Revitalizing Auto Communities
Environmental Response Trust

February 6, 2019

Ohio Environmental Protection Agency
Division of Environmental Response and Revitalization
Central Office
P.O. Box 1049
Columbus, Ohio 43216-1049
Attn: Laurie Stevenson, Director

RE: Post-Closure Amendment Request – Revision 1
Site Name: RACER Trust Moraine Facilities
Moraine, Ohio

Dear Ms. Stevenson:

The Revitalizing Auto Communities Environmental Response Trust (RACER Trust) is providing this Post-Closure Amendment Request for the RACER Trust Moraine Facilities in Moraine, Ohio (Site). This request is being provided to facilitate implementation of an interim measure called Phase 1 Dynamic Groundwater Recirculation (DGR™) on the closed South Settling Lagoon (SSL) property at the Site. This revised document is based on comments received from the Ohio EPA in the Notice of Deficiency – Amended Post-Closure Plan[1] letter. The specific revisions are highlighted in Attachment 3 of this submittal.

The information in this request is being provided per comments from the Ohio Environmental Protection Agency (Ohio EPA) that were provided via email on August 29, 2018, October 1, 2018, and October 19, 2018. The objective of the Phase 1 DGR™ interim measure is to reduce site-specific volatile organic compounds (VOCs) in groundwater within the Riverview Plat neighborhood (neighborhood) to concentrations below the United States Environmental Protection Agency (U.S. EPA) Maximum Contaminant Levels (MCLs), within 5 years of initiating full-scale operation. Once concentrations of VOCs have been adequately reduced, vapor intrusion mitigation systems in the neighborhood will no longer be necessary. Since RACER Trust has not been able to gain access to all the properties in the neighborhood for vapor intrusion assessment and/or mitigation, implementation of the Phase 1 DGR™ interim measure is a priority to reduce the risk of exposure from vapor intrusion and this amendment is needed.

The SSL was closed per Ohio Administrative Code (OAC) 3745-66-11 by solidifying sludge in-situ, backfilling the basins with material from existing on-site soil stockpiles or imported material, and constructing a vegetated soil cover as documented in the Certification of Lagoon Closure Report[2]. A portion of the Phase 1 DGR™ interim measure is proposed to be installed through the

[1] Ohio Environmental Protection Agency, 2019. Notice of Deficiency Amended Post-Closure Plan, Closed South Settling Lagoon, Moraine, Ohio. February 2019.
[2] Conestoga-Rovers & Associates, 2001. Closure Certification Report, General Motors, Harrison Radiator Division Facility, Moraine, Ohio. August 2001.

cover at the SSL and this portion includes three extraction wells and portions of the subgrade piping. None of the work will be within the limits of the waste units. The cover will be restored around the extraction wells and applicable portions of the piping. Based on the criteria set forth in OAC 3745-50-51 (K.3 of the Appendix) and communication from the Ohio EPA on October 19, 2018, the modification of the cover at the proposed three extraction well points and portions of subgrade piping constitute a Class 3 Modification.

The approved Lagoon Post-Closure Plan[3] (Attachment 1) and the approved Revised Human Health Risk Assessment Report[4] (Attachment 2) are attached to this letter. An appendix to the Lagoon Post-Closure Plan that includes the information requested by the Ohio EPA and details the proposed Phase 1 DGR™ activities is included as Attachment 3. The October 1, 2018 comments from the Ohio EPA indicated that "the table of contents and narrative of the post-closure plan should refer to the new appendix." The Lagoon Post-Closure Plan was prepared by others, contains information regarding the Closed North Lagoon, and cannot be easily modified. Therefore, the three attachments enclosed should be considered the amended Lagoon Post-Closure Plan. If Ohio EPA wishes to have RACER Trust revise and separate the Lagoon Post Plan to cover the Closed North and South Lagoon separately, we would be willing to complete this administrative task as part of our 2019 activities.

If you have questions or concerns, please contact me at 937-751-8635.

Sincerely,

Pamela L. Barnett

Pamela L. Barnett, P.G.
Cleanup Manager (DE, LA, MA, OH, PA, VA)
RACER Trust
RACER Properties, LLC

cc: Brian Gitzinger, Ohio EPA
Erik Hagen, Ohio EPA
Randall Kirkland, Ohio EPA
Brad Mitchell, Ohio EPA
Mirtha Capiro, U.S. EPA
Carolyn Grogan, Arcadis

Enclosures:
Attachment 1 - Lagoon Post-Closure Plan
Attachment 2 – Revised Human Health Risk Assessment Report
Attachment 3 – Appendix to the Lagoon Post-Closure Plan

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[3] Conestoga-Rovers & Associates, 2002. Lagoon Post-Closure Plan, General Motors, Harrison Radiator Division Facility, Moraine, Ohio. December 2002.

[4] Arcadis U.S., Inc., 2012. Revised Human Health Risk Assessment Report, Closed South Settling Lagoon, Moraine, Ohio. July 2012.

ATTACHMENT 1

Lagoon-Post Closure Plan

LAGOON POST-CLOSURE PLAN

GENERAL MOTORS
HARRISON RADIATOR DIVISION FACILITY
MORAINE, OHIO

Prepared by:
Conestoga-Rovers
& Associates

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Waterloo, Ontario
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DECEMBER 13, 2002
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1.0 INTRODUCTION

1.1 GENERAL

This report presents the Post-Closure Plan (PCP) for the former North and South Settling Lagoons (North and South Lagoons) at the former General Motors (GM) Harrison Radiator Division (Harrison Facility) in Moraine, Ohio (Site). The Site location is presented on Figure 1.1. The Site plan including the location of the former lagoons is presented on Figure 1.2.

This PCP has been prepared in accordance with the requirements of the Lagoon Closure Plan dated June 2000 and with the requirements of the Ohio Administrative Code (O.A.C.) rules for new and interim status facilities.

1.2 POST-CLOSURE PLAN OBJECTIVES

The PCP addresses the following elements:

1. Control of future land use and access in accordance with O.A.C. Rules 3745-55-17 and 55-19.
2. Inspection and maintenance of the covers, including regular mowing and erosion prevention in accordance with O.A.C. Rules 3745-55-18 and 56-28.
3. Monitoring of the groundwater in accordance with O.A.C. Rules 3745-54-90 through 54-99, 55-01, and 55-011. The rationale by which the intent of these rules is met is provided in the Site-Wide Groundwater Monitoring Plan (Attachment A).

A brief summary of the relevant sections of the applicable regulations is presented in Table 1.1.

1.3 ADMINISTRATIVE PROCEDURES

In accordance with O.A.C. Rule 3745-55-18, a copy of the approved PCP and any revisions will be kept at the Site while post-closure care activities are ongoing until certification and approval of completion of post-closure activities. A copy of the most current PCP will be furnished to the Ohio EPA upon request until final closure of the facility. The contact at GM is:

Ms. Pam Stubbs
Plant Engineering
2601 Stroop Road
Moraine, Ohio 45439
Phone: 937-455-2636
Fax: 937-455-2631

If an amendment to the PCP is required, a modification will be requested of the Ohio EPA within 60 days after occurrence of the event which affects the post-closure activities.

2.0 DESCRIPTION OF FORMER NORTH AND SOUTH LAGOONS

2.1 PRE-CLOSURE CONDITIONS IN THE LAGOONS

2.1.1 NORTH LAGOON

The existing conditions in the North Lagoon, at the start of closure activities, were surveyed. The lagoon area is approximately 4.6 acres in size and consists of a primary and secondary basin separated by an earthen berm. The secondary basin is also partially divided by an earthen berm, which was used to increase residence time in the basin. During the active life of the lagoon, flow entered the system through the primary basin, was diverted to the secondary basin after initial settling of solids, discharged under a National Pollutant Discharge Elimination System (NPDES) permit to a ditch, which crosses the Site, and eventually discharged to the Great Miami River.

The North Lagoon operated between 1972 and October 1989, when the lagoon was taken out of service. Between 1972 and 1979, the lagoon received industrial wastewater including metal plating wastes (zinc, nickel, and chrome), cutting fluids, pickling wastes, oils, porcelain sludge, and electrodeposition paint rinse waters. Between May 1980 and September 1984, the lagoon received only dilute process rinse wastewater, non-contact cooling water, and stormwater runoff. Beginning in September 1984, all process wastewater was diverted to the on-Site pretreatment facility. All stormwater and non-contact cooling water was diverted into a new concrete stormwater retention facility when the lagoon was taken out of service in October 1989.

2.1.2 SOUTH LAGOON

The existing conditions in the South Lagoon, at the start of closure activities, were surveyed. The lagoon area is approximately 7.9 acres in size and consists of a primary basin, secondary basin, and sludge drying basin that had been individually excavated at different times. During the active life of the lagoon, flow entered the system through the primary basin, was diverted to the secondary basin after initial settling of solids, discharged under a NPDES permit to a ditch, and eventually discharged to the Great Miami River. The sludge drying basin was previously used for the dewatering of sludge removed from the primary and secondary basins.

The South Lagoon originally consisted of a single basin occupying the footprint of the secondary basin, which was constructed in 1965. The sludge drying basin was added in 1967 and the primary basin was added in 1974. Between 1965 and 1979, the lagoon received industrial wastewater including zinc plating wastes, anodizing wastes, pickling wastes, oils, and porcelain sludge. Between 1980 and November 1985, the lagoon received process wastewater (consisting of dilute acid and alkali rinses from small parts cleaning and non-cyanodic electroplating processes and fly ash dewatering filtrate), water softening sludge, non-contact cooling water, and stormwater runoff. Beginning in November 1985, all process wastewater was diverted to the on-Site pretreatment facility. All stormwater and non-contact cooling water was diverted into a new concrete stormwater retention facility when the lagoon was taken out of service in October 1989.

2.2 SLUDGE CHARACTERIZATION

The RCRA Part A permit application dated June 13, 1988 indicated that the sludge in the North Lagoon was generated in part by mixed wastewater streams from the following listed hazardous wastes.

1. F006 - wastewater treatment sludges from electroplating operations;
2. F007 - spent cyanide plating bath solutions from electroplating operations;
3. F009 - spent stripping and cleaning bath solutions from electroplating operations;
4. F012 - quenching wastewater treatment sludges from metal heat treating operations; and
5. F019 - wastewater treatment sludges from the chemical conversion coating of aluminum.

F001 and F005 were identified on the Part A Permit Application. However, both F001 and F005 were not included in the mixed wastewater streams for the lagoons. The mixed wastewater stream included non-hazardous process waste, non-contact cooling water and stormwater.

The November 3, 1989, "Draft North Settling Lagoon Revised Closure/Post-Closure Plan" characterized the lagoon sludge and underlying soil. Samples were analyzed for total priority pollutants, VOC priority pollutants, selected metals and cyanide, full RCRA Appendix IX, oil and grease, percent solids and bulk density in 1988. The sludge was found to be not characteristically hazardous. VOCs were not detected in the underlying soils. In addition, levels of metal concentrations in soils do not exceed Site-specific background levels developed for the RFI Baseline Risk Assessment.

Similarly, the RCRA Part A permit application dated June 13, 1988 indicated that the sludge in the South Lagoon was generated in part by mixed wastewater streams from the following listed hazardous wastes.

1. F006 - wastewater treatment sludge from electroplating operations;
2. F007 - spent cyanide plating bath solutions from electroplating operations;
3. F009 - spent stripping and cleaning bath solutions from electroplating operations;
4. F012 - quenching wastewater treatment sludge from metal heat treating operations; and
5. F019 - wastewater treatment sludge from the chemical conversion coating of aluminum.

F001 and F005 were identified on the Part A Permit Application. However both F001 and F005 were not included in the mixed wastewater streams for the lagoons. In addition, the mixed wastewater stream included non-hazardous process waste, non-contact cooling water, and stormwater.

The November 3, 1989, "Draft South Settling Lagoon Revised Closure/Post-Closure Plan" characterized the lagoon sludge and underlying soil. Samples were analyzed for total priority pollutants, VOC priority pollutants, selected metals and cyanide, full RCRA Appendix IX parameters, oil and grease, percent solids, and bulk density. The sludge was found to be not characteristically hazardous. VOCs were not detected in the underlying soils. In addition, levels of metal concentrations in the soil do not exceed Site-specific background levels developed for the RFI Baseline Risk Assessment.

2.3 SLUDGE VOLUMES

At the start of closure activities in 2000, the sludge thickness in the primary and secondary basins of the North and South Lagoons was measured in situ utilizing a steel probe that was pushed through the sludge until resistance to the probe was found. This probe was advanced utilizing hand pressure until refusal, and was then given two blows with a small sledge hammer to confirm the refusal. The top of the probe was then surveyed, with the length of the probe subtracted to obtain a survey of the bottoms of the lagoons.

The sludge volume was then calculated utilizing an average-end method comparison of the top of sludge and bottom of lagoon surfaces for each lagoon. The North Lagoon was found to have a sludge volume of 7,074 cubic yards, whereas the South Lagoon was found to have a sludge volume of 47,614 cubic yards.

2.4 LAGOON CLOSURE ACTIVITIES

Closure activities included removal, demolition, and/or abandonment of certain subsurface structures; mixing all sludge with soil and either Cement Kiln Dust (CKD) or Portland cement; placing and compacting soil for backfill up to subgrade elevations; installing stormwater drainage features; installing a compacted clay soil cover system with a vegetated topsoil layer over the former South Lagoon; and installing an asphalt paving system over the former North Lagoon. Further detail regarding closure activities is presented in "Certification of Lagoon Closure Report" (CRA, August 10, 2001).

2.4.1 SITE PREPARATION

In preparation for lagoon closure activities, most of the area of the North and South Lagoons was cleared and grubbed during August and September 1999. Regrowth, stumps, and roots not cleared in 1999, were removed from lagoon surfaces and sidewalls. Trees and shrubs removed from the lagoons were chipped and stockpiled on Site.

2.4.2 DEMOLISH STRUCTURES

Pipes, inlet sewers, outlet structures, utility poles, vaults, and other structures located within the surface impoundment system were plugged in place with concrete, removed, partially demolished and removed, or filled with a flowable cement fill.

Metal debris removed from the lagoons was size reduced and then power washed at the vehicle decontamination facility. The metal debris was then transferred from the Site to a metal recycling facility. An underground flow-through tank with an approximate capacity of 2,000 gallons was removed from the North Lagoon, size reduced, and transferred to an off-Site metal recycling facility. The resulting excavation was filled with crushed limestone to subgrade elevation.

2.4.3 SLUDGE SOLIDIFICATION

The lagoon sludge was solidified by adding soil and a pozzolanic material (CKD or Portland cement) to the sludge. Solidification was conducted in place by placing the soil on the sludge surface and the pozzolanic material in trenches excavated into the sludge, and mixing with a track hoe. Sludge solidification was conducted to a minimum physical strength criterion of 25 pounds per square inch (psi). The actual strength 1 week following solidification ranged from 26 to 175 psi.

2.4.4 LAGOON BACKFILLING

Following successful solidification, the lagoons were backfilled with soil material from existing on-property soil stockpiles. A minimum of 10 feet of soil barrier was placed between the solidified sludge and the cover. Compaction testing was performed a minimum of every 2,500 cubic yards to ensure that the backfilled soils were achieving 95 percent modified proctor density. Although not needed for the 10-foot buffer, additional crushed limestone was used for topping the subgrade of the North Lagoon to provide additional bearing capacity for the asphalt pavement cover. Final grades were adjusted to match the volume of soil available in the on-property soil stockpiles. Stormwater drainage structures were adjusted accordingly.

2.4.5 STORMWATER DRAINAGE SYSTEMS

Surface water drainage for each lagoon was installed. Surface water is collected in a network of swales, catchbasins, and underground pipes. Collected stormwater is discharged to the existing underground 84-inch diameter storm sewer present along the north perimeter of the South Lagoon. Stormwater drainage from the North Lagoon is collected in a network of catchbasins and underground pipes. Collected stormwater is discharged to the GM stormwater retention basins located adjacent to the southwest side of the North Lagoon.

2.4.6 COVER

The North Lagoon cover system consisted of a compacted 5-inch thick layer of granular material that was overlain with a 3-inch thick asphalt pavement. The pavement extends from fence to fence along each side, with a narrow soil transition between the completed pavement and the existing fence. The pavement was placed in two lifts: an inch and a half thick base coarse (HL-3) overlain by an inch and a half thick layer of surface coarse asphalt (HL-6).

The cover system for the South Lagoon consisted of a foot thick compacted clay layer which was covered with a 6-inch thick vegetated top soil layer. The clay soil was selected based on its ability to achieve a maximum hydraulic conductivity of 1×10^{-7} cm/sec. On top of the completed clay layer was placed a nominal 6-inch thick layer of topsoil. The topsoil was fine graded to ensure positive drainage. The cover was vegetated with a grass seed mix (combination of perennial rye grass and red fescue).

3.0 POST-CLOSURE GROUNDWATER MONITORING

3.1 GROUNDWATER MONITORING PLAN OBJECTIVES

The Site-wide Groundwater Monitoring Plan is generally consistent with Ohio EPA requirements as presented in applicable sections of O.A.C. 3745-54-90 through 3745-54-99, 3745-55-01, and 3745-55-011.

The objective of the ongoing groundwater monitoring program is to collect sufficient data to evaluate changes and/or trends in groundwater quality or groundwater flow at the Site and to monitor corrective measures at the Site.

3.2 MONITORING PROGRAM

The monitoring program will be completed by the implementation of the Site-wide Groundwater Monitoring Plan presented in Attachment A.

4.0 INSPECTIONS

Regular inspections of the closed North and South Lagoons and associated facilities will be conducted. The inspection program is presented in Table 4.1.

An inspection log will be prepared each time an inspection is conducted. The log will contain the following information:

1. date of inspection;
2. inspection activities conducted;
3. problems/deficiencies noted;
4. corrections made (or actions taken to ensure corrections will be made); and
5. inspector's signature.

In addition to the regular inspections identified in Table 4.1, additional inspections will be conducted within 1 week after a documented 25-year, 24-hour storm event (approximately 4.5 inches of rain in 24 hours).

5.0 MAINTENANCE ACTIVITIES

Maintenance will be performed in response to deficiencies noted during inspections described in Table 4.1 in the previous section.

Maintenance and repair activities will be completed as soon as possible after problems are identified. Routine maintenance and repair activities will be completed no later than 6 weeks after problem identification. If significant repairs are required which will take longer than 6 weeks to complete, a schedule will be forwarded to Ohio EPA indicating when repairs will be completed.

5.1 COVER MAINTENANCE

The following maintenance activities will be completed for the asphalt cover over the North Lagoon:

1. erosion damage will be repaired through replacing asphalt, and minor regrading if necessary;
2. regrading in response to subsidence or settlement will be completed as necessary to maintain adequate surface water drainage. Damaged asphalt will be repaired or replaced; and
3. damage to the asphalt by pests is not anticipated due the resistant nature of the asphalt cover. However, if evidence of pest damage is discovered, the pests will be exterminated and the cover will be repaired.

The following maintenance activities will be completed for the vegetated cover over the South Lagoon:

1. erosion damage will be repaired through revegetation, and minor regrading if necessary;
2. regrading in response to subsidence or settlement will be completed as necessary to maintain adequate surface water drainage. Disturbed areas will be revegetated;
3. the grass will be mowed at least monthly during the growing season of April to October. At these times, bare areas or erosion damage will be repaired and deep-rooted vegetation will be removed; and
4. regular grass mowing will tend to discourage pests. If evidence of pest damage is discovered, the pests will be exterminated and the cover will be repaired.

5.2 MONITORING SYSTEM MAINTENANCE

Any damage to the well casing(s), cap(s), or locking system(s) will be repaired. In the event of damage to the below-grade installation, the well(s) will be assessed for potential repair or replacement. Since maintenance of the monitoring equipment is expected to be minimal, supplies of replacement materials will not be kept at the Site.

If it is necessary to replace a monitoring well, the new well will be installed by experienced individuals and the abandoned well will be grouted to the surface.

5.3 SECURITY SYSTEM MAINTENANCE

The former North and South Lagoons at the Site are enclosed within an 8-foot chain-link fence and access is gained via gates. Any damage to the fence or gate, noted during quarterly inspections will be repaired by Site personnel or a contractor to GM. Arrangements will be made for appropriate security provisions to remain in place for the duration of post-closure care if operations on Site cease.

5.4 RESPONSIBLE PARTY

Maintenance will be conducted by firms under contract to GM, who are qualified and familiar with appropriate procedures.

6.0 COST ESTIMATES

The cost estimate to implement the PCP is presented in Table 6.1. Financial assurance documents are presented in Attachment B.

7.0 POST-CLOSURE CERTIFICATION

7.1 INSPECTIONS

The security system, including fencing, gate and signs, will be inspected quarterly. The covers will be inspected quarterly for erosion damage, pest damage, and subsidence. The South Lagoon cover will be mowed monthly between April and October. The groundwater monitoring system will be inspected quarterly in conjunction with the sampling program.

7.2 TESTING AND ANALYSIS

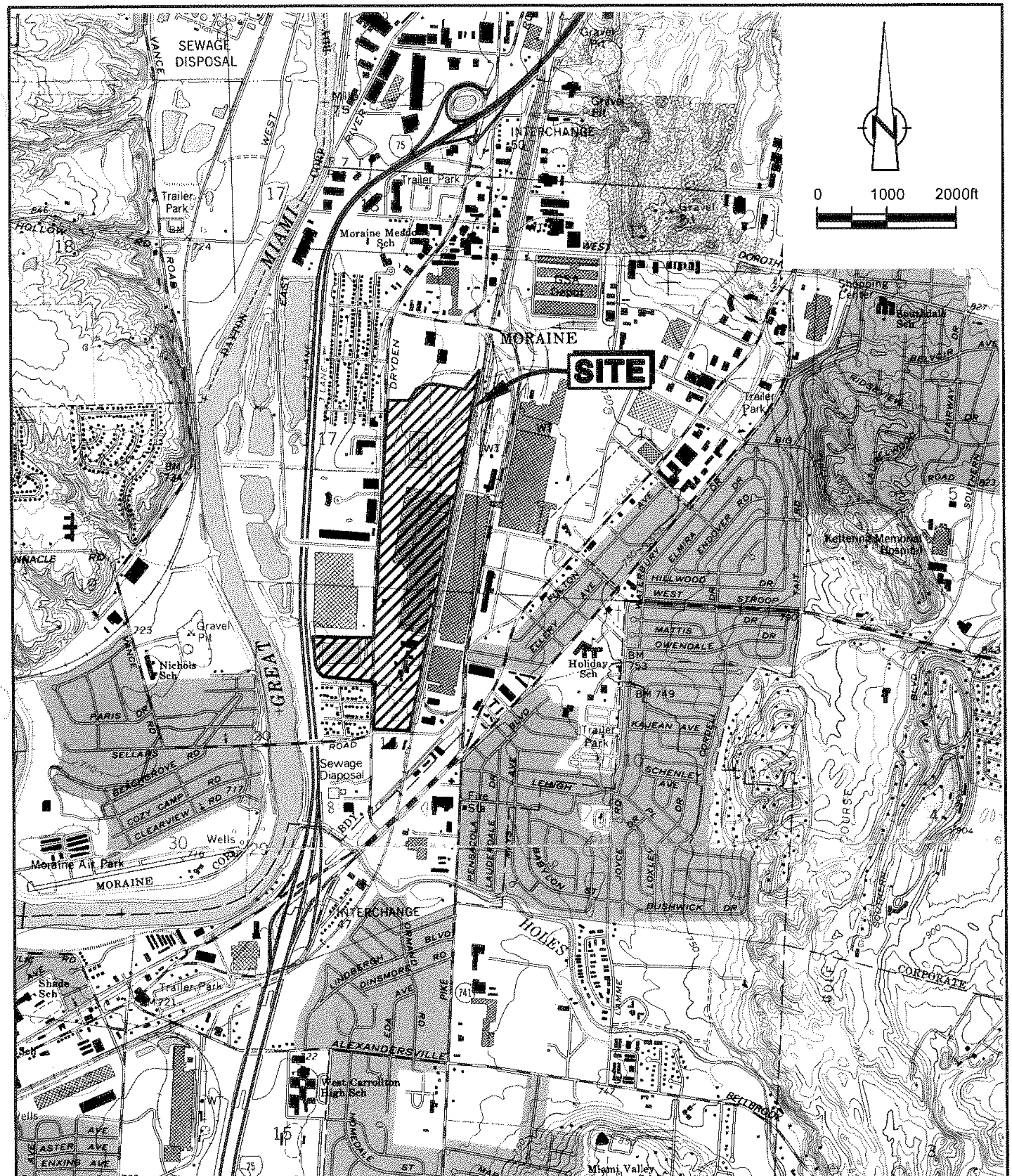
The groundwater monitoring program described in Section 3.0 is the only routine testing and analysis to be performed.

7.3 TYPES OF DOCUMENTATION

The owner or operator of the Site will submit a certificate that post-closure care has been completed in accordance with the approved post-closure plan, by registered mail, within 60 days after completion of the established post-closure care period. The certificate will be signed by an independent registered professional engineer.

8.0 REFERENCES

1. "Draft North Settling Lagoon Revised Closure Plan"; Geraghty & Miller Consulting Engineers, Inc.; November 3, 1989.
2. "Draft South Settling Lagoon Revised Closure/Post-Closure Plan"; Geraghty & Miller Consulting Engineers, Inc.; November 3, 1989.
3. "RFI Report"; Volume I Geraghty & Miller Consulting Engineers, Inc. and Volume II ENVIRON; April 2000.
4. "Supplemental RFI Report"; Volume I Geraghty & Miller Consulting Engineers, Inc. and Volume II ENVIRON; April 2000.
5. "Lagoon Closure Plan"; Conestoga-Rovers & Associates; June 2000.
6. "Certification of Lagoon Closure Report"; Conestoga-Rovers & Associates; August 10, 2001.



SOURCE: USGS QUADRANGLE MAP
DAYTON SOUTH, OHIO

figure 1.1

SITE LOCATION PLAN
HARRISON RADIATOR DIVISION FACILITY
Moraine, Ohio

12611-00(006)GN-WA001 AUG 08/2001

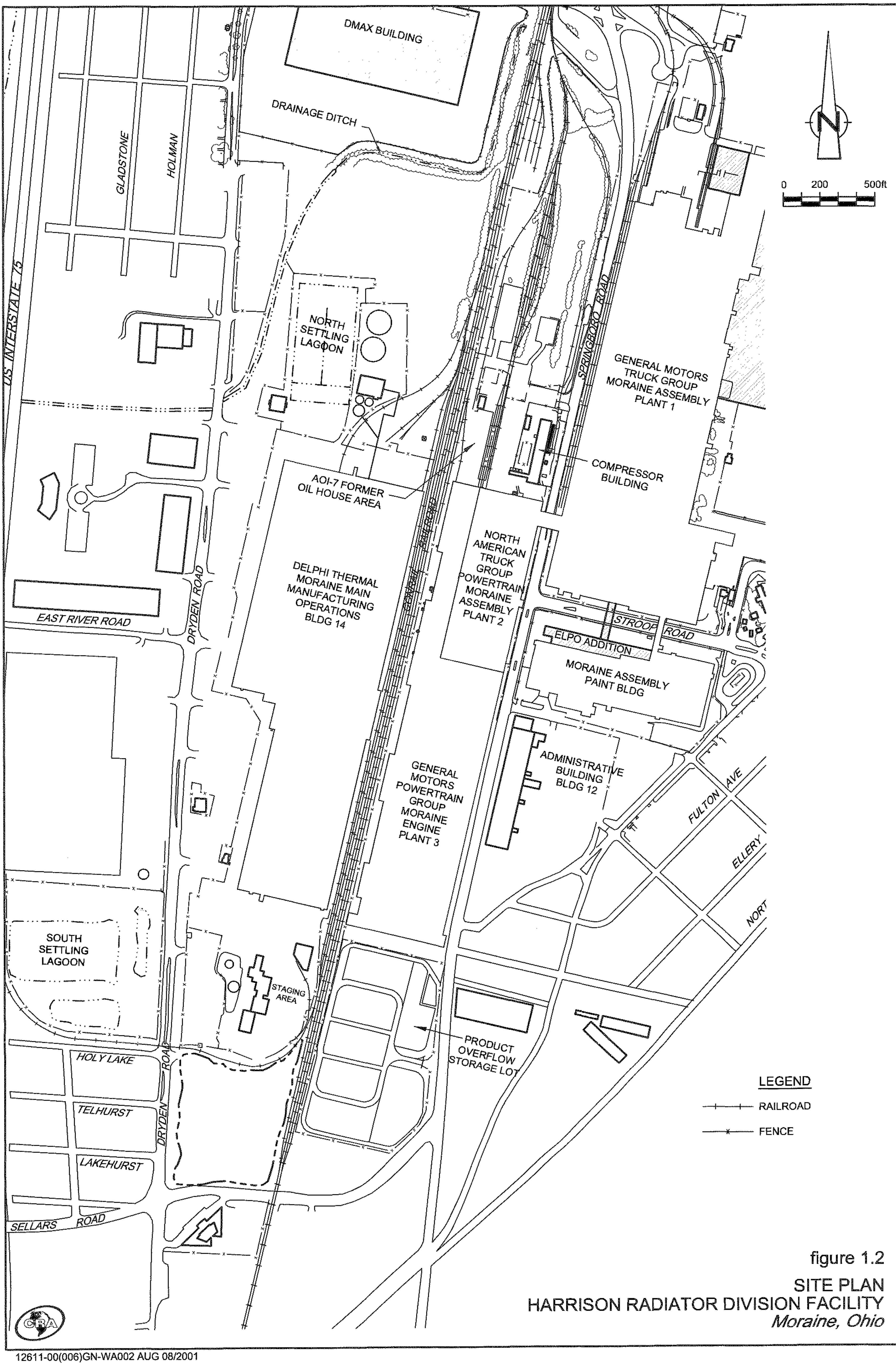


figure 1.2

SITE PLAN
HARRISON RADIATOR DIVISION FACILITY
Moraine, Ohio

12611-00(006)GN-WA002 AUG 08/2001

TABLE 1.1

POST-CLOSURE PLAN
SYNOPSIS OF APPLICABLE REGULATIONS
GM HARRISON RADIATOR DIVISION FACILITY
MORAINE, OHIO

Post-Closure Requirements	*Regulation*	*Content Summary*
1. Control Future Land Use and Access	3745-55-17	- conduct maintenance, monitoring, and reporting - post-closure use of property shall not be allowed to disturb integrity of final cover
	3745-55-19	- within 60 days of certification of closure submit a record of the type, location, and quantity of hazardous wastes to the local zoning authority - within 60 days of certification of closure record a notation on the deed of the facility property which will notify potential purchasers that the land has been used to manage hazardous waste, land use is restricted, and that a survey plat and record of the type, location and quantity of hazardous waste has been filed with the local zoning authority - submit certification to Ohio EPA director that a notation on the deed for the facility has been made, including a copy of the document on which the deed has been placed - if owner or subsequent owner wants to remove hazardous material a modification to the post-closure plan must be requested
2. Inspection and Maintenance of Cap	3745-55-18	- post-closure plan shall identify the activities that will be carried on after closure and the frequency including: 1. monitoring 2. maintenance - cap integrity - monitoring equipment 3. contact person - post-closure plan or length of post-closure care period may be modified through a petition to Ohio EPA director, including public notice period

TABLE 1.1

**POST-CLOSURE PLAN
SYNOPSIS OF APPLICABLE REGULATIONS
GM HARRISON RADIATOR DIVISION FACILITY
MORAINE, OHIO**

Post-Closure Requirements	*Regulation*	*Content Summary*
	3745-55-20	- within 60 days after completion of the established post-closure care period submit certification that post-closure core was performed in accordance with post-closure plan
	3745-56-28	- provide post-closure care including: 1. maintain the integrity and effectiveness of the final cover including repairs to correct effects of settling, subsidence, erosion, or other events 2. maintain and monitor the groundwater monitoring system 3. prevent runon or runoff from eroding or damaging the final cover
3. Monitoring of Groundwater	3745-54-90 through 3745-54-99	- see Groundwater Monitoring Plan in Attachment A

TABLE 2.1

SUMMARY OF 1988 NORTH SETTLING LAGOON SLUDGE ANALYTICAL RESULTS (TOTALS)[5]
GM HARRISON RADIATOR DIVISION FACILITY
MORAINE, OHIO

Constituent[1]	*CAS No.*	*Frequency of Detection*[2]	*Range of Detected Concentrations*[3]
Metals			
Antimony	7440-36-0	15/18	8.93 - 54.8
Arsenic	7440-38-2	18/18	8.58 - 158.0
Barium	7440-39-3	18/18	330.0 - 2550.0
Cadmium	7440-43-9	18/18	6.57 - 1430.0
Chromium	7440-47-3	18/18	244.0 - 3630.0
Cobalt	--	9/9	72.7 - 1210.0
Copper	--	18/18	54.2 - 969.0
Lead	7439-92-1	18/18	160.0 - 5970.0
Mercury	7439-97-6	18/18	0.207 - 1.87
Nickel	7440-02-0	18/18	218.0 - 3250.0
Selenium	7782-49-2	5/18	2.78 - 76.6
Silver	7440-22-4	17/18	0.492 - 1.33
Tin	--	4/9	213.0 - 741.0
Vanadium	--	5/9	19.1 - 30.7
Zinc	--	18/18	920.0 - 10501.0
Volatile Organics			
1,2-Dichlorobenzene	95-50-1	2/18	0.57 - 1.52
Ethylbenzene	--	7/18	0.153 - 3.4
Tetrachloroethene	127-18-4	2/18	2.05 - 4.7
Toluene	108-88-3	7/18	0.87 - 10.1
Trichloroethylene	79-01-6	3/18	0.55 - 6.66
Xylene	--	6/9	0.150 - 9.25
Extractable Organics			
Bis(2-ethylhexyl)Phthalate	--	4/9	17.4 - 31.2
Fluoranthene	206-44-0	5/9	6.18 - 104.0
Fluorene	--	4/9	1.6 - 18.5
2-Methylnaphthalene	--	6/9	1.2 - 9.54
Phenathrene	--	7/9	2.46 - 41.7
Pyrene	--	5/9	5.58 - 81.5
Miscellaneous			
Cyanide	--	15/18	0.615 - 5.32
PCB 1242	--	1/9	3.1
PCB 1260	--	6/9	5.1 - 27.4
Sulfide	--	9/9	110.0 - 39000.0

AVERAGE DRY WEIGHT AND OIL & GREASE CONTENTS[4]

Basin	*Dry Weight (%)*	*Oil & Grease (%)*
North Primary	43.42	8.37
North Secondary		
SE Segment	31.18	8.04
NE Segment	41.65	13.95
West Segment	29.73	4.33

Notes:

1 - Included only detected constituents from the Primary and Secondary Basins which have been grouped.
2 - Calculated by number of times constituent was detected divided by number of times it was tested for.
3 - Units in mg/kg (dry weight).
4 - Average values for lagoon sludges calculated from lab data for August/September 1998 sampling.
5 - Sludge analytical results contained in "North Settling Lagoon Revised Closure/Post Closure Plan", Geraghty & Miller Engineers, Inc., November 3, 1989.

TABLE 2.2

SUMMARY OF 1988 SOUTH SETTLING LAGOON SLUDGE ANALYTICAL RESULTS (TOTALS)[5]
GM HARRISON RADIATOR DIVISION FACILITY
MORAINE, OHIO

Constituent [1]	*CAS No.*	*Frequency of Detection* [2]	*Range of Detected Concentrations* [3]
Metals			
Antimony	7440-36-0	14/36	5.03 - 52.8
Arsenic	7440-38-2	36/36	3.4 - 157.0
Barium	7440-39-3	36/36	713.0 - 6740.0
Cadmium	7440-43-9	36/36	0.721 - 26.9
Chromium	7440-47-3	36/36	55.3 - 2020.0
Cobalt	--	5/6	17.8 - 222
Copper	--	36/36	37.2 - 16900.0
Lead	7439-92-1	36/36	87.1 - 398.0
Mercury	7439-97-6	34/36	0.081 - 4.03
Nickel	7440-02-0	36/36	26.3 - 1490.0
Selenium	7782-49-2	1/36	0.78
Silver	7440-22-4	34/36	0.317 - 2.45
Tin	--	1/6	28.3
Zinc	--	36/36	157.0 - 2190.0
Extractable Organics			
Bis(2-ethylhexyl)Phthalate	--	4/13	1.33 - 2.76
Di-n-butyl phthalate	--	1/13	1.99
Miscellaneous			
Cyanide	--	36/36	0.562 - 18.9
PCB 1254	--	8/13	1.6 - 206.0
PCB 1260	--	2/13	1.5 - 4.6

AVERAGE DRY WEIGHT AND OIL & GREASE CONTENTS[4]

Basin	*Dry Weight (%)*	*Oil & Grease (%)*
South Primary	30.03	6.64
South Secondary		
SE Quadrant	27.17	5.8
NE Quadrant	23.23	6.16
NW Quadrant	22.78	4.42
SW Quadrant	24.1	4.84
South Sludge	48.63	5.57

Notes:

1 - Included only detected constituents from the Primary, Secondary, and Sludge Basins which have been grouped.
2 - Calculated by number of times constituent was detected divided by number of times it was tested for.
3 - Units in mg/kg (dry weight).
4 - Average values for lagoon sludges calculated from lab data for August/September 1998 sampling.
5 - Sludge analytical results contained in "South Settling Lagoon Revised Closure Plan", Geraghty & Miller Engineers, Inc., November 3, 1989.

TABLE 4.1

SUMMARY OF POST-CLOSURE ACTIVITIES AND INSPECTIONS
GM HARRISON RADIATOR DIVISION FACILITY
MORAINE, OHIO

Item	*Activity*	*Frequency*
<u>*Cover Maintenance*</u>		
• Erosion damage	Check for bare spots, signs of damaged vegetation or asphalt, and areas of washout. Erosional damage will be identified if the topsoil layer or asphalt has been removed or exposed by water, wind, or any other erosional forces.	Quarterly
• Pest damage	Check for evidence of pests that may damage cover.	Monthly during April to October period
• Settlement and subsidence	Check for adequate surface water drainage. Surface water drainage will be evaluated by visual evaluation of proper grading and by looking for any areas of ponded water.	Quarterly
• Mowing and revegetation (South Lagoon)	Mow grass and check for bare areas and erosion damage. Also check for deep-rooted vegetation.	Monthly during April to October period
<u>*Monitoring System Maintenance*</u>		
• Groundwater monitoring	Collect groundwater samples and measure water levels.	See Site-Wide Groundwater Monitoring Plan (Attachment A)
• Well maintenance	Check for physical signs of damage to casing and cap locking system.	See Site-Wide Groundwater Monitoring Plan (Attachment A)
<u>*Security System Maintenance*</u>		
• Security and fencing	Check presence and condition of fencing, gate and signs.	Quarterly

TABLE 6.1

POST-CLOSURE COST ESTIMATE
FORMER SURFACE IMPOUNDMENTS
HARRISON RADIATOR DIVISION FACILITY
MORAINE, OHIO

		Quantity	*Annual Total*	*30-Year Period*
1.	Inspections	4 events/year	$ 2,400	$ 72,000
2.	Groundwater Monitoring*	lump sum	$ 64,000	$2,046,000
3.	Grass Mowing/Vegetation (South Lagoon)	Monthly (7 events/year)	$ 1,400	$ 42,000
4.	Cover Regrading/ Repair Allowance	1 event/year	$ 5,000	$ 150,000
5.	Fence Repairs	1 event/year	$ 700	$ 21,000
		Total Post-Closure Cost	**$ 73,500**	**$2,331,000**

Note:

* Groundwater monitoring cost is $130,000 for the first year, $94,000 for the next 2 years, and $64,000 for every year thereafter.

ATTACHMENT A

SITE-WIDE GROUNDWATER MONITORING PLAN

Site-Wide Groundwater Monitoring Plan

General Motors Corporation
Moraine, Ohio

December 2002

ARCADIS

Infrastructure, buildings, environment, communications

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A Summary of Baseline Risk Assessment

B Analysis of Post-Closure Monitoring Requirements for the Closed Lagoons

C Boring Logs and Well Construction Logs for the Lagoon Wells

D Standard Operating Procedures

1. Introduction

This Site-Wide Groundwater Monitoring Plan (monitoring plan) was prepared to address groundwater monitoring activities at the following General Motors Corporation (GM) facilities located in Moraine, Ohio: Delphi Harrison Thermal Systems Moraine Plant (Delphi Thermal Moraine), former General Motors Powertrain Group, Moraine Engine Plant (former Moraine Engine), and General Motors Truck Group, Moraine Assembly Plant (Moraine Assembly). This monitoring plan will replace the current Resource Conservation and Recovery Act (RCRA) monitoring as outlined in the Revised Groundwater Quality Assessment Plan for the Harrison Radiator North Lagoon (Geraghty & Miller, Inc., 1989a), the Revised Groundwater Monitoring Detection Program for the Harrison Radiator South Lagoon (Geraghty & Miller, Inc., 1989b), and the Final Interim Measures Design Plans (Geraghty & Miller, Inc., 1995).

The objectives of conducting groundwater monitoring are as follows:

1. Monitor groundwater quality upgradient and downgradient of the closed North and South Settling Lagoons.

2. Monitor groundwater quality upgradient and downgradient of Landfills L1, L2, and L3.

3. Monitor the effectiveness of and the need for corrective measures groundwater capture systems in the upper and lower aquifers at the southern, downgradient property boundary.

4. Monitor the effectiveness of corrective measures remediation activities in Reactive Zones (RZ) RZ-1, RZ-2, and RZ-3, to address volatile organic compounds (VOCs) related to Area of Interest 7 (AOI 7).

5. Monitor an appropriate list of wells once corrective measures objectives (defined in the Draft Interim Measures/Corrective Measures Report [ARCADIS Geraghty & Miller, Inc. 2001]) have been met to verify that these objectives continue to be met without active measures.

While this monitoring plan differs from the existing plans (i.e., reduced frequency of sampling certain monitoring wells and eliminating monitoring at other wells), a more appropriate set of monitoring wells and parameters will be monitored at a larger set of wells to provide a better overall understanding of improvements in groundwater conditions at the site.

1.1 Site Background

The former Moraine Engine and Moraine Assembly facilities occupy approximately 300 acres, while the adjacent Delphi Thermal Moraine facility occupies approximately 165 acres. The facilities are located in the City of Moraine in Montgomery County in southwestern Ohio. A small portion of the Moraine Assembly facility is located in the City of Kettering. Figure 1 presents the location of each facility, property boundaries, and site features.

The GM site has been used for industrial purposes since the property was acquired in the mid-1920's. Frigidaire (a division of GM) produced appliances from the late 1920's until 1979. GM announced the shut down of all Frigidaire operations in January 1979. During 1980 and 1981, the majority of the former Frigidaire Plant 2 was converted to the former Moraine Engine facility, and the former Frigidaire Plant 3 and the northeast corner of former Frigidaire Plant 2 were converted to the Moraine Assembly facility. Since 1981, former Moraine Engine operations have included the machining, painting (this operation was discontinued in September 1995), and assembly of diesel truck engines. Former Moraine Engine operations ceased in the fall of 2000. The plant building has undergone decommissioning and demolition. Since 1981, Moraine Assembly operations initially included the manufacture, assembly, and painting of small trucks, but currently Chevrolet TrailBlazers, GM Envoys, and Oldsmobile Bravadas are produced at this facility. Delphi Thermal Moraine's major operations, which began in 1941, are the machining and assembly of automotive air conditioning compressors, accumulator dehydrators, and miscellaneous air conditioning valves.

1.2 Site Regulatory History

Delphi Thermal Moraine contains North and South Settling Lagoons that are shown on Figure 2. GM filed a RCRA Part A Application with Ohio EPA for interim status in November 1980. GM began detection monitoring at the North and South Settling Lagoons in February 1981. In 1984, assessment monitoring began for the North Settling Lagoon. By October 1988, GM expanded the groundwater monitoring assessment plan network for the North Settling Lagoon and expanded the groundwater detection network in the South Settling Lagoon in accordance with an agreed consent order with the State of Ohio. The assessment and detection monitoring well network for the upper and lower aquifers are shown on Figures 2 and 3, respectively.

Delphi Thermal Moraine submitted closure plans for the North and South Settling Lagoons to U.S. EPA and Ohio EPA in November 1985 and November 1989. Closure discussions between GM and Ohio EPA were deferred by mutual agreement to coordinate ultimate closure requirements with the corrective action requirements from the United States Environmental Protection Agency (U.S. EPA) Region V (the North and South Settling Lagoons were evaluated as solid waste management units [SWMUs] in the RCRA Facility Investigation [RFI] at Delphi Thermal Moraine). During the summer of 1999, GM met with the Ohio EPA to present and discuss a revised approach for closure of the lagoons. This approach was presented to Ohio EPA in the Lagoon Closure Plan, dated February 2000 (Conestoga-Rovers & Associates, 2000), and approved by Ohio EPA in a letter to GM dated August 24, 2000. Closure activities were initiated in September 2000 and completed in June 2001. GM submitted the Closure Certification Report to Ohio EPA on August 10, 2001 (Conestoga-Rovers & Associates 2001). Ohio EPA approved full closure of the North and South Settling Lagoons in a letter dated June 27, 2002 (Ohio EPA, 2002).

Delphi Thermal Moraine received an Administrative Order (Docket No. V-W-91R-2) from the U.S. EPA Region V, which became effective on January 30, 1991. The Administrative Order, issued under Section 3008(h) of RCRA, as amended, 42 U.S.C. 6928(h), required Delphi Thermal Moraine to implement a RCRA Corrective Action program at the Moraine facility consisting of the following: 1) conduct an RFI and 2) conduct a Corrective Measures Study (CMS), if necessary.

GM is currently meeting the requirements of the Administrative Order through the completed two-phased RFI investigation at the Delphi Thermal Moraine facility and by implementing capture zone interim measures. The initial Interim Measure was implemented per the Final Interim Measures Design Plans (Geraghty & Miller, Inc. 1995), which was approved by the U.S. EPA in a July 31, 1995 letter. The initial, on-going interim measures consist of controlling migration of VOCs in the shallow and deep aquifers at the southern property boundary through groundwater extraction at TW-2 and DN-13, respectively (Figure 2). The groundwater recovered by the upper aquifer recovery well TW-2 is treated using an air stripper tower and discharged through GM's National Pollutant Discharge Elimination System (NPDES) permitted outfall to the Great Miami River. Based on the first four years of operation, the system recovered and treated a total of 231,658,610 gallons at an average flowrate of 150 gallons per minute (ARCADIS Geraghty & Miller, 2000a). DN-13 is a deep aquifer well that Montgomery County has been using in a Pump-to-Waste Program since March 1990. The interim measure consists of continued pumping of DN-13 at a rate of 2.663 million gallons per day.

The findings of the RFI for Delphi Thermal Moraine, including a Baseline Risk Assessment, were reported to the U.S. EPA and Ohio EPA in a draft RCRA Facility Investigation Final Report (Geraghty & Miller, Inc. 1996 and ENVIRON Corporation 1996 [these reports were approved by U.S. EPA in April 2000]). The RCRA Facility Investigation Final Report determined a CMS was not necessary for the SWMUs investigated in the RFI at Delphi Thermal Moraine, including the North Settling Lagoon and South Settling Lagoon. A summary of the Baseline Risk Assessment is presented in Appendix A.

The U.S. EPA issued an Amendment to the Administrative Order (Docket No. VW-R-002-91), effective on April 24, 1997, which included the former Moraine Engine and Moraine Assembly facilities in the Corrective Action program. This Amendment required GM to conduct a Supplemental RFI at the two additional facilities (6 AOIs were investigated). A multi-phased investigation was completed during the Supplemental RFI, which focused on AOI 7 - Former Oil House Area. The findings of the Supplemental RFI for former Moraine Engine and Moraine Assembly, including a Supplemental Baseline Risk Assessment, were reported to the U.S. EPA and Ohio EPA in a draft Supplemental RFI Report submitted to the U.S. EPA and Ohio EPA in June 1999 (ARCADIS Geraghty & Miller, Inc. 1999 and ENVIRON Corporation 1999 [these reports were approved by U.S. EPA in April 2000]). The Supplemental RFI Report determined that constituent concentrations in soils at the AOIs do not pose an unacceptable risk. However, GM recommended and implemented interim measures to address VOCs in groundwater associated with AOI 7. A Primary Groundwater Source Area (AOI 7) Interim Measures Work Plan was submitted to the U.S. EPA and Ohio EPA in June 1999 and was approved by the U.S. EPA in July 1999 (ARCADIS Geraghty & Miller, Inc. 1999). This Work Plan recommended a combination of in-situ technologies to address chlorinated VOCs in shallow groundwater (Figure 4). The recommended in-situ technologies were implemented between September 1999 and May 2000. The results of these AOI 7 Interim Measures were presented in the Draft Interim Measures/Corrective Measures Report submitted to the U.S. EPA and Ohio EPA in March 2001 (ARCADIS Geraghty & Miller, Inc. 2001).

To provide a basis for evaluating the performance of these AOI 7 Interim Measures, the Work Plan proposed that a comprehensive site-wide groundwater sampling event for VOCs be conducted to establish a baseline data set. This baseline sampling for

VOCs was completed in September 1999. Additionally, the first annual groundwater sampling event was completed between September and October 2000. During the 2000 sampling event, at the request of U.S. EPA, groundwater samples were analyzed for Appendix IX VOCs by Method 8260 and cis-1,2-dichloroethene, semi-volatile organic compounds (SVOCs) and metals to verify that current groundwater conditions were consistent with previous site conditions. The results of this one-time sampling event confirmed that VOCs were the only constituents of potential concern in groundwater at the site. SVOCs were not detected and metals were not detected above levels of concern during the 2000 sampling event. The analytical results from the 1999 baseline event and the 2000 first annual event are presented in the Interim Measures/Corrective Measures Report (ARCADIS Geraghty & Miller, Inc. 2001).

2. Site Conceptual Model

The site conceptual model is based on many years of lagoon monitoring and RFI investigations. Section 4.0 of the Supplemental RFI report presents the current site-wide groundwater conditions (ARCADIS Geraghty & Miller, Inc., 2000b). A summary of these conditions is presented below and serves as the basis for development of the site-wide groundwater monitoring plan discussed in the next section.

The site (Delphi Thermal Moraine, former Moraine Engine, Moraine Assembly) contains 56 upper aquifer monitoring wells (Figure 2), 18 lower aquifer monitoring wells (Figure 3), 6 injection wells for remediation purposes (Figure 5), 49 introduction wells for remediation purposes (Figures 5, 6, and 7), one upper and one lower aquifer capture zone extraction well (Figures 2 and 4, respectively), and several active production wells (Figure 4). The current groundwater sampling programs for the site monitoring well network are summarized on Table 1.

The site lies over the Great Miami River buried valley aquifer, which consists of valley fill deposits composed of sand and gravel outwash separated by locally discontinuous silt and clay units, referred to as till zones. Beneath the site, these glacial deposits have been divided into the following hydrogeologic units: the upper sand and gravel unit, the regional till zone, and the lower sand and gravel unit. The upper sand and gravel unit is generally 30, and in some areas, up to 70 feet thick and contains minor till lenses. The unit is considered a water-table aquifer. In addition, the upper aquifer beneath the AOI 7 area is divided into an upper and lower portion by the presence of an upper clay till. The upper clay till is continuous beneath the AOI 7 area at a depth ranging from approximately 25 feet to over 40 feet below land surface. The water table is located approximately 4 to 12 feet above the top of the upper clay till.

The regional till zone has a varied thickness and continuity, but appears to be discernible throughout the region; it ranges from being absent to being present in excess of 50 feet thick beneath the site. The regional till zone overlies at least 50, and in some areas, over 100 feet of sand and gravel that comprise the lower unit. This lower unit is a fully saturated, semi-confined aquifer throughout most of the Dayton area; however, there are locations where the regional till is thin or discontinuous. In areas where the regional till is absent, the upper and lower aquifers respond as one hydrogeologic unit. Consequently, aquifer parameters across the site vary with the thickness and distribution of the till layer. Additional information on site hydrogeologic units is presented in the RFI Report (Geraghty & Miller, Inc. 2000) and the Supplemental Description of Current Conditions (Geraghty & Miller, Inc. 1997a).

Depth-to-water measurements and water-level elevations measured on December 3 and 4, 2001, for the upper aquifer are summarized in Table 2. The water-table surface on December 3 and 4, 2001 (Figure 8) shows flow in the upper aquifer is generally from north-northeast to south-southwest over the majority of the site. A groundwater capture zone, centered around Capture Well TW-2 located in the southwest corner of Landfill L1, is evident at the southern end of the Delphi Thermal Moraine facility. December 3 and 4, 2001 water-level measurements show the water level in Well TW-2 is lower than the water levels to the west in monitoring well GM-16, to the southwest in monitoring well GM-17, and to the south in monitoring well WSU-24, indicating a localized reversal of groundwater flow south/southwest of Capture Well TW-2. TW-2, screened in the upper aquifer, has been operating since January 31, 1996.

Hydraulic characteristics of the water-table aquifer were determined by evaluation of data from pumping tests conducted in 1985 and in 1989. The median hydraulic conductivity (K) value estimated from pumping test data was 1,650 feet per day (ft/day), and effective porosity was assumed to be 0.3 to 0.5. Using average hydraulic gradients for December 2001, groundwater flow velocities in the upper aquifer ranged from 2.29 ft/day to 3.82 ft/day.

Water-level elevations, presented on Table 2, were measured in the deep monitoring wells and production wells on December 3 and 4, 2001. The potentiometric surface on December 3 and 4, 2001 (Figure 9) shows groundwater flow in the lower aquifer to be generally from northeast to southwest, with a groundwater capture zone centered around County Well DN-13. County Well DN-13 is located south of the Delphi Thermal Moraine facility in the Dryden Road North Wellfield. The Pump-to-Waste Program at the Dryden Road North Wellfield, which began in 1990, was incorporated into interim measures and was in operation during the December 2001 baseline groundwater monitoring event. Groundwater flow velocity in the lower aquifer ranged between 0.50 ft/day and 0.83 ft/day.

VOCs present in upper and lower aquifer groundwater primarily associated with AOI 7 - Former Oil House Area are above their respective Safe Drinking Water Act, Maximum Contaminant Level (MCL). However, the upper aquifer is not a drinking water source or industrial water source on-site and is not reasonably expected to serve as either type of water source in the future. Further, there are no known users of groundwater from this upper water-table aquifer in the immediate vicinity of the site.

The lower aquifer is currently used as a nonpotable industrial water supply at the Moraine Engine and Moraine Assembly facilities and has the potential for use as an emergency drinking water supply downgradient of the facilities.

Based on the findings of the RFI and Supplemental RFI investigations, constituents of potential concern for the facilities are limited to chlorinated VOCs in groundwater from historic releases. As stated in the approved AOI 7 Interim Measures Work Plan (ARCADIS Geraghty & Miller, 1999b), data from the site-wide baseline sampling event completed in September 1999 (submitted to U.S. EPA and Ohio EPA under separate cover) was evaluated to establish a site-specific parameter list for site-wide groundwater monitoring. This list contains the eight chlorinated VOCs, that U.S. EPA and GM agreed to during the AOI 7 investigation. In addition, as stated in the Supplemental RFI report (Section 3.4.3.3), toluene would be added to the site parameter list based on detected concentrations in the AOI 7 area during November 1998. Benzene, toluene, ethylbenzene, and xylenes (BTEX) were all detected during the September 1999 baseline sampling event. While BTEX constituents were not identified as constituents of concern during the RFI, they have been added to the site-specific parameter list in order to monitor the effectiveness of the AOI 7 corrective measures and evaluate the total level of organic carbon at the site. The appropriateness of this site-specific parameter list was verified by the results of the one-time sampling event for VOCs, SVOCs and metals requested by the U.S. EPA in comments dated June 16, 2000 that was completed between September and October 2000. Based on GM's assessment of the September and October 2000 groundwater data, GM will add arsenic and barium to the site-specific parameter list used for the site-wide groundwater monitoring program, downgradient of the reactive zones (upper aquifer wells GM-28, ME-3, GM-32, and GM-21) and at the property boundary wells (upper aquifer wells GM-6, TW-2, 4S, and GM-2). These constituents will be included in the site-wide monitoring program until such time as a sufficient database has been developed to demonstrate that the random detection of these two metals does not pose a concern at this site. Once this has been demonstrated, only samples collected from the property boundary wells will be analyzed for arsenic and barium. Using this data, GM will evaluate if changes in the groundwater geochemistry are contributing to solubilizing the arsenic and barium and will modify the enhanced reductive dechlorination process as necessary.

This site-specific list includes the following parameters: benzene, 1,1-dichloroethane, 1,1-dichloroethene, cis-1,2-dichloroethene, trans-1,2-dichloroethene, ethylbenzene, tetrachloroethene, toluene, 1,1,1-trichloroethane, trichloroethene, vinyl chloride, xylenes, arsenic, and barium.

3. Groundwater Monitoring Plan

In order to meet the objectives for groundwater monitoring presented in Section 1.0, a plan has been developed and is presented below. While this plan differs from the existing plans (i.e., reduced frequency of sampling certain monitoring wells and elimination of some wells), a more appropriate set of parameters will be monitored at a larger set of wells to give a better overall understanding of changes in groundwater quality at the site. The plan has been developed to meet the objectives of post-closure monitoring of the North and South Settling Lagoons and of monitoring effectiveness of the site-wide corrective measures. As discussed further in Appendix B, this plan is consistent with the intent of post-closure groundwater monitoring requirements for the closed lagoons, as specified in OAC 3745-54.

A summary of the monitoring plan is presented on Table 3. Figures 10 and 11 indicate the wells to be sampled for VOCs on a site-wide basis in the upper and lower aquifers, respectively. A schedule for the site-wide groundwater monitoring is presented on Figure 12.

3.1 North and South Settling Lagoons and Landfill Monitoring

The groundwater monitoring plan has been developed to meet the objectives of post-closure monitoring for the closed North and South Settling Lagoons. Groundwater quality in the upper-most aquifer downgradient of the closed North and South Settling Lagoons will be monitored on an annual basis for the site-specific list of VOCs. The monitoring well network will consist of three upper aquifer monitoring wells located at the downgradient point of compliance at each closed lagoon, as indicated on Table 3 and presented on Figure 10. Boring logs and well construction logs for these wells are presented in Appendix C. These monitoring wells are a subset of the existing site-wide monitoring well network:

- Closed North Settling Lagoon: W-2-N, W-3-N, and W-4-N.
- Closed South Settling Lagoon: W-2-S, W-3-S, and W-4-S.

VOC concentrations found in monitoring well HR-9, located upgradient from the site property, are similar to and sometimes higher than concentrations found in the monitoring wells directly downgradient of the closed North Settling Lagoon indicating other sources of VOCs are present upgradient from Delphi Thermal Moraine. VOC concentrations in the monitoring wells further downgradient (approximately 1,800 feet) are generally much higher than concentrations in monitoring wells directly downgradient of the North Settling Lagoon, suggesting that VOCs detected in those areas (located some distance from the North Settling Lagoon) are from other sources. These data coupled with the direction of groundwater flow suggests that other sources of these same VOC constituents exist east of the closed North Settling Lagoon at the Former Oil House. Therefore, only monitoring well data obtained from the downgradient point of compliance of the closed lagoons will be evaluated as part of this trend evaluation.

In addition, a subset of the existing monitoring wells located upgradient and downgradient of the landfills (Landfills L1, L2, and L3) will be monitored on an annual basis. The three landfill locations are shown on Figure 10 and the list of wells to be sampled are presented on Table 3.

3.2 Interim Measures Capture Zone Monitoring

GM has been operating a groundwater recovery and treatment system at Delphi Thermal Moraine since January 31, 1996, in order to control the off-site migration of upper aquifer groundwater that contains VOCs. Capture well TW-2, a component of this interim measures system, is located at the southern property boundary (Figure 2). In order to evaluate downgradient groundwater quality in the upper aquifer, a subset of the existing monitoring well network in the vicinity of TW-2 and downgradient of the site will be monitored on an annual basis, as presented on Table 3.

The Air Permit and NPDES Permit for the groundwater recovery and treatment system require periodic monitoring and reporting of water quality in the influent and effluent streams, and pumping flow rates. These activities will continue in accordance with the permit requirements presented in the Final Interim Measures Design Plans (Geraghty & Miller, Inc., 1995) and the new operational scheme presented in the October 1996 Monthly Technical Progress Report.

Interim measures also consist of continued pumping of Montgomery County Well DN-13 (Figure 4). In order to evaluate downgradient groundwater quality in the lower aquifer, a subset of the existing monitoring well network in the vicinity of DN-13 and downgradient of the site will be monitored on an annual basis, as presented on Table 3.

Continued interim measures pumping of groundwater at the downgradient property boundary at wells TW-2 and DN-13 to control migration of groundwater constituents has been recommended as a part of the corrective measures for the site, as discussed in the Interim Measures/Corrective Measures Report.

3.3 AOI 7 Interim/Corrective Measures Remediation Zones Monitoring

As presented in the AOI 7 Interim Measures Work Plan, groundwater quality in select wells upgradient and downgradient of the oxidation areas and reactive zones (Figures 5, 6, and 7) will be monitored, as presented on Table 3. Oxidation Area 1 (OA-1) consists of three wells where chemicals (such as hydrogen peroxide, ferrous sulfate, and sulfuric acid) were injected into the upper aquifer above the upper clay till to create Fenton's Reagent and oxidize the VOCs. The OA-1 wells surround the GM-23/GM-27 well cluster. OA-2 consists of three wells which surround the former Moraine Engine Tank Farm. These wells will be used for remediation purposes. Reactive Zone 1 (RZ-1) is located at the southern boundary of AOI 7 and consists of nine introduction wells; RZ-2 is located as an intermediate downgradient treatment curtain south of AOI 7 in the ME well series area and consists of 4 introduction wells; and RZ-3 is located downgradient of the Delphi Thermal Moraine and the former Moraine Engine facilities and consists of 40 wells. Interim measures within the reactive zones involves the introduction of a carbon source (molasses and potable water mixture) into the upper aquifer to allow the microbial population to develop the reducing conditions necessary to support enhanced anaerobic biodegradation of the chlorinated VOCs.

Based on an evaluation of the AOI 7 Interim Measures discussed above, the corrective measures for the site were proposed in the Draft Interim Measures/Corrective Measures report, submitted to the U.S. EPA and Ohio EPA in March 2001 (ARCADIS Geraghty & Miller, 2001). The proposed AOI 7 corrective measures include continued operation of RZ-1, RZ-2, and RZ-3, with an expansion of RZ-1 through installation and use of additional carbon introduction wells along the western side of RZ-1 during proposed redevelopment activities in this area.

Monitoring frequency of the wells in the reactive zones will be quarterly for the first year, semi-annually for years two and three, and annually thereafter. Field parameters collected from wells within these zones will be monitored more frequently in order to assess performance of the mobile reactive zones.

3.4 Waste Pile/Staging Area Interim Measures

A supplemental investigation is currently being conducted in the Waste Pile/Staging Area at the Delphi Thermal Moraine facility. This focused investigation involves the advancement of soil borings for collection of soil samples for screening and analysis, and to allow the installation of monitoring wells. This investigation is focused at locations upgradient, within and downgradient of the Waste Pile/Staging Area in the upper aquifer, above the regional clay till. Monitoring well pairs have been installed upgradient (deep upper aquifer well GM-33 and shallow well GM-34) and downgradient (deep/shallow pairs GM-35/GM-36 and GM-37/38). These monitoring wells have been sampled for VOCs, SVOCs, metals and polychlorinated biphenyls. After this groundwater data is validated and reviewed, GM will propose to U.S. EPA and Ohio EPA the wells in this area to be added to the site-wide groundwater-monitoring network.

3.5 Field Methodologies

The following sections present a summary of the field procedures to be followed during the site-wide groundwater-monitoring program.

3.5.1 Groundwater Sampling

Groundwater samples will be collected using low-flow sampling procedures from selected upper aquifer monitoring wells presented on Table 3. Field parameters including pH, specific conductance, temperature, oxidation/reduction potential, and dissolved oxygen will be measured during purging of each upper aquifer well using a multi-parameter flow-through cell. Standard Operating Procedure (SOP) #21 will be followed when sampling upper aquifer wells (Geraghty & Miller, Inc., 1997b). A copy of this SOP, along with other SOP's related to groundwater sampling are presented in Appendix D.

Groundwater samples from the lower aquifer wells presented in Table 3 will be collected using a 2-inch submersible pump or a site-dedicated bailer. Once three well volumes are evacuated, field parameters (pH, specific conductance, and temperature) will be measured. SOP #3 will be followed when sampling lower aquifer wells (Appendix D). Groundwater samples from the production wells will be collected according to SOP #28. All groundwater samples will be collected, managed under standard chain-of-custody procedures, and validated in accordance with the approved

Supplemental RFI Work Plan and the RFI Quality Assurance Project Plan (Geraghty & Miller, Inc., 1997b).

3.5.2 Water-Level Measurements

Water levels will be measured contemporaneously in all accessible on-site wells and wells located east of the site and at the southern end of the site, within the Dryden Road North Wellfield, and within the Dryden Road South Wellfield on an annual basis. Specific wells where depth to water will be measured are included on Table 4. SOP #4 will be followed when taking water level measurements.

3.5.3 Laboratory Analytical Methods

All groundwater samples will be analyzed for the site-specific parameter list using SW 846 Method 8260 and Method 6010B. This parameter list was developed after evaluating data from the September 1999 baseline groundwater sampling event and the one-time sampling event conducted in September/October 2000 (which included analysis of Appendix IX VOCs and cis-1,2-dichloroethene, SVOCs and metals), conducted as part of the AOI 7 interim measures. The site-specific parameter list includes: benzene, 1,1-dichloroethane, 1,1-dichloroethene, cis-1,2-dichloroethene, trans-1,2-dichloroethene, ethylbenzene, tetrachloroethene, toluene, 1,1,1-trichloroethane, trichloroethene, vinyl chloride, xylenes, arsenic, and barium. This site-specific list of VOCs may be modified, as necessary.

