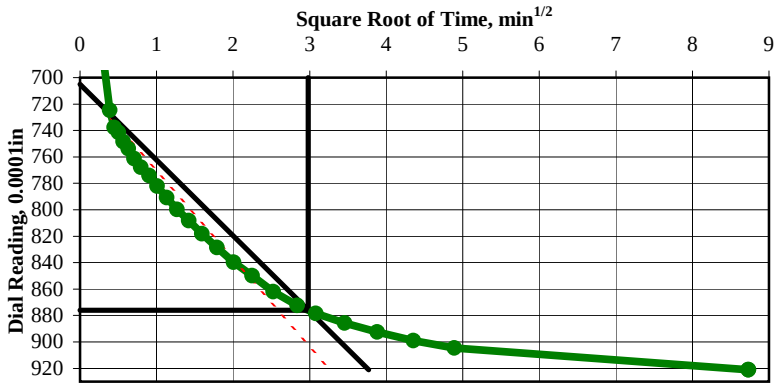
Applied Deflection Correction to Sample Height, 0.0001in 217

**Correction is applied to all dial readings.*

Log of Elapsed Time vs. Dial Reading



Square Root of Elapsed Time vs. Dial Reading



Sqrt. of Elapsed Time vs Dial Reading		Log of Elapsed Time vs Dial Reading		Load Summary	
T0 = 0 min.	D0 = 705.1 div.	T0 = 0 min.	D0 = 630.3 div.		
T90 = 8.88 min	D90 = 875.9 div.	T50 = 0.5 min.	D50 = 761.1 div.	Initial Sample Height, in	1.0000
T100 = NA min	D100 = 894.9 div.	T100 = 11.25 min.	D100 = 891.8 div.		
Height at: D90 = 0.8907, D100 = 0.8888		Height at: D50 = 0.9022, D100 = 0.8891		Final Sample Height, in	0.8862
Average Sample Height, in	0.9431	Average Sample Height, in	0.9431		
Average Drainage Height, in	0.4715	Average Drainage Height, in	0.4715	Incremental Strain, %	11.38%
T (Time Factor for T90)	0.848	T (Time Factor for T50)	0.197	Loading Duration, min	76
Coef. of Consol., C_v, in^2/min	0.021	Coef. of Consol., C_v, in^2/min	0.088		

Input Validation: Reviewed By: Date 12/7/2010

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ONE-DIMENSIONAL CONSOLIDATION PROPERTIES OF SOILS
ASTM D 2435

Client	Civil & Environmental Consultant	Boring	SB-6
Client Project	091-867 Apex Landfill Expansion	Depth	9'-10'
Project No.	30598	Sample	ST-2
		Lab Sample No.	30598014

Visual Description: Grayish Brown Clayey Gravel with Sand
Sample Conditions: Undisturbed, Inundated, and Double Drained
Machine Deflection Correction: Applied

SAMPLE PROPERTIES		
	Initial	Final
Tare Number	A12	B12
Wt. Tare & WS, gm	257.57	234.9
Wt. Tare & DS, gm	235.97	217.89
Wt. Tare, gm	9.53	85.04
Water Content, %	9.5%	12.8%
Sample Diameter, in	2.5	2.5
Sample Height, in	1.006	0.8095
Sample Volume, in^3	4.9394	3.9735
Wt. WS + Ring, gm	258.52	261.02
Wt. of Ring, gm	110.92	110.92
Wt. of WS, gm	147.6	150.10
Wet Density, pcf	113.79	143.84
Wet Density, g/cc	1.824	2.305
Water Content, %	9.5%	12.8%
Wt. of DS, gm	134.75	133.06
Dry Density, pcf	103.88	127.52
Dry Density, g/cc	1.665	2.044
Void Ratio, e	0.6339	0.3310
Saturation, %	40.9%	
Specific Gravity	2.72	Measured
Height of Solids, in	0.6159	0.6159

TEST DATA SUMMARY

Applied Pressure tsf	**Load Duration** min	**Final Height** in	**Vertical Strain** %	**Dry Density** g/cc	**Void Ratio** e	**a_v** ft^2/ton	**Incremental** C_c	**Incremental** C_r
Seating	NA	1.0063	0.00	1.6647	0.6339	NA	NA	NA
0.25	76	0.9739	3.21%	1.7200	0.5814	2.10E-01	NA	NA
0.5	120	0.9459	6.00%	1.7710	0.5358	1.82E-01	0.151	NA
1	60	0.9169	8.88%	1.8270	0.4888	9.42E-02	0.156	NA
2	758	0.8875	11.80%	1.8874	0.4411	4.76E-02	0.158	NA
4	190	0.8607	14.46%	1.9462	0.3976	2.18E-02	0.145	NA
1	120	0.8642	14.11%	1.9383	0.4033	1.90E-03	NA	NA
0.25	190	0.8704	13.50%	1.9246	0.4133	1.33E-02	NA	NA
0.5	38	0.8698	13.56%	1.9258	0.4124	3.56E-03	NA	0.003
1	1,514	0.8677	13.77%	1.9305	0.4089	6.88E-03	NA	0.011
2	955	0.8641	14.13%	1.9386	0.4031	5.88E-03	NA	0.020
4	190	0.8567	14.86%	1.9554	0.3910	6.01E-03	NA	0.040
8	120	0.8341	17.10%	2.0082	0.3545	9.14E-03	0.122	NA
16	120	0.8095	19.56%	2.0694	0.3144	5.01E-03	0.133	NA

Note: The calculations performed and the parameters presented herein are for preliminary purposes only. GTS only accepts responsibility for the raw data obtained from the consolidation tests. This data may be interpreted differently by others. It is the responsibility of the user to determine the appropriateness and accuracy of the computed values.

Input Validation | Reviewed By: | Date Tested: 12/18/2010 |

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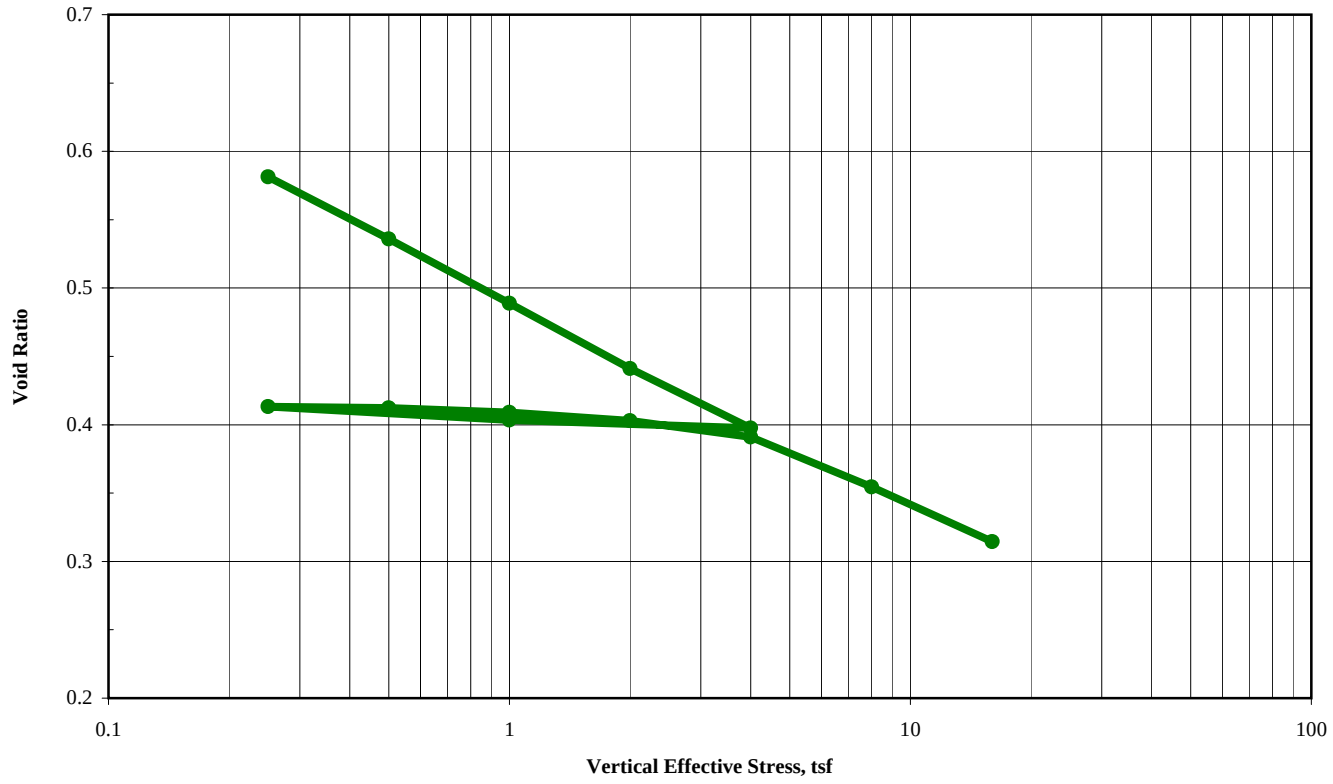
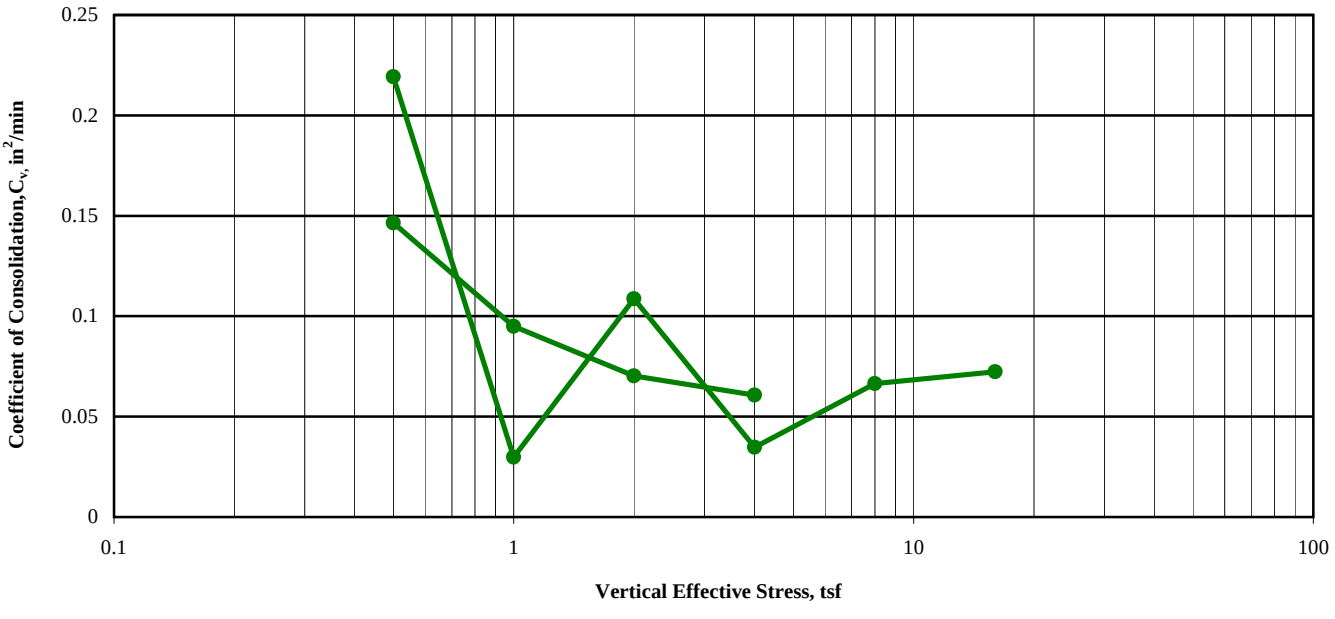
ONE-DIMENSIONAL CONSOLIDATION PROPERTIES OF SOILS
ASTM D 2435

Client	Civil & Environmental Consultants, Inc.	Boring	SB-6
Client Project	091-867 Apex Landfill Expansion	Depth	9'-10'
Project No.	30598	Sample	ST-2
		Lab Sample No.	30598014
Visual Description	Grayish Brown Clayey Gravel with Sand		
Sample Conditions	Undisturbed, Inundated, and Double Drained		
Machine Deflection Correction:	Applied		

Void Ratio (Final Height) vs Vertical Effective Consolidation Stress



Coeffieicent of Consolidation (log. method) vs. Vertical Effective Consolidation Stress



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ONE-DIMENSIONAL CONSOLIDATION PROPERTIES OF SOILS
ASTM D 2435

Client	Civil & Environmental Consultant	Boring	SB-6	**Test Load, tsf**	**0-0.25**
Client Project	091-867 Apex Landfill Expansion	Depth	9'-10'		Load 1 of 13
Project No.	30598	Sample	ST-2		
		Lab ID#	30598014		
Visual Description	Grayish Brown Clayey Gravel with Sand				
Test Conditions:	Undisturbed, Inundated, and Double Drained				

Time Vs. Dial Reading

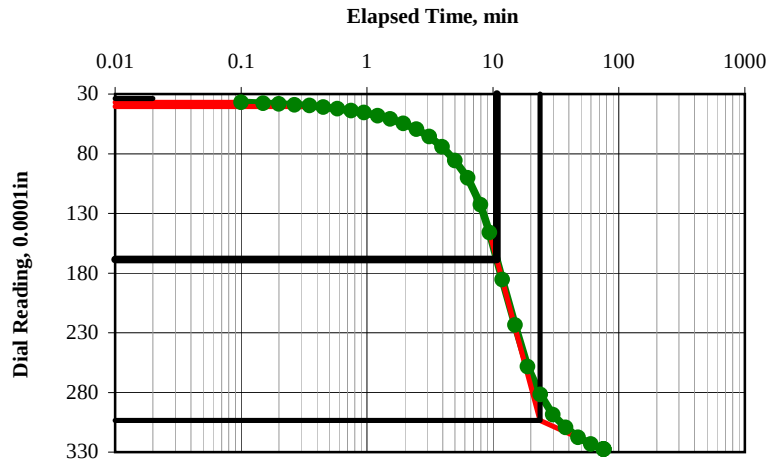
Elapsed Time (min)	Sqrt Time ($min^{1/2}$)	Dial Reading (0.0001in)	Sample Height (in)	Void Ratio
0	0	0	1.0063	0.6339
Corrections*		-4.5	-0.00045	-0.0007
Adjusted Sample Height & Void Ratio				
0.10	0.32	37.1	1.0030	0.6286
0.15	0.39	37.8	1.0029	0.6285
0.20	0.45	38.4	1.0029	0.6284
0.27	0.52	39.1	1.0028	0.6283
0.35	0.59	39.6	1.0027	0.6282
0.45	0.67	41.0	1.0026	0.6280
0.58	0.76	42.4	1.0025	0.6278
0.75	0.87	43.9	1.0023	0.6275
0.95	0.97	45.5	1.0022	0.6273
1.22	1.10	48.2	1.0019	0.6268
1.53	1.24	50.8	1.0016	0.6264
1.95	1.40	54.7	1.0012	0.6258
2.47	1.57	59.6	1.0007	0.6250
3.12	1.77	65.7	1.0001	0.6240
3.95	1.99	74.1	0.9993	0.6226
4.98	2.23	85.8	0.9981	0.6207
6.30	2.51	100.2	0.9967	0.6184
7.95	2.82	122.8	0.9944	0.6147
9.40	3.07	146.2	0.9921	0.6109
11.85	3.44	185.6	0.9881	0.6045
14.95	3.87	223.6	0.9843	0.5983
18.85	4.34	258.3	0.9809	0.5927
23.77	4.88	281.8	0.9785	0.5889
29.95	5.47	298.6	0.9768	0.5862
37.75	6.14	309.4	0.9758	0.5844
47.57	6.90	317.8	0.9749	0.5830
59.95	7.74	323.2	0.9744	0.5822
75.95	8.71	327.7	0.9739	0.5814

Machine Deflection

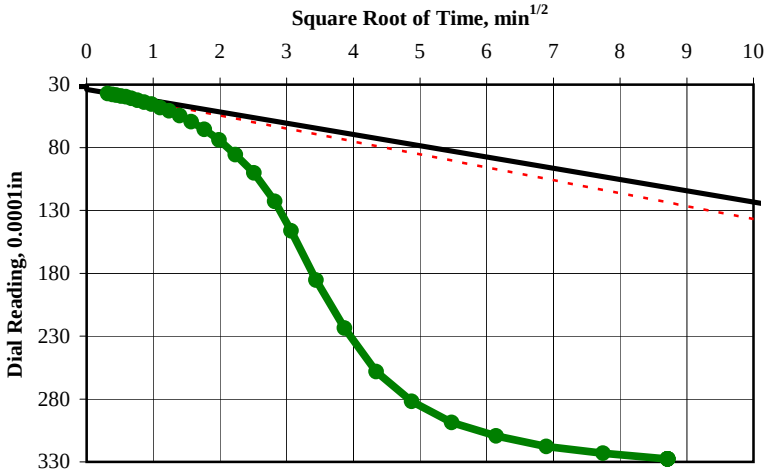
Applied Deflection Correction to Sample Height, 0.0001in -4.5

**Correction is applied to all dial readings.*

Log of Elapsed Time vs. Dial Reading



Square Root of Elapsed Time vs. Dial Reading



Sqrt. of Elapsed Time vs Dial Reading

T0 = 0 min.	D0 = 33.8 div.		
T90 = 0.063 min	D90 = 31.5 div.		
T100 = NA min	D100 = 31.3 div.		
Height at: D90 = 1.0036, D100 = 1.0036			
Average Sample Height, in	0.9901		
Average Drainage Height, in	0.4950		
T (Time Factor for T90)	0.848		
Coef. of Consol., C_v, in^2/min	3.265		

Log of Elapsed Time vs Dial Reading

T0 = 0 min.	D0 = 33.8 div.		
T50 = 10.73 min.	D50 = 168.7 div.		
T100 = 23.72 min.	D100 = 303.5 div.		
Height at: D50 = 0.9898, D100 = 0.9764			
Average Sample Height, in	0.9901		
Average Drainage Height, in	0.4950		
T (Time Factor for T50)	0.197		
Coef. of Consol., C_v, in^2/min	0.004		

Load Summary

Initial Sample Height, in	1.0063
Initial Sample Void Ratio	0.6339
Final Sample Height, in	0.9739
Final Sample Void Ratio	0.5814
Incremental Strain, %	3.21%
Loading Duration, min	75.95

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ONE-DIMENSIONAL CONSOLIDATION PROPERTIES OF SOILS
ASTM D 2435

Client	Civil & Environmental Consultant	Boring	SB-6	**Test Load, tsf**	**0.25-0.5**
Client Project	091-867 Apex Landfill Expansion	Depth	9'-10'		Load 2 of 13
Project No.	30598	Sample	ST-2		
		Lab ID#	30598014		
Visual Description	Grayish Brown Clayey Gravel with Sand				
Test Conditions:	Undisturbed, Inundated, and Double Drained				

Time Vs. Dial Reading

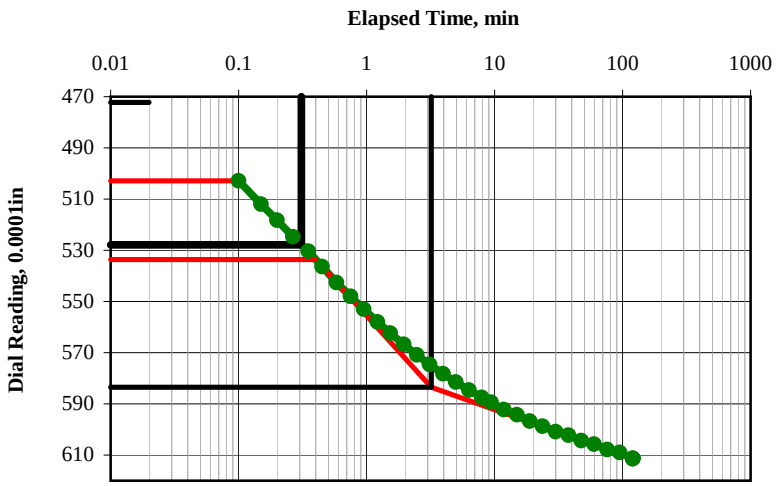
Elapsed Time (min)	Sqrt Time ($min^{1/2}$)	Dial Reading (0.0001in)	Sample Height (in)	Void Ratio
0	0	327.7	0.9739	0.5814
Corrections*		-3	-0.0003	-0.0005
Adjusted Sample Height & Void Ratio				
0.10	0.32	502.9	0.9567	0.5535
0.15	0.39	511.9	0.9558	0.5520
0.20	0.45	518.3	0.9552	0.5510
0.27	0.52	524.7	0.9545	0.5499
0.35	0.59	530.4	0.9540	0.5490
0.45	0.67	536.4	0.9534	0.5480
0.58	0.76	542.6	0.9527	0.5470
0.75	0.87	548.0	0.9522	0.5462
0.95	0.97	553.0	0.9517	0.5453
1.22	1.10	558.1	0.9512	0.5445
1.53	1.24	562.3	0.9508	0.5438
1.95	1.40	566.7	0.9503	0.5431
2.47	1.57	570.8	0.9499	0.5424
3.12	1.77	574.6	0.9495	0.5418
3.95	1.99	578.3	0.9492	0.5412
4.98	2.23	581.5	0.9488	0.5407
6.30	2.51	584.6	0.9485	0.5402
7.95	2.82	587.5	0.9483	0.5397
9.40	3.07	589.4	0.9481	0.5394
11.85	3.44	592.2	0.9478	0.5390
14.95	3.87	594.3	0.9476	0.5386
18.85	4.34	596.8	0.9473	0.5382
23.77	4.88	598.7	0.9471	0.5379
29.95	5.47	600.9	0.9469	0.5376
37.75	6.14	602.3	0.9468	0.5373
47.57	6.90	604.4	0.9466	0.5370
59.95	7.74	605.7	0.9464	0.5368
75.95	8.71	607.8	0.9462	0.5364
94.95	9.74	609.0	0.9461	0.5362
119.95	10.95	611.4	0.9459	0.5358

Machine Deflection

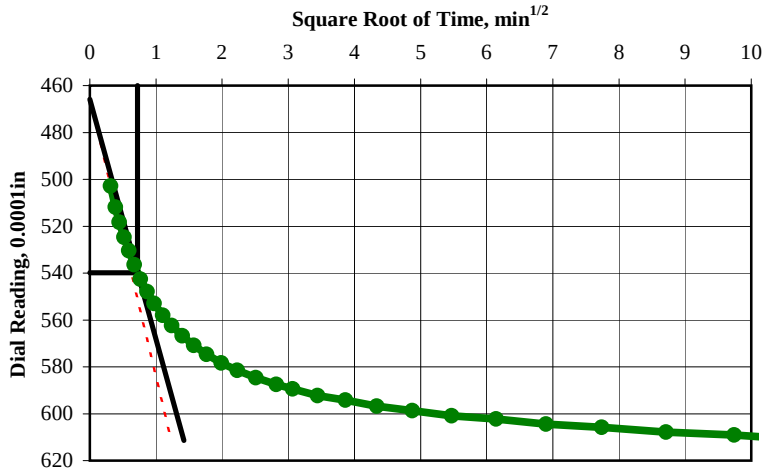
Applied Deflection Correction to Sample Height, 0.0001in -3

**Correction is applied to all dial readings.*

Log of Elapsed Time vs. Dial Reading



Square Root of Elapsed Time vs. Dial Reading



Sqrt. of Elapsed Time vs Dial Reading

T0 = 0 min.	D0 = 465.9 div.
T90 = 0.518 min	D90 = 539.8 div.
T100 = NA min	D100 = 548.1 div.
Height at: D90 = 0.953, D100 = 0.9522	
Average Sample Height, in	0.9599
Average Drainage Height, in	0.4799
T (Time Factor for T90)	0.848
Coef. of Consol., C_v, in^2/min	0.374

Log of Elapsed Time vs Dial Reading

T0 = 0 min.	D0 = 472.2 div.
T50 = 0.31 min.	D50 = 527.9 div.
T100 = 3.21 min.	D100 = 583.6 div.
Height at: D50 = 0.9542, D100 = 0.9486	
Average Sample Height, in	0.9599
Average Drainage Height, in	0.4799
T (Time Factor for T50)	0.197
Coef. of Consol., C_v, in^2/min	0.146

Load Summary

Initial Sample Height, in	0.9739
Initial Sample Void Ratio	0.5814
Final Sample Height, in	0.9459
Final Sample Void Ratio	0.5358
Incremental Strain, %	2.88%
Loading Duration, min	119.95

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ONE-DIMENSIONAL CONSOLIDATION PROPERTIES OF SOILS
ASTM D 2435

Client	Civil & Environmental Consultant	Boring	SB-6	**Test Load, tsf**	**0.5-1**
Client Project	091-867 Apex Landfill Expansion	Depth	9'-10'		Load 3 of 13
Project No.	30598	Sample	ST-2		
		Lab ID#	30598014		
Visual Description	Grayish Brown Clayey Gravel with Sand				
Test Conditions:	Undisturbed, Inundated, and Double Drained				

Time Vs. Dial Reading

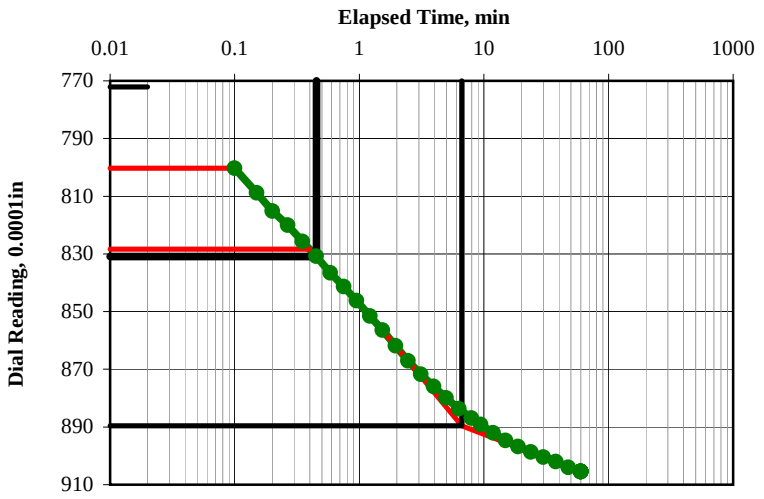
Elapsed Time (min)	Sqrt Time ($min^{1/2}$)	Dial Reading (0.0001in)	Sample Height (in)	Void Ratio
0	0	611.4	0.9459	0.5358
Corrections*		-4	-0.0004	-0.0006
Adjusted Sample Height & Void Ratio				
0.10	0.32	800.3	0.9274	0.5058
0.15	0.39	808.8	0.9265	0.5044
0.20	0.45	815.1	0.9259	0.5034
0.27	0.52	820.1	0.9254	0.5026
0.35	0.59	825.7	0.9248	0.5017
0.45	0.67	830.8	0.9243	0.5009
0.58	0.76	836.6	0.9237	0.4999
0.75	0.87	841.3	0.9233	0.4992
0.95	0.97	846.2	0.9228	0.4984
1.22	1.10	851.5	0.9222	0.4975
1.53	1.24	856.5	0.9218	0.4967
1.95	1.40	861.9	0.9212	0.4958
2.47	1.57	867.1	0.9207	0.4950
3.12	1.77	871.7	0.9202	0.4942
3.95	1.99	876.0	0.9198	0.4935
4.98	2.23	880.0	0.9194	0.4929
6.30	2.51	883.8	0.9190	0.4923
7.95	2.82	887.0	0.9187	0.4918
9.40	3.07	889.1	0.9185	0.4914
11.85	3.44	892.0	0.9182	0.4909
14.95	3.87	894.7	0.9179	0.4905
18.85	4.34	896.8	0.9177	0.4902
23.77	4.88	898.7	0.9175	0.4898
29.95	5.47	900.4	0.9174	0.4896
37.75	6.14	902.0	0.9172	0.4893
47.57	6.90	904.0	0.9170	0.4890
59.95	7.74	905.4	0.9169	0.4888

Machine Deflection

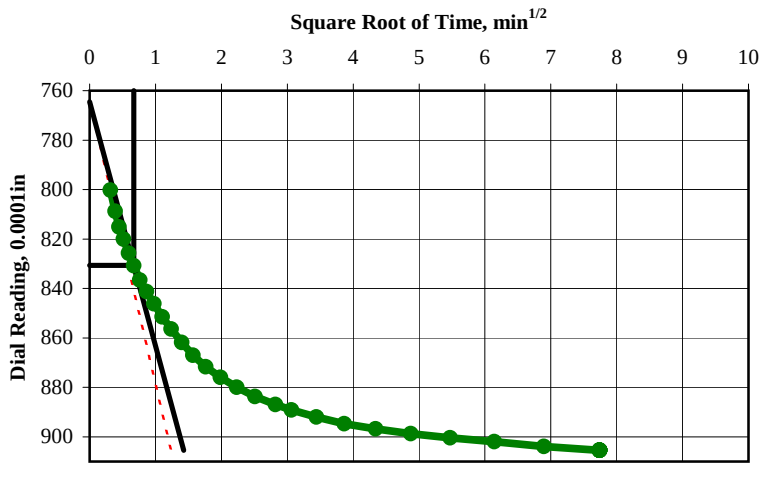
Applied Deflection Correction to Sample Height, 0.0001in -4

**Correction is applied to all dial readings.*

Log of Elapsed Time vs. Dial Reading



Square Root of Elapsed Time vs. Dial Reading



Sqrt. of Elapsed Time vs Dial Reading

T0 = 0 min.	D0 = 764.5 div.
T90 = 0.449 min	D90 = 830.7 div.
T100 = NA min	D100 = 838.1 div.
Height at: D90 = 0.9243, D100 = 0.9236	
Average Sample Height, in	0.9314
Average Drainage Height, in	0.4657
T (Time Factor for T90)	0.848
Coef. of Consol., C_v, in^2/min	0.409

Log of Elapsed Time vs Dial Reading

T0 = 0 min.	D0 = 772.2 div.
T50 = 0.45 min.	D50 = 830.9 div.
T100 = 6.63 min.	D100 = 889.6 div.
Height at: D50 = 0.9243, D100 = 0.9184	
Average Sample Height, in	0.9314
Average Drainage Height, in	0.4657
T (Time Factor for T50)	0.197
Coef. of Consol., C_v, in^2/min	0.095

Load Summary

Initial Sample Height, in	0.9459
Initial Sample Void Ratio	0.5358
Final Sample Height, in	0.9169
Final Sample Void Ratio	0.4888
Incremental Strain, %	3.07%
Loading Duration, min	59.95

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ONE-DIMENSIONAL CONSOLIDATION PROPERTIES OF SOILS
ASTM D 2435

Client	Civil & Environmental Consultant	Boring	SB-6	**Test Load, tsf**	**1-2**
Client Project	091-867 Apex Landfill Expansion	Depth	9'-10'		Load 4 of 13
Project No.	30598	Sample	ST-2		
		Lab ID#	30598014		
Visual Description	Grayish Brown Clayey Gravel with Sand				
Test Conditions:	Undisturbed, Inundated, and Double Drained				

Time Vs. Dial Reading

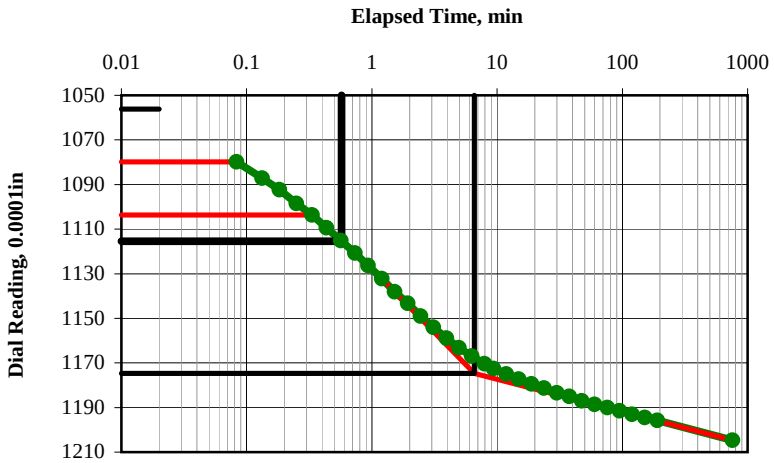
Elapsed Time (min)	Sqrt Time ($min^{1/2}$)	Dial Reading (0.0001in)	Sample Height (in)	Void Ratio
0	0	905.4	0.9169	0.4888
Corrections*		-6	-0.0006	-0.001
Adjusted Sample Height & Void Ratio				
0.08	0.29	1079.9	0.9000	0.4614
0.13	0.37	1087.2	0.8993	0.4602
0.18	0.43	1092.3	0.8988	0.4594
0.25	0.50	1098.5	0.8981	0.4584
0.33	0.58	1103.7	0.8976	0.4575
0.43	0.66	1109.3	0.8971	0.4566
0.57	0.75	1115.2	0.8965	0.4557
0.73	0.86	1120.7	0.8959	0.4548
0.93	0.97	1126.3	0.8954	0.4539
1.20	1.10	1132.3	0.8948	0.4529
1.52	1.23	1138.1	0.8942	0.4520
1.93	1.39	1143.3	0.8937	0.4511
2.45	1.57	1149.1	0.8931	0.4502
3.10	1.76	1154.1	0.8926	0.4494
3.93	1.98	1158.9	0.8921	0.4486
4.97	2.23	1163.2	0.8917	0.4479
6.28	2.51	1166.9	0.8913	0.4473
7.93	2.82	1170.4	0.8910	0.4467
9.38	3.06	1172.6	0.8907	0.4464
11.83	3.44	1175.0	0.8905	0.4460
14.93	3.86	1177.3	0.8903	0.4456
18.83	4.34	1179.5	0.8901	0.4452
23.75	4.87	1181.3	0.8899	0.4449
29.93	5.47	1183.4	0.8897	0.4446
37.73	6.14	1185.1	0.8895	0.4443
47.55	6.90	1187.1	0.8893	0.4440
59.93	7.74	1188.7	0.8891	0.4437
75.93	8.71	1190.1	0.8890	0.4435
94.93	9.74	1191.5	0.8888	0.4433
119.93	10.95	1193.0	0.8887	0.4430
150.93	12.29	1194.4	0.8886	0.4428
189.93	13.78	1195.8	0.8884	0.4426
757.93	27.53	1204.7	0.8875	0.4411

Machine Deflection

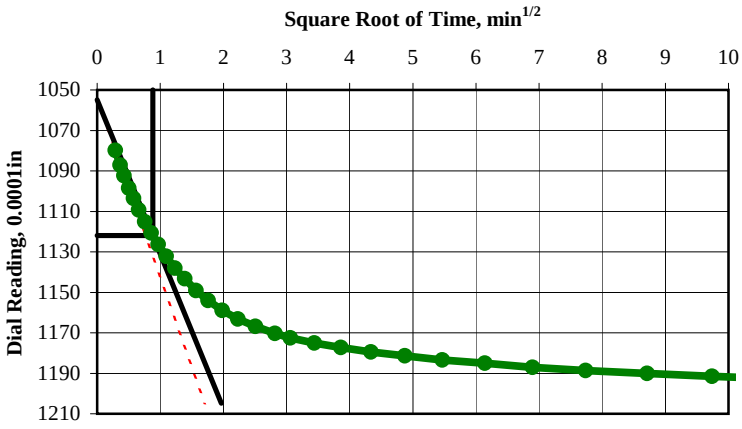
Applied Deflection Correction to Sample Height, 0.0001in -6

**Correction is applied to all dial readings.*

Log of Elapsed Time vs. Dial Reading



Square Root of Elapsed Time vs. Dial Reading



Sqrt. of Elapsed Time vs Dial Reading

T0 = 0 min.	D0 = 1054.8 div.		
T90 = 0.774 min	D90 = 1122 div.		
T100 = NA min	D100 = 1129.4 div.		
Height at: D90 = 0.8958, D100 = 0.8951			
Average Sample Height, in	0.9022		
Average Drainage Height, in	0.4511		
T (Time Factor for T90)	0.848		
Coef. of Consol., C_v, in^2/min	0.222		

Log of Elapsed Time vs Dial Reading

T0 = 0 min.	D0 = 1056.1 div.		
T50 = 0.57 min.	D50 = 1115.4 div.		
T100 = 6.6 min.	D100 = 1174.7 div.		
Height at: D50 = 0.8965, D100 = 0.8905			
Average Sample Height, in	0.9022		
Average Drainage Height, in	0.4511		
T (Time Factor for T50)	0.197		
Coef. of Consol., C_v, in^2/min	0.070		

Load Summary

Initial Sample Height, in	0.9169
Initial Sample Void Ratio	0.4888
Final Sample Height, in	0.8875
Final Sample Void Ratio	0.4411
Incremental Strain, %	3.20%
Loading Duration, min	757.93333

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ONE-DIMENSIONAL CONSOLIDATION PROPERTIES OF SOILS
ASTM D 2435

Client	Civil & Environmental Consultant	Boring	SB-6	**Test Load, tsf**	**2-4**
Client Project	091-867 Apex Landfill Expansion	Depth	9'-10'		Load 5 of 13
Project No.	30598	Sample	ST-2		
		Lab ID#	30598014		
Visual Description	Grayish Brown Clayey Gravel with Sand				
Test Conditions:	Undisturbed, Inundated, and Double Drained				

Time Vs. Dial Reading

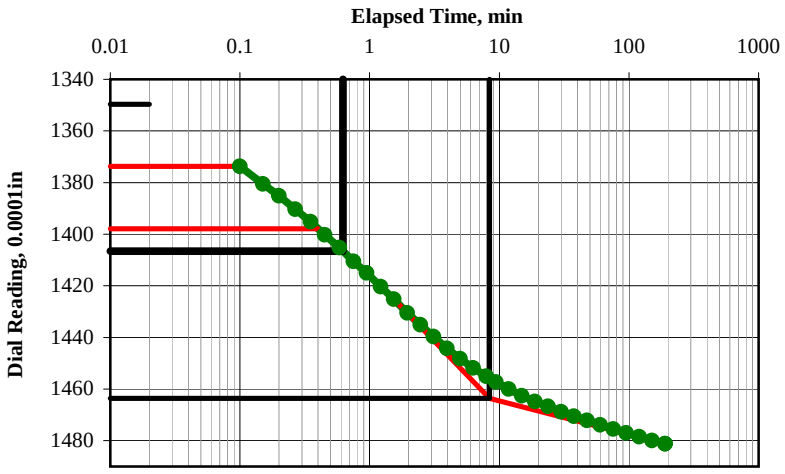
Elapsed Time (min)	Sqrt Time ($min^{1/2}$)	Dial Reading (0.0001in)	Sample Height (in)	Void Ratio
0	0	1204.7	0.8875	0.4411
Corrections*		-8.5	-0.00085	-0.0014
Adjusted Sample Height & Void Ratio				
0.10	0.32	1373.8	0.8715	0.4151
0.15	0.39	1380.5	0.8708	0.4140
0.20	0.45	1385.1	0.8703	0.4132
0.27	0.52	1390.3	0.8698	0.4124
0.35	0.59	1395.1	0.8693	0.4116
0.45	0.67	1400.3	0.8688	0.4108
0.58	0.76	1405.2	0.8683	0.4100
0.75	0.87	1410.5	0.8678	0.4091
0.95	0.97	1415.0	0.8673	0.4084
1.22	1.10	1420.3	0.8668	0.4075
1.53	1.24	1425.1	0.8663	0.4067
1.95	1.40	1430.6	0.8658	0.4058
2.47	1.57	1435.1	0.8653	0.4051
3.12	1.77	1439.7	0.8649	0.4044
3.95	1.99	1444.3	0.8644	0.4036
4.98	2.23	1448.2	0.8640	0.4030
6.30	2.51	1451.9	0.8637	0.4024
7.95	2.82	1455.1	0.8633	0.4019
9.40	3.07	1457.3	0.8631	0.4015
11.85	3.44	1460.0	0.8629	0.4011
14.95	3.87	1462.6	0.8626	0.4006
18.85	4.34	1464.8	0.8624	0.4003
23.77	4.88	1466.7	0.8622	0.4000
29.95	5.47	1468.8	0.8620	0.3996
37.75	6.14	1470.6	0.8618	0.3993
47.57	6.90	1472.1	0.8616	0.3991
59.95	7.74	1473.8	0.8615	0.3988
75.95	8.71	1475.5	0.8613	0.3986
94.95	9.74	1477.0	0.8611	0.3983
119.95	10.95	1478.5	0.8610	0.3981
150.95	12.29	1480.0	0.8609	0.3978
189.95	13.78	1481.1	0.8607	0.3976

Machine Deflection

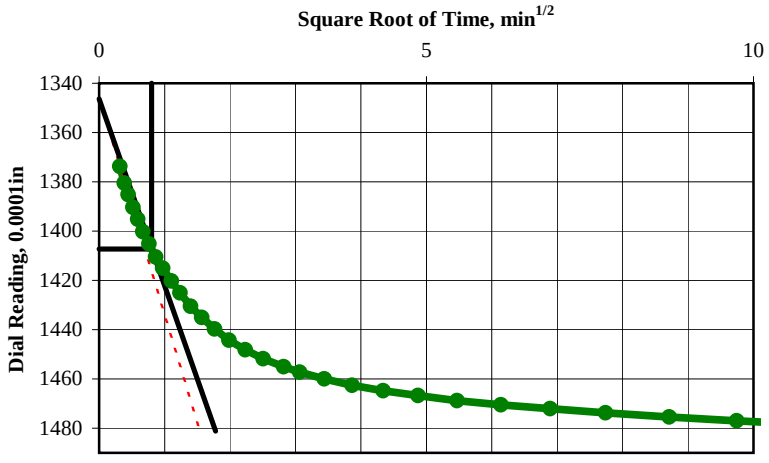
Applied Deflection Correction to Sample Height, 0.0001in -8.5

**Correction is applied to all dial readings.*

Log of Elapsed Time vs. Dial Reading



Square Root of Elapsed Time vs. Dial Reading



Sqrt. of Elapsed Time vs Dial Reading

T0 = 0 min.	D0 = 1346.4 div.
T90 = 0.64 min	D90 = 1407.3 div.
T100 = NA min	D100 = 1414 div.
Height at: D90 = 0.8681, D100 = 0.8674	
Average Sample Height, in	0.8741
Average Drainage Height, in	0.4371
T (Time Factor for T90)	0.848
Coef. of Consol., C_v, in^2/min	0.251

Log of Elapsed Time vs Dial Reading

T0 = 0 min.	D0 = 1349.6 div.
T50 = 0.62 min.	D50 = 1406.6 div.
T100 = 8.42 min.	D100 = 1463.6 div.
Height at: D50 = 0.8682, D100 = 0.8625	
Average Sample Height, in	0.8741
Average Drainage Height, in	0.4371
T (Time Factor for T50)	0.197
Coef. of Consol., C_v, in^2/min	0.061

Load Summary

Initial Sample Height, in	0.8875
Initial Sample Void Ratio	0.4411
Final Sample Height, in	0.8607
Final Sample Void Ratio	0.3976
Incremental Strain, %	3.02%
Loading Duration, min	189.95

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ONE-DIMENSIONAL CONSOLIDATION PROPERTIES OF SOILS
ASTM D 2435

Client	Civil & Environmental Consultant	Boring	SB-6	**Test Load, tsf**	**4-1**
Client Project	091-867 Apex Landfill Expansion	Depth	9'-10'		Load 6 of 13
Project No.	30598	Sample	ST-2		
		Lab ID#	30598014		
Visual Description	Grayish Brown Clayey Gravel with Sand				
Test Conditions:	Undisturbed, Inundated, and Double Drained				

Time Vs. Dial Reading

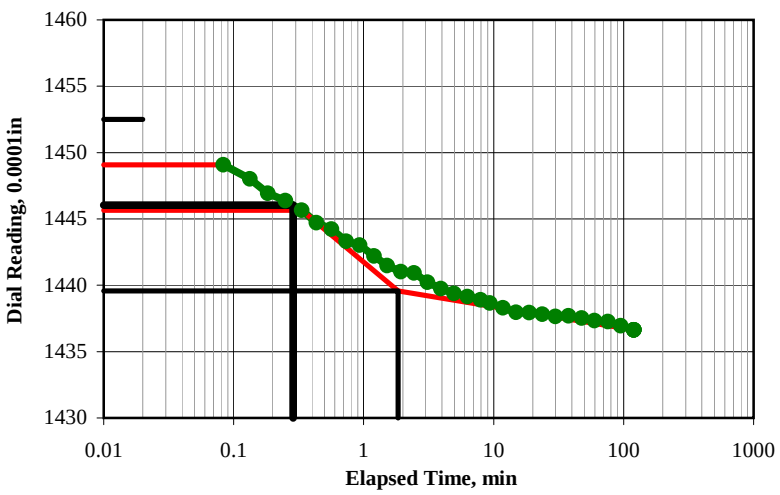
Elapsed Time (min)	Sqrt Time ($min^{1/2}$)	Dial Reading (0.0001in)	Sample Height (in)	Void Ratio
0	0	1481.1	0.8607	0.3976
Corrections*		9.5	0.00095	0.00154
Adjusted Sample Height & Void Ratio				
0.08	0.29	1449.1	0.8630	0.4013
0.13	0.37	1448.0	0.8631	0.4015
0.18	0.43	1446.9	0.8632	0.4016
0.25	0.50	1446.4	0.8633	0.4017
0.33	0.58	1445.6	0.8633	0.4019
0.43	0.66	1444.7	0.8634	0.4020
0.57	0.75	1444.2	0.8635	0.4021
0.73	0.86	1443.3	0.8636	0.4022
0.93	0.97	1443.0	0.8636	0.4023
1.20	1.10	1442.2	0.8637	0.4024
1.52	1.23	1441.5	0.8638	0.4025
1.93	1.39	1441.0	0.8638	0.4026
2.45	1.57	1440.9	0.8638	0.4026
3.10	1.76	1440.2	0.8639	0.4027
3.93	1.98	1439.8	0.8639	0.4028
4.97	2.23	1439.4	0.8640	0.4029
6.28	2.51	1439.1	0.8640	0.4029
7.93	2.82	1438.9	0.8640	0.4029
9.38	3.06	1438.6	0.8640	0.4030
11.83	3.44	1438.3	0.8641	0.4030
14.93	3.86	1438.0	0.8641	0.4031
18.83	4.34	1437.9	0.8641	0.4031
23.75	4.87	1437.8	0.8641	0.4031
29.93	5.47	1437.6	0.8641	0.4031
37.73	6.14	1437.7	0.8641	0.4031
47.55	6.90	1437.5	0.8641	0.4032
59.93	7.74	1437.3	0.8642	0.4032
75.93	8.71	1437.3	0.8642	0.4032
94.93	9.74	1436.9	0.8642	0.4033
119.93	10.95	1436.6	0.8642	0.4033

Machine Deflection

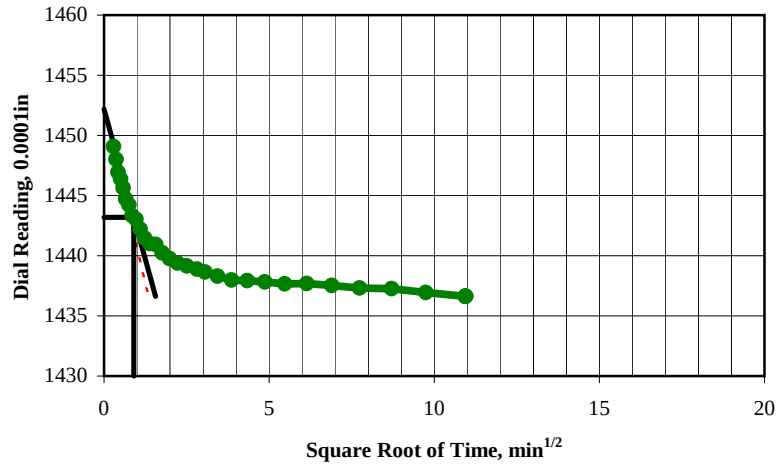
Applied Deflection Correction to Sample Height, 0.0001in 9.5

**Correction is applied to all dial readings.*

Log of Elapsed Time vs. Dial Reading



Square Root of Elapsed Time vs. Dial Reading



Sqrt. of Elapsed Time vs Dial Reading

T0 = 0 min.	D0 = 1452.2 div.		
T90 = 0.81 min	D90 = 1443.2 div.		
T100 = NA min	D100 = 1442.2 div.		
Height at: D90 = 0.8636, D100 = 0.8637			
Average Sample Height, in	0.8625		
Average Drainage Height, in	0.4312		
T (Time Factor for T90)	0.848		
Coef. of Consol., C_v, in^2/min	0.195		

Log of Elapsed Time vs Dial Reading

T0 = 0 min.	D0 = 1452.5 div.		
T50 = 0.29 min.	D50 = 1446 div.		
T100 = 1.84 min.	D100 = 1439.6 div.		
Height at: D50 = 0.8633, D100 = 0.8639			
Average Sample Height, in	0.8625		
Average Drainage Height, in	0.4312		
T (Time Factor for T50)	0.197		
Coef. of Consol., C_v, in^2/min	0.126		

Load Summary

Initial Sample Height, in	0.8607
Initial Sample Void Ratio	0.3976
Final Sample Height, in	0.8642
Final Sample Void Ratio	0.4033
Incremental Strain, %	-0.41%
Loading Duration, min	119.93333

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ONE-DIMENSIONAL CONSOLIDATION PROPERTIES OF SOILS
ASTM D 2435

Client	Civil & Environmental Consultant	Boring	SB-6	**Test Load, tsf**	**1-0.25**
Client Project	091-867 Apex Landfill Expansion	Depth	9'-10'		Load 7 of 13
Project No.	30598	Sample	ST-2		
		Lab ID#	30598014		
Visual Description	Grayish Brown Clayey Gravel with Sand				
Test Conditions:	Undisturbed, Inundated, and Double Drained				

Time Vs. Dial Reading

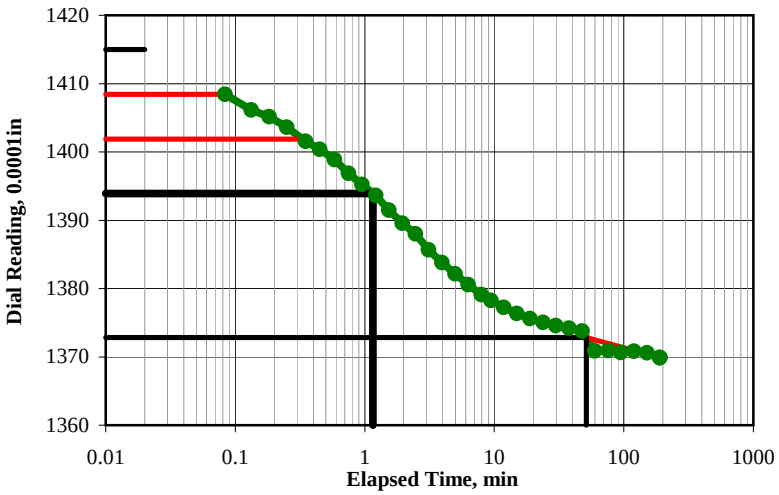
Elapsed Time (min)	Sqrt Time ($min^{1/2}$)	Dial Reading (0.0001in)	Sample Height (in)	Void Ratio
0	0	1436.6	0.8642	0.4033
Corrections*		5.5	0.00055	0.00089
Adjusted Sample Height & Void Ratio				
0.08	0.29	1408.4	0.8665	0.4070
0.13	0.37	1406.1	0.8667	0.4074
0.18	0.43	1405.2	0.8668	0.4075
0.25	0.50	1403.6	0.8670	0.4078
0.35	0.59	1401.6	0.8672	0.4081
0.45	0.67	1400.4	0.8673	0.4083
0.58	0.76	1398.9	0.8675	0.4086
0.75	0.87	1396.8	0.8677	0.4089
0.95	0.97	1395.2	0.8678	0.4091
1.22	1.10	1393.6	0.8680	0.4094
1.53	1.24	1391.5	0.8682	0.4098
1.95	1.40	1389.5	0.8684	0.4101
2.47	1.57	1388.0	0.8685	0.4103
3.12	1.77	1385.7	0.8688	0.4107
3.95	1.99	1383.8	0.8690	0.4110
4.98	2.23	1382.1	0.8691	0.4113
6.30	2.51	1380.6	0.8693	0.4115
7.95	2.82	1379.1	0.8694	0.4118
9.40	3.07	1378.3	0.8695	0.4119
11.85	3.44	1377.2	0.8696	0.4121
14.95	3.87	1376.4	0.8697	0.4122
18.85	4.34	1375.6	0.8698	0.4123
23.77	4.88	1375.0	0.8698	0.4124
29.95	5.47	1374.6	0.8699	0.4125
37.75	6.14	1374.2	0.8699	0.4126
47.57	6.90	1373.8	0.8700	0.4126
59.95	7.74	1370.9	0.8703	0.4131
75.95	8.71	1370.9	0.8703	0.4131
94.95	9.74	1370.6	0.8703	0.4131
119.95	10.95	1370.8	0.8703	0.4131
150.95	12.29	1370.6	0.8703	0.4131
189.95	13.78	1369.9	0.8704	0.4133

Machine Deflection

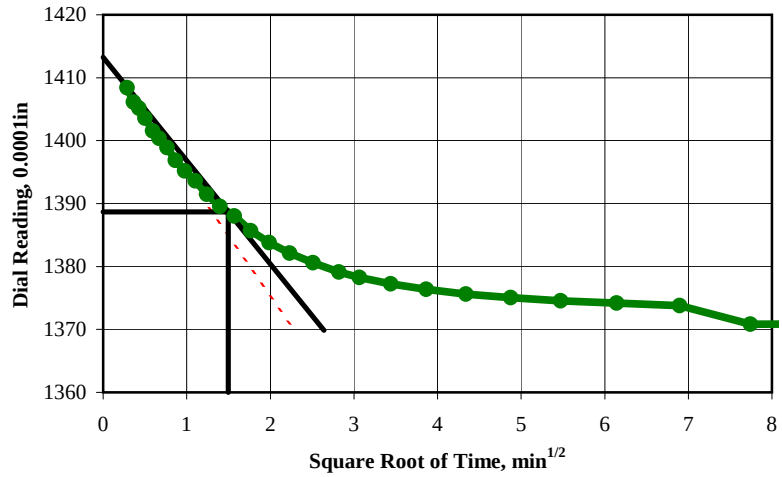
Applied Deflection Correction to Sample Height, 0.0001in 5.5

**Correction is applied to all dial readings.*

Log of Elapsed Time vs. Dial Reading



Square Root of Elapsed Time vs. Dial Reading



Sqrt. of Elapsed Time vs Dial Reading		Log of Elapsed Time vs Dial Reading		Load Summary	
T0 = 0 min.	D0 = 1413.2 div.	T0 = 0 min.	D0 = 1415 div.		
T90 = 2.25 min	D90 = 1388.7 div.	T50 = 1.16 min.	D50 = 1393.9 div.	Initial Sample Height, in	0.8642
T100 = NA min	D100 = 1385.9 div.	T100 = 51.21 min.	D100 = 1372.9 div.	Initial Sample Void Ratio	0.4033
Height at: D90 = 0.8685, D100 = 0.8688		Height at: D50 = 0.868, D100 = 0.8701		Final Sample Height, in	0.8704
Average Sample Height, in	0.8673	Average Sample Height, in	0.8673	Final Sample Void Ratio	0.4133
Average Drainage Height, in	0.4337	Average Drainage Height, in	0.4337	Incremental Strain, %	-0.71%
T (Time Factor for T90)	0.848	T (Time Factor for T50)	0.197	Loading Duration, min	189.95
Coef. of Consol., C_v, in^2/min	0.071	Coef. of Consol., C_v, in^2/min	0.032		

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ONE-DIMENSIONAL CONSOLIDATION PROPERTIES OF SOILS
ASTM D 2435

Client	Civil & Environmental Consultant	Boring	SB-6	**Test Load, tsf**	**0.25-0.5**
Client Project	091-867 Apex Landfill Expansion	Depth	9'-10'		Load 8 of 13
Project No.	30598	Sample	ST-2		
		Lab ID#	30598014		
Visual Description	Grayish Brown Clayey Gravel with Sand				
Test Conditions:	Undisturbed, Inundated, and Double Drained				

Time Vs. Dial Reading

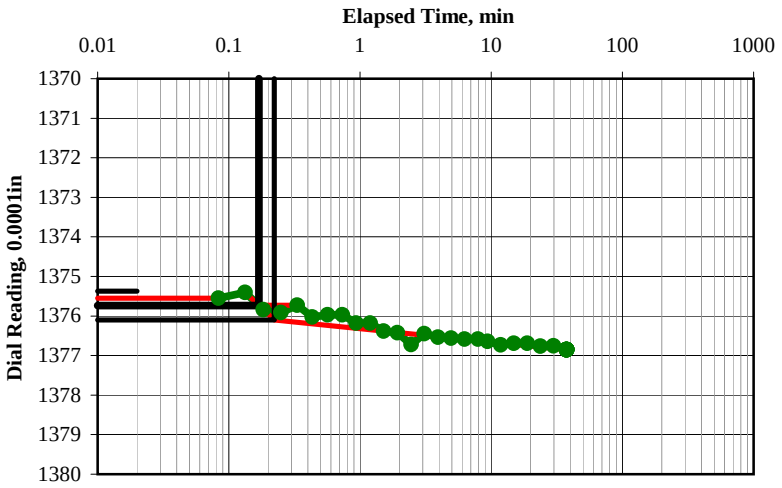
Elapsed Time (min)	Sqrt Time ($min^{1/2}$)	Dial Reading (0.0001in)	Sample Height (in)	Void Ratio
0	0	1369.9	0.8704	0.4133
Corrections*		-1.5	-0.00015	-0.0002
Adjusted Sample Height & Void Ratio				
0.08	0.29	1375.5	0.8699	0.4126
0.13	0.37	1375.4	0.8700	0.4126
0.18	0.43	1375.8	0.8699	0.4125
0.25	0.50	1375.9	0.8699	0.4125
0.33	0.58	1375.7	0.8699	0.4126
0.43	0.66	1376.0	0.8699	0.4125
0.57	0.75	1376.0	0.8699	0.4125
0.73	0.86	1376.0	0.8699	0.4125
0.93	0.97	1376.2	0.8699	0.4125
1.20	1.10	1376.2	0.8699	0.4125
1.52	1.23	1376.4	0.8699	0.4124
1.93	1.39	1376.4	0.8699	0.4124
2.45	1.57	1376.7	0.8698	0.4124
3.10	1.76	1376.4	0.8699	0.4124
3.93	1.98	1376.5	0.8698	0.4124
4.97	2.23	1376.6	0.8698	0.4124
6.28	2.51	1376.6	0.8698	0.4124
7.93	2.82	1376.6	0.8698	0.4124
9.38	3.06	1376.6	0.8698	0.4124
11.83	3.44	1376.7	0.8698	0.4124
14.93	3.86	1376.7	0.8698	0.4124
18.83	4.34	1376.7	0.8698	0.4124
23.75	4.87	1376.8	0.8698	0.4124
29.93	5.47	1376.8	0.8698	0.4124
37.73	6.14	1376.9	0.8698	0.4124

Machine Deflection

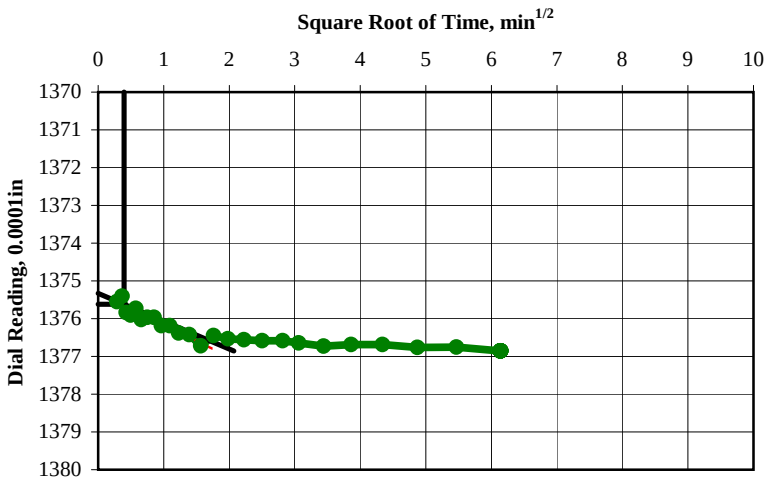
Applied Deflection Correction to Sample Height, 0.0001in -1.5

**Correction is applied to all dial readings.*

Log of Elapsed Time vs. Dial Reading



Square Root of Elapsed Time vs. Dial Reading



Sqrt. of Elapsed Time vs Dial Reading

T0 = 0 min.	D0 = 1375.3 div.		
T90 = 0.16 min	D90 = 1375.6 div.		
T100 = NA min	D100 = 1375.7 div.		
Height at: D90 = 0.8699, D100 = 0.8699			
Average Sample Height, in	0.8701		
Average Drainage Height, in	0.4350		
T (Time Factor for T90)	0.848		
Coef. of Consol., C_v, in^2/min	1.023		

Log of Elapsed Time vs Dial Reading

T0 = 0 min.	D0 = 1375.4 div.		
T50 = 0.17 min.	D50 = 1375.7 div.		
T100 = 0.22 min.	D100 = 1376.1 div.		
Height at: D50 = 0.8699, D100 = 0.8699			
Average Sample Height, in	0.8701		
Average Drainage Height, in	0.4350		
T (Time Factor for T50)	0.197		
Coef. of Consol., C_v, in^2/min	0.219		

Load Summary

Initial Sample Height, in	0.8704
Initial Sample Void Ratio	0.4133
Final Sample Height, in	0.8698
Final Sample Void Ratio	0.4124
Incremental Strain, %	0.06%
Loading Duration, min	37.733333

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ONE-DIMENSIONAL CONSOLIDATION PROPERTIES OF SOILS
ASTM D 2435

Client	Civil & Environmental Consultant	Boring	SB-6	**Test Load, tsf**	**0.5-1**
Client Project	091-867 Apex Landfill Expansion	Depth	9'-10'		Load 9 of 13
Project No.	30598	Sample	ST-2		
		Lab ID#	30598014		
Visual Description	Grayish Brown Clayey Gravel with Sand				
Test Conditions:	Undisturbed, Inundated, and Double Drained				

Time Vs. Dial Reading

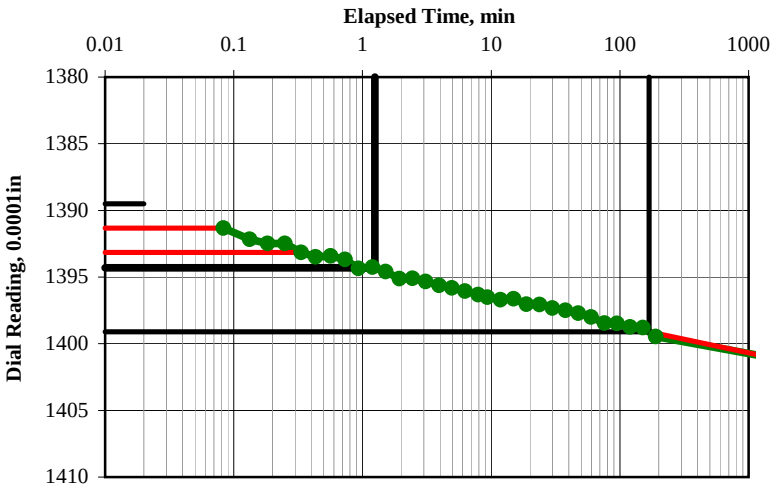
Elapsed Time (min)	Sqrt Time ($min^{1/2}$)	Dial Reading (0.0001in)	Sample Height (in)	Void Ratio
0	0	1376.9	0.8698	0.4124
Corrections*		-3	-0.0003	-0.0005
Adjusted Sample Height & Void Ratio				
0.08	0.29	1391.3	0.8687	0.4105
0.13	0.37	1392.2	0.8686	0.4104
0.18	0.43	1392.5	0.8686	0.4103
0.25	0.50	1392.5	0.8686	0.4103
0.33	0.58	1393.1	0.8685	0.4102
0.43	0.66	1393.5	0.8685	0.4102
0.57	0.75	1393.4	0.8685	0.4102
0.73	0.86	1393.7	0.8684	0.4101
0.93	0.97	1394.3	0.8684	0.4100
1.20	1.10	1394.3	0.8684	0.4100
1.52	1.23	1394.6	0.8683	0.4100
1.93	1.39	1395.1	0.8683	0.4099
2.45	1.57	1395.1	0.8683	0.4099
3.10	1.76	1395.3	0.8683	0.4099
3.93	1.98	1395.6	0.8682	0.4098
4.97	2.23	1395.8	0.8682	0.4098
6.28	2.51	1396.1	0.8682	0.4097
7.93	2.82	1396.3	0.8682	0.4097
9.38	3.06	1396.5	0.8681	0.4097
11.83	3.44	1396.7	0.8681	0.4096
14.93	3.86	1396.6	0.8681	0.4096
18.83	4.34	1397.0	0.8681	0.4096
23.75	4.87	1397.1	0.8681	0.4096
29.93	5.47	1397.3	0.8681	0.4095
37.73	6.14	1397.5	0.8681	0.4095
47.55	6.90	1397.7	0.8680	0.4095
59.93	7.74	1398.0	0.8680	0.4094
75.93	8.71	1398.5	0.8680	0.4094
94.93	9.74	1398.5	0.8680	0.4093
119.93	10.95	1398.7	0.8679	0.4093
150.93	12.29	1398.8	0.8679	0.4093
189.93	13.78	1399.5	0.8679	0.4092
1513.93	38.91	1401.0	0.8677	0.4089

Machine Deflection

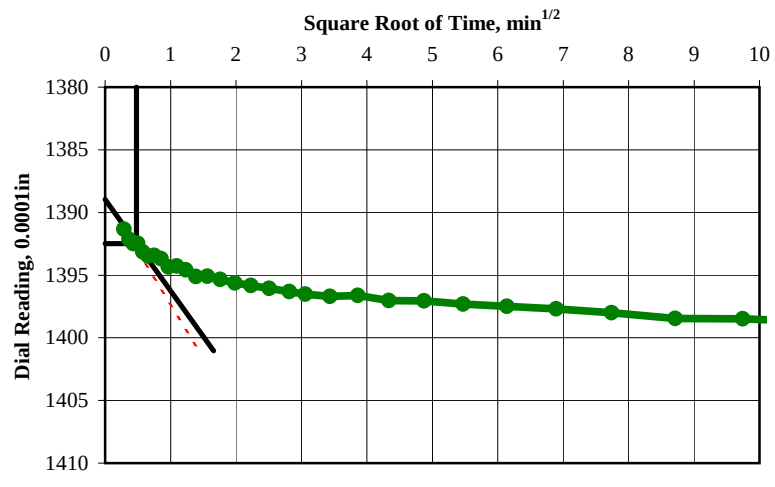
Applied Deflection Correction to Sample Height, 0.0001in -3

**Correction is applied to all dial readings.*

Log of Elapsed Time vs. Dial Reading



Square Root of Elapsed Time vs. Dial Reading



Sqrt. of Elapsed Time vs Dial Reading

T0 = 0 min.	D0 = 1389 div.
T90 = 0.23 min	D90 = 1392.5 div.
T100 = NA min	D100 = 1392.9 div.
Height at: D90 = 0.8686, D100 = 0.8685	
Average Sample Height, in	0.8688
Average Drainage Height, in	0.4344
T (Time Factor for T90)	0.848
Coef. of Consol., C_v, in^2/min	0.692

Log of Elapsed Time vs Dial Reading

T0 = 0 min.	D0 = 1389.5 div.
T50 = 1.25 min.	D50 = 1394.3 div.
T100 = 168.3 min.	D100 = 1399.1 div.
Height at: D50 = 0.8684, D100 = 0.8679	
Average Sample Height, in	0.8688
Average Drainage Height, in	0.4344
T (Time Factor for T50)	0.197
Coef. of Consol., C_v, in^2/min	0.030

Load Summary

Initial Sample Height, in	0.8698
Initial Sample Void Ratio	0.4124
Final Sample Height, in	0.8677
Final Sample Void Ratio	0.4089
Incremental Strain, %	0.24%
Loading Duration, min	1513.9333

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ONE-DIMENSIONAL CONSOLIDATION PROPERTIES OF SOILS
ASTM D 2435

Client	Civil & Environmental Consultant	Boring	SB-6	**Test Load, tsf**	**1-2**
Client Project	091-867 Apex Landfill Expansion	Depth	9'-10'		Load 10 of 13
Project No.	30598	Sample	ST-2		
		Lab ID#	30598014		
Visual Description	Grayish Brown Clayey Gravel with Sand				
Test Conditions:	Undisturbed, Inundated, and Double Drained				

Time Vs. Dial Reading

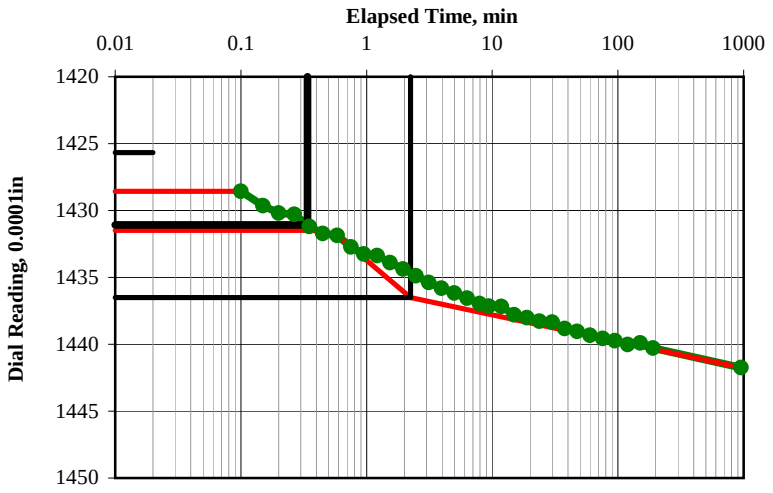
Elapsed Time (min)	Sqrt Time ($min^{1/2}$)	Dial Reading (0.0001in)	Sample Height (in)	Void Ratio
0	0	1401.0	0.8677	0.4089
Corrections*		-4.5	-0.00045	-0.0007
Adjusted Sample Height & Void Ratio				
0.10	0.32	1428.6	0.8654	0.4052
0.15	0.39	1429.6	0.8653	0.4050
0.20	0.45	1430.2	0.8652	0.4049
0.27	0.52	1430.3	0.8652	0.4049
0.35	0.59	1431.2	0.8651	0.4048
0.45	0.67	1431.7	0.8651	0.4047
0.58	0.76	1431.9	0.8651	0.4047
0.75	0.87	1432.7	0.8650	0.4045
0.95	0.97	1433.3	0.8649	0.4044
1.22	1.10	1433.4	0.8649	0.4044
1.53	1.24	1433.9	0.8649	0.4043
1.95	1.40	1434.4	0.8648	0.4042
2.47	1.57	1434.9	0.8648	0.4042
3.12	1.77	1435.4	0.8647	0.4041
3.95	1.99	1435.8	0.8647	0.4040
4.98	2.23	1436.2	0.8646	0.4040
6.30	2.51	1436.5	0.8646	0.4039
7.95	2.82	1437.0	0.8646	0.4038
9.40	3.07	1437.1	0.8645	0.4038
11.85	3.44	1437.2	0.8645	0.4038
14.95	3.87	1437.8	0.8645	0.4037
18.85	4.34	1438.0	0.8644	0.4037
23.77	4.88	1438.3	0.8644	0.4036
29.95	5.47	1438.4	0.8644	0.4036
37.75	6.14	1438.8	0.8644	0.4035
47.57	6.90	1439.0	0.8643	0.4035
59.95	7.74	1439.3	0.8643	0.4034
75.95	8.71	1439.6	0.8643	0.4034
94.95	9.74	1439.7	0.8643	0.4034
119.95	10.95	1440.0	0.8642	0.4033
150.95	12.29	1439.9	0.8643	0.4034
189.95	13.78	1440.3	0.8642	0.4033
954.95	30.90	1441.7	0.8641	0.4031

Machine Deflection

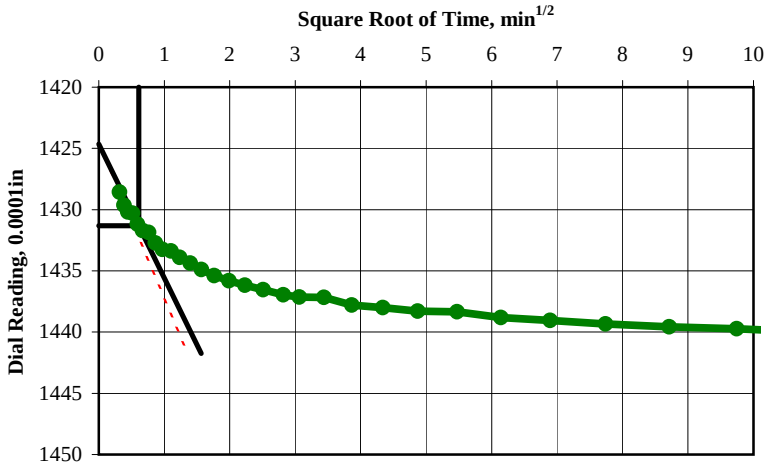
Applied Deflection Correction to Sample Height, 0.0001in -4.5

**Correction is applied to all dial readings.*

Log of Elapsed Time vs. Dial Reading



Square Root of Elapsed Time vs. Dial Reading



Sqrt. of Elapsed Time vs Dial Reading

T0 = 0 min.	D0 = 1424.7 div.		
T90 = 0.372 min	D90 = 1431.3 div.		
T100 = NA min	D100 = 1432.1 div.		
Height at: D90 = 0.8651, D100 = 0.865			
Average Sample Height, in	0.8659		
Average Drainage Height, in	0.4329		
T (Time Factor for T90)	0.848		
Coef. of Consol., C_v, in^2/min	0.426		

Log of Elapsed Time vs Dial Reading

T0 = 0 min.	D0 = 1425.7 div.		
T50 = 0.34 min.	D50 = 1431.1 div.		
T100 = 2.23 min.	D100 = 1436.5 div.		
Height at: D50 = 0.8651, D100 = 0.8646			
Average Sample Height, in	0.8659		
Average Drainage Height, in	0.4329		
T (Time Factor for T50)	0.197		
Coef. of Consol., C_v, in^2/min	0.109		

Load Summary

Initial Sample Height, in	0.8677
Initial Sample Void Ratio	0.4089
Final Sample Height, in	0.8641
Final Sample Void Ratio	0.4031
Incremental Strain, %	0.42%
Loading Duration, min	954.95

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ONE-DIMENSIONAL CONSOLIDATION PROPERTIES OF SOILS
ASTM D 2435

Client	Civil & Environmental Consultant	Boring	SB-6	**Test Load, tsf**	**2-4**
Client Project	091-867 Apex Landfill Expansion	Depth	9'-10'		Load 11 of 13
Project No.	30598	Sample	ST-2		
		Lab ID#	30598014		
Visual Description	Grayish Brown Clayey Gravel with Sand				
Test Conditions:	Undisturbed, Inundated, and Double Drained				

Time Vs. Dial Reading

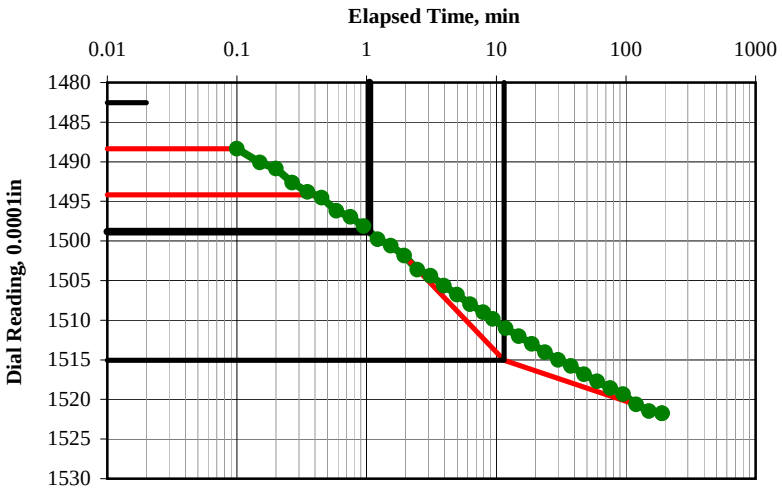
Elapsed Time (min)	Sqrt Time ($min^{1/2}$)	Dial Reading (0.0001in)	Sample Height (in)	Void Ratio
0	0	1441.7	0.8641	0.4031
Corrections*		-6	-0.0006	-0.001
Adjusted Sample Height & Void Ratio				
0.10	0.32	1488.4	0.8600	0.3965
0.15	0.39	1490.1	0.8598	0.3962
0.20	0.45	1490.9	0.8598	0.3961
0.27	0.52	1492.7	0.8596	0.3958
0.35	0.59	1493.8	0.8595	0.3956
0.45	0.67	1494.5	0.8594	0.3955
0.58	0.76	1496.2	0.8592	0.3952
0.75	0.87	1496.9	0.8592	0.3951
0.95	0.97	1498.1	0.8590	0.3949
1.22	1.10	1499.8	0.8589	0.3946
1.53	1.24	1500.6	0.8588	0.3945
1.95	1.40	1501.9	0.8587	0.3943
2.47	1.57	1503.6	0.8585	0.3940
3.12	1.77	1504.4	0.8584	0.3939
3.95	1.99	1505.6	0.8583	0.3937
4.98	2.23	1506.8	0.8582	0.3935
6.30	2.51	1508.0	0.8581	0.3933
7.95	2.82	1509.0	0.8579	0.3931
9.40	3.07	1509.9	0.8579	0.3930
11.85	3.44	1511.0	0.8577	0.3928
14.95	3.87	1512.0	0.8576	0.3926
18.85	4.34	1513.0	0.8575	0.3925
23.77	4.88	1514.0	0.8574	0.3923
29.95	5.47	1515.0	0.8574	0.3921
37.75	6.14	1515.8	0.8573	0.3920
47.57	6.90	1516.8	0.8572	0.3918
59.95	7.74	1517.7	0.8571	0.3917
75.95	8.71	1518.6	0.8570	0.3916
94.95	9.74	1519.3	0.8569	0.3914
119.95	10.95	1520.6	0.8568	0.3912
150.95	12.29	1521.5	0.8567	0.3911
189.95	13.78	1521.8	0.8567	0.3910

Machine Deflection

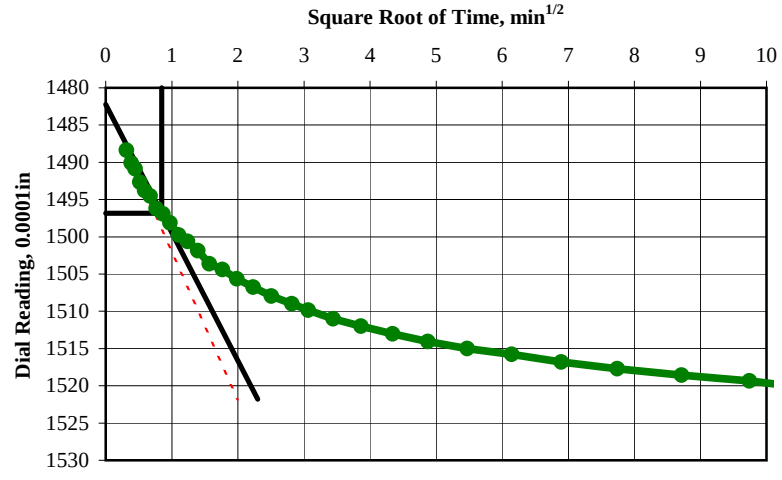
Applied Deflection Correction to Sample Height, 0.0001in -6

**Correction is applied to all dial readings.*

Log of Elapsed Time vs. Dial Reading



Square Root of Elapsed Time vs. Dial Reading



Sqrt. of Elapsed Time vs Dial Reading

T0 = 0 min.	D0 = 1482.2 div.		
T90 = 0.723 min	D90 = 1496.8 div.		
T100 = NA min	D100 = 1498.4 div.		
Height at: D90 = 0.8592, D100 = 0.859			
Average Sample Height, in	0.8604		
Average Drainage Height, in	0.4302		
T (Time Factor for T90)	0.848		
Coef. of Consol., C_v, in^2/min	0.218		

Log of Elapsed Time vs Dial Reading

T0 = 0 min.	D0 = 1482.5 div.		
T50 = 1.05 min.	D50 = 1498.8 div.		
T100 = 11.47 min.	D100 = 1515.1 div.		
Height at: D50 = 0.859, D100 = 0.8573			
Average Sample Height, in	0.8604		
Average Drainage Height, in	0.4302		
T (Time Factor for T50)	0.197		
Coef. of Consol., C_v, in^2/min	0.035		

Load Summary

Initial Sample Height, in	0.8641
Initial Sample Void Ratio	0.4031
Final Sample Height, in	0.8567
Final Sample Void Ratio	0.3910
Incremental Strain, %	0.86%
Loading Duration, min	189.95

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ONE-DIMENSIONAL CONSOLIDATION PROPERTIES OF SOILS
ASTM D 2435

Client	Civil & Environmental Consultant	Boring	SB-6	**Test Load, tsf**	**4-8**
Client Project	091-867 Apex Landfill Expansion	Depth	9'-10'		Load 12 of 13
Project No.	30598	Sample	ST-2		
		Lab ID#	30598014		
Visual Description	Grayish Brown Clayey Gravel with Sand				
Test Conditions:	Undisturbed, Inundated, and Double Drained				

Time Vs. Dial Reading

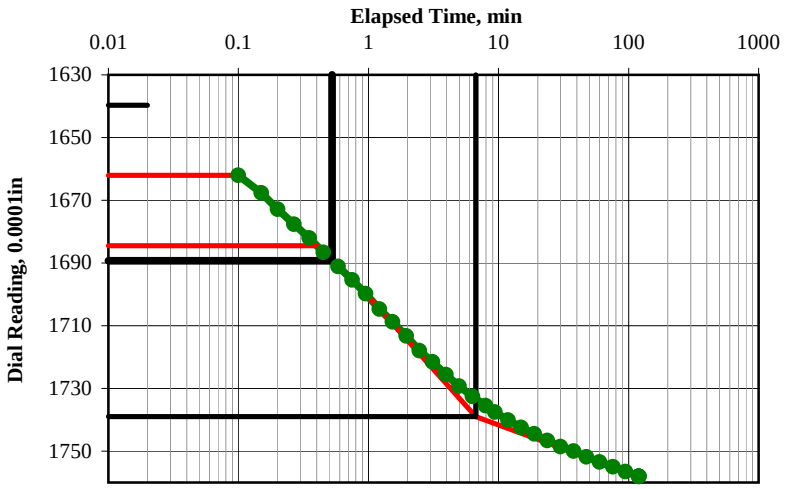
Elapsed Time (min)	Sqrt Time ($min^{1/2}$)	Dial Reading (0.0001in)	Sample Height (in)	Void Ratio
0	0	1521.8	0.8567	0.3910
Corrections*		-11	-0.0011	-0.0018
Adjusted Sample Height & Void Ratio				
0.10	0.32	1662.1	0.8437	0.3700
0.15	0.39	1667.6	0.8432	0.3691
0.20	0.45	1672.8	0.8427	0.3683
0.27	0.52	1677.6	0.8422	0.3675
0.35	0.59	1682.0	0.8417	0.3668
0.45	0.67	1686.6	0.8413	0.3661
0.58	0.76	1691.1	0.8408	0.3653
0.75	0.87	1695.4	0.8404	0.3646
0.95	0.97	1699.8	0.8400	0.3639
1.22	1.10	1704.7	0.8395	0.3631
1.53	1.24	1708.8	0.8391	0.3625
1.95	1.40	1713.2	0.8386	0.3617
2.47	1.57	1718.0	0.8382	0.3610
3.12	1.77	1721.6	0.8378	0.3604
3.95	1.99	1725.6	0.8374	0.3597
4.98	2.23	1729.2	0.8370	0.3591
6.30	2.51	1732.6	0.8367	0.3586
7.95	2.82	1735.5	0.8364	0.3581
9.40	3.07	1737.6	0.8362	0.3578
11.85	3.44	1740.1	0.8359	0.3574
14.95	3.87	1742.4	0.8357	0.3570
18.85	4.34	1744.5	0.8355	0.3566
23.77	4.88	1746.6	0.8353	0.3563
29.95	5.47	1748.5	0.8351	0.3560
37.75	6.14	1750.0	0.8349	0.3558
47.57	6.90	1751.8	0.8348	0.3555
59.95	7.74	1753.5	0.8346	0.3552
75.95	8.71	1755.0	0.8345	0.3550
94.95	9.74	1756.5	0.8343	0.3547
119.95	10.95	1758.0	0.8341	0.3545

Machine Deflection

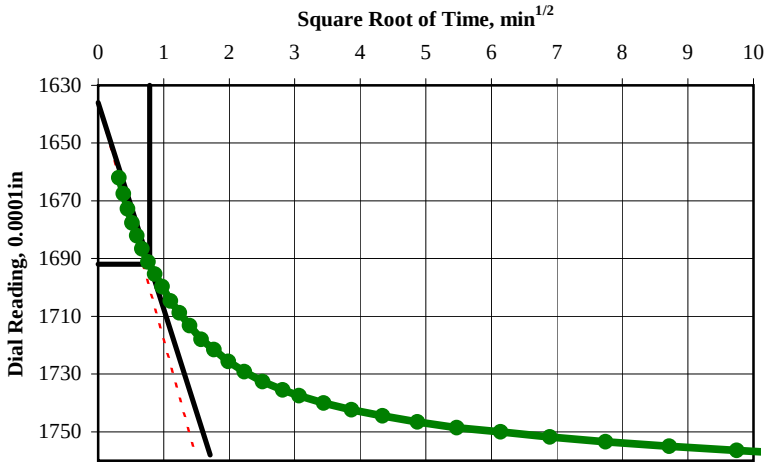
Applied Deflection Correction to Sample Height, 0.0001in -11

**Correction is applied to all dial readings.*

Log of Elapsed Time vs. Dial Reading



Square Root of Elapsed Time vs. Dial Reading



Sqrt. of Elapsed Time vs Dial Reading

T0 = 0 min.	D0 = 1636 div.		
T90 = 0.608 min	D90 = 1692 div.		
T100 = NA min	D100 = 1698.2 div.		
Height at: D90 = 0.8408, D100 = 0.8401			
Average Sample Height, in	0.8454		
Average Drainage Height, in	0.4227		
T (Time Factor for T90)	0.848		
Coef. of Consol., C_v, in^2/min	0.246		

Log of Elapsed Time vs Dial Reading

T0 = 0 min.	D0 = 1639.7 div.		
T50 = 0.53 min.	D50 = 1689.3 div.		
T100 = 6.68 min.	D100 = 1738.9 div.		
Height at: D50 = 0.841, D100 = 0.8361			
Average Sample Height, in	0.8454		
Average Drainage Height, in	0.4227		
T (Time Factor for T50)	0.197		
Coef. of Consol., C_v, in^2/min	0.066		

Load Summary

Initial Sample Height, in	0.8567
Initial Sample Void Ratio	0.3910
Final Sample Height, in	0.8341
Final Sample Void Ratio	0.3545
Incremental Strain, %	2.63%
Loading Duration, min	119.95

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ONE-DIMENSIONAL CONSOLIDATION PROPERTIES OF SOILS
ASTM D 2435

Client	Civil & Environmental Consultant	Boring	SB-6	**Test Load, tsf**	**8-16**
Client Project	091-867 Apex Landfill Expansion	Depth	9'-10'		Load 13 of 13
Project No.	30598	Sample	ST-2		
		Lab ID#	30598014		
Visual Description	Grayish Brown Clayey Gravel with Sand				
Test Conditions:	Undisturbed, Inundated, and Double Drained				

Time Vs. Dial Reading

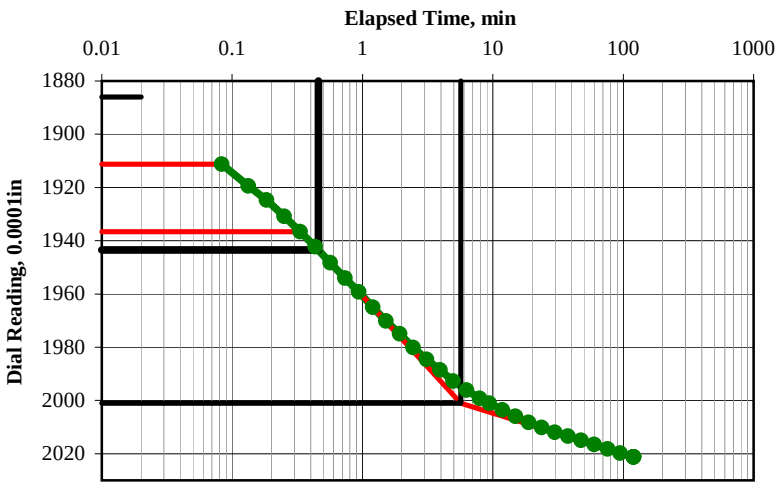
Elapsed Time (min)	Sqrt Time ($min^{1/2}$)	Dial Reading (0.0001in)	Sample Height (in)	Void Ratio
0	0	1758.0	0.8341	0.3545
Corrections*		-16.5	-0.00165	-0.0027
Adjusted Sample Height & Void Ratio				
0.08	0.29	1911.3	0.8205	0.3323
0.13	0.37	1919.4	0.8197	0.3309
0.18	0.43	1924.8	0.8191	0.3301
0.25	0.50	1930.9	0.8185	0.3291
0.33	0.58	1936.6	0.8179	0.3281
0.43	0.66	1942.2	0.8174	0.3272
0.57	0.75	1948.3	0.8168	0.3262
0.73	0.86	1954.0	0.8162	0.3253
0.93	0.97	1959.2	0.8157	0.3245
1.20	1.10	1965.0	0.8151	0.3235
1.52	1.23	1970.2	0.8146	0.3227
1.93	1.39	1975.0	0.8141	0.3219
2.45	1.57	1980.2	0.8136	0.3211
3.10	1.76	1984.6	0.8131	0.3203
3.93	1.98	1988.5	0.8128	0.3197
4.97	2.23	1992.7	0.8123	0.3190
6.28	2.51	1996.1	0.8120	0.3185
7.93	2.82	1999.2	0.8117	0.3180
9.38	3.06	2001.1	0.8115	0.3177
11.83	3.44	2003.5	0.8112	0.3173
14.93	3.86	2006.0	0.8110	0.3169
18.83	4.34	2008.2	0.8108	0.3165
23.75	4.87	2010.2	0.8106	0.3162
29.93	5.47	2012.0	0.8104	0.3159
37.73	6.14	2013.4	0.8103	0.3157
47.55	6.90	2014.9	0.8101	0.3154
59.93	7.74	2016.5	0.8100	0.3152
75.93	8.71	2018.2	0.8098	0.3149
94.93	9.74	2019.8	0.8096	0.3146
119.93	10.95	2021.3	0.8095	0.3144

Machine Deflection

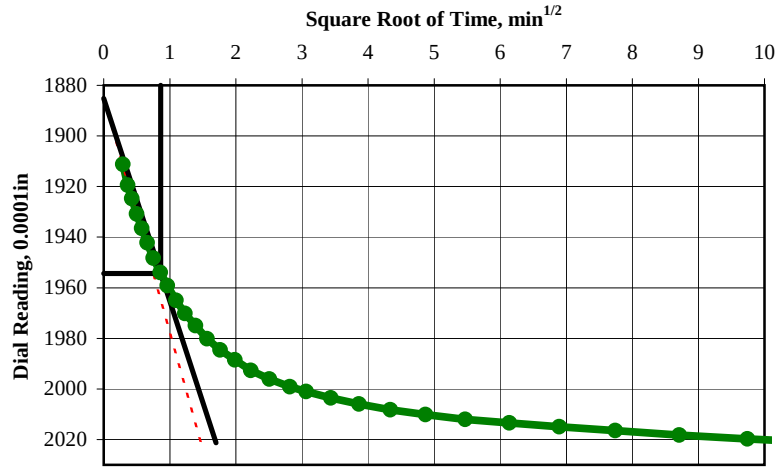
Applied Deflection Correction to Sample Height, 0.0001in -16.5

**Correction is applied to all dial readings.*

Log of Elapsed Time vs. Dial Reading



Square Root of Elapsed Time vs. Dial Reading



Sqrt. of Elapsed Time vs Dial Reading

T0 = 0 min.	D0 = 1885.1 div.
T90 = 0.74 min	D90 = 1954.3 div.
T100 = NA min	D100 = 1962 div.
Height at: D90 = 0.8162, D100 = 0.8154	
Average Sample Height, in	0.8218
Average Drainage Height, in	0.4109
T (Time Factor for T90)	0.848
Coef. of Consol., C_v, in^2/min	0.192

Log of Elapsed Time vs Dial Reading

T0 = 0 min.	D0 = 1886 div.
T50 = 0.46 min.	D50 = 1943.5 div.
T100 = 5.69 min.	D100 = 2001 div.
Height at: D50 = 0.8173, D100 = 0.8115	
Average Sample Height, in	0.8218
Average Drainage Height, in	0.4109
T (Time Factor for T50)	0.197
Coef. of Consol., C_v, in^2/min	0.072

Load Summary

Initial Sample Height, in	0.8341
Initial Sample Void Ratio	0.3545
Final Sample Height, in	0.8095
Final Sample Void Ratio	0.3144
Incremental Strain, %	2.96%
Loading Duration, min	119.93333

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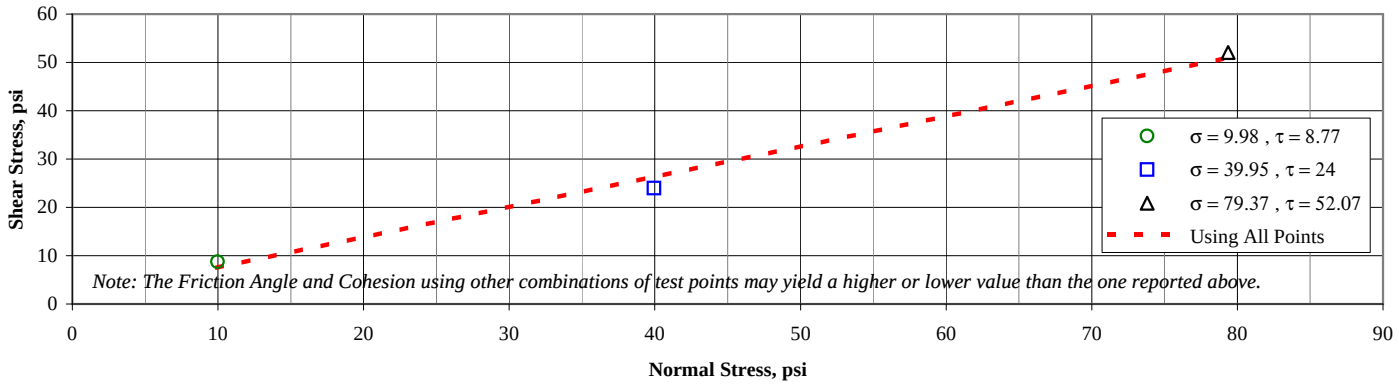
DIRECT SHEAR TEST OF SOILS UNDER CONSOLIDATED DRAINED CONDITIONS

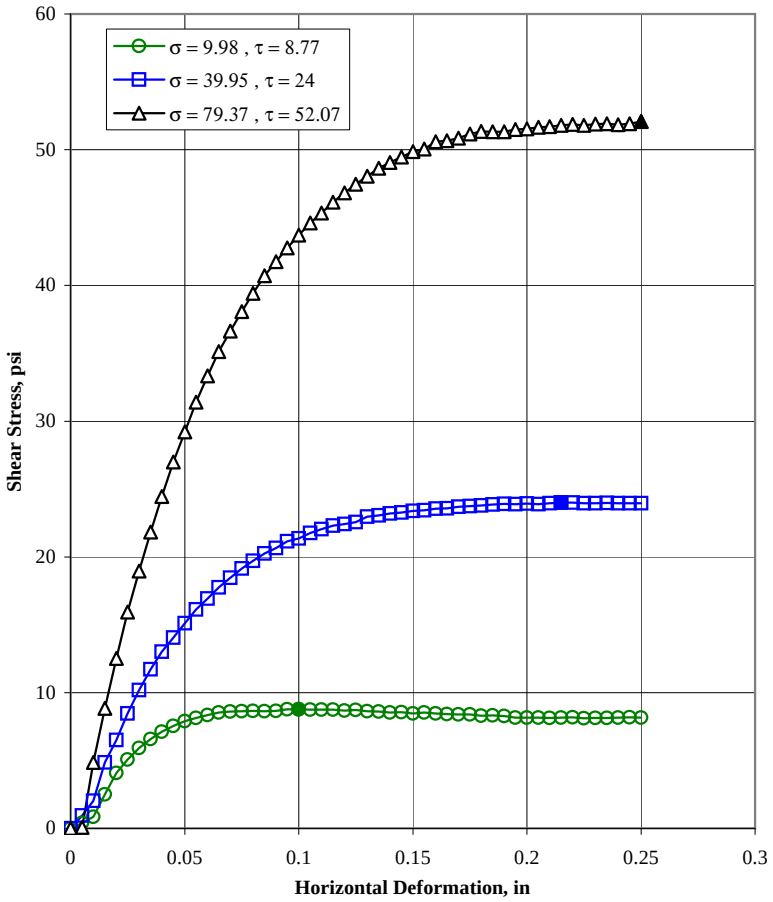
Client	Civil & Environmental Consultants, Inc.	Boring	SB-8
Client Project	091-867 Apex Landfill Expansion	Depth	2'-4'
Project No.	30598	Sample	ST-1
		Lab No.	30598015
Visual Description	YELLOWISH BROWN LEAN CLAY WITH SAND		
Sample Condition	Undisturbed		

NORMAL STRESS vs. SHEAR STRESS

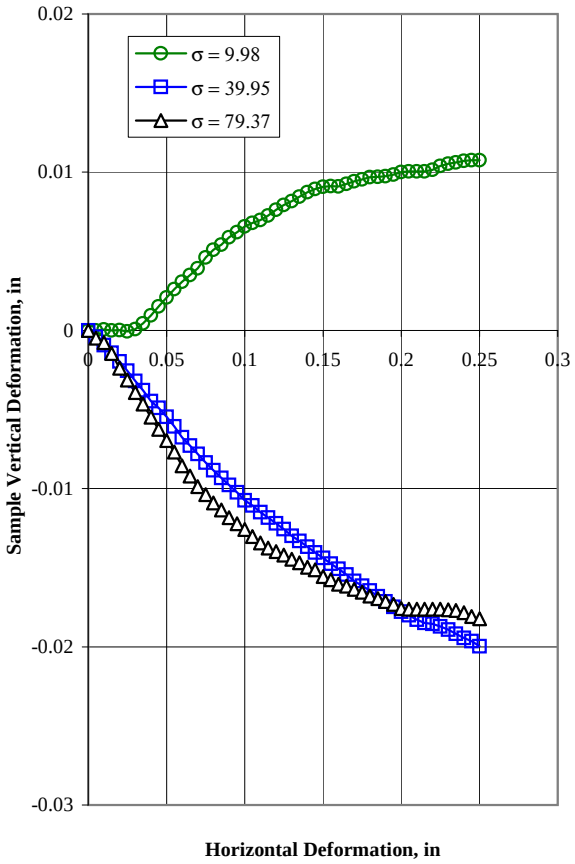
ϕ = 32.2° c = 1.2 psi



HORIZONTAL DEFORMATION vs. SHEAR STRESS



HORIZONTAL DEFORMATION vs. SAMPLE HEIGHT



Note: The calculations performed and the parameters presented herein are for preliminary purposes only. GTS only accepts responsibility for the raw data obtained from the direct shear tests. This data may be interpreted differently by others. It is the responsibility of the user to determine the appropriateness and accuracy of the computed values.

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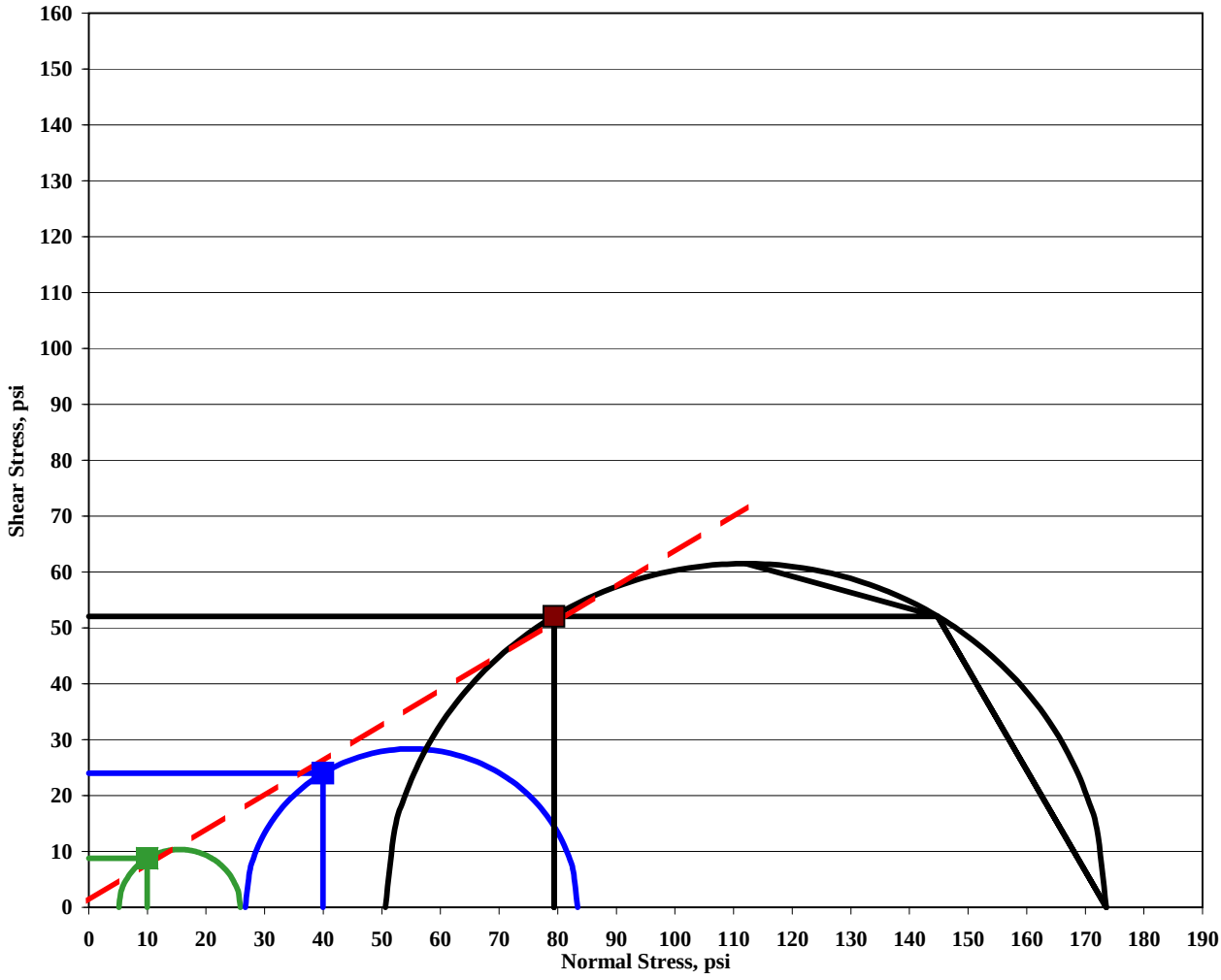
DIRECT SHEAR TEST OF SOILS
UNDER CONSOLIDATED, DRAINED CONDITIONS
MOHRS'S CIRCLE AND FAILURE PARAMETERS

Client:	Civil & Environmental Consultants, Inc.	Boring:	SB-8
Client Project	091-867 Apex Landfill Expansion	Depth:	2'-4'
Project No.	30598	Sample:	ST-1
		Lab Sample ID	30598015
Material:	YELLOWISH BROWN LEAN CLAY WITH SAND		
Condition	Undisturbed		

Average Friction Angle, ϕ, deg.		**32.2**	**Using All Points**
Average Cohesion, c, psi		**1.2**	**Using All Points**
Sample Condition		Undisturbed	
Normal Stress, psi	9.98	39.95	79.37
Shear Stress at Failure, psi	8.77	24.00	52.07
Mohr's Circle Radius, psi	10.4	28.3	61.5
Mohr's Circle Origin, psi	15.5	55.0	112.1
(Origin - Normal Stress), psi	5.5	15.1	32.7
Minor Principal Stress σ3, psi	5.1	26.7	50.6
Major Principal Stress σ1, psi	25.9	83.4	173.6
Principal Stress Difference, σ1–σ3, psi	20.7	56.7	123.0
Normal Stress Pole Coordinate, X, psi	21.0	70.1	144.8
Shear Stress Pole Coordinate, Y, psi	8.8	24.0	52.1
Assumed Failure Plane, deg	0 - Horizontal	0 - Horizontal	0 - Horizontal
Major Principal Failure Plane Angle, deg	61.1	61.1	61.1
Minor Principal Failure Plane Angle, deg	28.9	28.9	28.9
Maximum Shear Stress, psi	10.4	28.3	61.5
Maximum Shear Failure Plane Angle, deg	16.1	16.1	16.1
Initial Water Content, %	**15.4%**	**15.4%**	**15.4%**
Initial Dry Density, pcf	**107.0**	**107.2**	**108.0**



DIRECT SHEAR TEST OF SOILS UNDER CONSOLIDATED DRAINED CONDITIONS - ASTM D 3080

Client	Civil & Environmental Consultant	Boring	SB-8
Client Project	091-867 Apex Landfill Expansion	Depth	2'-4'
Project No.	30598	Sample	ST-1
		Lab No.	30598015
Visual Description	YELLOWISH BROWN LEAN CLAY WITH SAND		
Sample Condition	Undisturbed		

30598015 ds1.sdf
30598015 ds2.sdf
30598015 ds3.sdf

SAMPLE CONDITIONS

Test No.	1			2			3		
	Initial	**After Consol.**	**Final**	**Initial**	**After Consol.**	**Final**	**Initial**	**After Consol.**	**Final**
Tare I.D.	A37	-	A34	A37	-	A18	A37	-	A14
Wt. Wet Soil & Tare, gm	246.62	-	174.6	246.62	-	172.26	246.62	-	173.05
Wt. Dry Soil & Tare, gm	215.08	-	145.88	215.08	-	142.38	215.08	-	146.88
Wt. Tare, gm	9.67	-	9.65	9.67	-	9.43	9.67	-	9.65
Water Content, %	15.4%	-	21.1%	15.4%	-	22.5%	15.4%	-	19.1%
Wt. of Wet Soil & Mold, gr	310.25	-	-	310.36	-	-	312.57	-	-
Wt. of Mold, gm	151.07	-	-	150.96	-	-	152	-	-
Wt. of Wet Soil, gm	159.18	-	-	159.4	-	-	160.57	-	-
Sample Height, in	1	1.0045	1.0152	1	0.9528	0.9329	1	0.9127	0.8944
Sample Diameter, in	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5
Sample Area, in^2	4.9	4.9	4.9	4.9	4.9	4.9	4.9	4.9	4.9
Sample Volume, cc	80.44	80.80	81.66	80.44	76.65	75.04	80.44	73.41	71.95
Wet Density, pcf	123.5	NA	127.7	123.7	NA	140.7	124.6	NA	143.7
Dry Density, pcf	107.0	NA	105.4	107.2	NA	114.9	108.0	NA	120.7

DEFORMATION RATE CALCULATIONS

t_{90}, min. (Sqrt. Method)	0.96	0.31	0.35
Equivalent t_{50}, min. (Sqrt.)	0.22	0.07	0.08
t_{50}, min. (Log Method)	NA	0.07	0.10
Selected t_{50}, min. (Max.)	0.22	0.07	0.10
Calc. Disp. Rate, in./min.	0.0089	0.0586	0.0500

TEST DATA AND SUMMARY

Test No.	1			2			3		
Normal Stress, psi	**9.98**			**39.95**			**79.37**		
Shear Stress at Failure, psi	**8.8**	**Peak**		**24.0**	**Peak**		**52.1**	**10% Def**	
Shear Disp. at Failure, in	**0.100**			**0.215**			**0.250**		
Displacement Rate, in/min	**0.0020**			**0.0020**			**0.0020**		
Horizontal Displacement in	Shear Force lb.	Shear Stress psi	Vertical Deformation in	Shear Force lb.	Shear Stress psi	Vertical Deformation in	Shear Force lb.	Shear Stress psi	Vertical Deformation in
0	0.0	0.0	0.000	0.0	0.0	0.000	0.0	0.0	0.000
0.005	1.9	0.4	0.000	4.7	0.9	0.000	0.4	0.1	0.000
0.010	4.2	0.9	0.000	9.9	2.0	-0.001	23.8	4.8	-0.001
0.015	12.3	2.5	0.000	23.8	4.9	-0.001	43.4	8.8	-0.001
0.020	20.0	4.1	0.000	31.9	6.5	-0.002	61.4	12.5	-0.002
0.025	24.8	5.1	0.000	41.6	8.5	-0.003	78.2	15.9	-0.003
0.030	29.0	5.9	0.000	50.0	10.2	-0.003	93.0	18.9	-0.004
0.035	32.3	6.6	0.000	57.6	11.7	-0.004	107.2	21.8	-0.005
0.040	34.9	7.1	0.001	63.8	13.0	-0.004	120.0	24.4	-0.005
0.045	37.1	7.6	0.002	68.9	14.0	-0.005	132.5	27.0	-0.006
0.050	38.8	7.9	0.002	74.2	15.1	-0.005	143.4	29.2	-0.007
0.055	39.9	8.1	0.003	79.2	16.1	-0.006	154.1	31.4	-0.008
0.060	41.0	8.3	0.003	83.1	16.9	-0.007	163.6	33.3	-0.009
0.065	41.9	8.5	0.003	87.1	17.8	-0.007	172.4	35.1	-0.009
0.070	42.3	8.6	0.004	90.6	18.5	-0.008	179.8	36.6	-0.010

Horizontal Displacement in	Shear Force lb.	Shear Stress psi	Vertical Deformation in	Shear Force lb.	Shear Stress psi	Vertical Deformation in	Shear Force lb.	Shear Stress psi	Vertical Deformation in
0.075	42.4	8.6	0.005	93.9	19.1	-0.008	186.9	38.1	-0.010
0.080	42.4	8.6	0.005	96.8	19.7	-0.009	193.5	39.4	-0.011
0.085	42.4	8.6	0.005	99.4	20.3	-0.009	199.8	40.7	-0.011
0.090	42.5	8.7	0.006	101.4	20.6	-0.010	204.9	41.7	-0.012
0.095	43.0	8.8	0.006	103.8	21.1	-0.010	209.9	42.8	-0.012
0.100	43.1	8.8	0.007	104.9	21.4	-0.011	214.5	43.7	-0.013
0.105	42.9	8.7	0.007	106.8	21.8	-0.011	218.9	44.6	-0.013
0.110	43.0	8.8	0.007	108.2	22.0	-0.011	222.6	45.3	-0.013
0.115	43.0	8.8	0.007	109.4	22.3	-0.012	226.5	46.1	-0.014
0.120	42.6	8.7	0.008	110.1	22.4	-0.012	229.9	46.8	-0.014
0.125	42.8	8.7	0.008	110.8	22.6	-0.013	233.0	47.5	-0.014
0.130	42.3	8.6	0.008	112.7	23.0	-0.013	235.8	48.0	-0.014
0.135	42.2	8.6	0.008	113.2	23.1	-0.013	238.7	48.6	-0.015
0.140	41.9	8.5	0.009	113.8	23.2	-0.014	240.8	49.1	-0.015
0.145	42.0	8.5	0.009	114.3	23.3	-0.014	242.8	49.5	-0.015
0.150	41.6	8.5	0.009	114.8	23.4	-0.014	244.7	49.9	-0.016
0.155	41.9	8.5	0.009	115.1	23.4	-0.015	245.7	50.0	-0.016
0.160	41.5	8.5	0.009	115.6	23.6	-0.015	248.4	50.6	-0.016
0.165	41.3	8.4	0.009	115.8	23.6	-0.015	248.7	50.7	-0.016
0.170	41.2	8.4	0.009	116.3	23.7	-0.016	249.6	50.9	-0.016
0.175	41.3	8.4	0.010	116.5	23.7	-0.016	251.1	51.2	-0.017
0.180	40.8	8.3	0.010	116.8	23.8	-0.016	252.0	51.3	-0.017
0.185	40.8	8.3	0.010	117.1	23.9	-0.017	251.9	51.3	-0.017
0.190	40.6	8.3	0.010	117.3	23.9	-0.017	252.0	51.3	-0.017
0.195	40.1	8.2	0.010	117.2	23.9	-0.017	252.7	51.5	-0.017
0.200	40.0	8.2	0.010	117.5	23.9	-0.018	253.0	51.5	-0.018
0.205	40.0	8.2	0.010	117.3	23.9	-0.018	253.5	51.7	-0.018
0.210	40.0	8.1	0.010	117.6	24.0	-0.018	253.8	51.7	-0.018
0.215	40.1	8.2	0.010	117.8	24.0	-0.018	254.3	51.8	-0.018
0.220	40.1	8.2	0.010	117.8	24.0	-0.019	254.6	51.9	-0.018
0.225	39.8	8.1	0.010	117.5	23.9	-0.019	254.3	51.8	-0.018
0.230	40.0	8.1	0.011	117.5	23.9	-0.019	254.8	51.9	-0.018
0.235	39.9	8.1	0.011	117.7	24.0	-0.019	254.8	51.9	-0.018
0.240	40.1	8.2	0.011	117.6	24.0	-0.019	254.4	51.8	-0.018
0.245	40.1	8.2	0.011	117.5	23.9	-0.020	254.8	51.9	-0.018
0.250	40.0	8.2	0.011	117.6	24.0	-0.020	255.6	52.1	-0.018

Input Validation: Reviewed By:

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ONE DIMENSIONAL CONSOLIDATION TEST

Client	Civil & Environmental Consultant	Boring	SB-8	**Final Test Load, psi**	**9.98**
Client Project	091-867 Apex Landfill Expansion	Depth	2'-4'		
Project No.	30598	Sample	ST-1		
		Lab ID#	30598015		
Description	YELLOWISH BROWN LEAN CLAY WITH SAND				
Test Conditions:	Undisturbed				

Increment Start Date and Time: 12/03/10

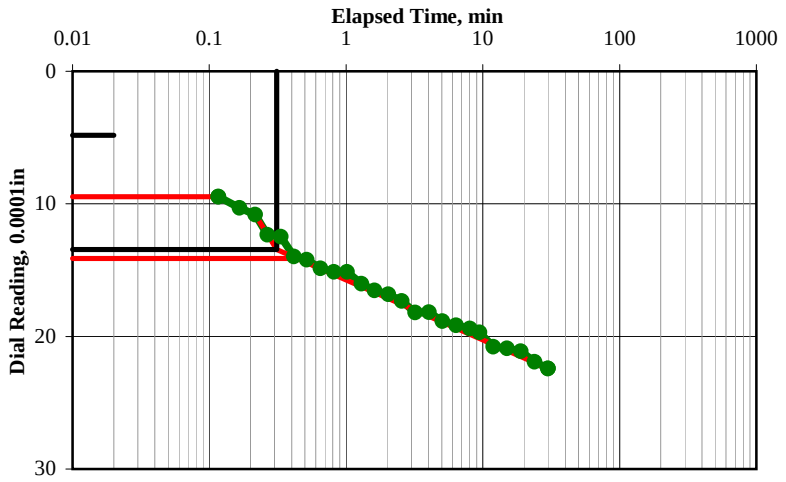
Elapsed Time (min)	Sqrt Time ($min^{1/2}$)	Dial Reading (0.0001in)	Sample Height (in)
0	0	0	1.0000
Corrections*		67	0.0067
Adjusted Sample Height			
0.12	0.34	9.5	1.0058
0.17	0.41	10.3	1.0057
0.22	0.47	10.8	1.0056
0.27	0.52	12.3	1.0055
0.33	0.58	12.5	1.0055
0.42	0.65	14.0	1.0053
0.52	0.72	14.2	1.0053
0.65	0.81	14.9	1.0052
0.82	0.90	15.1	1.0052
1.02	1.01	15.1	1.0052
1.30	1.14	16.0	1.0051
1.62	1.27	16.5	1.0050
2.03	1.43	16.8	1.0050
2.55	1.60	17.3	1.0050
3.20	1.79	18.2	1.0049
4.03	2.01	18.2	1.0049
5.07	2.25	18.8	1.0048
6.38	2.53	19.2	1.0048
8.03	2.83	19.4	1.0048
9.48	3.08	19.7	1.0047
11.95	3.46	20.8	1.0046
15.05	3.88	20.9	1.0046
18.95	4.35	21.1	1.0046
23.87	4.89	21.9	1.0045
30.05	5.48	22.4	1.0045

Machine Deflection

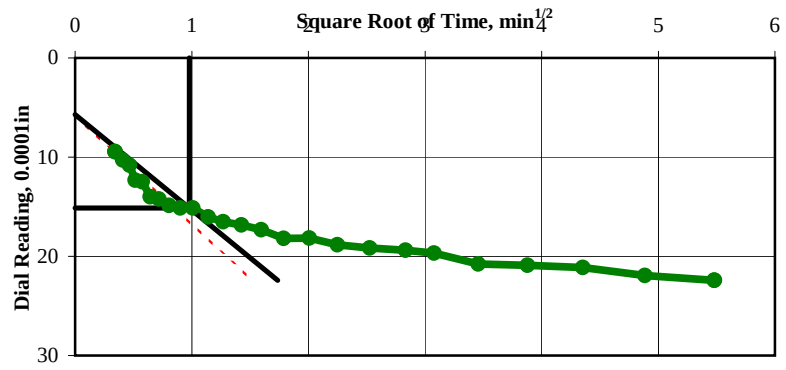
Applied Deflection Correction to Sample Height, 0.0001in 67

**Correction is applied to all dial readings.*

Log of Elapsed Time vs. Dial Reading



Square Root of Elapsed Time vs. Dial Reading



Sqrt. of Elapsed Time vs Dial Reading		Log of Elapsed Time vs Dial Reading		Load Summary	
T0 = 0 min.	D0 = 5.7 div.	NA	NA		
T90 = 0.96 min	D90 = 15.1 div.	NA	NA	Initial Sample Height, in	1.0000
T100 = NA min	D100 = 16.2 div.	NA	NA		
Height at: D90 = 0.9918, D100 = 0.9917		NA		Final Sample Height, in	1.0045
Average Sample Height, in	1.0022	Average Sample Height, in	1.0022		
Average Drainage Height, in	0.5011	Average Drainage Height, in	0.5011	Incremental Strain, %	-0.45%
T (Time Factor for T90)	0.848	T (Time Factor for T50)	0.197	Loading Duration, min	30
Coef. of Consol., C_v, in^2/min	0.222	Coef. of Consol., C_v, in^2/min	NA		

Input Validation: Reviewed By: Date 12/3/2010

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ONE DIMENSIONAL CONSOLIDATION TEST

Client	Civil & Environmental Consultant	Boring	SB-8	**Final Test Load, psi**	**39.95**
Client Project	091-867 Apex Landfill Expansion	Depth	2'-4'		
Project No.	30598	Sample	ST-1		
		Lab ID#	30598015		
Description	YELLOWISH BROWN LEAN CLAY WITH SAND				
Test Conditions:	Undisturbed				

Increment Start Date: 12/03/10

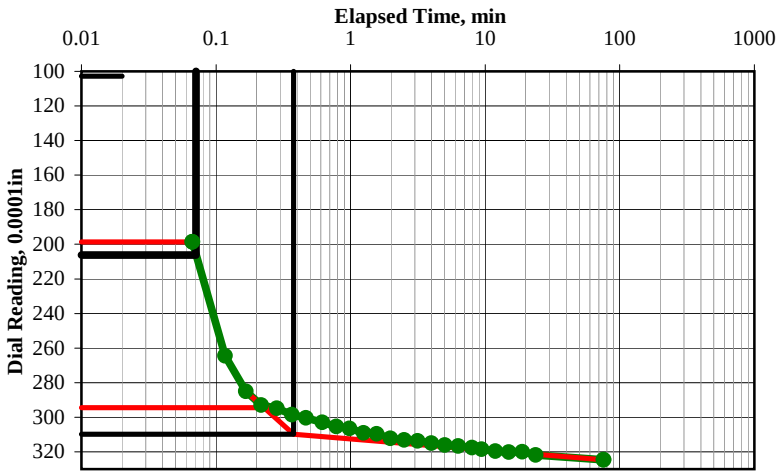
Elapsed Time (min)	Sqrt Time ($min^{1/2}$)	Dial Reading (0.0001in)	Sample Height (in)
0	0	0	1.0000
Corrections*		147	0.0147
Adjusted Sample Height			
0.07	0.26	198.6	0.9948
0.12	0.34	264.4	0.9883
0.17	0.41	285.1	0.9862
0.22	0.47	293.0	0.9854
0.28	0.53	294.9	0.9852
0.37	0.61	298.5	0.9849
0.47	0.68	300.3	0.9847
0.62	0.79	303.0	0.9844
0.78	0.89	305.4	0.9842
0.98	0.99	306.6	0.9840
1.25	1.12	309.1	0.9838
1.57	1.25	309.6	0.9837
1.98	1.41	312.2	0.9835
2.50	1.58	313.3	0.9834
3.15	1.77	313.7	0.9833
3.98	2.00	315.0	0.9832
5.02	2.24	316.2	0.9831
6.33	2.52	316.6	0.9830
8.00	2.83	317.6	0.9829
9.45	3.07	318.5	0.9829
11.90	3.45	319.6	0.9827
15.00	3.87	320.2	0.9827
18.90	4.35	320.1	0.9827
23.82	4.88	321.9	0.9825
76.02	8.72	324.7	0.9528

Machine Deflection

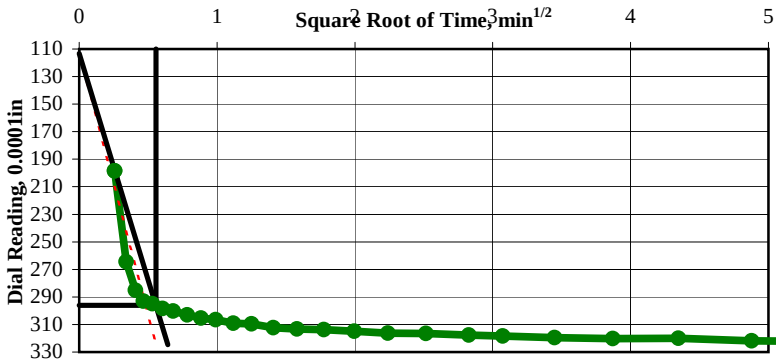
Applied Deflection Correction to Sample Height, 0.0001in 147

**Correction is applied to all dial readings.*

Log of Elapsed Time vs. Dial Reading



Square Root of Elapsed Time vs. Dial Reading



Sqrt. of Elapsed Time vs Dial Reading

T0 = 0 min.	D0 = 113.3 div.		
T90 = 0.314 min	D90 = 296.1 div.		
T100 = NA min	D100 = 316.4 div.		
Height at: D90 = 0.9557, D100 = 0.9537			
Average Sample Height, in	0.9764		
Average Drainage Height, in	0.4882		
T (Time Factor for T90)	0.848		
Coef. of Consol., C_v, in^2/min	0.652		

Log of Elapsed Time vs Dial Reading

T0 = 0 min.	D0 = 102.8 div.		
T50 = 0.07 min.	D50 = 206.3 div.		
T100 = 0.38 min.	D100 = 309.8 div.		
Height at: D50 = 0.9647, D100 = 0.9543			
Average Sample Height, in	0.9764		
Average Drainage Height, in	0.4882		
T (Time Factor for T50)	0.197		
Coef. of Consol., C_v, in^2/min	0.671		

Load Summary

Initial Sample Height, in	1.0000
Final Sample Height, in	0.9528
Incremental Strain, %	4.72%
Loading Duration, min	76

Input Validation: Reviewed By: Date 12/3/2010

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ONE DIMENSIONAL CONSOLIDATION TEST

Client	Civil & Environmental Consultant	Boring	SB-8	**Final Test Load, psi**	**79.37**
Client Project	091-867 Apex Landfill Expansion	Depth	2'-4'		
Project No.	30598	Sample	ST-1		
		Lab ID#	30598015		
Description	YELLOWISH BROWN LEAN CLAY WITH SAND				
Test Conditions:	Undisturbed				

Increment Start Date: 12/04/10

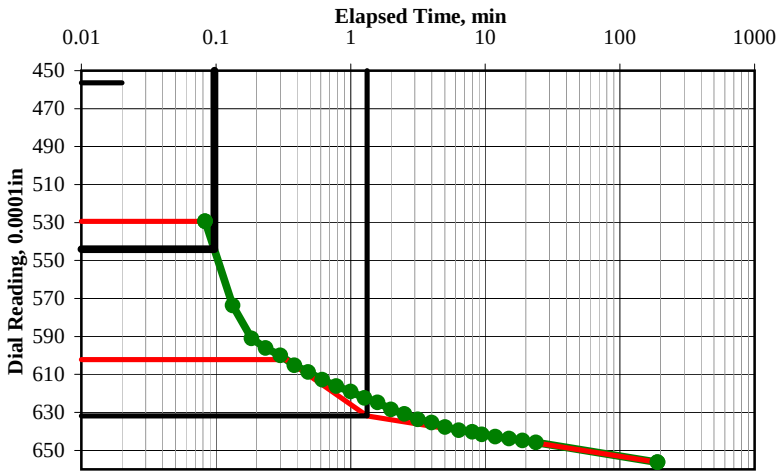
Elapsed Time (min)	Sqrt Time ($min^{1/2}$)	Dial Reading (0.0001in)	Sample Height (in)
0	0	0	1.0000
Corrections*		217	0.0217
Adjusted Sample Height			
0.08	0.29	529.3	0.9688
0.13	0.37	573.7	0.9643
0.18	0.43	591.0	0.9626
0.23	0.48	596.2	0.9621
0.30	0.55	600.0	0.9617
0.38	0.62	605.2	0.9612
0.48	0.70	608.7	0.9608
0.62	0.79	612.9	0.9604
0.78	0.89	616.3	0.9601
1.00	1.00	619.0	0.9598
1.27	1.13	622.5	0.9595
1.58	1.26	624.9	0.9592
2.00	1.41	628.5	0.9588
2.52	1.59	630.8	0.9586
3.17	1.78	633.8	0.9583
4.00	2.00	635.4	0.9582
5.03	2.24	637.8	0.9579
6.37	2.52	639.4	0.9578
8.02	2.83	640.3	0.9577
9.47	3.08	641.7	0.9575
11.92	3.45	642.8	0.9574
15.02	3.88	643.8	0.9573
18.92	4.35	644.8	0.9572
23.85	4.88	645.8	0.9571
190.03	13.79	656.3	0.9127

Machine Deflection

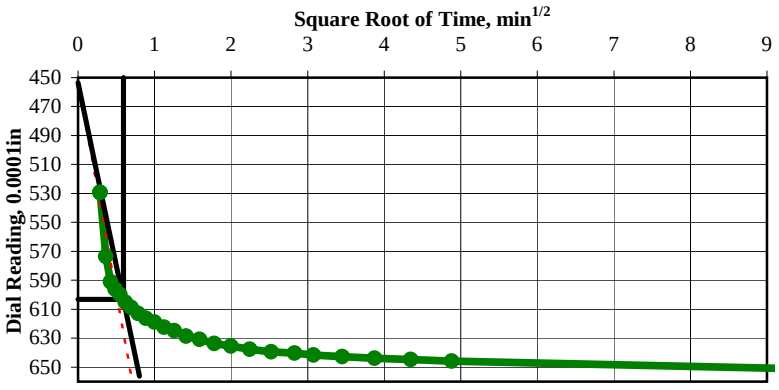
Applied Deflection Correction to Sample Height, 0.0001in 217

**Correction is applied to all dial readings.*

Log of Elapsed Time vs. Dial Reading



Square Root of Elapsed Time vs. Dial Reading



Sqrt. of Elapsed Time vs Dial Reading

T0 = 0 min.	D0 = 453.6 div.
T90 = 0.348 min	D90 = 603.2 div.
T100 = NA min	D100 = 619.9 div.
Height at: D90 = 0.918, D100 = 0.9163	
Average Sample Height, in	0.9563
Average Drainage Height, in	0.4782
T (Time Factor for T90)	0.848
Coef. of Consol., C_v, in^2/min	0.553

Log of Elapsed Time vs Dial Reading

T0 = 0 min.	D0 = 456.4 div.
T50 = 0.1 min.	D50 = 544.1 div.
T100 = 1.33 min.	D100 = 631.9 div.
Height at: D50 = 0.9239, D100 = 0.9151	
Average Sample Height, in	0.9563
Average Drainage Height, in	0.4782
T (Time Factor for T50)	0.197
Coef. of Consol., C_v, in^2/min	0.450

Load Summary

Initial Sample Height, in	1.0000
Final Sample Height, in	0.9127
Incremental Strain, %	8.73%
Loading Duration, min	190

Input Validation: Reviewed By: Date 12/4/2010

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CONSOLIDATED-UNDRAINED TRIAXIAL COMPRESSION TEST ON COHESIVE SOILS ASTM D 4767

Client	Civil & Environmental Consultants, Inc.	Boring	RB-1
Client Project	091-867 Apex Landfill Expansion	Depth	14'-19'
Project No.	30598	Sample	B-1
Test No.	1	Lab Sample No.	30598022
USCS Description:	Olive Brown Lean Clay with Sand	Test Conditions:	Remolded - Side And Double Drained

SAMPLE CONDITIONS

	Initial	After Consol.	Final
Tare Number	823	NA	943
Wt. Tare & WS, gm	273.29	NA	1319.43
Wt. Tare & DS, gm	246.66	NA	1095.96
Wt. Tare, gm	103.31	NA	97.70
Water Content, %	18.6	22.4	22.4
Wt. Tube & WS., gm	1179.8	NA	
Wt. Of Tube, gm	0.0	NA	
Wt. Of WS., gm	1179.8	1217.7	
Length 1, in	6	NA	
Length 2, in	6	NA	
Length 3, in	6	NA	
Top Diameter, in	2.864	NA	
Middle Diameter, in	2.865	NA	
Bottom Diameter, in	2.8655	NA	
Average Length, in	6.000	5.946	
Average Diameter, in	2.865	2.824	
Average Area, in^2	6.45	6.26	
Sample Volume, in^3	38.68	37.79	
Unit Dry Wt., gms/cc	1.57	1.61	
Unit Dry Wt., pcf	98.0	100.3	
Specific Gravity, Assume	2.70	2.70	
Volume of Solids, cc	368.52	368.52	
Void Ratio, e	0.72	0.68	
Porosity, n	0.42	0.40	
Pore Volume, cc	16.19	15.30	
Saturation, %	69.7	88.8	

TEST CONDITIONS

Cell Pressure, psi	79.83	
Back Pressure, psi	69.98	
Effective Consolidating Pressure, psi	9.85	σ_3
Pore Pressure Parameter (B), %	96	

SATURATION AND CONSOLIDATION VOLUME CHANGES

Height Change, mils	Reading	Change	Consolidation	
Initial Reading	7.02	0	Volume Change, ml	14.5
After Saturation	6.991	29	Volume Change, in^3	0.88
After Consolidation	6.966	54	Saturation Method:	Wet

STRAIN RATE CALCULATIONS

Calc. Strain Rate, %/min (t50=3.45)	0.0012	Strain Rate Used, %/min	0.0003
Calc. Deformation Rate, in/min	0.0069	Deformation Rate Used	0.002

EFFECTIVE FAILURE SUMMARY

Failure Conditions	Max σ_1'/σ_3'	15% ε	
Effective Consolidating Pressure, psi	9.85	9.85	σ_3
1St. Maximum Effective Principal Stress Ratio	4.157	3.97	σ_1'/σ_3'
Deviator Stress at Failure, psi	8.75	10.80	$\sigma_1-\sigma_3$
Axial Strain at Failure, %	8.23	15.00	ε
Effective Minor Principal Stress at Failure, psi	2.77	3.64	σ_3'
Effective Major Principal Stress at Failure, psi	11.52	14.44	σ_1'
Mohr's Circle Stress Path (Origin of Circle), psi	7.15	9.04	p'
Mohr's Circle Stress Path (Radius of Circle), psi	4.37	5.40	q

TOTAL FAILURE SUMMARY

Failure Conditions	Max σ_1'/σ_3'	15% ε	
Deviator Stress at Failure, psi	8.75	10.80	$\sigma_1-\sigma_3$
Axial Strain at Failure, %	8.23	15.00	ε
Total Minor Principal Stress at Failure, psi	9.85	9.85	σ_3
Total Major Principal Stress at Failure, psi	18.60	20.65	σ_1

TEST DATA

Axial Load	Axial Deformation	Total Pore Water Pressure	Axial Strain	Principal Stress Difference (Deviator Stress)	Induced Pore Water Pressure	Effective Major Principal Stress	Effective Minor Principal Stress	Effective Principal Stress Ratio	A-Bar	Mohr's Circle Stress Paths	
										Origin of Circle	Radius of Circle
lb.	mils	psi	%	psi	psi	psi	psi			psi	psi
P	ΔH	U	ε	$\sigma_1-\sigma_3$	ΔU	σ_1'	σ_3'	σ_1'/σ_3'	A'	p'	q
18.0	0	70.0	0	0	NA	NA	NA	NA	NA	9.85	0
44.8	6	71.9	0.10	4.28	1.91	12.22	7.94	1.539	0.47	10.08	2.14
50.1	12	72.9	0.20	5.13	2.97	12.01	6.88	1.745	0.60	9.45	2.57
52.7	18	73.6	0.30	5.53	3.63	11.75	6.22	1.889	0.68	8.99	2.76
54.5	24	74.1	0.40	5.81	4.10	11.56	5.75	2.010	0.74	8.66	2.90
55.9	30	74.4	0.51	6.03	4.47	11.41	5.38	2.120	0.77	8.40	3.01
56.9	36	74.7	0.61	6.18	4.77	11.26	5.08	2.216	0.81	8.17	3.09
57.7	43	75.0	0.72	6.30	5.01	11.14	4.84	2.300	0.83	7.99	3.15
58.4	49	75.2	0.82	6.41	5.20	11.06	4.65	2.378	0.85	7.86	3.20
59.0	55	75.4	0.92	6.50	5.40	10.96	4.46	2.459	0.86	7.71	3.25
59.6	61	75.5	1.02	6.59	5.55	10.90	4.31	2.530	0.88	7.60	3.29
60.1	67	75.6	1.13	6.65	5.67	10.83	4.18	2.590	0.89	7.51	3.33
60.4	73	75.8	1.23	6.70	5.81	10.75	4.05	2.656	0.90	7.40	3.35
61.5	92	76.0	1.54	6.85	6.07	10.64	3.79	2.809	0.92	7.21	3.42

62.3	110	76.3	1.85	6.95	6.30	10.51	3.56	2.953	0.94	7.03	3.47
62.9	129	76.4	2.17	7.02	6.46	10.41	3.39	3.070	0.96	6.90	3.51
63.5	148	76.6	2.48	7.10	6.60	10.35	3.26	3.180	0.97	6.80	3.55
64.2	166	76.7	2.79	7.17	6.71	10.32	3.14	3.281	0.97	6.73	3.59
64.8	184	76.8	3.10	7.24	6.79	10.30	3.06	3.367	0.98	6.68	3.62
65.6	203	76.8	3.41	7.34	6.87	10.33	2.98	3.464	0.97	6.65	3.67
66.2	221	76.9	3.72	7.42	6.91	10.36	2.94	3.520	0.97	6.65	3.71
66.8	239	77.0	4.03	7.49	6.98	10.37	2.88	3.603	0.97	6.62	3.74
67.6	257	77.0	4.33	7.59	7.02	10.42	2.84	3.676	0.96	6.63	3.79
68.3	275	77.0	4.63	7.66	7.05	10.47	2.80	3.734	0.96	6.63	3.83
69.0	294	77.1	4.94	7.76	7.08	10.53	2.78	3.795	0.95	6.65	3.88
69.8	311	77.1	5.24	7.85	7.10	10.60	2.75	3.851	0.94	6.67	3.92
70.5	329	77.1	5.53	7.92	7.09	10.68	2.76	3.871	0.93	6.72	3.96
71.3	346	77.1	5.83	8.02	7.11	10.76	2.74	3.926	0.92	6.75	4.01
72.2	364	77.1	6.13	8.13	7.13	10.85	2.72	3.983	0.91	6.79	4.06
72.9	382	77.1	6.43	8.21	7.14	10.93	2.72	4.020	0.91	6.83	4.11
73.6	400	77.1	6.72	8.29	7.14	11.01	2.72	4.053	0.90	6.86	4.15
74.4	417	77.1	7.02	8.39	7.13	11.11	2.72	4.081	0.89	6.92	4.19
75.3	435	77.1	7.31	8.49	7.12	11.22	2.73	4.109	0.87	6.98	4.25
76.0	454	77.1	7.64	8.56	7.11	11.31	2.75	4.119	0.86	7.03	4.28
76.8	472	77.1	7.93	8.65	7.10	11.41	2.76	4.134	0.85	7.08	4.32
77.7	489	77.1	8.23	8.75	7.08	11.52	2.77	4.157	0.84	7.15	4.37
78.7	507	77.0	8.52	8.87	7.04	11.68	2.81	4.156	0.83	7.25	4.43
79.5	525	77.0	8.82	8.96	7.04	11.78	2.82	4.177	0.82	7.30	4.48
80.4	543	77.0	9.13	9.06	7.02	11.90	2.84	4.196	0.81	7.37	4.53
81.3	561	77.0	9.43	9.16	6.99	12.02	2.86	4.198	0.80	7.44	4.58
82.0	579	76.9	9.73	9.24	6.97	12.13	2.89	4.200	0.79	7.51	4.62
83.0	596	76.9	10.03	9.35	6.93	12.27	2.92	4.203	0.77	7.60	4.68
83.9	614	76.9	10.33	9.44	6.90	12.40	2.96	4.191	0.76	7.68	4.72
84.8	633	76.8	10.64	9.54	6.86	12.53	2.99	4.191	0.75	7.76	4.77
85.6	650	76.8	10.93	9.63	6.82	12.66	3.03	4.175	0.74	7.85	4.81
86.6	668	76.7	11.23	9.73	6.77	12.81	3.08	4.158	0.72	7.95	4.87
87.4	685	76.7	11.52	9.82	6.74	12.94	3.12	4.152	0.71	8.03	4.91
88.3	703	76.7	11.83	9.91	6.70	13.06	3.15	4.142	0.70	8.11	4.95
89.0	721	76.6	12.13	9.98	6.66	13.17	3.20	4.123	0.70	8.18	4.99
90.0	739	76.6	12.42	10.08	6.62	13.31	3.23	4.117	0.68	8.27	5.04
90.9	756	76.5	12.71	10.17	6.57	13.45	3.28	4.098	0.67	8.36	5.08
91.7	773	76.5	13.01	10.25	6.53	13.57	3.33	4.080	0.66	8.45	5.12
92.7	792	76.5	13.31	10.35	6.49	13.72	3.37	4.075	0.65	8.54	5.17
93.5	809	76.4	13.61	10.43	6.44	13.84	3.42	4.052	0.64	8.63	5.21
94.4	827	76.4	13.90	10.51	6.40	13.96	3.46	4.040	0.63	8.71	5.25
95.3	844	76.3	14.19	10.61	6.32	14.14	3.53	4.000	0.62	8.84	5.30
96.2	862	76.3	14.49	10.69	6.29	14.26	3.57	3.996	0.61	8.91	5.34
96.9	880	76.2	14.80	10.74	6.24	14.35	3.61	3.974	0.61	8.98	5.37
97.8	898	76.2	15.10	10.82	6.20	14.48	3.66	3.961	0.60	9.07	5.41
98.7	916	76.1	15.40	10.92	6.16	14.61	3.70	3.952	0.59	9.16	5.46
99.6	933	76.1	15.70	10.99	6.11	14.74	3.75	3.933	0.58	9.24	5.49
100.2	952	76.0	16.01	11.04	6.05	14.84	3.80	3.904	0.57	9.32	5.52

Input Validation: Reviewed By: Date Tested: 12/30/10

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CONSOLIDATED-UNDRAINED TRIAXIAL COMPRESSION TEST ON COHESIVE SOILS ASTM D 4767

Client	Civil & Environmental Consultants, Inc.	Boring	RB-1
Client Project	091-867 Apex Landfill Expansion	Depth	14'-19'
Project No.	30598	Sample	B-1
Test No.	2	Lab Sample No.	30598022
USCS Description:	Olive Brown Lean Clay with Sand	Test Conditions:	Remolded - Side And Double Drained

SAMPLE CONDITIONS

	Initial	After Consol.	Final
Tare Number	823	NA	510
Wt. Tare & WS, gm	273.29	NA	1292.62
Wt. Tare & DS, gm	246.66	NA	1098.96
Wt. Tare, gm	103.31	NA	103.30
Water Content, %	18.6	19.5	19.5
Wt. Tube & WS., gm	1179.8	NA	
Wt. Of Tube, gm	0.0	NA	
Wt. Of WS., gm	1179.8	1188.5	
Length 1, in	6	NA	
Length 2, in	6	NA	
Length 3, in	6	NA	
Top Diameter, in	2.864	NA	
Middle Diameter, in	2.865	NA	
Bottom Diameter, in	2.8655	NA	
Average Length, in	6.000	5.825	
Average Diameter, in	2.865	2.775	
Average Area, in^2	6.45	6.05	
Sample Volume, in^3	38.68	35.78	
Unit Dry Wt., gms/cc	1.57	1.70	
Unit Dry Wt., pcf	98.0	105.9	
Specific Gravity, Assume	2.70	2.70	
Volume of Solids, cc	368.52	368.52	
Void Ratio, e	0.72	0.59	
Porosity, n	0.42	0.37	
Pore Volume, cc	16.19	13.30	
Saturation, %	69.7	88.8	

TEST CONDITIONS

Cell Pressure, psi	109.35	
Back Pressure, psi	69.45	
Effective Consolidating Pressure, psi	39.89	σ_3
Pore Pressure Parameter (B), %	96	

SATURATION AND CONSOLIDATION VOLUME CHANGES

Height Change, mils	Reading	Change	Consolidation	
Initial Dial Reading	6.631	0	Volume Change, ml	47.4
After Saturation	6.602	29	Volume Change, in^3	2.89
After Consolidation	6.456	175	Saturation Method:	Wet

STRAIN RATE CALCULATIONS

Calc. Strain Rate, %/min (t50=6.82)	0.0006	Strain Rate Used, %/min	0.0003
Calc. Deformation Rate, in/min	0.0034	Deformation Rate Used	0.002

EFFECTIVE FAILURE SUMMARY

Failure Conditions	Max σ_1'/σ_3'	15% ε	
Effective Consolidating Pressure, psi	39.89	39.89	σ_3
1St. Maximum Effective Principal Stress Ratio	3.200	3.21	σ_1'/σ_3'
Deviator Stress at Failure, psi	31.51	39.81	$\sigma_1-\sigma_3$
Axial Strain at Failure, %	4.96	15.00	ε
Effective Minor Principal Stress at Failure, psi	14.32	18.05	σ_3'
Effective Major Principal Stress at Failure, psi	45.83	57.86	σ_1'
Mohr's Circle Stress Path (Origin of Circle), psi	30.07	37.95	p'
Mohr's Circle Stress Path (Radius of Circle), psi	15.75	19.91	q

TOTAL FAILURE SUMMARY

Failure Conditions	Max σ_1'/σ_3'	15% ε	
Deviator Stress at Failure, psi	31.51	39.81	$\sigma_1-\sigma_3$
Axial Strain at Failure, %	4.96	15.00	ε
Total Minor Principal Stress at Failure, psi	39.89	39.89	σ_3
Total Major Principal Stress at Failure, psi	71.40	79.71	σ_1

TEST DATA

Axial Load	Axial Deformation	Total Pore Water Pressure	Axial Strain	Principal Stress Difference (Deviator Stress)	Induced Pore Water Pressure	Effective Major Principal Stress	Effective Minor Principal Stress	Effective Principal Stress Ratio	A-Bar	Mohr's Circle Stress Paths	
										Origin of Circle	Radius of Circle
lb.	mils	psi	%	psi	psi	psi	psi			psi	psi
P	ΔH	U	ε	$\sigma_1-\sigma_3$	ΔU	σ_1'	σ_3'	σ_1'/σ_3'	A'	p'	q
20.5	0	69.5	0	0.00	0	NA	NA	NA	NA	39.89	0
75.4	4	73.7	0.07	9.08	4.30	44.68	35.60	1.255	0.49	40.14	4.54
107.6	9	77.5	0.16	14.38	8.00	46.27	31.89	1.451	0.58	39.08	7.19
122.8	15	79.9	0.26	16.87	10.47	46.29	29.42	1.573	0.65	37.86	8.43
132.5	21	81.8	0.36	18.44	12.32	46.02	27.58	1.669	0.70	36.80	9.22
140.0	27	83.3	0.46	19.67	13.82	45.74	26.07	1.755	0.73	35.91	9.84
145.9	33	84.5	0.56	20.61	15.06	45.45	24.83	1.830	0.76	35.14	10.31
151.0	39	85.6	0.67	21.44	16.14	45.19	23.75	1.903	0.78	34.47	10.72
155.0	45	88.1	0.77	22.07	18.66	43.31	21.24	2.039	0.88	32.27	11.03
159.8	51	90.9	0.88	22.83	21.42	41.30	18.47	2.236	0.98	29.89	11.41
174.9	87	93.0	1.49	25.15	23.58	41.46	16.31	2.542	0.98	28.89	12.58
180.7	106	93.3	1.81	26.02	23.87	42.04	16.02	2.624	0.96	29.03	13.01
185.4	125	93.6	2.14	26.69	24.16	42.43	15.74	2.696	0.94	29.08	13.35
189.0	143	93.9	2.46	27.17	24.43	42.63	15.46	2.758	0.94	29.05	13.59

192.8	162	94.2	2.77	27.70	24.73	42.86	15.16	2.827	0.93	29.01	13.85
198.6	180	94.4	3.08	28.53	24.94	43.49	14.96	2.908	0.91	29.22	14.27
203.4	198	94.6	3.41	29.22	25.13	43.98	14.77	2.979	0.90	29.38	14.61
205.5	217	94.7	3.73	29.45	25.26	44.08	14.63	3.013	0.89	29.36	14.73
208.2	235	94.8	4.04	29.79	25.36	44.32	14.53	3.050	0.89	29.43	14.89
210.7	253	94.9	4.34	30.08	25.46	44.51	14.43	3.084	0.88	29.47	15.04
215.7	271	95.0	4.65	30.78	25.53	45.15	14.36	3.143	0.86	29.75	15.39
221.0	289	95.0	4.96	31.51	25.57	45.83	14.32	3.200	0.85	30.07	15.75
220.9	307	95.0	5.27	31.39	25.59	45.70	14.31	3.194	0.85	30.00	15.69
223.4	325	95.0	5.58	31.67	25.59	45.98	14.30	3.215	0.84	30.14	15.84
229.2	342	95.0	5.88	32.48	25.57	46.80	14.33	3.267	0.82	30.56	16.24
232.4	360	95.0	6.18	32.87	25.52	47.24	14.38	3.286	0.81	30.81	16.43
235.5	378	94.9	6.49	33.25	25.49	47.66	14.41	3.308	0.80	31.03	16.63
234.5	396	94.9	6.79	32.98	25.43	47.44	14.46	3.280	0.80	30.95	16.49
237.8	413	94.8	7.09	33.39	25.33	47.95	14.56	3.293	0.79	31.25	16.69
245.4	430	94.7	7.39	34.43	25.29	49.04	14.61	3.358	0.76	31.82	17.22
247.8	448	94.7	7.69	34.70	25.22	49.38	14.68	3.364	0.76	32.03	17.35
249.9	466	94.6	8.00	34.90	25.11	49.68	14.78	3.361	0.75	32.23	17.45
248.5	484	94.5	8.30	34.57	25.01	49.46	14.89	3.322	0.75	32.17	17.29
254.3	501	94.4	8.60	35.34	24.90	50.33	14.99	3.358	0.73	32.66	17.67
258.5	519	94.2	8.90	35.85	24.79	50.96	15.11	3.373	0.72	33.03	17.93
261.0	537	94.1	9.21	36.11	24.65	51.35	15.24	3.369	0.71	33.30	18.06
260.9	555	94.0	9.52	35.97	24.55	51.32	15.35	3.344	0.71	33.33	17.99
263.0	573	93.9	9.83	36.16	24.41	51.64	15.49	3.335	0.70	33.57	18.08
270.8	590	93.7	10.13	37.20	24.25	52.85	15.65	3.378	0.68	34.25	18.60
272.8	608	93.6	10.44	37.37	24.14	53.12	15.75	3.372	0.67	34.44	18.68
273.7	626	93.5	10.75	37.38	24.00	53.27	15.89	3.352	0.67	34.58	18.69
272.0	644	93.3	11.06	36.99	23.86	53.02	16.04	3.307	0.67	34.53	18.49
274.4	662	93.2	11.36	37.22	23.72	53.40	16.18	3.301	0.66	34.79	18.61
279.8	679	93.0	11.66	37.88	23.58	54.20	16.32	3.322	0.65	35.26	18.94
282.8	698	92.9	11.98	38.19	23.42	54.66	16.48	3.318	0.64	35.57	19.09
283.8	715	92.7	12.28	38.20	23.24	54.85	16.65	3.294	0.63	35.75	19.10
283.0	733	92.6	12.58	37.95	23.11	54.74	16.78	3.261	0.63	35.76	18.98
289.3	750	92.4	12.88	38.72	22.95	55.66	16.94	3.286	0.62	36.30	19.36
291.2	768	92.2	13.19	38.87	22.78	55.98	17.11	3.271	0.61	36.55	19.43
293.9	786	92.1	13.49	39.10	22.64	56.36	17.26	3.266	0.60	36.81	19.55
294.1	804	91.9	13.80	39.00	22.48	56.42	17.42	3.239	0.60	36.92	19.50
295.8	821	91.8	14.10	39.10	22.31	56.69	17.58	3.224	0.59	37.14	19.55
299.4	839	91.6	14.40	39.48	22.14	57.23	17.75	3.224	0.58	37.49	19.74
301.3	857	91.5	14.70	39.61	22.00	57.50	17.89	3.214	0.58	37.70	19.80
303.9	875	91.3	15.01	39.82	21.84	57.88	18.06	3.205	0.57	37.97	19.91
303.4	892	91.1	15.32	39.62	21.66	57.85	18.23	3.173	0.57	38.04	19.81
306.0	910	91.0	15.62	39.84	21.51	58.22	18.39	3.167	0.56	38.31	19.92
309.1	928	90.8	15.93	40.13	21.35	58.67	18.54	3.164	0.55	38.60	20.06
312.1	946	90.6	16.24	40.39	21.16	59.12	18.73	3.157	0.55	38.93	20.20

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CONSOLIDATED-UNDRAINED TRIAXIAL COMPRESSION TEST ON COHESIVE SOILS ASTM D 4767

Client	Civil & Environmental Consultants, Inc.	Boring	RB-1
Client Project	091-867 Apex Landfill Expansion	Depth	14'-19'
Project No.	30598	Sample	B-1
Test No.	3	Lab Sample No.	30598022
USCS Description:	Olive Brown Lean Clay with Sand	Test Conditions:	Remolded - Side And Double Drained

SAMPLE CONDITIONS

	Initial	After Consol.	Final
Tare Number	823	NA	808
Wt. Tare & WS, gm	273.29	NA	1275.95
Wt. Tare & DS, gm	246.66	NA	1096.60
Wt. Tare, gm	103.31	NA	102.65
Water Content, %	18.6	18.0	18.0
Wt. Tube & WS., gm	1179.8	NA	
Wt. Of Tube, gm	0.0	NA	
Wt. Of WS., gm	1179.8	1174.5	
Length 1, in	6	NA	
Length 2, in	6	NA	
Length 3, in	6	NA	
Top Diameter, in	2.864	NA	
Middle Diameter, in	2.865	NA	
Bottom Diameter, in	2.8655	NA	
Average Length, in	6.000	5.761	
Average Diameter, in	2.865	2.756	
Average Area, in^2	6.45	5.97	
Sample Volume, in^3	38.68	35.04	
Unit Dry Wt., gms/cc	1.57	1.73	
Unit Dry Wt., pcf	98.0	108.1	
Specific Gravity, Assume	2.70	2.70	
Volume of Solids, cc	368.52	368.52	
Void Ratio, e	0.72	0.56	
Porosity, n	0.42	0.36	
Pore Volume, cc	16.19	12.56	
Saturation, %	69.7	87.3	

TEST CONDITIONS

Cell Pressure, psi	118.52	
Back Pressure, psi	39.70	
Effective Consolidating Pressure, psi	78.82	σ_3
Pore Pressure Parameter (B), %	95	

SATURATION AND CONSOLIDATION VOLUME CHANGES

Height Change, mils	Reading	Change	Consolidation	
Initial Dial Reading	7.597	0	Volume Change, ml	59.5
After Saturation	7.562	35	Volume Change, in^3	3.63
After Consolidation	7.358	239	Saturation Method:	Wet

STRAIN RATE CALCULATIONS

Calc. Strain Rate, %/min (t50=.66)	0.0061	Strain Rate Used, %/min	0.0003
Calc. Deformation Rate, in/min	0.0349	Deformation Rate Used	0.002

EFFECTIVE FAILURE SUMMARY

Failure Conditions	Max σ_1'/σ_3'	15% ε	
Effective Consolidating Pressure, psi	78.82	78.82	σ_3
1St. Maximum Effective Principal Stress Ratio	3.042	3.02	σ_1'/σ_3'
Deviator Stress at Failure, psi	55.32	62.05	$\sigma_1-\sigma_3$
Axial Strain at Failure, %	8.34	15.00	ε
Effective Minor Principal Stress at Failure, psi	27.09	30.68	σ_3'
Effective Major Principal Stress at Failure, psi	82.41	92.73	σ_1'
Mohr's Circle Stress Path (Origin of Circle), psi	54.75	61.71	p'
Mohr's Circle Stress Path (Radius of Circle), psi	27.66	31.03	q

TOTAL FAILURE SUMMARY

Failure Conditions	Max σ_1'/σ_3'	15% ε	
Deviator Stress at Failure, psi	55.32	62.05	$\sigma_1-\sigma_3$
Axial Strain at Failure, %	8.34	15.00	ε
Total Minor Principal Stress at Failure, psi	78.82	78.82	σ_3
Total Major Principal Stress at Failure, psi	134.14	140.87	σ_1

TEST DATA

Axial Load	Axial Deformation	Total Pore Water Pressure	Axial Strain	Principal Stress Difference (Deviator Stress)	Induced Pore Water Pressure	Effective Major Principal Stress	Effective Minor Principal Stress	Effective Principal Stress Ratio	A-Bar	Mohr's Circle Stress Paths	
										Origin of Circle	Radius of Circle
lb.	mils	psi	%	psi	psi	psi	psi			psi	psi
P	ΔH	U	ε	$\sigma_1-\sigma_3$	ΔU	σ_1'	σ_3'	σ_1'/σ_3'	A'	p'	q
22.8	0	39.7	0	0	0	NA	NA	NA	NA	78.82	0
69.2	5	43.4	0.09	7.77	3.68	82.91	75.14	1.103	0.50	79.03	3.89
133.5	10	49.5	0.17	18.53	9.80	87.55	69.02	1.268	0.56	78.29	9.26
165.0	16	53.8	0.28	23.77	14.06	88.53	64.76	1.367	0.62	76.65	11.89
182.9	21	57.3	0.37	26.74	17.55	88.00	61.27	1.436	0.69	74.63	13.37
196.8	28	60.3	0.48	29.04	20.55	87.31	58.27	1.498	0.74	72.79	14.52
208.7	34	62.9	0.59	30.98	23.20	86.60	55.62	1.557	0.79	71.11	15.49
218.1	40	65.2	0.69	32.52	25.51	85.83	53.32	1.610	0.83	69.57	16.26
226.9	45	67.3	0.79	33.95	27.56	85.21	51.26	1.662	0.85	68.23	16.97
233.5	52	68.9	0.91	35.00	29.19	84.64	49.63	1.705	0.88	67.13	17.50
240.0	58	70.6	1.01	36.05	30.92	83.95	47.90	1.753	0.90	65.92	18.02
245.6	64	72.1	1.11	36.94	32.40	83.36	46.42	1.796	0.92	64.89	18.47
250.3	69	73.4	1.21	37.69	33.70	82.80	45.12	1.835	0.94	63.96	18.84
262.3	87	76.6	1.50	39.55	36.93	81.44	41.89	1.944	0.98	61.66	19.77

273.1	104	79.3	1.80	41.21	39.63	80.40	39.19	2.052	1.01	59.79	20.61
282.1	123	81.4	2.14	42.54	41.73	79.63	37.09	2.147	1.03	58.36	21.27
290.3	142	83.2	2.46	43.74	43.47	79.10	35.35	2.237	1.05	57.22	21.87
296.9	158	84.6	2.74	44.70	44.86	78.66	33.96	2.316	1.06	56.31	22.35
303.1	176	85.9	3.05	45.55	46.17	78.20	32.65	2.395	1.07	55.42	22.77
308.8	194	86.8	3.37	46.33	47.11	78.04	31.71	2.461	1.07	54.88	23.16
314.6	213	87.8	3.69	47.11	48.05	77.88	30.77	2.531	1.07	54.32	23.56
320.7	231	88.4	4.00	47.93	48.74	78.02	30.08	2.594	1.07	54.05	23.97
324.7	247	89.1	4.29	48.44	49.41	77.85	29.42	2.647	1.07	53.63	24.22
329.4	265	89.5	4.61	49.02	49.83	78.01	28.99	2.691	1.07	53.50	24.51
334.7	283	90.1	4.92	49.72	50.37	78.17	28.45	2.747	1.07	53.31	24.86
339.7	302	90.4	5.25	50.34	50.67	78.50	28.15	2.788	1.06	53.33	25.17
344.2	319	90.7	5.54	50.89	51.01	78.71	27.81	2.830	1.05	53.26	25.45
348.0	337	90.9	5.84	51.33	51.23	78.92	27.60	2.860	1.05	53.26	25.66
352.3	355	91.1	6.16	51.84	51.40	79.25	27.42	2.891	1.04	53.34	25.92
357.5	373	91.3	6.48	52.47	51.58	79.71	27.24	2.926	1.03	53.48	26.23
362.5	392	91.4	6.80	53.08	51.69	80.22	27.13	2.956	1.02	53.67	26.54
365.8	409	91.4	7.09	53.42	51.75	80.49	27.07	2.973	1.02	53.78	26.71
369.5	427	91.4	7.41	53.82	51.70	80.94	27.12	2.985	1.01	54.03	26.91
374.1	444	91.5	7.71	54.36	51.77	81.41	27.05	3.009	1.00	54.23	27.18
378.7	463	91.4	8.04	54.86	51.69	81.99	27.13	3.023	0.99	54.56	27.43
382.8	481	91.4	8.34	55.32	51.73	82.41	27.09	3.042	0.98	54.75	27.66
385.9	498	91.3	8.64	55.61	51.59	82.84	27.23	3.042	0.98	55.04	27.81
389.9	515	91.3	8.94	56.04	51.61	83.25	27.21	3.059	0.97	55.23	28.02
393.9	534	91.2	9.27	56.45	51.48	83.79	27.34	3.065	0.96	55.57	28.22
398.3	552	91.1	9.59	56.92	51.38	84.36	27.44	3.074	0.95	55.90	28.46
401.6	570	90.9	9.90	57.21	51.24	84.79	27.58	3.074	0.94	56.19	28.61
405.0	587	90.8	10.19	57.54	51.08	85.28	27.74	3.074	0.93	56.51	28.77
408.5	605	90.7	10.51	57.87	50.96	85.72	27.86	3.077	0.93	56.79	28.93
413.0	625	90.4	10.85	58.32	50.71	86.43	28.11	3.074	0.92	57.27	29.16
416.6	642	90.3	11.15	58.66	50.61	86.86	28.21	3.079	0.91	57.54	29.33
419.6	659	90.1	11.44	58.91	50.41	87.32	28.41	3.073	0.90	57.87	29.45
423.2	676	90.0	11.74	59.25	50.26	87.81	28.56	3.075	0.89	58.18	29.62
427.5	695	89.8	12.06	59.66	50.12	88.36	28.70	3.078	0.88	58.53	29.83
430.7	714	89.5	12.39	59.91	49.81	88.92	29.01	3.065	0.88	58.96	29.95
434.6	731	89.4	12.68	60.28	49.70	89.40	29.12	3.070	0.87	59.26	30.14
437.2	748	89.1	12.98	60.45	49.41	89.86	29.41	3.056	0.86	59.63	30.23
440.3	767	89.0	13.31	60.68	49.27	90.23	29.55	3.053	0.85	59.89	30.34
444.0	785	88.8	13.63	60.99	49.07	90.74	29.75	3.050	0.85	60.24	30.49
447.8	803	88.5	13.94	61.31	48.81	91.32	30.01	3.043	0.84	60.67	30.66
450.7	820	88.4	14.23	61.52	48.66	91.69	30.16	3.040	0.83	60.92	30.76
453.3	838	88.0	14.54	61.68	48.35	92.15	30.47	3.024	0.83	61.31	30.84
456.9	857	87.9	14.87	61.95	48.23	92.54	30.59	3.025	0.82	61.56	30.98
460.3	875	87.7	15.19	62.20	48.01	93.01	30.81	3.019	0.81	61.91	31.10
463.8	892	87.5	15.49	62.48	47.79	93.51	31.03	3.014	0.81	62.27	31.24
466.1	910	87.3	15.79	62.58	47.58	93.82	31.24	3.003	0.80	62.53	31.29
469.1	928	87.0	16.10	62.77	47.29	94.30	31.53	2.990	0.79	62.92	31.38
472.4	946	86.9	16.42	62.99	47.19	94.63	31.63	2.991	0.79	63.13	31.50
475.8	965	86.7	16.75	63.22	46.98	95.06	31.84	2.986	0.78	63.45	31.61
478.6	983	86.4	17.06	63.38	46.69	95.51	32.13	2.973	0.78	63.82	31.69
480.6	999	86.2	17.34	63.44	46.54	95.72	32.28	2.965	0.77	64.00	31.72
483.2	1018	86.0	17.67	63.55	46.31	96.06	32.51	2.954	0.77	64.29	31.77

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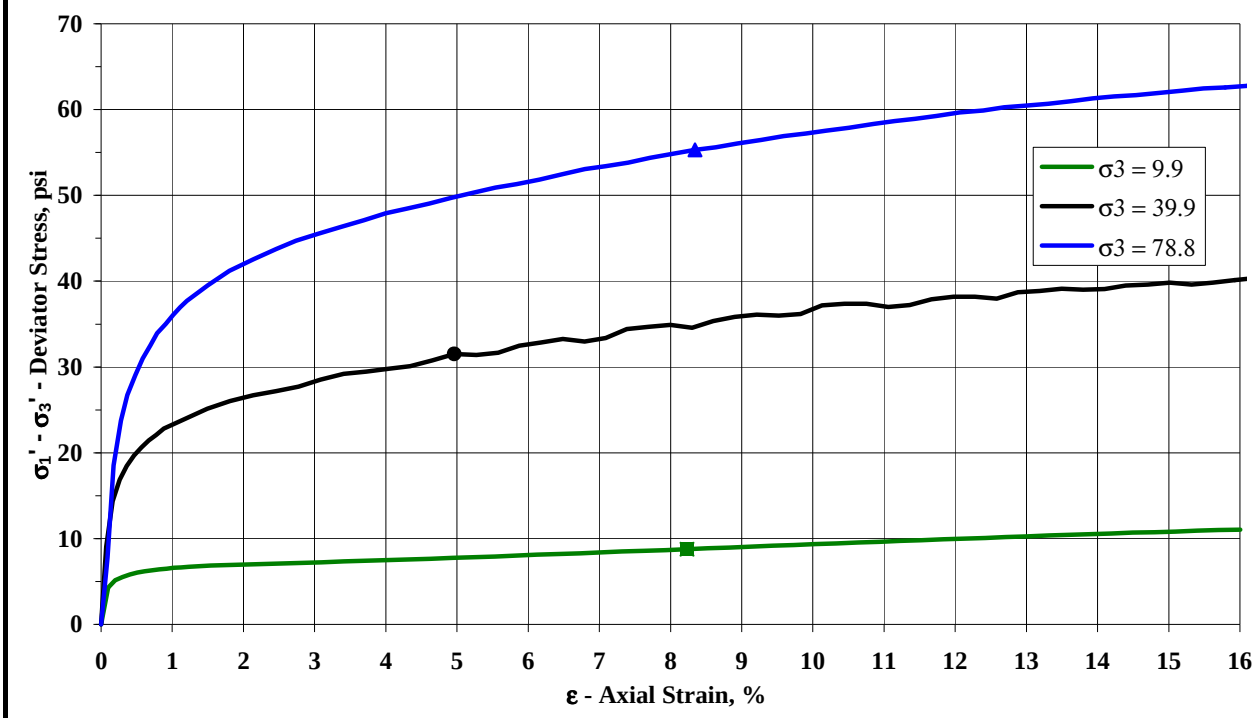
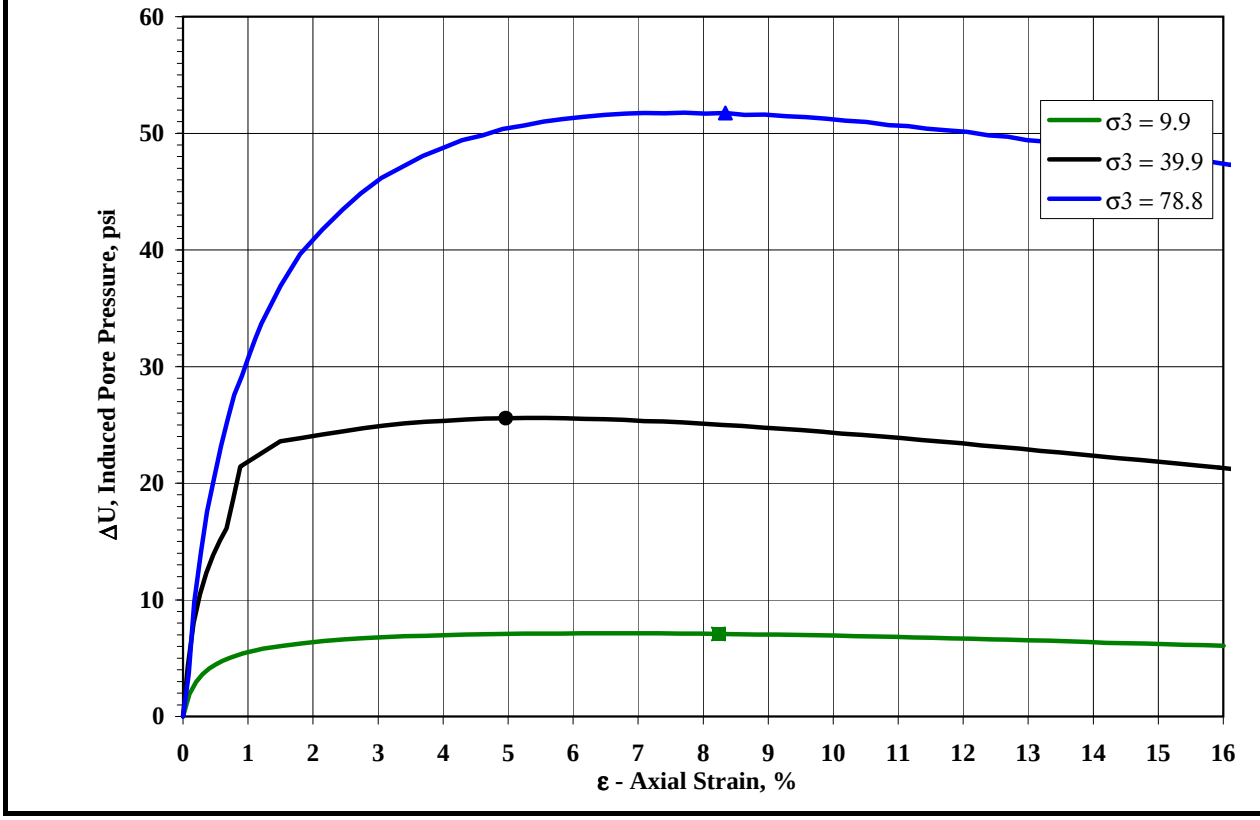
CONSOLIDATED-UNDRAINED TRIAXIAL COMPRESSION TEST ON COHESIVE SOILS ASTM D 4767

Client	Civil & Environmental Consultants, Inc.	Boring	RB-1
Client Project	091-867 Apex Landfill Expansion	Depth	14'-19'
Project No.	30598	Sample	B-1
Test Conditions:	Remolded - Side And Double Drained	Lab Sample No.	30598022
USCS Description:	Olive Brown Lean Clay with Sand		

AXIAL STRAIN vs. DEVIATOR STRESS



AXIAL STRAIN vs. INDUCED PORE-WATER PRESSURE



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CONSOLIDATED-UNDRAINED TRIAXIAL COMPRESSION TEST ON COHESIVE SOILS ASTM D 476

Client	Civil & Environmental Consultants, In	Boring	RB-1
Client Project	091-867 Apex Landfill Expansion	Depth	14'-19'
Project No.	30598	Sample	B-1
		Lab Sample No.	30598022
USCS Description:	Olive Brown Lean Clay with Sand		
Test Conditions:	Remolded - Side And Double Drained		

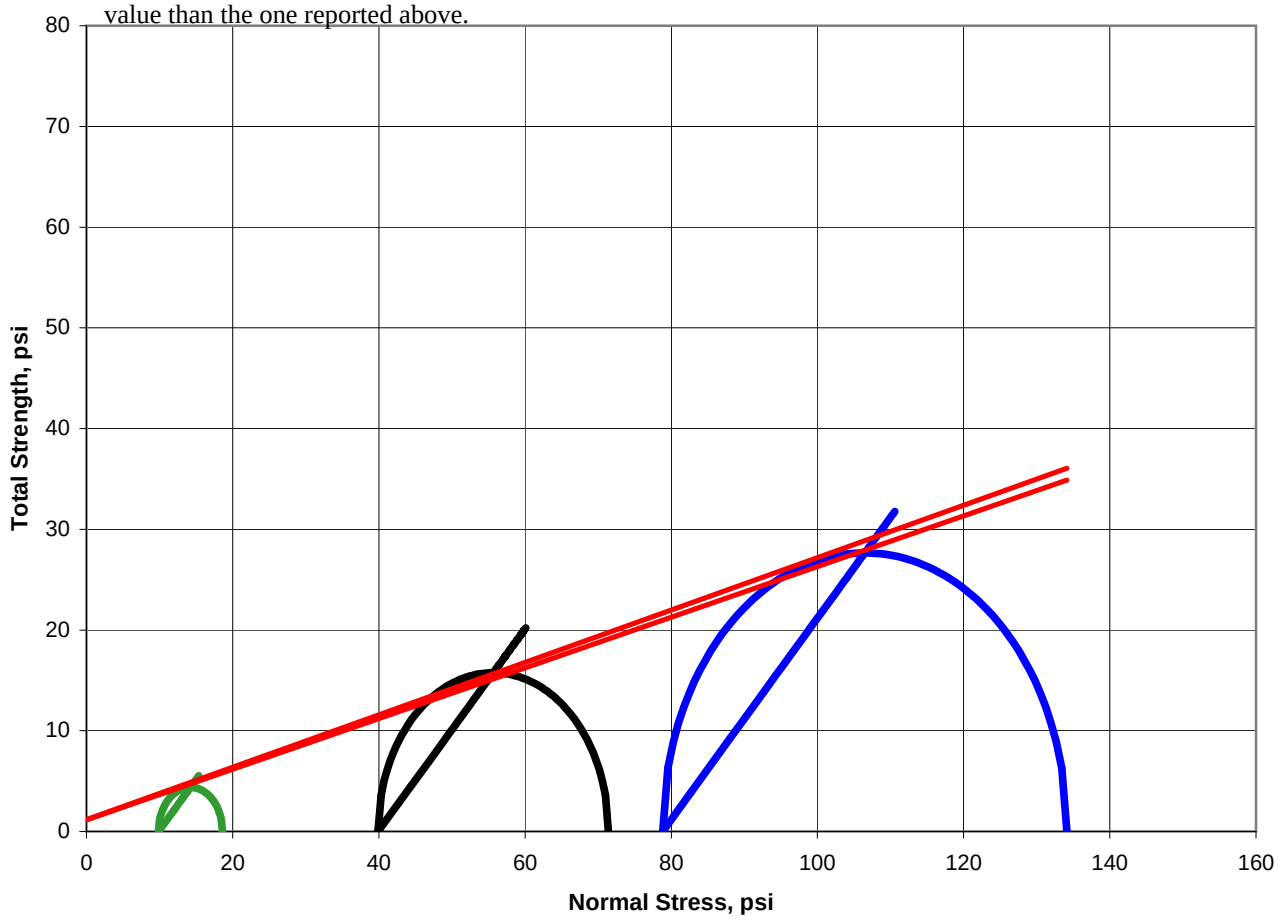
TOTAL STRESS

FAILURE CONDITION: 1st. MAX. EFFECTIVE PRINCIPAL STRESS RATIO

Test No.	Deviator Stress	Major Principal Stress	Minor Principal Stress	Strain at Failure	Mohr's Circle Stress Path		Failure Angle	
	$\sigma1-\sigma3$	$\sigma1$	$\sigma3$	ε	$(\sigma1+\sigma3)/2$	$(\sigma1-\sigma3)/2$		
	psi	psi	psi	%	psi	psi	α, deg	14.1
Test 1	8.75	18.60	9.85	8.23	14.23	4.37	a, psi	1.1
Test 2	31.51	71.40	39.89	4.96	55.65	15.75	Φ, deg	14.6
Test 3	55.32	134.14	78.82	8.34	106.48	27.66	C, psi	1.2

Calculations based on: Test 1 Test 2 Test 3

Note: The Friction Angle and Cohesion using other combinations of test points may yield a higher or lower value than the one reported above.



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CONSOLIDATED-UNDRAINED TRIAXIAL COMPRESSION TEST ON COHESIVE SOILS ASTM D 476

Client	Civil & Environmental Consultants, In	Boring	RB-1
Client Project	091-867 Apex Landfill Expansion	Depth	14'-19'
Project No.	30598	Sample	B-1
		Lab Sample No.	30598022
USCS Description:	Olive Brown Lean Clay with Sand		
Test Conditions:	Remolded - Side And Double Drained		

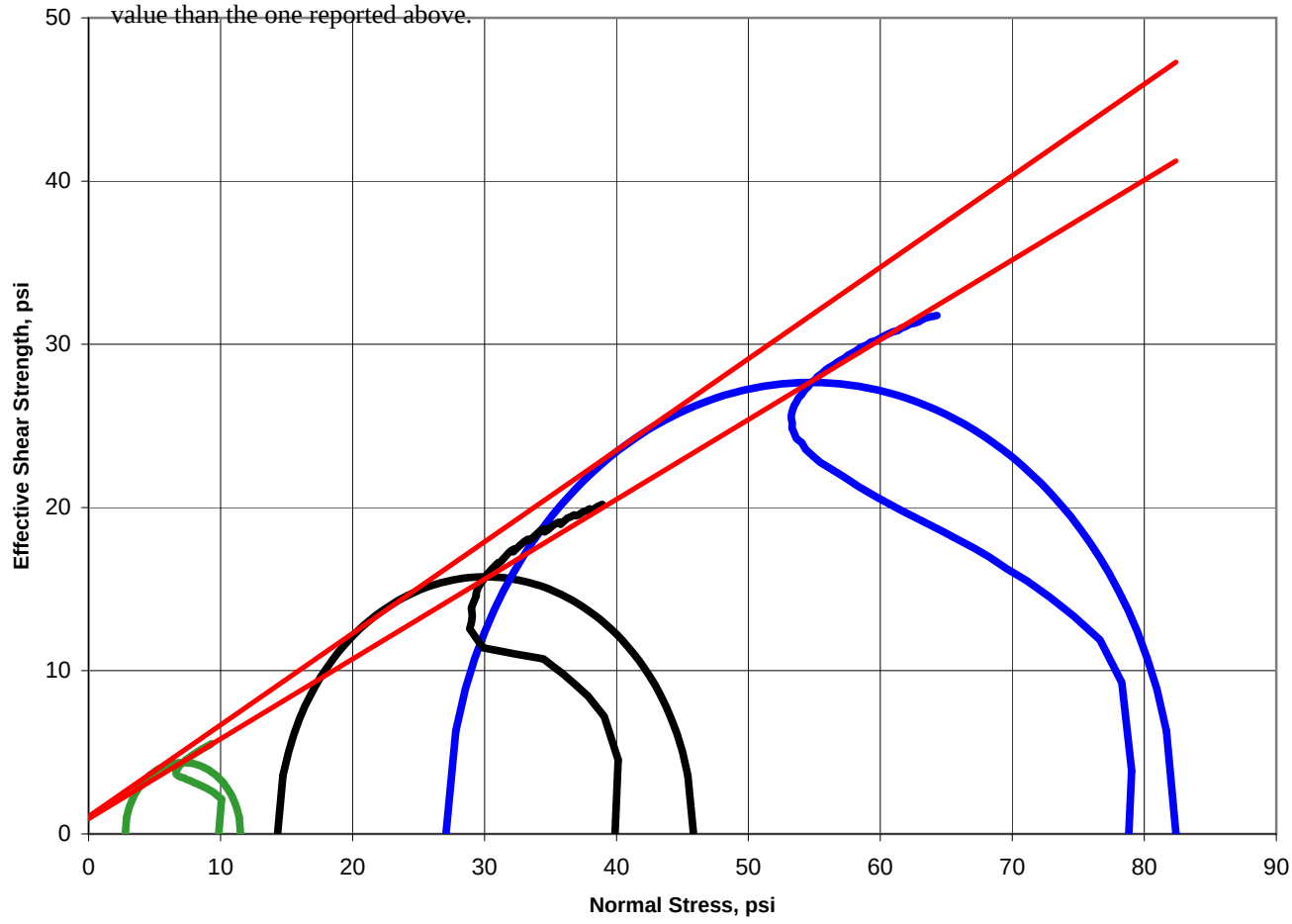
EFFECTIVE STRESS

FAILURE CONDITION: 1st. MAX. EFFECTIVE PRINCIPAL STRESS RATIO

Test No.	Deviator Stress	Major Principal Stress	Minor Principal Stress	Strain at Failure	Mohr's Circle Stress Path		Failure Angle	
	$\sigma 1-\sigma 3$	$\sigma' 1$	$\sigma' 3$	ε	p'	q		
	psi	psi	psi	%	psi	psi	α', deg	26.1
Test 1	8.75	11.52	2.77	8.23	7.15	4.37	a', psi	0.9
Test 2	31.51	45.83	14.32	4.96	30.07	15.75	Φ', deg	29.3
Test 3	55.32	82.41	27.09	8.34	54.75	27.66	C', psi	1.1

Calculations based on: Test 1 Test 2 Test 3

Note: The Friction Angle and Cohesion using other combinations of test points may yield a higher or lower value than the one reported above.



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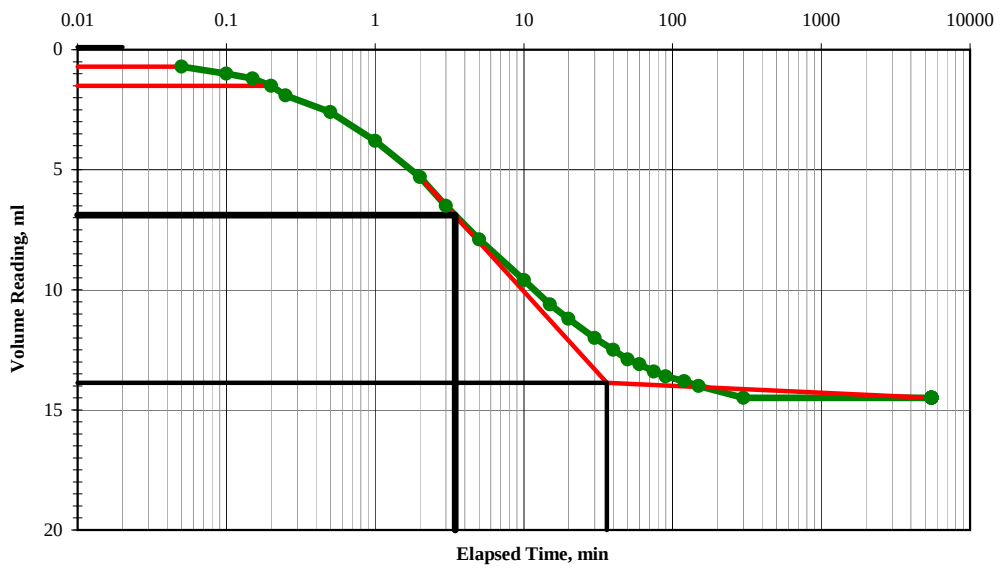
THREE DIMENSIONAL TRIAXIAL CONSOLIDATION TEST

Client	Civil & Environmental Consultants, Inc	Boring	RB-1	**Staged Consolidation**	
Client Project	091-867 Apex Landfill Expansion	Depth	14'-19'	Consolidation Plot Stress, psi	6.9
Project No.	30598	Sample	B-1	**Final Test Pressures**	
		Lab Sample	30598022	Cell Pressure, psi	79.8
USCS Description:	Olive Brown Lean Clay with Sand			Back Pressure, psi	70.0
Test Conditions:	Remolded - Side And Double Drained			Effective Consol., psi	9.9
				Additional Consol. Volume, ml	0.0

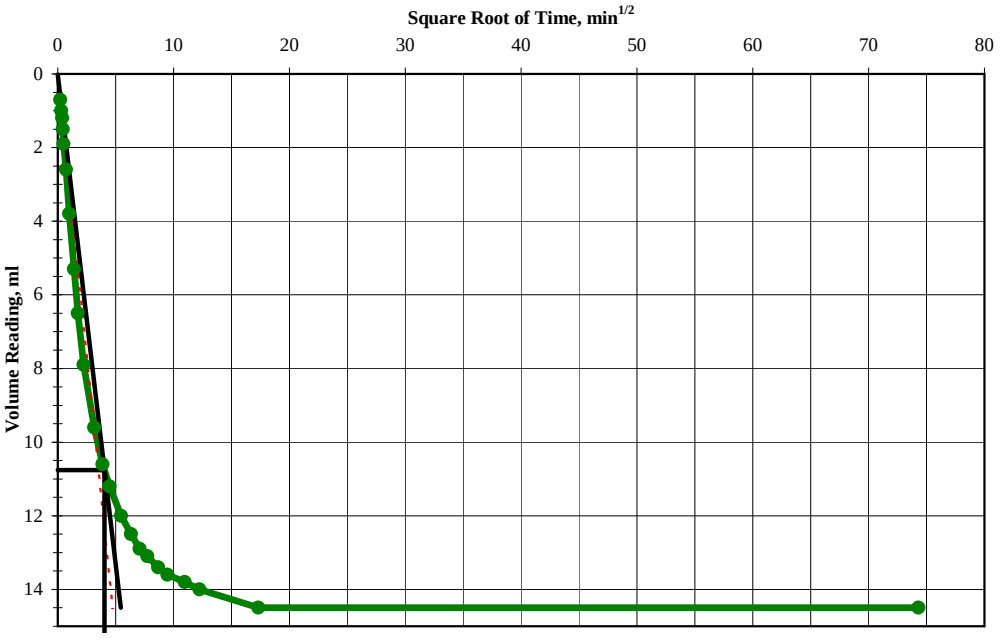
Consol. Start Date: 12/30/2010

Elapsed Time (min)	Sqrt Time ($min^{1/2}$)	Volume Reading ml
0	0	0.0
0.05	0.22	0.7
0.10	0.32	1.0
0.15	0.39	1.2
0.20	0.45	1.5
0.25	0.50	1.9
0.50	0.71	2.6
1.00	1.00	3.8
2.00	1.41	5.3
3.00	1.73	6.5
5.00	2.24	7.9
10.00	3.16	9.6
15.00	3.87	10.6
20.00	4.47	11.2
30.00	5.48	12.0
40.00	6.32	12.5
50.00	7.07	12.9
60.00	7.75	13.1
75.00	8.66	13.4
90.00	9.49	13.6
120.00	10.95	13.8
150.00	12.25	14.0
300.00	17.32	14.5
5520.00	74.30	14.5

Log of Elapsed Time vs. Volume Reading



Square Root of Elapsed Time vs. Volume Reading



Sqrt. of Elapsed Time vs Volume		Log of Elapsed Time vs Volume		Consolidation Summary	
T0 = 0 min.	V0 = 0.0 ml.	T0 = 0 min.	V0 = -0.1 ml.	Initial Volume Reading, ml	0.0
T90 = 16.2 min	V90 = 10.8 ml.	T50 = 3.5 min.	V50 = 6.9 ml.	Final Volume Reading, ml	14.5
T100 = NA min	V100 = 12.0 ml.	T100 = 36.2 min.	V100 = 13.9 ml.	Total Volume Change, ml	14.5

Input Validation: Reviewed By: Date 12/30/2010

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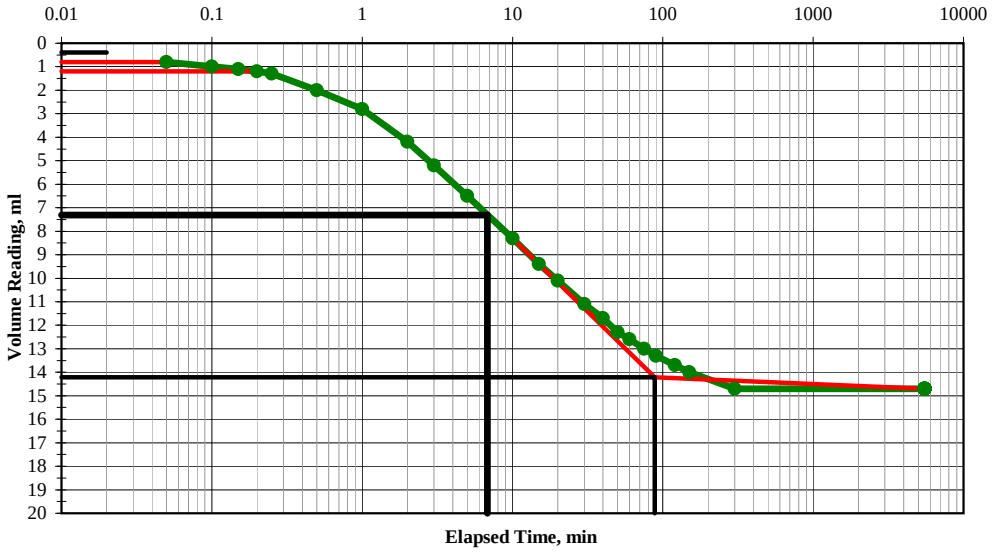
THREE DIMENSIONAL TRIAXIAL CONSOLIDATION TEST

Client	Civil & Environmental Consultants, Inc	Boring	RB-1	**Staged Consolidation**	
Client Project	091-867 Apex Landfill Expansion	Depth	14'-19'	Consolidation Plot Stress, psi	6.9
Project No.	30598	Sample	B-1	**Final Test Pressures**	
		Lab Sample	30598022	Cell Pressure, psi	109.3
USCS Description:	Olive Brown Lean Clay with Sand			Back Pressure, psi	69.5
Test Conditions:	Remolded - Side And Double Drained			Effective Consol., psi	39.9
				Additional Consol. Volume, ml	32.7

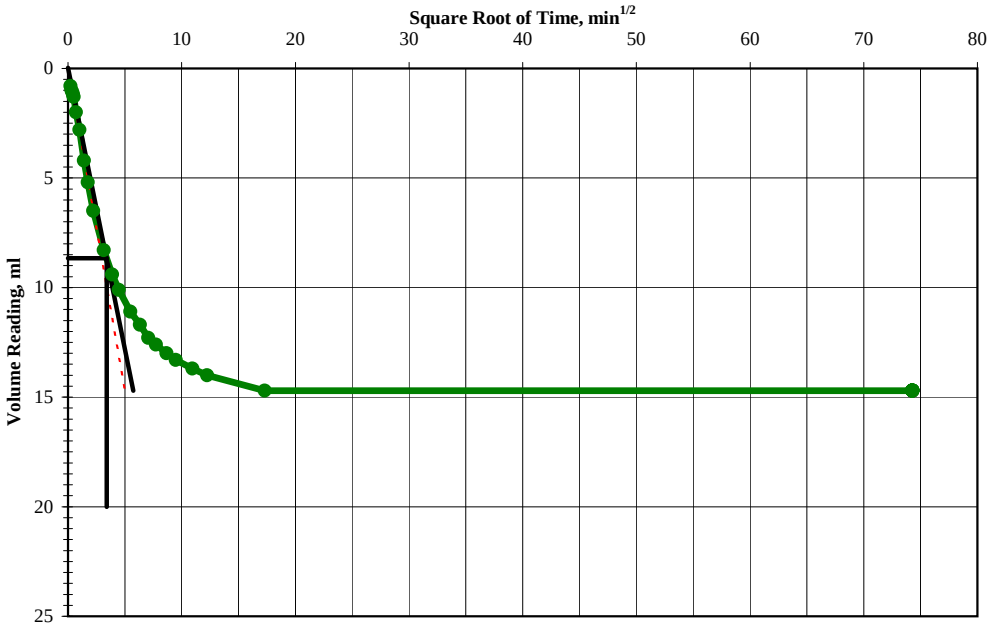
Consol. Start Date: 12/30/2010

Elapsed Time (min)	Sqrt Time ($min^{1/2}$)	Volume Reading ml
0	0	0.0
0.05	0.22	0.8
0.10	0.32	1.0
0.15	0.39	1.1
0.20	0.45	1.2
0.25	0.50	1.3
0.50	0.71	2.0
1.00	1.00	2.8
2.00	1.41	4.2
3.00	1.73	5.2
5.00	2.24	6.5
10.00	3.16	8.3
15.00	3.87	9.4
20.00	4.47	10.1
30.00	5.48	11.1
40.00	6.32	11.7
50.00	7.07	12.3
60.00	7.75	12.6
75.00	8.66	13.0
90.00	9.49	13.3
120.00	10.95	13.7
150.00	12.25	14.0
300.00	17.32	14.7
5520.00	74.30	14.7

Log of Elapsed Time vs. Volume Reading



Square Root of Elapsed Time vs. Volume Reading



Sqrt. of Elapsed Time vs Volume		Log of Elapsed Time vs Volume		Consolidation Summary	
T0 = 0 min.	V0 = 0.0 ml.	T0 = 0 min.	V0 = 0.4 ml.	Initial Volume Reading, ml	0.0
T90 = 11.5 min	V90 = 8.7 ml.	T50 = 6.8 min.	V50 = 7.3 ml.	Final Volume Reading, ml	14.7
T100 = NA min	V100 = 9.6 ml.	T100 = 88.4 min.	V100 = 14.2 ml.	Total Volume Change, ml	47.4

Input Validation: Reviewed By: Date 12/30/2010

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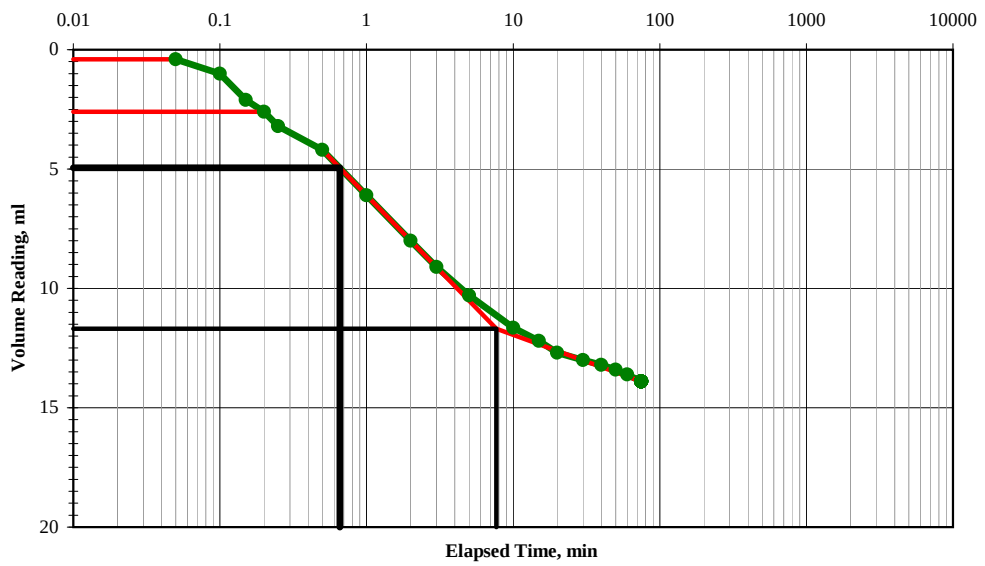
THREE DIMENSIONAL TRIAXIAL CONSOLIDATION TEST

Client	Civil & Environmental Consultants, Inc	Boring	RB-1	**Staged Consolidation**	
Client Project	091-867 Apex Landfill Expansion	Depth	14'-19'	Consolidation Plot Stress, psi	6.9
Project No.	30598	Sample	B-1	**Final Test Pressures**	
		Lab Sample	30598022	Cell Pressure, psi	118.5
USCS Description:	Olive Brown Lean Clay with Sand			Back Pressure, psi	39.7
Test Conditions:	Remolded - Side And Double Drained			Effective Consol., psi	78.8
				Additional Consol. Volume, m	45.6

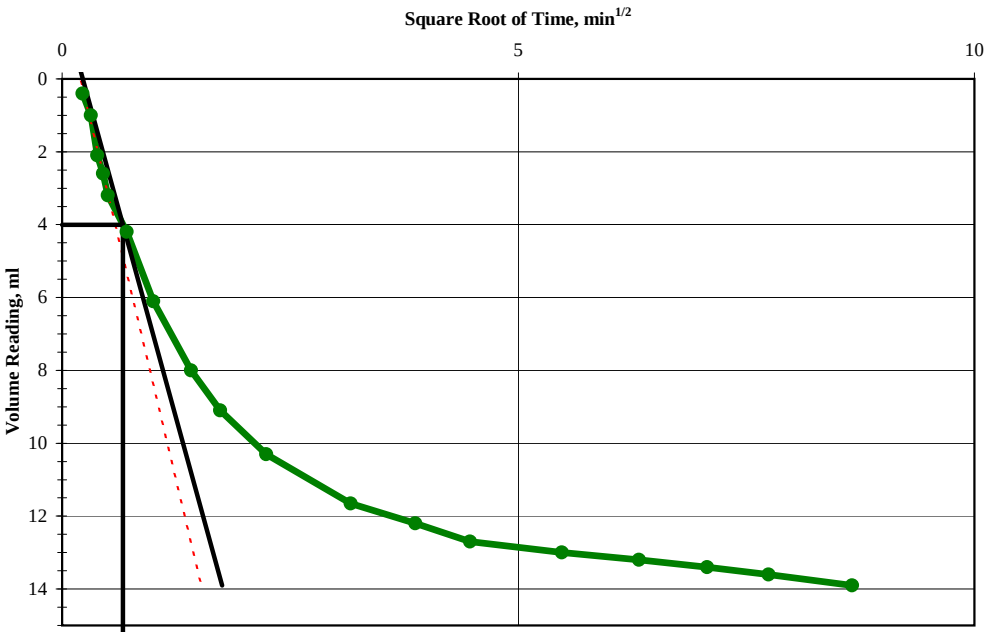
Consol. Start Date: 1/20/2011

Elapsed Time (min)	Sqrt Time ($min^{1/2}$)	Volume Reading ml
0	0	0.0
0.05	0.22	0.4
0.10	0.32	1.0
0.15	0.39	2.1
0.20	0.45	2.6
0.25	0.50	3.2
0.50	0.71	4.2
1.00	1.00	6.1
2.00	1.41	8.0
3.00	1.73	9.1
5.00	2.24	10.3
10.00	3.16	11.7
15.00	3.87	12.2
20.00	4.47	12.7
30.00	5.48	13.0
40.00	6.32	13.2
50.00	7.07	13.4
60.00	7.75	13.6
75.00	8.66	13.9

Log of Elapsed Time vs. Volume Reading



Square Root of Elapsed Time vs. Volume Reading



Sqrt. of Elapsed Time vs Volume		Log of Elapsed Time vs Volume		Consolidation Summary	
T0 = 0 min.	V0 = -2.1 ml.	T0 = 0 min.	V0 = -1.8 ml.	Initial Volume Reading, ml	0.0
T90 = 0.4 min	V90 = 4.0 ml.	T50 = 0.7 min.	V50 = 4.9 ml.	Final Volume Reading, ml	13.9
T100 = NA min	V100 = 4.7 ml.	T100 = 7.7 min.	V100 = 11.7 ml.	Total Volume Change, ml	59.5

Input Validation: Reviewed By: Date 1/20/2011

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CONSOLIDATED-UNDRAINED TRIAXIAL COMPRESSION TEST ON COHESIVE SOILS ASTM D 4767

Client	Civil & Environmental Consultants, Inc.	Boring	RB-8
Client Project	091-867 Apex Landfill Expansion	Depth	23'-27'
Project No.	30598	Sample	B-1
Test No.	1	Lab Sample No.	30598023
USCS Description:	DARK GRAY FAT CLAY	Test Conditions:	Remolded - Side And Double Drained

SAMPLE CONDITIONS

	Initial	After Consol.	Final
Tare Number	D4	NA	954
Wt. Tare & WS, gm	200.82	NA	1282.25
Wt. Tare & DS, gm	187.72	NA	1012.73
Wt. Tare, gm	123.40	NA	99.26
Water Content, %	20.4	29.5	29.5
Wt. Tube & WS., gm	1093.2	NA	
Wt. Of Tube, gm	0.0	NA	
Wt. Of WS., gm	1093.2	1176.2	
Length 1, in	6	NA	
Length 2, in	6	NA	
Length 3, in	6	NA	
Top Diameter, in	2.864	NA	
Middle Diameter, in	2.865	NA	
Bottom Diameter, in	2.8655	NA	
Average Length, in	6.000	5.458	
Average Diameter, in	2.865	2.935	
Average Area, in^2	6.45	6.76	
Sample Volume, in^3	38.68	37.21	
Unit Dry Wt., gms/cc	1.43	1.49	
Unit Dry Wt., pcf	89.4	93.0	
Specific Gravity, Assume	2.70	2.70	
Volume of Solids, cc	336.37	336.37	
Void Ratio, e	0.88	0.81	
Porosity, n	0.47	0.45	
Pore Volume, cc	18.15	16.68	
Saturation, %	62.2	98.0	

TEST CONDITIONS

Cell Pressure, psi	79.90	
Back Pressure, psi	70.02	
Effective Consolidating Pressure, psi	9.88	σ_3
Pore Pressure Parameter (B), %	96	

SATURATION AND CONSOLIDATION VOLUME CHANGES

Height Change, mils	Reading	Change	Consolidation	
Initial Reading	7.065	0	Volume Change, ml	24.1
After Saturation	7.05	15	Volume Change, in^3	1.47
After Consolidation	6.523	542	Saturation Method:	Wet

STRAIN RATE CALCULATIONS

Calc. Strain Rate, %/min (t50=13.64)	0.0003	Strain Rate Used, %/min	0.0002
Calc. Deformation Rate, in/min	0.0016	Deformation Rate Used	0.001

EFFECTIVE FAILURE SUMMARY

Failure Conditions	Max σ_1'/σ_3'	15% ε	
Effective Consolidating Pressure, psi	9.88	9.88	σ_3
1St. Maximum Effective Principal Stress Ratio	3.573	3.23	σ_1'/σ_3'
Deviator Stress at Failure, psi	7.28	7.74	$\sigma_1-\sigma_3$
Axial Strain at Failure, %	9.53	15.00	ε
Effective Minor Principal Stress at Failure, psi	2.83	3.48	σ_3'
Effective Major Principal Stress at Failure, psi	10.11	11.22	σ_1'
Mohr's Circle Stress Path (Origin of Circle), psi	6.47	7.35	p'
Mohr's Circle Stress Path (Radius of Circle), psi	3.64	3.87	q

TOTAL FAILURE SUMMARY

Failure Conditions	Max σ_1'/σ_3'	15% ε	
Deviator Stress at Failure, psi	7.28	7.74	$\sigma_1-\sigma_3$
Axial Strain at Failure, %	9.53	15.00	ε
Total Minor Principal Stress at Failure, psi	9.88	9.88	σ_3
Total Major Principal Stress at Failure, psi	17.16	17.62	σ_1

TEST DATA

Axial Load	Axial Deformation	Total Pore Water Pressure	Axial Strain	Principal Stress Difference (Deviator Stress)	Induced Pore Water Pressure	Effective Major Principal Stress	Effective Minor Principal Stress	Effective Principal Stress Ratio	A-Bar	Mohr's Circle Stress Paths	
										Origin of Circle	Radius of Circle
lb.	mils	psi	%	psi	psi	psi	psi			psi	psi
P	ΔH	U	ε	$\sigma_1-\sigma_3$	ΔU	σ_1'	σ_3'	σ_1'/σ_3'	A'	p'	q
19.9	0	70.0	0	0	NA	NA	NA	NA	NA	9.88	0
39.5	5	71.7	0.09	2.89	1.71	11.06	8.17	1.354	0.62	9.62	1.45
43.9	11	72.5	0.20	3.54	2.46	10.95	7.42	1.477	0.73	9.19	1.77
46.5	17	73.1	0.32	3.92	3.03	10.77	6.85	1.572	0.80	8.81	1.96
48.5	23	73.5	0.43	4.21	3.45	10.64	6.43	1.654	0.85	8.53	2.10
49.9	30	73.8	0.55	4.41	3.82	10.46	6.06	1.728	0.90	8.26	2.20
51.0	36	74.1	0.66	4.57	4.11	10.34	5.77	1.793	0.94	8.05	2.29
52.0	42	74.4	0.78	4.72	4.37	10.22	5.51	1.857	0.97	7.86	2.36
52.9	49	74.6	0.89	4.84	4.59	10.13	5.29	1.915	0.99	7.71	2.42
53.7	55	74.8	1.00	4.95	4.80	10.03	5.08	1.973	1.01	7.56	2.47
54.5	61	75.0	1.12	5.05	4.96	9.98	4.92	2.027	1.02	7.45	2.53
55.2	67	75.1	1.23	5.15	5.12	9.91	4.76	2.083	1.04	7.33	2.58
55.7	73	75.3	1.34	5.22	5.25	9.86	4.63	2.128	1.05	7.24	2.61
56.9	91	75.6	1.67	5.38	5.62	9.64	4.26	2.264	1.09	6.95	2.69

58.0	110	75.9	2.01	5.52	5.90	9.50	3.98	2.385	1.11	6.74	2.76
59.0	129	76.2	2.36	5.64	6.14	9.38	3.74	2.508	1.13	6.56	2.82
59.9	147	76.4	2.69	5.76	6.33	9.31	3.55	2.622	1.14	6.43	2.88
60.6	164	76.5	3.01	5.84	6.49	9.23	3.39	2.723	1.16	6.31	2.92
61.3	182	76.6	3.34	5.92	6.62	9.17	3.25	2.818	1.17	6.21	2.96
62.0	201	76.8	3.68	6.00	6.73	9.15	3.15	2.903	1.17	6.15	3.00
62.7	219	76.9	4.01	6.07	6.83	9.11	3.05	2.991	1.17	6.08	3.03
63.2	237	76.9	4.33	6.12	6.92	9.09	2.96	3.067	1.18	6.03	3.06
63.9	254	77.0	4.65	6.20	6.97	9.11	2.91	3.132	1.17	6.01	3.10
64.6	272	77.1	4.98	6.28	7.03	9.13	2.85	3.207	1.17	5.99	3.14
65.1	289	77.1	5.30	6.33	7.07	9.14	2.81	3.250	1.16	5.97	3.16
65.9	307	77.1	5.63	6.43	7.10	9.20	2.78	3.312	1.15	5.99	3.21
66.6	325	77.1	5.95	6.49	7.12	9.25	2.76	3.353	1.14	6.01	3.25
67.2	342	77.2	6.26	6.55	7.15	9.28	2.73	3.399	1.14	6.00	3.27
67.9	360	77.2	6.59	6.63	7.14	9.37	2.74	3.424	1.12	6.05	3.32
68.5	378	77.2	6.92	6.68	7.16	9.40	2.72	3.461	1.12	6.06	3.34
69.1	395	77.2	7.25	6.74	7.14	9.48	2.74	3.462	1.10	6.11	3.37
69.7	413	77.2	7.56	6.81	7.15	9.53	2.73	3.497	1.10	6.13	3.40
70.5	431	77.2	7.89	6.89	7.15	9.62	2.73	3.522	1.08	6.18	3.44
71.1	449	77.2	8.23	6.95	7.13	9.70	2.75	3.529	1.07	6.23	3.48
72.1	468	77.1	8.57	7.06	7.11	9.82	2.76	3.553	1.05	6.29	3.53
72.9	485	77.1	8.88	7.13	7.09	9.92	2.79	3.558	1.04	6.36	3.57
73.5	503	77.1	9.21	7.19	7.08	10.00	2.80	3.565	1.02	6.40	3.60
74.3	520	77.1	9.53	7.28	7.05	10.11	2.83	3.573	1.01	6.47	3.64
74.9	539	77.0	9.87	7.32	7.02	10.18	2.86	3.564	1.00	6.52	3.66
75.7	556	77.0	10.19	7.40	6.99	10.30	2.89	3.559	0.98	6.59	3.70
76.3	574	77.0	10.52	7.46	6.96	10.38	2.92	3.552	0.97	6.65	3.73
77.1	592	76.9	10.84	7.54	6.92	10.50	2.96	3.550	0.96	6.73	3.77
77.7	609	76.9	11.17	7.60	6.89	10.59	2.99	3.541	0.94	6.79	3.80
78.3	627	76.9	11.50	7.65	6.84	10.68	3.04	3.520	0.93	6.86	3.82
79.1	646	76.8	11.83	7.34	6.81	10.40	3.07	3.391	0.97	6.74	3.67
79.6	662	76.8	12.13	7.36	6.77	10.47	3.11	3.365	0.96	6.79	3.68
80.3	680	76.8	12.46	7.41	6.73	10.55	3.15	3.352	0.95	6.85	3.70
80.9	698	76.7	12.79	7.45	6.68	10.65	3.20	3.331	0.93	6.92	3.73
81.6	716	76.7	13.11	7.49	6.66	10.72	3.22	3.324	0.93	6.97	3.75
82.3	733	76.6	13.43	7.54	6.60	10.82	3.28	3.298	0.91	7.05	3.77
83.0	751	76.6	13.76	7.59	6.58	10.90	3.30	3.300	0.90	7.10	3.80
83.5	769	76.5	14.08	7.62	6.52	10.98	3.36	3.272	0.89	7.17	3.81
84.1	786	76.5	14.41	7.65	6.48	11.05	3.40	3.249	0.88	7.23	3.82
84.9	805	76.5	14.74	7.71	6.44	11.15	3.44	3.238	0.87	7.30	3.85
85.5	822	76.4	15.06	7.75	6.40	11.23	3.48	3.224	0.86	7.36	3.87
86.3	840	76.4	15.39	7.80	6.35	11.33	3.53	3.212	0.85	7.43	3.90
86.8	858	76.3	15.72	7.83	6.30	11.41	3.58	3.186	0.84	7.50	3.91
87.6	876	76.3	16.06	7.88	6.26	11.50	3.62	3.179	0.83	7.56	3.94
88.4	894	76.2	16.38	7.93	6.21	11.60	3.67	3.162	0.82	7.63	3.96
88.9	912	76.2	16.71	7.95	6.17	11.67	3.71	3.143	0.81	7.69	3.98
89.6	930	76.1	17.04	7.99	6.11	11.76	3.77	3.120	0.80	7.76	3.99
90.1	948	76.1	17.37	8.01	6.07	11.82	3.81	3.103	0.79	7.81	4.00
90.8	966	76.0	17.69	8.05	6.02	11.92	3.86	3.084	0.78	7.89	4.03
91.5	983	76.0	18.01	8.08	5.99	11.98	3.89	3.076	0.77	7.94	4.04

Input Validation: Reviewed By: Date Tested: 01/17/11

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CONSOLIDATED-UNDRAINED TRIAXIAL COMPRESSION TEST ON COHESIVE SOILS ASTM D 4767

Client	Civil & Environmental Consultants, Inc.	Boring	RB-8
Client Project	091-867 Apex Landfill Expansion	Depth	23'-27'
Project No.	30598	Sample	B-1
Test No.	2	Lab Sample No.	30598023
USCS Description:	DARK GRAY FAT CLAY	Test Conditions:	Remolded - Side And Double Drained

SAMPLE CONDITIONS

	Initial	After Consol.	Final
Tare Number	D4	NA	803
Wt. Tare & WS, gm	200.82	NA	1244.77
Wt. Tare & DS, gm	187.72	NA	1016.99
Wt. Tare, gm	123.4	NA	103.15
Water Content, %	20.4	24.9	24.9
Wt. Tube & WS., gm	1093.2	NA	
Wt. Of Tube, gm	0.0	NA	
Wt. Of WS., gm	1093.2	1134.6	
Length 1, in	6	NA	
Length 2, in	6	NA	
Length 3, in	6	NA	
Top Diameter, in	2.864	NA	
Middle Diameter, in	2.865	NA	
Bottom Diameter, in	2.8655	NA	
Average Length, in	6.000	5.791	
Average Diameter, in	2.865	2.748	
Average Area, in^2	6.45	5.93	
Sample Volume, in^3	38.68	34.74	
Unit Dry Wt., gms/cc	1.43	1.60	
Unit Dry Wt., pcf	89.4	99.5	
Specific Gravity, Assume	2.70	2.70	
Volume of Solids, cc	336.37	336.37	
Void Ratio, e	0.88	0.69	
Porosity, n	0.47	0.41	
Pore Volume, cc	18.15	14.21	
Saturation, %	62.2	97.2	

TEST CONDITIONS

Cell Pressure, psi	109.34	
Back Pressure, psi	69.79	
Effective Consolidating Pressure, psi	39.55	σ_3
Pore Pressure Parameter (B), %	95	

SATURATION AND CONSOLIDATION VOLUME CHANGES

Height Change, mils	Reading	Change	Consolidation	
Initial Dial Reading	7.254	0	Volume Change, ml	64.5
After Saturation	7.234	20	Volume Change, in^3	3.94
After Consolidation	7.045	209	Saturation Method:	Wet

STRAIN RATE CALCULATIONS

Calc. Strain Rate, %/min (t50=10.25)	0.0004	Strain Rate Used, %/min	0.0002
Calc. Deformation Rate, in/min	0.0023	Deformation Rate Used	0.001

EFFECTIVE FAILURE SUMMARY

Failure Conditions	Max σ_1'/σ_3'	15% ε	
Effective Consolidating Pressure, psi	39.55	39.55	σ_3
1St. Maximum Effective Principal Stress Ratio	2.889	2.80	σ_1'/σ_3'
Deviator Stress at Failure, psi	32.37	35.42	$\sigma_1-\sigma_3$
Axial Strain at Failure, %	10.02	15.00	ε
Effective Minor Principal Stress at Failure, psi	17.13	19.64	σ_3'
Effective Major Principal Stress at Failure, psi	49.51	55.05	σ_1'
Mohr's Circle Stress Path (Origin of Circle), psi	33.32	37.35	p'
Mohr's Circle Stress Path (Radius of Circle), psi	16.19	17.71	q

TOTAL FAILURE SUMMARY

Failure Conditions	Max σ_1'/σ_3'	15% ε	
Deviator Stress at Failure, psi	32.37	35.42	$\sigma_1-\sigma_3$
Axial Strain at Failure, %	10.02	15.00	ε
Total Minor Principal Stress at Failure, psi	39.55	39.55	σ_3
Total Major Principal Stress at Failure, psi	71.92	74.96	σ_1

TEST DATA

Axial Load	Axial Deformation	Total Pore Water Pressure	Axial Strain	Principal Stress Difference (Deviator Stress)	Induced Pore Water Pressure	Effective Major Principal Stress	Effective Minor Principal Stress	Effective Principal Stress Ratio	A-Bar	Mohr's Circle Stress Paths	
										Origin of Circle	Radius of Circle
lb.	mils	psi	%	psi	psi	psi	psi			psi	psi
P	ΔH	U	ε	$\sigma_1-\sigma_3$	ΔU	σ_1'	σ_3'	σ_1'/σ_3'	A'	p'	q
21.5	0	69.8	0	0.00	0	NA	NA	NA	NA	39.55	0
40.3	5	71.1	0.09	3.18	1.30	41.43	38.25	1.083	0.43	39.84	1.59
73.8	10	74.2	0.17	8.80	4.37	43.98	35.18	1.250	0.52	39.58	4.40
93.2	14	76.1	0.24	12.06	6.30	45.30	33.24	1.363	0.55	39.27	6.03
104.0	20	77.7	0.34	13.86	7.88	45.53	31.67	1.438	0.60	38.60	6.93
110.3	25	79.0	0.43	14.91	9.19	45.27	30.36	1.491	0.65	37.82	7.46
115.6	31	80.2	0.53	15.79	10.39	44.95	29.16	1.542	0.69	37.05	7.89
120.2	37	81.2	0.63	16.53	11.45	44.63	28.09	1.588	0.73	36.36	8.27
123.7	43	82.2	0.74	17.11	12.39	44.27	27.16	1.630	0.76	35.72	8.56
127.4	49	83.1	0.84	17.71	13.27	43.99	26.28	1.674	0.79	35.13	8.86
129.9	54	83.8	0.94	18.11	13.97	43.69	25.58	1.708	0.81	34.63	9.06
133.4	61	84.5	1.05	18.67	14.74	43.48	24.81	1.753	0.83	34.14	9.34
136.0	66	85.1	1.14	19.09	15.34	43.30	24.21	1.789	0.85	33.75	9.54
144.1	84	86.8	1.44	20.37	16.98	42.94	22.57	1.903	0.88	32.75	10.18

149.9	101	88.0	1.74	21.27	18.23	42.58	21.32	1.998	0.90	31.95	10.63
154.9	119	89.0	2.05	22.03	19.21	42.37	20.34	2.084	0.92	31.35	11.02
159.6	137	89.8	2.36	22.73	20.01	42.27	19.53	2.164	0.93	30.90	11.37
163.8	154	90.5	2.66	23.36	20.67	42.24	18.88	2.238	0.93	30.56	11.68
168.4	172	91.0	2.97	24.04	21.21	42.38	18.34	2.311	0.93	30.36	12.02
171.9	189	91.4	3.27	24.54	21.64	42.45	17.91	2.370	0.93	30.18	12.27
176.0	208	91.8	3.59	25.11	21.99	42.67	17.56	2.430	0.92	30.12	12.55
179.8	226	92.1	3.90	25.65	22.31	42.89	17.24	2.488	0.92	30.07	12.83
182.7	243	92.3	4.20	26.03	22.55	43.03	17.00	2.532	0.91	30.01	13.02
186.4	261	92.5	4.51	26.55	22.74	43.35	16.81	2.580	0.90	30.08	13.27
189.8	279	92.7	4.81	27.00	22.90	43.65	16.65	2.622	0.89	30.15	13.50
193.3	297	92.8	5.13	27.48	23.01	44.02	16.54	2.661	0.88	30.28	13.74
195.7	315	92.9	5.43	27.77	23.12	44.20	16.43	2.690	0.88	30.32	13.89
198.3	332	93.0	5.74	28.09	23.19	44.45	16.36	2.717	0.87	30.41	14.05
201.2	349	93.0	6.03	28.47	23.21	44.81	16.34	2.742	0.86	30.57	14.23
204.1	367	93.0	6.34	28.84	23.22	45.17	16.33	2.766	0.85	30.75	14.42
206.6	385	93.0	6.66	29.14	23.21	45.48	16.34	2.783	0.84	30.91	14.57
209.8	403	93.0	6.96	29.54	23.22	45.86	16.33	2.809	0.83	31.10	14.77
211.9	420	93.0	7.25	29.78	23.18	46.14	16.36	2.820	0.82	31.25	14.89
214.8	437	92.9	7.55	30.13	23.13	46.55	16.42	2.835	0.81	31.48	15.07
217.7	456	92.9	7.87	30.48	23.08	46.95	16.47	2.850	0.80	31.71	15.24
220.2	473	92.8	8.17	30.76	22.97	47.33	16.57	2.856	0.79	31.95	15.38
222.7	491	92.7	8.48	31.04	22.93	47.66	16.62	2.868	0.78	32.14	15.52
225.1	508	92.6	8.78	31.32	22.82	48.04	16.72	2.873	0.77	32.38	15.66
227.7	526	92.5	9.09	31.61	22.73	48.42	16.82	2.880	0.76	32.62	15.80
230.4	545	92.4	9.41	31.91	22.63	48.82	16.91	2.887	0.75	32.87	15.95
232.5	563	92.3	9.72	32.11	22.53	49.13	17.01	2.887	0.74	33.07	16.06
234.9	580	92.2	10.02	32.37	22.41	49.51	17.13	2.889	0.73	33.32	16.19
237.6	598	92.0	10.33	32.68	22.24	49.99	17.31	2.888	0.72	33.65	16.34
239.5	616	91.9	10.64	32.85	22.14	50.26	17.41	2.887	0.71	33.83	16.42
242.6	635	91.8	10.96	33.19	22.02	50.71	17.52	2.894	0.70	34.12	16.59
245.0	652	91.7	11.26	33.44	21.89	51.10	17.66	2.893	0.69	34.38	16.72
246.4	670	91.5	11.57	33.54	21.74	51.35	17.81	2.883	0.68	34.58	16.77
248.8	687	91.4	11.87	33.77	21.56	51.76	17.99	2.877	0.67	34.88	16.89
250.5	706	91.2	12.19	33.90	21.43	52.02	18.11	2.872	0.67	35.07	16.95
252.5	723	91.1	12.49	34.08	21.28	52.34	18.26	2.866	0.66	35.30	17.04
254.4	741	90.9	12.79	34.25	21.12	52.68	18.43	2.859	0.65	35.55	17.12
256.7	758	90.8	13.09	34.47	20.96	53.05	18.58	2.855	0.64	35.82	17.23
258.5	776	90.6	13.39	34.61	20.79	53.37	18.76	2.845	0.63	36.07	17.31
260.6	794	90.4	13.71	34.79	20.63	53.70	18.92	2.839	0.62	36.31	17.39
262.6	811	90.2	14.01	34.95	20.42	54.08	19.13	2.827	0.61	36.60	17.48
264.9	829	90.1	14.31	35.17	20.32	54.40	19.23	2.829	0.61	36.82	17.58
266.8	846	89.9	14.61	35.31	20.14	54.72	19.41	2.819	0.60	37.07	17.65
268.2	864	89.7	14.92	35.39	19.95	54.98	19.59	2.806	0.59	37.29	17.70
269.8	882	89.6	15.23	35.48	19.79	55.24	19.76	2.796	0.59	37.50	17.74
271.8	900	89.4	15.54	35.65	19.62	55.58	19.93	2.788	0.58	37.75	17.82
273.1	918	89.3	15.84	35.69	19.46	55.78	20.09	2.777	0.57	37.94	17.85
274.7	936	89.1	16.16	35.79	19.27	56.07	20.28	2.765	0.57	38.18	17.90
276.9	954	88.9	16.47	35.97	19.08	56.43	20.46	2.758	0.56	38.45	17.99
278.2	972	88.7	16.79	36.02	18.89	56.67	20.66	2.744	0.55	38.67	18.01
280.4	990	88.5	17.10	36.18	18.71	57.02	20.84	2.736	0.54	38.93	18.09
282.1	1008	88.3	17.41	36.29	18.55	57.28	21.00	2.728	0.54	39.14	18.14

Input Validation: Reviewed By: Date Tested: 01/17/11

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CONSOLIDATED-UNDRAINED TRIAXIAL COMPRESSION TEST ON COHESIVE SOILS ASTM D 4767

Client	Civil & Environmental Consultants, Inc.	Boring	RB-8
Client Project	091-867 Apex Landfill Expansion	Depth	23'-27'
Project No.	30598	Sample	B-1
Test No.	3	Lab Sample No.	30598023
USCS Description:	DARK GRAY FAT CLAY	Test Conditions:	Remolded - Side And Double Drained

SAMPLE CONDITIONS

	Initial	After Consol.	Final
Tare Number	D4	NA	944
Wt. Tare & WS, gm	200.82	NA	1221.40
Wt. Tare & DS, gm	187.72	NA	1013.66
Wt. Tare, gm	123.4	NA	99.27
Water Content, %	20.4	22.7	22.7
Wt. Tube & WS., gm	1093.2	NA	
Wt. Of Tube, gm	0.0	NA	
Wt. Of WS., gm	1093.2	1114.5	
Length 1, in	6	NA	
Length 2, in	6	NA	
Length 3, in	6	NA	
Top Diameter, in	2.864	NA	
Middle Diameter, in	2.865	NA	
Bottom Diameter, in	2.8655	NA	
Average Length, in	6.000	5.705	
Average Diameter, in	2.865	2.719	
Average Area, in^2	6.45	5.81	
Sample Volume, in^3	38.68	33.96	
Unit Dry Wt., gms/cc	1.43	1.63	
Unit Dry Wt., pcf	89.4	101.8	
Specific Gravity, Assume	2.70	2.70	
Volume of Solids, cc	336.37	336.37	
Void Ratio, e	0.88	0.65	
Porosity, n	0.47	0.40	
Pore Volume, cc	18.15	13.44	
Saturation, %	62.2	93.7	

TEST CONDITIONS

Cell Pressure, psi	118.87	
Back Pressure, psi	40.02	
Effective Consolidating Pressure, psi	78.85	σ_3
Pore Pressure Parameter (B), %	95	

SATURATION AND CONSOLIDATION VOLUME CHANGES

Height Change, mils	Reading	Change	Consolidation	
Initial Dial Reading	7.108	0	Volume Change, ml	77.2
After Saturation	7.065	43	Volume Change, in^3	4.71
After Consolidation	6.813	295	Saturation Method:	Wet

STRAIN RATE CALCULATIONS

Calc. Strain Rate, %/min (t50=80.03)	0.0000	Strain Rate Used, %/min	0.0002
Calc. Deformation Rate, in/min	0.000	Deformation Rate Used	0.001

EFFECTIVE FAILURE SUMMARY

Failure Conditions	Max σ_1'/σ_3'	15% ε	
Effective Consolidating Pressure, psi	78.85	78.85	σ_3
1St. Maximum Effective Principal Stress Ratio	2.701	2.66	σ_1'/σ_3'
Deviator Stress at Failure, psi	58.98	62.03	$\sigma_1-\sigma_3$
Axial Strain at Failure, %	11.26	15.00	ε
Effective Minor Principal Stress at Failure, psi	34.67	37.31	σ_3'
Effective Major Principal Stress at Failure, psi	93.65	99.34	σ_1'
Mohr's Circle Stress Path (Origin of Circle), psi	64.16	68.32	p'
Mohr's Circle Stress Path (Radius of Circle), psi	29.49	31.02	q

TOTAL FAILURE SUMMARY

Failure Conditions	Max σ_1'/σ_3'	15% ε	
Deviator Stress at Failure, psi	58.98	62.03	$\sigma_1-\sigma_3$
Axial Strain at Failure, %	11.26	15.00	ε
Total Minor Principal Stress at Failure, psi	78.85	78.85	σ_3
Total Major Principal Stress at Failure, psi	137.83	140.88	σ_1

TEST DATA

Axial Load	Axial Deformation	Total Pore Water Pressure	Axial Strain	Principal Stress Difference (Deviator Stress)	Induced Pore Water Pressure	Effective Major Principal Stress	Effective Minor Principal Stress	Effective Principal Stress Ratio	A-Bar	Mohr's Circle Stress Paths	
										Origin of Circle	Radius of Circle
lb.	mils	psi	%	psi	psi	psi	psi			psi	psi
P	ΔH	U	ε	$\sigma_1-\sigma_3$	ΔU	σ_1'	σ_3'	σ_1'/σ_3'	A'	p'	q
20.8	0	40.0	0	0	0	NA	NA	NA	NA	78.85	0
47.1	5	41.0	0.09	4.52	1.03	82.34	77.82	1.058	0.24	80.08	2.26
97.2	11	43.9	0.20	13.13	3.84	88.14	75.01	1.175	0.31	81.58	6.57
126.7	17	46.8	0.29	18.19	6.79	90.25	72.05	1.252	0.39	81.15	9.10
145.1	24	49.7	0.41	21.32	9.64	90.53	69.21	1.308	0.48	79.87	10.66
157.5	30	52.3	0.53	23.42	12.24	90.03	66.61	1.352	0.55	78.32	11.71
168.6	35	54.7	0.61	25.30	14.67	89.48	64.18	1.394	0.61	76.83	12.65
178.3	41	56.9	0.72	26.93	16.88	88.90	61.97	1.435	0.66	75.44	13.47
186.8	47	58.9	0.83	28.35	18.87	88.33	59.98	1.473	0.70	74.15	14.18
194.3	53	60.7	0.93	29.61	20.70	87.76	58.14	1.509	0.74	72.95	14.81
200.9	59	62.4	1.03	30.70	22.36	87.19	56.48	1.544	0.77	71.84	15.35
207.3	64	63.9	1.12	31.76	23.87	86.74	54.98	1.578	0.79	70.86	15.88
212.4	69	65.2	1.22	32.60	25.23	86.22	53.62	1.608	0.81	69.92	16.30
228.2	88	68.8	1.54	35.16	28.73	85.28	50.11	1.702	0.86	67.70	17.58

241.1	106	71.6	1.85	37.24	31.56	84.52	47.29	1.787	0.89	65.90	18.62
252.8	125	73.9	2.18	39.08	33.91	84.02	44.94	1.870	0.91	64.48	19.54
262.7	142	75.8	2.49	40.62	35.83	83.64	43.02	1.944	0.93	63.33	20.31
271.2	159	77.4	2.78	41.93	37.40	83.37	41.45	2.011	0.94	62.41	20.96
279.6	177	78.7	3.10	43.18	38.73	83.30	40.12	2.076	0.94	61.71	21.59
287.8	196	79.9	3.43	44.40	39.87	83.38	38.98	2.139	0.95	61.18	22.20
294.7	214	80.8	3.75	45.40	40.81	83.44	38.04	2.194	0.95	60.74	22.70
300.8	230	81.6	4.04	46.28	41.62	83.50	37.22	2.243	0.95	60.36	23.14
307.2	248	82.3	4.35	47.17	42.33	83.69	36.52	2.292	0.94	60.11	23.58
314.0	266	82.9	4.67	48.13	42.92	84.06	35.93	2.340	0.94	59.99	24.06
320.0	285	83.4	4.99	48.94	43.39	84.40	35.45	2.381	0.93	59.93	24.47
325.3	302	83.8	5.30	49.65	43.79	84.71	35.05	2.417	0.93	59.88	24.83
329.7	319	84.1	5.59	50.23	44.07	85.01	34.78	2.444	0.92	59.90	25.11
335.4	337	84.4	5.91	50.98	44.43	85.39	34.42	2.481	0.92	59.91	25.49
340.7	356	84.7	6.24	51.65	44.66	85.84	34.19	2.511	0.91	60.01	25.83
346.0	375	84.9	6.57	52.32	44.85	86.33	34.00	2.539	0.90	60.17	26.16
350.5	391	85.0	6.86	52.88	44.98	86.75	33.87	2.561	0.90	60.31	26.44
354.5	409	85.1	7.17	53.34	45.08	87.10	33.77	2.580	0.89	60.44	26.67
359.0	427	85.2	7.49	53.88	45.14	87.59	33.71	2.598	0.88	60.65	26.94
364.0	446	85.2	7.81	54.48	45.18	88.15	33.67	2.618	0.87	60.91	27.24
368.6	464	85.2	8.13	55.02	45.19	88.67	33.66	2.635	0.86	61.17	27.51
371.9	480	85.2	8.42	55.37	45.18	89.04	33.67	2.645	0.86	61.35	27.68
376.0	498	85.1	8.73	55.82	45.12	89.56	33.73	2.655	0.85	61.65	27.91
380.5	516	85.1	9.05	56.34	45.04	90.15	33.81	2.667	0.84	61.98	28.17
384.8	536	84.9	9.39	56.80	44.90	90.75	33.95	2.673	0.83	62.35	28.40
388.8	553	84.9	9.70	57.22	44.90	91.17	33.95	2.686	0.83	62.56	28.61
391.6	570	84.8	10.00	57.46	44.77	91.54	34.08	2.686	0.82	62.81	28.73
395.3	588	84.6	10.30	57.85	44.60	92.09	34.25	2.689	0.81	63.17	28.92
399.8	607	84.5	10.63	58.33	44.53	92.65	34.32	2.700	0.80	63.49	29.16
403.5	625	84.3	10.96	58.68	44.33	93.20	34.52	2.700	0.80	63.86	29.34
406.7	642	84.2	11.26	58.98	44.18	93.65	34.67	2.701	0.79	64.16	29.49
409.9	660	83.9	11.56	59.25	43.92	94.18	34.92	2.697	0.78	64.55	29.63
413.7	678	83.8	11.88	59.63	43.81	94.66	35.04	2.702	0.77	64.85	29.81
417.2	697	83.6	12.22	59.93	43.59	95.18	35.26	2.700	0.77	65.22	29.96
420.7	714	83.4	12.52	60.24	43.40	95.69	35.45	2.699	0.76	65.57	30.12
423.3	731	83.2	12.82	60.42	43.19	96.08	35.66	2.695	0.75	65.87	30.21
426.3	749	83.0	13.13	60.66	42.98	96.53	35.87	2.691	0.75	66.20	30.33
430.2	769	82.8	13.47	61.00	42.78	97.07	36.07	2.691	0.74	66.57	30.50
433.4	786	82.6	13.78	61.26	42.54	97.56	36.30	2.687	0.73	66.93	30.63
435.9	804	82.3	14.10	61.40	42.30	97.94	36.54	2.680	0.73	67.24	30.70
438.5	821	82.1	14.39	61.58	42.07	98.36	36.78	2.674	0.72	67.57	30.79
442.0	839	81.9	14.71	61.86	41.86	98.86	36.99	2.672	0.71	67.92	30.93
445.0	858	81.5	15.04	62.06	41.50	99.41	37.35	2.661	0.70	68.38	31.03
447.9	876	81.4	15.36	62.25	41.34	99.75	37.51	2.660	0.70	68.63	31.12
450.5	893	81.1	15.66	62.41	41.10	100.15	37.75	2.653	0.69	68.95	31.20
453.3	911	80.9	15.97	62.58	40.87	100.56	37.98	2.648	0.69	69.27	31.29
457.0	930	80.6	16.30	62.86	40.59	101.12	38.25	2.643	0.68	69.69	31.43
459.7	948	80.5	16.62	63.02	40.45	101.42	38.40	2.641	0.68	69.91	31.51
461.2	966	80.3	16.93	63.00	40.26	101.58	38.59	2.633	0.67	70.08	31.50
463.1	983	80.1	17.23	63.04	40.04	101.85	38.81	2.624	0.67	70.33	31.52
466.1	1001	79.7	17.55	63.22	39.71	102.36	39.14	2.615	0.66	70.75	31.61

Input Validation: Reviewed By: Date Tested: 01/25/11

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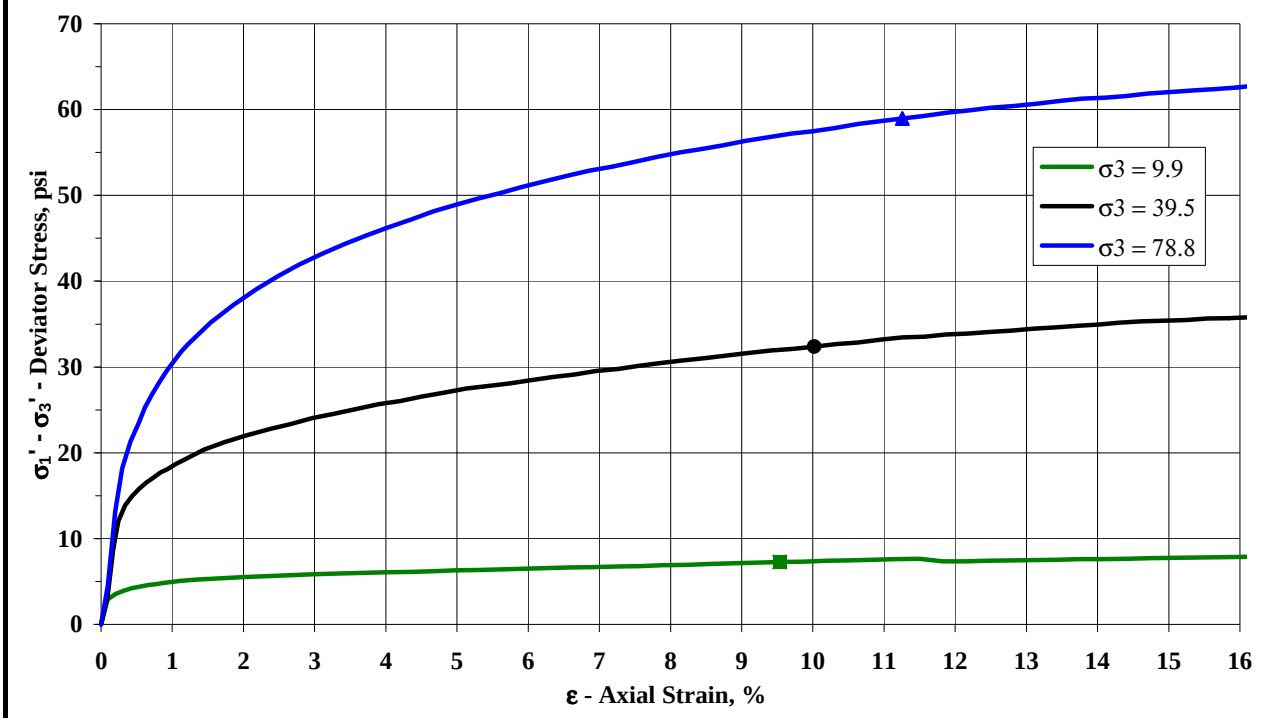
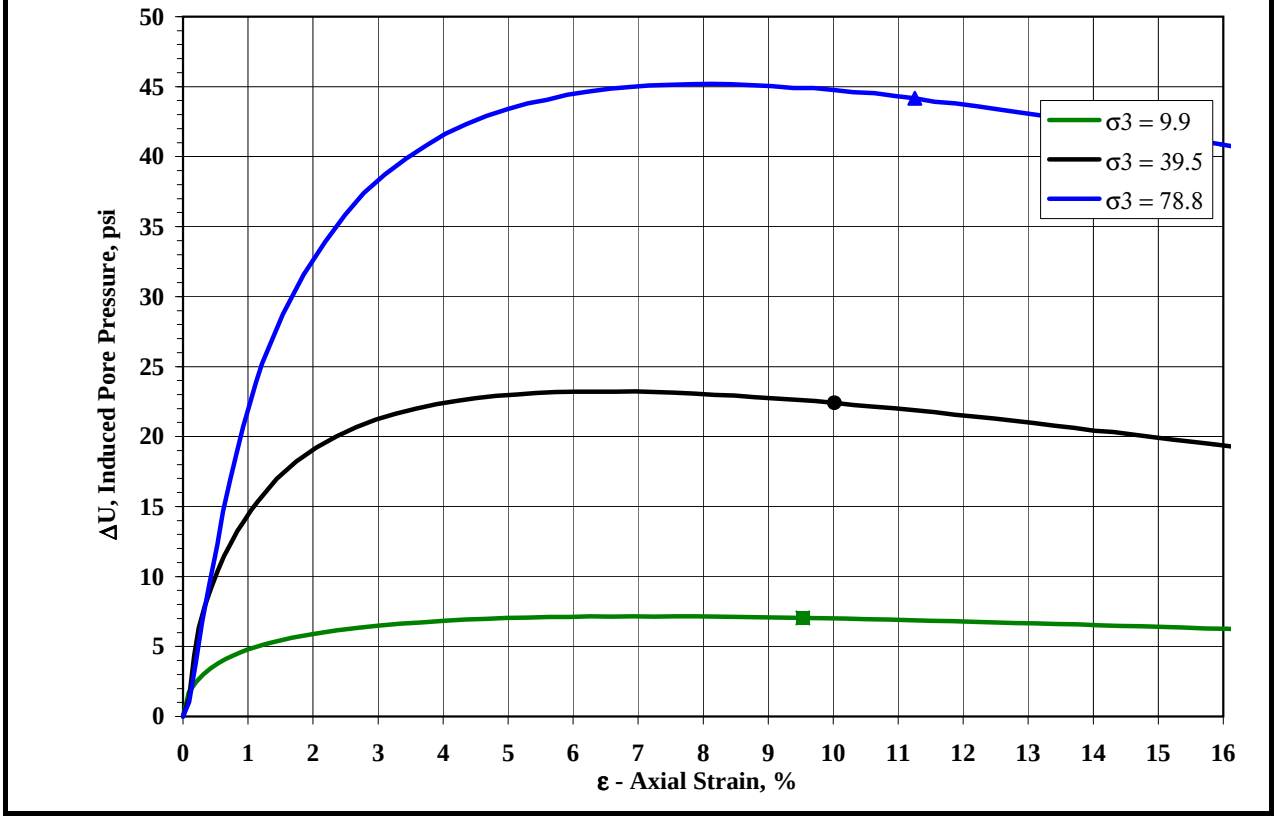
CONSOLIDATED-UNDRAINED TRIAXIAL COMPRESSION TEST ON COHESIVE SOILS ASTM D 4767

Client	Civil & Environmental Consultants, Inc.	Boring	RB-8
Client Project	091-867 Apex Landfill Expansion	Depth	23'-27'
Project No.	30598	Sample	B-1
Test Conditions:	Remolded - Side And Double Drained	Lab Sample No.	30598023
USCS Description:	DARK GRAY FAT CLAY		

AXIAL STRAIN vs. DEVIATOR STRESS



AXIAL STRAIN vs. INDUCED PORE-WATER PRESSURE



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CONSOLIDATED-UNDRAINED TRIAXIAL COMPRESSION TEST ON COHESIVE SOILS ASTM D 476

Client	Civil & Environmental Consultants, In	Boring	RB-8
Client Project	091-867 Apex Landfill Expansion	Depth	23'-27'
Project No.	30598	Sample	B-1
		Lab Sample No.	30598023
USCS Description:	DARK GRAY FAT CLAY		
Test Conditions:	Remolded - Side And Double Drained		

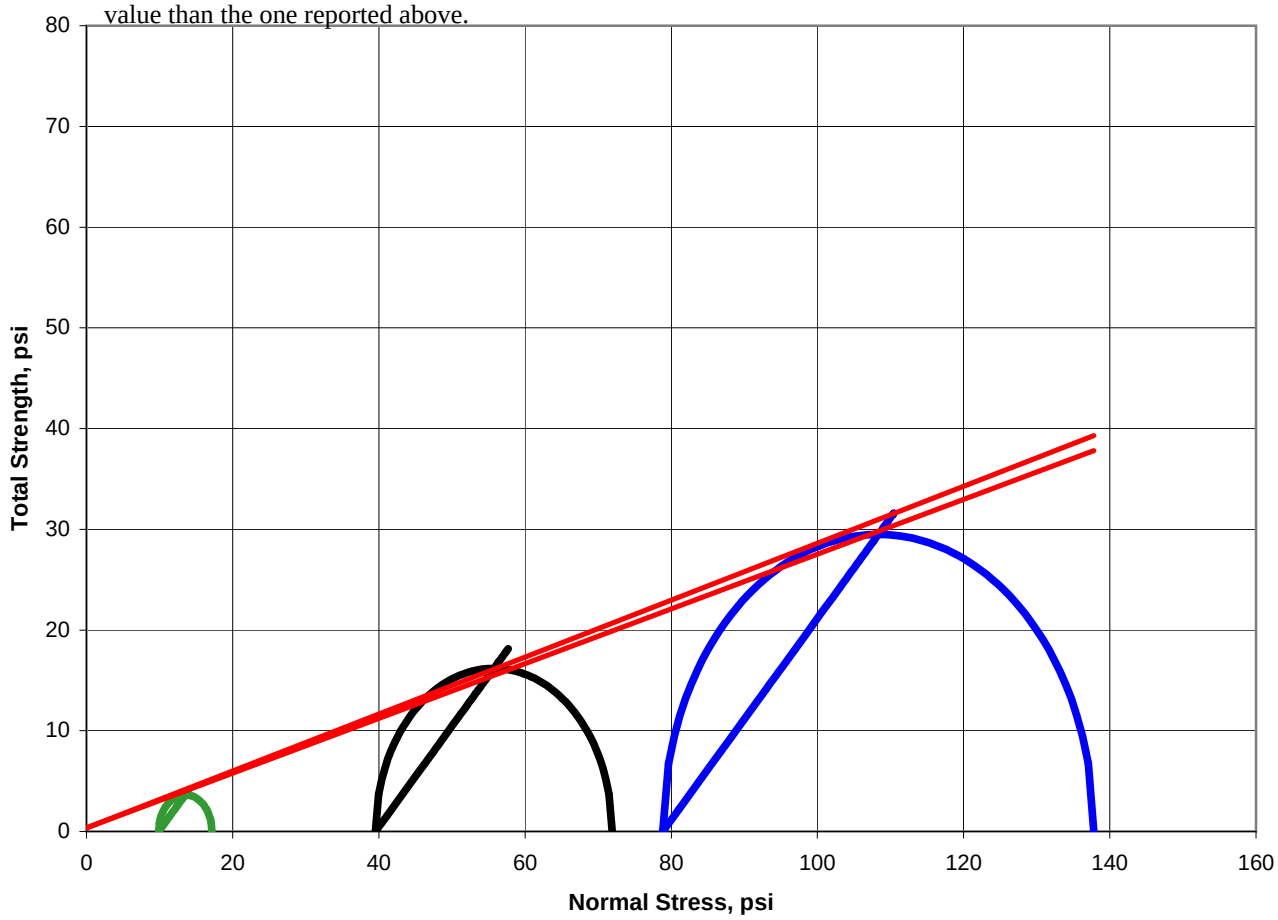
TOTAL STRESS

FAILURE CONDITION: 1st. MAX. EFFECTIVE PRINCIPAL STRESS RATIO

Test No.	Deviator Stress	Major Principal Stress	Minor Principal Stress	Strain at Failure	Mohr's Circle Stress Path		Failure Angle	
	$\sigma1-\sigma3$	$\sigma1$	$\sigma3$	ε	$(\sigma1+\sigma3)/2$	$(\sigma1-\sigma3)/2$		
	psi	psi	psi	%	psi	psi	α, deg	15.2
Test 1	7.28	17.16	9.88	9.53	13.52	3.64	a, psi	0.3
Test 2	32.37	71.92	39.55	10.02	55.73	16.19	Φ, deg	15.8
Test 3	58.98	137.83	78.85	11.26	108.34	29.49	C, psi	0.4

Calculations based on: Test 1 Test 2 Test 3

Note: The Friction Angle and Cohesion using other combinations of test points may yield a higher or lower value than the one reported above.



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CONSOLIDATED-UNDRAINED TRIAXIAL COMPRESSION TEST ON COHESIVE SOILS ASTM D 476

Client	Civil & Environmental Consultants, In	Boring	RB-8
Client Project	091-867 Apex Landfill Expansion	Depth	23'-27'
Project No.	30598	Sample	B-1
		Lab Sample No.	30598023
USCS Description:	DARK GRAY FAT CLAY		
Test Conditions:	Remolded - Side And Double Drained		

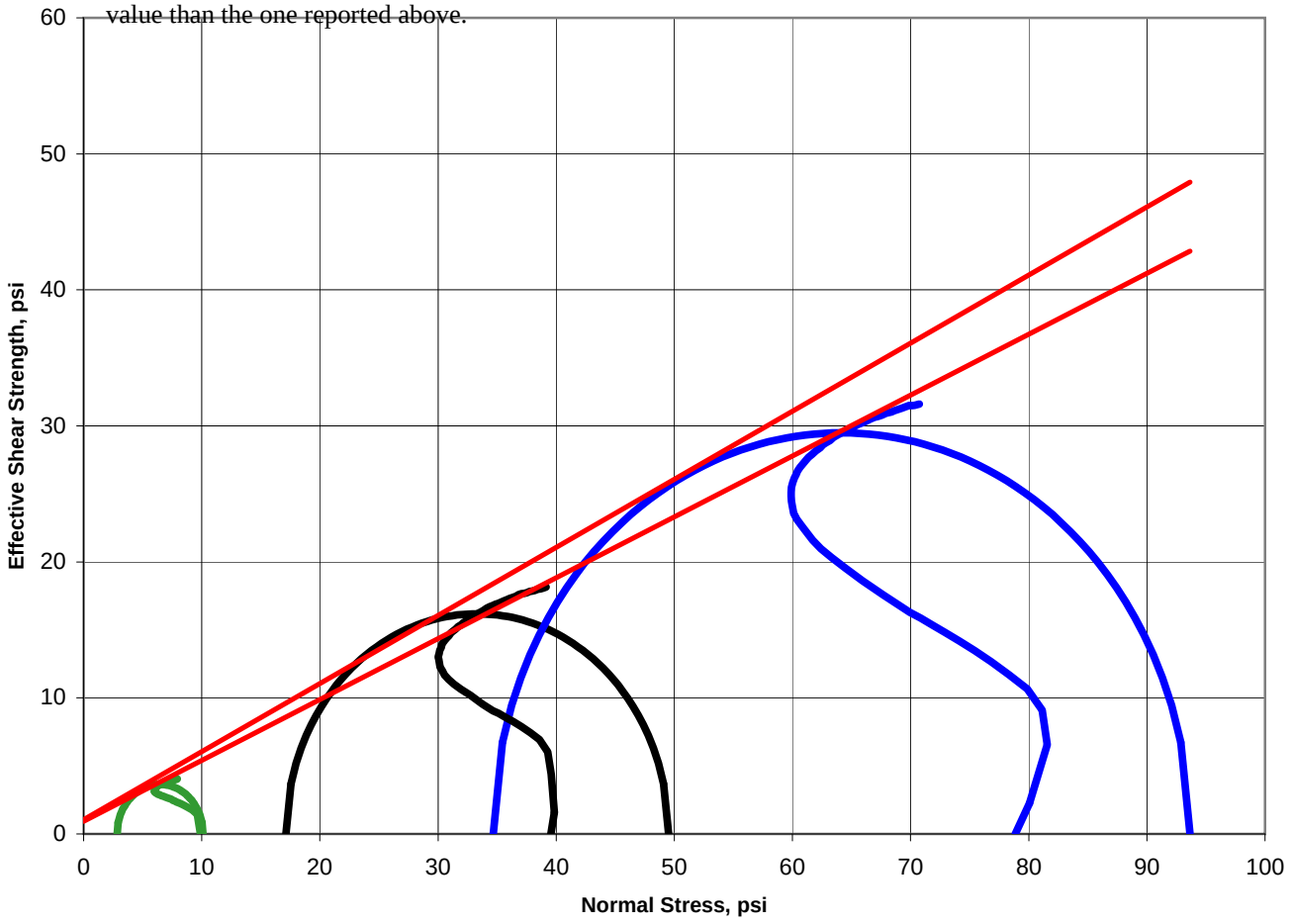
EFFECTIVE STRESS

FAILURE CONDITION: 1st. MAX. EFFECTIVE PRINCIPAL STRESS RATIO

Test No.	Deviator Stress	Major Principal Stress	Minor Principal Stress	Strain at Failure	Mohr's Circle Stress Path		Failure Angle	
	$\sigma 1-\sigma 3$	$\sigma' 1$	$\sigma' 3$	ε	p'	q		
	psi	psi	psi	%	psi	psi	α', deg	24.1
Test 1	7.28	10.11	2.83	9.53	6.47	3.64	a', psi	0.9
Test 2	32.37	49.51	17.13	10.02	33.32	16.19	Φ', deg	26.6
Test 3	58.98	93.65	34.67	11.26	64.16	29.49	C', psi	1.0

Calculations based on: Test 1 Test 2 Test 3

Note: The Friction Angle and Cohesion using other combinations of test points may yield a higher or lower value than the one reported above.



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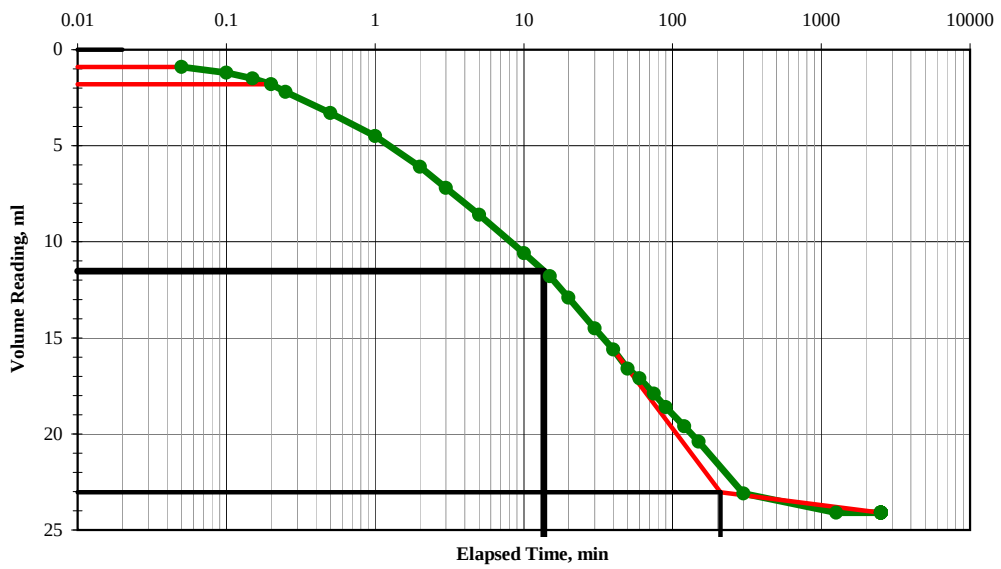
THREE DIMENSIONAL TRIAXIAL CONSOLIDATION TEST

Client	Civil & Environmental Consultants, Inc	Boring	RB-8	**Staged Consolidation**	
Client Project	091-867 Apex Landfill Expansion	Depth	23'-27'	Consolidation Plot Stress, psi	6.9
Project No.	30598	Sample	B-1	**Final Test Pressures**	
		Lab Sample	30598023	Cell Pressure, psi	79.9
USCS Description:	DARK GRAY FAT CLAY			Back Pressure, psi	70.0
Test Conditions:	Remolded - Side And Double Drained			Effective Consol., psi	9.9
				Additional Consol. Volume, ml	0.0

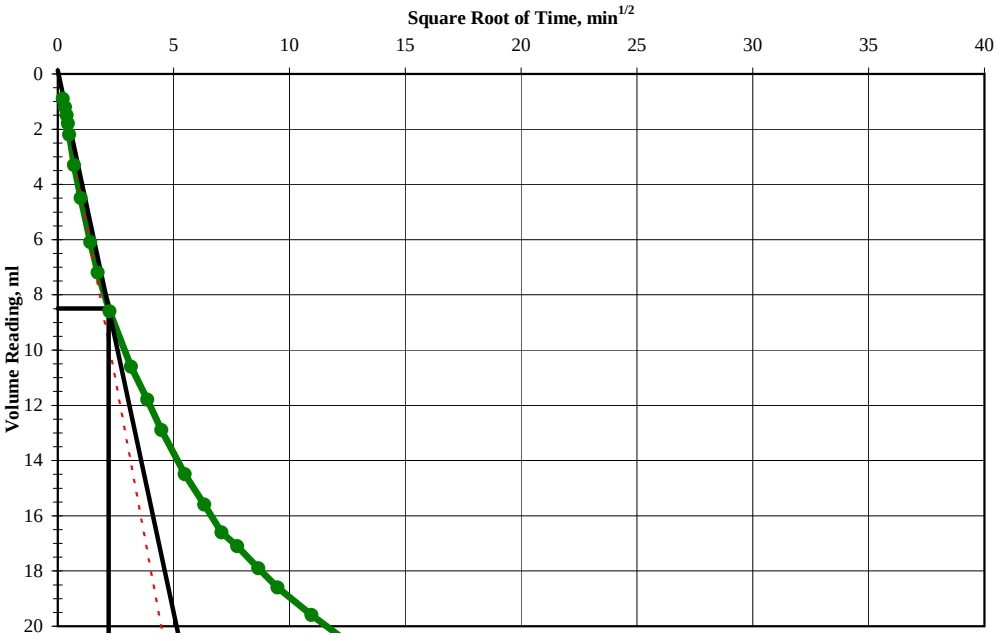
Consol. Start Date: 1/17/2011

Elapsed Time (min)	Sqrt Time ($min^{1/2}$)	Volume Reading ml
0	0	0.0
0.05	0.22	0.9
0.10	0.32	1.2
0.15	0.39	1.5
0.20	0.45	1.8
0.25	0.50	2.2
0.50	0.71	3.3
1.00	1.00	4.5
2.00	1.41	6.1
3.00	1.73	7.2
5.00	2.24	8.6
10.00	3.16	10.6
15.00	3.87	11.8
20.00	4.47	12.9
30.00	5.48	14.5
40.00	6.32	15.6
50.00	7.07	16.6
60.00	7.75	17.1
75.00	8.66	17.9
90.00	9.49	18.6
120.00	10.95	19.6
150.00	12.25	20.4
300.00	17.32	23.1
1260.00	35.50	24.1
2520.00	50.20	24.1

Log of Elapsed Time vs. Volume Reading



Square Root of Elapsed Time vs. Volume Reading



Sqrt. of Elapsed Time vs Volume		Log of Elapsed Time vs Volume		Consolidation Summary	
T0 = 0 min.	V0 = -0.1 ml.	T0 = 0 min.	V0 = 0.0 ml.	Initial Volume Reading, ml	0.0
T90 = 4.8 min	V90 = 8.5 ml.	T50 = 13.6 min.	V50 = 11.5 ml.	Final Volume Reading, ml	24.1
T100 = NA min	V100 = 9.5 ml.	T100 = 210.3 min.	V100 = 23.0 ml.	Total Volume Change, ml	24.1

Input Validation: Reviewed By: Date 1/17/2011

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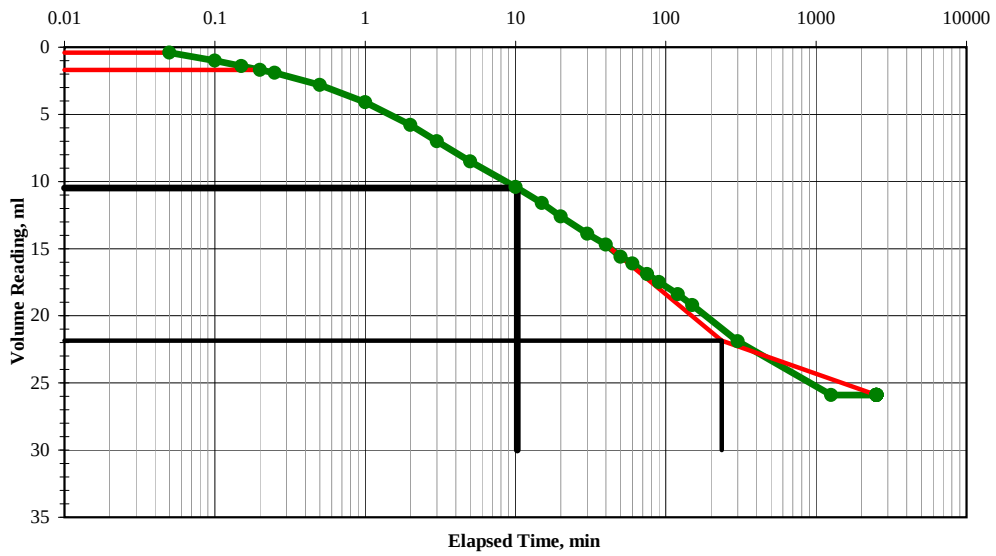
THREE DIMENSIONAL TRIAXIAL CONSOLIDATION TEST

Client	Civil & Environmental Consultants, Inc	Boring	RB-8	**Staged Consolidation**	
Client Project	091-867 Apex Landfill Expansion	Depth	23'-27'	Consolidation Plot Stress, psi	6.9
Project No.	30598	Sample	B-1	**Final Test Pressures**	
		Lab Sample	30598023	Cell Pressure, psi	109.3
USCS Description:	DARK GRAY FAT CLAY			Back Pressure, psi	69.8
Test Conditions:	Remolded - Side And Double Drained			Effective Consol., psi	39.5
				Additional Consol. Volume, ml	38.6

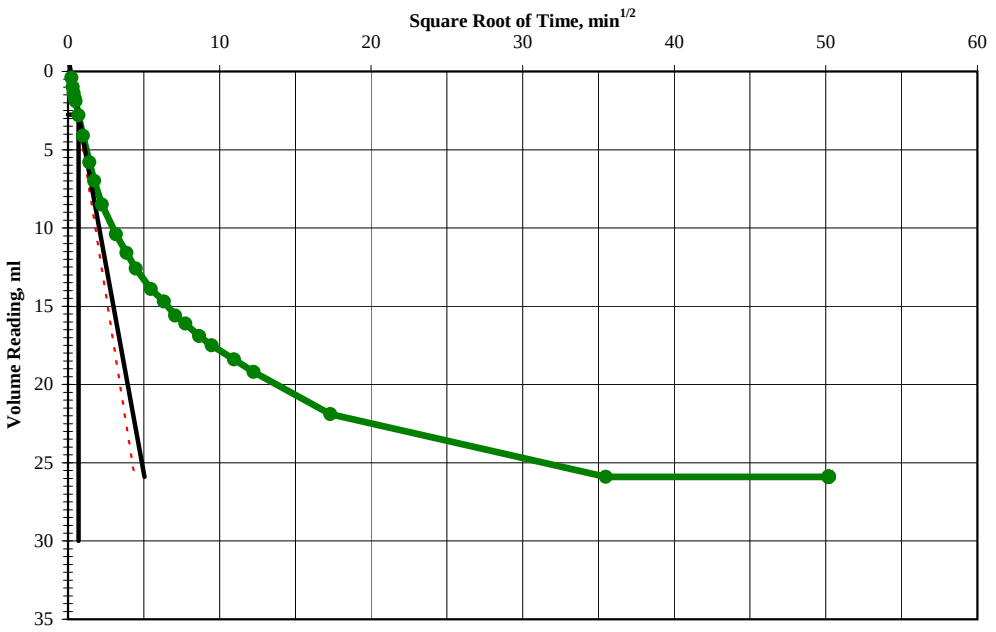
Consol. Start Date: 1/17/2011

Elapsed Time (min)	Sqrt Time ($min^{1/2}$)	Volume Reading ml
0	0	0.0
0.05	0.22	0.4
0.10	0.32	1.0
0.15	0.39	1.4
0.20	0.45	1.7
0.25	0.50	1.9
0.50	0.71	2.8
1.00	1.00	4.1
2.00	1.41	5.8
3.00	1.73	7.0
5.00	2.24	8.5
10.00	3.16	10.4
15.00	3.87	11.6
20.00	4.47	12.6
30.00	5.48	13.9
40.00	6.32	14.7
50.00	7.07	15.6
60.00	7.75	16.1
75.00	8.66	16.9
90.00	9.49	17.5
120.00	10.95	18.4
150.00	12.25	19.2
300.00	17.32	21.9
1260.00	35.50	25.9
2520.00	50.20	25.9

Log of Elapsed Time vs. Volume Reading



Square Root of Elapsed Time vs. Volume Reading



Sqrt. of Elapsed Time vs Volume		Log of Elapsed Time vs Volume		Consolidation Summary	
T0 = 0 min.	V0 = -1.0 ml.	T0 = 0 min.	V0 = -0.9 ml.	Initial Volume Reading, ml	0.0
T90 = 0.5 min	V90 = 2.8 ml.	T50 = 10.3 min.	V50 = 10.5 ml.	Final Volume Reading, ml	25.9
T100 = NA min	V100 = 3.2 ml.	T100 = 235.4 min.	V100 = 21.8 ml.	Total Volume Change, ml	64.5

Input Validation: Reviewed By: Date 1/17/2011

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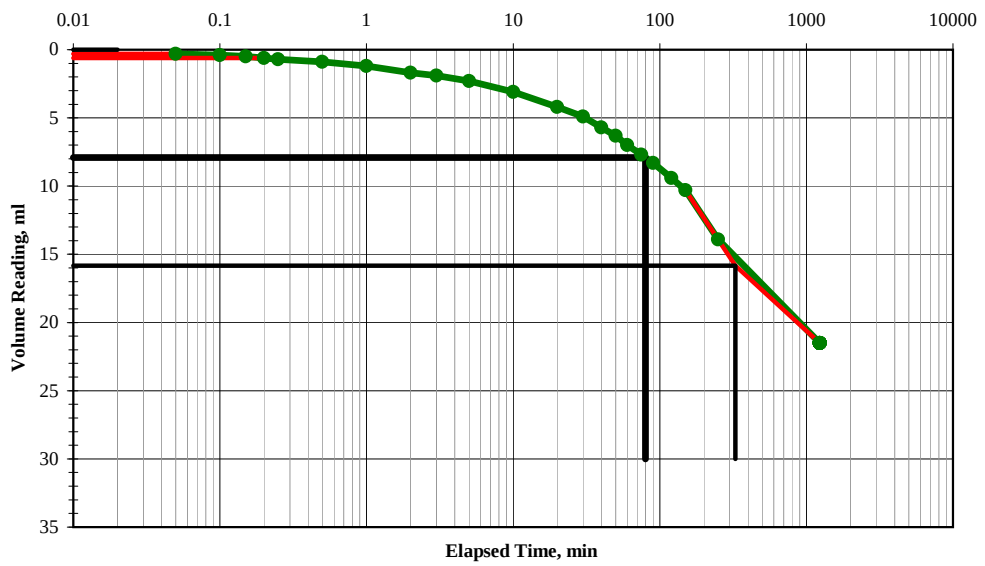
THREE DIMENSIONAL TRIAXIAL CONSOLIDATION TEST

Client	Civil & Environmental Consultants, Inc	Boring	RB-8	**Staged Consolidation**	
Client Project	091-867 Apex Landfill Expansion	Depth	23'-27'	Consolidation Plot Stress, psi	10
Project No.	30598	Sample	B-1	**Final Test Pressures**	
		Lab Sample	30598023	Cell Pressure, psi	118.9
USCS Description:	DARK GRAY FAT CLAY			Back Pressure, psi	40.0
Test Conditions:	Remolded - Side And Double Drained			Effective Consol., psi	78.8
				Additional Consol. Volume, m	55.7

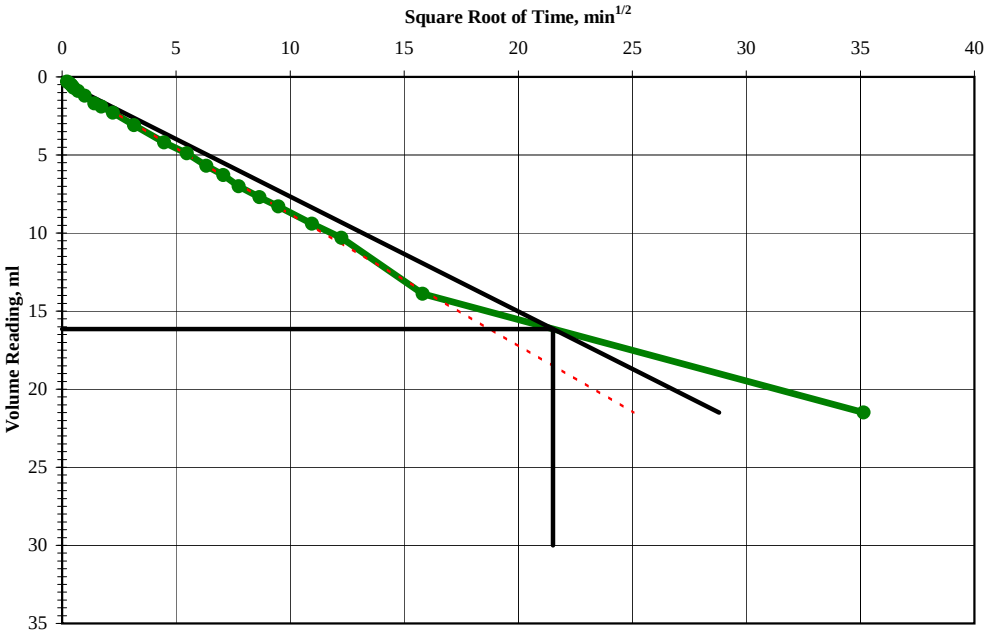
Consol. Start Date: 1/25/2011

Elapsed Time (min)	Sqrt Time ($min^{1/2}$)	Volume Reading ml
0	0	0.0
0.05	0.22	0.3
0.10	0.32	0.4
0.15	0.39	0.5
0.20	0.45	0.6
0.25	0.50	0.7
0.50	0.71	0.9
1.00	1.00	1.2
2.00	1.41	1.7
3.00	1.73	1.9
5.00	2.24	2.3
10.00	3.16	3.1
20.00	4.47	4.2
30.00	5.48	4.9
40.00	6.32	5.7
50.00	7.07	6.3
60.00	7.75	7.0
75.00	8.66	7.7
90.00	9.49	8.3
120.00	10.95	9.4
150.00	12.25	10.3
250.00	15.81	13.9
1235.00	35.14	21.5

Log of Elapsed Time vs. Volume Reading



Square Root of Elapsed Time vs. Volume Reading



Sqrt. of Elapsed Time vs Volume		Log of Elapsed Time vs Volume		Consolidation Summary	
T0 = 0 min.	V0 = 0.3 ml.	T0 = 0 min.	V0 = 0.0 ml.	Initial Volume Reading, ml	0.0
T90 = 463.5 min	V90 = 16.1 ml.	T50 = 80.0 min.	V50 = 7.9 ml.	Final Volume Reading, ml	21.5
T100 = NA min	V100 = 17.9 ml.	T100 = 328.6 min.	V100 = 15.8 ml.	Total Volume Change, ml	77.2

Input Validation: Reviewed By: Date 1/25/2011

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CONSOLIDATED-UNDRAINED TRIAXIAL COMPRESSION TEST ON COHESIVE SOILS ASTM D 4767

Client	Civil & Environmental Consultants, Inc.	Boring	SB-1
Client Project	091-867 Apex Landfill Expansion	Depth	58'-66'
Project No.	30598	Sample	B-1
Test No.	1	Lab Sample No.	30598024
USCS Description:	Grayish Brown Sandy Lean Clay	Test Conditions:	Remolded - Side And Double Drained

SAMPLE CONDITIONS

	Initial	After Consol.	Final
Tare Number	945	NA	510
Wt. Tare & WS, gm	238.79	NA	1399.32
Wt. Tare & DS, gm	219.70	NA	1194.74
Wt. Tare, gm	98.49	NA	103.27
Water Content, %	15.7	18.7	18.7
Wt. Tube & WS., gm	1262.6	NA	
Wt. Of Tube, gm	0.0	NA	
Wt. Of WS., gm	1262.6	1295.3	
Length 1, in	6	NA	
Length 2, in	6	NA	
Length 3, in	6	NA	
Top Diameter, in	2.864	NA	
Middle Diameter, in	2.865	NA	
Bottom Diameter, in	2.8655	NA	
Average Length, in	6.000	5.919	
Average Diameter, in	2.865	2.812	
Average Area, in^2	6.45	6.21	
Sample Volume, in^3	38.68	37.72	
Unit Dry Wt., gms/cc	1.72	1.76	
Unit Dry Wt., pcf	107.4	110.1	
Specific Gravity, Assume	2.70	2.70	
Volume of Solids, cc	404.01	404.01	
Void Ratio, e	0.57	0.53	
Porosity, n	0.36	0.35	
Pore Volume, cc	14.02	13.06	
Saturation, %	74.8	95.5	

TEST CONDITIONS

Cell Pressure, psi	49.75	
Back Pressure, psi	39.99	
Effective Consolidating Pressure, psi	9.76	σ_3
Pore Pressure Parameter (B), %	95	

SATURATION AND CONSOLIDATION VOLUME CHANGES

Height Change, mils	Reading	Change	Consolidation	
Initial Reading	7.272	0	Volume Change, ml	15.7
After Saturation	7.222	50	Volume Change, in^3	0.96
After Consolidation	7.191	81	Saturation Method:	Wet

STRAIN RATE CALCULATIONS

Calc. Strain Rate, %/min (t50=23.51)	0.0002	Strain Rate Used, %/min	0.0001
Calc. Deformation Rate, in/min	0.0010	Deformation Rate Used	0.0005

EFFECTIVE FAILURE SUMMARY

Failure Conditions	Max σ_1'/σ_3'	15% ε	
Effective Consolidating Pressure, psi	9.76	9.76	σ_3
1St. Maximum Effective Principal Stress Ratio	3.164	3.08	σ_1'/σ_3'
Deviator Stress at Failure, psi	9.79	12.54	$\sigma_1-\sigma_3$
Axial Strain at Failure, %	6.45	15.00	ε
Effective Minor Principal Stress at Failure, psi	4.52	6.03	σ_3'
Effective Major Principal Stress at Failure, psi	14.31	18.57	σ_1'
Mohr's Circle Stress Path (Origin of Circle), psi	9.42	12.30	p'
Mohr's Circle Stress Path (Radius of Circle), psi	4.89	6.27	q

TOTAL FAILURE SUMMARY

Failure Conditions	Max σ_1'/σ_3'	15% ε	
Deviator Stress at Failure, psi	9.79	12.54	$\sigma_1-\sigma_3$
Axial Strain at Failure, %	6.45	15.00	ε
Total Minor Principal Stress at Failure, psi	9.76	9.76	σ_3
Total Major Principal Stress at Failure, psi	19.55	22.30	σ_1

TEST DATA

Axial Load	Axial Deformation	Total Pore Water Pressure	Axial Strain	Principal Stress Difference (Deviator Stress)	Induced Pore Water Pressure	Effective Major Principal Stress	Effective Minor Principal Stress	Effective Principal Stress Ratio	A-Bar	Mohr's Circle Stress Paths	
										Origin of Circle	Radius of Circle
lb.	mils	psi	%	psi	psi	psi	psi			psi	psi
P	ΔH	U	ε	$\sigma_1-\sigma_3$	ΔU	σ_1'	σ_3'	σ_1'/σ_3'	A'	p'	q
21.7	0	40.0	0	0	NA	NA	NA	NA	NA	9.76	0
44.2	7	42.3	0.12	3.63	2.27	11.12	7.49	1.484	0.66	9.31	1.81
48.8	13	42.9	0.22	4.37	2.95	11.18	6.81	1.641	0.71	9.00	2.18
52.1	19	43.4	0.33	4.89	3.39	11.26	6.37	1.768	0.73	8.82	2.45
54.9	25	43.7	0.43	5.34	3.72	11.38	6.04	1.883	0.73	8.71	2.67
57.2	32	44.0	0.54	5.70	3.99	11.47	5.77	1.987	0.74	8.62	2.85
58.9	38	44.2	0.64	5.95	4.20	11.52	5.57	2.070	0.74	8.54	2.98
60.2	44	44.4	0.74	6.16	4.37	11.55	5.39	2.141	0.75	8.47	3.08
61.3	50	44.5	0.85	6.33	4.51	11.58	5.25	2.206	0.75	8.41	3.17
62.5	56	44.6	0.95	6.51	4.64	11.63	5.12	2.270	0.75	8.38	3.25
63.5	62	44.7	1.05	6.66	4.75	11.68	5.01	2.329	0.75	8.35	3.33
64.4	69	44.8	1.16	6.80	4.85	11.71	4.91	2.384	0.75	8.31	3.40
64.9	75	44.9	1.27	6.87	4.93	11.70	4.83	2.423	0.76	8.27	3.44
67.3	94	45.1	1.58	7.23	5.12	11.87	4.64	2.557	0.75	8.26	3.61

69.1	112	45.2	1.90	7.49	5.25	12.01	4.52	2.659	0.74	8.26	3.75
70.9	131	45.3	2.21	7.75	5.34	12.17	4.42	2.755	0.73	8.30	3.88
71.9	149	45.4	2.52	7.88	5.40	12.24	4.36	2.808	0.72	8.30	3.94
73.0	168	45.4	2.83	8.04	5.44	12.36	4.32	2.860	0.71	8.34	4.02
74.3	186	45.5	3.14	8.21	5.47	12.50	4.29	2.913	0.70	8.40	4.11
75.6	204	45.5	3.45	8.39	5.49	12.67	4.28	2.961	0.69	8.47	4.19
77.1	222	45.5	3.75	8.60	5.49	12.88	4.28	3.010	0.67	8.58	4.30
78.0	240	45.5	4.06	8.71	5.48	12.99	4.28	3.035	0.66	8.64	4.36
79.2	258	45.5	4.36	8.87	5.46	13.17	4.30	3.062	0.65	8.73	4.43
80.4	276	45.4	4.66	9.02	5.45	13.33	4.32	3.089	0.64	8.83	4.51
81.7	294	45.4	4.96	9.19	5.41	13.54	4.35	3.111	0.62	8.95	4.59
82.5	311	45.4	5.26	9.28	5.40	13.65	4.37	3.125	0.61	9.01	4.64
83.4	329	45.3	5.56	9.39	5.36	13.80	4.40	3.133	0.60	9.10	4.70
84.5	347	45.3	5.86	9.53	5.32	13.97	4.44	3.144	0.59	9.20	4.76
85.6	364	45.3	6.16	9.66	5.27	14.15	4.49	3.151	0.57	9.32	4.83
86.6	382	45.2	6.45	9.79	5.24	14.31	4.52	3.164	0.56	9.42	4.89
87.5	400	45.2	6.75	9.89	5.18	14.47	4.58	3.160	0.55	9.53	4.95
88.6	418	45.1	7.06	10.02	5.15	14.64	4.62	3.169	0.54	9.63	5.01
90.2	435	45.1	7.36	10.22	5.09	14.90	4.68	3.186	0.52	9.79	5.11
91.1	453	45.0	7.65	10.33	5.06	15.04	4.71	3.193	0.52	9.87	5.16
91.6	471	45.0	7.95	10.37	4.98	15.15	4.78	3.168	0.51	9.96	5.18
92.5	489	44.9	8.26	10.47	4.96	15.28	4.81	3.177	0.50	10.04	5.23
93.4	507	44.9	8.57	10.57	4.89	15.44	4.87	3.171	0.49	10.16	5.29
95.0	525	44.8	8.87	10.77	4.85	15.68	4.91	3.192	0.47	10.30	5.38
95.6	543	44.8	9.17	10.82	4.79	15.79	4.97	3.176	0.47	10.38	5.41
96.6	561	44.7	9.47	10.93	4.74	15.96	5.03	3.175	0.46	10.49	5.47
97.2	579	44.7	9.78	10.97	4.68	16.06	5.08	3.158	0.45	10.57	5.49
98.6	597	44.6	10.09	11.14	4.63	16.27	5.13	3.171	0.44	10.70	5.57
99.4	615	44.5	10.38	11.21	4.56	16.42	5.21	3.154	0.43	10.81	5.61
100.3	632	44.5	10.68	11.31	4.53	16.55	5.24	3.161	0.42	10.89	5.66
100.6	650	44.4	10.98	11.32	4.45	16.63	5.31	3.131	0.41	10.97	5.66
102.2	668	44.4	11.29	11.51	4.42	16.86	5.34	3.154	0.40	11.10	5.76
102.9	686	44.3	11.59	11.57	4.34	16.99	5.42	3.136	0.40	11.21	5.79
104.1	703	44.3	11.88	11.70	4.31	17.16	5.46	3.143	0.39	11.31	5.85
105.0	721	44.2	12.18	11.78	4.23	17.32	5.53	3.130	0.38	11.42	5.89
106.3	739	44.2	12.48	11.93	4.20	17.49	5.57	3.142	0.37	11.53	5.96
106.5	757	44.1	12.79	11.92	4.14	17.55	5.63	3.118	0.37	11.59	5.96
107.7	775	44.1	13.09	12.04	4.09	17.71	5.67	3.124	0.36	11.69	6.02
108.7	792	44.0	13.38	12.14	4.02	17.88	5.74	3.114	0.35	11.81	6.07
109.5	810	44.0	13.68	12.22	3.98	18.00	5.78	3.112	0.34	11.89	6.11
110.4	828	43.9	13.99	12.29	3.91	18.14	5.85	3.101	0.34	11.99	6.14
111.1	846	43.8	14.30	12.34	3.86	18.24	5.90	3.092	0.33	12.07	6.17
111.8	864	43.8	14.60	12.40	3.80	18.36	5.96	3.080	0.32	12.16	6.20
112.7	882	43.7	14.90	12.48	3.75	18.49	6.01	3.077	0.32	12.25	6.24
114.3	900	43.7	15.20	12.65	3.69	18.72	6.07	3.085	0.31	12.40	6.33
115.3	918	43.6	15.52	12.74	3.65	18.86	6.12	3.082	0.30	12.49	6.37
115.6	937	43.6	15.82	12.74	3.58	18.92	6.18	3.061	0.30	12.55	6.37
116.8	954	43.5	16.12	12.86	3.54	19.09	6.23	3.064	0.29	12.66	6.43
117.3	972	43.5	16.42	12.87	3.48	19.16	6.29	3.047	0.28	12.72	6.43
118.2	990	43.4	16.73	12.94	3.43	19.28	6.33	3.043	0.28	12.81	6.47

Input Validation: Reviewed By: Date Tested: 12/28/10

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CONSOLIDATED-UNDRAINED TRIAXIAL COMPRESSION TEST ON COHESIVE SOILS ASTM D 4767

Client	Civil & Environmental Consultants, Inc.	Boring	SB-1
Client Project	091-867 Apex Landfill Expansion	Depth	58'-66'
Project No.	30598	Sample	B-1
Test No.	2	Lab Sample No.	30598024
USCS Description:	Grayish Brown Sandy Lean Clay	Test Conditions:	Remolded - Side And Double Drained

SAMPLE CONDITIONS

	Initial	After Consol.	Final
Tare Number	945	NA	803
Wt. Tare & WS, gm	238.79	NA	1383.10
Wt. Tare & DS, gm	219.7	NA	1200.84
Wt. Tare, gm	98.49	NA	103.10
Water Content, %	15.7	16.6	16.6
Wt. Tube & WS., gm	1262.6	NA	
Wt. Of Tube, gm	0.0	NA	
Wt. Of WS., gm	1262.6	1271.9	
Length 1, in	6	NA	
Length 2, in	6	NA	
Length 3, in	6	NA	
Top Diameter, in	2.864	NA	
Middle Diameter, in	2.865	NA	
Bottom Diameter, in	2.8655	NA	
Average Length, in	6.000	5.853	
Average Diameter, in	2.865	2.814	
Average Area, in^2	6.45	6.22	
Sample Volume, in^3	38.68	36.28	
Unit Dry Wt., gms/cc	1.72	1.83	
Unit Dry Wt., pcf	107.4	114.5	
Specific Gravity, Assume	2.70	2.70	
Volume of Solids, cc	404.01	404.01	
Void Ratio, e	0.57	0.47	
Porosity, n	0.36	0.32	
Pore Volume, cc	14.02	11.63	
Saturation, %	74.8	95.1	

TEST CONDITIONS

Cell Pressure, psi	118.27	
Back Pressure, psi	79.50	
Effective Consolidating Pressure, psi	38.77	σ_3
Pore Pressure Parameter (B), %	98	

SATURATION AND CONSOLIDATION VOLUME CHANGES

Height Change, mils	Reading	Change	Consolidation	
Initial Dial Reading	7.554	0	Volume Change, ml	39.3
After Saturation	7.56	-6	Volume Change, in^3	2.40
After Consolidation	7.407	147	Saturation Method:	Wet

STRAIN RATE CALCULATIONS

Calc. Strain Rate, %/min (t50=.22)	0.0182	Strain Rate Used, %/min	0.0001
Calc. Deformation Rate, in/min	0.1064	Deformation Rate Used	0.0005

EFFECTIVE FAILURE SUMMARY

Failure Conditions	Max σ_1'/σ_3'	15% ε	
Effective Consolidating Pressure, psi	38.77	38.77	σ_3
1St. Maximum Effective Principal Stress Ratio	2.849	2.78	σ_1'/σ_3'
Deviator Stress at Failure, psi	32.99	38.46	$\sigma_1-\sigma_3$
Axial Strain at Failure, %	6.68	15.00	ε
Effective Minor Principal Stress at Failure, psi	17.84	21.56	σ_3'
Effective Major Principal Stress at Failure, psi	50.84	60.02	σ_1'
Mohr's Circle Stress Path (Origin of Circle), psi	34.34	40.79	p'
Mohr's Circle Stress Path (Radius of Circle), psi	16.50	19.23	q

TOTAL FAILURE SUMMARY

Failure Conditions	Max σ_1'/σ_3'	15% ε	
Deviator Stress at Failure, psi	32.99	38.46	$\sigma_1-\sigma_3$
Axial Strain at Failure, %	6.68	15.00	ε
Total Minor Principal Stress at Failure, psi	38.77	38.77	σ_3
Total Major Principal Stress at Failure, psi	71.77	77.23	σ_1

TEST DATA

Axial Load	Axial Deformation	Total Pore Water Pressure	Axial Strain	Principal Stress Difference (Deviator Stress)	Induced Pore Water Pressure	Effective Major Principal Stress	Effective Minor Principal Stress	Effective Principal Stress Ratio	A-Bar	Mohr's Circle Stress Paths	
										Origin of Circle	Radius of Circle
lb.	mils	psi	%	psi	psi	psi	psi			psi	psi
P	ΔH	U	ε	$\sigma_1-\sigma_3$	ΔU	σ_1'	σ_3'	σ_1'/σ_3'	A'	p'	q
21.5	0	79.5	0	0.00	0	NA	NA	NA	NA	38.77	0
72.8	5	82.9	0.08	8.25	3.39	43.63	35.39	1.233	0.42	39.51	4.12
98.2	10	86.4	0.17	12.32	6.92	44.18	31.86	1.387	0.57	38.02	6.16
112.9	16	88.8	0.28	14.67	9.35	44.09	29.42	1.499	0.65	36.76	7.33
123.8	21	90.6	0.37	16.40	11.14	44.04	27.63	1.594	0.69	35.84	8.20
132.5	27	92.1	0.47	17.78	12.58	43.98	26.20	1.679	0.72	35.09	8.89
139.9	34	93.2	0.58	18.93	13.71	43.99	25.06	1.755	0.74	34.53	9.47
145.9	39	94.2	0.67	19.88	14.65	44.00	24.12	1.824	0.75	34.06	9.94
151.3	46	94.9	0.78	20.71	15.45	44.03	23.32	1.888	0.76	33.68	10.36
155.8	51	95.6	0.87	21.41	16.14	44.04	22.63	1.946	0.77	33.34	10.71
159.7	57	96.2	0.98	22.01	16.73	44.06	22.04	1.999	0.78	33.05	11.01
163.8	63	96.7	1.08	22.64	17.25	44.17	21.52	2.052	0.78	32.85	11.32
167.2	69	97.2	1.18	23.15	17.72	44.21	21.06	2.100	0.78	32.63	11.58
175.9	87	98.3	1.49	24.46	18.83	44.41	19.95	2.226	0.79	32.18	12.23

182.9	105	99.2	1.80	25.49	19.67	44.59	19.10	2.334	0.79	31.85	12.74
188.9	122	99.7	2.09	26.37	20.24	44.90	18.54	2.422	0.78	31.72	13.18
194.3	140	100.2	2.40	27.13	20.67	45.23	18.11	2.498	0.78	31.67	13.56
198.6	159	100.4	2.72	27.71	20.93	45.56	17.84	2.553	0.77	31.70	13.86
202.7	177	100.7	3.02	28.26	21.18	45.85	17.59	2.606	0.76	31.72	14.13
206.6	194	100.9	3.31	28.79	21.36	46.21	17.42	2.653	0.76	31.81	14.40
210.5	211	100.9	3.60	29.30	21.43	46.65	17.34	2.690	0.75	31.99	14.65
214.3	231	101.0	3.94	29.78	21.49	47.06	17.28	2.724	0.74	32.17	14.89
217.5	249	101.0	4.25	30.19	21.52	47.44	17.25	2.750	0.73	32.35	15.10
220.3	266	101.0	4.54	30.52	21.49	47.80	17.29	2.765	0.72	32.55	15.26
224.0	284	100.9	4.85	30.99	21.43	48.33	17.34	2.787	0.71	32.84	15.49
227.2	302	100.9	5.15	31.38	21.37	48.79	17.40	2.803	0.69	33.09	15.69
230.4	320	100.8	5.47	31.77	21.28	49.26	17.49	2.816	0.68	33.37	15.88
232.5	338	100.7	5.78	31.97	21.23	49.52	17.54	2.822	0.68	33.53	15.99
235.5	356	100.6	6.07	32.33	21.15	49.96	17.63	2.835	0.67	33.79	16.17
238.3	373	100.5	6.38	32.64	21.04	50.38	17.73	2.841	0.66	34.05	16.32
241.3	391	100.4	6.68	32.99	20.93	50.84	17.84	2.849	0.65	34.34	16.50
243.6	410	100.3	7.00	33.23	20.80	51.20	17.97	2.849	0.64	34.59	16.61
246.3	428	100.2	7.31	33.51	20.69	51.60	18.08	2.854	0.63	34.84	16.76
248.9	445	100.1	7.60	33.80	20.57	52.00	18.20	2.857	0.62	35.10	16.90
251.9	462	99.9	7.90	34.13	20.43	52.47	18.34	2.861	0.61	35.41	17.06
254.2	481	99.8	8.22	34.35	20.28	52.84	18.50	2.857	0.60	35.67	17.17
256.7	500	99.7	8.54	34.60	20.17	53.21	18.61	2.859	0.59	35.91	17.30
258.8	518	99.5	8.85	34.79	20.01	53.55	18.76	2.854	0.59	36.16	17.39
261.7	535	99.4	9.13	35.11	19.85	54.03	18.92	2.855	0.58	36.47	17.55
264.5	553	99.2	9.44	35.39	19.68	54.48	19.10	2.853	0.57	36.79	17.69
266.3	571	99.0	9.76	35.54	19.53	54.78	19.25	2.846	0.56	37.02	17.77
268.2	589	98.9	10.07	35.68	19.39	55.06	19.38	2.841	0.55	37.22	17.84
270.4	607	98.8	10.36	35.89	19.27	55.39	19.50	2.840	0.55	37.45	17.94
272.8	624	98.7	10.66	36.11	19.16	55.72	19.62	2.841	0.54	37.67	18.05
275.6	642	98.5	10.97	36.39	19.02	56.14	19.75	2.843	0.53	37.94	18.19
277.5	661	98.4	11.30	36.52	18.86	56.44	19.92	2.834	0.53	38.18	18.26
279.1	679	98.2	11.60	36.63	18.69	56.71	20.08	2.824	0.52	38.39	18.31
281.4	696	98.0	11.89	36.83	18.53	57.08	20.25	2.819	0.51	38.66	18.42
284.0	714	98.0	12.20	37.06	18.46	57.38	20.31	2.825	0.51	38.84	18.53
286.2	733	97.8	12.52	37.24	18.32	57.70	20.45	2.821	0.50	39.07	18.62
288.1	751	97.7	12.83	37.37	18.17	57.98	20.61	2.814	0.50	39.29	18.69
289.6	769	97.5	13.13	37.46	18.04	58.20	20.74	2.806	0.49	39.47	18.73
292.2	786	97.4	13.42	37.69	17.90	58.56	20.87	2.806	0.48	39.72	18.84
294.8	805	97.3	13.75	37.92	17.78	58.91	21.00	2.806	0.48	39.95	18.96
296.6	822	97.1	14.04	38.03	17.65	59.16	21.13	2.800	0.47	40.14	19.02
298.2	841	97.0	14.36	38.11	17.52	59.37	21.25	2.793	0.47	40.31	19.06
300.0	858	96.9	14.65	38.22	17.36	59.64	21.42	2.784	0.46	40.53	19.11
302.6	876	96.7	14.97	38.45	17.23	59.99	21.54	2.785	0.46	40.76	19.22
304.5	894	96.6	15.27	38.57	17.09	60.25	21.68	2.779	0.45	40.97	19.28
306.3	911	96.5	15.57	38.67	17.01	60.43	21.76	2.777	0.45	41.10	19.34
308.2	930	96.4	15.90	38.77	16.89	60.66	21.89	2.772	0.44	41.27	19.39
310.0	947	96.3	16.18	38.89	16.77	60.90	22.00	2.767	0.44	41.45	19.45
312.6	965	96.2	16.49	39.10	16.66	61.21	22.11	2.768	0.43	41.66	19.55
314.8	984	96.1	16.81	39.24	16.56	61.45	22.21	2.766	0.43	41.83	19.62

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CONSOLIDATED-UNDRAINED TRIAXIAL COMPRESSION TEST ON COHESIVE SOILS ASTM D 4767

Client	Civil & Environmental Consultants, Inc.	Boring	SB-1
Client Project	091-867 Apex Landfill Expansion	Depth	58'-66'
Project No.	30598	Sample	B-1
Test No.	3	Lab Sample No.	30598024
USCS Description:	Grayish Brown Sandy Lean Clay	Test Conditions:	Remolded - Side And Double Drained

SAMPLE CONDITIONS

	Initial	After Consol.	Final
Tare Number	945	NA	808
Wt. Tare & WS, gm	238.79	NA	1368.14
Wt. Tare & DS, gm	219.7	NA	1202.34
Wt. Tare, gm	98.49	NA	102.53
Water Content, %	15.7	15.1	15.1
Wt. Tube & WS., gm	1262.6	NA	
Wt. Of Tube, gm	0.0	NA	
Wt. Of WS., gm	1262.6	1255.3	
Length 1, in	6	NA	
Length 2, in	6	NA	
Length 3, in	6	NA	
Top Diameter, in	2.864	NA	
Middle Diameter, in	2.865	NA	
Bottom Diameter, in	2.8655	NA	
Average Length, in	6.000	5.889	
Average Diameter, in	2.865	2.769	
Average Area, in^2	6.45	6.02	
Sample Volume, in^3	38.68	35.49	
Unit Dry Wt., gms/cc	1.72	1.88	
Unit Dry Wt., pcf	107.4	117.0	
Specific Gravity, Assume	2.70	2.70	
Volume of Solids, cc	404.01	404.01	
Void Ratio, e	0.57	0.44	
Porosity, n	0.36	0.31	
Pore Volume, cc	14.02	10.84	
Saturation, %	74.8	92.6	

TEST CONDITIONS

Cell Pressure, psi	119.14	
Back Pressure, psi	39.70	
Effective Consolidating Pressure, psi	79.44	σ_3
Pore Pressure Parameter (B), %	94	

SATURATION AND CONSOLIDATION VOLUME CHANGES

Height Change, mils	Reading	Change	Consolidation	
Initial Dial Reading	7.018	0	Volume Change, ml	52.2
After Saturation	7.016	2	Volume Change, in^3	3.19
After Consolidation	6.907	111	Saturation Method:	Wet

STRAIN RATE CALCULATIONS

Calc. Strain Rate, %/min (t50=1.56)	0.0026	Strain Rate Used, %/min	0.0001
Calc. Deformation Rate, in/min	0.0151	Deformation Rate Used	0.0005

EFFECTIVE FAILURE SUMMARY

Failure Conditions	Max σ_1'/σ_3'	15% ε	
Effective Consolidating Pressure, psi	79.44	NA	σ_3
1St. Maximum Effective Principal Stress Ratio	2.620	NA	σ_1'/σ_3'
Deviator Stress at Failure, psi	53.77	NA	$\sigma_1-\sigma_3$
Axial Strain at Failure, %	5.38	NA	ε
Effective Minor Principal Stress at Failure, psi	33.20	NA	σ_3'
Effective Major Principal Stress at Failure, psi	86.96	NA	σ_1'
Mohr's Circle Stress Path (Origin of Circle), psi	60.08	NA	p'
Mohr's Circle Stress Path (Radius of Circle), psi	26.88	NA	q

TOTAL FAILURE SUMMARY

Failure Conditions	Max σ_1'/σ_3'	15% ε	
Deviator Stress at Failure, psi	53.77	NA	$\sigma_1-\sigma_3$
Axial Strain at Failure, %	5.38	NA	ε
Total Minor Principal Stress at Failure, psi	79.44	NA	σ_3
Total Major Principal Stress at Failure, psi	133.21	NA	σ_1

TEST DATA

Axial Load	Axial Deformation	Total Pore Water Pressure	Axial Strain	Principal Stress Difference (Deviator Stress)	Induced Pore Water Pressure	Effective Major Principal Stress	Effective Minor Principal Stress	Effective Principal Stress Ratio	A-Bar	Mohr's Circle Stress Paths	
										Origin of Circle	Radius of Circle
lb.	mils	psi	%	psi	psi	psi	psi			psi	psi
P	ΔH	U	ε	$\sigma_1-\sigma_3$	ΔU	σ_1'	σ_3'	σ_1'/σ_3'	A'	p'	q
23.8	0	39.7	0	0	0	NA	NA	NA	NA	79.44	0
76.6	4	42.2	0.08	8.77	2.47	85.73	76.96	1.114	0.30	81.35	4.38
125.4	10	47.2	0.16	16.84	7.51	88.76	71.92	1.234	0.47	80.34	8.42
153.8	15	51.9	0.26	21.53	12.19	88.78	67.25	1.320	0.60	78.01	10.76
174.4	20	55.9	0.35	24.92	16.23	88.13	63.21	1.394	0.69	75.67	12.46
191.1	26	59.4	0.45	27.66	19.67	87.42	59.77	1.463	0.76	73.59	13.83
204.6	32	62.3	0.55	29.86	22.58	86.72	56.86	1.525	0.80	71.79	14.93
216.4	39	64.8	0.66	31.77	25.07	86.14	54.37	1.584	0.84	70.25	15.89
226.4	45	66.7	0.76	33.40	26.99	85.85	52.45	1.637	0.86	69.15	16.70
235.5	51	68.9	0.86	34.86	29.18	85.12	50.26	1.694	0.89	67.69	17.43
243.4	57	70.6	0.96	36.12	30.88	84.68	48.56	1.744	0.91	66.62	18.06
250.2	63	72.1	1.07	37.21	32.35	84.30	47.09	1.790	0.92	65.69	18.60
256.7	69	73.4	1.18	38.23	33.68	83.99	45.76	1.836	0.94	64.87	19.12
272.9	88	76.3	1.49	40.76	36.59	83.60	42.84	1.951	0.96	63.22	20.38

285.8	107	78.9	1.82	42.72	39.22	82.94	40.22	2.062	0.98	61.58	21.36
296.8	123	80.6	2.09	44.39	40.93	82.89	38.50	2.153	0.98	60.70	22.19
305.8	141	82.0	2.40	45.72	42.33	82.83	37.11	2.232	0.98	59.97	22.86
314.0	159	83.1	2.70	46.89	43.36	82.97	36.08	2.300	0.98	59.52	23.45
321.5	177	83.9	3.01	47.96	44.15	83.25	35.29	2.359	0.98	59.27	23.98
328.4	194	84.5	3.29	48.93	44.78	83.59	34.66	2.412	0.97	59.12	24.47
334.6	212	84.7	3.60	49.76	45.00	84.20	34.44	2.445	0.96	59.32	24.88
340.5	230	85.3	3.90	50.56	45.62	84.38	33.82	2.495	0.96	59.10	25.28
346.3	248	85.5	4.20	51.32	45.83	84.92	33.60	2.527	0.95	59.26	25.66
351.5	264	85.7	4.49	51.99	46.04	85.38	33.39	2.557	0.94	59.39	25.99
356.8	281	85.9	4.78	52.67	46.16	85.95	33.28	2.583	0.93	59.61	26.34
361.3	299	85.9	5.08	53.22	46.22	86.44	33.22	2.602	0.92	59.83	26.61
365.9	317	85.9	5.38	53.77	46.24	86.96	33.20	2.620	0.91	60.08	26.88
370.4	334	85.5	5.68	54.31	45.84	87.91	33.60	2.616	0.90	60.76	27.15
374.9	351	85.8	5.95	54.85	46.13	88.15	33.30	2.647	0.89	60.73	27.42
379.0	368	85.7	6.25	55.31	45.95	88.79	33.49	2.651	0.88	61.14	27.65
383.3	386	85.6	6.55	55.80	45.92	89.32	33.52	2.665	0.88	61.42	27.90
387.3	404	85.5	6.85	56.23	45.78	89.89	33.66	2.671	0.87	61.78	28.12
391.0	421	85.3	7.15	56.64	45.63	90.45	33.81	2.675	0.86	62.13	28.32
395.4	438	85.2	7.44	57.13	45.49	91.07	33.94	2.683	0.85	62.51	28.56
398.9	456	85.0	7.75	57.48	45.27	91.65	34.17	2.682	0.84	62.91	28.74
402.2	474	84.9	8.05	57.79	45.15	92.08	34.29	2.686	0.83	63.18	28.90
405.8	492	84.5	8.36	58.15	44.79	92.80	34.65	2.679	0.82	63.72	29.08
409.7	510	84.4	8.65	58.55	44.66	93.33	34.78	2.683	0.81	64.05	29.27
411.9	527	84.2	8.95	58.69	44.52	93.61	34.92	2.681	0.81	64.26	29.35
414.0	545	84.1	9.25	58.82	44.38	93.89	35.06	2.678	0.80	64.47	29.41
416.1	563	84.0	9.56	58.94	44.26	94.12	35.18	2.675	0.80	64.65	29.47
419.0	581	84.1	9.86	59.18	44.43	94.18	35.01	2.690	0.80	64.59	29.59
422.1	597	83.6	10.14	59.45	43.86	95.03	35.58	2.671	0.78	65.30	29.72
426.0	615	83.4	10.45	59.82	43.68	95.58	35.75	2.673	0.78	65.66	29.91
429.1	633	83.7	10.75	60.08	44.04	95.48	35.40	2.697	0.78	65.44	30.04
431.7	651	83.7	11.05	60.26	43.98	95.72	35.46	2.700	0.78	65.59	30.13
434.9	668	83.6	11.34	60.54	43.91	96.06	35.52	2.704	0.77	65.79	30.27

Input Validation: Reviewed By: Date Tested: 01/25/11

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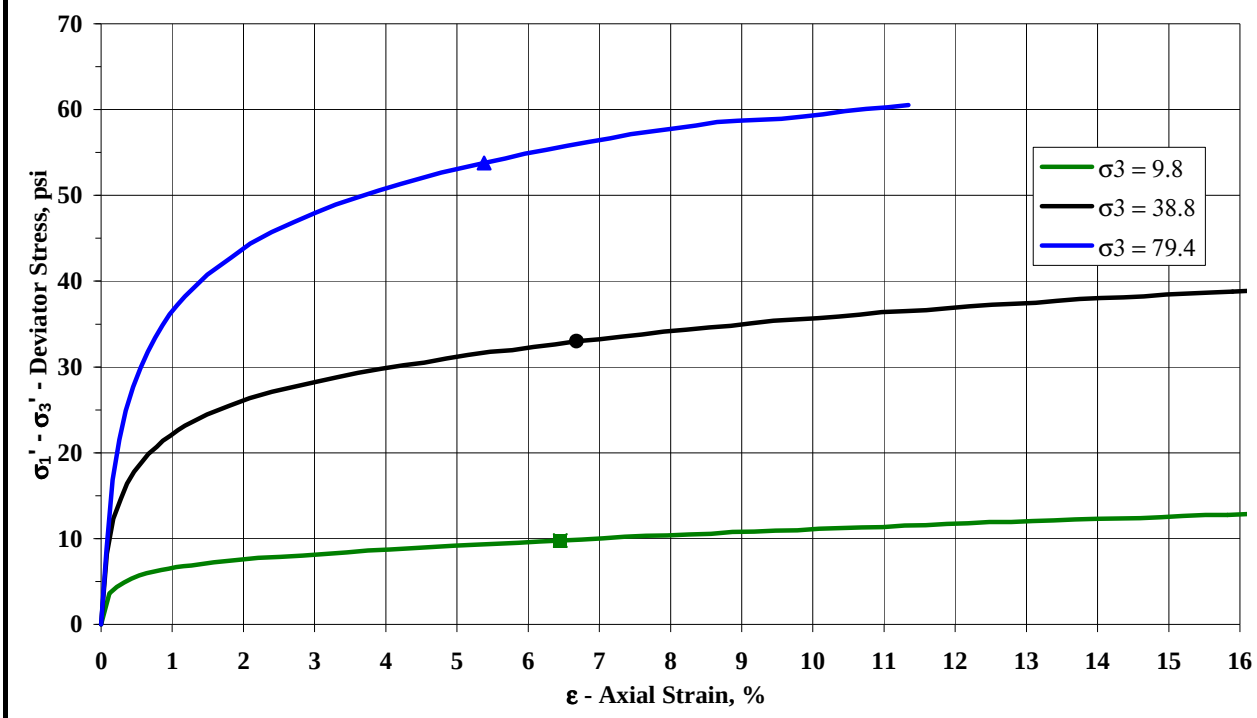
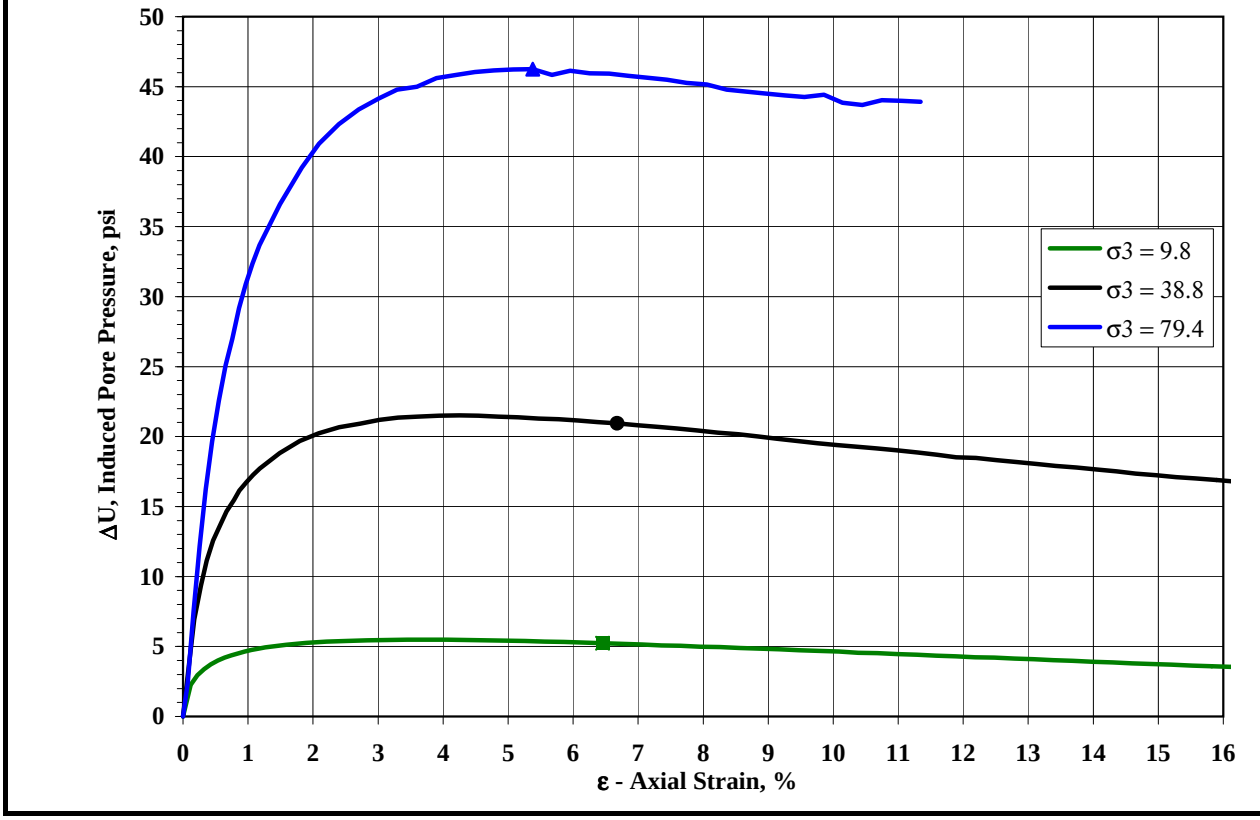
CONSOLIDATED-UNDRAINED TRIAXIAL COMPRESSION TEST ON COHESIVE SOILS ASTM D 4767

Client	Civil & Environmental Consultants, Inc.	Boring	SB-1
Client Project	091-867 Apex Landfill Expansion	Depth	58'-66'
Project No.	30598	Sample	B-1
Test Conditions:	Remolded - Side And Double Drained	Lab Sample No.	30598024
USCS Description:	Grayish Brown Sandy Lean Clay		

AXIAL STRAIN vs. DEVIATOR STRESS



AXIAL STRAIN vs. INDUCED PORE-WATER PRESSURE



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CONSOLIDATED-UNDRAINED TRIAXIAL COMPRESSION TEST ON COHESIVE SOILS ASTM D 476

Client	Civil & Environmental Consultants, In	Boring	SB-1
Client Project	091-867 Apex Landfill Expansion	Depth	58'-66'
Project No.	30598	Sample	B-1
		Lab Sample No.	30598024
USCS Description:	Grayish Brown Sandy Lean Clay		
Test Conditions:	Remolded - Side And Double Drained		

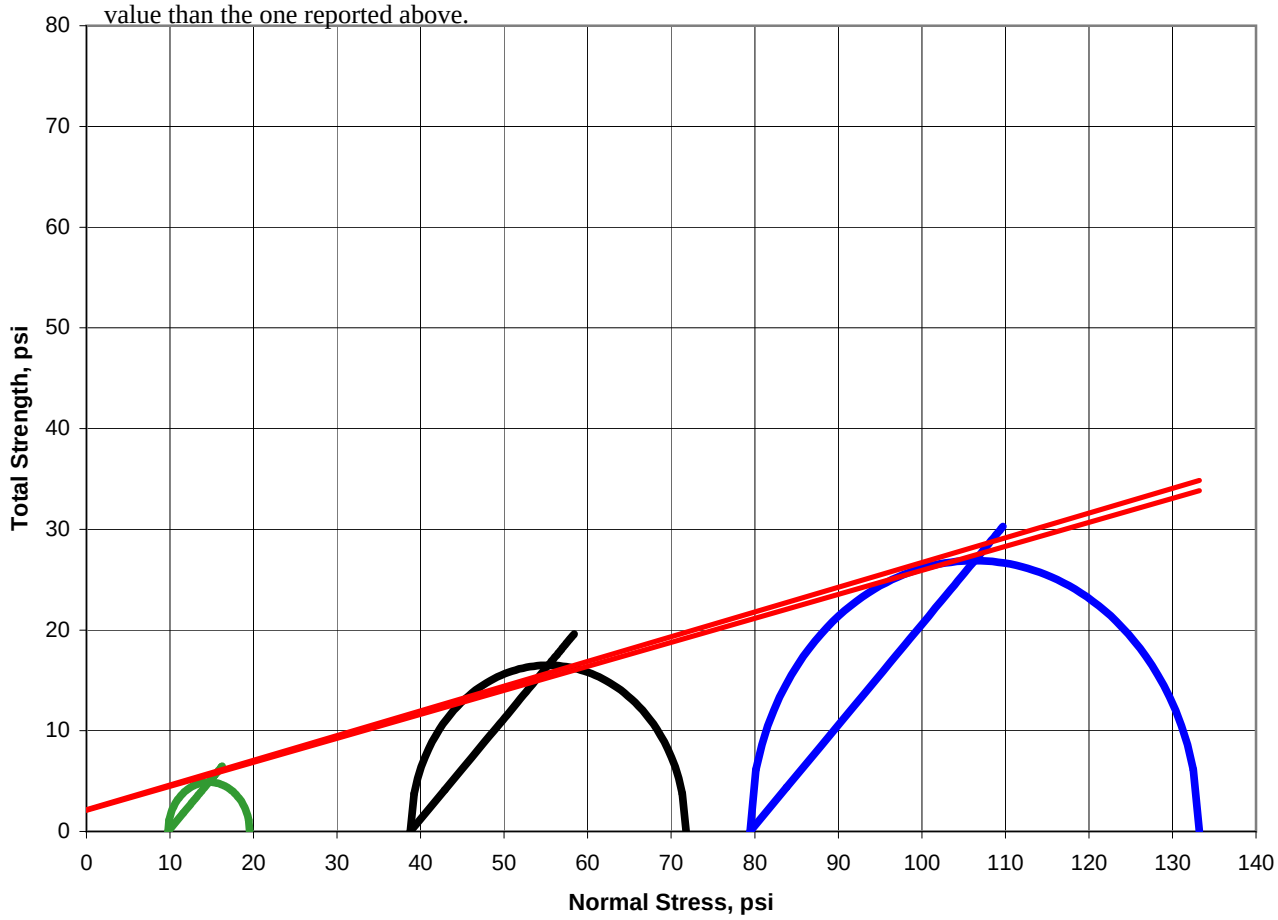
TOTAL STRESS

FAILURE CONDITION: 1st. MAX. EFFECTIVE PRINCIPAL STRESS RATIO

Test No.	Deviator Stress	Major Principal Stress	Minor Principal Stress	Strain at Failure	Mohr's Circle Stress Path		Failure Angle	
	$\sigma1-\sigma3$	$\sigma1$	$\sigma3$	ε	$(\sigma1+\sigma3)/2$	$(\sigma1-\sigma3)/2$		
	psi	psi	psi	%	psi	psi	α, deg	13.4
Test 1	9.79	19.55	9.76	6.45	14.66	4.89	a, psi	2.1
Test 2	32.99	71.77	38.77	6.68	55.27	16.50	Φ, deg	13.8
Test 3	53.77	133.21	79.44	5.38	106.32	26.88	C, psi	2.2

Calculations based on: Test 1 Test 2 Test 3

Note: The Friction Angle and Cohesion using other combinations of test points may yield a higher or lower value than the one reported above.



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CONSOLIDATED-UNDRAINED TRIAXIAL COMPRESSION TEST ON COHESIVE SOILS ASTM D 476

Client	Civil & Environmental Consultants, In	Boring	SB-1
Client Project	091-867 Apex Landfill Expansion	Depth	58'-66'
Project No.	30598	Sample	B-1
		Lab Sample No.	30598024
USCS Description:	Grayish Brown Sandy Lean Clay		
Test Conditions:	Remolded - Side And Double Drained		

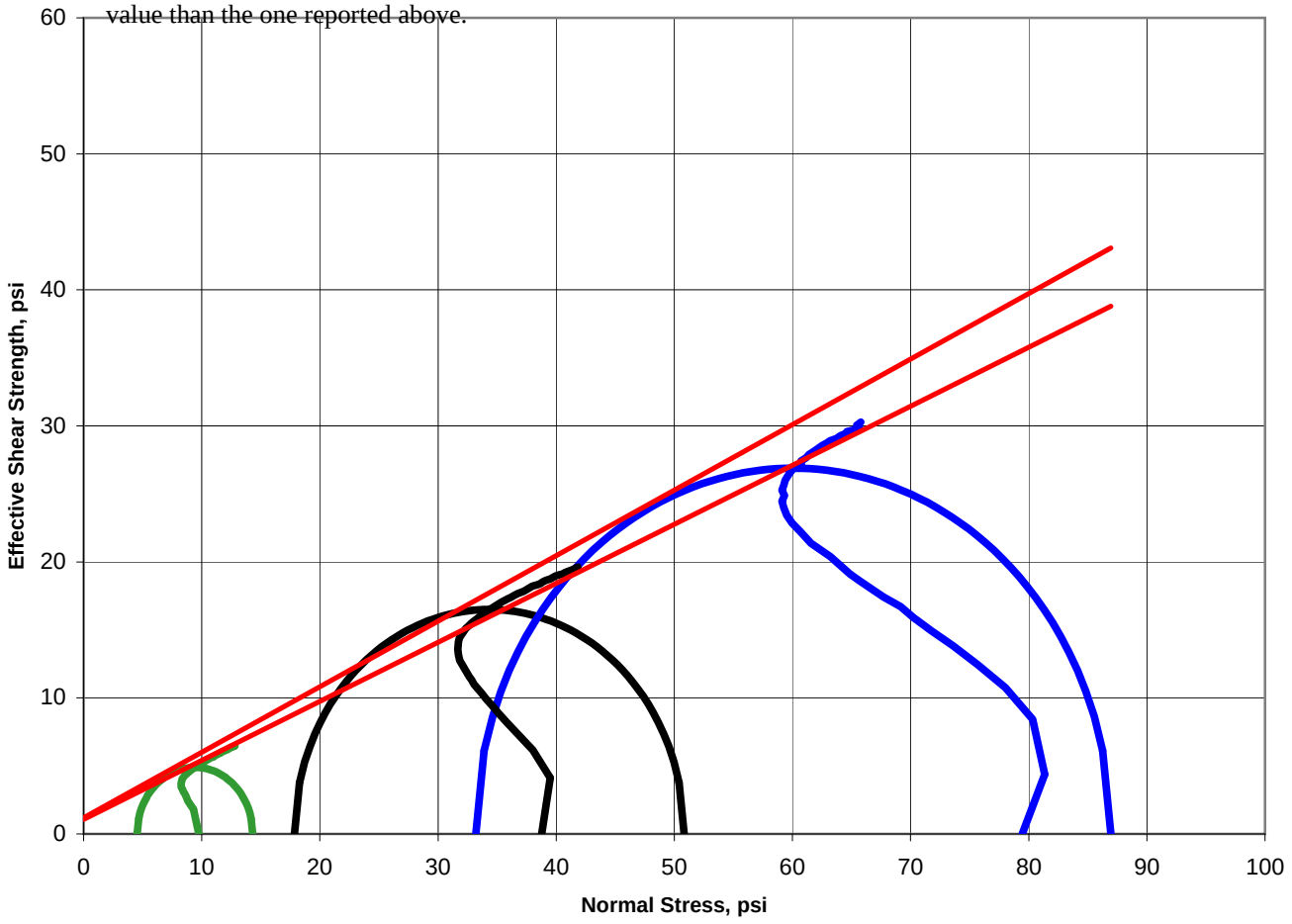
EFFECTIVE STRESS

FAILURE CONDITION: 1st. MAX. EFFECTIVE PRINCIPAL STRESS RATIO

Test No.	Deviator Stress	Major Principal Stress	Minor Principal Stress	Strain at Failure	Mohr's Circle Stress Path		Failure Angle	
	$\sigma 1-\sigma 3$	$\sigma' 1$	$\sigma' 3$	ε	p'	q		
	psi	psi	psi	%	psi	psi	α', deg	23.5
Test 1	9.79	14.31	4.52	6.45	9.42	4.89	a', psi	1.1
Test 2	32.99	50.84	17.84	6.68	34.34	16.50	Φ', deg	25.7
Test 3	53.77	86.96	33.20	5.38	60.08	26.88	C', psi	1.2

Calculations based on: Test 1 Test 2 Test 3

Note: The Friction Angle and Cohesion using other combinations of test points may yield a higher or lower value than the one reported above.