Select groundwater samples from upper aquifer monitoring wells will also be analyzed for the biogeochemical indicator parameters. Table 5 lists specific field, laboratory, and biogeochemical indicator parameters, and field and laboratory analytical methods. All samples will be submitted under appropriate chain-of-custody documentation to Severn Trent Laboratory in North Canton, Ohio (STL North Canton) and Microseeps in Pittsburgh, Pennsylvania.

4. Groundwater Data Evaluation

Water-level elevations measured from each well will be used to determine groundwater flow directions in the upper and lower aquifers and to determine the vertical gradients between the two aquifers. The cone of influence present around TW-2, DN-13, and any active production wells will be noted on the groundwater flow maps.

All analytical data collected for site-wide groundwater monitoring will be validated and reviewed in accordance with the Data Management Plan and the Quality Assurance Project Plan of the Supplemental RFI Work Plan (Geraghty & Miller, Inc., 1997b). As data are acquired, they will be interpreted to ensure that monitoring objectives outlined in Section 1.0 are met. In general, the data evaluation will be focused on two components: 1) continuing contributions, if any, from in-place waste management units, and 2) effectiveness of corrective measures activities. An outline of the general approach that will be used to evaluate data collected in the groundwater monitoring program is provided below; details regarding the data evaluation methodology are provided in the Interim Measures/Corrective Measures Report submitted by GM to U.S. EPA and Ohio EPA in March 2001 (ARCADIS Geraghty & Miller, 2001).

4.1 Program Objectives

4.1.1 Monitoring of In-Place Waste Management Units

One component of the groundwater monitoring program is monitoring of specific units that will continue to manage wastes in-place (i.e., the closed lagoons and landfills). Although the RFI and Supplemental RFI determined that the wastes at these units do not contribute constituents to groundwater at levels that would have any significant effect on current and reasonably expected future groundwater uses, the monitoring program includes monitoring wells that will be used to confirm these findings.

> <u>Objectives 1 and 2: Assessing contributions from the lagoons and landfills.</u> The monitoring wells associated with the monitoring of the lagoons and landfills will be evaluated to determine whether these units are significantly affecting groundwater quality. In general, this evaluation would include a review of groundwater quality from monitoring wells upgradient and downgradient of these units to identify whether a particular unit is affecting groundwater quality. If a unit is determined to be affecting groundwater quality, the health significance to current and reasonably expected groundwater uses on-site and

off-site will be evaluated. This evaluation will follow the groundwater assessment methods used in the Supplemental RFI Baseline Risk Assessment, accounting for the goal of achieving the conditions outlined in Objective 3 below.

4.1.2 Effectiveness of Corrective Measures

As discussed in the Supplemental RFI Report, the supplemental baseline risk assessment determined that no unacceptable human exposures are currently occurring. However, constituents in groundwater at AOI 7 were determined to have a potential to migrate to an extent that reasonably expected future uses of groundwater might be affected. Accordingly, GM has continued the interim measures pumping of groundwater at the downgradient property boundary at wells TW-2 and DN-13 to control migration of groundwater constituents and has implemented additional interim remedial measures to provide in-situ remediation in AOI 7 and at on-site locations downgradient of AOI 7. These remedial measures have been recommended as the corrective measures for the site, as discussed in the Interim Measures/Corrective Measures Report. Therefore, the second component of the site-wide groundwater monitoring program described in this plan is the collection and evaluation of data for ongoing determination of the effectiveness of and the need for continuation of corrective measures controls and remedial measures.

Objective 3: Assessing the need for pumping of wells TW-2 and DN-13. The need for continued operation of these wells will be determined based on achieving and maintaining the following conditions:

1. Upper Aquifer: Consistent with the criterion stated in the RCRA Corrective Action Environmental Indicator Determination – Migration of Contaminated Groundwater Under Control (CA 750), the condition to be met in the upper aquifer is no migration of VOCs at concentrations exceeding appropriately protective levels (i.e., "appropriate for the protection of the groundwater resource and its beneficial uses" as characterized in the RFI) beyond the "existing area of contaminated groundwater."

2. Lower Aquifer: Consistent with the goal to maintain a nsable aquifer, including off-site drinking water use, the condition to be met in the lower aquifer is no VOC concentrations exceeding MCLs (or equivalent risk-based drinking water concentrations) in the lower aquifer beyond the "existing area of contaminated groundwater."

GM expects that achievement of these conditions will be determined by comparing groundwater quality data from on-site monitoring wells in the upper aquifer at the downgradient facility boundary to specific remediation target levels that have been established to ensure achieving the above-defined conditions when the corrective measures wells are turned-off. The remediation target levels were established using the groundwater assessment methods used in the Supplemental Baseline Risk Assessment, supplemented as appropriate with additional predictive models. Specific modeling methods for establishing the concentration limits and specific monitoring points are described in the Interim Measures/Corrective Measures Report.

Objective 4: Assessing the effectiveness of and the need for continuing remediation in RZs 1 and 3.

Monitoring wells located at and downgradient of AOI 7 and each RZ are included in the site-wide groundwater monitoring program to provide data that will be evaluated to determine whether active remediation at AOI 7 or a particular RZ is performing as expected or has reached the feasible limits of the technology. This evaluation may suggest adjustments or modifications to the remedial actions, including terminating remediation. The specifics of how the data will be evaluated to monitor performance is described in the Interim Measures/Corrective Measures Report.

In addition to the evaluation of technical performance, the data from these wells will also be evaluated to determine the extent to which active remediation at each RZ is contributing significantly to achievement of the conditions outlined above for Objective 3. Specific approaches for evaluating these data from this perspective has been developed in conjunction with the work described above for Objective 3 during completion of the Interim Measures/Corrective Measures Report.

Objective 5: Verify the effectiveness of completed corrective measures.

The monitoring program also is designed to provide data that will allow ongoing confirmation of the Supplemental RFI findings that groundwater at AOI 7 is the only significant source affecting site-wide groundwater quality. Therefore, certain elements of this groundwater monitoring program are to be continued for some period after the completion of active corrective measures controls and remedial measures to verify that the conditions defined for Objective 3 continue to be met without these active measures. The Interim Measures/Corrective Measures Report describes the verification monitoring procedure that will follow shut-down of the active control measures and remedial measures, to ensure that groundwater quality remains acceptable.

4.1.3 Corrective Action Completion Strategy

GM's goal under its corrective action program is to reduce existing on-site and off-site groundwater concentrations to levels that are protective of reasonably expected future uses of groundwater. GM's approach for achieving this goal will be met through a combination of interim and corrective measures that achieve plume migration control, reduce existing plume concentrations, and monitor performance of these measures. Data will be acquired during the implementation of corrective measures to evaluate progress towards achieving this goal. Once on-site groundwater concentrations are reduced sufficiently by active corrective measures to ensure continued protection of reasonably expected groundwater uses, some or all of the active measures will be shut-off. Groundwater monitoring as described in this plan would continue to verify that groundwater conditions remain acceptable, and that ultimately, groundwater concentrations at the downgradient property boundary decline below appropriately protective levels (i.e., appropriate for the protection of the groundwater resource and its beneficial uses).

As discussed in Appendix A, supplemental baseline risk assessments determined that no unacceptable human exposures are currently occurring (Environ Corporation 2000). In particular, hazardous constituents present in soil/waste at the SWMUs and AOIs, including the land-based disposal units present at Delphi Thermal pose no unacceptable risk to groundwater under current and reasonably likely groundwater use conditions. However, constituents in groundwater at an unrelated area, AOI 7, were determined to have a potential to migrate to an extent that reasonably expected future uses of groundwater might be affected. As described in Section 1, at the request of U.S. EPA, GM implemented interim measures pumping of groundwater at the downgradient property boundary at wells TW-2 and DN-13 to control migration of groundwater constituents. GM has also implemented in-situ remediation at three on-site locations downgradient of AOI 7. In addition, GM has initiated a site-wide groundwater monitoring program to collect and evaluate data for its ongoing assessment of the effectiveness of these remedial measures in meeting the corrective measures objectives. The monitoring program includes monitoring for some period following termination of these remedial measures to ensure that groundwater quality remains acceptable, and that off-site contamination is reduced to below appropriately protective levels. In addition, the monitoring program includes provisions for identifying potentially significant contributions from the land-based units (i.e., landfills and closed lagoons), if any, relative to the existing site-wide groundwater quality, to ensure continuation of corrective action as necessary to address these units.

4.2 Data Evaluation Methodology

4.2.1 Shut-Down of Remediation Components

The need for continued operation of the remedial measures will be determined based on achieving and maintaining the following conditions:

1. Upper aquifer: consistent with the criterion stated in the approved RCRA Corrective Action Environmental Indicator Determination – Migration of Contaminated Groundwater Under Control (CA 750), the condition to be met in the upper aquifer is no migration of VOCs at concentrations exceeding appropriately protective levels (i.e., appropriate for the protection of the groundwater resource and its beneficial uses as characterized in the RFI) beyond the existing area of contaminated groundwater. Based on the groundwater conditions established during the September 1999 baseline sampling event, GM proposed for a short-/intermediate-term goal to use existing well GM-26 (Figure 10) as the point of compliance (POC) for ensuring that this condition is maintained.

2. Lower aquifer: consistent with the goal to maintain a usable aquifer, including off-site drinking water use, the condition to be met in the lower aquifer is no VOC concentrations exceeding maximum contaminant levels (MCLs) or equivalent risk-based drinking water concentrations in the lower aquifer beyond the existing area of contaminated groundwater. Based on the groundwater conditions established during the September 1999 baseline sampling event, GM proposed for a short-/intermediate-term goal to use existing wells GM-15, GM-11, and GM-20D (Figure 11) as the POCs for ensuring that this condition is maintained.

Progress towards achieving these conditions will be evaluated by comparing groundwater quality data from on-site monitoring wells to calculated remediation performance target levels (RTLs) that ensure compliance with these conditions without active corrective measures (RTLs are presented on a table in Appendix B). As described in GM's draft Interim Measures/Corrective Measures Report, preliminary RTLs have been estimated using the groundwater assessment methods developed in the Supplemental Baseline Risk Assessment (see summary provided in

Appendix A), taking into consideration the current pumping conditions at and in the vicinity of the facility. Specifically, the modflow groundwater flow model (Geraghty & Miller, Inc. 1994) developed for Delphi Thermal Moraine and the surrounding region (including former Moraine Engine and Moraine Assembly) is being used to support the estimation of RTLs equal to concentrations in on-site groundwater at locations downgradient of AOI 7 that would not be expected to result in exceedances of the MCL at the designated POCs.

The calculated RTLs are presented in Appendix B of the Interim Measures/Corrective Measures Report and Appendix B of this plan. These preliminary RTLs will be reviewed and updated, as needed, as part of the annual assessment of the corrective measures performance to ensure that the basis on which they were estimated remains valid. For example, these preliminary RTLs will be revised as appropriate to reflect knowledge of groundwater pumping conditions at the time of each annual evaluation. Any changes to the RTLs or the methodology for deriving the RTLs will be reviewed with U.S. EPA prior to making a decision regarding termination of one or more remedial measures.

As part of the annual remediation performance monitoring evaluation, data collected from on-site and off-site monitoring wells will be compared to RTLs as a measure of the performance of each remedial measure; i.e., to determine the extent to which each remedial measure is contributing to achievement of the specific conditions outlined above for the upper and lower aquifers. In addition, as part of the annual performance monitoring evaluation, GM will review the groundwater pumping conditions at the facility and surrounding area to confirm that the basis for the RTLs remain valid. In the event that pumping conditions at or surrounding the facility changed during the monitoring period, then GM will update the RTLs prior to conducting the performance evaluation. Further, because the models used to develop the RTLs do not take into consideration attenuation of constituents during transport in the groundwater (e.g., retardation, degradation), and one of the primary components of the remedial measures is enhanced in-situ biodegradation, GM will also assess the extent to which these processes should be accounted for in applying the RTLs during the performance evaluation. Any changes to the methodology for deriving the RTLs will be reviewed with U.S. EPA prior to making a decision regarding termination of one or more remedial measures.

GM's intermediate-term goal is to reduce existing on-site and off-site groundwater concentrations within the existing plume boundary to levels that are protective of reasonably expected future uses of groundwater without the active operation of corrective measures. Achievement of this goal will be determined by comparing groundwater quality data from monitoring wells to RTLs that are designed to ensure residual on-site concentrations will not result in off-site concentrations exceeding acceptable levels. For example, achieving the RTLs in areas downgradient of AOI 7 (e.g., downgradient of RZ-3) would indicate that the downgradient control measures (e.g., pumping TW-2) would no longer be necessary to meet the allowable POC concentration. However, in this example, if concentrations upgradient of RZ-3 remain above the target levels, the active measures at RZ-1, RZ-2, and/or RZ-3 would need to be maintained until upgradient concentrations are further reduced. Achieving RTLs in all of the on-site monitoring zones would indicate that the allowable POC concentrations would not be exceeded if all active measures were shut-off.

Once on-site groundwater concentrations are reduced sufficiently by active measures to be protective of reasonably expected future uses, some or all of these active measures will be shut-off. Following shut-down of any active measures, GM will continue its groundwater monitoring program to confirm that the conditions in the upper and lower aquifer continue to be met without these active measures. GM's long-term goal is to reduce the off-site groundwater concentrations to below appropriately protective levels so that the POC can be shifted to the downgradient facility boundary.

4.2.2 Assessment of Closed Lagoons

As previously described, this site-wide monitoring program provides for an equivalent monitoring of potentially significant contributions of hazardous waste constituents to existing groundwater quality. To determine if the closed lagoons may be significant contributors of hazardous waste constituents to existing groundwater concentrations, monitoring data collected from the designated post-closure monitoring wells located downgradient of each of the closed lagoons will be evaluated for temporal trends. The initial approach for evaluating trends in these data will be to apply straight line regression to the data and to determine if the regression line appears to show a strong positive correlation. This regression analysis will only be performed for wells and constituents where a sufficient percentage of analytical data are above detection limits to allow for a meaningful trend evaluation. In the event that the regression analysis shows a strong correlation, more rigorous statistical methods may be employed to determine the significance of the correlation. These more rigorous statistical methods may inclnde the Sen's Test or the Mann-Kendall Test (Gibbons, 2001). If a statistically significant trend is identified, the degree to which the closed lagoons are affecting groundwater quality will be further evaluated relative to changes in site-wide groundwater quality that are unrelated to the close lagoons. The results of the statistical trend analysis and any additional evaluation will be included in the annual groundwater monitoring report. Table 6 presents the first set of data to be included in the trend evaluation. This data was collected in November 2001 after the lagoons were closed.

If the closed lagoons are determined to be affecting groundwater quality, such effects will be evaluated as part of GM's comprehensive site-wide RCRA corrective action monitoring program. This evaluation will be conducted in lieu of a standard groundwater compliance program as described in OAC 3745-54-99 since it provides a more comprehensive assessment of the significance of groundwater concentrations attributed to the closed lagoons relative to potential site-specific human health impacts attributed to the existing groundwater conditions. Specifically, the health significance of concentrations downgradient of the closed lagoons will be evaluated using the assessment approach defined in the Supplemental Resource Conservation and Recovery Act Facility Investigation Report, Volume II Supplemental Baseline Risk Assessment ("Supplemental BRA"; ENVIRON 2000). The constituent concentrations in detection monitoring wells associated with a unit that are not attributable to an upgradient source(s) will be considered representative of the concentrations that are leaching from the unit, and used to confirm that the unit's contribution to existing groundwater concentrations do not represent levels that could adversely impact potential groundwater receptors.

In the event that one or both of the closed lagoons is determined to be contributing constituents to groundwater such that the site-wide corrective action objectives are not being met, then GM will consider the need for further action under the corrective action program with U.S. EPA. If U.S. EPA determines based on review of the monitoring results that one or both of the lagoons is contributing constituents to the groundwater, U.S. EPA will notify OEPA. OEPA reserves the right to make the determination as to whether or not further action is required with respect to addressing groundwater contamination potentially caused by releases from the closed lagoons.

4.2.3 Assessment of Other Land-Based Units

The monitoring program will also be used to evaluate potentially significant contributions from the other land-based units (i.e., landfills), if any, relative to the existing site-wide groundwater quality, to ensure that the groundwater conditions achieved by the remedial measures continue to be met. Consistent with the methodology specified for the closed lagoons, the significance of concentrations downgradient of the other land-based units will be evaluated using the assessment approach defined in the Supplemental Baseline Risk Assessment. The constituent concentration in monitoring wells associated with a unit that is not attributable to an upgradient source(s) will be considered representative of the concentration that is leaching from the waste, and used as that unit's source term. The source term will then be multiplied with the source reduction factors defined for that unit under current conditions without interim measures to confirm that the unit's contribution to groundwater concentrations do not represent levels that could adversely impact potential groundwater receptors.

5. Groundwater Data Reporting

By March 1st of each year, a summary report will be prepared that contains a discussion of field activities (water-level measurements and groundwater sampling), an assessment of groundwater quality, flow rate, and direction, an evaluation of the validated analytical results (as presented in Section 4.0), a discussion of corrective measures, and a discussion of any problems encountered during sampling and analysis. The report will also contain tabulated analytical results, a summary table that includes construction and location information for the wells in the monitoring program, tabulated water-level elevations, a figure showing water-table surface groundwater elevations, groundwater sampling logs, a hard copy of the laboratory report, and an electronic database. This annual report will be designed to provide adequate information such that it will serve as the annual capture zone monitoring report and the post-closure monitoring report for the closed lagoons and only one annual monitoring report will be required for the site to address both U.S. EPA and Ohio EPA requirements. As part of the data evaluation and reporting, GM will determine if the closed settling lagoons are serving as a significant contributor to groundwater contamination. In the event this occurs, GM will notify both U.S. EPA and Ohio EPA, per the requirements of OAC 3745-54-98(G).

On an annual basis, the wells included in the site-wide groundwater monitoring program and the site-specific parameter list will be assessed to ensure the most appropriate program is implemented. All project files for the site-wide groundwater monitoring program, including field notes and laboratory reports, will be maintained per the requirements of the QAPP.

As shown on Figure 12, groundwater monitoring and reporting are proposed for the next 5 years; however, groundwater monitoring will be implemented for a minimum of 30 years, unless otherwise demonstrated that no further monitoring is warranted. At the end of the fifth year, this monitoring plan will be reevaluated and modifications proposed, if necessary. However, changes to the monitoring program may be proposed prior to the five year timeframe, if necessary.

6. References

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Table 1. Current Groundwater Monitoring Programs Performed at General Motors Corporation, Moraine, Ohio.

Well	Quarterly Assessment Monitoring(1)	Semi-Annual Detection Monitoring(2)	Capture Zone Monitoring(3)
Upper Aquifer Wells			
HR-1	X(4)		
HR-2	X(4)		
HR-3	X(4)		
HR-4	X(4)		
HR-5	X(4)		
HR-6	X(4)		
HR-7	X(4)		
HR-8	X(4)		
HR-9	X(5)		
HR-11	X(5)		
HR-16		X(6,7)	
HR-17		X(6,7)	
W-1-N	X(4)		
W-2-N	X(4)		
W-3-N	X(5)		
W-4-N	X(5)		
W-2-S		X(6,7)	
W-3-S		X(6,7)	
W-4-S		X(6,7)	
4S			X(8)
GM-6			X(8)
GM-17			X(8)
GM-18			X(8)
TW-2			X(8)
Lower Aquifer Wells			
HR-10	X(5)		
HR-12	X(5)		
HR-13	X(4)		
HR-14	X(5)		
HR-15	X(5)		

VOCs Volatile organic compounds.
SVOC Semivolatile Organic Compounds.
TOC Total Organic Carbon.
Mn Manganese.
SpC Specific Conductance.
TOX Total Organic Halogens.
Fe Iron.
Na Sodium.

(1) The quarterly assessment monitoring is performed during March, June, September, and November.
(2) The semi-annual detection monitoring is performed during June and September.
(3) The capture zone monitoring is performed during July.
(4) Sampled quarterly for VOCs, SpC, pH.
(5) Sampled quarterly for VOCs, SpC, pH, SVOC, total cyanide, total metals, dissolved metals.
(6) Sampled second quarter for SpC, pH, TOX, TOC.
(7) Sampled fourth quarter for SpC, pH, TOX, TOC, phenol, chlorides, sulfates, total Fe, Mn, Na, dissolved Fe, Mn, Na.
(8) Sampled annually for VOCs.

Table 2. Water-Level Measurements During December 2001, General Motors Corporation, Moraine, Ohio.

Well	Measuring Point Elevation	Depth-to-Water (feet)	Water-Level Elevation
Shallow Aquifer Wells			
W-1-N	739.02	31.9	707.12
W-2-N	731.68	25.26	706.42
W-3-N	733.66	27.39	706.27
W-4-N	731.63	25.22	706.41
HR-1	732.71	28.09	704.62
HR-2	734.75	28.42	706.33
HR-3	736.75	30.47	706.28
HR-4	742.6	35.64	706.96
HR-5	734.27	28.46	705.81
HR-6	732.66	27.62	705.04
HR-7	731.73	25.85	705.88
HR-8	743.42	36.15	707.27
HR-9	743.51	36.68	707.83
HR-11	743.33	35.64	707.69
HR-16	727.01	22.65	704.36
HR-17	726.43	21.97	704.46
W-1-S	729.29	24.78	704.51
W-2-S	726.64	22.83	703.81
W-3-S	733.42	25.38	708.04*
W-4-S	727.68	23.93	703.75
GM-2	735.81	32.28	703.53
4S	731.36	NA	NA
GM-6	730.27	27.15	703.12
GM-8	735.17	31.79	703.38
GM-10	723.9	20.99	702.91
GM-16	725.3	22.09	703.21
GM-17	723.84	20.74	703.1
GM-18	723.8	22.07	701.73
GM-19S	730.85	26.86	703.99
EAST	730.98	26.75	704.23
WEST	731.08	26.84	704.24
WSU-24	725.1	21.53	703.57
WS-17	726.18	22.96	703.22
WS-18	733.52	31.63	701.89

Table 2. Water-Level Measurements During December 2001, General Motors Corporation, Moraine, Ohio.

Well	Measuring Point Elevation	Depth-to-Water (feet)	Water-Level Elevation
WS-19	726.62	23.25	703.37
TW-2	733.38	34.06	699.32
RW-10	728.53	24.44	704.09
RW-11	729.74	25.47	704.27
GM-21	724.2	21.2	703.81
GM-22	728.28	29.92	701.71
GM-23	730.99	26.2	704.8
GM-24	747.29	38.2	709.09
GM-25	746.17	40.16	706.01
GM-26	722.29	21.14	701.15
GM-27	730.59	24.12	706.45
GM-28	729.19	32.08	705.94
GM-29	730.78	27.26	703.52
GM-30	732.33	29.87	702.46
GM-31	728.20	31.78	703.45
GM-32	732.08	28.59	703.49
GM-33	729.77	25.49	704.28
GM-34	730.56	26.27	704.29
GM-35	731.27	28.84	702.43
GM-36	731.11	28.58	702.53
GM-37	730.05	26.03	704.02
GM-38	729.88	27.28	702.6
ME-2	728.4	**	NA
ME-3	728.09	29.5	703.09
ME-4	728.31	Dry	Dry
ME-6	728.34	32.73	703.18
<u>Deep Aquifer Wells</u>			
GM-1	735.74	32.38	703.36
GM-3	730.44	27.48	702.96
GM-4	731.46	28.51	702.95
GM-5	731.29	28.17	703.12
GM-7R	735.61	32.16	703.45
GM-9	724.07	21.55	702.52
GM-11	723.71	21.28	702.43
GM-13	723.82	21.84	701.98
GM-14	723.5	22.99	700.51
GM-15	725.23	23.35	701.88
GM-19D	730.25	26.68	703.57
GM-20D	727.26	23.81	703.45
HR-10	742.81	34.98	707.83

Table 2. Water-Level Measurements During December 2001, General Motors Corporation, Moraine, Ohio.

Well	Measuring Point Elevation	Depth-to-Water (feet)	Water-Level Elevation
HR-12	742.64	34.93	707.71
HR-13	735.03	28.66	706.37
HR-14	731.63	26.68	704.95
HR-15	733.74	27.49	706.25
M73C	716.55	15.87	700.68
MT68	746.45	41.26	705.19
MT69	722.71	20.38	702.33
MT576M	751.46	44.42	707.04
MT596M***	757.73	49.83	707.9
Production and Fire Wells			
11B	NS	On	NM
12A	742.35	On	NM
28	733.67	NM	NM
31	734.05	27.50	706.55
32	732.10	27.85	704.25
35	733.96	Dry	NM
37	731.24	NM	NM
39	732.07	On	NM
42	731.62	26.69	704.93
44	734.62	NM	NM
45	731.03	NM	NM
46	733.34	29.75	703.59
A	739.00	NM	NM
FW-1A	739.89	33.26	707.74
FW-2	737.48	31.74	705.74
FW-3	739.26	33.55	705.71
FW-4	731.62	27.57	704.05

Measuring point is to top of the PVC Casing.
Water-level elevations are reported in feet above mean sea level (msl).
Depth-to-water elevations were measured on December 3 and 4, 2001 using an electronic water level indicator.
Depth-to-water measurements are reported in feet below the measuring point.
NS - Not Surveyed.
NA - Not accessible because 4S still contains a submersible pump.
NM - Not measured.
*Well needs to be resurveyed.
** Well crushed but can be repaired.
***Measuring point is top of cement housing.

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Table 3. Summary of Site-Wide Groundwater Monitoring Plan, General Motors Corporation, Moraine, Ohio.

Monitoring Wells	Reason for Monitoring	Monitoring Frequency	Parameter List
Upper Aquifer Wells			
HR-9	Monitoring groundwater quality upgradient of the site.	Annual	1st Annual(1), VOCs(2)
HR-11	Monitoring groundwater quality upgradient of the site.	Annual	1st Annual(1), VOCs(2)
HR-8	Monitoring of groundwater quality upgradient of the North Settling Lagoon and Landfills L2 and L3.	Annual	1st Annual(1), VOCs(2)
HR-4	Monitoring of groundwater quality upgradient of the North Settling Lagoon and downgradient of Landfill L3.	Annual	1st Annual(1), VOCs(2)
W-2-N	Monitoring of groundwater quality downgradient of the North Settling Lagoon.	Annual	1st Annual(1), VOCs(2)
W-3-N	Monitoring of groundwater quality downgradient of the North Settling Lagoon.	Annual	1st Annual(1), VOCs(2)
W-4-N	Monitoring of groundwater quality downgradient of the North Settling Lagoon and Landfills L2 and L3.	Annual	1st Annual(1), VOCs(2)
HR-2	Monitoring groundwater quality downgradient of Landfills L2 and L3.	Annual.	1st Annual(1), VOCs(2)
HR-5	Monitoring of groundwater quality downgradient of the North Settling Lagoon.	Annual	1st Annual(1), VOCs(2)
HR-3	Monitoring groundwater quality in the central portion of the site.	Annual	1st Annual(1), VOCs(2)
HR-1	Monitoring groundwater quality in the central portion of the site.	Annual	1st Annual(1), VOCs(2)
GM-30	Monitoring effectiveness of interim measures at AOI 7.	Quarterly for 1st year, semi-annually for years 2 and 3, and annually thereafter.	1st Annual(1), VOCs(2) Biogeochemical(3)

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Table 3. Summary of Site-Wide Groundwater Monitoring Plan, General Motors Corporation, Moraine, Ohio.

Monitoring Wells	Reason for Monitoring	Monitoring Frequency	Parameter List
Upper Aquifer Wells			
GM-23	Monitoring effectiveness of interim measures at AOI 7.	Quarterly for 1st year, semi-annually for years 2 and 3, and annually thereafter.	1st Annual(1), VOCs(2) Biogeochemical(3)
GM-27	Monitoring effectiveness of interim measures at AOI 7 in lower portion of the upper aquifer.	Annual	1st Annual(1), VOCs(2)
GM-29	Monitoring effectiveness of interim measures upgradient of RZ-1.	Quarterly for 1st year, semi-annually for years 2 and 3, and annually thereafter.	1st Annual(1), VOCs(2) Biogeochemical(3)
GM-28	Monitoring effectiveness of interim measures downgradient of RZ-1.	Quarterly for 1st year, semi-annually for years 2 and 3, and annually thereafter.	1st Annual(1), VOCs(2) Biogeochemical(3), arsenic, barium
ME-6	Monitoring effectiveness of interim measures at the upgradient boundary of RZ-2.	Quarterly for 1st year, semi-annually for years 2 and 3, and annually thereafter.	1st Annual(1), VOCs(2) Biogeochemical(3)
GM-31	Monitoring effectiveness of interim measures within RZ-2.	Annual	1st Annual(1), VOCs(2) Biogeochemical(3)
ME-3	Monitoring effectiveness of interim measures at the downgradient boundary of RZ-2.	Quarterly for 1st year, semi-annually for years 2 and 3, and annually thereafter.	1st Annual(1), VOCs(2) Biogeochemical(3), arsenic, barium
GM-22	Monitoring effectiveness of interim measures upgradient of RZ-3.	Quarterly for 1st year, semi-annually for years 2 and 3, and annually thereafter.	1st Annual(1), VOCs(2) Biogeochemical(3)

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Table 3. Summary of Site-Wide Groundwater Monitoring Plan, General Motors Corporation, Moraine, Ohio.

Monitoring Wells	Reason for Monitoring	Monitoring Frequency	Parameter List
Upper Aquifer Wells			
19S	Monitoring effectiveness of interim measures upgradient of RZ-3 and groundwater quality upgradient of Landfill L1.	Quarterly for 1st year, semi-annually for years 2 and 3, and annually thereafter.	1st Annual(1), VOCs(2) Biogeochemical(3)
EAST	Monitoring effectiveness of interim measures upgradient of RZ-3 and groundwater quality upgradient of Landfill L1.	Quarterly for 1st year, semi-annually for years 2 and 3, and annually thereafter.	1st Annual(1), VOCs(2) Biogeochemical(3)
GM-32	Monitoring effectiveness of interim measures downgradient of RZ-3 and groundwater quality upgradient of Landfill L1.	Quarterly for 1st year, semi-annually for years 2 and 3, and annually thereafter.	1st Annual(1), VOCs(2) Biogeochemical(3), arsenic, barium
GM-21	Monitoring effectiveness of interim measures downgradient of RZ-3.	Quarterly for 1st year, semi-annually for years 2 and 3, and annually thereafter.	1st Annual(1), VOCs(2) Biogeochemical(3), arsenic, barium
HR-17	Monitoring of groundwater quality upgradient of the South Settling Lagoon.	Annual	1st Annual(1), VOCs(2)
W-2-S	Monitoring of groundwater quality downgradient of the South Settling Lagoon.	Annual	1st Annual(1), VOCs(2)
W-3-S	Monitoring of groundwater quality downgradient of the South Settling Lagoon.	Annual	1st Annual(1), VOCs(2)
W-4-S	Monitoring of groundwater quality downgradient of the South Settling Lagoon.	Annual	1st Annual(1), VOCs(2)
GM-8	Monitoring groundwater quality downgradient of the site and within Landfill L1.	Annual	1st Annual(1), VOCs(2)

Table 3. Summary of Site-Wide Groundwater Monitoring Plan, General Motors Corporation, Moraine, Ohio.

Monitoring Wells	Reason for Monitoring	Monitoring Frequency	Parameter List
Upper Aquifer Wells			
GM-6	Monitoring groundwater quality downgradient of the site and Landfill L1.	Annual	1st Annual(1), VOCs(2), arsenic, barium
4S/TW-2	Monitoring groundwater quality downgradient of the site and Landfill L1.	Annual	1st Annual(1), VOCs(2), arsenic, barium
GM-2	Monitoring groundwater qnality downgradient of the site.	Annual	1st Annual(1), VOCs(2), arseuic, barium
GM-16	Monitoring groundwater quality downgradient of the site.	Annual	1st Annual(1), VOCs(2)
GM-17	Monitoring groundwater quality downgradient of the site.	Annual	1st Annual(1), VOCs(2)
GM-18	Monitoring groundwater quality downgradient of the site.	Annual	1st Annual(1), VOCs(2)
WSU-24	Monitoring groundwater quality downgradient of the site.	Annual	1st Annual(1), VOCs(2)
GM-10	Monitoring groundwater quality downgradient of the site.	Annual	1st Annual(1), VOCs(2)
GM-26	Monitoring groundwater quality downgradient of the site.	Annual	1st Annual(1), VOCs(2)
Lower Aquifer Wells			
HR-10	Monitoring groundwater quality upgradient of the site.	Annual	1st Annual(1), VOCs(2)
HR-12	Monitoring groundwater quality upgradient of the site.	Annual	1st Annual(1), VOCs(2)
HR-15	Monitoring groundwater quality in the central portion of the site.	Annual	1st Annual(1), VOCs(2)
HR-13	Monitoring groundwater quality in the central portion of the site.	Annual	1st Annual(1), VOCs(2)
31	Monitoring groundwater quality in the central portion of the site.	Annual	1st Annual(1), VOCs(2)
32	Monitoring groundwater quality in the central portion of the site.	Annual	1st Annual(1), VOCs(2)

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Table 3. Summary of Site-Wide Groundwater Monitoring Plan, General Motors Corporation, Moraine, Ohio.

Monitoring Wells	Reason for Monitoring	Monitoring Frequency	Parameter List
Lower Aquifer Wells			
42	Monitoring groundwater quality in the central portion of the site.	Annual	1st Annual(1), VOCs(2)
28	Monitoring groundwater quality in the central portion of the site.	Annual	1st Annual(1), VOCs(2)
GM-19D	Monitoring groundwater quality downgradient of the site.	Annual	1st Annual(1), VOCs(2)
GM-3	Monitoring groundwater quality downgradient of the site.	Annual	1st Annual(1), VOCs(2)
GM-1	Monitoring groundwater quality downgradient of the site.	Annual	1st Annual(1), VOCs(2)
GM-15	Monitoring groundwater quality downgradient of the site.	Annual	1st Annual(1), VOCs(2)
GM-11	Monitoring groundwater quality downgradient of the site.	Annual	1st Annual(1), VOCs(2)
GM-20D	Monitoring groundwater quality downgradient of the site.	Annual	1st Annual(1), VOCs(2)
DN-13	Monitoring groundwater quality downgradient of the site.	Annual	1st Annual(1), VOCs(2)
GM-9	Monitoring groundwater quality downgradient of the site.	Annual	1st Annual(1), VOCs(2)
MT-69	Monitoring groundwater quality downgradient of the site.	Annual	1st Annual(1), VOCs(2)

VOCs - Volatile organic compounds.
SVOCs – Semi-volatile organic compounds.

(1) The following parameters will be analyzed for the 1st annual sampling event: Appendix IX VOCs and cis-1,2-dichloroethene, Appendix IX SVOCs, and Appendix IX total and dissolved metals.
(2) The parameters for the remaining annual sampling events will include the site-specific list of VOCs: benzene, 1,1,-dichloroethane, 1,1-dichloroethene, cis-1,2-dichloroethene, trans-1,2-dichloroethene, ethylbenzene, tetrachloroethene, toluene, 1,1,1-trichloroethane, trichloroethene, vinyl chloride, and xylenes.
(3) The biogeochemical list includes the field and laboratory parameters presented on Table 5.

Table 4. List of Wells to be Used for Water-Level Measurements, General Motors Corporation, Moraine, Ohio.

Upper Aquifer Monitoring Wells

W-1-N	HR-9	GM-10	GM-21	GM-33
W-2-N	HR-11	GM-16	GM-22	GM-34
W-3-N	HR-16	GM-17	GM-23	GM-35
W-4-N	HR-17	GM-18	GM-24	GM-36
HR-1	W-1-S	GM-19S	GM-25	GM-37
HR-2	W-2-S	EAST	GM-26	GM-38
HR-3	W-3-S	WEST	GM-27	ME-2
HR-4	W-4-S	TW-2	GM-28	ME-3
HR-5	GM-2	WSU-24	GM-29	ME-4
HR-6	4S	WS-17	GM-30	ME-6
HR-7	GM-6	WS-18	GM-31	
HR-8	GM-8	WS-19	GM-32	

Lower Aquifer Monitoring Wells

GM-1	GM-11	HR-12	MT-69
GM-3	GM-13	HR-13	MT576M
GM-4	GM-14	HR-14	MT68M
GM-5	GM-15	HR-15	MT596M
GM-7R	GM-19D	GM-20D	
GM-9	HR-10	M73C	

Lower Aquifer Production and Fire Wells (as accessible)

A	32	42	FW-1A
11B	35	44	FW-2
12A	37	45	FW-3
28	39	46	FW-4
31			

Table 5. Field and Laboratory Analytical Procedures for Groundwater, Geueral Motors Corporation, Moraine, Ohio.

Parameters	Method Number	Procedure
Site-Specific List of VOCs(1)	Method 8260B	Laboratory
Arsenic, Barium (select wells only)	Method 6010B	Laboratory
Dissolved Oxygen	(2)	Field
Reduction/Oxidation Potential	(2)	Field
pH	(2)	Field
Specific Conductance	(2)	Field
Manganese (Total)	Method 6010B	Laboratory
Manganese (Dissolved)	Method 6010B	Laboratory
Iron (Total)	Method 6010B	Laboratory
Iron (Dissolved)	Method 6010B	Laboratory
Sulfate	SM 375.4	Laboratory
Sulfide	SM 376.1	Laboratory
Total Organic Carbon	SM 415.1	Laboratory
Chlorides	SM 325.2	Laboratory
Light Hydrocarbon Scan (Ethane, Ethene, Methane)	Method AM18G(3)	Laboratory

Method Refers to U.S. Environmental Protection Agency SW 846.
SM Standard Methods for the Evaluation of Water and Wastewater, 18th Edition, 1992.
VOCs Volatile organic compounds.
(1) Site-specific parameter list for VOCs includes: benzene, 1,1-dichloroethane, 1,1-dichloroethene, cis-1,2-dichloroethene, trans-1,2-dichloroethene, ethylbenzene, tetrachloroethene, toluene, 1,1,1-trichloroethane, trichloroethene, vinyl chloride, and xylenes.
(2) Field parameters to be collected using a down-well or a flow-through meter.
(3) Method numbers are laboratory-specific and developed for monitoring natural attenuation projects.

Table 5. Field and Laboratory Analytical Procedures for Groundwater, General Motors Corporation, Moraine, Ohio.

Parameters	Method Number	Procedure
Site-Specific List of VOCs[(1)]	Method 8260B	Laboratory
Arsenic, Barium (select wells only)	Method 6010B	Laboratory
Dissolved Oxygen	[(2)]	Field
Reduction/Oxidation Potential	[(2)]	Field
pH	[(2)]	Field
Specific Conductance	[(2)]	Field
Manganese (Total)	Method 6010B	Laboratory
Manganese (Dissolved)	Method 6010B	Laboratory
Iron (Total)	Method 6010B	Laboratory
Iron (Dissolved)	Method 6010B	Laboratory
Sulfate	SM 375.4	Laboratory
Sulfide	SM 376.1	Laboratory
Total Organic Carbon	SM 415.1	Laboratory
Chlorides	SM 325.2	Laboratory
Light Hydrocarbon Scan (Ethane, Ethene, Methane)	Method AM18G[(3)]	Laboratory

Method — Refers to U.S. Environmental Protection Agency SW 846.
SM — Standard Methods for the Evaluation of Water and Wastewater, 18th Edition, 1992.
VOCs — Volatile organic compounds.
(1) Site-specific parameter list for VOCs includes: benzene, 1,1-dichloroethane, 1,1-dichloroethene, cis-1,2-dichloroethene, trans-1,2-dichloroethene, ethylbenzene, tetrachloroethene, toluene, 1,1,1-trichloroethane, trichloroethene, vinyl chloride, and xylenes.
(2) Field parameters to be collected using a down-well or a flow-through meter.
(3) Method numbers are laboratory-specific and developed for monitoring natural attenuation projects.

LEGEND

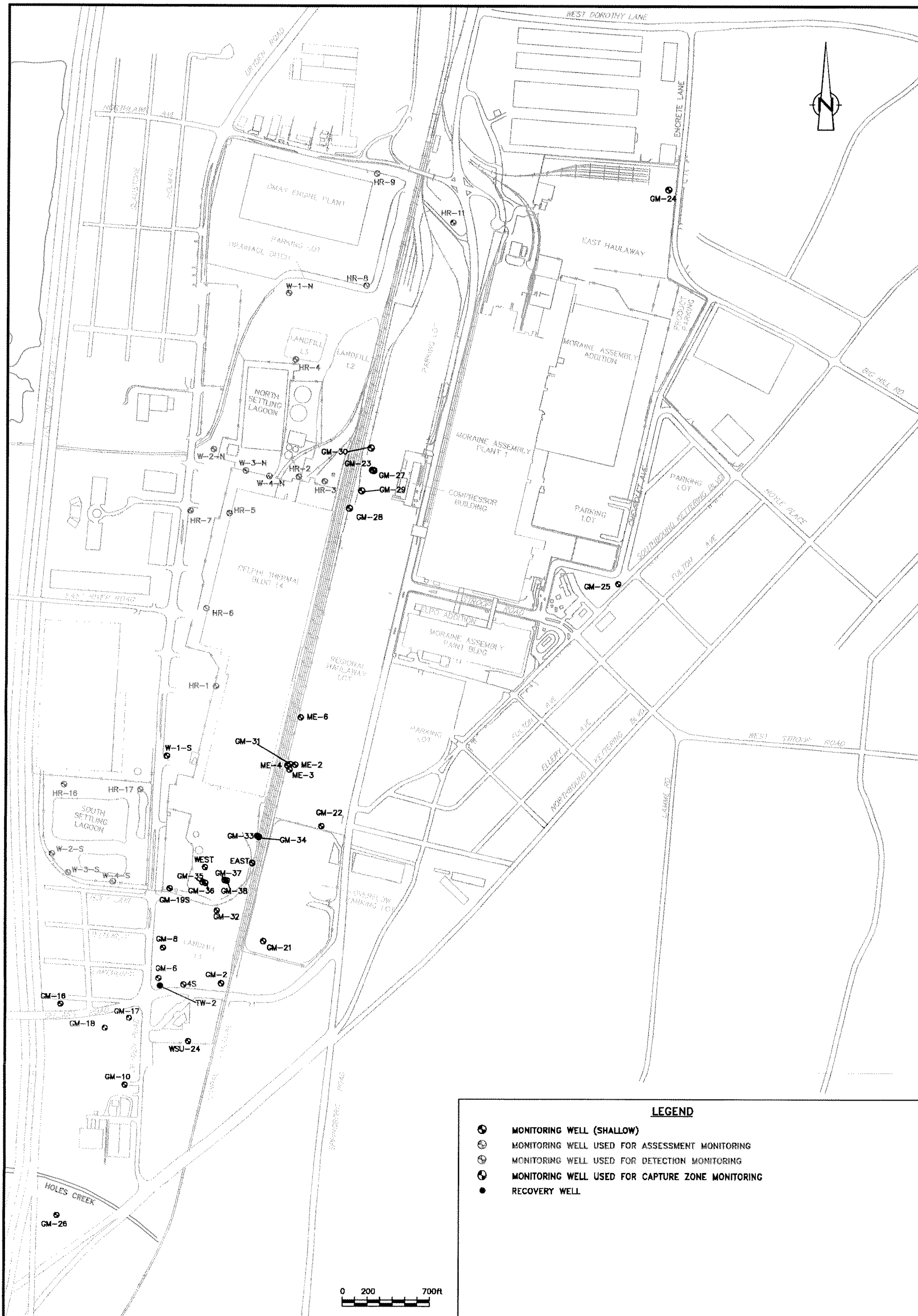
—— PROPERTY BOUNDARY

ARCADIS

6397 Emerald Parkway
Suite 150, Dublin, OH 43016
Tel: 614/764-2310 Fax: 614/764-1270

SITE LAYOUT
FORMER MORAINE ENGINE, MORAINE ASSEMBLY
AND DELPHI THERMAL FACILITIES
GENERAL MOTORS CORPORATION
MORAINE, OHIO

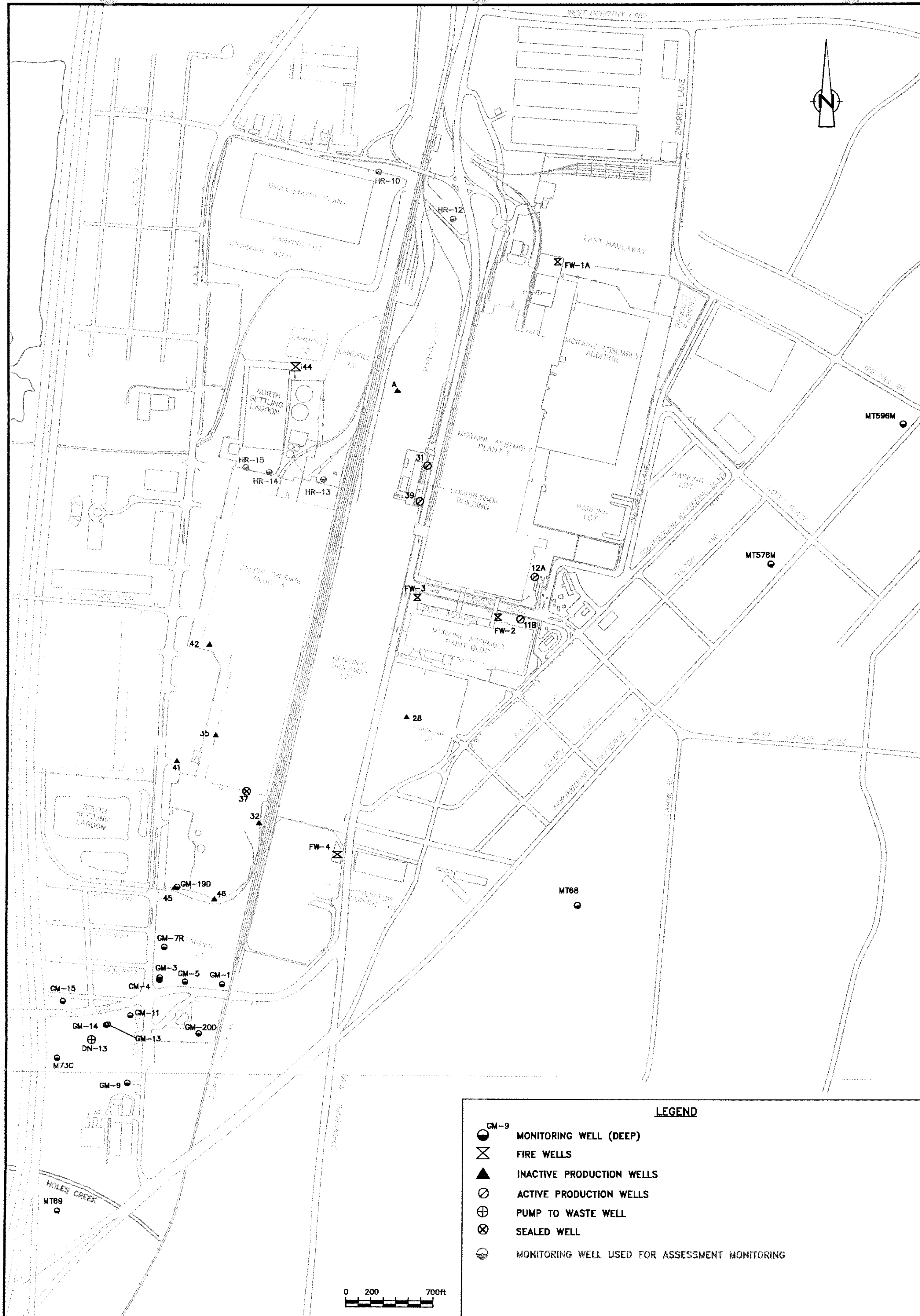
DATE 10/18/2002	PROJECT MANAGER N. GILLOTTI	DRAWING NAME CRA\GWM\GWMPLAN-00
DRAWN R. SMITH	LEAD DESIGN PROF. J. REID	CHECKED N. GILLOTTI
PROJECT NUMBER OH000294.0005.0003		DRAWING NUMBER 1



ARCADIS
6397 Emerald Parkway
Suite 150, Dublin, OH 43016
Tel: 614/764-2310 Fax: 614/764-1270

UPPER AQUIFER MONITORING WELL NETWORK
GENERAL MOTORS CORPORATION
MORAINE, OHIO

DATE 10/18/2002	PROJECT MANAGER N. GILLOTTI	DRAWING NAME CRA\GWP\GWMPLAN-01
DRAWN R. SMITH	LEAD DESIGN PROF. J. REID	CHECKED N. GILLOTTI
PROJECT NUMBER 0H000294.0005.0003		DRAWING NUMBER 2



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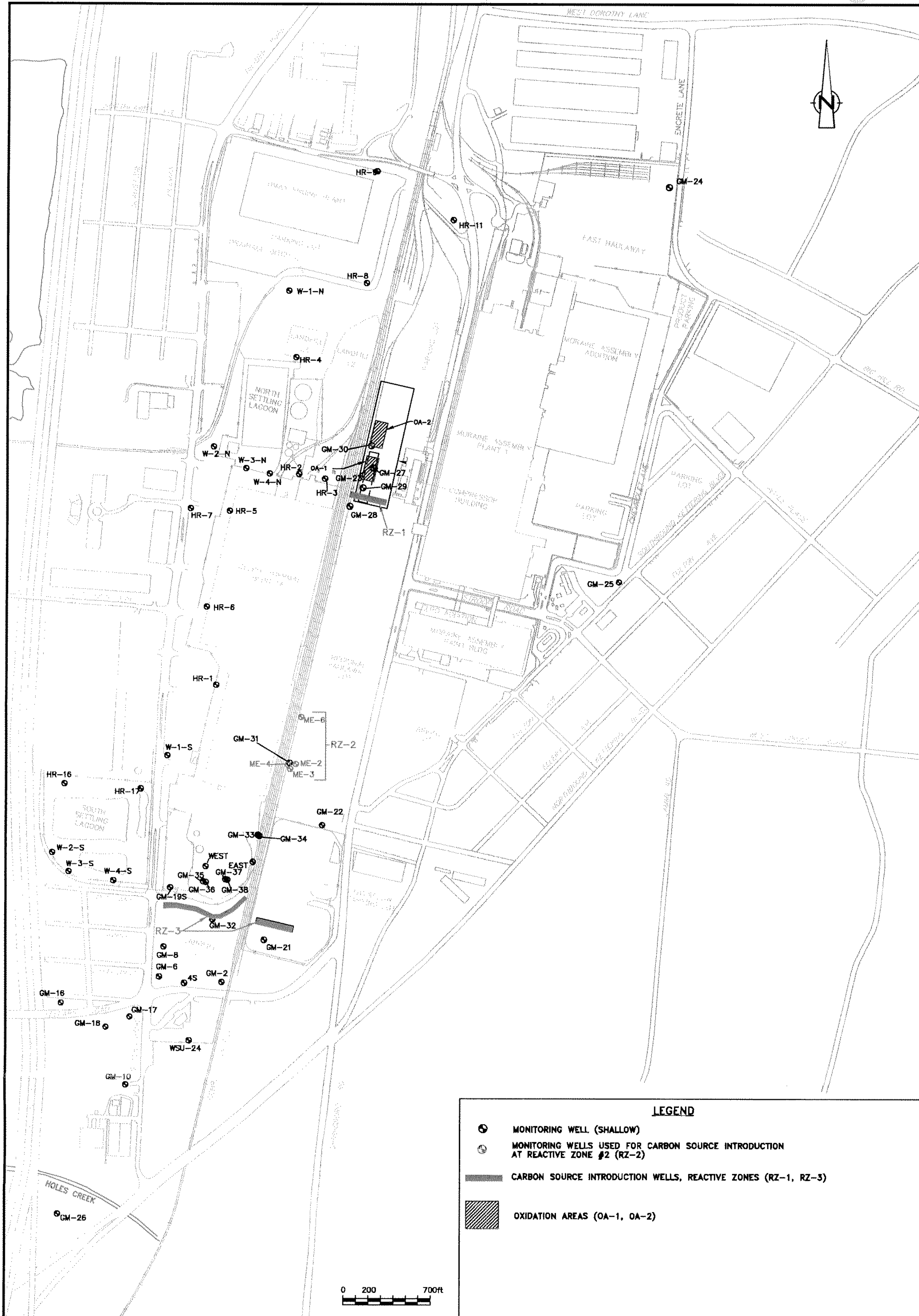
Suite 150, Dublin, OH 43016
Tel: 614/764-2310 Fax: 614/764-1270

LOWER AQUIFER MONITORING WELL NETWORK
GENERAL MOTORS CORPORATION
MORAINE, OHIO

DATE 10/18/2002	PROJECT MANAGER N. GILLOTTI	DRAWING NAME CRA\GWP\GWMPLAN-02
DRAWN R. SMITH	LEAD DESIGN PROF. J. REID	CHECKED N. GILLOTTI
PROJECT NUMBER OH000294.0005.0003		DRAWING NUMBER 3



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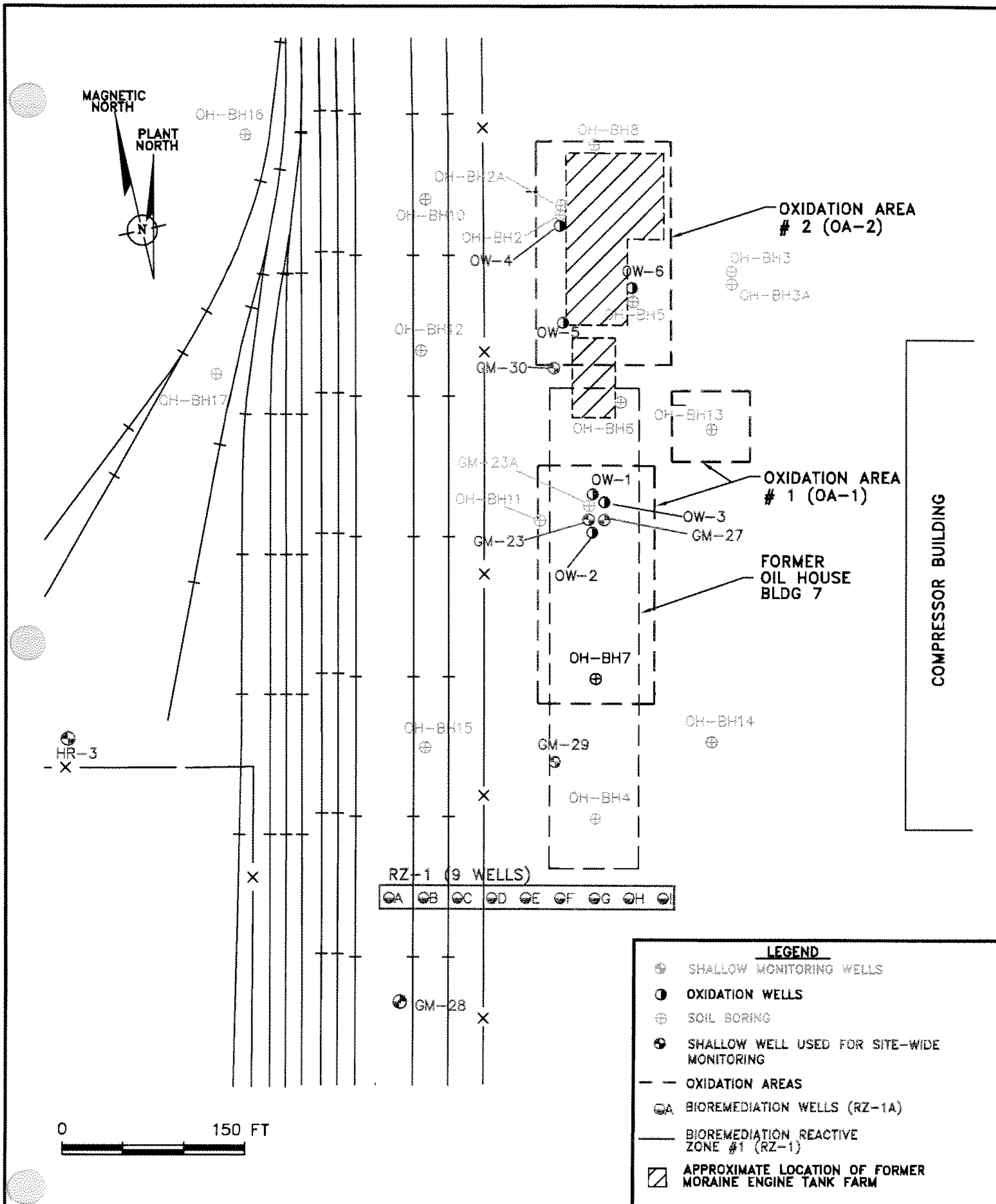
Suite 150, Dublin, OH 43016
Tel: 614/764-2310 Fax: 614/764-1270

AOI 7 CORRECTIVE MEASURES
GENERAL MOTORS CORPORATION
MORAINE, OHIO

DATE 10/18/2002	PROJECT MANAGER N. GILLOTTI	DRAWING NAME CRA\GWP\GWMPLAN-05
DRAWN R. SMITH	LEAD DESIGN PROF. J. REID	CHECKED N. GILLOTTI
PROJECT NUMBER OH000294.0005.0003		DRAWING NUMBER 4



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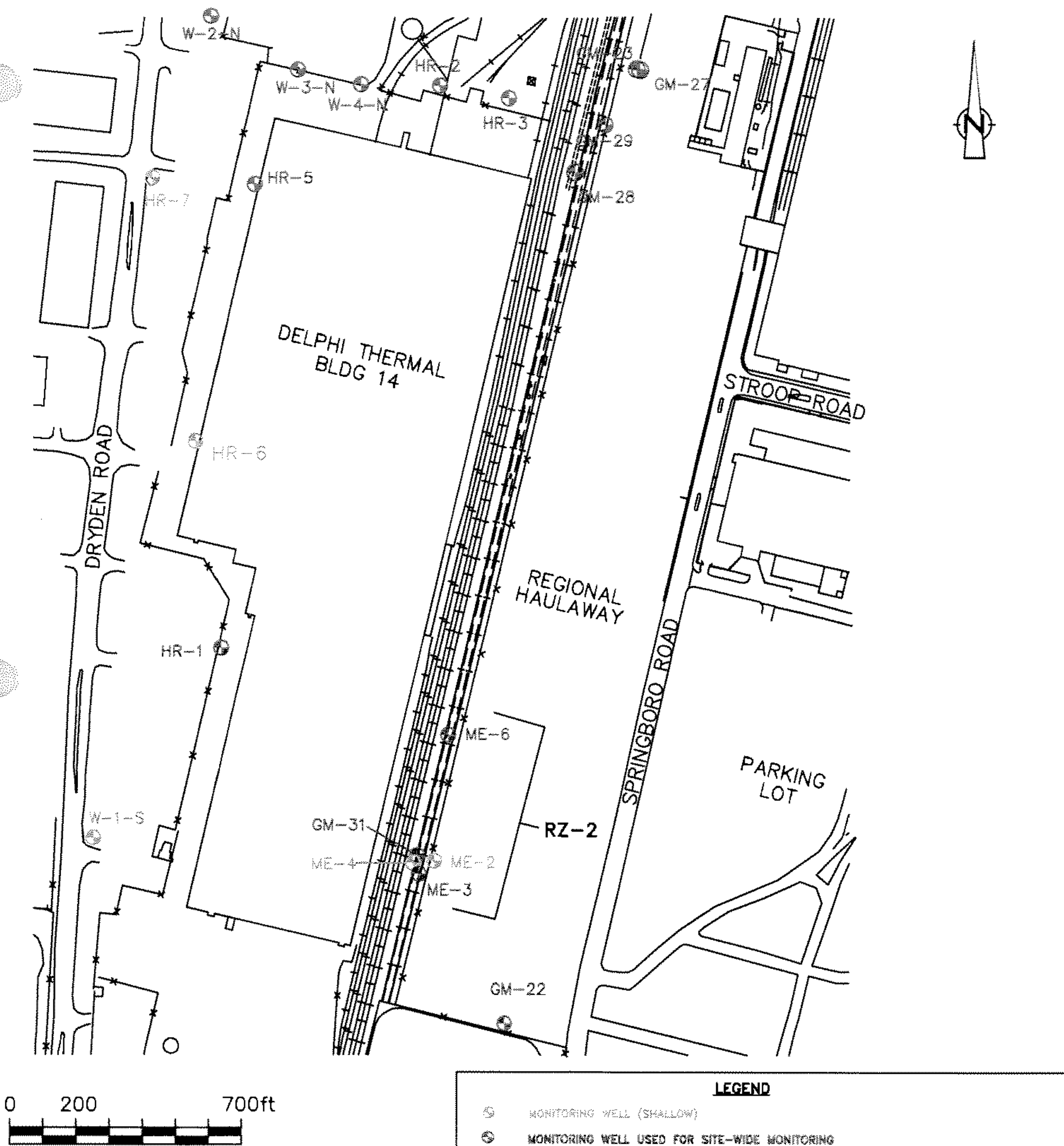
**BIOREMEDIATION REACTIVE ZONE #1
AND OXIDATION AREAS
GENERAL MOTORS CORPORATION
MORAINE, OHIO**

DATE 10/16/2002	PROJECT MANAGER N. GILLOTTI	DRAWING NAME CRA\GMM\GMMPLAN-09
DRAWN R. SMITH	LEAD DESIGN PROF. J. REID	CHECKED N. GILLOTTI
PROJECT NUMBER 0H000294.0005.0003		FIGURE NUMBER 5



LEGEND

MONITORING WELL (SHALLOW)

MONITORING WELL USED FOR SITE-WIDE MONITORING

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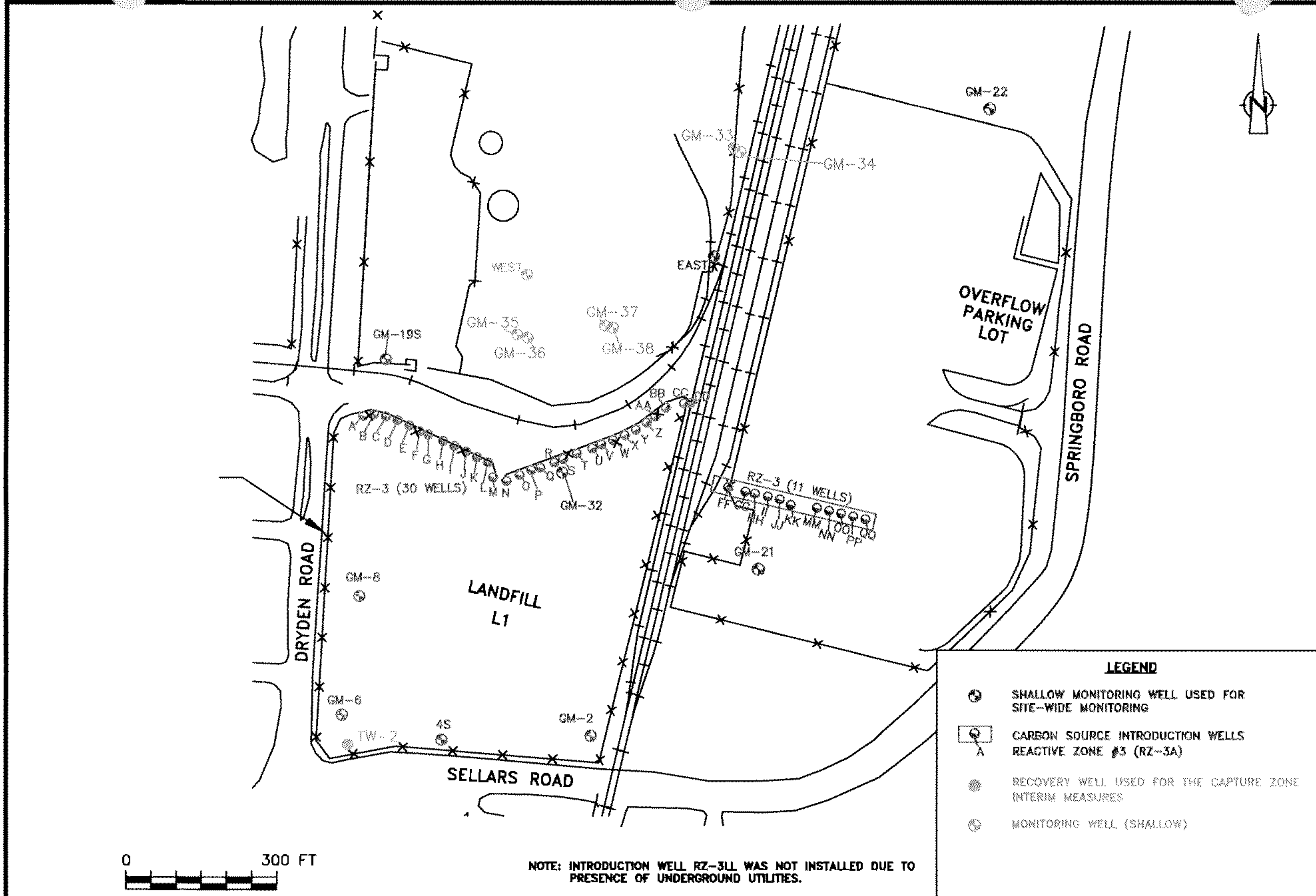
Suite 150, Dublin, OH 43016
Tel: 614/764-2310 Fax: 614/764-1270

BIOREMEDIATION REACTIVE ZONE #2
GENERAL MOTORS CORPORATION
MORAINE, OHIO

DATE 10/18/2002	PROJECT MANAGER N. GILLOTTI	DRAWING NAME CRA\GMM\GMMPLAN-10
DRAWN R. SMITH	LEAD DESIGN PROF. J. REID	CHECKED N. GILLOTTI
PROJECT NUMBER OH000294.0005.0003		FIGURE NUMBER 6



NOTE: INTRODUCTION WELL RZ-3LL WAS NOT INSTALLED DUE TO PRESENCE OF UNDERGROUND UTILITIES.

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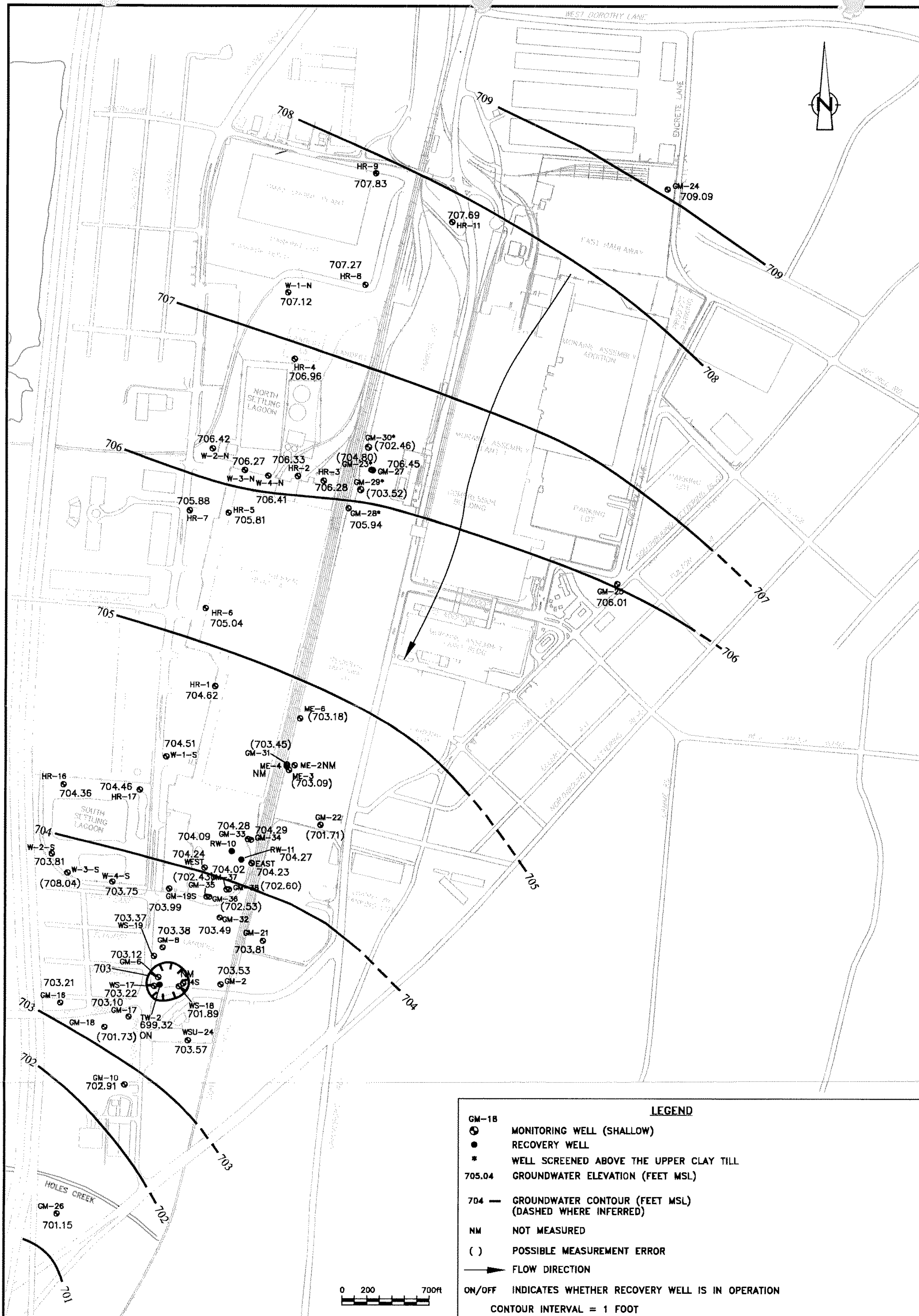
BIOREMEDIATION REACTIVE ZONE #3
GENERAL MOTORS CORPORATION
MORAINE, OHIO

DATE 10/18/2002	PROJECT MANAGER N. GILLOTTI	DRAWING NAME CRA\GW\GWMPLAN-11
DRAWN R. SMITH	LEAD DESIGN PROF. J. REID	CHECKED N. GILLOTTI
PROJECT NUMBER 0H000294.0005.0003		FIGURE NUMBER 7



ARCADIS

6397 Emerald Parkway
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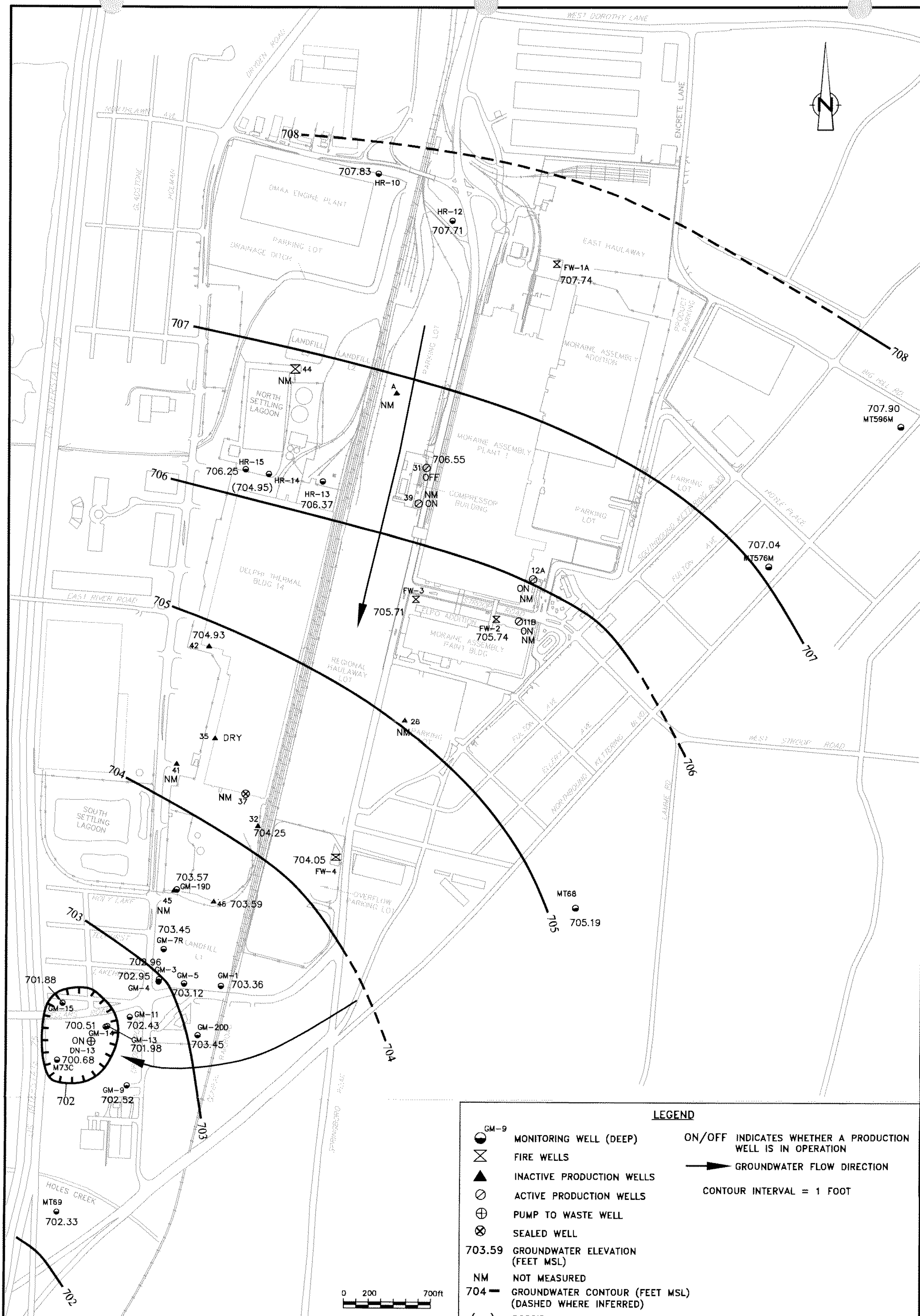
WATER TABLE SURFACE (UPPER AQUIFER)
ON DECEMBER 3 AND 4, 2001
FORMER MORAINE ENGINE, MORAINE ASSEMBLY
AND DELPHI THERMAL FACILITIES
GENERAL MOTORS CORPORATION, MORAINE, OHIO

DATE 10/18/2002	PROJECT MANAGER N. GILLOTTI	DRAWING NAME CRA\GWP\GWMPLAN-06
DRAWN R. SMITH	LEAD DESIGN PROF. J. REID	CHECKED N. GILLOTTI
PROJECT NUMBER 0H000294.0005.0003		DRAWING NUMBER 8



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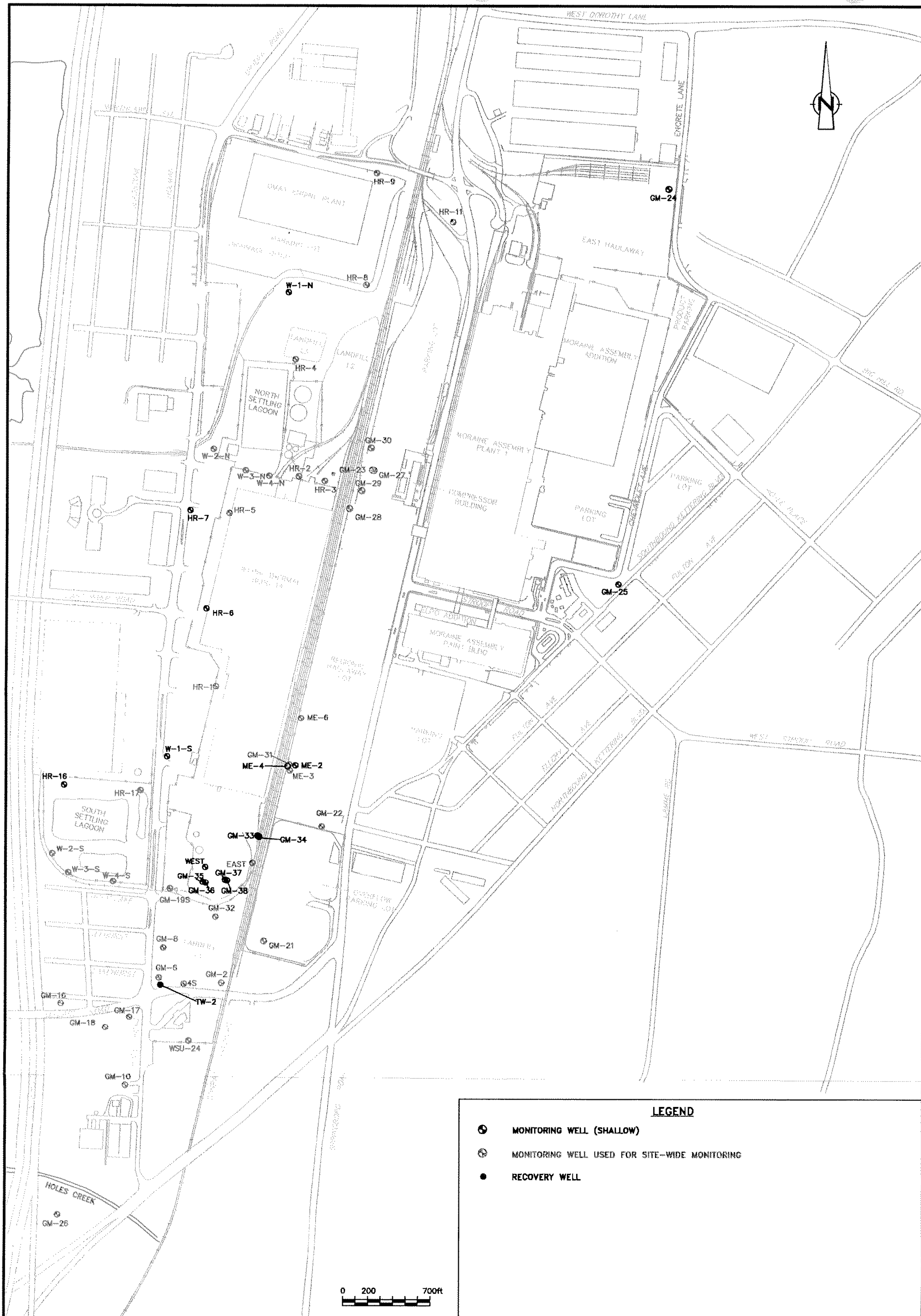
Suite 150, Dublin, OH 43016
Tel: 614/764-2310 Fax: 614/764-1270

POTENTIOMETRIC SURFACE (LOWER AQUIFER)
ON DECEMBER 3 AND 4, 2001
FORMER MORAINE ENGINE, MORAINE ASSEMBLY
AND DELPHI THERMAL FACILITIES
GENERAL MOTORS CORPORATION, MORAINE, OHIO

DATE	PROJECT MANAGER	DRAWING NAME
10/18/2002	N. GILLOTTI	CRA\GWP\GWMPLAN-07
DRAWN R. SMITH	LEAD DESIGN PROF. J. REID	CHECKED N. GILLOTTI
PROJECT NUMBER 0H000294.0005.0003		DRAWING NUMBER 9



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6397 Emerald Parkway
Suite 150, Dublin, OH 43016
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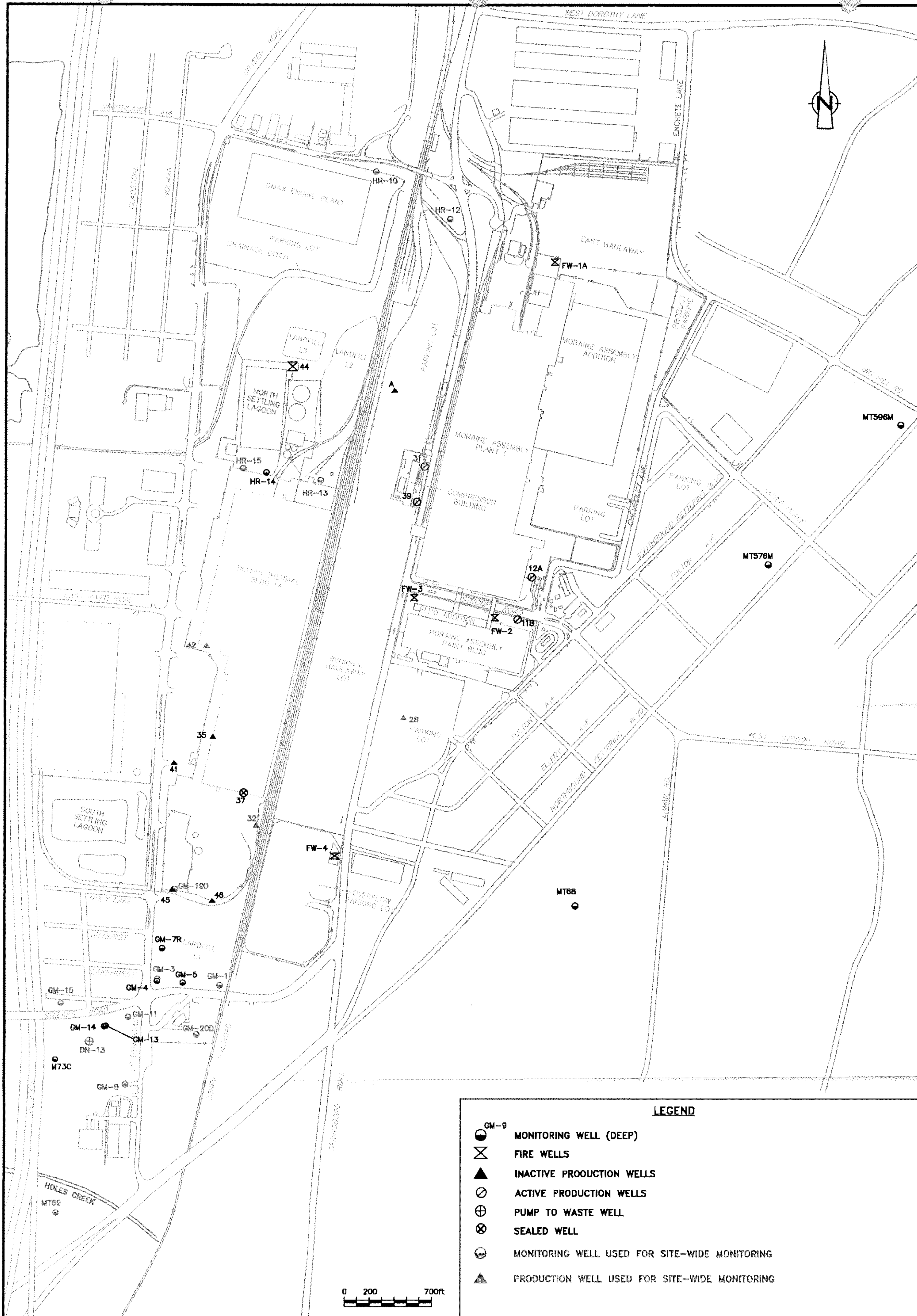
UPPER AQUIFER MONITORING WELLS
FOR SITE-WIDE
GROUNDWATER MONITORING
GENERAL MOTORS CORPORATION
MORAINE, OHIO

DATE 10/18/2002	PROJECT MANAGER N. GILLOTTI	DRAWING NAME CRA\GWP\GWMPLAN-03
DRAWN R. SMITH	LEAD DESIGN PROF. J. REID	CHECKED N. GILLOTTI
PROJECT NUMBER OH000294.0005.0003		DRAWING NUMBER 10



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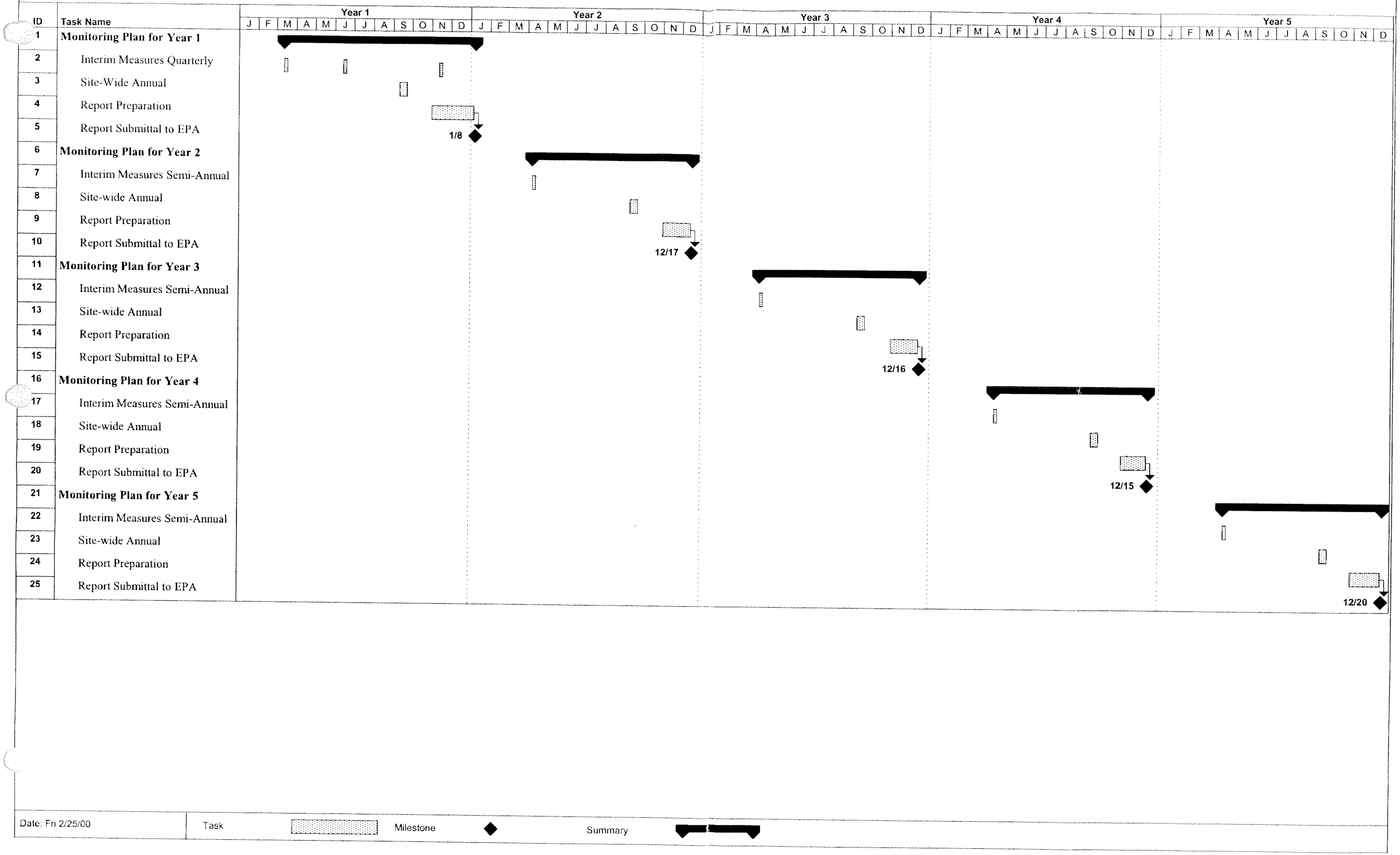
LOWER AQUIFER MONITORING WELLS
FOR SITE-WIDE
GROUNDWATER MONITORING
GENERAL MOTORS CORPORATION
MORAINE, OHIO

DATE 10/18/2002	PROJECT MANAGER N. GILLOTTI	DRAWING NAME CRA\GWP\GWMPLAN-04
DRAWN R. SMITH	LEAD DESIGN PROF. J. REID	CHECKED N. GILLOTTI
PROJECT NUMBER 0H000294.0005.0003		DRAWING NUMBER 11

Figure 12. Site-Wide Groundwater Monitoring Schedule, General Motors Corporation, Moraine, Ohio.



Appendix A

Summary of Baseline Risk Assessment

Summary of RFI Baseline Risk Assessment
General Motors Corporation
Moraine, Ohio

1 Scope of RFI Risk Assessment

The Baseline Risk Assessment conducted during the RFI at the Delphi Thermal Moraine facility evaluated the potential risk to human health and the environment posed by releases of hazardous waste and constituents from the 14 solid waste management units (SWMUs) investigated in the RFI at Delphi Thermal, including SWMUs undergoing closure under Ohio EPA's RCRA program (i.e., the North and South Settling Lagoons). Potential exposures to constituents in soil/waste at the SWMUs via direct contact, airborne transport, and groundwater transport were evaluated to determine whether soil/waste at the SWMUs warrants corrective measures and to support identification of appropriate corrective measures alternatives by determining which potential exposure pathways, if any, pose a significant risk. This Baseline Risk Assessment was supplemented with a risk assessment performed for constituents detected in soils within the 6 AOIs investigated at the former Moraine Engine facility and the Moraine Assembly facility. In addition to evaluating potential groundwater exposures to constituents that may leach from soil/waste at the SWMUs and AOIs, the supplemental Baseline Risk Assessment also evaluated potential groundwater exposures to constituents already in groundwater at the former Oil House (AOI 7) associated with the former Moraine Engine facility.

2 Assessment of Groundwater Exposure Pathway

The conceptual site model for the baseline and supplemental Baseline Risk Assessments established the reasonably anticipated future land uses and groundwater uses at and around Delphi Thermal Moraine, Moraine Assembly and former Moraine Engine facilities, the potential exposure pathways associated with constituents in soil/waste at the 14 SWMUs and 6 AOIs, and the potentially exposed populations on-site and off-site.

With respect to the exposure assessment for the groundwater pathway, it was determined that groundwater in the lower aquifer in the region surrounding the three facilities is a drinking and industrial water source; but the groundwater in the upper aquifer underlying the facilities is not a drinking or industrial water source and is not reasonably expected to serve as either type of water source in the future. The groundwater in the upper aquifer, however, is a medium for potential transport of constituents from the SWMUs at Delphi Thermal Moraine and the AOIs at Moraine Assembly and former Moraine Engine to the lower aquifer and the Great Miami River. As such, the Baseline Risk Assessments included an assessment of the extent to which the hydraulic interconnections could result in migration of constituents to the lower aquifer or to the River in concentrations of significance to human health.

The potential for drinking water exposure to groundwater was evaluated for current or potential drinking water use of groundwater extracted from the following municipal well fields:

- West Carrollton: as West Carrollton's drinking water supply
- Miami Shores: as Greater Moraine Water System (GMWS) of Montgomery County's primary emergency drinking water supply
- Dryden Road South: as GMWS's secondary emergency drinking water supply

Although the Dryden Road North well field is not expected to serve as a drinking water supply or as an emergency drinking water supply, the groundwater quality at this well field was also evaluated.

The Baseline Risk Assessment also evaluated the potential for exposures that may occur through current and potential nonpotable industrial use of groundwater extracted from industrial wells. Based on currently active production wells and potential operation of inactive production wells, potential exposures through nonpotable groundwater use was evaluated for the following on-site industrial wells:

- Delphi Thermal inactive production wells: as a potential industrial water supply
- Moraine Assembly active production wells: as an industrial water supply
- Moraine Engine active production wells: as an industrial water supply
- Moraine Engine inactive production well: as a potential industrial water supply

The significance of waste constituents potentially transported to the Great Miami River via groundwater flow from the upper aquifer was also evaluated.

3 Estimating Contributions To Groundwater Receptors

To estimate the magnitude of the potential exposures at the identified exposure points, mathematical models were used in combination with soil and groundwater monitoring data collected during the RFI and supplemental RFI. Based on the assessment of current and potential future groundwater pumping, 10 groundwater modeling scenarios were evaluated to predict potential waste constituent migration from the SWMUs and AOIs at the three facilities to potential points of groundwater exposure under various groundwater pumping patterns in the region. Each modeling scenario was defined by (1) a groundwater use scenario, (2) a set of wells that are expected to be pumping under the groundwater use scenario, and (3) a set of associated groundwater exposure points that are evaluated in the risk assessment. As described on Table 3-4 of the Baseline Risk Assessment (a copy is included in this Appendix A), the 10 scenarios were divided into two groups of five scenarios. One group (Scenarios 6 through 10) included current interim measures (i.e., operation of wells TW-2 and DN-13 for hydraulic control) in each scenario and the other group did not include interim measures pumping (Scenarios 1 through 5). The first scenario (Scenario 1) was the baseline groundwater use scenario, which represents current groundwater use conditions.

The MODFLOW model (G&M 1994) developed to evaluate groundwater flow at the three facilities and in the region under various pumping conditions was used in this exposure assessment as the basis for approximating the transport of waste constituents from the SWMUs and AOIs to potential points of groundwater use for the 10 scenarios. The groundwater flow model facilitates the approximation of transport of constituents in groundwater by allowing the calculation of source reduction factors that account for the natural dilution of constituents as they move in groundwater from under the facilities to potential exposure points. The source reduction factors were calculated by using the MODFLOW model in combination with MODALL (Potter 1995), a complete-mix model designed to work with MODFLOW. The MODALL model uses the cell-by-cell flow terms computed by MODFLOW to calculate source reduction factors for a specified source within each downgradient cell or block in the finite difference domain of the MODFLOW model. The source reduction factors were computed for steady-state transport (without dispersion) with the following conservative assumptions:

- Each SWMU or AOI provides a continuous, steady-state flux of constituents into the upper aquifer.
- No degradation of constituents occurs during transport.
- No dispersion of constituents occurs during transport.

A source reduction factor was computed by setting the concentration of the groundwater beneath a source to a constant, unit concentration (or dimensionless concentration C/C_0), such that the calculated concentration at an exposure point ranges from zero to one. The concentration estimated at the potential exposure point for a unit source concentration is the source reduction factor for that source and exposure point combination. The estimated exposure concentration of a constituent at an exposure point resulting from all SWMUs and AOIs was then obtained by multiplying the groundwater concentration at the SWMU or AOI with the source reduction factor and summing all the products.

With a few exceptions (e.g., the land based units), the groundwater concentrations at a SWMU or AOI were estimated using the maximum detected concentration in the soil/waste data. For the closed lagoons at Delphi Thermal Moraine, the maximum groundwater concentration of a constituent measured during the supplemental RFI (or the RFI, if no data were collected during the supplemental RFI) from monitoring wells associated with the lagoons was considered to be representative of the concentration that leaches from the lagoon waste, and was used as the source term, if the constituent was detected in the lagoon sludge or is a degradation product of constituents detected in the sludge. This approach may tend to overestimate the lagoon source concentration since it did not account for potential contributions from upgradient sources.

4 Conclusions for the Groundwater Pathway

The aggregate effect of these sources on the exposure point concentration was calculated by adding the concentration contributions from the individual SWMUs and AOIs. Potential groundwater and surface water exposures were then evaluated by comparison of exposure concentrations in groundwater and surface water at potential points of contact with maximum contaminant levels (MCLs) under the Safe Drinking Water Act, or similar risk-based drinking water concentrations for constituents without MCLs. For active nonpotable industrial water supply wells where predicted constituent concentrations are higher than MCLs or risk-based drinking water concentrations, their predicted constituent concentrations were further assessed based on the actual exposure setting and water usage.

With respect to the closed lagoons at the Delphi Thermal Moraine facility, based on the assessment of the combined contributions of hazardous constituents to groundwater from soil/waste present in the SWMUs at Delphi Thermal Moraine and the AOIs at the former Moraine Engine and Moraine Assembly, the supplemental Baseline Risk Assessment concluded that constituents in soil/waste at the closed lagoons, as represented by groundwater concentrations observed immediately downgradient of these two SWMUs, do not pose an unacceptable risk via groundwater transport under the 10 groundwater use scenarios evaluated. Specifically, under the current and hypothetical groundwater use conditions evaluated, with or without taking into account the current interim measures, potential leaching of constituents from soil/waste at the closed lagoons was not predicted to cause concentrations at points of groundwater use to exceed MCLs (or similar risk-based drinking water concentrations for constituents without MCLs).

In summary, the potential leaching of hazardous constituents in waste present in the closed lagoons was not predicted to result in unacceptable impacts to current or reasonably likely future groundwater uses. However, constituents in groundwater at AOI 7 were determined to have a potential to migrate to the extent that reasonably expected future uses of groundwater in the lower aquifer might be affected. As such, as described herein, GM is implementing corrective measures to remediate the source area contamination at AOI 7. The details of this corrective measure are presented in the Interim Measures/Corrective Measures Report.

Table 3-4: Ground Water Modeling Scenarios
Moraine Engine and Moraine Assembly Plants - GMC, Moraine, Ohio

Ground Water Use Scenario	Pumping Locations	Potential Exposure Points
Scenario 1: Baseline conditions	• Baseline wells[1]	• West Carrollton municipal well field • Moraine Assembly industrial wells (11A, 12A) • Moraine Engine industrial wells (31, 39)
Scenario 2: Potential use of Miami Shores in emergency	• Baseline wells • Miami Shores	• West Carrollton municipal well field • Moraine Assembly industrial wells (11A, 12A) • Moraine Engine industrial wells (31, 39) • Miami Shores well field
Scenario 3: Potential use of Miami Shores in emergency and redevelopment of Delphi Thermal wells and Well 28	• Baseline wells • Miami Shores • Delphi Thermal wells • Moraine Engine Well 28	• West Carrollton municipal well field • Moraine Assembly industrial wells (11A, 12A) • Moraine Engine industrial wells (31, 39) • Miami Shores well field • Delphi Thermal industrial wells (42, 44, 45) • Moraine Engine Well 28
Scenario 4: Potential use of Miami Shores with Dryden Rd South in severe emergency	• Baseline wells • Miami Shores • Dryden Rd South	• West Carrollton municipal well field • Moraine Assembly industrial wells (11A, 12A) • Moraine Engine industrial wells (31, 39) • Miami Shores well field • Dryden Rd South well field
Scenario 5: Potential use of Miami Shores with Dryden Rd South in severe emergency and redevelopment of Delphi Thermal wells and Well 28	• Baseline wells • Miami Shores • Dryden Rd South • Delphi Thermal wells • Moraine Engine Well 28	• West Carrollton municipal well field • Moraine Assembly industrial wells (11A, 12A) • Moraine Engine industrial wells (31, 39) • Miami Shores well field • Dryden Rd South well field • Delphi Thermal industrial wells (42, 44, 45) • Moraine Engine Well 28
Scenario 6: Same as Scenario 1 but with interim measures	• Same as Scenario 1 • TW2 and DN13	• Same as in Scenario 1
Scenario 7: Same as Scenario 2 but with interim measures	• Same as Scenario 2 • TW2 and DN13	• Same as in Scenario 2
Scenario 8: Same as Scenario 3 but with interim measures	• Same as Scenario 3 • TW2 and DN13	• Same as in Scenario 3
Scenario 9: Same as Scenario 4 but with interim measures	• Same as Scenario 4 • TW2 and DN13	• Same as in Scenario 4
Scenario 10: Same as Scenario 5 but with interim measures	• Same as Scenario 5 • TW2 and DN13	• Same as in Scenario 5

[1]Baseline wells include: Appleton Paper, Beerman Realty, Cains Mobile Home Park, Moraine Engine (31, 39), Moraine Assembly, Miami Paper, Moraine Country Club, NCR Country Club, Siebenthaler Nursery, City of West Carrollton, West Carrollton Parchment (G&M 1994)

[2] Well 44 is currently maintained for fire protection

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Appendix B

Analysis of Post-Closure Monitoring Requirements for the Closed Lagoons

Consistency with Ohio EPA Post-Closure Monitoring Requirements for the Settling Lagoons General Motors Corporation Moraine, Ohio

1 Basis for Monitoring Plan

The proposed monitoring described in this Site-Wide Groundwater Monitoring Plan (monitoring plan) provides for long-term monitoring of ongoing corrective action activities, and monitoring upgradient and downgradient of the two lagoons closed in accordance with an Ohio EPA-approved closure plan (Conestoga-Rovers & Associates 2000). The overall goal of this monitoring plan is to implement a single performance-based program that addresses both the corrective measures requirements and the post-closure requirements for the two closed settling lagoons.

As described in Section 3 of this monitoring plan, the scope and approach for the proposed site-wide monitoring has been developed by taking into account the considerable knowledge gained through 18 years of investigation which has included a RCRA Facility Investigation (RFI), Supplemental RFI, two Interim Measures programs, and the existing RCRA groundwater monitoring programs established for the two surface impoundments (the closed North and South Settling Lagoons) located on the GM property leased by the Delphi Thermal Moraine facility. In particular, the selection of wells and monitoring parameters to be included in this program is largely based on the findings of the RFI activities which identified chlorinated VOCs as the only constituents of concern for these facilities. Further, GM's intent is to utilize the findings of the Baseline Risk Assessment conducted as part of the RFI tasks as a key basis for evaluating future monitoring data with respect to the need for further action at the closed lagoons, as well as determining when corrective measures are no longer necessary. The specific details regarding the approach for evaluating future monitoring data are summarized in Section 4 of this monitoring plan.

As described in this monitoring plan, the scope and approach for the site-wide monitoring program has been developed to meet multiple objectives, including post-closure monitoring of the closed lagoons and monitoring the effectiveness of remedial measures being implemented as part of GM's corrective action program. GM believes that this proposed approach which combines (1) the monitoring program for a facility subject to site-wide corrective action with (2) the monitoring program for units at the same facility subject to post-closure requirements is consistent with the holistic approach contemplated in USEPA's Post-Closure Permit

Requirement and Closure Process: Final Rule (63 FR 56710, October 22, 1998). Specifically, this rule provides flexibility to "harmonize the two sets of requirements by substituting corrective action requirements for regulated units set out in Part 264 (for permitted facilities) or Part 265 (for interim status facilities)"; in particular, this portion of the rule provides the USEPA and authorized states with the discretion to allow alternate but equivalent groundwater monitoring and closure and post-closure standards at facilities where a release of hazardous waste or hazardous constituents has occurred, and the regulated unit(s) are located downgradient of one or more SWMUs or AOIs that have likely contributed to the release (as is the case with the closed lagoons). The approach discussed in USEPA's rulemaking is particularly relevant to this facility where groundwater quality impacts upgradient (including from off-site sources) to the two closed lagoons have been documented in the RFI, and where the RFI determined that these closed lagoons do not contribute constituents to groundwater at levels that would have any human health significance under current and reasonably expected future groundwater uses. Moreover, this approach is consistent with the site history in coordinating the closure of the lagoons with the site-wide corrective action activity.

Further, this Final Rule indicates that requirements for a regulated unit may be modified if the alternative standards will protect human health and the environment. That is, USEPA is allowing facilities undergoing corrective action to use a site-specific performance-based groundwater monitoring program for a regulated unit (i.e., the closed lagoons) to ensure protection of human health and the environment. The performance-based monitoring can be used to integrate the requirements for the regulated unit into the requirements for SWMUs developed under site-wide corrective action authorities. This approach is also consistent with the strategy proposed under Ohio's Government Performance and Results Act (GPRA) for closure/post-closure facilities for determining if closure/post-closure controls are in-place. According to the Ohio Hazardous Waste Notifier (Ohio EPA, Fall 2000), an approved control could include having units located among SWMUs, and having the closure and post-closure obligations covered by a corrective action order.

2 Evaluation of Groundwater Monitoring Requirements

GM believes that this monitoring plan satisfies the substantive requirements of OAC 3745-54 for post-closure monitoring by providing for the identification of potentially significant contributions from the closed lagoons, if any, relative to the existing site-wide groundwater quality, as well as ensuring continuation of corrective action as necessary to address these units. An analysis of compliance of this monitoring plan with OAC 3745-54 Chapters 90 through 99 and 3745-55 Chapters 01 and 011 is provided in Table B-1.

Table B-1 presents a comparison of the monitoring plan to the requirements of OAC 3745-54 which demonstrates that this monitoring plan meets or exceeds the intent, if not the specific requirements for post-closure monitoring of the two closed lagoons. In addition, as detailed below, based on the past 18 years of groundwater monitoring conducted for the closed lagoons and the results of the Baseline Risk Assessments presented in the RFI and Supplemental RFI Reports (ENVIRON Corporation 2000), GM believes that sufficient information has been developed for the closed lagoons to demonstrate that a modification of certain groundwater monitoring requirements for these closed lagoons is appropriate. However, it should be recognized that while GM is seeking relief from specific monitoring requirements, GM is committed to implementing a comprehensive long-term monitoring program, including monitoring for the closed lagoons, which provides for the protection of human health and the environment.

GM believes that the site-specific groundwater conditions warrant modification of the standard monitoring requirements specified under OAC 3745-54-90 to 3745-54-99.

- The closed lagoons ceased receiving wastes approximately 15 years ago. Groundwater monitoring conducted at these units during the last 18 years, including sampling events conducted during the RFI and Supplemental RFI, have not identified releases from these units warranting corrective action. The assessment of potential risks posed by wastes present in the lagoons via direct exposures and migration to groundwater demonstrated that these residual wastes do not pose an unacceptable risk to human health or the environment.

- The closure of these lagoons includes waste solidification followed by backfilling with 10-feet of clean soil to bring the units to level grade with the surrounding area, thus significantly limiting the potential for direct contact with the solidified waste.

- Groundwater monitoring upgradient and downgradient of the closed lagoons is provided for under the monitoring plan developed by GM for its ongoing corrective action program. This plan includes provisions for assessing whether the closed lagoons are significantly affecting groundwater quality. As described in Section 4 of this monitoring plan, this evaluation will be based on data from upgradient and downgradient wells to identify whether the closed lagoons are affecting groundwater quality relative to existing effects from other sources. If the closed lagoons are determined to be affecting groundwater quality, the human health significance to current and reasonably expected groundwater uses on-site and off-site will be evaluated using the methods in the approved Supplemental RFI Baseline Risk Assessment. Further, this assessment would consider the combined contributions from the closed lagoons and other sources, which is more protective of human health and the environment than if the contributions from the closed lagoons were assessed individually. The need for corrective measures to address the lagoons' incremental contributions will be implemented under GM's ongoing corrective action program.

In summary, the findings of the past 18 years of monitoring and the RFI and Supplemental RFI activities support a determination that a modification of certain monitoring requirements is appropriate because of the low potential for migration of hazardous waste or hazardous constituents from the lagoons to water supply wells or surface water. Specifically,

- Hazardous constituents to be monitored. According to OAC 3745-54-93(A), the hazardous constituents to be monitored are those identified in the appendix to OAC 3745-51-11 which have been detected in groundwater in the uppermost aquifer and that are reasonably expected to be in or derived from waste contained in the regulated unit. However, OAC 3745-54-93(B) specifies that constituents may be excluded from the monitoring program if it is found that the constituent is not capable of posing a substantial present or potential hazard to human health or the environment. As discussed above, the RFI completed by GM documented that the only constituents of concern identified in groundwater at the Facilities are chlorinated VOCs. Further, GM demonstrated in the Supplemental RFI Baseline Risk Assessment that no hazardous constituents of the wastes present in the lagoons (even before closure) would migrate to groundwater at levels that would pose a substantial present or potential hazard to human health or the environment.

- Point of compliance. According to OAC 3745-54-91(A), a compliance monitoring program is required whenever hazardous constituents are detected at the compliance point for the regulated unit, and a corrective action program is required when a statistically significant increase in concentrations is evidenced at the point of compliance (POC) or when a hazardous constituent exceeds concentration limits between the compliance point and the downgradient property boundary. In addition, OAC 3745-54-97(B) indicates that separate groundwater monitoring systems are not required at a Facility with more than one regulated unit where sampling of groundwater will enable detection of hazardous constituents from the multiple regulated units.

GM is currently implementing a corrective action program at the Facilities to address the presence of chlorinated VOCs in groundwater resulting from a release from an AOI located at the former Moraine Engine plant. Currently, the area of groundwater monitoring being addressed by GM encompasses the two closed lagoons and groundwater between these units and the downgradient property boundary. Further, GM has documented the presence of an upgradient off-site source which is contributing chlorinated VOCs to site groundwater.

GM's corrective action program is designed to address the combined effects of all sources of the existing groundwater contamination and the area of contaminated groundwater between these sources and the downgradient property boundary. Further, GM will monitor changes in groundwater quality over time to assess the performance of the ongoing corrective measures. Given the current groundwater conditions and GM's corrective action plans, GM believes that the locations downgradient of the closed lagoons defined as the POCs for the site-wide corrective action are appropriate POCs for the two closed lagoons (refer to Section 4.3 in the monitoring plan).

- Alternative Concentration Limits. According to OAC 3745-54-94, the facility will specify the concentration limits for hazardous constituents in groundwater. OAC 3745-54-94(B) provides for the use of an alternative concentration limit if it is found that the constituent will not pose a substantial present or potential hazard to human health or the environment.

  GM has developed risk-based remediation target concentrations that will be used to assess the performance of active corrective measures (i.e., in-situ remediation and active pumping at the downgradient property boundary). Specifically, these target concentrations will be defined as on-site groundwater concentrations that are protective of current and future groundwater uses, and must be achieved before the active corrective measures can be terminated. These target concentrations will also be used to identify other units that may be contributing hazardous constituents to groundwater at levels that prevent meeting these targets. Development of the remediation targets concentrations are based on the methodology presented in the Supplemental RFI Baseline Risk Assessment. GM expects that by using these remediation target concentrations to evaluate the performance of active corrective measures and implementing a data assessment plan that considers the combined contributions from all sources upgradient of the POCs defined for the site-wide corrective action, that these targets will be more protective of human health and the environment in comparison with alternative concentration limits developed for each individual unit. The development of these risk-based remediation target concentrations is summarized in Section 4.3 of this monitoring plan.

- Identification of a significant evidence of contamination. OAC 3745-54-97(H) specifies that a statistical method must be used for identifying significant evidence of contamination. Further, it is specified that the test method shall be protective of human health and the environment. As documented in the *Evaluation of Groundwater Detection Monitoring Data* submitted to Ohio EPA on February 8, 2000, statistically significant increases could be interpreted to have occurred in the vicinity of the South Settling Lagoon. However, historical groundwater concentration trends demonstrate that these statistically significant increases are unrelated to a release from the South Settling Lagoon, and that changes in upgradient groundwater quality are causing statistically significant increases in both upgradient and downgradient monitoring wells. Thus, as a result of site-wide groundwater contamination from sources other than the lagoons, the standard approaches contemplated in OAC 3745-54-97(H) are not practical for assessing data from monitoring of these units. As an alternative, GM has developed risk-based remediation targets for assessing the human health and environmental significance of data collected during the long-term groundwater monitoring program.

In summary, GM believes that the site-specific groundwater conditions warrant modification of the standard monitoring requirements specified under OAC 3745-54-90 to 3745-54-99. In particular, the use of a site-specific constituent monitoring list, alternative point of compliance, and alternative compliance limits are warranted for this site. These site-specific considerations are incorporated in this monitoring plan. However, based on the findings of the RFI, the monitoring plan still provides a program that will be protective of human health and the environment.

3 Summary

This monitoring plan meets the substantive requirements for post-closure monitoring specified in OAC 3745-54 for the two closed lagoons. For those requirements that are not fully addressed by this monitoring plan, prior monitoring and risk assessment calculations demonstrated that this monitoring plan is fully protective of human health and environment such that a modification of certain requirements is reasonable and appropriate. Finally, the approach presented in the monitoring plan which combines the objectives for corrective action with those of post-closure lagoon monitoring is consistent with both USEPA and Ohio EPA regulations and guidance for sites at which the regulated unit is located downgradient of one or more SWMUs or AOIs that have likely contributed to the release.

Table B-1. Analysis for Compliance with OAC 3745-54 Chapters 90 through 99 and 3745-55 Chapters 01 and 011, Site-Wide Groundwater Monitoring Program, General Motors Corporation, Moraine, Ohio.

Regulatory Citation	Regulation	Rationale for Applicability	Reference Document/Location Where Regulation is Addressed
OAC 3745-54 Standards for the Management of Hazardous Wastes			
3745-54-90 (A)	Groundwater Protection; Applicability Applies to owners/operators of facilities that treat, store, or dispose of hazardous waste. Owner or operator shall satisfy requirements of (A)(2) of this rule for all wastes contained in waste management units.	The NSL received industrial wastewater from 1972 to 1979, and the SSL received industrial wastewater from 1965 to 1979. The lagoons have been inactive since 1989 and are currently closed through solidification. Therefore, (A)(1) may be applicable, however, the GM facilities are under interim status and contain SWMUs/AOIs regulated under a corrective action order, including the lagoons. This enforceable order could be applied in lieu of these regulations.	Closure Plan, Section 1.1 SDOCC, Section 1.3.16 DOCC, Section 3.3
(B)	Units are not subject to 3745-54-90 to 3745-54-99 and 3745-55-01 to 3745-55-02 of the OAC for releases into the uppermost aquifer if particular criteria are met.	Lagoons do not meet exception criteria during their operating life, however, as residual waste was solidified during closure, the potential for migration of liquid is eliminated. Further, the RFI determined that these lagoons did not serve as a significant source of groundwater contamination from a risk perspective.	Closure Plan, Section 2.0 SWGM Plan, Section 1.2 RFI Reports
(C)	Applies for units during the active life and the closure period. After closure, these regulations apply if certain criteria are met.	This regulation applies during the compliance period under 3745-54-96 if the owner or operator is conducting compliance monitoring under a corrective action program under 3745-55-01; GM will continue conducting groundwater monitoring to verify that groundwater conditions remain the same, or improve over time.	Closure Plan, Section 2.0 SWGM Plan, Section 1.2 IM/CM Report, Section 2.0
(D)	Applies to miscellaneous units, when necessary to comply with 3745-57-91 through 3745-57-93.	NA as the lagoons are surface impoundments, not miscellaneous units.	NA
3745-54-91 (A)(1)	Required Programs Applies when hazardous constituents from a regulated unit are detected at the compliance point.	SSL constituents have never been detected in downgradient wells. NSL constituents have been detected in downgradient wells. Hazardous constituents from an AOI (which is not a regulated unit) have been detected downgradient of the AOI, as explained in the IM/CM report. The SWGM Plan addresses long-term monitoring of releases from the the major source of VOCs at the facility (AOI 7) and the monitoring of the lagoons and landfills. The downgradient point of compliance well is GM-26 for the site in the upper aquifer as presented in the IM/CM and SWGM reports.	RFI Reports SWGM Plan, Sections 1.2 and 3.0 IM/CM Report, Section 2.0

Table B-1. Analysis for Compliance with OAC 3745-54 Chapters 90 through 99 and 3745-55 Chapters 01 and 011, Site-Wide Groundwater Monitoring Program, General Motors Corporation, Moraine, Ohio.

Regulatory Citation	Regulation	Rationale for Applicability	Reference Document/Location Where Regulation is Addressed
(A)(2)	Applies when groundwater protection standards are exceeded at the compliance point.	The IM/CM and SWGM reports include a strategy for addressing exceedences in groundwater concentrations of VOCs from AOI 7 (which is not a regulated unit). No exceedences have occurred at the compliance point that are attributable to the lagoons.	IM/CM Report, Section 2.0 SWGM Plan, Sections 1.2 and 3.0
(A)(3)	Applies when hazardous constituents from a regulated unit are exceeded between the compliance point and the downgradient property boundary.	The IM/CM and SWGM reports include a strategy for addressing exceedences in groundwater concentrations of VOCs from AOI 7 (which is not a regulated unit). No exceedences have occurred at the compliance points or downgradient property boundary that are attributable to the lagoons.	IM/CM Report, Section 2.0 SWGM Plan, Sections 1.2 and 3.0
(A)(4)	Requirements for owner/operator to institute a detection monitoring plan under 3745-54-98	The site-wide groundwater monitoring will continue to assess if any significant contributions are occurring from the lagoons.	SWGM Plan, Section 1.0 BRA Report
(B)	Regional Administrator to specify in the facility permit the elements of the monitoring and response program.	The 3008(h) Order should serve as the "enforceable document" in lieu of "the permit" and the SWGM Plan should meet the monitoring elements necessary for compliance with the corrective action order or post-closure process. Additionally, the BRA concluded that the lagoons did not pose a significant risk to human health and the environment (with or without closure).	BRA Report, Section 5.0
3745-54-92	Groundwater Protection Standard Ensures that hazardous constituents under 3745-54-93 detected in the groundwater from a regulated unit do not exceed the concentration limits under 3745-54-94 in the uppermost aquifer underlying the waste management area beyond the point of compliance under 3745-54-95 during the compliance period under 3745-54-96.	The 3008(h) Order should serve as the "enforceable document" in lieu of "the permit". Site-specific risk-based standards and the groundwater flow model have been used to determine protective groundwater concentrations based on groundwater receptors and current use of the upper aquifer on a site-wide basis.	BRA Report, Section 3.0 IM/CM Report, Section 2.0
3745-54-93 (A)	Hazardous Constituents The permit will specify the hazardous constituents to which the groundwater protection standard of 3745-54-92 applies.	The approved RFI reports concluded that VOCs are the constituents of concern in groundwater. The SWGM Plan has been designed to address the site-specific constituents of concern, VOCs. Historic sampling of groundwater has determined that SVOCs, PCBs and metals are not of concern in groundwater.	SWGM Plan, Section 2.0 RFI Reports
(B)	A constituent listed in the appendix to rule 3745-51-11 will be excluded from the list of hazardous constituents specified in the permit, if it is found that the constituent is not capable of posing a risk.	Historic sampling of groundwater determined that SVOCs, PCBs, and metals are not of concern; therefore, is appropriate to exclude them from the monitoring parameters. The BRA concluded that estimates of risk from the constituents in the lagoon sludge were well below U.S. EPA-established acceptable levels.	BRA Report, Section 5.0 RFI Report, Sections 6.0 and 7.0 SWGM Plan, Section 2.0

Table B-1. Analysis for Compliance with OAC 3745-54 Chapters 90 through 99 and 3745-55 Chapters 01 and 011, Site-Wide Groundwater Monitoring Program, General Motors Corporation, Moraine, Ohio.

Regulatory Citation	Regulation	Rationale for Applicability	Reference Document/Location Where Regulation is Addressed
3745-54-94	Concentration Limits		
(A)	The permit will specify the concentration limits in the groundwater for hazardous constituents established under 3745-54-93.	Methods established in the approved BRA and the groundwater flow model have been used to determine protective groundwater concentrations (Remediation Target Levels [RTLs]) based on groundwater receptors and current use of the upper aquifer.	BRA Report, Section 3.0 IM/CM Report, Section 2.0
(B)	An alternate concentration limit may be established for a hazardous constituenis.	Methods established in the approved BRA have been used to calculate groundwater protection standards (RTLs) for VOCs.	IM/CM Report, Section 2.0
3745-54-95	Point of Compliance		
(A)	The permit will specify the point of compliance at which groundwater protection standard of rule 3745-54-92 applies and at which monitoring must be conducted.	The facility compliance point is defined as GM-26 for the upper aquifer. This location is downgradient of the site, including the primary source area (AOI 7), landfills and lagoons. The site also contains remediation performance monitoring points as presented in the IM/CM and SWGM reports.	IM/CM Report, Section 2.0 SWGM Plan
(B)	Definition of a waste management area.	The waste management areas are defined and discussed in the RFI Reports. The plan covers AOI 7 and the land-based units. For the purpose of groundwater monitoring, the waste management area can be defined by the property boundary, including the upper aquifer.	RFI Reports SWGM Plan, Sections 1.0, 2.0, 3.0
3745-54-96	Compliance Period		
(A)	The permit will specify the compliance period during which the groundwater protection standard of rule 3745-54-92 applies.	The compliance period is defined as the length of time necessary to meet the RTLs and to verify that groundwater conditions remain acceptable for VOCs in the upper aquifer for some period of time thereafter. The length of this period of time will be evaluated on an annual basis.	IM/CM Report, Section 2.0
(B)	Compliance period begins when the owner/operator initiates a compliance monitoring program meeting 3745-54-99.	The site-wide groundwater monitoring program was initiated in the fall of 2000 in order to monitor corrective measures. During this period, RCRA monitoring of the former lagoons has been on-going, and will continue until the SWGM plan is approved.	SWGM Plan, Figure 12 IM/CM Report, Section 4.0
(C)	If owner/operator is engaged in corrective action, compliance period may be extended until groundwater protection standard 3745-54-92 is not exceeded for a period of three consecutive years.	Groundwater data will be continuously evaluated using risk-based strategies to determine the appropriate compliance period.	IM/CM Report, Section 2.0
3745-54-97	General Groundwater Monitoring Requirements		
(A)	Groundwater monitoring system must be representative of the uppermost aquifer and contain a sufficient number of wells.	The well network includes those wells that are upgradient/downgradient of the lagoons. These wells are screened in the upper aquifer.	SWGM Plan, Section 3.0

Table B-1. Analysis for Compliance with OAC 3745-54 Chapters 90 through 99 and 3745-55 Chapters 01 and 011, Site-Wide Groundwater Monitoring Program, General Motors Corporation, Moraine, Ohio.

Regulatory Citation	Regulation	Rationale for Applicability	Reference Document/Location Where Regulation is Addressed
(B)	Facilities that contain more than one regulated unit are not required to have separate groundwater monitoring systems.	One, comprehensive, site-wide monitoring plan is appropriate for this facility.	SWGM Plan, Section 3.0
(C)	All monitoring wells must be cased in a manner that maintains the integrity of the monitoring well bore hole.	The existing wells were installed with care to protect the integrity of the borehole. The existing wells are regularly sampled and inspected. These wells were installed following approved protocols.	RFI Work Plans
(D)	Groundwater monitoring program must include consistent sampling and analysis procedures.	The groundwater monitoring program will be conducted following approved protocols.	SWGM Plan, Section 3.0
(E)	Groundwater monitoring program must include appropriate sampling and analytical methods.	The groundwater monitoring program will be conducted following approved protocols and an approved laboratory.	SWGM Plan, Section 3.0
(F)	Groundwater monitoring program must include determination of groundwater surface elevation.	Water-level measurements will be collected at each sampling event and groundwater contour maps will be prepared on an annual basis.	SWGM Plan, Section 3.0
(G)	Requirements for establishing background concentrations of hazardous constituents in groundwater.	Background groundwater quality at the upgradient property boundary was established in the RFI, but will continue to be monitored on an annual basis as part of the site-wide program.	RFI Reports SWGM Plan, Section 3.0
(H)	Statistical methods to be used in evaluating groundwater monitoring data.	Groundwater data will be evaluated using risk-based strategies and the groundwater flow model.	IM/CM Report, Section 2.0
(I)	Performance standards for the statistical methods in 3745-54-97(H).	The use of the parameters called for in the regulations will not adequately evaluate potential releases and therefore, site specific VOC analysis will be conducted.	SWGM Plan, Sections 2.0
(J)	Groundwater monitoring data must be filed at the facility.	The facility will maintain copies of the groundwater monitoring data.	RFI Work Plans
3745-54-98	Detection Monitoring Program	The components of a detection monitoring program as defined in 3745-54 -98 paragraphs A through H, are not appropriate for the site. Groundwater quality and historical releases of hazardous constituents have been well documented in the approved RFI reports. With the implementation of groundwater corrective measures and lagoon closure, a site-wide groundwater monitoring program using the existing well network, monitoring the site-specific constituents of concern, and following a risk-based strategy is an appropriate approach for this site.	SWGM Plan, Sections 1.0, 2.0, 3.0 IM/CM Report, Section 2.0 RFI Reports

Table B-1. Analysis for Compliance with OAC 3745-54 Chapters 90 through 99 and 3745-55 Chapters 01 and 011, Site-Wide Groundwater Monitoring Program, General Motors Corporation, Moraine, Ohio.

Regulatory Citation	Regulation	Rationale for Applicability	Reference Document/Location Where Regulation is Addressed
(A)	Owner/operator must monitor for indicator parameters.	Based on the findings of the RFI, monitoring will be conducted for the site-specific VOCs, which are appropriate parameters for evaluating potential releases from the former lagoons; therefore, analysis of the indicator parameters is not applicable to these units.	SWGM Plan, Sections 1.0, 2.0, 3.0 IM/CM Report, Section 2.0
(B)	Owner/operator must install a groundwater monitoring system at the compliance point under 3745-54-95.	A sufficient number of properly installed groundwater monitoring wells have been and will continue to be monitored to provide the necessary compliance point monitoring, as defined in the IM/CM Report.	SWGM Plan, Sections 1.0, 2.0, 3.0 IM/CM Report, Section 2.0
(C)	Owner/operator must conduct a groundwater monitoring program for each chemical parameter and hazardous constituent specified in the permit.	The site-wide groundwater monitoring plan proposes monitoring for site-specific VOCs which are appropriate parameters for evaluating potential releases from the former lagoons.	SWGM Plan, Sections 1.0, 2.0, 3.0 IM/CM Report, Section 2.0
(D)	The permit will specify frequencies for collecting samples and conducting statistical tests.	The site-wide groundwater monitoring plan proposes the frequency necessary to adequately monitor for site-specific VOCs and the methods for evaluating this data are provided in the IM/CM Report. Based on the IM/CM report, monitoring will be conducted annually.	SWGM Plan, Sections 1.0, 2.0, 3.0 IM/CM Report, Section 2.0
(E)	Owner/operator must determine the groundwater flow rate and direction in the uppermost aquifer at least annually.	The site-wide groundwater monitoring plan proposes annual evaluation of the groundwater flow rate and direction in the uppermost aquifer.	SWGM Plan, Sections 1.0, 2.0, 3.0 IM/CM Report, Section 2.0
(F)	Owner/operator must determine whether there is statistically significant evidence of contamination.	Methods to be used for evaluating the site-specific VOC data are provided in the IM/CM Report. Additionally, GM will determine if there is a significant contribution to groundwater from the land-based units.	SWGM Plan, Sections 1.0, 2.0, 3.0 IM/CM Report, Section 2.0
(G)	Applies when there is statistically significant evidence of contamination.	An effective monitoring network is already in place. As part of the annual data evaluation/reporting, the SWGM Plan has provisions for notification, if GM determines that the lagoons are a significant contributor to groundwater contamination.	SWGM Plan, Sections 1.0, 2.0, 3.0 IM/CM Report, Section 2.0
(H)	Applies when owner/operator determines the detection monitoring program no longer satisfies the requirements of this section.	The site-wide groundwater monitoring plan proposes a monitoring program that will adequately satisfy the requirements of this section over time. As part of the annual data evaluation/reporting, GM will propose any necessary modifications to the SWGM Plan.	SWGM Plan, Sections 1.0, 2.0, 3.0 IM/CM Report, Section 2.0

Table B-1. Analysis for Compliance with OAC 3745-54 Chapters 90 through 99 and 3745-55 Chapters 01 and 011, Site-Wide Groundwater Monitoring Program, General Motors Corporation, Moraine, Ohio.

Regulatory Citation	Regulation	Rationale for Applicability	Reference Document/Location Where Regulation is Addressed
3745-54-99	Compliance Monitoring Program	The components of a compliance monitoring program as defined in 3745-54-99 paragraphs A through J, are not appropriate for the site. Groundwater quality and historical releases of hazardous constituents have been well documented in the approved RFI reports. With the implementation of groundwater corrective measures and lagoon closure, a site-wide groundwater monitoring program using the existing well network, monitoring the site-specific constituents of concern, and following a risk-based strategy is an appropriate approach for the site.	SWGM Plan, Sections 1.0, 2.0, 3.0 IM/CM Report, Section 2.0 RFI Reports
(A)	Owner/operator must monitor groundwater to determine whether regulated units are in compliance with the groundwater protection standard under 3745-54-92.	The site-wide groundwater monitoring plan proposes the frequency necessary to adequately monitor for site-specific VOCs and the methods for evaluating this data are provided in the IM/CM Report. The monitoring includes wells upgradient and downgradient of the lagoons.	SWGM Plan, Sections 1.0, 2.0, 3.0 IM/CM Report, Section 2.0
(B)	Owner/operator must install a groundwater monitoring system at the compliance point under 3745-54-95.	A sufficient number of properly installed groundwater monitoring wells have been and will continue to be monitored to provide the necessary compliance point monitoring, as defined in the IM/CM Report.	SWGM Plan, Sections 1.0, 2.0, 3.0 IM/CM Report, Section 2.0
(C)	The director will specify sampling procedures and statistical methods.	The site-wide groundwater monitoring plan proposes the procedures necessary to adequately monitor for site-specific VOCs and the methods for evaluating this data are provided in the IM/CM Report. Sampling procedures specified in the SWGM Plan are consistent with previously approved RFI protocols.	SWGM Plan, Sections 1.0, 2.0, 3.0 IM/CM Report, Section 2.0
(D)	Owner/operator must determine whether there is statistically significant evidence of contamination.	The site-wide groundwater monitoring plan proposes the procedures necessary to adequately monitor for site-specific VOCs and the methods for evaluating this data are provided in the IM/CM Report. The monitoring program proposed in the SWGM Plan and the data evaluation approach proposed in the IM/CM Report specify the methodology to assess if the lagoons are having a significant contribution to groundwater contamination.	SWGM Plan, Sections 1.0, 2.0, 3.0 IM/CM Report, Section 2.0
(E)	Owner/operator must determine the groundwater flow rate and direction in the uppermost aquifer at least annually.	The site-wide groundwater monitoring plan proposes annual evaluation of the groundwater flow rate and direction in the uppermost aquifer.	SWGM Plan, Sections 1.0, 2.0, 3.0 IM/CM Report, Section 2.0

Table B-1. Analysis for Compliance with OAC 3745-54 Chapters 90 through 99 and 3745-55 Chapters 01 and 011, Site-Wide Groundwater Monitoring Program, General Motors Corporation, Moraine, Ohio.

Regulatory Citation	Regulation	Rationale for Applicability	Reference Document/Location Where Regulation is Addressed
(F)	The director will specify frequencies for collecting samples and conducting statistical tests.	The site-wide groundwater monitoring plan proposes the frequency necessary to adequately monitor for site-specific VOCs and the methods for evaluating this data are provided in the IM/CM Report.	SWGM Plan, Sections 1.0, 2.0, 3.0 IM/CM Report, Section 2.0
(G)	Owner/operator must analyze samples from all wells at the compliance point for all constituents at least annually.	The site-wide groundwater monitoring plan proposes annual evaluation of the site-wide groundwater quality, including the point of compliance.	SWGM Plan, Sections 1.0, 2.0, 3.0 IM/CM Report, Section 2.0
(H)	Owner/operator determines that any concentration limit are exceeded at any well at the point of compliance.	The SWGM program will assess whether there are exceedences of site-specific concentrations limits at the point of compliance on an annual basis. The SWGM Plan has provisions for notification, if GM determines that the lagoons are a significant contributor to groundwater contamination.	SWGM Plan, Sections 1.0, 2.0, 3.0 IM/CM Report, Section 2.0
(I)	Owner/operator determines that any concentration limit are exceeded at any well at the point of compliance and can demonstrate the presence of another source.	The site-wide groundwater monitoring plan proposes the frequency necessary to adequately monitor for site-specific VOCs and the methods for evaluating this data are provided in the IM/CM Report.	SWGM Plan, Sections 1.0, 2.0, 3.0 IM/CM Report, Section 2.0
(J)	Applies when owner/operator determines the compliance monitoring program no longer satisfies the requirements of this section.	The site-wide groundwater monitoring plan proposes a monitoring program that will adequately satisfy the requirements of this section over time. The SWGM Plan has provisions for notification, if GM determines that the lagoons are a significant contributor to groundwater contamination. As a part of the annual data evaluation/reporting, GM will propose any necessary modifications to the SWGM Plan.	SWGM Plan, Sections 1.0, 2.0, 3.0 IM/CM Report, Section 2.0
OAC 3745-55 Management of Hazardous Wastes: Closure and Post-Closure			
3745-55-01 (A)	Corrective Action Program Owner/operator must take corrective action to ensure that regulated units are in compliance with 3745-54-92.	GM will take a site-wide approach to monitor groundwater upgradient and downgradient of the primary source area (AOI 7), the reactive zones installed for remedial purposes and the land-based units (lagoons and landfills). GM will also monitor the capture zones. A comprehensive corrective action program has already been implemented at this site, which included the lagoons.	SWGM Plan, Sections 3.0
(B)	Owner/operator must implement a corrective action program that prevents hazardous constituents from exceeding their respective concentration limits.	GM is currently implementing corrective measures to address the AOI 7 source area and several areas downgradient of AOI 7.	SWGM Plan, Sections 1.0, 2.0 IM/CM Report, Section 5.0
(C)	Owner/operator must begin corrective action within a reasonable time period after the groundwater protection standard is exceeded.	GM has been implementing corrective measures over the last six years to address VOCs in the upper aquifer and will continue to do so until the groundwater RTLs are met.	IM/CM Report, Section 2.0

Table B-1. Analysis for Compliance with OAC 3745-54 Chapters 90 through 99 and 3745-55 Chapters 01 and 011, Site-Wide Groundwater Monitoring Program, General Motors Corporation, Moraine, Ohio.