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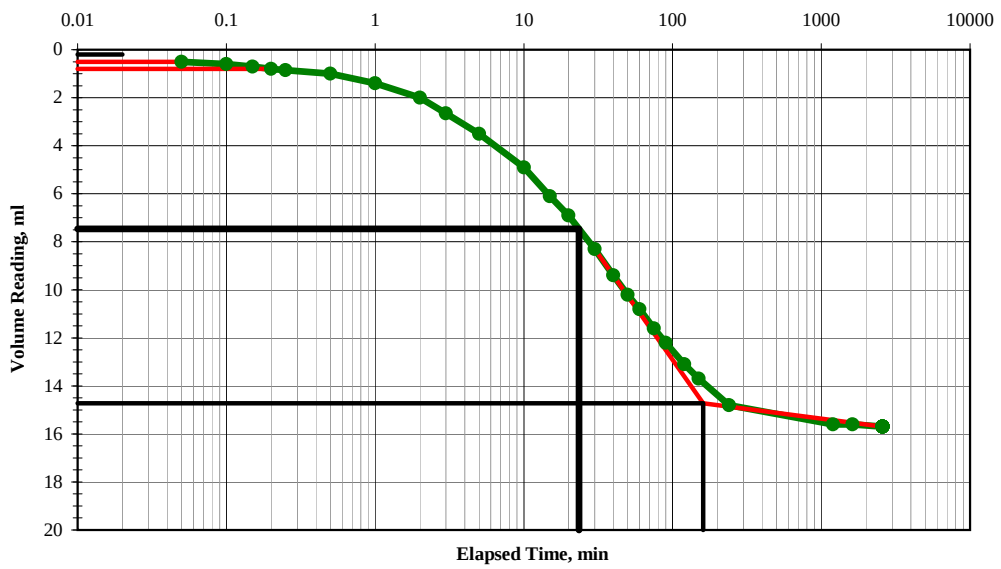
THREE DIMENSIONAL TRIAXIAL CONSOLIDATION TEST

Client	Civil & Environmental Consultants, Inc	Boring	SB-1	**Staged Consolidation**	
Client Project	091-867 Apex Landfill Expansion	Depth	58'-66'	Consolidation Plot Stress, psi	6.8
Project No.	30598	Sample	B-1	**Final Test Pressures**	
		Lab Sample	30598024	Cell Pressure, psi	49.8
USCS Description:	Grayish Brown Sandy Lean Clay			Back Pressure, psi	40.0
Test Conditions:	Remolded - Side And Double Drained			Effective Consol., psi	9.8
				Additional Consol. Volume, ml	0.0

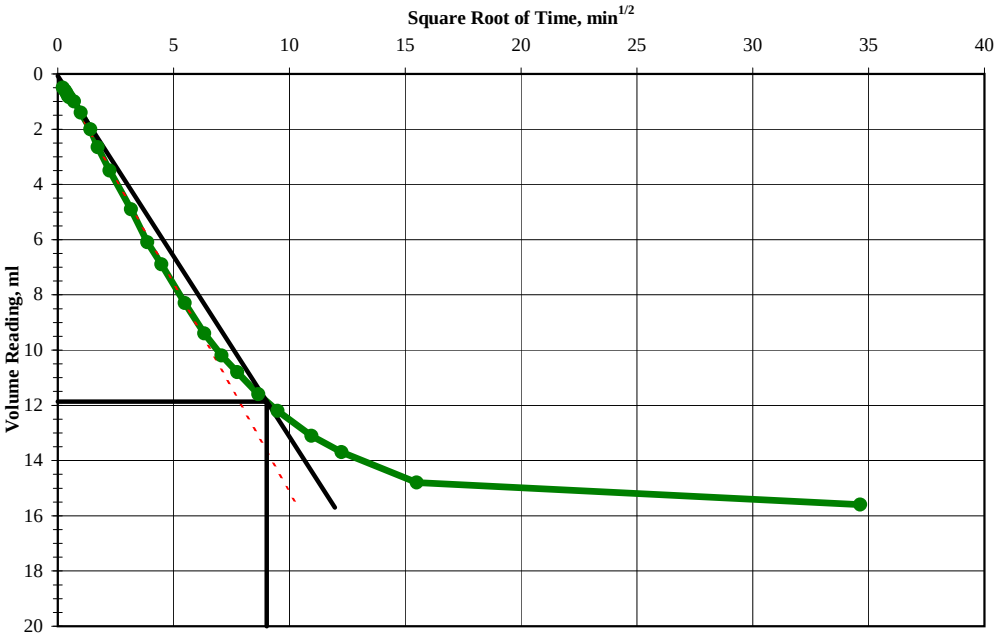
Consol. Start Date: 12/28/2010

Elapsed Time (min)	Sqrt Time ($min^{1/2}$)	Volume Reading ml
0	0	0.0
0.05	0.22	0.5
0.10	0.32	0.6
0.15	0.39	0.7
0.20	0.45	0.8
0.25	0.50	0.9
0.50	0.71	1.0
1.00	1.00	1.4
2.00	1.41	2.0
3.00	1.73	2.7
5.00	2.24	3.5
10.00	3.16	4.9
15.00	3.87	6.1
20.00	4.47	6.9
30.00	5.48	8.3
40.00	6.32	9.4
50.00	7.07	10.2
60.00	7.75	10.8
75.00	8.66	11.6
90.00	9.49	12.2
120.00	10.95	13.1
150.00	12.25	13.7
240.00	15.49	14.8
1200.00	34.64	15.6
1620.00	40.25	15.6
2580.00	50.79	15.7

Log of Elapsed Time vs. Volume Reading



Square Root of Elapsed Time vs. Volume Reading



Sqrt. of Elapsed Time vs Volume		Log of Elapsed Time vs Volume		Consolidation Summary	
T0 = 0 min.	V0 = 0.1 ml.	T0 = 0 min.	V0 = 0.2 ml.	Initial Volume Reading, ml	0.0
T90 = 81.4 min	V90 = 11.9 ml.	T50 = 23.5 min.	V50 = 7.5 ml.	Final Volume Reading, ml	15.7
T100 = NA min	V100 = 13.2 ml.	T100 = 160.7 min.	V100 = 14.7 ml.	Total Volume Change, ml	15.7

Input Validation: Reviewed By: Date 12/28/2010

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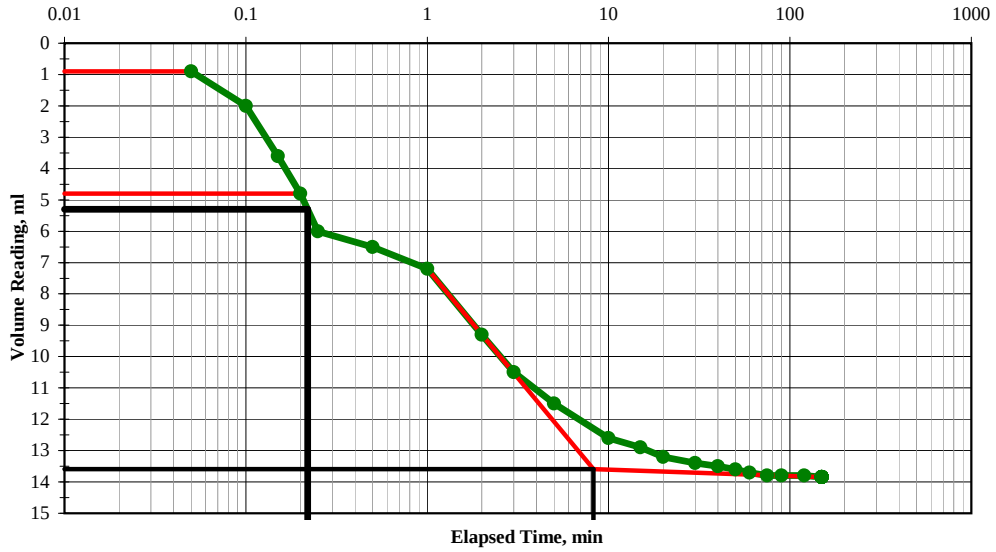
THREE DIMENSIONAL TRIAXIAL CONSOLIDATION TEST

Client	Civil & Environmental Consultants, Inc	Boring	SB-1	**Staged Consolidation**	
Client Project	091-867 Apex Landfill Expansion	Depth	58'-66'	Consolidation Plot Stress, psi	6.8
Project No.	30598	Sample	B-1	**Final Test Pressures**	
		Lab Sample	30598024	Cell Pressure, psi	118.3
USCS Description:	Grayish Brown Sandy Lean Clay			Back Pressure, psi	79.5
Test Conditions:	Remolded - Side And Double Drained			Effective Consol., psi	38.8
				Additional Consol. Volume, ml	25.4

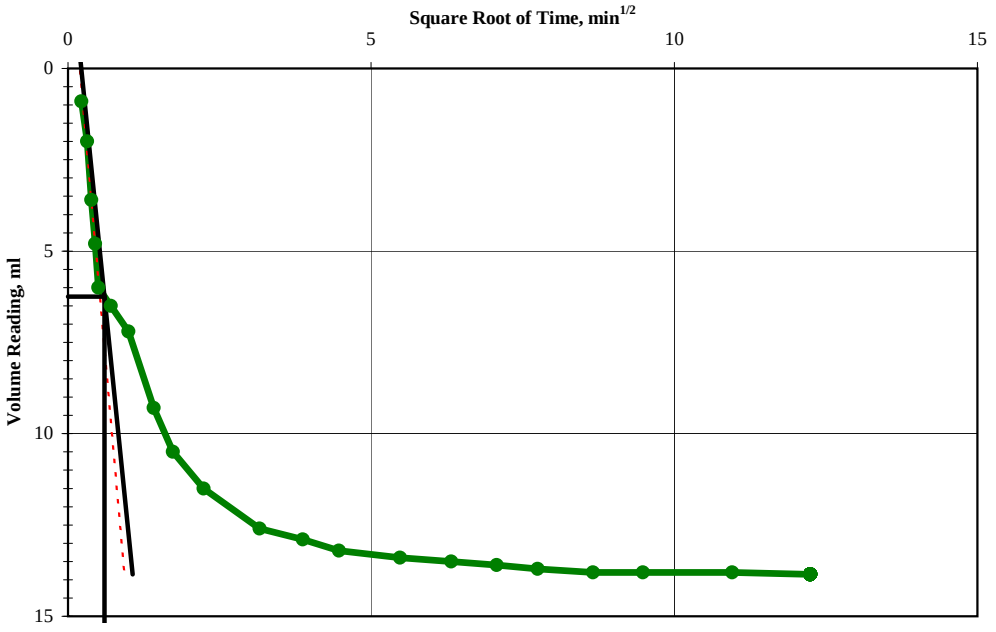
Consol. Start Date: 1/25/2011

Elapsed Time (min)	Sqrt Time ($min^{1/2}$)	Volume Reading ml
0	0	0.0
0.05	0.22	0.9
0.10	0.32	2.0
0.15	0.39	3.6
0.20	0.45	4.8
0.25	0.50	6.0
0.50	0.71	6.5
1.00	1.00	7.2
2.00	1.41	9.3
3.00	1.73	10.5
5.00	2.24	11.5
10.00	3.16	12.6
15.00	3.87	12.9
20.00	4.47	13.2
30.00	5.48	13.4
40.00	6.32	13.5
50.00	7.07	13.6
60.00	7.75	13.7
75.00	8.66	13.8
90.00	9.49	13.8
120.00	10.95	13.8
150.00	12.25	13.9

Log of Elapsed Time vs. Volume Reading



Square Root of Elapsed Time vs. Volume Reading



Sqrt. of Elapsed Time vs Volume		Log of Elapsed Time vs Volume		Consolidation Summary	
T0 = 0 min.	V0 = -3.6 ml.	T0 = 0 min.	V0 = -3.0 ml.	Initial Volume Reading, ml	0.0
T90 = 0.4 min	V90 = 6.2 ml.	T50 = 0.2 min.	V50 = 5.3 ml.	Final Volume Reading, ml	13.9
T100 = NA min	V100 = 7.3 ml.	T100 = 8.3 min.	V100 = 13.6 ml.	Total Volume Change, ml	39.3

Input Validation: Reviewed By: Date 1/25/2011

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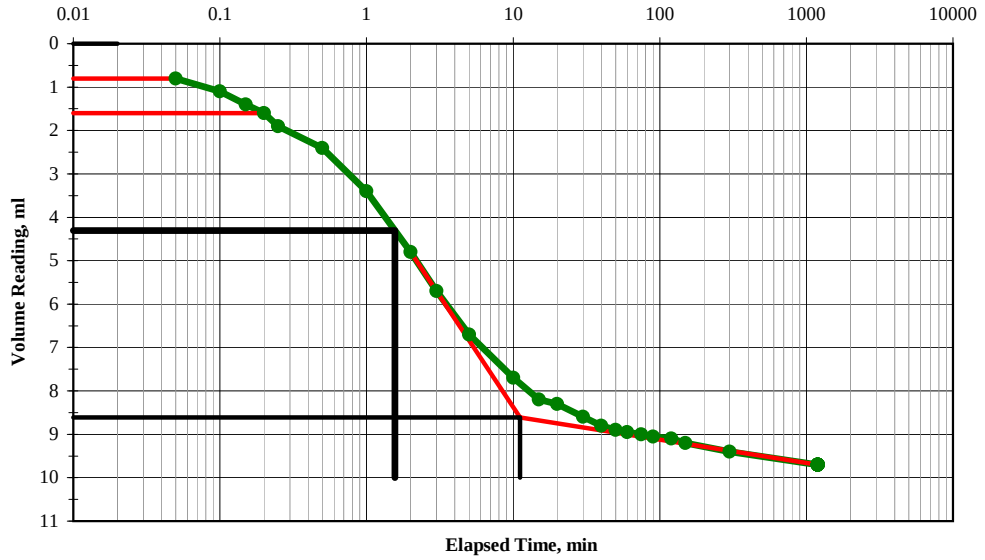
THREE DIMENSIONAL TRIAXIAL CONSOLIDATION TEST

Client	Civil & Environmental Consultants, Inc	Boring	SB-1	**Staged Consolidation**	
Client Project	091-867 Apex Landfill Expansion	Depth	58'-66'	Consolidation Plot Stress, psi	6.8
Project No.	30598	Sample	B-1	**Final Test Pressures**	
		Lab Sample I	30598024	Cell Pressure, psi	119.1
USCS Description:	Grayish Brown Sandy Lean Clay			Back Pressure, psi	39.7
Test Conditions:	Remolded - Side And Double Drained			Effective Consol., psi	79.4
				Additional Consol. Volume, m	42.5

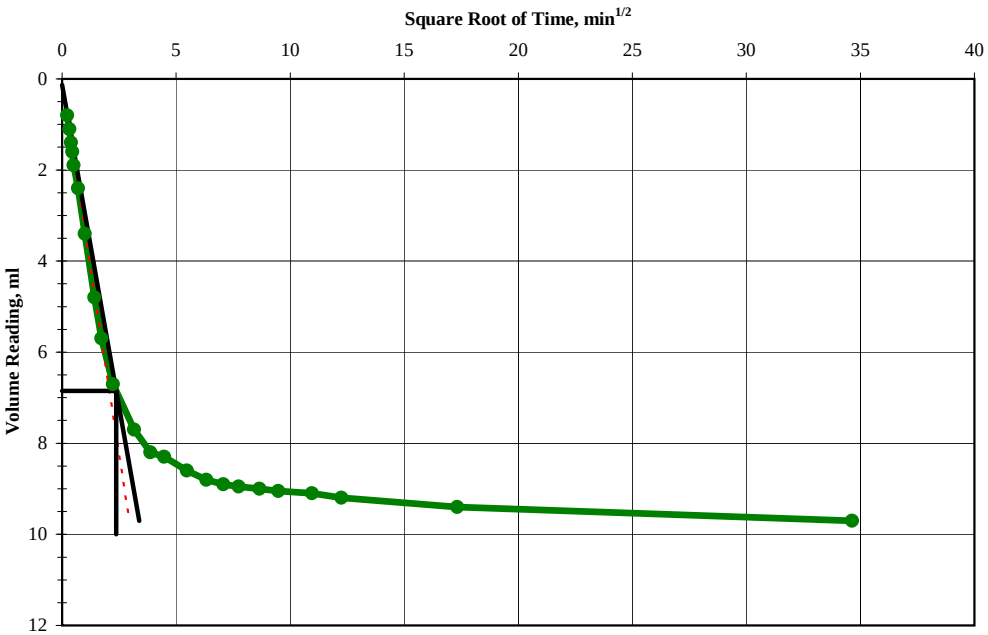
Consol. Start Date: 1/25/2011

Elapsed Time (min)	Sqrt Time ($min^{1/2}$)	Volume Reading ml
0	0	0.0
0.05	0.22	0.8
0.10	0.32	1.1
0.15	0.39	1.4
0.20	0.45	1.6
0.25	0.50	1.9
0.50	0.71	2.4
1.00	1.00	3.4
2.00	1.41	4.8
3.00	1.73	5.7
5.00	2.24	6.7
10.00	3.16	7.7
15.00	3.87	8.2
20.00	4.47	8.3
30.00	5.48	8.6
40.00	6.32	8.8
50.00	7.07	8.9
60.00	7.75	9.0
75.00	8.66	9.0
90.00	9.49	9.1
120.00	10.95	9.1
150.00	12.25	9.2
300.00	17.32	9.4
1200.00	34.64	9.7

Log of Elapsed Time vs. Volume Reading



Square Root of Elapsed Time vs. Volume Reading



Sqrt. of Elapsed Time vs Volume		Log of Elapsed Time vs Volume		Consolidation Summary	
T0 = 0 min.	V0 = 0.1 ml.	T0 = 0 min.	V0 = 0.0 ml.	Initial Volume Reading, ml	0.0
T90 = 5.6 min	V90 = 6.8 ml.	T50 = 1.6 min.	V50 = 4.3 ml.	Final Volume Reading, ml	9.7
T100 = NA min	V100 = 7.6 ml.	T100 = 11.1 min.	V100 = 8.6 ml.	Total Volume Change, ml	52.2

Input Validation: Reviewed By: Date 1/25/2011

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CONSOLIDATED-UNDRAINED TRIAXIAL COMPRESSION TEST ON COHESIVE SOILS ASTM D 4767

Client	Civil & Environmental Consultants, Inc.	Boring	SB-14
Client Project	091-867 Apex Landfill Expansion	Depth	16'-20'
Project No.	30598	Sample	B-1
Test No.	1	Lab Sample No.	30598025
USCS Description:	Dark Grayish Brown Lean Clay with Sand	Test Conditions:	Remolded - Side And Double Drained

SAMPLE CONDITIONS

	Initial	After Consol.	Final
Tare Number	11	NA	810
Wt. Tare & WS, gm	157.69	NA	1326.21
Wt. Tare & DS, gm	144.13	NA	1088.45
Wt. Tare, gm	81.87	NA	102.32
Water Content, %	21.8	24.1	24.1
Wt. Tube & WS., gm	1203.4	NA	
Wt. Of Tube, gm	0.0	NA	
Wt. Of WS., gm	1203.4	1226.5	
Length 1, in	6	NA	
Length 2, in	6	NA	
Length 3, in	6	NA	
Top Diameter, in	2.864	NA	
Middle Diameter, in	2.865	NA	
Bottom Diameter, in	2.8655	NA	
Average Length, in	6.000	6.232	
Average Diameter, in	2.865	2.983	
Average Area, in^2	6.45	6.99	
Sample Volume, in^3	38.68	37.92	
Unit Dry Wt., gms/cc	1.56	1.59	
Unit Dry Wt., pcf	97.3	99.2	
Specific Gravity, Assume	2.70	2.70	
Volume of Solids, cc	366.00	366.00	
Void Ratio, e	0.73	0.70	
Porosity, n	0.42	0.41	
Pore Volume, cc	16.34	15.58	
Saturation, %	80.4	93.3	

TEST CONDITIONS

Cell Pressure, psi	69.49	
Back Pressure, psi	59.92	
Effective Consolidating Pressure, psi	9.58	σ_3
Pore Pressure Parameter (B), %	95	

SATURATION AND CONSOLIDATION VOLUME CHANGES

Height Change, mils	Reading	Change	Consolidation	
Initial Reading	6.89	0	Volume Change, ml	12.4
After Saturation	7.182	-292	Volume Change, in^3	0.76
After Consolidation	7.122	-232	Saturation Method:	Wet

STRAIN RATE CALCULATIONS

Calc. Strain Rate, %/min (t50=2.62)	0.0015	Strain Rate Used, %/min	0.0003
Calc. Deformation Rate, in/min	0.010	Deformation Rate Used	0.002

EFFECTIVE FAILURE SUMMARY

Failure Conditions	Max σ_1'/σ_3'	15% ε	
Effective Consolidating Pressure, psi	9.58	9.58	σ_3
1St. Maximum Effective Principal Stress Ratio	4.116	3.71	σ_1'/σ_3'
Deviator Stress at Failure, psi	9.94	12.82	$\sigma_1-\sigma_3$
Axial Strain at Failure, %	4.01	15.00	ε
Effective Minor Principal Stress at Failure, psi	3.19	4.74	σ_3'
Effective Major Principal Stress at Failure, psi	13.12	17.56	σ_1'
Mohr's Circle Stress Path (Origin of Circle), psi	8.16	11.15	p'
Mohr's Circle Stress Path (Radius of Circle), psi	4.97	6.41	q

TOTAL FAILURE SUMMARY

Failure Conditions	Max σ_1'/σ_3'	15% ε	
Deviator Stress at Failure, psi	9.94	12.82	$\sigma_1-\sigma_3$
Axial Strain at Failure, %	4.01	15.00	ε
Total Minor Principal Stress at Failure, psi	9.58	9.58	σ_3
Total Major Principal Stress at Failure, psi	19.51	22.40	σ_1

TEST DATA

Axial Load	Axial Deformation	Total Pore Water Pressure	Axial Strain	Principal Stress Difference (Deviator Stress)	Induced Pore Water Pressure	Effective Major Principal Stress	Effective Minor Principal Stress	Effective Principal Stress Ratio	A-Bar	Mohr's Circle Stress Paths	
										Origin of Circle	Radius of Circle
lb.	mils	psi	%	psi	psi	psi	psi			psi	psi
P	ΔH	U	ε	$\sigma_1-\sigma_3$	ΔU	σ_1'	σ_3'	σ_1'/σ_3'	A'	p'	q
13.4	0	59.9	0	0	NA	NA	NA	NA	NA	9.58	0
48.1	5	62.2	0.08	4.95	2.31	12.21	7.26	1.682	0.49	9.74	2.48
56.3	10	63.2	0.17	6.12	3.29	12.41	6.29	1.974	0.57	9.35	3.06
60.1	17	63.7	0.26	6.65	3.82	12.41	5.76	2.155	0.60	9.08	3.33
62.7	22	64.1	0.36	7.02	4.21	12.39	5.37	2.308	0.63	8.88	3.51
64.8	28	64.4	0.44	7.32	4.53	12.37	5.05	2.449	0.65	8.71	3.66
66.4	33	64.7	0.53	7.54	4.77	12.34	4.80	2.569	0.67	8.57	3.77
67.6	39	64.9	0.62	7.70	4.96	12.32	4.62	2.667	0.68	8.47	3.85
69.1	45	65.1	0.73	7.91	5.15	12.34	4.43	2.787	0.69	8.38	3.95
70.3	52	65.2	0.83	8.06	5.30	12.34	4.28	2.886	0.69	8.31	4.03
71.1	57	65.3	0.92	8.18	5.42	12.34	4.16	2.967	0.70	8.25	4.09
71.8	64	65.4	1.02	8.26	5.53	12.30	4.04	3.043	0.70	8.17	4.13
72.1	70	65.5	1.12	8.30	5.63	12.25	3.95	3.101	0.71	8.10	4.15
73.9	89	65.8	1.42	8.53	5.85	12.25	3.72	3.289	0.72	7.99	4.26

74.8	106	65.9	1.70	8.63	5.99	12.21	3.58	3.408	0.73	7.90	4.31
76.9	123	66.0	1.97	8.91	6.09	12.39	3.48	3.559	0.72	7.93	4.45
78.8	141	66.1	2.27	9.14	6.17	12.55	3.41	3.681	0.71	7.98	4.57
80.4	159	66.1	2.56	9.33	6.23	12.68	3.34	3.793	0.70	8.01	4.67
80.4	178	66.2	2.86	9.31	6.29	12.60	3.29	3.832	0.71	7.94	4.66
81.9	196	66.2	3.15	9.48	6.32	12.73	3.25	3.917	0.70	7.99	4.74
83.3	213	66.3	3.42	9.66	6.37	12.86	3.21	4.009	0.69	8.04	4.83
84.9	232	66.3	3.73	9.84	6.37	13.05	3.20	4.075	0.68	8.12	4.92
85.8	250	66.3	4.01	9.94	6.39	13.12	3.19	4.116	0.68	8.16	4.97
85.7	268	66.3	4.30	9.89	6.40	13.07	3.18	4.115	0.68	8.12	4.95
86.2	286	66.3	4.59	9.94	6.40	13.11	3.17	4.134	0.68	8.14	4.97
87.6	303	66.3	4.86	10.09	6.42	13.24	3.15	4.199	0.67	8.20	5.04
88.5	322	66.3	5.17	10.18	6.41	13.35	3.17	4.210	0.66	8.26	5.09
89.7	340	66.3	5.45	10.32	6.42	13.48	3.16	4.269	0.65	8.32	5.16
90.1	358	66.3	5.74	10.34	6.41	13.51	3.17	4.266	0.65	8.34	5.17
91.0	374	66.3	6.00	10.43	6.39	13.62	3.19	4.273	0.64	8.40	5.22
92.3	392	66.3	6.30	10.57	6.38	13.77	3.19	4.311	0.64	8.48	5.29
93.4	411	66.3	6.59	10.69	6.35	13.92	3.23	4.309	0.62	8.57	5.34
93.7	430	66.2	6.90	10.70	6.33	13.95	3.25	4.291	0.62	8.60	5.35
94.5	447	66.2	7.18	10.76	6.29	14.04	3.29	4.274	0.62	8.66	5.38
96.4	464	66.2	7.45	10.98	6.27	14.29	3.31	4.322	0.60	8.80	5.49
98.0	482	66.2	7.74	11.15	6.24	14.49	3.34	4.344	0.59	8.91	5.58
97.8	501	66.1	8.04	11.10	6.18	14.50	3.39	4.271	0.59	8.95	5.55
98.9	519	66.1	8.33	11.20	6.14	14.64	3.44	4.260	0.58	9.04	5.60
99.0	537	66.0	8.61	11.19	6.10	14.66	3.48	4.218	0.57	9.07	5.59
100.3	554	66.0	8.90	11.32	6.05	14.84	3.53	4.209	0.56	9.18	5.66
102.1	572	65.9	9.18	11.51	6.00	15.09	3.57	4.223	0.55	9.33	5.76
102.2	591	65.9	9.48	11.49	5.97	15.09	3.60	4.190	0.55	9.35	5.75
103.1	609	65.8	9.77	11.58	5.92	15.23	3.66	4.168	0.54	9.44	5.79
104.1	626	65.8	10.05	11.66	5.86	15.38	3.72	4.139	0.53	9.55	5.83
105.3	644	65.7	10.34	11.78	5.80	15.55	3.77	4.122	0.52	9.66	5.89
106.7	663	65.7	10.64	11.92	5.74	15.76	3.84	4.107	0.51	9.80	5.96
107.0	681	65.6	10.92	11.92	5.69	15.80	3.89	4.067	0.50	9.84	5.96
107.6	698	65.6	11.21	11.96	5.64	15.90	3.94	4.039	0.50	9.92	5.98
108.6	716	65.5	11.49	12.05	5.59	16.03	3.99	4.022	0.49	10.01	6.02
109.8	734	65.4	11.77	12.16	5.52	16.22	4.06	3.995	0.48	10.14	6.08
111.1	752	65.4	12.07	12.28	5.46	16.39	4.11	3.985	0.47	10.25	6.14
111.4	770	65.3	12.36	12.28	5.42	16.44	4.16	3.953	0.46	10.30	6.14
112.1	788	65.3	12.64	12.33	5.34	16.57	4.23	3.914	0.46	10.40	6.17
113.1	805	65.2	12.92	12.41	5.28	16.70	4.29	3.893	0.45	10.50	6.21
114.5	824	65.1	13.22	12.55	5.22	16.91	4.36	3.881	0.44	10.63	6.27
115.2	843	65.1	13.53	12.59	5.16	17.00	4.42	3.848	0.43	10.71	6.29
115.3	860	65.0	13.80	12.55	5.08	17.05	4.50	3.792	0.43	10.77	6.28
116.9	878	65.0	14.08	12.72	5.05	17.25	4.53	3.808	0.42	10.89	6.36
117.8	895	64.9	14.37	12.79	4.99	17.38	4.59	3.788	0.41	10.98	6.40
118.9	914	64.8	14.66	12.87	4.91	17.54	4.66	3.761	0.40	11.10	6.44
118.7	932	64.8	14.95	12.81	4.85	17.53	4.73	3.711	0.40	11.13	6.40
119.7	950	64.7	15.24	12.88	4.79	17.67	4.79	3.690	0.39	11.23	6.44
120.7	967	64.6	15.51	12.97	4.73	17.81	4.84	3.677	0.38	11.33	6.48
121.8	986	64.6	15.82	13.05	4.67	17.96	4.91	3.661	0.38	11.43	6.53
122.9	1004	64.5	16.11	13.13	4.61	18.10	4.97	3.643	0.37	11.53	6.57
122.6	1022	64.5	16.40	13.06	4.54	18.09	5.03	3.594	0.37	11.56	6.53
123.8	1040	64.4	16.68	13.15	4.46	18.27	5.11	3.572	0.36	11.69	6.58
125.1	1057	64.3	16.96	13.26	4.41	18.43	5.16	3.569	0.35	11.80	6.63

Input Validation: Reviewed By: Date Tested: 01/03/11

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CONSOLIDATED-UNDRAINED TRIAXIAL COMPRESSION TEST ON COHESIVE SOILS ASTM D 4767

Client	Civil & Environmental Consultants, Inc.	Boring	SB-14
Client Project	091-867 Apex Landfill Expansion	Depth	16'-20'
Project No.	30598	Sample	B-1
Test No.	2	Lab Sample No.	30598025
USCS Description:	Dark Grayish Brown Lean Clay with Sand	Test Conditions:	Remolded - Side And Double Drained

SAMPLE CONDITIONS

	Initial	After Consol.	Final
Tare Number	11	NA	510
Wt. Tare & WS, gm	157.69	NA	1302.95
Wt. Tare & DS, gm	144.13	NA	1093.10
Wt. Tare, gm	81.87	NA	103.28
Water Content, %	21.8	21.2	21.2
Wt. Tube & WS., gm	1203.4	NA	
Wt. Of Tube, gm	0.0	NA	
Wt. Of WS., gm	1203.4	1197.7	
Length 1, in	6	NA	
Length 2, in	6	NA	
Length 3, in	6	NA	
Top Diameter, in	2.864	NA	
Middle Diameter, in	2.865	NA	
Bottom Diameter, in	2.8655	NA	
Average Length, in	6.000	5.833	
Average Diameter, in	2.865	2.834	
Average Area, in^2	6.45	6.31	
Sample Volume, in^3	38.68	37.03	
Unit Dry Wt., gms/cc	1.56	1.63	
Unit Dry Wt., pcf	97.3	101.6	
Specific Gravity, Assume	2.70	2.70	
Volume of Solids, cc	366.00	366.00	
Void Ratio, e	0.73	0.66	
Porosity, n	0.42	0.40	
Pore Volume, cc	16.34	14.70	
Saturation, %	80.4	87.0	

TEST CONDITIONS

Cell Pressure, psi	99.75	
Back Pressure, psi	59.98	
Effective Consolidating Pressure, psi	39.77	σ_3
Pore Pressure Parameter (B), %	95	

SATURATION AND CONSOLIDATION VOLUME CHANGES

Height Change, mils	Reading	Change	Consolidation	
Initial Dial Reading	7.259	0	Volume Change, ml	26.9
After Saturation	7.246	13	Volume Change, in^3	1.64
After Consolidation	7.092	167	Saturation Method:	Wet

STRAIN RATE CALCULATIONS

Calc. Strain Rate, %/min (t50=2.53)	0.0016	Strain Rate Used, %/min	0.0003
Calc. Deformation Rate, in/min	0.009	Deformation Rate Used	0.002

EFFECTIVE FAILURE SUMMARY

Failure Conditions	Max σ_1'/σ_3'	15% ε	
Effective Consolidating Pressure, psi	39.77	39.77	σ_3
1St. Maximum Effective Principal Stress Ratio	3.146	3.07	σ_1'/σ_3'
Deviator Stress at Failure, psi	30.22	33.05	$\sigma_1-\sigma_3$
Axial Strain at Failure, %	9.23	15.00	ε
Effective Minor Principal Stress at Failure, psi	14.08	15.97	σ_3'
Effective Major Principal Stress at Failure, psi	44.30	49.03	σ_1'
Mohr's Circle Stress Path (Origin of Circle), psi	29.19	32.50	p'
Mohr's Circle Stress Path (Radius of Circle), psi	15.11	16.53	q

TOTAL FAILURE SUMMARY

Failure Conditions	Max σ_1'/σ_3'	15% ε	
Deviator Stress at Failure, psi	30.22	33.05	$\sigma_1-\sigma_3$
Axial Strain at Failure, %	9.23	15.00	ε
Total Minor Principal Stress at Failure, psi	39.77	39.77	σ_3
Total Major Principal Stress at Failure, psi	69.99	72.82	σ_1

TEST DATA

Axial Load	Axial Deformation	Total Pore Water Pressure	Axial Strain	Principal Stress Difference (Deviator Stress)	Induced Pore Water Pressure	Effective Major Principal Stress	Effective Minor Principal Stress	Effective Principal Stress Ratio	A-Bar	Mohr's Circle Stress Paths	
										Origin of Circle	Radius of Circle
lb.	mils	psi	%	psi	psi	psi	psi			psi	psi
P	ΔH	U	ε	$\sigma_1-\sigma_3$	ΔU	σ_1'	σ_3'	σ_1'/σ_3'	A'	p'	q
17.1	0	60.0	0	0.00	0	NA	NA	NA	NA	39.77	0
50.8	6	63.0	0.11	5.35	3.06	42.06	36.71	1.146	0.60	39.39	2.67
100.0	12	67.9	0.21	13.12	7.89	45.00	31.88	1.412	0.63	38.44	6.56
115.4	19	70.1	0.32	15.55	10.08	45.23	29.68	1.524	0.68	37.46	7.77
124.0	25	71.7	0.43	16.89	11.77	44.88	28.00	1.603	0.73	36.44	8.44
129.7	31	73.1	0.54	17.77	13.11	44.43	26.66	1.667	0.78	35.55	8.89
134.1	37	74.2	0.63	18.44	14.18	44.03	25.59	1.721	0.81	34.81	9.22
137.9	42	75.1	0.72	19.03	15.09	43.70	24.67	1.771	0.84	34.19	9.51
141.5	48	75.9	0.82	19.57	15.96	43.38	23.81	1.822	0.86	33.60	9.78
144.1	54	76.7	0.92	19.95	16.73	42.99	23.04	1.866	0.88	33.01	9.98
146.5	59	77.3	1.01	20.31	17.37	42.71	22.40	1.907	0.90	32.56	10.16
148.9	65	77.9	1.11	20.67	17.94	42.50	21.83	1.947	0.91	32.16	10.33
151.6	71	78.5	1.22	21.07	18.48	42.36	21.28	1.990	0.92	31.82	10.54
157.9	89	79.8	1.53	21.99	19.86	41.90	19.91	2.105	0.95	30.91	11.00

163.2	109	80.9	1.86	22.73	20.88	41.63	18.89	2.203	0.97	30.26	11.37
168.1	126	81.7	2.16	23.43	21.69	41.51	18.08	2.296	0.97	29.79	11.72
171.1	143	82.4	2.46	23.83	22.39	41.21	17.38	2.372	0.99	29.29	11.92
174.9	160	83.0	2.75	24.34	23.00	41.11	16.77	2.451	0.99	28.94	12.17
178.7	180	83.4	3.08	24.84	23.46	41.15	16.31	2.523	0.99	28.73	12.42
182.2	198	83.9	3.40	25.29	23.89	41.17	15.87	2.593	0.99	28.52	12.65
184.6	215	84.2	3.69	25.59	24.25	41.11	15.52	2.649	1.00	28.31	12.79
186.8	232	84.5	3.98	25.84	24.51	41.10	15.25	2.694	1.00	28.18	12.92
190.0	251	84.8	4.30	26.24	24.80	41.20	14.96	2.754	1.00	28.08	13.12
192.8	270	85.0	4.62	26.57	25.05	41.29	14.71	2.806	0.99	28.00	13.29
195.7	288	85.2	4.93	26.93	25.21	41.48	14.55	2.850	0.99	28.02	13.46
197.6	305	85.3	5.23	27.14	25.37	41.53	14.40	2.885	0.98	27.97	13.57
199.9	323	85.5	5.53	27.39	25.52	41.64	14.25	2.923	0.98	27.95	13.70
202.5	341	85.6	5.85	27.68	25.61	41.84	14.15	2.956	0.97	28.00	13.84
205.6	360	85.7	6.17	28.05	25.68	42.14	14.09	2.990	0.96	28.12	14.02
207.4	377	85.7	6.46	28.24	25.77	42.24	14.00	3.017	0.96	28.12	14.12
209.5	394	85.8	6.75	28.46	25.85	42.37	13.91	3.046	0.96	28.14	14.23
212.1	412	85.8	7.06	28.74	25.80	42.71	13.96	3.058	0.94	28.34	14.37
214.4	431	85.9	7.38	28.98	25.88	42.87	13.89	3.086	0.94	28.38	14.49
217.0	449	85.9	7.70	29.27	25.89	43.14	13.88	3.109	0.93	28.51	14.63
218.5	466	85.8	7.99	29.39	25.84	43.32	13.93	3.110	0.93	28.63	14.70
221.0	483	85.8	8.29	29.66	25.86	43.57	13.91	3.132	0.92	28.74	14.83
223.5	503	85.8	8.62	29.91	25.81	43.87	13.96	3.142	0.91	28.92	14.95
225.4	521	85.7	8.93	30.09	25.74	44.12	14.03	3.144	0.90	29.07	15.04
227.0	539	85.7	9.23	30.22	25.69	44.30	14.08	3.146	0.89	29.19	15.11
228.7	555	85.6	9.51	30.37	25.62	44.52	14.15	3.146	0.89	29.34	15.19
231.6	573	85.6	9.82	30.68	25.58	44.87	14.19	3.162	0.88	29.53	15.34
233.5	592	85.5	10.15	30.84	25.52	45.10	14.25	3.164	0.87	29.67	15.42
235.7	610	85.4	10.46	31.05	25.38	45.43	14.39	3.158	0.86	29.91	15.52
236.9	628	85.3	10.77	31.10	25.34	45.53	14.43	3.156	0.86	29.98	15.55
239.4	645	85.2	11.06	31.36	25.27	45.86	14.50	3.163	0.85	30.18	15.68
241.7	663	85.1	11.37	31.57	25.11	46.23	14.66	3.154	0.84	30.44	15.79
243.5	682	85.0	11.69	31.71	25.06	46.41	14.71	3.156	0.83	30.56	15.85
245.5	700	85.0	12.00	31.88	24.98	46.67	14.79	3.156	0.82	30.73	15.94
246.2	717	84.8	12.29	31.87	24.78	46.86	14.99	3.126	0.82	30.93	15.93
248.8	735	84.7	12.60	32.11	24.71	47.17	15.06	3.132	0.81	31.12	16.06
251.1	753	84.6	12.91	32.32	24.63	47.46	15.14	3.134	0.80	31.30	16.16
252.3	772	84.4	13.23	32.37	24.46	47.68	15.31	3.114	0.80	31.49	16.18
253.8	790	84.4	13.54	32.46	24.39	47.84	15.38	3.110	0.79	31.61	16.23
255.9	807	84.2	13.83	32.63	24.25	48.15	15.51	3.104	0.78	31.83	16.32
258.1	825	84.1	14.14	32.81	24.13	48.45	15.64	3.098	0.77	32.04	16.41
259.4	843	84.0	14.46	32.88	24.02	48.62	15.75	3.088	0.77	32.18	16.44
261.2	862	83.8	14.78	33.00	23.86	48.91	15.91	3.074	0.76	32.41	16.50
262.6	879	83.8	15.06	33.07	23.78	49.06	15.99	3.068	0.76	32.52	16.54
264.3	897	83.6	15.38	33.17	23.63	49.31	16.14	3.056	0.75	32.72	16.59
266.7	915	83.5	15.68	33.37	23.48	49.66	16.29	3.049	0.74	32.98	16.69
267.9	933	83.4	16.00	33.41	23.38	49.81	16.39	3.038	0.74	33.10	16.71
269.5	952	83.2	16.32	33.49	23.27	50.00	16.50	3.030	0.73	33.25	16.75
270.4	969	83.1	16.62	33.50	23.11	50.16	16.66	3.010	0.73	33.41	16.75
273.3	987	83.0	16.92	33.76	23.02	50.51	16.75	3.015	0.72	33.63	16.88
274.8	1004	82.9	17.22	33.83	22.87	50.72	16.89	3.002	0.71	33.81	16.91
276.3	1023	82.7	17.54	33.89	22.76	50.90	17.01	2.993	0.71	33.95	16.95
277.2	1041	82.6	17.85	33.89	22.65	51.01	17.12	2.980	0.70	34.06	16.94
278.6	1058	82.4	18.14	33.95	22.47	51.25	17.30	2.963	0.70	34.28	16.98

Input Validation: Reviewed By: Date Tested: 01/03/11

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CONSOLIDATED-UNDRAINED TRIAXIAL COMPRESSION TEST ON COHESIVE SOILS ASTM D 4767

Client	Civil & Environmental Consultants, Inc.	Boring	SB-14
Client Project	091-867 Apex Landfill Expansion	Depth	16'-20'
Project No.	30598	Sample	B-1
Test No.	3	Lab Sample No.	30598025
USCS Description:	Dark Grayish Brown Lean Clay with Sand	Test Conditions:	Remolded - Side And Double Drained

SAMPLE CONDITIONS

	Initial	After Consol.	Final
Tare Number	11	NA	519
Wt. Tare & WS, gm	157.69	NA	1289.20
Wt. Tare & DS, gm	144.13	NA	1097.30
Wt. Tare, gm	81.87	NA	102.80
Water Content, %	21.8	19.3	19.3
Wt. Tube & WS., gm	12503.4	NA	
Wt. Of Tube, gm	0.0	NA	
Wt. Of WS., gm	12503.4	12248.5	
Length 1, in	6	NA	
Length 2, in	6	NA	
Length 3, in	6	NA	
Top Diameter, in	2.864	NA	
Middle Diameter, in	2.865	NA	
Bottom Diameter, in	2.8655	NA	
Average Length, in	6.000	5.751	
Average Diameter, in	2.865	2.822	
Average Area, in^2	6.45	6.26	
Sample Volume, in^3	38.68	36.23	
Unit Dry Wt., gms/cc	16.20	17.29	
Unit Dry Wt., pcf	1010.9	1079.2	
Specific Gravity, Assume	2.70	2.70	
Volume of Solids, cc	3802.69	3802.69	
Void Ratio, e	-0.83	-0.84	
Porosity, n	-5.00	-5.41	
Pore Volume, cc	-193.38	-195.83	
Saturation, %	-70.6	-61.7	

TEST CONDITIONS

Cell Pressure, psi	120.24	
Back Pressure, psi	40.03	
Effective Consolidating Pressure, psi	80.21	σ_3
Pore Pressure Parameter (B), %	97	

SATURATION AND CONSOLIDATION VOLUME CHANGES

Height Change, mils	Reading	Change	Consolidation	
Initial Dial Reading	7.126	0	Volume Change, ml	40.1
After Saturation	7.113	13	Volume Change, in^3	2.45
After Consolidation	6.877	249	Saturation Method:	Wet

STRAIN RATE CALCULATIONS

Calc. Strain Rate, %/min (t50=7.83)	0.0005	Strain Rate Used, %/min	0.0003
Calc. Deformation Rate, in/min	0.003	Deformation Rate Used	0.002

EFFECTIVE FAILURE SUMMARY

Failure Conditions	Max σ_1'/σ_3'	15% ε	
Effective Consolidating Pressure, psi	80.21	80.21	σ_3
1St. Maximum Effective Principal Stress Ratio	2.755	2.74	σ_1'/σ_3'
Deviator Stress at Failure, psi	51.47	54.36	$\sigma_1-\sigma_3$
Axial Strain at Failure, %	9.89	15.00	ε
Effective Minor Principal Stress at Failure, psi	29.33	31.32	σ_3'
Effective Major Principal Stress at Failure, psi	80.81	85.67	σ_1'
Mohr's Circle Stress Path (Origin of Circle), psi	55.07	58.50	p'
Mohr's Circle Stress Path (Radius of Circle), psi	25.74	27.18	q

TOTAL FAILURE SUMMARY

Failure Conditions	Max σ_1'/σ_3'	15% ε	
Deviator Stress at Failure, psi	51.47	54.36	$\sigma_1-\sigma_3$
Axial Strain at Failure, %	9.89	15.00	ε
Total Minor Principal Stress at Failure, psi	80.21	80.21	σ_3
Total Major Principal Stress at Failure, psi	131.68	134.56	σ_1

TEST DATA

Axial Load	Axial Deformation	Total Pore Water Pressure	Axial Strain	Principal Stress Difference (Deviator Stress)	Induced Pore Water Pressure	Effective Major Principal Stress	Effective Minor Principal Stress	Effective Principal Stress Ratio	A-Bar	Mohr's Circle Stress Paths	
										Origin of Circle	Radius of Circle
lb.	mils	psi	%	psi	psi	psi	psi			psi	psi
P	ΔH	U	ε	$\sigma_1-\sigma_3$	ΔU	σ_1'	σ_3'	σ_1'/σ_3'	A'	p'	q
23.0	0	40.0	0	0	0	NA	NA	NA	NA	80.21	0
99.2	5	45.2	0.08	12.17	5.15	87.23	75.06	1.162	0.44	81.14	6.09
149.3	10	50.8	0.17	20.16	10.80	89.57	69.41	1.290	0.55	79.49	10.08
171.6	15	54.5	0.26	23.70	14.50	89.41	65.71	1.361	0.63	77.56	11.85
186.7	20	57.7	0.35	26.07	17.72	88.56	62.49	1.417	0.70	75.53	13.04
198.3	26	60.3	0.46	27.89	20.31	87.79	59.89	1.466	0.75	73.84	13.95
207.1	31	62.6	0.54	29.27	22.59	86.89	57.62	1.508	0.80	72.26	14.64
215.1	36	64.8	0.63	30.51	24.74	85.98	55.47	1.550	0.84	70.72	15.26
221.8	42	66.6	0.73	31.55	26.57	85.19	53.64	1.588	0.87	69.41	15.78
228.5	48	68.3	0.83	32.57	28.22	84.56	51.99	1.627	0.89	68.27	16.29
234.0	55	69.5	0.95	33.41	29.50	84.11	50.70	1.659	0.91	67.41	16.70
239.3	61	71.0	1.06	34.22	31.01	83.42	49.20	1.696	0.93	66.31	17.11
244.3	66	72.3	1.15	34.96	32.31	82.87	47.90	1.730	0.95	65.38	17.48
256.4	86	75.4	1.50	36.76	35.37	81.60	44.84	1.820	0.99	63.22	18.38

266.9	102	78.0	1.78	38.30	37.97	80.53	42.23	1.907	1.02	61.38	19.15
274.7	120	79.9	2.08	39.40	39.90	79.71	40.31	1.978	1.04	60.01	19.70
282.2	138	81.6	2.39	40.44	41.56	79.09	38.65	2.046	1.06	58.87	20.22
288.9	156	83.1	2.70	41.36	43.09	78.48	37.12	2.114	1.07	57.80	20.68
296.2	175	84.3	3.04	42.34	44.30	78.25	35.91	2.179	1.08	57.08	21.17
300.6	192	85.3	3.33	42.91	45.25	77.86	34.96	2.227	1.09	56.41	21.45
305.8	209	86.1	3.64	43.56	46.02	77.75	34.18	2.274	1.09	55.96	21.78
310.5	227	86.8	3.95	44.14	46.80	77.55	33.41	2.321	1.09	55.48	22.07
315.6	246	87.6	4.27	44.77	47.56	77.42	32.65	2.371	1.10	55.03	22.39
320.4	264	88.2	4.59	45.36	48.15	77.42	32.06	2.415	1.09	54.74	22.68
323.8	281	88.6	4.88	45.73	48.58	77.36	31.63	2.446	1.10	54.50	22.87
327.6	299	89.1	5.19	46.17	49.02	77.35	31.19	2.480	1.09	54.27	23.08
332.5	317	89.3	5.51	46.75	49.27	77.69	30.94	2.511	1.09	54.31	23.37
336.7	336	89.7	5.85	47.21	49.66	77.76	30.55	2.545	1.08	54.15	23.60
340.2	353	89.9	6.15	47.59	49.90	77.90	30.31	2.570	1.08	54.11	23.80
343.6	370	90.0	6.44	47.96	49.99	78.17	30.21	2.587	1.07	54.19	23.98
347.5	388	90.3	6.74	48.38	50.25	78.34	29.95	2.615	1.07	54.15	24.19
350.7	407	90.3	7.07	48.68	50.28	78.61	29.93	2.626	1.06	54.27	24.34
354.8	426	90.4	7.41	49.11	50.40	78.92	29.81	2.648	1.06	54.37	24.56
358.0	442	90.7	7.69	49.44	50.66	78.99	29.55	2.673	1.06	54.27	24.72
360.8	460	90.8	7.99	49.69	50.75	79.15	29.46	2.686	1.05	54.30	24.84
364.6	478	90.8	8.31	50.07	50.73	79.55	29.48	2.698	1.04	54.52	25.03
367.9	497	90.7	8.64	50.37	50.71	79.87	29.50	2.707	1.04	54.69	25.19
371.2	515	90.8	8.96	50.67	50.80	80.07	29.41	2.723	1.03	54.74	25.33
373.8	532	90.8	9.25	50.89	50.72	80.38	29.49	2.726	1.03	54.93	25.44
377.0	550	90.9	9.56	51.17	50.87	80.51	29.34	2.744	1.02	54.92	25.59
380.3	569	90.9	9.89	51.47	50.88	80.81	29.33	2.755	1.02	55.07	25.74
383.4	587	90.6	10.21	51.74	50.57	81.37	29.64	2.746	1.01	55.50	25.87
386.0	604	90.7	10.51	51.93	50.68	81.46	29.53	2.759	1.01	55.50	25.97
388.5	621	90.7	10.80	52.12	50.63	81.70	29.58	2.762	1.00	55.64	26.06
391.7	640	90.5	11.13	52.38	50.44	82.14	29.76	2.760	0.99	55.95	26.19
394.6	659	90.5	11.45	52.60	50.46	82.35	29.75	2.768	0.99	56.05	26.30
397.3	677	90.4	11.76	52.80	50.41	82.60	29.80	2.772	0.98	56.20	26.40
399.8	695	90.1	12.08	52.95	50.11	83.05	30.10	2.759	0.98	56.58	26.48
402.0	712	90.2	12.38	53.09	50.18	83.12	30.02	2.768	0.97	56.57	26.55
404.7	731	90.1	12.71	53.26	50.10	83.37	30.11	2.769	0.97	56.74	26.63
407.6	749	89.9	13.02	53.47	49.87	83.81	30.33	2.763	0.96	57.07	26.74
410.0	766	89.8	13.33	53.62	49.81	84.02	30.40	2.764	0.96	57.21	26.81
412.0	784	89.6	13.63	53.71	49.58	84.34	30.63	2.753	0.95	57.48	26.85
415.0	802	89.5	13.95	53.92	49.50	84.63	30.71	2.756	0.95	57.67	26.96
417.4	820	89.4	14.26	54.06	49.35	84.91	30.85	2.752	0.94	57.88	27.03
420.2	838	89.3	14.58	54.24	49.27	85.18	30.94	2.753	0.94	58.06	27.12
422.3	856	89.0	14.89	54.33	49.01	85.53	31.20	2.741	0.93	58.37	27.17
424.3	874	88.7	15.19	54.40	48.68	85.93	31.53	2.726	0.92	58.73	27.20
426.9	892	88.8	15.50	54.55	48.73	86.03	31.48	2.733	0.92	58.76	27.28
429.6	910	88.6	15.83	54.71	48.58	86.34	31.63	2.730	0.92	58.98	27.36
432.4	929	88.4	16.15	54.87	48.38	86.69	31.82	2.724	0.91	59.26	27.43
434.1	946	88.3	16.45	54.91	48.31	86.80	31.90	2.721	0.91	59.35	27.45
435.9	963	87.9	16.75	54.95	47.91	87.25	32.30	2.701	0.90	59.77	27.47
438.1	982	87.8	17.08	55.03	47.79	87.44	32.41	2.698	0.90	59.93	27.51

Input Validation: Reviewed By: Date Tested: 01/06/11

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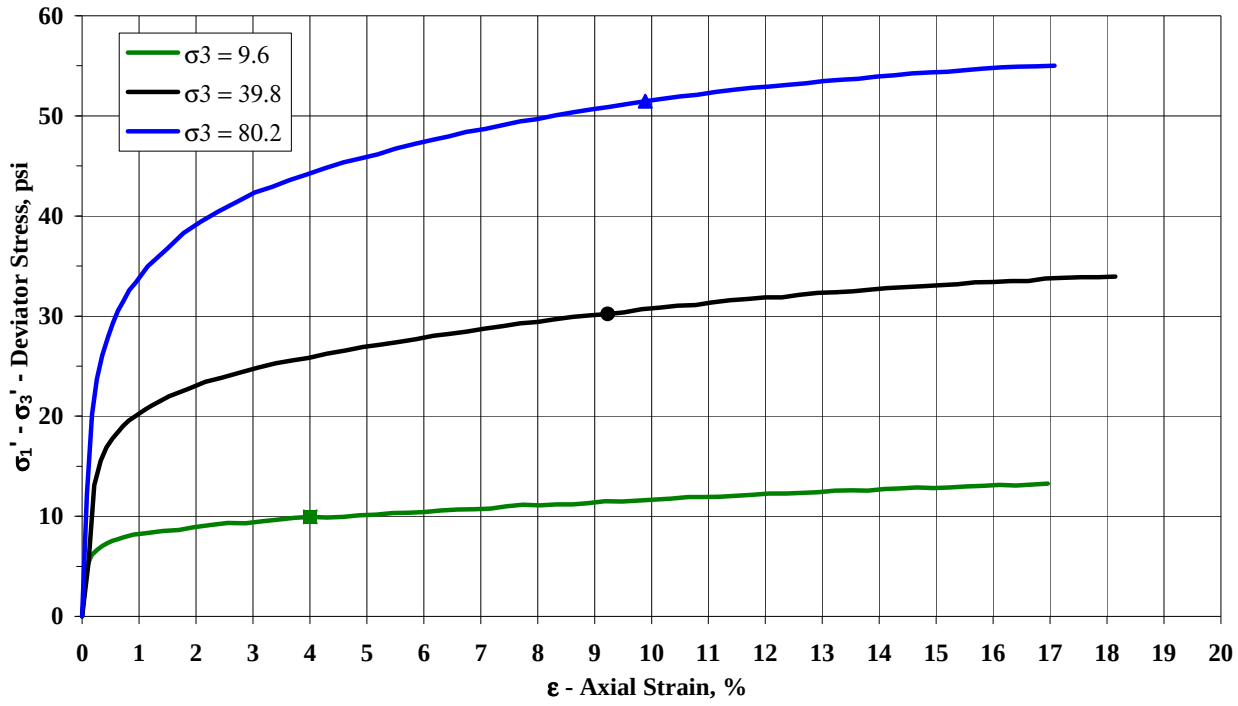
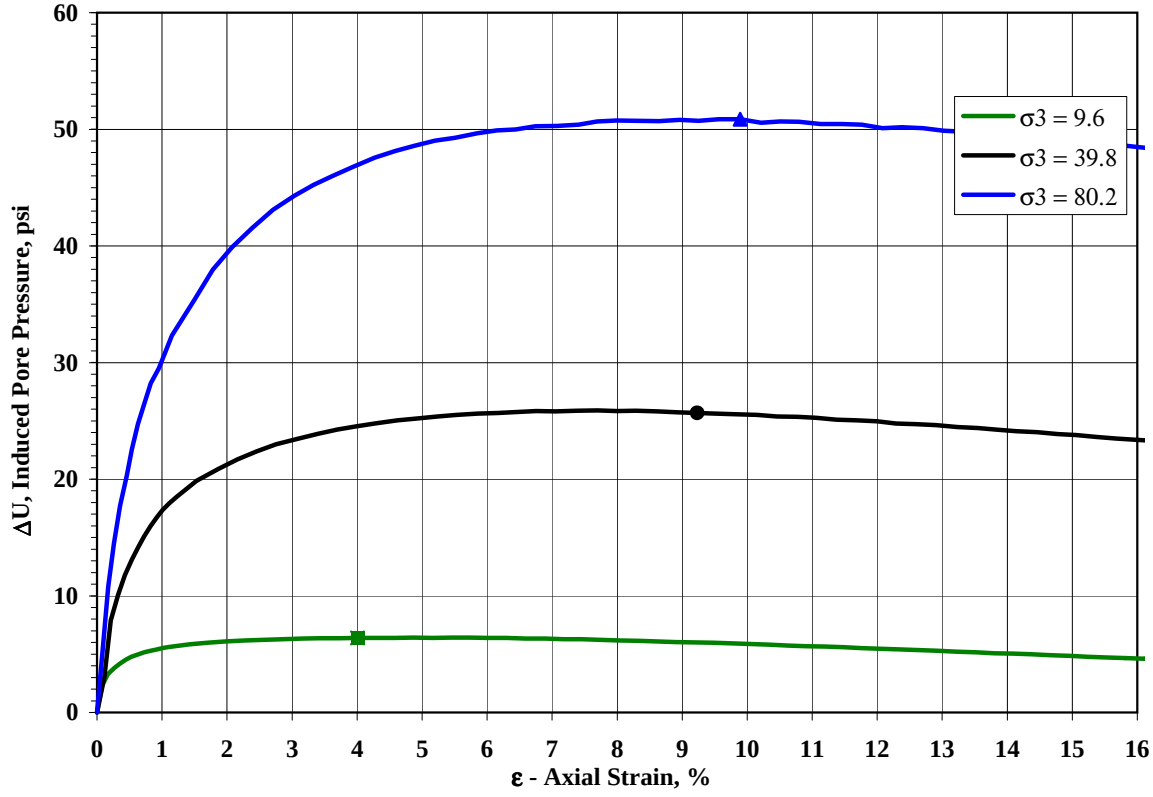
CONSOLIDATED-UNDRAINED TRIAXIAL COMPRESSION TEST ON COHESIVE SOILS ASTM D 4767

Client	Civil & Environmental Consultants, Inc.	Boring	SB-14
Client Project	091-867 Apex Landfill Expansion	Depth	16'-20'
Project No.	30598	Sample	B-1
Test Conditions:	Remolded - Side And Double Drained	Lab Sample No.	30598025
USCS Description:	Dark Grayish Brown Lean Clay with Sand		

AXIAL STRAIN vs. DEVIATOR STRESS



AXIAL STRAIN vs. INDUCED PORE-WATER PRESSURE



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CONSOLIDATED-UNDRAINED TRIAXIAL COMPRESSION TEST ON COHESIVE SOILS ASTM D 476

Client	Civil & Environmental Consultants, In	Boring	SB-14
Client Project	091-867 Apex Landfill Expansion	Depth	16'-20'
Project No.	30598	Sample	B-1
		Lab Sample No.	30598025
USCS Description:	Dark Grayish Brown Lean Clay with Sand		
Test Conditions:	Remolded - Side And Double Drained		

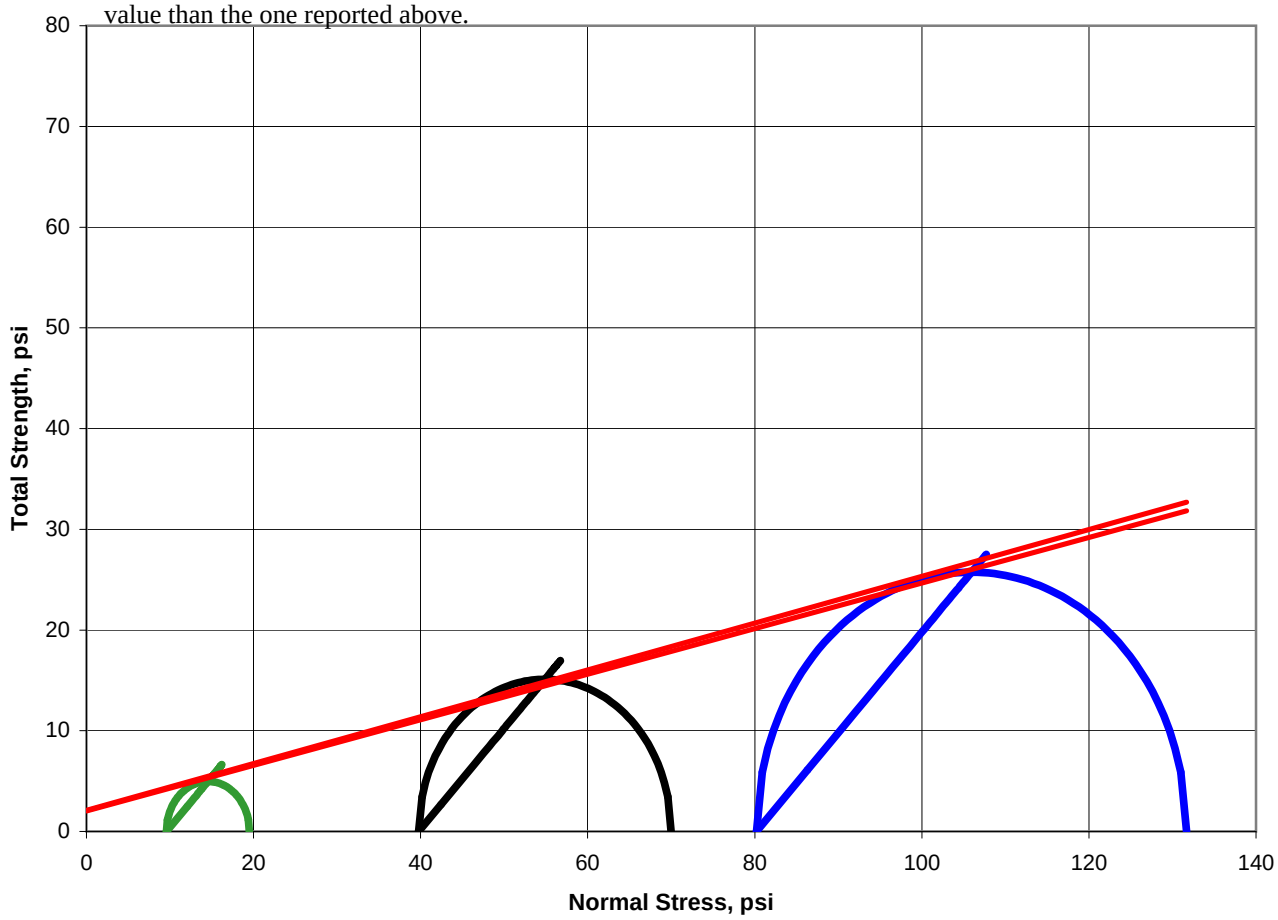
TOTAL STRESS

FAILURE CONDITION: 1st. MAX. EFFECTIVE PRINCIPAL STRESS RATIO

Test No.	Deviator Stress	Major Principal Stress	Minor Principal Stress	Strain at Failure	Mohr's Circle Stress Path		Failure Angle	
	$\sigma1-\sigma3$	$\sigma1$	$\sigma3$	ε	$(\sigma1+\sigma3)/2$	$(\sigma1-\sigma3)/2$		
	psi	psi	psi	%	psi	psi	α, deg	12.8
Test 1	9.94	19.51	9.58	4.01	14.54	4.97	a, psi	2.0
Test 2	30.22	69.99	39.77	9.23	54.88	15.11	Φ, deg	13.1
Test 3	51.47	131.68	80.21	9.89	105.94	25.74	C, psi	2.1

Calculations based on: Test 1 Test 2 Test 3

Note: The Friction Angle and Cohesion using other combinations of test points may yield a higher or lower value than the one reported above.



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CONSOLIDATED-UNDRAINED TRIAXIAL COMPRESSION TEST ON COHESIVE SOILS ASTM D 476

Client	Civil & Environmental Consultants, In	Boring	SB-14
Client Project	091-867 Apex Landfill Expansion	Depth	16'-20'
Project No.	30598	Sample	B-1
		Lab Sample No.	30598025
USCS Description:	Dark Grayish Brown Lean Clay with Sand		
Test Conditions:	Remolded - Side And Double Drained		

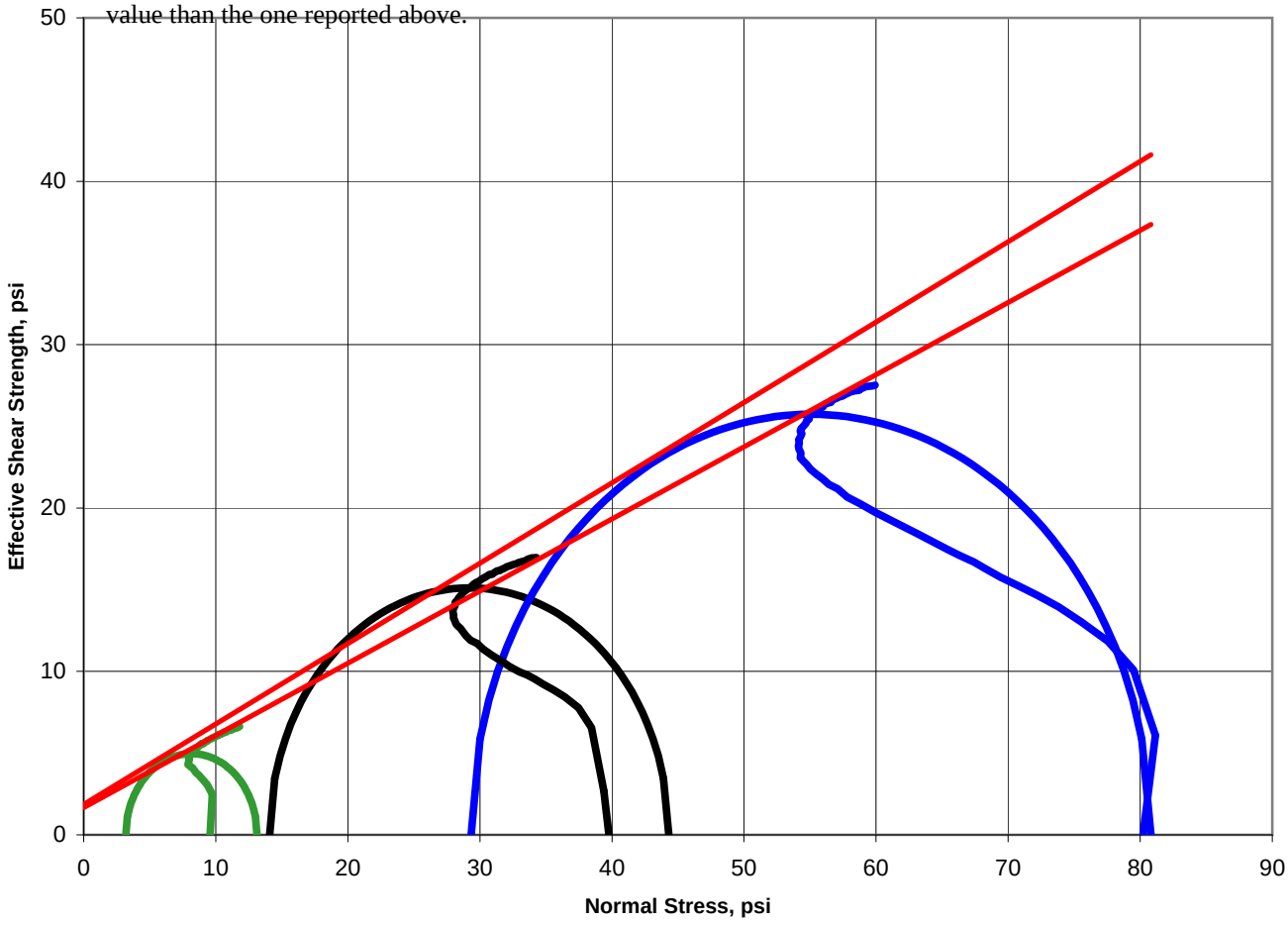
EFFECTIVE STRESS

FAILURE CONDITION: 1st. MAX. EFFECTIVE PRINCIPAL STRESS RATIO

Test No.	Deviator Stress	Major Principal Stress	Minor Principal Stress	Strain at Failure	Mohr's Circle Stress Path		Failure Angle	
	$\sigma 1-\sigma 3$	$\sigma'1$	$\sigma'3$	ε	p'	q		
	psi	psi	psi	%	psi	psi	α', deg	23.8
Test 1	9.94	13.12	3.19	4.01	8.16	4.97	a', psi	1.7
Test 2	30.22	44.30	14.08	9.23	29.19	15.11	Φ', deg	26.2
Test 3	51.47	80.81	29.33	9.89	55.07	25.74	C', psi	1.9

Calculations based on: Test 1 Test 2 Test 3

Note: The Friction Angle and Cohesion using other combinations of test points may yield a higher or lower value than the one reported above.



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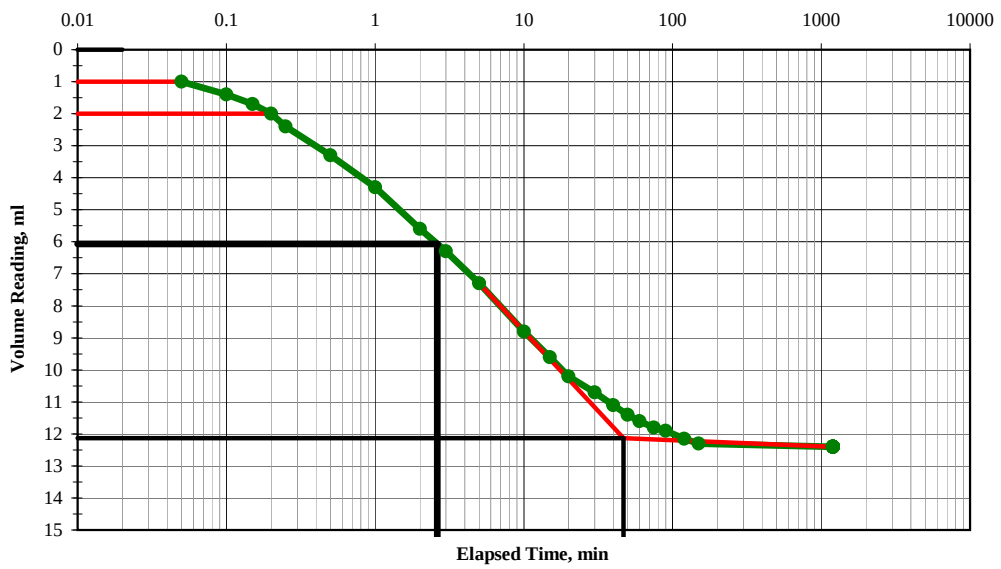
THREE DIMENSIONAL TRIAXIAL CONSOLIDATION TEST

Client	Civil & Environmental Consultants, Inc	Boring	SB-14	**Staged Consolidation**	
Client Project	091-867 Apex Landfill Expansion	Depth	16'-20'	Consolidation Plot Stress, psi	6.6
Project No.	30598	Sample	B-1	**Final Test Pressures**	
		Lab Sample	30598025	Cell Pressure, psi	69.5
USCS Description:	Dark Grayish Brown Lean Clay with Sand			Back Pressure, psi	59.9
Test Conditions:	Remolded - Side And Double Drained			Effective Consol., psi	9.6
				Additional Consol. Volume, ml	0.0

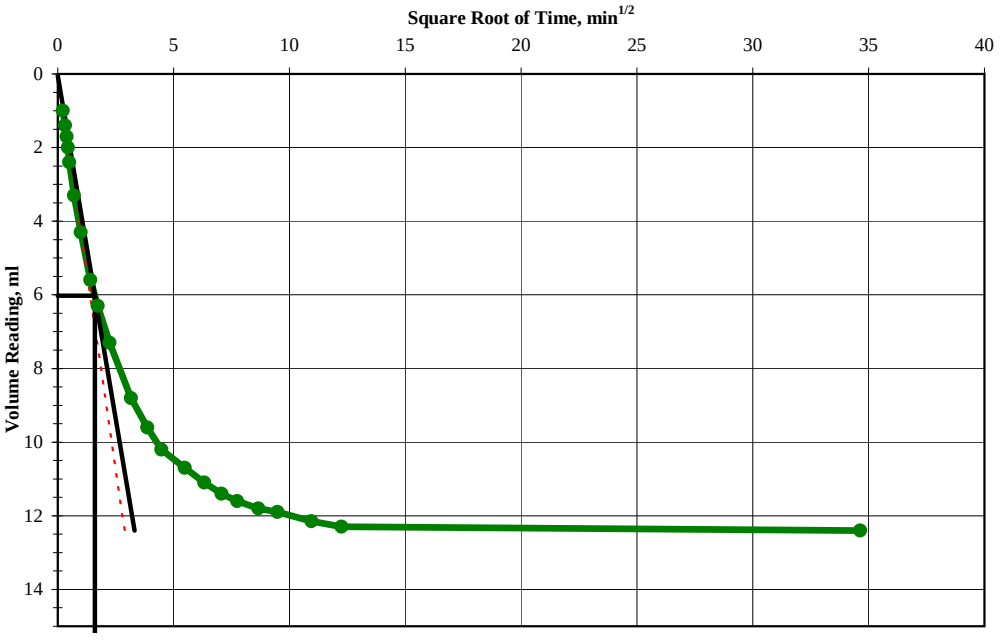
Consol. Start Date: 1/3/2011

Elapsed Time (min)	Sqrt Time ($min^{1/2}$)	Volume Reading ml
0	0	0.0
0.05	0.22	1.0
0.10	0.32	1.4
0.15	0.39	1.7
0.20	0.45	2.0
0.25	0.50	2.4
0.50	0.71	3.3
1.00	1.00	4.3
2.00	1.41	5.6
3.00	1.73	6.3
5.00	2.24	7.3
10.00	3.16	8.8
15.00	3.87	9.6
20.00	4.47	10.2
30.00	5.48	10.7
40.00	6.32	11.1
50.00	7.07	11.4
60.00	7.75	11.6
75.00	8.66	11.8
90.00	9.49	11.9
120.00	10.95	12.2
150.00	12.25	12.3
1200.00	34.64	12.4

Log of Elapsed Time vs. Volume Reading



Square Root of Elapsed Time vs. Volume Reading



Sqrt. of Elapsed Time vs Volume		Log of Elapsed Time vs Volume		Consolidation Summary	
T0 = 0 min.	V0 = 0.0 ml.	T0 = 0 min.	V0 = 0.0 ml.	Initial Volume Reading, ml	0.0
T90 = 2.6 min	V90 = 6.0 ml.	T50 = 2.6 min.	V50 = 6.1 ml.	Final Volume Reading, ml	12.4
T100 = NA min	V100 = 6.7 ml.	T100 = 46.7 min.	V100 = 12.1 ml.	Total Volume Change, ml	12.4

Input Validation: Reviewed By: Date 1/3/2011

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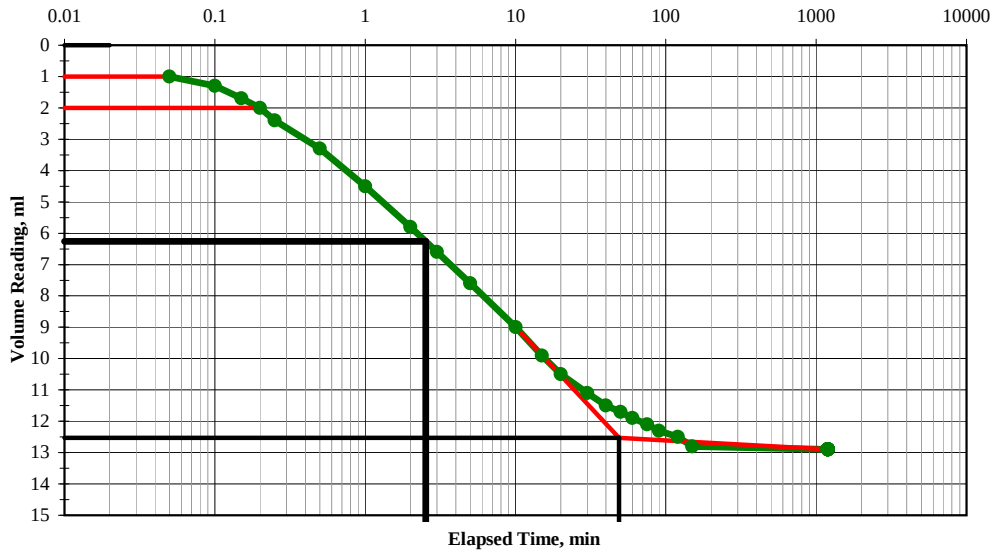
THREE DIMENSIONAL TRIAXIAL CONSOLIDATION TEST

Client	Civil & Environmental Consultants, Inc	Boring	SB-14	**Staged Consolidation**	
Client Project	091-867 Apex Landfill Expansion	Depth	16'-20'	Consolidation Plot Stress, psi	6.6
Project No.	30598	Sample	B-1	**Final Test Pressures**	
		Lab Sample	30598025	Cell Pressure, psi	99.7
USCS Description:	Dark Grayish Brown Lean Clay with Sand			Back Pressure, psi	60.0
Test Conditions:	Remolded - Side And Double Drained			Effective Consol., psi	39.8
				Additional Consol. Volume, ml	14.0

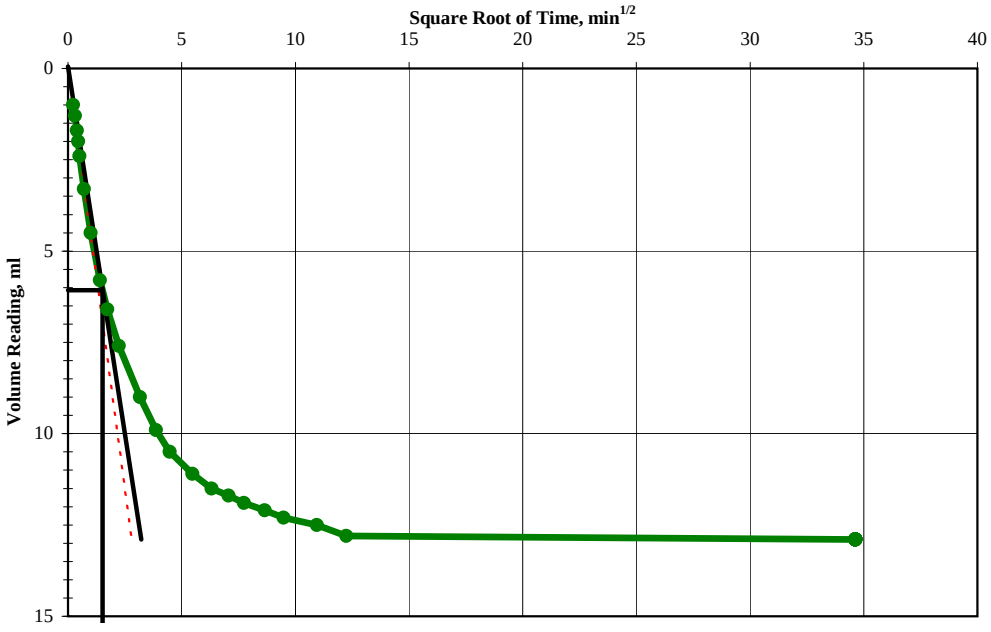
Consol. Start Date: 1/3/2011

Elapsed Time (min)	Sqrt Time ($min^{1/2}$)	Volume Reading ml
0	0	0.0
0.05	0.22	1.0
0.10	0.32	1.3
0.15	0.39	1.7
0.20	0.45	2.0
0.25	0.50	2.4
0.50	0.71	3.3
1.00	1.00	4.5
2.00	1.41	5.8
3.00	1.73	6.6
5.00	2.24	7.6
10.00	3.16	9.0
15.00	3.87	9.9
20.00	4.47	10.5
30.00	5.48	11.1
40.00	6.32	11.5
50.00	7.07	11.7
60.00	7.75	11.9
75.00	8.66	12.1
90.00	9.49	12.3
120.00	10.95	12.5
150.00	12.25	12.8
1200.00	34.64	12.9

Log of Elapsed Time vs. Volume Reading



Square Root of Elapsed Time vs. Volume Reading



Sqrt. of Elapsed Time vs Volume		Log of Elapsed Time vs Volume		Consolidation Summary	
T0 = 0 min.	V0 = -0.1 ml.	T0 = 0 min.	V0 = 0.0 ml.	Initial Volume Reading, ml	0.0
T90 = 2.3 min	V90 = 6.1 ml.	T50 = 2.5 min.	V50 = 6.3 ml.	Final Volume Reading, ml	12.9
T100 = NA min	V100 = 6.8 ml.	T100 = 48.9 min.	V100 = 12.5 ml.	Total Volume Change, ml	26.9

Input Validation: Reviewed By: Date 1/3/2011

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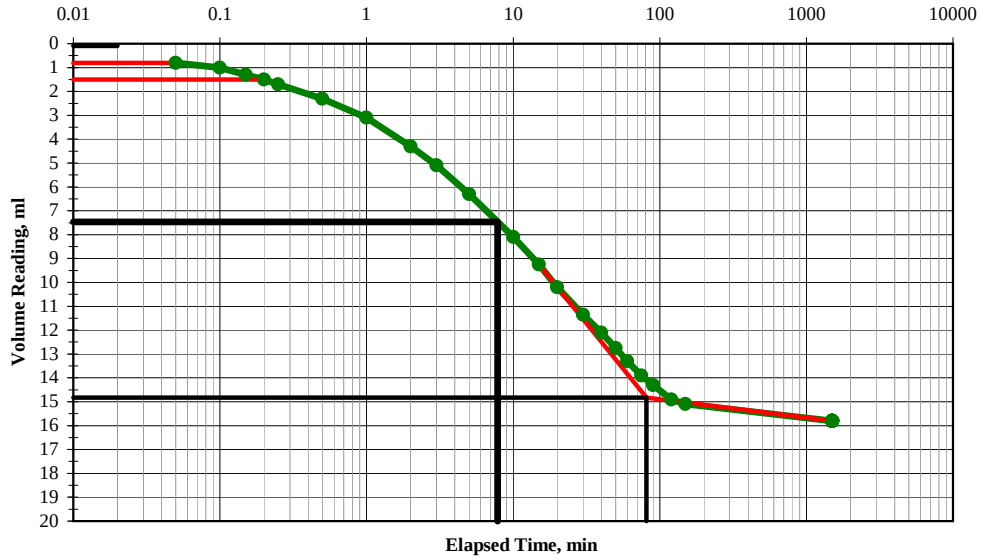
THREE DIMENSIONAL TRIAXIAL CONSOLIDATION TEST

Client	Civil & Environmental Consultants, Inc	Boring	SB-14	**Staged Consolidation**	
Client Project	091-867 Apex Landfill Expansion	Depth	16'-20'	Consolidation Plot Stress, psi	6.6
Project No.	30598	Sample	B-1	**Final Test Pressures**	
		Lab Sample	30598025	Cell Pressure, psi	120.2
USCS Description:	Dark Grayish Brown Lean Clay with Sand			Back Pressure, psi	40.0
Test Conditions:	Remolded - Side And Double Drained			Effective Consol., psi	80.2
				Additional Consol. Volume, m	24.3

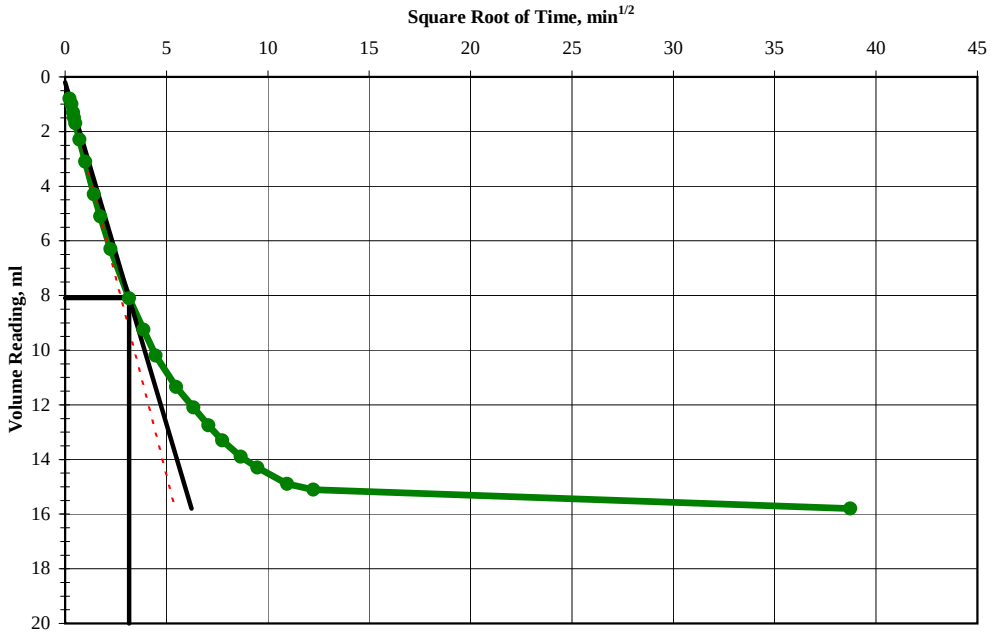
Consol. Start Date: 1/6/2011

Elapsed Time (min)	Sqrt Time ($min^{1/2}$)	Volume Reading ml
0	0	0.0
0.05	0.22	0.8
0.10	0.32	1.0
0.15	0.39	1.3
0.20	0.45	1.5
0.25	0.50	1.7
0.50	0.71	2.3
1.00	1.00	3.1
2.00	1.41	4.3
3.00	1.73	5.1
5.00	2.24	6.3
10.00	3.16	8.1
15.00	3.87	9.3
20.00	4.47	10.2
30.00	5.48	11.4
40.00	6.32	12.1
50.00	7.07	12.8
60.00	7.75	13.3
75.00	8.66	13.9
90.00	9.49	14.3
120.00	10.95	14.9
150.00	12.25	15.1
1500.00	38.73	15.8

Log of Elapsed Time vs. Volume Reading



Square Root of Elapsed Time vs. Volume Reading



Sqrt. of Elapsed Time vs Volume		Log of Elapsed Time vs Volume		Consolidation Summary	
T0 = 0 min.	V0 = 0.2 ml.	T0 = 0 min.	V0 = 0.1 ml.	Initial Volume Reading, ml	0.0
T90 = 10.0 min	V90 = 8.1 ml.	T50 = 7.8 min.	V50 = 7.5 ml.	Final Volume Reading, ml	15.8
T100 = NA min	V100 = 9.0 ml.	T100 = 81.3 min.	V100 = 14.8 ml.	Total Volume Change, ml	40.1

Input Validation: Reviewed By: Date 1/6/2011

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ONE-DIMENSIONAL CONSOLIDATION PROPERTIES OF SOILS
ASTM D 2435

Client	Civil & Environmental Consultant	Boring	RB-3
Client Project	091-867 Apex Landfill Expansion	Depth	20'-24'
Project No.	30598	Sample	B-1
		Lab Sample No.	30598026

Visual Description: Dark Gray Sandy Clay
Sample Conditions: Remolded, Inundated, and Double Drained
Machine Deflection Correction: Applied

SAMPLE PROPERTIES			*TEST DATA SUMMARY*								
	Initial	Final	**Applied**	**Load**	**Final**	**Vertical**	**Dry**	**Void**	**a_v**	**Incremental**	
Tare Number	Z12	F5	**Pressure**	**Duration**	**Height**	**Strain**	**Density**	**Ratio**		**C_c**	**C_r**
Wt. Tare & WS, gm	165.91	281.06	**tsf**	**min**	**in**	**%**	**g/cc**	**e**	**ft^2/ton**		
Wt. Tare & DS, gm	160.21	259.36	Seating	NA	1.0038	0.00	1.6992	0.5831	NA	NA	NA
Wt. Tare, gm	123.26	123.16	0.25	3	1.0028	0.09%	1.7008	0.5816	5.99E-03	NA	NA
Water Content, %	15.4%	15.9%	0.5	12	1.0013	0.25%	1.7034	0.5792	9.78E-03	0.008	NA
			1	758	0.9914	1.24%	1.7205	0.5635	3.12E-02	0.052	NA
Sample Diameter, in	2.5	2.5	2	380	0.9637	3.99%	1.7698	0.5199	4.36E-02	0.145	NA
Sample Height, in	1.004	0.8687	4	151	0.9335	7.00%	1.8272	0.4722	2.39E-02	0.158	NA
Sample Volume, in^3	4.9271	4.2642	1	758	0.9405	6.30%	1.8135	0.4833	3.71E-03	NA	NA
Wt. WS + Ring, gm	270.45	270.19	0.25	302	0.9521	5.15%	1.7914	0.5016	2.44E-02	NA	NA
Wt. of Ring, gm	112.09	112.09	0.5	240	0.9508	5.28%	1.7939	0.4995	8.52E-03	NA	0.007
Wt. of WS, gm	158.36	158.10	1	95	0.9468	5.68%	1.8015	0.4932	1.26E-02	NA	0.021
Wet Density, pcf	122.39	141.18	2	758	0.9400	6.36%	1.8145	0.4825	1.07E-02	NA	0.036
Wet Density, g/cc	1.961	2.263	4	302	0.9291	7.44%	1.8357	0.4654	8.56E-03	NA	0.057
Water Content, %	15.4%	15.9%	8	95	0.9016	10.18%	1.8918	0.4219	1.09E-02	0.144	NA
Wt. of DS, gm	137.20	136.37	16	955	0.8687	13.45%	1.9634	0.3701	6.48E-03	0.172	NA
Dry Density, pcf	106.03	121.78									
Dry Density, g/cc	1.699	1.952									
Void Ratio, e	0.5831	0.3784									
Saturation, %	71.2%		*Note: The calculations performed and the parameters presented herein are for preliminary purposes only. GTS only accepts responsibility for the raw data obtained from the consolidation tests. This data may be interpreted differently by others. It is the responsibility of the user to determine the appropriateness and accuracy of the computed values.*								
Specific Gravity	2.69	Measured									
Height of Solids, in	0.6340	0.6340									

Input Validation | Reviewed By: | Date Tested: 12/20/2010 |

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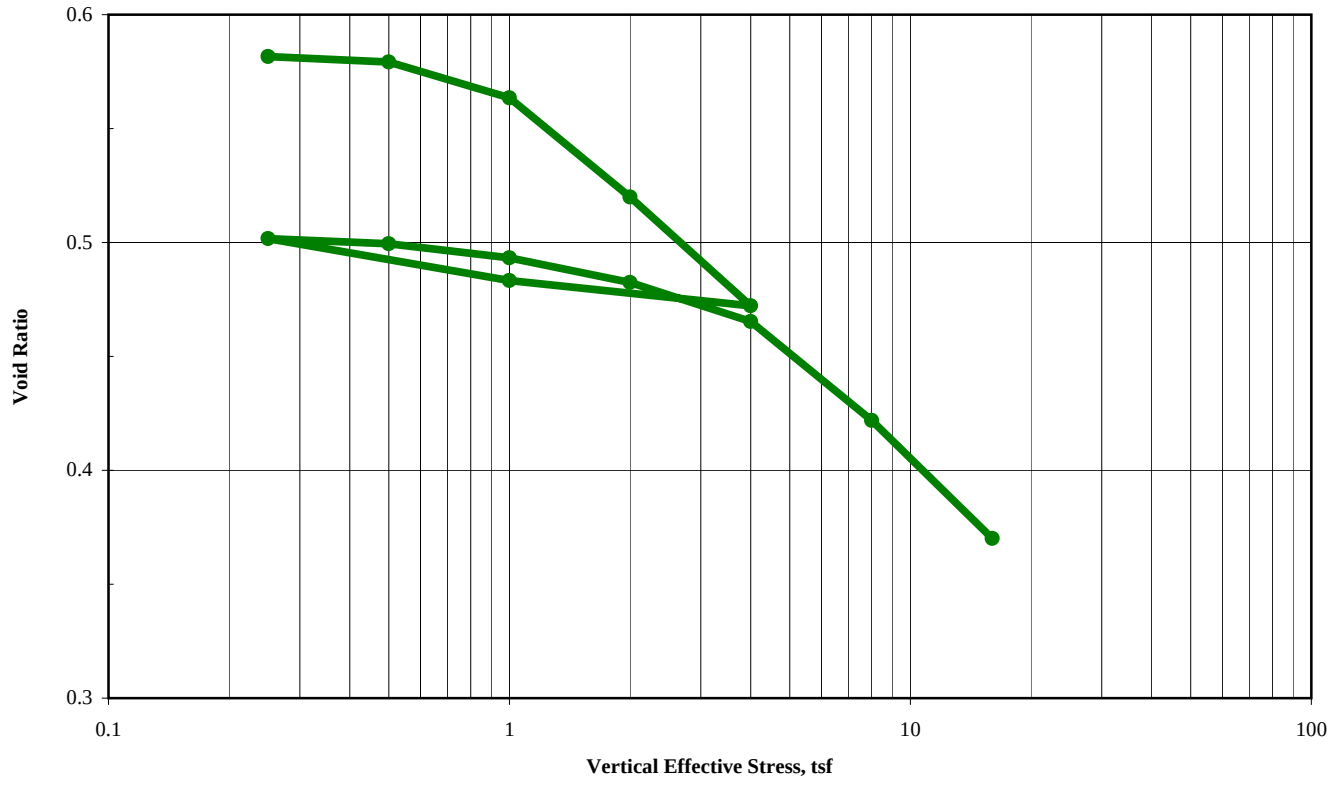
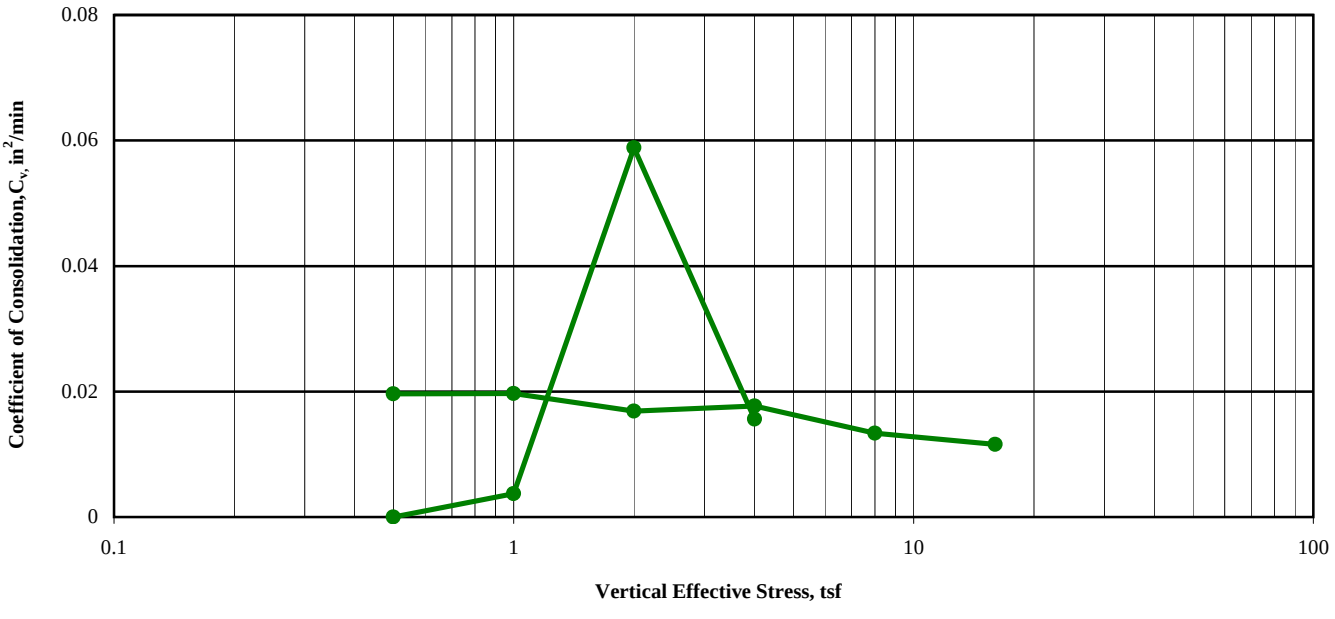
ONE-DIMENSIONAL CONSOLIDATION PROPERTIES OF SOILS
ASTM D 2435

Client	Civil & Environmental Consultants, Inc.	Boring	RB-3
Client Project	091-867 Apex Landfill Expansion	Depth	20'-24'
Project No.	30598	Sample	B-1
		Lab Sample No.	30598026
Visual Description	Dark Gray Sandy Clay		
Sample Conditions	Remolded, Inundated, and Double Drained		
Machine Deflection Correction:	Applied		

Void Ratio (Final Height) vs Vertical Effective Consolidation Stress



Coeffieicent of Consolidation (log. method) vs. Vertical Effective Consolidation Stress



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ONE-DIMENSIONAL CONSOLIDATION PROPERTIES OF SOILS
ASTM D 2435

Client	Civil & Environmental Consultant	Boring	RB-3	**Test Load, tsf**	**0-0.25**
Client Project	091-867 Apex Landfill Expansion	Depth	20'-24'		Load 1 of 13
Project No.	30598	Sample	B-1		
		Lab ID#	30598026		
Visual Description	Dark Gray Sandy Clay				
Test Conditions:	Remolded, Inundated, and Double Drained				

Time Vs. Dial Reading

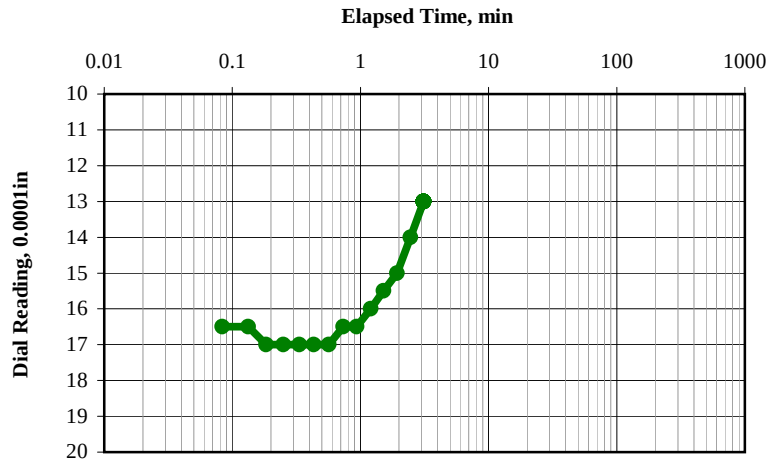
Elapsed Time (min)	Sqrt Time ($min^{1/2}$)	Dial Reading (0.0001in)	Sample Height (in)	Void Ratio
0	0	0	1.0038	0.5831
Corrections*		-3.5	-0.00035	-0.0006
Adjusted Sample Height & Void Ratio				
0.08	0.29	16.5	1.0025	0.5810
0.13	0.37	16.5	1.0025	0.5810
0.18	0.43	17.0	1.0024	0.5810
0.25	0.50	17.0	1.0024	0.5810
0.33	0.58	17.0	1.0024	0.5810
0.43	0.66	17.0	1.0024	0.5810
0.57	0.75	17.0	1.0024	0.5810
0.73	0.86	16.5	1.0025	0.5810
0.93	0.97	16.5	1.0025	0.5810
1.20	1.10	16.0	1.0025	0.5811
1.52	1.23	15.5	1.0026	0.5812
1.93	1.39	15.0	1.0026	0.5813
2.45	1.57	14.0	1.0027	0.5814
3.10	1.76	13.0	1.0028	0.5816

Machine Deflection

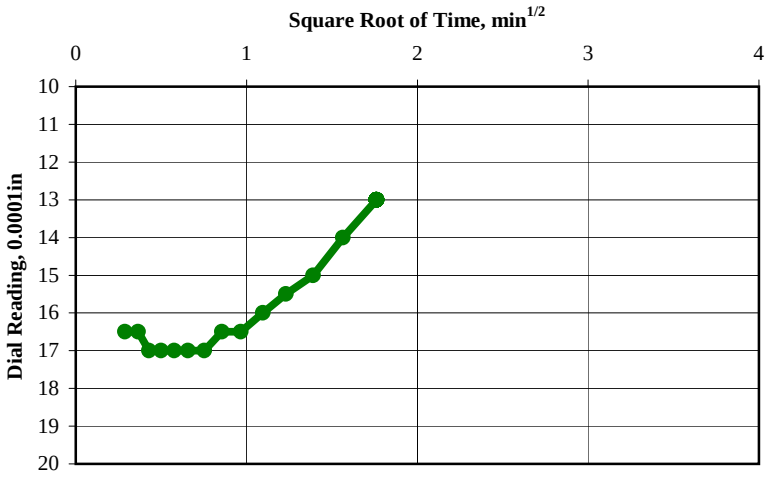
Applied Deflection Correction to Sample Height, 0.0001in -3.5

**Correction is applied to all dial readings.*

Log of Elapsed Time vs. Dial Reading



Square Root of Elapsed Time vs. Dial Reading



Sqrt. of Elapsed Time vs Dial Reading

Log of Elapsed Time vs Dial Reading

Specimen Swelled

Load Summary

Initial Sample Height, in	1.0038
Initial Sample Void Ratio	0.5831
Final Sample Height, in	1.0028
Final Sample Void Ratio	0.5816
Incremental Strain, %	0.09%
Loading Duration, min	3.1

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ONE-DIMENSIONAL CONSOLIDATION PROPERTIES OF SOILS
ASTM D 2435

Client	Civil & Environmental Consultant	Boring	RB-3	**Test Load, tsf**	**0.25-0.5**
Client Project	091-867 Apex Landfill Expansion	Depth	20'-24'		Load 2 of 13
Project No.	30598	Sample	B-1		
		Lab ID#	30598026		

Visual Description: Dark Gray Sandy Clay

Test Conditions: Remolded, Inundated, and Double Drained

Time Vs. Dial Reading

Elapsed Time (min)	Sqrt Time ($min^{1/2}$)	Dial Reading (0.0001in)	Sample Height (in)	Void Ratio
0	0	13.0	1.0028	0.5816
Corrections*		-2.5	-0.00025	-0.0004
Adjusted Sample Height & Void Ratio				
0.10	0.32	26.0	1.0018	0.5799
0.15	0.39	26.5	1.0017	0.5799
0.20	0.45	27.5	1.0016	0.5797
0.27	0.52	27.5	1.0016	0.5797
0.35	0.59	28.0	1.0016	0.5796
0.45	0.67	28.5	1.0015	0.5796
0.58	0.76	28.5	1.0015	0.5796
0.75	0.87	29.5	1.0014	0.5794
0.95	0.97	29.5	1.0014	0.5794
1.22	1.10	30.0	1.0014	0.5793
1.53	1.24	30.0	1.0014	0.5793
1.95	1.40	30.5	1.0013	0.5792
2.47	1.57	30.5	1.0013	0.5792
3.12	1.77	31.0	1.0013	0.5792
3.95	1.99	31.0	1.0013	0.5792
4.98	2.23	31.0	1.0013	0.5792
6.30	2.51	31.0	1.0013	0.5792
7.95	2.82	31.0	1.0013	0.5792
9.40	3.07	31.0	1.0013	0.5792
11.85	3.44	31.0	1.0013	0.5792

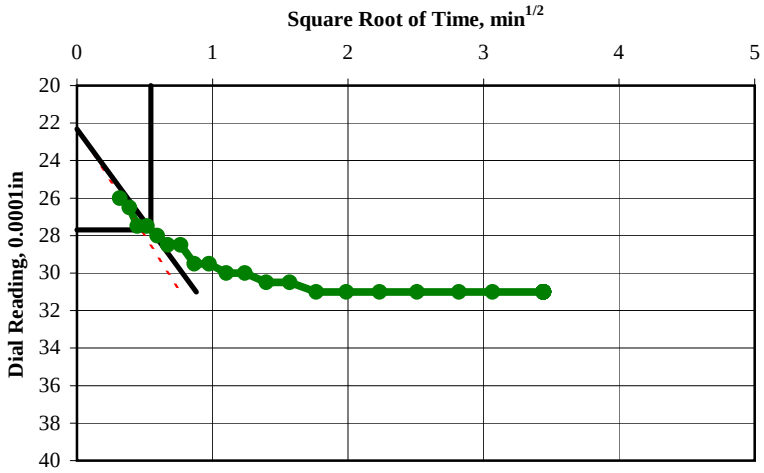
Machine Deflection

Applied Deflection Correction to Sample Height, 0.0001in: -2.5

**Correction is applied to all dial readings.*

Log of Elapsed Time vs. Dial Reading

Square Root of Elapsed Time vs. Dial Reading



Sqrt. of Elapsed Time vs Dial Reading

T0 = 0 min.	D0 = 22.3 div.
T90 = 0.303 min	D90 = 27.7 div.
T100 = NA min	D100 = 28.3 div.
Height at: D90 = 1.0016, D100 = 1.0015	
Average Sample Height, in	1.0020
Average Drainage Height, in	0.5010
T (Time Factor for T90)	0.848
Coef. of Consol., C_v, in^2/min	0.716

Log of Elapsed Time vs Dial Reading

T0 = 0 min.	D0 = 23.7 div.
T50 = 0.18 min.	D50 = 27.1 div.
T100 = 0.98 min.	D100 = 30.6 div.
Height at: D50 = 1.0016, D100 = 1.0013	
Average Sample Height, in	1.0020
Average Drainage Height, in	0.5010
T (Time Factor for T50)	0.197
Coef. of Consol., C_v, in^2/min	0.275

Load Summary

Initial Sample Height, in	1.0028
Initial Sample Void Ratio	0.5816
Final Sample Height, in	1.0013
Final Sample Void Ratio	0.5792
Incremental Strain, %	0.15%
Loading Duration, min	11.85

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ONE-DIMENSIONAL CONSOLIDATION PROPERTIES OF SOILS
ASTM D 2435

Client	Civil & Environmental Consultant	Boring	RB-3	**Test Load, tsf**	**0.5-1**
Client Project	091-867 Apex Landfill Expansion	Depth	20'-24'		Load 3 of 13
Project No.	30598	Sample	B-1		
		Lab ID#	30598026		

Visual Description: Dark Gray Sandy Clay

Test Conditions: Remolded, Inundated, and Double Drained

Time Vs. Dial Reading

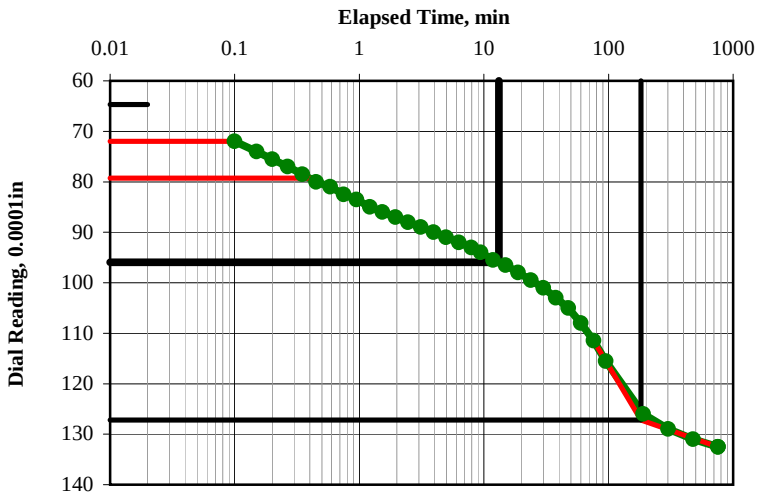
Elapsed Time (min)	Sqrt Time ($min^{1/2}$)	Dial Reading (0.0001in)	Sample Height (in)	Void Ratio
0	0	31.0	1.0013	0.5792
Corrections*		-2.5	-0.00025	-0.0004
Adjusted Sample Height & Void Ratio				
0.10	0.32	72.0	0.9974	0.5731
0.15	0.39	74.0	0.9972	0.5728
0.20	0.45	75.5	0.9971	0.5725
0.27	0.52	77.0	0.9969	0.5723
0.35	0.59	78.5	0.9968	0.5721
0.45	0.67	80.0	0.9966	0.5718
0.58	0.76	81.0	0.9965	0.5717
0.75	0.87	82.5	0.9964	0.5714
0.95	0.97	83.5	0.9963	0.5713
1.22	1.10	85.0	0.9961	0.5710
1.53	1.24	86.0	0.9960	0.5709
1.95	1.40	87.0	0.9959	0.5707
2.47	1.57	88.0	0.9958	0.5706
3.12	1.77	89.0	0.9957	0.5704
3.95	1.99	90.0	0.9956	0.5702
4.98	2.23	91.0	0.9955	0.5701
6.30	2.51	92.0	0.9954	0.5699
7.95	2.82	93.0	0.9953	0.5698
9.40	3.07	94.0	0.9952	0.5696
11.85	3.44	95.5	0.9951	0.5694
14.95	3.87	96.5	0.9950	0.5692
18.85	4.34	98.0	0.9948	0.5690
23.77	4.88	99.5	0.9947	0.5687
29.95	5.47	101.0	0.9945	0.5685
37.75	6.14	103.0	0.9943	0.5682
47.57	6.90	105.0	0.9941	0.5679
59.95	7.74	108.0	0.9938	0.5674
75.95	8.71	111.5	0.9935	0.5669
94.95	9.74	115.5	0.9931	0.5662
189.95	13.78	126.0	0.9920	0.5646
301.95	17.38	129.0	0.9917	0.5641
477.95	21.86	131.0	0.9915	0.5638
757.95	27.53	132.5	0.9914	0.5635

Machine Deflection

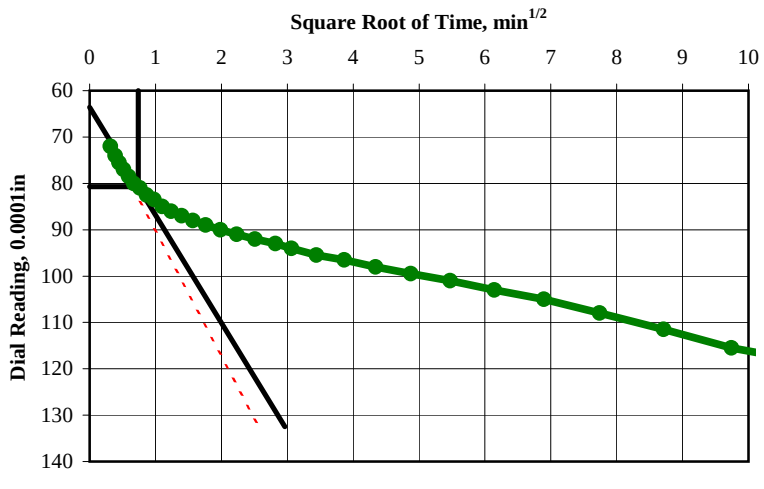
Applied Deflection Correction to Sample Height, 0.0001in: -2.5

**Correction is applied to all dial readings.*

Log of Elapsed Time vs. Dial Reading



Square Root of Elapsed Time vs. Dial Reading



Sqrt. of Elapsed Time vs Dial Reading

T0 = 0 min.	D0 = 63.6 div.
T90 = 0.548 min	D90 = 80.7 div.
T100 = NA min	D100 = 82.6 div.
Height at: D90 = 0.9965, D100 = 0.9963	
Average Sample Height, in	0.9963
Average Drainage Height, in	0.4982
T (Time Factor for T90)	0.848
Coef. of Consol., C_v, in^2/min	0.388

Log of Elapsed Time vs Dial Reading

T0 = 0 min.	D0 = 64.7 div.
T50 = 13.16 min.	D50 = 96 div.
T100 = 182.46 min.	D100 = 127.2 div.
Height at: D50 = 0.995, D100 = 0.9919	
Average Sample Height, in	0.9963
Average Drainage Height, in	0.4982
T (Time Factor for T50)	0.197
Coef. of Consol., C_v, in^2/min	0.004

Load Summary

Initial Sample Height, in	1.0013
Initial Sample Void Ratio	0.5792
Final Sample Height, in	0.9914
Final Sample Void Ratio	0.5635
Incremental Strain, %	0.99%
Loading Duration, min	757.95

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ONE-DIMENSIONAL CONSOLIDATION PROPERTIES OF SOILS
ASTM D 2435

Client	Civil & Environmental Consultant	Boring	RB-3	**Test Load, tsf**	**1-2**
Client Project	091-867 Apex Landfill Expansion	Depth	20'-24'		Load 4 of 13
Project No.	30598	Sample	B-1		
		Lab ID#	30598026		

Visual Description: Dark Gray Sandy Clay

Test Conditions: Remolded, Inundated, and Double Drained

Time Vs. Dial Reading

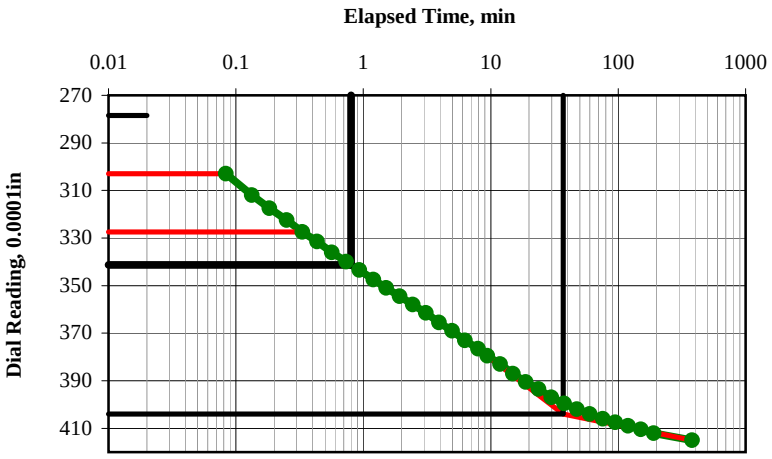
Elapsed Time (min)	Sqrt Time ($min^{1/2}$)	Dial Reading (0.0001in)	Sample Height (in)	Void Ratio
0	0	132.5	0.9914	0.5635
Corrections*		-6	-0.0006	-0.0009
Adjusted Sample Height & Void Ratio				
0.08	0.29	303.0	0.9749	0.5376
0.13	0.37	312.0	0.9740	0.5362
0.18	0.43	317.5	0.9735	0.5353
0.25	0.50	322.5	0.9730	0.5345
0.33	0.58	327.5	0.9725	0.5337
0.43	0.66	331.5	0.9721	0.5331
0.57	0.75	336.0	0.9716	0.5324
0.73	0.86	340.0	0.9712	0.5318
0.93	0.97	343.5	0.9709	0.5312
1.20	1.10	347.5	0.9705	0.5306
1.52	1.23	351.0	0.9701	0.5300
1.93	1.39	354.5	0.9698	0.5295
2.45	1.57	358.0	0.9694	0.5289
3.10	1.76	361.5	0.9691	0.5284
3.93	1.98	365.5	0.9687	0.5277
4.97	2.23	369.0	0.9683	0.5272
6.28	2.51	373.0	0.9679	0.5266
7.93	2.82	376.5	0.9676	0.5260
9.38	3.06	379.5	0.9673	0.5255
11.83	3.44	383.0	0.9669	0.5250
14.93	3.86	387.0	0.9665	0.5243
18.83	4.34	390.5	0.9662	0.5238
23.75	4.87	393.5	0.9659	0.5233
29.93	5.47	397.0	0.9655	0.5228
37.73	6.14	399.5	0.9653	0.5224
47.55	6.90	402.0	0.9650	0.5220
59.93	7.74	404.0	0.9648	0.5217
75.93	8.71	406.0	0.9646	0.5214
94.93	9.74	407.5	0.9645	0.5211
119.93	10.95	409.0	0.9643	0.5209
150.93	12.29	410.5	0.9642	0.5206
189.93	13.78	412.0	0.9640	0.5204
379.93	19.49	415.0	0.9637	0.5199

Machine Deflection

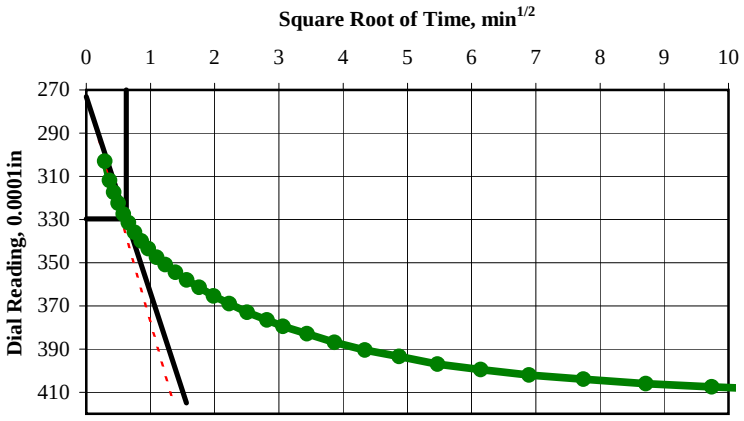
Applied Deflection Correction to Sample Height, 0.0001in: -6

**Correction is applied to all dial readings.*

Log of Elapsed Time vs. Dial Reading



Square Root of Elapsed Time vs. Dial Reading



Sqrt. of Elapsed Time vs Dial Reading

T0 = 0 min.	D0 = 273.2 div.
T90 = 0.384 min	D90 = 329.8 div.
T100 = NA min	D100 = 336.1 div.
Height at: D90 = 0.9722, D100 = 0.9716	
Average Sample Height, in	0.9775
Average Drainage Height, in	0.4888
T (Time Factor for T90)	0.848
Coef. of Consol., C_v, in^2/min	0.521

Log of Elapsed Time vs Dial Reading

T0 = 0 min.	D0 = 278.5 div.
T50 = 0.8 min.	D50 = 341.2 div.
T100 = 36.95 min.	D100 = 404 div.
Height at: D50 = 0.9711, D100 = 0.9648	
Average Sample Height, in	0.9775
Average Drainage Height, in	0.4888
T (Time Factor for T50)	0.197
Coef. of Consol., C_v, in^2/min	0.059

Load Summary

Initial Sample Height, in	0.9914
Initial Sample Void Ratio	0.5635
Final Sample Height, in	0.9637
Final Sample Void Ratio	0.5199
Incremental Strain, %	2.79%
Loading Duration, min	379.93333

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ONE-DIMENSIONAL CONSOLIDATION PROPERTIES OF SOILS
ASTM D 2435

Client	Civil & Environmental Consultant	Boring	RB-3	**Test Load, tsf**	**2-4**
Client Project	091-867 Apex Landfill Expansion	Depth	20'-24'		Load 5 of 13
Project No.	30598	Sample	B-1		
		Lab ID#	30598026		

Visual Description: Dark Gray Sandy Clay

Test Conditions: Remolded, Inundated, and Double Drained

Time Vs. Dial Reading

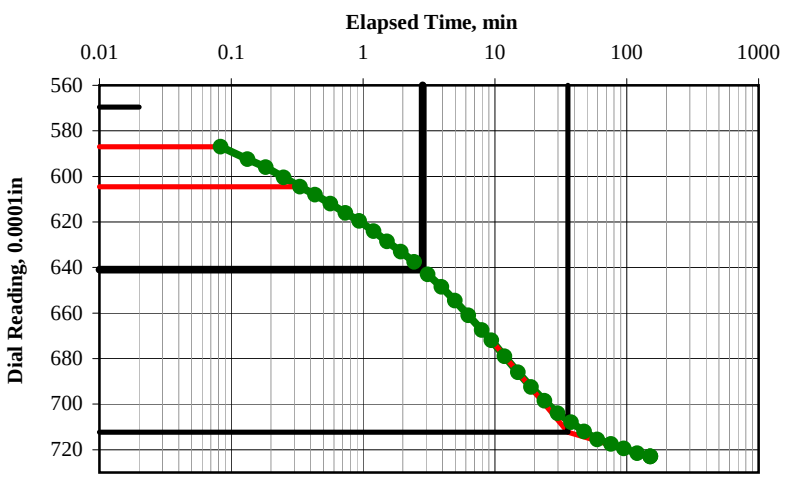
Elapsed Time (min)	Sqrt Time ($min^{1/2}$)	Dial Reading (0.0001in)	Sample Height (in)	Void Ratio
0	0	415.0	0.9637	0.5199
Corrections*		-5.5	-0.00055	-0.0009
Adjusted Sample Height & Void Ratio				
0.08	0.29	587.0	0.9471	0.4937
0.13	0.37	592.5	0.9465	0.4928
0.18	0.43	596.0	0.9462	0.4923
0.25	0.50	600.5	0.9457	0.4915
0.33	0.58	604.5	0.9453	0.4909
0.43	0.66	608.0	0.9450	0.4904
0.57	0.75	612.0	0.9446	0.4897
0.73	0.86	616.0	0.9442	0.4891
0.93	0.97	619.5	0.9438	0.4885
1.20	1.10	624.0	0.9434	0.4878
1.52	1.23	628.5	0.9429	0.4871
1.93	1.39	633.0	0.9425	0.4864
2.45	1.57	637.5	0.9420	0.4857
3.10	1.76	643.0	0.9415	0.4848
3.93	1.98	648.5	0.9409	0.4840
4.97	2.23	654.5	0.9403	0.4830
6.28	2.51	661.0	0.9397	0.4820
7.93	2.82	667.5	0.9390	0.4810
9.38	3.06	672.0	0.9386	0.4803
11.83	3.44	679.0	0.9379	0.4792
14.93	3.86	686.0	0.9372	0.4781
18.83	4.34	692.5	0.9365	0.4770
23.75	4.87	698.5	0.9359	0.4761
29.93	5.47	704.0	0.9354	0.4752
37.73	6.14	708.0	0.9350	0.4746
47.55	6.90	712.0	0.9346	0.4740
59.93	7.74	715.5	0.9342	0.4734
75.93	8.71	717.5	0.9340	0.4731
94.93	9.74	719.5	0.9338	0.4728
119.93	10.95	721.5	0.9336	0.4725
150.93	12.29	723.0	0.9335	0.4722

Machine Deflection

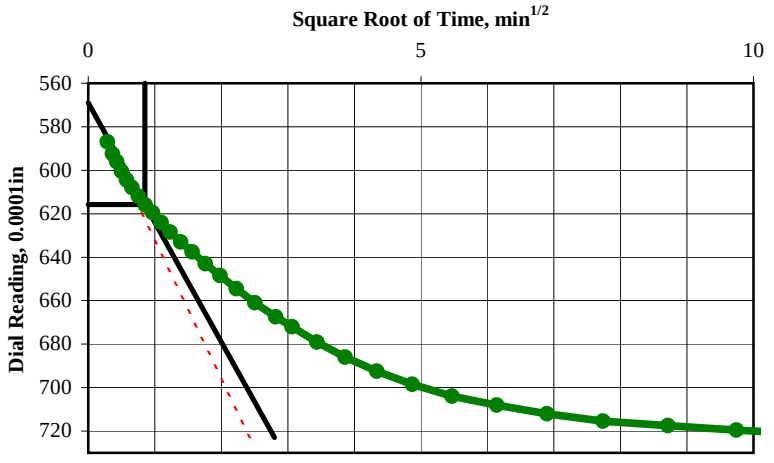
Applied Deflection Correction to Sample Height, 0.0001in: -5.5

**Correction is applied to all dial readings.*

Log of Elapsed Time vs. Dial Reading



Square Root of Elapsed Time vs. Dial Reading



Sqrt. of Elapsed Time vs Dial Reading

T0 = 0 min.	D0 = 569 div.
T90 = 0.723 min	D90 = 615.8 div.
T100 = NA min	D100 = 621 div.
Height at: D90 = 0.9442, D100 = 0.9436	
Average Sample Height, in	0.9486
Average Drainage Height, in	0.4743
T (Time Factor for T90)	0.848
Coef. of Consol., C_v, in^2/min	0.263

Log of Elapsed Time vs Dial Reading

T0 = 0 min.	D0 = 569.5 div.
T50 = 2.84 min.	D50 = 640.9 div.
T100 = 35.71 min.	D100 = 712.3 div.
Height at: D50 = 0.9417, D100 = 0.9345	
Average Sample Height, in	0.9486
Average Drainage Height, in	0.4743
T (Time Factor for T50)	0.197
Coef. of Consol., C_v, in^2/min	0.016

Load Summary

Initial Sample Height, in	0.9637
Initial Sample Void Ratio	0.5199
Final Sample Height, in	0.9335
Final Sample Void Ratio	0.4722
Incremental Strain, %	3.14%
Loading Duration, min	150.93333

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ONE-DIMENSIONAL CONSOLIDATION PROPERTIES OF SOILS
ASTM D 2435

Client	Civil & Environmental Consultant	Boring	RB-3	**Test Load, tsf**	**4-1**
Client Project	091-867 Apex Landfill Expansion	Depth	20'-24'		Load 6 of 13
Project No.	30598	Sample	B-1		
		Lab ID#	30598026		

Visual Description: Dark Gray Sandy Clay
Test Conditions: Remolded, Inundated, and Double Drained

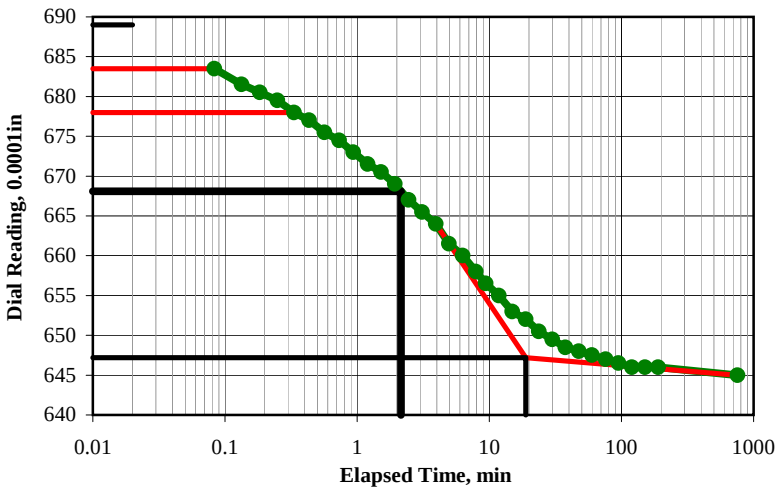
Time Vs. Dial Reading

Elapsed Time (min)	Sqrt Time ($min^{1/2}$)	Dial Reading (0.0001in)	Sample Height (in)	Void Ratio
0	0	723.0	0.9335	0.4722
Corrections*		7.5	0.00075	0.00118
Adjusted Sample Height & Void Ratio				
0.08	0.29	683.5	0.9367	0.4773
0.13	0.37	681.5	0.9369	0.4776
0.18	0.43	680.5	0.9370	0.4777
0.25	0.50	679.5	0.9371	0.4779
0.33	0.58	678.0	0.9372	0.4781
0.43	0.66	677.0	0.9373	0.4783
0.57	0.75	675.5	0.9375	0.4785
0.73	0.86	674.5	0.9376	0.4787
0.93	0.97	673.0	0.9377	0.4789
1.20	1.10	671.5	0.9379	0.4792
1.52	1.23	670.5	0.9380	0.4793
1.93	1.39	669.0	0.9381	0.4796
2.45	1.57	667.0	0.9383	0.4799
3.10	1.76	665.5	0.9385	0.4801
3.93	1.98	664.0	0.9386	0.4803
4.97	2.23	661.5	0.9389	0.4807
6.28	2.51	660.0	0.9390	0.4810
7.93	2.82	658.0	0.9392	0.4813
9.38	3.06	656.5	0.9394	0.4815
11.83	3.44	655.0	0.9395	0.4818
14.93	3.86	653.0	0.9397	0.4821
18.83	4.34	652.0	0.9398	0.4822
23.75	4.87	650.5	0.9400	0.4825
29.93	5.47	649.5	0.9401	0.4826
37.73	6.14	648.5	0.9402	0.4828
47.55	6.90	648.0	0.9402	0.4829
59.93	7.74	647.5	0.9403	0.4829
75.93	8.71	647.0	0.9403	0.4830
94.93	9.74	646.5	0.9404	0.4831
119.93	10.95	646.0	0.9404	0.4832
150.93	12.29	646.0	0.9404	0.4832
189.93	13.78	646.0	0.9404	0.4832
757.93	27.53	645.0	0.9405	0.4833

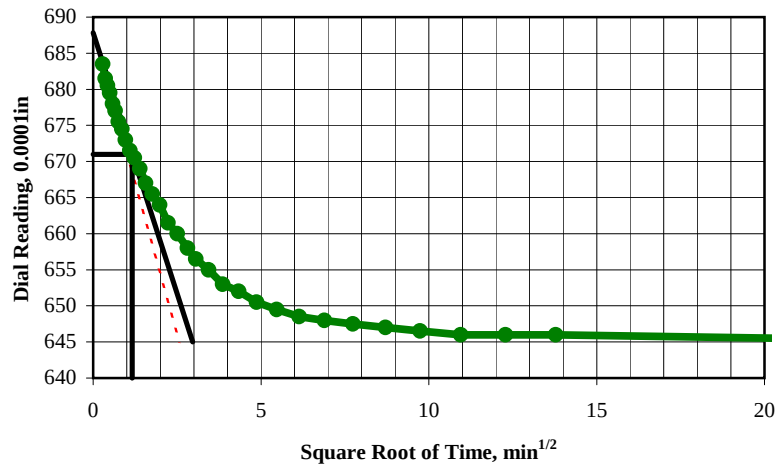
Machine Deflection

Applied Deflection Correction to Sample Height, 0.0001in 7.5
**Correction is applied to all dial readings.*

Log of Elapsed Time vs. Dial Reading



Square Root of Elapsed Time vs. Dial Reading



Sqrt. of Elapsed Time vs Dial Reading		Log of Elapsed Time vs Dial Reading		Load Summary	
T0 = 0 min.	D0 = 687.8 div.	T0 = 0 min.	D0 = 689 div.		
T90 = 1.346 min	D90 = 671 div.	T50 = 2.15 min.	D50 = 668.1 div.	Initial Sample Height, in	0.9335
T100 = NA min	D100 = 669.1 div.	T100 = 18.84 min.	D100 = 647.2 div.	Initial Sample Void Ratio	0.4722
Height at: D90 = 0.9379, D100 = 0.9381		Height at: D50 = 0.9382, D100 = 0.9403		Final Sample Height, in	0.9405
Average Sample Height, in	0.9370	Average Sample Height, in	0.9370	Final Sample Void Ratio	0.4833
Average Drainage Height, in	0.4685	Average Drainage Height, in	0.4685	Incremental Strain, %	-0.76%
T (Time Factor for T90)	0.848	T (Time Factor for T50)	0.197	Loading Duration, min	757.93333
Coef. of Consol., C_v, in^2/min	0.137	Coef. of Consol., C_v, in^2/min	0.020		

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ONE-DIMENSIONAL CONSOLIDATION PROPERTIES OF SOILS
ASTM D 2435

Client	Civil & Environmental Consultant	Boring	RB-3	**Test Load, tsf**	**1-0.25**
Client Project	091-867 Apex Landfill Expansion	Depth	20'-24'		Load 7 of 13
Project No.	30598	Sample	B-1		
		Lab ID#	30598026		
Visual Description	Dark Gray Sandy Clay				
Test Conditions:	Remolded, Inundated, and Double Drained				

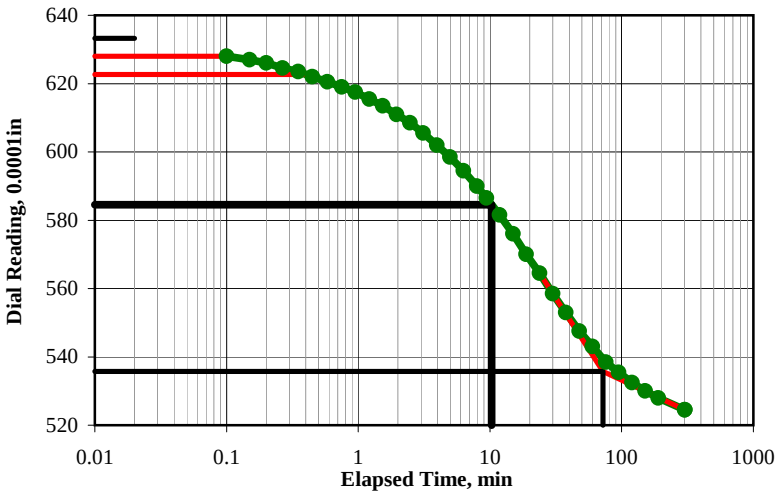
Time Vs. Dial Reading				
Elapsed Time (min)	**Sqrt Time ($min^{1/2}$)**	**Dial Reading (0.0001in)**	**Sample Height (in)**	**Void Ratio**
0	0	645.0	0.9405	0.4833
Corrections*		4.5	0.00045	0.00071
Adjusted Sample Height & Void Ratio				
0.10	0.32	628.0	0.9418	0.4853
0.15	0.39	627.0	0.9419	0.4855
0.20	0.45	626.0	0.9420	0.4856
0.27	0.52	624.5	0.9421	0.4859
0.35	0.59	623.5	0.9422	0.4860
0.45	0.67	622.0	0.9424	0.4863
0.58	0.76	620.5	0.9425	0.4865
0.75	0.87	619.0	0.9427	0.4867
0.95	0.97	617.5	0.9428	0.4870
1.22	1.10	615.5	0.9430	0.4873
1.53	1.24	613.5	0.9432	0.4876
1.95	1.40	611.0	0.9435	0.4880
2.47	1.57	608.5	0.9437	0.4884
3.12	1.77	605.5	0.9440	0.4889
3.95	1.99	602.0	0.9444	0.4894
4.98	2.23	598.5	0.9447	0.4900
6.30	2.51	594.5	0.9451	0.4906
7.95	2.82	590.0	0.9456	0.4913
9.40	3.07	586.5	0.9459	0.4919
11.85	3.44	581.5	0.9464	0.4926
14.95	3.87	576.0	0.9470	0.4935
18.85	4.34	570.0	0.9476	0.4945
23.77	4.88	564.5	0.9481	0.4953
29.95	5.47	558.5	0.9487	0.4963
37.75	6.14	553.0	0.9493	0.4971
47.57	6.90	547.5	0.9498	0.4980
59.95	7.74	543.0	0.9503	0.4987
75.95	8.71	538.5	0.9507	0.4994
94.95	9.74	535.5	0.9510	0.4999
119.95	10.95	532.5	0.9513	0.5004
150.95	12.29	530.0	0.9516	0.5008
189.95	13.78	528.0	0.9518	0.5011
301.95	17.38	524.5	0.9521	0.5016

Machine Deflection

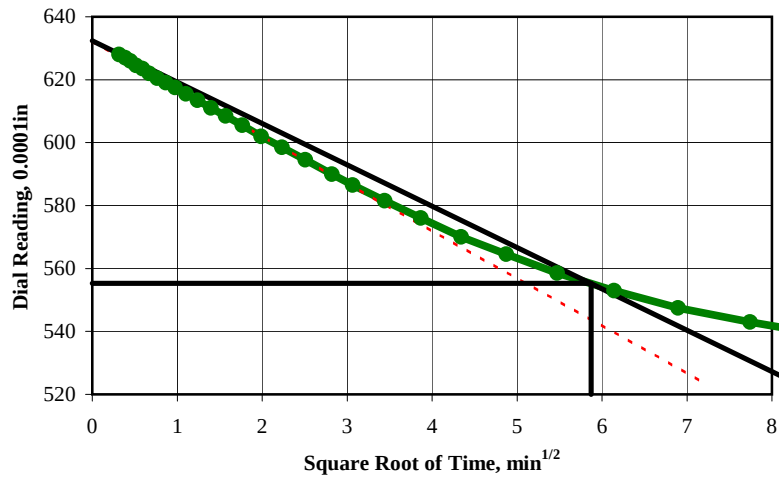
Applied Deflection Correction to Sample Height, 0.0001in 4.5

**Correction is applied to all dial readings.*

Log of Elapsed Time vs. Dial Reading



Square Root of Elapsed Time vs. Dial Reading



Sqrt. of Elapsed Time vs Dial Reading		**Log of Elapsed Time vs Dial Reading**		**Load Summary**	
T0 = 0 min.	D0 = 632.3 div.	T0 = 0 min.	D0 = 633.3 div.		
T90 = 34.457 min	D90 = 555.2 div.	T50 = 10.31 min.	D50 = 584.5 div.	Initial Sample Height, in	0.9405
T100 = NA min	D100 = 546.7 div.	T100 = 72.04 min.	D100 = 535.7 div.	Initial Sample Void Ratio	0.4833
Height at: D90 = 0.949, D100 = 0.9499		Height at: D50 = 0.9461, D100 = 0.951		Final Sample Height, in	0.9521
Average Sample Height, in	0.9463	Average Sample Height, in	0.9463	Final Sample Void Ratio	0.5016
Average Drainage Height, in	0.4732	Average Drainage Height, in	0.4732	Incremental Strain, %	-1.23%
T (Time Factor for T90)	0.848	T (Time Factor for T50)	0.197	Loading Duration, min	301.95
Coef. of Consol., C_v, in^2/min	0.006	Coef. of Consol., C_v, in^2/min	0.004		

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ONE-DIMENSIONAL CONSOLIDATION PROPERTIES OF SOILS
ASTM D 2435

Client	Civil & Environmental Consultant	Boring	RB-3	**Test Load, tsf**	**0.25-0.5**
Client Project	091-867 Apex Landfill Expansion	Depth	20'-24'		Load 8 of 13
Project No.	30598	Sample	B-1		
		Lab ID#	30598026		

Visual Description: Dark Gray Sandy Clay

Test Conditions: Remolded, Inundated, and Double Drained

Time Vs. Dial Reading

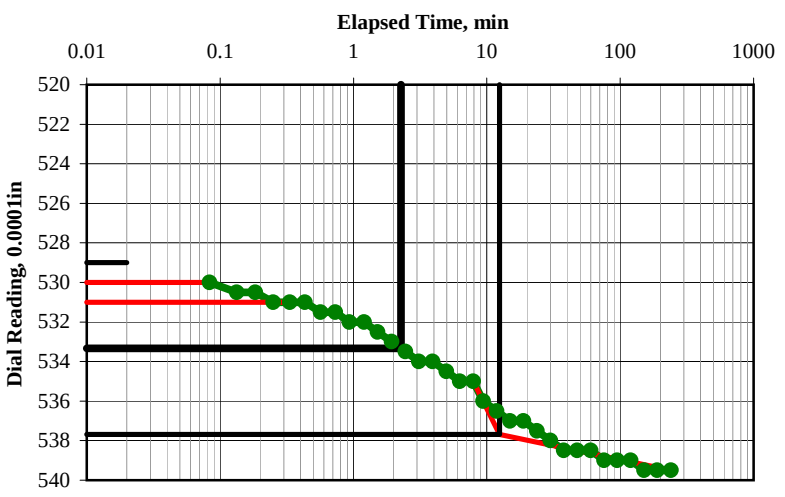
Elapsed Time (min)	Sqrt Time ($min^{1/2}$)	Dial Reading (0.0001in)	Sample Height (in)	Void Ratio
0	0	524.5	0.9521	0.5016
Corrections*		-1.5	-0.00015	-0.0002
Adjusted Sample Height & Void Ratio				
0.08	0.29	530.0	0.9517	0.5010
0.13	0.37	530.5	0.9517	0.5009
0.18	0.43	530.5	0.9517	0.5009
0.25	0.50	531.0	0.9516	0.5008
0.33	0.58	531.0	0.9516	0.5008
0.43	0.66	531.0	0.9516	0.5008
0.57	0.75	531.5	0.9516	0.5008
0.73	0.86	531.5	0.9516	0.5008
0.93	0.97	532.0	0.9515	0.5007
1.20	1.10	532.0	0.9515	0.5007
1.52	1.23	532.5	0.9515	0.5006
1.93	1.39	533.0	0.9514	0.5005
2.45	1.57	533.5	0.9514	0.5005
3.10	1.76	534.0	0.9513	0.5004
3.93	1.98	534.0	0.9513	0.5004
4.97	2.23	534.5	0.9513	0.5003
6.28	2.51	535.0	0.9512	0.5002
7.93	2.82	535.0	0.9512	0.5002
9.38	3.06	536.0	0.9511	0.5001
11.83	3.44	536.5	0.9511	0.5000
14.93	3.86	537.0	0.9510	0.4999
18.83	4.34	537.0	0.9510	0.4999
23.75	4.87	537.5	0.9510	0.4998
29.93	5.47	538.0	0.9509	0.4997
37.73	6.14	538.5	0.9509	0.4997
47.55	6.90	538.5	0.9509	0.4997
59.93	7.74	538.5	0.9509	0.4997
75.93	8.71	539.0	0.9508	0.4996
94.93	9.74	539.0	0.9508	0.4996
119.93	10.95	539.0	0.9508	0.4996
150.93	12.29	539.5	0.9508	0.4995
189.93	13.78	539.5	0.9508	0.4995
239.93	15.49	539.5	0.9508	0.4995

Machine Deflection

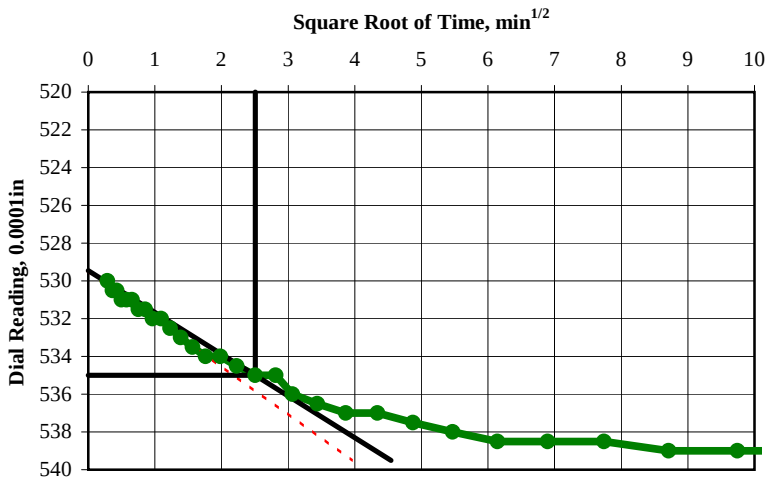
Applied Deflection Correction to Sample Height, 0.0001in: -1.5

**Correction is applied to all dial readings.*

Log of Elapsed Time vs. Dial Reading



Square Root of Elapsed Time vs. Dial Reading



Sqrt. of Elapsed Time vs Dial Reading

T0 = 0 min.	D0 = 529.5 div.		
T90 = 6.3 min	D90 = 535 div.		
T100 = NA min	D100 = 535.6 div.		
Height at: D90 = 0.9512, D100 = 0.9511			
Average Sample Height, in	0.9514		
Average Drainage Height, in	0.4757		
T (Time Factor for T90)	0.848		
Coef. of Consol., C_v, in^2/min	0.030		

Log of Elapsed Time vs Dial Reading

T0 = 0 min.	D0 = 529 div.		
T50 = 2.27 min.	D50 = 533.3 div.		
T100 = 12.44 min.	D100 = 537.7 div.		
Height at: D50 = 0.9514, D100 = 0.9509			
Average Sample Height, in	0.9514		
Average Drainage Height, in	0.4757		
T (Time Factor for T50)	0.197		
Coef. of Consol., C_v, in^2/min	0.020		

Load Summary

Initial Sample Height, in	0.9521
Initial Sample Void Ratio	0.5016
Final Sample Height, in	0.9508
Final Sample Void Ratio	0.4995
Incremental Strain, %	0.14%
Loading Duration, min	239.93333

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ONE-DIMENSIONAL CONSOLIDATION PROPERTIES OF SOILS
ASTM D 2435

Client	Civil & Environmental Consultant	Boring	RB-3	**Test Load, tsf**	**0.5-1**
Client Project	091-867 Apex Landfill Expansion	Depth	20'-24'		Load 9 of 13
Project No.	30598	Sample	B-1		
		Lab ID#	30598026		

Visual Description: Dark Gray Sandy Clay

Test Conditions: Remolded, Inundated, and Double Drained

Time Vs. Dial Reading

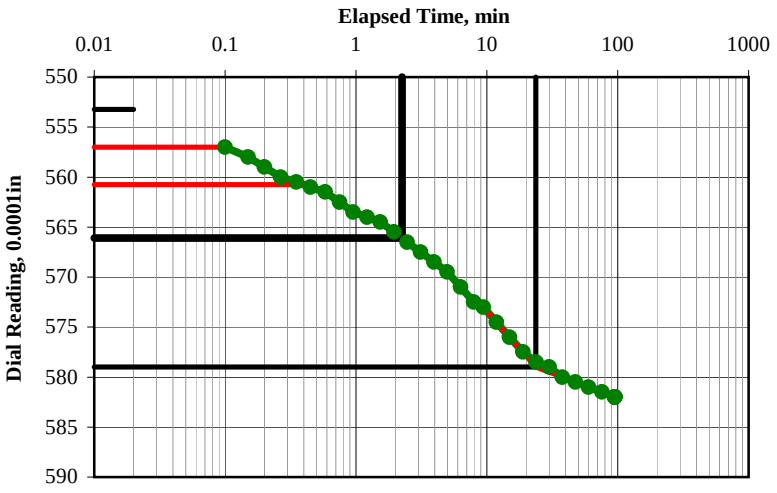
Elapsed Time (min)	Sqrt Time ($min^{1/2}$)	Dial Reading (0.0001in)	Sample Height (in)	Void Ratio
0	0	539.5	0.9508	0.4995
Corrections*		-2.5	-0.00025	-0.0004
Adjusted Sample Height & Void Ratio				
0.10	0.32	557.0	0.9493	0.4971
0.15	0.39	558.0	0.9492	0.4970
0.20	0.45	559.0	0.9491	0.4968
0.27	0.52	560.0	0.9490	0.4967
0.35	0.59	560.5	0.9489	0.4966
0.45	0.67	561.0	0.9489	0.4965
0.58	0.76	561.5	0.9488	0.4964
0.75	0.87	562.5	0.9487	0.4963
0.95	0.97	563.5	0.9486	0.4961
1.22	1.10	564.0	0.9486	0.4960
1.53	1.24	564.5	0.9485	0.4960
1.95	1.40	565.5	0.9484	0.4958
2.47	1.57	566.5	0.9483	0.4956
3.12	1.77	567.5	0.9482	0.4955
3.95	1.99	568.5	0.9481	0.4953
4.98	2.23	569.5	0.9480	0.4952
6.30	2.51	571.0	0.9479	0.4949
7.95	2.82	572.5	0.9477	0.4947
9.40	3.07	573.0	0.9477	0.4946
11.85	3.44	574.5	0.9475	0.4944
14.95	3.87	576.0	0.9474	0.4941
18.85	4.34	577.5	0.9472	0.4939
23.77	4.88	578.5	0.9471	0.4938
29.95	5.47	579.0	0.9471	0.4937
37.75	6.14	580.0	0.9470	0.4935
47.57	6.90	580.5	0.9469	0.4934
59.95	7.74	581.0	0.9469	0.4934
75.95	8.71	581.5	0.9468	0.4933
94.95	9.74	582.0	0.9468	0.4932

Machine Deflection

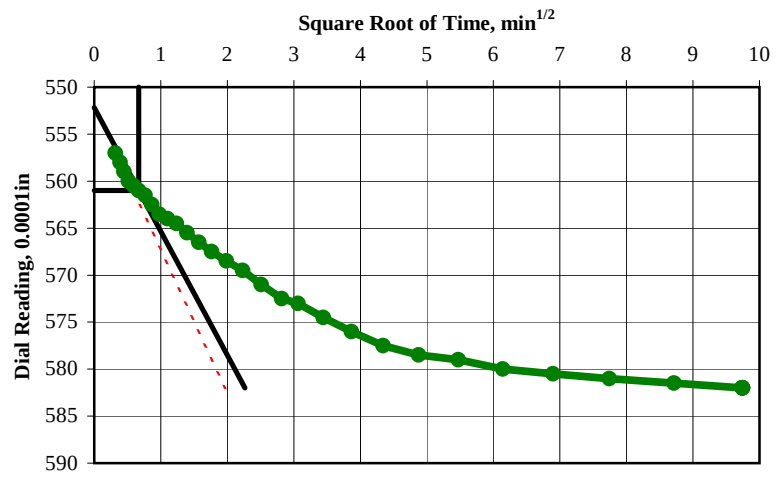
Applied Deflection Correction to Sample Height, 0.0001in: -2.5

**Correction is applied to all dial readings.*

Log of Elapsed Time vs. Dial Reading



Square Root of Elapsed Time vs. Dial Reading



Sqrt. of Elapsed Time vs Dial Reading

T0 = 0 min.	D0 = 552.2 div.		
T90 = 0.449 min	D90 = 561 div.		
T100 = NA min	D100 = 562 div.		
Height at: D90 = 0.9489, D100 = 0.9488			
Average Sample Height, in	0.9488		
Average Drainage Height, in	0.4744		
T (Time Factor for T90)	0.848		
Coef. of Consol., C_v, in^2/min	0.428		

Log of Elapsed Time vs Dial Reading

T0 = 0 min.	D0 = 553.2 div.		
T50 = 2.25 min.	D50 = 566.1 div.		
T100 = 23.69 min.	D100 = 579 div.		
Height at: D50 = 0.9483, D100 = 0.9471			
Average Sample Height, in	0.9488		
Average Drainage Height, in	0.4744		
T (Time Factor for T50)	0.197		
Coef. of Consol., C_v, in^2/min	0.020		

Load Summary

Initial Sample Height, in	0.9508
Initial Sample Void Ratio	0.4995
Final Sample Height, in	0.9468
Final Sample Void Ratio	0.4932
Incremental Strain, %	0.42%
Loading Duration, min	94.95

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ONE-DIMENSIONAL CONSOLIDATION PROPERTIES OF SOILS
ASTM D 2435

Client	Civil & Environmental Consultant	Boring	RB-3	**Test Load, tsf**	**1-2**
Client Project	091-867 Apex Landfill Expansion	Depth	20'-24'		Load 10 of 13
Project No.	30598	Sample	B-1		
		Lab ID#	30598026		

Visual Description: Dark Gray Sandy Clay

Test Conditions: Remolded, Inundated, and Double Drained

Time Vs. Dial Reading

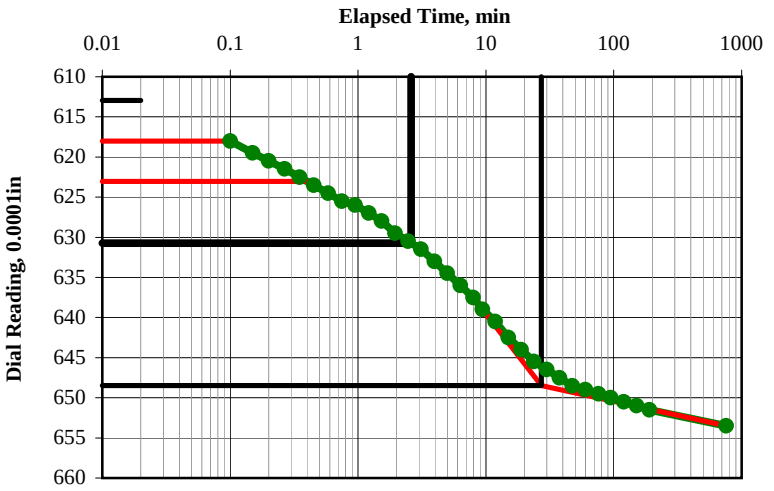
Elapsed Time (min)	Sqrt Time ($min^{1/2}$)	Dial Reading (0.0001in)	Sample Height (in)	Void Ratio
0	0	582.0	0.9468	0.4932
Corrections*		-3.5	-0.00035	-0.0006
Adjusted Sample Height & Void Ratio				
0.10	0.32	618.0	0.9435	0.4881
0.15	0.39	619.5	0.9434	0.4878
0.20	0.45	620.5	0.9433	0.4877
0.27	0.52	621.5	0.9432	0.4875
0.35	0.59	622.5	0.9431	0.4874
0.45	0.67	623.5	0.9430	0.4872
0.58	0.76	624.5	0.9429	0.4870
0.75	0.87	625.5	0.9428	0.4869
0.95	0.97	626.0	0.9427	0.4868
1.22	1.10	627.0	0.9426	0.4867
1.53	1.24	628.0	0.9425	0.4865
1.95	1.40	629.5	0.9424	0.4863
2.47	1.57	630.5	0.9423	0.4861
3.12	1.77	631.5	0.9422	0.4859
3.95	1.99	633.0	0.9420	0.4857
4.98	2.23	634.5	0.9419	0.4855
6.30	2.51	636.0	0.9417	0.4852
7.95	2.82	637.5	0.9416	0.4850
9.40	3.07	639.0	0.9414	0.4848
11.85	3.44	640.5	0.9413	0.4845
14.95	3.87	642.5	0.9411	0.4842
18.85	4.34	644.0	0.9409	0.4840
23.77	4.88	645.5	0.9408	0.4837
29.95	5.47	646.5	0.9407	0.4836
37.75	6.14	647.5	0.9406	0.4834
47.57	6.90	648.5	0.9405	0.4833
59.95	7.74	649.0	0.9404	0.4832
75.95	8.71	649.5	0.9404	0.4831
94.95	9.74	650.0	0.9403	0.4830
119.95	10.95	650.5	0.9403	0.4829
150.95	12.29	651.0	0.9402	0.4829
189.95	13.78	651.5	0.9402	0.4828
757.95	27.53	653.5	0.9400	0.4825

Machine Deflection

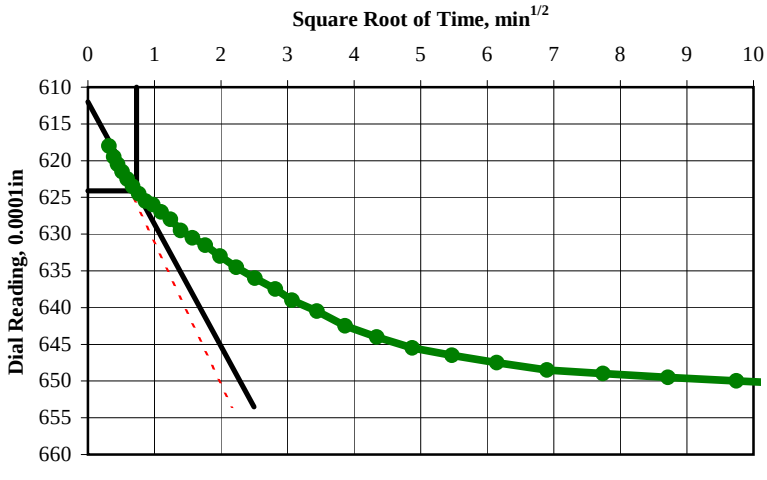
Applied Deflection Correction to Sample Height, 0.0001in: -3.5

**Correction is applied to all dial readings.*

Log of Elapsed Time vs. Dial Reading



Square Root of Elapsed Time vs. Dial Reading



Sqrt. of Elapsed Time vs Dial Reading

T0 = 0 min.	D0 = 612 div.
T90 = 0.533 min	D90 = 624.1 div.
T100 = NA min	D100 = 625.5 div.
Height at: D90 = 0.9429, D100 = 0.9428	
Average Sample Height, in	0.9434
Average Drainage Height, in	0.4717
T (Time Factor for T90)	0.848
Coef. of Consol., C_v, in^2/min	0.355

Log of Elapsed Time vs Dial Reading

T0 = 0 min.	D0 = 613 div.
T50 = 2.6 min.	D50 = 630.7 div.
T100 = 27.07 min.	D100 = 648.5 div.
Height at: D50 = 0.9422, D100 = 0.9405	
Average Sample Height, in	0.9434
Average Drainage Height, in	0.4717
T (Time Factor for T50)	0.197
Coef. of Consol., C_v, in^2/min	0.017

Load Summary

Initial Sample Height, in	0.9468
Initial Sample Void Ratio	0.4932
Final Sample Height, in	0.9400
Final Sample Void Ratio	0.4825
Incremental Strain, %	0.72%
Loading Duration, min	757.95

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ONE-DIMENSIONAL CONSOLIDATION PROPERTIES OF SOILS
ASTM D 2435

Client	Civil & Environmental Consultant	Boring	RB-3	**Test Load, tsf**	**2-4**
Client Project	091-867 Apex Landfill Expansion	Depth	20'-24'		Load 11 of 13
Project No.	30598	Sample	B-1		
		Lab ID#	30598026		

Visual Description: Dark Gray Sandy Clay

Test Conditions: Remolded, Inundated, and Double Drained

Time Vs. Dial Reading

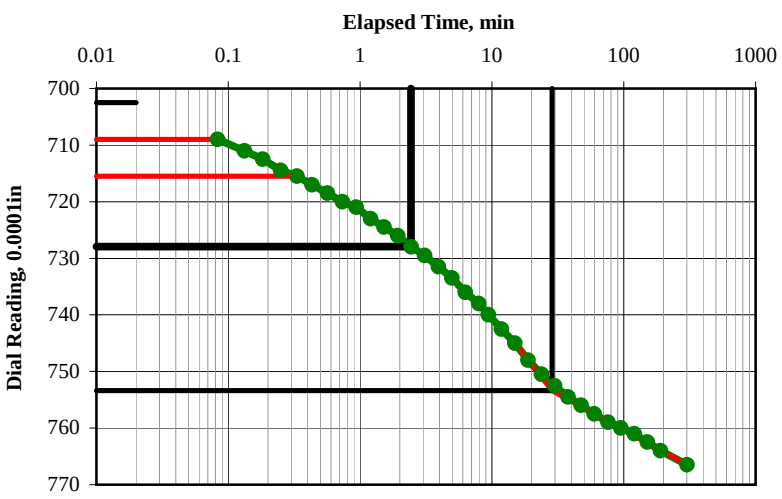
Elapsed Time (min)	Sqrt Time ($min^{1/2}$)	Dial Reading (0.0001in)	Sample Height (in)	Void Ratio
0	0	653.5	0.9400	0.4825
Corrections*		-4.5	-0.00045	-0.0007
Adjusted Sample Height & Void Ratio				
0.08	0.29	709.0	0.9349	0.4744
0.13	0.37	711.0	0.9347	0.4741
0.18	0.43	712.5	0.9345	0.4739
0.25	0.50	714.5	0.9343	0.4736
0.33	0.58	715.5	0.9342	0.4734
0.43	0.66	717.0	0.9341	0.4732
0.57	0.75	718.5	0.9339	0.4729
0.73	0.86	720.0	0.9338	0.4727
0.93	0.97	721.0	0.9337	0.4725
1.20	1.10	723.0	0.9335	0.4722
1.52	1.23	724.5	0.9333	0.4720
1.93	1.39	726.0	0.9332	0.4717
2.45	1.57	728.0	0.9330	0.4714
3.10	1.76	729.5	0.9328	0.4712
3.93	1.98	731.5	0.9326	0.4709
4.97	2.23	733.5	0.9324	0.4706
6.28	2.51	736.0	0.9322	0.4702
7.93	2.82	738.0	0.9320	0.4699
9.38	3.06	740.0	0.9318	0.4695
11.83	3.44	742.5	0.9315	0.4691
14.93	3.86	745.0	0.9313	0.4688
18.83	4.34	748.0	0.9310	0.4683
23.75	4.87	750.5	0.9307	0.4679
29.93	5.47	752.5	0.9305	0.4676
37.73	6.14	754.5	0.9303	0.4673
47.55	6.90	756.0	0.9302	0.4670
59.93	7.74	757.5	0.9300	0.4668
75.93	8.71	759.0	0.9299	0.4665
94.93	9.74	760.0	0.9298	0.4664
119.93	10.95	761.0	0.9297	0.4662
150.93	12.29	762.5	0.9295	0.4660
189.93	13.78	764.0	0.9294	0.4658
301.93	17.38	766.5	0.9291	0.4654

Machine Deflection

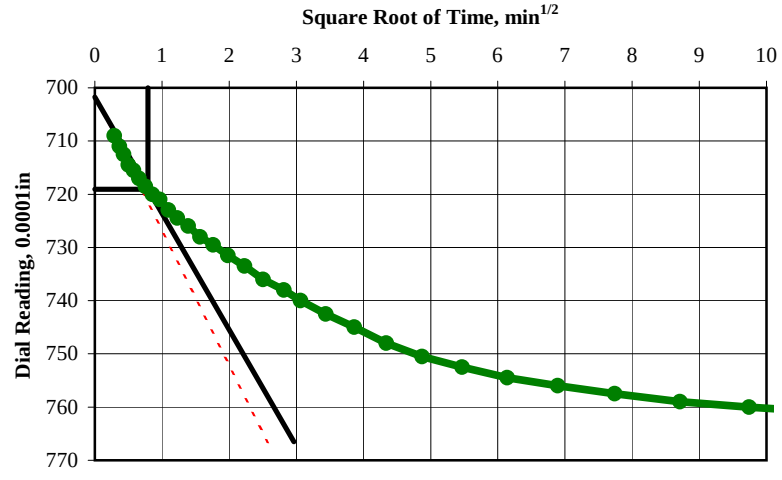
Applied Deflection Correction to Sample Height, 0.0001in: -4.5

**Correction is applied to all dial readings.*

Log of Elapsed Time vs. Dial Reading



Square Root of Elapsed Time vs. Dial Reading



Sqrt. of Elapsed Time vs Dial Reading

T0 = 0 min.	D0 = 701.8 div.
T90 = 0.624 min	D90 = 719.1 div.
T100 = NA min	D100 = 721 div.
Height at: D90 = 0.9338, D100 = 0.9337	
Average Sample Height, in	0.9345
Average Drainage Height, in	0.4673
T (Time Factor for T90)	0.848
Coef. of Consol., C_v, in^2/min	0.296

Log of Elapsed Time vs Dial Reading

T0 = 0 min.	D0 = 702.5 div.
T50 = 2.43 min.	D50 = 727.9 div.
T100 = 28.53 min.	D100 = 753.4 div.
Height at: D50 = 0.933, D100 = 0.9304	
Average Sample Height, in	0.9345
Average Drainage Height, in	0.4673
T (Time Factor for T50)	0.197
Coef. of Consol., C_v, in^2/min	0.018

Load Summary

Initial Sample Height, in	0.9400
Initial Sample Void Ratio	0.4825
Final Sample Height, in	0.9291
Final Sample Void Ratio	0.4654
Incremental Strain, %	1.15%
Loading Duration, min	301.93333

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ONE-DIMENSIONAL CONSOLIDATION PROPERTIES OF SOILS
ASTM D 2435

Client	Civil & Environmental Consultant	Boring	RB-3	**Test Load, tsf**	**4-8**
Client Project	091-867 Apex Landfill Expansion	Depth	20'-24'		Load 12 of 13
Project No.	30598	Sample	B-1		
		Lab ID#	30598026		

Visual Description: Dark Gray Sandy Clay

Test Conditions: Remolded, Inundated, and Double Drained

Time Vs. Dial Reading

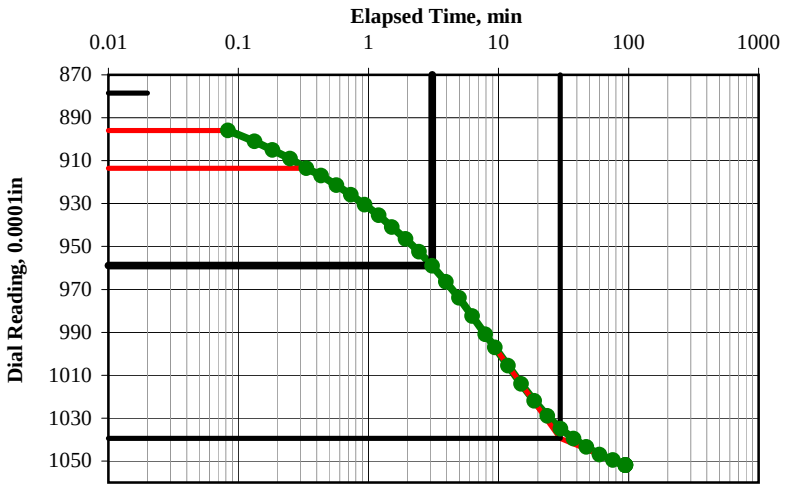
Elapsed Time (min)	Sqrt Time ($min^{1/2}$)	Dial Reading (0.0001in)	Sample Height (in)	Void Ratio
0	0	766.5	0.9291	0.4654
Corrections*		-10	-0.001	-0.0016
Adjusted Sample Height & Void Ratio				
0.08	0.29	896.0	0.9172	0.4465
0.13	0.37	901.0	0.9167	0.4457
0.18	0.43	905.0	0.9163	0.4451
0.25	0.50	909.0	0.9159	0.4445
0.33	0.58	913.5	0.9154	0.4438
0.43	0.66	917.0	0.9151	0.4432
0.57	0.75	921.5	0.9146	0.4425
0.73	0.86	926.0	0.9142	0.4418
0.93	0.97	930.5	0.9137	0.4411
1.20	1.10	935.5	0.9132	0.4403
1.52	1.23	941.0	0.9127	0.4394
1.93	1.39	946.5	0.9121	0.4385
2.45	1.57	952.5	0.9115	0.4376
3.10	1.76	959.0	0.9109	0.4366
3.93	1.98	966.5	0.9101	0.4354
4.97	2.23	974.0	0.9094	0.4342
6.28	2.51	982.5	0.9085	0.4329
7.93	2.82	991.0	0.9077	0.4315
9.38	3.06	997.0	0.9071	0.4306
11.83	3.44	1005.5	0.9062	0.4292
14.93	3.86	1014.0	0.9054	0.4279
18.83	4.34	1022.0	0.9046	0.4266
23.75	4.87	1029.0	0.9039	0.4255
29.93	5.47	1035.0	0.9033	0.4246
37.73	6.14	1039.5	0.9028	0.4239
47.55	6.90	1043.5	0.9024	0.4233
59.93	7.74	1047.0	0.9021	0.4227
75.93	8.71	1049.5	0.9018	0.4223
94.93	9.74	1052.0	0.9016	0.4219

Machine Deflection

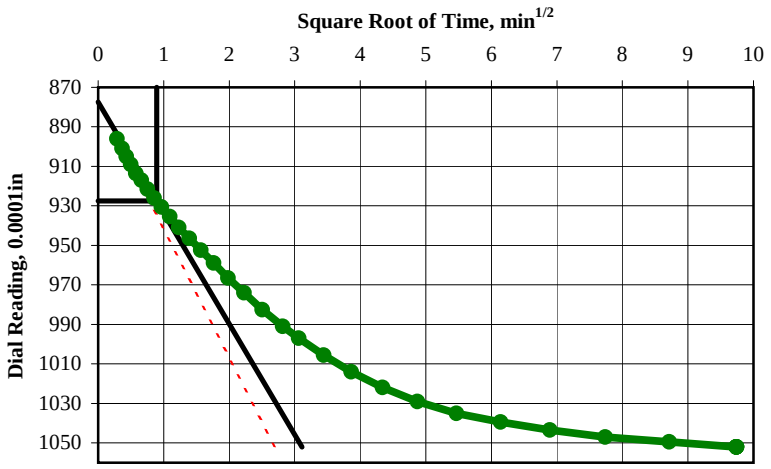
Applied Deflection Correction to Sample Height, 0.0001in: -10

**Correction is applied to all dial readings.*

Log of Elapsed Time vs. Dial Reading



Square Root of Elapsed Time vs. Dial Reading



Sqrt. of Elapsed Time vs Dial Reading

T0 = 0 min.	D0 = 877.4 div.		
T90 = 0.792 min	D90 = 927.5 div.		
T100 = NA min	D100 = 933.1 div.		
Height at: D90 = 0.914, D100 = 0.9134			
Average Sample Height, in	0.9153		
Average Drainage Height, in	0.4577		
T (Time Factor for T90)	0.848		
Coef. of Consol., C_v, in^2/min	0.223		

Log of Elapsed Time vs Dial Reading

T0 = 0 min.	D0 = 878.5 div.		
T50 = 3.09 min.	D50 = 958.9 div.		
T100 = 29.8 min.	D100 = 1039.3 div.		
Height at: D50 = 0.9109, D100 = 0.9028			
Average Sample Height, in	0.9153		
Average Drainage Height, in	0.4577		
T (Time Factor for T50)	0.197		
Coef. of Consol., C_v, in^2/min	0.013		

Load Summary

Initial Sample Height, in	0.9291
Initial Sample Void Ratio	0.4654
Final Sample Height, in	0.9016
Final Sample Void Ratio	0.4219
Incremental Strain, %	2.97%
Loading Duration, min	94.933333

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ONE-DIMENSIONAL CONSOLIDATION PROPERTIES OF SOILS
ASTM D 2435

Client	Civil & Environmental Consultant	Boring	RB-3	**Test Load, tsf**	**8-16**
Client Project	091-867 Apex Landfill Expansion	Depth	20'-24'		Load 13 of 13
Project No.	30598	Sample	B-1		
		Lab ID#	30598026		

Visual Description: Dark Gray Sandy Clay

Test Conditions: Remolded, Inundated, and Double Drained

Time Vs. Dial Reading

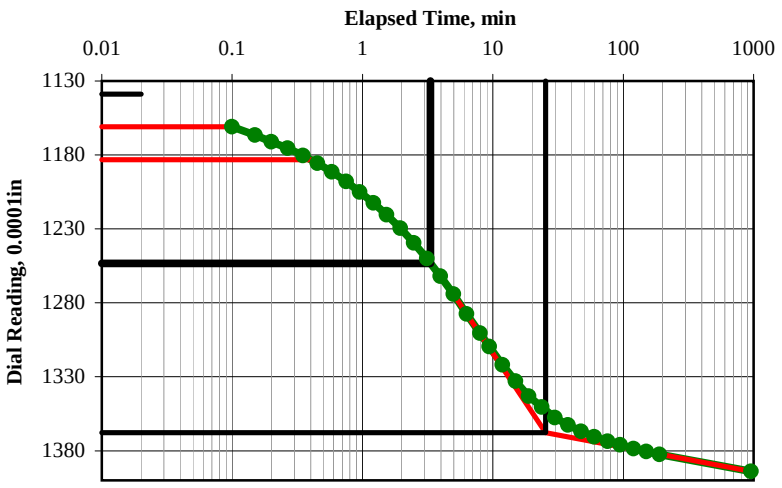
Elapsed Time (min)	Sqrt Time ($min^{1/2}$)	Dial Reading (0.0001in)	Sample Height (in)	Void Ratio
0	0	1052.0	0.9016	0.4219
Corrections*		-13.5	-0.00135	-0.0021
Adjusted Sample Height & Void Ratio				
0.10	0.32	1161.0	0.8920	0.4068
0.15	0.39	1166.5	0.8915	0.4060
0.20	0.45	1171.0	0.8910	0.4053
0.27	0.52	1175.5	0.8906	0.4046
0.35	0.59	1180.5	0.8901	0.4038
0.45	0.67	1185.5	0.8896	0.4030
0.58	0.76	1191.5	0.8890	0.4020
0.75	0.87	1198.0	0.8883	0.4010
0.95	0.97	1205.0	0.8876	0.3999
1.22	1.10	1212.5	0.8869	0.3987
1.53	1.24	1220.5	0.8861	0.3975
1.95	1.40	1229.5	0.8852	0.3960
2.47	1.57	1239.5	0.8842	0.3945
3.12	1.77	1250.0	0.8831	0.3928
3.95	1.99	1262.0	0.8819	0.3909
4.98	2.23	1274.0	0.8807	0.3890
6.30	2.51	1287.5	0.8794	0.3869
7.95	2.82	1300.5	0.8781	0.3848
9.40	3.07	1309.5	0.8772	0.3834
11.85	3.44	1322.0	0.8759	0.3815
14.95	3.87	1333.0	0.8748	0.3797
18.85	4.34	1343.0	0.8738	0.3781
23.77	4.88	1350.5	0.8731	0.3770
29.95	5.47	1357.5	0.8724	0.3759
37.75	6.14	1362.5	0.8719	0.3751
47.57	6.90	1367.0	0.8714	0.3744
59.95	7.74	1370.5	0.8711	0.3738
75.95	8.71	1373.5	0.8708	0.3733
94.95	9.74	1376.0	0.8705	0.3729
119.95	10.95	1378.5	0.8703	0.3725
150.95	12.29	1380.5	0.8701	0.3722
189.95	13.78	1382.5	0.8699	0.3719
954.95	30.90	1394.0	0.8687	0.3701

Machine Deflection

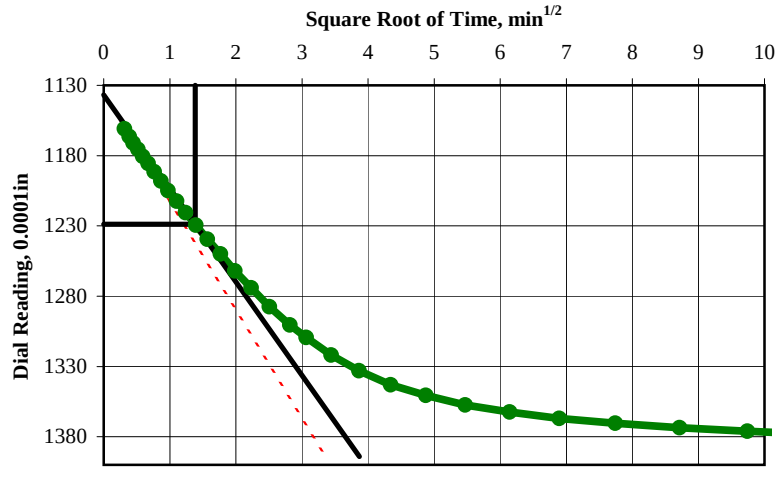
Applied Deflection Correction to Sample Height, 0.0001in: -13.5

**Correction is applied to all dial readings.*

Log of Elapsed Time vs. Dial Reading



Square Root of Elapsed Time vs. Dial Reading



Sqrt. of Elapsed Time vs Dial Reading

T0 = 0 min.	D0 = 1136.9 div.
T90 = 1.904 min	D90 = 1228.8 div.
T100 = NA min	D100 = 1239 div.
Height at: D90 = 0.8852, D100 = 0.8842	
Average Sample Height, in	0.8851
Average Drainage Height, in	0.4426
T (Time Factor for T90)	0.848
Coef. of Consol., C_v, in^2/min	0.087

Log of Elapsed Time vs Dial Reading

T0 = 0 min.	D0 = 1138.8 div.
T50 = 3.33 min.	D50 = 1253.3 div.
T100 = 25.38 min.	D100 = 1367.7 div.
Height at: D50 = 0.8828, D100 = 0.8713	
Average Sample Height, in	0.8851
Average Drainage Height, in	0.4426
T (Time Factor for T50)	0.197
Coef. of Consol., C_v, in^2/min	0.012

Load Summary

Initial Sample Height, in	0.9016
Initial Sample Void Ratio	0.4219
Final Sample Height, in	0.8687
Final Sample Void Ratio	0.3701
Incremental Strain, %	3.64%
Loading Duration, min	954.95

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ONE-DIMENSIONAL CONSOLIDATION PROPERTIES OF SOILS
ASTM D 2435

Client	Civil & Environmental Consultant	Boring	RB-4
Client Project	091-867 Apex Landfill Expansion	Depth	19'-24'
Project No.	30598	Sample	B-1
		Lab Sample No.	30598027

Visual Description: Olive Brown Lean Clay with Sand
Sample Conditions: Remolded, Inundated, and Double Drained
Machine Deflection Correction: Applied

SAMPLE PROPERTIES		
	Initial	Final
Tare Number	Z13	F5
Wt. Tare & WS, gm	174.68	266.37
Wt. Tare & DS, gm	164.74	244.32
Wt. Tare, gm	122.8	123.16
Water Content, %	23.7%	18.2%
Sample Diameter, in	2.5	2.5
Sample Height, in	1.008	0.8416
Sample Volume, in^3	4.9468	4.1313
Wt. WS + Ring, gm	260.73	254.34
Wt. of Ring, gm	110.92	110.92
Wt. of WS, gm	149.81	143.42
Wet Density, pcf	115.32	132.19
Wet Density, g/cc	1.848	2.118
Water Content, %	23.7%	18.2%
Wt. of DS, gm	121.11	121.34
Dry Density, pcf	93.22	111.84
Dry Density, g/cc	1.494	1.792
Void Ratio, e	0.7135	0.4283
Saturation, %	85.0%	
Specific Gravity	2.56	Measured
Height of Solids, in	0.5881	0.5881

TEST DATA SUMMARY

Applied Pressure tsf	Load Duration min	Final Height in	Vertical Strain %	Dry Density g/cc	Void Ratio e	a_v ft^2/ton	Incremental C_c	Incremental C_r
Seating	NA	1.0078	0.00	1.4940	0.7135	NA	NA	NA
0.25	60	1.0044	0.34%	1.4990	0.7078	2.31E-02	NA	NA
0.5	758	0.9938	1.39%	1.5150	0.6898	7.21E-02	0.060	NA
1	380	0.9676	3.98%	1.5559	0.6454	8.88E-02	0.148	NA
2	955	0.9360	7.12%	1.6085	0.5916	5.38E-02	0.179	NA
4	240	0.9050	10.20%	1.6636	0.5388	2.64E-02	0.175	NA
1	302	0.9121	9.49%	1.6506	0.5510	4.05E-03	NA	NA
0.25	955	0.9248	8.23%	1.6279	0.5726	2.88E-02	NA	NA
0.5	380	0.9237	8.34%	1.6299	0.5707	7.55E-03	NA	0.006
1	955	0.9201	8.70%	1.6363	0.5645	1.23E-02	NA	0.020
2	190	0.9131	9.39%	1.6488	0.5526	1.19E-02	NA	0.040
4	190	0.9011	10.58%	1.6708	0.5322	1.02E-02	NA	0.068
8	955	0.8717	13.50%	1.7272	0.4822	1.25E-02	0.166	NA
16	240	0.8416	16.49%	1.7889	0.4311	6.39E-03	0.170	NA

Note: The calculations performed and the parameters presented herein are for preliminary purposes only. GTS only accepts responsibility for the raw data obtained from the consolidation tests. This data may be interpreted differently by others. It is the responsibility of the user to determine the appropriateness and accuracy of the computed values.

Input Validation | Reviewed By: | Date Tested: 12/20/2010 |

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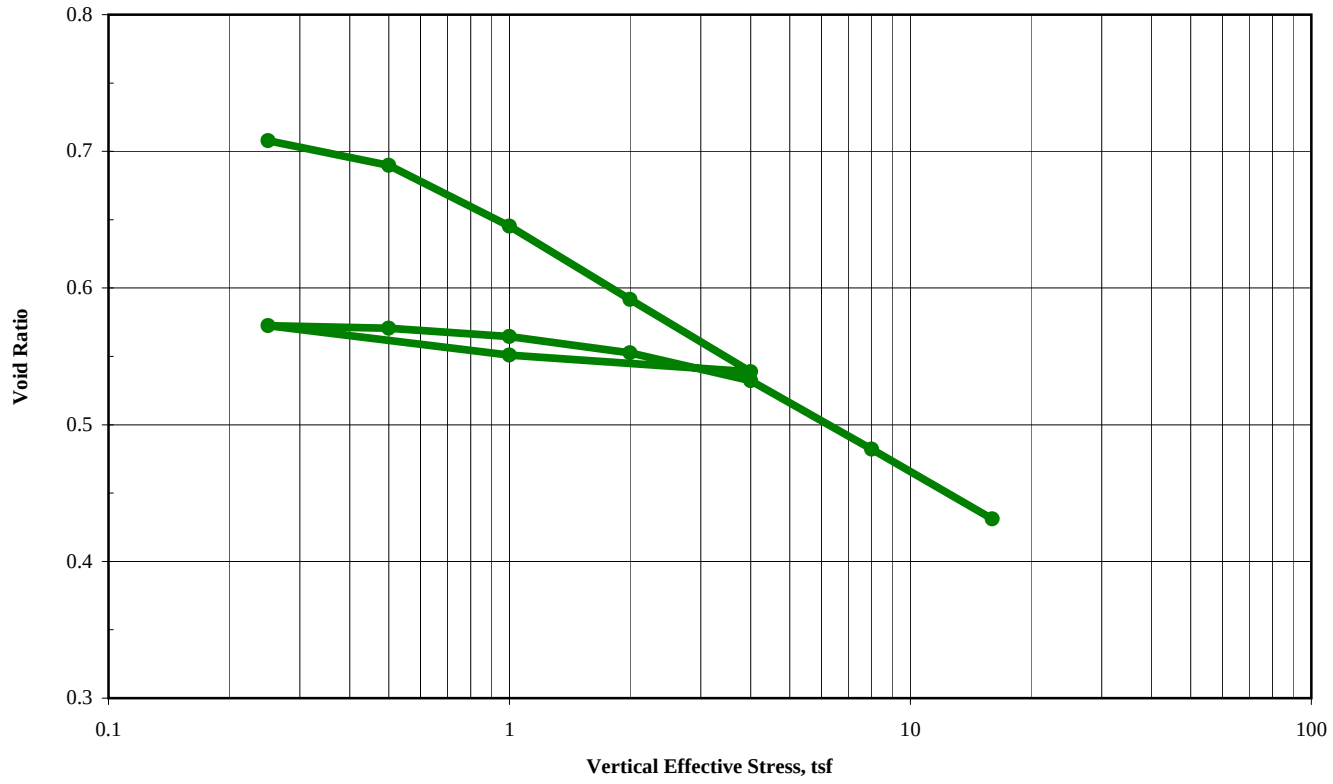
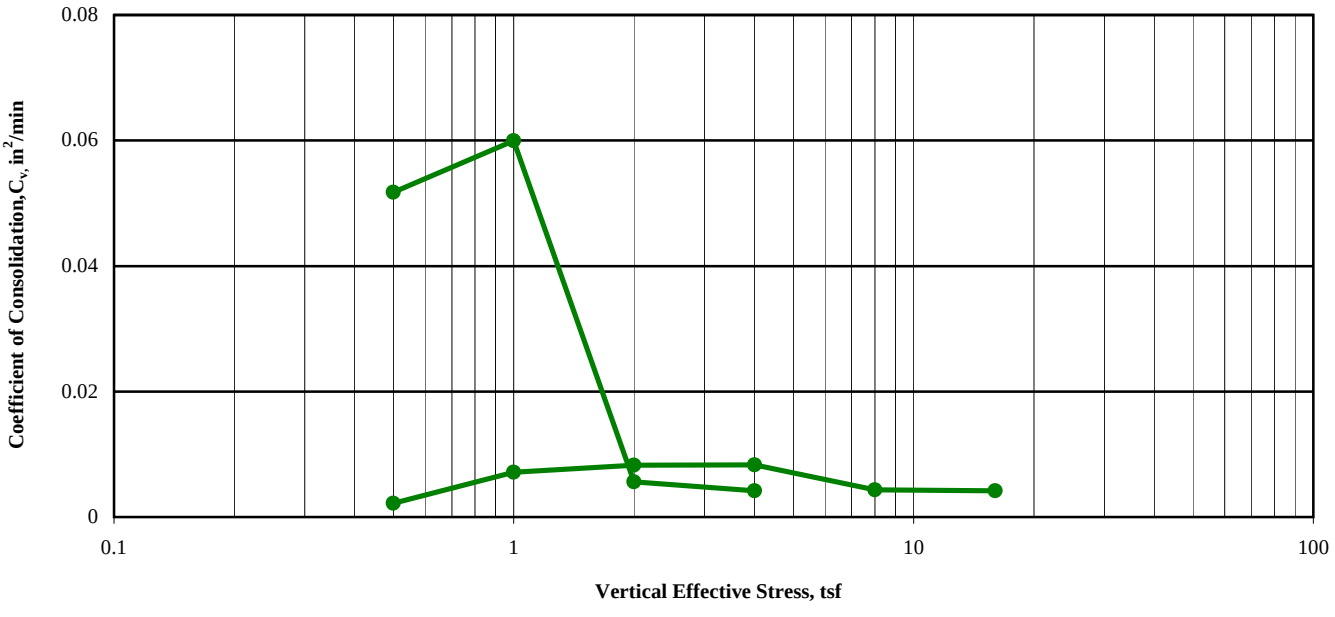
ONE-DIMENSIONAL CONSOLIDATION PROPERTIES OF SOILS
ASTM D 2435

Client	Civil & Environmental Consultants, Inc.	Boring	RB-4
Client Project	091-867 Apex Landfill Expansion	Depth	19'-24'
Project No.	30598	Sample	B-1
		Lab Sample No.	30598027
Visual Description	Olive Brown Lean Clay with Sand		
Sample Conditions	Remolded, Inundated, and Double Drained		
Machine Deflection Correction:	Applied		

Void Ratio (Final Height) vs Vertical Effective Consolidation Stress



Coeffieicent of Consolidation (log. method) vs. Vertical Effective Consolidation Stress



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ONE-DIMENSIONAL CONSOLIDATION PROPERTIES OF SOILS
ASTM D 2435

Client	Civil & Environmental Consultant	Boring	RB-4	**Test Load, tsf**	**0-0.25**
Client Project	091-867 Apex Landfill Expansion	Depth	19'-24'		Load 1 of 13
Project No.	30598	Sample	B-1		
		Lab ID#	30598027		
Visual Description	Olive Brown Lean Clay with Sand				
Test Conditions:	Remolded, Inundated, and Double Drained				

Time Vs. Dial Reading

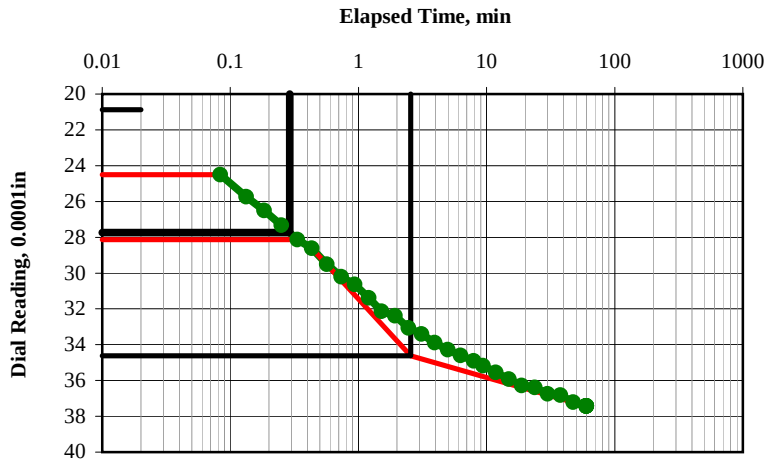
Elapsed Time (min)	Sqrt Time ($min^{1/2}$)	Dial Reading (0.0001in)	Sample Height (in)	Void Ratio
0	0	0	1.0078	0.7135
Corrections*		-3.5	-0.00035	-0.0006
Adjusted Sample Height & Void Ratio				
0.08	0.29	24.5	1.0056	0.7100
0.13	0.37	25.7	1.0055	0.7098
0.18	0.43	26.5	1.0054	0.7096
0.25	0.50	27.3	1.0054	0.7095
0.33	0.58	28.1	1.0053	0.7094
0.43	0.66	28.6	1.0052	0.7093
0.57	0.75	29.5	1.0051	0.7091
0.73	0.86	30.2	1.0051	0.7090
0.93	0.97	30.6	1.0050	0.7089
1.20	1.10	31.4	1.0050	0.7088
1.52	1.23	32.1	1.0049	0.7087
1.93	1.39	32.4	1.0049	0.7086
2.45	1.57	33.1	1.0048	0.7085
3.10	1.76	33.4	1.0048	0.7085
3.93	1.98	33.9	1.0047	0.7084
4.97	2.23	34.3	1.0047	0.7083
6.28	2.51	34.6	1.0046	0.7083
7.93	2.82	34.9	1.0046	0.7082
9.38	3.06	35.2	1.0046	0.7082
11.83	3.44	35.6	1.0045	0.7081
14.93	3.86	35.9	1.0045	0.7080
18.83	4.34	36.3	1.0045	0.7080
23.75	4.87	36.4	1.0045	0.7079
29.93	5.47	36.8	1.0044	0.7079
37.73	6.14	36.8	1.0044	0.7079
47.55	6.90	37.2	1.0044	0.7078
59.93	7.74	37.4	1.0044	0.7078

Machine Deflection

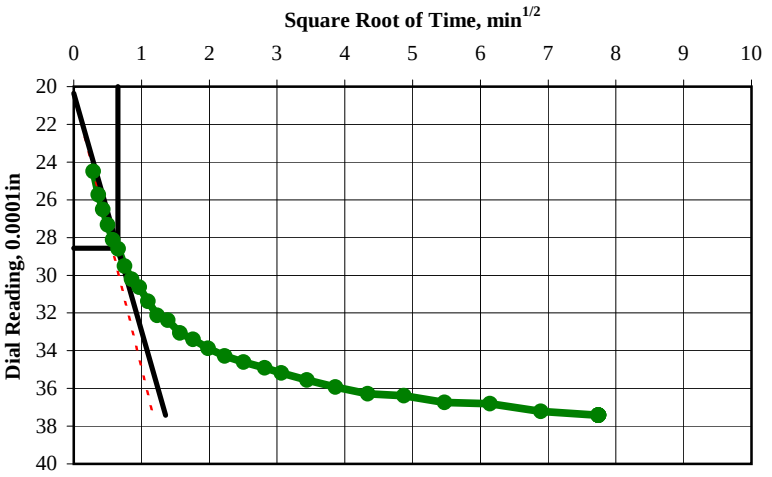
Applied Deflection Correction to Sample Height, 0.0001in -3.5

**Correction is applied to all dial readings.*

Log of Elapsed Time vs. Dial Reading



Square Root of Elapsed Time vs. Dial Reading



Sqrt. of Elapsed Time vs Dial Reading

T0 = 0 min.	D0 = 20.4 div.		
T90 = 0.423 min	D90 = 28.6 div.		
T100 = NA min	D100 = 29.5 div.		
Height at: D90 = 1.0052, D100 = 1.0052			
Average Sample Height, in	1.0061		
Average Drainage Height, in	0.5030		
T (Time Factor for T90)	0.848		
Coef. of Consol., C_v, in^2/min	0.506		

Log of Elapsed Time vs Dial Reading

T0 = 0 min.	D0 = 20.9 div.		
T50 = 0.29 min.	D50 = 27.7 div.		
T100 = 2.56 min.	D100 = 34.6 div.		
Height at: D50 = 1.0053, D100 = 1.0046			
Average Sample Height, in	1.0061		
Average Drainage Height, in	0.5030		
T (Time Factor for T50)	0.197		
Coef. of Consol., C_v, in^2/min	0.172		

Load Summary

Initial Sample Height, in	1.0078
Initial Sample Void Ratio	0.7135
Final Sample Height, in	1.0044
Final Sample Void Ratio	0.7078
Incremental Strain, %	0.34%
Loading Duration, min	59.933333

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ONE-DIMENSIONAL CONSOLIDATION PROPERTIES OF SOILS
ASTM D 2435

Client	Civil & Environmental Consultant	Boring	RB-4	**Test Load, tsf**	**0.25-0.5**
Client Project	091-867 Apex Landfill Expansion	Depth	19'-24'		Load 2 of 13
Project No.	30598	Sample	B-1		
		Lab ID#	30598027		
Visual Description	Olive Brown Lean Clay with Sand				
Test Conditions:	Remolded, Inundated, and Double Drained				

Time Vs. Dial Reading

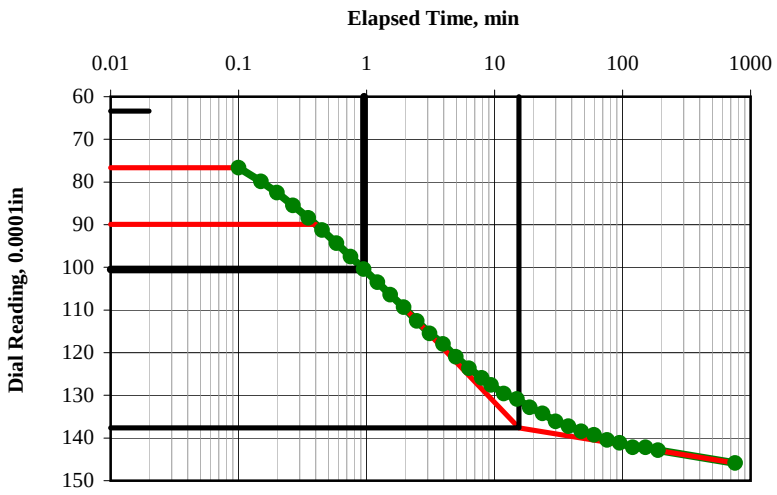
Elapsed Time (min)	Sqrt Time ($min^{1/2}$)	Dial Reading (0.0001in)	Sample Height (in)	Void Ratio
0	0	37.4	1.0044	0.7078
Corrections*		-2.5	-0.00025	-0.0004
Adjusted Sample Height & Void Ratio				
0.10	0.32	76.7	1.0007	0.7015
0.15	0.39	79.9	1.0004	0.7010
0.20	0.45	82.5	1.0001	0.7005
0.27	0.52	85.5	0.9998	0.7000
0.35	0.59	88.4	0.9995	0.6995
0.45	0.67	91.3	0.9992	0.6990
0.58	0.76	94.3	0.9989	0.6985
0.75	0.87	97.5	0.9986	0.6980
0.95	0.97	100.4	0.9983	0.6975
1.22	1.10	103.5	0.9980	0.6970
1.53	1.24	106.4	0.9977	0.6965
1.95	1.40	109.4	0.9974	0.6960
2.47	1.57	112.6	0.9971	0.6954
3.12	1.77	115.5	0.9968	0.6949
3.95	1.99	118.0	0.9966	0.6945
4.98	2.23	121.0	0.9963	0.6940
6.30	2.51	123.7	0.9960	0.6935
7.95	2.82	125.9	0.9958	0.6932
9.40	3.07	127.6	0.9956	0.6929
11.85	3.44	129.6	0.9954	0.6925
14.95	3.87	130.9	0.9953	0.6923
18.85	4.34	132.8	0.9951	0.6920
23.77	4.88	134.2	0.9949	0.6917
29.95	5.47	136.1	0.9947	0.6914
37.75	6.14	137.2	0.9946	0.6912
47.57	6.90	138.5	0.9945	0.6910
59.95	7.74	139.3	0.9944	0.6909
75.95	8.71	140.5	0.9943	0.6907
94.95	9.74	141.2	0.9942	0.6906
119.95	10.95	142.2	0.9941	0.6904
150.95	12.29	142.2	0.9941	0.6904
189.95	13.78	142.9	0.9941	0.6903
757.95	27.53	145.9	0.9938	0.6898

Machine Deflection

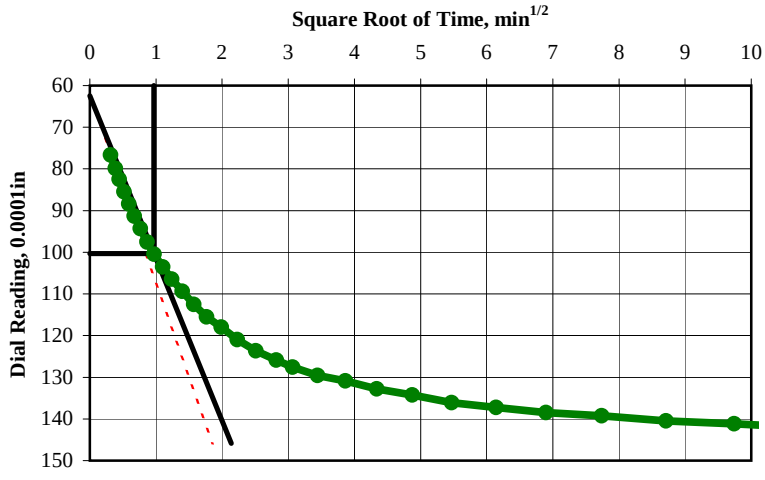
Applied Deflection Correction to Sample Height, 0.0001in -2.5

**Correction is applied to all dial readings.*

Log of Elapsed Time vs. Dial Reading



Square Root of Elapsed Time vs. Dial Reading



Sqrt. of Elapsed Time vs Dial Reading

T0 = 0 min.	D0 = 62.5 div.		
T90 = 0.941 min	D90 = 100.3 div.		
T100 = NA min	D100 = 104.5 div.		
Height at: D90 = 0.9983, D100 = 0.9979			
Average Sample Height, in	0.9991		
Average Drainage Height, in	0.4995		
T (Time Factor for T90)	0.848		
Coef. of Consol., C_v, in^2/min	0.225		

Log of Elapsed Time vs Dial Reading

T0 = 0 min.	D0 = 63.4 div.		
T50 = 0.95 min.	D50 = 100.5 div.		
T100 = 15.52 min.	D100 = 137.6 div.		
Height at: D50 = 0.9983, D100 = 0.9946			
Average Sample Height, in	0.9991		
Average Drainage Height, in	0.4995		
T (Time Factor for T50)	0.197		
Coef. of Consol., C_v, in^2/min	0.052		

Load Summary

Initial Sample Height, in	1.0044
Initial Sample Void Ratio	0.7078
Final Sample Height, in	0.9938
Final Sample Void Ratio	0.6898
Incremental Strain, %	1.05%
Loading Duration, min	757.95

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ONE-DIMENSIONAL CONSOLIDATION PROPERTIES OF SOILS
ASTM D 2435

Client	Civil & Environmental Consultant	Boring	RB-4	**Test Load, tsf**	**0.5-1**
Client Project	091-867 Apex Landfill Expansion	Depth	19'-24'		Load 3 of 13
Project No.	30598	Sample	B-1		
		Lab ID#	30598027		
Visual Description	Olive Brown Lean Clay with Sand				
Test Conditions:	Remolded, Inundated, and Double Drained				

Time Vs. Dial Reading

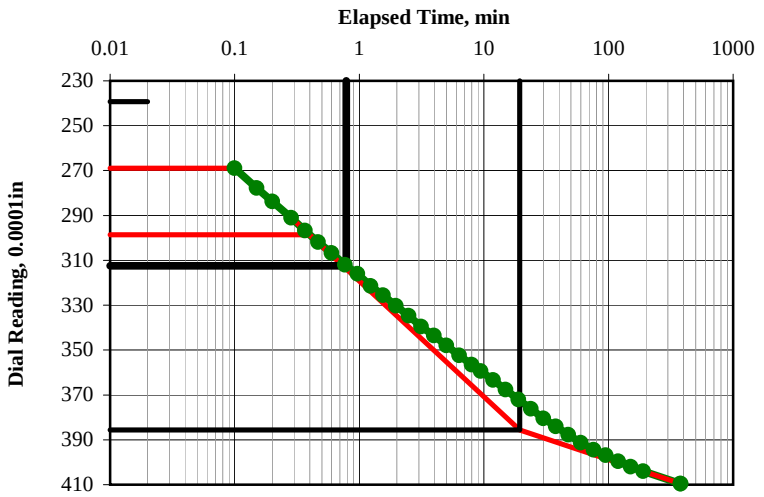
Elapsed Time (min)	Sqrt Time ($min^{1/2}$)	Dial Reading (0.0001in)	Sample Height (in)	Void Ratio
0	0	145.9	0.9938	0.6898
Corrections*		-2.5	-0.00025	-0.0004
Adjusted Sample Height & Void Ratio				
0.10	0.32	268.9	0.9817	0.6693
0.15	0.39	277.8	0.9808	0.6677
0.20	0.45	283.8	0.9802	0.6667
0.28	0.53	291.0	0.9795	0.6655
0.37	0.61	296.8	0.9789	0.6645
0.47	0.68	301.9	0.9784	0.6637
0.60	0.77	306.7	0.9779	0.6628
0.77	0.88	312.0	0.9774	0.6619
0.97	0.98	316.0	0.9770	0.6613
1.23	1.11	321.4	0.9765	0.6603
1.55	1.24	325.6	0.9760	0.6596
1.97	1.40	330.3	0.9756	0.6588
2.48	1.58	334.7	0.9751	0.6581
3.13	1.77	339.5	0.9747	0.6573
3.97	1.99	343.5	0.9743	0.6566
5.00	2.24	348.0	0.9738	0.6558
6.32	2.51	352.4	0.9734	0.6551
7.97	2.82	356.5	0.9729	0.6544
9.42	3.07	359.3	0.9727	0.6539
11.87	3.44	363.3	0.9723	0.6532
14.97	3.87	367.6	0.9718	0.6525
18.87	4.34	372.0	0.9714	0.6517
23.78	4.88	376.2	0.9710	0.6510
29.97	5.47	380.5	0.9705	0.6503
37.77	6.15	384.1	0.9702	0.6497
47.58	6.90	387.8	0.9698	0.6490
59.97	7.74	391.3	0.9695	0.6485
75.97	8.72	394.4	0.9692	0.6479
94.97	9.75	396.9	0.9689	0.6475
119.97	10.95	399.6	0.9686	0.6470
150.97	12.29	402.0	0.9684	0.6466
189.97	13.78	404.0	0.9682	0.6463
379.97	19.49	409.5	0.9676	0.6454

Machine Deflection

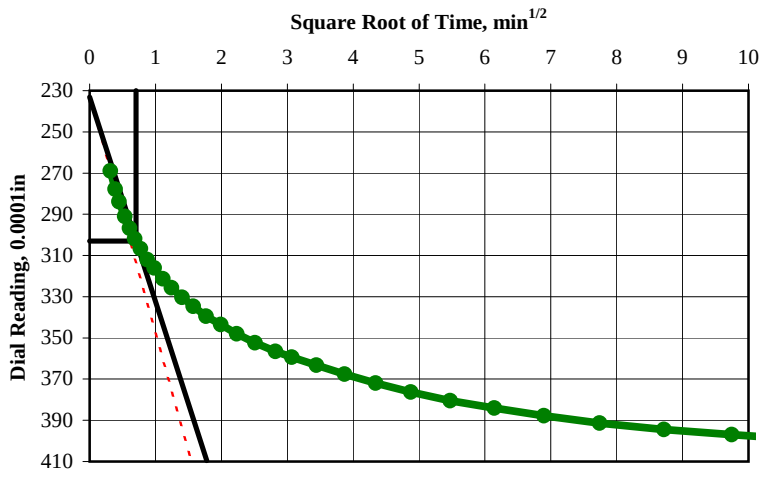
Applied Deflection Correction to Sample Height, 0.0001in -2.5

**Correction is applied to all dial readings.*

Log of Elapsed Time vs. Dial Reading



Square Root of Elapsed Time vs. Dial Reading



Sqrt. of Elapsed Time vs Dial Reading

T0 = 0 min.	D0 = 233.1 div.
T90 = 0.49 min	D90 = 303 div.
T100 = NA min	D100 = 310.7 div.
Height at: D90 = 0.9783, D100 = 0.9775	
Average Sample Height, in	0.9807
Average Drainage Height, in	0.4904
T (Time Factor for T90)	0.848
Coef. of Consol., C_v, in^2/min	0.411

Log of Elapsed Time vs Dial Reading

T0 = 0 min.	D0 = 239.2 div.
T50 = 0.79 min.	D50 = 312.4 div.
T100 = 19.41 min.	D100 = 385.6 div.
Height at: D50 = 0.9774, D100 = 0.97	
Average Sample Height, in	0.9807
Average Drainage Height, in	0.4904
T (Time Factor for T50)	0.197
Coef. of Consol., C_v, in^2/min	0.060

Load Summary

Initial Sample Height, in	0.9938
Initial Sample Void Ratio	0.6898
Final Sample Height, in	0.9676
Final Sample Void Ratio	0.6454
Incremental Strain, %	2.63%
Loading Duration, min	379.96667

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ONE-DIMENSIONAL CONSOLIDATION PROPERTIES OF SOILS
ASTM D 2435

Client	Civil & Environmental Consultant	Boring	RB-4	**Test Load, tsf**	**1-2**
Client Project	091-867 Apex Landfill Expansion	Depth	19'-24'		Load 4 of 13
Project No.	30598	Sample	B-1		
		Lab ID#	30598027		
Visual Description	Olive Brown Lean Clay with Sand				
Test Conditions:	Remolded, Inundated, and Double Drained				

Time Vs. Dial Reading

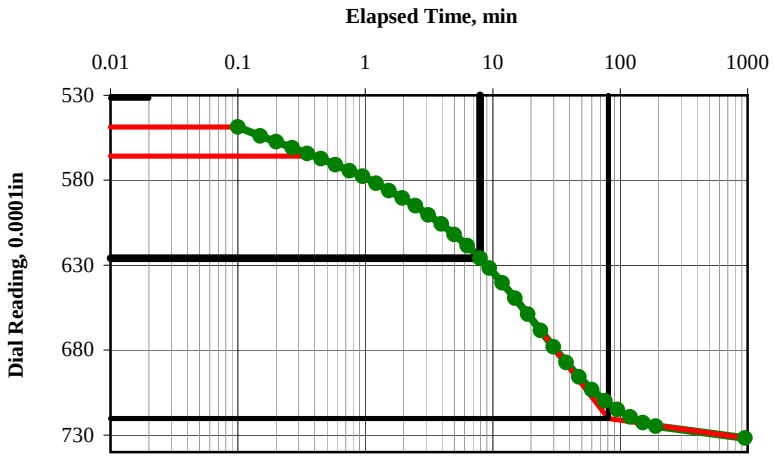
Elapsed Time (min)	Sqrt Time ($min^{1/2}$)	Dial Reading (0.0001in)	Sample Height (in)	Void Ratio
0	0	409.5	0.9676	0.6454
Corrections*		-6	-0.0006	-0.001
Adjusted Sample Height & Void Ratio				
0.10	0.32	548.7	0.9543	0.6227
0.15	0.39	553.9	0.9538	0.6218
0.20	0.45	557.3	0.9535	0.6213
0.27	0.52	560.9	0.9531	0.6206
0.35	0.59	564.2	0.9528	0.6201
0.45	0.67	567.3	0.9525	0.6195
0.58	0.76	570.9	0.9521	0.6189
0.75	0.87	574.4	0.9518	0.6183
0.95	0.97	577.7	0.9514	0.6178
1.22	1.10	581.8	0.9510	0.6171
1.53	1.24	586.1	0.9506	0.6164
1.95	1.40	590.4	0.9502	0.6156
2.47	1.57	595.1	0.9497	0.6148
3.12	1.77	600.4	0.9492	0.6139
3.95	1.99	605.7	0.9486	0.6130
4.98	2.23	611.9	0.9480	0.6120
6.30	2.51	618.5	0.9474	0.6108
7.95	2.82	626.0	0.9466	0.6096
9.40	3.07	631.7	0.9460	0.6086
11.85	3.44	640.3	0.9452	0.6071
14.95	3.87	649.4	0.9443	0.6056
18.85	4.34	658.9	0.9433	0.6040
23.77	4.88	668.3	0.9424	0.6024
29.95	5.47	678.1	0.9414	0.6007
37.75	6.14	687.2	0.9405	0.5992
47.57	6.90	695.7	0.9396	0.5977
59.95	7.74	703.3	0.9389	0.5964
75.95	8.71	709.9	0.9382	0.5953
94.95	9.74	714.9	0.9377	0.5944
119.95	10.95	719.3	0.9373	0.5937
150.95	12.29	722.7	0.9369	0.5931
189.95	13.78	724.7	0.9367	0.5928
954.95	30.90	731.7	0.9360	0.5916

Machine Deflection

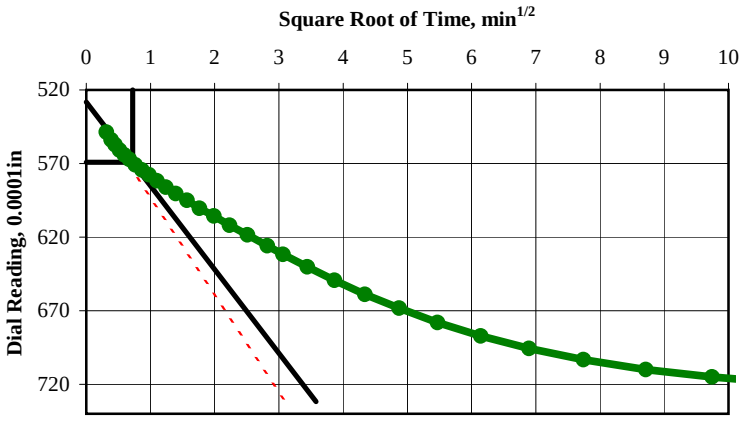
Applied Deflection Correction to Sample Height, 0.0001in -6

**Correction is applied to all dial readings.*

Log of Elapsed Time vs. Dial Reading



Square Root of Elapsed Time vs. Dial Reading



Sqrt. of Elapsed Time vs Dial Reading

T0 = 0 min.	D0 = 528.2 div.		
T90 = 0.518 min	D90 = 569.2 div.		
T100 = NA min	D100 = 573.8 div.		
Height at: D90 = 0.9523, D100 = 0.9518			
Average Sample Height, in	0.9518		
Average Drainage Height, in	0.4759		
T (Time Factor for T90)	0.848		
Coef. of Consol., C_v, in^2/min	0.370		

Log of Elapsed Time vs Dial Reading

T0 = 0 min.	D0 = 531.6 div.		
T50 = 7.94 min.	D50 = 625.9 div.		
T100 = 80.83 min.	D100 = 720.2 div.		
Height at: D50 = 0.9466, D100 = 0.9372			
Average Sample Height, in	0.9518		
Average Drainage Height, in	0.4759		
T (Time Factor for T50)	0.197		
Coef. of Consol., C_v, in^2/min	0.006		

Load Summary

Initial Sample Height, in	0.9676
Initial Sample Void Ratio	0.6454
Final Sample Height, in	0.9360
Final Sample Void Ratio	0.5916
Incremental Strain, %	3.27%
Loading Duration, min	954.95

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ONE-DIMENSIONAL CONSOLIDATION PROPERTIES OF SOILS
ASTM D 2435

Client	Civil & Environmental Consultant	Boring	RB-4	**Test Load, tsf**	**2-4**
Client Project	091-867 Apex Landfill Expansion	Depth	19'-24'		Load 5 of 13
Project No.	30598	Sample	B-1		
		Lab ID#	30598027		
Visual Description	Olive Brown Lean Clay with Sand				
Test Conditions:	Remolded, Inundated, and Double Drained				

Time Vs. Dial Reading

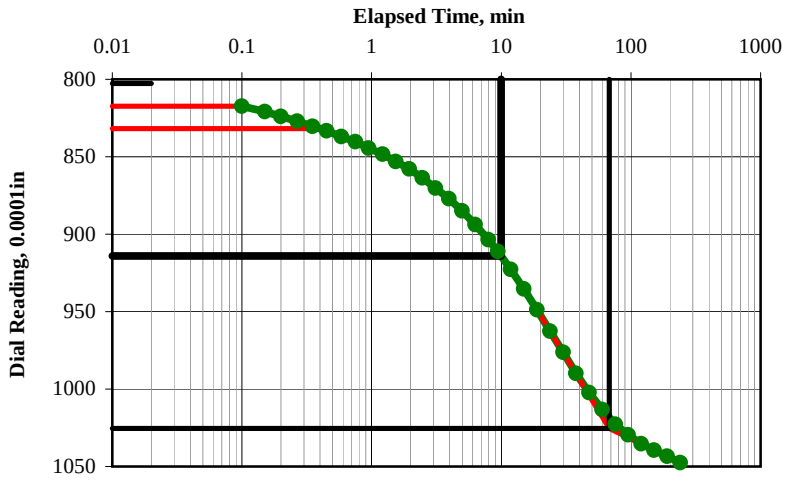
Elapsed Time (min)	Sqrt Time ($min^{1/2}$)	Dial Reading (0.0001in)	Sample Height (in)	Void Ratio
0	0	731.7	0.9360	0.5916
Corrections*		-5.5	-0.00055	-0.0009
Adjusted Sample Height & Void Ratio				
0.10	0.32	817.3	0.9280	0.5780
0.15	0.39	820.9	0.9277	0.5774
0.20	0.45	824.1	0.9273	0.5768
0.27	0.52	827.2	0.9270	0.5763
0.35	0.59	830.3	0.9267	0.5758
0.45	0.67	833.2	0.9264	0.5753
0.58	0.76	836.9	0.9261	0.5746
0.75	0.87	840.3	0.9257	0.5741
0.95	0.97	844.3	0.9253	0.5734
1.22	1.10	848.4	0.9249	0.5727
1.53	1.24	853.1	0.9244	0.5719
1.95	1.40	857.9	0.9240	0.5711
2.47	1.57	863.6	0.9234	0.5701
3.12	1.77	870.2	0.9227	0.5690
3.95	1.99	877.1	0.9220	0.5678
4.98	2.23	884.9	0.9213	0.5665
6.30	2.51	893.7	0.9204	0.5650
7.95	2.82	903.6	0.9194	0.5633
9.40	3.07	911.2	0.9186	0.5620
11.85	3.44	922.7	0.9175	0.5600
14.95	3.87	935.3	0.9162	0.5579
18.85	4.34	948.7	0.9149	0.5556
23.77	4.88	962.6	0.9135	0.5533
29.95	5.47	976.3	0.9121	0.5509
37.75	6.14	989.9	0.9108	0.5486
47.57	6.90	1002.3	0.9095	0.5465
59.95	7.74	1013.2	0.9084	0.5447
75.95	8.71	1022.7	0.9075	0.5431
94.95	9.74	1029.5	0.9068	0.5419
119.95	10.95	1035.3	0.9062	0.5409
150.95	12.29	1039.4	0.9058	0.5402
189.95	13.78	1043.5	0.9054	0.5395
239.95	15.49	1047.5	0.9050	0.5388

Machine Deflection

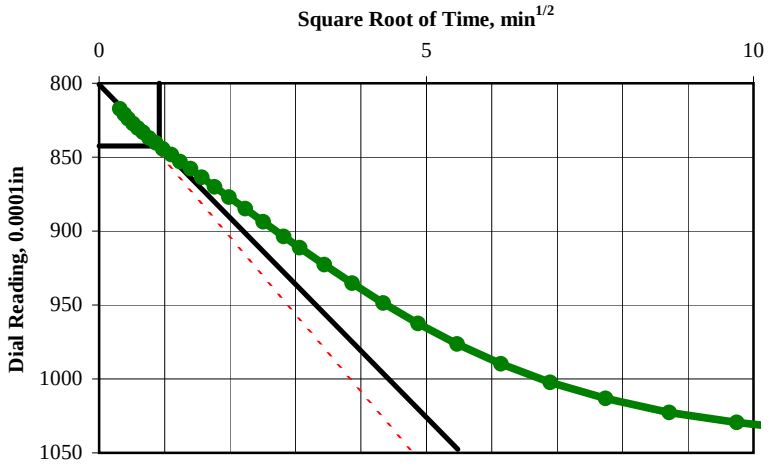
Applied Deflection Correction to Sample Height, 0.0001in -5.5

**Correction is applied to all dial readings.*

Log of Elapsed Time vs. Dial Reading



Square Root of Elapsed Time vs. Dial Reading



Sqrt. of Elapsed Time vs Dial Reading

T0 = 0 min.	D0 = 800.9 div.
T90 = 0.846 min	D90 = 842.3 div.
T100 = NA min	D100 = 846.9 div.
Height at: D90 = 0.9255, D100 = 0.9251	
Average Sample Height, in	0.9205
Average Drainage Height, in	0.4603
T (Time Factor for T90)	0.848
Coef. of Consol., C_v, in^2/min	0.212

Log of Elapsed Time vs Dial Reading

T0 = 0 min.	D0 = 802.8 div.
T50 = 9.97 min.	D50 = 914.1 div.
T100 = 68.11 min.	D100 = 1025.5 div.
Height at: D50 = 0.9183, D100 = 0.9072	
Average Sample Height, in	0.9205
Average Drainage Height, in	0.4603
T (Time Factor for T50)	0.197
Coef. of Consol., C_v, in^2/min	0.004

Load Summary

Initial Sample Height, in	0.9360
Initial Sample Void Ratio	0.5916
Final Sample Height, in	0.9050
Final Sample Void Ratio	0.5388
Incremental Strain, %	3.32%
Loading Duration, min	239.95

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ONE-DIMENSIONAL CONSOLIDATION PROPERTIES OF SOILS
ASTM D 2435

Client	Civil & Environmental Consultant	Boring	RB-4	**Test Load, tsf**	**4-1**
Client Project	091-867 Apex Landfill Expansion	Depth	19'-24'		Load 6 of 13
Project No.	30598	Sample	B-1		
		Lab ID#	30598027		
Visual Description	Olive Brown Lean Clay with Sand				
Test Conditions:	Remolded, Inundated, and Double Drained				

Time Vs. Dial Reading

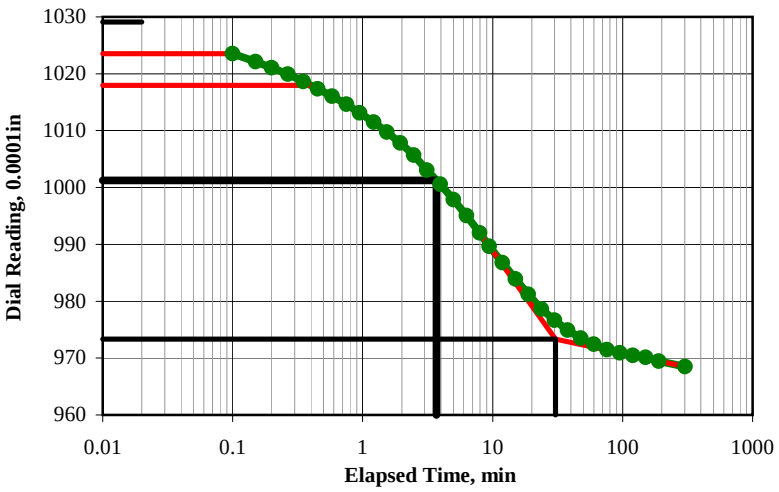
Elapsed Time (min)	Sqrt Time ($min^{1/2}$)	Dial Reading (0.0001in)	Sample Height (in)	Void Ratio
0	0	1047.5	0.9050	0.5388
Corrections*		7.5	0.00075	0.00128
Adjusted Sample Height & Void Ratio				
0.10	0.32	1023.5	0.9066	0.5416
0.15	0.39	1022.1	0.9068	0.5419
0.20	0.45	1021.1	0.9069	0.5421
0.27	0.52	1019.9	0.9070	0.5422
0.35	0.59	1018.6	0.9071	0.5425
0.45	0.67	1017.4	0.9073	0.5427
0.58	0.76	1016.0	0.9074	0.5429
0.75	0.87	1014.6	0.9075	0.5431
0.95	0.97	1013.1	0.9077	0.5434
1.22	1.10	1011.5	0.9079	0.5437
1.53	1.24	1009.8	0.9080	0.5440
1.95	1.40	1007.8	0.9082	0.5443
2.47	1.57	1005.7	0.9084	0.5447
3.12	1.77	1003.1	0.9087	0.5451
3.95	1.99	1000.5	0.9089	0.5455
4.98	2.23	997.9	0.9092	0.5460
6.30	2.51	995.1	0.9095	0.5465
7.95	2.82	992.0	0.9098	0.5470
9.40	3.07	989.7	0.9100	0.5474
11.85	3.44	986.8	0.9103	0.5479
14.95	3.87	983.9	0.9106	0.5484
18.85	4.34	981.2	0.9109	0.5488
23.77	4.88	978.6	0.9111	0.5493
29.95	5.47	976.6	0.9113	0.5496
37.75	6.14	974.9	0.9115	0.5499
47.57	6.90	973.5	0.9116	0.5501
59.95	7.74	972.4	0.9118	0.5503
75.95	8.71	971.5	0.9118	0.5505
94.95	9.74	970.9	0.9119	0.5506
119.95	10.95	970.5	0.9120	0.5507
150.95	12.29	970.1	0.9120	0.5507
189.95	13.78	969.5	0.9121	0.5508
301.95	17.38	968.5	0.9121	0.5510

Machine Deflection

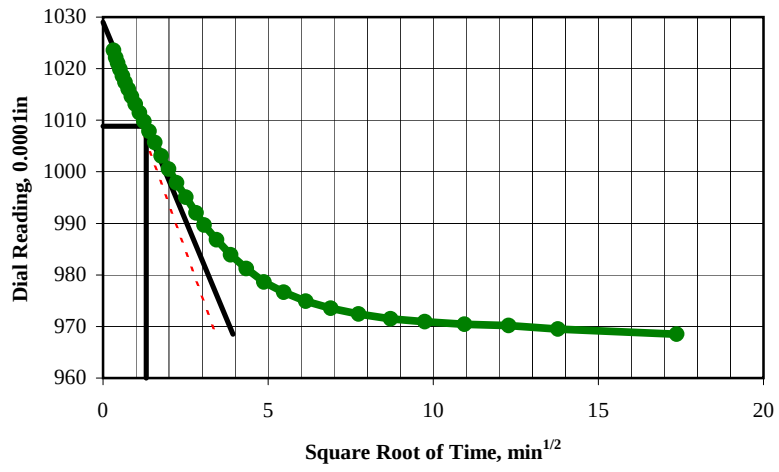
Applied Deflection Correction to Sample Height, 0.0001in 7.5

**Correction is applied to all dial readings.*

Log of Elapsed Time vs. Dial Reading



Square Root of Elapsed Time vs. Dial Reading



Sqrt. of Elapsed Time vs Dial Reading

T0 = 0 min.	D0 = 1029 div.
T90 = 1.716 min	D90 = 1008.8 div.
T100 = NA min	D100 = 1006.6 div.
Height at: D90 = 0.9081, D100 = 0.9083	
Average Sample Height, in	0.9086
Average Drainage Height, in	0.4543
T (Time Factor for T90)	0.848
Coef. of Consol., C_v, in^2/min	0.102

Log of Elapsed Time vs Dial Reading

T0 = 0 min.	D0 = 1029.1 div.
T50 = 3.71 min.	D50 = 1001.2 div.
T100 = 30.47 min.	D100 = 973.4 div.
Height at: D50 = 0.9089, D100 = 0.9117	
Average Sample Height, in	0.9086
Average Drainage Height, in	0.4543
T (Time Factor for T50)	0.197
Coef. of Consol., C_v, in^2/min	0.011

Load Summary

Initial Sample Height, in	0.9050
Initial Sample Void Ratio	0.5388
Final Sample Height, in	0.9121
Final Sample Void Ratio	0.5510
Incremental Strain, %	-0.79%
Loading Duration, min	301.95

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ONE-DIMENSIONAL CONSOLIDATION PROPERTIES OF SOILS
ASTM D 2435

Client	Civil & Environmental Consultant	Boring	RB-4	**Test Load, tsf**	**1-0.25**
Client Project	091-867 Apex Landfill Expansion	Depth	19'-24'		Load 7 of 13
Project No.	30598	Sample	B-1		
		Lab ID#	30598027		
Visual Description	Olive Brown Lean Clay with Sand				
Test Conditions:	Remolded, Inundated, and Double Drained				

Time Vs. Dial Reading

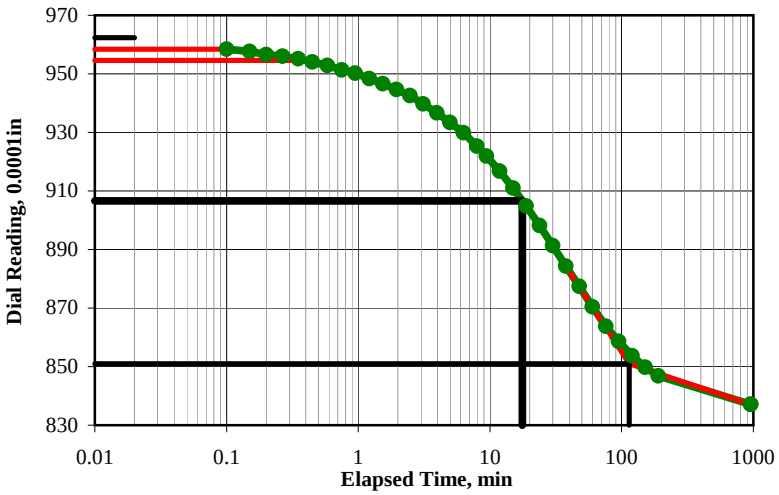
Elapsed Time (min)	Sqrt Time ($min^{1/2}$)	Dial Reading (0.0001in)	Sample Height (in)	Void Ratio
0	0	968.5	0.9121	0.5510
Corrections*		4.5	0.00045	0.00077
Adjusted Sample Height & Void Ratio				
0.10	0.32	958.4	0.9127	0.5519
0.15	0.39	957.7	0.9128	0.5521
0.20	0.45	956.6	0.9129	0.5523
0.27	0.52	956.0	0.9129	0.5523
0.35	0.59	955.1	0.9130	0.5525
0.45	0.67	954.1	0.9131	0.5527
0.58	0.76	952.9	0.9133	0.5529
0.75	0.87	951.3	0.9134	0.5531
0.95	0.97	950.2	0.9135	0.5533
1.22	1.10	948.3	0.9137	0.5536
1.53	1.24	946.6	0.9139	0.5539
1.95	1.40	944.6	0.9141	0.5543
2.47	1.57	942.6	0.9143	0.5546
3.12	1.77	939.7	0.9146	0.5551
3.95	1.99	936.7	0.9149	0.5556
4.98	2.23	933.4	0.9152	0.5562
6.30	2.51	929.8	0.9156	0.5568
7.95	2.82	925.4	0.9160	0.5576
9.40	3.07	921.9	0.9164	0.5581
11.85	3.44	916.7	0.9169	0.5590
14.95	3.87	910.9	0.9175	0.5600
18.85	4.34	904.9	0.9181	0.5610
23.77	4.88	898.2	0.9187	0.5622
29.95	5.47	891.3	0.9194	0.5633
37.75	6.14	884.4	0.9201	0.5645
47.57	6.90	877.4	0.9208	0.5657
59.95	7.74	870.5	0.9215	0.5669
75.95	8.71	863.8	0.9222	0.5680
94.95	9.74	858.6	0.9227	0.5689
119.95	10.95	853.7	0.9232	0.5697
150.95	12.29	849.8	0.9236	0.5704
189.95	13.78	846.9	0.9239	0.5709
954.95	30.90	837.1	0.9248	0.5726

Machine Deflection

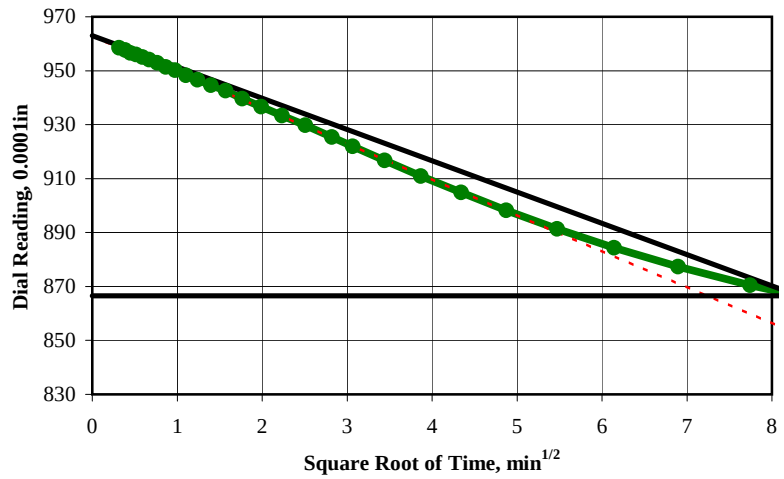
Applied Deflection Correction to Sample Height, 0.0001in 4.5

**Correction is applied to all dial readings.*

Log of Elapsed Time vs. Dial Reading



Square Root of Elapsed Time vs. Dial Reading



Sqrt. of Elapsed Time vs Dial Reading		**Log of Elapsed Time vs Dial Reading**		**Load Summary**	
T0 = 0 min.	D0 = 963 div.	T0 = 0 min.	D0 = 962.3 div.		
T90 = 69.056 min	D90 = 866.6 div.	T50 = 17.62 min.	D50 = 906.7 div.	Initial Sample Height, in	0.9121
T100 = NA min	D100 = 855.9 div.	T100 = 113.9 min.	D100 = 851 div.	Initial Sample Void Ratio	0.5510
Height at: D90 = 0.9219, D100 = 0.923		Height at: D50 = 0.9179, D100 = 0.9235		Final Sample Height, in	0.9248
Average Sample Height, in	0.9185	Average Sample Height, in	0.9185	Final Sample Void Ratio	0.5726
Average Drainage Height, in	0.4592	Average Drainage Height, in	0.4592	Incremental Strain, %	-1.39%
T (Time Factor for T90)	0.848	T (Time Factor for T50)	0.197	Loading Duration, min	954.95
Coef. of Consol., C_v, in^2/min	0.003	Coef. of Consol., C_v, in^2/min	0.002		

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ONE-DIMENSIONAL CONSOLIDATION PROPERTIES OF SOILS
ASTM D 2435

Client	Civil & Environmental Consultant	Boring	RB-4	**Test Load, tsf**	**0.25-0.5**
Client Project	091-867 Apex Landfill Expansion	Depth	19'-24'		Load 8 of 13
Project No.	30598	Sample	B-1		
		Lab ID#	30598027		
Visual Description	Olive Brown Lean Clay with Sand				
Test Conditions:	Remolded, Inundated, and Double Drained				

Time Vs. Dial Reading

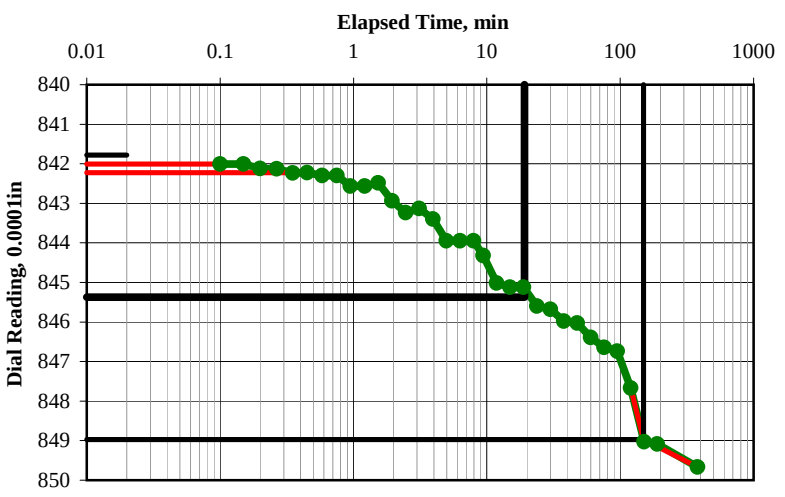
Elapsed Time (min)	Sqrt Time ($min^{1/2}$)	Dial Reading (0.0001in)	Sample Height (in)	Void Ratio
0	0	837.1	0.9248	0.5726
Corrections*		-1.5	-0.00015	-0.0003
Adjusted Sample Height & Void Ratio				
0.10	0.32	842.0	0.9245	0.5720
0.15	0.39	842.0	0.9245	0.5720
0.20	0.45	842.1	0.9245	0.5720
0.27	0.52	842.1	0.9245	0.5720
0.35	0.59	842.2	0.9245	0.5719
0.45	0.67	842.2	0.9245	0.5719
0.58	0.76	842.3	0.9245	0.5719
0.75	0.87	842.3	0.9245	0.5719
0.95	0.97	842.6	0.9244	0.5719
1.22	1.10	842.6	0.9244	0.5719
1.53	1.24	842.5	0.9245	0.5719
1.95	1.40	842.9	0.9244	0.5718
2.47	1.57	843.2	0.9244	0.5718
3.12	1.77	843.1	0.9244	0.5718
3.95	1.99	843.4	0.9244	0.5717
4.98	2.23	843.9	0.9243	0.5717
6.30	2.51	843.9	0.9243	0.5717
7.95	2.82	843.9	0.9243	0.5717
9.40	3.07	844.3	0.9243	0.5716
11.85	3.44	845.0	0.9242	0.5715
14.95	3.87	845.1	0.9242	0.5715
18.85	4.34	845.1	0.9242	0.5715
23.77	4.88	845.6	0.9241	0.5714
29.95	5.47	845.7	0.9241	0.5714
37.75	6.14	846.0	0.9241	0.5713
47.57	6.90	846.0	0.9241	0.5713
59.95	7.74	846.4	0.9241	0.5712
75.95	8.71	846.6	0.9240	0.5712
94.95	9.74	846.7	0.9240	0.5712
119.95	10.95	847.7	0.9239	0.5710
150.95	12.29	849.0	0.9238	0.5708
189.95	13.78	849.1	0.9238	0.5708
379.95	19.49	849.7	0.9237	0.5707

Machine Deflection

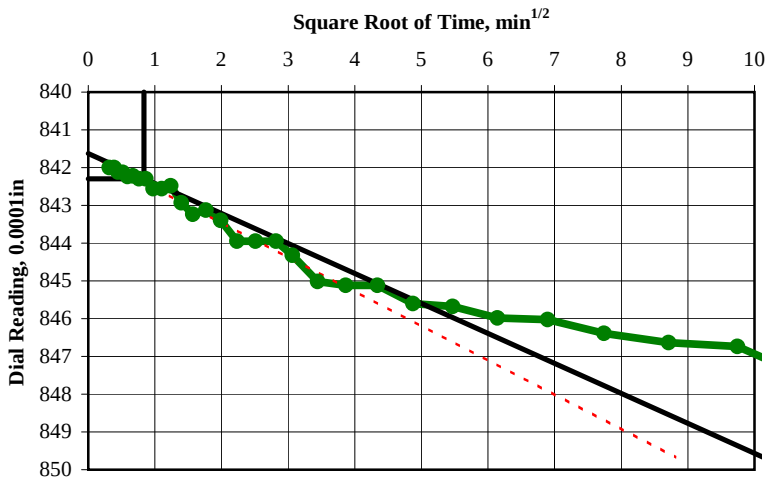
Applied Deflection Correction to Sample Height, 0.0001in -1.5

**Correction is applied to all dial readings.*

Log of Elapsed Time vs. Dial Reading



Square Root of Elapsed Time vs. Dial Reading



Sqrt. of Elapsed Time vs Dial Reading

T0 = 0 min.	D0 = 841.6 div.
T90 = 0.706 min	D90 = 842.3 div.
T100 = NA min	D100 = 842.4 div.
Height at: D90 = 0.9245, D100 = 0.9245	
Average Sample Height, in	0.9243
Average Drainage Height, in	0.4621
T (Time Factor for T90)	0.848
Coef. of Consol., C_v, in^2/min	0.258

Log of Elapsed Time vs Dial Reading

T0 = 0 min.	D0 = 841.8 div.
T50 = 19.12 min.	D50 = 845.4 div.
T100 = 149.6 min.	D100 = 849 div.
Height at: D50 = 0.9242, D100 = 0.9238	
Average Sample Height, in	0.9243
Average Drainage Height, in	0.4621
T (Time Factor for T50)	0.197
Coef. of Consol., C_v, in^2/min	0.002

Load Summary

Initial Sample Height, in	0.9248
Initial Sample Void Ratio	0.5726
Final Sample Height, in	0.9237
Final Sample Void Ratio	0.5707
Incremental Strain, %	0.12%
Loading Duration, min	379.95

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ONE-DIMENSIONAL CONSOLIDATION PROPERTIES OF SOILS
ASTM D 2435

Client	Civil & Environmental Consultant	Boring	RB-4	**Test Load, tsf**	**0.5-1**
Client Project	091-867 Apex Landfill Expansion	Depth	19'-24'		Load 9 of 13
Project No.	30598	Sample	B-1		
		Lab ID#	30598027		
Visual Description	Olive Brown Lean Clay with Sand				
Test Conditions:	Remolded, Inundated, and Double Drained				

Time Vs. Dial Reading

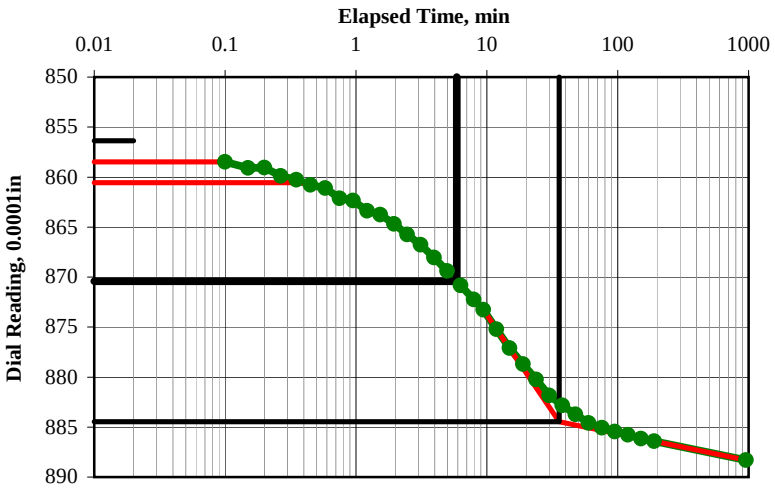
Elapsed Time (min)	Sqrt Time ($min^{1/2}$)	Dial Reading (0.0001in)	Sample Height (in)	Void Ratio
0	0	849.7	0.9237	0.5707
Corrections*		-2.5	-0.00025	-0.0004
Adjusted Sample Height & Void Ratio				
0.10	0.32	858.5	0.9231	0.5696
0.15	0.39	859.1	0.9230	0.5695
0.20	0.45	859.1	0.9230	0.5695
0.27	0.52	859.9	0.9230	0.5694
0.35	0.59	860.3	0.9229	0.5693
0.45	0.67	860.8	0.9229	0.5692
0.58	0.76	861.1	0.9228	0.5692
0.75	0.87	862.1	0.9227	0.5690
0.95	0.97	862.3	0.9227	0.5690
1.22	1.10	863.4	0.9226	0.5688
1.53	1.24	863.8	0.9226	0.5687
1.95	1.40	864.7	0.9225	0.5686
2.47	1.57	865.7	0.9224	0.5684
3.12	1.77	866.8	0.9223	0.5682
3.95	1.99	868.0	0.9221	0.5680
4.98	2.23	869.4	0.9220	0.5678
6.30	2.51	870.8	0.9219	0.5675
7.95	2.82	872.2	0.9217	0.5673
9.40	3.07	873.3	0.9216	0.5671
11.85	3.44	875.2	0.9214	0.5668
14.95	3.87	877.1	0.9212	0.5664
18.85	4.34	878.7	0.9211	0.5662
23.77	4.88	880.2	0.9209	0.5659
29.95	5.47	881.9	0.9208	0.5656
37.75	6.14	882.8	0.9207	0.5655
47.57	6.90	883.7	0.9206	0.5653
59.95	7.74	884.6	0.9205	0.5652
75.95	8.71	885.1	0.9204	0.5651
94.95	9.74	885.5	0.9204	0.5650
119.95	10.95	885.8	0.9204	0.5650
150.95	12.29	886.2	0.9203	0.5649
189.95	13.78	886.4	0.9203	0.5649
954.95	30.90	888.3	0.9201	0.5645

Machine Deflection

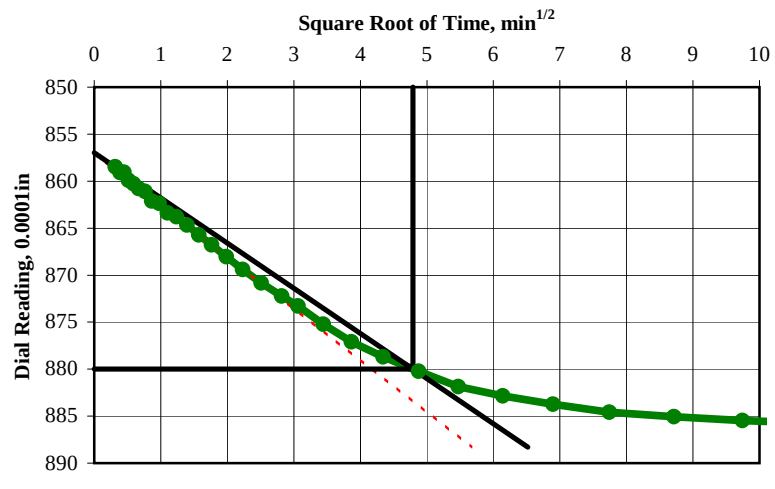
Applied Deflection Correction to Sample Height, 0.0001in -2.5

**Correction is applied to all dial readings.*

Log of Elapsed Time vs. Dial Reading



Square Root of Elapsed Time vs. Dial Reading



Sqrt. of Elapsed Time vs Dial Reading

T0 = 0 min.	D0 = 857 div.		
T90 = 22.944 min	D90 = 880 div.		
T100 = NA min	D100 = 882.5 div.		
Height at: D90 = 0.921, D100 = 0.9207			
Average Sample Height, in	0.9219		
Average Drainage Height, in	0.4610		
T (Time Factor for T90)	0.848		
Coef. of Consol., C_v, in^2/min	0.008		

Log of Elapsed Time vs Dial Reading

T0 = 0 min.	D0 = 856.4 div.		
T50 = 5.88 min.	D50 = 870.4 div.		
T100 = 35.7 min.	D100 = 884.5 div.		
Height at: D50 = 0.9219, D100 = 0.9205			
Average Sample Height, in	0.9219		
Average Drainage Height, in	0.4610		
T (Time Factor for T50)	0.197		
Coef. of Consol., C_v, in^2/min	0.007		

Load Summary

Initial Sample Height, in	0.9237
Initial Sample Void Ratio	0.5707
Final Sample Height, in	0.9201
Final Sample Void Ratio	0.5645
Incremental Strain, %	0.39%
Loading Duration, min	954.95

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ONE-DIMENSIONAL CONSOLIDATION PROPERTIES OF SOILS
ASTM D 2435

Client	Civil & Environmental Consultant	Boring	RB-4	**Test Load, tsf**	**1-2**
Client Project	091-867 Apex Landfill Expansion	Depth	19'-24'		Load 10 of 13
Project No.	30598	Sample	B-1		
		Lab ID#	30598027		
Visual Description	Olive Brown Lean Clay with Sand				
Test Conditions:	Remolded, Inundated, and Double Drained				

Time Vs. Dial Reading

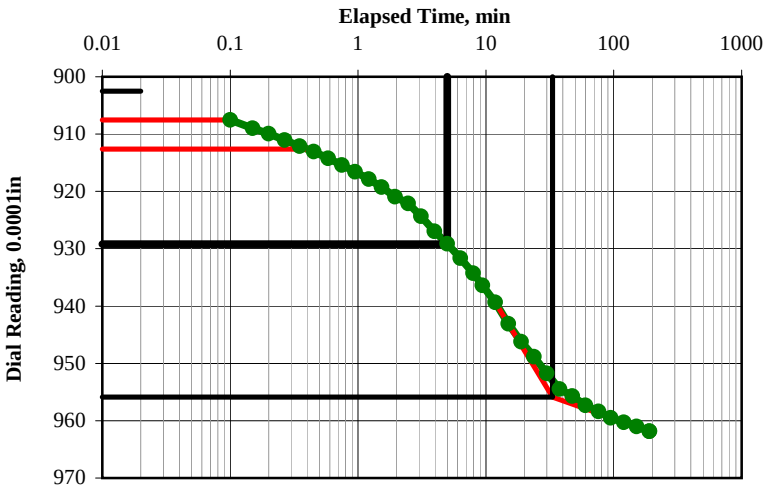
Elapsed Time (min)	Sqrt Time ($min^{1/2}$)	Dial Reading (0.0001in)	Sample Height (in)	Void Ratio
0	0	888.3	0.9201	0.5645
Corrections*		-3.5	-0.00035	-0.0006
Adjusted Sample Height & Void Ratio				
0.10	0.32	907.6	0.9185	0.5619
0.15	0.39	909.0	0.9184	0.5616
0.20	0.45	909.9	0.9183	0.5615
0.27	0.52	911.1	0.9182	0.5613
0.35	0.59	912.1	0.9181	0.5611
0.45	0.67	913.1	0.9180	0.5609
0.58	0.76	914.2	0.9179	0.5607
0.75	0.87	915.4	0.9178	0.5605
0.95	0.97	916.6	0.9176	0.5603
1.22	1.10	917.8	0.9175	0.5601
1.53	1.24	919.3	0.9174	0.5599
1.95	1.40	920.9	0.9172	0.5596
2.47	1.57	922.1	0.9171	0.5594
3.12	1.77	924.4	0.9169	0.5590
3.95	1.99	927.0	0.9166	0.5586
4.98	2.23	929.2	0.9164	0.5582
6.30	2.51	931.6	0.9161	0.5578
7.95	2.82	934.3	0.9159	0.5573
9.40	3.07	936.4	0.9157	0.5570
11.85	3.44	939.4	0.9154	0.5564
14.95	3.87	943.1	0.9150	0.5558
18.85	4.34	946.2	0.9147	0.5553
23.77	4.88	948.9	0.9144	0.5548
29.95	5.47	951.7	0.9141	0.5543
37.75	6.14	954.5	0.9139	0.5539
47.57	6.90	955.7	0.9137	0.5537
59.95	7.74	957.3	0.9136	0.5534
75.95	8.71	958.4	0.9135	0.5532
94.95	9.74	959.5	0.9134	0.5530
119.95	10.95	960.3	0.9133	0.5529
150.95	12.29	961.0	0.9132	0.5528
189.95	13.78	961.8	0.9131	0.5526

Machine Deflection

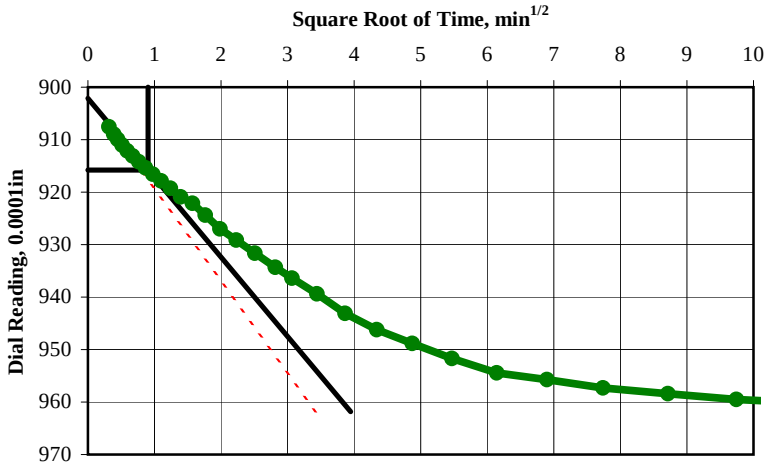
Applied Deflection Correction to Sample Height, 0.0001in -3.5

**Correction is applied to all dial readings.*

Log of Elapsed Time vs. Dial Reading



Square Root of Elapsed Time vs. Dial Reading



Sqrt. of Elapsed Time vs Dial Reading

T0 = 0 min.	D0 = 902.1 div.
T90 = 0.81 min	D90 = 915.8 div.
T100 = NA min	D100 = 917.3 div.
Height at: D90 = 0.9177, D100 = 0.9176	
Average Sample Height, in	0.9166
Average Drainage Height, in	0.4583
T (Time Factor for T90)	0.848
Coef. of Consol., C_v, in^2/min	0.219

Log of Elapsed Time vs Dial Reading

T0 = 0 min.	D0 = 902.5 div.
T50 = 5 min.	D50 = 929.2 div.
T100 = 33.27 min.	D100 = 955.9 div.
Height at: D50 = 0.9164, D100 = 0.9137	
Average Sample Height, in	0.9166
Average Drainage Height, in	0.4583
T (Time Factor for T50)	0.197
Coef. of Consol., C_v, in^2/min	0.008

Load Summary

Initial Sample Height, in	0.9201
Initial Sample Void Ratio	0.5645
Final Sample Height, in	0.9131
Final Sample Void Ratio	0.5526
Incremental Strain, %	0.76%
Loading Duration, min	189.95

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ONE-DIMENSIONAL CONSOLIDATION PROPERTIES OF SOILS
ASTM D 2435

Client	Civil & Environmental Consultant	Boring	RB-4	**Test Load, tsf**	**2-4**
Client Project	091-867 Apex Landfill Expansion	Depth	19'-24'		Load 11 of 13
Project No.	30598	Sample	B-1		
		Lab ID#	30598027		
Visual Description	Olive Brown Lean Clay with Sand				
Test Conditions:	Remolded, Inundated, and Double Drained				

Time Vs. Dial Reading

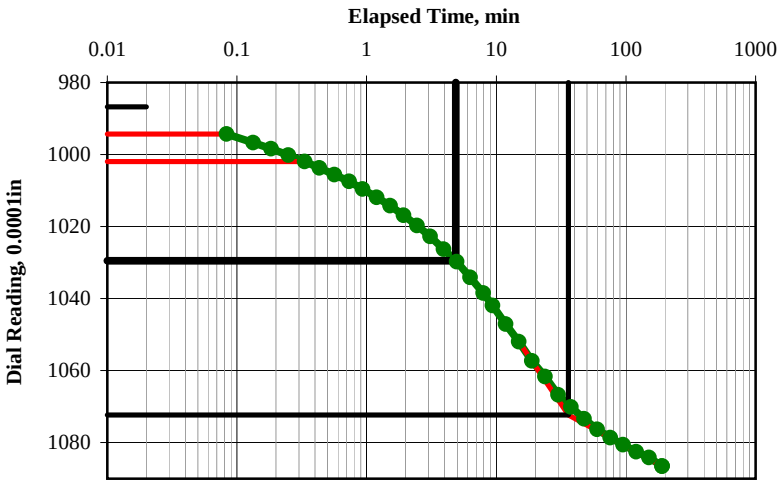
Elapsed Time (min)	Sqrt Time ($min^{1/2}$)	Dial Reading (0.0001in)	Sample Height (in)	Void Ratio
0	0	961.8	0.9131	0.5526
Corrections*		-4.5	-0.00045	-0.0008
Adjusted Sample Height & Void Ratio				
0.08	0.29	994.3	0.9103	0.5479
0.13	0.37	996.7	0.9101	0.5475
0.18	0.43	998.4	0.9099	0.5472
0.25	0.50	1000.2	0.9097	0.5469
0.33	0.58	1001.9	0.9096	0.5466
0.43	0.66	1003.7	0.9094	0.5463
0.57	0.75	1005.6	0.9092	0.5460
0.73	0.86	1007.5	0.9090	0.5456
0.93	0.97	1009.6	0.9088	0.5453
1.20	1.10	1011.9	0.9086	0.5449
1.52	1.23	1014.2	0.9083	0.5445
1.93	1.39	1016.9	0.9081	0.5440
2.45	1.57	1019.7	0.9078	0.5436
3.10	1.76	1022.8	0.9075	0.5430
3.93	1.98	1026.3	0.9071	0.5424
4.97	2.23	1029.8	0.9068	0.5418
6.28	2.51	1034.1	0.9063	0.5411
7.93	2.82	1038.5	0.9059	0.5404
9.38	3.06	1042.0	0.9056	0.5398
11.83	3.44	1047.1	0.9050	0.5389
14.93	3.86	1052.0	0.9046	0.5381
18.83	4.34	1057.3	0.9040	0.5372
23.75	4.87	1061.7	0.9036	0.5364
29.93	5.47	1066.8	0.9031	0.5356
37.73	6.14	1070.1	0.9027	0.5350
47.55	6.90	1073.4	0.9024	0.5344
59.93	7.74	1076.4	0.9021	0.5339
75.93	8.71	1078.6	0.9019	0.5335
94.93	9.74	1080.6	0.9017	0.5332
119.93	10.95	1082.5	0.9015	0.5329
150.93	12.29	1084.2	0.9013	0.5326
189.93	13.78	1086.5	0.9011	0.5322

Machine Deflection

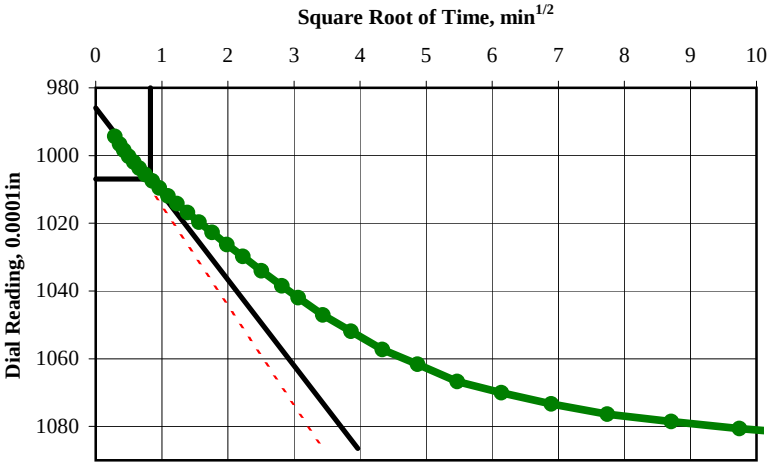
Applied Deflection Correction to Sample Height, 0.0001in -4.5

**Correction is applied to all dial readings.*

Log of Elapsed Time vs. Dial Reading



Square Root of Elapsed Time vs. Dial Reading



Sqrt. of Elapsed Time vs Dial Reading

T0 = 0 min.	D0 = 986 div.
T90 = 0.689 min	D90 = 1007 div.
T100 = NA min	D100 = 1009.3 div.
Height at: D90 = 0.9091, D100 = 0.9088	
Average Sample Height, in	0.9071
Average Drainage Height, in	0.4536
T (Time Factor for T90)	0.848
Coef. of Consol., C_v, in^2/min	0.254

Log of Elapsed Time vs Dial Reading

T0 = 0 min.	D0 = 986.7 div.
T50 = 4.88 min.	D50 = 1029.5 div.
T100 = 36.09 min.	D100 = 1072.3 div.
Height at: D50 = 0.9068, D100 = 0.9025	
Average Sample Height, in	0.9071
Average Drainage Height, in	0.4536
T (Time Factor for T50)	0.197
Coef. of Consol., C_v, in^2/min	0.008

Load Summary

Initial Sample Height, in	0.9131
Initial Sample Void Ratio	0.5526
Final Sample Height, in	0.9011
Final Sample Void Ratio	0.5322
Incremental Strain, %	1.32%
Loading Duration, min	189.93333

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ONE-DIMENSIONAL CONSOLIDATION PROPERTIES OF SOILS
ASTM D 2435

Client	Civil & Environmental Consultant	Boring	RB-4	**Test Load, tsf**	**4-8**
Client Project	091-867 Apex Landfill Expansion	Depth	19'-24'		Load 12 of 13
Project No.	30598	Sample	B-1		
		Lab ID#	30598027		
Visual Description	Olive Brown Lean Clay with Sand				
Test Conditions:	Remolded, Inundated, and Double Drained				

Time Vs. Dial Reading

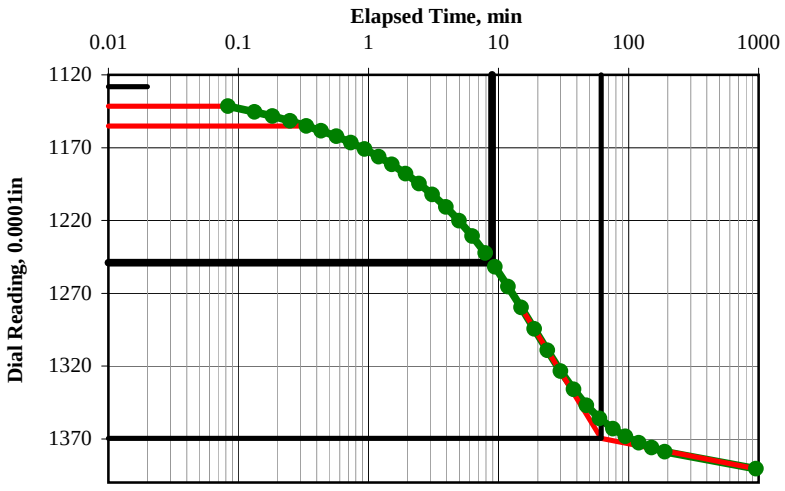
Elapsed Time (min)	Sqrt Time ($min^{1/2}$)	Dial Reading (0.0001in)	Sample Height (in)	Void Ratio
0	0	1086.5	0.9011	0.5322
Corrections*		-10	-0.001	-0.0017
Adjusted Sample Height & Void Ratio				
0.08	0.29	1141.6	0.8966	0.5245
0.13	0.37	1145.5	0.8962	0.5239
0.18	0.43	1148.4	0.8959	0.5234
0.25	0.50	1151.7	0.8956	0.5228
0.33	0.58	1155.1	0.8952	0.5222
0.43	0.66	1158.5	0.8949	0.5217
0.57	0.75	1162.3	0.8945	0.5210
0.73	0.86	1166.6	0.8941	0.5203
0.93	0.97	1171.0	0.8936	0.5195
1.20	1.10	1176.2	0.8931	0.5186
1.52	1.23	1181.6	0.8926	0.5177
1.93	1.39	1187.9	0.8920	0.5167
2.45	1.57	1194.7	0.8913	0.5155
3.10	1.76	1202.3	0.8905	0.5142
3.93	1.98	1210.7	0.8897	0.5128
4.97	2.23	1220.1	0.8887	0.5112
6.28	2.51	1230.8	0.8877	0.5094
7.93	2.82	1242.5	0.8865	0.5074
9.38	3.06	1251.8	0.8856	0.5058
11.83	3.44	1265.4	0.8842	0.5035
14.93	3.86	1279.8	0.8828	0.5010
18.83	4.34	1294.6	0.8813	0.4985
23.75	4.87	1309.2	0.8798	0.4960
29.93	5.47	1323.5	0.8784	0.4936
37.73	6.14	1336.1	0.8771	0.4914
47.55	6.90	1347.1	0.8760	0.4896
59.93	7.74	1356.1	0.8751	0.4881
75.93	8.71	1363.1	0.8744	0.4869
94.93	9.74	1368.4	0.8739	0.4860
119.93	10.95	1372.7	0.8735	0.4852
150.93	12.29	1376.1	0.8731	0.4847
189.93	13.78	1378.8	0.8729	0.4842
954.93	30.90	1390.5	0.8717	0.4822

Machine Deflection

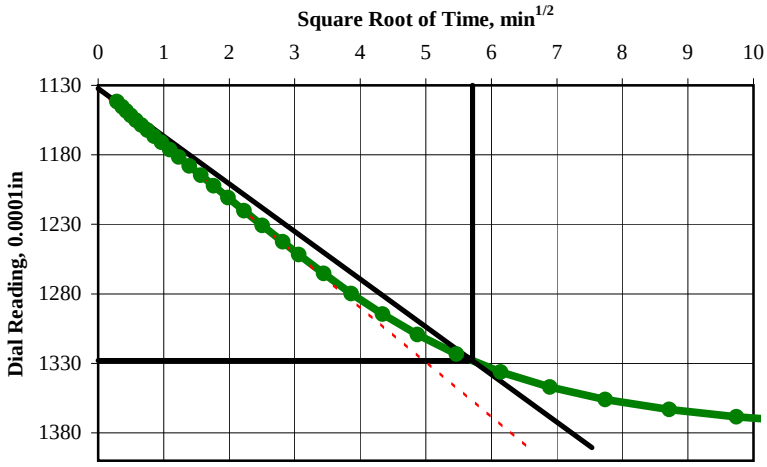
Applied Deflection Correction to Sample Height, 0.0001in -10

**Correction is applied to all dial readings.*

Log of Elapsed Time vs. Dial Reading



Square Root of Elapsed Time vs. Dial Reading



Sqrt. of Elapsed Time vs Dial Reading

T0 = 0 min.	D0 = 1132.2 div.
T90 = 32.604 min	D90 = 1328 div.
T100 = NA min	D100 = 1349.8 div.
Height at: D90 = 0.878, D100 = 0.8758	
Average Sample Height, in	0.8864
Average Drainage Height, in	0.4432
T (Time Factor for T90)	0.848
Coef. of Consol., C_v, in^2/min	0.005

Log of Elapsed Time vs Dial Reading

T0 = 0 min.	D0 = 1128.1 div.
T50 = 8.91 min.	D50 = 1248.9 div.
T100 = 61.53 min.	D100 = 1369.7 div.
Height at: D50 = 0.8859, D100 = 0.8738	
Average Sample Height, in	0.8864
Average Drainage Height, in	0.4432
T (Time Factor for T50)	0.197
Coef. of Consol., C_v, in^2/min	0.004

Load Summary

Initial Sample Height, in	0.9011
Initial Sample Void Ratio	0.5322
Final Sample Height, in	0.8717
Final Sample Void Ratio	0.4822
Incremental Strain, %	3.26%
Loading Duration, min	954.93333

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ONE-DIMENSIONAL CONSOLIDATION PROPERTIES OF SOILS
ASTM D 2435

Client	Civil & Environmental Consultant	Boring	RB-4	**Test Load, tsf**	**8-16**
Client Project	091-867 Apex Landfill Expansion	Depth	19'-24'		Load 13 of 13
Project No.	30598	Sample	B-1		
		Lab ID#	30598027		
Visual Description	Olive Brown Lean Clay with Sand				
Test Conditions:	Remolded, Inundated, and Double Drained				

Time Vs. Dial Reading

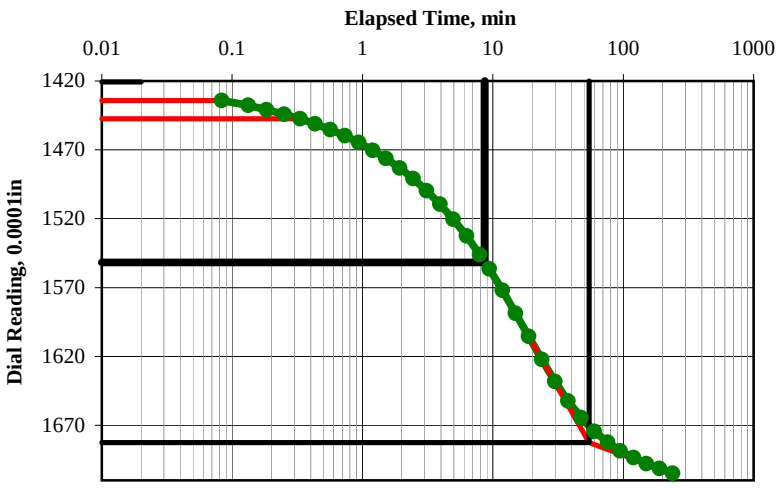
Elapsed Time (min)	Sqrt Time ($min^{1/2}$)	Dial Reading (0.0001in)	Sample Height (in)	Void Ratio
0	0	1390.5	0.8717	0.4822
Corrections*		-13.5	-0.00135	-0.0023
Adjusted Sample Height & Void Ratio				
0.08	0.29	1434.2	0.8687	0.4771
0.13	0.37	1437.7	0.8683	0.4765
0.18	0.43	1440.9	0.8680	0.4759
0.25	0.50	1444.1	0.8677	0.4754
0.33	0.58	1447.5	0.8673	0.4748
0.43	0.66	1451.1	0.8670	0.4742
0.57	0.75	1455.3	0.8666	0.4735
0.73	0.86	1459.8	0.8661	0.4727
0.93	0.97	1464.7	0.8656	0.4719
1.20	1.10	1470.3	0.8651	0.4709
1.52	1.23	1476.2	0.8645	0.4699
1.93	1.39	1483.2	0.8638	0.4687
2.45	1.57	1490.9	0.8630	0.4674
3.10	1.76	1499.6	0.8621	0.4659
3.93	1.98	1509.4	0.8612	0.4643
4.97	2.23	1520.3	0.8601	0.4624
6.28	2.51	1532.5	0.8589	0.4604
7.93	2.82	1546.1	0.8575	0.4580
9.38	3.06	1556.5	0.8565	0.4563
11.83	3.44	1571.9	0.8549	0.4537
14.93	3.86	1588.6	0.8532	0.4508
18.83	4.34	1605.4	0.8516	0.4480
23.75	4.87	1622.2	0.8499	0.4451
29.93	5.47	1638.2	0.8483	0.4424
37.73	6.14	1652.5	0.8469	0.4400
47.55	6.90	1664.4	0.8457	0.4379
59.93	7.74	1674.4	0.8447	0.4362
75.93	8.71	1682.4	0.8439	0.4349
94.93	9.74	1688.6	0.8432	0.4338
119.93	10.95	1693.5	0.8428	0.4330
150.93	12.29	1697.9	0.8423	0.4322
189.93	13.78	1701.4	0.8420	0.4316
239.93	15.49	1704.8	0.8416	0.4311

Machine Deflection

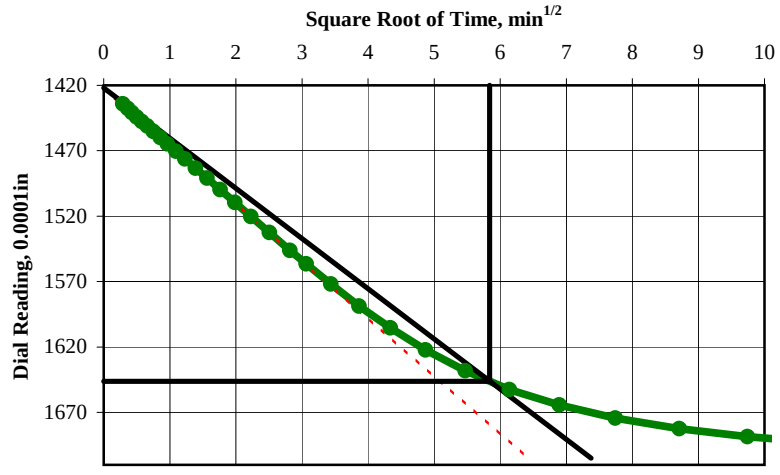
Applied Deflection Correction to Sample Height, 0.0001in -13.5

**Correction is applied to all dial readings.*

Log of Elapsed Time vs. Dial Reading



Square Root of Elapsed Time vs. Dial Reading



Sqrt. of Elapsed Time vs Dial Reading

T0 = 0 min.	D0 = 1421.9 div.		
T90 = 34.106 min	D90 = 1646.1 div.		
T100 = NA min	D100 = 1671 div.		
Height at: D90 = 0.8475, D100 = 0.845			
Average Sample Height, in	0.8567		
Average Drainage Height, in	0.4283		
T (Time Factor for T90)	0.848		
Coef. of Consol., C_v, in^2/min	0.005		

Log of Elapsed Time vs Dial Reading

T0 = 0 min.	D0 = 1420.8 div.		
T50 = 8.69 min.	D50 = 1551.7 div.		
T100 = 54.72 min.	D100 = 1682.6 div.		
Height at: D50 = 0.8569, D100 = 0.8438			
Average Sample Height, in	0.8567		
Average Drainage Height, in	0.4283		
T (Time Factor for T50)	0.197		
Coef. of Consol., C_v, in^2/min	0.004		

Load Summary

Initial Sample Height, in	0.8717
Initial Sample Void Ratio	0.4822
Final Sample Height, in	0.8416
Final Sample Void Ratio	0.4311
Incremental Strain, %	3.45%
Loading Duration, min	239.93333

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PARTICLE-SIZE ANALYSIS OF SOILS

Client	Civil & Environmental Consultants, Ir	Boring	SB-12
Client Project	091-867 Apex Landfill Expansion	Depth	16-'18'
Project No.	30598	Sample	SS-9
		Lab Sample No.	30598035
USCS Description	DARK GRAYISH BROWN FAT CLAY WITH SAND		
USCS Group Symbol	CH		
AASHTO Classification	A-7-6 (21)		

MECHANICAL SIEVE ANALYSIS

As-Received Representative Sample Size Split or Material Submitted Used	
Representable Wet Wt, gm	166.0
+#4 Grnd., Washed DS., gm	0.0
-#4 Wet Wt., gm	166.0
-#4 Water Content, %	23.6
-#4 Dry Wt., gm	134.3
Representable Dry Wt, gm	**134.3**
* Note: Percentages +#4 are based on total Dry representable sample.	
Split Sample, -#4 washed over #200	
Tare No.	G4
Tare + WS., gm	203.06
Tare + DS., gm	187.94
Tare, gm	123.82
Wt. of DS., gm	64.12
Water Content -#4, %	23.6
Wt. of +#200 Sample, gm	13.4

US Std. Sieve Size	Sieve Opening (mm)	Wt. of Soil Retained (gm)	Percent Retained (%)	Cumulative Percent Retained	Percent Finer (%)	Final Percent Finer
3"	75	0	0.0	0.0	100.0	100.0
2 1/2"	62.5	0	0.0	0.0	100.0	100.0
2"	50	0	0.0	0.0	100.0	100.0
1 1/2"	37.5	0	0.0	0.0	100.0	100.0
1"	25	0	0.0	0.0	100.0	100.0
3/4"	19	0	0.0	0.0	100.0	100.0
1/2"	12.5	0	0.0	0.0	100.0	100.0
3/8"	9.5	0	0.0	0.0	100.0	100.0
#4	4.75	0	0.0	0.0	100.0	100.0
#10	2	0.19	0.3	0.3	99.7	99.7
#20	0.85	2.26	3.5	3.8	96.2	96.2
#40	0.425	1.9	3.0	6.8	93.2	93.2
#60	0.25	1.75	2.7	9.5	90.5	90.5
#140	0.106	4.49	7.0	16.5	83.5	83.5
#200	0.075	2.8	4.4	20.9	79.1	79.1
Pan	-	13.4	7.1	28.0	-	-

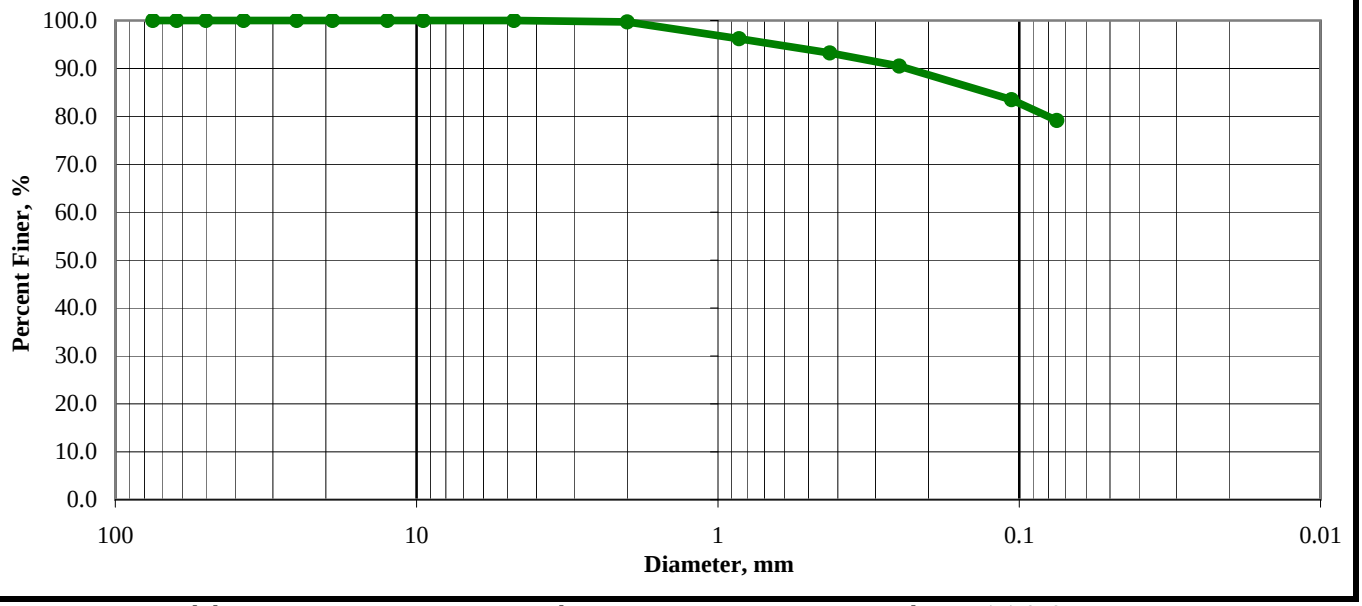
The final percent finer combines the gradation of the plus #4 and minus #4 material.

USCS SOIL CLASSIFICATION

Corrected For 100% Passing a 3" Sieve

% Gravel (-3" & +#4)	**0.0**		
Coarse=0; Fine=0		D60, mm	NA
% Sand (-#4 & +#200)	**20.9**	D30, mm	NA
Coarse=0.3; Med.=6.5; Fine=14.1		D10, mm	NA
% Fines (-#200)	**79.1**	Cc	NA
% Plus #200 (-3")	**20.9**	Cu	NA

USCS Description		
FAT CLAY WITH SAND		
USCS Group Symbol	Atterberg Limits Group Symbol	
CH	**CH, LL=50, PL=25, PI=25**	
Auxiliary Information	Wt Ret, gm	% Retained	% Finer
12" Sieve - 300 mm	0	0.0	100.0
6" Sieve - 150 mm	0	0.0	100.0
3" Sieve - 75 mm	0	0.0	100.0



Input Validation: Reviewed By: Date Tested: 12/1/2010

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LIQUID LIMIT, PLASTIC LIMIT, AND PLASTICITY INDEX OF SOILS

Client	Civil & Environmental Consultants, Ir	Boring No.	SB-12
Client Project	091-867 Apex Landfill Expansion	Depth(ft)	16-'18'
Project No.	30598	Sample No.	SS-9
		Lab Sample No.	30598035
Soil Description: (-#40 Fraction)	DARK GRAYISH BROWN FAT CLAY		

AS-RECEIVED W.C.

Tare Number	G4
Wt. Tare & WS, gm	203.06
Wt. Tare & DS, gm	187.94
Wt. Water, gm	15.12
Wt. Tare, gm	123.82
Wt. DS, gm	64.12
Water Content, %	23.6

SAMPLE SUMMARY

Liquid Limit (LL), %	50
Plastic Limit (PL), %	25
Plasticity Index (PI)	25
USCS Symbol (-#40 Fraction)	CH
Sample Preparation:	Wet Method
Liquidity Index, %	-5.7%
Clay Fraction (% 2 microns)	NA
Skempton's Activity (A)	NA

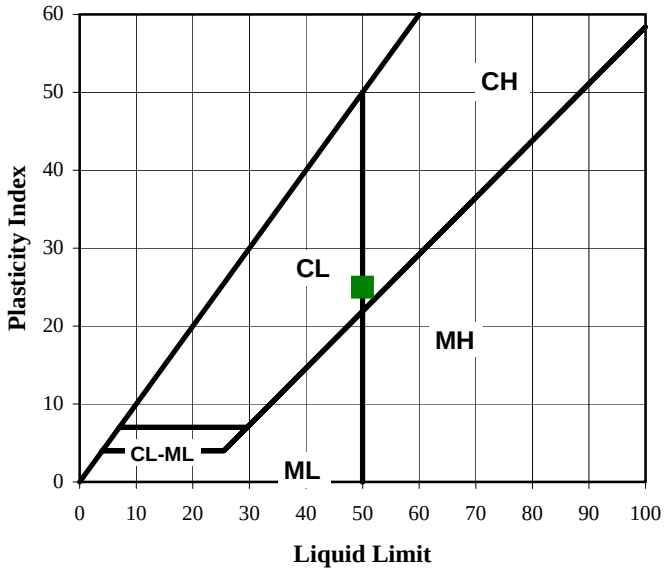
PLASTIC LIMIT

Test Number	1	2	3
Tare Number	469	510	
Wt. Tare & WS, gm	17.58	17.35	
Wt. Tare & DS, gm	16.22	16.08	
Wt. Water, gm	1.36	1.27	
Wt. Tare, gm	10.78	10.83	
Wt. DS, gm	5.44	5.25	
Water Content, %	25.0	24.2	

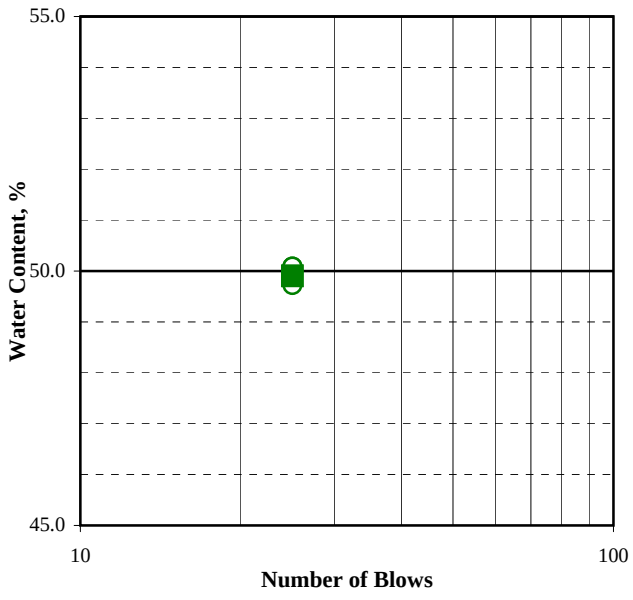
LIQUID LIMIT

	1	2
Tare Number	446	505
Wt. Tare & WS, gm	18.86	19.70
Wt. Tare & DS, gm	16.15	16.72
Wt. Water, gm	2.71	2.98
Wt. Tare, gm	10.70	10.77
Wt. DS, gm	5.45	5.95
Water Content, %	49.7	50.1
# of Blows	25	25

PLASTICITY CHART



FLOW CURVE



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PARTICLE-SIZE ANALYSIS OF SOILS

Client	Civil & Environmental Consultants, Ir	Boring	SB-17
Client Project	091-867 Apex Landfill Expansion	Depth	6'-8'
Project No.	30598	Sample	SS-4
		Lab Sample No.	30598037
USCS Description	DARK GRAYISH BROWN SANDY LEAN CLAY		
USCS Group Symbol	CL		
AASHTO Classification	A-6 (11)		

MECHANICAL SIEVE ANALYSIS

As-Received Representative Sample Size Split or Material Submitted Used	
Representable Wet Wt, gm	199.7
+#4 Grnd., Washed DS., gm	24.2
-#4 Wet Wt., gm	175.5
-#4 Water Content, %	13.9
-#4 Dry Wt., gm	154.1
Representable Dry Wt, gm	**178.3**
* Note: Percentages +#4 are based on total Dry representable sample.	
Split Sample, -#4 washed over #200	
Tare No.	C2
Tare + WS., gm	208.28
Tare + DS., gm	197.9
Tare, gm	123.17
Wt. of DS., gm	74.73
Water Content -#4, %	13.9
Wt. of +#200 Sample, gm	27.5

US Std. Sieve Size	Sieve Opening (mm)	Wt. of Soil Retained (gm)	Percent Retained (%)	Cumulative Percent Retained	Percent Finer (%)	Final Percent Finer
3"	75	0	0.0	0.0	100.0	100.0
2 1/2"	62.5	0	0.0	0.0	100.0	100.0
2"	50	0	0.0	0.0	100.0	100.0
1 1/2"	37.5	0	0.0	0.0	100.0	100.0
1"	25	0	0.0	0.0	100.0	100.0
3/4"	19	0	0.0	0.0	100.0	100.0
1/2"	12.5	6.72	3.8	3.8	96.2	96.2
3/8"	9.5	8.87	5.0	8.7	91.3	91.3
#4	4.75	8.57	4.8	13.6	86.4	86.4
#10	2	6.78	9.1	9.1	90.9	78.6
#20	0.85	7.31	9.8	18.9	81.1	70.1
#40	0.425	4.57	6.1	25.0	75.0	64.9
#60	0.25	2.96	4.0	28.9	71.1	61.4
#140	0.106	4.02	5.4	34.3	65.7	56.8
#200	0.075	1.82	2.4	36.7	63.3	54.7
Pan	-	27.5	13.9	50.6	-	-

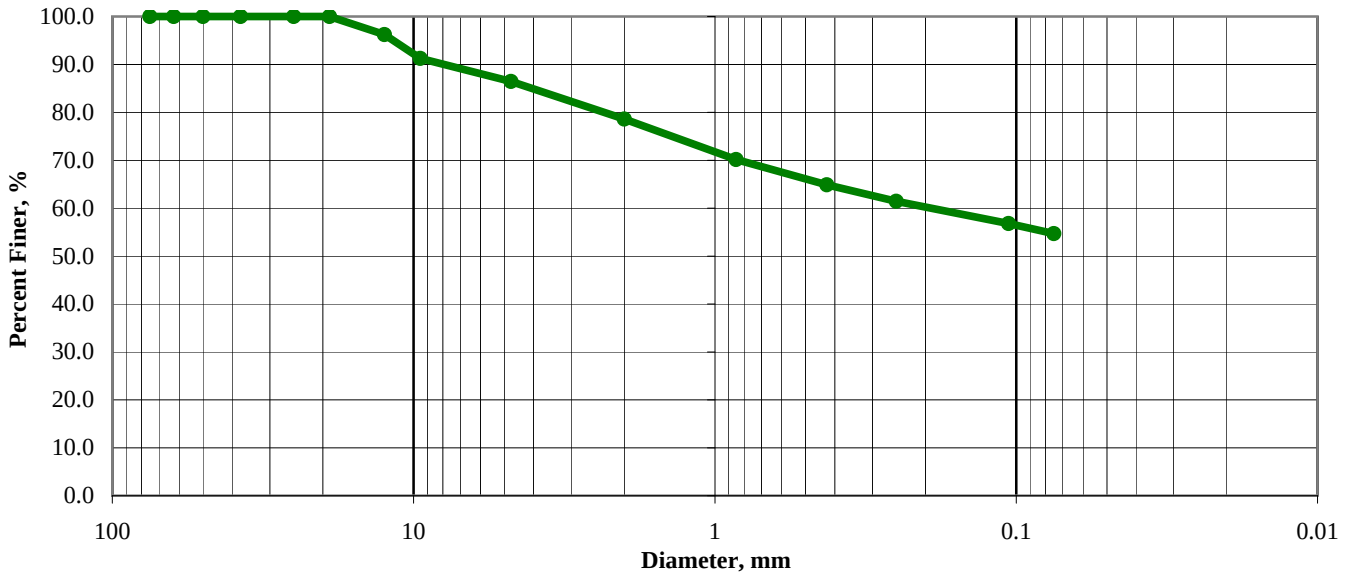
The final percent finer combines the gradation of the plus #4 and minus #4 material.

USCS SOIL CLASSIFICATION

Corrected For 100% Passing a 3" Sieve

% Gravel (-3" & +#4)	**13.6**		
Coarse=0; Fine=13.6		D60, mm	NA
% Sand (-#4 & +#200)	**31.8**	D30, mm	NA
Coarse=7.8; Med.=13.7; Fine=10.2		D10, mm	NA
% Fines (-#200)	**54.7**	Cc	NA
% Plus #200 (-3")	**45.3**	Cu	NA

USCS Description		
SANDY LEAN CLAY		
USCS Group Symbol	Atterberg Limits Group Symbol	
CL	**CL, LL=38, PL=10, PI=28**	
Auxiliary Information	Wt Ret, gm	% Retained	% Finer
12" Sieve - 300 mm	0	0.0	100.0
6" Sieve - 150 mm	0	0.0	100.0
3" Sieve - 75 mm	0	0.0	100.0



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LIQUID LIMIT, PLASTIC LIMIT, AND PLASTICITY INDEX OF SOILS

Client	Civil & Environmental Consultants, Ir	Boring No.	SB-17
Client Project	091-867 Apex Landfill Expansion	Depth(ft)	6'-8'
Project No.	30598	Sample No.	SS-4
		Lab Sample No.	30598037

Soil Description: DARK GRAYISH BROWN LEAN CLAY
(-#40 Fraction)

AS-RECEIVED W.C.

Tare Number	C2
Wt. Tare & WS, gm	208.28
Wt. Tare & DS, gm	197.90
Wt. Water, gm	10.38
Wt. Tare, gm	123.17
Wt. DS, gm	74.73
Water Content, %	13.9

SAMPLE SUMMARY

Liquid Limit (LL), %	38
Plastic Limit (PL), %	10
Plasticity Index (PI)	28
USCS Symbol (-#40 Fraction)	CL
Sample Preparation:	Wet Method
Liquidity Index, %	13.9%
Clay Fraction (% 2 microns)	NA
Skempton's Activity (A)	NA

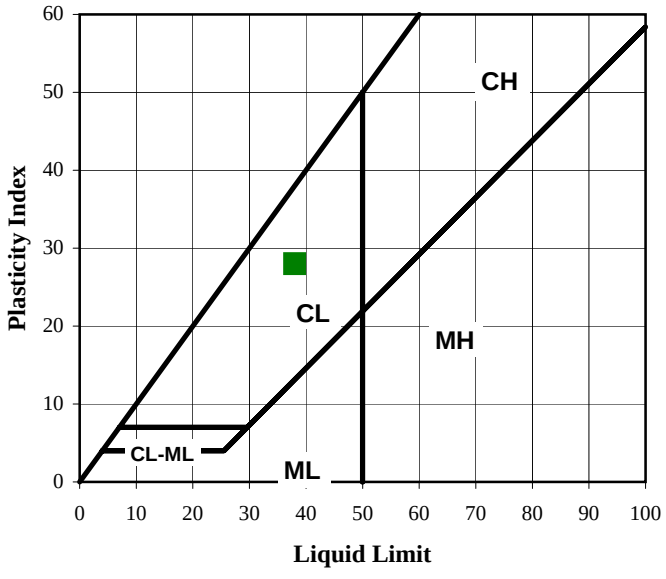
PLASTIC LIMIT

Test Number	1	2	3
Tare Number	403	509	429
Wt. Tare & WS, gm	18.55	20.50	18.88
Wt. Tare & DS, gm	17.85	19.65	18.15
Wt. Water, gm	0.70	0.85	0.73
Wt. Tare, gm	10.75	10.71	10.62
Wt. DS, gm	7.10	8.94	7.53
Water Content, %	9.9	9.5	9.7

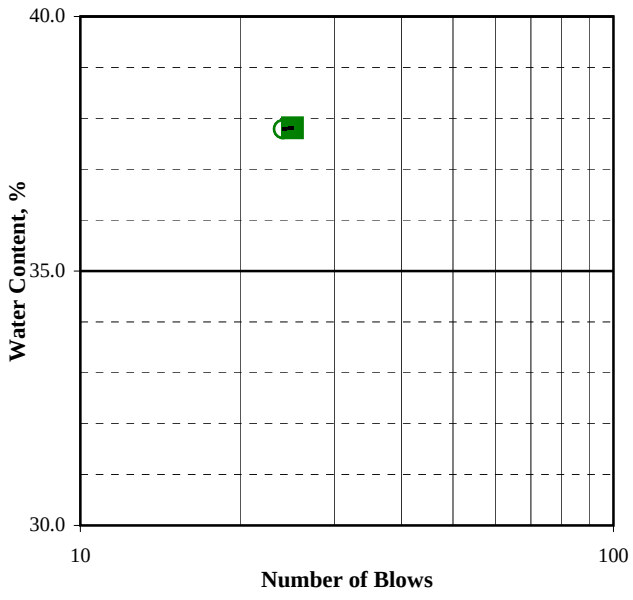
LIQUID LIMIT

	1	2
Tare Number	430	426
Wt. Tare & WS, gm	19.63	21.57
Wt. Tare & DS, gm	17.21	18.60
Wt. Water, gm	2.42	2.97
Wt. Tare, gm	10.81	10.74
Wt. DS, gm	6.40	7.86
Water Content, %	37.8	37.8
# of Blows	25	24

PLASTICITY CHART



FLOW CURVE



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PARTICLE-SIZE ANALYSIS OF SOILS

Client	Civil & Environmental Consultants, Ir	Boring	SB-18
Client Project	091-867 Apex Landfill Expansion	Depth	28'-30'
Project No.	30598	Sample	SS-11
		Lab Sample No.	30598038
USCS Description	DARK GRAY CLAYEY GRAVEL WITH SAND		
USCS Group Symbol	GC		
AASHTO Classification	A-7-6 (3)		

MECHANICAL SIEVE ANALYSIS

As-Received Representative Sample Size Split or Material Submitted Used	
Representable Wet Wt, gm	270.8
+#4 Grnd., Washed DS., gm	102.5
-#4 Wet Wt., gm	168.3
-#4 Water Content, %	17.3
-#4 Dry Wt., gm	143.5
Representable Dry Wt, gm	**246.0**
* Note: Percentages +#4 are based on total Dry representable sample.	
Split Sample, -#4 washed over #200	
Tare No.	446
Tare + WS., gm	154.13
Tare + DS., gm	143.7
Tare, gm	83.31
Wt. of DS., gm	60.39
Water Content -#4, %	17.3
Wt. of +#200 Sample, gm	20.9

US Std. Sieve Size	Sieve Opening (mm)	Wt. of Soil Retained (gm)	Percent Retained (%)	Cumulative Percent Retained	Percent Finer (%)	Final Percent Finer
3"	75	0	0.0	0.0	100.0	100.0
2 1/2"	62.5	0	0.0	0.0	100.0	100.0
2"	50	0	0.0	0.0	100.0	100.0
1 1/2"	37.5	0	0.0	0.0	100.0	100.0
1"	25	0	0.0	0.0	100.0	100.0
3/4"	19	0	0.0	0.0	100.0	100.0
1/2"	12.5	80.8	32.8	32.8	67.2	67.2
3/8"	9.5	9.43	3.8	36.7	63.3	63.3
#4	4.75	12.3	5.0	41.7	58.3	58.3
#10	2	3.84	6.4	6.4	93.6	54.6
#20	0.85	6.01	10.0	16.3	83.7	48.8
#40	0.425	4.02	6.7	23.0	77.0	44.9
#60	0.25	2.63	4.4	27.3	72.7	42.4
#140	0.106	3.15	5.2	32.5	67.5	39.3
#200	0.075	1.23	2.0	34.6	65.4	38.2
Pan	-	20.9	14.5	49.1	-	-

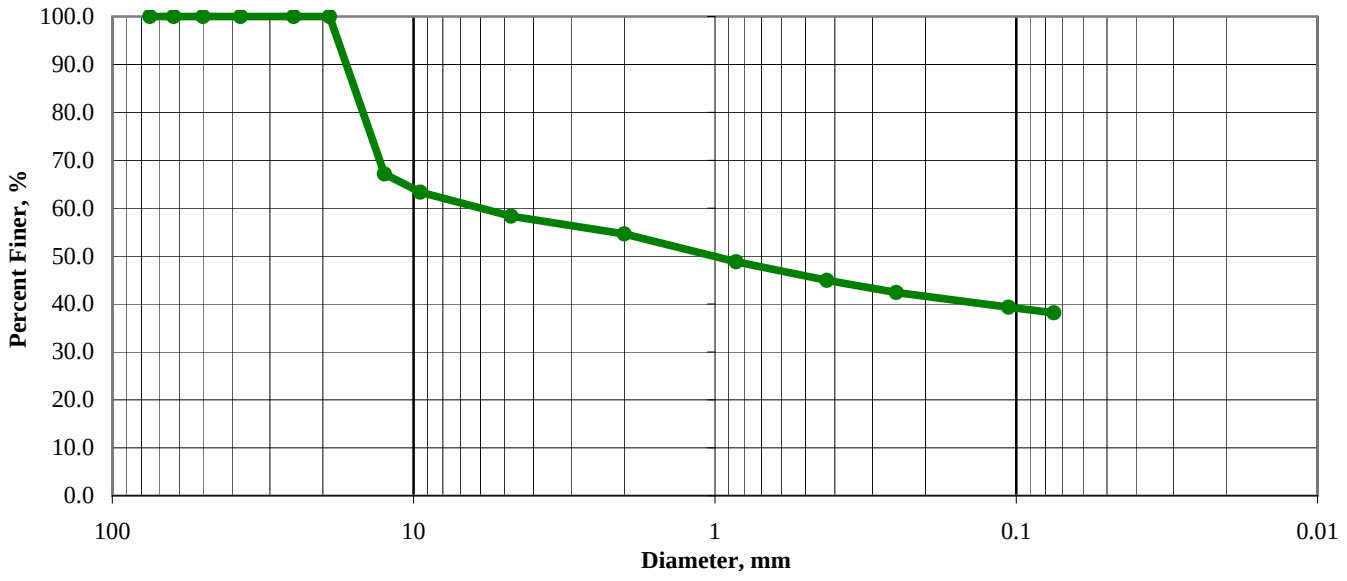
The final percent finer combines the gradation of the plus #4 and minus #4 material.

USCS SOIL CLASSIFICATION

Corrected For 100% Passing a 3" Sieve

% Gravel (-3" & +#4)	**41.7**		
Coarse=0; Fine=41.7		D60, mm	NA
% Sand (-#4 & +#200)	**20.2**	D30, mm	NA
Coarse=3.7; Med.=9.7; Fine=6.8		D10, mm	NA
% Fines (-#200)	**38.2**	Cc	NA
% Plus #200 (-3")	**61.8**	Cu	NA

USCS Description		
CLAYEY GRAVEL WITH SAND		
USCS Group Symbol	Atterberg Limits Group Symbol	
GC	**CL, LL=41, PL=20, PI=21**	
Auxiliary Information	Wt Ret, gm	% Retained	% Finer
12" Sieve - 300 mm	0	0.0	100.0
6" Sieve - 150 mm	0	0.0	100.0
3" Sieve - 75 mm	0	0.0	100.0



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LIQUID LIMIT, PLASTIC LIMIT, AND PLASTICITY INDEX OF SOILS

Client	Civil & Environmental Consultants, Ir	Boring No.	SB-18
Client Project	091-867 Apex Landfill Expansion	Depth(ft)	28'-30'
Project No.	30598	Sample No.	SS-11
		Lab Sample No.	30598038

Soil Description: DARK GRAY LEAN CLAY
(-#40 Fraction)

AS-RECEIVED W.C.

Tare Number	446
Wt. Tare & WS, gm	154.13
Wt. Tare & DS, gm	143.70
Wt. Water, gm	10.43
Wt. Tare, gm	83.31
Wt. DS, gm	60.39
Water Content, %	17.3

SAMPLE SUMMARY

Liquid Limit (LL), %	41
Plastic Limit (PL), %	20
Plasticity Index (PI)	21
USCS Symbol (-#40 Fraction)	CL
Sample Preparation:	Wet Method
Liquidity Index, %	-13.0%
Clay Fraction (% 2 microns)	NA
Skempton's Activity (A)	NA

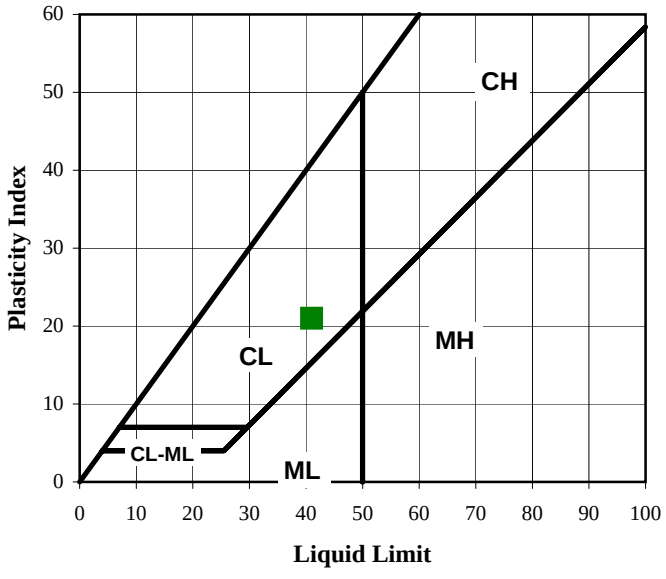
PLASTIC LIMIT

Test Number	1	2	3
Tare Number	421	426	
Wt. Tare & WS, gm	16.87	17.32	
Wt. Tare & DS, gm	15.82	16.23	
Wt. Water, gm	1.05	1.09	
Wt. Tare, gm	10.79	10.74	
Wt. DS, gm	5.03	5.49	
Water Content, %	20.9	19.9	

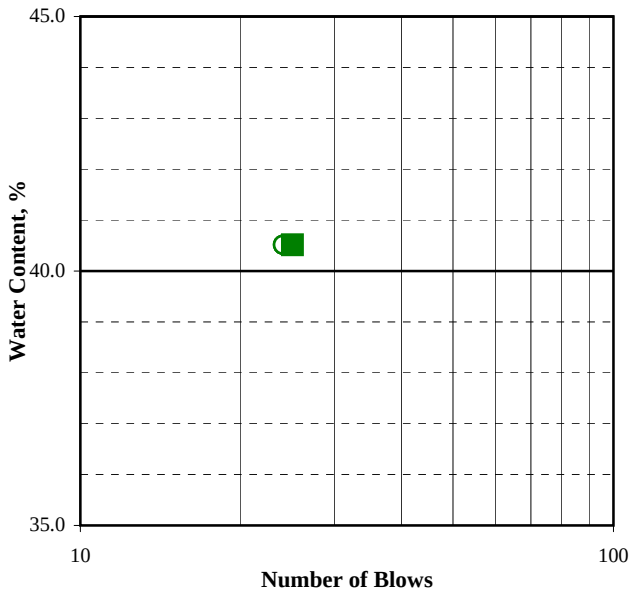
LIQUID LIMIT

	1
	427
	21.19
	18.20
	2.99
	10.82
	7.38
	40.5
# of Blows	24

PLASTICITY CHART



FLOW CURVE



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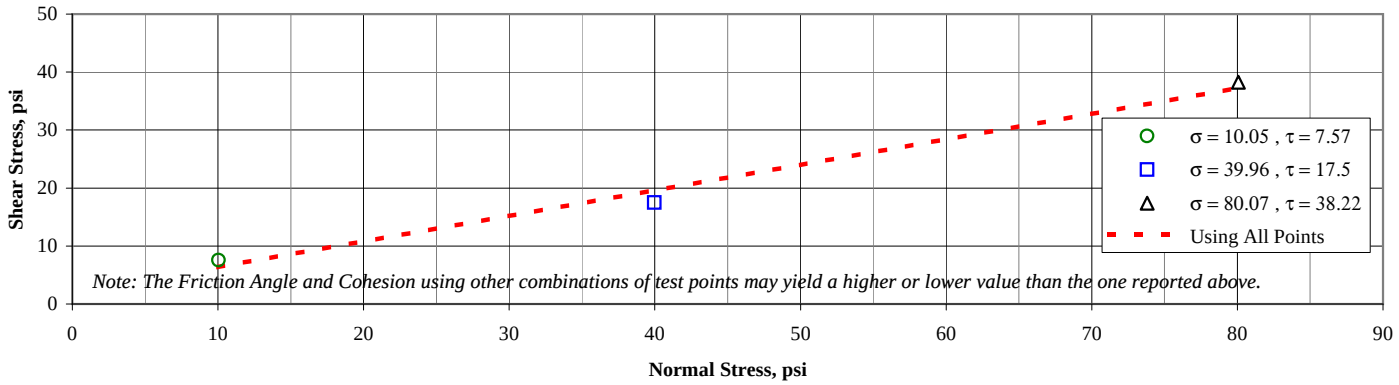
DIRECT SHEAR TEST OF SOILS UNDER CONSOLIDATED DRAINED CONDITIONS

Client	Civil & Environmental Consultants, Inc.	Boring	SB-14
Client Project	091-867 Apex Landfill Expansion	Depth	25' - 27'
Project No.	30598	Sample	ST-2 Bottom
		Lab No.	30598039

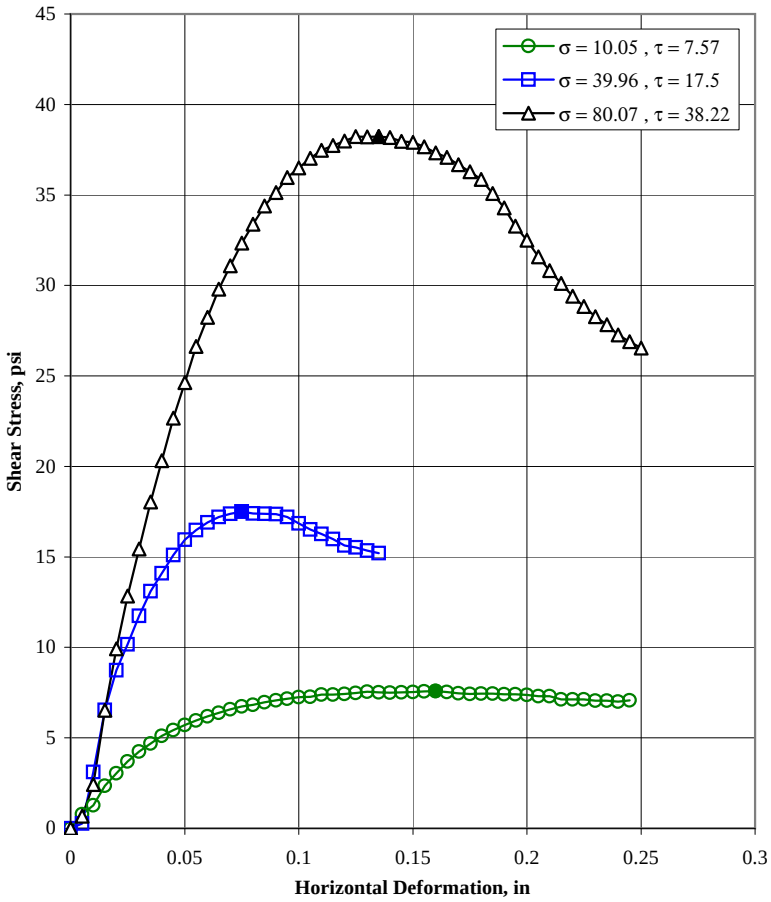
Visual Description	Grayish Brown Fat Clay
Sample Condition	Undisturbed

NORMAL STRESS vs. SHEAR STRESS

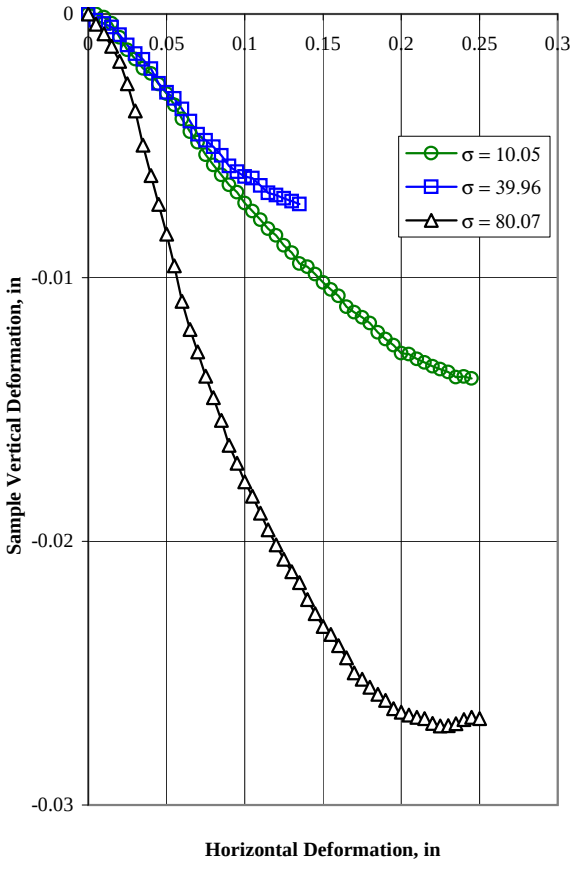
ϕ = 23.8° c = 1.9 psi



HORIZONTAL DEFORMATION vs. SHEAR STRESS



HORIZONTAL DEFORMATION vs. SAMPLE HEIGHT



Note: The calculations performed and the parameters presented herein are for preliminary purposes only. GTS only accepts responsibility for the raw data obtained from the direct shear tests. This data may be interpreted differently by others. It is the responsibility of the user to determine the appropriateness and accuracy of the computed values.

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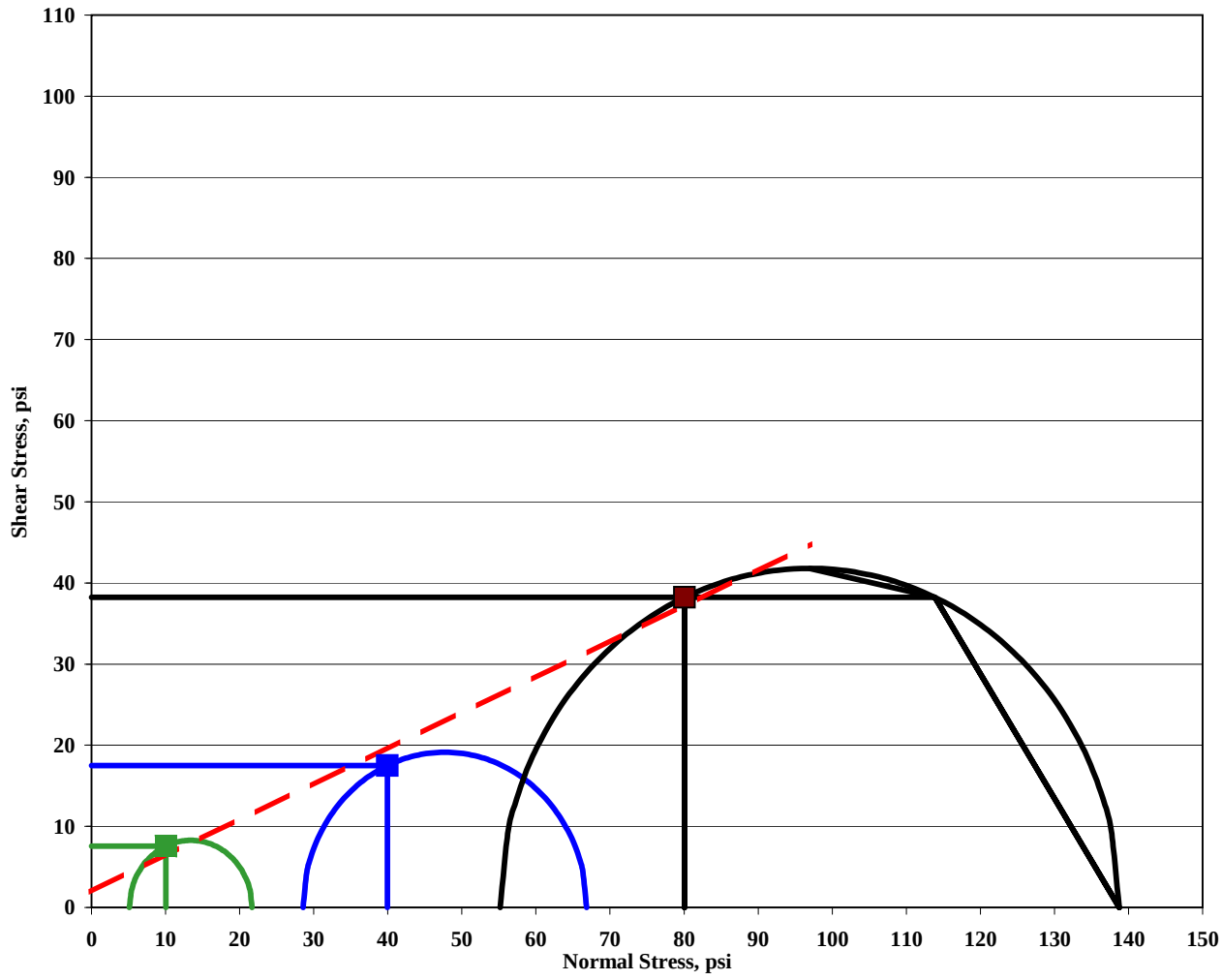
DIRECT SHEAR TEST OF SOILS
UNDER CONSOLIDATED, DRAINED CONDITIONS
MOHRS'S CIRCLE AND FAILURE PARAMETERS

Client:	Civil & Environmental Consultants, Inc.	Boring:	SB-14
Client Project	091-867 Apex Landfill Expansion	Depth:	25' - 27'
Project No.	30598	Sample:	ST-2 Bottom
		Lab Sample ID	30598039
Material:	Grayish Brown Fat Clay		
Condition	Undisturbed		

Average Friction Angle, ϕ, deg.		**23.8**	**Using All Points**
Average Cohesion, c, psi		**1.9**	**Using All Points**
Sample Condition		Undisturbed	
Normal Stress, psi	10.05	39.96	80.07
Shear Stress at Failure, psi	7.57	17.50	38.22
Mohr's Circle Radius, psi	8.3	19.1	41.8
Mohr's Circle Origin, psi	13.4	47.7	97.0
(Origin - Normal Stress), psi	3.3	7.7	16.9
Minor Principal Stress σ3, psi	5.1	28.6	55.2
Major Principal Stress σ1, psi	21.7	66.8	138.8
Principal Stress Difference, σ1–σ3, psi	16.6	38.3	83.6
Normal Stress Pole Coordinate, X, psi	16.7	55.4	113.9
Shear Stress Pole Coordinate, Y, psi	7.6	17.5	38.2
Assumed Failure Plane, deg	0 - Horizontal	0 - Horizontal	0 - Horizontal
Major Principal Failure Plane Angle, deg	56.9	56.9	56.9
Minor Principal Failure Plane Angle, deg	33.1	33.1	33.1
Maximum Shear Stress, psi	8.3	19.1	41.8
Maximum Shear Failure Plane Angle, deg	11.9	11.9	11.9
Initial Water Content, %	**38.1%**	**38.1%**	**38.1%**
Initial Dry Density, pcf	**78.0**	**90.6**	**77.6**



DIRECT SHEAR TEST OF SOILS UNDER CONSOLIDATED DRAINED CONDITIONS - ASTM D 3080

Client	Civil & Environmental Consultant	Boring	SB-14
Client Project	091-867 Apex Landfill Expansion	Depth	25' - 27'
Project No.	30598	Sample	ST-2 Bottom
		Lab No.	30598039
Visual Description	Grayish Brown Fat Clay		
Sample Condition	Undisturbed		

SAMPLE CONDITIONS

Test No.	1			2			3		
	Initial	**After Consol.**	**Final**	**Initial**	**After Consol.**	**Final**	**Initial**	**After Consol.**	**Final**
Tare I.D.	A45	-	Z3	A45	-	Z2	A45	-	Z1
Wt. Wet Soil & Tare, gm	94.14	-	260.67	94.14	-	276.26	94.14	-	256.49
Wt. Dry Soil & Tare, gm	70.66	-	217.43	70.66	-	242.63	70.66	-	216.55
Wt. Tare, gm	9.06	-	123.27	9.06	-	123.1	9.06	-	123.14
Water Content, %	38.1%	-	45.9%	38.1%	-	28.1%	38.1%	-	42.8%
Wt. of Wet Soil & Mold, gr	291.22	-	-	312.52	-	-	289.06	-	-
Wt. of Mold, gm	152.31	-	-	151.14	-	-	150.96	-	-
Wt. of Wet Soil, gm	138.91	-	-	161.38	-	-	138.1	-	-
Sample Height, in	1	0.9688	0.9550	1	0.9374	0.9302	1	0.8543	0.8275
Sample Diameter, in	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5
Sample Area, in^2	4.9	4.9	4.9	4.9	4.9	4.9	4.9	4.9	4.9
Sample Volume, cc	80.44	77.93	76.82	80.44	75.41	74.83	80.44	68.72	66.57
Wet Density, pcf	107.8	NA	119.2	125.2	NA	124.9	107.1	NA	133.8
Dry Density, pcf	78.0	NA	81.7	90.6	NA	97.4	77.6	NA	93.7

DEFORMATION RATE CALCULATIONS

t_{90}, min. (Sqrt. Method)	0.34	26.01	0.37
Equivalent t_{50}, min. (Sqrt.)	0.08	6.08	0.09
t_{50}, min. (Log Method)	0.16	0.82	0.23
Selected t_{50}, min. (Max.)	0.16	6.08	0.23
Calc. Disp. Rate, in./min.	0.0200	0.0002	0.0117

TEST DATA AND SUMMARY

Test No.	1		2		3	
Normal Stress, psi	**10.05**		**39.96**		**80.07**	
Shear Stress at Failure, psi	**7.6**	**Peak**	**17.5**	**Peak**	**38.2**	**Peak**
Shear Disp. at Failure, in	**0.160**		**0.075**		**0.135**	
Displacement Rate, in/min	**0.0020**		**0.0020**		**0.0020**	

Horizontal Displacement in	Shear Force lb.	Shear Stress psi	Vertical Deformation in	Shear Force lb.	Shear Stress psi	Vertical Deformation in	Shear Force lb.	Shear Stress psi	Vertical Deformation in
0	0.0	0.0	0.000	0.0	0.0	0.000	0.0	0.0	0.000
0.005	3.8	0.8	0.000	1.3	0.3	0.000	3.3	0.7	0.000
0.010	6.3	1.3	0.000	15.3	3.1	0.000	11.9	2.4	-0.001
0.015	11.5	2.3	0.000	32.1	6.5	0.000	32.0	6.5	-0.001
0.020	15.0	3.0	-0.001	42.9	8.7	-0.001	48.7	9.9	-0.002
0.025	18.1	3.7	-0.001	49.9	10.2	-0.001	63.0	12.8	-0.003
0.030	20.8	4.2	-0.002	57.6	11.7	-0.002	75.8	15.4	-0.004
0.035	23.0	4.7	-0.002	64.3	13.1	-0.002	88.5	18.0	-0.005
0.040	25.1	5.1	-0.002	69.2	14.1	-0.002	99.7	20.3	-0.006
0.045	26.7	5.4	-0.003	74.1	15.1	-0.003	111.2	22.7	-0.007
0.050	28.0	5.7	-0.003	78.3	16.0	-0.003	120.9	24.6	-0.008
0.055	29.3	6.0	-0.003	80.9	16.5	-0.003	130.7	26.6	-0.010
0.060	30.4	6.2	-0.004	83.0	16.9	-0.004	138.6	28.2	-0.011
0.065	31.4	6.4	-0.004	84.5	17.2	-0.004	146.3	29.8	-0.012
0.070	32.3	6.6	-0.005	85.4	17.4	-0.005	152.6	31.1	-0.013

Horizontal Displacement in	Shear Force lb.	Shear Stress psi	Vertical Deformation in	Shear Force lb.	Shear Stress psi	Vertical Deformation in	Shear Force lb.	Shear Stress psi	Vertical Deformation in
0.075	33.1	6.7	-0.005	85.9	17.5	-0.005	158.7	32.3	-0.014
0.080	33.5	6.8	-0.006	85.4	17.4	-0.005	163.8	33.4	-0.015
0.085	34.2	7.0	-0.006	85.3	17.4	-0.005	168.9	34.4	-0.015
0.090	34.7	7.1	-0.006	85.3	17.4	-0.006	172.5	35.1	-0.016
0.095	35.2	7.2	-0.007	84.4	17.2	-0.006	176.5	36.0	-0.017
0.100	35.6	7.2	-0.007	82.7	16.8	-0.006	179.2	36.5	-0.018
0.105	35.7	7.3	-0.007	81.1	16.5	-0.006	181.8	37.0	-0.018
0.110	36.3	7.4	-0.008	79.8	16.3	-0.007	183.9	37.5	-0.019
0.115	36.3	7.4	-0.008	78.5	16.0	-0.007	185.2	37.7	-0.020
0.120	36.5	7.4	-0.008	76.8	15.6	-0.007	186.4	38.0	-0.020
0.125	36.8	7.5	-0.009	76.2	15.5	-0.007	187.6	38.2	-0.021
0.130	37.0	7.5	-0.009	75.4	15.4	-0.007	187.6	38.2	-0.021
0.135	36.9	7.5	-0.009	74.6	15.2	-0.007	187.7	38.2	-0.022
0.140	36.8	7.5	-0.010				187.4	38.2	-0.022
0.145	36.9	7.5	-0.010				186.4	38.0	-0.023
0.150	37.0	7.5	-0.010				186.1	37.9	-0.023
0.155	37.1	7.6	-0.010				184.9	37.7	-0.024
0.160	37.2	7.6	-0.011				183.2	37.3	-0.024
0.165	36.9	7.5	-0.011				182.0	37.1	-0.024
0.170	36.7	7.5	-0.011				180.0	36.7	-0.025
0.175	36.5	7.4	-0.012				178.1	36.3	-0.025
0.180	36.5	7.4	-0.012				176.0	35.9	-0.026
0.185	36.6	7.4	-0.012				172.2	35.1	-0.026
0.190	36.4	7.4	-0.012				168.3	34.3	-0.026
0.195	36.3	7.4	-0.013				163.4	33.3	-0.026
0.200	36.2	7.4	-0.013				159.6	32.5	-0.026
0.205	35.8	7.3	-0.013				155.0	31.6	-0.027
0.210	35.8	7.3	-0.013				151.3	30.8	-0.027
0.215	35.0	7.1	-0.013				147.8	30.1	-0.027
0.220	35.0	7.1	-0.013				144.3	29.4	-0.027
0.225	35.0	7.1	-0.013				141.6	28.8	-0.027
0.230	34.6	7.0	-0.014				138.8	28.3	-0.027
0.235	34.6	7.1	-0.014				136.6	27.8	-0.027
0.240	34.4	7.0	-0.014				133.9	27.3	-0.027
0.245	34.7	7.1	-0.014				132.0	26.9	-0.027
0.250							130.3	26.5	-0.027

Input Validation: Reviewed By:

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ONE DIMENSIONAL CONSOLIDATION TEST

Client	Civil & Environmental Consultant	Boring	SB-14	**Final Test Load, psi**	**10.05**
Client Project	091-867 Apex Landfill Expansion	Depth	25' - 27'		
Project No.	30598	Sample	ST-2 Bottom		
		Lab ID#	30598039		
Description	Grayish Brown Fat Clay				
Test Conditions:	Undisturbed				

Increment Start Date and Time: 12/09/10

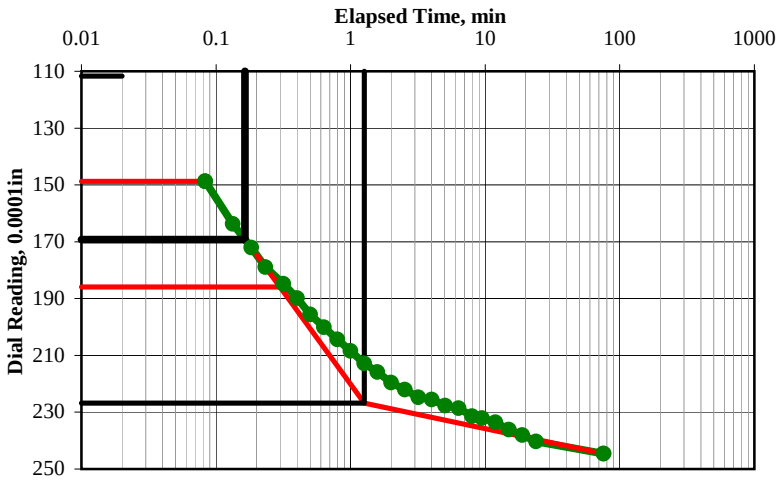
Elapsed Time (min)	Sqrt Time ($min^{1/2}$)	Dial Reading (0.0001in)	Sample Height (in)
0	0	0	1.0000
Corrections*		67	0.0067
Adjusted Sample Height			
0.08	0.29	148.8	0.9918
0.13	0.37	163.8	0.9903
0.18	0.43	172.1	0.9895
0.23	0.48	178.9	0.9888
0.32	0.56	184.8	0.9882
0.40	0.63	189.9	0.9877
0.50	0.71	195.6	0.9871
0.63	0.80	200.1	0.9867
0.80	0.89	204.4	0.9863
1.00	1.00	208.4	0.9859
1.27	1.13	212.8	0.9854
1.58	1.26	215.9	0.9851
2.00	1.41	219.5	0.9847
2.53	1.59	222.1	0.9845
3.18	1.78	224.8	0.9842
4.02	2.00	225.6	0.9841
5.05	2.25	227.7	0.9839
6.37	2.52	228.6	0.9838
8.02	2.83	231.5	0.9836
9.47	3.08	232.1	0.9835
11.92	3.45	233.6	0.9833
15.02	3.88	236.2	0.9831
18.92	4.35	238.0	0.9829
23.85	4.88	240.3	0.9827
76.03	8.72	244.6	0.9688

Machine Deflection

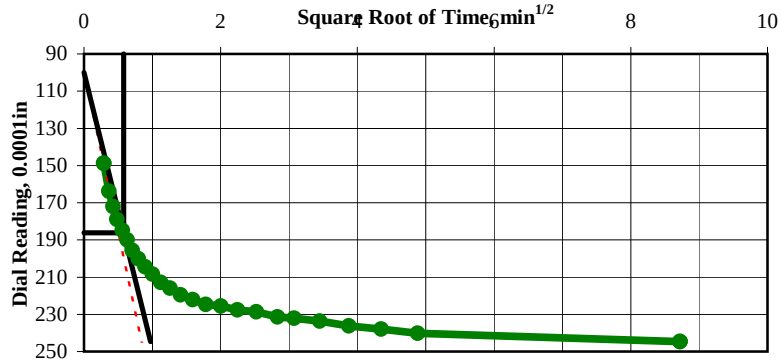
Applied Deflection Correction to Sample Height, 0.0001in 67

**Correction is applied to all dial readings.*

Log of Elapsed Time vs. Dial Reading



Square Root of Elapsed Time vs. Dial Reading



Sqrt. of Elapsed Time vs Dial Reading

T0 = 0 min.	D0 = 99.9 div.		
T90 = 0.336 min	D90 = 186.2 div.		
T100 = NA min	D100 = 195.7 div.		
Height at: D90 = 0.9747, D100 = 0.9737			
Average Sample Height, in	0.9844		
Average Drainage Height, in	0.4922		
T (Time Factor for T90)	0.848		
Coef. of Consol., C_v, in^2/min	0.607		

Log of Elapsed Time vs Dial Reading

T0 = 0 min.	D0 = 111.7 div.		
T50 = 0.16 min.	D50 = 169.2 div.		
T100 = 1.27 min.	D100 = 226.8 div.		
Height at: D50 = 0.9764, D100 = 0.9706			
Average Sample Height, in	0.9844		
Average Drainage Height, in	0.4922		
T (Time Factor for T50)	0.197		
Coef. of Consol., C_v, in^2/min	0.298		

Load Summary

Initial Sample Height, in	1.0000
Final Sample Height, in	0.9688
Incremental Strain, %	3.12%
Loading Duration, min	76

Input Validation: Reviewed By: Date 12/9/2010

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ONE DIMENSIONAL CONSOLIDATION TEST

Client	Civil & Environmental Consultant	Boring	SB-14	**Final Test Load, psi**	**39.96**
Client Project	091-867 Apex Landfill Expansion	Depth	25' - 27'		
Project No.	30598	Sample	ST-2 Bottom		
		Lab ID#	30598039		
Description	Grayish Brown Fat Clay				
Test Conditions:	Undisturbed				

Increment Start Date: 12/09/10

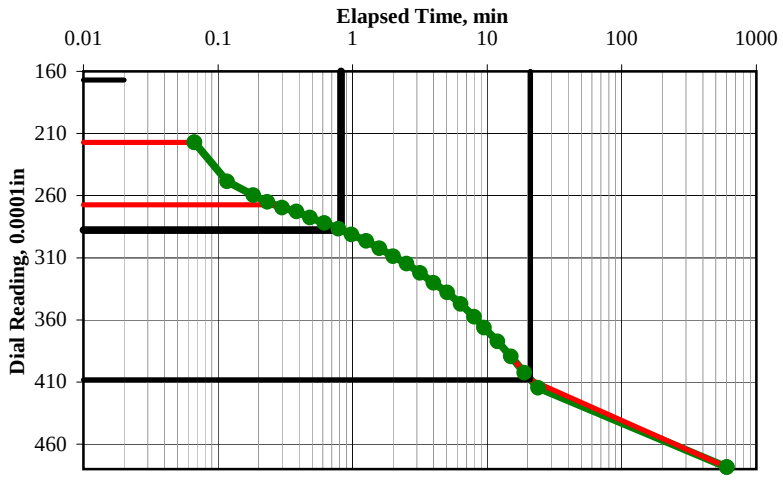
Elapsed Time (min)	Sqrt Time ($min^{1/2}$)	Dial Reading (0.0001in)	Sample Height (in)
0	0	0	1.0000
Corrections*		147	0.0147
Adjusted Sample Height			
0.07	0.26	217.3	0.9930
0.12	0.34	248.6	0.9898
0.18	0.43	259.6	0.9887
0.23	0.48	265.0	0.9882
0.30	0.55	269.6	0.9877
0.38	0.62	272.8	0.9874
0.48	0.70	277.7	0.9869
0.62	0.79	282.1	0.9865
0.78	0.89	286.6	0.9860
0.98	0.99	291.4	0.9856
1.27	1.13	296.4	0.9851
1.58	1.26	302.4	0.9845
2.00	1.41	308.8	0.9838
2.52	1.59	314.7	0.9832
3.17	1.78	322.3	0.9825
4.00	2.00	330.2	0.9817
5.05	2.25	338.0	0.9809
6.37	2.52	347.3	0.9800
8.02	2.83	357.6	0.9789
9.47	3.08	366.3	0.9781
11.92	3.45	377.2	0.9770
15.03	3.88	389.5	0.9757
18.93	4.35	402.4	0.9745
23.85	4.88	414.6	0.9732
603.07	24.56	478.5	0.9374

Machine Deflection

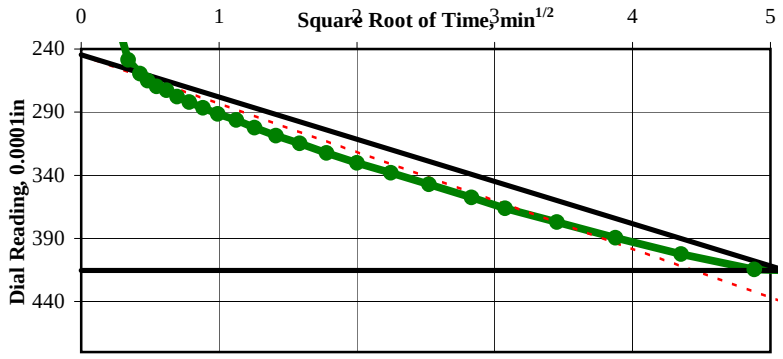
Applied Deflection Correction to Sample Height, 0.0001in 147

**Correction is applied to all dial readings.*

Log of Elapsed Time vs. Dial Reading



Square Root of Elapsed Time vs. Dial Reading



Sqrt. of Elapsed Time vs Dial Reading

T0 = 0 min.	D0 = 244.5 div.		
T90 = 26.01 min	D90 = 415.3 div.		
T100 = NA min	D100 = 434.3 div.		
Height at: D90 = 0.9438, D100 = 0.9419			
Average Sample Height, in	0.9687		
Average Drainage Height, in	0.4844		
T (Time Factor for T90)	0.848		
Coef. of Consol., C_v, in^2/min	0.008		

Log of Elapsed Time vs Dial Reading

T0 = 0 min.	D0 = 167.1 div.		
T50 = 0.82 min.	D50 = 287.6 div.		
T100 = 20.95 min.	D100 = 408.1 div.		
Height at: D50 = 0.9565, D100 = 0.9445			
Average Sample Height, in	0.9687		
Average Drainage Height, in	0.4844		
T (Time Factor for T50)	0.197		
Coef. of Consol., C_v, in^2/min	0.056		

Load Summary

Initial Sample Height, in	1.0000
Final Sample Height, in	0.9374
Incremental Strain, %	6.26%
Loading Duration, min	603

Input Validation: Reviewed By: Date 12/9/2010

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ONE DIMENSIONAL CONSOLIDATION TEST

Client	Civil & Environmental Consultant	Boring	SB-14	**Final Test Load, psi**	**80.07**
Client Project	091-867 Apex Landfill Expansion	Depth	25' - 27'		
Project No.	30598	Sample	ST-2 Bottom		
		Lab ID#	30598039		
Description	Grayish Brown Fat Clay				
Test Conditions:	Undisturbed				

Increment Start Date: 12/08/10

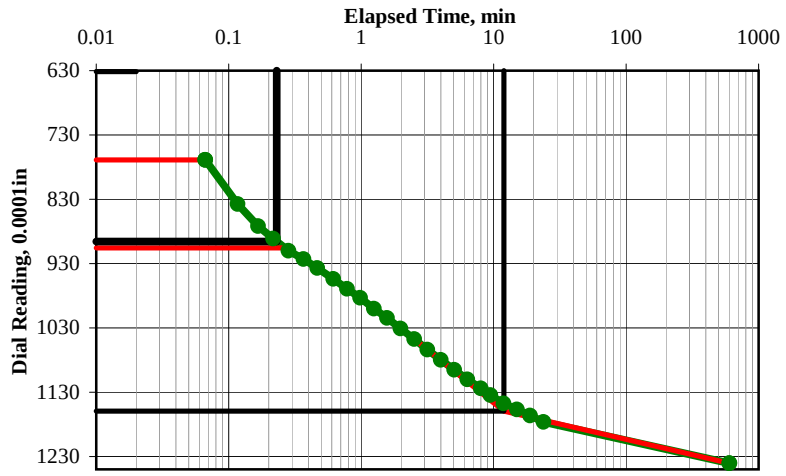
Elapsed Time (min)	Sqrt Time ($min^{1/2}$)	Dial Reading (0.0001in)	Sample Height (in)
0	0	0	1.0000
Corrections*		217	0.0217
Adjusted Sample Height			
0.07	0.26	768.7	0.9448
0.12	0.34	837.6	0.9379
0.17	0.41	872.0	0.9345
0.22	0.47	891.1	0.9326
0.28	0.53	910.0	0.9307
0.37	0.61	923.3	0.9294
0.47	0.68	937.0	0.9280
0.62	0.79	954.0	0.9263
0.78	0.89	969.1	0.9248
0.98	0.99	983.3	0.9234
1.25	1.12	1000.2	0.9217
1.57	1.25	1014.6	0.9202
1.98	1.41	1031.1	0.9186
2.52	1.59	1047.3	0.9170
3.17	1.78	1063.9	0.9153
4.00	2.00	1079.6	0.9137
5.03	2.24	1095.4	0.9122
6.35	2.52	1110.4	0.9107
8.00	2.83	1124.3	0.9093
9.45	3.07	1134.8	0.9082
11.90	3.45	1147.4	0.9070
15.00	3.87	1157.1	0.9060
18.90	4.35	1166.6	0.9050
23.83	4.88	1176.2	0.9041
603.03	24.56	1240.4	0.8543

Machine Deflection

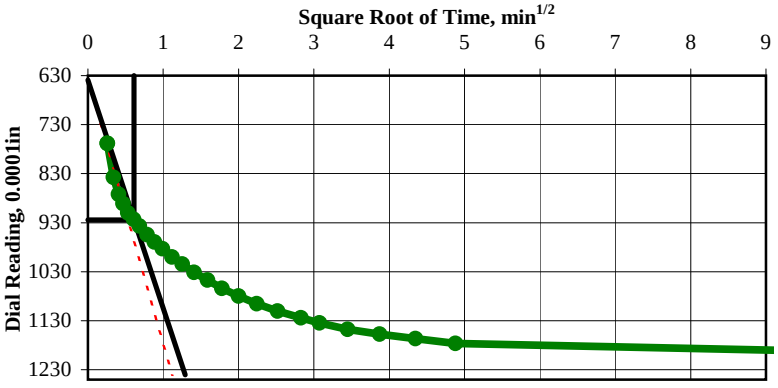
Applied Deflection Correction to Sample Height, 0.0001in 217

**Correction is applied to all dial readings.*

Log of Elapsed Time vs. Dial Reading



Square Root of Elapsed Time vs. Dial Reading



Sqrt. of Elapsed Time vs Dial Reading

T0 = 0 min.	D0 = 639.3 div.		
T90 = 0.372 min	D90 = 924.5 div.		
T100 = NA min	D100 = 956.2 div.		
Height at: D90 = 0.8859, D100 = 0.8827			
Average Sample Height, in	0.9271		
Average Drainage Height, in	0.4636		
T (Time Factor for T90)	0.848		
Coef. of Consol., C_v, in^2/min	0.486		

Log of Elapsed Time vs Dial Reading

T0 = 0 min.	D0 = 631.6 div.		
T50 = 0.23 min.	D50 = 895.5 div.		
T100 = 11.92 min.	D100 = 1159.4 div.		
Height at: D50 = 0.8888, D100 = 0.8624			
Average Sample Height, in	0.9271		
Average Drainage Height, in	0.4636		
T (Time Factor for T50)	0.197		
Coef. of Consol., C_v, in^2/min	0.184		

Load Summary

Initial Sample Height, in	1.0000
Final Sample Height, in	0.8543
Incremental Strain, %	14.57%
Loading Duration, min	603

Input Validation: Reviewed By: Date 12/8/2010

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PARTICLE-SIZE ANALYSIS OF SOILS
ASTM D 422

Client	Civil & Environmental Consultants, I	Boring	SB-12-1
Client Project	091-867 Apex Landfill Expansion	Depth	16'-18'
Project No.	31208	Sample	ST-1
		Lab Sample No.	31208001

USCS Description **BROWN SANDY LEAN CLAY**
USCS Group Symbol **CL** AASHTO: **A-7-6 (12)**
USDA Description **LOAM**

MECHANICAL SIEVE ANALYSIS

As-Received Sample Correction For Split Samples (J-Factor)	
+3/4" Air Dry Wt, gm	0.0
100% Passing 3/4 Sieve No Correction Needed.	
Passing -3/4" (J-Factor)	1.00
Split Sample, -3/4"	
Tare No.	978
Wt. Tare + WS., gm	1097.32
Wt. Tare + DS., gm	918.6
Wt. Tare, gm	102.08
Wt. of DS., gm	816.52
Water Content, %	21.9
Wt. of +#200 Sample, gm	295.5
Wt. of -#200 Sample, gm	521.0

US Std. Sieve Size	Sieve Opening (mm)	Wt. of Soil Retained (gm)	Percent Retained (%)	Cumulative Percent Retained	Percent Finer (%)	Final Percent Finer
3"	75	0	0.0	0.0	100.0	100.0
2 1/2"	62.5	0	0.0	0.0	100.0	100.0
2"	50	0	0.0	0.0	100.0	100.0
1 1/2"	37.5	0	0.0	0.0	100.0	100.0
1"	25	0	0.0	0.0	100.0	100.0
3/4"	19	0	0.0	0.0	100.0	100.0
1/2"	12.5	12.53	1.5	1.5	98.5	98.5
3/8"	9.5	12.58	1.5	3.1	96.9	96.9
#4	4.75	21.62	2.6	5.7	94.3	94.3
#10	2	36.84	4.5	10.2	89.8	89.8
#20	0.85	33.85	4.1	14.4	85.6	85.6
#40	0.425	33.21	4.1	18.4	81.6	81.6
#60	0.25	46.47	5.7	24.1	75.9	75.9
#140	0.106	70.71	8.7	32.8	67.2	67.2
#200	0.075	27.68	3.4	36.2	63.8	63.8
Pan	-	521.0	63.8	100.0	-	-

The final percent finer combines the gradation of the plus 3/4" and minus 3/4" material.