Regulatory Citation	Regulation	Rationale for Applicability	Reference Document/Location Where Regulation is Addressed
(D)	Owner/operator must establish and implement a groundwater monitoring program to demonstrate effectiveness of the corrective action program.	The groundwater monitoring program is presented in the SWGM Plan.	SWGM Plan, Section 3.0
(E)	Owner/operator must conduct corrective action program to remove or treat in place any hazardous constituents that exceed concentration limits.	GM is addressing the primary source area (AOI 7) through the implementation of in-situ remediation technologies and is addressing hydraulic control through the implementation of the capture zones. These active measures will result in attenuation of the VOC concentrations in groundwater. The lagoons have been closed in place with the sludge being solidified.	SWGM Plan, Sections 1.0, 2.0, 3.0
(F)	Owner/operator must continue corrective action measures during the compliance period.	GM will implement corrective measures and site-wide groundwater monitoring until the site-wide objectives have been met.	IM/CM Report, Sections 1.0, 2.0
(G)	Owner/operator must report in writing to the director on the effectiveness of the corrective action program.	GM will continue implementing corrective measures and site-wide groundwater monitoring until the site-wide objectives have been met. The effectiveness of this program will be documented in an annual report.	SWGM Plan, Sections 1.0, 4.0, 5.0
(H)	Applies when owner/operator determines the corrective action program no longer satisfies the requirements of this section.	GM will continue implementing corrective measures and site-wide groundwater monitoring until the site-wide objectives have been met. GM will assess the program at least annually and identify/propose any necessary changes to the program to ensure that the objectives of the SWGM Plan continue to be met.	SWGM Plan, Section 1.0
(I)	The director may exempt any person disposing of hazardous wastes from any requirement of 3734-55.	NA	NA
3745-55-011	Corrective Action for Waste Management Units		
(A)	Owner/operator seeking a permit for the treatment, storage, or disposal of hazardous waste shall institute corrective action as necessary to protect human health and the environment for all releases of hazardous waste or constituents from any waste at the facility, regardless of the time at which waste was placed in such unit.	NA; GM is not seeking a permit for the treatment, storage, or disposal of hazardous waste.	NA
(B)	Corrective action will be specified in the permit in accordance with this rule and with rules 3745-57-72 and 3745-57-73. Permit will contain schedules of compliance for such corrective action and assurances of financial responsibility for completing such corrective action.	NA; GM is not seeking a permit for the treatment, storage, or disposal of hazardous waste.	NA
(C)	Owner/operator shall implement corrective actions beyond the facility property boundary, where necessary to protect human health and environment, unless the owner/operator demonstrates to the satisfaction of the director that, despite the owner's/operator's best efforts, the owner/operator was unable to obtain the necessary permission to undertake such actions.	GM is currently implementing a comprehensive corrective action program, which included the lagoons. In-situ remedial technologies are addressing the historical release from AOI 7 across the site and capture zone corrective measures are addressing hydraulic control in the upper and lower aquifers at the property boundary and downgradient of the property, respectively. Under the SWGM program, GM will evaluate on an annual basis if there are any significant contributions to	IM/CM Report SWGM Plan

Table B-1. Analysis for Compliance with OAC 3745-54 Chapters 90 through 99 and 3745-55 Chapters 01 and 011, Site-Wide Groundwater Monitoring Program, General Motors Corporation, Moraine, Ohio.

Regulatory Citation	Regulation	Rationale for Applicability	Reference Document/Location Where Regulation is Addressed
(C) Continued	The owner/operator is not relieved of all responsibility to clean up a release that has migrated beyond the facility boundary where off-site access is denied. On-site measures to address such releases will be determined on a case-by-case basis. Assurances of financial responsibility for such corrective action shall be provided.	groundwater contamination.	

References

Closure Plan	Conestoga-Rovers & Associates, 2000. Lagoon Closure Plan, General Motors, Harrison Radiator Division Facility, Moraine, Ohio. June 2000.
SDOCC	Geraghty & Miller, Inc., 1997. Supplemental DOCC for General Motors Powertrain Group Moraine Engine Plant and General Motors Truck Group Moraine Assembly Plant, Moraine, Ohio. July 1997.
DOCC	Geraghty & Miller, Inc., 1991. Description of Current Conditions, Task 1 for the RCRA Facility Investigation for Harrison Radiator Division - GMC, Moraine, Ohio. January 1991.
SWGM Plan	ARCADIS Geraghty & Miller, 2000. Draft Site-Wide Groundwater Monitoring Plan, General Motors Corporation, Moraine, Ohio. March 2000, revised September 2001.
RFI Report	ARCADIS Geraghty & Miller, 2000. RFI and Supplemental RFI Reports, General Motors Corporation, Moraine Ohio. April 2000.
IM/CM Report	ARCADIS Geraghty & Miller, 2001. Draft Interim Measures/Corrective Measures (IM/CM) Report, General Motors Corporation, Moraine, Ohio. March 2001.
BRA Report	ENVIRON Corporation, 2000. Baseline Risk Assessment, General Motors Corporation, Moraine, Ohio. April 2000.
RFI Work Plans	Geraghty & Miller, Inc., 1992. RCRA Facility Investigation Work Plan, Harrison Division-GMC, Moraine, Ohio. November 1992.
	Geraghty & Miller, Inc., 1997. Supplemental RFI Work Plan for General Motors Powertrain Group Moraine Engine Plant and General Motors Truck Group Moraine Assembly Plant, Moraine, Ohio. July 1997.

- Not Applicable
- North Settling Lagoon

SSL - South Settling Lagoon
RTLs - Remediation Target Levels

TABLE B-2: Preliminary Remediation Target Levels

Remediation Target Levels (mg/L) - Upper Aquifer								
			Constituent of Concern					
Point of Compliance	***GM-26***		*PCE*	*TCE*	*1,1-DCE*	*cis-1,2-DCE*	*Vinyl Chloride*	**monitoring wells**
Allowable POC Concentration (mg/L):			*0.005*	*0.005*	*0.007*	*0.070*	*0.002*	
Estimated Remediation Target Level at AOI 7 (mg/L):			***1.667***	***1.667***	***2.333***	***23.333***	***0.667***	GM-23, GM-29 and GM-30
Distance from AOI 7 (monitoring zone)	**Source Reduction Factor**	**Normalized Remediation Target**	**Remediation Target (mg/L)**	**Remediation Target (mg/L)**	**Remediation Target (mg/L)**	**Remediation Target (mg/L)**	**Remediation Target (mg/L)**	
140 ft (Zone S1)	0.9	300	1.500	1.500	2.100	21.000	0.600	GM-28
1190 ft (Zone S1 to Zone S2)	0.7	233	1.167	1.167	1.633	16.333	0.467	GM-28, ME-6
2240 ft (Zone S2)	0.1	33	0.167	0.167	0.233	2.333	0.067	ME-6, ME-3, GM-31
2940 ft (Zone S2 to Zone S3)	0.04	13	0.067	0.067	0.093	0.933	0.027	ME-6, ME-3, GM-31, GM-22, GM-19S, and EAST
3640 ft (Zone S3)	0.03	10	0.050	0.050	0.070	0.700	0.020	GM-32, GM-21
4430 ft (Zone S3 to GM-10)	0.02	7	0.033	0.033	0.047	0.467	0.013	GM-32, GM-21, GM-8, GM-6, 4S, GM-2, GM-16, GM-17, GM-18, WSU-24, and GM-10
5215 ft (GM-10)	0.008	3	0.013	0.013	0.019	0.187	0.005	GM-10
6370 ft (POC)	0.003	1	0.005	0.005	0.007	0.070	0.002	GM-26

Remediation Target Level (mg/L) - Lower Aquifer								
			Constituent of Concern					
Point of Compliance	***GM-11, GM-15 and GM-20D***		*PCE*	*TCE*	*1,1-DCE*	*cis-1,2-DCE*	*Vinyl Chloride*	**monitoring wells**
Allowable POC Concentration (mg/L):			*0.005*	*0.005*	*0.007*	*0.070*	*0.002*	
Estimated Remediation Target Level at AOI 7 (mg/L):			***0.556***	***0.556***	***0.778***	***7.778***	***0.222***	GM-23, GM-29 and GM-30
Distance from AOI 7 (monitoring zone)	**Source Reduction Factor**	**Normalized Remediation Target**	**Remediation Target (mg/L)**	**Remediation Target (mg/L)**	**Remediation Target (mg/L)**	**Remediation Target (mg/L)**	**Remediation Target (mg/L)**	
3250 ft (Zone D1)	0.03	3	0.017	0.017	0.023	0.233	0.007	GM-19 and Well 32
4250 ft (Zone D2)	0.02	2	0.011	0.011	0.016	0.156	0.004	GM-1 and GM-3
4900 ft (POC)	0.009	1	0.005	0.005	0.007	0.070	0.002	GM-11, GM-15 and GM-20D

Guidance Checklist for GW Monitoring under OAC rules 3745-54-90 through 97

02/01/01

Section 1. Ground Water Monitoring Applicability OAC rule 3745-54-90(A)		Y/N	NA	Vio	Def	Pg	Rmk
1-1	If the facility contains a surface impoundment, landfill, land treatment facility, or wastepile has a GWM program according to OAC rules 3745-54-90 to 99 and 55-01 to 55-02 been implemented? OAC rule 3745-54-90(A)(1)	Y				SWGM Plan Sec 1.0, 2.0 Lagoon Annual and Quarterly Reports Prior to closure of the lagoons, the north settling lagoon was in assessment monitoring (3745-65-93) and the south settling lagoon was in detection monitoring (3745-65-92), per the requirements of the Consent Decree.	
1-2	All waste management units must comply with OAC rule 3745-55-011 regardless of when waste was placed in the unit. Are all units in compliance? OAC rule 3745-54-90(A)(2)	Y				Closure Plan Yes, however, the facility does not have a permit. In lieu of a permit, the corrective action order serves as the enforceable document.	
Section 2. Exemptions from Ground Water Monitoring Requirements OAC rule 3745-54-90(B) These will not be allowed for Baseline Call Ins.		**Y/N**	**NA**	**Vio**	**Def**	**Pg**	**Rmk**
2-1	Was a waiver from OAC rules 3745-54-90 through 55-01 gronnd water monitoring requested?		√			Closure Plan Sec. 2.0 SWGM Plan, Sec. 1.2 Lagoon Annual and Quarterly Reports RFI and Baseline Risk Assessment Reports Lagoons do not meet the exception criteria during their operating life; however, as waste was solidified during closure, the potential for migration of liquid is eliminated. Further, the RFI determined that these lagoons did not serve as a significant source of groundwater contamination from a risk perspective. A long-term groundwater monitoring plan has been proposed for the closed lagoons.	
2-2	Did the owner/operator make a demonstration that the facility was exempted under OAC rule 3745-54-01 and 90(B)(1)?		√			Closure Plan Section 2.0 SWGM Plan, Sec. 1.2 Lagoon Annual and Qnarterly Reports RFI and Baseline Risk Assessment Reports	
2-3	Did the owner/operator make a demonstration that a landfill was exempted due to engineering and secondary containment under OAC rule 3745-54-90(B)(2)?		√			Closure Plan Section 2.0 SWGM Plan, Sec. 1.2 Lagoon Annual and Quarterly Reports RFI and Baseline Risk Assessment Reports	
2-4	Did the owner/operator make a demonstration that the facility was exempted due to meeting the land treatment requirements under OAC rule 3745-54-90(B)(3)?		√			Closure Plan Section 2.0 SWGM Plan, Sec. 1.2 Lagoon Annual and Quarterly Reports RFI and Baseline Risk Assessment Reports	
2-5	Did the owner/operator demonstrate that there is not potential for migration of liquid from a regulated unit to the uppermost aquifer during the active life of the regulated unit (including the closure post-closure periods)? Predictions must be based on assumptions that maximize the rate of liquid migration. This demonstration must be certified by a qualified geologist or geotechnical engineer. OAC rule 3745-54-90(B)(4)		√			Closure Plan Section 2.0 SWGM Plan, Sec. 1.2 Lagoon Annual and Quarterly Reports RFI and Baseline Risk Assessment Reports	
2-6	Did the owner demonstrate that the waste pile is designed and operated in compliance with OAC rule 3745-56-50(C)? OAC rule 3745-54-90(B)(5)		√			Closure Plan Section 2.0 SWGM Plan, Sec. 1.2 Lagoon Annual and Quarterly Reports RFI and Baseline Risk Assessment Reports	

Guidance Checklist for GW Monitoring under OAC rules 3745-54-90 through 97

02/01/01

Section 2. Con't. Exemptions from Ground Water Monitoring Requirements OAC rule 3745-54-90(B) These will not be allowed for Baseline Call Ins.		Y/N	NA	Vio	Def	Pg	Rmk
2-7	Is the facility required to perform GWM during closure and post-closure periods? OAC rule 3745-54-90(C)		√			Closure Plan Section 2.0 SWGM Plan, Sec. 1.2 Lagoon Annual and Quarterly Reports RFI and Baseline Risk Assessment Reports	
2-8	Does the facility have a miscellaneous unit required to implement GWM according to OAC rules 3745-54-90 to 99 and 55-01 to 55-02?		√			Closure Plan Section 2.0 SWGM Plan, Sec. 1.2 Lagoon Annual and Quarterly Reports RFI and Baseline Risk Assessment Reports	
Section 3. Interim Status Ground Water Monitoring Data This section is required for a permit. If the facility has already been conducting ground water monitoring under the Interim Status regulations, Ohio EPA already has this data. **Therefore, it does not need to be submitted again.**		**Y/N**	**NA**	**Vio**	**Def**	**Pg**	**Rmk**
3-1	Did the owner/operator provide a summary of interim status ground water monitoring data? OAC rule 3745-50-44(B)(1)	Y				Lagoon Annual and Quarterly Reports Closure Plan	
3-2	Did it include a summary description of the wells according to OAC rule 3745-65-91 including: Location and identification of each well on a topographic map?	Y				Lagoon Annual and Quarterly Reports	
3-3	Which wells were upgradient and which wells were down gradient?	Y				Lagoon Annual and Quarterly Reports	
Section 3. Guidance Checklist for GW Monitoring under OAC rules 3745-54-90 through 97		**Y/N**	**NA**	**Vio**	**Def**	**Pg**	**Rmk**
3-4	Details of the design and construction of each monitoring well?	Y				Lagoon Annual and Quarterly Reports DOCC Reports RFI Reports	
3-5	Was a copy of the facility's SAP submitted and did it include all the necessary procedures required in OAC rule 3745-65-92(A) as listed in the SAP portion of this guidance in Section 10?	Y				Lagoon Sampling Plans for Assessment and Detection Monitoring Programs SWGM Plan	
3-6	Were all Interim Status sampling results required by OAC rules 3745-65-92 through 94 submitted including: Copies of each quarterly report from the first year of monitoring?	Y				Lagoon Annual and Quarterly Reports	
3-7	Copies of any subsequent (annual or semi-annual) analytical results for each well?	Y				RFI Reports	
3-8	Copies of any notifications of statistically significant changes reported to the Director pursuant to OAC rule 3745-65-93?	Y				Lagoon Annual Reports Correspondence to Ohio EPA	
3-9	Results of ground water surface elevations and evaluations for each sampling event?	Y				Lagoon Annual and Quarterly Reports RFI Reports	
3-10	Calculations of the initial background arithmetic mean and variance for each indicator parameter based on replicated measurements form upgradient well during the first year of sampling? OAC rule 3745-65-92(C)(2)	Y				Lagoon Annual and Quarterly Reports	
3-11	Was information related to statistical procedures provided, including: A description of statistical procedures used (if applicable) in processing the data submitted? OAC rule 3745-65-93(B)	Y				Lagoon Annual and Quarterly Reports	
3-12	Results of statistical comparisons between upgradient and downgradient sampling results and first year background values for each indicator parameter?	Y				Lagoon Annual and Quarterly Reports	

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Section 3.	Con't. Guidance Checklist for GW Monitoring under OAC rules 3745-54-90 through 97	Y/N	NA	Vio	Def	Pg	Rmk
3-13	If required, was an adequate Ground Water Quality Assessment Plan submitted? OAC rule 3745-65-93(D)(3)	Y				Lagoon Sampling Plan for the Assessment Monitoring Program	
3-14	Were the following results submitted and were the determinations adequately made to assess: Whether hazardous waste or hazardous waste constituents have entered the ground water?	Y				Lagoon Annual and Quarterly Reports	
3-15	Whether the rate, vertical and horizontal extent of ground water contamination has been fully determined according to OAC rule 3745-65-93(D)(4)(a)?	Y				Lagoon Annual and Quarterly Reports	
3-16	Whether the concentrations of hazardous waste or hazardous waste constituents in the ground water had been fully determined according to OAC rule 3745-65-93(D)(4)(b)?	Y				Lagoon Annual and Quarterly Reports	
Section 4.	**General Hydrogeologic Information - Guidance Checklist for OAC rules 3745-54-90 through 97**	**Y/N**	**NA**	**Vio**	**Def**	**Pg**	**Rmk**
4-1	Were the uppermost aquifer and any hydraulically interconnected underlying aquifers correctly identified so that **representative** samples may be collected as required by OAC rule 3745-54-97?	Y				Lagoon Annual and Quarterly Reports DOCC Reports RFI Reports	
4-2	Was the full lateral and vertical extent of subsurface materials characterized correctly?	Y				Lagoon Annual and Quarterly Reports RFI Reports Closure Plan	
4-3	Were all geological influences that might control ground water flow (highly conductive zones, fault zones, fracture traces, buried stream deposits, etc.) adequately evaluated?	Y				Lagoon Annual and Quarterly Reports DOCC Reports RFI Reports	
4-4	Are there geological influences that may restrict ground water flow (e.g., confining layers, hydraulic barriers) to any stratigraphically lower water-bearing units?	Y				Lagoon Annual and Quarterly Reports DOCC Reports RFI Reports	
4-5	If there are any confining layers, are they laterally continuous across the entire site?	Y				DOCC Reports RFI Reports	
4-6	Was the ground water flow direction and rate correctly identified including the basis for those determinations?	Y				Lagoon Annual and Quarterly Reports DOCC Reports RFI Reports	
4-7	Were there any **Fluctuations** in static ground water levels?	Y				Lagoon Annual and Quarterly Reports DOCC Reports RFI Reports	
4-8	If yes, are the fluctuations caused by any of the following: Off site well pumping?	N				DOCC Reports RFI Reports Off-site pumping in the deep aquifer is continuous and does not result in fluctuations.	

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Section 4. Con't. General Hydrogeologic Information - Guidance Checklist for OAC rules 3745-54-90 through 97		Y/N	NA	Vio	Def	Pg	Rmk
4-9	On site well pumping?	N				DOCC Reports RFI Reports On-site production well pumping in the deep aquifer is typically continuous and does not result in fluctuations. However, historic pumping did result in fluctuations.	
4-10	Off or On site construction or changing land-use patterns?	N				No current changes are proposed at the facility.	
4-11	Seasonal variations?	Y				Lagoon Annual and Quarterly Reports DOCC Reports RFI Reports	
4-12	Do the water level fluctuations alter the general ground water gradients and flow directions?	N				Lagoon Annual and Quarterly Reports DOCC Reports RFI Reports	
4-13	Were the **hydraulic conductivity** properties of the uppermost aquifer determined?	Y				Lagoon Annual and Quarterly Reports DOCC Reports RFI Reports	
4-14	Was the following information from hydrogeologic investigations submitted in a report written by a qualified hydrogeologist?	Y				Lagoon Annual and Quarterly Reports DOCC Reports RFI Reports	
4-15	Did the owner/operator address means for resolution of any information gaps of geologic data?	Y				Lagoon Annual and Quarterly Reports DOCC Reports RFI Reports	
4-16	Did the report include regional as well as site specific descriptions of the geology and hydrogeology including at a minimum, the depth to bedrock?	Y				DOCC Reports RFI Reports	
4-17	Characteristics of the major stratigraphic units?	Y				DOCC Reports RFI Reports	
4-18	Average yield of water wells within a one mile radius? (Logs should be submitted as well)	Y				DOCC Reports RFI and Baseline Risk Assessment Reports	
4-19	Identification and estimation of the amount of recharge and discharge?	Y				DOCC Reports RFI Reports	
4-20	Did the written description include an accurate classification and description of the **Site Specific** consolidated and unconsolidated materials from the ground surface down to the base of the lowest saturated zone of concern?	Y				DOCC Reports RFI Reports	
4-21	Did the narrative include a site-specific description of the **occurrence of ground water** at the site, including: Identification of saturated zones, including depth and lateral and vertical extent?	Y				DOCC Reports RFI Reports	
4-22	Description of the interconnection between saturated zones and surface water?	Y				DOCC Reports RFI Reports	

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Section 4. Con't. General Hydrogeologic Information - Guidance Checklist for OAC rules 3745-54-90 through 97		Y/N	NA	Vio	Def	Pg	Rmk
4-23	Were the results of this report supported by an adequate and complete set of raw data?	Y				DOCC Reports RFI Reports	
4-24	Were the **boring logs** complete technical records of conditions encountered including the results of the laboratory analyses?	Y				DOCC Reports RFI Reports	
4-25	Did the logs include: Site name and Site-specific coordinates?	Y				DOCC Reports RFI Reports	
4-26	Date started, completed, abandoned or converted into well?	Y				DOCC Reports RFI Reports	
4-27	Depth and reason for termination of borehole?	Y				DOCC Reports RFI Work Plans and Reports	
4-28	Sampling interval?	Y				DOCC Reports RFI Work Plans and Reports	
4-29	Surface elevation based on Mean Sea level (MSL) or fixed reference point?	Y				DOCC Reports RFI Reports	
4-30	Description and classification of unconsolidated materials? (Field and lab)	Y				DOCC Reports RFI Reports	
4-31	Description and classification of consolidated materials? (Field and lab)	Y				DOCC Reports RFI Reports	
4-32	Presence of structural features such as fractures, solution cavities, or bedding?		√			DOCC Reports RFI Reports These features are not present at the facility in the monitored unconsolidated zones.	
4-33	Depth to water, water-bearing zone(s) and vertical extent of each?	Y				DOCC Reports RFI Reports	
4-34	Depth and location of any color and/or stains (possible contamination) encountered in borehole?	Y				DOCC Reports RFI Reports	
4-35	Did the interval and depth of sample collection adequately reflect subsurface complexity?	Y				DOCC Reports RFI Reports	
4-36	Were **well construction logs** provided for all wells and piezometers?	Y				DOCC Reports RFI Reports	
4-37	Did the construction logs include: Date/time of start and completion of construction?	Y				DOCC Reports RFI Reports	
4-38	Boring/well number?	Y				DOCC Reports RFI Reports	

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Section 4.	Con't. General Hydrogeologic Information - Guidance Checklist for OAC rules 3745-54-90 through 97	Y/N	NA	Vio	Def	Pg	Rmk
4-39	Drilling method and drilling fluid used?	Y				DOCC Reports RFI Reports	
4-40	Borehole diameter and well casing diameter?	Y				DOCC Reports RFI Reports	
4-41	Latitude and longitude?	Y				DOCC Reports RFI Reports	
4-42	Borehole depth?	Y				DOCC Reports RFI Reports	
4-43	Well depth?	Y				DOCC Reports RFI Reports	
4-44	Casing length and materials?	Y				DOCC Reports RFI Reports	
4-45	Screened interval?	Y				DOCC Reports RFI Reports	
4-46	Screen materials, length, design and slot size?	Y				DOCC Reports RFI Reports	
4-47	Casing and screen joint type?	Y				DOCC Reports RFI Reports	
4-48	Depth/elevation of top and bottom of screen?	Y				DOCC Reports RFI Reports	
4-49	Filter pack material/size, volume calculations, and placement method?	Y				DOCC Reports RFI Reports	
4-50	Depth/elevation to top and bottom of filter pack?	Y				DOCC Reports RFI Reports	
4-51	Annular seal composition, volume, and placement method?	Y				DOCC Reports RFI Reports	
4-52	Surface seal composition, placement method and volume?	Y				DOCC Reports RFI Reports	
4-53	Surface seal and well apron design/construction?	Y				DOCC Reports RFI Reports	
4-54	Depth/elevation of water?	Y				DOCC Reports RFI Reports	
4-55	Well development procedure and ground water turbidity?	Y				DOCC Reports RFI Reports	

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Section 4. Con't. General Hydrogeologic Information - Guidance Checklist for OAC rules 3745-54-90 through 97		**Y/N**	**NA**	**Vio**	**Def**	**Pg**	**Rmk**
4-56	Type/design of protective casing?	Y				DOCC Reports RFI Reports	
4-57	Well cap and lock?	Y				DOCC Reports RFI Reports	
4-58	Ground surface elevation (+/- 0.01 ft)?	Y				DOCC Reports RFI Reports	
4-59	Surveyed reference point (+/- 0.01 ft) on well casing?	Y				DOCC Reports RFI Reports	
4-60	Water level after completion of well development?	Y				DOCC Reports RFI Reports	
4-61	Did the report include a description of field methods used and a summary of which data were collected by each method?	Y				DOCC Reports RFI Reports	
Section 5. Topographic Map Requirements - Guidance Checklist for GW Monitoring under OAC rules 3745-54-90 through 97 The owner/operators of facilities required to perform ground water monitoring shall include the following information on a topo map:		**Y/N**	**NA**	**Vio**	**Def**	**Pg**	**Rmk**
5-1	Do all maps include: Legend?	Y				Lagoon Annual and Quarterly Reports DOCC Reports RFI Reports	
5-2	Map scale and date?	Y				Lagoon Annual and Quarterly Reports DOCC Reports RFI Reports	
5-3	North arrow?	Y				Lagoon Annual and Quarterly Reports DOCC Reports RFI Reports	
5-4	Wind rose (prevailing wind speed and direction)?	N				A wind rose diagram has not been prepared for the GM Moraine facilities.	
5-5	A contour interval at a level of detail appropriate for the investigation?	Y				Lagoon Annual and Quarterly Reports DOCC Reports RFI Reports	
5-6	Anthropogenic features such as utility lines and buildings?	Y				Lagoon Annual and Quarterly Reports DOCC Reports RFI Reports	
5-7	Legal boundaries of the regulated facility?	Y				Lagoon Annual and Quarterly Reports DOCC Reports RFI Reports	

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Section 5. Con't. Topo Map Requirements - Guidance Checklist for GW Monitoring under OAC rules 3745-54-90 through 97		Y/N	NA	Vio	Def	Pg	Rmk
5-23	Indication of ground water flow direction?	Y				Lagoon Annual and Quarterly Reports DOCC Reports RFI Reports	
5-24	Was an explanation for the flow direction and a justification of the extrapolation of flow outside the area defined by data points included?	Y				Lagoon Annual and Quarterly Reports DOCC Reports RFI Reports	
5-25	Were separate potentiometric maps submitted for each zone monitored?	Y				Lagoon Annual and Quarterly Reports DOCC Reports RFI Reports	
5-26	Location of any injection or withdrawal monitoring wells?	Y				RFI Reports SWGM Plan IM/CM Report	
Section 6.	**Contaminant Plume Description**	**Y/N**	**NA**	**Vio**	**Def**	**Pg**	**Rmk**
6-1	For existing facilities with contaminated ground water, did the owner/operator provide a description of any plume of contamination that has entered the ground water from a regulated unit at the time the plan/application is submitted?	Y				Lagoon Annual and Quarterly Reports SWGM Plan IM/CM Report RFI Reports	
6-2	Did the description include delineating the horizontal extent of any plume on the topographic map required above?	Y				IM/CM Report RFI Reports	
6-3	Did the owner/operator identify the concentration of each constituent listed in the Appendix to OAC rule 3745-54-98 throughout the plume or identify the maximum concentration of each of those constituents in the plume?	Y				Lagoon Annual and Quarterly Reports RFI Reports SWGM Plan During the RFI, the Appendix IX list was used and a site-specific parameter list is proposed in the SWGM Plan.	
6-4	Was the vertical extent of each plume delineated in cross section?	Y				Data Visualization	
Section 7.	**Correct GW Monitoring Program - Guidance Checklist for Monitoring under OAC rules 3745-54-90 through 97**	**Y/N**	**NA**	**Vio**	**Def**	**Pg**	**Rmk**
7-1	Is the facility operating under the correct GWM program?	Y				SWGM Plan	
7-2	If hazardous constituents under OAC rule 3745-54-93 have been detected in the ground water at the compliance point, was a compliance GWM program in accordance with OAC rule 3745-54-99 implemented? OAC rule 3745-54-91(A)(1)	N				Prior to closure of the lagoons, the North Settling Lagoon was in assessment monitoring (3745-65-93) and the South Settling Lagoon was in detection monitoring (3745-65-92), per the requirements of the Consent Decree. Hazardous constituents have also been detected from on-site and off-site sources.	

Section 7. Con't. Correct GW Monitoring Program - Guidance Checklist for Monitoring under OAC rules 3745-54-90 through 97		Y/N	NA	Vio	Def	Pg	Rmk
7-3	If the ground water protection standard under OAC rule 3745-54-92 was exceeded at the compliance point under OAC rule 3745-54-95, was a corrective action GWM program in accordance with OAC rule 3745-55-01 implemented? OAC rule 3745-54-91(A)(2)		√			Lagoon Annual and Quarterly Reports Consent Decree, October 26, 1988 SWGM Plan	
7-4	If hazardous constituents under OAC rule 3745-54-93 exceeded concentration limits as established under OAC 3745-54-94 in the ground water between the compliance point and the downgradient facility property boundary was a corrective action GWM program according to OAC rule 3745-55-01 implemented? OAC rule 3745-54-91(A)(3)		√			Lagoon Annual and Quarterly Reports Consent Decree, October 26, 1988 SWGM Plan	
7-5	Has a detection GWM program (capable of determining the facility's impact on the quality of ground water in the uppermost aquifer underlying the facility) been implemented? OAC rule 3745-54-91(A)(4)	Y				Lagoon Supplemental Annual Reports Consent Decree, October 26, 1988 A detection monitoring program was implemented for the south settling lagoon (3745-65-92). SWGM Plan	
7-6	Did the owner/operator submit an adequately detailed plan/ engineering report specify all the elements of the correct ground water monitoring program? OAC rule 3745-54-91(B)(1)	Y				SWGM Plan	
7-7	If required, is more than one GWM program presently in operation at the site? OAC rule 3745-54-91(B)(2)	Y				SWGM Plan	
Section 8. Ground Water Protection Standard OAC rules 3745-54-92 through 96		**Y/N**	**NA**	**Vio**	**Def**	**Pg**	**Rmk**
	If hazardous constituents have been detected in the ground water, has the ground water protection standard been established in the facility permit/closure or post-closure plan? OAC rule 3745-54-92	Y				SWGM Plan Sec. 4.0 IM/CM Report, Sec. 2.0 Remediation target levels that are risk-based and protective of human health are proposed.	
8-2	Will the ground water protection standard ensure that hazardous constituents detected in the ground water from a regulated unit will not exceed the concentration limits in the uppermost aquifer underlying the waste management area beyond the point of compliance during the compliance period? OAC rule 3745-54-92	Y				SWGM Plan, Sec. 4.0 IM/CM Report, Sec. 2.0 A site-wide data evaluation that includes the closed lagoons and compliance points will be conducted.	
8-3	Does the **list of hazardous constituents** for ground water monitoring include any constituent listed in the appendix to OAC rule 3745-51-11 that have been detected in the ground water in the uppermost aquifer underlying a regulated unit and that are reasonably expected to be in or derived from waste contained in a regulated unit? OAC rule 3745-54-93(A)	Y				SWGM Plan, Sec. 2.0, 3.0, 4.0 RFI and Baseline Risk Assessment Reports IM/CM Report	
8-4	Have constituents been excluded from the parameter list due to their lack of adverse effects on ground water quality? OAC rule 3745-54-93(B)(1)	Y				SWGM Plan, Sec. 2.0, 3.0, 4.0 RFI and Baseline Risk Assessment Reports IM/CM Report	
8-5	Have any constituents been excluded from the parameter list due to their potentially adverse effects on hydraulically connected surface water quality? OAC rule 3745-54-93(B)(2)	N				RFI and Baseline Risk Assessment Reports Surface water was evaluated in the RFI and based on the conclusions in the Baseline Risk Assessment, there were no adverse impacts to the Drainage Ditch.	

...ction 8. Con't. GW Protection Standard - Guidance Checklist for GW Monitoring under OAC rules 3745-54-90 through 97		Y/N	NA	Vio	Def	Pg	Rmk
8-6	Have the **concentration limits** been set in the permit/plan? OAC rule 3745-54-94(A)	N				SWGM Plan, Sec. 4.0 IM/CM Report, Sec. 2.0 Baseline Risk Assessment Remediation target levels are proposed in the SWGM Plan and a trend evaluation will be conducted for the lagoons.	
8-7	Were concentration limits set so as to not exceed background levels of that constituent in the ground water at the time the limit was specified in the permit? OAC rule 3745-54-94(A)(1)	N				SWGM Plan, Sec. 4.0 IM/CM Report, Sec. 2.0 Baseline Risk Assessment Remediation target levels were derived using methodologies in the baseline risk assessment.	
8-8	Were concentration limits set so as to not exceed the respective MCL value if the background level of the constituent is below the MCL? OAC rule 3745-54-94(A)	N				SWGM Plan, Sec. 4.0 IM/CM Report, Sec. 2.0 Baseline Risk Assessment Remediation target levels were derived using methodologies in the baseline risk assessment.	
8-9	Were concentration limits set so as to not exceed the alternate concentration limit (ACL) established in the permit? OAC rule 3745-54-94(A)(3)		√			The facility does not have a permit, in lieu of a permit, the corrective action order serves as the enforceable document.	
8-10	Have all potentially adverse effects on ground water quality been correctly considered when establishing the ACL? OAC rule 3745-54-94(B)(1)	Y				SWGM Plan, Sec. 4.0 IM/CM Report, Sec. 2.0 Baseline Risk Assessment Risk-based remediation target levels are proposed.	
8-11	Have all potentially adverse effects on hydraulically connected surface-water quality been correctly considered when establishing the ACL? OAC rule 3745-54-94(B)(2)	Y				SWGM Plan, Sec. 4.0 IM/CM Report, Sec. 2.0 Baseline Risk Assessment Surface water was evaluated in the RFI and based on the conclusions in the Baseline Risk Assessment, there were no adverse impacts to the Drainage Ditch.	
8-12	Does the permit/plan identify the **point of compliance** where the ground water protection standard applies? OAC rule 3745-54-95	Y				SWGM Plan, Sec. 4.0 IM/CM Report, Sec. 2.0	
8-13	Is ground water monitoring conducted at the vertical surface located at the hydraulically downgradient limit of the waste management area that extends down into the uppermost aquifer underlying the regulated units? OAC rule 3745-54-95(A)	Y				SWGM Plan, Sec. 3.0	
8-14	Is the waste management area correctly defined for the purposes of the point of compliance? OAC rule 3745-54-95(B)	Y				SWGM Plan, Sec. 3.0	

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Section 8. Con't. GW Protection Standard - Guidance Checklist for GW Monitoring under OAC rules 3745-54-90 through 97		**Y/N**	**NA**	**Vio**	**Def**	**Pg**	**Rmk**
8-15	If the facility contains more than one regulated unit, does the point of compliance correctly circumscribe the regulated units? OAC rule 3745-54-95(B)(2)	N				SWGM Plan, Sec. 4.0 IM/CM Report, Sec. 2.0 The lagoon point of compliance wells are located immediately downgradient of each closed lagoon.	
8-16	Has the permit/plan correctly specified the **compliance period** in the permit as the number of years equal to the active life of the waste management area? OAC rule 3745-54-96(A)	N				SWGM Plan, Sec. 5.0 Site-wide groundwater monitoring will be conducted for a minimum of 30 years, unless otherwise demonstrated that no further monitoring is warranted.	
8-17	Has the permit/plan correctly specified when the compliance monitoring period begins when the compliance monitoring program was initiated? OAC rule 3745-54-96(B)		√			SWGM Plan, Sec. 4.0 Consent Decree, October 26, 1988 The closed lagoons are not in a compliance monitoring program.	
8-18	Has it been necessary to extend the compliance period to demonstrate that the GW protection standard has not been exceeded for 3 consecutive years? OAC rule 3745-54-96(C)	N				SWGM Plan, Sec. 4.0 Consent Decree, October 26, 1988 The closed lagoons are not in a compliance monitoring program.	
Section 9.	**Wells for Part B Ground Water Monitoring OAC rules 3745-54-97(A-C)**	**Y/N**	**NA**	**Vio**	**Def**	**Pg**	**Rmk**
9-1	Do the actual numbers, locations, and depths of the GWM wells and waste management areas agree with the data in the GWM Plan? Is the location and identification of each well on a topographic map?	Y				SWGM Plan, Sec. 3.0	
9-2	Is it clear which wells are upgradient and which wells are down gradient?	Y				SWGM Plan, Sec. 3.0	
9-3	Does the GWM system consist of a sufficient number of wells, installed at appropriate locations and depths to yield groundwater samples from the uppermost aquifer? OAC rule 3745-54-97(A)	Y				SWGM Plan, Sec. 3.0	
9-4	Will the GWM system produce samples that represent the quality of background water that has not been affected by leakage from the unit? OAC rule 3745-54-97(A)(1)	Y				RFI and Baseline Risk Assessment Reports SWGM Plan Sec. 3.0 Comparison of upgradient versus downgradient groundwater quality is not appropriate without evaluating site-wide conditions.	
9-5	If it cannot be determined what wells are hydraulically upgradient, does the GWM system correctly include sampling of wells that are not hydraulically upgradient of the waste management area? OAC rule 3745-54-97(A)(1)(a)(i)		√			SWGM Plan, Section 3.0 RFI Reports GM has determined which wells are hydraulically upgradient.	
9-6	Has sampling at other non-upgradient wells provided an indication of background GW quality that is as or more representative than monitoring upgradient wells? OAC rule 3745-54-97(A)(1)(a)(ii)		√			SWGM Plan, Sec. 3.0 RFI Reports GM has determined which wells are hydraulically upgradient.	

...ction 9. Con't. Wells for Part B GWM - Guidance Checklist for GW Monitoring under OAC rules 3745-54-90 through 97		Y/N	NA	Vio	Def	Pg	Rmk
9-7	Is there upgradient contamination emanating from a source on-site?	Y				RFI and Baseline Risk Assessment Reports Lagoon Annual and Quarterly Reports	
9-8	Off-site?	Y				RFI and Baseline Risk Assessment Reports Lagoon Annual and Quarterly Reports	
9-9	Is the ground water flow direction variable (i.e., no location is clearly hydraulically upgradient under all conditions)?	N				DOCC Reports RFI Reports	
9-10	If representative upgradient groundwater quality is contaminated, has an additional upgradient well been installed to provide uncontaminated samples representative of the same stratigraphic unit as the downgradient wells?		√			SWGM Plan, Sec. 1.0, 2.0, 3.0 RFI Reports Groundwater quality upgradient of the site is contaminated from off-site sources.	
9-11	Are there background well(s) of sufficient number to account for any heterogeneity in background groundwater quality?	Y				SWGW Plan, Sec. 1.0, 2.0, 3.0 RFI Reports Lagoon Annual and Quarterly Reports	
9-12	Are the background well(s) screened in the same stratigraphic horizon(s) as the downgradient wells to ensure comparability of data?	Y				DOCC Reports, RFI Reports Lagoon Annual and Quarterly Reports	
9-13	Have sufficient monitoring wells been installed hydraulically downgradient to represent the quality of ground water passing the point of compliance? OAC rule 3745-54-97(A)(2)	Y				DOCC Reports RFI Reports SWGM Plan, Sec. 3.0 Lagoon Annual and Quarterly Reports	
9-14	Have sufficient monitoring wells been installed to allow for the immediate detection of contamination when hazardous waste or hazardous constituents have migrated from the waste management area to the uppermost aquifer? OAC rule 3745-54-97(A)(3)	Y				SWGM Plan, Sec. 3.0 Lagoon Annual and Quarterly Reports DOCC Reports RFI Reports	
9-15	If more than one hydrogeologic zone is monitored, are an adequate number of downgradient wells in each hydrogeologic zone?	Y				SWGM Plan, Sec. 3.0 DOCC Reports, RFI Reports	
9-16	In the case of a facility consisting of only one regulated unit, is the point of compliance described by the waste boundary or perimeter?		√			Lagoon Annual and Quarterly Reports RFI Reports The GM Moraine Facilities contain two closed lagoons.	
9-17	If the point of compliance circumscribes several regulated units, does the GWM system enable detection and measurement at the compliance point of hazardous constituents that have entered the uppermost aquifer? OAC rule 3745-54-97(B)	Y				SWGM Plan, Sec. 3.0 The lagoon point of compliance wells are located immediately downgradient of each closed lagoon. The point of compliance does not circumscribe the units.	
9-18	Has the owner/operator reported to Ohio EPA the well design, construction and installation information for all monitoring wells?	Y				RFI Work Plans and Reports, DOCC Reports Lagoon Annual and Quarterly Reports	

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Section 9. Con't. Wells for Part B GWM - Guidance Checklist for GW Monitoring under OAC rules 3745-54-90 through 97		Y/N	NA	Vio	Def	Pg	Rmk
9-19	Is all monitoring well design, construction and installation information kept on-site as part of the operating record?	Y				RFI Work Plans Project files are maintained at the Moraine facility, GM headquarters in Troy, Michigan, and the ARCADIS Columbus, Ohio office. Historic files are kept in a secured off-site storage location.	
9-20	Are the monitoring well casing and screen materials such that they will be resistant to chemical and microbiological corrosion and degradation in contaminated and uncontaminated waters over their operating life?	Y				RFI Work Plan	
9-21	Are the monitoring wells and screens cased and installed properly to maintain an open passage to the aquifer materials?	Y				RFI Work Plan	
9-22	Does the owner/operator identify the well screen lengths of each monitoring well?	Y				RFI Work Plan	
9-23	Does the design and construction of the owner/operator's monitoring wells permit depth discrete groundwater samples to be taken?	Y				RFI Work Plan	
9-24	Was a filter pack installed?	Y				RFI Work Plan	
9-25	If yes, was the filter pack compatible with formation materials?(size and inertness)	Y				RFI Work Plan	
9-26	Was the length of the filter pack sufficient to encompass the entire screened interval?	Y				RFI Work Plan	
9-27	Was the filter pack installed properly? (If no, comment)	Y				RFI Work Plan	
9-28	Is the annular space above the sampling depth sealed with suitable to prevent vertical movement of water within the borehole and contamination of samples and the ground water by infiltration of surface water and contaminants?	Y				RFI Work Plan	
9-29	Are the sealant materials chemically inert to the highest anticipated concentration of constituents expected in the ground water?	Y				RFI Work Plan	
9-30	Will the wells produce samples representative of groundwater quality?	Y				RFI Work Plan and Reports	
9-31	Does the monitoring well's construction and design permit an accurate assessment of aquifer characteristics?	Y				RFI Work Plan and Reports	
9-32	Are the ground water samples free from turbidity?	N				RFI Work Plan Some samples are more turbid than others; however, low-flow sampling procedures should reduce the amount of turbidity in the sample. Based on 20 years of groundwater monitoring, turbidity has not been an issue.	
9-33	Were the wells properly developed?	Y				RFI Work Plan	
9-34	Was there evidence of siltation in the bottom of the well that could reduce representativeness of groundwater samples?	N				RFI Work Plan Siltation of the lagoon point of compliance wells has not occurred.	
9-35	Does the screened interval yield sufficient quantities of ground water for the collection of representative samples?	Y				RFI Work Plan and Reports	

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Section 10.	SAP OAC rules 3745-54-97(D through F)	Y/N	NA	Vio	Def	Pg	Rmk
10-1	Has a Sampling and Analysis Plan (SAP) been developed and implemented as written to ensure that monitoring results will provide a reliable indication of ground water quality below the waste management area? OAC rule 3745-54-97(D)	Y				Lagoon Work Plans for Assessment and Detection Monitoring Programs RFI Work Plan SWGM Plan	
10-2	Does the owner/operator keep a copy of the most recent SAP on-site?	Y				Project files are maintained at the Moraine facility. Historic files are kept in a secured off-site storage location.	
10-3	If the facility is abandoned and no operations are maintained on-site, was the SAP present for review during the site inspection? (It must be present during all sampling events.)		√			The GM Moraine facilities are still active.	
10-4	Does the plan include procedures and techniques for measuring ground water elevations as required by OAC rule 3745-54-97(D)(1) including: Taking all water level measurements within a 24 hour period?	Y				RFI Work Plan SWGM Plan	
10-5	Taking all water level measurements to an accuracy of +/-0.01 feet?	Y				RFI Work Plan SWGM Plan	
10-6	Taking all water level measurements prior to purging?	Y				RFI Work Plan SWGM Plan	
10-7	Were groundwater surface elevations determined at each monitoring well during each sampling event?	Y				RFI Work Plan SWGM Plan	
10-8	Are total well depths measured at least once a year?	Y				SWGM Plan	
10-9	Was a marked reference point established by a licensed surveyor used when measuring the water levels in each well?	Y				RFI Work Plan	
10-10	Was there proper decontamination of the measuring equipment between well locations to prevent cross contamination?	Y				RFI Work Plan SWGM Plan	
10-11	Were the measurements skewed by the presence of an immiscible layer?	N				RFI Work Plan SWGM Plan An immiscible layer is not present at the lagoon point of compliance wells.	
10-12	Were the measurements skewed by on or off-site pumping?	N				RFI Work Plan SWGM Plan	
10-13	If the detection of immiscible layers is applicable, were procedures for both dense and light phases included? OAC rule 3745-54-97(D)(2)	Y				RFI Work Plan There are several wells (not associated with the lagoons) that intermittently contain an immiscible layer.	
10-14	If applicable, are immiscible layers sampled separately prior to well evacuation?	N				A sufficient quantity of the immiscible layer is not present for sampling purposes.	
10-15	If applicable, are procedures to be used to minimize mixing the water soluble phases?	Y				RFI Work Plan	

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Section 10.	Con't. SAP - Guidance Checklist for GW Monitoring under OAC rules 3745-54-90 through 97	Y/N	NA	Vio	Def	Pg	Rmk
10-16	If procedures for immiscibles were not included, did the SAP provide a justification as to why immiscibles were not applicable?		√			There are several wells (not associated with the lagoons) that intermittently contain an immiscible layer.	
10-17	Did the SAP contain procedures and techniques for well evacuation as required by OAC rule 3745-54-97(D)(3)(a), inclnding: whether low-yielding wells will be evacuated to dryness?	Y				RFI Work Plan SWGM Plan	
10-18	Evacuation of an adequate amount of water from high-yielding wells?	Y				RFI Work Plan SWGM Plan	
10-19	The correct formula to calculate well volumes?	Y				RFI Work Plan SWGM Plan	
10-20	The device used to evacuate the wells?	Y				RFI Work Plan SWGM Plan	
10-21	The use of micropurging techniques, if applicable?	Y				RFI Work Plan SWGM Plan	
10-22	Did the SAP contain procedures and techniques for sample withdrawal as required by OAC rule 3745-54-97(D)(3)(b), including: Proper decontamination of equipment between wells?	Y				RFI Work Plan SWGM Plan	
10-23	Sampling wells in order from least to most contaminated?	Y				RFI Work Plan SWGM Plan	
10-24	Sampling of parameters in order of sensitivity to volatilization?	Y				RFI Work Plan SWGM Plan	
10-25	Did the SAP contain procedures and techniques for sample eqnipment as required by OAC rule 3745-54-97(D)(3)(c), inclnding: devices with sample-contacting parts of either fluorocarbon/resins or stainless steel?	Y				RFI Work Plan SWGM Plan	
10-26	Type of sampling device used?	Y				RFI Work Plan SWGM Plan	
10-27	Type of pump to be used?	Y				RFI Work Plan SWGM Plan	
10-28	Whether the sampling devices be dedicated?	Y				RFI Work Plan SWGM Plan	
10-29	Type of cord/wire used to raise and lower bailers?	Y				RFI Work Plan SWGM Plan	
10-30	Will bailers be lowered slowly?	Y				RFI Work Plan SWGM Plan	
10-31	If bladder pumps are to be used, will they be operated in a continuous manner to prevent aeration?		√			RFI Work Plan SWGM Plan Use of bladder pumps is not proposed in the groundwater sampling SOP.	

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Section 10.	Con't. SAP - Guidance Checklist for GW Monitoring under OAC rules 3745-54-90 through 97	Y/N	NA	Vio	Def	Pg	Rmk
10-32	Will pumping rates remain below 100 ml/min?		√			RFI Work Plan SWGM Plan Groundwater pumping rates are discussed in the groundwater sampling SOP.	
10-33	Will care be taken to avoid placing clean sampling equipment on the ground or other contaminated surfaces prior to insertion into the well?	Y				RFI Work Plan SWGM Plan	
10-34	Did the SAP contain procedures and techniques for sample collection including sample containers as required by OAC rule 3745-54-97(D)(3)(d), including: whether samples would be transferred from the sampling device directly to their compatible containers?	Y				RFI Work Plan SWGM Plan	
10-35	Whether sample containers for metals (inorganics) analysis are polyethylene, Teflon, or glass with polypropylene-lined caps?	Y				RFI Work Plan SWGM Plan	
10-36	Whether sample containers for organic analysis were glass bottles with fluorocarbon resin-lined caps?	Y				RFI Work Plan SWGM Plan	
10-37	Whether sample bottles are pre-cleaned by the laboratory?	Y				RFI Work Plan SWGM Plan	
10-38	Whether if not pre-cleaned, prior to sampling will sample containers for metals analysis be cleaned using these sequential steps: Nonphosphate detergent wash, Potable water rinse, 10% hydrochloric or nitric acid rinse, and Distilled/deionized water rinse?		√			RFI Work Plan Sample containers are pre-cleaned by the laboratory.	
10-39	Whether if not pre-cleaned, will sample containers for organic analyses be cleaned using these sequential steps: Nonphosphate detergent/hot water wash, Potable water rinse, Solvent-pesticide grade isopropanol, acetone, methanol or hexane rinse, and Distilled/deionized water rinse?		√			RFI Work Plan Sample containers are pre-cleaned by the laboratory.	
10-40	If bailers are used, will contents be transferred to the sample container so that agitation and aeration are minimized?	Y				RFI Work Plan SWGM Plan	
10-41	Are samples for VOCs transferred to containers and capped in a timely manner to prevent aeration?	Y				RFI Work Plan SWGM Plan	
10-42	Was the container for organic analysis filled to form a meniscus?	Y				RFI Work Plan SWGM Plan	
10-43	Was the bottle checked for air after capping it?	Y				RFI Work Plan SWGM Plan	
10-44	Did the SAP contain procedures and techniques for sample preservation as required by OAC rule 3745-54-97(D)(3)(e), including whether: Samples for the following analysis are cooled to 4° C: Organic Analyses, PCBs, Chromium VI, Phenols, Sulfate, Nitrate/Nitrite, Coliform bacteria, Cyanide, Oil and Grease, Turbidity, Pesticides, and Specific Conductance?	Y				RFI Work Plan SWGM Plan QAPP	
10-45	Did the SAP contain procedures and techniques for sample filtration as required by OAC rule 3745-54-97(D)(3)(f)?	Y				RFI Work Plan SWGM Plan	

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Section 10.	Con't. SAP - Guidance Checklist for GW Monitoring under OAC rules 3745-54-90 through 97	Y/N	NA	Vio	Def	Pg	Rmk
10-46	Did the SAP contain procedures and techniques for sample preservation as required by OAC rule 3745-54-97(D)(3)(e), including whether samples for the following analyses are field acidified to pH <2 with HNO_3: Sodium, Total metals, Dissolved Metals, Mercury, Endrin, Lindane, Methoxychlor, Toxaphene, 2,4 D, 2,4,5 TP Silvex, Radium, Gross Alpha and Beta?	Y				RFI Work Plan SWGM Plan QAPP	
10-47	Did the SAP contain procedures and techniques for sample preservation as required by OAC rule 3745-54-97(D)(3)(e), including whether samples for the following analyses are field acidified to pH <2 with H_2SO_4? Phenols, Oil and grease, ammonia, Nitrate/Nitrite?	Y				RFI Work Plan SWGM Plan QAPP	
10-48	Did the SAP contain procedures and techniques for sample preservation as required by OAC rule 3745-54-97(D)(3)(e), including whether the sample for TOC analysis is field acidified to pH <2 with HCl ?	Y				RFI Work Plan SWGM Plan QAPP	
10-49	Did the SAP contain procedures and techniques for sample preservation as required by OAC rule 3745-54-97(D)(3)(e), including whether the sample for TOX analysis is preserved with 1 ml of 1.1 M sodium sulfite?	Y				RFI Work Plan SWGM Plan QAPP	
10-50	Did the SAP contain procedures and techniques for sample preservation as required by OAC rule 3745-54-97(D)(3)(e), including whether the sample for cyanide analysis is preserved with NaOH to pH >12?	Y				RFI Work Plan SWGM Plan QAPP	
10-51	Did the SAP contain procedures and techniques for sample shipment as required by OAC rule 3745-54-97(D)(3)(g)?	Y				RFI Work Plan SWGM Plan QAPP	
10-52	Did the SAP contain procedures and techniques for performing field analysis, inclnding: Procedures and forms for recording raw data as required by OAC rule 3745-54-97(D)(4)(a), including: **Maintaining a field logbook** containing: Monitoring program?	Y				RFI Work Plan SWGM Plan QAPP	
10-53	Locations/identification numbers of well(s) monitored?	Y				RFI Work Plan SWGM Plan	
10-54	Total depth of each well?	Y				RFI Work Plan SWGM Plan	
10-55	Static water level depth and measurement technique?	Y				RFI Work Plan SWGM Plan	
10-56	Presence of immiscible layers and detection method?	Y				RFI Work Plan	
10-57	Collection method for immiscible layers and sample identification numbers?	N				RFI Work Plan Immiscible layers are not consistently present in any one well. Immiscible layers are not present in the lagoon point of compliance wells.	
10-58	Well purging procedures and requirements?	Y				RFI Work Plan SWGM Plan	

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Section 10.	Con't. SAP - Guidance Checklist for GW Monitoring under OAC rules 3745-54-90 through 97	Y/N	NA	Vio	Def	Pg	Rmk
10-59	Sample withdrawal procedure?	Y				RFI Work Plan SWGM Plan	
10-60	Date and time of sample collection?	Y				RFI Work Plan SWGM Plan	
10-61	Well sampling sequence?	Y				RFI Work Plan SWGM Plan	
10-62	Types of sample containers and sample identification number(s)?	Y				RFI Work Plan SWGM Plan QAPP	
10-63	Preservative(s) used?	Y				RFI Work Plan SWGM Plan QAPP	
10-64	Internal temperature of shipping containers?	Y				RFI Work Plan SWGM Plan QAPP	
10-65	Parameters requested?	Y				RFI Work Plan SWGM Plan QAPP	
10-66	Field analysis data and method(s)?	Y				RFI Work Plan SWGM Plan QAPP	
10-67	Sample distribution in containers and transporter?	Y				RFI Work Plan SWGM Plan QAPP	
10-68	Field Observations/ sample appearance?	Y				RFI Work Plan SWGM Plan QAPP	
10-69	Unusual well recharge rates?	Y				RFI Work Plan SWGM Plan	
10-70	Equipment malfunction(s)?	Y				RFI Work Plan SWGM Plan QAPP	
10-71	Possible sample contamination?	Y				RFI Work Plan SWGM Plan QAPP	

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Section 10.	Con't. SAP - Guidance Checklist for GW Monitoring under OAC rules 3745-54-90 through 97	Y/N	NA	Vio	Def	Pg	Rmk
10-72	Sampling rate?	Y				RFI Work Plan SWGM Plan QAPP	
10-73	Any deviations from the SAP and why modifications were necessary?	Y				RFI Work Plan SWGM Plan QAPP	
10-74	Field team members?	Y				RFI Work Plan SWGM Plan QAPP	
10-75	Climatic conditions?	Y				RFI Work Plan SWGM Plan	
10-76	Does a copy of the log remain on-site as part of the owner/operator's groundwater monitoring operating record?	Y				RFI Work Plan SWGM Plan QAPP Project files are maintained at the facility. Historic files are kept in a secured off-site storage location.	
	Does the SAP specify that the following chemically unstable parameters, if applicable, will be measured in the field: pH, temperature, specific conductivity, redox potential, chlorine, dissolved oxygen, and turbidity?	Y				RFI Work Plan SWGM Plan QAPP Chlorine and turbidity are not regularly monitored.	
10-78	Does the SAP specify that in-situ determinations are made after well evacuation and before sample removal?	Y				RFI Work Plan SWGM Plan	
10-79	Does the SAP specify whether in-situ samples are drawn from split portions?	N				RFI Work Plan SWGM Plan	
10-80	Does the SAP specify whether pH and specific conductivity were measured immediately upon collection?	Y				RFI Work Plan SWGM Plan	
10-81	Did the SAP contain procedures and techniques for calibration methods as reqnired by OAC rule 3745-54-97(D)(4)(b), including: calibration of field instruments according to manufacturer's specifications?	Y				RFI Work Plan SWGM Plan QAPP	
10-82	Documentation of date, procedure, and maintenance for equipment calibration in the field logbook?	Y				RFI Work Plan SWGM Plan QAPP	
10-83	Did the SAP contain procedures and techniques for sample filtration as required by OAC rule 3745-54-97(D)(4)(c)) including: Handling of organic samples without filtering?	Y				RFI Work Plan SWGM Plan QAPP	

...ion 10.	Con't. SAP - Guidance Checklist for GW Monitoring under OAC rules 3745-54-90 through 97	Y/N	NA	Vio	Def	Pg	Rmk
10-84	Filtering the sample for dissolved metals through a 0.45 micron filter?	Y				RFI Work Plan SWGM Plan QAPP	
10-85	Did the SAP contain procedures and techniques for decontamination as required by OAC rule 3745-54-97(D)(5)) including: Decontamination to prevent cross-contamination during filtering?	Y				RFI Work Plan SWGM Plan QAPP	
10-86	Decontaminating the measuring equipment between well locations to prevent cross contamination?	Y				RFI Work Plan SWGM Plan QAPP	
10-87	Whether sampling equipment will be disassembled and thoroughly cleaned between sampling of individual wells?	Y				RFI Work Plan SWGM Plan QAPP	
10-88	Whether the cleaning procedure for inorganic analysis will include the following sequential steps: Nonphosphate detergent wash, potable water rinse, dilute 10% hydrochloric/nitric acid rinse, and deionized water rinse?	N				RFI Work Plan and QAPP SWGM Plan Sample containers are pre-cleaned by the laboratory. The equipment decontamination SOP will be followed.	
10-89	Whether the cleaning procedure for organic analysis will include: Nonphosphate detergent wash, potable water rinse, solvent-pesticide grade isopropanol, acetone, methanol or hexane rinse, and a distilled/deionized water rinse?	N				RFI Work Plan and QAPP SWGM Plan Sample containers are pre-cleaned by the laboratory. The equipment decontamination SOP will be followed.	
10-90	Whether the sampling equipment will be thoroughly dry before use?	Y				RFI Work Plan SWGM Plan	
10-91	Did the SAP contain procedures and techniques for disposal of purge water as required by OAC rule 3745-54-97(D)(6)?	Y				RFI Work Plan SWGM Plan	
10-92	Did the SAP contain procedures and techniques that the purge water be containerized until evaluated and disposed in an environmentally acceptable method according to the requirements of Ohio EPA?	N				RFI Work Plan SWGM Plan Purge water from the lagoon wells is not containerized because it does not require treatment. Purge water from the Former Oil House Area and the Waste Pile/Staging Area are treated at the on-site wastewater treatment plant.	
10-93	Did the SAP include discussions if normal detection monitoring indicates that the groundwater is not contaminated: whether the purge water will containerized?	Y				RFI Work Plan SWGM Plan Purge water from the lagoon wells is not containerized because it does not require treatment. Purge water from the Former Oil House Area and the Waste Pile/Staging Area are treated at the on-site wastewater treatment plant.	

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Section 10.	Con't. SAP - Guidance Checklist for GW Monitoring under OAC rules 3745-54-90 through 97	Y/N	NA	Vio	Def	Pg	Rmk
10-94	Whether it will be disposed of properly?	Y				RFI Work Plan SWGM Plan QAPP Purge water from the lagoon wells is not containerized because it does not require treatment. Purge water from the Former Oil House Area and the Waste Pile/Staging Area are treated at the on-site wastewater treatment plant.	
10-95	If monitoring has indicated that the purged ground water exhibits constituent concentrations above ambient/natural quality did the SAP discuss whether it would be managed as a wastewater or hazardous waste?	Y				RFI Work Plan SWGM Plan QAPP Purge water from the lagoon wells is not containerized because it does not require treatment. Purge water from the Former Oil House Area and the Waste Pile/Staging Area are treated at the on-site wastewater treatment plant.	
10-96	If contaminated, did the SAP discuss whether the purge water would be stored, treated, and disposed of as though it were a hazardous waste?	Y	-			RFI Work Plan SWGM Plan QAPP Purge water from the lagoon wells is not containerized because it does not require treatment. Purge water from the Former Oil House Area and the Waste Pile/Staging Area are treated at the on-site wastewater treatment plant.	
10-97	Did the SAP include a discussion of the sample analysis including: A list of all site-specific applicable constituents associated with the facility as required by OAC rule 3745-54-97(D)(7)(a)?	Y				SWGM Plan RFI Work Plans and Reports	
10-98	The analytical method for each constituent as required by OAC rule 3745-54-97(D)(7)(b)?	Y				RFI Work Plan SWGM Plan QAPP	
10-99	Methods using the lowest detection limit as listed in the most recent SW-846?	Y				QAPP	
10-100	The detection limit for each parameter as required by OAC rule 3745-54-97(D)(7)(b)?	Y				QAPP	
10-101	Detection limits less than or equal to the MCL for each constituent?	Y				QAPP	
10-102	Sample holding times for each parameter as required by OAC rule 3745-54-97(D)(7)(c)?	Y				QAPP	
10-103	Did the SAP include discussions of Quality Assurance/Quality Control as required by OAC rule 3745-54-97(D)(8), including: Whether the generated data is ensured by a QA/QC program?	Y				QAPP	
10-104	Does the QA/QC program include documentation of any deviation from approved procedures?	Y				QAPP	

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Section 10.	Con't. SAP - Guidance Checklist for GW Monitoring under OAC rules 3745-54-90 through 97	Y/N	NA	Vio	Def	Pg	Rmk
10-105	Did the SAP include discussions of the following under OAC rule 3745-54-97(D)(8)(a)): Equipment or field blanks?	Y				QAPP	
10-106	Trip blanks?	Y				QAPP	
10-107	Lab blanks?	Y				QAPP	
10-108	Are the correct number of the following to be taken? Equipment or field blanks? (one for each day)	N				QAPP Rinseate blanks are collected for every 10 analytical samples.	
10-109	Trip blanks? (one for each day)	Y				QAPP Trip blanks are collected one per cooler of VOCs.	
10-110	Lab blanks? (one for each run)	Y				QAPP	
10-111	Did the SAP include discussions of whether duplicate samples be taken as required by OAC rule 3745-54-97(D)(8)(b)?	Y				QAPP	
10-112	Did the SAP include discussions of whether standards will be run?	Y				QAPP	
10-113	Did the SAP include discussions of whether any spiked samples be required?	Y				QAPP	
10-114	Did the SAP inclnde discussions of potential lab interferences as required by OAC rule 3745-54-97(D)(8)(c)?	Y				QAPP	
10-115	If the lab is unable to obtain an analytical measurement for any constituent or parameter did the owner/operator's SAP discuss procedures for sampling matrix interferences?	N				QAPP Matrix interference has not been an issue at the lagoon wells.	
10-116	Was a statement provided in the SAP that QA/QC samples will not be used to correct data?	N				QAPP Matrix interference has not been an issue at the lagoon wells.	
10-117	Was a statement provided in the SAP that that only approved statistical QA/QC methods be used?	Y				QAPP	
10-118	Did the SAP discuss how and who will be critically examining the data to ensure it has been properly calculated and reported?	Y				QAPP	
10-119	Did the SAP include discussions of Chain of Custody /Sample Analysis Request Sheet Procedures including: Standardized field tracking reporting forms to establish sample custody for the field prior to and during shipping as required by OAC rule 3745-54-97(D)(9)(a)?	Y				QAPP	
10-120	Did the SAP discuss whether the chain-of custody/sample analysis request sheet would be included with the sample?	Y				QAPP	
10-121	Did the SAP discuss whether the chain-of-custody/sample request sheet will include the following: Sample number?	Y				QAPP	
10-122	Signature of collector?	Y				QAPP	
10-123	Date and time of sample collection?	Y				QAPP	
10-124	Sample type?	Y				QAPP	
10-125	Well ID (or other sample location)?	Y				QAPP	

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Section 10.	Con't. SAP - Guidance Checklist for GW Monitoring under OAC rules 3745-54-90 through 97	Y/N	NA	Vio	Def	Pg	Rmk
10-126	Identification of duplicates?	Y				QAPP	
10-127	Number of containers?	Y				QAPP	
10-128	Parameters requested?	Y				QAPP	
10-129	Preservatives used?	Y				QAPP	
10-130	Analysis to be performed?	Y				QAPP	
10-131	Signatures of persons involved in chain-of-custody?	Y				QAPP	
10-132	Inclusive dates and times of custody?	Y				QAPP	
10-133	Internal temperature of shipping container when samples were sealed?	N				QAPP	
10-134	Internal temperature of shipping container upon opening at laboratory?	Y				QAPP	
10-135	Did the SAP discuss whether sample seals will be placed on shipping containers to ensure samples are not altered?	Y				QAPP	
10-136	Did the SAP discuss how the chain-of-custody/sample request forms will help prevent: Misidentification of the samples?	Y				QAPP	
10-137	How they will allow easy tracking of possession?	Y				QAPP	
10-138	Did the SAP discuss whether the labels will contain all the information necessary for effective sample tracking as required by OAC rule 3745-54-97(D)(9)(b), including: Sample identification number?	Y				QAPP	
10-139	Name of collector?	Y				QAPP	
10-140	Date and time of collection?	Y				QAPP	
10-141	Place of collection (well or other location)?	Y				QAPP	
10-142	Parameter(s) requested?	Y				QAPP	
10-143	Preservative used?	Y				QAPP	
10-144	Did the SAP discuss whether the sample labels will remain legible even if wet?	Y				QAPP	
10-145	Does the ground water monitoring program include sampling and analytical methods that are appropriate for ground water sampling as required by OAC rule 3745-54-97(E)?	Y				RFI Work Plan SWGM Plan QAPP	
10-146	Does the ground water monitoring program include sampling and analytical methods that accurately measure hazardous constituents in the ground water as required by OAC rule 3745-54-97(E)?	Y				RFI Work Plan SWGM Plan QAPP	
10-147	Was the surface elevation measured each time ground water is sampled as required by OAC rule 3745-54-97(F)?	Y				RFI Work Plan SWGM Plan	

ion 11. Background Determinations OAC rule 3745-54-97(G)		Y/N	NA	Vio	Def	Pg	Rmk
11-1	Has data on each constituent specified in the permit/plan been collected from each background well and each well at the compliance point? OAC rule 3745-54-97(G)	Y				Lagoon Annual and Quarterly Reports RFI Reports SWGM Plan	
11-2	Are the number and kinds of samples collected to establish background appropriate for the form of statistical test employed, following generally accepted statistical principles? OAC rule 3745-54-97(G)	Y				Lagoon Annual and Quarterly Reports RFI and Baseline Risk Assessment Reports SWGM Plan, Sec. 4.0	
11-3	Is the sample size as large as necessary to ensure with reasonable confidence that a contaminant release to ground water from a facility will be detected? OAC rule 3745-54-97(G)	Y				Lagoon Annual and Quarterly Reports SWGM Plan, Sec. 3.0 and 4.0	
11-4	Has the owner/operator followed (as specified in the permit/plan) the appropriate sampling procedure and interval for each hazardous constituent listed in the facility permit? OAC rule 3745-54-97(G)		√			The facility does not have a permit, in lieu of a permit, the corrective action order serves as the enforceable document.	
11-5	Were at least four independent samples taken for each constituent from each well? OAC rule 3745-54-97(G)(1)	Y				Lagoon Annual and Quarterly Reports RFI Reports SWGM Plan, Sec. 2.0 and 3.0	
11-6	Has an alternate sampling procedure been proposed and approved in the permit/plan that takes into account the uppermost aquifer's effective porosity, hydraulic conductivity and hydraulic gradient and the fate and transport characteristics of the potential contaminants? OAC rule 3745-54-97(G)(2)	Y				Lagoon Annual and Quarterly Reports RFI Reports SWGM Plan, Sec. 2.0, 3.0, 4.0 IM/CM Report	
Section 12.	**Statistics for Part B GWM OAC rules 3745-54-97(H, I, & J)**	**Y/N**	**NA**	**Vio**	**Def**	**Pg**	**Rmk**
12-1	For each constituent in each well, was a statistical method, protective of human health and the environment, followed as specified in the permit/plan? OAC rule 3745-54-97(H)	N				SWGM Plan, Sec. 4.0 IM/CM Report, Sec. 2.0 Groundwater data will be evaluated on a site-wide basis with a trend evaluation performed on the downgradient lagoon wells. Approved methodologies in the baseline risk assessment will also be used to evaluate the data on a site-wide basis.	
12-2	Will the tests be conducted separately for each hazardous constituent in each well? OAC rule 3745-54-97(H)		√			SWGM Plan, Sec. 4.0 IM/CM Report, Sec. 2.0 Groundwater data will be evaluated on a site-wide basis with a trend evaluation performed on the downgradient lagoon wells. Approved methodologies in the baseline risk assessment will also be used to evaluate the data on a site-wide basis.	

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Section 12.	Con't. Statistics for Part B GWM OAC rules 3745-54-97(H, I, & J)	Y/N	NA	Vio	Def	Pg	Rmk
12-3	Were any PQLs proposed by the owner/operator and approved by the Director? OAC rule 3745-54-97(H)		√			SWGM Plan, Sec. 4.0 IM/CM Report, Sec. 2.0 Groundwater data will be evaluated on a site-wide basis with a trend evaluation performed on the downgradient lagoon wells. Approved methodologies in the baseline risk assessment will also be used to evaluate the data on a site-wide basis.	
12-4	Do each of the chosen statistical methods comply with the performance standards listed in OAC rule 3745-54-97(I)?		√			SWGM Plan, Sec. 4.0 IM/CM Report, Sec. 2.0 Groundwater data will be evaluated on a site-wide basis with a trend evaluation performed on the downgradient lagoon wells. Approved methodologies in the baseline risk assessment will also be used to evaluate the data on a site-wide basis.	
12-5	If a parametric ANOVA was used, did the method include estimation and testing of the contrasts between each compliance well's mean and the background mean levels for each constituent? OAC rule 3745-54-97(H)(1)		√			SWGM Plan, Sec. 4.0 IM/CM Report, Sec. 2.0 Groundwater data will be evalnated on a site-wide basis with a trend evaluation performed on the downgradient lagoon wells. Approved methodologies in the baseline risk assessment will also be used to evaluate the data on a site-wide basis.	
12-6	If ANOVA based on ranks was used, did the method include estimation and testing of the contrasts between each compliance well's median and the backgronnd median levels for each constituent? OAC rule 3745-54-97(H)(2)		√			SWGM Plan, Sec. 4.0 IM/CM Report, Sec. 2.0 Groundwater data will be evaluated on a site-wide basis with a trend evaluation performed on the downgradient lagoon wells. Approved methodologies in the baseline risk assessment will also be used to evaluate the data on a site-wide basis.	
12-7	If a tolerance/prediction intervals were used, was the interval based on the distribution of the background data and was the level of each constituent compared to the upper tolerance or prediction limit? OAC rule 3745-54-97(H)(3)		√			SWGM Plan, Sec. 4.0 IM/CM Report, Sec. 2.0 Groundwater data will be evaluated on a site-wide hasis with a trend evaluation performed on the downgradient lagoon wells. Approved methodologies in the baseline risk assessment will also be used to evaluate the data on a site-wide basis.	

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Section 12.	Con't. Statistics for Part B GWM OAC rules 3745-54-97(H, I, & J)	Y/N	NA	Vio	Def	Pg	Rmk
12-8	If control charts were used, was a control limit set for each constituent? OAC rule 3745-54-97(H)(4)		√			SWGM Plan, Sec. 4.0 IM/CM Report, Sec. 2.0 Groundwater data will be evaluated on a site-wide basis with a trend evaluation performed on the downgradient lagoon wells. Approved methodologies in the baseline risk assessment will also be used to evaluate the data on a site-wide basis.	
12-9	If another statistical test method was presented, was it approved by the Director? OAC rule 3745-54-97(H)(5)		√			SWGM Plan, Sec. 4.0 IM/CM Report, Sec. 2.0 Groundwater data will be evaluated on a site-wide basis with a trend evaluation performed on the downgradient lagoon wells. Approved methodologies in the baseline risk assessment will also be used to evaluate the data on a site-wide basis.	
12-10	Were the statistical methods chosen appropriate for the distribution of each constituent? OAC rule 3745-54-97(I)(1)		√			SWGM Plan, Sec. 4.0 IM/CM Report, Sec. 2.0 Groundwater data will be evaluated on a site-wide basis with a trend evaluation performed on the downgradient lagoon wells. Approved methodologies in the baseline risk assessment will also be used to evaluate the data on a site-wide basis.	
12-11	With the exception of tolerance, prediction intervals and control charts: Was the Type 1 experimentwise error (false positive) for individual well comparisons no less than .01 for each testing period? OAC rule 3745-54-97(I)(2)		√			SWGM Plan, Sec. 4.0 IM/CM Report, Sec. 2.0 Groundwater data will be evaluated on a site-wide basis with a trend evaluation performed on the downgradient lagoon wells. Approved methodologies in the baseline risk assessment will also be used to evaluate the data on a site-wide basis.	
12-12	Was the Type 1 experimentwise error for multiple comparisons procedures no less than .05 per period? OAC rule 3745-54-97(I)(2)		√			SWGM Plan, Sec. 4.0 IM/CM Report, Sec. 2.0 Groundwater data will be evaluated on a site-wide basis with a trend evaluation performed on the downgradient lagoon wells. Approved methodologies in the baseline risk assessment will also be used to evaluate the data on a site-wide basis.	

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Section 12.	Con't. Statistics for Part B GWM OAC rules 3745-54-97(H, I, & J)	Y/N	NA	Vio	Def	Pg	Rmk
12-18	Data distribution? OAC rule 3745-54-97(I)(4)		√			SWGM Plan, Sec. 4.0 IM/CM Report, Sec. 2.0 Groundwater data will be evaluated on a site-wide basis with a trend evaluation performed on the downgradient lagoon wells. Approved methodologies in the baseline risk assessment will also be used to evaluate the data on a site-wide basis.	
12-19	Range of concentration values for each constituent of concern? OAC rule 3745-54-97(I)(4)		√			SWGM Plan, Sec. 4.0 IM/CM Report, Sec. 2.0 Groundwater data will be evaluated on a site-wide basis with a trend evaluation performed on the downgradient lagoon wells. Approved methodologies in the baseline risk assessment will also be used to evaluate the data on a site-wide basis.	
12-20	Does the statistical method chosen for each parameter account for data below the detection limit? OAC rule 3745-54-97(I)(5)		√			SWGM Plan, Sec. 4.0 IM/CM Report, Sec. 2.0 Groundwater data will be evaluated on a site-wide basis with a trend evaluation performed on the downgradient lagoon wells. Approved methodologies in the baseline risk assessment will also be used to evaluate the data on a site-wide basis.	
12-21	If a PQL is used, is it the lowest concentration level that could reliably be achieved during routine laboratory operating procedures? OAC rule 3745-54-97(I)(5)		√			SWGM Plan, Sec. 4.0 IM/CM Report, Sec. 2.0 Groundwater data will be evaluated on a site-wide basis with a trend evaluation performed on the downgradient lagoon wells. Approved methodologies in the baseline risk assessment will also be used to evaluate the data on a site-wide basis.	
12-22	Were proper procedures employed, if necessary, to control or correct for: Seasonal variability? OAC rule 3745-54-97(I)(6)		√			SWGM Plan, Sec. 4.0 IM/CM Report, Sec. 2.0 Groundwater data will be evaluated on a site-wide basis with a trend evaluation performed on the downgradient lagoon wells. Approved methodologies in the baseline risk assessment will also be used to evaluate the data on a site-wide basis.	

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Section 12.	Con't. Statistics for Part B GWM OAC rules 3745-54-97(H, I, & J)	Y/N	NA	Vio	Def	Pg	Rmk
12-23	Spatial variability? OAC rule 3745-54-97(I)(6)		√			SWGM Plan, Sec. 4.0 IM/CM Report, Sec. 2.0 Groundwater data will be evaluated on a site-wide basis with a trend evaluation performed on the downgradient lagoon wells. Approved methodologies in the baseline risk assessment will also be used to evaluate the data on a site-wide basis.	
12-24	Temporal correlations? OAC rule 3745-54-97(I)(6)		√			SWGM Plan, Sec. 4.0 IM/CM Report, Sec. 2.0 Groundwater data will be evaluated on a site-wide basis with a trend evaluation performed on the downgradient lagoon wells. Approved methodologies in the baseline risk assessment will also be used to evaluate the data on a site-wide basis.	
12-25	Is all ground water monitoring data maintained at the facility as part of the operating record? OAC rule 3745-54-97(J)	Y				RFI Work Plan Project files are maintained at the Moraine facility and historic files are kept in a secured off-site storage location.	
12-26	Has all data been submitted to the Agency for review per the permit/plan schedule? OAC rule 3745-54-97(J)	Y				RFI Reports IM/CM Report DOCC and Supplemental DOCC	
Section 13.	**General Operating Record Requirements OAC rules 3745-54-73 (A), (B)(5&6), and 74(A&B)**	**Y/N**	**NA**	**Vio**	**Def**	**Pg**	**Rmk**
13-1	Does the plan specify that a written operating record is kept at the facility as required by OAC rule 3745-54-73(A)?	Y				RFI Work Plan QAPP Project files are maintained at the Moraine facility, GM headquarters in Troy, Michigan, and the ARCADIS Columbus, Ohio office. Historic files are kept in a secured off-site storage location.	
13-2	Will the operating record contain the results from the last three years of all inspections required under OAC rule 3745-54-15(D) as required by OAC rule 3745-54-73(B)(5)?	Y				RFI Work Plan QAPP Project files are maintained at the Moraine facility, GM headquarters in Troy, Michigan, and the ARCADIS Columbus, Ohio office. Historic files are kept in a secured off-site storage location.	

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Section 13. Con't. General Operating Record Requirements OAC rules 3745-54-73 (A), (B)(5&6), and 74(A&B)		Y/N	NA	Vio	Def	Pg	Rmk
13-3	Will all records, including plans, be furnished upon request and made available at all reasonable times for inspection by Ohio EPA as required by OAC rule 3745-54-74(A)?	Y				Project files are maintained at the Moraine facility, GM headquarters in Troy, Michigan, and the ARCADIS Columbus, Ohio office. Historic files are kept in a secured off-site storage location. Records can be furnished upon request.	
13-4	If the facility has been sold and the new owner assumed responsibility for monitoring, will the records remain onsite?		√			The facility is owned by GM.	
13-5	If the facility is closed and no data storage areas are operational, will the information be available if requested for any inspection?		√			The GM Moraine facilities are active.	
13-6	Will all records for monitoring, corrective action, and all other records be kept until closure of the facility? OAC rule 3745-54-74(B)	Y				RFI Work Plan QAPP Project files are maintained at the Moraine facility, GM headquarters in Troy, Michigan, and the ARCADIS Columbus, Ohio office. Historic files are kept in a secured off-site storage location.	
13-7	Was the record retention period extended due to enforcement action? OAC rule 3745-54-74(B)		√			There have been no enforcement actions.	
13-8	Does the plan say that the following records will be available during inspections as required by OAC rule 3745-54-73(B)(6)? Results of sampling (including lab sheets) for all required parameters according to OAC rules 3745-55-02(A&B)(2)?	Y				RFI Work Plan QAPP Project files are maintained at the Moraine facility, GM headquarters in Troy, Michigan, and the ARCADIS Columbus, Ohio office. Historic files are kept in a secured off-site storage location.	
13-9	Results of annual Appendix IX sampling events as required by OAC rule 3745-55-02(B)(4)?	Y				RFI Work Plan QAPP Project files are maintained at the Moraine facility, GM headquarters in Troy, Michigan, and the ARCADIS Columbus, Ohio office. Historic files are kept in a secured off-site storage location.	
13-10	Groundwater surface elevations taken at the time of sampling for each well? OAC rule 3745-55-02(A&B)(1)	Y				RFI Work Plan QAPP Project files are maintained at the Moraine facility, GM headquarters in Troy, Michigan, and the ARCADIS Columbus, Ohio office. Historic files are kept in a secured off-site storage location.	

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Section 13. Con't. General Operating Record Requirements OAC rules 3745-54-73 (A), (B)(5&6), and 74(A&B)		Y/N	NA	Vio	Def	Pg	Rmk
13-11	Annual determinations of groundwater flow rate and direction? OAC rule 3745-55-02(A)(3)	Y				RFI Work Plan QAPP Project files are maintained at the Moraine facility, GM headquarters in Troy, Michigan, and the ARCADIS Columbus, Ohio office. Historic files are kept in a secured off-site storage location.	
13-12	Evaluations of extent of contamination and effectiveness of corrective action? 55-01(D) or 55-02(B)(3)	Y				IM/CM Report SWGM Plan The site is not currently in corrective action per 3745-55-01 and 3745-55-02.	
13-13	All statistical comparisons for all parameters? OAC rule 3745-54-97(J) and 55-02(A)(4)	Y				IM/CM Report SWGM Plan A trend evaluation is proposed for the lagoons.	
13-14	Results of statistical comparisons for increased contamination? OAC rule 3745-55-02(B)(4)	Y				IM/CM Report SWGM Plan A trend evaluation is proposed for the lagoons.	
13-15	Results of statistical comparisons determining whether concentration limits have been exceeded? OAC rule 3745-55-02(B)(5)	Y				IM/CM Report SWGM Plan A trend evaluation is proposed for the lagoons.	
13-16	Any permit modifications related to establishing either a compliance or corrective action system that would include: Identification of any hazardous constituents identified in the ground water? OAC rule 3745-54-98(G)(4)		√			The facility does not have a permit, in lieu of a permit, the corrective action order serves as the enforceable document.	
13-17	Any proposed additions or changes to monitoring frequency, SAP procedures or methods, or statistics needed to establish either an assessment/compliance/corrective action ground water monitoring plan? OAC rule 3745-54-98(G)(4)(c)	Y				SWGM Plan Project files are maintained at the Moraine facility, GM headquarters in Troy, Michigan, and the ARCADIS Columbus, Ohio office. Historic files are kept in a secured off-site storage location.	
13-18	Any notices of intent to seek an ACL and any ACL demonstrations? OAC rule 3745-54-98(G)(4)(d)	Y				SWGM Plan Project files are maintained at the Moraine facility, GM headquarters in Troy, Michigan, and the ARCADIS Columbus, Ohio office. Historic files are kept in a secured off-site storage location.	

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Section 13. Con't. General Operating Record Requirements OAC rules 3745-54-73 (A), (B)(5&6), and 74(A&B)		Y/N	NA	Vio	Def	Pg	Rmk
13-19	Notices of intent/demonstrations that a source other than the unit caused the contamination? OAC rule 3745-54-99(I)	Y				Interim Measures Work Plans IM/CM Report Project files are maintained at the Moraine facility, GM headquarters in Troy, Michigan, and the ARCADIS Columbus, Ohio office. Historic files are kept in a secured off-site storage location.	
13-20	Any engineering feasibility plans for corrective action programs? OAC rule 3745-54-99(H)(2)	Y				IM/CM Report Project files are maintained at the Moraine facility, GM headquarters in Troy, Michigan, and the ARCADIS Columbus, Ohio office. Historic files are kept in a secured off-site storage location.	
13-21	Current SAP? OAC rule 3745-54-97(D&E)	Y				SWGM Plan Project files are maintained at the Moraine facility, GM headquarters in Troy, Michigan, and the ARCADIS Columbus, Ohio office. Historic files are kept in a secured off-site storage location.	
13-22	Current Groundwater Monitoring Plan? OAC rule 3745-54-98, 99, 55-01	Y				SWGM Plan Project files are maintained at the Moraine facility, GM headquarters in Troy, Michigan, and the ARCADIS Columbus, Ohio office. Historic files are kept in a secured off-site storage location.	
13-23	A copy of the Ground Water Protection Standard?	Y				SWGM Plan Project files are maintained at the Moraine facility, GM headquarters in Troy, Michigan, and the ARCADIS Columbus, Ohio office. Historic files are kept in a secured off-site storage location.	
13-24	Copy of field logbook or notes? OAC rule 3745-54-97(D)(4)(a)	Y				SWGM Plan Project files are maintained at the Moraine facility, GM headquarters in Troy, Michigan, and the ARCADIS Columbus, Ohio office. Historic files are kept in a secured off-site storage location.	
13-25	Chain of Custody forms? OAC rule 3745-54-97(D)(9)(a)	Y				SWGM Plan Project files are maintained at the Moraine facility, GM headquarters in Troy, Michigan, and the ARCADIS Columbus, Ohio office. Historic files are kept in a secured off-site storage location.	

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Section 14.	General Part B Reporting Requirements OAC rules 3745-54-75, 77(C), 90(A&B), and 55-02	Y/N	NA	Vio	Def	Pg	Rmk
14-1	Does the plan specify that the owner/operator will submit a copy of the annual report to the Director by March 1st?	Y				SWGM Plan, Sec. 5.0	
14-2	Will the owner/operator use the reporting form supplied by the Director?	Y				The supplemental groundwater form can be found on the OEPA web site.	
14-3	Will it contain a certification signed by the owner/operator that the report was accurate & complete? OAC 3745-54-75(J)	Y				SWGM Plan, Sec. 5.0	
14-4	Will it be complete as required by OAC rule 3745-54-75(F)?	Y				SWGM Plan, Sec. 5.0	
14-5	Does the plan specify that the 5 data files required will be accurate and complete: Facility dbf?	Y				SWGM Plan, Sec. 5.0	
14-6	Will the Wells dbf be accurate and complete?	Y				SWGM Plan, Sec. 5.0	
14-7	Will the Sampling dbf be accurate and complete?	Y				SWGM Plan, Sec. 5.0	
14-8	Will the Parameters dbf be accurate and complete?	Y				SWGM Plan, Sec. 5.0	
14-9	Will the GW Data dbf be accurate and complete?	Y				SWGM Plan, Sec. 5.0	
14-10	Will it include all the results of quarterly/semi-annual/annual sampling of indicator parameters, waste constituents or reaction products, or hazardous constituents specified in the ground water protection standard as specified in the permit/plan? OAC rule 3745-55-02(A&B)(2)	Y				SWGM Plan, Sec. 5.0	
[illegible]1	Will it include all the results of annual Appendix IX sampling required under OAC rule 3745-54-99(H) for Compliance Monitoring? OAC rule 3745-55-02(B)(4)	Y				SWGM Plan, Sec. 5.0	
14-12	Were the statistics, if any, performed correctly?		√			SWGM Plan A trend evaluation is proposed for the lagoon wells.	
14-13	Does the plan specify that the report will include results of statistical tests determining whether a significant increase has occurred over the background values for any parameter or constituent specified in the permit/plan for Detection Monitoring? OAC rule 3745-55-02(A)(4)	Y				SWGM Plan, Sec. 4.0 IM/CM Report, Sec. 2.0	
14-14	Will it include results of statistical tests determining whether a significant increase has occurred over the concentration limit for any hazardous constituent specified in the permit/plan under OAC rule 3745-55-02(B)(5)?	Y				SWGM Plan, Sec. 4.0 IM/CM Report, Sec. 2.0	
14-15	Will Chain of Custody forms be included in the Annual Report?	Y				SWGM Plan, Sec. 5.0	
14-16	Will lab sheets be included in the submittal?	Y				SWGM Plan, Sec. 5.0	
14-17	Will dilution, spike, spike recovery % be included on the lab sheets?	Y				SWGM Plan, Sec. 5.0	
14-18	Will it include any data validation issues (qualifiers) such that the information provided may not be used for compliance requirements?	Y				SWGM Plan, Sec. 5.0	
14-19	Will method codes, detection limits and units of measurement be included in the report?	Y				SWGM Plan, Sec. 5.0	
14-20	Will all sample blanks and duplicates be identified?	Y				SWGM Plan, Sec. 5.0	
14-21	Will documentation be present of any parameter omissions during any sampling event?	Y				SWGM Plan, Sec. 5.0	

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Section 14.	Con't. General Part B Reporting Requirements OAC rules 3745-54-75, 77(C), 90(A&B), and 55-02	Y/N	NA	Vio	Def	Pg	Rmk
14-22	Will the results of the evaluation of groundwater surface elevations be in map form including: Monitoring well locations in relation to the hazardous waste unit?	Y				SWGM Plan, Sec. 5.0	
14-23	Ground water surface elevations required under OAC rule 3745-54-97(F)? OAC rule 3745-55-02(A&B)	Y				SWGM Plan, Sec. 5.0	
14-24	Ground water flow rate and direction (with arrows) in the uppermost aquifer? OAC rule 3745-55-02(A&B)(3)	Y				SWGM Plan, Sec. 5.0	
14-25	Separate maps for separate zones monitored?	Y				SWGM Plan, Sec. 5.0	
14-26	A discussion of any response necessary to restore compliance with the up and downgradient monitoring well requirements?	Y				SWGM Plan, Sec. 5.0	
14-27	If ground water contamination has been determined: Were calculated or measured rates of migration included?	Y				SWGM Plan, Sec. 5.0 Baseline Risk Assessment	
14-28	Were supporting calculations submitted?	Y				SWGM Plan, Sec. 5.0	
14-29	Were there maps correctly delineating the extent of contamination?	Y				SWGM Plan, Sec. 5.0	
14-30	Were there separate maps for each zone monitored?	Y				SWGM Plan, Sec. 5.0	
14-31	Were there separate maps for each sampling event?	Y				SWGM Plan, Sec. 5.0	
14-32	Will all other reports otherwise required by OAC rules 3745-54-90 through 55-02 be submitted, complete and accurate, as required by OAC rule 3745-54-77(C)?	Y				SWGM Plan, Sec. 5.0	
14-33	Did the owner/operator submit an land treatment exemption request from GWM and demonstration due to OAC rule 3745-54-90(B)(3)?		√			GM did not submit an exemption request.	
14-34	Did the owner/operator submit an exemption request from GWM and demonstration due to no migration as specified in OAC rule 3745-54-90(B)(4)?		√			GM did not submit an exemption request.	
14-35	Did the owner/operator submit an exemption request from GWM and demonstration due to OAC rule 3745-54-90(B)(5)?		√			GM did not submit an exemption request.	
Section 15.	**Part B Operations & Maintenance Requirements (OAC rule 3745-54-15 & 54-33(B))**	**Y/N**	**NA**	**Vio**	**Def**	**Pg**	**Rmk**
15-1	Does the plan specify that the owner/operator will inspect the facility for malfunctions and deteriorations of monitoring equipment? OAC rule 3745-54-15(A)	Y				SWGM Plan, Sec. 5.0 RFI Work Plans	
15-2	Does the plan specify that these inspections will be conducted with such regularity as to be able to identify problems in time to correct them before such problems harm human health or the environment? OAC rule 3745-54-15(A)	Y				SWGM Plan, Sec. 5.0	
15-3	Does the plan include a written schedule for inspecting monitoring equipment? OAC rule 3745-54-15(B)(1)	Y				QAPP	
15-4	Does the written schedule contain an inventory of any facility-owned sampling and purging equipment including information on model/serial numbers used as part of the monitoring program? OAC rule 3745-54-15(B)(1)		√			The facility does not own the equipment. ARCADIS will maintain and inspect all equipment.	
15-5	Does the plan contain detailed operating, calibration, and maintenance procedures and schedules for each sampling device? OAC rule 3745-54-15(B)(1)	Y				QAPP	

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Section 15. Con't. Part B Operations & Maintenance Requirements (OAC rule 3745-54-15 & 54-33(B))		Y/N	NA	Vio	Def	Pg	Rmk
15-6	Does the plan specify that the schedule will be kept at the facility and be available for review during the inspection? OAC rule 3745-54-15(B)(2)	Y				SWGM Plan, Sec. 5.0 QAPP	
15-7	Does the plan specify that the schedule will identify the types of problems (malfunctions or deterioration) to be looked for during the inspection? OAC rule 3745-54-15(B)(3)	Y				QAPP	
15-8	Is the frequency of the inspections based on possible equipment deterioration rates? OAC rule 3745-54-15(B)(4)	N				Regular equipment inspections will be conducted regardless of the age of the equipment.	
15-9	Does the plan include decision criteria to be used to replace or repair sampling equipment and/or monitoring wells? OAC rule 3745-54-15(B)(4)	Y				Only equipment that is in good working order will be brought to the site. Visual observations on monitoring well conditions will be made during each sampling event.	
15-10	Does the plan specify that the owner/operator will keep a log or summary of these inspections? OAC rule 3745-54-15(D)	Y				QAPP	
15-11	Does the plan specify that these logs will be kept for 3 years from the date of the inspection? OAC rule 3745-54-15(D)	Y				QAPP	
15-12	Does the plan specify that these logs will include: OAC rule 3745-54-15(D) and OAC rule 3745-54-33(B) Date and time of inspection?	Y				QAPP	
15-13	Name of the inspector? OAC rule 3745-54-15(D) and OAC rule 3745-54-33(B)	Y				QAPP	
15-14	Notation of observations? OAC rule 3745-54-15(D) and OAC rule 3745-54-33(B)	Y				QAPP	
15-15	Date and nature of any repairs or remedial actions? OAC rule 3745-54-15(D) and OAC rule 3745-54-33(B)	Y				QAPP	

SWGM Plan – Site-Wide Groundwater Monitoring Plan
IM/CM Report – Interim Measures/Corrective Measures Report
RFI Report – RCRA Facility Investigation Report
QAPP – Quality Assurance Project Plan
DOCC – Description of Current Condition
SOP – Standard Operating Procedures

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Section 12.	Con't. Statistics for Part B GWM OAC rules 3745-54-97(H, I, & J)	Y/N	NA	Vio	Def	Pg	Rmk
12-13	If multiple well comparisons were used, were the individual well comparisons maintained at .01 experimentwise error for each testing period? OAC rule 3745-54-97(I)(2)		√			SWGM Plan, Sec. 4.0 IM/CM Report, Sec. 2.0 Groundwater data will be evaluated on a site-wide basis with a trend evaluation performed on the downgradient lagoon wells. Approved methodologies in the baseline risk assessment will also be used to evaluate the data on a site-wide basis.	
12-14	If a control chart was used, was the specific type of control chart and its associated parameters specified in the permit/plan? OAC rule 3745-54-97(I)(3)		√			SWGM Plan, Sec. 4.0 IM/CM Report, Sec. 2.0 Groundwater data will be evaluated on a site-wide basis with a trend evaluation performed on the downgradient lagoon wells. Approved methodologies in the baseline risk assessment will also be used to evaluate the data on a site-wide basis.	
12-15	If tolerance intervals were used, was the percentage of population contained in the interval protective of human health and the environment? OAC rule 3745-54-97(I)(3)		√			SWGM Plan, Sec. 4.0 IM/CM Report, Sec. 2.0 Groundwater data will be evaluated on a site-wide basis with a trend evaluation performed on the downgradient lagoon wells. Approved methodologies in the baseline risk assessment will also be used to evaluate the data on a site-wide basis.	
12-16	If prediction intervals were used, were confidence levels protective of human health and the environment? OAC rule 3745-54-97(I)(4)		√			SWGM Plan, Sec. 4.0 IM/CM Report, Sec. 2.0 Groundwater data will be evaluated on a site-wide basis with a trend evaluation performed on the downgradient lagoon wells. Approved methodologies in the baseline risk assessment will also be used to evaluate the data on a site-wide basis.	
12-17	Were the intervals based on: Number of samples in the background database? OAC rule 3745-54-97(I)(4)		√			SWGM Plan, Sec. 4.0 IM/CM Report, Sec. 2.0 Groundwater data will be evaluated on a site-wide basis with a trend evaluation performed on the downgradient lagoon wells. Approved methodologies in the baseline risk assessment will also be used to evaluate the data on a site-wide basis.	

Guidance Checklist for Detection GW Monitoring under OAC rule 3745-54-98

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Guidance Checklist for Part B Detection Monitoring Program: OAC rule 3745-54-98

ction 1. Parameters - OAC rule 3745-54-98(A)

		Y/N	NA	Vio	Def	Pg	Rmk
1-1	Does the plan indicate that the facility will be monitoring for all the indicator parameters, waste constituents and reaction products that will provide a reliable indication of the presence of hazardous constituents in the ground water based on: types/quantities/concentrations of constituents in wastes managed at the regulated unit? OAC rule 3745-54-98(A)(1)	Y				SWGM Plan Sec. 1.0, 2.0, 3.0, 4.0 IM/CM Report Sec. 2.0 RFI and Baseline Risk Assessment Reports Based on the findings of the RFI and Baseline Risk Assessment, monitoring will be conducted for the site-specific VOCs, which are appropriate parameters for evaluating potential releases on a site-wide basis.	
1-2	Mobility, stability, and persistence of waste constituents or their reaction products in the unsaturated zone beneath the waste management area? OAC rule 3745-54-98(A)(2)	Y				Closure Plan RFI and Baseline Risk Assessment Reports The waste is now solidified per the reqnirements of the Closure Plan.	
1-3	Detectability of indicator parameters/waste constituents/reaction products? OAC rule 3745-54-98(A)(3)	Y				SWGM Plan Sec. 1.0, 2.0, 3.0 IM/CM Report Sec. 2.0 RFI and Baseline Risk Assessment Reports The groundwater COCs have been fully delineated based on 18 years of lagoon monitoring and 10 years of corrective action monitoring. The COCs in groundwater are VOCs. The lagoon point of compliance wells are properly located to detect a release.	
1-4	Concentrations of values and coefficients of variation of proposed monitoring parameters or constituents in the ground water background? OAC rule 3745-54-98(A)(4)	Y				SWGM Plan Sec. 3.0 IM/CM Report Sec. 2.0 RFI and Baseline Risk Assessment Reports The site-specific parameter list appropriately includes VOCs as the upgradient COCs.	
1-5	Have all of these parameters been specified in the permit/plan? OAC rule 3745-54-98(A)	Y				SWGM Plan Sec. 1.0, 2.0, 3.0 IM/CM Report Sec. 2.0 The site-specific parameter list is defined in the SWGM Plan.	

Section 2. Wells OAC rule 3745-54-98(B)

		Y/N	NA	Vio	Def	Pg	Rmk
2-1	Does the plan include a monitoring system with wells installed at the compliance point?	Y				SWGM Plan Sec. 3.0 The wells include W-2-N, W-3-N, and W-4-N for the North Settling Lagoon and W-2-S, W-3-S, and W-4-S for the Sonth Settling Lagoon.	

Guidance Checklist for Detection GW Monitoring under OAC rule 3745-54-98

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Section 2. Con't. Wells OAC rule 3745-54-98(B)		Y/N	NA	Vio	Def	Pg	Rmk
2-2	Will the wells provide representative samples for water passing the compliance point?	Y				SWGM Plan IM/CM Report Sec. 2.0 RFI and Baseline Risk Assessment Reports Yes, if the data is evaluated on a site-wide basis.	
2-3	Does the plan specify how the wells will be properly maintained?	Y				SWGM Plan Sec. 3.0	
Section 3. Background Frequency of Sampling and Analysis OAC rule 3745-54-98(C&D)		**Y/N**	**NA**	**Vio**	**Def**	**Pg**	**Rmk**
3-1	Does the plan specify that records will be maintained of analytical/statistical/elevation data? OAC rule 3745-54-98(C)	Y				QAPP The site-wide QAPP details document holding times. Project files are maintained at the facility and historic files are kept in a secured off-site storage location.	
3-2	Does the permit/plan specify an appropriate ground water monitoring system be used to establish background values for each parameter including number and type of samples for each hazardous constituent appropriate for the statistical test employed? OAC rule 3745-54-98(D)	Y				SWGM Plan Sec. 3.0, 4.0 IM/CM Report Sec. 2.0 A trend evaluation is proposed for the lagoon wells.	
3-3	Does the permit/plan specify that a sequence of at least four samples from each well (background and compliance wells) must be collected at least semi-annually during detection monitoring? OAC rule 3745-54-98D	N				SWGM Plan Sec. 3.0, 4.0 IM/CM Report Sec. 2.0 The lagoon point of compliance wells will be sampled on an annual basis for the site-specific parameters.	
3-4	Or did the plan specify another sampling frequency to be approved by the Director? OAC rule 3745-54-98(D)	Y				SWGM Plan Sec. 3.0 IM/CM Report Sec. 2.0 Annual sampling is proposed.	
3-5	Does it specify that four samples will be collected at intervals assuring independence relative to the uppermost aquifer's effective porosity/hydraulic conductivity/gradient/fate/transport of contaminants? OAC rule 3745-54-98(D)	N				SWGM Plan Sec. 3.0 IM/CM Report Sec. 2.0 The lagoon point of compliance wells will be sampled on an annual basis for the site-specific parameters. However, historically data was collected quarterly for the North Settling Lagoon and semi-annually for the South Settling Lagoon.	
3-6	Does the plan specify the frequency for collection of all ground water samples? OAC rule 3745-54-98(D)	Y				SWGM Plan Sec. 3.0 IM/CM Report Sec. 2.0 Annual sampling is proposed.	
3-7	Does the plan specify the frequency for conducting statistical tests? OAC rule 3745-54-98(D)	Y				SWGM Plan Sec. 3.0, 4.0 IM/CM Report Sec. 2.0 A trend evaluation will be performed on the data on an annual basis.	

Section 4. Sampling & Analysis Procedures OAC rules 3745-54-98(E&F)		Y/N	NA	Vio	Def	Pg	Rmk
4-1	Did the permit/plan include a documentation of proper sampling and analysis procedures including procedures and techniques for measuring ground water elevations according to OAC rule3745-54-97(D)?	Y				RFI Work Plans QAPP SWGM Plan Sec. 3.0 The groundwater monitoring program will be conducted following approved RFI protocols.	
4-2	Was the surface elevation to be measured each time ground water is sampled?	Y				SWGM Plan Sec. 3.0	
4-3	Did the permit/plan contain procedures for determining the ground water flow rate and direction at least annually in the uppermost aquifer? OAC rule 3745-54-98(E)	Y				SWGM Plan Sec. 3.0	
4-4	Did the plan specify that the ground water flow rate and direction in the uppermost aquifer would be determined at least annually? OAC rule 3745-54-98(E)	Y				SWGM Plan Sec. 3.0	
4-5	Did the permit/plan include methods for determining statistically significant increases for any monitored parameter specified in the permit/plan? OAC rule 3745-54-98(F)	N				SWGM Plan Sec. 4.0 IM/CM Report Sec. 2.0 A trend evaluation is proposed for the lagoon point of compliance wells.	
4-6	Did these methods compare data collected at the compliance point to the background well quality? OAC rule 3745-54-98(F)(1)	N				SWGM Plan Sec. 4.0 IM/CM Report Sec. 2.0 Comparison of upgradient versus downgradient groundwater quality is not appropriate without also evaluating site-wide conditions.	
4-7	Did the plan specify whether determinations of statistical significance are to be made within a reasonable period of time considering the complexity of the statistical test & the availability of labs to perform the analysis? OAC rule 3745-54-98(F)(2)	Y				SWGM Plan Sec. 4.0, 5.0 The trend evaluation will be completed in time to meet the March 1st deadline for the annual report.	
Section 5. Statistical Determinations and Response OAC rules 3745-54-98(E&F)		**Y/N**	**NA**	**Vio**	**Def**	**Pg**	**Rmk**
5-1	Does the plan specify what actions the owner/operator will take if hazardous constituents at any compliance point well show statistically significant evidence of contamination?	Y				SWGM Plan Sec. 4.0 IM/CM Report Sec. 2.0 If the closed lagoons are determined to be affecting groundwater quality, such effects will be evaluated as part of GM's comprehensive site-wide RCRA corrective action monitoring program on an annual basis. Consideration will be given to the need for further action for the lagoon(s) pursuant to OAC 3745-55-11 and - 011.	

Section 5. Con't. Statistical Determinations and Response OAC rules 3745-54-98(E&F)		Y/N	NA	Vio	Def	Pg	Rmk
5-2	Does this include a written notice sent to the Director within seven days indicating which chemical parameter(s) or hazardous constituent(s)(s) have shown statistically significant evidence of contamination? OAC rule 3745-54-98(G)(1)	N				SWGM Plan Sec. 4.0, 5.0 IM/CM Report Sec. 2.0 Upon completion of data validation, the data evaluation will be conducted. If the data evaluation process concludes there is a concern, OEPA will be notified. Historical data at the lagoon point of compliance wells do not indicate this will be an issue.	
5-3	Does it include whether all wells will be immediately sampled for all Appendix IX constituents? OAC rule 3745-54-98(G)(2)	N				SWGM Plan Sec. 4.0, 5.0 IM/CM Report Sec. 2.0 Immediate resampling will be negotiated with OEPA after the data evaluation is complete.	
5-4	Does it include what the owner/operator will do if any compounds in Appendix IX are found during the resampling? OAC rule 3745-54-98(G)(3)	N				SWGM Plan Sec. 4.0, 5.0 IM/CM Report Sec. 2.0 The site-specific parameter list will be used for all groundwater sampling events.	
5-5	Does it include whether the owner/operator will resample those wells for those parameters within 1 month? OAC rule 3745-54-98(G)(3)	N				SWGM Plan Sec. 4.0, 5.0 IM/CM Report Sec. 2.0 Immediate resampling will be negotiated with OEPA after the data evaluation is complete.	
5-6	Does it include what actions the owner/operator will perform if the second analysis confirms the initial results?	N				SWGM Plan Sec. 4.0, 5.0 IM/CM Report Sec. 2.0 If the closed lagoons are determined to be affecting groundwater quality, such effects will be evaluated as part of GM's comprehensive site-wide RCRA corrective action monitoring program on an annual basis. Consideration will be given to the need for further action for the lagoon(s) pursuant to OAC 3745-55-11 and - 011.	
5-7	Does that plan specify that all of the confirmed Appendix IX parameters will be incorporated into the compliance monitoring parameter list? OAC rule 3745-54-98(G)(3)	N				SWGM Plan Sec. 4.0, 5.0 IM/CM Report Sec. 2.0 GM will assess the need to modify the number of wells that are sampled and the parameter list on an annual basis.	

ection 5. Con't. Statistical Determinations and Response OAC rules 3745-54-98(E&F)		Y/N	NA	Vio	Def	Pg	Rmk
5-8	Does it also specify that if the owner/operator does not resample for Appendix IX parameters within 1 month, that the list of detected parameters from the first Appendix IX sampling will form the basis for the compliance ground water monitoring parameter list? OAC rule 3745-54-98(G)(3)	Y				SWGM Plan Sec. 4.0 and 5.0 IM/CM Report Sec. 2.0 The site-specific parameter list will be used for all groundwater sampling events. Additionally, GM will assess the need to modify the number of wells that are sampled and the parameter list on an annual basis.	
5-9	Does the plan specify that the owner/operator shall submit an application for a permit modification to the Director within 90 days of the original statistical trigger to establish a compliance ground water monitoring program? OAC rule 3745-54-98(G)(4)		√			The facility does not have a permit. In lieu of a permit, the enforceable document is the corrective action order.	
5-10	Does the plan specify that the permit modification application will include: Identification of the concentration of any constituent listed in Appendix IX detected in the ground water at each monitoring well at the compliance point? OAC rule 3745-54-98(G)(4)(a)		√			The facility does not have a permit. In lieu of a permit, the enforceable document is the corrective action order.	
5-11	Does the plan specify that the permit modification application will include any proposed changes to the ground water monitoring system necessary to meet the requirements a Compliance Ground Water Monitoring Program according to OAC rule 3745-54-99? OAC rule 3745-54-98(G)(4)(b)		√			The facility does not have a permit. In lieu of a permit, the enforceable document is the corrective action order.	
5-12	Does the plan specify that the permit modification application will include any proposed changes to the monitoring frequency, sampling, analysis procedures, or statistical method necessary to meet the requirements of a Compliance Monitoring Program according to OAC rule 3745-54-99? OAC rule 3745-54-98(G)(4)(c)		√			The facility does not have a permit. In lieu of a permit, the enforceable document is the corrective action order. GM will assess the need to modify the number of wells that are sampled and the parameter list on an annual basis.	
5-13	Does the plan specify that the permit modification application will include a proposed concentration limit (or notice of intent to seek an alternate concentration limit) for each hazardous constituent detected at the compliance point? OAC rule 3745-54-98(G)(4)(d)		√			The facility does not have a permit. In lieu of a permit, the enforceable document is the corrective action order. The corrective action completion strategy and remediation target levels are defined in the IM/CM Report and the SWGM Plan.	
5-14	Does the plan specify that within 180 days of the initial detection, the owner/operator will submit to the Director all data necessary to justify an ACL if one is to be sought? OAC rule 3745-54-98(G)(5)(a)	Y				SWGM Plan Sec. 5.0 Any proposed changes to the risk-based remediation target levels will be included in the annual report due on March 1st.	
5-15	Does the plan specify that if an ACL is to be sought whether each constituent that has an MCL has concentrations below that MCL? OAC rule 3745-54-98(G)(5)(b)(i)	N				SWGM Plan Sec. 4.0, 5.0 IM/CM Report Sec. 2.0 The corrective action completion strategy and risk-based remediation target levels are currently proposed.	
5-16	Does the plan specify if an ACL is to be sought whether the owner/operator applied for an ACL for every hazardous constituent identified during the Appendix IX sampling? OAC rule 3745-54-98(G)(5)(b)(ii)	N				SWGM Plan Sec. 5.0 IM/CM Report Sec. 2.0 Risk-based remediation target levels are proposed for the site-specific parameter list.	

ction 5. Con't. Statistical Determinations and Response OAC rules 3745-54-98(E&F)		Y/N	NA	Vio	Def	Pg	Rmk
5-17	Does the plan specify that if either of the last two questions were answered "NO", that an engineering feasibility plan for corrective action shall be submitted within 180 days of the initial detection ? OAC rule 3745-54-98(G)(5)(b)	N				SWGM Plan Sec. 5.0 IM/CM Report Sec. 2.0 If the closed lagoons are determined to be affecting groundwater quality, such effects will be evaluated as part of GM's comprehensive site-wide RCRA corrective action monitoring program on an annual basis. Consideration will be given to the need for further action for the lagoon(s) pursuant to OAC 3745-55-11 and - 011.	
5-18	Does the plan specify that the owner/operator may chose to make a demonstration that a source other than the regulated unit caused the contaminatiou or that the detection resulted from sampling, lab error, statistical evaluation or natural variation in the ground water? (Other Source Demonstration) OAC rule 3745-54-98(G)(6)	Y				SWGM Plan Sec. 4.0 IM/CM Report Sec. 2.0 The data will be assessed on a site-wide basis.	
5-19	Does the plan specify that the owner/operator may chose to make such a demonstration either in lieu of a permit modification or in addition to a permit modification? OAC rule 3745-54-98(G)(6)		√			The facility does not have a permit. In lieu of a permit, the enforceable document is the corrective action order.	
5-20	Does the plan specify that the Director will be notified that the owner/operator intends to make Another Source demonstration within 7 days of determining statistically significant evidence of contamination at the compliance point? OAC rule 3745-54-98(G)(6)(a)	N				SWGM Plan Sec. 4.0, 5.0 IM/CM Report Sec. 2.0 The annual sampling will be conducted in the fall and the data evaluation process completed in time to meet the March 1st deadline. This evaluation will include a site-wide assessment of groundwater quality and source areas.	
5-21	Does the plan specify that within 90 days of the confirmed statistical trigger, if the owner/operator intends to make Another Source demonstration he must submit a report to the Director demonstrating **successfully** that a source other than the regulated unit caused the contamination and that the demonstration may be based on an error in sampling? OAC rule 3745-54-98(G)(6)(b)	N				SWGM Plan Sec. 4.0, 5.0 IM/CM Report Sec. 2.0 The annual sampling will be conducted in the fall and the data evaluation process completed in time to meet the March 1st deadline. This evaluation will include a site-wide assessment of groundwater quality and source areas. A treud evaluation will be conducted on the lagoon point of compliance wells.	
5-22	Or error in lab analysis ? OAC rule 3745-54-98(G)(6)(b)	N				SWGM Plan Sec. 4.0, 5.0 QAPP Data validation will be performed on all data packages in accordance with the QAPP.	

Guidance Checklist for Detection GW Monitoring under OAC rule 3745-54-98

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ction 5.	Con't. Statistical Determinations and Response OAC rules 3745-54-98(E&F)	Y/N	NA	Vio	Def	Pg	Rmk
5-23	Or error in statistical evaluation? OAC rule 3745-54-98(G)(6)(b)	N				SWGM Plan Sec. 4.0, 5.0 IM/CM Report Sec. 2.0 The annual sampling will be conducted in the fall and the data evaluation process completed in time to meet the March 1st deadline. This evaluation will include a site-wide assessment of groundwater quality and source areas. A trend evaluation will be conducted on the lagoon point of compliance wells.	
5-24	Or natural variability in the ground water quality? OAC rule 3745-54-98(G)(6)(b)	N				SWGM Plan Sec. 4.0, 5.0 IM/CM Report Sec. 2.0 The annual sampling will be conducted in the fall and the data evaluation process completed in time to meet the March 1st deadline. This evaluation will include a site-wide assessment of groundwater quality and source areas. A trend evaluation will be conducted on the lagoon point of compliance wells.	
5-25	Does the plan specify that if the demonstration is not successful, a permit modification shall be submitted to make any changes in the Detection ground water monitoring program necessary to bring it back into compliance within the required 90 days? OAC rule 3745-54-98(G)(6)(c)		√			The facility does not have a permit. In lieu of a permit, the enforceable document is the corrective action order.	
5-26	Does the plan specify that throughout this period the owner/operator shall continue detection monitoring according to OAC rule 3745-54-98(G)(6)(d)?	Y				SWGM Plan Sec. 4.0, 5.0 IM/CM Report Sec. 2.0 Groundwater monitoring will be implemented for a minimum of 30 years, unless otherwise demonstrated that no further monitoring is warranted.	
5-27	Does the plan specify that if at any point the owner/operator determines that the detection monitoring program is not satisfying the regulations, that he/she will submit a permit modification to the Director within 90 days to make appropriate changes? OAC rule 3745-54-98(H)		√			The facility does not have a permit. In lieu of a permit, the enforceable document is the corrective action order.	
Section 6.	**Detection Reporting & Recordkeeping Requirements for Part B GWM OAC rules 3745-55-01(A&C)**	**Y/N**	**NA**	**Vio**	**Def**	**Pg**	**Rmk**
6-1	Does the plan specify that the owner/operator will keep records of the ground water monitoring information required by the detection monitoring program outlined in OAC rule 3745-54-98?	Y				SWGM Plan Sec. 5.0 QAPP Project files are maintained at the facility, GM headquarters in Troy, MI, and the ARCADIS Columbus, OH office. Historic files are kept in a secured off-site storage location.	
6-2	Will records be kept of: Ground water elevations under OAC rule 3745-54-97(F)? OAC rule 3745-55-02(A)(1)	Y				SWGM Plan Sec. 5.0 QAPP	
6-3	Semi-annual sampling results as required by OAC rule 3745-54-98(A)? OAC rule 3745-55-02(A)(2)	Y				SWGM Plan Sec. 5.0 QAPP	

Guidance Checklist for Detection GW Monitoring under OAC rule 3745-54-98

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...ction 6.	Con't. Detection Reporting & Recordkeeping Requirements for Part B GWM OAC rules 3745-55-01(A&C)	Y/N	NA	Vio	Def	Pg	Rmk
6-4	Ground water flow rate & direction in the uppermost aquifer as required by OAC rule 3745-54-98(E)? OAC rule 3745-55-02(A)(3)	Y				SWGM Plan Sec. 5.0 QAPP	
6-5	Results of statistical tests as required by OAC rule 3745-54-98(G)? OAC rule 3745-55-02(A)(4)	Y				SWGM Plan Sec. 4.0, 5.0 IM/CM Report Sec. 2.0 QAPP	
6-6	Did the plan specify that an annual report would be submitted as required by OAC rule 3745-54-75 including all the above information in the form the Director makes available? OAC rule 3745-55-02(C)	Y				SWGM Plan Sec. 5.0	
6-7	Did the plan specify that the annual report would be submitted to the Director by March 1st of the following year? OAC rule 3745-54-75 & 3745-55-02(C)	Y				SWGM Plan Sec. 5.0	

SWGM Plan – Site-Wide Groundwater Monitoring Plan
IM/CM Report – Interim Measures/Corrective Measures Report
RFI Report – RCRA Facility Investigation Report
QAPP – Quality Assurance Project Plan

Appendix C

Boring Logs and Well Construction Logs for the Lagoon Wells

LOG OF BORING NO. W-2-N

GROUNDWATER MONITORING WELLS, HARRISON RADIATOR, DAYTON OPERATIONS, MORAINE, OHIO

BORING LOCATION: As shown on boring location plan

DATE STARTED: 9-22-81

SURFACE ELEVATION: 729.68'

DATE COMPLETED: 9-22-81

STRATUM	DESCRIPTION OF MATERIAL	SAMPLE NO. & TYPE	SAMPLE DEPTH	BLOWS PER 6" ON SAMPLER	"N" BLOWS /FT. OR CORE REC.
0.0'	(FILL) Asphalt and base				
1.0'	(FILL) Brown silt and sand, some gravel - moist				
7.0'	(ORIGINAL) Brown sand and gravel - moist				
10'					
20'					
30'	(Becomes wet at 32.0')				
40'					
50'					
60'					

(continued on next page)

METHOD: DRIVE CASING

TECHNICIAN: BARRETT

JOB NO.: 26418 (kab)

WATER OBSERVATIONS

INITIAL DEPTH: 32.0'

COMPLETION DEPTH: 32.0'

DEPTH AFTER: 24 HRS. 32.0'

TYPE SAMPLER:

A. SPLIT SPOON

B.

C. SHELBY TUBE

BOWSER – MORNER
TESTING LABORATORIES, INC.

LOG OF BORING NO. W-2-N (second page)

GROUNDWATER MONITORING WELLS, HARRISON RADIATOR, DAYTON OPERATIONS, MORAINE, OHIO

BORING LOCATION As shown on boring location paln

DATE STARTED: 9-22-81

SURFACE ELEVATION: 729.68'

DATE COMPLETED: 9-22-81

STRATUM	DESCRIPTION OF MATERIAL	SAMPLE NO. & TYPE	SAMPLE DEPTH	BLOWS PER 6" ON SAMPLER	"N" BLOWS /FT. OR CORE REC.
60'	(continued)				
	Bottom of borin at 60.0'				
70'					
80'					
90'					
100'					
110'					
120'					

METHOD: DRIVE CASING

TECHNICIAN: BARRETT

JOB NO.: 26418 (kab)

WATER OBSERVATIONS

INITIAL DEPTH: 32.0'

COMPLETION DEPTH: 32.0'

DEPTH AFTER: 24 HRS. 32.0'

TYPE SAMPLER:

A. SPLIT SPOON

B.

C. SHELBY TUBE

BOWSER – MORNER
TESTING LABORATORIES, INC.

LOG OF WELL NO. W-2-N

GROUNDWATER MONITORING WELLS, HARRISON RADIATOR,
DAYTON OPERATIONS, MORAINE, OHIO

BORING LOCATION: As shown on boring location plan
DATE INSTALLED: 9-22-81

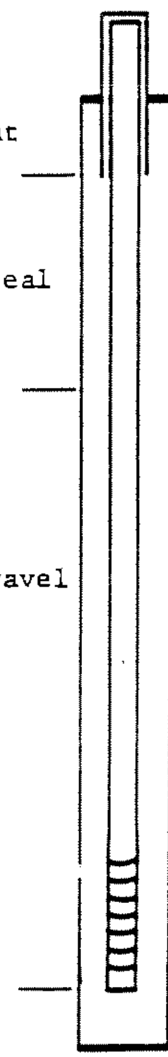
SURFACE ELEVATION: 729.68'
TOP OF PIPE ELEVATION: 731.77'*

TYPE OF PIEZOMETER: Monitoring Well - 4" Schedule 40 PVC Casing

DATE	WATER SURFACE DEPTH (FT.)	WATER SURFACE ELEV. (FT.)	
9-28-81	32.0	697.7	
10-5-81	32.7	697.0	

INSTALLATION DESCRIPTION

DESCRIPTION	DEPTH (FT.)
	2.1'
	0.0'
Cement Grout	3.0'
Bentonite Seal	13.0'
Sand and Gravel	35.0'
	60.0'
	60.0'



TECHNICIAN BARRETT

JOB NO. 26418

NOTES: PVC screen length - 25 feet
Screen slot size - 0.010 inches
Guard pipe - 5" x 4' 2" black iron with locking cap
*Elevation given is top of guard pipe without cap

LOG OF BORING NO. W-3-N

GROUNDWATER MONITORING WELLS, HARRISON RADIATOR, DAYTON OPERATIONS, MORAINE, OHIO

BORING LOCATION: As shown on boring location plan

DATE STARTED: 9-8-81

SURFACE ELEVATION: 731.98'

DATE COMPLETED: 9-9-81

STRATUM	DESCRIPTION OF MATERIAL	SAMPLE NO. & TYPE	SAMPLE DEPTH	BLOWS PER 6" ON SAMPLER	"N" BLOWS /FT. OR CORE REC.
0.0'	Brown silt, trace of sand, trace of gravel - damp				
2.0'	Brown sand and gravel, trace of silt - damp				
10'					
20'					
	(Becomes wet at 25.5')				
30'					
40'					
50'					
60'	Bottom of boring at 57.0'				

METHOD: HOLLOW STEM AUGER

TECHNICIAN: CHRISTY

JOB NO.: 26418 (kab)

WATER OBSERVATIONS

INITIAL DEPTH: 25.5'

COMPLETION DEPTH: 25.5'

DEPTH AFTER 24 HRS. 26.0'

TYPE SAMPLER:

____ A. SPLIT SPOON

____ B.

____ C. SHELBY TUBE

BOWSER – MORNER

TESTING LABORATORIES, INC.

LOG OF WELL NO. W-3-N

GROUNDWATER MONITORING WELLS, HARRISON RADIATOR,
DAYTON OPERATIONS, MORAINE, OHIO

BORING LOCATION: As shown on boring location plan
DATE INSTALLED: 9-9-81

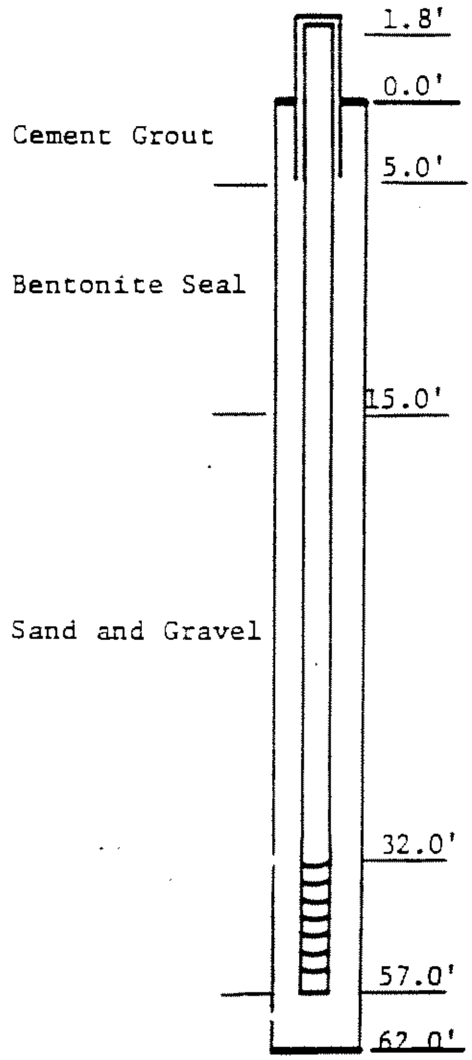
SURFACE ELEVATION: 731.98'
TOP OF PIPE ELEVATION: 733.82' *

TYPE OF PIEZOMETER:

DATE	WATER SURFACE DEPTH (FT.)	WATER SURFACE ELEV. (FT.)	
9-9-81	25.5	706.5	
9-10-81	26.0	706.0	
10-5-81	35.1	696.9	

INSTALLATION DESCRIPTION

DESCRIPTION — DEPTH (FT.)



TECHNICIAN CHRISTY

JOB NO. 26418

NOTES: PVC screen length - 25 feet
Screen slot size - 0.010 inches
Guard pipe - 5" x 4' 2" black iron with locking cap
*Elevation given in top of guard pipe without cap

LOG OF BORING NO. W-4-N

GROUNDWATER MONITORING WELLS, HARRISON RADIATOR, DAYTON OPERATIONS, MORAINE, OHIO

BORING LOCATION: As shown on boring location plan **DATE STARTED:** 9-10-81

SURFACE ELEVATION: 729.88' **DATE COMPLETED:** 9-10-81

STRATUM	DESCRIPTION OF MATERIAL	SAMPLE NO. & TYPE	SAMPLE DEPTH	BLOWS PER 6" ON SAMPLER	"N" BLOWS /FT. OR CORE REC.
0.0'	(FILL) Brown sand and gravel, some silt				
2.0'	(FILL) Brown clay, trace of sand, trace of gravel				
3.0'	(ORIGINAL) Brown sand and gravel, some cobbles, trace of silt				
10'					
20'					
30'	(Becomes wet at 32.0')				
40'					
50'					
60'	(continued on next page)				

METHOD: HOLLOW STEM AUGER

TECHNICIAN: CHRISTY

JOB NO.: 26418 (kab)

WATER OBSERVATIONS

INITIAL DEPTH: 32.0'

COMPLETION DEPTH: 26.5'

DEPTH AFTER: 24 HRS. 32.3'

TYPE SAMPLER:

A. SPLIT SPOON

B.

C. SHELBY TUBE

BOWSER – MORNER
TESTING LABORATORIES, INC.

LOG OF BORING NO. W-4-N (second page)

GROUNDWATER MONITORING WELLS, HARRISON RADIATOR, DAYTON OPERATIONS, MORAINE, OHIO

BORING LOCATION: As shown on boring location plan

DATE STARTED: 9-10-81

SURFACE ELEVATION: 729.88'

DATE COMPLETED: 9-10-81

STRATUM	DESCRIPTION OF MATERIAL	SAMPLE NO. & TYPE	SAMPLE DEPTH	BLOWS PER 6" ON SAMPLER	"N" BLOWS /FT. OR CORE REC.
60'	(continued)				
61.0'	Gray silt and clay - moist				
62.0'	Brown sand and gravel, trace of silt				
	Bottom of boring at 65.0'				
70'					
80'					
90'					
100'					
110'					
120'					

METHOD: HOLLOW STEM AUGER

TECHNICIAN: CHRISTY

JOB NO.: 26418 (kab)

WATER OBSERVATIONS

INITIAL DEPTH: 32.0'

COMPLETION DEPTH: 26.5'

DEPTH AFTER: 24 HRS. 32.3'

TYPE SAMPLER:

A. SPLIT SPOON

B.

C. SHELBY TUBE

BOWSER – MORNER
TESTING LABORATORIES, INC.

LOG OF WELL NO. W-4-N

GROUNDWATER MONITORING WELLS, HARRISON RADIATOR,
DAYTON OPERATIONS, MORAINE, OHIO

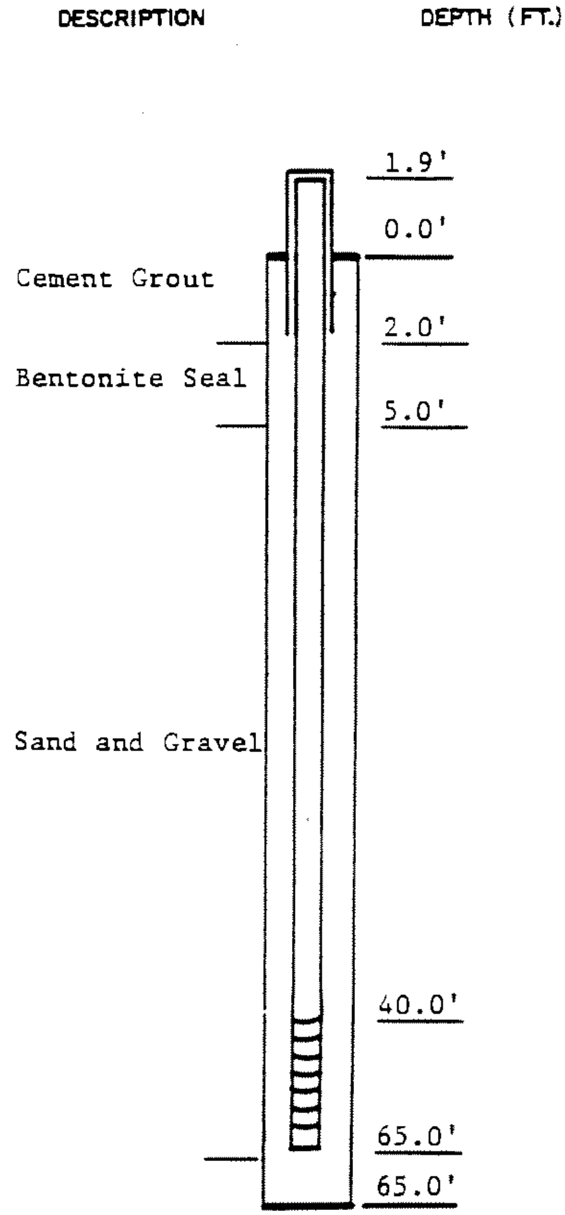
BORING LOCATION: As shown on boring location plan
DATE INSTALLED: 9-24-81

SURFACE ELEVATION: 729.88'
TOP OF PIPE ELEVATION: 731.78'*

TYPE OF PIEZOMETER: Monitor Well - 4" Schedule 40 PVC Casing

DATE	WATER SURFACE DEPTH (FT.)	WATER SURFACE ELEV. (FT.)	
9-10-81	26.5	703.4	
9-25-81	32.3	697.6	
9-28-81	33.5	696.4	
10-5-81	32.8	697.1	

INSTALLATION DESCRIPTION



TECHNICIAN PATTERSON

JOB NO. 26418

NOTES: PVC screen length - 25 feet
Screen slot size - 0.010 inches
Guard pipe - 5" x 4' 2" black iron with locking cap
* Elevation given is top of guard pipe without cap

LOG OF BORING NO. W-2-S

GROUNDWATER MONITORING WELLS, HARRISON RADIATOR, DAYTON OPERATIONS, MORAINE, OHIO

BORING LOCATION: As shown on boring location plan

DATE STARTED: 9-18-81

SURFACE ELEVATION: 725.01'

DATE COMPLETED: 9-21-81

STRATUM	DESCRIPTION OF MATERIAL	SAMPLE NO. & TYPE	SAMPLE DEPTH	BLOWS PER 6" ON SAMPLER	"N" BLOWS /FT. OR CORE REC.
0.0'	Brown clay, trace of sand, trace of gravel				
3.0'	Brown sand and gravel - damp				
10'					
20'					
30'					
	(Becomes wet at 35.5')				
40'					
50'					
60'					

(continued on next page)

METHOD: DRIVE CASING

TECHNICIAN: PATTERSON

JOB NO.: 26418 (kab)

WATER OBSERVATIONS

INITIAL DEPTH: 35.0'

COMPLETION DEPTH: 34.5'

DEPTH AFTER: 24 HRS. 35.3'

TYPE SAMPLER:

- A. SPLIT SPOON
- B.
- C. SHELBY TUBE

BOWSER – MORNER
TESTING LABORATORIES INC.