HYDROMETER ANALYSIS

Hydrometer Sample Weight	
Tare No.	969
Wt. Tare + DS., gm	151.22
Wt. Tare, gm	102.84
Wt. Dispers., gm	5
Wt. Dry Soil, gm	43.38
-#10 Dispersed 1min in Hamilton Beach Mixer	
K Factor	0.0131
Composite Correction	6
a Factor	0.99
Average Test Temp, °C	22.3
Specific Gravity, Assumed	2.7

Elapsed Time (min.)	R Measured	Composite Correction	R Corrected	Percent Finer (%)	Particle Diameter (mm)	Adjusted % Finer (%)
0	NA	NA	NA	NA	NA	NA
2	44.5	6	38.5	87.8	0.0277	56.0
5	40.5	6	34.5	78.6	0.0181	50.2
15	36	6	30	68.4	0.0109	43.6
30	33	6	27	61.5	0.0079	39.3
60	29.5	6	23.5	53.6	0.0057	34.2
250	24	6	18	41.0	0.0029	26.2
1440	20	6	14	31.9	0.0012	20.4

The adjusted percent finer is corrected for the percent passing the -#200 sieve.

USCS SOIL CLASSIFICATION

Corrected For 100% Passing a 3" Sieve

% Gravel (-3" & +#4)	**5.7**	Silt=31.1%	Clay=32.6%
Coarse=0; Fine=5.7		D60, mm	NA
% Sand (-#4 & +#200)	**30.5**	D30, mm	NA
Coa.=4.5; Med.=8.2; Fine=17.7		D10, mm	NA
% Fines (-#200)	**63.8**	Cc	NA
% Plus #200 (-3")	**36.2**	Cu	NA

USCS Description
SANDY LEAN CLAY

USCS Group Symbol	Atterberg Limits Group Symbol
CL	**CL, LL=43, PL=22, PI=21**

Auxiliary Information	Wt Ret, gm	% Retained	% Finer
12" Sieve - 300 mm	0	0.0	100.0
6" Sieve - 150 mm	0	0.0	100.0
3" Sieve - 75 mm	0	0.0	100.0

USDA CLASSIFICATION

Particle Size (mm)	Percent Finer (%)	Percent of Each Component (Material)	(%)	Corrected Percent of -2.0 mm Material for USDA
100	100			
		Gravel	10.2	0
2	89.8			
		Sand	29.1	32.5
0.05	60.6			
		Silt	37.0	41.2
0.002	23.6			
		Clay	23.6	26.3

USDA Classification
LOAM

Input Validation: Reviewed By: Date Tested: 2/25/2011

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LIQUID LIMIT, PLASTIC LIMIT, AND PLASTICITY INDEX OF SOILS
ASTM D 4318

Client	Civil & Environmental Consultants, I	Boring No.	SB-12-1
Client Project	091-867 Apex Landfill Expansion	Depth(ft)	16'-18'
Project No.	31208	Sample No.	ST-1
		Lab Sample No.	31208001

Soil Description: BROWN LEAN CLAY
(-#40 Fraction)

AS-RECEIVED W.C.

Tare Number	978
Wt. Tare & WS, gm	1097.32
Wt. Tare & DS, gm	918.60
Wt. Water, gm	178.72
Wt. Tare, gm	102.08
Wt. DS, gm	816.52
Water Content, %	21.9

SAMPLE SUMMARY

Liquid Limit (LL), %	43
Plastic Limit (PL), %	22
Plasticity Index (PI)	21
USCS Symbol (-#40 Fraction)	CL
Sample Preparation:	Wet Method
Liquidity Index, %	-0.5%
Clay Fraction (% 2 microns)	NA
Skempton's Activity (A)	NA

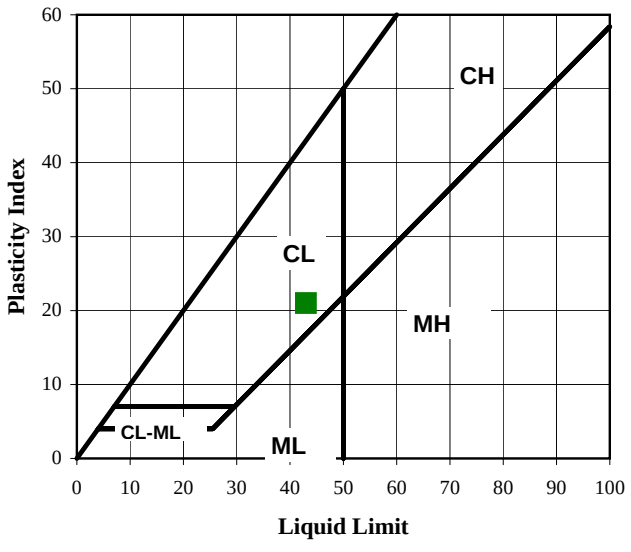
PLASTIC LIMIT

Test Number	1	2	3
Tare Number	416	429	505
Wt. Tare & WS, gm	16.85	16.75	17.14
Wt. Tare & DS, gm	15.77	15.67	16.02
Wt. Water, gm	1.08	1.08	1.12
Wt. Tare, gm	10.85	10.64	10.80
Wt. DS, gm	4.92	5.03	5.22
Water Content, %	22.0	21.5	21.5

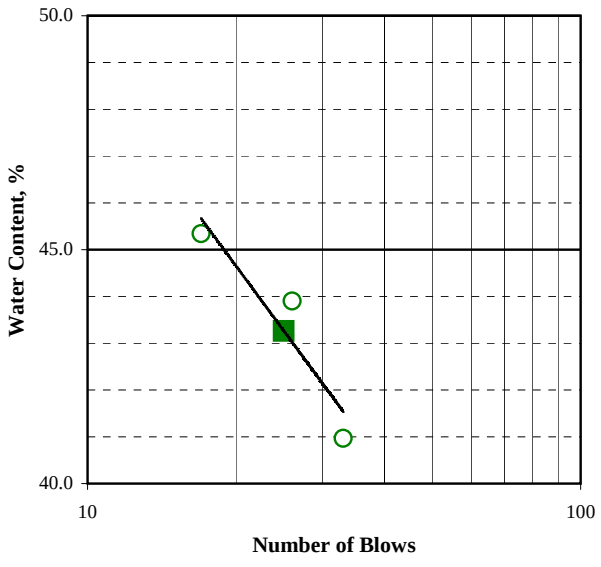
LIQUID LIMIT

	1	2	3
Tare Number	424	455	467
Wt. Tare & WS, gm	20.14	19.02	20.37
Wt. Tare & DS, gm	17.22	16.50	17.58
Wt. Water, gm	2.92	2.52	2.79
Wt. Tare, gm	10.78	10.76	10.77
Wt. DS, gm	6.44	5.74	6.81
Water Content, %	45.3	43.9	41.0
# of Blows	17	26	33

PLASTICITY CHART



FLOW CURVE



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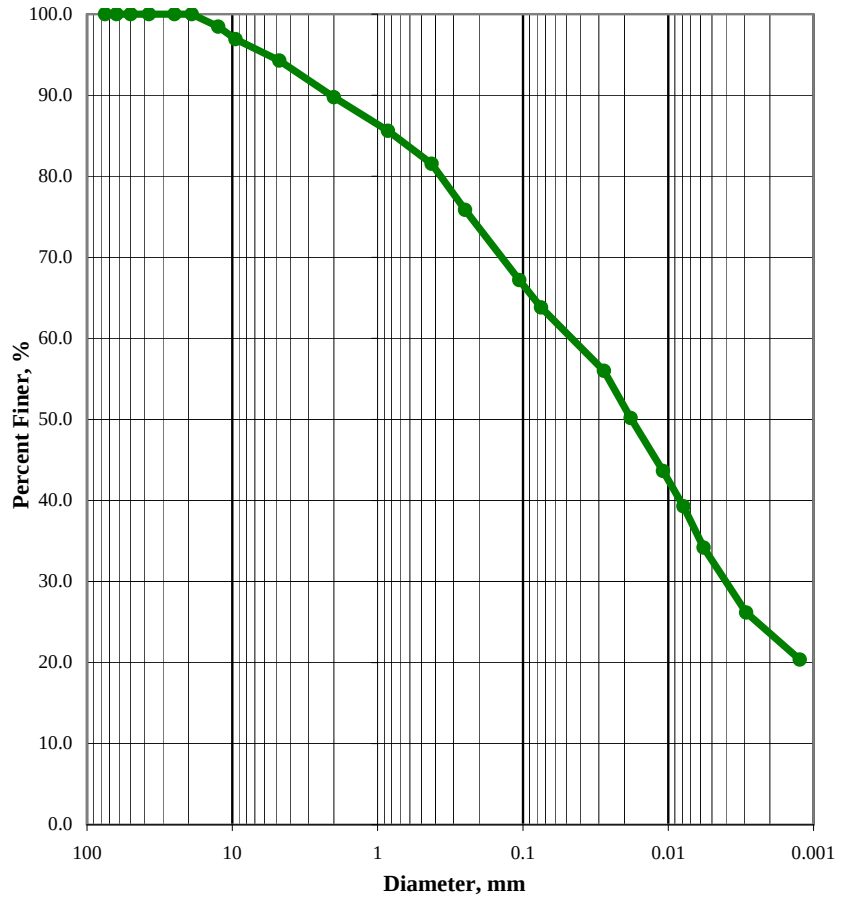
PARTICLE-SIZE ANALYSIS OF SOILS

Client	Civil & Environmental Consultants, I	Boring	SB-12-1
Client Project	091-867 Apex Landfill Expansion	Depth	16'-18'
Project No.	31208	Sample	ST-1
		Lab Sample No.	31208001

USCS Description **BROWN SANDY LEAN CLAY**
USCS Group Symbol **CL** AASHTO: **A-7-6 (12)**
USDA Description **LOAM**



US Std. Sieve Size	Particle Diameter (mm)	Percent Finer (%)
3"	75	100.0
2 1/2"	62.5	100.0
2"	50	100.0
1 1/2"	37.5	100.0
1"	25	100.0
3/4"	19	100.0
1/2"	12.5	98.5
3/8"	9.5	96.9
#4	4.75	94.3
#10	2	89.8
#20	0.85	85.6
#40	0.425	81.6
#60	0.25	75.9
#140	0.106	67.2
#200	0.075	63.8
NA	0.0277	56.0
NA	0.0181	50.2
NA	0.0109	43.6
NA	0.0079	39.3
NA	0.0057	34.2
NA	0.0029	26.2
NA	0.0012	20.4

USCS SOIL CLASSIFICATION

Corrected For 100% Passing a 3" Sieve

% Gravel (-3" & +#4)	**5.7**	Silt=31.1% Clay=32.6%	
Coarse=0; Fine=5.7		D60, mm	NA
% Sand (-#4 & +#200)	**30.5**	D30, mm	NA
Coa.=4.5; Med.=8.2; Fine=17.7		D10, mm	NA
% Fines (-#200)	**63.8**	Cc	NA
% Plus #200 (-3")	**36.2**	Cu	NA

USCS Description
SANDY LEAN CLAY

USCS Group Symbol	Atterberg Limits Group Symbol
CL	**CL, LL=43, PL=22, PI=21**

Auxiliary Information	Wt Ret, gm	% Retained	% Finer
12" Sieve - 300 mm	0	0.0	100.0
6" Sieve - 150 mm	0	0.0	100.0
3" Sieve - 75 mm	0	0.0	100.0

USDA CLASSIFICATION

Particle Size (mm)	Percent Finer (%)	Percent of Each Component (Material)	(%)	Corrected Percent of -2.0 mm Material for USDA
100	100			
		Gravel	10.2	0
2	89.8			
		Sand	29.1	32.5
0.05	60.6			
		Silt	37.0	41.2
0.002	23.6			
		Clay	23.6	26.3

USDA Classification
LOAM

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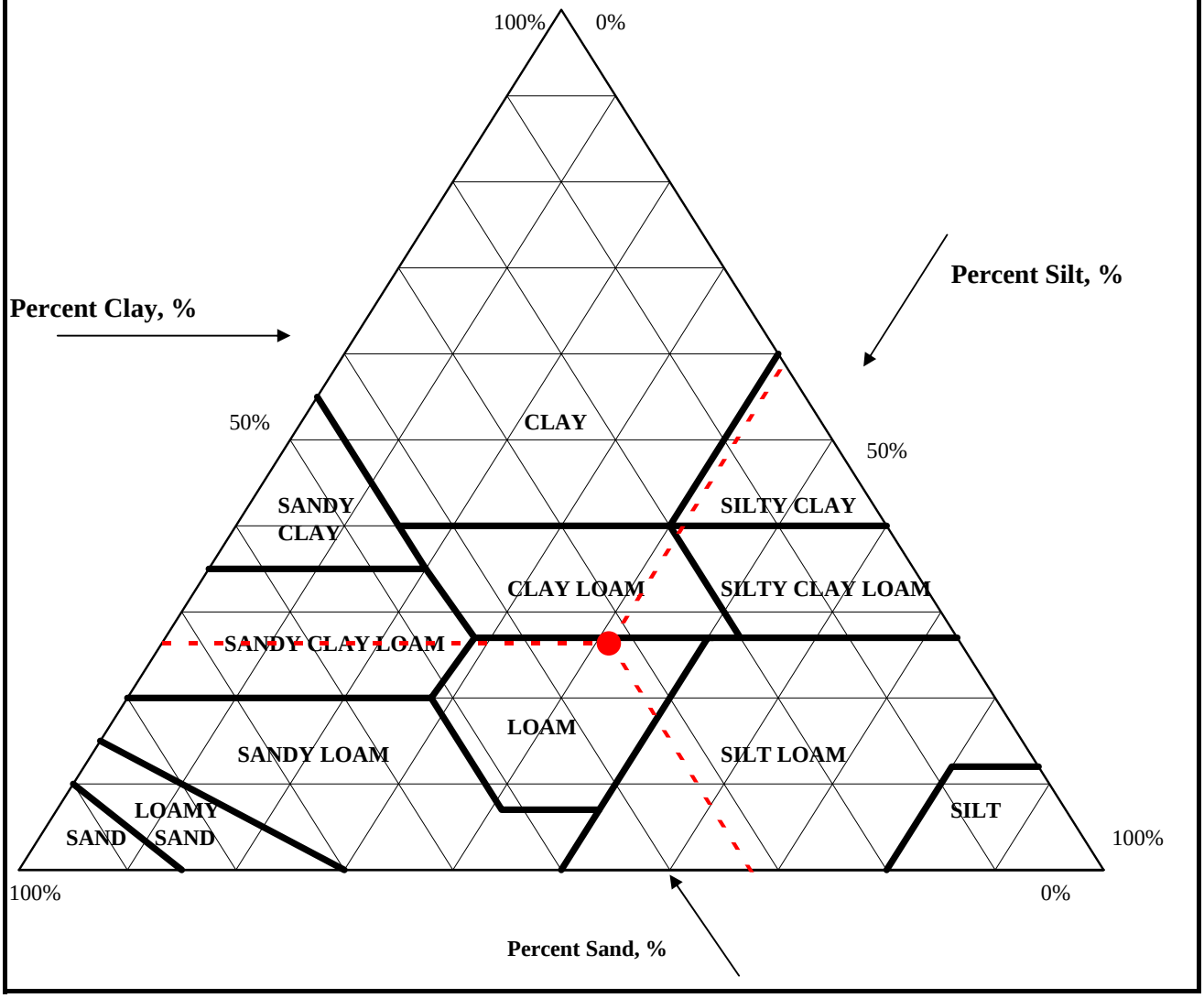
USDA CLASSIFICATION CHART

Client	Civil & Environmental Consultants, I	Boring	SB-12-1
Client Project	091-867 Apex Landfill Expansion	Depth	16'-18'
Project No.	31208	Sample	ST-1
		Lab Sample No.	31208001
USCS Description	**BROWN SANDY LEAN CLAY**		
USCS Group Symbol	**CL**	AASHTO Classification	**A-7-6 (12)**
USDA Description	**LOAM**		

Corrected for 0% gravel	
Percent Gravel, %	0.0
Percent Sand, %	32.5
Percent Silt, %	41.2
Percent Clay, %	26.3

Sand Subsizes Corrected Percentages	
Very Coarse Sand; 2-1	3.7
Coarse Sand; 1-0.5	4.3
Medium Sand; 0.5-0.25	7.4
Fine Sand; 0.25-0.1	10.3
Very Fine Sand; 0.1-0.05	6.7
Total	**32.5**



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CONSOLIDATED-UNDRAINED TRIAXIAL COMPRESSION TEST ON COHESIVE SOILS ASTM D 4767

Client	Civil & Environmental Consultants, Inc.	Boring	SB-12-1
Client Project	091-867 Apex Landfill Expansion	Depth	16'-18'
Project No.	31208	Sample	ST-1
Test No.	1	Lab Sample No.	31208001
USCS Description:	Brown Sandy Lean Clay	Test Conditions:	Undisturbed

SAMPLE CONDITIONS

	Initial	After Consol.	Final
Tare Number	A38	NA	978
Wt. Tare & WS, gm	204.03	NA	1097.32
Wt. Tare & DS, gm	173.38	NA	918.60
Wt. Tare, gm	9.62	NA	102.08
Water Content, %	18.7	21.9	21.9
Wt. Tube & WS., gm	1702.6	NA	
Wt. Of Tube, gm	432.4	NA	
Wt. Of WS., gm	1270.2	1304.1	
Length 1, in	6.042	NA	
Length 2, in	6.043	NA	
Length 3, in	6.021	NA	
Top Diameter, in	2.882	NA	
Middle Diameter, in	2.879	NA	
Bottom Diameter, in	2.881	NA	
Average Length, in	6.035	5.971	
Average Diameter, in	2.881	2.864	
Average Area, in^2	6.52	6.44	
Sample Volume, in^3	39.33	38.46	
Unit Dry Wt., gms/cc	1.66	1.70	
Unit Dry Wt., pcf	103.6	105.9	
Specific Gravity, Assume	2.70	2.70	
Volume of Solids, cc	396.28	396.28	
Void Ratio, e	0.63	0.59	
Porosity, n	0.39	0.37	
Pore Volume, cc	15.15	14.27	
Saturation, %	80.6	100.1	

TEST CONDITIONS

Cell Pressure, psi	50.67	
Back Pressure, psi	40.54	
Effective Consolidating Pressure, psi	10.14	σ_3
Pore Pressure Parameter (B), %	95	

SATURATION AND CONSOLIDATION VOLUME CHANGES

Height Change, mils	Reading	Change	Consolidation	
Initial Reading	6.42	0	Volume Change, ml	14.4
After Saturation	6.42	0	Volume Change, in^3	0.88
After Consolidation	6.356	64	Saturation Method:	Wet

STRAIN RATE CALCULATIONS

Calc. Strain Rate, %/min (t50=64.41)	0.0001	Strain Rate Used, %/min	0.0002
Calc. Deformation Rate, in/min	0.0004	Deformation Rate Used	0.001

EFFECTIVE FAILURE SUMMARY

Failure Conditions	Max σ_1'/σ_3'	15% ε	
Effective Consolidating Pressure, psi	10.14	10.14	σ_3
1St. Maximum Effective Principal Stress Ratio	3.562	3.05	σ_1'/σ_3'
Deviator Stress at Failure, psi	11.86	16.66	$\sigma_1-\sigma_3$
Axial Strain at Failure, %	6.43	15.00	ε
Effective Minor Principal Stress at Failure, psi	4.63	8.14	σ_3'
Effective Major Principal Stress at Failure, psi	16.49	24.80	σ_1'
Mohr's Circle Stress Path (Origin of Circle), psi	10.56	16.47	p'
Mohr's Circle Stress Path (Radius of Circle), psi	5.93	8.33	q

TOTAL FAILURE SUMMARY

Failure Conditions	Max σ_1'/σ_3'	15% ε	
Deviator Stress at Failure, psi	11.86	16.66	$\sigma_1-\sigma_3$
Axial Strain at Failure, %	6.43	15.00	ε
Total Minor Principal Stress at Failure, psi	10.14	10.14	σ_3
Total Major Principal Stress at Failure, psi	22.00	26.80	σ_1

TEST DATA

Axial Load	Axial Deformation	Total Pore Water Pressure	Axial Strain	Principal Stress Difference (Deviator Stress)	Induced Pore Water Pressure	Effective Major Principal Stress	Effective Minor Principal Stress	Effective Principal Stress Ratio	A-Bar	Mohr's Circle Stress Paths	
										Origin of Circle	Radius of Circle
lb.	mils	psi	%	psi	psi	psi	psi			psi	psi
P	ΔH	U	ε	$\sigma_1-\sigma_3$	ΔU	σ_1'	σ_3'	σ_1'/σ_3'	A'	p'	q
13.1	0	40.5	0	0	NA	NA	NA	NA	NA	10.14	0
30.2	14	42.0	0.23	2.65	1.45	11.34	8.69	1.305	0.58	10.01	1.32
36.1	19	43.0	0.32	3.56	2.42	11.28	7.72	1.461	0.71	9.50	1.78
40.2	26	43.6	0.43	4.19	3.07	11.26	7.07	1.594	0.77	9.16	2.10
42.9	32	44.1	0.53	4.60	3.57	11.17	6.57	1.700	0.82	8.87	2.30
45.0	38	44.5	0.63	4.92	3.95	11.11	6.19	1.795	0.84	8.65	2.46
46.9	44	44.8	0.73	5.21	4.27	11.08	5.87	1.888	0.86	8.48	2.61
48.6	50	45.1	0.83	5.46	4.54	11.06	5.60	1.974	0.88	8.33	2.73
49.9	56	45.3	0.94	5.66	4.75	11.05	5.39	2.051	0.88	8.22	2.83
51.4	62	45.5	1.04	5.88	4.93	11.09	5.20	2.131	0.88	8.15	2.94
52.5	68	45.6	1.13	6.04	5.11	11.07	5.03	2.201	0.89	8.05	3.02
53.3	73	45.8	1.22	6.17	5.24	11.07	4.90	2.260	0.89	7.98	3.08
54.4	79	45.9	1.33	6.32	5.36	11.10	4.77	2.325	0.89	7.94	3.16
57.7	97	46.2	1.62	6.80	5.65	11.29	4.48	2.517	0.87	7.88	3.40

61.1	114	46.4	1.91	7.31	5.85	11.60	4.29	2.706	0.84	7.94	3.66
63.9	133	46.5	2.23	7.71	5.99	11.86	4.15	2.858	0.82	8.00	3.85
66.0	151	46.6	2.54	8.00	6.07	12.07	4.06	2.969	0.80	8.07	4.00
68.6	169	46.7	2.83	8.36	6.13	12.38	4.01	3.086	0.77	8.19	4.18
71.0	186	46.7	3.12	8.70	6.15	12.69	3.98	3.186	0.74	8.33	4.35
73.4	204	46.7	3.42	9.04	6.16	13.03	3.98	3.272	0.72	8.50	4.52
75.6	223	46.7	3.73	9.33	6.13	13.34	4.00	3.332	0.69	8.67	4.67
77.9	241	46.6	4.03	9.65	6.11	13.68	4.03	3.394	0.67	8.86	4.83
79.7	258	46.6	4.31	9.89	6.05	13.98	4.09	3.418	0.64	9.04	4.95
82.3	276	46.5	4.62	10.24	6.01	14.37	4.13	3.479	0.62	9.25	5.12
84.6	295	46.5	4.94	10.55	5.95	14.74	4.19	3.519	0.59	9.46	5.28
86.5	313	46.4	5.23	10.80	5.87	15.06	4.27	3.529	0.57	9.67	5.40
88.4	330	46.3	5.53	11.04	5.79	15.39	4.35	3.540	0.55	9.87	5.52
90.4	347	46.2	5.82	11.30	5.71	15.73	4.43	3.549	0.53	10.08	5.65
92.6	366	46.1	6.14	11.58	5.61	16.11	4.53	3.559	0.51	10.32	5.79
94.7	384	46.0	6.43	11.86	5.51	16.49	4.63	3.562	0.49	10.56	5.93
96.4	402	45.9	6.73	12.06	5.40	16.80	4.74	3.547	0.47	10.77	6.03
97.9	419	45.8	7.01	12.24	5.29	17.08	4.84	3.526	0.46	10.96	6.12
100.3	437	45.7	7.32	12.55	5.17	17.51	4.97	3.526	0.43	11.24	6.27
102.1	455	45.6	7.62	12.77	5.05	17.86	5.09	3.508	0.42	11.48	6.38
103.9	473	45.5	7.93	12.98	4.93	18.19	5.21	3.492	0.40	11.70	6.49
105.6	491	45.3	8.23	13.18	4.81	18.51	5.33	3.473	0.38	11.92	6.59
107.1	508	45.2	8.51	13.36	4.68	18.82	5.46	3.446	0.37	12.14	6.68
109.1	527	45.1	8.82	13.59	4.55	19.18	5.59	3.431	0.35	12.38	6.79
110.7	545	45.0	9.13	13.77	4.42	19.49	5.72	3.406	0.34	12.61	6.88
112.2	563	44.8	9.42	13.94	4.28	19.79	5.85	3.381	0.32	12.82	6.97
113.4	580	44.7	9.71	14.06	4.15	20.05	5.98	3.350	0.31	13.01	7.03
115.3	598	44.6	10.01	14.28	4.03	20.39	6.11	3.339	0.30	13.25	7.14
117.2	616	44.4	10.32	14.49	3.90	20.73	6.24	3.322	0.28	13.48	7.24
118.6	635	44.3	10.63	14.64	3.76	21.02	6.38	3.296	0.27	13.70	7.32
120.0	652	44.2	10.93	14.78	3.64	21.28	6.50	3.275	0.26	13.89	7.39
121.2	671	44.0	11.23	14.89	3.51	21.52	6.63	3.246	0.25	14.08	7.45
123.2	688	43.9	11.52	15.12	3.39	21.86	6.75	3.240	0.24	14.31	7.56
124.6	707	43.8	11.83	15.27	3.26	22.14	6.87	3.221	0.23	14.51	7.63
126.0	725	43.7	12.13	15.40	3.14	22.39	7.00	3.200	0.21	14.70	7.70
127.0	742	43.6	12.43	15.49	3.01	22.61	7.12	3.174	0.20	14.87	7.74
128.4	760	43.4	12.72	15.62	2.88	22.87	7.25	3.153	0.19	15.06	7.81
130.2	779	43.3	13.04	15.81	2.76	23.18	7.38	3.143	0.18	15.28	7.90
131.8	797	43.2	13.34	15.97	2.65	23.45	7.49	3.133	0.17	15.47	7.98
133.2	815	43.1	13.65	16.11	2.54	23.70	7.60	3.120	0.17	15.65	8.05
134.4	833	43.0	13.95	16.20	2.41	23.93	7.72	3.098	0.16	15.83	8.10
135.4	850	42.8	14.24	16.28	2.30	24.12	7.84	3.077	0.15	15.98	8.14
137.8	869	42.7	14.55	16.54	2.19	24.49	7.95	3.081	0.14	16.22	8.27
139.0	887	42.6	14.85	16.64	2.06	24.71	8.07	3.061	0.13	16.39	8.32
139.8	904	42.5	15.14	16.69	1.94	24.89	8.20	3.036	0.12	16.54	8.35
141.5	922	42.4	15.44	16.85	1.83	25.16	8.31	3.028	0.11	16.73	8.43
142.9	940	42.2	15.74	16.98	1.71	25.41	8.43	3.014	0.11	16.92	8.49
144.6	958	42.1	16.04	17.13	1.59	25.68	8.54	3.005	0.10	17.11	8.57
145.8	977	42.0	16.36	17.23	1.47	25.89	8.66	2.989	0.09	17.28	8.61
146.8	994	41.9	16.65	17.30	1.37	26.07	8.77	2.973	0.08	17.42	8.65
148.1	1012	41.8	16.94	17.40	1.26	26.29	8.88	2.959	0.08	17.58	8.70
150.0	1030	41.7	17.26	17.58	1.15	26.56	8.98	2.957	0.07	17.77	8.79
151.6	1048	41.6	17.55	17.72	1.05	26.81	9.09	2.950	0.06	17.95	8.86
152.1	1066	41.5	17.85	17.73	0.93	26.93	9.20	2.926	0.06	18.07	8.86

Input Validation: Reviewed By: Date Tested: 03/01/11

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CONSOLIDATED-UNDRAINED TRIAXIAL COMPRESSION TEST ON COHESIVE SOILS ASTM D 4767

Client	Civil & Environmental Consultants, Inc.	Boring	SB-12-1
Client Project	091-867 Apex Landfill Expansion	Depth	16'-18'
Project No.	31208	Sample	ST-1
Test No.	2	Lab Sample No.	31208001
USCS Description:	Brown Sandy Lean Clay	Test Conditions:	Undisturbed

SAMPLE CONDITIONS

	Initial	After Consol.	Final
Tare Number	A38	NA	831
Wt. Tare & WS, gm	204.03	NA	1481.54
Wt. Tare & DS, gm	173.38	NA	1276.68
Wt. Tare, gm	9.62	NA	102.71
Water Content, %	18.7	17.5	17.5
Wt. Tube & WS., gm	1820.3	NA	
Wt. Of Tube, gm	433.1	NA	
Wt. Of WS., gm	1387.3	1372.5	
Length 1, in	6.042	NA	
Length 2, in	6.042	NA	
Length 3, in	6.038	NA	
Top Diameter, in	2.882	NA	
Middle Diameter, in	2.88	NA	
Bottom Diameter, in	2.881	NA	
Average Length, in	6.041	5.970	
Average Diameter, in	2.881	2.849	
Average Area, in^2	6.52	6.38	
Sample Volume, in^3	39.38	38.19	
Unit Dry Wt., gms/cc	1.81	1.87	
Unit Dry Wt., pcf	113.0	116.5	
Specific Gravity, Assume	2.70	2.70	
Volume of Solids, cc	432.80	432.80	
Void Ratio, e	0.49	0.45	
Porosity, n	0.33	0.31	
Pore Volume, cc	12.97	11.78	
Saturation, %	102.9	105.6	

TEST CONDITIONS

Cell Pressure, psi	80.85	
Back Pressure, psi	40.50	
Effective Consolidating Pressure, psi	40.35	$\sigma 3$
Pore Pressure Parameter (B), %	97	

SATURATION AND CONSOLIDATION VOLUME CHANGES

Height Change, mils	Reading	Change	Consolidation	
Initial Dial Reading	6.326	0	Volume Change, ml	19.4
After Saturation	6.319	7	Volume Change, in^3	1.18
After Consolidation	6.255	71	Saturation Method:	Wet

STRAIN RATE CALCULATIONS

Calc. Strain Rate, %/min (t50=7.88)	0.0005	Strain Rate Used, %/min	0.0002
Calc. Deformation Rate, in/min	0.0030	Deformation Rate Used	0.001

EFFECTIVE FAILURE SUMMARY

Failure Conditions	Max σ_1'/σ_3'	15% ε	
Effective Consolidating Pressure, psi	40.35	40.35	σ_3
1St. Maximum Effective Principal Stress Ratio	3.605	3.16	σ_1'/σ_3'
Deviator Stress at Failure, psi	54.02	72.23	$\sigma_1-\sigma_3$
Axial Strain at Failure, %	3.87	15.00	ε
Effective Minor Principal Stress at Failure, psi	20.74	33.43	σ_3'
Effective Major Principal Stress at Failure, psi	74.76	105.66	σ_1'
Mohr's Circle Stress Path (Origin of Circle), psi	47.75	69.55	p'
Mohr's Circle Stress Path (Radius of Circle), psi	27.01	36.12	q

TOTAL FAILURE SUMMARY

Failure Conditions	Max σ_1'/σ_3'	15% ε	
Deviator Stress at Failure, psi	54.02	72.23	$\sigma_1-\sigma_3$
Axial Strain at Failure, %	3.87	15.00	ε
Total Minor Principal Stress at Failure, psi	40.35	40.35	σ_3
Total Major Principal Stress at Failure, psi	94.37	112.58	σ_1

TEST DATA

Axial Load	Axial Deformation	Total Pore Water Pressure	Axial Strain	Principal Stress Difference (Deviator Stress)	Induced Pore Water Pressure	Effective Major Principal Stress	Effective Minor Principal Stress	Effective Principal Stress Ratio	A-Bar	Mohr's Circle Stress Paths	
										Origin of Circle	Radius of Circle
lb.	mils	psi	%	psi	psi	psi	psi			psi	psi
P	ΔH	U	ε	$\sigma_1-\sigma_3$	ΔU	σ_1'	σ_3'	σ_1'/σ_3'	A'	p'	q
13.9	0	40.5	0	0.00	0	NA	NA	NA	NA	40.35	0
55.1	4	43.9	0.08	6.46	3.37	43.44	36.98	1.175	0.54	40.21	3.23
107.1	10	49.2	0.17	14.60	8.67	46.28	31.68	1.461	0.61	38.98	7.30
136.9	15	52.6	0.25	19.25	12.13	47.47	28.22	1.682	0.65	37.85	9.62
158.4	21	55.0	0.36	22.59	14.51	48.43	25.84	1.874	0.66	37.14	11.29
175.7	28	56.8	0.47	25.26	16.29	49.32	24.06	2.050	0.66	36.69	12.63
189.3	34	58.1	0.57	27.35	17.60	50.10	22.75	2.202	0.66	36.43	13.68
201.3	40	59.1	0.67	29.20	18.61	50.94	21.74	2.343	0.66	36.34	14.60
211.5	46	59.9	0.77	30.75	19.45	51.65	20.90	2.471	0.65	36.28	15.38
220.3	52	60.6	0.87	32.09	20.09	52.35	20.26	2.584	0.65	36.31	16.05
228.9	58	61.1	0.96	33.40	20.60	53.15	19.75	2.691	0.64	36.45	16.70
237.7	64	61.5	1.07	34.73	21.04	54.04	19.31	2.798	0.62	36.68	17.36
245.3	70	61.8	1.17	35.88	21.32	54.91	19.03	2.886	0.61	36.97	17.94
267.0	87	62.4	1.45	39.13	21.92	57.56	18.43	3.123	0.58	37.99	19.56

286.9	105	62.6	1.75	42.07	22.11	60.31	18.24	3.306	0.54	39.28	21.03
304.4	124	62.5	2.07	44.62	22.04	62.93	18.31	3.438	0.51	40.62	22.31
315.7	141	62.3	2.36	46.22	21.78	64.79	18.57	3.488	0.49	41.68	23.11
328.5	158	61.9	2.65	48.04	21.42	66.97	18.94	3.537	0.46	42.95	24.02
341.6	176	61.5	2.95	49.89	21.00	69.23	19.35	3.579	0.43	44.29	24.94
353.4	196	61.0	3.28	51.51	20.54	71.32	19.81	3.600	0.41	45.56	25.75
363.0	214	60.6	3.58	52.80	20.07	73.08	20.28	3.604	0.39	46.68	26.40
372.2	231	60.1	3.87	54.02	19.61	74.76	20.74	3.605	0.37	47.75	27.01
380.9	249	59.6	4.17	55.17	19.12	76.39	21.23	3.599	0.36	48.81	27.58
389.8	266	59.1	4.46	56.32	18.64	78.04	21.71	3.594	0.34	49.87	28.16
397.0	285	58.7	4.78	57.23	18.15	79.43	22.20	3.578	0.33	50.81	28.61
403.2	304	58.2	5.09	57.97	17.68	80.64	22.67	3.557	0.31	51.65	28.98
411.4	320	57.7	5.37	59.01	17.22	82.14	23.13	3.551	0.30	52.64	29.51
418.0	339	57.3	5.67	59.80	16.77	83.37	23.58	3.536	0.29	53.47	29.90
425.4	357	56.8	5.97	60.70	16.31	84.73	24.04	3.525	0.28	54.38	30.35
432.9	375	56.4	6.29	61.59	15.89	86.05	24.46	3.518	0.27	55.26	30.80
436.7	393	55.9	6.58	61.96	15.43	86.88	24.92	3.486	0.26	55.90	30.98
443.8	410	55.5	6.86	62.81	15.04	88.11	25.31	3.482	0.25	56.71	31.40
450.2	428	55.1	7.17	63.53	14.63	89.25	25.72	3.470	0.24	57.48	31.76
456.6	446	54.7	7.47	64.25	14.23	90.37	26.12	3.460	0.23	58.24	32.13
461.4	464	54.3	7.78	64.74	13.84	91.25	26.51	3.442	0.22	58.88	32.37
465.4	481	54.0	8.07	65.11	13.45	92.01	26.90	3.421	0.21	59.45	32.55
470.5	500	53.6	8.37	65.63	13.10	92.88	27.25	3.409	0.21	60.06	32.82
474.7	517	53.2	8.67	66.01	12.75	93.62	27.60	3.391	0.20	60.61	33.01
480.1	536	52.9	8.99	66.56	12.37	94.54	27.98	3.379	0.19	61.26	33.28
484.2	555	52.5	9.29	66.91	12.03	95.24	28.32	3.362	0.19	61.78	33.46
487.8	572	52.2	9.58	67.21	11.70	95.87	28.65	3.346	0.18	62.26	33.61
493.1	590	51.9	9.89	67.74	11.38	96.71	28.97	3.338	0.17	62.84	33.87
500.8	608	51.6	10.18	68.60	11.06	97.89	29.29	3.342	0.17	63.59	34.30
504.1	627	51.2	10.50	68.82	10.75	98.43	29.60	3.325	0.16	64.02	34.41
507.4	644	50.9	10.79	69.06	10.44	98.97	29.91	3.309	0.16	64.44	34.53
513.1	661	50.6	11.07	69.63	10.14	99.84	30.21	3.305	0.15	65.02	34.81
516.2	679	50.4	11.38	69.83	9.85	100.33	30.50	3.289	0.15	65.42	34.91
520.3	698	50.1	11.70	70.15	9.55	100.95	30.80	3.277	0.14	65.88	35.07
521.1	716	49.8	12.00	70.02	9.28	101.09	31.07	3.254	0.14	66.08	35.01
523.6	734	49.5	12.29	70.11	9.00	101.47	31.35	3.236	0.13	66.41	35.06
527.5	751	49.2	12.58	70.43	8.73	102.06	31.62	3.227	0.13	66.84	35.22
533.0	770	49.0	12.89	70.93	8.49	102.79	31.86	3.226	0.12	67.32	35.46
537.4	788	48.8	13.20	71.27	8.26	103.36	32.09	3.221	0.12	67.73	35.63
538.2	806	48.5	13.49	71.14	8.01	103.48	32.34	3.200	0.12	67.91	35.57
541.0	824	48.3	13.80	71.27	7.79	103.83	32.56	3.189	0.11	68.19	35.63
545.7	841	48.1	14.09	71.67	7.56	104.46	32.79	3.185	0.11	68.63	35.83
552.6	859	47.9	14.39	72.34	7.35	105.33	33.00	3.192	0.10	69.17	36.17
554.1	877	47.6	14.70	72.29	7.12	105.52	33.23	3.175	0.10	69.38	36.14
555.6	895	47.4	15.00	72.23	6.92	105.66	33.43	3.161	0.10	69.54	36.11
560.2	913	47.2	15.29	72.58	6.72	106.21	33.63	3.158	0.10	69.92	36.29
565.1	931	47.1	15.60	72.98	6.55	106.78	33.80	3.159	0.09	70.29	36.49
567.5	950	46.8	15.91	73.02	6.33	107.04	34.02	3.147	0.09	70.53	36.51
569.5	968	46.7	16.21	73.02	6.16	107.21	34.19	3.136	0.09	70.70	36.51
572.7	985	46.5	16.50	73.19	5.98	107.56	34.37	3.129	0.08	70.96	36.59
574.8	1002	46.3	16.79	73.21	5.82	107.74	34.53	3.120	0.08	71.13	36.60

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CONSOLIDATED-UNDRAINED TRIAXIAL COMPRESSION TEST ON COHESIVE SOILS ASTM D 4767

Client	Civil & Environmental Consultants, Inc.	Boring	SB-12-1
Client Project	091-867 Apex Landfill Expansion	Depth	16'-18'
Project No.	31208	Sample	ST-1
Test No.	3	Lab Sample No.	31208001
USCS Description:	Brown Sandy Lean Clay	Test Conditions:	Undisturbed

SAMPLE CONDITIONS

	Initial	After Consol.	Final
Tare Number	A38	NA	475
Wt. Tare & WS, gm	204.03	NA	1483.27
Wt. Tare & DS, gm	173.38	NA	1293.61
Wt. Tare, gm	9.62	NA	103.48
Water Content, %	18.7	15.9	15.9
Wt. Tube & WS., gm	1828.1	NA	
Wt. Of Tube, gm	433.4	NA	
Wt. Of WS., gm	1394.7	1362.0	
Length 1, in	6.037	NA	
Length 2, in	6.03	NA	
Length 3, in	6.033	NA	
Top Diameter, in	2.885	NA	
Middle Diameter, in	2.879	NA	
Bottom Diameter, in	2.881	NA	
Average Length, in	6.033	5.954	
Average Diameter, in	2.882	2.843	
Average Area, in^2	6.52	6.35	
Sample Volume, in^3	39.35	37.85	
Unit Dry Wt., gms/cc	1.82	1.89	
Unit Dry Wt., pcf	113.7	118.2	
Specific Gravity, Assume	2.70	2.70	
Volume of Solids, cc	435.12	435.12	
Void Ratio, e	0.48	0.43	
Porosity, n	0.33	0.30	
Pore Volume, cc	12.80	11.30	
Saturation, %	104.9	101.1	

TEST CONDITIONS

Cell Pressure, psi	119.82	
Back Pressure, psi	40.56	
Effective Consolidating Pressure, psi	79.26	σ_3
Pore Pressure Parameter (B), %	96	

SATURATION AND CONSOLIDATION VOLUME CHANGES

Height Change, mils	Reading	Change	Consolidation	
Initial Dial Reading	6.471	0	Volume Change, ml	24.6
After Saturation	6.469	2	Volume Change, in^3	1.50
After Consolidation	6.392	79	Saturation Method:	Wet

STRAIN RATE CALCULATIONS

Calc. Strain Rate, %/min (t50=2.55)	0.0016	Strain Rate Used, %/min	0.0002
Calc. Deformation Rate, in/min	0.009	Deformation Rate Used	0.001

EFFECTIVE FAILURE SUMMARY

Failure Conditions	Max σ_1'/σ_3'	15% ε	
Effective Consolidating Pressure, psi	79.26	79.26	σ_3
1St. Maximum Effective Principal Stress Ratio	3.654	3.28	σ_1'/σ_3'
Deviator Stress at Failure, psi	102.07	124.31	$\sigma_1-\sigma_3$
Axial Strain at Failure, %	4.39	15.00	ε
Effective Minor Principal Stress at Failure, psi	38.46	54.49	σ_3'
Effective Major Principal Stress at Failure, psi	140.53	178.80	σ_1'
Mohr's Circle Stress Path (Origin of Circle), psi	89.50	116.64	p'
Mohr's Circle Stress Path (Radius of Circle), psi	51.03	62.16	q

TOTAL FAILURE SUMMARY

Failure Conditions	Max σ_1'/σ_3'	15% ε	
Deviator Stress at Failure, psi	102.07	124.31	$\sigma_1-\sigma_3$
Axial Strain at Failure, %	4.39	15.00	ε
Total Minor Principal Stress at Failure, psi	79.26	79.26	σ_3
Total Major Principal Stress at Failure, psi	181.32	203.57	σ_1

TEST DATA

Axial Load	Axial Deformation	Total Pore Water Pressure	Axial Strain	Principal Stress Difference (Deviator Stress)	Induced Pore Water Pressure	Effective Major Principal Stress	Effective Minor Principal Stress	Effective Principal Stress Ratio	A-Bar	Mohr's Circle Stress Paths	
										Origin of Circle	Radius of Circle
lb.	mils	psi	%	psi	psi	psi	psi			psi	psi
P	ΔH	U	ε	$\sigma_1-\sigma_3$	ΔU	σ_1'	σ_3'	σ_1'/σ_3'	A'	p'	q
18.9	0	40.6	0	0	0	NA	NA	NA	NA	79.26	0
55.7	4	41.8	0.07	5.79	1.21	83.84	78.05	1.074	0.22	80.94	2.89
131.3	9	47.8	0.16	17.68	7.21	89.72	72.04	1.245	0.43	80.88	8.84
193.1	14	54.9	0.24	27.36	14.38	92.24	64.87	1.422	0.55	78.55	13.68
241.2	19	61.3	0.33	34.90	20.73	93.43	58.53	1.596	0.62	75.98	17.45
278.9	25	66.3	0.41	40.78	25.74	94.30	53.52	1.762	0.66	73.91	20.39
308.4	30	70.3	0.51	45.35	29.70	94.91	49.55	1.915	0.68	72.23	22.68
333.3	36	73.4	0.61	49.22	32.79	95.69	46.47	2.059	0.69	71.08	24.61
355.0	42	75.8	0.70	52.56	35.22	96.60	44.04	2.194	0.70	70.32	26.28
374.9	47	77.7	0.79	55.62	37.13	97.75	42.13	2.320	0.70	69.94	27.81
392.9	53	79.3	0.89	58.38	38.77	98.87	40.49	2.442	0.69	69.68	29.19
409.9	59	80.6	0.99	60.97	40.07	100.16	39.19	2.556	0.68	69.67	30.48
425.7	64	81.7	1.08	63.38	41.11	101.52	38.14	2.662	0.68	69.83	31.69
469.0	83	83.8	1.39	69.90	43.26	105.90	36.00	2.942	0.64	70.95	34.95

505.2	101	84.9	1.69	75.29	44.35	110.21	34.91	3.157	0.61	72.56	37.65
534.8	119	85.4	1.99	79.63	44.81	114.08	34.45	3.312	0.59	74.26	39.82
563.0	137	85.4	2.29	83.72	44.82	118.15	34.44	3.431	0.56	76.29	41.86
590.1	154	85.1	2.58	87.63	44.53	122.36	34.73	3.523	0.53	78.55	43.81
612.8	172	84.6	2.90	90.83	44.06	126.02	35.20	3.580	0.51	80.61	45.41
632.7	190	84.0	3.20	93.57	43.46	129.36	35.79	3.614	0.48	82.58	46.78
649.1	208	83.4	3.50	95.77	42.79	132.24	36.47	3.626	0.47	84.36	47.89
666.4	226	82.6	3.79	98.11	42.05	135.32	37.21	3.637	0.45	86.26	49.05
683.0	243	82.0	4.09	100.30	41.40	138.16	37.86	3.649	0.43	88.01	50.15
696.8	261	81.4	4.39	102.07	40.79	140.53	38.46	3.654	0.42	89.50	51.03
709.1	279	80.6	4.69	103.61	40.08	142.79	39.18	3.644	0.40	90.98	51.80
720.0	297	79.9	4.99	104.91	39.37	144.80	39.89	3.630	0.39	92.34	52.45
732.9	314	79.2	5.27	106.53	38.63	147.16	40.63	3.622	0.38	93.89	53.26
744.2	332	78.5	5.57	107.87	37.94	149.19	41.32	3.611	0.37	95.26	53.94
753.7	349	77.8	5.86	108.93	37.26	150.93	42.00	3.594	0.36	96.46	54.47
762.7	366	77.2	6.16	109.93	36.61	152.57	42.64	3.578	0.35	97.61	54.96
771.0	384	76.5	6.44	110.82	35.98	154.09	43.28	3.560	0.34	98.69	55.41
781.9	401	75.9	6.73	112.07	35.37	155.95	43.89	3.554	0.33	99.92	56.03
789.6	419	75.4	7.04	112.84	34.79	157.30	44.46	3.538	0.32	100.88	56.42
796.5	436	74.8	7.33	113.48	34.23	158.50	45.02	3.520	0.31	101.76	56.74
803.4	454	74.3	7.63	114.12	33.69	159.69	45.57	3.504	0.31	102.63	57.06
811.5	471	73.7	7.91	114.94	33.18	161.02	46.08	3.495	0.30	103.55	57.47
818.8	489	73.2	8.21	115.63	32.66	162.22	46.59	3.482	0.29	104.41	57.82
825.4	507	72.7	8.52	116.20	32.19	163.27	47.07	3.469	0.29	105.17	58.10
831.5	525	72.3	8.81	116.69	31.72	164.22	47.53	3.455	0.28	105.88	58.34
837.0	543	71.8	9.11	117.10	31.27	165.08	47.98	3.440	0.28	106.53	58.55
844.6	560	71.4	9.40	117.80	30.84	166.22	48.42	3.433	0.27	107.32	58.90
851.1	578	71.0	9.71	118.33	30.42	167.16	48.83	3.423	0.27	108.00	59.17
857.0	596	70.6	10.01	118.77	30.01	168.02	49.25	3.412	0.26	108.64	59.39
862.5	614	70.2	10.31	119.15	29.62	168.79	49.64	3.400	0.26	109.21	59.58
868.6	631	69.8	10.60	119.63	29.21	169.68	50.04	3.391	0.25	109.86	59.82
875.2	649	69.4	10.90	120.16	28.84	170.57	50.41	3.383	0.25	110.49	60.08
881.4	667	69.1	11.20	120.62	28.52	171.36	50.74	3.377	0.25	111.05	60.31
886.9	684	68.7	11.49	120.99	28.18	172.06	51.07	3.369	0.24	111.57	60.49
891.8	702	68.4	11.79	121.26	27.87	172.65	51.39	3.360	0.24	112.02	60.63
898.5	719	68.1	12.07	121.79	27.54	173.51	51.71	3.355	0.24	112.61	60.90
902.2	737	67.8	12.37	121.89	27.22	173.93	52.04	3.342	0.23	112.99	60.95
907.0	755	67.5	12.67	122.14	26.93	174.47	52.33	3.334	0.23	113.40	61.07
911.4	772	67.2	12.97	122.33	26.65	174.94	52.61	3.325	0.23	113.77	61.17
916.4	790	66.9	13.26	122.60	26.34	175.51	52.91	3.317	0.22	114.21	61.30
922.1	807	66.6	13.55	122.97	26.06	176.16	53.19	3.312	0.22	114.68	61.48
927.2	825	66.3	13.85	123.22	25.78	176.70	53.48	3.304	0.22	115.09	61.61
932.2	842	66.1	14.15	123.49	25.53	177.21	53.73	3.298	0.22	115.47	61.74
936.5	860	65.8	14.45	123.63	25.27	177.61	53.99	3.290	0.21	115.80	61.81
941.7	878	65.6	14.74	123.90	25.00	178.15	54.25	3.284	0.21	116.20	61.95
948.4	895	65.3	15.04	124.37	24.73	178.90	54.52	3.281	0.21	116.71	62.19
952.6	914	65.1	15.35	124.48	24.52	179.22	54.74	3.274	0.21	116.98	62.24
956.4	931	64.9	15.64	124.54	24.30	179.50	54.95	3.266	0.20	117.22	62.27
961.3	949	64.6	15.94	124.75	24.07	179.94	55.19	3.260	0.20	117.56	62.37
966.0	967	64.4	16.23	124.94	23.84	180.35	55.41	3.255	0.20	117.88	62.47
970.3	985	64.2	16.54	125.04	23.62	180.68	55.64	3.247	0.20	118.16	62.52
976.2	1003	64.0	16.84	125.36	23.41	181.21	55.85	3.245	0.19	118.53	62.68

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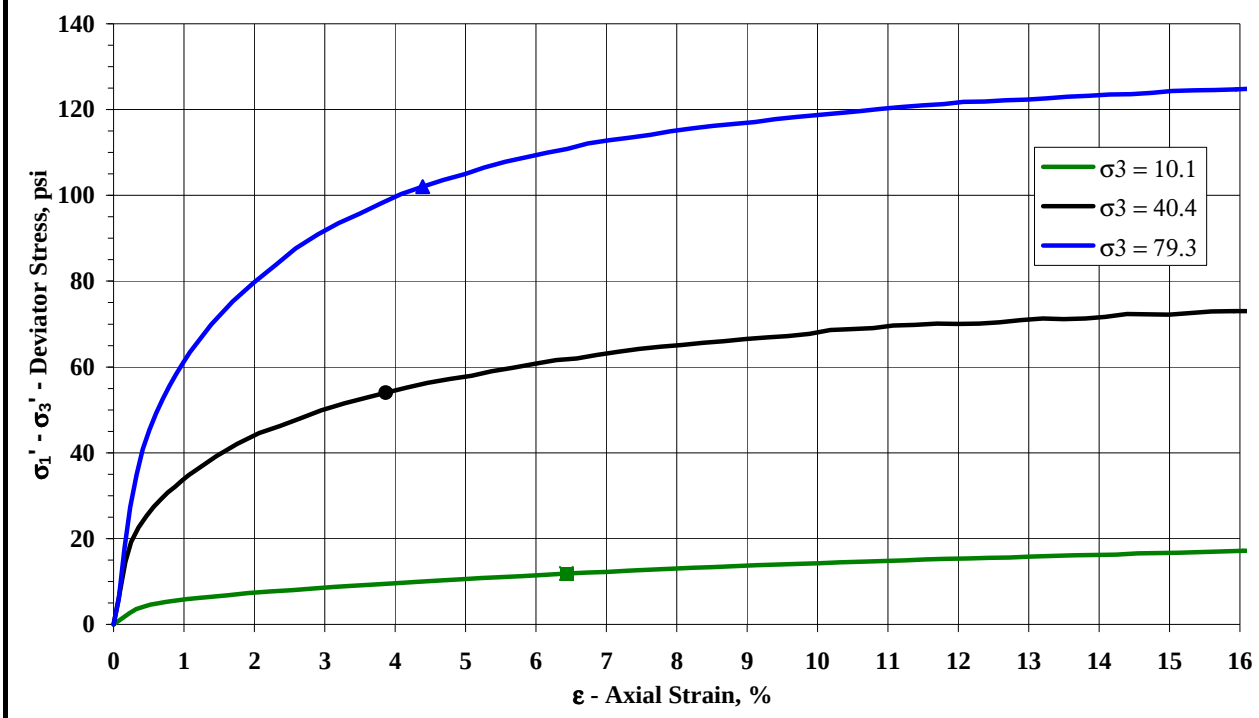
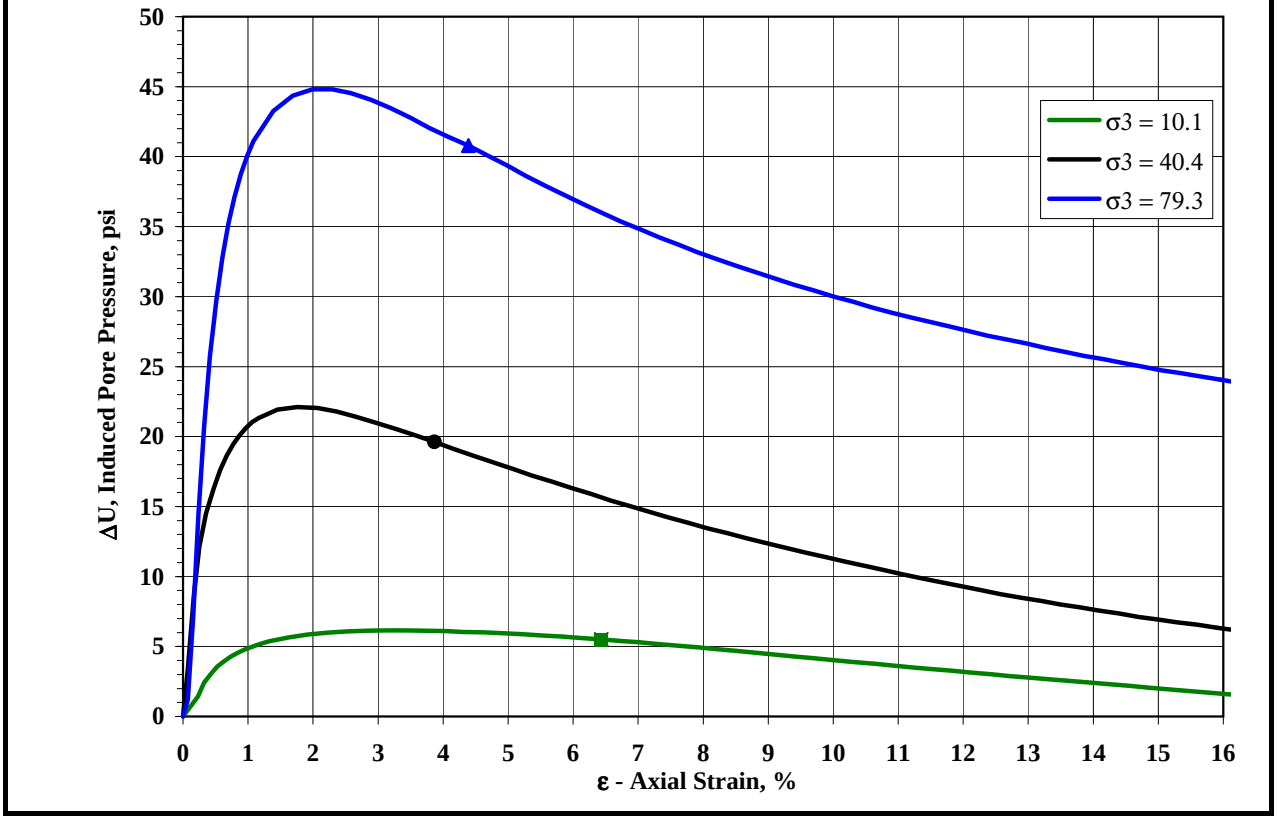
CONSOLIDATED-UNDRAINED TRIAXIAL COMPRESSION TEST ON COHESIVE SOILS ASTM D 4767

Client	Civil & Environmental Consultants, Inc.	Boring	SB-12-1
Client Project	091-867 Apex Landfill Expansion	Depth	16'-18'
Project No.	31208	Sample	ST-1
Test Conditions:	Undisturbed	Lab Sample No.	31208001
USCS Description:	Brown Sandy Lean Clay		

AXIAL STRAIN vs. DEVIATOR STRESS



AXIAL STRAIN vs. INDUCED PORE-WATER PRESSURE



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CONSOLIDATED-UNDRAINED TRIAXIAL COMPRESSION TEST ON COHESIVE SOILS ASTM D 476

Client	Civil & Environmental Consultants, In	Boring	SB-12-1
Client Project	091-867 Apex Landfill Expansion	Depth	16'-18'
Project No.	31208	Sample	ST-1
		Lab Sample No.	31208001
USCS Description:	Brown Sandy Lean Clay		
Test Conditions:	Undisturbed		

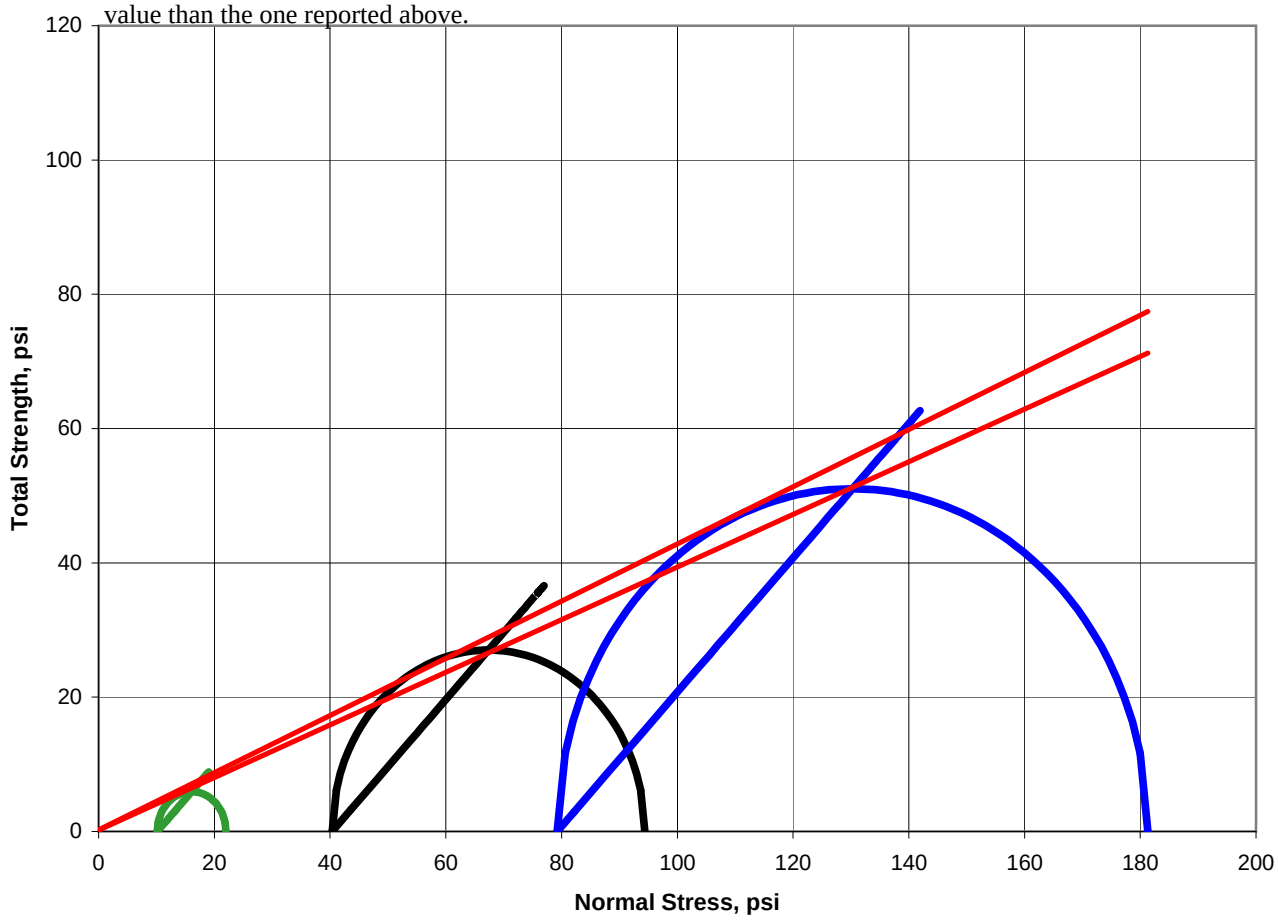
TOTAL STRESS

FAILURE CONDITION: 1st. MAX. EFFECTIVE PRINCIPAL STRESS RATIO

Test No.	Deviator Stress	Major Principal Stress	Minor Principal Stress	Strain at Failure	Mohr's Circle Stress Path		Failure Angle	
	$\sigma1-\sigma3$	$\sigma1$	$\sigma3$	ε	$(\sigma1+\sigma3)/2$	$(\sigma1-\sigma3)/2$		
	psi	psi	psi	%	psi	psi	α, deg	21.4
Test 1	11.86	22.00	10.14	6.43	16.07	5.93	a, psi	0.2
Test 2	54.02	94.37	40.35	3.87	67.36	27.01	Φ, deg	23.1
Test 3	102.07	181.32	79.26	4.39	130.29	51.03	C, psi	0.2

Calculations based on: 0,0 and Test 2 Test 3

Note: The Friction Angle and Cohesion using other combinations of test points may yield a higher or lower value than the one reported above.



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CONSOLIDATED-UNDRAINED TRIAXIAL COMPRESSION TEST ON COHESIVE SOILS ASTM D 476

Client	Civil & Environmental Consultants, In	Boring	SB-12-1
Client Project	091-867 Apex Landfill Expansion	Depth	16'-18'
Project No.	31208	Sample	ST-1
		Lab Sample No.	31208001
USCS Description:	Brown Sandy Lean Clay		
Test Conditions:	Undisturbed		

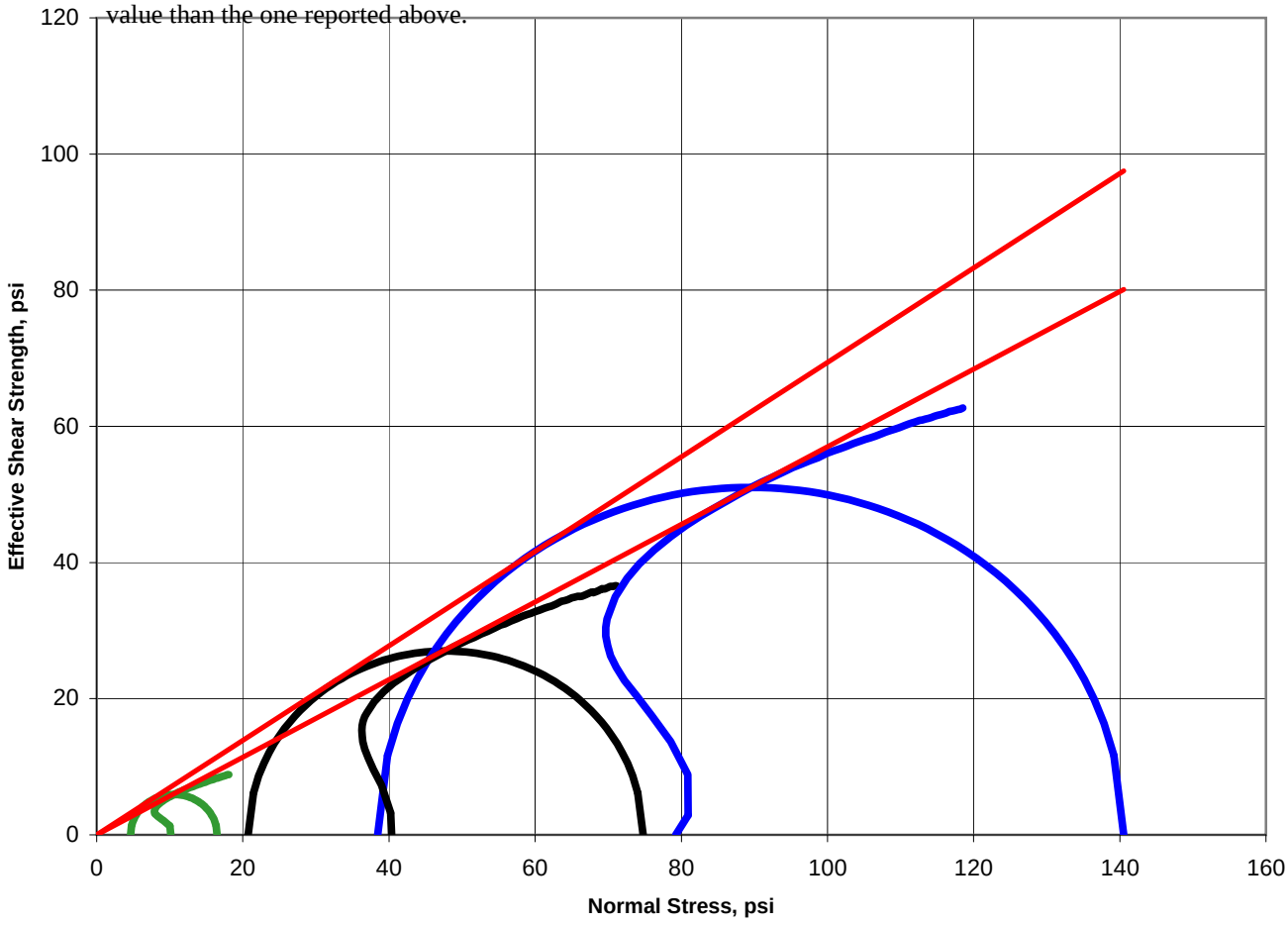
EFFECTIVE STRESS

FAILURE CONDITION: 1st. MAX. EFFECTIVE PRINCIPAL STRESS RATIO

Test No.	Deviator Stress	Major Principal Stress	Minor Principal Stress	Strain at Failure	Mohr's Circle Stress Path		Failure Angle	
	$\sigma 1-\sigma 3$	$\sigma' 1$	$\sigma' 3$	ε	p'	q		
	psi	psi	psi	%	psi	psi	α', deg	29.7
Test 1	11.86	16.49	4.63	6.43	10.56	5.93	a', psi	0.0
Test 2	54.02	74.76	20.74	3.87	47.75	27.01	Φ', deg	34.8
Test 3	102.07	140.53	38.46	4.39	89.50	51.03	C', psi	0.0

Calculations based on: 0,0 and Test 2 Test 3

Note: The Friction Angle and Cohesion using other combinations of test points may yield a higher or lower value than the one reported above.



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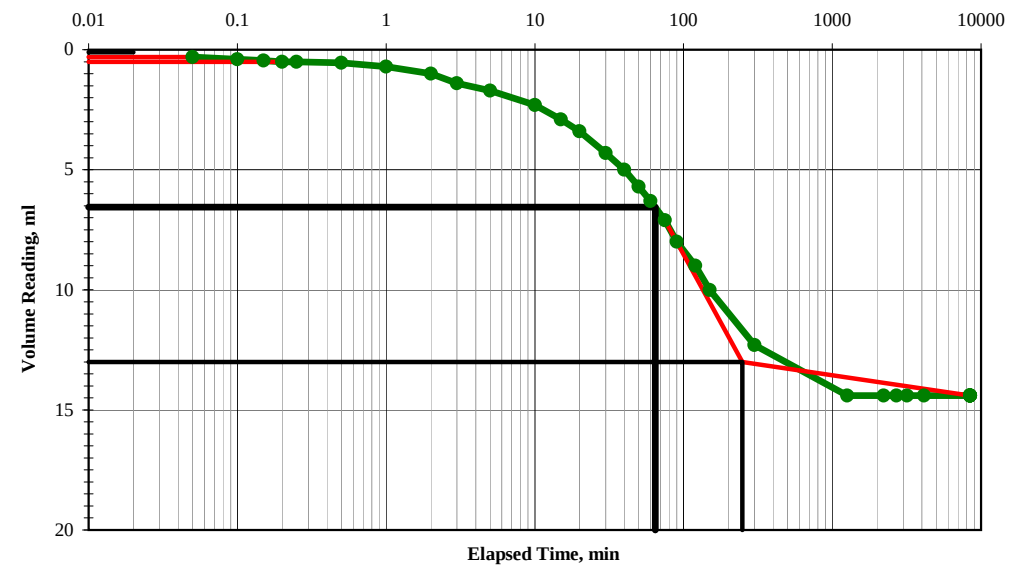
THREE DIMENSIONAL TRIAXIAL CONSOLIDATION TEST

Client	Civil & Environmental Consultants, Inc	Boring	SB-12-1	**Staged Consolidation**	
Client Project	091-867 Apex Landfill Expansion	Depth	16'-18'	Consolidation Plot Stress, psi	7.1
Project No.	31208	Sample	ST-1	**Final Test Pressures**	
		Lab Sample	31208001	Cell Pressure, psi	50.7
USCS Description:	Brown Sandy Lean Clay			Back Pressure, psi	40.5
Test Conditions:	Undisturbed			Effective Consol., psi	10.1
				Additional Consol. Volume, ml	0.0

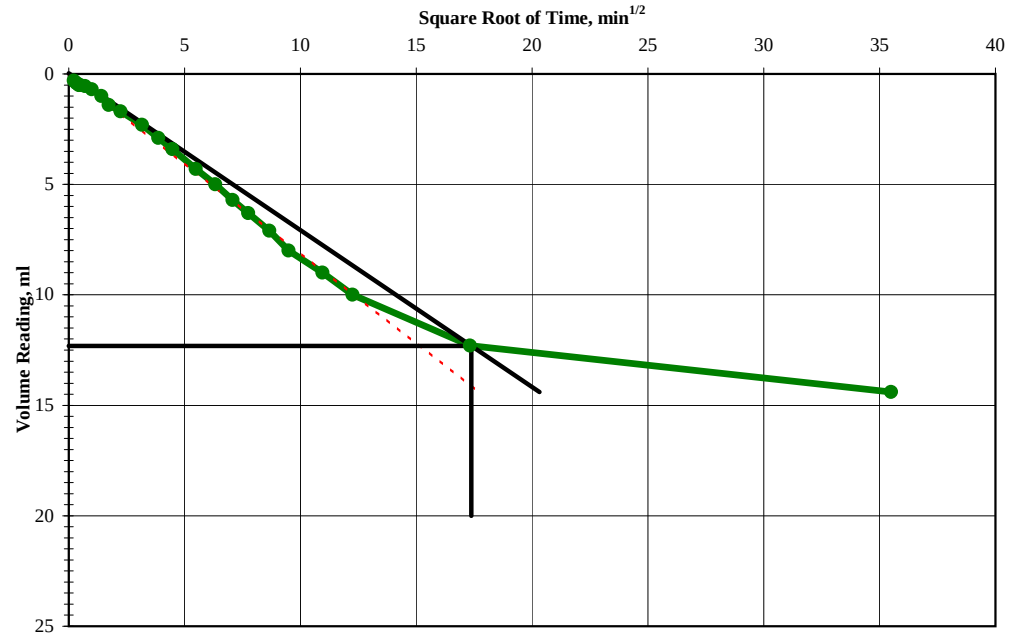
Consol. Start Date: 3/1/2011

Elapsed Time (min)	Sqrt Time ($min^{1/2}$)	Volume Reading ml
0	0	0.0
0.05	0.22	0.3
0.10	0.32	0.4
0.15	0.39	0.4
0.20	0.45	0.5
0.25	0.50	0.5
0.50	0.71	0.6
1.00	1.00	0.7
2.00	1.41	1.0
3.00	1.73	1.4
5.00	2.24	1.7
10.00	3.16	2.3
15.00	3.87	2.9
20.00	4.47	3.4
30.00	5.48	4.3
40.00	6.32	5.0
50.00	7.07	5.7
60.00	7.75	6.3
75.00	8.66	7.1
90.00	9.49	8.0
120.00	10.95	9.0
150.00	12.25	10.0
300.00	17.32	12.3
1260.00	35.50	14.4
2700.00	51.96	14.4
3180.00	56.39	14.4
2220.00	47.12	14.4
4141.00	64.35	14.4
8460.00	91.98	14.4

Log of Elapsed Time vs. Volume Reading



Square Root of Elapsed Time vs. Volume Reading



Sqrt. of Elapsed Time vs Volume		Log of Elapsed Time vs Volume		Consolidation Summary	
T0 = 0 min.	V0 = 0.0 ml.	T0 = 0 min.	V0 = 0.1 ml.	Initial Volume Reading, ml	0.0
T90 = 301.7 min	V90 = 12.3 ml.	T50 = 64.4 min.	V50 = 6.6 ml.	Final Volume Reading, ml	14.4
T100 = NA min	V100 = 13.7 ml.	T100 = 248.2 min.	V100 = 13.0 ml.	Total Volume Change, ml	14.4

Input Validation: Reviewed By: Date 3/1/2011

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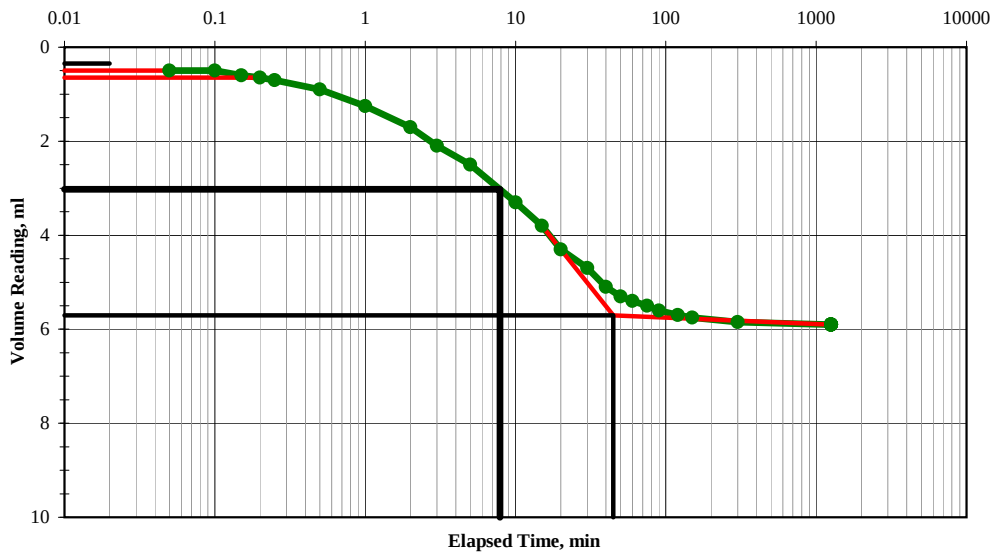
THREE DIMENSIONAL TRIAXIAL CONSOLIDATION TEST

Client	Civil & Environmental Consultants, Inc	Boring	SB-12-1	**Staged Consolidation**	
Client Project	091-867 Apex Landfill Expansion	Depth	16'-18'	Consolidation Plot Stress, psi	7.1
Project No.	31208	Sample	ST-1	**Final Test Pressures**	
		Lab Sample	31208001	Cell Pressure, psi	80.9
USCS Description:	Brown Sandy Lean Clay			Back Pressure, psi	40.5
Test Conditions:	Undisturbed			Effective Consol., psi	40.4
				Additional Consol. Volume, ml	13.5

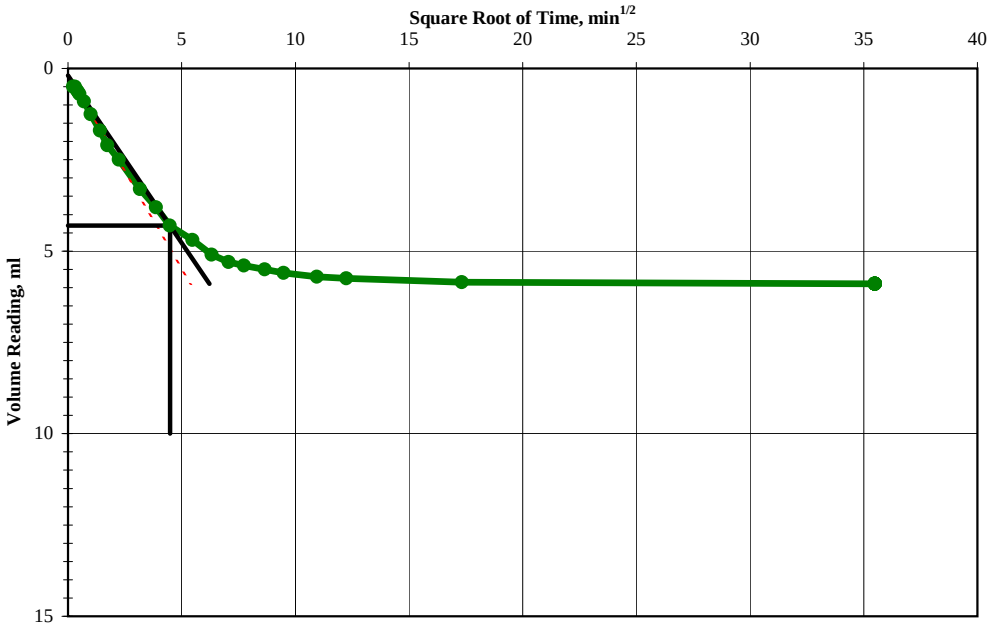
Consol. Start Date: 3/1/2011

Elapsed Time (min)	Sqrt Time ($min^{1/2}$)	Volume Reading ml
0	0	0.0
0.05	0.22	0.5
0.10	0.32	0.5
0.15	0.39	0.6
0.20	0.45	0.6
0.25	0.50	0.7
0.50	0.71	0.9
1.00	1.00	1.3
2.00	1.41	1.7
3.00	1.73	2.1
5.00	2.24	2.5
10.00	3.16	3.3
15.00	3.87	3.8
20.00	4.47	4.3
30.00	5.48	4.7
40.00	6.32	5.1
50.00	7.07	5.3
60.00	7.75	5.4
75.00	8.66	5.5
90.00	9.49	5.6
120.00	10.95	5.7
150.00	12.25	5.8
300.00	17.32	5.9
1260.00	35.50	5.9

Log of Elapsed Time vs. Volume Reading



Square Root of Elapsed Time vs. Volume Reading



Sqrt. of Elapsed Time vs Volume		Log of Elapsed Time vs Volume		Consolidation Summary	
T0 = 0 min.	V0 = 0.2 ml.	T0 = 0 min.	V0 = 0.4 ml.	Initial Volume Reading, ml	0.0
T90 = 20.1 min	V90 = 4.3 ml.	T50 = 7.9 min.	V50 = 3.0 ml.	Final Volume Reading, ml	5.9
T100 = NA min	V100 = 4.8 ml.	T100 = 44.8 min.	V100 = 5.7 ml.	Total Volume Change, ml	19.4

Input Validation: Reviewed By: Date 3/1/2011

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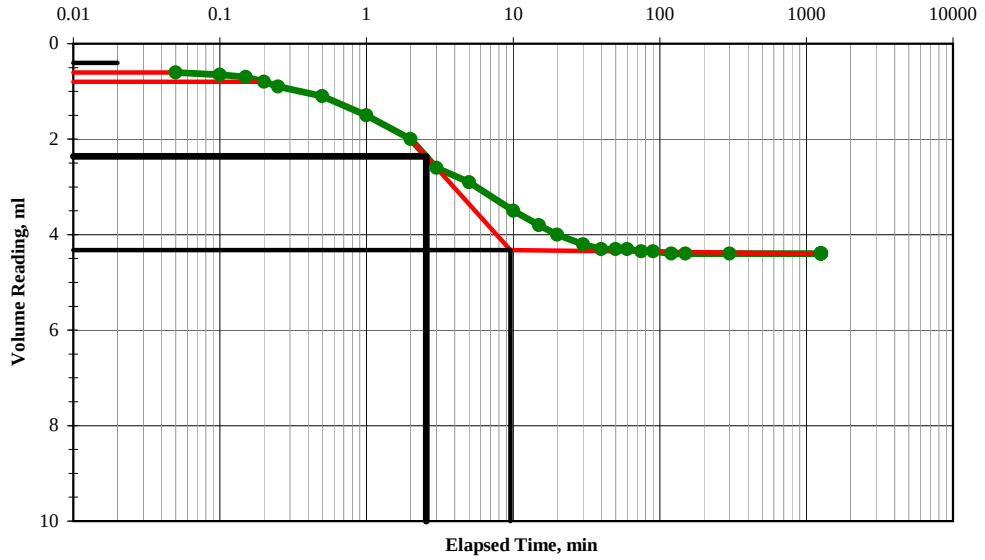
THREE DIMENSIONAL TRIAXIAL CONSOLIDATION TEST

Client	Civil & Environmental Consultants, Inc	Boring	SB-12-1	**Staged Consolidation**	
Client Project	091-867 Apex Landfill Expansion	Depth	16'-18'	Consolidation Plot Stress, psi	7.1
Project No.	31208	Sample	ST-1	**Final Test Pressures**	
		Lab Sample	31208001	Cell Pressure, psi	119.8
USCS Description:	Brown Sandy Lean Clay			Back Pressure, psi	40.6
Test Conditions:	Undisturbed			Effective Consol., psi	79.3
				Additional Consol. Volume, m	20.2

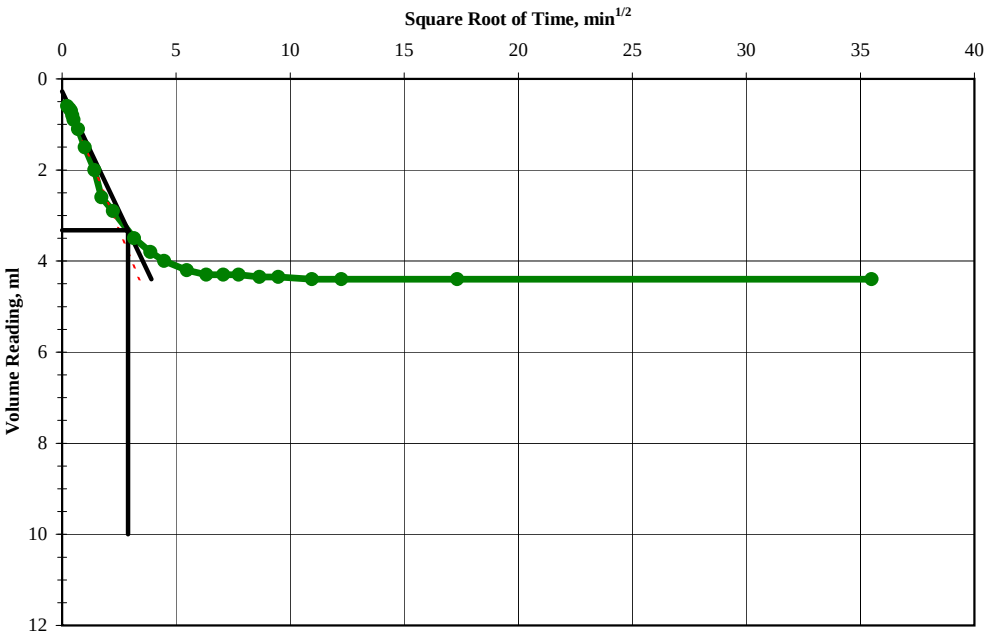
Consol. Start Date: 3/1/2011

Elapsed Time (min)	Sqrt Time ($min^{1/2}$)	Volume Reading ml
0	0	0.0
0.05	0.22	0.6
0.10	0.32	0.6
0.15	0.39	0.7
0.20	0.45	0.8
0.25	0.50	0.9
0.50	0.71	1.1
1.00	1.00	1.5
2.00	1.41	2.0
3.00	1.73	2.6
5.00	2.24	2.9
10.00	3.16	3.5
15.00	3.87	3.8
20.00	4.47	4.0
30.00	5.48	4.2
40.00	6.32	4.3
50.00	7.07	4.3
60.00	7.75	4.3
75.00	8.66	4.4
90.00	9.49	4.4
120.00	10.95	4.4
150.00	12.25	4.4
300.00	17.32	4.4
1260.00	35.50	4.4

Log of Elapsed Time vs. Volume Reading



Square Root of Elapsed Time vs. Volume Reading



Sqrt. of Elapsed Time vs Volume		Log of Elapsed Time vs Volume		Consolidation Summary	
T0 = 0 min.	V0 = 0.3 ml.	T0 = 0 min.	V0 = 0.4 ml.	Initial Volume Reading, ml	0.0
T90 = 8.4 min	V90 = 3.3 ml.	T50 = 2.6 min.	V50 = 2.4 ml.	Final Volume Reading, ml	4.4
T100 = NA min	V100 = 3.7 ml.	T100 = 9.6 min.	V100 = 4.3 ml.	Total Volume Change, ml	24.6

Input Validation: Reviewed By: Date 3/1/2011

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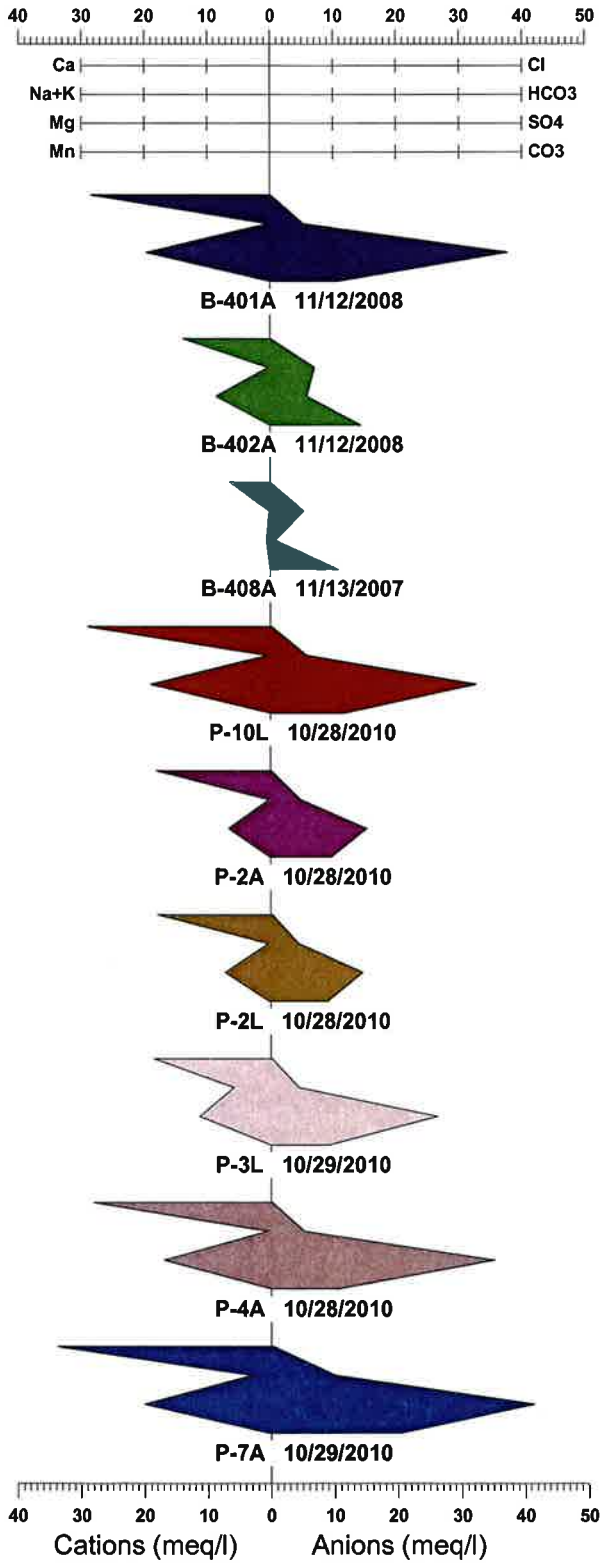
APPENDIX C3-E

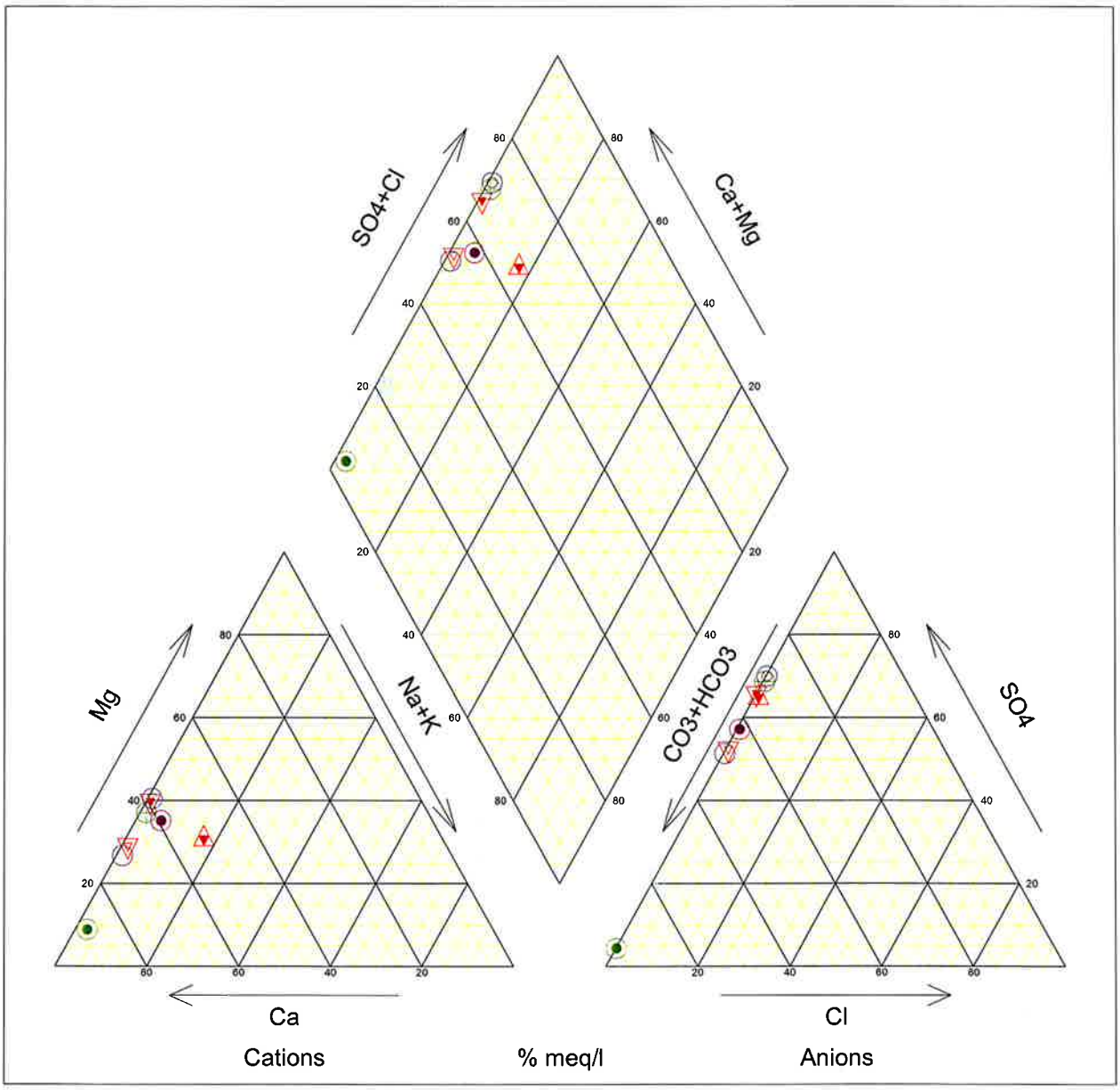
GROUNDWATER QUALITY DATA
FIELD FORMS, COCs, LABORATORY REPORT,
STIFF & PIPER DIAGRAMS

Apex Landfill - Limestone & Mine Spoil Wells



Prepared by: CEC, Inc.

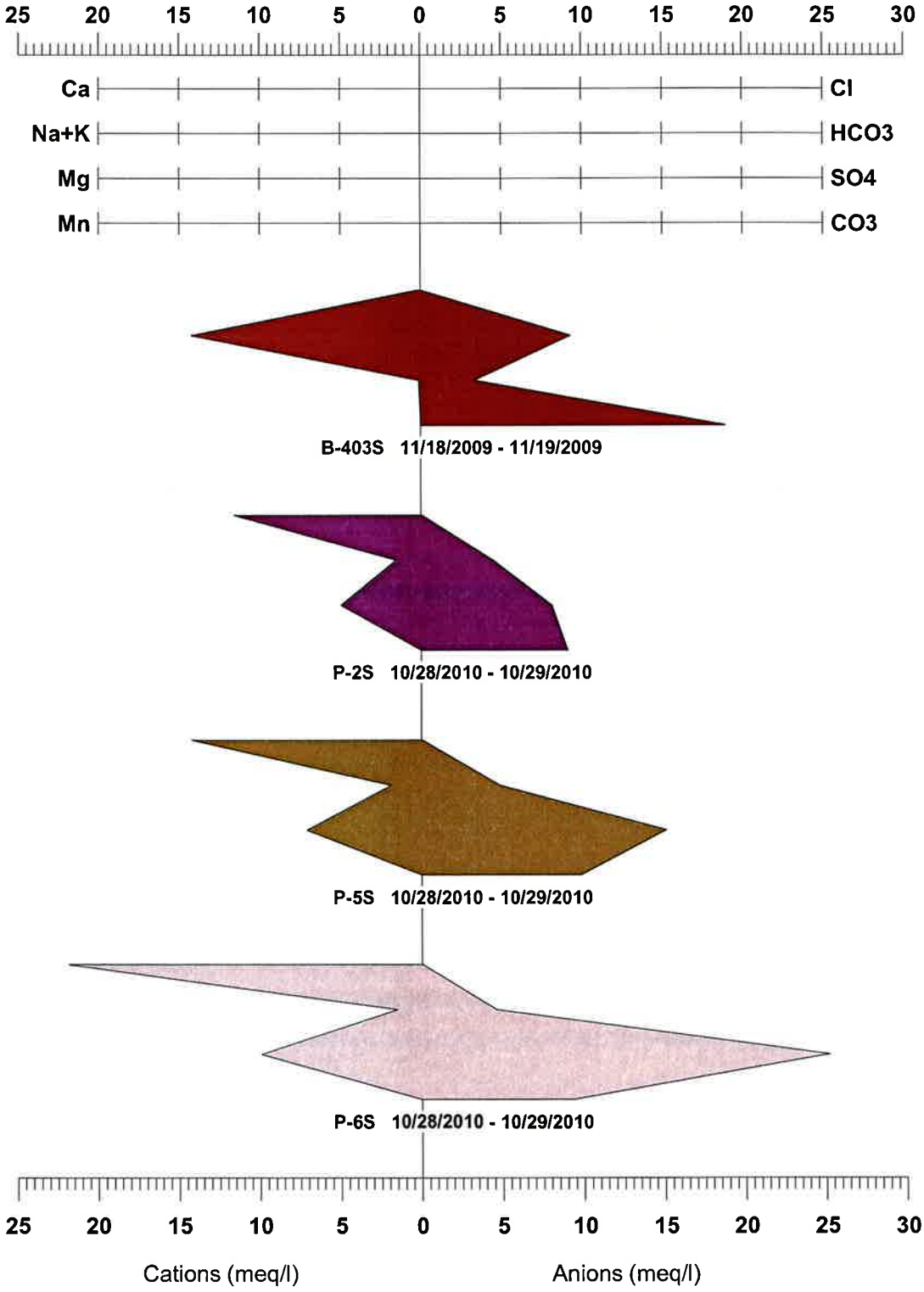
Apex Landfill - Limestone & Mine Spoil Wells



B-401A	11/12/2008	P-7A	10/29/2010
B-402A	11/12/2008		
B-408A	11/13/2007		
P-10L	10/28/2010		
P-2A	10/28/2010		
P-2L	10/28/2010		
P-3L	10/29/2010		
P-4A	10/28/2010		

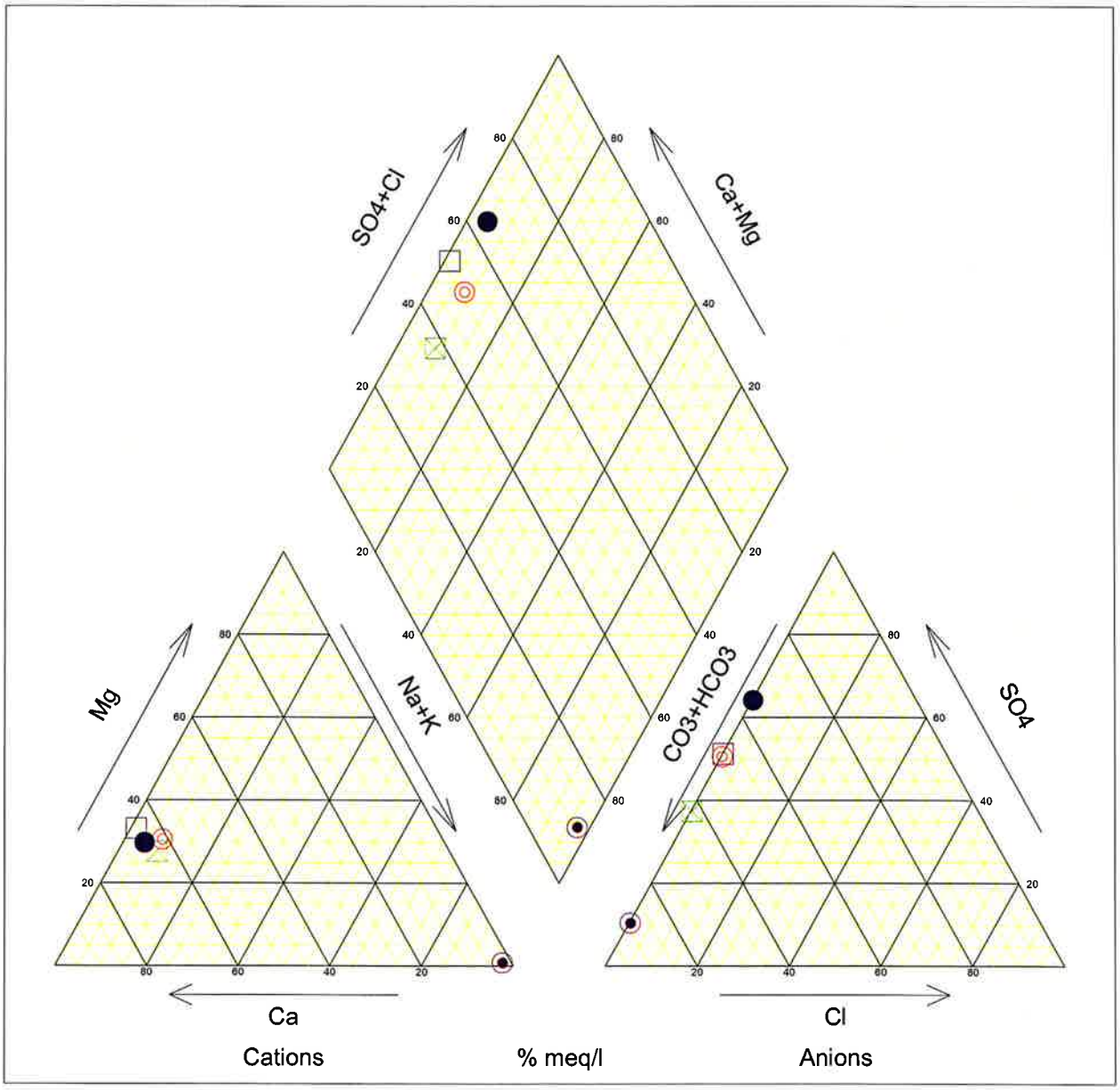
Prepared by: CEC, Inc.

Apex Landfill - Bedrock SZS Wells



Prepared by: CEC, Inc.

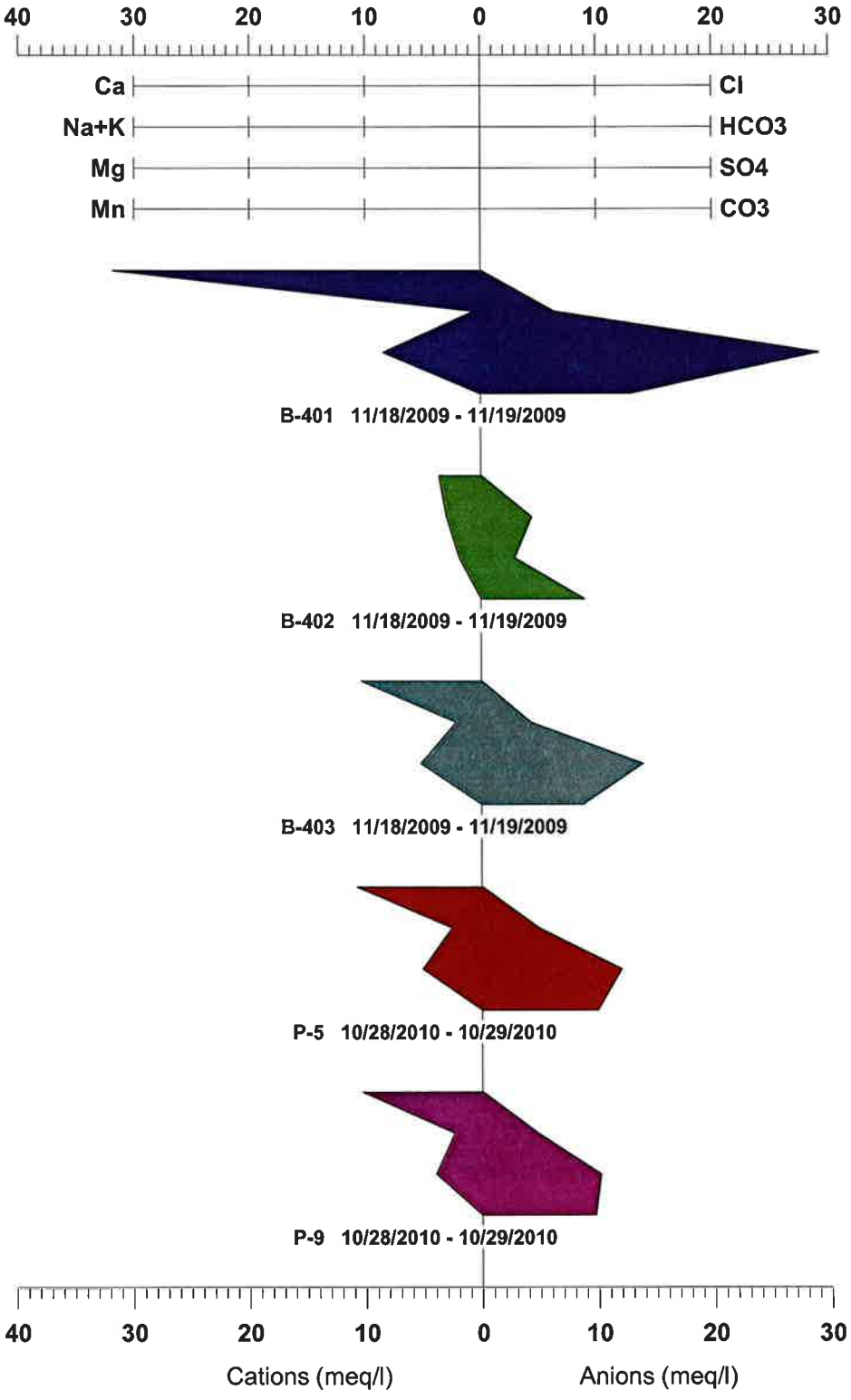
Apex Landfill - Bedrock SZS Wells



□	B-11S	5/30/2006 - 5/31/2006
	B-401S	11/12/2007 -11/14/2007
	B-402S	7/02/2007 - 7/03/2007
◉	B-403S	11/18/2009 -11/19/2009
▨	P-2S	10/28/2010 -10/29/2010
◎	P-5S	10/28/2010 -10/29/2010
●	P-6S	10/28/2010 -10/29/2010

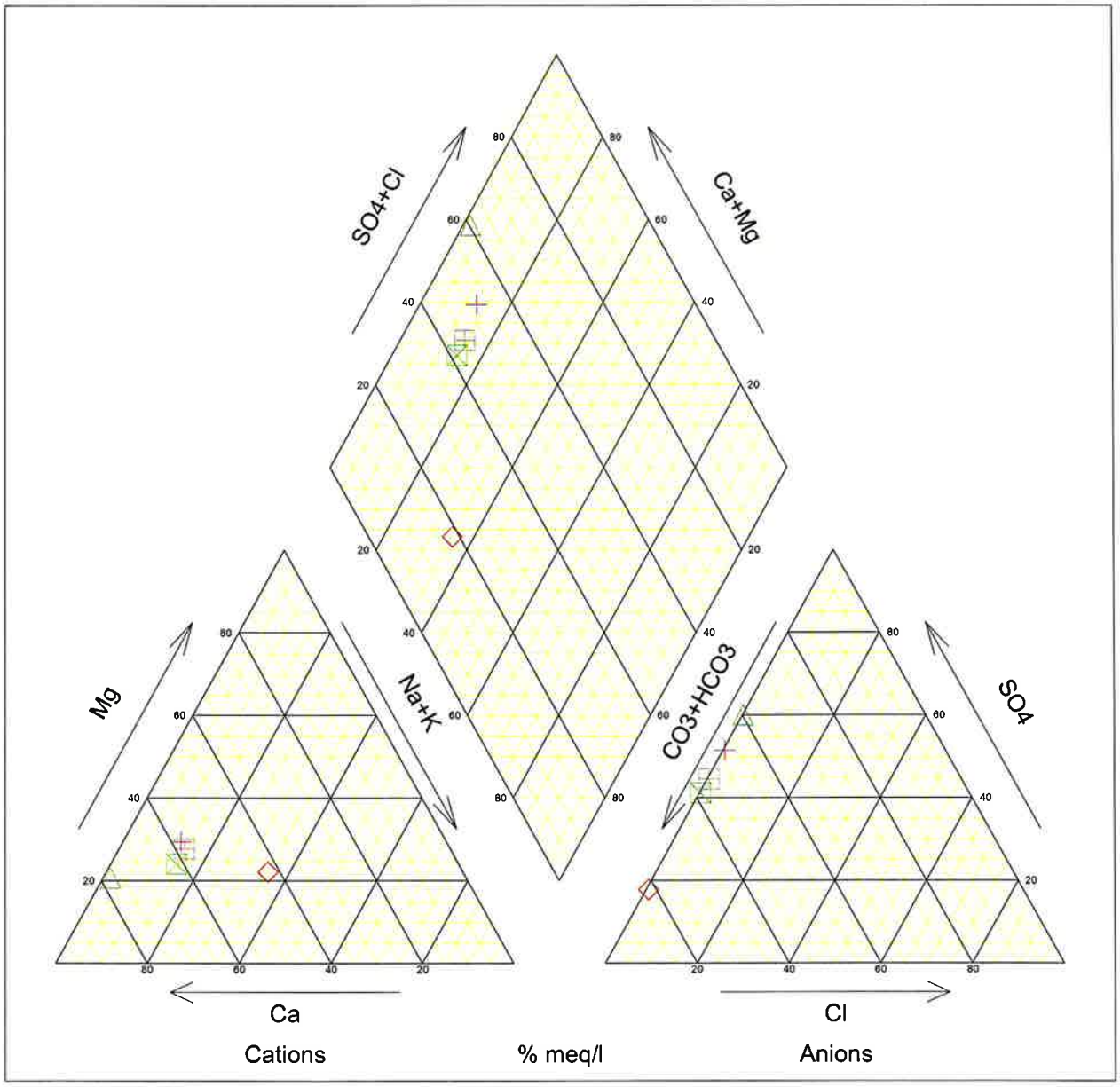
Prepared by: CEC, Inc.

Apex Landfill - Uppermost Aquifer System Wells



Prepared by: CEC, Inc.

Apex Landfill - Uppermost Aquifer System Wells



△	B-401	11/18/2009 -11/19/2009
◇	B-402	11/18/2009 -11/19/2009
+	B-403	11/18/2009 -11/19/2009
⊟	P-5	10/28/2010 -10/29/2010
⊠	P-9	10/28/2010 -10/29/2010

Prepared by: CEC, Inc.

GROUNDWATER MONITORING WELL SAMPLING FIELD DATA SHEET

Client: Apex Sanitary Landfill

CEC Project Number: ~~081-898.1A09~~ 100-804

Date: 12-7-10

Weather Observations: 15°F, Sunny

WELL ID: B-401S

Water Volume Factors	
Diameter	Gallons/Foot
1 inches	0.04
1.5 inches	0.092
2 inches	0.17
3 inches	0.38
4 inches	0.66

Casing Diameter: 2 (inches)

Total Depth: 118.07 (feet)

Depth to Water: 112.48 (feet)

Depth to Top of Screen: 108.07 (feet)

Water Height in Well: 5.59 (feet)

Water Volume in Well: 0.91 (gallons)

Purge Volume: 2.73 gal.(calculated)

2.10 gal. (removed)

Min. Purge Vol. for Passive Sampling ((tubing)(ml/ft)+(pump Vol.)) = _____

Measured using: Electric water level tape.

Purged using: **Disposable Bailer/Polypro Rope** Bladder pump/poly tubing Other _____

Sampled using: **Disposable Bailer/Polypro Rope** Bladder pump/poly tubing Other _____

Field Measurements

Temperature (degrees C)	pH (s.u.)	Conductivity (umhos/cm)	Turbidity (NTU)	Volume (gallons)	Water Level During Purging (feet)	Time
10.7	6.95	1485	75.2	initial	112.48	1150
9.7	6.91	2860	71000	1.0	—	1153
9.7	6.93	2810	71000	2.0	—	1200
					DRY	1203

Field Measurements at Time of Sampling

Temperature (degrees C)	pH (s.u.)	Conductivity (umhos/cm)	Turbidity (NTU)	Volume (gallons)	Water Level During Sampling (feet)	Time
9.3	6.47	2900	>1000	2.10	116.08	920

Instrument Calibration

See B-405

Turbidity Meter Type: Hach

1.0 NTU std = _____ 5.94 NTU std = _____

10.0 NTD std = _____ 49.6 NTU std = _____

505 NTU std = _____

pH/Conductivity Meter Type: Oakton

4.01 std = _____

7.0 std = _____ 1413 umhos/cm = _____

10.1 std = _____

Physical Properties

Odor: NONE

Color: Brown

Turbidity: HIGH

Analysis Required: App I (1-78)

Sample time/date: 920 12/8/10

Comments: Bailed Dry on 12-7-10 Sampled 12/8/10

Deviations from SAP: _____

Sampler: VH4BB

Signature: V Hall

GROUNDWATER MONITORING WELL SAMPLING FIELD DATA SHEET

Client: Apex Sanitary Landfill

CEC Project Number: ~~081-808-[illegible]~~ 100-804

Date: 12/9/10

Weather Observations: 15°F, Sunny

WELL ID: B-402

Water Volume Factors	
Diameter	Gallons/Foot
1 inches	0.04
1.5 inches	0.092
2 inches	0.17
3 inches	0.38
4 inches	0.66

Casing Diameter: 2 (inches)

Water Height in Well: 46.11 (feet)

Total Depth: 157.53 (feet)

Water Volume in Well: 7.51 (gallons)

Depth to Water: 111.42 (feet)

Purge Volume: 0.49 gal.(calculated)

0.50 gal. (removed)

Depth to Top of Screen: 147.53 (feet)

Min. Purge Vol. for Passive Sampling ((153' tubing)(~9.65ml/ft)+(395ml pump Vol.)) = 1,871 mL / **0.49 gal**

Measured using: Electric water level tape.

Purged using: Bailer/Polypro Rope **Dedicated Bladder pump/poly tubing** Other

Sampled using: Bailer/Polypro Rope **Dedicated Bladder pump/poly tubing** Other

Field Measurements

Temperature (degrees C)	pH (s.u.)	Conductivity (umhos/cm)	Turbidity (NTU)	Volume (gallons)	Water Level During Purging (feet)	Time
passive sample	NA	NA	NA	Start Purge	111.42	1137
na		na	na	0.10	112.76	1142
				0.20	112.28	1147
				0.30	112.61	1152
				0.40	112.89	1157
8.0	8.31	545	1.24	0.50	113.41	1202
na	na	na	na	na	113.79	1207
					114.11	1212
					114.40	1217
					114.71	1222
					114.93	1227
					115.31	1232
					115.79	1237

MAX 6.97 - 118.39

Field Measurements at Time of Sampling

Temperature (degrees C)	pH (s.u.)	Conductivity (umhos/cm)	Turbidity (NTU)	Volume (gallons)	Water Level During Sampling (feet)	Time
8.0	8.31	545	1.24	0.50	113.41	~~1157~~ 1202

Instrument Calibration

See B-401A

Turbidity Meter Type: Hach

1.0 NTU std = 5.94 NTU std =

10.0 NTD std = 49.6 NTU std =

505 NTU std =

pH/Conductivity Meter Type: Oakton

4.01 std =

7.0 std = 1413 umhos/cm =

10.1 std =

Physical Properties

Odor: None

Color: Clear

Turbidity: Low

Analysis Required: App II (1-78)

Sample time/date: 12/9/10 ~~1157~~ 1202

Comments: 4 rpm 10/5 @ 76 psi = 100 mL/min

Deviations from SAP:

Sampler: VH & BB

Signature: VHeun

GROUNDWATER MONITORING WELL SAMPLING FIELD DATA SHEET

Client: Apex Sanitary Landfill
CEC Project Number: ~~081-898-1A09~~ 100804
Date: 12-9-10
Weather Observations: 150F Sunny

WELL ID: B-402A

Water Volume Factors	
Diameter	Gallons/Foot
1 inches	0.04
1.5 inches	0.092
2 inches	0.17
3 inches	0.38
4 inches	0.66

Casing Diameter: 2 (inches)
Water Height in Well: 6.99 (feet)
Total Depth: 37.88 (feet)
Water Volume in Well: 1.12 (gallons)
Depth to Water: 30.99 (feet)
Purge Volume: 3.36 gal (calculated)
4.0 gal. (removed)
Depth to Top of Screen: 32.88 (feet)

Min. Purge Vol. for Passive Sampling ((tubing)(ml/ft)+(pump Vol.)) = _____

Measured using: Electric water level tape.

Purged using: Bailer/Polypro Rope **Dedicated Bladder pump/poly tubing** Other _____

Sampled using: Bailer/Polypro Rope **Dedicated Bladder pump/poly tubing** Other _____

Field Measurements

Temperature (degrees C)	pH (s.u.)	Conductivity (umhos/cm)	Turbidity (NTU)	Volume (gallons)	Water Level During Purging (feet)	Time
6.5	6.77	3050	23.9	initial	30.99	~~1047~~ 1103
9.4	6.91	1755	8.95	1.0	31.74	~~1052~~ 1108
9.7	6.90	1760	4.55	1.77	31.74	~~1055~~ 1111
10.0	6.84	1761	3.48	2.7		~~1058~~ 1114
						~~1102~~
10.1	6.85	1770	2.72	3.25		~~1114~~ 1117
10.1	6.84	1766	1.24	4.0		1120

VH

Field Measurements at Time of Sampling

Temperature (degrees C)	pH (s.u.)	Conductivity (umhos/cm)	Turbidity (NTU)	Volume (gallons)	Water Level During Sampling (feet)	Time
10.1	6.84	1766	1.24	4.0	31.74	~~1114~~ 1120

VH

Instrument Calibration

See B-401A

Turbidity Meter Type: Hach
1.0 NTU std = _____
10.0 NTD std = _____
5.94 NTU std = _____
49.6 NTU std = _____
505 NTU std = _____

pH/Conductivity Meter Type: Oakton
4.01 std = _____
7.0 std = _____
10.1 std = _____
1413 umhos/cm = _____

Physical Properties
Odor: slight sulfur
Color: none
Turbidity: low

Analysis Required: App II (1-78)
Sample time/date: 12-9-10 / ~~1114~~ 1120 VH

Comments: 4 LPM 10/5 @ 30 psi = 500

Deviations from SAP: _____

Sampler: VH & BB
Signature: VHall

CEC

GROUNDWATER MONITORING WELL SAMPLING FIELD DATA SHEET

Client: Apex Sanitary Landfill

Date: 12/9/10

CEC Project Number: ~~081-898.1A09~~ 100-804

Weather Observations: 15°F, overcast

WELL ID: B-403

Water Volume Factors	
Diameter	Gallons/Foot
1 inches	0.04
1.5 inches	0.092
2 inches	0.17
3 inches	0.38
4 inches	0.66

Casing Diameter: 2 (inches)

Total Depth: 120.29 (feet)

Depth to Water: 66.90 (feet)

Depth to Top of Screen: 110.29 (feet)

Water Height in Well: 53.39 (feet)

Water Volume in Well: 8.70 (gallons)

Purge Volume: 0.40 gal.(calculated)

0.45 gal (removed)

Min. Purge Vol. for Passive Sampling ((115.5' tubing)(~9.65ml/ft)+(395ml pump Vol.))= 1,509 mL / 0.40 gal

Measured using: Electric water level tape.

Purged using: Bailer/Polypro Rope **Dedicated Bladder pump/poly tubing** Other

Sampled using: Bailer/Polypro Rope **Dedicated Bladder pump/poly tubing** Other

Max. 6.71 73.61

Field Measurements

Temperature (degrees C)	pH (s.u.)	Conductivity (umhos/cm)	Turbidity (NTU)	Volume (gallons)	Water Level During Purging (feet)	Time
passive sample	NA	NA	NA	start purge	66.90	1342
↓	↓	↓	↓	0.10	68.05	1347
				0.10	69.30	1352
				0.30	69.91	1357
↓	↓	↓	↓	0.40	70.53	1403
8.2	7.60	1219	2.57	0.45	70.73	1405
na	na	na	na	na	71.53	1410
↓	↓	↓	↓	↓	71.60	1415
					71.62	1420
					71.93	1425
					72.29	1430
↓	↓	↓	↓	↓	72.30	1435

WL	TIME
72.34	1440
72.36	1445
72.38	1450
72.4	1455

Field Measurements at Time of Sampling

Temperature (degrees C)	pH (s.u.)	Conductivity (umhos/cm)	Turbidity (NTU)	Volume (gallons)	Water Level During Sampling (feet)	Time
8.2	7.60	1219	2.57	0.45	70.73	1405

Instrument Calibration

See B-405

Turbidity Meter Type: Hach — 1.0 NTU std = ; 10.0 NTD std = ; 5.94 NTU std = ; 40.6 NTU std = ; 505 NTU std =

pH/Conductivity Meter Type: Oakton — 4.01 std = ; 7.0 std = ; 10.1 std = ; 1413 umhos/cm =

Physical Properties
Odor: none
Color: clear
Turbidity: low

Analysis Required: Ohio App I (1-78)

Sample time/date: 12/9/10 1405

Comments: 4cpm 10/5 @ 60 psi = 100mL/min - slowed rate to 80mL/min @ 1400

VH ~~Deviations from SAP:~~ 1cpm 55/60 = slowed rate to 50mL/min @1410

Sampler: VH/BB

Signature: VH/MA

GROUNDWATER MONITORING WELL SAMPLING FIELD DATA SHEET

Client: Apex Sanitary Landfill

CEC Project Number: ~~081-898-5400~~ 100-904

Date: 12/9/10

Weather Observations: 15°F, sunny

WELL ID: B-403S

Water Volume Factors	
Diameter	Gallons/Foot
1 inches	0.04
1.5 inches	0.092
2 inches	0.17
3 inches	0.38
4 inches	0.66

Casing Diameter: 2 (inches)

Water Height in Well: 14.84 (feet)

Total Depth: 136.83 (feet)

Water Volume in Well: 2.41 (gallons)

Depth to Water: 121.99 (feet)

Purge Volume: 0.19 gal (calculated)

0.2 gal. (removed)

Depth to Top of Screen: 126.83 (feet)

Min. Purge Vol. for Passive Sampling ((133.5' tubing)(~4.46ml/ft)+(130ml pump Vol.)) = 726 mL / 0.19 gal

Measured using: Electric water level tape.

Purged using: Bailer/Polypro Rope **Dedicated Bladder pump/poly tubing** Other

Sampled using: Bailer/Polypro Rope **Dedicated Bladder pump/poly tubing** Other

Field Measurements

Temperature (degrees C)	pH (s.u.)	Conductivity (umhos/cm)	Turbidity (NTU)	Volume (gallons)	Water Level During Purging (feet)	Time
Passive Sample	NA	NA	NA	NA	121.99	1300
NA	NA	NA	NA	0.1	122.97	1305
8.3	8.34	1038	0.76	0.2	123.61	1310
NA	NA	NA	NA	NA	124.37	1315
					125.01	1320
					125.91	1325
					126.11	1330
					126.73	1335

P:\Project Documents\APEX LF\Well Sampling\Background #1

MAX: 6.17' • 128.16

Field Measurements at Time of Sampling

Temperature (degrees C)	pH (s.u.)	Conductivity (umhos/cm)	Turbidity (NTU)	Volume (gallons)	Water Level During Sampling (feet)	Time
8.3	8.34	1038	0.76	0.2	123.61	1310

Instrument Calibration

See B-401A

Turbidity Meter Type: Hach

1.0 NTU std = 94 NTU std =

10.0 NTD std = 40.6 NTU std =

505 NTU std =

pH/Conductivity Meter Type: Oakton

4.01 std =

7.0 std = 1413 umhos/cm =

10.1 std =

Physical Properties

Odor: none

Color: Light

Turbidity: low

Analysis Required: Ohio App III-78)

Sample time/date: 12/9/10 1310

Comments: 2 rpm 20/10 @ 70 psi = 100mL/min

Deviations from SAP:

Sampler: VHABB

Signature: VHAM

GROUND WATER MONITORING WELL SAMPLING FIELD DATA SHEET

Client: APEX

CEC Project Number: 106-049

Date: 10/28/10

Weather Observations: SUNNY 56° (WINDY)

WELL ID: P-7A

Water Volume Factors	
Diameter	Gallons/Foot
1 inches	0.04
1.5 inches	0.092
2 inches	0.17
3 inches	0.38
4 inches	0.66

Casing Diameter: 2 (inches)

Water Height in Well: ~~8.71~~ 6.22 (feet)

Total Depth: 40.49 ~~38.0~~ (feet)

Water Volume in Well: ~~1.01~~ 1.48 (gallons)

Depth to Water: 31.78 (feet)

Purge Volume: 4.44 gal.(calculated)

1.5 +Dry gal. (removed)

Depth to Top of Screen: ~~28.0~~ 30.49 (feet)

Mimimum Purge Volume (drawdown)(gal./ft.) + (well screen length)(gal./ft.) = NA

Measured using:

Purged using: Dedicated Bailer/Polypro Rope Grundfos pump/poly tubing Other Disposable Bailer

Sampled using: Dedicated Bailer/Polypro Rope Grundfos pump/poly tubing Other Disposable Bailer

Field Measurements

Temperature (degrees C)	pH (s.u.)	Conductivity (umhos/cm)	Turbidity (NTU)	Volume (gallons)	Water Level During Purging (feet)	Time
10.2	6.33	5340	47.3	Initial	31.78	0823
—	—	—	—	1.5	DRY	0832
8.7	7.34	5030	62.0	1.5	31.88	0751
~~8.7~~	~~7.34~~	~~5030~~	~~62.0~~	~~1.5~~	~~31.88~~	0751

10/29/10

P: Administrative Documents\Handy Forms\Field form - Revised 9-04.xls

Field Measurements at Time of Sampling

Temperature (degrees C)	pH (s.u.)	Conductivity (umhos/cm)	Turbidity (NTU)	Volume (gallons)	Water Level During Sampling (feet)	Time
8.7	7.34	5030	62.0	1.5	31.88	0751

Instrument Calibration

Turbidity Meter Type HACH

1.0 NTU std = — 4.53 ~~5.42~~ NTU std = 4.11

10.0 NTD std = — 49.2 ~~51.8~~ NTU std = 50.6

551 ~~499~~ NTU std = 561

pH/Conductivity Meter Type OAKTON

4.01 std = 4.00

7.0 std = 7.06 1413 umhos/cm = 1396

10.1 std = 10.19

Physical Properties

Odor: NONE

Color: LIGHT BROWN

Turbidity: MEDIUM

Analysis Required: App I (1-78)

Sample time/date: 0751 / 10-29-10

Comments:

Deviations from SAP: Used empty distilled water jug (1 gallon) to transport groundwater to VOC bottles.

Sampler: BB + LW

Signature:

GROUNDWATER MONITORING WELL SAMPLING FIELD DATA SHEET

Client: Apex Sanitary Landfill

CEC Project Number: 100-804

Date: 12-9-10

Weather Observations: 15°F, Overcast

WELL ID: B-401

Water Volume Factors	
Diameter	Gallons/Foot
1 inches	0.04
1.5 inches	0.092
2 inches	0.17
3 inches	0.38
4 inches	0.66

Casing Diameter: 2 (inches)

Total Depth: 145.40 (feet)

Depth to Water: ~~107.05~~ 107.12 (feet)

Depth to Top of Screen: 135.40 (feet)

Water Height in Well: 38.28 (feet)

Water Volume in Well: 6.24 (gallons)

Purge Volume: 18.72 gal (calculated)

4.00 gal. (removed)

Min. Purge Vol. for Passive Sampling ((tubing)(ml/ft)+(pump Vol.)) = NA

Measured using: Electric water level tape.

Purged using: Bailer/Polypro Rope **Dedicated Bladder pump/poly tubing** Other

Sampled using: Bailer/Polypro Rope **Dedicated Bladder pump/poly tubing** Other

Field Measurements

Temperature (degrees C)	pH (s.u.)	Conductivity (umhos/cm)	Turbidity (NTU)	Volume (gallons)	Water Level During Purging (feet)	Time
9.0	7.68	1430	7.07	Initial	107.12	1009
9.6	6.94	3060	1.17	1.0	107.86	1013
9.5	6.77	3040	0.88	1.75	107.86	1016
9.4	6.76	3040	0.68	2.5		1019
9.5	6.78	3040	0.53	3.25		1022
9.4	6.80	3050	0.57	4.00	↓	1025

Field Measurements at Time of Sampling

Temperature (degrees C)	pH (s.u.)	Conductivity (umhos/cm)	Turbidity (NTU)	Volume (gallons)	Water Level During Sampling (feet)	Time
9.4	6.80	3050	0.57	4.00	107.86	1025

Instrument Calibration

See B-401A

Turbidity Meter Type

1.0 NTU std = 5.94 NTU std =

10.0 NTD std = 49.6 NTU std =

505 NTU std =

pH/Conductivity Meter Type

4.01 std =

7.0 std = 1413 umhos/cm =

10.1 std =

Physical Properties

Odor: none

Color: clear

Turbidity: low

Analysis Required: App IA (1-78)

Sample time/date: 12/9/10 1025

Comments: truck traffic 2 cpm @ 11 @ 85 PSI = 500 mL/min

Dup-2 collected here

Deviations from SAP:

Sampler: VH & BB

Signature: VHall

GROUNDWATER MONITORING WELL SAMPLING FIELD DATA SHEET

Client: Apex Sanitary Landfill

CEC Project Number: ~~081-003~~ 100804

Date: 12/9/10

Weather Observations: 15°F, OVERCAST

WELL ID: B-401A

Water Volume Factors	
Diameter	Gallons/Foot
1 inches	0.04
1.5 inches	0.092
2 inches	0.17
3 inches	0.38
4 inches	0.66

Casing Diameter: 2 (inches)

Water Height in Well: NA (feet)

Total Depth: 48.30 (feet)

Water Volume in Well: NA (gallons)

Depth to Water: BTOP (feet)

Purge Volume: NA gal (calculated)

3.25 gal (removed)

Depth to Top of Screen: 38.30 (feet)

Min. Purge Vol. for Passive Sampling ((tubing)(ml/ft)+(pump Vol.)) = NA

Measured using: Electric water level tape.

Purged using: Bailer/Polypro Rope **Dedicated Bladder pump/poly tubing** Other

Sampled using: Bailer/Polypro Rope **Dedicated Bladder pump/poly tubing** Other

Field Measurements

Temperature (degrees C)	pH (s.u.)	Conductivity (umhos/cm)	Turbidity (NTU)	Volume (gallons)	Water Level During Purging (feet)	Time
9.1	6.77	3180	5.32	initial	BTOP	923
9.7	6.73	3450	4.45	0.75		933
9.6	6.91	3490	3.72	1.50		936
9.5	6.91	3480	2.96	2.0		939
9.5	6.91	3490	2.58	2.60		942
9.4	6.92	3490	2.36	3.25		945

Field Measurements at Time of Sampling

Temperature (degrees C)	pH (s.u.)	Conductivity (umhos/cm)	Turbidity (NTU)	Volume (gallons)	Water Level During Sampling (feet)	Time
9.4	6.92	3490	2.36	3.25	BTOP	945

Instrument Calibration

588

Turbidity Meter Type Hach

1.0 NTU std = ____ ~~5.94~~ NTU std = 5.80

10.0 NTD std = 30.2 ~~49.6~~ NTU std = 51.8

~~505~~ NTU std = 500

pH/Conductivity Meter Type Oakton

4.01 std = 3.99 498

7.0 std = 7.13 1413 umhos/cm = 1430

10.1 std = 10.32

Physical Properties

Odor: none

Color: clear

Turbidity: low

Analysis Required: App I (1-78)

Sample time/date: 12/9/10 945

Comments: TRUCK TRAFFIC WHEN COLLECTING 4 cpm 10/5 @ 30 psi = 320 mL/min

BTOP = Below top of Pump

Deviations from SAP:

Sampler: VH & BB

Signature: VHall

GROUND WATER MONITORING WELL SAMPLING FIELD DATA SHEET

Client: APEX CEC Project Number: 101-049

Date: 10/27/10 Weather Observations: SUNNY 62° (WINDY)

WELL ID: P-6S

Water Volume Factors	
Diameter	Gallons/Foot
1 inches	0.04
1.5 inches	0.092
2 inches	0.17
3 inches	0.38
4 inches	0.66

Casing Diameter: 2 (inches) Water Height in Well: 19.34 (feet)

Total Depth: 82.83 (feet) Water Volume in Well: 3.29 (gallons)

Depth to Water: 63.49 (feet) Purge Volume: 9.86 gal (calculated) / 8.0 gal. (removed)

Depth to Top of Screen: 72.83 (feet)

Minimum Purge Volume (drawdown)(gal./ft.) + (well screen length)(gal./ft.) = NA

Measured using: Electric WL Meter

Purged using: Disposable Bailer/Polypro Rope Grundfos pump/poly tubing Other Disposable Bailer

Sampled using: Disposable Bailer/Polypro Rope Grundfos pump/poly tubing Other Disposable Bailer

Field Measurements

Temperature (degrees C)	pH (s.u.)	Conductivity (umhos/cm)	Turbidity (NTU)	Volume (gallons)	Water Level During Purging (feet)	Time
11.9	7.15	3430	561	Initial	63.49	1500
11.2	7.09	3450	561	2.6	—	1513
11.3	7.09	3420	>1000	5.0	—	1522
11.4	7.11	3370	>1000	7.5	—	1535
—	—	—	—	8.0	DRY	1539
9.3	7.25	3020	25.4	8.0	63.31	0914

10/29/10

Field Measurements at Time of Sampling

Temperature (degrees C)	pH (s.u.)	Conductivity (umhos/cm)	Turbidity (NTU)	Volume (gallons)	Water Level During Sampling (feet)	Time
9.3	7.25	3020	25.4	8.0	63.31	0914

Instrument Calibration

Turbidity Meter Type HACH

1.0 NTU std = ____ 4.53 NTU std = 4.38

10.0 NTD std = ____ 49.2 NTU std = 51.0

551 NTU std = 561

pH/Conductivity Meter Type OAKTON

4.01 std = 3.99

7.00 std = 7.06 1413 umhos/cm = 1400

10.01 std = 10.21

Physical Properties

Odor: NONE

Color: CLEAR

Turbidity: LOW

Analysis Required: App I (1-78)

Sample time/date: 0914 / 10-29-10

Comments:

Deviations from SAP: Used empty container which once contained distilled water to transport groundwater into VOC bottles.

Samplers: BR + LW Signature:

GROUND WATER MONITORING WELL SAMPLING FIELD DATA SHEET

Client: APEX
CEC Project Number: 101-079
Date: 10/27/10
Weather Observations: SUNNY 62°

WELL ID: P-55

Water Volume Factors	
Diameter	Gallons/Foot
1 inches	0.04
1.5 inches	0.092
2 inches	0.17
3 inches	0.38
4 inches	0.66

Casing Diameter: 2 (inches)
Water Height in Well: ~~0.70~~ 3.73 (feet)
Total Depth: 67.03 ~~64~~ (feet)
Water Volume in Well: 0.63 (gallons)
Depth to Water: 63.30 (feet)
Purge Volume: 1.90 gal.(calculated)
2.25 DM gal. (removed)
Depth to Top of Screen: 54 (feet)
Minimum Purge Volume (drawdown)(gal./ft.) + (well screen length)(gal./ft.) = NA
Measured using: ~~Graduated Cylinder~~

Purged using: Dedicated Bailer/Polypro Rope Grundfos pump/poly tubing Other Disposable Bailer
Sampled using: Dedicated Bailer/Polypro Rope Grundfos pump/poly tubing Other Disposable Bailer

Field Measurements

Temperature (degrees C)	pH (s.u.)	Conductivity (umhos/cm)	Turbidity (NTU)	Volume (gallons)	Water Level During Purging (feet)	Time
14.3	7.23	1604 MS	513	INITIAL	63.30	1554
11.6	7.13	1601	231	1.5	—	1620
—	—	—	—	2.25	—	1625
8.7	7.19	1717	7.59	2.25	63.60	0841

10/29/10

Field Measurements at Time of Sampling

Temperature (degrees C)	pH (s.u.)	Conductivity (umhos/cm)	Turbidity (NTU)	Volume (gallons)	Water Level During Sampling (feet)	Time
8.7	7.19	1717	7.59	2.25	63.60	0841

Instrument Calibration

Turbidity Meter Type _____
1.0 NTU std = _____ 5.42 NTU std = _____
10.0 NTD std = _____ 51.8 NTU std = _____
499 NTU std = _____

SEE P-65

pH/Conductivity Meter Type _____
4.01 std = _____
7.0 std = _____ 1413 umhos/cm = _____
10.1 std = _____

Physical Properties
Odor: NONE
Color: CLEAR
Turbidity: VERY LOW

Analysis Required: App I (1-78)
Sample time/date: 0841 / 10-24-10

Comments:

Deviations from SAP: USED EMPTY DISTILLED WATER JUG (1 Gallon) to transport groundwater into VOC's bottles.

Sampler: BB
Signature:

P: Administrative Documents\Blank Forms\Field Forms • Revised 9-04.xls

GROUND WATER MONITORING WELL SAMPLING FIELD DATA SHEET

Client: APEX
CEC Project Number: 101-049
Date: 10/28/10
Weather Observations: SUNNY, WINDY 63°

WELL ID: P-2L

Water Volume Factors	
Diameter	Gallons/Foot
1 inches	0.04
1.5 inches	0.092
2 inches	0.17
3 inches	0.38
4 inches	0.66

Casing Diameter: 2 (inches)
Water Height in Well: 16.61 (feet)
Total Depth: 31 (feet)
Water Volume in Well: 2.71 (gallons)
Depth to Water: 14.39 (feet)
Purge Volume: NA gal.(calculated)
~~30,380~~ ~~gal.~~ mL (removed)
Depth to Top of Screen: 21 (feet)
Mimimum Purge Volume (drawdown)(gal./ft.) + (well screen length)(gal./ft.) = NA
Measured using: 5-gallon bucket

Purged using: Dedicated Bailer/Polypro Rope (Grundfos pump/poly tubing) Other
Sampled using: Dedicated Bailer/Polypro Rope (Grundfos pump/poly tubing) Other

P: Administrative Documents\Handy Forms\Field Form - Revised 9-04.xls

Field Measurements

Temperature (degrees C)	pH (s.u.)	Conductivity (umhos/cm)	Turbidity (NTU)	Volume ~~(gallons)~~ (mL)	Water Level During Purging (feet)	Time
11.6	7.07	1751	473	Initial	14.39	0950
~~12.1~~	~~6.56~~	~~1777~~	~~170~~	980 mL/Min	14.75	0953
12.1	6.56	1772	17.0	4,900		0958
12.3	6.58	1781	2.48	10,780	14.79	1004
12.4	6.60	1782	1.40	15,680	14.79	1009
12.1	6.61	1767	2.06	20,580	14.79	1014
12.1	6.62	~~1784~~ 1779	1.23	25,480	14.75	1019
12.5	6.64	1782	0.92	27,440	14.74	~~1024~~ 1022
12.4	6.65	1784	1.19	30,380	14.74	1024

Field Measurements at Time of Sampling

Temperature (degrees C)	pH (s.u.)	Conductivity (umhos/cm)	Turbidity (NTU)	Volume ~~(gallons)~~ mL	Water Level During Sampling (feet)	Time
12.4	6.65	1784	1.19	30,380 mL	14.74	1024

Instrument Calibration

Turbidity Meter Type
1.0 NTU std = 5.42 NTU std =
10.0 NTU std = 51.8 NTU std =
499 NTU std =

SEE P. 7A

pH/Conductivity Meter Type
4.01 std =
7.0 std = 1413 umhos/cm =
10.1 std =

Physical Properties
Odor: NONE
Color: CLEAR
Turbidity: VERY LOW

Analysis Required: App I (1-78)
Sample time/date: 1024 / 10-28-10

Comments: Roadside Traffic

Deviations from SAP: —

Sampler: BB & LW
Signature:

GROUND WATER MONITORING WELL SAMPLING FIELD DATA SHEET

Client: APEX
CEC Project Number: 101-049
Date: 10/28/10
Weather Observations: Sunny, windy mid 60's

WELL ID: P-25

Water Volume Factors	
Diameter	Gallons/Foot
1 inches	0.04
1.5 inches	0.092
2 inches	0.17
3 inches	0.38
4 inches	0.66

Casing Diameter: 2 (inches)
Water Height in Well: 11.76 (feet)
Total Depth: 63 (feet)
Water Volume in Well: 2.0 (gallons)
Depth to Water: 51.24 (feet)
Purge Volume: NA gal.(calculated)
17,200 gal. (removed) ML
Depth to Top of Screen: 53 (feet)
Mimimum Purge Volume (drawdown)(gal./ft.) + (well screen length)(gal./ft.) = NA
Measured using: Graduated Cylinder
Purged using: Dedicated Bailer/Polypro Rope Grundfos pump/poly tubing Other
Sampled using: Dedicated Bailer/Polypro Rope Grundfos pump/poly tubing Other

Field Measurements

Temperature (degrees C)	pH (s.u.)	Conductivity (umhos/cm)	Turbidity (NTU)	Volume (gallons) ML	Water Level During Purging (feet)	Time
11.4	7.65 ~~7.44~~	1397	>1000	Initial	52.66	1107
					860 ml/min	
13.1	7.41	1358	58.3	860 ml/min	52.99	1112
13.7	7.55	1378	8.12	4,300	52.70 ~~650ml~~	1117
14.0	7.45	1374	4.53	8,600	52.91	1122
14.0	7.46	1370	3.50	12,900	53.04	1127
14.2	7.45	1373	2.09	17,200	53.04	1132

Field Measurements at Time of Sampling

Temperature (degrees C)	pH (s.u.)	Conductivity (umhos/cm)	Turbidity (NTU)	Volume ~~(gallons)~~ (ML)	Water Level During Sampling (feet)	Time
14.2	7.45	1373	2.09	~~21,500~~ 17,200	53.04	1132

Instrument Calibration

Turbidity Meter Type SEE P-7A
1.0 NTU std = 5.42 NTU std =
10.0 NTD std = 51.8 NTU std =
499 NTU std =

pH/Conductivity Meter Type
4.01 std =
7.0 std = 1413 umhos/cm =
10.1 std =

Physical Properties
Odor: NONE
Color: CLEAR
Turbidity: VERY LOW

Analysis Required: App I (1-78)
Sample time/date: 1132 / 10-28-10

Comments: Roadside Traffic

Deviations from SAP:

Sampler: EB + LW
Signature:

P:\Administrative Documents\Handy Forms\Field Form - Revised 9-04.xls

GROUND WATER MONITORING WELL SAMPLING FIELD DATA SHEET

Client: APEX

CEC Project Number: 101-049

Date: 10/28/10

Weather Observations: Sunny, windy, mid 60s

WELL ID: P-2A

Water Volume Factors	
Diameter	Gallons/Foot
1 inches	0.04
1.5 inches	0.092
2 inches	0.17
3 inches	0.38
4 inches	0.66

Casing Diameter: 2 (inches)

Water Height in Well: 4.38 (feet)

Total Depth: 13.80 (feet)

Water Volume in Well: 0.74 (gallons)

Depth to Water: 9.42 (feet)

Purge Volume: NA gal.(calculated)

17,500 ~~gal~~ mL (removed)

Depth to Top of Screen: 8.80 (feet)

Minimum Purge Volume (drawdown)(gal./ft.) + (well screen length)(gal./ft.) = NA

Measured using: Graduated Cylinder

Purged using: Dedicated Bailer/Polypro Rope (Grundfos pump/poly tubing) Other

Sampled using: Dedicated Bailer/Polypro Rope (Grundfos pump/poly tubing) Other

P:\Administrative Documents\Handy Forms\Field Form - Revised 9-04.xls

Field Measurements

Temperature (degrees C)	pH (s.u.)	Conductivity (umhos/cm)	Turbidity (NTU)	Volume ~~(gallons)~~ mL	Water Level During Purging (feet)	Time
12.5	7.93	1837	>1000	Initial	10.35	1217
13.3	7.96	1841	225	580 mL/min	10.28	1222
13.8	7.12	1811	187	5,800	10.34	1227
14.5	7.10	1788	60.9	8,700	10.34	1232
14.4	7.09	1786	39.4	11,600	10.34	1237
14.6	7.11	1785	33.8	14,500	10.34	1242
14.5	7.08	1781	21.4	17,500	10.34	1247

Field Measurements at Time of Sampling

Temperature (degrees C)	pH (s.u.)	Conductivity (umhos/cm)	Turbidity (NTU)	Volume ~~(gallons)~~ mL	Water Level During Sampling (feet)	Time
14.5	7.08	1781	21.4	17,500 mL	10.34	1247

Instrument Calibration

Turbidity Meter Type

1.0 NTU std = 5.42 NTU std =

10.0 NTD std = 51.8 NTU std =

499 NTU std =

pH/Conductivity Meter Type SEE P-7A

4.01 std =

7.0 std = 1413 umhos/cm =

10.1 std =

Physical Properties

Odor: NONE

Color: CLEAR

Turbidity: LOW

Analysis Required: AOI 1 (1-78)

Sample time/date: 1247 / 10-28-10

Comments: Roadside Traffic

Deviations from SAP:

Sampler: BB + LW

Signature:

GROUND WATER MONITORING WELL SAMPLING FIELD DATA SHEET

Client: APEX

CEC Project Number: 101-049

Date: 10/29/10

Weather Observations: CLOUDY 40°

WELL ID: P-3L

Water Volume Factors	
Diameter	Gallons/Foot
1 inches	0.04
1.5 inches	0.092
2 inches	0.17
3 inches	0.38
4 inches	0.66

Casing Diameter: 2 (inches)

Water Height in Well: 14.86 (feet)

Total Depth: 73.0 (feet)

Water Volume in Well: 2.53 (gallons)

Depth to Water: 58.14 (feet)

Purge Volume: NA gal.(calculated)

18,750 ~~gal.~~ mL (removed)

Depth to Top of Screen: 63.0 (feet)

Mimimum Purge Volume (drawdown)(gal./ft.) + (well screen length)(gal./ft.) = NA

Measured using: Graduated Cylinder

Purged using: Dedicated Bailer/Polypro Rope (Grundfos pump/poly tubing) Other

Sampled using: Dedicated Bailer/Polypro Rope (Grundfos pump/poly tubing) Other

Field Measurements

Temperature (degrees C)	pH (s.u.)	Conductivity (umhos/cm)	Turbidity (NTU)	Volume (~~gallons~~) mL	Water Level During Purging (feet)	Time
8.8	7.30	3590	845	Initial	~~14.86~~ 58.14	1004
11.3	7.17	3550	75.2	750 mL/min	60.67	1009
13.1	7.18	3490	41.7	7,500	60.69	1014
13.1	7.16	3500	18.8	11,250	60.70	1019
13.1	7.18	3510	13.1	15,000	60.70	1024
13.1	7.19	3500	11.5	18,750	60.71	1029

Field Measurements at Time of Sampling

Temperature (degrees C)	pH (s.u.)	Conductivity (umhos/cm)	Turbidity (NTU)	Volume (~~gallons~~) mL	Water Level During Sampling (feet)	Time
13.1	7.19	3500	11.5	18,750	60.71	1029

Instrument Calibration

Turbidity Meter Type HACH

1.0 NTU std = ~~4.53~~ 4.53 ~~5.42~~ NTU std = 3.59

10.0 NTD std = ~~49.2~~ 49.2 ~~51.8~~ NTU std = 49.4

~~499~~ 551 NTU std = 557

pH/Conductivity Meter Type OAKTON

4.01 std = 4.00

7.0 std = 7.13 1413 umhos/cm = 1401

10.1 std = 7.21

Physical Properties

Odor: NONE

Color: Clear

Turbidity: Low

Analysis Required: App I (1-78)

Sample time/date: 1029 / 10/29/10

Comments:

Deviations from SAP:

Sampler: BB/LW

Signature: (for)

Civil & Environmental Consultants, Inc. ♦ 8740 Orion Place, Suite 100 ♦ Columbus, Ohio 42340 ♦ phone: (614) 540-6633 ♦ fax: (614) 540-6638

GROUND WATER MONITORING WELL SAMPLING FIELD DATA SHEET

Client: APEX — CEC Project Number: 101-049

Date: 10/28/10 — Weather Observations: CLOUDY 55°

WELL ID: P-4A / P-4L

Water Volume Factors	
Diameter	Gallons/Foot
1 inches	0.04
1.5 inches	0.092
2 inches	0.17
3 inches	0.38
4 inches	0.66

Casing Diameter: 2 (inches) — Water Height in Well: 13.05 (feet)

Total Depth: 53.5 (feet) — Water Volume in Well: 2.22 (gallons)

Depth to Water: 40.45 (feet) — Purge Volume: NA gal (calculated); 23,800 mL gal. (removed)

Depth to Top of Screen: 43.5 (feet)

Minimum Purge Volume (drawdown)(gal./ft.) + (well screen length)(gal./ft.) = NA

Measured using: Graduated Cylinder

Purged using: Dedicated Bailer/Polypro Rope — (Grundfos pump/poly tubing) — Other

Sampled using: Dedicated Bailer/Polypro Rope — (Grundfos pump/poly tubing) — Other

Field Measurements

Temperature (degrees C)	pH (s.u.)	Conductivity (umhos/cm)	Turbidity (NTU)	Volume (gallons) mL	Water Level During Purging (feet)	Time
9.8	7.92	4050	>1000	Initial	40.45	1632
10.6	7.22	4066	>1000	680 mL/min	40.48	1637
11.6	7.24	4060	>1000	6,800	40.48	1642
13.3	7.13	4030	802	10,200	—	1647
13.0	7.20	4020	395	13,600	—	1652
13.3	7.18	4010	251	17,000	—	1657
13.1	7.19	4010	180	20,400	40.47	1702
13.0	7.21	4010	163	23,800	40.47	1707

Field Measurements at Time of Sampling

Temperature (degrees C)	pH (s.u.)	Conductivity (umhos/cm)	Turbidity (NTU)	Volume (gallons) mL	Water Level During Sampling (feet)	Time
13.0	7.21	4010	163	23,800 mL	40.47	1707

Instrument Calibration

Turbidity Meter Type SEE P-7A — 1.0 NTU std = ____ — 10.0 NTD std = ____ — 5.42 NTU std = ____ — 51.8 NTU std = ____ — 499 NTU std = ____

pH/Conductivity Meter Type ____ — 4.01 std = ____ — 7.0 std = ____ — 10.1 std = ____ — 1413 umhos/cm = ____

Physical Properties

Odor: NONE

Color: CLOUDY

Turbidity: VERY HIGH

Analysis Required: App I (1-78)

Sample time/date: 1707 / 10-28-10

Comments: Roadside Traffic, Water never cleaned up during well development.

Deviations from SAP: ____

Sampler: BB — Signature: ____

P:\Administrative Documents\Handy Forms\Field Form - Revised 9-04.xls

GROUND WATER MONITORING WELL SAMPLING FIELD DATA SHEET

Client: PBX

CEC Project Number: 101-049

Date: 10/28/10

Weather Observations: Sunny, windy mid 60's

WELL ID: P-5

Water Volume Factors	
Diameter	Gallons/Foot
1 inches	0.04
1.5 inches	0.092
2 inches	0.17
3 inches	0.38
4 inches	0.66

Casing Diameter: 2 (inches)

Water Height in Well: 52.29 (feet)

Total Depth: 144 (feet)

Water Volume in Well: 8.8 (gallons)

Depth to Water: 91.71 (feet)

Purge Volume: NA gal (calculated)

22,900 mL gal. (removed)

Depth to Top of Screen: 134 (feet)

Mimimum Purge Volume (drawdown)(gal./ft.) + (well screen length)(gal./ft.) = NA

Measured using: Graduated Cylinder

Purged using: Dedicated Bailer/Polypro Rope (Grundfos pump/poly tubing) Other

Sampled using: Dedicated Bailer/Polypro Rope (Grundfos pump/poly tubing) Other

Field Measurements

Temperature (degrees C)	pH (s.u.)	Conductivity (umhos/cm)	Turbidity (NTU)	Volume (gallons) mL	Water Level During Purging (feet)	Time
10.5	7.77	1708	170	Initial	91.71	1344
12.6	7.58	1574	38.2	830 mL/min	92.2	1349
12.2	7.64	1476	21.4	230 ml/min	91.99	1354
13.3	7.52	1476	5.55	11,950	—	1359
13.5	7.57	1462	3.85	15,600	—	1404
13.3	7.54	1464	2.43	19,250	—	1409
(BB) ~~13.5~~ 13.4	7.52	1458	2.36	22,900	92.0	~~1414~~

Field Measurements at Time of Sampling

Temperature (degrees C)	pH (s.u.)	Conductivity (umhos/cm)	Turbidity (NTU)	Volume (gallons) mL	Water Level During Sampling (feet)	Time
13.4	7.52	1458	2.36	22,900 mL	92.0	1414

Instrument Calibration

Turbidity Meter Type SEE P-7A

1.0 NTU std = 5.42 NTU std =

10.0 NTD std = 51.8 NTU std =

499 NTU std =

pH/Conductivity Meter Type

4.01 std =

7.0 std = 1413 umhos/cm =

10.1 std =

Physical Properties

Odor: NONE

Color: CLEAR

Turbidity: VERY LOW

Analysis Required: App I (1-78)

Sample time/date: 1414 / 10-28-10

Comments: ~~Duplicate~~ Duplicate taken here @ 1414

Deviations from SAP:

Sampler: BB & LW

Signature:

Civil & Environmental Consultants, Inc. ♦ 8740 Orion Place, Suite 100 ♦ Columbus, Ohio 42340 ♦ phone: (614) 540-6633 ♦ fax: (614) 540-6638

GROUND WATER MONITORING WELL SAMPLING FIELD DATA SHEET

Client: APEX
CEC Project Number: 101-049
Date: 10/28/10
Weather Observations: Cloudy mid 60's

WELL ID: P-9

Water Volume Factors	
Diameter	Gallons/Foot
1 inches	0.04
1.5 inches	0.092
2 inches	0.17
3 inches	0.38
4 inches	0.66

Casing Diameter: 2 (inches)
Water Height in Well: 58.84 (feet)
Total Depth: 165 (feet)
Water Volume in Well: 10,00 (gallons)
Depth to Water: 106.16 (feet)
Purge Volume: NA gal.(calculated)
20,750 gal. (removed) mL
Depth to Top of Screen: 155 (feet)
Mimimum Purge Volume (drawdown)(gal./ft.) + (well screen length)(gal./ft.) = NA
Measured using: Graduated Cylinder
Purged using: Dedicated Bailer/Polypro Rope (Grundfos pump/poly tubing) Other
Sampled using: Dedicated Bailer/Polypro Rope (Grundfos pump/poly tubing) Other

Field Measurements

Temperature (degrees C)	pH (s.u.)	Conductivity (umhos/cm)	Turbidity (NTU)	Volume ~~(gallons)~~ mL	Water Level During Purging (feet)	Time
10.8	7.91	1335	930	Initial	106.16	1510
10.9	7.47	1316	146	850 mL/min	106.45	1515
12.3	7.47	1313	29.4	8,500	106.47	1520
12.4	7.45	1319	11.4	800 mL/min	106.47	1525
12.5	7.45	1321	13.8	16,750	106.47	1530
12.5	7.41	1325	6.20	20,750	106.47	1535

Field Measurements at Time of Sampling

Temperature (degrees C)	pH (s.u.)	Conductivity (umhos/cm)	Turbidity (NTU)	Volume ~~(gallons)~~ mL	Water Level During Sampling (feet)	Time
12.5	7.41	1325	6.20	20,750	106.47	1535

Instrument Calibration

Turbidity Meter Type _____ 1.0 NTU std = _____ 5.42 NTU std = _____
10.0 NTD std = _____ 51.8 NTU std = _____
499 NTU std = _____

pH/Conductivity Meter Type _____ (SEE P-7A)
4.01 std = _____
7.0 std = _____ 1413 umhos/cm = _____
10.1 std = _____

Physical Properties
Odor: NONE
Color: CLEAR
Turbidity: VERY LOW

Analysis Required: App I (1-78)
Sample time/date: 1535 / 10-28-10

Comments:

Deviations from SAP:

Sampler: BB / LW
Signature:

P:\Administrative Documents\Blank Forms\Field Form - Revised 9-04.xls

GROUND WATER MONITORING WELL SAMPLING FIELD DATA SHEET

Client: APEX

CEC Project Number: 101-049

Date: 10-28-10

Weather Observations: CLOUDY 52° (WINDY)

WELL ID: P-10L

Water Volume Factors	
Diameter	Gallons/Foot
1 inches	0.04
1.5 inches	0.092
2 inches	0.17
3 inches	0.38
4 inches	0.66

Casing Diameter: 2 (inches)

Water Height in Well: 13.81 (feet)

Total Depth: 60.6 (feet)

Water Volume in Well: 2.35 (gallons)

Depth to Water: 46.19 (feet)

Purge Volume: NA gal.(calculated)

11,250 ~~gal.~~ mL (removed)

Depth to Top of Screen: ~~[illegible]~~ 50 (feet)

Mimimum Purge Volume (drawdown)(gal./ft.) + (well screen length)(gal./ft.) = NA

Measured using: Graduated Cylinder

Purged using: Dedicated Bailer/Polypro Rope (Grundfos pump/poly tubing) Other

Sampled using: Dedicated Bailer/Polypro Rope (Grundfos pump/poly tubing) Other

Field Measurements

Temperature (degrees C)	pH (s.u.)	Conductivity (umhos/cm)	Turbidity (NTU)	Volume ~~(gallons)~~ mL	Water Level During Purging (feet)	Time
11.0	7.56	4510	179	Initial	46.19	1750
11.9	7.04	4450	407	450 mL/min	46.30	1755
12.1	7.06	4400	46.1	4,500	46.30	1800
12.1	7.17	4330	7.92	6,750	46.30	1805
12.5	7.19	4300	4.26	9,000	46.31	1810
12.6	7.18	4300	2.87	11,250	46.30	1815

Field Measurements at Time of Sampling

Temperature (degrees C)	pH (s.u.)	Conductivity (umhos/cm)	Turbidity (NTU)	Volume ~~(gallons)~~ mL	Water Level During Sampling (feet)	Time
12.6	7.18	4300	2.87	11,250	46.30	1815

Instrument Calibration

Turbidity Meter Type _____

1.0 NTU std = _____ 5.42 NTU std = _____

10.0 NTD std = _____ 51.8 NTU std = _____

499 NTU std = _____

pH/Conductivity Meter Type SEE P-7A

4.01 std = _____

7.0 std = _____ 1413 umhos/cm = _____

10.1 std = _____

Physical Properties

Odor: NONE

Color: Clear

Turbidity: Low

Analysis Required: App I (1-78)

Sample time/date: 1815 / 10-28-10

Comments:

Deviations from SAP:

Sampler: BB/LW

Signature: DWCyn (For)

Civil & Environmental Consultants, Inc. ♦ 8740 Orion Place, Suite 100 ♦ Columbus, Ohio 42340 ♦ phone: (614) 540-6633 ♦ fax: (614) 540-6638

Form F-5079, 01.03
Geochemical Testing

REQUEST FOR LABORATORY ANALYTICAL SERVICES

Chain of Custody (COC) for State of Ohio

Shuttle / Cooler ID# 9767

Landfill Site	GT Quote No.	Client Job No.	Date Results Required:
Apex Landfill			Standard TAT

REPORT RESULTS to

Name	Title	Mailing Address
David Crayne	PM	8740 Orion Place
Company	**Dept.**	**City, State, Zip**
CEC		Columbus, OH 43240
Telephone No.	**Telefax No.**	
614-540-6637	6636	

Special Instructions:

All for (1-7B)

G1011042

ANALYSIS REQUESTED
Enter 'X' in box below to indicate request

CLIENT SAMPLE ID	DATE SAMPLED	TIME (24 hr)	COMP	GRAB	SAMPLE TYPE (MATRIX)	Number of Containers	Appendix I: Ammonia-N, COD Preservative: 1:1 H_2SO_4	Appendix I: Total Metals Preservative: 1:1 HNO_3	Appendix I: Alkalinity Preservative: NONE	Appendix I: Chloride, NO_3+NO_2, Sulfate Preservative: NONE	Appendix I: TDS (Lab Filtered) Preservative: NONE	Appendix I: EDB/ DBCP Preservative: 1:1 HCl	Appendix I: VOC Preservative: 1:1 HCl	Appendix II: Benzo(a) pyrene (EPA 8310) Preservative: NONE	Appendix II: Semivolatiles (EPA 8270) Preservative: NONE	Appendix II: Pest / PCB / Hexachlorobenzene Preservative: NONE	Appendix II: Herbicides Preservative: NONE	Appendix II: Sulfide Preservative: NaOH / Zn acetate	Appendix II: Cyanide Preservative: NaOH	Lab Use Only: Lab Number
P-2S 001	10/28/10	1132		X	GW	10	X	X	X	X	X	X	X							
P-2L 002	10/28/10	1024		X	GW	10	X	X	X	X	X	X	X							
P-7A 003	10/29/10	0751		X	↑	10	X	X	X	X	X	X	X							
Field Dup 004	10/28/10	--		X		10	X	X	X	X	X	X	X							
P-10L 005	10/28/10	1815		X	↓	10	X	X	X	X	X	X	X							
P-2A 006	10/28/10	1247		X	GW	10	X	X	X	X	X	X	X							

CHAIN OF CUSTODY

Relinquished by: Dave Crayne	Date/Time 11/1/10 1800	Received by: FedEx	Date/Time 11/1/10 1800
Relinquished by:	Date/Time	Received at lab by: B. Mill	Date/Time 11/2/10 13:22
Method of Shipment:		Comments:	Ice present on receipt: X Yes or ___ No
Authorized by: (Signature MUST Accompany Request)	Date: 11/1/10		Cooler Temp (°C) on receipt: 4

Please return completed form and samples to **Geochemical Testing • 2005 N Center Ave • Somerset, PA • 15501** • 814-443-1671 • (Fax: 814-445-6729)

Form F-5079, 01.03
Geochemical Testing

REQUEST FOR LABORATORY ANALYTICAL SERVICES

Chain of Custody (COC) for State of Ohio

Shuttle / Cooler ID# 1046-B

Landfill Site	GT Quote No.	Client Job No.	Date Results Required:
Apex Landfill		101-049	Standard TAT

REPORT RESULTS to

Name	Title	Mailing Address
David Crayne	PM	8740 Orion Place
Company CEC	**Dept.**	**City, State, Zip** Columbus, Oh 43240
Telephone No. 614-540-6633	**Telefax No.** 6638	

Special Instructions:

All Bar 1-78

G1011042

ANALYSIS REQUESTED
Enter 'X' in box below to indicate request

CLIENT SAMPLE ID	DATE SAMPLED	TIME (24 hr)	COMP	GRAB	SAMPLE TYPE (MATRIX)	Number of Containers	Appendix I: Ammonia-N, COD Preservative: 1:1 H_2SO_4	Appendix I: Total Metals Preservative: 1:1 HNO_3	Appendix I: Alkalinity Preservative: NONE	Appendix I: Chloride, NO_3+NO_2, Sulfate Preservative: NONE	Appendix I: TDS (Lab Filtered) Preservative: NONE	Appendix I: EDB/ DBCP Preservative: 1:1 HCl	Appendix I: VOC Preservative: 1:1 HCl	Appendix II: Benzo(a) pyrene (EPA 8310) Preservative: NONE	Appendix II: Semivolatiles (EPA 8270) Preservative: NONE	Appendix II: Pest / PCB / Hexachlorobenzene Preservative: NONE	Appendix II: Herbicides Preservative: NONE	Appendix II: Sulfide Preservative: NaOH / Zn acetate	Appendix II: Cyanide Preservative: NaOH	Lab Use Only: Lab Number
P-65 007	10/29/10	914		X	Gw	10	X	X	X	X	X	X	X							
P-9 008	10/26/10	1535		X	↑	10	X	X	X	X	X	X	X							
Trip Blanks 009	—	—		X	—	10					X	X								
P-5 010	10/28/10	1414		X		10	X	X	X	X	X	X	X							
P-55 011	10/29/10	0841		X		10	X	X	X	X	X	X	X							
P-3L 012	10/29/10	1029		X	↓	10	X	X	X	X	X	X	X							
P-4A 013	10/26/10	1707		X	Gw	10	X	X	X	X	X	X	X							

CHAIN OF CUSTODY			
Relinquished by:	Date/Time 10/1/10 1800	Received by: FedEx	Date/Time 10/1/10 1800
Relinquished by:	Date/Time	Received at lab by: B. Mills	Date/Time 11/2/10 13:22
Method of Shipment:			

Authorized by: _____ Date: 10/1/10
(Signature MUST Accompany Request)

Comments:
P5 EDB Vial Frozen + Broke!
P3L ASK/TOL Bottle Frozen, applied Green Cl bottles. 11/2/10

Ice present on receipt: X Yes or ___ No

Cooler Temp (°C) on receipt: 4

Please return completed form and samples to **Geochemical Testing • 2005 N Center Ave • Somerset, PA • 15501** • 814-443-1671 • (Fax: 814-445-6729)

Form F-5079, 01.03
Geochemical Testing

REQUEST FOR LABORATORY ANALYTICAL SERVICES

Chain of Custody (COC) for State of Ohio

Shuttle / Cooler ID# 07665

Landfill Site	GT Quote No.	Client Job No.	Date Results Required:
ADEX		100-504	

REPORT RESULTS to

Name	Title	Mailing Address
David Crayne	PM	5740 Orion Pl.
Company	**Dept.**	**City, State, Zip**
CEC	SW	Columbus, OH 43240
Telephone No.	**Telefax No.**	
614-540-6633	614-540-6638	

Special Instructions:

ANALYSIS REQUESTED
Enter 'X' in box below to indicate request

CLIENT SAMPLE ID	DATE SAMPLED	TIME (24 hr)	COMP	GRAB	SAMPLE TYPE (MATRIX)	Number of Containers	Appendix I: Ammonia-N, COD Preservative: 1:1 H_2SO_4	Appendix I: Total Metals Preservative: 1:1 HNO_3	Appendix I: Alkalinity Preservative: NONE	Appendix I: Chloride, NO_3+NO_2, Sulfate Preservative: NONE	Appendix I: TDS (Lab Filtered) Preservative: NONE	Appendix I: EDB/ DBCP Preservative: 1:1 HCl	Appendix I: VOC Preservative: 1:1 HCl	Appendix II: Benzo(a) pyrene (EPA 8310) Preservative: NONE	Appendix II: Semivolatiles (EPA 8270) Preservative: NONE	Appendix II: Pest / PCB / Hexachlorobenzene Preservative: NONE	Appendix II: Herbicides Preservative: NONE	Appendix II: Sulfide Preservative: NaOH / Zn acetate	Appendix II: Cyanide Preservative: NaOH	Lab Use Only: Lab Number
B-402	12/9/10	1202		X	Aqua	10	X	X	X	X	X	X	X							605
B-402A	12/9/10	1120		↓	↓	↓	↓	↓	↓	↓	↓	↓	↓							606
B-401	12/9/10	1025		↓	↓	↓	↓	↓	↓	↓	↓	↓	↓							607
B-401A	12/9/10	945		↓	↓	↓	↓	↓	↓	↓	↓	↓	↓							608
B-403	12/9/10	1405		↓	↓	↓	↓	↓	↓	↓	↓	↓	↓							609
TRIP BLANK	—	—	—	↓	↓	6						↓	↓							610

CHAIN OF CUSTODY				
Relinquished by:		Date/Time	Received by:	Date/Time
Relinquished by:		Date/Time	Received at lab by:	Date/Time 12/10/10 13:16
Method of Shipment:			Comments:	Ice present on receipt: X Yes or ___ No
Authorized by: _____ (Signature MUST Accompany Request)		Date: _____		Cooler Temp (°C) on receipt: 1

Please return completed form and samples to **Geochemical Testing • 2005 N Center Ave • Somerset, PA • 15501** • 814-443-1671 • (Fax: 814-445-6729)

Form F-5079, 01.03
Geochemical Testing

REQUEST FOR LABORATORY ANALYTICAL SERVICES

Chain of Custody (COC) for State of Ohio

Shuttle / Cooler ID# 9739

Landfill Site: Apex LF	GT Quote No.	Client Job No: 100404	Date Results Required:

REPORT RESULTS to

Name: Dave Crayne	Title: PM	Mailing Address: 5740 Orion Pl	
Company: GT	Dept: SW	City, State, Zip: Columbus, OH 43240	
Telephone No.: 614-540-6633	Telefax No.: 614-540-6638		

Special Instructions:

B-412 Metals Only

ANALYSIS REQUESTED
Enter 'X' in box below to indicate request

CLIENT SAMPLE ID	DATE SAMPLED	TIME (24 hr)	COMP	GRAB	SAMPLE TYPE (MATRIX)	Number of Containers	Appendix I: Ammonia-N, COD Preservative: 1:1 H_2SO_4	Appendix I: Total Metals Preservative: 1:1 HNO_3	Appendix I: Alkalinity Preservative: NONE	Appendix I: Chloride, NO_3+NO_2, Sulfate Preservative: NONE	Appendix I: TDS (Lab Filtered) Preservative: NONE	Appendix I: EDB/ DBCP Preservative: 1:1 HCl	Appendix I: VOC Preservative: 1:1 HCl	Appendix II: Benzo(a) pyrene (EPA 8310) Preservative: NONE	Appendix II: Semivolatiles (EPA 8270) Preservative: NONE	Appendix II: Pest / PCB / Hexachlorobenzene Preservative: NONE	Appendix II: Herbicides Preservative: NONE	Appendix II: Sulfide Preservative: NaOH / Zn acetate	Appendix II: Cyanide Preservative: NaOH	Lab Use Only: 6/012414 Lab Number
B-403S	12/9/10	1310		X	AQUA	10	X	X	X	X	X	X	X							011
SHALLOW-2	12/9/10	1625				1														012
B-413R	12/10/10	817																		013
B-407	12/10/10	941																		014
B-412	12/10/10	1033				1														015

CHAIN OF CUSTODY	Relinquished by:	Date/Time: 12/10/10 1600	Received by:	Date/Time
	Relinquished by:	Date/Time	Received at lab by:	Date/Time 12/14/10 13:16
	Method of Shipment:		Comments:	Ice present on receipt: X Yes or ___ No
Authorized by: _____ (Signature MUST Accompany Request)		Date: _____		Cooler Temp (°C) on receipt: 1

Please return completed form and samples to **Geochemical Testing • 2005 N Center Ave • Somerset, PA • 15501** • 814-443-1671 • (Fax: 814-445-6729)

Form F-5 01.03
Geochemical Testing

REQUEST FOR ORATORY ANALYTICAL SERVICES

Chain of Custody (COC) for State of Ohio

Shuttle / Cooler ID. S-467

Landfill Site: Apex LF	GT Quote No.	Client Job No. 081-898	Date Results Required:

REPORT RESULTS to

Name: David Crayne	Title: PM	Mailing Address: 8740 Orion Pl.	
Company: CEC	Dept. SW	City/State/Zip: Columbus OH 43240	
Telephone No. 614-540-6633	Telefax No. 614-540-6638		

Special Instructions:

ANALYSIS REQUESTED
Enter 'X' in box below to indicate request

CLIENT SAMPLE ID	DATE SAMPLED	TIME (24 hr)	COMP	GRAB	SAMPLE TYPE (MATRIX)	Number of Containers	Appendix I: Ammonia-N, COD Preservative: 1:1 H_2SO_4	Appendix I: Total Metals Preservative: 1:1 HNO_3	Appendix I: Alkalinity Preservative: NONE	Appendix I: Chloride, NO_3+NO_2, Sulfate Preservative: NONE	Appendix I: TDS (Lab Filtered) Preservative: NONE	Appendix I: EDB/ DBCP Preservative: 1:1 HCl	Appendix I: VOC Preservative: 1:1 HCl	Appendix II: Benzo(a) pyrene (EPA 8310) Preservative: NONE	Appendix II: Semivolatiles (EPA 8270) Preservative: NONE	Appendix II: Pest / PCB / Hexachlorobenzene Preservative: NONE	Appendix II: Herbicides Preservative: NONE	Appendix II: Sulfide Preservative: NaOH / Zn acetate	Appendix II: Cyanide Preservative: NaOH	Lab Use Only: Lab Number 610-2353
B-414	12-8-10	1018		X	Aqua	10	X	X	X	X	X	X	X							001
B-412	12-8-10	1257																		002
B-411	12-8-10	1407																		003
B-410	12-8-10	1447																		004
B-410S	12-8-10	920		↓	↓	↓	↓	↓	↓	↓	↓	↓	↓							005

CHAIN OF CUSTODY

Relinquished by: [signature]	Date/Time 12/10/10 1000	Received by:
Relinquished by:	Date/Time	Received at lab by: [signature]
Method of Shipment:		Comments:

Date/Time: 12/10/10 1015

Ice present on receipt: X Yes or ___ No

Cooler Temp (°C) on receipt: 3

Authorized by: _____ Date: _____
(Signature MUST Accompany Request)

GEOCHEMICAL TESTING
Environmental and Energy Analysis

2005 N. Center Ave.
Somerset, PA 15501

814/443-1671
814/445-6666
FAX: 814/445-6729

Wednesday, January 12, 2011

David Crayne
CIVIL & ENVIRONMENTAL-COLUMBUS
8740 ORION PLACE
SUITE 100
COLUMBUS, OH 43240

RE: APEX Second SA

Order No.: G1012414

Dear David Crayne:

Geochemical Testing received 15 sample(s) on 12/14/2010 for the analyses presented in the following report.

There were no problems with the analyses and all QC data met NELAC, EPA, and laboratory specifications except where noted in the Case Narrative or Laboratory Results.

If you have any questions regarding these tests results, please feel free to call.

Sincerely,

Timothy W Bergstresser

Timothy W. Bergstresser
Director of Technical Services

ACCREDITED IN ACCORDANCE WITH nelac
I.D. 56-00306PA DEP

Geochemical Testing

Date: *12-Jan-11*

CLIENT: CIVIL & ENVIRONMENTAL-COLUMBU
Project: APEX Second SA
Lab Order: G1012414

CASE NARRATIVE

No problems were encountered during analysis of this workorder, except if noted in this report.

Legend:

ND - Not Detected at the Quantitation Limit

J - Indicates an estimated value.

U - The analyte was not detected at or above the listed concentration, which is below the laboratory quantitation limit.

B - Analyte detected in the associated Method Blank

Q - Qualifier QL -Quantitation Limit DF - Dilution Factor

S - Spike Recovery outside accepted recovery limits

R - RPD outside accepted recovery limits

E - Value above quantitation range

** - Value exceeds Action Limit

H - Method Hold Time Exceeded

MCL - Contaminant Limit

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Laboratory Results

Geochemical Testing

Date: *12-Jan-11*

CLIENT:	CIVIL & ENVIRONMENTAL-COLUMBU	**Client Sample ID:**	B-406
Lab Order:	G1012414		
Project:	APEX Second SA	**Collection Date:**	12/9/2010 3:43:00 PM
Lab ID:	G1012414-001	**Sampled By:**	Client
Matrix:	AQUEOUS	**DateReceived:**	12/14/2010 1:16:39 PM

Analyses	Result	Q	MDL	PQL	Units	DF	Date Analyzed
FIELD PARAMETERS			**FIELD**			Analyst:	
pH (Field)	7.51		0		S.U.	0	12/9/2010 3:43:00 PM
Specific Conductance (Field)	1330		0		umhos/cm	0	12/9/2010 3:43:00 PM
Temperature (Field)	9.1		0		deg C	0	12/9/2010 3:43:00 PM
Turbidity (Field)	4.94		0		NTU	0	12/9/2010 3:43:00 PM
INORGANIC NON-METALS			**SM 18 2320B**			Analyst: **LNW**	
Alkalinity to pH 4.5	264		2.0	5	mg/L CaCO3	1	12/17/2010 12:33:00 P
INORGANIC NON-METALS			**SM 2540 C**			Analyst: **KLS**	
Total dissolved solids	1330		10.0	20	mg/L	1	12/15/2010 9:16:00 A
INORGANIC NON-METALS			**SM 4500-CL E**			Analyst: **SAG**	
Chloride	4	J	2.0	5	mg/L	1	12/21/2010 2:33:00 P
INORGANIC NON-METALS			**EPA 350.1**			Analyst: **SLY**	
Ammonia Nitrogen - Distilled	0.09	J	0.040	0.10	mg/L as N	1	12/22/2010 12:09:39 P
INORGANIC NON-METALS			**EPA 353.2**			Analyst: **SLY**	
Nitrate - Nitrite	0.12		0.020	0.05	mg/L as N	1	12/20/2010 8:52:21 A
INORGANIC NON METALS			**ASTM D516-02**			Analyst: **SAG**	
Sulfate	733		50.0	250	mg/L	50	12/20/2010 2:56:00 P
INORGANIC METALS			**EPA 200.7**			Analyst: **MS**	
Barium	0.024		0.0050	0.010	mg/L	1	12/20/2010 5:50:00 P
Beryllium	0.00050	U	0.00050	0.0010	mg/L	1	12/20/2010 5:50:00 P
Cadmium	0.0010	U	0.0010	0.002	mg/L	1	12/20/2010 5:50:00 P
Calcium	292		0.050	0.10	mg/L	1	12/20/2010 5:50:00 P
Chromium	0.0050	U	0.0050	0.010	mg/L	1	12/20/2010 5:50:00 P
Cobalt	0.004	J	0.0020	0.005	mg/L	1	12/20/2010 5:50:00 P
Copper	0.0050	U	0.0050	0.010	mg/L	1	12/20/2010 5:50:00 P
Iron	0.75		0.010	0.05	mg/L	1	12/20/2010 5:50:00 P
Magnesium	85.4		0.050	0.10	mg/L	1	12/20/2010 5:50:00 P
Manganese	1.27		0.0020	0.010	mg/L	1	12/20/2010 5:50:00 P
Nickel	0.0050	U	0.0050	0.010	mg/L	1	12/20/2010 5:50:00 P
Potassium	3.6		0.20	0.5	mg/L	1	12/20/2010 5:50:00 P
Silver	0.0020	U	0.0020	0.005	mg/L	1	12/20/2010 5:50:00 P
Sodium	69.3		0.10	0.2	mg/L	1	12/20/2010 5:50:00 P
Vanadium	0.0020	U	0.0020	0.005	mg/L	1	12/20/2010 5:50:00 P
Zinc	0.0040	U	0.0040	0.010	mg/L	1	12/20/2010 5:50:00 P

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Geochemical Testing

Date: *12-Jan-11*

CLIENT:	CIVIL & ENVIRONMENTAL-COLUMBU	**Client Sample ID:**	B-406
Lab Order:	G1012414		
Project:	APEX Second SA	**Collection Date:**	12/9/2010 3:43:00 PM
Lab ID:	G1012414-001	**Sampled By:**	Client
Matrix:	AQUEOUS	**DateReceived:**	12/14/2010 1:16:39 PM

Analyses	Result	Q	MDL	PQL	Units	DF	Date Analyzed
INORGANIC METALS			**EPA 200.8**				Analyst: **JEK**
Antimony	0.50	U	0.50	1.0	µg/L	1	12/16/2010 6:26:00 P
Arsenic	2.8		0.50	1.0	µg/L	1	12/16/2010 6:26:00 P
Lead	0.3	J	0.20	1.0	µg/L	1	12/16/2010 6:26:00 P
Selenium	0.50	U	0.50	1.0	µg/L	1	12/16/2010 6:26:00 P
Thallium	0.1	J	0.10	0.2	µg/L	1	12/16/2010 6:26:00 P
VOLATILE ORGANIC COMPOUNDS			**EPA 8011**				Analyst: **TEW**
1,2-Dibromo-3-chloropropane	0.0100	U	0.0100	0.0400	µg/L	1	12/15/2010 9:05:07 P
1,2-Dibromoethane	0.0100	U	0.0100	0.0400	µg/L	1	12/15/2010 9:05:07 P
Surr: 1,1,2,2-Tetrachloroethane	89.0		0	60-140	%REC	1	12/15/2010 9:05:07 P
VOLATILE ORGANIC COMPOUNDS			**EPA 8260**				Analyst: **JAW**
1,1,1,2-Tetrachloroethane	0.50	U	0.50	1.0	µg/L	1	12/15/2010 5:00:00 A
1,1,1-Trichloroethane	0.50	U	0.50	1.0	µg/L	1	12/15/2010 5:00:00 A
1,1,2,2-Tetrachloroethane	0.50	U	0.50	1.0	µg/L	1	12/15/2010 5:00:00 A
1,1,2-Trichloroethane	0.50	U	0.50	1.0	µg/L	1	12/15/2010 5:00:00 A
1,1-Dichloroethane	0.50	U	0.50	1.0	µg/L	1	12/15/2010 5:00:00 A
1,1-Dichloroethene	0.50	U	0.50	1.0	µg/L	1	12/15/2010 5:00:00 A
1,2,3-Trichloropropane	0.50	U	0.50	1.0	µg/L	1	12/15/2010 5:00:00 A
1,2-Dichlorobenzene	0.50	U	0.50	1.0	µg/L	1	12/15/2010 5:00:00 A
1,2-Dichloroethane	0.50	U	0.50	1.0	µg/L	1	12/15/2010 5:00:00 A
1,2-Dichloropropane	0.50	U	0.50	1.0	µg/L	1	12/15/2010 5:00:00 A
1,4-Dichlorobenzene	0.50	U	0.50	1.0	µg/L	1	12/15/2010 5:00:00 A
2-Hexanone	1.0	U	1.0	5.0	µg/L	1	12/15/2010 5:00:00 A
4-Methyl-2-Pentanone	0.50	U	0.50	1.0	µg/L	1	12/15/2010 5:00:00 A
Acetone	5.0	U	5.0	10	µg/L	1	12/15/2010 5:00:00 A
Acrylonitrile	2.0	U	2.0	5.0	µg/L	1	12/15/2010 5:00:00 A
Benzene	0.50	U	0.50	1.0	µg/L	1	12/15/2010 5:00:00 A
Bromochloromethane	0.50	U	0.50	1.0	µg/L	1	12/15/2010 5:00:00 A
Bromoform	0.50	U	0.50	1.0	µg/L	1	12/15/2010 5:00:00 A
Bromomethane	0.50	U	0.50	1.0	µg/L	1	12/15/2010 5:00:00 A
Carbon Disulfide	0.50	U	0.50	1.0	µg/L	1	12/15/2010 5:00:00 A
Carbon Tetrachloride	0.50	U	0.50	1.0	µg/L	1	12/15/2010 5:00:00 A
Chlorobenzene	0.50	U	0.50	1.0	µg/L	1	12/15/2010 5:00:00 A
Chlorodibromomethane	0.50	U	0.50	1.0	µg/L	1	12/15/2010 5:00:00 A
Chloroethane	0.50	U	0.50	1.0	µg/L	1	12/15/2010 5:00:00 A
Chloroform	0.50	U	0.50	1.0	µg/L	1	12/15/2010 5:00:00 A
Chloromethane	0.50	U	0.50	1.0	µg/L	1	12/15/2010 5:00:00 A
cis-1,2-Dichloroethene	0.50	U	0.50	1.0	µg/L	1	12/15/2010 5:00:00 A
cis-1,3-Dichloropropene	0.50	U	0.50	1.0	µg/L	1	12/15/2010 5:00:00 A
Dibromomethane	0.50	U	0.50	1.0	µg/L	1	12/15/2010 5:00:00 A

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Laboratory Results

Geochemical Testing

Date: *12-Jan-11*

CLIENT:	CIVIL & ENVIRONMENTAL-COLUMBU	**Client Sample ID:**	B-406
Lab Order:	G1012414		
Project:	APEX Second SA	**Collection Date:**	12/9/2010 3:43:00 PM
Lab ID:	G1012414-001	**Sampled By:**	Client
Matrix:	AQUEOUS	**DateReceived:**	12/14/2010 1:16:39 PM

Analyses	Result	Q	MDL	PQL	Units	DF	Date Analyzed
VOLATILE ORGANIC COMPOUNDS			**EPA 8260**			Analyst: **JAW**	
Dichlorobromomethane	0.50	U	0.50	1.0	µg/L	1	12/15/2010 5:00:00 A
Ethylbenzene	0.50	U	0.50	1.0	µg/L	1	12/15/2010 5:00:00 A
Iodomethane	0.50	U	0.50	5.0	µg/L	1	12/15/2010 5:00:00 A
Methyl Ethyl Ketone	1.0	U	1.0	5.0	µg/L	1	12/15/2010 5:00:00 A
Methylene Chloride	0.50	U	0.50	1.0	µg/L	1	12/15/2010 5:00:00 A
Styrene	0.50	U	0.50	1.0	µg/L	1	12/15/2010 5:00:00 A
Tetrachloroethene	0.50	U	0.50	1.0	µg/L	1	12/15/2010 5:00:00 A
Toluene	0.50	U	0.50	1.0	µg/L	1	12/15/2010 5:00:00 A
trans-1,2-Dichloroethene	0.50	U	0.50	1.0	µg/L	1	12/15/2010 5:00:00 A
trans-1,3-Dichloropropene	0.50	U	0.50	1.0	µg/L	1	12/15/2010 5:00:00 A
trans-1,4-Dichloro-2-butene	1.0	U	1.0	2.0	µg/L	1	12/15/2010 5:00:00 A
Trichloroethene	0.50	U	0.50	1.0	µg/L	1	12/15/2010 5:00:00 A
Trichlorofluoromethane	0.50	U	0.50	1.0	µg/L	1	12/15/2010 5:00:00 A
Vinyl Acetate	0.50	U	0.50	1.0	µg/L	1	12/15/2010 5:00:00 A
Vinyl Chloride	0.50	U	0.50	1.0	µg/L	1	12/15/2010 5:00:00 A
Total Xylene	1.0	U	1.0	2.0	µg/L	1	12/15/2010 5:00:00 A
Surr: 1,2-Dichloroethane-d4	101		0	70-130	%REC	1	12/15/2010 5:00:00 A
Surr: 4-Bromofluorobenzene	98.8		0	70-130	%REC	1	12/15/2010 5:00:00 A
Surr: Dibromofluoromethane	102		0	70-130	%REC	1	12/15/2010 5:00:00 A
Surr: Toluene-d8	99.4		0	70-130	%REC	1	12/15/2010 5:00:00 A

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Laboratory Results

Geochemical Testing

Date: *12-Jan-11*

CLIENT:	CIVIL & ENVIRONMENTAL-COLUMBU	**Client Sample ID:**	DUP-2
Lab Order:	G1012414		
Project:	APEX Second SA	**Collection Date:**	12/9/2010 3:43:00 PM
Lab ID:	G1012414-002	**Sampled By:**	Client
Matrix:	AQUEOUS	**DateReceived:**	12/14/2010 1:16:39 PM

Analyses	Result	Q	MDL	PQL	Units	DF	Date Analyzed
INORGANIC NON-METALS			**SM 18 2320B**				Analyst: **LNW**
Alkalinity to pH 4.5	386		2.0	5	mg/L CaCO3	1	12/17/2010 1:00:00 P
INORGANIC NON-METALS			**SM 2540 C**				Analyst: **KLS**
Total dissolved solids	2470		10.0	20	mg/L	1	12/15/2010 9:17:00 A
INORGANIC NON-METALS			**SM 4500-CL E**				Analyst: **SAG**
Chloride	7		2.0	5	mg/L	1	12/21/2010 2:33:00 P
INORGANIC NON-METALS			**EPA 350.1**				Analyst: **SLY**
Ammonia Nitrogen - Distilled	0.21		0.040	0.10	mg/L as N	1	12/22/2010 12:10:47 P
INORGANIC NON-METALS			**EPA 353.2**				Analyst: **SLY**
Nitrate - Nitrite	0.020	U	0.020	0.05	mg/L as N	1	12/20/2010 8:53:31 A
INORGANIC NON METALS			**ASTM D516-02**				Analyst: **SAG**
Sulfate	1380		50.0	250	mg/L	50	12/20/2010 2:56:00 P
INORGANIC METALS			**EPA 200.7**				Analyst: **MS**
Barium	0.025		0.0050	0.010	mg/L	1	12/20/2010 6:09:00 P
Beryllium	0.00050	U	0.00050	0.0010	mg/L	1	12/20/2010 6:09:00 P
Cadmium	0.0010	U	0.0010	0.002	mg/L	1	12/20/2010 6:09:00 P
Calcium	666		0.500	1.00	mg/L	10	12/21/2010 1:24:00 P
Chromium	0.0050	U	0.0050	0.010	mg/L	1	12/20/2010 6:09:00 P
Cobalt	0.003	J	0.0020	0.005	mg/L	1	12/20/2010 6:09:00 P
Copper	0.0050	U	0.0050	0.010	mg/L	1	12/20/2010 6:09:00 P
Iron	0.09		0.010	0.05	mg/L	1	12/20/2010 6:09:00 P
Magnesium	119		0.050	0.10	mg/L	1	12/20/2010 6:09:00 P
Manganese	3.31		0.0020	0.010	mg/L	1	12/20/2010 6:09:00 P
Nickel	0.0050	U	0.0050	0.010	mg/L	1	12/20/2010 6:09:00 P
Potassium	3.7		0.20	0.5	mg/L	1	12/20/2010 6:09:00 P
Silver	0.0020	U	0.0020	0.005	mg/L	1	12/20/2010 6:09:00 P
Sodium	19.6		0.10	0.2	mg/L	1	12/20/2010 6:09:00 P
Vanadium	0.0020	U	0.0020	0.005	mg/L	1	12/20/2010 6:09:00 P
Zinc	0.0040	U	0.0040	0.010	mg/L	1	12/20/2010 6:09:00 P
INORGANIC METALS			**EPA 200.8**				Analyst: **JEK**
Antimony	0.50	U	0.50	1.0	µg/L	1	12/16/2010 6:46:00 P
Arsenic	0.50	U	0.50	1.0	µg/L	1	12/16/2010 6:46:00 P
Lead	0.20	U	0.20	1.0	µg/L	1	12/16/2010 6:46:00 P
Selenium	0.50	U	0.50	1.0	µg/L	1	12/16/2010 6:46:00 P
Thallium	0.10	U	0.10	0.2	µg/L	1	12/16/2010 6:46:00 P

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Laboratory Results

Geochemical Testing

Date: *12-Jan-11*

CLIENT:	CIVIL & ENVIRONMENTAL-COLUMBU	**Client Sample ID:**	DUP-2
Lab Order:	G1012414		
Project:	APEX Second SA	**Collection Date:**	12/9/2010 3:43:00 PM
Lab ID:	G1012414-002	**Sampled By:**	Client
Matrix:	AQUEOUS	**DateReceived:**	12/14/2010 1:16:39 PM

Analyses	Result	Q	MDL	PQL	Units	DF	Date Analyzed
INORGANIC METALS			**EPA 200.8**				Analyst: **JEK**
VOLATILE ORGANIC COMPOUNDS			**EPA 8011**				Analyst: **TEW**
1,2-Dibromo-3-chloropropane	0.0100	U	0.0100	0.0400	µg/L	1	12/15/2010 9:26:41 P
1,2-Dibromoethane	0.0100	U	0.0100	0.0400	µg/L	1	12/15/2010 9:26:41 P
Surr: 1,1,2,2-Tetrachloroethane	89.3		0	60-140	%REC	1	12/15/2010 9:26:41 P
VOLATILE ORGANIC COMPOUNDS			**EPA 8260**				Analyst: **JAW**
1,1,1,2-Tetrachloroethane	0.50	U	0.50	1.0	µg/L	1	12/15/2010 5:36:00 A
1,1,1-Trichloroethane	0.50	U	0.50	1.0	µg/L	1	12/15/2010 5:36:00 A
1,1,2,2-Tetrachloroethane	0.50	U	0.50	1.0	µg/L	1	12/15/2010 5:36:00 A
1,1,2-Trichloroethane	0.50	U	0.50	1.0	µg/L	1	12/15/2010 5:36:00 A
1,1-Dichloroethane	0.50	U	0.50	1.0	µg/L	1	12/15/2010 5:36:00 A
1,1-Dichloroethene	0.50	U	0.50	1.0	µg/L	1	12/15/2010 5:36:00 A
1,2,3-Trichloropropane	0.50	U	0.50	1.0	µg/L	1	12/15/2010 5:36:00 A
1,2-Dichlorobenzene	0.50	U	0.50	1.0	µg/L	1	12/15/2010 5:36:00 A
1,2-Dichloroethane	0.50	U	0.50	1.0	µg/L	1	12/15/2010 5:36:00 A
1,2-Dichloropropane	0.50	U	0.50	1.0	µg/L	1	12/15/2010 5:36:00 A
1,4-Dichlorobenzene	0.50	U	0.50	1.0	µg/L	1	12/15/2010 5:36:00 A
2-Hexanone	1.0	U	1.0	5.0	µg/L	1	12/15/2010 5:36:00 A
4-Methyl-2-Pentanone	0.50	U	0.50	1.0	µg/L	1	12/15/2010 5:36:00 A
Acetone	5.0	U	5.0	10	µg/L	1	12/15/2010 5:36:00 A
Acrylonitrile	2.0	U	2.0	5.0	µg/L	1	12/15/2010 5:36:00 A
Benzene	0.50	U	0.50	1.0	µg/L	1	12/15/2010 5:36:00 A
Bromochloromethane	0.50	U	0.50	1.0	µg/L	1	12/15/2010 5:36:00 A
Bromoform	0.50	U	0.50	1.0	µg/L	1	12/15/2010 5:36:00 A
Bromomethane	0.50	U	0.50	1.0	µg/L	1	12/15/2010 5:36:00 A
Carbon Disulfide	0.50	U	0.50	1.0	µg/L	1	12/15/2010 5:36:00 A
Carbon Tetrachloride	0.50	U	0.50	1.0	µg/L	1	12/15/2010 5:36:00 A
Chlorobenzene	0.50	U	0.50	1.0	µg/L	1	12/15/2010 5:36:00 A
Chlorodibromomethane	0.50	U	0.50	1.0	µg/L	1	12/15/2010 5:36:00 A
Chloroethane	0.50	U	0.50	1.0	µg/L	1	12/15/2010 5:36:00 A
Chloroform	0.50	U	0.50	1.0	µg/L	1	12/15/2010 5:36:00 A
Chloromethane	0.50	U	0.50	1.0	µg/L	1	12/15/2010 5:36:00 A
cis-1,2-Dichloroethene	0.50	U	0.50	1.0	µg/L	1	12/15/2010 5:36:00 A
cis-1,3-Dichloropropene	0.50	U	0.50	1.0	µg/L	1	12/15/2010 5:36:00 A
Dibromomethane	0.50	U	0.50	1.0	µg/L	1	12/15/2010 5:36:00 A
Dichlorobromomethane	0.50	U	0.50	1.0	µg/L	1	12/15/2010 5:36:00 A
Ethylbenzene	0.50	U	0.50	1.0	µg/L	1	12/15/2010 5:36:00 A
Iodomethane	0.50	U	0.50	5.0	µg/L	1	12/15/2010 5:36:00 A
Methyl Ethyl Ketone	1.0	U	1.0	5.0	µg/L	1	12/15/2010 5:36:00 A
Methylene Chloride	0.50	U	0.50	1.0	µg/L	1	12/15/2010 5:36:00 A

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Laboratory Results

Geochemical Testing

Date: *12-Jan-11*

CLIENT:	CIVIL & ENVIRONMENTAL-COLUMBU	**Client Sample ID:**	DUP-2
Lab Order:	G1012414		
Project:	APEX Second SA	**Collection Date:**	12/9/2010 3:43:00 PM
Lab ID:	G1012414-002	**Sampled By:**	Client
Matrix:	AQUEOUS	**DateReceived:**	12/14/2010 1:16:39 PM

Analyses	Result	Q	MDL	PQL	Units	DF	Date Analyzed
VOLATILE ORGANIC COMPOUNDS			**EPA 8260**			Analyst: **JAW**	
Styrene	0.50	U	0.50	1.0	µg/L	1	12/15/2010 5:36:00 A
Tetrachloroethene	0.50	U	0.50	1.0	µg/L	1	12/15/2010 5:36:00 A
Toluene	0.50	U	0.50	1.0	µg/L	1	12/15/2010 5:36:00 A
trans-1,2-Dichloroethene	0.50	U	0.50	1.0	µg/L	1	12/15/2010 5:36:00 A
trans-1,3-Dichloropropene	0.50	U	0.50	1.0	µg/L	1	12/15/2010 5:36:00 A
trans-1,4-Dichloro-2-butene	1.0	U	1.0	2.0	µg/L	1	12/15/2010 5:36:00 A
Trichloroethene	0.50	U	0.50	1.0	µg/L	1	12/15/2010 5:36:00 A
Trichlorofluoromethane	0.50	U	0.50	1.0	µg/L	1	12/15/2010 5:36:00 A
Vinyl Acetate	0.50	U	0.50	1.0	µg/L	1	12/15/2010 5:36:00 A
Vinyl Chloride	0.50	U	0.50	1.0	µg/L	1	12/15/2010 5:36:00 A
Total Xylene	1.0	U	1.0	2.0	µg/L	1	12/15/2010 5:36:00 A
Surr: 1,2-Dichloroethane-d4	94.5		0	70-130	%REC	1	12/15/2010 5:36:00 A
Surr: 4-Bromofluorobenzene	98.8		0	70-130	%REC	1	12/15/2010 5:36:00 A
Surr: Dibromofluoromethane	94.0		0	70-130	%REC	1	12/15/2010 5:36:00 A
Surr: Toluene-d8	103		0	70-130	%REC	1	12/15/2010 5:36:00 A

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Laboratory Results

Geochemical Testing

Date: *12-Jan-11*

CLIENT:	CIVIL & ENVIRONMENTAL-COLUMBU	**Client Sample ID:**	B-406S
Lab Order:	G1012414		
Project:	APEX Second SA	**Collection Date:**	12/9/2010 4:44:00 PM
Lab ID:	G1012414-003	**Sampled By:**	Client
Matrix:	AQUEOUS	**DateReceived:**	12/14/2010 1:16:39 PM

Analyses	Result	Q	MDL	PQL	Units	DF	Date Analyzed
FIELD PARAMETERS			**FIELD**			Analyst:	
pH (Field)	6.72		0		S.U.	0	12/9/2010 4:44:00 PM
Specific Conductance (Field)	3200		0		umhos/cm	0	12/9/2010 4:44:00 PM
Temperature (Field)	7.5		0		deg C	0	12/9/2010 4:44:00 PM
Turbidity (Field)	3.76		0		NTU	0	12/9/2010 4:44:00 PM
INORGANIC NON-METALS			**SM 18 2320B**			Analyst: **LNW**	
Alkalinity to pH 4.5	361		2.0	5	mg/L CaCO3	1	12/17/2010 1:15:00 P
INORGANIC NON-METALS			**SM 2540 C**			Analyst: **KLS**	
Total dissolved solids	2530		10.0	20	mg/L	1	12/15/2010 9:17:00 A
INORGANIC NON-METALS			**SM 4500-CL E**			Analyst: **SAG**	
Chloride	3	J	2.0	5	mg/L	1	12/21/2010 2:33:00 P
INORGANIC NON-METALS			**EPA 350.1**			Analyst: **SLY**	
Ammonia Nitrogen - Distilled	0.040	U	0.040	0.10	mg/L as N	1	12/28/2010 10:51:30 A
INORGANIC NON-METALS			**EPA 353.2**			Analyst: **SLY**	
Nitrate - Nitrite	0.24		0.020	0.05	mg/L as N	1	12/20/2010 8:54:39 A
INORGANIC NON METALS			**ASTM D516-02**			Analyst: **SAG**	
Sulfate	1550		50.0	250	mg/L	50	12/20/2010 2:56:00 P
INORGANIC METALS			**EPA 200.7**			Analyst: **MS**	
Barium	0.012		0.0050	0.010	mg/L	1	12/20/2010 6:18:00 P
Beryllium	0.00050	U	0.00050	0.0010	mg/L	1	12/20/2010 6:18:00 P
Cadmium	0.0010	U	0.0010	0.002	mg/L	1	12/20/2010 6:18:00 P
Calcium	753		0.500	1.00	mg/L	10	12/21/2010 1:28:00 P
Chromium	0.0050	U	0.0050	0.010	mg/L	1	12/20/2010 6:18:00 P
Cobalt	0.0020	U	0.0020	0.005	mg/L	1	12/20/2010 6:18:00 P
Copper	0.0050	U	0.0050	0.010	mg/L	1	12/20/2010 6:18:00 P
Iron	0.14		0.010	0.05	mg/L	1	12/20/2010 6:18:00 P
Magnesium	108		0.050	0.10	mg/L	1	12/20/2010 6:18:00 P
Manganese	1.08		0.0020	0.010	mg/L	1	12/20/2010 6:18:00 P
Nickel	0.010	J	0.0050	0.010	mg/L	1	12/20/2010 6:18:00 P
Potassium	2.1		0.20	0.5	mg/L	1	12/20/2010 6:18:00 P
Silver	0.0020	U	0.0020	0.005	mg/L	1	12/20/2010 6:18:00 P
Sodium	17.4		0.10	0.2	mg/L	1	12/20/2010 6:18:00 P
Vanadium	0.0020	U	0.0020	0.005	mg/L	1	12/20/2010 6:18:00 P
Zinc	0.005	J	0.0040	0.010	mg/L	1	12/20/2010 6:18:00 P

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Laboratory Results

Geochemical Testing

Date: *12-Jan-11*

CLIENT:	CIVIL & ENVIRONMENTAL-COLUMBU	**Client Sample ID:**	B-406S
Lab Order:	G1012414		
Project:	APEX Second SA	**Collection Date:**	12/9/2010 4:44:00 PM
Lab ID:	G1012414-003	**Sampled By:**	Client
Matrix:	AQUEOUS	**DateReceived:**	12/14/2010 1:16:39 PM

Analyses	Result	Q	MDL	PQL	Units	DF	Date Analyzed
INORGANIC METALS			**EPA 200.8**				Analyst: **JEK**
Antimony	0.50	U	0.50	1.0	µg/L	1	12/16/2010 7:04:00 P
Arsenic	0.50	U	0.50	1.0	µg/L	1	12/16/2010 7:04:00 P
Lead	0.20	U	0.20	1.0	µg/L	1	12/16/2010 7:04:00 P
Selenium	0.5	J	0.50	1.0	µg/L	1	12/16/2010 7:04:00 P
Thallium	0.10	U	0.10	0.2	µg/L	1	12/16/2010 7:04:00 P
VOLATILE ORGANIC COMPOUNDS			**EPA 8011**				Analyst: **TEW**
1,2-Dibromo-3-chloropropane	0.0100	U	0.0100	0.0400	µg/L	1	12/15/2010 9:48:17 P
1,2-Dibromoethane	0.0100	U	0.0100	0.0400	µg/L	1	12/15/2010 9:48:17 P
Surr: 1,1,2,2-Tetrachloroethane	89.0		0	60-140	%REC	1	12/15/2010 9:48:17 P
VOLATILE ORGANIC COMPOUNDS			**EPA 8260**				Analyst: **JAW**
1,1,1,2-Tetrachloroethane	0.50	U	0.50	1.0	µg/L	1	12/15/2010 6:11:00 A
1,1,1-Trichloroethane	0.50	U	0.50	1.0	µg/L	1	12/15/2010 6:11:00 A
1,1,2,2-Tetrachloroethane	0.50	U	0.50	1.0	µg/L	1	12/15/2010 6:11:00 A
1,1,2-Trichloroethane	0.50	U	0.50	1.0	µg/L	1	12/15/2010 6:11:00 A
1,1-Dichloroethane	0.50	U	0.50	1.0	µg/L	1	12/15/2010 6:11:00 A
1,1-Dichloroethene	0.50	U	0.50	1.0	µg/L	1	12/15/2010 6:11:00 A
1,2,3-Trichloropropane	0.50	U	0.50	1.0	µg/L	1	12/15/2010 6:11:00 A
1,2-Dichlorobenzene	0.50	U	0.50	1.0	µg/L	1	12/15/2010 6:11:00 A
1,2-Dichloroethane	0.50	U	0.50	1.0	µg/L	1	12/15/2010 6:11:00 A
1,2-Dichloropropane	0.50	U	0.50	1.0	µg/L	1	12/15/2010 6:11:00 A
1,4-Dichlorobenzene	0.50	U	0.50	1.0	µg/L	1	12/15/2010 6:11:00 A
2-Hexanone	1.0	U	1.0	5.0	µg/L	1	12/15/2010 6:11:00 A
4-Methyl-2-Pentanone	0.50	U	0.50	1.0	µg/L	1	12/15/2010 6:11:00 A
Acetone	5.0	U	5.0	10	µg/L	1	12/15/2010 6:11:00 A
Acrylonitrile	2.0	U	2.0	5.0	µg/L	1	12/15/2010 6:11:00 A
Benzene	0.50	U	0.50	1.0	µg/L	1	12/15/2010 6:11:00 A
Bromochloromethane	0.50	U	0.50	1.0	µg/L	1	12/15/2010 6:11:00 A
Bromoform	0.50	U	0.50	1.0	µg/L	1	12/15/2010 6:11:00 A
Bromomethane	0.50	U	0.50	1.0	µg/L	1	12/15/2010 6:11:00 A
Carbon Disulfide	0.50	U	0.50	1.0	µg/L	1	12/15/2010 6:11:00 A
Carbon Tetrachloride	0.50	U	0.50	1.0	µg/L	1	12/15/2010 6:11:00 A
Chlorobenzene	0.50	U	0.50	1.0	µg/L	1	12/15/2010 6:11:00 A
Chlorodibromomethane	0.50	U	0.50	1.0	µg/L	1	12/15/2010 6:11:00 A
Chloroethane	0.50	U	0.50	1.0	µg/L	1	12/15/2010 6:11:00 A
Chloroform	0.50	U	0.50	1.0	µg/L	1	12/15/2010 6:11:00 A
Chloromethane	0.50	U	0.50	1.0	µg/L	1	12/15/2010 6:11:00 A
cis-1,2-Dichloroethene	0.50	U	0.50	1.0	µg/L	1	12/15/2010 6:11:00 A
cis-1,3-Dichloropropene	0.50	U	0.50	1.0	µg/L	1	12/15/2010 6:11:00 A
Dibromomethane	0.50	U	0.50	1.0	µg/L	1	12/15/2010 6:11:00 A

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Laboratory Results

Geochemical Testing

Date: *12-Jan-11*

CLIENT:	CIVIL & ENVIRONMENTAL-COLUMBU	**Client Sample ID:**	B-406S
Lab Order:	G1012414		
Project:	APEX Second SA	**Collection Date:**	12/9/2010 4:44:00 PM
Lab ID:	G1012414-003	**Sampled By:**	Client
Matrix:	AQUEOUS	**DateReceived:**	12/14/2010 1:16:39 PM

Analyses	Result	Q	MDL	PQL	Units	DF	Date Analyzed
VOLATILE ORGANIC COMPOUNDS			**EPA 8260**				Analyst: **JAW**
Dichlorobromomethane	0.50	U	0.50	1.0	µg/L	1	12/15/2010 6:11:00 A
Ethylbenzene	0.50	U	0.50	1.0	µg/L	1	12/15/2010 6:11:00 A
Iodomethane	0.50	U	0.50	5.0	µg/L	1	12/15/2010 6:11:00 A
Methyl Ethyl Ketone	1.0	U	1.0	5.0	µg/L	1	12/15/2010 6:11:00 A
Methylene Chloride	0.50	U	0.50	1.0	µg/L	1	12/15/2010 6:11:00 A
Styrene	0.50	U	0.50	1.0	µg/L	1	12/15/2010 6:11:00 A
Tetrachloroethene	0.50	U	0.50	1.0	µg/L	1	12/15/2010 6:11:00 A
Toluene	0.50	U	0.50	1.0	µg/L	1	12/15/2010 6:11:00 A
trans-1,2-Dichloroethene	0.50	U	0.50	1.0	µg/L	1	12/15/2010 6:11:00 A
trans-1,3-Dichloropropene	0.50	U	0.50	1.0	µg/L	1	12/15/2010 6:11:00 A
trans-1,4-Dichloro-2-butene	1.0	U	1.0	2.0	µg/L	1	12/15/2010 6:11:00 A
Trichloroethene	0.50	U	0.50	1.0	µg/L	1	12/15/2010 6:11:00 A
Trichlorofluoromethane	0.50	U	0.50	1.0	µg/L	1	12/15/2010 6:11:00 A
Vinyl Acetate	0.50	U	0.50	1.0	µg/L	1	12/15/2010 6:11:00 A
Vinyl Chloride	0.50	U	0.50	1.0	µg/L	1	12/15/2010 6:11:00 A
Total Xylene	1.0	U	1.0	2.0	µg/L	1	12/15/2010 6:11:00 A
Surr: 1,2-Dichloroethane-d4	101		0	70-130	%REC	1	12/15/2010 6:11:00 A
Surr: 4-Bromofluorobenzene	98.8		0	70-130	%REC	1	12/15/2010 6:11:00 A
Surr: Dibromofluoromethane	100		0	70-130	%REC	1	12/15/2010 6:11:00 A
Surr: Toluene-d8	97.5		0	70-130	%REC	1	12/15/2010 6:11:00 A

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Laboratory Results

Geochemical Testing

Date: *12-Jan-11*

CLIENT:	CIVIL & ENVIRONMENTAL-COLUMBU	**Client Sample ID:**	B-408
Lab Order:	G1012414		
Project:	APEX Second SA	**Collection Date:**	12/10/2010 9:02:00 AM
Lab ID:	G1012414-004	**Sampled By:**	Client
Matrix:	AQUEOUS	**DateReceived:**	12/14/2010 1:16:39 PM

Analyses	Result	Q	MDL	PQL	Units	DF	Date Analyzed
FIELD PARAMETERS			**FIELD**			Analyst:	
pH (Field)	7.37		0		S.U.	0	12/10/2010 9:02:00 A
Specific Conductance (Field)	612		0		umhos/cm	0	12/10/2010 9:02:00 A
Temperature (Field)	8.1		0		deg C	0	12/10/2010 9:02:00 A
Turbidity (Field)	2.74		0		NTU	0	12/10/2010 9:02:00 A
INORGANIC NON-METALS			**SM 18 2320B**			Analyst: **LNW**	
Alkalinity to pH 4.5	263		2.0	5	mg/L CaCO3	1	12/17/2010 1:26:00 P
INORGANIC NON-METALS			**SM 2540 C**			Analyst: **KLS**	
Total dissolved solids	892		10.0	20	mg/L	1	12/15/2010 9:17:00 A
INORGANIC NON-METALS			**SM 4500-CL E**			Analyst: **SAG**	
Chloride	2.0	U	2.0	5	mg/L	1	12/21/2010 2:33:00 P
INORGANIC NON-METALS			**EPA 350.1**			Analyst: **SLY**	
Ammonia Nitrogen - Distilled	0.23		0.040	0.10	mg/L as N	1	12/28/2010 10:52:36 A
INORGANIC NON-METALS			**EPA 353.2**			Analyst: **SLY**	
Nitrate - Nitrite	0.10		0.020	0.05	mg/L as N	1	12/20/2010 8:55:49 A
INORGANIC NON METALS			**ASTM D516-02**			Analyst: **SAG**	
Sulfate	420		20.0	100	mg/L	20	12/20/2010 2:56:00 P
INORGANIC METALS			**EPA 200.7**			Analyst: **MS**	
Barium	0.052		0.0050	0.010	mg/L	1	12/20/2010 6:42:00 P
Beryllium	0.00050	U	0.00050	0.0010	mg/L	1	1/11/2011 5:53:00 PM
Cadmium	0.0010	U	0.0010	0.002	mg/L	1	12/20/2010 6:42:00 P
Calcium	207		0.050	0.10	mg/L	1	12/20/2010 6:42:00 P
Chromium	0.0050	U	0.0050	0.010	mg/L	1	12/20/2010 6:42:00 P
Cobalt	0.0020	U	0.0020	0.005	mg/L	1	12/20/2010 6:42:00 P
Copper	0.0050	U	0.0050	0.010	mg/L	1	12/20/2010 6:42:00 P
Iron	0.82		0.010	0.05	mg/L	1	12/20/2010 6:42:00 P
Magnesium	44.0		0.050	0.10	mg/L	1	12/20/2010 6:42:00 P
Manganese	0.359		0.0020	0.010	mg/L	1	12/20/2010 6:42:00 P
Nickel	0.0050	U	0.0050	0.010	mg/L	1	12/20/2010 6:42:00 P
Potassium	3.5		0.20	0.5	mg/L	1	12/20/2010 6:42:00 P
Silver	0.0020	U	0.0020	0.005	mg/L	1	12/20/2010 6:42:00 P
Sodium	53.6		0.10	0.2	mg/L	1	12/20/2010 6:42:00 P
Vanadium	0.002	J	0.0020	0.005	mg/L	1	12/20/2010 6:42:00 P
Zinc	0.005	J	0.0040	0.010	mg/L	1	12/20/2010 6:42:00 P

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Laboratory Results

Geochemical Testing

Date: *12-Jan-11*

CLIENT:	CIVIL & ENVIRONMENTAL-COLUMBU	**Client Sample ID:**	B-408
Lab Order:	G1012414		
Project:	APEX Second SA	**Collection Date:**	12/10/2010 9:02:00 AM
Lab ID:	G1012414-004	**Sampled By:**	Client
Matrix:	AQUEOUS	**DateReceived:**	12/14/2010 1:16:39 PM

Analyses	Result	Q	MDL	PQL	Units	DF	Date Analyzed
INORGANIC METALS			**EPA 200.8**				Analyst: **JEK**
Antimony	0.50	U	0.50	1.0	µg/L	1	12/16/2010 7:09:00 P
Arsenic	1.9		0.50	1.0	µg/L	1	12/16/2010 7:09:00 P
Lead	0.20	U	0.20	1.0	µg/L	1	12/16/2010 7:09:00 P
Selenium	0.50	U	0.50	1.0	µg/L	1	12/16/2010 7:09:00 P
Thallium	0.10	U	0.10	0.2	µg/L	1	12/16/2010 7:09:00 P
VOLATILE ORGANIC COMPOUNDS			**EPA 8011**				Analyst: **TEW**
1,2-Dibromo-3-chloropropane	0.0100	U	0.0100	0.0400	µg/L	1	12/15/2010 10:09:52 P
1,2-Dibromoethane	0.0100	U	0.0100	0.0400	µg/L	1	12/15/2010 10:09:52 P
Surr: 1,1,2,2-Tetrachloroethane	90.5		0	60-140	%REC	1	12/15/2010 10:09:52 P
VOLATILE ORGANIC COMPOUNDS			**EPA 8260**				Analyst: **JAW**
1,1,1,2-Tetrachloroethane	0.50	U	0.50	1.0	µg/L	1	12/15/2010 6:47:00 A
1,1,1-Trichloroethane	0.50	U	0.50	1.0	µg/L	1	12/15/2010 6:47:00 A
1,1,2,2-Tetrachloroethane	0.50	U	0.50	1.0	µg/L	1	12/15/2010 6:47:00 A
1,1,2-Trichloroethane	0.50	U	0.50	1.0	µg/L	1	12/15/2010 6:47:00 A
1,1-Dichloroethane	0.50	U	0.50	1.0	µg/L	1	12/15/2010 6:47:00 A
1,1-Dichloroethene	0.50	U	0.50	1.0	µg/L	1	12/15/2010 6:47:00 A
1,2,3-Trichloropropane	0.50	U	0.50	1.0	µg/L	1	12/15/2010 6:47:00 A
1,2-Dichlorobenzene	0.50	U	0.50	1.0	µg/L	1	12/15/2010 6:47:00 A
1,2-Dichloroethane	0.50	U	0.50	1.0	µg/L	1	12/15/2010 6:47:00 A
1,2-Dichloropropane	0.50	U	0.50	1.0	µg/L	1	12/15/2010 6:47:00 A
1,4-Dichlorobenzene	0.50	U	0.50	1.0	µg/L	1	12/15/2010 6:47:00 A
2-Hexanone	1.0	U	1.0	5.0	µg/L	1	12/15/2010 6:47:00 A
4-Methyl-2-Pentanone	0.50	U	0.50	1.0	µg/L	1	12/15/2010 6:47:00 A
Acetone	5.0	U	5.0	10	µg/L	1	12/15/2010 6:47:00 A
Acrylonitrile	2.0	U	2.0	5.0	µg/L	1	12/15/2010 6:47:00 A
Benzene	0.50	U	0.50	1.0	µg/L	1	12/15/2010 6:47:00 A
Bromochloromethane	0.50	U	0.50	1.0	µg/L	1	12/15/2010 6:47:00 A
Bromoform	0.50	U	0.50	1.0	µg/L	1	12/15/2010 6:47:00 A
Bromomethane	0.50	U	0.50	1.0	µg/L	1	12/15/2010 6:47:00 A
Carbon Disulfide	0.50	U	0.50	1.0	µg/L	1	12/15/2010 6:47:00 A
Carbon Tetrachloride	0.50	U	0.50	1.0	µg/L	1	12/15/2010 6:47:00 A
Chlorobenzene	0.50	U	0.50	1.0	µg/L	1	12/15/2010 6:47:00 A
Chlorodibromomethane	0.50	U	0.50	1.0	µg/L	1	12/15/2010 6:47:00 A
Chloroethane	0.50	U	0.50	1.0	µg/L	1	12/15/2010 6:47:00 A
Chloroform	0.50	U	0.50	1.0	µg/L	1	12/15/2010 6:47:00 A
Chloromethane	0.50	U	0.50	1.0	µg/L	1	12/15/2010 6:47:00 A
cis-1,2-Dichloroethene	0.50	U	0.50	1.0	µg/L	1	12/15/2010 6:47:00 A
cis-1,3-Dichloropropene	0.50	U	0.50	1.0	µg/L	1	12/15/2010 6:47:00 A
Dibromomethane	0.50	U	0.50	1.0	µg/L	1	12/15/2010 6:47:00 A

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Laboratory Results

Geochemical Testing

Date: *12-Jan-11*

CLIENT:	CIVIL & ENVIRONMENTAL-COLUMBU	**Client Sample ID:**	B-408
Lab Order:	G1012414		
Project:	APEX Second SA	**Collection Date:**	12/10/2010 9:02:00 AM
Lab ID:	G1012414-004	**Sampled By:**	Client
Matrix:	AQUEOUS	**DateReceived:**	12/14/2010 1:16:39 PM

Analyses	Result	Q	MDL	PQL	Units	DF	Date Analyzed
VOLATILE ORGANIC COMPOUNDS			**EPA 8260**			Analyst: **JAW**	
Dichlorobromomethane	0.50	U	0.50	1.0	µg/L	1	12/15/2010 6:47:00 A
Ethylbenzene	0.50	U	0.50	1.0	µg/L	1	12/15/2010 6:47:00 A
Iodomethane	0.50	U	0.50	5.0	µg/L	1	12/15/2010 6:47:00 A
Methyl Ethyl Ketone	1.0	U	1.0	5.0	µg/L	1	12/15/2010 6:47:00 A
Methylene Chloride	0.50	U	0.50	1.0	µg/L	1	12/15/2010 6:47:00 A
Styrene	0.50	U	0.50	1.0	µg/L	1	12/15/2010 6:47:00 A
Tetrachloroethene	0.50	U	0.50	1.0	µg/L	1	12/15/2010 6:47:00 A
Toluene	0.50	U	0.50	1.0	µg/L	1	12/15/2010 6:47:00 A
trans-1,2-Dichloroethene	0.50	U	0.50	1.0	µg/L	1	12/15/2010 6:47:00 A
trans-1,3-Dichloropropene	0.50	U	0.50	1.0	µg/L	1	12/15/2010 6:47:00 A
trans-1,4-Dichloro-2-butene	1.0	U	1.0	2.0	µg/L	1	12/15/2010 6:47:00 A
Trichloroethene	0.50	U	0.50	1.0	µg/L	1	12/15/2010 6:47:00 A
Trichlorofluoromethane	0.50	U	0.50	1.0	µg/L	1	12/15/2010 6:47:00 A
Vinyl Acetate	0.50	U	0.50	1.0	µg/L	1	12/15/2010 6:47:00 A
Vinyl Chloride	0.50	U	0.50	1.0	µg/L	1	12/15/2010 6:47:00 A
Total Xylene	1.0	U	1.0	2.0	µg/L	1	12/15/2010 6:47:00 A
Surr: 1,2-Dichloroethane-d4	95.6		0	70-130	%REC	1	12/15/2010 6:47:00 A
Surr: 4-Bromofluorobenzene	101		0	70-130	%REC	1	12/15/2010 6:47:00 A
Surr: Dibromofluoromethane	96.2		0	70-130	%REC	1	12/15/2010 6:47:00 A
Surr: Toluene-d8	96.4		0	70-130	%REC	1	12/15/2010 6:47:00 A

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Laboratory Results

Geochemical Testing

Date: *12-Jan-11*

CLIENT:	CIVIL & ENVIRONMENTAL-COLUMBU	**Client Sample ID:**	B-402
Lab Order:	G1012414		
Project:	APEX Second SA	**Collection Date:**	12/9/2010 12:02:00 PM
Lab ID:	G1012414-005	**Sampled By:**	Client
Matrix:	AQUEOUS	**DateReceived:**	12/14/2010 1:16:39 PM

Analyses	Result	Q	MDL	PQL	Units	DF	Date Analyzed
FIELD PARAMETERS			**FIELD**			Analyst:	
pH (Field)	8.31		0		S.U.	0	12/9/2010 12:02:00 P
Specific Conductance (Field)	595		0		umhos/cm	0	12/9/2010 12:02:00 P
Temperature (Field)	8.0		0		deg C	0	12/9/2010 12:02:00 P
Turbidity (Field)	1.24		0		NTU	0	12/9/2010 12:02:00 P
INORGANIC NON-METALS			**SM 18 2320B**			Analyst: **LNW**	
Alkalinity to pH 4.5	272		2.0	5	mg/L CaCO3	1	12/17/2010 1:37:00 P
INORGANIC NON-METALS			**SM 2540 C**			Analyst: **KLS**	
Total dissolved solids	456		10.0	20	mg/L	1	12/15/2010 9:17:00 A
INORGANIC NON-METALS			**SM 4500-CL E**			Analyst: **SAG**	
Chloride	2.0	U	2.0	5	mg/L	1	12/21/2010 2:33:00 P
INORGANIC NON-METALS			**EPA 350.1**			Analyst: **SLY**	
Ammonia Nitrogen - Distilled	0.60		0.040	0.10	mg/L as N	1	12/28/2010 11:06:12 A
INORGANIC NON-METALS			**EPA 353.2**			Analyst: **SLY**	
Nitrate - Nitrite	0.10		0.020	0.05	mg/L as N	1	12/20/2010 8:56:57 A
INORGANIC NON METALS			**ASTM D516-02**			Analyst: **SAG**	
Sulfate	166		5.0	25	mg/L	5	12/20/2010 2:56:00 P
INORGANIC METALS			**EPA 200.7**			Analyst: **MS**	
Barium	0.042		0.0050	0.010	mg/L	1	12/20/2010 6:48:00 P
Beryllium	0.0006	J	0.00050	0.0010	mg/L	1	12/20/2010 6:48:00 P
Cadmium	0.0010	U	0.0010	0.002	mg/L	1	12/20/2010 6:48:00 P
Calcium	89.9		0.050	0.10	mg/L	1	12/20/2010 6:48:00 P
Chromium	0.0050	U	0.0050	0.010	mg/L	1	12/20/2010 6:48:00 P
Cobalt	0.0020	U	0.0020	0.005	mg/L	1	12/20/2010 6:48:00 P
Copper	0.0050	U	0.0050	0.010	mg/L	1	12/20/2010 6:48:00 P
Iron	0.12		0.010	0.05	mg/L	1	12/20/2010 6:48:00 P
Magnesium	29.0		0.050	0.10	mg/L	1	12/20/2010 6:48:00 P
Manganese	0.083		0.0020	0.010	mg/L	1	12/20/2010 6:48:00 P
Nickel	0.0050	U	0.0050	0.010	mg/L	1	12/20/2010 6:48:00 P
Potassium	4.2		0.20	0.5	mg/L	1	12/20/2010 6:48:00 P
Silver	0.0020	U	0.0020	0.005	mg/L	1	12/20/2010 6:48:00 P
Sodium	64.9		0.10	0.2	mg/L	1	12/20/2010 6:48:00 P
Vanadium	0.0020	U	0.0020	0.005	mg/L	1	12/20/2010 6:48:00 P
Zinc	0.0040	U	0.0040	0.010	mg/L	1	12/20/2010 6:48:00 P

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Laboratory Results

Geochemical Testing

Date: *12-Jan-11*

CLIENT:	CIVIL & ENVIRONMENTAL-COLUMBU	**Client Sample ID:**	B-402
Lab Order:	G1012414		
Project:	APEX Second SA	**Collection Date:**	12/9/2010 12:02:00 PM
Lab ID:	G1012414-005	**Sampled By:**	Client
Matrix:	AQUEOUS	**DateReceived:**	12/14/2010 1:16:39 PM

Analyses	Result	Q	MDL	PQL	Units	DF	Date Analyzed
INORGANIC METALS			**EPA 200.8**				Analyst: **JEK**
Antimony	0.50	U	0.50	1.0	µg/L	1	12/16/2010 7:14:00 P
Arsenic	8.0		0.50	1.0	µg/L	1	12/16/2010 7:14:00 P
Lead	0.20	U	0.20	1.0	µg/L	1	12/16/2010 7:14:00 P
Selenium	0.50	U	0.50	1.0	µg/L	1	12/16/2010 7:14:00 P
Thallium	0.10	U	0.10	0.2	µg/L	1	12/16/2010 7:14:00 P
VOLATILE ORGANIC COMPOUNDS			**EPA 8011**				Analyst: **TEW**
1,2-Dibromo-3-chloropropane	0.0100	U	0.0100	0.0400	µg/L	1	12/15/2010 11:14:25 P
1,2-Dibromoethane	0.0100	U	0.0100	0.0400	µg/L	1	12/15/2010 11:14:25 P
Surr: 1,1,2,2-Tetrachloroethane	91.9		0	60-140	%REC	1	12/15/2010 11:14:25 P
VOLATILE ORGANIC COMPOUNDS			**EPA 8260**				Analyst: **JAW**
1,1,1,2-Tetrachloroethane	0.50	U	0.50	1.0	µg/L	1	12/15/2010 7:22:00 A
1,1,1-Trichloroethane	0.50	U	0.50	1.0	µg/L	1	12/15/2010 7:22:00 A
1,1,2,2-Tetrachloroethane	0.50	U	0.50	1.0	µg/L	1	12/15/2010 7:22:00 A
1,1,2-Trichloroethane	0.50	U	0.50	1.0	µg/L	1	12/15/2010 7:22:00 A
1,1-Dichloroethane	0.50	U	0.50	1.0	µg/L	1	12/15/2010 7:22:00 A
1,1-Dichloroethene	0.50	U	0.50	1.0	µg/L	1	12/15/2010 7:22:00 A
1,2,3-Trichloropropane	0.50	U	0.50	1.0	µg/L	1	12/15/2010 7:22:00 A
1,2-Dichlorobenzene	0.50	U	0.50	1.0	µg/L	1	12/15/2010 7:22:00 A
1,2-Dichloroethane	0.50	U	0.50	1.0	µg/L	1	12/15/2010 7:22:00 A
1,2-Dichloropropane	0.50	U	0.50	1.0	µg/L	1	12/15/2010 7:22:00 A
1,4-Dichlorobenzene	0.50	U	0.50	1.0	µg/L	1	12/15/2010 7:22:00 A
2-Hexanone	1.0	U	1.0	5.0	µg/L	1	12/15/2010 7:22:00 A
4-Methyl-2-Pentanone	0.50	U	0.50	1.0	µg/L	1	12/15/2010 7:22:00 A
Acetone	5.0	U	5.0	10	µg/L	1	12/15/2010 7:22:00 A
Acrylonitrile	2.0	U	2.0	5.0	µg/L	1	12/15/2010 7:22:00 A
Benzene	0.50	U	0.50	1.0	µg/L	1	12/15/2010 7:22:00 A
Bromochloromethane	0.50	U	0.50	1.0	µg/L	1	12/15/2010 7:22:00 A
Bromoform	0.50	U	0.50	1.0	µg/L	1	12/15/2010 7:22:00 A
Bromomethane	0.50	U	0.50	1.0	µg/L	1	12/15/2010 7:22:00 A
Carbon Disulfide	0.50	U	0.50	1.0	µg/L	1	12/15/2010 7:22:00 A
Carbon Tetrachloride	0.50	U	0.50	1.0	µg/L	1	12/15/2010 7:22:00 A
Chlorobenzene	0.50	U	0.50	1.0	µg/L	1	12/15/2010 7:22:00 A
Chlorodibromomethane	0.50	U	0.50	1.0	µg/L	1	12/15/2010 7:22:00 A
Chloroethane	0.50	U	0.50	1.0	µg/L	1	12/15/2010 7:22:00 A
Chloroform	0.50	U	0.50	1.0	µg/L	1	12/15/2010 7:22:00 A
Chloromethane	0.50	U	0.50	1.0	µg/L	1	12/15/2010 7:22:00 A
cis-1,2-Dichloroethene	0.50	U	0.50	1.0	µg/L	1	12/15/2010 7:22:00 A
cis-1,3-Dichloropropene	0.50	U	0.50	1.0	µg/L	1	12/15/2010 7:22:00 A
Dibromomethane	0.50	U	0.50	1.0	µg/L	1	12/15/2010 7:22:00 A

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Laboratory Results

Geochemical Testing

Date: *12-Jan-11*

CLIENT:	CIVIL & ENVIRONMENTAL-COLUMBU	**Client Sample ID:**	B-402
Lab Order:	G1012414		
Project:	APEX Second SA	**Collection Date:**	12/9/2010 12:02:00 PM
Lab ID:	G1012414-005	**Sampled By:**	Client
Matrix:	AQUEOUS	**DateReceived:**	12/14/2010 1:16:39 PM

Analyses	Result	Q	MDL	PQL	Units	DF	Date Analyzed
VOLATILE ORGANIC COMPOUNDS			**EPA 8260**			Analyst: **JAW**	
Dichlorobromomethane	0.50	U	0.50	1.0	µg/L	1	12/15/2010 7:22:00 A
Ethylbenzene	0.50	U	0.50	1.0	µg/L	1	12/15/2010 7:22:00 A
Iodomethane	0.50	U	0.50	5.0	µg/L	1	12/15/2010 7:22:00 A
Methyl Ethyl Ketone	1.0	U	1.0	5.0	µg/L	1	12/15/2010 7:22:00 A
Methylene Chloride	0.50	U	0.50	1.0	µg/L	1	12/15/2010 7:22:00 A
Styrene	0.50	U	0.50	1.0	µg/L	1	12/15/2010 7:22:00 A
Tetrachloroethene	0.50	U	0.50	1.0	µg/L	1	12/15/2010 7:22:00 A
Toluene	0.50	U	0.50	1.0	µg/L	1	12/15/2010 7:22:00 A
trans-1,2-Dichloroethene	0.50	U	0.50	1.0	µg/L	1	12/15/2010 7:22:00 A
trans-1,3-Dichloropropene	0.50	U	0.50	1.0	µg/L	1	12/15/2010 7:22:00 A
trans-1,4-Dichloro-2-butene	1.0	U	1.0	2.0	µg/L	1	12/15/2010 7:22:00 A
Trichloroethene	0.50	U	0.50	1.0	µg/L	1	12/15/2010 7:22:00 A
Trichlorofluoromethane	0.50	U	0.50	1.0	µg/L	1	12/15/2010 7:22:00 A
Vinyl Acetate	0.50	U	0.50	1.0	µg/L	1	12/15/2010 7:22:00 A
Vinyl Chloride	0.50	U	0.50	1.0	µg/L	1	12/15/2010 7:22:00 A
Total Xylene	1.0	U	1.0	2.0	µg/L	1	12/15/2010 7:22:00 A
Surr: 1,2-Dichloroethane-d4	102		0	70-130	%REC	1	12/15/2010 7:22:00 A
Surr: 4-Bromofluorobenzene	96.9		0	70-130	%REC	1	12/15/2010 7:22:00 A
Surr: Dibromofluoromethane	104		0	70-130	%REC	1	12/15/2010 7:22:00 A
Surr: Toluene-d8	98.0		0	70-130	%REC	1	12/15/2010 7:22:00 A

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Laboratory Results

Geochemical Testing

Date: *12-Jan-11*

CLIENT:	CIVIL & ENVIRONMENTAL-COLUMBU	**Client Sample ID:**	B-402A
Lab Order:	G1012414		
Project:	APEX Second SA	**Collection Date:**	12/9/2010 11:20:00 AM
Lab ID:	G1012414-006	**Sampled By:**	Client
Matrix:	AQUEOUS	**DateReceived:**	12/14/2010 1:16:39 PM

Analyses	Result	Q	MDL	PQL	Units	DF	Date Analyzed
FIELD PARAMETERS			**FIELD**			Analyst:	
pH (Field)	6.84		0		S.U.	0	12/9/2010 11:20:00 A
Specific Conductance (Field)	1766		0		umhos/cm	0	12/9/2010 11:20:00 A
Temperature (Field)	10.1		0		deg C	0	12/9/2010 11:20:00 A
Turbidity (Field)	1.24		0		NTU	0	12/9/2010 11:20:00 A
INORGANIC NON-METALS			**SM 18 2320B**			Analyst: **LNW**	
Alkalinity to pH 4.5	427		2.0	5	mg/L CaCO3	1	12/17/2010 1:55:00 P
INORGANIC NON-METALS			**SM 2540 C**			Analyst: **KLS**	
Total dissolved solids	1540		10.0	20	mg/L	1	12/15/2010 9:17:00 A
INORGANIC NON-METALS			**SM 4500-CL E**			Analyst: **SAG**	
Chloride	155		4.0	10	mg/L	2	12/21/2010 2:33:00 P
INORGANIC NON-METALS			**EPA 350.1**			Analyst: **SLY**	
Ammonia Nitrogen - Distilled	0.22		0.040	0.10	mg/L as N	1	12/28/2010 11:07:19 A
INORGANIC NON-METALS			**EPA 353.2**			Analyst: **SLY**	
Nitrate - Nitrite	0.020	U	0.020	0.05	mg/L as N	1	12/20/2010 8:58:05 A
INORGANIC NON METALS			**ASTM D516-02**			Analyst: **SAG**	
Sulfate	719		25.0	125	mg/L	25	12/20/2010 2:56:00 P
INORGANIC METALS			**EPA 200.7**			Analyst: **MS**	
Barium	0.013		0.0050	0.010	mg/L	1	12/20/2010 6:52:00 P
Beryllium	0.00050	U	0.00050	0.0010	mg/L	1	12/20/2010 6:52:00 P
Cadmium	0.0010	U	0.0010	0.002	mg/L	1	12/20/2010 6:52:00 P
Calcium	349		0.050	0.10	mg/L	1	12/20/2010 6:52:00 P
Chromium	0.0050	U	0.0050	0.010	mg/L	1	12/20/2010 6:52:00 P
Cobalt	0.0020	U	0.0020	0.005	mg/L	1	12/20/2010 6:52:00 P
Copper	0.0050	U	0.0050	0.010	mg/L	1	12/20/2010 6:52:00 P
Iron	2.55		0.010	0.05	mg/L	1	12/20/2010 6:52:00 P
Magnesium	129		0.050	0.10	mg/L	1	12/20/2010 6:52:00 P
Manganese	0.195		0.0020	0.010	mg/L	1	12/20/2010 6:52:00 P
Nickel	0.006	J	0.0050	0.010	mg/L	1	12/20/2010 6:52:00 P
Potassium	7.8		0.20	0.5	mg/L	1	12/20/2010 6:52:00 P
Silver	0.0020	U	0.0020	0.005	mg/L	1	12/20/2010 6:52:00 P
Sodium	34.5		0.10	0.2	mg/L	1	12/20/2010 6:52:00 P
Vanadium	0.0020	U	0.0020	0.005	mg/L	1	12/20/2010 6:52:00 P
Zinc	0.005	J	0.0040	0.010	mg/L	1	12/20/2010 6:52:00 P

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Laboratory Results

Geochemical Testing

Date: *12-Jan-11*

CLIENT:	CIVIL & ENVIRONMENTAL-COLUMBU	**Client Sample ID:**	B-402A
Lab Order:	G1012414		
Project:	APEX Second SA	**Collection Date:**	12/9/2010 11:20:00 AM
Lab ID:	G1012414-006	**Sampled By:**	Client
Matrix:	AQUEOUS	**DateReceived:**	12/14/2010 1:16:39 PM

Analyses	Result	Q	MDL	PQL	Units	DF	Date Analyzed
INORGANIC METALS			**EPA 200.8**				Analyst: **JEK**
Antimony	0.50	U	0.50	1.0	µg/L	1	12/16/2010 7:18:00 P
Arsenic	2.1		0.50	1.0	µg/L	1	12/16/2010 7:18:00 P
Lead	0.20	U	0.20	1.0	µg/L	1	12/16/2010 7:18:00 P
Selenium	2.6		0.50	1.0	µg/L	1	12/16/2010 7:18:00 P
Thallium	0.10	U	0.10	0.2	µg/L	1	12/16/2010 7:18:00 P
VOLATILE ORGANIC COMPOUNDS			**EPA 8011**				Analyst: **TEW**
1,2-Dibromo-3-chloropropane	0.0100	U	0.0100	0.0400	µg/L	1	12/15/2010 11:36:01 P
1,2-Dibromoethane	0.0100	U	0.0100	0.0400	µg/L	1	12/15/2010 11:36:01 P
Surr: 1,1,2,2-Tetrachloroethane	89.0		0	60-140	%REC	1	12/15/2010 11:36:01 P
VOLATILE ORGANIC COMPOUNDS			**EPA 8260**				Analyst: **JAW**
1,1,1,2-Tetrachloroethane	0.50	U	0.50	1.0	µg/L	1	12/15/2010 7:58:00 A
1,1,1-Trichloroethane	0.50	U	0.50	1.0	µg/L	1	12/15/2010 7:58:00 A
1,1,2,2-Tetrachloroethane	0.50	U	0.50	1.0	µg/L	1	12/15/2010 7:58:00 A
1,1,2-Trichloroethane	0.50	U	0.50	1.0	µg/L	1	12/15/2010 7:58:00 A
1,1-Dichloroethane	0.50	U	0.50	1.0	µg/L	1	12/15/2010 7:58:00 A
1,1-Dichloroethene	0.50	U	0.50	1.0	µg/L	1	12/15/2010 7:58:00 A
1,2,3-Trichloropropane	0.50	U	0.50	1.0	µg/L	1	12/15/2010 7:58:00 A
1,2-Dichlorobenzene	0.50	U	0.50	1.0	µg/L	1	12/15/2010 7:58:00 A
1,2-Dichloroethane	0.50	U	0.50	1.0	µg/L	1	12/15/2010 7:58:00 A
1,2-Dichloropropane	0.50	U	0.50	1.0	µg/L	1	12/15/2010 7:58:00 A
1,4-Dichlorobenzene	0.50	U	0.50	1.0	µg/L	1	12/15/2010 7:58:00 A
2-Hexanone	1.0	U	1.0	5.0	µg/L	1	12/15/2010 7:58:00 A
4-Methyl-2-Pentanone	0.50	U	0.50	1.0	µg/L	1	12/15/2010 7:58:00 A
Acetone	5.0	U	5.0	10	µg/L	1	12/15/2010 7:58:00 A
Acrylonitrile	2.0	U	2.0	5.0	µg/L	1	12/15/2010 7:58:00 A
Benzene	0.50	U	0.50	1.0	µg/L	1	12/15/2010 7:58:00 A
Bromochloromethane	0.50	U	0.50	1.0	µg/L	1	12/15/2010 7:58:00 A
Bromoform	0.50	U	0.50	1.0	µg/L	1	12/15/2010 7:58:00 A
Bromomethane	0.50	U	0.50	1.0	µg/L	1	12/15/2010 7:58:00 A
Carbon Disulfide	0.50	U	0.50	1.0	µg/L	1	12/15/2010 7:58:00 A
Carbon Tetrachloride	0.50	U	0.50	1.0	µg/L	1	12/15/2010 7:58:00 A
Chlorobenzene	0.50	U	0.50	1.0	µg/L	1	12/15/2010 7:58:00 A
Chlorodibromomethane	0.50	U	0.50	1.0	µg/L	1	12/15/2010 7:58:00 A
Chloroethane	0.50	U	0.50	1.0	µg/L	1	12/15/2010 7:58:00 A
Chloroform	0.50	U	0.50	1.0	µg/L	1	12/15/2010 7:58:00 A
Chloromethane	0.50	U	0.50	1.0	µg/L	1	12/15/2010 7:58:00 A
cis-1,2-Dichloroethene	0.50	U	0.50	1.0	µg/L	1	12/15/2010 7:58:00 A
cis-1,3-Dichloropropene	0.50	U	0.50	1.0	µg/L	1	12/15/2010 7:58:00 A
Dibromomethane	0.50	U	0.50	1.0	µg/L	1	12/15/2010 7:58:00 A

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Laboratory Results

Geochemical Testing

Date: *12-Jan-11*

CLIENT:	CIVIL & ENVIRONMENTAL-COLUMBU	**Client Sample ID:**	B-402A
Lab Order:	G1012414		
Project:	APEX Second SA	**Collection Date:**	12/9/2010 11:20:00 AM
Lab ID:	G1012414-006	**Sampled By:**	Client
Matrix:	AQUEOUS	**DateReceived:**	12/14/2010 1:16:39 PM

Analyses	Result	Q	MDL	PQL	Units	DF	Date Analyzed
VOLATILE ORGANIC COMPOUNDS			**EPA 8260**			Analyst: **JAW**	
Dichlorobromomethane	0.50	U	0.50	1.0	µg/L	1	12/15/2010 7:58:00 A
Ethylbenzene	0.50	U	0.50	1.0	µg/L	1	12/15/2010 7:58:00 A
Iodomethane	0.50	U	0.50	5.0	µg/L	1	12/15/2010 7:58:00 A
Methyl Ethyl Ketone	1.0	U	1.0	5.0	µg/L	1	12/15/2010 7:58:00 A
Methylene Chloride	0.50	U	0.50	1.0	µg/L	1	12/15/2010 7:58:00 A
Styrene	0.50	U	0.50	1.0	µg/L	1	12/15/2010 7:58:00 A
Tetrachloroethene	0.50	U	0.50	1.0	µg/L	1	12/15/2010 7:58:00 A
Toluene	0.50	U	0.50	1.0	µg/L	1	12/15/2010 7:58:00 A
trans-1,2-Dichloroethene	0.50	U	0.50	1.0	µg/L	1	12/15/2010 7:58:00 A
trans-1,3-Dichloropropene	0.50	U	0.50	1.0	µg/L	1	12/15/2010 7:58:00 A
trans-1,4-Dichloro-2-butene	1.0	U	1.0	2.0	µg/L	1	12/15/2010 7:58:00 A
Trichloroethene	0.50	U	0.50	1.0	µg/L	1	12/15/2010 7:58:00 A
Trichlorofluoromethane	0.50	U	0.50	1.0	µg/L	1	12/15/2010 7:58:00 A
Vinyl Acetate	0.50	U	0.50	1.0	µg/L	1	12/15/2010 7:58:00 A
Vinyl Chloride	0.50	U	0.50	1.0	µg/L	1	12/15/2010 7:58:00 A
Total Xylene	1.0	U	1.0	2.0	µg/L	1	12/15/2010 7:58:00 A
Surr: 1,2-Dichloroethane-d4	96.7		0	70-130	%REC	1	12/15/2010 7:58:00 A
Surr: 4-Bromofluorobenzene	99.5		0	70-130	%REC	1	12/15/2010 7:58:00 A
Surr: Dibromofluoromethane	95.5		0	70-130	%REC	1	12/15/2010 7:58:00 A
Surr: Toluene-d8	97.6		0	70-130	%REC	1	12/15/2010 7:58:00 A

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Laboratory Results

Geochemical Testing

Date: *12-Jan-11*

CLIENT:	CIVIL & ENVIRONMENTAL-COLUMBU	**Client Sample ID:**	B-401
Lab Order:	G1012414		
Project:	APEX Second SA	**Collection Date:**	12/9/2010 10:25:00 AM
Lab ID:	G1012414-007	**Sampled By:**	Client
Matrix:	AQUEOUS	**DateReceived:**	12/14/2010 1:16:39 PM

Analyses	Result	Q	MDL	PQL	Units	DF	Date Analyzed
FIELD PARAMETERS			**FIELD**			Analyst:	
pH (Field)	6.80		0		S.U.	0	12/9/2010 10:25:00 A
Specific Conductance (Field)	3050		0		umhos/cm	0	12/9/2010 10:25:00 A
Temperature (Field)	9.4		0		deg C	0	12/9/2010 10:25:00 A
Turbidity (Field)	0.52		0		NTU	0	12/9/2010 10:25:00 A
INORGANIC NON-METALS			**SM 18 2320B**			Analyst: **LNW**	
Alkalinity to pH 4.5	389		2.0	5	mg/L CaCO3	1	12/17/2010 2:10:00 P
INORGANIC NON-METALS			**SM 2540 C**			Analyst: **KLS**	
Total dissolved solids	2430		10.0	20	mg/L	1	12/15/2010 9:17:00 A
INORGANIC NON-METALS			**SM 4500-CL E**			Analyst: **SAG**	
Chloride	8		2.0	5	mg/L	1	12/21/2010 2:33:00 P
INORGANIC NON-METALS			**EPA 350.1**			Analyst: **SLY**	
Ammonia Nitrogen - Distilled	0.12		0.040	0.10	mg/L as N	1	12/28/2010 11:08:26 A
INORGANIC NON-METALS			**EPA 353.2**			Analyst: **SLY**	
Nitrate - Nitrite	0.020	U	0.020	0.05	mg/L as N	1	12/20/2010 8:59:12 A
INORGANIC NON METALS			**ASTM D516-02**			Analyst: **SAG**	
Sulfate	1320		100	500	mg/L	100	12/20/2010 2:56:00 P
INORGANIC METALS			**EPA 200.7**			Analyst: **MS**	
Barium	0.023		0.0050	0.010	mg/L	1	12/20/2010 6:59:00 P
Beryllium	0.00050	U	0.00050	0.0010	mg/L	1	12/20/2010 6:59:00 P
Cadmium	0.0010	U	0.0010	0.002	mg/L	1	12/20/2010 6:59:00 P
Calcium	695		0.500	1.00	mg/L	10	12/21/2010 1:33:00 P
Chromium	0.0050	U	0.0050	0.010	mg/L	1	12/20/2010 6:59:00 P
Cobalt	0.002	J	0.0020	0.005	mg/L	1	12/20/2010 6:59:00 P
Copper	0.0050	U	0.0050	0.010	mg/L	1	12/20/2010 6:59:00 P
Iron	0.08		0.010	0.05	mg/L	1	12/20/2010 6:59:00 P
Magnesium	116		0.050	0.10	mg/L	1	12/20/2010 6:59:00 P
Manganese	3.18		0.0020	0.010	mg/L	1	12/20/2010 6:59:00 P
Nickel	0.0050	U	0.0050	0.010	mg/L	1	12/20/2010 6:59:00 P
Potassium	3.6		0.20	0.5	mg/L	1	12/20/2010 6:59:00 P
Silver	0.0020	U	0.0020	0.005	mg/L	1	12/20/2010 6:59:00 P
Sodium	19.2		0.10	0.2	mg/L	1	12/20/2010 6:59:00 P
Vanadium	0.0020	U	0.0020	0.005	mg/L	1	12/20/2010 6:59:00 P
Zinc	0.0040	U	0.0040	0.010	mg/L	1	12/20/2010 6:59:00 P

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Laboratory Results

Geochemical Testing

Date: *12-Jan-11*

CLIENT:	CIVIL & ENVIRONMENTAL-COLUMBU	**Client Sample ID:**	B-401
Lab Order:	G1012414		
Project:	APEX Second SA	**Collection Date:**	12/9/2010 10:25:00 AM
Lab ID:	G1012414-007	**Sampled By:**	Client
Matrix:	AQUEOUS	**DateReceived:**	12/14/2010 1:16:39 PM

Analyses	Result	Q	MDL	PQL	Units	DF	Date Analyzed
INORGANIC METALS			**EPA 200.8**				Analyst: **JEK**
Antimony	0.50	U	0.50	1.0	µg/L	1	12/16/2010 7:23:00 P
Arsenic	0.50	U	0.50	1.0	µg/L	1	12/16/2010 7:23:00 P
Lead	0.20	U	0.20	1.0	µg/L	1	12/16/2010 7:23:00 P
Selenium	0.7	J	0.50	1.0	µg/L	1	12/16/2010 7:23:00 P
Thallium	0.10	U	0.10	0.2	µg/L	1	12/16/2010 7:23:00 P
VOLATILE ORGANIC COMPOUNDS			**EPA 8011**				Analyst: **TEW**
1,2-Dibromo-3-chloropropane	0.0100	U	0.0100	0.0400	µg/L	1	12/15/2010 11:57:40 P
1,2-Dibromoethane	0.0100	U	0.0100	0.0400	µg/L	1	12/15/2010 11:57:40 P
Surr: 1,1,2,2-Tetrachloroethane	92.1		0	60-140	%REC	1	12/15/2010 11:57:40 P
VOLATILE ORGANIC COMPOUNDS			**EPA 8260**				Analyst: **JAW**
1,1,1,2-Tetrachloroethane	0.50	U	0.50	1.0	µg/L	1	12/15/2010 8:33:00 A
1,1,1-Trichloroethane	0.50	U	0.50	1.0	µg/L	1	12/15/2010 8:33:00 A
1,1,2,2-Tetrachloroethane	0.50	U	0.50	1.0	µg/L	1	12/15/2010 8:33:00 A
1,1,2-Trichloroethane	0.50	U	0.50	1.0	µg/L	1	12/15/2010 8:33:00 A
1,1-Dichloroethane	0.50	U	0.50	1.0	µg/L	1	12/15/2010 8:33:00 A
1,1-Dichloroethene	0.50	U	0.50	1.0	µg/L	1	12/15/2010 8:33:00 A
1,2,3-Trichloropropane	0.50	U	0.50	1.0	µg/L	1	12/15/2010 8:33:00 A
1,2-Dichlorobenzene	0.50	U	0.50	1.0	µg/L	1	12/15/2010 8:33:00 A
1,2-Dichloroethane	0.50	U	0.50	1.0	µg/L	1	12/15/2010 8:33:00 A
1,2-Dichloropropane	0.50	U	0.50	1.0	µg/L	1	12/15/2010 8:33:00 A
1,4-Dichlorobenzene	0.50	U	0.50	1.0	µg/L	1	12/15/2010 8:33:00 A
2-Hexanone	1.0	U	1.0	5.0	µg/L	1	12/15/2010 8:33:00 A
4-Methyl-2-Pentanone	0.50	U	0.50	1.0	µg/L	1	12/15/2010 8:33:00 A
Acetone	5.0	U	5.0	10	µg/L	1	12/15/2010 8:33:00 A
Acrylonitrile	2.0	U	2.0	5.0	µg/L	1	12/15/2010 8:33:00 A
Benzene	0.50	U	0.50	1.0	µg/L	1	12/15/2010 8:33:00 A
Bromochloromethane	0.50	U	0.50	1.0	µg/L	1	12/15/2010 8:33:00 A
Bromoform	0.50	U	0.50	1.0	µg/L	1	12/15/2010 8:33:00 A
Bromomethane	0.50	U	0.50	1.0	µg/L	1	12/15/2010 8:33:00 A
Carbon Disulfide	0.50	U	0.50	1.0	µg/L	1	12/15/2010 8:33:00 A
Carbon Tetrachloride	0.50	U	0.50	1.0	µg/L	1	12/15/2010 8:33:00 A
Chlorobenzene	0.50	U	0.50	1.0	µg/L	1	12/15/2010 8:33:00 A
Chlorodibromomethane	0.50	U	0.50	1.0	µg/L	1	12/15/2010 8:33:00 A
Chloroethane	0.50	U	0.50	1.0	µg/L	1	12/15/2010 8:33:00 A
Chloroform	0.50	U	0.50	1.0	µg/L	1	12/15/2010 8:33:00 A
Chloromethane	0.50	U	0.50	1.0	µg/L	1	12/15/2010 8:33:00 A
cis-1,2-Dichloroethene	0.50	U	0.50	1.0	µg/L	1	12/15/2010 8:33:00 A
cis-1,3-Dichloropropene	0.50	U	0.50	1.0	µg/L	1	12/15/2010 8:33:00 A
Dibromomethane	0.50	U	0.50	1.0	µg/L	1	12/15/2010 8:33:00 A

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Geochemical Testing

Date: *12-Jan-11*

CLIENT:	CIVIL & ENVIRONMENTAL-COLUMBU	**Client Sample ID:**	B-401
Lab Order:	G1012414		
Project:	APEX Second SA	**Collection Date:**	12/9/2010 10:25:00 AM
Lab ID:	G1012414-007	**Sampled By:**	Client
Matrix:	AQUEOUS	**DateReceived:**	12/14/2010 1:16:39 PM

Analyses	Result	Q	MDL	PQL	Units	DF	Date Analyzed
VOLATILE ORGANIC COMPOUNDS			**EPA 8260**			Analyst: **JAW**	
Dichlorobromomethane	0.50	U	0.50	1.0	µg/L	1	12/15/2010 8:33:00 A
Ethylbenzene	0.50	U	0.50	1.0	µg/L	1	12/15/2010 8:33:00 A
Iodomethane	0.50	U	0.50	5.0	µg/L	1	12/15/2010 8:33:00 A
Methyl Ethyl Ketone	1.0	U	1.0	5.0	µg/L	1	12/15/2010 8:33:00 A
Methylene Chloride	0.50	U	0.50	1.0	µg/L	1	12/15/2010 8:33:00 A
Styrene	0.50	U	0.50	1.0	µg/L	1	12/15/2010 8:33:00 A
Tetrachloroethene	0.50	U	0.50	1.0	µg/L	1	12/15/2010 8:33:00 A
Toluene	0.50	U	0.50	1.0	µg/L	1	12/15/2010 8:33:00 A
trans-1,2-Dichloroethene	0.50	U	0.50	1.0	µg/L	1	12/15/2010 8:33:00 A
trans-1,3-Dichloropropene	0.50	U	0.50	1.0	µg/L	1	12/15/2010 8:33:00 A
trans-1,4-Dichloro-2-butene	1.0	U	1.0	2.0	µg/L	1	12/15/2010 8:33:00 A
Trichloroethene	0.50	U	0.50	1.0	µg/L	1	12/15/2010 8:33:00 A
Trichlorofluoromethane	0.50	U	0.50	1.0	µg/L	1	12/15/2010 8:33:00 A
Vinyl Acetate	0.50	U	0.50	1.0	µg/L	1	12/15/2010 8:33:00 A
Vinyl Chloride	0.50	U	0.50	1.0	µg/L	1	12/15/2010 8:33:00 A
Total Xylene	1.0	U	1.0	2.0	µg/L	1	12/15/2010 8:33:00 A
Surr: 1,2-Dichloroethane-d4	102		0	70-130	%REC	1	12/15/2010 8:33:00 A
Surr: 4-Bromofluorobenzene	99.6		0	70-130	%REC	1	12/15/2010 8:33:00 A
Surr: Dibromofluoromethane	101		0	70-130	%REC	1	12/15/2010 8:33:00 A
Surr: Toluene-d8	97.2		0	70-130	%REC	1	12/15/2010 8:33:00 A

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Laboratory Results

Geochemical Testing

Date: *12-Jan-11*

CLIENT:	CIVIL & ENVIRONMENTAL-COLUMBU	**Client Sample ID:**	B-401A
Lab Order:	G1012414		
Project:	APEX Second SA	**Collection Date:**	12/9/2010 9:45:00 AM
Lab ID:	G1012414-008	**Sampled By:**	Client
Matrix:	AQUEOUS	**DateReceived:**	12/14/2010 1:16:39 PM

Analyses	Result	Q	MDL	PQL	Units	DF	Date Analyzed
FIELD PARAMETERS			**FIELD**			Analyst:	
pH (Field)	6.82		0		S.U.	0	12/9/2010 9:45:00 AM
Specific Conductance (Field)	3490		0		umhos/cm	0	12/9/2010 9:45:00 AM
Temperature (Field)	9.4		0		deg C	0	12/9/2010 9:45:00 AM
Turbidity (Field)	2.36		0		NTU	0	12/9/2010 9:45:00 AM
INORGANIC NON-METALS			**SM 18 2320B**			Analyst: **LNW**	
Alkalinity to pH 4.5	325		2.0	5	mg/L CaCO3	1	12/17/2010 2:23:00 P
INORGANIC NON-METALS			**SM 2540 C**			Analyst: **KLS**	
Total dissolved solids	2980		10.0	20	mg/L	1	12/15/2010 9:18:00 A
INORGANIC NON-METALS			**SM 4500-CL E**			Analyst: **SAG**	
Chloride	3	J	2.0	5	mg/L	1	12/21/2010 2:33:00 P
INORGANIC NON-METALS			**EPA 350.1**			Analyst: **SLY**	
Ammonia Nitrogen - Distilled	0.06	J	0.040	0.10	mg/L as N	1	12/28/2010 11:09:33 A
INORGANIC NON-METALS			**EPA 353.2**			Analyst: **SLY**	
Nitrate - Nitrite	0.05	J	0.020	0.05	mg/L as N	1	12/20/2010 9:03:44 A
INORGANIC NON METALS			**ASTM D516-02**			Analyst: **SAG**	
Sulfate	1810		100	500	mg/L	100	12/20/2010 2:56:00 P
INORGANIC METALS			**EPA 200.7**			Analyst: **MS**	
Barium	0.010		0.0050	0.010	mg/L	1	12/20/2010 7:07:00 P
Beryllium	0.00050	U	0.00050	0.0010	mg/L	1	12/20/2010 7:07:00 P
Cadmium	0.0010	U	0.0010	0.002	mg/L	1	12/20/2010 7:07:00 P
Calcium	676		0.500	1.00	mg/L	10	12/21/2010 1:38:00 P
Chromium	0.0050	U	0.0050	0.010	mg/L	1	12/20/2010 7:07:00 P
Cobalt	0.002	J	0.0020	0.005	mg/L	1	12/20/2010 7:07:00 P
Copper	0.0050	U	0.0050	0.010	mg/L	1	12/20/2010 7:07:00 P
Iron	0.12		0.010	0.05	mg/L	1	12/20/2010 7:07:00 P
Magnesium	261		0.500	1.00	mg/L	10	12/21/2010 1:38:00 P
Manganese	0.181		0.0020	0.010	mg/L	1	12/20/2010 7:07:00 P
Nickel	0.014		0.0050	0.010	mg/L	1	12/20/2010 7:07:00 P
Potassium	7.4		0.20	0.5	mg/L	1	12/20/2010 7:07:00 P
Silver	0.0020	U	0.0020	0.005	mg/L	1	12/20/2010 7:07:00 P
Sodium	7.0		0.10	0.2	mg/L	1	12/20/2010 7:07:00 P
Vanadium	0.0020	U	0.0020	0.005	mg/L	1	12/20/2010 7:07:00 P
Zinc	0.006	J	0.0040	0.010	mg/L	1	12/20/2010 7:07:00 P

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Laboratory Results

Geochemical Testing

Date: *12-Jan-11*

CLIENT:	CIVIL & ENVIRONMENTAL-COLUMBU	**Client Sample ID:**	B-401A
Lab Order:	G1012414		
Project:	APEX Second SA	**Collection Date:**	12/9/2010 9:45:00 AM
Lab ID:	G1012414-008	**Sampled By:**	Client
Matrix:	AQUEOUS	**DateReceived:**	12/14/2010 1:16:39 PM

Analyses	Result	Q	MDL	PQL	Units	DF	Date Analyzed
INORGANIC METALS			**EPA 200.8**				Analyst: **JEK**
Antimony	0.50	U	0.50	1.0	µg/L	1	12/16/2010 7:33:00 P
Arsenic	0.50	U	0.50	1.0	µg/L	1	12/16/2010 7:33:00 P
Lead	0.20	U	0.20	1.0	µg/L	1	12/16/2010 7:33:00 P
Selenium	1.5		0.50	1.0	µg/L	1	12/16/2010 7:33:00 P
Thallium	0.10	U	0.10	0.2	µg/L	1	12/16/2010 7:33:00 P
VOLATILE ORGANIC COMPOUNDS			**EPA 8011**				Analyst: **TEW**
1,2-Dibromo-3-chloropropane	0.0100	U	0.0100	0.0400	µg/L	1	12/16/2010 12:19:18 A
1,2-Dibromoethane	0.0100	U	0.0100	0.0400	µg/L	1	12/16/2010 12:19:18 A
Surr: 1,1,2,2-Tetrachloroethane	89.7		0	60-140	%REC	1	12/16/2010 12:19:18 A
VOLATILE ORGANIC COMPOUNDS			**EPA 8260**				Analyst: **JAW**
1,1,1,2-Tetrachloroethane	0.50	U	0.50	1.0	µg/L	1	12/15/2010 9:09:00 A
1,1,1-Trichloroethane	0.50	U	0.50	1.0	µg/L	1	12/15/2010 9:09:00 A
1,1,2,2-Tetrachloroethane	0.50	U	0.50	1.0	µg/L	1	12/15/2010 9:09:00 A
1,1,2-Trichloroethane	0.50	U	0.50	1.0	µg/L	1	12/15/2010 9:09:00 A
1,1-Dichloroethane	0.50	U	0.50	1.0	µg/L	1	12/15/2010 9:09:00 A
1,1-Dichloroethene	0.50	U	0.50	1.0	µg/L	1	12/15/2010 9:09:00 A
1,2,3-Trichloropropane	0.50	U	0.50	1.0	µg/L	1	12/15/2010 9:09:00 A
1,2-Dichlorobenzene	0.50	U	0.50	1.0	µg/L	1	12/15/2010 9:09:00 A
1,2-Dichloroethane	0.50	U	0.50	1.0	µg/L	1	12/15/2010 9:09:00 A
1,2-Dichloropropane	0.50	U	0.50	1.0	µg/L	1	12/15/2010 9:09:00 A
1,4-Dichlorobenzene	0.50	U	0.50	1.0	µg/L	1	12/15/2010 9:09:00 A
2-Hexanone	1.0	U	1.0	5.0	µg/L	1	12/15/2010 9:09:00 A
4-Methyl-2-Pentanone	0.50	U	0.50	1.0	µg/L	1	12/15/2010 9:09:00 A
Acetone	5.0	U	5.0	10	µg/L	1	12/15/2010 9:09:00 A
Acrylonitrile	2.0	U	2.0	5.0	µg/L	1	12/15/2010 9:09:00 A
Benzene	0.50	U	0.50	1.0	µg/L	1	12/15/2010 9:09:00 A
Bromochloromethane	0.50	U	0.50	1.0	µg/L	1	12/15/2010 9:09:00 A
Bromoform	0.50	U	0.50	1.0	µg/L	1	12/15/2010 9:09:00 A
Bromomethane	0.50	U	0.50	1.0	µg/L	1	12/15/2010 9:09:00 A
Carbon Disulfide	0.50	U	0.50	1.0	µg/L	1	12/15/2010 9:09:00 A
Carbon Tetrachloride	0.50	U	0.50	1.0	µg/L	1	12/15/2010 9:09:00 A
Chlorobenzene	0.50	U	0.50	1.0	µg/L	1	12/15/2010 9:09:00 A
Chlorodibromomethane	0.50	U	0.50	1.0	µg/L	1	12/15/2010 9:09:00 A
Chloroethane	0.50	U	0.50	1.0	µg/L	1	12/15/2010 9:09:00 A
Chloroform	0.50	U	0.50	1.0	µg/L	1	12/15/2010 9:09:00 A
Chloromethane	0.50	U	0.50	1.0	µg/L	1	12/15/2010 9:09:00 A
cis-1,2-Dichloroethene	0.50	U	0.50	1.0	µg/L	1	12/15/2010 9:09:00 A
cis-1,3-Dichloropropene	0.50	U	0.50	1.0	µg/L	1	12/15/2010 9:09:00 A
Dibromomethane	0.50	U	0.50	1.0	µg/L	1	12/15/2010 9:09:00 A

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Laboratory Results

Geochemical Testing

Date: *12-Jan-11*

CLIENT:	CIVIL & ENVIRONMENTAL-COLUMBU	**Client Sample ID:**	B-401A
Lab Order:	G1012414		
Project:	APEX Second SA	**Collection Date:**	12/9/2010 9:45:00 AM
Lab ID:	G1012414-008	**Sampled By:**	Client
Matrix:	AQUEOUS	**DateReceived:**	12/14/2010 1:16:39 PM

Analyses	Result	Q	MDL	PQL	Units	DF	Date Analyzed
VOLATILE ORGANIC COMPOUNDS			**EPA 8260**			Analyst: **JAW**	
Dichlorobromomethane	0.50	U	0.50	1.0	µg/L	1	12/15/2010 9:09:00 A
Ethylbenzene	0.50	U	0.50	1.0	µg/L	1	12/15/2010 9:09:00 A
Iodomethane	0.50	U	0.50	5.0	µg/L	1	12/15/2010 9:09:00 A
Methyl Ethyl Ketone	1.0	U	1.0	5.0	µg/L	1	12/15/2010 9:09:00 A
Methylene Chloride	0.50	U	0.50	1.0	µg/L	1	12/15/2010 9:09:00 A
Styrene	0.50	U	0.50	1.0	µg/L	1	12/15/2010 9:09:00 A
Tetrachloroethene	0.50	U	0.50	1.0	µg/L	1	12/15/2010 9:09:00 A
Toluene	0.50	U	0.50	1.0	µg/L	1	12/15/2010 9:09:00 A
trans-1,2-Dichloroethene	0.50	U	0.50	1.0	µg/L	1	12/15/2010 9:09:00 A
trans-1,3-Dichloropropene	0.50	U	0.50	1.0	µg/L	1	12/15/2010 9:09:00 A
trans-1,4-Dichloro-2-butene	1.0	U	1.0	2.0	µg/L	1	12/15/2010 9:09:00 A
Trichloroethene	0.50	U	0.50	1.0	µg/L	1	12/15/2010 9:09:00 A
Trichlorofluoromethane	0.50	U	0.50	1.0	µg/L	1	12/15/2010 9:09:00 A
Vinyl Acetate	0.50	U	0.50	1.0	µg/L	1	12/15/2010 9:09:00 A
Vinyl Chloride	0.50	U	0.50	1.0	µg/L	1	12/15/2010 9:09:00 A
Total Xylene	1.0	U	1.0	2.0	µg/L	1	12/15/2010 9:09:00 A
Surr: 1,2-Dichloroethane-d4	96.4		0	70-130	%REC	1	12/15/2010 9:09:00 A
Surr: 4-Bromofluorobenzene	102		0	70-130	%REC	1	12/15/2010 9:09:00 A
Surr: Dibromofluoromethane	96.7		0	70-130	%REC	1	12/15/2010 9:09:00 A
Surr: Toluene-d8	96.1		0	70-130	%REC	1	12/15/2010 9:09:00 A

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Laboratory Results

Geochemical Testing

Date: *12-Jan-11*

CLIENT:	CIVIL & ENVIRONMENTAL-COLUMBU	**Client Sample ID:**	B-403
Lab Order:	G1012414		
Project:	APEX Second SA	**Collection Date:**	12/9/2010 2:05:00 PM
Lab ID:	G1012414-009	**Sampled By:**	Client
Matrix:	AQUEOUS	**DateReceived:**	12/14/2010 1:16:39 PM

Analyses	Result	Q	MDL	PQL	Units	DF	Date Analyzed
FIELD PARAMETERS			**FIELD**			Analyst:	
pH (Field)	7.60		0		S.U.	0	12/9/2010 2:05:00 PM
Specific Conductance (Field)	1219		0		umhos/cm	0	12/9/2010 2:05:00 PM
Temperature (Field)	8.2		0		deg C	0	12/9/2010 2:05:00 PM
Turbidity (Field)	2.87		0		NTU	0	12/9/2010 2:05:00 PM
INORGANIC NON-METALS			**SM 18 2320B**			Analyst: **LNW**	
Alkalinity to pH 4.5	259		2.0	5	mg/L CaCO3	1	12/17/2010 2:33:00 P
INORGANIC NON-METALS			**SM 2540 C**			Analyst: **KLS**	
Total dissolved solids	1110		10.0	20	mg/L	1	12/15/2010 9:18:00 A
INORGANIC NON-METALS			**SM 4500-CL E**			Analyst: **SAG**	
Chloride	2.0	U	2.0	5	mg/L	1	12/21/2010 2:33:00 P
INORGANIC NON-METALS			**EPA 350.1**			Analyst: **SLY**	
Ammonia Nitrogen - Distilled	0.12		0.040	0.10	mg/L as N	1	12/28/2010 11:11:47 A
INORGANIC NON-METALS			**EPA 353.2**			Analyst: **SLY**	
Nitrate - Nitrite	0.29		0.020	0.05	mg/L as N	1	12/20/2010 9:04:52 A
INORGANIC NON METALS			**ASTM D516-02**			Analyst: **SAG**	
Sulfate	514		25.0	125	mg/L	25	12/20/2010 2:56:00 P
INORGANIC METALS			**EPA 200.7**			Analyst: **MS**	
Barium	0.033		0.0050	0.010	mg/L	1	12/20/2010 7:22:00 P
Beryllium	0.00050	U	0.00050	0.0010	mg/L	1	12/20/2010 7:22:00 P
Cadmium	0.0010	U	0.0010	0.002	mg/L	1	12/20/2010 7:22:00 P
Calcium	227		0.050	0.10	mg/L	1	12/20/2010 7:22:00 P
Chromium	0.0050	U	0.0050	0.010	mg/L	1	12/20/2010 7:22:00 P
Cobalt	0.0020	U	0.0020	0.005	mg/L	1	12/20/2010 7:22:00 P
Copper	0.0050	U	0.0050	0.010	mg/L	1	12/20/2010 7:22:00 P
Iron	0.13		0.010	0.05	mg/L	1	12/20/2010 7:22:00 P
Magnesium	71.8		0.050	0.10	mg/L	1	12/20/2010 7:22:00 P
Manganese	0.037		0.0020	0.010	mg/L	1	12/20/2010 7:22:00 P
Nickel	0.0050	U	0.0050	0.010	mg/L	1	12/20/2010 7:22:00 P
Potassium	4.8		0.20	0.5	mg/L	1	12/20/2010 7:22:00 P
Silver	0.0020	U	0.0020	0.005	mg/L	1	12/20/2010 7:22:00 P
Sodium	58.4		0.10	0.2	mg/L	1	12/20/2010 7:22:00 P
Vanadium	0.0020	U	0.0020	0.005	mg/L	1	12/20/2010 7:22:00 P
Zinc	0.005	J	0.0040	0.010	mg/L	1	12/20/2010 7:22:00 P

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Geochemical Testing

Date: *12-Jan-11*

CLIENT:	CIVIL & ENVIRONMENTAL-COLUMBU	**Client Sample ID:**	B-403
Lab Order:	G1012414		
Project:	APEX Second SA	**Collection Date:**	12/9/2010 2:05:00 PM
Lab ID:	G1012414-009	**Sampled By:**	Client
Matrix:	AQUEOUS	**DateReceived:**	12/14/2010 1:16:39 PM

Analyses	Result	Q	MDL	PQL	Units	DF	Date Analyzed
INORGANIC METALS			**EPA 200.8**				Analyst: **JEK**
Antimony	0.50	U	0.50	1.0	µg/L	1	12/16/2010 7:38:00 P
Arsenic	0.50	U	0.50	1.0	µg/L	1	12/16/2010 7:38:00 P
Lead	0.20	U	0.20	1.0	µg/L	1	12/16/2010 7:38:00 P
Selenium	0.50	U	0.50	1.0	µg/L	1	12/16/2010 7:38:00 P
Thallium	0.10	U	0.10	0.2	µg/L	1	12/16/2010 7:38:00 P
VOLATILE ORGANIC COMPOUNDS			**EPA 8011**				Analyst: **TEW**
1,2-Dibromo-3-chloropropane	0.0100	U	0.0100	0.0400	µg/L	1	12/16/2010 12:40:54 A
1,2-Dibromoethane	0.0100	U	0.0100	0.0400	µg/L	1	12/16/2010 12:40:54 A
Surr: 1,1,2,2-Tetrachloroethane	91.9		0	60-140	%REC	1	12/16/2010 12:40:54 A
VOLATILE ORGANIC COMPOUNDS			**EPA 8260**				Analyst: **JAW**
1,1,1,2-Tetrachloroethane	0.50	U	0.50	1.0	µg/L	1	12/15/2010 9:45:00 A
1,1,1-Trichloroethane	0.50	U	0.50	1.0	µg/L	1	12/15/2010 9:45:00 A
1,1,2,2-Tetrachloroethane	0.50	U	0.50	1.0	µg/L	1	12/15/2010 9:45:00 A
1,1,2-Trichloroethane	0.50	U	0.50	1.0	µg/L	1	12/15/2010 9:45:00 A
1,1-Dichloroethane	0.50	U	0.50	1.0	µg/L	1	12/15/2010 9:45:00 A
1,1-Dichloroethene	0.50	U	0.50	1.0	µg/L	1	12/15/2010 9:45:00 A
1,2,3-Trichloropropane	0.50	U	0.50	1.0	µg/L	1	12/15/2010 9:45:00 A
1,2-Dichlorobenzene	0.50	U	0.50	1.0	µg/L	1	12/15/2010 9:45:00 A
1,2-Dichloroethane	0.50	U	0.50	1.0	µg/L	1	12/15/2010 9:45:00 A
1,2-Dichloropropane	0.50	U	0.50	1.0	µg/L	1	12/15/2010 9:45:00 A
1,4-Dichlorobenzene	0.50	U	0.50	1.0	µg/L	1	12/15/2010 9:45:00 A
2-Hexanone	1.0	U	1.0	5.0	µg/L	1	12/15/2010 9:45:00 A
4-Methyl-2-Pentanone	0.50	U	0.50	1.0	µg/L	1	12/15/2010 9:45:00 A
Acetone	5.0	U	5.0	10	µg/L	1	12/15/2010 9:45:00 A
Acrylonitrile	2.0	U	2.0	5.0	µg/L	1	12/15/2010 9:45:00 A
Benzene	0.50	U	0.50	1.0	µg/L	1	12/15/2010 9:45:00 A
Bromochloromethane	0.50	U	0.50	1.0	µg/L	1	12/15/2010 9:45:00 A
Bromoform	0.50	U	0.50	1.0	µg/L	1	12/15/2010 9:45:00 A
Bromomethane	0.50	U	0.50	1.0	µg/L	1	12/15/2010 9:45:00 A
Carbon Disulfide	0.50	U	0.50	1.0	µg/L	1	12/15/2010 9:45:00 A
Carbon Tetrachloride	0.50	U	0.50	1.0	µg/L	1	12/15/2010 9:45:00 A
Chlorobenzene	0.50	U	0.50	1.0	µg/L	1	12/15/2010 9:45:00 A
Chlorodibromomethane	0.50	U	0.50	1.0	µg/L	1	12/15/2010 9:45:00 A
Chloroethane	0.50	U	0.50	1.0	µg/L	1	12/15/2010 9:45:00 A
Chloroform	0.50	U	0.50	1.0	µg/L	1	12/15/2010 9:45:00 A
Chloromethane	0.50	U	0.50	1.0	µg/L	1	12/15/2010 9:45:00 A
cis-1,2-Dichloroethene	0.50	U	0.50	1.0	µg/L	1	12/15/2010 9:45:00 A
cis-1,3-Dichloropropene	0.50	U	0.50	1.0	µg/L	1	12/15/2010 9:45:00 A
Dibromomethane	0.50	U	0.50	1.0	µg/L	1	12/15/2010 9:45:00 A

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Geochemical Testing

Date: *12-Jan-11*

CLIENT:	CIVIL & ENVIRONMENTAL-COLUMBU	**Client Sample ID:**	B-403
Lab Order:	G1012414		
Project:	APEX Second SA	**Collection Date:**	12/9/2010 2:05:00 PM
Lab ID:	G1012414-009	**Sampled By:**	Client
Matrix:	AQUEOUS	**DateReceived:**	12/14/2010 1:16:39 PM

Analyses	Result	Q	MDL	PQL	Units	DF	Date Analyzed
VOLATILE ORGANIC COMPOUNDS			**EPA 8260**			Analyst: **JAW**	
Dichlorobromomethane	0.50	U	0.50	1.0	µg/L	1	12/15/2010 9:45:00 A
Ethylbenzene	0.50	U	0.50	1.0	µg/L	1	12/15/2010 9:45:00 A
Iodomethane	0.50	U	0.50	5.0	µg/L	1	12/15/2010 9:45:00 A
Methyl Ethyl Ketone	1.0	U	1.0	5.0	µg/L	1	12/15/2010 9:45:00 A
Methylene Chloride	0.50	U	0.50	1.0	µg/L	1	12/15/2010 9:45:00 A
Styrene	0.50	U	0.50	1.0	µg/L	1	12/15/2010 9:45:00 A
Tetrachloroethene	0.50	U	0.50	1.0	µg/L	1	12/15/2010 9:45:00 A
Toluene	0.50	U	0.50	1.0	µg/L	1	12/15/2010 9:45:00 A
trans-1,2-Dichloroethene	0.50	U	0.50	1.0	µg/L	1	12/15/2010 9:45:00 A
trans-1,3-Dichloropropene	0.50	U	0.50	1.0	µg/L	1	12/15/2010 9:45:00 A
trans-1,4-Dichloro-2-butene	1.0	U	1.0	2.0	µg/L	1	12/15/2010 9:45:00 A
Trichloroethene	0.50	U	0.50	1.0	µg/L	1	12/15/2010 9:45:00 A
Trichlorofluoromethane	0.50	U	0.50	1.0	µg/L	1	12/15/2010 9:45:00 A
Vinyl Acetate	0.50	U	0.50	1.0	µg/L	1	12/15/2010 9:45:00 A
Vinyl Chloride	0.50	U	0.50	1.0	µg/L	1	12/15/2010 9:45:00 A
Total Xylene	1.0	U	1.0	2.0	µg/L	1	12/15/2010 9:45:00 A
Surr: 1,2-Dichloroethane-d4	104		0	70-130	%REC	1	12/15/2010 9:45:00 A
Surr: 4-Bromofluorobenzene	97.6		0	70-130	%REC	1	12/15/2010 9:45:00 A
Surr: Dibromofluoromethane	100		0	70-130	%REC	1	12/15/2010 9:45:00 A
Surr: Toluene-d8	99.0		0	70-130	%REC	1	12/15/2010 9:45:00 A

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Laboratory Results

Geochemical Testing

Date: *12-Jan-11*

CLIENT:	CIVIL & ENVIRONMENTAL-COLUMBU	**Client Sample ID:**	Trip Blank
Lab Order:	G1012414		
Project:	APEX Second SA	**Collection Date:**	12/9/2010
Lab ID:	G1012414-010	**Sampled By:**	Client
Matrix:	TRIP BLANK	**DateReceived:**	12/14/2010 1:16:39 PM

Analyses	Result	Q	MDL	PQL	Units	DF	Date Analyzed
VOLATILE ORGANIC COMPOUNDS			**EPA 8011**				Analyst: **TEW**
1,2-Dibromo-3-chloropropane	0.0100	U	0.0100	0.0400	µg/L	1	12/16/2010 1:02:32 A
1,2-Dibromoethane	0.0100	U	0.0100	0.0400	µg/L	1	12/16/2010 1:02:32 A
Surr: 1,1,2,2-Tetrachloroethane	92.3		0	60-140	%REC	1	12/16/2010 1:02:32 A
VOLATILE ORGANIC COMPOUNDS			**EPA 8260**				Analyst: **SJM**
1,1,1,2-Tetrachloroethane	0.50	U	0.50	1.0	µg/L	1	12/15/2010 7:50:00 A
1,1,1-Trichloroethane	0.50	U	0.50	1.0	µg/L	1	12/15/2010 7:50:00 A
1,1,2,2-Tetrachloroethane	0.50	U	0.50	1.0	µg/L	1	12/15/2010 7:50:00 A
1,1,2-Trichloroethane	0.50	U	0.50	1.0	µg/L	1	12/15/2010 7:50:00 A
1,1-Dichloroethane	0.50	U	0.50	1.0	µg/L	1	12/15/2010 7:50:00 A
1,1-Dichloroethene	0.50	U	0.50	1.0	µg/L	1	12/15/2010 7:50:00 A
1,2,3-Trichloropropane	0.50	U	0.50	1.0	µg/L	1	12/15/2010 7:50:00 A
1,2-Dichlorobenzene	0.50	U	0.50	1.0	µg/L	1	12/15/2010 7:50:00 A
1,2-Dichloroethane	0.50	U	0.50	1.0	µg/L	1	12/15/2010 7:50:00 A
1,2-Dichloropropane	0.50	U	0.50	1.0	µg/L	1	12/15/2010 7:50:00 A
1,4-Dichlorobenzene	0.50	U	0.50	1.0	µg/L	1	12/15/2010 7:50:00 A
2-Hexanone	1.0	U	1.0	5.0	µg/L	1	12/15/2010 7:50:00 A
4-Methyl-2-Pentanone	0.50	U	0.50	1.0	µg/L	1	12/15/2010 7:50:00 A
Acetone	5.0	U	5.0	10	µg/L	1	12/15/2010 7:50:00 A
Acrylonitrile	2.0	U	2.0	5.0	µg/L	1	12/15/2010 7:50:00 A
Benzene	0.50	U	0.50	1.0	µg/L	1	12/15/2010 7:50:00 A
Bromochloromethane	0.50	U	0.50	1.0	µg/L	1	12/15/2010 7:50:00 A
Bromoform	0.50	U	0.50	1.0	µg/L	1	12/15/2010 7:50:00 A
Bromomethane	0.50	U	0.50	1.0	µg/L	1	12/15/2010 7:50:00 A
Carbon Disulfide	0.50	U	0.50	1.0	µg/L	1	12/15/2010 7:50:00 A
Carbon Tetrachloride	0.50	U	0.50	1.0	µg/L	1	12/15/2010 7:50:00 A
Chlorobenzene	0.50	U	0.50	1.0	µg/L	1	12/15/2010 7:50:00 A
Chlorodibromomethane	0.50	U	0.50	1.0	µg/L	1	12/15/2010 7:50:00 A
Chloroethane	0.50	U	0.50	1.0	µg/L	1	12/15/2010 7:50:00 A
Chloroform	0.50	U	0.50	1.0	µg/L	1	12/15/2010 7:50:00 A
Chloromethane	0.50	U	0.50	1.0	µg/L	1	12/15/2010 7:50:00 A
cis-1,2-Dichloroethene	0.50	U	0.50	1.0	µg/L	1	12/15/2010 7:50:00 A
cis-1,3-Dichloropropene	0.50	U	0.50	1.0	µg/L	1	12/15/2010 7:50:00 A
Dibromomethane	0.50	U	0.50	1.0	µg/L	1	12/15/2010 7:50:00 A
Dichlorobromomethane	0.50	U	0.50	1.0	µg/L	1	12/15/2010 7:50:00 A
Ethylbenzene	0.50	U	0.50	1.0	µg/L	1	12/15/2010 7:50:00 A
Iodomethane	0.50	U	0.50	5.0	µg/L	1	12/15/2010 7:50:00 A
Methyl Ethyl Ketone	1.0	U	1.0	5.0	µg/L	1	12/15/2010 7:50:00 A
Methylene Chloride	0.50	U	0.50	1.0	µg/L	1	12/15/2010 7:50:00 A
Styrene	0.50	U	0.50	1.0	µg/L	1	12/15/2010 7:50:00 A
Tetrachloroethene	0.50	U	0.50	1.0	µg/L	1	12/15/2010 7:50:00 A

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Geochemical Testing

Date: *12-Jan-11*

CLIENT:	CIVIL & ENVIRONMENTAL-COLUMBU	**Client Sample ID:**	Trip Blank
Lab Order:	G1012414		
Project:	APEX Second SA	**Collection Date:**	12/9/2010
Lab ID:	G1012414-010	**Sampled By:**	Client
Matrix:	TRIP BLANK	**DateReceived:**	12/14/2010 1:16:39 PM

Analyses	Result	Q	MDL	PQL	Units	DF	Date Analyzed
VOLATILE ORGANIC COMPOUNDS			**EPA 8260**			Analyst: **SJM**	
Toluene	0.50	U	0.50	1.0	µg/L	1	12/15/2010 7:50:00 A
trans-1,2-Dichloroethene	0.50	U	0.50	1.0	µg/L	1	12/15/2010 7:50:00 A
trans-1,3-Dichloropropene	0.50	U	0.50	1.0	µg/L	1	12/15/2010 7:50:00 A
trans-1,4-Dichloro-2-butene	1.0	U	1.0	2.0	µg/L	1	12/15/2010 7:50:00 A
Trichloroethene	0.50	U	0.50	1.0	µg/L	1	12/15/2010 7:50:00 A
Trichlorofluoromethane	0.50	U	0.50	1.0	µg/L	1	12/15/2010 7:50:00 A
Vinyl Acetate	0.50	U	0.50	1.0	µg/L	1	12/15/2010 7:50:00 A
Vinyl Chloride	0.50	U	0.50	1.0	µg/L	1	12/15/2010 7:50:00 A
Total Xylene	1.0	U	1.0	2.0	µg/L	1	12/15/2010 7:50:00 A
Surr: 1,2-Dichloroethane-d4	97.9		0	70-130	%REC	1	12/15/2010 7:50:00 A
Surr: 4-Bromofluorobenzene	111		0	70-130	%REC	1	12/15/2010 7:50:00 A
Surr: Dibromofluoromethane	87.5		0	70-130	%REC	1	12/15/2010 7:50:00 A
Surr: Toluene-d8	97.8		0	70-130	%REC	1	12/15/2010 7:50:00 A

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Laboratory Results

Geochemical Testing

Date: *12-Jan-11*

CLIENT:	CIVIL & ENVIRONMENTAL-COLUMBU	**Client Sample ID:**	B-403S
Lab Order:	G1012414		
Project:	APEX Second SA	**Collection Date:**	12/9/2010 1:10:00 PM
Lab ID:	G1012414-011	**Sampled By:**	Client
Matrix:	AQUEOUS	**DateReceived:**	12/14/2010 1:16:39 PM

Analyses	Result	Q	MDL	PQL	Units	DF	Date Analyzed
FIELD PARAMETERS			**FIELD**			Analyst:	
pH (Field)	8.34		0		S.U.	0	12/9/2010 1:10:00 PM
Specific Conductance (Field)	1038		0		umhos/cm	0	12/9/2010 1:10:00 PM
Temperature (Field)	8.3		0		deg C	0	12/9/2010 1:10:00 PM
Turbidity (Field)	0.76		0		NTU	0	12/9/2010 1:10:00 PM
INORGANIC NON-METALS			**SM 18 2320B**			Analyst: **LNW**	
Alkalinity to pH 4.5	533		2.0	5	mg/L CaCO3	1	12/17/2010 2:52:00 P
INORGANIC NON-METALS			**SM 2540 C**			Analyst: **KLS**	
Total dissolved solids	754		10.0	20	mg/L	1	12/15/2010 9:19:00 A
INORGANIC NON-METALS			**SM 4500-CL E**			Analyst: **SAG**	
Chloride	3	J	2.0	5	mg/L	1	12/21/2010 2:33:00 P
INORGANIC NON-METALS			**EPA 350.1**			Analyst: **SLY**	
Ammonia Nitrogen - Distilled	0.30		0.040	0.10	mg/L as N	1	12/28/2010 11:15:12 A
INORGANIC NON-METALS			**EPA 353.2**			Analyst: **SLY**	
Nitrate - Nitrite	0.08		0.020	0.05	mg/L as N	1	12/20/2010 9:08:14 A
INORGANIC NON METALS			**ASTM D516-02**			Analyst: **SAG**	
Sulfate	148		10.0	50	mg/L	10	12/20/2010 2:56:00 P
INORGANIC METALS			**EPA 200.7**			Analyst: **MS**	
Barium	0.058		0.0050	0.010	mg/L	1	12/20/2010 7:28:00 P
Beryllium	0.00050	U	0.00050	0.0010	mg/L	1	12/20/2010 7:28:00 P
Cadmium	0.0010	U	0.0010	0.002	mg/L	1	12/20/2010 7:28:00 P
Calcium	5.61		0.050	0.10	mg/L	1	12/20/2010 7:28:00 P
Chromium	0.0050	U	0.0050	0.010	mg/L	1	12/20/2010 7:28:00 P
Cobalt	0.0020	U	0.0020	0.005	mg/L	1	12/20/2010 7:28:00 P
Copper	0.0050	U	0.0050	0.010	mg/L	1	12/20/2010 7:28:00 P
Iron	0.010	U	0.010	0.05	mg/L	1	12/20/2010 7:28:00 P
Magnesium	1.29		0.050	0.10	mg/L	1	12/20/2010 7:28:00 P
Manganese	0.018		0.0020	0.010	mg/L	1	12/20/2010 7:28:00 P
Nickel	0.0050	U	0.0050	0.010	mg/L	1	12/20/2010 7:28:00 P
Potassium	2.2		0.20	0.5	mg/L	1	12/20/2010 7:28:00 P
Silver	0.0020	U	0.0020	0.005	mg/L	1	12/20/2010 7:28:00 P
Sodium	332		0.10	0.2	mg/L	1	12/20/2010 7:28:00 P
Vanadium	0.0020	U	0.0020	0.005	mg/L	1	12/20/2010 7:28:00 P
Zinc	0.0040	U	0.0040	0.010	mg/L	1	12/20/2010 7:28:00 P

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I.D. 56-00306 PA DEP

Laboratory Results

Geochemical Testing

Date: *12-Jan-11*

CLIENT:	CIVIL & ENVIRONMENTAL-COLUMBU	**Client Sample ID:**	B-403S
Lab Order:	G1012414		
Project:	APEX Second SA	**Collection Date:**	12/9/2010 1:10:00 PM
Lab ID:	G1012414-011	**Sampled By:**	Client
Matrix:	AQUEOUS	**DateReceived:**	12/14/2010 1:16:39 PM

Analyses	Result	Q	MDL	PQL	Units	DF	Date Analyzed
INORGANIC METALS			**EPA 200.8**				Analyst: **JEK**
Antimony	0.50	U	0.50	1.0	µg/L	1	12/16/2010 7:43:00 P
Arsenic	0.9	J	0.50	1.0	µg/L	1	12/16/2010 7:43:00 P
Lead	0.20	U	0.20	1.0	µg/L	1	12/16/2010 7:43:00 P
Selenium	0.50	U	0.50	1.0	µg/L	1	12/16/2010 7:43:00 P
Thallium	0.10	U	0.10	0.2	µg/L	1	12/16/2010 7:43:00 P
VOLATILE ORGANIC COMPOUNDS			**EPA 8011**				Analyst: **TEW**
1,2-Dibromo-3-chloropropane	0.0100	U	0.0100	0.0400	µg/L	1	12/16/2010 1:24:08 A
1,2-Dibromoethane	0.0100	U	0.0100	0.0400	µg/L	1	12/16/2010 1:24:08 A
Surr: 1,1,2,2-Tetrachloroethane	90.5		0	60-140	%REC	1	12/16/2010 1:24:08 A
VOLATILE ORGANIC COMPOUNDS			**EPA 8260**				Analyst: **SJM**
1,1,1,2-Tetrachloroethane	0.50	U	0.50	1.0	µg/L	1	12/15/2010 8:25:00 A
1,1,1-Trichloroethane	0.50	U	0.50	1.0	µg/L	1	12/15/2010 8:25:00 A
1,1,2,2-Tetrachloroethane	0.50	U	0.50	1.0	µg/L	1	12/15/2010 8:25:00 A
1,1,2-Trichloroethane	0.50	U	0.50	1.0	µg/L	1	12/15/2010 8:25:00 A
1,1-Dichloroethane	0.50	U	0.50	1.0	µg/L	1	12/15/2010 8:25:00 A
1,1-Dichloroethene	0.50	U	0.50	1.0	µg/L	1	12/15/2010 8:25:00 A
1,2,3-Trichloropropane	0.50	U	0.50	1.0	µg/L	1	12/15/2010 8:25:00 A
1,2-Dichlorobenzene	0.50	U	0.50	1.0	µg/L	1	12/15/2010 8:25:00 A
1,2-Dichloroethane	0.50	U	0.50	1.0	µg/L	1	12/15/2010 8:25:00 A
1,2-Dichloropropane	0.50	U	0.50	1.0	µg/L	1	12/15/2010 8:25:00 A
1,4-Dichlorobenzene	0.50	U	0.50	1.0	µg/L	1	12/15/2010 8:25:00 A
2-Hexanone	1.0	U	1.0	5.0	µg/L	1	12/15/2010 8:25:00 A
4-Methyl-2-Pentanone	0.50	U	0.50	1.0	µg/L	1	12/15/2010 8:25:00 A
Acetone	5.0	U	5.0	10	µg/L	1	12/15/2010 8:25:00 A
Acrylonitrile	2.0	U	2.0	5.0	µg/L	1	12/15/2010 8:25:00 A
Benzene	0.50	U	0.50	1.0	µg/L	1	12/15/2010 8:25:00 A
Bromochloromethane	0.50	U	0.50	1.0	µg/L	1	12/15/2010 8:25:00 A
Bromoform	0.50	U	0.50	1.0	µg/L	1	12/15/2010 8:25:00 A
Bromomethane	0.50	U	0.50	1.0	µg/L	1	12/15/2010 8:25:00 A
Carbon Disulfide	0.50	U	0.50	1.0	µg/L	1	12/15/2010 8:25:00 A
Carbon Tetrachloride	0.50	U	0.50	1.0	µg/L	1	12/15/2010 8:25:00 A
Chlorobenzene	0.50	U	0.50	1.0	µg/L	1	12/15/2010 8:25:00 A
Chlorodibromomethane	0.50	U	0.50	1.0	µg/L	1	12/15/2010 8:25:00 A
Chloroethane	0.50	U	0.50	1.0	µg/L	1	12/15/2010 8:25:00 A
Chloroform	0.50	U	0.50	1.0	µg/L	1	12/15/2010 8:25:00 A
Chloromethane	0.50	U	0.50	1.0	µg/L	1	12/15/2010 8:25:00 A
cis-1,2-Dichloroethene	0.50	U	0.50	1.0	µg/L	1	12/15/2010 8:25:00 A
cis-1,3-Dichloropropene	0.50	U	0.50	1.0	µg/L	1	12/15/2010 8:25:00 A
Dibromomethane	0.50	U	0.50	1.0	µg/L	1	12/15/2010 8:25:00 A

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Laboratory Results

Geochemical Testing

Date: *12-Jan-11*

CLIENT:	CIVIL & ENVIRONMENTAL-COLUMBU	**Client Sample ID:**	B-403S
Lab Order:	G1012414		
Project:	APEX Second SA	**Collection Date:**	12/9/2010 1:10:00 PM
Lab ID:	G1012414-011	**Sampled By:**	Client
Matrix:	AQUEOUS	**DateReceived:**	12/14/2010 1:16:39 PM

Analyses	Result	Q	MDL	PQL	Units	DF	Date Analyzed
VOLATILE ORGANIC COMPOUNDS			**EPA 8260**			Analyst: **SJM**	
Dichlorobromomethane	0.50	U	0.50	1.0	µg/L	1	12/15/2010 8:25:00 A
Ethylbenzene	0.50	U	0.50	1.0	µg/L	1	12/15/2010 8:25:00 A
Iodomethane	0.50	U	0.50	5.0	µg/L	1	12/15/2010 8:25:00 A
Methyl Ethyl Ketone	1.0	U	1.0	5.0	µg/L	1	12/15/2010 8:25:00 A
Methylene Chloride	0.50	U	0.50	1.0	µg/L	1	12/15/2010 8:25:00 A
Styrene	0.50	U	0.50	1.0	µg/L	1	12/15/2010 8:25:00 A
Tetrachloroethene	0.50	U	0.50	1.0	µg/L	1	12/15/2010 8:25:00 A
Toluene	0.50	U	0.50	1.0	µg/L	1	12/15/2010 8:25:00 A
trans-1,2-Dichloroethene	0.50	U	0.50	1.0	µg/L	1	12/15/2010 8:25:00 A
trans-1,3-Dichloropropene	0.50	U	0.50	1.0	µg/L	1	12/15/2010 8:25:00 A
trans-1,4-Dichloro-2-butene	1.0	U	1.0	2.0	µg/L	1	12/15/2010 8:25:00 A
Trichloroethene	0.50	U	0.50	1.0	µg/L	1	12/15/2010 8:25:00 A
Trichlorofluoromethane	0.50	U	0.50	1.0	µg/L	1	12/15/2010 8:25:00 A
Vinyl Acetate	0.50	U	0.50	1.0	µg/L	1	12/15/2010 8:25:00 A
Vinyl Chloride	0.50	U	0.50	1.0	µg/L	1	12/15/2010 8:25:00 A
Total Xylene	1.0	U	1.0	2.0	µg/L	1	12/15/2010 8:25:00 A
Surr: 1,2-Dichloroethane-d4	101		0	70-130	%REC	1	12/15/2010 8:25:00 A
Surr: 4-Bromofluorobenzene	115		0	70-130	%REC	1	12/15/2010 8:25:00 A
Surr: Dibromofluoromethane	88.1		0	70-130	%REC	1	12/15/2010 8:25:00 A
Surr: Toluene-d8	97.7		0	70-130	%REC	1	12/15/2010 8:25:00 A

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Laboratory Results

Geochemical Testing

Date: *12-Jan-11*

CLIENT:	CIVIL & ENVIRONMENTAL-COLUMBU	**Client Sample ID:**	SHAUDS-2
Lab Order:	G1012414		
Project:	APEX Second SA	**Collection Date:**	12/9/2010 11:25:00 AM
Lab ID:	G1012414-012	**Sampled By:**	Client
Matrix:	AQUEOUS	**DateReceived:**	12/14/2010 1:16:39 PM

Analyses	Result	Q	MDL	PQL	Units	DF	Date Analyzed
FIELD PARAMETERS			**FIELD**			Analyst:	
pH (Field)	6.92		0		S.U.	0	12/9/2010 11:25:00 A
Specific Conductance (Field)	1982		0		umhos/cm	0	12/9/2010 11:25:00 A
Temperature (Field)	8.4		0		deg C	0	12/9/2010 11:25:00 A
Turbidity (Field)	16.4		0		NTU	0	12/9/2010 11:25:00 A
INORGANIC NON-METALS			**SM 18 2320B**			Analyst: **LNW**	
Alkalinity to pH 4.5	314		2.0	5	mg/L CaCO3	1	12/17/2010 3:05:00 P
INORGANIC NON-METALS			**SM 2540 C**			Analyst: **KLS**	
Total dissolved solids	2160		10.0	20	mg/L	1	12/15/2010 9:19:00 A
INORGANIC NON-METALS			**SM 4500-CL E**			Analyst: **SAG**	
Chloride	32		2.0	5	mg/L	1	12/21/2010 2:33:00 P
INORGANIC NON-METALS			**EPA 350.1**			Analyst: **SLY**	
Ammonia Nitrogen - Distilled	0.11		0.040	0.10	mg/L as N	1	12/28/2010 11:16:20 A
INORGANIC NON-METALS			**EPA 353.2**			Analyst: **SLY**	
Nitrate - Nitrite	1.6		0.020	0.05	mg/L as N	1	12/20/2010 9:09:23 A
INORGANIC NON METALS			**ASTM D516-02**			Analyst: **SAG**	
Sulfate	1040		100	500	mg/L	100	12/20/2010 2:56:00 P
INORGANIC METALS			**EPA 200.7**			Analyst: **MS**	
Barium	0.021		0.0050	0.010	mg/L	1	12/20/2010 7:40:00 P
Beryllium	0.00050	U	0.00050	0.0010	mg/L	1	12/20/2010 7:40:00 P
Cadmium	0.0010	U	0.0010	0.002	mg/L	1	12/20/2010 7:40:00 P
Calcium	441		0.050	0.10	mg/L	1	12/20/2010 7:40:00 P
Chromium	0.0050	U	0.0050	0.010	mg/L	1	12/20/2010 7:40:00 P
Cobalt	0.016		0.0020	0.005	mg/L	1	12/20/2010 7:40:00 P
Copper	0.0050	U	0.0050	0.010	mg/L	1	12/20/2010 7:40:00 P
Iron	1.37		0.010	0.05	mg/L	1	12/20/2010 7:40:00 P
Magnesium	145		0.050	0.10	mg/L	1	12/20/2010 7:40:00 P
Manganese	1.66		0.0020	0.010	mg/L	1	12/20/2010 7:40:00 P
Nickel	0.042		0.0050	0.010	mg/L	1	12/20/2010 7:40:00 P
Potassium	8.2		0.20	0.5	mg/L	1	12/20/2010 7:40:00 P
Silver	0.0020	U	0.0020	0.005	mg/L	1	12/20/2010 7:40:00 P
Sodium	43.5		0.10	0.2	mg/L	1	12/20/2010 7:40:00 P
Vanadium	0.0020	U	0.0020	0.005	mg/L	1	12/20/2010 7:40:00 P
Zinc	0.020		0.0040	0.010	mg/L	1	12/20/2010 7:40:00 P

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Laboratory Results

Geochemical Testing

Date: *12-Jan-11*

CLIENT:	CIVIL & ENVIRONMENTAL-COLUMBU	**Client Sample ID:**	SHAUDS-2
Lab Order:	G1012414		
Project:	APEX Second SA	**Collection Date:**	12/9/2010 11:25:00 AM
Lab ID:	G1012414-012	**Sampled By:**	Client
Matrix:	AQUEOUS	**DateReceived:**	12/14/2010 1:16:39 PM

Analyses	Result	Q	MDL	PQL	Units	DF	Date Analyzed
INORGANIC METALS			**EPA 200.8**				Analyst: **JEK**
Antimony	0.50	U	0.50	1.0	µg/L	1	12/16/2010 7:48:00 P
Arsenic	0.50	U	0.50	1.0	µg/L	1	12/16/2010 7:48:00 P
Lead	0.20	U	0.20	1.0	µg/L	1	12/16/2010 7:48:00 P
Selenium	4.6		0.50	1.0	µg/L	1	12/16/2010 7:48:00 P
Thallium	0.10	U	0.10	0.2	µg/L	1	12/16/2010 7:48:00 P
VOLATILE ORGANIC COMPOUNDS			**EPA 8011**				Analyst: **TEW**
1,2-Dibromo-3-chloropropane	0.0100	U	0.0100	0.0400	µg/L	1	12/16/2010 1:45:41 A
1,2-Dibromoethane	0.0100	U	0.0100	0.0400	µg/L	1	12/16/2010 1:45:41 A
Surr: 1,1,2,2-Tetrachloroethane	88.6		0	60-140	%REC	1	12/16/2010 1:45:41 A
VOLATILE ORGANIC COMPOUNDS			**EPA 8260**				Analyst: **SJM**
1,1,1,2-Tetrachloroethane	0.50	U	0.50	1.0	µg/L	1	12/15/2010 8:59:00 A
1,1,1-Trichloroethane	0.50	U	0.50	1.0	µg/L	1	12/15/2010 8:59:00 A
1,1,2,2-Tetrachloroethane	0.50	U	0.50	1.0	µg/L	1	12/15/2010 8:59:00 A
1,1,2-Trichloroethane	0.50	U	0.50	1.0	µg/L	1	12/15/2010 8:59:00 A
1,1-Dichloroethane	0.50	U	0.50	1.0	µg/L	1	12/15/2010 8:59:00 A
1,1-Dichloroethene	0.50	U	0.50	1.0	µg/L	1	12/15/2010 8:59:00 A
1,2,3-Trichloropropane	0.50	U	0.50	1.0	µg/L	1	12/15/2010 8:59:00 A
1,2-Dichlorobenzene	0.50	U	0.50	1.0	µg/L	1	12/15/2010 8:59:00 A
1,2-Dichloroethane	0.50	U	0.50	1.0	µg/L	1	12/15/2010 8:59:00 A
1,2-Dichloropropane	0.50	U	0.50	1.0	µg/L	1	12/15/2010 8:59:00 A
1,4-Dichlorobenzene	0.50	U	0.50	1.0	µg/L	1	12/15/2010 8:59:00 A
2-Hexanone	1.0	U	1.0	5.0	µg/L	1	12/15/2010 8:59:00 A
4-Methyl-2-Pentanone	0.50	U	0.50	1.0	µg/L	1	12/15/2010 8:59:00 A
Acetone	5.0	U	5.0	10	µg/L	1	12/15/2010 8:59:00 A
Acrylonitrile	2.0	U	2.0	5.0	µg/L	1	12/15/2010 8:59:00 A
Benzene	0.50	U	0.50	1.0	µg/L	1	12/15/2010 8:59:00 A
Bromochloromethane	0.50	U	0.50	1.0	µg/L	1	12/15/2010 8:59:00 A
Bromoform	0.50	U	0.50	1.0	µg/L	1	12/15/2010 8:59:00 A
Bromomethane	0.50	U	0.50	1.0	µg/L	1	12/15/2010 8:59:00 A
Carbon Disulfide	0.50	U	0.50	1.0	µg/L	1	12/15/2010 8:59:00 A
Carbon Tetrachloride	0.50	U	0.50	1.0	µg/L	1	12/15/2010 8:59:00 A
Chlorobenzene	0.50	U	0.50	1.0	µg/L	1	12/15/2010 8:59:00 A
Chlorodibromomethane	0.50	U	0.50	1.0	µg/L	1	12/15/2010 8:59:00 A
Chloroethane	0.50	U	0.50	1.0	µg/L	1	12/15/2010 8:59:00 A
Chloroform	0.50	U	0.50	1.0	µg/L	1	12/15/2010 8:59:00 A
Chloromethane	0.50	U	0.50	1.0	µg/L	1	12/15/2010 8:59:00 A
cis-1,2-Dichloroethene	0.50	U	0.50	1.0	µg/L	1	12/15/2010 8:59:00 A
cis-1,3-Dichloropropene	0.50	U	0.50	1.0	µg/L	1	12/15/2010 8:59:00 A
Dibromomethane	0.50	U	0.50	1.0	µg/L	1	12/15/2010 8:59:00 A

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Laboratory Results

Geochemical Testing

Date: *12-Jan-11*

CLIENT:	CIVIL & ENVIRONMENTAL-COLUMBU	**Client Sample ID:**	SHAUDS-2
Lab Order:	G1012414		
Project:	APEX Second SA	**Collection Date:**	12/9/2010 11:25:00 AM
Lab ID:	G1012414-012	**Sampled By:**	Client
Matrix:	AQUEOUS	**DateReceived:**	12/14/2010 1:16:39 PM

Analyses	Result	Q	MDL	PQL	Units	DF	Date Analyzed
VOLATILE ORGANIC COMPOUNDS			**EPA 8260**			Analyst: **SJM**	
Dichlorobromomethane	0.50	U	0.50	1.0	µg/L	1	12/15/2010 8:59:00 A
Ethylbenzene	0.50	U	0.50	1.0	µg/L	1	12/15/2010 8:59:00 A
Iodomethane	0.50	U	0.50	5.0	µg/L	1	12/15/2010 8:59:00 A
Methyl Ethyl Ketone	1.0	U	1.0	5.0	µg/L	1	12/15/2010 8:59:00 A
Methylene Chloride	0.50	U	0.50	1.0	µg/L	1	12/15/2010 8:59:00 A
Styrene	0.50	U	0.50	1.0	µg/L	1	12/15/2010 8:59:00 A
Tetrachloroethene	0.50	U	0.50	1.0	µg/L	1	12/15/2010 8:59:00 A
Toluene	0.50	U	0.50	1.0	µg/L	1	12/15/2010 8:59:00 A
trans-1,2-Dichloroethene	0.50	U	0.50	1.0	µg/L	1	12/15/2010 8:59:00 A
trans-1,3-Dichloropropene	0.50	U	0.50	1.0	µg/L	1	12/15/2010 8:59:00 A
trans-1,4-Dichloro-2-butene	1.0	U	1.0	2.0	µg/L	1	12/15/2010 8:59:00 A
Trichloroethene	0.50	U	0.50	1.0	µg/L	1	12/15/2010 8:59:00 A
Trichlorofluoromethane	0.50	U	0.50	1.0	µg/L	1	12/15/2010 8:59:00 A
Vinyl Acetate	0.50	U	0.50	1.0	µg/L	1	12/15/2010 8:59:00 A
Vinyl Chloride	0.50	U	0.50	1.0	µg/L	1	12/15/2010 8:59:00 A
Total Xylene	1.0	U	1.0	2.0	µg/L	1	12/15/2010 8:59:00 A
Surr: 1,2-Dichloroethane-d4	96.7		0	70-130	%REC	1	12/15/2010 8:59:00 A
Surr: 4-Bromofluorobenzene	109		0	70-130	%REC	1	12/15/2010 8:59:00 A
Surr: Dibromofluoromethane	91.2		0	70-130	%REC	1	12/15/2010 8:59:00 A
Surr: Toluene-d8	101		0	70-130	%REC	1	12/15/2010 8:59:00 A

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Laboratory Results

Geochemical Testing

Date: *12-Jan-11*

CLIENT:	CIVIL & ENVIRONMENTAL-COLUMBU	**Client Sample ID:**	B-413R
Lab Order:	G1012414		
Project:	APEX Second SA	**Collection Date:**	12/10/2010 8:17:00 AM
Lab ID:	G1012414-013	**Sampled By:**	Client
Matrix:	AQUEOUS	**DateReceived:**	12/14/2010 1:16:39 PM

Analyses	Result	Q	MDL	PQL	Units	DF	Date Analyzed
FIELD PARAMETERS			**FIELD**			Analyst:	
pH (Field)	7.54		0		S.U.	0	12/10/2010 8:17:00 A
Specific Conductance (Field)	1060		0		umhos/cm	0	12/10/2010 8:17:00 A
Temperature (Field)	6.2		0		deg C	0	12/10/2010 8:17:00 A
Turbidity (Field)	3.02		0		NTU	0	12/10/2010 8:17:00 A
INORGANIC NON-METALS			**SM 18 2320B**			Analyst: **LNW**	
Alkalinity to pH 4.5	186		2.0	5	mg/L CaCO3	1	12/17/2010 4:03:00 P
INORGANIC NON-METALS			**SM 2540 C**			Analyst: **KLS**	
Total dissolved solids	990		10.0	20	mg/L	1	12/15/2010 9:20:00 A
INORGANIC NON-METALS			**SM 4500-CL E**			Analyst: **SAG**	
Chloride	11		2.0	5	mg/L	1	12/21/2010 2:33:00 P
INORGANIC NON-METALS			**EPA 350.1**			Analyst: **SLY**	
Ammonia Nitrogen - Distilled	0.040	U	0.040	0.10	mg/L as N	1	12/28/2010 11:17:28 A
INORGANIC NON-METALS			**EPA 353.2**			Analyst: **SLY**	
Nitrate - Nitrite	0.44		0.020	0.05	mg/L as N	1	12/20/2010 9:10:32 A
INORGANIC NON METALS			**ASTM D516-02**			Analyst: **SAG**	
Sulfate	482		50.0	250	mg/L	50	12/20/2010 2:56:00 P
INORGANIC METALS			**EPA 200.7**			Analyst: **MS**	
Barium	0.036		0.0050	0.010	mg/L	1	12/20/2010 7:47:00 P
Beryllium	0.00050	U	0.00050	0.0010	mg/L	1	12/20/2010 7:47:00 P
Cadmium	0.0010	U	0.0010	0.002	mg/L	1	12/20/2010 7:47:00 P
Calcium	242		0.050	0.10	mg/L	1	12/20/2010 7:47:00 P
Chromium	0.0050	U	0.0050	0.010	mg/L	1	12/20/2010 7:47:00 P
Cobalt	0.0020	U	0.0020	0.005	mg/L	1	12/20/2010 7:47:00 P
Copper	0.0050	U	0.0050	0.010	mg/L	1	12/20/2010 7:47:00 P
Iron	0.09		0.010	0.05	mg/L	1	12/20/2010 7:47:00 P
Magnesium	37.7		0.050	0.10	mg/L	1	12/20/2010 7:47:00 P
Manganese	0.032		0.0020	0.010	mg/L	1	12/20/2010 7:47:00 P
Nickel	0.0050	U	0.0050	0.010	mg/L	1	12/20/2010 7:47:00 P
Potassium	2.5		0.20	0.5	mg/L	1	12/20/2010 7:47:00 P
Silver	0.0020	U	0.0020	0.005	mg/L	1	12/20/2010 7:47:00 P
Sodium	36.2		0.10	0.2	mg/L	1	12/20/2010 7:47:00 P
Vanadium	0.0020	U	0.0020	0.005	mg/L	1	12/20/2010 7:47:00 P
Zinc	0.0040	U	0.0040	0.010	mg/L	1	12/20/2010 7:47:00 P

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Laboratory Results

Geochemical Testing

Date: *12-Jan-11*

CLIENT:	CIVIL & ENVIRONMENTAL-COLUMBU	**Client Sample ID:**	B-413R
Lab Order:	G1012414		
Project:	APEX Second SA	**Collection Date:**	12/10/2010 8:17:00 AM
Lab ID:	G1012414-013	**Sampled By:**	Client
Matrix:	AQUEOUS	**DateReceived:**	12/14/2010 1:16:39 PM

Analyses	Result	Q	MDL	PQL	Units	DF	Date Analyzed
INORGANIC METALS			**EPA 200.8**				Analyst: **JEK**
Antimony	0.50	U	0.50	1.0	µg/L	1	12/16/2010 8:06:00 P
Arsenic	0.50	U	0.50	1.0	µg/L	1	12/16/2010 8:06:00 P
Lead	0.2	J	0.20	1.0	µg/L	1	12/16/2010 8:06:00 P
Selenium	4.9		0.50	1.0	µg/L	1	12/16/2010 8:06:00 P
Thallium	0.10	U	0.10	0.2	µg/L	1	12/16/2010 8:06:00 P
VOLATILE ORGANIC COMPOUNDS			**EPA 8011**				Analyst: **TEW**
1,2-Dibromo-3-chloropropane	0.0100	U	0.0100	0.0400	µg/L	1	12/16/2010 2:07:14 A
1,2-Dibromoethane	0.0100	U	0.0100	0.0400	µg/L	1	12/16/2010 2:07:14 A
Surr: 1,1,2,2-Tetrachloroethane	88.8		0	60-140	%REC	1	12/16/2010 2:07:14 A
VOLATILE ORGANIC COMPOUNDS			**EPA 8260**				Analyst: **SJM**
1,1,1,2-Tetrachloroethane	0.50	U	0.50	1.0	µg/L	1	12/15/2010 9:34:00 A
1,1,1-Trichloroethane	0.50	U	0.50	1.0	µg/L	1	12/15/2010 9:34:00 A
1,1,2,2-Tetrachloroethane	0.50	U	0.50	1.0	µg/L	1	12/15/2010 9:34:00 A
1,1,2-Trichloroethane	0.50	U	0.50	1.0	µg/L	1	12/15/2010 9:34:00 A
1,1-Dichloroethane	0.50	U	0.50	1.0	µg/L	1	12/15/2010 9:34:00 A
1,1-Dichloroethene	0.50	U	0.50	1.0	µg/L	1	12/15/2010 9:34:00 A
1,2,3-Trichloropropane	0.50	U	0.50	1.0	µg/L	1	12/15/2010 9:34:00 A
1,2-Dichlorobenzene	0.50	U	0.50	1.0	µg/L	1	12/15/2010 9:34:00 A
1,2-Dichloroethane	0.50	U	0.50	1.0	µg/L	1	12/15/2010 9:34:00 A
1,2-Dichloropropane	0.50	U	0.50	1.0	µg/L	1	12/15/2010 9:34:00 A
1,4-Dichlorobenzene	0.50	U	0.50	1.0	µg/L	1	12/15/2010 9:34:00 A
2-Hexanone	1.0	U	1.0	5.0	µg/L	1	12/15/2010 9:34:00 A
4-Methyl-2-Pentanone	0.50	U	0.50	1.0	µg/L	1	12/15/2010 9:34:00 A
Acetone	5.0	U	5.0	10	µg/L	1	12/15/2010 9:34:00 A
Acrylonitrile	2.0	U	2.0	5.0	µg/L	1	12/15/2010 9:34:00 A
Benzene	0.50	U	0.50	1.0	µg/L	1	12/15/2010 9:34:00 A
Bromochloromethane	0.50	U	0.50	1.0	µg/L	1	12/15/2010 9:34:00 A
Bromoform	0.50	U	0.50	1.0	µg/L	1	12/15/2010 9:34:00 A
Bromomethane	0.50	U	0.50	1.0	µg/L	1	12/15/2010 9:34:00 A
Carbon Disulfide	0.50	U	0.50	1.0	µg/L	1	12/15/2010 9:34:00 A
Carbon Tetrachloride	0.50	U	0.50	1.0	µg/L	1	12/15/2010 9:34:00 A
Chlorobenzene	0.50	U	0.50	1.0	µg/L	1	12/15/2010 9:34:00 A
Chlorodibromomethane	0.50	U	0.50	1.0	µg/L	1	12/15/2010 9:34:00 A
Chloroethane	0.50	U	0.50	1.0	µg/L	1	12/15/2010 9:34:00 A
Chloroform	0.50	U	0.50	1.0	µg/L	1	12/15/2010 9:34:00 A
Chloromethane	0.50	U	0.50	1.0	µg/L	1	12/15/2010 9:34:00 A
cis-1,2-Dichloroethene	0.50	U	0.50	1.0	µg/L	1	12/15/2010 9:34:00 A
cis-1,3-Dichloropropene	0.50	U	0.50	1.0	µg/L	1	12/15/2010 9:34:00 A
Dibromomethane	0.50	U	0.50	1.0	µg/L	1	12/15/2010 9:34:00 A

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Laboratory Results

Geochemical Testing

Date: *12-Jan-11*

CLIENT:	CIVIL & ENVIRONMENTAL-COLUMBU	**Client Sample ID:**	B-413R
Lab Order:	G1012414		
Project:	APEX Second SA	**Collection Date:**	12/10/2010 8:17:00 AM
Lab ID:	G1012414-013	**Sampled By:**	Client
Matrix:	AQUEOUS	**DateReceived:**	12/14/2010 1:16:39 PM

Analyses	Result	Q	MDL	PQL	Units	DF	Date Analyzed
VOLATILE ORGANIC COMPOUNDS			**EPA 8260**			Analyst: **SJM**	
Dichlorobromomethane	0.50	U	0.50	1.0	µg/L	1	12/15/2010 9:34:00 A
Ethylbenzene	0.50	U	0.50	1.0	µg/L	1	12/15/2010 9:34:00 A
Iodomethane	0.50	U	0.50	5.0	µg/L	1	12/15/2010 9:34:00 A
Methyl Ethyl Ketone	1.0	U	1.0	5.0	µg/L	1	12/15/2010 9:34:00 A
Methylene Chloride	0.50	U	0.50	1.0	µg/L	1	12/15/2010 9:34:00 A
Styrene	0.50	U	0.50	1.0	µg/L	1	12/15/2010 9:34:00 A
Tetrachloroethene	0.50	U	0.50	1.0	µg/L	1	12/15/2010 9:34:00 A
Toluene	0.50	U	0.50	1.0	µg/L	1	12/15/2010 9:34:00 A
trans-1,2-Dichloroethene	0.50	U	0.50	1.0	µg/L	1	12/15/2010 9:34:00 A
trans-1,3-Dichloropropene	0.50	U	0.50	1.0	µg/L	1	12/15/2010 9:34:00 A
trans-1,4-Dichloro-2-butene	1.0	U	1.0	2.0	µg/L	1	12/15/2010 9:34:00 A
Trichloroethene	0.50	U	0.50	1.0	µg/L	1	12/15/2010 9:34:00 A
Trichlorofluoromethane	0.50	U	0.50	1.0	µg/L	1	12/15/2010 9:34:00 A
Vinyl Acetate	0.50	U	0.50	1.0	µg/L	1	12/15/2010 9:34:00 A
Vinyl Chloride	0.50	U	0.50	1.0	µg/L	1	12/15/2010 9:34:00 A
Total Xylene	1.0	U	1.0	2.0	µg/L	1	12/15/2010 9:34:00 A
Surr: 1,2-Dichloroethane-d4	105		0	70-130	%REC	1	12/15/2010 9:34:00 A
Surr: 4-Bromofluorobenzene	112		0	70-130	%REC	1	12/15/2010 9:34:00 A
Surr: Dibromofluoromethane	90.9		0	70-130	%REC	1	12/15/2010 9:34:00 A
Surr: Toluene-d8	97.8		0	70-130	%REC	1	12/15/2010 9:34:00 A

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Laboratory Results

Geochemical Testing

Date: *12-Jan-11*

CLIENT:	CIVIL & ENVIRONMENTAL-COLUMBU	**Client Sample ID:**	B-407
Lab Order:	G1012414		
Project:	APEX Second SA	**Collection Date:**	12/10/2010 9:41:00 AM
Lab ID:	G1012414-014	**Sampled By:**	Client
Matrix:	AQUEOUS	**DateReceived:**	12/14/2010 1:16:39 PM

Analyses	Result	Q	MDL	PQL	Units	DF	Date Analyzed
FIELD PARAMETERS			**FIELD**			Analyst:	
pH (Field)	8.48		0		S.U.	0	12/10/2010 9:41:00 A
Specific Conductance (Field)	3540		0		umhos/cm	0	12/10/2010 9:41:00 A
Temperature (Field)	7.4		0		deg C	0	12/10/2010 9:41:00 A
Turbidity (Field)	2.74		0		NTU	0	12/10/2010 9:41:00 A
INORGANIC NON-METALS			**SM 18 2320B**			Analyst: **LNW**	
Alkalinity to pH 4.5	306		2.0	5	mg/L CaCO3	1	12/17/2010 4:22:00 P
INORGANIC NON-METALS			**SM 2540 C**			Analyst: **KLS**	
Total dissolved solids	486		10.0	20	mg/L	1	12/15/2010 9:20:00 A
INORGANIC NON-METALS			**SM 4500-CL E**			Analyst: **SAG**	
Chloride	2.0	U	2.0	5	mg/L	1	12/21/2010 2:33:00 P
INORGANIC NON-METALS			**EPA 350.1**			Analyst: **SLY**	
Ammonia Nitrogen - Distilled	0.23		0.040	0.10	mg/L as N	1	12/28/2010 11:18:36 A
INORGANIC NON-METALS			**EPA 353.2**			Analyst: **SLY**	
Nitrate - Nitrite	0.03	J	0.020	0.05	mg/L as N	1	12/20/2010 9:11:41 A
INORGANIC NON METALS			**ASTM D516-02**			Analyst: **SAG**	
Sulfate	87		5.0	25	mg/L	5	12/20/2010 2:56:00 P
INORGANIC METALS			**EPA 200.7**			Analyst: **MS**	
Barium	0.026		0.0050	0.010	mg/L	1	12/20/2010 8:22:00 P
Beryllium	0.00050	U	0.00050	0.0010	mg/L	1	12/20/2010 8:22:00 P
Cadmium	0.0010	U	0.0010	0.002	mg/L	1	12/20/2010 8:22:00 P
Calcium	84.6		0.050	0.10	mg/L	1	12/20/2010 8:22:00 P
Chromium	0.0050	U	0.0050	0.010	mg/L	1	12/20/2010 8:22:00 P
Cobalt	0.0020	U	0.0020	0.005	mg/L	1	12/20/2010 8:22:00 P
Copper	0.0050	U	0.0050	0.010	mg/L	1	12/20/2010 8:22:00 P
Iron	0.51		0.010	0.05	mg/L	1	12/20/2010 8:22:00 P
Magnesium	18.6		0.050	0.10	mg/L	1	12/20/2010 8:22:00 P
Manganese	0.110		0.0020	0.010	mg/L	1	12/20/2010 8:22:00 P
Nickel	0.0050	U	0.0050	0.010	mg/L	1	12/20/2010 8:22:00 P
Potassium	2.7		0.20	0.5	mg/L	1	12/20/2010 8:22:00 P
Silver	0.0020	U	0.0020	0.005	mg/L	1	12/20/2010 8:22:00 P
Sodium	85.2		0.10	0.2	mg/L	1	12/20/2010 8:22:00 P
Vanadium	0.0020	U	0.0020	0.005	mg/L	1	12/20/2010 8:22:00 P
Zinc	0.0040	U	0.0040	0.010	mg/L	1	12/20/2010 8:22:00 P

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Laboratory Results

Geochemical Testing

Date: *12-Jan-11*

CLIENT:	CIVIL & ENVIRONMENTAL-COLUMBU	**Client Sample ID:**	B-407
Lab Order:	G1012414		
Project:	APEX Second SA	**Collection Date:**	12/10/2010 9:41:00 AM
Lab ID:	G1012414-014	**Sampled By:**	Client
Matrix:	AQUEOUS	**DateReceived:**	12/14/2010 1:16:39 PM

Analyses	Result	Q	MDL	PQL	Units	DF	Date Analyzed
INORGANIC METALS			**EPA 200.8**				Analyst: **JEK**
Antimony	0.50	U	0.50	1.0	µg/L	1	12/16/2010 8:20:00 P
Arsenic	3.1		0.50	1.0	µg/L	1	12/16/2010 8:20:00 P
Lead	0.20	U	0.20	1.0	µg/L	1	12/16/2010 8:20:00 P
Selenium	0.50	U	0.50	1.0	µg/L	1	12/16/2010 8:20:00 P
Thallium	0.10	U	0.10	0.2	µg/L	1	12/16/2010 8:20:00 P
VOLATILE ORGANIC COMPOUNDS			**EPA 8011**				Analyst: **TEW**
1,2-Dibromo-3-chloropropane	0.0100	U	0.0100	0.0400	µg/L	1	12/16/2010 2:28:33 A
1,2-Dibromoethane	0.0100	U	0.0100	0.0400	µg/L	1	12/16/2010 2:28:33 A
Surr: 1,1,2,2-Tetrachloroethane	91.2		0	60-140	%REC	1	12/16/2010 2:28:33 A
VOLATILE ORGANIC COMPOUNDS			**EPA 8260**				Analyst: **SJM**
1,1,1,2-Tetrachloroethane	0.50	U	0.50	1.0	µg/L	1	12/15/2010 10:08:00 A
1,1,1-Trichloroethane	0.50	U	0.50	1.0	µg/L	1	12/15/2010 10:08:00 A
1,1,2,2-Tetrachloroethane	0.50	U	0.50	1.0	µg/L	1	12/15/2010 10:08:00 A
1,1,2-Trichloroethane	0.50	U	0.50	1.0	µg/L	1	12/15/2010 10:08:00 A
1,1-Dichloroethane	0.50	U	0.50	1.0	µg/L	1	12/15/2010 10:08:00 A
1,1-Dichloroethene	0.50	U	0.50	1.0	µg/L	1	12/15/2010 10:08:00 A
1,2,3-Trichloropropane	0.50	U	0.50	1.0	µg/L	1	12/15/2010 10:08:00 A
1,2-Dichlorobenzene	0.50	U	0.50	1.0	µg/L	1	12/15/2010 10:08:00 A
1,2-Dichloroethane	0.50	U	0.50	1.0	µg/L	1	12/15/2010 10:08:00 A
1,2-Dichloropropane	0.50	U	0.50	1.0	µg/L	1	12/15/2010 10:08:00 A
1,4-Dichlorobenzene	0.50	U	0.50	1.0	µg/L	1	12/15/2010 10:08:00 A
2-Hexanone	1.0	U	1.0	5.0	µg/L	1	12/15/2010 10:08:00 A
4-Methyl-2-Pentanone	0.50	U	0.50	1.0	µg/L	1	12/15/2010 10:08:00 A
Acetone	5.0	U	5.0	10	µg/L	1	12/15/2010 10:08:00 A
Acrylonitrile	2.0	U	2.0	5.0	µg/L	1	12/15/2010 10:08:00 A
Benzene	0.50	U	0.50	1.0	µg/L	1	12/15/2010 10:08:00 A
Bromochloromethane	0.50	U	0.50	1.0	µg/L	1	12/15/2010 10:08:00 A
Bromoform	0.50	U	0.50	1.0	µg/L	1	12/15/2010 10:08:00 A
Bromomethane	0.50	U	0.50	1.0	µg/L	1	12/15/2010 10:08:00 A
Carbon Disulfide	0.50	U	0.50	1.0	µg/L	1	12/15/2010 10:08:00 A
Carbon Tetrachloride	0.50	U	0.50	1.0	µg/L	1	12/15/2010 10:08:00 A
Chlorobenzene	0.50	U	0.50	1.0	µg/L	1	12/15/2010 10:08:00 A
Chlorodibromomethane	0.50	U	0.50	1.0	µg/L	1	12/15/2010 10:08:00 A
Chloroethane	0.50	U	0.50	1.0	µg/L	1	12/15/2010 10:08:00 A
Chloroform	0.50	U	0.50	1.0	µg/L	1	12/15/2010 10:08:00 A
Chloromethane	0.50	U	0.50	1.0	µg/L	1	12/15/2010 10:08:00 A
cis-1,2-Dichloroethene	0.50	U	0.50	1.0	µg/L	1	12/15/2010 10:08:00 A
cis-1,3-Dichloropropene	0.50	U	0.50	1.0	µg/L	1	12/15/2010 10:08:00 A
Dibromomethane	0.50	U	0.50	1.0	µg/L	1	12/15/2010 10:08:00 A

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Laboratory Results

Geochemical Testing

Date: *12-Jan-11*

CLIENT:	CIVIL & ENVIRONMENTAL-COLUMBU	**Client Sample ID:**	B-407
Lab Order:	G1012414		
Project:	APEX Second SA	**Collection Date:**	12/10/2010 9:41:00 AM
Lab ID:	G1012414-014	**Sampled By:**	Client
Matrix:	AQUEOUS	**DateReceived:**	12/14/2010 1:16:39 PM

Analyses	Result	Q	MDL	PQL	Units	DF	Date Analyzed
VOLATILE ORGANIC COMPOUNDS			**EPA 8260**			Analyst: **SJM**	
Dichlorobromomethane	0.50	U	0.50	1.0	µg/L	1	12/15/2010 10:08:00 A
Ethylbenzene	0.50	U	0.50	1.0	µg/L	1	12/15/2010 10:08:00 A
Iodomethane	0.50	U	0.50	5.0	µg/L	1	12/15/2010 10:08:00 A
Methyl Ethyl Ketone	1.0	U	1.0	5.0	µg/L	1	12/15/2010 10:08:00 A
Methylene Chloride	0.50	U	0.50	1.0	µg/L	1	12/15/2010 10:08:00 A
Styrene	0.50	U	0.50	1.0	µg/L	1	12/15/2010 10:08:00 A
Tetrachloroethene	0.50	U	0.50	1.0	µg/L	1	12/15/2010 10:08:00 A
Toluene	0.50	U	0.50	1.0	µg/L	1	12/15/2010 10:08:00 A
trans-1,2-Dichloroethene	0.50	U	0.50	1.0	µg/L	1	12/15/2010 10:08:00 A
trans-1,3-Dichloropropene	0.50	U	0.50	1.0	µg/L	1	12/15/2010 10:08:00 A
trans-1,4-Dichloro-2-butene	1.0	U	1.0	2.0	µg/L	1	12/15/2010 10:08:00 A
Trichloroethene	0.50	U	0.50	1.0	µg/L	1	12/15/2010 10:08:00 A
Trichlorofluoromethane	0.50	U	0.50	1.0	µg/L	1	12/15/2010 10:08:00 A
Vinyl Acetate	0.50	U	0.50	1.0	µg/L	1	12/15/2010 10:08:00 A
Vinyl Chloride	0.50	U	0.50	1.0	µg/L	1	12/15/2010 10:08:00 A
Total Xylene	1.0	U	1.0	2.0	µg/L	1	12/15/2010 10:08:00 A
Surr: 1,2-Dichloroethane-d4	101		0	70-130	%REC	1	12/15/2010 10:08:00 A
Surr: 4-Bromofluorobenzene	114		0	70-130	%REC	1	12/15/2010 10:08:00 A
Surr: Dibromofluoromethane	89.2		0	70-130	%REC	1	12/15/2010 10:08:00 A
Surr: Toluene-d8	97.4		0	70-130	%REC	1	12/15/2010 10:08:00 A

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Laboratory Results

Geochemical Testing

Date: *12-Jan-11*

CLIENT:	CIVIL & ENVIRONMENTAL-COLUMBU	**Client Sample ID:**	B-412
Lab Order:	G1012414		
Project:	APEX Second SA	**Collection Date:**	12/10/2010 10:33:00 AM
Lab ID:	G1012414-015	**Sampled By:**	Client
Matrix:	AQUEOUS	**DateReceived:**	12/14/2010 1:16:39 PM

Analyses	Result	Q	MDL	PQL	Units	DF	Date Analyzed
FIELD PARAMETERS			**FIELD**			Analyst:	
pH (Field)	7.87		0		S.U.	0	12/10/2010 10:33:00 A
Specific Conductance (Field)	960		0		umhos/cm	0	12/10/2010 10:33:00 A
Temperature (Field)	8.0		0		deg C	0	12/10/2010 10:33:00 A
Turbidity (Field)	115		0		NTU	0	12/10/2010 10:33:00 A
INORGANIC METALS			**EPA 200.7**			Analyst: **MS**	
Barium	0.10		0.005	0.01	mg/L	1	12/20/2010 8:08:00 P
Beryllium	0.0005	U	0.0005	0.001	mg/L	1	12/20/2010 8:08:00 P
Cadmium	0.0010	U	0.0010	0.002	mg/L	1	12/20/2010 8:08:00 P
Calcium	243		0.05	0.1	mg/L	1	12/20/2010 8:08:00 P
Chromium	0.01		0.005	0.01	mg/L	1	12/20/2010 8:08:00 P
Cobalt	0.007		0.0020	0.005	mg/L	1	12/20/2010 8:08:00 P
Copper	0.005	U	0.005	0.01	mg/L	1	12/20/2010 8:08:00 P
Iron	13.9		0.010	0.05	mg/L	1	12/20/2010 8:08:00 P
Magnesium	35.4		0.05	0.1	mg/L	1	12/20/2010 8:08:00 P
Manganese	0.82		0.002	0.01	mg/L	1	12/20/2010 8:08:00 P
Nickel	0.02		0.005	0.01	mg/L	1	12/20/2010 8:08:00 P
Potassium	2.7		0.20	0.5	mg/L	1	12/20/2010 8:08:00 P
Silver	0.0020	U	0.0020	0.005	mg/L	1	12/20/2010 8:08:00 P
Sodium	27.0		0.10	0.2	mg/L	1	12/20/2010 8:08:00 P
Vanadium	0.014		0.0020	0.005	mg/L	1	12/20/2010 8:08:00 P
Zinc	0.03		0.004	0.01	mg/L	1	12/20/2010 8:08:00 P
INORGANIC METALS			**EPA 200.8**			Analyst: **JEK**	
Antimony	0.50	U	0.50	1.0	µg/L	1	12/16/2010 8:11:00 P
Arsenic	3.9		0.50	1.0	µg/L	1	12/16/2010 8:11:00 P
Lead	7.5		0.20	1.0	µg/L	1	12/16/2010 8:11:00 P
Selenium	1.5		0.50	1.0	µg/L	1	12/16/2010 8:11:00 P
Thallium	0.10	U	0.10	0.2	µg/L	1	12/16/2010 8:11:00 P

ACCREDITED IN ACCORDANCE WITH nelac
I.D. 56-00306 PA DEP

Geochemical Testing

Quality Assurance Project Report
Prepared for
CIVIL & ENVIRONMENTAL-COLUMBUS

1/4/2011

Signed: _____
Leslie Ann Nemeth
Project Manager

Signed: _____
David M. Glessner
Quality Assurance Coordinator

Geochemical Testing

Date: *04-Jan-11*

CLIENT: CIVIL & ENVIRONMENTAL-COLUMB
Project: APEX Second SA
Lab Order: G1012353

Work Order Sample Summary

Lab Sample ID	Client Sample ID	Tag Number	Collection Date	Date Received
G1012353-001A	B-414		12/8/2010 10:18:00 AM	12/10/2010
G1012353-001B	B-414		12/8/2010 10:18:00 AM	12/10/2010
G1012353-001C	B-414		12/8/2010 10:18:00 AM	12/10/2010
G1012353-001D	B-414		12/8/2010 10:18:00 AM	12/10/2010
G1012353-001E	B-414		12/8/2010 10:18:00 AM	12/10/2010
G1012353-001F	B-414		12/8/2010 10:18:00 AM	12/10/2010
G1012353-002A	B-412		12/8/2010 12:57:00 PM	12/10/2010
G1012353-002B	B-412		12/8/2010 12:57:00 PM	12/10/2010
G1012353-002C	B-412		12/8/2010 12:57:00 PM	12/10/2010
G1012353-002D	B-412		12/8/2010 12:57:00 PM	12/10/2010
G1012353-002E	B-412		12/8/2010 12:57:00 PM	12/10/2010
G1012353-002F	B-412		12/8/2010 12:57:00 PM	12/10/2010
G1012353-003A	B-411		12/8/2010 2:07:00 PM	12/10/2010
G1012353-003B	B-411		12/8/2010 2:07:00 PM	12/10/2010
G1012353-003C	B-411		12/8/2010 2:07:00 PM	12/10/2010
G1012353-003D	B-411		12/8/2010 2:07:00 PM	12/10/2010
G1012353-003E	B-411		12/8/2010 2:07:00 PM	12/10/2010
G1012353-003F	B-411		12/8/2010 2:07:00 PM	12/10/2010
G1012353-004A	B-410		12/8/2010 2:47:00 PM	12/10/2010
G1012353-004B	B-410		12/8/2010 2:47:00 PM	12/10/2010
G1012353-004C	B-410		12/8/2010 2:47:00 PM	12/10/2010
G1012353-004D	B-410		12/8/2010 2:47:00 PM	12/10/2010
G1012353-004E	B-410		12/8/2010 2:47:00 PM	12/10/2010
G1012353-004F	B-410		12/8/2010 2:47:00 PM	12/10/2010
G1012353-005A	B-401S		12/8/2010 9:20:00 AM	12/10/2010
G1012353-005B	B-401S		12/8/2010 9:20:00 AM	12/10/2010
G1012353-005C	B-401S		12/8/2010 9:20:00 AM	12/10/2010
G1012353-005D	B-401S		12/8/2010 9:20:00 AM	12/10/2010
G1012353-005E	B-401S		12/8/2010 9:20:00 AM	12/10/2010
G1012353-005F	B-401S		12/8/2010 9:20:00 AM	12/10/2010
G1012353-006A	B-408A		12/8/2010 8:55:00 AM	12/10/2010
G1012353-006B	B-408A		12/8/2010 8:55:00 AM	12/10/2010
G1012353-006C	B-408A		12/8/2010 8:55:00 AM	12/10/2010
G1012353-006D	B-408A		12/8/2010 8:55:00 AM	12/10/2010
G1012353-006E	B-408A		12/8/2010 8:55:00 AM	12/10/2010
G1012353-006F	B-408A		12/8/2010 8:55:00 AM	12/10/2010

CLIENT: CIVIL & ENVIRONMENTAL-COLUMB
Project: APEX Second SA
Lab Order: G1012353

Work Order Sample Summary

Lab Sample ID	Client Sample ID	Tag Number	Collection Date	Date Received
G1012353-007A	B-405		12/8/2010 9:55:00 AM	12/10/2010
G1012353-007B	B-405		12/8/2010 9:55:00 AM	12/10/2010
G1012353-007C	B-405		12/8/2010 9:55:00 AM	12/10/2010
G1012353-007D	B-405		12/8/2010 9:55:00 AM	12/10/2010
G1012353-007E	B-405		12/8/2010 9:55:00 AM	12/10/2010
G1012353-007F	B-405		12/8/2010 9:55:00 AM	12/10/2010
G1012353-008A	B-409		12/8/2010 3:52:00 PM	12/10/2010
G1012353-008B	B-409		12/8/2010 3:52:00 PM	12/10/2010
G1012353-008C	B-409		12/8/2010 3:52:00 PM	12/10/2010
G1012353-008D	B-409		12/8/2010 3:52:00 PM	12/10/2010
G1012353-008E	B-409		12/8/2010 3:52:00 PM	12/10/2010
G1012353-008F	B-409		12/8/2010 3:52:00 PM	12/10/2010
G1012353-009A	B-408S		12/8/2010 8:45:00 AM	12/10/2010
G1012353-009B	B-408S		12/8/2010 8:45:00 AM	12/10/2010
G1012353-009C	B-408S		12/8/2010 8:45:00 AM	12/10/2010
G1012353-009D	B-408S		12/8/2010 8:45:00 AM	12/10/2010
G1012353-009E	B-408S		12/8/2010 8:45:00 AM	12/10/2010
G1012353-009F	B-408S		12/8/2010 8:45:00 AM	12/10/2010
G1012353-010A	DUP-1		12/8/2010	12/10/2010
G1012353-010B	DUP-1		12/8/2010	12/10/2010
G1012353-010C	DUP-1		12/8/2010	12/10/2010
G1012353-010D	DUP-1		12/8/2010	12/10/2010
G1012353-010E	DUP-1		12/8/2010	12/10/2010
G1012353-010F	DUP-1		12/8/2010	12/10/2010

Geochemical Testing

Date: *04-Jan-11*

CLIENT: CIVIL & ENVIRONMENTAL-COLUMB
Project: APEX Second SA
Lab Order: G1012414

Work Order Sample Summary

Lab Sample ID	Client Sample ID	Tag Number	Collection Date	Date Received
G1012414-001A	B-406		12/9/2010 3:43:00 PM	12/14/2010
G1012414-001B	B-406		12/9/2010 3:43:00 PM	12/14/2010
G1012414-001C	B-406		12/9/2010 3:43:00 PM	12/14/2010
G1012414-001D	B-406		12/9/2010 3:43:00 PM	12/14/2010
G1012414-001E	B-406		12/9/2010 3:43:00 PM	12/14/2010
G1012414-001F	B-406		12/9/2010 3:43:00 PM	12/14/2010
G1012414-002A	DUP-2		12/9/2010 3:43:00 PM	12/14/2010
G1012414-002B	DUP-2		12/9/2010 3:43:00 PM	12/14/2010
G1012414-002C	DUP-2		12/9/2010 3:43:00 PM	12/14/2010
G1012414-002D	DUP-2		12/9/2010 3:43:00 PM	12/14/2010
G1012414-002E	DUP-2		12/9/2010 3:43:00 PM	12/14/2010
G1012414-002F	DUP-2		12/9/2010 3:43:00 PM	12/14/2010
G1012414-003A	B-406S		12/9/2010 4:44:00 PM	12/14/2010
G1012414-003B	B-406S		12/9/2010 4:44:00 PM	12/14/2010
G1012414-003C	B-406S		12/9/2010 4:44:00 PM	12/14/2010
G1012414-003D	B-406S		12/9/2010 4:44:00 PM	12/14/2010
G1012414-003E	B-406S		12/9/2010 4:44:00 PM	12/14/2010
G1012414-003F	B-406S		12/9/2010 4:44:00 PM	12/14/2010
G1012414-004A	B-408		12/10/2010 9:02:00 AM	12/14/2010
G1012414-004B	B-408		12/10/2010 9:02:00 AM	12/14/2010
G1012414-004C	B-408		12/10/2010 9:02:00 AM	12/14/2010
G1012414-004D	B-408		12/10/2010 9:02:00 AM	12/14/2010
G1012414-004E	B-408		12/10/2010 9:02:00 AM	12/14/2010
G1012414-004F	B-408		12/10/2010 9:02:00 AM	12/14/2010
G1012414-005A	B-402		12/9/2010 12:02:00 PM	12/14/2010
G1012414-005B	B-402		12/9/2010 12:02:00 PM	12/14/2010
G1012414-005C	B-402		12/9/2010 12:02:00 PM	12/14/2010
G1012414-005D	B-402		12/9/2010 12:02:00 PM	12/14/2010
G1012414-005E	B-402		12/9/2010 12:02:00 PM	12/14/2010
G1012414-005F	B-402		12/9/2010 12:02:00 PM	12/14/2010
G1012414-006A	B-402A		12/9/2010 11:20:00 AM	12/14/2010
G1012414-006B	B-402A		12/9/2010 11:20:00 AM	12/14/2010
G1012414-006C	B-402A		12/9/2010 11:20:00 AM	12/14/2010
G1012414-006D	B-402A		12/9/2010 11:20:00 AM	12/14/2010
G1012414-006E	B-402A		12/9/2010 11:20:00 AM	12/14/2010
G1012414-006F	B-402A		12/9/2010 11:20:00 AM	12/14/2010

CLIENT:	CIVIL & ENVIRONMENTAL-COLUMB
Project:	APEX Second SA
Lab Order:	G1012414

Work Order Sample Summary

Lab Sample ID	Client Sample ID	Tag Number	Collection Date	Date Received
G1012414-007A	B-401		12/9/2010 10:25:00 AM	12/14/2010
G1012414-007B	B-401		12/9/2010 10:25:00 AM	12/14/2010
G1012414-007C	B-401		12/9/2010 10:25:00 AM	12/14/2010
G1012414-007D	B-401		12/9/2010 10:25:00 AM	12/14/2010
G1012414-007E	B-401		12/9/2010 10:25:00 AM	12/14/2010
G1012414-007F	B-401		12/9/2010 10:25:00 AM	12/14/2010
G1012414-008A	B-401A		12/9/2010 9:45:00 AM	12/14/2010
G1012414-008B	B-401A		12/9/2010 9:45:00 AM	12/14/2010
G1012414-008C	B-401A		12/9/2010 9:45:00 AM	12/14/2010
G1012414-008D	B-401A		12/9/2010 9:45:00 AM	12/14/2010
G1012414-008E	B-401A		12/9/2010 9:45:00 AM	12/14/2010
G1012414-008F	B-401A		12/9/2010 9:45:00 AM	12/14/2010
G1012414-009A	B-403		12/9/2010 2:05:00 PM	12/14/2010
G1012414-009B	B-403		12/9/2010 2:05:00 PM	12/14/2010
G1012414-009C	B-403		12/9/2010 2:05:00 PM	12/14/2010
G1012414-009D	B-403		12/9/2010 2:05:00 PM	12/14/2010
G1012414-009E	B-403		12/9/2010 2:05:00 PM	12/14/2010
G1012414-009F	B-403		12/9/2010 2:05:00 PM	12/14/2010
G1012414-010A	Trip Blank		12/9/2010	12/14/2010
G1012414-010B	Trip Blank		12/9/2010	12/14/2010
G1012414-011A	B-403S		12/9/2010 1:10:00 PM	12/14/2010
G1012414-011B	B-403S		12/9/2010 1:10:00 PM	12/14/2010
G1012414-011C	B-403S		12/9/2010 1:10:00 PM	12/14/2010
G1012414-011D	B-403S		12/9/2010 1:10:00 PM	12/14/2010
G1012414-011E	B-403S		12/9/2010 1:10:00 PM	12/14/2010
G1012414-011F	B-403S		12/9/2010 1:10:00 PM	12/14/2010
G1012414-012A	SHAUDS-2		12/9/2010 11:25:00 AM	12/14/2010
G1012414-012B	SHAUDS-2		12/9/2010 11:25:00 AM	12/14/2010
G1012414-012C	SHAUDS-2		12/9/2010 11:25:00 AM	12/14/2010
G1012414-012D	SHAUDS-2		12/9/2010 11:25:00 AM	12/14/2010
G1012414-012E	SHAUDS-2		12/9/2010 11:25:00 AM	12/14/2010
G1012414-012F	SHAUDS-2		12/9/2010 11:25:00 AM	12/14/2010
G1012414-013A	B-413R		12/10/2010 8:17:00 AM	12/14/2010
G1012414-013B	B-413R		12/10/2010 8:17:00 AM	12/14/2010
G1012414-013C	B-413R		12/10/2010 8:17:00 AM	12/14/2010
G1012414-013D	B-413R		12/10/2010 8:17:00 AM	12/14/2010
G1012414-013E	B-413R		12/10/2010 8:17:00 AM	12/14/2010

CLIENT: CIVIL & ENVIRONMENTAL-COLUMB
Project: APEX Second SA
Lab Order: G1012414

Work Order Sample Summary

Lab Sample ID	Client Sample ID	Tag Number	Collection Date	Date Received
G1012414-013F	B-413R		12/10/2010 8:17:00 AM	12/14/2010
G1012414-014A	B-407		12/10/2010 9:41:00 AM	12/14/2010
G1012414-014B	B-407		12/10/2010 9:41:00 AM	12/14/2010
G1012414-014C	B-407		12/10/2010 9:41:00 AM	12/14/2010
G1012414-014D	B-407		12/10/2010 9:41:00 AM	12/14/2010
G1012414-014E	B-407		12/10/2010 9:41:00 AM	12/14/2010
G1012414-014F	B-407		12/10/2010 9:41:00 AM	12/14/2010
G1012414-015E	B-412		12/10/2010 10:33:00 AM	12/14/2010

Qualifier Exception Code

(1) Spike recovery limits are not applicable when the sample concentration exceeds the spike concentration by a factor of four or greater.