LOG OF BORING NO. W-2-S

GROUNDWATER MONITORING WELLS, HARRISON RADIATOR, DAYTON OPERATIONS, MORAINE, OHIO

BORING LOCATION: As shown on boring location plan **DATE STARTED:** 9-18-81

SURFACE ELEVATION: 725.01' **DATE COMPLETED:** 9-21-81

STRATUM	DESCRIPTION OF MATERIAL	SAMPLE NO. & TYPE	SAMPLE DEPTH	BLOWS PER 6" ON SAMPLER	"N" BLOWS /FT. OR CORE REC.
60'	(continued)				
63.0'	Gray silt, trace of clay - moist				
64.0'	Brown sand and gravel - wet				
	Bottom of boring at 65.0'				
70'					
80'					
90'					
100'					
110'					
120'					

METHOD: DRIVE CASING

TECHNICIAN: PATTERSON

JOB NO.: 26418 (kab)

WATER OBSERVATIONS

INITIAL DEPTH: 35.0'

COMPLETION DEPTH: 34.5'

DEPTH AFTER: 24 HRS. 35.3'

TYPE SAMPLER:

A. SPLIT SPOON

B.

C. SHELBY TUBE

BOWSER – MORNER
TESTING LABORATORIES, INC.

LOG OF WELL NO. W-2-S

GROUNDWATER MONITORING WELLS, HARRISON RADIATOR,
DAYTON OPERATIONS, MORAINE, OHIO

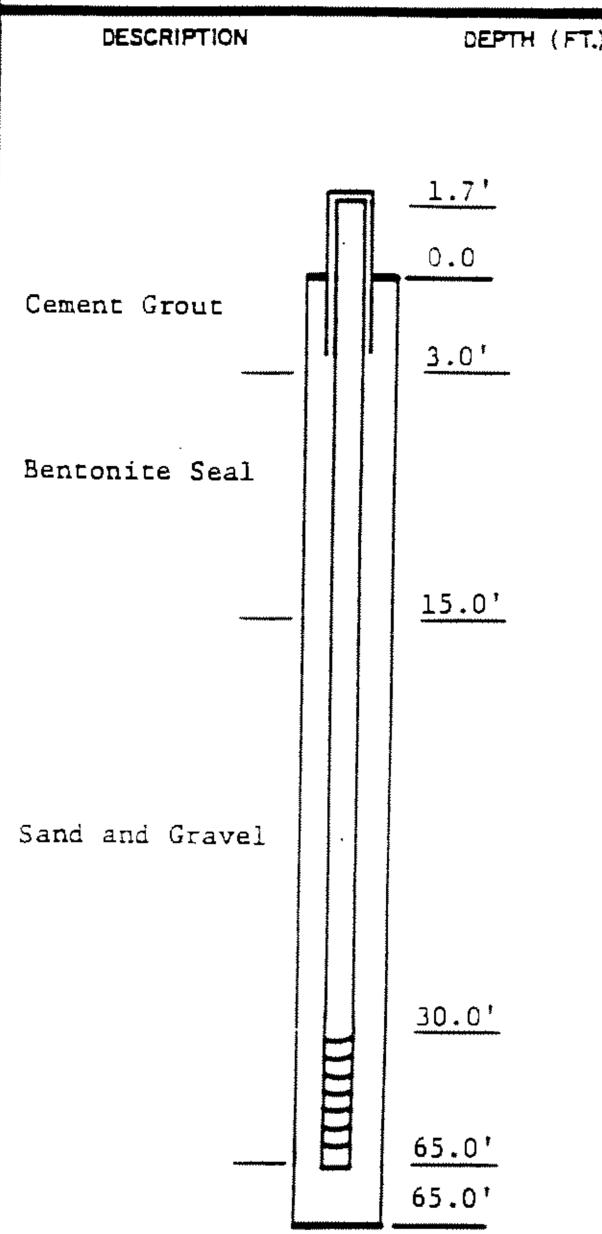
BORING LOCATION: As shown on boring location plan
DATE INSTALLED: 9-21-81

SURFACE ELEVATION: 725.01'
TOP OF PIPE ELEVATION: 726.75'*

TYPE OF PIEZOMETER: Monitor Well - 4" Schedule 40 PVC Casing

DATE	WATER SURFACE DEPTH (FT.)	WATER SURFACE ELEV. (FT.)	
9-21-81	34.5	690.5	
9-22-81	35.3	689.7	
10-5-81	35.3	689.7	

INSTALLATION DESCRIPTION



TECHNICIAN PATTERSON

JOB NO. 26418

NOTES: PVC screen length - 35 feet
Screen slot size - 0.010 inches
Guard pipe - 5" x 4' 2" black iron with locking cap
* Elevation given is top of guard pipe without cap

LOG OF BORING NO. W-3-S

GROUNDWATER MONITORING WELLS, HARRISON RADIATOR, DAYTON OPERATIONS, MORAINE, OHIO

BORING LOCATION: As shown on boring location plan

DATE STARTED: 9-23-81

SURFACE ELEVATION: 731.47'

DATE COMPLETED: 9-23-81

STRATUM	DESCRIPTION OF MATERIAL	SAMPLE NO. & TYPE	SAMPLE DEPTH	BLOWS PER 6" ON SAMPLER	"N" BLOWS /FT. OR CORE REC.
0.0'	(FILL) Topsoil and sand and gravel - moist				
6.0'	(ORIGINAL) Brown sand and gravel - moist				
10'					
20'					
30'					
40'	(Becomes wet at 41.0')				
50'					
60'					

(continued on next page)

METHOD: DRIVE CASING

TECHNICIAN: PATTERSON

JOB NO.: 26418 (kab)

WATER OBSERVATIONS

INITIAL DEPTH: 41.0'

COMPLETION DEPTH: 41.0'

DEPTH AFTER: 24 HRS. 41.0'

TYPE SAMPLER:

A. SPLIT SPOON

B.

C. SHELBY TUBE

BOWSER – MORNER
TESTING LABORATORIES, INC.

LOG OF BORING NO. W-3-S (second page)

GROUNDWATER MONITORING WELL, HARRISON RADIATOR, DAYTON OPERATIONS, MORAINE, OHIO

BORING LOCATION: As shown on boring location plan — **DATE STARTED:** 9-23-81

SURFACE ELEVATION: 731.47' — **DATE COMPLETED:** 9-23-81

STRATUM	DESCRIPTION OF MATERIAL	SAMPLE NO. & TYPE	SAMPLE DEPTH	BLOWS PER 6" ON SAMPLER	"N" BLOWS /FT. OR CORE REC.
60'	(continued)				
70'					
	Bottom of boring at 76.0'				
80'					
90'					
100'					
110'					
120'					

METHOD: DRIVE CASING

TECHNICIAN: PATTERSON

JOB NO.: 26418 (kab)

WATER OBSERVATIONS

INITIAL DEPTH: 41.0'

COMPLETION DEPTH: 41.0'

DEPTH AFTER 24 HRS. 41.0'

TYPE SAMPLER:

A. SPLIT SPOON

B.

C. SHELBY TUBE

BOWSER – MORNER
TESTING LABORATORIES, INC.

LOG OF WELL NO. W-3-S

GROUNDWATER MONITORING WELLS, HARRISON RADIATOR, DAYTON OPERATIONS, MORAINE, OHIO

BORING LOCATION: As shown on boring location plan
DATE INSTALLED: 9-23-81

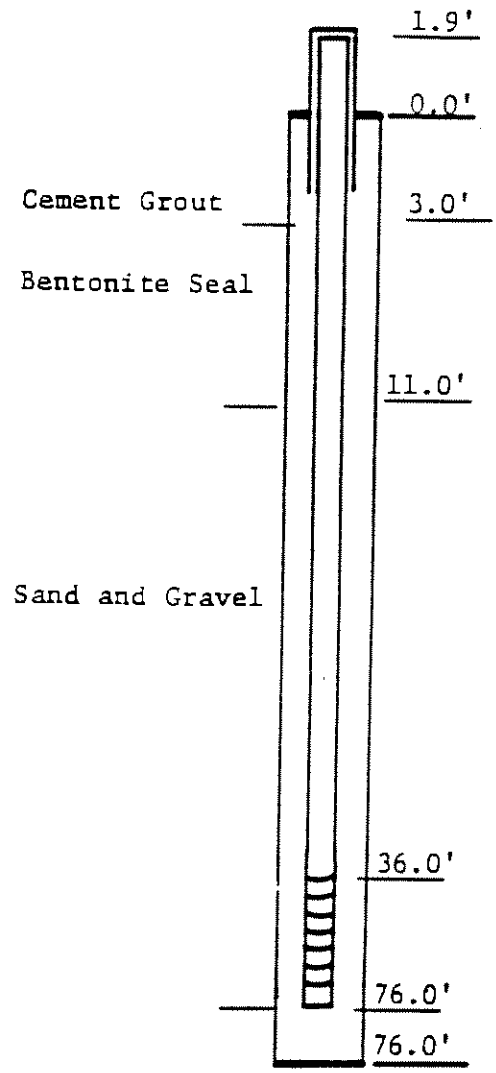
SURFACE ELEVATION: 731.47'
TOP OF PIPE ELEVATION: 733.39'*

TYPE OF PIEZOMETER: Monitoring Well - 4" Schedule 40 PVC Casing

DATE	WATER SURFACE DEPTH (FT.)	WATER SURFACE ELEV. (FT.)	
9-23-81	41.0	690.5	
9-24-81	41.0	690.5	
10-5-81	42.0	689.5	

INSTALLATION DESCRIPTION

DESCRIPTION — DEPTH (FT.)



TECHNICIAN PATTERSON

JOB NO. 26418

NOTES: PVC screen length - 40 feet
Screen slot size - 0.010 inches
Guard pipe - 5" x 4' 2" black iron with locking cap
*Elevation given is top of guard pipe without cap

LOG OF BORING NO. W-4-S

GROUNDWATER MONITORING WELLS, HARRISON RADIATOR, DAYTON OPERATIONS, MORAINE, OHIO

BORING LOCATION: As shown on boring location plan **DATE STARTED:** 9-25-81

SURFACE ELEVATION: 726.66' **DATE COMPLETED:** 9-28-81

STRATUM	DESCRIPTION OF MATERIAL	SAMPLE NO. & TYPE	SAMPLE DEPTH	BLOWS PER 6" ON SAMPLER	"N" BLOWS /FT. OR CORE REC.
0.0'	Brown sand and gravel, some silt, trace of cobbles				
10'					
20'					
30'					
	(Becomes wet at 37.5')				
40'					
50'					
60'					

(continued on next page

METHOD: DRIVE CASING

TECHNICIAN: PATTERSON

JOB NO.: 26418 (kab)

WATER OBSERVATIONS

INITIAL DEPTH: 37.5'

COMPLETION DEPTH: 37.5'

DEPTH AFTER: 24 HRS. 37.5'

TYPE SAMPLER:

____ A. SPLIT SPOON

____ B.

____ C. SHELBY TUBE

BOWSER – MORNER
TESTING LABORATORIES, INC.

LOG OF BORING NO. W-4-S (second page)

GROUNDWATER MONITORING WELLS, HARRISON RADIATOR, DAYTON OPERATIONS, MORAINE, OHIO

BORING LOCATION: As shown on boring location plan

DATE STARTED: 9-25-81

SURFACE ELEVATION: 726.66'

DATE COMPLETED: 9-28-81

STRATUM	DESCRIPTION OF MATERIAL	SAMPLE NO. & TYPE	SAMPLE DEPTH	BLOWS PER 6" ON SAMPLER	"N" BLOWS /FT. OR CORE REC.
60'	(continued)				
70'					
	Bottom of boring at 70.0'				
80'					
90'					
100'					
110'					
120'					

METHOD: DRIVE CASING

TECHNICIAN: PATTERSON

JOB NO.: 26418 (kab)

WATER OBSERVATIONS

INITIAL DEPTH: 37.5'

COMPLETION DEPTH: 37.5'

DEPTH AFTER: 24 HRS. 37.5'

TYPE SAMPLER:

A. SPLIT SPOON

B.

C. SHELBY TUBE

BOWSER – MORNER
TESTING LABORATORIES, INC.

LOG OF WELL NO. W-4-S

GROUNDWATER MONITORING WELLS, HARRISON RADIATOR,
DAYTON OPERATIONS, MORAINE, OHIO

BORING LOCATION: As shown on boring location plan

DATE INSTALLED: 9-28-81

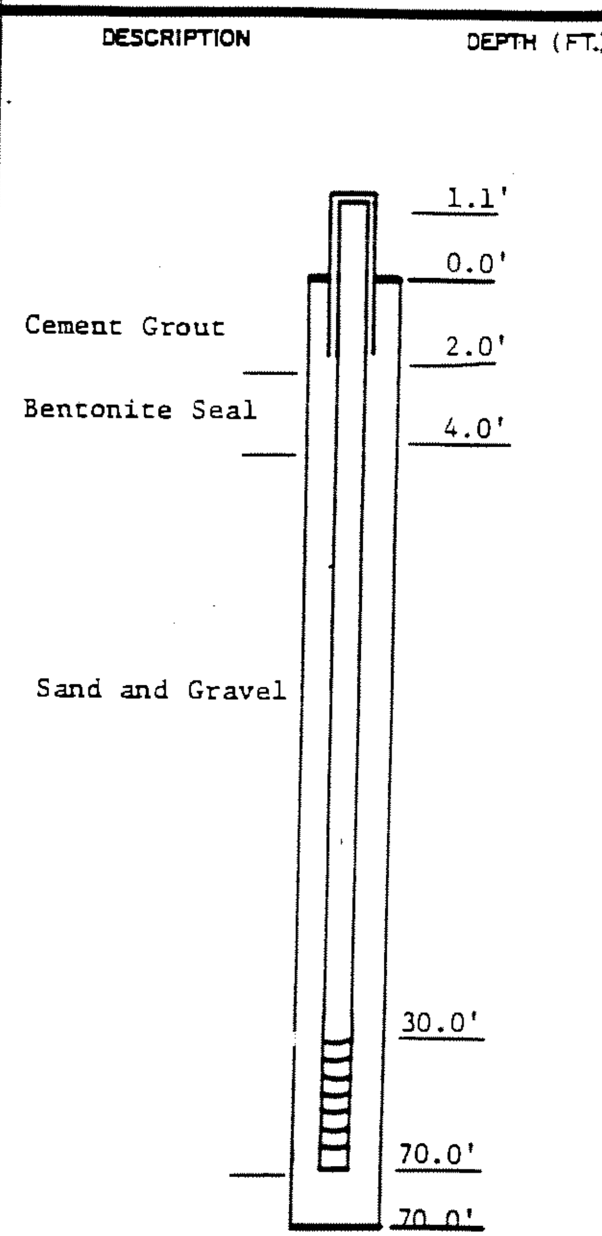
SURFACE ELEVATION: 726.66'

TOP OF PIPE ELEVATION: 727.80'*

TYPE OF PIEZOMETER: Monitoring Well - 4" Schedule 40 PVC Casing

DATE	WATER SURFACE DEPTH (FT.)	WATER SURFACE ELEV. (FT.)	
9-28-81	37.6	689.1	
9-29-81	37.6	689.1	
10-5-81	37.3	689.4	

INSTALLATION DESCRIPTION



TECHNICIAN PATTERSON

JOB NO. 26418

NOTES: PVC screen length - 40 feet

Screen slot size - 0.010 inches

Guard pipe - 5" x 4' 2" black iron with locking cap

* Elevation given is top of guard pipe without cap

ARCADIS

Appendix D

Standard Operating Procedures

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SOP #2 - Monitor Well Purging With A Bailer Or Pump

EQUIPMENT:

_______ PPE
_______ Plastic sheeting
_______ Paperwork
_______ Conductivity meter
_______ PID
_______ Calculator
_______ "Caution" tape and stakes
_______ Bailer
_______ Rope
_______ Thermometer
_______ M-scope

PROCEDURES:

Prior to Well Sampling:

A. Acquire necessary equipment and paperwork.

At Sampling Location:

1. Don appropriate PPE (see Health and Safety Plan).

2. Establish exclusion zone.

3. Set up monitoring equipment (PID).

4. Place plastic sheeting near well and work area.

5. Unlock and remove well cap, note condition of well.

6. Measure water level and sound well (See SOP #4).

7. Calculate volume of water in the well using one of the following equations:

   a. <u>2-inch diameter well</u>
   0.1632 gal/ft x____

   (linear ft of water in well) = 1 well volume

   b. <u>4-inch diameter well</u>
   0.6528 gal/ft x____

   (linear ft of water in well) = 1 well volume

   Record the well volume on the water sampling log.

8. Insert pump/bailer into well. If using pump, connect clean length of tubing to pump. If using bailer, connect rope to bailer, allowing sufficient length to reach bottom of well.

9. Purge 3 well volumes of water; dispose of purge and excess sampling water at well site.

10. Record volume of water purged, clarity and all other pertinent information on Water Sampling Log.

11. Commence with sampling (See SOP #3).

EQUIPMENT:

______	PPE	______	"Caution" tape and stakes
______	Plastic sheeting	______	Bailer
______	Sample labels	______	Rope
______	Sample bottles	______	Thermometer
______	Cooler and ice	______	pH meter
______	Conductivity meter	______	M-scope
______	Pyrex™ cup	______	Paperwork
______	PID		

PROCEDURES:

Prior to Well Sampling:

A. Acquire necessary equipment and paperwork.

At Sampling Location:

1. Don appropriate PPE (see Health and Safety Plan).

2. Establish exclusion zone.

3. Set up monitoring equipment (PID).

4. Place plastic sheeting near well and work area.

5. Unlock and remove well cap, note condition of well.

6. Record sampling station number, sample identification, date, time, weather condition, and project number on Water Sampling Log.

7. Use M-Scope to determine depth-to-water and total depth of well (see SOP #4). Record on water sampling log.

8. Calculate volume of water in well and volume to be purged from well (three well volumes). Record on water sampling log (see SOP #2).

9. Remove decontaminated bailer from protective covering and attach cord, allowing enough length for bailer to reach bottom of well.

10. Lower bailer slowly to bottom of well with a minimum of surface disturbance.

11. Raise bailer to surface carefully, not allowing bailer cord to contact ground.

12. Continue bailing until appropriate volume has been purged. Record purged volume on water sampling log.

12A. Pour sample into a Pyrex™ cup. Measure temperature, pH, and conductivity (see SOPs #5 and #6). Record information on water sampling log.

13. Begin sampling well. The following order of sample collection must be followed: volatile organic compounds (VOCs), semivolatiles, and metals. Any remaining samples should be collected as soon as possible.

14. Remove the cap from the sample bottle, and tilt the bottle slightly.

15. Pour the sample slowly down the inside of the sample bottle. Avoid splashing of the sample. Assure that any suspended matter in the sample is transferred quantitatively to the sample bottle.

16. Leave adequate air space in the bottle to allow for expansion, except for volatile organic analysis (VOA) flasks. VOCs should be collected without head space or bubbles.

17. Label the bottle with the following information: sample ID, date, time of sampling, sampler's initials, and method of preservation. Enter all information accurately and legibly. Complete chain-of-custody forms (see SOP #11).

18. Pour sample into Pyrex™ cup. Measure temperature, pH, and conductivity again (see SOPs #5 and #6). Record information on water sampling log.

19. Samples should be placed in appropriate containers, and packed with ice in coolers as soon as practical.

20. Replace well cap and lock.

21. Decontaminate bailer and dispose of bailer rope (see SOP #9).

22. Personnel decontamination (see Health and Safety Plan).

After Sampling:

A. Ship samples to analytical laboratory with full Chain-of-Custody documentation.

B. Complete all necessary paperwork.

SOP #3 - Groundwater Sampling - Teflon Bailer

QA/QC REQUIREMENTS:

One rinseate blank and duplicate sample per ten investigative samples or per day, whichever is greater, must be collected by each ground-water sampling crew.

A trip blank must accompany each cooler of VOC samples that is shipped during the project.

SOP #4 - Measuring Water-Levels With An M-Scope

EQUIPMENT:

_______	PPE	_______	Paperwork
_______	M-scope		

PROCEDURES:

1. Check to see if there are any grossly contaminated wells requiring measurements made with separate M-Scopes; don appropriate PPE (see Health and Safety Plan).

2. Check that the M-Scope battery is functional.

3. Decontaminate the probe and tape with a distilled water rinse. Dry with a lint-free paper towel (see SOP #7).

4. Remove cap from well and check for the measuring point mark and for any sharp edges which may damage tape.

5. If the M-scope has metallic markers, check to see that they have not shifted.

6. Lower the probe into the center of the well until a contact with the water surface is indicated, either by audible alarm, light or meter deflection.

7. Mark and hold the tape at the measuring point (lip of 2-inch casing) and repeat the measurement.

8. Read off the measurement and record. If the tape has only five foot markers, measure the distance to the measured point with a folding ruler. Measurements should be made to the ± 0.01 feet.

9. Lower probe to bottom of well. Raise probe slowly until there is no slack in the tape. Gently "feel" the bottom of the well by slowly raising and lowering the probe.

10. Read off the measurement and record on Water Level Measurement field-data sheet or water sampling log.

After Field Work:

A. Complete all necessary paperwork.

QA/QC REQUIREMENTS:

One replicate water-level measurement must be made per five investigative measurements or one per day, whichever is greater.

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SOP #5 - pH Meter Standard Operating Procedures

EQUIPMENT:

_______ pH meter
_______ Paperwork
_______ Standard solutions (4, 7, and 10)

PROCEDURES:

1. Pour sample into Pyrex™ cup.
2. Place thermometer in sample.
3. Remove cap from pH probe and rinse with distilled water.
4. Place probe in sample and allow it to stabilize (10 to 20 seconds).
5. Adjust temperature control on pH meter to proper setting.
6. Take a pH reading and record value on sampling log.
7. Rinse probe with distilled water.
8. Repeat the above two steps four times to collect a quadruplicate measurement of pH.
9. Fill cap with distilled water and place on end of probe.

pH METER CALIBRATION:

EQUIPMENT:

_______ pH Standards (4, 7, and 10)
_______ Distilled water
_______ Thermometer

SOP #5 - pH Meter Standard Operating Procedures

Note: pH standards and distilled water should be stored in a similar location so temperature is the same.

PROCEDURES:

1. Place thermometer in standard solution.
2. Set temperature adjustment of pH meter to the temperature of the standard solution.
3. Remove cap from pH probe and rinse with distilled water.
4. Place pH probe in pH standard 7 and allow it to stabilize for 10 to 20 seconds.
5. Take a pH reading. If necessary, adjust "zero" control until reading is ± 0.1 of standard. Record readings on calibration log.
6. Remove pH probe from solution and rinse with distilled water.
7. Place pH probe in pH standard 4 or 10 and allow it to stabilize.
8. Take a pH reading. If necessary, adjust "slope" control until reading is ± 0.1 of standard. Record reading on calibration log.
9. Remove pH probe from solution and rinse with distilled water.
10. Place pH probe in remaining pH standard and allow it to stabilize.
11. Take a pH reading. If necessary, adjust "slope" control until reading is ± 0.1 of standard. Record reading on calibration log.
12. Repeat above process until all readings are ± 0.1 of standard.
13. Rinse probe with distilled water.
14. Fill cap for probe with distilled water (to keep probe moist) and place it on probe.
15. Record all calibration details on pH Meter Calibration Log sheet.

QA/QC REQUIREMENTS:

pH meter calibration should be checked with a 7-standard solution every four hours. If reading is greater than ± 0.1 of standard, repeat calibration process.

Standard solutions should be replaced every six months.

One replicate pH measurement per every five investigative measurements or one per day, whichever is greater must be made.

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SOP #6 - Specific Conductivity Meter Standard Operating Procedures

EQUIPMENT:

_______ Specific conductivity meter
_______ Standard solutions (1413 mmhos/cm)
_______ Paperwork

PROCEDURES:

1. Pour sample into Pyrex™ cup.
2. Place thermometer in sample.
3. Adjust temperature control on meter to the temperature of the sample.
4. Rinse probe with distilled water.
5. Insert conductivity probe into sample and allow it to stabilize (10 to 20 seconds).
6. Take a reading and record on sampling log.
7. Rinse probe with distilled water.
8. Repeat the above two steps four times to collect a quadruplicate measurement of specific conductance.

SPECIFIC CONDUCTIVITY METER CALIBRATION:

EQUIPMENT:

_______ Conductivity Standards (1413 mmhos/cm)
_______ Thermometer
_______ Small regular screwdriver
_______ Distilled water

Conductivity standards and distilled water should be stored in similar locations so temperature is the same.

SOP #6 - Specific Conductivity Meter Standard Operating Procedures

PROCEDURES:

1. Place thermometer in distilled water.

2. Set temperature adjustment of conductivity meter to the temperature of distilled water.

3. Rinse conductivity probe with distilled water.

4. Place probe in 1413 standard and allow it to stabilize for 10 to 20 seconds.

5. Take reading. If necessary, adjust calibration screw to ± 10 mmhos/cm. Record value on Specific Conductivity Meter Calibration Log.

6. Rinse probe with distilled water.

7. Record all calibration details on specific conductance meter calibration log sheet.

QA/QC REQUIREMENTS:

Specific conductivity calibration should be checked every four hours with a 1413 mmhos/cm standard. If reading is greater than ± 10 mmhos/cm of standard, repeat calibration.

Standard solutions should be replaced every six months.

One replicate specific conductance measurement should be made per every five investigative measurements or every day, whichever is greater.

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SOP #7 - Decontamination Of M-Scopes And Steel Tapes

EQUIPMENT:

_______ Distilled water

_______ Paper towels

_______ Paperwork

PROCEDURE:

1. Rinse entire device (probe and tape) with distilled water and dry with paper towels.
2. Wrap equipment in plastic to prevent contamination during long-term storage.
3. Record date, time and details of decontamination on Equipment Maintenance/Decontamination Log for that field meter.

ARCADIS

SOP #8 - Decontamination Of Submersible Pump

EQUIPMENT:

________	Submersible pump	________	Micro™ solution
________	30 gallon trash can	________	Distilled water
________	Paper towels	________	Paperwork

PROCEDURE:

1. Place pump in 30-gallon trash can, remove, and discard rope used to hang pump in well.

2. Wash pump thoroughly using Micro™ solution and distilled water and brushes or towels, if required.

3. Rinse pump repeatedly with distilled water and dry.

4. Pump should be wrapped in plastic to prevent contamination during storage or transit.

5. Record date, time and details of decontamination on Equipment Maintenance/Decontamination Log for the pump.

ARCADIS

SOP #9 - Decontamination Of Teflon Bailer

EQUIPMENT:

________	Micro™ solution	________	Brush
________	Distilled water		

PROCEDURE:

1. Wash bailer thoroughly with laboratory detergent (Micro™ solution) and distilled water using a brush to remove any particulate matter or surface film, if required.

2. Rinse bailer thoroughly with distilled water and allow to air dry as long as possible.

3. Wrap bailer with plastic to prevent contamination during long-term storage.

4. Record date, time and details of decontamination on an Equipment Maintenance/Decontamination Log.

ARCADIS

SOP #11 - Chain-Of-Custody/Sample Shipment Procedures

PROCEDURE:

A Chain-of-Custody Record must be completed by the sampling team for all samples immediately upon collection. The Chain-of-Custody Reeord will be delivered to the analytical laboratory. A Chain-of-Custody Record is included in Appendix A. Information to be provided on this form includes:

- Project number and ID;
- Laboratory identification;
- Sampling personnel;
- Sample identification;
- Sample matrix;
- Sample container material;
- Sample preservation;
- Date and time of collection;
- Type of analysis to be performed; and
- Shipment method and carrier.

All suspected low concentration samples (less than 100 ppm based on field screening) should be packed in coolers by the sampling team with sufficient packaging to prevent damage to sample bottles during shipment. Frozen ice packs must be included in each sample cooler. (If the container is to be shipped, a Chain-of-Custody seal should be applied in such a manner so as to monitor tampering.) Sample coolers will then usually be hand-delivered each day to the analytical laboratory by the sampling team or designated personnel.

Upon change of possession, the record is to be signed and dated by both parties. The white (original) copy accompanies the shipment, the field sampler retains the yellow and pink copies. The analytical laboratory will be responsible for routing samples to the appropriate analytical section in a timely manner.

Based on existing data, all samples are expected to be low concentration samples. However, if VOC concentrations exceeding 100 ppm (see Note) are suspected in samples based on field screening, appropriate measures will be taken. Samples suspected of containing medium or high concentrations (greater than 100 ppm based on field screening) will be stored and shipped separate from suspected low concentration samples. Tertiary containment will be provided by placing the medium or high concentration samples in appropriate containers prior to placing them in shipping coolers.

NOTE:

"Medium level" concentrations = 100 x Average Upper Laboratory Calibration Limit (200 ppb) = 20,000 ppb.

HNU field screening measures a mixture of compounds with varying instrument response.

Assumption: Five VOCs present in mixture for field screening.

20,000 ppb x 5 = 100,000 ppb = 100 ppm.

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SOP #13 - Rinseate Blank Collection

EQUIPMENT:

________	Distilled water	________	Water Sampling Log
________	Sample containers		

PROCEDURE:

1. Decontaminate equipment (split-spoons, bailer, etc.) according to SOP #9 or #10.
2. Following the final distilled water rinse, rinse the sampling device with high purity distilled water this time washing the rinseate into sample containers for laboratory analysis.
3. All rinseate blanks must be handled and analyzed in the same manner as investigative samples. (See SOP #11 for Chain-of-Custody and Sample Shipment Procedures.) Record details of rinseate blank collection on a Water Sampling Log.

QA/QC REQUIREMENTS:

One rinseate blank per ten investigative samples or one per day, whichever is greater, must be collected by <u>each</u> sampling crew (i.e., each drill rig team is one sample crew, each ground-water sampling team is one crew, etc.).

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SOP #14 - Duplicate Sample Collection

EQUIPMENT:

_______ Sample containers _______ Paperwork

PROCEDURE:

1. Immediately following sample collection, fill a second set of sample containers using the same order of sample collection and procedures.

2. Label the sample with its duplicate sample identification.

3. All duplicate samples should be handled and analyzed in the same manner as investigative samples. (See SOP #11 for Chain-of-Custody and Sample Shipment Procedures.) Record details of duplicate sample collection on the appropriate sampling log.

QA/QC REQUIREMENTS:

One duplicate sample of ground water, surface water, sediment, soil or sludge must be collected per ten investigative samples or per day, whichever is greater by each sampling crew (i.e., each ground-water sampling team is a separate sampling crew, etc.).

SOP #21 - Low-Flow Purging And Sampling Of Groundwater

EQUIPMENT:

- _______ Adjustable-rate, low-flow, positive-displacement pump, dedicated to the well
- _______ Generator (if needed)
- _______ Teflon-lined polyethylene tubing, dedicated to the well
- _______ Polyethylene sheeting
- _______ In-line, flow-through cell equipped with pH, Eh, dissolved oxygen (DO), specific conductivity, and temperature electrodes
- _______ Turbidity meter
- _______ Large, wide-mouth beakers
- _______ PID, or equivalent
- _______ Electronic water-level indicator or equivalent (marked in 0.01-foot increments)
- _______ Nylon stay-ties
- _______ Logbook
- _______ Sampling gloves

PROCEDURES:

1. Check the condition of the well and look for any damage or evidence of tampering and record.

2. Remove the well cap.

3. Measure well headspace with a PID and record the reading in the logbook.

4. Measure the depth to water with an electronic water-level device and record the measurement in the logbook. Do not measure the depth to the bottom of the well at this time (in order to avoid disturbing any accumulated sediment). Obtain depth to bottom information from well installation log. Calculate standing water volume as: depth of water column times cross-sectional area of the well.

5. Lay out the polyethylene sheeting and place all equipment on the sheeting. To avoid cross contamination, do not let any downhole equipment touch the ground surface.

6. Measure the depth to water in the well again. If the measurement has changed more than 1/100th of a foot, check and record the measurement again.

7. Attach and secure the polyethylene tubing to the low-flow pump. As the pump is slowly lowered into the well, secure the safety drop cable, tubing, and electronic lines to each other using nylon stay-ties.

8. The pump should be set at approximately the middle of the screen. Avoid placing the pump intake less than 2 feet above the bottom of the well as this may cause mobilization of any sediment present in the bottom of the well. Start purging the well. Avoid surging. Observe air bubbles displaced from discharge tube to assess progress of steady pumping until water arrives at the surface.

9. The water level in the well should be monitored during purging, and ideally, the purge rate should equal the well recharge rate so that there is little or no drawdown in the well. (The water level should stabilize for the specific purge rate.) There should be at least 1 foot of water over the pump intake so there is no risk of the pump suction being broken, or entrainment of air in the sample. Record adjustments in the purge rate and changes in depth to water in the logbook. Purge rates should, if needed, be decreased to the minimum capabilities of the pump to avoid affecting well drawdown. The well should not be purged dry. If the recharge rate of the well is so low that the well is purged dry, then wait until the well has recharged to a sufficient level and collect the appropriate volume of water for the sample with the pump.

10. During well purging, use the flow-through cell to monitor the field parameters frequently (every 3 to 5 minutes) until the parameters have stabilized to within 10 percent (plus or minus 5 percent) over a minimum of three readings. Repeatedly collect water in the beaker and assess turbidity. Turbidity and DO are typically the last parameters to stabilize. If turbidity readings fall below 7 NTUs, then the stabilization range can be amended to 20 percent (plus or minus 10 percent) over a minimum of three readings.

11. Once the field parameters have stabilized, collect the samples directly from the end of the discharge tube. Volatile organic compounds (VOCs) and analytes that degrade by aeration should be collected first. All sample bottles should be filled by allowing the water from the discharge tube to flow gently down the inside of the bottle with minimal turbulence. Cap each bottle as it is filled.

12. The pump assembly should be carefully removed from the well. The tubing should be dedicated to each well and should be placed in a large plastic garbage bag, sealed, and labeled with the appropriate well identification number.

13. Close and lock the well.

ARCADIS

SOP #28 - Purging and Sampling of Active Production Well

EQUIPMENT:

________	PPE	________	Cooler with ice
________	Plastic sheeting	________	5-gallon buckets
________	Paperwork	________	ACTAT probe
________	PID	________	Measuring cup
________	Calculator	________	pH meter, solutions
________	Pens, etc.	________	Conductivity meter, solutions
________	Thermometer	________	Parameter-measuring cup
________	Sample Bottles	________	Ziploc baggies

PROCEDURES:

Prior to Well Sampling:

A. Acquire necessary equipment, lab bottles, and paperwork (Daily notes and groundwater sampling log).

At Sampling Location:

1. Don appropriate PPE (see Health and Safety Plan).
2. Establish exclusion zone.
3. Set up monitoring equipment (PID).
4. Place plastic sheeting near well and work area.
5. Note condition of well and whether it is in operation.
6. Measure water level with ACTAT (if a measuring port exists) (See SOP #4).
7. Open the in-line valve or spigot.
8. Allow spigot to remain open at constant flow for a minimum of 5 minutes. If applicable, contain purge water in buckets for proper disposal.
9. Reduce the flow to approximately 100 mL per minute (when applicable), usiug measured cup.
10. Record volume of water purged (when applicable), clarity and all other pertinent information on Water Sampling Log.

11. Fill the appropriate sample containers. Ensure that VOC vials do not have headspace.

12. Label vials with sample name, date, time, analysis, sampler, etc.

13. Place sample bottles in ice-filled cooler.

14. Collect additional water in a parameter container. Measure pH, Specific Conductivity, and Temperature using 4 replicate measurements (see SOP #5 and SOP #6). Record results on sampling log.

15. Turn off spigot.

16. Pack up equipment, dispose of purge water according to work plan, and dispose of PPE.

17. Complete a Chain-of-Custody form for each cooler to establish the necessary documentation to track possession from time of collection to analysis. The Chain-of-Custody form must include the following information:

    Project identification (REALM, Production Well Sampling)
    AG&M project number and project manager
    REALM laboratory P.O. number (R-I-00-11-01 for 2000)
    Indicate Level III Data Package, Reports to Pam Stubbs, copy Nancy Gillotti.
    Sampling personnel
    Identity of samples
    Description and number of sample containers
    Date and time of sampling
    Signatures of persons involved in the Chain-of-Custody and the dates and times of possession

18. Place the completed Chain-of-Custody form in a ziploc bag and place inside cooler. Deliver cooler in person to Test America - Dayton Division for analysis. After laboratory personnel signs the Chain-of-Custody, retain the pink copy.

19. Note on groundwater sampling log whether the production well is ON or OFF. If DN-13 is OFF contact the office immediately.

ATTACHMENT 2

Revised Human Health Risk Assessment Report

Revitalizing Auto Communities
Environmental Response Trust

July 3, 2012

Mr. Ed Lim
Manager
Ohio Environmental Protection Agency
Division of Environmental Response and Revitalization
Engineering Section
P. O. Box 1049, Columbus, Ohio 43216-1049

RE: Response to Notice of Deficiency
Human Health Risk Assessment for the Closed South Settling Lagoon
RACER Moraine Facilities, Moraine, Ohio
OHD 000 817 577

Dear Mr. Lim:

RACER Trust, respectfully submits the following responses to the letter dated May 31, 2012 received by RACER Trust on June 4, 2012 from the Ohio Environmental Protection Agency (Ohio EPA). The letter provides comments on the Human Health Risk Assessment (HHRA) for the Closed South Settling Lagoon, RACER Moraine Facilities, Moraine, Ohio. The text, tables and figures associated with this report have been revised based on the Ohio EPA comments and the report in its entirety is being reissued. Upon the request of Ohio EPA, old language was over struck rather than eliminated and new language was included in capitalized font within the report text.

The Ohio EPA comments from the May 31 2012 letter and responses (with the corresponding change to the report) are as follows:

Comment 1. Section 1.4: Media of Concern

Direct contact to a construction worker should be quantitatively evaluated for the entire soil column for the scenarios where the final cover will be disturbed in order to properly evaluate all potential exposure pathways.

Response: On the recommendation of Ohio EPA, risk to a construction worker from direct exposure to soil was evaluated in the refined HHRA. As noted in the report, the SSL material is solidified and covered with a minimum of 10 feet of clean soil, then a one foot layer of clay, and finally a 6 inch vegetated top soil layer. Therefore, within the footprint of the solidified waste, the soil column is defined as surface soil to immediately above the solidified waste (which is a minimum of 10 feet in depth), while in the area beyond the solidified waste, the soil column is defined as the vadose zone (i.e., from surface soil to the groundwater interface). Data from the fill soil was available and was used in the revised HHRA to evaluate exposure to soil above the solidified waste. Data for soil outside the solidified waste footprint was not available but was assumed equal to the stockpile data since the stockpile soil was obtained from other portions of the Moraine site. Fill stockpile data is presented in Table 0B in the revised HHRA report. Soil data was compared to USEPA Regional Screening Levels (RSLs) for an industrial scenario and to background concentrations at the site. The exposure point concentration (based on the upper confidence limit on the mean (UCL)) of benzo(a)pyrene at 1.03 milligram per kilogram (mg/kg) exceed the industrial soil RSL of 0.21 mg/kg; therefore benzo(a)pyrene was selected as constituent of potential concern (COPC) for quantitative evaluation. This selection of COPC for soil is presented in Table 3 in report; while the quantitative risk charactering for direct contact with soil for a construction worker receptor is presented in Table 10. The HHRA report text was revised accordingly.

Comment 2. Section 2.2: Soil Gas Risk Assessment Dataset

If soil gas sampling more recent than November 2010 has occurred, please include those results in the vapor intrusion evaluation.

Response: On-site soil gas data was recently obtained at the SSL and was used in addition to the near off-site data to assess risk to receptors at the SSL. On-site soil gas data is presented in Table 1A. The HHRA report was revised accordingly.

Comment 3. Section 2.3: Selection of Constituents of Potential Concern

U.S. EPA has revised their recommendations for attenuation factors; http://www.epa.gov/superfund/sites/npl/Vapor Intrusion FAQs Feb2012.pdf (see page 23). Based on this guidance, we recommend the use of an attenuation factor of 0.1 for exterior soil gas.

Response: Consistent with USEPA 2012, an attenuation factor of 0.1 was used to estimate soil gas screening levels using air regional screening levels. Section 2.3 and Table 4 were revised accordingly.

Comment 4. Section 3.0: Exposure Assessment

Only the Reasonable Maximum Exposure (RME) scenario needs to be presented in future revisions.

Response: As requested, only the RME scenario was presented in the revised HHRA.

Comment 5. Section 3.1: Exposure Scenarios

A quantitative evaluation to a child recreational user should be included to verify that the risk to child receptors is within the risk goal for the site.

Response: As requested, a quantitative evaluation to a child recreational user from exposure to vapors in air was presented in the revised HHRA. This evaluation is presented in Tables 15 through 18. The HHRA report text was revised accordingly.

Comment 6. Section 4.3: Chemical-Specific Issues

Prior to the report being sent to the Agency, the toxicity information for PCE (02/10/2012) and TCE (09/28/2011) were updated in IRIS. Please use the current toxicological information for these chemicals and revise the risk assessment.

Response: The most current toxicological information for TCE and PCE were used in the revised HHRA. Those values are presented in Table 9 of the revised HHRA.

Comment 7. Section 5.3.2: Construction Worker and Visitor Risk Characterization

The incorrect section was noted in Section 5.3.2 of the HHRA. Revise the first sentence of Section 5.3.2 to state the following, "As discussed in Section 3.1, exposure of a future commercial worker to vapors volatizing from subsurface is higher than that of a future construction worker and a future visitor/recreator."

Response: The correction was made in the revised HHRA report text.

Comment 8. Maintaining Integrity of Final Cover

According to the current Lagoon Post-Closure Plan dated December 13, 2002 as prepared by Conestoga-Rovers & Associates, the cover system of the SSL consists of a foot thick compacted clay layer which was covered with a 6-inch thick vegetative top soil layer. On top of the compacted clay layer was placed a nominal 6-inch thick layer of topsoil. The topsoil was fine graded to ensure positive drainage. The cover was vegetated with a grass seed mix consisting of perennial rye grass and red fescue.

It is important that the integrity of the final cover system of the SSL not be disturbed. The intent of the final cover system is to prevent any migration of wastes out of the unit to the adjacent subsurface soil or ground water or surface water at any time during the active life of the unit.

In accordance with OAC Rule 3745-56-28, the final cover of the surface impoundment must be designed and constructed to:

a. Provide long-term minimization of the migration of liquids through the closed impoundment; and

b. Function with minimum maintenance; and

c. Promote drainage and minimize erosion or abrasion of the final cover; and

d. Accommodate settling and subsidence so that the cover's integrity is maintained; and

e. Have permeability less or equal to the permeability of any bottom liner system or natural sub-soils present.

The final cover system must continue to conform to the above conditions during the life of the unit. The current owner, RACER Trust, and any future owner or operator, must ensure that the cover is maintained in a manner to be protective of human health and the environment. There may be instances where the cover system may be disturbed on a temporary basis to facilitate the installation of various future land use activities (i.e. asphalt parking lots, utility trenches, slab-on-grade foundations).

Under these situations, Ohio EPA would expect the cover system to be replaced in a manner that (1) does not increase the potential hazard to human health and the environment and (2) the cover system continues to conform to the criteria listed in OAC Rule 3745-56-28. Any change in the future land use of the SSL which could potentially impact the cover system must also conform to the approved Lagoon Post-Closure Plan.

Response: A "Recommendations" section was added to the report which recommends that at the time of redevelopment, consideration must be given to the design, construction, and operation of any facilities to ensure that 1) the integrity of the cover is not affected, and 2) that any disturbance of the cover will not increase the potential hazard to human health and the environment.

Comment 9. Slab-On-Grade Construction and Basement Scenarios

The HHRA evaluated both slab-on-grade construction and basement scenarios. Although consideration may be given to slab-on-grade construction, Ohio EPA will not permit buildings with a basement. In order to minimize or avoid disturbance to the integrity of the cover, Ohio EPA recommends that all slab-on-grade buildings be located off the cover system and preferably in the northern and southeast areas of the site. Pursuant to OAC Rule 3745-55-17(C), in the event that buildings or any other structures (i.e. parking lots, soccer fields) are located on the cover, consideration must *be given to the design, construction, and operation of these facilities to ensure that any disturbance of the cover will not increase the potential hazard to human health and the environment.*

Response: Because Ohio EPA has stated that it would not permit buildings with a basement, the basement scenario was deleted from the revised HHRA. As previously stated a "Recommendations" section was added to the revised HHRA. In that section, it is recommended that that the redevelopment plans design and the Post Closure Care Plan should consider that on-grade buildings could be located off the cover system and preferably in the northern and southeast areas of the site. Further that in the event that buildings or any other structures (i.e. parking lots, soccer fields) are located on the cover, consideration must be given to the design, construction, and operation of these facilities to ensure that any disturbance of the cover will not increase the potential hazard to human health and the environment.

Comment 10. Storm Water Management

The existing surface water drainage system for the SSL consists of a network of swales, catch basins, and underground pipes. The SSL was graded to ensure positive drainage. The grades and surface water controls direct water away from the cover, controlling the potential for run-on. The SSL cover system directs storm water runoff from the south toward the northwest corner of the site where it is collected and discharged to an underground 84-inch diameter storm sewer along the north perimeter of the SSL. The storm water is then directed to a storm sewer located along Dryden Road. Any future change in land use must be evaluated to ensure that storm water is managed to prevent run-on, promote drainage, and minimize erosion of the final cover.

Response: A "Recommendations" section was added to the HHRA report that recommends that any future change in land use must be evaluated to ensure that storm water is managed to prevent run-on, promote drainage, and minimize erosion of the final cover.

Comment 11. Amendment of Post-Closure Plan

Pursuant to OAC Rule 3745-55-18(D), the owner or operator must submit a written notification of, or request for a permit modification to authorize a change in the approved post-closure plan in accordance with the applicable requirements of rules 3745-50-40 to 3745-50-235 of the OAC. The owner or operator would be required to determine if any change in the future land use of the SSL would necessitate an amendment to the approved post-closure plan in accordance with OAC Rule 3745- 55-18(D).

Response: A "Recommendations" section was added to the HHRA report which states the above information.

Please contact me at (937) 751-8635 with any questions concerning the revised HHRA.

Sincerely,

Pamela L. Barnett

Pamela L. Barnett, PG
Assembly Region Cleanup Manager (DE, LA, MA, OH, PA, VA)
RACER Trust

Copies:
Jeff Stark, Site Coordinator,
Ohio Environmental Protection Agency, Southwest District Office
Division of Environmental Response and Revitalization
401 East Fifth Street, Dayton, Ohio 45402-2911

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REVISED Human Health Risk Assessment Report

Closed South Settling Lagoon, Moraine, Ohio

OH001102.0001

~~January~~ JULY 3, 2012

ARCADIS

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REVISED Human Health Risk Assessment Report

Closed South Settling Lagoon,

Moraine, Ohio

Prepared for:

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OH001102.0001

Date:

JULY 3, ~~January~~ 2012

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List of Acronyms and Abbreviations

ATSDR	Agency for Toxic Substances and Disease Registry
BRA	Baseline Risk Assessment
CFR	Code of Federal Regulations
CMP	Corrective Measures Proposal
COPC	Constituents of Potential Concern
CSF	Cancer Slope Factor
CSM	Conceptual Site Model
CTE	Central Tendency Exposure
ELCR	Excess Lifetime Cancer Risk
EPC	Exposure Point Concentration
GM	General Motors
HEAST	Health Effects Assessment Summary Tables
HHRA	Human Health Risk Assessment
HI	Hazard Indices
HQ	Hazard Quotients
IARC	International Agency for Research on Cancer
IM/CM	Interim Measures/Corrective Measures
IRIS	Integrated Risk Information System
RACER	Revitalizing Auto Communities Environmental Response Trust
NAS	National Academy of Science

NCEA	National Center for Environmental Assessment
NCP	National Contingency Plan
Ohio EPA	Ohio Environmental Protection Agency
OSHA	Occupational Health and Safety Administration
PCE	Tetrachloroethene
PPRTV	Provisional Peer Reviewed Toxicity Values
QA/QC	Quality Assurance/Quality Control
RCRA	Resource Conservation and Recovery Act
RfC	Reference Concentration
RFI	RCRA Facility Investigation
RME	Reasonable Maximum Exposure
RSL	Regional Screening Tables
SSL	South Settling Lagoon
STSC	Superfund Health Risk Technical Support Center
SWMU	Solid Waste Management Unit
TCE	Trichloroethene
UCL	Upper Confidence Limit on the Mean
URF	Unit Risk Factor
USEPA	United States Environmental Protection Agency
VIVI	Vapor Intrusion Verification Investigation

Executive Summary

This report presents ~~a~~THE REVISED Human Health Risk Assessment (HHRA) for the closed South Settling Lagoon (SSL) located at the RACER Moraine Site, in Moraine, Ohio (the Site). The goal of the HHRA was to assess the effects of Site conditions on human health considering future redevelopment plans. The HHRA was conducted under ~~both~~ a Reasonable Maximum Exposure (RME) scenario~~ and a Central Tendency Exposure (CTE) scenario~~. The RME depicts the upper range of exposure ~~while the CTE represents average exposure~~.

THE SSL WENT THROUGH RCRA CLOSURE IN 2001 BY SOLIDIFICATION OF THE SLUDGE, BACKFILL WITH A MINIMUM OF 10 FEET OF CLEAN STOCKPILE SOIL, PLACEMENT OF A ONE FOOT CLAY LAYER, AND A 6 INCH VEGETATED TOP SOIL LAYER. Proposed redevelopment at the Site may include recreational use, parking lots, trailer parking and warehouse space. Residential use of the property AND USE OF GROUNDWATER AS POTABLE WATER is not likely to occur and is not included in the HHRA. Therefore, the following receptors were identified in this HHRA: future on-site commercial/ industrial worker; future on-site construction worker; and future on-site child and adult visitor / recreator. The only media of concern at the Site ARE SOIL AND ~~is~~ soil vapor due to volatilization from groundwater FROM AN UPGRADIENT SOURCE ~~since the proposed area of excavation is all within clean fill and~~ the depth to groundwater precludes contact during excavation activities. Vapors tend to accumulate in indoor air thus exposure to vapors in indoor air is considered to be of much greater concern than exposure to vapors in outdoor air. Therefore the only exposure pathway RELATED TO INHALATION OF VOLATILES evaluated in the HHRA was inhalation of vapors in indoor air. Exposure was evaluated assuming ~~both~~ slab-on-grade construction~~ and a basement scenario~~.

TO EVALUATE DIRECT CONTACT WITH SOIL, DATA FOR THE STOCKPILE SOIL WAS USED. To evaluate vapor intrusions, data from both on-site groundwater wells SAMPLED AT BOTH THE SHALLOW AND DEEP PORTIONS OF THE UPPER AQUIFER, ~~and~~ ON-SITE SOIL GAS SAMPLING, AND near off-site soil gas sampling points was used in this HHRA. Constituents with maximum detected concentrations exceeding risk based screening levels (RBSLs) ~~for the vapor intrusion pathways~~ and METALS EXCEEDING BACKGROUND LEVELS were identified as constituents of potential concern (COPCs). RBSLs for the vapor intrusion pathway were derived using the latest USEPA Regional Screening Levels (RSL) for residential indoor air. BENZO(A)PYRENE WAS THE ONLY SOIL COPC IDENTIFIED AT THE SITE. ~~The only~~ COPCs identified in ~~both~~ groundwater ~~and soil gas~~ were: tetrachloroethene (PCE), and trichloroethene (TCE); WHILE COPCS IN SOIL INCLUDED PCE AND

TCE IN ADDITION TO BENZENE, ETHYLBENZENE, AND 1,1-DICHLOROETHANE (1,1-DCA).

Exposure point concentrationS (EPCs) in indoor air were estimated using the USEPA spreadsheets for Johnson and Ettinger model. Receptor exposure assumptions and toxicity values were obtained from USEPA and other relevant sources. Excess lifetime cancer risks and non-cancer hazard indices were calculated using standard methods.

Results show that risks to THE FUTURE CHILD VISITOR / RECREATOR AND the site commercial/ industrial worker were all below Ohio EPA target levels. Since the exposure of the commercial receptor TO VAPORS IN INDOOR AIR is higher than that of a future construction worker TO OUTDOOR AIR and a future ADULT visitor/ recreator TO INDOOR AIR, it was concluded that risks to those other two receptors were likewise acceptable.

Introduction

This document presents ~~an~~ THE REVISED amended human health risk assessment (HHRA) for the closed South Settling Lagoon (SSL) located at the RACER Moraine Facilities in Moraine, Ohio (the Site). A Baseline Risk Assessment (BRA) was previously prepared for the Site as part of the Resource Conservation and Recovery Act (RCRA) Facility Investigation (RFI) Report (ARCADIS Geraghty & Miller, Inc. 2000a and ENVIRON Corporation 2000a). Subsequently, the results of the BRA were updated via an updated HHRA presented in the Corrective Measures Proposal (CMP; ARCADIS 2008). Both the BRA and the updated HHRA were based on the assumption of industrial use for the SSL property.

Currently, potential property redevelopment indicates that an industrial use scenario may no longer be applicable for the SSL. Therefore, this amended HHRA was conducted to evaluate the potential future risks and hazards to human health associated with constituents detected at the SSL under future redevelopment conditions. The REVISED amended HHRA evaluates risk under ~~both a~~THE Reasonable Maximum Exposure (RME) ~~and Central Tendency Exposure (CTE) scenarios~~.

The amended HHRA was conducted consistent with Ohio EPA and United States Environmental Protection Agency (USEPA) regulatory guidance for risk assessment including: the Code of Federal Regulations (CFR) National Oil and Hazardous Substances Pollution Contingency Plan (NCP; 40CFR300.430); USEPA Risk Assessment Guidance for Superfund Parts A, D, and F; supporting USEPA guidance (USEPA 2009a; 2003; 2000; 2002a; 1997a, 1997b; 1992; 1991; 1989); and Ohio EPA Technical Decision Compendium (Ohio EPA 2009).

The amended HHRA is organized as follows:

- Site Overview
- Data Evaluation
- Exposure Assessment
- Toxicity Assessment
- Risk Characterization

- Uncertainty Analysis

1. Site Overview

Section 12 provides a brief summary of Site background and history and provides a description of key site characteristics and media of concern.

1.1 Site History

The SSL is a 7.9 acre portion of the former Delphi Thermal Moraine facility which is part of the 363 acre RACER Moraine Facilities located within the City of Moraine and the City of Kettering in Montgomery County in southwestern Ohio (Figures 1 and 2). Former Delphi Thermal Moraine's major operations, which began in 1941, included the machining and assembly of automotive air conditioning compressors, accumulator dehydrators, and miscellaneous air conditioning valves. Operations at the former Delphi Thermal Moraine Building 14 ceased in September 2003 and the building was decommissioned. Demolition of Building 14 was completed in 2005.

Former Delphi Thermal Moraine used the SSL between1965 and 1979 to divert industrial waste water including zinc plating wastes, anodizing wastes, pickling wastes, oils, and porcelain sludge for ultimate discharge into the Greater Miami River. Between 1980 and 1985, the SSL received process wastewater (consisting of dilute acid and alkali rinses from parts cleaning and non-cyanodic electroplating processes and fly ash dewatering filtrate), water softening sludges, non-contact cooling water, and storm water runoff. Beginning in November 1985, all process wastewaters were diverted to the on-site pretreatment facility. All stormwater and non-contact cooling water was diverted into a new concrete stormwater retention facility when the SSL was taken out of service in October 1989. Detection monitoring commenced at the SSL in February 1981 and continued until the lagoon closure activities were completed in 2001.

1.2 Site Characterization

In 1991, an Administrative Order was issued by the USEPA Region V, requiring Delphi Thermal Moraine to implement a RCRA Corrective Action program. General Motors CORPORATION (GM) met these requirements through the completion of a two-phased RFI at the Delphi Thermal Moraine facility and by implementing capture zone interim measures. The SSL was treated as a solid waste management unit (SWMU) within the Delphi Thermal Moraine facility.

The findings of both phases of the RFI for Delphi Thermal Moraine, including a BRA, were reported to the USEPA in a 1996 draft RFI Report which was finalized in April 2000 (ARCADIS Geraghty & Miller, Inc. 2000a and ENVIRON Corporation 2000a). The BRA within the RFI report determined that there were no unacceptable risks associated with soil at the Site, however, it was recommended that additional interim measures to address volatile constituents in groundwater should be implemented. An Interim Measures/Corrective Measures (IM/CM) Report was developed in 2001 (ARCADIS Geraghty & Miller, Inc. 2001) and implementation by RACER is ongoing.

Closure activities for the SSL were initiated in September 2000 and completed in June 2001. THREE WASTE BASINS WERE IDENTIIFED AT THE SSL: THE PRIMARY AND SECONDARY BASINS IN THE NORTHERN PORTION OF THE SITE AND THE SLUDGE BASIN ALONG THE SOUTHERN PORTION OF THE SITE. DURING THE RCRA CLOSURE ACTIVITIES, THE WASTE MATERIAL IN THE SLUDGE BASIN WAS RELOCATED TO THE SECONDARY BASIN. THE SLUDGE IN BOTH PRIMARY AND SECONDARY BASINS WAS THEN SOLIDIFIED AND THE AREA WAS BACKFILLED WITH A MINIMUM OF 10 FEET OF CLEAN STOCKPILE SOIL, THEN TOPPED WITH A ONE FOOT CLAY LAYER AND A 6 INCH VEGETATED TOP SOIL LAYER (CONESTOGA-ROVERS & ASSOCIATES, 2000). A SURVEY OF THE SOLIDIFIED WASTE AREA IN THE NORTHERN PORTION OF THE SITE IS INCLUDED AS APPENDIX A. GM submitted the Closure Certification Report to Ohio EPA on August 10, 2001 (Conestoga-Rovers & Associates, 2001) and the report was approved by Ohio EPA in a letter to GM dated June 27, 2002. The Lagoon Post-Closure Plan (Conestoga-Rovers & Associates, 2002) was submitted to the Ohio EPA on December 13, 2002 and was approved by Ohio EPA in a letter to GM dated December 24, 2003.

In 2008, a CMP (ARCADIS 2008) was submitted to the USEPA which serves as a comprehensive document that includes a summary of the RFI and Supplemental RFI, and all additional supplemental investigations. The CMP included an updated HHRA to update the BRA issued with the RFI.

Groundwater continues to be monitored on a yearly basis at the Site. Groundwater wells in the SSL include: HR-16, HR-17, W-2-S, W-3-S, and W-4-S (Figure 3). The most recent groundwater data considered in this HHRA was from November 2009.

In October 2010, a Vapor Intrusion Verification Investigation (VIVI) was conducted to the east and southwest of the Site. Soil vapor samples were collected from nine locations within the right-of-way (SGP-1 through SGP-9) in the area southwest of

RACER which is immediately south and downgradient of the SSL. Two of those locations (SGP-1 and SGP-2) are within approximately 25 feet of the southern boundary of the SSL (Figure 3). Therefore, soil gas data from those two locations are considered representative of soil gas at the SSL. The results of the soil gas investigation will be submitted to USEPA and Ohio EPA under a separate cover.

BETWEEN JANUARY 30, 2012, AND FEBRUARY 6, 2012, A VAPOR INTRUSION VERIFICATION INVESTIGATION WAS COMPLETED AT THE SSL UNDER US EPA AS PART OF SITE-WIDE RCRA CORRECTIVE ACTION. THE INVESTIGATION ACTIVITIES INCLUDED DRILLING; GROUNDWATER SAMPLING; AND SOIL-GAS POINT CONSTRUCTION, PURGING, LEAK TESTS, AND SAMPLING AT LOCATIONS SSL-1, SSL-2, AND SSL-3. RESULTS WERE REPORTED TO OHIO EPA IN A LETTER REPORT DATED MARCH 30, 2012 (RACER TRUST 2012).

1.3 Site Description

The SSL went through RCRA closure in 2001 by solidification of the sludge, backfill with 10 to 15 feet of clean stockpile soil, placement of a one foot clay layer, and a 6 inch vegetated top soil layer (Conestoga-Rovers & Associates, 2000). Currently the SSL is subject to post-closure care requirements and a restrictive covenant that was established in 2001 to restrict "activities that will not disturb the integrity of the final cover system in a manner that is inconsistent with the risk assessment for the Site." ~~This HHRA was conducted under two scenarios: 1) assuming the restrictive convent stays in place and 2) assuming the covenant is lifted. Under the first scenario, buildings on-site were assumed to be slab on grade; under the second scenario buildings with basements were considered.~~

1.3.1 Site Geology and Hydrogeology

The Site and surrounding areas lie over the Great Miami River buried valley aquifer, which consists of valley unconsolidated deposits of sand and gravel outwash deposits separated by discontinuous deposits of silt and clay-rich till.

As part of the RCRA closure in 2001, the sludge material in the SSL was solidified and covered with 10 to 15 feet of on-site and imported material, a one foot layer of clay, and a 6 inch vegetated top soil layer. The on-site backfill material was taken from clean stockpile soil from other areas of the RACER Moraine Site and broken or crushed on-site concrete structures. The imported material was clean soil, and clean hard fill material.

The SSL is underlain by two aquifers distinguished by the relation to a relatively continuous clay till referred to as the regional clay till. Where the regional clay till is absent, the upper and lower aquifers are in direct communication and identified by depth only. Groundwater elevation at the SSL ranges between from 17 feet (HR-16 and HR-17) to 26 feet (W-4-S) in 2008 (ARCADIS 2008). Groundwater flow is to the south.

1.3.2 Land Use

Areas adjacent to the RACER Moraine Site are zoned for general industry, light industry, general business, neighborhood business, and one- and two-family residential uses. The businesses in the surrounding area north of the RACER Moraine Site include warehouses, office buildings, light manufacturing and assembly, a gravel pit, cosmetics manufacturing, and dry cleaning. Businesses located east of the RACER Moraine Site include an analytical laboratory, a motel, and a television station. The area south of the RACER Moraine Site is zoned for general industry, light industry, neighborhood business, general business, and residential uses. The SSL lies in the south west corner of the RACER Moraine Site. The former Delphi Thermal Moraine facility is to the east of the SSL while the Great Miami River lies to the west of it. A residential area lies to the south of SSL and north of SSL is a former warehouse.

1.3.3 Regional Groundwater Use

Regional groundwater in the vicinity of the RACER Moraine Site has historically been used for public and private water supply as well as an industrial water supply. The development of public wells in the area is regulated by Ohio EPA while the development of private wells is regulated by the Ohio Department of Health. The upper aquifer in the region has been used historically for shallow private well use, but is typically no longer used as a potable or an industrial water supply. Future development of the upper aquifer as an industrial or a potable water source is not expected due to low sustainability and storage compared to the lower aquifer.

Historic records indicate that private water wells in the upper and lower aquifers have been installed in the vicinity of the RACER Moraine Site. GM conducted several off-site well surveys (including the most current in 2008; ARCADIS 2008) of existing wells to determine use and purpose. Based on the well survey, two properties located near the Site were identified that use well water. The closest active public well field is approximately two miles to the south, consisting of three wells that supply the City of West Carrollton.

Potable water in the area of the SSL is supplied through the City of Dayton supply in conjunction with county storage facilities and pump stations.

1.4 Media of Concern – CONCEPTUAL SITE MODEL

THE EXPOSURE SCENARIOS IN A HHRA ARE TYPICALLY DEPICTED BY A CONCEPTUAL SITE MODEL (CSM). THE CSM PROVIDES THE FRAMEWORK OF THE HHRA. IT CHARACTERIZES THE PRIMARY AND SECONDARY POTENTIAL SOURCES AND RELEASE MECHANISMS AND IDENTIFIES THE PRIMARY EXPOSURE POINTS, RECEPTORS, AND EXPOSURE ROUTES. EXPOSURE POINTS ARE PLACES OR "POINTS" WHERE EXPOSURE COULD POTENTIALLY OCCUR, AND EXPOSURE ROUTES ARE THE MEANS BY WHICH CONSTITUENTS OF INTEREST MAY BE TAKEN UP BY THE RECEPTOR (INGESTION, INHALATION, AND DERMAL CONTACT). THE CSM FOR THE SITE IS PROVIDED IN FIGURE 4 AND DISCUSSED BELOW.

THE SITE IS IN A COMMERCIAL / INDUSTRIAL ZONED AREA. FUTURE RESIDENTIAL REDEVELOPMENT IS NOT LIKELY AND WAS NOT INCLUDED IN THE HHRA.

THE CURRENT SITE USE IS INDUSTRIAL. AT THIS TIME, PROPOSED REDEVELOPMENT FOR THE SSL MAY INCLUDE RECREATIONAL USE, PARKING LOTS, TRAILER PARKING AND WAREHOUSE SPACE. THEREFORE, THE FOLLOWING CATEGORIES OF RECEPTORS ARE IDENTIFIED AT THE SITE:

- FUTURE ON-SITE COMMERCIAL / INDUSTRIAL WORKER
- FUTURE ON-SITE CONSTRUCTION WORKER
- FUTURE ON-SITE CHILD AND ADULT VISITOR / RECREATOR

EXPOSURE TO SOIL

EXPOSURE TO SOIL FOR THESE RECEPTORS CAN OCCUR ONLY WHEN THE POTENTIAL EXISTS FOR A RECEPTOR TO DIRECTLY CONTACT RELEASED CONSTITUENTS OR WHEN THERE IS A MECHANISM FOR RELEASED CONSTITUENTS TO BE TRANSPORTED TO A RECEPTOR. THE ONLY RECEPTOR EXPECTED TO HAVE DIRECT CONTACT WITH SOIL IS THE CONSTRUCTION WORKER RECEPTOR. AS NOTED EARLIER, THE SSL MATERIAL IS SOLIDIFIED AND COVERED WITH A MINIMUM OF 10 FEET OF CLEAN SOIL, A ONE FOOT LAYER OF CLAY, AND A 6 INCH VEGETATED TOP

SOIL LAYER. ALL FUTURE DEVELOPMENT (INCLUDING CONSTRUCTION) IN THE AREA OF THE SOLIDIFIED SSL MATERIAL WILL BE LIMITED TO THE CLEAN FILL OVERLYING THE SOLIDIFIED MATERIAL (10-15 FEET). TO ASSESS DIRECT EXPOSURE OF A CONSTRUCTION WORKER TO THE SOIL COLUMN, DATA FROM THE STOCKPILE FILL MATERIAL WAS USED IN THE CALCULATIONS.

EXPOSURE TO GROUNDWATER

GROUNDWATER IS NOT USED AS A POTABLE WATER SOURCE AND USE OF GROUNDWATER AS A POTABLE WATER SUPPLY IS NOT LIKELY TO OCCUR AND IS NOT INCLUDED IN THE HHRA. FURTHER, DIRECT CONTACT WITH GROUNDWATER IS ALSO NOT A COMPLETE EXPOSURE PATHWAY FOR THE CONSTRUCTION WORKER RECEPTOR BECAUSE THE DEPTH TO GROUNDWATER (APPROXIMATELY 18.5 FEET) PRECLUDES CONTACT DURING EXCAVATION ACTIVITIES WHICH ARE TYPICALLY LIMITED TO THE TOP 10 FEET OF SOIL. THE ONLY COMPLETE EXPOSURE PATHWAY TO GROUNDWATER IS INHALATION OF VOLATILE CONSTITUENTS THROUGH VAPOR MIGRATION FROM GROUNDWATER INTO INDOOR OR AMBIENT AIR. VAPORS TEND TO CONCENTRATE INDOORS AND AS SUCH VAPOR MIGRATION INTO INDOOR AIR IS GENERALLY CONSIDERED TO BE OF MUCH GREATER CONCERN THAN INTO OUTDOOR AIR, THEREFORE, EVALUATION OF INHALATION OF VAPORS INDOORS IS EXPECTED TO BE PROTECTIVE OF EXPOSURE TO VAPORS IN OUTDOOR AIR. BOTH GROUNDWATER AND SOIL GAS DATA WERE USED TO ASSESS THIS EXPOSURE SCENARIO. ~~As noted above, the SSL material is solidified and covered with 10 to 15 feet of clean soil, a one foot layer of clay, and a 6 inch vegetated top soil layer. Groundwater is located below the clean cover at a depth of approximately 17 to 26 feet. These conditions limit the media of concern. First, groundwater depth precludes direct contact even during excavation as typical excavation depths are 10 feet. Second, all surface soils are currently comprised of clean fill materials. These overlying materials prevent exposure to the SSL material present at depth. Currently, post-closure care requirements and a restrictive covenant (established in 2001) also restrict "activities that will disturb the integrity of the final cover system in a manner that is inconsistent with the risk assessment for the Site." These restrictions ensure that there is no contact with any subsurface soil or groundwater. In case the restrictions are lifted, any future development will be limited to excavating within the overlying clean soil, also limiting any future direct exposures to subsurface soils and groundwater. Finally, it should be noted that groundwater is not used as a potable water source and residential use of the property is not likely to occur and is not included in the HHRA.~~

~~Future redevelopment of the area over the SSL is currently being considered. Proposed redevelopment is potentially expected to include recreational use, parking lots, trailer parking and warehouse space. As noted above, it is assumed that all future development (including construction) will be limited to the 10 feet of clean fill overlying the solidified SSL material. Based on the discussion above, the only potential media of concern at the Site is soil gas that could migrate from the subsurface into indoor or ambient air. Since vapor migration into indoor air is generally considered to be of much greater concern than into outdoor air (due to concentration indoors), the media of concern / exposure pathway evaluated in this HHRA is indoor air or vapor intrusion. This HHRA considered two scenarios related to vapor intrusion: 1) a slab on grade building, and 2) a building with a basement.~~

2. Data Evaluation

Section 2~~3~~ describes the methods used to evaluate the data for use in the HHRA. The following was considered in the data evaluation: data quality, the vertical and spatial distribution of the data, sample date, sample type (e.g., primary or duplicate), and data qualifications. Data was found to be of adequate quality for inclusion in the HHRA per the USEPA data usability guidance (USEPA 1992). Qualified data with the exception of rejected data was included in the HHRA dataset.

Where there are duplicate results either due to duplicate samples or duplicate analyses (constituent analyzed for via several methods), the average detected concentration or the minimum detection limit for non-detected constituents was used. If a constituent was detected in a parent sample and not detected in the duplicate, the detected concentration was used.

The risk assessment datasets are described in the following sections.

2.1 SOIL RISK ASSESSMENT DATASET

AS DESCRIBED PREVIOUSLY, THE SSL WENT THROUGH RCRA CLOSURE UNDER OHIO EPA IN 2001 BY SOLIDIFICATION OF THE SLUDGE, BACKFILL WITH A MINIMUM OF 10 FEET OF CLEAN STOCKPILE SOIL, PLACEMENT OF A ONE FOOT CLAY LAYER, AND A 6 INCH VEGETATED TOP SOIL LAYER (CONESTOGA-ROVERS & ASSOCIATES, 2000). PRIOR TO SOLIDIFICATION, SAMPLES FROM THE SLUDGE WERE ANALYZED FOR METALS, ORGANICS, AND POLYCHLORINATED BIPHENYLS (PCBS). METALS AND PCBS WERE THE MAIN CONSTITUENTS IDENTIFIED IN THE SLUDGE. THE ANALYTICAL RESULTS

OF THE SLUDGE WERE REPORTED IN THE "DRAFT SOUTH SETTLING LAGOON REVISED CLOSURE / POST CLOSURE PLAN" (ARCADIS G&M 1989) AND ARE PRESENTED IN TABLE 0A. THE SLUDGE WAS THEN SOLIDIFIED BY MIXING WITH CEMENT AND KILN DUST TO A MINIMUM PHYSICAL STRENGTH CRITERION OF 25 POUNDS PER SQUARE INCH (PSI). THE SPECIFICATIONS OF THE SOLIDIFIED MATERIAL WERE PRESENTED IN THE LAGOON CLOSURE CERTIFICATION REPORT (CONESTOGA-ROVERS & ASSOCIATES, 2001).

ON TOP OF THE SOLIDIFIED SLUDGE, A MINIMUM OF 10 FEET OF STOCKPILED SOIL WAS ADDED. THE ANALYTICAL RESULTS OF THE CLEAN STOCKPILE SOIL WERE REPORTED IN THE "SOIL PILE CHARACTERIZATION" (ARCADIS G&M 1999) AND ARE PRESENTED IN TABLE 0B. THE STOCKPILE SOIL DATA WAS USED TO ASSESS DIRECT EXPOSURE TO SOIL AT THE SSL.

~~2.1~~2.2 Groundwater Risk Assessment Dataset

RECENT GROUNDWATER DATA FROM THE SHALLOW PORTION OF THE UPPER AQUIFER (SSL-1, SSL-2, SSL-3; FIGURE 3) ARE PRESENTED IN TABLE 1A. CONSTITUENTS DETECTED AT LEAST ONCE ARE PRESENTED.

All available groundwater data from THE DEEP PORTION OF THE upper aquifer wells at the SSL: HR-16, HR-17, W-2-S, W-3-S, W-4-S were evaluated for use in the HHRA (Figure 3). At each location, groundwater samples were analyzed for Appendix 9 constituents via SW-46 methods to support the RFI. However, as noted in Section 1.4 only the inhalation pathway is potentially complete FOR GROUNDWATER. Therefore, only volatile organic compounds (VOCs) are included in the risk evaluation. To evaluate current conditions, only the groundwater results for samples collected during the last 4 events per well were used in the HHRA. During this time period, monitoring well HR-16 was only sampled three times: 1999, 2002, and 2008. As a result, all available data for HR-16 was included in the HHRA but data from only 2006 to November 2009 was included for the other wells. The uncertainty associated with including old data especially for volatile compounds is discussed in the uncertainty discussion (Section 7.1). The groundwater dataset FROM THE DEEP PORTION OF THE AQUIFER ~~used in the HHRA~~ is presented in Table 1B. Constituents detected at least once are presented.

DATA FROM BOTH THE SHALLOW AND DEEP PORTIONS OF THE UPPER AQUIFER WERE USED TO ASSESS RISK FROM INHALATION OF VAPORS VOLATILIZING FROM CONSTITUENTS IN GROUNDWATER AT THE SITE.

2.22.3 Soil Gas Risk Assessment Dataset

BETWEEN JANUARY AND FEBRUARY 2012, NINE SOIL GAS SAMPLES (THREE DEPTHS AT THREE LOCATIONS) WERE TAKEN ONSITE AT THE SSL (SSL-1, SSL-2, SSL-3; FIGURE 3). THE ONSITE SOIL GAS DATASET IS PRESENTED IN TABLE 2A. CONSTITUENTS DETECTED AT LEAST ONCE ARE PRESENTED.

Soil gas samples were collected off-site near the southern boundary of SSL during the VIVI conducted in October and November 2010. In particular, two of the sample locations (SGP-1 and SGP-2) are approximately 25 feet south of the SSL (Figure 3). Soil gas data from these two locations are considered representative of soil gas at the SSL and are used for the soil gas risk assessment dataset for the SSL evaluation of vapor migration into indoor air. The OFFSITE soil gas HHRA dataset is presented in Table 2B. The list of constituents evaluated as part of the soil gas investigation was limited to site-related VOCs in groundwater. Only compounds detected at least once are presented in Table 2B.

DATA FROM BOTH THE ONSITE AND NEAR OFFSITE SOIL GAS DATASETS WERE USED TO ASSESS RISK FROM INHALATION OF VAPORS VOLATILIZING FROM CONSTITUENTS IN GROUNDWATER AT THE SITE.

2.32.4 Selection of Constituents of Potential Concern

Constituents of potential concern (COPCs) for the HHRA are generally selected based on the exceedance of applicable screening levels (USEPA 1989). COPC identification constitutes a conservative, risk-based screening evaluation that is used to identify those constituents that are expected to contribute the majority of potential exposure and risk. Under USEPA (1989) guidelines, COPCs can be identified based on criteria such as frequency of detection, toxicity, comparison with background concentrations (if applicable), or whether a chemical can be considered a common laboratory contaminant (e.g., acetone).

COPCs for this HHRA are selected based on the exceedance of applicable screening levels (i.e., toxicity screen). No chemicals were eliminated based on frequency of detection or comparison to background levels. RISK BASED SCREENING LEVELS FOR SOIL, UNDER THE INDUSTRIAL SCENARIO, WERE IDENTIFIED FROM THE LATEST USEPA REGIONAL SCREENING LEVELS (RSLS; USEPA 2012a). Risk based screening levels for groundwater and soil gas for the vapor intrusion pathways were derived using the latest USEPA Regional Screening Levels (RSLs) for residential indoor air (USEPA 2010a) per methods described in USEPA's *Draft Guidance for Evaluating the Vapor Intrusion to Indoor Air Pathway* (USEPA 2002a) AND RECOMMENDATIONS IN *VAPOR INTRUSION FREQUENTLY ASKED QUESTIONS* (USEPA 2012b). To obtain the groundwater RSLs, air RSLs were adjusted using Henry's Law Constant and an attenuation factor of 0.001; while indoor air RSLs were simply adjusted with an attenuation factor of 0.01 to obtain soil gas RSLs (USEPA 2012b). An indoor air RSL for cis-1,2-dichloroethene was not available, therefore trans-1,2,-dichloroethene was used as surrogate.

2.4.1 SOIL COPCS

THE SELECTION OF COPCS FOR DIRECT CONTACT WITH SOIL FOR A CONSTRUCTION WORKER RECEPTOR IS PRESENTED IN TABLE 3. SOIL EXPOSURE POINT CONCENTRATIONS (EPCS) WERE SET AT THE UPPER CONFIDENCE LIMIT ON THE MEAN PER USEPA METHODS (USEPA, 1989). UCLS WERE CALCULATED USING USEPA'S STATISTICAL SOFTWARE PROUCL (USEPA 2011). CONSTITUENTS WITH EPCS GREATER THAN THE INDUSTRIAL SOIL RSLS AND BACKGROUND (FOR METALS) WERE IDENTIFIED AS SOIL COPCS. BENZO(A)PYRENE WAS THE ONLY SOIL COPC IDENTIFIED AT THE SITE (Table 3).

2.3.12.4.2 Groundwater COPCs

The derivation of groundwater screening levels for the vapor intrusion pathway and the selection of COPCs are presented in Table 43. The only two constituents with maximum Site wide concentrations exceeding the screening levels were tetrachloroethene (PCE) and trichloroethene (TCE); therefore TCE and PCE were selected as COPCs in groundwater.

2.3.22.4.3 Soil Gas COPCs

The selection of COPCs for soil gas is presented in Table 45. USING THE ONSITE SOIL GAS DATASET, CONSTITUENTS WITH MAXIMUM CONCENTRATIONS EXCEEDING THE RSL WHICH WERE THUS IDENTIFIED AS THE COPCS WERE: BENZENE, ETHYLBENZENE, 1,1-DCA, PCE, AND TCE. USING THE NEAR OFFSITE SOIL GAS DATASET, Oonly PCE and TCE had maximum concentrations exceeding the screening levels, . ThereforeAND THEREFORE TCE and PCE were selected as COPCs in NEAR OFFSITE soil gas. The maximum concentrations of both constituents occur in sample SGP-2 at 15.4 feet.

3. Exposure Assessment

Exposure assessment is the process of measuring or estimating the intensity, frequency and duration of human exposure to substances present in the environment. The exposure assessment includes: (1) identification of potentially exposed populations; (2) development of exposure scenarios; (3) analysis of exposure pathways; (4) definition of exposure points; and (5) estimation of exposure point concentrations (EPCs). Together, these elements are used to estimate potential doses under past, current and reasonably foreseeable future conditions. Dose estimates are subsequently combined with the toxicity values identified in Section 5 to estimate risks associated with current and foreseeable future exposures, as part of the risk characterization discussed in Section 6. The exposure assessment is a critical component of the risk assessment process, as it qualitatively and quantitatively describes potential contact between COPCs and the people that may be affected by them.

In accordance with USEPA exposure assessment and risk characterization guidance (USEPA 1992b, 1995), doses and risks CAN BE~~are~~ calculated for both RME and CENTRAL TENDENCY EXPOUSRE (CTE) scenarios. The RME scenario describes individuals at the upper end of the population distribution (greater than 90th percentile, but not above the distribution), while the CTE scenario characterizes individuals in the middle of the population distribution (approximately 50th percentile). PER OHIO EPA RECOMMENDATIONS (OHIO EPA 2012), RISK UNDER THE RME SCENARIO ONLY ARE PRESENTED IN THE REVISED AMENDED HHRA.

The exposure assessment includes identification of exposure scenarios, EPC, and receptor exposure assumptions. Each of these is described below in greater detail

3.1 Exposure Scenarios

THE CSM PRESENTED IN SECTION 1.4, PROVIDES A CLEAR DESCRIPTION OF THE EXPOSURE SCENARIOS EVALUATED IN THIS REVISED HHRA. THE FOLLOWING CATEGORIES OF RECEPTORS AND COMPLETE EXPOSURE PATHWAYS WERE IDENTIFIED AT THE SITE:

- FUTURE ON-SITE COMMERCIAL / INDUSTRIAL WORKER
  - INHALATION OF VAPORS IN INDOOR AIR
- FUTURE ON-SITE CONSTRUCTION WORKER

  - DIRECT CONTACT WITH SOIL
  - INHALATION OF VAPORS AND DUST IN OUTDOOR AIR
- FUTURE ON-SITE CHILD AND ADULT VISITOR / RECREATOR
  - INHALATION OF VAPORS IN INDOOR AIR

~~The exposure scenarios in a HHRA are typically depicted by a conceptual site model (CSM). The CSM provides the framework of the HHRA. It characterizes the primary and secondary potential sources and release mechanisms and identifies the primary exposure points, receptors, and exposure routes. Exposure points are places or "points" where exposure could potentially occur, and exposure routes are the means by which constituents of interest may be taken up by the receptor (ingestion, inhalation, and dermal contact). The CSM for the Site is provided in Figure 4 and discussed below.~~

~~The current Site use is industrial. At this time, proposed redevelopment for the SSL may include recreational use, parking lots, trailer parking and warehouse space. Residential use of the property is not likely to occur and is not included in the HHRA. Therefore, the following categories of receptors are identified at the Site:~~

~~Future on-site Commercial/ Industrial Worker~~

~~Future on-site Construction Worker~~

~~Future on-site Child and Adult Visitor / Recreator~~

~~Exposure for these receptors can occur only when the potential exists for a receptor to directly contact released constituents or when there is a mechanism for released constituents to be transported to a receptor. As mentioned earlier (Section 2.4), all future development (including construction) will be limited to the 10 feet of clean fill overlying the solidified SSL material. As a result, potential receptors will not have any contact with Site materials or constituents in subsurface soil. Receptors will not have any direct contact with groundwater since the depth to groundwater (approximately 17 to 26 feet) precludes contact during excavation activities and because groundwater is not used as a potable water supply.~~

~~Therefore, the only potential exposure pathway for the receptors at the Site is the inhalation of volatile constituents through vapor migration from groundwater should buildings be constructed at the Site in the future. Although migration of VOCs from groundwater to outdoor air is also possible, VOC accumulation in indoor air is generally~~

considered to be of much greater concern than VOC migration into outdoor air. Therefore, evaluation of the vapor intrusion pathway is expected to be protective of a construction worker receptor exposed to vapors in outdoor air. Further, exposure to a site worker is typically higher than a visitor receptor, because exposure time, frequency, and duration are higher, and thus risk to a site worker receptor is protective to that for a visitor receptor. Therefore, risk to the site worker receptor will be quantitatively evaluated and risk to the visitor receptor will be qualitatively evaluated by comparison to the site worker.

In summary, the following receptor and pathway will be quantitatively evaluated in the HHRA:

- Future on-site Commercial/ Industrial Worker
  - Inhalation of vapors in indoor air.

3.2 Exposure Assumptions

Table 65 presents the exposure equation and exposure parameter values used to estimate potential exposure of site workers to groundwater and soil gas RECEPTORS TO COPCs in indoor airAT THE SITE. For the inhalation pathway, exposure values are selected for the following parameters: concentration in air, exposure duration, exposure frequency and exposure time.

When calculating exposure for inhalation, intake is presented in units of milligrams per cubic meter (mg/m^3). In all cases, intakes (doses) are calculated for both RME and CTE SCENARIOSAS RECOMMENDED BY OHIO EPA (2012), EXPOSURE UNDER THE RME SCENARIO WAS EVALUATED. RME exposure is defined by USEPA (1992b) as the "plausible estimate of the individual risk for those persons at the upper end of the risk distribution. The intent of this descriptor is to convey an estimate of risk in the upper range of the distribution, but to avoid estimates which are beyond the true distribution." RME risk estimates may be calculated by "identifying the most sensitive parameters and using maximum or near-maximum values for one or a few of these variables, leaving others at their mean values" (USEPA 1992b). In contrast to the RME exposure, central tendency evaluates potential intake for the average exposure. As such, CTE parameters are generally set at the 50^{th} percentile values.

THE EXPOSURE PARAMETER USED FOR ASSESSING RISK TO THE FUTURE ON-SITE CONSTRUCTION WORKER RECEPTOR IN THIS HHRA WERE BASED

ON DEFAULT VALUES RECOMMENDED BY USEPA (1989, 1991, 2002C, 2004C). EXPOSURE ASSUMPTIONS ARE PRESENTED IN TABLE 6.

The exposure parameter used for assessing risk to the future on-site industrial/commercial site worker receptor in this HHRA are presented in Table ~~5~~6 and discussed below.

- Exposure Frequency (EF) in days/year. The EF was set 250 days/year, based upon a 5-day work week for 50 weeks/year, for the RME scenario as recommended by USEPA (1989; 1991; 1997a). ~~The EF was set at 230 days/ year for the CTE scenario as recommended by USEPA (1997a).~~

- Exposure Duration (ED) in years. The ED was set at 25 years for the RME scenario per USEPA recommendations (1989; 1991; 1997a). ~~The ED was set at 6.6 years for the CTE scenario as recommended by USEPA (1997a).~~

- Exposure Time (ET) in hours per day. The ET was set at the typical work day of 8 hours per day for ~~both~~ the RME ~~and CTE~~ scenarios.

- Averaging Time (AT) in days. The values for AT used in this HHRA were consistent with USEPA (1989). USEPA (1989) guidance recommend an AT equal to 70 years for evaluating carcinogenic risk and an AT equal to the ED for evaluating noncarcinogenic hazard. USEPA (1989) calculates AT for carcinogens by multiplying 365 days/year by a 70-year lifetime. USEPA (1989) calculates AT for noncarcinogens by multiplying 365 days/year by the ED for each receptor.

THE EXPOSURE PARAMETER USED FOR ASSESSING RISK TO THE FUTURE ON-SITE CHILD VISITOR RECEPTOR IN THIS HHRA ARE ALSO PRESENTED IN TABLE 6 AND DISCUSSED BELOW.

- EXPOSURE FREQUENCY (EF) IN DAYS/YEAR. THE EF WAS SET 156 DAYS/YEAR, ASSUMING 3 VISITS PER WEEK FOR 52 WEEKS/YEAR.

- EXPOSURE DURATION (ED) IN YEARS. THE ED WAS SET AT 6 YEARS FOR THE RME SCENARIO PER USEPA RECOMMENDATIONS (1989; 1991; 1997A).

- EXPOSURE TIME (ET) IN HOURS PER DAY. THE ET WAS SET AT 3 HOURS PER DAY.

- AVERAGING TIME (AT) IN DAYS. THE VALUES FOR AT USED IN THIS HHRA WERE CONSISTENT WITH USEPA (1989). USEPA (1989) GUIDANCE RECOMMEND AN AT EQUAL TO 70 YEARS FOR EVALUATING CARCINOGENIC RISK AND AN AT EQUAL TO THE ED FOR EVALUATING NONCARCINOGENIC HAZARD. USEPA (1989) CALCULATES AT FOR CARCINOGENS BY MULTIPLYING 365 DAYS/YEAR BY A 70-YEAR LIFETIME. USEPA (1989) CALCULATES AT FOR NONCARCINOGENS BY MULTIPLYING 365 DAYS/YEAR BY THE ED FOR EACH RECEPTOR.

3.3 Exposure Point Concentrations

The EPC is the representative concentration of a constituent in an environmental medium that is potentially contacted by the receptor (USEPA, 1989). The EPC is defined as "the arithmetic average of the concentration that is contacted over the exposure period" (USEPA, 1989). Direct EPCs are based on measured concentrations in the affected media while indirect EPCs are estimated EPCs in secondary media (e.g., indoor air). ~~EPCs for both the RME and the CTE scenarios were used in this HHRA.~~ Indoor air EPCs were calculated from groundwater and soil gas data using the USEPA spreadsheets for Johnson and Ettinger model (USEPA 2004b,c) per the User's Guide (USEPA 2004a). The calculated indirect EPCs represent the concentration in indoor air that could volatilize through the subsurface from either groundwater or soil gas.

Groundwater and soil gas concentrations input into the model were as follows:

- Groundwater concentrations used in the model were the 95 percent upper confidence level (95UCL) on the mean (assuming a one-tailed distribution) ~~for the RME scenario and the average concentration for the CTE scenario~~. The UCL is a statistical number calculated to represent the mean concentration with 95 percent confidence that the true arithmetic mean concentration for the Site will be less than the UCL. The high level of confidence (i.e., 95 percent) is used to compensate for the uncertainty involved in representing site conditions with a finite number of samples. The ProUCL software available from USEPA (USEPA 2010c) was used to calculate the 95UCLs. ProUCL outputs are presented in Appendix AB. ~~The average concentrations used in the CTE scenario were calculated using all the data assuming ½ the detection limit as a detected value for non detected results~~.

- Soil gas concentrations used in the model were the maximum detected concentration, for the RME scenario which were reported in the sample taken at SGP-2 at 15.5 feet. The average concentration detected in both SGP-1 and SGP-2 at 15.5 feet was used for the CTE scenario.

Both aA slab-on-grade and basement scenario were was evaluated with the J&E model consistent with the approach outlined in Section 2.4. Model input parameters and estimated EPCs are summarized in Tables 67 and 78 for both scenarios, respectively.

Input parameters related to the structure were set at the default values for a residential structure (e.g., building size, building pressure differential, air exchange rate, floor thickness, floor crack and seam sizes etc). This approach is conservative as a residential building is expected to overestimate potential EPCs and exposures for a commercial building. Some Site specific model input parameters were used as discussed below.

- Depth below grade to bottom of enclosed space was set at 15 cm for the slab-on-grade scenario and 200 cm for the basement scenario. Both tThishese values are is default (USEPA 2004).

- Depth below grade to water table was set at 17.5 feet since groundwater elevation at the SSL ranges between from 17 feet (HR-16 and HR-17) to 26 feet (W-4-S) in 2008 (ARCADIS 2008).

- Soil gas sampling depth was set at 15.5 feet AS SOIL GAS CONCENTRATIONS WERE HIGHER AT DEPTH AND GROUNDWATER WAS AT 18.5 FEETwhich is the depth where the maximum off-site soil gas concentrations were encountered.

- Soil type was set consistent with the native soil. As noted previously, the sludge in the SSL is covered with 10 to 15 feet of clean stockpile soil, a one foot layer of clay, and a 6 inch vegetated top soil layer (Conestoga-Rovers & Associates, 2000). The stockpile soil was taken from the Site which has a general soil type of silty sand. This soil type was confirmed by the soil borings from near off-site location (SGP-1 and SP-2). Based on this information, the following soil types were used in the models:

- ~~For the slab-on-grade scenario, t~~Three soil strata were used to simulate the vapor migration zones: soil in stratum A (immediately above water table) was set at sandy loam (per USEPA 2004a recommendations for a silty sand soil type with up to 24% fine material), soil in stratum B was set at clay, and finally the soil type of stratum C was set at loam (top soil).
  - ~~For the basement scenario, it was assumed that the top soil layer and the clay layer are removed during basement construction. Only one soil type (sandy loam) was used in the model.~~
- ~~The thickness of soil in the groundwater model varied depending on scenario:~~
- ~~For the slab-on-grade scenario, t~~The thickness of stratum A (immediately above water table) IN THE GROUNDWATER MODEL was set at 16 feet~~, while the thickness of stratum B was set at 1 foot, and finally the thickness of stratum C was set at 0.5 foot~~.
  - ~~For the basement scenario the thickness of stratum A was set at 16 feet (assuming the clay layer and top soil will be removed at excavation).~~
- Thickness of soil in the soil gas model was set at 15.5 feet AS SOIL GAS CONCENTRATIONS WERE HIGHER AT DEPTH AND GROUNDWATER WAS AT 18.5 FEET~~which was the depth of the samples used in this assessment~~.

4. Toxicity Assessment

The toxicity assessment describes the relationship between the administered and/or the absorbed dose of a chemical and the magnitude or likelihood of adverse health effects (USEPA 1989). For chemicals that are known or suspected to cause cancer, the toxicity assessment defines the relationship between the dose of the chemical or agent and the probability of induction of carcinogenic effects in humans or animal species of interest. For systemic toxicants, or chemicals that give rise to toxic endpoints other than cancer and gene mutations (called noncarcinogenic effects), the toxicity assessment process determines a threshold value below which adverse noncarcinogenic effects are not expected in the general population, including sensitive subgroups.

Toxicity values for potential non-carcinogenic and carcinogenic effects are determined from available databases. For this HHRA, toxicity values are consistent with the recommended USEPA hierarchy (USEPA 2003) and the latest USEPA guidance (USEPA 2009a). Therefore, the following sources were used to obtain toxicity values, in the order in which they are presented below.

- USEPA's Integrated Risk Information System (IRIS) (2012~~0b~~c);
- USEPA's ~~The~~ Provisional Peer Reviewed Toxicity Values (PPRTVs) (USEPA 2012d) ~~derived by USEPA's Superfund Health Risk Technical Support Center (STSC) for the USEPA Superfund program as obtained from the National Center for Environmental Assessment (NCEA 2009)~~;
- The Agency for Toxic Substances and Disease Registry (ATSDR 2012) as referenced in the RSL tables (USEPA 201~~0~~2a);
- State Environmental Protection Agencies – specifically the California Environmental Protection Agency/Office of Environmental Health Hazard Assessment's Toxicity Criteria Database (CalEPA 201~~0~~2); and
- The USEPA Superfund program's Health Effects Assessment Summary Tables (HEAST; USEPA 1997b).

4.1 Non-Carcinogenic Effects

For many non-carcinogenic effects, protective mechanisms must be overcome before an effect is manifested. Therefore, a finite dose (threshold), below which adverse effects will not occur, exists for non-carcinogens. Constituents may exhibit their toxic effects at the point of application or contact (local effect) or at other sites (systemic effects) after they have been distributed throughout the body. The goal of toxicity studies for application in risk assessment is to identify the most sensitive toxic effect and the exposure levels that are expected to be safe. For noncancer effects, the toxicity assessment yields a reference dose (RfD) or reference concentration (RfC), which corresponds to an estimate of the daily dose or concentration likely to be without appreciable risk of adverse noncarcinogenic effects during a lifetime, with uncertainty spanning perhaps an order of magnitude (Dourson and Stara 1983).

RfCs and RfDs are generally calculated by determining the highest dose at which there are no observed adverse health effects (NOAEL) and by adjusting this dose using a series of uncertainty factors (UFs) and modifying factors (MFs). The UFs are intended to conservatively account for the variation in sensitivity within the human population, uncertainty in extrapolating from animals to humans, uncertainty in extrapolating from short-term animal studies to chronic exposures in humans, and/or the inability of the toxicological database to address all possible adverse outcomes in humans. The MFs may be applied to address specific scientific uncertainties or overall database quality. For studies in which a NOAEL cannot be identified, the lowest dose associated with an observed adverse effect (LOAEL) is used and an additional UF is applied to account for the uncertainty of using LOAEL data rather than NOAEL data.

~~For this HHRA, only the inhalation pathway is evaluated and therefore, only RfC values are identified for evaluating potential toxicity.~~ Table ~~8~~9 summarizes the noncancer toxicity data for the COPCs ~~for the inhalation pathway~~ AT THE SITE.

4.2 Carcinogenic Effects

Cancer induction in humans and animals by chemicals proceeds through a complex series of reactions and processes. Carcinogenic constituents may produce tumors at the point of application or contact, or they may produce tumors in other tissues after they have been distributed throughout the body. Constituents are classified as known, probable, or possible human carcinogens based on a USEPA weight-of-evidence scheme in which they are systematically evaluated for their ability to cause cancer in humans or laboratory animals. The USEPA classification scheme (USEPA 1989) contains five classes based on the weight of available evidence, as follows:

- A known human carcinogen
- B probable human carcinogen
  - B1 probable human carcinogen—limited evidence in humans
  - B2 probable human carcinogen—sufficient evidence in animals and inadequate data in humans
- C possible human carcinogen—limited evidence in animals
- D inadequate evidence to classify
- E evidence of non-carcinogenicity

Constituents in Classes A, B1, and B2 generally are evaluated as carcinogens in risk assessments; however, Class C carcinogens may be evaluated on a case-by-case basis (USEPA 1989).

For carcinogens, USEPA's Cancer Guidelines (USEPA 2005) recommends a conservative default approach in which it is assumed that any level of exposure could cause cancer when data are not adequate to understand the mode of action. Although the 2005 guidelines recommend that USEPA consider both linear and nonlinear dose-response models, USEPA generally relies on the default approach and extrapolates either the lowest dose or point of departure from laboratory animal data or human occupational exposure data using a mathematical model that plots a line through the zero point and, based on the slope of this dose-response line, assigns a risk level for increasingly smaller doses of a particular compound. While constructing the linear extrapolation from animal or human data, USEPA uses values that are based on a UCL of the dose/response slope. Therefore, any risk estimates derived from the model are based on values higher than those reported in the underlying studies and not the most likely estimates generated by applying the mathematical model to the actual study data. The UCL for the slope of this line is called the cancer slope factor (CSF) if the units are risk per dose or an inhalation unit risk (IUR) if the units are risk per air concentration. CSFs and IURs are used to assess carcinogenic risk.

~~For this HHRA, only the inhalation pathway is evaluated and therefore, only IUR values are identified for evaluating potential toxicity.~~ Table ~~8~~9 summarizes the cancer toxicity data for the COPCs AT THE SITE ~~for the inhalation pathway and they are discussed in further detail below~~.

4.3 Chemical-Specific Issues

~~Toxicity assessments are currently under review for both TCE and PCE. The USEPA released an external review draft IRIS Toxicological Assessment for TCE in 2009 and for PCE in 2008.~~ THE CHEMICALS OF INTEREST AT THE SITE ARE PCE AND TCE. USEPA RECENTLY ISSUED TOXICITY ASSESSMENTS FOR TCE AND PCE (USEPA 2011, 2012). ~~The National Academy of Sciences (NAS) released their comments on the PCE draft in 2010.~~ The ~~draft~~ IRIS Toxicological Assessment for TCE (USEPA 2011~~09b~~) classified TCE as "carcinogenic to humans."; WHILE -T~~T~~HE ~~draft~~ IRIS Toxicological Assessment FOR PCE (USEPA 2012e~~08~~) classifie~~d~~s it ~~PCE~~ as "likely to be a human carcinogen." ~~NAS (2010) agreed with the USEPA classification for PCE, but disagreed with the cancer endpoint of leukemia selected to derive the cancer slope factor. Rather, NAS felt that there was significant uncertainty with the leukemia results and recommended that USEPA use the liver cancer data, followed by data on kidney cancer and leukemia (NAS 2010). This change would yield a more scientifically defensible IUR rather than one based on the highest risk estimates.~~

~~USEPA has not finalized the toxicological evaluations for TCE and PCE; however, CalEPA has published IURs for both PCE and TCE that are currently being used by USEPA in the Regional Screening Levels (USEPA 2010a). Therefore, CalEPA IURs were used to estimate risks associated with inhalation exposure for both PCE and TCE in this HHRA.~~

5. Risk Characterization

Risk characterization is the final step in the risk assessment process. In this step, the results of the hazard identification, exposure assessment and toxicity assessment are integrated to yield a quantitative measure of carcinogenic risk and noncarcinogenic hazard. Potential carcinogenic risks and noncarcinogenic hazards are evaluated for the complete exposure pathways identified in Section 5.

5.1 Non-Carcinogens

Non-cancer hazards are estimated by calculating hazard quotients (HQ) and hazard indices (HI). The HQ is the ratio of the estimated exposure concentration and the RfC for a specific chemical.

$$HQ = [Intake] \div [RfC/\underline{RfD}]$$

Consistent with USEPA policy, the pathway-specific HQs are summed to yield HIs for each scenario. HIs are evaluated relative to a benchmark value of 1. An HQ/HI greater than 1 indicates that the estimated exposure level for that constituent exceeds the RfC. An HQ less than 1 indicates that health effects should not occur, an HQ that exceeds 1 does not imply that health effects will occur, but that health effects are potentially possible. In this HHRA, calculated HIs were compared to the target HI of 1 consistent with USEPA's NCP and Ohio EPA (2009).

5.2 Carcinogens

The excess lifetime cancer risk (ELCR) is an estimate of the potential increased risk of cancer that results from lifetime exposure to constituents detected in media at a site. Estimated doses or intakes for each constituent are averaged over the hypothesized lifetime of 70 years. It is assumed that a large dose received over a short period is equivalent to a smaller dose received over a longer period, as long as the total doses are equal. The ELCR is calculated as the product of the exposure concentration and the IUR.

$$ELCR = [Intake] \times [IUR/CSF]$$

The ELCR indicates the potential increased risk, above that applying to the general population, which may result from the exposure to COPCs at the Site. The ELCR is considered to be an upper-bound estimate; therefore, it is likely that the true risk is far less than the ELCR. In this HHRA, calculated ELCRs were compared to both USEPA's NCP (40CFR300.430) cancer risk range of 10^{-6} to 10^{-4} with 10^{-6} as point of departure and to Ohio EPA (2009) target ELCR of 10^{-5}.

5.3 Risk Characterization Results

The risk assessment evaluated risk to the following receptors: future on-site commercial/ industrial worker; future on-site construction worker; and future on-site child and adult visitor / recreator. Risk to the CONSTRUCTION WORKER, THE commercial worker receptor, AND THE CHILD RECREATOR was evaluated quantitatively while risk to the ADULT VISITOR FROM EXPOSURE TO VAPORS ~~other receptors~~ was qualitatively evaluated in comparison to that of the commercial worker receptor.

5.3.1 CONSTRUCTION WORKER RISK CHARACTERIZATION

THE ONLY COPCS FOR SOIL WAS BENZO(A)PYRENE. CANCER AND NONCANCER RISK FOR A CONSTRUCTION WORKER RECEPTOR WERE EVALUATED FOR THE DIRECT CONTACT WITH SOIL (INCIDENTAL INGESTION, DERMAL CONTACT, AND INHALATION OF COPCS ADHERED TO DUST). RISK CALCULATIONS FOR THESE SCENARIOS ARE PRESENTED IN TABLE 10. THE ESTIMATED CUMULATIVE CANCER RISK FOR THE CONSTRUCTION WORKER FROM DIRECT EXPOSURE TO SOIL WAS 5×10^{-7} WHICH IS WELL BELOW THE LOWER END OF THE NCP ACCEPTABLE CANCER RISK RANGE OF 10^{-4} TO 10^{-6} AND WELL BELOW THE OHIO EPA TARGET RISK OF 10^{-5}. THE TOTAL HI WAS NOT CALCULATED SINCE THE COPC - BENZO(A)PYRENE - IS TOXIC BY A CARCINOGENIC MODE OF ACTION.

~~5.3.1~~5.3.2 Commercial Worker Risk Characterization

Cancer and noncancer risk for a commercial worker receptor were evaluated for the indoor air pathway using both groundwater and soil gas data and assuming ~~both~~ slab-on-grade construction ~~and a basement scenario~~. Risk calculations ~~for these scenarios~~

are presented in Tables 119 through 164, ~~summarized in Table 17,~~ and described briefly beneath.

~~Slab on grade scenario~~

Estimated cancer risks for a site worker exposed to VOCs in indoor air using SHALLOW AND DEEP ONSITE groundwater data are 91 x 10^{-78} and 26 x 10^{-87} ~~for the CTE and RME scenarios~~, respectively (Tables 911 and 120). All estimated cancer risk are below the lower end of the NCP acceptable cancer risk range of 10^{-4} to 10^{-6} and well below the Ohio EPA target risk of 10^{-5}. The total HIs from indoor vapor inhalation from shallow and deep groundwater are 0.40006 and 0.04009 ~~for the CTE and RME scenarios~~, respectively. All HIs are also below the USEPA NCP and the Ohio EPA target non-cancer hazard of 1.

The total ELCR for the site worker exposed to VOCs in indoor air using ONSITE AND near off-site soil gas data, are 65 x10^{-87} and 25 x10^{-76} ~~for the CTE and RME scenarios~~, respectively (Tables 131 and 142). The total ELCR ~~under CTE~~ is well below the NCP acceptable risks range ~~while the total ELCR under RME is within the range of acceptable risk by USEPA~~ and is lower than the Ohio EPA target risk of 10^{-5}. The total HIs from indoor vapor inhalation, based on ONSITE AND NEAR OFF-SITE soil gas concentrations, are 0.1004 and 0.0508 ~~for the CTE and RME scenarios~~, respectively. All hazards are below the USEPA NCP and Ohio EPA target non cancer hazard of 1.

~~Basement scenario~~

~~Estimated cancer risks for a site worker exposed to VOCs in indoor air using groundwater data are 8 x 10^{-8} and 5 x 10^{-7} for the CTE and RME scenarios, respectively (Tables 13 and 14). All estimated cancer risk are below the lower end of the NCP acceptable cancer risk range of 10^{-4} to 10^{-6} and well below the Ohio EPA target risk of 10^{-5}. The total HIs from indoor vapor inhalation from groundwater are 0.0005 and 0.0008 for the CTE and RME scenarios, respectively. All HIs are also below the USEPA NCP and the Ohio EPA target non-cancer hazard of 1.~~

~~The total ELCR for the site worker exposed to VOCs in indoor air using near off-site soil gas data, are 4 x10^{-7} and 3 x10^{-6} for the CTE and RME scenarios, respectively (Tables 15 and 16). The total ELCR under CTE is well below the NCP acceptable risks range while the total ELCR under RME is within the range of acceptable risk by USEPA and is lower than the Ohio EPA target risk of 10^{-5}. The total HIs from indoor vapor inhalation, based on soil gas concentrations, are 0.002 and 0.004 for the CTE~~

~~and RME scenarios, respectively. All hazards are below the USEPA NCP and Ohio EPA target non cancer hazard of 1.~~

5.3.3 ~~Construction Worker and~~ Visitor Risk Characterization

CANCER AND NONCANCER RISK FOR A CHILD VISITOR RECEPTOR WERE EVALUATED FOR THE INDOOR AIR PATHWAY USING BOTH GROUNDWATER AND SOIL GAS DATA AND ASSUMING SLAB-ON-GRADE CONSTRUCTION. RISK CALCULATIONS ARE PRESENTED IN TABLES 15 THROUGH 18, AND DESCRIBED BRIEFLY BENEATH.

ESTIMATED CANCER RISKS FOR A CHILD VISITOR EXPOSED TO VOCS IN INDOOR AIR USING SHALLOW AND DEEP ONSITE GROUNDWATER DATA ARE 6 X 10^{-9} AND 1 X 10^{-9}, RESPECTIVELY (TABLES 15 AND 16). ALL ESTIMATED CANCER RISK ARE BELOW THE LOWER END OF THE NCP ACCEPTABLE CANCER RISK RANGE OF 10^{-4} TO 10^{-6} AND WELL BELOW THE OHIO EPA TARGET RISK OF 10^{-5}. THE TOTAL HIS FROM INDOOR VAPOR INHALATION FROM SHALLOW AND DEEP GROUNDWATER ARE 0.09 AND 0.01, RESPECTIVELY. ALL HIS ARE ALSO BELOW THE USEPA NCP AND THE OHIO EPA TARGET NON-CANCER HAZARD OF 1.

THE TOTAL ELCR FOR THE CHILD VISITOR EXPOSED TO VOCS IN INDOOR AIR USING ONSITE AND NEAR OFF-SITE SOIL GAS DATA, ARE 3 X10^{-9} AND 1 X10^{-8}, RESPECTIVELY (TABLES 17 AND 18). THE TOTAL ELCR IS WELL BELOW THE NCP ACCEPTABLE RISK RANGE AND IS LOWER THAN THE OHIO EPA TARGET RISK OF 10^{-5}. THE TOTAL HIS FROM INDOOR VAPOR INHALATION, BASED ON ONSITE AND NEAR OFF-SITE SOIL GAS CONCENTRATIONS, ARE 0.02 AND 0.1, RESPECTIVELY. ALL HAZARDS ARE BELOW THE USEPA NCP AND OHIO EPA TARGET NON CANCER HAZARD OF 1.

As discussed in Section 34.1, exposure of a future commercial worker to vapors volatizing from subsurface is higher than that of a future construction worker and a future ADULT visitor/ recreator. Compared to a commercial worker, construction worker exposure would be limited to ambient air. Unlike indoor air, there is no potential for accumulation of vapors in ambient air and all construction worker risks are estimated to be lower. Similarly, a visitor or recreator using the outside recreational options would have exposure only to ambient air. Visitors could come indoors to use on-site buildings, but the exposure time, frequency, and duration of exposure would be much lower than that of a commercial worker. RISK TO AN ADULT VISITOR FROM

EXPOSURE TO VAPORS IN INDOOR AIR WILL BE LESS THAN THAT OF A COMMERCIAL WORKER FROM EXPOSURE TO INDOOR AIR. WHILE RISK TO A CHILD VISITOR FROM EXPOSURE TO VAPORS IN INDOOR AIR IS SIMILARLY EXPECTED TO BE LOWER THAN THE COMMERCIAL WORKER, IT WAS QUANTITATIVELY EVALUATED (SECTION 5.3.2).

~~As noted above, in all cases, commercial worker exposure will exceed that of a a future construction worker receptor and to a child/ adult visitor/ recreator. As a result, , that the risk calculations for the site worker represent a worst case scenario. to~~ Because all cancer and non-cancer risks for the commercial worker are below Ohio EPA target levels, risks to a construction worker and AN ADULT visitor or recreator FROM INHALATION OF VAPORS are estimated to be well below acceptable risk benchmarks.

6. Uncertainty Analysis

The risk estimates presented here are conservative estimates of potential risks associated with exposure to constituents detected in the Site subsurface. Uncertainty is inherent in the risk assessment process, and a discussion of these uncertainties is presented in this section. Each of the three basic building blocks for risk assessment (data, exposure assessment, and toxicity values) contributes uncertainties. Each of the uncertainties is accounted for by using conservative assumptions wherever specific data are unavailable.

6.1 Data Evaluation

The data evaluation step can lead to uncertainty in the risk estimates due to uncertainty in the data itself or due to uncertainty in due to the COPC selection process as discussed below.

6.1.1 Sample Location and Collection

This risk assessment is based on the assumption that the available monitoring data adequately describe the occurrence of constituents in media at the Site. Environmental sampling itself introduces uncertainty. This source of uncertainty can be reduced through a well-designed sampling plan, use of appropriate sampling techniques, and implementation of laboratory data validation and quality assurance and quality control (QA/QC). The data used in this report meet QA/QC requirements and are appropriate for use in a risk assessment.

6.1.2 Screening of Constituents of Potential Concern

Uncertainty is inherent in the selection of COPCs for the risk assessment. Eliminating constituents in the COPC screening process can lead to lower estimates of potential health effects than inclusion of all analytes. The screening concentrations used for the human health screening were based on conservative values. Further, in this risk assessment, the maximum concentration was used to screen for COPCs. Because of the way in which screening was done, the possibility of overlooking a significant constituent is considered minimal.

6.2 Toxicity Assessment

The toxicity values and other toxicological information used in this report likewise are associated with significant uncertainty. Many toxicity values are developed using results of studies in which laboratory animals are exposed to massively high doses of particular constituents over an entire lifetime. As such, these studies do not represent realistic examples of environmental exposures. In addition, humans are different than laboratory animals. Many, if not most, animals used for laboratory studies are genetically designed to be more sensitive than humans to specific compounds. In addition, the effects shown by the animals in the high-dose studies are often very different than effects reported by humans in parallel epidemiological studies. This is because a particular compound may have a different mechanism of action in laboratory animals than it does in humans. Even epidemiological studies, which are generally preferable to animal toxicity studies, are characterized by several uncertainties, such as differential exposures and unknown (and uncontrolled) doses.

Uncertainty is also associated with constituent mixtures. Information on the toxicity of specific mixtures is rarely available. The procedure generally applied to a potential event of simultaneous exposure to multiple constituents from a variety of sources assumes dose additivity, although it is possible that the interaction of multiple constituents could be synergistic or antagonistic. This provides uncertainty that could either overestimate or underestimate the risk depending on the actual relationship of these constituents. Cumulative risk in this HHRA was estimated by adding the calculated risk from the ~~two~~ COPCs together per USEPA guidance (1989, 2005).

6.3 Exposure Assessment

Although uncertainty is inherent in the exposure assessment, the exposure scenarios, the EPCs, and the receptor exposure assumptions were chosen to err on the side of conservatism potentially leading to an overestimation of potential risk.

6.3.1 Exposure Scenarios

Potential exposure scenarios contribute uncertainty to the risk assessment. Exposure scenarios were developed based on site-specific information, USEPA exposure guidance documents, and professional judgment. RISKS AT THE SITE WERE QUANTIFIED FOR THE RME SCENARIO WHICH DESCRIBES INDIVIDUALS AT THE UPPER END OF THE POPULATION DISTRIBUTION AND ARE LESS CONSERVATIVE.~~To better understand the risk at the Site, risks were calculated based on both the CTE and RME scenarios.~~

6.3.2 Exposure Point Concentrations

Conservative EPCs were used in this risk assessment which leads to overestimation of risk. Indoor air EPCs were calculated using the Johnson and Ettinger model using conservative input parameters.

EPCs were based on concentrations in groundwater and soil gas that were assumed to remain constant throughout the exposure period, which is a conservative approach. It is highly unlikely that receptors would be exposed to the same concentrations particularly over an extended period of time since ongoing natural attenuation and degradation processes are expected to reduce concentrations over time. Moreover, in the RME scenario, the EPCs were based on upper bound estimates (UCLs for groundwater and maximum concentrations for soil gas), which further overestimates the risk.

EPCs were calculated based on default model input parameters for a residential structure (e.g., building size, building pressure differential, air exchange rate, floor thickness, floor crack and seam sizes, etc). This approach is conservative as a residential building is expected to overestimate potential EPCs and exposures for a commercial building.

6.3.3 Receptor Exposure Assumptions

Exposure assumptions were identified based on both the CTE and RME scenarios to give a CONSERVATIVE better indication of the risk estimates. The intent of calculating risk under RME is to convey an estimate of risk in the upper range of the distribution, while in contrast to the RME exposure, central tendency evaluates potential intake for the average exposure.

6.4 Risk Characterization

Constituent-specific risks are generally assumed to be additive (USEPA 1989). Noncancer hazards are thought to be additive if they act on the same target organ. This oversimplifies the fact that some constituents may act synergistically (1 + 1 > 2) or antagonistically (1 + 1 < 2). The overall effect of these mechanisms on multi-constituent risk estimates is difficult to determine, but the effects are usually assumed to balance. Cumulative risk in this HHRA was estimated by adding the calculated risk from the two COPCs together per USEPA guidance (1989, 2005).

7. Conclusions

Cancer and noncancer risk WERE ESTIMATED FOR THE FOLLOWING RECEPTORS: A CONSTRUCTION WORKER RECEPTOR FROM DIRECT EXPOSURE TO SOIL; for a commercial worker receptor FROM INHALATION OF VAPORS IN INDOOR AIR, AND A CHILD VISITOR ALSO FOR EXPOSURE TO VAPORS IN INDOOR AIR. RISK FOR THE CONSTRUCTION WORKER FROM EXPOSURE TO SOIL ASSUMED A SCENARIO IN WHICH THE WORKER WILL ENCOUNTER SOIL FROM THE SURFACE TO THE GROUNDWATER OR THE SOIL COLUMN ABOVE THE SOLIDIFIED WASTE. were quantitatively evaluated for the indoor air pathway using both RISK FOR THE VAPOR INTRUSION SCENARIOS USED on-site groundwater data FROM BOTH SHALLOW AND DEEP PORTIONS OF THE UPPER AQUIFER SEPARATELY AND, ONSITE and near off-site soil gas data TO CALCULATE CONCENTRATIONS INDOORS ASSUMING . The HHRA was conducted assuming both slab-on-grade construction. and a basement scenario under both a RISKS WERE CALCULATED FOR A RME scenario and a CTE scenario. Results show that risks to the CONSTRUCTION WORKER, THE site commercial/ industrial worker, AND THE SITE VISITOR were all below Ohio EPA target levels (Table 178). Since the exposure of the commercial receptor is higher than that of a future construction worker and a future visitor/ recreator, this also leads to the conclusion that risks to those two other receptors are also acceptable.

8. RECOMMENDATIONS

AS PREVIOUSLY NOTED, THE COVER SYSTEM OF THE SSL CURRENTLY CONSISTS OF A ONE FOOT THICK COMPACTED CLAY LAYER WHICH WAS COVERED WITH A 6-INCH THICK VEGETATIVE TOP SOIL LAYER. ON TOP OF THE COMPACTED CLAY LAYER WAS PLACED A NOMINAL 6-INCH THICK LAYER OF TOPSOIL. THE TOPSOIL WAS FINE GRADED TO ENSURE POSITIVE DRAINAGE. THE COVER WAS VEGETATED WITH A GRASS SEED MIX CONSISTING OF PERENNIAL RYE GRASS AND RED FESCUE. THE INTENT OF THE FINAL COVER SYSTEM IS TO PREVENT ANY MIGRATION OF WASTES OUT OF THE UNIT TO THE ADJACENT SUBSURFACE SOIL OR GROUNDWATER OR SURFACE WATER AT ANY TIME DURING THE ACTIVE LIFE OF THE UNIT.

THE OWNER OR OPERATOR WOULD BE REQUIRED TO DETERMINE IF ANY CHANGE IN THE FUTURE LAND USE OF THE SSL WOULD NECESSITATE AN AMENDMENT TO THE APPROVED POST-CLOSURE PLAN IN ACCORDANCE WITH OAC RULE 3745- 55-18(D). FURTHER, IF AT ANY TIME, THE OWNER OR OPERATOR FORESEES THE NEED FOR MODIFYING THE COVER, THEN, A WRITTEN NOTIFICATION OF, OR REQUEST FOR A PERMIT MODIFICATION IS REQUIRED TO AUTHORIZE A CHANGE IN THE APPROVED POST-CLOSURE PLAN IN ACCORDANCE WITH THE APPLICABLE REQUIREMENTS OF RULES 3745-50-40 TO 3745-50-235 OF THE OAC.

AT THE TIME OF REDEVELOPMENT, CONSIDERATION MUST BE GIVEN TO THE DESIGN, CONSTRUCTION, AND OPERATION OF ANY FACILITIES TO ENSURE THAT 1) THE INTEGRITY OF THE COVER IS NOT AFFECTED, AND 2) THAT ANY DISTURBANCE OF THE COVER WILL NOT INCREASE THE POTENTIAL HAZARD TO HUMAN HEALTH AND THE ENVIRONMENT.

8.1 MAINTAINING INTEGRITY OF FINAL COVER

IN ACCORDANCE WITH OAC RULE 3745-56-28, THE INTENT OF THE FINAL COVER OF THE SURFACE IMPOUNDMENT IS TO:

A. PROVIDE LONG-TERM MINIMIZATION OF THE MIGRATION OF LIQUIDS THROUGH THE CLOSED IMPOUNDMENT; AND

B. FUNCTION WITH MINIMUM MAINTENANCE; AND

C. PROMOTE DRAINAGE AND MINIMIZE EROSION OR ABRASION OF THE FINAL COVER; AND

D. ACCOMMODATE SETTLING AND SUBSIDENCE SO THAT THE COVER'S INTEGRITY IS MAINTAINED; AND

E. HAVE PERMEABILITY LESS OR EQUAL TO THE PERMEABILITY OF ANY BOTTOM LINER SYSTEM OR NATURAL SUB-SOILS PRESENT.

THE FINAL COVER SYSTEM MUST CONTINUE TO CONFORM TO THE ABOVE CONDITIONS DURING THE LIFE OF THE UNIT AND SHOULD CONTINUE TO BE MAINTAINED IN A MANNER TO BE PROTECTIVE OF HUMAN HEALTH AND THE ENVIRONMENT.

8.1.1 STORM WATER MANAGEMENT

THE EXISTING SURFACE WATER DRAINAGE SYSTEM FOR THE SSL CONSISTS OF A NETWORK OF SWALES, CATCH BASINS, AND UNDERGROUND PIPES. THE SSL WAS GRADED TO ENSURE POSITIVE DRAINAGE. THE GRADES AND SURFACE WATER CONTROLS DIRECT WATER AWAY FROM THE COVER, CONTROLLING THE POTENTIAL FOR RUN-ON. THE SSL COVER SYSTEM DIRECTS STORM WATER RUNOFF FROM THE SOUTH TOWARD THE NORTHWEST CORNER OF THE SITE WHERE IT IS COLLECTED AND DISCHARGED TO AN UNDERGROUND 84-INCH DIAMETER STORM SEWER ALONG THE NORTH PERIMETER OF THE SSL. THE STORM WATER IS THEN DIRECTED TO A STORM SEWER LOCATED ALONG DRYDEN ROAD. ANY FUTURE CHANGE IN LAND USE MUST BE EVALUATED TO ENSURE THAT STORM WATER IS MANAGED TO PREVENT RUN-ON, PROMOTE DRAINAGE, AND MINIMIZE EROSION OF THE FINAL COVER.

8.2 RISK AND HAZARD TO HUMAN HEALTH AND THE ENVIRONMENT

FURTHER, THE ASSUMPTIONS OF THE RISK ASSESSMENT SHOULD BE REVIEWED AT THE TIME OF REDEVELOPMENT. IF THE ASSUMPTIONS ARE STILL VALID, THEN RISK TO HUMAN HEALTH AND THE ENVIRONMENT MEET ACCEPTABLE CRITERIA. HOWEVER IF EXPOSURE OTHER THAN THAT EVALUATED IN THE RISK ASSESSMENT IS EXPECTED (E.G., DIGGING INTO THE SOLIDIFIED MATERIAL; USING GROUNDWATER AS A POTABLE WATER SOURCE), ANOTHER RISK ASSESSMENT SHOULD BE CONDUCTED OR

HEALTH AND SAFETY PLAN SHOULD BE UTILIZED TO LIMIT EXPOSURE (E.G., DIGGING INTO THE SOLIDIFIED MATERIAL). ASSUMPTIONS THAT WERE USED IN THIS HHRA ARE AS FOLLOWS:

- THE HHRA DID NOT EVALUATE RESIDENTIAL USE OF THE PROPERTY,
- THE HHRA DID NOT EVALUATE DIRECT CONTACT WITH GROUNDWATER IN CASE OF DEEP EXCAVATION,
- THE HHRA DID NOT EVALUATE POTABLE USE OF GROUNDWATER,
- THE HHRA DID NOT EVALUATE RISK FROM DIRECT CONTACT WITH SOLIDIFIED SLUDGE MATERIAL THAT MAY BE ENCOUNTERED IN CASE THE SOLIDIFIED MATERIAL IS BREACHED, AND
- ALL EXCAVATION WAS ASSUMED TO BE CONDUCTED ABOVE SOLIDIFIED MATERIAL WHERE PRESENT AT THE SITE (FIGURE 4).

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Tables

Table 0A
Sludge Data
South Settling Lagoon
Moraine, Ohio

Constituent	Sludge Analytical Results [a]		
	Frequency of Detection	Minimum Concentration (mg/kg)	Maximum Concentration (mg/kg)
Semi Volatile Organic Compounds			
Bis(2-ethylhexyl)phthalate	4/13	1.33	2.76
Dibutyl Phthalate	1/13	--	1.99
Aroclor 1254	8/13	1.6	206
Aroclor 1260	2/13	1.5	4.6
Inorganics			
Antimony	14/36	5.03	52.8
Arsenic	36/36	3.4	157
Barium	36/36	713	6740
Cadmium	36/36	0.721	26.9
Chromium	36/36	55.3	2020
Cobalt	5/6	17.8	222
Copper	36/36	37.2	16900
Cyanide	36/36	0.562	18.9
Lead	36/36	87.1	398
Mercury	34/36	0.081	4.03
Nickel	36/36	26.3	1490
Selenium	1/36	--	0.78
Silver	34/36	0.317	2.45
Tin	1/6	--	28.3
Zinc	36/36	157	2190

[a] From South Settling Lagoon Revised Closure Plan (Geraghty and Miller 1989).

Table 0B
Fill Stockpile Soil Data
South Settling Lagoon
Moraine, Ohio

Constituent	Units	H1 (2 -4)	H1 (10 -12)	H2 (4 -6)	H2 (8 -10)	H3 (14 -16)	H3 (18 -20)	H4 (4 -6)	H4 (10 -12)	H5 (12 -14)	H5 (30 -32)	H6 (2 -4)	H6 (12 -14)	H10 (6 -8)	H10 (18 -20)
Volatile Organic Compounds (VOCs)	ug/Kg	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Semi Volatile Organic Compounds (SVOCs)															
Benzo(a)anthracene	ug/Kg	<330	<3,300	<330	<330	<330	<330	1,100	<330	<3,300	<3,300	<3,300	<330	<1,320	<3,300
Benzo(b)fluoranthene	ug/Kg	<330	<3,300	449	<330	<330	477	1,570	<330	<3,300	<3,300	<3,300	<330	1,550	<3,300
Benzo(k)fluoranthene	ug/Kg	<330	<3,300	<330	<330	<330	<330	<660	<330	<3,300	<3,300	<3,300	<330	<1,320	<3,300
Benzo(a)pyrene	ug/Kg	204	1,690	242	<165	307	315	1,040	<165	<1,650	<1,650	<1,650	<165	1,330	<1,650
Chrysene	ug/Kg	<330	<3,300	<330	<330	351	341	1,170	<330	<3,300	<3,300	<3,300	<330	<1,320	<3,300
Fluoranthene	ug/Kg	420	4,080	570	<330	812	734	2,340	337	3,500	<3,300	<3,300	<330	2,440	<3,300
Phenanthrene	ug/Kg	<330	<3,300	<330	<330	562	544	1,930	<330	<3,300	<3,300	<3,300	<330	<1,320	<3,300
Pyrene	ug/Kg	<330	3,490	588	<330	811	741	2,230	<330	<3,300	<3,300	<3,300	342	2,120	<3,300
Metals															
Antimony	mg/Kg	<33	<32	<33	<33	<32	<32	<32	<33	<33	<33	<33	<330	<31	<32
Arsenic	mg/Kg	4.75	5.21	5.20	3.49	4.83	4.55	5.36	4.15	9.16	4.63	5.39	<0.808	5.19	5.25
Barium	mg/Kg	17	44.8	15	30	77.2	65.6	44.6	23	64.0	20	60.7	<66	52.9	34.9
Beryllium	mg/Kg	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<20	<2	<2
Cadmium	mg/Kg	<9.9	<9.5	<9.8	<9.9	<9.5	<9.6	<9.6	<9.8	<9.9	<9.9	<9.8	<99	<9.4	<9.6
Chromium	mg/Kg	<13	<13	<13	<13	14	20	<13	<13	13	<13	<13	<130	<13	<13
Cobalt	mg/Kg	<6.6	<6.4	<6.5	<6.6	<6.3	<6.4	<6.4	<6.5	<6.6	<6.6	<6.6	<66	<6.3	<6.4
Copper	mg/Kg	7	12	8.2	10	14	11	9.0	7.5	12	9.2	12	<66	12	10
Lead	mg/Kg	6.72	8.35	6.14	7.56	7.89	10.2	9.41	7.66	12.4	5.51	23.2	6.65	13.5	10.3
Manganese	mg/Kg	219	410	221	437	286	395	388	235	264	290	423	360	382	254
Mercury	mg/Kg	0.013	0.022	0.013	0.015	0.027	0.022	0.019	0.015	0.029	0.018	0.027	0.012	0.025	0.024
Nickel	mg/Kg	5.3	11	7.5	7.3	15	15	8.0	6.2	14	9.6	12	<33	10	9.9
Selenium	mg/Kg	<0.166	0.264	0.518	<0.162	<0.161	<0.162	<0.160	<0.159	0.280	0.363	<0.161	<0.323	<0.165	<0.162
Silver	mg/Kg	<13	<13	<13	<13	<13	<13	<13	<13	<13	<13	<13	<130	<13	<13
Thallium	mg/Kg	0.361	<0.330	0.352	<0.323	<0.322	<0.323	<0.319	<0.318	<0.325	<0.324	<0.322	0.352	0.340	0.342
Vanadium	mg/Kg	<17	<16	<16	<17	19	18	<16	<16	<17	<16	<16	<170	<16	<16
Zinc	mg/Kg	19	36	24	28	49	41	31	24	45	27	46	<170	43	26
PCBs	mg/Kg	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50

Constituent	Units	H11 (16 -18)	H11 (1) (22 -24)	H11 (24 -26)	H12 (10 -12)	H12 (32 -34)	H13 (6 -8)	H13 (8 -10)	A1 (2 -4)	A2 (2 -4)	A3 (2 -4)	A4 (2 -4)	A5 (2 -4)	A6 (2 -4)	D1 (2 -4)	D2 (2 -4)	D3 (2 -4)	D4 (2 -4)
Volatile Organic Compounds (VOCs)	ug/Kg	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Semi Volatile Organic Compounds (SVOCs)																		
Benzo(a)anthracene	ug/Kg	<330	<3,300	<330	550	<3,300	<330	<330	<3,300	<3,300	<3,300	<3,300	7,560	<330	<3,300	<330	865	<3,300
Benzo(b)fluoranthene	ug/Kg	<330	<3,300	<330	821	<3,300	<330	<330	<3,300	<3,300	<3,300	<3,300	8,230	<330	<3,300	<330	1,120	<3,300
Benzo(k)fluoranthene	ug/Kg	<330	<3,300	<330	<330	<3,300	<330	<330	<3,300	<3,300	<3,300	<3,300	3,450	<330	<3,300	<330	<660	<3,300
Benzo(a)pyrene	ug/Kg	<165	<1,650	<165	507	<1,650	<165	<165	<1,650	<1,650	<1,650	<1,650	6,140	<165	<1,650	<165	868	<1,650
Chrysene	ug/Kg	<330	<3,300	<330	608	<3,300	<330	<330	<3,300	<3,300	<3,300	<3,300	8,240	<330	<3,300	<330	998	<3,300
Fluoranthene	ug/Kg	<330	<3,300	<330	1,340	<3,300	<330	<330	<3,300	<3,300	<3,300	<3,300	10,200	<330	<3,300	<330	1,620	<3,300
Phenanthrene	ug/Kg	<330	<3,300	<330	601	<3,300	<330	<330	<3,300	<3,300	<3,300	<3,300	3,480	<330	<3,300	<330	1,290	<3,300
Pyrene	ug/Kg	<330	<3,300	<330	1,170	<3,300	<330	<330	<3,300	<3,300	<3,300	<3,300	12,200	<330	<3,300	<330	1,440	<3,300
Metals																		
Antimony	mg/Kg	<33	<33	<33	<31	<33	<33	<32	<33	<33	<32	<32	<32	<33	<33	<33	<32	<33
Arsenic	mg/Kg	4.49	5.66	4.51	3.77	5.05	5.24	4.01	5.89	4.49	3.51	9.03	6.46	4.31	2.36	4.51	5.38	4.20
Barium	mg/Kg	12	36	44.2	40.3	65.4	54.3	25	35.6	29	30	41.9	58	46	28	21	35.1	22
Beryllium	mg/Kg	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2
Cadmium	mg/Kg	<9.9	<9.9	<10	<9.4	<10	<9.8	<9.7	<9.9	<9.9	<9.6	<9.5	<9.7	<10	<9.9	<9.8	<9.7	<9.9
Chromium	mg/Kg	<13	<13	<13	<13	14	<13	<13	<13	<13	<13	<13	<13	<13	<13	<13	<13	<13
Cobalt	mg/Kg	<6.6	<6.6	<6.6	<6.3	<6.6	<6.5	<6.4	<6.6	<6.6	<6.4	<6.3	<6.4	<6.6	<6.6	<6.5	<6.5	<6.6
Copper	mg/Kg	<6.6	7.9	12	9	11	10	9.0	11	8.6	9.9	15	12	11	8.0	8.2	10	<6.6
Lead	mg/Kg	6.05	7.82	7.85	5.51	8.18	11.1	7.07	8.00	7.46	5.87	18.9	10.2	8.59	11.6	6.56	8.96	6.80
Manganese	mg/Kg	181	339	328	330	445	351	680	359	285	309	352	393	388	261	226	328	340
Mercury	mg/Kg	0.011	0.024	0.014	0.016	0.032	0.009	0.011	0.024	0.014	0.015	0.041	0.027	0.019	0.020	0.017	0.025	0.016
Nickel	mg/Kg	6.3	7.9	10	10	11	11	11	10	7.9	8.3	10	13	9.3	7	7.5	10	5.0
Selenium	mg/Kg	<0.164	<0.166	0.234	<0.166	0.288	<0.161	<0.166	<0.164	<0.162	<0.163	<0.163	0.297	<0.159	<0.161	0.463	0.189	<0.165
Silver	mg/Kg	<13	<13	<13	<13	<13	<13	<13	<13	<13	<13	<13	<13	<13	<13	<13	<13	<13
Thallium	mg/Kg	0.468	<0.333	0.412	0.346	<0.320	<0.321	0.468	0.413	0.430	0.499	<0.326	<0.323	0.356	0.565	0.543	0.458	<0.330
Vanadium	mg/Kg	<16	<16	<17	<16	<17	<16	<16	<16	<17	<16	<16	<16	<17	<17	<16	<16	<17
Zinc	mg/Kg	19	29	40	35	38	37	31	33	30	30	64	42	35	25	26	34	21
PCBs	mg/Kg	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50

ND - VOCs and SVOCs not detected above their respective laboratory detection limit, unless presented on the table.
< - Constituent not detected above laboratory detection limit shown.
mg/Kg - Milligram per kilogram.
ug/Kg - Microgram per kilogram.