(2) When the LCS recovery is greater than the upper control limit, sample data is acceptable if it is less than the quantitation limit.

(3) Batch data is acceptable when the matrix spike exceeds control limits but the corresponding LCS is within control limits.

(4) Laboratory duplicate. If one or both of the values is less than 5 times the PQL, the allowed difference is +/- the PQL.

CLIENT: CIVIL & ENVIRONMENTAL-COLUMB
Work Order: G1012414
Project: APEX Second SA

ANALYTICAL QC SUMMARY REPORT

TestCode: ALK_SM2320

Sample ID: **LCS**	SampType: **LCS**	TestCode: **ALK_SM2320**	Units: **mg/L CaCO3**	Prep Date:		RunNo: **70180**
Client ID:	Batch ID: **R70180**	TestNo: **SM 18 2320B**		Analysis Date: **12/17/2010**		SeqNo: **1562865**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Alkalinity to pH 4.5	49.90	5.00	47.5	0	105	85	115				

Sample ID: **LCS**	SampType: **LCS**	TestCode: **ALK_SM2320**	Units: **mg/L CaCO3**	Prep Date:		RunNo: **70180**
Client ID:	Batch ID: **R70180**	TestNo: **SM 18 2320B**		Analysis Date: **12/17/2010**		SeqNo: **1562930**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Alkalinity to pH 4.5	49.50	5.00	47.5	0	104	85	115				

Sample ID: **LCS**	SampType: **LCS**	TestCode: **ALK_SM2320**	Units: **mg/L CaCO3**	Prep Date:		RunNo: **70180**
Client ID:	Batch ID: **R70180**	TestNo: **SM 18 2320B**		Analysis Date: **12/17/2010**		SeqNo: **1562963**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Alkalinity to pH 4.5	48.52	5.00	47.5	0	102	85	115				

Sample ID: **LCS**	SampType: **LCS**	TestCode: **ALK_SM2320**	Units: **mg/L CaCO3**	Prep Date:		RunNo: **70180**
Client ID:	Batch ID: **R70180**	TestNo: **SM 18 2320B**		Analysis Date: **12/17/2010**		SeqNo: **1562996**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Alkalinity to pH 4.5	49.30	5.00	47.5	0	104	85	115				

Sample ID: **LCSD**	SampType: **LCSD**	TestCode: **ALK_SM2320**	Units: **mg/L CaCO3**	Prep Date:		RunNo: **70180**
Client ID:	Batch ID: **R70180**	TestNo: **SM 18 2320B**		Analysis Date: **12/17/2010**		SeqNo: **1563012**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Alkalinity to pH 4.5	50.00	5.00						49.9	0.199	20	

Sample ID: **LCSD**	SampType: **LCSD**	TestCode: **ALK_SM2320**	Units: **mg/L CaCO3**	Prep Date:		RunNo: **70180**
Client ID:	Batch ID: **R70180**	TestNo: **SM 18 2320B**		Analysis Date: **12/17/2010**		SeqNo: **1563013**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Alkalinity to pH 4.5	49.00	5.00						49.5	1.02	20	

CLIENT: CIVIL & ENVIRONMENTAL-COLUMB
Work Order: G1012414
Project: APEX Second SA

ANALYTICAL QC SUMMARY REPORT

TestCode: ALK_SM2320

Sample ID: **LCSD**	SampType: **LCSD**	TestCode: **ALK_SM2320**	Units: **mg/L CaCO3**	Prep Date:			RunNo: **70180**		
Client ID:	Batch ID: **R70180**	TestNo: **SM 18 2320B**		Analysis Date: **12/17/2010**			SeqNo: **1563014**		
Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Alkalinity to pH 4.5	49.00	5.00						48.52	0.994	20	

Sample ID: **G1012377-009AMS**	SampType: **MS**	TestCode: **ALK_SM2320**	Units: **mg/L CaCO3**	Prep Date:			RunNo: **70180**		
Client ID:	Batch ID: **R70180**	TestNo: **SM 18 2320B**		Analysis Date: **12/17/2010**			SeqNo: **1562928**		
Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Alkalinity to pH 4.5	67.00	5.00	47.5	21	96.8	75	125				

Sample ID: **G1012414-012AMS**	SampType: **MS**	TestCode: **ALK_SM2320**	Units: **mg/L CaCO3**	Prep Date:			RunNo: **70180**		
Client ID: **SHAUDS-2**	Batch ID: **R70180**	TestNo: **SM 18 2320B**		Analysis Date: **12/17/2010**			SeqNo: **1562961**		
Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Alkalinity to pH 4.5	361.0	5.00	47.5	314	98.9	75	125				

Sample ID: **G1012420-006BMS**	SampType: **MS**	TestCode: **ALK_SM2320**	Units: **mg/L CaCO3**	Prep Date:			RunNo: **70180**		
Client ID:	Batch ID: **R70180**	TestNo: **SM 18 2320B**		Analysis Date: **12/17/2010**			SeqNo: **1562994**		
Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Alkalinity to pH 4.5	622.0	5.00	47.5	576	96.8	75	125				

Sample ID: **G1012375-001ADUP**	SampType: **DUP**	TestCode: **ALK_SM2320**	Units: **mg/L CaCO3**	Prep Date:			RunNo: **70180**		
Client ID:	Batch ID: **R70180**	TestNo: **SM 18 2320B**		Analysis Date: **12/17/2010**			SeqNo: **1562872**		
Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Alkalinity to pH 4.5	61.00	5.00						62	1.63	20	

Sample ID: **G1012390-001ADUP**	SampType: **DUP**	TestCode: **ALK_SM2320**	Units: **mg/L CaCO3**	Prep Date:			RunNo: **70180**		
Client ID:	Batch ID: **R70180**	TestNo: **SM 18 2320B**		Analysis Date: **12/17/2010**			SeqNo: **1562886**		
Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Alkalinity to pH 4.5	61.00	5.00						59	3.33	20	

CLIENT: CIVIL & ENVIRONMENTAL-COLUMB
Work Order: G1012414
Project: APEX Second SA

ANALYTICAL QC SUMMARY REPORT

TestCode: ALK_SM2320

Sample ID: **G1012414-001ADUP**	SampType: **DUP**	TestCode: **ALK_SM2320**	Units: **mg/L CaCO3**	Prep Date:		RunNo: **70180**			
Client ID: **B-406**	Batch ID: **R70180**	TestNo: **SM 18 2320B**		Analysis Date: **12/17/2010**		SeqNo: **1562948**			
Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Alkalinity to pH 4.5	261.0	5.00						264	1.14	20	

Sample ID: **G1012414-013ADUP**	SampType: **DUP**	TestCode: **ALK_SM2320**	Units: **mg/L CaCO3**	Prep Date:		RunNo: **70180**			
Client ID: **B-413R**	Batch ID: **R70180**	TestNo: **SM 18 2320B**		Analysis Date: **12/17/2010**		SeqNo: **1562967**			
Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Alkalinity to pH 4.5	186.0	5.00						186	0	20	

Sample ID: **G1012420-005BDUP**	SampType: **DUP**	TestCode: **ALK_SM2320**	Units: **mg/L CaCO3**	Prep Date:		RunNo: **70180**			
Client ID:	Batch ID: **R70180**	TestNo: **SM 18 2320B**		Analysis Date: **12/17/2010**		SeqNo: **1562987**			
Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Alkalinity to pH 4.5	295.0	5.00						295	0	20	

CLIENT: CIVIL & ENVIRONMENTAL-COLUMB
Work Order: G1012414
Project: APEX Second SA

ANALYTICAL QC SUMMARY REPORT

TestCode: CL_SM

Sample ID: **LCS**	SampType: **LCS**	TestCode: **CL_SM**	Units: **mg/L**	Prep Date:	RunNo: **70275**
Client ID:	Batch ID: **30307**	TestNo: **SM 4500-Cl E**		Analysis Date: **12/21/2010**	SeqNo: **1565766**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Chloride	54.42	5.00	50	0	109	90	110				

Sample ID: **LCSD**	SampType: **LCSD**	TestCode: **CL_SM**	Units: **mg/L**	Prep Date:	RunNo: **70275**
Client ID:	Batch ID: **30307**	TestNo: **SM 4500-Cl E**		Analysis Date: **12/21/2010**	SeqNo: **1565767**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Chloride	54.75	5.00						54.42	0.599	20	

Sample ID: **G1012414-011CMS**	SampType: **MS**	TestCode: **CL_SM**	Units: **mg/L**	Prep Date: **12/21/2010**	RunNo: **70275**
Client ID: **B-403S**	Batch ID: **30307**	TestNo: **SM 4500-Cl E**		Analysis Date: **12/21/2010**	SeqNo: **1565780**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Chloride	29.44	5.00	25	2.648	107	75	125				

Sample ID: **G1012463-002AMS**	SampType: **MS**	TestCode: **CL_SM**	Units: **mg/L**	Prep Date: **12/21/2010**	RunNo: **70275**
Client ID:	Batch ID: **30307**	TestNo: **SM 4500-Cl E**		Analysis Date: **12/21/2010**	SeqNo: **1565791**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Chloride	52.38	5.00	25	28.892	93.9	75	125				

Sample ID: **G1012529-008CMS**	SampType: **MS**	TestCode: **CL_SM**	Units: **mg/L**	Prep Date: **12/21/2010**	RunNo: **70275**
Client ID:	Batch ID: **30307**	TestNo: **SM 4500-Cl E**		Analysis Date: **12/21/2010**	SeqNo: **1565866**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Chloride	61.08	5.00	25	36.396	98.7	75	125				

Sample ID: **G1012476-018CMS**	SampType: **MS**	TestCode: **CL_SM**	Units: **mg/L**	Prep Date: **12/21/2010**	RunNo: **70275**
Client ID:	Batch ID: **30307**	TestNo: **SM 4500-Cl E**		Analysis Date: **12/21/2010**	SeqNo: **1565888**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Chloride	157.7	10.0	25	136.84	83.5	75	125				

CLIENT: CIVIL & ENVIRONMENTAL-COLUMB
Work Order: G1012414
Project: APEX Second SA

ANALYTICAL QC SUMMARY REPORT

TestCode: CL_SM

Sample ID: **G1012476-009CMS**	SampType: **MS**	TestCode: **CL_SM**	Units: **mg/L**	Prep Date: **12/21/2010**	RunNo: **70275**
Client ID:	Batch ID: **30307**	TestNo: **SM 4500-Cl E**		Analysis Date: **12/21/2010**	SeqNo: **1565892**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Chloride	138.0	10.0	25	117.35	82.6	75	125				

Sample ID: **G1012414-011CDUP**	SampType: **DUP**	TestCode: **CL_SM**	Units: **mg/L**	Prep Date: **12/21/2010**	RunNo: **70275**
Client ID: **B-403S**	Batch ID: **30307**	TestNo: **SM 4500-Cl E**		Analysis Date: **12/21/2010**	SeqNo: **1565779**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Chloride	< 5.00	5.00						2.648	0	20	

Sample ID: **G1012463-002ADUP**	SampType: **DUP**	TestCode: **CL_SM**	Units: **mg/L**	Prep Date: **12/21/2010**	RunNo: **70275**
Client ID:	Batch ID: **30307**	TestNo: **SM 4500-Cl E**		Analysis Date: **12/21/2010**	SeqNo: **1565790**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Chloride	28.66	5.00						28.89	0.796	20	

Sample ID: **G1012529-008CDUP**	SampType: **DUP**	TestCode: **CL_SM**	Units: **mg/L**	Prep Date: **12/21/2010**	RunNo: **70275**
Client ID:	Batch ID: **30307**	TestNo: **SM 4500-Cl E**		Analysis Date: **12/21/2010**	SeqNo: **1565865**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Chloride	35.80	5.00						36.4	1.66	20	

Sample ID: **G1012530-007ADUP**	SampType: **DUP**	TestCode: **CL_SM**	Units: **mg/L**	Prep Date: **12/21/2010**	RunNo: **70275**
Client ID:	Batch ID: **30307**	TestNo: **SM 4500-Cl E**		Analysis Date: **12/21/2010**	SeqNo: **1565879**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Chloride	1212	250						1287	6.06	20	

Sample ID: **G1012476-018CDUP**	SampType: **DUP**	TestCode: **CL_SM**	Units: **mg/L**	Prep Date: **12/21/2010**	RunNo: **70275**
Client ID:	Batch ID: **30307**	TestNo: **SM 4500-Cl E**		Analysis Date: **12/21/2010**	SeqNo: **1565887**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Chloride	137.5	10.0						136.8	0.505	20	

CLIENT: CIVIL & ENVIRONMENTAL-COLUMB
Work Order: G1012414
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ANALYTICAL QC SUMMARY REPORT

TestCode: CL_SM

Sample ID: **G1012476-009CDUP**	SampType: **DUP**	TestCode: **CL_SM**	Units: **mg/L**	Prep Date: **12/21/2010**	RunNo: **70275**
Client ID:	Batch ID: **30307**	TestNo: **SM 4500-Cl E**		Analysis Date: **12/21/2010**	SeqNo: **1565891**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Chloride	117.4	10.0						117.4	0.0494	20	

Sample ID: **CCB**	SampType: **CCB**	TestCode: **CL_SM**	Units: **mg/L**	Prep Date:	RunNo: **70275**
Client ID:	Batch ID: **R70275**	TestNo: **SM 4500-Cl E**		Analysis Date: **12/21/2010**	SeqNo: **1565764**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Chloride	< 5.00	5.00									

Sample ID: **CCB**	SampType: **CCB**	TestCode: **CL_SM**	Units: **mg/L**	Prep Date:	RunNo: **70275**
Client ID:	Batch ID: **R70275**	TestNo: **SM 4500-Cl E**		Analysis Date: **12/21/2010**	SeqNo: **1565775**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Chloride	< 5.00	5.00									

CLIENT: CIVIL & ENVIRONMENTAL-COLUMB
Work Order: G1012414
Project: APEX Second SA

ANALYTICAL QC SUMMARY REPORT

TestCode: EPA8260_VOA

Sample ID: **BLANK** SampType: **MBLK** TestCode: **EPA8260_VO** Units: **µg/L** Prep Date: RunNo: **70064**
Client ID: Batch ID: **R70064** TestNo: **EPA 8260** Analysis Date: **12/15/2010** SeqNo: **1559806**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
1,1,1,2-Tetrachloroethane	< 1.0	1.0									
1,1,1-Trichloroethane	< 1.0	1.0									
1,1,2,2-Tetrachloroethane	< 1.0	1.0									
1,1,2-Trichloroethane	< 1.0	1.0									
1,1-Dichloroethane	< 1.0	1.0									
1,1-Dichloroethene	< 1.0	1.0									
1,2,3-Trichloropropane	< 1.0	1.0									
1,2-Dichlorobenzene	< 1.0	1.0									
1,2-Dichloroethane	< 1.0	1.0									
1,2-Dichloropropane	< 1.0	1.0									
1,4-Dichlorobenzene	< 1.0	1.0									
2-Hexanone	< 5.0	5.0									
4-Methyl-2-Pentanone	< 1.0	1.0									
Acetone	< 10	10									
Acrylonitrile	< 5.0	5.0									
Benzene	< 1.0	1.0									
Bromochloromethane	< 1.0	1.0									
Bromoform	< 1.0	1.0									
Bromomethane	< 1.0	1.0									
Carbon Disulfide	< 1.0	1.0									
Carbon Tetrachloride	< 1.0	1.0									
Chlorobenzene	< 1.0	1.0									
Chlorodibromomethane	< 1.0	1.0									
Chloroethane	< 1.0	1.0									
Chloroform	< 1.0	1.0									
Chloromethane	< 1.0	1.0									
cis-1,2-Dichloroethene	< 1.0	1.0									
cis-1,3-Dichloropropene	< 1.0	1.0									
Dibromomethane	< 1.0	1.0									
Dichlorobromomethane	< 1.0	1.0									
Ethylbenzene	< 1.0	1.0									
Iodomethane	< 5.0	5.0									
Methyl Ethyl Ketone	< 5.0	5.0									
Methylene Chloride	< 1.0	1.0									
Styrene	< 1.0	1.0									
Tetrachloroethene	< 1.0	1.0									

CLIENT: CIVIL & ENVIRONMENTAL-COLUMB
Work Order: G1012414
Project: APEX Second SA

ANALYTICAL QC SUMMARY REPORT

TestCode: EPA8260_VOA

Sample ID: **BLANK**	SampType: **MBLK**	TestCode: **EPA8260_VO**	Units: **µg/L**	Prep Date:	RunNo: **70064**
Client ID:	Batch ID: **R70064**	TestNo: **EPA 8260**		Analysis Date: **12/15/2010**	SeqNo: **1559806**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Toluene	< 1.0	1.0									
Total Xylene	< 2.0	2.0									
trans-1,2-Dichloroethene	< 1.0	1.0									
trans-1,3-Dichloropropene	< 1.0	1.0									
trans-1,4-Dichloro-2-butene	< 2.0	2.0									
Trichloroethene	< 1.0	1.0									
Trichlorofluoromethane	< 1.0	1.0									
Vinyl Acetate	< 1.0	1.0									
Vinyl Chloride	< 1.0	1.0									

Sample ID: **20 PPB LCS**	SampType: **LCS**	TestCode: **EPA8260_VO**	Units: **µg/L**	Prep Date:	RunNo: **70064**
Client ID:	Batch ID: **R70064**	TestNo: **EPA 8260**		Analysis Date: **12/15/2010**	SeqNo: **1559805**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
1,1-Dichloroethene	19.19	1.0	20	0	95.9	67.2	114				
Benzene	18.26	1.0	20	0	91.3	78.4	122				
Chlorobenzene	19.46	1.0	20	0	97.3	87.3	115				
Toluene	18.66	1.0	20	0	93.3	84.6	118				
Trichloroethene	18.92	1.0	20	0	94.6	83.6	119				

Sample ID: **G1012364-011IMS**	SampType: **MS**	TestCode: **EPA8260_VO**	Units: **µg/L**	Prep Date:	RunNo: **70064**
Client ID:	Batch ID: **R70064**	TestNo: **EPA 8260**		Analysis Date: **12/15/2010**	SeqNo: **1559807**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
1,1-Dichloroethene	18.65	1.0	20	0	93.3	54.9	116				
Benzene	17.32	1.0	20	0	86.6	64.3	123				
Chlorobenzene	19.17	1.0	20	0	95.8	72.4	115				
Toluene	18.05	1.0	20	0	90.2	65.2	124				
Trichloroethene	20.31	1.0	20	0	102	65.9	123				

Sample ID: **G1012364-011IMSD**	SampType: **MSD**	TestCode: **EPA8260_VO**	Units: **µg/L**	Prep Date:	RunNo: **70064**
Client ID:	Batch ID: **R70064**	TestNo: **EPA 8260**		Analysis Date: **12/15/2010**	SeqNo: **1559808**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
1,1-Dichloroethene	18.87	1.0	20	0	94.3	54.9	116	18.65	1.13	16.7	

CLIENT: CIVIL & ENVIRONMENTAL-COLUMB
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Project: APEX Second SA

ANALYTICAL QC SUMMARY REPORT

TestCode: EPA8260_VOA

Sample ID: **G1012364-011IMSD** SampType: **MSD** TestCode: **EPA8260_VO** Units: **µg/L** Prep Date: RunNo: **70064**
Client ID: Batch ID: **R70064** TestNo: **EPA 8260** Analysis Date: **12/15/2010** SeqNo: **1559808**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Benzene	17.10	1.0	20	0	85.5	64.3	123	17.32	1.31	15.9	
Chlorobenzene	18.25	1.0	20	0	91.2	72.4	115	19.17	4.92	11.7	
Toluene	19.11	1.0	20	0	95.5	65.2	124	18.05	5.70	18.6	
Trichloroethene	20.08	1.0	20	0	100	65.9	123	20.31	1.16	12.9	

CLIENT: CIVIL & ENVIRONMENTAL-COLUMB
Work Order: G1012414
Project: APEX Second SA

ANALYTICAL QC SUMMARY REPORT

TestCode: NH3D_350.1

Sample ID: **LCS**	SampType: **LCS1**	TestCode: **NH3D_350.1**	Units: **mg/L as N**	Prep Date:	RunNo: **70285**
Client ID:	Batch ID: **30302**	TestNo: **EPA 350.1**		Analysis Date: **12/22/2010**	SeqNo: **1565978**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Ammonia Nitrogen - Distilled	0.8380	0.100	0.82	0	102	90	110				

Sample ID: **G1012414-002BMS**	SampType: **MS**	TestCode: **NH3D_350.1**	Units: **mg/L as N**	Prep Date: **12/22/2010**	RunNo: **70285**
Client ID: **DUP-2**	Batch ID: **30302**	TestNo: **EPA 350.1**		Analysis Date: **12/22/2010**	SeqNo: **1565975**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Ammonia Nitrogen - Distilled	1.161	0.100	1	0.21	95.1	90	110				

Sample ID: **G1012540-004AMS**	SampType: **MS**	TestCode: **NH3D_350.1**	Units: **mg/L as N**	Prep Date: **12/22/2010**	RunNo: **70391**
Client ID:	Batch ID: **30321**	TestNo: **EPA 350.1**		Analysis Date: **12/28/2010**	SeqNo: **1568075**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Ammonia Nitrogen - Distilled	1.067	0.100	1	0.102	96.5	90	110				

Sample ID: **G1012414-008BMS**	SampType: **MS**	TestCode: **NH3D_350.1**	Units: **mg/L as N**	Prep Date: **12/27/2010**	RunNo: **70391**
Client ID: **B-401A**	Batch ID: **30333**	TestNo: **EPA 350.1**		Analysis Date: **12/28/2010**	SeqNo: **1568084**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Ammonia Nitrogen - Distilled	1.032	0.100	1	0.057	97.5	90	110				

Sample ID: **G1012418-002AMS**	SampType: **MS**	TestCode: **NH3D_350.1**	Units: **mg/L as N**	Prep Date: **12/27/2010**	RunNo: **70391**
Client ID:	Batch ID: **30333**	TestNo: **EPA 350.1**		Analysis Date: **12/28/2010**	SeqNo: **1568096**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Ammonia Nitrogen - Distilled	1.093	0.100	1	0.161	93.2	90	110				

Sample ID: **G1012407-001AMS**	SampType: **MS**	TestCode: **NH3D_350.1**	Units: **mg/L as N**	Prep Date: **12/22/2010**	RunNo: **70391**
Client ID:	Batch ID: **30302**	TestNo: **EPA 350.1**		Analysis Date: **12/28/2010**	SeqNo: **1568225**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Ammonia Nitrogen - Distilled	1.217	0.100	1	0.231	98.6	90	110				

CLIENT: CIVIL & ENVIRONMENTAL-COLUMB
Work Order: G1012414
Project: APEX Second SA

ANALYTICAL QC SUMMARY REPORT

TestCode: NH3D_350.1

Sample ID: **G1012414-002BDUP**	SampType: **DUP**	TestCode: **NH3D_350.1**	Units: **mg/L as N**	Prep Date: **12/22/2010**	RunNo: **70285**
Client ID: **DUP-2**	Batch ID: **30302**	TestNo: **EPA 350.1**		Analysis Date: **12/22/2010**	SeqNo: **1565974**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Ammonia Nitrogen - Distilled	< 0.100	0.100						0.21	0	20	

Sample ID: **G1012540-004ADUP**	SampType: **DUP**	TestCode: **NH3D_350.1**	Units: **mg/L as N**	Prep Date: **12/22/2010**	RunNo: **70391**
Client ID:	Batch ID: **30321**	TestNo: **EPA 350.1**		Analysis Date: **12/28/2010**	SeqNo: **1568074**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Ammonia Nitrogen - Distilled	0.1220	0.100						0.102	17.9	20	

Sample ID: **G1012418-002ADUP**	SampType: **DUP**	TestCode: **NH3D_350.1**	Units: **mg/L as N**	Prep Date: **12/27/2010**	RunNo: **70391**
Client ID:	Batch ID: **30333**	TestNo: **EPA 350.1**		Analysis Date: **12/28/2010**	SeqNo: **1568095**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Ammonia Nitrogen - Distilled	0.1710	0.100						0.161	6.02	20	

Sample ID: **G1012414-002BDUP**	SampType: **DUP**	TestCode: **NH3D_350.1**	Units: **mg/L as N**	Prep Date: **12/22/2010**	RunNo: **70391**
Client ID: **DUP-2**	Batch ID: **30302**	TestNo: **EPA 350.1**		Analysis Date: **12/28/2010**	SeqNo: **1568226**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Ammonia Nitrogen - Distilled	< 0.100	0.100						0.21	0	20	

Sample ID: **CCB**	SampType: **CCB**	TestCode: **NH3D_350.1**	Units: **mg/L as N**	Prep Date:	RunNo: **70285**
Client ID:	Batch ID: **R70285**	TestNo: **EPA 350.1**		Analysis Date: **12/22/2010**	SeqNo: **1565964**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Ammonia Nitrogen - Distilled	< 0.100	0.100									

Sample ID: **CCB**	SampType: **CCB**	TestCode: **NH3D_350.1**	Units: **mg/L as N**	Prep Date:	RunNo: **70285**
Client ID:	Batch ID: **R70285**	TestNo: **EPA 350.1**		Analysis Date: **12/22/2010**	SeqNo: **1565976**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Ammonia Nitrogen - Distilled	< 0.100	0.100									

CLIENT: CIVIL & ENVIRONMENTAL-COLUMB
Work Order: G1012414
Project: APEX Second SA

ANALYTICAL QC SUMMARY REPORT

TestCode: NH3D_350.1

Sample ID: **CCB**	SampType: **CCB**	TestCode: **NH3D_350.1**	Units: **mg/L as N**	Prep Date:	RunNo: **70391**
Client ID:	Batch ID: **R70391**	TestNo: **EPA 350.1**		Analysis Date: **12/28/2010**	SeqNo: **1568076**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Ammonia Nitrogen - Distilled	< 0.100	0.100									

Sample ID: **CCB**	SampType: **CCB**	TestCode: **NH3D_350.1**	Units: **mg/L as N**	Prep Date:	RunNo: **70391**
Client ID:	Batch ID: **R70391**	TestNo: **EPA 350.1**		Analysis Date: **12/28/2010**	SeqNo: **1568086**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Ammonia Nitrogen - Distilled	< 0.100	0.100									

Sample ID: **CCB**	SampType: **CCB**	TestCode: **NH3D_350.1**	Units: **mg/L as N**	Prep Date:	RunNo: **70391**
Client ID:	Batch ID: **R70391**	TestNo: **EPA 350.1**		Analysis Date: **12/28/2010**	SeqNo: **1568097**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Ammonia Nitrogen - Distilled	< 0.100	0.100									

CLIENT: CIVIL & ENVIRONMENTAL-COLUMB
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TestCode: NO3-NO2_353.2

Sample ID: **LCS**	SampType: **LCS**	TestCode: **NO3-NO2_35**	Units: **mg/L as N**	Prep Date:	RunNo: **70204**
Client ID:	Batch ID: **30243**	TestNo: **EPA 353.2**		Analysis Date: **12/20/2010**	SeqNo: **1564237**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Nitrate - Nitrite	1.014	0.050	1	0	101	90	110				

Sample ID: **LCS**	SampType: **LCS**	TestCode: **NO3-NO2_35**	Units: **mg/L as N**	Prep Date:	RunNo: **70204**
Client ID:	Batch ID: **30243**	TestNo: **EPA 353.2**		Analysis Date: **12/20/2010**	SeqNo: **1564239**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Nitrate - Nitrite	1.010	0.050	1	0	101	90	110				

Sample ID: **LCSD**	SampType: **LCSD**	TestCode: **NO3-NO2_35**	Units: **mg/L as N**	Prep Date:	RunNo: **70204**
Client ID:	Batch ID: **30243**	TestNo: **EPA 353.2**		Analysis Date: **12/20/2010**	SeqNo: **1564238**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Nitrate - Nitrite	1.004	0.050						1.014	0.991	20	

Sample ID: **LCSD**	SampType: **LCSD**	TestCode: **NO3-NO2_35**	Units: **mg/L as N**	Prep Date:	RunNo: **70204**
Client ID:	Batch ID: **30243**	TestNo: **EPA 353.2**		Analysis Date: **12/20/2010**	SeqNo: **1564240**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Nitrate - Nitrite	1.016	0.050						1.01	0.592	20	

Sample ID: **G1012414-009BMS**	SampType: **MS**	TestCode: **NO3-NO2_35**	Units: **mg/L as N**	Prep Date:	RunNo: **70204**
Client ID: **B-403**	Batch ID: **30243**	TestNo: **EPA 353.2**		Analysis Date: **12/20/2010**	SeqNo: **1563565**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Nitrate - Nitrite	1.330	0.050	1	0.29	104	90	110				

Sample ID: **G1012414-009BDUP**	SampType: **DUP**	TestCode: **NO3-NO2_35**	Units: **mg/L as N**	Prep Date:	RunNo: **70204**
Client ID: **B-403**	Batch ID: **30243**	TestNo: **EPA 353.2**		Analysis Date: **12/20/2010**	SeqNo: **1563564**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Nitrate - Nitrite	0.2920	0.050						0.29	0.687	20	

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TestCode: NO3-NO2_353.2

Sample ID: **CCB**	SampType: **CCB**	TestCode: **NO3-NO2_35**	Units: **mg/L as N**	Prep Date:	RunNo: **70204**
Client ID:	Batch ID: **R70204**	TestNo: **EPA 353.2**		Analysis Date: **12/20/2010**	SeqNo: **1563546**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Nitrate - Nitrite	< 0.050	0.050									

Sample ID: **CCB**	SampType: **CCB**	TestCode: **NO3-NO2_35**	Units: **mg/L as N**	Prep Date:	RunNo: **70204**
Client ID:	Batch ID: **R70204**	TestNo: **EPA 353.2**		Analysis Date: **12/20/2010**	SeqNo: **1563559**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Nitrate - Nitrite	< 0.050	0.050									

Sample ID: **CCB**	SampType: **CCB**	TestCode: **NO3-NO2_35**	Units: **mg/L as N**	Prep Date:	RunNo: **70204**
Client ID:	Batch ID: **R70204**	TestNo: **EPA 353.2**		Analysis Date: **12/20/2010**	SeqNo: **1563573**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Nitrate - Nitrite	< 0.050	0.050									

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TestCode: TDS_SM 2540-C

Sample ID: **LCS**	SampType: **LCS**	TestCode: **TDS_SM 254**	Units: **mg/L**	Prep Date:			RunNo: **70117**			
Client ID:	Batch ID: **R70117**	TestNo: **SM2540-C**		Analysis Date: **12/15/2010**			SeqNo: **1560908**			
Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Total dissolved solids	276.0	20.0	292	0	94.5	85	115				

Sample ID: **LCS**	SampType: **LCS**	TestCode: **TDS_SM 254**	Units: **mg/L**	Prep Date:			RunNo: **70117**			
Client ID:	Batch ID: **R70117**	TestNo: **SM2540-C**		Analysis Date: **12/15/2010**			SeqNo: **1560934**			
Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Total dissolved solids	282.0	20.0	292	0	96.6	85	115				

Sample ID: **LCS**	SampType: **LCS**	TestCode: **TDS_SM 254**	Units: **mg/L**	Prep Date:			RunNo: **70117**			
Client ID:	Batch ID: **R70117**	TestNo: **SM2540-C**		Analysis Date: **12/15/2010**			SeqNo: **1560958**			
Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Total dissolved solids	274.0	20.0	292	0	93.8	85	115				

Sample ID: **G1012411-001ADUP**	SampType: **DUP**	TestCode: **TDS_SM 254**	Units: **mg/L**	Prep Date:			RunNo: **70117**			
Client ID:	Batch ID: **R70117**	TestNo: **SM2540-C**		Analysis Date: **12/15/2010**			SeqNo: **1560909**			
Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Total dissolved solids	2070	20.0						2116	2.20	20	

Sample ID: **G1012414-009ADUP**	SampType: **DUP**	TestCode: **TDS_SM 254**	Units: **mg/L**	Prep Date:			RunNo: **70117**			
Client ID: **B-403**	Batch ID: **R70117**	TestNo: **SM2540-C**		Analysis Date: **12/15/2010**			SeqNo: **1560922**			
Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Total dissolved solids	1140	20.0						1112	2.49	20	

Sample ID: **G1012420-003BDUP**	SampType: **DUP**	TestCode: **TDS_SM 254**	Units: **mg/L**	Prep Date:			RunNo: **70117**			
Client ID:	Batch ID: **R70117**	TestNo: **SM2540-C**		Analysis Date: **12/15/2010**			SeqNo: **1560936**			
Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Total dissolved solids	468.0	20.0						448	4.37	20	

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TestCode: TDS_SM 2540-C

Sample ID: **G1012426-002ADUP**	SampType: **DUP**	TestCode: **TDS_SM 254**	Units: **mg/L**	Prep Date:	RunNo: **70117**
Client ID:	Batch ID: **R70117**	TestNo: **SM2540-C**		Analysis Date: **12/15/2010**	SeqNo: **1560944**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Total dissolved solids	278.0	20.0						278	0	20	

Sample ID: **G1012433-006ADUP**	SampType: **DUP**	TestCode: **TDS_SM 254**	Units: **mg/L**	Prep Date:	RunNo: **70117**
Client ID:	Batch ID: **R70117**	TestNo: **SM2540-C**		Analysis Date: **12/15/2010**	SeqNo: **1560959**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Total dissolved solids	34.00	20.0						34	0	20	

Sample ID: **G1012450-002ADUP**	SampType: **DUP**	TestCode: **TDS_SM 254**	Units: **mg/L**	Prep Date:	RunNo: **70117**
Client ID:	Batch ID: **R70117**	TestNo: **SM2540-C**		Analysis Date: **12/15/2010**	SeqNo: **1561000**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Total dissolved solids	764.0	20.0						736	3.73	20	

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TestCode: TOT_METALS

Sample ID: **LCS1-30155**	SampType: **LCS1**	TestCode: **TOT_METAL**	Units: **mg/L**	Prep Date: **12/15/2010**	RunNo: **70170**
Client ID:	Batch ID: **30155**	TestNo: **EPA 200.7**		Analysis Date: **12/17/2010**	SeqNo: **1562612**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Antimony	1.029	0.0200	1	0	103	85	115				
Arsenic	1.019	0.0200	1	0	102	85	115				
Barium	1.041	0.0100	1	0	104	85	115				
Beryllium	0.2059	0.00100	0.2	0	103	85	115				
Cadmium	0.4100	0.00200	0.4	0	102	85	115				
Calcium	10.42	0.100	10	0	104	85	115				
Chromium	1.022	0.0100	1	0	102	85	115				
Cobalt	0.4176	0.00500	0.4	0	104	85	115				
Copper	1.072	0.0100	1	0	107	85	115				
Iron	10.30	0.0500	10	0	103	85	115				
Lead	1.060	0.0200	1	0	106	85	115				
Magnesium	2.005	0.100	2	0	100	85	115				
Manganese	1.084	0.0100	1	0	108	85	115				
Nickel	1.058	0.0100	1	0	106	85	115				
Potassium	10.34	0.500	10	0	103	85	115				
Selenium	1.041	0.0200	1	0	104	85	115				
Silver	0.01030	0.00500	0.01	0	103	85	115				
Sodium	10.28	0.200	10	0	103	85	115				
Thallium	1.063	0.0200	1	0	106	85	115				
Vanadium	0.4074	0.00500	0.4	0	102	85	115				
Zinc	1.032	0.0100	1	0	103	85	115				

Sample ID: **LCSD1-30155**	SampType: **LCSD1**	TestCode: **TOT_METAL**	Units: **mg/L**	Prep Date: **12/15/2010**	RunNo: **70170**
Client ID:	Batch ID: **30155**	TestNo: **EPA 200.7**		Analysis Date: **12/17/2010**	SeqNo: **1562613**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Antimony	1.021	0.0200						1.029	0.780	20	
Arsenic	1.011	0.0200						1.019	0.788	20	
Barium	1.050	0.0100						1.041	0.861	20	
Beryllium	0.2079	0.00100						0.2059	0.967	20	
Cadmium	0.4097	0.00200						0.41	0.0732	20	
Calcium	10.64	0.100						10.42	2.09	20	
Chromium	1.017	0.0100						1.022	0.490	20	
Cobalt	0.4151	0.00500						0.4176	0.600	20	
Copper	1.064	0.0100						1.072	0.749	20	

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TestCode: TOT_METALS

Sample ID: **LCSD1-30155**	SampType: **LCSD1**	TestCode: **TOT_METAL**	Units: **mg/L**	Prep Date: **12/15/2010**	RunNo: **70170**
Client ID:	Batch ID: **30155**	TestNo: **EPA 200.7**		Analysis Date: **12/17/2010**	SeqNo: **1562613**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Iron	10.27	0.0500						10.3	0.292	20	
Lead	1.059	0.0200						1.06	0.0944	20	
Magnesium	2.006	0.100						2.005	0.0499	20	
Manganese	1.102	0.0100						1.084	1.65	20	
Nickel	1.052	0.0100						1.058	0.569	20	
Potassium	10.28	0.500						10.34	0.582	20	
Selenium	1.032	0.0200						1.041	0.868	20	
Silver	0.01020	0.00500						0.0103	0.976	20	
Sodium	10.40	0.200						10.28	1.16	20	
Thallium	1.061	0.0200						1.063	0.188	20	
Vanadium	0.4153	0.00500						0.4074	1.92	20	
Zinc	1.027	0.0100						1.032	0.486	20	

Sample ID: **PB-30155**	SampType: **MBLK**	TestCode: **TOT_METAL**	Units: **mg/L**	Prep Date: **12/15/2010**	RunNo: **70170**
Client ID:	Batch ID: **30155**	TestNo: **EPA 200.7**		Analysis Date: **12/17/2010**	SeqNo: **1562611**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Antimony	< 0.0200	0.0200									
Arsenic	< 0.0200	0.0200									
Barium	< 0.0100	0.0100									
Beryllium	< 0.00100	0.00100									
Cadmium	< 0.00200	0.00200									
Calcium	< 0.100	0.100									
Chromium	< 0.0100	0.0100									
Cobalt	< 0.00500	0.00500									
Copper	< 0.0100	0.0100									
Iron	< 0.0500	0.0500									
Lead	< 0.0200	0.0200									
Magnesium	< 0.100	0.100									
Manganese	< 0.0100	0.0100									
Nickel	< 0.0100	0.0100									
Potassium	< 0.500	0.500									
Selenium	< 0.0200	0.0200									
Silver	< 0.00500	0.00500									
Sodium	< 0.200	0.200									

Sample ID: **PB-30155**	SampType: **MBLK**	TestCode: **TOT_METAL**	Units: **mg/L**	Prep Date: **12/15/2010**	RunNo: **70170**
Client ID:	Batch ID: **30155**	TestNo: **EPA 200.7**		Analysis Date: **12/17/2010**	SeqNo: **1562611**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Thallium	< 0.0200	0.0200									
Vanadium	< 0.00500	0.00500									
Zinc	< 0.0100	0.0100									

Sample ID: **G1012414-001EMS**	SampType: **MS**	TestCode: **TOT_METAL**	Units: **mg/L**	Prep Date: **12/15/2010**	RunNo: **70216**
Client ID: **B-406**	Batch ID: **30155**	TestNo: **EPA 200.7**		Analysis Date: **12/20/2010**	SeqNo: **1563981**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Barium	1.088	0.0100	1	0.0244	106	75	125				
Beryllium	0.2068	0.00100	0.2	0	103	75	125				
Cadmium	0.4495	0.00200	0.4	0	112	75	125				
Calcium	292.0	0.100	10	292.3	-3.00	75	125				1
Chromium	1.133	0.0100	1	0	113	75	125				
Cobalt	0.4495	0.00500	0.4	0.0044	111	75	125				
Copper	1.069	0.0100	1	0	107	75	125				
Iron	11.72	0.0500	10	0.7489	110	75	125				
Magnesium	84.38	0.100	2	85.45	-53.5	75	125				1
Manganese	2.307	0.0100	1	1.275	103	75	125				
Nickel	1.135	0.0100	1	0	113	75	125				
Potassium	14.75	0.500	10	3.561	112	75	125				
Silver	0.01050	0.00500	0.01	0	105	75	125				
Sodium	76.27	0.200	10	69.26	70.1	75	125				1
Vanadium	0.4322	0.00500	0.4	0	108	75	125				
Zinc	1.111	0.0100	1	0	111	75	125				

Sample ID: **G1012414-008EMS**	SampType: **MS**	TestCode: **TOT_METAL**	Units: **mg/L**	Prep Date: **12/15/2010**	RunNo: **70216**
Client ID: **B-401A**	Batch ID: **30155**	TestNo: **EPA 200.7**		Analysis Date: **12/20/2010**	SeqNo: **1563996**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Barium	1.031	0.0100	1	0	103	75	125				
Beryllium	0.1912	0.00100	0.2	0	95.6	75	125				
Cadmium	0.4607	0.00200	0.4	0	115	75	125				
Chromium	1.158	0.0100	1	0	116	75	125				
Cobalt	0.4588	0.00500	0.4	0	115	75	125				
Copper	1.008	0.0100	1	0	101	75	125				

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TestCode: TOT_METALS

Sample ID: **G1012414-008EMS**	SampType: **MS**	TestCode: **TOT_METAL**	Units: **mg/L**	Prep Date: **12/15/2010**	RunNo: **70216**
Client ID: **B-401A**	Batch ID: **30155**	TestNo: **EPA 200.7**		Analysis Date: **12/20/2010**	SeqNo: **1563996**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Iron	11.00	0.0500	10	0	110	75	125				
Manganese	1.203	0.0100	1	0	120	75	125				
Nickel	1.171	0.0100	1	0	117	75	125				
Silver	0.009200	0.00500	0.01	0	92.0	75	125				
Vanadium	0.4244	0.00500	0.4	0	106	75	125				
Zinc	1.118	0.0100	1	0	112	75	125				

Sample ID: **G1012414-001EDUP**	SampType: **DUP**	TestCode: **TOT_METAL**	Units: **mg/L**	Prep Date: **12/15/2010**	RunNo: **70216**
Client ID: **B-406**	Batch ID: **30155**	TestNo: **EPA 200.7**		Analysis Date: **12/20/2010**	SeqNo: **1563979**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Barium	0.02430	0.0100						0.0244	0.411	20	
Beryllium	< 0.00100	0.00100						0	0	20	
Cadmium	< 0.00200	0.00200						0	0	20	
Calcium	287.4	0.100						292.3	1.69	20	
Chromium	< 0.0100	0.0100						0	0	20	
Cobalt	< 0.00500	0.00500						0.0044	0	20	
Copper	< 0.0100	0.0100						0	0	20	
Iron	0.7250	0.0500						0.7489	3.24	20	
Magnesium	84.30	0.100						85.45	1.35	20	
Manganese	1.247	0.0100						1.275	2.22	20	
Nickel	< 0.0100	0.0100						0	0	20	
Potassium	3.593	0.500						3.561	0.895	20	
Silver	< 0.00500	0.00500						0	0	20	
Sodium	66.71	0.200						69.26	3.75	20	
Vanadium	< 0.00500	0.00500						0	0	20	
Zinc	< 0.0100	0.0100						0	0	20	

Sample ID: **CCB**	SampType: **CCB**	TestCode: **TOT_METAL**	Units: **mg/L**	Prep Date:	RunNo: **70216**
Client ID:	Batch ID: **R70216**	TestNo: **EPA 200.7**		Analysis Date: **12/20/2010**	SeqNo: **1563969**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Antimony	< 0.0200	0.0200									
Arsenic	< 0.0200	0.0200									
Barium	< 0.0100	0.0100									

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TestCode: TOT_METALS

Sample ID: **CCB**	SampType: **CCB**	TestCode: **TOT_METAL**	Units: **mg/L**	Prep Date:	RunNo: **70216**
Client ID:	Batch ID: **R70216**	TestNo: **EPA 200.7**		Analysis Date: **12/20/2010**	SeqNo: **1563969**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Beryllium	< 0.00100	0.00100									
Cadmium	< 0.00200	0.00200									
Calcium	< 0.100	0.100									
Chromium	< 0.0100	0.0100									
Cobalt	< 0.00500	0.00500									
Copper	< 0.0100	0.0100									
Iron	< 0.0500	0.0500									
Lead	< 0.0200	0.0200									
Magnesium	< 0.100	0.100									
Manganese	< 0.0100	0.0100									
Nickel	< 0.0100	0.0100									
Potassium	< 0.500	0.500									
Selenium	< 0.0200	0.0200									
Silver	< 0.00500	0.00500									
Sodium	< 0.200	0.200									
Thallium	< 0.0200	0.0200									
Vanadium	< 0.00500	0.00500									
Zinc	< 0.0100	0.0100									

Sample ID: **CCB**	SampType: **CCB**	TestCode: **TOT_METAL**	Units: **mg/L**	Prep Date:	RunNo: **70216**
Client ID:	Batch ID: **R70216**	TestNo: **EPA 200.7**		Analysis Date: **12/20/2010**	SeqNo: **1563987**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Antimony	< 0.0200	0.0200									
Arsenic	< 0.0200	0.0200									
Barium	< 0.0100	0.0100									
Beryllium	< 0.00100	0.00100									
Cadmium	< 0.00200	0.00200									
Calcium	< 0.100	0.100									
Chromium	< 0.0100	0.0100									
Cobalt	< 0.00500	0.00500									
Copper	< 0.0100	0.0100									
Iron	< 0.0500	0.0500									
Lead	< 0.0200	0.0200									
Magnesium	< 0.100	0.100									

Sample ID: **CCB**	SampType: **CCB**	TestCode: **TOT_METAL**	Units: **mg/L**	Prep Date:	RunNo: **70216**
Client ID:	Batch ID: **R70216**	TestNo: **EPA 200.7**		Analysis Date: **12/20/2010**	SeqNo: **1563987**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Manganese	< 0.0100	0.0100									
Nickel	< 0.0100	0.0100									
Potassium	< 0.500	0.500									
Selenium	< 0.0200	0.0200									
Silver	< 0.00500	0.00500									
Sodium	< 0.200	0.200									
Thallium	< 0.0200	0.0200									
Vanadium	< 0.00500	0.00500									
Zinc	< 0.0100	0.0100									

Sample ID: **CCB**	SampType: **CCB**	TestCode: **TOT_METAL**	Units: **mg/L**	Prep Date:	RunNo: **70216**
Client ID:	Batch ID: **R70216**	TestNo: **EPA 200.7**		Analysis Date: **12/20/2010**	SeqNo: **1564005**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Antimony	< 0.0200	0.0200									
Arsenic	< 0.0200	0.0200									
Barium	< 0.0100	0.0100									
Beryllium	< 0.00100	0.00100									
Cadmium	< 0.00200	0.00200									
Calcium	< 0.100	0.100									
Chromium	< 0.0100	0.0100									
Cobalt	< 0.00500	0.00500									
Copper	< 0.0100	0.0100									
Iron	< 0.0500	0.0500									
Lead	< 0.0200	0.0200									
Magnesium	< 0.100	0.100									
Manganese	< 0.0100	0.0100									
Nickel	< 0.0100	0.0100									
Potassium	< 0.500	0.500									
Selenium	< 0.0200	0.0200									
Silver	< 0.00500	0.00500									
Sodium	< 0.200	0.200									
Thallium	< 0.0200	0.0200									
Vanadium	< 0.00500	0.00500									
Zinc	< 0.0100	0.0100									

CLIENT: CIVIL & ENVIRONMENTAL-COLUMB
Work Order: G1012414
Project: APEX Second SA

ANALYTICAL QC SUMMARY REPORT

TestCode: TOT_METALS

Sample ID: **CCB**	SampType: **CCB**	TestCode: **TOT_METAL**	Units: **mg/L**	Prep Date:	RunNo: **70216**
Client ID:	Batch ID: **R70216**	TestNo: **EPA 200.7**		Analysis Date: **12/20/2010**	SeqNo: **1564024**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Antimony	< 0.0200	0.0200									
Arsenic	< 0.0200	0.0200									
Barium	< 0.0100	0.0100									
Beryllium	< 0.00100	0.00100									
Cadmium	< 0.00200	0.00200									
Calcium	< 0.100	0.100									
Chromium	< 0.0100	0.0100									
Cobalt	< 0.00500	0.00500									
Copper	< 0.0100	0.0100									
Iron	< 0.0500	0.0500									
Lead	< 0.0200	0.0200									
Magnesium	< 0.100	0.100									
Manganese	< 0.0100	0.0100									
Nickel	< 0.0100	0.0100									
Potassium	< 0.500	0.500									
Selenium	< 0.0200	0.0200									
Silver	< 0.00500	0.00500									
Sodium	< 0.200	0.200									
Thallium	< 0.0200	0.0200									
Vanadium	< 0.00500	0.00500									
Zinc	< 0.0100	0.0100									

Sample ID: **CCB**	SampType: **CCB**	TestCode: **TOT_METAL**	Units: **mg/L**	Prep Date:	RunNo: **70256**
Client ID:	Batch ID: **R70256**	TestNo: **EPA 200.7**		Analysis Date: **12/21/2010**	SeqNo: **1565254**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Antimony	< 0.0200	0.0200									
Arsenic	< 0.0200	0.0200									
Barium	< 0.0100	0.0100									
Beryllium	< 0.00100	0.00100									
Cadmium	< 0.00200	0.00200									
Calcium	< 0.100	0.100									
Chromium	< 0.0100	0.0100									
Cobalt	< 0.00500	0.00500									
Copper	< 0.0100	0.0100									

CLIENT: CIVIL & ENVIRONMENTAL-COLUMB
Work Order: G1012414
Project: APEX Second SA

ANALYTICAL QC SUMMARY REPORT

TestCode: TOT_METALS

Sample ID: **CCB**	SampType: **CCB**	TestCode: **TOT_METAL**	Units: **mg/L**	Prep Date:	RunNo: **70256**
Client ID:	Batch ID: **R70256**	TestNo: **EPA 200.7**		Analysis Date: **12/21/2010**	SeqNo: **1565254**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Iron	< 0.0500	0.0500									
Lead	< 0.0200	0.0200									
Magnesium	< 0.100	0.100									
Manganese	< 0.0100	0.0100									
Nickel	< 0.0100	0.0100									
Potassium	< 0.500	0.500									
Selenium	< 0.0200	0.0200									
Silver	< 0.00500	0.00500									
Sodium	< 0.200	0.200									
Thallium	< 0.0200	0.0200									
Vanadium	< 0.00500	0.00500									
Zinc	< 0.0100	0.0100									

Sample ID: **CCB**	SampType: **CCB**	TestCode: **TOT_METAL**	Units: **mg/L**	Prep Date:	RunNo: **70256**
Client ID:	Batch ID: **R70256**	TestNo: **EPA 200.7**		Analysis Date: **12/21/2010**	SeqNo: **1565266**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Antimony	< 0.0200	0.0200									
Arsenic	< 0.0200	0.0200									
Barium	< 0.0100	0.0100									
Beryllium	< 0.00100	0.00100									
Cadmium	< 0.00200	0.00200									
Calcium	< 0.100	0.100									
Chromium	< 0.0100	0.0100									
Cobalt	< 0.00500	0.00500									
Copper	< 0.0100	0.0100									
Iron	< 0.0500	0.0500									
Lead	< 0.0200	0.0200									
Magnesium	< 0.100	0.100									
Manganese	< 0.0100	0.0100									
Nickel	< 0.0100	0.0100									
Potassium	< 0.500	0.500									
Selenium	< 0.0200	0.0200									
Silver	< 0.00500	0.00500									
Sodium	< 0.200	0.200									

CLIENT: CIVIL & ENVIRONMENTAL-COLUMB
Work Order: G1012414
Project: APEX Second SA

ANALYTICAL QC SUMMARY REPORT

TestCode: TOT_METALS

Sample ID: **CCB**	SampType: **CCB**	TestCode: **TOT_METAL**	Units: **mg/L**	Prep Date:	RunNo: **70256**
Client ID:	Batch ID: **R70256**	TestNo: **EPA 200.7**		Analysis Date: **12/21/2010**	SeqNo: **1565266**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Thallium	< 0.0200	0.0200									
Vanadium	< 0.00500	0.00500									
Zinc	< 0.0100	0.0100									

CLIENT: CIVIL & ENVIRONMENTAL-COLUMB
Work Order: G1012414
Project: APEX Second SA

ANALYTICAL QC SUMMARY REPORT

TestCode: TOT-ICPMS_200.8

Sample ID: **PB-30155**	SampType: **PB**	TestCode: **TOT-ICPMS_**	Units: **µg/L**	Prep Date: **12/15/2010**	RunNo: **70120**
Client ID:	Batch ID: **30155**	TestNo: **EPA 200.8**		Analysis Date: **12/16/2010**	SeqNo: **1561038**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Antimony	< 1.00	1.00									
Arsenic	< 1.00	1.00									
Lead	< 1.00	1.00									
Selenium	< 1.00	1.00									
Thallium	< 0.200	0.200									

Sample ID: **LCS2-30155**	SampType: **LCS2**	TestCode: **TOT-ICPMS_**	Units: **µg/L**	Prep Date: **12/15/2010**	RunNo: **70120**
Client ID:	Batch ID: **30155**	TestNo: **EPA 200.8**		Analysis Date: **12/16/2010**	SeqNo: **1561039**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Antimony	6.638	1.00	6	0	111	85	115				
Arsenic	9.556	1.00	10	0	95.6	85	115				
Lead	5.082	1.00	5	0	102	85	115				
Selenium	20.72	1.00	20	0	104	85	115				
Thallium	1.878	0.200	2	0	93.9	85	115				

Sample ID: **LCSD2-30155**	SampType: **LCSD2**	TestCode: **TOT-ICPMS_**	Units: **µg/L**	Prep Date: **12/15/2010**	RunNo: **70120**
Client ID:	Batch ID: **30155**	TestNo: **EPA 200.8**		Analysis Date: **12/16/2010**	SeqNo: **1561040**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Antimony	6.686	1.00						6.638	0.708	20	
Arsenic	9.778	1.00						9.556	2.30	20	
Lead	5.123	1.00						5.082	0.807	20	
Selenium	21.24	1.00						20.72	2.46	20	
Thallium	1.874	0.200						1.878	0.219	20	

Sample ID: **G1012414-007EMS**	SampType: **MS**	TestCode: **TOT-ICPMS_**	Units: **µg/L**	Prep Date: **12/15/2010**	RunNo: **70120**
Client ID: **B-401**	Batch ID: **30155**	TestNo: **EPA 200.8**		Analysis Date: **12/16/2010**	SeqNo: **1561049**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Antimony	6.331	1.00	6	0	106	70	130				
Arsenic	9.830	1.00	10	0	98.3	70	130				
Lead	4.927	1.00	5	0	98.5	70	130				
Selenium	22.93	1.00	20	4.9875	89.7	70	130				
Thallium	1.939	0.200	2	0	97.0	70	130				

CLIENT: CIVIL & ENVIRONMENTAL-COLUMB
Work Order: G1012414
Project: APEX Second SA

ANALYTICAL QC SUMMARY REPORT

TestCode: TOT-ICPMS_200.8

Sample ID: **G1012414-014EMS**	SampType: **MS**	TestCode: **TOT-ICPMS_**	Units: **µg/L**	Prep Date: **12/15/2010**	RunNo: **70120**
Client ID: **B-407**	Batch ID: **30155**	TestNo: **EPA 200.8**		Analysis Date: **12/16/2010**	SeqNo: **1561058**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Antimony	6.528	1.00	6	0	109	70	130				
Arsenic	13.54	1.00	10	3.071	105	70	130				
Lead	4.928	1.00	5	0	98.6	70	130				
Selenium	20.53	1.00	20	0	103	70	130				
Thallium	1.806	0.200	2	0	90.3	70	130				

Sample ID: **G1012414-001EDUP**	SampType: **DUP**	TestCode: **TOT-ICPMS_**	Units: **µg/L**	Prep Date: **12/15/2010**	RunNo: **70120**
Client ID: **B-406**	Batch ID: **30155**	TestNo: **EPA 200.8**		Analysis Date: **12/16/2010**	SeqNo: **1561042**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Antimony	< 1.00	1.00						0	0	20	
Arsenic	2.637	1.00						2.781	5.32	20	
Lead	< 1.00	1.00						0.2708	0	20	
Selenium	< 1.00	1.00						0	0	20	
Thallium	< 0.200	0.200						0.1396	0	20	

GLOSSARY OF TERMS

Aliquot: A separate measured and representative portion of a sample used for analysis.

Analyte: The specific chemicals or components that a sample is used for analysis.

Acceptance Criteria: Specified limits established either from a method or by the laboratory for a target analyte.

Accuracy: The measured agreement between an observed value and an accepted reference value.

Corporate Detection Limit (CDL): The value based on method detection limits that may encompass multiple studies generated from several instruments. The CDL is based on the highest MDL study and is rounded to a useable value.

Corporate Quantitation Limit (CQL): The laboratory's lowest level of data quantification for reporting a target analyte at a concentration level that does not require use of data qualifiers. The CQL is calculated as two times the Corporate Detection Limit (CDL) or two times the CDL times any dilution factor.

Batch: Samples prepared or analyzed together with the same process and personnel, using the same lot(s) of reagents. A **preparation batch** is a group of one to twenty samples of the same defined matrix, meeting the above-mentioned conditions and with a maximum time between the start of processing of the first and last sample in the batch to be 24 hours. An **analytical batch** is comprised of prepared samples (extracts, digestates or concentrates) that are analyzed together as a group. An analytical batch can include prepared samples originating from various sample matrices and may exceed 20 samples.

Chain of Custody: A form that documents the possession of the samples from the time of collection to lab receipt. This record includes: sample matrix, the number and types of containers; the mode of collection; collector; time of collection; preservation; and requested analyses.

Equipment Blank: Sampling equipment rinsed with laboratory water immediately before use in sampling with the rinsing submitted to the laboratory as a sample for analysis. Data from the analysis of equipment blanks provides a check on sampling device cleanliness.

Field Duplicate: Two separate samples taken from the same source (e.g. monitoring well) and analyzed independently. The data obtained from field duplicate samples is used to evaluate the variability of the sampling procedures and the source from which the sample was obtained. There are no acceptance criteria for comparing field duplicate data results.

Laboratory Control Sample (LCS): A sample matrix, free from the analytes of interest, spiked with known amounts of analytes or a material containing known and verified amounts of analytes. It is used to establish intra-laboratory or analyst-specific precision and bias or to assess the performance of a method.

Matrix: The component or substrate that contains the analyte of interest. For purposes of batch and QC requirement determinations, the following matrix distinctions are used:

- Aqueous: Any aqueous sample excluded from the definition of Drinking Water matrix or Saline/Estuarine source. Includes surface water, groundwater, effluents and TCLP or other extracts.
- Drinking water: Any aqueous sample designated a potable or potential potable water source.

- ❖ Non-aqueous Liquid: Any organic liquid with < 15% settleable solids.
- ❖ Solids: Includes soils, sediments, sludges and other matricies with > 15% settleable solids.
- ❖ Chemical Waste: A product or by-product of an industrial process that results in a matrix not previously defined.

Matrix Spike (MS): A sample prepared by adding a known mass of target analyte to a specified amount of matrix sample for which an independent estimate of target analyte concentration is available. Matrix spikes are used to determine the effect of the matrix on a method's recovery efficiency. Calculation of recovery data is not quality assessed when the concentration of the target analyte in the unspiked sample is $\geq$ 4x the spiking concentration.

Matrix Spike Duplicate (MSD): A second replicate matrix spike prepared in the laboratory and analyzed to obtain a measure of the precision of the recovery for each analyte. Calculation of recovery data is not required when the concentration of the target analyte in the unspiked sample is $\geq$ 4x the spiking concentration.

Method Detection Limit: The minimum concentration of an analyte that can be measured and reported with 99% confidence that the analyte concentration is greater than zero and is determined from analysis of a sample in deionized water containing the analyte. MDLs are verified annually and are subject to change.

Preservation: Refrigeration and/or reagents added at the time of sample collection to maintain the chemical and/or biological integrity of the sample.

Recovery: The total amount of the analyte found in the sample divided by the amount of the analyte added into the sample as a spike.

Relative Percent Difference (RPD): The difference between two values divided by the average of the values, expressed as percent. Quality assessment on RPD is not used when at least one of the two values is $\leq$ 5x the reporting limit; assessment between the two values is based on whether the absolute difference is at or within 2x the reporting limit.

Reporting Limit: A data value set by the laboratory based on the CDL and CQL. Any value at or above the CQL requires no qualification. Any reported values required by the client from an analysis that shows a non-detect at the CDL is flagged with a "U" qualifier. Any reported value required by the client when an analyte is detected between the CDL and CQL is flagged with a "J" that reports the result as an estimated value.

Sample: A portion for analysis in a single or multiple containers with a composition known to the submitter and identified by lab number to the analyst.

Surrogates: Compounds added to the sample before preparation, then measured after analysis to detect problems in the sample preparation procedure.

GEOCHEMICAL TESTING
Environmental and Energy Analysis

2005 N. Center Ave.
Somerset, PA 15501

814/443-1671
814/445-6666
FAX: 814/445-6729

Thursday, December 02, 2010

David Crayne
CIVIL & ENVIRONMENTAL-COLUMBUS
8740 ORION PLACE
SUITE 100
COLUMBUS, OH 43240

RE: APEX Second SA

Order No.: G1011042

Dear David Crayne:

Geochemical Testing received 13 sample(s) on 11/2/2010 for the analyses presented in the following report.

There were no problems with the analyses and all QC data met NELAC, EPA, and laboratory specifications except where noted in the Case Narrative or Laboratory Results.

If you have any questions regarding these tests results, please feel free to call.

Sincerely,

Timothy W Bergstresser

Timothy W. Bergstresser
Director of Technical Services

ACCREDITED IN ACCORDANCE WITH nelac
I.D. 56-00306PA DEP

Geochemical Testing

Date: *02-Dec-10*

CLIENT: CIVIL & ENVIRONMENTAL-COLUMBU
Project: APEX Second SA
Lab Order: G1011042

CASE NARRATIVE

No problems were encountered during analysis of this workorder, except if noted in this report.

Legend:

ND - Not Detected at the Quantitation Limit

J - Indicates an estimated value.

U - The analyte was not detected at or above the listed concentration, which is below the laboratory quantitation limit.

B - Analyte detected in the associated Method Blank

Q - Qualifier QL -Quantitation Limit DF - Dilution Factor

S - Spike Recovery outside accepted recovery limits

R - RPD outside accepted recovery limits

E - Value above quantitation range

** - Value exceeds Action Limit

H - Method Hold Time Exceeded

MCL - Contaminant Limit

ACCREDITED IN ACCORDANCE WITH nelac
I.D. 56-00306 PA DEP

Laboratory Results

Geochemical Testing

Date: *02-Dec-10*

CLIENT:	CIVIL & ENVIRONMENTAL-COLUMBU	**Client Sample ID:**	P-2S
Lab Order:	G1011042		
Project:	APEX Second SA	**Collection Date:**	10/28/2010 11:32:00 AM
Lab ID:	G1011042-001	**Sampled By:**	Client
Matrix:	AQUEOUS	**DateReceived:**	11/2/2010 1:22:41 PM

Analyses	Result	Q	MDL	PQL	Units	DF	Date Analyzed
FIELD PARAMETERS			**FIELD**			Analyst:	
pH (Field)	7.45		0		S.U.	0	10/28/2010 11:32:00 A
Specific Conductance (Field)	1373		0		umhos/cm	0	10/28/2010 11:32:00 A
Temperature (Field)	14.2		0		deg C	0	10/28/2010 11:32:00 A
Turbidity (Field)	2.09		0		NTU	0	10/28/2010 11:32:00 A
INORGANIC NON-METALS			**SM 18 2320B**			Analyst: **LNW**	
Alkalinity to pH 4.5	272		2.0	5	mg/L CaCO3	1	11/3/2010 5:41:00 PM
INORGANIC NON-METALS			**SM 2540 C**			Analyst: **KLS**	
Total dissolved solids	1130		10.0	20	mg/L	1	11/2/2010 9:30:00 AM
INORGANIC NON-METALS			**SM 4500-CL E**			Analyst: **SAG**	
Chloride	4	J	2.0	5	mg/L	1	11/3/2010 4:05:00 PM
NOTES:							
S - Spike recovery indicates a possible matrix effect. The method is in control as indicated by the LCS.							
INORGANIC NON-METALS			**EPA 350.1**			Analyst: **SLY**	
Ammonia Nitrogen - Distilled	0.65		0.040	0.10	mg/L as N	1	11/9/2010 10:57:13 A
INORGANIC NON-METALS			**EPA 353.2**			Analyst: **CAS**	
Nitrate - Nitrite	0.05		0.020	0.05	mg/L as N	1	11/4/2010 11:54:14 A
INORGANIC NON METALS			**ASTM D516-02**			Analyst: **SAG**	
Sulfate	389		10.0	50	mg/L	10	11/5/2010 4:56:00 PM
INORGANIC METALS			**EPA 200.7**			Analyst: **MS**	
Barium	0.021		0.0050	0.010	mg/L	1	11/4/2010 9:46:00 PM
Beryllium	0.00050	U	0.00050	0.0010	mg/L	1	11/4/2010 9:46:00 PM
Cadmium	0.0010	U	0.0010	0.002	mg/L	1	11/4/2010 9:46:00 PM
Calcium	232		0.050	0.10	mg/L	1	11/4/2010 9:46:00 PM
Chromium	0.0050	U	0.0050	0.010	mg/L	1	11/4/2010 9:46:00 PM
Cobalt	0.0020	U	0.0020	0.005	mg/L	1	11/4/2010 9:46:00 PM
Copper	0.0050	U	0.0050	0.010	mg/L	1	11/4/2010 9:46:00 PM
Iron	0.26		0.010	0.05	mg/L	1	11/5/2010 11:51:00 A
Magnesium	60.8		0.050	0.10	mg/L	1	11/4/2010 9:46:00 PM
Manganese	0.269		0.0020	0.010	mg/L	1	11/4/2010 9:46:00 PM
Nickel	0.0050	U	0.0050	0.010	mg/L	1	11/4/2010 9:46:00 PM
Potassium	5.1		0.20	0.5	mg/L	1	11/4/2010 9:46:00 PM
Silver	0.0020	U	0.0020	0.005	mg/L	1	11/4/2010 9:46:00 PM
Sodium	33.0		0.10	0.2	mg/L	1	11/4/2010 9:46:00 PM
Vanadium	0.0020	U	0.0020	0.005	mg/L	1	11/4/2010 9:46:00 PM
Zinc	0.0040	U	0.0040	0.010	mg/L	1	11/4/2010 9:46:00 PM

ACCREDITED IN ACCORDANCE WITH nelac
I.D. 56-00306 PA DEP

Laboratory Results

Geochemical Testing

Date: *02-Dec-10*

CLIENT:	CIVIL & ENVIRONMENTAL-COLUMBU	**Client Sample ID:**	P-2S
Lab Order:	G1011042		
Project:	APEX Second SA	**Collection Date:**	10/28/2010 11:32:00 AM
Lab ID:	G1011042-001	**Sampled By:**	Client
Matrix:	AQUEOUS	**DateReceived:**	11/2/2010 1:22:41 PM

Analyses	Result	Q	MDL	PQL	Units	DF	Date Analyzed
INORGANIC METALS			**EPA 200.7**				Analyst: **MS**
INORGANIC METALS			**EPA 200.8**				Analyst: **JEK**
Antimony	0.50	U	0.50	1.0	µg/L	1	11/4/2010 2:32:00 PM
Arsenic	0.50	U	0.50	1.0	µg/L	1	11/4/2010 2:32:00 PM
Lead	0.20	U	0.20	1.0	µg/L	1	11/4/2010 2:32:00 PM
Selenium	0.50	U	0.50	1.0	µg/L	1	11/4/2010 2:32:00 PM
Thallium	0.10	U	0.10	0.2	µg/L	1	11/4/2010 2:32:00 PM
VOLATILE ORGANIC COMPOUNDS			**EPA 8011**				Analyst: **TEW**
1,2-Dibromo-3-chloropropane	0.0100	U	0.0100	0.0400	µg/L	1	11/15/2010 7:54:45 P
1,2-Dibromoethane	0.0100	U	0.0100	0.0400	µg/L	1	11/15/2010 7:54:45 P
Surr: 1,1,2,2-Tetrachloroethane	95.6		0	60-140	%REC	1	11/15/2010 7:54:45 P
VOLATILE ORGANIC COMPOUNDS			**EPA 8260**				Analyst: **JAW**
1,1,1,2-Tetrachloroethane	0.50	U	0.50	1.0	µg/L	1	11/3/2010 5:11:00 PM
1,1,1-Trichloroethane	0.50	U	0.50	1.0	µg/L	1	11/3/2010 5:11:00 PM
1,1,2,2-Tetrachloroethane	0.50	U	0.50	1.0	µg/L	1	11/3/2010 5:11:00 PM
1,1,2-Trichloroethane	0.50	U	0.50	1.0	µg/L	1	11/3/2010 5:11:00 PM
1,1-Dichloroethane	0.50	U	0.50	1.0	µg/L	1	11/3/2010 5:11:00 PM
1,1-Dichloroethene	0.50	U	0.50	1.0	µg/L	1	11/3/2010 5:11:00 PM
1,2,3-Trichloropropane	0.50	U	0.50	1.0	µg/L	1	11/3/2010 5:11:00 PM
1,2-Dichlorobenzene	0.50	U	0.50	1.0	µg/L	1	11/3/2010 5:11:00 PM
1,2-Dichloroethane	0.50	U	0.50	1.0	µg/L	1	11/3/2010 5:11:00 PM
1,2-Dichloropropane	0.50	U	0.50	1.0	µg/L	1	11/3/2010 5:11:00 PM
1,4-Dichlorobenzene	0.50	U	0.50	1.0	µg/L	1	11/3/2010 5:11:00 PM
2-Hexanone	1.0	U	1.0	5.0	µg/L	1	11/3/2010 5:11:00 PM
4-Methyl-2-Pentanone	0.50	U	0.50	1.0	µg/L	1	11/3/2010 5:11:00 PM
Acetone	5.0	U	5.0	10	µg/L	1	11/3/2010 5:11:00 PM
Acrylonitrile	2.0	U	2.0	5.0	µg/L	1	11/3/2010 5:11:00 PM
Benzene	0.50	U	0.50	1.0	µg/L	1	11/3/2010 5:11:00 PM
Bromochloromethane	0.50	U	0.50	1.0	µg/L	1	11/3/2010 5:11:00 PM
Bromodichloromethane	0.50	U	0.50	1.0	µg/L	1	11/3/2010 5:11:00 PM
Bromoform	0.50	U	0.50	1.0	µg/L	1	11/3/2010 5:11:00 PM
Bromomethane	0.50	U	0.50	1.0	µg/L	1	11/3/2010 5:11:00 PM
Carbon Disulfide	0.50	U	0.50	1.0	µg/L	1	11/3/2010 5:11:00 PM
Carbon Tetrachloride	0.50	U	0.50	1.0	µg/L	1	11/3/2010 5:11:00 PM
Chlorobenzene	0.50	U	0.50	1.0	µg/L	1	11/3/2010 5:11:00 PM
Chlorodibromomethane	0.50	U	0.50	1.0	µg/L	1	11/3/2010 5:11:00 PM
Chloroethane	0.50	U	0.50	1.0	µg/L	1	11/3/2010 5:11:00 PM
Chloroform	0.50	U	0.50	1.0	µg/L	1	11/3/2010 5:11:00 PM
Chloromethane	0.50	U	0.50	1.0	µg/L	1	11/3/2010 5:11:00 PM

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Laboratory Results

Geochemical Testing

Date: *02-Dec-10*

CLIENT:	CIVIL & ENVIRONMENTAL-COLUMBU	**Client Sample ID:**	P-2S
Lab Order:	G1011042		
Project:	APEX Second SA	**Collection Date:**	10/28/2010 11:32:00 AM
Lab ID:	G1011042-001	**Sampled By:**	Client
Matrix:	AQUEOUS	**DateReceived:**	11/2/2010 1:22:41 PM

Analyses	Result	Q	MDL	PQL	Units	DF	Date Analyzed
VOLATILE ORGANIC COMPOUNDS			**EPA 8260**			Analyst: **JAW**	
cis-1,2-Dichloroethene	0.50	U	0.50	1.0	µg/L	1	11/3/2010 5:11:00 PM
cis-1,3-Dichloropropene	0.50	U	0.50	1.0	µg/L	1	11/3/2010 5:11:00 PM
Dibromomethane	0.50	U	0.50	1.0	µg/L	1	11/3/2010 5:11:00 PM
Dichlorobromomethane	0.50	U	0.50	1.0	µg/L	1	11/3/2010 5:11:00 PM
Ethylbenzene	0.50	U	0.50	1.0	µg/L	1	11/3/2010 5:11:00 PM
Iodomethane	0.50	U	0.50	5.0	µg/L	1	11/3/2010 5:11:00 PM
Methyl Ethyl Ketone	1.0	U	1.0	5.0	µg/L	1	11/3/2010 5:11:00 PM
Methylene Chloride	0.50	U	0.50	1.0	µg/L	1	11/3/2010 5:11:00 PM
Styrene	0.50	U	0.50	1.0	µg/L	1	11/3/2010 5:11:00 PM
Tetrachloroethene	0.50	U	0.50	1.0	µg/L	1	11/3/2010 5:11:00 PM
Toluene	0.50	U	0.50	1.0	µg/L	1	11/3/2010 5:11:00 PM
trans-1,2-Dichloroethene	0.50	U	0.50	1.0	µg/L	1	11/3/2010 5:11:00 PM
trans-1,3-Dichloropropene	0.50	U	0.50	1.0	µg/L	1	11/3/2010 5:11:00 PM
trans-1,4-Dichloro-2-butene	1.0	U	1.0	2.0	µg/L	1	11/3/2010 5:11:00 PM
Trichloroethene	0.50	U	0.50	1.0	µg/L	1	11/3/2010 5:11:00 PM
Trichlorofluoromethane	0.50	U	0.50	1.0	µg/L	1	11/3/2010 5:11:00 PM
Vinyl Acetate	0.50	U	0.50	1.0	µg/L	1	11/3/2010 5:11:00 PM
Vinyl Chloride	0.50	U	0.50	1.0	µg/L	1	11/3/2010 5:11:00 PM
Total Xylene	1.0	U	1.0	2.0	µg/L	1	11/3/2010 5:11:00 PM
Surr: 1,2-Dichloroethane-d4	91.9		0	70-130	%REC	1	11/3/2010 5:11:00 PM
Surr: 4-Bromofluorobenzene	93.6		0	70-130	%REC	1	11/3/2010 5:11:00 PM
Surr: Dibromofluoromethane	95.3		0	70-130	%REC	1	11/3/2010 5:11:00 PM
Surr: Toluene-d8	95.8		0	70-130	%REC	1	11/3/2010 5:11:00 PM

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Laboratory Results

Geochemical Testing

Date: *02-Dec-10*

CLIENT:	CIVIL & ENVIRONMENTAL-COLUMBU	**Client Sample ID:**	P-2L
Lab Order:	G1011042		
Project:	APEX Second SA	**Collection Date:**	10/28/2010 10:24:00 AM
Lab ID:	G1011042-002	**Sampled By:**	Client
Matrix:	AQUEOUS	**DateReceived:**	11/2/2010 1:22:41 PM

Analyses	Result	Q	MDL	PQL	Units	DF	Date Analyzed
FIELD PARAMETERS			**FIELD**			Analyst:	
pH (Field)	6.65		0		S.U.	0	10/28/2010 10:24:00 A
Specific Conductance (Field)	1784		0		umhos/cm	0	10/28/2010 10:24:00 A
Temperature (Field)	12.4		0		deg C	0	10/28/2010 10:24:00 A
Turbidity (Field)	1.19		0		NTU	0	10/28/2010 10:24:00 A
INORGANIC NON-METALS			**SM 18 2320B**			Analyst: **LNW**	
Alkalinity to pH 4.5	268		2.0	5	mg/L CaCO3	1	11/3/2010 1:05:00 PM
INORGANIC NON-METALS			**SM 2540 C**			Analyst: **KLS**	
Total dissolved solids	1680		10.0	20	mg/L	1	11/2/2010 9:20:00 AM
INORGANIC NON-METALS			**SM 4500-CL E**			Analyst: **SAG**	
Chloride	8		2.0	5	mg/L	1	11/3/2010 4:05:00 PM
INORGANIC NON-METALS			**EPA 350.1**			Analyst: **SLY**	
Ammonia Nitrogen - Distilled	0.24		0.040	0.10	mg/L as N	1	11/9/2010 10:58:22 A
INORGANIC NON-METALS			**EPA 353.2**			Analyst: **CAS**	
Nitrate - Nitrite	0.02	J	0.020	0.05	mg/L as N	1	11/4/2010 11:55:21 A
INORGANIC NON METALS			**ASTM D516-02**			Analyst: **SAG**	
Sulfate	697		20.0	100	mg/L	20	11/5/2010 4:56:00 PM
INORGANIC METALS			**EPA 200.7**			Analyst: **MS**	
Barium	0.024		0.0050	0.010	mg/L	1	11/4/2010 10:18:00 P
Beryllium	0.00050	U	0.00050	0.0010	mg/L	1	11/4/2010 10:18:00 P
Cadmium	0.0010	U	0.0010	0.002	mg/L	1	11/4/2010 10:18:00 P
Calcium	358		0.050	0.10	mg/L	1	11/4/2010 10:18:00 P
Chromium	0.0050	U	0.0050	0.010	mg/L	1	11/4/2010 10:18:00 P
Cobalt	0.026		0.0020	0.005	mg/L	1	11/4/2010 10:18:00 P
Copper	0.0050	U	0.0050	0.010	mg/L	1	11/4/2010 10:18:00 P
Iron	0.32		0.010	0.05	mg/L	1	11/5/2010 12:07:00 P
Magnesium	88.0		0.050	0.10	mg/L	1	11/4/2010 10:18:00 P
Manganese	8.27		0.0020	0.010	mg/L	1	11/4/2010 10:18:00 P
Nickel	0.046		0.0050	0.010	mg/L	1	11/4/2010 10:18:00 P
Potassium	2.9		0.20	0.5	mg/L	1	11/4/2010 10:18:00 P
Silver	0.0020	U	0.0020	0.005	mg/L	1	11/4/2010 10:18:00 P
Sodium	7.8		0.10	0.2	mg/L	1	11/4/2010 10:18:00 P
Vanadium	0.005	J	0.0020	0.005	mg/L	1	11/4/2010 10:18:00 P
Zinc	0.012		0.0040	0.010	mg/L	1	11/4/2010 10:18:00 P

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Laboratory Results

Geochemical Testing

Date: *02-Dec-10*

CLIENT:	CIVIL & ENVIRONMENTAL-COLUMBU	**Client Sample ID:**	P-2L
Lab Order:	G1011042		
Project:	APEX Second SA	**Collection Date:**	10/28/2010 10:24:00 AM
Lab ID:	G1011042-002	**Sampled By:**	Client
Matrix:	AQUEOUS	**DateReceived:**	11/2/2010 1:22:41 PM

Analyses	Result	Q	MDL	PQL	Units	DF	Date Analyzed
INORGANIC METALS			**EPA 200.8**				Analyst: **JEK**
Antimony	0.50	U	0.50	1.0	µg/L	1	11/4/2010 2:46:00 PM
Arsenic	0.50	U	0.50	1.0	µg/L	1	11/4/2010 2:46:00 PM
Lead	0.20	U	0.20	1.0	µg/L	1	11/4/2010 2:46:00 PM
Selenium	0.50	U	0.50	1.0	µg/L	1	11/4/2010 2:46:00 PM
Thallium	0.10	U	0.10	0.2	µg/L	1	11/4/2010 2:46:00 PM
VOLATILE ORGANIC COMPOUNDS			**EPA 8011**				Analyst: **TEW**
1,2-Dibromo-3-chloropropane	0.0100	U	0.0100	0.0400	µg/L	1	11/15/2010 8:18:56 P
1,2-Dibromoethane	0.0100	U	0.0100	0.0400	µg/L	1	11/15/2010 8:18:56 P
Surr: 1,1,2,2-Tetrachloroethane	95.1		0	60-140	%REC	1	11/15/2010 8:18:56 P
VOLATILE ORGANIC COMPOUNDS			**EPA 8260**				Analyst: **JAW**
1,1,1,2-Tetrachloroethane	0.50	U	0.50	1.0	µg/L	1	11/3/2010 5:46:00 PM
1,1,1-Trichloroethane	0.50	U	0.50	1.0	µg/L	1	11/3/2010 5:46:00 PM
1,1,2,2-Tetrachloroethane	0.50	U	0.50	1.0	µg/L	1	11/3/2010 5:46:00 PM
1,1,2-Trichloroethane	0.50	U	0.50	1.0	µg/L	1	11/3/2010 5:46:00 PM
1,1-Dichloroethane	0.50	U	0.50	1.0	µg/L	1	11/3/2010 5:46:00 PM
1,1-Dichloroethene	0.50	U	0.50	1.0	µg/L	1	11/3/2010 5:46:00 PM
1,2,3-Trichloropropane	0.50	U	0.50	1.0	µg/L	1	11/3/2010 5:46:00 PM
1,2-Dichlorobenzene	0.50	U	0.50	1.0	µg/L	1	11/3/2010 5:46:00 PM
1,2-Dichloroethane	0.50	U	0.50	1.0	µg/L	1	11/3/2010 5:46:00 PM
1,2-Dichloropropane	0.50	U	0.50	1.0	µg/L	1	11/3/2010 5:46:00 PM
1,4-Dichlorobenzene	0.50	U	0.50	1.0	µg/L	1	11/3/2010 5:46:00 PM
2-Hexanone	1.0	U	1.0	5.0	µg/L	1	11/3/2010 5:46:00 PM
4-Methyl-2-Pentanone	0.50	U	0.50	1.0	µg/L	1	11/3/2010 5:46:00 PM
Acetone	5.0	U	5.0	10	µg/L	1	11/3/2010 5:46:00 PM
Acrylonitrile	2.0	U	2.0	5.0	µg/L	1	11/3/2010 5:46:00 PM
Benzene	0.50	U	0.50	1.0	µg/L	1	11/3/2010 5:46:00 PM
Bromochloromethane	0.50	U	0.50	1.0	µg/L	1	11/3/2010 5:46:00 PM
Bromodichloromethane	0.50	U	0.50	1.0	µg/L	1	11/3/2010 5:46:00 PM
Bromoform	0.50	U	0.50	1.0	µg/L	1	11/3/2010 5:46:00 PM
Bromomethane	0.50	U	0.50	1.0	µg/L	1	11/3/2010 5:46:00 PM
Carbon Disulfide	0.50	U	0.50	1.0	µg/L	1	11/3/2010 5:46:00 PM
Carbon Tetrachloride	0.50	U	0.50	1.0	µg/L	1	11/3/2010 5:46:00 PM
Chlorobenzene	0.50	U	0.50	1.0	µg/L	1	11/3/2010 5:46:00 PM
Chlorodibromomethane	0.50	U	0.50	1.0	µg/L	1	11/3/2010 5:46:00 PM
Chloroethane	0.50	U	0.50	1.0	µg/L	1	11/3/2010 5:46:00 PM
Chloroform	0.50	U	0.50	1.0	µg/L	1	11/3/2010 5:46:00 PM
Chloromethane	0.50	U	0.50	1.0	µg/L	1	11/3/2010 5:46:00 PM
cis-1,2-Dichloroethene	0.50	U	0.50	1.0	µg/L	1	11/3/2010 5:46:00 PM
cis-1,3-Dichloropropene	0.50	U	0.50	1.0	µg/L	1	11/3/2010 5:46:00 PM

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Laboratory Results

Geochemical Testing

Date: *02-Dec-10*

CLIENT:	CIVIL & ENVIRONMENTAL-COLUMBU	**Client Sample ID:**	P-2L
Lab Order:	G1011042		
Project:	APEX Second SA	**Collection Date:**	10/28/2010 10:24:00 AM
Lab ID:	G1011042-002	**Sampled By:**	Client
Matrix:	AQUEOUS	**DateReceived:**	11/2/2010 1:22:41 PM

Analyses	Result	Q	MDL	PQL	Units	DF	Date Analyzed
VOLATILE ORGANIC COMPOUNDS			**EPA 8260**			Analyst: **JAW**	
Dibromomethane	0.50	U	0.50	1.0	µg/L	1	11/3/2010 5:46:00 PM
Dichlorobromomethane	0.50	U	0.50	1.0	µg/L	1	11/3/2010 5:46:00 PM
Ethylbenzene	0.50	U	0.50	1.0	µg/L	1	11/3/2010 5:46:00 PM
Iodomethane	0.50	U	0.50	5.0	µg/L	1	11/3/2010 5:46:00 PM
Methyl Ethyl Ketone	1.0	U	1.0	5.0	µg/L	1	11/3/2010 5:46:00 PM
Methylene Chloride	0.50	U	0.50	1.0	µg/L	1	11/3/2010 5:46:00 PM
Styrene	0.50	U	0.50	1.0	µg/L	1	11/3/2010 5:46:00 PM
Tetrachloroethene	0.50	U	0.50	1.0	µg/L	1	11/3/2010 5:46:00 PM
Toluene	0.50	U	0.50	1.0	µg/L	1	11/3/2010 5:46:00 PM
trans-1,2-Dichloroethene	0.50	U	0.50	1.0	µg/L	1	11/3/2010 5:46:00 PM
trans-1,3-Dichloropropene	0.50	U	0.50	1.0	µg/L	1	11/3/2010 5:46:00 PM
trans-1,4-Dichloro-2-butene	1.0	U	1.0	2.0	µg/L	1	11/3/2010 5:46:00 PM
Trichloroethene	0.50	U	0.50	1.0	µg/L	1	11/3/2010 5:46:00 PM
Trichlorofluoromethane	0.50	U	0.50	1.0	µg/L	1	11/3/2010 5:46:00 PM
Vinyl Acetate	0.50	U	0.50	1.0	µg/L	1	11/3/2010 5:46:00 PM
Vinyl Chloride	0.50	U	0.50	1.0	µg/L	1	11/3/2010 5:46:00 PM
Total Xylene	1.0	U	1.0	2.0	µg/L	1	11/3/2010 5:46:00 PM
Surr: 1,2-Dichloroethane-d4	91.7		0	70-130	%REC	1	11/3/2010 5:46:00 PM
Surr: 4-Bromofluorobenzene	94.4		0	70-130	%REC	1	11/3/2010 5:46:00 PM
Surr: Dibromofluoromethane	98.1		0	70-130	%REC	1	11/3/2010 5:46:00 PM
Surr: Toluene-d8	94.8		0	70-130	%REC	1	11/3/2010 5:46:00 PM

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Laboratory Results

Geochemical Testing

Date: *02-Dec-10*

CLIENT:	CIVIL & ENVIRONMENTAL-COLUMBU	**Client Sample ID:**	P-7A
Lab Order:	G1011042		
Project:	APEX Second SA	**Collection Date:**	10/29/2010 7:51:00 AM
Lab ID:	G1011042-003	**Sampled By:**	Client
Matrix:	AQUEOUS	**DateReceived:**	11/2/2010 1:22:41 PM

Analyses	Result	Q	MDL	PQL	Units	DF	Date Analyzed
FIELD PARAMETERS			**FIELD**			Analyst:	
pH (Field)	7.34		0		S.U.	0	10/29/2010 7:51:00 A
Specific Conductance (Field)	5030		0		umhos/cm	0	10/29/2010 7:51:00 A
Temperature (Field)	8.7		0		deg C	0	10/29/2010 7:51:00 A
Turbidity (Field)	62.0		0		NTU	0	10/29/2010 7:51:00 A
INORGANIC NON-METALS			**SM 18 2320B**			Analyst: **LNW**	
Alkalinity to pH 4.5	615		2.0	5	mg/L CaCO3	1	11/3/2010 1:30:00 PM
INORGANIC NON-METALS			**SM 2540 C**			Analyst: **KLS**	
Total dissolved solids	3830		10.0	20	mg/L	1	11/2/2010 9:20:00 AM
INORGANIC NON-METALS			**SM 4500-CL E**			Analyst: **SAG**	
Chloride	13		2.0	5	mg/L	1	11/3/2010 4:05:00 PM
INORGANIC NON-METALS			**EPA 350.1**			Analyst: **SLY**	
Ammonia Nitrogen - Distilled	2.33		0.040	0.10	mg/L as N	1	11/9/2010 10:59:31 A
INORGANIC NON-METALS			**EPA 353.2**			Analyst: **CAS**	
Nitrate - Nitrite	0.05		0.020	0.05	mg/L as N	1	11/4/2010 11:59:52 A
INORGANIC NON METALS			**ASTM D516-02**			Analyst: **SAG**	
Sulfate	1990		50.0	250	mg/L	50	11/5/2010 4:56:00 PM
INORGANIC METALS			**EPA 200.7**			Analyst: **MS**	
Barium	0.055		0.0050	0.010	mg/L	1	11/4/2010 10:23:00 P
Beryllium	0.00050	U	0.00050	0.0010	mg/L	1	11/4/2010 10:23:00 P
Cadmium	0.0010	U	0.0010	0.002	mg/L	1	11/4/2010 10:23:00 P
Calcium	678		0.500	1.00	mg/L	10	11/5/2010 12:11:00 P
Chromium	0.0050	U	0.0050	0.010	mg/L	1	11/4/2010 10:23:00 P
Cobalt	0.003	J	0.0020	0.005	mg/L	1	11/4/2010 10:23:00 P
Copper	0.0050	U	0.0050	0.010	mg/L	1	11/4/2010 10:23:00 P
Iron	84.6		0.010	0.05	mg/L	1	11/5/2010 12:15:00 P
Magnesium	244		0.500	1.00	mg/L	10	11/5/2010 12:11:00 P
Manganese	10.8		0.0020	0.010	mg/L	1	11/4/2010 10:23:00 P
Nickel	0.017		0.0050	0.010	mg/L	1	11/4/2010 10:23:00 P
Potassium	30.2		0.20	0.5	mg/L	1	11/4/2010 10:23:00 P
Silver	0.0020	U	0.0020	0.005	mg/L	1	11/4/2010 10:23:00 P
Sodium	53.4		0.10	0.2	mg/L	1	11/4/2010 10:23:00 P
Vanadium	0.008		0.0020	0.005	mg/L	1	11/4/2010 10:23:00 P
Zinc	0.042		0.0040	0.010	mg/L	1	11/4/2010 10:23:00 P

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Laboratory Results

Geochemical Testing

Date: *02-Dec-10*

CLIENT:	CIVIL & ENVIRONMENTAL-COLUMBU	**Client Sample ID:**	P-7A
Lab Order:	G1011042		
Project:	APEX Second SA	**Collection Date:**	10/29/2010 7:51:00 AM
Lab ID:	G1011042-003	**Sampled By:**	Client
Matrix:	AQUEOUS	**DateReceived:**	11/2/2010 1:22:41 PM

Analyses	Result	Q	MDL	PQL	Units	DF	Date Analyzed
INORGANIC METALS			**EPA 200.8**				Analyst: **JEK**
Antimony	0.50	U	0.50	1.0	µg/L	1	11/4/2010 2:51:00 PM
Arsenic	15.0		0.50	1.0	µg/L	1	11/4/2010 2:51:00 PM
Lead	2.7		0.20	1.0	µg/L	1	11/4/2010 2:51:00 PM
Selenium	1.3		0.50	1.0	µg/L	1	11/4/2010 2:51:00 PM
Thallium	1.0		0.10	0.2	µg/L	1	11/4/2010 2:51:00 PM
VOLATILE ORGANIC COMPOUNDS			**EPA 8011**				Analyst: **TEW**
1,2-Dibromo-3-chloropropane	0.0100	U	0.0100	0.0400	µg/L	1	11/15/2010 9:33:02 P
1,2-Dibromoethane	0.0100	U	0.0100	0.0400	µg/L	1	11/15/2010 9:33:02 P
Surr: 1,1,2,2-Tetrachloroethane	94.6		0	60-140	%REC	1	11/15/2010 9:33:02 P
VOLATILE ORGANIC COMPOUNDS			**EPA 8260**				Analyst: **JAW**
1,1,1,2-Tetrachloroethane	0.50	U	0.50	1.0	µg/L	1	11/3/2010 6:22:00 PM
1,1,1-Trichloroethane	0.50	U	0.50	1.0	µg/L	1	11/3/2010 6:22:00 PM
1,1,2,2-Tetrachloroethane	0.50	U	0.50	1.0	µg/L	1	11/3/2010 6:22:00 PM
1,1,2-Trichloroethane	0.50	U	0.50	1.0	µg/L	1	11/3/2010 6:22:00 PM
1,1-Dichloroethane	0.50	U	0.50	1.0	µg/L	1	11/3/2010 6:22:00 PM
1,1-Dichloroethene	0.50	U	0.50	1.0	µg/L	1	11/3/2010 6:22:00 PM
1,2,3-Trichloropropane	0.50	U	0.50	1.0	µg/L	1	11/3/2010 6:22:00 PM
1,2-Dichlorobenzene	0.50	U	0.50	1.0	µg/L	1	11/3/2010 6:22:00 PM
1,2-Dichloroethane	0.50	U	0.50	1.0	µg/L	1	11/3/2010 6:22:00 PM
1,2-Dichloropropane	0.50	U	0.50	1.0	µg/L	1	11/3/2010 6:22:00 PM
1,4-Dichlorobenzene	0.50	U	0.50	1.0	µg/L	1	11/3/2010 6:22:00 PM
2-Hexanone	1.0	U	1.0	5.0	µg/L	1	11/3/2010 6:22:00 PM
4-Methyl-2-Pentanone	0.50	U	0.50	1.0	µg/L	1	11/3/2010 6:22:00 PM
Acetone	5.0	U	5.0	10	µg/L	1	11/3/2010 6:22:00 PM
Acrylonitrile	2.0	U	2.0	5.0	µg/L	1	11/3/2010 6:22:00 PM
Benzene	0.50	U	0.50	1.0	µg/L	1	11/3/2010 6:22:00 PM
Bromochloromethane	0.50	U	0.50	1.0	µg/L	1	11/3/2010 6:22:00 PM
Bromodichloromethane	0.50	U	0.50	1.0	µg/L	1	11/3/2010 6:22:00 PM
Bromoform	0.50	U	0.50	1.0	µg/L	1	11/3/2010 6:22:00 PM
Bromomethane	0.50	U	0.50	1.0	µg/L	1	11/3/2010 6:22:00 PM
Carbon Disulfide	0.50	U	0.50	1.0	µg/L	1	11/3/2010 6:22:00 PM
Carbon Tetrachloride	0.50	U	0.50	1.0	µg/L	1	11/3/2010 6:22:00 PM
Chlorobenzene	0.50	U	0.50	1.0	µg/L	1	11/3/2010 6:22:00 PM
Chlorodibromomethane	0.50	U	0.50	1.0	µg/L	1	11/3/2010 6:22:00 PM
Chloroethane	0.50	U	0.50	1.0	µg/L	1	11/3/2010 6:22:00 PM
Chloroform	0.50	U	0.50	1.0	µg/L	1	11/3/2010 6:22:00 PM
Chloromethane	0.50	U	0.50	1.0	µg/L	1	11/3/2010 6:22:00 PM
cis-1,2-Dichloroethene	0.50	U	0.50	1.0	µg/L	1	11/3/2010 6:22:00 PM
cis-1,3-Dichloropropene	0.50	U	0.50	1.0	µg/L	1	11/3/2010 6:22:00 PM

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Laboratory Results

Geochemical Testing

Date: *02-Dec-10*

CLIENT:	CIVIL & ENVIRONMENTAL-COLUMBU	**Client Sample ID:**	P-7A
Lab Order:	G1011042		
Project:	APEX Second SA	**Collection Date:**	10/29/2010 7:51:00 AM
Lab ID:	G1011042-003	**Sampled By:**	Client
Matrix:	AQUEOUS	**DateReceived:**	11/2/2010 1:22:41 PM

Analyses	Result	Q	MDL	PQL	Units	DF	Date Analyzed
VOLATILE ORGANIC COMPOUNDS			**EPA 8260**			Analyst: **JAW**	
Dibromomethane	0.50	U	0.50	1.0	µg/L	1	11/3/2010 6:22:00 PM
Dichlorobromomethane	0.50	U	0.50	1.0	µg/L	1	11/3/2010 6:22:00 PM
Ethylbenzene	0.50	U	0.50	1.0	µg/L	1	11/3/2010 6:22:00 PM
Iodomethane	0.50	U	0.50	5.0	µg/L	1	11/3/2010 6:22:00 PM
Methyl Ethyl Ketone	1.0	U	1.0	5.0	µg/L	1	11/3/2010 6:22:00 PM
Methylene Chloride	0.50	U	0.50	1.0	µg/L	1	11/3/2010 6:22:00 PM
Styrene	0.50	U	0.50	1.0	µg/L	1	11/3/2010 6:22:00 PM
Tetrachloroethene	0.50	U	0.50	1.0	µg/L	1	11/3/2010 6:22:00 PM
Toluene	0.50	U	0.50	1.0	µg/L	1	11/3/2010 6:22:00 PM
trans-1,2-Dichloroethene	0.50	U	0.50	1.0	µg/L	1	11/3/2010 6:22:00 PM
trans-1,3-Dichloropropene	0.50	U	0.50	1.0	µg/L	1	11/3/2010 6:22:00 PM
trans-1,4-Dichloro-2-butene	1.0	U	1.0	2.0	µg/L	1	11/3/2010 6:22:00 PM
Trichloroethene	0.50	U	0.50	1.0	µg/L	1	11/3/2010 6:22:00 PM
Trichlorofluoromethane	0.50	U	0.50	1.0	µg/L	1	11/3/2010 6:22:00 PM
Vinyl Acetate	0.50	U	0.50	1.0	µg/L	1	11/3/2010 6:22:00 PM
Vinyl Chloride	0.50	U	0.50	1.0	µg/L	1	11/3/2010 6:22:00 PM
Total Xylene	1.0	U	1.0	2.0	µg/L	1	11/3/2010 6:22:00 PM
Surr: 1,2-Dichloroethane-d4	93.8		0	70-130	%REC	1	11/3/2010 6:22:00 PM
Surr: 4-Bromofluorobenzene	91.5		0	70-130	%REC	1	11/3/2010 6:22:00 PM
Surr: Dibromofluoromethane	97.4		0	70-130	%REC	1	11/3/2010 6:22:00 PM
Surr: Toluene-d8	93.8		0	70-130	%REC	1	11/3/2010 6:22:00 PM

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Laboratory Results

Geochemical Testing

Date: *02-Dec-10*

CLIENT:	CIVIL & ENVIRONMENTAL-COLUMBU	**Client Sample ID:**	FIELD DUP
Lab Order:	G1011042		
Project:	APEX Second SA	**Collection Date:**	10/28/2010
Lab ID:	G1011042-004	**Sampled By:**	Client
Matrix:	AQUEOUS	**DateReceived:**	11/2/2010 1:22:41 PM

Analyses	Result	Q	MDL	PQL	Units	DF	Date Analyzed
INORGANIC NON-METALS			**SM 18 2320B**				Analyst: **LNW**
Alkalinity to pH 4.5	297		2.0	5	mg/L CaCO3	1	11/3/2010 1:41:00 PM
INORGANIC NON-METALS			**SM 2540 C**				Analyst: **KLS**
Total dissolved solids	1200		10.0	20	mg/L	1	11/2/2010 9:20:00 AM
INORGANIC NON-METALS			**SM 4500-CL E**				Analyst: **SAG**
Chloride	4	J	2.0	5	mg/L	1	11/3/2010 4:05:00 PM
INORGANIC NON-METALS			**EPA 350.1**				Analyst: **SLY**
Ammonia Nitrogen - Distilled	0.77		0.040	0.10	mg/L as N	1	11/9/2010 11:00:40 A
INORGANIC NON-METALS			**EPA 353.2**				Analyst: **CAS**
Nitrate - Nitrite	0.02	J	0.020	0.05	mg/L as N	1	11/4/2010 12:00:59 P
INORGANIC NON METALS			**ASTM D516-02**				Analyst: **SAG**
Sulfate	571		20.0	100	mg/L	20	11/5/2010 4:56:00 PM
INORGANIC METALS			**EPA 200.7**				Analyst: **MS**
Barium	0.023		0.0050	0.010	mg/L	1	11/4/2010 10:28:00 P
Beryllium	0.00050	U	0.00050	0.0010	mg/L	1	11/4/2010 10:28:00 P
Cadmium	0.0010	U	0.0010	0.002	mg/L	1	11/4/2010 10:28:00 P
Calcium	225		0.050	0.10	mg/L	1	11/4/2010 10:28:00 P
Chromium	0.0050	U	0.0050	0.010	mg/L	1	11/4/2010 10:28:00 P
Cobalt	0.008		0.0020	0.005	mg/L	1	11/4/2010 10:28:00 P
Copper	0.0050	U	0.0050	0.010	mg/L	1	11/4/2010 10:28:00 P
Iron	0.05		0.010	0.05	mg/L	1	11/5/2010 12:19:00 P
Magnesium	65.7		0.050	0.10	mg/L	1	11/4/2010 10:28:00 P
Manganese	0.620		0.0020	0.010	mg/L	1	11/4/2010 10:28:00 P
Nickel	0.010		0.0050	0.010	mg/L	1	11/4/2010 10:28:00 P
Potassium	3.6		0.20	0.5	mg/L	1	11/4/2010 10:28:00 P
Silver	0.0020	U	0.0020	0.005	mg/L	1	11/4/2010 10:28:00 P
Sodium	60.2		0.10	0.2	mg/L	1	11/4/2010 10:28:00 P
Vanadium	0.0020	U	0.0020	0.005	mg/L	1	11/4/2010 10:28:00 P
Zinc	0.0040	U	0.0040	0.010	mg/L	1	11/4/2010 10:28:00 P
INORGANIC METALS			**EPA 200.8**				Analyst: **JEK**
Antimony	1.1		0.50	1.0	µg/L	1	11/4/2010 2:56:00 PM
Arsenic	13.7		0.50	1.0	µg/L	1	11/4/2010 2:56:00 PM
Lead	0.20	U	0.20	1.0	µg/L	1	11/4/2010 2:56:00 PM
Selenium	0.50	U	0.50	1.0	µg/L	1	11/4/2010 2:56:00 PM
Thallium	0.10	U	0.10	0.2	µg/L	1	11/4/2010 2:56:00 PM

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Laboratory Results

Geochemical Testing

Date: *02-Dec-10*

CLIENT:	CIVIL & ENVIRONMENTAL-COLUMBU	**Client Sample ID:**	FIELD DUP
Lab Order:	G1011042		
Project:	APEX Second SA	**Collection Date:**	10/28/2010
Lab ID:	G1011042-004	**Sampled By:**	Client
Matrix:	AQUEOUS	**DateReceived:**	11/2/2010 1:22:41 PM

Analyses	Result	Q	MDL	PQL	Units	DF	Date Analyzed
INORGANIC METALS			**EPA 200.8**				Analyst: **JEK**
VOLATILE ORGANIC COMPOUNDS			**EPA 8011**				Analyst: **TEW**
1,2-Dibromo-3-chloropropane	0.0100	U	0.0100	0.0400	µg/L	1	11/15/2010 9:57:51 P
1,2-Dibromoethane	0.0100	U	0.0100	0.0400	µg/L	1	11/15/2010 9:57:51 P
Surr: 1,1,2,2-Tetrachloroethane	94.2		0	60-140	%REC	1	11/15/2010 9:57:51 P
VOLATILE ORGANIC COMPOUNDS			**EPA 8260**				Analyst: **JAW**
1,1,1,2-Tetrachloroethane	0.50	U	0.50	1.0	µg/L	1	11/3/2010 6:57:00 PM
1,1,1-Trichloroethane	0.50	U	0.50	1.0	µg/L	1	11/3/2010 6:57:00 PM
1,1,2,2-Tetrachloroethane	0.50	U	0.50	1.0	µg/L	1	11/3/2010 6:57:00 PM
1,1,2-Trichloroethane	0.50	U	0.50	1.0	µg/L	1	11/3/2010 6:57:00 PM
1,1-Dichloroethane	0.50	U	0.50	1.0	µg/L	1	11/3/2010 6:57:00 PM
1,1-Dichloroethene	0.50	U	0.50	1.0	µg/L	1	11/3/2010 6:57:00 PM
1,2,3-Trichloropropane	0.50	U	0.50	1.0	µg/L	1	11/3/2010 6:57:00 PM
1,2-Dichlorobenzene	0.50	U	0.50	1.0	µg/L	1	11/3/2010 6:57:00 PM
1,2-Dichloroethane	0.50	U	0.50	1.0	µg/L	1	11/3/2010 6:57:00 PM
1,2-Dichloropropane	0.50	U	0.50	1.0	µg/L	1	11/3/2010 6:57:00 PM
1,4-Dichlorobenzene	0.50	U	0.50	1.0	µg/L	1	11/3/2010 6:57:00 PM
2-Hexanone	1.0	U	1.0	5.0	µg/L	1	11/3/2010 6:57:00 PM
4-Methyl-2-Pentanone	0.50	U	0.50	1.0	µg/L	1	11/3/2010 6:57:00 PM
Acetone	5.0	U	5.0	10	µg/L	1	11/3/2010 6:57:00 PM
Acrylonitrile	2.0	U	2.0	5.0	µg/L	1	11/3/2010 6:57:00 PM
Benzene	0.50	U	0.50	1.0	µg/L	1	11/3/2010 6:57:00 PM
Bromochloromethane	0.50	U	0.50	1.0	µg/L	1	11/3/2010 6:57:00 PM
Bromodichloromethane	0.50	U	0.50	1.0	µg/L	1	11/3/2010 6:57:00 PM
Bromoform	0.50	U	0.50	1.0	µg/L	1	11/3/2010 6:57:00 PM
Bromomethane	0.50	U	0.50	1.0	µg/L	1	11/3/2010 6:57:00 PM
Carbon Disulfide	0.50	U	0.50	1.0	µg/L	1	11/3/2010 6:57:00 PM
Carbon Tetrachloride	0.50	U	0.50	1.0	µg/L	1	11/3/2010 6:57:00 PM
Chlorobenzene	0.50	U	0.50	1.0	µg/L	1	11/3/2010 6:57:00 PM
Chlorodibromomethane	0.50	U	0.50	1.0	µg/L	1	11/3/2010 6:57:00 PM
Chloroethane	0.50	U	0.50	1.0	µg/L	1	11/3/2010 6:57:00 PM
Chloroform	0.50	U	0.50	1.0	µg/L	1	11/3/2010 6:57:00 PM
Chloromethane	0.50	U	0.50	1.0	µg/L	1	11/3/2010 6:57:00 PM
cis-1,2-Dichloroethene	0.50	U	0.50	1.0	µg/L	1	11/3/2010 6:57:00 PM
cis-1,3-Dichloropropene	0.50	U	0.50	1.0	µg/L	1	11/3/2010 6:57:00 PM
Dibromomethane	0.50	U	0.50	1.0	µg/L	1	11/3/2010 6:57:00 PM
Dichlorobromomethane	0.50	U	0.50	1.0	µg/L	1	11/3/2010 6:57:00 PM
Ethylbenzene	0.50	U	0.50	1.0	µg/L	1	11/3/2010 6:57:00 PM
Iodomethane	0.50	U	0.50	5.0	µg/L	1	11/3/2010 6:57:00 PM
Methyl Ethyl Ketone	1.0	U	1.0	5.0	µg/L	1	11/3/2010 6:57:00 PM

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Laboratory Results

Geochemical Testing

Date: *02-Dec-10*

CLIENT:	CIVIL & ENVIRONMENTAL-COLUMBU	**Client Sample ID:**	FIELD DUP
Lab Order:	G1011042		
Project:	APEX Second SA	**Collection Date:**	10/28/2010
Lab ID:	G1011042-004	**Sampled By:**	Client
Matrix:	AQUEOUS	**DateReceived:**	11/2/2010 1:22:41 PM

Analyses	Result	Q	MDL	PQL	Units	DF	Date Analyzed
VOLATILE ORGANIC COMPOUNDS			**EPA 8260**			Analyst: **JAW**	
Methylene Chloride	0.50	U	0.50	1.0	µg/L	1	11/3/2010 6:57:00 PM
Styrene	0.50	U	0.50	1.0	µg/L	1	11/3/2010 6:57:00 PM
Tetrachloroethene	0.50	U	0.50	1.0	µg/L	1	11/3/2010 6:57:00 PM
Toluene	0.50	U	0.50	1.0	µg/L	1	11/3/2010 6:57:00 PM
trans-1,2-Dichloroethene	0.50	U	0.50	1.0	µg/L	1	11/3/2010 6:57:00 PM
trans-1,3-Dichloropropene	0.50	U	0.50	1.0	µg/L	1	11/3/2010 6:57:00 PM
trans-1,4-Dichloro-2-butene	1.0	U	1.0	2.0	µg/L	1	11/3/2010 6:57:00 PM
Trichloroethene	0.50	U	0.50	1.0	µg/L	1	11/3/2010 6:57:00 PM
Trichlorofluoromethane	0.50	U	0.50	1.0	µg/L	1	11/3/2010 6:57:00 PM
Vinyl Acetate	0.50	U	0.50	1.0	µg/L	1	11/3/2010 6:57:00 PM
Vinyl Chloride	0.50	U	0.50	1.0	µg/L	1	11/3/2010 6:57:00 PM
Total Xylene	1.0	U	1.0	2.0	µg/L	1	11/3/2010 6:57:00 PM
Surr: 1,2-Dichloroethane-d4	91.5		0	70-130	%REC	1	11/3/2010 6:57:00 PM
Surr: 4-Bromofluorobenzene	92.7		0	70-130	%REC	1	11/3/2010 6:57:00 PM
Surr: Dibromofluoromethane	98.0		0	70-130	%REC	1	11/3/2010 6:57:00 PM
Surr: Toluene-d8	94.8		0	70-130	%REC	1	11/3/2010 6:57:00 PM

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Laboratory Results

Geochemical Testing

Date: *02-Dec-10*

CLIENT:	CIVIL & ENVIRONMENTAL-COLUMBU	**Client Sample ID:**	P-10L
Lab Order:	G1011042		
Project:	APEX Second SA	**Collection Date:**	10/28/2010 6:15:00 PM
Lab ID:	G1011042-005	**Sampled By:**	Client
Matrix:	AQUEOUS	**DateReceived:**	11/2/2010 1:22:41 PM

Analyses	Result	Q	MDL	PQL	Units	DF	Date Analyzed
FIELD PARAMETERS			**FIELD**			Analyst:	
pH (Field)	7.18		0		S.U.	0	10/28/2010 6:15:00 P
Specific Conductance (Field)	4300		0		umhos/cm	0	10/28/2010 6:15:00 P
Temperature (Field)	12.6		0		deg C	0	10/28/2010 6:15:00 P
Turbidity (Field)	2.87		0		NTU	0	10/28/2010 6:15:00 P
INORGANIC NON-METALS			**SM 18 2320B**			Analyst: **LNW**	
Alkalinity to pH 4.5	348		2.0	5	mg/L CaCO3	1	11/3/2010 1:55:00 PM
INORGANIC NON-METALS			**SM 2540 C**			Analyst: **KLS**	
Total dissolved solids	2960		10.0	20	mg/L	1	11/2/2010 9:20:00 AM
INORGANIC NON-METALS			**SM 4500-CL E**			Analyst: **SAG**	
Chloride	5		2.0	5	mg/L	1	11/3/2010 4:05:00 PM
INORGANIC NON-METALS			**EPA 350.1**			Analyst: **SLY**	
Ammonia Nitrogen - Distilled	0.16		0.040	0.10	mg/L as N	1	11/9/2010 11:01:48 A
INORGANIC NON-METALS			**EPA 353.2**			Analyst: **CAS**	
Nitrate - Nitrite	0.020	U	0.020	0.05	mg/L as N	1	11/4/2010 12:04:19 P
INORGANIC NON METALS			**ASTM D516-02**			Analyst: **SAG**	
Sulfate	1560		50.0	250	mg/L	50	11/5/2010 4:56:00 PM
INORGANIC METALS			**EPA 200.7**			Analyst: **MS**	
Barium	0.013		0.0050	0.010	mg/L	1	11/4/2010 10:33:00 P
Beryllium	0.00050	U	0.00050	0.0010	mg/L	1	11/4/2010 10:33:00 P
Cadmium	0.0010	U	0.0010	0.002	mg/L	1	11/4/2010 10:33:00 P
Calcium	581		0.500	1.00	mg/L	10	11/5/2010 12:23:00 P
Chromium	0.0050	U	0.0050	0.010	mg/L	1	11/4/2010 10:33:00 P
Cobalt	0.007		0.0020	0.005	mg/L	1	11/4/2010 10:33:00 P
Copper	0.0050	U	0.0050	0.010	mg/L	1	11/4/2010 10:33:00 P
Iron	2.32		0.010	0.05	mg/L	1	11/5/2010 12:27:00 P
Magnesium	231		0.500	1.00	mg/L	10	11/5/2010 12:23:00 P
Manganese	0.882		0.0020	0.010	mg/L	1	11/4/2010 10:33:00 P
Nickel	0.015		0.0050	0.010	mg/L	1	11/4/2010 10:33:00 P
Potassium	7.2		0.20	0.5	mg/L	1	11/4/2010 10:33:00 P
Silver	0.0020	U	0.0020	0.005	mg/L	1	11/4/2010 10:33:00 P
Sodium	8.8		0.10	0.2	mg/L	1	11/4/2010 10:33:00 P
Vanadium	0.0020	U	0.0020	0.005	mg/L	1	11/4/2010 10:33:00 P
Zinc	0.007	J	0.0040	0.010	mg/L	1	11/4/2010 10:33:00 P

I.D. 56-00306 PA DEP

Laboratory Results

Geochemical Testing

Date: *02-Dec-10*

CLIENT:	CIVIL & ENVIRONMENTAL-COLUMBU	**Client Sample ID:**	P-10L
Lab Order:	G1011042		
Project:	APEX Second SA	**Collection Date:**	10/28/2010 6:15:00 PM
Lab ID:	G1011042-005	**Sampled By:**	Client
Matrix:	AQUEOUS	**DateReceived:**	11/2/2010 1:22:41 PM

Analyses	Result	Q	MDL	PQL	Units	DF	Date Analyzed
INORGANIC METALS			**EPA 200.8**				Analyst: **JEK**
Antimony	0.50	U	0.50	1.0	µg/L	1	11/4/2010 3:01:00 PM
Arsenic	1.0	J	0.50	1.0	µg/L	1	11/4/2010 3:01:00 PM
Lead	0.20	U	0.20	1.0	µg/L	1	11/4/2010 3:01:00 PM
Selenium	0.6	J	0.50	1.0	µg/L	1	11/4/2010 3:01:00 PM
Thallium	0.10	U	0.10	0.2	µg/L	1	11/4/2010 3:01:00 PM
VOLATILE ORGANIC COMPOUNDS			**EPA 8011**				Analyst: **TEW**
1,2-Dibromo-3-chloropropane	0.0100	U	0.0100	0.0400	µg/L	1	11/15/2010 10:22:39 P
1,2-Dibromoethane	0.0100	U	0.0100	0.0400	µg/L	1	11/15/2010 10:22:39 P
Surr: 1,1,2,2-Tetrachloroethane	94.2		0	60-140	%REC	1	11/15/2010 10:22:39 P
VOLATILE ORGANIC COMPOUNDS			**EPA 8260**				Analyst: **JAW**
1,1,1,2-Tetrachloroethane	0.50	U	0.50	1.0	µg/L	1	11/3/2010 7:33:00 PM
1,1,1-Trichloroethane	0.50	U	0.50	1.0	µg/L	1	11/3/2010 7:33:00 PM
1,1,2,2-Tetrachloroethane	0.50	U	0.50	1.0	µg/L	1	11/3/2010 7:33:00 PM
1,1,2-Trichloroethane	0.50	U	0.50	1.0	µg/L	1	11/3/2010 7:33:00 PM
1,1-Dichloroethane	0.50	U	0.50	1.0	µg/L	1	11/3/2010 7:33:00 PM
1,1-Dichloroethene	0.50	U	0.50	1.0	µg/L	1	11/3/2010 7:33:00 PM
1,2,3-Trichloropropane	0.50	U	0.50	1.0	µg/L	1	11/3/2010 7:33:00 PM
1,2-Dichlorobenzene	0.50	U	0.50	1.0	µg/L	1	11/3/2010 7:33:00 PM
1,2-Dichloroethane	0.50	U	0.50	1.0	µg/L	1	11/3/2010 7:33:00 PM
1,2-Dichloropropane	0.50	U	0.50	1.0	µg/L	1	11/3/2010 7:33:00 PM
1,4-Dichlorobenzene	0.50	U	0.50	1.0	µg/L	1	11/3/2010 7:33:00 PM
2-Hexanone	1.0	U	1.0	5.0	µg/L	1	11/3/2010 7:33:00 PM
4-Methyl-2-Pentanone	0.50	U	0.50	1.0	µg/L	1	11/3/2010 7:33:00 PM
Acetone	5.0	U	5.0	10	µg/L	1	11/3/2010 7:33:00 PM
Acrylonitrile	2.0	U	2.0	5.0	µg/L	1	11/3/2010 7:33:00 PM
Benzene	0.50	U	0.50	1.0	µg/L	1	11/3/2010 7:33:00 PM
Bromochloromethane	0.50	U	0.50	1.0	µg/L	1	11/3/2010 7:33:00 PM
Bromodichloromethane	0.50	U	0.50	1.0	µg/L	1	11/3/2010 7:33:00 PM
Bromoform	0.50	U	0.50	1.0	µg/L	1	11/3/2010 7:33:00 PM
Bromomethane	0.50	U	0.50	1.0	µg/L	1	11/3/2010 7:33:00 PM
Carbon Disulfide	0.50	U	0.50	1.0	µg/L	1	11/3/2010 7:33:00 PM
Carbon Tetrachloride	0.50	U	0.50	1.0	µg/L	1	11/3/2010 7:33:00 PM
Chlorobenzene	0.50	U	0.50	1.0	µg/L	1	11/3/2010 7:33:00 PM
Chlorodibromomethane	0.50	U	0.50	1.0	µg/L	1	11/3/2010 7:33:00 PM
Chloroethane	0.50	U	0.50	1.0	µg/L	1	11/3/2010 7:33:00 PM
Chloroform	0.50	U	0.50	1.0	µg/L	1	11/3/2010 7:33:00 PM
Chloromethane	0.50	U	0.50	1.0	µg/L	1	11/3/2010 7:33:00 PM
cis-1,2-Dichloroethene	0.50	U	0.50	1.0	µg/L	1	11/3/2010 7:33:00 PM
cis-1,3-Dichloropropene	0.50	U	0.50	1.0	µg/L	1	11/3/2010 7:33:00 PM

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I.D. 56-00306 PA DEP

Laboratory Results

Geochemical Testing

Date: *02-Dec-10*

CLIENT:	CIVIL & ENVIRONMENTAL-COLUMBU	**Client Sample ID:**	P-10L
Lab Order:	G1011042		
Project:	APEX Second SA	**Collection Date:**	10/28/2010 6:15:00 PM
Lab ID:	G1011042-005	**Sampled By:**	Client
Matrix:	AQUEOUS	**DateReceived:**	11/2/2010 1:22:41 PM

Analyses	Result	Q	MDL	PQL	Units	DF	Date Analyzed
VOLATILE ORGANIC COMPOUNDS			**EPA 8260**			Analyst: **JAW**	
Dibromomethane	0.50	U	0.50	1.0	µg/L	1	11/3/2010 7:33:00 PM
Dichlorobromomethane	0.50	U	0.50	1.0	µg/L	1	11/3/2010 7:33:00 PM
Ethylbenzene	0.50	U	0.50	1.0	µg/L	1	11/3/2010 7:33:00 PM
Iodomethane	0.50	U	0.50	5.0	µg/L	1	11/3/2010 7:33:00 PM
Methyl Ethyl Ketone	1.0	U	1.0	5.0	µg/L	1	11/3/2010 7:33:00 PM
Methylene Chloride	0.50	U	0.50	1.0	µg/L	1	11/3/2010 7:33:00 PM
Styrene	0.50	U	0.50	1.0	µg/L	1	11/3/2010 7:33:00 PM
Tetrachloroethene	0.50	U	0.50	1.0	µg/L	1	11/3/2010 7:33:00 PM
Toluene	0.50	U	0.50	1.0	µg/L	1	11/3/2010 7:33:00 PM
trans-1,2-Dichloroethene	0.50	U	0.50	1.0	µg/L	1	11/3/2010 7:33:00 PM
trans-1,3-Dichloropropene	0.50	U	0.50	1.0	µg/L	1	11/3/2010 7:33:00 PM
trans-1,4-Dichloro-2-butene	1.0	U	1.0	2.0	µg/L	1	11/3/2010 7:33:00 PM
Trichloroethene	0.50	U	0.50	1.0	µg/L	1	11/3/2010 7:33:00 PM
Trichlorofluoromethane	0.50	U	0.50	1.0	µg/L	1	11/3/2010 7:33:00 PM
Vinyl Acetate	0.50	U	0.50	1.0	µg/L	1	11/3/2010 7:33:00 PM
Vinyl Chloride	0.50	U	0.50	1.0	µg/L	1	11/3/2010 7:33:00 PM
Total Xylene	1.0	U	1.0	2.0	µg/L	1	11/3/2010 7:33:00 PM
Surr: 1,2-Dichloroethane-d4	91.6		0	70-130	%REC	1	11/3/2010 7:33:00 PM
Surr: 4-Bromofluorobenzene	93.6		0	70-130	%REC	1	11/3/2010 7:33:00 PM
Surr: Dibromofluoromethane	98.0		0	70-130	%REC	1	11/3/2010 7:33:00 PM
Surr: Toluene-d8	95.4		0	70-130	%REC	1	11/3/2010 7:33:00 PM

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Laboratory Results

Geochemical Testing

Date: *02-Dec-10*

CLIENT:	CIVIL & ENVIRONMENTAL-COLUMBU	**Client Sample ID:**	P-2A
Lab Order:	G1011042		
Project:	APEX Second SA	**Collection Date:**	10/28/2010 12:47:00 PM
Lab ID:	G1011042-006	**Sampled By:**	Client
Matrix:	AQUEOUS	**DateReceived:**	11/2/2010 1:22:41 PM

Analyses	Result	Q	MDL	PQL	Units	DF	Date Analyzed
FIELD PARAMETERS			**FIELD**			Analyst:	
pH (Field)	7.08		0		S.U.	0	10/28/2010 12:47:00 P
Specific Conductance (Field)	1781		0		umhos/cm	0	10/28/2010 12:47:00 P
Temperature (Field)	14.5		0		deg C	0	10/28/2010 12:47:00 P
Turbidity (Field)	21.4		0		NTU	0	10/28/2010 12:47:00 P
INORGANIC NON-METALS			**SM 18 2320B**			Analyst: **LNW**	
Alkalinity to pH 4.5	287		2.0	5	mg/L CaCO3	1	11/3/2010 2:07:00 PM
INORGANIC NON-METALS			**SM 2540 C**			Analyst: **KLS**	
Total dissolved solids	1600		10.0	20	mg/L	1	11/2/2010 9:21:00 AM
INORGANIC NON-METALS			**SM 4500-CL E**			Analyst: **SAG**	
Chloride	4	J	2.0	5	mg/L	1	11/3/2010 4:05:00 PM
INORGANIC NON-METALS			**EPA 350.1**			Analyst: **SLY**	
Ammonia Nitrogen - Distilled	0.06	J	0.040	0.10	mg/L as N	1	11/9/2010 11:02:56 A
INORGANIC NON-METALS			**EPA 353.2**			Analyst: **CAS**	
Nitrate - Nitrite	0.020	U	0.020	0.05	mg/L as N	1	11/4/2010 12:05:27 P
INORGANIC NON METALS			**ASTM D516-02**			Analyst: **SAG**	
Sulfate	728		20.0	100	mg/L	20	11/5/2010 4:56:00 PM
INORGANIC METALS			**EPA 200.7**			Analyst: **MS**	
Barium	0.026		0.0050	0.010	mg/L	1	11/4/2010 10:38:00 P
Beryllium	0.00050	U	0.00050	0.0010	mg/L	1	11/4/2010 10:38:00 P
Cadmium	0.0010	U	0.0010	0.002	mg/L	1	11/4/2010 10:38:00 P
Calcium	361		0.050	0.10	mg/L	1	11/4/2010 10:38:00 P
Chromium	0.0050	U	0.0050	0.010	mg/L	1	11/4/2010 10:38:00 P
Cobalt	0.014		0.0020	0.005	mg/L	1	11/4/2010 10:38:00 P
Copper	0.0050	U	0.0050	0.010	mg/L	1	11/4/2010 10:38:00 P
Iron	0.91		0.010	0.05	mg/L	1	11/5/2010 12:53:00 P
Magnesium	81.5		0.050	0.10	mg/L	1	11/4/2010 10:38:00 P
Manganese	4.04		0.0020	0.010	mg/L	1	11/4/2010 10:38:00 P
Nickel	0.017		0.0050	0.010	mg/L	1	11/4/2010 10:38:00 P
Potassium	2.3		0.20	0.5	mg/L	1	11/4/2010 10:38:00 P
Silver	0.0020	U	0.0020	0.005	mg/L	1	11/4/2010 10:38:00 P
Sodium	5.9		0.10	0.2	mg/L	1	11/4/2010 10:38:00 P
Vanadium	0.003	J	0.0020	0.005	mg/L	1	11/4/2010 10:38:00 P
Zinc	0.004	J	0.0040	0.010	mg/L	1	11/4/2010 10:38:00 P

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Laboratory Results

Geochemical Testing

Date: *02-Dec-10*

CLIENT:	CIVIL & ENVIRONMENTAL-COLUMBU	**Client Sample ID:**	P-2A
Lab Order:	G1011042		
Project:	APEX Second SA	**Collection Date:**	10/28/2010 12:47:00 PM
Lab ID:	G1011042-006	**Sampled By:**	Client
Matrix:	AQUEOUS	**DateReceived:**	11/2/2010 1:22:41 PM

Analyses	Result	Q	MDL	PQL	Units	DF	Date Analyzed
INORGANIC METALS			**EPA 200.8**				Analyst: **JEK**
Antimony	0.50	U	0.50	1.0	µg/L	1	11/4/2010 3:06:00 PM
Arsenic	0.50	U	0.50	1.0	µg/L	1	11/4/2010 3:06:00 PM
Lead	0.4	J	0.20	1.0	µg/L	1	11/4/2010 3:06:00 PM
Selenium	0.50	U	0.50	1.0	µg/L	1	11/4/2010 3:06:00 PM
Thallium	0.10	U	0.10	0.2	µg/L	1	11/4/2010 3:06:00 PM
VOLATILE ORGANIC COMPOUNDS			**EPA 8011**				Analyst: **TEW**
1,2-Dibromo-3-chloropropane	0.0100	U	0.0100	0.0400	µg/L	1	11/15/2010 10:47:27 P
1,2-Dibromoethane	0.0100	U	0.0100	0.0400	µg/L	1	11/15/2010 10:47:27 P
Surr: 1,1,2,2-Tetrachloroethane	93.9		0	60-140	%REC	1	11/15/2010 10:47:27 P
VOLATILE ORGANIC COMPOUNDS			**EPA 8260**				Analyst: **JAW**
1,1,1,2-Tetrachloroethane	0.50	U	0.50	1.0	µg/L	1	11/3/2010 8:08:00 PM
1,1,1-Trichloroethane	0.50	U	0.50	1.0	µg/L	1	11/3/2010 8:08:00 PM
1,1,2,2-Tetrachloroethane	0.50	U	0.50	1.0	µg/L	1	11/3/2010 8:08:00 PM
1,1,2-Trichloroethane	0.50	U	0.50	1.0	µg/L	1	11/3/2010 8:08:00 PM
1,1-Dichloroethane	0.50	U	0.50	1.0	µg/L	1	11/3/2010 8:08:00 PM
1,1-Dichloroethene	0.50	U	0.50	1.0	µg/L	1	11/3/2010 8:08:00 PM
1,2,3-Trichloropropane	0.50	U	0.50	1.0	µg/L	1	11/3/2010 8:08:00 PM
1,2-Dichlorobenzene	0.50	U	0.50	1.0	µg/L	1	11/3/2010 8:08:00 PM
1,2-Dichloroethane	0.50	U	0.50	1.0	µg/L	1	11/3/2010 8:08:00 PM
1,2-Dichloropropane	0.50	U	0.50	1.0	µg/L	1	11/3/2010 8:08:00 PM
1,4-Dichlorobenzene	0.50	U	0.50	1.0	µg/L	1	11/3/2010 8:08:00 PM
2-Hexanone	1.0	U	1.0	5.0	µg/L	1	11/3/2010 8:08:00 PM
4-Methyl-2-Pentanone	0.50	U	0.50	1.0	µg/L	1	11/3/2010 8:08:00 PM
Acetone	5.0	U	5.0	10	µg/L	1	11/3/2010 8:08:00 PM
Acrylonitrile	2.0	U	2.0	5.0	µg/L	1	11/3/2010 8:08:00 PM
Benzene	0.50	U	0.50	1.0	µg/L	1	11/3/2010 8:08:00 PM
Bromochloromethane	0.50	U	0.50	1.0	µg/L	1	11/3/2010 8:08:00 PM
Bromodichloromethane	0.50	U	0.50	1.0	µg/L	1	11/3/2010 8:08:00 PM
Bromoform	0.50	U	0.50	1.0	µg/L	1	11/3/2010 8:08:00 PM
Bromomethane	0.50	U	0.50	1.0	µg/L	1	11/3/2010 8:08:00 PM
Carbon Disulfide	0.50	U	0.50	1.0	µg/L	1	11/3/2010 8:08:00 PM
Carbon Tetrachloride	0.50	U	0.50	1.0	µg/L	1	11/3/2010 8:08:00 PM
Chlorobenzene	0.50	U	0.50	1.0	µg/L	1	11/3/2010 8:08:00 PM
Chlorodibromomethane	0.50	U	0.50	1.0	µg/L	1	11/3/2010 8:08:00 PM
Chloroethane	0.50	U	0.50	1.0	µg/L	1	11/3/2010 8:08:00 PM
Chloroform	0.50	U	0.50	1.0	µg/L	1	11/3/2010 8:08:00 PM
Chloromethane	0.50	U	0.50	1.0	µg/L	1	11/3/2010 8:08:00 PM
cis-1,2-Dichloroethene	0.50	U	0.50	1.0	µg/L	1	11/3/2010 8:08:00 PM
cis-1,3-Dichloropropene	0.50	U	0.50	1.0	µg/L	1	11/3/2010 8:08:00 PM

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I.D. 56-00306 PA DEP

Laboratory Results

Geochemical Testing

Date: *02-Dec-10*

CLIENT:	CIVIL & ENVIRONMENTAL-COLUMBU	**Client Sample ID:**	P-2A
Lab Order:	G1011042		
Project:	APEX Second SA	**Collection Date:**	10/28/2010 12:47:00 PM
Lab ID:	G1011042-006	**Sampled By:**	Client
Matrix:	AQUEOUS	**DateReceived:**	11/2/2010 1:22:41 PM

Analyses	Result	Q	MDL	PQL	Units	DF	Date Analyzed
VOLATILE ORGANIC COMPOUNDS			**EPA 8260**			Analyst: **JAW**	
Dibromomethane	0.50	U	0.50	1.0	µg/L	1	11/3/2010 8:08:00 PM
Dichlorobromomethane	0.50	U	0.50	1.0	µg/L	1	11/3/2010 8:08:00 PM
Ethylbenzene	0.50	U	0.50	1.0	µg/L	1	11/3/2010 8:08:00 PM
Iodomethane	0.50	U	0.50	5.0	µg/L	1	11/3/2010 8:08:00 PM
Methyl Ethyl Ketone	1.0	U	1.0	5.0	µg/L	1	11/3/2010 8:08:00 PM
Methylene Chloride	0.50	U	0.50	1.0	µg/L	1	11/3/2010 8:08:00 PM
Styrene	0.50	U	0.50	1.0	µg/L	1	11/3/2010 8:08:00 PM
Tetrachloroethene	0.50	U	0.50	1.0	µg/L	1	11/3/2010 8:08:00 PM
Toluene	0.50	U	0.50	1.0	µg/L	1	11/3/2010 8:08:00 PM
trans-1,2-Dichloroethene	0.50	U	0.50	1.0	µg/L	1	11/3/2010 8:08:00 PM
trans-1,3-Dichloropropene	0.50	U	0.50	1.0	µg/L	1	11/3/2010 8:08:00 PM
trans-1,4-Dichloro-2-butene	1.0	U	1.0	2.0	µg/L	1	11/3/2010 8:08:00 PM
Trichloroethene	0.50	U	0.50	1.0	µg/L	1	11/3/2010 8:08:00 PM
Trichlorofluoromethane	0.50	U	0.50	1.0	µg/L	1	11/3/2010 8:08:00 PM
Vinyl Acetate	0.50	U	0.50	1.0	µg/L	1	11/3/2010 8:08:00 PM
Vinyl Chloride	0.50	U	0.50	1.0	µg/L	1	11/3/2010 8:08:00 PM
Total Xylene	1.0	U	1.0	2.0	µg/L	1	11/3/2010 8:08:00 PM
Surr: 1,2-Dichloroethane-d4	92.3		0	70-130	%REC	1	11/3/2010 8:08:00 PM
Surr: 4-Bromofluorobenzene	92.4		0	70-130	%REC	1	11/3/2010 8:08:00 PM
Surr: Dibromofluoromethane	100		0	70-130	%REC	1	11/3/2010 8:08:00 PM
Surr: Toluene-d8	95.2		0	70-130	%REC	1	11/3/2010 8:08:00 PM

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I.D. 56-00306 PA DEP

Laboratory Results

Geochemical Testing

Date: *02-Dec-10*

CLIENT:	CIVIL & ENVIRONMENTAL-COLUMBU	**Client Sample ID:**	P-6S
Lab Order:	G1011042		
Project:	APEX Second SA	**Collection Date:**	10/29/2010 9:14:00 AM
Lab ID:	G1011042-007	**Sampled By:**	Client
Matrix:	AQUEOUS	**DateReceived:**	11/2/2010 1:22:41 PM

Analyses	Result	Q	MDL	PQL	Units	DF	Date Analyzed
FIELD PARAMETERS			**FIELD**				Analyst:
pH (Field)	7.25		0		S.U.	0	10/29/2010 9:14:00 A
Specific Conductance (Field)	3020		0		umhos/cm	0	10/29/2010 9:14:00 A
Temperature (Field)	9.3		0		deg C	0	10/29/2010 9:14:00 A
Turbidity (Field)	25.4		0		NTU	0	10/29/2010 9:14:00 A
INORGANIC NON-METALS			**SM 18 2320B**				Analyst: **LNW**
Alkalinity to pH 4.5	281		2.0	5	mg/L CaCO3	1	11/3/2010 2:18:00 PM
INORGANIC NON-METALS			**SM 2540 C**				Analyst: **KLS**
Total dissolved solids	2090		10.0	20	mg/L	1	11/2/2010 9:29:00 AM
INORGANIC NON-METALS			**SM 4500-CL E**				Analyst: **SAG**
Chloride	2	J	2.0	5	mg/L	1	11/3/2010 4:05:00 PM
INORGANIC NON-METALS			**EPA 350.1**				Analyst: **SLY**
Ammonia Nitrogen - Distilled	0.54		0.040	0.10	mg/L as N	1	11/9/2010 11:10:53 A
INORGANIC NON-METALS			**EPA 353.2**				Analyst: **CAS**
Nitrate - Nitrite	0.03	J	0.020	0.05	mg/L as N	1	11/4/2010 12:06:36 P
INORGANIC NON METALS			**ASTM D516-02**				Analyst: **SAG**
Sulfate	1210		50.0	250	mg/L	50	11/5/2010 4:56:00 PM
INORGANIC METALS			**EPA 200.7**				Analyst: **MS**
Barium	0.043		0.0050	0.010	mg/L	1	11/4/2010 10:43:00 P
Beryllium	0.00050	U	0.00050	0.0010	mg/L	1	11/4/2010 10:43:00 P
Cadmium	0.0010	U	0.0010	0.002	mg/L	1	11/4/2010 10:43:00 P
Calcium	439		0.050	0.10	mg/L	1	11/4/2010 10:43:00 P
Chromium	0.0050	U	0.0050	0.010	mg/L	1	11/4/2010 10:43:00 P
Cobalt	0.0020	U	0.0020	0.005	mg/L	1	11/4/2010 10:43:00 P
Copper	0.0050	U	0.0050	0.010	mg/L	1	11/4/2010 10:43:00 P
Iron	0.47		0.010	0.05	mg/L	1	11/5/2010 12:56:00 P
Magnesium	121		0.050	0.10	mg/L	1	11/4/2010 10:43:00 P
Manganese	0.771		0.0020	0.010	mg/L	1	11/4/2010 10:43:00 P
Nickel	0.0050	U	0.0050	0.010	mg/L	1	11/4/2010 10:43:00 P
Potassium	5.2		0.20	0.5	mg/L	1	11/4/2010 10:43:00 P
Silver	0.0020	U	0.0020	0.005	mg/L	1	11/4/2010 10:43:00 P
Sodium	32.5		0.10	0.2	mg/L	1	11/4/2010 10:43:00 P
Vanadium	0.0020	U	0.0020	0.005	mg/L	1	11/4/2010 10:43:00 P
Zinc	0.010	J	0.0040	0.010	mg/L	1	11/4/2010 10:43:00 P

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Laboratory Results

Geochemical Testing

Date: *02-Dec-10*

CLIENT:	CIVIL & ENVIRONMENTAL-COLUMBU	**Client Sample ID:**	P-6S
Lab Order:	G1011042		
Project:	APEX Second SA	**Collection Date:**	10/29/2010 9:14:00 AM
Lab ID:	G1011042-007	**Sampled By:**	Client
Matrix:	AQUEOUS	**DateReceived:**	11/2/2010 1:22:41 PM

Analyses	Result	Q	MDL	PQL	Units	DF	Date Analyzed
INORGANIC METALS			**EPA 200.8**				Analyst: **JEK**
Antimony	0.50	U	0.50	1.0	µg/L	1	11/4/2010 3:11:00 PM
Arsenic	0.50	U	0.50	1.0	µg/L	1	11/4/2010 3:11:00 PM
Lead	1.7		0.20	1.0	µg/L	1	11/4/2010 3:11:00 PM
Selenium	0.50	U	0.50	1.0	µg/L	1	11/4/2010 3:11:00 PM
Thallium	0.10	U	0.10	0.2	µg/L	1	11/4/2010 3:11:00 PM
VOLATILE ORGANIC COMPOUNDS			**EPA 8011**				Analyst: **TEW**
1,2-Dibromo-3-chloropropane	0.0100	U	0.0100	0.0400	µg/L	1	11/15/2010 11:12:21 P
1,2-Dibromoethane	0.0100	U	0.0100	0.0400	µg/L	1	11/15/2010 11:12:21 P
Surr: 1,1,2,2-Tetrachloroethane	95.8		0	60-140	%REC	1	11/15/2010 11:12:21 P
VOLATILE ORGANIC COMPOUNDS			**EPA 8260**				Analyst: **JAW**
1,1,1,2-Tetrachloroethane	0.50	U	0.50	1.0	µg/L	1	11/3/2010 8:44:00 PM
1,1,1-Trichloroethane	0.50	U	0.50	1.0	µg/L	1	11/3/2010 8:44:00 PM
1,1,2,2-Tetrachloroethane	0.50	U	0.50	1.0	µg/L	1	11/3/2010 8:44:00 PM
1,1,2-Trichloroethane	0.50	U	0.50	1.0	µg/L	1	11/3/2010 8:44:00 PM
1,1-Dichloroethane	0.50	U	0.50	1.0	µg/L	1	11/3/2010 8:44:00 PM
1,1-Dichloroethene	0.50	U	0.50	1.0	µg/L	1	11/3/2010 8:44:00 PM
1,2,3-Trichloropropane	0.50	U	0.50	1.0	µg/L	1	11/3/2010 8:44:00 PM
1,2-Dichlorobenzene	0.50	U	0.50	1.0	µg/L	1	11/3/2010 8:44:00 PM
1,2-Dichloroethane	0.50	U	0.50	1.0	µg/L	1	11/3/2010 8:44:00 PM
1,2-Dichloropropane	0.50	U	0.50	1.0	µg/L	1	11/3/2010 8:44:00 PM
1,4-Dichlorobenzene	0.50	U	0.50	1.0	µg/L	1	11/3/2010 8:44:00 PM
2-Hexanone	1.0	U	1.0	5.0	µg/L	1	11/3/2010 8:44:00 PM
4-Methyl-2-Pentanone	0.50	U	0.50	1.0	µg/L	1	11/3/2010 8:44:00 PM
Acetone	5.0	U	5.0	10	µg/L	1	11/3/2010 8:44:00 PM
Acrylonitrile	2.0	U	2.0	5.0	µg/L	1	11/3/2010 8:44:00 PM
Benzene	0.50	U	0.50	1.0	µg/L	1	11/3/2010 8:44:00 PM
Bromochloromethane	0.50	U	0.50	1.0	µg/L	1	11/3/2010 8:44:00 PM
Bromodichloromethane	0.50	U	0.50	1.0	µg/L	1	11/3/2010 8:44:00 PM
Bromoform	0.50	U	0.50	1.0	µg/L	1	11/3/2010 8:44:00 PM
Bromomethane	0.50	U	0.50	1.0	µg/L	1	11/3/2010 8:44:00 PM
Carbon Disulfide	0.50	U	0.50	1.0	µg/L	1	11/3/2010 8:44:00 PM
Carbon Tetrachloride	0.50	U	0.50	1.0	µg/L	1	11/3/2010 8:44:00 PM
Chlorobenzene	0.50	U	0.50	1.0	µg/L	1	11/3/2010 8:44:00 PM
Chlorodibromomethane	0.50	U	0.50	1.0	µg/L	1	11/3/2010 8:44:00 PM
Chloroethane	0.50	U	0.50	1.0	µg/L	1	11/3/2010 8:44:00 PM
Chloroform	0.50	U	0.50	1.0	µg/L	1	11/3/2010 8:44:00 PM
Chloromethane	0.50	U	0.50	1.0	µg/L	1	11/3/2010 8:44:00 PM
cis-1,2-Dichloroethene	0.50	U	0.50	1.0	µg/L	1	11/3/2010 8:44:00 PM
cis-1,3-Dichloropropene	0.50	U	0.50	1.0	µg/L	1	11/3/2010 8:44:00 PM

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Laboratory Results

Geochemical Testing

Date: *02-Dec-10*

CLIENT:	CIVIL & ENVIRONMENTAL-COLUMBU	**Client Sample ID:**	P-6S
Lab Order:	G1011042		
Project:	APEX Second SA	**Collection Date:**	10/29/2010 9:14:00 AM
Lab ID:	G1011042-007	**Sampled By:**	Client
Matrix:	AQUEOUS	**DateReceived:**	11/2/2010 1:22:41 PM

Analyses	Result	Q	MDL	PQL	Units	DF	Date Analyzed
VOLATILE ORGANIC COMPOUNDS			**EPA 8260**			Analyst: **JAW**	
Dibromomethane	0.50	U	0.50	1.0	µg/L	1	11/3/2010 8:44:00 PM
Dichlorobromomethane	0.50	U	0.50	1.0	µg/L	1	11/3/2010 8:44:00 PM
Ethylbenzene	0.50	U	0.50	1.0	µg/L	1	11/3/2010 8:44:00 PM
Iodomethane	0.50	U	0.50	5.0	µg/L	1	11/3/2010 8:44:00 PM
Methyl Ethyl Ketone	1.0	U	1.0	5.0	µg/L	1	11/3/2010 8:44:00 PM
Methylene Chloride	0.50	U	0.50	1.0	µg/L	1	11/3/2010 8:44:00 PM
Styrene	0.50	U	0.50	1.0	µg/L	1	11/3/2010 8:44:00 PM
Tetrachloroethene	0.50	U	0.50	1.0	µg/L	1	11/3/2010 8:44:00 PM
Toluene	0.50	U	0.50	1.0	µg/L	1	11/3/2010 8:44:00 PM
trans-1,2-Dichloroethene	0.50	U	0.50	1.0	µg/L	1	11/3/2010 8:44:00 PM
trans-1,3-Dichloropropene	0.50	U	0.50	1.0	µg/L	1	11/3/2010 8:44:00 PM
trans-1,4-Dichloro-2-butene	1.0	U	1.0	2.0	µg/L	1	11/3/2010 8:44:00 PM
Trichloroethene	0.50	U	0.50	1.0	µg/L	1	11/3/2010 8:44:00 PM
Trichlorofluoromethane	0.50	U	0.50	1.0	µg/L	1	11/3/2010 8:44:00 PM
Vinyl Acetate	0.50	U	0.50	1.0	µg/L	1	11/3/2010 8:44:00 PM
Vinyl Chloride	0.50	U	0.50	1.0	µg/L	1	11/3/2010 8:44:00 PM
Total Xylene	1.0	U	1.0	2.0	µg/L	1	11/3/2010 8:44:00 PM
Surr: 1,2-Dichloroethane-d4	91.8		0	70-130	%REC	1	11/3/2010 8:44:00 PM
Surr: 4-Bromofluorobenzene	92.1		0	70-130	%REC	1	11/3/2010 8:44:00 PM
Surr: Dibromofluoromethane	98.3		0	70-130	%REC	1	11/3/2010 8:44:00 PM
Surr: Toluene-d8	94.6		0	70-130	%REC	1	11/3/2010 8:44:00 PM

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Laboratory Results

Geochemical Testing

Date: *02-Dec-10*

CLIENT:	CIVIL & ENVIRONMENTAL-COLUMBU	**Client Sample ID:**	P-9
Lab Order:	G1011042		
Project:	APEX Second SA	**Collection Date:**	10/28/2010 3:35:00 PM
Lab ID:	G1011042-008	**Sampled By:**	Client
Matrix:	AQUEOUS	**DateReceived:**	11/2/2010 1:22:41 PM

Analyses	Result	Q	MDL	PQL	Units	DF	Date Analyzed
FIELD PARAMETERS			**FIELD**			Analyst:	
pH (Field)	7.41		0		S.U.	0	10/28/2010 3:35:00 P
Specific Conductance (Field)	1325		0		umhos/cm	0	10/28/2010 3:35:00 P
Temperature (Field)	12.5		0		deg C	0	10/28/2010 3:35:00 P
Turbidity (Field)	6.20		0		NTU	0	10/28/2010 3:35:00 P
INORGANIC NON-METALS			**SM 18 2320B**			Analyst: **LNW**	
Alkalinity to pH 4.5	292		2.0	5	mg/L CaCO3	1	11/3/2010 2:29:00 PM
INORGANIC NON-METALS			**SM 2540 C**			Analyst: **KLS**	
Total dissolved solids	1050		10.0	20	mg/L	1	11/2/2010 9:29:00 AM
INORGANIC NON-METALS			**SM 4500-CL E**			Analyst: **SAG**	
Chloride	2.0	U	2.0	5	mg/L	1	11/3/2010 4:05:00 PM
INORGANIC NON-METALS			**EPA 350.1**			Analyst: **SLY**	
Ammonia Nitrogen - Distilled	0.34		0.040	0.10	mg/L as N	1	11/9/2010 11:11:59 A
INORGANIC NON-METALS			**EPA 353.2**			Analyst: **CAS**	
Nitrate - Nitrite	0.020	U	0.020	0.05	mg/L as N	1	11/4/2010 12:07:44 P
INORGANIC NON METALS			**ASTM D516-02**			Analyst: **SAG**	
Sulfate	490		20.0	100	mg/L	20	11/5/2010 4:56:00 PM
INORGANIC METALS			**EPA 200.7**			Analyst: **MS**	
Barium	0.037		0.0050	0.010	mg/L	1	11/4/2010 10:48:00 P
Beryllium	0.00050	U	0.00050	0.0010	mg/L	1	11/4/2010 10:48:00 P
Cadmium	0.0010	U	0.0010	0.002	mg/L	1	11/4/2010 10:48:00 P
Calcium	207		0.050	0.10	mg/L	1	11/4/2010 10:48:00 P
Chromium	0.0050	U	0.0050	0.010	mg/L	1	11/4/2010 10:48:00 P
Cobalt	0.006		0.0020	0.005	mg/L	1	11/4/2010 10:48:00 P
Copper	0.0050	U	0.0050	0.010	mg/L	1	11/4/2010 10:48:00 P
Iron	0.19		0.010	0.05	mg/L	1	11/5/2010 1:00:00 PM
Magnesium	49.0		0.050	0.10	mg/L	1	11/4/2010 10:48:00 P
Manganese	0.545		0.0020	0.010	mg/L	1	11/4/2010 10:48:00 P
Nickel	0.006	J	0.0050	0.010	mg/L	1	11/4/2010 10:48:00 P
Potassium	3.3		0.20	0.5	mg/L	1	11/4/2010 10:48:00 P
Silver	0.0020	U	0.0020	0.005	mg/L	1	11/4/2010 10:48:00 P
Sodium	53.8		0.10	0.2	mg/L	1	11/4/2010 10:48:00 P
Vanadium	0.0020	U	0.0020	0.005	mg/L	1	11/4/2010 10:48:00 P
Zinc	0.0040	U	0.0040	0.010	mg/L	1	11/4/2010 10:48:00 P

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I.D. 56-00306 PA DEP

Laboratory Results

Geochemical Testing

Date: *02-Dec-10*

CLIENT:	CIVIL & ENVIRONMENTAL-COLUMBU	**Client Sample ID:**	P-9
Lab Order:	G1011042		
Project:	APEX Second SA	**Collection Date:**	10/28/2010 3:35:00 PM
Lab ID:	G1011042-008	**Sampled By:**	Client
Matrix:	AQUEOUS	**DateReceived:**	11/2/2010 1:22:41 PM

Analyses	Result	Q	MDL	PQL	Units	DF	Date Analyzed
INORGANIC METALS			**EPA 200.8**				Analyst: **JEK**
Antimony	0.50	U	0.50	1.0	µg/L	1	11/4/2010 3:16:00 PM
Arsenic	12.4		0.50	1.0	µg/L	1	11/4/2010 3:16:00 PM
Lead	0.4	J	0.20	1.0	µg/L	1	11/4/2010 3:16:00 PM
Selenium	0.50	U	0.50	1.0	µg/L	1	11/4/2010 3:16:00 PM
Thallium	0.10	U	0.10	0.2	µg/L	1	11/4/2010 3:16:00 PM
VOLATILE ORGANIC COMPOUNDS			**EPA 8011**				Analyst: **TEW**
1,2-Dibromo-3-chloropropane	0.0100	U	0.0100	0.0400	µg/L	1	11/15/2010 11:37:07 P
1,2-Dibromoethane	0.0100	U	0.0100	0.0400	µg/L	1	11/15/2010 11:37:07 P
Surr: 1,1,2,2-Tetrachloroethane	96.5		0	60-140	%REC	1	11/15/2010 11:37:07 P
VOLATILE ORGANIC COMPOUNDS			**EPA 8260**				Analyst: **JAW**
1,1,1,2-Tetrachloroethane	0.50	U	0.50	1.0	µg/L	1	11/3/2010 9:19:00 PM
1,1,1-Trichloroethane	0.50	U	0.50	1.0	µg/L	1	11/3/2010 9:19:00 PM
1,1,2,2-Tetrachloroethane	0.50	U	0.50	1.0	µg/L	1	11/3/2010 9:19:00 PM
1,1,2-Trichloroethane	0.50	U	0.50	1.0	µg/L	1	11/3/2010 9:19:00 PM
1,1-Dichloroethane	0.50	U	0.50	1.0	µg/L	1	11/3/2010 9:19:00 PM
1,1-Dichloroethene	0.50	U	0.50	1.0	µg/L	1	11/3/2010 9:19:00 PM
1,2,3-Trichloropropane	0.50	U	0.50	1.0	µg/L	1	11/3/2010 9:19:00 PM
1,2-Dichlorobenzene	0.50	U	0.50	1.0	µg/L	1	11/3/2010 9:19:00 PM
1,2-Dichloroethane	0.50	U	0.50	1.0	µg/L	1	11/3/2010 9:19:00 PM
1,2-Dichloropropane	0.50	U	0.50	1.0	µg/L	1	11/3/2010 9:19:00 PM
1,4-Dichlorobenzene	0.50	U	0.50	1.0	µg/L	1	11/3/2010 9:19:00 PM
2-Hexanone	1.0	U	1.0	5.0	µg/L	1	11/3/2010 9:19:00 PM
4-Methyl-2-Pentanone	0.50	U	0.50	1.0	µg/L	1	11/3/2010 9:19:00 PM
Acetone	5.0	U	5.0	10	µg/L	1	11/3/2010 9:19:00 PM
Acrylonitrile	2.0	U	2.0	5.0	µg/L	1	11/3/2010 9:19:00 PM
Benzene	0.50	U	0.50	1.0	µg/L	1	11/3/2010 9:19:00 PM
Bromochloromethane	0.50	U	0.50	1.0	µg/L	1	11/3/2010 9:19:00 PM
Bromodichloromethane	0.50	U	0.50	1.0	µg/L	1	11/3/2010 9:19:00 PM
Bromoform	0.50	U	0.50	1.0	µg/L	1	11/3/2010 9:19:00 PM
Bromomethane	0.50	U	0.50	1.0	µg/L	1	11/3/2010 9:19:00 PM
Carbon Disulfide	0.50	U	0.50	1.0	µg/L	1	11/3/2010 9:19:00 PM
Carbon Tetrachloride	0.50	U	0.50	1.0	µg/L	1	11/3/2010 9:19:00 PM
Chlorobenzene	0.50	U	0.50	1.0	µg/L	1	11/3/2010 9:19:00 PM
Chlorodibromomethane	0.50	U	0.50	1.0	µg/L	1	11/3/2010 9:19:00 PM
Chloroethane	0.50	U	0.50	1.0	µg/L	1	11/3/2010 9:19:00 PM
Chloroform	0.50	U	0.50	1.0	µg/L	1	11/3/2010 9:19:00 PM
Chloromethane	0.50	U	0.50	1.0	µg/L	1	11/3/2010 9:19:00 PM
cis-1,2-Dichloroethene	0.50	U	0.50	1.0	µg/L	1	11/3/2010 9:19:00 PM
cis-1,3-Dichloropropene	0.50	U	0.50	1.0	µg/L	1	11/3/2010 9:19:00 PM

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I.D. 56-00306 PA DEP

Laboratory Results

Geochemical Testing

Date: *02-Dec-10*

CLIENT:	CIVIL & ENVIRONMENTAL-COLUMBU	**Client Sample ID:**	P-9
Lab Order:	G1011042		
Project:	APEX Second SA	**Collection Date:**	10/28/2010 3:35:00 PM
Lab ID:	G1011042-008	**Sampled By:**	Client
Matrix:	AQUEOUS	**DateReceived:**	11/2/2010 1:22:41 PM

Analyses	Result	Q	MDL	PQL	Units	DF	Date Analyzed
VOLATILE ORGANIC COMPOUNDS			**EPA 8260**			Analyst: **JAW**	
Dibromomethane	0.50	U	0.50	1.0	µg/L	1	11/3/2010 9:19:00 PM
Dichlorobromomethane	0.50	U	0.50	1.0	µg/L	1	11/3/2010 9:19:00 PM
Ethylbenzene	0.50	U	0.50	1.0	µg/L	1	11/3/2010 9:19:00 PM
Iodomethane	0.50	U	0.50	5.0	µg/L	1	11/3/2010 9:19:00 PM
Methyl Ethyl Ketone	1.0	U	1.0	5.0	µg/L	1	11/3/2010 9:19:00 PM
Methylene Chloride	0.50	U	0.50	1.0	µg/L	1	11/3/2010 9:19:00 PM
Styrene	0.50	U	0.50	1.0	µg/L	1	11/3/2010 9:19:00 PM
Tetrachloroethene	0.50	U	0.50	1.0	µg/L	1	11/3/2010 9:19:00 PM
Toluene	0.50	U	0.50	1.0	µg/L	1	11/3/2010 9:19:00 PM
trans-1,2-Dichloroethene	0.50	U	0.50	1.0	µg/L	1	11/3/2010 9:19:00 PM
trans-1,3-Dichloropropene	0.50	U	0.50	1.0	µg/L	1	11/3/2010 9:19:00 PM
trans-1,4-Dichloro-2-butene	1.0	U	1.0	2.0	µg/L	1	11/3/2010 9:19:00 PM
Trichloroethene	0.50	U	0.50	1.0	µg/L	1	11/3/2010 9:19:00 PM
Trichlorofluoromethane	0.50	U	0.50	1.0	µg/L	1	11/3/2010 9:19:00 PM
Vinyl Acetate	0.50	U	0.50	1.0	µg/L	1	11/3/2010 9:19:00 PM
Vinyl Chloride	0.50	U	0.50	1.0	µg/L	1	11/3/2010 9:19:00 PM
Total Xylene	1.0	U	1.0	2.0	µg/L	1	11/3/2010 9:19:00 PM
Surr: 1,2-Dichloroethane-d4	91.4		0	70-130	%REC	1	11/3/2010 9:19:00 PM
Surr: 4-Bromofluorobenzene	92.2		0	70-130	%REC	1	11/3/2010 9:19:00 PM
Surr: Dibromofluoromethane	97.6		0	70-130	%REC	1	11/3/2010 9:19:00 PM
Surr: Toluene-d8	97.3		0	70-130	%REC	1	11/3/2010 9:19:00 PM

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I.D. 56-00306 PA DEP

Laboratory Results

Geochemical Testing

Date: *02-Dec-10*

CLIENT:	CIVIL & ENVIRONMENTAL-COLUMBU	**Client Sample ID:**	TRIP BLANK
Lab Order:	G1011042		
Project:	APEX Second SA	**Collection Date:**	10/28/2010
Lab ID:	G1011042-009	**Sampled By:**	Client
Matrix:		**DateReceived:**	11/2/2010 1:22:41 PM

Analyses	Result	Q	MDL	PQL	Units	DF	Date Analyzed
VOLATILE ORGANIC COMPOUNDS			**EPA 8011**				Analyst: **TEW**
1,2-Dibromo-3-chloropropane	0.0100	U	0.0100	0.0400	µg/L	1	11/16/2010 12:01:29 A
1,2-Dibromoethane	0.0100	U	0.0100	0.0400	µg/L	1	11/16/2010 12:01:29 A
Surr: 1,1,2,2-Tetrachloroethane	95.4		0	60-140	%REC	1	11/16/2010 12:01:29 A
VOLATILE ORGANIC COMPOUNDS			**EPA 8260**				Analyst: **JAW**
1,1,1,2-Tetrachloroethane	0.50	U	0.50	1.0	µg/L	1	11/3/2010 9:55:00 PM
1,1,1-Trichloroethane	0.50	U	0.50	1.0	µg/L	1	11/3/2010 9:55:00 PM
1,1,2,2-Tetrachloroethane	0.50	U	0.50	1.0	µg/L	1	11/3/2010 9:55:00 PM
1,1,2-Trichloroethane	0.50	U	0.50	1.0	µg/L	1	11/3/2010 9:55:00 PM
1,1-Dichloroethane	0.50	U	0.50	1.0	µg/L	1	11/3/2010 9:55:00 PM
1,1-Dichloroethene	0.50	U	0.50	1.0	µg/L	1	11/3/2010 9:55:00 PM
1,2,3-Trichloropropane	0.50	U	0.50	1.0	µg/L	1	11/3/2010 9:55:00 PM
1,2-Dichlorobenzene	0.50	U	0.50	1.0	µg/L	1	11/3/2010 9:55:00 PM
1,2-Dichloroethane	0.50	U	0.50	1.0	µg/L	1	11/3/2010 9:55:00 PM
1,2-Dichloropropane	0.50	U	0.50	1.0	µg/L	1	11/3/2010 9:55:00 PM
1,4-Dichlorobenzene	0.50	U	0.50	1.0	µg/L	1	11/3/2010 9:55:00 PM
2-Hexanone	1.0	U	1.0	5.0	µg/L	1	11/3/2010 9:55:00 PM
4-Methyl-2-Pentanone	0.50	U	0.50	1.0	µg/L	1	11/3/2010 9:55:00 PM
Acetone	5.0	U	5.0	10	µg/L	1	11/3/2010 9:55:00 PM
Acrylonitrile	2.0	U	2.0	5.0	µg/L	1	11/3/2010 9:55:00 PM
Benzene	0.50	U	0.50	1.0	µg/L	1	11/3/2010 9:55:00 PM
Bromochloromethane	0.50	U	0.50	1.0	µg/L	1	11/3/2010 9:55:00 PM
Bromodichloromethane	0.50	U	0.50	1.0	µg/L	1	11/3/2010 9:55:00 PM
Bromoform	0.50	U	0.50	1.0	µg/L	1	11/3/2010 9:55:00 PM
Bromomethane	0.50	U	0.50	1.0	µg/L	1	11/3/2010 9:55:00 PM
Carbon Disulfide	0.50	U	0.50	1.0	µg/L	1	11/3/2010 9:55:00 PM
Carbon Tetrachloride	0.50	U	0.50	1.0	µg/L	1	11/3/2010 9:55:00 PM
Chlorobenzene	0.50	U	0.50	1.0	µg/L	1	11/3/2010 9:55:00 PM
Chlorodibromomethane	0.50	U	0.50	1.0	µg/L	1	11/3/2010 9:55:00 PM
Chloroethane	0.50	U	0.50	1.0	µg/L	1	11/3/2010 9:55:00 PM
Chloroform	0.50	U	0.50	1.0	µg/L	1	11/3/2010 9:55:00 PM
Chloromethane	0.50	U	0.50	1.0	µg/L	1	11/3/2010 9:55:00 PM
cis-1,2-Dichloroethene	0.50	U	0.50	1.0	µg/L	1	11/3/2010 9:55:00 PM
cis-1,3-Dichloropropene	0.50	U	0.50	1.0	µg/L	1	11/3/2010 9:55:00 PM
Dibromomethane	0.50	U	0.50	1.0	µg/L	1	11/3/2010 9:55:00 PM
Dichlorobromomethane	0.50	U	0.50	1.0	µg/L	1	11/3/2010 9:55:00 PM
Ethylbenzene	0.50	U	0.50	1.0	µg/L	1	11/3/2010 9:55:00 PM
Iodomethane	0.50	U	0.50	5.0	µg/L	1	11/3/2010 9:55:00 PM
Methyl Ethyl Ketone	1.0	U	1.0	5.0	µg/L	1	11/3/2010 9:55:00 PM
Methylene Chloride	0.50	U	0.50	1.0	µg/L	1	11/3/2010 9:55:00 PM
Styrene	0.50	U	0.50	1.0	µg/L	1	11/3/2010 9:55:00 PM

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Laboratory Results

Geochemical Testing

Date: *02-Dec-10*

CLIENT:	CIVIL & ENVIRONMENTAL-COLUMBU	**Client Sample ID:**	TRIP BLANK
Lab Order:	G1011042		
Project:	APEX Second SA	**Collection Date:**	10/28/2010
Lab ID:	G1011042-009	**Sampled By:**	Client
Matrix:		**DateReceived:**	11/2/2010 1:22:41 PM

Analyses	Result	Q	MDL	PQL	Units	DF	Date Analyzed
VOLATILE ORGANIC COMPOUNDS			**EPA 8260**			Analyst: **JAW**	
Tetrachloroethene	0.50	U	0.50	1.0	µg/L	1	11/3/2010 9:55:00 PM
Toluene	0.50	U	0.50	1.0	µg/L	1	11/3/2010 9:55:00 PM
trans-1,2-Dichloroethene	0.50	U	0.50	1.0	µg/L	1	11/3/2010 9:55:00 PM
trans-1,3-Dichloropropene	0.50	U	0.50	1.0	µg/L	1	11/3/2010 9:55:00 PM
trans-1,4-Dichloro-2-butene	1.0	U	1.0	2.0	µg/L	1	11/3/2010 9:55:00 PM
Trichloroethene	0.50	U	0.50	1.0	µg/L	1	11/3/2010 9:55:00 PM
Trichlorofluoromethane	0.50	U	0.50	1.0	µg/L	1	11/3/2010 9:55:00 PM
Vinyl Acetate	0.50	U	0.50	1.0	µg/L	1	11/3/2010 9:55:00 PM
Vinyl Chloride	0.50	U	0.50	1.0	µg/L	1	11/3/2010 9:55:00 PM
Total Xylene	1.0	U	1.0	2.0	µg/L	1	11/3/2010 9:55:00 PM
Surr: 1,2-Dichloroethane-d4	91.2		0	70-130	%REC	1	11/3/2010 9:55:00 PM
Surr: 4-Bromofluorobenzene	93.6		0	70-130	%REC	1	11/3/2010 9:55:00 PM
Surr: Dibromofluoromethane	98.2		0	70-130	%REC	1	11/3/2010 9:55:00 PM
Surr: Toluene-d8	95.2		0	70-130	%REC	1	11/3/2010 9:55:00 PM

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Laboratory Results

Geochemical Testing

Date: *02-Dec-10*

CLIENT:	CIVIL & ENVIRONMENTAL-COLUMBU	**Client Sample ID:**	P-5
Lab Order:	G1011042		
Project:	APEX Second SA	**Collection Date:**	10/28/2010 2:14:00 PM
Lab ID:	G1011042-010	**Sampled By:**	Client
Matrix:	AQUEOUS	**DateReceived:**	11/2/2010 1:22:41 PM

Analyses	Result	Q	MDL	PQL	Units	DF	Date Analyzed
FIELD PARAMETERS			**FIELD**			Analyst:	
pH (Field)	7.52		0		S.U.	0	10/28/2010 2:14:00 P
Specific Conductance (Field)	1458		0		umhos/cm	0	10/28/2010 2:14:00 P
Temperature (Field)	13.4		0		deg C	0	10/28/2010 2:14:00 P
Turbidity (Field)	2.36		0		NTU	0	10/28/2010 2:14:00 P
INORGANIC NON-METALS			**SM 18 2320B**			Analyst: **LNW**	
Alkalinity to pH 4.5	299		2.0	5	mg/L CaCO3	1	11/3/2010 2:40:00 PM
INORGANIC NON-METALS			**SM 2540 C**			Analyst: **KLS**	
Total dissolved solids	1220		10.0	20	mg/L	1	11/2/2010 9:30:00 AM
INORGANIC NON-METALS			**SM 4500-CL E**			Analyst: **SAG**	
Chloride	4	J	2.0	5	mg/L	1	11/3/2010 4:05:00 PM
INORGANIC NON-METALS			**EPA 350.1**			Analyst: **SLY**	
Ammonia Nitrogen - Distilled	0.78		0.040	0.10	mg/L as N	1	11/9/2010 11:13:07 A
INORGANIC NON-METALS			**EPA 353.2**			Analyst: **CAS**	
Nitrate - Nitrite	0.020	U	0.020	0.05	mg/L as N	1	11/4/2010 12:08:52 P
INORGANIC NON METALS			**ASTM D516-02**			Analyst: **SAG**	
Sulfate	577		20.0	100	mg/L	20	11/24/2010 3:05:00 P
INORGANIC METALS			**EPA 200.7**			Analyst: **MS**	
Barium	0.023		0.0050	0.010	mg/L	1	11/4/2010 10:52:00 P
Beryllium	0.00050	U	0.00050	0.0010	mg/L	1	11/4/2010 10:52:00 P
Cadmium	0.0010	U	0.0010	0.002	mg/L	1	11/4/2010 10:52:00 P
Calcium	216		0.050	0.10	mg/L	1	11/4/2010 10:52:00 P
Chromium	0.0050	U	0.0050	0.010	mg/L	1	11/4/2010 10:52:00 P
Cobalt	0.009		0.0020	0.005	mg/L	1	11/4/2010 10:52:00 P
Copper	0.0050	U	0.0050	0.010	mg/L	1	11/4/2010 10:52:00 P
Iron	0.05		0.010	0.05	mg/L	1	11/5/2010 1:04:00 PM
Magnesium	62.6		0.050	0.10	mg/L	1	11/4/2010 10:52:00 P
Manganese	0.604		0.0020	0.010	mg/L	1	11/4/2010 10:52:00 P
Nickel	0.010		0.0050	0.010	mg/L	1	11/4/2010 10:52:00 P
Potassium	3.4		0.20	0.5	mg/L	1	11/4/2010 10:52:00 P
Silver	0.0020	U	0.0020	0.005	mg/L	1	11/4/2010 10:52:00 P
Sodium	58.5		0.10	0.2	mg/L	1	11/4/2010 10:52:00 P
Vanadium	0.0020	U	0.0020	0.005	mg/L	1	11/4/2010 10:52:00 P
Zinc	0.0040	U	0.0040	0.010	mg/L	1	11/4/2010 10:52:00 P

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Laboratory Results

Geochemical Testing

Date: *02-Dec-10*

CLIENT:	CIVIL & ENVIRONMENTAL-COLUMBU	**Client Sample ID:**	P-5
Lab Order:	G1011042		
Project:	APEX Second SA	**Collection Date:**	10/28/2010 2:14:00 PM
Lab ID:	G1011042-010	**Sampled By:**	Client
Matrix:	AQUEOUS	**DateReceived:**	11/2/2010 1:22:41 PM

Analyses	Result	Q	MDL	PQL	Units	DF	Date Analyzed
INORGANIC METALS			**EPA 200.8**				Analyst: **JEK**
Antimony	1.1		0.50	1.0	µg/L	1	11/4/2010 3:36:00 PM
Arsenic	13.0		0.50	1.0	µg/L	1	11/4/2010 3:36:00 PM
Lead	0.20	U	0.20	1.0	µg/L	1	11/4/2010 3:36:00 PM
Selenium	0.50	U	0.50	1.0	µg/L	1	11/4/2010 3:36:00 PM
Thallium	0.10	U	0.10	0.2	µg/L	1	11/4/2010 3:36:00 PM
VOLATILE ORGANIC COMPOUNDS			**EPA 8011**				Analyst: **TEW**
1,2-Dibromo-3-chloropropane	0.0100	U	0.0100	0.0400	µg/L	1	11/16/2010 12:25:59 A
1,2-Dibromoethane	0.0100	U	0.0100	0.0400	µg/L	1	11/16/2010 12:25:59 A
Surr: 1,1,2,2-Tetrachloroethane	94.2		0	60-140	%REC	1	11/16/2010 12:25:59 A
VOLATILE ORGANIC COMPOUNDS			**EPA 8260**				Analyst: **JAW**
1,1,1,2-Tetrachloroethane	0.50	U	0.50	1.0	µg/L	1	11/3/2010 10:30:00 P
1,1,1-Trichloroethane	0.50	U	0.50	1.0	µg/L	1	11/3/2010 10:30:00 P
1,1,2,2-Tetrachloroethane	0.50	U	0.50	1.0	µg/L	1	11/3/2010 10:30:00 P
1,1,2-Trichloroethane	0.50	U	0.50	1.0	µg/L	1	11/3/2010 10:30:00 P
1,1-Dichloroethane	0.50	U	0.50	1.0	µg/L	1	11/3/2010 10:30:00 P
1,1-Dichloroethene	0.50	U	0.50	1.0	µg/L	1	11/3/2010 10:30:00 P
1,2,3-Trichloropropane	0.50	U	0.50	1.0	µg/L	1	11/3/2010 10:30:00 P
1,2-Dichlorobenzene	0.50	U	0.50	1.0	µg/L	1	11/3/2010 10:30:00 P
1,2-Dichloroethane	0.50	U	0.50	1.0	µg/L	1	11/3/2010 10:30:00 P
1,2-Dichloropropane	0.50	U	0.50	1.0	µg/L	1	11/3/2010 10:30:00 P
1,4-Dichlorobenzene	0.50	U	0.50	1.0	µg/L	1	11/3/2010 10:30:00 P
2-Hexanone	1.0	U	1.0	5.0	µg/L	1	11/3/2010 10:30:00 P
4-Methyl-2-Pentanone	0.50	U	0.50	1.0	µg/L	1	11/3/2010 10:30:00 P
Acetone	5.0	U	5.0	10	µg/L	1	11/3/2010 10:30:00 P
Acrylonitrile	2.0	U	2.0	5.0	µg/L	1	11/3/2010 10:30:00 P
Benzene	0.50	U	0.50	1.0	µg/L	1	11/3/2010 10:30:00 P
Bromochloromethane	0.50	U	0.50	1.0	µg/L	1	11/3/2010 10:30:00 P
Bromodichloromethane	0.50	U	0.50	1.0	µg/L	1	11/3/2010 10:30:00 P
Bromoform	0.50	U	0.50	1.0	µg/L	1	11/3/2010 10:30:00 P
Bromomethane	0.50	U	0.50	1.0	µg/L	1	11/3/2010 10:30:00 P
Carbon Disulfide	0.50	U	0.50	1.0	µg/L	1	11/3/2010 10:30:00 P
Carbon Tetrachloride	0.50	U	0.50	1.0	µg/L	1	11/3/2010 10:30:00 P
Chlorobenzene	0.50	U	0.50	1.0	µg/L	1	11/3/2010 10:30:00 P
Chlorodibromomethane	0.50	U	0.50	1.0	µg/L	1	11/3/2010 10:30:00 P
Chloroethane	0.50	U	0.50	1.0	µg/L	1	11/3/2010 10:30:00 P
Chloroform	0.50	U	0.50	1.0	µg/L	1	11/3/2010 10:30:00 P
Chloromethane	0.50	U	0.50	1.0	µg/L	1	11/3/2010 10:30:00 P
cis-1,2-Dichloroethene	0.50	U	0.50	1.0	µg/L	1	11/3/2010 10:30:00 P
cis-1,3-Dichloropropene	0.50	U	0.50	1.0	µg/L	1	11/3/2010 10:30:00 P

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Laboratory Results

Geochemical Testing

Date: *02-Dec-10*

CLIENT:	CIVIL & ENVIRONMENTAL-COLUMBU	**Client Sample ID:**	P-5
Lab Order:	G1011042		
Project:	APEX Second SA	**Collection Date:**	10/28/2010 2:14:00 PM
Lab ID:	G1011042-010	**Sampled By:**	Client
Matrix:	AQUEOUS	**DateReceived:**	11/2/2010 1:22:41 PM

Analyses	Result	Q	MDL	PQL	Units	DF	Date Analyzed
VOLATILE ORGANIC COMPOUNDS			**EPA 8260**			Analyst: **JAW**	
Dibromomethane	0.50	U	0.50	1.0	µg/L	1	11/3/2010 10:30:00 P
Dichlorobromomethane	0.50	U	0.50	1.0	µg/L	1	11/3/2010 10:30:00 P
Ethylbenzene	0.50	U	0.50	1.0	µg/L	1	11/3/2010 10:30:00 P
Iodomethane	0.50	U	0.50	5.0	µg/L	1	11/3/2010 10:30:00 P
Methyl Ethyl Ketone	1.0	U	1.0	5.0	µg/L	1	11/3/2010 10:30:00 P
Methylene Chloride	0.50	U	0.50	1.0	µg/L	1	11/3/2010 10:30:00 P
Styrene	0.50	U	0.50	1.0	µg/L	1	11/3/2010 10:30:00 P
Tetrachloroethene	0.50	U	0.50	1.0	µg/L	1	11/3/2010 10:30:00 P
Toluene	0.50	U	0.50	1.0	µg/L	1	11/3/2010 10:30:00 P
trans-1,2-Dichloroethene	0.50	U	0.50	1.0	µg/L	1	11/3/2010 10:30:00 P
trans-1,3-Dichloropropene	0.50	U	0.50	1.0	µg/L	1	11/3/2010 10:30:00 P
trans-1,4-Dichloro-2-butene	1.0	U	1.0	2.0	µg/L	1	11/3/2010 10:30:00 P
Trichloroethene	0.50	U	0.50	1.0	µg/L	1	11/3/2010 10:30:00 P
Trichlorofluoromethane	0.50	U	0.50	1.0	µg/L	1	11/3/2010 10:30:00 P
Vinyl Acetate	0.50	U	0.50	1.0	µg/L	1	11/3/2010 10:30:00 P
Vinyl Chloride	0.50	U	0.50	1.0	µg/L	1	11/3/2010 10:30:00 P
Total Xylene	1.0	U	1.0	2.0	µg/L	1	11/3/2010 10:30:00 P
Surr: 1,2-Dichloroethane-d4	91.0		0	70-130	%REC	1	11/3/2010 10:30:00 P
Surr: 4-Bromofluorobenzene	91.4		0	70-130	%REC	1	11/3/2010 10:30:00 P
Surr: Dibromofluoromethane	97.2		0	70-130	%REC	1	11/3/2010 10:30:00 P
Surr: Toluene-d8	95.6		0	70-130	%REC	1	11/3/2010 10:30:00 P

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I.D. 56-00306 PA DEP

Laboratory Results

Geochemical Testing

Date: *02-Dec-10*

CLIENT:	CIVIL & ENVIRONMENTAL-COLUMBU	**Client Sample ID:**	P-5S
Lab Order:	G1011042		
Project:	APEX Second SA	**Collection Date:**	10/29/2010 8:41:00 AM
Lab ID:	G1011042-011	**Sampled By:**	Client
Matrix:	AQUEOUS	**DateReceived:**	11/2/2010 1:22:41 PM

Analyses	Result	Q	MDL	PQL	Units	DF	Date Analyzed
FIELD PARAMETERS			**FIELD**			Analyst:	
pH (Field)	7.19		0		S.U.	0	10/29/2010 8:41:00 A
Specific Conductance (Field)	1717		0		umhos/cm	0	10/29/2010 8:41:00 A
Temperature (Field)	8.7		0		deg C	0	10/29/2010 8:41:00 A
Turbidity (Field)	7.59		0		NTU	0	10/29/2010 8:41:00 A
INORGANIC NON-METALS			**SM 18 2320B**			Analyst: **LNW**	
Alkalinity to pH 4.5	295		2.0	5	mg/L CaCO3	1	11/3/2010 4:19:00 PM
INORGANIC NON-METALS			**SM 2540 C**			Analyst: **KLS**	
Total dissolved solids	1430		10.0	20	mg/L	1	11/2/2010 9:30:00 AM
INORGANIC NON-METALS			**SM 4500-CL E**			Analyst: **SAG**	
Chloride	2	J	2.0	5	mg/L	1	11/3/2010 4:05:00 PM
INORGANIC NON-METALS			**EPA 350.1**			Analyst: **SLY**	
Ammonia Nitrogen - Distilled	0.43		0.040	0.10	mg/L as N	1	11/9/2010 11:14:13 A
INORGANIC NON-METALS			**EPA 353.2**			Analyst: **CAS**	
Nitrate - Nitrite	0.35		0.020	0.05	mg/L as N	1	11/4/2010 12:15:41 P
INORGANIC NON METALS			**ASTM D516-02**			Analyst: **SAG**	
Sulfate	726		20.0	100	mg/L	20	11/5/2010 4:56:00 PM
INORGANIC METALS			**EPA 200.7**			Analyst: **MS**	
Barium	0.034		0.0050	0.010	mg/L	1	11/4/2010 11:13:00 P
Beryllium	0.00050	U	0.00050	0.0010	mg/L	1	11/4/2010 11:13:00 P
Cadmium	0.0010	U	0.0010	0.002	mg/L	1	11/4/2010 11:13:00 P
Calcium	285		0.050	0.10	mg/L	1	11/4/2010 11:13:00 P
Chromium	0.0050	U	0.0050	0.010	mg/L	1	11/4/2010 11:13:00 P
Cobalt	0.0020	U	0.0020	0.005	mg/L	1	11/4/2010 11:13:00 P
Copper	0.0050	U	0.0050	0.010	mg/L	1	11/4/2010 11:13:00 P
Iron	0.30		0.010	0.05	mg/L	1	11/5/2010 1:12:00 PM
Magnesium	86.5		0.050	0.10	mg/L	1	11/4/2010 11:13:00 P
Manganese	0.470		0.0020	0.010	mg/L	1	11/4/2010 11:13:00 P
Nickel	0.0050	U	0.0050	0.010	mg/L	1	11/4/2010 11:13:00 P
Potassium	6.0		0.20	0.5	mg/L	1	11/4/2010 11:13:00 P
Silver	0.0020	U	0.0020	0.005	mg/L	1	11/4/2010 11:13:00 P
Sodium	40.2		0.10	0.2	mg/L	1	11/4/2010 11:13:00 P
Vanadium	0.0020	U	0.0020	0.005	mg/L	1	11/4/2010 11:13:00 P
Zinc	0.012		0.0040	0.010	mg/L	1	11/4/2010 11:13:00 P

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Laboratory Results

Geochemical Testing

Date: *02-Dec-10*

CLIENT:	CIVIL & ENVIRONMENTAL-COLUMBU	**Client Sample ID:**	P-5S
Lab Order:	G1011042		
Project:	APEX Second SA	**Collection Date:**	10/29/2010 8:41:00 AM
Lab ID:	G1011042-011	**Sampled By:**	Client
Matrix:	AQUEOUS	**DateReceived:**	11/2/2010 1:22:41 PM

Analyses	Result	Q	MDL	PQL	Units	DF	Date Analyzed
INORGANIC METALS			**EPA 200.8**				Analyst: **JEK**
Antimony	0.50	U	0.50	1.0	µg/L	1	11/4/2010 3:40:00 PM
Arsenic	0.50	U	0.50	1.0	µg/L	1	11/4/2010 3:40:00 PM
Lead	0.9	J	0.20	1.0	µg/L	1	11/4/2010 3:40:00 PM
Selenium	0.8	J	0.50	1.0	µg/L	1	11/4/2010 3:40:00 PM
Thallium	0.10	U	0.10	0.2	µg/L	1	11/4/2010 3:40:00 PM
VOLATILE ORGANIC COMPOUNDS			**EPA 8011**				Analyst: **TEW**
1,2-Dibromo-3-chloropropane	0.0100	U	0.0100	0.0400	µg/L	1	11/16/2010 12:50:33 A
1,2-Dibromoethane	0.0100	U	0.0100	0.0400	µg/L	1	11/16/2010 12:50:33 A
Surr: 1,1,2,2-Tetrachloroethane	96.3		0	60-140	%REC	1	11/16/2010 12:50:33 A
VOLATILE ORGANIC COMPOUNDS			**EPA 8260**				Analyst: **JAW**
1,1,1,2-Tetrachloroethane	0.50	U	0.50	1.0	µg/L	1	11/4/2010 6:47:00 AM
1,1,1-Trichloroethane	0.50	U	0.50	1.0	µg/L	1	11/4/2010 6:47:00 AM
1,1,2,2-Tetrachloroethane	0.50	U	0.50	1.0	µg/L	1	11/4/2010 6:47:00 AM
1,1,2-Trichloroethane	0.50	U	0.50	1.0	µg/L	1	11/4/2010 6:47:00 AM
1,1-Dichloroethane	0.50	U	0.50	1.0	µg/L	1	11/4/2010 6:47:00 AM
1,1-Dichloroethene	0.50	U	0.50	1.0	µg/L	1	11/4/2010 6:47:00 AM
1,2,3-Trichloropropane	0.50	U	0.50	1.0	µg/L	1	11/4/2010 6:47:00 AM
1,2-Dichlorobenzene	0.50	U	0.50	1.0	µg/L	1	11/4/2010 6:47:00 AM
1,2-Dichloroethane	0.50	U	0.50	1.0	µg/L	1	11/4/2010 6:47:00 AM
1,2-Dichloropropane	0.50	U	0.50	1.0	µg/L	1	11/4/2010 6:47:00 AM
1,4-Dichlorobenzene	0.50	U	0.50	1.0	µg/L	1	11/4/2010 6:47:00 AM
2-Hexanone	1.0	U	1.0	5.0	µg/L	1	11/4/2010 6:47:00 AM
4-Methyl-2-Pentanone	0.50	U	0.50	1.0	µg/L	1	11/4/2010 6:47:00 AM
Acetone	5.0	U	5.0	10	µg/L	1	11/4/2010 6:47:00 AM
Acrylonitrile	2.0	U	2.0	5.0	µg/L	1	11/4/2010 6:47:00 AM
Benzene	0.50	U	0.50	1.0	µg/L	1	11/4/2010 6:47:00 AM
Bromochloromethane	0.50	U	0.50	1.0	µg/L	1	11/4/2010 6:47:00 AM
Bromodichloromethane	0.50	U	0.50	1.0	µg/L	1	11/4/2010 6:47:00 AM
Bromoform	0.50	U	0.50	1.0	µg/L	1	11/4/2010 6:47:00 AM
Bromomethane	0.50	U	0.50	1.0	µg/L	1	11/4/2010 6:47:00 AM
Carbon Disulfide	0.50	U	0.50	1.0	µg/L	1	11/4/2010 6:47:00 AM
Carbon Tetrachloride	0.50	U	0.50	1.0	µg/L	1	11/4/2010 6:47:00 AM
Chlorobenzene	0.50	U	0.50	1.0	µg/L	1	11/4/2010 6:47:00 AM
Chlorodibromomethane	0.50	U	0.50	1.0	µg/L	1	11/4/2010 6:47:00 AM
Chloroethane	0.50	U	0.50	1.0	µg/L	1	11/4/2010 6:47:00 AM
Chloroform	0.50	U	0.50	1.0	µg/L	1	11/4/2010 6:47:00 AM
Chloromethane	0.50	U	0.50	1.0	µg/L	1	11/4/2010 6:47:00 AM
cis-1,2-Dichloroethene	0.50	U	0.50	1.0	µg/L	1	11/4/2010 6:47:00 AM
cis-1,3-Dichloropropene	0.50	U	0.50	1.0	µg/L	1	11/4/2010 6:47:00 AM

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Laboratory Results

Geochemical Testing

Date: *02-Dec-10*

CLIENT:	CIVIL & ENVIRONMENTAL-COLUMBU	**Client Sample ID:**	P-5S
Lab Order:	G1011042		
Project:	APEX Second SA	**Collection Date:**	10/29/2010 8:41:00 AM
Lab ID:	G1011042-011	**Sampled By:**	Client
Matrix:	AQUEOUS	**DateReceived:**	11/2/2010 1:22:41 PM

Analyses	Result	Q	MDL	PQL	Units	DF	Date Analyzed
VOLATILE ORGANIC COMPOUNDS			**EPA 8260**			Analyst: **JAW**	
Dibromomethane	0.50	U	0.50	1.0	µg/L	1	11/4/2010 6:47:00 AM
Dichlorobromomethane	0.50	U	0.50	1.0	µg/L	1	11/4/2010 6:47:00 AM
Ethylbenzene	0.50	U	0.50	1.0	µg/L	1	11/4/2010 6:47:00 AM
Iodomethane	0.7	J	0.50	5.0	µg/L	1	11/4/2010 6:47:00 AM
Methyl Ethyl Ketone	1.0	U	1.0	5.0	µg/L	1	11/4/2010 6:47:00 AM
Methylene Chloride	0.50	U	0.50	1.0	µg/L	1	11/4/2010 6:47:00 AM
Styrene	0.50	U	0.50	1.0	µg/L	1	11/4/2010 6:47:00 AM
Tetrachloroethene	0.50	U	0.50	1.0	µg/L	1	11/4/2010 6:47:00 AM
Toluene	0.50	U	0.50	1.0	µg/L	1	11/4/2010 6:47:00 AM
trans-1,2-Dichloroethene	0.50	U	0.50	1.0	µg/L	1	11/4/2010 6:47:00 AM
trans-1,3-Dichloropropene	0.50	U	0.50	1.0	µg/L	1	11/4/2010 6:47:00 AM
trans-1,4-Dichloro-2-butene	1.0	U	1.0	2.0	µg/L	1	11/4/2010 6:47:00 AM
Trichloroethene	0.50	U	0.50	1.0	µg/L	1	11/4/2010 6:47:00 AM
Trichlorofluoromethane	0.50	U	0.50	1.0	µg/L	1	11/4/2010 6:47:00 AM
Vinyl Acetate	0.50	U	0.50	1.0	µg/L	1	11/4/2010 6:47:00 AM
Vinyl Chloride	0.50	U	0.50	1.0	µg/L	1	11/4/2010 6:47:00 AM
Total Xylene	1.0	U	1.0	2.0	µg/L	1	11/4/2010 6:47:00 AM
Surr: 1,2-Dichloroethane-d4	90.8		0	70-130	%REC	1	11/4/2010 6:47:00 AM
Surr: 4-Bromofluorobenzene	92.9		0	70-130	%REC	1	11/4/2010 6:47:00 AM
Surr: Dibromofluoromethane	96.0		0	70-130	%REC	1	11/4/2010 6:47:00 AM
Surr: Toluene-d8	94.7		0	70-130	%REC	1	11/4/2010 6:47:00 AM

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Laboratory Results

Geochemical Testing

Date: *02-Dec-10*

CLIENT:	CIVIL & ENVIRONMENTAL-COLUMBU	**Client Sample ID:**	P-3L
Lab Order:	G1011042		
Project:	APEX Second SA	**Collection Date:**	10/29/2010 10:29:00 AM
Lab ID:	G1011042-012	**Sampled By:**	Client
Matrix:	AQUEOUS	**DateReceived:**	11/2/2010 1:22:41 PM

Analyses	Result	Q	MDL	PQL	Units	DF	Date Analyzed
FIELD PARAMETERS			**FIELD**			Analyst:	
pH (Field)	7.19		0		S.U.	0	10/29/2010 10:29:00 A
Specific Conductance (Field)	3500		0		umhos/cm	0	10/29/2010 10:29:00 A
Temperature (Field)	13.1		0		deg C	0	10/29/2010 10:29:00 A
Turbidity (Field)	11.5		0		NTU	0	10/29/2010 10:29:00 A
INORGANIC NON-METALS			**SM 18 2320B**			Analyst: **LNW**	
Alkalinity to pH 4.5	272		2.0	5	mg/L CaCO3	1	11/4/2010 9:44:00 AM
INORGANIC NON-METALS			**SM 2540 C**			Analyst: **KLS**	
Total dissolved solids	2230		10.0	20	mg/L	1	11/2/2010 9:31:00 AM
INORGANIC NON-METALS			**SM 4500-CL E**			Analyst: **SAG**	
Chloride	6		2.0	5	mg/L	1	11/3/2010 4:05:00 PM
INORGANIC NON-METALS			**EPA 350.1**			Analyst: **SLY**	
Ammonia Nitrogen - Distilled	1.65		0.040	0.10	mg/L as N	1	11/9/2010 11:15:20 A
INORGANIC NON-METALS			**EPA 353.2**			Analyst: **CAS**	
Nitrate - Nitrite	0.020	U	0.020	0.05	mg/L as N	1	11/4/2010 12:16:52 P
INORGANIC NON METALS			**ASTM D516-02**			Analyst: **SAG**	
Sulfate	1260		50.0	250	mg/L	50	11/5/2010 4:56:00 PM
INORGANIC METALS			**EPA 200.7**			Analyst: **MS**	
Barium	0.017		0.0050	0.010	mg/L	1	11/4/2010 11:18:00 P
Beryllium	0.00050	U	0.00050	0.0010	mg/L	1	11/4/2010 11:18:00 P
Cadmium	0.0010	U	0.0010	0.002	mg/L	1	11/4/2010 11:18:00 P
Calcium	370		0.050	0.10	mg/L	1	11/4/2010 11:18:00 P
Chromium	0.0050	U	0.0050	0.010	mg/L	1	11/4/2010 11:18:00 P
Cobalt	0.0020	U	0.0020	0.005	mg/L	1	11/4/2010 11:18:00 P
Copper	0.0050	U	0.0050	0.010	mg/L	1	11/4/2010 11:18:00 P
Iron	3.04		0.010	0.05	mg/L	1	11/5/2010 1:16:00 PM
Magnesium	137		0.050	0.10	mg/L	1	11/4/2010 11:18:00 P
Manganese	0.304		0.0020	0.010	mg/L	1	11/4/2010 11:18:00 P
Nickel	0.0050	U	0.0050	0.010	mg/L	1	11/4/2010 11:18:00 P
Potassium	9.1		0.20	0.5	mg/L	1	11/4/2010 11:18:00 P
Silver	0.0020	U	0.0020	0.005	mg/L	1	11/4/2010 11:18:00 P
Sodium	130		0.10	0.2	mg/L	1	11/4/2010 11:18:00 P
Vanadium	0.0020	U	0.0020	0.005	mg/L	1	11/4/2010 11:18:00 P
Zinc	0.0040	U	0.0040	0.010	mg/L	1	11/4/2010 11:18:00 P

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Laboratory Results

Geochemical Testing

Date: *02-Dec-10*

CLIENT:	CIVIL & ENVIRONMENTAL-COLUMBU	**Client Sample ID:**	P-3L
Lab Order:	G1011042		
Project:	APEX Second SA	**Collection Date:**	10/29/2010 10:29:00 AM
Lab ID:	G1011042-012	**Sampled By:**	Client
Matrix:	AQUEOUS	**DateReceived:**	11/2/2010 1:22:41 PM

Analyses	Result	Q	MDL	PQL	Units	DF	Date Analyzed
INORGANIC METALS			**EPA 200.8**				Analyst: **JEK**
Antimony	0.50	U	0.50	1.0	µg/L	1	11/4/2010 3:45:00 PM
Arsenic	0.50	U	0.50	1.0	µg/L	1	11/4/2010 3:45:00 PM
Lead	0.20	U	0.20	1.0	µg/L	1	11/4/2010 3:45:00 PM
Selenium	0.50	U	0.50	1.0	µg/L	1	11/4/2010 3:45:00 PM
Thallium	0.10	U	0.10	0.2	µg/L	1	11/4/2010 3:45:00 PM
VOLATILE ORGANIC COMPOUNDS			**EPA 8011**				Analyst: **TEW**
1,2-Dibromo-3-chloropropane	0.0100	U	0.0100	0.0400	µg/L	1	11/16/2010 1:14:59 A
1,2-Dibromoethane	0.0100	U	0.0100	0.0400	µg/L	1	11/16/2010 1:14:59 A
Surr: 1,1,2,2-Tetrachloroethane	93.5		0	60-140	%REC	1	11/16/2010 1:14:59 A
VOLATILE ORGANIC COMPOUNDS			**EPA 8260**				Analyst: **JAW**
1,1,1,2-Tetrachloroethane	0.50	U	0.50	1.0	µg/L	1	11/4/2010 7:23:00 AM
1,1,1-Trichloroethane	0.50	U	0.50	1.0	µg/L	1	11/4/2010 7:23:00 AM
1,1,2,2-Tetrachloroethane	0.50	U	0.50	1.0	µg/L	1	11/4/2010 7:23:00 AM
1,1,2-Trichloroethane	0.50	U	0.50	1.0	µg/L	1	11/4/2010 7:23:00 AM
1,1-Dichloroethane	0.50	U	0.50	1.0	µg/L	1	11/4/2010 7:23:00 AM
1,1-Dichloroethene	0.50	U	0.50	1.0	µg/L	1	11/4/2010 7:23:00 AM
1,2,3-Trichloropropane	0.50	U	0.50	1.0	µg/L	1	11/4/2010 7:23:00 AM
1,2-Dichlorobenzene	0.50	U	0.50	1.0	µg/L	1	11/4/2010 7:23:00 AM
1,2-Dichloroethane	0.50	U	0.50	1.0	µg/L	1	11/4/2010 7:23:00 AM
1,2-Dichloropropane	0.50	U	0.50	1.0	µg/L	1	11/4/2010 7:23:00 AM
1,4-Dichlorobenzene	0.50	U	0.50	1.0	µg/L	1	11/4/2010 7:23:00 AM
2-Hexanone	1.0	U	1.0	5.0	µg/L	1	11/4/2010 7:23:00 AM
4-Methyl-2-Pentanone	0.50	U	0.50	1.0	µg/L	1	11/4/2010 7:23:00 AM
Acetone	5.0	U	5.0	10	µg/L	1	11/4/2010 7:23:00 AM
Acrylonitrile	2.0	U	2.0	5.0	µg/L	1	11/4/2010 7:23:00 AM
Benzene	0.50	U	0.50	1.0	µg/L	1	11/4/2010 7:23:00 AM
Bromochloromethane	0.50	U	0.50	1.0	µg/L	1	11/4/2010 7:23:00 AM
Bromodichloromethane	0.50	U	0.50	1.0	µg/L	1	11/4/2010 7:23:00 AM
Bromoform	0.50	U	0.50	1.0	µg/L	1	11/4/2010 7:23:00 AM
Bromomethane	0.50	U	0.50	1.0	µg/L	1	11/4/2010 7:23:00 AM
Carbon Disulfide	0.50	U	0.50	1.0	µg/L	1	11/4/2010 7:23:00 AM
Carbon Tetrachloride	0.50	U	0.50	1.0	µg/L	1	11/4/2010 7:23:00 AM
Chlorobenzene	0.50	U	0.50	1.0	µg/L	1	11/4/2010 7:23:00 AM
Chlorodibromomethane	0.50	U	0.50	1.0	µg/L	1	11/4/2010 7:23:00 AM
Chloroethane	0.50	U	0.50	1.0	µg/L	1	11/4/2010 7:23:00 AM
Chloroform	0.50	U	0.50	1.0	µg/L	1	11/4/2010 7:23:00 AM
Chloromethane	0.50	U	0.50	1.0	µg/L	1	11/4/2010 7:23:00 AM
cis-1,2-Dichloroethene	0.50	U	0.50	1.0	µg/L	1	11/4/2010 7:23:00 AM
cis-1,3-Dichloropropene	0.50	U	0.50	1.0	µg/L	1	11/4/2010 7:23:00 AM

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I.D. 56-00306 PA DEP

Laboratory Results

Geochemical Testing

Date: *02-Dec-10*

CLIENT:	CIVIL & ENVIRONMENTAL-COLUMBU	**Client Sample ID:**	P-3L
Lab Order:	G1011042		
Project:	APEX Second SA	**Collection Date:**	10/29/2010 10:29:00 AM
Lab ID:	G1011042-012	**Sampled By:**	Client
Matrix:	AQUEOUS	**DateReceived:**	11/2/2010 1:22:41 PM

Analyses	Result	Q	MDL	PQL	Units	DF	Date Analyzed
VOLATILE ORGANIC COMPOUNDS			**EPA 8260**			Analyst: **JAW**	
Dibromomethane	0.50	U	0.50	1.0	µg/L	1	11/4/2010 7:23:00 AM
Dichlorobromomethane	0.50	U	0.50	1.0	µg/L	1	11/4/2010 7:23:00 AM
Ethylbenzene	0.50	U	0.50	1.0	µg/L	1	11/4/2010 7:23:00 AM
Iodomethane	0.50	U	0.50	5.0	µg/L	1	11/4/2010 7:23:00 AM
Methyl Ethyl Ketone	1.0	U	1.0	5.0	µg/L	1	11/4/2010 7:23:00 AM
Methylene Chloride	0.50	U	0.50	1.0	µg/L	1	11/4/2010 7:23:00 AM
Styrene	0.50	U	0.50	1.0	µg/L	1	11/4/2010 7:23:00 AM
Tetrachloroethene	0.50	U	0.50	1.0	µg/L	1	11/4/2010 7:23:00 AM
Toluene	0.50	U	0.50	1.0	µg/L	1	11/4/2010 7:23:00 AM
trans-1,2-Dichloroethene	0.50	U	0.50	1.0	µg/L	1	11/4/2010 7:23:00 AM
trans-1,3-Dichloropropene	0.50	U	0.50	1.0	µg/L	1	11/4/2010 7:23:00 AM
trans-1,4-Dichloro-2-butene	1.0	U	1.0	2.0	µg/L	1	11/4/2010 7:23:00 AM
Trichloroethene	0.50	U	0.50	1.0	µg/L	1	11/4/2010 7:23:00 AM
Trichlorofluoromethane	0.50	U	0.50	1.0	µg/L	1	11/4/2010 7:23:00 AM
Vinyl Acetate	0.50	U	0.50	1.0	µg/L	1	11/4/2010 7:23:00 AM
Vinyl Chloride	0.50	U	0.50	1.0	µg/L	1	11/4/2010 7:23:00 AM
Total Xylene	1.0	U	1.0	2.0	µg/L	1	11/4/2010 7:23:00 AM
Surr: 1,2-Dichloroethane-d4	93.5		0	70-130	%REC	1	11/4/2010 7:23:00 AM
Surr: 4-Bromofluorobenzene	93.3		0	70-130	%REC	1	11/4/2010 7:23:00 AM
Surr: Dibromofluoromethane	97.3		0	70-130	%REC	1	11/4/2010 7:23:00 AM
Surr: Toluene-d8	95.3		0	70-130	%REC	1	11/4/2010 7:23:00 AM

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Laboratory Results

Geochemical Testing

Date: *02-Dec-10*

CLIENT:	CIVIL & ENVIRONMENTAL-COLUMBU	**Client Sample ID:**	P-4A
Lab Order:	G1011042		
Project:	APEX Second SA	**Collection Date:**	10/28/2010 5:07:00 PM
Lab ID:	G1011042-013	**Sampled By:**	Client
Matrix:	AQUEOUS	**DateReceived:**	11/2/2010 1:22:41 PM

Analyses	Result	Q	MDL	PQL	Units	DF	Date Analyzed
FIELD PARAMETERS			**FIELD**			Analyst:	
pH (Field)	7.21		0		S.U.	0	10/28/2010 5:07:00 P
Specific Conductance (Field)	4010		0		umhos/cm	0	10/28/2010 5:07:00 P
Temperature (Field)	13.0		0		deg C	0	10/28/2010 5:07:00 P
Turbidity (Field)	163		0		NTU	0	10/28/2010 5:07:00 P
INORGANIC NON-METALS			**SM 18 2320B**			Analyst: **LNW**	
Alkalinity to pH 4.5	319		2.0	5	mg/L CaCO3	1	11/4/2010 9:56:00 AM
INORGANIC NON-METALS			**SM 2540 C**			Analyst: **KLS**	
Total dissolved solids	3070		10.0	20	mg/L	1	11/2/2010 9:31:00 AM
INORGANIC NON-METALS			**SM 4500-CL E**			Analyst: **SAG**	
Chloride	6		2.0	5	mg/L	1	11/3/2010 4:05:00 PM
INORGANIC NON-METALS			**EPA 350.1**			Analyst: **SLY**	
Ammonia Nitrogen - Distilled	0.08	J	0.040	0.10	mg/L as N	1	11/9/2010 11:16:26 A
INORGANIC NON-METALS			**EPA 353.2**			Analyst: **CAS**	
Nitrate - Nitrite	0.020	U	0.020	0.05	mg/L as N	1	11/4/2010 12:18:04 P
INORGANIC NON METALS			**ASTM D516-02**			Analyst: **SAG**	
Sulfate	1690		50.0	250	mg/L	50	11/5/2010 4:56:00 PM
INORGANIC METALS			**EPA 200.7**			Analyst: **MS**	
Barium	0.025		0.0050	0.010	mg/L	1	11/4/2010 11:24:00 P
Beryllium	0.00050	U	0.00050	0.0010	mg/L	1	11/4/2010 11:24:00 P
Cadmium	0.0010	U	0.0010	0.002	mg/L	1	11/4/2010 11:24:00 P
Calcium	564		0.500	1.00	mg/L	10	11/5/2010 1:20:00 PM
Chromium	0.006	J	0.0050	0.010	mg/L	1	11/4/2010 11:24:00 P
Cobalt	0.007		0.0020	0.005	mg/L	1	11/4/2010 11:24:00 P
Copper	0.0050	U	0.0050	0.010	mg/L	1	11/4/2010 11:24:00 P
Iron	3.01		0.010	0.05	mg/L	1	11/5/2010 1:24:00 PM
Magnesium	206		0.500	1.00	mg/L	10	11/5/2010 1:20:00 PM
Manganese	0.574		0.0020	0.010	mg/L	1	11/4/2010 11:24:00 P
Nickel	0.019		0.0050	0.010	mg/L	1	11/4/2010 11:24:00 P
Potassium	7.5		0.20	0.5	mg/L	1	11/4/2010 11:24:00 P
Silver	0.0020	U	0.0020	0.005	mg/L	1	11/4/2010 11:24:00 P
Sodium	10.2		0.10	0.2	mg/L	1	11/4/2010 11:24:00 P
Vanadium	0.004	J	0.0020	0.005	mg/L	1	11/4/2010 11:24:00 P
Zinc	0.015		0.0040	0.010	mg/L	1	11/4/2010 11:24:00 P

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Laboratory Results

Geochemical Testing

Date: *02-Dec-10*

CLIENT:	CIVIL & ENVIRONMENTAL-COLUMBU	**Client Sample ID:**	P-4A
Lab Order:	G1011042		
Project:	APEX Second SA	**Collection Date:**	10/28/2010 5:07:00 PM
Lab ID:	G1011042-013	**Sampled By:**	Client
Matrix:	AQUEOUS	**DateReceived:**	11/2/2010 1:22:41 PM

Analyses	Result	Q	MDL	PQL	Units	DF	Date Analyzed
INORGANIC METALS			**EPA 200.8**				Analyst: **JEK**
Antimony	0.50	U	0.50	1.0	µg/L	1	11/4/2010 3:50:00 PM
Arsenic	1.00	U	1.00	2.0	µg/L	2	11/5/2010 11:40:00 A
Lead	2.0		0.20	1.0	µg/L	1	11/4/2010 3:50:00 PM
Selenium	1.00	U	1.00	2.0	µg/L	2	11/5/2010 11:40:00 A
Thallium	0.10	U	0.10	0.2	µg/L	1	11/4/2010 3:50:00 PM
VOLATILE ORGANIC COMPOUNDS			**EPA 8011**				Analyst: **TEW**
1,2-Dibromo-3-chloropropane	0.0100	U	0.0100	0.0400	µg/L	1	11/16/2010 1:39:37 A
1,2-Dibromoethane	0.0100	U	0.0100	0.0400	µg/L	1	11/16/2010 1:39:37 A
Surr: 1,1,2,2-Tetrachloroethane	95.4		0	60-140	%REC	1	11/16/2010 1:39:37 A
VOLATILE ORGANIC COMPOUNDS			**EPA 8260**				Analyst: **JAW**
1,1,1,2-Tetrachloroethane	0.50	U	0.50	1.0	µg/L	1	11/4/2010 7:58:00 AM
1,1,1-Trichloroethane	0.50	U	0.50	1.0	µg/L	1	11/4/2010 7:58:00 AM
1,1,2,2-Tetrachloroethane	0.50	U	0.50	1.0	µg/L	1	11/4/2010 7:58:00 AM
1,1,2-Trichloroethane	0.50	U	0.50	1.0	µg/L	1	11/4/2010 7:58:00 AM
1,1-Dichloroethane	0.50	U	0.50	1.0	µg/L	1	11/4/2010 7:58:00 AM
1,1-Dichloroethene	0.50	U	0.50	1.0	µg/L	1	11/4/2010 7:58:00 AM
1,2,3-Trichloropropane	0.50	U	0.50	1.0	µg/L	1	11/4/2010 7:58:00 AM
1,2-Dichlorobenzene	0.50	U	0.50	1.0	µg/L	1	11/4/2010 7:58:00 AM
1,2-Dichloroethane	0.50	U	0.50	1.0	µg/L	1	11/4/2010 7:58:00 AM
1,2-Dichloropropane	0.50	U	0.50	1.0	µg/L	1	11/4/2010 7:58:00 AM
1,4-Dichlorobenzene	0.50	U	0.50	1.0	µg/L	1	11/4/2010 7:58:00 AM
2-Hexanone	1.0	U	1.0	5.0	µg/L	1	11/4/2010 7:58:00 AM
4-Methyl-2-Pentanone	0.50	U	0.50	1.0	µg/L	1	11/4/2010 7:58:00 AM
Acetone	5.0	U	5.0	10	µg/L	1	11/4/2010 7:58:00 AM
Acrylonitrile	2.0	U	2.0	5.0	µg/L	1	11/4/2010 7:58:00 AM
Benzene	0.50	U	0.50	1.0	µg/L	1	11/4/2010 7:58:00 AM
Bromochloromethane	0.50	U	0.50	1.0	µg/L	1	11/4/2010 7:58:00 AM
Bromodichloromethane	0.50	U	0.50	1.0	µg/L	1	11/4/2010 7:58:00 AM
Bromoform	0.50	U	0.50	1.0	µg/L	1	11/4/2010 7:58:00 AM
Bromomethane	0.50	U	0.50	1.0	µg/L	1	11/4/2010 7:58:00 AM
Carbon Disulfide	0.50	U	0.50	1.0	µg/L	1	11/4/2010 7:58:00 AM
Carbon Tetrachloride	0.50	U	0.50	1.0	µg/L	1	11/4/2010 7:58:00 AM
Chlorobenzene	0.50	U	0.50	1.0	µg/L	1	11/4/2010 7:58:00 AM
Chlorodibromomethane	0.50	U	0.50	1.0	µg/L	1	11/4/2010 7:58:00 AM
Chloroethane	0.50	U	0.50	1.0	µg/L	1	11/4/2010 7:58:00 AM
Chloroform	0.50	U	0.50	1.0	µg/L	1	11/4/2010 7:58:00 AM
Chloromethane	0.50	U	0.50	1.0	µg/L	1	11/4/2010 7:58:00 AM
cis-1,2-Dichloroethene	0.50	U	0.50	1.0	µg/L	1	11/4/2010 7:58:00 AM
cis-1,3-Dichloropropene	0.50	U	0.50	1.0	µg/L	1	11/4/2010 7:58:00 AM

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Laboratory Results

Geochemical Testing

Date: *02-Dec-10*

CLIENT:	CIVIL & ENVIRONMENTAL-COLUMBU	**Client Sample ID:**	P-4A
Lab Order:	G1011042		
Project:	APEX Second SA	**Collection Date:**	10/28/2010 5:07:00 PM
Lab ID:	G1011042-013	**Sampled By:**	Client
Matrix:	AQUEOUS	**DateReceived:**	11/2/2010 1:22:41 PM

Analyses	Result	Q	MDL	PQL	Units	DF	Date Analyzed
VOLATILE ORGANIC COMPOUNDS			**EPA 8260**			Analyst: **JAW**	
Dibromomethane	0.50	U	0.50	1.0	µg/L	1	11/4/2010 7:58:00 AM
Dichlorobromomethane	0.50	U	0.50	1.0	µg/L	1	11/4/2010 7:58:00 AM
Ethylbenzene	0.50	U	0.50	1.0	µg/L	1	11/4/2010 7:58:00 AM
Iodomethane	0.50	U	0.50	5.0	µg/L	1	11/4/2010 7:58:00 AM
Methyl Ethyl Ketone	1.0	U	1.0	5.0	µg/L	1	11/4/2010 7:58:00 AM
Methylene Chloride	0.50	U	0.50	1.0	µg/L	1	11/4/2010 7:58:00 AM
Styrene	0.50	U	0.50	1.0	µg/L	1	11/4/2010 7:58:00 AM
Tetrachloroethene	0.50	U	0.50	1.0	µg/L	1	11/4/2010 7:58:00 AM
Toluene	0.50	U	0.50	1.0	µg/L	1	11/4/2010 7:58:00 AM
trans-1,2-Dichloroethene	0.50	U	0.50	1.0	µg/L	1	11/4/2010 7:58:00 AM
trans-1,3-Dichloropropene	0.50	U	0.50	1.0	µg/L	1	11/4/2010 7:58:00 AM
trans-1,4-Dichloro-2-butene	1.0	U	1.0	2.0	µg/L	1	11/4/2010 7:58:00 AM
Trichloroethene	0.50	U	0.50	1.0	µg/L	1	11/4/2010 7:58:00 AM
Trichlorofluoromethane	0.50	U	0.50	1.0	µg/L	1	11/4/2010 7:58:00 AM
Vinyl Acetate	0.50	U	0.50	1.0	µg/L	1	11/4/2010 7:58:00 AM
Vinyl Chloride	0.50	U	0.50	1.0	µg/L	1	11/4/2010 7:58:00 AM
Total Xylene	1.0	U	1.0	2.0	µg/L	1	11/4/2010 7:58:00 AM
Surr: 1,2-Dichloroethane-d4	91.4		0	70-130	%REC	1	11/4/2010 7:58:00 AM
Surr: 4-Bromofluorobenzene	91.8		0	70-130	%REC	1	11/4/2010 7:58:00 AM
Surr: Dibromofluoromethane	96.6		0	70-130	%REC	1	11/4/2010 7:58:00 AM
Surr: Toluene-d8	91.7		0	70-130	%REC	1	11/4/2010 7:58:00 AM

ACCREDITED IN ACCORDANCE WITH nelac
I.D. 56-00306 PA DEP

Geochemical Testing

Quality Assurance Project Report
Prepared for
CIVIL & ENVIRONMENTAL-COLUMBUS

11/18/2010

Signed: _____
Leslie Ann Nemeth
Project Manager

Signed: _____
David M. Glessner
Quality Assurance Coordinator

Geochemical Testing

Date: *18-Nov-10*

CLIENT: CIVIL & ENVIRONMENTAL-COLUMB
Project: APEX Second SA
Lab Order: G1011042

Work Order Sample Summary

Lab Sample ID	Client Sample ID	Tag Number	Collection Date	Date Received
G1011042-001A	P-2S		10/28/2010 11:32:00 AM	11/2/2010
G1011042-001B	P-2S		10/28/2010 11:32:00 AM	11/2/2010
G1011042-001C	P-2S		10/28/2010 11:32:00 AM	11/2/2010
G1011042-001D	P-2S		10/28/2010 11:32:00 AM	11/2/2010
G1011042-001E	P-2S		10/28/2010 11:32:00 AM	11/2/2010
G1011042-001F	P-2S		10/28/2010 11:32:00 AM	11/2/2010
G1011042-002A	P-2L		10/28/2010 10:24:00 AM	11/2/2010
G1011042-002B	P-2L		10/28/2010 10:24:00 AM	11/2/2010
G1011042-002C	P-2L		10/28/2010 10:24:00 AM	11/2/2010
G1011042-002D	P-2L		10/28/2010 10:24:00 AM	11/2/2010
G1011042-002E	P-2L		10/28/2010 10:24:00 AM	11/2/2010
G1011042-002F	P-2L		10/28/2010 10:24:00 AM	11/2/2010
G1011042-003A	P-7A		10/29/2010 7:51:00 AM	11/2/2010
G1011042-003B	P-7A		10/29/2010 7:51:00 AM	11/2/2010
G1011042-003C	P-7A		10/29/2010 7:51:00 AM	11/2/2010
G1011042-003D	P-7A		10/29/2010 7:51:00 AM	11/2/2010
G1011042-003E	P-7A		10/29/2010 7:51:00 AM	11/2/2010
G1011042-003F	P-7A		10/29/2010 7:51:00 AM	11/2/2010
G1011042-004A	FIELD DUP		10/28/2010	11/2/2010
G1011042-004B	FIELD DUP		10/28/2010	11/2/2010
G1011042-004C	FIELD DUP		10/28/2010	11/2/2010
G1011042-004D	FIELD DUP		10/28/2010	11/2/2010
G1011042-004E	FIELD DUP		10/28/2010	11/2/2010
G1011042-004F	FIELD DUP		10/28/2010	11/2/2010
G1011042-005A	P-10L		10/28/2010 6:15:00 PM	11/2/2010
G1011042-005B	P-10L		10/28/2010 6:15:00 PM	11/2/2010
G1011042-005C	P-10L		10/28/2010 6:15:00 PM	11/2/2010
G1011042-005D	P-10L		10/28/2010 6:15:00 PM	11/2/2010
G1011042-005E	P-10L		10/28/2010 6:15:00 PM	11/2/2010
G1011042-005F	P-10L		10/28/2010 6:15:00 PM	11/2/2010
G1011042-006A	P-2A		10/28/2010 12:47:00 PM	11/2/2010
G1011042-006B	P-2A		10/28/2010 12:47:00 PM	11/2/2010
G1011042-006C	P-2A		10/28/2010 12:47:00 PM	11/2/2010
G1011042-006D	P-2A		10/28/2010 12:47:00 PM	11/2/2010
G1011042-006E	P-2A		10/28/2010 12:47:00 PM	11/2/2010
G1011042-006F	P-2A		10/28/2010 12:47:00 PM	11/2/2010

CLIENT:	CIVIL & ENVIRONMENTAL-COLUMB
Project:	APEX Second SA
Lab Order:	G1011042

Work Order Sample Summary

Lab Sample ID	Client Sample ID	Tag Number	Collection Date	Date Received
G1011042-007A	P-6S		10/29/2010 9:14:00 AM	11/2/2010
G1011042-007B	P-6S		10/29/2010 9:14:00 AM	11/2/2010
G1011042-007C	P-6S		10/29/2010 9:14:00 AM	11/2/2010
G1011042-007D	P-6S		10/29/2010 9:14:00 AM	11/2/2010
G1011042-007E	P-6S		10/29/2010 9:14:00 AM	11/2/2010
G1011042-007F	P-6S		10/29/2010 9:14:00 AM	11/2/2010
G1011042-008A	P-9		10/28/2010 3:35:00 PM	11/2/2010
G1011042-008B	P-9		10/28/2010 3:35:00 PM	11/2/2010
G1011042-008C	P-9		10/28/2010 3:35:00 PM	11/2/2010
G1011042-008D	P-9		10/28/2010 3:35:00 PM	11/2/2010
G1011042-008E	P-9		10/28/2010 3:35:00 PM	11/2/2010
G1011042-008F	P-9		10/28/2010 3:35:00 PM	11/2/2010
G1011042-009A	TRIP BLANK		10/28/2010	11/2/2010
G1011042-009B	TRIP BLANK		10/28/2010	11/2/2010
G1011042-010A	P-5		10/28/2010 2:14:00 PM	11/2/2010
G1011042-010B	P-5		10/28/2010 2:14:00 PM	11/2/2010
G1011042-010C	P-5		10/28/2010 2:14:00 PM	11/2/2010
G1011042-010D	P-5		10/28/2010 2:14:00 PM	11/2/2010
G1011042-010E	P-5		10/28/2010 2:14:00 PM	11/2/2010
G1011042-010F	P-5		10/28/2010 2:14:00 PM	11/2/2010
G1011042-011A	P-5S		10/29/2010 8:41:00 AM	11/2/2010
G1011042-011B	P-5S		10/29/2010 8:41:00 AM	11/2/2010
G1011042-011C	P-5S		10/29/2010 8:41:00 AM	11/2/2010
G1011042-011D	P-5S		10/29/2010 8:41:00 AM	11/2/2010
G1011042-011E	P-5S		10/29/2010 8:41:00 AM	11/2/2010
G1011042-011F	P-5S		10/29/2010 8:41:00 AM	11/2/2010
G1011042-012A	P-3L		10/29/2010 10:29:00 AM	11/2/2010
G1011042-012B	P-3L		10/29/2010 10:29:00 AM	11/2/2010
G1011042-012C	P-3L		10/29/2010 10:29:00 AM	11/2/2010
G1011042-012D	P-3L		10/29/2010 10:29:00 AM	11/2/2010
G1011042-012E	P-3L		10/29/2010 10:29:00 AM	11/2/2010
G1011042-012F	P-3L		10/29/2010 10:29:00 AM	11/2/2010
G1011042-013A	P-4A		10/28/2010 5:07:00 PM	11/2/2010
G1011042-013B	P-4A		10/28/2010 5:07:00 PM	11/2/2010
G1011042-013C	P-4A		10/28/2010 5:07:00 PM	11/2/2010
G1011042-013D	P-4A		10/28/2010 5:07:00 PM	11/2/2010
G1011042-013E	P-4A		10/28/2010 5:07:00 PM	11/2/2010

CLIENT:	CIVIL & ENVIRONMENTAL-COLUMB
Project:	APEX Second SA
Lab Order:	G1011042

Work Order Sample Summary

Lab Sample ID	Client Sample ID	Tag Number	Collection Date	Date Received
G1011042-013F	P-4A		10/28/2010 5:07:00 PM	11/2/2010

Qualifier Exception Code

(1) Spike recovery limits are not applicable when the sample concentration exceeds the spike concentration by a factor of four or greater.

(2) When the LCS recovery is greater than the upper control limit, sample data is acceptable if it is less than the quantitation limit.

(3) Batch data is acceptable when the matrix spike exceeds control limits but the corresponding LCS is within control limits.

(4) Laboratory duplicate. If one or both of the values is less than 5 times the PQL, the allowed difference is +/- the PQL.

CLIENT: CIVIL & ENVIRONMENTAL-COLUMB
Work Order: G1011042
Project: APEX Second SA

ANALYTICAL QC SUMMARY REPORT

TestCode: ALK_SM2320

Sample ID: **LCS**	SampType: **LCS**	TestCode: **ALK_SM2320**	Units: **mg/L CaCO3**	Prep Date:			RunNo: **68701**			
Client ID:	Batch ID: **R68701**	TestNo: **SM 18 2320B**		Analysis Date: **11/3/2010**			SeqNo: **1526567**			
Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Alkalinity to pH 4.5	48.80	5.00	47.5	0	103	85	115				

Sample ID: **LCS**	SampType: **LCS**	TestCode: **ALK_SM2320**	Units: **mg/L CaCO3**	Prep Date:			RunNo: **68701**			
Client ID:	Batch ID: **R68701**	TestNo: **SM 18 2320B**		Analysis Date: **11/3/2010**			SeqNo: **1526603**			
Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Alkalinity to pH 4.5	49.10	5.00	47.5	0	103	85	115				

Sample ID: **LCS**	SampType: **LCS**	TestCode: **ALK_SM2320**	Units: **mg/L CaCO3**	Prep Date:			RunNo: **68701**			
Client ID:	Batch ID: **R68701**	TestNo: **SM 18 2320B**		Analysis Date: **11/3/2010**			SeqNo: **1526622**			
Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Alkalinity to pH 4.5	48.31	5.00	47.5	0	102	85	115				

Sample ID: **LCS**	SampType: **LCS**	TestCode: **ALK_SM2320**	Units: **mg/L CaCO3**	Prep Date:			RunNo: **68770**			
Client ID:	Batch ID: **R68770**	TestNo: **SM 18 2320B**		Analysis Date: **11/4/2010**			SeqNo: **1528071**			
Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Alkalinity to pH 4.5	47.41	5.00	47.5	0	99.8	85	115				

Sample ID: **LCS**	SampType: **LCS**	TestCode: **ALK_SM2320**	Units: **mg/L CaCO3**	Prep Date:			RunNo: **68770**			
Client ID:	Batch ID: **R68770**	TestNo: **SM 18 2320B**		Analysis Date: **11/4/2010**			SeqNo: **1528146**			
Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Alkalinity to pH 4.5	48.40	5.00	47.5	0	102	85	115				

Sample ID: **LCS**	SampType: **LCS**	TestCode: **ALK_SM2320**	Units: **mg/L CaCO3**	Prep Date:			RunNo: **68770**			
Client ID:	Batch ID: **R68770**	TestNo: **SM 18 2320B**		Analysis Date: **11/4/2010**			SeqNo: **1528219**			
Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Alkalinity to pH 4.5	48.00	5.00	47.5	0	101	85	115				

CLIENT: CIVIL & ENVIRONMENTAL-COLUMB
Work Order: G1011042
Project: APEX Second SA

ANALYTICAL QC SUMMARY REPORT

TestCode: ALK_SM2320

Sample ID: **LCS**	SampType: **LCS**	TestCode: **ALK_SM2320**	Units: **mg/L CaCO3**	Prep Date:			RunNo: **68770**		
Client ID:	Batch ID: **R68770**	TestNo: **SM 18 2320B**		Analysis Date: **11/4/2010**			SeqNo: **1528341**		
Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Alkalinity to pH 4.5	48.31	5.00	47.5	0	102	85	115				

Sample ID: **LCSD**	SampType: **LCSD**	TestCode: **ALK_SM2320**	Units: **mg/L CaCO3**	Prep Date:			RunNo: **68701**		
Client ID:	Batch ID: **R68701**	TestNo: **SM 18 2320B**		Analysis Date: **11/3/2010**			SeqNo: **1527124**		
Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Alkalinity to pH 4.5	49.00	5.00						48.8	0.406	20	

Sample ID: **LCSD**	SampType: **LCSD**	TestCode: **ALK_SM2320**	Units: **mg/L CaCO3**	Prep Date:			RunNo: **68701**		
Client ID:	Batch ID: **R68701**	TestNo: **SM 18 2320B**		Analysis Date: **11/3/2010**			SeqNo: **1527126**		
Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Alkalinity to pH 4.5	48.00	5.00						49.1	2.27	20	

Sample ID: **LCSD**	SampType: **LCSD**	TestCode: **ALK_SM2320**	Units: **mg/L CaCO3**	Prep Date:			RunNo: **68770**		
Client ID:	Batch ID: **R68770**	TestNo: **SM 18 2320B**		Analysis Date: **11/4/2010**			SeqNo: **1528431**		
Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Alkalinity to pH 4.5	48.00	5.00						47.41	1.25	20	

Sample ID: **LCSD**	SampType: **LCSD**	TestCode: **ALK_SM2320**	Units: **mg/L CaCO3**	Prep Date:			RunNo: **68770**		
Client ID:	Batch ID: **R68770**	TestNo: **SM 18 2320B**		Analysis Date: **11/4/2010**			SeqNo: **1528432**		
Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Alkalinity to pH 4.5	48.00	5.00						48.4	0.832	20	

Sample ID: **LCSD**	SampType: **LCSD**	TestCode: **ALK_SM2320**	Units: **mg/L CaCO3**	Prep Date:			RunNo: **68770**		
Client ID:	Batch ID: **R68770**	TestNo: **SM 18 2320B**		Analysis Date: **11/4/2010**			SeqNo: **1528433**		
Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Alkalinity to pH 4.5	48.00	5.00						48	0.000833	20	

CLIENT: CIVIL & ENVIRONMENTAL-COLUMB
Work Order: G1011042
Project: APEX Second SA

ANALYTICAL QC SUMMARY REPORT

TestCode: ALK_SM2320

Sample ID: **G1011042-010DMS**	SampType: **MS**	TestCode: **ALK_SM2320**	Units: **mg/L CaCO3**	Prep Date:		RunNo: **68701**
Client ID: **P-5**	Batch ID: **R68701**	TestNo: **SM 18 2320B**		Analysis Date: **11/3/2010**		SeqNo: **1526601**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Alkalinity to pH 4.5	344.0	5.00	47.5	299	94.7	75	125				

Sample ID: **G1011042-001DMS**	SampType: **MS**	TestCode: **ALK_SM2320**	Units: **mg/L CaCO3**	Prep Date:		RunNo: **68701**
Client ID: **P-2S**	Batch ID: **R68701**	TestNo: **SM 18 2320B**		Analysis Date: **11/3/2010**		SeqNo: **1526620**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Alkalinity to pH 4.5	316.0	5.00	47.5	272	92.6	75	125				

Sample ID: **G1011073-016AMS**	SampType: **MS**	TestCode: **ALK_SM2320**	Units: **mg/L CaCO3**	Prep Date:		RunNo: **68770**
Client ID:	Batch ID: **R68770**	TestNo: **SM 18 2320B**		Analysis Date: **11/4/2010**		SeqNo: **1528217**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Alkalinity to pH 4.5	227.0	5.00	47.5	182	94.7	75	125				

Sample ID: **G1011078-012AMS**	SampType: **MS**	TestCode: **ALK_SM2320**	Units: **mg/L CaCO3**	Prep Date:		RunNo: **68770**
Client ID:	Batch ID: **R68770**	TestNo: **SM 18 2320B**		Analysis Date: **11/4/2010**		SeqNo: **1528339**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Alkalinity to pH 4.5	49.00	5.00	47.5	0	103	75	125				

Sample ID: **G1011007-001ADUP**	SampType: **DUP**	TestCode: **ALK_SM2320**	Units: **mg/L CaCO3**	Prep Date:		RunNo: **68701**
Client ID:	Batch ID: **R68701**	TestNo: **SM 18 2320B**		Analysis Date: **11/3/2010**		SeqNo: **1526574**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Alkalinity to pH 4.5	139.0	5.00						139	0	20	

Sample ID: **G1011042-011DDUP**	SampType: **DUP**	TestCode: **ALK_SM2320**	Units: **mg/L CaCO3**	Prep Date:		RunNo: **68701**
Client ID: **P-5S**	Batch ID: **R68701**	TestNo: **SM 18 2320B**		Analysis Date: **11/3/2010**		SeqNo: **1526607**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Alkalinity to pH 4.5	297.0	5.00						295	0.676	20	

CLIENT: CIVIL & ENVIRONMENTAL-COLUMB
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Project: APEX Second SA

ANALYTICAL QC SUMMARY REPORT

TestCode: ALK_SM2320

Sample ID: **G1011058-001ADUP**	SampType: **DUP**	TestCode: **ALK_SM2320**	Units: **mg/L CaCO3**	Prep Date:		RunNo: **68770**			
Client ID:	Batch ID: **R68770**	TestNo: **SM 18 2320B**		Analysis Date: **11/4/2010**		SeqNo: **1528082**			
Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Alkalinity to pH 4.5	59.00	5.00						59	0	20	

Sample ID: **G1011062-001ADUP**	SampType: **DUP**	TestCode: **ALK_SM2320**	Units: **mg/L CaCO3**	Prep Date:		RunNo: **68770**			
Client ID:	Batch ID: **R68770**	TestNo: **SM 18 2320B**		Analysis Date: **11/4/2010**		SeqNo: **1528098**			
Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Alkalinity to pH 4.5	382.0	5.00						380	0.525	20	

Sample ID: **G1011073-005ADUP**	SampType: **DUP**	TestCode: **ALK_SM2320**	Units: **mg/L CaCO3**	Prep Date:		RunNo: **68770**			
Client ID:	Batch ID: **R68770**	TestNo: **SM 18 2320B**		Analysis Date: **11/4/2010**		SeqNo: **1528152**			
Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Alkalinity to pH 4.5	47.00	5.00						48	2.11	20	

Sample ID: **G1011073-011ADUP**	SampType: **DUP**	TestCode: **ALK_SM2320**	Units: **mg/L CaCO3**	Prep Date:		RunNo: **68770**			
Client ID:	Batch ID: **R68770**	TestNo: **SM 18 2320B**		Analysis Date: **11/4/2010**		SeqNo: **1528179**			
Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Alkalinity to pH 4.5	20.00	5.00						20	0	20	

Sample ID: **G1011078-002ADUP**	SampType: **DUP**	TestCode: **ALK_SM2320**	Units: **mg/L CaCO3**	Prep Date:		RunNo: **68770**			
Client ID:	Batch ID: **R68770**	TestNo: **SM 18 2320B**		Analysis Date: **11/4/2010**		SeqNo: **1528225**			
Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Alkalinity to pH 4.5	198.0	5.00						197	0.506	20	

Sample ID: **G1011078-011ADUP**	SampType: **DUP**	TestCode: **ALK_SM2320**	Units: **mg/L CaCO3**	Prep Date:		RunNo: **68770**			
Client ID:	Batch ID: **R68770**	TestNo: **SM 18 2320B**		Analysis Date: **11/4/2010**		SeqNo: **1528266**			
Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Alkalinity to pH 4.5	197.0	5.00						199	1.01	20	

CLIENT: CIVIL & ENVIRONMENTAL-COLUMB
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ANALYTICAL QC SUMMARY REPORT

TestCode: CL_SM

Sample ID: **LCS**	SampType: **LCS**	TestCode: **CL_SM**	Units: **mg/L**	Prep Date:	RunNo: **68700**
Client ID:	Batch ID: **29261**	TestNo: **SM 4500-Cl E**		Analysis Date: **11/3/2010**	SeqNo: **1526541**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Chloride	51.74	5.00	50	0	103	90	110				

Sample ID: **LCSD**	SampType: **LCSD**	TestCode: **CL_SM**	Units: **mg/L**	Prep Date:	RunNo: **68700**
Client ID:	Batch ID: **29261**	TestNo: **SM 4500-Cl E**		Analysis Date: **11/3/2010**	SeqNo: **1526542**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Chloride	52.06	5.00						51.74	0.626	20	

Sample ID: **G1011042-012BMS**	SampType: **MS**	TestCode: **CL_SM**	Units: **mg/L**	Prep Date: **11/3/2010**	RunNo: **69063**
Client ID: **P-3L**	Batch ID: **29261**	TestNo: **SM 4500-Cl E**		Analysis Date: **11/11/2010**	SeqNo: **1536365**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Chloride	16.04	5.00	10	5.531	105	75	125				

Sample ID: **G1011042-001BDUP**	SampType: **DUP**	TestCode: **CL_SM**	Units: **mg/L**	Prep Date: **11/3/2010**	RunNo: **68700**
Client ID: **P-2S**	Batch ID: **29261**	TestNo: **SM 4500-Cl E**		Analysis Date: **11/3/2010**	SeqNo: **1526544**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Chloride	< 5.00	5.00						4.056	0	20	

Sample ID: **G1011042-012BDUP**	SampType: **DUP**	TestCode: **CL_SM**	Units: **mg/L**	Prep Date: **11/3/2010**	RunNo: **68700**
Client ID: **P-3L**	Batch ID: **29261**	TestNo: **SM 4500-Cl E**		Analysis Date: **11/3/2010**	SeqNo: **1526556**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Chloride	5.500	5.00						5.531	0.562	20	

CLIENT: CIVIL & ENVIRONMENTAL-COLUMB
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ANALYTICAL QC SUMMARY REPORT

TestCode: EPA8260_VOA

Sample ID: **BLANK**	SampType: **MBLK**	TestCode: **EPA8260_VO**	Units: **µg/L**	Prep Date:	RunNo: **68704**
Client ID:	Batch ID: **R68704**	TestNo: **EPA 8260**		Analysis Date: **11/3/2010**	SeqNo: **1526747**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
1,1,1,2-Tetrachloroethane	< 1.0	1.0									
1,1,1-Trichloroethane	< 1.0	1.0									
1,1,2,2-Tetrachloroethane	< 1.0	1.0									
1,1,2-Trichloroethane	< 1.0	1.0									
1,1-Dichloroethane	< 1.0	1.0									
1,1-Dichloroethene	< 1.0	1.0									
1,2,3-Trichloropropane	< 1.0	1.0									
1,2-Dichlorobenzene	< 1.0	1.0									
1,2-Dichloroethane	< 1.0	1.0									
1,2-Dichloropropane	< 1.0	1.0									
1,4-Dichlorobenzene	< 1.0	1.0									
2-Hexanone	< 5.0	5.0									
4-Methyl-2-Pentanone	< 1.0	1.0									
Acetone	< 10	10									
Acrylonitrile	< 5.0	5.0									
Benzene	< 1.0	1.0									
Bromochloromethane	< 1.0	1.0									
Bromodichloromethane	< 1.0	1.0									
Bromoform	< 1.0	1.0									
Bromomethane	< 1.0	1.0									
Carbon Disulfide	< 1.0	1.0									
Carbon Tetrachloride	< 1.0	1.0									
Chlorobenzene	< 1.0	1.0									
Chloroethane	< 1.0	1.0									
Chloroform	< 1.0	1.0									
Chloromethane	< 1.0	1.0									
cis-1,2-Dichloroethene	< 1.0	1.0									
cis-1,3-Dichloropropene	< 1.0	1.0									
Dibromomethane	< 1.0	1.0									
Ethylbenzene	< 1.0	1.0									
Iodomethane	< 5.0	5.0									
Methyl Ethyl Ketone	< 5.0	5.0									
Methylene Chloride	< 1.0	1.0									
Styrene	< 1.0	1.0									
Tetrachloroethene	< 1.0	1.0									
Toluene	< 1.0	1.0									

CLIENT: CIVIL & ENVIRONMENTAL-COLUMB
Work Order: G1011042
Project: APEX Second SA

ANALYTICAL QC SUMMARY REPORT

TestCode: EPA8260_VOA

Sample ID: **BLANK**	SampType: **MBLK**	TestCode: **EPA8260_VO**	Units: **µg/L**	Prep Date:	RunNo: **68704**
Client ID:	Batch ID: **R68704**	TestNo: **EPA 8260**		Analysis Date: **11/3/2010**	SeqNo: **1526747**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Total Xylene	< 2.0	2.0									
trans-1,2-Dichloroethene	< 1.0	1.0									
trans-1,3-Dichloropropene	< 1.0	1.0									
trans-1,4-Dichloro-2-butene	< 2.0	2.0									
Trichloroethene	< 1.0	1.0									
Trichlorofluoromethane	< 1.0	1.0									
Vinyl Acetate	< 1.0	1.0									
Vinyl Chloride	< 1.0	1.0									

Sample ID: **20 PPB LCS**	SampType: **LCS**	TestCode: **EPA8260_VO**	Units: **µg/L**	Prep Date:	RunNo: **68704**
Client ID:	Batch ID: **R68704**	TestNo: **EPA 8260**		Analysis Date: **11/3/2010**	SeqNo: **1526742**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
1,1-Dichloroethene	18.80	1.0	20	0	94.0	67.2	114				
Benzene	18.36	1.0	20	0	91.8	78.4	122				
Chlorobenzene	20.09	1.0	20	0	100	87.3	115				
Toluene	21.00	1.0	20	0	105	84.6	118				
Trichloroethene	21.35	1.0	20	0	107	83.6	119				

Sample ID: **G1011042-001FMS**	SampType: **MS**	TestCode: **EPA8260_VO**	Units: **µg/L**	Prep Date:	RunNo: **68704**
Client ID: **P-2S**	Batch ID: **R68704**	TestNo: **EPA 8260**		Analysis Date: **11/3/2010**	SeqNo: **1526751**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
1,1-Dichloroethene	19.76	1.0	20	0	98.8	54.9	116				
Benzene	17.50	1.0	20	0	87.5	64.3	123				
Chlorobenzene	18.99	1.0	20	0	95.0	72.4	115				
Toluene	18.94	1.0	20	0	94.7	65.2	124				
Trichloroethene	20.66	1.0	20	0	103	65.9	123				

Sample ID: **G1011042-001FMSD**	SampType: **MSD**	TestCode: **EPA8260_VO**	Units: **µg/L**	Prep Date:	RunNo: **68704**
Client ID: **P-2S**	Batch ID: **R68704**	TestNo: **EPA 8260**		Analysis Date: **11/3/2010**	SeqNo: **1526752**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
1,1-Dichloroethene	18.39	1.0	20	0	91.9	54.9	116	19.76	7.18	16.7	
Benzene	16.17	1.0	20	0	80.9	64.3	123	17.5	7.87	15.9	

CLIENT: CIVIL & ENVIRONMENTAL-COLUMB
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ANALYTICAL QC SUMMARY REPORT

TestCode: EPA8260_VOA

Sample ID: **G1011042-001FMSD** SampType: **MSD** TestCode: **EPA8260_VO** Units: **µg/L** Prep Date: RunNo: **68704**
Client ID: **P-2S** Batch ID: **R68704** TestNo: **EPA 8260** Analysis Date: **11/3/2010** SeqNo: **1526752**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Chlorobenzene	17.97	1.0	20	0	89.8	72.4	115	18.99	5.55	11.7	
Toluene	19.35	1.0	20	0	96.7	65.2	124	18.94	2.12	18.6	
Trichloroethene	18.66	1.0	20	0	93.3	65.9	123	20.66	10.2	12.9	

CLIENT: CIVIL & ENVIRONMENTAL-COLUMB
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ANALYTICAL QC SUMMARY REPORT

TestCode: NH3D_350.1

Sample ID: **LCS**	SampType: **LCS1**	TestCode: **NH3D_350.1**	Units: **mg/L as N**	Prep Date:	RunNo: **68863**
Client ID:	Batch ID: **29339**	TestNo: **EPA 350.1**		Analysis Date: **11/9/2010**	SeqNo: **1531306**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Ammonia Nitrogen - Distilled	0.8050	0.100	0.82	0	98.2	90	110				

Sample ID: **LCS**	SampType: **LCS1**	TestCode: **NH3D_350.1**	Units: **mg/L as N**	Prep Date:	RunNo: **68863**
Client ID:	Batch ID: **29373**	TestNo: **EPA 350.1**		Analysis Date: **11/9/2010**	SeqNo: **1531327**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Ammonia Nitrogen - Distilled	0.8360	0.100	0.82	0	102	90	110				

Sample ID: **LCS**	SampType: **LCS1**	TestCode: **NH3D_350.1**	Units: **mg/L as N**	Prep Date:	RunNo: **68863**
Client ID:	Batch ID: **29373**	TestNo: **EPA 350.1**		Analysis Date: **11/9/2010**	SeqNo: **1531351**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Ammonia Nitrogen - Distilled	0.7780	0.100	0.82	0	94.9	90	110				

Sample ID: **G1011030-004AMS**	SampType: **MS**	TestCode: **NH3D_350.1**	Units: **mg/L as N**	Prep Date: **11/8/2010**	RunNo: **68863**
Client ID:	Batch ID: **29339**	TestNo: **EPA 350.1**		Analysis Date: **11/9/2010**	SeqNo: **1531314**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Ammonia Nitrogen - Distilled	1.234	0.100	1	0.234	100	90	110				

Sample ID: **G1011042-006AMS**	SampType: **MS**	TestCode: **NH3D_350.1**	Units: **mg/L as N**	Prep Date: **11/8/2010**	RunNo: **68863**
Client ID: **P-2A**	Batch ID: **29339**	TestNo: **EPA 350.1**		Analysis Date: **11/9/2010**	SeqNo: **1531326**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Ammonia Nitrogen - Distilled	1.069	0.100	1	0.056	101	90	110				

Sample ID: **G1011049-001AMS**	SampType: **MS**	TestCode: **NH3D_350.1**	Units: **mg/L as N**	Prep Date: **11/8/2010**	RunNo: **68863**
Client ID:	Batch ID: **29373**	TestNo: **EPA 350.1**		Analysis Date: **11/9/2010**	SeqNo: **1531337**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Ammonia Nitrogen - Distilled	3.015	0.100	1	2.051	96.4	90	110				

CLIENT: CIVIL & ENVIRONMENTAL-COLUMB
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ANALYTICAL QC SUMMARY REPORT

TestCode: NH3D_350.1

Sample ID: **G1011054-002AMS**	SampType: **MS**	TestCode: **NH3D_350.1**	Units: **mg/L as N**	Prep Date: **11/8/2010**	RunNo: **68863**
Client ID:	Batch ID: **29373**	TestNo: **EPA 350.1**		Analysis Date: **11/9/2010**	SeqNo: **1531347**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Ammonia Nitrogen - Distilled	1.610	0.100	1	0.592	102	90	110				

Sample ID: **G1011042-006ADUP**	SampType: **DUP**	TestCode: **NH3D_350.1**	Units: **mg/L as N**	Prep Date: **11/8/2010**	RunNo: **68863**
Client ID: **P-2A**	Batch ID: **29339**	TestNo: **EPA 350.1**		Analysis Date: **11/9/2010**	SeqNo: **1531325**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Ammonia Nitrogen - Distilled	< 0.100	0.100						0.056	0	20	

Sample ID: **G1011054-002ADUP**	SampType: **DUP**	TestCode: **NH3D_350.1**	Units: **mg/L as N**	Prep Date: **11/8/2010**	RunNo: **68863**
Client ID:	Batch ID: **29373**	TestNo: **EPA 350.1**		Analysis Date: **11/9/2010**	SeqNo: **1531346**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Ammonia Nitrogen - Distilled	0.6450	0.100						0.592	8.57	20	

Sample ID: **CCB**	SampType: **CCB**	TestCode: **NH3D_350.1**	Units: **mg/L as N**	Prep Date:	RunNo: **68863**
Client ID:	Batch ID: **R68863**	TestNo: **EPA 350.1**		Analysis Date: **11/9/2010**	SeqNo: **1531311**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Ammonia Nitrogen - Distilled	< 0.100	0.100									

Sample ID: **CCB**	SampType: **CCB**	TestCode: **NH3D_350.1**	Units: **mg/L as N**	Prep Date:	RunNo: **68863**
Client ID:	Batch ID: **R68863**	TestNo: **EPA 350.1**		Analysis Date: **11/9/2010**	SeqNo: **1531323**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Ammonia Nitrogen - Distilled	< 0.100	0.100									

Sample ID: **CCB**	SampType: **CCB**	TestCode: **NH3D_350.1**	Units: **mg/L as N**	Prep Date:	RunNo: **68863**
Client ID:	Batch ID: **R68863**	TestNo: **EPA 350.1**		Analysis Date: **11/9/2010**	SeqNo: **1531334**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Ammonia Nitrogen - Distilled	< 0.100	0.100									

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ANALYTICAL QC SUMMARY REPORT

TestCode: NH3D_350.1

Sample ID: **CCB**	SampType: **CCB**	TestCode: **NH3D_350.1**	Units: **mg/L as N**	Prep Date:	RunNo: **68966**
Client ID:	Batch ID: **R68966**	TestNo: **EPA 350.1**		Analysis Date: **11/11/2010**	SeqNo: **1534044**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Ammonia Nitrogen - Distilled	< 0.100	0.100									

Sample ID: **CCB**	SampType: **CCB**	TestCode: **NH3D_350.1**	Units: **mg/L as N**	Prep Date:	RunNo: **68966**
Client ID:	Batch ID: **R68966**	TestNo: **EPA 350.1**		Analysis Date: **11/11/2010**	SeqNo: **1534046**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Ammonia Nitrogen - Distilled	< 0.100	0.100									

Sample ID: **CCB**	SampType: **CCB**	TestCode: **NH3D_350.1**	Units: **mg/L as N**	Prep Date:	RunNo: **68966**
Client ID:	Batch ID: **R68966**	TestNo: **EPA 350.1**		Analysis Date: **11/11/2010**	SeqNo: **1534056**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Ammonia Nitrogen - Distilled	< 0.100	0.100									

Sample ID: **CCB**	SampType: **CCB**	TestCode: **NH3D_350.1**	Units: **mg/L as N**	Prep Date:	RunNo: **68966**
Client ID:	Batch ID: **R68966**	TestNo: **EPA 350.1**		Analysis Date: **11/11/2010**	SeqNo: **1534065**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Ammonia Nitrogen - Distilled	< 0.100	0.100									

Sample ID: **CCB**	SampType: **CCB**	TestCode: **NH3D_350.1**	Units: **mg/L as N**	Prep Date:	RunNo: **68966**
Client ID:	Batch ID: **R68966**	TestNo: **EPA 350.1**		Analysis Date: **11/11/2010**	SeqNo: **1534075**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Ammonia Nitrogen - Distilled	< 0.100	0.100									

Sample ID: **CCB**	SampType: **CCB**	TestCode: **NH3D_350.1**	Units: **mg/L as N**	Prep Date:	RunNo: **68966**
Client ID:	Batch ID: **R68966**	TestNo: **EPA 350.1**		Analysis Date: **11/11/2010**	SeqNo: **1534085**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Ammonia Nitrogen - Distilled	< 0.100	0.100									

CLIENT: CIVIL & ENVIRONMENTAL-COLUMB
Work Order: G1011042
Project: APEX Second SA

ANALYTICAL QC SUMMARY REPORT

TestCode: NH3D_350.1

Sample ID: **CCB**	SampType: **CCB**	TestCode: **NH3D_350.1**	Units: **mg/L as N**	Prep Date:	RunNo: **68966**
Client ID:	Batch ID: **R68966**	TestNo: **EPA 350.1**		Analysis Date: **11/11/2010**	SeqNo: **1534120**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Ammonia Nitrogen - Distilled	< 0.100	0.100									

Sample ID: **CCB**	SampType: **CCB**	TestCode: **NH3D_350.1**	Units: **mg/L as N**	Prep Date:	RunNo: **68966**
Client ID:	Batch ID: **R68966**	TestNo: **EPA 350.1**		Analysis Date: **11/11/2010**	SeqNo: **1534127**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Ammonia Nitrogen - Distilled	< 0.100	0.100									

Sample ID: **CCB**	SampType: **CCB**	TestCode: **NH3D_350.1**	Units: **mg/L as N**	Prep Date:	RunNo: **68966**
Client ID:	Batch ID: **R68966**	TestNo: **EPA 350.1**		Analysis Date: **11/11/2010**	SeqNo: **1534139**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Ammonia Nitrogen - Distilled	< 0.100	0.100									

Sample ID: **CCB**	SampType: **CCB**	TestCode: **NH3D_350.1**	Units: **mg/L as N**	Prep Date:	RunNo: **68966**
Client ID:	Batch ID: **R68966**	TestNo: **EPA 350.1**		Analysis Date: **11/11/2010**	SeqNo: **1534143**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Ammonia Nitrogen - Distilled	< 0.100	0.100									

CLIENT: CIVIL & ENVIRONMENTAL-COLUMB
Work Order: G1011042
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ANALYTICAL QC SUMMARY REPORT

TestCode: NO3-NO2_353.2

Sample ID: **LCS**	SampType: **LCS**	TestCode: **NO3-NO2_35**	Units: **mg/L as N**	Prep Date:		RunNo: **68716**
Client ID:	Batch ID: **R68716**	TestNo: **EPA 353.2**		Analysis Date: **11/4/2010**		SeqNo: **1527150**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Nitrate - Nitrite	1.033	0.050	1	0	103	90	110				

Sample ID: **LCS**	SampType: **LCS**	TestCode: **NO3-NO2_35**	Units: **mg/L as N**	Prep Date:		RunNo: **68716**
Client ID:	Batch ID: **R68716**	TestNo: **EPA 353.2**		Analysis Date: **11/4/2010**		SeqNo: **1527152**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Nitrate - Nitrite	0.9880	0.050	1	0	98.8	90	110				

Sample ID: **LCSD**	SampType: **LCSD**	TestCode: **NO3-NO2_35**	Units: **mg/L as N**	Prep Date:		RunNo: **68716**
Client ID:	Batch ID: **R68716**	TestNo: **EPA 353.2**		Analysis Date: **11/4/2010**		SeqNo: **1527151**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Nitrate - Nitrite	1.012	0.050						0.988	2.40	20	

Sample ID: **LCSD**	SampType: **LCSD**	TestCode: **NO3-NO2_35**	Units: **mg/L as N**	Prep Date:		RunNo: **68716**
Client ID:	Batch ID: **R68716**	TestNo: **EPA 353.2**		Analysis Date: **11/4/2010**		SeqNo: **1527153**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Nitrate - Nitrite	1.001	0.050						0.988	1.31	20	

Sample ID: **G1011042-004AMS**	SampType: **MS**	TestCode: **NO3-NO2_35**	Units: **mg/L as N**	Prep Date:		RunNo: **68716**
Client ID: **FIELD DUP**	Batch ID: **R68716**	TestNo: **EPA 353.2**		Analysis Date: **11/4/2010**		SeqNo: **1527113**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Nitrate - Nitrite	0.9910	0.050	1	0.022	96.9	90	110				

Sample ID: **G1010584-011BDUP**	SampType: **DUP**	TestCode: **NO3-NO2_35**	Units: **mg/L as N**	Prep Date:		RunNo: **68716**
Client ID:	Batch ID: **R68716**	TestNo: **EPA 353.2**		Analysis Date: **11/4/2010**		SeqNo: **1527100**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Nitrate - Nitrite	< 0.050	0.050						0	0	20	

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ANALYTICAL QC SUMMARY REPORT

TestCode: NO3-NO2_353.2

Sample ID: **G1011042-004ADUP**	SampType: **DUP**	TestCode: **NO3-NO2_35**	Units: **mg/L as N**	Prep Date:			RunNo: **68716**		
Client ID: **FIELD DUP**	Batch ID: **R68716**	TestNo: **EPA 353.2**		Analysis Date: **11/4/2010**			SeqNo: **1527112**		
Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Nitrate - Nitrite	< 0.050	0.050						0.022	0	20	

Sample ID: **CCB**	SampType: **CCB**	TestCode: **NO3-NO2_35**	Units: **mg/L as N**	Prep Date:			RunNo: **68716**		
Client ID:	Batch ID: **R68716**	TestNo: **EPA 353.2**		Analysis Date: **11/4/2010**			SeqNo: **1527086**		
Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Nitrate - Nitrite	< 0.050	0.050									

Sample ID: **CCB**	SampType: **CCB**	TestCode: **NO3-NO2_35**	Units: **mg/L as N**	Prep Date:			RunNo: **68716**		
Client ID:	Batch ID: **R68716**	TestNo: **EPA 353.2**		Analysis Date: **11/4/2010**			SeqNo: **1527107**		
Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Nitrate - Nitrite	< 0.050	0.050									

Sample ID: **CCB**	SampType: **CCB**	TestCode: **NO3-NO2_35**	Units: **mg/L as N**	Prep Date:			RunNo: **68716**		
Client ID:	Batch ID: **R68716**	TestNo: **EPA 353.2**		Analysis Date: **11/4/2010**			SeqNo: **1527120**		
Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Nitrate - Nitrite	< 0.050	0.050									

Sample ID: **CCB**	SampType: **CCB**	TestCode: **NO3-NO2_35**	Units: **mg/L as N**	Prep Date:			RunNo: **68716**		
Client ID:	Batch ID: **R68716**	TestNo: **EPA 353.2**		Analysis Date: **11/4/2010**			SeqNo: **1527134**		
Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Nitrate - Nitrite	< 0.050	0.050									

Sample ID: **CCB**	SampType: **CCB**	TestCode: **NO3-NO2_35**	Units: **mg/L as N**	Prep Date:			RunNo: **68716**		
Client ID:	Batch ID: **R68716**	TestNo: **EPA 353.2**		Analysis Date: **11/4/2010**			SeqNo: **1527144**		
Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Nitrate - Nitrite	< 0.050	0.050									

CLIENT: CIVIL & ENVIRONMENTAL-COLUMB
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ANALYTICAL QC SUMMARY REPORT

TestCode: TDS_SM 2540-C

Sample ID: **LCS**	SampType: **LCS**	TestCode: **TDS_SM 254**	Units: **mg/L**	Prep Date:	RunNo: **68680**
Client ID:	Batch ID: **R68680**	TestNo: **SM2540-C**		Analysis Date: **11/1/2010**	SeqNo: **1525855**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Total dissolved solids	288.0	20.0	292	0	98.6	85	115				

Sample ID: **LCS**	SampType: **LCS**	TestCode: **TDS_SM 254**	Units: **mg/L**	Prep Date:	RunNo: **68680**
Client ID:	Batch ID: **R68680**	TestNo: **SM2540-C**		Analysis Date: **11/2/2010**	SeqNo: **1525880**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Total dissolved solids	288.0	20.0	292	0	98.6	85	115				

Sample ID: **LCS**	SampType: **LCS**	TestCode: **TDS_SM 254**	Units: **mg/L**	Prep Date:	RunNo: **68828**
Client ID:	Batch ID: **R68828**	TestNo: **SM2540-C**		Analysis Date: **11/2/2010**	SeqNo: **1530099**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Total dissolved solids	296.0	20.0	292	0	101	85	115				

Sample ID: **LCS**	SampType: **LCS**	TestCode: **TDS_SM 254**	Units: **mg/L**	Prep Date:	RunNo: **68828**
Client ID:	Batch ID: **R68828**	TestNo: **SM2540-C**		Analysis Date: **11/3/2010**	SeqNo: **1530123**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Total dissolved solids	294.0	20.0	292	0	101	85	115				

Sample ID: **LCS**	SampType: **LCS**	TestCode: **TDS_SM 254**	Units: **mg/L**	Prep Date:	RunNo: **68828**
Client ID:	Batch ID: **R68828**	TestNo: **SM2540-C**		Analysis Date: **11/3/2010**	SeqNo: **1530193**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Total dissolved solids	260.0	20.0	292	0	89.0	85	115				

Sample ID: **G1011011-001ADUP**	SampType: **DUP**	TestCode: **TDS_SM 254**	Units: **mg/L**	Prep Date:	RunNo: **68680**
Client ID:	Batch ID: **R68680**	TestNo: **SM2540-C**		Analysis Date: **11/1/2010**	SeqNo: **1525853**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Total dissolved solids	< 20.0	20.0						0	0	20	

CLIENT: CIVIL & ENVIRONMENTAL-COLUMB
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ANALYTICAL QC SUMMARY REPORT

TestCode: TDS_SM 2540-C

Sample ID: **G1011025-008ADUP**	SampType: **DUP**	TestCode: **TDS_SM 254**	Units: **mg/L**	Prep Date:			RunNo: **68680**		
Client ID:	Batch ID: **R68680**	TestNo: **SM2540-C**		Analysis Date: **11/2/2010**			SeqNo: **1525870**		
Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Total dissolved solids	604.0	20.0						608	0.660	20	

Sample ID: **G1011042-007DDUP**	SampType: **DUP**	TestCode: **TDS_SM 254**	Units: **mg/L**	Prep Date:			RunNo: **68680**		
Client ID: **P-6S**	Batch ID: **R68680**	TestNo: **SM2540-C**		Analysis Date: **11/2/2010**			SeqNo: **1525882**		
Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Total dissolved solids	2224	20.0						2090	6.21	20	

Sample ID: **G1011057-004ADUP**	SampType: **DUP**	TestCode: **TDS_SM 254**	Units: **mg/L**	Prep Date:			RunNo: **68828**		
Client ID:	Batch ID: **R68828**	TestNo: **SM2540-C**		Analysis Date: **11/3/2010**			SeqNo: **1530113**		
Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Total dissolved solids	158.0	20.0						158	0	20	

Sample ID: **G1011064-003BDUP**	SampType: **DUP**	TestCode: **TDS_SM 254**	Units: **mg/L**	Prep Date:			RunNo: **68828**		
Client ID:	Batch ID: **R68828**	TestNo: **SM2540-C**		Analysis Date: **11/3/2010**			SeqNo: **1530126**		
Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Total dissolved solids	44.00	20.0						44	0	20	

Sample ID: **G1011073-003ADUP**	SampType: **DUP**	TestCode: **TDS_SM 254**	Units: **mg/L**	Prep Date:			RunNo: **68828**		
Client ID:	Batch ID: **R68828**	TestNo: **SM2540-C**		Analysis Date: **11/3/2010**			SeqNo: **1530151**		
Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Total dissolved solids	248.0	20.0						250	0.803	20	

Sample ID: **G1011078-007ADUP**	SampType: **DUP**	TestCode: **TDS_SM 254**	Units: **mg/L**	Prep Date:			RunNo: **68828**		
Client ID:	Batch ID: **R68828**	TestNo: **SM2540-C**		Analysis Date: **11/3/2010**			SeqNo: **1530196**		
Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Total dissolved solids	232.0	20.0						228	1.74	20	

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ANALYTICAL QC SUMMARY REPORT

TestCode: TDS_SM 2540-C

Sample ID: **G1011073-017ADUP**	SampType: **DUP**	TestCode: **TDS_SM 254**	Units: **mg/L**	Prep Date:	RunNo: **68828**
Client ID:	Batch ID: **R68828**	TestNo: **SM2540-C**		Analysis Date: **11/3/2010**	SeqNo: **1532999**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Total dissolved solids	222.0	20.0						212	4.61	20	

Sample ID: **G1011076-002DDUP**	SampType: **DUP**	TestCode: **TDS_SM 254**	Units: **mg/L**	Prep Date:	RunNo: **68828**
Client ID:	Batch ID: **R68828**	TestNo: **SM2540-C**		Analysis Date: **11/3/2010**	SeqNo: **1533003**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Total dissolved solids	3040	20.0						2880	5.41	20	

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ANALYTICAL QC SUMMARY REPORT

TestCode: TOT_METALS

Sample ID: **LCS1-29233**	SampType: **LCS1**	TestCode: **TOT_METAL**	Units: **mg/L**	Prep Date: **11/3/2010**	RunNo: **68740**
Client ID:	Batch ID: **29233**	TestNo: **EPA 200.7**		Analysis Date: **11/4/2010**	SeqNo: **1527492**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Barium	1.028	0.0100	1	0	103	85	115				
Beryllium	0.2018	0.00100	0.2	0	101	85	115				
Cadmium	0.3993	0.00200	0.4	0	99.8	85	115				
Calcium	10.45	0.100	10	0	104	85	115				
Chromium	1.000	0.0100	1	0	100	85	115				
Cobalt	0.4055	0.00500	0.4	0	101	85	115				
Copper	1.023	0.0100	1	0	102	85	115				
Magnesium	2.045	0.100	2	0	102	85	115				
Manganese	1.085	0.0100	1	0	109	85	115				
Nickel	1.033	0.0100	1	0	103	85	115				
Potassium	10.36	0.500	10	0	104	85	115				
Silver	0.01020	0.00500	0.01	0	102	85	115				
Sodium	10.15	0.200	10	0	101	85	115				
Vanadium	0.4179	0.00500	0.4	0	104	85	115				
Zinc	1.007	0.0100	1	0	101	85	115				

Sample ID: **LCSD1-29233**	SampType: **LCSD1**	TestCode: **TOT_METAL**	Units: **mg/L**	Prep Date: **11/3/2010**	RunNo: **68740**
Client ID:	Batch ID: **29233**	TestNo: **EPA 200.7**		Analysis Date: **11/4/2010**	SeqNo: **1527493**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Barium	1.016	0.0100						1.028	1.17	20	
Beryllium	0.1983	0.00100						0.2018	1.75	20	
Cadmium	0.3917	0.00200						0.3993	1.92	20	
Calcium	10.21	0.100						10.45	2.32	20	
Chromium	0.9828	0.0100						1	1.73	20	
Cobalt	0.3986	0.00500						0.4055	1.72	20	
Copper	1.024	0.0100						1.023	0.0977	20	
Magnesium	2.010	0.100						2.045	1.73	20	
Manganese	1.068	0.0100						1.085	1.58	20	
Nickel	1.012	0.0100						1.033	2.05	20	
Potassium	10.12	0.500						10.36	2.34	20	
Silver	0.009600	0.00500						0.0102	6.06	20	
Sodium	10.02	0.200						10.15	1.29	20	
Vanadium	0.4087	0.00500						0.4179	2.23	20	
Zinc	0.9900	0.0100						1.007	1.70	20	

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ANALYTICAL QC SUMMARY REPORT

TestCode: TOT_METALS

Sample ID: **PB-29233**	SampType: **MBLK**	TestCode: **TOT_METAL**	Units: **mg/L**	Prep Date: **11/3/2010**	RunNo: **68740**
Client ID:	Batch ID: **29233**	TestNo: **EPA 200.7**		Analysis Date: **11/4/2010**	SeqNo: **1527491**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Barium	< 0.0100	0.0100									
Beryllium	< 0.00100	0.00100									
Cadmium	< 0.00200	0.00200									
Calcium	< 0.100	0.100									
Chromium	< 0.0100	0.0100									
Cobalt	< 0.00500	0.00500									
Copper	< 0.0100	0.0100									
Magnesium	< 0.100	0.100									
Manganese	< 0.0100	0.0100									
Nickel	< 0.0100	0.0100									
Potassium	< 0.500	0.500									
Silver	< 0.00500	0.00500									
Sodium	< 0.200	0.200									
Vanadium	< 0.00500	0.00500									
Zinc	< 0.0100	0.0100									

Sample ID: **G1011042-001EMS**	SampType: **MS**	TestCode: **TOT_METAL**	Units: **mg/L**	Prep Date: **11/3/2010**	RunNo: **68740**
Client ID: **P-2S**	Batch ID: **29233**	TestNo: **EPA 200.7**		Analysis Date: **11/4/2010**	SeqNo: **1527609**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Barium	1.000	0.0100	1	0.0208	97.9	75	125				
Beryllium	0.1929	0.00100	0.2	0	96.5	75	125				
Cadmium	0.4066	0.00200	0.4	0	102	75	125				
Calcium	239.7	0.100	10	231.8	79.0	75	125				
Chromium	1.021	0.0100	1	0	102	75	125				
Cobalt	0.4041	0.00500	0.4	0	101	75	125				
Copper	1.008	0.0100	1	0	101	75	125				
Magnesium	60.56	0.100	2	60.8	-12.0	75	125				1
Manganese	1.265	0.0100	1	0.2692	99.6	75	125				
Nickel	1.031	0.0100	1	0	103	75	125				
Potassium	15.43	0.500	10	5.148	103	75	125				
Silver	0.009500	0.00500	0.01	0	95.0	75	125				
Sodium	42.61	0.200	10	33	96.1	75	125				
Vanadium	0.4108	0.00500	0.4	0	103	75	125				
Zinc	0.9980	0.0100	1	0	99.8	75	125				

CLIENT: CIVIL & ENVIRONMENTAL-COLUMB
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ANALYTICAL QC SUMMARY REPORT

TestCode: TOT_METALS

Sample ID: **G1011042-010EMS**	SampType: **MS**	TestCode: **TOT_METAL**	Units: **mg/L**	Prep Date: **11/3/2010**	RunNo: **68740**
Client ID: **P-5**	Batch ID: **29233**	TestNo: **EPA 200.7**		Analysis Date: **11/4/2010**	SeqNo: **1527635**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Barium	1.008	0.0100	1	0.0233	98.5	75	125				
Beryllium	0.1954	0.00100	0.2	0	97.7	75	125				
Cadmium	0.4150	0.00200	0.4	0	104	75	125				
Calcium	230.8	0.100	10	215.9	149	75	125				1
Chromium	1.038	0.0100	1	0	104	75	125				
Cobalt	0.4202	0.00500	0.4	0.0091	103	75	125				
Copper	1.003	0.0100	1	0	100	75	125				
Magnesium	67.06	0.100	2	62.58	224	75	125				1
Manganese	1.626	0.0100	1	0.6044	102	75	125				
Nickel	1.063	0.0100	1	0.0103	105	75	125				
Potassium	14.00	0.500	10	3.414	106	75	125				
Silver	0.009900	0.00500	0.01	0	99.0	75	125				
Sodium	71.39	0.200	10	58.51	129	75	125				1
Vanadium	0.4305	0.00500	0.4	0	108	75	125				
Zinc	1.016	0.0100	1	0	102	75	125				

Sample ID: **G1011042-001EMS**	SampType: **MS**	TestCode: **TOT_METAL**	Units: **mg/L**	Prep Date: **11/3/2010**	RunNo: **68785**
Client ID: **P-2S**	Batch ID: **29233**	TestNo: **EPA 200.7**		Analysis Date: **11/5/2010**	SeqNo: **1528793**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Iron	9.670	0.0500	10	0.25596	94.1	75	125				

Sample ID: **G1011042-010EMS**	SampType: **MS**	TestCode: **TOT_METAL**	Units: **mg/L**	Prep Date: **11/3/2010**	RunNo: **68785**
Client ID: **P-5**	Batch ID: **29233**	TestNo: **EPA 200.7**		Analysis Date: **11/5/2010**	SeqNo: **1528811**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Iron	9.458	0.0500	10	0.05146	94.1	75	125				

Sample ID: **G1011042-001EDUP**	SampType: **DUP**	TestCode: **TOT_METAL**	Units: **mg/L**	Prep Date: **11/3/2010**	RunNo: **68740**
Client ID: **P-2S**	Batch ID: **29233**	TestNo: **EPA 200.7**		Analysis Date: **11/4/2010**	SeqNo: **1527608**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Barium	0.02160	0.0100						0.0208	3.77	20	
Beryllium	< 0.00100	0.00100						0	0	20	
Cadmium	< 0.00200	0.00200						0	0	20	

CLIENT: CIVIL & ENVIRONMENTAL-COLUMB
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TestCode: TOT_METALS

Sample ID: **G1011042-001EDUP**	SampType: **DUP**	TestCode: **TOT_METAL**	Units: **mg/L**	Prep Date: **11/3/2010**	RunNo: **68740**
Client ID: **P-2S**	Batch ID: **29233**	TestNo: **EPA 200.7**		Analysis Date: **11/4/2010**	SeqNo: **1527608**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Calcium	232.0	0.100						231.8	0.0862	20	
Chromium	< 0.0100	0.0100						0	0	20	
Cobalt	< 0.00500	0.00500						0	0	20	
Copper	< 0.0100	0.0100						0	0	20	
Magnesium	59.56	0.100						60.8	2.06	20	
Manganese	0.2733	0.0100						0.2692	1.51	20	
Nickel	< 0.0100	0.0100						0	0	20	
Potassium	5.111	0.500						5.148	0.721	20	
Silver	< 0.00500	0.00500						0	0	20	
Sodium	32.93	0.200						33	0.212	20	
Vanadium	< 0.00500	0.00500						0	0	20	
Zinc	< 0.0100	0.0100						0	0	20	

Sample ID: **G1011042-001EDUP**	SampType: **DUP**	TestCode: **TOT_METAL**	Units: **mg/L**	Prep Date: **11/3/2010**	RunNo: **68785**
Client ID: **P-2S**	Batch ID: **29233**	TestNo: **EPA 200.7**		Analysis Date: **11/5/2010**	SeqNo: **1528792**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Iron	0.2506	0.0500						0.256	2.13	20	

Sample ID: **CCB**	SampType: **CCB**	TestCode: **TOT_METAL**	Units: **mg/L**	Prep Date:	RunNo: **68740**
Client ID:	Batch ID: **R68740**	TestNo: **EPA 200.7**		Analysis Date: **11/4/2010**	SeqNo: **1527481**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Antimony	< 0.0200	0.0200									
Arsenic	< 0.0200	0.0200									
Barium	< 0.0100	0.0100									
Beryllium	< 0.00100	0.00100									
Cadmium	< 0.00200	0.00200									
Calcium	< 0.100	0.100									
Chromium	< 0.0100	0.0100									
Cobalt	< 0.00500	0.00500									
Copper	< 0.0100	0.0100									
Iron	< 0.0500	0.0500									
Lead	< 0.0200	0.0200									
Magnesium	< 0.100	0.100									

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TestCode: TOT_METALS

Sample ID: **CCB**	SampType: **CCB**	TestCode: **TOT_METAL**	Units: **mg/L**	Prep Date:	RunNo: **68740**
Client ID:	Batch ID: **R68740**	TestNo: **EPA 200.7**		Analysis Date: **11/4/2010**	SeqNo: **1527481**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Manganese	< 0.0100	0.0100									
Nickel	< 0.0100	0.0100									
Potassium	< 0.500	0.500									
Selenium	< 0.0200	0.0200									
Silver	< 0.00500	0.00500									
Thallium	< 0.0200	0.0200									
Vanadium	< 0.00500	0.00500									
Zinc	< 0.0100	0.0100									

Sample ID: **CCB**	SampType: **CCB**	TestCode: **TOT_METAL**	Units: **mg/L**	Prep Date:	RunNo: **68740**
Client ID:	Batch ID: **R68740**	TestNo: **EPA 200.7**		Analysis Date: **11/4/2010**	SeqNo: **1527499**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Antimony	< 0.0200	0.0200									
Arsenic	< 0.0200	0.0200									
Barium	< 0.0100	0.0100									
Beryllium	< 0.00100	0.00100									
Cadmium	< 0.00200	0.00200									
Calcium	< 0.100	0.100									
Chromium	< 0.0100	0.0100									
Cobalt	< 0.00500	0.00500									
Copper	< 0.0100	0.0100									
Iron	< 0.0500	0.0500									
Lead	< 0.0200	0.0200									
Magnesium	< 0.100	0.100									
Manganese	< 0.0100	0.0100									
Nickel	< 0.0100	0.0100									
Potassium	< 0.500	0.500									
Selenium	< 0.0200	0.0200									
Silver	< 0.00500	0.00500									
Thallium	< 0.0200	0.0200									
Vanadium	< 0.00500	0.00500									
Zinc	< 0.0100	0.0100									

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TestCode: TOT_METALS

Sample ID: **CCB**	SampType: **CCB**	TestCode: **TOT_METAL**	Units: **mg/L**	Prep Date:	RunNo: **68740**
Client ID:	Batch ID: **R68740**	TestNo: **EPA 200.7**		Analysis Date: **11/4/2010**	SeqNo: **1527599**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Antimony	< 0.0200	0.0200									
Arsenic	< 0.0200	0.0200									
Barium	< 0.0100	0.0100									
Beryllium	< 0.00100	0.00100									
Cadmium	< 0.00200	0.00200									
Calcium	< 0.100	0.100									
Chromium	< 0.0100	0.0100									
Cobalt	< 0.00500	0.00500									
Copper	< 0.0100	0.0100									
Iron	< 0.0500	0.0500									
Lead	< 0.0200	0.0200									
Magnesium	< 0.100	0.100									
Manganese	< 0.0100	0.0100									
Nickel	< 0.0100	0.0100									
Potassium	< 0.500	0.500									
Selenium	< 0.0200	0.0200									
Silver	< 0.00500	0.00500									
Thallium	< 0.0200	0.0200									
Vanadium	< 0.00500	0.00500									
Zinc	< 0.0100	0.0100									

Sample ID: **CCB**	SampType: **CCB**	TestCode: **TOT_METAL**	Units: **mg/L**	Prep Date:	RunNo: **68740**
Client ID:	Batch ID: **R68740**	TestNo: **EPA 200.7**		Analysis Date: **11/4/2010**	SeqNo: **1527611**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Antimony	< 0.0200	0.0200									
Arsenic	< 0.0200	0.0200									
Barium	< 0.0100	0.0100									
Beryllium	< 0.00100	0.00100									
Cadmium	< 0.00200	0.00200									
Calcium	< 0.100	0.100									
Chromium	< 0.0100	0.0100									
Cobalt	< 0.00500	0.00500									
Copper	< 0.0100	0.0100									
Iron	< 0.0500	0.0500									

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ANALYTICAL QC SUMMARY REPORT

TestCode: TOT_METALS

Sample ID: **CCB**	SampType: **CCB**	TestCode: **TOT_METAL**	Units: **mg/L**	Prep Date:	RunNo: **68740**
Client ID:	Batch ID: **R68740**	TestNo: **EPA 200.7**		Analysis Date: **11/4/2010**	SeqNo: **1527611**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Lead	< 0.0200	0.0200									
Magnesium	< 0.100	0.100									
Manganese	< 0.0100	0.0100									
Nickel	< 0.0100	0.0100									
Potassium	< 0.500	0.500									
Selenium	< 0.0200	0.0200									
Silver	< 0.00500	0.00500									
Thallium	< 0.0200	0.0200									
Vanadium	< 0.00500	0.00500									
Zinc	< 0.0100	0.0100									

Sample ID: **CCB**	SampType: **CCB**	TestCode: **TOT_METAL**	Units: **mg/L**	Prep Date:	RunNo: **68740**
Client ID:	Batch ID: **R68740**	TestNo: **EPA 200.7**		Analysis Date: **11/4/2010**	SeqNo: **1527637**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Antimony	< 0.0200	0.0200									
Arsenic	< 0.0200	0.0200									
Barium	< 0.0100	0.0100									
Beryllium	< 0.00100	0.00100									
Cadmium	< 0.00200	0.00200									
Calcium	< 0.100	0.100									
Chromium	< 0.0100	0.0100									
Cobalt	< 0.00500	0.00500									
Copper	< 0.0100	0.0100									
Iron	< 0.0500	0.0500									
Lead	< 0.0200	0.0200									
Magnesium	< 0.100	0.100									
Manganese	< 0.0100	0.0100									
Nickel	< 0.0100	0.0100									
Potassium	< 0.500	0.500									
Selenium	< 0.0200	0.0200									
Silver	< 0.00500	0.00500									
Thallium	< 0.0200	0.0200									
Vanadium	< 0.00500	0.00500									
Zinc	< 0.0100	0.0100									

ANALYTICAL QC SUMMARY REPORT

TestCode: TOT_METALS

Sample ID: **CCB**	SampType: **CCB**	TestCode: **TOT_METAL**	Units: **mg/L**	Prep Date:	RunNo: **68740**
Client ID:	Batch ID: **R68740**	TestNo: **EPA 200.7**		Analysis Date: **11/5/2010**	SeqNo: **1527649**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Antimony	< 0.0200	0.0200									
Arsenic	< 0.0200	0.0200									
Barium	< 0.0100	0.0100									
Beryllium	< 0.00100	0.00100									
Cadmium	< 0.00200	0.00200									
Calcium	< 0.100	0.100									
Chromium	< 0.0100	0.0100									
Cobalt	< 0.00500	0.00500									
Copper	< 0.0100	0.0100									
Iron	< 0.0500	0.0500									
Lead	< 0.0200	0.0200									
Magnesium	< 0.100	0.100									
Manganese	< 0.0100	0.0100									
Nickel	< 0.0100	0.0100									
Potassium	< 0.500	0.500									
Selenium	< 0.0200	0.0200									
Silver	< 0.00500	0.00500									
Thallium	< 0.0200	0.0200									
Vanadium	< 0.00500	0.00500									
Zinc	< 0.0100	0.0100									

Sample ID: **CCB**	SampType: **CCB**	TestCode: **TOT_METAL**	Units: **mg/L**	Prep Date:	RunNo: **68785**
Client ID:	Batch ID: **R68785**	TestNo: **EPA 200.7**		Analysis Date: **11/5/2010**	SeqNo: **1528787**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Antimony	< 0.0200	0.0200									
Arsenic	< 0.0200	0.0200									
Barium	< 0.0100	0.0100									
Beryllium	< 0.00100	0.00100									
Cadmium	< 0.00200	0.00200									
Calcium	< 0.100	0.100									
Chromium	< 0.0100	0.0100									
Cobalt	< 0.00500	0.00500									
Copper	< 0.0100	0.0100									
Iron	< 0.0500	0.0500									

ANALYTICAL QC SUMMARY REPORT

TestCode: TOT_METALS

Sample ID: **CCB**	SampType: **CCB**	TestCode: **TOT_METAL**	Units: **mg/L**	Prep Date:	RunNo: **68785**
Client ID:	Batch ID: **R68785**	TestNo: **EPA 200.7**		Analysis Date: **11/5/2010**	SeqNo: **1528787**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Lead	< 0.0200	0.0200									
Magnesium	< 0.100	0.100									
Manganese	< 0.0100	0.0100									
Nickel	< 0.0100	0.0100									
Potassium	< 0.500	0.500									
Selenium	< 0.0200	0.0200									
Silver	< 0.00500	0.00500									
Sodium	< 0.200	0.200									
Thallium	< 0.0200	0.0200									
Vanadium	< 0.00500	0.00500									
Zinc	< 0.0100	0.0100									

Sample ID: **CCB**	SampType: **CCB**	TestCode: **TOT_METAL**	Units: **mg/L**	Prep Date:	RunNo: **68785**
Client ID:	Batch ID: **R68785**	TestNo: **EPA 200.7**		Analysis Date: **11/5/2010**	SeqNo: **1528806**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Antimony	< 0.0200	0.0200									
Arsenic	< 0.0200	0.0200									
Barium	< 0.0100	0.0100									
Beryllium	< 0.00100	0.00100									
Cadmium	< 0.00200	0.00200									
Calcium	< 0.100	0.100									
Chromium	< 0.0100	0.0100									
Cobalt	< 0.00500	0.00500									
Copper	< 0.0100	0.0100									
Iron	< 0.0500	0.0500									
Lead	< 0.0200	0.0200									
Magnesium	< 0.100	0.100									
Manganese	< 0.0100	0.0100									
Nickel	< 0.0100	0.0100									
Potassium	< 0.500	0.500									
Selenium	< 0.0200	0.0200									
Silver	< 0.00500	0.00500									
Sodium	< 0.200	0.200									
Thallium	< 0.0200	0.0200									

CLIENT: CIVIL & ENVIRONMENTAL-COLUMB
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ANALYTICAL QC SUMMARY REPORT

TestCode: TOT_METALS

Sample ID: **CCB**	SampType: **CCB**	TestCode: **TOT_METAL**	Units: **mg/L**	Prep Date:	RunNo: **68785**
Client ID:	Batch ID: **R68785**	TestNo: **EPA 200.7**		Analysis Date: **11/5/2010**	SeqNo: **1528806**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Vanadium	< 0.00500	0.00500									
Zinc	< 0.0100	0.0100									

Sample ID: **CCB**	SampType: **CCB**	TestCode: **TOT_METAL**	Units: **mg/L**	Prep Date:	RunNo: **68785**
Client ID:	Batch ID: **R68785**	TestNo: **EPA 200.7**		Analysis Date: **11/5/2010**	SeqNo: **1528818**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Antimony	< 0.0200	0.0200									
Arsenic	< 0.0200	0.0200									
Barium	< 0.0100	0.0100									
Beryllium	< 0.00100	0.00100									
Cadmium	< 0.00200	0.00200									
Calcium	< 0.100	0.100									
Chromium	< 0.0100	0.0100									
Cobalt	< 0.00500	0.00500									
Copper	< 0.0100	0.0100									
Iron	< 0.0500	0.0500									
Lead	< 0.0200	0.0200									
Magnesium	< 0.100	0.100									
Manganese	< 0.0100	0.0100									
Nickel	< 0.0100	0.0100									
Potassium	< 0.500	0.500									
Selenium	< 0.0200	0.0200									
Silver	< 0.00500	0.00500									
Sodium	< 0.200	0.200									
Thallium	< 0.0200	0.0200									
Vanadium	< 0.00500	0.00500									
Zinc	< 0.0100	0.0100									

CLIENT: CIVIL & ENVIRONMENTAL-COLUMB
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ANALYTICAL QC SUMMARY REPORT

TestCode: TOT-ICPMS_200.8

Sample ID: **PB-29233**	SampType: **PB**	TestCode: **TOT-ICPMS_**	Units: **µg/L**	Prep Date: **11/3/2010**	RunNo: **68735**
Client ID:	Batch ID: **29233**	TestNo: **EPA 200.8**		Analysis Date: **11/4/2010**	SeqNo: **1527346**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Antimony	< 1.00	1.00									
Arsenic	< 1.00	1.00									
Lead	< 1.00	1.00									
Selenium	< 1.00	1.00									
Thallium	< 0.200	0.200									

Sample ID: **LCS2-29233**	SampType: **LCS2**	TestCode: **TOT-ICPMS_**	Units: **µg/L**	Prep Date: **11/3/2010**	RunNo: **68735**
Client ID:	Batch ID: **29233**	TestNo: **EPA 200.8**		Analysis Date: **11/4/2010**	SeqNo: **1527347**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Antimony	5.859	1.00	6	0	97.7	85	115				
Arsenic	9.175	1.00	10	0	91.8	85	115				
Lead	4.860	1.00	5	0	97.2	85	115				
Selenium	19.95	1.00	20	0	99.8	85	115				
Thallium	1.912	0.200	2	0	95.6	85	115				

Sample ID: **LCSD2-29233**	SampType: **LCSD2**	TestCode: **TOT-ICPMS_**	Units: **µg/L**	Prep Date: **11/3/2010**	RunNo: **68735**
Client ID:	Batch ID: **29233**	TestNo: **EPA 200.8**		Analysis Date: **11/4/2010**	SeqNo: **1527348**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Antimony	5.993	1.00						5.859	2.27	20	
Arsenic	9.390	1.00						9.175	2.32	20	
Lead	4.973	1.00						4.86	2.31	20	
Selenium	20.59	1.00						19.95	3.15	20	
Thallium	1.957	0.200						1.912	2.29	20	

Sample ID: **G1011042-008EMS**	SampType: **MS**	TestCode: **TOT-ICPMS_**	Units: **µg/L**	Prep Date: **11/3/2010**	RunNo: **68735**
Client ID: **P-9**	Batch ID: **29233**	TestNo: **EPA 200.8**		Analysis Date: **11/4/2010**	SeqNo: **1527358**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Antimony	5.852	1.00	6	0	97.5	70	130				
Arsenic	22.16	1.00	10	12.411	97.4	70	130				
Lead	5.035	1.00	5	0.3876	92.9	70	130				
Selenium	18.88	1.00	20	0	94.4	70	130				
Thallium	1.936	0.200	2	0	96.8	70	130				

CLIENT: CIVIL & ENVIRONMENTAL-COLUMB
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ANALYTICAL QC SUMMARY REPORT

TestCode: TOT-ICPMS_200.8

Sample ID: **G1011042-001EDUP** SampType: **DUP** TestCode: **TOT-ICPMS_** Units: **µg/L** Prep Date: **11/3/2010** RunNo: **68735**
Client ID: **P-2S** Batch ID: **29233** TestNo: **EPA 200.8** Analysis Date: **11/4/2010** SeqNo: **1527350**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Antimony	< 1.00	1.00						0	0	20	
Arsenic	< 1.00	1.00						0	0	20	
Lead	< 1.00	1.00						0	0	20	
Selenium	< 1.00	1.00						0	0	20	
Thallium	< 0.200	0.200						0	0	20	

GLOSSARY OF TERMS

Aliquot: A separate measured and representative portion of a sample used for analysis.

Analyte: The specific chemicals or components that a sample is used for analysis.

Acceptance Criteria: Specified limits established either from a method or by the laboratory for a target analyte.

Accuracy: The measured agreement between an observed value and an accepted reference value.

Corporate Detection Limit (CDL): The value based on method detection limits that may encompass multiple studies generated from several instruments. The CDL is based on the highest MDL study and is rounded to a useable value.

Corporate Quantitation Limit (CQL): The laboratory's lowest level of data quantification for reporting a target analyte at a concentration level that does not require use of data qualifiers. The CQL is calculated as two times the Corporate Detection Limit (CDL) or two times the CDL times any dilution factor.

Batch: Samples prepared or analyzed together with the same process and personnel, using the same lot(s) of reagents. A **preparation batch** is a group of one to twenty samples of the same defined matrix, meeting the above-mentioned conditions and with a maximum time between the start of processing of the first and last sample in the batch to be 24 hours. An **analytical batch** is comprised of prepared samples (extracts, digestates or concentrates) that are analyzed together as a group. An analytical batch can include prepared samples originating from various sample matrices and may exceed 20 samples.

Chain of Custody: A form that documents the possession of the samples from the time of collection to lab receipt. This record includes: sample matrix, the number and types of containers; the mode of collection; collector; time of collection; preservation; and requested analyses.

Equipment Blank: Sampling equipment rinsed with laboratory water immediately before use in sampling with the rinsing submitted to the laboratory as a sample for analysis. Data from the analysis of equipment blanks provides a check on sampling device cleanliness.

Field Duplicate: Two separate samples taken from the same source (e.g. monitoring well) and analyzed independently. The data obtained from field duplicate samples is used to evaluate the variability of the sampling procedures and the source from which the sample was obtained. There are no acceptance criteria for comparing field duplicate data results.

Laboratory Control Sample (LCS): A sample matrix, free from the analytes of interest, spiked with known amounts of analytes or a material containing known and verified amounts of analytes. It is used to establish intra-laboratory or analyst-specific precision and bias or to assess the performance of a method.

Matrix: The component or substrate that contains the analyte of interest. For purposes of batch and QC requirement determinations, the following matrix distinctions are used:

- Aqueous: Any aqueous sample excluded from the definition of Drinking Water matrix or Saline/Estuarine source. Includes surface water, groundwater, effluents and TCLP or other extracts.
- Drinking water: Any aqueous sample designated a potable or potential potable water source.

- ❖ Non-aqueous Liquid: Any organic liquid with < 15% settleable solids.
- ❖ Solids: Includes soils, sediments, sludges and other matricies with > 15% settleable solids.
- ❖ Chemical Waste: A product or by-product of an industrial process that results in a matrix not previously defined.

Matrix Spike (MS): A sample prepared by adding a known mass of target analyte to a specified amount of matrix sample for which an independent estimate of target analyte concentration is available. Matrix spikes are used to determine the effect of the matrix on a method's recovery efficiency. Calculation of recovery data is not quality assessed when the concentration of the target analyte in the unspiked sample is $\geq$ 4x the spiking concentration.

Matrix Spike Duplicate (MSD): A second replicate matrix spike prepared in the laboratory and analyzed to obtain a measure of the precision of the recovery for each analyte. Calculation of recovery data is not required when the concentration of the target analyte in the unspiked sample is $\geq$ 4x the spiking concentration.

Method Detection Limit: The minimum concentration of an analyte that can be measured and reported with 99% confidence that the analyte concentration is greater than zero and is determined from analysis of a sample in deionized water containing the analyte. MDLs are verified annually and are subject to change.

Preservation: Refrigeration and/or reagents added at the time of sample collection to maintain the chemical and/or biological integrity of the sample.

Recovery: The total amount of the analyte found in the sample divided by the amount of the analyte added into the sample as a spike.

Relative Percent Difference (RPD): The difference between two values divided by the average of the values, expressed as percent. Quality assessment on RPD is not used when at least one of the two values is $\leq$ 5x the reporting limit; assessment between the two values is based on whether the absolute difference is at or within 2x the reporting limit.

Reporting Limit: A data value set by the laboratory based on the CDL and CQL. Any value at or above the CQL requires no qualification. Any reported values required by the client from an analysis that shows a non-detect at the CDL is flagged with a "U" qualifier. Any reported value required by the client when an analyte is detected between the CDL and CQL is flagged with a "J" that reports the result as an estimated value.

Sample: A portion for analysis in a single or multiple containers with a composition known to the submitter and identified by lab number to the analyst.

Surrogates: Compounds added to the sample before preparation, then measured after analysis to detect problems in the sample preparation procedure.

APPENDIX C3-F

HYDROGEOLOGIC TESTING RESULTS AND CALCULATIONS
SLUG TESTS, PUMP TESTS, ~~&~~ WELL DEVELOPMENT, & HYDROGRAPHS

WELL DEVELOPMENT FORM

Well ID P-1
Diameter (in): 2
Initial Static DTW (ft): 178.18
Total Depth Before Development (ft): 200.65
Total Depth After Development (ft): 200.65
Casing Volume (g): 3.66
Casing Vol. = (Total Well Depth - Static DTW) X 0.163

Date: 10/11/2010
Developed By: DC, BB & LW
Purge Method: Grundfos Pump
Total Gallons Removed: 20.05
Well Volumes Removed: 5.48

Time	Gallons Purged	Flow gpm	pH	Temp. (°C)	Cond. (uS)	Turb.	DTW	Comments
1541	Initial	0.80	7.23	14.10	3570	622.0	178.18	Begin Well Development using Grundfos Pump @ 330 Hz
1547	5.00	1.25	7.11	16.70	2900	-----	198.05	Surged full length of screen
1548	7.25	-----	-----	-----	-----	-----	DRY	DRY
1611	7.25	-----	-----	-----	-----	-----	183.98	-----
1624	7.25	0.80	7.15	13.90	2920	>1000	180.95	Resumed Purging @ 375 Hz
1630	12.25	-----	-----	-----	-----	-----	DRY	Surged full length of screen; Water: brown w/ high turbidity
1644	12.25	-----	-----	-----	-----	-----	DRY	DRY
1654	12.25	0.80	7.38	15.20	3010	>1000	183.40	Resumed Purging
1700	12.75	0.24	7.22	14.50	1810	>1000	188.61	Purging @ 330 Hz
1708	14.70	0.25	7.11	16.10	1636	848.0	189.70	Flow Rate = 1.0 L/min (0.25 gal)
1713	15.40	0.25	7.11	18.90	1575	181.0	189.74	-----
1718	16.10	0.25	7.12	19.40	1573	80.6	189.74	-----
1723	16.80	0.65	7.11	19.70	1572	47.6	189.65	Increased Flow to Purge Dry and End Development
1728	20.05	0.65	-----	-----	-----	-----	DRY	End of Well Development

WELL DEVELOPMENT FORM

Well ID P-5
Diameter (in): 2
Initial Static DTW (ft): 91.53
Total Depth Before Development (ft): 126.00
Total Depth After Development (ft): 126.00
Casing Volume (g): 5.62
Casing Vol. = (Total Well Depth - Static DTW) X 0.163

Date: 10/11/2010
Developed By: DC & BB
Purge Method: Grundfos Pump
Total Gallons Removed: 121.0
Well Volumes Removed: 21.53

Time	Gallons Purged	Flow gpm	pH	Temp. (°C)	Cond. (uS)	Turb.	DTW	Comments
1332	Initial	0.80	7.28	13.20	2920	>1000	91.53	Begin Well Development using Grundfos Pump
1338	5.00	1.25	7.11	13.10	1696	>1000	92.48	Surged full length of screen; Purging @ 265 Hz
1342	10.00	1.00	-----	-----	-----	-----	93.55	Surged full length of screen
1347	15.00	1.67	6.95	12.60	1568	>1000	93.45	Purging @ 335 Hz
1350	20.00	2.50	-----	-----	-----	-----	95.70	Purging @ 335 Hz
1352	25.00	2.50	6.97	12.90	1525	>1000	96.00	Purging @ 335 Hz
1354	30.00	1.67	-----	-----	-----	-----	-----	Purging @ 390 Hz
1357	38.00	-----	-----	-----	-----	-----	-----	Generator runs out of gas while purging
1402	38.00	-----	-----	-----	-----	-----	-----	Resume purging @ 395 Hz
1404	40.00	-----	-----	-----	-----	-----	-----	Generator breaks down
1405	40.00	3.00	-----	-----	-----	-----	-----	Resume purging @ 390 Hz
1408	49.00	3.00	7.06	13.00	1469	265	98.53	Purging @ 390 Hz
1418	79.00	3.00	7.01	13.20	1470	44.3	96.90	Surged full length of screen
1423	94.00	3.00	7.04	12.60	1467	33.4	-----	-----
1432	121.00	3.00	7.05	12.60	1469	11.9	97.40	End of Well Development
1446	-----	-----	-----	-----	-----	-----	91.81	-----

WELL DEVELOPMENT FORM

Well ID P-9
Diameter (in): 2
Initial Static DTW (ft): 105.81
Total Depth Before Development (ft): 146.80
Total Depth After Development (ft): 146.80
Casing Volume (g): 6.68
Casing Vol. = (Total Well Depth - Static DTW) X 0.163

Date: 10/13/2010
Developed By: BB & LW
Purge Method: Grundfos Pump
Total Gallons Removed: 70.0
Well Volumes Removed: 10.48

Time	Gallons Purged	Flow gpm	pH	Temp. (°C)	Cond. (uS)	Turb.	DTW	Comments
1501	Initial	1.30	7.12	14.90	1605	>1000	105.81	Begin Well Development using Grundfos Pump @ 234 Hz
1504	4.00	0.50	-----	-----	-----	-----	-----	Surged full length of screen; Water: brown
1506	5.00	2.50	7.07	13.70	1367	>1000	107.01	Purging @ 304 Hz
1508	10.00	2.50	7.09	13.10	1289	-----	-----	Flow Rate = 2.50 gpm
1510	15.00	2.50	-----	-----	-----	-----	110.35	-----
1512	20.00	2.50	-----	-----	-----	-----	-----	Purging @ 390 Hz (max)
1514	25.00	3.00	-----	-----	-----	-----	110.89	-----
1517	34.00	3.00	7.09	13.10	1269	982	-----	-----
1524	55.00	3.00	7.11	13.10	1275	588	111.11	Surged full length of screen
1529	70.00	3.00	7.11	13.00	1270	46.7	111.25	Surged full length of screen; Water: clear; End of Development

WELL DEVELOPMENT FORM

Well ID P-1S
Diameter (in): 2
Initial Static DTW (ft): 135.96
Total Depth Before Development (ft): 138.23
Total Depth After Development (ft): 138.23
Casing Volume (g): 0.37
Casing Vol. = (Total Well Depth - Static DTW) X 0.163

Date: 10/11/2010
Developed By: DC, BB, & LW
Purge Method: Disposable Bailer
Total Gallons Removed: 0.8
Well Volumes Removed: 2.16

Time	Gallons Purged	Flow gpm	pH	Temp. (°C)	Cond. (uS)	Turb.	DTW	Comments
1538	Initial	-----	7.38	13.70	4220	174.0	135.96	Begin Well Development using Disposable Bailer
1602	0.75	-----	-----	-----	-----	-----	DRY	-----
1640	0.75	-----	-----	-----	-----	-----	137.71	Water Level Check
10/14/2010								
1522	0.75	-----	7.85	12.40	4380	>1000	137.58	Resume Well Development using Disposable Bailer
1532	0.80	-----	-----	-----	-----	-----	DRY	Removed 1/4 of a bailer; DRY; End of Well Development

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WELL DEVELOPMENT FORM

Well ID P-2S
Diameter (in): 2
Initial Static DTW (ft): 51.32
Total Depth Before Development (ft): 65.59
Total Depth After Development (ft): 65.59
Casing Volume (g): 2.33
Casing Vol. = (Total Well Depth - Static DTW) X 0.163

Date: 10/12/2010
Developed By: BB & LW
Purge Method: Grundfos Pump
Total Gallons Removed: 23.5
Well Volumes Removed: 10.09

Time	Gallons Purged	Flow gpm	pH	Temp. (°C)	Cond. (uS)	Turb.	DTW	Comments
1035	Initial	1.25	7.01	12.40	1345	191	50.90	Begin Well Development using Grundfos Pump @ 176 Hz
1039	5.00	0.45	7.07	13.00	1331	>1000	57.57	Surged full length of screen; Water: cloudy
1050	10.00	0.38	7.06	14.20	1361	296	56.21	-----
1103	15.00	0.25	7.03	14.60	1367	288	56.21	Surged full length of screen
1105	15.50	0.50	-----	-----	-----	-----	-----	-----
1109	17.50	0.50	7.02	14.30	1345	32.3	-----	Surged full length of screen
1116	21.00	0.50	7.01	13.70	1350	39.0	56.75	-----
1121	23.50	0.50	7.02	14.40	1336	6.88	55.69	End of Well Development

WELL DEVELOPMENT FORM

Well ID P-3S
Diameter (in): 2
Initial Static DTW (ft): 88.87
Total Depth Before Development (ft): 116.76
Total Depth After Development (ft): 116.76
Casing Volume (g): 4.55
Casing Vol. = (Total Well Depth - Static DTW) X 0.163

Date: 10/13/2010
Developed By: BB & LW
Purge Method: Grundfos Pump
Total Gallons Removed: 7.0
Well Volumes Removed: 1.54

Time	Gallons Purged	Flow gpm	pH	Temp. (°C)	Cond. (uS)	Turb.	DTW	Comments
849	Initial	1.00	7.27	10.90	3610	>1000	88.87	Begin Well Development using Grundfos Pump @ 252 Hz
854	5.00	0.63	7.18	12.50	3790	>1000	112.30	Purging @ 239 Hz; Water: cloudy; Surged full length of screen
856	6.25	-----	-----	-----	-----	-----	DRY	DRY
1052	6.25	0.30	7.23	12.30	3940	>1000	110.51	110.51
1056	7.00	-----	-----	-----	-----	-----	DRY	DRY; End of Well Development

WELL DEVELOPMENT FORM

Well ID **P-5S**

Diameter (in): 2

Initial Static DTW (ft): 63.50

Total Depth Before Development (ft): 67.03

Total Depth After Development (ft): 67.03

Casing Volume (g): 0.58

Casing Vol. = (Total Well Depth - Static DTW) X 0.163

Date: 10/11/2010

Developed By: BB & LW

Purge Method: Disposable Bailer

Total Gallons Removed: 5.75

Well Volumes Removed: 9.91

Time	Gallons Purged	Flow gpm	pH	Temp. (°C)	Cond. (uS)	Turb.	DTW	Comments
1341	Initial	-----	6.93	11.50	1615	187	63.50	Begin Well Development using Disposable Bailer
1356	1.50	-----	7.02	12.10	1627	277	-----	-----
1430	3.00	-----	7.08	12.10	1684	110	-----	-----
1432	3.25	-----	-----	-----	-----	-----	DRY	DRY
10/14/2010								
1630	3.25	-----	7.60	11.30	1519	94.9	63.54	Resume Well Development using Disposable Bailer; Water: Clear
1649	5.75	-----	-----	10.90	1466	72.9	65.52	DRY; End of Well Development

WELL DEVELOPMENT FORM

Well ID P-6S
Diameter (in): 2
Initial Static DTW (ft): 62.51
Total Depth Before Development (ft): 82.83
Total Depth After Development (ft): 82.83
Casing Volume (g): 3.31
Casing Vol. = (Total Well Depth - Static DTW) X 0.163

Date: 10/13/2010
Developed By: BB & LW
Purge Method: Grundfos Pump
Total Gallons Removed: 11.0
Well Volumes Removed: 3.32

Time	Gallons Purged	Flow gpm	pH	Temp. (°C)	Cond. (uS)	Turb.	DTW	Comments
1155	Initial	0.67	7.08	11.80	3710	>1000	62.51	Begin Well Development using Grundfos Pump @ 211 Hz
1158	2.00	0.34	-----	-----	-----	-----	-----	Surged full length of screen; Water: cloudy
1207	5.00	0.21	7.08	14.00	3660	>1000	80.15	Surged full length of screen; Purging @ 203 Hz
1214	6.50	-----	-----	-----	-----	-----	DRY	DRY
1406	6.50	0.56	7.09	13.10	3330	>1000	65.78	Resumed Purging @ 194 Hz; Water: cloudy
1414	11.00	-----	7.08	16.00	3250	>1000	DRY	Surged full length of screen; End of Well Development

WELL DEVELOPMENT FORM

Well ID P-9S
Diameter (in): 2
Initial Static DTW (ft): 69.73
Total Depth Before Development (ft): 83.20
Total Depth After Development (ft): 83.20
Casing Volume (g): 2.20
Casing Vol. = (Total Well Depth - Static DTW) X 0.163

Date: 10/13/2010
Developed By: BB & LW
Purge Method: Grundfos Pump
Total Gallons Removed: 3.50
Well Volumes Removed: 1.59

Time	Gallons Purged	Flow gpm	pH	Temp. (°C)	Cond. (uS)	Turb.	DTW	Comments
1553	Initial	1.00	7.19	14.20	3490	>1000	69.73	Begin Well Development using Grundfos Pump
1555	2.00	0.50	-----	-----	-----	-----	-----	Surged full length of screen; Water: medium-brown
1557	3.00	0.50	-----	-----	-----	-----	78.81	-----
1558	3.00	-----	-----	-----	-----	-----	DRY	DRY
10/14/2010								
928	3.00	0.13	7.70	11.70	3490	>1000	77.42	Resumed purging; Surged full length of screen
932	3.50	-----	-----	-----	-----	-----	DRY	End of Well Development

WELL DEVELOPMENT FORM

Well ID **P-10S**

Diameter (in): 2

Initial Static DTW (ft): 19.09

Total Depth Before Development (ft): 27.34

Total Depth After Development (ft): 27.34

Casing Volume (g): 1.34

Casing Vol. = (Total Well Depth - Static DTW) X 0.163

Date: 10/13/2010

Developed By: BB & LW

Purge Method: Disposable Bailer

Total Gallons Removed: 6.50

Well Volumes Removed: 4.85

Time	Gallons Purged	Flow gpm	pH	Temp. (°C)	Cond. (uS)	Turb.	DTW	Comments
940	Initial	-----	7.20	10.20	1218	25.2	19.09	Begin Well Development using Disposable Bailer; Water: clear
949	3.00	-----	7.13	10.00	1245	-----	-----	Water: light gray
957	4.50	-----	7.14	9.90	1264	-----	DRY	Water: light gray
10/14/2010								
950	4.50	-----	7.67	10.30	1099	26.3	22.57	Resume Well Development using Disposable Bailer; Water: clear
959	6.50	-----	7.65	10.00	1105.00	>1000	-----	Water: dirty brown
1001	6.50	-----	-----	-----	-----	-----	DRY	End of Well Development

WELL DEVELOPMENT FORM

Well ID P-12

Diameter (in): 2

Initial Static DTW (ft): 103.61

Total Depth Before Development (ft): 136.56

Total Depth After Development (ft): 136.56

Casing Volume (g): 5.77

Casing Vol. = (Total Well Depth - Static DTW) X 0.163

Date: 2/25/2011

Developed By: BB & TM

Purge Method: Disposable Bailer

Total Gallons Removed: 13.00

Well Volumes Removed: 2.25

Time	Gallons Purged	Flow gpm	pH	Temp. (°C)	Cond. (uS)	Turb.	DTW	Comments
936	Initial	-----	7.52	9.40	1379	737	103.61	Begin Well Development using Disposable Bailer; Water: Dark Gray
955	2.50	-----	7.34	9.00	1380.00	685	118.45	Water: Dark Gray
1024	5.00	-----	7.36	8.50	1358	>1000	127.07	Water: Brown
1029	5.00	-----	-----	-----	-----	-----	126.54	-----
1048	5.00	-----	-----	-----	-----	-----	125.61	-----
1110	7.50	-----	7.50	9.00	1391	>1000	128.32	Water: Brown
1136	10.00	-----	7.48	9.60	1444	>1000	131.50	-----
1158	12.00	-----	-----	-----	-----	-----	DRY	DRY
1323	12.00	-----	-----	-----	-----	-----	133.39	Well Recharges for 1 hour and 25 minutes
1342	13.00	-----	7.67	8.00	1362	>1000	135.69	DRY; End of Well Development

WELL DEVELOPMENT FORM

Well ID P-12S
Diameter (in): 2
Initial Static DTW (ft): 66.52
Total Depth Before Development (ft): 83.70
Total Depth After Development (ft): 83.70
Casing Volume (g): 2.80
Casing Vol. = (Total Well Depth - Static DTW) X 0.163

Date: 3/29/2011
Developed By: BB & TM
Purge Method: Grundfos Pump
Total Gallons Removed: 69.25
Well Volumes Removed: 24.73

Time	Gallons Purged	Flow gpm	pH	Temp. (°C)	Cond. (uS)	Turb.	DTW	Comments
1011	Initial	---	6.44	13.10	2170	>1000	66.52	Begin Well Development; Water: Gray, very silty
1016	3.00	0.60	6.72	11.10	3030.00	>1000	71.07	Surged full length of screen
1021	6.00	0.60	6.74	13.00	2880	>1000	72.29	Water: Light gray, high silt content
1026	8.00	---	---	-----	-----	-----	-----	Control box malfunction, restart pump; Surge full length of screen
1029	10.00	---	6.70	13.00	2990	>1000	72.28	-----
1034	12.00	0.40	6.74	11.40	3090	>1000	75.09	-----
10.37	15.00	1.00	-----	-----	-----	-----	78.50	Water light gray, silt content slowly decreasing
1040	16.00	0.33	---	-----	-----	-----	DRY	Water level below top of pump; stop test to allow well to recharge
1042	16.75	---	6.73	11.40	3130	>1000	72.11	Restart Test
1045	20.00	1.08	6.69	11.40	3160	>1000	75.63	Surged full length of screen
1048	22.50	0.83	6.71	11.70	3110	>1000	78.66	-----
1053	27.50	1.00	6.71	12.10	3090	>1000	81.35	-----
1058	28.50	0.20	6.73	11.40	3140	535	-----	Water level below top of pump
1103	-----	-----	-----	-----	-----	-----	DRY	Water level below top of pump; stop test to allow well to recharge
1105	RESTART TEST							
1110	32.50	-----	6.69	11.50	3140	>1000	78.02	Surged full length of screen
1113	35.50	1.00	6.68	12.10	3130	>1000	79.31	-----
1116	38.50	1.00	6.71	12.70	3140	253	76.25	-----
1119	40.00	0.50	6.70	13.00	3080	132	74.60	Water: Clear, Noticeable Sulfuric Odor
1122	42.25	0.75	6.70	12.50	3100	98.6	74.60	-----
1125	44.50	0.75	6.70	13.00	3100	104	74.60	-----
1128	46.75	0.75	6.71	12.60	3130	39.7	74.60	End well development; Begin Max Yield
1134	46.75	0.75	NA	NA	NA	NA	80.64	
1135	47.50	0.75	NA	NA	NA	NA	80.57	
1136	48.25	0.75	NA	NA	NA	NA	80.52	
1137	49.00	0.75	NA	NA	NA	NA	80.48	
1138	49.75	0.75	NA	NA	NA	NA	80.40	
1139	50.50	0.75	NA	NA	NA	NA	80.42	
1140	51.25	0.75	NA	NA	NA	NA	80.50	
1141	52.00	0.75	NA	NA	NA	NA	80.52	
1142	52.75	0.75	NA	NA	NA	NA	80.55	
1143	53.50	0.75	NA	NA	NA	NA	80.54	
1144	54.25	0.75	NA	NA	NA	NA	80.51	
1145	55.00	0.75	NA	NA	NA	NA	80.56	
1146	55.75	0.75	NA	NA	NA	NA	80.61	
1204	69.25	0.75	NA	NA	NA	NA	80.66	

WELL DEVELOPMENT FORM

Well ID P-1L
Diameter (in): 2
Initial Static DTW (ft): 95.89
Total Depth Before Development (ft): 101.31
Total Depth After Development (ft): 101.31
Casing Volume (g): 0.88
Casing Vol. = (Total Well Depth - Static DTW) X 0.163

Date: 10/11/2010
Developed By: BB & LW
Purge Method: Disposable Bailer
Total Gallons Removed: 4.30
Well Volumes Removed: 4.89

Time	Gallons Purged	Flow gpm	pH	Temp. (°C)	Cond. (uS)	Turb.	DTW	Comments
1557	Initial	-----	6.72	13.60	4440	>1000	95.89	Begin Well Development using Disposable Bailer
1606	1.25	-----	6.96	13.80	4430	>1000	-----	-----
1611	2.25	-----	-----	-----	-----	-----	DRY	DRY
1644	2.25	-----	-----	-----	-----	-----	100.15	-----
1650	2.30	-----	6.85	13.40	4470	>1000	DRY	DRY - Removed 1/2 bailer
10/14/2010								
1540	2.30	-----	7.01	12.30	4530	>1000	96.91	Resumed Well Development; Water: cloudy
1613	4.30	-----	-----	-----	-----	-----	DRY	Only removing 1/2 bailers; End of Well Development

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WELL DEVELOPMENT FORM

Well ID P-2L

Diameter (in): 2

Initial Static DTW (ft): 14.27

Total Depth Before Development (ft): 33.02

Total Depth After Development (ft): 33.02

Casing Volume (g): 3.06

Casing Vol. = (Total Well Depth - Static DTW) X 0.163

Date: 10/12/2010

Developed By: BB & LW

Purge Method: Grundfos Pump

Total Gallons Removed: 41.25

Well Volumes Removed: 13.48

Time	Gallons Purged	Flow gpm	pH	Temp. (°C)	Cond. (uS)	Turb.	DTW	Comments
918	Initial	0.56	6.38	12.00	1689	210	14.27	Begin Well Development using Grundfos Pump; Generator breaks down
927	5.00	1.67	6.33	11.90	1692	551	16.03	Resume purging @ 121 Hz; Water: brown
930	10.00	1.00	-----	-----	-----	-----	-----	Surged full length of screen
935	15.00	1.25	6.36	11.90	1718	559	16.30	-----
939	20.00	0.63	-----	-----	-----	-----	-----	-----
941	21.25	1.25	-----	-----	-----	-----	16.39	Surged full length of screen
946	27.50	1.25	6.33	12.00	1725	174.0	-----	Water: clear
952	35.00	1.25	6.33	12.20	1722	35.1	16.48	Surged full length of screen
957	41.25	1.25	6.33	12.80	1709	121	16.89	End of Well Development

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WELL DEVELOPMENT FORM

Well ID P-3L
Diameter (in): 2
Initial Static DTW (ft): 57.78
Total Depth Before Development (ft): 75.04
Total Depth After Development (ft): 75.04
Casing Volume (g): 2.81
Casing Vol. = (Total Well Depth - Static DTW) X 0.163

Date: 10/12/2010
Developed By: BB & LW
Purge Method: Grundfos Pump
Total Gallons Removed: 31.50
Well Volumes Removed: 11.21

Time	Gallons Purged	Flow gpm	pH	Temp. (°C)	Cond. (uS)	Turb.	DTW	Comments
1455	Initial	1.00	7.02	13.10	3870	>1000	57.78	Begin Well Development using Grundfos Pump @ 195 Hz
1500	5.00	0.56	6.96	13.80	3620	>1000	66.73	Surged full length of screen; Water: brown
1509	10.00	0.45	7.06	14.60	3560	544	68.24	Water: clear
1520	15.00	0.38	6.95	14.60	3530	388	68.95	Surged full length of screen
1533	20.00	0.50	6.87	14.50	3500	>1000	68.16	Purging @ 191 Hz
1538	22.50	0.50	6.96	14.50	3520	>1000	-----	Surged full length of screen
1546	26.50	0.50	6.92	14.50	3490	22.2	68.15	Water: clear
1551	29.00	0.50	6.96	14.60	3490	9.55	-----	-----
1556	31.50	0.50	6.95	14.70	3450	11.2	68.16	End of Well Development

WELL DEVELOPMENT FORM

Well ID P-5L
Diameter (in): 2
Initial Static DTW (ft): 35.19
Total Depth Before Development (ft): 40.26
Total Depth After Development (ft): 40.26
Casing Volume (g): 0.83
Casing Vol. = (Total Well Depth - Static DTW) X 0.163

Date: 10/11/2010
Developed By: DC, BB, & LW
Purge Method: Disposable Bailer
Total Gallons Removed: 6.75
Well Volumes Removed: 8.13

Time	Gallons Purged	Flow gpm	pH	Temp. (°C)	Cond. (uS)	Turb.	DTW	Comments
1259	Initial	-----	-----	-----	-----	-----	40.26	Begin Well Development using Disposable Bailer
1310	2.00	-----	6.82	11.60	3290	>1000	-----	-----
1316	2.50	-----	6.66	12.20	3210	>1000	DRY	Purged Dry
1445	2.50	-----	-----	-----	-----	-----	35.92	Water percolated through minespoil during P-5 purging
1451	3.00	-----	6.61	12.90	3190	174	-----	-----
1457	4.75	-----	-----	-----	-----	-----	DRY	-----
10/14/2010								
1720	4.75	-----	6.92	10.40	1932	35.80	35.22	Resume Well Development using Disposable Bailer
1734	6.75	-----	-----	-----	-----	-----	-----	Dry; End of Well Development

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WELL DEVELOPMENT FORM

Well ID **P-6L**
Diameter (in): 2
Initial Static DTW (ft): 32.52
Total Depth Before Development (ft): 40.00
Total Depth After Development (ft): 40.00
Casing Volume (g): 1.22
Casing Vol. = (Total Well Depth - Static DTW) X 0.163

Date: 10/13/2010
Developed By: BB & LW
Purge Method: Disposable Bailer
Total Gallons Removed: 5.00
Well Volumes Removed: 4.10

Time	Gallons Purged	Flow gpm	pH	Temp. (°C)	Cond. (uS)	Turb.	DTW	Comments
1154	Initial	-----	7.12	11.30	3030	9.79	32.52	Begin Well Development using Disposable Bailer; Water: clear
1204	2.00	-----	7.05	10.90	3750	-----	-----	Water: light brown
1206	2.50	-----	-----	-----	-----	-----	DRY	DRY
1356	2.50	-----	-----	-----	-----	-----	38.57	Water Level Check
10/14/2010								
1751	2.50	-----	7.23	10.30	3800	-----	32.70	Resume Well Development; Water: clear
1815	5.00	-----	-----	-----	-----	-----	DRY	End of Well Development

WELL DEVELOPMENT FORM

Well ID **P-10L**

Diameter (in): 2

Initial Static DTW (ft): 46.89

Total Depth Before Development (ft): 62.64

Total Depth After Development (ft): 62.64

Casing Volume (g): 2.57

Casing Vol. = (Total Well Depth - Static DTW) X 0.163

Date: 10/14/2010

Developed By: BB & LW

Purge Method: Grundfos Pump

Total Gallons Removed: 63.00

Well Volumes Removed: 24.51

Time	Gallons Purged	Flow gpm	pH	Temp. (°C)	Cond. (uS)	Turb.	DTW	Comments
837	Initial	0.67	6.88	11.60	4310	>1000	46.89	Begin Well Development using Grundfos Pump; Water: light brown
840	2.00	-----	-----	-----	-----	-----	46.05	Surged full length of screen
840	2.50	0.83	6.78	12.80	4240	>1000	-----	-----
843	5.00	3.33	6.82	12.80	4160	>1000	47.00	Water: very light brown
846	15.00	1.67	6.94	12.80	4110	>1000	47.90	Flow rate = 2.25 gpm; Surged full length of screen
849	20.00	5.00	6.96	12.80	4090	>1000	-----	-----
850	25.00	5.00	6.89	13.00	4080	-----	47.96	Water: clear
852	35.00	4.00	6.87	12.80	4090	135	41.25	Purging @ 337 Hz (max); Surged full length of screen
857	55.00	4.00	6.89	13.00	4060	201	-----	-----
859	63.00	4.00	6.87	13.00	4050	20.8	48.15	Water: clear; End of Well Development

WELL DEVELOPMENT FORM

Well ID P-11L
Diameter (in): 2
Initial Static DTW (ft): 50.96
Total Depth Before Development (ft): 53.69
Total Depth After Development (ft): 53.69
Casing Volume (g): 0.44
Casing Vol. = (Total Well Depth - Static DTW) X 0.163

Date: 10/13/2010
Developed By: BB & LW
Purge Method: Disposable Bailer
Total Gallons Removed: 1.60
Well Volumes Removed: 3.64

Time	Gallons Purged	Flow gpm	pH	Temp. (°C)	Cond. (uS)	Turb.	DTW	Comments
1328	Initial	-----	7.36	11.90	1370	154	50.96	Begin Well Development using Disposable Bailer; Water: clear
1337	1.50	-----	7.34	11.60	1713	-----	DRY	Water: light brown; DRY
10/14/2010								
1353	1.50	-----	-----	-----	-----	-----	52.94	Resumed Well Development using Disposable Bailer
1401	1.60	-----	8.48	11.80	1296	273	DRY	End of Well Development

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WELL DEVELOPMENT FORM

Well ID **P-1A**

Diameter (in): 2

Initial Static DTW (ft): 46.32

Total Depth Before Development (ft): 47.50

Total Depth After Development (ft): 49.95

Casing Volume (g): 0.19

Casing Vol. = (Total Well Depth - Static DTW) X 0.163

Date: 10/14/2010

Developed By: BB & LW

Purge Method: Disposable Bailer

Total Gallons Removed: 1.00

Well Volumes Removed: 5.21

Time	Gallons Purged	Flow gpm	pH	Temp. (°C)	Cond. (uS)	Turb.	DTW	Comments
1305	Initial	-----	7.12	12.10	4580	>1000	46.32	Begin Well Development using Disposable Bailer; Water: dark brown
1311	0.50	-----	-----	-----	-----	-----	DRY	DRY
10/15/2010								
850	0.50	-----	7.10	10.90	4550	231.00	46.37	Resume Well Development using Disposable Bailer; Water: cloudy/ clear
858	1.00	-----	-----	-----	-----	-----	DRY	End of Well Development

WELL DEVELOPMENT FORM

Well ID P-2A
Diameter (in): 2
Initial Static DTW (ft): 9.25
Total Depth Before Development (ft): 15.79
Total Depth After Development (ft): 15.79
Casing Volume (g): 1.07
Casing Vol. = (Total Well Depth - Static DTW) X 0.163

Date: 10/12/2010
Developed By: BB & LW
Purge Method: Disposable Bailer/ Grundfos Pump
Total Gallons Removed: 28.75
Well Volumes Removed: 26.87

Time	Gallons Purged	Flow gpm	pH	Temp. (°C)	Cond. (uS)	Turb.	DTW	Comments
858	Initial	-----	6.34	14.50	1808	210	9.25	Begin Well Development using Disposable Bailer
930	2.50	-----	6.41	14.00	1796	Out of Range	-----	Water: medium brown
951	5.00	-----	6.48	14.00	1796	Out of Range	-----	Water: medium brown
1003	7.50	-----	6.49	13.80	1782	Out of Range	-----	Water: medium brown
1010	10.00	-----	6.48	13.70	1762	Out of Range	-----	Water: medium brown
1017	12.50	-----	6.50	13.70	1774.00	Out of Range	-----	Water: light brown
1032	15.50	-----	6.53	13.90	1759	Out of Range	-----	Water: light brown
1041	18.50	-----	6.56	13.80	1768	Out of Range	-----	Water: light brown
1053	21.00	-----	6.49	14.60	1765	Out of Range	10.43	Water: light brown
10/14/2010								
1202	Initial	0.42	6.79	15.20	1676	>1000	9.27	Resume Well Development using Grundfos Pump @ 78 Hz; Water: brown
1208	2.50	0.83	-----	-----	-----	-----	11.69	Surged full length of screen; Purging @ 74 Hz
1212	5.00	0.25	6.67	15.30	1631	93.5	11.61	-----
1213	5.25	0.25	-----	-----	-----	-----	-----	-----
1218	6.50	0.25	6.63	14.9	1608	15.1	10.85	Surged full length of screen
1223	7.75	0.25	6.65	14.3	1614	273	-----	End of Well Development

WELL DEVELOPMENT FORM

Well ID P-3A
Diameter (in): 2
Initial Static DTW (ft): 51.14
Total Depth Before Development (ft): 56.39
Total Depth After Development (ft): 56.39
Casing Volume (g): 0.85
Casing Vol. = (Total Well Depth - Static DTW) X 0.163

Date: 10/12/2010
Developed By: BB & LW
Purge Method: Disposable Bailer
Total Gallons Removed: 2.25
Well Volumes Removed: 2.65

Time	Gallons Purged	Flow gpm	pH	Temp. (°C)	Cond. (uS)	Turb.	DTW	Comments
1438	Initial	-----	7.14	12.60	4160	Out of Range	56.39	Begin Well Development using Disposable Bailer; Very sludgy on bottom
1446	1.25	-----	-----	-----	-----	-----	DRY	DRY
1536	1.25	-----	7.17	12.70	3900	-----	DRY	Recharged Parameter; DRY
10/15/2010								
931	1.25	-----	7.16	11.10	4020	701	51.18	Resume Well Development using Disposable Bailer; Water: light brown
942	2.25	-----	-----	-----	-----	-----	DRY	Water: very dark brown; DRY; End of Well Development

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WELL DEVELOPMENT FORM

Well ID P-4L
Diameter (in): 2
Initial Static DTW (ft): 40.07
Total Depth Before Development (ft): 54.00
Total Depth After Development (ft): 54.97
Casing Volume (g): 2.27
Casing Vol. = (Total Well Depth - Static DTW) X 0.163

Date: 10/12/2010
Developed By: BB & LW
Purge Method: Disposable Bailer/ Grundfos Pump
Total Gallons Removed: 121.00
Well Volumes Removed: 53.30

Time	Gallons Purged	Flow gpm	pH	Temp. (°C)	Cond. (uS)	Turb.	DTW	Comments
1219	Initial	-----	6.65	12.90	4050	>1000	40.07	Begin Well Development using Disposable Bailer; Water: dark brown
1227	2.50	-----	6.77	12.50	4000	>1000	-----	-----
1235	5.00	-----	6.78	12.60	4100	>1000	-----	-----
1243	7.50	-----	6.78	12.30	4070	>1000	-----	-----
1250	10.00	-----	6.78	12.50	4050	>1000	-----	-----
1252	10.50	-----	-----	-----	-----	-----	40.17	-----
1305	13.50	-----	6.88	12.50	4090	>1000	-----	-----
1313	16.00	-----	6.81	12.20	4080	>1000	-----	Water: medium brown
1321	18.50	-----	6.79	12.00	4050	>1000	-----	Water: medium brown
1329	21.00	-----	6.77	12.40	4050	>1000	40.14	Sludge on bottom of well
10/14/2010								
1104	Initial	-----	7.00	12.00	4010	>1000	40.15	Resume Well Development using Grundfos Pump; Water: very dark brown
1107	3.00	-----	6.90	11.90	4040	>1000	40.15	Surged full length of screen; Water: very dark brown
1111	15.00	-----	-----	-----	-----	-----	40.14	Purging @ 352 Hz (max)
1116	40.00	5.00	6.88	12.6	3980	>1000	40.20	Surged full length of screen
1121	65.00	5.00	6.86	12.7	4020	>1000	-----	Surged full length of screen
1126	90.00	5.00	6.87	12.6	4000	>1000	-----	-----
1128	100.00	5.00	-----	-----	-----	-----	-----	End of Well Development

WELL DEVELOPMENT FORM

Well ID **P-5A**

Diameter (in): 2

Initial Static DTW (ft): 19.41

Total Depth Before Development (ft): 23.51

Total Depth After Development (ft): 23.51

Casing Volume (g): 0.69

Casing Vol. = (Total Well Depth - Static DTW) X 0.163

Date: 10/11/2010

Developed By: BB & LW

Purge Method: Disposable Bailer

Total Gallons Removed: 3.25

Well Volumes Removed: 4.71

Time	Gallons Purged	Flow gpm	pH	Temp. (°C)	Cond. (uS)	Turb.	DTW	Comments
1319	Initial	-----	6.43	12.10	3220	79.2	19.41	Begin Well Development using Disposable Bailer
1325	1.50	-----	6.46	11.90	1999	79.2	-----	-----
1440	1.75	-----	6.66	13.10	3200	>1000	DRY	DRY
10/14/2010								
1704	1.75	-----	6.75	11.00	3210	10.80	19.57	Resume Well Development using Disposable Bailer
1725	3.25	-----	-----	-----	-----	-----	DRY	Water: light brown; End of Well Development

WELL DEVELOPMENT FORM

Well ID P-7A

Diameter (in): 2

Initial Static DTW (ft): 31.63

Total Depth Before Development (ft): 40.49

Total Depth After Development (ft): 40.49

Casing Volume (g): 1.44

Casing Vol. = (Total Well Depth - Static DTW) X 0.163

Date: 10/13/2010

Developed By: BB & LW

Purge Method: Disposable Bailer

Total Gallons Removed: 3.50

Well Volumes Removed: 2.43

Time	Gallons Purged	Flow gpm	pH	Temp. (°C)	Cond. (uS)	Turb.	DTW	Comments
1306	Initial	-----	6.88	11.70	6280	70.6	31.63	Begin Well Development using Disposable Bailer; Water: clear
1313	2.00	-----	6.99	12.10	5710	>1000	DRY	Water: dark brown
10/14/2010								
1451	2.00	-----	6.16	10.90	5420.00	435	31.55	Resume Well Development using Disposable Bailer; Water: light brown
1502	3.50	-----	-----	-----	-----	-----	DRY	Water: dark brown; End of Well Development

WELL DEVELOPMENT FORM

Well ID P-8A
Diameter (in): 2
Initial Static DTW (ft): 15.41
Total Depth Before Development (ft): 16.61
Total Depth After Development (ft): 16.61
Casing Volume (g): 0.20
Casing Vol. = (Total Well Depth - Static DTW) X 0.163

Date: 10/13/2010
Developed By: BB & LW
Purge Method: Disposable Bailer
Total Gallons Removed: 0.50
Well Volumes Removed: 2.50

Time	Gallons Purged	Flow gpm	pH	Temp. (°C)	Cond. (uS)	Turb.	DTW	Comments
1019	Initial	-----	7.17	11.60	781	>1000	15.41	Begin Well Development using Disposable Bailer; Water: brown/ cloudy
1022	0.50	-----	-----	-----	-----	-----	DRY	DRY
10/14/2010								
1022	0.50	-----	7.74	11.60	673	>1000	16.12	Resume Well Development using Disposable Bailer; Water: dark brown
1032	0.50	-----	-----	-----	-----	-----	-----	Only removed 1/2 bailer; End of Well Development

PUMPING TEST

Site	Total Depth	Measuring Point	Date Test Started	Well ID
APEX	195.00	1284.83	1/27/11	B-12
	Casing Diameter: 4"	Static Water Level: 133.27	Date Test Ended: 1/27/11	Page 1 of 3

Date	Time	Elapsed Time (min)	Water Level (Ft)	Pumping Rate (gpm)	Notes
1/27/11	1242	Initial	133.27	—	—
	1305	1	134.05	1.0 (MAX)	STEP 1
	1306	2	134.10		
	1307	3	134.14		
	1308	4	134.17		
	1309	5	134.18		
	1310	6	134.18		
	1311	7	134.19		
	1312	8	134.20		
	1313	9	134.19		
	1314	10	134.17		
	1315	11	134.16		
	1316	12	134.15		
	1317	13	134.14		
	1318	14	134.14		
	1319	15	134.15		
	1320	16	134.15		
	1321	17	134.15		
	1322	18	134.14		
	1323	19	134.13		
	1324	20	134.13		
	1325	21	134.11		
	1326	22	134.10		
	1327	23	134.10		
	1328	24	134.11		
	1329	25	134.11		
	1330	26	134.12		
	1331	27	134.12		
1/27/11	1332	28	134.13	1.0 (MAX)	STEP 1
	1333	29	134.14		
	1334	30	134.15		
	1335	31	134.15		
	1336	32	134.15		
	1337	33	134.15		
	1338	34	134.15		
	1339	35	134.14		
	1340	36	134.14		
	1341	37	134.14		
	1342	38	134.14		
	1343	39	134.13		
	1344	40	134.13		
	1345	41	134.12		
	1346	42	134.11		
	1347	43	134.10		
	1348	44	134.09		
	1349	45	134.09		
	1350	46	134.09		
	1351	47	134.08		
	1352	48	134.08		
	1353	49	134.08		
	1354	50	134.08		
	1355	51	134.08		
	1356	52	134.07		
	1357	53	134.07		
	1358	54	134.08		
	1359	55	134.09		

* = Max drawdown

PUMPING TEST

Site	Total Depth	Measuring Point	Date Test Started	Well ID
APEX	195.00	1284.83	1/27/11	B-12
	Casing Diameter: 4"	Static Water Level: 133.27	Date Test Ended: 1/27/11	Page 2 of 3

Date	Time	Elapsed Time (min)	Water Level (Ft)	Pumping Rate (gpm)	Notes
1/27/11	1400	56	134.10	1.0	(MAX)
	1401	57	134.11		STEP 1
	1402	58	134.11		
	1403	59	134.11		
	1404	60	134.12		
	1405	61	134.12		
	1406	62	134.12		
	1407	63	134.12		
	1408	64	134.12		
	1409	65	134.11		
	1410	66	134.12		
	1411	67	134.13		
	1412	68	134.11		
	1413	69	134.09		
	1414	70	134.07		
	1415	71	134.04		
	1416	72	134.08		
	1417	73	134.13		
	1418	74	134.12		
	1419	75	134.10		
	1420	76	134.11		
	1421	77	134.11		
	1422	78	134.12		
	1423	79	134.14		
	1424	80	134.12		
	1425	81	134.11		
	1426	82	134.11		
	1427	83	134.11		
1/27/11	1428	84	134.12	1.0	(MAX)
	1429	85	134.12		STEP 1
	1430	86	134.10		
	1431	87	134.11		
	1432	88	134.11		
	1433	89	134.12		
	1434	90	134.12		
1/28/11	837	NA	133.20	NA	NA
	845	NA	132.90	1 gal/min	325.6 M_2 (MAX)
	—	10 sec	133.10	NA	OFF
	—	20 sec	133.21		OFF
	—	30 sec	133.21		OFF
	—	40 sec	133.21		OFF

OBSERVATION WELLS

Site			Total Depth		Measuring Point		Date Test Started				Pump Test Well ID	
APEX			195.00		1284.83		1/27/11				B-12	
			Casing Diameter		Static Water Level		Date Test Ended				Page 3 of 3	
			4"		133.27		1/27/11					
Observation Well ID	Date	Time	Elapsed Time (min)	Water Level (Ft)	Pumping Rate	Notes: Observation Well ID	Date	Time	Elapsed Time (min)	Water Level (Ft)	Pumping Rate	Notes
P-3A	1/27/11	1249	Initial	50.87	NA	P-3S	1/27/11	1248	Initial	113.70	NA	
		1309	4	50.87				1311	6	113.69		
		1330	25	50.88				1328	23	113.67		
		1344	39	50.90				1346	41	113.68		
		1356	51	50.90				1354	49	113.65		
		1409	64	50.90				1410	65	113.68		
		1418	73	50.88				1417	72	113.66		
P-3L	1/27/11	1250	Initial	57.63	NA							
		1308	3	57.62								
		1332	27	57.63								
		1342	37	57.64								
		1358	53	57.62								
		1407	62	57.63								
		1420	75	57.62								

PUMPING TEST

Site	Total Depth	Measuring Point	Date Test Started	Well ID
APEX	37.55	1260.50	1/27/11	B-402A
	Casing Diameter: 2"	Static Water Level: 32.84	Date Test Ended: 1/27/11	Page 1 of 3

Date	Time	Elapsed Time (min)	Water Level (Ft)	Pumping Rate (gpm)	Notes	Date	Time	Elapsed Time (min)	Water Level (Ft)	Pumping Rate (gpm)	Notes
1/27/11	829	Initial	34.53	—	—	1/27/11	929	28	34.65	1.65	STEP 1
1	902	1	34.53	1.65	STEP 1	1	930	29	34.65	1	1
	903	2	34.56				931	30	34.65		
	904	3	34.59				932	31	34.65		
	905	4	34.62				933	32	34.64		
	906	5	34.62				934	33	34.64		
	907	6	34.62				935	34	34.65		
	908	7	34.63				936	35	34.65		
	909	8	34.65				937	36	34.65		
	910	9	34.65				938	37	34.66		
	911	10	34.66				939	38	34.66		
	912	11	34.62				940	39	34.66		
	913	12	34.60				941	40	34.66		
	914	13	34.62				942	41	34.66		
	915	14	34.63				943	42	34.66		
	916	15	34.63				944	43	34.66		
	917	16	34.64				945	44	34.67		
	918	17	34.64				946	45	34.68		
	919	18	34.64				947	46	34.67		
	920	19	34.65				948	47	34.67		
	921	20	34.69				949	48	34.66		
	922	21	34.76				950	49	34.65		
	923	22	34.69				951	50	34.65		
	924	23	34.66				952	51	34.65		
	925	24	34.66				953	52	34.66		
	926	25	34.66				954	53	34.66		
	927	26	34.65				955	54	34.66		
↓	928	27	34.65	↓	↓	↓	956	55	34.66	↓	↓

* = Max drawdown

PUMPING TEST

Site	Total Depth	Measuring Point	Date Test Started	Well ID
APEX	77.55	1260.50	1/27/11	B-402 A
	Casing Diameter	Static Water Level	Date Test Ended	Page 2 of 3
	2"	32.84	1/27/11	

Date	Time	Elapsed Time (min)	Water Level (Ft)	Pumping Rate (gpm)	Notes
1/27/11	957	56	34.65	1.65	STEP 1
	958	57	34.65		
	959	58	34.64		
	1000	59	34.63		
	1001	60	34.66		
	1002	61	34.71		
	1003	62	34.78		
	1004	63	34.83		
	1005	64	34.79		
	1006	65	34.76		
	1007	66	34.77		
	1008	67	34.77		
	1009	68	34.78		
	1010	69	34.78		
	1011	70	34.78		
	1012	71	34.79		
	1013	72	34.80		
	1014	73	34.78		
	1015	74	34.77		
	1016	75	34.75		
	1017	76	34.74		
	1018	77	34.74		
	1019	78	34.74		
	1020	79	34.75		
	1021	80	34.75		
	1022	81	34.75		
	1023	82	34.74		
	1024	83	34.73		
1/27/11	1025	84	34.73	1.65	STEP 1
	1026	85	34.73		
	1027	86	34.72		
	1028	87	34.71		
	1029	88	34.71		
	1030	89	34.71		
	1031	90	34.72		
1/28/11	1408	—	32.85	—	—
	1418	—	34.72	1.65 gpm	171.2 Hz
		10 sec	33.80	OFF	OFF
		20	33.31		
		30	33.10		
		40	32.99		
		50	32.93		
	1419	60	32.90		
		70	32.88		
		80	32.88		
		90	32.88		

OBSERVATION WELLS

Site			Total Depth		Measuring Point		Date Test Started				Pump Test Well ID	
APEX			37.55		1260.50		1/27/11 0902				B-402A	
			Casing Diameter		Static Water Level		Date Test Ended				Page 3 of 3	
			2"		32.84		1/27/11					
Observation Well ID	Date	Time	Elapsed Time (min)	Water Level (Ft)	Pumping Rate	~~Notes~~ Observation Well ID	Date	Time	Elapsed Time (min)	Water Level (Ft)	Pumping Rate	Notes
P-4A	1/27/11	824	Initial	39.85	NA	B-402S	1/27/11	829	Initial	91.75	NA	
		917	15	39.85				0904	2	91.73		
		937	35	39.85				0920	18	91.75		
		953	51	39.84				0944	42	91.75		
		1009	67	39.85				0958	56	91.75		
P-7A	1/27/11	819	Initial	28.95	NA							
		0910	8	28.93								
		0929	27	28.93								
		0948	46	28.93								
		1002	60	28.93								

PUMPING TEST

Site		Total Depth		Measuring Point		Date Test Started				Well ID	
APEX		15.80		1239.05		1/25/11				P-2A	
		Casing Diameter		Static Water Level		Date Test Ended				Page 1 of 4	
		2"		8.63		1/25/11					
Date	Time	Elapsed Time (min)	Water Level (Ft)	Pumping Rate (gpm)	Notes	Date	Time	Elapsed Time (min)	Water Level (Ft)	Pumping Rate (gpm)	Notes
1/25/11	1317	Initial	8.63	—	—	1/25/11	1360	28	12.96	0.75	STEP 1
1/25/11	1333	1	11.58	0.95	Step 1		1361	29	12.96		
	1334	2	11.61				1362	30	12.96		
	1335	3	11.65				1363	31	12.97		
	1336	4	11.92				1364	32	12.97		
	1337	5	12.21				1365	33	12.97		
	1338	6	12.56				1366	34	12.97		
	1339	7	12.88				1367	35	12.97		
	1340	8	13.05	↓			1368	36	12.98		
	1341	9	12.85	0.75			1369	37	12.98		
	1342	10	12.85				1370	38	12.98		
	1343	11	12.87				1371	39	12.98		
	1344	12	12.91				1372	40	12.98		
	1345	13	12.92				1373	41	12.99		
	1346	14	12.95				1374	42	13.00		
	1347	15	12.96				1375	43	13.00		
	1348	16	12.98				1376	44	13.01		
	1349	17	12.95				1377	45	12.99		
	1350	18	12.94				1378	46	12.99		
	1351	19	12.93				1379	47	12.99		
	1352	20	12.95				1380	48	12.99		
	1353	21	12.95				1381	49	12.99		
	1354	22	12.95				1382	50	12.99		
	1355	23	12.95				1383	51	12.99		
	1356	24	12.95				1384	52	12.98		
	1357	25	12.95				1385	53	12.98		
	1358	26	12.95				1386	54	12.98		
↓	1359	27	12.95	↓	↓	↓	1387	55	12.98	↓	↓

PUMPING TEST

Site	Total Depth	Measuring Point	Date Test Started	Well ID
APEX	15.80	1239.05	1/25/11	P-2A
	Casing Diameter: 2"	Static Water Level: 8.63	Date Test Ended: 1/25/11	Page 2 of 4

Date	Time	Elapsed Time (min)	Water Level (Ft)	Pumping Rate (gpm)	Notes	Date	Time	Elapsed Time (min)	Water Level (Ft)	Pumping Rate (gpm)	Notes
1/25/11	1428	56	12.99	0.75	STEP 1	1/25/11	1456	84	12.99	0.75	STEP 1
	1429	57	12.99				1457	85	12.99		
	1430	58	12.99				1458	86	12.99		
	1431	59	12.99				1459	87	12.99		
	1432	60	12.99				1500	88	12.99		
	1433	61	13.00				1501	89	12.99		
	1434	62	13.00				1502	90	12.99		
	1435	63	13.00								
	1436	64	12.99								
	1437	65	12.99			1/28/11	1245	—	8.71	—	—
	1438	66	12.99			1/28/11	1254	—	12.95	0.75 gpm	98.5 Hz
	1439	67	12.99					10 sec	12.63	OFF	OFF
	1440	68	12.99					20	12.40		
	1441	69	12.99					30	12.22		
	1442	70	12.99					40	12.04		
	1443	71	12.99					50	11.91		
	1444	72	12.99				1255	60	11.65		
	1445	73	12.99					70	11.08		
	1446	74	13.00					80	10.69		
	1447	75	13.00					90	10.32		
	1448	76	13.00					100	10.10		
	1449	77	13.00					110	9.91		
	1450	78	13.00				1256	120	9.75		
	1451	79	13.00					130	9.61		
	1452	80	12.99					140	9.50		
	1453	81	12.99					150	9.42		
	1454	82	12.99					160	9.37		
	1455	83	12.99					170	9.28		

PUMPING TEST

Site	Total Depth	Measuring Point	Date Test Started	Well ID
APEX	15.80	1239.05	1/25/11	P-2A
	Casing Diameter	Static Water Level	Date Test Ended	Page 3 of 4
	2"	8.63	1/25/11	

Date	Time	Elapsed Time ~~(min)~~ sec	Water Level (Ft)	Pumping Rate	Notes	Date	Time	Elapsed Time (min)	Water Level (Ft)	Pumping Rate	Notes
1/28/11	1257	180	9.25	OFF	OFF						
↓	↓	190	9.20	↓	↓						
		200	9.16								
		210	9.12								
		220	9.12								
	↓	230	9.12								
	1258	240	9.13								
	1258	250	9.12								
↓	1435	—	8.72	↓	↓						

OBSERVATION WELLS

Site			Total Depth		Measuring Point		Date Test Started				Pump Test Well ID	
APEX			15.80		1239.05		1/25/11				P-2A	
			Casing Diameter		Static Water Level		Date Test Ended				Page 4 of 4	
			2"		8.63		1/25/11					
Observation Well ID	Date	Time	Elapsed Time (min)	Water Level (Ft)	Pumping Rate	Notes	Date	Time	Elapsed Time (min)	Water Level (Ft)	Pumping Rate	Notes
P-2[redacted]	1/25/11	1318	Initial	15.13	NA							
		1343	10	15.12								
		1349	16	15.12								
		1402	29	15.11								
		1411	38	15.12								
		1422	49	15.12								
		1434	61	15.13								
		1448	75	15.14								
		1458	85	15.14								
P-2S	1/25/11	1319	Initial	49.32	NA							
		1334	1	49.31								
		1342	9	49.32								
		1350	17	49.31								
		1400	27	49.30								
		1412	39	49.31								
		1422	49	49.30								
		1434	61	49.30								
		1448	75	49.29								
		1458	85	49.31								

PUMPING TEST

Site	Total Depth	Measuring Point	Date Test Started	Well ID
APEX	32.90	1238.64	1/27/11	P-2L
	Casing Diameter	Static Water Level	Date Test Ended	Page 1 of 3
	2"	15.18	1/27/11	

Date	Time	Elapsed Time (min)	Water Level (Ft)	Pumping Rate (gpm)	Notes
1/27/11	1048	Initial	15.18	—	—
	1104	1	18.02	1.60	STEP 1
	1105	2	18.03		
	1106	3	18.07		
	1107	4	18.12		
	1108	5	18.21		
	1109	6	18.28		
	1110	7	18.29		
	1111	8	18.30		
	1112	9	18.32		
	1113	10	18.33		
	1114	11	18.37		
	1115	12	18.37		
	1116	13	18.37		
	1117	14	18.40		
	1118	15	18.40	↓	
	1119	16	19.56	4.50	
	1120	17	22.81		
	1121	18	24.57		
	1122	19	26.03		
	1123	20	27.99	↓	
	1124	21	28.90	3.75	
	1125	22	29.22		
	1126	23	29.93		
	1127	24	30.18		↓
*	1128	25	30.19		STEP 2
	1129	26	30.02		
	1130	27	30.01	↓	↓

Date	Time	Elapsed Time (min)	Water Level (Ft)	Pumping Rate (gpm)	Notes
1/27/11	1131	28	30.01	3.75	STEP 2
	1132	29	29.53		
	1133	30	29.68		
	1134	31	29.95		
	1135	32	30.30		
	1136	33	30.47		
	1137	34	30.80		
	1138	35	31.21		
	1139	36	30.15		
	1140	37	31.25		
	1141	38	30.85		
	1142	39	30.32		
	1143	40	29.90		
	1144	41	30.00		
	1145	42	30.27		
	1146	43	30.67		
	1147	44	30.97		
	1148	45	31.08		
	1149	46	31.10		
	1150	47	31.15		
	1151	48	31.30		
	1152	49	31.18		
	1153	50	31.29		
	1154	51	31.15		
	1155	52	30.93		
	1156	53	30.98		
	1157	54	31.18		
	1158	55	31.19	↓	↓

* = Max drawdown

PUMPING TEST

Site	Total Depth	Measuring Point	Date Test Started	Well ID
APEX	32.90	1238.64	1/27/11	P-2L
	Casing Diameter	Static Water Level	Date Test Ended	Page 2 of 3
	2"	15.18	1/27/11	

Date	Time	Elapsed Time (min)	Water Level (Ft)	Pumping Rate (gpm)	Notes
1/27/11	1159	56	31.10	3.75	STEP 2
	1200	57	31.21		
	1201	58	31.16		
	1202	59	30.98		
	1203	60	30.75		
	1204	61	30.61		
	1205	62	30.61		
	1206	63	30.66		
	1207	64	30.72		
	1208	65	30.50		
	1209	66	30.57		
	1210	67	30.68		
	1211	68	30.80		
	1212	69	30.98		
	1213	70	30.89		
	1214	71	30.85		
	1215	72	30.64		
	1216	73	30.75		
	1217	74	30.92		
	1218	75	31.25		
	1219	76	30.91		
	1220	77	30.45		
	1221	78	30.11		
	1222	79	29.65		
	1223	80	28.91		
	1224	81	28.51		
	1225	82	28.62		
	1226	83	28.65		
1/27/11	1227	84	29.06	3.75	STEP 2
	1228	85	29.34		
	1229	86	29.61		
	1230	87	30.00		
	1231	88	30.28		
	1232	89	30.39		
	1233	90	30.57		
1/28/11	1222	—	15.40	—	—
	1226	—	18.32	1.6 gpm	142.7 Hz
	1234	—	30.55	3.75 gpm	271.8 Hz
		10 sec	24.95	OFF	OFF
		20	20.62		
		30	18.35		
		40	17.40		
		50	16.92		
	1235	60	16.75		
		70	16.65		
		80	16.60		
		90	16.54		
		100	16.51		
		110	16.50		
	1236	120	16.49		
	1236	130	16.49		
	1434	—	15.79		

OBSERVATION WELLS

Site			Total Depth		Measuring Point		Date Test Started				Pump Test Well ID	
APEX			32.90		1238.64		1/27/11				P-2L	
			Casing Diameter		Static Water Level		Date Test Ended				Page 3 of 3	
			2"		15.18		1/27/11					
Observation Well ID	Date	Time	Elapsed Time (min)	Water Level (Ft)	Pumping Rate	Notes	Date	Time	Elapsed Time (min)	Water Level (Ft)	Pumping Rate	Notes
P-2A	1/27/11	1044	Initial	8.68	NA							
		1107	3	8.67								
		1129	25	8.68								
		1137	32	8.69								
		1149	44	8.70								
		1159	54	8.70								
		1211	66	8.71								
		1223	78	8.70								
P-2S	1/27/11	1044	Initial	49.57	NA							
		1108	4	49.55								
		1129	25	49.56								
		1139	34	49.54								
		1148	43	49.52								
		1159	54	49.51								
		1210	65	49.49								
		1223	78	49.47								

PUMPING TEST

Site	Total Depth	Measuring Point	Date Test Started	Well ID
Apex	66.44	1238.75	1/26/11	P-25
	Casing Diameter	Static Water Level	Date Test Ended	Page 1 of 4
	2"	49.12	1/26/11	

Date	Time	Elapsed Time (min)	Water Level (Ft)	Pumping Rate (gpm)	Notes
1/26/11	830	Initial	49.12	—	—
	843	1	55.00	0.70	Step 1
	844	2	55.21		
	845	3	55.22		
	846	4	55.23		
	847	5	55.24		
	848	6	55.45	↓	
	849	7	55.42	0.75	
	850	8	55.42		
	851	9	55.44		
	852	10	55.45		
	853	11	55.42		
	854	12	55.39		
	855	13	55.28		
	856	14	55.35		
	857	15	55.49		
	858	16	55.46		
	859	17	55.40		
	900	18	55.40		
	901	19	55.37		
	902	20	55.39	↓	
	903	21	57.83	0.90	
	904	22	58.91		
	905	23	60.11		
	906	24	62.85	↓	
	907	25	63.11	0.70	
	908	26	62.12	0.70	
↓	909	27	62.40	0.75	↓

Date	Time	Elapsed Time (min)	Water Level (Ft)	Pumping Rate (gpm)	Notes
1/26/11	910	28	62.64	0.75	STEP 1
	911	29	62.65		↓
	912	30	62.75		STEP 2 *
	913	31	62.73		
	914	32	62.74		
	915	33	62.77		
	916	34	62.78		
	917	35	62.80		
	918	36	62.82		
	919	37	62.74		
	920	38	62.75		
	921	39	62.81		
	922	40	62.85		
	923	41	62.76		
	924	42	62.78		
	925	43	62.78		
	926	44	62.79		
	927	45	62.86		
	928	46	62.81		
	929	47	62.80		
	930	48	62.81		
	931	49	62.81		
	932	50	62.81		
	933	51	62.81		
	934	52	62.82		
	935	53	62.84		
	936	54	62.85		
↓	937	55	62.87	↓	↓

* = Max drawdown

PUMPING TEST

Site	Total Depth	Measuring Point	Date Test Started	Well ID
APEX	66.44	1238.75	1/26/11	P-2S
	Casing Diameter: 2"	Static Water Level: 49.12	Date Test Ended: 1/26/11	Page 2 of 4

Date	Time	Elapsed Time (min)	Water Level (Ft)	Pumping Rate	Notes	Date	Time	Elapsed Time (min)	Water Level (Ft)	Pumping Rate	Notes
1/26/11	938	56	62.90	0.75	STEP 2	1/26/11	1006	84	62.88	0.75	STEP 2
	939	57	62.82				1007	85	62.88		
	940	58	62.82				1008	86	62.89		
	941	59	62.86				1009	87	62.89		
	942	60	62.87				1010	88	62.89		
	943	61	62.90				1011	89	62.90		
	944	62	62.90				1012	90	62.90		
	945	63	62.86								
	946	64	62.86			1/28/11	1141	—	48.95	—	—
	947	65	62.86				1151	—	55.23	0.75 gpm	184.8 Hz
	948	66	62.87				1158		62.80	0.75 gpm	191.8 Hz
	949	67	62.87					10 sec	62.63	OFF	OFF
	950	68	62.88					20	60.55		
	951	69	62.88					30	59.60		
	952	70	62.88					40	58.92		
	953	71	62.90					50	58.31		
	954	72	62.85				1159	60	57.77		
	955	73	62.85					70	57.27		
	956	74	62.86					80	56.75		
	957	75	62.86					90	56.33		
	958	76	62.87					100	55.90		
	959	77	62.88					110	55.27		
	1000	78	62.90				1200	120	54.78		
	1001	79	62.82					130	54.25		
	1002	80	62.75					140	53.80		
	1003	81	62.80					150	53.40		
	1004	82	62.85					160	53.06		
	1005	83	62.88					170	52.83		

PUMPING TEST

Site	Total Depth	Measuring Point	Date Test Started	Well ID
APEX	66.44	1238.75	1/26/11	P-25
	Casing Diameter	Static Water Level	Date Test Ended	Page 3 of 4
	2"	49.12	1/26/11	

Date	Time	Elapsed Time ~~(min)~~ sec	Water Level (Ft)	Pumping Rate	Notes	Date	Time	Elapsed Time (min)	Water Level (Ft)	Pumping Rate	Notes
1/28/11	1201	180	52.55	OFF	OFF						
		190	52.30								
		200	52.13								
		210	52.06								
		220	51.72								
	↓	230	51.60								
	1202	240	51.45								
		250	51.35								
		260	51.23								
		270	51.16								
		280	51.10								
	↓	290	51.05								
	1203	300	51.00								
	1203	301	50.96								
↓	1433	—	49.61	↓	↓						

OBSERVATION WELLS

Site			Total Depth		Measuring Point		Date Test Started				Pump Test Well ID	
APEX			66.44		1238.75		1/26/11				P-2S	
			Casing Diameter		Static Water Level		Date Test Ended				Page 4 of 4	
			2"		49.12		1/26/11					
Observation Well ID	Date	Time	Elapsed Time (min)	Water Level (Ft)	Pumping Rate	Notes	Date	Time	Elapsed Time (min)	Water Level (Ft)	Pumping Rate	Notes
P-2A	1/26/11	828	Initial	8.55	NA							
		845	2	8.55								
		852	9	8.54								
		912	29	8.54								
		924	41	8.55								
		936	53	8.55								
		949	66	8.54								
		1003	80	8.55								
P-2L	1/26/11	829	Initial	15.04	NA							
		845	2	15.05								
		852	9	15.05								
		912	29	15.05								
		924	41	15.04								
		936	53	15.04								
		949	66	15.03								
		1003	80	15.04								

PUMPING TEST

Site	Total Depth	Measuring Point	Date Test Started	Well ID
APEX	75.07	1279.00	1/26/11	P-3L
	Casing Diameter	Static Water Level	Date Test Ended	Page 1 of 4
	2"	58.11	1/26/11	

Date	Time	Elapsed Time (min)	Water Level (Ft)	Pumping Rate (gpm)	Notes
1/26/11	1236	Initial	58.11	—	—
	1258	1	60.80	0.15	STEP 1
	1259	2	60.81		
	1300	3	60.84		
	1301	4	60.85		
	1302	5	60.89		
	1303	6	60.91		
	1304	7	60.92		
	1305	8	60.94		
	1306	9	60.96		
	1307	10	60.94		
	1308	11	60.91		
	1309	12	60.91		
	1310	13	60.92		
	1311	14	60.93		
	1312	15	60.93	↓	
	1313	16	61.54	0.95	
	1314	17	62.83		
	1315	18	63.75		
	1316	19	65.01		
	1317	20	66.12		
	1318	21	67.53		
	1319	22	69.01		
	1320	23	71.95	↓	↓
*	1321	24	71.61	0.65	STEP 2
	1322	25	71.61		
	1323	26	71.71		
↓	1324	27	71.78	↓	↓

Date	Time	Elapsed Time (min)	Water Level (Ft)	Pumping Rate (gpm)	Notes
1/26/11	1325	28	71.82	0.65	STEP 2
	1326	29	71.87		
	1327	30	71.79		
	1328	31	71.72		
	1329	32	71.73		
	1330	33	71.85		
	1331	34	71.88		
	1332	35	71.89		
	1333	36	71.89		
	1334	37	71.89		
	1335	38	71.91		
	1336	39	71.94		
	1337	40	71.96		
	1338	41	71.99		
	1339	42	71.94		
	1340	43	71.89		
	1341	44	71.90		
	1342	45	71.90		
	1343	46	71.91		
	1344	47	71.91		
	1345	48	71.92		
	1346	49	71.93		
	1347	50	71.95		
	1348	51	71.98		
	1349	52	71.95		
	1350	53	71.92		
	1351	54	71.93		
↓	1352	55	71.93	↓	↓

* = max drawdown

PUMPING TEST

Site	Total Depth	Measuring Point	Date Test Started	Well ID
APEX	75.07	1279.00	1/26/11	P-3L
	Casing Diameter: 2"	Static Water Level: 58.11	Date Test Ended: 1/26/11	Page 2 of 4

Date	Time	Elapsed Time (min)	Water Level (Ft)	Pumping Rate (gpm)	Notes
1/26/11	1353	56	71.94	0.65	STEP 2
	1354	57	71.95		
	1355	58	71.95		
	1356	59	71.97		
	1357	60	71.99		
	1358	61	71.99		
	1359	62	71.99		
	1400	63	72.00		
	1401	64	72.00		
	1402	65	72.01		
	1403	66	72.00		
	1404	67	72.01		
	1405	68	72.03		
	1406	69	72.03		
	1407	70	71.99		
	1408	71	71.98		
	1409	72	71.97		
	1410	73	71.95		
	1411	74	71.95		
	1412	75	71.96		
	1413	76	71.96		
	1414	77	71.99		
	1415	78	71.98		
	1416	79	71.99		
	1417	80	72.01		
	1418	81	72.01		
	1419	82	71.99		
	1420	83	71.98		

Date	Time	Elapsed Time (min)	Water Level (Ft)	Pumping Rate (gpm)	Notes
1/26/11	1421	84	71.97	0.65	STEP 2
	1422	85	71.95		
	1423	86	71.95		
	1424	87	71.97		
	1425	88	71.92		
	1426	89	71.92		
	1427	90	71.92		
1/28/11	1051	—	57.10	—	—
	1100	—	68.43	0.15 gpm	126.7 Hz
	1108	—	72.02	0.65 gpm	209.8 Hz
		10 sec	70.00	OFF	OFF
		20	69.55		
		30	68.95		
		40	68.62		
		50	68.28		
	1109	60	67.74		
		70	67.40		
		80	67.05		
		90	66.72		
		100	66.41		
		110	66.14		
	1110	120	65.93		
		130	65.60		
		140	65.27		
		150	64.96		
		160	64.35		

PUMPING TEST

Site	Total Depth	Measuring Point	Date Test Started	Well ID
APEX	75.07	1279.00	1/26/11	P-3L
	Casing Diameter	Static Water Level	Date Test Ended	Page 3 of 4
	2"	58.11	1/26/11	

Date	Time	Elapsed Time (~~min~~) sec	Water Level (Ft)	Pumping Rate (gpm)	Notes	Date	Time	Elapsed Time (min)	Water Level (Ft)	Pumping Rate	Notes
1/25/11	1110	170	64.00	OFF	OFF						
	1111	180	63.53								
		190	63.15								
		200	62.88								
		210	62.53								
		220	62.31								
	↓	230	62.07								
	1112	240	61.89								
		250	61.72								
		260	61.51								
		270	61.34								
		280	61.21								
	↓	290	61.09								
	1113	300	60.95								
		310	60.85								
		320	60.73								
		330	60.64								
		340	60.53								
	↓	350	60.45								
	1114	360	60.40								
		370	60.28								
		380	60.22								
	↓	390	60.13								
↓	1612	—	57.70	↓	↓						

OBSERVATION WELLS

Site			Total Depth		Measuring Point		Date Test Started				Pump Test Well ID	
APEX			75.07		1279.00		1/26/11				P-3L	
			Casing Diameter		Static Water Level		Date Test Ended				Page 4 of 4	
			2"		58.11		1/26/11					
Observation Well ID	Date	Time	Elapsed Time (min)	Water Level (Ft)	Pumping Rate	~~Notes~~ Observation Well ID	Date	Time	Elapsed Time (min)	Water Level (Ft)	Pumping Rate	Notes
P-3A	1/26/11	1239	Initial	50.87	NA	B-12	1/26/11	1245	Initial	833.11	NA	
		1305	7	50.87				1302	4	133.10		
		1323	25	50.87				1327	29	133.11		
		1341	43	50.87				1345	47	133.12		
		1357	59	50.87				1401	63	133.12		
		1417	79	50.87				1420	82	133.13		
P-3S	1/26/11	1241	Initial	113.68	NA							
		1304	6	113.69								
		1324	26	113.68								
		1341	43	113.68								
		1357	59	113.69								
		1416	78	113.70								

PUMPING TEST

Site	Total Depth	Measuring Point	Date Test Started	Well ID
APEX	54.69	1263.34	1/25/11	P-4A
	Casing Diameter: 2"	Static Water Level: 39.81	Date Test Ended: 1/25/11	Page 1 of 3

Date	Time	Elapsed Time (min)	Water Level (Ft)	Pumping Rate (gpm)	Notes
1/25/11	1547	Initial	39.81	—	—
	1607	1	39.95	4.25	(MAX)
	1608	2	39.90		STEP 1
	1609	3	39.90		
	1610	4	39.90		
	1611	5	39.90		
	1612	6	39.90		
	1613	7	39.90		
	1614	8	39.90		
	1615	9	39.90		
	1616	10	39.90		
	1617	11	39.90		
	1618	12	39.90		
	1619	13	39.90		
	1620	14	39.90		
	164	15	39.90		
	1622	16	39.90		
	1623	17	39.90		
	1624	18	39.90		
	1625	19	39.90		
	1626	20	39.90		
	1627	21	39.90		
	1628	22	39.90		
	1629	23	39.90		
	1630	24	39.90		
	1631	25	39.90		
	1632	26	39.90		
↓	1633	27	39.90	↓	↓

Date	Time	Elapsed Time (min)	Water Level (Ft)	Pumping Rate (gpm)	Notes
1/25/11	1634	28	39.90	4.25	(MAX)
	1635	29	39.91		STEP 1
	1636	30	39.91		
	1637	31	39.91		
	1638	32	39.91		
	1639	33	39.91		
	1640	34	39.91		
	1641	35	39.91		
	1642	36	39.91		
	1643	37	39.91		
	1644	38	39.91		
	1645	39	39.91		
	1646	40	39.91		
	1647	41	39.91		
	1648	42	39.91		
	1649	43	39.91		
	1650	44	39.91		
	1651	45	39.91		
	1652	46	39.91		
	1653	47	39.91		
	1654	48	39.91		
	1655	49	39.91		
	1656	50	39.91		
	1657	51	39.91		
	1658	52	39.91		
	1659	53	39.91		
	1700	54	39.91		
↓	1701	55	39.91	↓	↓

PUMPING TEST

Site	Total Depth	Measuring Point	Date Test Started	Well ID
APEX	54.69	1263.34	1/25/11	P-4A
	Casing Diameter 2"	Static Water Level 39.81	Date Test Ended 1/25/11	Page 2 of 3

Date	Time	Elapsed Time (min)	Water Level (Ft)	Pumping Rate (gpm)	Notes	Date	Time	Elapsed Time (min)	Water Level (Ft)	Pumping Rate (gpm)	Notes
1/25/11	1702	56	39.91	4.25	(MAX)	1/25/11	1730	84	39.91	4.25	(MAX)
	1703	57	39.91		STEP 1		1731	85	39.91		STEP 1
	1704	58	39.91				1732	86	39.91		
	1705	59	39.91				1733	87	39.91		
	1706	60	39.91				1734	88	39.91		
	1707	61	39.91				1735	89	39.91		
	1708	62	39.91				1736	90	39.91		
	1709	63	39.91								
	1710	64	39.91			1/28/11	1346	—	39.83	—	—
	1711	65	39.91				1354	—	39.91	4.25 gpm	353.6 (MAX)
	1712	66	39.91					10 sec	39.87	OFF	OFF
	1713	67	39.91					20	39.87		
	1714	68	39.91					30	39.87		
	1715	69	39.91					40	39.87		
	1716	70	39.91					50	39.87		
	1717	71	39.91				1355	60	39.87		
	1718	72	39.91								
	1719	73	39.91								
	1720	74	39.91								
	1721	75	39.91								
	1722	76	39.91								
	1723	77	39.91								
	1724	78	39.91								
	1725	79	39.91								
	1726	80	39.91								
	1727	81	39.91								
	1728	82	39.91								
	1729	83	39.91								

OBSERVATION WELLS

Site			Total Depth		Measuring Point		Date Test Started				Pump Test Well ID	
APEX			54.69		1263.34		1/25/11				P-4A	
			Casing Diameter		Static Water Level		Date Test Ended				Page 3 of 3	
			2"		39.81		1/25/11					

Observation Well ID	Date	Time	Elapsed Time (min)	Water Level (Ft)	Pumping Rate	~~Notes~~ Observation Well ID	Date	Time	Elapsed Time (min)	Water Level (Ft)	Pumping Rate	Notes
P-10L	1/25/11	1515	Initial	45.57	NA	B-402A	1/25/11	1527	Initial	32.83	NA	
		1617	10	45.57				1611	4	32.85		
		1638	31	45.57				1633	26	32.83		
		1659	52	45.57				1653	46	32.83		
		1716	69	45.58				1707	60	32.83		
		—	—	—				—	—	—		
		—	—	—				—	—	—		
		—	—	—				—	—	—		
		—	—	—				—	—	—		
		—	—	—				—	—	—		
								—	—	—		
B-401	1/25/11	1549	Initial	107.61	N/A	B-402S	1/25/11	1528	Initial	91.73	NA	
		1621	14	107.44				1612	5	91.75		
		1643	36	107.44				1634	27	91.73		
		1703	56	107.44				1651	44	91.74		
		1722	75	107.43				1708	61	91.74		
		—	—	—				—	—	—		
		—	—	—				—	—	—		
		—	—	—				—	—	—		
		—	—	—				—	—	—		
		—	—	—				—	—	—		
		—	—	—				—	—	—		
		—	—	—				—	—	—		

PUMPING TEST

Site	Total Depth	Measuring Point	Date Test Started	Well ID
APEX LANDFILL	127.70	1243.49	1/25/11	P-5
	Casing Diameter: 2"	Static Water Level: 90.48	Date Test Ended: 1/25/11	Page 1 of 4

Date	Time	Elapsed Time (min)	Water Level (Ft)	Pumping Rate (gpm)	Notes
1/25/11	1045	Initial	90.48	—	—
	1116	1	96.50	2.85	STEP 1
	1117	2	97.22		
	1118	3	97.73		
	1119	4	97.31		
	1120	5	96.98		
	1121	6	97.45		
	1122	7	97.55		
	1123	8	97.67		
	1124	9	97.42		
	1125	10	97.64		
	1126	11	97.70		
	1127	12	97.74		
	1128	13	97.65		
	1129	14	97.70		
	1130	15	97.77		
	1131	16	97.80		
	1132	17	97.81	↓	↓
	1133	18	98.00	3.0	(Max)
	1134	19	98.07		STEP 2
	1135	20	98.19		
	1136	21	98.34		
	1137	22	98.38		
	1138	23	98.41		
	1139	24	98.41		
	1140	25	98.43		
	1141	26	98.43		
↓	1142	27	98.46	↓	↓

Date	Time	Elapsed Time (min)	Water Level (Ft)	Pumping Rate (gpm)	Notes
1/25/11	1143	28	98.47	3.0 (max)	STEP 2
	1144	29	98.50		
	1145	30	98.50		
	1146	31	98.55		
	1147	32	98.57		
	1148	33	98.55		
	1149	34	98.57		
	1150	35	98.58		
	1151	36	98.59		
	1152	37	98.60		
	1153	38	98.62		
	1154	39	98.63		
	1155	40	98.66		
	1156	41	98.66		
	1157	42	98.67		
	1158	43	98.68		
	1159	44	98.69		
	1200	45	98.70		
	1201	46	98.71		
	1202	47	98.71		
	1203	48	98.72		
	1204	49	98.75		
	1205	50	98.77		
	1206	51	98.81		
	1207	52	98.80		
	1208	53	98.80		
	1209	54	98.82		
↓	1210	55	98.83	↓	↓

PUMPING TEST

Site	Total Depth	Measuring Point	Date Test Started	Well ID
APEX	127.70	1243.49	1/25/11	P-5
	Casing Diameter: 2"	Static Water Level: 90.48	Date Test Ended: 1/25/11	Page 2 of 4

Date	Time	Elapsed Time (min)	Water Level (Ft)	Pumping Rate (gpm)	Notes	Date	Time	Elapsed Time (min)	Water Level (Ft)	Pumping Rate	Notes
1/25/11	1211	56	98.87	3.0	STEP 2	1/25/11	1239	84	99.06	3.0	STEP2
	1212	57	98.89				1240	85	99.07		
	1213	58	98.92				1241	86	99.08		
	1214	59	98.92				1242	87	99.08		
	1215	60	98.93				1243	88	99.09		
	1216	61	98.95				1244	89	99.10		
	1217	62	98.96				1245	90	99.11		
	1218	63	98.96			↓	1246	91	99.11	↓	↓
	1219	64	98.97								
	1220	65	98.99								
	1221	66	98.99			1/28/11	1004	NA	90.48	—	—
	1222	67	99.00				1010	—	97.01	2.85 gpm	377.2 Hz
	1223	68	99.01				1016		97.61	3.0 gpm	377.7 Hz
	1224	69	99.00				1017		97.64		
	1225	70	98.99				1018		97.68		
	1226	71	99.00				1019		97.70		
	1227	72	99.01				1020	↓	97.71	↓	↓
	1228	73	99.02					5 sec.	95.34	OFF	OFF
	1229	74	99.02					10 sec.	92.30		
	1230	75	99.02					15 sec.	92.25		
	1231	76	99.02					20 sec.	91.0		
	1232	77	99.02					25 sec.	91.85		
	1233	78	99.03					30 sec.	91.81		
	1234	79	99.03					35 sec.	91.80		
	1235	80	99.04				↓	40 sec.	91.77	↓	↓
	1236	81	99.05				1021	100 sec	90.81		
	1237	82	99.05					110 sec	90.78		
↓	1238	83	99.06	↓	↓	↓	↓	120 sec	90.76	↓	↓

PUMPING TEST

Site	Total Depth	Measuring Point	Date Test Started	Well ID
APEX	127.70	1243.49	1/25/11	P-5
	Casing Diameter: 2"	Static Water Level: 90.48	Date Test Ended: 1/25/11	Page 3 of 4

Date	Time	Elapsed Time (min)	Water Level (Ft)	Pumping Rate	Notes	Date	Time	Elapsed Time (min)	Water Level (Ft)	Pumping Rate	Notes
1/25/11		130 sec	90.74	OFF	OFF						
↓		140 sec	90.70	↓	↓						
		150 sec	90.70								
		160 sec	90.71								
	↓	170 sec	90.69								
	1022	180 sec	90.70								
↓	1022	190 sec	90.69	↓	↓						

OBSERVATION WELLS

Site			Total Depth		Measuring Point		Date Test Started				Pump Test Well ID	
APEX LANDFILL			1243.49		1243.49		1/25/11				P-5	
			Casing Diameter		Static Water Level		Date Test Ended				Page 4 of 4	
			2"		90.48		1/25/11					
Observation Well ID	Date	Time	Elapsed Time (min)	Water Level (Ft)	Pumping Rate	Notes	Date	Time	Elapsed Time (min)	Water Level (Ft)	Pumping Rate	Notes
P-5S	1/25/11	1048	Initial	60.11	NA		1/25/11				NA	
		1119	3	60.16								
		1124	8	60.11								
		1133	17	60.12								
		1141	25	60.12								
		1158	42	60.11								
		1207	51	60.11								
		1223	67	60.11								
		1234	78	60.10								
P-5A		1050	Initial	19.05								
		1118	2	19.08								
		1124	8	19.08								
		1132	16	19.07								
		1148	27	19.07								
		1156	40	19.06								
		1209	53	19.06								
		1222	66	19.06								
		1236	80	19.06								

PUMPING TEST

Site	Total Depth	Measuring Point	Date Test Started	Well ID
APEX	148.50	1259.50	1/27/11	P-9
	Casing Diameter: 2"	Static Water Level: 104.35	Date Test Ended: 1/27/11	Page 1 of 3

Date	Time	Elapsed Time (min)	Water Level (Ft)	Pumping Rate (gpm)	Notes
1/27/11	1513	Initial	104.35	—	—
	1538	1	107.91	2.25	STEP 1
	1539	2	108.00		
	1540	3	108.08		
	1541	4	108.19		
	1542	5	108.30		
	1543	6	108.34		
	1544	7	108.39		
	1545	8	108.41		
	1546	9	108.42		
	1547	10	108.42		
	1548	11	108.43		
	1549	12	108.43		
	1550	13	108.44		
	1551	14	108.45		
	1552	15	108.45		
	1553	16	108.46	↓	
	1554	17	108.71	2.50	
	1555	18	108.80		
	1556	19	108.85		
	1557	20	108.83		
	1558	21	108.80		
	1559	22	108.67		
	1600	23	108.55		
	1601	24	108.47		
	1602	25	108.58		
	1603	26	108.72		
↓	1604	27	108.80	↓	↓

Date	Time	Elapsed Time (min)	Water Level (Ft)	Pumping Rate (gpm)	Notes
1/27/11	1605	28	108.83	2.25	STEP 1
	1606	29	108.65		
	1607	30	108.50		
	1608	31	108.37		
	1609	32	108.27		
	1610	33	108.20		
	1611	34	107.79		
	1612	35	107.74		
	1613	36	107.71		
	1614	37	107.61	↓	
	1623	38	107.05	3.0	STEP 2
	1624	39	107.12		
	1625	40	107.11		
	1626	41	107.15		
	1627	42	107.13		
	1628	43	107.31		
	1629	44	107.29		
	1630	45	107.35		
	1631	46	107.39		
	1632	47	107.46		
	1633	48	107.51		
	1634	49	107.53		
	1635	50	107.56		
	1636	51	107.60		
	1637	52	107.65		
	1638	53	107.69		
	1639	54	107.72		
↓	1640	55	107.75	↓	↓

■ = Frequency Drive (Control Box Failure); restarted test @ 1623

PUMPING TEST

Site	Total Depth	Measuring Point	Date Test Started	Well ID
APEX	148.50	1259.50	1/27/11	P-9
	Casing Diameter: 2"	Static Water Level: 104.35	Date Test Ended: 1/27/11	Page 2 of 3

Date	Time	Elapsed Time (min)	Water Level (Ft)	Pumping Rate	Notes	Date	Time	Elapsed Time (min)	Water Level (Ft)	Pumping Rate	Notes
1/27/11	1641	56	107.76	3.0	STEP 2	1/27/11	1709	84	108.35	3.0	STEP 2
	1642	57	107.77				1710	85	108.37		
	1643	58	107.78				1711	86	108.40		
	1644	59	107.79				1712	87	108.41		
	1645	60	107.79				1713	88	108.42		
	1646	61	107.81				1714	89	108.44		
	1647	62	107.89				1715	90	108.45		
	1648	63	107.92								
	1649	64	107.95								
	1650	65	108.01								
	1651	66	108.08								
	1652	67	108.09								
	1653	68	108.10								
	1654	69	108.11								
	1655	70	108.12								
	1656	71	108.12								
	1657	72	108.13								
	1658	73	108.15								
	1659	74	108.17								
	1700	75	108.18								
	1701	76	108.19								
	1702	77	108.22								
	1703	78	108.24								
	1704	79	108.25								
	1705	80	108.26								
	1706	81	108.30								
	1707	82	108.31								
	1708	83	108.33								

OBSERVATION WELLS

Site			Total Depth		Measuring Point		Date Test Started				Pump Test Well ID	
APEX			148.50		1259.50		1/27/11				P-9	
			Casing Diameter		Static Water Level		Date Test Ended				Page 3 of 3	
			2"		104.35		1/27/11					
Observation Well ID	Date	Time	Elapsed Time (min)	Water Level (Ft)	Pumping Rate	Notes	Date	Time	Elapsed Time (min)	Water Level (Ft)	Pumping Rate	Notes
P-9S	1/27/11	1514	Initial	79.48	NA							
		1543	5	79.46								
		1553	15	79.46								
		1603	25	79.46								
		1626	38	79.46								
		1641	53	79.45								
		1658	70	79.46								

PUMPING TEST

Site	Total Depth	Measuring Point	Date Test Started	Well ID
APEX	62.67	1268.83	1/26/11	P-10L
	Casing Diameter: 2"	Static Water Level: 45.57	Date Test Ended: 1/26/11	Page 1 of 3

Date	Time	Elapsed Time (min)	Water Level (Ft)	Pumping Rate (gpm)	Notes
1/26/11	1030	Initial	45.57	—	—
	1047	1	48.74	3.75	STEP 1
	1048	2	48.74		
	1049	3	48.74		
	1050	4	48.75		
	1051	5	48.76		
	1052	6	48.77		
	1053	7	48.77		
	1054	8	48.77		
	1055	9	48.78		
	1056	10	48.78		
	1057	11	48.78		
	1058	12	48.79		
	1059	13	48.78		
	1100	14	48.80		
	1101	15	48.80	↓	↓
	1102	16	50.10	4.50 (MAX)	
*	1103	17	50.20		STEP 2
	1104	18	50.20		
	1105	19	50.20		
	1106	20	50.20		
	1107	21	50.21		
	1108	22	50.20		
	1109	23	50.17		
	1110	24	50.18		
	1111	25	50.19		
	1112	26	50.20		
	1113	27	50.21	↓	↓

Date	Time	Elapsed Time (min)	Water Level (Ft)	Pumping Rate (gpm)	Notes
1/26/11	1114	28	50.20	4.50	STEP 2
	1115	29	50.20		
	1116	30	50.19		
	1117	31	50.19		
	1118	32	50.19		
	1119	33	50.18		
	1120	34	50.18		
	1121	35	50.18		
	1122	36	50.17		
	1123	37	50.16		
	1124	38	50.16		
	1125	39	50.18		
	1126	40	50.20		
	1127	41	50.20		
	1128	42	50.20		
	1129	43	50.20		
	1130	44	50.20		
	1131	45	50.21		
	1132	46	50.20		
	1133	47	50.18		
	1134	48	50.16		
	1135	49	50.16		
	1136	50	50.15		
	1137	51	50.15		
	1138	52	50.16		
	1139	53	50.16		
	1140	54	50.16		
	1141	55	50.17	↓	↓

* = Max Drawdown

PUMPING TEST

Site	Total Depth	Measuring Point	Date Test Started	Well ID
APEX	62.67	1268.83	1/26/11	P-10L
	Casing Diameter	Static Water Level	Date Test Ended	Page 2 of 3
	2"	45.57	1/26/11	

Date	Time	Elapsed Time (min)	Water Level (Ft)	Pumping Rate (gpm)	Notes
1/26/11	1142	56	50.17	4.50 (MAX)	STEP 2
	1143	57	50.16		
	1144	58	50.16		
	1145	59	50.15		
	1146	60	50.14		
	1147	61	50.13		
	1148	62	50.13		
	1149	63	50.12		
	1150	64	50.12		
	1151	65	50.11		
	1152	66	50.12		
	1153	67	50.13		
	1154	68	50.13		
	1155	69	50.13		
	1156	70	50.12		
	1157	71	50.12		
	1158	72	50.12		
	1159	73	50.12		
	1200	74	50.12		
	1201	75	50.11		
	1202	76	50.11		
	1203	77	50.12		
	1204	78	50.12		
	1205	79	50.12		
	1206	80	50.12		
	1207	81	50.12		
	1208	82	50.11		
	1209	83	50.11		

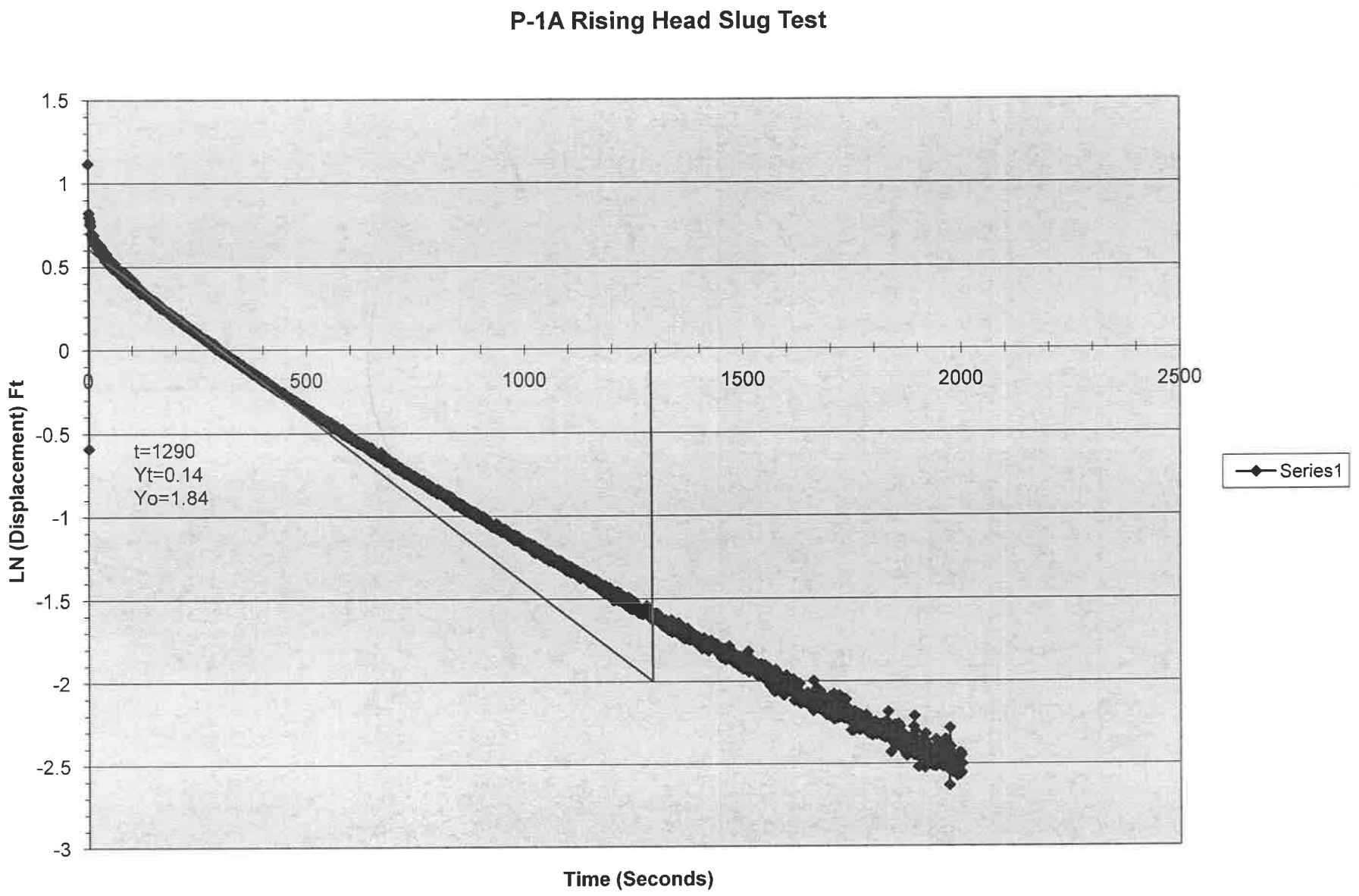
Date	Time	Elapsed Time (min)	Water Level (Ft)	Pumping Rate (gpm)	Notes
1/26/11	1210	84	50.11	4.50 (max)	STEP 2
	1211	85	50.11		
	1212	86	50.11		
	1213	87	50.12		
	1214	88	50.12		
	1215	89	50.12		
	1216	90	50.11		
1/28/11	1318	—	45.60	—	—
	1322	—	48.76	3.75 gpm	331.7 Hz
	1330	—	49.94	4.5 gpm	387.6 (MAX)
		10 sec	46.76	OFF	OFF
		20	45.75		
		30	45.67		
		40	45.60		
		50	45.60		
	1331	60	45.60		

OBSERVATION WELLS

Site			Total Depth		Measuring Point		Date Test Started				Pump Test Well ID	
APEX			62.67		1268.83		1/26/11				P-10L	
			Casing Diameter		Static Water Level		Date Test Ended				Page 3 of 3	
			2"		45.57		1/26/11					

Observation Well ID	Date	Time	Elapsed Time (min)	Water Level (Ft)	Pumping Rate	Notes	Date	Time	Elapsed Time (min)	Water Level (Ft)	Pumping Rate	Notes
B-401	1/26/11	1021	Initial	107.28	NA	observation well ID	1/26/11	1035	Initial	44.61	NA	
	↓	1055	8	107.30	↓	B-2A ↓	↓	1050	3	44.62	↓	
		1125	38	107.30				1119	32	44.61		
		1138	51	107.29				1135	48	44.62		
		1153	66	107.29				1148	61	44.62		
	↓				↓		↓				↓	
P-4A	1/26/11	1022	Initial	39.82	NA	B-2B	1/26/11	1037	Initial	110.42	NA	
	↓	1057	10	39.83	↓	↓	↓	1051	4	110.43	↓	
		1128	41	39.84				1120	33	110.41		
		1142	55	39.83				1136	49	110.42		
		1155	68	39.84				1149	62	110.42		
	↓				↓		↓				↓	
B-401A	1/26/11	1034	Initial	45.98	NA							
	↓	1048	1	45.98	↓							
		1118	31	45.98								
		1134	47	45.98								
		1148	61	45.98								
	↓				↓							

Apex Landfill Lateral Expansion
Single Well Slug Test



SLUG TEST ANALYSIS

BOUWER-RICE METHOD

Confined Aquifer

Client:	Apex Environmental, LLC
Location:	Amsterdam, OH
Project No:	101-049

P-1

Well Name:	P-1

Well Data

Top of casing elevation	=	1330.30	ft. msl
Ground surface elevation	=	1327.54	ft. msl
Depth to base of screen (bgs)	=	198	ft.
Screen Length	=	10	ft.
Sand pack above screen	=	3	ft.
Sand pack below screen	=	1	ft.
Static water level (bTOC)	=	178.57	ft.
Depth to Top of Aquifer (bgs)	=	184.2	ft.
Depth to aquifer base (bgs)	=	263.6	ft.
Radius of the well casing	=	0.0833	ft.
Radius of the bore hole	=	0.4063	ft.
Gravel pack porosity	=	0.3	
Initial displacement of water	=	3.169	ft.
Effective Base of Screen	=	1129.54	ft msl
Effective Top of Screen	=	1139.54	ft msl
Effective screen length	=	10	ft

Bouwer - Rice Data

H =	13.8	ft.	
L =	10	ft.	
D =	79.4	ft.	
rc'=	0.0833	ft.	
rw =	0.4063	ft.	
Top of Aquifer	1143.34	ft msl	
Base of Aquifer	1063.94	ft msl	
Top of Screen	1139.54	ft msl	
Base of Screen	1129.54	ft msl	
Saturated Thickness	79.4	ft.	
Total Head	13.8	ft	
Sand pack length(e)	14	ft	
Screen radius [rc'](e)	0.2332	ft	
WL at start of test	1148.56	ft msl	
Static Water Level	1151.73	ft msl	
Le/rw =	24.6124		

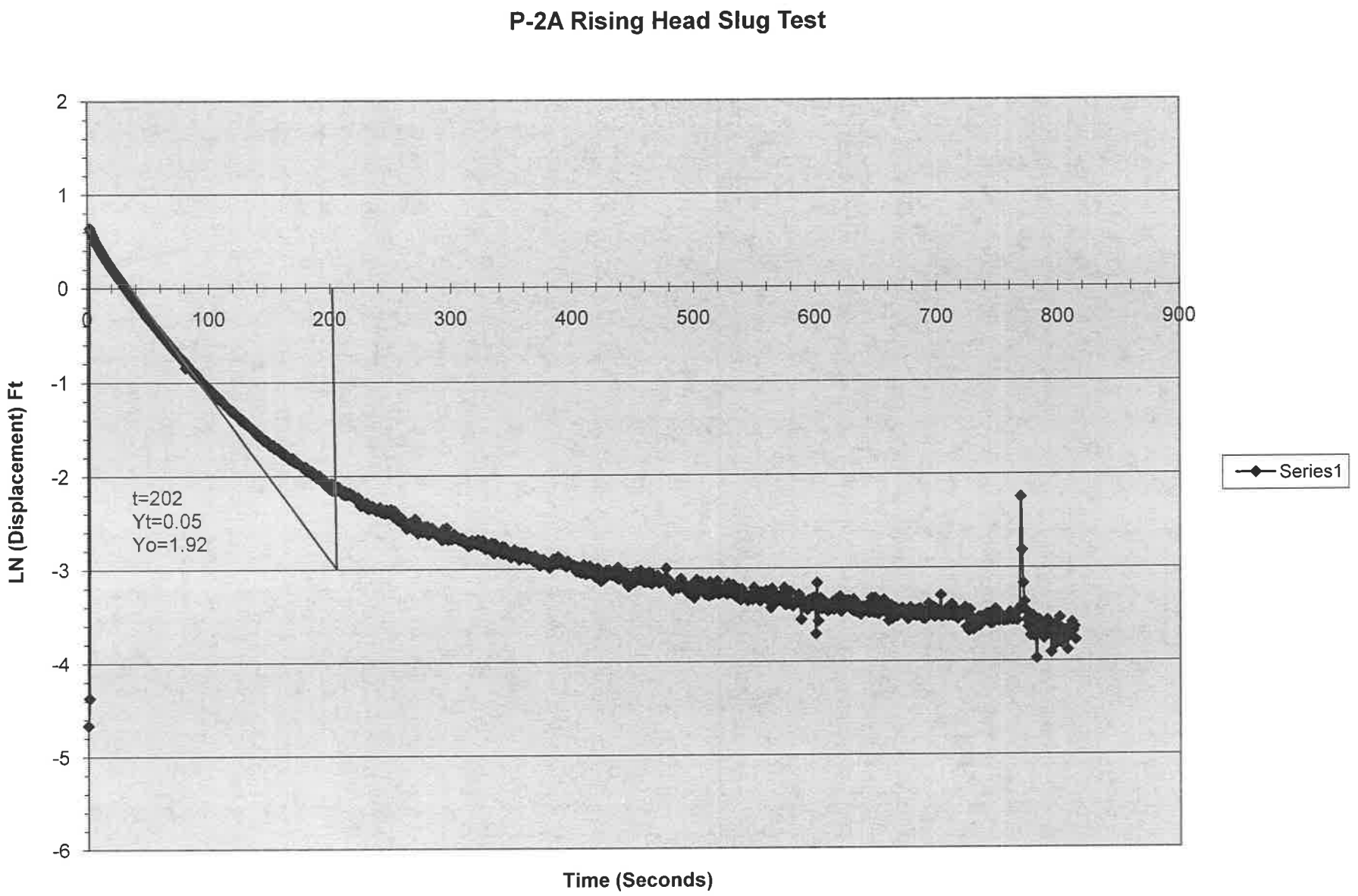
Use the Bouwer-Rice plot to determine A, B, and C. Enter the values here:

A =	**2.27**
B =	**0.35**
C =	**1.86**

ln(Re/rw) =	2.579985062	(fully pen.)			
ln(Re/rw) =	2.098381057	(partial pen.)	yo =	**1.84**	ft.
ln(Re/rw) =	2.098381057	(value used)	yt =	**0.14**	ft.
Re =	20.06635503	ft	t =	**1290**	sec

Hydraulic Conductivity (K)	=	**1.45E-06**	**ft./sec**
K	=	**1.26E-01**	**ft./day**
K	=	**4.44E-05**	**cm/sec**
K	=	**3.83E-02**	**m/day**
K	=	**9.37E-01**	**gpd/ft^2**

Apex Landfill Lateral Expansion
Single Well Slug Test



SLUG TEST ANALYSIS

BOUWER-RICE METHOD

Confined Aquifer

Client:	Apex Environmental, LLC
Location:	Amsterdam, OH
Project No:	101-049

P-2A

Well Name:	P-2A

Well Data

Top of casing elevation	=	1239.05	ft. msl
Ground surface elevation	=	1236.93	ft. msl
Depth to base of screen (bgs)	=	13.8	ft.
Screen Length	=	5	ft.
Sand pack above screen	=	2	ft.
Sand pack below screen	=	0.3	ft.
Static water level (bTOC)	=	9.35	ft.
Depth to Top of Aquifer (bgs)	=	8	ft.
Depth to aquifer base (bgs)	=	14	ft.
Radius of the well casing	=	0.0833	ft.
Radius of the bore hole	=	0.67	ft.
Gravel pack porosity	=	0.3	
Initial displacement of water	=	3.169	ft.
Effective Base of Screen	=	1223.13	ft msl
Effective Top of Screen	=	1228.13	ft msl
Effective screen length	=	5	ft

Bouwer - Rice Data

H =	5.8	ft.	
L =	5	ft.	
D =	6	ft.	
rc'=	0.37353343	ft.	
rw =	0.67	ft.	
Top of Aquifer	1228.93	ft msl	
Base of Aquifer	1222.93	ft msl	
Top of Screen	1228.13	ft msl	
Base of Screen	1223.13	ft msl	
Saturated Thickness	6	ft.	
Total Head	5.8	ft	
Sand pack length(e)	7.3	ft	
Screen radius [rc'](e)	0.37353	ft	
WL at start of test	1226.53	ft msl	
Static Water Level	1229.70	ft msl	
Le/rw =	7.46269		

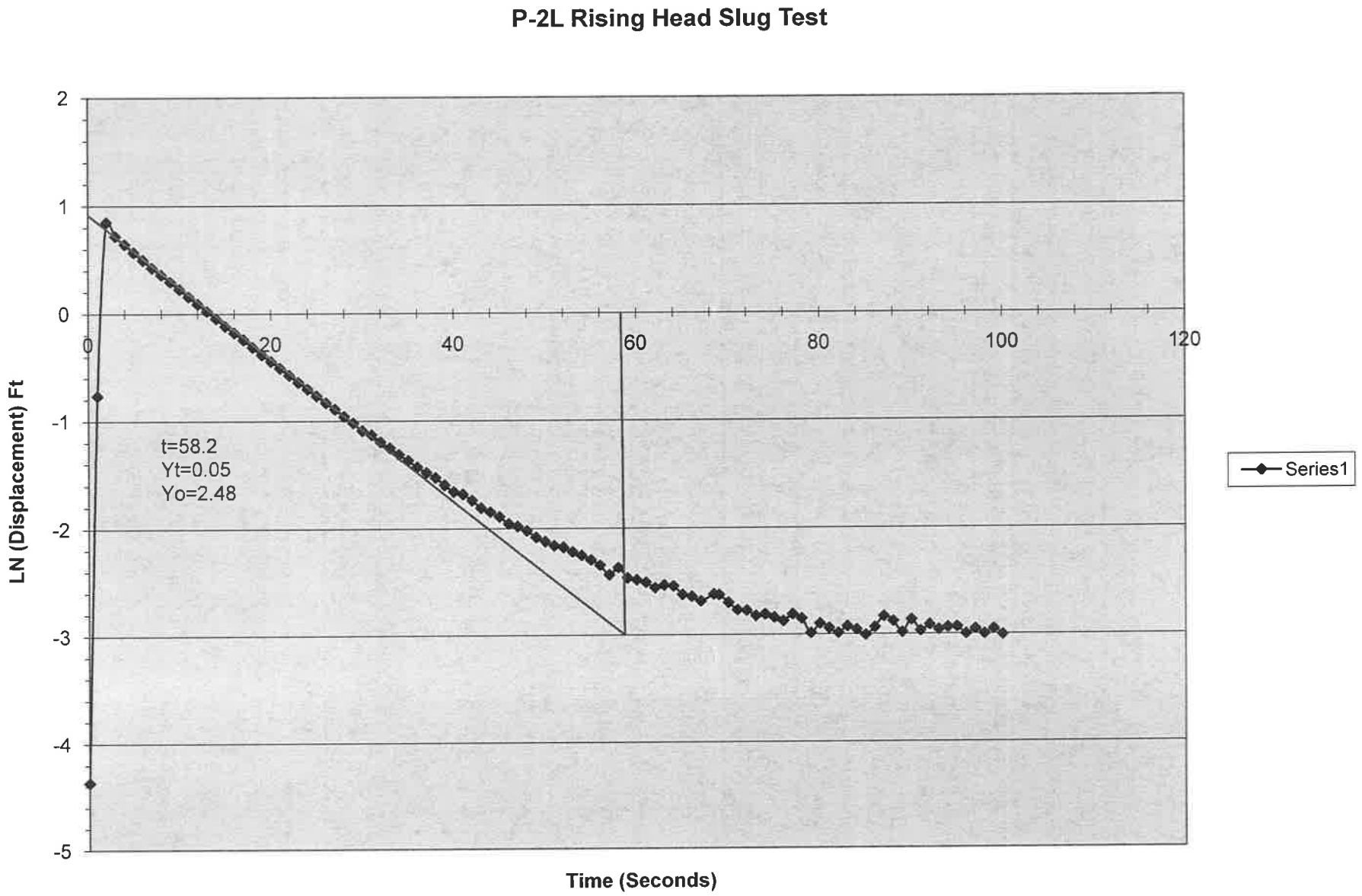
Use the Bouwer-Rice plot to determine A, B, and C. Enter the values here:

A =	1.77
B =	0.25
C =	1

ln(Re/rw) =	1.553634568	(fully pen.)			
ln(Re/rw) =	1.415765165	(partial pen.)	yo =	1.92	ft.
ln(Re/rw) =	1.415765165	(value used)	yt =	0.05	ft.
Re =	6.14871263	ft	t =	202	sec

Hydraulic Conductivity (K)	=	**3.57E-04**	**ft./sec**
K	=	**3.08E+01**	**ft./day**
K	=	**1.09E-02**	**cm/sec**
K	=	**9.40E+00**	**m/day**
K	=	**2.30E+02**	**gpd/ft^2**

Apex Landfill Lateral Expansion
Single Well Slug Test



SLUG TEST ANALYSIS

BOUWER-RICE METHOD

Confined Aquifer

Client:	Apex Environmental, LLC
Location:	Amsterdam, OH
Project No:	101-049

P-2L

Well Name:	P-2L

Well Data

Top of casing elevation	=	1238.64	ft. msl
Ground surface elevation	=	1236.62	ft. msl
Depth to base of screen (bgs)	=	31	ft.
Screen Length	=	10	ft.
Sand pack above screen	=	3	ft.
Sand pack below screen	=	1	ft.
Static water level (bTOC)	=	14.19	ft.
Depth to Top of Aquifer (bgs)	=	25.9	ft.
Depth to aquifer base (bgs)	=	34.1	ft.
Radius of the well casing	=	0.0833	ft.
Radius of the bore hole	=	0.4063	ft.
Gravel pack porosity	=	0.3	
Initial displacement of water	=	3.169	ft.
Effective Base of Screen	=	1205.62	ft msl
Effective Top of Screen	=	1210.72	ft msl
Effective screen length	=	5.1	ft

Bouwer - Rice Data

H =	5.1	ft.
L =	5.1	ft.
D =	8.2	ft.
rc'=	0.0833	ft.
rw =	0.4063	ft.
Top of Aquifer	1210.72	ft msl
Base of Aquifer	1202.52	ft msl
Top of Screen	1215.62	ft msl
Base of Screen	1205.62	ft msl
Saturated Thickness	8.2	ft.
Total Head	5.1	ft
Sand pack length(e)	14	ft
Screen radius [rc'](e)	0.2332	ft
WL at start of test	1221.28	ft msl
Static Water Level	1224.45	ft msl
Le/rw =	12.5523	

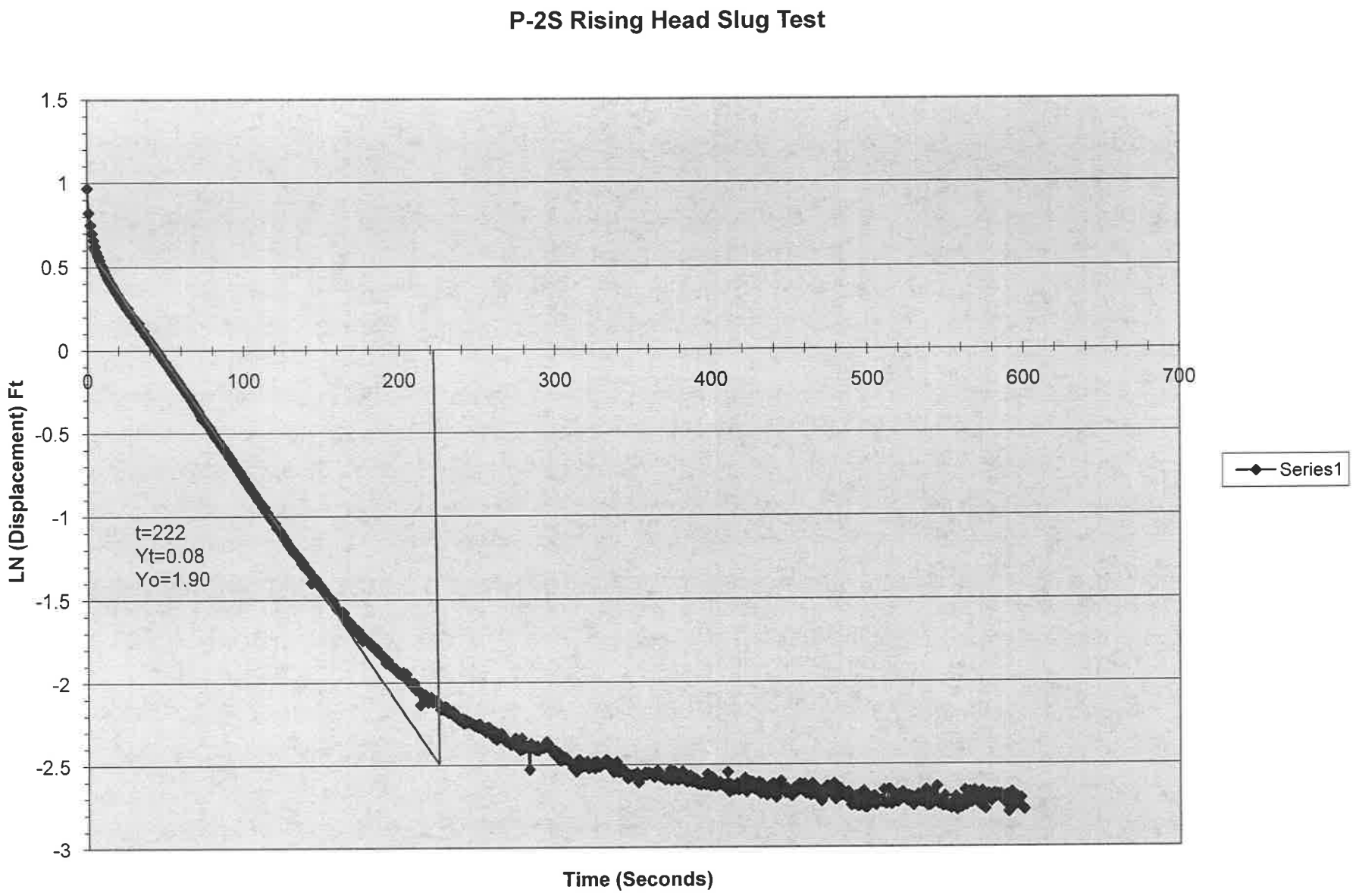
Use the Bouwer-Rice plot to determine A, B, and C. Enter the values here:

A =	**1.85**
B =	**0.26**
C =	**1.37**

ln(Re/rw) =	1.838429824	(fully pen.)			
ln(Re/rw) =	1.601862545	(partial pen.)	yo =	**2.48**	ft.
ln(Re/rw) =	1.601862545	(value used)	yt =	**0.05**	ft.
Re =	12.21330609	ft	t =	**58.2**	sec

Hydraulic Conductivity (K)	=	**7.31E-05**	**ft./sec**
K	=	**6.32E+00**	**ft./day**
K	=	**2.23E-03**	**cm/sec**
K	=	**1.93E+00**	**m/day**
K	=	**4.71E+01**	**gpd/ft^2**

Apex Landfill Lateral Expansion
Single Well Slug Test



SLUG TEST ANALYSIS

BOUWER-RICE METHOD

Confined Aquifer

Client:	Apex Environmental, LLC
Location:	Amsterdam, OH
Project No:	101-049

P-2S

Well Name:	P-2S

Well Data

Top of casing elevation	=	1238.75	ft. msl
Ground surface elevation	=	1236.44	ft. msl
Depth to base of screen (bgs)	=	63	ft.
Screen Length	=	10	ft.
Sand pack above screen	=	3	ft.
Sand pack below screen	=	1	ft.
Static water level (bTOC)	=	51.14	ft.
Depth to Top of Aquifer (bgs)	=	34.1	ft.
Depth to aquifer base (bgs)	=	81.4	ft.
Radius of the well casing	=	0.0833	ft.
Radius of the bore hole	=	0.4063	ft.
Gravel pack porosity	=	0.3	
Initial displacement of water	=	3.169	ft.
Effective Base of Screen	=	1173.44	ft msl
Effective Top of Screen	=	1183.44	ft msl
Effective screen length	=	10	ft

Bouwer - Rice Data

H =	28.9	ft.
L =	10	ft.
D =	47.3	ft.
rc'=	0.0833	ft.
rw =	0.4063	ft.
Top of Aquifer	1202.34	ft msl
Base of Aquifer	1155.04	ft msl
Top of Screen	1183.44	ft msl
Base of Screen	1173.44	ft msl
Saturated Thickness	47.3	ft.
Total Head	28.9	ft
Sand pack length(e)	14	ft
Screen radius [rc'](e)	0.2332	ft
WL at start of test	1184.44	ft msl
Static Water Level	1187.61	ft msl
Le/rw =	24.6124	

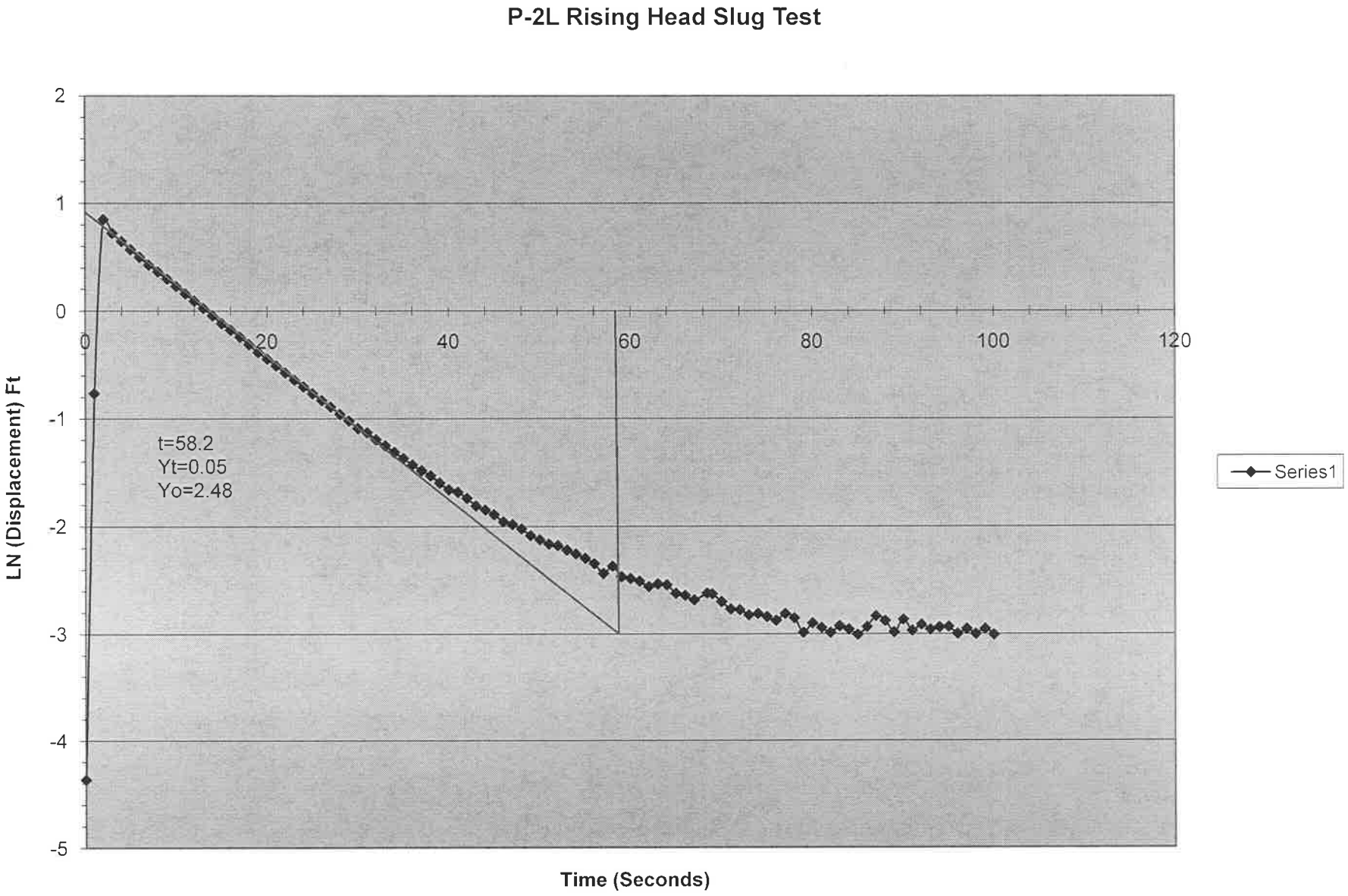
Use the Bouwer-Rice plot to determine A, B, and C. Enter the values here:

A =	**2.27**
B =	**0.35**
C =	**1.86**

ln(Re/rw) =	2.998366069	(fully pen.)			
ln(Re/rw) =	2.472822153	(partial pen.)	yo =	**1.9**	ft.
ln(Re/rw) =	2.472822153	(value used)	yt =	**0.08**	ft.
Re =	29.18006086	ft	t =	**222**	sec

Hydraulic Conductivity (K)	=	**1.22E-05**	**ft./sec**
K	=	**1.06E+00**	**ft./day**
K	=	**3.74E-04**	**cm/sec**
K	=	**3.23E-01**	**m/day**
K	=	**7.89E+00**	**gpd/ft^2**

Apex Landfill Lateral Expansion
Single Well Slug Test



SLUG TEST ANALYSIS

BOUWER-RICE METHOD

Confined Aquifer

Client:	Apex Environmental, LLC
Location:	Amsterdam, OH
Project No:	101-049

P-2L

Well Name:	P-2L

Well Data

Top of casing elevation	=	1238.64	ft. msl
Ground surface elevation	=	1236.62	ft. msl
Depth to base of screen (bgs)	=	31	ft.
Screen Length	=	10	ft.
Sand pack above screen	=	3	ft.
Sand pack below screen	=	1	ft.
Static water level (bTOC)	=	14.19	ft.
Depth to Top of Aquifer (bgs)	=	25.9	ft.
Depth to aquifer base (bgs)	=	34.1	ft.
Radius of the well casing	=	0.0833	ft.
Radius of the bore hole	=	0.4063	ft.
Gravel pack porosity	=	0.3	
Initial displacement of water	=	3.169	ft.
Effective Base of Screen	=	1205.62	ft msl
Effective Top of Screen	=	1210.72	ft msl
Effective screen length	=	5.1	ft

Bouwer - Rice Data

H =	5.1	ft.	
L =	5.1	ft.	
D =	8.2	ft.	
rc'=	0.0833	ft.	
rw =	0.4063	ft.	
Top of Aquifer	1210.72	ft msl	
Base of Aquifer	1202.52	ft msl	
Top of Screen	1215.62	ft msl	
Base of Screen	1205.62	ft msl	
Saturated Thickness	8.2	ft.	
Total Head	5.1	ft	
Sand pack length(e)	14	ft	
Screen radius [rc'](e)	0.2332	ft	
WL at start of test	1221.28	ft msl	
Static Water Level	1224.45	ft msl	
Le/rw =	12.5523		

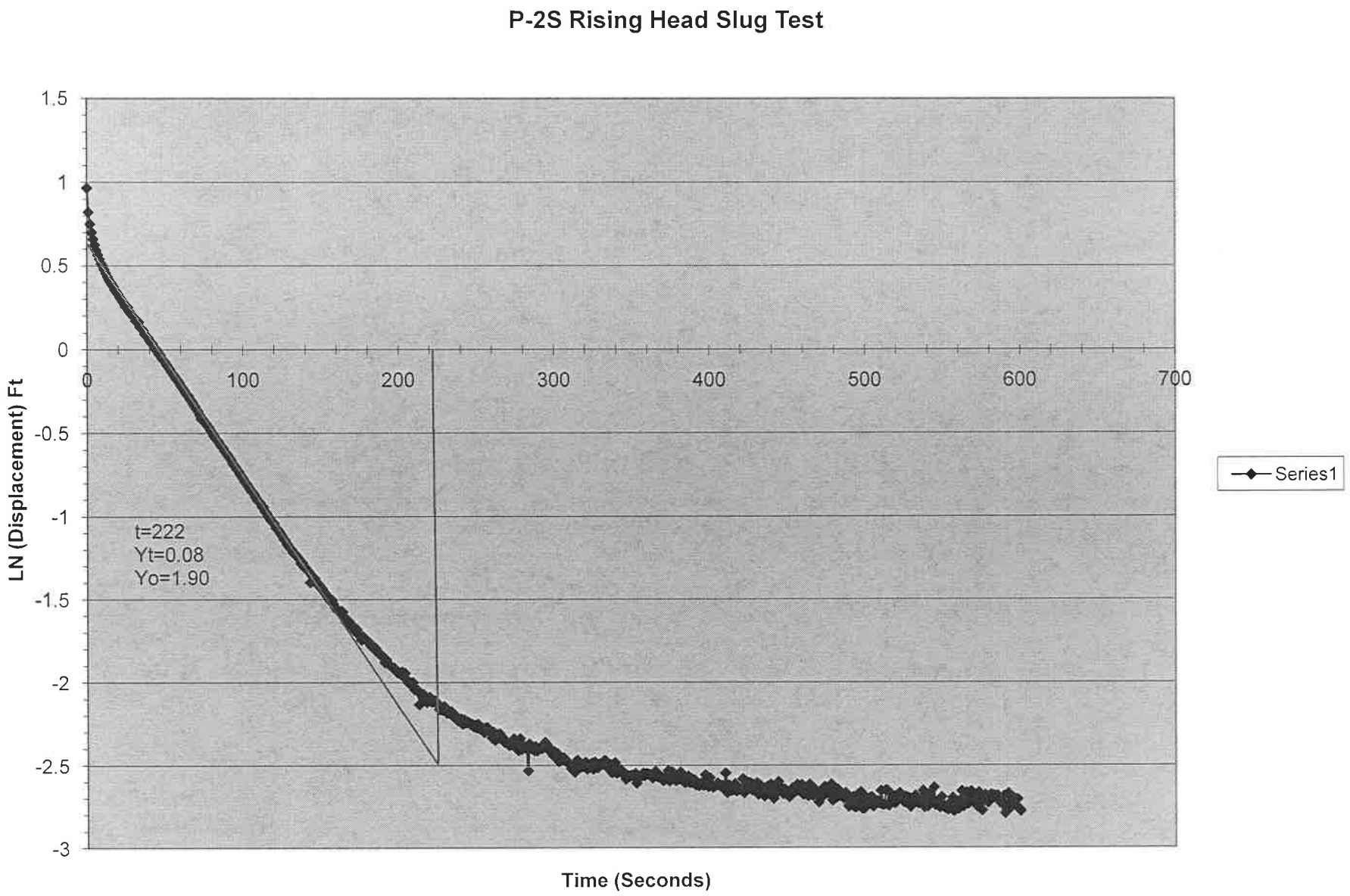
Use the Bouwer-Rice plot to determine A, B, and C. Enter the values here:

A =	**1.85**
B =	**0.26**
C =	**1.37**

ln(Re/rw) =	1.838429824	(fully pen.)			
ln(Re/rw) =	1.601862545	(partial pen.)	yo =	2.48	ft.
ln(Re/rw) =	1.601862545	(value used)	yt =	0.05	ft.
Re =	12.21330609	ft	t =	58.2	sec

Hydraulic Conductivity (K)	=	**7.31E-05**	**ft./sec**
K	=	**6.32E+00**	**ft./day**
K	=	**2.23E-03**	**cm/sec**
K	=	**1.93E+00**	**m/day**
K	=	**4.71E+01**	**gpd/ft^2**

Apex Landfill Lateral Expansion
Single Well Slug Test



SLUG TEST ANALYSIS

BOUWER-RICE METHOD
Confined Aquifer

Client:	Apex Environmental, LLC
Location:	Amsterdam, OH
Project No:	101-049

P-2S

Well Name:	P-2S

Well Data

Top of casing elevation	=	1238.75	ft. msl
Ground surface elevation	=	1236.44	ft. msl
Depth to base of screen (bgs)	=	63	ft.
Screen Length	=	10	ft.
Sand pack above screen	=	3	ft.
Sand pack below screen	=	1	ft.
Static water level (bTOC)	=	51.14	ft.
Depth to Top of Aquifer (bgs)	=	34.1	ft.
Depth to aquifer base (bgs)	=	81.4	ft.
Radius of the well casing	=	0.0833	ft.
Radius of the bore hole	=	0.4063	ft.
Gravel pack porosity	=	0.3	
Initial displacement of water	=	3.169	ft.
Effective Base of Screen	=	1173.44	ft msl
Effective Top of Screen	=	1183.44	ft msl
Effective screen length	=	10	ft

Bouwer - Rice Data

H =	28.9	ft.
L =	10	ft.
D =	47.3	ft.
rc'=	0.0833	ft.
rw =	0.4063	ft.
Top of Aquifer	1202.34	ft msl
Base of Aquifer	1155.04	ft msl
Top of Screen	1183.44	ft msl
Base of Screen	1173.44	ft msl
Saturated Thickness	47.3	ft.
Total Head	28.9	ft
Sand pack length(e)	14	ft
Screen radius [rc'](e)	0.2332	ft
WL at start of test	1184.44	ft msl
Static Water Level	1187.61	ft msl
Le/rw =	24.6124	

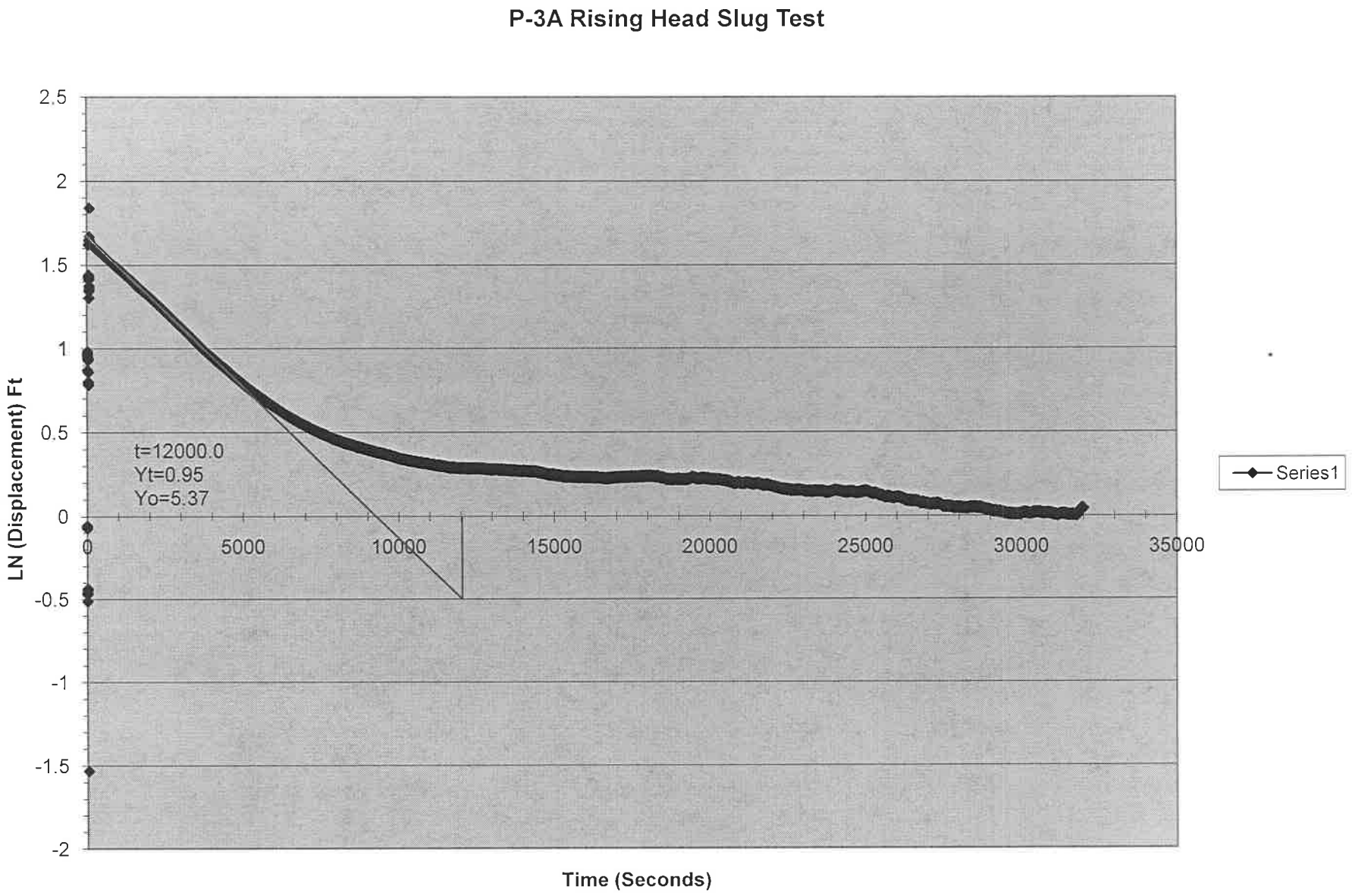
Use the Bouwer-Rice plot to determine A, B, and C. Enter the values here:

A =	**2.27**
B =	**0.35**
C =	**1.86**

ln(Re/rw) =	2.998366069	(fully pen.)			
ln(Re/rw) =	2.472822153	(partial pen.)	yo =	1.9	ft.
ln(Re/rw) =	2.472822153	(value used)	yt =	0.08	ft.
Re =	29.18006086	ft	t =	222	sec

Hydraulic Conductivity (K)	=	**1.22E-05**	**ft./sec**
K	=	**1.06E+00**	**ft./day**
K	=	**3.74E-04**	**cm/sec**
K	=	**3.23E-01**	**m/day**
K	=	**7.89E+00**	**gpd/ft^2**

Apex Landfill Lateral Expansion
Single Well Slug Test



SLUG TEST ANALYSIS

BOUWER-RICE METHOD

Confined Aquifer

Client:	Apex Environmental, LLC
Location:	Amsterdam, OH
Project No:	101-049

P-3A

Well Name:	P-3A

Well Data

Top of casing elevation	=	1280.87	ft. msl
Ground surface elevation	=	1278.34	ft. msl
Depth to base of screen (bgs)	=	54.5	ft.
Screen Length	=	10	ft.
Sand pack above screen	=	17.5	ft.
Sand pack below screen	=	0.3	ft.
Static water level (bTOC)	=	51.21	ft.
Depth to Top of Aquifer (bgs)	=	49.5	ft.
Depth to aquifer base (bgs)	=	55.5	ft.
Radius of the well casing	=	0.0833	ft.
Radius of the bore hole	=	0.67	ft.
Gravel pack porosity	=	0.3	
Initial displacement of water	=	3.169	ft.
Effective Base of Screen	=	1223.84	ft msl
Effective Top of Screen	=	1228.84	ft msl
Effective screen length	=	5	ft

Bouwer - Rice Data

H =	5	ft.	
L =	5	ft.	
D =	6	ft.	
rc'=	0.37353343	ft.	
rw =	0.67	ft.	
Top of Aquifer	1228.84	ft msl	
Base of Aquifer	1222.84	ft msl	
Top of Screen	1233.84	ft msl	
Base of Screen	1223.84	ft msl	
Saturated Thickness	6	ft.	
Total Head	5	ft	
Sand pack length(e)	27.8	ft	
Screen radius [rc'](e)	0.37353	ft	
WL at start of test	1226.49	ft msl	
Static Water Level	1229.66	ft msl	
Le/rw =	7.46269		

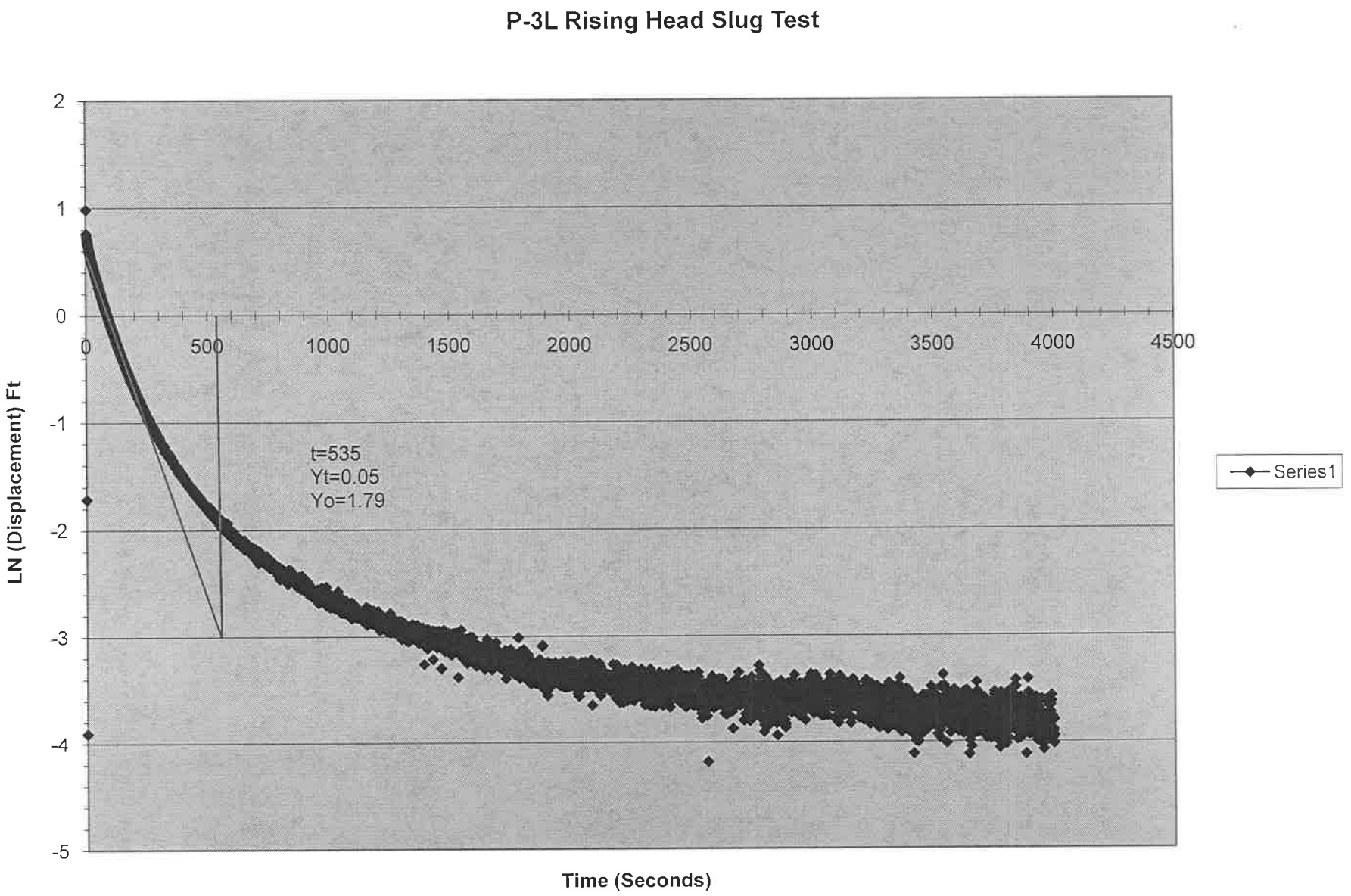
Use the Bouwer-Rice plot to determine A, B, and C. Enter the values here:

A =	**1.77**
B =	**0.25**
C =	**1**

ln(Re/rw) =	1.467810846	(fully pen.)			
ln(Re/rw) =	1.25331707	(partial pen.)	yo =	**5.37**	ft.
ln(Re/rw) =	1.25331707	(value used)	yt =	**0.95**	ft.
Re =	5.226775961 ft		t =	**12000**	sec

Hydraulic Conductivity (K)	=	**2.52E-06**	**ft./sec**
K	=	**2.18E-01**	**ft./day**
K	=	**7.71E-05**	**cm/sec**
K	=	**6.65E-02**	**m/day**
K	=	**1.63E+00**	**gpd/ft^2**

Apex Landfill Lateral Expansion
Single Well Slug Test



SLUG TEST ANALYSIS

BOUWER-RICE METHOD

Confined Aquifer

Client:	Apex Environmental, LLC
Location:	Amsterdam, OH
Project No:	101-049

P-3L

Well Name:	P-3L

Well Data

Top of casing elevation	=	1279.00	ft. msl
Ground surface elevation	=	1277.28	ft. msl
Depth to base of screen (bgs)	=	73	ft.
Screen Length	=	10	ft.
Sand pack above screen	=	3	ft.
Sand pack below screen	=	0.5	ft.
Static water level (bTOC)	=	57.97	ft.
Depth to Top of Aquifer (bgs)	=	59.5	ft.
Depth to aquifer base (bgs)	=	72.9	ft.
Radius of the well casing	=	0.0833	ft.
Radius of the bore hole	=	0.4063	ft.
Gravel pack porosity	=	0.3	
Initial displacement of water	=	3.169	ft.
Effective Base of Screen	=	1204.38	ft msl
Effective Top of Screen	=	1214.28	ft msl
Effective screen length	=	9.9	ft

Bouwer - Rice Data

H =	13.4	ft.	
L =	9.9	ft.	
D =	13.4	ft.	
rc'=	0.0833	ft.	
rw =	0.4063	ft.	
Top of Aquifer	1217.78	ft msl	
Base of Aquifer	1204.38	ft msl	
Top of Screen	1214.28	ft msl	
Base of Screen	1204.28	ft msl	
Saturated Thickness	13.4	ft.	
Total Head	13.5	ft	
Sand pack length(e)	13.5	ft	
Screen radius [rc']{e}	0.2332	ft	
WL at start of test	1217.86	ft msl	
Static Water Level	1221.03	ft msl	
Le/rw =	24.3662		

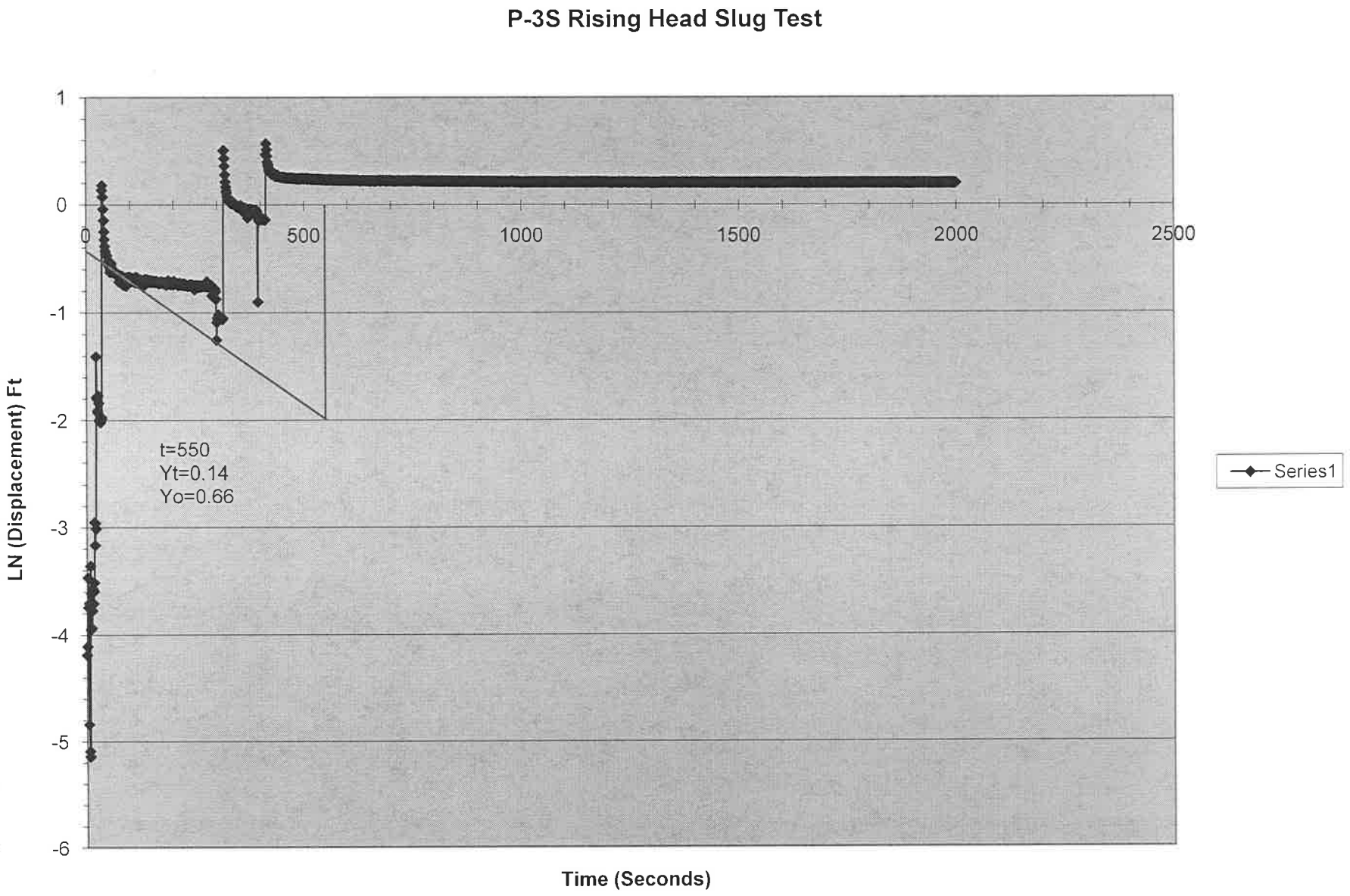
Use the Bouwer-Rice plot to determine A, B, and C. Enter the values here:

A =	**2.27**
B =	**0.35**
C =	**1.86**

ln(Re/rw) =	2.557624401	(fully pen.)			
ln(Re/rw) =	#NUM!	(partial pen.)	yo =	1.79	ft.
ln(Re/rw) =	2.557624401	(value used)	yt =	0.05	ft.
Re =	31.76254856 ft		t =	535	sec

Hydraulic Conductivity (K)	=	**5.99E-06**	**ft./sec**
K	=	**5.18E-01**	**ft./day**
K	=	**1.83E-04**	**cm/sec**
K	=	**1.58E-01**	**m/day**
K	=	**3.87E+00**	**gpd/ft^2**

Apex Landfill Lateral Expansion
Single Well Slug Test



SLUG TEST ANALYSIS

BOUWER-RICE METHOD

Confined Aquifer

Client:	Apex Environmental, LLC
Location:	Amsterdam, OH
Project No:	101-049

P-3S

Well Name:	P-3S

Well Data

Top of casing elevation	=	1281.02	ft. msl
Ground surface elevation	=	1278.33	ft. msl
Depth to base of screen (bgs)	=	104	ft.
Screen Length	=	10	ft.
Sand pack above screen	=	3	ft.
Sand pack below screen	=	1	ft.
Static water level (bTOC)	=	112.56	ft.
Depth to Top of Aquifer (bgs)	=	72.9	ft.
Depth to aquifer base (bgs)	=	123.6	ft.
Radius of the well casing	=	0.0833	ft.
Radius of the bore hole	=	0.4063	ft.
Gravel pack porosity	=	0.3	
Initial displacement of water	=	3.169	ft.
Effective Base of Screen	=	1174.33	ft msl
Effective Top of Screen	=	1184.33	ft msl
Effective screen length	=	10	ft

Bouwer - Rice Data

H =	31.1	ft.
L =	10	ft.
D =	50.7	ft.
rc'=	0.23319762	ft.
rw =	0.4063	ft.
Top of Aquifer	1205.43	ft msl
Base of Aquifer	1154.73	ft msl
Top of Screen	1184.33	ft msl
Base of Screen	1174.33	ft msl
Saturated Thickness	50.7	ft.
Total Head	31.1	ft
Sand pack length(e)	14	ft
Screen radius [rc'](e)	0.2332	ft
WL at start of test	1165.29	ft msl
Static Water Level	1168.46	ft msl
Le/rw =	24.6124	

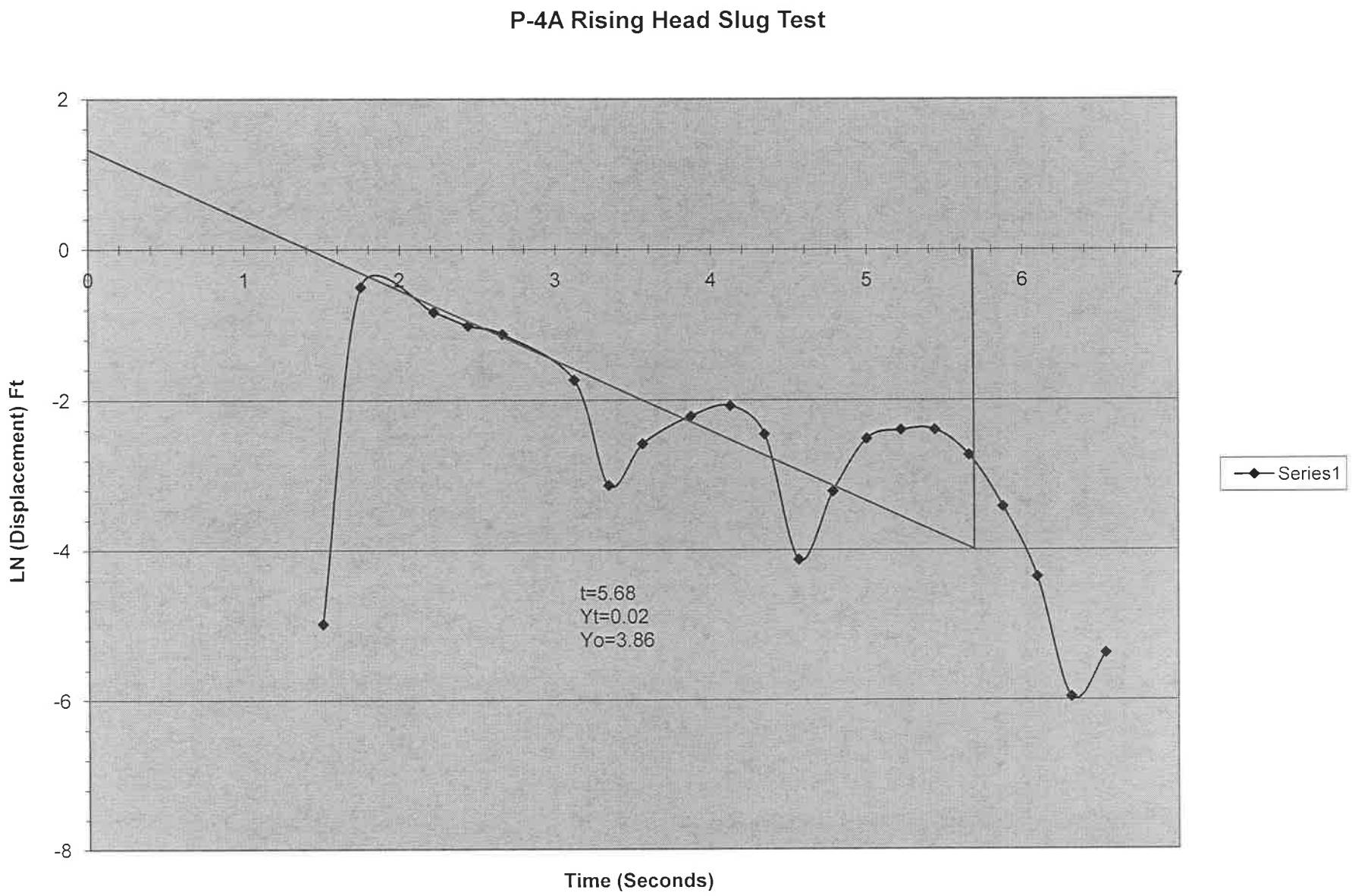
Use the Bouwer-Rice plot to determine A, B, and C. Enter the values here:

A =	**2.27**
B =	**0.35**
C =	**1.86**

ln(Re/rw) =	3.038106373	(fully pen.)			
ln(Re/rw) =	2.494187907	(partial pen.)	yo =	0.66	ft.
ln(Re/rw) =	2.494187907	(value used)	yt =	0.14	ft.
Re =	29.81022285	ft	t =	550	sec

Hydraulic Conductivity (K)	=	**1.91E-05**	**ft./sec**
K	=	**1.65E+00**	**ft./day**
K	=	**5.84E-04**	**cm/sec**
K	=	**5.04E-01**	**m/day**
K	=	**1.23E+01**	**gpd/ft^2**

Apex Landfill Lateral Expansion
Single Well Slug Test



SLUG TEST ANALYSIS

BOUWER-RICE METHOD
Confined Aquifer

Client:	Apex Environmental, LLC
Location:	Amsterdam, OH
Project No:	101-049

P-4A

Well Name:	P-4A

Well Data

Top of casing elevation	=	1263.34	ft. msl
Ground surface elevation	=	1260.88	ft. msl
Depth to base of screen (bgs)	=	53.5	ft.
Screen Length	=	10	ft.
Sand pack above screen	=	1.5	ft.
Sand pack below screen	=	0.6	ft.
Static water level (bTOC)	=	40.41	ft.
Depth to Top of Aquifer (bgs)	=	37	ft.
Depth to aquifer base (bgs)	=	54.1	ft.
Radius of the well casing	=	0.0833	ft.
Radius of the bore hole	=	0.67	ft.
Gravel pack porosity	=	0.3	
Initial displacement of water	=	3.169	ft.
Effective Base of Screen	=	1207.38	ft msl
Effective Top of Screen	=	1217.38	ft msl
Effective screen length	=	10	ft

Bouwer - Rice Data

H =	16.5	ft.	
L =	10	ft.	
D =	17.1	ft.	
rc'=	0.0833	ft.	
rw =	0.67	ft.	
Top of Aquifer	1223.88	ft msl	
Base of Aquifer	1206.78	ft msl	
Top of Screen	1217.38	ft msl	
Base of Screen	1207.38	ft msl	
Saturated Thickness	17.1	ft.	
Total Head	16.5	ft	
Sand pack length(e)	12.1	ft	
Screen radius [rc'](e)	0.37353	ft	
WL at start of test	1219.76	ft msl	
Static Water Level	1222.93	ft msl	
Le/rw =	14.9254		

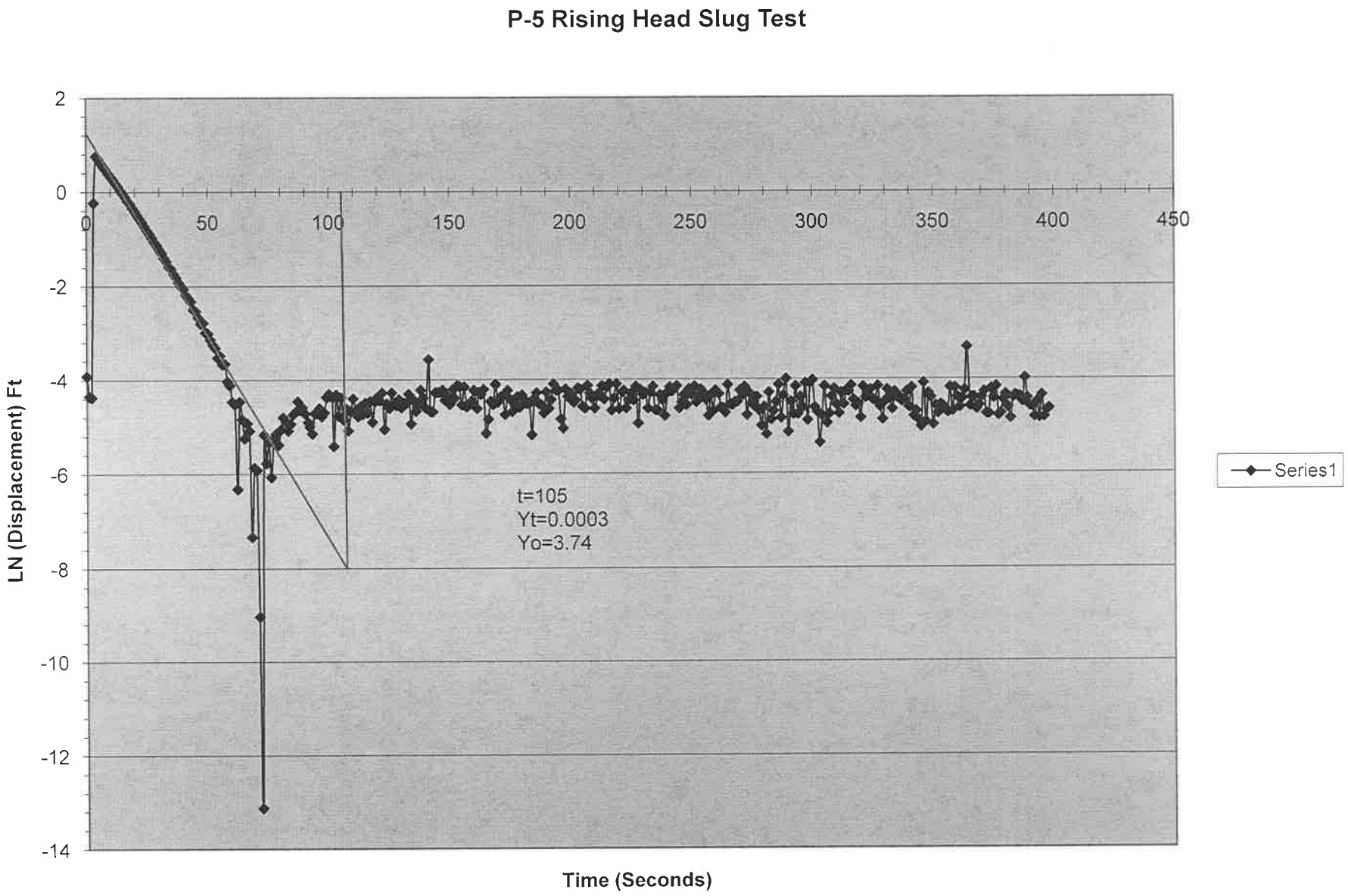
Use the Bouwer-Rice plot to determine A, B, and C. Enter the values here:

A =	**1.89**
B =	**0.29**
C =	**1.47**

ln(Re/rw) =	2.263323091	(fully pen.)			
ln(Re/rw) =	2.137555311	(partial pen.)	yo =	3.86	ft.
ln(Re/rw) =	2.137555311	(value used)	yt =	0.02	ft.
Re =	12.65475303 ft		t =	5.68	sec

Hydraulic Conductivity (K)	=	**6.87E-04**	**ft./sec**
K	=	**5.94E+01**	**ft./day**
K	=	**2.10E-02**	**cm/sec**
K	=	**1.81E+01**	**m/day**
K	=	**4.43E+02**	**gpd/ft^2**

Apex Landfill Lateral Expansion
Single Well Slug Test



SLUG TEST ANALYSIS

BOUWER-RICE METHOD

Confined Aquifer

Client:	Apex Environmental, LLC
Location:	Amsterdam, OH
Project No:	101-049

P-5

Well Name:	P-5

Well Data

Top of casing elevation	=	1243.49	ft. msl
Ground surface elevation	=	1240.98	ft. msl
Depth to base of screen (bgs)	=	123	ft.
Screen Length	=	10	ft.
Sand pack above screen	=	3	ft.
Sand pack below screen	=	2	ft.
Static water level (bTOC)	=	91.56	ft.
Depth to Top of Aquifer (bgs)	=	110	ft.
Depth to aquifer base (bgs)	=	179.3	ft.
Radius of the well casing	=	0.0833	ft.
Radius of the bore hole	=	0.4063	ft.
Gravel pack porosity	=	0.3	
Initial displacement of water	=	3.169	ft.
Effective Base of Screen	=	1117.98	ft msl
Effective Top of Screen	=	1127.98	ft msl
Effective screen length	=	10	ft

Bouwer - Rice Data

H =	13	ft.
L =	10	ft.
D =	69.3	ft.
rc'=	0.0833	ft.
rw =	0.4063	ft.
Top of Aquifer	1130.98	ft msl
Base of Aquifer	1061.68	ft msl
Top of Screen	1127.98	ft msl
Base of Screen	1117.98	ft msl
Saturated Thickness	69.3	ft.
Total Head	13	ft
Sand pack length(e)	15	ft
Screen radius [rc'](e)	0.2332	ft
WL at start of test	1148.76	ft msl
Static Water Level	1151.93	ft msl
Le/rw =	24.6124	

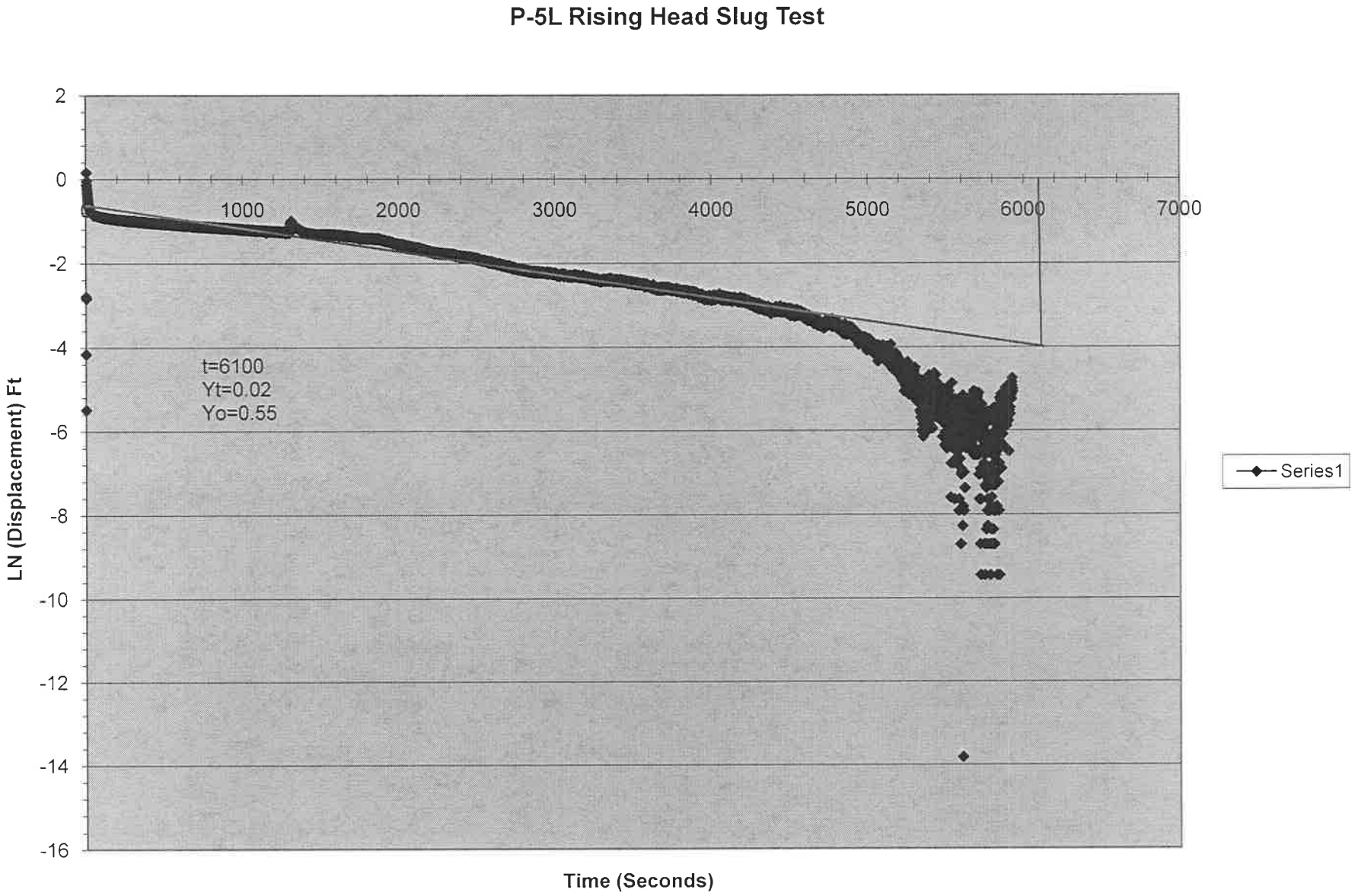
Use the Bouwer-Rice plot to determine A, B, and C. Enter the values here:

A =	**2.27**
B =	**0.35**
C =	**1.86**

ln(Re/rw) =	2.544684791	(fully pen.)			
ln(Re/rw) =	2.084372668	(partial pen.)	yo =	3.74	ft.
ln(Re/rw) =	2.084372668	(value used)	yt =	0.0003	ft.
Re =	19.78721741	ft	t =	105	sec

Hydraulic Conductivity (K)	=	**6.50E-05**	**ft./sec**
K	=	**5.61E+00**	**ft./day**
K	=	**1.98E-03**	**cm/sec**
K	=	**1.71E+00**	**m/day**
K	=	**4.19E+01**	**gpd/ft^2**

Apex Landfill Lateral Expansion
Single Well Slug Test



SLUG TEST ANALYSIS

BOUWER-RICE METHOD

Confined Aquifer

Client:	Apex Environmental, LLC
Location:	Amsterdam, OH
Project No:	101-049

P-5L

Well Name:	P-5L

Well Data

Top of casing elevation	=	1242.43	ft. msl
Ground surface elevation	=	1240.08	ft. msl
Depth to base of screen (bgs)	=	37.5	ft.
Screen Length	=	5	ft.
Sand pack above screen	=	3	ft.
Sand pack below screen	=	1.5	ft.
Static water level (bTOC)	=	35.21	ft.
Depth to Top of Aquifer (bgs)	=	29.5	ft.
Depth to aquifer base (bgs)	=	47.7	ft.
Radius of the well casing	=	0.0833	ft.
Radius of the bore hole	=	0.4063	ft.
Gravel pack porosity	=	0.3	
Initial displacement of water	=	3.169	ft.
Effective Base of Screen	=	1202.58	ft msl
Effective Top of Screen	=	1207.58	ft msl
Effective screen length	=	5	ft

Bouwer - Rice Data

H =	8	ft.	
L =	5	ft.	
D =	18.2	ft.	
rc'=	0.23319762	ft.	
rw =	0.4063	ft.	
Top of Aquifer	1210.58	ft msl	
Base of Aquifer	1192.38	ft msl	
Top of Screen	1207.58	ft msl	
Base of Screen	1202.58	ft msl	
Saturated Thickness	18.2	ft.	
Total Head	8	ft	
Sand pack length(e)	9.5	ft	
Screen radius [rc'](e)	0.2332	ft	
WL at start of test	1204.05	ft msl	
Static Water Level	1207.22	ft msl	
Le/rw =	12.3062		

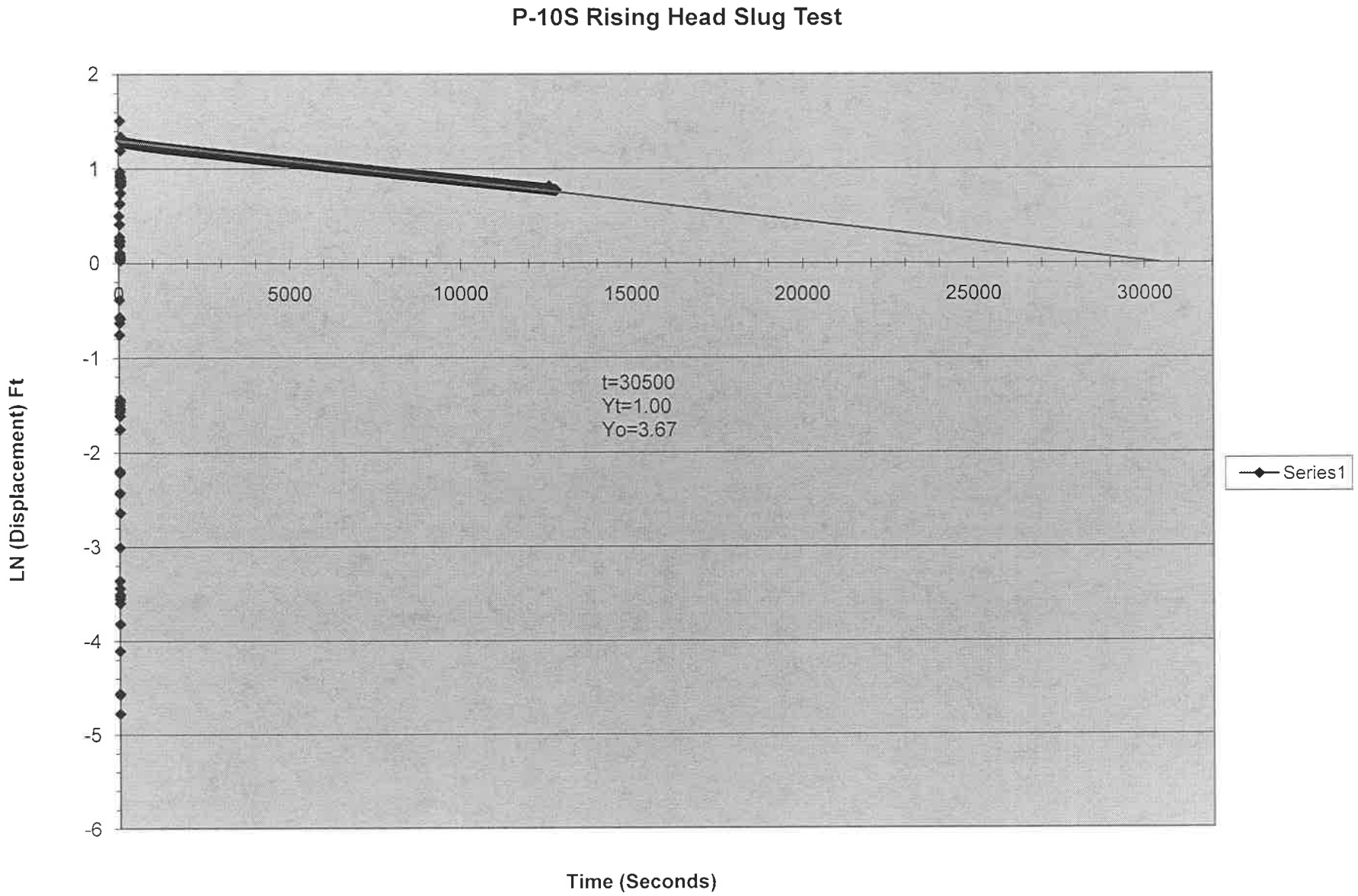
Use the Bouwer-Rice plot to determine A, B, and C. Enter the values here:

A =	**1.84**
B =	**0.26**
C =	**1.35**

ln(Re/rw) =	2.088487072	(fully pen.)			
ln(Re/rw) =	1.704366558	(partial pen.)	yo =	0.55	ft.
ln(Re/rw) =	1.704366558	(value used)	yt =	0.02	ft.
Re =	13.53163171	ft	t =	6100	sec

Hydraulic Conductivity (K)	=	**5.04E-06**	**ft./sec**
K	=	**4.35E-01**	**ft./day**
K	=	**1.54E-04**	**cm/sec**
K	=	**1.33E-01**	**m/day**
K	=	**3.25E+00**	**gpd/ft^2**

Apex Landfill Lateral Expansion
Single Well Slug Test



SLUG TEST ANALYSIS

BOUWER-RICE METHOD

Confined Aquifer

Client:	Apex Environmental, LLC
Location:	Amsterdam, OH
Project No:	101-049

P-10S

Well Name:	P-10S

Well Data

Top of casing elevation	=	1204.05	ft. msl
Ground surface elevation	=	1201.78	ft. msl
Depth to base of screen (bgs)	=	25	ft.
Screen Length	=	5	ft.
Sand pack above screen	=	7	ft.
Sand pack below screen	=	1	ft.
Static water level (bTOC)	=	19.26	ft.
Depth to Top of Aquifer (bgs)	=	17	ft.
Depth to aquifer base (bgs)	=	105.5	ft.
Radius of the well casing	=	0.0833	ft.
Radius of the bore hole	=	0.67	ft.
Gravel pack porosity	=	0.3	
Initial displacement of water	=	3.169	ft.
Effective Base of Screen	=	1176.78	ft msl
Effective Top of Screen	=	1181.78	ft msl
Effective screen length	=	5	ft

Bouwer - Rice Data

H =	8	ft.
L =	5	ft.
D =	88.5	ft.
rc'=	0.37353343	ft.
rw =	0.67	ft.
Top of Aquifer	1184.78	ft msl
Base of Aquifer	1096.28	ft msl
Top of Screen	1181.78	ft msl
Base of Screen	1176.78	ft msl
Saturated Thickness	88.5	ft.
Total Head	8	ft
Sand pack length(e)	13	ft
Screen radius [rc'](e)	0.37353	ft
WL at start of test	1181.62	ft msl
Static Water Level	1184.79	ft msl
Le/rw =	7.46269	

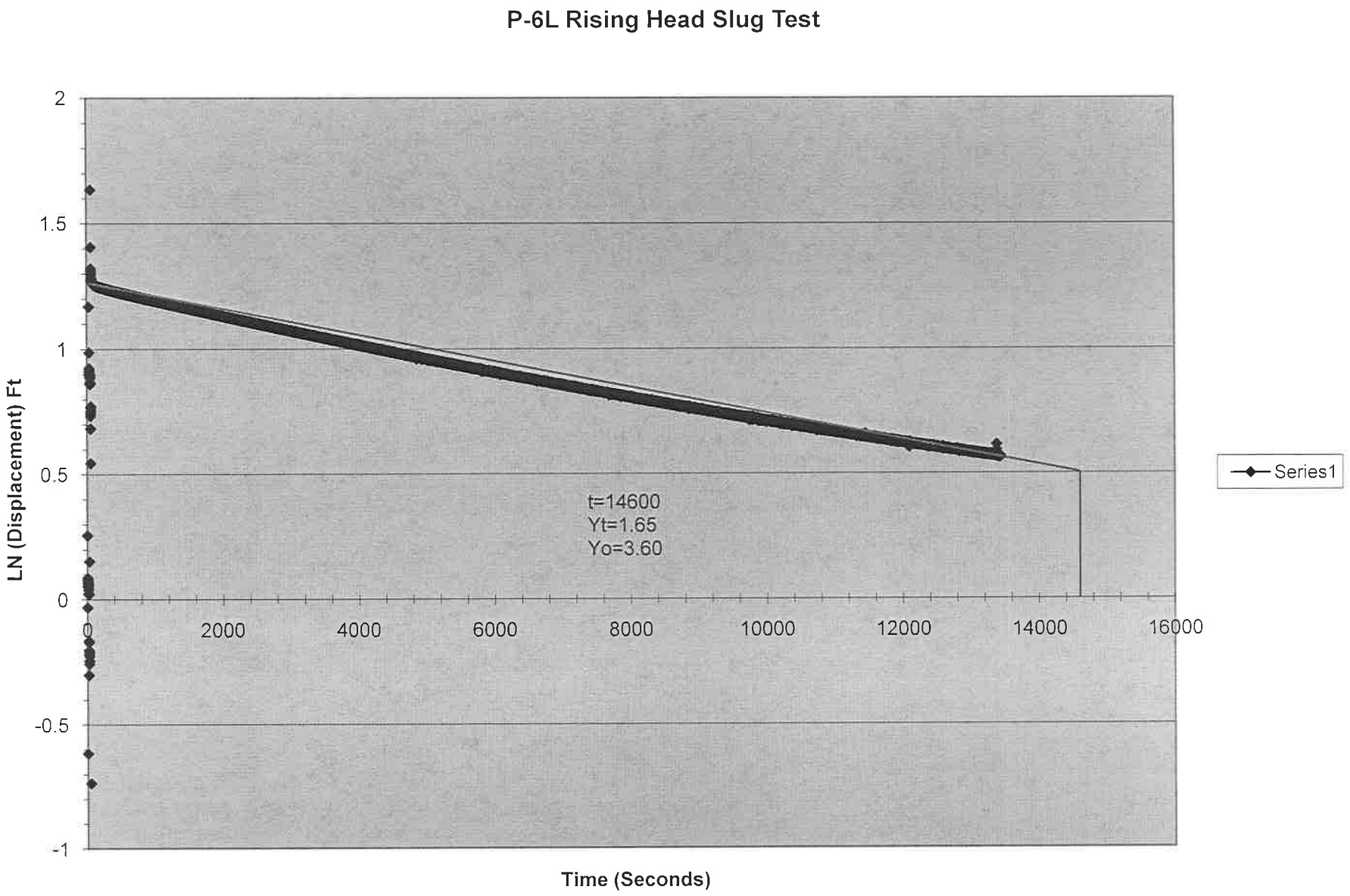
Use the Bouwer-Rice plot to determine A, B, and C. Enter the values here:

A =	**1.77**
B =	**0.25**
C =	**1**

ln(Re/rw) =	1.731413285	(fully pen.)			
ln(Re/rw) =	1.188826737	(partial pen.)	yo =	3.67	ft.
ln(Re/rw) =	1.188826737	(value used)	yt =	1	ft.
Re =	4.900338594	ft	t =	30500	sec

Hydraulic Conductivity (K)	=	**7.07E-07**	**ft./sec**
K	=	**6.11E-02**	**ft./day**
K	=	**2.16E-05**	**cm/sec**
K	=	**1.86E-02**	**m/day**
K	=	**4.56E-01**	**gpd/ft^2**

Apex Landfill Lateral Expansion
Single Well Slug Test



SLUG TEST ANALYSIS

BOUWER-RICE METHOD

Confined Aquifer

Client:	Apex Environmental, LLC
Location:	Amsterdam, OH
Project No:	101-049

P-6L

Well Name:	P-6L

Well Data

Top of casing elevation	=	1246.18	ft. msl
Ground surface elevation	=	1243.35	ft. msl
Depth to base of screen (bgs)	=	37	ft.
Screen Length	=	5	ft.
Sand pack above screen	=	3	ft.
Sand pack below screen	=	0	ft.
Static water level (bTOC)	=	32.57	ft.
Depth to Top of Aquifer (bgs)	=	28	ft.
Depth to aquifer base (bgs)	=	34.7	ft.
Radius of the well casing	=	0.0833	ft.
Radius of the bore hole	=	0.4063	ft.
Gravel pack porosity	=	0.3	
Initial displacement of water	=	3.169	ft.
Effective Base of Screen	=	1208.65	ft msl
Effective Top of Screen	=	1211.35	ft msl
Effective screen length	=	2.7	ft

Bouwer - Rice Data

H =	6.7	ft.	
L =	2.7	ft.	
D =	6.7	ft.	
rc'=	0.23319762	ft.	
rw =	0.4063	ft.	
Top of Aquifer	1215.35	ft msl	
Base of Aquifer	1208.65	ft msl	
Top of Screen	1211.35	ft msl	
Base of Screen	1206.35	ft msl	
Saturated Thickness	6.7	ft.	
Total Head	9	ft	
Sand pack length(e)	8	ft	
Screen radius [rc'](e)	0.2332	ft	
WL at start of test	1210.44	ft msl	
Static Water Level	1213.61	ft msl	
Le/rw =	6.64534		

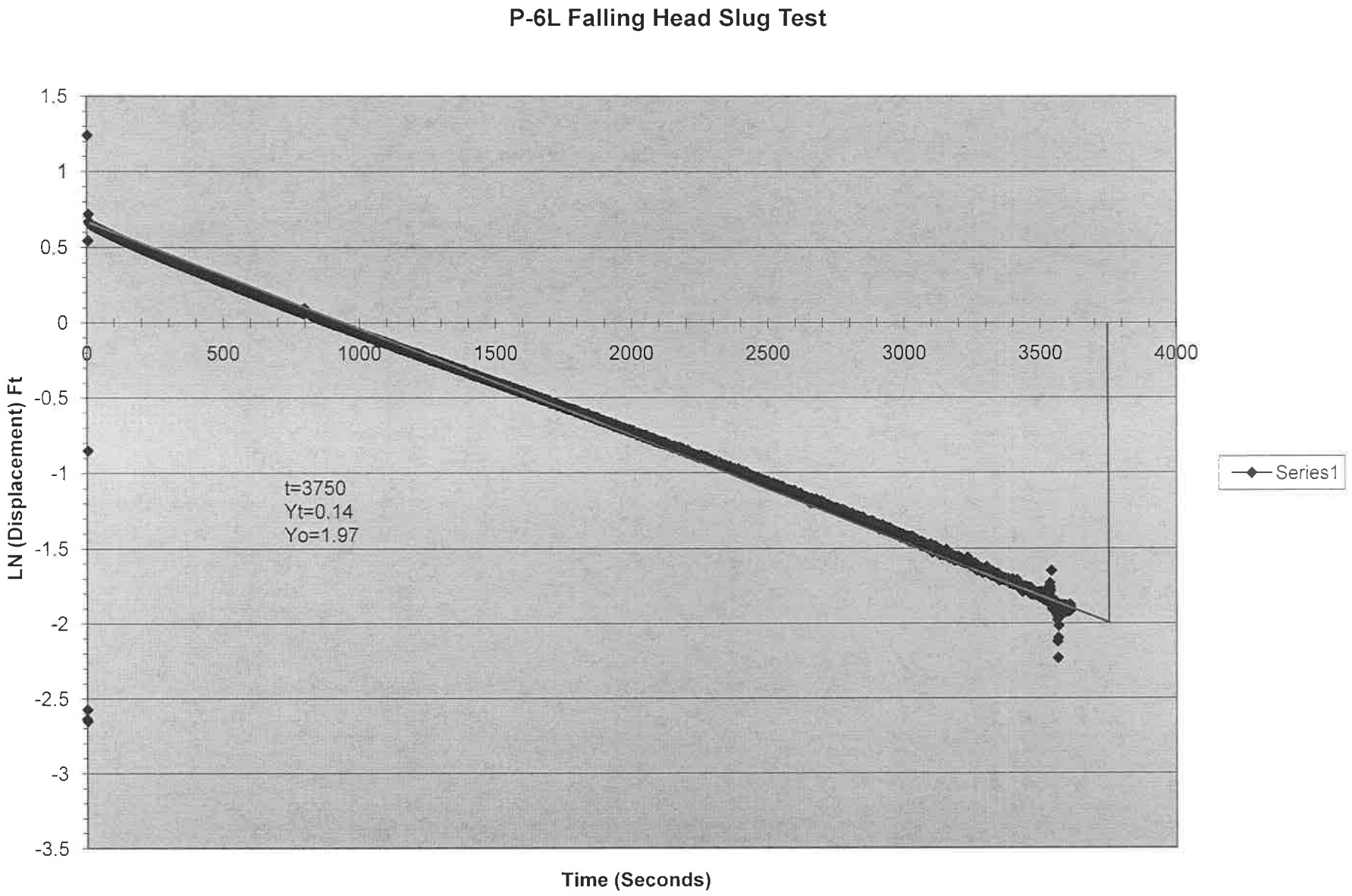
Use the Bouwer-Rice plot to determine A, B, and C. Enter the values here:

A =	**1.76**	
B =	**0.25**	
C =	**0.95**	

ln(Re/rw) =	1.867671214	(fully pen.)			
ln(Re/rw) =	#NUM!	(partial pen.)	yo =	3.6	ft.
ln(Re/rw) =	1.867671214	(value used)	yt =	1.65	ft.
Re =	15.93208005 ft		t =	14600	sec

Hydraulic Conductivity (K)	=	**1.01E-06**	**ft./sec**
K	=	**8.68E-02**	**ft./day**
K	=	**3.07E-05**	**cm/sec**
K	=	**2.65E-02**	**m/day**
K	=	**6.48E-01**	**gpd/ft^2**

Apex Landfill Lateral Expansion
Single Well Slug Test



SLUG TEST ANALYSIS

BOUWER-RICE METHOD

Confined Aquifer

Client:	Apex Environmental, LLC
Location:	Amsterdam, OH
Project No:	101-049

P-6S

Well Name:	P-6S

Well Data

Top of casing elevation	=	1246.75	ft. msl
Ground surface elevation	=	1244.12	ft. msl
Depth to base of screen (bgs)	=	80	ft.
Screen Length	=	10	ft.
Sand pack above screen	=	3	ft.
Sand pack below screen	=	1	ft.
Static water level (bTOC)	=	63.66	ft.
Depth to Top of Aquifer (bgs)	=	34.7	ft.
Depth to aquifer base (bgs)	=	96.5	ft.
Radius of the well casing	=	0.0833	ft.
Radius of the bore hole	=	0.4063	ft.
Gravel pack porosity	=	0.3	
Initial displacement of water	=	3.169	ft.
Effective Base of Screen	=	1164.12	ft msl
Effective Top of Screen	=	1174.12	ft msl
Effective screen length	=	10	ft

Bouwer - Rice Data

H =	45.3	ft.	
L =	10	ft.	
D =	61.8	ft.	
rc'=	0.0833	ft.	
rw =	0.4063	ft.	
Top of Aquifer	1209.42	ft msl	
Base of Aquifer	1147.62	ft msl	
Top of Screen	1174.12	ft msl	
Base of Screen	1164.12	ft msl	
Saturated Thickness	61.8	ft.	
Total Head	45.3	ft	
Sand pack length(e)	14	ft	
Screen radius [rc'](e)	0.2332	ft	
WL at start of test	1179.92	ft msl	
Static Water Level	1183.09	ft msl	
Le/rw =	24.6124		

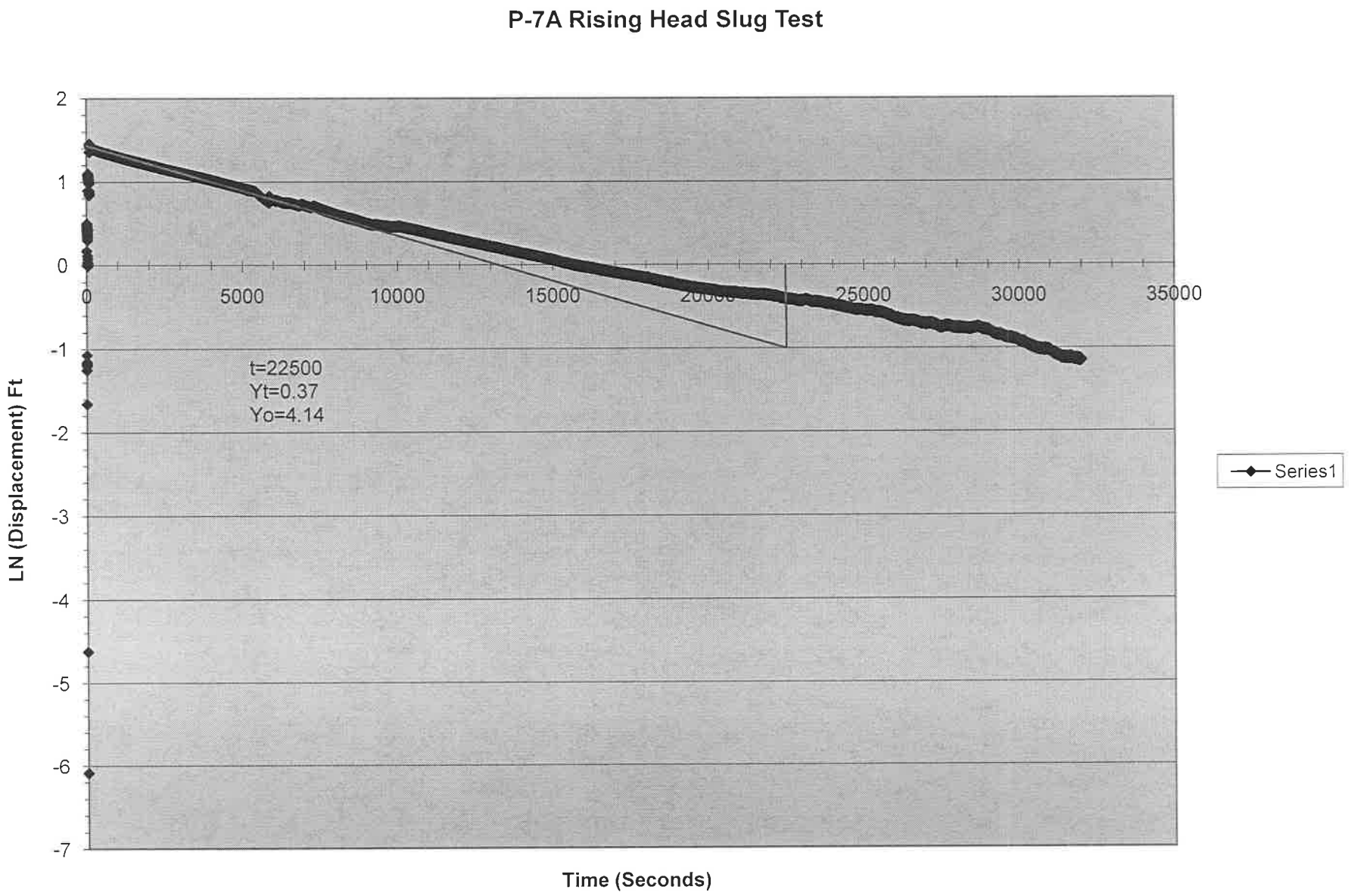
Use the Bouwer-Rice plot to determine A, B, and C. Enter the values here:

A =	**2.27**
B =	**0.35**
C =	**1.86**

ln(Re/rw) =	3.237076328	(fully pen.)			
ln(Re/rw) =	2.643739406	(partial pen.)	yo =	**1.97**	ft.
ln(Re/rw) =	2.643739406	(value used)	yt =	**0.14**	ft.
Re =	34.61900754	ft	t =	**3750**	sec

Hydraulic Conductivity (K)	=	**6.47E-07**	**ft./sec**
K	=	**5.59E-02**	**ft./day**
K	=	**1.97E-05**	**cm/sec**
K	=	**1.70E-02**	**m/day**
K	=	**4.17E-01**	**gpd/ft^2**

Apex Landfill Lateral Expansion
Single Well Slug Test



SLUG TEST ANALYSIS

BOUWER-RICE METHOD

Confined Aquifer

Client:	Apex Environmental, LLC
Location:	Amsterdam, OH
Project No:	101-049

P-7A

Well Name:	P-7A

Well Data

Top of casing elevation	=	1266.64	ft. msl
Ground surface elevation	=	1263.93	ft. msl
Depth to base of screen (bgs)	=	38	ft.
Screen Length	=	5	ft.
Sand pack above screen	=	1.2	ft.
Sand pack below screen	=	1	ft.
Static water level (bTOC)	=	63.66	ft.
Depth to Top of Aquifer (bgs)	=	32	ft.
Depth to aquifer base (bgs)	=	40	ft.
Radius of the well casing	=	0.0833	ft.
Radius of the bore hole	=	0.67	ft.
Gravel pack porosity	=	0.3	
Initial displacement of water	=	3.169	ft.
Effective Base of Screen	=	1225.93	ft msl
Effective Top of Screen	=	1230.93	ft msl
Effective screen length	=	5	ft

Bouwer - Rice Data

H =	6	ft.	
L =	5	ft.	
D =	8	ft.	
rc'=	0.37353343	ft.	
rw =	0.67	ft.	
Top of Aquifer	1231.93	ft msl	
Base of Aquifer	1223.93	ft msl	
Top of Screen	1230.93	ft msl	
Base of Screen	1225.93	ft msl	
Saturated Thickness	8	ft.	
Total Head	6	ft	
Sand pack length(e)	7.2	ft	
Screen radius [rc'](e)	0.37353	ft	
WL at start of test	1199.81	ft msl	
Static Water Level	1202.98	ft msl	
Le/rw =	7.46269		

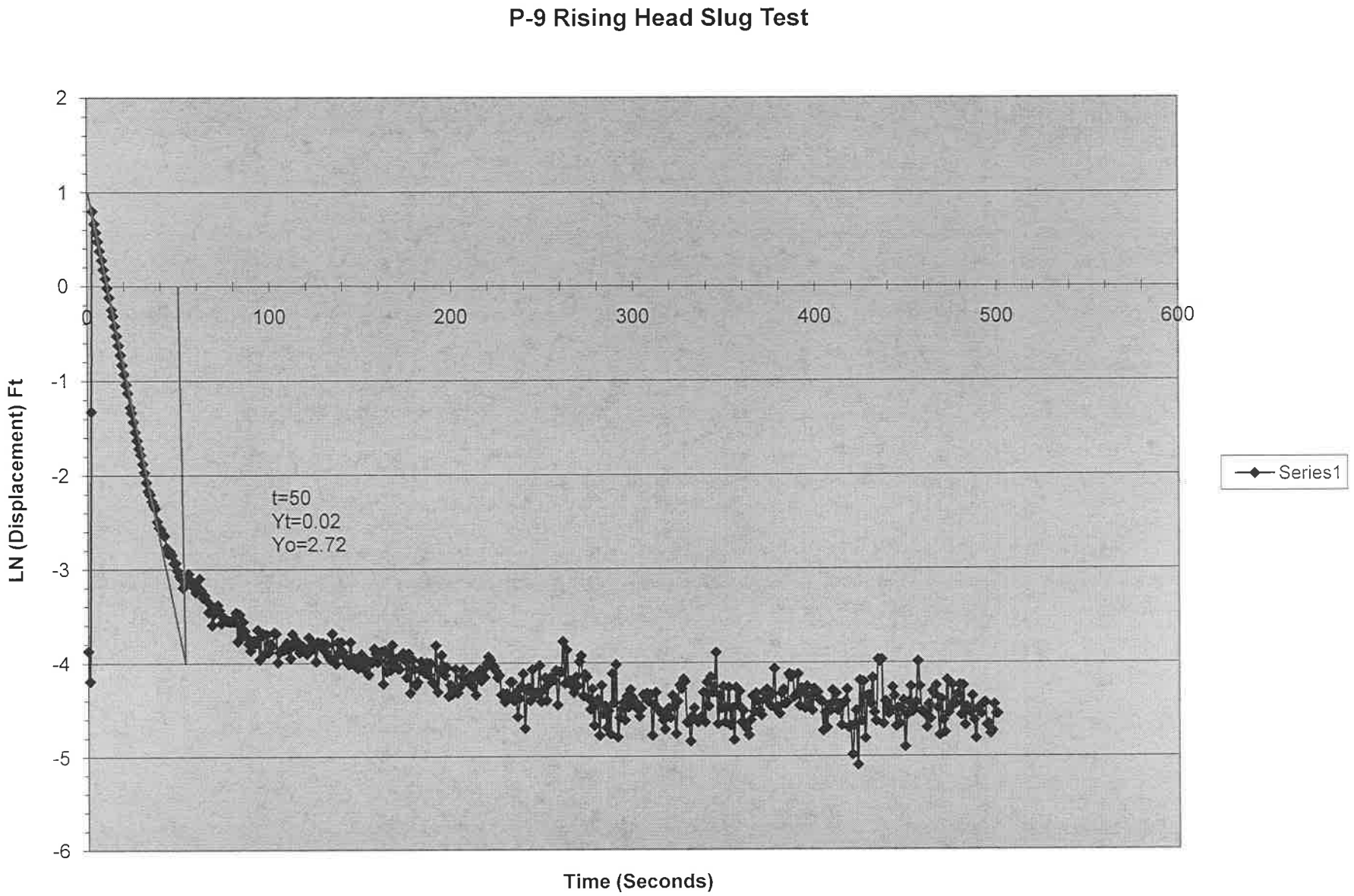
Use the Bouwer-Rice plot to determine A, B, and C. Enter the values here:

A =	**1.77**
B =	**0.25**
C =	**1**

ln(Re/rw) =	1.572894479	(fully pen.)	
ln(Re/rw) =	1.289346027	(partial pen.)	yo = **4.14** ft.
ln(Re/rw) =	1.289346027	(value used)	yt = **0.37** ft.
Re =	5.418524759 ft		t = **22500** sec

Hydraulic Conductivity (K)	=	**1.93E-06**	**ft./sec**
K	=	**1.67E-01**	**ft./day**
K	=	**5.89E-05**	**cm/sec**
K	=	**5.09E-02**	**m/day**
K	=	**1.24E+00**	**gpd/ft^2**

Apex Landfill Lateral Expansion
Single Well Slug Test



SLUG TEST ANALYSIS

BOUWER-RICE METHOD

Confined Aquifer

Client:	Apex Environmental, LLC
Location:	Amsterdam, OH
Project No:	101-049

P-9

Well Name:	P-9

Well Data

Top of casing elevation	=	1259.50	ft. msl
Ground surface elevation	=	1256.94	ft. msl
Depth to base of screen (bgs)	=	144	ft.
Screen Length	=	10	ft.
Sand pack above screen	=	3	ft.
Sand pack below screen	=	1	ft.
Static water level (bTOC)	=	106.17	ft.
Depth to Top of Aquifer (bgs)	=	112.6	ft.
Depth to aquifer base (bgs)	=	160.5	ft.
Radius of the well casing	=	0.0833	ft.
Radius of the bore hole	=	0.4063	ft.
Gravel pack porosity	=	0.3	
Initial displacement of water	=	3.169	ft.
Effective Base of Screen	=	1112.94	ft msl
Effective Top of Screen	=	1122.94	ft msl
Effective screen length	=	10	ft

Bouwer - Rice Data

H =	31.4	ft.
L =	10	ft.
D =	47.9	ft.
rc'=	0.0833	ft.
rw =	0.4063	ft.
Top of Aquifer	1144.34	ft msl
Base of Aquifer	1096.44	ft msl
Top of Screen	1122.94	ft msl
Base of Screen	1112.94	ft msl
Saturated Thickness	47.9	ft.
Total Head	31.4	ft
Sand pack length(e)	14	ft
Screen radius [rc'](e)	0.2332	ft
WL at start of test	1150.16	ft msl
Static Water Level	1153.33	ft msl
Le/rw =	24.6124	

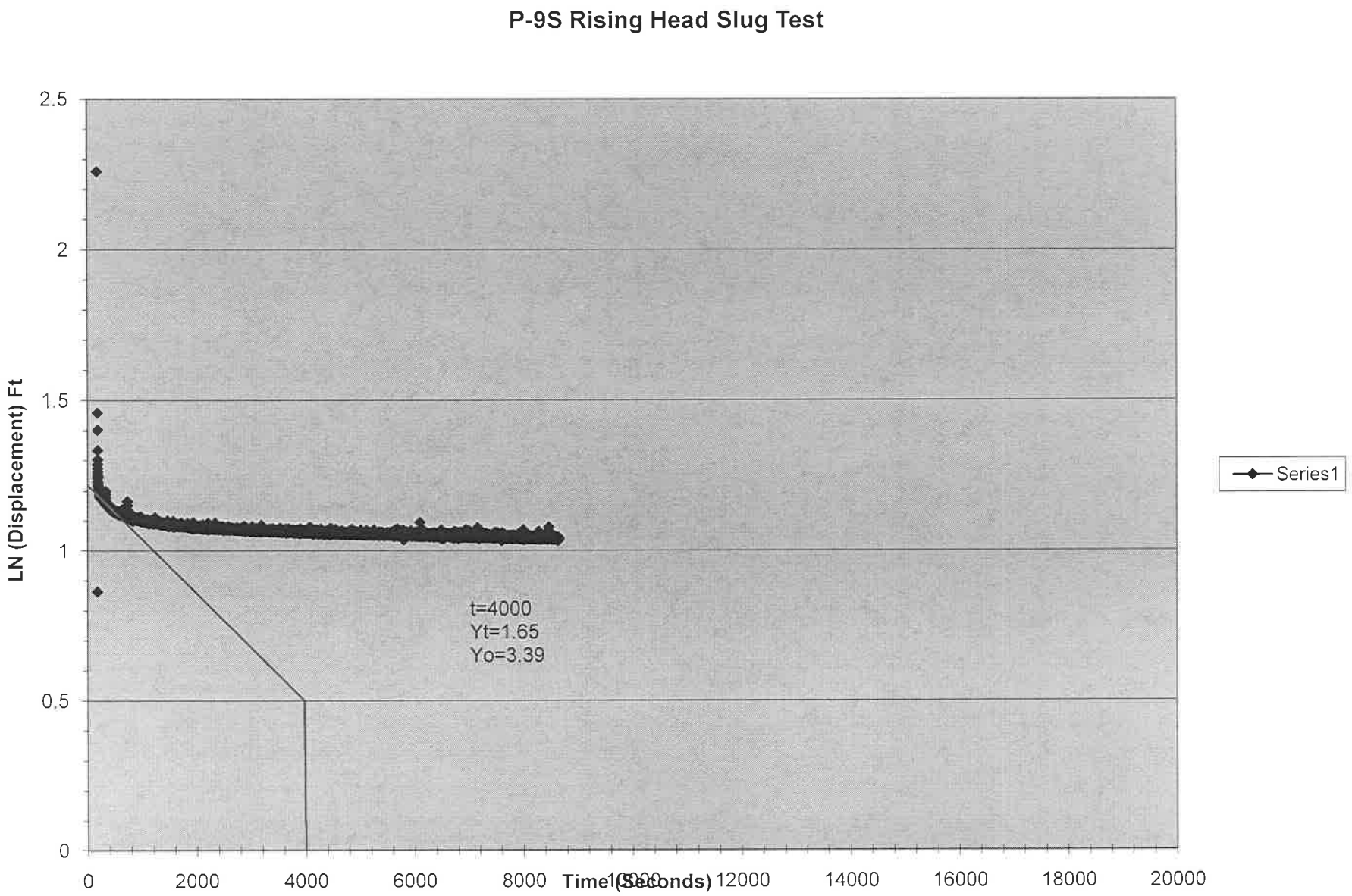
Use the Bouwer-Rice plot to determine A, B, and C. Enter the values here:

A =	**2.27**
B =	**0.35**
C =	**1.86**

ln(Re/rw) =	3.043283624	(fully pen.)			
ln(Re/rw) =	2.513043866	(partial pen.)	yo =	2.72	ft.
ln(Re/rw) =	2.513043866	(value used)	yt =	0.02	ft.
Re =	30.37765613	ft	t =	50	sec

Hydraulic Conductivity (K)	=	**8.57E-05**	**ft./sec**
K	=	**7.40E+00**	**ft./day**
K	=	**2.62E-03**	**cm/sec**
K	=	**2.26E+00**	**m/day**
K	=	**5.52E+01**	**gpd/ft^2**

Apex Landfill Lateral Expansion
Single Well Slug Test



SLUG TEST ANALYSIS

BOUWER-RICE METHOD

Confined Aquifer

Client:	Apex Environmental, LLC
Location:	Amsterdam, OH
Project No:	101-049

P-9S

Well Name:	P-9S

Well Data

Top of casing elevation	=	1260.76	ft. msl
Ground surface elevation	=	1257.81	ft. msl
Depth to base of screen (bgs)	=	80	ft.
Screen Length	=	10	ft.
Sand pack above screen	=	3	ft.
Sand pack below screen	=	1	ft.
Static water level (bTOC)	=	78.6	ft.
Depth to Top of Aquifer (bgs)	=	50.9	ft.
Depth to aquifer base (bgs)	=	112.6	ft.
Radius of the well casing	=	0.0833	ft.
Radius of the bore hole	=	0.4063	ft.
Gravel pack porosity	=	0.3	
Initial displacement of water	=	3.169	ft.
Effective Base of Screen	=	1177.81	ft msl
Effective Top of Screen	=	1187.81	ft msl
Effective screen length	=	10	ft

Bouwer - Rice Data

H =	29.1	ft.
L =	10	ft.
D =	61.7	ft.
rc'=	0.23319762	ft.
rw =	0.4063	ft.
Top of Aquifer	1206.91	ft msl
Base of Aquifer	1145.21	ft msl
Top of Screen	1187.81	ft msl
Base of Screen	1177.81	ft msl
Saturated Thickness	61.7	ft.
Total Head	29.1	ft
Sand pack length(e)	14	ft
Screen radius [rc'](e)	0.2332	ft
WL at start of test	1178.99	ft msl
Static Water Level	1182.16	ft msl
Le/rw =	24.6124	

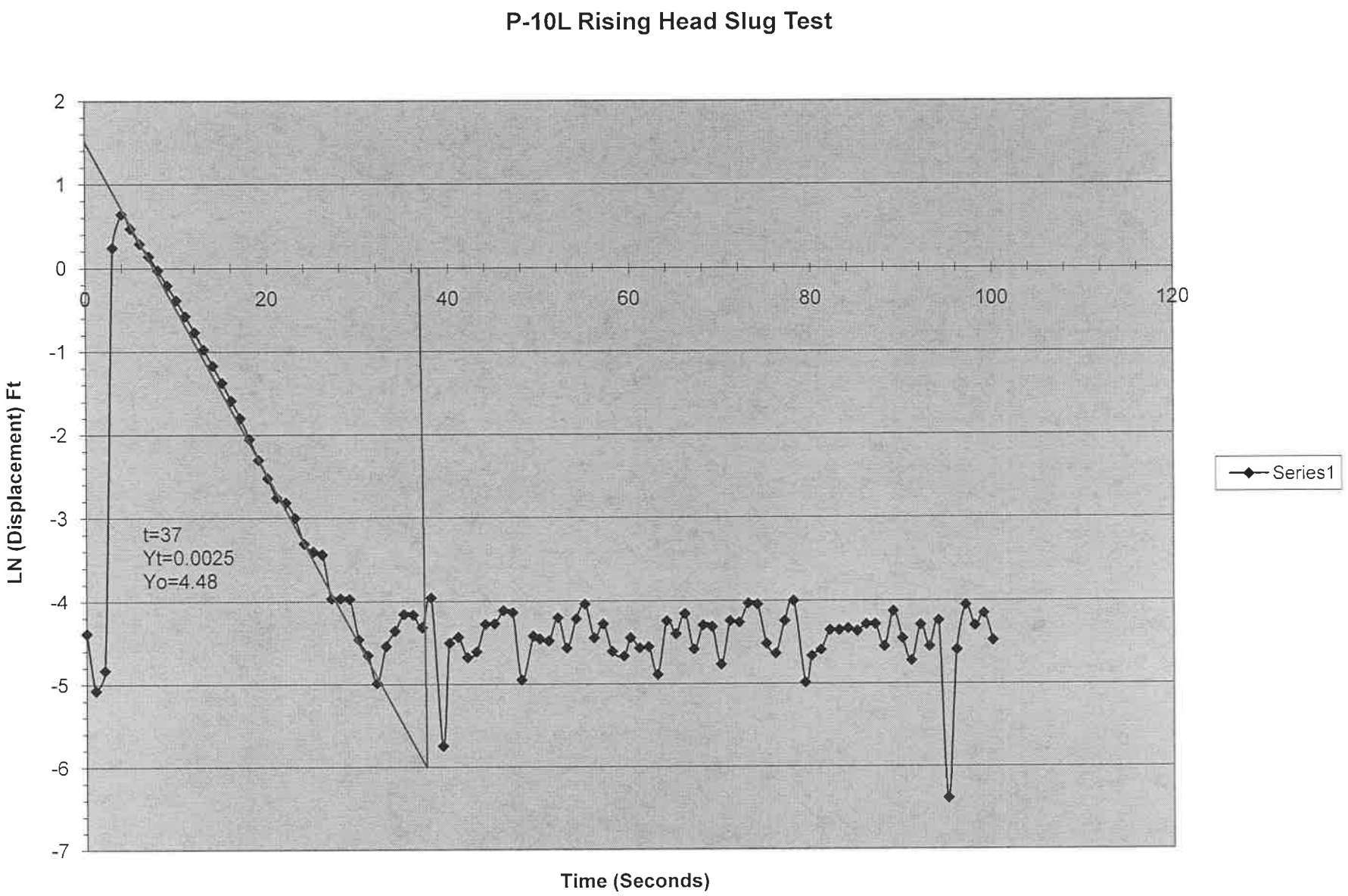
Use the Bouwer-Rice plot to determine A, B, and C. Enter the values here:

A =	**2.27**
B =	**0.35**
C =	**1.86**

ln(Re/rw) =	3.00211493	(fully pen.)			
ln(Re/rw) =	2.426516853	(partial pen.)	yo =	**3.39**	ft.
ln(Re/rw) =	2.426516853	(value used)	yt =	**1.65**	ft.
Re =	27.85967572	ft	t =	**4000**	sec

Hydraulic Conductivity (K)	=	**1.19E-06**	**ft./sec**
K	=	**1.03E-01**	**ft./day**
K	=	**3.63E-05**	**cm/sec**
K	=	**3.13E-02**	**m/day**
K	=	**7.66E-01**	**gpd/ft^2**

Apex Landfill Lateral Expansion
Single Well Slug Test



SLUG TEST ANALYSIS

BOUWER-RICE METHOD

Confined Aquifer

Client:	Apex Environmental, LLC
Location:	Amsterdam, OH
Project No:	101-049

P-10L

Well Name:	P-10L

Well Data

Top of casing elevation	=	1268.83	ft. msl
Ground surface elevation	=	1266.43	ft. msl
Depth to base of screen (bgs)	=	60	ft.
Screen Length	=	10	ft.
Sand pack above screen	=	3	ft.
Sand pack below screen	=	1	ft.
Static water level (bTOC)	=	46.11	ft.
Depth to Top of Aquifer (bgs)	=	44	ft.
Depth to aquifer base (bgs)	=	79.7	ft.
Radius of the well casing	=	0.0833	ft.
Radius of the bore hole	=	0.4063	ft.
Gravel pack porosity	=	0.3	
Initial displacement of water	=	3.169	ft.
Effective Base of Screen	=	1206.43	ft msl
Effective Top of Screen	=	1216.43	ft msl
Effective screen length	=	10	ft

Bouwer - Rice Data

H =	16	ft.
L =	10	ft.
D =	35.7	ft.
rc'=	0.0833	ft.
rw =	0.4063	ft.
Top of Aquifer	1222.43	ft msl
Base of Aquifer	1186.73	ft msl
Top of Screen	1216.43	ft msl
Base of Screen	1206.43	ft msl
Saturated Thickness	35.7	ft.
Total Head	16	ft
Sand pack length(e)	14	ft
Screen radius [rc'](e)	0.2332	ft
WL at start of test	1219.55	ft msl
Static Water Level	1222.72	ft msl
Le/rw =	24.6124	

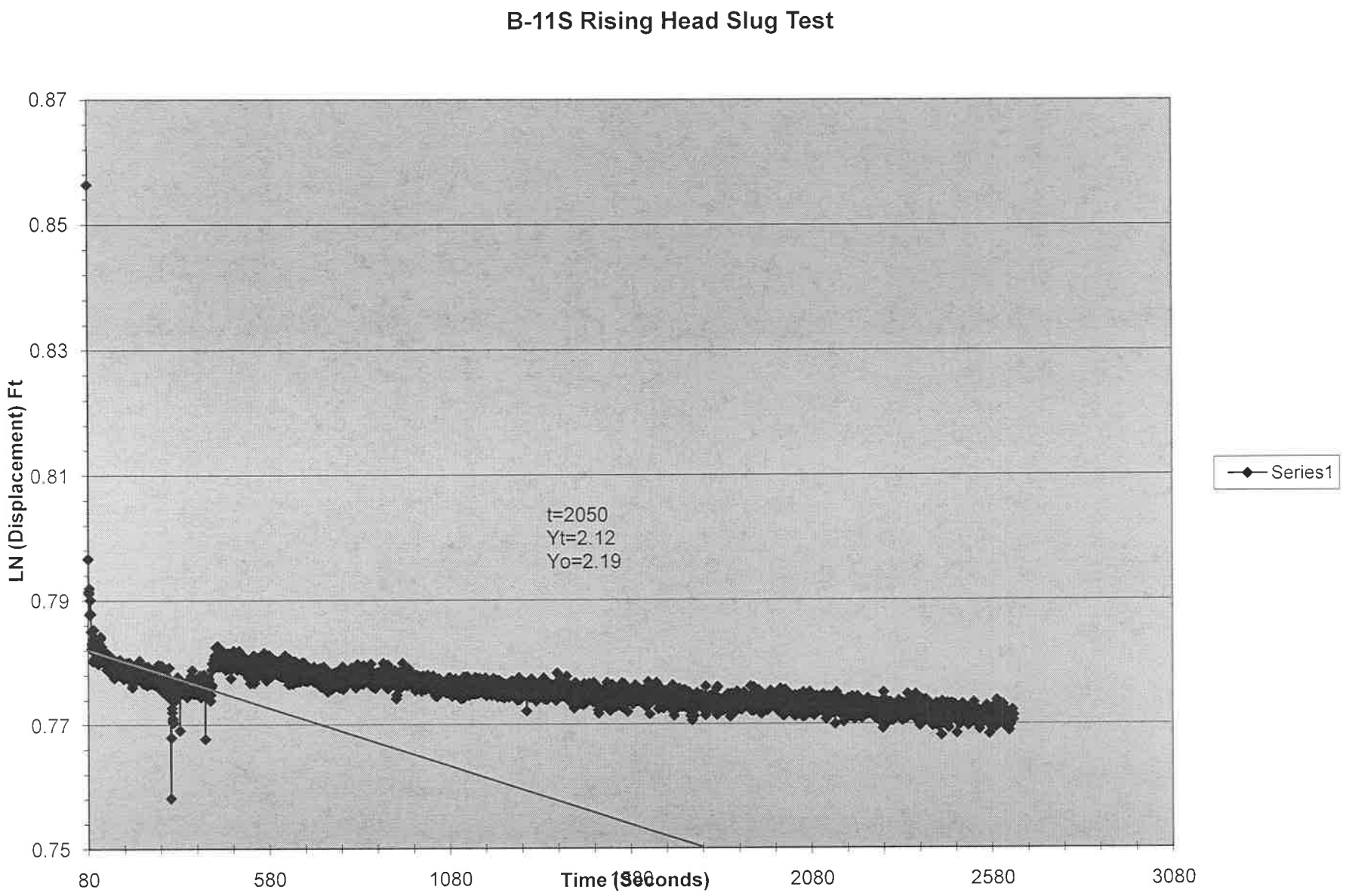
Use the Bouwer-Rice plot to determine A, B, and C. Enter the values here:

A =	**2.27**
B =	**0.35**
C =	**1.86**

ln(Re/rw) =	2.666425268	(fully pen.)			
ln(Re/rw) =	2.237707045	(partial pen.)	yo =	4.48	ft.
ln(Re/rw) =	2.237707045	(value used)	yt =	0.0025	ft.
Re =	23.06625026	ft	t =	37	sec

Hydraulic Conductivity (K)	=	**1.57E-04**	**ft./sec**
K	=	**1.36E+01**	**ft./day**
K	=	**4.80E-03**	**cm/sec**
K	=	**4.14E+00**	**m/day**
K	=	**1.01E+02**	**gpd/ft^2**

Apex Landfill Lateral Expansion
Single Well Slug Test



SLUG TEST ANALYSIS

BOUWER-RICE METHOD

Confined Aquifer

Client:	Apex Environmental, LLC
Location:	Amsterdam, OH
Project No:	101-049

B-11S

Well Name:	B-11S

Well Data

Top of casing elevation	=	1246.63	ft. msl
Ground surface elevation	=	1244.30	ft. msl
Depth to base of screen (bgs)	=	58.5	ft.
Screen Length	=	10	ft.
Sand pack above screen	=	5.7	ft.
Sand pack below screen	=	1.9	ft.
Static water level (bTOC)	=	36.49	ft.
Depth to Top of Aquifer (bgs)	=	13.5	ft.
Depth to aquifer base (bgs)	=	61	ft.
Radius of the well casing	=	0.0833	ft.
Radius of the bore hole	=	0.2604	ft.
Gravel pack porosity	=	0.3	
Initial displacement of water	=	3.169	ft.
Effective Base of Screen	=	1185.8	ft msl
Effective Top of Screen	=	1195.8	ft msl
Effective screen length	=	10	ft

Bouwer - Rice Data

H =	45	ft.
L =	10	ft.
D =	47.5	ft.
rc'=	0.0833	ft.
rw =	0.2604	ft.
Top of Aquifer	1230.8	ft msl
Base of Aquifer	1183.3	ft msl
Top of Screen	1195.8	ft msl
Base of Screen	1185.8	ft msl
Saturated Thickness	47.5	ft.
Total Head	45	ft
Sand pack length(e)	17.6	ft
Screen radius [rc'](e)	0.15874	ft
WL at start of test	1206.97	ft msl
Static Water Level	1210.14	ft msl
Le/rw =	38.4025	

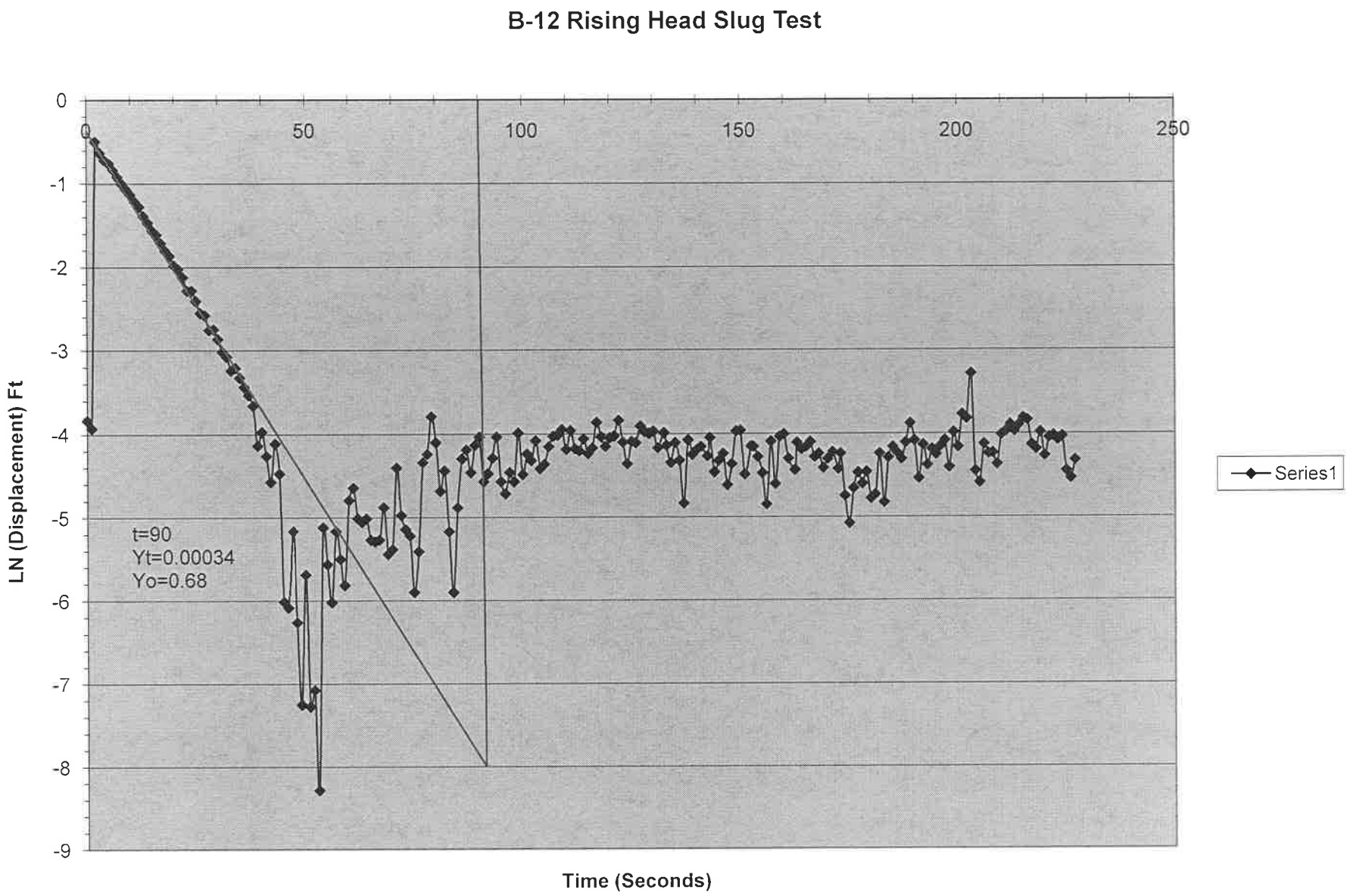
Use the Bouwer-Rice plot to determine A, B, and C. Enter the values here:

A =	**2.66**
B =	**0.41**
C =	**2.32**

ln(Re/rw) =	3.650782555	(fully pen.)			
ln(Re/rw) =	3.258224239	(partial pen.)	yo =	**2.19**	ft.
ln(Re/rw) =	3.258224239	(value used)	yt =	**2.12**	ft.
Re =	99.8591415	ft	t =	**2050**	sec

Hydraulic Conductivity (K)	=	**1.79E-08**	**ft./sec**
K	=	**1.55E-03**	**ft./day**
K	=	**5.47E-07**	**cm/sec**
K	=	**4.72E-04**	**m/day**
K	=	**1.16E-02**	**gpd/ft^2**

Apex Landfill Lateral Expansion
Single Well Slug Test



SLUG TEST ANALYSIS

BOUWER-RICE METHOD
Confined Aquifer

Client:	Apex Environmental, LLC
Location:	Amsterdam, OH
Project No:	101-049

B-12

Well Name:	B-12

Well Data

Top of casing elevation	=	1284.83	ft. msl
Ground surface elevation	=	1282.30	ft. msl
Depth to base of screen (bgs)	=	182.2	ft.
Screen Length	=	10	ft.
Sand pack above screen	=	14.8	ft.
Sand pack below screen	=	10.8	ft.
Static water level (bTOC)	=	131.43	ft.
Depth to Top of Aquifer (bgs)	=	129	ft.
Depth to aquifer base (bgs)	=	187	ft.
Radius of the well casing	=	0.0833	ft.
Radius of the bore hole	=	0.2448	ft.
Gravel pack porosity	=	0.3	
Initial displacement of water	=	3.169	ft.
Effective Base of Screen	=	1100.1	ft msl
Effective Top of Screen	=	1110.1	ft msl
Effective screen length	=	10	ft

Bouwer - Rice Data

H =	53.2	ft.	
L =	10	ft.	
D =	58	ft.	
rc'=	0.0833	ft.	
rw =	0.2448	ft.	
Top of Aquifer	1153.3	ft msl	
Base of Aquifer	1095.3	ft msl	
Top of Screen	1110.1	ft msl	
Base of Screen	1100.1	ft msl	
Saturated Thickness	58	ft.	
Total Head	53.2	ft	
Sand pack length(e)	35.6	ft	
Screen radius [rc'](e)	0.15111	ft	
WL at start of test	1150.23	ft msl	
Static Water Level	1153.40	ft msl	
Le/rw =	40.8497		

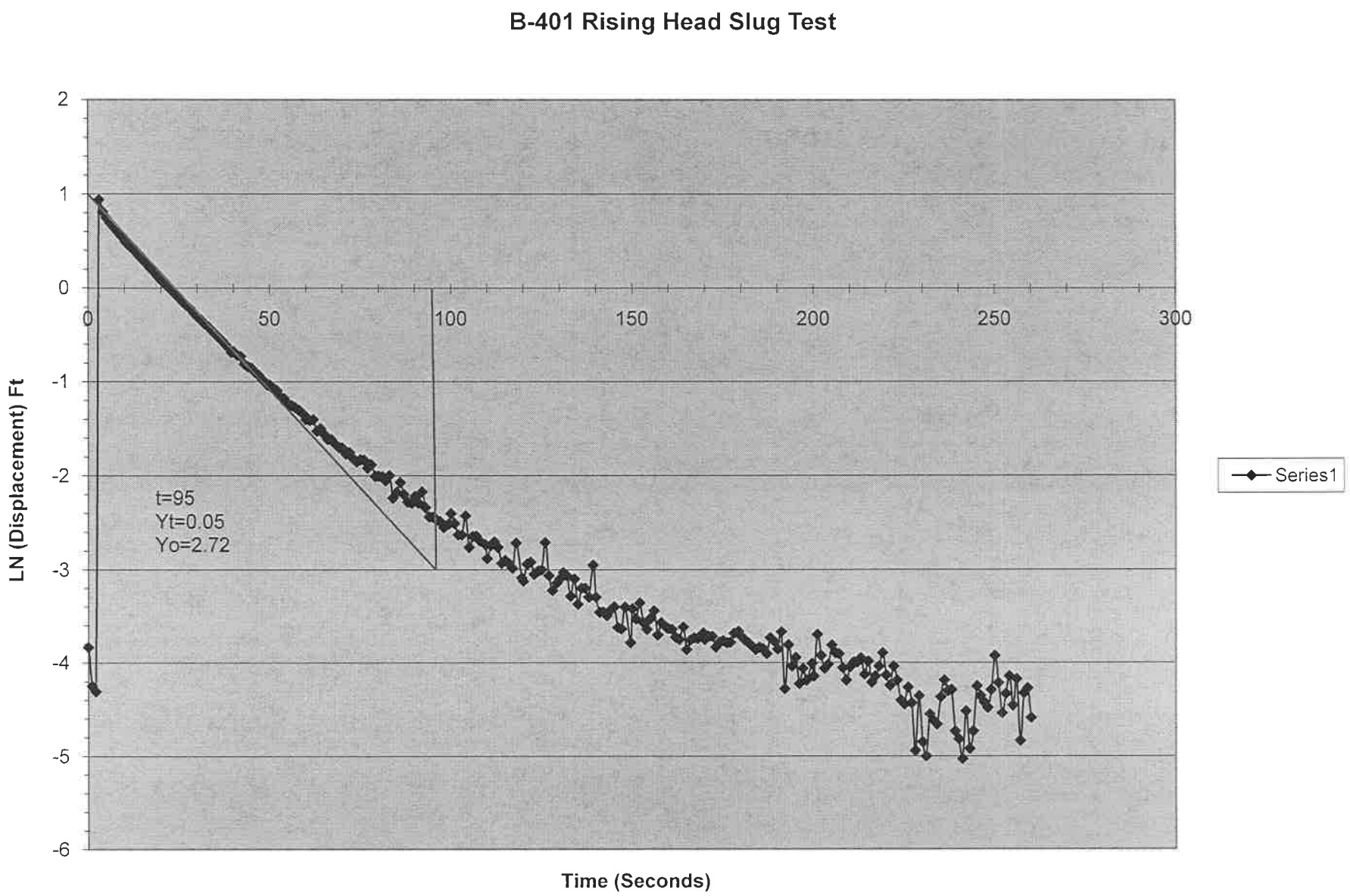
Use the Bouwer-Rice plot to determine A, B, and C. Enter the values here:

A =	**2.7**
B =	**0.42**
C =	**2.4**

ln(Re/rw) =	3.799957561	(fully pen.)			
ln(Re/rw) =	3.321132026	(partial pen.)	yo =	0.68	ft.
ln(Re/rw) =	3.321132026	(value used)	yt =	0.00034	ft.
Re =	113.1196099 ft		t =	90	sec

Hydraulic Conductivity (K)	=	**9.73E-05**	**ft./sec**
K	=	**8.41E+00**	**ft./day**
K	=	**2.97E-03**	**cm/sec**
K	=	**2.56E+00**	**m/day**
K	=	**6.27E+01**	**gpd/ft^2**

Apex Landfill Lateral Expansion
Single Well Slug Test



SLUG TEST ANALYSIS

BOUWER-RICE METHOD

Confined Aquifer

Client:	Apex Environmental, LLC
Location:	Amsterdam, OH
Project No:	101-049

B-401

Well Name:	B-401

Well Data

Top of casing elevation	=	1265.63	ft. msl
Ground surface elevation	=	1262.95	ft. msl
Depth to base of screen (bgs)	=	142	ft.
Screen Length	=	10	ft.
Sand pack above screen	=	3	ft.
Sand pack below screen	=	0	ft.
Static water level (bTOC)	=	109.03	ft.
Depth to Top of Aquifer (bgs)	=	124.5	ft.
Depth to aquifer base (bgs)	=	157.5	ft.
Radius of the well casing	=	0.0833	ft.
Radius of the bore hole	=	0.2552	ft.
Gravel pack porosity	=	0.3	
Initial displacement of water	=	3.169	ft.
Effective Base of Screen	=	1120.95	ft msl
Effective Top of Screen	=	1130.95	ft msl
Effective screen length	=	10	ft

Bouwer - Rice Data

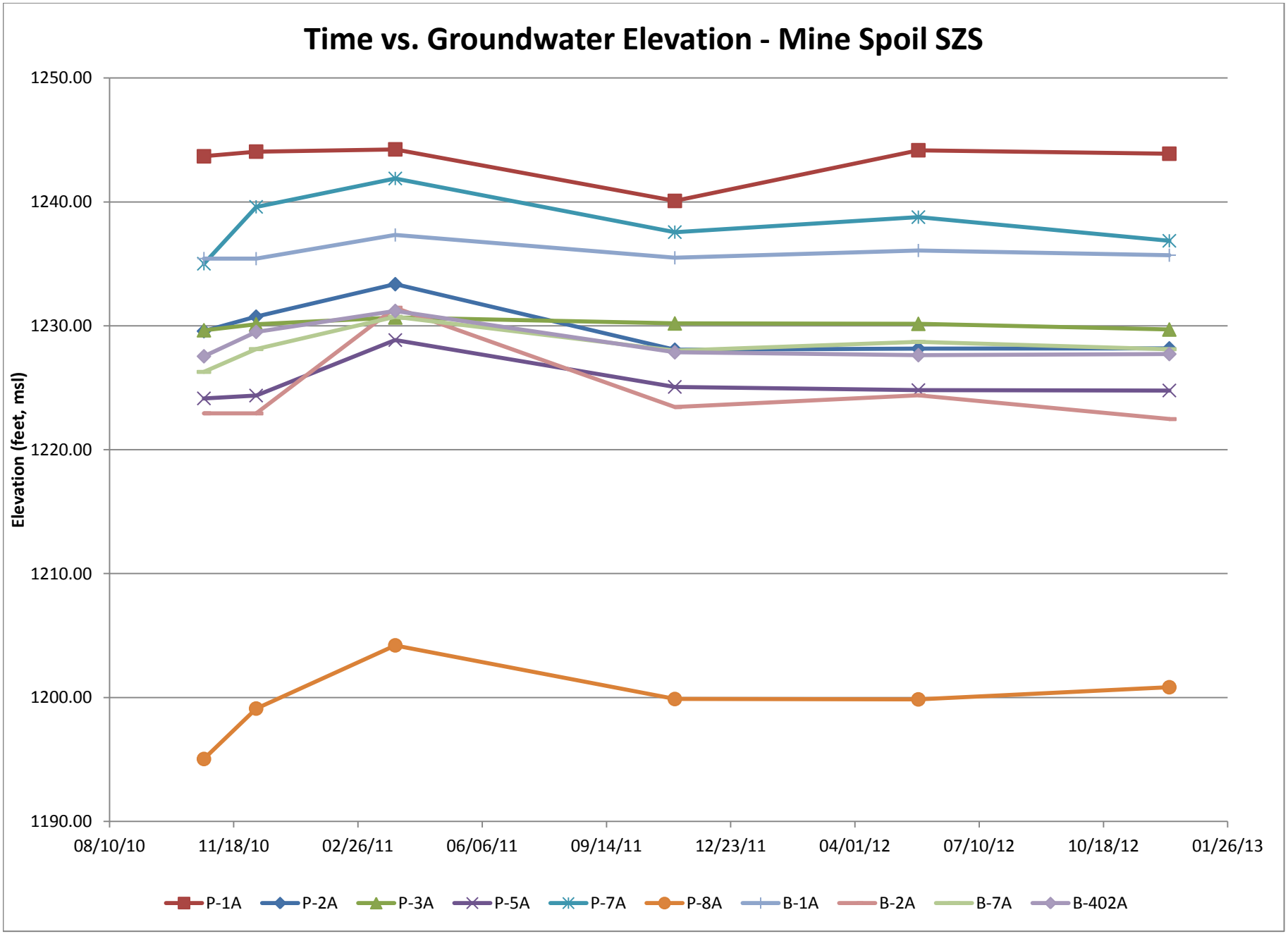
H =	17.5	ft.	
L =	10	ft.	
D =	33	ft.	
rc'=	0.0833	ft.	
rw =	0.2552	ft.	
Top of Aquifer	1138.45	ft msl	
Base of Aquifer	1105.45	ft msl	
Top of Screen	1130.95	ft msl	
Base of Screen	1120.95	ft msl	
Saturated Thickness	33	ft.	
Total Head	17.5	ft	
Sand pack length(e)	13	ft	
Screen radius [rc'](e)	0.15619	ft	
WL at start of test	1153.43	ft msl	
Static Water Level	1156.60	ft msl	
Le/rw =	39.185		

Use the Bouwer-Rice plot to determine A, B, and C. Enter the values here:

A =	**2.68**
B =	**0.42**
C =	**2.36**

ln(Re/rw) =	3.121068262	(fully pen.)			
ln(Re/rw) =	2.683950315	(partial pen.)	yo =	2.72	ft.
ln(Re/rw) =	2.683950315	(value used)	yt =	0.05	ft.
Re =	57.37783289	ft	t =	95	sec

Hydraulic Conductivity (K)	=	**3.92E-05**	**ft./sec**
K	=	**3.38E+00**	**ft./day**
K	=	**1.20E-03**	**cm/sec**
K	=	**1.03E+00**	**m/day**
K	=	**2.53E+01**	**gpd/ft^2**


Time vs. Groundwater Elevation - Mine Spoil SZS
Elevation (feet, msl)
1250.00
1240.00
1230.00
1220.00
1210.00
1200.00
1190.00
08/10/10
11/18/10
02/26/11
06/06/11
09/14/11
12/23/11
04/01/12
07/10/12
10/18/12
01/26/13
P-1A
P-2A
P-3A
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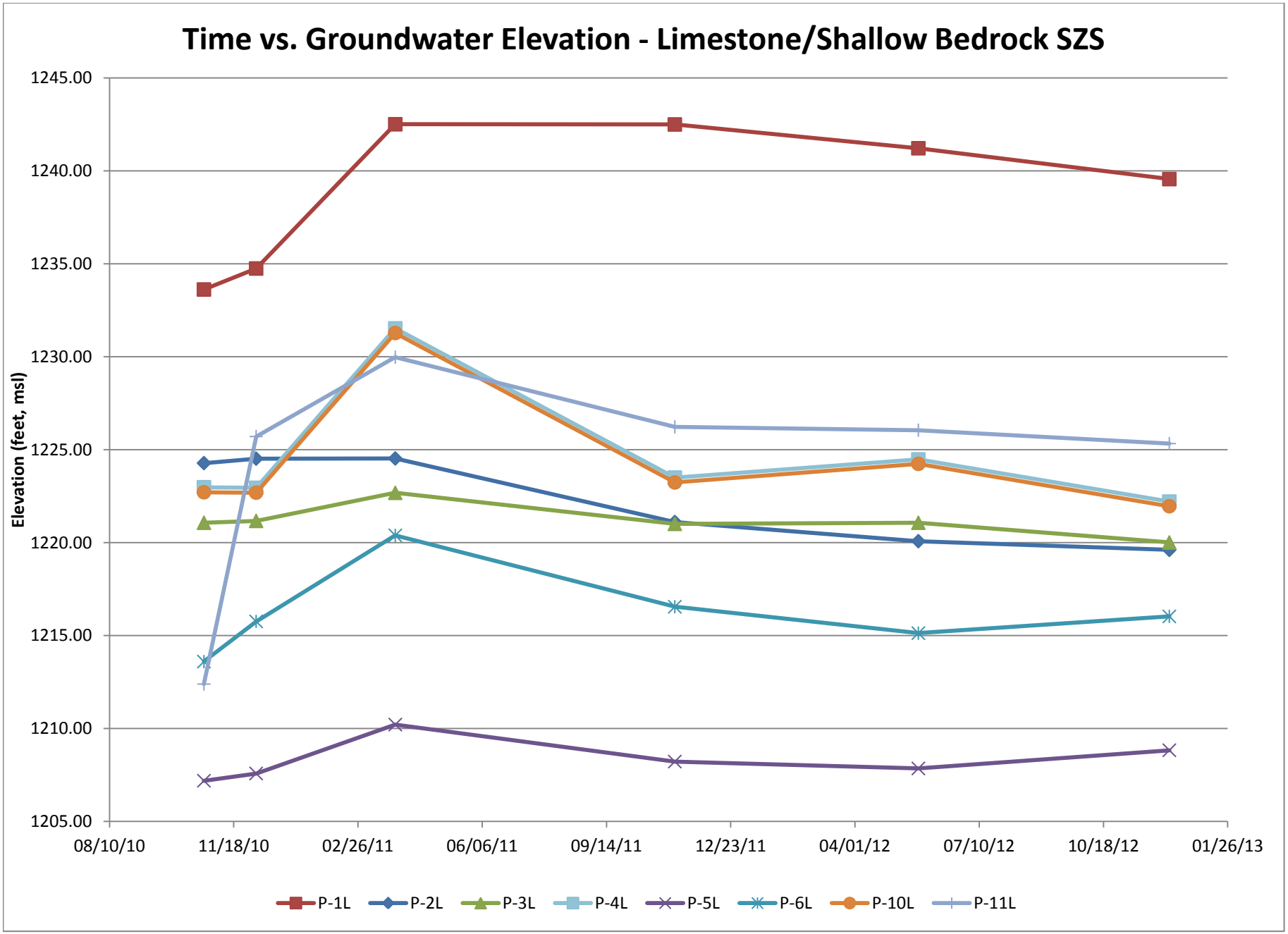
P-8A
B-1A
B-2A
B-7A
B-402A


Time vs. Groundwater Elevation - Limestone/Shallow Bedrock SZS
Elevation (feet, msl)
1245.00
1240.00
1235.00
1230.00
1225.00
1220.00
1215.00
1210.00
1205.00
08/10/10
11/18/10
02/26/11
06/06/11
09/14/11
12/23/11
04/01/12
07/10/12
10/18/12
01/26/13
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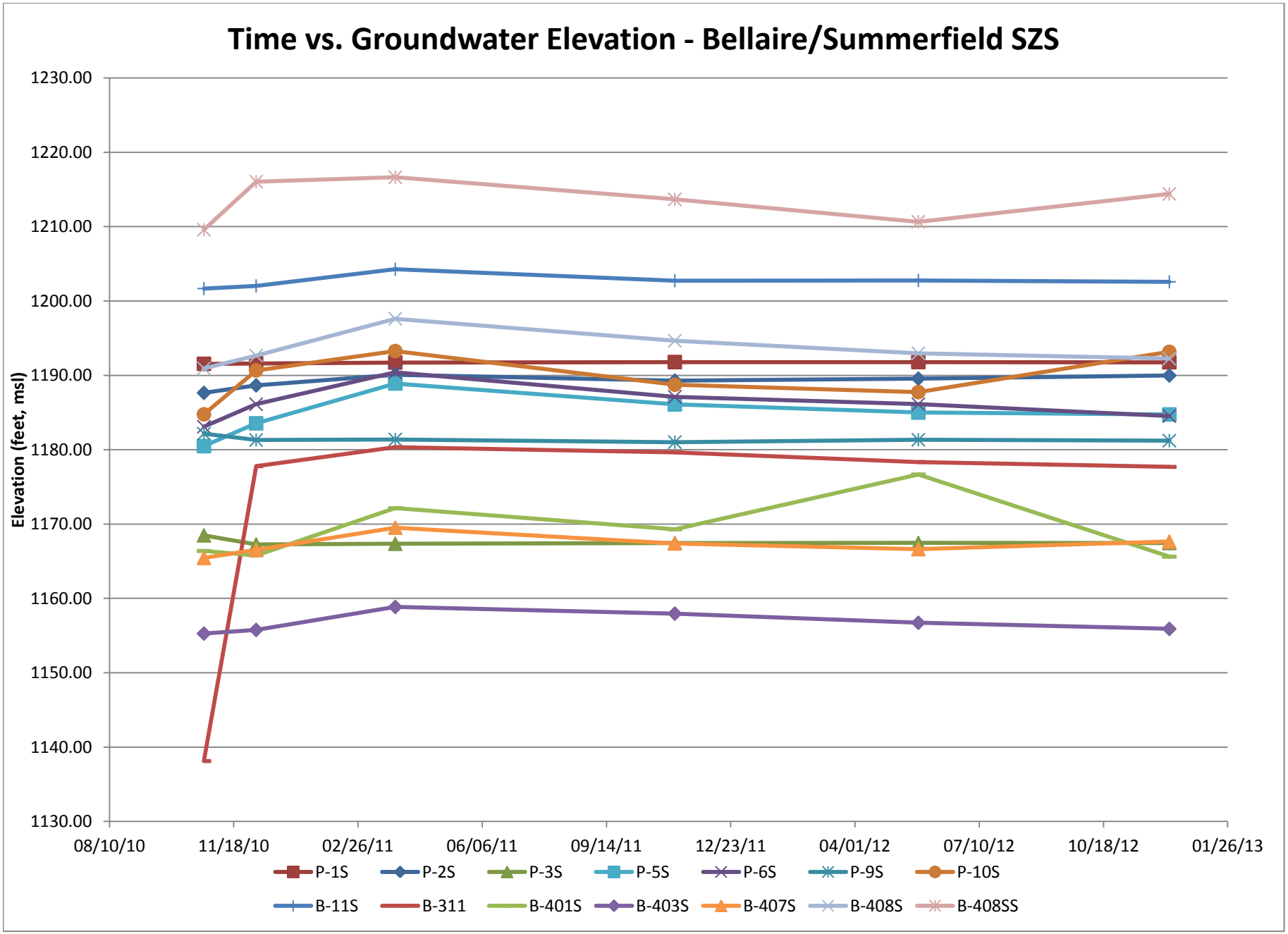
P-10L
P-11L


Time vs. Groundwater Elevation - Bellaire/Summerfield SZS
Elevation (feet, msl)
1230.00
1220.00
1210.00
1200.00
1190.00
1180.00
1170.00
1160.00
1150.00
1140.00
1130.00
08/10/10
11/18/10
02/26/11
06/06/11
09/14/11
12/23/11
04/01/12
07/10/12
10/18/12
01/26/13
P-1S
P-2S
P-3S
P-5S
P-6S
P-9S
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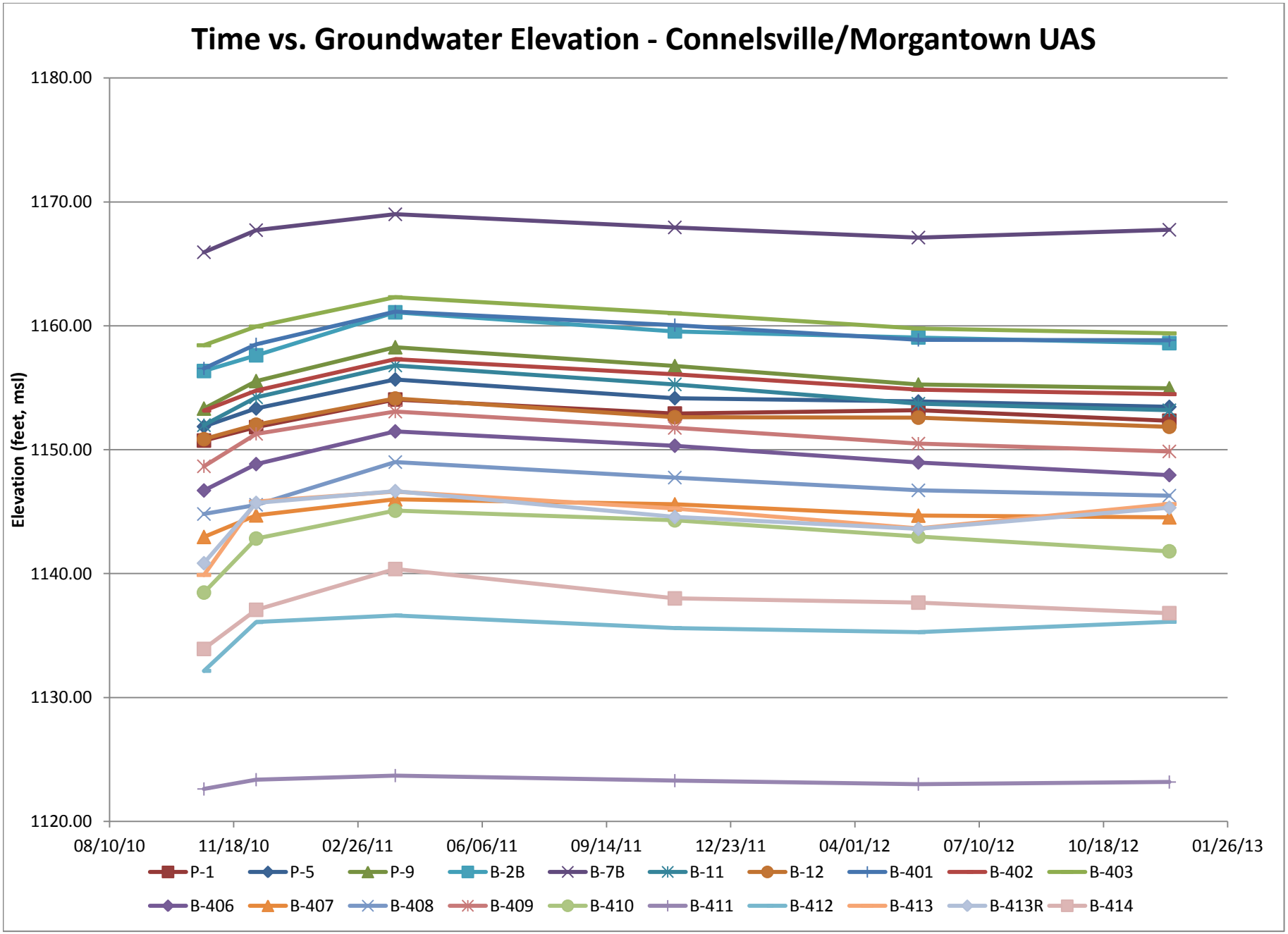
B-311
B-401S
B-403S
B-407S
B-408S
B-408SS


Time vs. Groundwater Elevation - Connelsville/Morgantown UAS
Elevation (feet, msl)
1180.00
1170.00
1160.00
1150.00
1140.00
1130.00
1120.00
08/10/10
11/18/10
02/26/11
06/06/11
09/14/11
12/23/11
04/01/12
07/10/12
10/18/12
01/26/13
P-1
P-5
P-9
B-2B
B-7B
B-11
B-12
B-401
B-402
B-403
B-406
B-407
B-408
B-409
B-410
B-411
B-412
B-413
B-413R
B-414

CONTIGUOUS EXPANSION
PERMIT TO INSTALL APPLICATION
APEX SANITARY LANDFILL
JEFFERSON COUNTY, OHIO

PREPARED FOR

Apex Environmental LLC
11 County Road 78
Amsterdam, Ohio 43903

PREPARED BY

Civil & Environmental Consultants, Inc.
333 Baldwin Road
Pittsburgh, Pennsylvania 15205

Revised May 2016

CEC Project 101-049

Volume VI of VI

Section (C)(9)(a) Groundwater Detection Monitoring Program

APEX
ENVIRONMENTAL LLC

CONTIGUOUS EXPANSION
PERMIT TO INSTALL APPLICATION
APEX SANITARY LANDFILL
JEFFERSON COUNTY, OHIO

CEC

May 2016
CEC Project
101-049

Volume VI of VI
Section
(C)(9)(a)

CONTIGUOUS EXPANSION
PERMIT TO INSTALL APPLICATION
APEX SANITARY LANDFILL
JEFFERSON COUNTY, OHIO

Prepared For:

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Pittsburgh, PA 15205

May 2016

CEC Project 101-049

Volume VI of VI
Section (C)(9)(a) Groundwater Detection Monitoring Program

Section C(9) Volume V

(Appendix C9-A)

CERTIFICATION BY QUALIFIED GROUNDWATER SCIENTIST

This certifies that the data and accompanying text submitted herein has been reviewed by me and, to the best of my knowledge, is accurate, complete, and complies with the applicable regulations included in OAC 3745-27 for a municipal solid waste disposal facility.

Roy A. Stanley, CPG
Project Manager
Civil & Environmental Consultants, Inc.

7-2-13
Date

Sworn to before me and subscribed by Roy A Stanley in my presence this 2nd day of July, 2013.

Suzanne D. DiPietro
Notary

My Commission expires on

NOTARY SEAL STATE OF OHIO

SUZANNE D. DI PIETRO
NOTARY PUBLIC, STATE OF OHIO
MY COMMISSION EXPIRES FEBRUARY 20, 2018

APEX SANITARY LANDFILL
GROUNDWATER DETECTION MONITORING PROGRAM
REVISIONS LOG

Date of Revision	Number	Revision By:
October 2011 (Original)	0	Created by CEC
Revision 1 July 2013	1	CEC

GROUNDWATER DETECTION MONITORING PROGRAM

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3745-27-10 GROUNDWATER DETECTION MONITORING PROGRAM FOR A SANITARY LANDFILL FACILITY

The groundwater monitoring program for the existing Apex Sanitary Landfill and the contiguous lateral expansion is presented in the following sections, in accordance with Ohio Administrative Code (OAC) 3745-27-10 Municipal Solid Waste Landfill Regulations. The Apex Sanitary Landfill is located in Springfield Township, Jefferson County and is approximately three miles south of Amsterdam, Ohio. The majority of the proposed contiguous expansion area is positioned along the southern portion of the existing Apex Sanitary Landfill within the revised facility boundary and Apex owned property.

The existing facility is currently in detection monitoring status in accordance with the approved Groundwater Detection Monitoring Program (GWDMP), October 9, 2009, revised December 16, 2011. To account for the proposed contiguous lateral expansion, the December 16, 2011~~October 2009~~ GWDMP has been updated and is included herein.

The existing Apex Landfill is rectangular in shape with plan dimensions of 1600 by 3200 feet (approximately 118 acres). The landfill has been and will continue to be constructed by excavating the existing mine spoil, underclay, and in some places the Upper Pittsburgh Limestone, placing structural fill or added geologic material (AGM) (where additional isolation is required from the uppermost aquifer), constructing the liner and leachate collection system, placing the solid waste, and covering the waste with a final cap. Detailed engineering plans have been developed for the landfill by Linn Engineering, Inc. of Zanesville, Ohio with several alteration requests submitted by CEC. BBC&M Engineering, Inc. prepared and submitted the revised Hydrogeologic Site Investigation (HSI) Report of the site in January of 2001. At the request of Ohio EPA for additional information regarding the Upper Pittsburgh Limestone beneath the permitted landfill, CEC prepared the Addendum I to the Hydrogeologic Investigation Report (Addendum I)[1].

The proposed landfill expansion area is also generally rectangular in shape with approximate plan dimensions of 2100 by 4500 feet (approximately 178 acres) with portions of the proposed expansion area overlying the southern permitted facility. The proposed landfill expansion will be

[1] Addendum I to the Hydrogeologic Investigation Report, Apex Sanitary Landfill, Jefferson County, Ohio. Original HIR prepared by BBC&M Engineering, Inc., November 1994, revised January 2001. Addendum prepared by Civil & Environmental Consultants, Inc., Project No. 100-804, October 2012.

constructed by excavating the existing mine spoil and in some places the Upper Pittsburgh Limestone / Ss~~s~~hallow Bb~~b~~edrock which yields higher amount of groundwater as documented in the Hydrogeologic Site Investigation Report (HSIR), August 2011, revised July 2013. The mine spoil and shallow bedrock, where applicable, will be removed from beneath the proposed limits of waste; however, will remain beneath the proposed perimeter berm. Because mine spoil will remain beneath the perimeter berm, the mine spoil (were saturated) could potentially act as a contaminate pathway. Subsequently, the saturated mine spoil has been designated as a Significant Zone of Saturation (SZS) for the proposed landfill expansion. For the existing facility, the mine spoil was completely removed from beneath the limits of waste and perimeter berm, therefore cannot act as a potential contaminate pathway. Detailed engineering plans have been developed for the proposed landfill expansion as detailed in the Permit to Install (PTI) application. This GWDMP will be incorporated in the PTI application in Volume V, Appendix C9-A upon final submittal of the PTI application.

(A)(1) APPLICABILITY

The Groundwater Detection Monitoring Program (GWDMP) and all the required elements are outlined in the following sections. Figure 1 is a site map which outlines the approximate location of the existing Apex Landfill and proposed expansion area.

(A)(1)(a) Groundwater Detection Monitoring Program

The following sections detail the GWDMP for the Apex facility. The purpose of the monitoring program is to detect potential chemical degradation of the uppermost aquifer system (UAS) and the Significant Zone(s) of Saturation (SZS) from the sanitary landfill facility. This GWDMP complies with all requirements set forth in OAC 3745-27-10(B) through (D) and is based upon accepted industry standards.

(A)(1)(b) and (A)(1)(c)

A Groundwater Quality Assessment Monitoring Program and a Corrective Measures Program are not required for this site. Should the need arise for these plans, Apex will prepare them in accordance with OAC 3745-27-10(E) and (F), respectively.

(A)(2) Schedule for Implementation of Detection Monitoring

The Groundwater Detection Monitoring Program was implemented prior to any waste being placed in the facility. The first phase of detection monitoring wells were installed in June and August of 2005 during the construction of Phase 1 of the landfill. The first samples associated with background sampling were collected from the first phase of wells in July 2005 prior to waste being placed in the facility in accordance with OAC 3745-27-10(D)(5). Apex started accepting waste on November 28, 2005. At least five background samples were collected from most of the wells prior to waste acceptance. The eight background sampling events for Phase 1 detection monitoring wells were completed in July 2006.

The second phase of detection monitoring wells were installed during July 2006 during the construction of Phase 2 of the landfill. The Phase 2 monitoring well network also monitors Phase 3 of the landfill. Background sampling was initiated on the Phase 2 wells in September 2006 and

completed on October 1, 2007. Three independent background sampling events were conducted on the Phase 2 wells, prior to Phase 2 excepting waste on November 20, 2006.

The third phase of detection monitoring wells were installed in February 2008 during the construction of Phase 4a of the landfill. Background sampling was initiated on the Phase 4a wells in March 2008 prior to waste being placed in Phase 4a. Apex started accepting waste in Phase 4a in August 2008. Three background events were collected from the Phase 4a wells prior to waste acceptance. As of January 2009, eight background sampling events have been conducted on the Phase 4a monitoring wells. Monitoring well B-413 was installed during the construction of Phase 4a of the landfill. However, well B-413 was periodically dry during the background sampling events and was only sampled four out of eight events. Based on correspondence with the Ohio EPA dated January 28, 2009, it was suggested that a replacement well (B-413R) be installed if monitoring well B-413 continues to produce insufficient groundwater for sampling purposes. Therefore, replacement monitoring well B-413R was installed deeper into the UAS on May 5-8, 2009 just north of well B-413. B-413 will continue to monitored for the presence or absence of groundwater, however not sampled on a routine basis.

The fourth phase of detection monitoring wells were installed in May and August 2009 during the construction of Phase 4b of the landfill. Background sampling was initiated on the Phase 4b wells in May and August 2009 prior to waste being placed in Phase 4b. Apex started accepting waste in Phase 4b (cell #1) in October 2009. Three background sampling events were conducted on the Phase 4b monitoring wells prior to waste placement.

The fifth phase of detection monitoring wells were installed in November 2010 during the construction of Phase 5 of the landfill. Background sampling was initiated on the Phase 5 wells in December 2011 prior to waste being placed in Phase 5. Apex started accepting waste in Phase 5 in March 2011. Three background sampling events were conducted on the Phase 5 monitoring wells prior to waste placement.

Phase 5 monitoring wells B-405 and B-405S, were installed in December 2010. Apex began collecting background samples from these wells in December 2010. Three background samples were collected from B-405 prior to waste placement in Phase 5 in March 2011. Sampling was attempted at B-405S during each background event; however the well was typically dry. Partial bottle sets were collected from B-405S during two background events. Apex installed a replacement well, B-405S-R in August 2012. The replacement well was dry during the first several

attempts to collect a background sample in 2012. Well B-405S yielded enough water to sample during the 2nd Semiannual sampling event in December 2012. In May 2013, B-405S-R yielded enough water for the first background sample from this well.

Phase 6 monitoring wells B-404 and B-404S were installed in December 2012. As of June 2013, 6 background samples have been collected from B-404. B-404S was dry during the December 2012 background sampling event, thus only 5 background samples have been collected from B-404S as of the date of this revised GWDMP, and waste placement in Phase 6A has not yet begun.

~~As of October 2011 landfill construction has yet to proceed into Phases 6 and 7 for the existing facility. Therefore, the Phase 6 and 7 monitoring wells have not been installed. Based on the design of the proposed landfill expansion, the locations of these wells (B-404 and B-415) have been moved slightly to accommodate the proposed alterations of the landfill perimeter berm.~~ As documented for the existing facility, phased well installation activities with background sampling prior to waste placement is an effective tool for implementation of the groundwater monitoring well network at the Apex Landfill. The well network for the proposed landfill expansion will likewise be installed in phases based on landfill cell development.

(A)(3) Implementation of Groundwater Quality Assessment Monitoring Program and Corrective Measures Program

A Groundwater Quality Assessment Monitoring Program will be prepared and implemented in accordance with OAC Rule 3745-27-10(E) if the conditions of OAC Rule 3745-27-10(D)(7) apply at the site.

A Corrective Measures Program will be prepared and implemented in accordance with OAC Rule 3745-27-10(F) if the Groundwater Quality Assessment Monitoring Program determines that waste derived constituents have been detected in the groundwater.

(A)(4) Detection Monitoring Program Commencement

This GWDMP commenced with the first groundwater samples collected in July 2005 from the Phase 1 monitoring wells prior to waste placement on November 28, 2005. The permanent monitoring well network described herein will be installed in phases around the proposed landfill expansion after structural fill or AGM has been established to grade along the perimeter berm.

(A)(5) Qualified Groundwater Scientist Certification

Per OAC Rule 3745-27-09, this GWDMP has been certified by a qualified groundwater scientist as defined in OAC Rules 3745-27-01(Q)(1). A signed and notarized affirmation page is included in the front of this document.

(A)(6) Detection Monitoring Program Documentation and Operating Record

The GWDMP will be documented in the Operating Record. Any revision(s) made to this Plan will be submitted to the operating record prior to the implementation of the revision(s).

(B) GROUNDWATER MONITORING SYSTEM

(B)(1) Groundwater Monitoring System

Existing Landfill Monitoring Well Network

The current monitoring well network for the existing landfill consists of ~~13~~ 14 monitoring wells installed into the Uppermost Aquifer System (UAS) and~~,~~ ~~nine~~ 11 monitoring wells installed into the bedrock Significant Zone of Saturation (SZS). The locations of the wells are shown Drawing A-1. In addition to the monitoring well network, piezometers are also installed surrounding the facility to aid in determining the groundwater flow directions of the SZS and UAS. A summary of the existing monitoring wells, piezometers and their construction details is documented on Table 1. All monitoring wells, with the exception of upgradient monitoring wells B-401, B-402, and B-403, are constructed on the outside edge of the perimeter haul road.

~~As of October 2011 landfill construction (no perimeter berm) has yet to allow for the installation of the Phase 6 and 7 monitoring wells. Based on the design of the proposed expansion area, the locations of the Phase 6 and 7 well clusters (B-404 and B-415) have been moved slightly to accommodate the proposed alterations of the landfill perimeter berm.~~

Waste placement occurs in landfill cells which are currently identified as Phases 1 through 7 for the existing permitted facility. The proposed landfill expansion will likewise be constructed in cells, which are identified as Phases 8 through 14~~13~~. The approximate extent of the landfill footprint for each Phase is shown on Drawing A-1. The installation, development, and sampling of the proposed wells will also be phased and correspond with the construction of each waste cell as outlined on Table 2 and as shown on Drawing A-1. The monitoring wells will be installed and the initial samples collected prior to waste placement in each corresponding phase. The following tables list the monitoring well network for both the existing landfill and the proposed expansion area as they relate to the landfill phasing.

PERMITTED / EXISTING LANDFILL MONITORING WELL NETWORK			
PHASE	**CONNELLSVILLE/ MORGANTOWN UAS**	**BELLAIRE/ SUMMERFIELD SZS**	**UNDERDRAIN**
1	B-401 upgradient B-402 upgradient B-403 upgradient B-410 downgradient B-411 downgradient B-412 downgradient	B-401S downgradient B-402S downgradient B-403S downgradient	SHAUDS-1
2	B-407 downgradient B-408 downgradient B-409 downgradient	B-407S downgradient B-408S downgradient B-408SS downgradient B-409S downgradient	SHAUDS-2
4A	B-406 downgradient	B-406S downgradient	SHAUDS-2
4B	B-413 (piezometer) B-413R downgradient B-414 downgradient		SHAUDS-2
5	B-405 downgradient	B-405S downgradient, B-405S-R downgradient	SHAUDS-2
6 & 14	B-404 downgradient	B-404S downgradient	SHAUDS-2 & SHAUDS-3
7 & 8	B-415 downgradient	B-415S downgradient	SHAUDS-3

Note: Well clusters B-404 and B-415 are located near the transition from the existing permitted landfill to the proposed landfill expansion; therefore, are designated as both Phase 6 & 14 and Phase 7 & 8 monitoring wells.

~~PROPOSED LANDFILL EXPANSION MONITORING WELL NETWORK INSTALLATION SCHEDULE~~				
~~PHASE~~	~~CONNELLSVILLE/ MORGANTOWN UAS~~	~~BELLAIRE/ SUMMERFIELD SZS~~	~~LIMESTONE/ SHALLOW BEDROCK SZS (IF SATURATED)~~	~~MINE SPOIL SZS (IF SATURATED)~~
~~8~~	~~B-404 downgradient~~ ~~B-427 downgradient~~ ~~B-428 downgradient~~	~~B-404S downgradient~~ ~~B-427S downgradient~~ ~~B-428S upgradient~~	~~Not found to be saturated near phase~~	~~B-404A downgradient~~ ~~B-427A downgradient~~ ~~B-428A downgradient~~
~~9~~	~~B-424 downgradient~~ ~~B-425 upgradient~~ ~~B-426 downgradient~~	~~B-424S downgradient~~ ~~B-425S upgradient~~ ~~B-426S upgradient~~	~~B-424L downgradient~~ ~~B-425L downgradient~~ ~~B-426L if saturated~~	~~B-424A downgradient~~ ~~B-425A downgradient~~ ~~B-426A if saturated~~
~~10~~	~~B-423 downgradient~~	~~B-423S downgradient~~	~~B-423L downgradient~~	~~B-423A downgradient~~
~~11~~	~~B-415 downgradient~~	~~B-415S downgradient~~	~~Not saturated~~	~~B-415A downgradient~~
~~12~~	~~B-419 downgradient~~ ~~B-420 downgradient~~ ~~B-421 downgradient~~ ~~B-422 downgradient~~	~~B-419S downgradient~~ ~~B-420S downgradient~~ ~~B-421S downgradient~~ ~~B-422S downgradient~~	~~Not saturated~~ ~~B-420L if saturated~~ ~~B-421L downgradient~~ ~~B-422L downgradient~~	~~B-419A downgradient~~ ~~B-420A downgradient~~ ~~B-421A downgradient~~ ~~B-422A downgradient~~
~~13~~	~~B-416 downgradient~~ ~~B-417 upgradient~~ ~~B-418 downgradient~~	~~B-416S downgradient~~ ~~B-417S upgradient~~ ~~B-418S upgradient~~	~~Not found to be saturated near phase~~	~~B-416A downgradient~~ ~~B-417A downgradient~~ ~~B-418A downgradient~~

PROPOSED LANDFILL EXPANSION MONITORING WELL NETWORK INSTALLATION SCHEDULE				
PHASE	**CONNELLSVILLE/ MORGANTOWN UAS**	**BELLAIRE/ SUMMERFIELD SZS**	**LIMESTONE/ SHALLOW BEDROCK SZS (IF SATURATED)**	**MINE SPOIL SZS (IF SATURATED)**
8	B-415 downgradient	B-415S downgradient	B-415L downgradient	B-415A downgradient
10	B-416 downgradient B-417 upgradient B-418 downgradient	B-416S downgradient B-417S upgradient B-418S upgradient	B-416L upgradient B-417L upgradient B-418L downgradient	B-416A downgradient B-417A ~~down~~upgradient B-418A ~~down~~upgradient
11	B-419 downgradient B-420 downgradient B-421 downgradient	B-419S downgradient B-420S downgradient B-421S downgradient	B-419L downgradient B-420L if saturated B-421L downgradient	B-419A downgradient B-420A downgradient B-421A downgradient
12	B-422 downgradient B-423 downgradient B-424 downgradient	B-422S downgradient B-423S downgradient B-424S downgradient	B-422L downgradient B-423L downgradient B-424L downgradient	B-422A downgradient B-423A downgradient B-424A downgradient
13	B-425 upgradient B-426 downgradient B-429 upgradient	B-425S ~~up~~downgradient B-426S upgradient B-429S downgradient	B-425L downgradient B-426L downgradient Not applicable	B-425A downgradient B-426A ~~downgradient~~if saturated Not applicable
14	~~B-404 downgradient~~ B-427 downgradient B-428 downgradient	~~B-404S downgradient~~ B-427S downgradient B-428S ~~up~~downgradient	Not saturated B-427L downgradient B-428L downgradient	B-404A downgradient B-427A downgradient B-428A downgradient

Note: Underdrains systems will be installed for the proposed landfill expansion and monitored in accordance with the underdrain compliance program (Appendix C).

As noted above and depicted on Drawing A-1, the Connellsville/Morgantown UAS and Bellaire/Summerfield SZS monitoring wells will be installed surrounding the proposed landfill on approximate 800 foot intervals, with slightly more spacing between wells when they are

known to exist upgradient of waste placement. Both of these units were found to exist beneath the entire landfill; however as documented during the installation of the Bellaire/Summerfield SZS well network for the existing facility, this SZS unit can sometimes be dry.

Based on the limited occurrence of groundwater within the Limestone/Shallow Bedrock SZS and Mine Spoil SZS, monitoring wells will only be installed within the aforementioned units if groundwater is encountered during drilling the well cluster. The UAS monitoring well will be the first monitoring well installed at the well cluster location; therefore, all potential groundwater producing zones will be identified and the Limestone/Shallow Bedrock SZS and Mine Spoil SZS wells will be installed only if groundwater is present in the zone. The presence of groundwater within these zones will be evaluated by the drilling procedures outlined in Section (B)(3).

For the existing landfill the mine spoil has been or will be completely removed from beneath the landfill and perimeter berm; therefore, mine spoil cannot be monitored as an SZS. ~~Additionally, the Limestone/Shallow Bedrock SZS was not found to be saturated beneath the existing landfill.~~

The Ohio Environmental Protection Agency (Ohio EPA) indicated in their Interoffice Memorandum (IM) dated March 29, 2013 regarding the Addendum I report that the Pittsburgh Limestone does not qualify as an Uppermost Aquifer System (UAS) in the eastern halves of Phases 6 and 7 of the operating landfill. This determination is based on low yields of piezometers P-13L, P-14L and P-15L (piezometer locations shown on Drawing A-1) discussed in Addendum I. The Addendum I information is sufficient to determine that the limestone in the eastern portion of Phases 6 and 7 needs to be monitored as a Significant Zone of Saturation (SZS) in accordance with Ohio Administrative Code (OAC) 3745-27-10(B). Thus, existing piezometers P-15L and P-11L will be converted to Limestone/Shallow Bedrock monitoring wells in this area to monitor Phase 7.

For the proposed landfill expansion, the mine spoil will be removed from beneath the limits of waste; however will remain beneath the perimeter berm of the proposed landfill. Therefore, the mine spoil will be monitored as an SZS when found to be saturated beneath the perimeter berm. Additionally, the Limestone/Shallow bedrock, where not removed, will also be monitored as an SZS when found to be saturated beneath the proposed landfill.

Existing Landfill Underdrains

Based on the permit drawings and subsequent alteration requests, three separate underdrain systems (SHAUDS-1, SHAUDS-2, and SHAUDS-3) have been or will be constructed to control hydrostatic pressure beneath the liner system. During the construction of Phase 1, the first underdrain was installed and is currently operational as SHAUDS-1. During the construction of Phase 2, Phase 3, Phase 4a, and Phase 5 the second underdrain system was installed and is currently operating as SHAUDS-2. SHAUDS-2 wasmay also be extended into Phase 6 and is explained in greater detail below. During construction of Phase 4b, the third underdrain system was partially installed and is operating as SHAUDS-3. SHAUDS-3 will be constructed through Phases 6 and 7 and is explained in greater detail below. Locations of the existing SHAUDS-1 and SHAUDS-2 and SHAUDS-3 are depicted on Drawing A-1. Please note that SHAUDS-1 does not have a collection piping system, like SHAUDS-2 and SHAUDS-3; therefore, it is not depicted on the drawing. Each underdrain system is discussed in detail below.

Side Hill Aggregate Underdrain SHAUDS-1

The side hill aggregate underdrain system (SHAUDS-1) associated with Phase 1 of the landfill was constructed during the summer of 2005. The side hill aggregate underdrain was constructed along the top of bedrock and controls groundwater flow into the structural fill during and after site construction. The side hill aggregate underdrain system is generally constructed on 200 foot centers and is used to control groundwater flow that can cause structural fill instability. In November 2005 a pipe for sample collection was installed into the toe of the aggregate underdrain. The pipe consists of a four inch diameter; slotted PVC pipe (inlet screen) installed approximately six feet into the aggregate and a solid two inch PVC pipe that "Ts" off the inlet screen to create a centralized sampling location.

Side Hill Aggregate Underdrain SHAUDS-2

The side hill aggregate underdrain system (SHAUDS-2) was constructed along the eastern side of Phase 2 and Phase 3 and also extends beneath Phase 4a and Phase 5 of the landfill, as depicted on Drawing A-1. The aggregate underdrain system was constructed following the same general procedures and techniques explained above for SHAUDS-1, with the exception that a six-inch HDPE pipe was installed within the aggregate underdrain. The SHAUDS-2 collection pipe is constructed beneath the aggregate and collects shallow groundwater being diverted through the aggregate underdrain. In some places, aggregate filled trenches were also constructed off the six-inch pipe. This piping system and lateral trenches are depicted on Drawing A-1.

As documented in the October 2009 version of the GWDMP, SHAUDS-2 was originally proposed to only extend beneath Phase 2, Phase 3, and Phase 4a of the landfill. Within Phase 4a, drainage from a clay pipe associated with drift mining of the coal had been tied into the existing SHAUDS-2 underdrain pipe and is monitored at the SHAUDS-2 discharge point. This discharge changed the water quality and flow rate of SHAUDS-2. In accordance with the October 2009 GWDMP, SHAUDS-2 was to remain in background sampling until the Phase 4a landfill liner system had been installed. In August 2008 the Phase 4a liner system was completed and Phase 4a began accepting waste. Subsequently, SHAUDS-2 was then subject to trend testing; however, the groundwater chemistry of SHAUDS-2 was continuing to change based on the continued extension of the underdrain and subsequent change in source water.

Due to ongoing construction activities in Phase 5, the SHAUDS-2 underdrain is receiving surface water infiltration which has previously been documented to affect groundwater quality. Additionally, the SHAUDS-2 underdrain will be extended through Phase 5 to provide a "tie in" location for Phase 6 in order to capture water that could impede construction. This engineering design is required to provide an outlet for shallow groundwater, if encountered during cell construction of Phases 5 and 6. With the future extension of SHAUDS-2 through Phase 5 and ~~likely~~ extension beneath Phase 6, the groundwater quality of SHAUDS-2 will not be consistent with data previously collected. Therefore, an underdrain compliance monitoring program has been developed to allow for the collection of groundwater quality data during construction of the underdrains. A discussion of the underdrain compliance monitoring program is presented below and summarized in Appendix C.

Side Hill Aggregate Underdrain SHAUDS-3

The side hill aggregate underdrain system (SHAUDS-3) has been constructed under the western portion of Phases 6 and 7 of the landfill and is proposed for installation along the southern portion of Phase 7. Drawing A-1 depicts the already installed sections of SHAUDS-3 and the proposed sections. The aggregate underdrain system has been and will be constructed following the same procedures and techniques explained above for SHAUDS-2. Based on a telephone conversation between CEC and Mr. Steve Saines of the Ohio EPA on July 16, 2009, groundwater sampling will commence on SHAUDS-3 prior to Phase 6 accepting waste. As presented below and in Appendix C, the underdrain compliance monitoring program will be implemented for SHAUDS-3. Sampling of the SHAUDS-3 underdrain began in December 2012.

Proposed Landfill Expansion Side Hill Aggregate Underdrains

Similar to the design and construction of the existing landfill, side hill aggregate underdrain systems will likely be required for the proposed landfill expansion. This engineering design is required to provide an outlet for shallow groundwater, if encountered during cell construction. ~~Once these systems are designed, they will be added to Drawing A-1.~~ There is a probability that underdrains will be needed in the existing valleys in the southeastern and southwestern portions of the proposed contiguous expansion. The underdrain compliance monitoring program, as documented in Appendix C will be implemented for any underdrain constructed beneath the proposed landfill expansion.

Underdrain Sampling Compliance Program

Based on discussions with the Ohio EPA on April 14, 2005, the side hill aggregate underdrains will be included as part of the monitoring system for the Apex Landfill. However, please note that sampling is implemented as a check of liner integrity. Underdrain sampling will not be performed as a routine compliance point to trigger Assessment Sampling as defined in OAC 3745-27-10 (E), unless it is otherwise determined that there has been a waste derived release to the underdrain system.

Underdrain sampling is proposed throughout the operational life of the Apex Landfill. Should the underdrains no longer flow and become dry, sampling will be discontinued. Please note that construction activities which open the underdrains to surface water have proven to alter the groundwater geochemistry and bias the analytical results. Therefore, background sampling to establish a database prior to the underdrain being completely installed will be limited. The underdrain outlet points do not represent a discrete zone of monitoring; therefore, detection monitoring with a modified data review procedure has been developed as documented in Appendix C and discussed below in Section (C)(6).

(B)(2) Uppermost Aquifer System and Significant Zone of Saturation

Connellsville/Morgantown Uppermost Aquifer System

The UAS is continuous beneath the site and consists of fine to medium-grained sandstones. The sandstones belong to the Connellsville and Morgantown Members of the Pennsylvanian Age Conemaugh Formation. The highest elevation of the UAS within the existing landfill is 1205 feet msl in the vicinity of Phase 1. Added Geologic Material (AGM) has been placed in the

vicinity of Phase 1 to maintain the minimum separation distance between the UAS and the base of the recompacted soil liner.

The UAS beneath the existing landfill is generally unconfined. In contrast, UAS piezometers with groundwater elevations above the unit suggest that t~~T~~he aquifer~~, however,~~ is confined below the proposed expansion with the exception of the southwestern and northeastern portions.~~on the southern and eastern portions of the site.~~ Groundwater flow under the existing (northern) facility is from the south to northeast and northwest along the ridge on which the facility is located. The groundwater flow under the majority of the proposed landfill expansion also flows toward the north; however, a divide is present in the southwestern portion of the landfill expansion. The groundwater flow turns toward the south near piezometer B-12 where it follows a large valley. It should be noted that along the eastern side of the proposed landfill expansion, groundwater flows toward the north, which is opposite the southeastern valley. This groundwater flow is caused by the northerly dip of the Connellsville/Morgantown unit in the vicinity.

Two existing piezometers, B-7B and B-403 located south-southeast of the expansion area, exhibit water levels that are higher than surrounding piezometers and, thus, a potentiometric high is mapped in this vicinity of the UAS. Geologic cross sections included in the contiguous expansion PTI Application indicate that the base of the Connellsville and Morgantown units do not exhibit a consistent, site-wide dip direction. The variable nature of the UAS structure appears to influence groundwater flow directions in portions of the UAS. As indicated on Drawing 5D Geologic Cross Section C-C', the UAS dips to the north in the vicinity of B-7B and B-403. The observed flow direction in the vicinity of these two piezometers may be due to the structural dip.

Also, in valley areas where the UAS outcrops/subcrops, it is expect that topographically-controlled groundwater divides exist. The approximate location of the Connellsville/Morgantown subcrop has been added to Drawing 3R - Connellsville–Morgantown Potentiometric Map December 10, 2012 that is included in the revised PTI Application (HSIR). The UAS outcrop/subcrop, based on surface elevations in the southern valleys, is expected to be found more than 2,000 feet south of piezometer B-7B and is beyond the map area in Drawing 3R. Topographic influences that create a groundwater divide and discharge boundary this far south of the expansion apparently do not override the structural influence in the vicinity of B-7B and B-403. Apex believes the proposed UAS monitoring well network and designation of

upgradient and downgradient wells is accurate based on existing information. As proposed monitoring wells for the expansion area are completed and water levels recorded, another evaluation of the UAS flow lines and adequacy of the monitoring well network will be completed and reported to Ohio EPA.

Bellaire/Summerfield Signification Zone of Saturation

The Bellaire/Summerfield Significant Zone of Saturation (SZS) consists of the shales and siltstones of the Bellaire and Summerfield Members of the Pennsylvanian Age Conemaugh Formation. This zone is present beneath approximately two-thirds of the existing facility at approximately 1183 feet msl and is present beneath the entire proposed contiguous ~~landfill~~ expansion. Groundwater flow within the unit generally follows topography and the dip of the bedrock units. Flow for the northern existing facility flows toward the east following a valley which was previously filled during construction of the landfill and also flows toward the south along the southeastern permitted limits of waste. Groundwater flow in this unit in the southern proposed contiguous expansion landfill flows toward the southeast from a potentiometric high at piezometer P-12S and also exhibits a southerly flow following the valleys along the southern proposed waste limits. This flow direction may change over time as landfill construction activities develop in the southern portion of the permitted landfill footprint and additional underdrain systems are installed. ~~During well network installation activities, dry wells have been noted within the low yielding Bellaire/Summerfield SZS. Per previous discussions with Ohio EPA, a dry SZS well does not warrant a notice of violation from Ohio EPA for an inadequate well network. It is our opinion that dry wells substantiate the fact that no shallow groundwater exists; hence potential impacts from the landfill are also minimized.~~

Limestone/Shallow Bedrock Signification Zone of Saturation

The Limestone/Shallow Bedrock unit has been classified as a SZS and consists of the first 10 to 15 feet of bedrock. This zone is present beneath the entire proposed landfill, however, is not present or has been removed during landfill construction from beneath the existing northern facility. Although this unit is present beneath the entire proposed landfill, because it has been identified as the first 10 to 15 feet of bedrock, it is found to be saturated and yield a significant amount of water in the south central portion of the proposed landfill. As detailed in the expansion PTI Application ~~Hydrogeologic Site Investigation Report~~ (HSIR), this unit has been identified as "UAS to be removed" where the unit yields a significant amount of groundwater. Groundwater flow within the unit generally follows topography and the top of bedrock surface and flows toward the south. Because portions of this unit will remain beneath the proposed

contiguous expansion landfill perimeter berms, the unit has been identified as an SZS (where saturated) and well installation is proposed.

Mine Spoil Signification Zone of Saturation (Unconsolidated)

The Mine Spoil SZS consists of mine spoil and residual soil in unmined areas. The majority of the site consists of mine spoil; therefore, the unconsolidated deposits are referred to as the Mine Spoil SZS. The Mine Spoil SZS is present beneath the entire proposed contiguous expansion landfill footprint, however, is not present or has been removed during landfill construction from beneath the existing facility. Groundwater flow, when saturated, generally follows topography and the top of bedrock surface. Groundwater flow in this zone in the northwestern portion of the proposed landfill footprint flows to the north/northeast toward the valley. Groundwater flows toward the northeast and south in the eastern portion of the proposed landfill, which follows topography. Groundwater flow within this unit in the southeastern portion of the proposed landfill, also follows topography and is to the south. It should be noted that the underdrain (SHAUDS-3) is partially installed along the southern permitted limits of waste and has begun to affect the groundwater flow within the Mine Spoil SZS. This underdrain directs flow toward the northwest following the existing topography of the valley. It is anticipated that landfill construction activities will require the installation of permanent underdrain systems, which will alter groundwater flow directions and likely dewater areas of the Mine Spoil SZS. The mine spoil is to be fully excavated within the footprint of the existing facility during construction; however, will remain beneath the proposed contiguous expansion landfill perimeter berms. Therefore, it has been designated as an SZS, where saturated.

(B)(3) Drilling and Monitoring Well Construction

The borings for the ~~current~~ 400 series monitoring wells ~~have been and~~ will be drilled using air rotary and auger drilling methods. A combination of split-spoon sampling, ~~A~~air rotary rock chip logging, and continuous rock coring will be used to identify the limits of the SZS and UAS and for locating screened intervals for the proposed monitoring wells. The drilling program will consist of completing each monitoring well at the proposed locations presented in Drawing A-1. Specifically, the drilling procedures will consist of the following:

- Split-spoon samplers will be utilized to collect soil samples in five-foot intervals through the overburden (mine spoil, native soil, etc.) to determine if the Mine Spoil SZS is saturated.

- Steel or PVC surface casing will be used to seal off groundwater from unconsolidated and consolidated overburden when bedrock borings are advanced.
- Bedrock will be continuously sampled using wire-line air coring techniques or equivalent. Compressed air will be used to remove cuttings from the borehole as the drill bit is advanced. Unless absolutely necessary, no water will be used during the air core sampling.
- To evaluate the presence (or absence) of groundwater within the Limestone/Shallow Bedrock SZS, boreholes will remain open for no less than 15 minutes and no more than overnight once the total depth of the boring has been reached.
- Install monitoring wells at proposed locations in the UAS and SZS (if saturated) units using 2-inch diameter PVC screen and riser pipe. Screen lengths will be 5 or 10 feet in length. Each well will be constructed as described below.
- Develop each monitoring well by surging and purging with bailers and pumps when appropriate.
- Survey the horizontal grid coordinates and vertical elevations ~~grid coordinates~~ of each boring and piezometer.
- Install dedicated pumps in each well that does not bail dry during well development activities.

Drilling Methodology

Drilling equipment mobilized to the site will be steam cleaned prior to commencement of drilling. Any down hole tooling or equipment (drilling rods, augers, bailers, pumps, etc…) will be cleaned prior to use at each borehole. Samples of the unconsolidated material will be taken at five-foot intervals from ground surface to bedrock in each soil boring advanced at each proposed location. Soil samples will be collected with a 2-foot split spoon sampler (ASTM D-1586). Split spoon samples will be collected using a 2-inch outer diameter (OD) split spoon sampler, 24 inches in length. The sampler will be driven with a 140-pound slide hammer or equivalent hydraulic hammer (Auto-Hammer). Blow counts will be recorded for every 6-inch advance of the split spoon sampler and will be recorded on the boring logs.

In locations where bedrock borings are proposed, the deep boring will be continuously sampled from top of bedrock to total depth (i.e. the base of the UAS). Subsequent borings made in nearby locations will not require continuous sampling, except for the screened interval~~. These borings will only be sampled across the screened interval~~ The lithology in the unsampled portion of the boring will be logged by observation of the drill cuttings, drilling pressure, and bit advance rate. ~~Soil~~

~~samples will be collected with a 2-foot split spoon sampler (ASTM D-1586), while rock core samples will be collected with air coring methods. Visual identification of the samples will be noted on each boring log.~~

~~Split spoon samples will be collected using a 2-inch outer diameter (OD) split spoon sampler, 24 inches in length. The sampler will be driven with a 140-pound slide hammer or equivalent hydraulic hammer (Auto-Hammer). Blow counts will be recorded for every 6-inch advance of the split spoon sampler and will be recorded on the boring logs.~~

The rock coring techniques will consist of a double tube core barrel wire line assembly using compressed air to remove cuttings from the borehole as the drill bit is advanced. This allows the geologist to identify saturated horizons during drilling. The coring assembly is advanced through rock by the application of downward pressure during rotation and the rock core feeds into the inner barrel. The cutting end of the core barrel is equipped with a diamond or tungsten carbide drill bit. As coring progresses, high-pressure air is introduced downward between the inner and outer tubes to cool the bit and to return cuttings to the surface. The inner tube protects the core from the highly erosive action of the air. The rate of advance is controlled to obtain the maximum possible core recovery. Rock Quality Designation (RQD) will be calculated for each core run and recovery will be calculated. Identification of stained rock will be used to assist in identification of fractures zones and water producing areas for potential well screen placement. Visual identification of the samples will be noted on each boring log. All rock cores will be boxed, labeled and stored at the Apex facility. Upon reaching the total depth of coring, the boring will be reamed with a 6-inch diameter tri-cone roller bit to the desired depth of monitoring well installation to provide a larger diameter borehole. When the screen tip is positioned above the corehole bottom depth, granular bentonite will be used to backfill the lower portion below the screen tip. Approximately 1 foot of and filter sand will be placed above the granular bentonite backfill and below the screen tip.

Monitoring Well Construction

The boreholes will be converted to monitoring wells generally in accordance with the typical monitoring well diagram included as Figure 2. All drilling equipment and tools which come in contact with the soil, bedrock, or groundwater will be thoroughly cleaned with a high-pressure, hot-water spray cleaner prior to drilling each well. The materials to be used for construction of the monitoring wells will include the following:

- ✧ 2-inch flush joint schedule 40 PVC well casing;
- ✧ 2-inch, flush joint, schedule 40 PVC, 10 slot, well screens; well screens will not exceed 10-foot in lenght;
- ✧ Washed, quartz sand filter pack;
- ✧ 3/8-inch bentonite chips (bentonite seal);
- ✧ 3/8-inch bentonite chips or 80 mesh granular bentonite (bentonite grout),
- ✧ Steel or PVC surface casing installed through overburden, and,
- ✧ Steel locking protective covers, with keyed alike locks.

The screens will be placed in the borings in accordance with the typical monitoring well diagram (Figure 2). The remaining materials will be poured from the surface into the annulus between the well casing and boring wall. If ~~granular~~ bentonite slurry is used as a grout, the bentonite will be mixed with potable water and placed in the annulus from the bottom upward using tremie methods. The level to which each material is placed will be measured and the volume of material placed will be recorded to ensure the entire volume of the well is sealed. The protective cover will be cemented in place with the concrete mounded at ground surface to prevent ponding at the well head. Wells will be locked with padlocks or equivalent locking devices.

All new monitoring wells will be developed after installation in order to restore the natural hydraulic characteristics in the area of the well screen. The wells will be developed by using a combination of pumping, ~~and~~ surging and bailing techniques. Equipment used to develop the wells will be decontaminated prior to its use in each well. The wells will be developed to remove fines, establish low turbidity, and to improve the hydraulic communication between the well/sand pack and the surrounding aquifer materials.

Monitoring wells that exhibit sufficient yield required for low flow sampling during development (i.e. cannot be bailed dry) will be equipped with a dedicated bladder pump for well sampling.

Boring logs and well completion diagrams for the Phase 1, 2, 3, 4, ~~and~~ 5 and 6 of the existing landfill monitoring wells are included in Appendix D. The integrity of each monitoring well at the site will be maintained through active landfill operations and the closure period. If during a sampling event a problem is observed with any well, repair or replacement activities will be performed prior to the next sampling event.

Monitoring Well Abandonment

Any groundwater monitoring well which must be abandoned will be decommissioned in accordance with the *State of Ohio Technical Guidance for Sealing Unused Wells* dated 1996. The work will be completed by removing the protective steel casing, filling the PVC well screen and riser with granular bentonite or bentonite slurry, pulling the PVC casing and well screen, over-drilling the boring to the original depth, and grouting the borehole. The grout will consist of bentonite slurry placed into the boring from the bottom upward using tremie methods. Granular bentonite may also be used to backfill abandoned well borings. In the event that the inner casings and screens cannot be pulled, they will be removed by drilling through the materials. Details of the abandonment will be submitted to the Ohio EPA under separate cover after any well has been abandoned. In addition the drilling contractor will submit water well sealing reports to the Ohio Department of Natural Resources.

Drawing A-1 depicts the groundwater monitoring wells and piezometers which have been or will be abandoned during landfill construction activities. The following table also depicts the wells to be abandoned.

PROPOSED LANDFILL EXPANSION MONITORING WELL / PIEZOMETER ABANDONMENT SCHEDULE	
PHASE	**MONITORING WELL / PIEZOMETER IDENTIFICATION**
~~7~~	~~B-310~~
8	B-310, B-401S, B-402A, B-402S, P-11L, P-7A, B-403S, B-401A, P-4L~~B-309, B-11, B-11S, P-8A (POSSIBLY NOT ABANDON)~~
9	B-2A, B-2B, P-10L, B-401, B-402 ~~P-7A, B-403S, B-311, B-403, P-9, P-9S~~
10	P-1, P-1L, P-1S, P-1A, P-2A, P-2L, P-2S, P-12, P-12S ~~B-401S, P-4L, B-401, B-402A, B-402S, P-11L, B-402, P-5, P-5A, P-5L, P-5S~~
11	B-12, P-3A, P-3L, P-3S ~~B-2S, B-2B, B-401A, P-10L~~
12	B-311, P-5, P-5A, P-5L, P-5S ~~B-12, P-3A, P-3L, P-3S~~
13	B-403, P-9, P-9S ~~P-2A, P-2L, P-2S, P-12, P-12S, P-1A, P-1, P-1L, P-1S~~
14	B-11, B-115, B-309, P-15L

(B)(4) Numbers, Spacing and Depth of Groundwater Monitoring Wells

The proposed and existing locations of the monitoring wells are shown on Drawing A-1. Details regarding the installation of the existing monitoring well network are depicted on Table 1. Additionally, details for the installation of the proposed monitoring wells including approximate locations, depths, zones monitored, and screen placements are summarized on Table 2. Similar to the existing facility, the proposed monitoring wells will be located on the outside edge of the perimeter landfill berm. The exact monitoring well placement will be determined in the field based on site conditions encountered and access. Should the proposed well location be moved a significant amount from the original locations or if an existing piezometer will be converted to a monitoring well, the Ohio EPA will be notified.

The downgradient SZS and UAS monitoring wells will be installed on approximately 800 foot intervals along the east, south, and west sides of the proposed landfill, with slightly more spacing when the well is known to exist upgradient of waste placement. A typical monitoring well construction detail is included as Figure 2. The location and spacing of the SZS and UAS monitoring wells are capable of detecting waste-derived constituents released from the facility in accordance with OAC 3745-27-10(B).

(B)(5) Annual Monitoring System Evaluation

The static groundwater elevation in all wells and piezometers at the site which have not been abandoned will be measured during each sampling event. This includes the following:

- monitoring wells (400 series) installed at the time of the sampling event; and,
- all piezometers scheduled for abandonment (until actually abandoned).

Potentiometric maps for the UAS and all SZS units will be prepared and submitted with the Semi-annual Groundwater Detection Monitoring Program Reports. At least annually, the number, spacing, and depth of the wells will be evaluated in order to determine if the Groundwater Monitoring System is adequate for the facility. Results of this evaluation will be submitted with the Annual Operating Report submitted pursuant to OAC Rule 3745-27-10(B)(5). If the groundwater well network system is found to be inadequate, it will be modified to meet the requirements of OAC 3745-27-10(B).

(C) GROUNDWATER SAMPLING ANALYSIS AND STATISTICAL METHODS

(C)(1) General Requirements

The following sections of the GWDMP provide the sampling and analysis procedures and statistical methods for groundwater monitoring at the facility. The procedures and methods were prepared in accordance with Ohio EPA and U.S. EPA procedures, and are consistent with accepted industry protocol. The procedures and methods are intended to provide guidance to obtain accurate, consistent and meaningful water quality data. This document will be maintained within the Operating Record of the facility and will be available for Ohio EPA inspection.

(C)(2)(a) Groundwater Elevation Measurements

To insure consistent groundwater elevation data, all monitoring wells will be surveyed by a licensed Ohio surveyor for ground surface, top of PVC casing, and pump cap assembly (if applicable), and will be tied to a site datum. Elevations will be accurate to 0.01 foot. The reference point for water levels will be marked with a small notch or permanent marking where all taped depth to water measurements will be obtained. Wells equipped with pumps will be measured from the water-level measurement port. Site-wide groundwater levels will be collected within a 24-hour period prior to the initiation of sampling. Water level measurements will be made using a battery-operated electronic water level meter with audible signal and calibrated tape (or equivalent). The static water level and bottom of well will be measured prior to well evacuation and recorded on a Field Sampling Form. If a well has a dedicated pump, well depth will not be measured each event but will be measured if the pump is removed for maintenance.

(C)(2)(b) Detection of Immiscible Layers

OAC 3745-27-10(C)(2)(b) requires that on a semi-annual basis the presence of immiscible layers in each monitoring well at the facility be determined. However, it is CEC's experience that immiscible layers are only detected when volatile organic compounds (VOCs) are present in groundwater at concentrations high enough to form dense (or light) non-aqueous phase liquids (DNAPLs). Based on existing groundwater quality data, it is not likely for immiscible layers to be present. Should any evidence suggesting their presence be identified, immiscible layers will be evaluated. Should future analytical data show high detectable concentrations of volatile organic

compounds (VOCs) in wells, or if field observations suggest immiscible layers could be present, immiscible layer monitoring will be initiated, as detailed below.

An optical interface probe capable of detecting both dense and light phase immiscible layers will be used to determine if immiscible layers are present in any of the wells. This determination will be made at the same time the static water levels are being collected. The interface probe will be decontaminated after each use with deionized water.

During purging and sampling activities, field personnel will visually inspect the purge water and sample bottles to denote floating or sinking product layers or to detect a "sheen" on the surface of the water. Likewise, non-dedicated sampling equipment will be visually inspected to determine the presence of any immiscible layers in the wells at the Apex Landfill.

(C)(2)(c) Collection of Groundwater Samples

Groundwater samples will be collected in accordance with the procedures outlined below.

(C)(2)(c)(i) Well Evacuation

~~Low-Flow Sampling~~

The objective of well purging or evacuation is to collect a sample of groundwater that is representative of the formation and free from the effects of stagnation in the well. Conventional and low-flow purging methods are acceptable at the site. With conventional purging techniques, stagnate water is removed from the well by removing three well volumes in productive wells or by purging the well dry in non-productive wells utilizing a bailer or submersible pump. Low-flow or minimal drawdown purging techniques focus on pumping slowly from the screened interval of the well to obtain a sample that is representative of formation water. Low-flow purging is less invasive and often results in the collection of a more representative sample, particularly in the case of non-productive wells or where turbidity is an issue. All monitoring wells which can sustain a yield required for low-flow ~~or minimum/no purge~~ sampling will be equipped with a dedicated bladder pump. ~~The focus of low-flow purging will be to reach stabilization of field water quality parameters rather than to purge a predetermined volume or to purge the well dry. Conventional and low-flow purging methods are acceptable at the site. In addition, minimum/no purge sampling will be utilized in low-yield wells.~~ Purging procedures are summarized below.

Low Flow Sampling

The focus of low-flow purging will be to reach stabilization of field water quality parameters rather than to purge a predetermined volume or to purge the well dry. Low-flow purging and sampling will be accomplished with an electric submersible pump or bladder pump. Flow rates (usually less than 500 ml/min) will be selected based on individual well yields. The flow rate should create the least amount of disturbance to the well and produce the least amount of drawdown, as practical. Samples of water will be taken directly from the dedicated pump discharge and analyzed for pH, specific conductance (SC), turbidity, and temperature. Samples will be collected at intervals of approximately 3 to 5 minutes.

While purging, field measurements of pH, specific conductance, turbidity, and temperature will be collected at approximately three to five-minute intervals. Stabilization of pH, specific conductance and temperature will be the criteria for determining when purging is complete and the well is ready to be sampled. Stabilization of field parameters will be obtained when the previous reading for each parameter has stabilized in accordance with the following schedule:

- pH ± 0.1 units
- Specific Conductance ± 3%
- Temperature ± 0.5ºC
- Three Consecutive Water-Level Measurements Vary by less than 1.0 feet

Turbidity will be measured during purging and sampling however, will not be used as a stabilization parameter. If the above stabilization criteria cannot be achieved the sampling team will stop purging, allow the well to recover, and perform one of the alternate purging sampling procedures described below.

Minimum / No Purge Sampling

Minimum/no purge sampling will be conducted in accordance with the previously approved GWDMP (Revised December 2011) for the operating landfill and Section 4.5.4 of the Ohio EPA Technical Guidance Manual for Groundwater Investigations (May 2012)~~for the existing landfill. for~~ This procedure is utilized on monitoring wells that yield an insufficient volume for low-flow purge techniques (less than 100 ml/min). Minimual/no purge sampling is especially important during the collection of background data from low yield wells. The object of this method is to obtain a sample from within the well screen and above the pump intake by withdrawing a limited volume of water prior to sampling. A portable pump may be used for minimal/no purge sampling

because well sampled using this method are often seasonally dry. Groundwater will be pumped a rate or 100 ml/min or less until a volume equal to the volume of the pump and discharge tubing is withdrawn. Once this volume has been withdrawn, a measurement of the field parameters pH, specific conductance, and temperature will be collected to fulfill the requirement of OAC 3745-27-10 (d)(5)(d). Turbidity will also be field measured at this time.

Sampling will proceed once the volume of groundwater in the tubing and pump has been removed and a minimum of one set of field parameter measurements have been collected. Because of the low-yield of some of the wells, drawdown may be unavoidable. Therefore, drawdown will be monitored by collecting depth-to-water readings during sampling to ensure that water present above the screened interval does not enter the pump. The amount of drawdown allowed will be no more than the distance from the top of the screen to the position of the top of the pump intake, minus a 2-foot safety margin. As presented in Table 3, measurements were collected to evaluate the top of screen and top of pump intake elevations for the monitoring wells with dedicated pumps. Based upon these elevations, additional calculations were completed to determine the allowed drawdown distance for each monitoring well (including the 2-foot safety margin), and an estimated volume of groundwater that can be removed before the drawdown limit is reached. It should be noted that the volume calculations will only be used for reference purposes and that the wells will likely be able to yield a higher volume of water than presented in Table 3 before the drawdown limit is reached. In the event the depth-to-water measurement reaches the maximum drawdown level included in Table 3, sampling will be postponed. Sampling will recommence when the well has recharged sufficiently to meet the remaining sampling volume requirements, and always within 24 hours.

Conventional Purging Procedure (Bailing Low Yield Wells)

Low yielding wells which cannot be purged using a dedicated pump system may be sampled with a dedicated or disposable bailer. Purging will be initiated and continue until at least three well volumes are removed or until the well is purged dry. One well volume (V) will be calculated as follows:

$$V = \pi r^2 h \times 7.48 \text{ gals/ft}^3$$

where:

π = 3.1415,

r = radius of the casing in feet, and

h = height of water in the casing in feet.

Temperature, pH, turbidity and specific conductance measurements will be collected at the initiation of purging, after each well volume is completed and during sampling. Purging will continue until the well goes dry, or three well volumes have been removed.

In low yielding wells that can only be purged with a bailer, samples will be collected as soon as there is sufficient groundwater to fill the majority of the sample bottles. To minimize extended recovery times after purging, attempts to collect adequate sample volumes in a well will not exceed 24 hours.

All wells will be evacuated using dedicated or non-dedicated bladder pumps, or by hand bailing, no more than 24 hours prior to sampling. The volume of water and the rate at which water is purged from the well will be recorded on the Field Sampling Form (Appendix A)

Purge Water Management

Purge water collected during well evacuation will be disposed of directly to the ground, away from the monitoring well being sampled. Should hazardous or volatile compounds be detected in the groundwater during future sampling events, the purge water will be containerized from the affected wells(s) and disposed in the facility's leachate collection system.

(C)(2)(c)(ii) Sample Withdrawal

Samples will be collected immediately after purging of each well. If the sample is collected utilizing a bailer, the sample will be slowly poured into the sampling containers to minimize aeration of the sample. If any well is bailed "dry", purging will be terminated and sufficient time (no more than 24 hours) will be given for water to seep back into the well before collecting the sample. If water has not re-entered the well by the end of the sampling event or within 24 hours, it may be necessary to collect a partial sample or the well will be considered to be "dry" for the sampling event.

If low flow techniques are utilized, the operational procedures are shown below:

- Prior to arrival at the monitoring well, check controller unit and compressor or power source for any signs of wear or leaks.
- Upon arrival at the monitoring well, set up gas-powered engines (if any) at least 20 feet downwind from the well.
- Purge the well at or below the well's recharge rate, if possible.

- Samples for volatile constituents (VOCs) should be completely filled to form a meniscus and will not contain atmospheric air bubbles.
- Samples for other constituents should be collected at the low-flow or minimum/no purge sampling purge rate. If the well was purged using conventional methods, the sample will be collected with the dedicated or disposable bailer.

If a pump is not working properly, a well may be sampled utilizing dedicated or disposable bailers. Samples will be obtained by lowering the bottom-emptying bailer suspended from a clean rope or string, stainless steel wire or heavy test monofilament line. The bailer will be slowly raised and lowered to minimize agitation and aeration of samples.

Underdrain sampling does not require purging protocols due to the assumption that the drain continuously flows. Therefore, samples from the underdrain will be collected from the "discharge pipe". Sample bottles will be filled directly from the discharge pipe and care will be taken not to disrupt flow or suspend any sediment that may have settled at the base of the pipe. After groundwater collection, approximate flow measurements will be made to assess seasonal fluctuations from the pipe and noted on the field sampling form.

If contamination is known to be present and non-dedicated or non-disposable sampling equipment is utilized, samples will be collected from the least to most contaminated wells, to minimize the potential for any cross-contamination. After the collection of the metals and field parameters aliquots, samples will be collected and containerized according to the volatility of the requested analytes. A specific collection order is as follows:

1. Total Metals
2. Field Parameters
3. Volatile Organics
4. Wet Chemistry Parameters

Total metals are sampled prior to the organics due to the need to minimize turbidity within the wells assuming bailing sampling protocols. It is assumed that the low yields of the units may require bailing methods rather than low-flow pumps which will stir up sediment within the well screen and gravel pack.

(C)(2)(c)(iii)/(iv) Sample Containers, Handling & Preservation

Precleaned and pre–preserved sample containers will be provided by the laboratory. All samples will be containerized and preserved according to the following table - *Recommended Containerization and Preservation of Samples*. In the goal to obtain the most representative sample possible, preserving the sample for transportation and storage to the laboratory is also important. Methods of preservation are intended to retard biological action and retard hydrolysis of chemical compounds and complexes. Samples requiring refrigeration to 4ºC (+/- 2^0C) will be accomplished by placing the sample containers immediately into coolers containing wet ice and delivering the samples to the analytical laboratory as soon as possible.

New containers used to collect samples will be provided by the laboratory. In the field, containers will be carefully handled and filled to prevent loss of preservatives. Once filled, containers will be sealed tightly and placed in a cooler with wet ice in preparation for transport to the laboratory.

A list of sample containment, preservatives, handling, and holding times follows:

RECOMMENDED CONTAINERIZATION AND PRESERVATION OF SAMPLES

Measurement	Typical Volume (mL)	Container[a]	Preservative	Holding Times
Specific Conductance, pH, Temperature and Turbidity	500	P,G	Field Measure	
Total Dissolved Solids (TDS)	200	P,G	Cool, 4°C	7 Days
Total Metals	500	P,G	HNO_3 to pH<2	6 months
Alkalinity	200	P,G	Cool, 4°C	14 days
Chloride	200	P,G	None	28 days
Nitrogen Ammonia	400	P,G	Cool, 4°C H_2SO_4 to pH<2	28 days
Nitrate plus Nitrite	200	P,G	Cool, 4°C H_2SO_4 to pH<2	28 days
Sulfate	100	P,G	Cool, 4°C	28 days
VOCs except EDB & DBCP	3 x 40	G, Teflon™ septum cap	Cool, 4°C HCL to pH<2	14 days
EDB & DBCP	3 x 40	G, Teflon™ septum cap	Cool, 4°C Na-Thiosulfate	14 days

Notes: a -Plastic (P) or Glass (G). For metals, polyethylene with an all-polypropylene cap is preferred.

Samples shall be shipped from the field to the analytical laboratory by utilizing an overnight courier service or delivery by site personnel. Samples will be shipped in sealed insulated shipping containers. Standard shipping containers will be of sturdy water-proof design (ice chests are commonly used) equipped with cushion material to prevent breakage during shipment. Since wet ice is the most common means by which to refrigerate the samples, appropriate measures will be taken to fully waterproof the contents from leakage.

(C)(2)(d)(i) Performance of Field Analysis

A copy of the form used to record raw data and conditions of sample collection is provided in Appendix A (Field Sampling Form).

(C)(2)(d)(ii) Field Equipment Calibration

All field equipment shall be calibrated prior to the sampling event. Equipment calibration procedures shall be those set forth in the manufacturer's instructions manual which are kept with the sampling equipment. Field calibrations will be performed at a minimum of once per day (at the beginning of each day), or as needed should field readings indicate results significantly different from historical field results. Field calibrations performed during a sampling event will be noted on a minimum of one Field Sampling From.

(C)(2)(e) Decontamination of Equipment

With the exception of the water-level meter and field parameter meters, non-dedicated equipment typically will not be used. Disposable, factory-cleaned and sealed bailers may be used. All non-disposable equipment entering the well casing, except dedicated pumps, will be decontaminated at each sampling point. This is to include field analytical equipment and filtration devices (if used) coming in contact with groundwater samples. The following procedure will be used to decontaminate this equipment:

1. All non-dedicated or non-disposable equipment entering the well casing (except the water level indicator) will be decontaminated using the following procedure:
    a. Wash with a non-phosphate detergent and potable water;
    b. Rinse with potable water;
    c. Rinse with deionized/distilled water.

2. Should light or heavy phase organic compounds be found in a well the procedure for decontamination will be:
    a. Wash with a non-phosphate detergent and potable water;
    b. Rinse with potable water;
    c. Rinse with deionized/distilled water;
    d. Rinse with methanol;
    e. Rinse with deionized/distilled water.

3. The water level meter will be wiped down with a clean disposable paper towel saturated with deionized water. If light or heavy phases are found in a well, a clean disposable paper towel soaked with methanol will be used to wipe all parts in contact with the well, followed by repeated flushing with copious amounts of deionized water.

4. No other non-dedicated equipment will be used for the routine detection sampling with the exception of field parameter meters. These meters (pH, temperature, specific conductance and turbidity) will not be placed down the well and have no potential to cross-contaminate the detection network wells. They will be rinsed between wells with deionized or distilled water.

(C)(2)(f) Chain of Custody Tracking Forms

Chain-of-custody information will be maintained on a standardized form provided by the analytical laboratory. A chain-of-custody form will accompany the sample shuttles at all times (see example in Appendix A). While in the field, the sampler will fill out appropriate information in ink and sign the form. If the sampler delivers the samples to the receiving laboratory, the next signature, date, and time should be completed by the laboratory personnel logging in the samples. From this point, internal tracking of forms should be maintained. In the event a third party (delivery service) delivers the samples to the lab, a chain-of-custody form should be placed in each cooler and the cooler should be sealed with a tamper-proof device. The internal temperature of the sample cooler(s) shall be documented on the chain of custody by the receiving laboratory's personnel.

(C)(2)(f)(ii) Sample Labels

Waterproof sample labels will be provided by the laboratory and shall contain sample identification, type of analysis, sample date and time, internal laboratory identification (if any), samplers names, preservatives and any special instructions.

(C)(2)(g) Field and Laboratory Quality Assurance/Quality Control

(C)(2)(g)(i) Field Duplicates

One field duplicate set of samples will be taken at a particular monitoring point and labeled "Field Duplicate". These are independent samples which are collected as close as possible to the same point in space and time. They are two (2) separate samples taken from the same source, stored in separate containers, and analyzed independently. Field duplicates are useful in documenting the precision of the sampling and analytical process. Samples shall be collected in proper alternating order for the sample point and field duplicate for each parameter (e.g. VOA – VOA, metals – metals, etc). Field duplicates shall be taken and analyzed at a batch minimum of 1 in 20.

Site-specific matrix spike and matrix spike duplicate samples may be collected as part of the overall laboratory QA/QC program. Matrix spikes are added to the sample, at the lab, prior to sample preparation and analysis. The matrix spike is used to determine the bias of a method in a given sample matrix. Matrix spike duplicates are intra-laboratory split samples spiked with identical concentrations of target analyte(s). The spiking occurs at the lab prior to sample preparation and analysis. They are used to document the precision and bias of a method in a given sample matrix.

(C)(2)(g)(ii) Equipment (Rinsate) Blank

If equipment (i.e. non-dedicated sampling pump) is decontaminated and re-used between wells, equipment blanks will be prepared in the field immediately following decontamination cleaning procedures on any non-dedicated equipment used for purging, and sampling. Following decontamination, field supply organic free water is passed through the non-dedicated equipment in the same procedure as a groundwater sample. This blank confirms proper field decontamination procedures on non-dedicated equipment utilized in the field.

(C)(2)(g)(iii) Trip Blank

Trip blanks will be prepared in the laboratory by filling the appropriate clean sample containers with organic free water and adding the applicable chemical preservative, if any, for each type of sample. These containers are to be labeled "Trip Blank", the analyses to be performed on each container indicated, and then shipped in the typical transportation cooler to the field and back to the laboratory along with the other sample set containers for a given event. This blank is tested for any contamination that may occur as a result of the containers, sample coolers, cleaning procedures, or chemical preservatives used. At least one set of trip blanks will be prepared by the laboratory and accompany the groundwater samples at all times during the groundwater sampling event. Trip blanks will generally not be collected in the field.

(C)(2)(h) Well Maintenance

Wells in the monitoring program will be evaluated each time they are sampled to assure their integrity. Well maintenance issues will be noted on the Monitoring Well Condition Report, or the comments section of the Field Sampling Form (Appendix A). Issues that affect the integrity of the well and its groundwater samples will be repaired prior to the next semiannual event or sooner if warranted.

(C)(3) Measurements of Groundwater Elevations

In accordance with OAC 3745-27-10(C)(3), ~~P~~potentiometric surface maps will be prepared ~~–~~in conjunction with any major sampling event. If dry monitoring wells preclude the ability to prepare representative potentiometric contours, then only a plot of the data for these wells will be shown on the map. ~~whenever more than 50 percent of the detection network wells are sampled in a particular zone.~~ Groundwater depths will be measured in all the wells to be sampled prior to purging in as short a time as possible (within a 24-hour period at a maximum) to avoid temporary variations in groundwater levels which may complicate the determination of the true groundwater flow rate and direction.

The total depth of each well, not equipped with a dedicated pump, will be measured prior to purging and sampling in all wells at least annually. The top of PVC casing will be marked with a small notch or permanent mark where all taped depth to water measurements will be obtained. Wells equipped with pumps will be measured from the water-level measurement port. If a well is

equipped with a dedicated pump that does not allow total depth measurements, the depth of that well will be measured whenever maintenance allows (i.e. the dedicated pump is removed from the well).

(C)(4) Background Groundwater Quality

Apex proposes to establish a background data set for each detection monitoring well (both upgradient and downgradient). This dataset establishes the baseline (i.e., unaffected by facility operations) for which any subsequent sample will be compared. As outlined in section (C)(9) below, each data set will consist of at least eight sample points (or the appropriate number required for the applied statistical method). In accordance with OAC 3745-27-10(D)(5), a minimum of eight independent samples will be collected within the first year after well installation, with a minimum of four independent samples within 180 days of monitoring.

The monitoring well network has been and will be installed along the perimeter berm of the landfill once the perimeter berm has been constructed. Background groundwater sampling is than initiated on the monitoring wells prior to waste placement in the associated landfill phase for which the well is to monitor. All attempts will be made to conduct as many background sampling events as possible prior to waste placement in the phase as the perimeter construction allows.

Prior to establishing the background data set, the data will be examined to assess the presence of outliers, anomalies, and/or trends that could unnaturally skew the statistical limits, which could cause misinterpretation of the compliance data during statistical evaluation. Outliers and anomalies are defined as inconsistently large or small values that can occur due to sampling, laboratory, transportation, or transcription errors, or even by chance alone. If present, outliers will be removed from the data set and replaced with additional data (i.e., resamples, historical data, etc.).

(C)(6) Statistical Methods

UAS and SZS Monitoring Wells.

Due to the heterogeneous hydrogeology (e.g., Pennsylvanian Age Conemaugh formation and overlying mine spoil deposits) underlying the site which contributes to the significant variability of groundwater characteristics, Apex has implemented intra-well statistical methods for the UAS and SZS well network for the existing facility and will be the chosen method for the proposed landfill. An intra-well approach compares each new measurement for a given constituent at an individual

well to its own historical background data set instead of changes between upgradient and downgradient wells. This method eliminates the possibility that spatial variation between upgradient and downgradient wells can cause an erroneous conclusion that a release has occurred. In addition, this method assumes that the historical data at the detection wells have not been impacted by the facility. The Apex facility fulfills this assumption and is the ideal situation in which to implement intra-well analysis. Therefore, intrawell analyses are the most appropriate statistical method for use at the proposed landfill expansion.

Background data collection has been and will continue to be collected for the existing facility. Background will also be collected on the Phase 8 through 13 well network. Intra-well statistical methods are used and will be used for future data analyses. More specifically Combined Shewhart-CUSUM control charts are used for statistically analyzing inorganic constituents. The statistical limits for organic compounds are the current Practical Quantitation Limits (PQLs) which are below drinking water Maximum Contamination Limits (MCLs) and the Ohio EPA's Target Quantitation Limits (TQLs) as described in OAC Rule 3745-27-10(C)(7)(e). In addition, Apex proposes to review the analytical data on a regular basis to determine if the most appropriate statistical test is utilized based on data distributions, percentage of non-detects, or equality of variances which can change as the groundwater monitoring program matures.

No matter which statistical method is applied, statistical parameters will consist of those outlined in OAC 3745-27-10(D)(5). These parameters will be reviewed during each sampling event to minimize the site-wide false positive rate and maintain the statistical power of the analyses. The statistical evaluation will be provided with each semiannual detection monitoring report. Any revisions to the statistical methods will be submitted to the Ohio EPA thirty (30) days prior to submitting the first set of data analyzed using the revised method.

Should the statistical analysis show that the reported concentration of a constituent exceed its respective statistical limit, the "1 of M Resampling Method" using an Ohio EPA 1 of 2 resampling procedure will be utilized. The confirmation sample(s) will be collected from the affected well(s) and analyzed for the constituent(s) in question. The results of both the initial sample and verification resample must be statistically significant, otherwise the result is considered a false positive. This resample helps eliminate random false positives caused by sampling or analytical errors.

If the resample results are obtained prior to submitting the original data report to Ohio EPA and the resample is below the statistical limit, both the original and resample results will be presented but the potential statistically significant increase (SSI) will be reported as unverified. If the resample results are obtained after the semi-annual data report is submitted to Ohio EPA, the report will list the SSI. If results of the resample, once received, show that the initially reported SSI has been disproved, Apex will submit the new information to Ohio EPA with a request for the well to remain in the detection monitoring program according to OAC 3745-27-10(D)(7)(c).

Underdrains

Since the existing and proposed underdrains do not provide "representative" samples and/or discrete samples of specific zones (in fact the underdrains produce composite samples), Apex will not perform statistical analysis on the underdrains with the concurrence of the Ohio EPA[1]. ~~Apex will utilize graphical comparisons (i.e., time series graphs, piper diagrams, stiff diagrams, or other relevant graphical form) and trend testing as a means to classify and compare groundwater results obtained from the underdrains as outlined in Appendix C and discussed below.~~Apex will follow the procedures provided in the flow chart in Appendix C to evaluate water quality data from the underdrain system at the facility. ~~If it is determined that there has been a waste derived release to the underdrain system, assessment activities will be initiated in accordance with OAC Rule 3745-27-10(E) if deemed appropriate by the Ohio EPA.~~

The underdrains will be sampled on a semi-annual basis for the same constituents as the SZS monitoring wells. The flow of each underdrain will also be measured at the time of sampling. The underdrain groundwater quality results will be submitted with the semi-annual groundwater quality report. The report will also contain time series plots for the underdrains for SZS parameters ammonia, chloride, potassium, and sodium for all groundwater data collected to date. Based on the changing groundwater quality noted during construction and numerous extensions of the underdrains, the semi-annual sampling and subsequent time series plots will be prepared for the underdrains until the underdrain is completely installed. Once the underdrain is completely installed, the groundwater quality data collected after the completion date of the underdrain will be subject to trend testing. By only conducting trend testing on the groundwater data collected after the underdrain is completed, should minimize erroneously reporting increasing trends which are due to the changing groundwater source and the underdrain being open to surface water infiltration during construction.

[1] April 14, 2005 Ohio EPA agrees that statistical analyses of the underdrain analytical results are not required.

Should results of the trend testing indicate that an increasing trend is noted for two consecutive semi-annual sampling events, a further data review will be completed. This further review will be submitted with the semi-annual groundwater quality report and could included, but not be limited to, comparing flow rates of the underdrain, comparing groundwater quality to other monitoring wells and leachate, and preparing stiff and piper diagrams. If appropriate, submit demonstration report documenting other source of impact no related to the landfill. If it is determined that there has been a waste derived release to the underdrain system, the Ohio EPA will be notified and assessment activities will be initiated in accordance with OAC Rule 3745-27-10(E).

Volatile Organic Compounds (VOCs) part of the SZS parameter lists will be analyzed at the underdrains sampling locations. If one or more VOC(s) are detected above the statistical limit, verification resampling will be conducted. A statistical exceedance (statistically significant increase above background - SSI) will be recorded if any single VOC is measured above the PQL and confirmed in the verification resample(s). If appropriate, submit demonstration report documenting other source of impact no related to the landfill. If it is determined that there has been a waste derived release to the underdrain system, the Ohio EPA will be notified and assessment activities will be initiated in accordance with OAC Rule 3745-27-10(E).

(C)(7) Performance Standards for Statistical Methods

Apex will use appropriate statistical tests as outlined in the U.S. EPA Unified Guidance *"Statistical Analysis of Groundwater Monitoring Data at RCRA Facilities"*, March 2009. Apex reserves the right to use any other statistical test generally accepted by the professional community which meets the performance standard requirements and accepted by the Ohio EPA. In general, the statistical method used to evaluate groundwater monitoring data must be appropriate for the distribution of constituents, *i.e.*, normal vs. non-normal distribution; the method must account for type I error levels (for certain statistical procedures); the statistical method must account for data below the limit of detection; if necessary the statistical method must account for seasonal and spatial variability as well as temporal correlation in the data.

Following establishment of background for each detection monitoring well, background will be updated in blocks of at least four, pursuant to OAC 3745-27-10(C)(7)(g). This rule states that the new data must be statistically compared to the existing background data before adding the new data.

Since the analytical results for each well are statistically analyzed using intra-well statistical methods, any new data has already been statistically compared to the background database during each semiannual event and further comparisons are not required for updating background. Therefore, background for wells using intra-well procedures will be updated to include the non-SSI data after four or more statistically independent samples are collected. In accordance with the Rule, data that exhibit SSIs may be added to background with written approval of the Director or if it is determined that the SSI does not originate from a waste derived constituent (i.e., approved ASD).

Based on the timing for the installation of the well network, the desire to use intra-well statistical methods, and the date that waste was first placed in the landfill. Apex does not anticipate submitting an intra-well statistical demonstration per OAC 3745-27-10(C)(7)(h). However, if future background results demonstrate a statistically significant change in the analytical results following the date of waste acceptance, Apex will provide an intra-well demonstration on a constituent-specific basis.

(C)(8) Determination of Statistically Significant Increase from Background Values

Once groundwater analytical results have been collected, checked for QA/QC consistency and determined to be above the appropriate statistical level, the results must be verified in accordance with the objectives of 40 CFR Part 258.53 and OAC 3745-27-10(C)(8). Verification resampling is an integral part of the statistical methodology described by U.S. EPA Unified Guidance *"Statistical Analysis of Groundwater Monitoring Data at RCRA Facilities"*, March 2009. Without verification resampling, much larger statistical limits would be required to achieve site-wide false positive rates of 5% or less. Furthermore, the resulting false negative rate would be greatly increased. The following procedure will be performed for each compound determined to be initially above its statistical limit. Only compounds that initially exceed their statistical limit will be sampled for verification purposes. Under this program, a verified statistical exceedance is not declared unless the initial sample and one subsequent resample exceed the statistical limit (i.e., a "pass 1 of 1 resample" which is a pass 1 of 2 per Ohio EPA definition). Resampling will be performed such that the resample results can be submitted within 75 days of the initial sampling event. If resamples are not collected or the results are not available in the 75 day time frame, the Ohio EPA must be notified of the exceedance based on the initial sample results. Thereupon, the resampling results will be used in making an alternate source demonstration to Ohio EPA and be submitted to Ohio EPA under separate cover.

Should a statistically significant increase (SSI) be determined, Apex will submit written notification to the Director of the Ohio EPA or his authorized representative no later than 75 days after the initial sample date of the monitoring well(s) and constituent(s) designated SSIs. A copy of the notice will also be placed in the facility's Operating Record.

If one or more VOCs are detected above the statistical limit, verification resampling will be conducted. A statistical exceedance (statistically significant increase above background - SSI) will be recorded if any single VOC is measured above the PQL and confirmed in the verification resample(s).

Following submittal of the notice to the Director, Apex will prepare a report for submittal to the Ohio EPA (director or authorized representative). The report will identify the significance of the SSI. If it is determined that the SSI is the result of an error in sampling, an error in analysis, an error in statistical evaluation, an alternative source, or a natural variation in groundwater quality, Apex will request approval to continue detection monitoring according to Rule OAC 3745-27-10(D)(7)(c)(ii). If Apex does not receive Ohio EPA approval to return to detection monitoring within 210 days of the initial sampling, Apex will initiate an assessment monitoring program in accordance with OAC 3745-27-10(E).

Appendix I of OAC 3745-27-10 lists the parameters evaluated in order to monitor groundwater quality in the UAS and SZS zones. The UAS wells will be statistically analyzed for parameters 1-66 of Appendix I and the SZS wells will be statistically analyzed for parameters 18, 25, 33, 61, 63, 64, 65 and 66 of Appendix I (benzene, chloroethane, 1,1-dichloroethane, vinyl chloride, ammonia, chloride, sodium and potassium) as described in Sections (C)(6) and (C)(7). The determination of a statistically significant increase from background values for each parameter or constituent required in this particular groundwater monitoring program will be made on semiannual (six month) intervals.

(C)(9) Sample Number

The appropriate number of background samples collected will be consistent with the appropriate statistical methods chosen pursuant to paragraphs (C)(6) and (C)(7) of this Plan. It is anticipated that a minimum of eight background samples will be obtained from each compliance well in the network.

(C)(10) Submission of Results

A letter report providing the results of field, laboratory, and statistical analyses of the groundwater samples collected from the monitoring well network will be submitted to the Ohio EPA and placed in the Operating Record no later than 75 days after sampling the well. The accompanying text will include, at a minimum:

- Lab Data Sheets
- Field and Lab QA/QC data
- Chain of Custody and Sample Receipt Forms
- Data Summary Tables
- Statistical Analysis Results and Summary Tables including Normality Test Results
- Potentiometric Surface Maps of the UAS and SZS zones
- Description of Analytical methods used including Method Detection Limits and Practical Quantitation Limits
- Underdrain sampling results, graphical comparisons and trend testing.

These items may be submitted on an electronic format with the exception of the Chain of Custody and Field Information Forms.

(D) GROUNDWATER DETECTION MONITORING PROGRAM

(D)(1) Monitoring Parameters

Monitoring parameters will consist of constituents listed in OAC 3745-27-10, Appendix I. This list of chemicals can also be reviewed in Appendix B of this Plan.

(D)(2) Alternate Monitoring Parameter List

No constituents are proposed to be deleted at this time. In accordance with the specifications of OAC Rule 3745-27-10(D)(2) Apex reserves the right to propose to the director at a later date an alternate list of inorganic testing parameters.

(D)(3) Alternate Inorganic Parameter List

No constituents are proposed to be deleted at this time. In accordance with the specifications of OAC Rule 3745-27-10(D)(3) Apex reserves the right to propose to the director at a later date an alternate list of inorganic testing parameters.

(D)(4) Alternate Parameters for Low-Yield Wells not Screened in the UAS

In accordance with the specifications of OAC Rule 3745-27-10(D)(4), Apex reserves the right to propose to the Director at a later date an alternate list of testing parameters for low-yield wells not screened in the uppermost aquifer system and for sampling points for the underdrain system.

(D)(5) Monitoring Parameters, Frequency, Location

This section summarizes the parameters, frequency and location for groundwater monitoring of the landfill.

(D)(5)(a)(i) UAS Parameters & Frequency

Following establishment of background, UAS wells will be monitored for parameters 1-66 in the Appendix I list semiannually, and for parameters 1 through 78 of the Appendix I list annually.

(D)(5)(a)(ii) UAS Semiannual Sampling

When intra-well statistics are performed on a new UAS well, a minimum of eight independent samples will be collected within the first year after well installation, with a minimum of four independent samples within 180 days of initial monitoring. Samples will be analyzed for parameters 1-66 of the Appendix I list semiannually, and for parameters 1 through 78 of the Appendix I list annually beginning one year after the GWDMP is implemented.

(D)(5)(a)(iii) UAS Statistical Analysis Schedule

Statistical evaluation of the UAS water quality data will be conducted semi-annually on parameters 1-66 of Appendix I of Rule OAC 3745-27-10.

(D)(5)(b)(i) Non UAS Wells - Sampling Parameters & Frequencies

Following establishment of background, SZS wells will be monitored for parameters 18, 25, 33, 61, 63, 64, 65 and 66 in the Appendix I list (benzene, chloroethane, 1,1-dichloroethane, vinyl chloride, ammonia, chloride, sodium and potassium) semiannually, and for parameters 1 through 78 of the Appendix I list annually.

(D)(5)(b)(ii) Non-UAS Semi-Annual Sampling

When intra-well statistics are performed on a new non-UAS well, a minimum of eight independent samples will be collected within the first year after well installation, with a minimum of four independent samples within 180 days of monitoring. Samples will be analyzed for 18, 25, 33, 61, 63, 64, 65 and 66 of the in Appendix I list (benzene, chloroethane, 1,1-dichloroethane, vinyl chloride, ammonia, chloride, sodium and potassium) semiannually, and for parameters 1 through 78 of the Appendix I list annually beginning one year after the GWDMP is implemented.

Eight (8) baseline samples from the underdrain system(s) will be collected within 12 months and semi – annually thereafter and analyzed for parameters 18, 25, 33, 61, 63, 64 ,65, and 66 of the Appendix I list.

(D)(5)(b)(iii) Non-UAS Statistical Analysis Schedule

Statistical evaluation of the non-UAS water quality data will be conducted semi-annually on parameters 18, 25, 33, 61, 63, 64, 65 and 66 (benzene, chloroethane, 1,1-dichloroethane, vinyl chloride, ammonia, chloride, sodium and potassium) of Appendix I of Rule OAC 3745-27-10.

Apex proposes that no statistical evaluation be performed on the underdrain system samples; however, graphical reporting and trend testing as described in the Underdrain Sampling Compliance Program (see Appendix C) will be performed on the data.

(D)(5)(c) Appendix I List Minimum Frequency

All monitoring wells will be monitored for all parameters in OAC 3745-27-10 Appendix I (1-78) at least annually.

(D)(5)(d) Field Parameters

Samples from all wells and underdrains will be field analyzed for temperature, pH, and specific conductance during each monitoring event. Turbidity will also typically be measured in the field. Laboratory measurements (except temperature) may be conducted in lieu of field measurements in the event of field instrument failure.

(D)(5)(e) New or Replacement Well Schedule

The groundwater data from new or replacement wells shall be statistically analyzed as soon as possible after 8 independent background samples have been collected, but no later than one year after installation.

(D)(6) Alternate Sampling and Statistical Analysis Frequency

No alternate sampling and statistical modification is requested at this time. Apex reserves the right to propose an alternate frequency at a later date.

(D)(7)(a) Determination of Statistically Significant Increase

If a confirmed SSI over background is determined, the following procedures will be executed.

(D)(7)(b) Notification to Ohio EPA

If a SSI over background is confirmed for any of the constituents statistically analyzed, the Ohio EPA will be notified in writing no later than 75 days after sampling the well showing the SSI. The notification will indicate which wells and parameters have shown a SSI over background levels. A copy of this notification will be placed in the Operating Record.

(D)(7)(c) Demonstration of a False Positive

If Apex determines that a statistical increase over background is a false positive determination, Apex may do one of the following:

(D)(7)(c)(i) Confirmation Resampling Method/False Positive Demonstration

Apex may choose to resample the well with the suspected false-positive detection (referred to as the "1 of M Resampling Method" in Section (D)(7)(c)(i)). Pursuant to the Ohio EPA DSIWM Guidance Document No 606 (an Interoffice Communication from Lindsay Taliaferro to Division of Drinking and Groundwater District Supervisors, dated August 26, 1996), Apex may choose to use the 1 of 2 resampling strategy for all statistical procedures. If the validated resampling result is also at a statistically significant concentration, the false-positive hypothesis will be refuted.

(D)(7)(c)(ii) Alternate Source Demonstration

If Apex can demonstrate that a source other than the sanitary landfill facility caused the contamination or that the statistically significant increase resulted from error in the sampling, analysis, statistical evaluation, or natural variation in groundwater quality, a report documenting this demonstration will be submitted to the director or his authorized representative.

If Apex does not obtain approval to continue detection monitoring within 210 days from the initial sampling, Apex shall initiate an assessment monitoring program as required by OAC 3745-27-10(E).

(E) GROUNDWATER QUALITY ASSESSMENT MONITORING PROGRAM

Unless the Ohio EPA approves the alternative source demonstration report, a Groundwater Quality Assessment Plan (GWQAP) will be submitted to the Ohio EPA within 135 days of notifying the Agency of a statistically significant increase over background in accordance with OAC Rule 3745-27-10(D)(7). The GWQAP will comply with OAC Rule 3745-27-10(E).

Pursuant to OAC 3745-27-10(E)(8), a Compliance Monitoring Plan may be submitted along with the Groundwater Assessment Report if the assessment parameters exclusively consist of parameters 63 through 78 of Appendix I of the Rule, and the other criteria in the Rule are met.

(F) CORRECTIVE MEASURES PROGRAM

Unless the Ohio EPA Director reinstates detection monitoring, or a Compliance Monitoring Plan is submitted pursuant to OAC 3745-27-10(E)(8), a Corrective Measures Plan will be submitted to the Ohio EPA within 180 days of making a determination of rate, extent and concentration of waste-derived constituents.

REFERENCES

BBC&M Engineering, Inc. May 2001. Groundwater Monitoring Program Plan, Apex Solid Waste Disposal Facility, Jefferson County, Ohio.

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Civil & Environmental Consultants, Inc. October 2009, Revised December 16, 2011. Groundwater Monitoring Program Plan, Apex Sanitary Landfill, Jefferson County, Ohio.

Ohio Environmental Protection Agency. Municipal Solid Waste Landfill Regulations. Ohio Administrative Code, OAC 3745-27-10. August 2003.

Ohio Environmental Protection Agency. November 3, 2009. Guidance for DDAGW Review and Comment of a Statistical Demonstration for Returning to Detection Monitoring. Number GD0303.300.

Ohio Environmental Protection Agency, July 27, 1997, Definition of an Aquifer System, Final Guidance Number DDAGW 02-05-100.

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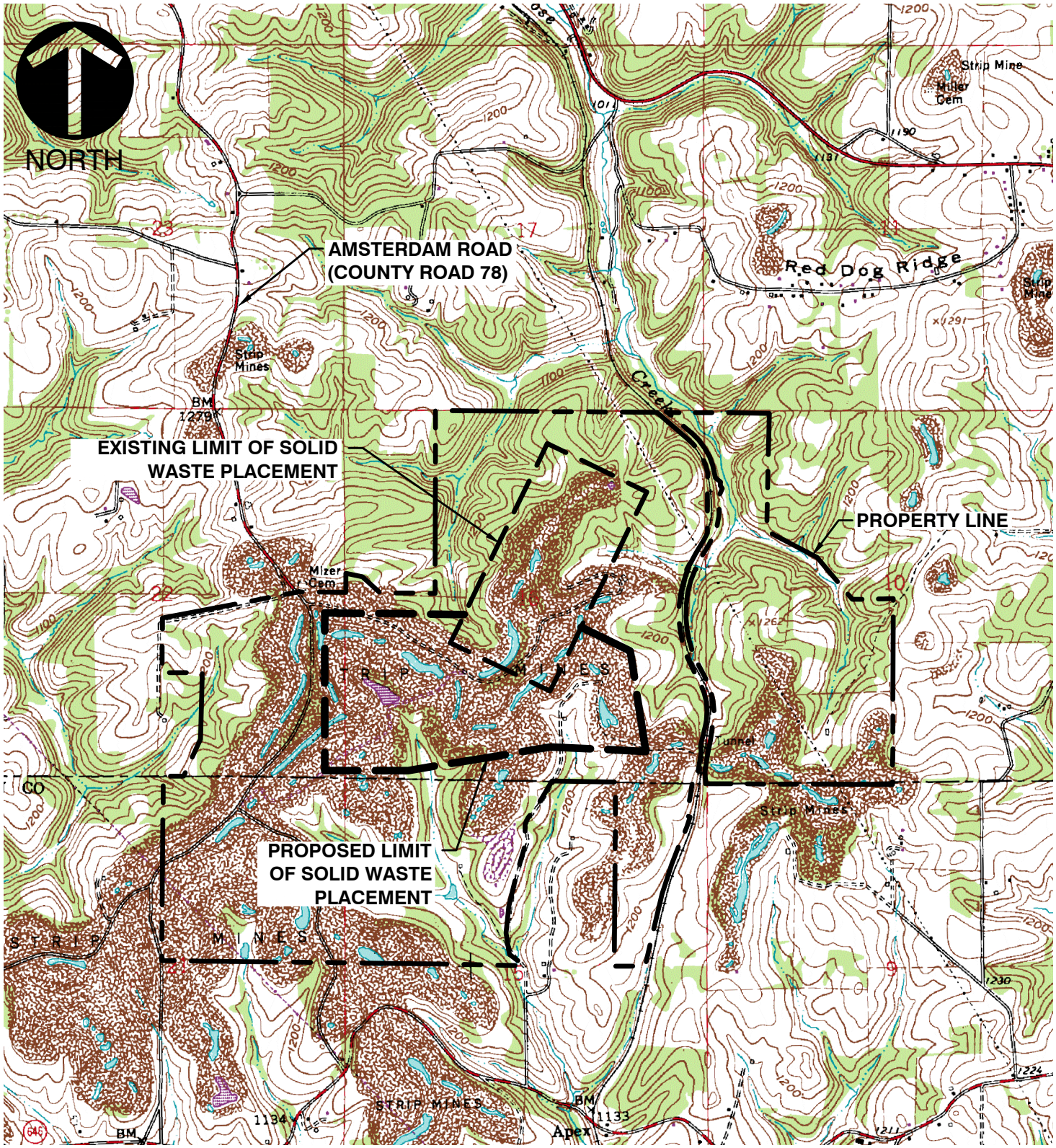
Ohio Environmental Protection Agency, May 2012~~February 1995~~, Technical Guidance Manual for Groundwater Investigations~~Hydrogeologic Investigations and Ground Water Monitoring~~.

Robert D. Gibbons Ltd. DUMPStat Statistical Guide. Prepared by Robert D. Gibbons. Copyright© 2003 Robert D. Gibbons Ltd. and Discerning Systems Inc.

U.S. Environmental Protection Agency, March 2009. Statistical Analysis of Ground Water Monitoring Data at RCRA Facilities, Office of Solid Waste, Waste Management Division, Washington, D. C.

FIGURES



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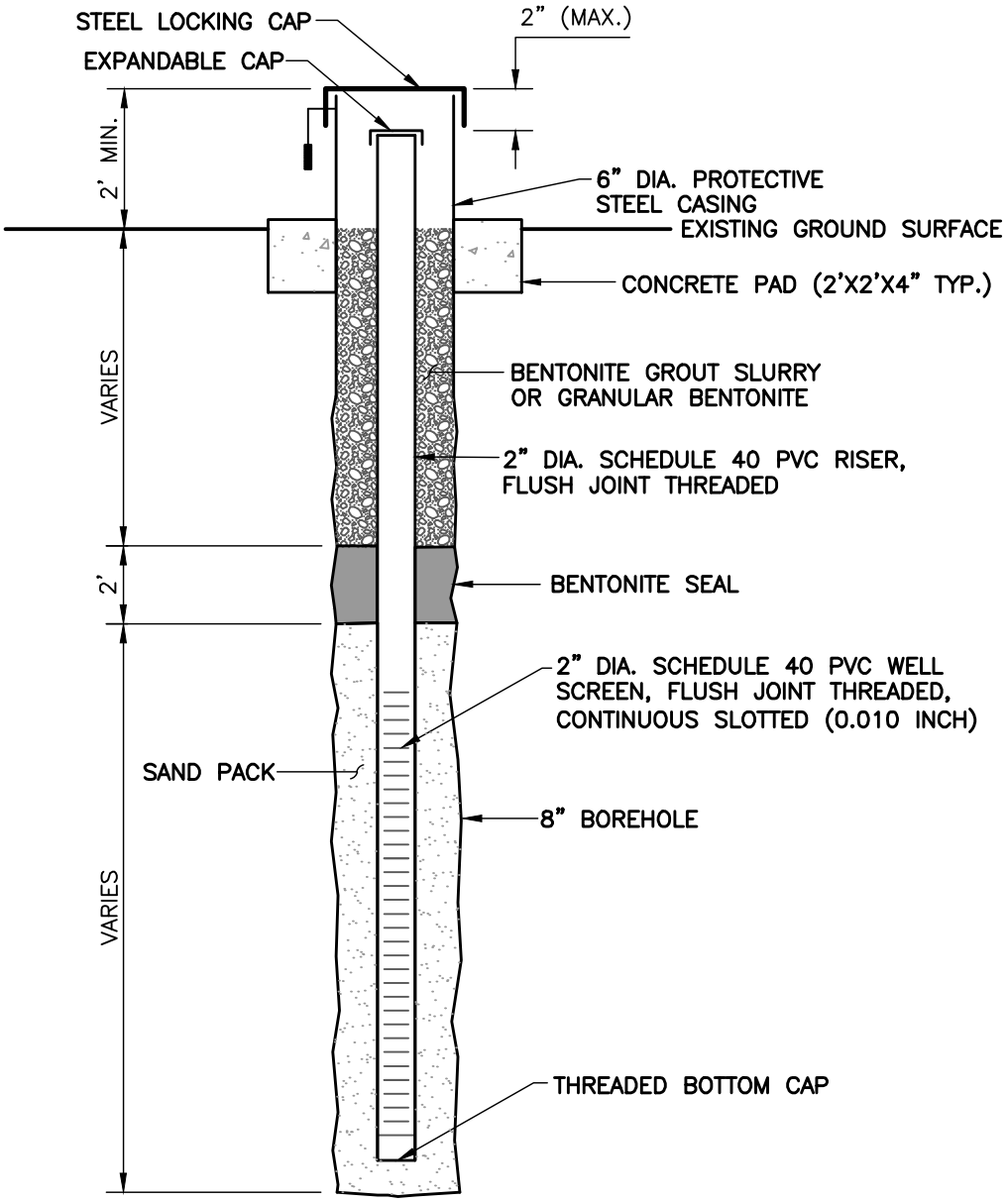
APEX ENVIRONMENTAL LLC.
GROUNDWATER DETECTION MONITORING PLAN
APEX SANITARY LANDFILL
JEFFERSON COUNTY, OHIO

SITE LOCATION MAP

DRAWN BY:	BTW	CHECKED BY:	DLC	APPROVED BY:	*JMD	FIGURE NO.:	1
DATE:	AUG 2011	DWG SCALE:	1"=2000'	PROJECT NO:	101-049		

P:\2010\101-049\-CADD\DWG\EXHIBITS\101049 - FIG 1 - SITE LOCATION MAP.DWG\USGS 8X11.PLS;(WWEHNER - 7/1/2013) - LP: 7/1/2013 2:31:05 PM



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APEX ENVIRONMENTAL LLC.
GROUNDWATER DETECTION MONITORING PLAN
APEX SANITARY LANDFILL
JEFFERSON COUNTY, OHIO

MONITORING WELL CONSTRUCTION DIAGRAM

DRAWN BY:	BTW	CHECKED BY:	DLC	APPROVED BY:	*JMD	FIGURE NO.:
DATE:	AUG 2011	DWG SCALE:	NTS	PROJECT NO:	101-049	2

P:\2010\101-049\-CADD\DWG\EXHIBITS\101049 - FIG 1 - SITE LOCATION MAP.DWG\DETAIL 8X11 (2)\LS:(WWEHNER - 7/1/2013) - LP: 7/1/2013 2:31:07 PM

DRAWING

REVISION RECORD

NO	DATE	DESCRIPTION
1	JULY 2013	REVISION FOR OHIO EPA NOD (12/28/2012

SUBMITTAL RECORD

NO	DATE	DESCRIPTION

DETECTION WELL NETWORK INSTALLATION SCHEDULE

PHASE	CONNELLSVILLE/MORGANTOWN UAS	BELLAIRE/SUMMERFIELD SZS	LIMESTONE/SHALLOW BEDROCK SZS (IF SATURATED)	MINE SPOIL SZS (IF SATURATED)
8	B-415 (DOWNGRADIENT)	B-415S (DOWNGRADIENT)	B-415L (DOWNGRADIENT)	B-415A (DOWNGRADIENT)
10	B-416 (DOWNGRADIENT)	B-416S (DOWNGRADIENT)	B-416L (UPGRADIENT)	B-416A (DOWNGRADIENT)
	B-417 (UPGRADIENT)	B-417S (UPGRADIENT)	B-417L (UPGRADIENT)	B-417A (UPGRADIENT)
	B-418 (DOWNGRADIENT)	B-418S (UPGRADIENT)	B-418L (DOWNGRADIENT)	B-418A (UPGRADIENT)
11	B-419 (DOWNGRADIENT)	B-419S (DOWNGRADIENT)	B-419L (DOWNGRADIENT)	B-419A (DOWNGRADIENT)
	B-420 (DOWNGRADIENT)	B-420S (DOWNGRADIENT)	B-420L (ONLY IF SATURATED)	B-420A (DOWNGRADIENT)
	B-421 (DOWNGRADIENT)	B-42S1 (DOWNGRADIENT)	B-421L (DOWNGRADIENT)	B-421A (DOWNGRADIENT)
12	B-422 (DOWNGRADIENT)	B-422S (DOWNGRADIENT)	B-422L (DOWNGRADIENT)	B-422A (DOWNGRADIENT)
	B-423 (DOWNGRADIENT)	B-423S (DOWNGRADIENT)	B-423L (DOWNGRADIENT)	B-423A (DOWNGRADIENT)
	B-424 (DOWNGRADIENT)	B-424S (DOWNGRADIENT)	B-424L (DOWNGRADIENT)	B-424A (DOWNGRADIENT)
13	B-425 (UPGRADIENT)	B-425S (DOWNGRADIENT)	B-425L (DOWNGRADIENT)	B-425A (DOWNGRADIENT)
	B-426 (DOWNGRADIENT)	B-426S (UPGRADIENT)	B-426L (DOWNGRADIENT)	B-426A (IF SATURATED)
	B-429 (UPGRADIENT)	B-429S (DOWNGRADIENT)	NOT APPLICABLE	NOT APPLICABLE
14	B404 (INSTALLED DEC 2012)	B404S (INSTALLED DEC 2012)	NOT SATURATED	B-404A (DOWNGRADIENT)
	B-427 (DOWNGRADIENT)	B-427S (DOWNGRADIENT)	B-427L (DOWNGRADIENT)	B-427A (DOWNGRADIENT)
	B-428 (DOWNGRADIENT)	B-428S (DOWNGRADIENT)	B-428L (DOWNGRADIENT)	B-428A (DOWNGRADIENT)

PIEZOMETER ABANDONMENT SCHEDULE

PHASE	PIEZOMETER / WELL IDENTIFICATION
8	B–310,B–401S, B–402A, B–402S, P–11L (B–431L), B–401A, P–4L, P–7A, B–403S, B–431S, B–431
9	B–2A, B–2B, P–10L, B–401, B–402
10	P–1, P–1L, P–1S, P–1A, P–12, P–12S, P–2A, P–2L, P–2S
11	B–12, P–3A, P–3L, P–3S
12	B–311, P–5, P–5A, P–5L, P–5S
13	B–403, P–9, P–9S
14	B–11, B–115, B–309, P–15L (B–430L), B–430S, B–430

LEGEND

PROPERTY LINE
TREELINE
EXISTING UNPAVED DRIVE
EXISTING RAIL ROAD
1200 EXISTING INDEX CONTOUR
UD EXISTING UNDERDRAIN
EXISTING UNDERDRAIN TRENCH
PROPOSED UNDERDRAIN
STRUCTURE/BUILDING
B-309 PIEZOMETER
B-402 DETECTION MONITORING WELL
P-5A MINESPOIL PIEZOMETER
P-5L LIMESTONE/SHALLOW ROCK PIEZOMETER
P-5S BELLAIRE/SUMMERFIELD PIEZOMETER
P-5 CONNELLSVILLE/MORGANTOWN PIEZOMETER
B-420A PROPOSED MINESPOIL DETECTION MONITORING WELL
B-420L PROPOSED LINESTONE/SHALLOW BEDROCK DETECTION MONITORING WELL
B-420S PROPOSED BELLAIRE/SUMMERFIELD DETECTION MONITORING WELL
B-420 PROPOSED CONNELLSVILLE/MORGANTOWN DETECTION MONITORING WELL
PG-1 POND GAUGE
ABANDONED MONITORING WELL OR PIEZOMETER

NOTES

1. OAC RULE 3745–27–06(B)(3)(6) REQUIRES A PLAN SHEET TO CONTAIN ALL SUBSURFACE INVESTIGATION SITES, INCLUDING: TEST PITS, MONITORING WELLS, PIEZOMETERS, TENSIOMETERS, GEOPHYSICAL SURVEY STATIONS, SOIL GAS SURVEY STATIONS, AND ALL PROPOSED GROUNDWATER MONITORING WELLS. THIS SHEET (DRAWING 3D) CONTAINS ALL SUBSURFACE INVESTIGATION SITES AS DEPICTED. IF NOT DEPICTED IN THIS DRAWING, THEY DO NOT EXIST.

2. PURSUANT TO OAC RULE 3745–27–06(B)(3)(E) THREE PERMANENT GROUNDWATER CONTROL STRUCTURES EXIST FOR THE PERMITTED FACILITY, SHAUDS–1, 2, AND 3, AND HAVE BEEN DEPICTED IN THIS DRAWING.

REFERENCE

TOPOGRAPHIC MAPPING PREPARED BY KEDDAL AERIAL MAPPING, INC. USING AERIAL PHOTOGRAPHY DATED JANUARY 6, 2012 AND JANUARY 5, 2011. ADDITIONAL MAPPING PREPARED BY M.A.N. MAPPING USING 12/14/00 AERIAL PHOTOGRAPHY.

SCALE IN FEET
0 300 600

* HAND SIGNATURE ON FILE

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APEX ENVIRONMENTAL, LLC.
GROUNDWATER DETECTION MONITORING PLAN
APEX SANITARY LANDFILL
JEFFERSON COUNTY, OHIO

DRAWN BY: BTW	CHECKED BY: BRB	APPROVED BY: JMD*
DATE: FEB 2013	DWG SCALE: 1"=300'	PROJECT NO: 101-049

EXISTING AND PROPOSED GROUNDWATER MONITORING WELL NETWORK

DRAWING NO.: A-1
SHEET OF

TABLES

TABLE 1
EXISTING MONITORING WELL AND PIEZOMETER CONSTRUCTION SUMMARY
APEX SANITARY LANDFILL

Well No.	Date Installed	Date Abandoned	Stratigraphic Unit	Ground Elevation (ft. MSL)	Boring Total Depth (ft. BGS)	Top of Casing Elevation (ft. MSL)	Screen Interval (ft MSL)		Screen Interval (ft BGS)		Well Diameter (in.)	Comments
							Top	Bottom	Top	Bottom		
Uppermost Aquifer Monitoring Wells												
B-2B	Jun-91	TBD	Summerfield/Connellsville	1265.9	159.0	1268.23	1142.50	1133.50	123.4	132.4	4	-----
B-3*	Jul-91	Oct-04	Morgantown/Birmingham	1228.3	155.0	1230.83	1085.40	1076.40	142.9	151.9	4	Abandoned
B-4	Jun-91	TBD	Birmingham	1205.3	143.0	1207.75	1083.80	1074.80	121.5	130.5	4	7' of filter pack
B-5	Jun-91	TBD	Morgantown/Birmingham	1174.2	96.0	1176.74	1093.70	1084.70	80.5	89.5	4	-----
B-6	Jun-91	TBD	Morgantown	1247.9	133.0	1250.41	1159.90	1150.90	88	97.0	4	4' of filter pack
B-7B	Jul-91	TBD	Morgantown	1244	130.0	1246.53	1130.00	1121.00	114	123.0	4	7' of filter pack
B-8	Jul-91	TBD	Connellsville/Morgantown	1172.4	52.0	1174.92	1134.90	1125.90	37.5	46.5	4	9' filter pack
B-9B*	Sep-91	Sep-08	Morgantown	1256.9	157.0	1259.42	1132.90	1123.90	124	133.0	4	Abandoned
B-11	Jul-91	TBD	Morgantown	1243.9	141.0	1246.36	1140.70	1131.60	103.2	112.3	4	9' filter pack
B-12	Aug-91	TBD	Morgantown	1282.3	193.0	1284.83	1109.10	1100.10	173.2	182.2	4	18.5 of filter pack
B-13*	May-92	1992	Unknown	1249	180.0	Unknown						Exploratory boring. No well installed.
B-14*	May-92	1992	Unknown	1262	206.0	Unknown						Abandoned
B-15*	May-92	TBD	Unknown	1240	180.0	Unknown						Abandoned
B-101*	Sep-94	Sep-08	Morgantown	1193.6	120.0	1194.66	1119.30	1109.90	74.3	83.7	4	Abandoned
B-102*	Aug-94	Oct-04	Morgantown	1204.8	118.5	1206.79	1111.50	1097.10	93.3	107.7	4	Abandoned
B-103*	Aug-94	Oct-04	Morgantown	1206	113.0	1208.07	1117.80	1108.30	88.2	97.7	4	Abandoned
B-104*	Aug-94	Oct-04	Morgantown	1221.1	133.0	1221.96	1131.70	1117.40	89.4	103.7	4	Abandoned
B-105	Aug-94	TBD	Morgantown	1227.3	140.0	1229.12	1108.80	1099.30	118.5	128.0	4	4' of filter pack
B-106*	Aug-94	Jan-06	Morgantown	1165	85.0	1166.76	1096.50	1087.00	68.5	78.0	4	Abandoned
B-401	Jun-05	-----	Connellsville/Morgantown	1262.95	145.0	1265.63	1130.23	1120.23	132.72	142.72	2	Upgradient Monitoring Well
B-402	Jun-05	-----	Connellsville/Morgantown	1263.12	155.0	1266.19	1118.66	1108.66	144.46	154.46	2	Upgradient Monitoring Well
B-403	Jun-05	-----	Connellsville/Morgantown	1224.47	118.0	1226.84	1116.55	1106.55	107.92	117.92	2	Upgradient Monitoring Well
B-404	Dec-12	-----	Connellsville/Morgantown	1243.07	128.0	1246.17	1133.07	1123.07	110.00	120.00	2	Downgradient Monitoring Well
B-405	Dec-10	-----	Connellsville/Morgantown	1231.11	152.0	1234.20	1119.11	1109.11	112.00	122.00	2	Downgradient Monitoring Well
B-406	Feb-08	-----	Connellsville/Morgantown	1227.47	144.0	1230.13	1102.16	1092.16	125.31	135.31	2	Downgradient Monitoring Well
B-407	Jul-06	-----	Connellsville/Morgantown	1233.15	150.0	1235.74	1108.19	1098.19	124.96	134.96	2	Downgradient Monitoring Well
B-408	Jul-06	-----	Connellsville/Morgantown	1238.07	138.0	1240.71	1118.76	1108.76	119.31	129.31	2	Downgradient Monitoring Well
B-409	Jul-06	-----	Connellsville/Morgantown	1245.12	127.5	1247.57	1143.37	1133.37	101.75	111.75	2	Downgradient Monitoring Well
B-410	Jun-05	-----	Connellsville/Morgantown	1242.79	137.0	1245.32	1132.00	1123.00	110.79	119.79	2	Downgradient Monitoring Well
B-411	Aug-05	-----	Connellsville/Morgantown	1237.07	139.0	1240.13	1121.50	1111.50	115.57	125.57	2	Downgradient Monitoring Well
B-412	Sep-05	-----	Connellsville/Morgantown	1233.74	128.0	1236.38	1115.96	1105.96	117.78	127.78	2	Downgradient Monitoring Well
B-413	Feb-08	-----	Connellsville/Morgantown	1240.11	107.0	1242.11	1148.12	1138.12	91.99	101.99	2	Downgradient Monitoring Well
B-413R	May-09	-----	Connellsville/Morgantown	1238.88	146.0	1241.61	1115.34	1105.34	123.54	133.54	2	Downgradient Monitoring Well
B-414	Aug-09	-----	Connellsville/Morgantown	1229.42	125.0	1231.50	1121.20	1111.20	108.22	118.22	2	Downgradient Monitoring Well
P-1	Sep-10	TBD	Connellsville/Morgantown	1327.11	270.0	1329.37	1138.72	1128.72	188.39	198.39	2	-----
P-5	Sep-10	TBD	Connellsville/Morgantown	1240.98	189.0	1243.49	1127.49	1117.49	113.49	123.49	2	-----
P-9	Sep-10	TBD	Connellsville/Morgantown	1256.94	163.0	1259.50	1122.70	1112.70	134.24	144.24	2	-----
P-12	Feb-11	TBD	Connellsville/Morgantown	1300.36	141.0	1303.25	1176.69	1166.69	123.67	133.67	2	-----

TABLE 1
EXISTING MONITORING WELL AND PIEZOMETER CONSTRUCTION SUMMARY
APEX SANITARY LANDFILL

Well No.	Date Installed	Date Abandoned	Stratigraphic Unit	Ground Elevation (ft. MSL)	Boring Total Depth (ft. BGS)	Top of Casing Elevation (ft. MSL)	Screen Interval (ft MSL)		Screen Interval (ft BGS)		Well Diameter (in.)	Comments
							Top	Bottom	Top	Bottom		
Bellaire / Summerfield Significant Zone of Saturation Monitoring Wells												
B-4S	Jun-91	TBD	Summerfield	1205.8	36.0	1206.81	1181.40	1172.00	24.4	33.8	2	-----
B-11S	Apr-95	TBD	Bellaire/Summerfield	1244.3	60.0	1246.63	1195.20	1185.80	49.1	58.5	2	6' of filter pack
B-101S*	Sep-94	Sep-08	Summerfield	1193.7	49.0	1196.44	1151.10	1146.40	42.6	47.3	2	Abandoned
B-104S*	Aug-94	Oct-04	Summerfield	1221.2	35.0	1223.22	1192.90	1188.60	28.3	32.6	2	Abandoned
B-105S	Sep-94	TBD	Bellaire	1227.7	44.6	1228.37	1198.30	1183.80	29.4	43.9	2	14.5' of screen; 4' of filter pack
B-106S*	Sep-94	Jan-06	Summerfield	1164.7	28.6	1166.36	1146.20	1136.70	18.5	28.0	2	Abandoned
B-201	Apr-95	TBD	Summerfield	1209.3	40.0	1210.63	1180.20	1170.80	29.1	38.5	2	-----
B-202	Apr-95	TBD	Summerfield	1201.1	31.5	1201.63	1179.70	1170.30	21.8	30.8	2	-----
B-203*	Apr-95	Jun-05	Bellaire	1213.7	40.0	1215.33	1194.90	1185.50	18.8	28.2	2	Abandoned
B-204*	Apr-95	Jul-07	Summerfield	1196.8	50.3	1198.25	1167.80	1158.40	29	38.4	2	-----
B-301*	Aug-95	Jan-06	Summerfield	1163.9	31.0	1166.37	1138.50	1134.20	25.4	29.7	2	Abandoned
B-302*	Aug-95	Jan-06	Bellaire	1173	22.0	1174.43	1164.00	1154.60	9	18.4	2	Abandoned
B-303*	Aug-95	Jul-07	Bellaire/Summerfield	1190.2	25.0	1192.12	1181.70	1172.30	8.5	17.9	2	-----
B-304*	Aug-95	Jul-07	Bellaire/Summerfield	1215.93	50.5	1218.13	1187.90	1178.00	27.7	37.6	2	-----
B-305*	Aug-95	Jul-07	Summerfield	1216.74	87.0	1218.43	1177.60	1167.70	38.3	48.2	2	4' of filter pack
B-306*	Aug-95	Jan-06	Bellaire/Summerfield	1201.4	30.3	1202.99	1182.60	1172.70	18.8	28.7	2	Abandoned
Bellaire / Summerfield Significant Zone of Saturation Monitoring Wells (Continued)												
B-307*	Unknown	Jul-07	Summerfield	1216.56	45.0	1218.96	1181.00	1171.60	34.00	44.00	2	-----
B-308	Unknown	TBD	Bellaire	Unknown		1220.84	1198.40	1189.00	Unknown		2	-----
B-309	Unknown	TBD	Summerfield	Unknown		1214.63	1190.30	1180.90	Unknown		2	-----
B-310	Unknown	TBD	Summerfield	Unknown		1254.20	1146.30	1137.00	Unknown		2	-----
B-311	Unknown	TBD	Summerfield	Unknown		1233.87	1145.80	1136.40	Unknown		2	-----
B-312*	May-96	Jul-07	Bellaire	1215.00	40.0	1217.00	1187.80	1177.90	27.20	36.70	2	-----
B-313*	May-96	Jul-07	Summerfield	1178.30	20.0	1179.84	1169.40	1159.50	8.90	18.80	2	-----
B-401S	Jun-05	-----	Bellaire/Summerfield	1275.52	115.0	1278.27	1170.20	1160.20	105.32	115.32	2	Downgradient Monitoring Well
B-402S	Jun-05	-----	Bellaire/Summerfield	1257.59	90.0	1258.61	1178.25	1168.25	79.34	89.34	2	Downgradient Monitoring Well
B-403S	Jun-05	-----	Bellaire/Summerfield	1275.55	134.5	1277.75	1150.92	1140.92	124.63	134.63	2	Downgradient Monitoring Well
B-404S	Dec-12	-----	Bellaire/Summerfield	1242.26	81.0	1245.09	1172.26	1162.26	70.00	80.00	2	Downgradient Monitoring Well
B-405S	Dec-10	-----	Bellaire/Summerfield	1230.41	58.0	1233.55	1190.47	1180.47	39.94	49.94	2	Downgradient Monitoring Well
B-405SR	Aug-12	-----	Bellaire/Summerfield	1230.44	81.5	1232.94	1160.44	1150.44	70.00	80.00	2	Downgradient Monitoring Well
B-406S	Feb-08	-----	Bellaire/Summerfield	1227.54	73.0	1230.24	1169.92	1159.92	57.62	67.62	2	Downgradient Monitoring Well
B-407S	Jul-07	-----	Bellaire/Summerfield	1232.74	72.0	1235.55	1170.25	1165.25	62.49	67.49	2	Downgradient Monitoring Well
B-408S	Jul-06	-----	Bellaire/Summerfield	1238.80	60.0	1241.40	1193.49	1183.49	45.31	55.31	2	Downgradient Monitoring Well
B-408SS	Jul-06	-----	Fill / Bedrock	1238.80	32.0	1241.37	1213.55	1208.55	25.25	30.25	2	Downgradient Monitoring Well
B-409S	Jul-06	-----	Bellaire/Summerfield	1245.09	68.0	1247.55	1194.80	1184.80	50.29	60.29	2	Downgradient Monitoring Well
P-1S	Sep-10	TBD	Bellaire/Summerfield	1326.50	150.0	1329.18	1200.95	1190.95	125.55	135.55	2	-----
P-2S	Sep-10	TBD	Bellaire/Summerfield	1236.44	90.0	1238.75	1183.16	1173.16	53.28	63.28	2	-----
P-3S	Sep-10	TBD	Bellaire/Summerfield	1278.33	127.0	1281.02	1174.26	1164.26	104.07	114.07	2	-----
P-5S	Sep-10	TBD	Bellaire/Summerfield	1242.01	72.0	1244.40	1187.37	1177.37	54.64	64.64	2	-----
P-6S	Sep-10	TBD	Bellaire/Summerfield	1244.12	100.0	1246.75	1173.92	1163.92	70.20	80.20	2	-----
P-9S	Sep-10	TBD	Bellaire/Summerfield	1257.81	98.0	1260.76	1187.56	1177.56	70.25	80.25	2	-----
P-10S	Aug-10	TBD	Bellaire/Summerfield	1201.78	42.1	1204.05	1181.71	1176.71	20.07	25.07	2	-----
P-12S	Feb-11	TBD	Bellaire/Summerfield	1300.58	82.0	1303.04	1229.34	1219.34	71.24	81.24	2	-----

TABLE 1
EXISTING MONITORING WELL AND PIEZOMETER CONSTRUCTION SUMMARY
APEX SANITARY LANDFILL

Well No.	Date Installed	Date Abandoned	Stratigraphic Unit	Ground Elevation (ft. MSL)	Boring Total Depth (ft. BGS)	Top of Casing Elevation (ft. MSL)	Screen Interval (ft MSL)		Screen Interval (ft BGS)		Well Diameter (in.)	Comments
							Top	Bottom	Top	Bottom		
Mine Spoil Significant Zone of Saturation Monitoring Wells												
B-401A	Jul-06	-----	Mine Spoil	1266.75	50.0	1269.45	1226.15	1221.15	40.60	45.60	2	
B-402A	Jul-06	-----	Mine Spoil	1258.03	60.0	1260.50	1232.62	1222.62	25.41	35.41	2	
B-1A	Jul-91	TBD	Mine Spoil	1293.90	64.0	1296.4	1235.40	1231.40	58.50	62.50	2	4' of filter pack
B-2A	Jul-91	TBD	Mine Spoil	1265.50	46.0	1268.04	1226.50	1222.50	39.00	43.00	2	4' of filter pack
B-7A	Jul-91	TBD	Mine Spoil	1243.70	21.3	1246.18	1228.20	1224.20	15.50	19.50	2	-----
B-9A*	Jul-91	Sep-08	Mine Spoil	1256.50	26.0	1258.97	1235.50	1231.50	21.00	25.00	2	Abandoned
B-9C	Jul-91	NA	Mine Spoil	1261.80	26.0	NA	NA	NA	NA	NA	NA	Monitoring Well Never Installed
P-1A	Aug-10	TBD	Mine Spoil	1287.61	47.6	1290.04	1245.09	1240.09	42.52	47.52	2	-----
P-2A	Aug-10	TBD	Mine Spoil	1236.68	14.0	1239.05	1228.26	1223.26	8.42	13.42	2	-----
P-3A	Aug-10	TBD	Mine Spoil	1278.34	55.9	1280.87	1233.94	1223.94	44.40	54.40	2	-----
P-5A	Aug-10	TBD	Mine Spoil/Residual Soil	1241.24	28.4	1243.60	1225.09	1220.09	16.15	21.15	2	-----
P-7A	Aug-10	TBD	Mine Spoil	1263.93	42.1	1266.64	1231.15	1226.15	32.78	37.78	2	-----
P-8A	Aug-10	TBD	Mine Spoil/Residual Soil	1209.50	22.2	1211.20	1199.59	1194.59	9.91	14.91	2	-----
Limestone / Shallow Bedrock Significant Zone of Saturation Monitoring Wells												
P-1L	Sep-10	TBD	Limestone/Shallow Bedrock	1327.18	101.0	1330.30	1238.99	1228.99	88.19	98.19	2	-----
P-2L	Sep-10	TBD	Limestone/Shallow Bedrock	1236.62	32.0	1238.64	1215.62	1205.62	21.00	31.00	2	-----
P-3L	Sep-10	TBD	Limestone/Shallow Bedrock	1277.28	87.0	1279.00	1213.96	1203.96	63.32	73.32	2	-----
P-4L	Aug-10	TBD	Limestone/Shallow Bedrock	1260.88	54.1	1263.34	1218.47	1208.47	42.41	52.41	2	-----
P-5L	Sep-10	TBD	Limestone/Shallow Bedrock	1240.08	39.0	1242.43	1177.39	1167.39	62.69	72.69	2	-----
P-6L	Sep-10	TBD	Limestone/Shallow Bedrock	1243.35	37.0	1246.18	1216.18	1206.18	27.17	37.17	2	-----
P-10L	Sep-10	TBD	Limestone/Shallow Bedrock	1266.43	84.0	1268.83	1216.19	1206.19	50.24	60.24	2	-----
P-11L	Oct-10	TBD	Limestone/Shallow Bedrock	1257.31	53.0	1259.54	1215.85	1205.85	41.46	51.46	2	-----
P-13L	Jul-12	Jun-13	Limestone/Shallow Bedrock	1260.40	61.6	1262.65	1215.40	1205.40	45.00	55.00	2	-----
P-14L	Jun-12	Jun-13	Limestone/Shallow Bedrock	1230.06	16.0	1232.80	1227.06	1222.06	3.00	8.00	2	-----
P-15L	Jun-12	TBD	Limestone/Shallow Bedrock	1285.30	66.3	1287.35	1232.30	1222.30	53.00	63.00	2	-----
Miscellaneous Wells												
B-103S*	Sep-94	Oct-04	Connellsville	1206.10	33.3	1208.17	1177.90	1173.40	28.20	32.70	2	Abandoned
B-1B	Jul-91	TBD	Birmingham/Gaysport	1293.50	193.0	1295.96	1129.50	1120.50	164.00	173.00	4	-----
B-10*	Jul-91	Jul-07	Gaysport	1254.80	207.0	1257.28	1069.60	1060.60	185.20	194.20	4	12' of filter pack

Notes:

* Abandoned Monitoring Well

TBD=To Be Determined

TABLE 2
PROPOSED MONITORING WELL CONSTRUCTION SUMMARY
APEX SANITARY LANDFILL

Well No.	Monitoring Phase	Coordinates		Estimated Ground Elevation on Proposed Berm (ft. MSL)	Estimated Existing Ground Elevation (ft. MSL)	Estimated Thickness of Structural Fill (feet)	Stratigraphic Unit	Estimated Boring Total Depth (ft. MSL)	Estimated Screen Interval (ft. MSL)		Estimated Screen Interval (ft. BGL)		Estimated Top of Aquifer (ft. MSL)	Well Diam. (in.)	Estimated Gradient Position
		North	East						Top	Bottom	Top	Bottom			
Proposed Connellsville/Morgantown Uppermost Aquifer System Wells															
B-415	8	282406	2409044	1240.9	1197.2	43.7	Connellsville/Morgantown	1076	1120	1110	120.9	130.9	1140	2	downgradient
B-416	10	282415	2408129	1282.4	1297.1	(-14.7 cut)	Connellsville/Morgantown	1075	1130	1120	152.4	162.4	1140	2	downgradient
B-417	10	282424	2407244	1315.7	1246.9	68.8	Connellsville/Morgantown	1115	1160	1150	155.7	165.7	1160	2	upgradient
B-418	10	281643	2407265	1304.4	1255.5	48.9	Connellsville/Morgantown	1115	1160	1150	144.4	154.4	1160	2	downgradient
B-419	11	280827	2407244	1295.9	1309.3	(-13.4 cut)	Connellsville/Morgantown	1115	1160	1150	135.9	145.9	1160	2	downgradient
B-420	11	280029	2407247	1282.9	1279.9	3.0	Connellsville/Morgantown	1094	1135	1125	147.9	157.9	1140	2	downgradient
B-421	11	280022	2408032	1289.5	1258.5	31.0	Connellsville/Morgantown	1095	1135	1125	154.5	164.5	1140	2	downgradient
B-422	12	280072	2408825	1298.6	1180.6	118.0	Connellsville/Morgantown	1068	1135	1125	163.6	173.6	1140	2	downgradient
B-423	12	280207	2409641	1306.3	1267.8	38.4	Connellsville/Morgantown	1067	1135	1125	171.3	181.3	1140	2	downgradient
B-424	12	280336	2410426	1314.1	1258.4	55.7	Connellsville/Morgantown	1085	1135	1125	179.1	189.1	1140	2	downgradient
B-425	13	280331	2411237	1308.4	1223.4	85.0	Connellsville/Morgantown	1095	1135	1125	173.4	183.4	1140	2	upgradient
B-426	13	280791	2411948	1297.9	1276.9	21.0	Connellsville/Morgantown	1098	1120	1110	177.9	187.9	1140	2	downgradient
B-427	14	281384	2411854	1280.7	1225.0	55.7	Connellsville/Morgantown	1098	1120	1110	160.7	170.7	1140	2	downgradient
B-428	14	281908	2411668	1261.2	1223.0	38.2	Connellsville/Morgantown	1120	1140	1130	121.2	131.2	1140	2	downgradient
B-429	13	280356	2410869	1314.7	1196.2	118.5	Connellsville/Morgantown	1095	1125	1115	189.7	199.7	1140	2	upgradient
Proposed Bellaire/Summerfield Significant Zone of Saturation Wells															
B-415S	8	282406	2409044	1240.9	1197.2	43.7	Bellaire/Summerfield	1165	1180	1170	60.9	70.9	1225	2	downgradient
B-416S	10	282415	2408129	1282.4	1297.1	(-14.7 cut)	Bellaire/Summerfield	1186	1201	1191	81.4	91.4	1225	2	downgradient
B-417S	10	282424	2407244	1315.7	1246.9	68.8	Bellaire/Summerfield	1185	1200	1190	115.7	125.7	1225	2	upgradient
B-418S	10	281643	2407265	1304.4	1255.5	48.9	Bellaire/Summerfield	1192	1207	1197	97.4	107.4	1225	2	upgradient
B-419S	11	280827	2407244	1295.9	1309.3	(-13.4 cut)	Bellaire/Summerfield	1192	1207	1197	88.9	98.9	1225	2	downgradient
B-420S	11	280029	2407247	1282.9	1279.9	3.0	Bellaire/Summerfield	1171	1186	1176	96.9	106.9	1190	2	downgradient
B-421S	11	280022	2408032	1289.5	1258.5	31.0	Bellaire/Summerfield	1175	1190	1180	99.5	109.5	1190	2	downgradient
B-422S	12	280072	2408825	1298.6	1180.6	118.0	Bellaire/Summerfield	1167	1182	1172	116.6	126.6	1190	2	downgradient
B-423S	12	280207	2409641	1306.3	1267.8	38.4	Bellaire/Summerfield	1167	1182	1172	124.3	134.3	1190	2	downgradient
B-424S	12	280336	2410426	1314.1	1258.4	55.7	Bellaire/Summerfield	1065	1080	1070	234.1	244.1	1190	2	downgradient
B-425S	13	280331	2411237	1308.4	1223.4	85.0	Bellaire/Summerfield	1175	1190	1180	118.4	128.4	1190	2	~~upgradient~~downgradient
B-426S	13	280791	2411948	1297.9	1276.9	21.0	Bellaire/Summerfield	1185	1200	1190	97.9	107.9	1210	2	upgradient
B-427S	14	281384	2411854	1280.7	1225.0	55.7	Bellaire/Summerfield	1184	1199	1189	81.7	91.7	1210	2	upgradient
B-428S	14	281908	2411668	1261.2	1223.0	38.2	Bellaire/Summerfield	1167	1182	1172	79.2	89.2	1210	2	downgradient
B-429S	13	280356	2410869	1314.7	1196.2	118.5	Bellaire/Summerfield	1140	1180	1170	134.7	144.7	1185	2	downgradient

NOTES:

All well depths and reference elevations are estimated. Actual coordinates, boring depths, screened interval, and top of aquifer measurements will be presented upon well installation.

TBD=To Be Determined

NA=Not Applicable

upgradient/downgradient=upgradient/downgradient from proposed limits of waste.

stratigraphic unit column = anticipated stratigraphic unit of well screen.

TABLE 2
PROPOSED MONITORING WELL CONSTRUCTION SUMMARY
APEX SANITARY LANDFILL

Well No.	Monitoring Phase	Coordinates		Estimated Ground Elevation on Proposed Berm (ft. MSL)	Estimated Existing Ground Elevation (ft. MSL)	Estimated Thickness of Structural Fill (feet)	Stratigraphic Unit	Estimated Boring Total Depth (ft. MSL)	Estimated Screen Interval (ft. MSL)		Estimated Screen Interval (ft. BGL)		Estimated Top of Aquifer (ft. MSL)	Well Diam. (in.)	Estimated Gradient Position
		North	East						Top	Bottom	Top	Bottom			
Proposed Limestone / Shallow Bedrock Significant Zone of Saturation Wells															
B-415L	8	282406	2409044	1240.9	1197.2	43.7	Limestone/Shallow Bedrock	1205	1220	1210	20.9	30.9	1225	2	downgradient
B-416L	10	282415	2408129	1282.4	1297.1	(-14.7 cut)	Limestone/Shallow Bedrock	1220	1235	1225	47.4	57.4	1235	2	upgradient
B-417L	10	282424	2407244	1315.7	1246.9	68.8	Limestone/Shallow Bedrock	1220	1235	1225	80.7	90.7	1235	2	upgradient
B-418L	10	281643	2407265	1304.4	1255.5	48.9	Limestone/Shallow Bedrock	1215	1230	1220	74.4	84.4	1230	2	downgradient
B-419L	11	280827	2407244	1295.9	1309.3	(-13.4 cut)	Limestone/Shallow Bedrock	1220	1235	1225	60.9	70.9	1235	2	downgradient
B-420L	11	280029	2407247	1282.9	1279.9	3.0	Limestone/Shallow Bedrock	1195	1210	1200	72.9	82.9	1210	2	if saturated
B-421L	11	280022	2408032	1289.5	1258.5	31.0	Limestone/Shallow Bedrock	1195	1210	1200	79.5	89.5	1210	2	downgradient
B-422L	12	280072	2408825	1298.6	1180.6	118.0	Limestone/Shallow Bedrock	1195	1210	1200	88.6	98.6	1210	2	downgradient
B-423L	12	280207	2409641	1306.3	1267.8	38.4	Limestone/Shallow Bedrock	1195	1210	1200	96.3	106.3	1210	2	downgradient
B-424L	12	280336	2410426	1314.1	1258.4	55.7	Limestone/Shallow Bedrock	1195	1210	1200	104.1	114.1	1210	2	downgradient
B-425L	13	280331	2411237	1308.4	1223.4	85.0	Limestone/Shallow Bedrock	1195	1210	1200	98.4	108.4	1210	2	downgradient
B-426L	13	280791	2411948	1297.9	1276.9	21.0	Limestone/Shallow Bedrock	1215	1230	1220	67.9	77.9	1230	2	downgradient
B-427L	14	281384	2411854	1280.7	1225.0	55.7	Limestone/Shallow Bedrock	1215	1230	1220	50.7	60.7	1230	2	downgradient
B-428L	14	281908	2411668	1261.2	1223.0	38.2	Limestone/Shallow Bedrock	1175	1190	1180	71.2	81.2	1230	2	downgradient
Proposed Mine Spoil Significant Zone of Saturation Wells															
B-404A	14	282172	2411129	1245.4	1230.3	15.1	Mine Spoil	1210	1220	1210	25.4	35.4	TBD	2	downgradient
B-415A	8	282406	2409044	1240.9	1197.2	43.7	Mine Spoil	TBD	TBD	TBD	TBD	TBD	TBD	2	downgradient
B-416A	10	282415	2408129	1282.4	1297.1	(-14.7 cut)	Mine Spoil	1240	1250	1240	32.4	42.4	TBD	2	downgradient
B-417A	10	282424	2407244	1315.7	1246.9	68.8	Mine Spoil	1235	1245	1235	70.7	80.7	TBD	2	~~downgradient~~upgradient
B-418A	10	281643	2407265	1304.4	1255.5	48.9	Mine Spoil	1235	1245	1235	59.4	69.4	TBD	2	~~downgradient~~upgradient
B-419A	11	280827	2407244	1295.9	1309.3	(-13.4 cut)	Mine Spoil	1235	1245	1235	50.9	60.9	TBD	2	downgradient
B-420A	11	280029	2407247	1282.9	1279.9	3.0	Mine Spoil	1210	1220	1210	62.9	72.9	TBD	2	downgradient
B-421A	11	280022	2408032	1289.5	1258.5	31.0	Mine Spoil	1210	1220	1210	69.5	79.5	TBD	2	downgradient
B-422A	12	280072	2408825	1298.6	1180.6	118.0	Mine Spoil	1210	1220	1210	78.6	88.6	TBD	2	downgradient
B-423A	12	280207	2409641	1306.3	1267.8	38.4	Mine Spoil	1210	1220	1210	86.3	96.3	TBD	2	downgradient
B-424A	12	280336	2410426	1314.1	1258.4	55.7	Mine Spoil	1210	1220	1210	94.1	104.1	TBD	2	downgradient
B-425A	13	280331	2411237	1308.4	1223.4	85.0	Mine Spoil	1210	1220	1210	88.4	98.4	TBD	2	downgradient
B-426A	13	280791	2411948	1297.9	1276.9	21.0	Mine Spoil	1230	1240	1230	57.9	67.9	TBD	2	if saturated
B-427A	14	281384	2411854	1280.7	1225.0	55.7	Mine Spoil	1230	1240	1230	40.7	50.7	TBD	2	downgradient
B-428A	14	281908	2411668	1261.2	1223.0	38.2	Mine Spoil	1200	1210	1200	51.2	61.2	TBD	2	downgradient

NOTES:
All well depths and reference elevations are estimated. Actual coordinates, boring depths, screened interval, and top of aquifer measurements will be presented upon well installation.
TBD=To Be Determined
NA=Not Applicable
upgradient/downgradient=upgradient/downgradient from proposed limits of waste.
stratigraphic unit column = anticipated stratigraphic unit of well screen.

TABLE 3

EXISTING MONITORING WELL PURGING REQUIREMENTS

APEX SANITARY LANDFILL

Well/ Piezometer	Ground Surface Elevation (feet amsl)	Reference Point Elevation[1] (feet amsl)	Total Well Depth from Reference Point (feet)	Well Diameter (inches)	Screen Length (feet)	Screened Interval Elevations[2] (feet amsl)	Screen Volume (gal)	Screen Volume (ml)	Continual Drawdown Occurred? (yes/no)	Top-of-Screen Elevation (feet amsl)	Top-of Pump Intake Elevation (feet amsl)	Allowed Drawdown Distance[3] (feet)	Estimated Volume of Drawdown Permitted (gal)	Estimated Volume of Drawdown Permitted (ml)	ID Tubing Diameter (inches)	Tubing Length (feet)	Tubing Volume (ml)	Tubing and Pump Volume (ml)	Tubing and Pump Volume (gal)	Suggested Flow Rate (ml/min)
Significant Zone of Saturation																				
B-401A	1266.75	1269.45	48.30	2	5.0	1226.15 - 1221.15	0.82	3,085	no	1226.15	1221.45	2.70	0.44	1,666	0.17	46.5	207	337	0.09	≤ 500
B-401S	1275.52	1278.27	118.07	2	10.0	1170.20 - 1160.20	1.63	6,170	na	1170.20	No dedicated pump. Well typically dry									
B-402A	1258.03	1260.50	37.88	2	10.0	1232.62 - 1222.62	1.63	6,170	no	1232.62	1223.10	7.52	1.23	4,640	0.17	35.9	160	290	0.08	≤ 500
B-402S	1257.59	1258.61	92.10	2	10.0	1178.25 - 1168.25	1.63	6,170	na	1178.25	No dedicated pump. Well typically dry									
B-403S	1275.55	1277.75	136.83	2	10.0	1150.92 - 1140.92	1.63	6,170	**yes**	1150.92	1142.75	6.17	1.01	3,807	0.17	133.5	596	726	0.19	≤ 100
B-404S	1242.26	1245.09	81.36	2	10.0	1172.26 - 1162.26	1.63	6,170	na	1172.26	Disposable bailer used for sample collection									
B-405S	1227.7	1228.37	53.09	2	10.0	1198.30 - 1183.80	1.63	6,170	na	1193.80	Disposable bailer used for sample collection									
B-405SR	1230.44	1232.94	83.19	2	10.0	1160.44 - 1150.44	1.63	6,170	na	1160.44	Disposable bailer used for sample collection									
B-406S	1227.54	1230.24	70.32	2	10.0	1169.92 - 1159.92	1.63	6,170	**yes**	1169.92	1161.24	6.68	1.09	4,122	0.17	67.5	301	431	0.11	≤ 100
B-407S	1232.74	1235.55	70.30	2	5.0	1170.25 - 1165.25	0.82	3,085	na	1170.25	Disposable bailer used for sample collection									
B-408SS	1238.80	1241.37	32.82	2	5.0	1213.55 - 1208.55	0.82	3,085	na	1213.55	Disposable bailer used for sample collection									
B-408S	1238.80	1241.40	57.91	2	10.0	1193.49 - 1183.49	1.63	6,170	na	1193.49	Disposable bailer used for sample collection									
B-409S	1245.09	1247.55	62.75	2	10.0	1194.80 - 1184.80	1.63	6,170	na	1194.80	No dedicated pump. Well typically dry									
Uppermost Aquifer System																				
B-401	1262.95	1265.63	145.40	2	10.0	1130.23 - 1120.23	1.63	6,170	no	1130.23	1121.13	7.10	1.16	4,381	0.25	141.0	1,360	1,755	0.46	≤ 500
B-402	1263.12	1266.19	157.53	2	10.0	1118.66 - 1108.66	1.63	6,170	**yes**	1118.66	1109.69	6.97	1.14	4,301	0.25	153.0	1,476	1,871	0.49	≤ 100
B-403	1224.47	1226.84	120.29	2	10.0	1116.55 - 1106.55	1.63	6,170	**yes**	1116.55	1107.84	6.71	1.09	4,140	0.25	115.5	1,114	1,509	0.40	≤ 100
B-404	1243.07	1246.17	123.11	2	10.0	1133.07 - 1123.07	1.63	6,170	no	1133.07	1126.17	4.90	0.80	3,023	0.25	116.5	1,124	1,519	0.40	≤ 500
B-405	1231.11	1234.20	127.72	2	10.0	1116.48 - 1106.48	1.63	6,170	no	1116.48	1111.20	3.28	0.53	2,024	0.25	119.5	1,153	1,548	0.41	≤ 500
B-406	1227.47	1227.47	137.97	2	10.0	1102.16 - 1092.16	1.63	6,170	**yes**	1102.16	1094.47	5.69	0.93	3,511	0.25	129.5	1,249	1,644	0.43	≤ 100
B-407	1233.15	1235.74	137.55	2	10.0	1108.19 - 1098.19	1.63	6,170	**yes**	1108.19	1103.24	2.95	0.48	1,820	0.25	129.0	1,245	1,640	0.43	≤ 100
B-408	1238.07	1240.71	131.95	2	10.0	1118.76 - 1108.76	1.63	6,170	no	1118.76	1113.71	3.05	0.50	1,882	0.25	123.5	1,192	1,587	0.42	≤ 500
B-409	1245.12	1247.57	114.20	2	10.0	1143.37 - 1133.37	1.63	6,170	no	1143.37	1138.57	2.80	0.46	1,728	0.25	105.5	1,018	1,413	0.37	≤ 400
B-410	1242.79	1245.32	122.32	2	10.0	1132.00 - 1122.00	1.63	6,170	**yes**	1132.00	1124.32	5.68	0.93	3,505	0.17	119.5	533	663	0.18	≤ 100
B-411	1237.07	1240.13	128.37	2	10.0	1121.50 - 1111.50	1.63	6,170	no	1121.50	1113.13	6.37	1.04	3,930	0.17	125.5	560	690	0.18	≤ 170
B-412	1233.47	1236.38	130.42	2	10.0	1115.96 - 1105.96	1.63	6,170	**yes**	1115.96	1106.88	7.08	1.15	4,369	0.25	126.0	1,216	1,611	0.43	≤ 100
B-413	1240.11	1242.11	103.69	2	10.0	1148.12 - 1138.12	1.63	6,170	na	1148.12	Well typically dry. Replaced with B-413R									
B-413R	1238.88	1241.61	136.27	2	10.0	1115.34 - 1105.34	1.63	6,170	no	1115.34	1106.34	7.00	1.14	4,319	0.17	132.3	590	720	0.19	≤ 500
B-414	1229.42	1231.50	120.30	2	10.0	1121.20 - 1111.20	1.63	6,170	**yes**	1121.20	1112.71	6.49	1.06	4,004	0.17	116.3	519	649	0.17	≤ 100

[1] = Reference elevation is the top of PVC cap for wells with dedicated sampling pumps and the top of PVC riser for all other wells.

[2] = Screened interval does not include sand pack.

[3] = Allowed drawdown. Value is the distance between the top of the screen and the top of the pump intake, minus a 2-foot safety margin.

na = Well is sampled with a disposable bailed or the well is typically dry.

APPENDIX A

FIELD SAMPLING FORM AND CHAIN OF CUSTODY FORM

GROUNDWATER MONITORING WELL SAMPLING FIELD DATA SHEET

Client: Apex Sanitary Landfill

CEC Project Number: _____

Date: _____

Weather Observations: _____

WELL ID: _____

Water Volume Factors	
Diameter	Gallons/Foot
1 inches	0.04
1.5 inches	0.092
2 inches	0.17
3 inches	0.38
4 inches	0.66

Casing Diameter: _____ (inches)

Water Height in Well: _____ (feet)

Total Depth: _____ (feet)

Water Volume in Well: _____ (gallons)

Depth to Water: _____ (feet)

Purge Volume: _____ gal.(calculated)

_____ gal. (removed)

Depth to Top of Screen: _____ (feet)

Min. Purge Vol. for Passive Sampling ((feet of tubing)(ml/ft)+(pump Vol.))= _____

Measured using: Electric water level tape.

Purged using: Disp. Bailer/Polypro Rope Dedicated Bladder pump/poly tubing Other _____

(circle one) ⇒

Sampled using: Disp. Bailer/Polypro Rope Dedicated Bladder pump/poly tubing Other _____

Field Measurements

Temperature (degrees C)	pH (s.u.)	Conductivity (umhos/cm)	Turbidity (NTU)	Volume (gallons)	Water Level During Purging (feet)	Time

Field Measurements at Time of Sampling

Temperature (degrees C)	pH (s.u.)	Conductivity (umhos/cm)	Turbidity (NTU)	Volume (gallons)	Water Level During Sampling (feet)	Time

Instrument Calibration

Turbidity Meter Type _____

1.0 NTU std = _____ 5.94 NTU std = _____

10.0 NTD std = _____ 50.8 NTU std = _____

505 NTU std = _____

pH/Conductivity Meter Type _____

4.01 std = _____

7.0 std = _____ 1413 umhos/cm = _____

10.1 std = _____

Physical Properties

Odor: _____

Color: _____

Turbidity: _____

Analysis Required: _____

Sample time/date: _____

Comments: _____

Deviations from SAP: _____

Sampler: _____

Signature: _____

Civil & Environmental Consultants, Inc. ♦ 8740 Orion Place, Suite 100 ♦ Columbus, Ohio 42340 ♦ phone: (614) 540-6633 ♦ fax: (614) 540-6638

Form F-507 .03
Geochemical Testing

REQUEST FOR LABORATORY ANALYTICAL SERVICES

Chain of Custody (COC) for State of Ohio

Shuttle / Cooler

Landfill Site	GT Quote No.	Client Job No.	Date Results Required:

REPORT RESULTS to

Name	Title	Mailing Address
Company	Dept.	City, State, Zip
Telephone No.	Telefax No.	

Special Instructions:

ANALYSIS REQUESTED
Enter 'X' in box below to indicate request

CLIENT SAMPLE ID	DATE SAMPLED	TIME (24 hr)	COMP	GRAB	SAMPLE TYPE (MATRIX)	Number of Containers	Appendix I: Ammonia-N, COD Preservative: 1:1 H_2SO_4	Appendix I: Total Metals Preservative: 1:1 HNO_3	Appendix I: Alkalinity Preservative: NONE	Appendix I: Chloride, NO_3+NO_2, Sulfate Preservative: NONE	Appendix I: TDS (Lab Filtered) Preservative: NONE	Appendix I: EDB/ DBCP Preservative: 1:1 HCl	Appendix I: VOC Preservative: 1:1 HCl	Appendix II: Benzo(a) pyrene (EPA 8310) Preservative: NONE	Appendix II: Semivolatiles (EPA 8270) Preservative: NONE	Appendix II: Pest / PCB / Hexachlorobenzene Preservative: NONE	Appendix II: Herbicides Preservative: NONE	Appendix II: Sulfide Preservative: NaOH / Zn acetate	Appendix II: Cyanide Preservative: NaOH	Lab Use Only: Lab Number

CHAIN OF CUSTODY				
	Relinquished by:	Date/Time	**Received by:**	Date/Time
	Relinquished by:	Date/Time	**Received at lab by:**	Date/Time
	Method of Shipment:		Comments:	Ice present on receipt: ___Yes or ___No
				Cooler Temp (°C) on receipt: _____

Authorized by: _____ Date: _____
(Signature MUST Accompany Request)

Please return completed form and samples to **Geochemical Testing • 2005 N Center Ave • Somerset, PA • 15501** • 814-443-1671 • (Fax: 814-445-6729)

APPENDIX B

OAC 3745-27-10 APPENDIX I PARAMETER LIST

APPENDIX I

Compound	CAS RN2
1) Antimony	See note 3
2) Arsenic	See note 3
3) Barium	See note 3
4) Beryllium	See note 3
5) Cadmium	See note 3
6) Chromium	See note 3
7) Cobalt	See note 3
8) Copper	See note 3
9) Lead	See note 3
10) Nickel	See note 3
11) Selenium	See note 3
12) Silver	See note 3
13) Thallium	See note 3
14) Vanadium	See note 3
15) Zinc	See note 3
16) Acetone	67-64-1
17) Acrylonitrile	107-13-1
18) Benzene	71-43-2
19) Bromocholoromethane	74-97-5
20) Bromodicholoromethane	75-27-4
21) Bromoform; Tribromomethane	75-25-2
22) Carbon disulfide	75-15-0
23) Carbon tetrachloride	56-23-5
24) Chlorobenzene	108-90-7
25) Chloroethane; Ethyl cloride	75-00-3
26) Chloroform; Trichloromethane	67-66-3
27) Dibromochloromethane; Chlorodibromomethane	124-48-1
28) 1,2-Dibromo-3-chloropropane; DBCP	96-12-8
29) 1,2 Dibromoethane;Ethylene dibromide;EDB	106-93-4
30) o-Dichlorobenzene; 1,2-Dichlorobenzene	95-50-1
31) p-Dichlorobenzene; 1,4-Dichlorobenzene	106-46-7
32) trans-1,4-Dichloro-2-butene	110-57-6
33) 1,1-Dichloroethane; Ethylidene chloride	75-34-3
34) 1,2-Dichloroethane; Ethylidene dichloride	107-06-2
35) 1,1-Dichloroethylene; 1,1-Dichloroethene; Vinylidene chloride	75-35-4
36) cis-1,2-Dichlorothylene; cis-1,2-Dichloro-ethene	156-59-2
37) trans-1,2-Dichloroethylene; trans-1,2-Dichloro-ethene	156-60-5
38) 1,2-Dichloropropane; Propylene dichloride	78-87-5
39) cis-1,3-Dichloropropene	10061-01-5
40) trans-1,3-Dichloropropene	10061-02-6

41) Ethylbenzene 100-41-4
42) 2-Hexanone; Methyl butyl ketone. 591-78-6
43) Methyl bromide; Bromomethane 74-83-9
44) Methyl chloride; Chloromethane 74-87-3
45) Methylene bromide; Dibromomethane. 74-95-3
46) Methylene chloride; Dichloromethane. 75-09-2
47) Methyl ethyl ketone; MEK; 2-Butanone 78-93-3
48) Methyl iodide; iodomethane 74-88-4
49) 4-Methyl-2-pentanone; Methyl isobutyl ketone . . 108-10-1
50) Styrene. 100-42-5
51) 1,1,1,2-Tetrachloroethane. 630-20-6
52) 1,1,2,2-Tetrachloroethane. 79-34-5
53) Tetrachloroethylene; Tetrachloroethene; Perchloroethylene 127-18-4
54) Toluene. 108-88-3
55) 1,1,1-Trichloroethane; Methylchloroform. 71-55-6
56) 1,1,2-Trichloroethane. 79-00-5
57) Trichloroethylene; Trichloroethene 79-01-6
58) Trichloroflouromethane; CFC-11 75-69-4
59) 1,2,3-Trichloropropane 96-18-4
60) Vinyl acetate. 108-05-4
61) Vinyl chloride 75-01-4
62) Xylenes. . . . . See note 4
63) Ammonia
64) Chloride
65) Sodium
66) Potassium
67) Temperature
68) pH
69) Specific conductance
70) Total dissolved solids
71) Total alkalinity
72) Nitrate-nitrite
73) Sulfate
74) Magnesium
75) Calcium
76) Turbidity
77) Iron
78) Manganese

Note 1. Common names are those widely used in government regulations, scientific publications, and commerce; synonyms exist for many chemicals.

Note 2. Chemical Abstract Service registry number.

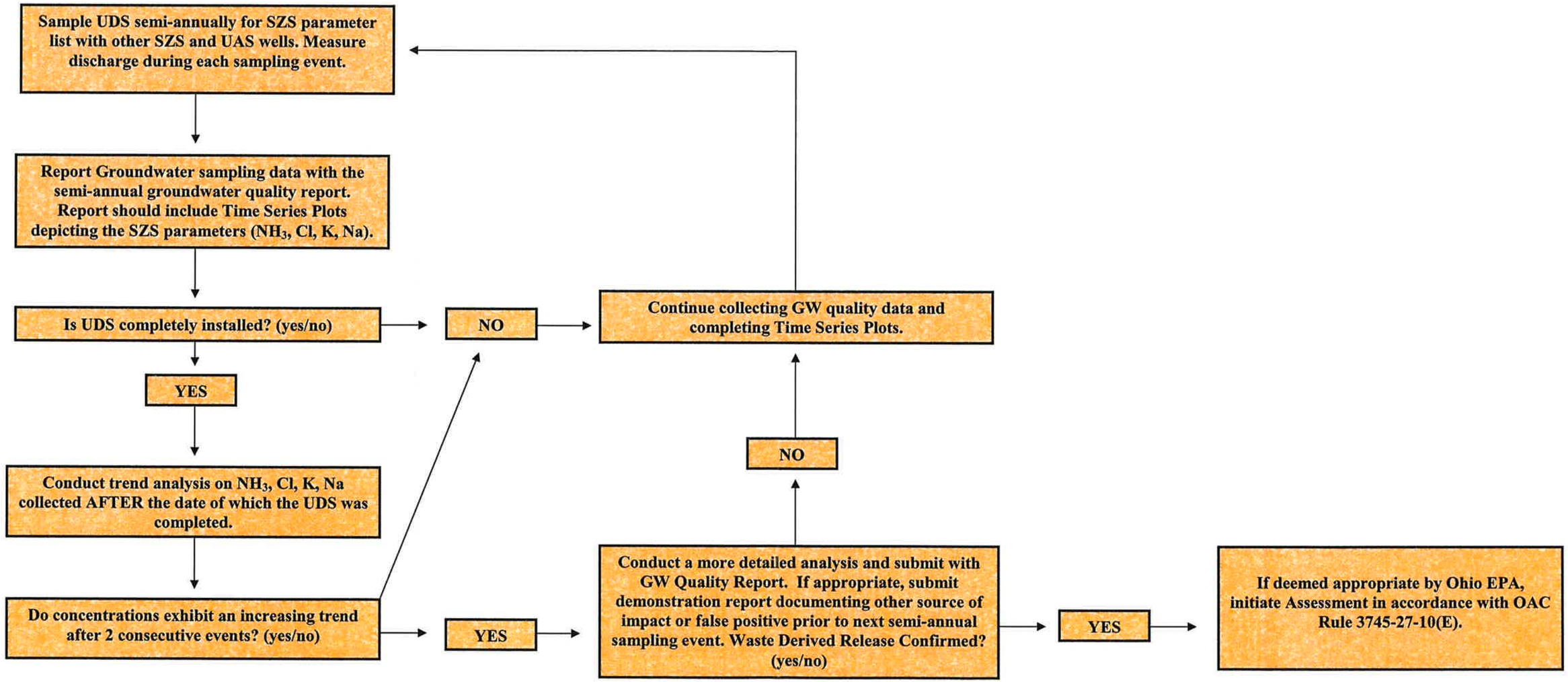
Note 3. Analysis for these compounds shall be representative of the quality background ground water that has not been affected by past or present operations at the sanitary landfill facility and representative of the quality of ground water passing directly downgradient of the limits of solid waste placement.

Note 4. Xylene (total): this entry includes o-xylene (CAS RN 96-47-6), m-xylene (CAS RN 108-38-3), p-xylene (CAS RN 106-42-3), and unspecified xylenes (dimethylbenzenes) (CAS RN 1330-20-7).

APPENDIX C

UNDERDRAIN SAMPLING COMPLIANCE PROGRAM

APPENDIX C
UNDERDRAIN SAMPLING COMPLIANCE PROGRAM
APEX SANITARY LANDFILL



Notes:
UDS = Underdrain System

APPENDIX D

BORING LOGS AND WELL COMPLETION DIAGRAMS

CIVIL & ENVIRONMENTAL CONSULTANTS, INC

8740 Orion Pl., Suite 100
Columbus, OH 43240

Phone 614-540-6633 Fax 614-540-6638

BOREHOLE LOG

BOREHOLE/WELL NO.: **B-401**

TOTAL DEPTH (BGS): **146 feet**

PROJECT INFORMATION

PROJECT:	**Apex Sanitary Landfill**
SITE LOCATION:	**Amsterdam, OH**
PROJECT NO.:	**042-021**
FIELD GEOLOGIST:	**D. Crayne**
DATES DRILLED:	**6/10/05 to 6/15/05**

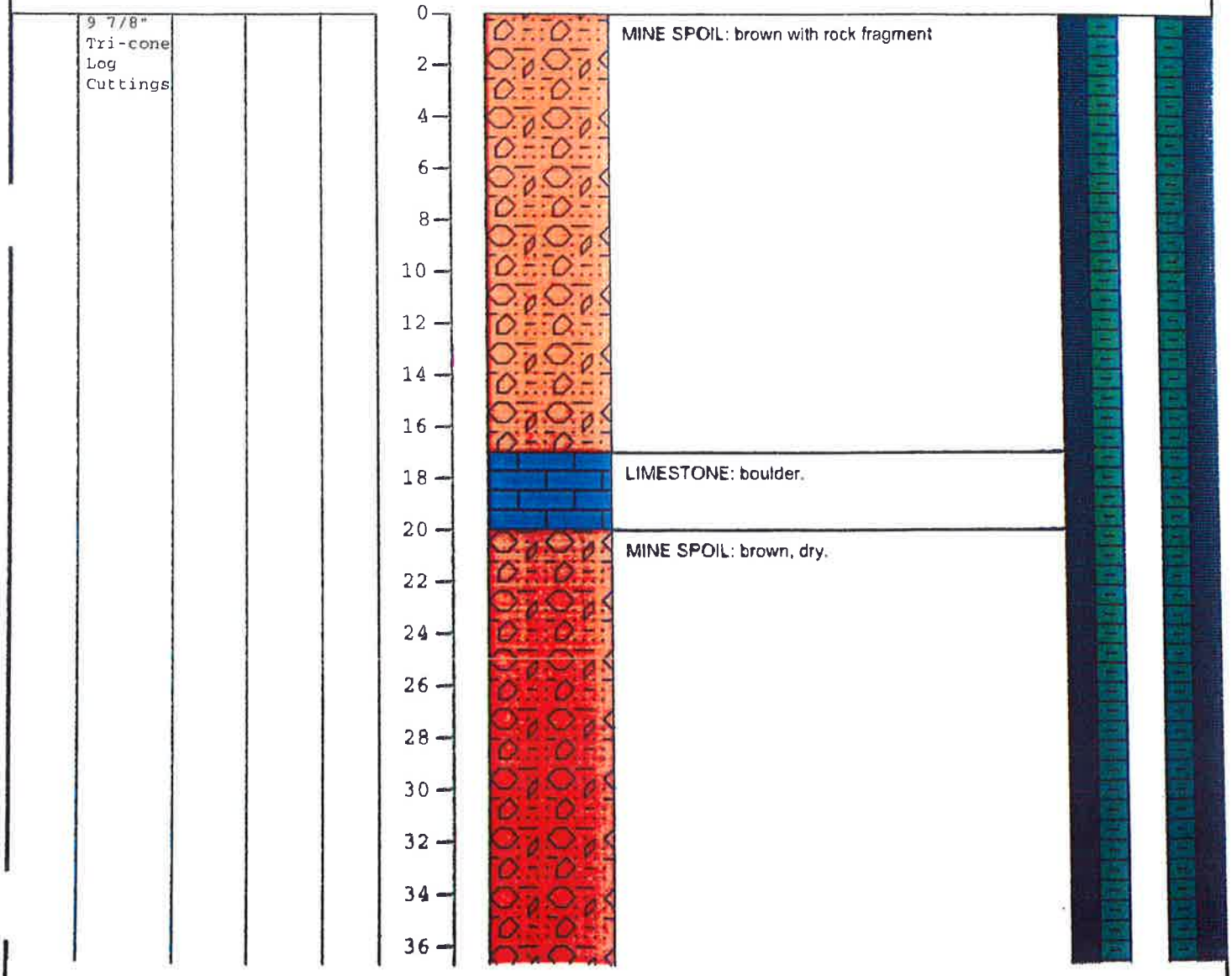
DRILLING INFORMATION

DRILLING CO./DRILLER:	**Duncan Bros. Drilling Inc.**
DRILLING RIG/METHOD:	**Air Rotary / NX Air Core**
BOREHOLE DIAMETER:	**9 7/8" & 6 1/8" Tri-cone Bits**
WELL DIAMETER:	**2"**
GROUND/TOC ELEVATION:	**1262.95 / 1265.63 ft amsl**

Water level during drilling

Water Level After Development

SAMPLE/ CORE NO.	SAMPLE INTERVAL	SAMPLE RECOVERY (ft' in")	RQD (%)	%Recovery	DEPTH	SOIL SYMBOLS	LITHOLOGY	WELL COMPLETION
	9 7/8" Tri-cone Log Cuttings				0		MINE SPOIL: brown with rock fragment	
					18		LIMESTONE: boulder.	
					20		MINE SPOIL: brown, dry.	



OBSERVATIONS:
9 7/8" Tri-cone to 60' set 7" casing. 6 1/8" Tri-cone to 105'. Core from 105' to 146'.

SAMPLE/ CORE NO.	SAMPLE INTERVAL	SAMPLE RECOVERY (ft' in")	RQD (%)	%Recovery	DEPTH	SOIL SYMBOLS	LITHOLOGY	WELL COMPLETION
					38			
					40		**LIMESTONE**: gray, weak, with SHALE fragments, wet @ 47 feet.	
					42			
					44			
					46			
					48			
					50			
					52			
					54		COAL: seam, wet, estimated thickness.	
					56		SHALE: black, trace pyrite, black water return. Above contact is approximate	
					58			
					60			
	6 1/8" Tri-cone Log Cuttings				62			
					64			
					66			
					68			
					70		SILTSTONE: with some SHALE cutting, gray.	
					72			
					74		SHALE: black.	
					76			
					78		SILTSTONE: with SHALE interbeds.	
					80		SHALE: black, with few SILTSTONE interbeds.	
					82			
					84			
					86		SILTSTONE: gray, with trace black SHALE cuttings.	
					88			
					90		SHALE: black, with few interbeds of gray SHALE.	

OBSERVATIONS:
9 7/8" Tri-cone to 60' set 7" casing. 6 1/8" Tri-cone to 105'. Core from 105' to 146'.

SAMPLE/ CORE NO.	SAMPLE INTERVAL	SAMPLE RECOVERY (ft' in")	RQD (%)	%Recovery
CR#1	105'-110'	4'2"	75%	83%
CR#2	110'-119'	8'10"	84%	98%
CR#3	119'-128'	8'5"	60%	94%
CR#4	128'-137'	8'	43%	89%
CR#5	137'-146'	9'3"	50%	100%

DEPTH: 92, 94, 96, 98, 100, 102, 104, 106, 108, 110, 112, 114, 116, 118, 120, 122, 124, 126, 128, 130, 132, 134, 136, 138, 140, 142, 144, 146

SOIL SYMBOLS

LITHOLOGY

SHALE: black.

SANDSTONE: gray fine grained, thin laminations if COAL.

SHALE: black, micaceous, trace wood fossils, slighty fractured.

thin seam of COAL at 122.5 feet.

SANDSTONE: gray, fine grained, with thinly laminated SHALE.

SANDSTONE: gray, with interbedded gray SHALE, micaceous.

SANDSTONE: gray, with thinly laminated SHALE and occasional thin COAL seams, moderately fractured.

WELL COMPLETION

OBSERVATIONS:
9 7/8" Tri-cone to 60' set 7" casing. 6 1/8" Tri-cone to 105'. Core from 105' to 146'.

WELL CONSTRUCTION LOG

PROJECT	PROJECT NUMBER	
Apex Sanitary Landfill	042-021	B-401

COORDINATES	GROUND SURFACE ELEVATION	TOP OF PVC ELEVATION
N 281493.54 E 2409466.83	1262.95 feet amsl	1265.63 feet amsl

CITY & STATE:
Amsterdam, OH
COUNTY: Jefferson County
INSTALLATION DATE:
6/10/05 to 6/15/05

DRILLING METHOD: Air Rotary / NX Air Core
DRILLING CONTRACTOR:
Duncan Bros. Drilling Inc.

DELEVOPED BY: DWC
DATE: 7/7/05

DEVELOPMENT TECHNIQUE(S):
Grundfos Pump and Bailer

WATER REMOVED DURING DEVELOPMENT:
35 gallons

DEPTH to WATER: 109.93

SOUNDED DEPTH FROM TOC:
145.40 feet

SCREENED INTERVAL ELEVATION: 1130.23'-1120.23'

COMMENTS:
9 7/8" Tri-cone to 60' set 7" casing. 6 1/8" Tri-cone to 105'. Core from 105' to 146'.

7" Surface Casing to 60'

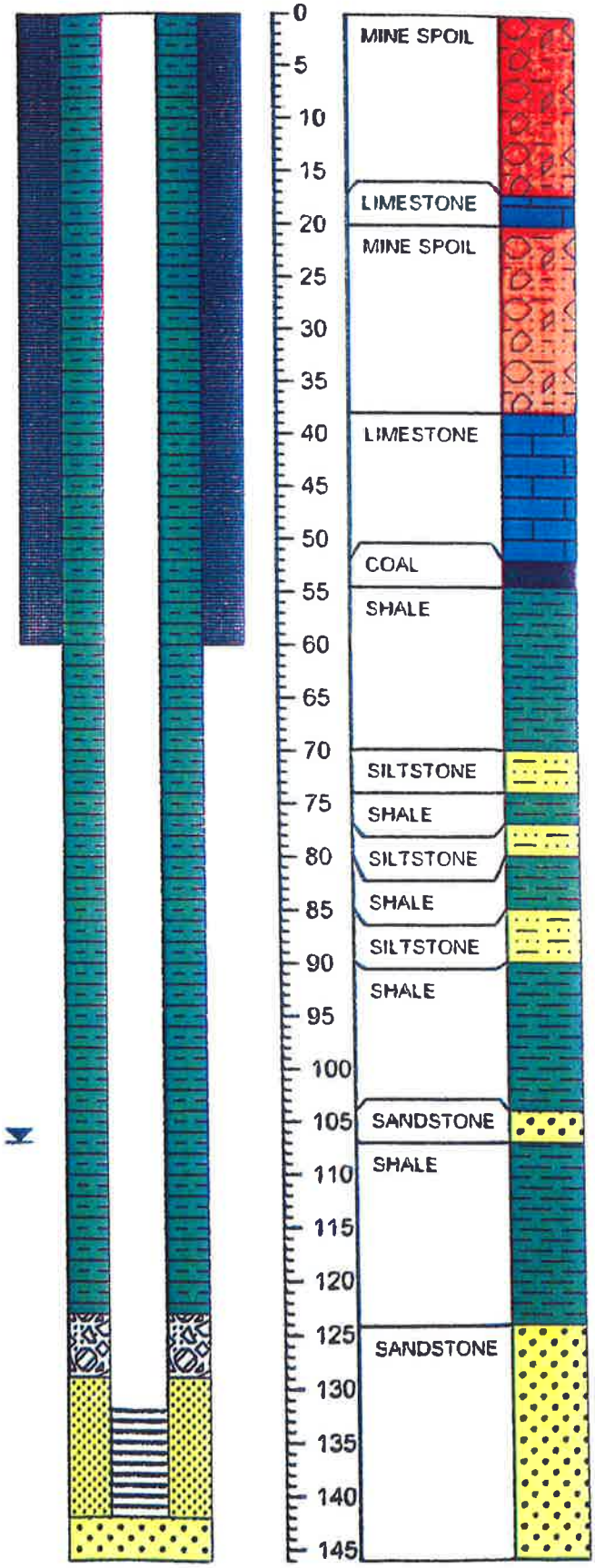
Sealed using bentonite clay slurry

2" Well Diameter

6" Borehole Diameter

Hole Plug

No. 7 Fine Sand



CIVIL & ENVIRONMENTAL CONSULTANTS, INC.

CIVIL & ENVIRONMENTAL CONSULTANTS, INC

8740 Orion Pl., Suite 100
Columbus, OH 43240

Phone 614-540-6633 Fax 614-540-6638

BOREHOLE LOG

BOREHOLE/WELL NO.: B-401S

TOTAL DEPTH (BGS): 115 feet

PROJECT INFORMATION

PROJECT:	Apex Sanitary Landfill
SITE LOCATION:	Amsterdam, OH
PROJECT NO.:	042-021
FIELD GEOLOGIST:	D. Crayne
DATES DRILLED:	6/16/05 to 6/17/05

DRILLING INFORMATION

DRILLING CO./DRILLER:	Duncan Bros. Drilling Inc.
DRILLING RIG/METHOD:	Air Rotary / NX Air Core
BOREHOLE DIAMETER:	9 7/8" & 6 1/8" Tri-cone Bits
WELL DIAMETER:	2"
GROUND/TOC ELEVATION:	1275.52 / 1278.27 ft amsl

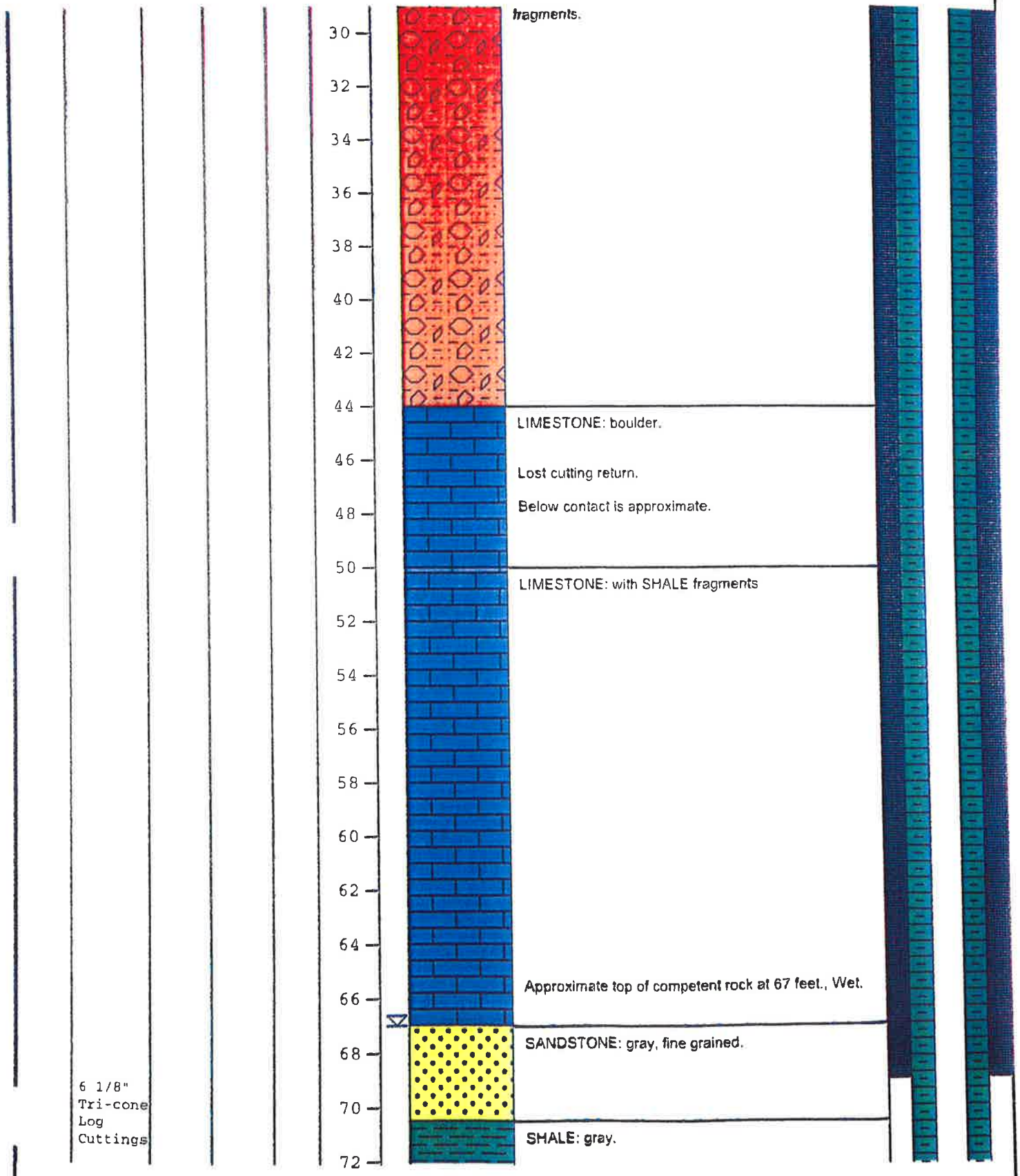
⧗ Water level during drilling

⧗ Water Level After Development

SAMPLE/ CORE NO.	SAMPLE INTERVAL	SAMPLE RECOVERY (ft' in")	RQD (%)	%Recovery	DEPTH	SOIL SYMBOLS	LITHOLOGY	WELL COMPLETION
	9 7/8" Tri-cone Log Cuttings				0		MINE SPOIL: brown to gray, with CLAY and rock fragments.	
					2			
					4			
					6			
					8			
					10			
					12			
					14			
					16			
					18			
					20			
					22			
					24			
					26		LIMESTONE: boulder.	
					28		MINE SPOIL: brown to gray, with CLAY and rock	

OBSERVATIONS:
9 7/8" Tri-cone to 69' set 7" casing. 6 1/8" Tri-cone to 75'. Core from 75' to 115'.

SAMPLE/ CORE NO.	SAMPLE INTERVAL	SAMPLE RECOVERY (ft. in.)	RQD (%)	%Recovery	DEPTH	SOIL SYMBOLS	LITHOLOGY	WELL COMPLETION



OBSERVATIONS:
9 7/8" Tri-cone to 69' set 7" casing. 6 1/8" Tri-cone to 75'. Core from 75' to 115'.

SAMPLE/ CORE NO.	SAMPLE INTERVAL	SAMPLE RECOVERY (ft' in")	RQD (%)	%Recovery	DEPTH	SOIL SYMBOLS	LITHOLOGY	WELL COMPLETION
CR#1	75'-85'	8'3"	37%	83%	74			
					76		SHALE: black, intensely fractured.	
					78		SILTSTONE: dark gray, highly weathered, moderately fractured. Vertical fracture at 83 feet.	
CR#2	85'-94'	5'10"	36%	65%	80			
					82			
					84			
					86			
					88			
					90			
					92		SHALE: black, laminated COAL, highly weathered, intensely fractured.	
CR#3	94'-103'	6'4"	40%	70%	94			
					96			
					98			
					100		SILTSTONE: gray, moderately fractured, horizontal and vertical.	
CR#4	103'-109'	6'3"	5%	100%	102			
					104		SILTSTONE: gray, intensely fractured, horizontal.	
					106			
					108			
CR#5	109'-115'	5'6"	12%	92%	110			
					112			
					114			

OBSERVATIONS:
9 7/8" Tri-cone to 69' set 7" casing. 6 1/8" Tri-cone to 75'. Core from 75' to 115'.

WELL CONSTRUCTION LOG

PROJECT	PROJECT NUMBER	
Apex Sanitary Landfill	042-021	B-401S

COORDINATES	GROUND SURFACE ELEVATION	TOP OF PVC ELEVATION
N 281703.01 E 2409401.50	1275.52 feet amsl	1278.27 feet amsl

CITY & STATE:
Amsterdam, OH

COUNTY: Jefferson County

INSTALLATION DATE:
6/16/05 to 6/17/05

DRILLING METHOD: Air Rotary / NX Air Core

DRILLING CONTRACTOR:
Duncan Bros. Drilling Inc.

DELEVOPED BY: DWC

DATE: 7/7/05

DEVELOPMENT TECHNIQUE(S):
Grundfos Pump and Bailer

WATER REMOVED DURING DEVELOPMENT:
5 gallons and DRY

DEPTH to WATER: DRY

SOUNDED DEPTH FROM TOC:
118.07 feet

SCREENED INTERVAL ELEVATION: 1170.20'-1160.20'

COMMENTS:
9 7/8" Tri-cone to 69' set 7" casing. 6 1/8" Tri-cone to 75'. Core from 75' to 115'.

7" Surface Casing to 69'

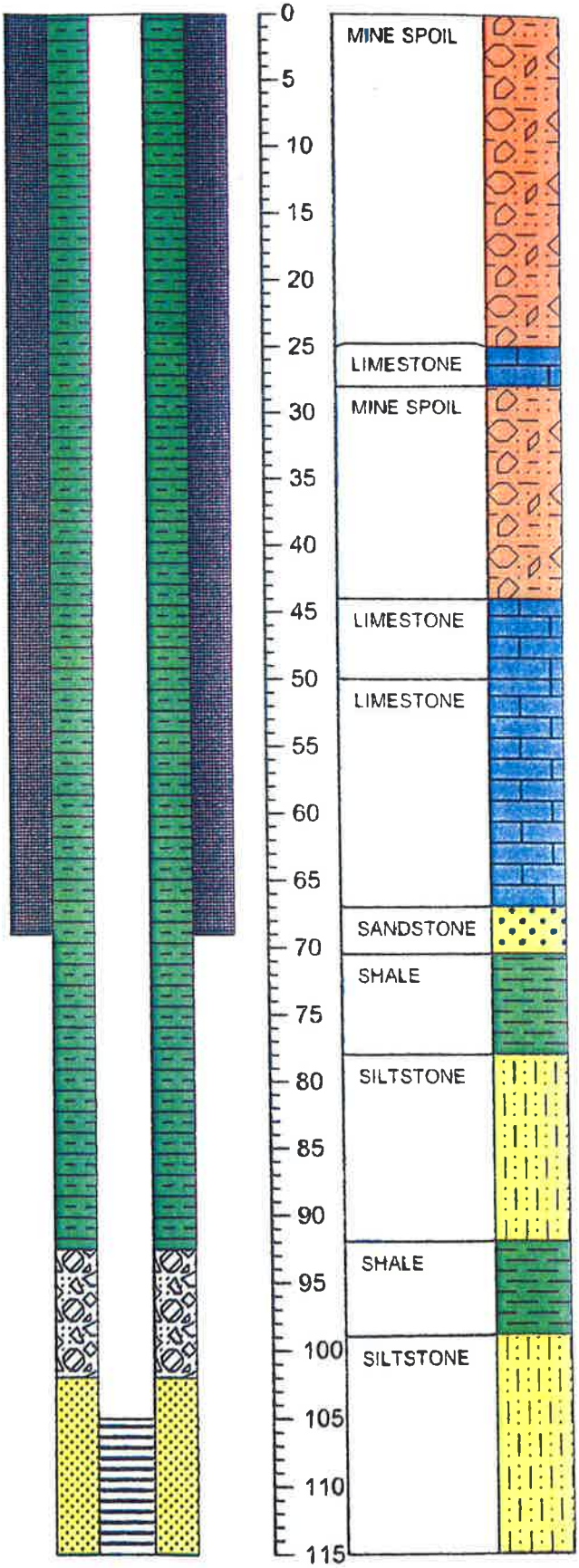
Sealed using bentonite clay slurry

2" Well Diameter

6" Borehole Diameter

Hole Plug

No. 7 Fine Sand



CIEC CIVIL & ENVIRONMENTAL CONSULTANTS, INC.

CIVIL & ENVIRONMENTAL CONSULTANTS, INC

8740 Orion Pl., Suite 100
Columbus, OH 43240

Phone 614-540-6633 Fax 614-540-6638

BOREHOLE LOG

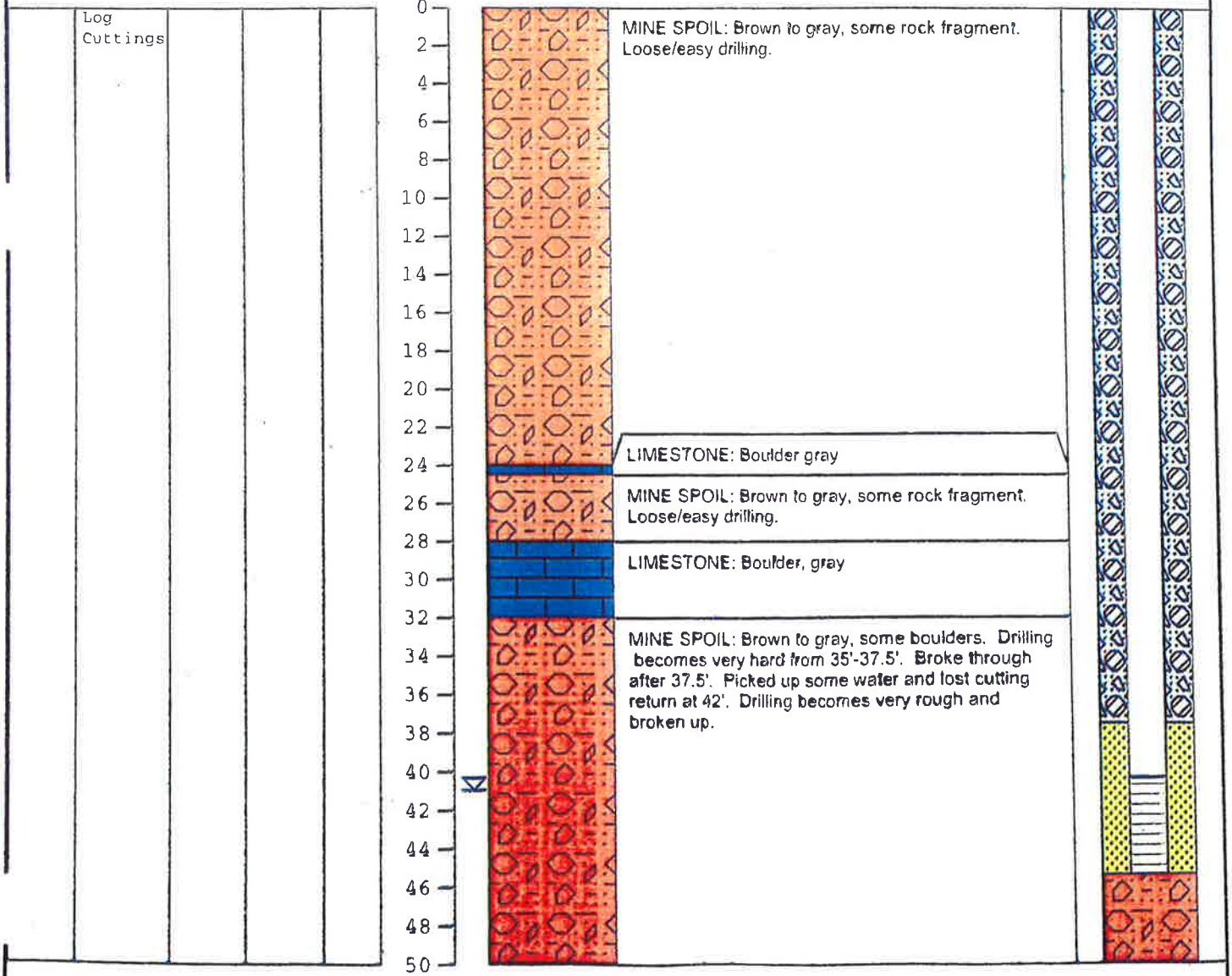
BOREHOLE/WELL NO.: **B-401A**

TOTAL DEPTH (BGS): **50 feet**

PROJECT INFORMATION		DRILLING INFORMATION	
PROJECT:	Apex Sanitary Landfill	DRILLING CO./DRILLER:	Duncan Bros. Drilling Inc.
SITE LOCATION:	Amsterdam, OH	DRILLING RIG/METHOD:	Air Rotary
PROJECT NO.:	042-021	BOREHOLE DIAMETER:	6 1/8" Tri-cone
FIELD GEOLOGIST:	D. Crayne	WELL DIAMETER:	2"
DATES DRILLED:	8/3/06	GROUND/TOC ELEVATION:	1266.75 / 1269.45ft amsl

▼ Water level during drilling ▼ Water Level After Development

SAMPLE/ CORE NO.	SAMPLE INTERVAL	SAMPLE RECOVERY (ft' in")	RQD (%)	%Recovery	DEPTH	SOIL SYMBOLS	LITHOLOGY	WELL COMPLETION
Log Cuttings					0–50		MINE SPOIL: Brown to gray, some rock fragment. Loose/easy drilling.	
					24		LIMESTONE: Boulder gray	
					24–28		MINE SPOIL: Brown to gray, some rock fragment. Loose/easy drilling.	
					28–32		LIMESTONE: Boulder, gray	
					32–50		MINE SPOIL: Brown to gray, some boulders. Drilling becomes very hard from 35'-37.5'. Broke through after 37.5'. Picked up some water and lost cutting return at 42'. Drilling becomes very rough and broken up.	



OBSERVATIONS:
Blind drill with 6 1/8" tri-cone

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8740 Orion Pl., Suite 100
Columbus, OH 43240

Phone 614-540-6633 Fax 614-540-6638

BOREHOLE LOG

BOREHOLE/WELL NO.: **B-402**

TOTAL DEPTH (BGS): **155 feet**

PROJECT INFORMATION

PROJECT:	**Apex Sanitary Landfill**
SITE LOCATION:	**Amsterdam, OH**
PROJECT NO.:	**042-021**
FIELD GEOLOGIST:	**D. Crayne**
DATES DRILLED:	**6/8/05 to 6/9/05**

DRILLING INFORMATION

DRILLING CO./DRILLER:	**Duncan Bros. Drilling Inc.**
DRILLING RIG/METHOD:	**Air Rotary / NX Air Core**
BOREHOLE DIAMETER:	**9 7/8" & 6 1/8" Tri-cone Bits**
WELL DIAMETER:	**2"**
GROUND/TOC ELEVATION:	**1263.12 / 1266.19 ft amsl**

⧗ Water level during drilling

⧗ Water Level After Development

SAMPLE/ CORE NO.	SAMPLE INTERVAL	SAMPLE RECOVERY (ft' in")	RQD (%)	%Recovery	DEPTH	SOIL SYMBOLS	LITHOLOGY	WELL COMPLETION
	9 7/8" Tri-cone Log Cuttings				0 2 4 6 8 10 12 14 16 18 20 22 24 26 28 30 32 34 36 38		MINE SPOIL: brown, with CLAY and rock fragments. wet at 36 feet.	

OBSERVATIONS:
9 7/8" Tri-cone to 44' set 7" casing. 6 1/8" Tri-cone to 110'. Core from 110' to 155'

SAMPLE/ CORE NO.	SAMPLE INTERVAL	SAMPLE RECOVERY (ft in)	RQD (%)	%Recovery	DEPTH	SOIL SYMBOLS	LITHOLOGY	WELL COMPLETION
	6 1/8" Tri-cone Log Cuttings				40 42 44 46 48 50 52 54 56 58 60 62 64 66 68 70 72 74 76 78 80 82 84 86 88 90 92 94 96		LIMESTONE: gray, with some SHALE cuttings. wet @ 45 feet. SILTSTONE: gray, with some SHALE interbeds.	

OBSERVATIONS:
9 7/8" Tri-cone to 44' set 7" casing. 6 1/8" Tri-cone to 110'. Core from 110' to 155'.

SAMPLE/ CORE NO.	SAMPLE INTERVAL	SAMPLE RECOVERY (ft' in")	RQD (%)	%Recovery	DEPTH	SOIL SYMBOLS	LITHOLOGY	WELL COMPLETION
CR#1	110'-120'	7'10"	83%	78%	98 100 102 104 106 108 110 112 114 116 118 120 122 124		SILTSTONE: gray, few organic fossils, trace lenses of SANDSTONE, few seams of SHALE, moderately fractured	
CR#2	120'-128'	7'10"	45%	98%				
CR#3	128'-137'	8'4"	55%	93%	126 128 130 132 134 136		SILTSTONE: with interbedded SHALE, few organic fossils, intensely fractured.	
CR#4	137'-146'	9'4"	78%	100%	138 140 142 144		SANDSTONE: gray, medium grained, thin laminations of COAL and SHALE at fractures, moderately fractured.	
CR#5	146'-155'	9'6"	88%	100%	146 148 150 152 154			

OBSERVATIONS:
9 7/8" Tri-cone to 44' set 7" casing. 6 1/8" Tri-cone to 110'. Core from 110' to 155'

WELL CONSTRUCTION LOG

PROJECT	PROJECT NUMBER	
Apex Sanitary Landfill	042-021	B-401A

COORDINATES	GROUND SURFACE ELEVATION	TOP OF PVC ELEVATION
N 281586.96 E 2409294.44	1266.75 feet amsl	1269.45 feet amsl

CITY & STATE:
Amsterdam, OH

COUNTY: Jefferson County

INSTALLATION DATE:
8/3/2006

DRILLING METHOD: 6 1/8"
Tri-cone w/ Air Rotary

DRILLING CONTRACTOR:
Duncan Bros. Drilling Inc.

DELEVOPED BY: DWC/JK
DATE: 8/17/06

DEVELOPMENT TECHNIQUE(S):
Grundfos Pump and SS Bailer

WATER REMOVED DURING DEVELOPMENT:
151 gallons

Depth to WATER: 44.54 feet

SOUNDED DEPTH FROM TOC:
48.30 feet

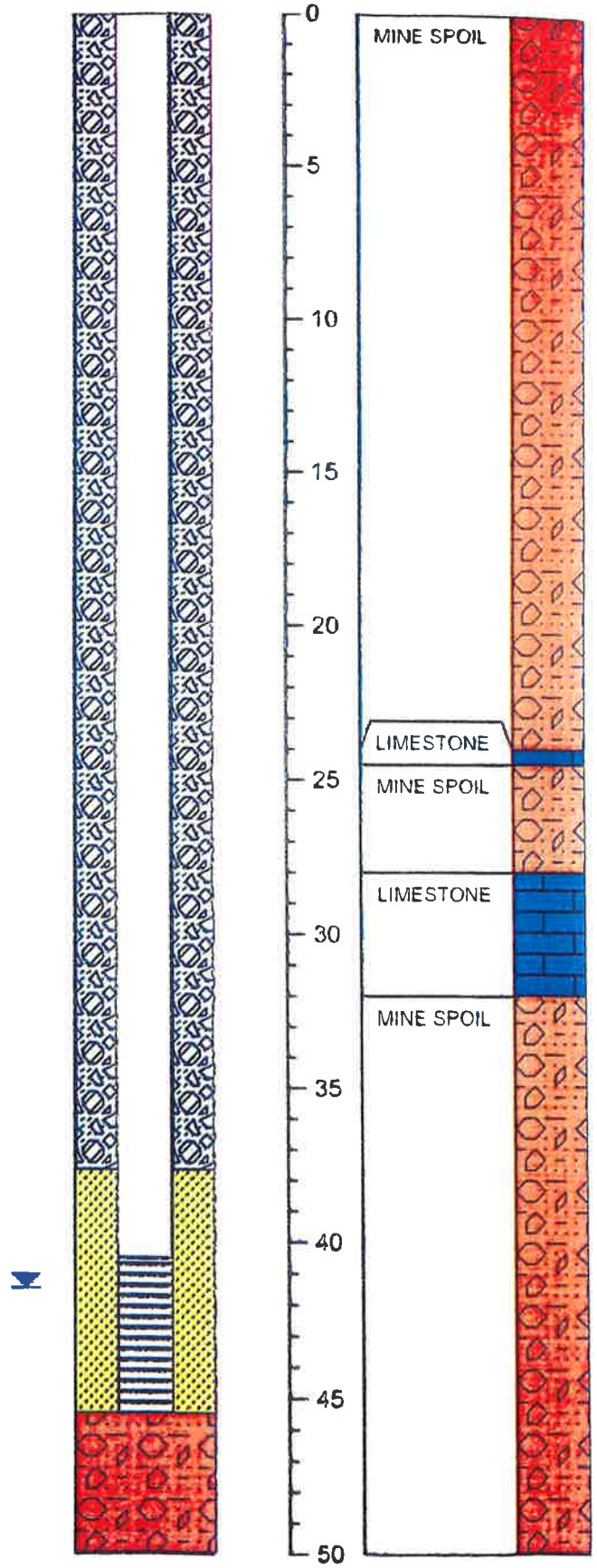
SCREENED INTERVAL ELEVATION: '-'

COMMENTS:

6" Borehole Diameter

2" Well Diameter

No. 4 Fine Sand



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WELL CONSTRUCTION LOG

PROJECT	PROJECT NUMBER	
Apex Sanitary Landfill	042-021	B-402

COORDINATES	GROUND SURFACE ELEVATION	TOP OF PVC ELEVATION
N 281126.81 E 2410084.67	1263.12 feet amsl	1266.19 feet amsl

CITY & STATE:
Amsterdam, OH
COUNTY: Jefferson County
INSTALLATION DATE:
6/8/05 to 6/9/05

DRILLING METHOD: Air Rotary / NX Air Core
DRILLING CONTRACTOR:
Duncan Bros. Drilling Inc.

DELEVOPED BY: DWC
DATE: 7/6 & 7/7/05

DEVELOPMENT TECHNIQUE(S):
Grundfos Pump and Bailer

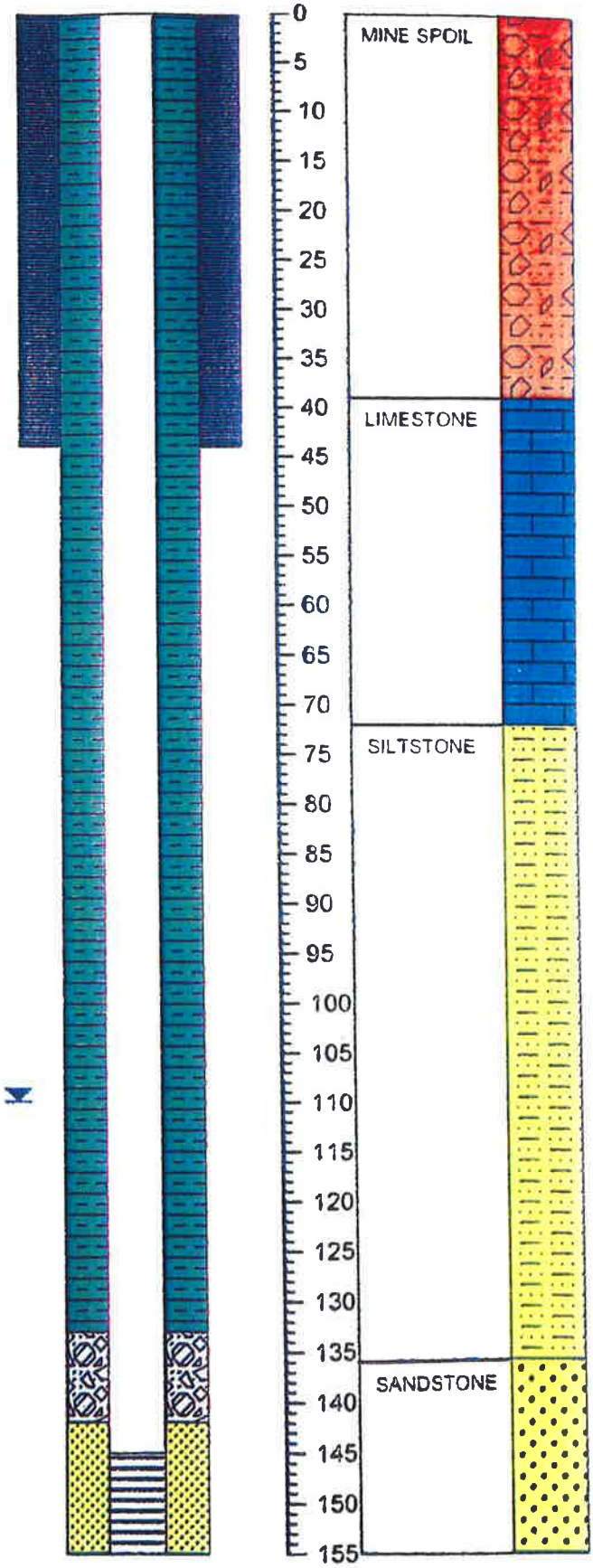
WATER REMOVED DURING DEVELOPMENT:
24 gallons

DEPTH to WATER: 112.53

SOUNDED DEPTH FROM TOC:
157.53 feet

SCREENED INTERVAL ELEVATION: 1118.66'-1108.66'

COMMENTS:
9 7/8" Tri-cone to 44' set 7" casing. 6 1/8" Tri-cone to 110'. Core from 110' to 155'.



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BOREHOLE LOG

BOREHOLE/WELL NO.: **B-402S**

TOTAL DEPTH (BGS): **90 feet**

PROJECT INFORMATION

PROJECT:	**Apex Sanitary Landfill**
SITE LOCATION:	**Amsterdam, OH**
PROJECT NO.:	**042-021**
FIELD GEOLOGIST:	**D. Crayne**
DATES DRILLED:	**6/6/05 to 6/7/05**

DRILLING INFORMATION

DRILLING CO./DRILLER:	**Duncan Bros. Drilling Inc.**
DRILLING RIG/METHOD:	**Air Rotary / NX Air Core**
BOREHOLE DIAMETER:	**9 7/8" & 6 1/8" Tri-cone Bits**
WELL DIAMETER:	**2"**
GROUND/TOC ELEVATION:	**1257.59 / 1260.64 ft amsl**

⧗ Water level during drilling

⧗ Water Level After Development

SAMPLE/ CORE NO.	SAMPLE INTERVAL	SAMPLE RECOVERY (ft, in")	RQD (%)	%Recovery	DEPTH	SOIL SYMBOLS	LITHOLOGY	WELL COMPLETION
	9 7/8" Tri-cone Log Cuttings				0		MINE SPOIL: gray, with CLAY and rock fragments, hit water @ 23 feet.	
					2			
					4			
					6			
					8			
					10			
					12			
					14			
					16			
					18			
					20			
					22			
					24		LIMESTONE: gray trace SHALE fragments.	
					26			
	6 1/8" Tri-cone Log Cuttings				28			
					30			
					32			
					34			
					36			

OBSERVATIONS:
9 7/8" Tri-cone to 27' set 7" casing. 6 1/8" Tri-cone to 40'. Core from 40' to 90'.

SAMPLE/ CORE NO.	SAMPLE INTERVAL	SAMPLE RECOVERY (ft' in")	RQD (%)	%Recovery
CR#1	40'-50'	9'2"	48%	92%
CR#2	50'-59'	6'5"	32%	71%
CR#3	59'-68'	9'3"	58%	100%
CR#4	68'-77'	8'7"	96%	95%
CR#5	77'-86'	9'7"	83%	100%
CR#6	86'-90'	3'7"	81%	90%

DEPTH: 38, 40, 42, 44, 46, 48, 50, 52, 54, 56, 58, 60, 62, 64, 66, 68, 70, 72, 74, 76, 78, 80, 82, 84, 86, 88, 90

SOIL SYMBOLS

LITHOLOGY

LIMESTONE: gray to black with some Sandstone lenses and Siltstone lenses

SHALE: very weak, poor RQD, some Clay lenses.

SILTSTONE: gray, micaceous, lenses of Sandstone, trace organic fossils

WELL COMPLETION

OBSERVATIONS:
9 7/8" Tri-cone to 27' set 7" casing. 6 1/8" Tri-cone to 40'. Core from 40' to 90'.

WELL CONSTRUCTION LOG

PROJECT	PROJECT NUMBER	
Apex Sanitary Landfill	042-021	B-402S

COORDINATES	GROUND SURFACE ELEVATION	TOP OF PVC ELEVATION
N 281453.23 E 2409947.60	1257.59 feet amsl	1260.64 feet amsl

CITY & STATE:
Amsterdam, OH

COUNTY: Jefferson County

INSTALLATION DATE:
6/6/05 to 6/7/05

DRILLING METHOD: Air Rotary / NX Air Core

DRILLING CONTRACTOR:
Duncan Bros. Drilling Inc.

DELEVOPED BY: DWC

DATE: 7/6 & 7/7/05

DEVELOPMENT TECHNIQUE(S):
Grundfos Pump and Bailer

WATER REMOVED DURING DEVELOPMENT:
17 gallons and DRY

DEPTH to WATER: DRY

SOUNDED DEPTH FROM TOC:
92.39 feet

SCREENED INTERVAL ELEVATION: 1178.25'-1168.25'

7" Surface Casing to 27'

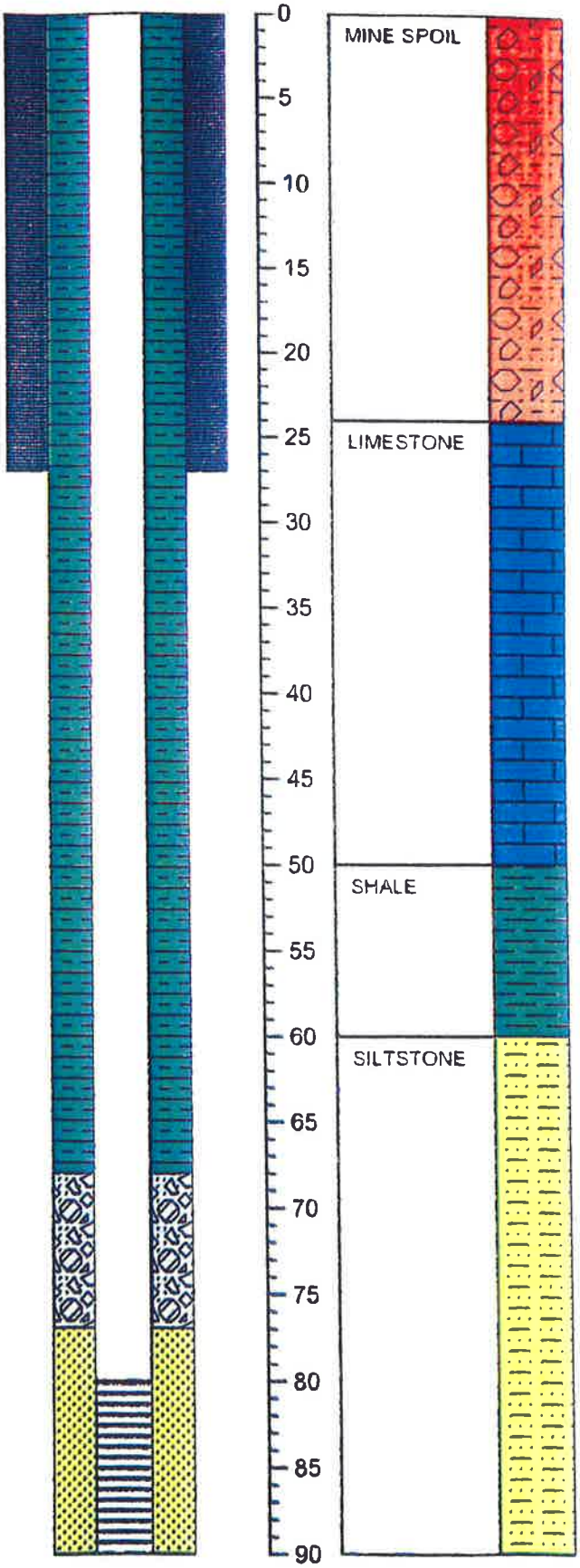
2" Well Diameter

6" Borehole Diameter

Sealed using bentonite clay slurry

Hole Plug

No. 7 Fine Sand



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BOREHOLE LOG

BOREHOLE/WELL NO.: **B-402A**

TOTAL DEPTH (BGS): **60 feet**

PROJECT INFORMATION

PROJECT:	Apex Sanitary Landfill
SITE LOCATION:	Amsterdam, OH
PROJECT NO.:	042-021
FIELD GEOLOGIST:	D. Crayne
DATES DRILLED:	8/2/06

DRILLING INFORMATION

DRILLING CO./DRILLER:	Duncan Bros. Drilling Inc.
DRILLING RIG/METHOD:	Air Rotary
BOREHOLE DIAMETER:	6 1/8" Tri-cone Bit
WELL DIAMETER:	2"
GROUND/TOC ELEVATION:	1258.03 / 1260.50ft amsl

Water level during drilling

Water Level After Development

SAMPLE/ CORE NO.	SAMPLE INTERVAL	SAMPLE RECOVERY (ft' in")	RQD (%)	%Recovery	DEPTH	SOIL SYMBOLS	LITHOLOGY	WELL COMPLETION
	Log Cuttings				0–60		TOPSOIL: brown MINE SPOIL: brown to gray, some rock fragments. Water seepage at bottom of mine spoil. SHALE: black to gray, dry. LIMESTONE: gray trace SHALE fragments. LIMESTONE: gray to black with some Sandstone lenses and Siltstone lenses SHALE: very weak, poor RQD, some Clay lenses.	
	Log from B-402S							

OBSERVATIONS:
Blind drill with 6 1/8" tri-cone

WELL CONSTRUCTION LOG

PROJECT	PROJECT NUMBER	
Apex Sanitary Landfill	042-021	B-402A

COORDINATES	GROUND SURFACE ELEVATION	TOP OF PVC ELEVATION
N 281447.40 E 2409956.70	1258.03 feet amsl	1260.50 feet amsl

CITY & STATE:
Amsterdam, OH

COUNTY: Jefferson County

INSTALLATION DATE:
8/2/2006

DRILLING METHOD: 6 1/8"
Tri-cone w/ Air Rotary

DRILLING CONTRACTOR:
Duncan Bros. Drilling Inc.

DELEVOPED BY: DWC/JK
DATE: 8/16/06

DEVELOPMENT TECHNIQUE(S):
Grundfos Pump and SS Bailer

WATER REMOVED DURING DEVELOPMENT:
24 gallons
Depth to WATER: 32.79 feet

SOUNDED DEPTH FROM TOC:
37.88 feet
SCREENED INTERVAL ELEVATION: '-'

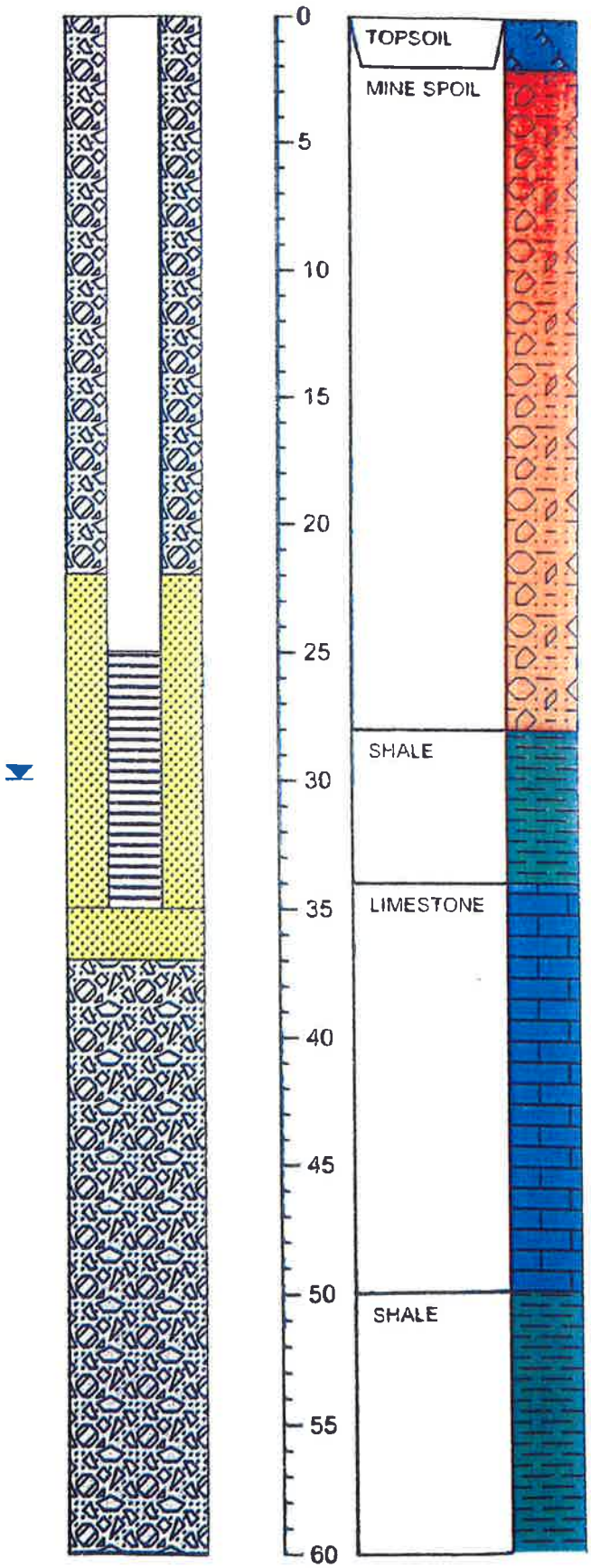
COMMENTS:

6" Borehole Diameter

2" Well Diameter

No. 4 Fine Sand

Hole Plug



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BOREHOLE LOG

BOREHOLE/WELL NO.: **B-403**

TOTAL DEPTH (BGS): **118 feet**

PROJECT INFORMATION

PROJECT:	**Apex Sanitary Landfill**
SITE LOCATION:	**Amsterdam, OH**
PROJECT NO.:	**042-021**
FIELD GEOLOGIST:	**D. Crayne**
DATES DRILLED:	**6/21/05**

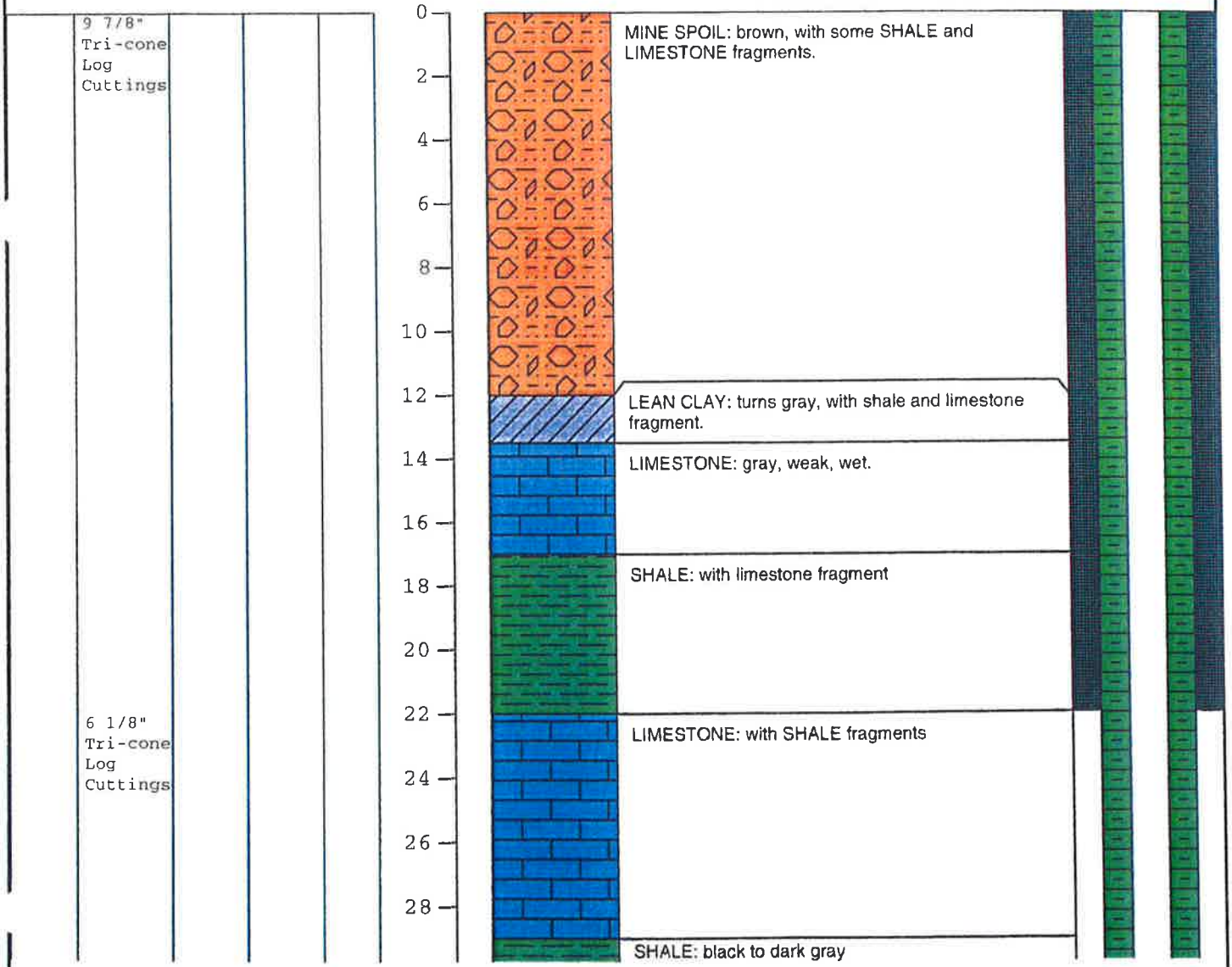
DRILLING INFORMATION

DRILLING CO./DRILLER:	**Duncan Bros. Drilling Inc.**
DRILLING RIG/METHOD:	**Air Rotary / NX Air Core**
BOREHOLE DIAMETER:	**9 7/8" & 6 1/8" Tri-cone Bits**
WELL DIAMETER:	**2"**
GROUND/TOC ELEVATION:	**1224.47 / 1226.84 ft amsl**

⧗ Water level during drilling

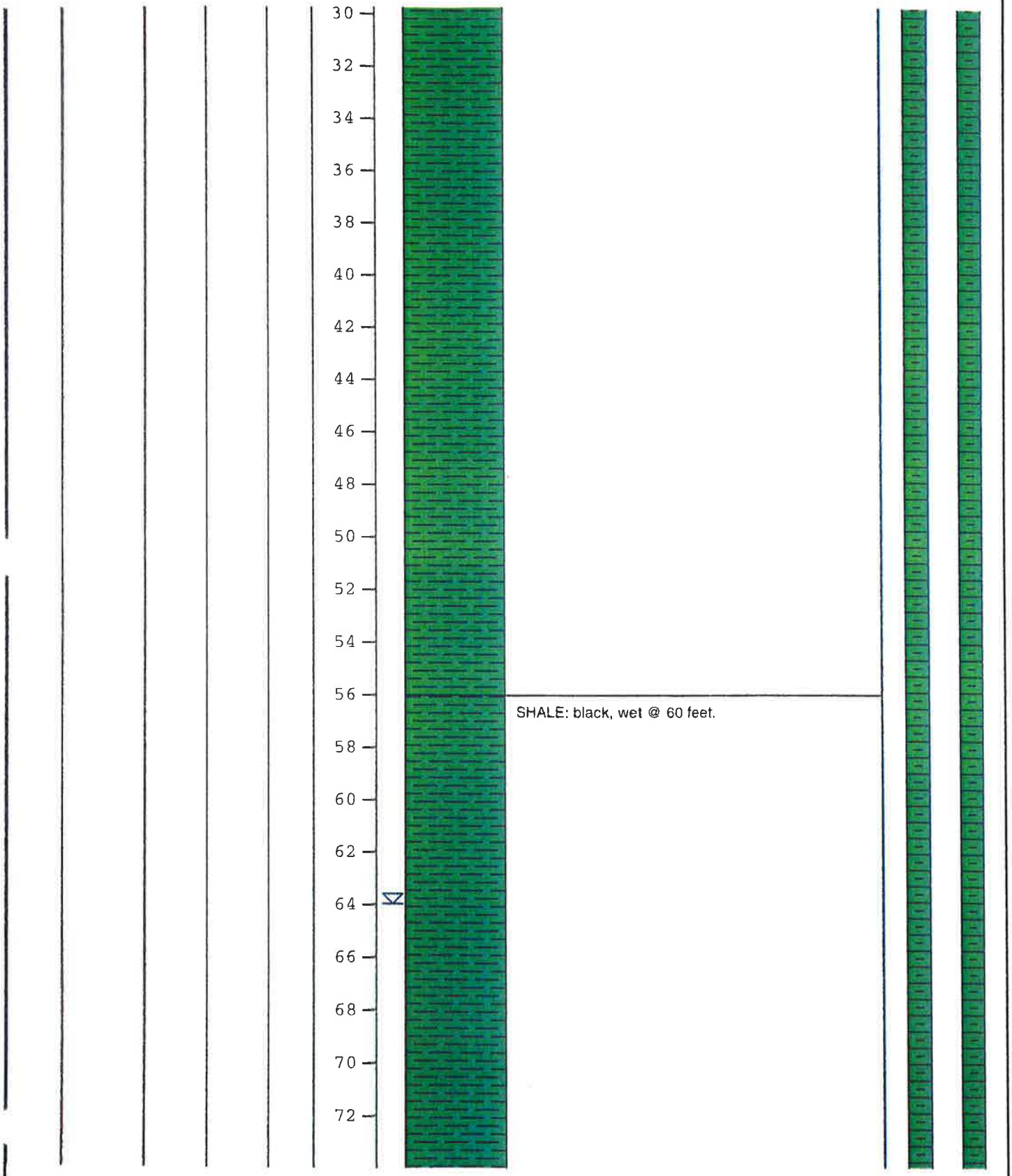
⧗ Water Level After Development

SAMPLE/ CORE NO.	SAMPLE INTERVAL	SAMPLE RECOVERY (ft' in")	RQD (%)	%Recovery	DEPTH	SOIL SYMBOLS	LITHOLOGY	WELL COMPLETION
	9 7/8" Tri-cone Log Cuttings				0		MINE SPOIL: brown, with some SHALE and LIMESTONE fragments.	
					2			
					4			
					6			
					8			
					10			
					12		LEAN CLAY: turns gray, with shale and limestone fragment.	
					14		LIMESTONE: gray, weak, wet.	
					16			
					18		SHALE: with limestone fragment	
					20			
	6 1/8" Tri-cone Log Cuttings				22		LIMESTONE: with SHALE fragments	
					24			
					26			
					28		SHALE: black to dark gray	



OBSERVATIONS:
9 7/8" Tri-cone to 22' set 7" casing. 6 1/8" Tri-cone to 90'. Core from 90' to 118'.

SAMPLE/ CORE NO.	SAMPLE INTERVAL	SAMPLE RECOVERY (ft' in")	RQD (%)	%Recovery	DEPTH	SOIL SYMBOLS	LITHOLOGY	WELL COMPLETION



OBSERVATIONS:
9 7/8" Tri-cone to 22' set 7" casing. 6 1/8" Tri-cone to 90'. Core from 90' to 118'.

SAMPLE/ CORE NO.	SAMPLE INTERVAL	SAMPLE RECOVERY (ft' in")	RQD (%)	%Recovery	DEPTH	SOIL SYMBOLS	LITHOLOGY	WELL COMPLETION
					74			
					76			
					78			
					80			
					82			
					84			
					86		SILTSTONE: and SHALE fragments.	
					88			
CR#1	90'-100'	9'8"	49%	97%	90		SANDSTONE: gray, fine grained, with laminations of SILTSTONE.	
					92		SILTSTONE: black, slightly fractured.	
					94		SANDSTONE: gray, fine grained, moderately fractured.	
					96		SILTSTONE: gray to black, intensely fractured	
					98			
CR#2	100'-109'	9'1"	41%	100%	100		SANDSTONE: gray, fine grained.	
					102		SILTSTONE: black	
					104		SANDSTONE: gray fine grained, intensely fractured.	
					106			
					108			
CR#3	109'-118'	9'3"	13%	100%	110		SANDSTONE: gray, fine grained, with thin laminations of SILTSTONE, intensely fractured.	
					112			
					114			
					116		SANDSTONE: gray, fine grained with thinly bedded SILTSTONE, moderately fractured.	
					118			

OBSERVATIONS:
9 7/8" Tri-cone to 22' set 7" casing. 6 1/8" Tri-cone to 90'. Core from 90' to 118'.

WELL CONSTRUCTION LOG	PROJECT	PROJECT NUMBER	B-403
	Apex Sanitary Landfill	042-021	
COORDINATES	GROUND SURFACE ELEVATION	TOP OF PVC ELEVATION	
N 281075.51 E 2410797.63	1224.47 feet amsl	1226.84 feet amsl	

CITY & STATE:
Amsterdam, OH

COUNTY: Jefferson County

INSTALLATION DATE:
6/21/05

DRILLING METHOD: Air Rotary / NX Air Core

DRILLING CONTRACTOR:
Duncan Bros. Drilling Inc.

DELEVOPED BY: DWC

DATE: 7/6 & 7/7/05

DEVELOPMENT TECHNIQUE(S):
Grundfos Pump and Bailer

WATER REMOVED DURING DEVELOPMENT:
25 gallons

DEPTH to WATER: 67.07

SOUNDED DEPTH FROM TOC:
120.29 feet

SCREENED INTERVAL ELEVATION: 1116.55'-1106.55'

COMMENTS:
9 7/8" Tri-cone to 22' set 7" casing. 6 1/8" Tri-cone to 90'. Core from 90' to 118'.

7" Surface Casing to 22'

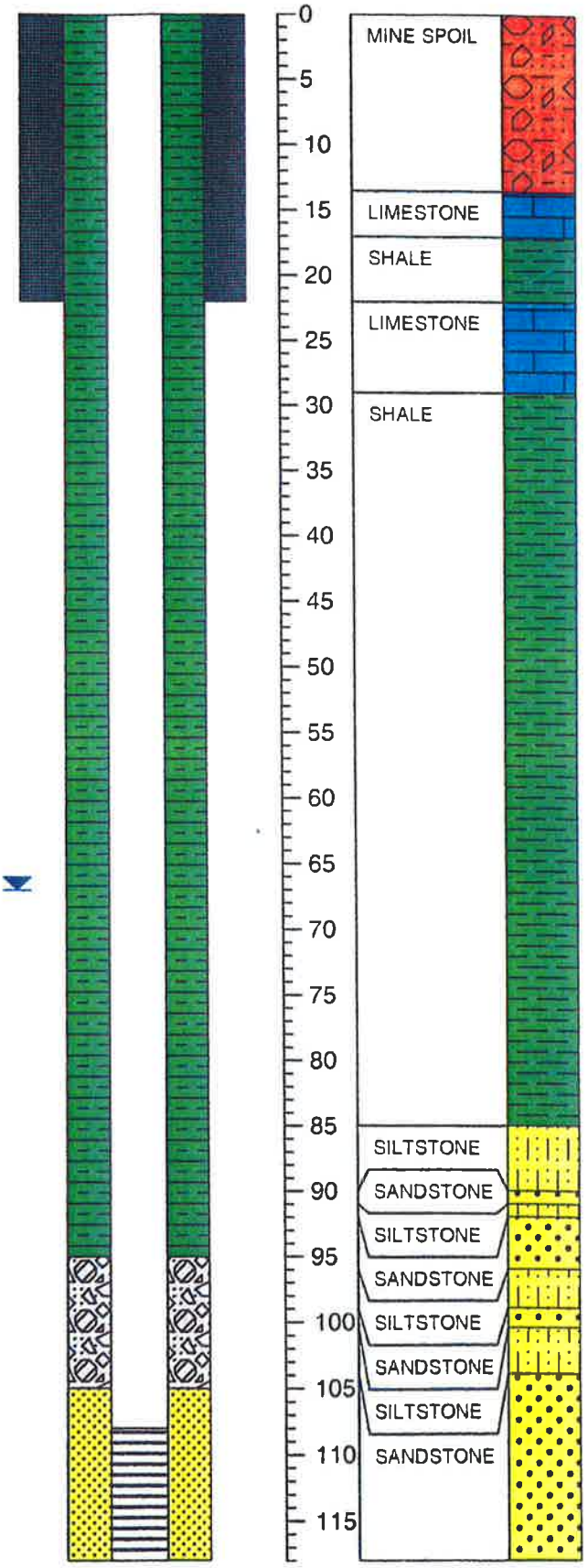
Sealed using bentonite clay slurry

2" Well Diameter

6" Borehole Diameter

Hole Plug

No. 7 Fine Sand



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BOREHOLE LOG

BOREHOLE/WELL NO.: **B-403S**

TOTAL DEPTH (BGS): **134.5 feet**

PROJECT INFORMATION

PROJECT:	**Apex Sanitary Landfill**
SITE LOCATION:	**Amsterdam, OH**
PROJECT NO.:	**042-021**
FIELD GEOLOGIST:	**D. Crayne**
DATES DRILLED:	**6/22/05 to 6/23/05**

DRILLING INFORMATION

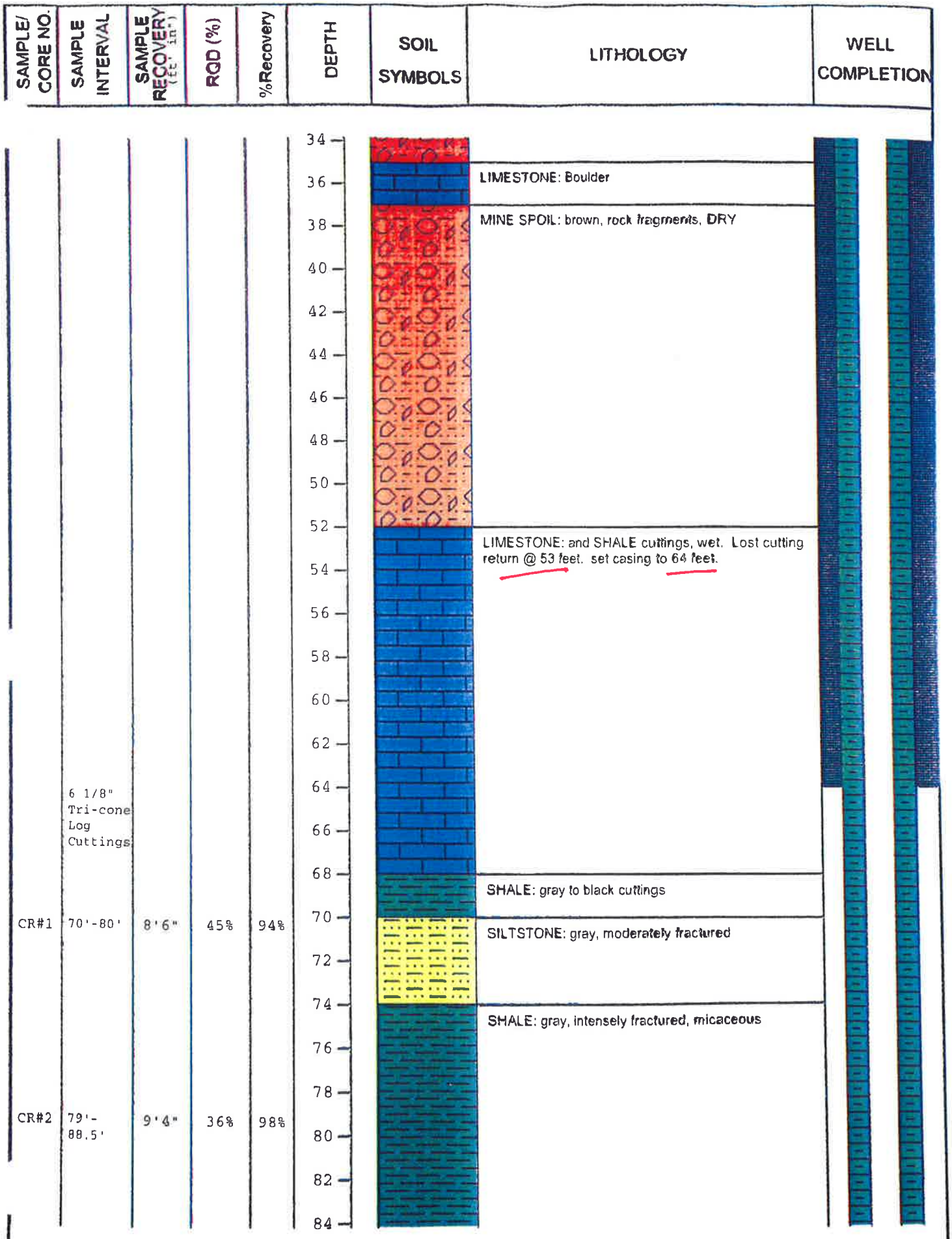
DRILLING CO./DRILLER:	**Duncan Bros. Drilling Inc.**
DRILLING RIG/METHOD:	**Air Rotary / NX Air Core**
BOREHOLE DIAMETER:	**9 7/8" & 6 1/8" Tri-cone Bits**
WELL DIAMETER:	**2"**
GROUND/TOC ELEVATION:	**1275.55 / 1277.75 ft amsl**

⧗ Water level during drilling

⧗ Water Level After Development

SAMPLE/ CORE NO.	SAMPLE INTERVAL	SAMPLE RECOVERY (ft' in")	RQD (%)	%Recovery	DEPTH	SOIL SYMBOLS	LITHOLOGY	WELL COMPLETION
	9 7/8" Tri-cone Log Cuttings				0		MINE SPOIL: brown to gray, clay and rock fragments, DRY.	
					2			
					4			
					6			
					8			
					10			
					12			
					14			
					16			
					18			
					20			
					22			
					24			
					26			
					28			
					30			
					32			

OBSERVATIONS:
9 7/8" Tri-cone to 64' set 7" casing. 6 1/8" Tri-cone to 70'. Core from 70' to 134.5'.



OBSERVATIONS:
9 7/8" Tri-cone to 64' set 7" casing. 6 1/8" Tri-cone to 70'. Core from 70' to 134.5'.

SAMPLE/ CORE NO.	SAMPLE INTERVAL	SAMPLE RECOVERY (ft' in")	RQD (%)	%Recovery
CR#3	88.5'-98'	9'3"	42%	96%
CR#4	98'-107.5'	9'4"	18%	98%
'#5	107.5'-117'	7'8"	15%	81%
CR#6	117'-125'	7'	37%	88%
CR#6	125'-134.5'	9'2"	16%	96%

DEPTH: 86, 88, 90, 92, 94, 96, 98, 100, 102, 104, 106, 108, 110, 112, 114, 116, 118, 120, 122, 124, 126, 128, 130, 132, 134

SOIL SYMBOLS

LITHOLOGY

SANDSTONE: fine grained, with thinly bedded SHALE, intensely fractured.

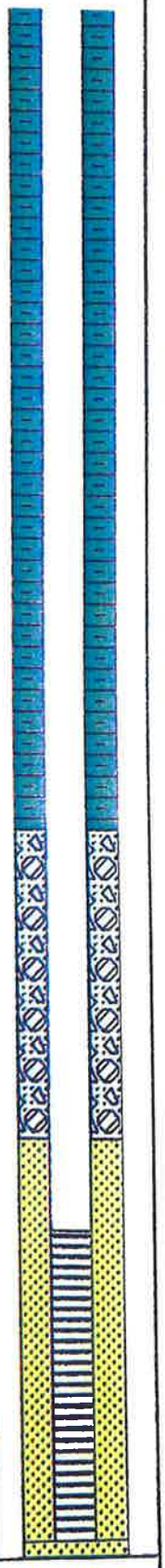
SILTSTONE: gray, moderately fractured

SHALE: gray with a few thin interbeds of gray fine grained SANDSTONE, intensely fractured.

SHALE: gray, dry in some places, intensely to moderately fractured.

SHALE: gray, with thinly bedded SILTSTONE, thin SANDSTONE layer @ 119 feet. Thin Laminations of COAL.

WELL COMPLETION



OBSERVATIONS:
9 7/8" Tri-cone to 64' set 7" casing. 6 1/8" Tri-cone to 70'. Core from 70' to 134.5'.

WELL CONSTRUCTION LOG

PROJECT	PROJECT NUMBER	
Apex Sanitary Landfill	042-021	B-403S

COORDINATES	GROUND SURFACE ELEVATION	TOP OF PVC ELEVATION
N 281221.66 E 2410383.66	1275.55 feet amsl	1277.75 feet amsl

CITY & STATE:
Amsterdam, OH
COUNTY: Jefferson County
INSTALLATION DATE:
6/22/05 to 6/23/05

DRILLING METHOD: Air Rotary / NX Air Core
DRILLING CONTRACTOR:
Duncan Bros. Drilling Inc.

DELEVOPED BY: DWC
DATE: 7/6 & 7/8/05

DEVELOPMENT TECHNIQUE(S):
Grundfos Pump and Bailer

WATER REMOVED DURING DEVELOPMENT:
15 gallons and DRY

DEPTH to WATER: 123.23

SOUNDED DEPTH FROM TOC:
136.83 feet

SCREENED INTERVAL ELEVATION: 1150.92'-1140.92'

COMMENTS:
9 7/8" Tri-cone to 64' set 7" casing. 6 1/8" Tri-cone to 70'. Core from 70' to 134.5'.

7" Surface Casing to 64'

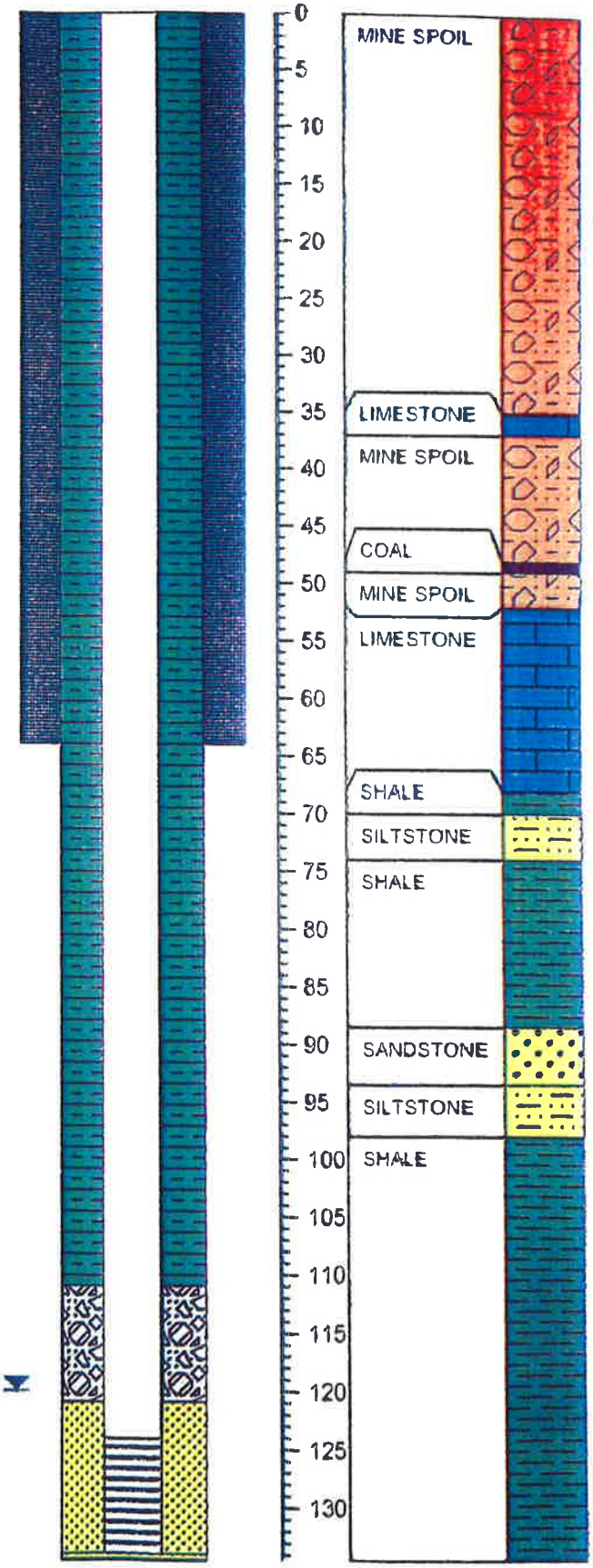
Sealed using bentonite clay slurry

2" Well Diameter

6" Borehole Diameter

Hole Plug

No. 7 Fine Sand



Civil & Environmental Consultants, Inc.
8740 Orion Place, Suite 100
Columbus, Ohio 43240

BORING NUMBER B-404

CLIENT Apex Environmental, LLC
PROJECT NAME Apex Sanitary Landfill
CEC PROJECT NUMBER 100-804
PROJECT LOCATION Amsterdam, OH
DATE STARTED 12/3/12 **COMPLETED** 12/4/12
GROUND ELEVATION 1243.07 ft **HOLE SIZE** 9.75" / 5.00"
DRILLINGCONTRACTOR Duncan Brothers
TOP OF PVC ELEVATION 1246.17 ft
DRILLING METHOD Air Rotary / HQ Core
GROUND WATER LEVELS:
LOGGED BY BRB **CHECKED BY** JD
AT END OF DRILLING 107.0 ft / Elev 1136.1 ft
LOCATION Northing: 282116.08 Easting: 2411184.30

DEPTH (ft)	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	GRAPHIC LOG	MATERIAL DESCRIPTION	WELL DIAGRAM
0	GB 1			Brown to gray SILTY CLAY; some siltstone fragments, some limestone fragments, DRY **(STRUCTURAL FILL)**	
2.5				1240.6	
	GB 2			Brown to gray SILTY CLAY and SILT; some shale fragments, some limestone fragments, trace sand, DRY **(MINE SPOIL)**	
5	GB 3			Note: encountered limestone boulder from 3.0' to 4.0'	6" Steel Surface Casing
10	GB 4			Note: encountered limestone boulder from 9.5' to 11.0'	Bentonite Grout
15	GB 5				
16.5				1226.6	
	GB 6			Gray SHALE; few limestone fragments, hard **(BEDROCK)**	
19.0				1224.1	2-Inch Solid PVC Riser
20				Gray SHALE; trace limestone inclusions, smooth to rough texture, moderate hard, DRY **(BEDROCK)**	
				Note: horizontal fracture @ 19.7'	
22.4				Note: horizontal fracture w/ slight weathering @ 20.5' and 21.1' 1220.7	
23.5				Dark gray LIMESTONE; very hard, high reaction to HCL, DRY **(BEDROCK)**	
	RC 1	57 (48)		Note: horizontal fracture @ 22.9' and 24.5' 1219.6	
25				Dark gray SHALE; trace interbedded limestone, rough to waxy texture, highly weathered, soft, DRY **(BEDROCK)**	
				Note: broken and crumbled w/ high weathering from 23.9' to 24.7'	Bentonite Grout
29.3				1213.8	
30				Gray to light gray LIMESTONE; very hard, high reaction to HCL, DRY **(BEDROCK)**	
30.3				1212.8	
				Dark gray SHALE; trace limestone inclusions, rough texture, moderate hard, DRY **(BEDROCK)**	
	RC 2	77 (69)			
35				Note: horizontal fracture @ 32.5', 33.9', and 35.2'	

P-12S TEMPLATE B-404 & B-404S BORING LOGS.GPJ GOOD TEMPLATE.GDT 1/22/13

(Continued Next Page)

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Columbus, Ohio 43240

BORING NUMBER B-404

CLIENT Apex Environmental, LLC **PROJECT NAME** Apex Sanitary Landfill

CEC PROJECT NUMBER 100-804 **PROJECT LOCATION** Amsterdam, OH

DEPTH (ft)	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	GRAPHIC LOG	MATERIAL DESCRIPTION	WELL DIAGRAM
35				Dark gray SHALE; trace limestone inclusions, rough texture, moderate hard, DRY **(BEDROCK)** ***(continued)***	
38.0					1205.1
40	RC 3	92 (92)		Dark gray SHALE; few limestone inclusions, trace sandstone laminations, rough texture, moderate hard, DRY to MOIST **(BEDROCK)** Note: horizontal fracture @ 39.3' and 39.8' Note: horizontal fracture w/ slight weathering @ 40.9' Note: first trace of water @ 40.9'	Bentonite Grout
45				Note: horizontal fracture @ 43.1' Note: horizontal fracture w/ slight weathering @ 45.0'	
47.0				Note: horizontal fracture @ 46.3'	1196.1
50	RC 4	82 (82)		Dark gray SHALE; few limestone inclusions, smooth to rough texture, moderate hard, DRY **(BEDROCK)** Note: horizontal fracture @ 47.8' and 50.5'	2-Inch Solid PVC Riser
55				Note: horizontal fracture w/ moderate weathering @ 51.8' Note: horizontal fracture @ 52.9' and 54.2'	
56.0					1187.1
60	RC 5	81 (63)		Dark gray SHALE; few limestone inclusions, rough texture, moderate hard to soft, DRY to WET **(BEDROCK)** Note: moderately fractured w/ slight weathering from 56.0' to 57.7' Note: horizontal fracture w/ high weathering @ 58.5' Note: partially wet cores in core run #5	
65				Note: horizontal fracture @ 60.2', 60.5', 62.4', and 65.8'	
65.0					1178.1
70	RC 6	100 (94)		Dark gray SHALE; some sandstone laminations, trace limestone inclusions, trace plant fossils, rough to gritty texture, moderate hard to hard, DRY **(BEDROCK)** Note: diagonal fracture @ 67.2'	Bentonite Grout
74.0				Note: horizontal fracture w/ slight weathering @ 72.0' Note: horizontal fracture @ 73.0', 73.3', and 73.5'	1169.1
75				75.0	1168.1

P-12S TEMPLATE B-404 & B-404S BORING LOGS.GPJ GOOD TEMPLATE.GDT 1/22/13

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Civil & Environmental Consultants, Inc.
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BORING NUMBER B-404

CLIENT Apex Environmental, LLC **PROJECT NAME** Apex Sanitary Landfill

CEC PROJECT NUMBER 100-804 **PROJECT LOCATION** Amsterdam, OH

DEPTH (ft)	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	GRAPHIC LOG	MATERIAL DESCRIPTION	WELL DIAGRAM
75				Dark gray to black SHALE; few sandstone laminations, few plant fossils, rough texture, moderate hard to hard, WET to DRY **(BEDROCK)**	
				Note: horizontal fracture @ 75.5' and 76.0'	
				Note: mostly wet cores in core run #7	
	RC 7	94 (87)		Note: horizontal fracture w/ high weathering @ 77.2' and 77.6'	
				Note: horizontal fracture w/ moderate weathering @ 78.1'	
80				Note: horizontal fracture w/ high weathering @ 80.6' and 80.9'	
				80.9 — 1162.2	
				Dark gray interbedded SHALE and SANDSTONE; trace mica, sand fine grained, gritty to rough texture, moderate hard, WET to DRY **(BEDROCK)**	
				83.0 — 1160.1	2-Inch Solid PVC Riser
				Gray SANDSTONE; few shale laminations, fine to medium grained, micaceous, hard, DRY **(BEDROCK)**	
85					
	RC 8	100 (100)		Note: horizontal fracture @ 85.1'	
				Note: horizontal fracture @ 88.6'	
90					
				Note: horizontal fracture @ 91.7'	
				92.0 — 1151.1	
				Gray SANDSTONE; few shale laminations, fine to medium grained, micaceous, moderate hard, DRY to WET **(BEDROCK)**	
95					Bentonite Grout
	RC 9	100 (100)		Note: horizontal fracture @ 96.5', 98.3', and 101.6'	
100					
				101.0 — 1142.1	
				Gray SANDSTONE; some coal laminations, few plant fossils, trace shale laminations, fine to medium grained, micaceous, hard, DRY **(BEDROCK)**	
				Note: horizontal fracture @ 102.8'	
105	RC 10	100 (97)		Note: calcareous from 104.7' to 108.1'	Hydrated Bentonite Chips
				Note: horizontal fracture @ 108.3', 108.6', 108.9', and 110.5'	#5 Filter Sand
110				110.0 — 1133.1	
				Gray SANDSTONE; few coal laminations, trace calcite inclusions, trace plant fossils, fine to medium grained, micaceous, hard to very hard, WET **(BEDROCK)**	0.010-Inch Slotted Screen
				Note: horizontal fracture @ 112.2'	
115	RC 11	100 (100)		Note: horizontal fracture w/ brown oxidized staining @ 112.9' and 114.6'	

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BORING NUMBER B-404

CLIENT Apex Environmental, LLC **PROJECT NAME** Apex Sanitary Landfill

CEC PROJECT NUMBER 100-804 **PROJECT LOCATION** Amsterdam, OH

DEPTH (ft)	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	GRAPHIC LOG	MATERIAL DESCRIPTION	WELL DIAGRAM
115				Gray SANDSTONE; few coal laminations, trace calcite inclusions, trace plant fossils, fine to medium grained, micaceous, hard to very hard, WET **(BEDROCK)** ***(continued)***	0.010-Inch Slotted Screen
				119.0 Note: horizontal fracture @ 118.7' 1124.1	
120				Gray SANDSTONE; few coal laminations, few plant fossils, trace calcite inclusions, fine to medium grained, micaceous, hard, WET **(BEDROCK)**	#5 Filter Sand
	RC 12	100 (97)		Note: horizontal fracture @ 122.4', 123.6', 124.7', and 125.5'	
125					Hydrated Bentonite Chips
				128.0 1115.1	
				Bottom of hole at 128.0 feet	

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BORING NUMBER B-404S

CLIENT Apex Environmental, LLC
PROJECT NAME Apex Sanitary Landfill
CEC PROJECT NUMBER 100-804
PROJECT LOCATION Amsterdam, OH
DATE STARTED 12/4/12 **COMPLETED** 12/5/12
GROUND ELEVATION 1242.26 ft **HOLE SIZE** 9.75" / 5.00"
DRILLINGCONTRACTOR Duncan Brothers
TOP OF PVC ELEVATION 1245.09 ft
DRILLING METHOD Air Rotary / HQ Core
GROUND WATER LEVELS:
LOGGED BY BRB **CHECKED BY** JD
AT END OF DRILLING DRY
LOCATION Northing: 282116.73 Easting: 2411195.56

DEPTH (ft)	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	GRAPHIC LOG	MATERIAL DESCRIPTION	WELL DIAGRAM
0				Blind drilled from 0' to 50'. See B-404 boring log for description.	6" Steel Surface Casing; Bentonite Grout; 2-Inch Solid PVC Riser; Bentonite Grout
5					
10					
15					
20					
25					
30					
35					

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BORING NUMBER B-404S

CLIENT Apex Environmental, LLC **PROJECT NAME** Apex Sanitary Landfill

CEC PROJECT NUMBER 100-804 **PROJECT LOCATION** Amsterdam, OH

DEPTH (ft)	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	GRAPHIC LOG	MATERIAL DESCRIPTION	WELL DIAGRAM
35				Blind drilled from 0' to 50'. See B-404 boring log for description. *(continued)* Note: Water Level = DRY (13 hours after 35' TD)	
40					
45					Bentonite Grout
50				50.0 1192.3	
55	RC 1	81 (66)		Dark gray SHALE; few limestone inclusions, smooth to rough texture, moderate hard to soft, DRY to MOIST **(BEDROCK)** Note: diagonal fracture @ 50.9' Note: trace of water from 50.0' to 52.0' Note: horizontal fracture @ 51.2', 51.5', 51.8', and 52.7' Note: horizontal fracture @ 54.4' and 57.8'	2-Inch Solid PVC Riser
60				60.0 Note: Water Level = DRY (20 minutes after core run #1) 1182.3	
65	RC 2	100 (93)		Dark gray SHALE; some limestone inclusions, trace sandstone laminations, rough to smooth texture, moderate hard to hard, DRY **(BEDROCK)** Note: horizontal fracture @ 60.1', 60.3', 62.4', and 62.7' Note: diagonal fracture @ 65.1' Note: horizontal fracture @ 65.9'	Hydrated Bentonite Chips
70				69.0 Note: Water Level = DRY (35 minutes after core run #2) 1173.3	#5 Filter Sand
75	RC 3	100 (97)		Dark gray to black SHALE; few sandstone laminations, trace plant fossils, rough to gritty texture, moderate hard to hard, DRY to WET **(BEDROCK)** Note: wet cores and fractures from 70.4' to 72.0' Note: horizontal fracture @ 69.8', 70.4', 70.9', and 71.3' Note: horizontal fracture w/ moderate weathering @ 72.0'	0.010-Inch Slotted Screen

P-12S TEMPLATE B-404 & B-404S BORING LOGS.GPJ GOOD TEMPLATE.GDT 1/22/13

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BORING NUMBER B-404S

CLIENT Apex Environmental, LLC **PROJECT NAME** Apex Sanitary Landfill

CEC PROJECT NUMBER 100-804 **PROJECT LOCATION** Amsterdam, OH

DEPTH (ft)	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	GRAPHIC LOG	MATERIAL DESCRIPTION		WELL DIAGRAM
75				Note: horizontal fracture @ 73.5', 75.5', 75.8', and 76.8'		
				Dark gray to black SHALE; few sandstone laminations, trace plant fossils, rough to gritty texture, moderate hard to hard, DRY to WET **(BEDROCK)**		0.010-Inch Slotted Screen
				Note: wet cores and fractures from 70.4' to 72.0' *(continued)*		
				78.0 Note: Water Level = DRY (35 minutes after core run #3)	1164.3	
				Dark gray to black SHALE; few sandstone laminations, few plant fossils, rough texture, moderate hard to hard, DRY **(BEDROCK)**		
80	RC 4	100 (100)		Note: horizontal fractures w/ high weathering @ 79.5' and 80.9'		#5 Filter Sand
				81.0 Note: Water Level = DRY (75 minutes after borehole completion)	1161.3	
				Bottom of hole at 81.0 feet		

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BORING NUMBER B-405

CLIENT Apex Environmental, LLC
PROJECT NAME Apex Sanitary Landfill
CEC PROJECT NUMBER 100-804
PROJECT LOCATION Amsterdam, OH
DATE STARTED 11/30/10 **COMPLETED** 12/1/10
GROUND ELEVATION 1231.11 ft **HOLE SIZE** 8" / 5"
DRILLINGCONTRACTOR Frontz Drilling, Inc.
TOP OF PVC ELEVATION 1234.20 ft
DRILLING METHOD Air Rotary & HQ Core
GROUND WATER LEVELS:
LOGGED BY BRB **CHECKED BY** DWC
▼ AT END OF DRILLING 80.8 ft / Elev 1150.3 ft
LOCATION Apex Sanitary Landfill

DEPTH (ft)	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	GRAPHIC LOG	MATERIAL DESCRIPTION	WELL DIAGRAM
0				Structural Fill; clay and rock fragments Blind drilled from 0' - 8' and set 6" steel surface casing. Top of rock = 6'	
6.0					1225.1
8.0				SHALE; gray to dark gray, moderate-strong, silty, trace limestone note: logged rock cuttings from 8' - 15'	1223.1
15.0					1216.1
17.5				SHALE, gray, moderate-strong, intense fracturing w/ moderate weathering	1213.6
18.4	RC 1	60 (46)		LIMESTONE; dark gray, very strong, high reaction to HCl	1212.7
23.0				SHALE; gray, very weak, high weathering	1208.1
26.2				NO RECOVERY; assuming highly weathered shale	1204.9
30.3	RC 2	69 (57)		LIMESTONE; light gray, very strong, high reaction to HCl note: horizontal fracture @ 28.9'	1200.8
31.4				LIMESTONE/ SHALE, interbedded limestone and shale, dark gray, weak, moderate reaction to HCl	1199.7
33.0				SHALE; dark gray, weak, some limestone inclusions note: horizontal fracture w/ moderate weathering @ 33.8	1198.1
35.0					1196.1

6-Inch Steel Surface Casing
Bentonite Grout
2-Inch Solid PVC Riser

GENERAL BH / TP / WELL APEX BEDROCK PIEZOMETERS.GPJ GOOD TEMPLATE.GDT 1/5/11

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BORING NUMBER B-405

CLIENT Apex Environmental, LLC
PROJECT NAME Apex Sanitary Landfill
CEC PROJECT NUMBER 100-804
PROJECT LOCATION Amsterdam, OH

DEPTH (ft)	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	GRAPHIC LOG	MATERIAL DESCRIPTION	WELL DIAGRAM
35	RC 3	102 (97)		SHALE; dark gray, moderate-strong to weak, some limestone inclusions note: horizontal fracture w/ slight weathering @ 35.0' and 36.1' note: horizontal fracture w/ slight weathering @ 40.9'	
43.0 / 1188.1					
45	RC 4	100 (90)		SHALE; dark gray, moderate-strong, some sandstone laminations, few limestone inclusions note: horizontal fracture w/ brown oxidized staining **@ 44.3'** note: diagonal fracture @ 44.5' note: horizontal fracture w/ brown oxidized staining **@ 45.8', 46.3', and 46.6'** note: broken w/ brown oxidized staining from 48.9' - 49.4' note: diagonal fracture @ 51.6'	Bentonite Grout
53.0 / 1178.1					
55	RC 5	84 (63)		SHALE; dark gray to black, moderate-strong, some plant fossils, trace limestone inclusions note: horizontal fracture @ 54.4' note: intense horizontal fracturing w/ high weathering from 55.3' - 57.4' note: horizontal fracturing w/ slight weathering @ 58.6' and 59.2'	2-Inch Solid PVC Riser
63.0 / 1168.1					
65	RC 6	88 (85)		SHALE; dark gray, strong, some plant fossils, few sandstone laminations, few calcite inclusions note: horizontal fracture @ 64.3', 65.6', and 66.1' note: horizontal fracture @ 68.7', 70.6', and 71.2'	
73.0 / 1158.1					
75					

GENERAL BH / TP / WELL APEX_BEDROCK_PIEZOMETERS.GPJ GOOD TEMPLATE.GDT 1/5/11

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BORING NUMBER B-405

CLIENT Apex Environmental, LLC
PROJECT NAME Apex Sanitary Landfill
CEC PROJECT NUMBER 100-804
PROJECT LOCATION Amsterdam, OH

DEPTH (ft)	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	GRAPHIC LOG	MATERIAL DESCRIPTION	WELL DIAGRAM
75	RC 7	93 (88)		SHALE; dark gray to black, moderate-strong, some plant fossils, trace sandstone laminations, trace calcite inclusions, micaceous	
				note: horizontal fracture w/ slight weathering @ 73.8' and 76.5'	
80				note: horizontal fracture w/ slight weathering @ 79.0' and 79.9' *(continued)*	
				83.0 — 1148.1	
	RC 8	87 (83)		SHALE; dark gray to black, moderate-strong, few plant fossils, trace sandstone laminations, micaceous	
85				note: horizontal fracture @ 85.6'	Bentonite Grout
				note: diagonal fracture @ 89.4'	
90				note: horizontal fracture @ 90.4'	
				93.0 — 1138.1	
	RC 9	84 (82)		SHALE; gray, strong, trace plant fossils, micaceous	
95				note: horizontal fracture w/ slight weathering @ 93.5' and 95.6'	
				note: horizontal fracture @ 97.5'	2-inch Solid PVC Riser
100				note: horizontal fracture w/ moderate weathering @ 99.3'	
				100.9 — 1130.2	
				102.0 SHALE/ SANDSTONE, interbedded shale and sandstone, dark gray, strong, few coal inclusions, micaceous — 1129.1	
				103.4 SHALE; dark gray, weak, micaceous, intensely fractured w/ moderate weathering — 1127.7	
105	RC 10	101 (94)		SANDSTONE; gray, very strong, fine to medium-grained, micaceous	Bentonite Chips
				note: horizontal fracture @ 106.5'	
110					#2 Filter Sand
					0.010-Inch Slotted Screen
115				115.0 — 1116.1	

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GENERAL BH / TP / WELL APEX_BEDROCK_PIEZOMETERS.GPJ GOOD TEMPLATE.GDT 1/5/11

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BORING NUMBER B-405

CLIENT Apex Environmental, LLC
PROJECT NAME Apex Sanitary Landfill
CEC PROJECT NUMBER 100-804
PROJECT LOCATION Amsterdam, OH

DEPTH (ft)	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	GRAPHIC LOG	MATERIAL DESCRIPTION	WELL DIAGRAM
115					
	RC 11	99 (98)		SANDSTONE; gray, very strong, fine to medium-grained, micaceous note: broken w/ moderate weathering from 113.3' - 113.6' note: horizontal fracture w/ brown oxidized staining @ 114.6' note: horizontal fracture @ 116.7'	0.010-Inch Slotted Screen
120					
				122.0 / 1109.1 SANDSTONE, gray, very strong, fine to medium-grained, micaceous	#3 Filter Sand
125	RC 12	101 (100)		note: horizontal fracture @ 126.9' and 128.9'	
130				132.0 / 1099.1 SANDSTONE; gray, very strong, fine to medium-grained, micaceous	
135	RC 13	93 (92)		note: horizontal fracture w/ slight weathering @ 137.7'	Bentonite Chips
				138.2 / 1092.9 SANDSTONE/ SHALE; interbedded gray sandstone with black shale, moderate-strong, micaceous note: horizontal fracture w/ slight weathering @ 138.3', 140.0', 140.5', and 141.2' note: broken and crumbled from 142.6' - 143.1'	
140				143.1 / 1088.0 SHALE; dark gray to black, moderate-strong, no reaction to HCl	
145	RC 14	57 (44)		note: intense horizontal fracturing w/ moderate weathering from 145.9' - 152'	
150				152.0 / 1079.1 Bottom of hole at 152.0 feet	

GENERAL BH / TP / WELL APEX_BEDROCK_PIEZOMETERS.GPJ GOOD TEMPLATE.GDT 1/6/11

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Columbus, Ohio 43240

BORING NUMBER B-405S

CLIENT Apex Environmental, LLC
CEC PROJECT NUMBER 100-804
DATE STARTED 12/2/10 COMPLETED 12/2/10
DRILLINGCONTRACTOR Frontz Drilling, Inc.
DRILLING METHOD Air Rotary & HQ Core
LOGGED BY BRB CHECKED BY DWC
LOCATION Apex Sanitary Landfill

PROJECT NAME Apex Sanitary Landfill
PROJECT LOCATION Amsterdam, OH
GROUND ELEVATION 1230.41 ft HOLE SIZE 8" / 5"
TOP OF PVC ELEVATION 1233.55 ft
GROUND WATER LEVELS:
AT END OF DRILLING 43.6 ft / Elev 1186.8 ft

DEPTH (ft)	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	GRAPHIC LOG	MATERIAL DESCRIPTION	WELL DIAGRAM
0				Structural Fill; clay and rock fragments Blind drilled from 0' - 11' and set 6" steel surface casing. Top of rock = 8'. **See** B-405 for description.	
8.0					1222.4
11.0				Blind drilled from 11' - 38'. See B-405 for description.	1219.4

WELL DIAGRAM: 6-Inch Steel Surface Casing; Bentonite Grout; 2-Inch Solid PVC Riser

GENERAL BH / TP / WELL APEX_BEDROCK_PIEZOMETERS.GPJ GOOD TEMPLATE.GDT 1/5/11

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BORING NUMBER B-405S

CLIENT Apex Environmental, LLC
PROJECT NAME Apex Sanitary Landfill
CEC PROJECT NUMBER 100-804
PROJECT LOCATION Amsterdam, OH

DEPTH (ft)	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	GRAPHIC LOG	MATERIAL DESCRIPTION	WELL DIAGRAM
35				Blind drilled from 11' - 38'. See B-405 for description. *(continued)*	Bentonite Chips; 2-Inch Solid PVC Riser
				38.0 — 1192.4	
40	RC 1	76 (68)		SHALE; dark gray, moderate-strong, few limestone inclusions, trace sandstone laminations note: horizontal fracture w/ slight brown oxidized staining @ 38.8' note: horizontal fracture @ 39.4' and 39.9' note: horizontal fracture w/ high weathering @ 41.3' note: intense horizontal and vertical fracturing from 42.1' - 43.1'	#3 Filter Sand
45				note: horizontal fracture w/ brown oxidized staining @ 45.5' note: bottom 2' (46' - 48') not recovered, assuming its highly weathered shale	0.010-Inch Slotted Screen
				48.0 — 1182.4	
50	RC 2	93 (88)		SHALE; dark gray, moderate-strong, few limestone inclusions note: intense horizontal fracturing from 49.0' - 49.8' note: horizontal fracture @ 54.6'	#3 Filter Sand; Bentonite Chips
55				58.0 — 1172.4	
				Bottom of hole at 58.0 feet	

GENERAL BH / TP / WELL APEX BEDROCK PIEZOMETERS.GPJ GODC TEMPLATE.GDT 1/5/11

Civil & Environmental Consultants, Inc.
8740 Orion Place, Suite 100
Columbus, Ohio 43240

BORING NUMBER B-405SR

CLIENT Apex Environmental, LLC
PROJECT NAME Apex Sanitary Landfill
CEC PROJECT NUMBER 100-804
PROJECT LOCATION Amsterdam, OH
DATE STARTED 8/6/12 **COMPLETED** 8/9/12
GROUND ELEVATION 1230.44 ft **HOLE SIZE** 8.25" / 5.88" / 3.88"
DRILLINGCONTRACTOR Terra Testing
TOP OF PVC ELEVATION 1232.94 ft
DRILLING METHOD Hollow Stem Auger & HQ Core
GROUND WATER LEVELS:
LOGGED BY BRB **CHECKED BY** JD
AT END OF DRILLING DRY
LOCATION Northing: 282489.58 Easting: 2411278.05

DEPTH (ft)	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	GRAPHIC LOG	MATERIAL DESCRIPTION	WELL DIAGRAM
0	GB 1			Brown to tan SILT; some clay, some rock fragments, loose, dry **(STRUCTURAL FILL)**	
				note: few inches of mine spoil on top of structural fill	
5				6.0 1224.4	
	GB 2			Gray to dark gray SHALE; rough texture, moderate-hard **(BEDROCK)**	
				7.0 1223.4	Hydrated Bentonite Chips
	RC 1	58 (44)		Gray to brownish-gray LIMESTONE; trace calcite inclusions, very hard, high reaction to HCl **(BEDROCK)**	
10				note: horizontal fracture @ 7.3' and 8.1'	
				note: horizontal fracture w/ brown oxidized staining @ 8.7'	
				note: horizontal fracture @ 9.6'	
				12.5 1217.9	
	RC 2	100 (87)		Gray to dark gray SHALE; some interbedded limestone, rough texture, hard, moderate reaction to HCl **(BEDROCK)**	
15				note: horizontal fracture @ 13.6', 13.7', 14.8', 15.8', 16.2', 18.0', and 19.0'	2-Inch Solid PVC Riser
				18.2 1212.2	
				19.1 Dark gray LIMESTONE; very hard, high reaction to HCl **(BEDROCK)** 1211.3	
20				Dark gray to gray SHALE; some interbedded limestone, highly weathered, rough texture, soft to moderate-hard, moderate reaction to HCl **(BEDROCK)**	
				note: horizontal fracture w/ moderate weathering @ 19.8', 20.2', and 21.1'	
				22.2 1208.2	
				22.5 Dark gray LIMESTONE; very hard, high reaction to HCl **(BEDROCK)** 1207.9	
				NO RECOVERY; assumming highly weathered shale due to drilling observations	
25					Hole Collapse
				26.4 1204.0	
				26.9 Dark gray to gray SHALE; highly weathered, rough texture, soft **(BEDROCK)** 1203.5	
	RC 3	43 (34)		Light gray to gray LIMESTONE; very strong, high reaction to HCl **(BEDROCK)**	
30				note: unable to retrieve 1.5' of limestone from the core barrel (this section of limestone is not included in recovery and RQD calculations)	
				note: horizontal fracture @ 30.1'	
				31.6 1198.8	
				32.5 Interbedded LIMESTONE and SHALE; soft to moderate-hard, moderate reaction to HCl **(BEDROCK)** 1197.9	
				note: horizontal fracture @ 32.2' and 32.4'	
				Dark gray SHALE; some limestone inclusions, rough to smooth texture,	
35	RC	100		35.0 moderate-hard to soft **(BEDROCK)** 1195.4	

P-12S TEMPLATE B-405SR BORING LOG.GPJ GOOD TEMPLATE.GDT 8/14/12

(Continued Next Page)

Civil & Environmental Consultants, Inc.
8740 Orion Place, Suite 100
Columbus, Ohio 43240

BORING NUMBER B-405SR

CLIENT Apex Environmental, LLC **PROJECT NAME** Apex Sanitary Landfill

CEC PROJECT NUMBER 100-804 **PROJECT LOCATION** Amsterdam, OH

DEPTH (ft)	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	GRAPHIC LOG	MATERIAL DESCRIPTION	WELL DIAGRAM
35	4	(94)		Dark gray SHALE; some limestone inclusions, rough to smooth texture, moderate-hard to soft **(BEDROCK)** note: diagonal fracture @ 33.5' 37.5 note: horizontal fracture @ 33.2', 34.3', 35.1', and 36.0' 1192.9 38.0 note: overdrilled borehole w/ 5.88" roller bit to set temporary 4" surface casing 1192.4	Hole Collapse
40	RC 5	100 (100)		Dark gray SHALE; few limestone inclusions, smooth to rough texture, moderate-hard **(BEDROCK)** note: horizontal fracture @ 38.4' and 39.4' note: horizontal fracture w/ moderate weathering @ 40.3' 42.3 1188.1	
45	RC 6	98 (98)		Dark gray SHALE; trace sandstone laminations, trace mica, smooth to rough texture, moderate-hard **(BEDROCK)** note: horizontal fracture @ 43.4' and 44.8' note: diagonal fracture w/ slight weathering @ 44.1' note: horizontal fracture w/ moderate weathering @ 45.6' 47.3 1183.1	2-Inch Solid PVC Riser
50	RC 7	94 (82)		Dark gray SHALE; some sandstone laminations, trace mica, trace limestone inclusions, rough to smooth texture, moderate-hard **(BEDROCK)** note: horizontal fracture @ 47.7', 48.0', 48.8', 50.8', 51.3', and 51.5' 52.3 1178.1	
55	RC 8	98 (94)		Dark gray SHALE; few plant fossils, rough to smooth texture, moderate-hard **(BEDROCK)** note: horizontal fracture w/ moderate weathering @ 52.8' note: horizontal fracture @ 54.7' and 56.7' 57.3 1173.1	Hydrated Bentonite Chips / Pellets
60	RC 9	100 (100)		Dark gray SHALE; few plant fossils, trace calcite inclusions, smooth to rough texture, moderate-hard **(BEDROCK)** note: horizontal fracture w/ slight weathering @ 59.6' and 60.0' 61.4 1169.0	
				Dark gray SILTSTONE; trace calcite inclusions, trace mica, gritty texture, moderate-hard to hard **(BEDROCK)** 62.5 1167.9	
65	RC 10	100 (88)		Dark gray SHALE; some plant fossils, few sandstone laminations, trace limestone inclusions, smooth to rough texture, moderate-hard to hard **(BEDROCK)** note: horizontal fracture @ 62.5', 63.0', 63.1' 64.1', 64.3', 65.5', and 66.7' 67.3 1163.1	
70	RC 11	96 (90)		Dark gray SHALE; some plant fossils, trace sandstone laminations, trace mica, smooth to rough texture, moderate-hard **(BEDROCK)** note: horizontal fracture @ 68.3', 69.0', 69.9', and 70.2' 72.3 1158.1	#3 Filter Sand 0.010-Inch Slotted Screen
75	RC	100		Dark gray to black SHALE; some plant fossils, trace mica, smooth to rough texture, moderate-hard to hard **(BEDROCK)** note: horizontal fracture @ 73.1', 75.2', and 76.5' 75.0 1155.4	

P-12S TEMPLATE B-405SR BORING LOG.GPJ GOOD TEMPLATE.GDT 8/14/12

(Continued Next Page)

Civil & Environmental Consultants, Inc.
8740 Orion Place, Suite 100
Columbus, Ohio 43240

BORING NUMBER B-405SR

CLIENT Apex Environmental, LLC **PROJECT NAME** Apex Sanitary Landfill

CEC PROJECT NUMBER 100-804 **PROJECT LOCATION** Amsterdam, OH

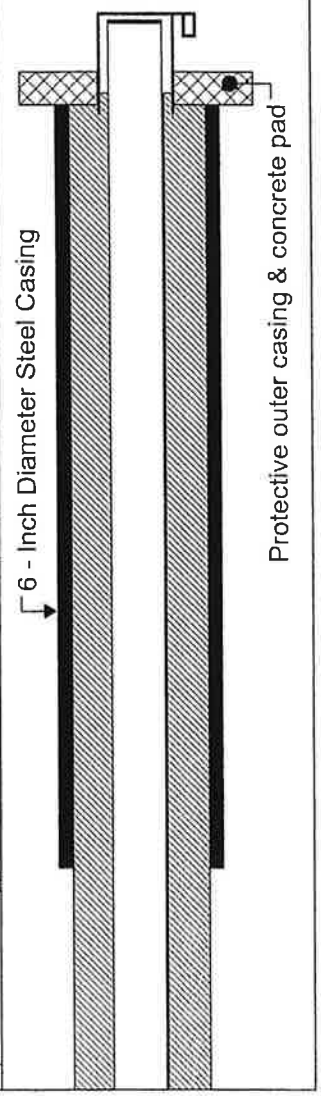
DEPTH (ft)	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	GRAPHIC LOG	MATERIAL DESCRIPTION	WELL DIAGRAM
75	12	(100)		note: horizontal fracture w/ moderate weathering @ 75.6'	0.010-Inch Slotted Screen
				Dark gray to black SHALE; some plant fossils, trace mica, smooth to rough texture, moderate-hard to hard **(BEDROCK)**	
				77.3 1153.1	
				Dark gray to black SHALE; some plant fossils, trace sandstone laminations, trace mica, smooth to rough texture, moderate-hard **(BEDROCK)**	
80	RC 13	100 (86)		note: horizontal fracture @ 77.5', 77.7', 80.1', and 80.4'	#3 Filter Sand
				81.5 1148.9	
				Bottom of hole at 81.5 feet	

Civil & Environmental Consultants, Inc.

Chicago Cincinnati Columbus Export Detroit Indianapolis Nashville Pittsburgh St. Louis

Project Name: Apex Sanitary Landfill Amsterdam, OH	Borehole/Well ID: B-406
	Northing: 283002.51
	Easting: 2411520.65
	Casing Elevation: 1230.13
Project No.: 042-021	Ground Elevation: 1227.47
Date Started: 2-6-08 Completed: 2-8-08	Groundwater Elevation: 1151.79 Date: 3-24-08 Time: 1629
Drilling Company: Duncan Bros. Drilling Inc.	Sample Information: 9 7/8 tri-cone to 37', set 6"steel casing to 37'. NX core from 20'-144'. See boring log B-406S for description from 20'-37'.
Driller: Dave	
CEC Representative: D. Crayne	
Drilling Method: Air Rotary	Comments/Problems: 6" tri-cone to 135' to set well.
Bore Hole: 9 7/8" & 6" Core Size: NX	
Well Installed: ☑	
Screened Interval:	

Sample No./ Core Run	Recovery (feet)	Blow Counts/ RQD	Pocket Pen.	Sample Type	Depth (feet)	Material Description and Comments	Graphic Log	Elevation (feet, msl)	Well Diagram
					-3				
					-1	Ground Surface		1227.5	
					1	brown to gray LEAN CLAY, moist (FILL)			
					3				
					5				
					7				
					9				
					11				
					13				
					15			1211.0	
					17	gray SHALE, very weak, moist			
					19			1207.0	
					21	gray LIMESTONE, non-fractured, strong reaction to HCL. dry		1205.0	
1	2	67%		NX	23				
					25	brown to gray SHALE, moist. Very low recovery because weak shale is blowing out of core barrel.			
2	.8	0%		NX	27				
					29				
					31				
					33				
					35				
					37			1190.0	
					39	brown SANDSTONE, dry			
3	9	41%		NX	41	brown weak SHALE with few siltstone inclusions (1-3 inches thick), weathered to highly weathered, intensely fractured, no reaction to HCL.			
					43				
					45			1181.5	



Civil & Environmental Consultants, Inc.	Project Name: Apex Sanitary Landfill Project No.: 042-021	Borehole/Well ID: B-406

Sample No./ Core Run	Recovery	Blow Counts/ RQD	Pocket Pen.	Sample Type	Depth (feet)	Material Description and Comments	Graphic Log	Elevation (feet, msl)	Well Diagram
4	7.5	36%		NX	48 50 52 54	brown to gray weak SHALE, weathered, intensely fractured, some brown water staining at horizontal fractures at 49, 50, & 51.		1172.5	
5	8.9	55%		NX	56 58 60 62 64	gray weak SHALE, micaceous, laminated, weathered, some brown water staining every foot from 55-64. highly weathered and stained brown from 63-64 and at 66		1163.5	
6	9	70%		NX	66 68 70 72	gray SHALE, moderate strength, micaceous, no reaction to HCL, slightly weathered, slightly fractured brown water staining at fractures at 64, 65, 67, & 69.5			Bentonite Slurry Backfill
7	9	66%		NX	74 76 78 80	brown water staining at 75, 78, & 79			
8	9	70%		NX	82 84 86 88 90	brown water staining at 83 & 88			
9		80%			92 94	brown water staining at 94.5 &			

Civil & Environmental Consultants, Inc.	Project Name: Apex Sanitary Landfill Project No.: 042-021	Borehole/Well ID: B-406

Sample No./ Core Run	Recovery	Blow Counts/ RQD	Pocket Pen.	Sample Type	Depth (feet)	Material Description and Comments	Graphic Log	Elevation (feet, msl)	Well Diagram
9	8.6	80%		NX	97			1129.0	
					99	gray SHALE same as above with some laminated sandstone inclusions.		1127.5	
					101			1126.0	
10	8.3	86%		NX	103	black SHALE, micaceous, intensely fractured.		1124.0	
					105	gray SANDSTONE with some laminated shale, slightly fractured		1122.0	
					107			1119.5	
11	9	100%		NX	109	black SHALE, trace laminated sandstone, intensely fractured, wet			
					111	gray SANDSTONE, strong, trace black bark fossils.			
					113	gray SANDSTONE, trace shale inclusions, massive bedding.			
					115				
					117				
12	9	100%		NX	119				
					121				
					123				
					125				
					127				
13	9.3	65%		NX	129			1097.5	
					131	gray SANDSTONE, highly fractured, brown water staining at fractures, some laminated shale.			
					133				
					135			1091.0	
					137	gray to black weak SHALE, laminated, highly fractured, no reaction to HCL			
14	7.6	44%		NX	139			1087.0	
					141	gray weak LIMESTONE, moderate fractured, strong reaction to HCL.			
					143	BOB = 144 feet		1083.5	

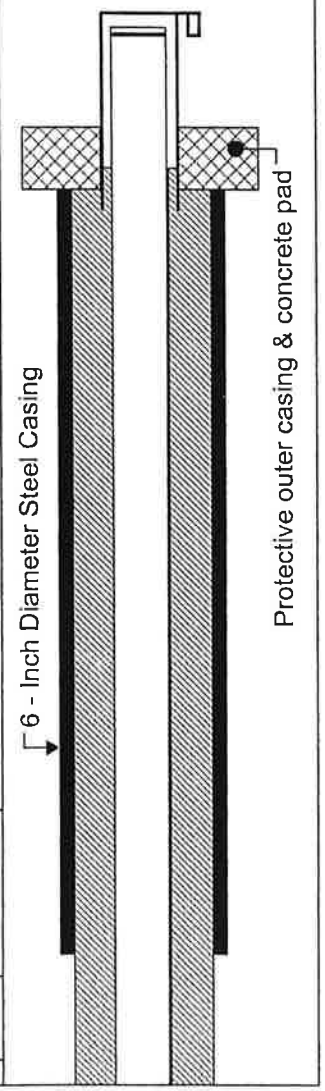
Bentonite Slurry Backfill
#5 Silica Sand Pack
Hole Collapse
Bentonite Chips
2" Slot 10 Well Screen

Civil & Environmental Consultants, Inc.

Chicago Cincinnati Columbus Export Detroit Indianapolis Nashville Pittsburgh St. Louis

Project Name: Apex Sanitary Landfill Amsterdam, OH	Borehole/Well ID: B-406S
	Northing: 282995.2
	Easting: 2411518.19
	Casing Elevation: 1230.24
Project No.: 042-021	Ground Elevation: 1227.54
Date Started: 2-12-08 Completed: 2-12-08	Groundwater Elevation: 1178.68 Date: 3-24-08 Time: 1112
Drilling Company: Duncan Bros. Drilling Inc.	Sample Information: 9 7/8 tri-cone to 20', set 6"steel casing to 20'. NX core from 20'-38'. 6 inch tri-cone from 38'-67'.
Driller: Dave	
CEC Representative: D. Crayne	
Drilling Method: Air Rotary	Comments/Problems: Description taken from boring B-406 for 38-73'.
Bore Hole: 9 7/8" & 6" Core Size: NX	
Well Installed: ☑	
Screened Interval:	

Sample No./ Core Run	Recovery (feet)	Blow Counts/ RQD	Pocket Pen.	Sample Type	Depth (feet)	Material Description and Comments	Graphic Log	Elevation (feet, msl)	Well Diagram
					-3				
					-1	Ground Surface		1227.5	
					1	brown to gray LEAN CLAY, moist (FILL)			
					3				
					5				
					7				
					9				
					11				
					13				
					15				
					17	gray SHALE, very weak, moist. logged cuttings		1211.0	
					19			1207.0	
					21	gray LIMESTONE, non-fractured, strong reaction to HCL. dry		1205.0	



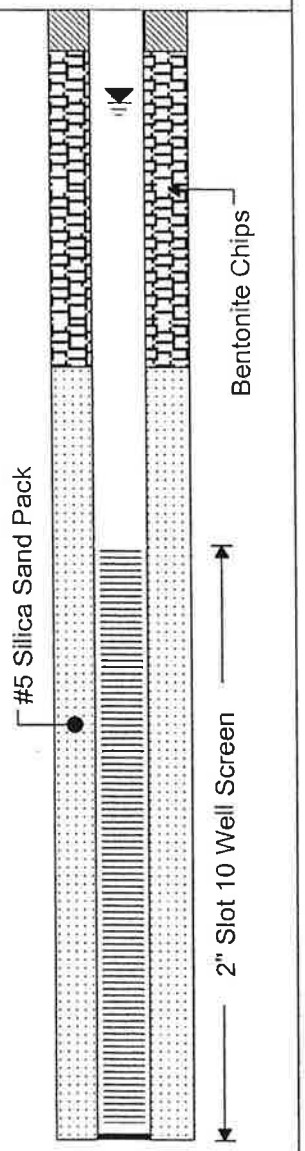
Civil & Environmental Consultants, Inc.	Project Name: Apex Sanitary Landfill Project No.: 042-021	Borehole/Well ID: B-406S

Sample No./ Core Run	Recovery	Blow Counts/ RQD	Pocket Pen.	Sample Type	Depth (feet)	Material Description and Comments	Graphic Log	Elevation (feet, msl)	Well Diagram
1	2	67%		NX	24	brown to gray SHALE, moist. Very low recovery because weak shale is blowing out of core barrel.			
					26				
					28				
					30				
2	.8	0%		NX	32				
					34				
					36				
					38	brown SANDSTONE, dry		1190.0 1189.5	
						brown weak SHALE with few siltstone inclusions (1-3 inches thick), weathered to highly weathered, intensely fractured, no reaction to HCL.			
3	9	41%		NX	40				
					42				
					44				
					46			1181.5	
					48				

Bentonite Slurry Backfill

Civil & Environmental Consultants, Inc.	Project Name: Apex Sanitary Landfill Project No.: 042-021	Borehole/Well ID: B-406S

Sample No./ Core Run	Recovery	Blow Counts/ RQD	Pocket Pen.	Sample Type	Depth (feet)	Material Description and Comments	Graphic Log	Elevation (feet, msl)	Well Diagram
4	7.5	36%		NX	50 52 54	brown to gray weak SHALE, weathered, intensely fractured, some brown water staining at horizontal fractures at 49, 50, & 51.		1172.5	
5	8.9	55%		NX	56 58 60 62 64	gray weak SHALE, micaceous, laminated, weathered, some brown water staining every foot from 55-64. highly weathered and stained brown from 63-64 and at 66		1163.5	
6	9	70%		NX	66 68 70 72	gray SHALE, moderate strength, micaceous, no reaction to HCL, slightly weathered, slightly fractured Used 6 inch tri-cone to drill to 67 feet and set 406S. Description taken from B-406 BOB = 67 feet for B-406S.		1154.5	



CIVIL & ENVIRONMENTAL CONSULTANTS, INC

8740 Orion Pl., Suite 100
Columbus, OH 43240

Phone 614-540-6633 Fax 614-540-6638

BOREHOLE LOG

BOREHOLE/WELL NO.: B-407

TOTAL DEPTH (BGS): 150 feet

PROJECT INFORMATION

PROJECT:	Apex Sanitary Landfill
SITE LOCATION:	Amsterdam, OH
PROJECT NO.:	042-021
FIELD GEOLOGIST:	D. Crayne
DATES DRILLED:	7/18/06

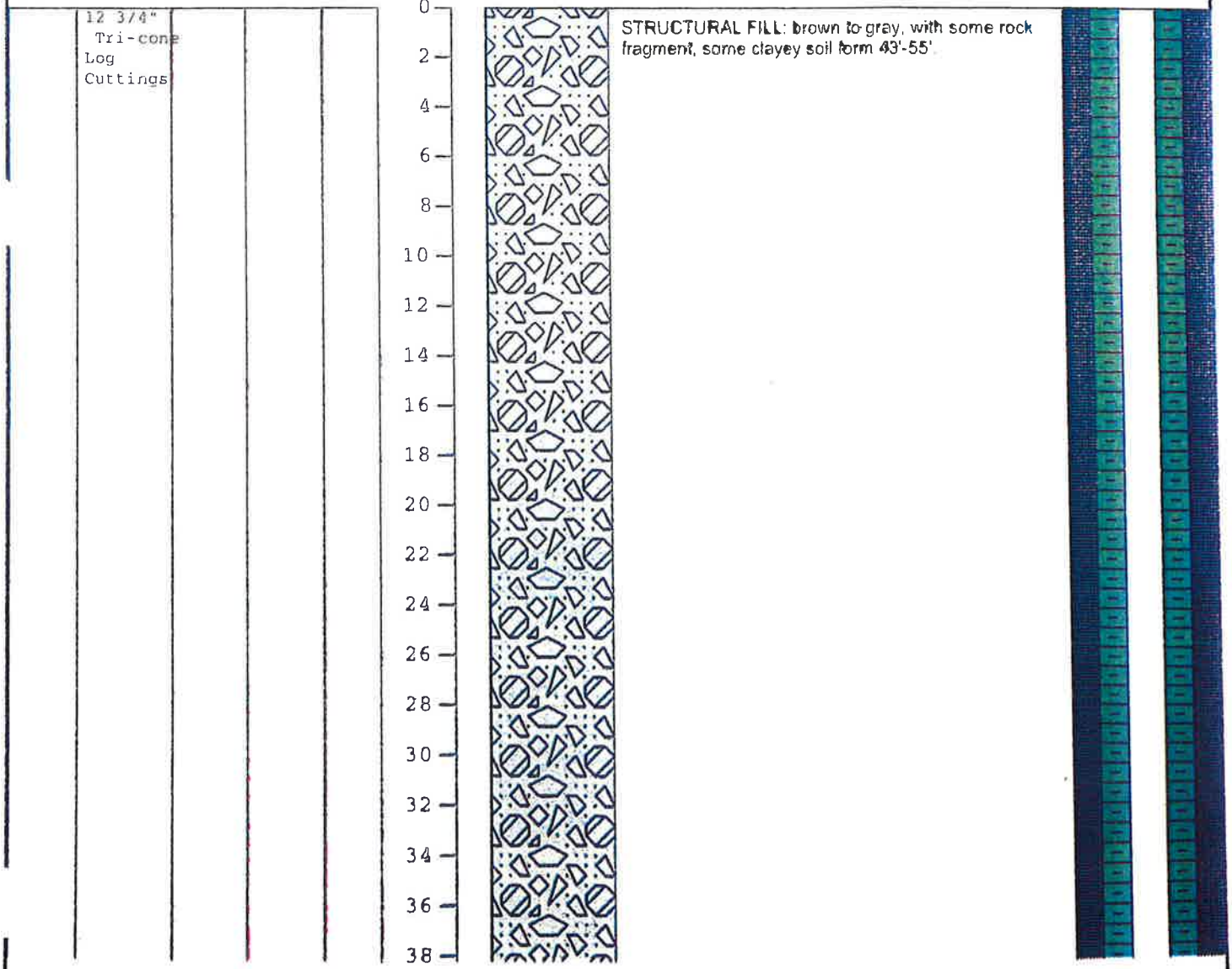
DRILLING INFORMATION

DRILLING CO./DRILLER:	Duncan Bros. Drilling Inc.
DRILLING RIG/METHOD:	Air Rotary / NX Air Core
BOREHOLE DIAMETER:	12 3/4" & 6 1/8" Tri-cone Bits
WELL DIAMETER:	2"
GROUND/TOC ELEVATION:	1233.15 / 1235.74ft amsl

⧖ Water level during drilling

⧖ Water Level After Development

SAMPLE/ CORE NO.	SAMPLE INTERVAL	SAMPLE RECOVERY (ft, in")	RQD (%)	%Recovery	DEPTH	SOIL SYMBOLS	LITHOLOGY	WELL COMPLETION
	12 3/4" Tri-cone Log Cuttings				0		STRUCTURAL FILL: brown to gray, with some rock fragment, some clayey soil form 43'-55'.	



OBSERVATIONS:
12 3/4" Reamer Tri-cone to 80' set 7" casing. 6 1/8" Tri-cone to 90'. Core from 90' to 150'.

SAMPLE/ CORE NO.	SAMPLE INTERVAL	SAMPLE RECOVERY (ft' in")	RQD (%)	%Recovery	DEPTH	SOIL SYMBOLS	LITHOLOGY	WELL COMPLETION
					40			
					42			
					44			
					46			
					48			
					50			
					52			
					54			
					56			
					58			
					60		SHALE: & SILTSTONE, contact estimated because of drilling with 12 3/4" reamer tri-cone bit. Could not set casing in very soft material at base of structural fill.	
					62			
					64			
					66			
					68			
					70			
					72			
					74			
					76		SANDSTONE: brown, more competent rock, set casing to 79.5'	
					78			
	6 1/8" Tri-cone Log Cuttings				80		SANDSTONE: gray fine to grained with some black shale cuttings.	
					82			
					84			
					86			
					88			
CR#1	90'-100'	9'10"	92%	98%	90		SANDSTONE: gray fine to medium grained, black thinly laminated shale @ 99', brown staining @ 90' and 91.5' in horizontal fractures.	
					92			
					94			

OBSERVATIONS:
12 3/4" Reamer Tri-cone to 80' set 7" casing. 6 1/8" Tri-cone to 90'. Core from 90' to 150'.

SAMPLE/ CORE NO.	SAMPLE INTERVAL	SAMPLE RECOVERY (ft' in")	RQD (%)	%Recovery	DEPTH	SOIL SYMBOLS	LITHOLOGY	WELL COMPLETION
CR#2	100'-110'	10'	87%	100%	96–150		SANDSTONE: SAA, black shale @ 100.5' and 106', picked up water during coring 100'-110'	
CR#3	110'-120'	9'11"	81%	99%			SANDSTONE: SAA, un-fractured from 110'-116'.5 black coal stringers at 120'	
CR#4	120'-130'	10'2"	52%	102%			SANDSTONE: SAA, black SHALE from 122.5'-123', micaceous, seepage.	
CR#5	130'-140'	10'1"	74%	101%			SANDSTONE: SAA, some black laminated shale and coal stringers, moderately fractured.	
CR#6	140'-150'	9'8"	83%	97%			SHALE: gray, highly fractured SANDSTONE: gray fine to medium grained, trace laminated shale. SILTSTONE: gray, medium hard moderately fractured.	

OBSERVATIONS:
12 3/4" Reamer Tri-cone to 80' set 7" casing. 6 1/8" Tri-cone to 90'. Core from 90' to 150'.

WELL CONSTRUCTION LOG

PROJECT	PROJECT NUMBER	
Apex Sanitary Landfill	042-021	B-407

COORDINATES	GROUND SURFACE ELEVATION	TOP OF PVC ELEVATION
N 283612.12 E 2411818.30	1233.15 feet amsl	1235.74 feet amsl

CITY & STATE:
Amsterdam, OH
COUNTY: Jefferson County

INSTALLATION DATE:
7/18/06

DRILLING METHOD: Air Rotary / NX Air Core

DRILLING CONTRACTOR:
Duncan Bros. Drilling Inc.

DELEVOPED BY: DWC/JK

DATE: 8/16/06

DEVELOPMENT TECHNIQUE(S):
Grundfos Pump and SS Bailer

WATER REMOVED DURING DEVELOPMENT:
22 gallons

Depth to WATER: 95.09 feet

SOUNDED DEPTH FROM TOC:
137.55 feet

SCREENED INTERVAL ELEVATION: '- '

COMMENTS: 12 3/4" Reamer Tri-cone to 80' set 7" casing. 6 1/8" Tri-cone to 90'. Core from 90' to 150'.

12 3/4" Borehole Diameter

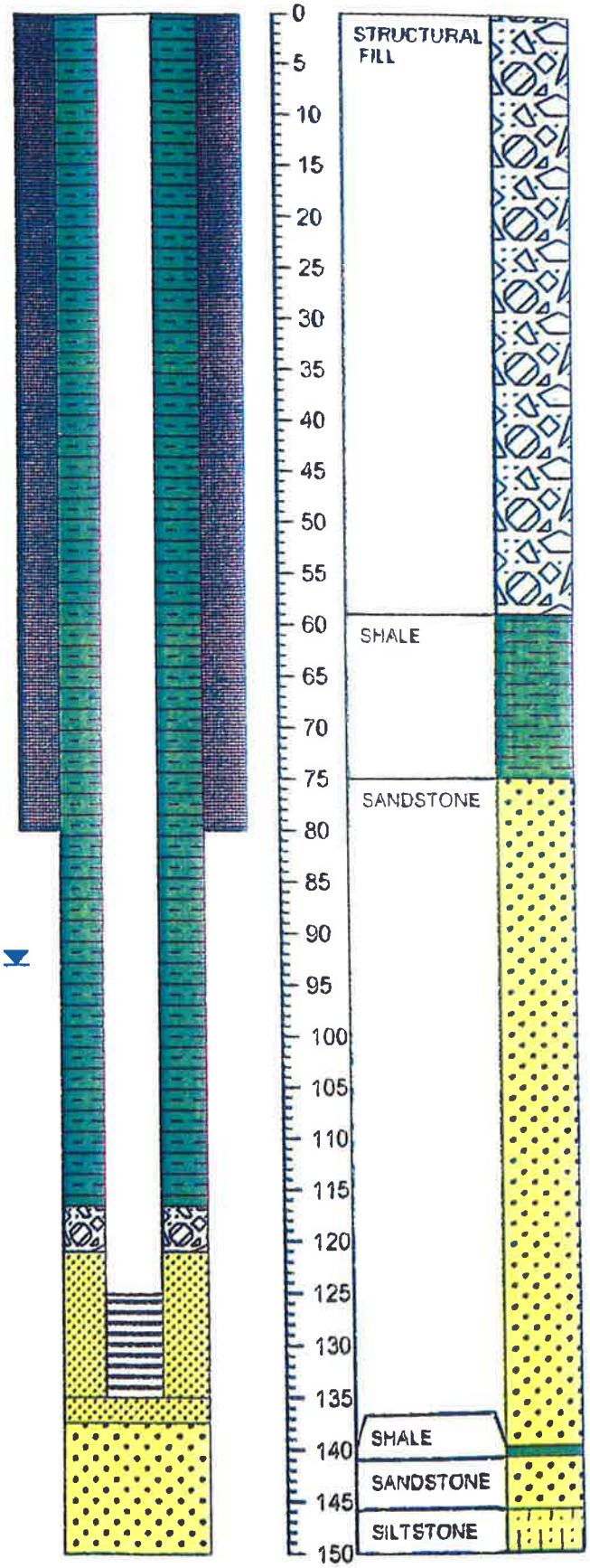
7" Surface Casing to 80'

6" Borehole Diameter Sealed using bentonite clay slurry

2" Well Diameter

Hole Plug

No. 4 Fine Sand



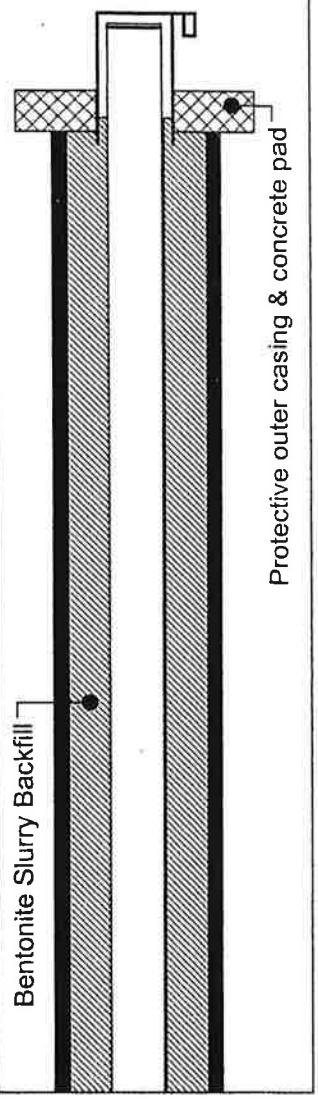
CIVIL & ENVIRONMENTAL CONSULTANTS, INC.

Civil & Environmental Consultants, Inc.

Chicago Cincinnati Columbus Export Detroit Indianapolis Nashville Pittsburgh St. Louis

Project Name: Apex Sanitary Landfill Amsterdam, OH	Borehole/Well ID: B-407S
	Northing: 283619.69
	Easting: 2411822.89
	Casing Elevation: 1235.24
Project No.: 042-021	Ground Elevation: 1232.74
Date Started: 7-16-07 Completed: 7-16-07	Groundwater Elevation: DRY Date: Time:
Drilling Company: Duncan Bros. Drilling Inc.	Sample Information: 9 7/8 tri-cone to 59', set 7" temporary steel casing. PQ core from 59'-72'
Driller: Dave	
CEC Representative: D. Crayne	
Drilling Method: Air Rotary	Comments/Problems:
Bore Hole: 9 7/8 & 6 1/8 Core Size: PQ	
Well Installed: ☑	
Screened Interval:	

Sample No./ Core Run	Recovery (feet)	Blow Counts/ RQD	Pocket Pen.	Sample Type	Depth (feet)	Material Description and Comments	Graphic Log	Elevation (feet, msl)	Well Diagram
					-3				
					-1	Ground Surface		1232.7	
					1	FILL brown to gray LEAN CLAY, some shale fragments, few small boulders,dry			
					3				
					5				
					7				
					9				
					11				
					13				
					15				
					17				
					19				
					21				
					23				
					25				
					27				
					29				
					31				
					33				
					35				



Civil & Environmental Consultants, Inc.	Project Name: Apex Sanitary Landfill Project No.: 042-021	Borehole/Well ID: B-407S

Sample No./ Core Run	Recovery	Blow Counts/ RQD	Pocket Pen.	Sample Type	Depth (feet)	Material Description and Comments	Graphic Log	Elevation (feet, msl)	Well Diagram
					37 39 41 43 45 47 49 51 53 55 57 59	FILL brown to gray LEAN CLAY, some shale fragments, few small boulders,dry		1172.7	7 - Inch Diameter Temporary Steel Casing Bentonite Chips
1	4	0%		PQ	61	brown LEAN CLAY, trace sand, low plasticity, moist, gray mottling from 62-63.		1169.7	Silica Sand Pack
					63	brown-gray SHALE, highly weathered, moist		1168.7	
2	3.5	0%		PQ	65 67	brown SILTSTONE, some sandstone lenses, few clay at fractures, trace black oxidation at fractures		1163.7	Bentonite Chips 2" Slot 10 Well Screen
3	2.5	0%		PQ	69 71	gray SANDSTONE, brown staining at fractures, trace plant fossils BOB = 72 feet		1160.7	
					73				

CIVIL & ENVIRONMENTAL CONSULTANTS, INC

8740 Orion Pl., Suite 100
Columbus, OH 43240

Phone 614-540-6633 Fax 614-540-6638

BOREHOLE LOG

BOREHOLE/WELL NO.: B-408

TOTAL DEPTH (BGS): 138 feet

PROJECT INFORMATION

PROJECT:	Apex Sanitary Landfill
SITE LOCATION:	Amsterdam, OH
PROJECT NO.:	042-021
FIELD GEOLOGIST:	D. Crayne
DATES DRILLED:	7/20/06

DRILLING INFORMATION

DRILLING CO./DRILLER:	Duncan Bros. Drilling Inc.
DRILLING RIG/METHOD:	Air Rotary / NX Air Core
BOREHOLE DIAMETER:	9 7/8" & 6 1/8" Tri-cone Bits
WELL DIAMETER:	2"
GROUND/TOC ELEVATION:	1238.07 / 1240.71ft amsl

▽ Water level during drilling ▼ Water Level After Development

SAMPLE/ CORE NO.	SAMPLE INTERVAL	SAMPLE RECOVERY (ft, in")	RQD (%)	%Recovery	DEPTH	SOIL SYMBOLS	LITHOLOGY	WELL COMPLETION
	9 7/8" Tri-cone Log Cuttings				0		STRUCTURAL FILL: brown to gray, frequent boulders.	
					2			
					4			
					6			
					8		SILTY CLAY: residual soil, with some rock fragments.	
					10			
					12		Structural fill?	
					14			
					16			
					18			
					20			
					22			
					24			
					26		SHALE: gray, picked up water at 30', set 7" casing to 33' to seal off water.	
					28			
					30			
					32			
	6 1/8" Tri-cone				34			

OBSERVATIONS:
9 7/8" Reamer Tri-cone to 33' set 7" casing. 6 1/8" Tri-cone to 99'. Core from 99' to 138'.

SAMPLE/ CORE NO.	SAMPLE INTERVAL	SAMPLE RECOVERY (ft, in)	RQD (%)	%Recovery	DEPTH	SOIL SYMBOLS	LITHOLOGY	WELL COMPLETION
	Log Cuttings				36		SILTSTONE: gray, medium soft, moderately fractured some clay at fractures, no oxidation. Rock description from 35'-60' taken from coring B-408S.	
					38			
					40			
					42		SILTSTONE: gray weak siltstone with some medium interbeds of gray fine to medium grained sandstone. brown oxidized horizontal fractures at 43.5'	
					44			
					46		SILTSTONE: gray weak siltstone with brown oxidized fractures from 45'-49'	
					48			
					50		SANDSTONE: gray, hard, fine grained sandstone with laminated shale. Slight oxidation from 51'-52'.	
					52		SHALE: moderately hard, gray, with little laminated fine grained sandstone. No oxidation at fractures.	
					54			
					56			
					58		SANDSTONE: hard gray, fine grained sandstone with laminated shale, no oxidation at fractures, hole still drilling dry.	
					60		SANDSTONE: brown to gray, picks up a little moisture at 74'-78'	
					62			
					64			
					66			
					68			
					70			
					72			
					74			
					76			
					78			
					80			
					82			
					84			
					86			

OBSERVATIONS:
9 7/8" Reamer Tri-cone to 33' set 7" casing. 6 1/8" Tri-cone to 99'. Core from 99' to 138'.

SAMPLE/ CORE NO.	SAMPLE INTERVAL	SAMPLE RECOVERY (FEET, IN.")	RQD (%)	%Recovery	DEPTH	SOIL SYMBOLS	LITHOLOGY	WELL COMPLETION
CR#1	99' - 109'	10'	74%	100%	88 90 92 94 96 98 100 102 104 106 108		SANDSTONE: gray, fine to medium grained, some laminated shale. 2" thick coal seam at 108.5'. Water stained fractures at 99.5' and 102'	
CR#2	109' - 119'	9'8"	47%	97%	110 112		SHALE: gray to black, highly fractured.	
					114 116		SANDSTONE: gray, with some laminated shale, moderately fractured.	
CR#3	119' - 128'	9'1"	51%	101%	118 120 122 124 126		SANDSTONE: gray, fine to medium grained, some inclusions of black shale and dark gray sandstone, highly fractured from 120'-121', 122'-124.5', and 125'-126.5'. Producing a lot of water (approx. 8 gpm) during drilling.	
CR#4	128' - 138'	9'6"	95%	95%	128 130 132 134 136 138		SANDSTONE: gray fine to medium grained, with little laminated shale, micaceous, slightly fractured.	

OBSERVATIONS:
9 7/8" Reamer Tri-cone to 33' set 7" casing. 6 1/8" Tri-cone to 99'. Core from 99' to 138'.

WELL CONSTRUCTION LOG

PROJECT	PROJECT NUMBER	
Apex Sanitary Landfill	042-021	B-408

COORDINATES	GROUND SURFACE ELEVATION	TOP OF PVC ELEVATION
N 284104.43 E 2412045.93	1238.07 feet amsl	1240.71 feet amsl

CITY & STATE:
Amsterdam, OH
COUNTY: Jefferson County

INSTALLATION DATE:
7/20/06

DRILLING METHOD: Air Rotary / NX Air Core

DRILLING CONTRACTOR:
Duncan Bros. Drilling Inc.

DELEVOPED BY: DWC/JK
DATE: 8/16/06

DEVELOPMENT TECHNIQUE(S):
Grundfos Pump and SS Bailer

WATER REMOVED DURING DEVELOPMENT:
87 gallons

Depth to WATER: 98.26 feet

SOUNDED DEPTH FROM TOC:
131.95 feet

SCREENED INTERVAL ELEVATION: '- '

COMMENTS: 9 7/8" Reamer Tri-cone to 33' set 7" casing. 6 1/8" Tri-cone to 99'. Core from 99' to 138'.

9 7/8" Borehole Diameter

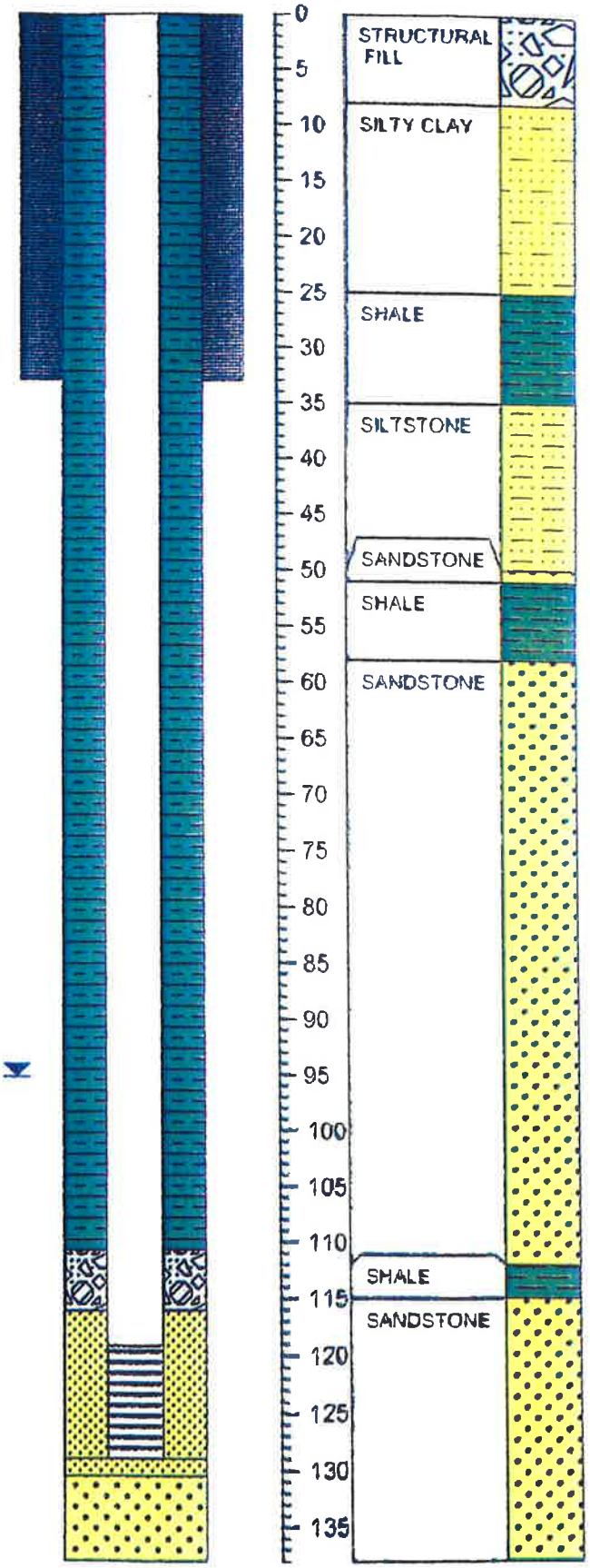
7" Surface Casing to 33'

6" Borehole Diameter Sealed using bentonite clay slurry

2" Well Diameter

Hole Plug

No. 4 Fine Sand



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BOREHOLE LOG

BOREHOLE/WELL NO.: **B-408S**

TOTAL DEPTH (BGS): **60 feet**

PROJECT INFORMATION

PROJECT:	Apex Sanitary Landfill
SITE LOCATION:	Amsterdam, OH
PROJECT NO.:	042-021
FIELD GEOLOGIST:	D. Crayne
DATES DRILLED:	7/31/06

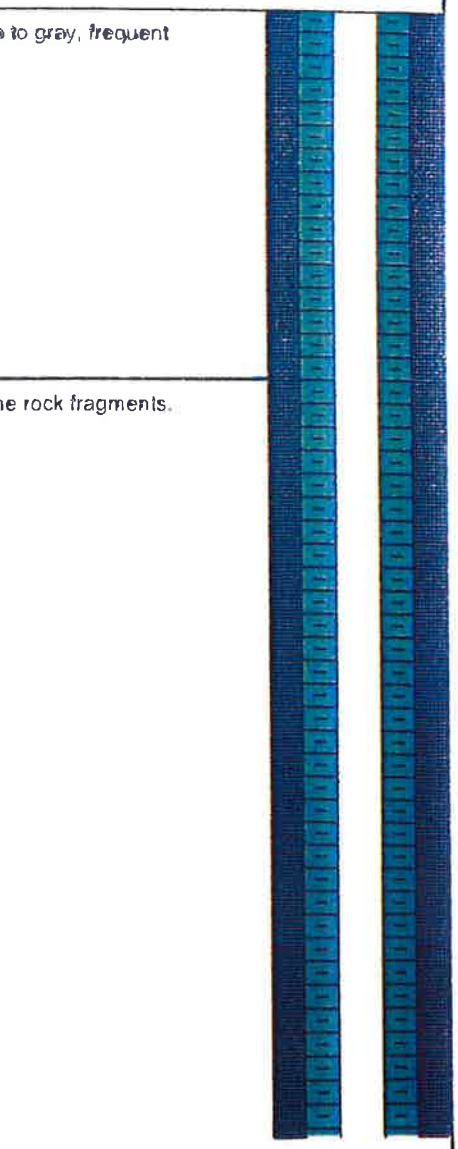
DRILLING INFORMATION

DRILLING CO./DRILLER:	Duncan Bros. Drilling Inc.
DRILLING RIG/METHOD:	Air Rotary
BOREHOLE DIAMETER:	9 7/8" & 6 1/8" Tri-cone Bits
WELL DIAMETER:	2"
GROUND/TOC ELEVATION:	1238.80 / 1241.40ft amsl

▼ Water level during drilling

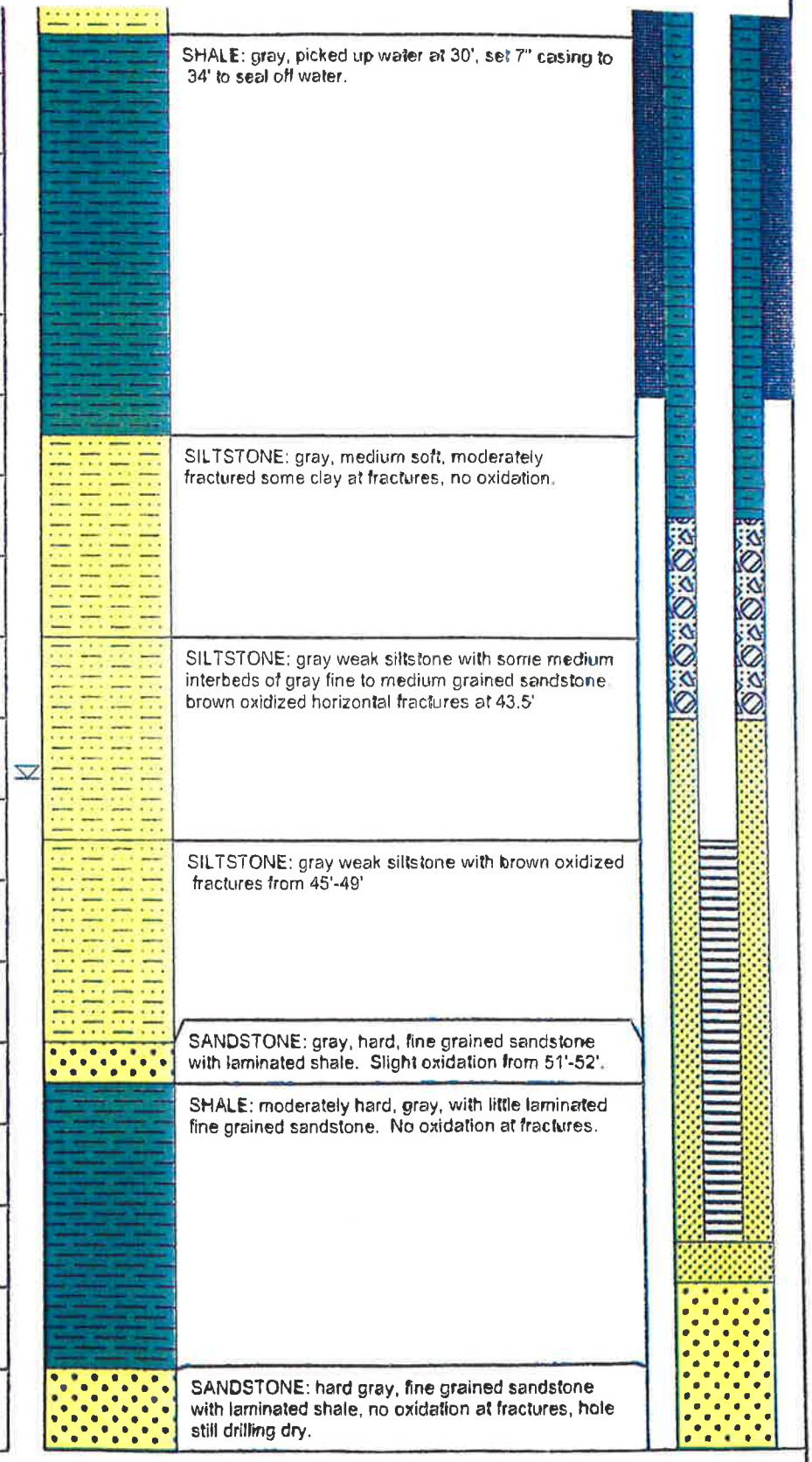
▼ Water Level After Development

SAMPLE/ CORE NO.	SAMPLE INTERVAL	SAMPLE RECOVERY (ft, in")	RQD (%)	%Recovery	DEPTH	SOIL SYMBOLS	LITHOLOGY	WELL COMPLETION
	9 7/8" Tri-cone Log Cuttings				0		STRUCTURAL FILL: brown to gray, frequent boulders.	
					2			
					4			
					6			
					8		SILTY CLAY: soil, with some rock fragments.	
					10			
					12			
					14			
					16			
					18			
					20			
					22			
					24			



OBSERVATIONS:
9 7/8" Reamer Tri-cone to 34' set 7" casing. 6 1/8" Tri-cone to 35'. Core from 35' to 60'.

SAMPLE/ CORE NO.	SAMPLE INTERVAL	SAMPLE RECOVERY (ft' in")	RQD (%)	%Recovery
	6 1/8" Tri-cone Log Cuttings			
CR#1	35'-40'	4'4"	25%	87%
CR#2	40'-45'	4'8"	34%	93%
CR#3	45'-50'	3'7"	37%	72%
CR#4	50'-60'	8'9"	55%	88%



OBSERVATIONS:
9 7/8" Reamer Tri-cone to 34' set 7" casing. 6 1/8" Tri-cone to 35'. Core from 35' to 60'.

Borehole/Well No. B-408S
Project No. 042-021

WELL CONSTRUCTION LOG

PROJECT	PROJECT NUMBER	
Apex Sanitary Landfill	042-021	B-408S

COORDINATES	GROUND SURFACE ELEVATION	TOP OF PVC ELEVATION
N 284113.85 E 2412045.35	1238.80 feet amsl	1241.40 feet amsl

CITY & STATE:
Amsterdam, OH

COUNTY: Jefferson County

INSTALLATION DATE:
7/31/06

DRILLING METHOD: Air Rotary / NX Air Core

DRILLING CONTRACTOR:
Duncan Bros. Drilling Inc.

DELEVOPED BY: DWC/JK

DATE: 8/16/06

DEVELOPMENT TECHNIQUE(S):
SS Bailer

WATER REMOVED DURING DEVELOPMENT:
10 gallons

Depth to WATER: 45.69'

SOUNDED DEPTH FROM TOC:
57.91 feet

SCREENED INTERVAL ELEVATION: '-'

COMMENTS: 9 7/8" Reamer Tri-cone to 34' set 7" casing. 6 1/8" Tri-cone to 35'. Core from 35' to 50'.

9 7/8" Borehole Diameter

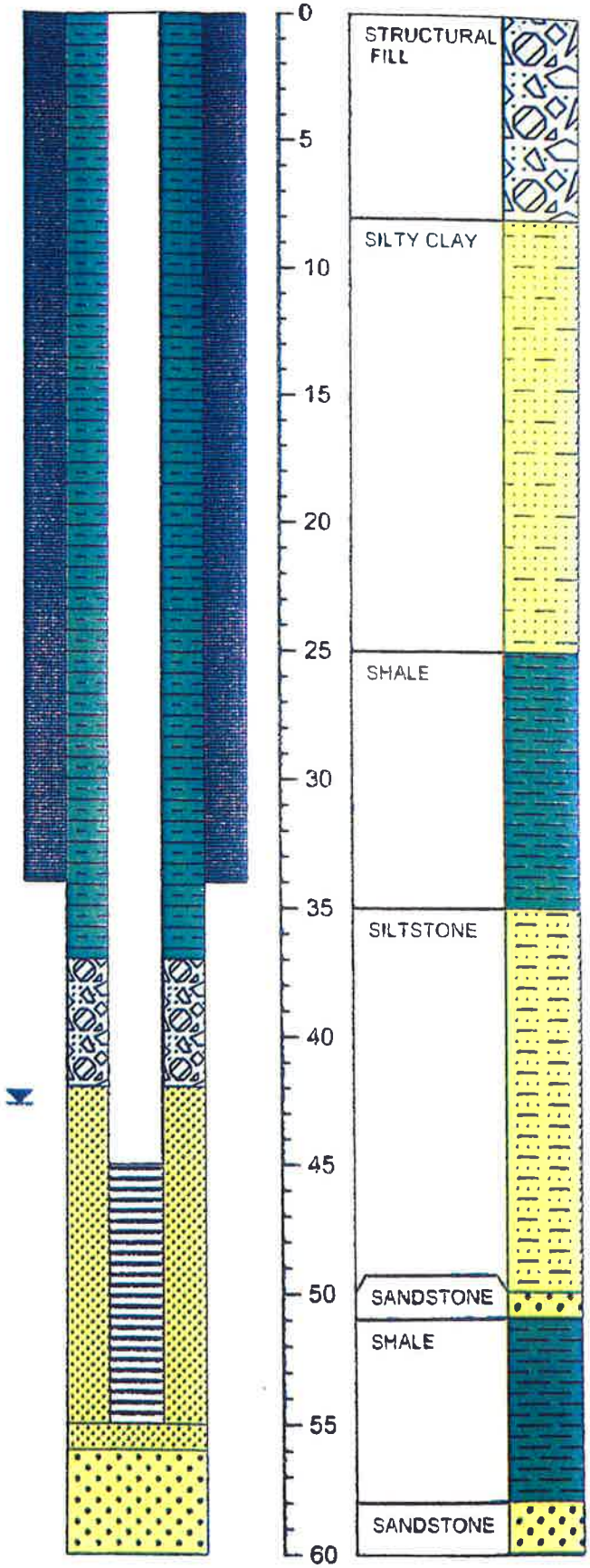
6" Borehole Diameter
Sealed using bentonite clay slurry

7" Surface Casing to 34'

Hole Plug

2" Well Diameter

No. 4 Fine Sand



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BOREHOLE LOG

BOREHOLE/WELL NO.: **B-408A**

TOTAL DEPTH (BGS): **32 feet**

PROJECT INFORMATION

PROJECT:	**Apex Sanitary Landfill**
SITE LOCATION:	**Amsterdam, OH**
PROJECT NO.:	**042-021**
FIELD GEOLOGIST:	**D. Crayne**
DATES DRILLED:	**8/1/06**

DRILLING INFORMATION

DRILLING CO./DRILLER:	**Duncan Bros. Drilling Inc.**
DRILLING RIG/METHOD:	**Air Rotary**
BOREHOLE DIAMETER:	**6 1/8" Tri-cone Bit**
WELL DIAMETER:	**2"**
GROUND/TOC ELEVATION:	**1238.80 / 1241.37 ft amsl**

⧗ Water level during drilling

⧗ Water Level After Development

SAMPLE/ CORE NO.	SAMPLE INTERVAL	SAMPLE RECOVERY (ft, in")	RQD (%)	%Recovery	DEPTH	SOIL SYMBOLS	LITHOLOGY	WELL COMPLETION
	log cuttings				0		STRUCTURAL FILL: brown to gray, some boulders.	
					2			
					4			
					6			
					8			
					10			
					12			
					14			
					16			
					18			
					20			
					22	⧗		
					24			
					26		SHALE: brown to gray. slightly wet at 27 feet.	
					28			
					30			
					32			

OBSERVATIONS:

WELL CONSTRUCTION LOG

PROJECT	PROJECT NUMBER	
Apex Sanitary Landfill	042-021	B-408A

COORDINATES	GROUND SURFACE ELEVATION	TOP OF PVC ELEVATION
N 284123.40 E 2412042.73	1238.80 feet amsl	1241.37 feet amsl

CITY & STATE:
Amsterdam, OH

COUNTY: Jefferson County

INSTALLATION DATE:
8/1/2006

DRILLING METHOD: 6 1/8"
Tri-cone w/ Air Rotary

DRILLING CONTRACTOR:
Duncan Bros. Drilling Inc.

DELEVOPED BY: DWC/JK

DATE: 8/1/06 & 8/16/06

DEVELOPMENT TECHNIQUE(S):
SS Bailer

WATER REMOVED DURING DEVELOPMENT:
10 gallons

Depth to WATER: 26.90 feet

SOUNDED DEPTH FROM TOC:
32.82 feet

SCREENED INTERVAL ELEVATION: '-'

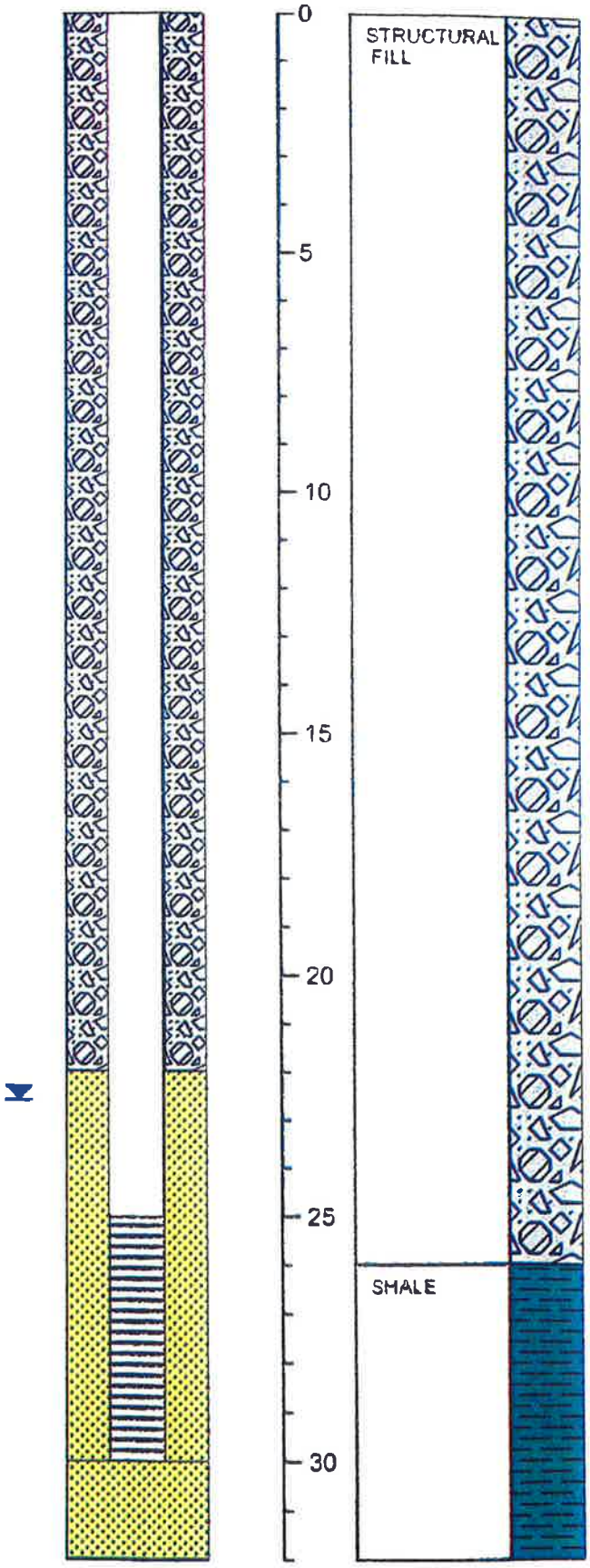
COMMENTS:

Hole Plug

6" Borehole Diameter

2" Well Diameter

No. 4 Fine Sand



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BOREHOLE LOG

BOREHOLE/WELL NO.: **B-409**

TOTAL DEPTH (BGS): **127.5 feet**

PROJECT INFORMATION

PROJECT:	**Apex Sanitary Landfill**
SITE LOCATION:	**Amsterdam, OH**
PROJECT NO.:	**042-021**
FIELD GEOLOGIST:	**D. Crayne**
DATES DRILLED:	**7/24/06**

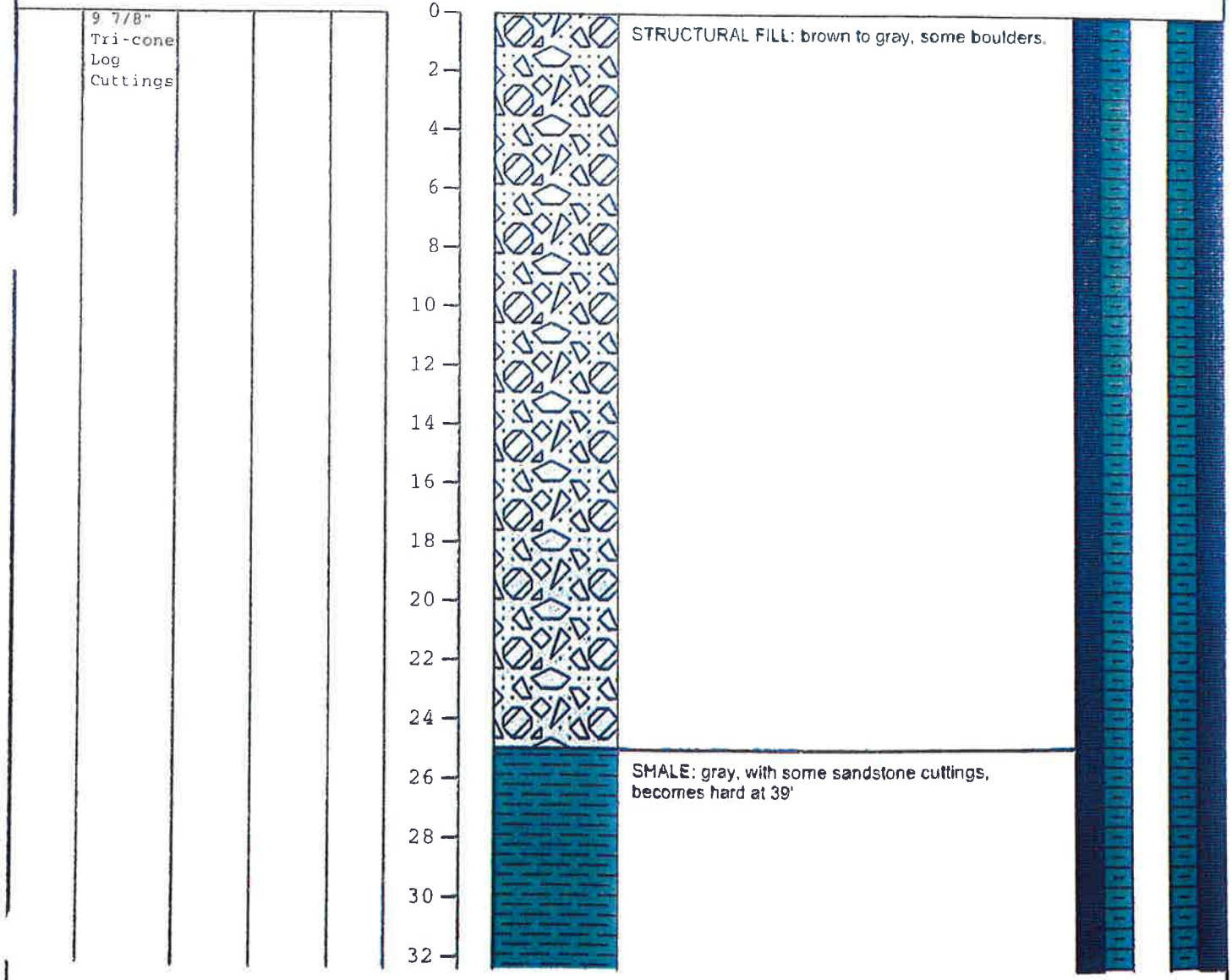
DRILLING INFORMATION

DRILLING CO./DRILLER:	**Duncan Bros. Drilling Inc.**
DRILLING RIG/METHOD:	**Air Rotary / NX Air Core**
BOREHOLE DIAMETER:	**9 7/8" & 6 1/8" Tri-cone Bits**
WELL DIAMETER:	**2"**
GROUND/TOC ELEVATION:	**1245.12 / 1247.57 ft amsl**

⧗ Water level during drilling

⧗ Water Level After Development

SAMPLE/ CORE NO.	SAMPLE INTERVAL	SAMPLE RECOVERY (ft, in")	RQD (%)	%Recovery	DEPTH	SOIL SYMBOLS	LITHOLOGY	WELL COMPLETION
	9 7/8" Tri-cone Log Cuttings				0		STRUCTURAL FILL: brown to gray, some boulders.	
					24		SHALE: gray, with some sandstone cuttings, becomes hard at 39'	
					32			



OBSERVATIONS:

9 7/8" Reamer Tri-cone to 39.5' set 7" casing. 6 1/8" Tri-cone to 90'. Core from 90' to 127.5'.

SAMPLE/ CORE NO.	SAMPLE INTERVAL	SAMPLE RECOVERY (ft' in")	RQD (%)	%Recovery	DEPTH	SOIL SYMBOLS	LITHOLOGY	WELL COMPLETION
	6 1/8" Tri-cone Log Cuttings				34 36 38 40 42 44 46 48 50 52 54 56 58 60 62 64 66 68 70 72 74 76 78 80		SILTSTONE: gray, medium soft, near vertical fracture at 42.5'-43' with brown oxidation. Rock description from 40'-68' from boring B-409S SHALE: very little recovery, pulverizing soft black shale during coring from 43'-50' SHALE: black, highly fractured, little coal stringers at 56', no oxidation at fractures, still drilling dry. SILTSTONE: gray, medium soft, moderately fractured, slightly micaceous, boring still dry. SANDSTONE: Gray, turns brown denoting water at 74' and 80'	

OBSERVATIONS:
9 7/8" Reamer Tri-cone to 39.5' set 7" casing. 6 1/8" Tri-cone to 90'. Core from 90' to 127.5'.

SAMPLE/ CORE NO.	SAMPLE INTERVAL	SAMPLE RECOVERY (ft' in")	RQD (%)	%Recovery	DEPTH	SOIL SYMBOLS	LITHOLOGY	WELL COMPLETION
CR#1	90'-100'	9'10"	25%	98%	82, 84, 86, 88, 90, 92, 94, 96, 98, 100		SANDSTONE: gray to black, with some shale, intensely fractured, micaceous, dry, no staining or oxidation.	
							SANDSTONE: gray with some laminated shale, moderately fractured, micaceous shale.	
CR#2	100'-109.5'	8'4"	53%	88%	100, 102, 104, 106, 108		SHALE: black, with some laminated gray sandstone, highly fractured.	
							SANDSTONE: gray fine to medium grained, some laminated shale at fractures, brown water staining from 104'-105', with 6" near vertical fracture.	
CR#3	109.5'-118.5'	8'3"	93%	92%	110, 112, 114, 116, 118		SANDSTONE: gray, with brown water staining at horizontal fracture.	
							SANDSTONE: gray fine to medium grained with little inclusions of brown sandstone, almost unfractured.	
CR#4	118.5'-127.5'	10'2"	98%	113%	120, 122, 124, 126		SANDSTONE: gray fine to medium grained, unfractured except at 125.5', brown water staining at 3" horizontal fracture, produced more water when drilling.	

OBSERVATIONS:
9 7/8" Reamer Tri-cone to 39.5' set 7" casing. 6 1/8" Tri-cone to 90'. Core from 90' to 127.5'.

WELL CONSTRUCTION LOG

PROJECT	PROJECT NUMBER	
Apex Sanitary Landfill	042-021	B-409

COORDINATES	GROUND SURFACE ELEVATION	TOP OF PVC ELEVATION
N 284430.49 E 2411502.07	1245.12 feet amsl	1247.57 feet amsl

CITY & STATE:
Amsterdam, OH
COUNTY: Jefferson County

INSTALLATION DATE:
7/24/06

DRILLING METHOD: Air Rotary / NX Air Core

DRILLING CONTRACTOR:
Duncan Bros. Drilling Inc.

DELEVOPED BY: DWC/JK

DATE: 8/17/06

DEVELOPMENT TECHNIQUE(S):
Grundfos Pump and SS Bailer

WATER REMOVED DURING DEVELOPMENT:
52.5 gallons

Depth to WATER: 103.02 feet

SOUNDED DEPTH FROM TOC:
114.20 feet

SCREENED INTERVAL ELEVATION: '- '

COMMENTS: 9 7/8" Reamer Tri-cone to 39.5' set 7" casing. 6 1/8" Tri-cone to 90'. Core from 90' to 127.5'.

9 7/8" Borehole Diameter

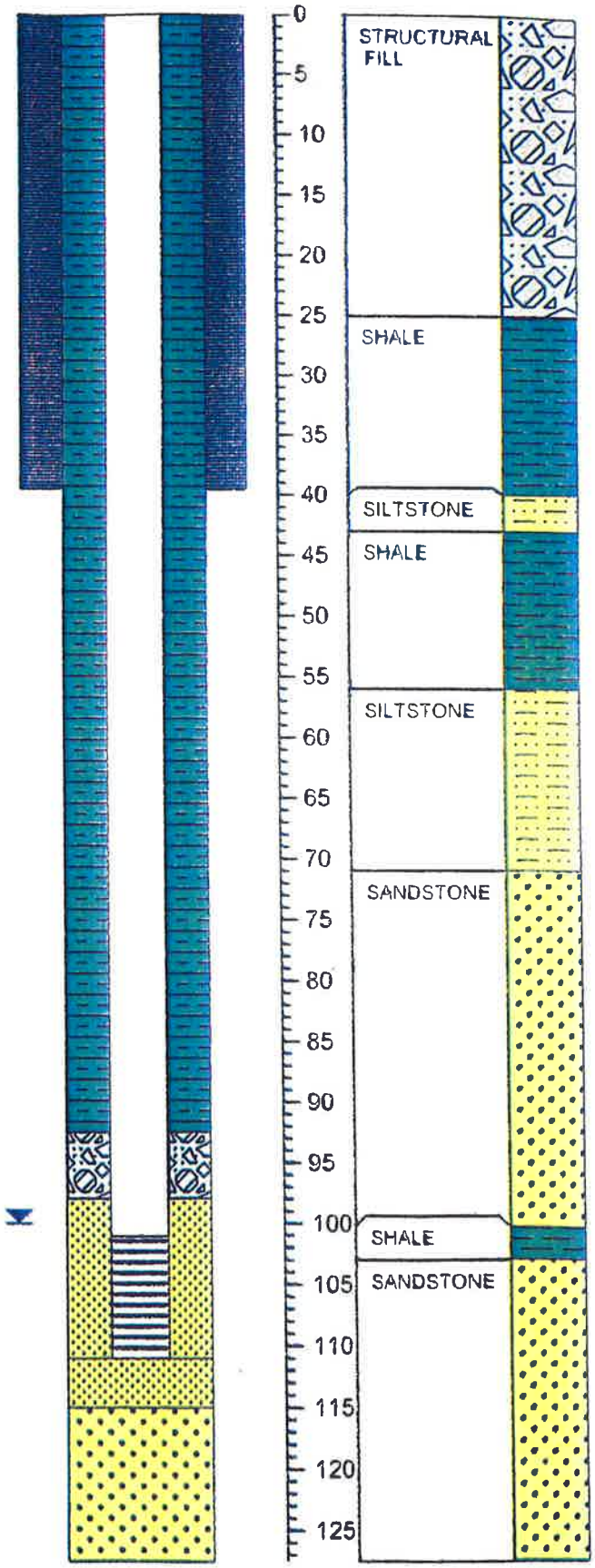
7" Surface Casing to 39.5'

6" Borehole Diameter Sealed using bentonite clay slurry

2" Well Diameter

Hole Plug

No. 4 Fine Sand



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BOREHOLE LOG

BOREHOLE/WELL NO.: **B-409S**

TOTAL DEPTH (BGS): **68 feet**

PROJECT INFORMATION

PROJECT:	Apex Sanitary Landfill
SITE LOCATION:	Amsterdam, OH
PROJECT NO.:	042-021
FIELD GEOLOGIST:	D. Crayne
DATES DRILLED:	7/27/06

DRILLING INFORMATION

DRILLING CO./DRILLER:	Duncan Bros. Drilling Inc.
DRILLING RIG/METHOD:	Air Rotary / NX Air Core
BOREHOLE DIAMETER:	9 7/8" & 6 1/8" Tri-cone Bits
WELL DIAMETER:	2"
GROUND/TOC ELEVATION:	1245.09 / 1247.55ft amsl

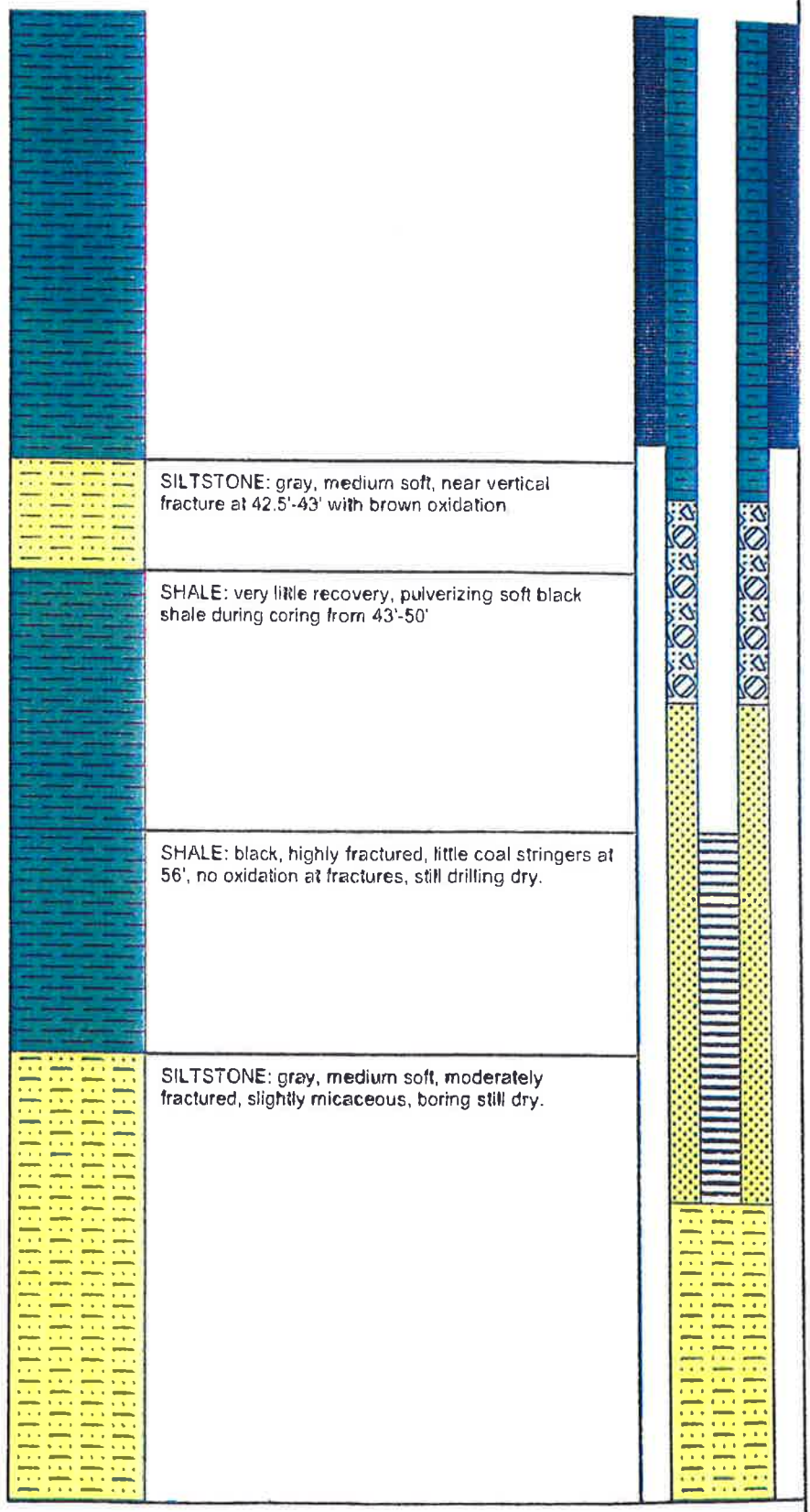
⧗ Water level during drilling

⧗ Water Level After Development

SAMPLE/ CORE NO.	SAMPLE INTERVAL	SAMPLE RECOVERY (ft. in.)	RQD (%)	%Recovery	DEPTH	SOIL SYMBOLS	LITHOLOGY	WELL COMPLETION
	9 7/8" Tri-cone Log Cuttings				0		STRUCTURAL FILL: brown to gray, some boulders.	
					2			
					4			
					6			
					8			
					10			
					12			
					14			
					16			
					18			
					20			
					22			
					24			
					26		SHALE: gray, with some sandstone cuttings, becomes hard at 39'	

OBSERVATIONS:
9 7/8" Reamer Tri-cone to 39.5' set 7" casing. 6 1/8" Tri-cone to 40'. Core from 40' to 68'.

SAMPLE/ CORE NO.	SAMPLE INTERVAL	SAMPLE RECOVERY (ft' in")	RQD (%)	%Recovery
	6 1/8" Tri-cone Log Cuttings			
CR#1	40'-50'	3'	39%	30%
CR#2	50'-56'	4'6"	7%	75%
CR#3	56'-62'	4'	42%	67%
CR#4	62'-68'	5'7"	58%	81%



SOIL SYMBOLS | LITHOLOGY | WELL COMPLETION

OBSERVATIONS:
9 7/8" Reamer Tri-cone to 39.5' set 7" casing. 6 1/8" Tri-cone to 40'. Core from 40' to 68'.

WELL CONSTRUCTION LOG

PROJECT	PROJECT NUMBER	
Apex Sanitary Landfill	042-021	B-409S

COORDINATES	GROUND SURFACE ELEVATION	TOP OF PVC ELEVATION
N 284430.49 E 2411502.07	1245.12 feet amsl	1247.57 feet amsl

CITY & STATE:
Amsterdam, OH

COUNTY: Jefferson County

INSTALLATION DATE:
7/27/06

DRILLING METHOD: Air Rotary / NX Air Core

DRILLING CONTRACTOR:
Duncan Bros. Drilling Inc.

DELEVOPED BY: DWC/JK

DATE: 8/17/06

DEVELOPMENT TECHNIQUE(S):
SS Bailer

WATER REMOVED DURING DEVELOPMENT:
Removed 1.3 gallons of water added to hydrate hole plug, and DRY

Depth to WATER: DRY

SOUNDED DEPTH FROM TOC:
62.75 feet

SCREENED INTERVAL ELEVATION: '-'

COMMENTS: 9 7/8" Reamer Tri-cone to 39.5' set 7" casing. 6 1/8" Tri-cone to 40'. Core from 40' to 68'.

9 7/8" Borehole Diameter

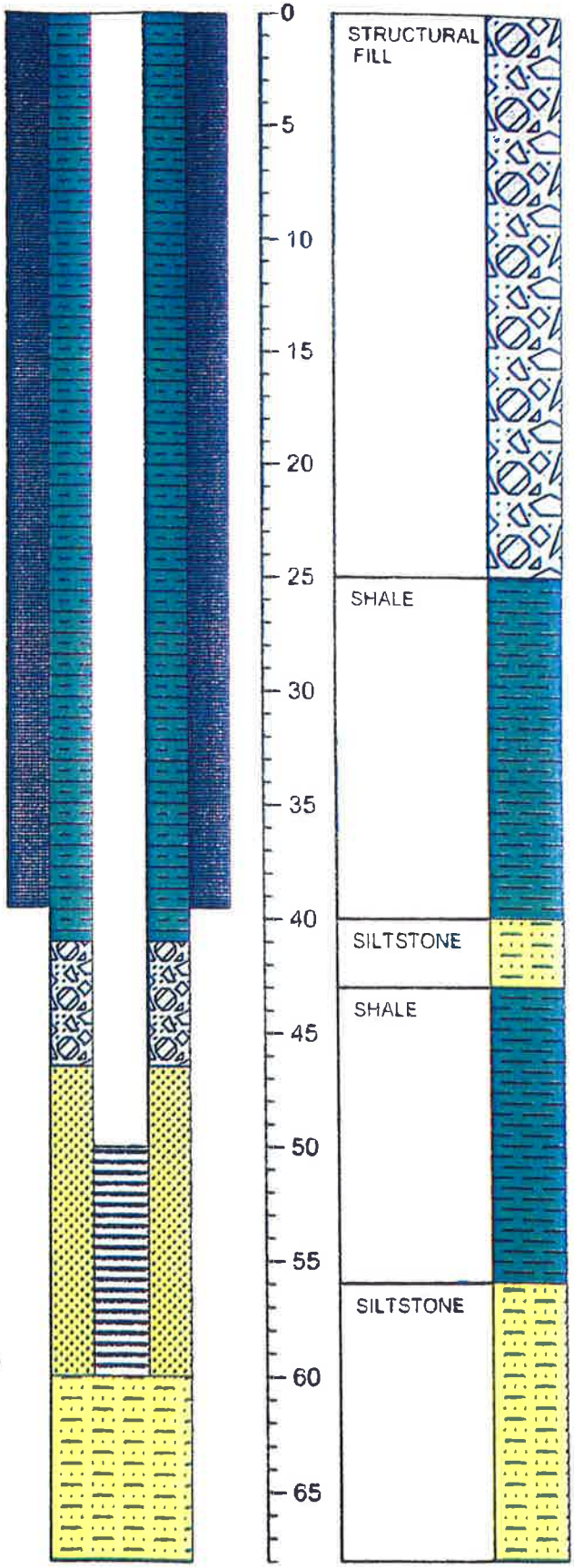
6" Borehole Diameter
Sealed using bentonite clay slurry

7" Surface Casing to 39.5'

Hole Plug

2" Well Diameter

No. 4 Fine Sand



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BOREHOLE LOG

BOREHOLE/WELL NO.: **B-410**

TOTAL DEPTH (BGS): **137 feet**

PROJECT INFORMATION

PROJECT:	Apex Sanitary Landfill
SITE LOCATION:	Amsterdam, OH
PROJECT NO.:	042-021
FIELD GEOLOGIST:	D. Crayne
DATES DRILLED:	6/27/05 to 6/28/05

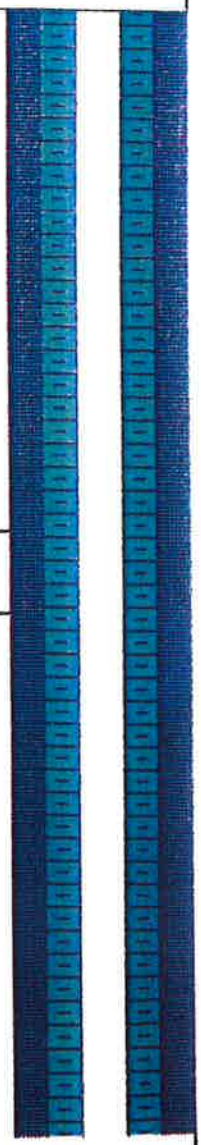
DRILLING INFORMATION

DRILLING CO./DRILLER:	Duncan Bros. Drilling Inc.
DRILLING RIG/METHOD:	Air Rotary / NX Air Core
BOREHOLE DIAMETER:	9 7/8" & 6 1/8" Tri-cone Bits
WELL DIAMETER:	2"
GROUND/TOC ELEVATION:	1242.79 / 1245.32 ft amsl

⧗ Water level during drilling

⧗ Water Level After Development

SAMPLE/ CORE NO.	SAMPLE INTERVAL	SAMPLE RECOVERY (ft. in.)	RQD (%)	%Recovery	DEPTH	SOIL SYMBOLS	LITHOLOGY	WELL COMPLETION
	9 7/8" Tri-cone Log Cuttings				0		STRUCTURAL FILL: re-compacted FILL brown, trace rock fragment.	
					2			
					4			
					6			
					8			
					10		turns gray @ 10 feet.	
					12			
					14			
					16		LIMESTONE: boulder, gray	
					18			
					20		STRUCTURAL FILL: re-compacted FILL, brown.	
					22			
					24			
					26			
					28			
					30			
					32			
					34			



OBSERVATIONS:
9 7/8" Tri-cone to 50' set 7" casing. 6 1/8" Tri-cone to 80'. Core from 80' to 137'.

SAMPLE/ CORE NO.	SAMPLE INTERVAL	SAMPLE RECOVERY (ft' in")	RQD (%)	%Recovery	DEPTH	SOIL SYMBOLS	LITHOLOGY	WELL COMPLETION
					36		SANDSTONE: brown to gray, with some SHALE fragments	
					38			
					40			
					42			
					44			
					46			
					48		SHALE: gray, dry.	
	6 1/8" Tri-cone Log Cuttings				50		SANDSTONE: gray, fine grained, dry.	
					52			
					54			
					56			
					58			
					60			
					62			
					64			
					66			
					68			
					70			
					72			
					74			
					76			
					78			
CR#1	80'-90'	10'1"	78%	100%	80		SANDSTONE: gray fine to medium grained, horizontal bedding, intensely fractured, wet.	
					82		SANDSTONE: brown water stained vertical fracture.	
					84		SANDSTONE: gray fine to medium grained, with SILTSTONE lenses, slightly fractured.	

OBSERVATIONS:
9 7/8" Tri-cone to 50' set 7" casing. 6 1/8" Tri-cone to 80'. Core from 80' to 137'.

SAMPLE/ CORE NO.	SAMPLE INTERVAL	SAMPLE RECOVERY (ft' in")	RQD (%)	%Recovery
CR#2	90'-100'	9'11"	97%	99%
CR#3	100'-110'	9'7"	79%	96%
#4	110'-119'	6'6"	53%	72%
CR#5	119'-128'	9'2"	92%	100%
CR#6	128'-137'	9'6"	65%	100%

DEPTH: 86, 88, 90, 92, 94, 96, 98, 100, 102, 104, 106, 108, 110, 112, 114, 116, 118, 120, 122, 124, 126, 128, 130, 132, 134, 136

SOIL SYMBOLS

LITHOLOGY

SANDSTONE: brown fine to medium grained, with SILTSTONE lenses, moderately fractured, wet.

SANDSTONE: SAA, near vertical fracture.

SANDSTONE: gray, fine to medium grained, with some brown staining at fractures. Wet, but not producing water during drilling.

SANDSTONE: gray, fine to medium grained, with some brown staining at fractures. Wet, but not producing water during drilling.

Core barrel jamed during Core Run (CR # 4).

Let boring sit open over night to obtain water level during drilling (static water level) noted on the left.

SANDSTONE: gray, with thin laminations of COAL.

WELL COMPLETION

OBSERVATIONS:
9 7/8" Tri-cone to 50' set 7" casing. 6 1/8" Tri-cone to 80'. Core from 80' to 137'.

WELL CONSTRUCTION LOG

PROJECT	PROJECT NUMBER	
Apex Sanitary Landfill	042-021	B-410

COORDINATES	GROUND SURFACE ELEVATION	TOP OF PVC ELEVATION
N 284690.00 E 2410966.53	1242.79 feet amsl	1245.32 feet amsl

CITY & STATE:
Amsterdam, OH
COUNTY: Jefferson County
INSTALLATION DATE:
6/27/05 to 6/28/05

DRILLING METHOD: Air Rotary / NX Air Core
DRILLING CONTRACTOR:
Duncan Bros. Drilling Inc.

DELEVOPED BY: DWC
DATE: 7/7 & 7/8/05

DEVELOPMENT TECHNIQUE(S):
Grundfos Pump and Bailer

WATER REMOVED DURING DEVELOPMENT:
16 gallons

Depth to WATER: 110.29 feet
SOUNDED DEPTH FROM TOC:
122.32 feet

SCREENED INTERVAL ELEVATION: 1133.00'-1123.00 '

COMMENTS:
9 7/8" Tri-cone to 50' set 7" casing. 6 1/8" Tri-cone to 80'. Core from 80' to 137'.

7" Surface Casing to 50'

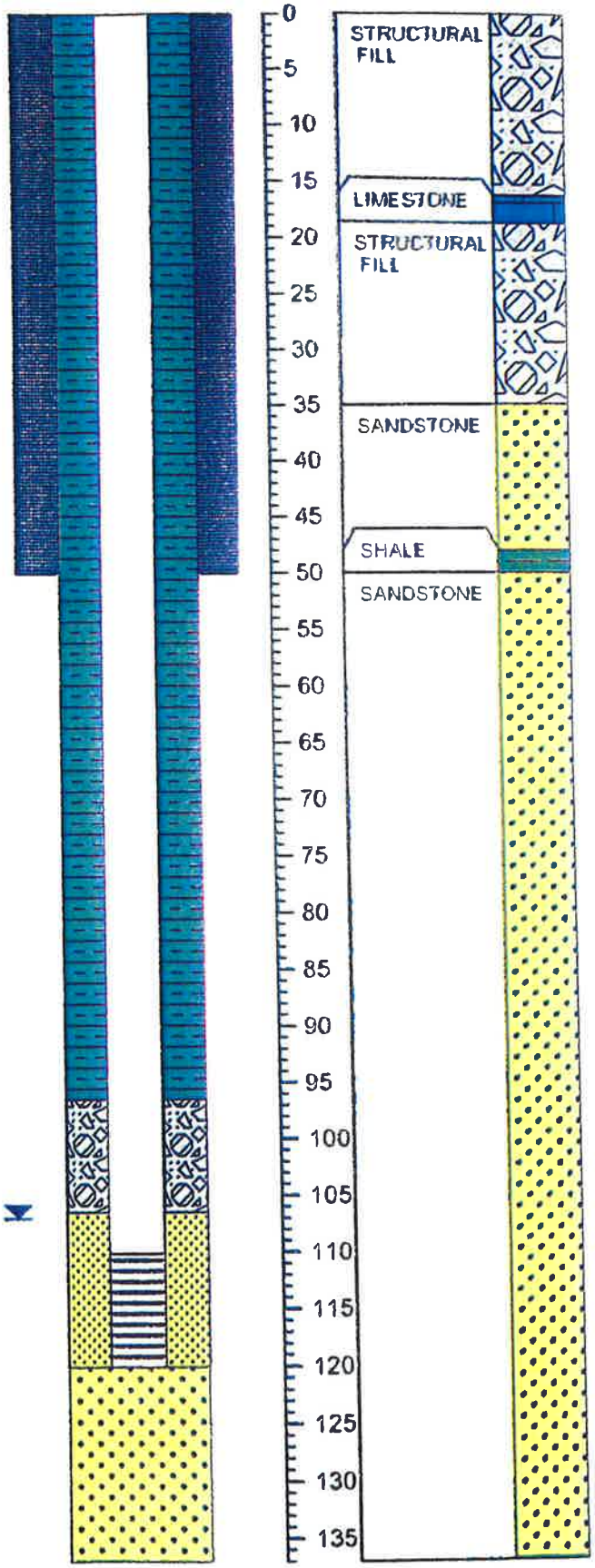
Sealed using bentonite clay slurry

2" Well Diameter

6" Borehole Diameter

Hole Plug

No. 7 Fine Sand



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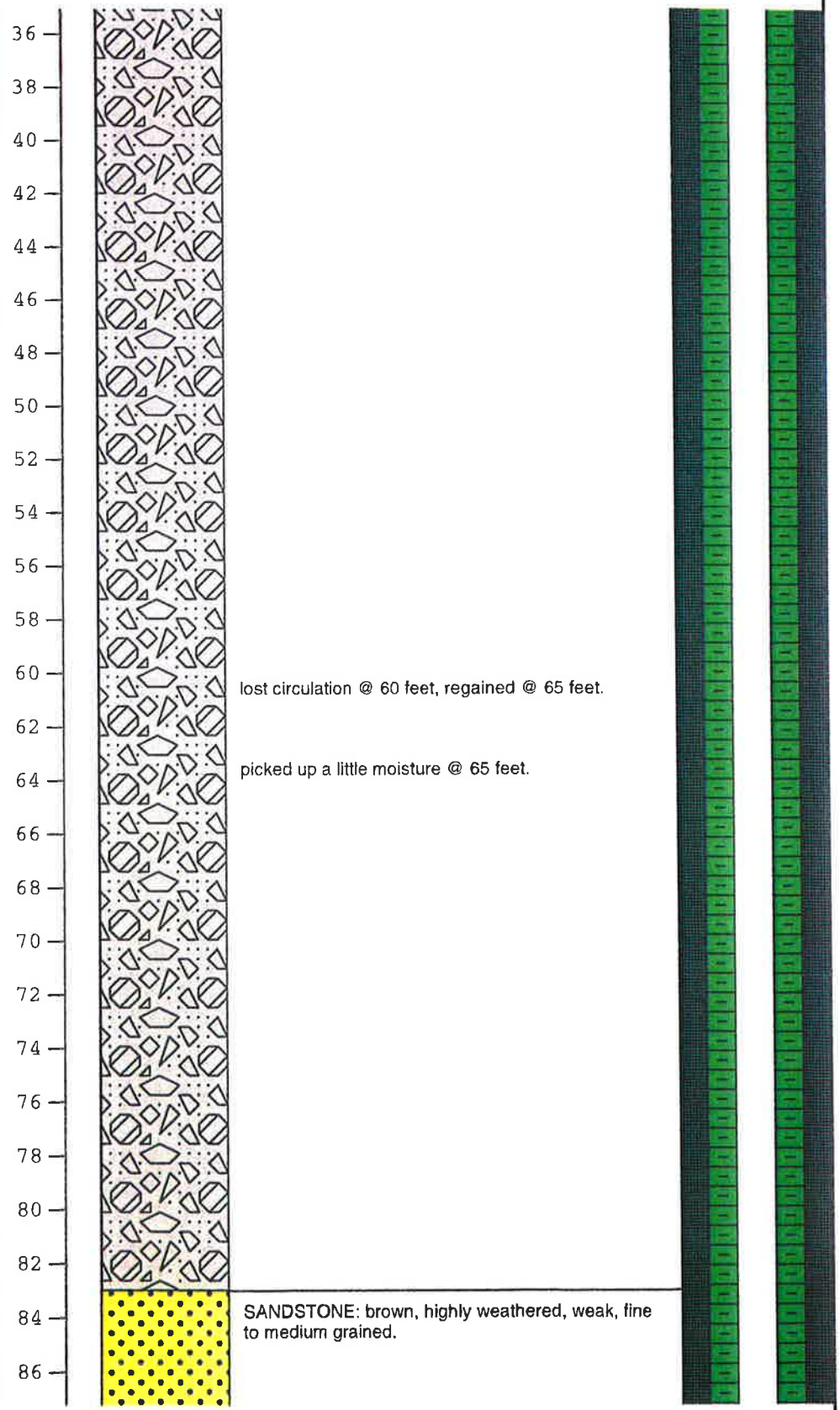
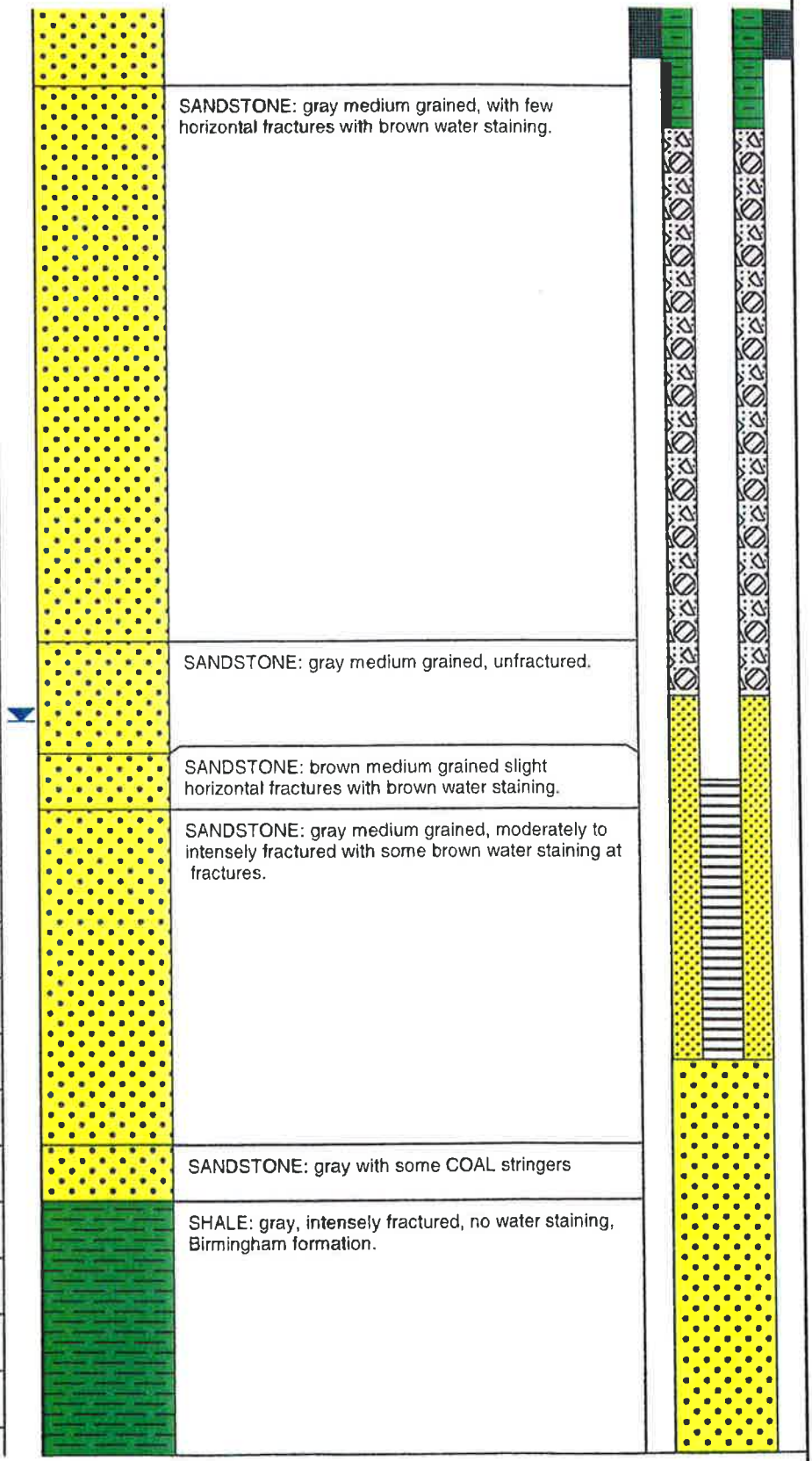
SAMPLE/ CORE NO.	SAMPLE INTERVAL	SAMPLE RECOVERY (ft' in")	RQD (%)	%Recovery	DEPTH	SOIL SYMBOLS	LITHOLOGY	WELL COMPLETION



OBSERVATIONS:
9 7/8" Tri-cone to 89' set 7" casing. 6 1/8" Tri-cone to 90'. Core from 90' to 139'.

SAMPLE/ CORE NO.	SAMPLE INTERVAL	SAMPLE RECOVERY (ft' in")	RQD (%)	%Recovery	DEPTH	SOIL SYMBOLS	LITHOLOGY	WELL COMPLETION
	6 1/8" Tri-cone 1 foot				88			
CR#1	90'- 100'	10'1"	57%	>100%	90		SANDSTONE: gray medium grained, with few horizontal fractures with brown water staining.	
					92			
					94			
					96			
					98			
CR#2	100'- 110'	6'5"	62%	64%	100			
					102			
					104			
					106			
					108			
CR#3	110'- 116'	9'9"	73%	>100%	110		SANDSTONE: gray medium grained, unfractured.	
					112			
					114		SANDSTONE: brown medium grained slight horizontal fractures with brown water staining.	
CR#4	116'- 125'	7'	69%	67%	116		SANDSTONE: gray medium grained, moderately to intensely fractured with some brown water staining at fractures.	
					118			
					120			
					122			
					124			
CR#5	125'- 130'	4'	50%	80%	126			
					128		SANDSTONE: gray with some COAL stringers	
CR#6	130'- 139'	7'6"	30%	83%	130		SHALE: gray, intensely fractured, no water staining, Birmingham formation.	
					132			
					134			
					136			
					138			



OBSERVATIONS:
9 7/8" Tri-cone to 89' set 7" casing. 6 1/8" Tri-cone to 90'. Core from 90' to 139'.

WELL CONSTRUCTION LOG

PROJECT	PROJECT NUMBER	
Apex Sanitary Landfill	042-021	B-411-rev

COORDINATES	GROUND SURFACE ELEVATION	TOP OF PVC ELEVATION
N 284634.20 E 2410335.01	1237.07feet amsl	1240.13 feet amsl

CITY & STATE:
Amsterdam, OH
COUNTY: Jefferson County
INSTALLATION DATE:
8/29/05 to 8/30/05

DRILLING METHOD: Air Rotary / NX Air Core
DRILLING CONTRACTOR:
Duncan Bros. Drilling Inc.

DELEVOPED BY: DWC
DATE: 9/2 & 9/22/05

DEVELOPMENT TECHNIQUE(S):
Grundfos Pump and Bailer

WATER REMOVED DURING DEVELOPMENT:
15 gallons

DEPTH to WATER: 118.67

SOUNDED DEPTH FROM TOC:
128.37 feet

SCREENED INTERVAL ELEVATION: 1121.50'-1111.50 '

COMMENTS:
9 7/8" Tri-cone to 89' set 7" casing. 6 1/8" Tri-cone to 90'. Core from 90' to 139'.

7" Surface Casing to 89'

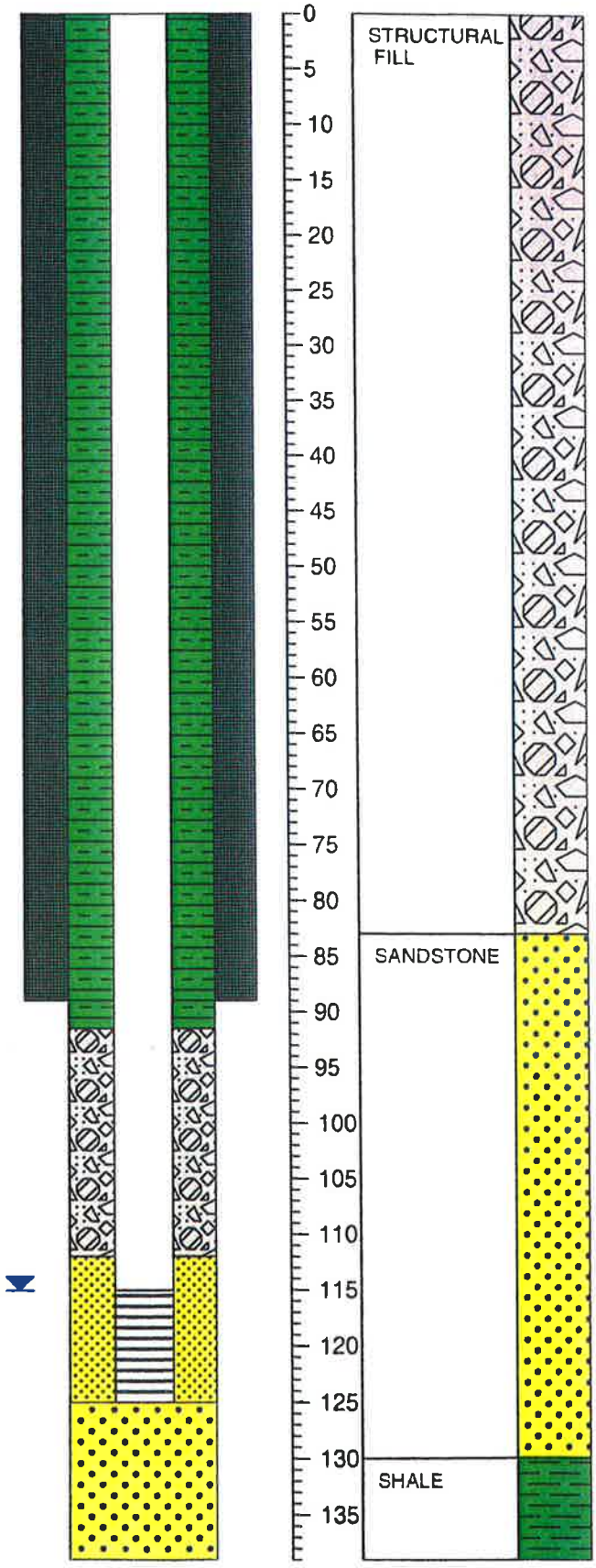
Sealed using bentonite clay slurry

2" Well Diameter

6" Borehole Diameter

Hole Plug

No. 7 Fine Sand



CIVIL & ENVIRONMENTAL CONSULTANTS, INC.

CIVIL & ENVIRONMENTAL CONSULTANTS, INC

8740 Orion Pl., Suite 100
Columbus, OH 43240

Phone 614-540-6633 Fax 614-540-6638

BOREHOLE LOG

BOREHOLE/WELL NO.: **B-412-rev**

TOTAL DEPTH (BGS): **128 feet**

PROJECT INFORMATION

PROJECT:	**Apex Sanitary Landfill**
SITE LOCATION:	**Amsterdam, OH**
PROJECT NO.:	**042-021**
FIELD GEOLOGIST:	**D. Crayne**
DATES DRILLED:	**9/1/05**

DRILLING INFORMATION

DRILLING CO./DRILLER:	**Duncan Bros. Drilling Inc.**
DRILLING RIG/METHOD:	**Air Rotary / NX Air Core**
BOREHOLE DIAMETER:	**9 7/8" & 6 1/8" Tri-cone Bits**
WELL DIAMETER:	**2"**
GROUND/TOC ELEVATION:	**1233.74 / 1236.38 ft amsl**

⧖ Water level during drilling

⧗ Water Level After Development

SAMPLE/ CORE NO.	SAMPLE INTERVAL	SAMPLE RECOVERY (ft' in")	RQD (%)	%Recovery	DEPTH	SOIL SYMBOLS	LITHOLOGY	WELL COMPLETION
	9 7/8" Tri-cone Log Cuttings				0 – 20		STRUCTURAL FILL: brown to gray, occasional limestone boulder	
					20 – 32		SANDSTONE: brown, weak, not solid enough for casing.	

OBSERVATIONS:
9 7/8" Tri-cone to 41' set 7" casing. 6 1/8" Tri-cone to 80'. Core from 80' to 128'.

SAMPLE/ CORE NO.	SAMPLE INTERVAL	SAMPLE RECOVERY (ft' in")	RQD (%)	%Recovery	DEPTH	SOIL SYMBOLS	LITHOLOGY	WELL COMPLETION
	6 1/8" Tri-cone Log Cuttings				34 36 38 40 42 44 46 48 50 52 54 56 58 60 62 64 66 68 70 72 74 76 78 80		SHALE: brown to gray. SANDSTONE: gray medium grained sandstone with occasional seams of brown water stained cuttings. Drilling very dry and dusty to 80 feet.	

OBSERVATIONS:
9 7/8" Tri-cone to 41' set 7" casing. 6 1/8" Tri-cone to 80'. Core from 80' to 128'.

SAMPLE/ CORE NO.	SAMPLE INTERVAL	SAMPLE RECOVERY (ft' in")	RQD (%)	%Recovery	DEPTH	SOIL SYMBOLS	LITHOLOGY	WELL COMPLETION
CR#1	80'-90'	9'11"	77%	99%	82		SANDSTONE: gray with verticle fractures and brown water staining at fractures.	
					84			
					86		SANDSTONE: gray medium grained, unfractured.	
					88			
CR#2	90'-100'	9'6"	26%	95%	90			
					92		SANDSTONE: brown to gray. Core very broken due to the loss of the core down hole. Two attempts made to retrieve the 10 foot core run.	
					94			
					96			
					98			
CR#3	100'-109'	8'5"	81%	94%	100			
					102		SANDSTONE: gray, medium grained, with two brown horizontal fractures @ 103' and 107'	
					104			
					106			
					108			
CR#4	109'-118'	9'9"	100%	100%	110		SANDSTONE: gray with SILTSTONE lenses, unfractured.	
					112			
					114			
					116			
CR#5	118'-128'	9'10"	58%	98%	118		SANDSTONE: gray with a few COAL stringers. 10 inch near vertical fracture @ 121', brown staining.	
					120			
					122			
					124			
					126			
					128			

OBSERVATIONS:
9 7/8" Tri-cone to 41' set 7" casing. 6 1/8" Tri-cone to 80'. Core from 80' to 128'.

WELL CONSTRUCTION LOG	PROJECT Apex Sanitary Landfill	PROJECT NUMBER 042-021	B-412-rev
COORDINATES N 284220.02 E 2410143.72	GROUND SURFACE ELEVATION 1233.74 feet amsl	TOP OF PVC ELEVATION 1236.38 feet amsl	

CITY & STATE:
Amsterdam, OH
COUNTY: Jefferson County
INSTALLATION DATE:
9/1/05

DRILLING METHOD: Air Rotary / NX Air Core
DRILLING CONTRACTOR:
Duncan Bros. Drilling Inc.

DELEVOPED BY: DWC
DATE: 9/2 & 9/22/05

DEVELOPMENT TECHNIQUE(S):
Grundfos Pump and Bailer

WATER REMOVED DURING DEVELOPMENT:
19 gallons

DEPTH to WATER: 109.29

SOUNDED DEPTH FROM TOC:
130.42 feet

SCREENED INTERVAL ELEVATION: 1115.96'-1105.96 '

COMMENTS:
9 7/8" Tri-cone to 41' set 7" casing. 6 1/8" Tri-cone to 80'. Core from 80' to 128'.

7" Surface Casing to 41'

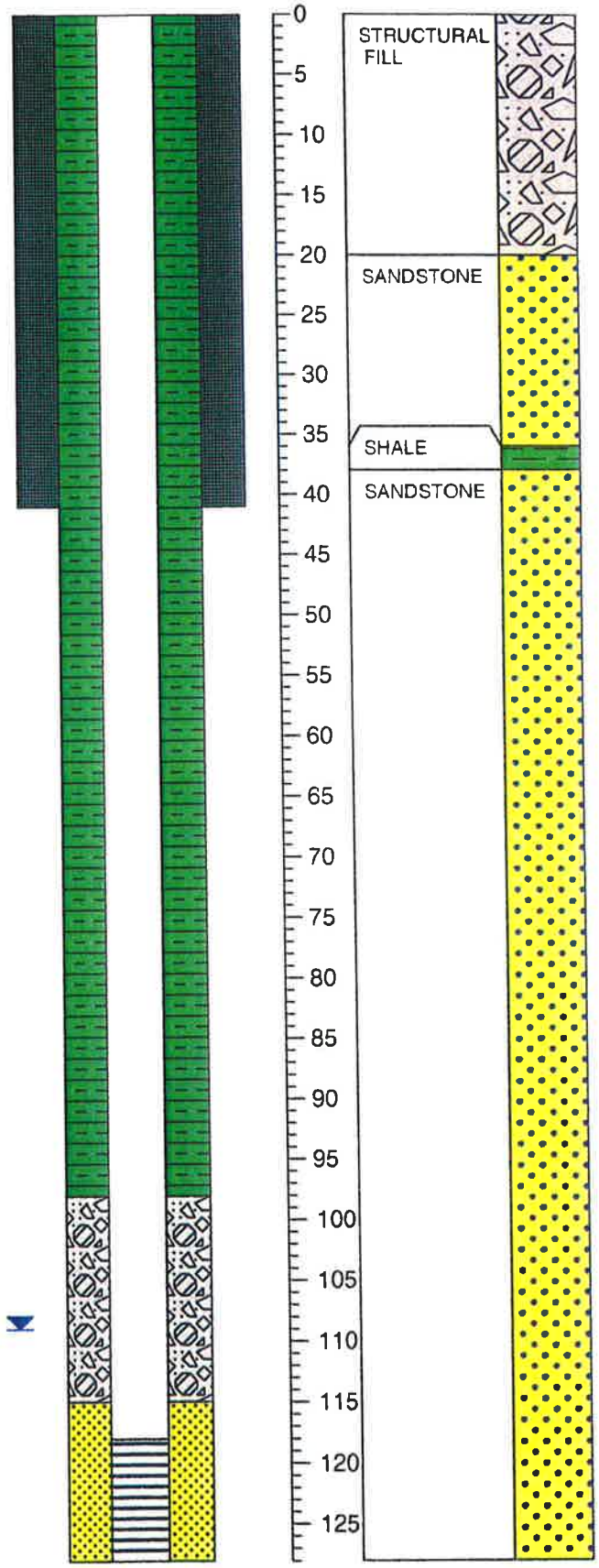
Sealed using bentonite clay slurry

2" Well Diameter

6" Borehole Diameter

Hole Plug

No. 7 Fine Sand



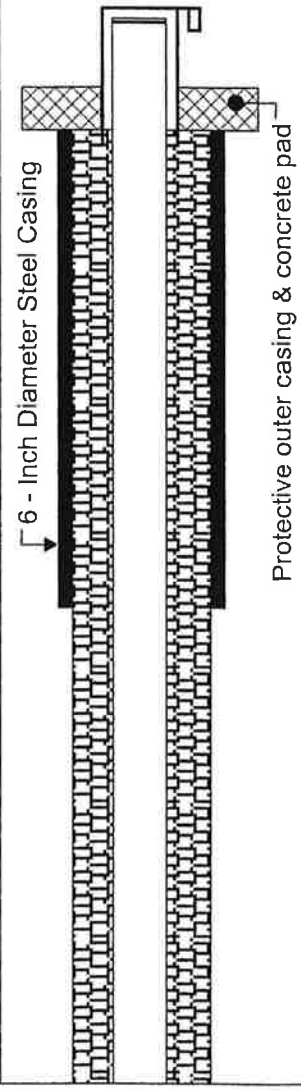
CIVIL & ENVIRONMENTAL CONSULTANTS, INC.

Civil & Environmental Consultants, Inc.

Chicago Cincinnati Columbus Export Detroit Indianapolis Nashville Pittsburgh St. Louis

Project Name: Apex Sanitary Landfill Amsterdam, OH	Borehole/Well ID: B-413
	Northing: 283549.12
	Easting: 2409818.42
	Casing Elevation: 1242.96
Project No.: 042-021	Ground Elevation: 1240.11
Date Started: 2-13-08 Completed: 2-13-08	Groundwater Elevation: 1147.65 Date: 3-24-08 Time: 1448
Drilling Company: Duncan Bros. Drilling Inc.	Sample Information: 9 7/8 tri-cone to 18'. Set 6" steel casing to 18.3'. 6 inch tri-cone from 18'-80'. NX core from 80'-107'. 6 inch tri-cone 80'-100' to
Driller: Dave	
CEC Representative: D. Crayne	
Drilling Method: Air Rotary	Comments/Problems:
Bore Hole: 9 7/8" & 6" / Core Size: NX	
Well Installed: ☑	
Screened Interval:	

Sample No./ Core Run	Recovery (feet)	Blow Counts/ RQD	Pocket Pen.	Sample Type	Depth (feet)	Material Description and Comments	Graphic Log	Elevation (feet, msl)	Well Diagram
					-3				
					-1	Ground Surface		1240.1	
					1	brown to gray LEAN CLAY, moist (FILL)		1237.1	
					3	brown to gray weak SHALE, dry			
					5				
					7				
					9				
					11				
					13				
					15			1224.6	
					17	gray LIMESTONE (15.5-15.9) strong reaction to HCL, dry.			
					19	brown SHALE, dry.			
					21				
					23				
					25				
					27				
					29				
					31				
					33			1207.1	
						gray SHALE, dry			

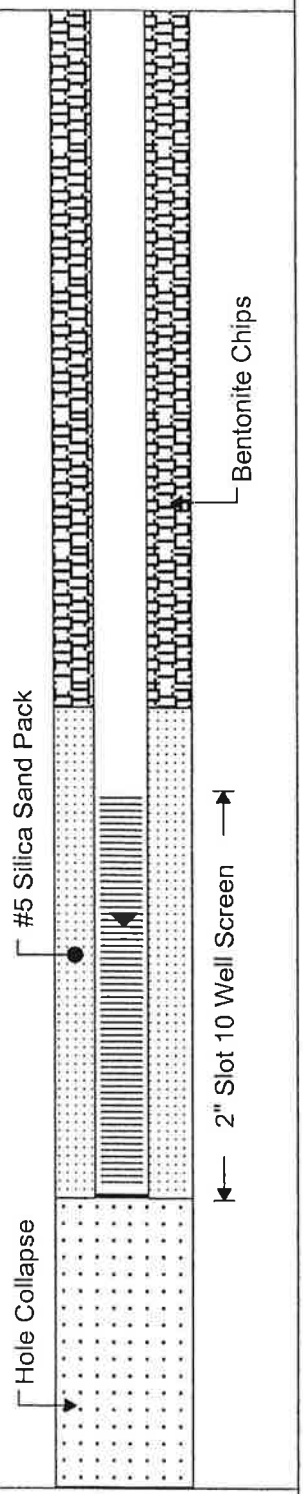


Civil & Environmental Consultants, Inc.	Project Name: Apex Sanitary Landfill Project No.: 042-021	Borehole/Well ID: B-413

Sample No./ Core Run	Recovery	Blow Counts/ RQD	Pocket Pen.	Sample Type	Depth (feet)	Material Description and Comments	Graphic Log	Elevation (feet, msl)	Well Diagram
					36 38 40 42 44 46				
					48	black SHALE, trace coal, dry		1192.1 1191.1	
					50 52	alternating brown to gray SHALE, dry		1187.1	Bentonite Chips
					54 56 58 60	gray SANDSTONE, very hard, dry		1179.1	
					62	brown SANDSTONE, dust died down a little, possibly a little water		1176.1	
					64 66 68 70	gray SANDSTONE, dry			

Civil & Environmental Consultants, Inc.	Project Name: Apex Sanitary Landfill Project No.: 042-021	Borehole/Well ID: B-413

Sample No./ Core Run	Recovery	Blow Counts/ RQD	Pocket Pen.	Sample Type	Depth (feet)	Material Description and Comments	Graphic Log	Elevation (feet, msl)	Well Diagram
					73 75 77 79			1160.1	
1	8.8	94%		NX	81 83 85 87	gray hard SANDSTONE, trace black fossils, non-fractured, massive bedding		1152.1	
					89	brown SANDSTONE, oxidized fracture at 88.7', wet		1149.1	
2	8.8	90%		NX	91 93 95 97	gray fine SANDSTONE, trace brown fine sandstone inclusions, slightly fractured, hard. brown 6 inch diagonal fracture with oxidation, wet.			
3	7.4	97%		NX	99 101 103 105 107	brown oxidized fracture at 98.5, wet brown oxidized fracture at 101.75, wet probably lost recovery to fractures. BOB = 107 feet		1133.1	



Civil & Environmental Consultants, Inc.

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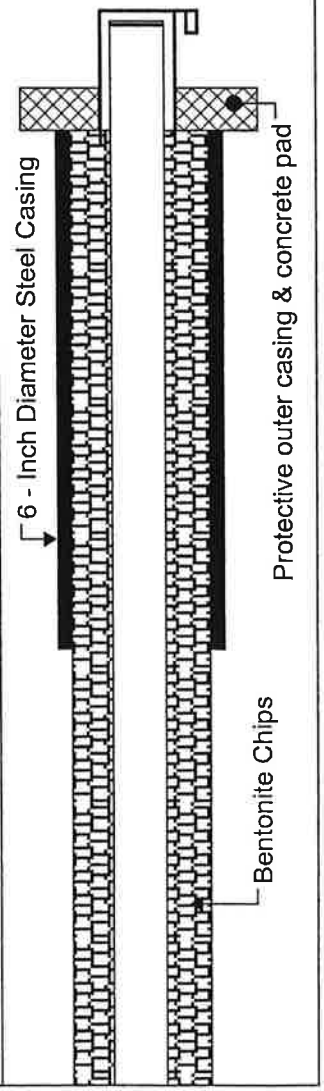
Project Name: Apex Sanitary Landfill Amsterdam, OH	Borehole/Well ID: B-413R
	Northing: 283575.05
	Easting: 2409823.98
	Casing Elevation: 1241.61
Project No.: 081-898.413A	Ground Elevation: 1238.88
Date Started: 5-5-09 Completed: 5-8-09	Groundwater Elevation: 1142.64 Date: 5-20-09 Time: 1500
Drilling Company: Double J Drilling, Inc.	Sample Information: Drilled 6 1/4" augers to 20'. Set 6" steel casing to 20'. Drilled 5 7/8" tri-cone from 20' to 100". Cored with NQ (1 7/8") from 100'-146'. Reamed boring with 5 7/8" tri-cone from 100' to 134'. Set well screen from 123' to 133'.
Driller: Cliff	
CEC Representative: D. Crayne	
Drilling Method: Air Rotary & HSA for surface casing	Comments/Problems: Sealed well with all bentonite chips from top of sand pack at 118' to ground surface. Hydrated chips to activate. Sealed surface casing with all bentonite chips, hydrated to activate. All drilling was completed with air. No water used.
Bore Hole: 5 7/8" Core Size: NQ (1 7/8")	
Well Installed: ☑	
Screened Interval: 123'-133'	

Sample No./ Core Run	Recovery (feet)	Blow Counts/ RQD	Pocket Pen.	Sample Type	Depth (feet)	Material Description and Comments	Graphic Log	Elevation (feet, msl)	Well Diagram
					-3				
					-1	Ground Surface		1238.9	
					1	brown to gray LEAN CLAY, moist (FILL)			
					3			1233.9	
					5	brown to gray weathered SHALE, dry			
					7				
					9				
					11			1227.9	
					13	gray LIMESTONE (approx.11-11.8) strong reaction to HCL, dry.		1224.9	
					15	brown SHALE, dry.			
					17	alternating brown to gray SHALE, dry			
					19				
					21				
					23				
					25				
					27				
					29				
					31				
					33				



Civil & Environmental Consultants, Inc.	Project Name: Apex Sanitary Landfill Project No.: 081-898.413A	Borehole/Well ID: B-413R

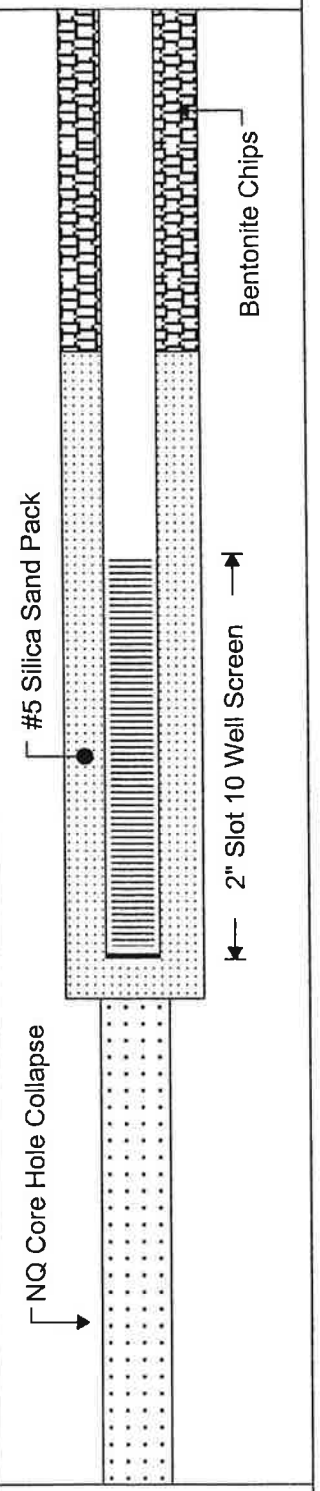
Sample No./ Core Run	Recovery	Blow Counts/ RQD	Pocket Pen.	Sample Type	Depth (feet)	Material Description and Comments	Graphic Log	Elevation (feet, msl)	Well Diagram
					36 38 40 42 44 46	Log cuttings, same as above.		1191.9	
					48 50 52 54	brown SANDSTONE, very hard, dry		1183.9	Bentonite Chips
					56 58 60 62 64 66 68 70 72	gray SANDSTONE, dry.			

Civil & Environmental Consultants, Inc.	Project Name: Apex Sanitary Landfill Project No.: 081-898.413A	Borehole/Well ID: B-413R

Sample No./ Core Run	Recovery	Blow Counts/ RQD	Pocket Pen.	Sample Type	Depth (feet)	Material Description and Comments	Graphic Log	Elevation (feet, msl)	Well Diagram
					74 76 78 80 82 84 86 88 90 92 94 96 98	Log cuttings, same as above. Dust died down a little during drilling, possibly a little water around approx. 94 feet. Start NQ coring at 99.5 feet.		1139.4	Bentonite Chips
1	4.8	0%		NQ	100 102 104 106 108	gray SANDSTONE, fine to medium grained, dry, Poor RQD due to rod chatter. brown oxidized fractures from 107.5' to 108'.			

Civil & Environmental Consultants, Inc.	Project Name: Apex Sanitary Landfill Project No.: 081-898.413A	Borehole/Well ID: B-413R

Sample No./ Core Run	Recovery	Blow Counts/ RQD	Pocket Pen.	Sample Type	Depth (feet)	Material Description and Comments	Graphic Log	Elevation (feet, msl)	Well Diagram
2	9.6	40%		NQ	111 113 115	brown oxidized fracture at 115.7'.		1122.9	
3	6	0%		NQ	117 119 121 123 125	gray SANDSTONE, fine grained, Poor RQD due to rod chatter. brown oxidized staining from 117.8' to 118.1". brown oxidized staining from 119.7' to 120.3'. small amount of brown staining at 126'.		1112.9	
4	4.4	20%		NQ	127 129 131	gray SANDSTONE, fine grained, Poor RQD due to rod chatter.		1107.9 1106.9	
5	5	30%		NQ	133 135	(131-132) gray fine grained SANDSTONE, brown oxidized fracture at 132.5, few limestone inclusions (conglomeritic). Limestone has strong reaction with HCl. Highly fractured.			
6	3.8	0%		NQ	137 139	gray fine grained SANDSTONE, some laminated shale partings. Shale is micaceous.			
7	3.7	0%		NQ	141 143 145	Poor RQD's due to rod chatter mechanically breaking cores		1092.9	
					147	BOB = 146 feet			

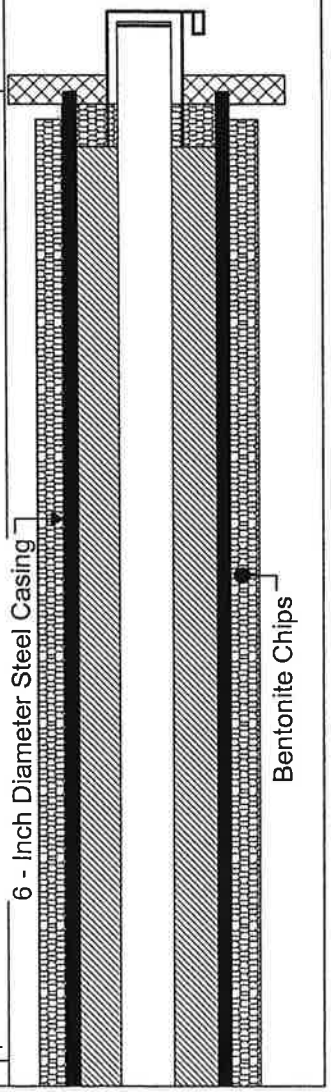


Civil & Environmental Consultants, Inc.

Chicago Cincinnati Columbus Export Detroit Indianapolis Nashville Pittsburgh St. Louis

Project Name: Apex Sanitary Landfill Amsterdam, OH	Borehole/Well ID: B-414
	Northing: 282957.72
	Easting: 2409494.13
	Casing Elevation: 1231.50
Project No.: 081-898	Ground Elevation: 1229.42
Date Started: 8/11/2009 Completed: 8/12/2009	Groundwater Elevation: 1137.51 Date: 8/18/09 Time: -
Drilling Company: Duncan Bros. Drilling Inc.	Sample Information: 9 7/8 tri-cone to 40'. Set 6" steel casing to 40'. 5 7/8 inch tri-cone from 40'-85'. 94mm core from 85'-125'. 6 inch tri-cone 85'-118' to set well.
Driller: Mark Duncan	
CEC Representative: J. Kennedy	
Drilling Method: Air Rotary	Comments/Problems:
Bore Hole: 9 7/8" & 6" Core Size: 94 mm	
Well Installed: ☑	
Screened Interval: 108-118 ft bgs	

Sample No./ Core Run	Recovery (feet)	Blow Counts/ RQD	Pocket Pen.	Sample Type	Depth (feet)	Material Description and Comments	Graphic Log	Elevation (feet, msl)	Well Diagram
					-3				
					-1	Ground Surface		1229.4	
					1	Fill Brown and gray, Lean CLAY, moist.			
					3				
					5				
					7				
					9				
					11				
					13				
					15				
					17				
					19				
					21				
					23				
					25				
					27				
					29				
					31				
					33			1195.4	



Civil & Environmental Consultants, Inc.	Project Name: Apex Sanitary Landfill Project No.: 081-898	Borehole/Well ID: B-414

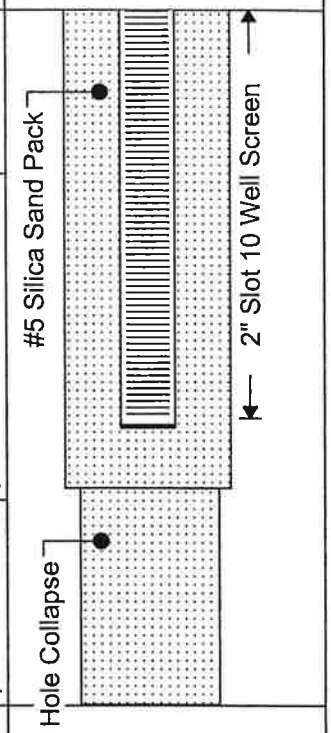
Sample No./ Core Run	Recovery	Blow Counts/ RQD	Pocket Pen.	Sample Type	Depth (feet)	Material Description and Comments	Graphic Log	Elevation (feet, msl)	Well Diagram
					36 38 40 42 44 46 48 50 52	Brown SHALE, dry.		1176.4	Bentonite Grout
					54	Gray SHALE, dry.		1173.4	
					56	Gray SANDSTONE, moist,weathered, soft.		1171.4	
					58 60 62	Gray to black SHALE, dry,.		1166.4	
					64	Brown SHALE, dry.		1165.4	
					66 68 70	Gray, SHALE, dry.			

Civil & Environmental Consultants, Inc.	Project Name: Apex Sanitary Landfill Project No.: 081-898	Borehole/Well ID: B-414

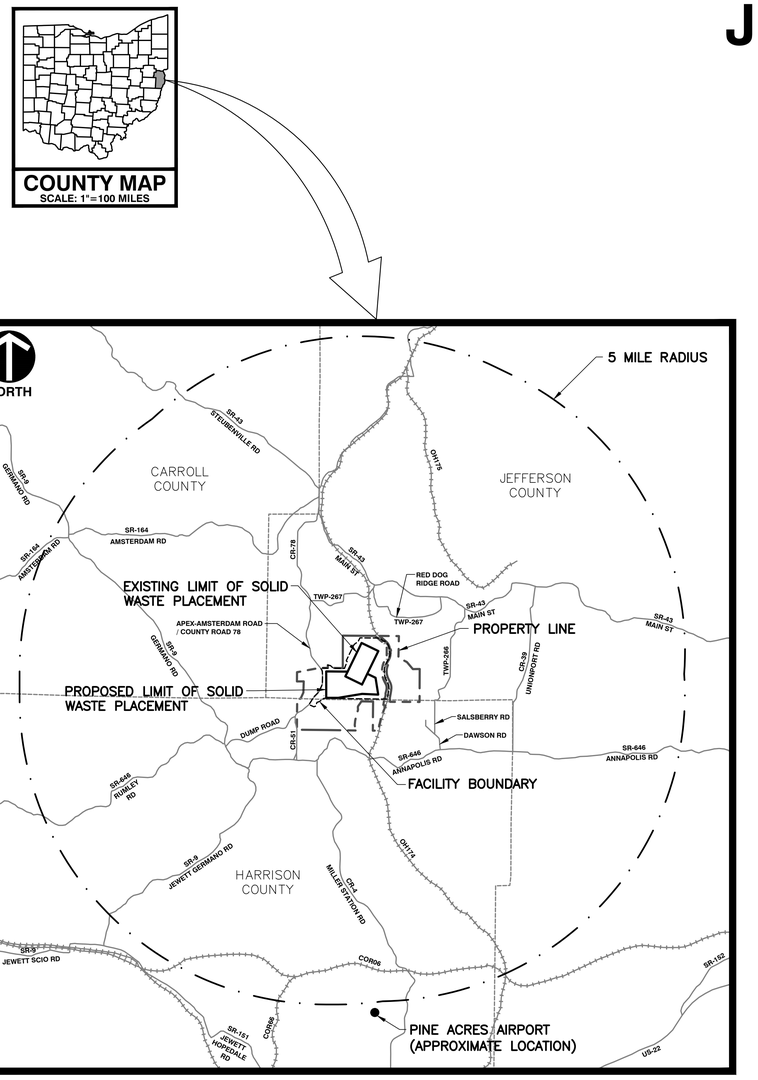
Sample No./ Core Run	Recovery	Blow Counts/ RQD	Pocket Pen.	Sample Type	Depth (feet)	Material Description and Comments	Graphic Log	Elevation (feet, msl)	Well Diagram
					73				
					75				
					77				
					79	Brown, Sandy SHALE, dry.		1150.4	
					81	Gray, SANDSTONE, moist.		1148.4	
					83	Brown, SHALE, dry.		1146.4	
C1	3.5	73%		HQ	85	Gray, SANDSTONE, fine to medium grained, hard, slight shale interbedding, moderately fractured, some black staining/weathering, moist.		1145.4	
					87				
C2	5.0	14%		HQ	89				
					91				
					93				
C3	0.9	0%		HQ	95				Bentonite Chips
					97				
					99				
C4	1.9	100%		HQ	101				
					103			1124.4	
					105				
					107				

Civil & Environmental Consultants, Inc.	Project Name: Apex Sanitary Landfill Project No.: 081-898	Borehole/Well ID: B-414

Sample No./ Core Run	Recovery	Blow Counts/ RQD	Pocket Pen.	Sample Type	Depth (feet)	Material Description and Comments	Graphic Log	Elevation (feet, msl)	Well Diagram
C5	7.9	61%		HQ	110				
					112			1117.4	
						Gray, SANDSTONE, hard, slightly weathered, slightly fractured, wet. Significant oxidation on fracture at 114.7.			
C6	6.7	71%		HQ	114				
					116				
					118				
					120			1109.4	
C7	4.9	86%		HQ		Gray, SANDSTONE, becoming fine grained, hard, unweathered, massive, wet.			
					122				
					124			1104.4	
						End of Boring - 125'			
					126				
					128				
					130				
					132				
					134				
					136				
					138				
					140				
					142				
					144				



PERMIT TO INSTALL APPLICATION
CONTIGUOUS EXPANSION
APEX SANITARY LANDFILL
JEFFERSON COUNTY, OHIO



REFERENCE:
ROAD LOCATIONS ARE COMPILED GIS DATA FROM THE PUBLIC UTILIES COMMISSION OF OHIO (PUCO) GIS REPOSITORY AND USGS QUADRANGLES.

NOTE:
THERE ARE NO AIRPORTS LOCATED WITHIN 5 MILES OF THE LIMIT OF WASTE. THE NEAREST AIRPORT IS PINE ACRES AIRPORT WHICH IS 5.15 MILES AWAY.

SITE LOCATION MAP
SCALE IN MILES
0 1 2

PREPARED FOR:

APEX ENVIRONMENTAL LLC

APEX ENVIRONMENTAL LLC
11 COUNTY ROAD 78
AMSTERDAM, JEFFERSON COUNTY,
OHIO 43903

PREPARED BY:

Civil & Environmental Consultants, Inc.
333 Baldwin Road
Pittsburgh, PA 15205
412.429.2324 800.365.2324

8740 Orion Place, Suite 100 –
Columbus, OH 43240
614–540–6633 888–598–6808

PROJECT NO. 091-867

STATE OF OHIO
RICK BUFFALINI
E-55305
REGISTERED
PROFESSIONAL ENGINEER
5-18-16

OCTOBER 2011
REVISED JULY 2013
REVISED DECEMBER 2015
REVISED MAY 2016

REVISION RECORD

NO	DATE	DESCRIPTION
1	7/2013	RESPONSE TO OHIO EPA NOD DATED 12/26/12.
2	12/2015	REVISED IN RESPONSE TO OHIO EPA NOD DATED 6/18/2015.
3	5/2016	REVISED IN RESPONSE TO OHIO EPA NOD DATED 4/26/2016.
4		

SUBMITTAL RECORD

NO	DATE	DESCRIPTION

LIST OF DRAWINGS

DRAWING NO.	DRAWING TITLE	REVISION
1	TITLE SHEET	2
2A	PROPERTY INFORMATION (OVERVIEW)	2
2A–1	PROPERTY INFORMATION (NORTH, 1 OF 2)	2
2A–2	PROPERTY INFORMATION (SOUTH, 2 OF 2)	2
2B	PUBLICLY AVAILABLE INFORMATION (OVERVIEW)	1
2B–1	PUBLICLY AVAILABLE INFORMATION (NORTH, 1 OF 2)	2
2B–2	PUBLICLY AVAILABLE INFORMATION (SOUTH, 2 OF 2)	2
2C–1	MAN–MADE POTENTIAL EXPLOSIVE GAS MIGRATION PATHWAYS (NORTH, 1 OF 2)	2
2C–2	MAN–MADE POTENTIAL EXPLOSIVE GAS MIGRATION PATHWAYS (SOUTH, 2 OF 2)	2
2D–1	SITING CRITERIA SUMMARY (NORTH, 1 OF 2)	1
2D–2	SITING CRITERIA SUMMARY (SOUTH, 2 OF 2)	1
2E	REGIONAL WELL LOCATION MAP	SEE NOTE 1
3A	LANDFILL FACILITIES / UTILITIES LOCATION PLAN	3
3B	EXPLOSIVE GAS CONTROL SYSTEM PLAN	2
3C	UAS SEPARATION ISOPACH MAP	2
3D	MONITORING WELL AND SOIL BORING LOCATIONS	SEE NOTE 1
3E	TOP OF BEDROCK CONTOUR MAP	SEE NOTE 1
3E–1	AREA OF LIMESTONE – SHALLOW BEDROCK REMOVAL	SEE NOTE 1
3F	TOP OF UPPERMOST AQUIFER SYSTEM CONTOUR MAP	SEE NOTE 1
3F–1	LIMESTONE – SHALLOW BEDROCK AVERAGE WELL YIELD CONTOURS	SEE NOTE 1
3G	MINE SPOIL POTENTIOMETRIC MAP, DECEMBER 6, 2010	SEE NOTE 1
3H	LIMESTONE – SHALLOW BEDROCK POTENTIOMETRIC MAP, DECEMBER 6, 2010	SEE NOTE 1
3I	BELLAIRE – SUMMERFIELD POTENTIOMETRIC MAP, DECEMBER 6, 2010	SEE NOTE 1
3J	CONNELLSVILLE – MORGANTOWN POTENTIOMETRIC MAP, DECEMBER 6, 2010	SEE NOTE 1
3K	MINE SPOIL POTENTIOMETRIC MAP MARCH 28, 2011	SEE NOTE 1
3L	LIMESTONE – SHALLOW BEDROCK POTENTIOMETRIC MAP MARCH 28, 2011	SEE NOTE 1
3M	BELLAIRE – SUMMERFIELD POTENTIOMETRIC MAP MARCH 28, 2011	SEE NOTE 1
3N	CONNELLSVILLE – MORGANTOWN POTENTIOMETRIC MAP MARCH 28, 2011	SEE NOTE 1
3O	MINE SPOIL POTENTIOMETERIC MAP DECEMBER 10, 2012	SEE NOTE 1
3P	LIMESTONE – SHALLOW BEDROCK POTENTIOMETERIC MAP DECEMBER 10, 2012	SEE NOTE 1
3Q	BELLAIRE – SUMMERFIELD POTENTIOMETERIC MAP DECEMBER 10, 2012	SEE NOTE 1
3R	CONNELLSVILLE – MORGANTOWN POTENTIOMETERIC MAP DECEMBER 10, 2012	SEE NOTE 1
4A	HORIZONTAL AND VERTICAL LIMITS OF EXCAVATION	2
4B	BASE OF RECOMPACTED SOIL LINER GRADING PLAN	1
4C	TOP OF RECOMPACTED SOIL LINER GRADING PLAN	1
4D	TOP OF GRANULAR LEACHATE COLLECTION LAYER / BOTTOM OF WASTE GRADING PLAN	1
4E	TOP OF TIRE SHRED LEACHATE COLLECTION LAYER / BOTTOM OF WASTE GRADING PLAN	1
4F	TOP OF WASTE GRADING PLAN	1
4G	TOP OF FINAL COVER GRADING PLAN	1
4H	SURFACE WATER MANAGEMENT PLAN	2
5A	GEOLOGIC CROSS SECTION LOCATION MAP	SEE NOTE 1
5B	GEOLOGIC CROSS SECTION A–A'	SEE NOTE 1
5C	GEOLOGIC CROSS SECTION B–B'	SEE NOTE 1
5D	GEOLOGIC CROSS SECTION C–C'	SEE NOTE 1
5E	GEOLOGIC CROSS SECTION D–D'	SEE NOTE 1
5F	GEOLOGIC CROSS SECTION E–E'	SEE NOTE 1
5G	GEOLOGIC CROSS SECTION F–F'	SEE NOTE 1
5H	ENGINEERING CROSS SECTION LOCATION PLAN	1
5I	ENGINEERING CROSS–SECTIONS (SHEET 1 OF 2)	1
5J	ENGINEERING CROSS–SECTIONS (SHEET 2 OF 2)	1
6A	PHASE 7 DEVELOPMENT PLAN	1
6B	PHASE 8 DEVELOPMENT PLAN	1
6C	PHASE 9 DEVELOPMENT PLAN	1
6D	PHASE 10 DEVELOPMENT PLAN	1
6E	PHASE 11 DEVELOPMENT PLAN	2
6F	PHASE 12 DEVELOPMENT PLAN	2
6G	PHASE 13 DEVELOPMENT PLAN	1
6H	PHASE 14 DEVELOPMENT PLAN	2
6I	FINAL DEVELOPMENT PLAN	1
7A	LINER SYSTEM AND FINAL COVER SYSTEM DETAILS (SHEET 1 OF 3)	2
7B	LINER SYSTEM AND FINAL COVER SYSTEM DETAILS (SHEET 2 OF 3)	2
7C	LINER SYSTEM AND FINAL COVER SYSTEM DETAILS (SHEET 3 OF 3)	2
7D	LEACHATE MANAGEMENT SYSTEM DETAILS (SHEET 1 OF 3)	2
7E	LEACHATE MANAGEMENT SYSTEM DETAILS (SHEET 2 OF 3)	0
7F	LEACHATE MANAGEMENT SYSTEM DETAILS (SHEET 3 OF 3)	0
7G	GAS MANAGEMENT SYSTEM DETAILS (SHEET 1 OF 4)	0
7H	GAS MANAGEMENT SYSTEM DETAILS (SHEET 2 OF 4)	1
7I	GAS MANAGEMENT SYSTEM DETAILS (SHEET 3 OF 4)	0
7J	GAS MANAGEMENT SYSTEM DETAILS (SHEET 4 OF 4)	1
7K	SURFACE WATER MANAGEMENT SYSTEM DETAILS (SHEET 1 OF 2)	1
7L	SURFACE WATER MANAGEMENT SYSTEM DETAILS (SHEET 2 OF 2)	1
7M	SEDIMENTATION PONDS 1, 2, AND 3 PLAN VIEWS	1
7N	SEDIMENTATION PONDS 1, 2, AND 3 DISCHARGE STRUCTURES	1
7O	PROPOSED RAIL UNLOADING BUILDING	0
7P	PROPOSED RAIL UNLOADING BUILDING RENDERINGS	0

NOTES:
1.) HYDROGEOLOGIC DRAWINGS WERE SUBMITTED SEPARATELY IN AUGUST 2011 AND REVISED IN JULY 2013.

A:\2008\091-867\CAD\2000 - PTI LATERAL EXPANSION\DWG\091-867PTI_DWG1-TITLESHEET - 5/18/2016 - DR - 5/18/2016 1:46:38 PM

NORTH

34-00171-000
CIACCI EDWARD A
0.25 ACRES

34-00519-000
MILLER DAVID
76 ACRES

34-00309-000
MCCOY MARK L & RHONDA S
160 ACRES

34-00307-000
MCCOY MARK L & RHONDA S
30 ACRES

34-00709-000
SCHULTZ JOHN
43.36 ACRES

34-01004-000
SCHULTZ JOHN M
18.94 ACRES

34-01248-000
JOHNSTON DAVID
MARGARET
3.35 ACRES

34-00365-000
JOHNSTON DAVID R &
MARGARETE
43.49 ACRES

34-00141-000
STULL RICHARD W
& GINA L
2.00 ACRES

34-01198-000
CIACCI EDWARD A
& CYNTHIA
2.07 ACRES

34-01197-000
CIACCI EDWARD A
17.43 ACRES

34-00142-000
CIACCI DAVID ETAL
134.08 ACRES

34-00519-000
MILLER DAVID
78.04 ACRES

34-00142-002
CUMMINS GEORGE M
1.72 ACRES

34-00142-001
CIACCI ROGER E & DIANE L
2.19 ACRES

34-00098-000
SCHULTZ JOHN MICHAEL
(LE JACK & JOY SCHULTZ)
17.42 ACRES

34-00364-000
JOHNSTON DAVID R &
MARGARETE
31.73 ACRES

34-01274-000
GARDNER THOMAS W & JANICE
10.56 ACRES

34-01280-000
JOHNSTON DAVID R &
MARGARETE
50.77 ACRES

34-00308-000
MCCOY MARK L
& RHONDA S
3.5 ACRES

34-01135-000
CEMETERY (JEFF CO COMM
0.5 ACRES

34-00143-000
CIACCI DAVID L & EDWARD A
9 ACRES

34-00768-000
KUHN RONALD M
98.4 ACRES

11-00161000
APEX ENVIROMENTAL LLC
47.88 ACRES

11-00169000
WILD N WOOLY ACRES INC
90483 MILLER STATION
HOPEDALE, OHIO
14.84 ACRES

11-00170000
WILD N WOOLY ACRES INC
90483 MILLER STATION RD
HOPEDALE, OHIO
54.08 ACRES

11-0000040003
DAWSON MYRON M
91.13 ACRES

11-0000040004
DAWSON MYRON M
64.63 ACRES

11-00043000
DAWSON, MYRON M & CAROLYN L J&S
91797 DAWSO RD
HOPEDALE, OHIO
20.06 ACRES

PARCEL #3
APEX ENVIROMENTAL LLC
678.004 ACRES

PARCEL #4
APEX ENVIROMENTAL LLC
242.33 ACRES

PARCEL #1
APEX ENVIROMENTAL LLC
317.029 ACRES

PARCEL #2
APEX ENVIROMENTAL LLC
47.952ACRES

EXISTING UNIT

CONTIGUOUS
EXPANSION
UNIT

FACILITY BOUNDARY

WEST SEDIMENTATION POND

1,000-FT OFFSET FROM LIMIT
OF SOLID WASTE PLACEMENT

NORTH
SEDIMENTATION
POND

EXISTING
COMPRESSOR
BUILDING

RAIL SCALE
HOUSE

ELECTRIC
DISTRIBUTION
BOX

LEACHATE
STORAGE TANK

TRUCK LOAD-OUT PAD

POWER LINE
(69 kv/12 kv)
DILLONVALE-
AMSTERDAM

SEDIMENT
BASIN

RAIL UNLOADING
AREA

RAIL CAR UNLOADING
PLATFORM

ACCESS ROAD

TBM-7
ODOR CONTROL SHED

AEP SERVICE LINE
(12 kv)

AEP POWER LINE
(138 kv)
WINDSOR-CANTON

TBM-6

TBM-4

TBM-2

TBM-1

TBM-5

MAINTENANCE
BUILDING

EMPLOYEE TRAILERS

MAIN OFFICE

ACCESS ROAD

SOLIDIFICATION BASIN ENCLOSURE

SCALE

POWER LINE
(69 kv/12 kv)
DILLONVALE-AMSTERDAM
(SEE REFERENCE 2)

JEFFERSON COUNTY
HARRISON COUNTY

SPRINGFIELD TOWNSHIP
GERMAN TOWNSHIP

APEX - AMSTERDAM RD. - CO. RD 78

SITE ENTRANCE

CO. RD 51

APEX - AMSTERDAM RD.

1,000-FT OFFSET FROM THE
LIMIT OF SOLID WASTE PLACEMENT

BENCHMARK TABLE			
DESCRIPTION	NORTHING	EASTING	ELEVATION
TBM-1	279202.74	2406169.74	1288.36
TBM-2	282605.19	2407871.35	1304.17
TBM-3	283414.35	2412722.84	1154.60
TBM-5	279260.13	2409777.80	1246.77
TBM-6	284152.95	2412150.85	1223.74
TBM-7	285182.50	2410786.21	1220.14

REVISION RECORD

NO	DATE	DESCRIPTION
1	7/2013	UPDATED AERIAL TOPOGRAPHY.
2	12/2015	UPDATED PROPERTY OWNERSHIP INFORMATION, ADDED WETLAND CONSERVATION EASEMENTS, AND UPDATED AEP POWER LINE LOCATION.
3		

SUBMITTAL RECORD

NO	DATE	DESCRIPTION

OHIO EPA RULE REFERENCE

3745-27 RULE REFERENCE			COMMENT
3745-27-06(B)(2)(a)	(i)	The property lines of land owned or leased for the sanitary landfill facility as determined by a property survey conducted by a professional surveyor registered in Ohio; and	SHOWN ON DRAWINGS 2A-1 & 2A-2
	(ii)	The limits of solid waste placement; and	SHOWN ON DRAWINGS 2A-1 & 2A-2
	(iii)	All occupied structures; and	SHOWN ON DRAWINGS 2A-1 & 2A-2
	(iv)	Existing topography showing streams, lakes, springs, wetlands, and other surface waters, with a contour interval no greater than five feet; and	SHOWN ON DRAWINGS 2A-1 & 2A-2
	(v)	The north arrow; and	SHOWN ON DRAWINGS 2A-1 & 2A-2
	(vi)	The location of all survey marks; and	SHOWN ON DRAWINGS 2A-1 & 2A-2
	(vii)	The unit(s) of the sanitary landfill facility; and	SHOWN ON DRAWINGS 2A-1 & 2A-2
	(viii)	The facility boundary.	SHOWN ON DRAWINGS 2A-1 & 2A-2

LEGEND

- 1220 — EXISTING GROUND CONTOUR (SEE REFERENCE)
- PROPERTY LINE
- ADJACENT PROPERTY LINE
- FACILITY BOUNDARY
- LIMIT OF SOLID WASTE PLACEMENT
- 1000-FT OFFSET FROM LIMIT OF SOLID WASTE PLACEMENT
- WETLANDS AND STREAMS
- WETLAND CONSERVATION EASEMENT
- ▲TBM-1 BENCHMARK LOCATION (SEE TABLE THIS DRAWING)
- OCCUPIED STRUCTURES
- OTHER STRUCTURES
- 34-00709-000 SHULTZ, JOHN 43.36 ACRES — PROPERTY OWNERSHIP INFORMATION (NON-APEX PROPERTY)
- PARCEL #3 APEX ENVIRONMENTAL, LLC 678.004 ACRES — APEX PROPERTY OWNERSHIP INFORMATION

NOTES

1. THIS DRAWING PROVIDES THE INFORMATION REQUIRED IN OAC 3745-27-06(B)(2)(a) AT A SCALE WHICH DEPICTS THE ENTIRE PROPERTY LINE AND FACILITY BOUNDARY. THIS DRAWING WAS ADDED FOR CLARITY. REFER TO SHEETS 2A-1 AND 2A-2 WHICH MEETS THE REQUIREMENTS IN OAC 3745-27-06(B)(2)(a).
2. SEE APPENDIX C1-D FOR APEX PROPERTY SURVEY INFORMATION PROVIDED BY BAIR, GOODIE AND ASSOCIATES, INC. AND PROPERTY DEEDS. ADJACENT PROPERTY LINES ARE COMPILED GIS SHAPE FILE DATA OBTAINED FROM JEFFERSON COUNTY AND HARRISON COUNTY GIS DEPARTMENT AND ARE APPROXIMATE.
3. SEE SECTION C10 OF THE PTI APPLICATION FOR THE WETLANDS AND STREAMS DELINEATION REPORT PREPARED BY CEC.
4. THE FACILITY BOUNDARY WAS OFFSET FROM THE PROPERTY LINE AND COUNTY LINE FOR CLARITY PURPOSES.

REFERENCE

1. EXISTING TOPOGRAPHY PREPARED BY KEDDAL AERIAL MAPPING; DATE OF PHOTOGRAPHY: 1/18/13. ADDITIONAL MAPPING WAS PREPARED BY KEDDAL AERIAL MAPPING FROM AERIAL PHOTOGRAPHY DATED 1/6/12 AND 1/5/11 AND BY M.A.N. MAPPING FROM AERIAL PHOTOGRAPHY DATED 12/14/00.
2. AEP POWER LINE SURVEY PROVIDED BY BGA, CADD FILE: APEX EASEMENT - STRS.44-80.

STATE OF OHIO
RICK BUFFALINI
E-55305
REGISTERED
PROFESSIONAL ENGINEER

12-29-15

SCALE IN FEET
0 300 600

*HAND SIGNATURE ON FILE

Authorized Use:

☐ Survey ☑ Permitting ☐ Construction
☐ Design Dev. ☐ Bidding ☐ -

Civil & Environmental Consultants, Inc.
333 Baldwin Road - Pittsburgh, PA 15205
Ph: 412.429.2324 · 800.365.2324 · Fax: 412.429.2114
www.cecinc.com

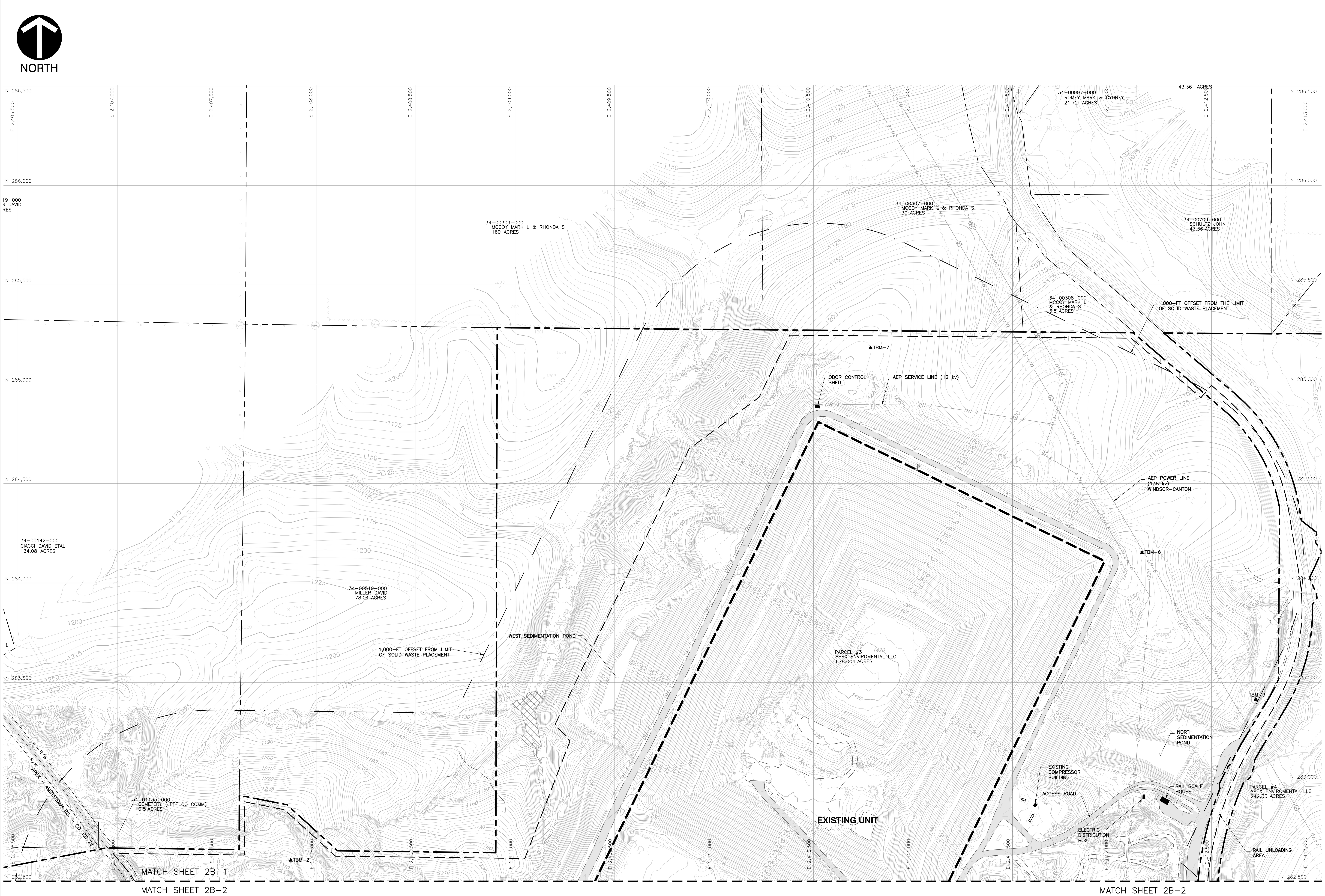
APEX ENVIRONMENTAL, LLC.
PERMIT TO INSTALL APPLICATION
CONTIGUOUS EXPANSION
APEX SANITARY LANDFILL
JEFFERSON COUNTY, OHIO

DRAWN BY:	JM	CHECKED BY:	MRB	APPROVED BY:	RJB*
DATE:	10/17/11	DWG SCALE:	1"=300'	PROJECT NO:	091-867

PROPERTY INFORMATION
(OVERVIEW)

DRAWING NO.: 2A

P:\2009\091-867\1-CAD\DOCS - PTI LATERAL EXPANSION\DWG\091-867PTI2A.DWG[2A1]LAYOUT1 - 12/14/2015 - LP, 12/17/2015_7:45:41_PM



REVISION RECORD

NO	DATE	DESCRIPTION
1	7/2013	UPDATED AERIAL TOPOGRAPHY.
2	12/2015	UPDATED AEP POWER LINE LOCATION.

SUBMITTAL RECORD

NO	DATE	DESCRIPTION

[illegible]

3745-27 RULE REFERENCE			COMMENT
3745-27-06(B)(2)(a)	(i)	The property lines of land owned or leased for the sanitary landfill facility as determined by a property survey conducted by a professional surveyor registered in Ohio; and	SHOWN ON DRAWINGS 2A-1 & 2A-2
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LEGEND

- 1220 — EXISTING GROUND CONTOUR (SEE REFERENCE)
- PROPERTY LINE
- ADJACENT PROPERTY LINE
- FACILITY BOUNDARY
- LIMIT OF SOLID WASTE PLACEMENT
- 1000-FT OFFSET FROM LIMIT OF SOLID WASTE PLACEMENT
- WETLANDS AND STREAMS
- ▲TBM-1 — BENCHMARK LOCATION (SEE TABLE THIS DRAWING)
- OCCUPIED STRUCTURES
- OTHER STRUCTURES
- 34-00709-000 SHULTZ, JOHN 43.36 ACRES — PROPERTY OWNERSHIP INFORMATION (NON-APEX PROPERTY)
- PARCEL #3 APEX ENVIRONMENTAL, LLC 678.004 ACRES — APEX PROPERTY OWNERSHIP INFORMATION

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REFERENCE

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2. AEP POWER LINE SURVEY PROVIDED BY BGA, CADD FILE: APEX EASEMENT - STRS.44-80.

STATE OF OHIO
RICK BUFFALINI
E-55305
REGISTERED
PROFESSIONAL ENGINEER

Rick Buffalini
12-29-15

SCALE IN FEET
0 200 400

*HAND SIGNATURE ON FILE

[illegible]

DESCRIPTION	NORTHING	EASTING	ELEVATION
TBM-1	279202.74	2406169.74	1288.36
TBM-2	282605.19	2407871.35	1304.17
TBM-3	283414.35	2412722.84	1154.60
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Authorized Use:
☐ Survey ☑ Permitting ☐ Construction
☐ Design Dev. ☐ Bidding ☐ -

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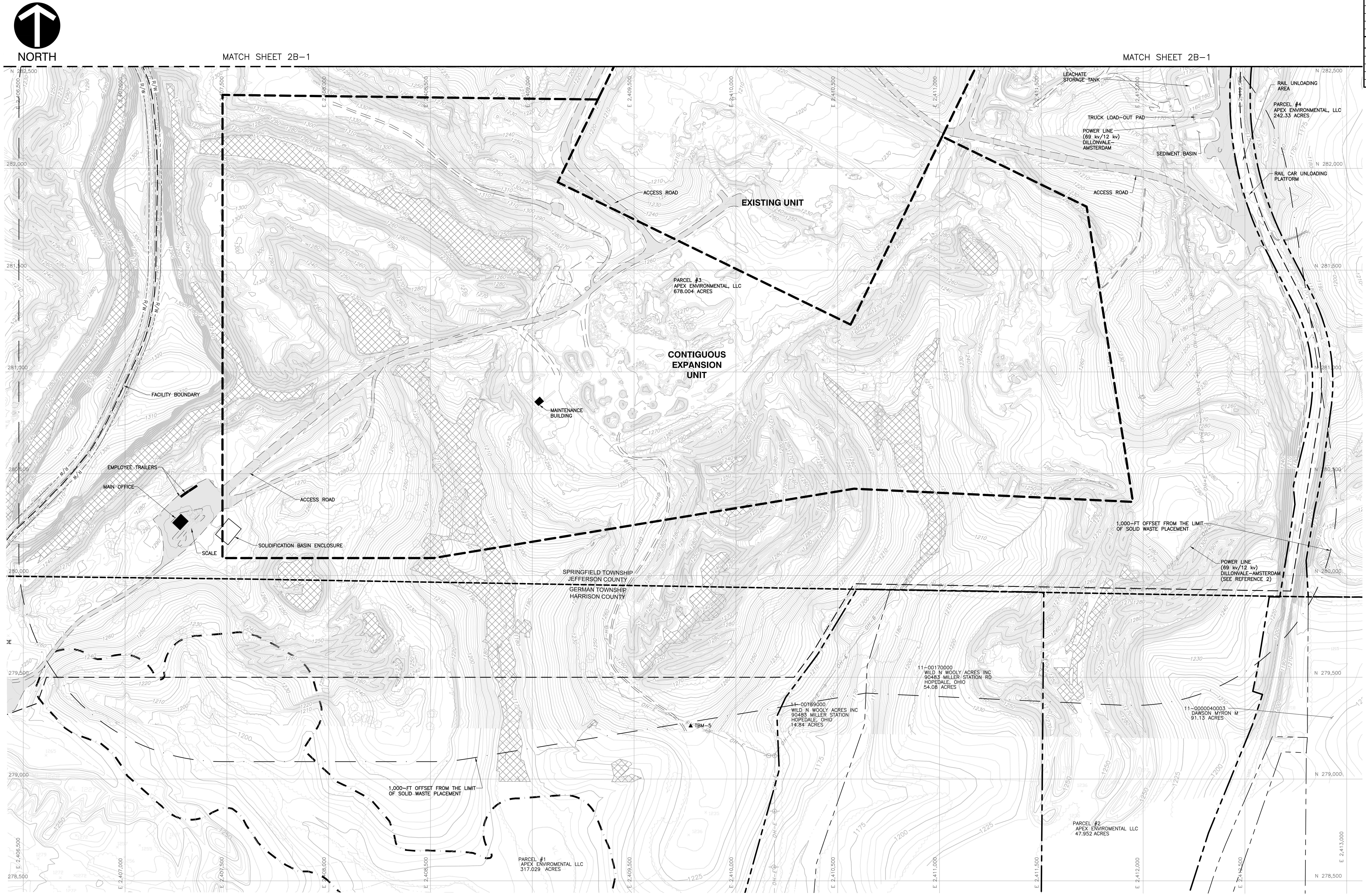
www.cecinc.com

APEX ENVIRONMENTAL, LLC.
PERMIT TO INSTALL APPLICATION
CONTIGUOUS EXPANSION
APEX SANITARY LANDFILL
JEFFERSON COUNTY, OHIO

DRAWN BY:	JM	CHECKED BY:	MRB	APPROVED BY:	RJB*
DATE:	10/17/11	DWG SCALE:	1"=200'	PROJECT NO:	091-867

PROPERTY INFORMATION
(NORTH, 1 OF 2)

DRAWING NO.: 2A-1



REVISION RECORD

NO	DATE	DESCRIPTION
1	7/2013	UPDATED AERIAL TOPOGRAPHY.
2	12/2015	UPDATED PROPERTY OWNERSHIP INFORMATION, ADDED WETLAND CONSERVATION EASEMENTS, AND
		UPDATED AEP POWER LINE LOCATION.

SUBMITTAL RECORD

NO	DATE	DESCRIPTION

O O E E S MM

3745–27 RULE REFERENCE			COMMENT
3745–27–06(B)(2)(a)	(i)	The property lines of land owned or leased for the sanitary landfill facility as determined by a property survey conducted by a professional surveyor registered in Ohio; and	SHOWN ON DRAWINGS 2A–1 & 2A–2
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	(v)	The north arrow; and	SHOWN ON DRAWINGS 2A–1 & 2A–2
	(vi)	The location of all survey marks; and	SHOWN ON DRAWINGS 2A–1 & 2A–2
	(vii)	The unit(s) of the sanitary landfill facility; and	SHOWN ON DRAWINGS 2A–1 & 2A–2
	(viii)	The facility boundary.	SHOWN ON DRAWINGS 2A–1 & 2A–2

LEGEND

Symbol	Description
1220	EXISTING GROUND CONTOUR (SEE REFERENCE)
	PROPERTY LINE
	ADJACENT PROPERTY LINE
	FACILITY BOUNDARY
	LIMIT OF SOLID WASTE PLACEMENT
	1000–FT OFFSET FROM LIMIT OF SOLID WASTE PLACEMENT
	WETLANDS AND STREAMS
	WETLAND CONSERVATION EASEMENT
▲TBM–1	BENCHMARK LOCATION (SEE TABLE THIS DRAWING)
	OCCUPIED STRUCTURES
	OTHER STRUCTURES
34–00709–000 SHULTZ, JOHN 43.36 ACRES	PROPERTY OWNERSHIP INFORMATION (NON–APEX PROPERTY)
PARCEL #3 APEX ENVIRONMENTAL, LLC 678.004 ACRES	APEX PROPERTY OWNERSHIP INFORMATION

NOTES

1. THIS DRAWING PROVIDES THE INFORMATION REQUIRED IN OAC 3745–27–06(B)(2)(a) AT A SCALE WHICH DEPICTS THE ENTIRE PROPERTY LINE AND FACILITY BOUNDARY. THIS DRAWING WAS ADDED FOR CLARITY. REFER TO SHEETS 2A–1 AND 2A–2 WHICH MEETS THE REQUIREMENTS IN OAC 3745–27–06(B)(2)(a).
2. SEE APPENDIX C1–D FOR APEX PROPERTY SURVEY INFORMATION PROVIDED BY BAIR, GOODIE AND ASSOCIATES, INC. AND PROPERTY DEEDS. ADJACENT PROPERTY LINES ARE COMPILED GIS SHAPE FILE DATA OBTAINED FROM JEFFERSON COUNTY AND HARRISON COUNTY GIS DEPARTMENT AND ARE APPROXIMATE.
3. SEE SECTION C10 OF THE PTI APPLICATION FOR THE WETLANDS AND STREAMS DELINEATION REPORT PREPARED BY CEC.
4. THE FACILITY BOUNDARY WAS OFFSET FROM THE PROPERTY LINE AND COUNTY LINE FOR CLARITY PURPOSES.

REFERENCE

1. EXISTING TOPOGRAPHY PREPARED BY KEDDAL AERIAL MAPPING; DATE OF PHOTOGRAPHY: 1/18/13. ADDITIONAL MAPPING WAS PREPARED BY KEDDAL AERIAL MAPPING FROM AERIAL PHOTOGRAPHY DATED 1/6/12 AND 1/5/11 AND BY M.A.N. MAPPING FROM AERIAL PHOTOGRAPHY DATED 12/14/00.
2. AEP POWER LINE SURVEY PROVIDED BY BGA, CADD FILE: APEX EASEMENT – STRS.44–80.

STATE OF OHIO
RICK BUFFALINI
E–55305
REGISTERED
PROFESSIONAL ENGINEER

12-29-15

SCALE IN FEET
0 200 400

*HAND SIGNATURE ON FILE

Authorized Use:

☐ Survey ☑ Permitting ☐ Construction
☐ Design Dev. ☐ Bidding ☐ -

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APEX ENVIRONMENTAL, LLC.
PERMIT TO INSTALL APPLICATION
CONTIGUOUS EXPANSION
APEX SANITARY LANDFILL
JEFFERSON COUNTY, OHIO

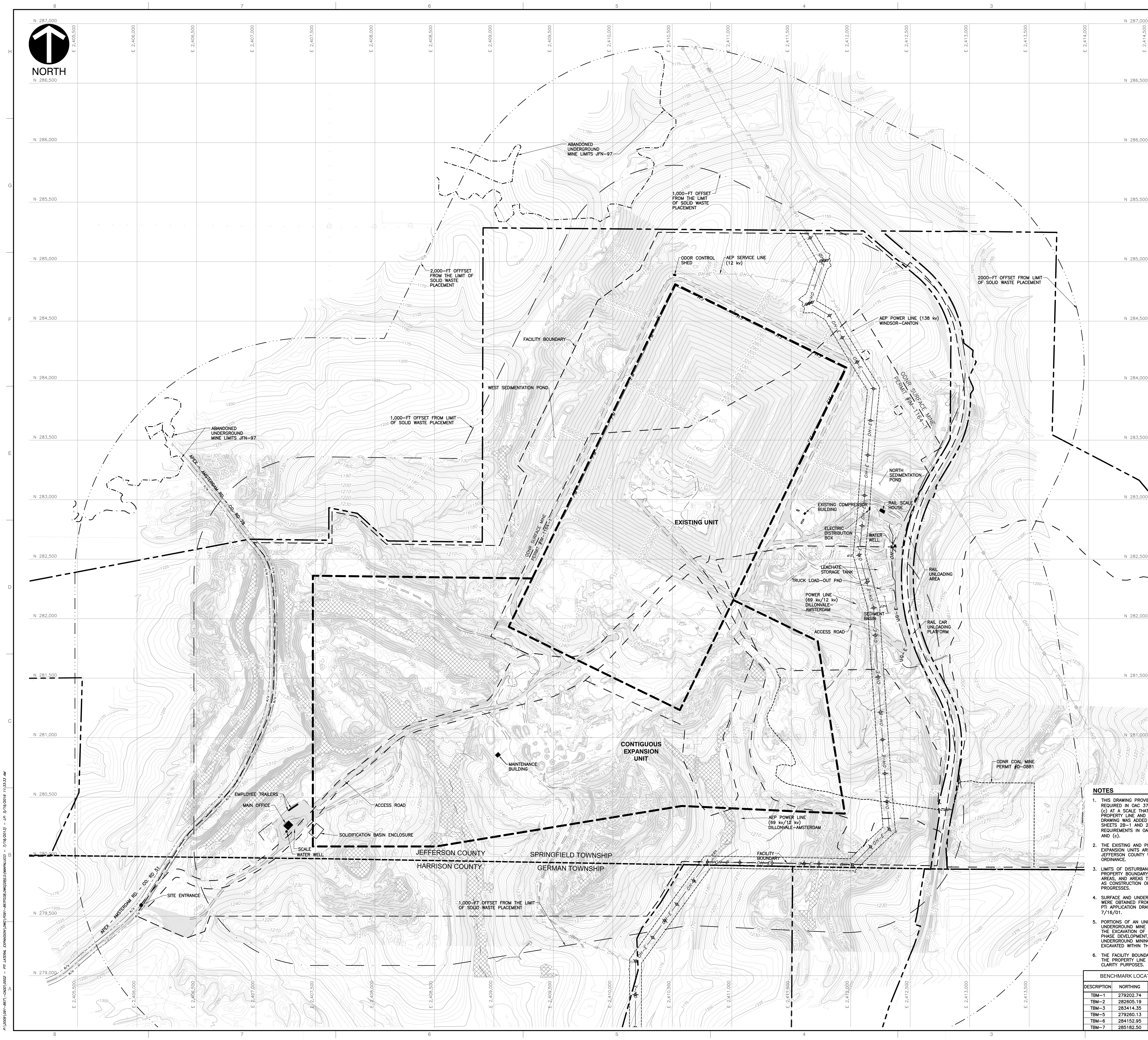
B C MA CA MA

DESCRIPTION	NORTHING	EASTING	ELEVATION
TBM–1	279202.74	2406169.74	1288.36
TBM–2	282605.19	2407871.35	1304.17
TBM–3	283414.35	2412722.84	1154.60
TBM–5	279260.13	2409777.80	1246.77
TBM–6	284152.95	2412150.85	1223.74
TBM–7	285182.50	2410786.21	1220.14

DRAWN BY:	JM	CHECKED BY:	MRB	APPROVED BY:	RJB*
DATE:	10/17/11	DWG SCALE:	1"=200'	PROJECT NO:	091-867

PROPERTY INFORMATION (SOUTH, 2 OF 2)

DRAWING NO.: 2A-2



REVISION RECORD

NO	DATE	DESCRIPTION
1	7/2013	UPDATED AERIAL TOPOGRAPHY.

SUBMITTAL RECORD

NO	DATE	DESCRIPTION

O OE ES MM

3745-27-RULE REFERENCE			COMMENT
3745-27-06(B)(2)(b)	(i)	All zoning classifications, property owners, political subdivisions; and	SHOWN ON DRAWINGS 2A, 2B-1 & 2B-2.
	(ii)	All man-made potential explosive gas migration pathways, including underground utilities (sewers, water lines, electrical cables), field tiles, french drains, pipelines, and all other potential sources of explosive gas including oil wells and gas wells and other landfills; and	SHOWN ON DRAWINGS 2C-1 & 2C-2.
	(iii)	The limits of a regulatory floodplain; and	NONE WITHIN 1,000-FT OF WASTE PLACEMENT.
	(iv)	National park or recreation areas, candidate areas for potential inclusion into the national park system, and any state park or established state park purchase areas; and	NONE WITHIN 1,000-FT OF WASTE PLACEMENT.
	(v)	State nature preserves, state wildlife areas, national and state scenic rivers, any national wildlife refuge, special interest areas, research natural areas, in the Wayne National Forest, outstanding national resource waters, and exceptional coldwater habitats, or exceptional warm water habitats as defined in chapter 3745-1 of the Administrative Code; and	NONE WITHIN 1,000-FT OF WASTE PLACEMENT.
	(vi)	All public and private water supply wells within two thousand feet of the limits of solid waste placement; and	SHOWN ON DRAWING 2B.
	(vii)	The limits of all wellhead protection areas or groundwater source water assessment and protection areas that have been endorsed or delineated by the Ohio EPA for a public water supply; and	NONE WITHIN 1,000-FT OF WASTE PLACEMENT.
	(viii)	Faults that have had displacement in holocene time; and	NONE WITHIN 1,000-FT OF WASTE PLACEMENT.
	(ix)	All surface and underground mining of coal and noncoal minerals within two thousand feet of the limits of solid waste placement and all oil & gas wells; and	SHOWN ON DRAWINGS 2B-1 & 2B-2. (SEE NOTES 4 & 5)
	(x)	The limits of all aquifers declared by the federal government under the "Safe Drinking Water Act" to be a sole source aquifer.	NONE WITHIN 1,000-FT OF WASTE PLACEMENT.
3745-27-06(B)(2)(c)	The limits of disturbance and the facility boundary. The limits of disturbance include but is not limited to the limits of excavation, borrow areas, storage areas, staging areas, areas to be cleared and grubbed, and roadways.		SHOWN ON DRAWINGS 2B-1 & 2B-2. (SEE NOTE 3)

LEGEND

- 1220 — EXISTING GROUND CONTOUR (SEE REFERENCE)
- PROPERTY LINE
- FACILITY BOUNDARY
- LIMIT OF SOLID WASTE PLACEMENT
- 1000-FT OFFSET FROM LIMIT OF SOLID WASTE PLACEMENT
- 2000-FT OFFSET FROM LIMIT OF SOLID WASTE PLACEMENT
- WETLANDS AND STREAMS
- TBM-1 — BENCHMARK LOCATION (SEE TABLE THIS DRAWING)
- OCCUPIED STRUCTURES
- OTHER STRUCTURES
- UNDERGROUND MINE LIMITS JFN-97
- ODNR SURFACE MINE PERMIT IM-1164-1
- ODNR SURFACE MINE PERMIT IM-1164
- ODNR COAL MINE PERMIT D-0881
- WATER SUPPLY WELL

REFERENCE

EXISTING TOPOGRAPHY PREPARED BY KEDDAL AERIAL MAPPING; DATE OF PHOTOGRAPHY: 1/18/13. ADDITIONAL MAPPING WAS PREPARED BY KEDDAL AERIAL MAPPING FROM AERIAL PHOTOGRAPHY DATED 1/6/12 AND 1/5/11 AND BY M.A.N. MAPPING FROM AERIAL PHOTOGRAPHY DATED 12/14/00.

STATE OF OHIO
RICK BUFFALINI
E-55305
REGISTERED
PROFESSIONAL ENGINEER

Rick B. Buffalini
7-18-13

SCALE IN FEET

*HAND SIGNATURE ON FILE

NOTES

1. THIS DRAWING PROVIDES THE INFORMATION REQUIRED IN OAC 3745-27-06(B)(2)(b) AND (c) AT A SCALE THAT DEPICTS THE ENTIRE PROPERTY LINE AND FACILITY BOUNDARY. THIS DRAWING WAS ADDED FOR CLARITY. REFER TO SHEETS 2B-1 AND 2B-2 WHICH MEET THE REQUIREMENTS IN OAC 3745-27-06(B)(2)(b) AND (c).
2. THE EXISTING AND PROPOSED CONTIGUOUS EXPANSION UNITS ARE LOCATED WITHIN JEFFERSON COUNTY WHICH HAS NO ZONING ORDINANCE.
3. LIMITS OF DISTURBANCE MAY EXTEND TO THE PROPERTY BOUNDARY. STORAGE AREAS, STAGING AREAS, AND AREAS TO BE CLEARED WILL MOVE AS CONSTRUCTION OF THE FACILITY PROGRESSES.
4. SURFACE AND UNDERGROUND MINING LIMITS WERE OBTAINED FROM LINN ENGINEERING. INC. PTI APPLICATION DRAWING 2A-1 DATED 7/16/01.
5. PORTIONS OF AN UNDOCUMENTED UNDERGROUND MINE WERE DISCOVERED DURING THE EXCAVATION OF PHASE 4. DURING FUTURE PHASE DEVELOPMENT, ANY FURTHER UNDERGROUND MINING REMNANTS WILL BE EXCAVATED WITHIN THE MINE ANGLE OF DRAW.
6. THE FACILITY BOUNDARY WAS OFFSET FROM THE PROPERTY LINE AND COUNTY LINE FOR CLARITY PURPOSES.

BENCHMARK LOCATION INFORMATION

DESCRIPTION	NORTHING	EASTING	ELEVATION
TBM-1	279202.74	2406169.74	1288.36
TBM-2	282605.19	2407871.35	1304.17
TBM-3	283414.35	2412722.84	1154.60
TBM-5	279260.13	2409777.80	1246.77
TBM-6	284152.95	2412150.85	1223.74
TBM-7	285182.50	2410786.21	1220.14

Authorized Use:

☐ Survey ☑ Permitting ☐ Construction
☐ Design Dev. ☐ Bidding ☐ -

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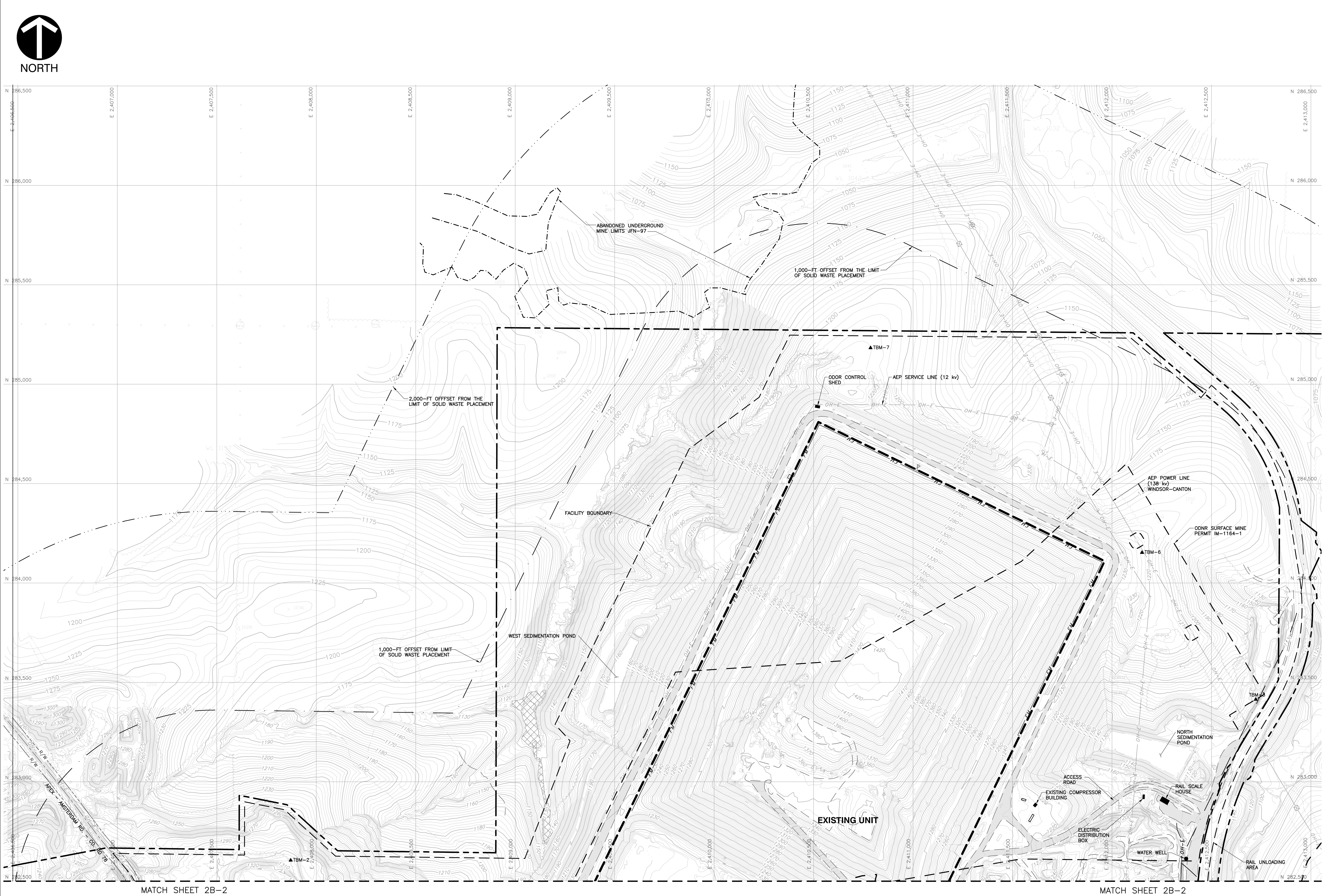
www.cecinc.com

APEX ENVIRONMENTAL, LLC.
PERMIT TO INSTALL APPLICATION
CONTIGUOUS EXPANSION
APEX SANITARY LANDFILL
JEFFERSON COUNTY, OHIO

DRAWN BY:	JM	CHECKED BY:	MRB	APPROVED BY:	RJB*
DATE:	10/17/11	DWG SCALE:	1"=300'	PROJECT NO:	091-867

PUBLICLY AVAILABLE INFORMATION (OVERVIEW)

DRAWING NO.: 2B



REVISION RECORD

NO	DATE	DESCRIPTION
1	7/2013	UPDATED AERIAL TOPOGRAPHY.
2	12/2015	UPDATED AEP POWER LINE LOCATION.

SUBMITTAL RECORD

NO	DATE	DESCRIPTION

O□ □OE□□ □□□□E□S□ MM□□□

3745-27-RULE REFERENCE			COMMENT
3745-27-06(B)(2)(b)	(i)	All zoning classifications, property owners, political subdivisions; and	SHOWN ON DRAWINGS 2A, 2B-1 & 2B-2.
	(ii)	All man-made potential explosive gas migration pathways, including underground utilities (sewers, water lines, electrical cables), field tiles, french drains, pipelines, and all other potential sources of explosive gas including oil wells and gas wells and other landfills; and	SHOWN ON DRAWINGS 2C-1 & 2C-2.
	(iii)	The limits of a regulatory floodplain; and	NONE WITHIN 1,000-FT OF WASTE PLACEMENT.
	(iv)	National park or recreation areas, candidate areas for potential inclusion into the national park system, and any state park or established state park purchase areas; and	NONE WITHIN 1,000-FT OF WASTE PLACEMENT.
	(v)	State nature preserves, state wildlife areas, national and state scenic rivers, any national wildlife refuge, special interest areas, research natural areas, in the Wayne National Forest, outstanding national resource waters, and exceptional coldwater habitats, or exceptional warm water habitats as defined in chapter 3745-1 of the Administrative Code; and	NONE WITHIN 1,000-FT OF WASTE PLACEMENT.
	(vi)	All public and private water supply wells within two thousand feet of the limits of solid waste placement; and	SHOWN ON DRAWINGS 2B-1 AND 2B-2.
	(vii)	The limits of all wellhead protection areas or groundwater source water assessment and protection areas that have been endorsed or delineated by the Ohio EPA for a public water supply; and	NONE WITHIN 1,000-FT OF WASTE PLACEMENT.
	(viii)	Faults that have had displacement in holocene time; and	NONE WITHIN 1,000-FT OF WASTE PLACEMENT.
	(ix)	All surface and underground mining of coal and noncoal minerals within two thousand feet of the limits of solid waste placement and all oil & gas wells; and	SHOWN ON DRAWINGS 2B-1 & 2B-2. (SEE NOTES 4 & 6)
	(x)	The limits of all aquifers declared by the federal government under the "Safe Drinking Water Act" to be a sole source aquifer.	NONE WITHIN 1,000-FT OF WASTE PLACEMENT.
3745-27-06(B)(2)(c)		The limits of disturbance and the facility boundary. The limits of disturbance include but is not limited to the limits of excavation, borrow areas, storage areas, staging areas, areas to be cleared and grubbed, and roadways.	SHOWN ON DRAWINGS 2B-1 & 2B-2. (SEE NOTE 3)

LEGEND

- 1220 — EXISTING GROUND CONTOUR (SEE REFERENCE)
- PROPERTY LINE
- FACILITY BOUNDARY
- LIMIT OF SOLID WASTE PLACEMENT
- 1000-FT OFFSET FROM LIMIT OF SOLID WASTE PLACEMENT
- 2000-FT OFFSET FROM LIMIT OF SOLID WASTE PLACEMENT
- WETLANDS AND STREAMS
- TBM-1 — BENCHMARK LOCATION (SEE TABLE THIS DRAWING)
- OCCUPIED STRUCTURES
- OTHER STRUCTURES
- UNDERGROUND MINE LIMITS JFN-97
- ODNR SURFACE MINE PERMIT IM-1164-1
- ODNR SURFACE MINE PERMIT IM-1164
- ODNR COAL MINE PERMIT D-0881
- WATER SUPPLY WELL

REFERENCE

1. EXISTING TOPOGRAPHY PREPARED BY KEDDAL AERIAL MAPPING; DATE OF PHOTOGRAPHY: 1/18/13. ADDITIONAL MAPPING WAS PREPARED BY KEDDAL AERIAL MAPPING FROM AERIAL PHOTOGRAPHY DATED 1/6/12 AND 1/5/11 AND BY M.A.N. MAPPING FROM AERIAL PHOTOGRAPHY DATED 12/14/00.
2. AEP POWER LINE SURVEY PROVIDED BY BGA, CADD FILE: APEX EASEMENT - STR5.44-80.

STATE OF OHIO
RICK BUFFALINI
E-55305
REGISTERED
PROFESSIONAL ENGINEER

Rick Buffalini
12-29-15

SCALE IN FEET
0 200 400

*HAND SIGNATURE ON FILE

NOTES

1. THIS DRAWING PROVIDES THE INFORMATION REQUIRED IN OAC 3745-27-06(B)(2)(b) AND (c).
2. THE EXISTING UNIT IS LOCATED WITHIN JEFFERSON COUNTY AND HAS NO ZONING ORDINANCE.
3. LIMITS OF DISTURBANCE MAY EXTEND TO THE PROPERTY BOUNDARY. STORAGE AREAS, STAGING AREAS, AND AREAS TO BE CLEARED WILL MOVE AS CONSTRUCTION OF THE FACILITY PROGRESSES.
4. SURFACE AND UNDERGROUND MINING LIMITS WERE OBTAINED FROM LINN ENGINEERING. INC. PTI APPLICATION DRAWING 2A-1 DATED 7/16/01.
5. THE FACILITY BOUNDARY WAS OFFSET FROM THE PROPERTY LINE AND COUNTY LINE FOR CLARITY PURPOSES.
6. PORTIONS OF AN UNDOCUMENTED UNDERGROUND MINE WERE DISCOVERED DURING THE EXCAVATION OF PHASE 4. DURING FUTURE PHASE DEVELOPMENT, ANY FURTHER UNDERGROUND MINING REMNANTS WILL BE EXCAVATED WITHIN THE MINE ANGLE OF DRAW.

B□□C□MA□□ □□CA□□□ □□□□MA□□□

DESCRIPTION	NORTHING	EASTING	ELEVATION
TBM-1	279202.74	2406169.74	1288.36
TBM-2	282605.19	2407871.35	1304.17
TBM-3	283414.35	2412722.84	1154.60
TBM-5	279260.13	2409777.80	1246.77
TBM-6	284152.95	2412150.85	1223.74
TBM-7	285182.50	2410786.21	1220.14

Authorized Use:

- ☐ Survey
- ☐ Design Dev.
- ☑ Permitting
- ☐ Bidding
- ☐ Construction
- ☐ -

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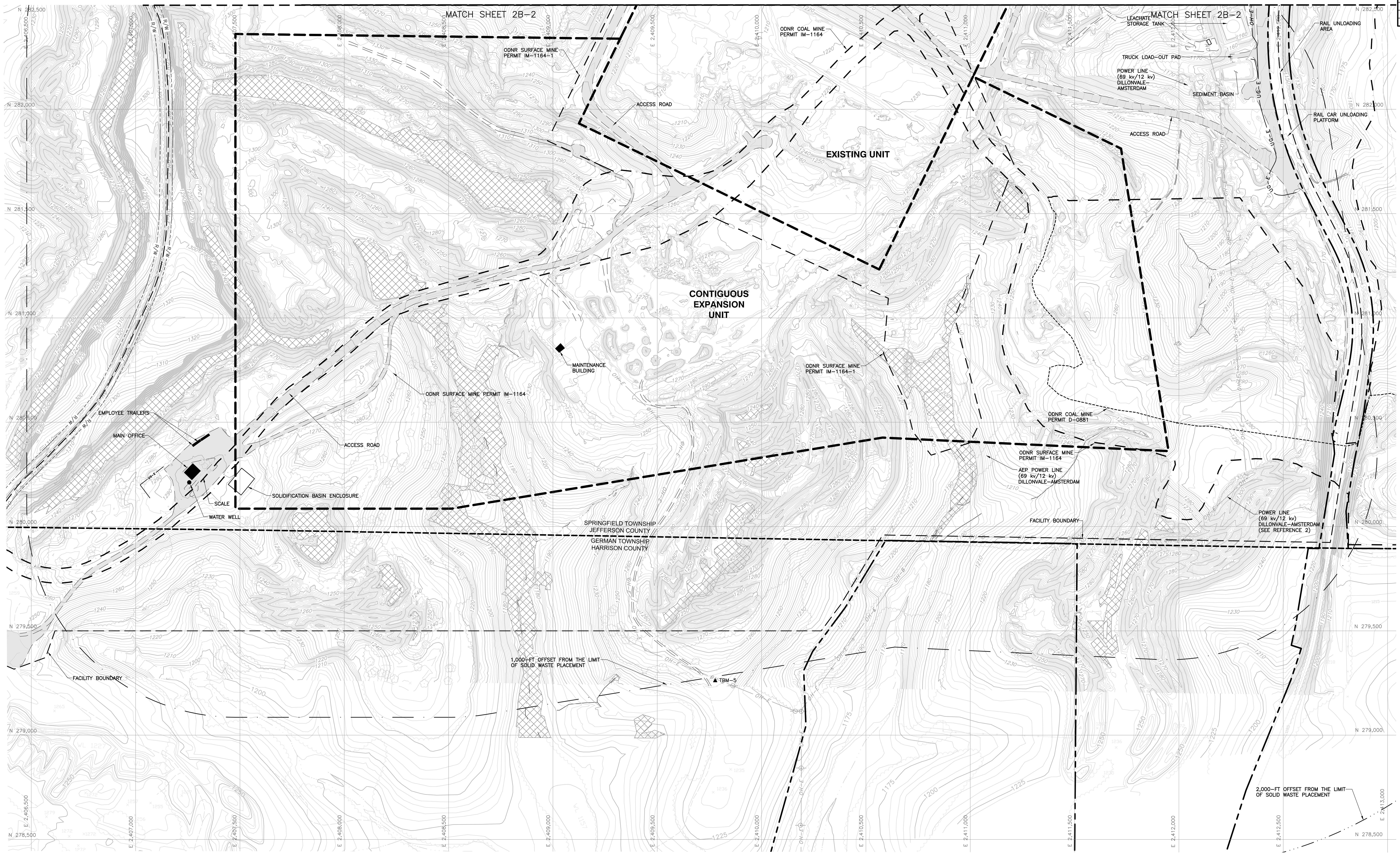
APEX ENVIRONMENTAL, LLC.
PERMIT TO INSTALL APPLICATION
CONTIGUOUS EXPANSION
APEX SANITARY LANDFILL
JEFFERSON COUNTY, OHIO

DRAWN BY: JM	CHECKED BY: MRB	APPROVED BY: RJB*
DATE: 10/17/11	DWG SCALE: 1"=200'	PROJECT NO: 091-867

PUBLICLY AVAILABLE INFORMATION (NORTH, 1 OF 2)

DRAWING NO.: 2B-1



REVISION RECORD

NO	DATE	DESCRIPTION
1	7/2013	UPDATED AERIAL TOPOGRAPHY.
2	12/2015	UPDATED PROPERTY OWNERSHIP INFORMATION AND UPDATED AEP POWER LINE LOCATION.

SUBMITTAL RECORD

NO	DATE	DESCRIPTION

O OE E S MM

3745–27–RULE REFERENCE			COMMENT
3745–27–06(B)(2)(b)	(i)	All zoning classifications, property owners, political subdivisions; and	SHOWN ON DRAWINGS 2A, 2B–1 & 2B–2.
	(ii)	All man–made potential explosive gas migration pathways, including underground utilities (sewers, water lines, electrical cables), field tiles, french drains, pipelines, and all other potential sources of explosive gas including oil wells and gas wells and other landfills; and	SHOWN ON DRAWINGS 2C–1 & 2C–2.
	(iii)	The limits of a regulatory floodplain; and	NONE WITHIN 1,000–FT OF WASTE PLACEMENT.
	(iv)	National park or recreation areas, candidate areas for potential inclusion into the national park system, and any state park or established state park purchase areas; and	NONE WITHIN 1,000–FT OF WASTE PLACEMENT.
	(v)	State nature preserves, state wildlife areas, national and state scenic rivers, any national wildlife refuge, special interest areas, research natural areas, in the Wayne National Forest, outstanding national resource waters, and exceptional coldwater habitats, or exceptional warm water habitats as defined in chapter 3745–1 of the Administrative Code; and	NONE WITHIN 1,000–FT OF WASTE PLACEMENT.
	(vi)	All public and private water supply wells within two thousand feet of the limits of solid waste placement; and	SHOWN ON DRAWINGS 2B–1 AND 2B–2.
	(vii)	The limits of all wellhead protection areas or groundwater source water assessment and protection areas that have been endorsed or delineated by the Ohio EPA for a public water supply; and	NONE WITHIN 1,000–FT OF WASTE PLACEMENT.
	(viii)	Faults that have had displacement in holocene time; and	NONE WITHIN 1,000–FT OF WASTE PLACEMENT.
	(ix)	All surface and underground mining of coal and noncoal minerals within two thousand feet of the limits of solid waste placement and all oil & gas wells; and	SHOWN ON DRAWINGS 2B–1 & 2B–2. (SEE NOTES 4 & 6)
	(x)	The limits of all aquifers declared by the federal government under the "Safe Drinking Water Act" to be a sole source aquifer.	NONE WITHIN 1,000–FT OF WASTE PLACEMENT.
3745–27–06(B)(2)(c)	The limits of disturbance and the facility boundary. The limits of disturbance include but is not limited to the limits of excavation, borrow areas, storage areas, staging areas, areas to be cleared and grubbed, and roadways.		SHOWN ON DRAWINGS 2B–1 & 2B–2. (SEE NOTE 3)

LEGEND

- 1220 — EXISTING GROUND CONTOUR (SEE REFERENCE)
- PROPERTY LINE
- FACILITY BOUNDARY
- LIMIT OF SOLID WASTE PLACEMENT
- 1000–FT OFFSET FROM LIMIT OF SOLID WASTE PLACEMENT
- 2000–FT OFFSET FROM LIMIT OF SOLID WASTE PLACEMENT
- WETLANDS AND STREAMS
- TBM–1 BENCHMARK LOCATION (SEE TABLE THIS DRAWING)
- OCCUPIED STRUCTURES
- OTHER STRUCTURES
- UNDERGROUND MINE LIMITS JFN–97
- ODNR SURFACE MINE PERMIT IM–1164–1
- ODNR SURFACE MINE PERMIT IM–1164
- ODNR COAL MINE PERMIT D–0881
- WATER SUPPLY WELL

REFERENCE

1. EXISTING TOPOGRAPHY PREPARED BY KEDDAL AERIAL MAPPING; DATE OF PHOTOGRAPHY: 1/18/13. ADDITIONAL MAPPING WAS PREPARED BY KEDDAL AERIAL MAPPING FROM AERIAL PHOTOGRAPHY DATED 1/6/12 AND 1/5/11 AND BY M.A.N. MAPPING FROM AERIAL PHOTOGRAPHY DATED 12/14/00.
2. AEP POWER LINE SURVEY PROVIDED BY BGA, CADD FILE: APEX EASEMENT – STRS.44–80.

STATE OF OHIO
RICK BUFFALINI
E-55305
REGISTERED
PROFESSIONAL ENGINEER

12-29-15

SCALE IN FEET
0 200 400

*HAND SIGNATURE ON FILE

NOTES

1. THIS DRAWING PROVIDES THE INFORMATION REQUIRED IN OAC 3745–27–06(B)(2)(b) AND (c).
2. THE EXISTING UNIT IS LOCATED WITHIN JEFFERSON COUNTY AND HAS NO ZONING ORDINANCE.
3. LIMITS OF DISTURBANCE MAY EXTEND TO THE PROPERTY BOUNDARY. STORAGE AREAS, STAGING AREAS, AND AREAS TO BE CLEARED WILL MOVE AS CONSTRUCTION OF THE FACILITY PROGRESSES.
4. SURFACE AND UNDERGROUND MINING LIMITS WERE OBTAINED FROM LINN ENGINEERING. INC. PTI APPLICATION DRAWING 2A–1 DATED 7/16/01.
5. THE FACILITY BOUNDARY WAS OFFSET FROM THE PROPERTY LINE AND COUNTY LINE FOR CLARITY PURPOSES.
6. PORTIONS OF AN UNDOCUMENTED UNDERGROUND MINE WERE DISCOVERED DURING THE EXCAVATION OF PHASE 4. DURING FUTURE PHASE DEVELOPMENT, ANY FURTHER UNDERGROUND MINING REMNANTS WILL BE EXCAVATED WITHIN THE MINE ANGLE OF DRAW.

Authorized Use:

☐ Survey ☑ Permitting ☐ Construction
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B C MA CA MA

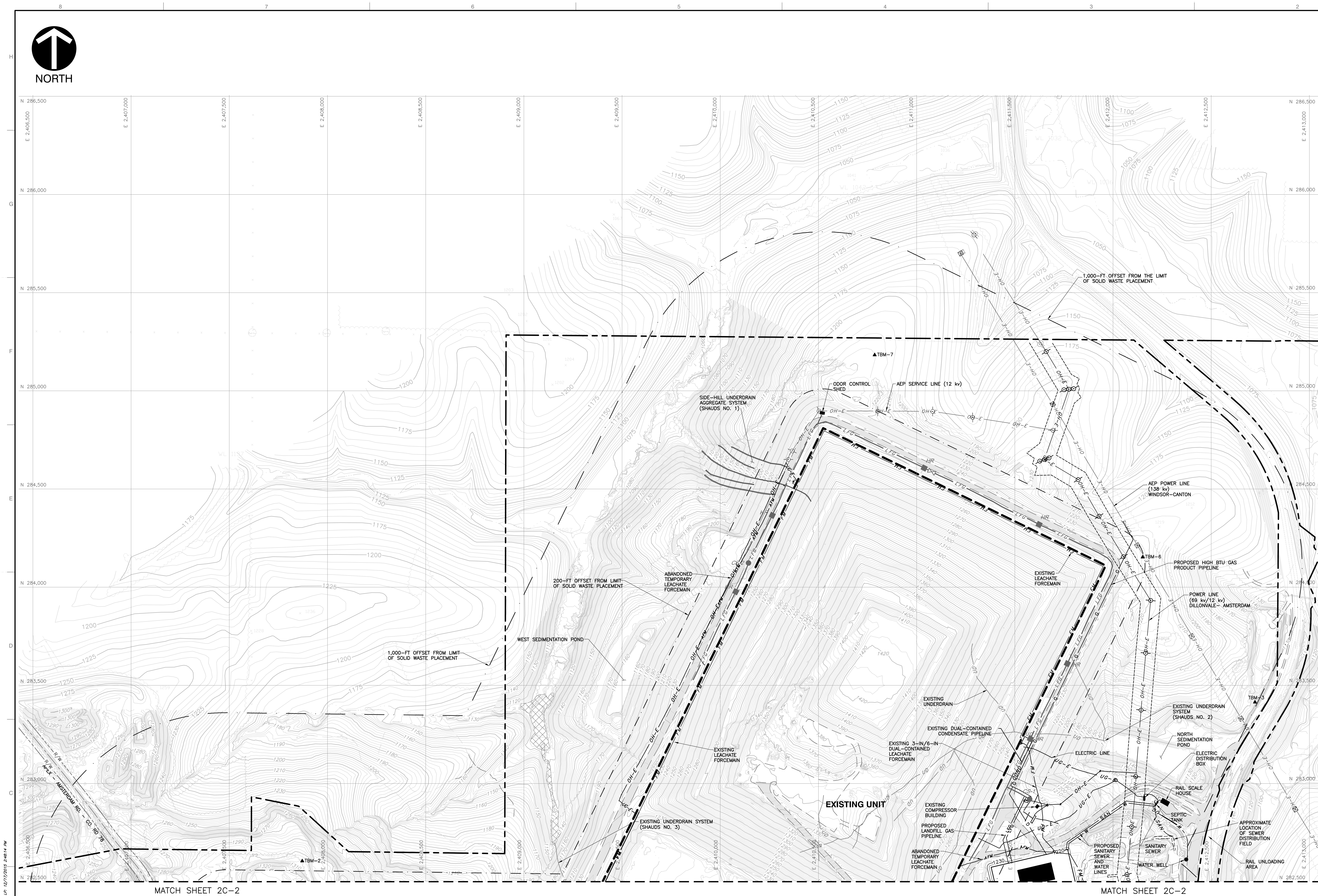
DESCRIPTION	NORTHING	EASTING	ELEVATION
TBM–1	279202.74	2406169.74	1288.36
TBM–2	282605.19	2407871.35	1304.17
TBM–3	283414.35	2412722.84	1154.60
TBM–5	279260.13	2409777.80	1246.77
TBM–6	284152.95	2412150.85	1223.74
TBM–7	285182.50	2410786.21	1220.14

APEX ENVIRONMENTAL, LLC.
PERMIT TO INSTALL APPLICATION
CONTIGUOUS EXPANSION
APEX SANITARY LANDFILL
JEFFERSON COUNTY, OHIO

DRAWN BY: JM	CHECKED BY: MRB	APPROVED BY: RJB*
DATE: 10/17/11	DWG SCALE: 1"=200'	PROJECT NO: 091-867

PUBLICLY AVAILABLE INFORMATION
(SOUTH, 2 OF 2)

DRAWING NO.: 2B-2



REVISION RECORD

NO	DATE	DESCRIPTION
1	7/2013	RESPONSE TO OHIO EPA NOD DATED 12/28/12.
2	12/2015	UPDATED AEP POWER LINE LOCATION.

SUBMITTAL RECORD

NO	DATE	DESCRIPTION

[illegible]

3745-27-RULE REFERENCE			COMMENT
3745-27-06(B)(2)(b)	(ii)	All man-made potential explosive gas migration pathways, including underground utilities (sewers, water lines, electrical cables), field tiles, french drains, pipelines, and all other potential sources of explosive gas including oil wells and gas wells and other landfills; and	SHOWN ON DRAWINGS 2C-1 & 2C-2.

LEGEND

- 1220 — EXISTING GROUND CONTOUR (SEE REFERENCE)
- PROPERTY LINE
- LIMIT OF SOLID WASTE PLACEMENT
- 1000-FT OFFSET FROM LIMIT OF SOLID WASTE PLACEMENT
- 200-FT OFFSET FROM LIMIT OF SOLID WASTE PLACEMENT
- WETLANDS AND STREAMS
- TBM-6 — BENCHMARK LOCATION (SEE TABLE THIS DRAWING)
- OCCUPIED STRUCTURES
- OTHER STRUCTURES
- FM — EXISTING LEACHATE FORCEMAIN
- FM — PROPOSED LEACHATE FORCEMAIN
- AFM — ABANDONED LEACHATE FORCEMAIN
- GRAV — EXISTING LEACHATE GRAVITY LINE
- GRAV — PROPOSED LEACHATE GRAVITY LINE
- UD — EXISTING UNDERDRAIN PIPE
- UD — PROPOSED UNDERDRAIN PIPE
- SAN — EXISTING SANITARY SEWER LINE
- SAN — PROPOSED SANITARY SEWER LINE
- W — EXISTING WATER LINE
- W — PROPOSED WATER LINE
- UG-E — EXISTING UNDERGROUND ELECTRIC LINE
- UG-E — PROPOSED UNDERGROUND ELECTRIC LINE
- OH-E — EXISTING OVERHEAD ELECTRIC LINE
- G — PROPOSED PRODUCT GAS PIPELINE
- LFG — PROPOSED LANDFILL GAS LINE
- COND — EXISTING DUAL-CONTAINED CONDENSATE PIPELINE
- COND — PROPOSED DUAL-CONTAINED CONDENSATE PIPELINE
- LFG — EXISTING LANDFILL GAS HEADER PIPE
- CS-1 — CONDENSATE SUMP

NOTES

1. THIS DRAWING PROVIDES THE INFORMATION REQUIRED IN OAC 3745-27-06(B)(2)(b)(ii).
2. POTENTIAL GAS MIGRATION PATHWAYS INCLUDE UNDERGROUND UTILITIES.
3. UTILITIES PROVIDED BY BAIR GOODIE & ASSOCIATES, INC. SHEET TITLE: UTILITY RECORD DRAWING OVERALL SITE PLAN, DATED: 10/30/07. UPDATED UTILITIES AND GAS COLECTION CONTROL SYSTEM, PROVIDED BY BAIR GOODIE & ASSOCIATES, INC. SHEET TITLE: RECORD DRAWING 2010 GCCS STAGE 1 CONSTRUCTION, DATED: 12/29/10.
4. PROPOSED GAS PROCESSING PLANT AND ASSOCIATED APPURTENANCES ARE SHOWN IN APPROXIMATE LOCATIONS. ACTUAL LOCATIONS WILL BE DETERMINED TO SUIT FIELD CONDITIONS.
5. PROPOSED UNDERDRAIN LOCATIONS MAY CHANGE BASED ON SITE CONDITIONS.

REFERENCE

1. EXISTING TOPOGRAPHY PREPARED BY KEDDAL AERIAL MAPPING; DATE OF PHOTOGRAPHY: 1/18/13. ADDITIONAL MAPPING WAS PREPARED BY KEDDAL AERIAL MAPPING FROM AERIAL PHOTOGRAPHY DATED 1/6/12 AND 1/5/11 AND BY M.A.N. MAPPING FROM AERIAL PHOTOGRAPHY DATED 12/14/00.
2. AEP POWER LINE SURVEY PROVIDED BY BGA, CADD FILE: APEX EASEMENT – STRS.44–80.

STATE OF OHIO
RICK BUFFALINI
E-55305
REGISTERED
PROFESSIONAL ENGINEER

12-29-15

SCALE IN FEET
0 200 400

*HAND SIGNATURE ON FILE

Authorized Use:
☐ Survey ☑ Permitting ☐ Construction
☐ Design Dev. ☐ Bidding ☐ -

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333 Baldwin Road - Pittsburgh, PA 15205
Ph: 412.429.2324 · 800.365.2324 · Fax: 412.429.2114
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APEX ENVIRONMENTAL, LLC.
PERMIT TO INSTALL APPLICATION
CONTIGUOUS EXPANSION
APEX SANITARY LANDFILL
JEFFERSON COUNTY, OHIO

DRAWN BY: JM	CHECKED BY: MRB	APPROVED BY: RJB*	
DATE: 10/17/11	DWG SCALE: 1"=200'	PROJECT NO: 091-867	

MAN-MADE POTENTIAL EXPLOSIVE GAS MIGRATION PATHWAYS (NORTH, 1 OF 2)

DRAWING NO.: 2C-1

[illegible]

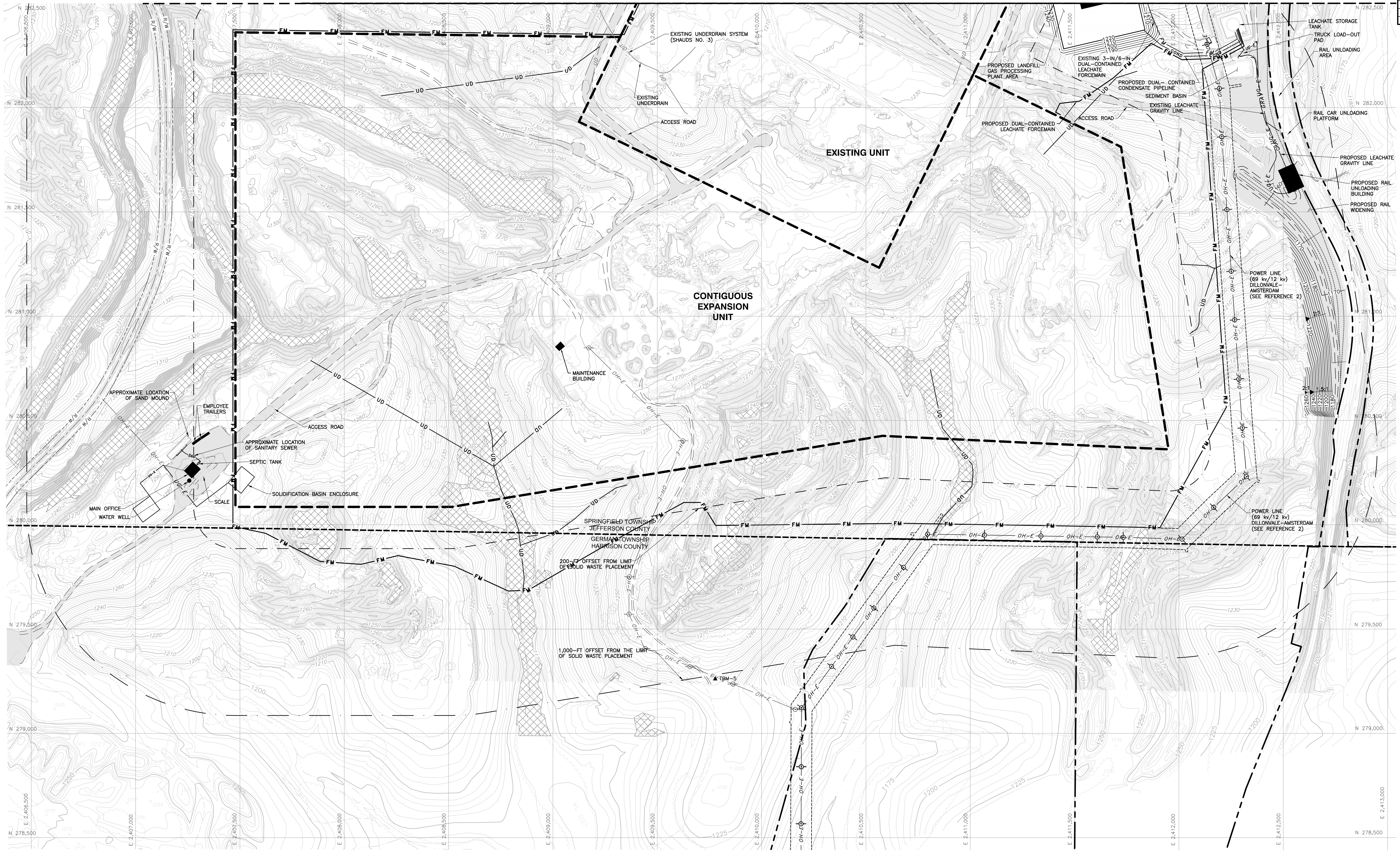
DESCRIPTION	NORTHING	EASTING	ELEVATION
TBM-1	279202.74	2406169.74	1288.36
TBM-2	282605.19	2407871.35	1304.17
TBM-3	283414.35	2412722.84	1154.60
TBM-5	279260.13	2409777.80	1246.77
TBM-6	284152.95	2412150.85	1223.74
TBM-7	285182.50	2410786.21	1220.14

REVISION RECORD		
NO	DATE	DESCRIPTION
1	7/2013	RESPONSE TO OHIO EPA NOD DATED 12/28/12.
2	12/2015	UPDATED AEP POWER LINE LOCATION. REVISED UNDERDRAIN SYSTEM IN RESPONSE TO OHIO EPA NOD DATED 6/18/2015.

SUBMITTAL RECORD		
NO	DATE	DESCRIPTION

NORTH

MATCH SHEET 2C-1



[illegible]

3745-27-RULE REFERENCE			COMMENT
3745-27-06(B)(2)(b)	(ii)	All man-made potential explosive gas migration pathways, including underground utilities (sewers, water lines, electrical cables), field tiles, french drains, pipelines, and all other potential sources of explosive gas including oil wells and gas wells and other landfills; and	SHOWN ON DRAWINGS 2C-1 & 2C-2.

LEGEND

- 1220 — EXISTING GROUND CONTOUR (SEE REFERENCE)
- PROPERTY LINE
- LIMIT OF SOLID WASTE PLACEMENT
- 1000-FT OFFSET FROM LIMIT OF SOLID WASTE PLACEMENT
- 200-FT OFFSET FROM LIMIT OF SOLID WASTE PLACEMENT
- WETLANDS AND STREAMS
- TBM-6 — BENCHMARK LOCATION (SEE TABLE THIS DRAWING)
- DOMICILE (NONE WITHIN 1,000 FEET)
- OCCUPIED STRUCTURES
- FM — EXISTING LEACHATE FORCEMAIN
- FM — PROPOSED LEACHATE FORCEMAIN
- AFM — ABANDONED LEACHATE FORCEMAIN
- GRAV — EXISTING LEACHATE GRAVITY LINE
- GRAV — PROPOSED LEACHATE GRAVITY LINE
- UD — EXISTING UNDERDRAIN PIPE
- UD — PROPOSED UNDERDRAIN PIPE
- SAN — EXISTING SANITARY SEWER LINE
- SAN — PROPOSED SANITARY SEWER LINE
- W — EXISTING WATER LINE
- W — PROPOSED WATER LINE
- UG-E — EXISTING UNDERGROUND ELECTRIC LINE
- UG-E — PROPOSED UNDERGROUND ELECTRIC LINE
- OH-E — EXISTING OVERHEAD ELECTRIC LINE
- G — PROPOSED PRODUCT GAS PIPELINE
- LFG — PROPOSED LANDFILL GAS LINE
- COND — EXISTING DUAL-CONTAINED CONDENSATE PIPELINE
- COND — PROPOSED DUAL-CONTAINED CONDENSATE PIPELINE
- LFG — EXISTING LANDFILL GAS HEADER PIPE
- CS-1 — CONDENSATE SUMP

NOTES

1. THIS DRAWING PROVIDES THE INFORMATION REQUIRED IN OAC 3745-27-06(B)(2)(b)(ii).
2. POTENTIAL GAS MIGRATION PATHWAYS INCLUDE UNDERGROUND UTILITIES.
3. UTILITIES PROVIDED BY BAIR GOODIE & ASSOCIATES, INC. SHEET TITLE: UTILITY RECORD DRAWING OVERALL SITE PLAN, DATED: 10/30/07. UPDATED UTILITIES AND GAS COLECTION CONTROL SYSTEM, PROVIDED BY BAIR GOODIE & ASSOCIATES, INC. SHEET TITLE: RECORD DRAWING 2010 GCCS STAGE 1 CONSTRUCTION, DATED: 12/29/10.
4. PROPOSED GAS PROCESSING PLANT AND ASSOCIATED APPURTENANCES ARE SHOWN IN APPROXIMATE LOCATIONS. ACTUAL LOCATIONS WILL BE DETERMINED TO SUIT FIELD CONDITIONS.
5. PROPOSED UNDERDRAIN LOCATIONS MAY CHANGE BASED ON SITE CONDITIONS.

REFERENCE

1. EXISTING TOPOGRAPHY PREPARED BY KEDDAL AERIAL MAPPING; DATE OF PHOTOGRAPHY: 1/18/13. ADDITIONAL MAPPING WAS PREPARED BY KEDDAL AERIAL MAPPING FROM AERIAL PHOTOGRAPHY DATED 1/6/12 AND 1/5/11 AND BY M.A.N. MAPPING FROM AERIAL PHOTOGRAPHY DATED 12/14/00.
2. AEP POWER LINE SURVEY PROVIDED BY BGA, CADD FILE: APEX EASEMENT – STRS.44-80.

STATE OF OHIO
RICK BUFFALINI
E-55305
REGISTERED
PROFESSIONAL ENGINEER

12-29-15

SCALE IN FEET
0 200 400

*HAND SIGNATURE ON FILE

[illegible]			
DESCRIPTION	NORTHING	EASTING	ELEVATION
TBM-1	279202.74	2406169.74	1288.36
TBM-2	282605.19	2407871.35	1304.17
TBM-3	283414.35	2412722.84	1154.60
TBM-5	279260.13	2409777.80	1246.77
TBM-6	284152.95	2412150.85	1223.74
TBM-7	285182.50	2410786.21	1220.14

Authorized Use:

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APEX ENVIRONMENTAL, LLC.
PERMIT TO INSTALL APPLICATION
CONTIGUOUS EXPANSION
APEX SANITARY LANDFILL
JEFFERSON COUNTY, OHIO

DRAWN BY: JM	CHECKED BY: MRB	APPROVED BY: RJB*
DATE: 10/17/11	DWG SCALE: 1"=200'	PROJECT NO: 091-867

MAN-MADE POTENTIAL EXPLOSIVE GAS MIGRATION PATHWAYS (SOUTH, 2 OF 2)

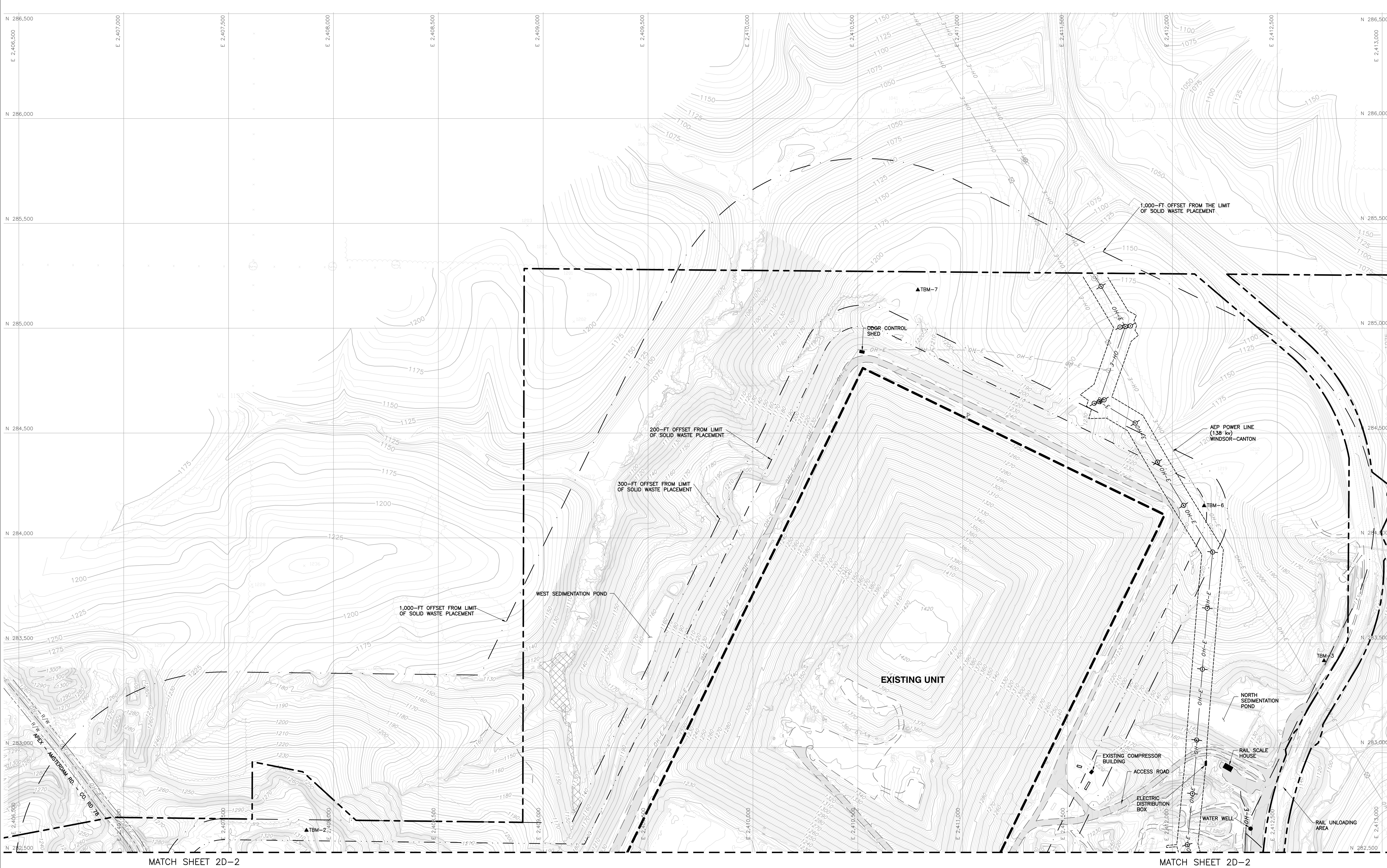
DRAWING NO.: 2C-2

REVISION RECORD

NO	DATE	DESCRIPTION
1	7/2013	RESPONSE TO OHIO EPA NOD DATED 12/28/12

SUBMITTAL RECORD

NO	DATE	DESCRIPTION



[illegible]

3745-27-RULE REFERENCE			COMMENT
3745-27-07(H)(1)	(a)	National park or recreation area.	NONE WITHIN 1000-FT OF WASTE PLACEMENT.
	(b)	Candidate area for potential inclusion in the national park system.	NONE WITHIN 1000-FT OF WASTE PLACEMENT.
	(c)	State park or established state park purchase area.	NONE WITHIN 1000-FT OF WASTE PLACEMENT.
	(d)	Property within the boudnaries of a national park or recreation area that has not been acquired or is not administered by the secretary of the US department of the interior.	NONE WITHIN 1000-FT OF WASTE PLACEMENT.
3745-27-07(H)(2)	(a)	Within a sand or gravel pit.	NOT LOCATED IN A SAND/GRAVEL PIT.
	(b)	Within a limestone or sandstone quarry.	SEE SECTION C2 OF PTI APLICATION FOR EXEMPTION REQUEST.
	(c)	Landfill facility is not located above a sole source aquifer as defined under the Safe Drinking Water Act, 42 U.S.C. 300f et. seq. (2003).	NOT LOCATED ABOVE SOLE SOURCE AQUIFER.
	(d)	Landfill is not located above an unconsolidated aquifer capable of sustaining a yield of 100 gpm for a 24 hour period to an existing or future water supply well located within 1,000 feet of the limits of waste.	NOT LOCATED ABOVE 100 GPM AQUIFER.
	(e)	The isolation distance between the uppermost aquifer system and the bottom of the recompacted soil liner of a sanitary landfill facility is ≥ 15 feet of insitu or added geologic material.	ISOLATION DISTANCE IS ≥ 15 FEET. SEE DRAWING 3C.
3745-27-07(H)(3)	(a)	The limits of waste and any temporary or permanent leachate ponds or lagoons are not located within the surface and subsurface areas of either of the following: (i) Surrounding an existing or proposed public water supply well through which contaminants may reach within a period of five years. (ii) A wellhead protection area or a drinking water source protection area for a public water system using groundwater.	NOT LOCATED WITHIN 5 YEAR TIME OF TRAVEL TO PUBLIC WATER SUPPLY WELL.
	(b)	Landfill facility is not located within an area of potential subsidence due to, or within the angle of draw of an underground mine.	NOT LOCATED IN AN AREA WITHIN KNOWN UNDERGROUND MINES.
	(c)	One thousand feet from water supply well. The limits of solid waste placement of the sanitary landfill facility are not located within one thousand feet of a water supply well or a developed spring in existence on the date the Permit to Install Application was received by the Ohio EPA unless deemed acceptable by the director or any of the following conditions are met: (i) The water supply well or developed spring is controlled by the owner or operator of the sanitary landfill facility and provided the following: (a) The water supply well or developed spring is needed as the source of nonpotable water in order to meet the requirements of the approved permit. (b) No other reasonable alternate water source is available. (c) The water supply well or developed spring is constructed to prevent contamination of the ground water.	SEE SECTIONS C1 AND C2 FOR DISCUSSION OF WATER WELL WITHIN 1,000 FEET.
3745-27-07(H)(4)	(a)	One thousand feet from natural areas. The limits of solid waste placement of the sanitary landfill facility are not located within one thousand feet of the following, that are in existence on the date of receipt of the Permit to Install Application by Ohio EPA. (i) State nature preserve, state wildlife area, state scenice river; or (ii) Areas designated, owned, and managed by the Ohio historical society as a nature preserve; or (iii) National wildlife refuge or national scenic river; or (iv) United States Forest Service special interest area or research natural area in the Wayne National Forest; or (v) Stream segments designated as a state resource water, a coldwater habitat, or exceptional warmwater habitat.	NONE WITHIN 1,000-FT OF WASTE PLACEMENT.
	(b)	Three hundred feet from property line.	NOT WITHIN 300-FT OF WASTE PLACEMENT
	(c)	One thousand feet from a domicile.	NONE WITHIN 1,000-FT OF WASTE PLACEMENT
	(d)	Two hundred feet from surface waters, streams, lakes or wetlands.	EXISTING STREAMS AND WETLANDS WILL BE IMPACTED AND MITIGATED WITH THE APPROPRIATE PERMIT REQUIREMENTS.

NOTES

1. THIS DRAWING PRESENTS THE INFORMATION REQUIRED IN OAC 3745-27-07(H).
2. SEE SECTION C10 OF THE PTI APPLICATION FOR THE WETLANDS AND STREAMS DELINEATION REPORT PREPARED BY CEC.

REFERENCE

EXISTING TOPOGRAPHY PREPARED BY KEDDAL AERIAL MAPPING; DATE OF PHOTOGRAPHY: 1/18/13. ADDITIONAL MAPPING WAS PREPARED BY KEDDAL AERIAL MAPPING FROM AERIAL PHOTOGRAPHY DATED 1/6/12 AND 1/5/11 AND BY M.A.N. MAPPING FROM AERIAL PHOTOGRAPHY DATED 12/14/00.

STATE OF OHIO
RICK BUFFALINI
E-55305
REGISTERED PROFESSIONAL ENGINEER

7-18-13

SCALE IN FEET
0 200 400

*HAND SIGNATURE ON FILE

LEGEND

- 1220 — EXISTING GROUND CONTOUR (SEE REFERENCE)
- PROPERTY LINE
- LIMIT OF SOLID WASTE PLACEMENT
- 1000-FT OFFSET FROM LIMIT OF SOLID WASTE PLACEMENT
- 300-FT OFFSET FROM LIMIT OF SOLID WASTE PLACEMENT
- 200-FT OFFSET FROM LIMIT OF SOLID WASTE PLACEMENT
- STREAM AND WETLANDS
- ▲TBM-6 BENCHMARK LOCATION (SEE TABLE THIS DRAWING)
- OCCUPIED STRUCTURES
- OTHER STRUCTURES
- WATER WELL

BENCHMARK LOCATION INFORMATION

DESCRIPTION	NORTHING	EASTING	ELEVATION
TBM-1	279202.74	2406169.74	1288.36
TBM-2	282605.19	2407871.35	1304.17
TBM-3	283414.35	2412722.84	1154.60
TBM-5	279260.13	2409777.80	1246.77
TBM-6	284152.95	2412150.85	1223.74
TBM-7	285182.50	2410786.21	1220.14

Authorized Use:
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☐ Design Dev. ☐ Bidding ☐ -

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APEX ENVIRONMENTAL, LLC.
PERMIT TO INSTALL APPLICATION
CONTIGUOUS EXPANSION
APEX SANITARY LANDFILL
JEFFERSON COUNTY, OHIO

DRAWN BY:	JM	CHECKED BY:	MRB	APPROVED BY:	RJB*
DATE:	10/17/11	DWG SCALE:	1"=200'	PROJECT NO:	091-867

SITING CRITERIA SUMMARY (NORTH, 1 OF 2)

DRAWING NO.: 2D-1

REVISION RECORD

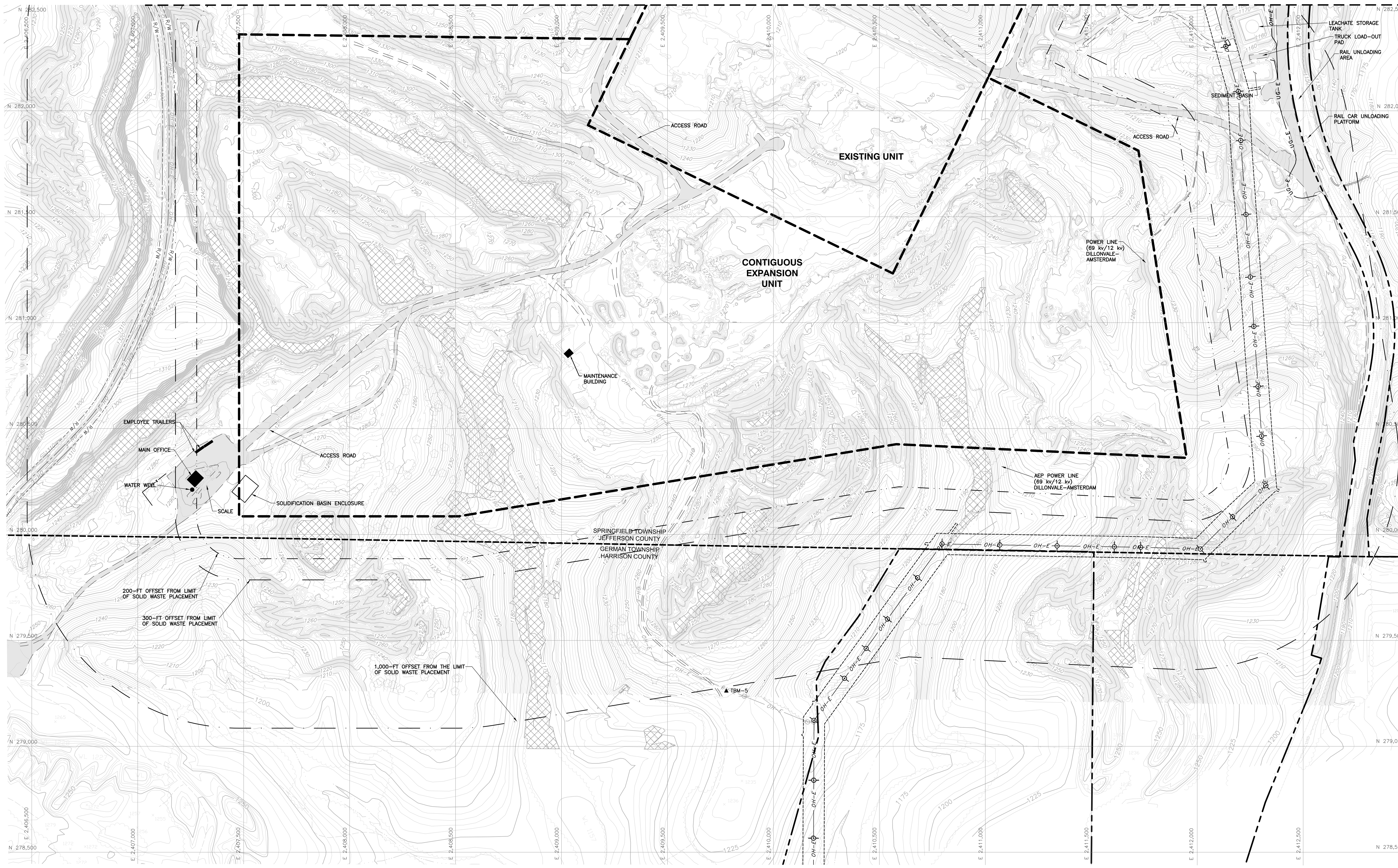
NO	DATE	DESCRIPTION
1	7/2013	RESPONSE TO OHIO EPA NOD DATED 12/28/12.

SUBMITTAL RECORD

NO	DATE	DESCRIPTION

NORTH

MATCH SHEET 2D–1 MATCH SHEET 2D–1



O OE ES MM

3745–27–RULE REFERENCE			COMMENT
3745–27–07(H)(1)	(a)	National park or recreation area.	NONE WITHIN 1000–FT OF WASTE PLACEMENT.
	(b)	Candidate area for potential inclusion in the national park system.	NONE WITHIN 1000–FT OF WASTE PLACEMENT.
	(c)	State park or established state park purchase area.	NONE WITHIN 1000–FT OF WASTE PLACEMENT.
	(d)	Property within the boudnaries of a national park or recreation area that has not been acquired or is not administered by the secretary of the US department of the interior.	NONE WITHIN 1000–FT OF WASTE PLACEMENT.
3745–27–07(H)(2)	(a)	Within a sand or gravel pit.	NOT LOCATED IN A SAND/GRAVEL PIT.
	(b)	Within a limestone or sandstone quarry.	SEE SECTION C2 OF PTI APPLICATION FOR EXEMPTION REQUEST.
	(c)	Landfill facility is not located above a sole source aquifer as defined under the Safe Drinking Water Act, 42 U.S.C. 300f et. seq. (2003).	NOT LOCATED ABOVE SOLE SOURCE AQUIFER.
	(d)	Landfill is not located above an unconsolidated aquifer capable of sustaining a yield of 100 gpm for a 24 hour period to an existing or future water supply well located within 1,000 feet of the limits of waste.	NOT LOCATED ABOVE 100 GPM AQUIFER.
	(e)	The isolation distance between the uppermost aquifer system and the bottom of the recompacted soil liner of a sanitary landfill facility is ≥ 15 feet of insitu or added geologic material.	ISOLATION DISTANCE IS ≥ 15 FEET. SEE DRAWING 3C.
3745–27–07(H)(3)	(a)	The limits of waste and any temporary or permanent leachate ponds or lagoons are not located within the surface and subsurface areas of either of the following: (i) Surrounding an existing or proposed public water supply well through which contaminants may reach within a period of five years. (ii) A wellhead protection area or a drinking water source protection area for a public water system using groundwater.	NOT LOCATED WITHIN 5 YEAR TIME OF TRAVEL TO PUBLIC WATER SUPPLY WELL.
	(b)	Landfill facility is not located within an area of potential subsidence due to, or within the angle of draw of an underground mine.	NOT LOCATED IN AN AREA WITHIN KNOWN UNDERGROUND MINES.
	(c)	One thousand feet from water supply well. The limits of solid waste placement of the sanitary landfill facility are not located within one thousand feet of a water supply well or a developed spring in existence on the date the Permit to Install Application was received by the Ohio EPA unless deemed acceptable by the director or any of the following conditions are met: (i) The water supply well or developed spring is controlled by the owner or operator of the sanitary landfill facility and provided the following: (a) The water supply well or developed spring is needed as the source of nonpotable water in order to meet the requirements of the approved permit. (b) No other reasonable alternate water source is available. (c) The water supply well or developed spring is constructed to prevent contamination of the ground water.	SEE SECTIONSC1 AND C2 FOR DISCUSSION OF WATER WELL WITHIN 1,000–FT.
3745–27–07(H)(4)	(a)	One thousand feet from natural areas. The limits of solid waste placement of the sanitary landfill facility are not located within one thousand feet of the following, that are in existence on the date of receipt of the Permit to Install Application by Ohio EPA. (i) State nature preserve, state wildlife area, state scenice river; or (ii) Areas designated, owned, and managed by the Ohio historical society as a nature preserve; or (iii) National wildlife refuge or national scenic river; or (iv) United States Forest Service special interest area or research natural area in the Wayne National Forest; or (v) Stream segments designated as a state resource water, a coldwater habitat, or exceptional warmwater habitat.	NONE WITHIN 1,000–FT OF WASTE PLACEMENT.
	(b)	Three hundred feet from property line.	NOT WITHIN 300–FT OF WASTE PLACEMENT
	(c)	One thousand feet from a domicile.	NONE WITHIN 1,000–FT OF WASTE PLACEMENT
	(d)	Two hundred feet from surface waters, streams, lakes or wetlands.	EXISTING STREAMS AND WETLANDS WILL BE IMPACTED AND MITIGATED WITH THE APPROPRIATE PERMIT REQUIREMENTS.

NOTES

1. THIS DRAWING PRESENTS THE INFORMATION REQUIRED IN OAC 3745–27–07(H).
2. SEE SECTION C10 OF THE PTI APPLICATION FOR THE WETLANDS AND STREAMS DELINEATION REPORT PREPARED BY CEC.

REFERENCE

EXISTING TOPOGRAPHY PREPARED BY KEDDAL AERIAL MAPPING; DATE OF PHOTOGRAPHY: 1/18/13. ADDITIONAL MAPPING WAS PREPARED BY KEDDAL AERIAL MAPPING FROM AERIAL PHOTOGRAPHY DATED 1/6/12 AND 1/5/11 AND BY M.A.N. MAPPING FROM AERIAL PHOTOGRAPHY DATED 12/14/00.

STATE OF OHIO
RICK BUFFALINI
E–55305
REGISTERED
PROFESSIONAL ENGINEER

7-18-13

SCALE IN FEET
0 200 400

*HAND SIGNATURE ON FILE

LEGEND

- EXISTING GROUND CONTOUR (SEE REFERENCE)
- PROPERTY LINE
- LIMIT OF SOLID WASTE PLACEMENT
- 1000–FT OFFSET FROM LIMIT OF SOLID WASTE PLACEMENT
- 300–FT OFFSET FROM LIMIT OF SOLID WASTE PLACEMENT
- 200–FT OFFSET FROM LIMIT OF SOLID WASTE PLACEMENT
- STREAM AND WETLANDS
- TBM–6 BENCHMARK LOCATION (SEE TABLE THIS DRAWING)
- OCCUPIED STRUCTURES
- OTHER STRUCTURES
- WATER WELL

BENCHMARK LOCATION INFORMATION

DESCRIPTION	NORTHING	EASTING	ELEVATION
TBM–1	279202.74	2406169.74	1288.36
TBM–2	282605.19	2407871.35	1304.17
TBM–3	283414.35	2412722.84	1154.60
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TBM–6	284152.95	2412150.85	1223.74
TBM–7	285182.50	2410786.21	1220.14

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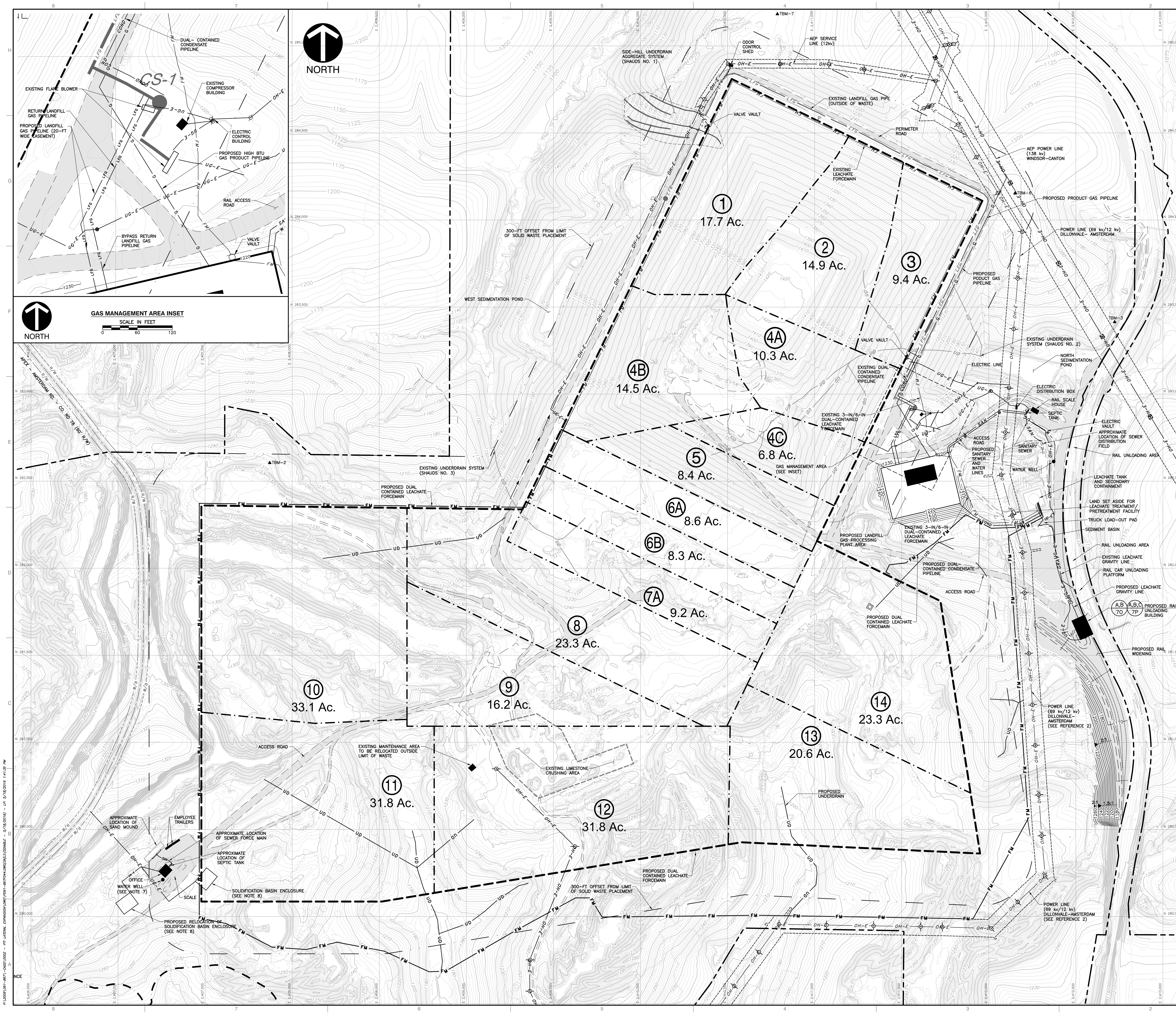
APEX ENVIRONMENTAL, LLC.
PERMIT TO INSTALL APPLICATION
CONTIGUOUS EXPANSION
APEX SANITARY LANDFILL
JEFFERSON COUNTY, OHIO

DRAWN BY: JM	CHECKED BY: MRB	APPROVED BY: RJB*
DATE: 10/17/11	DWG SCALE: 1"=200'	PROJECT NO: 091-867

SITING CRITERIA SUMMARY (SOUTH, 2 OF 2)

DRAWING NO.: 2D-2



REVISION RECORD

NO	DATE	DESCRIPTION
1	7/2013	RESPONSE TO OHIO EPA NOD DATED 12/28/12 AND REVISED PHASE LIMITS.
2	12/2015	UPDATED AEP POWER LINE LOCATION AND ADDED WETLAND CONSERVATION EASEMENT. REVISED UNDERDRAIN SYSTEM IN
		RESPONSE TO OHIO EPA NOD DATED 6/18/2015.
3	5/2016	REVISED TO INCLUDE CALLOUTS TO RAIL UNLOADING BUILDING IN RESPONSE TO OHIO EPA NOD DATED 4/26/2016.

SUBMITTAL RECORD

NO	DATE	DESCRIPTION

BENCHMARK LOCATION INFORMATION

DESCRIPTION	NORTHING	EASTING	ELEVATION
TBM-1	279202.74	2406169.74	1288.36
TBM-2	282605.19	2407871.35	1304.17
TBM-3	283414.35	2412722.84	1154.60
TBM-5	279260.13	2409777.80	1246.77
TBM-6	284152.95	2412150.85	1223.74
TBM-7	285182.50	2410786.21	1220.14

LEGEND

1220	EXISTING GROUND CONTOUR (SEE REFERENCE)
	PROPERTY LINE
	LIMIT OF SOLID WASTE PLACEMENT
	300-FT OFFSET FROM LIMIT OF SOLID WASTE PLACEMENT
	WETLAND CONSERVATION EASEMENT
	PHASE LIMIT
⑧ 23.3 Ac.	PHASE DESIGNATION AND ACREAGE
	ACCESS ROAD
▲ TBM-6	BENCHMARK LOCATION (SEE TABLE THIS DRAWING)
	OCCUPIED STRUCTURES
	OTHER STRUCTURES
	UTILITY RIGHT-OF-WAY
OH-E	EXISTING OVERHEAD ELECTRIC LINE
UG-E	EXISTING UNDERGROUND ELECTRIC LINE
UG-E	PROPOSED UNDERGROUND ELECTRIC LINE
FM	EXISTING LEACHATE FORCEMAIN
FM	PROPOSED LEACHATE FORCEMAIN
G	PROPOSED PRODUCT GAS PIPELINE
LFG	EXISTING LANDFILL GAS HEADER PIPE (OUTSIDE OF WASTE)
COND	EXISTING DUAL-CONTAINED CONDENSATE PIPELINE
COND	PROPOSED DUAL-CONTAINED CONDENSATE PIPELINE
CS-1	CONDENSATE SUMP
GRAV	EXISTING LEACHATE GRAVITY LINE
GRAV	PROPOSED LEACHATE GRAVITY LINE
UD	EXISTING UNDERDRAIN PIPE
UD	PROPOSED UNDERDRAIN PIPE
SAN	EXISTING SANITARY SEWER LINE
SAN	PROPOSED SANITARY SEWER LINE
W	EXISTING WATER LINE
W	PROPOSED WATER LINE
●	WATER WELL

NOTES

1. THIS DRAWING PROVIDES THE INFORMATION REQUIRED IN OAC 3745-27-06(B)(3)(b), (g) AND (h).
2. THE PROPOSED EXPANSION WILL BE CONSTRUCTED AND DEVELOPED SEQUENTIALLY AS INDICATED HERE. SEE 6 SERIES DRAWINGS FOR DETAILED PHASE DEVELOPMENT PLANS.
3. UTILITIES PROVIDED BY BAIR GOODIE & ASSOCIATES, INC. SHEET TITLE: UTILITY RECORD DRAWING OVERALL SITE PLAN, DATED: 10/30/07. UPDATED UTILITIES AND GAS COLLECTION CONTROL SYSTEM, PROVIDED BY BAIR GOODIE & ASSOCIATES, INC. SHEET TITLE: RECORD DRAWING 2010 GCCS STAGE 1 CONSTRUCTION, DATED: 12/29/10.
4. PROPOSED ACCESS ROADS MAY BE ADJUSTED BASED ON SITE CONDITIONS.
5. PROPOSED GAS PROCESSING PLANT AND ASSOCIATED APPURTENANCES ARE SHOWN IN APPROXIMATE LOCATIONS. ACTUAL LOCATIONS WILL BE DETERMINED TO SUIT FIELD CONDITIONS.
6. PROPOSED UNDERDRAIN LOCATIONS MAY CHANGE BASED ON SITE CONDITIONS.
7. SEE SECTIONS C1 AND C2 FOR DISCUSSION OF THIS WATER WELL.
8. SOLIDIFICATION BASIN WILL BE RELOCATED PRIOR TO PHASE 11 CONSTRUCTION.

REFERENCE

1. EXISTING TOPOGRAPHY PREPARED BY KEDDAL AERIAL MAPPING; DATE OF PHOTOGRAPHY: 1/18/13. ADDITIONAL MAPPING WAS PREPARED BY KEDDAL AERIAL MAPPING FROM AERIAL PHOTOGRAPHY DATED 1/6/12 AND 1/5/11 AND BY M.A.N. MAPPING FROM AERIAL PHOTOGRAPHY DATED 12/14/00.
2. AEP POWER LINE SURVEY PROVIDED BY BGA, CADD FILE: APEX EASEMENT - STRS.44-80.

STATE OF OHIO
RICK BUFFALINI
E-55305
REGISTERED
PROFESSIONAL ENGINEER

Rick Buffalini
5-18-16

SCALE IN FEET
0 200 400

*HAND SIGNATURE ON FILE

Authorized Use:

☐ Survey ☑ Permitting ☐ Construction
☐ Design Dev. ☐ Bidding ☐ -

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333 Baldwin Road - Pittsburgh, PA 15205
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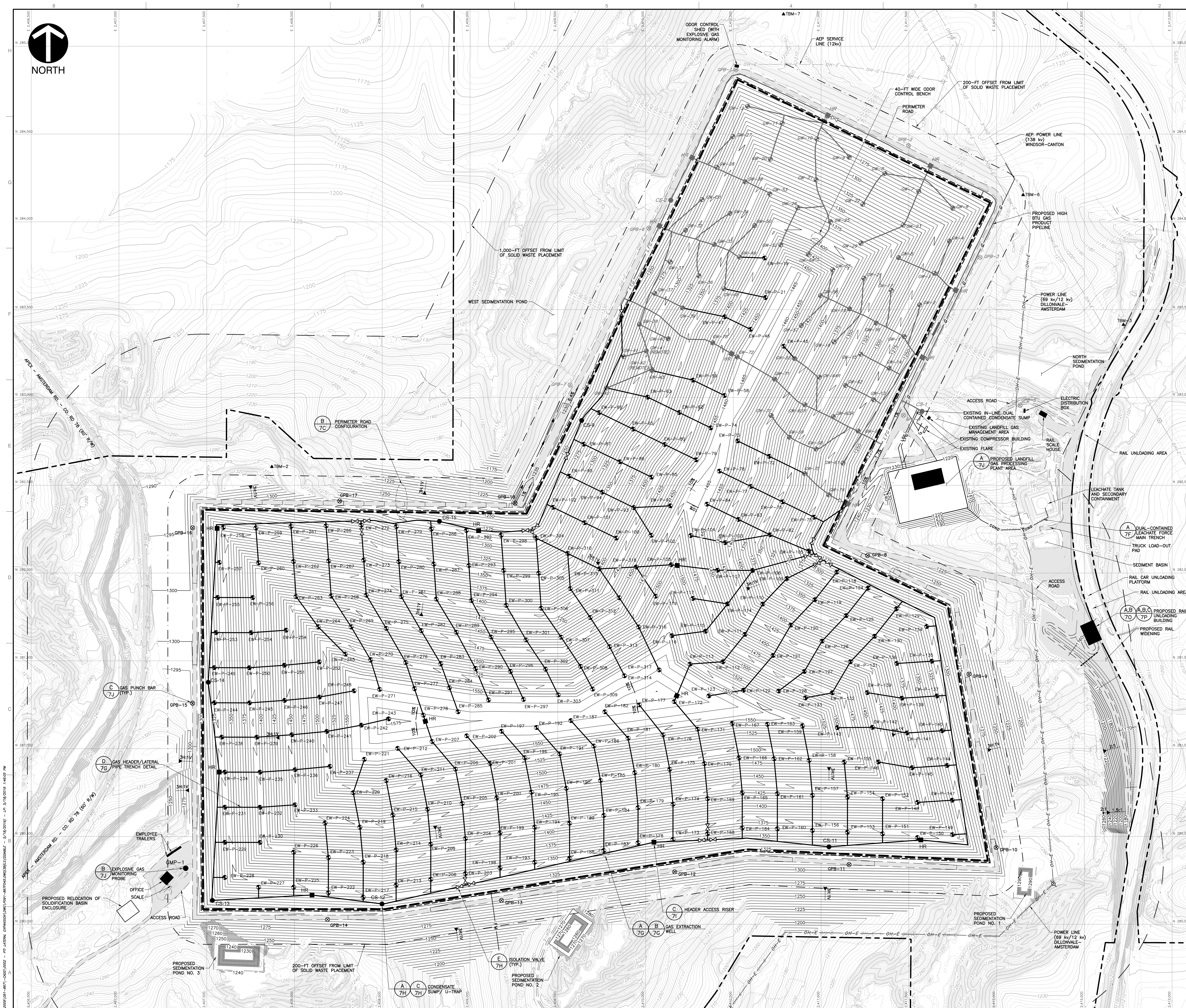
APEX ENVIRONMENTAL, LLC.
PERMIT TO INSTALL APPLICATION
CONTIGUOUS EXPANSION
APEX SANITARY LANDFILL
JEFFERSON COUNTY, OHIO

DRAWN BY:	MJI	CHECKED BY:	MRB	APPROVED BY:	RJB*
DATE:	10/19/11	DWG SCALE:	1"=200'	PROJECT NO:	091-867

LANDFILL FACILITIES/
UTILITIES LOCATION PLAN

DRAWING NO.: 3A



REVISION RECORD

NO	DATE	DESCRIPTION
1	7/2013	RESPONSE TO OHIO EPA NOD DATED 12/28/12.
2	5/2016	UPDATED AEP POWER LINE LOCATION AND REVISED TO INCLUDE CALLOUTS TO RAIL UNLOADING BUILDING IN RESPONSE TO
		OHIO EPA NOD DATED 4/26/2016, AND SEDIMENTATION POND NO. 3.

SUBMITTAL RECORD

NO	DATE	DESCRIPTION

BENCHMARK LOCATION INFORMATION

DESCRIPTION	NORTHING	EASTING	ELEVATION
TBM-1	279202.74	2406169.74	1288.36
TBM-2	282605.19	2407871.35	1304.17
TBM-3	283414.35	2412722.84	1154.60
TBM-5	279260.13	2409777.80	1246.77
TBM-6	284152.95	2412150.85	1223.74
TBM-7	285182.50	2410786.21	1220.14

LEGEND

1220 — EXISTING GROUND CONTOUR (SEE REFERENCE)
PROPERTY LINE
LIMIT OF SOLID WASTE PLACEMENT
1000-FT OFFSET FROM LIMIT OF SOLID WASTE PLACEMENT
200-FT OFFSET FROM LIMIT OF SOLID WASTE PLACEMENT
▲ TBM-7 — BENCHMARK LOCATION (SEE TABLE THIS DRAWING)
OCCUPIED STRUCTURES
OTHER STRUCTURES
1300 — PROPOSED TOP OF FINAL COVER CONTOUR
ACCESS ROAD
LFG — EXISTING GAS HEADER PIPE
EXISTING GAS LATERAL PIPE
GW-24 — EXISTING GAS EXTRACTION WELL
EXISTING ISOLATION VALVE
CS — EXISTING CONDENSATE SUMP/U-TRAP
HR — EXISTING ACCESS RISER
GPB-1 — EXISTING PUNCH BAR STATION
6" — GAS HEADER/LATERAL PIPE
OPTIONAL GAS COLLECTOR PIPE
EW-P-58 — PROPOSED GAS EXTRACTION WELL
PROPOSED ISOLATION VALVE
CS — PROPOSED CONDENSATE SUMP/U-TRAP
HR — PROPOSED ACCESS RISER
GPB-1 — PROPOSED PUNCH BAR STATION
GMP-1 — PROPOSED GAS MONITORING PROBE LOCATION

NOTES

1. THIS DRAWING PROVIDES THE INFORMATION REQUIRED IN OAC 3745-27-06(B)(3)(f).
2. DESIGN GRADES SHOWN ON THIS DRAWING REPRESENT THE TOP OF THE FINAL COVER SYSTEM AND ARE SHOWN FOR REFERENCE ONLY.
3. PROPOSED GAS EXTRACTION WELLS, HEADERS, LATERALS, CONTROL VALVES, CONDENSATE SUMPS AND OTHER APPURTENANCES ARE SHOWN IN APPROXIMATE LOCATIONS. ACTUAL LOCATIONS WILL BE DETERMINED TO SUIT FIELD CONDITIONS AND TO PROVIDE ODOR CONTROL AND EFFECTIVE BENEFICIAL USE OF THE GAS. HEADER AND LATERAL PIPING WITHIN THE LIMITS OF WASTE WILL BE INSTALLED AT A MINIMUM 2 PERCENT SLOPE. HEADERS MAY BE PLACED OUTSIDE THE LIMIT OF WASTE WHERE APPROPRIATE.
4. PROPOSED GAS PROCESSING PLANT AND ASSOCIATED APPURTENANCES ARE SHOWN IN APPROXIMATE LOCATIONS. ACTUAL LOCATIONS WILL BE DETERMINED TO SUIT FIELD CONDITIONS.
5. CONDENSATE SUMPS OR TRAPS WILL BE INSTALLED AT ALL GAS HEADER LOW POINTS. CONDENSATE FROM EACH SUMP OR TRAP WILL BE PIPED TO THE CLOSEST LEACHATE COLLECTION CLEANOUT RISER OR COLLECTED IN THE CONDENSATE MANAGEMENT SYSTEM.
6. GAS MONITORING PUNCH BARS WILL BE MONITORED AT 1,000-FT SPACING AROUND THE LIMIT OF WASTE AND BETWEEN OCCUPIED STRUCTURES WITHIN 1,000 FEET OF THE LIMIT OF WASTE.
7. EXISTING GAS COLLECTION SYSTEM WAS TAKEN FROM BAIR, GOODIE, AND ASSOCIATES, INC. "FALL 2012 RECORD DRAWING" DATED: 2/19/2013; SCALE OF DRAWING 1"=100'; FILE ID: APEX 996.

REFERENCE

1. EXISTING TOPOGRAPHY PREPARED BY KEDDAL AERIAL MAPPING; DATE OF PHOTOGRAPHY: 1/18/13. ADDITIONAL MAPPING WAS PREPARED BY KEDDAL AERIAL MAPPING FROM AERIAL PHOTOGRAPHY DATED 1/6/12 AND 1/5/11 AND BY M.A.N. MAPPING FROM AERIAL PHOTOGRAPHY DATED 12/14/00.
2. AEP POWER LINE SURVEY PROVIDED BY BGA, CADD FILE: APEX EASEMENT - STRS.44-80.

STATE OF OHIO
RICK BUFFALINI
E-55305
REGISTERED
PROFESSIONAL ENGINEER

5-18-16

SCALE IN FEET
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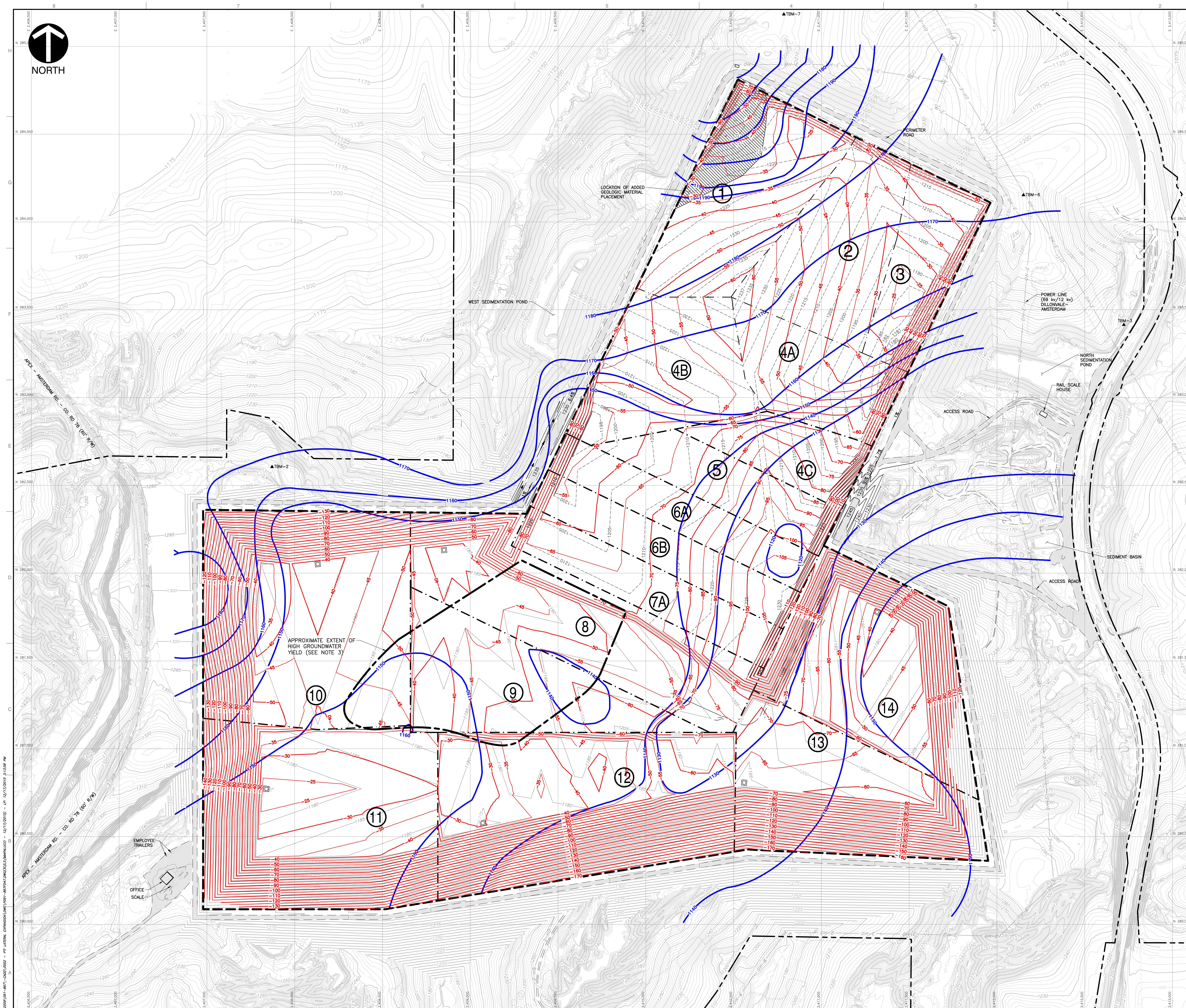
JEFFERSON COUNTY, OHIO

DRAWN BY:	MJI	CHECKED BY:	MRB	APPROVED BY:	RJB*
DATE:	10/17/11	DWG SCALE:	1"=200'	PROJECT NO:	091-867

EXPLOSIVE GAS CONTROL SYSTEM PLAN

DRAWING NO.: 3B



REVISION RECORD

NO	DATE	DESCRIPTION
1	7/2013	RESPONSE TO OHIO EPA NOD DATED 12/28/12 AND REVISED PHASING
2	12/2015	REVISED IN ACCORDANCE WITH OHIO EPA LETTER DATED JULY 7, 2015 AND SEDIMENTATION POND NO. 3 LOCATION.

SUBMITTAL RECORD

NO	DATE	DESCRIPTION

LEGEND

- 1220 — EXISTING GROUND CONTOUR (SEE REFERENCE)
- PROPERTY LINE
- LIMIT OF SOLID WASTE PLACEMENT
- PHASE LIMIT
- 1220 — PERMITTED BASE OF RECOMPACTED SOIL LINER CONTOUR
- 1220 — PROPOSED BASE OF RECOMPACTED SOIL LINER CONTOUR
- LEACHATE SUMP
- 1120 — TOP OF UAS CONTOUR (SEE NOTE 3)
- -75 — UAS SEPARATION ISOPACH CONTOUR (SEE NOTE 2)
- APPROXIMATE EXTENT OF HIGH GROUNDWATER YIELD (SEE NOTE 3)
- LOCATION OF ADDED GEOLOGIC MATERIAL PLACEMENT

NOTES

1. THIS DRAWING PROVIDES THE INFORMATION REQUIRED IN OAC 3745-27-07(H)(2)(e).
2. THIS DRAWING PROVIDES THE VERTICAL SEPARATION BETWEEN THE BASE OF RECOMPACTED SOIL LINER (DRAWING 4B) AND THE UPPERMOST AQUIFER SYSTEM (SEE NOTE 3).
3. TOP OF UAS CONTOURS ARE FROM DRAWING 3F OF THE HYDROGEOLOGIC REPORT. THE AREA DELINEATED AS THE HIGH GROUNDWATER YIELD WILL BE REMOVED IN ITS ENTIRETY EXCEPT FOR AN APPROXIMATE 1/4 ACRE AREA IN PHASE 10. THE SMALL REMAINING AREA WILL NOT BE HIGH YEILD AND NOT A UAS. THEREFORE, THE UAS SEPARATION IN THIS AREA IS FROM THE UNDERLYING SANDSTONE UAS.
   IN RESPONSE TO AN OHIO EPA LETTER DATED JULY 7, 2014, APEX WILL REMOVE THE PITTSBURGH LIMESTONE IN THE WESTERN PORTION OF PHASE 8 WHERE INDICATED. THE EXTENT OF THE PITTSBURGH LIMESTONE WILL BE FIELD DETERMINED BY A QUALIFIED PERSON. ALTERNATIVELY, APEX MAY SUBMIT A WORK PLAN TO THE OHIO EPA AND IMPLEMENT A HYDROGEOLOGIC INVESTIGATION TO CLASSIFY THE LIMESTONE AN UPPERMOST AQUIFER SYSTEM OR SIGNIFICANT ZONE OF SATURATION.
4. PHASES 1 THROUGH 7 ARE PREVIOUSLY PERMITTED UNDER PERMIT NO. 06-08438 APPROVED 12/31/09.

[illegible]

DESCRIPTION	NORTHING	EASTING	ELEVATION
TBM-1	279202.74	2406169.74	1288.36
TBM-2	282605.19	2407871.35	1304.17
TBM-3	283414.35	2412722.84	1154.60
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TBM-6	284152.95	2412150.85	1223.74
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REFERENCE

1. EXISTING TOPOGRAPHY PREPARED BY KEDDAL AERIAL MAPPING; DATE OF PHOTOGRAPHY: 1/18/13. ADDITIONAL MAPPING WAS PREPARED BY KEDDAL AERIAL MAPPING FROM AERIAL PHOTOGRAPHY DATED 1/6/12 AND 1/5/11 AND BY M.A.N. MAPPING FROM AERIAL PHOTOGRAPHY DATED 12/14/00.
2. AEP POWER LINE SURVEY PROVIDED BY BGA, CADD FILE: APEX EASEMENT – STRS.44-80.

STATE OF OHIO
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E-55305
REGISTERED PROFESSIONAL ENGINEER
12-29-15

SCALE IN FEET
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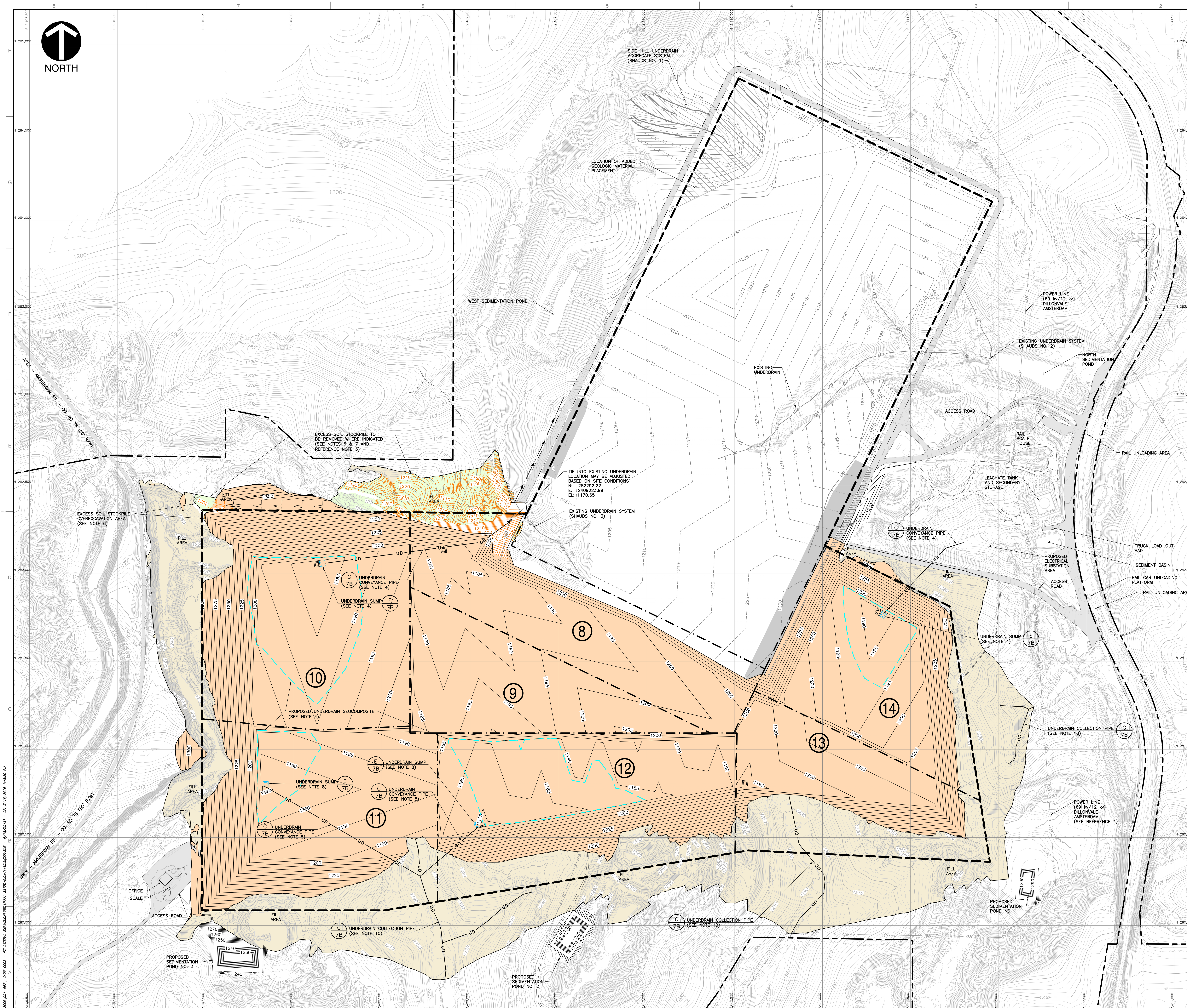
JEFFERSON COUNTY, OHIO

DRAWN BY:	MJI	CHECKED BY:	MRB	APPROVED BY:	RJB*
DATE:	10/17/11	DWG SCALE:	1"=200'	PROJECT NO:	091-867

UAS SEPARATION ISOPACH MAP

DRAWING NO.: 3C



REVISION RECORD

NO	DATE	DESCRIPTION
1	7/2013	RESPONSE TO OHIO EPA NOD DATED 12/28/12 AND REVISED PHASING
2	12/2015	UPDATED THE AEP POWER LINE LOCATION. REVISED UNDERDRAIN SYSTEM AND DRAWING NOTE 4
		IN RESPONSE TO OHIO EPA NOD DATED 6/18/2015 AND SEDIMENTATION POND NO. 3 LOCATION.
3	5/2016	REVISED NOTE 4 AND ADDED NOTES 8, 9, AND 10 IN RESPONSE TO OHIO EPA COMMENTS.

SUBMITTAL RECORD

NO	DATE	DESCRIPTION

LEGEND

- 1220 — EXISTING GROUND CONTOUR (SEE REFERENCE)
- PROPERTY LINE
- LIMIT OF SOLID WASTE PLACEMENT
- PHASE LIMIT
- 8 — PHASE DESIGNATION
- ACCESS ROAD
- 1220 — PERMITTED BASE OF EXCAVATION CONTOUR
- 1220 — PROPOSED BASE OF EXCAVATION CONTOUR
- UD — EXISTING UNDERDRAIN PIPE
- UD — PROPOSED UNDERDRAIN PIPE
- PROPOSED UNDERDRAIN GEOCOMPOSITE (SEE NOTE 4)
- LOCATION OF ADDED GEOLOGIC MATERIAL PLACEMENT
- APPROXIMATE LOCATION OF MINESPOIL EXCAVATION IN EXISTING UNIT (SEE NOTE 3)
- AREA OF EXCAVATION
- AREA OF STRUCTURAL FILL
- APPROXIMATE LOCATION OF EXCESS SOIL STOCKPILE OVER EXCAVATION (SEE NOTE 6)
- LEACHATE SUMP
- UNDERDRAIN SUMP

NOTES

1. THIS DRAWING PROVIDES THE INFORMATION REQUIRED IN OAC 3745–27–06(B)(4)(a).
2. THIS DRAWING REPRESENTS THE EXCAVATION GRADES OF 3–FEET THICK RSL.
3. MINE SPOIL AND OTHER UNSUITABLE SOILS WILL BE OVER EXCAVATED BENEATH THE STRUCTURAL COMPONENTS OF THE EXISTING UNIT IN ACCORDANCE WITH PERMIT NO. 06–08438 APPROVED 12/31/09. IN THE SHADED AREA, THE LIMIT OF EXCAVATION WILL BE FIELD DETERMINED TO REMOVE ALL MINE SPOIL 30 FEET BEYOND THE LIMITS OF WASTE. GRADES SHOWN HERE MAY VARY.
4. A TEMPORARY GEOCOMPOSITE AND/OR PIPE UNDERDRAIN SYSTEM WILL BE INSTALLED BENEATH THE LINER SYSTEM TO COLLECT GROUND WATER, AS NEEDED. THE UNDERDRAINS WILL DIRECT FLOW TO A SUMP AT THE LOW POINT IN THE PHASE. IN PHASES 8, 9, 10, 13 AND 14; THE UNDERDRAIN SUMP WILL EITHER DRAIN BY GRAVITY TO A TOPOGRAPHIC LOW AREA OUTSIDE THE LIMITS OF WASTE OR BE PUMPED TO DISCHARGE INTO THE PERIMETER CHANNEL WHICH FLOWS TO A PROPOSED SEDIMENTATION POND. A BACKUP GENERATOR WILL BE AVAILABLE TO OPERATE THE UNDERDRAIN PUMPS DURING A POWER OUTAGE. APEX WILL NOTIFY THE OHIO EPA IF PUMP FAILURE OCCURS OR THE PUMP IS NOT OPERABLE.
5. ANY UNDERGROUND MINE VOIDS, IF PRESENT WITHIN THE LANDFILL ANGLE OF DRAW, WILL BE OVEREXCAVATED BEYOND THESE GRADES.
6. EXCESS SOIL STOCKPILE AREA WILL BE OVEREXCAVATED TO THE 12/14/00 CONTOURS WHICH INDICATE CONDITIONS PRIOR TO PLACING EXCESS SOIL IN THIS AREA. REPLACE WITH STRUCTURAL FILL TO DESIGN GRADES.
7. CONTOURS IN EXCESS SOIL STOCKPILE OVEREXCAVATION AREA SHOWN IN RED ARE THE JANUARY 5, 2011 TOPOGRAPHY AND THE LIMIT OF EXCAVATION GRADES, REPRESENTING THE GRADES THAT WILL BE OVEREXCAVATED.
8. A TEMPORARY GEOCOMPOSITE AND/OR PIPE UNDERDRAIN SYSTEM WILL BE INSTALLED BENEATH THE LINER SYSTEM TO COLLECT GROUND WATER, AS NEEDED. THE UNDERDRAINS WILL DIRECT FLOW TO A SUMP AT THE LOW POINT IN THE PHASE. IN PHASES 11 AND 12, THE UNDERDRAIN SUMP WILL DRAIN BY GRAVITY TO A TOPOGRAPHIC LOW AREA OUTSIDE THE LIMITS OF WASTE, UNLESS APPROVED BY THE OHIO EPA TO PUMP THE UNDERDRAIN.
9. ADDITIONAL UNDERDRAINS WILL BE INSTALLED TO COLLECT SEEPS ENCOUNTERED AT THE LIMIT OF EXCAVATION WITHIN THE LIMITS OF WASTE. THE UNDERDRAINS WILL EITHER DRAIN BY GRAVITY TO A TOPOGRAPHIC LOW AREA OUTSIDE THE LIMITS OF WASTE OR BE PUMPED IN ACCORDANCE WITH NOTES 4 AND 8.
10. PERMANENT UNDERDRAIN PIPES ARE PROPOSED AS NEEDED TO COLLECT GROUND WATER SEEPAGE IN EXISTING VALLEYS WHERE STRUCTURAL FILL WILL BE PLACED. THESE UNDERDRAINS WILL DRAIN BY GRAVITY.

REFERENCE

1. EXISTING TOPOGRAPHY PREPARED BY KEDDAL AERIAL MAPPING; DATE OF PHOTOGRAPHY: 1/18/13. ADDITIONAL MAPPING WAS PREPARED BY KEDDAL AERIAL MAPPING FROM AERIAL PHOTOGRAPHY DATED 1/6/12 AND 1/5/11 AND BY M.A.N. MAPPING FROM AERIAL PHOTOGRAPHY DATED 12/14/00.
2. TOPOGRAPHIC MAPPING IN FILL AREAS OF EXISTING UNIT PREPARED BY KEDDAL AERIAL MAPPING DATED 12/18/07 AND 3/7/06.
3. EXISTING CONTOURS OF EXCESS SOIL STOCKPILE OVEREXCAVATION AREA WERE DEVELOPED BY M.A.N. MAPPING DATED 12/14/00.
4. AEP POWER LINE SURVEY PROVIDED BY BGA, CADD FILE: APEX EASEMENT – STRS.44–80.

STATE OF OHIO
RICK BUFFALINI
E-55305
REGISTERED PROFESSIONAL ENGINEER

5-18-16

SCALE IN FEET
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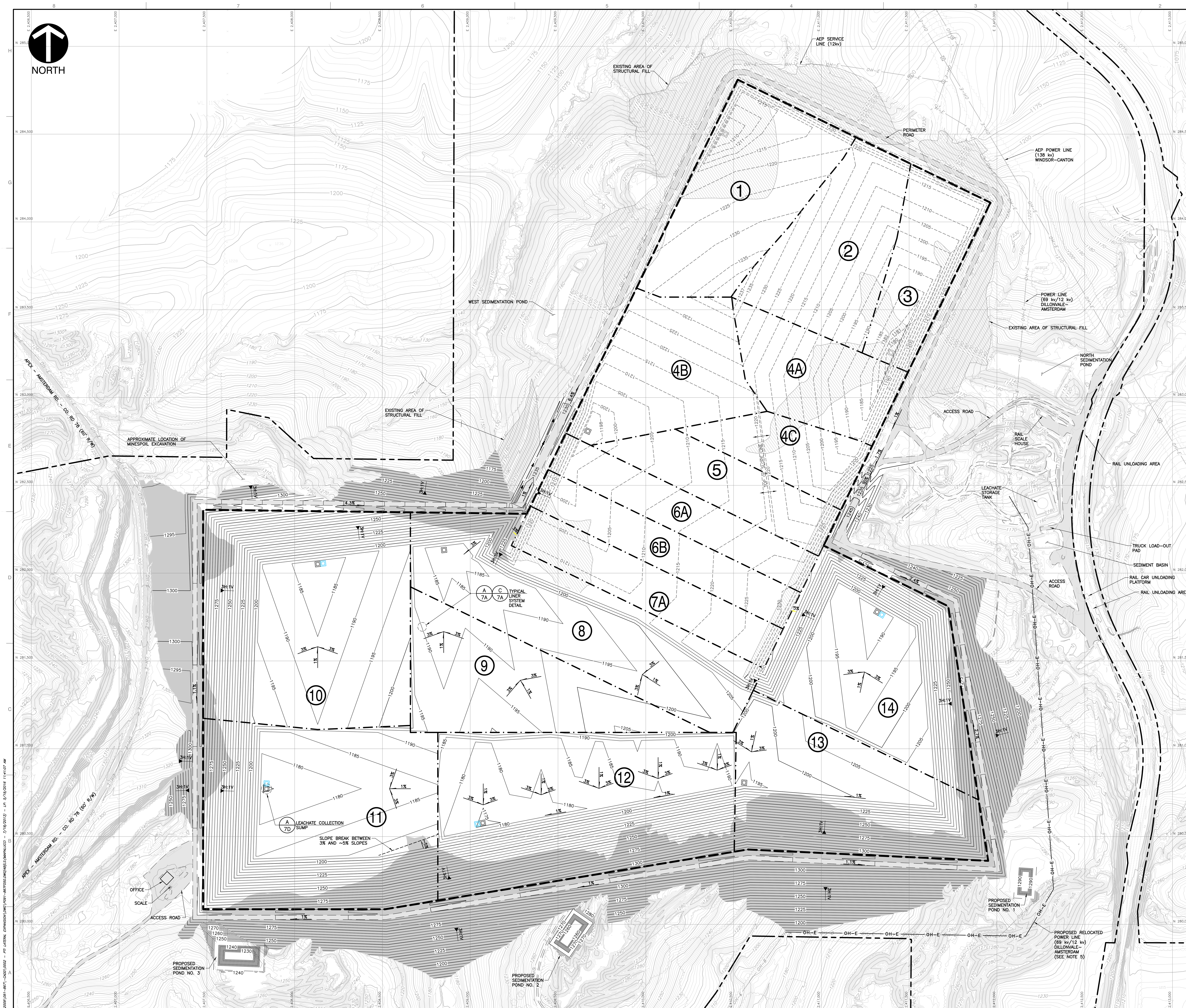
APEX ENVIRONMENTAL, LLC.
PERMIT TO INSTALL APPLICATION CONTIGUOUS EXPANSION APEX SANITARY LANDFILL JEFFERSON COUNTY, OHIO

DRAWN BY: MJI	CHECKED BY: MRB	APPROVED BY: RJB *
DATE: 10/17/11	DWG SCALE: 1"=200'	PROJECT NO: 091-867

HORIZONTAL AND VERTICAL LIMITS OF EXCAVATION

DRAWING NO.: 4A



REVISION RECORD

NO	DATE	DESCRIPTION
1	7/2013	RESPONSE TO OHIO EPA NOD DATED 12/28/12 AND REVISED PHASING

SUBMITTAL RECORD

NO	DATE	DESCRIPTION

LEGEND

- EXISTING GROUND CONTOUR (SEE REFERENCE) — 1220
- PROPERTY LINE
- LIMIT OF SOLID WASTE PLACEMENT
- PHASE LIMIT
- (8) PHASE DESIGNATION
- ACCESS ROAD
- PERMITTED BASE OF RECOMPACTED SOIL LINER CONTOUR — 1220
- PROPOSED BASE OF RECOMPACTED SOIL LINER CONTOUR — 1220
- LEACHATE SUMP
- EXISTING AREA OF STRUCTURAL FILL
- AREA OF STRUCTURAL FILL

NOTES

1. THIS DRAWING PROVIDES THE INFORMATION REQUIRED IN OAC 3745–27–06(B)(4)(b).
2. THIS DRAWING REPRESENTS THE BASE OF RSL GRADES IF A 3–FEET THICK RSL LAYER IS USED WITH A GCL.
3. DESIGN GRADES SHOWN WITHIN THE LIMITS OF WASTE REPRESENT THE BASE OF RECOMPACTED SOIL LINER. CONTOURS OUTSIDE THE LIMITS OF WASTE REPRESENT TOP OF STRUCTURAL FILL OR LIMIT OF EXCAVATION.
4. PHASES 1 THROUGH 7 ARE PREVIOUSLY PERMITTED UNDER PERMIT NO. 06–08438 APPROVED 12/31/09.
5. RELOCATE POWER LINES AS NEEDED, LOCATION SHOWN IS APPROXIMATE.

REFERENCE

EXISTING TOPOGRAPHY PREPARED BY KEDDAL AERIAL MAPPING; DATE OF PHOTOGRAPHY: 1/18/13. ADDITIONAL MAPPING WAS PREPARED BY KEDDAL AERIAL MAPPING FROM AERIAL PHOTOGRAPHY DATED 1/6/12 AND 1/5/11 AND BY M.A.N. MAPPING FROM AERIAL PHOTOGRAPHY DATED 12/14/00.

STATE OF OHIO
RICK BUFFALINI
E–55305
REGISTERED PROFESSIONAL ENGINEER

7·18·13

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JEFFERSON COUNTY, OHIO

DRAWN BY:	MJI	CHECKED BY:	MRB	APPROVED BY:	RJB *
DATE:	10/17/11	DWG SCALE:	1"=200'	PROJECT NO:	091-867

BASE OF RECOMPACTED SOIL LINER GRADING PLAN

DRAWING NO.: 4B

REVISION RECORD

NO	DATE	DESCRIPTION
1	7/2013	RESPONSE TO OHIO EPA NOD DATED 12/28/12 AND REVISED PHASING

SUBMITTAL RECORD

NO	DATE	DESCRIPTION

LEGEND

- 1220 — EXISTING GROUND CONTOUR (SEE REFERENCE)
- PROPERTY LINE
- LIMIT OF SOLID WASTE PLACEMENT
- PHASE LIMIT
- (8) PHASE DESIGNATION
- ACCESS ROAD
- 1220 — PERMITTED TOP OF RECOMPACTED SOIL LINER CONTOUR
- 1220 — PROPOSED TOP OF RECOMPACTED SOIL LINER CONTOUR
- LEACHATE SUMP

NOTES

1. THIS DRAWING PROVIDES THE INFORMATION REQUIRED IN OAC 3745-27-06(B)(4)(b).
2. DESIGN GRADES SHOWN WITHIN THE LIMITS OF WASTE REPRESENT THE TOP OF RECOMPACTED SOIL LINER. CONTOURS OUTSIDE THE LIMITS OF WASTE REPRESENT TOP OF STRUCTURAL FILL OR LIMIT OF EXCAVATION.
3. PHASES 1 THROUGH 7 ARE PREVIOUSLY PERMITTED UNDER PERMIT NO. 06-08438 APPROVED 12/31/09.

REFERENCE

EXISTING TOPOGRAPHY PREPARED BY KEDDAL AERIAL MAPPING; DATE OF PHOTOGRAPHY: 1/18/13. ADDITIONAL MAPPING WAS PREPARED BY KEDDAL AERIAL MAPPING FROM AERIAL PHOTOGRAPHY DATED 1/6/12 AND 1/5/11 AND BY M.A.N. MAPPING FROM AERIAL PHOTOGRAPHY DATED 12/14/00.

STATE OF OHIO
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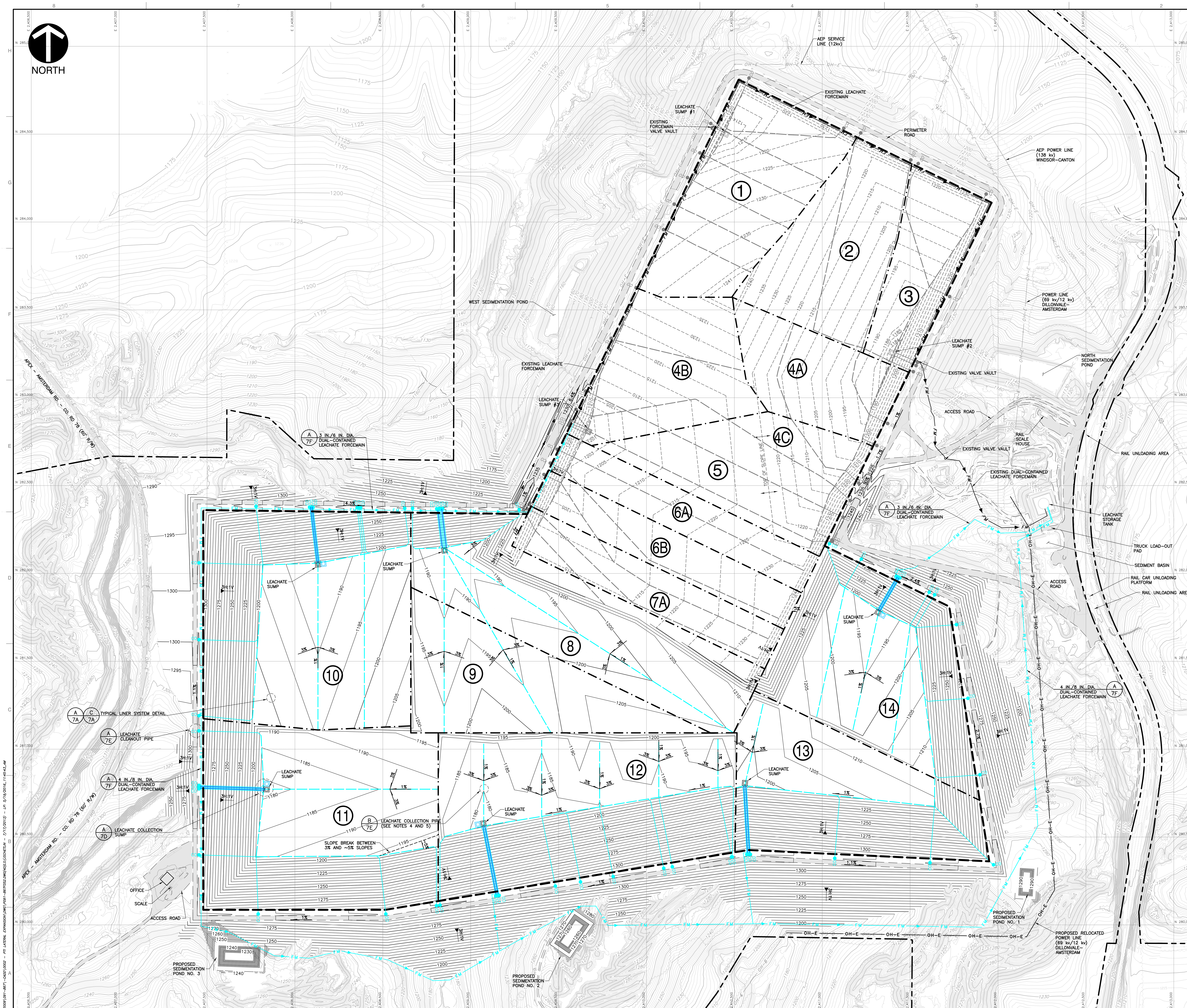
DRAWN BY:	MJI	CHECKED BY:	MRB	APPROVED BY:	RJB *
DATE:	10/17/11	DWG SCALE:	1"=200'	PROJECT NO:	091-867

TOP OF RECOMPACTED SOIL LINER GRADING PLAN

DRAWING NO.: 4C



NO	DATE	DESCRIPTION
1	7/2013	RESPONSE TO OHIO EPA NOD DATED 12/28/12 AND REVISED PHASING

REVISION RECORD

SUBMITTAL RECORD

NO	DATE	DESCRIPTION

LEGEND

- EXISTING GROUND CONTOUR (SEE REFERENCE)
- PROPERTY LINE
- LIMIT OF SOLID WASTE PLACEMENT
- PHASE LIMIT
- PHASE DESIGNATION
- ACCESS ROAD
- PERMITTED TOP OF GRANULAR LEACHATE COLLECTION LAYER CONTOUR
- PROPOSED TOP OF GRANULAR LEACHATE COLLECTION LAYER CONTOUR
- FLOW DIRECTION AND SLOPE
- EXISTING FORCEMAIN
- PERMITTED LEACHATE COLLECTION CLEANOUT
- PERMITTED LEACHATE COLLECTION PIPE
- PROPOSED FORCEMAIN
- PROPOSED LEACHATE COLLECTION CLEANOUT
- PROPOSED LEACHATE COLLECTION PIPE (SEE NOTE 4)
- LEACHATE SUMP AND SIDESLOPE RISER

NOTES

1. THIS DRAWING PROVIDES THE INFORMATION REQUIRED IN OAC 3745–27–06(B)(4)(c) AND (d).
2. DESIGN GRADES SHOWN WITHIN THE LIMITS OF WASTE REPRESENT THE TOP OF 1–FOOT THICK GRANULAR LEACHATE COLLECTION LAYER GRADES/BOTTOM OF WASTE GRADES. CONTOURS OUTSIDE THE LIMITS OF WASTE REPRESENT TOP OF STRUCTURAL FILL OR LIMIT OF EXCAVATION.
3. THIS LEACHATE COLLECTION PIPING LAYOUT WILL BE USED FOR LEACHATE COLLECTION MATERIAL WITH A PERMEABILITY EQUAL TO OR GREATER THAN $1X10^{-2}$ CM/SEC BUT LESS THAN 0.1 CM/SEC. SEE DRAWING 4E FOR LEACHATE COLLECTION PIPING LAYOUT IF THE PERMEABILITY OF THE LEACHATE COLLECTION MATERIAL IS GREATER THAN OR EQUAL TO 0.1 CM/SEC.
4. LEACHATE COLLECTION PIPE INVERT ELEVATIONS ARE 1–FT BELOW CONTOURS SHOWN.
5. LEACHATE COLLECTION PIPES LOCATED AT THE IMMEDIATE TOE OF THE 3H:1V PERIMETER BERM MAY BE MINIMUM SDR 11. ALL OTHER LEACHATE COLLECTION PIPES SHALL BE MINIMUM SDR 9.
6. PHASES 1 THROUGH 7 ARE PREVIOUSLY PERMITTED UNDER PERMIT NO. 06–08438 APPROVED 12/31/09.

REFERENCE

EXISTING TOPOGRAPHY PREPARED BY KEDDAL AERIAL MAPPING; DATE OF PHOTOGRAPHY: 1/18/13. ADDITIONAL MAPPING WAS PREPARED BY KEDDAL AERIAL MAPPING FROM AERIAL PHOTOGRAPHY DATED 1/6/12 AND 1/5/11 AND BY M.A.N. MAPPING FROM AERIAL PHOTOGRAPHY DATED 12/14/00.

STATE OF OHIO
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7-18-13

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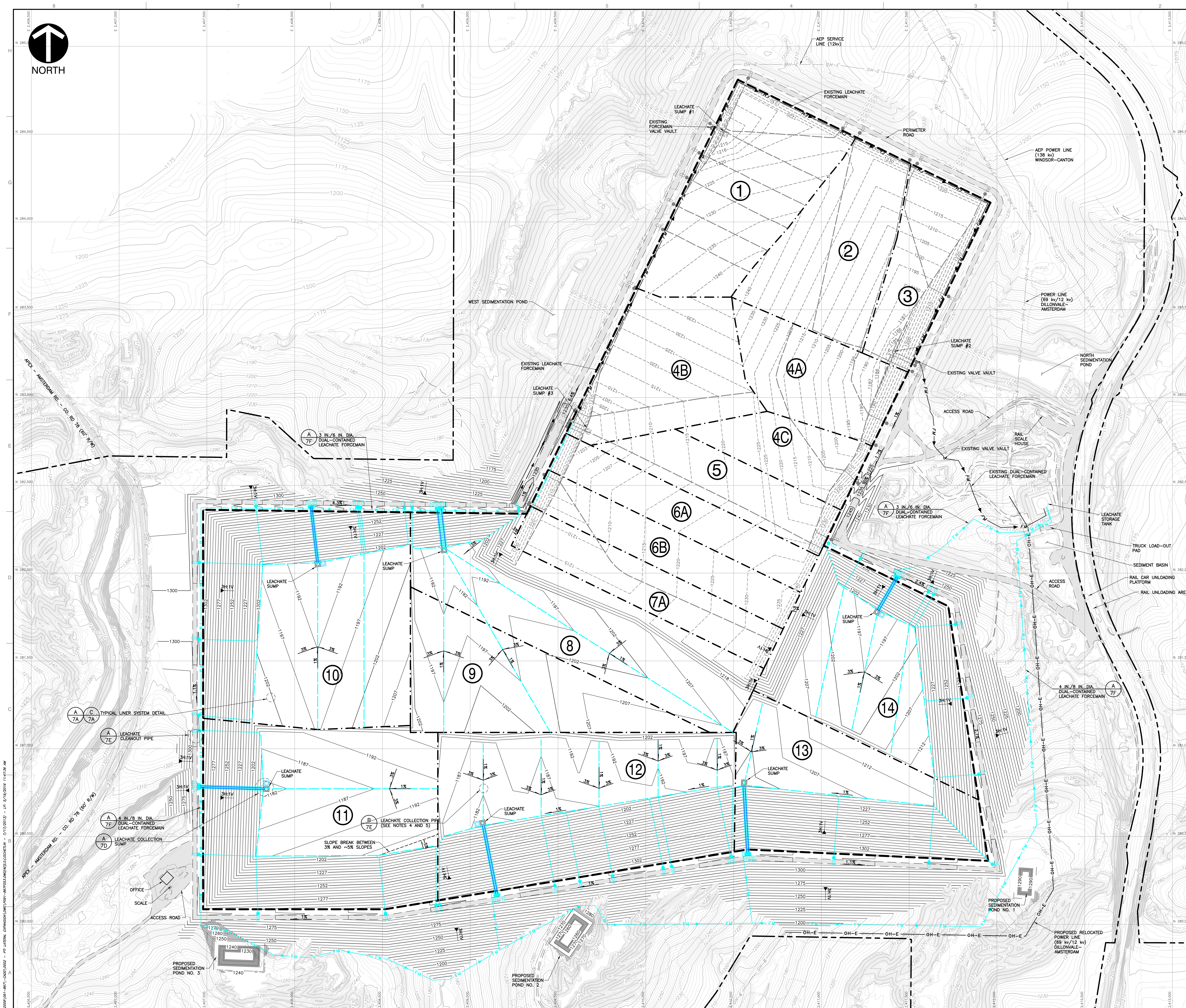
DRAWN BY: JM	CHECKED BY: MRB	APPROVED BY: RJB *
DATE: 10/17/11	DWG SCALE: 1"=200'	PROJECT NO: 091-867

TOP OF GRANULAR LEACHATE COLLECTION LAYER/ BOTTOM OF WASTE GRADING PLAN

DRAWING NO.: 4D



REVISION RECORD

NO	DATE	DESCRIPTION
1	7/2013	RESPONSE TO OHIO EPA NOD DATED 12/28/12 AND REVISED PHASING

SUBMITTAL RECORD

NO	DATE	DESCRIPTION

LEGEND

- EXISTING GROUND CONTOUR (SEE REFERENCE)
- PROPERTY LINE
- LIMIT OF SOLID WASTE PLACEMENT
- PHASE LIMIT
- PHASE DESIGNATION
- PERIMETER ROAD
- PERMITTED TOP OF TIRE SHRED LEACHATE COLLECTION LAYER CONTOUR
- PROPOSED TOP OF TIRE SHRED LEACHATE COLLECTION LAYER CONTOUR
- 4.6% FLOW DIRECTION AND SLOPE
- FM EXISTING FORCEMAIN
- CO PERMITTED LEACHATE COLLECTION CLEANOUT
- PERMITTED LEACHATE COLLECTION PIPE
- FM PROPOSED FORCEMAIN
- CO PROPOSED LEACHATE COLLECTION CLEANOUT
- PROPOSED LEACHATE COLLECTION PIPE (SEE NOTE 4)
- LEACHATE SUMP

NOTES

1. THIS DRAWING PROVIDES THE INFORMATION REQUIRED IN OAC 3745–27–06(B)(4)(c) AND (d).
2. DESIGN GRADES SHOWN WITHIN THE LIMITS OF WASTE REPRESENT THE TOP OF 2–FOOT THICK TIRE SHRED LEACHATE COLLECTION LAYER GRADES/BOTTOM OF WASTE GRADES. CONTOURS OUTSIDE THE LIMITS OF WASTE REPRESENT TOP OF STRUCTURAL FILL OR LIMIT OF EXCAVATION.
3. THIS LEACHATE COLLECTION PIPING LAYOUT WILL BE USED FOR LEACHATE COLLECTION MATERIAL (TIRE SHREDS OR GRANULAR MATERIAL) WITH A PERMEABILITY GREATER THAN OR EQUAL TO 0.1 CM/SEC.
4. LEACHATE COLLECTION PIPE INVERT ELEVATIONS ARE 2–FT BELOW CONTOURS SHOWN.
5. LEACHATE COLLECTION PIPES LOCATED AT THE IMMEDIATE TOE OF THE 3H:1V PERIMETER BERM MAY BE MINIMUM SDR 11. ALL OTHER LEACHATE COLLECTION PIPES SHALL BE MINIMUM SDR 9.
6. PHASES 1 THROUGH 7 ARE PREVIOUSLY PERMITTED UNDER PERMIT NO. 06–08438 APPROVED 12/31/09.

REFERENCE

EXISTING TOPOGRAPHY PREPARED BY KEDDAL AERIAL MAPPING; DATE OF PHOTOGRAPHY: 1/18/13. ADDITIONAL MAPPING WAS PREPARED BY KEDDAL AERIAL MAPPING FROM AERIAL PHOTOGRAPHY DATED 1/6/12 AND 1/5/11 AND BY M.A.N. MAPPING FROM AERIAL PHOTOGRAPHY DATED 12/14/00.

STATE OF OHIO
RICK BUFFALINI
E-55305
REGISTERED
PROFESSIONAL ENGINEER

7-18-13

SCALE IN FEET
0 200 400

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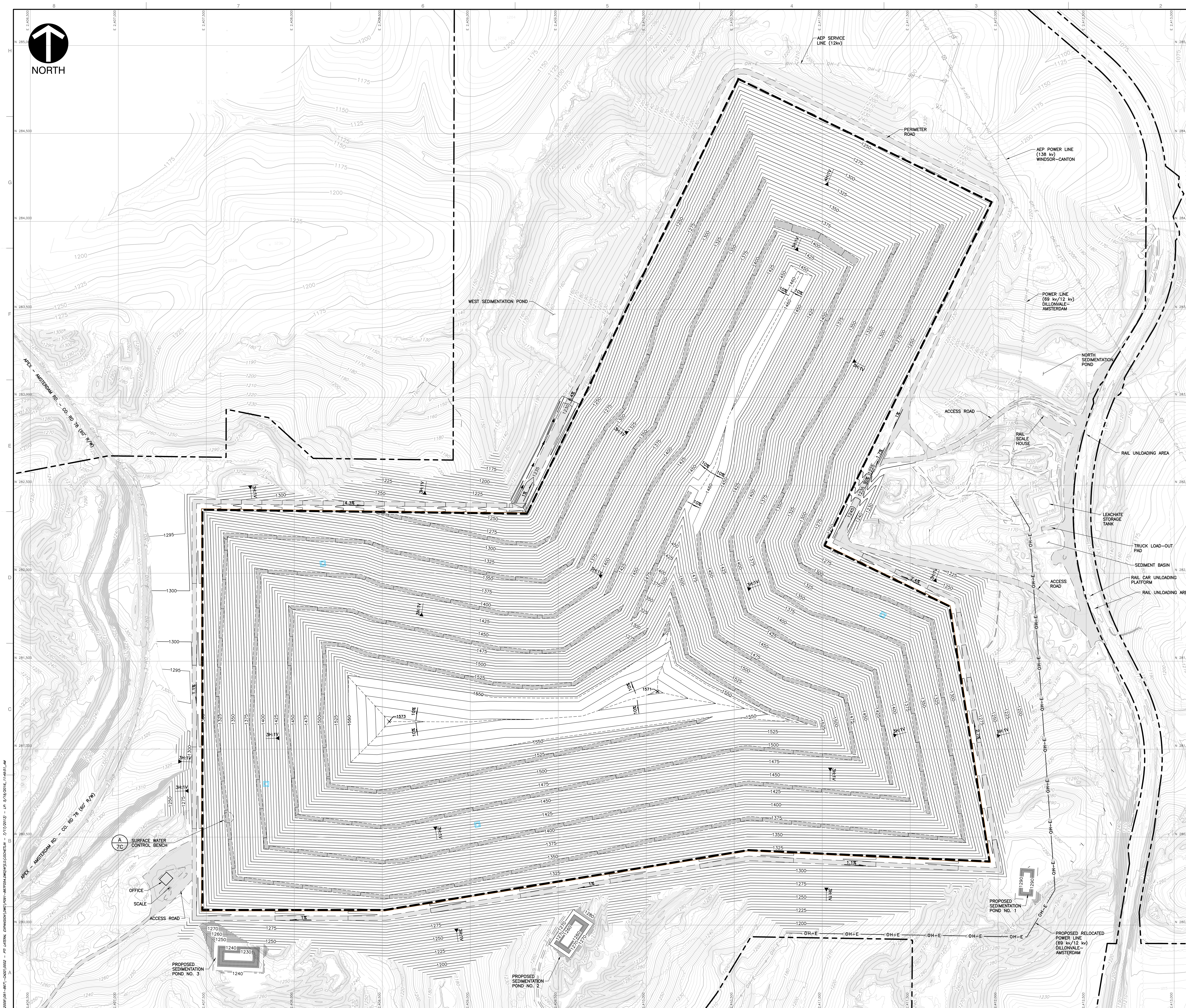
APEX SANITARY LANDFILL
JEFFERSON COUNTY, OHIO

DRAWN BY: MJI	CHECKED BY: MRB	APPROVED BY: RJB *
DATE: 10/17/11	DWG SCALE: 1"=200'	PROJECT NO: 091-867

TOP OF TIRE SHRED LEACHATE COLLECTION LAYER/ BOTTOM OF WASTE GRADING PLAN

DRAWING NO.: 4E



REVISION RECORD

NO	DATE	DESCRIPTION
1	7/2013	RESPONSE TO OHIO EPA NOD DATED 12/28/12.

SUBMITTAL RECORD

NO	DATE	DESCRIPTION

LEGEND

- 1220 — EXISTING GROUND CONTOUR (SEE REFERENCE)
- PROPERTY LINE
- LIMIT OF SOLID WASTE PLACEMENT
- ACCESS ROAD
- 1220 — TOP OF WASTE CONTOUR
- SURFACE WATER CONTROL BENCH

NOTES

1. THIS DRAWING PROVIDES THE INFORMATION REQUIRED IN OAC 3745–27–06(B)(4)(d) AND (f).
2. DESIGN GRADES SHOWN WITHIN THE LIMITS OF WASTE REPRESENT THE TOP OF WASTE GRADES INCLUDING 1–FOOT THICK INTERMEDIATE COVER. CONTOURS OUTSIDE THE LIMIT OF WASTE REPRESENT THE TOP OF STRUCTURAL FILL OR LIMIT OF EXCAVATION.
3. PHASES 1 THROUGH 7 ARE PREVIOUSLY PERMITTED UNDER PERMIT NO. 06–08438 APPROVED 12/31/09.

REFERENCE

EXISTING TOPOGRAPHY PREPARED BY KEDDAL AERIAL MAPPING; DATE OF PHOTOGRAPHY: 1/18/13. ADDITIONAL MAPPING WAS PREPARED BY KEDDAL AERIAL MAPPING FROM AERIAL PHOTOGRAPHY DATED 1/6/12 AND 1/5/11 AND BY M.A.N. MAPPING FROM AERIAL PHOTOGRAPHY DATED 12/14/00.

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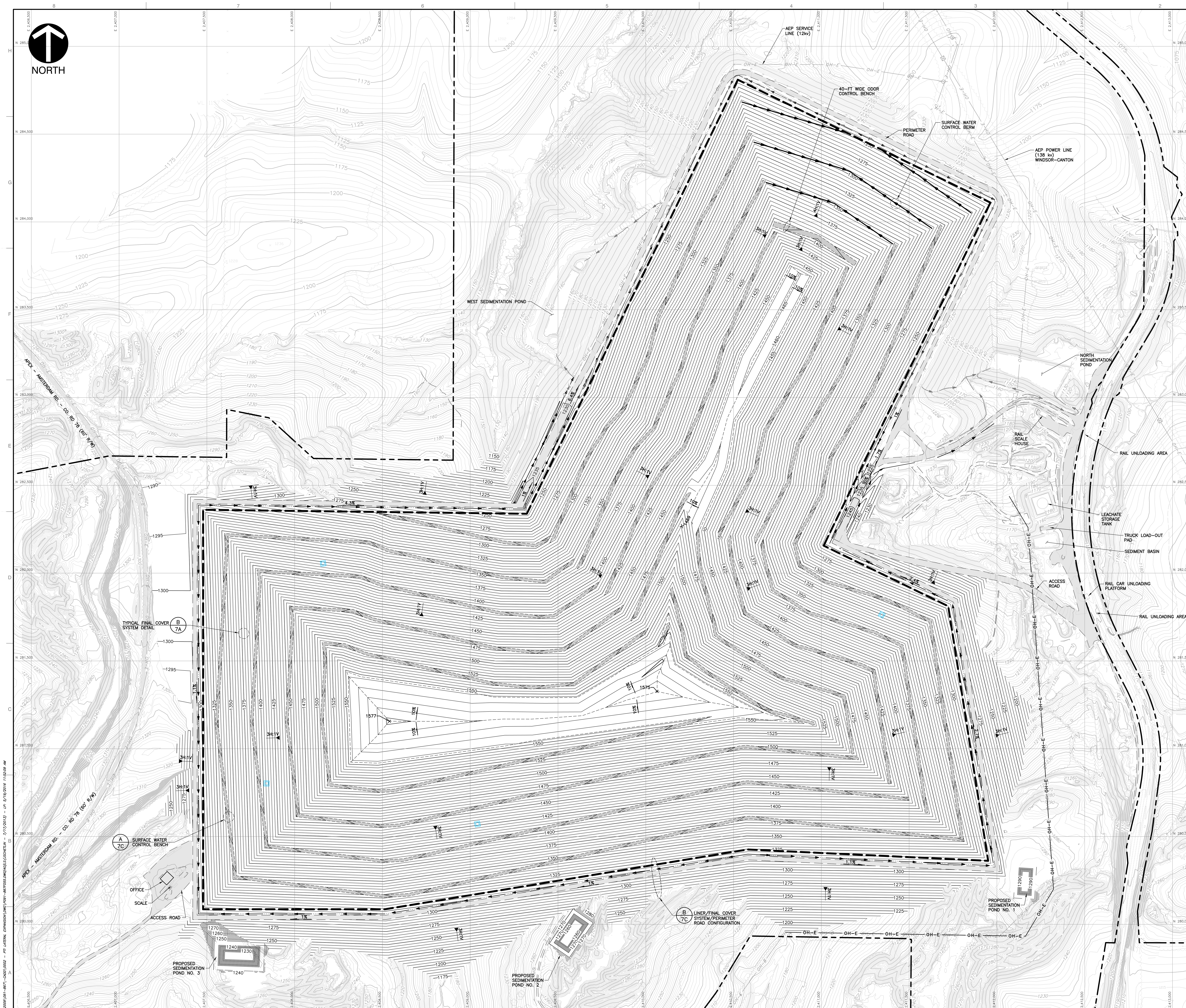
DATE:	10/17/11	DWG SCALE:	1"=200'	PROJECT NO:	091-867

TOP OF WASTE GRADING PLAN

DRAWING NO.: 4F



REVISION RECORD

NO	DATE	DESCRIPTION
1	7/2013	RESPONSE TO OHIO EPA NOD DATED 12/28/12.

SUBMITTAL RECORD

NO	DATE	DESCRIPTION

LEGEND

- EXISTING GROUND CONTOUR (SEE REFERENCE)
- PROPERTY LINE
- LIMIT OF SOLID WASTE PLACEMENT
- ACCESS ROAD
- TOP OF FINAL COVER CONTOUR
- SURFACE WATER CONTROL BENCH
- EXISTING CHANNEL AND FLOW DIRECTION
- PROPOSED CHANNEL AND FLOW DIRECTION
- SURFACE WATER CONTROL BERM

NOTES

1. THIS DRAWING PROVIDES THE INFORMATION REQUIRED IN OAC 3745-27-06(B)(4)(f).
2. DESIGN GRADES SHOWN WITHIN THE LIMITS OF WASTE REPRESENT THE TOP OF COMPOSITE CAP SYSTEM. CONTOURS OUTSIDE THE LIMITS OF WASTE REPRESENT TOP OF STRUCTURAL FILL OR LIMIT OF EXCAVATION.
3. PHASES 1 THROUGH 7 ARE PREVIOUSLY PERMITTED UNDER PERMIT NO. 06-08438 APPROVED 12/31/09.

REFERENCE

EXISTING TOPOGRAPHY PREPARED BY KEDDAL AERIAL MAPPING; DATE OF PHOTOGRAPHY: 1/18/13. ADDITIONAL MAPPING WAS PREPARED BY KEDDAL AERIAL MAPPING FROM AERIAL PHOTOGRAPHY DATED 1/6/12 AND 1/5/11 AND BY M.A.N. MAPPING FROM AERIAL PHOTOGRAPHY DATED 12/14/00.

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DATE: 10/17/11	DWG SCALE: 1"=200'	PROJECT NO: 091-867

TOP OF FINAL COVER GRADING PLAN

DRAWING NO.: 4G

NORTH

REVISION RECORD		
NO	DATE	DESCRIPTION
1	7/2013	UPDATED AERIAL TOPOGRAPHY AND MOVED LANDFILL GAS PROCESSING PLANT AREA
2	12/2015	UPDATED POWER LINE LOCATION. REVISED POND NO. 1 DISCHARGE LOCATION AND SEDIMENTATION POND NO. 3 LOCATION.
3		
4		

SUBMITTAL RECORD		
NO	DATE	DESCRIPTION

LEGEND

- EXISTING GROUND CONTOUR (SEE REFERENCE)
- PROPERTY LINE
- LIMIT OF SOLID WASTE PLACEMENT
- ACCESS ROAD
- TOP OF FINAL COVER CONTOUR
- SURFACE WATER CONTROL BENCH
- EXISTING CHANNEL AND FLOW DIRECTION
- PROPOSED CHANNEL AND FLOW DIRECTION
- SURFACE WATER CONTROL BERM
- DOWNCHUTE
- CULVERT

NOTES

1. THIS DRAWING PROVIDES THE INFORMATION REQUIRED IN OAC 3745-27-06(B)(4)(I).
2. DESIGN GRADES SHOWN WITHIN THE LIMITS OF WASTE REPRESENT THE TOP OF COMPOSITE CAP SYSTEM. CONTOURS OUTSIDE THE LIMITS OF WASTE REPRESENT TOP OF STRUCTURAL FILL OR LIMIT OF EXCAVATION.
3. SEE DRAWING 7K FOR CULVERT SCHEDULE AND DRAWING 7L FOR CHANNEL SCHEDULES.
4. PHASES 1 THROUGH 7 ARE PREVIOUSLY PERMITTED UNDER PERMIT NO. 06-08438 APPROVED 12/31/09.

REFERENCE

1. EXISTING TOPOGRAPHY PREPARED BY KEDDAL AERIAL MAPPING; DATE OF PHOTOGRAPHY: 1/18/13. ADDITIONAL MAPPING WAS PREPARED BY KEDDAL AERIAL MAPPING FROM AERIAL PHOTOGRAPHY DATED 1/6/12 AND 1/5/11 AND BY M.A.N. MAPPING FROM AERIAL PHOTOGRAPHY DATED 12/14/00.
2. AEP POWER LINE SURVEY PROVIDED BY BGA, CADD FILE: APEX EASEMENT – STRS.44-80.

STATE OF OHIO
RICK BUFFALINI
E-55305
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12-29-15

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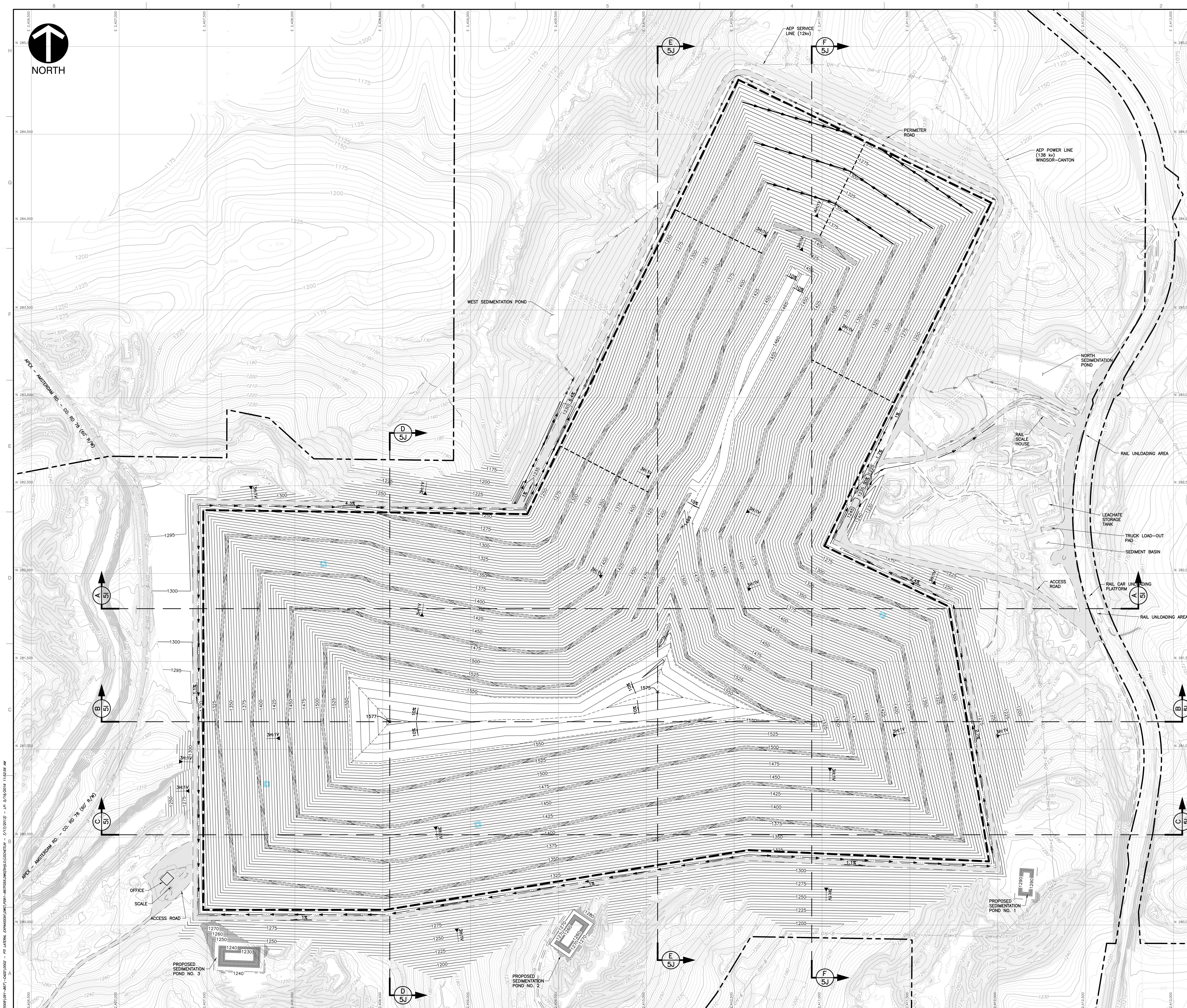
DATE:	10/17/11	DWG SCALE:	1"=200'	PROJECT NO:	091-867

SURFACE WATER MANAGEMENT PLAN

DRAWING NO.: **4H**

P:\2009\091-867_CAD\10002 - PTI LATERAL EXPANSION\DWG\PDSP\-867PDSP06.DWG(WOLS\MARKUP\DD - 12/17/2015 5:37:41 PM



REVISION RECORD

NO	DATE	DESCRIPTION
1	7/2013	RESPONSE TO OHIO EPA NOD DATED 12/28/12.

SUBMITTAL RECORD

NO	DATE	DESCRIPTION

LEGEND

- 1220 — EXISTING GROUND CONTOUR (SEE REFERENCE)
- PROPERTY LINE
- LIMIT OF SOLID WASTE PLACEMENT
- ACCESS ROAD
- 1220 — TOP OF FINAL COVER CONTOUR
- SURFACE WATER CONTROL BENCH
- CHANNEL/FLOW DIRECTION
- SURFACE WATER CONTROL BERM
- DOWNCHUTE
- A/5I — SECTION LOCATION: SECTION ID / SHEET NUMBER

NOTES

1. THIS DRAWING PROVIDES THE INFORMATION REQUIRED IN OAC 3745–27–06(B)(4)(f).
2. DESIGN GRADES SHOWN WITHIN THE LIMITS OF WASTE REPRESENT THE TOP OF COMPOSITE CAP SYSTEM. CONTOURS OUTSIDE THE LIMITS OF WASTE REPRESENT TOP OF STRUCTURAL FILL OR LIMIT OF EXCAVATION.
3. PHASES 1 THROUGH 7 ARE PREVIOUSLY PERMITTED UNDER PERMIT NO. 06–08438 APPROVED 12/31/09.

REFERENCE

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STATE OF OHIO — RICK BUFFALINI — E-55305 — REGISTERED — PROFESSIONAL ENGINEER

[signature] 7-18-13

SCALE IN FEET: 0 200 400

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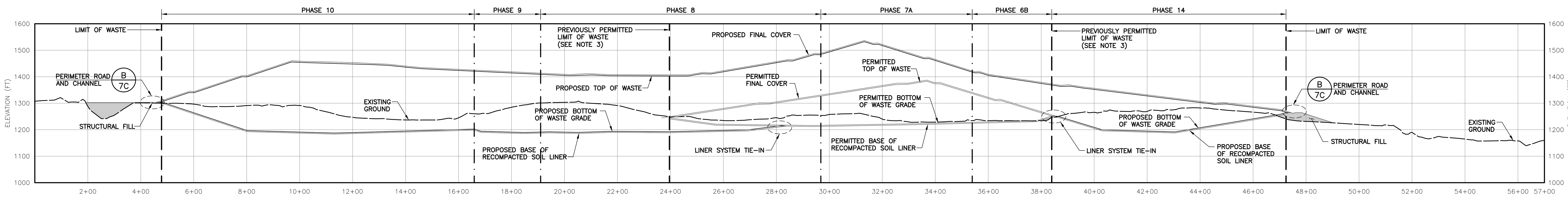
DRAWN BY: MJI	CHECKED BY: MRB	APPROVED BY: RJB *
DATE: 10/17/11	DWG SCALE: 1"=200'	PROJECT NO: 091-867

ENGINEERING CROSS SECTION LOCATION PLAN

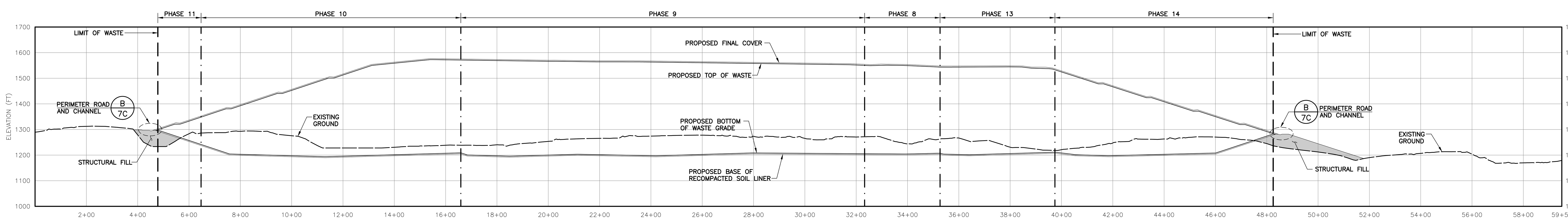
DRAWING NO.: 5H

NORTH



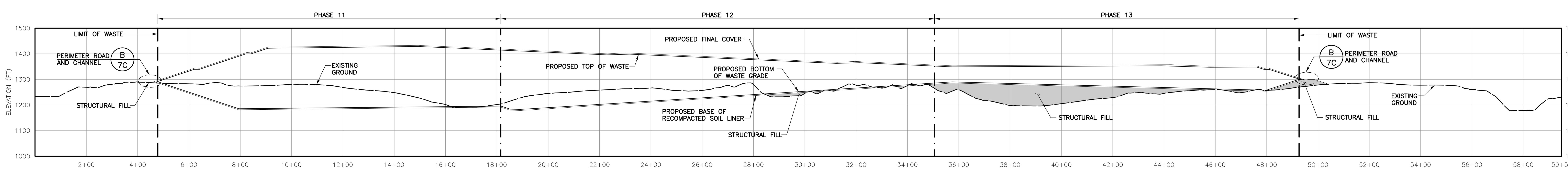
SECTION A-A

SCALE:
HORIZ: 1"=200'
VERT: 1"=200'



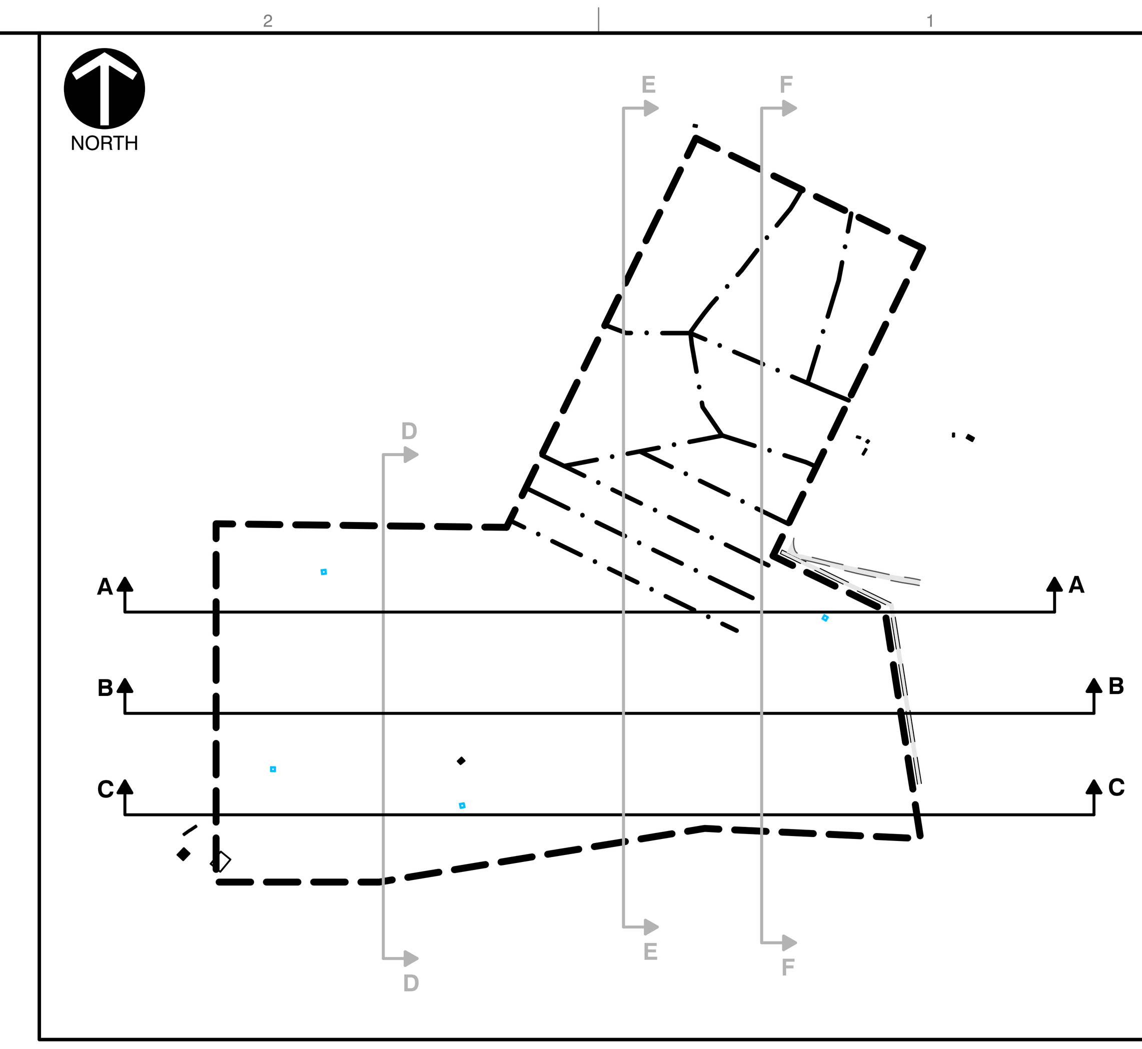
SECTION B-B

SCALE:
HORIZ: 1"=200'
VERT: 1"=200'



SECTION C-C

SCALE:
HORIZ: 1"=200'
VERT: 1"=200'



KEYMAP

N.T.S.

LEGEND

- 1220 — EXISTING GROUND CONTOUR (SEE REFERENCE)
- PROPERTY LINE
- LIMIT OF SOLID WASTE PLACEMENT
- STRUCTURAL FILL

NOTES

1. THIS DRAWING PROVIDES THE INFORMATION REQUIRED IN OAC 3745-27-06(B)(5)(c) AND (d).
2. PHASES 1 THROUGH 7 ARE PREVIOUSLY PERMITTED UNDER PERMIT NO. 06-08438 APPROVED 12/31/09.

REFERENCE

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7-18-13

SCALE IN FEET
0 200 400

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REVISION RECORD

NO	DATE	DESCRIPTION
1	7/2013	RESPONSE TO OHIO EPA NOD DATED 12/28/12 AND REVISED GRADES FOR PHASING

SUBMITTAL RECORD

NO	DATE	DESCRIPTION

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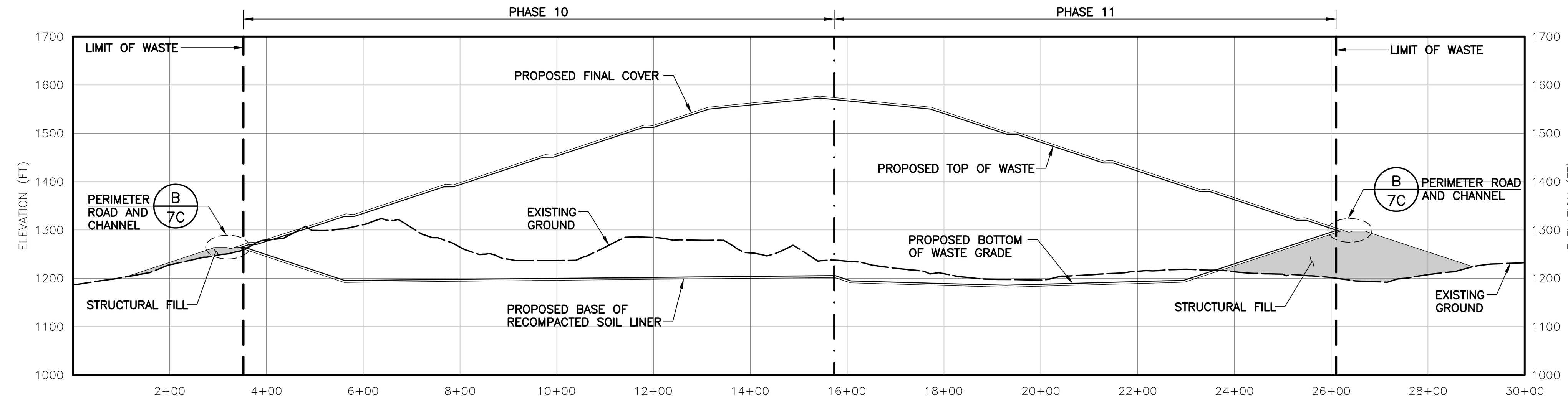
JEFFERSON COUNTY, OHIO

DRAWN BY: MJI	CHECKED BY: MRB	APPROVED BY: RJB *
DATE: 10/17/11	DWG SCALE: 1"=200'	PROJECT NO: 091-867

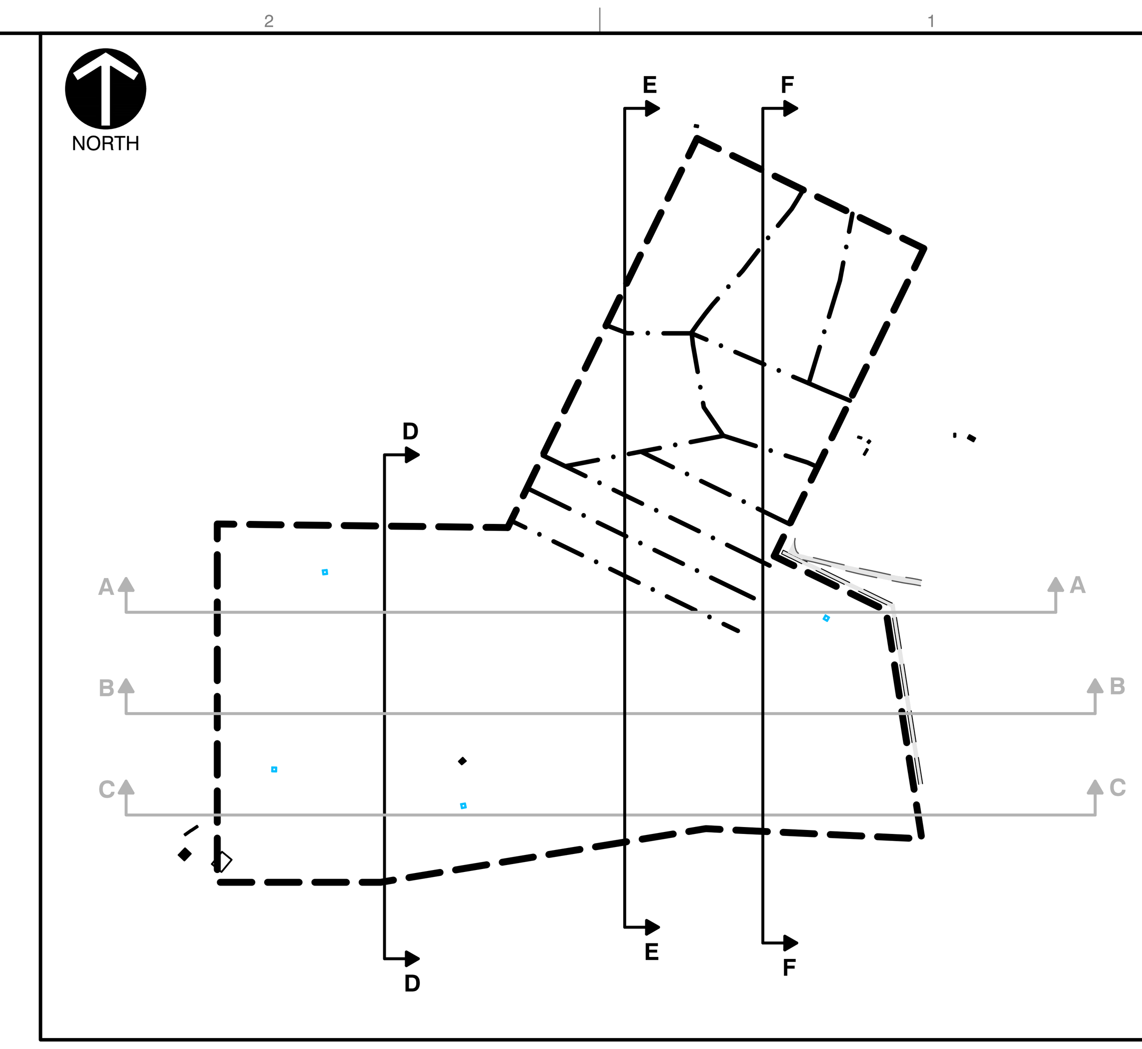
ENGINEERING CROSS SECTIONS
(SHEET 1 OF 2)

DRAWING NO.: 5I

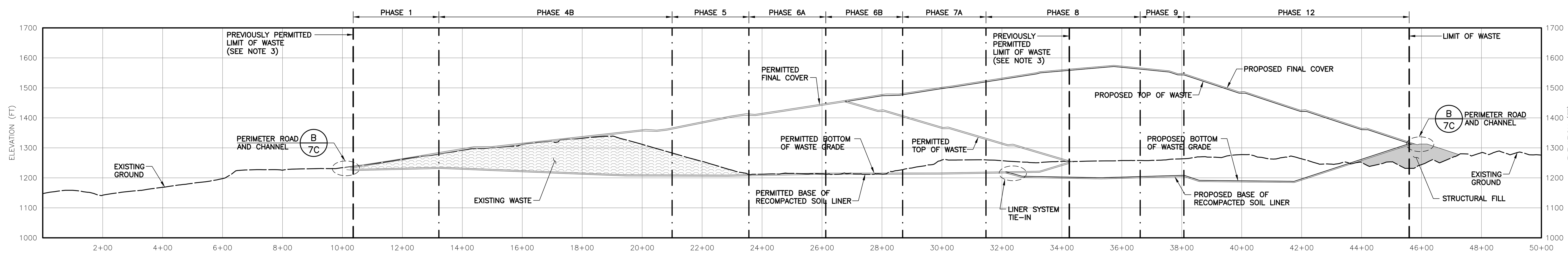
NORTH



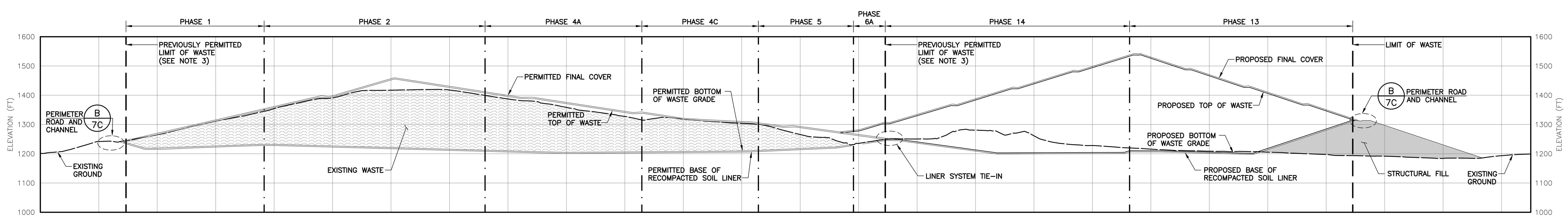
SECTION D-D
SCALE:
HORIZ: 1"=200'
VERT: 1"=200'



KEYMAP
N.T.S.



SECTION E-E
SCALE:
HORIZ: 1"=200'
VERT: 1"=200'



SECTION F-F
SCALE:
HORIZ: 1"=200'
VERT: 1"=200'

LEGEND

- EXISTING GROUND CONTOUR (SEE REFERENCE)
- PROPERTY LINE
- LIMIT OF SOLID WASTE PLACEMENT
- STRUCTURAL FILL
- EXISTING WASTE

NOTES

1. THIS DRAWING PROVIDES THE INFORMATION REQUIRED IN OAC 3745-27-06(B)(5)(c) AND (d).
2. PHASES 1 THROUGH 7 ARE PREVIOUSLY PERMITTED UNDER PERMIT NO. 06-08438 APPROVED 12/31/09.

REFERENCE

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E-55305
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PROFESSIONAL ENGINEER

7-18-13

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REVISION RECORD

NO	DATE	DESCRIPTION
1	7/2013	RESPONSE TO OHIO EPA NOD DATED 12/26/12 AND REVISED GRADES FOR PHASING

SUBMITTAL RECORD

NO	DATE	DESCRIPTION

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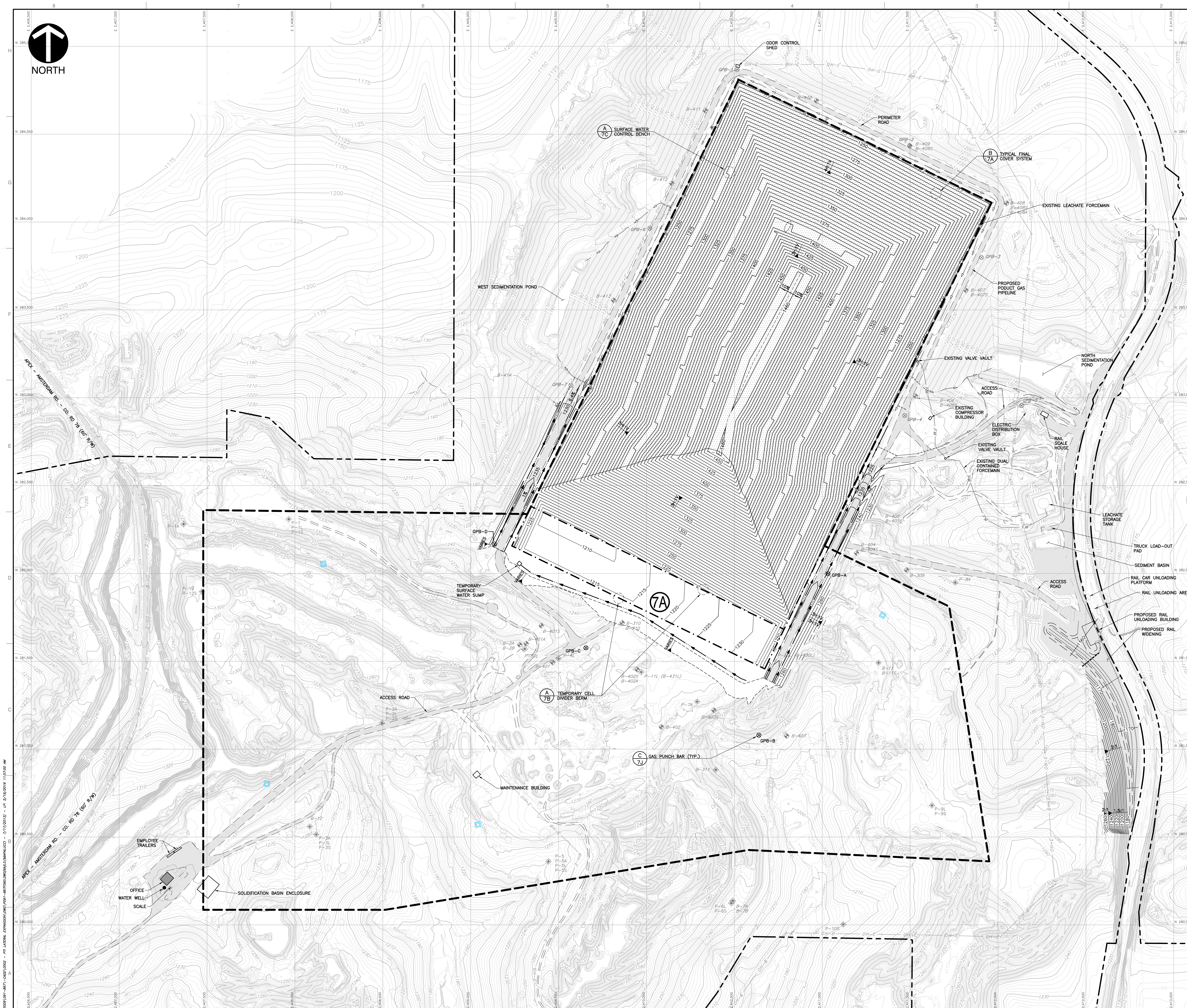
JEFFERSON COUNTY, OHIO

DRAWN BY: MJI	CHECKED BY: MRB	APPROVED BY: RJB *
DATE: 10/17/11	DWG SCALE: 1"=200'	PROJECT NO: 091-867

ENGINEERING CROSS SECTIONS (SHEET 2 OF 2)

DRAWING NO.: 5J



REVISION RECORD

NO	DATE	DESCRIPTION
1	4/2013	RESPONSE TO OHIO EPA NOD DATED 12/28/12 AND REVISED PHASING.

SUBMITTAL RECORD

NO	DATE	DESCRIPTION

LEGEND

- 1220 — EXISTING GROUND CONTOUR (SEE REFERENCE)
- PROPERTY LINE
- LIMIT OF SOLID WASTE PLACEMENT
- PHASE LIMIT
- 8 — PHASE DESIGNATION
- ACCESS ROAD
- 1450 — PROPOSED CONTOUR
- FM — EXISTING FORCEMAIN
- EXISTING SURFACE WATER CHANNEL
- PROPOSED SURFACE WATER CHANNEL
- PROPOSED CULVERT
- VARIES — SLOPE INDICATOR
- AREA OF FINAL COVER (SEE GENERAL OPERATION NOTE 6)
- B-310 — EXISTING PIEZOMETER
- B-410 — EXISTING MONITORING WELL
- GPB-6 — EXISTING EXPLOSIVE GAS MONITORING PUNCH BAR
- GPB-D — PROPOSED EXPLOSIVE GAS MONITORING PUNCH BAR

GENERAL OPERATION NOTES

1. THE BASE GRADES SHOWN IN THE CONSTRUCTED PHASE ARE THE TOP OF THE 1-FOOT THICK AGGREGATE LEACHATE COLLECTION/PROTECTIVE COVER LAYER. IF AN ALTERNATIVE LEACHATE COLLECTION LAYER IS USED, THE GRADES WILL BE CORRESPONDINGLY DIFFERENT, SEE DETAIL A ON DRAWING 7A. GRADES SHOWN IN WASTE PLACEMENT PHASES ARE TOP OF WASTE.
2. THE MAXIMUM EXTENT OF EACH PHASE IS SHOWN ON THESE PHASING DRAWINGS. PHASES MAY BE DIVIDED INTO SEPARATE SUB-PHASES OR CONSTRUCTED IN THEIR ENTIRETY DEPENDING ON ANTICIPATED FILLING RATE, CONSTRUCTION SCHEDULING AND SEASONAL CONSTRUCTION FEASIBILITY.
3. THE WASTE FILLING ELEVATIONS SHOWN ARE THE MAXIMUM PROPOSED TOP OF WASTE GRADES. FILLING MAY STOP SHORT OF THESE GRADES. SOLID WASTE MAY BE PLACED IN SUBSEQUENT PHASES PRIOR TO THE COMPLETION OF PREVIOUS PHASES TO PROVIDE FROST PROTECTION, SURFACE WATER DRAINAGE OR FOR PROPER OPERATION OF THE FACILITY. REMAINING AIRSPACE WITHIN PREVIOUS PHASES WILL BE FILLED TO THE PERMITTED GRADES AS QUICKLY AS POSSIBLE. THE JEFFERSON COUNTY HEALTH DEPARTMENT AND OHIO EPA WILL BE CONSULTED REGARDING THE TRANSITION BETWEEN PHASES.
4. TEMPORARY HAUL ROADS WILL BE CONSTRUCTED WITHIN THE DISPOSAL AREA AND MAY BE ADJUSTED BASED ON FIELD CONDITIONS, WEATHER AND WASTE ACCEPTANCE RATES.
5. SURFACE WATER FLOW PATTERNS ARE APPROXIMATE AND ARE SHOWN HERE TO SHOW GENERAL FLOW DIRECTIONS. CHANNELS, CULVERTS, BERMS, ETC. SHALL BE CONSTRUCTED AND MAINTAINED AS NECESSARY TO DIRECT RUN-OFF TO THE SURFACE WATER MANAGEMENT SYSTEM. TEMPORARY EROSION CONTROLS SUCH AS SILT FENCE AND SEEDING WILL BE INSTALLED AS NECESSARY TO REDUCE EROSION AND SEDIMENTATION.
6. FINAL COVER WILL BE INSTALLED OVER AREAS OF A PHASE THAT HAVE REACHED APPROVED FINAL ELEVATIONS FOR SOLID WASTE PLACEMENT. THE EXTENT OF FINAL COVER CONSTRUCTED IN ANY GIVEN CONSTRUCTION SEASON WILL BE BASED ON CONSTRUCTION CONSIDERATIONS SUCH AS SURFACE WATER MANAGEMENT, FUTURE TIE-INS, AND ACCESSIBILITY. TRANSITIONAL COVER MAY BE INSTALLED IN PLACE OF THE FINAL COVER SYSTEM.

CONSTRUCTION NOTES

1. CONTINUE SOLID WASTE FILLING IN EXISTING UNIT.
2. ABANDON GROUNDWATER MONITORING WELL/PIEZOMETER B-310.
3. EXCAVATE CELL AND PLACE STRUCTURAL FILL TO LIMITS AS SHOWN. CONSTRUCT COMPOSITE LINER SYSTEM AND LEACHATE MANAGEMENT SYSTEM. CONSTRUCT SURFACE WATER MANAGEMENT SYSTEM. TIE CELL LINER SYSTEM INTO EXISTING COMPOSITE LINER SYSTEM.
4. INSTALL TEMPORARY PUNCH BARS GPB-A, GPB-B, GPB-C AND GPB-D.

NOTES

1. THIS DRAWING PROVIDES INFORMATION REQUIRED IN OAC 3745-27-06(B)(6).
2. PHASING PRIOR TO THIS PERMIT ISSUANCE IS ADDRESSED IN THE CURRENT APPROVED PERMIT APPLICATION.
3. PHASES 1 THROUGH 7 ARE PREVIOUSLY PERMITTED UNDER PERMIT NO. 06-08438 APPROVED 12/31/09.

REFERENCE

EXISTING TOPOGRAPHY PREPARED BY KEDDAL AERIAL MAPPING; DATE OF PHOTOGRAPHY: 1/18/13. ADDITIONAL MAPPING WAS PREPARED BY KEDDAL AERIAL MAPPING FROM AERIAL PHOTOGRAPHY DATED 1/6/12 AND 1/5/11 AND BY M.A.N. MAPPING FROM AERIAL PHOTOGRAPHY DATED 12/14/00.

STATE OF OHIO
RICK BUFFALINI
E-55305
REGISTERED PROFESSIONAL ENGINEER

[signature]
7-18-13

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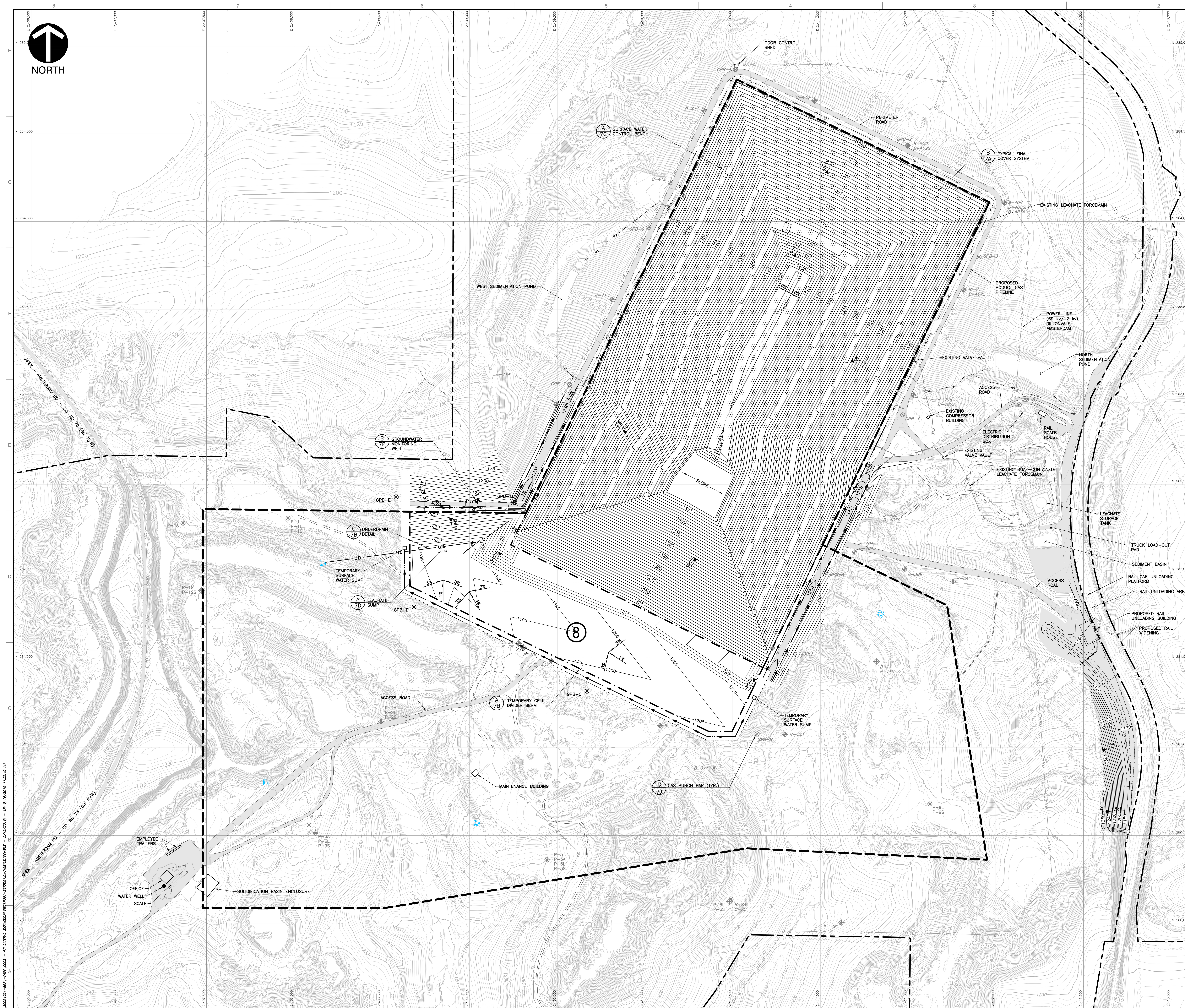
APEX SANITARY LANDFILL
JEFFERSON COUNTY, OHIO

DRAWN BY: MJI	CHECKED BY: MRB	APPROVED BY: RJB *
DATE: 10/17/11	DWG SCALE: 1"=200'	PROJECT NO: 091-867

PHASE 7
DEVELOPMENT PLAN

DRAWING NO.: 6A



REVISION RECORD

NO	DATE	DESCRIPTION
1	4/2013	RESPONSE TO OHIO EPA NOD DATED 12/28/12 AND REVISED PHASING.

SUBMITTAL RECORD

NO	DATE	DESCRIPTION

LEGEND

- 1220 — EXISTING GROUND CONTOUR (SEE REFERENCE)
- PROPERTY LINE
- LIMIT OF SOLID WASTE PLACEMENT
- PHASE LIMIT
- (8) — PHASE DESIGNATION
- ACCESS ROAD
- 1450 — PROPOSED CONTOUR
- FM — EXISTING FORCEMAIN
- FM — PROPOSED FORCEMAIN
- EXISTING SURFACE WATER CHANNEL
- PROPOSED SURFACE WATER CHANNEL
- PROPOSED CULVERT
- VARIES — SLOPE INDICATOR
- AREA OF FINAL COVER (SEE GENERAL OPERATION NOTE 6)
- B-310 — EXISTING PIEZOMETER
- B-410 — EXISTING MONITORING WELL
- B-428 — PROPOSED MONITORING WELL
- GPB-6 — EXISTING EXPLOSIVE GAS MONITORING PUNCH BAR
- GPB-8 — PROPOSED EXPLOSIVE GAS MONITORING PUNCH BAR
- UD — PROPOSED UNDERDRAIN

GENERAL OPERATION NOTES

1. THE BASE GRADES SHOWN IN THE CONSTRUCTED PHASE ARE THE TOP OF THE 1-FOOT THICK AGGREGATE LEACHATE COLLECTION/PROTECTIVE COVER LAYER. IF AN ALTERNATIVE LEACHATE COLLECTION LAYER IS USED, THE GRADES WILL BE CORRESPONDINGLY DIFFERENT, SEE DETAIL A ON DRAWING 7A. GRADES SHOWN IN WASTE PLACEMENT PHASES ARE TOP OF WASTE.
2. THE MAXIMUM EXTENT OF EACH PHASE IS SHOWN ON THESE PHASING DRAWINGS. PHASES MAY BE DIVIDED INTO SEPARATE SUB-PHASES OR CONSTRUCTED IN THEIR ENTIRETY DEPENDING ON ANTICIPATED FILLING RATE, CONSTRUCTION SCHEDULING AND SEASONAL CONSTRUCTION FEASIBILITY.
3. THE WASTE FILLING ELEVATIONS SHOWN ARE THE MAXIMUM PROPOSED TOP OF WASTE GRADES. FILLING MAY STOP SHORT OF THESE GRADES. SOLID WASTE MAY BE PLACED IN SUBSEQUENT PHASES PRIOR TO THE COMPLETION OF PREVIOUS PHASES TO PROVIDE FROST PROTECTION, SURFACE WATER DRAINAGE OR FOR PROPER OPERATION OF THE FACILITY. REMAINING AIRSPACE WITHIN PREVIOUS PHASES WILL BE FILLED TO THE PERMITTED GRADES AS QUICKLY AS POSSIBLE. THE JEFFERSON COUNTY HEALTH DEPARTMENT AND OHIO EPA WILL BE CONSULTED REGARDING THE TRANSITION BETWEEN PHASES.
4. TEMPORARY HAUL ROADS WILL BE CONSTRUCTED WITHIN THE DISPOSAL AREA AND MAY BE ADJUSTED BASED ON FIELD CONDITIONS, WEATHER AND WASTE ACCEPTANCE RATES.
5. SURFACE WATER FLOW PATTERNS ARE APPROXIMATE AND ARE SHOWN HERE TO SHOW GENERAL FLOW DIRECTIONS. CHANNELS, CULVERTS, BERMS, ETC. SHALL BE CONSTRUCTED AND MAINTAINED AS NECESSARY TO DIRECT RUN-OFF TO THE SURFACE WATER MANAGEMENT SYSTEM. TEMPORARY EROSION CONTROLS SUCH AS SILT FENCE AND SEEDING WILL BE INSTALLED AS NECESSARY TO REDUCE EROSION AND SEDIMENTATION.
6. FINAL COVER WILL BE INSTALLED OVER AREAS OF A PHASE THAT HAVE REACHED APPROVED FINAL ELEVATIONS FOR SOLID WASTE PLACEMENT. THE EXTENT OF FINAL COVER CONSTRUCTED IN ANY GIVEN CONSTRUCTION SEASON WILL BE BASED ON CONSTRUCTION CONSIDERATIONS SUCH AS SURFACE WATER MANAGEMENT, FUTURE TIE-INS, AND ACCESSIBILITY. TRANSITIONAL COVER MAY BE INSTALLED IN PLACE OF THE FINAL COVER SYSTEM.

CONSTRUCTION NOTES

1. CONTINUE SOLID WASTE PLACEMENT IN EXISTING UNIT.
2. OVEREXCAVATE EXCESS SPOIL DISPOSAL AREA AND REPLACE WITH STRUCTURAL FILL.
3. ABANDON GROUNDWATER MONITORING WELLS B-310, B-401S, B-402A, B-402S, P-11L (B-431L), B-401A, P-4L, P-7A, B-403S, B-431S, B-431.
4. EXCAVATE CELL AND PLACE STRUCTURAL FILL TO LIMITS AS SHOWN. INSTALL UNDERDRAIN SYSTEM AS NEEDED. CONSTRUCT COMPOSITE LINER SYSTEM AND LEACHATE MANAGEMENT SYSTEM. CONSTRUCT SURFACE WATER MANAGEMENT SYSTEM. TIE CELL LINER SYSTEM INTO EXISTING COMPOSITE LINER SYSTEM.
5. INSTALL PUNCH BAR GPB-18 AND TEMPORARY PUNCH BARS GPB-C, GPB-D, AND GPB-E. INSTALL GROUNDWATER MONITORING WELL B-415.

NOTES

1. THIS DRAWING PROVIDES INFORMATION REQUIRED IN OAC 3745-27-06(B)(6).
2. PHASING PRIOR TO THIS PERMIT ISSUANCE IS ADDRESSED IN THE CURRENT APPROVED PERMIT APPLICATION.

REFERENCE

EXISTING TOPOGRAPHY PREPARED BY KEDDAL AERIAL MAPPING; DATE OF PHOTOGRAPHY: 1/18/13. ADDITIONAL MAPPING WAS PREPARED BY KEDDAL AERIAL MAPPING FROM AERIAL PHOTOGRAPHY DATED 1/6/12 AND 1/5/11 AND BY M.A.N. MAPPING FROM AERIAL PHOTOGRAPHY DATED 12/14/00.

STATE OF OHIO
RICK BUFFALINI
E-55305
REGISTERED PROFESSIONAL ENGINEER

7-18-13

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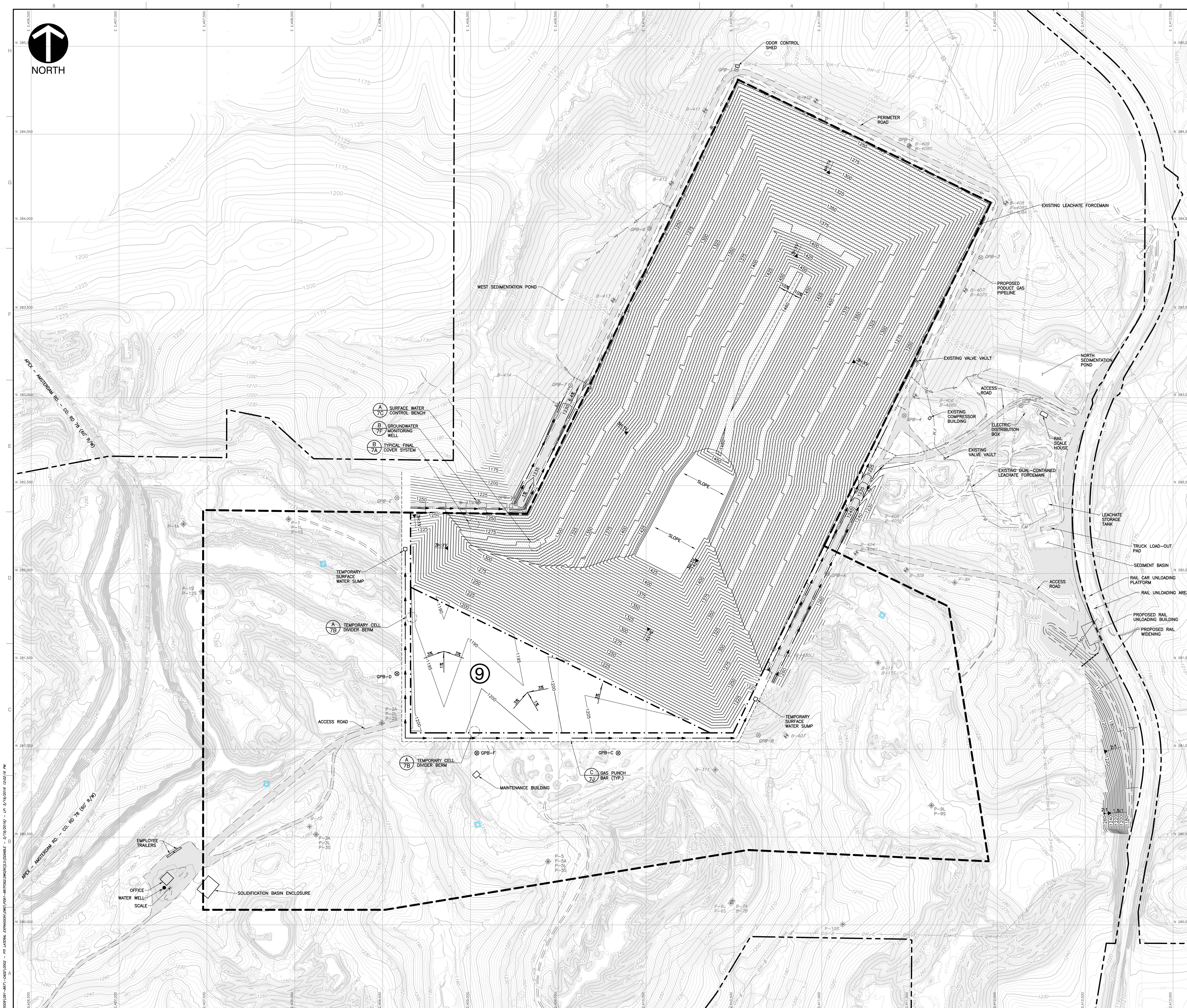
JEFFERSON COUNTY, OHIO

DRAWN BY:	MJI	CHECKED BY:	MRB	APPROVED BY:	RJB *
DATE:	9/9/11	DWG SCALE:	1"=200'	PROJECT NO:	091-867

PHASE 8
DEVELOPMENT PLAN

DRAWING NO.: 6B



REVISION RECORD

NO	DATE	DESCRIPTION
1	4/2013	RESPONSE TO OHIO EPA NOD DATED 12/28/12 AND REVISED PHASING.

SUBMITTAL RECORD

NO	DATE	DESCRIPTION

LEGEND

- EXISTING GROUND CONTOUR (SEE REFERENCE)
- PROPERTY LINE
- LIMIT OF SOLID WASTE PLACEMENT
- PHASE LIMIT
- (8) PHASE DESIGNATION
- PERIMETER ROAD
- 1450 PROPOSED CONTOUR
- FM EXISTING FORCEMAIN
- FM PROPOSED FORCEMAIN
- EXISTING SURFACE WATER CHANNEL
- PROPOSED SURFACE WATER CHANNEL
- SURFACE WATER CONTROL BENCH
- PROPOSED CULVERT
- VARIES SLOPE INDICATOR
- AREA OF FINAL COVER (SEE GENERAL OPERATION NOTE 6)
- B-310 EXISTING PIEZOMETER
- B-410 EXISTING MONITORING WELL
- B-428 PROPOSED MONITORING WELL
- GPB-6 EXISTING EXPLOSIVE GAS MONITORING PUNCH BAR
- GPB-9 PROPOSED EXPLOSIVE GAS MONITORING PUNCH BAR
- UD EXISTING UNDERDRAIN
- UD PROPOSED UNDERDRAIN

GENERAL OPERATION NOTES

1. THE BASE GRADES SHOWN IN THE CONSTRUCTED PHASE ARE THE TOP OF THE 1-FOOT THICK AGGREGATE LEACHATE COLLECTION/PROTECTIVE COVER LAYER. IF AN ALTERNATIVE LEACHATE COLLECTION LAYER IS USED, THE GRADES WILL BE CORRESPONDINGLY DIFFERENT, SEE DETAIL A ON DRAWING 7A. GRADES SHOWN IN WASTE PLACEMENT PHASES ARE TOP OF WASTE.
2. THE MAXIMUM EXTENT OF EACH PHASE IS SHOWN ON THESE PHASING DRAWINGS. PHASES MAY BE DIVIDED INTO SEPARATE SUB-PHASES OR CONSTRUCTED IN THEIR ENTIRETY DEPENDING ON ANTICIPATED FILLING RATE, CONSTRUCTION SCHEDULING AND SEASONAL CONSTRUCTION FEASIBILITY.
3. THE WASTE FILLING ELEVATIONS SHOWN ARE THE MAXIMUM PROPOSED TOP OF WASTE GRADES. FILLING MAY STOP SHORT OF THESE GRADES. SOLID WASTE MAY BE PLACED IN SUBSEQUENT PHASES PRIOR TO THE COMPLETION OF PREVIOUS PHASES TO PROVIDE FROST PROTECTION, SURFACE WATER DRAINAGE OR FOR PROPER OPERATION OF THE FACILITY. REMAINING AIRSPACE WITHIN PREVIOUS PHASES WILL BE FILLED TO THE PERMITTED GRADES AS QUICKLY AS POSSIBLE. THE JEFFERSON COUNTY HEALTH DEPARTMENT AND OHIO EPA WILL BE CONSULTED REGARDING THE TRANSITION BETWEEN PHASES.
4. TEMPORARY HAUL ROADS WILL BE CONSTRUCTED WITHIN THE DISPOSAL AREA AND MAY BE ADJUSTED BASED ON FIELD CONDITIONS, WEATHER AND WASTE ACCEPTANCE RATES.
5. SURFACE WATER FLOW PATTERNS ARE APPROXIMATE AND ARE SHOWN HERE TO SHOW GENERAL FLOW DIRECTIONS. CHANNELS, CULVERTS, BERMS, ETC. SHALL BE CONSTRUCTED AND MAINTAINED AS NECESSARY TO DIRECT RUN-OFF TO THE SURFACE WATER MANAGEMENT SYSTEM. TEMPORARY EROSION CONTROLS SUCH AS SILT FENCE AND SEEDING WILL BE INSTALLED AS NECESSARY TO REDUCE EROSION AND SEDIMENTATION.
6. FINAL COVER WILL BE INSTALLED OVER AREAS OF A PHASE THAT HAVE REACHED APPROVED FINAL ELEVATIONS FOR SOLID WASTE PLACEMENT. THE EXTENT OF FINAL COVER CONSTRUCTED IN ANY GIVEN CONSTRUCTION SEASON WILL BE BASED ON CONSTRUCTION CONSIDERATIONS SUCH AS SURFACE WATER MANAGEMENT, FUTURE TIE-INS, AND ACCESSIBILITY. TRANSITIONAL COVER MAY BE INSTALLED IN PLACE OF THE FINAL COVER SYSTEM.

CONSTRUCTION NOTES

1. CONTINUE SOLID WASTE PLACEMENT IN EXISTING UNIT.
2. ABANDON GROUNDWATER MONITORING WELLS B-2A, B-2B, P-10L, B-401, B-402.
3. 3. EXCAVATE CELL AND PLACE STRUCTURAL FILL TO LIMITS AS SHOWN. INSTALL UNDERDRAIN SYSTEM AS NEEDED. CONSTRUCT COMPOSITE LINER SYSTEM AND LEACHATE MANAGEMENT SYSTEM. CONSTRUCT SURFACE WATER MANAGEMENT SYSTEM. TIE CELL LINER SYSTEM INTO EXISTING COMPOSITE LINER SYSTEM.
4. INSTALL PUNCH BAR GPB-18 AND TEMPORARY PUNCH BARS GPB-C, GPB-D, GPB-F.

NOTES

1. THIS DRAWING PROVIDES INFORMATION REQUIRED IN OAC 3745-27-06(B)(6).
2. PHASING PRIOR TO THIS PERMIT ISSUANCE IS ADDRESSED IN THE CURRENT APPROVED PERMIT APPLICATION.

REFERENCE

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STATE OF OHIO
RICK BUFFALINI
E-55305
REGISTERED
PROFESSIONAL ENGINEER

7.18.13

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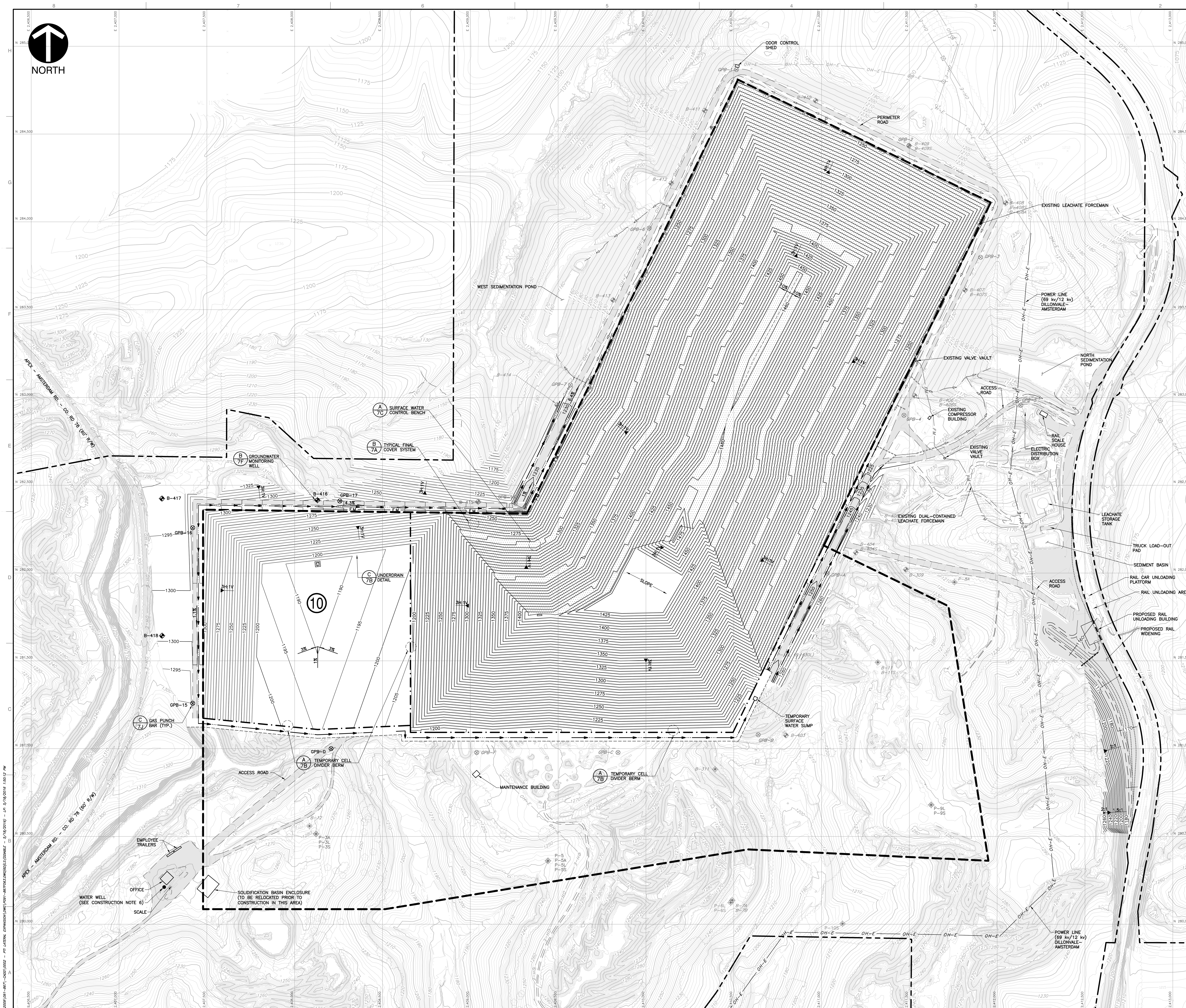
APEX SANITARY LANDFILL
JEFFERSON COUNTY, OHIO

DRAWN BY: MJI	CHECKED BY: MRB	APPROVED BY: RJB *
DATE: 9/9/11	DWG SCALE: 1"=200'	PROJECT NO: 091-867

PHASE 9
DEVELOPMENT PLAN

DRAWING NO.: 6C



REVISION RECORD

NO	DATE	DESCRIPTION
1	4/2013	RESPONSE TO OHIO EPA NOD DATED 12/28/12 AND REVISED PHASING.
2	5/2016	UPDATED AEP POWER LINE LOCATION AND REVISED NOTE REGARDING WATER WELL IN RESPONSE TO OHIO EPA NOD DATED 4/26/2016.

SUBMITTAL RECORD

NO	DATE	DESCRIPTION

LEGEND

- 1220 — EXISTING GROUND CONTOUR (SEE REFERENCE)
- PROPERTY LINE
- LIMIT OF SOLID WASTE PLACEMENT
- PHASE LIMIT
- 8 — PHASE DESIGNATION
- ACCESS ROAD
- 1450 — PROPOSED CONTOUR
- FM — EXISTING FORCEMAIN
- FM — PROPOSED FORCEMAIN
- EXISTING SURFACE WATER CHANNEL
- PROPOSED SURFACE WATER CHANNEL
- PROPOSED CULVERT
- VARIES — SLOPE INDICATOR
- AREA OF FINAL COVER (SEE GENERAL OPERATION NOTE 6)
- B-310 — EXISTING PIEZOMETER
- B-410 — EXISTING MONITORING WELL
- B-428 — PROPOSED MONITORING WELL
- GPB-6 — EXISTING EXPLOSIVE GAS MONITORING PUNCH BAR
- GPB-12 — PROPOSED EXPLOSIVE GAS MONITORING PUNCH BAR
- UD — EXISTING UNDERDRAIN
- UD — PROPOSED UNDERDRAIN

GENERAL OPERATION NOTES

1. THE BASE GRADES SHOWN IN THE CONSTRUCTED PHASE ARE THE TOP OF THE 1-FOOT THICK AGGREGATE LEACHATE COLLECTION/PROTECTIVE COVER LAYER. IF AN ALTERNATIVE LEACHATE COLLECTION LAYER IS USED, THE GRADES WILL BE CORRESPONDINGLY DIFFERENT, SEE DETAIL A ON DRAWING 7A. GRADES SHOWN IN WASTE PLACEMENT PHASES ARE TOP OF WASTE.
2. THE MAXIMUM EXTENT OF EACH PHASE IS SHOWN ON THESE PHASING DRAWINGS. PHASES MAY BE DIVIDED INTO SEPARATE SUB-PHASES OR CONSTRUCTED IN THEIR ENTIRETY DEPENDING ON ANTICIPATED FILLING RATE, CONSTRUCTION SCHEDULING AND SEASONAL CONSTRUCTION FEASIBILITY.
3. THE WASTE FILLING ELEVATIONS SHOWN ARE THE MAXIMUM PROPOSED TOP OF WASTE GRADES. FILLING MAY STOP SHORT OF THESE GRADES. SOLID WASTE MAY BE PLACED IN SUBSEQUENT PHASES PRIOR TO THE COMPLETION OF PREVIOUS PHASES TO PROVIDE FROST PROTECTION, SURFACE WATER DRAINAGE OR FOR PROPER OPERATION OF THE FACILITY. REMAINING AIRSPACE WITHIN PREVIOUS PHASES WILL BE FILLED TO THE PERMITTED GRADES AS QUICKLY AS POSSIBLE. THE JEFFERSON COUNTY HEALTH DEPARTMENT AND OHIO EPA WILL BE CONSULTED REGARDING THE TRANSITION BETWEEN PHASES.
4. TEMPORARY HAUL ROADS WILL BE CONSTRUCTED WITHIN THE DISPOSAL AREA AND MAY BE ADJUSTED BASED ON FIELD CONDITIONS, WEATHER AND WASTE ACCEPTANCE RATES.
5. SURFACE WATER FLOW PATTERNS ARE APPROXIMATE AND ARE SHOWN HERE TO SHOW GENERAL FLOW DIRECTIONS. CHANNELS, CULVERTS, BERMS, ETC. SHALL BE CONSTRUCTED AND MAINTAINED AS NECESSARY TO DIRECT RUN-OFF TO THE SURFACE WATER MANAGEMENT SYSTEM. TEMPORARY EROSION CONTROLS SUCH AS SILT FENCE AND SEEDING WILL BE INSTALLED AS NECESSARY TO REDUCE EROSION AND SEDIMENTATION.
6. FINAL COVER WILL BE INSTALLED OVER AREAS OF A PHASE THAT HAVE REACHED APPROVED FINAL ELEVATIONS FOR SOLID WASTE PLACEMENT. THE EXTENT OF FINAL COVER CONSTRUCTED IN ANY GIVEN CONSTRUCTION SEASON WILL BE BASED ON CONSTRUCTION CONSIDERATIONS SUCH AS SURFACE WATER MANAGEMENT, FUTURE TIE-INS, AND ACCESSIBILITY. TRANSITIONAL COVER MAY BE INSTALLED IN PLACE OF THE FINAL COVER SYSTEM.

CONSTRUCTION NOTES

1. CONTINUE SOLID WASTE PLACEMENT IN EXISTING UNIT.
2. OVEREXCAVATE EXCESS SPOIL DISPOSAL AREA AND REPLACE WITH STRUCTURAL FILL.
3. ABANDON GROUNDWATER MONITORING WELLS P-1, P-1L, P-1S, P-1A, P-12, P-12S, P-2A, P-2L, P-2S.
4. EXCAVATE CELL AND PLACE STRUCTURAL FILL TO LIMITS AS SHOWN. INSTALL UNDERDRAIN SYSTEM AS NEEDED. CONSTRUCT COMPOSITE LINER SYSTEM AND LEACHATE MANAGEMENT SYSTEM. CONSTRUCT SURFACE WATER MANAGEMENT SYSTEM. TIE CELL LINER SYSTEM INTO EXISTING COMPOSITE LINER SYSTEM.
5. INSTALL PUNCH BARS GPB-15, GPB-16, AND GPB-17 AND TEMPORARY PUNCH BAR GPB-D. INSTALL GROUNDWATER MONITORING WELLS B-416, B-417, AND B-418.
6. THE APEX WATER SUPPLY WELL WILL BE ABANDONED PRIOR TO INITIAL WASTE PLACEMENT IN PHASE10 WITHIN 1,000 FEET OF THE WATER SUPPLY WELL. SEE SECTIONS C1 AND C2 FOR DISCUSSION OF THIS WATER WELL.

NOTES

1. THIS DRAWING PROVIDES INFORMATION REQUIRED IN OAC 3745-27-06(B)(6).
2. PHASING PRIOR TO THIS PERMIT ISSUANCE IS ADDRESSED IN THE CURRENT APPROVED PERMIT APPLICATION.

REFERENCE

1. EXISTING TOPOGRAPHY PREPARED BY KEDDAL AERIAL MAPPING; DATE OF PHOTOGRAPHY: 1/18/13. ADDITIONAL MAPPING WAS PREPARED BY KEDDAL AERIAL MAPPING FROM AERIAL PHOTOGRAPHY DATED 1/6/12 AND 1/5/11 AND BY M.A.N. MAPPING FROM AERIAL PHOTOGRAPHY DATED 12/14/00.
2. AEP POWER LINE SURVEY PROVIDED BY BGA, CADD FILE: APEX EASEMENT – STRS.44-80.

STATE OF OHIO
RICK BUFFALINI
E-55305
REGISTERED PROFESSIONAL ENGINEER

5-18-16

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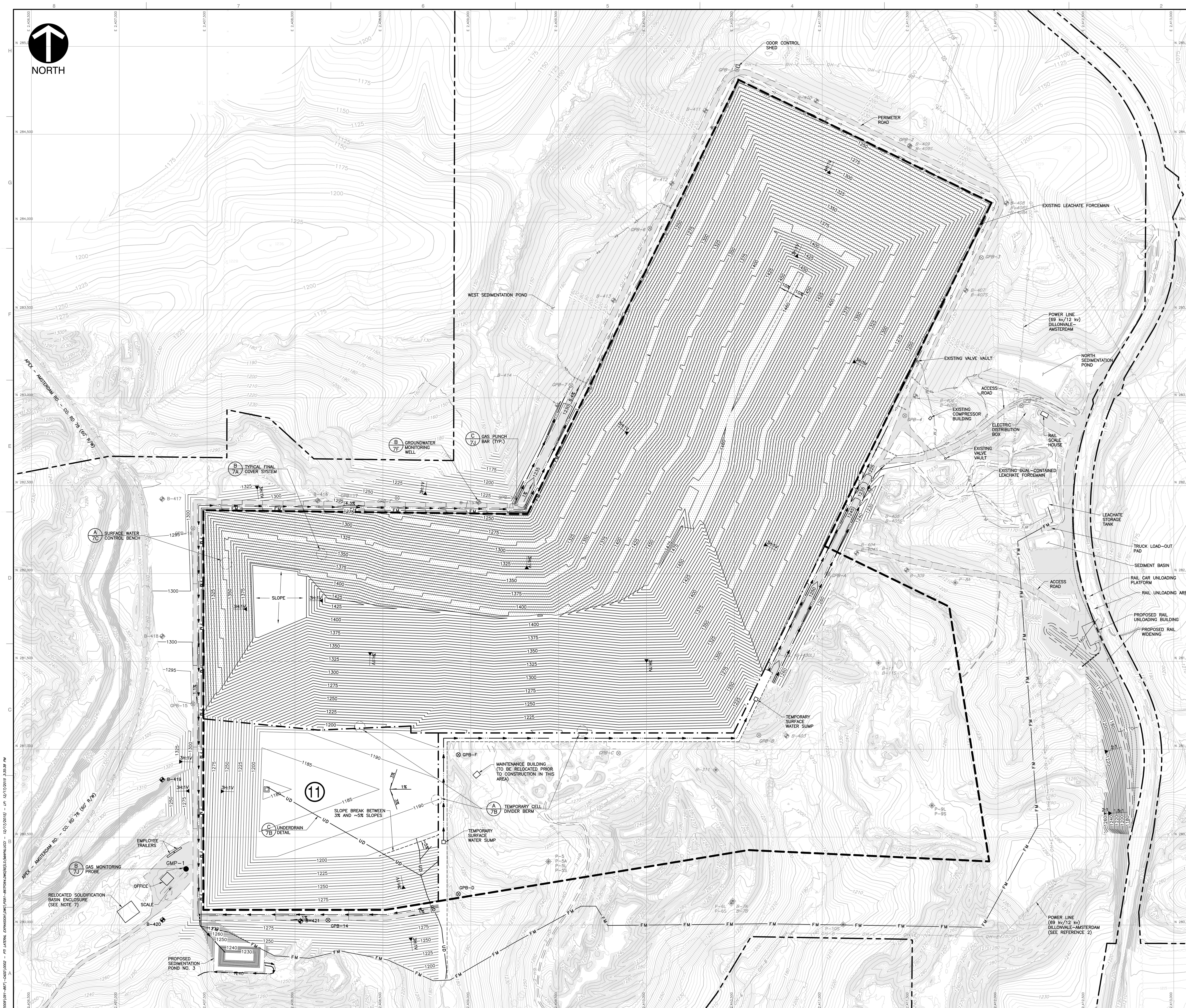
JEFFERSON COUNTY, OHIO

DRAWN BY: MJI	CHECKED BY: MRB	APPROVED BY: RJB *
DATE: 10/17/11	DWG SCALE: 1"=200'	PROJECT NO: 091-867

PHASE 10
DEVELOPMENT PLAN

DRAWING NO.: 6D



REVISION RECORD

NO	DATE	DESCRIPTION
1	4/2013	RESPONSE TO OHIO EPA NOD DATED 12/28/12 AND REVISED PHASING.
2	12/2015	UPDATED AEP POWER LINE LOCATION. REVISED UNDERDRAIN SYSTEM IN RESPONSE TO OHIO EPA COMMENT DATED 6/18/2015 AND
		SEDIMENTATION POND NO. 3 LOCATION.

SUBMITTAL RECORD

NO	DATE	DESCRIPTION

LEGEND

1220	EXISTING GROUND CONTOUR (SEE REFERENCE)
	PROPERTY LINE
	LIMIT OF SOLID WASTE PLACEMENT
	PHASE LIMIT
8	PHASE DESIGNATION
	ACCESS ROAD
1450	PROPOSED CONTOUR
FM	EXISTING FORCEMAIN
FM	PROPOSED FORCEMAIN
	EXISTING SURFACE WATER CHANNEL
	PROPOSED SURFACE WATER CHANNEL
	PROPOSED CULVERT
VARIES	SLOPE INDICATOR
	AREA OF FINAL COVER (SEE GENERAL OPERATION NOTE 6)
B-310	EXISTING PIEZOMETER
B-410	EXISTING MONITORING WELL
B-428	PROPOSED MONITORING WELL
GPB-6	EXISTING EXPLOSIVE GAS MONITORING PUNCH BAR
GPB-18	PROPOSED EXPLOSIVE GAS MONITORING PUNCH BAR
GMP-1	PROPOSED GAS MONITORING PROBE LOCATION
UD	EXISTING UNDERDRAIN
UD	PROPOSED UNDERDRAIN

GENERAL OPERATION NOTES

1. THE BASE GRADES SHOWN IN THE CONSTRUCTED PHASE ARE THE TOP OF THE 1-FOOT THICK AGGREGATE LEACHATE COLLECTION/PROTECTIVE COVER LAYER. IF AN ALTERNATIVE LEACHATE COLLECTION LAYER IS USED, THE GRADES WILL BE CORRESPONDINGLY DIFFERENT, SEE DETAIL A ON DRAWING 7A. GRADES SHOWN IN WASTE PLACEMENT PHASES ARE TOP OF WASTE.
2. THE MAXIMUM EXTENT OF EACH PHASE IS SHOWN ON THESE PHASING DRAWINGS. PHASES MAY BE DIVIDED INTO SEPARATE SUB-PHASES OR CONSTRUCTED IN THEIR ENTIRETY DEPENDING ON ANTICIPATED FILLING RATE, CONSTRUCTION SCHEDULING AND SEASONAL CONSTRUCTION FEASIBILITY.
3. THE WASTE FILLING ELEVATIONS SHOWN ARE THE MAXIMUM PROPOSED TOP OF WASTE GRADES. FILLING MAY STOP SHORT OF THESE GRADES. SOLID WASTE MAY BE PLACED IN SUBSEQUENT PHASES PRIOR TO THE COMPLETION OF PREVIOUS PHASES TO PROVIDE FROST PROTECTION, SURFACE WATER DRAINAGE OR FOR PROPER OPERATION OF THE FACILITY. REMAINING AIRSPACE WITHIN PREVIOUS PHASES WILL BE FILLED TO THE PERMITTED GRADES AS QUICKLY AS POSSIBLE. THE JEFFERSON COUNTY HEALTH DEPARTMENT AND OHIO EPA WILL BE CONSULTED REGARDING THE TRANSITION BETWEEN PHASES.
4. TEMPORARY HAUL ROADS WILL BE CONSTRUCTED WITHIN THE DISPOSAL AREA AND MAY BE ADJUSTED BASED ON FIELD CONDITIONS, WEATHER AND WASTE ACCEPTANCE RATES.
5. SURFACE WATER FLOW PATTERNS ARE APPROXIMATE AND ARE SHOWN HERE TO SHOW GENERAL FLOW DIRECTIONS. CHANNELS, CULVERTS, BERMS, ETC. SHALL BE CONSTRUCTED AND MAINTAINED AS NECESSARY TO DIRECT RUN-OFF TO THE SURFACE WATER MANAGEMENT SYSTEM. TEMPORARY EROSION CONTROLS SUCH AS SILT FENCE AND SEEDING WILL BE INSTALLED AS NECESSARY TO REDUCE EROSION AND SEDIMENTATION.
6. FINAL COVER WILL BE INSTALLED OVER AREAS OF A PHASE THAT HAVE REACHED APPROVED FINAL ELEVATIONS FOR SOLID WASTE PLACEMENT. THE EXTENT OF FINAL COVER CONSTRUCTED IN ANY GIVEN CONSTRUCTION SEASON WILL BE BASED ON CONSTRUCTION CONSIDERATIONS SUCH AS SURFACE WATER MANAGEMENT, FUTURE TIE-INS, AND ACCESSIBILITY. TRANSITIONAL COVER MAY BE INSTALLED IN PLACE OF THE FINAL COVER SYSTEM.

CONSTRUCTION NOTES

1. CONTINUE SOLID WASTE PLACEMENT IN EXISTING UNIT.
2. ABANDON GROUNDWATER MONITORING WELLS B-12, P-3A, P-3L, P-3S.
3. EXCAVATE CELL AND PLACE STRUCTURAL FILL TO LIMITS AS SHOWN. INSTALL UNDERDRAIN SYSTEM AS NEEDED. CONSTRUCT COMPOSITE LINER SYSTEM AND LEACHATE MANAGEMENT SYSTEM. CONSTRUCT SURFACE WATER MANAGEMENT SYSTEM. TIE CELL LINER SYSTEM INTO EXISTING COMPOSITE LINER SYSTEM.
4. INSTALL NEW LEACHATE FORCEMAIN TO LEACHATE STORAGE TANK, TEMPORARY FORCEMAIN WITHIN THE LIMITS OF WASTE OR CONNECT TO EXISTING FORCEMAIN IN PHASE 10.
5. INSTALL PUNCH BAR GPB-14 AND TEMPORARY PUNCH BARS GPB-D AND GPB-F. INSTALL GAS MONITORING PROBE GPB-1. INSTALL GROUNDWATER MONITORING WELLS B-419, B-420, AND B-421.
6. CONSTRUCT SURFACE WATER MANAGEMENT SYSTEM AND SEDIMENTATION POND NO. 3.
7. SOLIDIFICATION BASIN WILL BE RELOCATED PRIOR TO PHASE 11 CONSTRUCTION.

NOTES

1. THIS DRAWING PROVIDES INFORMATION REQUIRED IN OAC 3745-27-06(B)(6).
2. PHASING PRIOR TO THIS PERMIT ISSUANCE IS ADDRESSED IN THE CURRENT APPROVED PERMIT APPLICATION.

REFERENCE

1. EXISTING TOPOGRAPHY PREPARED BY KEDDAL AERIAL MAPPING; DATE OF PHOTOGRAPHY: 1/18/13. ADDITIONAL MAPPING WAS PREPARED BY KEDDAL AERIAL MAPPING FROM AERIAL PHOTOGRAPHY DATED 1/6/12 AND 1/5/11 AND BY M.A.N. MAPPING FROM AERIAL PHOTOGRAPHY DATED 12/14/00.
2. AEP POWER LINE SURVEY PROVIDED BY BGA, CADD FILE: APEX EASEMENT – STRS.44-80.

STATE OF OHIO
12-24-15
RICK BUFFALINI
E-55305
REGISTERED PROFESSIONAL ENGINEER

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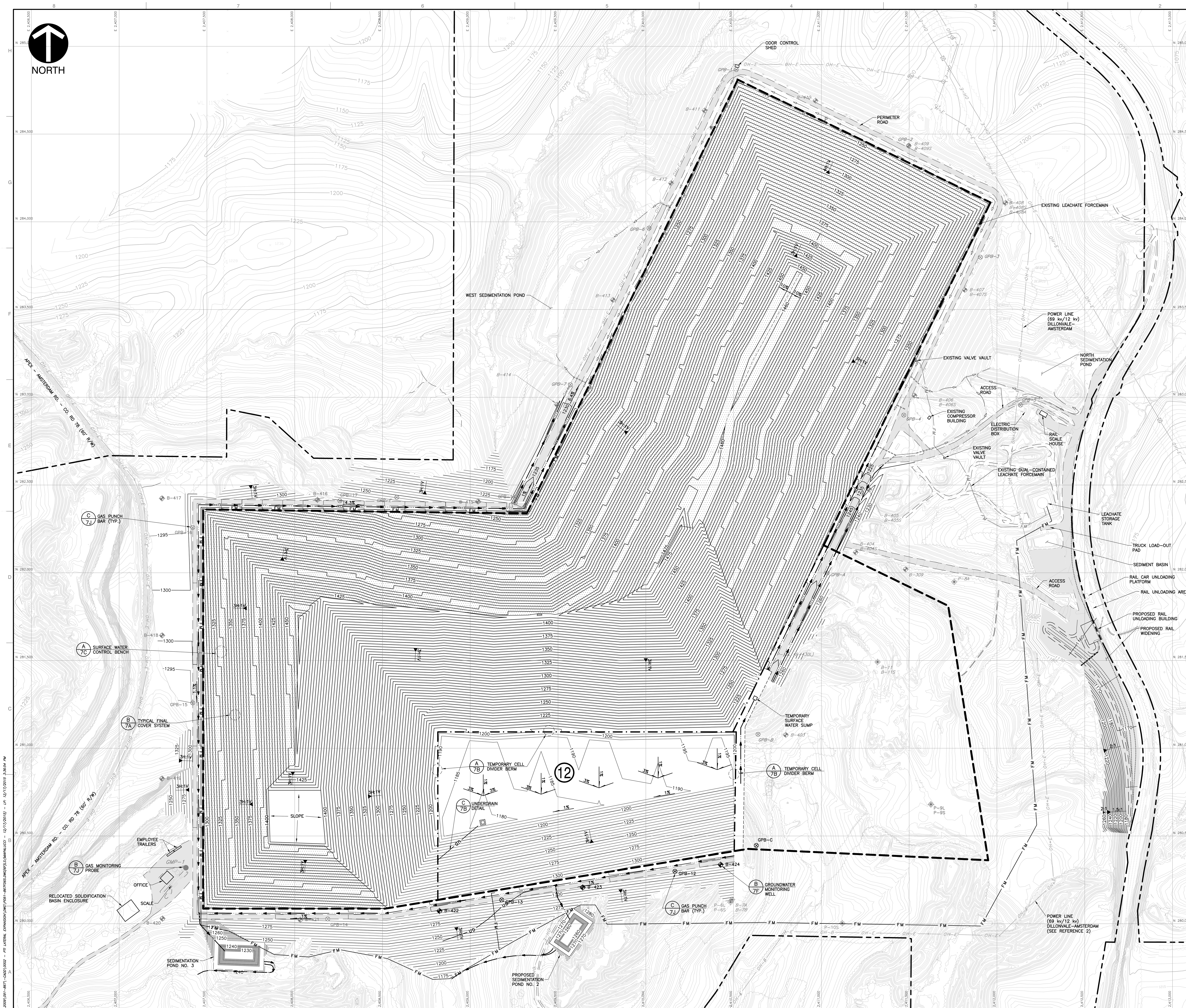
APEX SANITARY LANDFILL
JEFFERSON COUNTY, OHIO

DRAWN BY: MJI	CHECKED BY: MRB	APPROVED BY: RJB *
DATE: 9/9/11	DWG SCALE: 1"=200'	PROJECT NO: 091-867

PHASE 11
DEVELOPMENT PLAN

DRAWING NO.: 6E



REVISION RECORD

NO	DATE	DESCRIPTION
1	4/2013	RESPONSE TO OHIO EPA NOD DATED 12/28/12 AND REVISED PHASING.
2	12/2015	UPDATED AEP POWER LINE LOCATION. REVISED UNDERDRAIN SYSTEM IN RESPONSE TO OHIO EPA COMMENT DATED 6/18/2015 AND
		SEDIMENTATION POND NO. 3 LOCATION.

SUBMITTAL RECORD

NO	DATE	DESCRIPTION

LEGEND

- 1220 — EXISTING GROUND CONTOUR (SEE REFERENCE)
- PROPERTY LINE
- LIMIT OF SOLID WASTE PLACEMENT
- PHASE LIMIT
- 8 — PHASE DESIGNATION
- ACCESS ROAD
- 1450 — PROPOSED CONTOUR
- FM — EXISTING FORCEMAIN
- FM — PROPOSED FORCEMAIN
- EXISTING SURFACE WATER CHANNEL
- PROPOSED SURFACE WATER CHANNEL
- PROPOSED CULVERT
- VARIES — SLOPE INDICATOR
- AREA OF FINAL COVER (SEE GENERAL OPERATION NOTE 6)
- B-310 — EXISTING PIEZOMETER
- B-410 — EXISTING MONITORING WELL
- B-428 — PROPOSED MONITORING WELL
- GPB-6 — EXISTING EXPLOSIVE GAS MONITORING PUNCH BAR
- GPB-15 — PROPOSED EXPLOSIVE GAS MONITORING PUNCH BAR
- GMP-1 — EXISTING GAS MONITORING PROBE LOCATION
- UD — EXISTING UNDERDRAIN
- UD — PROPOSED UNDERDRAIN

GENERAL OPERATION NOTES

1. THE BASE GRADES SHOWN IN THE CONSTRUCTED PHASE ARE THE TOP OF THE 1–FOOT THICK AGGREGATE LEACHATE COLLECTION/PROTECTIVE COVER LAYER. IF AN ALTERNATIVE LEACHATE COLLECTION LAYER IS USED, THE GRADES WILL BE CORRESPONDINGLY DIFFERENT, SEE DETAIL A ON DRAWING 7A. GRADES SHOWN IN WASTE PLACEMENT PHASES ARE TOP OF WASTE.
2. THE MAXIMUM EXTENT OF EACH PHASE IS SHOWN ON THESE PHASING DRAWINGS. PHASES MAY BE DIVIDED INTO SEPARATE SUB–PHASES OR CONSTRUCTED IN THEIR ENTIRETY DEPENDING ON ANTICIPATED FILLING RATE, CONSTRUCTION SCHEDULING AND SEASONAL CONSTRUCTION FEASIBILITY.
3. THE WASTE FILLING ELEVATIONS SHOWN ARE THE MAXIMUM PROPOSED TOP OF WASTE GRADES. FILLING MAY STOP SHORT OF THESE GRADES. SOLID WASTE MAY BE PLACED IN SUBSEQUENT PHASES PRIOR TO THE COMPLETION OF PREVIOUS PHASES TO PROVIDE FROST PROTECTION, SURFACE WATER DRAINAGE OR FOR PROPER OPERATION OF THE FACILITY. REMAINING AIRSPACE WITHIN PREVIOUS PHASES WILL BE FILLED TO THE PERMITTED GRADES AS QUICKLY AS POSSIBLE. THE JEFFERSON COUNTY HEALTH DEPARTMENT AND OHIO EPA WILL BE CONSULTED REGARDING THE TRANSITION BETWEEN PHASES.
4. TEMPORARY HAUL ROADS WILL BE CONSTRUCTED WITHIN THE DISPOSAL AREA AND MAY BE ADJUSTED BASED ON FIELD CONDITIONS, WEATHER AND WASTE ACCEPTANCE RATES.
5. SURFACE WATER FLOW PATTERNS ARE APPROXIMATE AND ARE SHOWN HERE TO SHOW GENERAL FLOW DIRECTIONS. CHANNELS, CULVERTS, BERMS, ETC. SHALL BE CONSTRUCTED AND MAINTAINED AS NECESSARY TO DIRECT RUN–OFF TO THE SURFACE WATER MANAGEMENT SYSTEM. TEMPORARY EROSION CONTROLS SUCH AS SILT FENCE AND SEEDING WILL BE INSTALLED AS NECESSARY TO REDUCE EROSION AND SEDIMENTATION.
6. FINAL COVER WILL BE INSTALLED OVER AREAS OF A PHASE THAT HAVE REACHED APPROVED FINAL ELEVATIONS FOR SOLID WASTE PLACEMENT. THE EXTENT OF FINAL COVER CONSTRUCTED IN ANY GIVEN CONSTRUCTION SEASON WILL BE BASED ON CONSTRUCTION CONSIDERATIONS SUCH AS SURFACE WATER MANAGEMENT, FUTURE TIE–INS, AND ACCESSIBILITY. TRANSITIONAL COVER MAY BE INSTALLED IN PLACE OF THE FINAL COVER SYSTEM.

CONSTRUCTION NOTES

1. CONTINUE SOLID WASTE PLACEMENT IN EXISTING UNIT.
2. RELOCATE MAINTENANCE BUILDING.
3. ABANDON GROUNDWATER MONITORING WELLS B–311, P–5, P–5A, P–5L, P–5S.
4. EXCAVATE CELL AND PLACE STRUCTURAL FILL TO LIMITS AS SHOWN. INSTALL UNDERDRAIN SYSTEM AS NEEDED. CONSTRUCT COMPOSITE LINER SYSTEM AND LEACHATE MANAGEMENT SYSTEM. CONSTRUCT SURFACE WATER MANAGEMENT SYSTEM. TIE CELL LINER SYSTEM INTO EXISTING COMPOSITE LINER SYSTEM.
5. INSTALL PUNCH BARS GPB–12 AND GPB–13; AND TEMPORARY PUNCH BAR GPB–C. INSTALL GROUNDWATER MONITORING WELLS B–422, B–423, AND B–424.
6. CONSTRUCT SURFACE WATER MANAGEMENT SYSTEM AND SEDIMENTATION POND NO. 2.

NOTES

1. THIS DRAWING PROVIDES INFORMATION REQUIRED IN OAC 3745–27–06(B)(6).
2. PHASING PRIOR TO THIS PERMIT ISSUANCE IS ADDRESSED IN THE CURRENT APPROVED PERMIT APPLICATION.

REFERENCE

1. EXISTING TOPOGRAPHY PREPARED BY KEDDAL AERIAL MAPPING; DATE OF PHOTOGRAPHY: 1/18/13. ADDITIONAL MAPPING WAS PREPARED BY KEDDAL AERIAL MAPPING FROM AERIAL PHOTOGRAPHY DATED 1/6/12 AND 1/5/11 AND BY M.A.N. MAPPING FROM AERIAL PHOTOGRAPHY DATED 12/14/00.
2. AEP POWER LINE SURVEY PROVIDED BY BGA, CADD FILE: APEX EASEMENT – STRS.44–80.

STATE OF OHIO
12-29-15
RICK BUFFALINI
E-55305
REGISTERED PROFESSIONAL ENGINEER

SCALE IN FEET
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JEFFERSON COUNTY, OHIO

DRAWN BY:	MJI	CHECKED BY:	MRB	APPROVED BY:	RJB *
DATE:	9/9/11	DWG SCALE:	1"=200'	PROJECT NO:	091-867

PHASE 12
DEVELOPMENT PLAN

DRAWING NO.: 6F

REVISION RECORD

NO	DATE	DESCRIPTION
1	4/2013	RESPONSE TO OHIO EPA NOD DATED 12/28/12 AND REVISED PHASING.

SUBMITTAL RECORD

NO	DATE	DESCRIPTION

LEGEND

1220	EXISTING GROUND CONTOUR (SEE REFERENCE)
	PROPERTY LINE
	LIMIT OF SOLID WASTE PLACEMENT
	PHASE LIMIT
8	PHASE DESIGNATION
	ACCESS ROAD
1450	PROPOSED CONTOUR
FM	EXISTING FORCEMAIN
FM	PROPOSED FORCEMAIN
	EXISTING SURFACE WATER CHANNEL
	PROPOSED SURFACE WATER CHANNEL
	PROPOSED CULVERT
VARIES	SLOPE INDICATOR
	AREA OF FINAL COVER (SEE GENERAL OPERATION NOTE 6)
B–310	EXISTING PIEZOMETER
B–410	EXISTING MONITORING WELL
B–428	PROPOSED MONITORING WELL
GPB–6	EXISTING EXPLOSIVE GAS MONITORING PUNCH BAR
GPB–13	PROPOSED EXPLOSIVE GAS MONITORING PUNCH BAR
GMP–1	EXISTING GAS MONITORING PROBE LOCATION
UD	EXISTING UNDERDRAIN
UD	PROPOSED UNDERDRAIN

GENERAL OPERATION NOTES

1. THE BASE GRADES SHOWN IN THE CONSTRUCTED PHASE ARE THE TOP OF THE 1–FOOT THICK AGGREGATE LEACHATE COLLECTION/PROTECTIVE COVER LAYER. IF AN ALTERNATIVE LEACHATE COLLECTION LAYER IS USED, THE GRADES WILL BE CORRESPONDINGLY DIFFERENT, SEE DETAIL A ON DRAWING 7A. GRADES SHOWN IN WASTE PLACEMENT PHASES ARE TOP OF WASTE.
2. THE MAXIMUM EXTENT OF EACH PHASE IS SHOWN ON THESE PHASING DRAWINGS. PHASES MAY BE DIVIDED INTO SEPARATE SUB–PHASES OR CONSTRUCTED IN THEIR ENTIRETY DEPENDING ON ANTICIPATED FILLING RATE, CONSTRUCTION SCHEDULING AND SEASONAL CONSTRUCTION FEASIBILITY.
3. THE WASTE FILLING ELEVATIONS SHOWN ARE THE MAXIMUM PROPOSED TOP OF WASTE GRADES. FILLING MAY STOP SHORT OF THESE GRADES. SOLID WASTE MAY BE PLACED IN SUBSEQUENT PHASES PRIOR TO THE COMPLETION OF PREVIOUS PHASES TO PROVIDE FROST PROTECTION, SURFACE WATER DRAINAGE OR FOR PROPER OPERATION OF THE FACILITY. REMAINING AIRSPACE WITHIN PREVIOUS PHASES WILL BE FILLED TO THE PERMITTED GRADES AS QUICKLY AS POSSIBLE. THE JEFFERSON COUNTY HEALTH DEPARTMENT AND OHIO EPA WILL BE CONSULTED REGARDING THE TRANSITION BETWEEN PHASES.
4. TEMPORARY HAUL ROADS WILL BE CONSTRUCTED WITHIN THE DISPOSAL AREA AND MAY BE ADJUSTED BASED ON FIELD CONDITIONS, WEATHER AND WASTE ACCEPTANCE RATES.
5. SURFACE WATER FLOW PATTERNS ARE APPROXIMATE AND ARE SHOWN HERE TO SHOW GENERAL FLOW DIRECTIONS. CHANNELS, CULVERTS, BERMS, ETC. SHALL BE CONSTRUCTED AND MAINTAINED AS NECESSARY TO DIRECT RUN–OFF TO THE SURFACE WATER MANAGEMENT SYSTEM. TEMPORARY EROSION CONTROLS SUCH AS SILT FENCE AND SEEDING WILL BE INSTALLED AS NECESSARY TO REDUCE EROSION AND SEDIMENTATION.
6. FINAL COVER WILL BE INSTALLED OVER AREAS OF A PHASE THAT HAVE REACHED APPROVED FINAL ELEVATIONS FOR SOLID WASTE PLACEMENT. THE EXTENT OF FINAL COVER CONSTRUCTED IN ANY GIVEN CONSTRUCTION SEASON WILL BE BASED ON CONSTRUCTION CONSIDERATIONS SUCH AS SURFACE WATER MANAGEMENT, FUTURE TIE–INS, AND ACCESSIBILITY. TRANSITIONAL COVER MAY BE INSTALLED IN PLACE OF THE FINAL COVER SYSTEM.

CONSTRUCTION NOTES

1. CONTINUE SOLID WASTE PLACEMENT IN EXISTING UNIT.
2. RELOCATE AEP POWERLINE.
3. ABANDON GROUNDWATER MONITORING WELLS B–403, P–9, P–9S.
4. EXCAVATE CELL AND PLACE STRUCTURAL FILL TO LIMITS AS SHOWN. INSTALL UNDERDRAIN SYSTEM AS NEEDED. CONSTRUCT COMPOSITE LINER SYSTEM AND LEACHATE MANAGEMENT SYSTEM. CONSTRUCT SURFACE WATER MANAGEMENT SYSTEM. TIE CELL LINER SYSTEM INTO EXISTING COMPOSITE LINER SYSTEM.
5. INSTALL PUNCH BARS GPB–10 AND GPB–11; AND TEMPORARY PUNCH BAR GPB–B AND GPB–C. INSTALL GROUNDWATER MONITORING WELLS B–425, B–426, AND B–429.
6. CONSTRUCT SURFACE WATER MANAGEMENT SYSTEM AND SEDIMENTATION POND NO. 1.

NOTES

1. THIS DRAWING PROVIDES INFORMATION REQUIRED IN OAC 3745–27–06(B)(6).
2. PHASING PRIOR TO THIS PERMIT ISSUANCE IS ADDRESSED IN THE CURRENT APPROVED PERMIT APPLICATION.

REFERENCE

EXISTING TOPOGRAPHY PREPARED BY KEDDAL AERIAL MAPPING; DATE OF PHOTOGRAPHY: 1/18/13. ADDITIONAL MAPPING WAS PREPARED BY KEDDAL AERIAL MAPPING FROM AERIAL PHOTOGRAPHY DATED 1/6/12 AND 1/5/11 AND BY M.A.N. MAPPING FROM AERIAL PHOTOGRAPHY DATED 12/14/00.

STATE OF OHIO
RICK BUFFALINI
E-55305
REGISTERED
PROFESSIONAL ENGINEER

7-18-13

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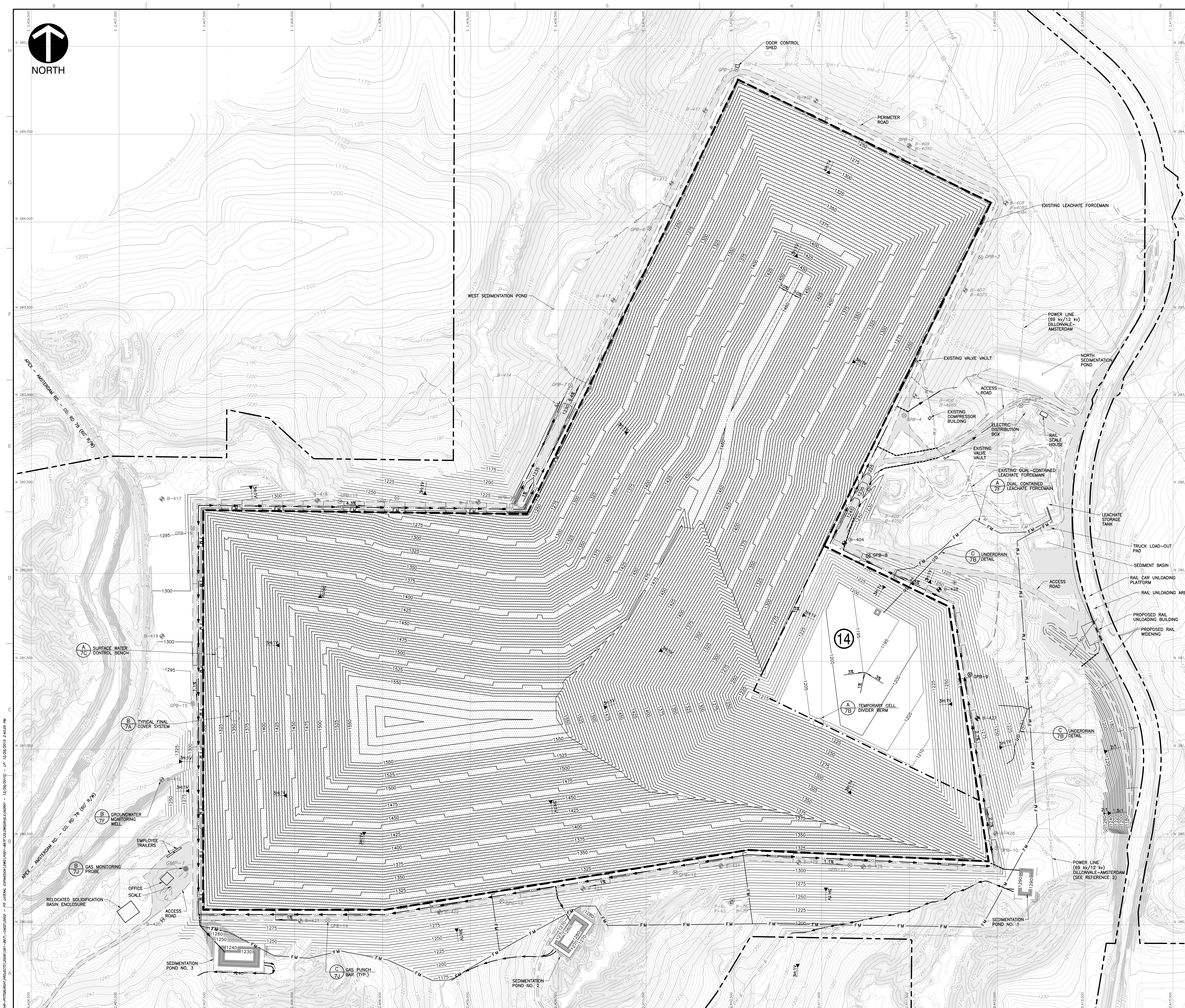
JEFFERSON COUNTY, OHIO

DRAWN BY:	MJI	CHECKED BY:	MRB	APPROVED BY:	RJB *
DATE:	1017/11	DWG SCALE:	1"=200'	PROJECT NO:	091-867

PHASE 13
DEVELOPMENT PLAN

DRAWING NO.: 6G



REVISION RECORD

NO	DATE	DESCRIPTION
1	4/2013	RESPONSE TO OHIO EPA NOD DATED 12/28/12 AND REVISED PHASING.
2	12/2015	UPDATED AEP POWER LINE LOCATION. REVISED UNDERDRAIN SYSTEM IN RESPONSE TO OHIO EPA COMMENT DATED 6/18/2015 AND SEDIMENTATION POND NO. 3 LOCATION.

SUBMITTAL RECORD

NO	DATE	DESCRIPTION

LEGEND

- 1220 — EXISTING GROUND CONTOUR (SEE REFERENCE)
- PROPERTY LINE
- LIMIT OF SOLID WASTE PLACEMENT
- PHASE LIMIT
- (8) — PHASE DESIGNATION
- ACCESS ROAD
- 1450 — PROPOSED CONTOUR
- FM — EXISTING FORCEMAIN
- FM — PROPOSED FORCEMAIN
- EXISTING SURFACE WATER CHANNEL
- PROPOSED SURFACE WATER CHANNEL
- PROPOSED CULVERT
- VARIES — SLOPE INDICATOR
- AREA OF FINAL COVER (SEE GENERAL OPERATION NOTE 6)
- B–310 — EXISTING WELL/PIEZOMETER TO BE ABANDONED
- B–410 — EXISTING MONITORING WELL
- B–428 — PROPOSED MONITORING WELL
- GPB–6 — EXISTING EXPLOSIVE GAS MONITORING PUNCH BAR
- GPB–13 — PROPOSED EXPLOSIVE GAS MONITORING PUNCH BAR
- GMP–1 — EXISTING GAS MONITORING PROBE LOCATION
- UD — EXISTING UNDERDRAIN
- UD — PROPOSED UNDERDRAIN

GENERAL OPERATION NOTES

1. THE BASE GRADES SHOWN IN THE CONSTRUCTED PHASE ARE THE TOP OF THE 1–FOOT THICK AGGREGATE LEACHATE COLLECTION/PROTECTIVE COVER LAYER. IF AN ALTERNATIVE LEACHATE COLLECTION LAYER IS USED, THE GRADES WILL BE CORRESPONDINGLY DIFFERENT, SEE DETAIL A ON DRAWING 7A. GRADES SHOWN IN WASTE PLACEMENT PHASES ARE TOP OF WASTE.
2. THE MAXIMUM EXTENT OF EACH PHASE IS SHOWN ON THESE PHASING DRAWINGS. PHASES MAY BE DIVIDED INTO SEPARATE SUB–PHASES OR CONSTRUCTED IN THEIR ENTIRETY DEPENDING ON ANTICIPATED FILLING RATE, CONSTRUCTION SCHEDULING AND SEASONAL CONSTRUCTION FEASIBILITY.
3. THE WASTE FILLING ELEVATIONS SHOWN ARE THE MAXIMUM PROPOSED TOP OF WASTE GRADES. FILLING MAY STOP SHORT OF THESE GRADES. SOLID WASTE MAY BE PLACED IN SUBSEQUENT PHASES PRIOR TO THE COMPLETION OF PREVIOUS PHASES TO PROVIDE FROST PROTECTION, SURFACE WATER DRAINAGE OR FOR PROPER OPERATION OF THE FACILITY. REMAINING AIRSPACE WITHIN PREVIOUS PHASES WILL BE FILLED TO THE PERMITTED GRADES AS QUICKLY AS POSSIBLE. THE JEFFERSON COUNTY HEALTH DEPARTMENT AND OHIO EPA WILL BE CONSULTED REGARDING THE TRANSITION BETWEEN PHASES.
4. TEMPORARY HAUL ROADS WILL BE CONSTRUCTED WITHIN THE DISPOSAL AREA AND MAY BE ADJUSTED BASED ON FIELD CONDITIONS, WEATHER AND WASTE ACCEPTANCE RATES.
5. SURFACE WATER FLOW PATTERNS ARE APPROXIMATE AND ARE SHOWN HERE TO SHOW GENERAL FLOW DIRECTIONS. CHANNELS, CULVERTS, BERMS, ETC. SHALL BE CONSTRUCTED AND MAINTAINED AS NECESSARY TO DIRECT RUN–OFF TO THE SURFACE WATER MANAGEMENT SYSTEM. TEMPORARY EROSION CONTROLS SUCH AS SILT FENCE AND SEEDING WILL BE INSTALLED AS NECESSARY TO REDUCE EROSION AND SEDIMENTATION.
6. FINAL COVER WILL BE INSTALLED OVER AREAS OF A PHASE THAT HAVE REACHED APPROVED FINAL ELEVATIONS FOR SOLID WASTE PLACEMENT. THE EXTENT OF FINAL COVER CONSTRUCTED IN ANY GIVEN CONSTRUCTION SEASON WILL BE BASED ON CONSTRUCTION CONSIDERATIONS SUCH AS SURFACE WATER MANAGEMENT, FUTURE TIE–INS, AND ACCESSIBILITY. TRANSITIONAL COVER MAY BE INSTALLED IN PLACE OF THE FINAL COVER SYSTEM.

CONSTRUCTION NOTES

1. CONTINUE SOLID WASTE PLACEMENT IN EXISTING UNIT.
2. ABANDON GROUNDWATER MONITORING WELLS B–11, B–11S, B–309, P–15L, B–430S, AND B–430.
3. EXCAVATE CELL AND PLACE STRUCTURAL FILL TO LIMITS AS SHOWN. INSTALL UNDERDRAIN SYSTEM AS NEEDED. CONSTRUCT COMPOSITE LINER SYSTEM AND LEACHATE MANAGEMENT SYSTEM. CONSTRUCT SURFACE WATER MANAGEMENT SYSTEM. TIE CELL LINER SYSTEM INTO EXISTING COMPOSITE LINER SYSTEM.
4. INSTALL PUNCH BARS GPB–8 AND GPB–9. INSTALL GROUNDWATER MONITORING WELLS B–427 AND B–428.

NOTES

1. THIS DRAWING PROVIDES INFORMATION REQUIRED IN OAC 3745–27–06(B)(6).
2. PHASING PRIOR TO THIS PERMIT ISSUANCE IS ADDRESSED IN THE CURRENT APPROVED PERMIT APPLICATION.

REFERENCE

1. EXISTING TOPOGRAPHY PREPARED BY KEDDAL AERIAL MAPPING; DATE OF PHOTOGRAPHY: 1/18/13. ADDITIONAL MAPPING WAS PREPARED BY KEDDAL AERIAL MAPPING FROM AERIAL PHOTOGRAPHY DATED 1/6/12 AND 1/5/11 AND BY M.A.N. MAPPING FROM AERIAL PHOTOGRAPHY DATED 12/14/00.
2. AEP POWER LINE SURVEY PROVIDED BY BGA, CADD FILE: APEX EASEMENT – STRS.44–80.

STATE OF OHIO
RICK BUFFALINI
E–55305
REGISTERED
PROFESSIONAL ENGINEER

12-29-15

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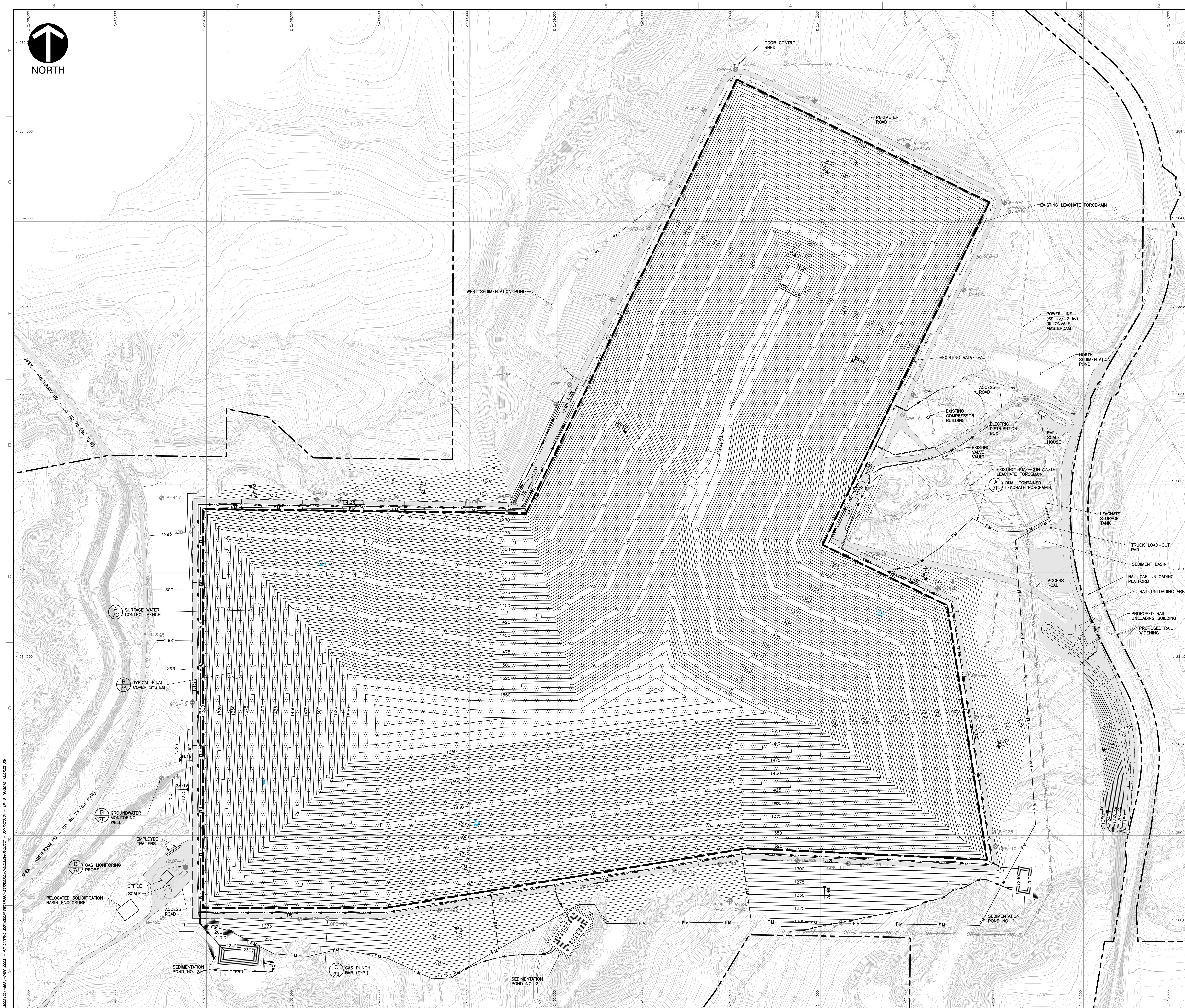
JEFFERSON COUNTY, OHIO

DRAWN BY:	MJI	CHECKED BY:	MRB	APPROVED BY:	RJB*
DATE:	7/1/13	DWG SCALE:	1"=200'	PROJECT NO:	091-867

PHASE 14
DEVELOPMENT PLAN

DRAWING NO.: 6H



REVISION RECORD

NO	DATE	DESCRIPTION
1	4/2013	RESPONSE TO OHIO EPA NOD DATED 12/28/12 AND REVISED PHASING.

SUBMITTAL RECORD

NO	DATE	DESCRIPTION

LEGEND

- 1220 — EXISTING GROUND CONTOUR (SEE REFERENCE)
- PROPERTY LINE
- LIMIT OF SOLID WASTE PLACEMENT
- PHASE LIMIT
- ACCESS ROAD
- 1450 — PROPOSED CONTOUR
- FM — EXISTING FORCEMAIN
- FM — PROPOSED FORCEMAIN
- EXISTING SURFACE WATER CHANNEL
- PROPOSED SURFACE WATER CHANNEL
- PROPOSED CULVERT
- VARIES — SLOPE INDICATOR
- AREA OF FINAL COVER (SEE GENERAL OPERATION NOTE 6)
- B-310 — EXISTING WELL/PIEZOMETER TO BE ABANDONED
- B-410 — EXISTING MONITORING WELL
- B-428 — PROPOSED MONITORING WELL
- GPB-6 — EXISTING EXPLOSIVE GAS MONITORING PUNCH BAR
- GPB-13 — PROPOSED EXPLOSIVE GAS MONITORING PUNCH BAR
- GMP-1 — EXISTING GAS MONITORING PROBE LOCATION
- UD — EXISTING UNDERDRAIN
- UD — PROPOSED UNDERDRAIN

GENERAL OPERATION NOTES

1. THE BASE GRADES SHOWN IN THE CONSTRUCTED PHASE ARE THE TOP OF THE 1-FOOT THICK AGGREGATE LEACHATE COLLECTION/PROTECTIVE COVER LAYER. IF AN ALTERNATIVE LEACHATE COLLECTION LAYER IS USED, THE GRADES WILL BE CORRESPONDINGLY DIFFERENT, SEE DETAIL A ON DRAWING 7A. GRADES SHOWN IN WASTE PLACEMENT PHASES ARE TOP OF WASTE.
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6. FINAL COVER WILL BE INSTALLED OVER AREAS OF A PHASE THAT HAVE REACHED APPROVED FINAL ELEVATIONS FOR SOLID WASTE PLACEMENT. THE EXTENT OF FINAL COVER CONSTRUCTED IN ANY GIVEN CONSTRUCTION SEASON WILL BE BASED ON CONSTRUCTION CONSIDERATIONS SUCH AS SURFACE WATER MANAGEMENT, FUTURE TIE-INS, AND ACCESSIBILITY. TRANSITIONAL COVER MAY BE INSTALLED IN PLACE OF THE FINAL COVER SYSTEM.

CONSTRUCTION NOTES

1. COMPLETE FINAL CLOSURE ACTIVITIES FOR ALL REMAINING AREAS.

NOTES

1. THIS DRAWING PROVIDES INFORMATION REQUIRED IN OAC 3745-27-06(B)(6).
2. PHASING PRIOR TO THIS PERMIT ISSUANCE IS ADDRESSED IN THE CURRENT APPROVED PERMIT APPLICATION.

REFERENCE

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STATE OF OHIO
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7.18.13

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JEFFERSON COUNTY, OHIO

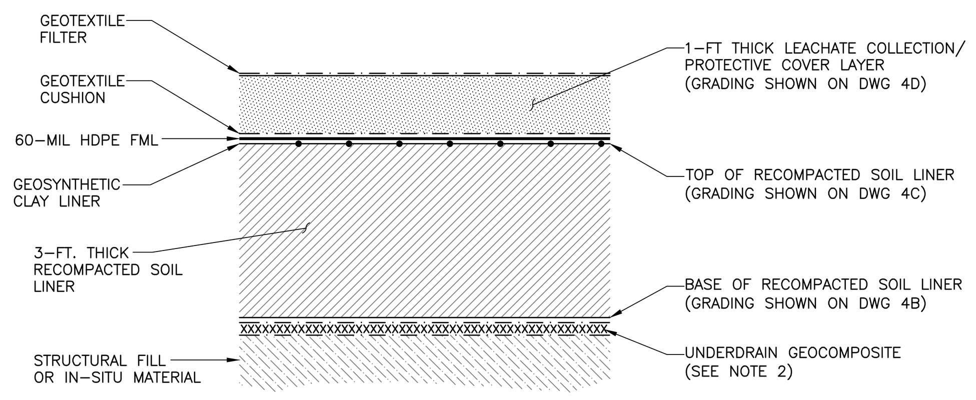
DRAWN BY: MJI	CHECKED BY: MRB	APPROVED BY: RJB *
DATE: 9/9/11	DWG SCALE: 1"=200'	PROJECT NO: 091-867

FINAL
DEVELOPMENT PLAN

DRAWING NO.: 6I

REVISION RECORD		
NO	DATE	DESCRIPTION
1	7/2013	REVISED DETAILS A1 AND A2 IN RESPONSE TO OHIO EPA NOD DATED 12/28/12.
2	12/2015	REVISED DETAILS B AND D IN RESPONSE TO OHIO EPA NOD DATED 6/18/2015.

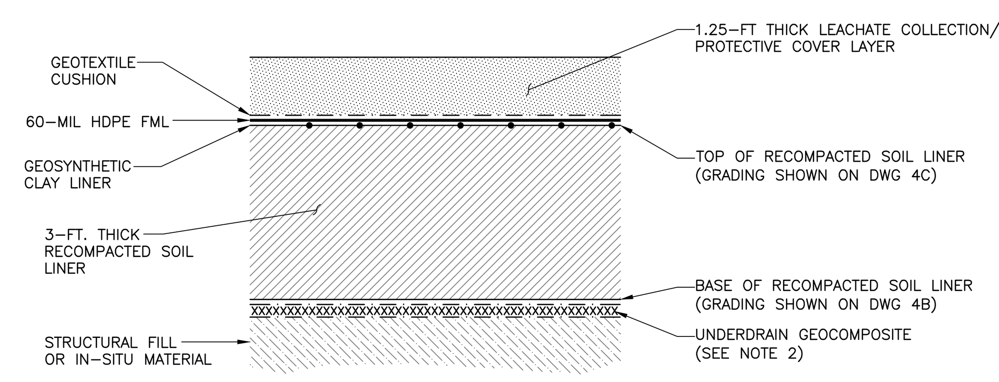
SUBMITTAL RECORD		
NO	DATE	DESCRIPTION



NOTES:
1. REFER TO CONSTRUCTION COMPONENT SUMMARY FOR COMPONENT NAME AND REQUIRED PROPERTY SUMMARY.
2. BASED ON SITE CONDITIONS THE UNDERDRAIN GEOCOMPOSITE MAY BE USED AS NEEDED ON THE FLOOR OR SIDESLOPE.

A1/7A TYPICAL LINER SYSTEM DETAIL (WITH GEOTEXTILE FILTER)

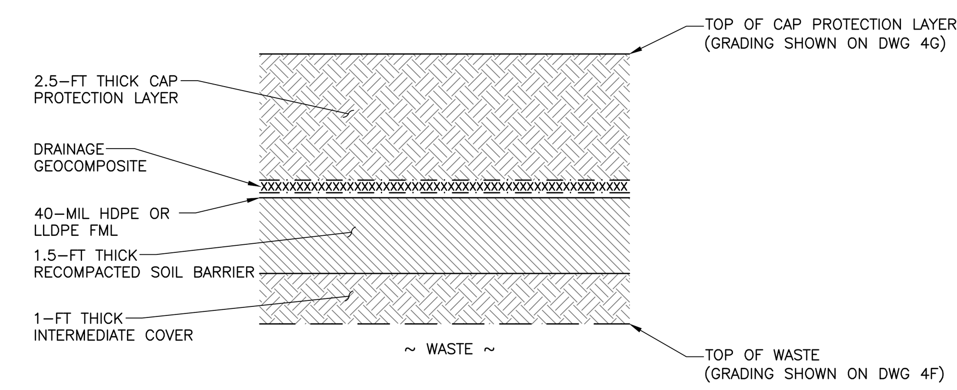
N.T.S.



NOTES:
1. REFER TO CONSTRUCTION COMPONENT SUMMARY FOR COMPONENT NAME AND REQUIRED PROPERTY SUMMARY.
2. BASED ON SITE CONDITIONS THE UNDERDRAIN GEOCOMPOSITE MAY BE USED AS NEEDED ON THE FLOOR OR SIDESLOPE.

A2/7A TYPICAL LINER SYSTEM DETAIL (WITHOUT GEOTEXTILE FILTER)

N.T.S.



NOTE:
1. REFER TO CONSTRUCTION COMPONENT SUMMARY FOR COMPONENT NAME AND REQUIRED PROPERTY SUMMARY.

B/7A TYPICAL FINAL COVER SYSTEM DETAIL

N.T.S.

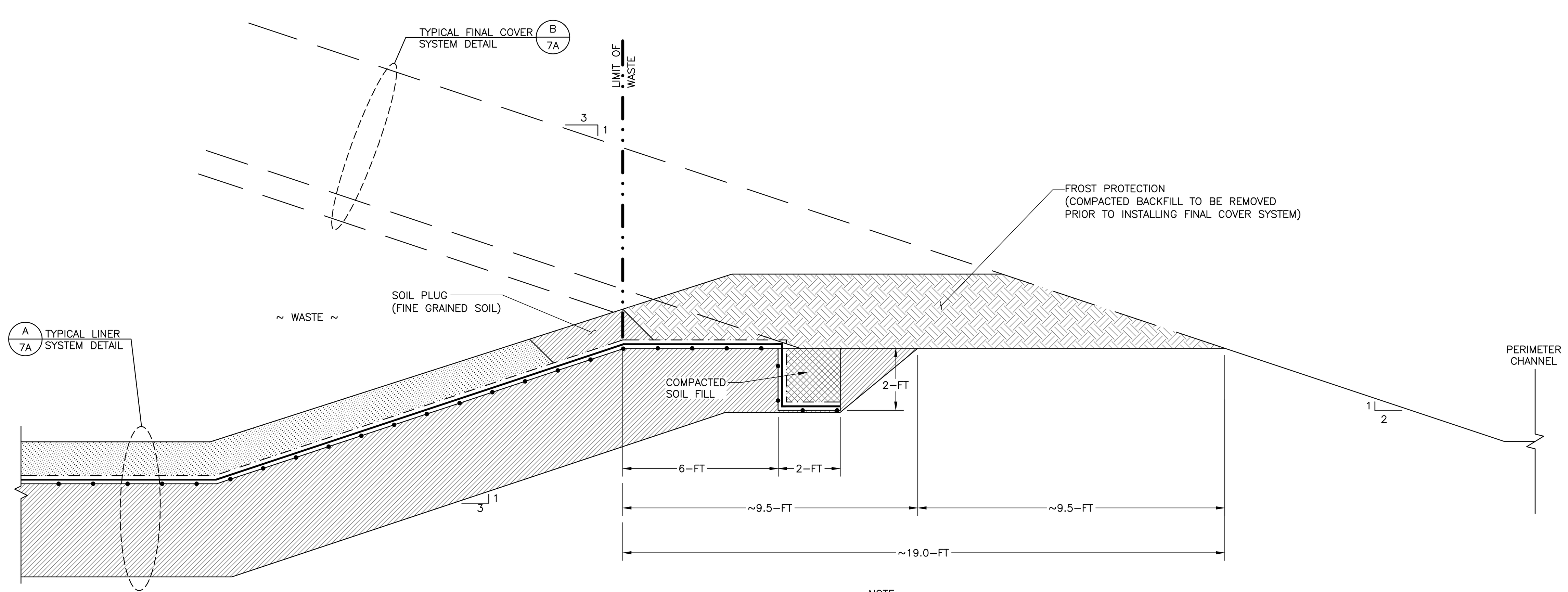
LINER SYSTEM		
COMPONENT NAME	SYMBOL	REQUIRED PROPERTY SUMMARY
DRAINAGE AGGREGATE		AASHTO #57 OR EQUIVALENT MAXIMUM CARBONATE CONTENT 5% @ PH=4.0
LEACHATE COLLECTION/FILTER/ PROTECTIVE COVER LAYER		AGGREGATE MIN. PERMEABILITY $1x10^{-2}$ CM/SEC (PIPE SPACING SHOWN ON DWG 4D) OR $1x10^{-1}$ CM/SEC (PIPE SPACING SHOWN ON DWG 4E) OPTION 1 – 1-FOOT THICK WITH FILTER GEOTEXTILE ABOVE OPTION 2 – 1.25-FEET THICK WITHOUT FILTER GEOTEXTILE ABOVE
		TIRE SHREDS MINIMUM PERMEABILITY $1x10^{-1}$ CM/SEC OPTION 3 – 2-FEET THICK WITH FILTER GEOTEXTILE ABOVE
GEOTEXTILE CUSHION/FILTER		6 OZ/SY (NOMINAL) NONWOVEN GEOTEXTILE (USED AS CUSHION AND FILTER WITH AGGREGATE, USED AS FILTER WITH TIRE SHREDS) 16 OZ/SY (NOMINAL) NONWOVEN GEOTEXTILE (USED AS CUSHION WITH TIRE SHREDS)
60-MIL HDPE FML		60-MIL NOMINAL HDPE TEXTURED GEOMEMBRANE
GEOSYNTHETIC CLAY LINER (GCL)		REINFORCED GCL
RECOMPACTED SOIL LINER (RSL)		MAXIMUM PERMEABILITY $1x10^{-7}$ CM/SEC 3-FEET THICK
ADDED GEOLOGIC MATERIAL (AGM)		MAXIMUM PERMEABILITY $1x10^{-5}$ CM/SEC
STRUCTURAL FILL		SOIL – MAXIMUM PARTICLE SIZE 12-INCHES, 12-INCH LIFTS ROCK – MAXIMUM PARTICLE SIZE 24-INCHES, 24-INCH LIFTS
COMPACTED SOIL FILL		SUITABLE SOIL

FINAL COVER SYSTEM		
COMPONENT NAME	SYMBOL	REQUIRED PROPERTY SUMMARY
CAP PROTECTION LAYER		2.5-FEET THICK SOIL
DRAINAGE GEOCOMPOSITE		GEONET WITH 6 OZ/SY NONWOVEN GEOTEXTILE FILTER BONDED TO EACH SIDE
40-MIL FML		40-MIL NOMINAL TEXTURED FLEXIBLE MEMBRANE LINER
RECOMPACTED SOIL BARRIER (RSB)		MAXIMUM PERMEABILITY $1x10^{-6}$ CM/SEC 1.5-FEET THICK

NOTE: THIS TABLE PROVIDES A SUMMARY OF MATERIAL PERFORMANCE CRITERIA, REFER TO CQA/QC PLAN FOR DETAILED INFORMATION.

C/7A CONSTRUCTION COMPONENT SUMMARY

N.T.S.



NOTE:
1. A V-DITCH ANCHOR MAY BE USED IN PLACE OF THE SQUARE ANCHOR TRENCH.

D/7A LINER ANCHOR TRENCH DETAIL

N.T.S.

NOTES

1. THIS DRAWING PROVIDES INFORMATION REQUIRED BY OAC 3745-27-06(B)(7)(c) & (b).
2. LINER SYSTEM COMPONENT THICKNESSES EXAGGERATED FOR CLARITY.

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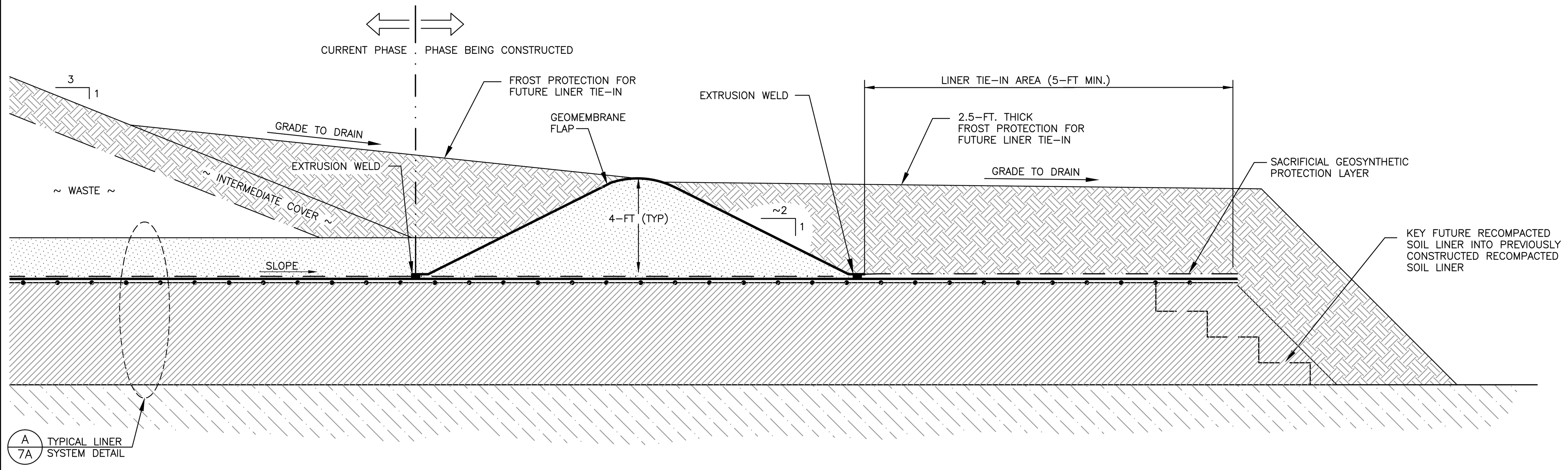
DATE:	9/9/11	DWG SCALE:	N.T.S.	PROJECT NO:	091-867

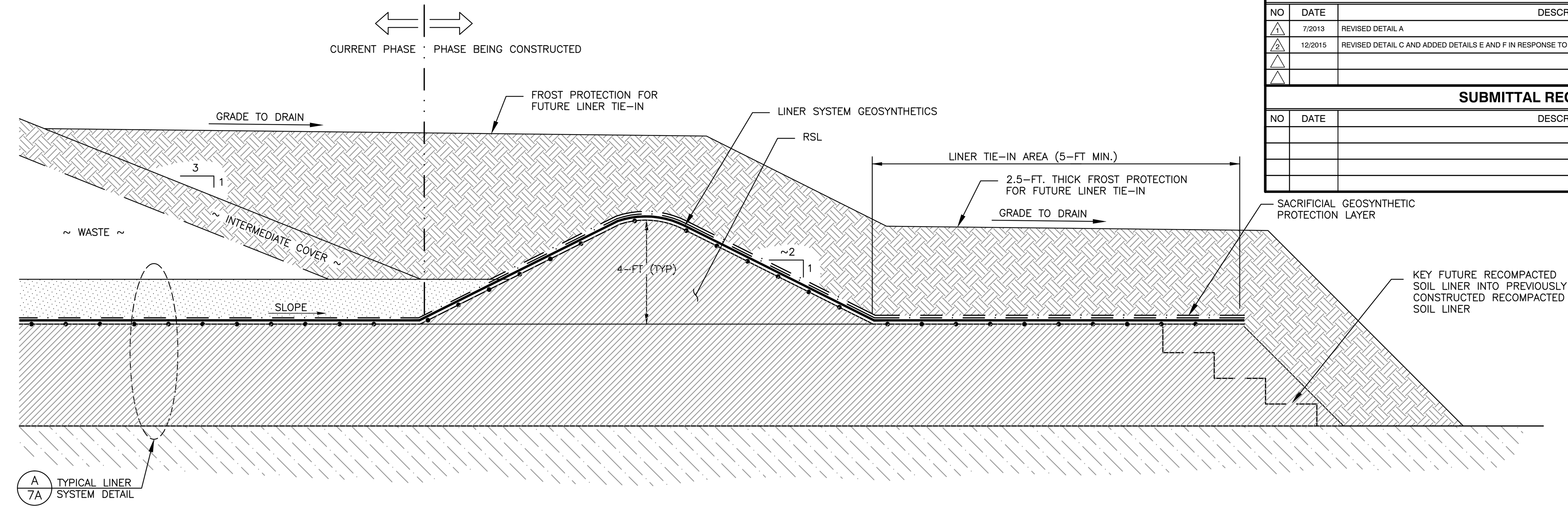
LINER AND FINAL COVER SYSTEM DETAILS (SHEET 1 OF 3)

DRAWING NO.: 7A



NOTES:
1. THE TEMPORARY CELL BERM CONFIGURATION MAY BE USED AS AN INTERIM TERMINATION OF CELL CONSTRUCTION OR AS A RAINFLAP TO SUBDIVIDE CONSTRUCTED CELLS TO DIVERT RAINWATER FROM ACTIVE DISPOSAL AREAS.

OPTION 1

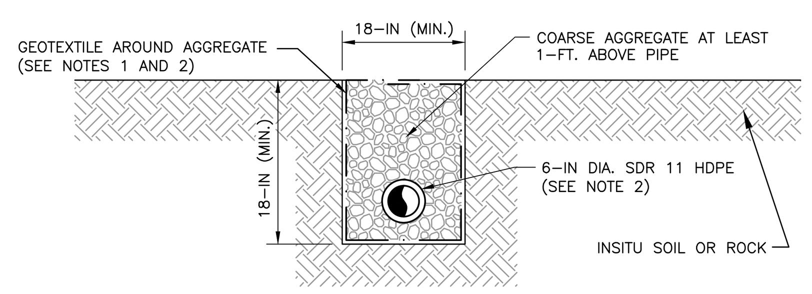


NOTES:
1. THE CELL BERM CONFIGURATION MAY BE USED AS A PERMANENT SEPARATION BERM BETWEEN PHASES.

OPTION 2

A / 7B TEMPORARY CELL DIVIDER BERM CONFIGURATION

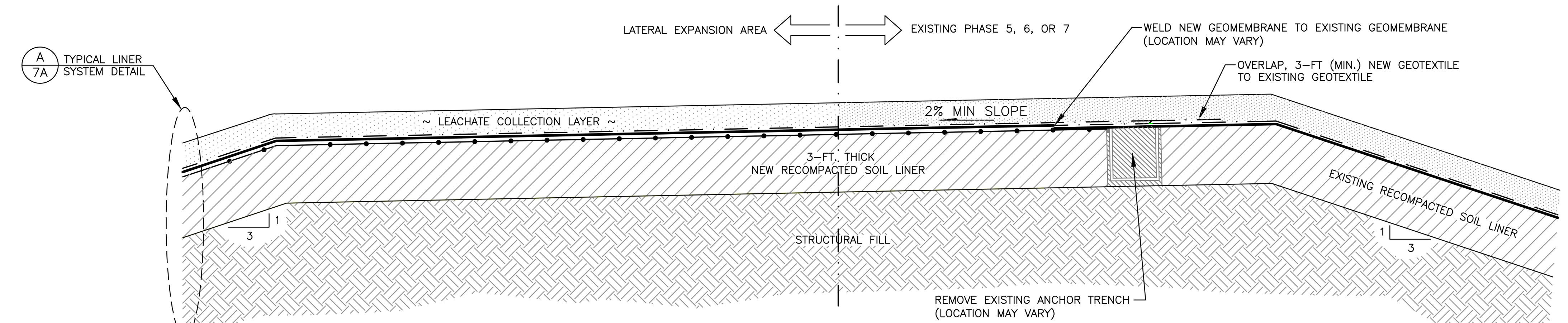
N.T.S.



NOTE:
1. COLLECTION PIPES WILL BE PERFORATED. ADDITIONAL COLLECTION PIPES MAY BE USED AS NEEDED ON THE FLOOR AND SIDE SLOPE AND WILL DRAIN TO THE UNDERDRAIN SUMPS. COLLECTION PIPES IN THE EXISTING VALLEYS WILL DRAIN BY GRAVITY. GEOTEXTILE WILL BE PLACED AROUND AGGREGATE FOR PERFORATED COLLECTION PIPE.
2. CONVEYANCE PIPES WILL BE SOLID AND MAY BE USED AS NEEDED TO DRAIN THE SUMPS BY GRAVITY TO A TOPOGRAPHIC LOW AREA. GEOTEXTILE IS NOT REQUIRED AROUND AGGREGATE FOR SOLID CONVEYANCE PIPE.

C / 7B UNDERDRAIN PIPE DETAIL

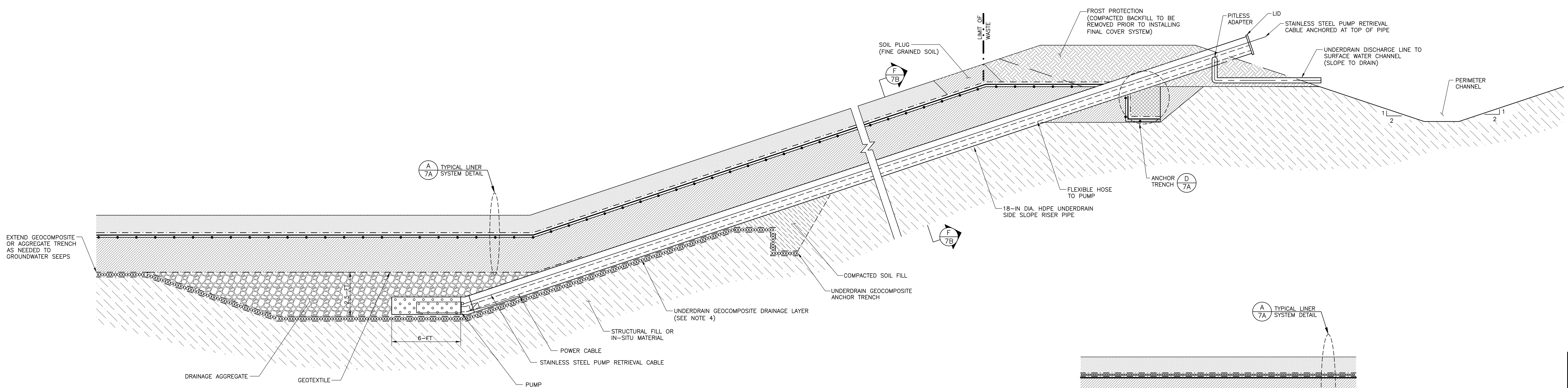
N.T.S.



NOTE:
1. EXCAVATE EXISTING FROST PROTECTION SOIL DOWN TO EXISTING CELL GEOSYNTHETICS.
2. CUT GEOSYNTHETICS, LEAVING SUFFICIENT OVERLAP FOR TIE-IN OF GEOMEMBRANE AND GEOTEXTILE.
3. EXCAVATE 3-FEET THICKNESS OF EXISTING SOIL TO REACH BOTTOM OF PROPOSED RSL ELEVATION.
4. PLACE 3-FEET OF RSL, TIE-IN TO RSL OF ADJACENT CELL.
5. INSTALL GCL AND GEOMEMBRANE IN EXPANSION CELL AND WELD THE GEOMEMBRANE TO THE EXISTING CELL GEOMEMBRANE.
6. INSTALL CUSHION GEOTEXTILE WITH A MINIMUM 3-FEET OVERLAP.
7. PLACE LEACHATE COLLECTION LAYER, TYING IN TO CELL EXISTING LEACHATE COLLECTION LAYER.

D / 7B LINER SYSTEM TIE-IN BETWEEN CELLS 5, 6, AND 7 TO LATERAL EXPANSION

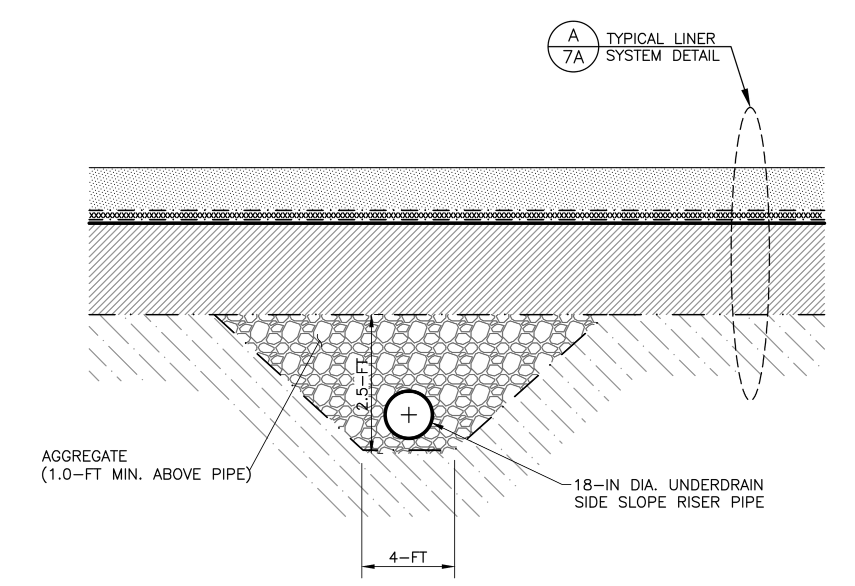
N.T.S.



NOTE:
1. CONSTRUCT UNDERDRAIN SUMP ADJACENT TO LEACHATE SUMP AS NEEDED BASED ON SITE CONDITIONS.
2. DIMENSIONS OF UNDERDRAIN TO BE DETERMINED BASED ON SITE CONDITIONS.
3. UNDERDRAIN SUMP MAY BE PUMPED AS DEPICTED IN DETAIL. ALTERNATELY, A PIPE MAY BE INSTALLED TO GRAVITY DRAIN THE SUMP.
4. UNDERDRAIN GEOCOMPOSITE TO BE EXTENDED UP THE SIDE SLOPE AS NEEDED BASED ON SITE CONDITIONS.

E / 7B UNDERDRAIN SUMP ELEVATION VIEW

N.T.S.

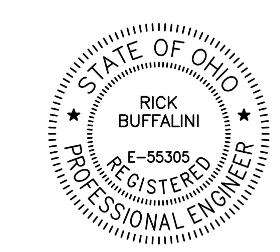


F / 7B UNDERDRAIN SIDESLOPE RISER PIPE-SECTION F

N.T.S.

NOTES

1. THIS DRAWING PROVIDES INFORMATION REQUIRED IN OAC 3745-27-06(B)(7)(c), (b), & (e).



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REVISION RECORD		
NO	DATE	DESCRIPTION
	7/2013	REVISED DETAIL A
	12/2015	REVISED DETAIL C AND ADDED DETAILS E AND F IN RESPONSE TO OHIO EPA NOD DATED 8/18/2015.

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JEFFERSON COUNTY, OHIO

DRAWN BY: JM	CHECKED BY: MRB	APPROVED BY: RJB*
DATE: 9/9/11	DWG SCALE: N.T.S.	PROJECT NO: 091-867

LINER AND FINAL COVER SYSTEM DETAILS (SHEET 2 OF 3)

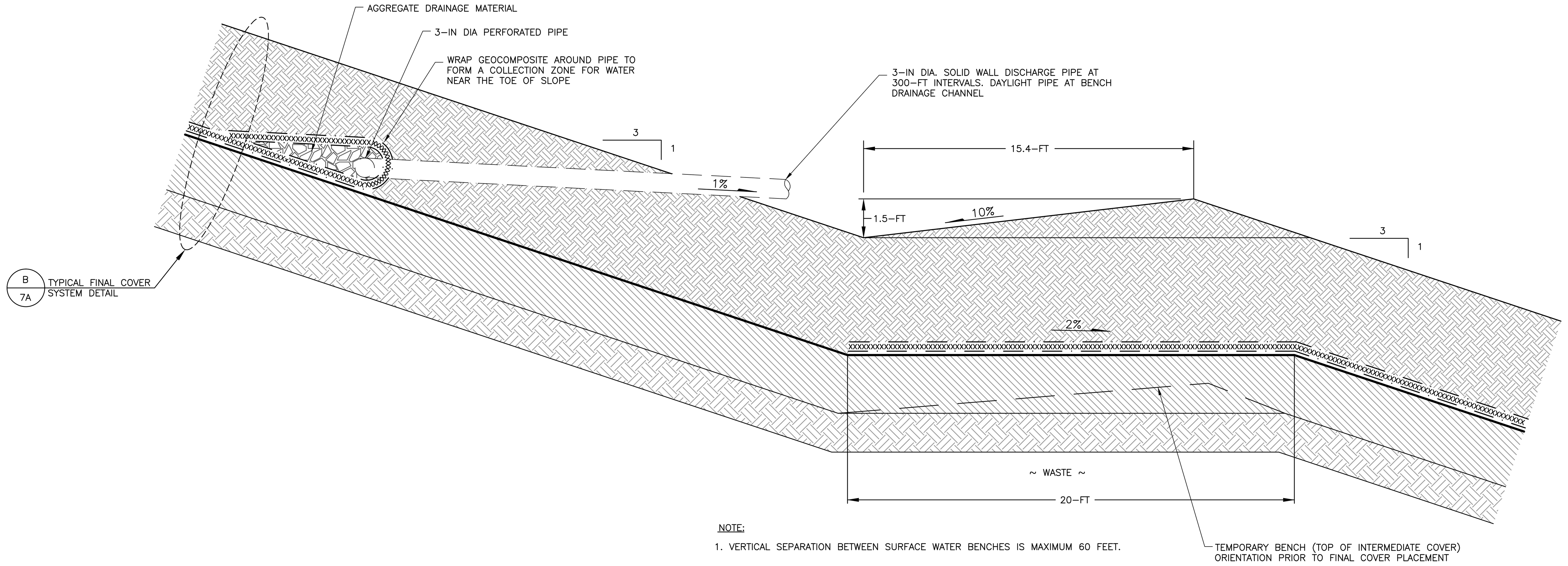
DRAWING NO.: 7B

REVISION RECORD

NO	DATE	DESCRIPTION
1	12/2015	REVISED DETAIL B IN RESPONSE TO OHIO EPA NOD DATED 6/18/2015.

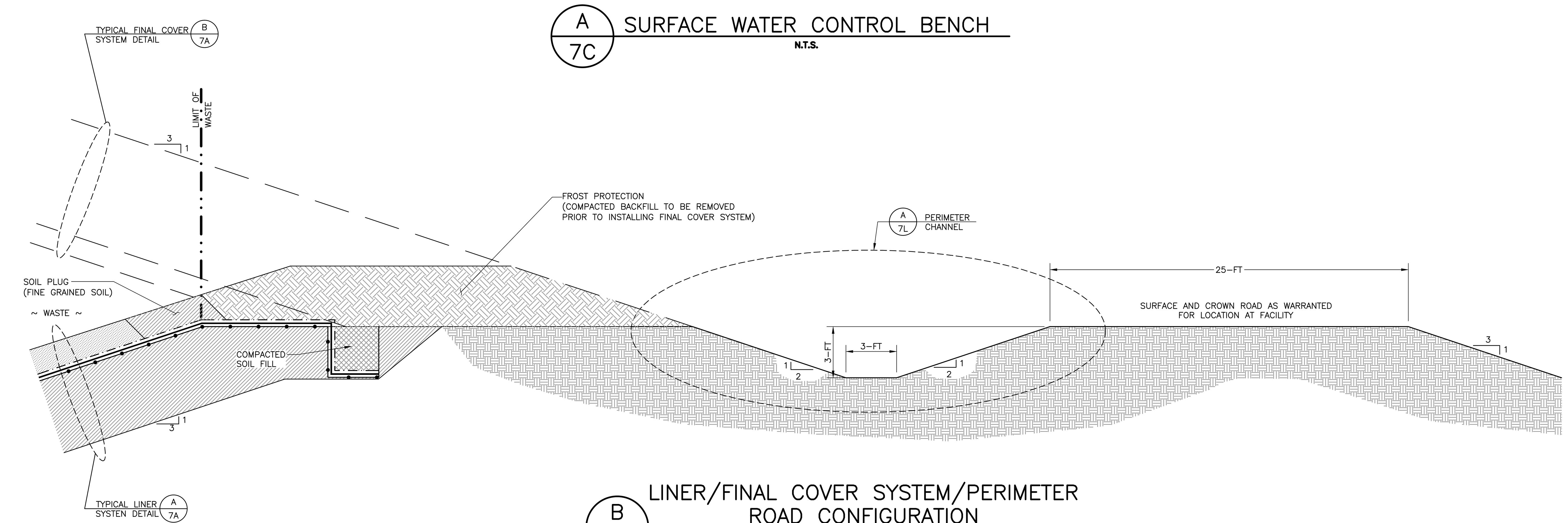
SUBMITTAL RECORD

NO	DATE	DESCRIPTION



NOTE:
1. VERTICAL SEPARATION BETWEEN SURFACE WATER BENCHES IS MAXIMUM 60 FEET.

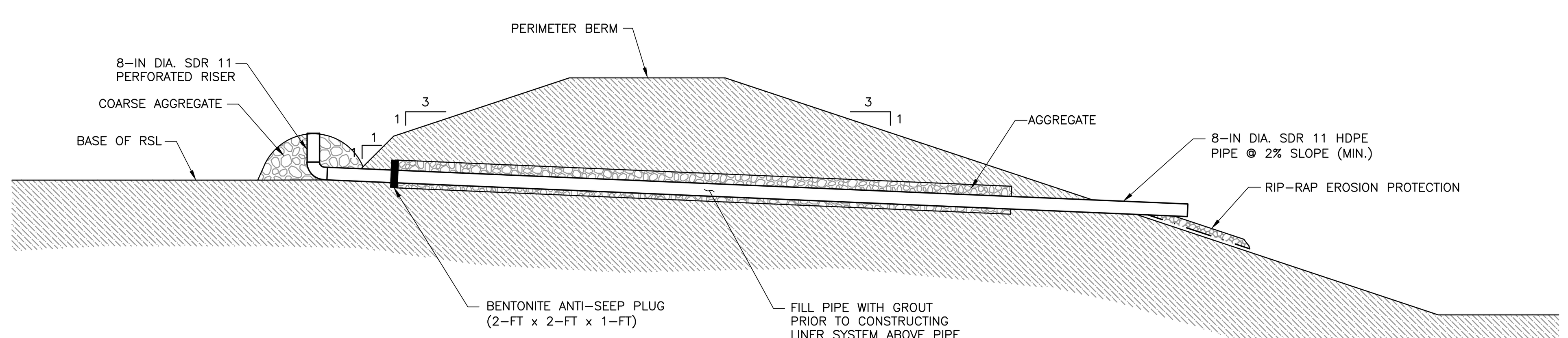
A/7C SURFACE WATER CONTROL BENCH
N.T.S.



B/7C LINER/FINAL COVER SYSTEM/PERIMETER ROAD CONFIGURATION
N.T.S.

NOTES

1. THIS DRAWING PROVIDES INFORMATION REQUIRED IN OAC 3745-27-06(B)(7)(b).



NOTES:
1. THE SURFACE WATER DRAIN MAY BE USED AS A TEMPORARY MEASURE TO CONTROL SURFACE WATER PRIOR TO LINER SYSTEM CONSTRUCTION.
2. A PORTION OF THE PIPE INLET WILL BE REMOVED PRIOR TO LINER SYSTEM CONSTRUCTION TO PROVIDE AT LEAST 3 FEET OF SEPARATION FROM THE RSL.

C/7C SURFACE WATER DRAIN DETAIL
N.T.S.

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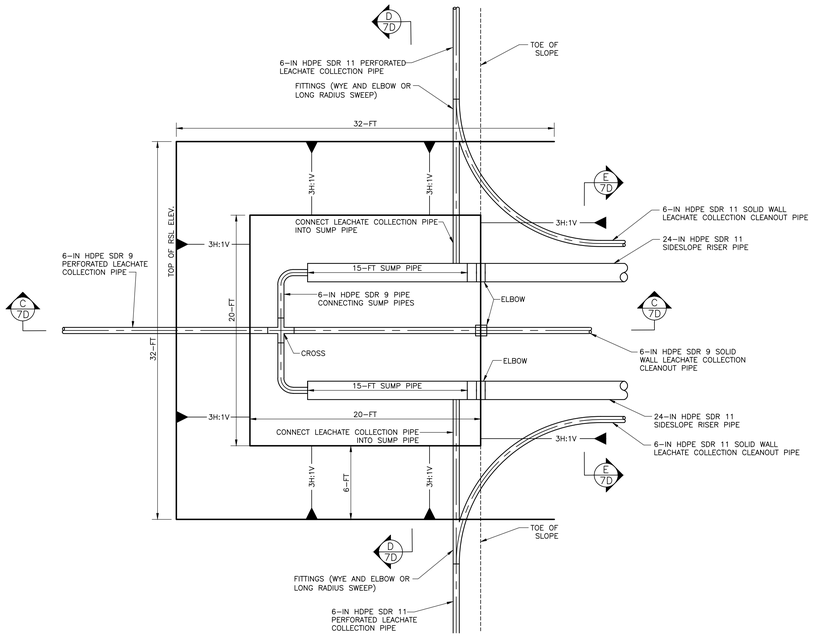
LINER AND FINAL COVER SYSTEM DETAILS (SHEET 3 OF 3)

DRAWING NO.: **7C**

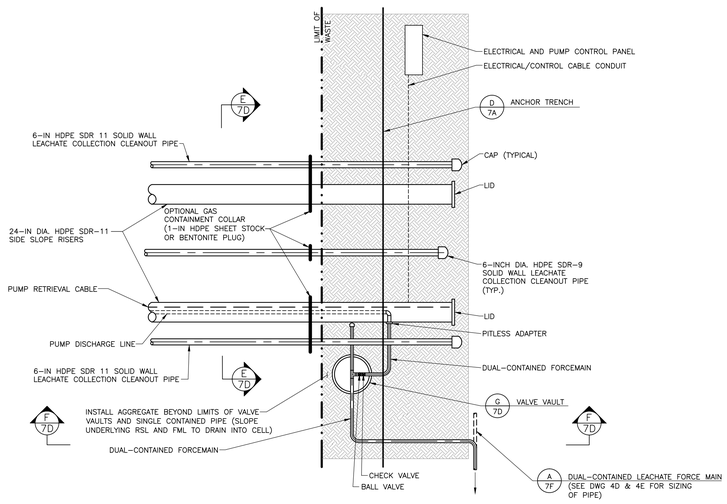
REVISION RECORD		
NO	DATE	DESCRIPTION
1	7/2013	REVISED DETAIL F IN RESPONSE TO OHIO EPA NOD DATED 12/28/12.
2	12/2015	REVISED SIDESLOPE RISER SDR IN DETAILS A, B, C, E, AND F.
3		
4		

SUBMITTAL RECORD		
NO	DATE	DESCRIPTION



A 7D LEACHATE COLLECTION SUMP STATION PLAN VIEW

N.T.S.

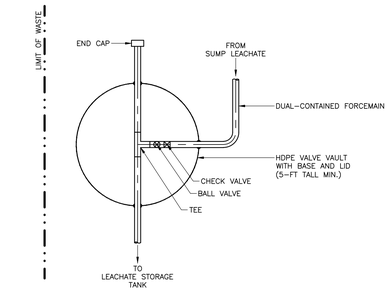


NOTE:

A LEACHATE PUMP IS REQUIRED IN ONLY ONE SIDE SLOPE RISER.

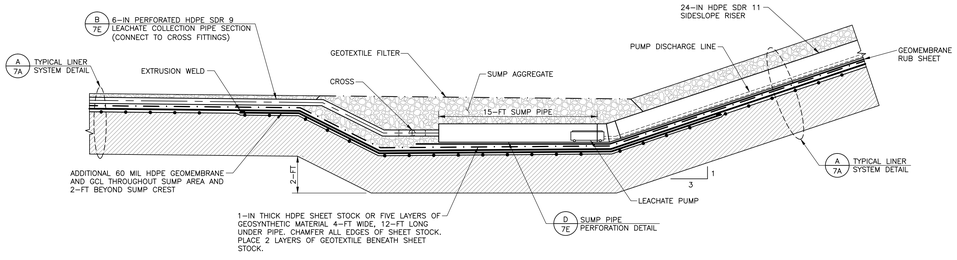
B 7D LEACHATE PUMP STATION PLAN VIEW

N.T.S.



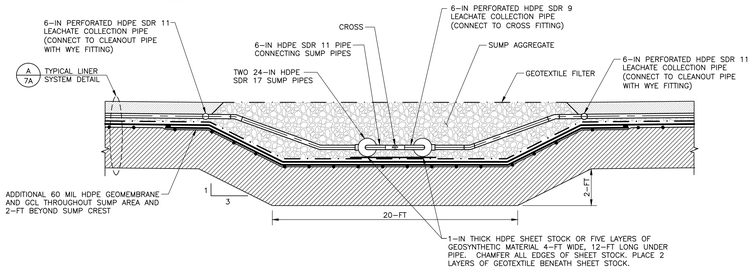
G 7D VALVE VAULT AT LEACHATE PUMP STATION

N.T.S.



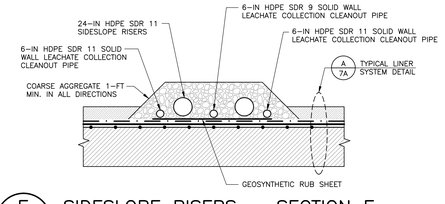
C 7D LEACHATE COLLECTION SUMP – SECTION C

N.T.S.



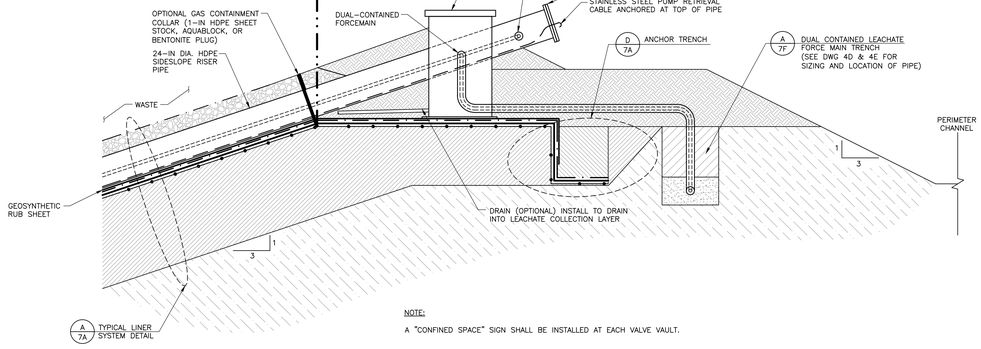
D 7D LEACHATE COLLECTION SUMP – SECTION D

N.T.S.



E 7D SIDESLOPE RISERS – SECTION E

N.T.S.



NOTE:

A "CONFINED SPACE" SIGN SHALL BE INSTALLED AT EACH VALVE VAULT.

F 7D VALVE VAULT – SECTION F

N.T.S.

NOTES

1. THIS DRAWING PROVIDES INFORMATION REQUIRED IN OAC 3745-27-06(B)(7)(d).

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DATE:	9/9/11	DWG SCALE:	N.T.S.	PROJECT NO:	091-867

LEACHATE MANAGEMENT SYSTEM DETAILS (SHEET 1 OF 3)

DRAWING NO.: **7D**

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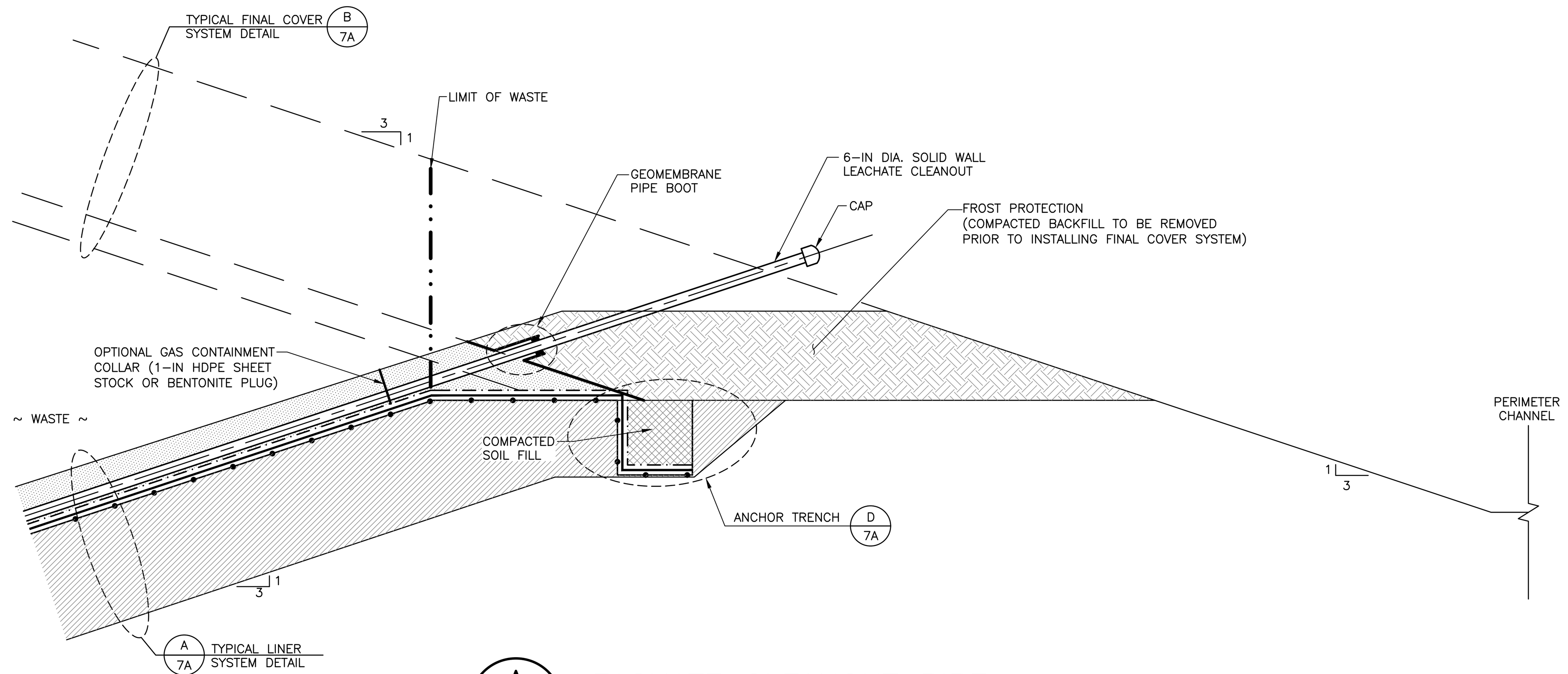
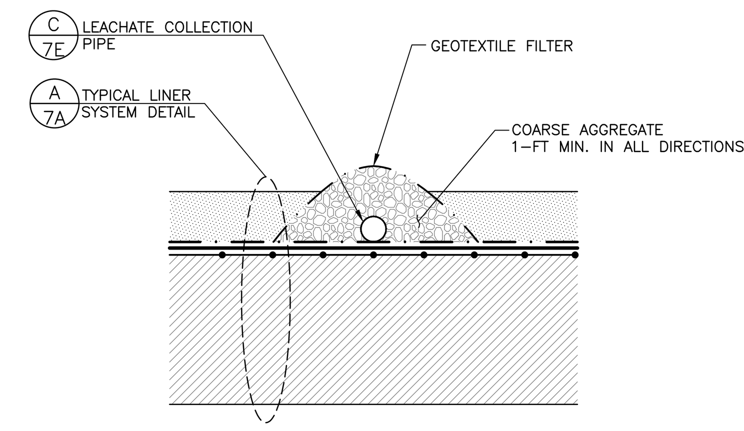


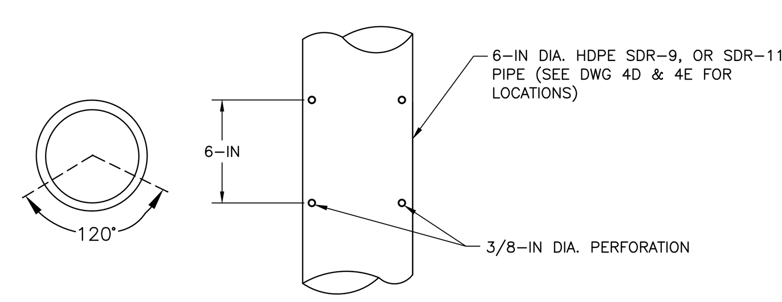
A/7E LEACHATE CLEANOUT PIPE

N.T.S.



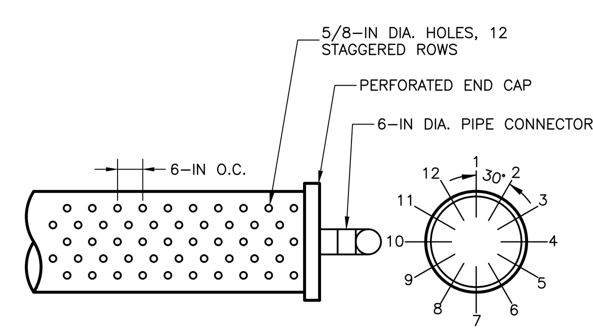
B/7E LEACHATE COLLECTION PIPE SECTION

N.T.S.



C/7E LEACHATE COLLECTION PIPE PERFORATION DETAIL

N.T.S.



D/7E SUMP PIPE PERFORATION DETAIL

N.T.S.

NOTES

1. THIS DRAWING PROVIDES INFORMATION REQUIRED IN OAC 3745–27–06(B)(7)(c) & (d).

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LEACHATE MANAGEMENT SYSTEM DETAILS (SHEET 2 OF 3)

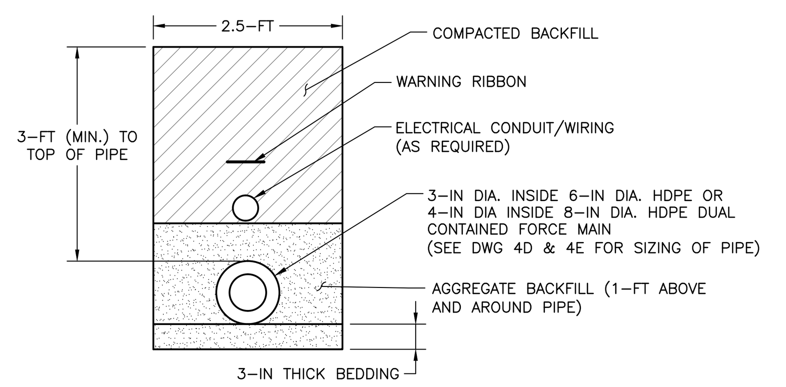
DRAWING NO.: 7E

REVISION RECORD

NO	DATE	DESCRIPTION

SUBMITTAL RECORD

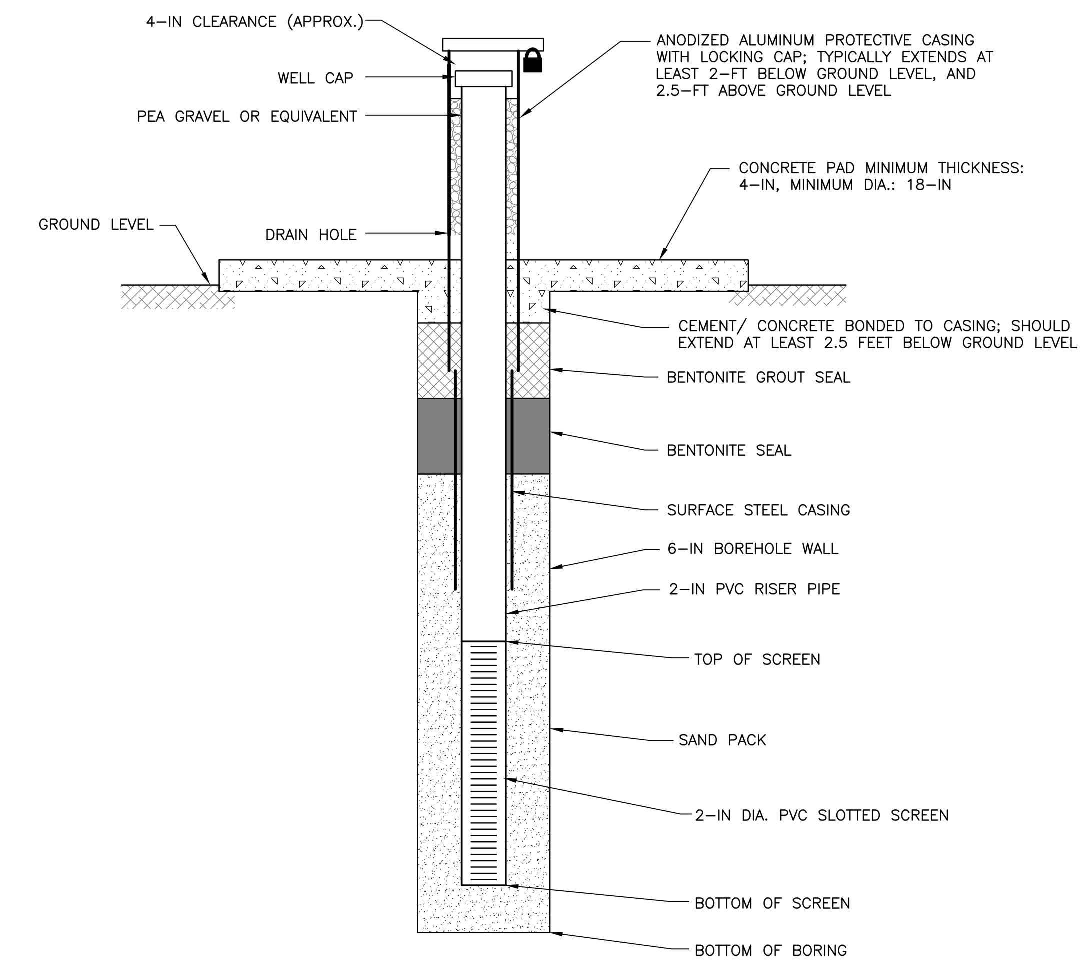
NO	DATE	DESCRIPTION



NOTE:
DUAL CONTAINED FORCEMAIN WILL BE INSTALLED WHERE LOCATED OUTSIDE OF COMPOSITE LINED AREAS.

A / 7F DUAL-CONTAINED LEACHATE FORCE MAIN TRENCH

N.T.S.



B / 7F GROUNDWATER MONITORING WELL DETAIL

N.T.S.

NOTES

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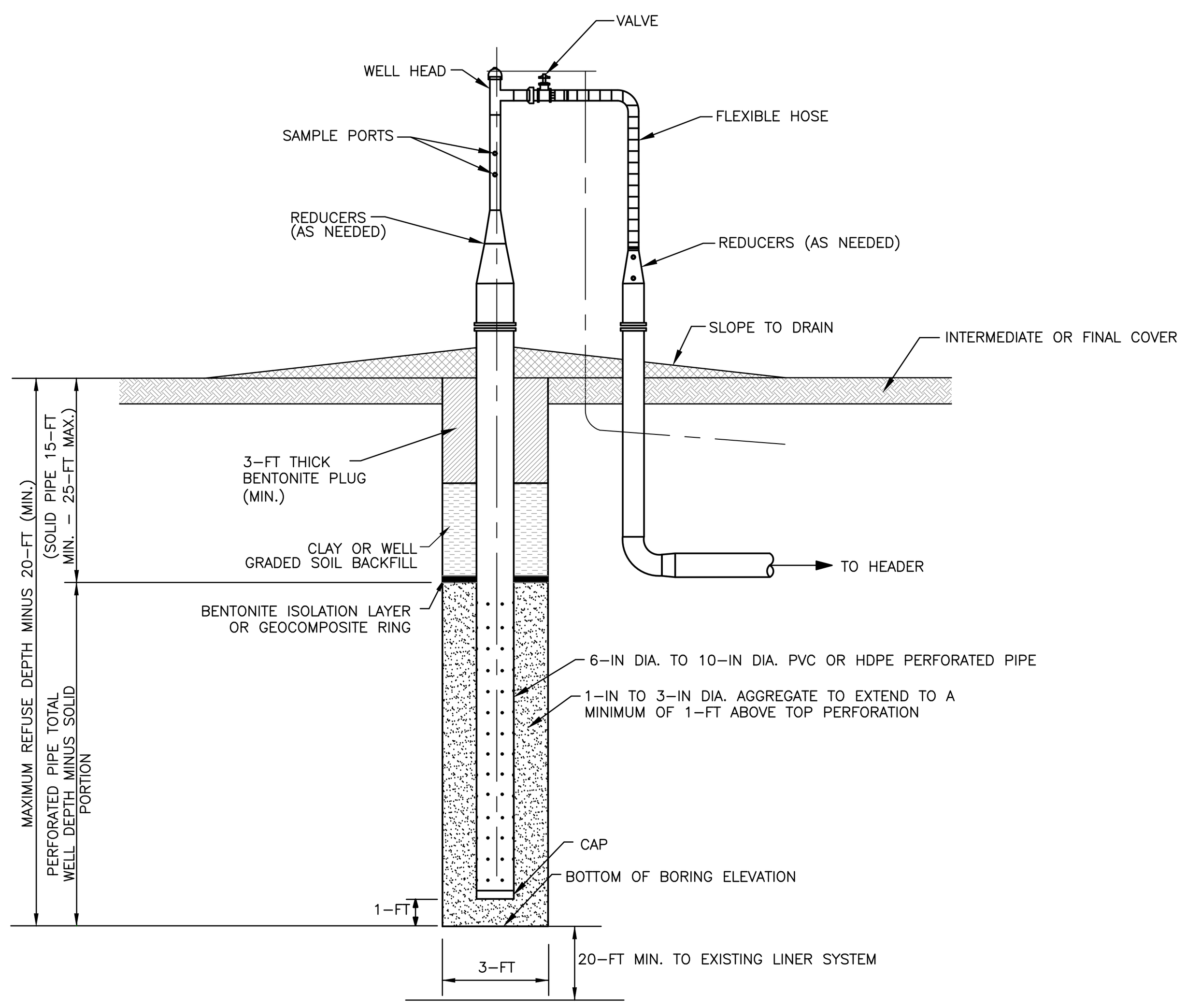
DATE: 9/9/11	DWG SCALE: N.T.S.	PROJECT NO: 091-867

LEACHATE MANAGEMENT SYSTEM DETAILS (SHEET 3 OF 3)

DRAWING NO.: 7F

REVISION RECORD		
NO	DATE	DESCRIPTION

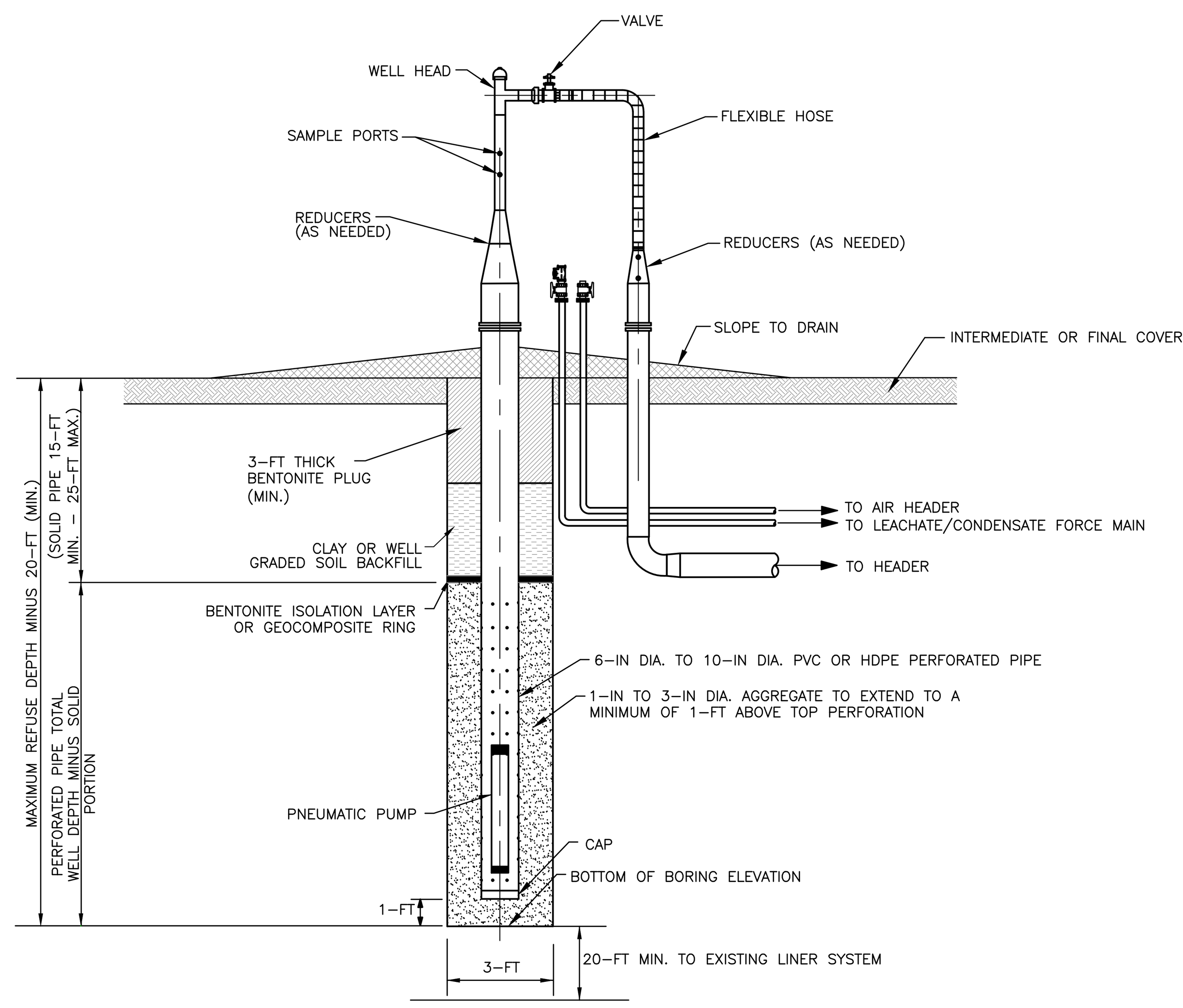
SUBMITTAL RECORD		
NO	DATE	DESCRIPTION



NOTES:

1. WELL MATERIALS AND DIMENSIONS MAY CHANGE TO SUIT ALTERNATE DRILLING AND WELL COMPLETION METHODS.

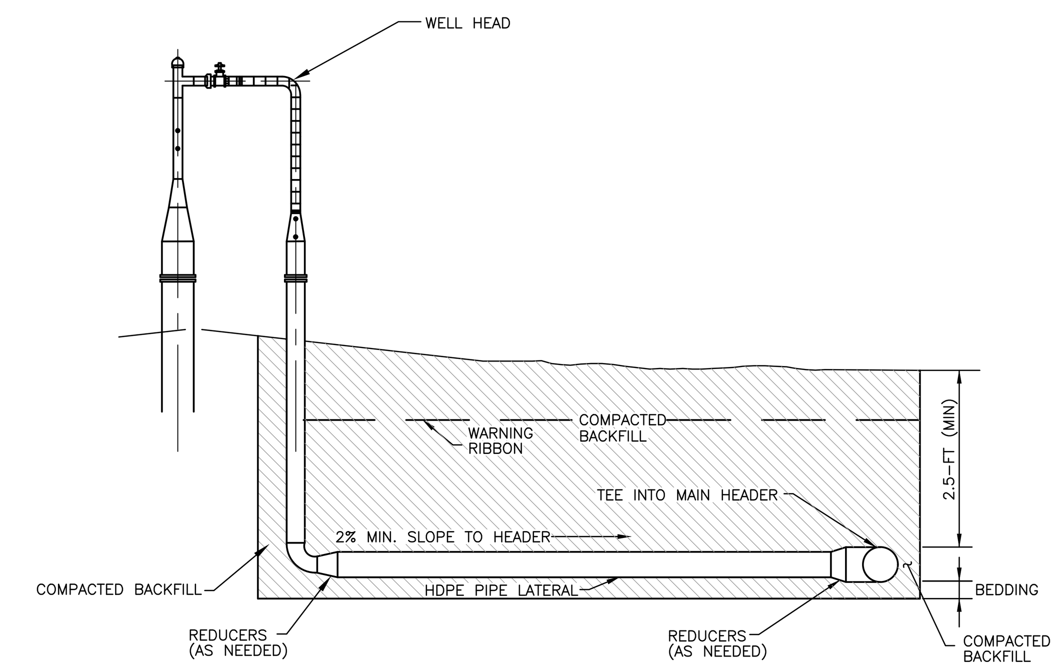
A / 7G TYPICAL GAS EXTRACTION WELL DETAIL
N.T.S.



NOTES:

1. LANDFILL GAS/LEACHATE EXTRACTION WELLS MAY BE INSTALLED IN AREAS WITH ELEVATED LEACHATE LEVELS BASED ON SITE CONDITIONS.
2. WELL MATERIALS AND DIMENSIONS MAY CHANGE TO SUIT ALTERNATE DRILLING AND WELL COMPLETION METHODS.

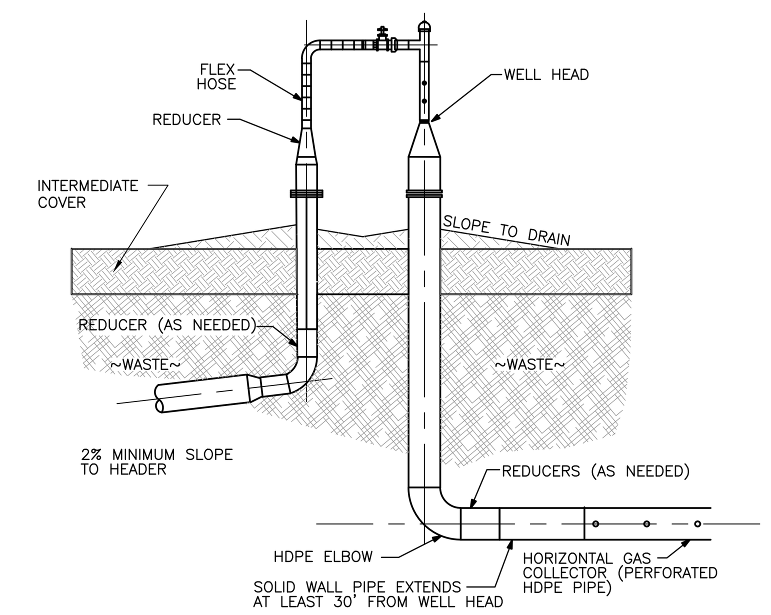
B / 7G TYPICAL LANDFILL GAS/LEACHATE EXTRACTION WELL DETAIL
N.T.S.



NOTES:

1. THIS DETAIL SHOWS LATERAL INSTALLATION PRIOR TO FINAL COVER INSTALLATION.
2. GAS COLLECTION PIPING INSTALLED IN AREAS OF THE LANDFILL YET TO RECEIVE FINAL COVER WILL BE INSTALLED EITHER 2.5-FEET BELOW GRADE OR ABOVE GRADE. GAS COLLECTION PIPING INSTALLED AFTER FINAL COVER SYSTEM INSTALLATION WILL BE INSTALLED WITHIN THE CAP PROTECTION LAYER.

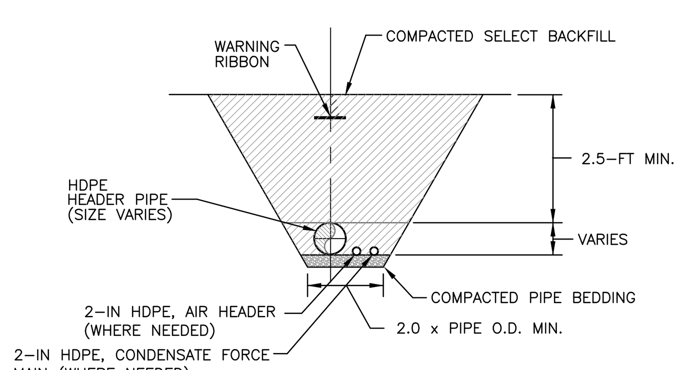
C / 7G GAS EXTRACTION WELL AND PIPING DETAIL
N.T.S.



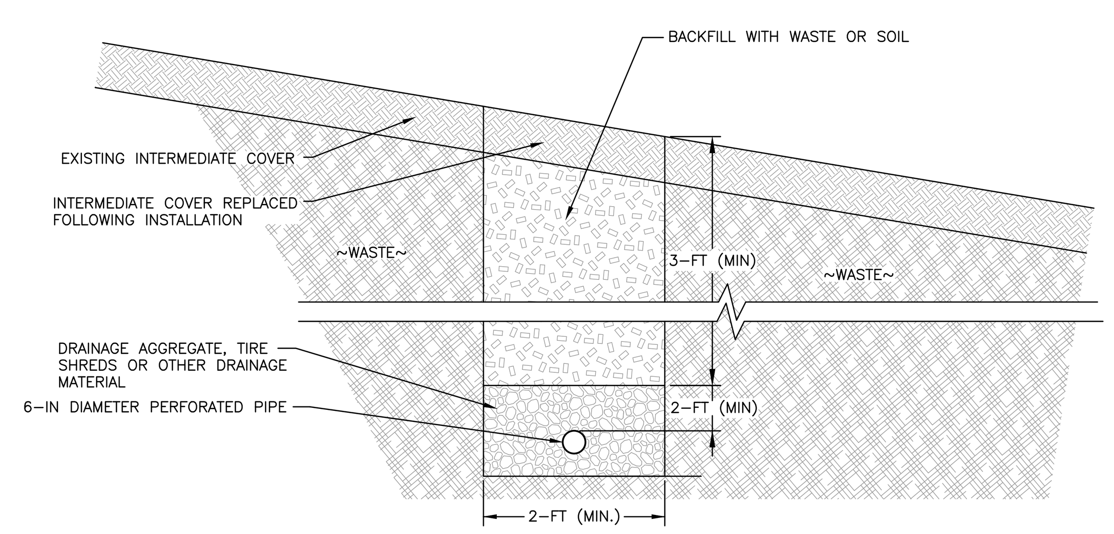
NOTE:

1. HORIZONTAL GAS COLLECTOR MAY BE USED TO PROVIDE GAS COLLECTION DEPENDING ON SITE CONDITIONS.

F / 7G HORIZONTAL GAS COLLECTOR WELL HEAD
N.T.S.



D / 7G GAS HEADER/LATERAL PIPE TRENCH DETAIL
N.T.S.



NOTE:

1. HORIZONTAL GAS COLLECTOR MAY BE USED TO PROVIDE GAS COLLECTION.

E / 7G HORIZONTAL GAS COLLECTOR
N.T.S.

STATE OF OHIO
RICK BUFFALINI
E-55305
REGISTERED PROFESSIONAL ENGINEER

10-24-11

SCALE IN FEET
0 200 400

*HAND SIGNATURE ON FILE

NOTES

1. THIS DRAWING PROVIDES INFORMATION REQUIRED IN OAC 3745-27-06(B)(7)(g).
2. IN AREAS WHERE ADDITIONAL WASTE WILL BE PLACED AFTER WELL INSTALLATION, GAS EXTRACTION WELLS MAY BE VERTICALLY EXTENDED TO ALLOW ADDITIONAL WASTE PLACEMENT. SOLID PIPE WILL BE WELDED TO THE WELL STRING AND RISER TO EXTEND VERTICALLY. IF EXTENDING THE WELL IS NOT FEASIBLE, THE WELL WILL BE ABANDONED AND A NEW WELL WILL BE INSTALLED FOLLOWING WASTE PLACEMENT.
3. SEE DETAIL D ON DRAWING 7I FOR THE GEOMEMBRANE PENETRATION BOOT DETAIL.

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CONTIGUOUS EXPANSION
APEX SANITARY LANDFILL
JEFFERSON COUNTY, OHIO

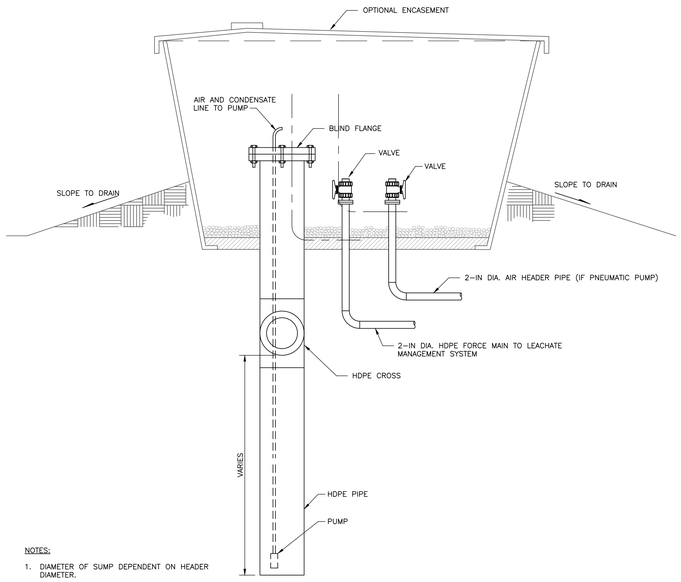
DRAWN BY: JM	CHECKED BY: MRB	APPROVED BY: RJB*
DATE: 9/9/11	DWG SCALE: N.T.S.	PROJECT NO: 091-867

GAS MANAGEMENT SYSTEM DETAILS (SHEET 1 OF 4)

DRAWING NO.: 7G

REVISION RECORD		
NO	DATE	DESCRIPTION
1	7/2013	REVISED DETAILS A AND B IN RESPONSE TO OHIO EPA NOD DATED 12/28/12.
2		
3		
4		

SUBMITTAL RECORD		
NO	DATE	DESCRIPTION



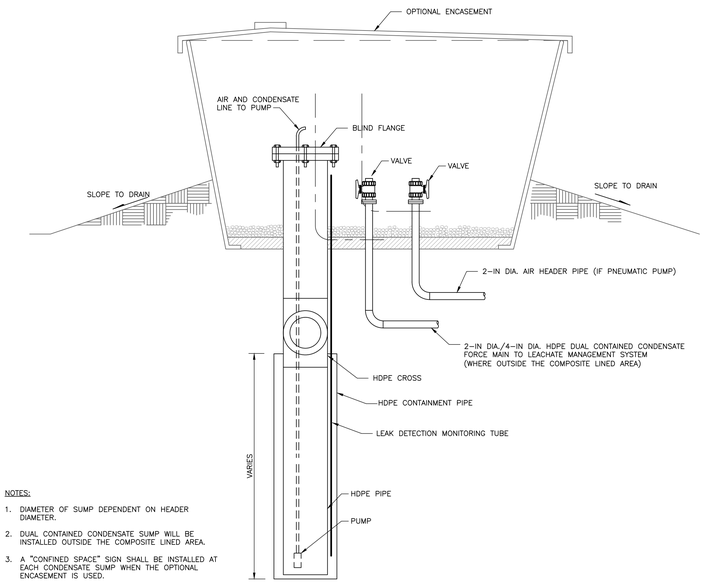
NOTES:

1. DIAMETER OF SUMP DEPENDENT ON HEADER DIAMETER.
2. SINGLE CONTAINED CONDENSATE SUMP WILL BE INSTALLED WITHIN THE COMPOSITE LINED AREA.
3. A "CONFINED SPACE" SIGN SHALL BE INSTALLED WITH EACH CONDENSATE SUMP WHEN THE OPTIONAL ENCASEMENT IS USED.

SECTION VIEW

A / 7H — IN-LINE CONDENSATE SUMP INSIDE COMPOSITE LINED AREA

N.T.S.



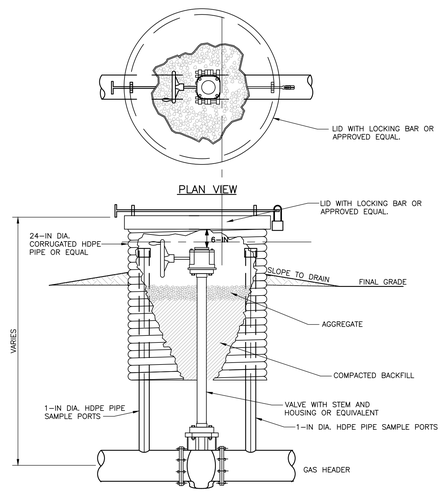
NOTES:

1. DIAMETER OF SUMP DEPENDENT ON HEADER DIAMETER.
2. DUAL CONTAINED CONDENSATE SUMP WILL BE INSTALLED OUTSIDE THE COMPOSITE LINED AREA.
3. A "CONFINED SPACE" SIGN SHALL BE INSTALLED AT EACH CONDENSATE SUMP WHEN THE OPTIONAL ENCASEMENT IS USED.

SECTION VIEW

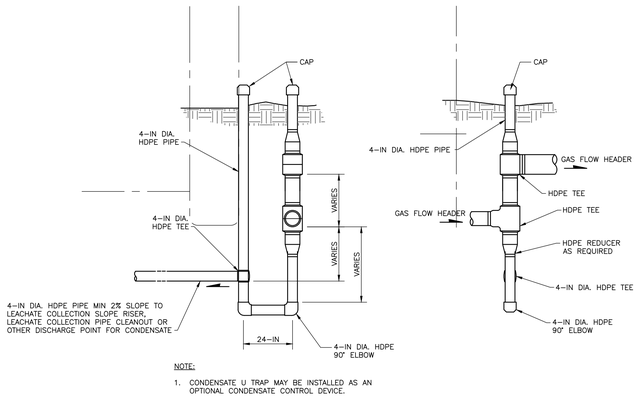
B / 7H — IN-LINE DUAL CONTAINED CONDENSATE SUMP OUTSIDE COMPOSITE LINED AREA

N.T.S.



E / 7H — ISOLATION VALVE DETAIL

N.T.S.

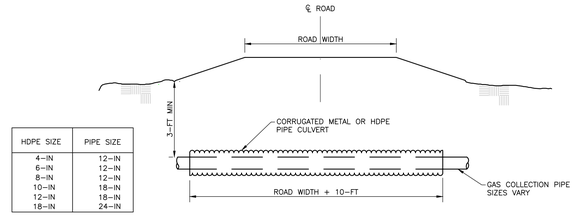


NOTE:

1. CONDENSATE U TRAP MAY BE INSTALLED AS AN OPTIONAL CONDENSATE CONTROL DEVICE.

C / 7H — CONDENSATE "U" TRAP

N.T.S.



HDPE SIZE	PIPE SIZE
4-IN	12-IN
6-IN	12-IN
8-IN	12-IN
10-IN	18-IN
12-IN	18-IN
18-IN	24-IN

D / 7H — PROTECTIVE ENCASEMENT FOR LANDFILL GAS PIPES AT ROAD CROSSINGS

N.T.S.

NOTES

1. THIS DRAWING PROVIDES INFORMATION REQUIRED IN OAC 3745-27-06(B)(7)(g).

STATE OF OHIO — RICK BUFFALINI — E-55305 — REGISTERED PROFESSIONAL ENGINEER

7-18-13

SCALE IN FEET: 0 200 400

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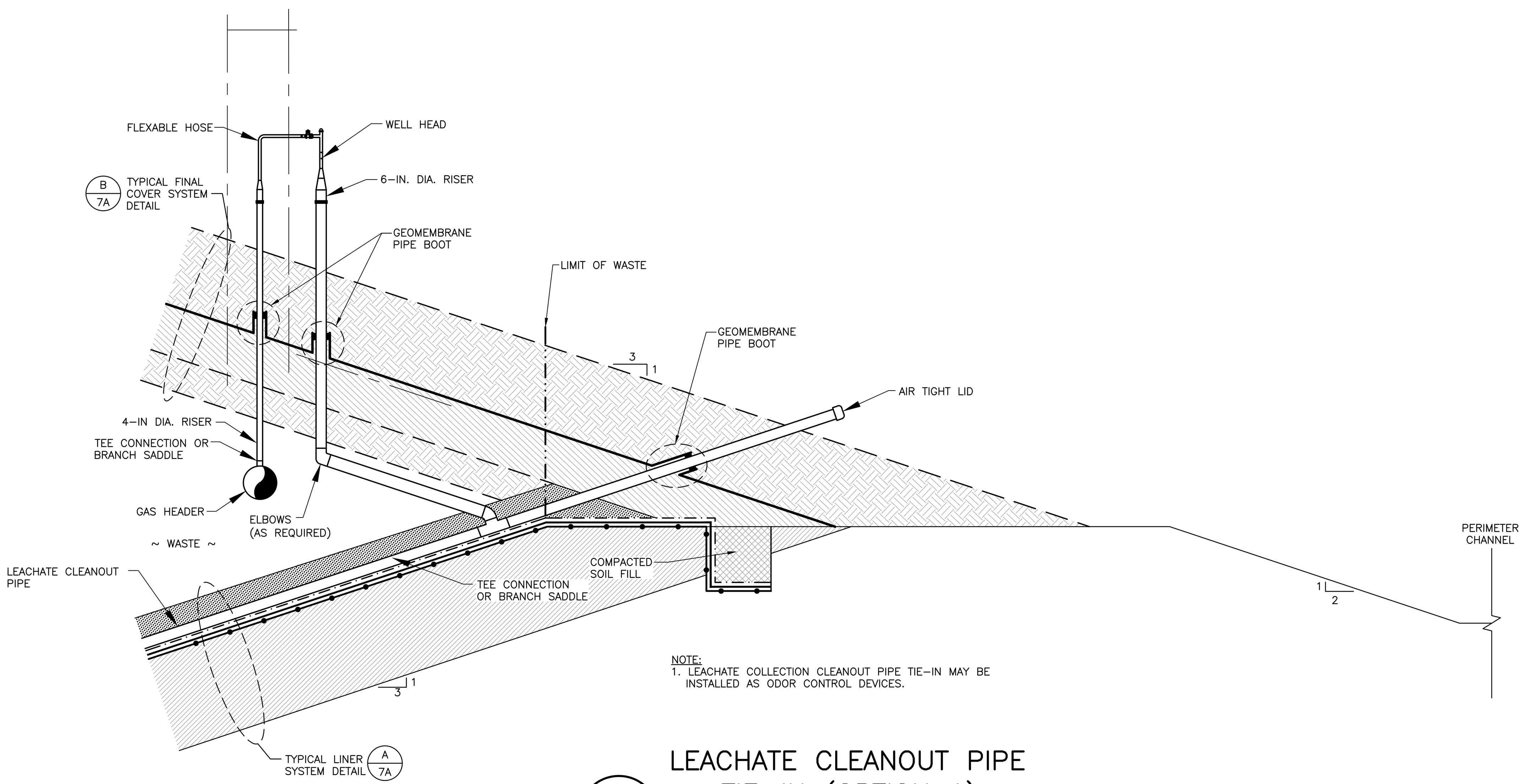
APEX SANITARY LANDFILL
JEFFERSON COUNTY, OHIO

DRAWN BY:	JM	CHECKED BY:	MRB	APPROVED BY:	RJB*
DATE:	9/9/11	DWG SCALE:	N.T.S.	PROJECT NO:	091-867

GAS MANAGEMENT SYSTEM DETAILS (SHEET 2 OF 4)

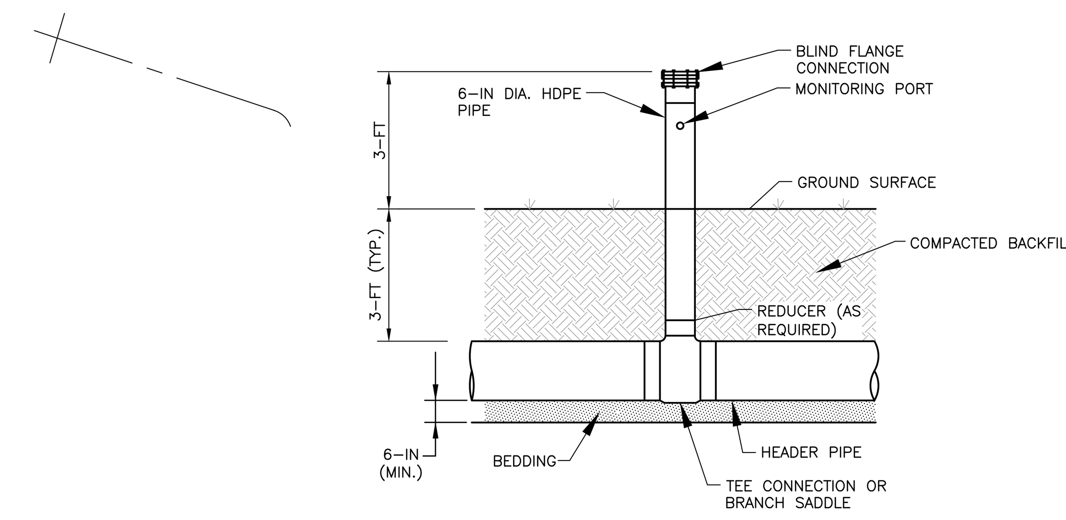
DRAWING NO.: **7H**

P:\2009\091-867\1-GAS\DGN - PH LATERAL EXPANSION\DWG\PERMIT\PHASE3\MAPAL.DGN - 7/17/2013 - LP, 5/19/2016 12:23:38 PM

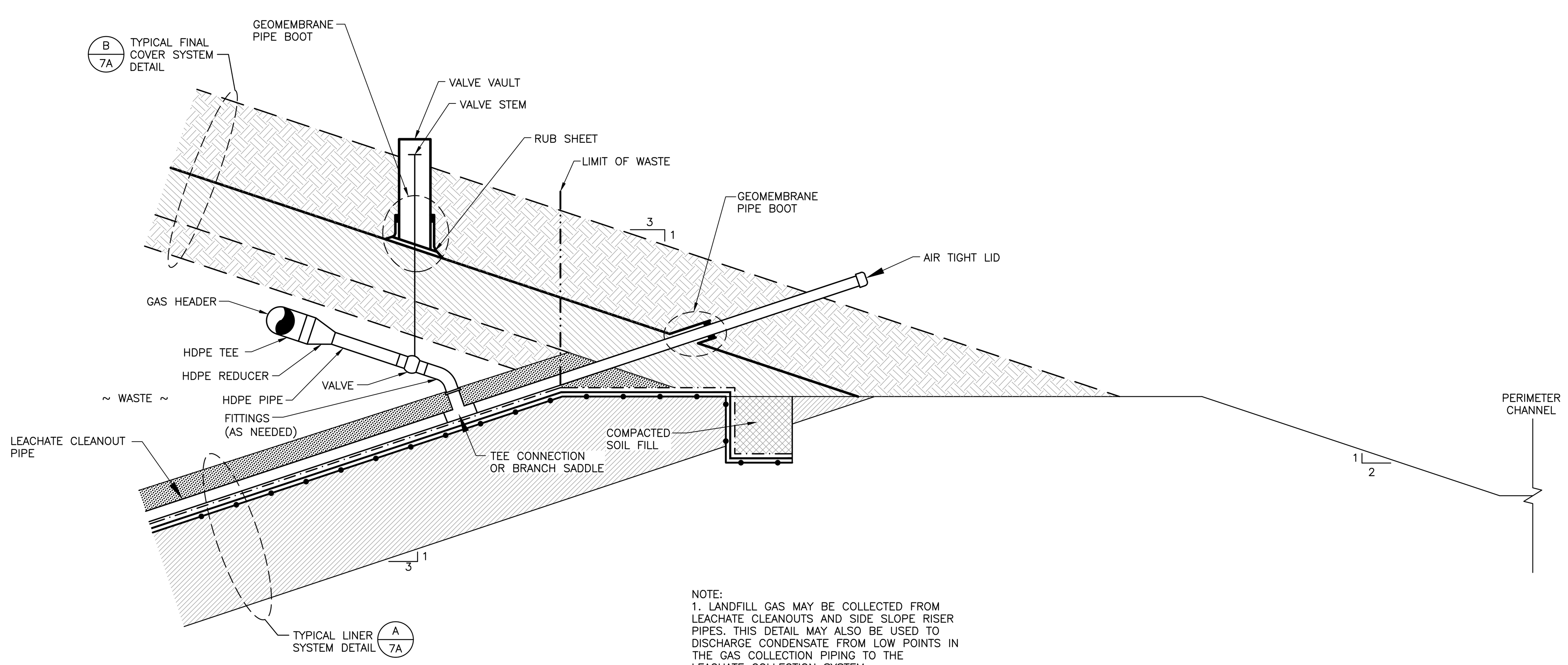


NOTE:
1. LEACHATE COLLECTION CLEANOUT PIPE TIE-IN MAY BE INSTALLED AS ODOR CONTROL DEVICES.

A / 7I — LEACHATE CLEANOUT PIPE TIE-IN (OPTION 1)
N.T.S.

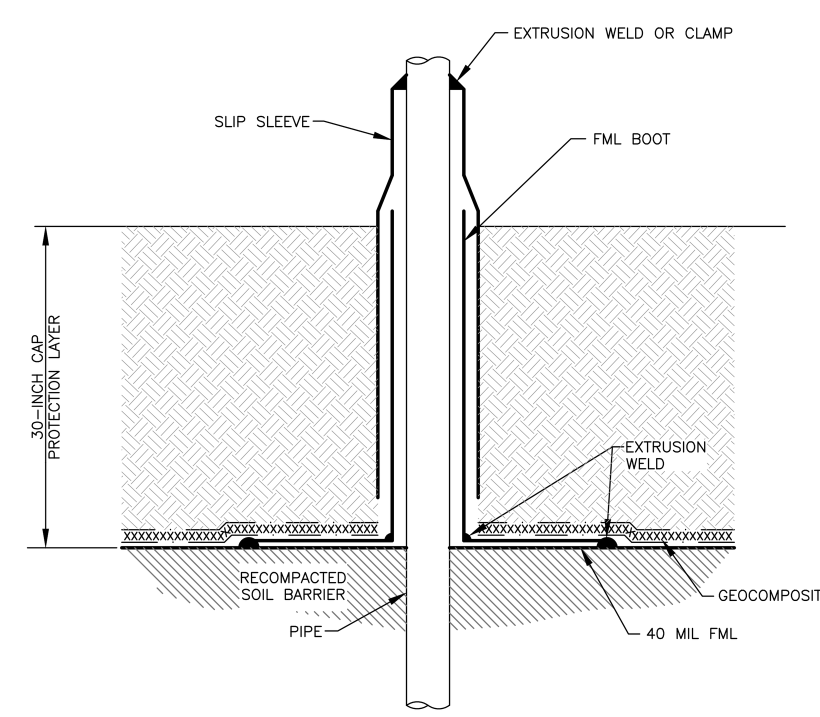


C / 7I — HEADER ACCESS RISER
N.T.S.



NOTE:
1. LANDFILL GAS MAY BE COLLECTED FROM LEACHATE CLEANOUTS AND SIDE SLOPE RISER PIPES. THIS DETAIL MAY ALSO BE USED TO DISCHARGE CONDENSATE FROM LOW POINTS IN THE GAS COLLECTION PIPING TO THE LEACHATE COLLECTION SYSTEM.

B / 7I — LEACHATE CLEANOUT PIPE TIE-IN (OPTION 2)
N.T.S.



NOTES:
1. BOOTS MUST BE INSTALLED WHEN PIPES PENETRATE THE FINAL COVER SYSTEM.
2. PENETRATIONS TO FINAL COVER GEOMEMBRANE INCLUDE LEACHATE MANAGEMENT SYSTEM COMPONENTS, GAS MANAGEMENT SYSTEM COMPONENTS, OR ANY OTHER PENETRATIONS.

D / 7I — GEOMEMBRANE PENETRATION BOOT
N.T.S.

REVISION RECORD

NO	DATE	DESCRIPTION

SUBMITTAL RECORD

NO	DATE	DESCRIPTION

NOTES

1. THIS DRAWING PROVIDES INFORMATION REQUIRED IN OAC 3745-27-06(B)(7)(g).

STATE OF OHIO — RICK BUFFALINI — E-55305 — REGISTERED PROFESSIONAL ENGINEER

10-24-11

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JEFFERSON COUNTY, OHIO

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DATE:	9/9/11	DWG SCALE:	N.T.S.	PROJECT NO:	091-867

GAS MANAGEMENT SYSTEM DETAILS (SHEET 3 OF 4)

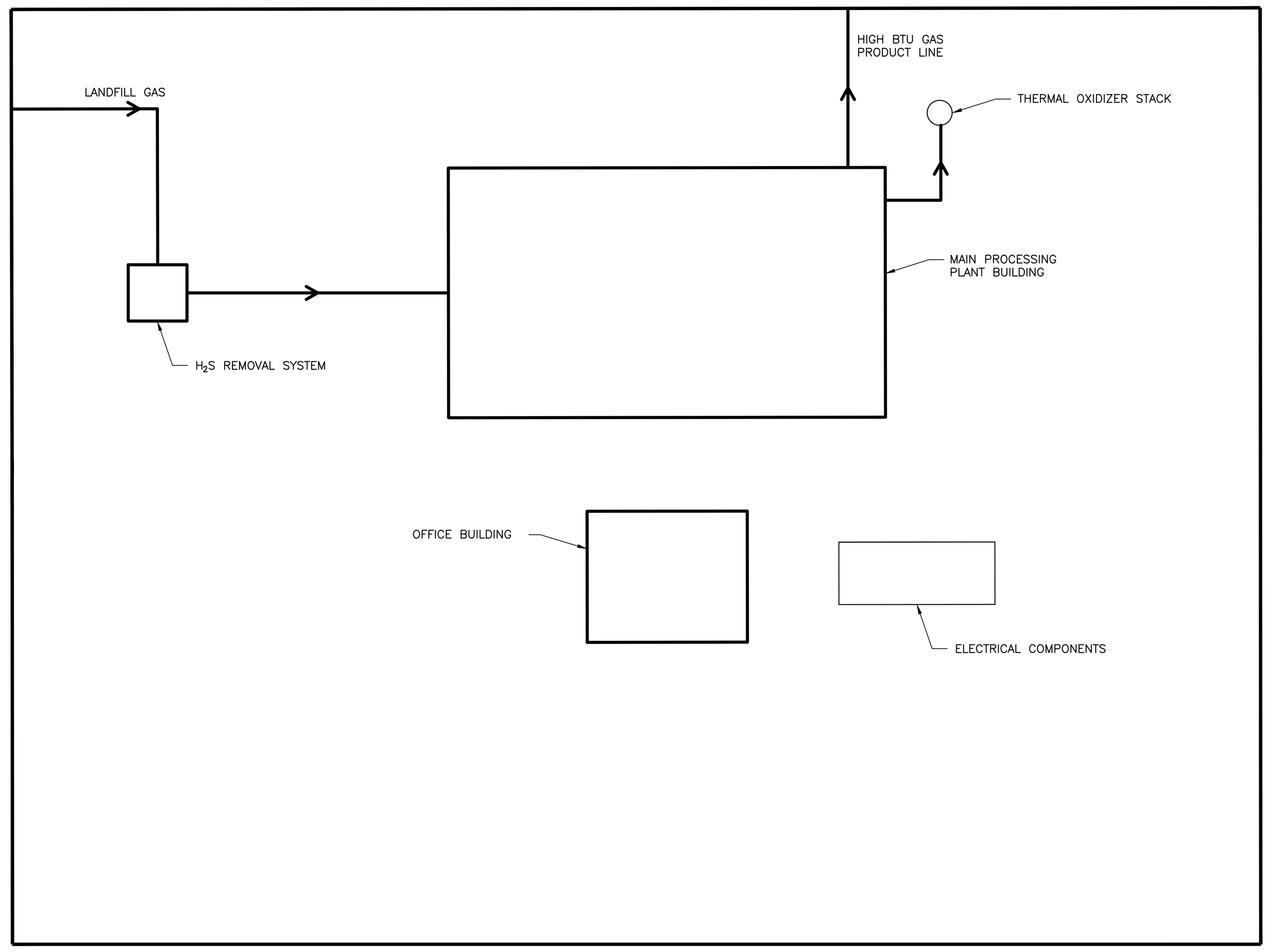
DRAWING NO.: 7I

REVISION RECORD

NO	DATE	DESCRIPTION
1	7/20/13	REVISED DETAIL A

SUBMITTAL RECORD

NO	DATE	DESCRIPTION

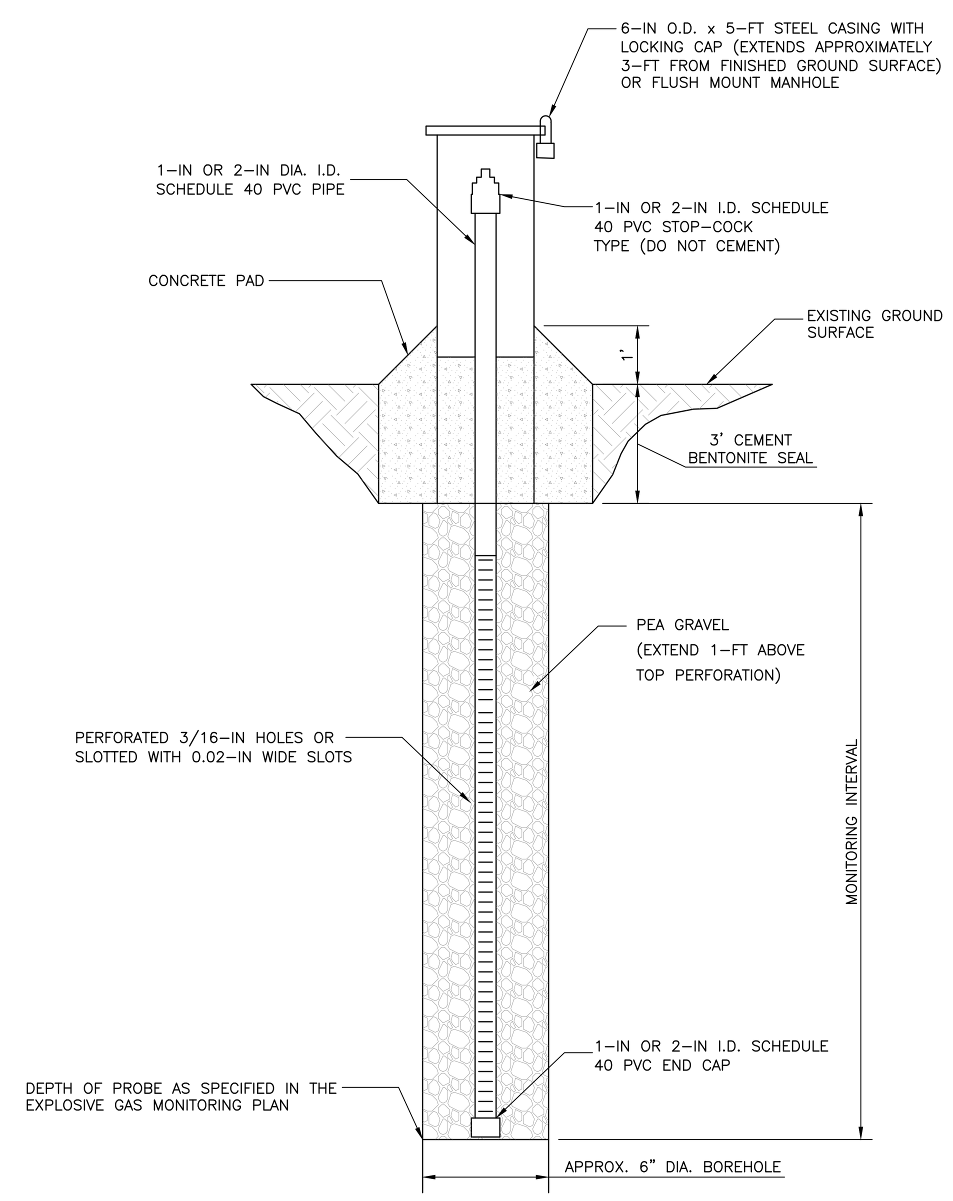


A/7J LANDFILL GAS MANAGEMENT PROCESSING PLANT AREA

N.T.S.

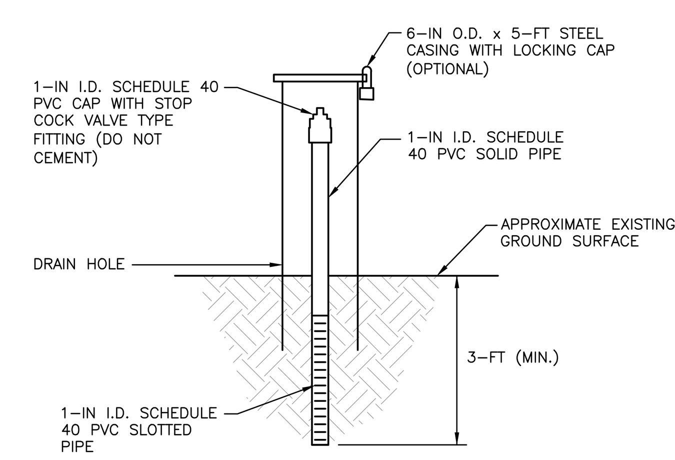
GAS MANAGEMENT AREA NOTE

THE SCHEMATIC PLAN VIEW SHOWN HERE PRESENTS A TYPICAL INSTALLATION OF A GAS MANAGEMENT AREA. THE SIZE, CONFIGURATION AND COMPONENTS MAY BE DIFFERENT FROM THAT SHOWN HERE BASED ON SITE SPECIFIC OPERATIONAL REQUIREMENTS AND OHIO EPA APPROVAL.



B/7J EXPLOSIVE GAS MONITORING PROBE

N.T.S.



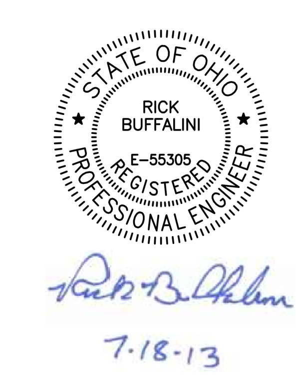
NOTE:
1. PERMANENT PUNCH BAR SAMPLE LOCATIONS MAY BE INSTALLED OR PUNCH BAR SAMPLING MAY BE PERFORMED DURING EACH SAMPLE EVENT.

C/7J EXPLOSIVE GAS MONITORING PUNCH BAR

N.T.S.

NOTES

1. THIS DRAWING PROVIDES INFORMATION REQUIRED IN OAC 3745–27–06(B)(7)(g).



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JEFFERSON COUNTY, OHIO

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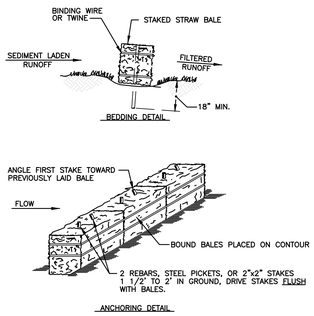
DATE: 9/9/11	DWG SCALE: N.T.S.	PROJECT NO: 091-867

GAS MANAGEMENT SYSTEM DETAILS (SHEET 4 OF 4)

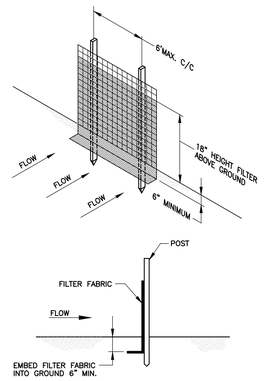
DRAWING NO.: 7J

REVISION RECORD		
NO	DATE	DESCRIPTION
1	7/2013	REVISED CHANNEL SUMMARY TABLE
2		
3		
4		

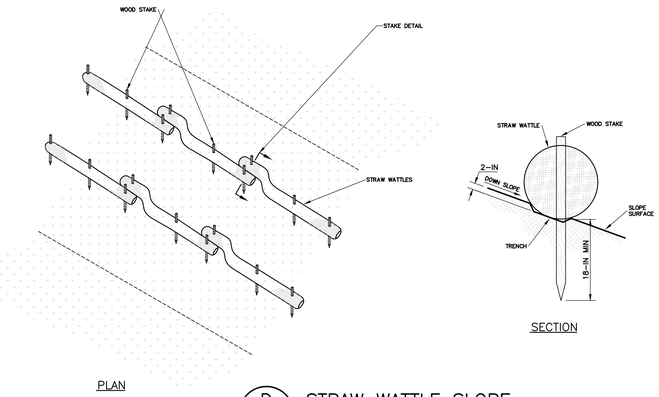
SUBMITTAL RECORD		
NO	DATE	DESCRIPTION



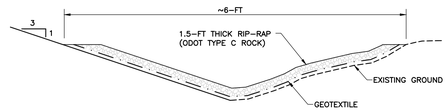
A / 7K STRAW BALE DIKE DETAIL
N.T.S.



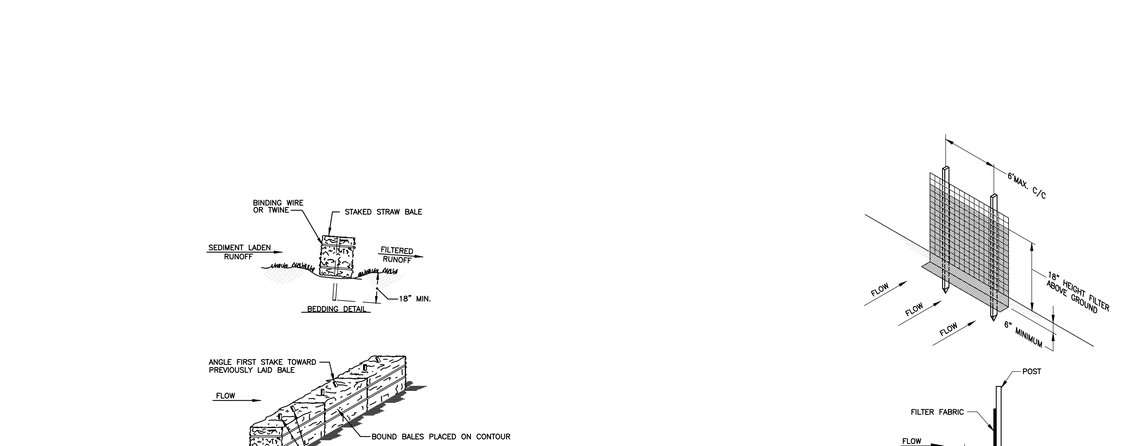
B / 7K SILT FENCE DETAIL
N.T.S.



D / 7K STRAW WATTLE SLOPE
N.T.S.



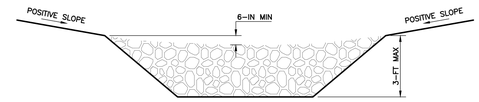
E / 7K RIP-RAP EROSION PROTECTION
N.T.S.

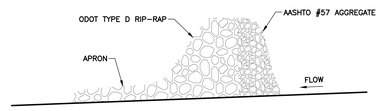


CULVERT SUMMARY TABLE							
CULVERT	CULVERT DIAMETER (IN)	INVERT ELEVATIONS		CULVERT LENGTH (FT)	CULVERT SLOPE (FT/FT)	PEAK FLOW (CFS)	QUANTITY
		INLET	OUTLET				
CU-O	36	1242.0	1241.0	193	0.01	55	2
CU-Z	36	1227.5	1210.3	310	0.06	54	2
CY-Y	36	1172.4	1172.0	87	0.00	53	2
CU-K	30	1221.0	1215.0	85	0.07	71	2
CU-H	30	1222.0	1212.0	358	0.03	42	3
CU-K	30	1298.0	1297.0	83	0.01	32	1
CU-L	36	1302.5	1295.0	70	0.11	47	1
CU-M	36	1280.0	1270.0	47	0.21	111	2

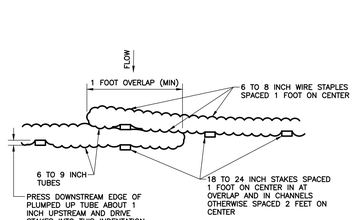
NOTES:
1. LOCATIONS OF SURFACE WATER CULVERTS ARE SHOWN ON DRAWING 4H.
2. THE MINIMUM SEPARATION BETWEEN TWO CULVERTS SHALL BE 2 FEET.

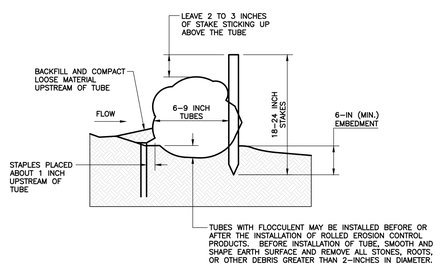
C / 7K TYPICAL CULVERT DETAIL
N.T.S.





F / 7K ROCK CHECK DAM
N.T.S.





NOTES:
1. REPLACE TUBES WITH FLOCCULENT PER MANUFACTURER'S SPECIFICATIONS.
2. IF INSTALLING TUBE ACROSS A DITCH THEN EXCAVATE A PLACEMENT TRENCH ABOUT 3 INCHES DEEP.

G / 7K FIBER FLOCCULENT TUBE
N.T.S.

NOTES

1. THIS DRAWING PROVIDES INFORMATION REQUIRED IN OAC 3745-27-06(B)(7)(i).
2. TEMPORARY EROSION AND SEDIMENT CONTROLS WILL BE INSTALLED WHERE NEEDED BASED ON SITE CONDITIONS.

STATE OF OHIO
RICK BUFFALINI
E-55305
REGISTERED
PROFESSIONAL ENGINEER

7-18-13

SCALE IN FEET
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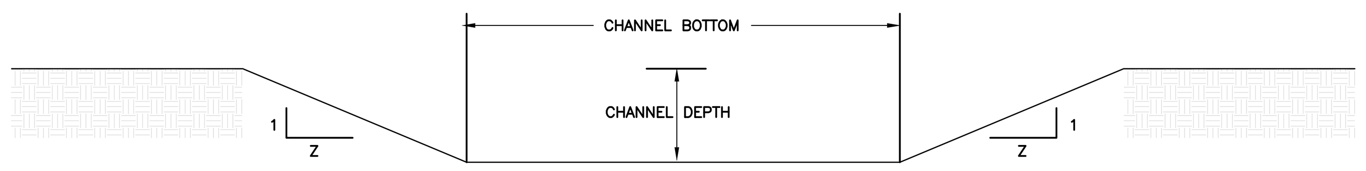
JEFFERSON COUNTY, OHIO

DRAWN BY:	JM	CHECKED BY:	MRB	APPROVED BY:	RJB*
DATE:	9/9/11	DWG SCALE:	N.T.S.	PROJECT NO:	091-867

SURFACE WATER MANAGEMENT SYSTEM DETAILS (SHEET 1 OF 2)

DRAWING NO.: 7K

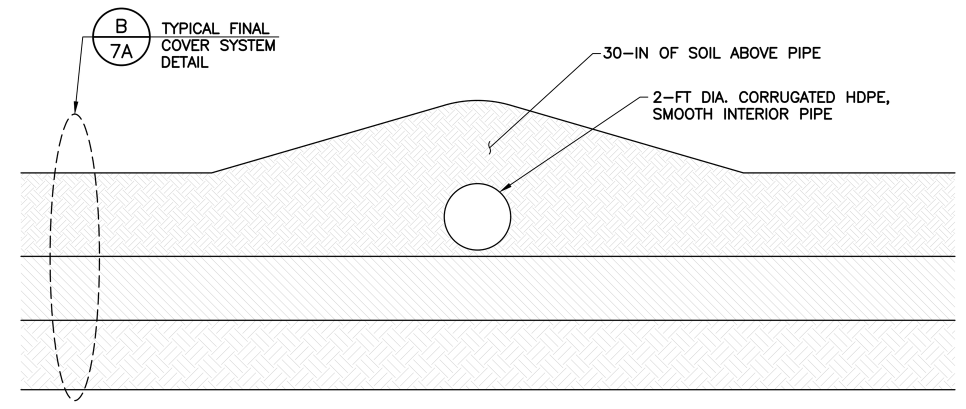
P:\2009\091-867\1-CAD\DGN\ - PTI LATERAL EXPANSION\PWS\091-867PTI2.DWG?VLS:LMARKLAND - 7/17/2013 - LD: 5/16/2014 12:05:37 PM



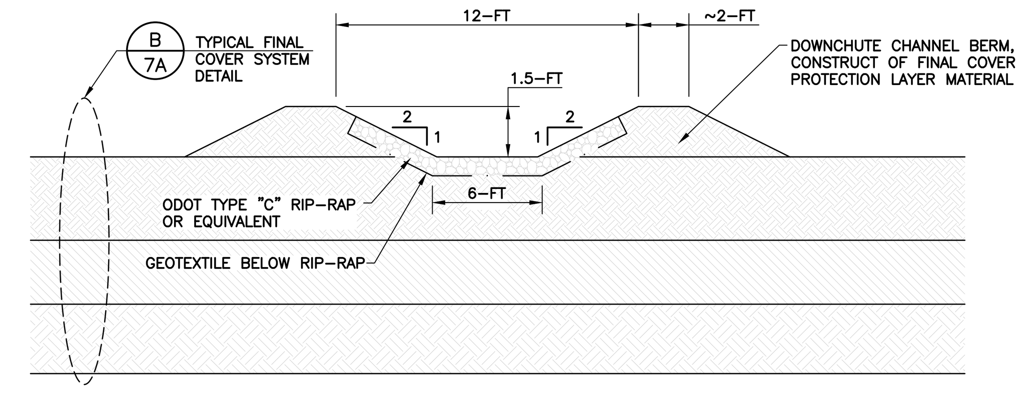
CHANNEL SUMMARY TABLE											
CHANNEL	DRAINAGE AREA (ACRES)	INLET ELEVATIONS		LENGTH (FT)	SLOPE (FT/FT)	PEAK FLOW (CFS)	DIMENSIONS			MAXIMUM VELOCITY (FPS)	LINING SEE NOTES 1 & 2
		INLET	OUTLET				BASE (FT)	DEPTH (FT)	SIDESLOPES (ZH:1V)		
CH–J1	0.4	1300.1	1297.1	173	0.02	1	3	3	2	1.8	GRASS
CH–J2	5.5	1297.1	1262.0	1300	0.03	15	3	3	2	4.8	GRASS
CH–J3	5.6	1262.0	1260.9	70	0.02	12	3	3	2	4.0	GRASS
CH–J4	6.2	1260.9	1257.0	171	0.02	12	3	3	2	4.5	GRASS
CH–J5	6.9	1257.0	1251.0	180	0.03	12	3	3	2	3.4	RIPRAP TYPE D
CH–J6	27.9	1251.0	1247.0	236	0.02	55	3	3	2	4.7	RIPRAP TYPE D
CH–J7	29.4	1247.0	1242.5	86	0.05	55	3	3	2	7.0	RIPRAP TYPE D
CH–E2	1.2	1223.8	1222.0	352	0.01	3	2	3	3	1.7	GRASS
CH–Z1	30.2	1210.3	1172.4	377	0.10	54	2	2	2	8.8	RIPRAP TYPE D
D–F1	29.7	1241.0	1227.5	343	0.04	55	2	3	3	5.8	RIPRAP TYPE D
D–H3	100.8	1160.0	1129.3	130	0.24	163	4	3	3	11.9	RIPRAP TYPE C
D–C2	53.2	1212.5	1165.0	434	0.11	95	4	3	2	9.0	RIPRAP TYPE D
D–C3	53.2	1165.0	1160.0	174	0.03	93	4	3	2	5.6	RIPRAP TYPE D
CH–F2	20.5	1242.4	1222.0	524	0.04	41	2	3	3	4.7	RIPRAP TYPE C
CH–I1	0.3	1306.0	1302.0	93	0.04	1	3	3	2	1.4	RIPRAP TYPE D
CH–I2	5.3	1302.0	1264.6	869	0.04	14	3	3	2	3.6	RIPRAP TYPE D
CH–I3	41.2	1264.6	1232.2	755	0.04	73	3	3	2	7.1	RIPRAP TYPE D
CH–I4	41.2	1232.2	1231.0	311	0.00	70	3	3	2	3.7	GRASS
CH–A2	54.0	1231.0	1229.3	165	0.01	87	2	3	3	4.2	RIPRAP TYPE D
CH–A3	77.4	1229.3	1217.0	405	0.03	110	2	3	3	6.2	RIPRAP TYPE C
CH–K1	1.4	1314.8	1312.0	259	0.01	4	3	3	2	2.3	GRASS
CH–K2	5.6	1312.0	1302.0	910	0.01	13	3	3	2	3.4	GRASS
CH–K3	17.0	1302.0	1298.0	287	0.01	32	3	3	2	4.9	GRASS
D–K	17.0	1297.0	1295.0	84	0.02	32	3	3	2	4.4	RIPRAP TYPE D
CH–L1	1.5	1314.8	1311.2	276	0.01	4	3	3	2	2.6	GRASS
CH–L2	4.4	1311.2	1302.5	660	0.01	11	3	3	2	3.5	GRASS
D–L	22.3	1295.0	1270.0	145	0.17	47	3	3	2	8.5	RIPRAP TYPE C
CH–M1	3.3	1304.6	1294.5	1009	0.01	9	3	3	2	2.8	GRASS
CH–M2	37.9	1294.5	1286.8	770	0.01	67	3	3	2	4.2	RIPRAP TYPE D
CH–M3	39.7	1286.8	1280.0	457	0.01	64	3	3	2	4.7	RIPRAP TYPE D
CH–N1	1.7	1306.0	1302.0	362	0.01	4	3	3	2	2.5	GRASS
CH–N2	4.5	1302.0	1293.2	805	0.01	11	3	3	2	3.2	GRASS
CH–N3	29.2	1293.2	1287.0	559	0.01	51	3	3	2	3.9	RIPRAP TYPE D
CH–N4	31.2	1287.0	1280.0	507	0.01	50	3	3	2	4.3	RIPRAP TYPE D
D–M1	70.9	1270.0	1255.0	197	0.08	111	8	3	2	8.6	RIPRAP TYPE D

NOTES: 1. MATTING MAY BE USED IN PLACE OF RIP–RAP DURING CONSTRUCTION WITH PRIOR OHIO EPA APPROVAL.
2. RIPRAP REFERS TO ODOT TYPE OR EQUIVALENT AGGREGATE.

A / 7L CHANNEL DETAIL
N.T.S.



B / 7L PIPE DOWNCHUTE (OPTION 1)
N.T.S.



C / 7L ROCK–LINED DOWNCHUTES (OPTION 2)
N.T.S.

REVISION RECORD

NO	DATE	DESCRIPTION
1	7/2013	REVISED CHANNEL SUMMARY TABLE

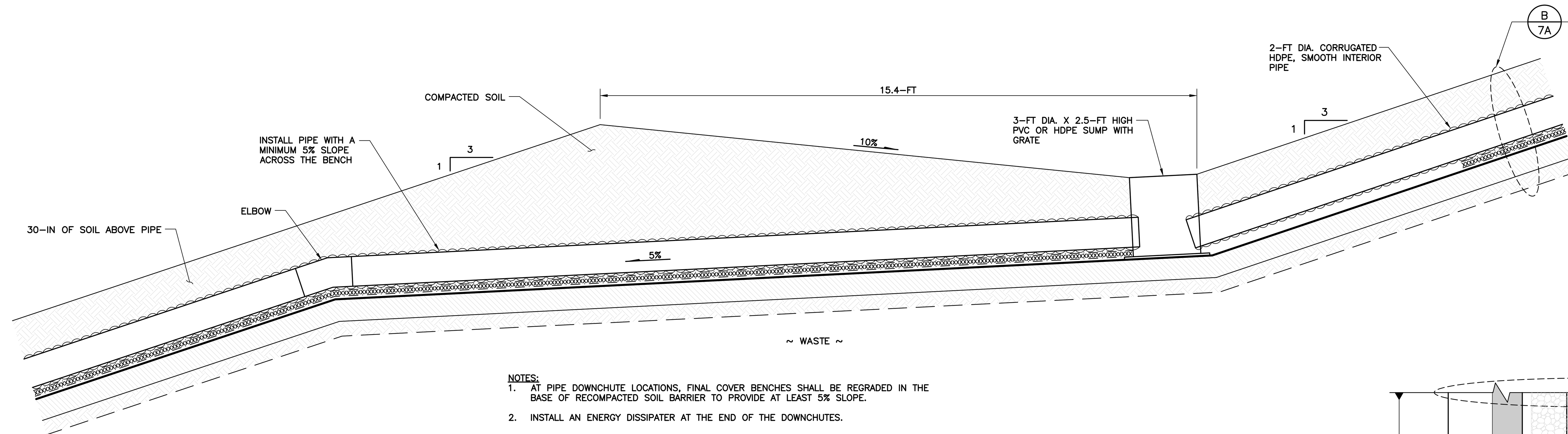
SUBMITTAL RECORD

NO	DATE	DESCRIPTION

DOWNCHUTE ID	DRAINAGE AREA	INVERT ELEVATIONS		LENGTH	PEAK FLOW
	(ACRES)	INLET	OUTLET	(FT)	(CFS)
DC–1	10.1	1548.4	1231.0	1084	19
DC–2	20.9	1468.7	1229.3	778	48
DC–3	14.7	1403.2	1225.7	592	33
DC–4	9.3	1392.5	1243.4	637	22
DC–5	26.7	1390.3	1221.6	566	52
DC–6	14.7	1458.4	1242.4	768	50
DC–7	2.8	1521.1	1465.6	186	6
DC–8	20.0	1538.1	1251.0	976	47
DC–9	10.9	1478.8	1302.0	1008	24
DC–10	17.9	1469.7	1302.5	556	37
DC–11	31.8	1501.0	1294.5	679	60
DC–12	22.5	1501.4	1293.2	694	42
DC–13	27.8	1505.0	1264.6	792	51

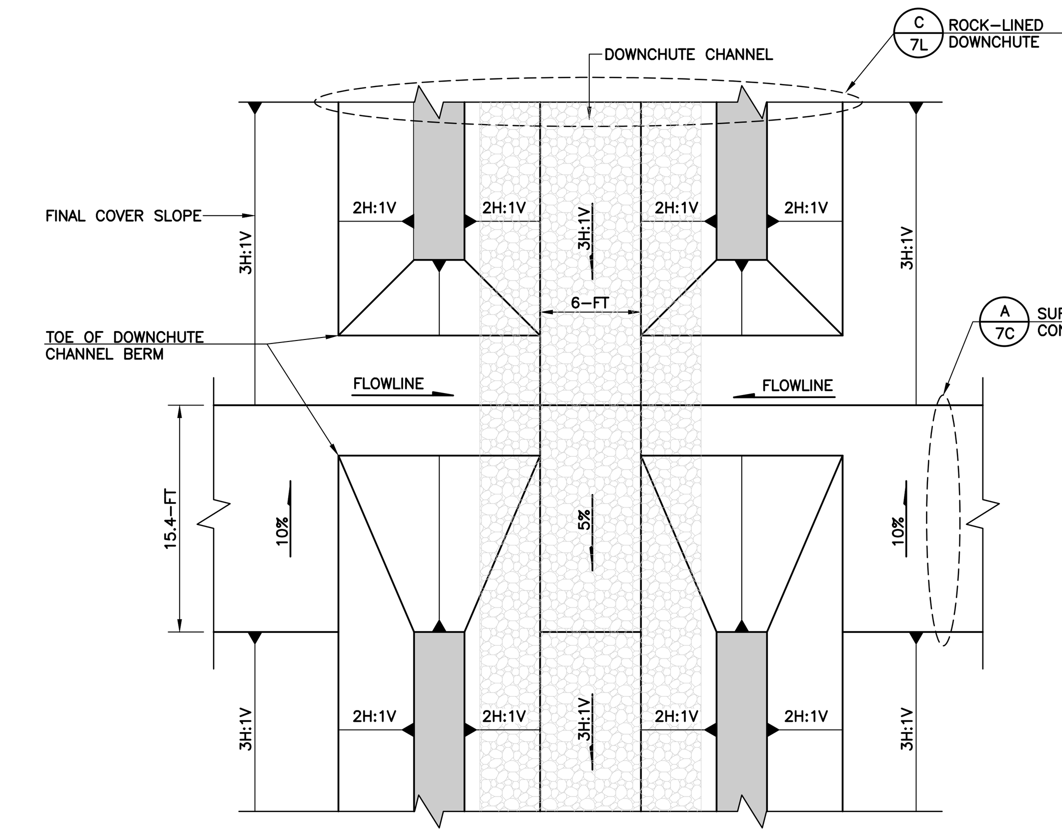
(1) DOWNCHUTE WAS DESIGNED FOR THE VERTICAL EXPANSION. DESIGN WAS RE–EVALUATED BECAUSE THE FINAL COVERACITIES OF THE WEST SEDIMENTATION POND AND THE NORTH SEDIMENTATION POND WERE RE–EVALUATED. THESE DOWNCHUTES DISCHARGE INTO EITHER THE WEST SEDIMENTATION POND OR THE NORTH SEDIMENTATION POND.

(2) DOWNCHUTE DC–2 WAS EXTENDED FOR THE PROPOSED EXPANSION.

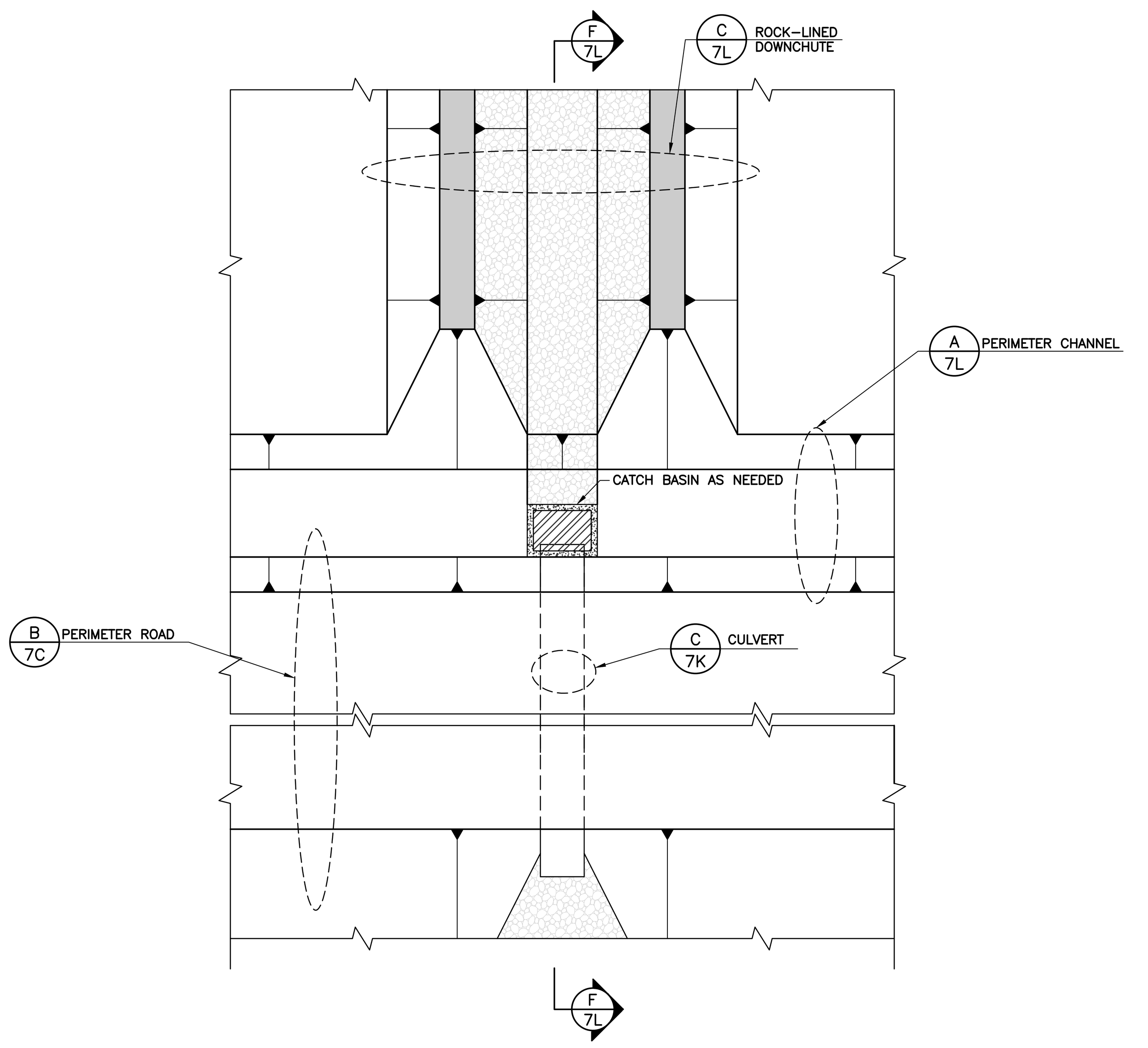


NOTES:
1. AT PIPE DOWNCHUTE LOCATIONS, FINAL COVER BENCHES SHALL BE REGRADED IN THE BASE OF RECOMPACTED SOIL BARRIER TO PROVIDE AT LEAST 5% SLOPE.
2. INSTALL AN ENERGY DISSIPATER AT THE END OF THE DOWNCHUTES.

D / 7L PIPE DOWNCHUTE AT SURFACE WATER CONTROL BENCH DETAIL (OPTION 1)
N.T.S.

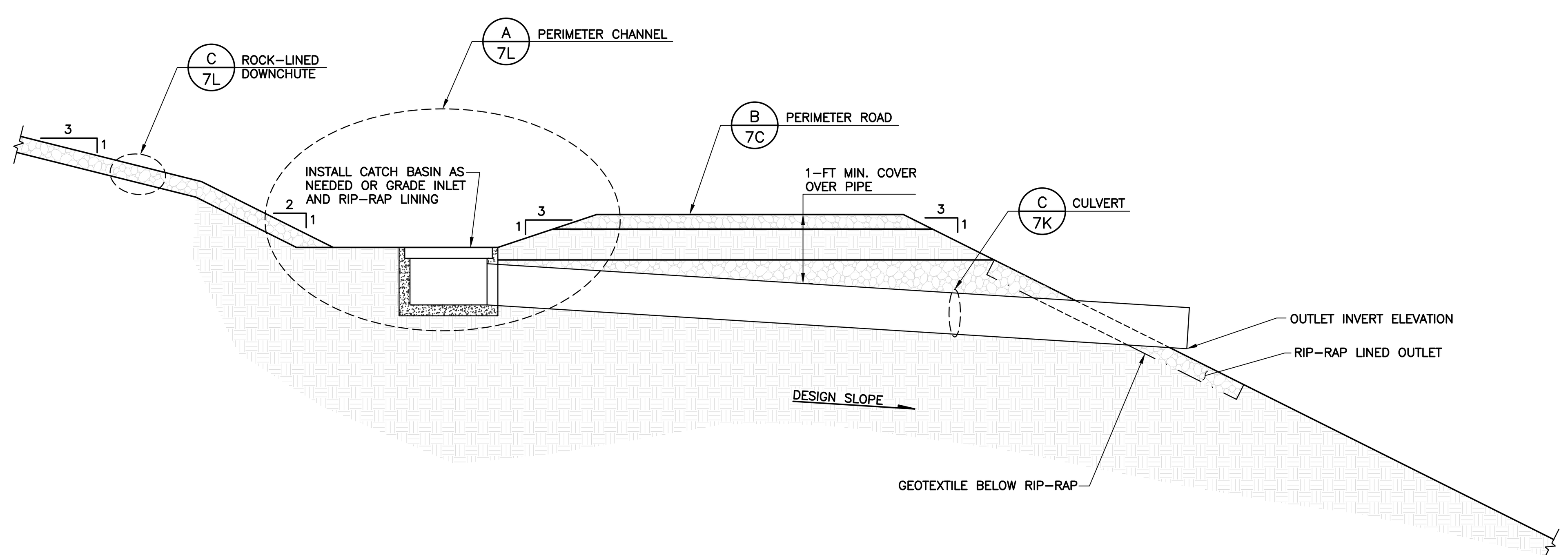


E / 7L ROCK–LINED DOWNCHUTE AND SURFACE WATER CONTROL BENCH DETAIL
N.T.S.



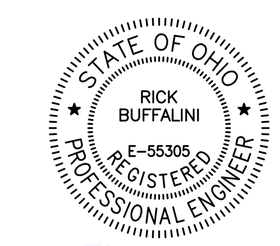
NOTE: THIS DETAIL SHOWS WHERE THE DOWNCHUTE ENTERS THE PERIMETER CHANNEL AT A LOCATION WHERE A CULVERT IS UNDER THE PERIMETER ROAD.

G / 7L PERIMETER CHANNEL/CULVERT/DOWNCHUTE CHANNEL DETAIL
N.T.S.



NOTE: THIS DETAIL SHOWS WHERE THE DOWNCHUTE ENTERS THE PERIMETER CHANNEL AT A LOCATION WHERE A CULVERT IS UNDER THE PERIMETER ROAD.

F / 7L ROCK–LINED DOWNCHUTE/PERIMETER CHANNEL/CULVERT DETAIL
N.T.S.



7.18.13

SCALE IN FEET
0 200 400

*HAND SIGNATURE ON FILE

NOTES

1. THIS DRAWING PROVIDES INFORMATION REQUIRED IN OAC 3745–27–06(B)(7)(i).
2. LOCATIONS OF SURFACE WATER STRUCTURES ARE SHOWN ON DRAWING 4H.

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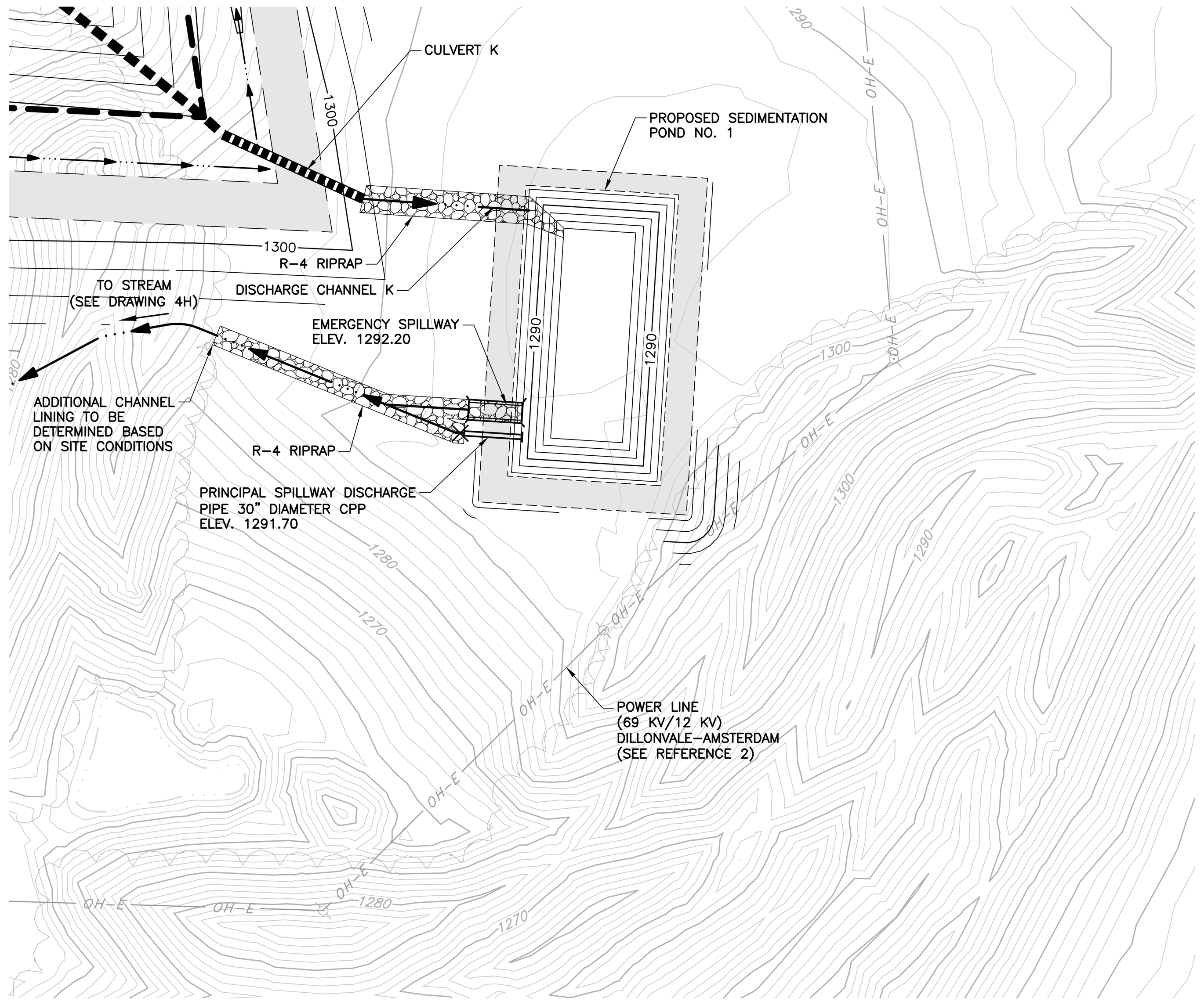
APEX ENVIRONMENTAL, LLC.
PERMIT TO INSTALL APPLICATION
CONTIGUOUS EXPANSION
APEX SANITARY LANDFILL
JEFFERSON COUNTY, OHIO

DRAWN BY: JM	CHECKED BY: MRB	APPROVED BY: RJB*
DATE: 9/9/11	DWG SCALE: N.T.S.	PROJECT NO: 091-867

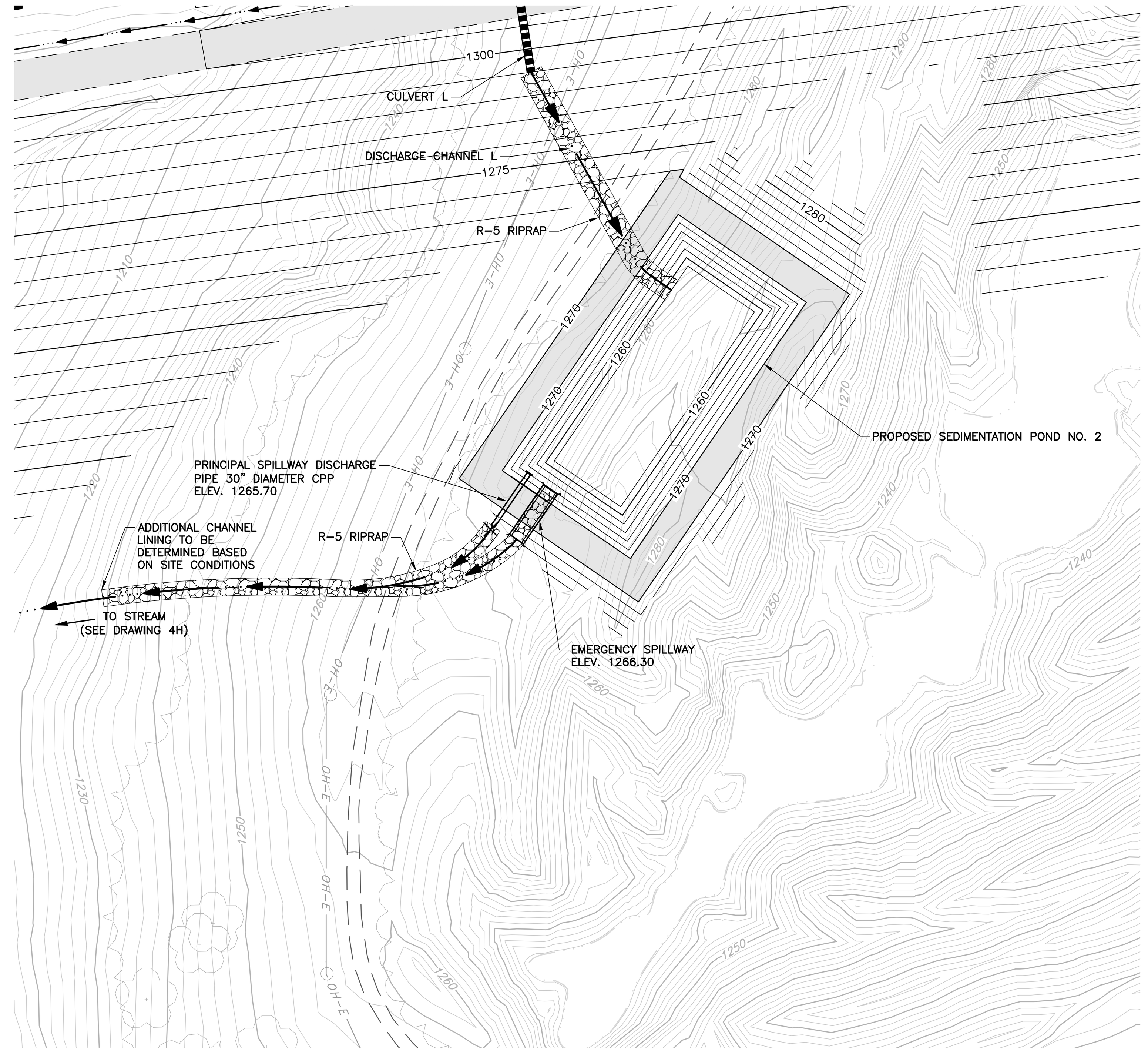
SURFACE WATER
MANAGEMENT SYSTEM DETAILS
(SHEET 2 OF 2)

DRAWING NO.: 7L

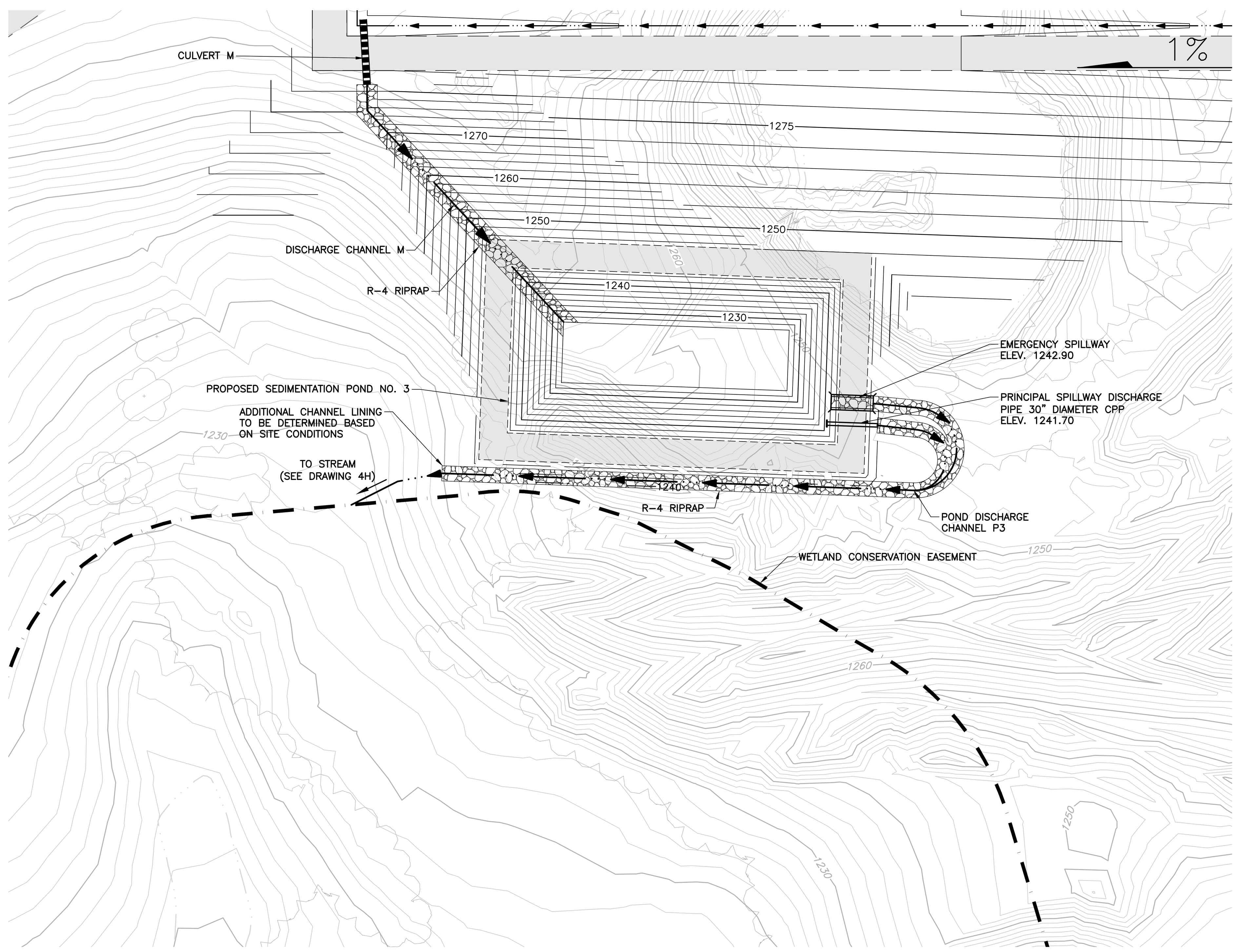
NORTH



A
7M
SEDIMENTATION POND NO. 1
N.T.S.



B
7M
SEDIMENTATION POND NO. 2
N.T.S.



C
7M
SEDIMENTATION POND NO. 3
N.T.S.

REVISION RECORD

NO	DATE	DESCRIPTION
1	12/2015	ADDED WETLAND CONSERVATION EASEMENTS, AND UPDATED AEP POWER LINE LOCATION.
		REVISED SEDIMENTATION POND NO. 1 DISCHARGE LOCATION AND SEDIMENTATION POND NO. 3 LOCATION.

SUBMITTAL RECORD

NO	DATE	DESCRIPTION

LEGEND

- 1220 EXISTING GROUND CONTOUR (SEE REFERENCE)
- LIMIT OF SOLID WASTE PLACEMENT
- WETLAND CONSERVATION EASEMENT
- ACCESS ROAD
- SEDIMENTATION POND BERMS
- 1220 PROPOSED CONTOUR
- CHANNEL FLOW DIRECTION
- CULVERT
- DOWNCHUTE

NOTES

1. THIS DRAWING PROVIDES INFORMATION REQUIRED IN OAC 3745-27-06(B)(7)(i).
2. LOCATIONS OF SURFACE WATER STRUCTURES ARE SHOWN ON DRAWING 4H.

REFERENCE

1. EXISTING TOPOGRAPHY PREPARED BY KEDDAL AERIAL MAPPING; DATE OF PHOTOGRAPHY: 1/18/13. ADDITIONAL MAPPING WAS PREPARED BY KEDDAL AERIAL MAPPING FROM AERIAL PHOTOGRAPHY DATED 1/6/12 AND 1/5/11 AND BY M.A.N. MAPPING FROM AERIAL PHOTOGRAPHY DATED 12/14/00.
2. AEP POWER LINE SURVEY PROVIDED BY BGA, CADD FILE: APEX EASEMENT – STRS.44-80.

STATE OF OHIO
RICK BUFFALINI
E-55305
REGISTERED
PROFESSIONAL ENGINEER

Rick Buffalini
12-29-15

*HAND SIGNATURE ON FILE

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APEX ENVIRONMENTAL, LLC.
PERMIT TO INSTALL APPLICATION
CONTIGUOUS EXPANSION
APEX SANITARY LANDFILL
JEFFERSON COUNTY, OHIO

DRAWN BY:	MJI	CHECKED BY:	MRB	APPROVED BY:	RJB*
DATE:	10/17/11	DWG SCALE:	1"=200'	PROJECT NO:	091-867

SEDIMENTATION PONDS 1, 2, AND 3 PLAN VIEWS

DRAWING NO.: **7M**

NORTH

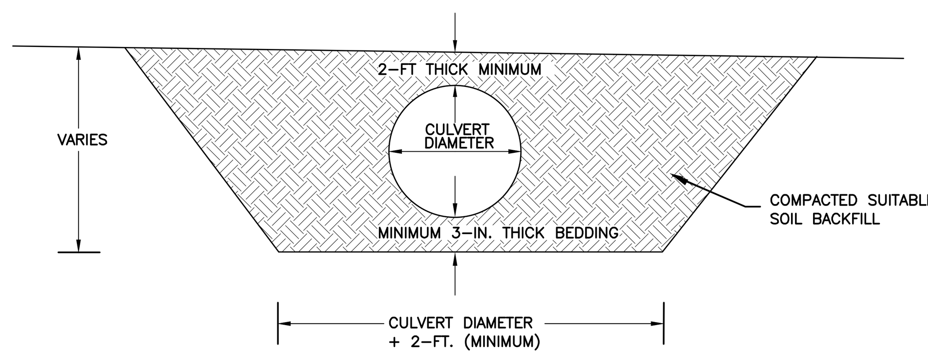
REVISION RECORD

NO	DATE	DESCRIPTION
1	12/2015	REVISED ELEVATIONS FOR SEDIMENTATION POND NO. 3.

SUBMITTAL RECORD

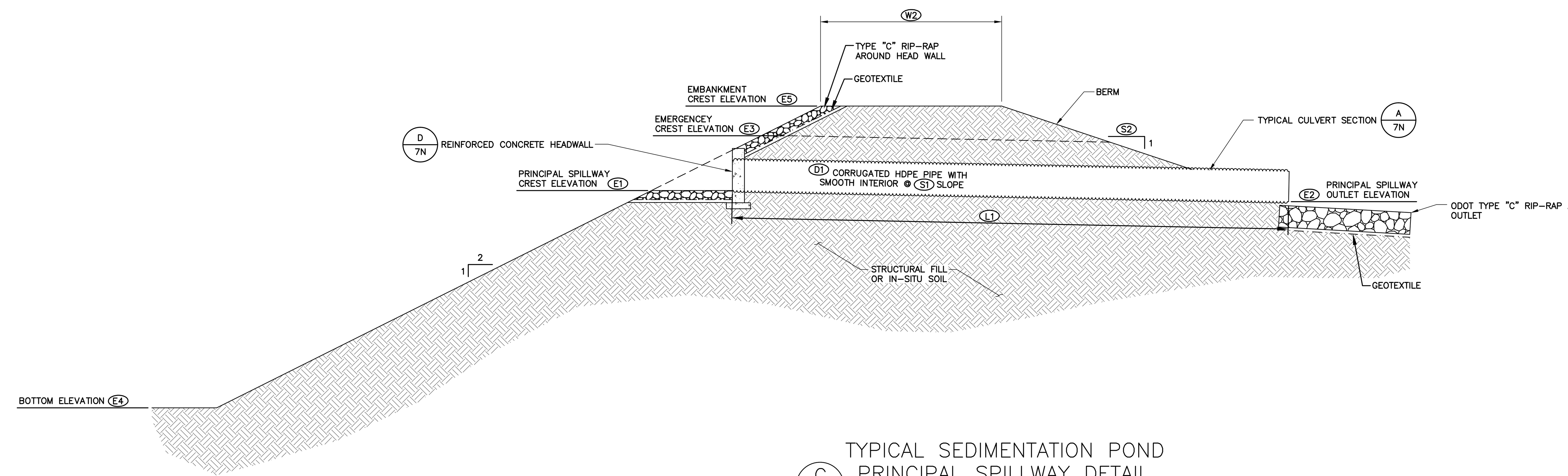
NO	DATE	DESCRIPTION

SPILLWAYS					
VARIABLE	DESCRIPTION	POND 1	POND 2	POND 3	UNITS
E1	PRINCIPAL SPILLWAY CREST ELEVATION	1291.7	1265.7	1241.7	FEET
E2	PRINCIPAL SPILLWAY OUTLET ELEVATION	1287.0	1260.0	1241.0	FEET
D1	BARREL DIAMETER	30	30	30	INCHES
	BARREL QUANTITY	1	1	1	EACH
S1	BARREL SLOPE	0.04	0.14	0.12	FT/FT
L1	BARREL LENGTH	125.0	42.0	151.0	FEET
E3	EMERGENCY SPILLWAY CREST ELEVATION	1292.2	1266.3	1242.9	FEET
W1	EMERGENCY SPILLWAY WIDTH	8	8	8	FEET
SEDIMENTATION POND					
VARIABLE	DESCRIPTION	POND 1	POND 2	POND 3	UNITS
E4	BOTTOM ELEVATION	1283.0	1258.0	1225.0	FEET
S2	EMBANKMENT SIDE SLOPE	3	3	3	ZH:1V
E5	EMBANKMENT CREST ELEVATION	1295.0	1270.0	1245.0	FEET
W2	TOP WIDTH OF EMBANKMENT (MIN)	10	20	20	FEET



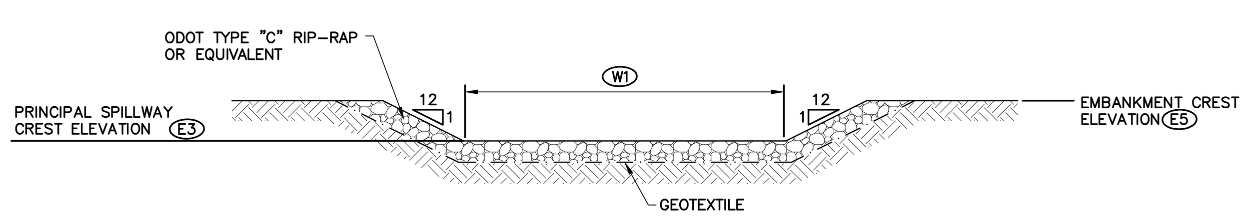
A / 7N TYPICAL CULVERT SECTION

N.T.S.



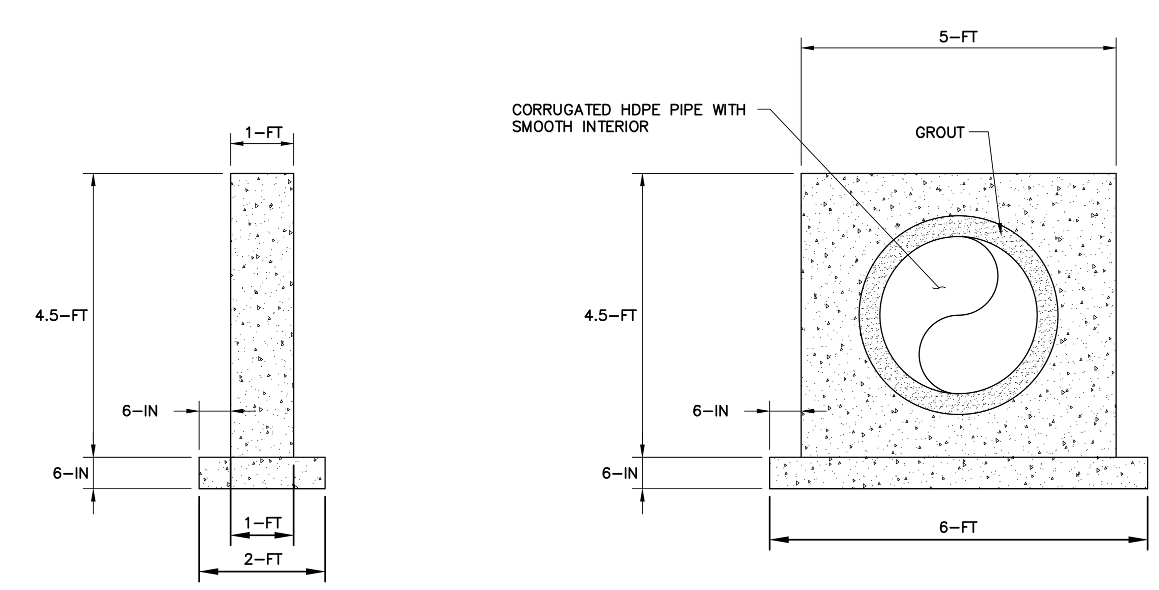
C / 7N TYPICAL SEDIMENTATION POND PRINCIPAL SPILLWAY DETAIL

N.T.S.



B / 7N EMERGENCY SPILLWAY TYPICAL SECTION

N.T.S.



D / 7N REINFORCED CONCRETE HEADWALL DETAIL

N.T.S.

NOTES

1. THIS DRAWING PROVIDES INFORMATION REQUIRED IN OAC 3745-27-06(B)(7)(i).
2. LOCATIONS OF SURFACE WATER STRUCTURES ARE SHOWN ON DRAWING 4H.

STATE OF OHIO
RICK BUFFALINI
E-55305
REGISTERED
PROFESSIONAL ENGINEER

Rick Buffalini
12-29-15

*HAND SIGNATURE ON FILE

Authorized Use:

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APEX ENVIRONMENTAL, LLC.
PERMIT TO INSTALL APPLICATION
CONTIGUOUS EXPANSION
APEX SANITARY LANDFILL
JEFFERSON COUNTY, OHIO

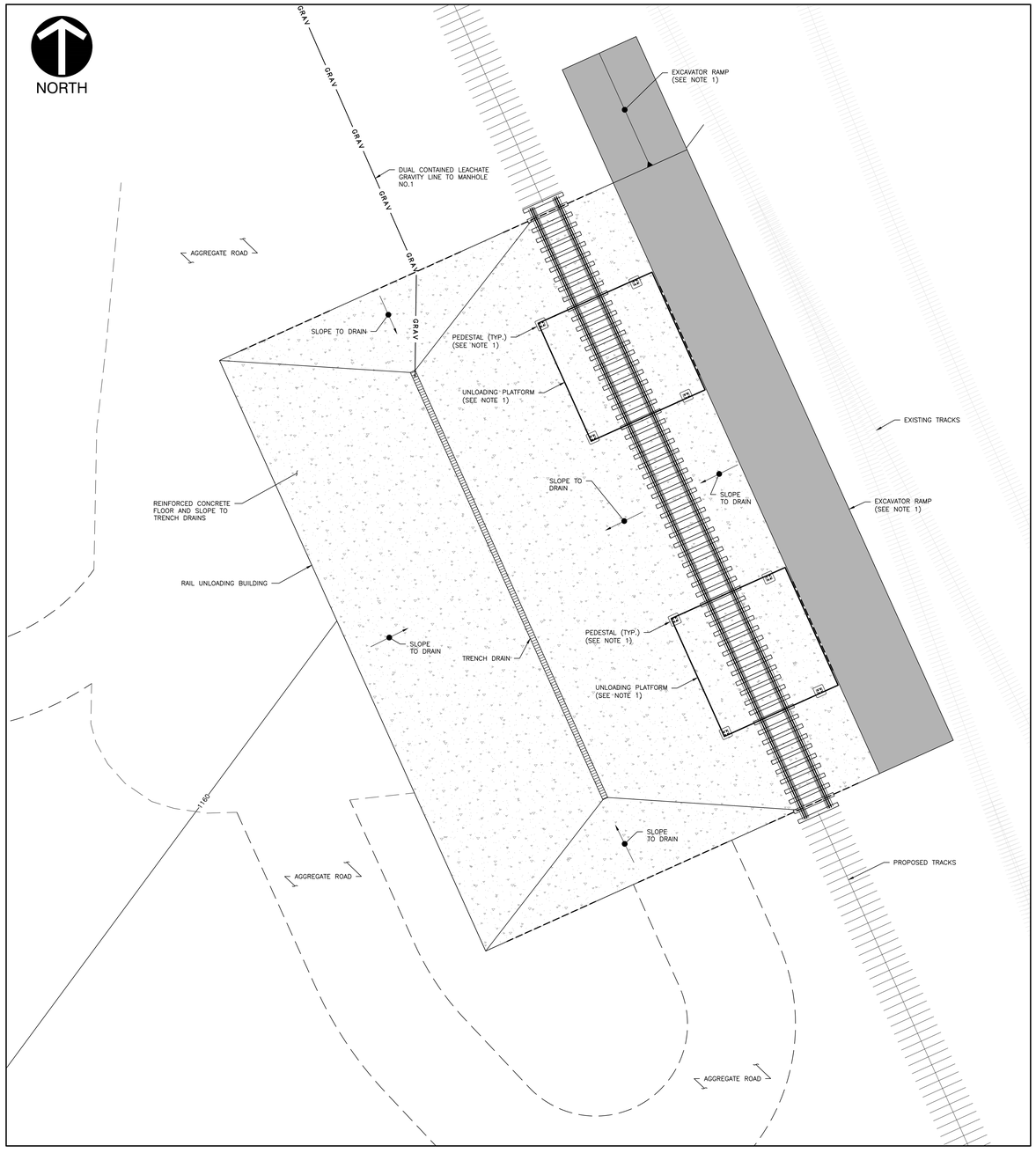
DRAWN BY:	MJI	CHECKED BY:	MRB	APPROVED BY:	RJB*
DATE:	10/19/11	DWG SCALE:	N.T.S.	PROJECT NO:	091-867

SEDIMENTATION PONDS 1, 2, AND 3 DISCHARGE STRUCTURES

DRAWING NO.: 7N

REVISION RECORD		
NO	DATE	DESCRIPTION
1		
2		
3		
4		

SUBMITTAL RECORD		
NO	DATE	DESCRIPTION



A 70

PROPOSED RAIL UNLOADING BUILDING
(PLAN VIEW)

SCALE IN FEET
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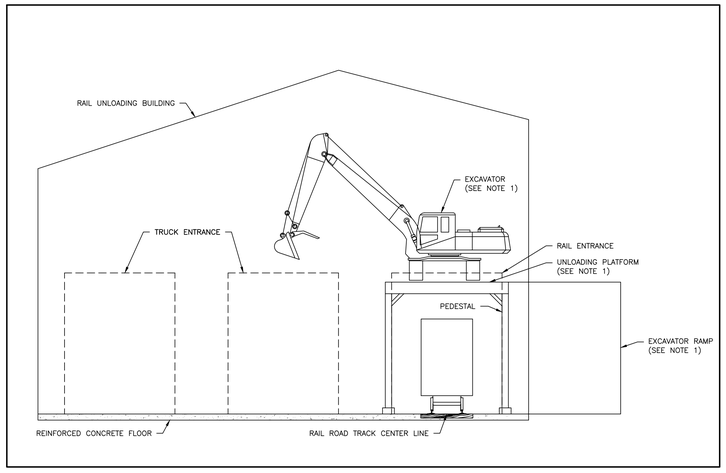

B 70

PROPOSED RAIL UNLOADING BUILDING
(ELEVATION VIEW)

N.T.S.

NOTES

1. RAIL CARS WILL BE UNLOADED EITHER USING AN EXCAVATOR OPERATING ON A PLATFORM OR A RAISED MATERIAL HANDLER. THE BUILDING WILL BE SIZED SO THAT TWO UNLOADING PLATFORMS OR THREE RAISED MATERIAL HANDLERS CAN BE USED SIMULTANEOUSLY. THE RAMP, UNLOADING PLATFORM, AND PEDESTAL WILL NOT BE CONSTRUCTED IF RAISED MATERIAL HANDLERS ARE USED FOR UNLOADING.
2. RAIL CAR UNLOADING WILL BE PERFORMED IN A BUILDING. BUILDING WILL HAVE A REINFORCED CONCRETE FLOOR. ANY LIQUID OR LEACHATE IN BUILDING WILL BE DIRECTED TO TRENCH DRAIN OR CATCH BASIN.

LEGEND

1220 — EXISTING GROUND CONTOUR (SEE REFERENCE)

L S — LEACHATE SEWER

REFERENCE

TOPOGRAPHIC MAPPING PREPARED BY KEDDAL AERIAL MAPPING, INC. USING AERIAL PHOTOGRAPHY DATED JANUARY 6, 2012.

STATE OF OHIO
RICK BUFFALINI
E-55305
REGISTERED PROFESSIONAL ENGINEER

5-18-16

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APEX ENVIRONMENTAL, LLC.
PERMIT TO INSTALL APPLICATION
CONTIGUOUS EXPANSION
APEX SANITARY LANDFILL
JEFFERSON COUNTY, OHIO

DRAWN BY:	DWD	CHECKED BY:	AMR	APPROVED BY:	RJB*
DATE:	4/28/2016	DWG SCALE:	1"=200'	PROJECT NO:	091-867

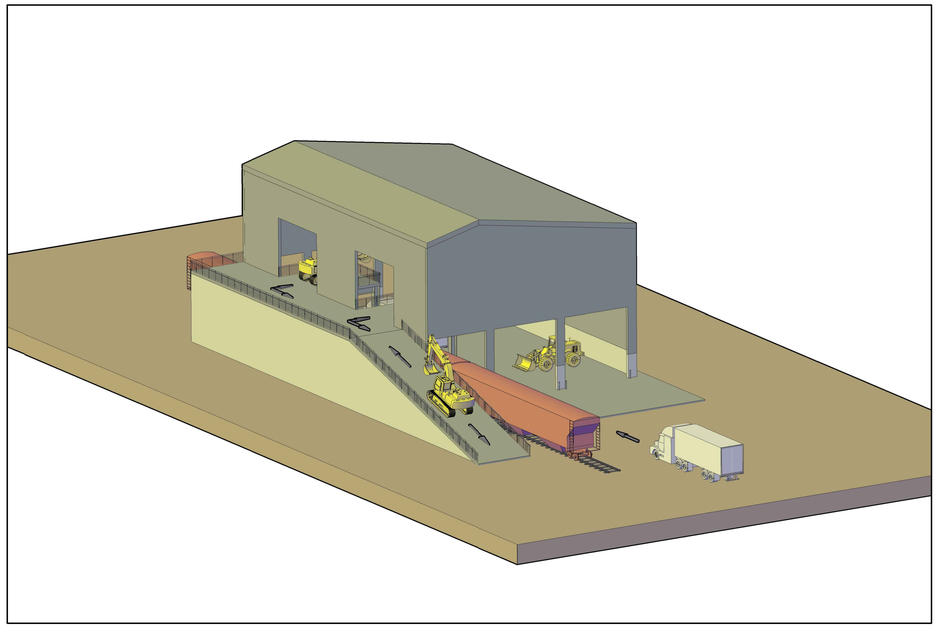
PROPOSED RAIL UNLOADING BUILDING

DRAWING NO.: 70

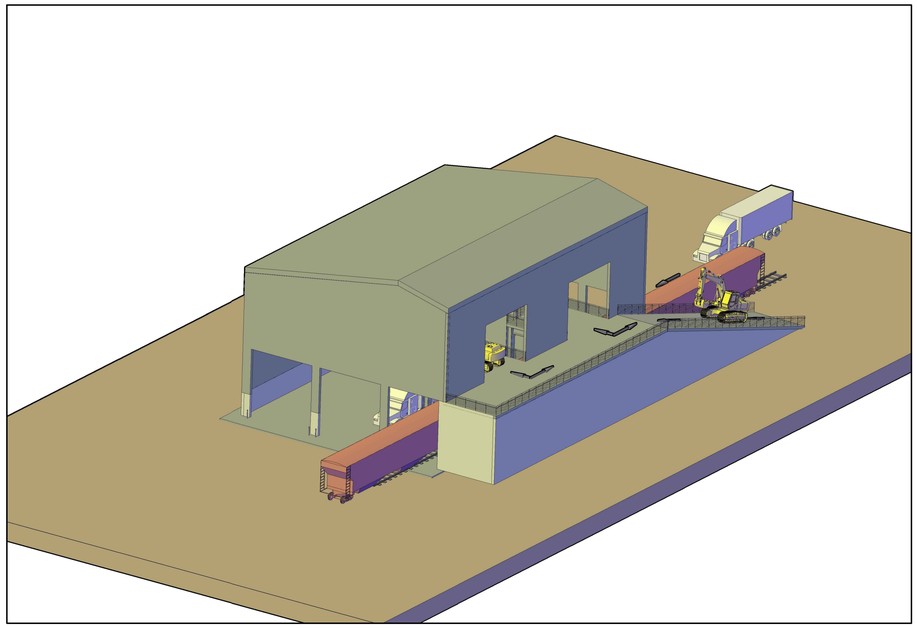
P:\2009\091-867\1-CAD\LOD02 - PIT LATERAL EXPANSION\DWG\091-867F70.dwg(PROPOSED RAIL UNLOADING BLDG (2)) LS(16/05/2016 - dbbank) - LD: 5/18/2016 1:52 PM

REVISION RECORD		
NO	DATE	DESCRIPTION
1		
2		
3		
4		

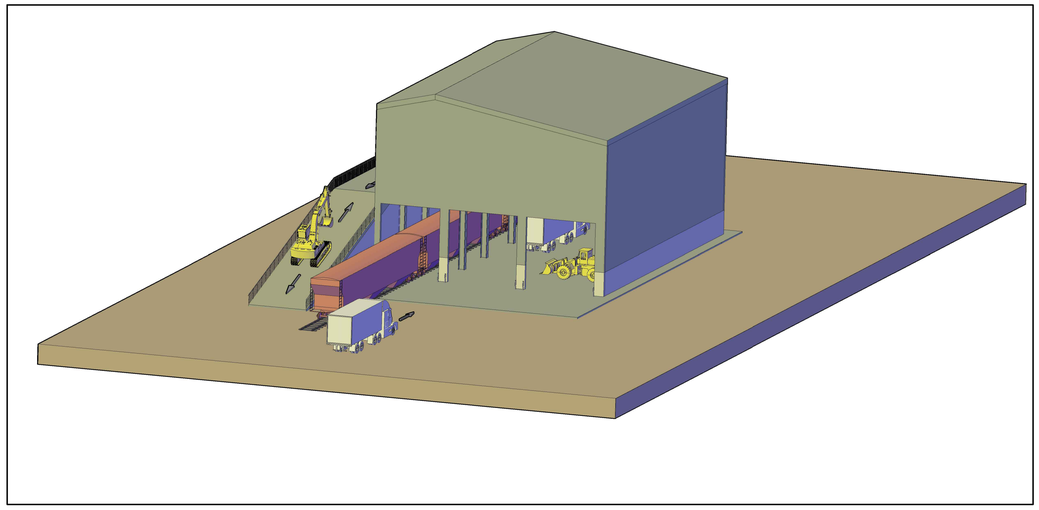
SUBMITTAL RECORD		
NO	DATE	DESCRIPTION



A 7P PROPOSED RAIL UNLOADING BUILDING (VIEW 1)
N.T.S.



B 7P PROPOSED RAIL UNLOADING BUILDING (VIEW 2)
N.T.S.



C 7P PROPOSED RAIL UNLOADING BUILDING (VIEW 3)
N.T.S.

NOTES

1. THIS DRAWING IS A RENDERING WHICH PRESENTS THE RELATIVE ALIGNMENT OF THE PROPOSED RAIL BUILDING, EXCAVATOR RAMP, RAIL, AND TRUCK ROUTES.
2. RAIL CARS WILL BE UNLOADED EITHER USING AN EXCAVATOR OPERATING ON A PLATFORM OR A RAISED MATERIAL HANDLER. THE BUILDING WILL BE SIZED SO THAT TWO UNLOADING PLATFORMS OR THREE RAISED MATERIAL HANDLERS CAN BE USED SIMULTANEOUSLY. THE RAMP, UNLOADING PLATFORM, AND PEDESTAL WILL NOT BE CONSTRUCTED IF RAISED MATERIAL HANDLERS ARE USED FOR UNLOADING.

STATE OF OHIO
RICK BUFFALINI
E-55305
REGISTERED PROFESSIONAL ENGINEER

5-18-16

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LEGEND

TRAVEL DIRECTION ARROW FOR EXCAVATORS AND TUCKS

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PERMIT TO INSTALL APPLICATION
CONTIGUOUS EXPANSION
APEX SANITARY LANDFILL
JEFFERSON COUNTY, OHIO

DRAWN BY:	MJI	CHECKED BY:	AMR	APPROVED BY:	RJB*
DATE:	4/28/2016	DWG SCALE:	1"=200'	PROJECT NO:	091-867

PROPOSED RAIL UNLOADING BUILDING RENDERINGS

DRAWING NO.: **7P**

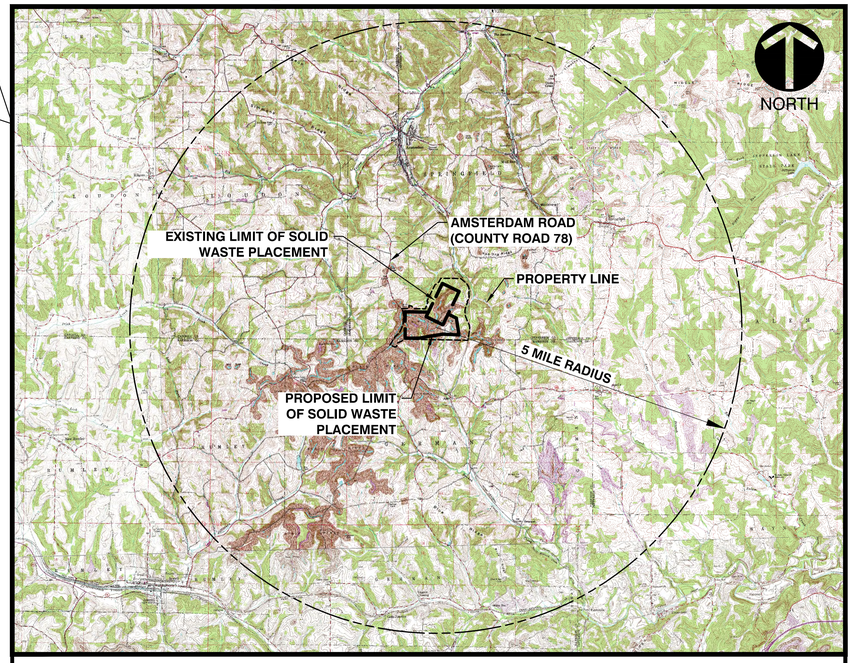
P:\2009\091-867\1-GIS\1002 - PTI MATERIAL EXPANSION\DWG\PDF\~867P7P.dwg(LAYOUT) LS\16/05/2016 - dbailey - LP: 5/18/2016 1:51 PM

PERMIT TO INSTALL APPLICATION
HYDROGEOLOGIC SITE INVESTIGATION
DRAWING SET
CONTIGUOUS EXPANSION
APEX SANITARY LANDFILL

REVISION RECORD		
NO	DATE	DESCRIPTION
1	JULY 2013	REVISION FOR OHIO EPA NOD (12/28/2012)

SUBMITTAL RECORD		
NO	DATE	DESCRIPTION

COUNTY MAP
SCALE: 1"=100 MILES



LOCATION MAP
SCALE: 1" = 1 MILE

SCALE IN FEET
0 1 MI 2 MI
DRAWING NOT TO SCALE IF SCALE BAR DOES NOT MEASURE 2 INCHES

LIST OF DRAWINGS	
NUMBER	SHEET TITLE
1	COVER SHEET
2E	REGIONAL WELL LOCATION MAP
3D	MONITORING WELL AND SOIL BORING LOCATIONS
3E	TOP OF BEDROCK CONTOUR MAP
3E-1	AREA OF LIMESTONE-SHALLOW BEDROCK REMOVAL
3F	TOP OF UPPERMOST AQUIFER SYSTEM CONTOUR MAP
3F-1	LIMESTONE-SHALLOW BEDROCK AVERAGE WELL YIELD CONTOURS
3G	MINE SPOIL POTENTIOMETRIC MAP DECEMBER 6, 2010
3H	LIMESTONE – SHALLOW BEDROCK POTENTIOMETRIC MAP DECEMBER 6, 2010
3I	BELLAIRE – SUMMERFIELD POTENTIOMETRIC MAP DECEMBER 6, 2010
3J	CONNELLSVILLE – MORGANTOWN POTENTIOMETRIC MAP DECEMBER 6, 2010
3K	MINESPOIL POTENTIOMETRIC MAP MARCH 28, 2011
3L	LIMESTONE – SHALLOW BEDROCK POTENTIOMETRIC MAP MARCH 28, 2011
3M	BELLAIRE – SUMMERFIELD POTENTIOMETRIC MAP MARCH 28, 2011
3N	CONNELLSVILLE – MORGANTOWN POTENTIOMETRIC MAP MARCH 28, 2011
3O	MINE SPOIL POTENTIOMETRIC MAP DECEMBER 10, 2012
3P	LIMESTONE – SHALLOW BEDROCK POTENTIOMETRIC MAP DECEMBER 10, 2012
3Q	BELLAIRE – SUMMERFIELD POTENTIOMETRIC MAP DECEMBER 10, 2012
3R	CONNELSVILLE – MORGANTOWN POTENTIONMETRIC MAP DECEMBER 10, 2012
5A	GEOLOGIC CROSS-SECTION LOCATION MAP
5B	GEOLOGIC CROSS SECTION A-A'
5C	GEOLOGIC CROSS SECTION B-B'
5D	GEOLOGIC CROSS SECTION C-C
5E	GEOLOGIC CROSS SECTION D-D'
5F	GEOLOGIC CROSS SECTION E-E'
5G	GEOLOGIC CROSS SECTION F-F'

PREPARED FOR:

APEX ENVIRONMENTAL, LLC.
11 COUNTY ROAD 78
AMSTERDAM, JEFFERSON COUNTY,
OHIO 43903

PREPARED BY:

Civil & Environmental Consultants, Inc.
8740 ORION PLACE, SUITE 100
COLUMBUS, OHIO 43240

AUGUST 2011
REVISED JULY 2013
CEC PROJECT NO. 101-049

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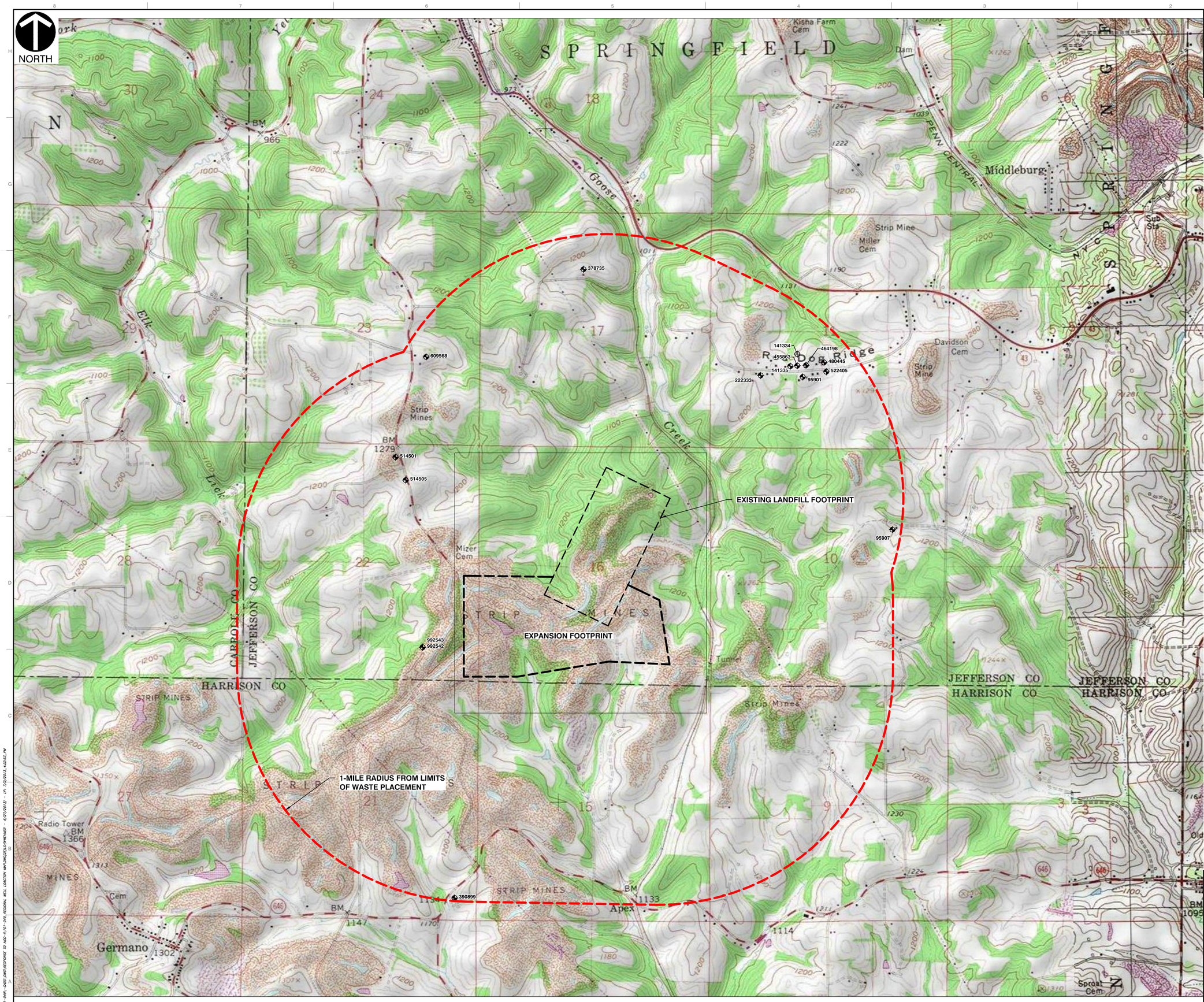
APEX ENVIRONMENTAL, LLC.
PERMIT TO INSTALL APPLICATION
CONTIGUOUS EXPANSION
APEX SANITARY LANDFILL
JEFFERSON COUNTY, OHIO

DRAWN BY:	BTW	CHECKED BY:	JMB	APPROVED BY:	JMD*
DATE:	AUG 2011	DWG.SCALE:	1"=200'	PROJECT NO:	101-049

COVER SHEET

DRAWING NO.: 1
SHEET - OF

P:\2011\101-049\-DGN\DWG\PTI\101049 - COVER SHEET.DWG\LAYOUT:XREFBINDER - 7/2/2013 - LM 7/2/2013 4:43:42 PM



REVISION RECORD		
NO	DATE	DESCRIPTION
1	JULY 2013	REVISION FOR OHIO EPA NOD (12/26/2012

SUBMITTAL RECORD		
NO	DATE	DESCRIPTION

LEGEND

- PERMITTED LIMIT OF SOLID WASTE PLACEMENT
- PROPOSED LIMIT OF SOLID WASTE PLACEMENT
- 464198 — DOMESTIC WELL LOCATION
- 141334 — APPROXIMATE DOMESTIC WELL LOCATION / SURVEY DATA NOT AVAILABLE ON ODNR WELL LOG.

REFERENCE

USGS TOPOGRAPHIC MAP.
ARCGIS MAP SERVICE: http://gotoarcgisonline.com/maps/USA_topo_maps, ACCESSED 1/21/2013.

USGS 7.5 MINUTE TOPOGRAPHIC MAP: AMSTERDAM, OHIO QUADRANGLE REVISED: 1976, PUBLISHED: 1978.

OHIO DNR DIVISION OF WATER, WATER WELL LOG AND DRILLING REPORTS, ACCESSED: 1/2013.

SCALE IN FEET
0 800 1600

* HAND SIGNATURE ON FILE

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APEX SANITARY LANDFILL
JEFFERSON COUNTY, OHIO

DRAWN BY:	BTW	CHECKED BY:	BRB	APPROVED BY:	JMD*
DATE:	FEB 2013	DWG SCALE:	1"=800'	PROJECT NO:	101-049

REGIONAL WELL LOCATION MAP

DRAWING NO.: 2E
SHEET OF

P:\2012\101-049\-CAD\DWG\RESPONSE TO NOD-1\101-049_REGIONAL WELL LOCATION MAP.DWG(ELS.DIMENER - 6/27/2013) - LP: 7/3/2013, 4:23:51 PM

NORTH

REVISION RECORD		
NO	DATE	DESCRIPTION
1	JULY 2013	REVISION FOR OHIO EPA NOD (12/28/2012)
2		
3		
4		

SUBMITTAL RECORD		
NO	DATE	DESCRIPTION

SIDEHILL AGGREGATE UNDERDRAIN (SHAUDS-1)
WEST SEDIMENTATION POND
SIDEHILL AGGREGATE UNDERDRAIN (SHAUDS-2)
NORTH SEDIMENTATION POND
SHAUDS-3
PROPOSED SHAUDS-3 EXTENTION
EXISTING LANDFILL OFFICE
OFFICE
LEACHATE STORAGE TANK AND SECONDARY CONTAINMENT

TP-1, TP-105, B-4, B-4S, B-103, B-103S, TP-108, B-410, B-411, TP-107, TP-104, B-104, B-104S, B-409, B-409S, TP-106, TP-205, B-201, B-412, B-102, TP-204, TP-3, TP-206, TP-2, B-408, B-408SS, B-408A, TP-215, B-105, B-105S, TP-207, TP-203, B-202, B-407, B-407S, B-413R, B-413, B-3, B-13, B-306, TP-102, TP-110, TP-111, SE-8, B-1A, B-1B, B-416A, B-416B, B-416, B-415A, B-415S, B-415, B-417A, B-417S, B-417, SB-4, P-1A, SB-1, P-1, P-1L, P-1S, TPE-2, TPE-3, TPE-4, TP-8, SB-2, P-12, P-12S, SB-25, TP-7, TPE-5, B-418A, B-418S, B-418, RB-3, SB-26, B-2A, B-2B, B-401A, P-10L, B-401S, SB-10, P-4L, B-401, B-402A, B-402S, P-11L, RB-5, SB-28, PG-1, SB-7, P-2A, P-2L, P-2S, B-15, TP-9, RB-1, TPE-16, TP-112, B-419A, B-419S, B-419, RB-2, SB-3, B-12, SB-6, P-3A, P-3L, P-3S, TPE-15, TPE-17, RB-4, SB-9, SB-5, SB-23, B-420A, B-420L, B-420S, B-420, B-421A, B-421L, B-421S, B-421, SB-22, B-422A, B-422L, B-422S, B-422, B-423A, B-423L, B-423S, B-423, SB-11, B-7A, B-7B, P-6S, P-6L, B-424A, B-424L, B-424S, B-424, SB-14, SB-12, P-5, P-5A, P-5L, P-5S, TPE-18, TPE-20, TPE-19, B-425A, B-425L, B-425S, B-425, SB-16, TPE-25, SB-15, P-10S, B-6, B-426A, B-426L, B-426S, B-426, SB-20, P-9, P-9S, TPE-23/24, SB-19, B-427A, B-427S, B-427, TP-12, B-11, B-11S, SB-18, TP-11, P-15L, TP-214, B-403, B-403S, SB-13, P-7A, B-402, TPE-22, TPE-21A, TPE-21, B-311, RB-6, RB-8, RB-7, SB-24, TP-10, TP-13, B-14, B-404A, B-404S, B-404, B-405, B-405S, B-405SR, B-308, B-309, SB-21, P-8A, B-428A, B-428S, B-428, SB-17, P-14L, TP-211, TP-213, P-13L, B-310, TP-5, TP-210, B-5, TP-6, B-203, B-312, TP-202, TP-201, B-303, B-304, B-307, B-204, B-313, B-302, B-301, TP-101, B-106, B-106S, B-406, B-406S, B-305, TP-103, TP-208, TP-4, TP-209, B-10, B-414, B-101, B-101S, TP-109, TP-110, TP-111, 1200, 1175, 1150, 1125, 1100, 1075, 1250, 1225, 1275, 1300, 1325

LEGEND

- PROPERTY LINE
- TREELINE
- EXISTING UNPAVED DRIVE
- EXISTING RAIL ROAD
- 1200 EXISTING INDEX CONTOUR
- PERMITTED LIMIT OF SOLID WASTE PLACEMENT
- PROPOSED LIMIT OF SOLID WASTE PLACEMENT
- UD EXISTING UNDERDRAIN
- EXISTING UNDERDRAIN TRENCH
- PROPOSED UNDERDRAIN
- APPROXIMATE EXTENT OF HIGH GROUNDWATER YIELD (TO BE REMOVED)
- STRUCTURE/BUILDING
- B-309 PIEZOMETER
- B-402 DETECTION MONITORING WELL
- B-303 ABANDONED WELL/PIEZOMETER
- P-5S BELLAIRE/SUMMERFIELD PIEZOMETER
- P-5 CONNELLSVILLE/MORGANTOWN PIEZOMETER
- P-5A MINESPOIL PIEZOMETER
- P-5L LIMESTONE/SHALLOW ROCK PIEZOMETER
- SB-17 SOIL BORING
- RB-8 SOIL BORING TO TOP OF ROCK – NO SPLIT SPOON SAMPLING
- TPE-22 TEST PIT (CONDUCTED FOR EXPANSION)
- TP-13 EXISTING TEST PIT
- B-420 PROPOSED DETECTION MONITORING WELL FOR THE LATERAL EXPANSION AREA
- PG-1 POND GAUGE
- ABANDONED MONITORING WELL OR PIEZOMETER

NOTES

1. OAC RULE 3745-27-06(B)(3)(6) REQUIRES A PLANSHEET TO CONTAIN ALL SUBSURFACE INVESTIGATION SITES, INCLUDING: TEST PITS, MONITORING WELLS, PIEZOMETERS, TENSIOMETERS, GEOPHYSICAL SURVEY STATIONS, SOIL GAS SURVEY STATIONS, AND ALL PROPOSED GROUNDWATER MONITORING WELLS. THIS SHEET (DRAWING 3D) CONTAINS ALL SUBSURFACE INVESTIGATION SITES AS DEPICTED.
2. PURSUANT TO OAC RULE 3745-27-06(B)(3)(E) THREE PERMANENT GROUNDWATER CONTROL STRUCTURES EXIST FOR THE PERMITTED FACILITY, SHAUDS-1, 2, AND 3, AND HAVE BEEN DEPICTED IN THIS DRAWING.

REFERENCE

TOPOGRAPHIC MAPPING PREPARED BY KEDDAL AERIAL MAPPING, INC. USING AERIAL PHOTOGRAPHY DATED JANUARY 6, 2012 AND JANUARY 5, 2011. ADDITIONAL MAPPING PREPARED BY M.A.N. MAPPING USING 12/14/00 AERIAL PHOTOGRAPHY.

SCALE IN FEET
0 200 400

* HAND SIGNATURE ON FILE

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APEX SANITARY LANDFILL
JEFFERSON COUNTY, OHIO

DRAWN BY:	BTW	CHECKED BY:	JMB	APPROVED BY:	JMD*
DATE:	AUG 2011	DWG SCALE:	1"=200'	PROJECT NO:	101-049

MONITORING WELL AND SOIL BORING LOCATIONS

DRAWING NO.: 3D
SHEET - OF

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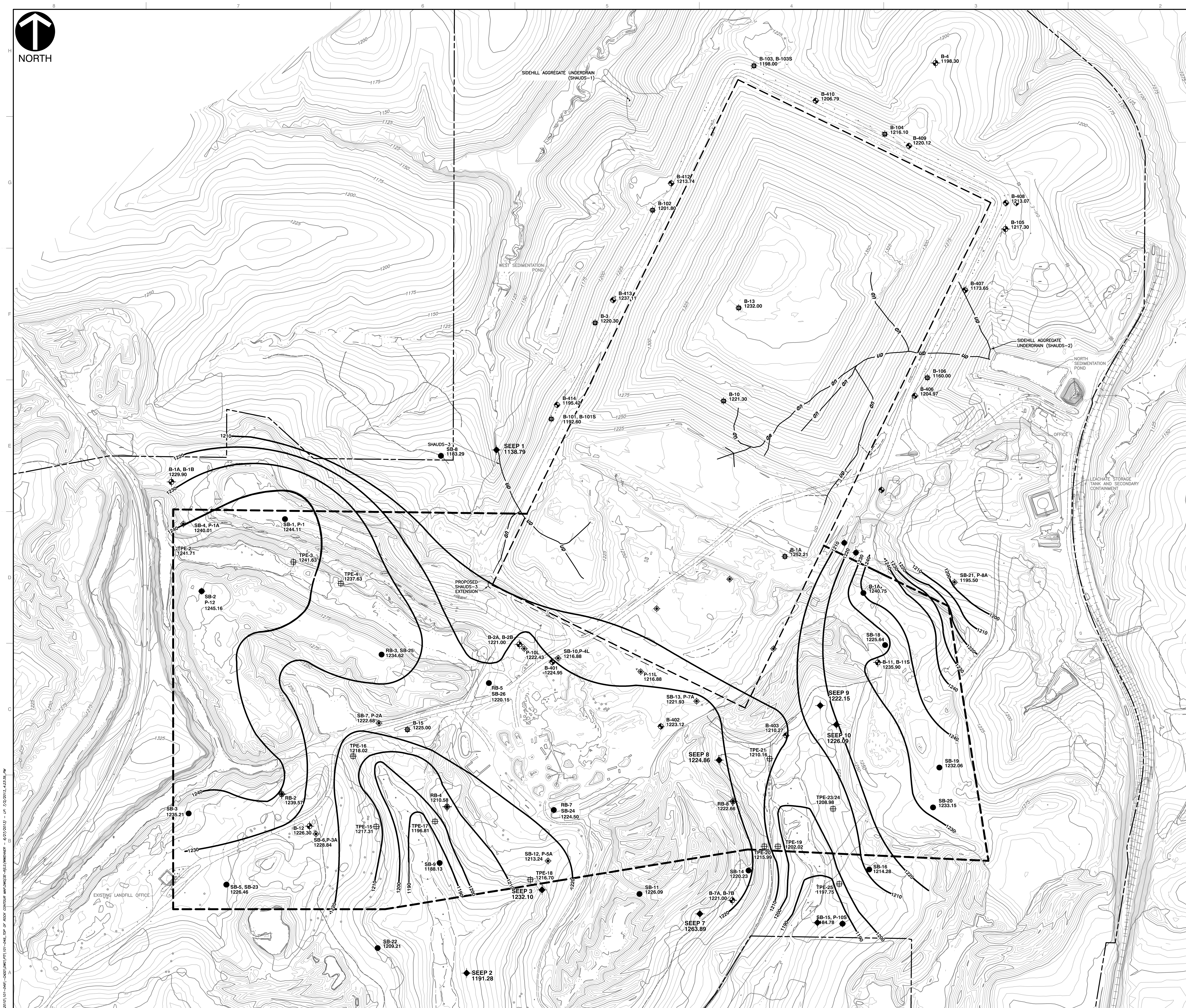

REVISION RECORD

NO	DATE	DESCRIPTION
1	AUG 2011	REVISION FOR OHIO EPA NOD (12/28/2012)

SUBMITTAL RECORD

NO	DATE	DESCRIPTION

LEGEND

- PROPERTY LINE
- TREELINE
- EXISTING UNPAVED DRIVE
- EXISTING RAIL ROAD
- 1200 EXISTING INDEX CONTOUR
- PERMITTED LIMIT OF SOLID WASTE PLACEMENT
- PROPOSED LIMIT OF SOLID WASTE PLACEMENT
- UD EXISTING UNDERDRAIN
- EXISTING UNDERDRAIN TRENCH
- PROPOSED UNDERDRAIN
- APPROXIMATE EXTENT OF HIGH GROUNDWATER YIELD (TO BE REMOVED)
- 1200 TOP OF ROCK CONTOUR
- GROUNDWATER FLOW DIRECTION
- STRUCTURE/BUILDING
- B-309 PIEZOMETER
- B-402 DETECTION MONITORING WELL
- B-303 ABANDONED WELL/PIEZOMETER
- P-5S BELLAIRE/SUMMERFIELD PIEZOMETER
- P-5 CONNELLSVILLE/MORGANTOWN PIEZOMETER
- P-5A MINESPOIL PIEZOMETER
- P-5L LIMESTONE/SHALLOW ROCK PIEZOMETER
- SB-17 SOIL BORING
- RB-8 SOIL BORING TO TOP OF ROCK – NO SPLIT SPOON SAMPLING
- TPE-22 TEST PIT (CONDUCTED FOR EXPANSION)
- TP-13 EXISTING TEST PIT
- PG-1 POND GAUGE
- SEEP 8 1224.86 GROUNDWATER SEEP AND ELEVATION

GEOLOGIC CONDITIONS

THE BORING LOGS AND RELATED INFORMATION PRESENTED HEREIN DEPICT SUBSURFACE CONDITIONS AT THE TEST BORING LOCATIONS AND AT THE TIME OF DRILLING. SOIL CONDITIONS AT OTHER LOCATIONS MAY DIFFER.

GEOLOGIC CORRELATIONS SHOWN BETWEEN TEST BORINGS GENERALLY ARE BASED ON STRAIGHT–LINE INTERPOLATION. ACTUAL CONDITIONS BETWEEN TEST BORINGS MAY DIFFER.

REFERENCE

TOPOGRAPHIC MAPPING PREPARED BY KEDDAL AERIAL MAPPING, INC. USING AERIAL PHOTOGRAPHY DATED JANUARY 6, 2012 AND JANUARY 5, 2011. ADDITIONAL MAPPING PREPARED BY M.A.N. MAPPING USING 12/14/00 AERIAL PHOTOGRAPHY.

SCALE IN FEET
0 300 600

* HAND SIGNATURE ON FILE

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APEX ENVIRONMENTAL, LLC.
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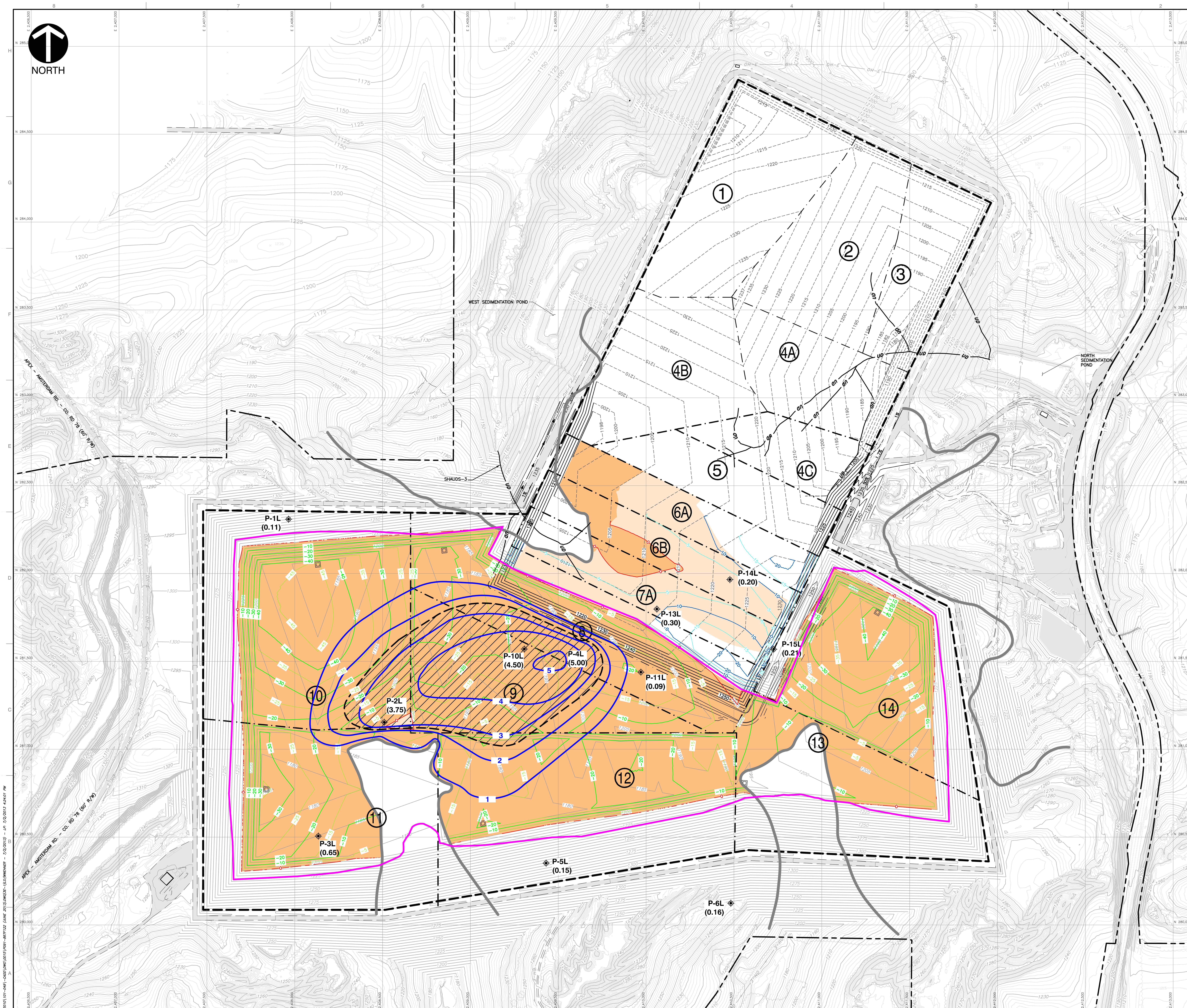
CONTIGUOUS EXPANSION
APEX SANITARY LANDFILL
JEFFERSON COUNTY, OHIO

DRAWN BY:	BTW	CHECKED BY:	JMB	APPROVED BY:	JMD*
DATE:	AUG 2011	DWG SCALE:	1"=200'	PROJECT NO:	101-049

TOP OF BEDROCK CONTOUR MAP

DRAWING NO.: **3E**

SHEET OF



REVISION RECORD

NO	DATE	DESCRIPTION
1	JULY 2013	REVISION FOR OHIO EPA NOD (12/28/2012)

SUBMITTAL RECORD

NO	DATE	DESCRIPTION

LEGEND

- 1220 — EXISTING GROUND CONTOUR (SEE REFERENCE)
- PROPERTY LINE
- LIMIT OF SOLID WASTE PLACEMENT
- 1220 — PERMITTED BASE OF RECOMPACTED SOIL LINER CONTOUR
- -10 — CUT ISOPACH CONTOUR (SEE NOTE 1)
- -10 — FILL ISOPACH CONTOUR (SEE NOTE 2)
- APPROXIMATE LOCATION OF LIMESTONE SUBCROP/OUTCROP
- 2 — AVERAGE LIMESTONE WELL YIELD (GPM) CONTOUR
- APPROXIMATE LOCATION OF LIMESTONE/SHALLOW BEDROCK CONSIDERED AS UPPERMOST AQUIFER SYSTEM (>2.6 GPM)
- P-5L (4.50) — LIMESTONE/SHALLOW ROCK PIEZOMETER AVERAGE YIELD (GPM)
- AREA WHERE LIMESTONE UNIT COMPLETELY REMOVED
- AREA WHERE LIMESTONE UNIT PARTIALLY REMOVED

NOTES

1. THE CUT ISOPACH CONTOUR PROVIDES DEPTH OF THE BASE OF RECOMPACTED SOIL LINER BELOW THE LIMESTONE UNIT BASE.
2. THE FILL ISOPACH CONTOUR PROVIDES HEIGHT OF THE BASE OF RECOMPACTED SOIL LINER ABOVE THE LIMESTONE UNIT BASE.

REFERENCE

EXISTING TOPOGRAPHY PREPARED BY KEDDAL AERIAL MAPPING; DATE OF PHOTOGRAPHY: 1/18/13. ADDITIONAL MAPPING WAS PREPARED BY KEDDAL AERIAL MAPPING FROM AERIAL PHOTOGRAPHY DATED 1/6/12 AND 1/5/11 AND BY M.A.N. MAPPING FROM AERIAL PHOTOGRAPHY DATED 12/14/00.

SCALE IN FEET
0 200 400

*HAND SIGNATURE ON FILE

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APEX ENVIRONMENTAL, LLC.
PERMIT TO INSTALL APPLICATION
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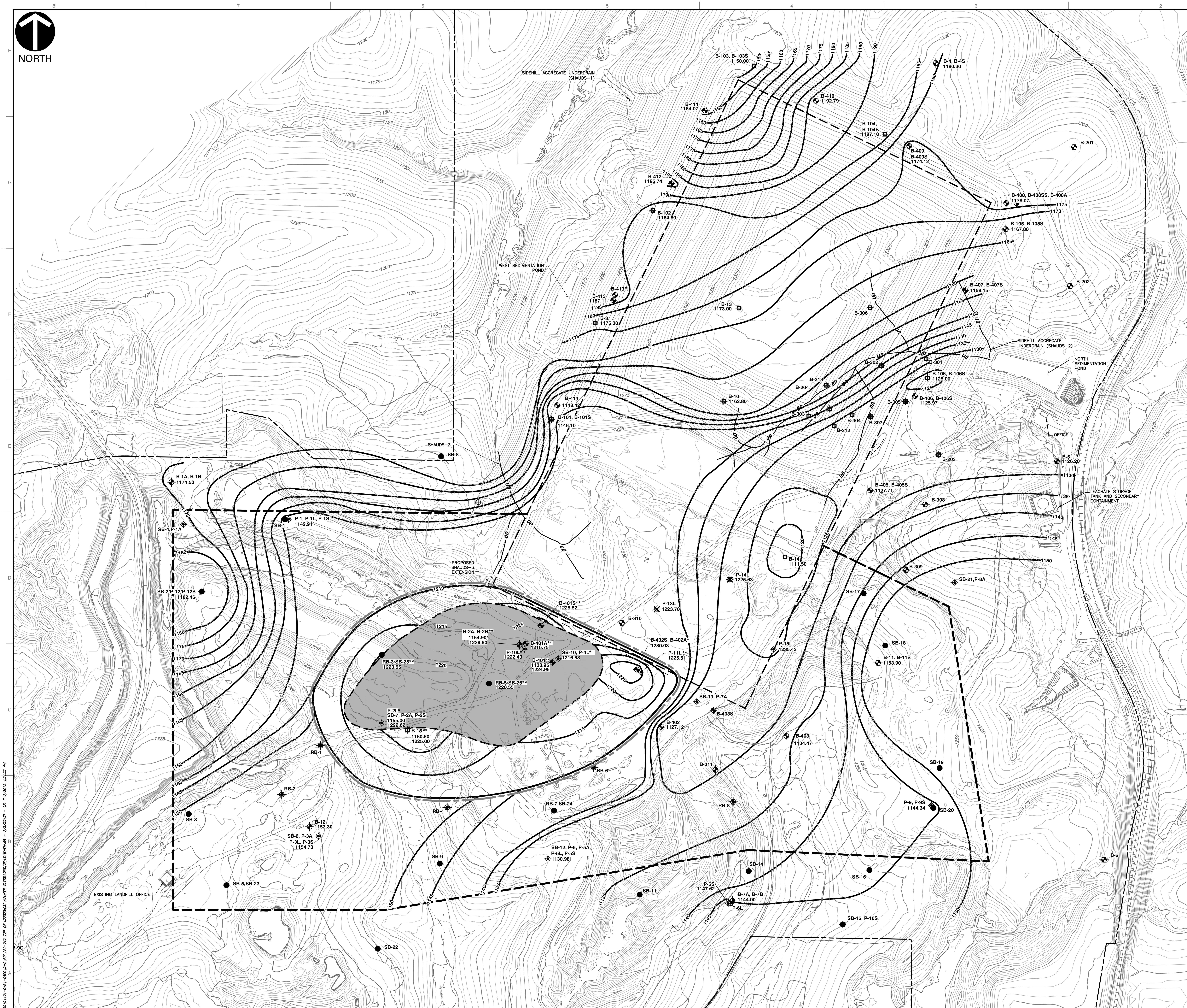
APEX SANITARY LANDFILL
JEFFERSON COUNTY, OHIO

DRAWN BY:	MJI	CHECKED BY:	DRAFT	APPROVED BY:	DRAFT
DATE:	6/26/13	DWG SCALE:	1"=200'	PROJECT NO:	101-049

AREA OF LIMESTONE-SHALLOW BEDROCK REMOVAL

DRAWING NO.: **3E-1**



REVISION RECORD

NO	DATE	DESCRIPTION
1	AUG 2011	REVISION FOR OHIO EPA NOD (12/28/2012)

SUBMITTAL RECORD

NO	DATE	DESCRIPTION

UAS TO BE EXCAVATED

PIEZOMETER DETERMINED AS UAS BASED ON AQUIFER YIELD (DENOTED ON MAP AS *)

WELL ID	TOP OF UAS BASED ON YIELD	BOTTOM OF UAS FOR EXCAVATION
P-4L*	1216.88	1208
P-2L*	1222.62	1205
P-10L*	1222.43	1206

PIEZOMETER DETERMINED TO BE IN THE PROXIMITY OF SHALLOW UAS (THEREFORE, WILL BE EXCAVATED) (DENOTED AS **)

WELL ID	TOP OF UAS	BOTTOM OF UAS FOR EXCAVATION
RB-3/SB-25**	1232.80	1228
B-15**	1225.00	1205
RB-5/SB-26**	1220.55	1206
B-2A/B-2B**	1229.90	1206
B-401S**	1225.52	1206
B-401A**	1216.75	1206
B-401**	1224.95	1208
P-11L**	1225.31	1204

LEGEND

- PROPERTY LINE
- TREELINE
- EXISTING UNPAVED DRIVE
- EXISTING RAIL ROAD
- 1200 EXISTING INDEX CONTOUR
- PERMITTED LIMIT OF SOLID WASTE PLACEMENT
- PROPOSED LIMIT OF SOLID WASTE PLACEMENT
- UD EXISTING UNDERDRAIN
- EXISTING UNDERDRAIN TRENCH
- PROPOSED UNDERDRAIN
- APPROXIMATE EXTENT OF HIGH GROUNDWATER YIELD (TO BE REMOVED)
- 1200 TOP OF UPPERMOST AQUIFER SYSTEM CONTOUR
- STRUCTURE/BUILDING
- B-309 PIEZOMETER
- B-402 DETECTION MONITORING WELL
- B-303 ABANDONED WELL/PIEZOMETER
- P-5S BELLAIRE/SUMMERFIELD PIEZOMETER
- P-5 CONNELLSVILLE/MORGANTOWN PIEZOMETER
- P-5A MINESPOIL PIEZOMETER
- P-5L LIMESTONE/SHALLOW ROCK PIEZOMETER
- SB-17 SOIL BORING
- RB-8 SOIL BORING TO TOP OF ROCK – NO SPLIT SPOON SAMPLING
- TPE-22 TEST PIT (CONDUCTED FOR EXPANSION)
- TP-13 EXISTING TEST PIT
- PG-1 POND GAUGE
- REVISED APPROXIMATE LOCATION OF LIMESTONE/SHALLOW BEDROCK CONSIDERED AS UPPERMOST AQUIFER SYSTEM (>2.6 GPM)
- ORIGINAL APPROXIMATE LOCATION OF LIMESTONE/SHALLOW BEDROCK CONSIDERED AS UPPERMOST AQUIFER SYSTEM (>2.6 GPM)
- × ABANDONED MONITORING WELL OR PIEZOMETER

GEOLOGIC CONDITIONS

THE BORING LOGS AND RELATED INFORMATION PRESENTED HEREIN DEPICT SUBSURFACE CONDITIONS AT THE TEST BORING LOCATIONS AND AT THE TIME OF DRILLING. SOIL CONDITIONS AT OTHER LOCATIONS MAY DIFFER.

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DRAWN BY:	BTW	CHECKED BY:	JMB	APPROVED BY:	JMD*
DATE:	AUG 2011	DWG SCALE:	1"=200'	PROJECT NO:	101-049

TOP OF UPPERMOST AQUIFER SYSTEM CONTOUR MAP

DRAWING NO.: **3F**

SHEET - OF

NORTH

REVISION RECORD		
NO	DATE	DESCRIPTION
1	JULY 2013	REVISION FOR OHIO EPA NOD (12/28/2012

SUBMITTAL RECORD		
NO	DATE	DESCRIPTION

WEST SEDIMENTATION POND

REPORTED LIMITS OF LIMESTONE REMOVAL

NORTH SEDIMENTATION POND

OFFICE

LEACHATE STORAGE TANK AND SECONDARY CONTAINMENT

(APPROXIMATE) LOCATION OF LIMESTONE OUTCROP

(APPROXIMATE) LOCATION OF LIMESTONE SUBCROP

P-1L (0.11)

P-14L (0.20)

P-13L (0.30)

P-15L (0.21)

P-10L (4.50)

P-4L (5.00)

P-11L (0.09)

P-2L (3.75)

PLANNED EXTENT OF LIMESTONE OVER-EXCAVATION

P-3L (0.65)

P-5L (0.15)

P-6L (0.16)

EXISTING LANDFILL OFFICE

APEX - AMSTERDAM RD. - CO. RD. 78

(APPROXIMATE) LOCATION OF LIMESTONE SUBCROP

(APPROXIMATE) LOCATION OF LIMESTONE SUBCROP

LEGEND

- PROPERTY LINE
- TREELINE
- EXISTING UNPAVED DRIVE
- EXISTING RAIL ROAD
- 1200 EXISTING INDEX CONTOUR
- PERMITTED LIMIT OF SOLID WASTE PLACEMENT
- PROPOSED LIMIT OF SOLID WASTE PLACEMENT
- APPROXIMATE LOCATION OF LIMESTONE/SHALLOW BEDROCK SUBCROP/OUTCROP
- 2 AVERAGE WELL YIELD (GPM) CONTOUR
- APPROXIMATE LOCATION OF LIMESTONE/SHALLOW BEDROCK CONSIDERED AS UPPERMOST AQUIFER SYSTEM (>2.6 GPM)
- B-309 PIEZOMETER
- B-402 DETECTION MONITORING WELL
- B-303 ABANDONED WELL/PIEZOMETER
- P-5S BELLAIRE/SUMMERFIELD PIEZOMETER
- P-5 CONNELLSVILLE/MORGANTOWN PIEZOMETER
- P-5A MINESPOIL PIEZOMETER
- P-5L LIMESTONE/SHALLOW ROCK PIEZOMETER
- SB-17 SOIL BORING
- RB-8 SOIL BORING TO TOP OF ROCK – NO SPLIT SPOON SAMPLING
- TPE-22 TEST PIT (CONDUCTED FOR EXPANSION)
- TP-13 EXISTING TEST PIT
- (4.50) AVERAGE YIELD (GPM)

NOTES

1. APPROXIMATE LOCATION OF LIMESTONE SUBCROPS/OUTCROPS REFERENCED FROM: LINN ENGINEERING, INC. MAY 2001 (REVISED) DRAWING 3E–5 AERIAL EXTENTS OF BEDROCK MEMBERS, "PERMIT TO INSTALL APPLICATION, APEX SANITARY LANDFILL, PREPARED FOR APEX ENERGY, INC., STEUBENVILLE, OHIO.

REFERENCE

TOPOGRAPHIC MAPPING PREPARED BY KEDDAL AERIAL MAPPING, INC. USING AERIAL PHOTOGRAPHY DATED JANUARY 6, 2012 AND JANUARY 5, 2011. ADDITIONAL MAPPING PREPARED BY M.A.N. MAPPING USING 12/14/00 AERIAL PHOTOGRAPHY.

SCALE IN FEET

0 300 600

* HAND SIGNATURE ON FILE

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www.cecinc.com

APEX ENVIRONMENTAL, LLC.
PERMIT TO INSTALL APPLICATION
CONTIGUOUS EXPANSION
APEX SANITARY LANDFILL
JEFFERSON COUNTY, OHIO

DRAWN BY:	BTW	CHECKED BY:	BRB	APPROVED BY:	JMD*
DATE:	FEB 2013	DWG SCALE:	1"=300'	PROJECT NO:	101-049

LIMESTONE-SHALLOW BEDROCK AVERAGE WELL YIELD CONTOURS

DRAWING NO.: 3F-1

SHEET OF

P:\2010\101-049\-DGD\DWG\MTL\101049 - 3F-1 - LIMESTONE - SHALLOW BEDROCK GAS VERSUS SIZE\MXD\SOLIDOWNER - 6/28/2013 - LM 1/3/2013, 4:24:35 PM

NORTH

SIDEHILL AGGREGATE UNDERDRAIN (SHAUDS-1)

WEST SEDIMENTATION POND

SHAUDS-3

PROPOSED SHAUDS-3 EXTENSION

SIDEHILL AGGREGATE UNDERDRAIN (SHAUDS-2)

NORTH SEDIMENTATION POND

OFFICE

LEACHATE STORAGE TANK AND SECONDARY CONTAINMENT

EXISTING LANDFILL OFFICE

B-1A 1235.42

P-1A 1244.06

B-2A 1222.93

B-401A (<1222.85)

B-402A 1229.51

P-7A 1239.60

PG-1 1231.14

P-2A 1230.74

P-3A 1230.13

P-5A 1224.37

SEEP 1 1232.10

SEEP 2 1191.28

SEEP 7 1263.89

B-7A 1228.12

SEEP 8 1224.85

SEEP 9 1222.15

SEEP 10 1226.09

SEEP 12 1185.85

WELL ID	GROUNDWATER ELEV.
P-1A	1244.06
P-2A	1230.74
P-3A	1230.13
P-5A	1224.37
P-7A	1239.60
P-8A	1199.11
B-1A	1235.42
B-2A	1222.93
B-7A	1228.12
B-401A	DRY<222.85
B-402A	1229.51
B-408A	1216.05

LEGEND

- ISOLATED OPEN WATER
- ISOLATED WETLAND
- JURISDICTIONAL WETLAND
- PROPERTY LINE
- TREELINE
- EXISTING UNPAVED DRIVE
- EXISTING RAIL ROAD
- 1200 EXISTING INDEX CONTOUR
- PERMITTED LIMIT OF SOLID WASTE PLACEMENT
- PROPOSED LIMIT OF SOLID WASTE PLACEMENT
- ESTIMATED LIMITS OF MINESPOIL
- UD EXISTING UNDERDRAIN
- EXISTING UNDERDRAIN TRENCH
- PROPOSED UNDERDRAIN
- APPROXIMATE EXTENT OF HIGH GROUNDWATER YIELD (TO BE REMOVED)
- 1200 POTENTIOMETRIC SURFACE CONTOUR (DASHED WHERE INFERRED)
- GROUNDWATER FLOW DIRECTION
- STRUCTURE/BUILDING
- B-309 PIEZOMETER
- B-402 DETECTION MONITORING WELL
- B-303 ABANDONED WELL/PIEZOMETER
- P-5S BELLAIRE/SUMMERFIELD PIEZOMETER
- P-5 CONNELLSVILLE/MORGANTOWN PIEZOMETER
- P-5A MINESPOIL PIEZOMETER
- P-5L LIMESTONE/SHALLOW ROCK PIEZOMETER
- SB-17 SOIL BORING
- RB-8 SOIL BORING TO TOP OF ROCK – NO SPLIT SPOON SAMPLING
- TPE-22 TEST PIT (CONDUCTED FOR EXPANSION)
- TP-13 EXISTING TEST PIT
- PG-1 POND GAUGE
- SEEP 8 1224.86 GROUNDWATER SEEP AND ELEVATION

NOTES

1. MINESPOIL WILL BE REMOVED FROM BENEATH THE PROPOSED LIMITS OF WASTE, BUT WILL REMAIN BENEATH THE PERIMETER BERM OF THE PROPOSED EXPANSION AREA.

GROUNDWATER CONDITIONS

THE WATER LEVELS PRESENTED HEREIN ARE APPLICABLE TO THE LOCATION AND TIME OF MEASUREMENT. WATER LEVELS MAY FLUCTUATE THROUGH TIME.

POTENTIOMETRIC CONTOURS GENERATED FROM THESE DATA ARE CONSTRUCTED BY INTERPOLATION BETWEEN POINTS OF KNOWN STATIC WATER LEVEL ELEVATIONS AND USING KNOWLEDGE OF SPECIFIC SITE CONDITIONS. ACTUAL STATIC WATER LEVELS AT LOCATIONS BETWEEN THE MONITORING POINTS MAY DIFFER FROM THOSE DEPICTED.

REFERENCE

TOPOGRAPHIC MAPPING PREPARED BY KEDDAL AERIAL MAPPING, INC. USING AERIAL PHOTOGRAPHY DATED JANUARY 6, 2012 AND JANUARY 5, 2011. ADDITIONAL MAPPING PREPARED BY M.A.N. MAPPING USING 12/14/00 AERIAL PHOTOGRAPHY.

MINE SPOIL LOCATIONS FROM LINN ENGINEERING DRAWING DATED DECEMBER 31, 2000.

SCALE IN FEET
0 300 600

* HAND SIGNATURE ON FILE

REVISION RECORD

NO	DATE	DESCRIPTION
1	JULY 2013	REVISION FOR OHIO EPA NOD (12/28/2012

SUBMITTAL RECORD

NO	DATE	DESCRIPTION

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APEX ENVIRONMENTAL, LLC.
PERMIT TO INSTALL APPLICATION
CONTIGUOUS EXPANSION
APEX SANITARY LANDFILL
JEFFERSON COUNTY, OHIO

DRAWN BY:	BTW	CHECKED BY:	BRB	APPROVED BY:	JMD*
DATE:	FEB 2013	DWG SCALE:	1"=200'	PROJECT NO:	101-049

MINE SPOIL POTENTIOMETRIC MAP
DECEMBER 6, 2010

DRAWING NO.: 3G
SHEET OF

P:\101\101-049\-CAD\DWG\RESPONSE TO NOD-1\101-049 - 3G-A - MINE SPOIL PIEZOMETER POTENTIOMETRIC CONTOUR MAP_DEC 2010(DWG)3G-SOLIDWORKS - 6/28/2013 - LP 7/3/2013, 4:24:54 PM

NORTH

SIDEHILL AGGREGATE UNDERDRAIN (SHAUDS-1)

WEST SEDIMENTATION POND

SHAUDS-3

P-1L** 1234.75

PROPOSED SHAUDS-3 EXTENSION

EXISTING LANDFILL OFFICE

P-10L 1222.69

P-4L 1222.95

P-11L 1225.71

PG-1 1231.14

P-2L 1224.52

P-3L 1221.17

P-5L 1207.58

P-6L 1215.76

P-9L*

SIDEHILL AGGREGATE UNDERDRAIN (SHAUDS-2)

NORTH SEDIMENTATION POND

OFFICE

LEACHATE STORAGE TANK AND SECONDARY CONTAINMENT

REVISION RECORD

NO	DATE	DESCRIPTION
1	JULY 2013	REVISION FOR OHIO EPA NOD (12/28/2012
2		
3		
4		

SUBMITTAL RECORD

NO	DATE	DESCRIPTION

WELL ID	GROUNDWATER ELEV.
P-1L	1234.75
P-2L	1224.52
P-3L	1221.17
P-4L	1222.95
P-5L	1207.58
P-6L	1215.76
P-10L	1222.69
P-11L	1225.71

LEGEND

- PROPERTY LINE
- TREELINE
- EXISTING UNPAVED DRIVE
- EXISTING RAIL ROAD
- 1200 EXISTING INDEX CONTOUR
- PERMITTED LIMIT OF SOLID WASTE PLACEMENT
- PROPOSED LIMIT OF SOLID WASTE PLACEMENT
- UD EXISTING UNDERDRAIN
- EXISTING UNDERDRAIN TRENCH
- PROPOSED UNDERDRAIN
- APPROXIMATE EXTENT OF HIGH GROUNDWATER YIELD (TO BE REMOVED)
- 1200 POTENTIOMETRIC SURFACE CONTOUR (DASHED WHERE INFERRED)
- GROUNDWATER FLOW DIRECTION
- STRUCTURE/BUILDING
- B-309 PIEZOMETER
- B-402 DETECTION MONITORING WELL
- B-303 ABANDONED WELL/PIEZOMETER
- P-5S BELLAIRE/SUMMERFIELD PIEZOMETER
- P-5 CONNELLSVILLE/MORGANTOWN PIEZOMETER
- P-5A MINESPOIL PIEZOMETER
- P-5L LIMESTONE/SHALLOW ROCK PIEZOMETER
- SB-17 SOIL BORING
- RB-8 SOIL BORING TO TOP OF ROCK – NO SPLIT SPOON SAMPLING
- TPE-22 TEST PIT (CONDUCTED FOR EXPANSION)
- TP-13 EXISTING TEST PIT
- PG-1 POND GAUGE

NOTE

* P-9L = LIMESTONE WAS DRY DURING DRILLING. NO WELL INSTALLED.

* P-1L = NOT USED FOR CONTOURING DUE TO ISOLATION FROM STRIP POND.

GROUNDWATER CONDITIONS

THE WATER LEVELS PRESENTED HEREIN ARE APPLICABLE TO THE LOCATION AND TIME OF MEASUREMENT. WATER LEVELS MAY FLUCTUATE THROUGH TIME.

POTENTIOMETRIC CONTOURS GENERATED FROM THIS DATA ARE CONSTRUCTED BY INTERPOLATION BETWEEN POINTS OF KNOWN STATIC WATER LEVEL ELEVATIONS AND USING KNOWLEDGE OF SPECIFIC SITE CONDITIONS. ACTUAL STATIC WATER LEVELS AT LOCATIONS BETWEEN THE MONITORING POINTS MAY DIFFER FROM THOSE DEPICTED.

REFERENCE

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SCALE IN FEET

0 300 600

* HAND SIGNATURE ON FILE

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APEX ENVIRONMENTAL, LLC.
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CONTIGUOUS EXPANSION
APEX SANITARY LANDFILL
JEFFERSON COUNTY, OHIO

DRAWN BY:	BTW	CHECKED BY:	JMB	APPROVED BY:	JMD*
DATE:	AUG 2011	DWG SCALE:	1"=300'	PROJECT NO:	101-049

LIMESTONE - SHALLOW BEDROCK
POTENTIOMETRIC MAP DECEMBER 6, 2010

DRAWING NO.: 3H

SHEET OF

P:\2010\101-049\DWG\PTI\LIMESTONE PIEZOMETER POTENTIOMETRIC CONTOUR MAP_DEC 2010.DWG(ENGLISH)(WINNER - 6/27/2013) - LP, 7/2/2013, 4:29:05 PM

REVISION RECORD

NO	DATE	DESCRIPTION
1	JULY 2013	REVISION FOR OHIO EPA NOD (12/28/2012)

SUBMITTAL RECORD

NO	DATE	DESCRIPTION

WELL ID	GROUNDWATER ELEV.
P–1S	1191.61
P–2S	1188.65
P–3S	1167.25
P–5S	1183.55
P–6S	1186.12
P–9S	1181.30
P–10S	1196.45
B–4S	1177.05
B–11S	1202.03
B–105S	1196.45
B–201	DRY
B–310	1159.58
B–311	1177.79
B–401S	1165.79
B–402S	1168.86
B–403S	1155.76
B–405S	1178.69
B–406S	1169.41
B–407S	1166.54
B–408SS	1192.65
B–409S	<1179.00

LEGEND

- PROPERTY LINE
- TREELINE
- EXISTING UNPAVED DRIVE
- EXISTING RAIL ROAD
- 1200 EXISTING INDEX CONTOUR
- PERMITTED LIMIT OF SOLID WASTE PLACEMENT
- PROPOSED LIMIT OF SOLID WASTE PLACEMENT
- UD EXISTING UNDERDRAIN
- EXISTING UNDERDRAIN TRENCH
- PROPOSED UNDERDRAIN
- APPROXIMATE EXTENT OF HIGH GROUNDWATER YIELD (TO BE REMOVED)
- 1200 POTENTIOMETRIC SURFACE CONTOUR (DASHED WHERE INFERRED)
- GROUNDWATER FLOW DIRECTION
- STRUCTURE/BUILDING
- B-309 PIEZOMETER
- B-402 DETECTION MONITORING WELL
- B-303 ABANDONED WELL/PIEZOMETER
- P-5S BELLAIRE/SUMMERFIELD PIEZOMETER
- P-5 CONNELLSVILLE/MORGANTOWN PIEZOMETER
- P-5A MINESPOIL PIEZOMETER
- P-5L LIMESTONE/SHALLOW ROCK PIEZOMETER
- SB-17 SOIL BORING
- RB-8 SOIL BORING TO TOP OF ROCK – NO SPLIT SPOON SAMPLING
- TPE-22 TEST PIT (CONDUCTED FOR EXPANSION)
- TP-13 EXISTING TEST PIT
- PG-1 POND GAUGE

GROUNDWATER CONDITIONS

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SCALE IN FEET
0 300 600

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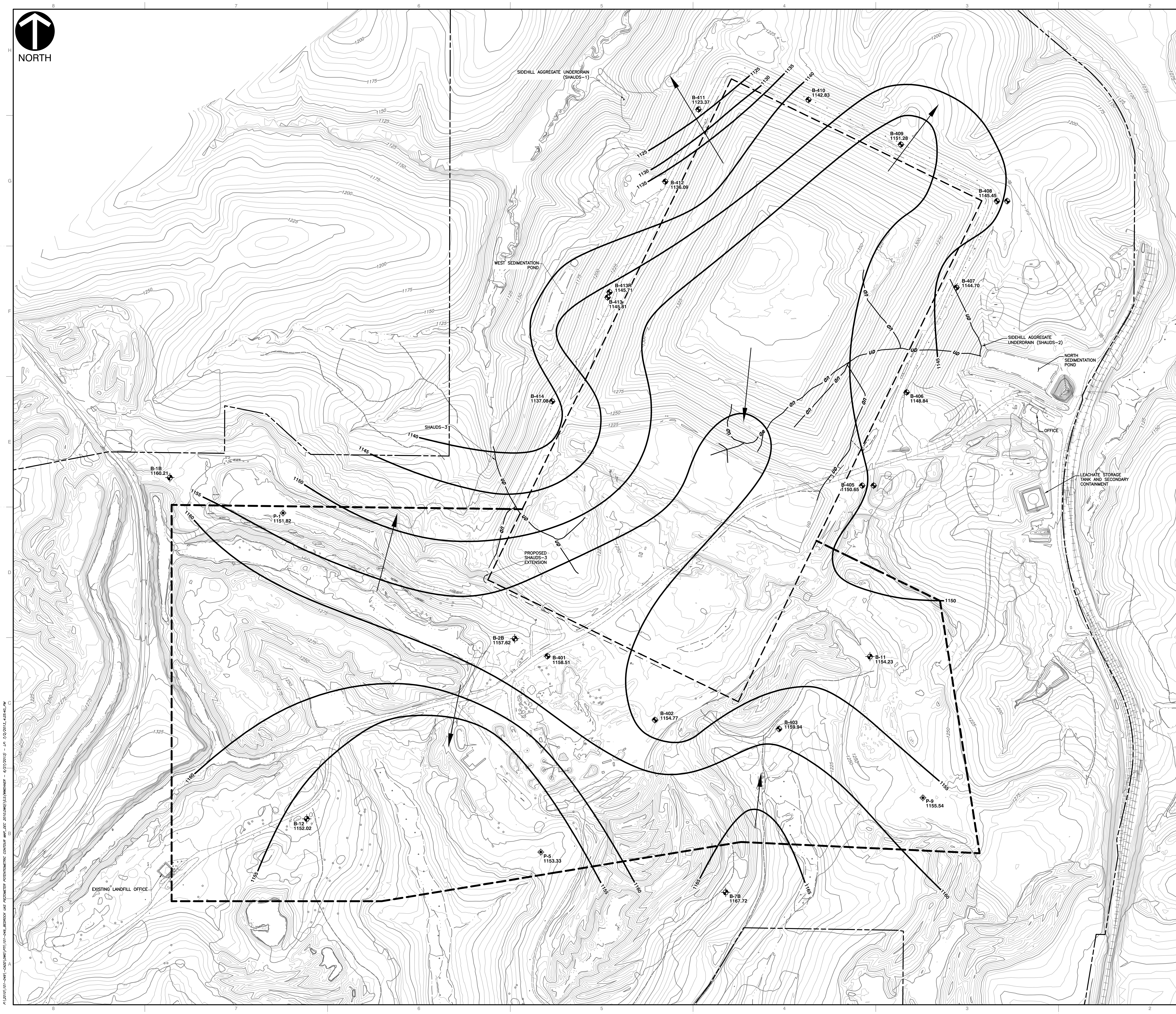
JEFFERSON COUNTY, OHIO

DRAWN BY: BTW	CHECKED BY: JMB	APPROVED BY: JMD*
DATE: AUG 2011	DWG SCALE: 1"=300'	PROJECT NO: 101-049

BELLAIRE - SUMMERFIELD POTENTIOMETRIC MAP
DECEMBER 6, 2010

DRAWING NO.: 3I
SHEET - OF



REVISION RECORD

NO	DATE	DESCRIPTION
1	JULY 2013	REVISION FOR OHIO EPA NOD (12/28/2012)

SUBMITTAL RECORD

NO	DATE	DESCRIPTION

WELL ID	GROUNDWATER ELEV.
P–1	1151.82
P–5	1153.33
P–9	1155.54
B–1B*	1160.21
B–2B	1157.62
B–7B	1167.72
B–11	1154.23
B–12	1152.02
B–401	1158.51
B–402	1154.77
B–403	1159.94
B–406	1148.84
B–407	1144.70
B–408	1145.45
B–409	1151.28
B–410	1142.83
B–411	1123.37
B–412	1136.09
B–413	1145.81
B–413R	1145.71
B–414	1137.08
B–405	1150.65

* NOT USED FOR CONTOURING

LEGEND

- PROPERTY LINE
- TREELINE
- EXISTING UNPAVED DRIVE
- EXISTING RAIL ROAD
- 1200 EXISTING INDEX CONTOUR
- PERMITTED LIMIT OF SOLID WASTE PLACEMENT
- PROPOSED LIMIT OF SOLID WASTE PLACEMENT
- UD EXISTING UNDERDRAIN
- EXISTING UNDERDRAIN TRENCH
- PROPOSED UNDERDRAIN
- APPROXIMATE EXTENT OF HIGH GROUNDWATER YIELD (TO BE REMOVED)
- 1200 POTENTIOMETRIC SURFACE CONTOUR (DASHED WHERE INFERRED)
- GROUNDWATER FLOW DIRECTION
- STRUCTURE/BUILDING
- B-309 PIEZOMETER
- B-402 DETECTION MONITORING WELL
- B-303 ABANDONED WELL/PIEZOMETER
- P-5S BELLAIRE/SUMMERFIELD PIEZOMETER
- P-5 CONNELLSVILLE/MORGANTOWN PIEZOMETER
- P-5A MINESPOIL PIEZOMETER
- P-5L LIMESTONE/SHALLOW ROCK PIEZOMETER
- SB-17 SOIL BORING
- RB-8 SOIL BORING TO TOP OF ROCK – NO SPLIT SPOON SAMPLING
- TPE-22 TEST PIT (CONDUCTED FOR EXPANSION)
- TP-13 EXISTING TEST PIT
- PG-1 POND GAUGE

GROUNDWATER CONDITIONS

THE WATER LEVELS PRESENTED HEREIN ARE APPLICABLE TO THE LOCATION AND TIME OF MEASUREMENT. WATER LEVELS MAY FLUCTUATE THROUGH TIME.

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REFERENCE

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SCALE IN FEET
0 300 600

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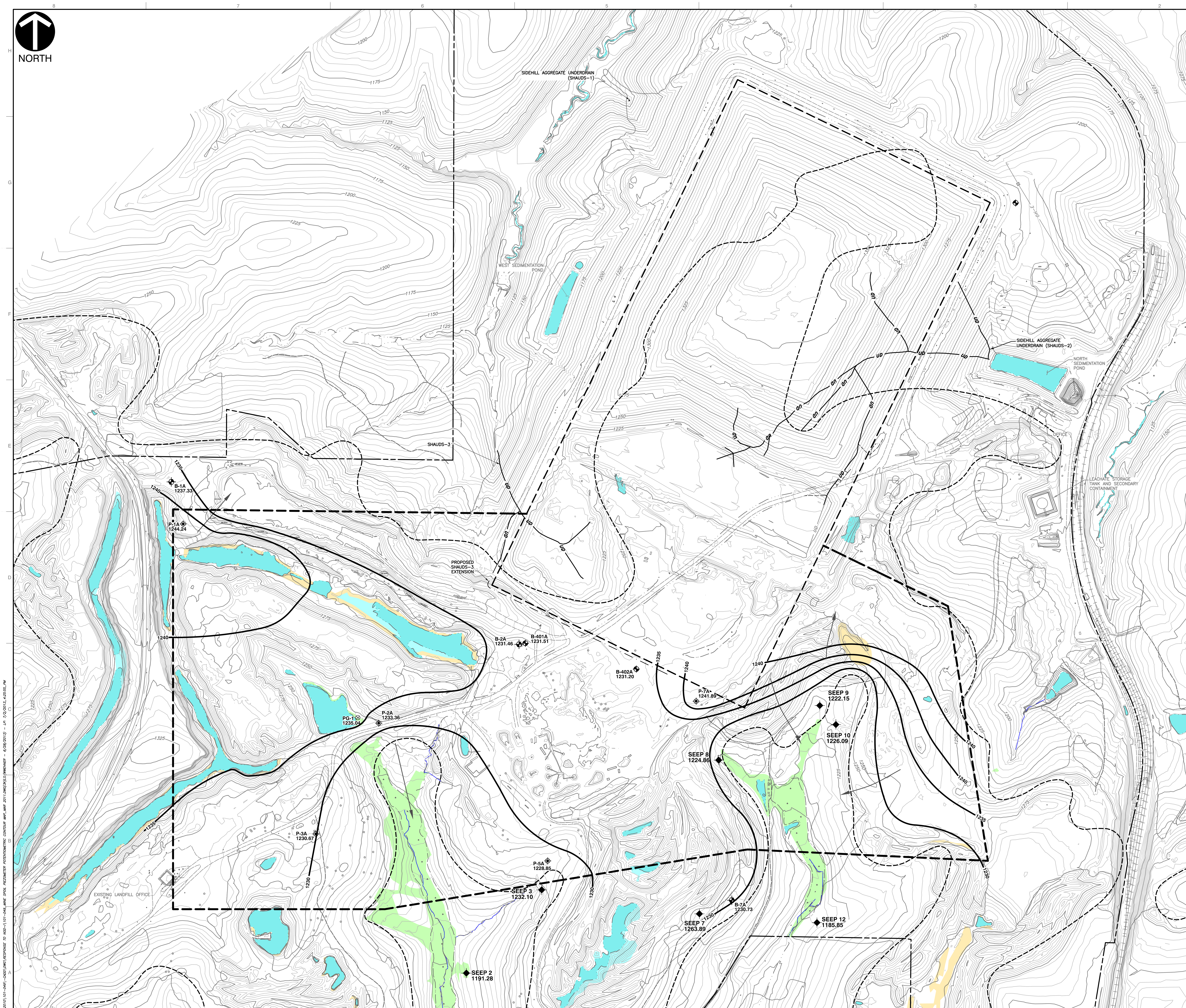
JEFFERSON COUNTY, OHIO

DRAWN BY: BTW	CHECKED BY: JMB	APPROVED BY: JMD*
DATE: AUG 2011	DWG SCALE: 1"=300'	PROJECT NO: 101-049

CONNELLSVILLE - MORGANTOWN
POTENTIOMETRIC MAP DECEMBER 6, 2010

DRAWING NO.: 3J
SHEET - OF



REVISION RECORD

NO	DATE	DESCRIPTION
△	JULY 2013	REVISION FOR OHIO EPA NOD (12/28/2012

SUBMITTAL RECORD

NO	DATE	DESCRIPTION

WELL ID	GROUNDWATER ELEV.
P−1A	1244.24
P−2A	1233.36
P−3A	1230.67
P−5A	1228.85
P−7A	1241.89
P−8A	1204.21
B−1A	1237.33
B−2A	1231.46
B−7A	1230.73
B−401A	1231.51
B−402A	1231.20
B−408A	1216.65

LEGEND

ISOLATED OPEN WATER
ISOLATED WETLAND
JURISDICTIONAL WETLAND
PROPERTY LINE
TREELINE
EXISTING UNPAVED DRIVE
EXISTING RAIL ROAD
1200 EXISTING INDEX CONTOUR
PERMITTED LIMIT OF SOLID WASTE PLACEMENT
PROPOSED LIMIT OF SOLID WASTE PLACEMENT
ESTIMATED LIMITS OF MINESPOIL
UD EXISTING UNDERDRAIN
EXISTING UNDERDRAIN TRENCH
PROPOSED UNDERDRAIN
APPROXIMATE EXTENT OF HIGH GROUNDWATER YIELD (TO BE REMOVED)
1200 POTENTIOMETRIC SURFACE CONTOUR (DASHED WHERE INFERRED)
GROUNDWATER FLOW DIRECTION
STRUCTURE/BUILDING
B-309 PIEZOMETER
B-402 DETECTION MONITORING WELL
B-303 ABANDONED WELL/PIEZOMETER
P-5S BELLAIRE/SUMMERFIELD PIEZOMETER
P-5 CONNELLSVILLE/MORGANTOWN PIEZOMETER
P-5A MINESPOIL PIEZOMETER
P-5L LIMESTONE/SHALLOW ROCK PIEZOMETER
SB-17 SOIL BORING
RB-8 SOIL BORING TO TOP OF ROCK − NO SPLIT SPOON SAMPLING
TPE-22 TEST PIT (CONDUCTED FOR EXPANSION)
TP-13 EXISTING TEST PIT
PG-1 POND GAUGE
SEEP 8 1224.86 GROUNDWATER SEEP AND ELEVATION

NOTES

1. MINESPOIL HAS BEEN REMOVED OR WILL BE REMOVED BENEATH EXISTING LANDFILL FOOTPRINT.

GROUNDWATER CONDITIONS

THE WATER LEVELS PRESENTED HEREIN ARE APPLICABLE TO THE LOCATION AND TIME OF MEASUREMENT. WATER LEVELS MAY FLUCTUATE THROUGH TIME.

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MINE SPOIL LOCATIONS FROM LINN ENGINEERING DRAWING DATED DECEMBER 31, 2000.

SCALE IN FEET
0 200 400

* HAND SIGNATURE ON FILE

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JEFFERSON COUNTY, OHIO

DRAWN BY:	BTW	CHECKED BY:	BRB	APPROVED BY:	JMD*
DATE:	FEB 2013	DWG SCALE:	1"=200'	PROJECT NO:	101-049

MINESPOIL POTENTIOMETRIC MAP
MARCH 28, 2011

DRAWING NO.: 3K
SHEET OF

NORTH

SIDEHILL AGGREGATE UNDERDRAIN (SHAUDS-1)

WEST SEDIMENTATION POND

SHAUDS-3

SIDEHILL AGGREGATE UNDERDRAIN (SHAUDS-2)

NORTH SEDIMENTATION POND

OFFICE

LEACHATE STORAGE TANK AND SECONDARY CONTAINMENT

PROPOSED SHAUDS-3 EXTENSION

EXISTING LANDFILL OFFICE

P-1L** 1242.51

P-10L 1231.28

P-4L 1231.53

P-11L 1229.98

P-2L 1235.04

P-2L 1224.53

P-3L 1222.68

P-5L 1210.21

P-6L 1220.39

P-9*

REVISION RECORD

NO	DATE	DESCRIPTION
1	JULY 2013	REVISION FOR OHIO EPA NOD (12/28/2012)
2		
3		
4		

SUBMITTAL RECORD

NO	DATE	DESCRIPTION

WELL ID	GROUNDWATER ELEV.
P-1L	1242.51
P-2L	1224.53
P-3L	1222.68
P-4L	1231.53
P-5L	1210.21
P-6L	1220.39
P-10L	1231.28
P-11L	1229.98

LEGEND

- PROPERTY LINE
- TREELINE
- EXISTING UNPAVED DRIVE
- EXISTING RAIL ROAD
- 1200 EXISTING INDEX CONTOUR
- PERMITTED LIMIT OF SOLID WASTE PLACEMENT
- PROPOSED LIMIT OF SOLID WASTE PLACEMENT
- UD EXISTING UNDERDRAIN
- EXISTING UNDERDRAIN TRENCH
- PROPOSED UNDERDRAIN
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- 1200 POTENTIOMETRIC SURFACE CONTOUR (DASHED WHERE INFERRED)
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- STRUCTURE/BUILDING
- B-309 PIEZOMETER
- B-402 DETECTION MONITORING WELL
- B-303 ABANDONED WELL/PIEZOMETER
- P-5S BELLAIRE/SUMMERFIELD PIEZOMETER
- P-5 CONNELLSVILLE/MORGANTOWN PIEZOMETER
- P-5A MINESPOIL PIEZOMETER
- P-5L LIMESTONE/SHALLOW ROCK PIEZOMETER
- SB-17 SOIL BORING
- RB-8 SOIL BORING TO TOP OF ROCK – NO SPLIT SPOON SAMPLING
- TPE-22 TEST PIT (CONDUCTED FOR EXPANSION)
- TP-13 EXISTING TEST PIT
- PG-1 POND GAUGE AND ELEVATION

NOTE

* P-9 = LIMESTONE WAS DRY DURING DRILLING. NO WELL INSTALLED.

**P-1L = NOT USED FOR CONTOURING DUE TO ISOLATION FROM STRIP POND.

GROUNDWATER CONDITIONS

THE WATER LEVELS PRESENTED HEREIN ARE APPLICABLE TO THE LOCATION AND TIME OF MEASUREMENT. WATER LEVELS MAY FLUCTUATE THROUGH TIME.

POTENTIOMETRIC CONTOURS GENERATED FROM THIS DATA ARE CONSTRUCTED BY INTERPOLATION BETWEEN POINTS OF KNOWN STATIC WATER LEVEL ELEVATIONS AND USING KNOWLEDGE OF SPECIFIC SITE CONDITIONS. ACTUAL STATIC WATER LEVELS AT LOCATIONS BETWEEN THE MONITORING POINTS MAY DIFFER FROM THOSE DEPICTED.

REFERENCE

TOPOGRAPHIC MAPPING PREPARED BY KEDDAL AERIAL MAPPING, INC. USING AERIAL PHOTOGRAPHY DATED JANUARY 6, 2012 AND JANUARY 5, 2011. ADDITIONAL MAPPING PREPARED BY M.A.N. MAPPING USING 12/14/00 AERIAL PHOTOGRAPHY.

SCALE IN FEET

0 300 600

* HAND SIGNATURE ON FILE

Civil & Environmental Consultants, Inc.
8740 Orion Place, Suite 100 · Columbus, OH 43240
Ph: 614.540.6633 · 888.598.6808 · Fax: 614.540.6638
www.cecinc.com

APEX ENVIRONMENTAL, LLC.
PERMIT TO INSTALL APPLICATION
CONTIGUOUS EXPANSION
APEX SANITARY LANDFILL
JEFFERSON COUNTY, OHIO

DRAWN BY:	BTW	CHECKED BY:	JMB	APPROVED BY:	JMD*
DATE:	AUG 2011	DWG SCALE:	1"=300'	PROJECT NO:	101-049

LIMESTONE - SHALLOW BEDROCK
POTENTIOMETRIC MAP MARCH 28, 2011

DRAWING NO.: 3L

SHEET - OF

P:\2010\101-049\-CAD\DWG\PTI\LIMESTONE PIEZOMETER POTENTIOMETRIC CONTOUR MAR_MAR 2011.DWG,8.5,EXTENDED — 7/2/2013 — LP, 7/2/2013, 4:26:10, PM

REVISION RECORD

NO	DATE	DESCRIPTION
1	JULY 2013	REVISION FOR OHIO EPA NOD (12/28/2012)

SUBMITTAL RECORD

NO	DATE	DESCRIPTION

WELL ID	GROUNDWATER ELEV.
P–1S	1191.73
P–2S	1190.09
P–3S	1167.35
P–5S	1188.91
P–6S	1190.42
P–9S	1181.38
P–10S	1193.27
P–12S	1236.61
B–4S	1177.30
B–11S	1204.28
B–105S	1198.88
B–201	DRY
B–308	1209.77
B–310	1166.89
B–311	1180.33
B–401S	1172.14
B–402S	1168.90
B–403S	1158.85
B–405S	1181.86*
B–406S	DRY
B–407S	1169.52
B–408SS	1197.61
B–409S	DRY

* NOT USED FOR CONTOURING. WELL TYPICALLY DRY DURING RECENT BACKGROUND SAMPLING EVENTS

LEGEND

- PROPERTY LINE
- TREELINE
- EXISTING UNPAVED DRIVE
- EXISTING RAIL ROAD
- 1200 — EXISTING INDEX CONTOUR
- PERMITTED LIMIT OF SOLID WASTE PLACEMENT
- PROPOSED LIMIT OF SOLID WASTE PLACEMENT
- UD — EXISTING UNDERDRAIN
- EXISTING UNDERDRAIN TRENCH
- PROPOSED UNDERDRAIN
- APPROXIMATE EXTENT OF HIGH GROUNDWATER YIELD (TO BE REMOVED)
- 1200 — POTENTIOMETRIC SURFACE CONTOUR (DASHED WHERE INFERRED)
- GROUNDWATER FLOW DIRECTION
- STRUCTURE/BUILDING
- B-309 PIEZOMETER
- B-402 DETECTION MONITORING WELL
- B-303 ABANDONED WELL/PIEZOMETER
- P-5S BELLAIRE/SUMMERFIELD PIEZOMETER
- P-5 CONNELLSVILLE/MORGANTOWN PIEZOMETER
- P-5A MINESPOIL PIEZOMETER
- P-5L LIMESTONE/SHALLOW ROCK PIEZOMETER
- SB-17 SOIL BORING
- RB-8 SOIL BORING TO TOP OF ROCK – NO SPLIT SPOON SAMPLING
- TPE-22 TEST PIT (CONDUCTED FOR EXPANSION)
- TP-13 EXISTING TEST PIT
- PG-1 POND GAUGE

GROUNDWATER CONDITIONS

THE WATER LEVELS PRESENTED HEREIN ARE APPLICABLE TO THE LOCATION AND TIME OF MEASUREMENT. WATER LEVELS MAY FLUCTUATE THROUGH TIME.

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SCALE IN FEET
0 300 600

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CONTIGUOUS EXPANSION
APEX SANITARY LANDFILL
JEFFERSON COUNTY, OHIO

DRAWN BY:	BTW	CHECKED BY:	JMB	APPROVED BY:	JMD*
DATE:	AUG 2011	DWG SCALE:	1"=300'	PROJECT NO:	101-049

BELLAIRE - SUMMERFIELD POTENTIOMETRIC MAP
MARCH 28, 2011

DRAWING NO.: 3M
SHEET - OF

NORTH

REVISION RECORD		
NO	DATE	DESCRIPTION
1	JULY 2013	REVISION FOR OHIO EPA NOD (12/28/2012)

SUBMITTAL RECORD		
NO	DATE	DESCRIPTION

WELL ID	GROUNDWATER ELEV.
P-1	1154.05
P-5	1155.67
P-9	1158.27
P-12	DRY <1160
B-1B*	1163.71
B-2B	1161.09
B-4	1136.68
B-7B	1169.00
B-8	1155.03
B-11	1156.80
B-12	1154.13
B-105	1148.63
B-401	1161.14
B-402	1157.31
B-403	1162.31
B-405	1156.51
B-406	1151.48
B-407	1145.99
B-408	1149.00
B-409	1153.08
B-410	1145.08
B-411	1123.70
B-412	1136.62
B-413	1146.62
B-413R	1146.66
B-414	1140.37
B-405	1156.51

* NOT USED FOR CONTOURING

LEGEND

- PROPERTY LINE
- TREELINE
- EXISTING UNPAVED DRIVE
- EXISTING RAIL ROAD
- 1200 EXISTING INDEX CONTOUR
- PERMITTED LIMIT OF SOLID WASTE PLACEMENT
- PROPOSED LIMIT OF SOLID WASTE PLACEMENT
- UD EXISTING UNDERDRAIN
- EXISTING UNDERDRAIN TRENCH
- PROPOSED UNDERDRAIN
- APPROXIMATE EXTENT OF HIGH GROUNDWATER YIELD (TO BE REMOVED)
- 1200 POTENTIOMETRIC SURFACE CONTOUR (DASHED WHERE INFERRED)
- GROUNDWATER FLOW DIRECTION
- STRUCTURE/BUILDING
- B-309 PIEZOMETER
- B-402 DETECTION MONITORING WELL
- B-303 ABANDONED WELL/PIEZOMETER
- P-5S BELLAIRE/SUMMERFIELD PIEZOMETER
- P-5 CONNELLSVILLE/MORGANTOWN PIEZOMETER
- P-5A MINESPOIL PIEZOMETER
- P-5L LIMESTONE/SHALLOW ROCK PIEZOMETER
- SB-17 SOIL BORING
- RB-8 SOIL BORING TO TOP OF ROCK – NO SPLIT SPOON SAMPLING
- TPE-22 TEST PIT (CONDUCTED FOR EXPANSION)
- TP-13 EXISTING TEST PIT
- PG-1 POND GAUGE

* NOT USED FOR CONTOURING

GROUNDWATER CONDITIONS

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SCALE IN FEET

0 300 600

* HAND SIGNATURE ON FILE

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JEFFERSON COUNTY, OHIO

DRAWN BY:	BTW	CHECKED BY:	JMB	APPROVED BY:	JMD*
DATE:	AUG 2011	DWG SCALE:	1"=300'	PROJECT NO:	101-049

CONNELLSVILLE - MORGANTOWN
POTENTIOMETRIC MAP MARCH 28, 2011

DRAWING NO.: 3N

SHEET - OF

P:\2010\101-049\-CAD\DWG\PIT\101-049_BEDROCK LMS PIEZOMETER POTENTIOMETRIC CONTOUR MAP_MAR 2011.DWG(3N)(SUMMENOS - 6/27/2013 - LM 7/2/2013,4:26:40 PM

NORTH

REVISION RECORD		
NO	DATE	DESCRIPTION
1	JULY 2013	REVISION FOR OHIO EPA NOD (12/28/2012

SUBMITTAL RECORD		
NO	DATE	DESCRIPTION

SIDEHILL AGGREGATE UNDERDRAIN (SHAUDS-1)

WEST SEDIMENTATION POND

SHAUDS-3

PROPOSED SHAUDS-3 EXTENSION

SIDEHILL AGGREGATE UNDERDRAIN (SHAUDS-2)

NORTH SEDIMENTATION POND

OFFICE

LEACHATE STORAGE TANK AND SECONDARY CONTAINMENT

EXISTING LANDFILL OFFICE

B-1A 1235.70

P-1A 1243.89

B-2A 1222.47

B-401A (<1222.85)

B-402A 1227.72

P-7A 1236.86

PG-1 <1231.04

P-2A 1228.18

P-3A 1229.70

P-5A 1224.78

B-7A 1228.11

SEEP 1 1222.15

SEEP 2 1191.28

SEEP 3 1232.10

SEEP 7 1263.89

SEEP 8 1225.53

SEEP 10 1226.09

SEEP 11 1185.85

LEGEND

- ISOLATED OPEN WATER
- ISOLATED WETLAND
- JURISDICTIONAL WETLAND
- PROPERTY LINE
- TREELINE
- EXISTING UNPAVED DRIVE
- EXISTING RAIL ROAD
- 1200 EXISTING INDEX CONTOUR
- PERMITTED LIMIT OF SOLID WASTE PLACEMENT
- PROPOSED LIMIT OF SOLID WASTE PLACEMENT
- ESTIMATED LIMITS OF MINESPOIL
- UD EXISTING UNDERDRAIN
- EXISTING UNDERDRAIN TRENCH
- PROPOSED UNDERDRAIN
- APPROXIMATE EXTENT OF HIGH GROUNDWATER YIELD (TO BE REMOVED)
- 1200 POTENTIOMETRIC SURFACE CONTOUR (DASHED WHERE INFERRED)
- GROUNDWATER FLOW DIRECTION
- STRUCTURE/BUILDING
- B-309 PIEZOMETER
- B-402 DETECTION MONITORING WELL
- B-303 ABANDONED WELL/PIEZOMETER
- P-5S BELLAIRE/SUMMERFIELD PIEZOMETER
- P-5 CONNELLSVILLE/MORGANTOWN PIEZOMETER
- P-5A MINESPOIL PIEZOMETER
- P-5L LIMESTONE/SHALLOW ROCK PIEZOMETER
- SB-17 SOIL BORING
- RB-8 SOIL BORING TO TOP OF ROCK – NO SPLIT SPOON SAMPLING
- TPE-22 TEST PIT (CONDUCTED FOR EXPANSION)
- TP-13 EXISTING TEST PIT
- PG-1 POND GAUGE
- SEEP 8 1224.86 GROUNDWATER SEEP AND ELEVATION

NOTES

1. MINESPOIL WILL BE REMOVED FROM BENEATH THE PROPOSED LIMITS OF WASTE, BUT WILL REMAIN BENEATH THE PERIMETER BERM OF THE PROPOSED EXPANSION AREA.

GROUNDWATER CONDITIONS

THE WATER LEVELS PRESENTED HEREIN ARE APPLICABLE TO THE LOCATION AND TIME OF MEASUREMENT. WATER LEVELS MAY FLUCTUATE THROUGH TIME.

POTENTIOMETRIC CONTOURS GENERATED FROM THESE DATA ARE CONSTRUCTED BY INTERPOLATION BETWEEN POINTS OF KNOWN STATIC WATER LEVEL ELEVATIONS AND USING KNOWLEDGE OF SPECIFIC SITE CONDITIONS. ACTUAL STATIC WATER LEVELS AT LOCATIONS BETWEEN THE MONITORING POINTS MAY DIFFER FROM THOSE DEPICTED.

REFERENCE

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MINE SPOIL LOCATIONS FROM LINN ENGINEERING DRAWING DATED DECEMBER 31, 2000.

SCALE IN FEET

0 200 400

* HAND SIGNATURE ON FILE

Civil & Environmental Consultants, Inc.
8740 Orion Place, Suite 100 · Columbus, OH 43240
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PERMIT TO INSTALL APPLICATION
CONTIGUOUS EXPANSION
APEX SANITARY LANDFILL
JEFFERSON COUNTY, OHIO

DRAWN BY:	BTW	CHECKED BY:	BRB	APPROVED BY:	JMD*
DATE:	FEB 2013	DWG SCALE:	1"=200'	PROJECT NO:	101-049

MINE SPOIL POTENTIOMETRIC MAP
DECEMBER 10, 2012

DRAWING NO.: 30
SHEET OF

P:\2010\101-049\-CAD\DWG\RESPONSE TO NOD-1\101-049 - 3D-A - MINE SPOIL PIEZOMETER POTENTIOMETRIC CONTOUR MAP_DEC 2012(DWG)3D-GDLSUMMONER - 6/26/2013 - LPL 7/3/2013_4:29:53_PM

NORTH

REVISION RECORD		
NO	DATE	DESCRIPTION
1	JULY 2013	REVISION FOR OHIO EPA NOD (12/28/2012
2		
3		
4		

SUBMITTAL RECORD		
NO	DATE	DESCRIPTION

WEST SEDIMENTATION POND

REPORTED LIMITS OF LIMESTONE REMOVAL

NORTH SEDIMENTATION POND

OFFICE

LEACHATE STORAGE TANK AND SECONDARY CONTAINMENT

(APPROXIMATE) LOCATION OF LIMESTONE OUTCROP

(APPROXIMATE) LOCATION OF LIMESTONE SUBCROP

SEEP 1 1138.79

P-1L 1239.56

P-2L 1219.61

P-3L 1220.01

P-4L 1222.21

P-5L 1208.83

P-6L 1216.03

P-10L 1221.96

P-11L 1225.33

P-13L 1223.70

P-14L 1225.63

P-15L 1235.43

OPEN WATER 1 (2.94 AC.)

OPEN WATER 4 (0.73 AC.)

OPEN WATER 5 (0.24 AC.)

OPEN WATER 6 (0.18 AC.)

OPEN WATER 7 (0.07 AC.)

OPEN WATER 8 (0.96 AC.)

OPEN WATER 10 (0.77 AC.)

OPEN WATER 11 (0.09 AC.)

OPEN WATER 12 (1.37 AC.)

OPEN WATER 13 (0.16 AC.)

OPEN WATER 14 (0.04 AC.)

OPEN WATER 15 (0.11 AC.)

STREAM 1A (132 LN. FT.)

STREAM 1B (257 LN. FT.)

STREAM 1C (113 LN. FT.)

STREAM 1D (182 LN. FT.)

STREAM 1E (380 LN. FT.)

STREAM 2A (732 LN. FT.)

STREAM 2B (LN. FT.)

STREAM 2C (637 LN. FT.)

STREAM 3A (111 LN. FT.)

STREAM 3B (257 LN. FT.)

STREAM 3C (89 LN. FT.)

STREAM 3D (63 LN. FT.)

STREAM (363 LN. FT.)

EAM 1A (802 LN. FT.)

SEEP 2 1191.28

SEEP 3 1232.10

SEEP 4 1216.31

SEEP 5 1203.96

SEEP 6 1191.52

SEEP 7 1263.89

SEEP 8 1224.86

SEEP 9 1222.15

SEEP 10 1226.09

SEEP 11 1195.89

SEEP 12 1193.46

EXISTING LANDFILL OFFICE

APEX - AMSTERDAM RD. - CO. RD. 78

LEGEND

- ISOLATED OPEN WATER
- ISOLATED WETLAND
- JURISDICTIONAL WETLAND
- PROPERTY LINE
- TREELINE
- EXISTING UNPAVED DRIVE
- EXISTING RAIL ROAD
- 1200 EXISTING INDEX CONTOUR
- PERMITTED LIMIT OF SOLID WASTE PLACEMENT
- PROPOSED LIMIT OF SOLID WASTE PLACEMENT
- APPROXIMATE LOCATION OF LIMESTONE/SHALLOW BEDROCK SUBCROP/OUTCROP
- 1200 CONTOUR (DASHED WHERE INFERRED)
- GROUNDWATER FLOW DIRECTION
- STRUCTURE/BUILDING
- B-309 PIEZOMETER
- B-402 DETECTION MONITORING WELL
- B-303 ABANDONED WELL/PIEZOMETER
- P-5S BELLAIRE/SUMMERFIELD PIEZOMETER
- P-5 CONNELLSVILLE/MORGANTOWN PIEZOMETER
- P-5A MINESPOIL PIEZOMETER
- P-5L LIMESTONE/SHALLOW BEDROCK PIEZOMETER
- SB-17 SOIL BORING
- RB-8 SOIL BORING TO TOP OF ROCK – NO SPLIT SPOON SAMPLING
- TPE-22 TEST PIT (CONDUCTED FOR EXPANSION)
- TP-13 EXISTING TEST PIT
- SEEP 6 1191.52 GROUNDWATER SEEP AND ELEVATION

NOTES

1. APPROXIMATE LOCATION OF LIMESTONE SUBCROPS/OUTCROPS REFERENCED FROM: LINN ENGINEERING, INC. MAY 2001 (REVISED) DRAWING 3E–5 AERIAL EXTENTS OF BEDROCK MEMBERS, "PERMIT TO INSTALL APPLICATION, APEX SANITARY LANDFILL, PREPARED FOR APEX ENERGY, INC., STEUBENVILLE, OHIO.

REFERENCE

TOPOGRAPHIC MAPPING PREPARED BY KEDDAL AERIAL MAPPING, INC. USING AERIAL PHOTOGRAPHY DATED JANUARY 6, 2012 AND JANUARY 5, 2011. ADDITIONAL MAPPING PREPARED BY M.A.N. MAPPING USING 12/14/00 AERIAL PHOTOGRAPHY.

SCALE IN FEET

0 300 600

* HAND SIGNATURE ON FILE

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APEX ENVIRONMENTAL, LLC.
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JEFFERSON COUNTY, OHIO
JEFFERSON COUNTY, OHIO

DRAWN BY:	BTW	CHECKED BY:	BRB	APPROVED BY:	JMD*
DATE:	JUNE 2013	DWG SCALE:	AS NOTED	PROJECT NO:	101-049

LIMESTONE/SHALLOW BEDROCK POTENTIOMETRIC MAP DECEMBER 10, 2012

DRAWING NO.: 3P

SHEET OF

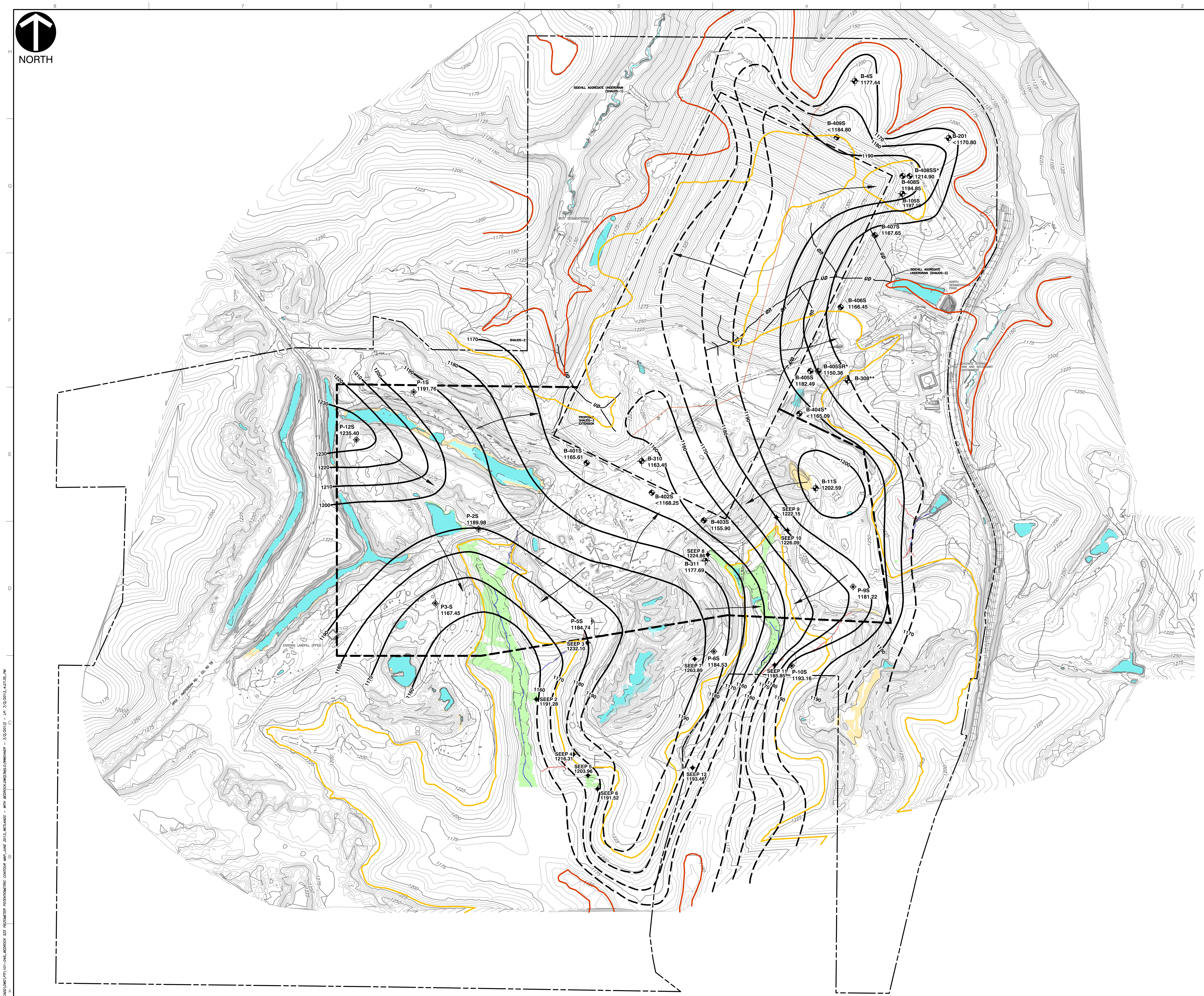
P:\2010\101-049\1-CAD\DRAWINGS\FEB 2013\101049 - FIG 4 - LIMESTONE AND SHALLOW BEDROCK POTENTIOMETRIC MAP - SEEPS.DWG(FIG3)(EXPANDED) - 7/3/2013 - LP- 7/3/2013,4:37:25 PM

REVISION RECORD

NO	DATE	DESCRIPTION
1	JULY 2013	REVISION FOR OHIO EPA NOD (12/28/2012)

SUBMITTAL RECORD

NO	DATE	DESCRIPTION



LEGEND

- ISOLATED OPEN WATER
- ISOLATED WETLAND
- JURISDICTIONAL WETLAND
- APPROXIMATE LOCATION OF UPPERMOST BELLAIRE/SUMMERFIELD SUBCROP/OUTCROP
- APPROXIMATE LOCATION OF LOWERMOST BELLAIRE/SUMMERFIELD SUBCROP/OUTCROP
- PROPERTY LINE
- TREELINE
- EXISTING UNPAVED DRIVE
- EXISTING RAIL ROAD
- 1200 — EXISTING INDEX CONTOUR
- PERMITTED LIMIT OF SOLID WASTE PLACEMENT
- PROPOSED LIMIT OF SOLID WASTE PLACEMENT
- UD — EXISTING UNDERDRAIN
- EXISTING UNDERDRAIN TRENCH
- PROPOSED UNDERDRAIN
- APPROXIMATE EXTENT OF HIGH GROUNDWATER YIELD (TO BE REMOVED)
- 1200 — POTENTIOMETRIC SURFACE CONTOUR (DASHED WHERE INFERRED)
- GROUNDWATER FLOW DIRECTION
- STRUCTURE/BUILDING
- B-309 — PIEZOMETER
- B-402 — DETECTION MONITORING WELL
- B-303 — ABANDONED WELL/PIEZOMETER
- P-5S — BELLAIRE/SUMMERFIELD PIEZOMETER
- P-5 — CONNELLSVILLE/MORGANTOWN PIEZOMETER
- P-5A — MINESPOIL PIEZOMETER
- P-5L — LIMESTONE/SHALLOW ROCK PIEZOMETER
- SB-17 — SOIL BORING
- RB-8 — SOIL BORING TO TOP OF ROCK – NO SPLIT SPOON SAMPLING
- TPE-22 — TEST PIT (CONDUCTED FOR EXPANSION)
- TP-13 — EXISTING TEST PIT
- SEEP 6 1191.52 — GROUNDWATER SEEP AND ELEVATION
- PG-1 — POND GAUGE

* NOT USED FOR CONTOURING
** UNABLE TO LOCATE/DAMAGED BY CONSTRUCTION ACTIVITIES

GROUNDWATER CONDITIONS

THE WATER LEVELS PRESENTED HEREIN ARE APPLICABLE TO THE LOCATION AND TIME OF MEASUREMENT. WATER LEVELS MAY FLUCTUATE THROUGH TIME.

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SCALE IN FEET: 0 300 600

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APEX SANITARY LANDFILL
JEFFERSON COUNTY, OHIO

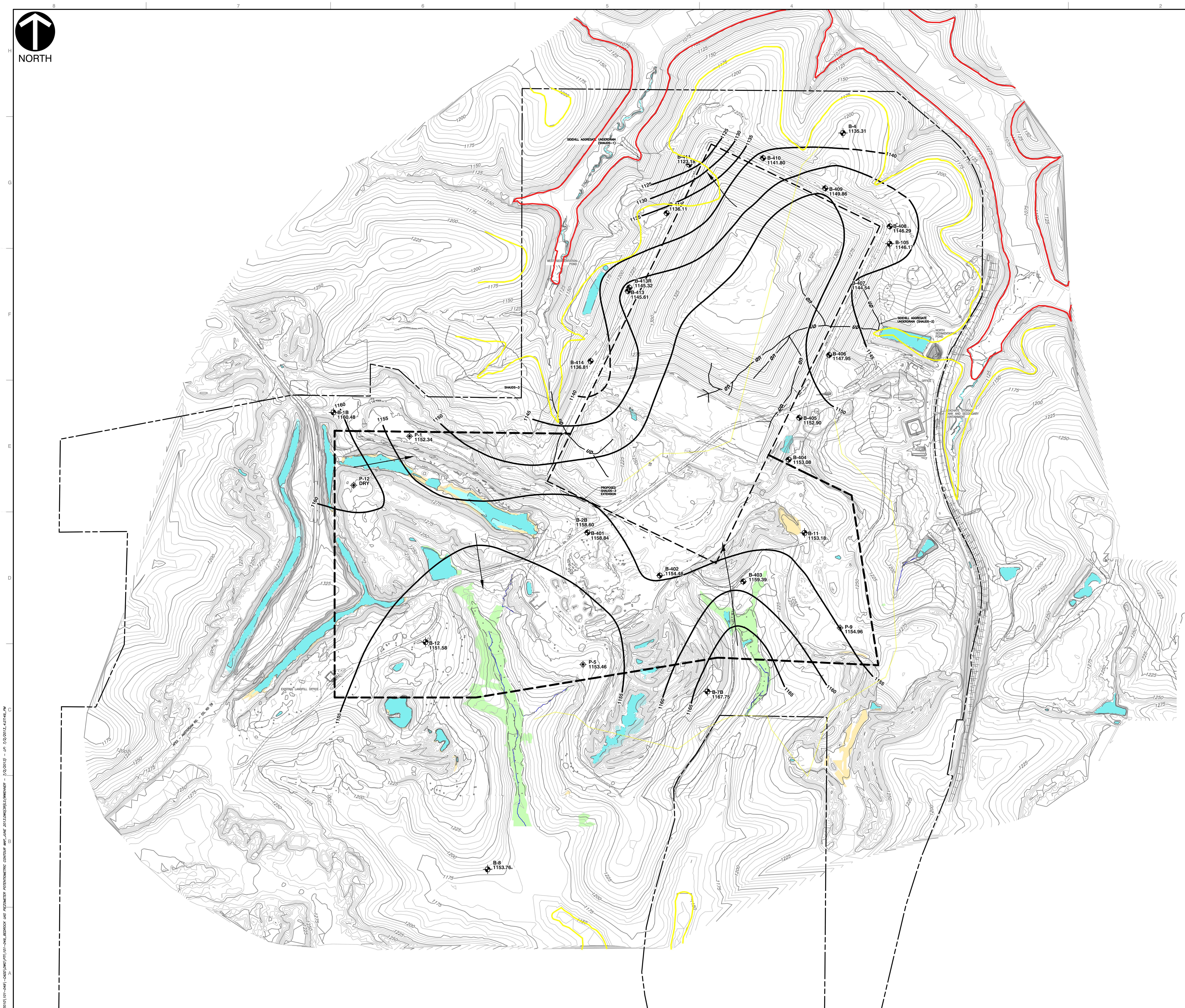
DRAWN BY:	BTW	CHECKED BY:	RAS	APPROVED BY:	DRAFT
DATE:	JUNE 2013	DWG SCALE:	1"=300'	PROJECT NO:	101-049

BELLAIRE - SUMMERFIELD POTENTIOMETRIC MAP
DECEMBER 10, 2012

DRAWING NO.: 3Q
SHEET - OF

NO	DATE	DESCRIPTION
REVISION RECORD		
1	JULY 2013	REVISION FOR OHIO EPA NOD (12/28/2012)

NO	DATE	DESCRIPTION
SUBMITTAL RECORD		



LEGEND

- ISOLATED OPEN WATER
- ISOLATED WETLAND
- JURSIDICTIONAL WETLAND
- APPROXIMATE LOCATION OF CONNELSVILLE/MORGANTOWN LOWERMOST SUBCROP/OUTCROP
- APPROXIMATE LOCATION OF CONNELSVILLE/MORGANTOWN UPPERMOST SUBCROP/OUTCROP
- PROPERTY LINE
- TREELINE
- EXISTING UNPAVED DRIVE
- EXISTING RAIL ROAD
- 1200 — EXISTING INDEX CONTOUR
- PERMITTED LIMIT OF SOLID WASTE PLACEMENT
- PROPOSED LIMIT OF SOLID WASTE PLACEMENT
- UD — EXISTING UNDERDRAIN
- EXISTING UNDERDRAIN TRENCH
- PROPOSED UNDERDRAIN
- APPROXIMATE EXTENT OF HIGH GROUNDWATER YIELD (TO BE REMOVED)
- 1200 — POTENTIOMETRIC SURFACE CONTOUR (DASHED WHERE INFERRED)
- GROUNDWATER FLOW DIRECTION
- STRUCTURE/BUILDING
- B-309 PIEZOMETER
- B-402 DETECTION MONITORING WELL
- B-303 ABANDONED WELL/PIEZOMETER
- P-5S BELLAIRE/SUMMERFIELD PIEZOMETER
- P-5 CONNELLSVILLE/MORGANTOWN PIEZOMETER
- P-5A MINESPOIL PIEZOMETER
- P-5L LIMESTONE/SHALLOW ROCK PIEZOMETER
- SB-17 SOIL BORING
- RB-8 SOIL BORING TO TOP OF ROCK – NO SPLIT SPOON SAMPLING
- TPE-22 TEST PIT (CONDUCTED FOR EXPANSION)
- TP-13 EXISTING TEST PIT
- PG-1 POND GAUGE

* NOT USED FOR CONTOURING

GROUNDWATER CONDITIONS

THE WATER LEVELS PRESENTED HEREIN ARE APPLICABLE TO THE LOCATION AND TIME OF MEASUREMENT. WATER LEVELS MAY FLUCTUATE THROUGH TIME.

POTENTIOMETRIC CONTOURS GENERATED FROM THIS DATA ARE CONSTRUCTED BY INTERPOLATION BETWEEN POINTS OF KNOWN STATIC WATER LEVEL ELEVATIONS AND USING KNOWLEDGE OF SPECIFIC SITE CONDITIONS. ACTUAL STATIC WATER LEVELS AT LOCATIONS BETWEEN THE MONITORING POINTS MAY DIFFER FROM THOSE DEPICTED.

REFERENCE

TOPOGRAPHIC MAPPING PREPARED BY KEDDAL AERIAL MAPPING, INC. USING AERIAL PHOTOGRAPHY DATED JANUARY 6, 2012 AND JANUARY 5, 2011. ADDITIONAL MAPPING PREPARED BY M.A.N. MAPPING USING 12/14/00 AERIAL PHOTOGRAPHY.

SCALE IN FEET
0 300 600

* HAND SIGNATURE ON FILE

Civil & Environmental Consultants, Inc.
8740 Orion Place, Suite 100 - Columbus, OH 43240
Ph: 614.540.6633 · 888.598.6808 · Fax: 614.540.6638
www.cecinc.com

APEX ENVIRONMENTAL, LLC.
PERMIT TO INSTALL APPLICATION
CONTIGUOUS EXPANSION
APEX SANITARY LANDFILL
JEFFERSON COUNTY, OHIO

DRAWN BY:	BTW	CHECKED BY:	BRB	APPROVED BY:	DRAFT
DATE:	JUNE 2013	DWG SCALE:	1"=300'	PROJECT NO:	101-049

CONNELLSVILLE - MORGANTOWN
POTENTIOMETRIC MAP DECEMBER 10, 2012

DRAWING NO.: 3R
SHEET - OF

NORTH

REVISION RECORD		
NO	DATE	DESCRIPTION
1	JULY 2013	REVISION FOR OHIO EPA NOD (12/28/2012)
2		
3		
4		
5		

SUBMITTAL RECORD		
NO	DATE	DESCRIPTION

SIDEHILL AGGREGATE UNDERDRAIN (SHAUDS-1)
WEST SEDIMENTATION POND
SHAUDS-3
PROPOSED SHAUDS-3 EXTENTION
SIDEHILL AGGREGATE UNDERDRAIN (SHAUDS-2)
NORTH SEDIMENTATION POND
OFFICE
LEACHATE STORAGE TANK AND SECONDARY CONTAINMENT
EXISTING LANDFILL OFFICE
APEX - AMSTERDAM RD. - CO. RD. 78

LEGEND

- PROPERTY LINE
- TREELINE
- EXISTING UNPAVED DRIVE
- EXISTING RAIL ROAD
- EXISTING INDEX CONTOUR
- PERMITTED LIMIT OF SOLID WASTE PLACEMENT
- PROPOSED LIMIT OF SOLID WASTE PLACEMENT
- UD — EXISTING UNDERDRAIN
- EXISTING UNDERDRAIN TRENCH
- PROPOSED UNDERDRAIN
- APPROXIMATE EXTENT OF HIGH GROUNDWATER YIELD (TO BE REMOVED)
- STRUCTURE/BUILDING
- B-309 — PIEZOMETER
- B-402 — DETECTION MONITORING WELL
- B-303 — ABANDONED WELL/PIEZOMETER
- P-5S — BELLAIRE/SUMMERFIELD PIEZOMETER
- P-5 — CONNELLSVILLE/MORGANTOWN PIEZOMETER
- P-5A — MINESPOIL PIEZOMETER
- P-5L — LIMESTONE/SHALLOW ROCK PIEZOMETER
- SB-17 — SOIL BORING
- RB-8 — SOIL BORING TO TOP OF ROCK – NO SPLIT SPOON SAMPLING
- TPE-22 — TEST PIT (CONDUCTED FOR EXPANSION)
- TP-13 — EXISTING TEST PIT
- B-404 / B-404S — PROPOSED DETECTION MONITORING WELL FOR PERMITTED FACILITY
- B-420 — PROPOSED DETECTION MONITORING WELL FOR THE LATERAL EXPANSION AREA
- TBM-2 — EXISTING BENCHMARK
- PG-1 — POND GAUGE

REFERENCE

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SCALE IN FEET
0 300 600

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CONTIGUOUS EXPANSION
APEX SANITARY LANDFILL
JEFFERSON COUNTY, OHIO

DRAWN BY:	BTW	CHECKED BY:	JMB	APPROVED BY:	JMD*
DATE:	AUG 2011	DWG SCALE:	1"=200'	PROJECT NO:	101-049

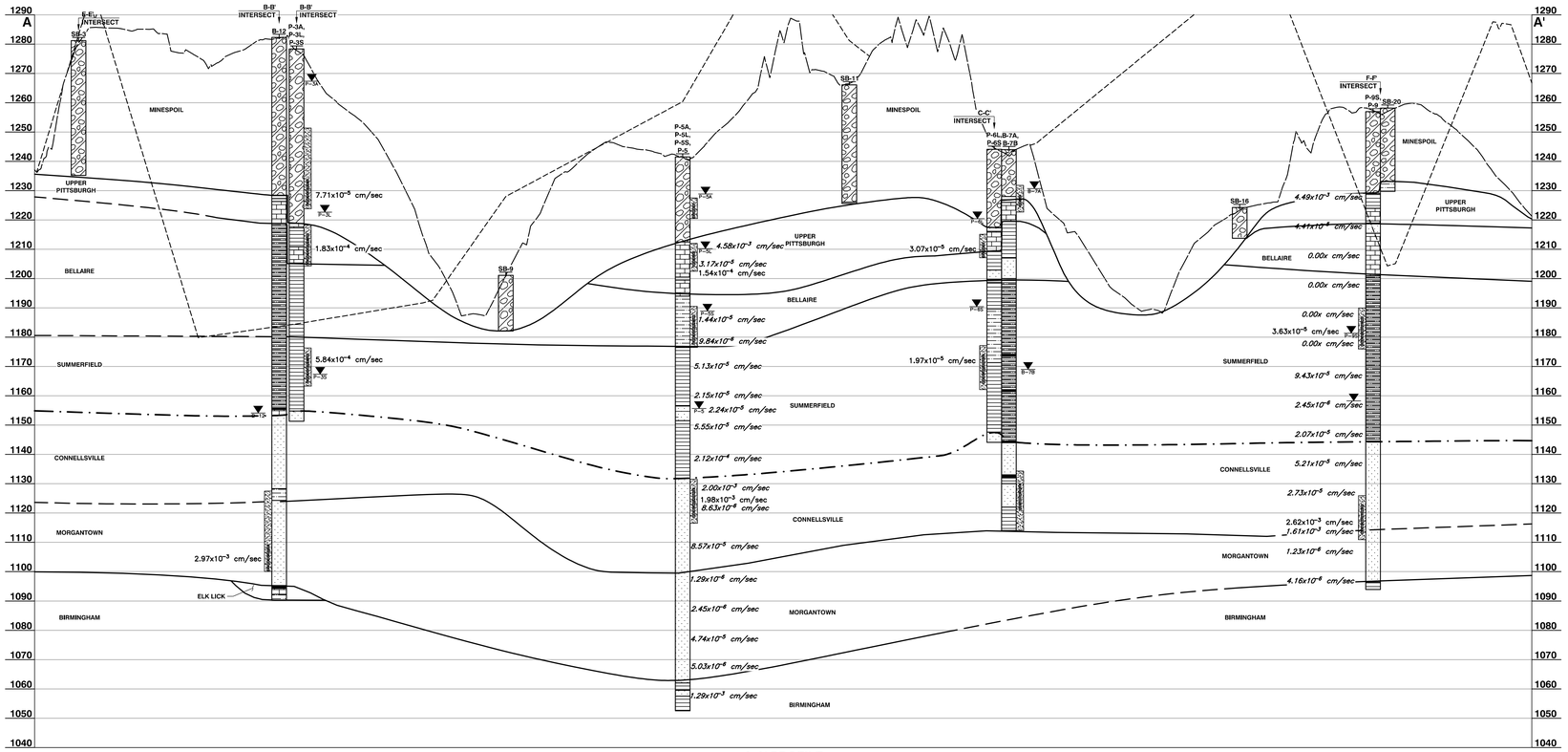
GEOLOGIC CROSS-SECTION LOCATION MAP

DRAWING NO.: 5A
SHEET OF

P:\101\01-049\-DAGS\DWG\01-049_GEOLOGIC CROSS SECTION LOCATIONS.DWG 7/2/2013 - LR 7/2/2013 4:38:46 PM

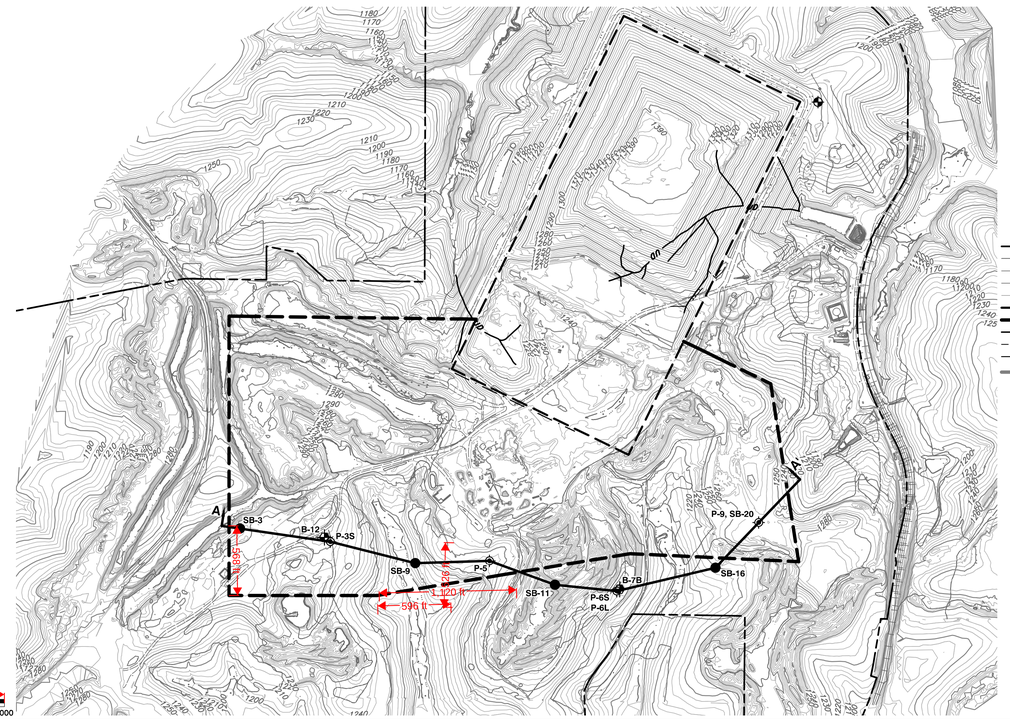
REVISION RECORD		
NO	DATE	DESCRIPTION

SUBMITTAL RECORD		
NO	DATE	DESCRIPTION



A-A' PROFILE

VERTICAL SCALE IN FEET 0 20 40 HORIZONTAL SCALE IN FEET 0 200 400



LEGEND

- FORMATION CONTACT (DASHED WHERE INFERRED)
- APPROXIMATE TOP OF UPPERMOST AQUIFER SYSTEM (UAS)
- BASE OF PROPOSED RECOMPACTED SOIL LINER
- 1.00x10⁻⁵ cm/sec — HYDRAULIC CONDUCTIVITY SINGLE WELL SLUG TEST (CENTIMETERS PER SECOND)
- 1.00x10⁻⁵ cm/sec — HYDRAULIC CONDUCTIVITY OPEN HOLE PACKER TEST CONDUCTED ON 10-FT INTERVALS (CENTIMETERS PER SECOND)
- GROUNDWATER ELEVATION (MARCH 28, 2011)
- SCREENED INTERVAL
- SAND PACK INTERVAL
- INTERBEDDED SHALE & LIMESTONE
- SHALEY LIMESTONE
- LIMESTONE
- LIMESTONE NODULES
- MINESPOIL
- RESIDUAL SOIL
- SHALE/CLAYSTONE
- SHALE
- SANDSTONE
- SILTSTONE
- COAL
- SHALEY SANDSTONE
- CONGLOMERATE
- SILTSTONE AND SHALE
- INTERBEDDED SANDSTONE AND SILTSTONE

LEGEND

- PROPERTY LINE
- TREELINE
- EXISTING UNPAVED DRIVE
- EXISTING RAIL ROAD
- EXISTING INDEX CONTOUR
- PERMITTED LIMIT OF SOLID WASTE PLACEMENT
- PROPOSED LIMIT OF SOLID WASTE PLACEMENT
- UD — EXISTING UNDERDRAIN
- EXISTING UNDERDRAIN TRENCH
- PROPOSED UNDERDRAIN
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- STRUCTURE/BUILDING
- B-309 — PIEZOMETER
- B-402 — DETECTION MONITORING WELL
- B-303 — ABANDONED WELL/PIEZOMETER
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- P-5 — CONNELLSVILLE/MORGANTOWN PIEZOMETER
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- B-420 — PROPOSED DETECTION MONITORING WELL FOR THE LATERAL EXPANSION AREA
- TBM-2 — EXISTING BENCHMARK
- PG-1 — POND GAUGE

GEOLOGIC CONDITIONS

THE BORING LOGS AND RELATED INFORMATION PRESENTED HEREIN DEPICT SUBSURFACE CONDITIONS AT TEST BORING LOCATIONS AND AT THE TIME OF DRILLING. SOIL CONDITIONS AT OTHER LOCATIONS MAY DIFFER.

GEOLOGIC CORRELATIONS SHOWN BETWEEN TEST BORINGS GENERALLY ARE BASED ON STRAIGHT-LINE INTERPOLATION. ACTUAL CONDITIONS BETWEEN TEST BORINGS MAY DIFFER.

REFERENCE

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JEFFERSON COUNTY, OHIO

DRAWN BY:	BTW	CHECKED BY:	JMB	APPROVED BY:	JMD*
DATE:	AUG 2011	DWG SCALE:	AS NOTED	PROJECT NO:	101-049

GEOLOGIC CROSS SECTION A-A'

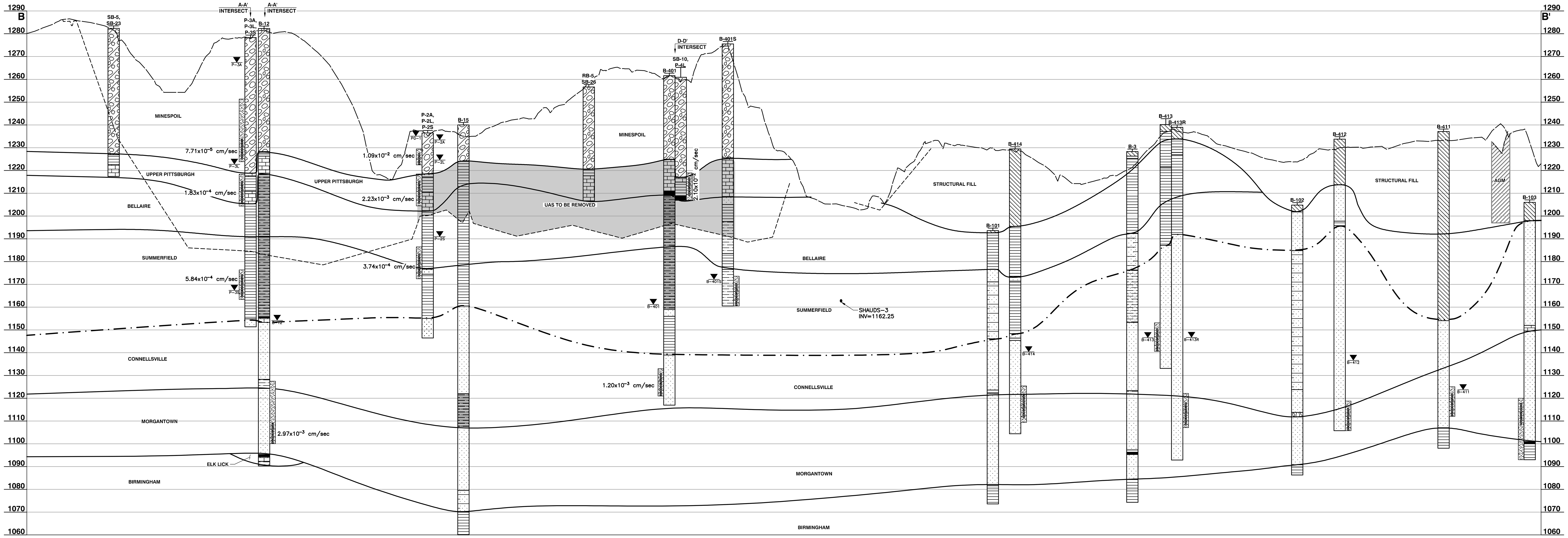
DRAWING NO.: 5B

SHEET OF

P:\2010\101-049\-DWG\[WD\101-049_GEOLOGIC CROSS SECTIONS 24 x36'.DWG]BASIS OWNER - 2/2/2012 - LP, 2/2/2012 4:28:22 PM

REVISION RECORD		
NO	DATE	DESCRIPTION

SUBMITTAL RECORD		
NO	DATE	DESCRIPTION



B-B' PROFILE

VERTICAL SCALE IN FEET 0 20 40 — HORIZONTAL SCALE IN FEET 0 200 400

DETERMINED TO BE UAS BASED ON YIELD. TO BE REMOVED DURING EXCAVATION

AGM – ADDED GEOLOGIC MATERIAL

LEGEND

- FORMATION CONTACT (DASHED WHERE INFERRED)
- APPROXIMATE TOP OF UPPERMOST AQUIFER SYSTEM (UAS)
- BASE OF PROPOSED RECOMPACTED SOIL LINER
- 1.00x10⁻⁵ cm/sec — HYDRAULIC CONDUCTIVITY SINGLE WELL SLUG TEST (CENTIMETERS PER SECOND)
- *1.00x10⁻⁵ cm/sec* — HYDRAULIC CONDUCTIVITY OPEN HOLE PACKER TEST CONDUCTED ON 10-FT INTERVALS (CENTIMETERS PER SECOND)
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- LIMESTONE
- LIMESTONE NODULES
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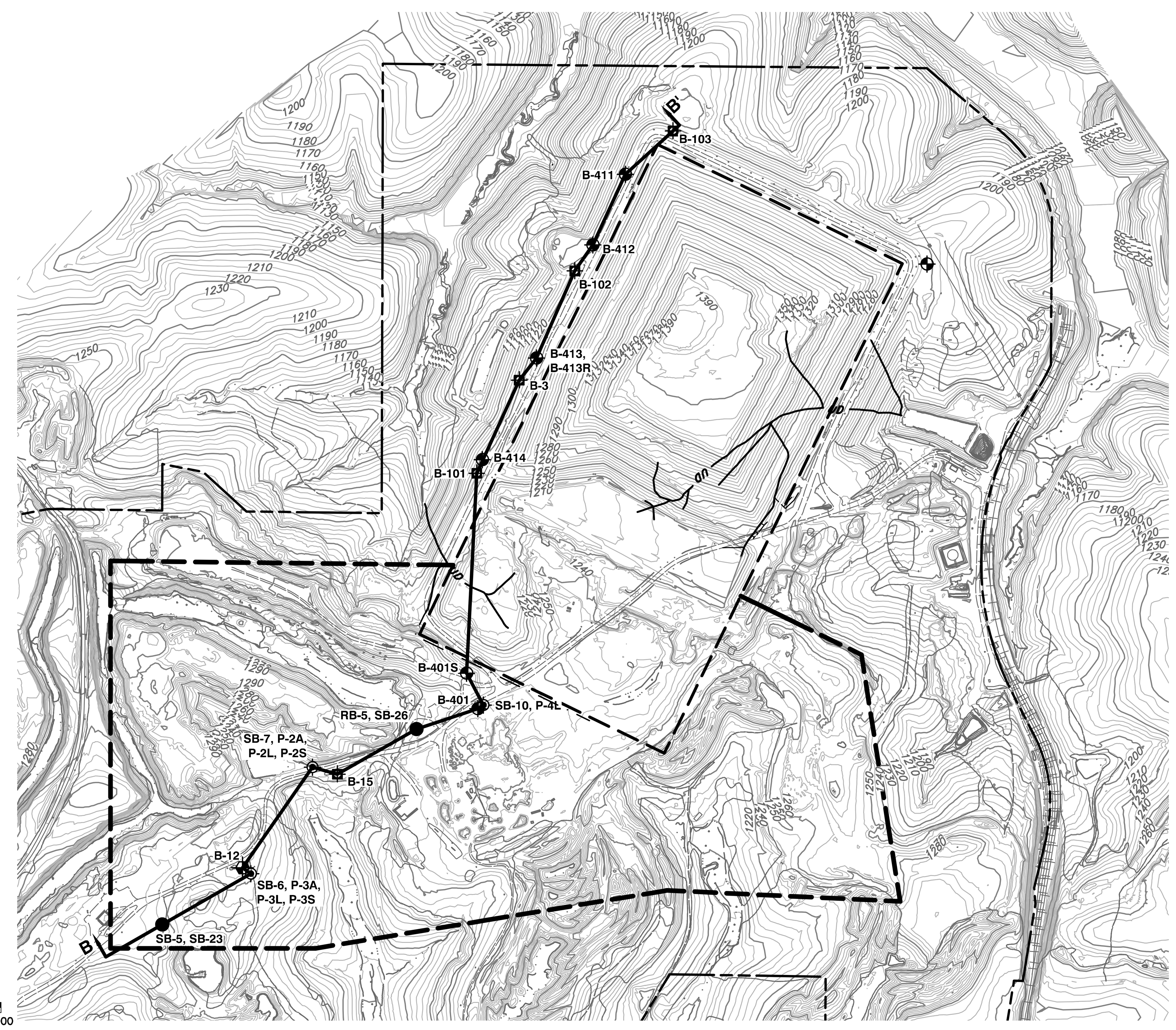
- COAL
- SHALEY SANDSTONE
- CONGLOMERATE
- SILTSTONE AND SHALE
- INTERBEDDED SANDSTONE AND SILTSTONE



NORTH

SCALE IN FEET 0 500 1000

LEGEND

- PROPERTY LINE
- TREELINE
- EXISTING UNPAVED DRIVE
- EXISTING RAIL ROAD
- EXISTING INDEX CONTOUR
- PERMITTED LIMIT OF SOLID WASTE PLACEMENT
- PROPOSED LIMIT OF SOLID WASTE PLACEMENT
- EXISTING UNDERDRAIN
- EXISTING UNDERDRAIN TRENCH
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- TP-13 EXISTING TEST PIT
- B-404, B-404S PROPOSED DETECTION MONITORING WELL FOR PERMITTED FACILITY
- B-420 PROPOSED DETECTION MONITORING WELL FOR THE LATERAL EXPANSION AREA
- TBM-2 EXISTING BENCHMARK
- PG-1 POND GAUGE

GEOLOGIC CONDITIONS

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JEFFERSON COUNTY, OHIO

DRAWN BY: BTW	CHECKED BY: JMB	APPROVED BY: JMD*
DATE: AUG 2011	DWG SCALE: AS NOTED	PROJECT NO: 101-049

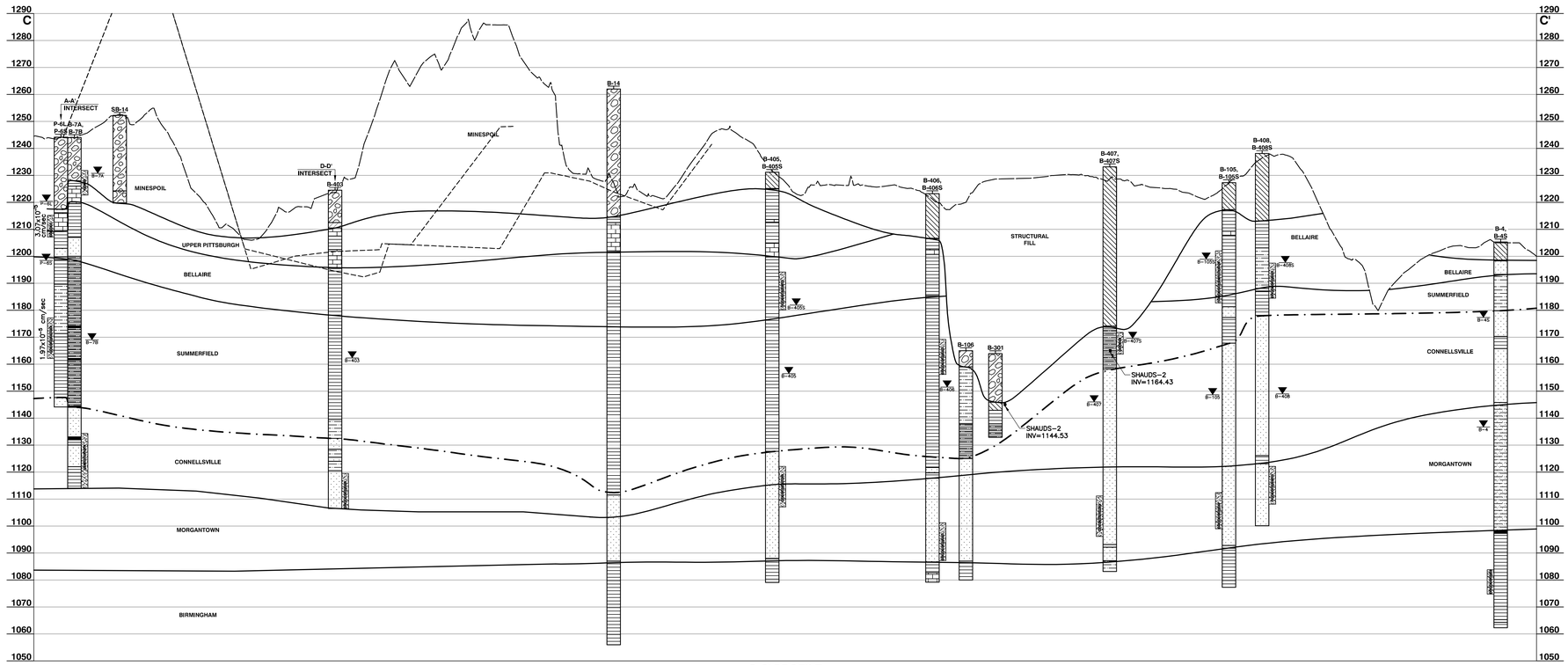
GEOLOGIC CROSS SECTION B-B'

DRAWING NO.: 5C

SHEET OF

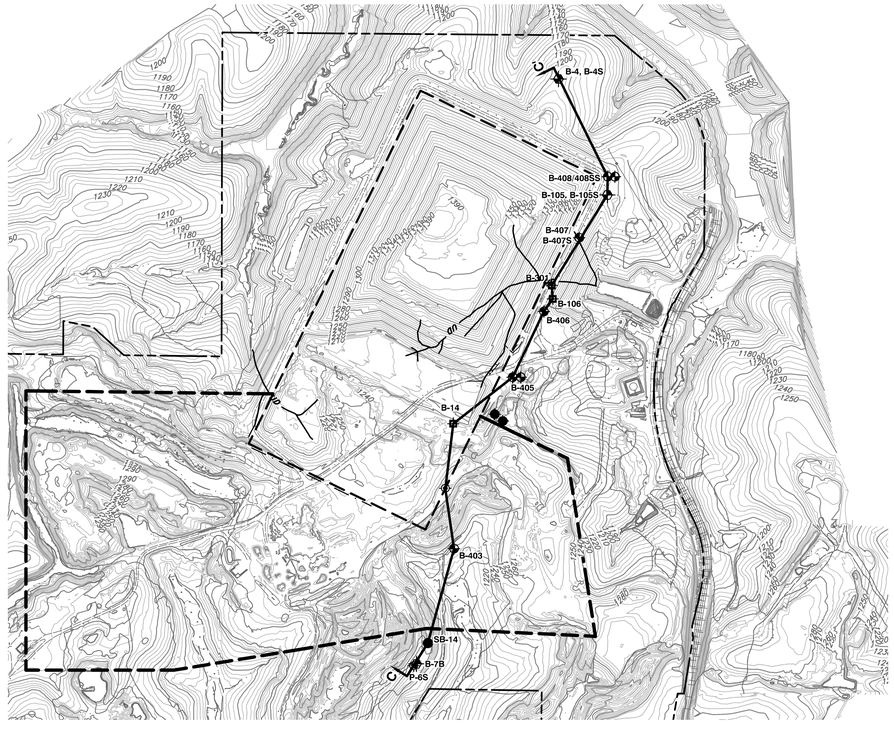
REVISION RECORD		
NO	DATE	DESCRIPTION

SUBMITTAL RECORD		
NO	DATE	DESCRIPTION



C-C' PROFILE

VERTICAL SCALE IN FEET 0 20 40 HORIZONTAL SCALE IN FEET 0 200 400



NORTH

SCALE IN FEET 0 500 1000

LEGEND

- PROPERTY LINE
- TREELINE
- EXISTING UNPAVED DRIVE
- EXISTING RAIL ROAD
- EXISTING INDEX CONTOUR
- PERMITTED LIMIT OF SOLID WASTE PLACEMENT
- PROPOSED LIMIT OF SOLID WASTE PLACEMENT
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LEGEND

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- APPROXIMATE TOP OF UPPERMOST AQUIFER SYSTEM (UAS)
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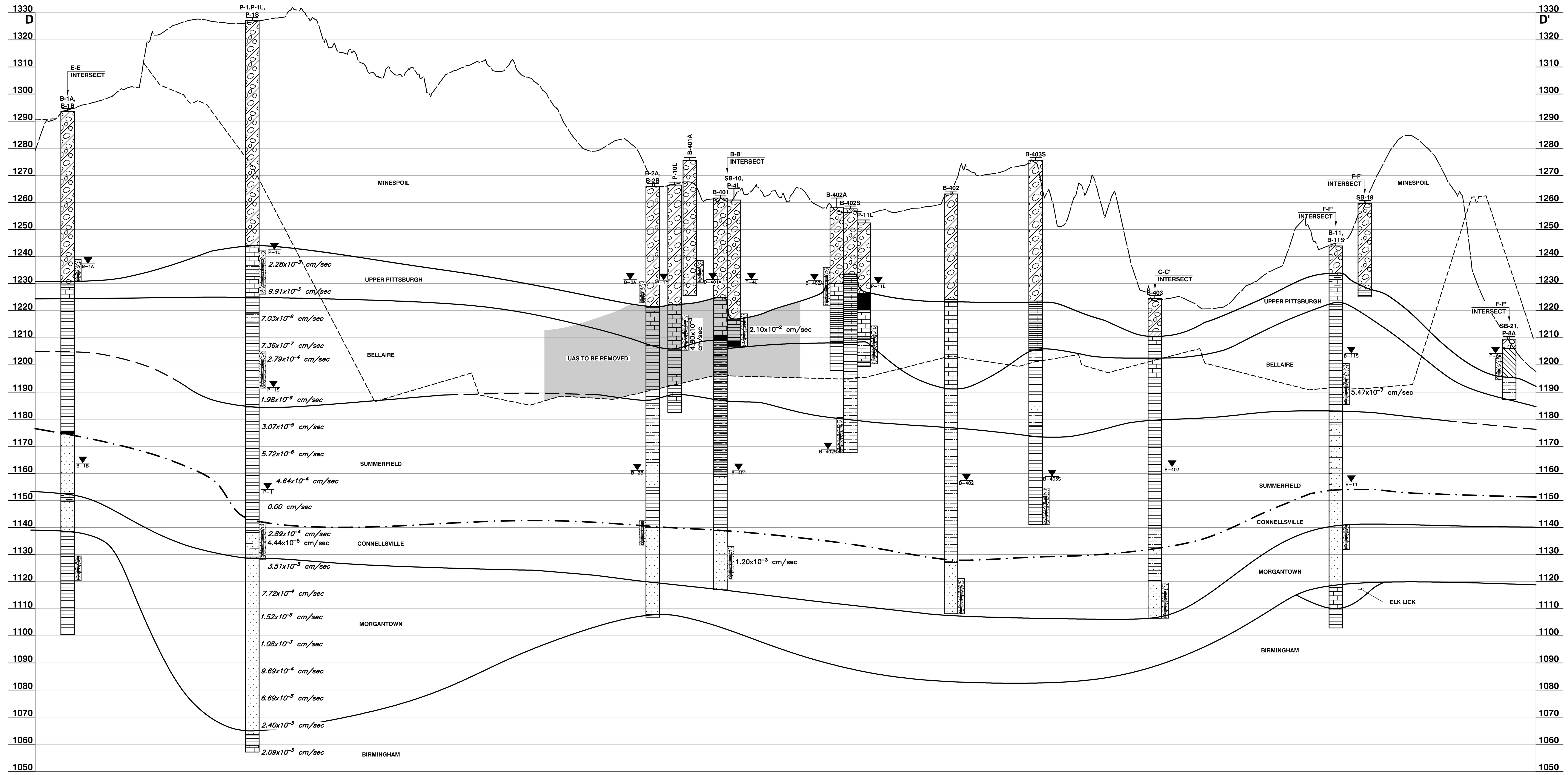
DRAWN BY:	BTW	CHECKED BY:	JMB	APPROVED BY:	JMD*
DATE:	AUG 2011	DWG SCALE:	AS NOTED	PROJECT NO:	101-049

GEOLOGIC CROSS SECTION C-C'

DRAWING NO.: 5D

SHEET OF

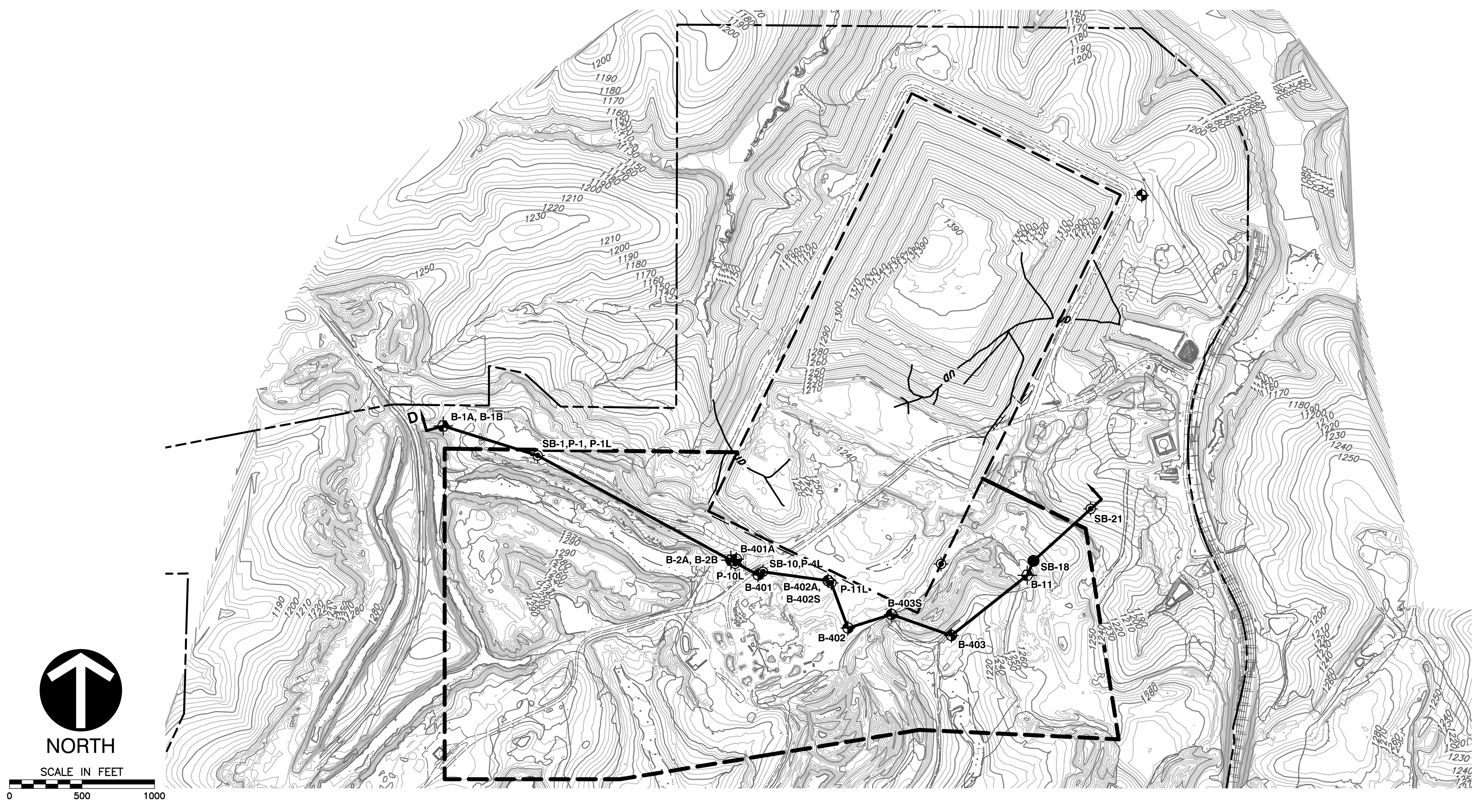
P:\2010\101-049\-DWG\[WG1P1]101-049_GEOLOGIC CROSS SECTIONS 30 JULY 2013.DWG|GEOLOGIC CROSS SECTION C-C'|JMENDER - 7/2/2013 - LP: 7/2/2013_4:29:35_PM



D-D' PROFILE

VERTICAL SCALE IN FEET 0 20 40 — HORIZONTAL SCALE IN FEET 0 200 400

DETERMINED TO BE UAS BASED ON YIELD. TO BE REMOVED DURING EXCAVATION



LEGEND

- PROPERTY LINE
- TREELINE
- EXISTING UNPAVED DRIVE
- EXISTING RAIL ROAD
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- TBM-2 EXISTING BENCHMARK
- PG-1 POND GAUGE

REVISION RECORD

NO	DATE	DESCRIPTION

SUBMITTAL RECORD

NO	DATE	DESCRIPTION

LEGEND

- FORMATION CONTACT (DASHED WHERE INFERRED)
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GEOLOGIC CONDITIONS

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JEFFERSON COUNTY, OHIO

DRAWN BY: BTW	CHECKED BY: JMB	APPROVED BY: JMD*
DATE: AUG 2011	DWG SCALE: AS NOTED	PROJECT NO: 101-049

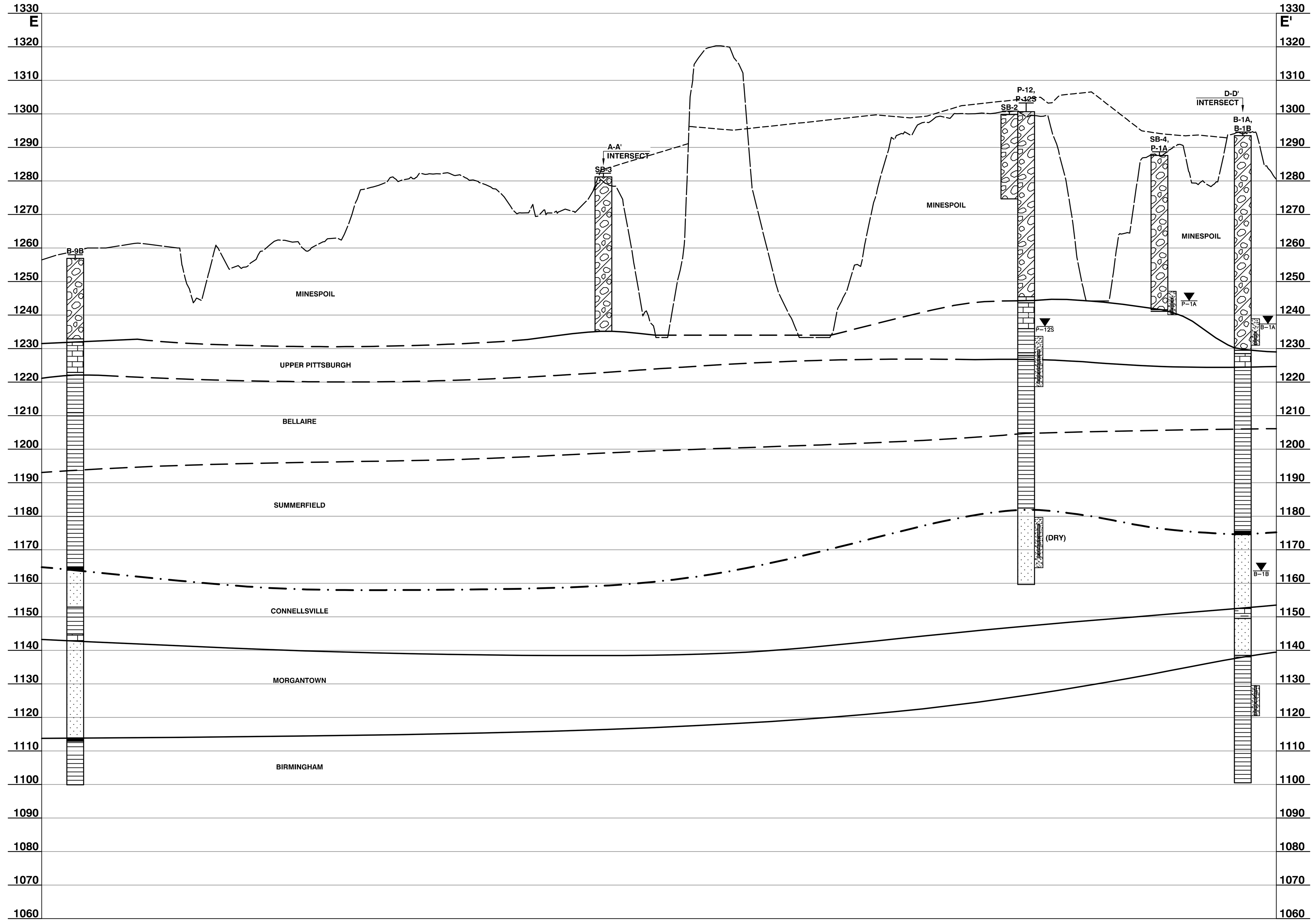
GEOLOGIC CROSS SECTION D-D' — DRAWING NO.: 5E — SHEET OF

REVISION RECORD

NO	DATE	DESCRIPTION

SUBMITTAL RECORD

NO	DATE	DESCRIPTION



E-E' PROFILE

VERTICAL SCALE IN FEET: 0 20 40 HORIZONTAL SCALE IN FEET: 0 200 400

LEGEND

- FORMATION CONTACT (DASHED WHERE INFERRED)
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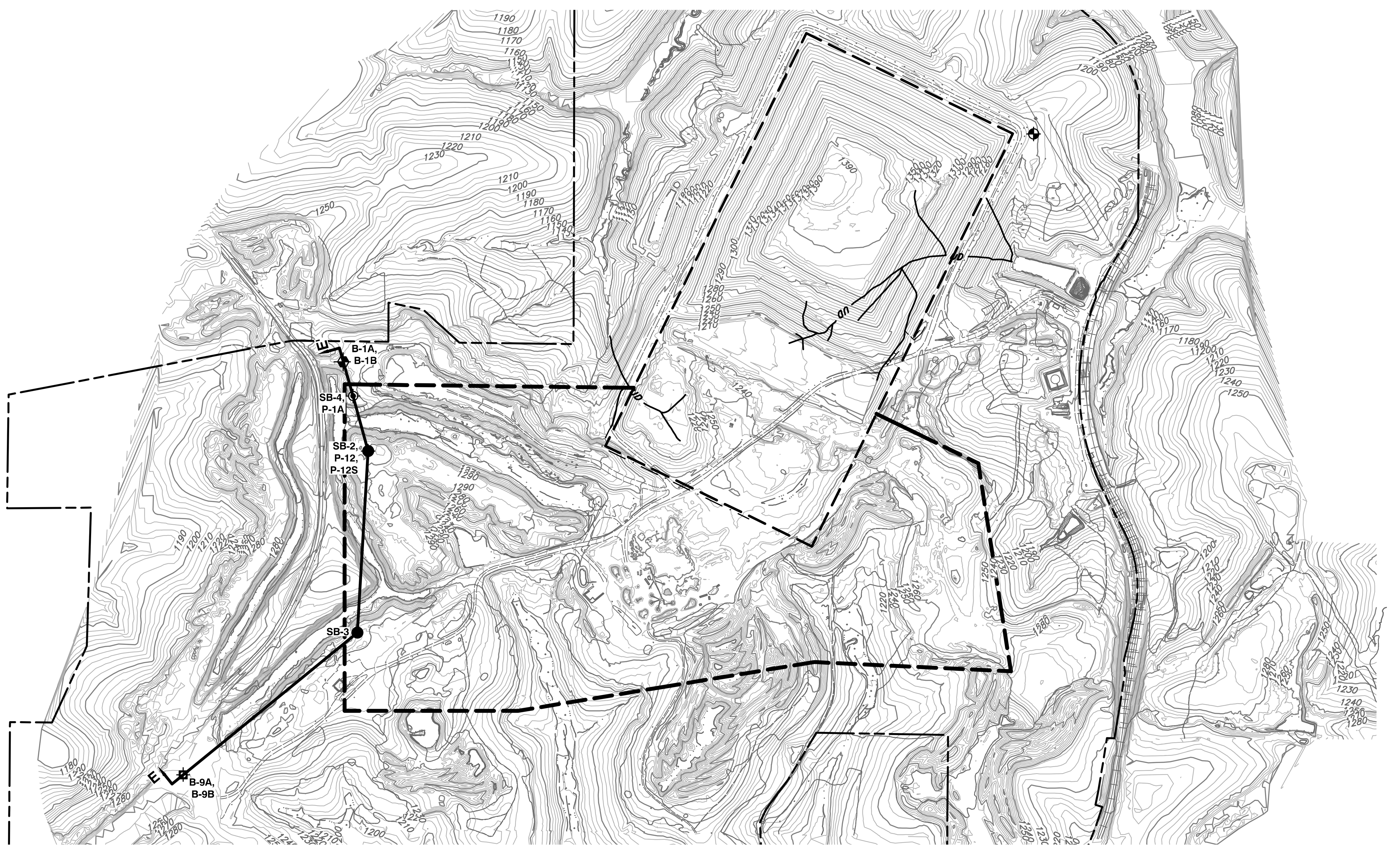
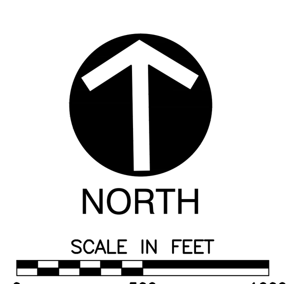
- SHALE/CLAYSTONE
- SHALE
- SANDSTONE
- SILTSTONE
- COAL
- SHALEY SANDSTONE
- CONGLOMERATE
- SILTSTONE AND SHALE
- INTERBEDDED SANDSTONE AND SILTSTONE





LEGEND

- PROPERTY LINE
- TREELINE
- EXISTING UNPAVED DRIVE
- EXISTING RAIL ROAD
- EXISTING INDEX CONTOUR
- PERMITTED LIMIT OF SOLID WASTE PLACEMENT
- PROPOSED LIMIT OF SOLID WASTE PLACEMENT
- UD — EXISTING UNDERDRAIN
- EXISTING UNDERDRAIN TRENCH
- PROPOSED UNDERDRAIN
- APPROXIMATE EXTENT OF HIGH GROUNDWATER YIELD (TO BE REMOVED)
- STRUCTURE/BUILDING
- B-309 — PIEZOMETER
- B-402 — DETECTION MONITORING WELL
- B-303 — ABANDONED WELL/PIEZOMETER
- P-5S — BELLAIRE/SUMMERFIELD PIEZOMETER
- P-5 — CONNELLSVILLE/MORGANTOWN PIEZOMETER
- P-5A — MINESPOIL PIEZOMETER
- P-5L — LIMESTONE/SHALLOW ROCK PIEZOMETER
- SB-17 — SOIL BORING
- RB-8 — SOIL BORING TO TOP OF ROCK – NO SPLIT SPOON SAMPLING
- TPE-22 — TEST PIT (CONDUCTED FOR EXPANSION)
- TP-13 — EXISTING TEST PIT
- B-404, B-404S — PROPOSED DETECTION MONITORING WELL FOR PERMITTED FACILITY
- B-420 — PROPOSED DETECTION MONITORING WELL FOR THE LATERAL EXPANSION AREA
- TBM-2 — EXISTING BENCHMARK
- PG-1 — POND GAUGE

GEOLOGIC CONDITIONS

THE BORING LOGS AND RELATED INFORMATION PRESENTED HEREIN DEPICT SUBSURFACE CONDITIONS AT THE TEST BORING LOCATIONS AND AT THE TIME OF DRILLING. SOIL CONDITIONS AT OTHER LOCATIONS MAY DIFFER.

GEOLOGIC CORRELATIONS SHOWN BETWEEN TEST BORINGS GENERALLY ARE BASED ON STRAIGHT-LINE INTERPOLATION. ACTUAL CONDITIONS BETWEEN TEST BORINGS MAY DIFFER.

REFERENCE

TOPOGRAPHIC MAPPING PREPARED BY KEDDAL AERIAL MAPPING, INC. USING AERIAL PHOTOGRAPHY DATED JANUARY 6, 2012 AND JANUARY 5, 2011. ADDITIONAL MAPPING PREPARED BY M.A.N. MAPPING USING 12/14/00 AERIAL PHOTOGRAPHY.

* HAND SIGNATURE ON FILE

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Ph: 614.540.6633 · 888.598.6808 · Fax: 614.540.6638
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APEX ENVIRONMENTAL, LLC.
PERMIT TO INSTALL APPLICATION
CONTIGUOUS EXPANSION
JEFFERSON COUNTY, OHIO

DRAWN BY:	BTW	CHECKED BY:	JMB	APPROVED BY:	JMD*
DATE:	AUG 2011	DWG SCALE:	AS NOTED	PROJECT NO:	101-049

GEOLOGIC CROSS SECTION F-F'

DRAWING NO.: 5F

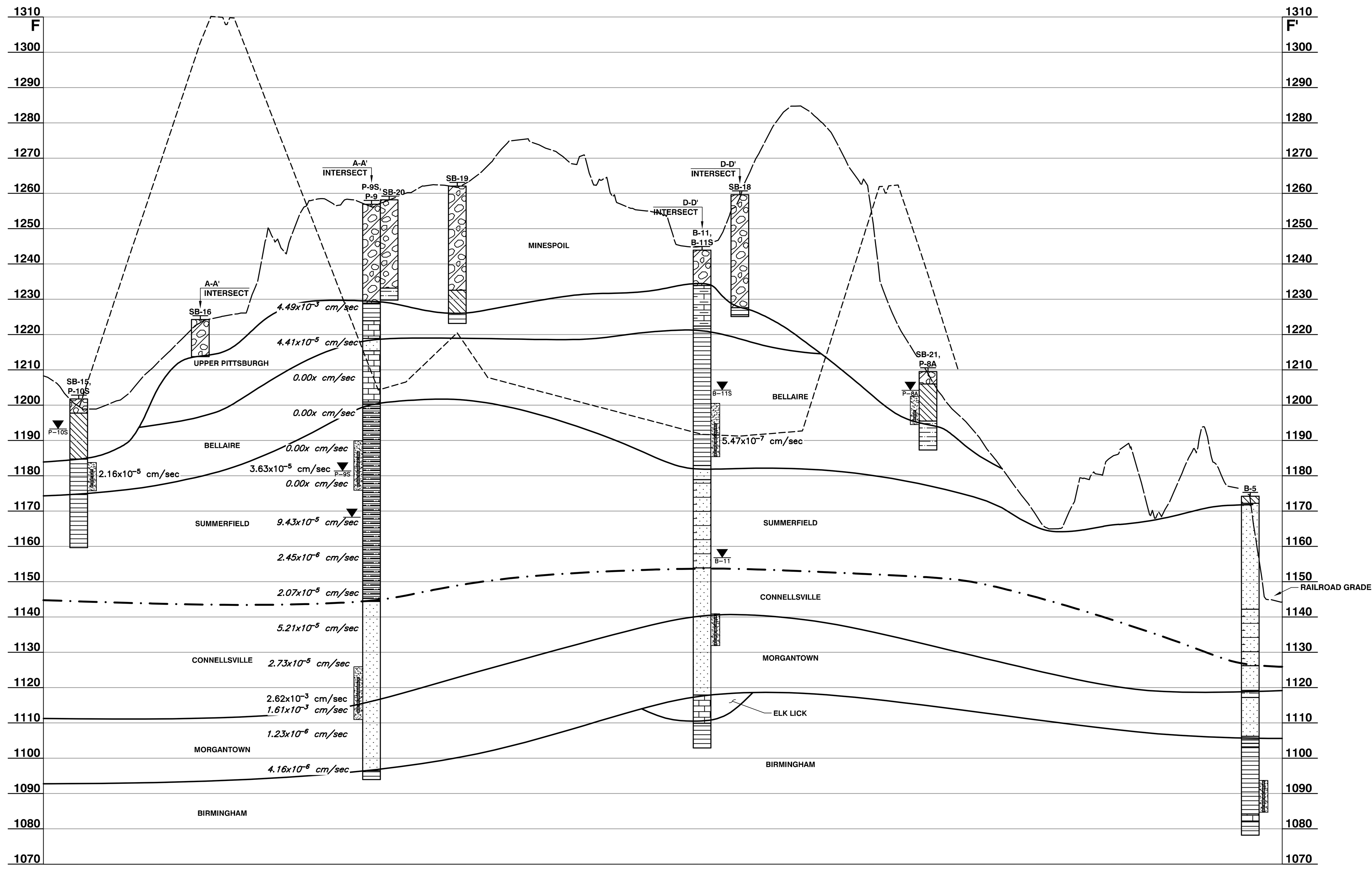
SHEET OF

REVISION RECORD

NO	DATE	DESCRIPTION

SUBMITTAL RECORD

NO	DATE	DESCRIPTION



F-F' PROFILE

VERTICAL SCALE IN FEET 0 20 40 — HORIZONTAL SCALE IN FEET 0 200 400

LEGEND

- FORMATION CONTACT (DASHED WHERE INFERRED)
- APPROXIMATE TOP OF UPPERMOST AQUIFER SYSTEM (UAS)
- BASE OF PROPOSED RECOMPACTED SOIL LINER
- 1.00x10^-5 cm/sec — HYDRAULIC CONDUCTIVITY SINGLE WELL SLUG TEST (CENTIMETERS PER SECOND)
- *1.00x10^-5 cm/sec* — HYDRAULIC CONDUCTIVITY OPEN HOLE PACKER TEST CONDUCTED ON 10-FT INTERVALS (CENTIMETERS PER SECOND)
- GROUNDWATER ELEVATION (MARCH 28, 2011)
- SCREENED INTERVAL
- SAND PACK INTERVAL
- INTERBEDDED SHALE & LIMESTONE
- SHALEY LIMESTONE
- LIMESTONE
- LIMESTONE NODULES
- MINESPOIL
- RESIDUAL SOIL
- SHALE/CLAYSTONE
- SHALE
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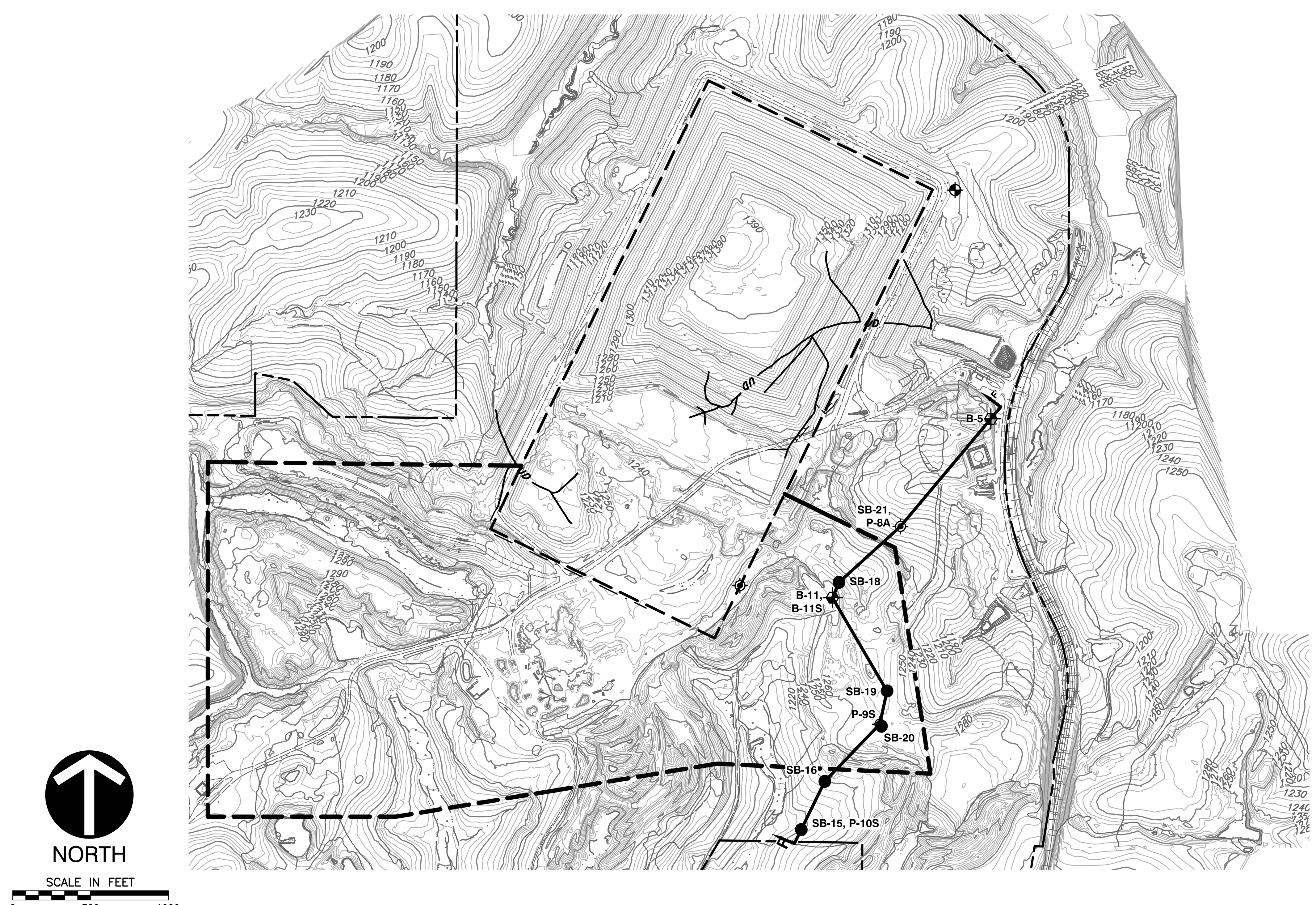

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JEFFERSON COUNTY, OHIO

DRAWN BY: BTW	CHECKED BY: JMB	APPROVED BY: JMD*
DATE: AUG 2011	DWG SCALE: AS NOTED	PROJECT NO: 101-049

GELOGIC CROSS SECTION E-E'

DRAWING NO.: 5G

SHEET OF