Table 1A
Groundwater Risk Assessment Data from the Shallow Portion of Upper Aquifer
South Settling Lagoon
Moraine, Ohio

Constituent	Units	SSL-1 SSL-1-GW/02012012/ 2/1/2012	SSL-2 SSL-2-GW/01312012/ 1/31/2012	SSL-3 SSL-3-GW/01302012/ 1/30/2012	SSL-3 DUP-01/01302012/ 1/30/2012	GM-63 GM-63/01282010/ 1/28/2010
1,1,1-Trichloroethane	µg/L	< 1.0 U	< 3.3 U	< 5.0 U	< 5.0 U	2.0 J
1,1-Dichloroethane	µg/L	0.76 J	< 3.3 U	< 5.0 U	< 5.0 U	< 5.7 U
1,1-Dichloroethene	µg/L	< 1.0 U	< 3.3 U	< 5.0 U	< 5.0 U	< 5.7 U
Benzene	µg/L	< 1.0 U	< 3.3 U	< 5.0 U	< 5.0 U	< 5.7 U
cis-1,2-Dichloroethene	µg/L	5.4	0.95 J	1.4 J	1.6 J	3.2 J
Ethylbenzene	µg/L	< 1.0 U	< 3.3 U	< 5.0 U	< 5.0 U	< 5.7 U
Tetrachloroethene	µg/L	**15**	**86**	**130**	**130**	**150**
Toluene	µg/L	< 1.0 UB	< 3.3 UB	< 5.0 U	< 5.0 U	< 5.7 U
trans-1,2-Dichloroethene	µg/L	0.41 J	< 3.3 U	< 5.0 U	< 5.0 U	< 5.7 U
Trichloroethene	µg/L	**11**	**74**	**120**	**130**	**140**
Vinyl chloride	µg/L	< 1.0 U	< 3.3 U	< 5.0 U	< 5.0 U	< 5.7 U
Xylenes	µg/L	< 2.0 U	< 6.7 U	< 10 U	< 10 U	< 11 U

µg/L - Micrograms per Liter.
< - Chemical of concern not detected above laboratory reporting limit shown.
U - Chemical of concern not detected above laboratory reporting limit shown.
J - Value estimated.
UB - Chemical of concern considered non-detect at the listed due to associated blank contamination.
NA - No action level.
Bold indicates sample result is above the MCL.

Table 1B
Groundwater Risk Assessment Data from the Deep Portion of Upper Aquifer
South Settling Lagoon
Moraine, Ohio

Sample Location		HR-16	HR-16	HR-16	HR-17	HR-17	HR-17	HR-17	W-2-S	W-2-S	W-2-S	W-2-S	W-3-S	W-3-S	W-3-S	W-3-S	W-4-S	W-4-S	W-4-S	W-4-S
Constituent	**Date**	**9/23/1999**	**9/18/2002**	**1/21/2008**	**9/18/2006**	**9/25/2007**	**9/26/2008**	**11/12/2009**	**9/18/2006**	**9/24/2007**	**9/25/2008**	**11/12/2009**	**9/18/2006**	**9/24/2007**	**9/26/2008**	**11/12/2009**	**12/4/2007**	**3/4/2008**	**9/26/2008**	**11/12/2009**
Benzene	µg/L	< 1.0	< 1.0	< 1.0	< 1.0	< 2.5	< 4.0	< 2.5 [< 2.5]	< 1.0	< 1.0	< 1.0	0.43 J	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0 [< 2.0]	< 1.0
1,1-Dichloroethane	µg/L	< 1.0	< 1.0	< 1.0	0.60 J	1.2 J	1.1 J	1.7 J [1.7 J]	1.2	1.1	0.92 J	1.2	< 1.0	< 1.0	0.21 J	< 1.0	1.5	1.6	1.6 [1.5 J]	1.6
1,1-Dichloroethene	µg/L	< 1.0	< 1.0	< 1.0	< 1.0	< 2.5	< 4.0	< 2.5 [< 2.5]	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0 [< 2.0]	< 1.0
cis-1,2-Dichloroethene	µg/L	< 1.0	0.46 J	< 1.0	4.6	1.9 J	2.7 J	1.9 J [2.0 J]	1.2	0.89 J	0.78 J	0.90 J	< 1.0	< 1.0	0.52 J	0.33 J	5.5	6.1	6.1 [7.1]	9.1
trans-1,2-Dichloroethene	µg/L	< 1.0	< 0.50	< 1.0	0.46 J	0.69 J	1.0 J	1.3 J [1.2 J]	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	1.2	1.5	1.5 [1.5 J]	1.5
Tetrachloroethene	µg/L	< 1.0	< 1.0	< 1.0	34	51	120	85 [84]	< 1.0	< 1.0	< 1.0	0.35 J	0.60 J	0.72 J	1.3	0.87 J	22	29	29 [46]	39
1,1,1-Trichloroethane	µg/L	< 1.0	< 1.0	< 1.0	< 1.0	< 2.5	< 4.0	< 2.5 [< 2.5]	1.8	1.4	1.4	1.7	2.5	1.4	1.2	1.2	1.5	1.8	1.8 [1.1 J]	1.3
Trichloroethene	µg/L	2.7	1.5	1.3	5.6	16	31	21 [20]	5.1	5.3	5.2	6.6	3.4	2	2.1	2.5	13	16	16 [22]	23

Notes:

µg/L = micrograms per liter.

J = estimated value.

Duplicate results are shown between brackets [ ].

Table 2A
On-Site Soil Gas Data
South Settling Lagoon
Moraine, Ohio

Constituent	Units	On-Site Samples									
		SSL-1 2/6/2012				SSL-2 2/6/2012			SSL-3 2/6/2012		
		6 feet bls	11 feet bls	14.2 feet bls	14.2 feet bls DUP	6 feet bls	11 feet bls	14.2 feet bls	6 feet bls	11 feet bls	14.2 feet bls
1,1,1-Trichloroethane	μg/m^3	< 5.1 UB	< 5.0 UB	< 4.3 UB	< 5.1 UB	< 5.1 UB	13	91	< 4.8 UB	15	21
1,1-Dichloroethane	μg/m^3	< 3.8 U	2.1 J	2.7 J	4.9	< 3.8 U	< 3.6 U	18 J	< 3.6 U	< 5.0 U	< 8.2 U
1,1-Dichloroethene	μg/m^3	< 3.7 U	< 3.6 U	< 3.1 U	< 3.7 U	< 3.7 U	< 3.5 U	< 21 U	< 3.5 U	< 4.9 U	< 8.1 U
Benzene	μg/m^3	22	< 3.5 UB	< 2.5 UB	< 4.7 UB	< 3.0 UB	< 4.2 UB	< 26 UB	14	< 7.1 UB	18
cis-1,2-Dichloroethene	μg/m^3	< 3.7 U	3.8	8.8	16	< 3.7 U	< 3.5 U	< 21 UB	< 3.5 U	< 4.9 U	< 8.1 U
Ethylbenzene	μg/m^3	28	3.0 J	1.0 J	1.8 J	< 4.1 U	3.7 J	16 J	16	15	37
Tetrachloroethene	μg/m^3	86	94	96	200	52	1400	9600	360	2700	4500
Toluene	μg/m^3	130	7.4	2.9 J	5.6	< 3.5 UB	12	55	80	38	100
trans-1,2-Dichloroethene	μg/m^3	< 3.7 U	3.1 J	2.9 J	5.5	< 3.7 U	< 3.5 UB	21	< 3.5 U	< 4.9 U	< 8.1 U
Trichloroethene	μg/m^3	8.3	45	47	96	7.0	320	3100	13	270	530
Vinyl chloride	μg/m^3	< 2.4 U	< 2.3 U	< 2.0 UB	< 2.4 UB	< 2.4 U	< 2.3 U	< 14 U	< 2.3 U	< 3.1 U	< 5.2 U
Xylenes	μg/m^3	130	8.3 J	2.3 J	5.3 J	< 8.2 U	6.0 J	20 J	72	51	110

bls - below land surface.
μg/m^3 - Micrograms per cubic meter.
< - Chemical of concern not detected above laboratory reporting limit shown.
U - Chemical of concern not detected above laboratory reporting limit shown.
B - The chemical of concern has been found in the sample as well as its associated blank.
UB - Chemical of concern considered non-detect at the listed reporting limit due to associated blank contamination.
J - Value estimated.
Bold indicates chemical of concern is above the Action Level.

Table 2B
Near Off-site Soil Gas Data
South Settling Lagoon
Moraine, Ohio

Constituent	Units	Near Offsite Sample					
		SGP-1(6) 11/10/2010	SGP-1(11) 11/10/2010	SGP-1(16) 11/10/2010	SGP-2(6) 11/11/2010	SGP-2(11) 11/11/2010	SGP-2(15.4) 11/11/2010
Benzene	µg/m^3	2 J	1.3 J	3 J	8.9 J	ND	ND
1,1-Dichloroethane	µg/m^3	ND	2.3 J	6.8	6.3 J	26 J	82
cis-1,2-Dichloroethene	µg/m^3	ND	ND	8.6	2.3 J	10 J	54 J
trans-1,2-Dichloroethene	µg/m^3	ND	4.9	12	9.8 J	41	110
Ethylbenzene	µg/m^3	2.2 J	ND	1.9 J	ND	ND	ND
Tetrachloroethene	µg/m^3	370	970	2400	5700	21000	38000
Toluene	µg/m^3	8.2	1.8 J	3.2 J	21	ND	ND
1,1,1-Trichloroethane	µg/m^3	10	13	23	77	140	260
Trichloroethene	µg/m^3	86	250	620	2000	6800	16000
m,p-Xylene	µg/m^3	7.4	ND	2.1 J	4.3 J	ND	ND
o-Xylene	µg/m^3	2.6 J	ND	3.2 J	ND	ND	ND

Notes:
µg/m^3 = micrograms per cubic meter.
ND = not detected.
J = estimated value.
Sample depth indicated in parentheses in sample name.

Table 3
Selection of Constituents of Potential Concern in Soil
South Settling Lagoon
Moraine, Ohio

Constituent	Units	Data Summary [a] Detection Frequency	Detection Frequency (%)	Minimum Detect	Maximum Detect	Max Detect Location	Minimum Non-Detect	Maximum Non-Detect	Exposure Point Concentration (EPC) [b]	USEPA Industrial RSL [c]	Background [d]	Constituent of Potential Concern (COPC)? [e]
Volatile Organic Compounds	ug/Kg	0/31	0	ND	ND	–	--	–	ND	NA	–	no
Semi Volatile Organic Compounds											–	
Benzo(a)anthracene	ug/Kg	4/31	13	550	7560	A5(2 -4)	330	3300	1293	2,100	--	no
Benzo(b)fluoranthene	ug/Kg	7/31	23	449	8230	A5(2 -4)	330	3300	1394	2,100	--	no
Benzo(k)fluoranthene	ug/Kg	1/31	3	3450	3450	A5(2 -4)	330	3300	3450	21,000	--	no
Benzo(a)pyrene	ug/Kg	10/31	32	204	6140	A5(2 -4)	165	1650	1027	210	--	**YES**
Chrysene	ug/Kg	6/31	19	341	8240	A5(2 -4)	330	3300	1481	210,000	--	no
Fluoranthene	ug/Kg	12/31	39	337	10200	A5(2 -4)	330	3300	1972	22,000,000	--	no
Phenanthrene	ug/Kg	6/31	19	544	3480	A5(2 -4)	330	3300	1018	NA	--	no
Pyrene	ug/Kg	10/31	32	342	12200	A5(2 -4)	330	3300	1966	17,000,000	--	no
<u>Metals</u>												
Antimony	mg/Kg	0/31	0	ND	ND		31	330	ND	410	--	no
Arsenic	mg/Kg	30/31	97	2.36	9.16	H5(12 -14)	0.81	0.81	9.16	1.6	29	no
Barium	mg/Kg	30/31	97	12	77.2	H3(14 -16)	66	66	45.16	190,000	229	no
Beryllium	mg/Kg	0/31	0	ND	ND	–	2	20	ND	2,000	2	no
Cadmium	mg/Kg	0/31	0	ND	ND	–	9.4	99	ND	800	13	no
Chromium	mg/Kg	4/31	13	13	20	H3(18 -20)	13	130	20	1,500,000	47	no
Cobalt	mg/Kg	0/31	0	ND	ND	–	6.3	66	ND	300	26	no
Copper	mg/Kg	28/31	90	7	15	A4(2 -4)	6.6	66	10.77	41,000	41	no
Lead	mg/Kg	31/31	100	5.51	23.20	H6(2 -4)	–	--	10.42	800	49	no
Manganese	mg/Kg	31/31	100	181	680	H13(8 -10)	–	--	371	23,000	1,600	no
Mercury	mg/Kg	31/31	100	0.009	0.041	A4(2 -4)	–	--	0.0223	43	1	no
Nickel	mg/Kg	30/31	97	5.0	15.0	H3(14 -16),H3(18 -20)	33.0	33.0	10.48	20,000	64	no
Selenium	mg/Kg	9/31	29	0.189	0.518	H2(4 -6)	0.159	0.323	0.257	5,100	2	no
Silver	mg/Kg	0/31	0	ND	ND	–	13	130	ND	5,100	1	no
Thallium	mg/Kg	16/31	52	0.34	0.565	D1(2 -4)	0.318	0.333	0.404	10	--	no
Vanadium	mg/Kg	2/31	6	18	19	H3(14 -16)	16	170	19	5,200	84	no
Zinc	mg/Kg	30/31	97	19	64	A4(2 -4)	170	170	37.15	310,000	152	no
PCBs	mg/Kg	0/31	0	ND	ND	–	0.5	0.5	ND	NA		no

ND - not detected.
mg/Kg - Milligram per kilogram.
ug/Kg - Microgram per kilogram.

[a] Raw data presented in Table 0B.
[b] The exposure point concentration (EPC) was set at upper confidence limit on the mean (UCL) concentration as calculated by USEPA's ProUCL software (USEPA 2011; Appendix B) or the maximum concentration were a UCL was incalculable.
[c] From USEPA Regional Screening Level (RSL) Table (USEPA 2012a).
[d] Background data from RCRA Facility Investigation Report Volume II; Baseline Risk Assessment (RFI; Environ 200oa).
[e] Constituents were selected as COPCs if the EPC exceeded the RSL unless they were metals below the background concentration.

Table 4
Selection of Constituents of Potential Concern in Groundwater
South Settling Lagoon
Moraine, Ohio

Constituent	Data from Shallow Portion of Upper Aquifer [a]				Data from Deep Portion of Upper Aquifer [a]				USEPA Air	Henry's Law	Henry's	Calculated GW VI RSL [d]	Constituent of Potential Concern (COPC)? [e]	
	Frequency of Detection	Minimum Detect (µg/L)	Maximum Detect (µg/L)	Location of Maximum	Frequency of Detection	Minimum Detect (µg/L)	Maximum Detect (µg/L)	Location of Maximum	Residential ($\mu g/m^3$)	Constant [c] ($atm\text{-}m^3/mol$) (25 °C)	Law Constant (unitless)	Residential (µg/L)	(YES/no)	Rational
Benzene	0/5	NA	NA	NA	1/19	0.43	0.43	W-2-S	3.1E-01	5.6E-03	2.3E-01	1	no	BSL
1,1-Dichloroethane	1/5	0.76	0.76	SSL-1	13/19	0.21	1.7	HR-17	1.5E+00	5.6E-03	2.3E-01	7	no	BSL
cis-1,2-Dichloroethene	5/5	0.95	5.40	SSL-1	15/19	0.33	9.1	W-4-S	6.3E+01	4.1E-03	1.7E-01	378	no	BSL
trans-1,2-Dichloroethene	1/5	0.41	0.41	SSL-1	8/19	0.46	1.5	W-4-S	6.3E+01	4.1E-03	1.7E-01	378	no	BSL
Tetrachloroethene	5/5	15.00	150	GM-63	13/19	0.35	120	HR-17	9.4E+00	1.8E-02	7.2E-01	13.0	YES	ASL
1,1,1-Trichloroethane	1/5	2.00	2	GM-63	12/19	1.1	2.5	W-3-S	5.2E+03	1.7E-02	7.0E-01	7397	no	BSL
Trichloroethene	5/5	11.00	140	GM-63	19/19	1.3	31	HR-17	4.3E-01	9.9E-03	4.0E-01	1	YES	ASL

Notes:

$atm\text{-}m^3/mol$ = atmosphere per cubic meter per mol; µg/L = micrograms per liter; $\mu g/m^3$ = micrograms per cubic meter; NA = not available.

[a] Data from the shallow portion-of upper aquifer was comprised of data from the February 2012 investigation at SSL1, SSl2, SSL3, and data from 2010 at nearby GM 63 (Table 1A).
Data from the deep portion of upper aquifer was comprised of data from the last four events from upper aquifer wells: HR-16, HR-17, W-2-S, W-3-S, and W-4-S (Table 1B).
Frequency of detection = number of samples detected / total number of samples analyzed.

[b] From USEPA Regional Screening Level (RSL) Table (USEPA 2012a).
RSL for trans-1,2-dichloroethene was used as surrogate for cis-1,2-dichloroethene.

[c] Parameter obtained from USEPA RSL Table (USEPA 2012a).

[d] Calculated GW VI SL = IA RSL x CF x (1/HLC) x (1/AF)
GW VI SL = calculated groundwater to indoor air vapor intrusion Screening Level (µg/L)
Air RSL = indoor air Regional Screening Level ($\mu g/m^3$; USEPA 2012a)
HLC = Henry's Law Constant (unitless)
CF = conversion factor (0.001 cubic meters per liter (m^3/L))
AF = attenuation factor (0.001; USEPA 2012)

[e] Constituents were selected as COPCs if the maximum exceeded the residential screening level or if a screening level was not identified.
Rational: ASL = above screening level, NSL = no screening level, BSL = below screening level.

Table 5
Selection of Constituents of Potential Concern in Soil Gas
South Settling Lagoon
Moraine, Ohio

Constituent	On-Site Data Summary [a]				Near Off-Site Data Summary [a]				USEPA Residential Air RSL [b]	Calculated Soil Gas RSL [c]	Constituent of Potential Concern (COPC)? [d]	
	Frequency of Detection	Minimum Detect μg/m³	Maximum Detect μg/m³	Location of Maximum	Frequency of Detection	Minimum Detect μg/m³	Maximum Detect μg/m³	Location of Maximum	(μg/m³)	(μg/m³)	(YES/no)	Rational
Benzene	3/10	14	22	SSL-1	4/6	1.3	8.9	SGP-2 (6)	0.31	3	YES	ASL
1,1-Dichloroethane	4/10	2.1	18	SSL-2	5/6	2.30	82	SGP-2 (15.4)	1.5	15	YES	ASL
cis-1,2-Dichloroethene	3/10	3.8	16	SSL-1	4/6	2.30	54	SGP-2 (15.4)	63	630	no	BSL
trans-1,2-Dichloroethene	4/10	2.9	21	SSL-2	5/6	4.90	110	SGP-2 (15.4)	63	630	no	BSL
Ethylbenzene	9/10	1	37	SSL-3	2/6	1.9	2.2	SGP-2 (6)	0.97	10	YES	ASL
Tetrachloroethene	10/10	52	9600	SSL-2	6/6	370	38000	SGP-2 (15.4)	9.4	94	YES	ASL
Toluene	9/10	2.9	130	SSL-1	4/6	1.8	21	SGP-2 (6)	5,200	52,000	no	BSL
1,1,1-Trichloroethane	4/10	13	91	SSL-2	6/6	10	260	SGP-2 (15.4)	5,200	52,000	no	BSL
Trichloroethene	10/10	7	3100	SSL-2	6/6	86	16000	SGP-2 (15.4)	0.43	4	YES	ASL
m,p-Xylene	NA	NA	NA	NA	3/6	2.1	7.4	SGP-2 (6)	100	1,000	no	BSL
o-Xylene	NA	NA	NA	NA	2/6	2.6	3.2	SGP-2 (16)	100	1,000	no	BSL
Xylenes	9/10	2.3	130	SSL-1	NA	NA	NA	NA	100	1,000	no	BSL

Notes:
μg/m³ = micrograms per cubic meter.
[a] From on-site soil gas risk assessment dataset comprised of data from SSL1, SSL2, and SS-3 (Table 2A).
From near off-site soil gas risk assessment dataset comprised of data from SGP-1 and SGP-2 (Table 2B).
Frequency of detection = number of samples detected / total number of samples analyzed.
[b] From USEPA Regional Screening Level (RSL) Table (USEPA 2012a).
RSL for trans-1,2-dichloroethene was used as surrogate for cis-1,2-dichloroethene.
[c] Calculated Soil Gas RSL = Air RSL x (1/AF)
Air RSL = indoor air Regional Screening Level (μg/m³; USEPA 2012a)
AF = attenuation factor (0.1; USEPA 2012b)
[d] Constituents were selected as COPCs if the maximum exceeded the screening level.
Rational: ASL = above screening level, NSL = no screening level, BSL = below screening level.

Table 6
Receptor Exposure Parameters
South Settling Lagoon
Moraine, Ohio

Exposure Route	Parameter Code	Parameter Definition	Units	Reasonable Maximum Expsoure Value	Reasonable Maximum Expsoure Rationale/ Reference	Intake Equation/ Model Name
Construction Worker Receptor						
Ingestion	CS	Chemical concentration	mg/kg	Chemical specific	–	CDI (mg/kg-day)=
	CF	Conversion factor	kg/mg	1.00E-06	Unit conversion	(EPC x IR x EF x ED x CF) / (BW x AT)
	IR	Soil ingestion rate	mg/day	330	USEPA 2002c	
	FI	Fraction ingested	unitless	1		
	EF	Exposure frequency	days/year	250	USEPA 2002c	
	ED	Exposure duration	years	1	USEPA 2002c	
	BW	Body weight	kg	70	USEPA 2002c	
	ATc	Averaging time - cancer	days	25,550	USEPA 2002c	
	ATnc	Averaging time - noncancer	days	365	USEPA 2002c	
Dermal Contact	CS	Chemical concentration	mg/kg	Chemical specific	–	CDI (mg/kg-day)=
	CF	Conversion factor	kg/mg	1.00E-06	Unit conversion	(EPC x SSA x ABSs x AF x EF x ED x CF) / (BW x AT)
	AF	Skin adherence factor	mg/cm^2	0.3	USEPA 2004c	
	ABSd	Dermal absorption factor				
		benzo(a)pyrene	unitless	0.13	USEPA 2004c	
	EF	Exposure frequency	days/year	250	USEPA 2002c	
	ED	Exposure duration	years	1	USEPA 2002c	
	SA	Skin surface area	cm^2/day	3300	USEPA 2002c	
	BW	Body weight	kg	70	USEPA 2002c	
	ATc	Averaging time - cancer	days	25,550	USEPA 2002c	
	ATnc	Averaging time - noncancer	days	365	USEPA 2002c	
Inhalation	CS	Chemical concentration	mg/kg	Chemical specific	–	CDI (mg/m^3)=
	PEF	Particulate emission factor	m^3/kg	1.36E+09	USEPA 2002c	(EPC x EF x ED x ET x CF) / AT
	VF	Volatilization factor	m^3/kg	Chemical specific		
	ET	Exposure time	hour/day	8	workday	
	EF	Exposure frequency	day/year	250	USEPA 2002c	
	ED	Exposure duration	years	1	USEPA 2002c	
	CF	Conversion factor	day/hrs	0.042	by definition	
	ATc	Averaging time - cancer	days	25,550	USEPA 2002c	
	ATnc	Averaging time - noncancer	days	365	USEPA 2002c	
Commercial/Industrial Worker Receptor						
Inhalation	EPC	Chemical Concentration in Air	mg/m^3	TBD	–	CDI (mg/m^3)=
	EF	Exposure Frequency	days/year	250	USEPA, 1991	(EPC x EF x ED x ET x CF) / AT
	ED	Exposure Duration	years	25	USEPA, 1991	
	ET	Exposure Time	hrs/day	8	assumed	
	CF	Conversion Factor	day/hrs	0.042	–	
	AT-C	Averaging Time (Cancer)	days	25,550	USEPA, 1989	
	AT-N	Averaging Time (Non-Cancer)	days	9,125	USEPA, 1989	
Child Recreational Visitor Receptor						
Inhalation	EPC	Chemical Concentration in Air	mg/m^3	TBD	–	CDI (mg/m^3)=
	EF	Exposure Frequency	days/year	156	assumed	(EPC x EF x ED x ET x CF) / AT
	ED	Exposure Duration	years	6	USEPA, 1991	
	ET	Exposure Time	hrs/day	3	assumed	
	CF	Conversion Factor	day/hrs	0.042	–	
	AT-C	Averaging Time (Cancer)	days	25,550	USEPA, 1989	
	AT-N	Averaging Time (Non-Cancer)	days	2,190	USEPA, 1989	

Notes:
CDI = Chronic Daily Intake.
EPC = exposure point concetration.
hrs = hours.
kg = kilograms.
mg/m^3 = milligrams per cubic meter.
TBD = To be determined.

Table 7
Johnston and Ettinger Vapor Intrusion Model Input Parameters
South Settling Lagoon
Moraine, Ohio

Model Parameter	Parameter Code	Units	Value		Justification
			Slab-on grade	Basement	
All Runs					
Average Soil temperature	T_s	ºC	11	11	site specific (USEPA 2004 Figure 8)
Soil Stratum A - Soil Type	SL	--	SL	SL	site-specific - silty sand (sandy loam (SL) used per USEPA 2004 Table 11)
Soil Stratum B - Soil Type	C	--	C	C	site-specific - clay
Soil Stratum C - Soil Type	L	--	L	L	site-specific - top soil (Loam (L) used)
Enclosed space floor thickness	L_{crack}	cm	10	10	Default
Soil-building pressure differential	ΔP	g/cm-s^2	40	40	Default
Enclosed space floor length	L_B	cm	1000	1000	Default
Enclosed space floor width	W_B	cm	1000	1000	Default
Enclosed space height	H_B	cm	244	366	Default
Floor-wall seam crack width	w	cm	0.1	0.1	Default
Indoor air exchange rate	ER	1/hr	0.25	0.25	Default
Groundwater Model					
Depth below grade to bottom of enclosed space	L_F	cm	15	200	Default
Depth below grade to water table	L_{WT}	cm	533	533	site-specific
Thickness of Soil Stratum A [a]	h_A	cm	488	533	site-specific
Thickness of Soil Stratum B	h_B	cm	30	--	site-specific
Thickness of Soil Stratum C	h_C	cm	15	--	site-specific
Soil Gas Model					
Depth below grade to bottom of enclosed space	L_F	cm	15	200	Default
Soil Gas Sampling Depth [b]	L_s	cm	472	472	site-specific
Thickness of Soil Stratum A	h_A	cm	427	472	site-specific
Thickness of Soil Stratum B	h_B	cm	30	--	site-specific
Thickness of Soil Stratum C	h_C	cm	15	--	site-specific

Notes:

hr - hour

cm - centimeter

g/cm-s^2 - gram per centimer per square second

[a] Set at 16 feet since depth to groundwater is 17.5 and the depth of clay cover and top soil is 1 and 0.5 foot, respectively.

[b] Set at 15.5 feet as soil gas concentrations were higher at deeper depths.

Table 8
Indirect Exposure Point Concentrations
Reasonable Maximum Expsoure
South Settling Lagoon
Moraine, Ohio

Receptor/ Scenario	Exposure Point Concentration (EPC) [a]	Air Exposure Point Concentration [b] (µg/m^3)
<u>Slab-on-grade Scenario</u>		
Using on-site Shallow groundwater data	**<u>µg/L</u>**	
Tetrachloroethene	150	5
Trichloroethene	140	3.1
Using on-site Deep groundwater data	**<u>µg/L</u>**	
Tetrachloroethene	35	1.17
Trichloroethene	14	0.31
Using on-site soil gas data	**<u>µg/m^3</u>**	
Benzene	22	0.0054
1,1-Dichloroethane	18	0.0042
Ethylbenzene	37	0.0088
Tetrachloroethene	9600	2.25
Trichloroethene	3100	0.74
Using near off-site soil gas data	**<u>µg/m^3</u>**	
Reasonable Maximum Expsoure (RME)		
Tetrachloroethene	38000	8.89
Trichloroethene	16000	3.83

ug/L = micrograms per liter
µg/m^3 = micrograms per cubic meter

[a] For on-site groundwater: the EPC was set at the maximum concentration.
For off-site groundwater: the EPC was set at upper confidence limit on the mean (UCL) concentration as calculated by USEPA's ProUCL software (USEPA 2011; Appendix B).
The EPCs for soil gas were set at the maximum detected concentration

[b] Calculated using USEPA's spreadsheet for the Johnson and Ettinger Vapor Intrusion Model (USEPA 2004a,c)

Table 9
Toxicity Values for Constituents of Potential Concern
South Settling Lagoon
Moraine, Ohio

Constituent	Oral RfD (mg/kg/day) [a]		Dermal RfD (mg/kg/day) [b]	Inhalation RfC (mg/m^3) [a]		Inhalation RfC ($\mu g/m^3$) [a]	Oral CSF $(mg/kg/day)^{-1}$ [a]		Dermal CSF $(mg/kg/day)^{-1}$ [b]	Inhalation Unit Risk $(mg/m^3)^{-1}$ [a]		Inhalation Unit Risk $(\mu g/m^3)^{-1}$ [a]	ABS_{GI} [b]
	value	[ref]	value	value	[ref]		value	[ref]	value	value	[ref]		
Volatile Organic Compounds													
Benzene	NAp		NAp	3.0E-02	I	3.0E+01	NAp		NAp	7.8E-03	I	7.8E-06	1
1,1-Dichloroethane	NAp		NAp	NA		NA	NAp		NAp	1.6E-03	C	1.6E-06	1
Ethylbenzene	NAp		NAp	1.0E+00	I	1.0E+03	NAp		NAp	2.5E-03	C	2.5E-06	1
Tetrachloroethene	NAp		NAp	4.0E-02	I	4.0E+01	NAp		NAp	2.6E-04	I	2.6E-07	1
Trichloroethene	NAp		NAp	2.0E-03	I	2.0E+00	NAp		NAp	4.1E-06	I	4.1E-09	1
Semi Volatile Organic Compounds													
Benzo[a]pyrene	NA		NA	NA		NA	7.3E+00	I	7.3E+00	1.1E+00	C	1.1E-03	1

References [ref]:

A	Agency for Toxic Substances Disease Registry (ATSDR 2012).
C	CalEPA, Toxicity Criteria database (CalEPA 2012).
I	USEPA, Integrated Risk Information System (IRIS) (USEPA 2012c).
P	Provisional Peer Reviewed Toxicity Values (PPRTV) (USEPA 2012d).

NA	Not available.
NAp	Not Applicable; not a direct contact constituent of potential concern.
mg/kg/day	Milligrams per kilogram per day.
mg/m^3	Milligrams per cubic meter.
$(mg/kg/day)^{-1}$	Inverse milligrams per kilogram per day (risk per unit dose).
$(mg/m^3)^{-1}$	Inverse milligrams per cubic meter.

[a] Toxicity values were obtained per USEPA hierarchy (USEPA 2003).

[b] The oral-to-dermal adjustment factor (oral absorption efficiency [ABS_{GI}]) was used to calculate the dermal RfD values.
RfD (dermal) = RfD (oral) × Adjustment Factor (oral absorption efficiency).
CSF (dermal) = CSF (oral) / Adjustment Factor (oral absorption efficiency).

Table 10
Risk Characterization for Construction Worker from Direct Exposure to Soil
Reasonable Maximum Exposure
South Settling Lagoon
Moraine, Ohio

Scenario: RME
Scenario Timeframe: Future
Receptor: Construction Worker
Receptor Age: Adult

Medium	Exposure Medium	Exposure Point	Exposure Route	Chemical of Potential Concern	Exposure Point Concentration [a]		Cancer Risk Calculations					Non-Cancer Hazard Calculations				
							Intake/Exposure Concentration		CSF/Unit Risk		Cancer Risk	Intake/Exposure Concentration		RfD/RfC		Hazard Quotient
					Value	Units	Value	Units	Value	Units		Value	Units	Value	Units	
Soil	Soil	Soil	Ingestion	Benzo(a)pyrene	1.0E+00	mg/kg	4.6E-08	mg/kg/day	7.3E+00	$(mg/kg/day)^{-1}$	3.4E-07	3.2E-06	mg/kg/day	NA	mg/kg/day	NA
		Soil	Dermal	Benzo(a)pyrene	1.0E+00	mg/kg	1.8E-08	mg/kg/day	7.3E+00	$(mg/kg/day)^{-1}$	1.3E-07	1.3E-06	mg/kg/day	NA	mg/kg/day	NA
		Air	Inhalation	Benzo(a)pyrene	7.4E-10	mg/kg	2.4E-12	mg/kg/day	1.1E+00	(mg/m^3)-1	2.6E-12	1.7E-10	mg/kg/day	NA	mg/m^3	NA
Soil Total											5E-07					NA

mg/kg = milligrams per kilogram
mg/kg/day = milligrams per kilogram per day
mg/m^3 = milligrams per cubic meter
NA = not available/not applicable
RfC = reference concentration
RfD = reference dose
RME = reasonable maximum exposure

[a] The Exposure Point Concentration in soil was from Table 3.
The Exposure Point Concentration in air was the exposure point concentration in soil divided by the particulate emission factor (PEF; Table 6).

Table 11
Risk Characterization for Site Worker from Inhalation of Vapors due to Vapor Intrusion Using On-site Shallow Groundwater Samples
Slab-on-grade Scenario
Reasonable Maximum Exposure
South Settling Lagoon
Moraine, Ohio

Scenario:	RME
Scenario Timeframe:	Future
Receptor Population:	Site Worker
Receptor Age:	Adult

Medium	Exposure Medium	Exposure Point	Exposure Route	Chemical of Potential Concern	Exposure Point Concentration		Cancer Risk Calculations					Non-Cancer Hazard Calculations				
							Intake		Inhalation Unit		Cancer Risk	Intake		Reference		Hazard Quotient
					Value	Units	Value	Units	Value	Units		Value	Units	Value	Units	
Groundwater	Air	Indoor Air	Inhalation	Tetrachloroethene	5.0E+00	µg/m³	4.1E-01	µg/m³	2.6E-07	(µg/m³)⁻	1.1E-07	1.1E+00	µg/m³	4.0E+01	µg/m³	0.029
				Trichloroethene	3.1E+00	µg/m³	2.5E-01	µg/m³	4.1E-09	(µg/m³)⁻	1.0E-09	7.1E-01	µg/m³	2.0E+00	µg/m³	0.35
			Exposure Route Total								1E-07					0.4
		Exposure Point Total									1E-07					0.4
	Exposure Medium Total										1E-07					0.4
Groundwater Total											1E-07					0.4

$\mu g/m^3$ = micrograms per cubic meter
RME = reasonable maximum exposure

Table 12
Risk Characterization for Site Worker from Inhalation of Vapors due to Vapor Intrusion Using On-site Deep Groundwater Samples
Slab-on-grade Scenario
Reasonable Maximum Exposure
South Settling Lagoon
Moraine, Ohio

Scenario:	RME
Scenario Timeframe:	Future
Receptor Population:	Site Worker
Receptor Age:	Adult

Medium	Exposure Medium	Exposure Point	Exposure Route	Chemical of Potential Concern	Exposure Point Concentration		Cancer Risk Calculations					Non-Cancer Hazard Calculations				
							Intake		Inhalation Unit		Cancer Risk	Intake		Reference		Hazard Quotient
					Value	Units	Value	Units	Value	Units		Value	Units	Value	Units	
Groundwater	Air	Indoor Air	Inhalation	Tetrachloroethene	1.2E+00	µg/m^3	9.5E-02	µg/m^3	2.6E-07	(µg/m^3)$^-$	2.5E-08	2.7E-01	µg/m^3	4.0E+01	µg/m^3	0.0067
				Trichloroethene	3.1E-01	µg/m^3	2.5E-02	µg/m^3	4.1E-09	(µg/m^3)$^-$	1.0E-10	7.1E-02	µg/m^3	2.0E+00	µg/m^3	0.035
			Exposure Route Total								2E-08					0.04
		Exposure Point Total									2E-08					0.04
	Exposure Medium Total										2E-08					0.04
Groundwater Total											2E-08					0.04

µg/m^3 = micrograms per cubic meter
RME = reasonable maximum exposure

Table 13
Risk Characterization for Site Worker from Inhalation of Vapors due to Vapor Intrusion Using On-site Soil Gas Samples
Slab-on-grade Scenario
Reasonable Maximum Exposure
South Settling Lagoon
Moraine, Ohio

Scenario:	RME
Scenario Timeframe:	Future
Receptor Population:	Site Worker
Receptor Age:	Adult

Medium	Exposure Medium	Exposure Point	Exposure Route	Chemical of Potential Concern	Exposure Point Concentration		Cancer Risk Calculations					Non-Cancer Hazard Calculations				
							Intake		Inhalation Unit Risk		Cancer Risk	Intake		Reference Concentration		Hazard Quotient
					Value	Units	Value	Units	Value	Units		Value	Units	Value	Units	
Groundwater	Soil Gas	Indoor Air	Inhalation	Benzene	5.4E-03	µg/m^3	4.4E-04	µg/m^3	7.8E-06	(µg/m^3)$^{-1}$	3.4E-09	1.2E-03	µg/m^3	3.0E+01	µg/m^3	0.000041
				1,1-Dichloroethane	4.2E-03	µg/m^3	3.5E-04	µg/m^3	1.6E-06	(µg/m^3)$^{-1}$	5.5E-10	9.7E-04	µg/m^3	NA	µg/m^3	NA
				Ethylbenzene	8.8E-03	µg/m^3	7.1E-04	µg/m^3	2.5E-06	(µg/m^3)$^{-1}$	1.8E-09	2.0E-03	µg/m^3	1.0E+03	µg/m^3	0.0000020
				Tetrachloroethene	2.2E+00	µg/m^3	1.8E-01	µg/m^3	2.6E-07	(µg/m^3)$^{-1}$	4.8E-08	5.1E-01	µg/m^3	4.0E+01	µg/m^3	0.013
				Trichloroethene	7.4E-01	µg/m^3	6.1E-02	µg/m^3	4.1E-09	(µg/m^3)$^{-1}$	2.5E-10	1.7E-01	µg/m^3	2.0E+00	µg/m^3	0.085
			Exposure Route Total								5E-08					0.1
		Exposure Point Total									5E-08					0.1
	Exposure Medium Total										5E-08					0.1
Groundwater Total											5E-08					0.1

µg/m^3 = micrograms per cubic meter
RME = reasonable maximum exposure

Table 14
Risk Characterization for Site Worker from Inhalation of Vapors due to Vapor Intrusion Using Off-site Soil Gas Samples
Slab-on-grade Scenario
Reasonable Maximum Exposure
South Settling Lagoon
Moraine, Ohio

Scenario:	RME
Scenario Timeframe:	Future
Receptor Population:	Site Worker
Receptor Age:	Adult

Medium	Exposure Medium	Exposure Point	Exposure Route	Chemical of Potential Concern	Exposure Point Concentration		Cancer Risk Calculations					Non-Cancer Hazard Calculations				
							Intake		Inhalation Unit Risk		Cancer Risk	Intake		Reference Concentration		Hazard Quotient
					Value	Units	Value	Units	Value	Units		Value	Units	Value	Units	
Groundwater	Soil Gas	Indoor Air	Inhalation	Tetrachloroethene	8.9E+00	µg/m^3	7.2E-01	µg/m^3	2.6E-07	(µg/m^3)$^{-1}$	1.9E-07	2.0E+00	µg/m^3	4.0E+01	µg/m^3	0.051
				Trichloroethene	3.8E+00	µg/m^3	3.1E-01	µg/m^3	4.1E-09	(µg/m^3)$^{-1}$	1.3E-09	8.7E-01	µg/m^3	2.0E+00	µg/m^3	0.44
			Exposure Route Total								2E-07					0.5
		Exposure Point Total									2E-07					0.5
	Exposure Medium Total										2E-07					0.5
Groundwater Total											2E-07					0.5

µg/m^3 = micrograms per cubic meter
RME = reasonable maximum exposure

Table 15
Risk Characterization for Child Visitor from Inhalation of Vapors due to Vapor Intrusion Using On-site Shallow Groundwater Samples
Slab-on-grade Scenario
Reasonable Maximum Exposure
South Settling Lagoon
Moraine, Ohio

Scenario:	RME
Scenario Timeframe:	Future
Receptor Population:	Child Visitor
Receptor Age:	Child

Medium	Exposure Medium	Exposure Point	Exposure Route	Chemical of Potential Concern	Exposure Point Concentration		Cancer Risk Calculations					Non-Cancer Hazard Calculations				
							Intake		Inhalation Unit Risk		Cancer Risk	Intake		Reference Concentration		Hazard Quotient
					Value	Units	Value	Units	Value	Units		Value	Units	Value	Units	
Groundwater	Air	Indoor Air	Inhalation	Tetrachloroethene	5.0E+00	μg/m^3	2.3E-02	μg/m^3	2.6E-07	(μg/m^3)$^{-1}$	6.0E-09	2.7E-01	μg/m^3	4.0E+01	μg/m^3	0.0067
				Trichloroethene	3.1E+00	μg/m^3	1.4E-02	μg/m^3	4.1E-09	(μg/m^3)$^{-1}$	5.8E-11	1.7E-01	μg/m^3	2.0E+00	μg/m^3	0.083
			Exposure Route Total								6E-09					0.09
		Exposure Point Total									6E-09					0.09
	Exposure Medium Total										6E-09					0.09
Groundwater Total											6E-09					0.09

μg/m^3 = micrograms per cubic meter
RME = reasonable maximum exposure

Table 16
Risk Characterization for Child Visitor from Inhalation of Vapors due to Vapor Intrusion Using On-site Deep Groundwater Samples
Slab-on-grade Scenario
Reasonable Maximum Exposure
South Settling Lagoon
Moraine, Ohio

Scenario:	RME
Scenario Timeframe:	Future
Receptor Population:	Child Visitor
Receptor Age:	Child

Medium	Exposure Medium	Exposure Point	Exposure Route	Chemical of Potential Concern	Exposure Point Concentration		Cancer Risk Calculations					Non-Cancer Hazard Calculations				
							Intake		Inhalation Unit Risk		Cancer Risk	Intake		Reference Concentration		Hazard Quotient
					Value	Units	Value	Units	Value	Units		Value	Units	Value	Units	
Groundwater	Air	Indoor Air	Inhalation	Tetrachloroethene	1.2E+00	μg/m^3	5.4E-03	μg/m^3	2.6E-07	(μg/m^3)$^{-1}$	1.4E-09	6.3E-02	μg/m^3	4.0E+01	μg/m^3	0.0016
				Trichloroethene	3.1E-01	μg/m^3	1.4E-03	μg/m^3	4.1E-09	(μg/m^3)$^{-1}$	5.8E-12	1.7E-02	μg/m^3	2.0E+00	μg/m^3	0.0083
			Exposure Route Total								1E-09					0.01
		Exposure Point Total									1E-09					0.01
	Exposure Medium Total										1E-09					0.01
Groundwater Total											1E-09					0.01

μg/m^3 = micrograms per cubic meter
RME = reasonable maximum exposure

Table 17
Risk Characterization for Child Visitor from Inhalation of Vapors due to Vapor Intrusion Using On-site Soil Gas Samples
Slab-on-grade Scenario
Reasonable Maximum Exposure
South Settling Lagoon
Moraine, Ohio

Scenario:	RME
Scenario Timeframe:	Future
Receptor Population:	Child Visitor
Receptor Age:	Child

Medium	Exposure Medium	Exposure Point	Exposure Route	Chemical of Potential Concern	Exposure Point Concentration		Cancer Risk Calculations					Non-Cancer Hazard Calculations				
							Intake		Inhalation Unit Risk		Cancer Risk	Intake		Reference Concentration		Hazard Quotient
					Value	Units	Value	Units	Value	Units		Value	Units	Value	Units	
Groundwater	Soil Gas	Indoor Air	Inhalation	Benzene	5.4E-03	$\mu g/m^3$	2.5E-05	$\mu g/m^3$	7.8E-06	$(\mu g/m^3)^{-1}$	1.9E-10	2.9E-04	$\mu g/m^3$	3.0E+01	$\mu g/m^3$	0.000010
				1,1-Dichloroethane	4.2E-03	$\mu g/m^3$	1.9E-05	$\mu g/m^3$	1.6E-06	$(\mu g/m^3)^{-1}$	3.1E-11	2.3E-04	$\mu g/m^3$	NA	$\mu g/m^3$	NA
				Ethylbenzene	8.8E-03	$\mu g/m^3$	4.0E-05	$\mu g/m^3$	2.5E-06	$(\mu g/m^3)^{-1}$	1.0E-10	4.7E-04	$\mu g/m^3$	1.0E+03	$\mu g/m^3$	0.00000047
				Tetrachloroethene	2.2E+00	$\mu g/m^3$	1.0E-02	$\mu g/m^3$	2.6E-07	$(\mu g/m^3)^{-1}$	2.7E-09	1.2E-01	$\mu g/m^3$	4.0E+01	$\mu g/m^3$	0.0030
				Trichloroethene	7.4E-01	$\mu g/m^3$	3.4E-03	$\mu g/m^3$	4.1E-09	$(\mu g/m^3)^{-1}$	1.4E-11	4.0E-02	$\mu g/m^3$	2.0E+00	$\mu g/m^3$	0.020
			Exposure Route Total								3E-09					0.02
		Exposure Point Total									3E-09					0.02
	Exposure Medium Total										3E-09					0.02
Groundwater Total											3E-09					0.02

$\mu g/m^3$ = micrograms per cubic meter
NA = not available/not applicable
RME = reasonable maximum exposure

Table 18
Risk Characterization for Child Visitor from Inhalation of Vapors due to Vapor Intrusion Using Off-site Soil Gas Samples
Slab-on-grade Scenario
Reasonable Maximum Exposure
South Settling Lagoon
Moraine, Ohio

Scenario:	RME
Scenario Timeframe:	Future
Receptor Population:	Child Visitor
Receptor Age:	Child

Medium	Exposure Medium	Exposure Point	Exposure Route	Chemical of Potential Concern	Exposure Point Concentration		Cancer Risk Calculations					Non-Cancer Hazard Calculations				
							Intake		Inhalation Unit Risk		Cancer Risk	Intake		Reference Concentration		Hazard Quotient
					Value	Units	Value	Units	Value	Units		Value	Units	Value	Units	
Groundwater	Soil Gas	Indoor Air	Inhalation	Tetrachloroethene	8.9E+00	μg/m^3	4.1E-02	μg/m^3	2.6E-07	(μg/m^3)$^{-1}$	1.1E-08	4.7E-01	μg/m^3	4.0E+01	μg/m^3	0.012
				Trichloroethene	3.8E+00	μg/m^3	1.8E-02	μg/m^3	4.1E-09	(μg/m^3)$^{-1}$	7.2E-11	2.0E-01	μg/m^3	2.0E+00	μg/m^3	0.10
			Exposure Route Total								1E-08					0.1
		Exposure Point Total									1E-08					0.1
	Exposure Medium Total										1E-08					0.1
Groundwater Total											1E-08					0.1

μg/m^3 = micrograms per cubic meter
RME = reasonable maximum exposure

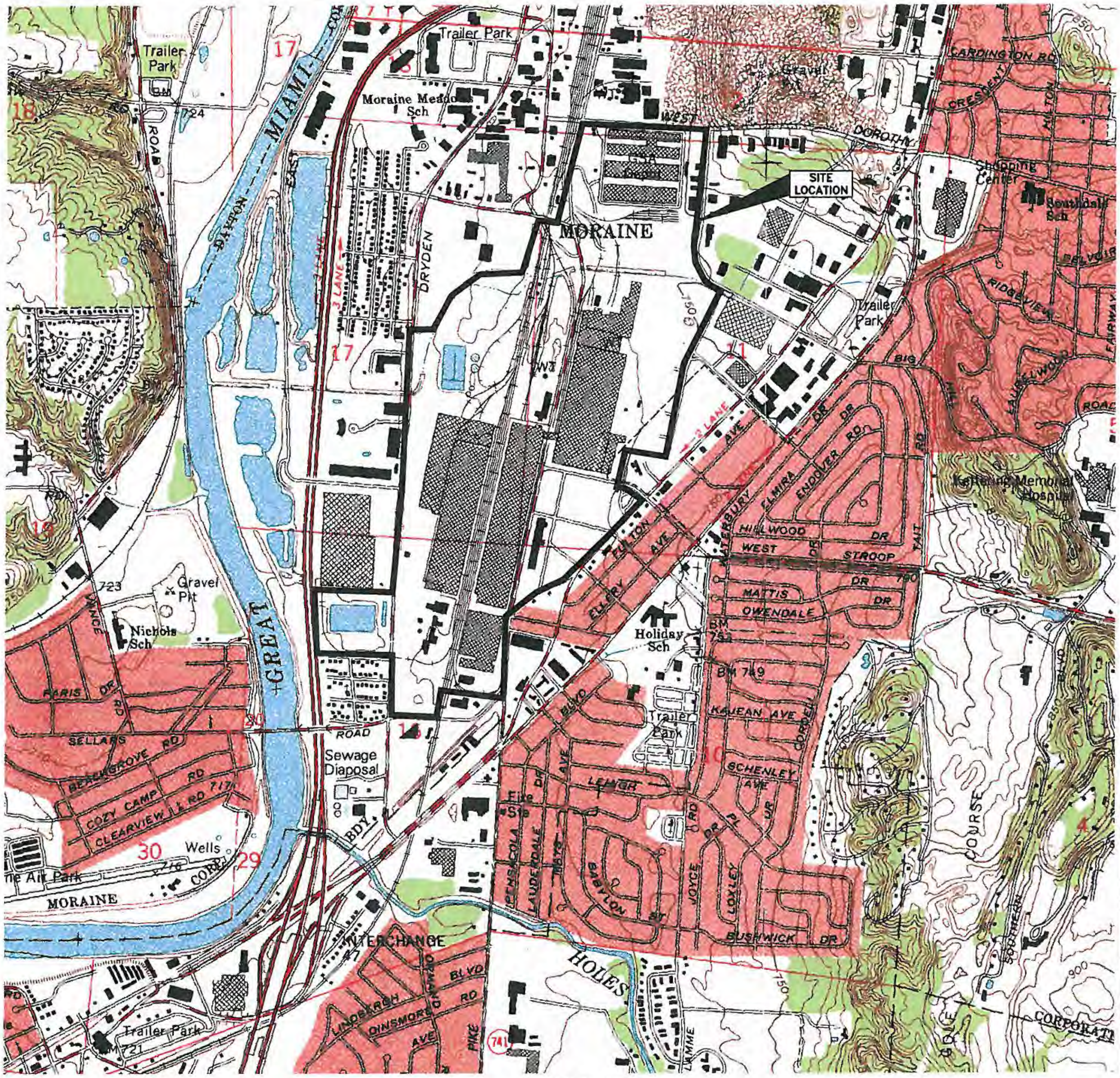
Table 19
Summary of Risk Characterization Results for the Vapor Intrusion Pathway for a Site Worker
South Settling Lagoon
Moraine, Ohio

Scenario	**Table Number**	**Total Excess Lifetime Cancer Risk (unitless)**	**Total Non-Cancer Hazard (unitless)**
Hypothetical Construction Worker Receptor			
Direct contact with soil (ingestion, dermal, inhalation of dust)	Table 10	5E-07	NA
Hypothetical Commercial Receptor			
Inhalation of vapor in indoor air - slab-on-grade scenario			
Using on-site shallow groundwater data	Table 11	1E-07	0.4
Using on-site deep groundwater data	Table 12	2E-08	0.04
Using near on-site soil gas data	Table 13	5E-08	0.1
Using near off-site soil gas data	Table 14	2E-07	0.5
Hypothetical Child Visitor Receptor			
Inhalation of vapor in indoor air - slab-on-grade scenario			
Using on-site shallow groundwater data	Table 15	6E-09	0.09
Using on-site deep groundwater data	Table 16	1E-09	0.01
Using near on-site soil gas data	Table 17	3E-09	0.02
Using near off-site soil gas data	Table 18	1E-08	0.1

NA = not applicable

Figures

CITY:(COLUMBUS) DIV/GROUP:(SER1) DB:(R. SMITH) LD:(Opt) PIC:(Opt) PM:(N. GILLOTTI) TM:(Opt) LYR:(Opt)ON=*;OFF=*REF*
G:\ENVCAD\Columbus-OH\ACT\OH001102 - MIAMI VALLEY SPORTS FOUNDATION\OH110212-02.dwg LAYOUT: FIG 1 SITE LOCATION - HHRA SAVED: 7/3/2012 11:29 AM ACADVER: 18.1S (LMS TECH) PAGESETUP: ---- PLOTSTYLETABLE: ACAD.CTB PLOTTED: 7/3/2012 11:32 AM BY: SMITH, BOB
PROJECTNAME: ----
XREFS:



SCALE 1:24 000

1 1/2 0 1

SCALE IN MILE

1000 0 1000 2000 3000 4000 5000 6000 7000

SCALE IN FEET: 1" = 2000'

OHIO QUADRANGLE LOCATION

REFERENCE: USGS 7.5 MINUTE QUADRANGLE; DAYTON SOUTH, OHIO 1966, PHOTOREVISED 1991

RACER TRUST
MORAINE, OHIO

OH001102.0001

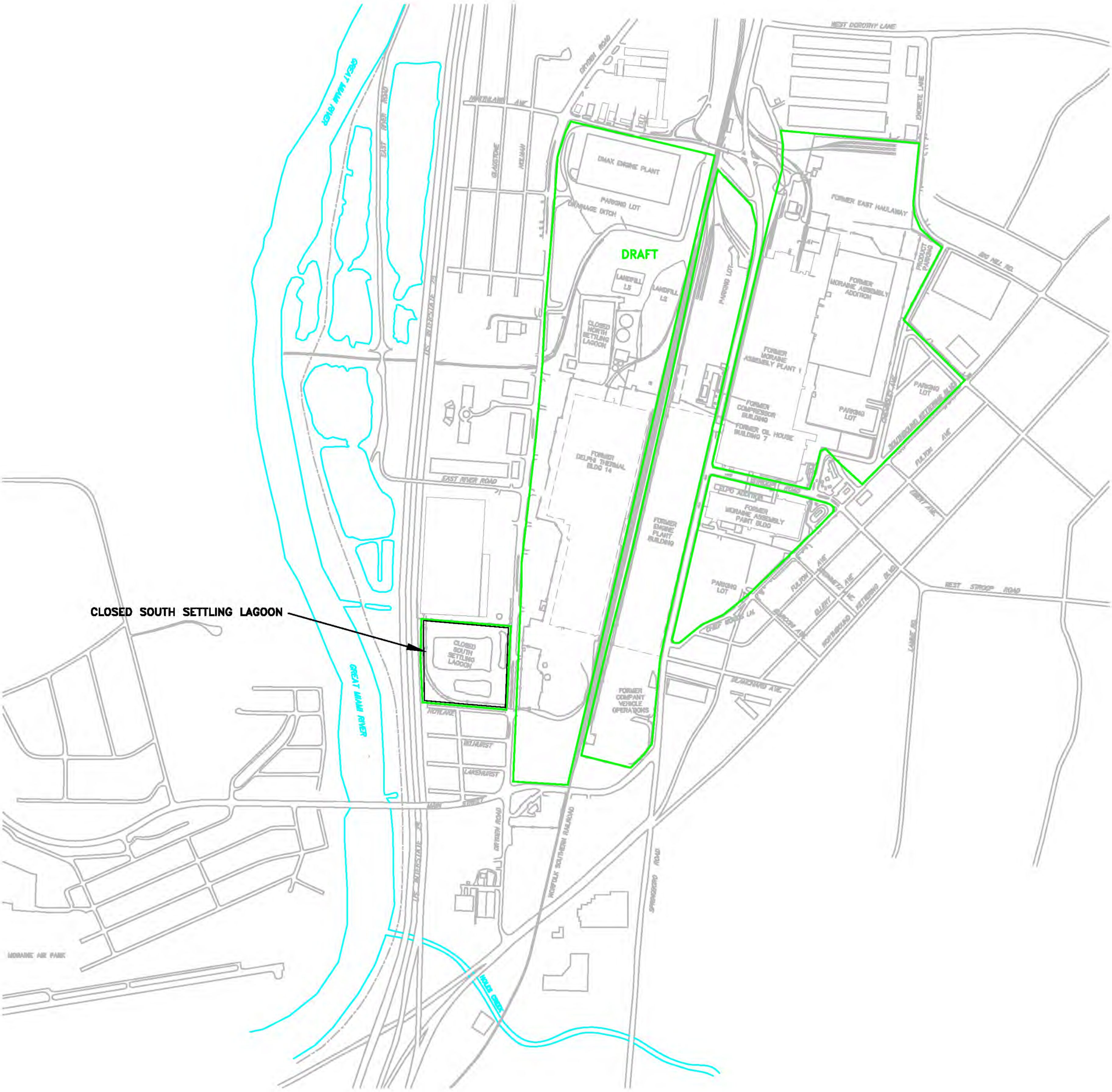
SITE LOCATION MAP

ARCADIS

FIGURE
1

CITY:DUBLIN DIV/GROUP:SER2 DB:R. SMITH LD:(Opt) PIC:(Opt) PM:N. GILLOTTI TM:T. FORTNER LYR:(Opt)ON=*;OFF=*REF*
G:\ENVCAD\Columbus-OH\ACT\OH001102 - MIAMI VALLEY SPORTS FOUNDATION\OH110212-00.dwg LAYOUT: FIG 1 SITE LAYOUT L1 (2) SAVED: 7/3/2012 11:27 AM ACADVER: 18.1S (LMS TECH) PAGESETUP: ---- PLOTSTYLETABLE: ACAD.CTB PLOTTED: 7/3/2012 11:28 AM BY: SMITH, BOB

XREFS: PROJECTNAME: ----
MLCBASE MAP 2010



LEGEND

- PROPERTY BOUNDARY
- RIVER LEVEE
- FORMER BUILDING FOOTPRINT
- SURFACE WATER FEATURE

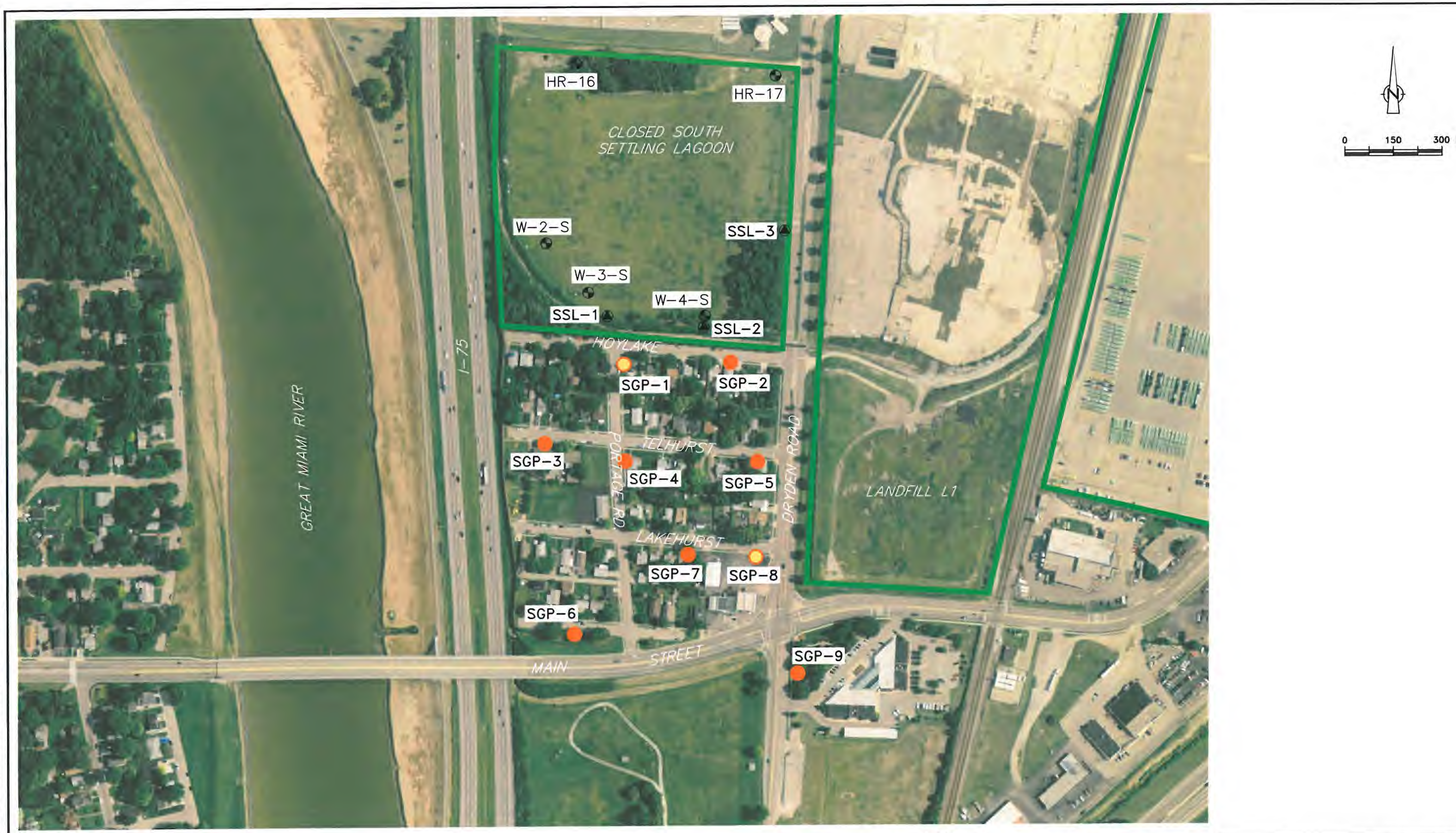
RACER TRUST
MORAINE, OHIO

OH001102.0001

SITE VICINITY MAP

ARCADIS

FIGURE
2



LEGEND

- SOIL–GAS SAMPLING POINT
- SOIL–GAS SAMPLING POINT AND SHELBY TUBE SAMPLING LOCATION
- SHALLOW MONITORING WELL
- SOIL GAS AND GROUNDWATER LOCATION
- PROPERTY BOUNDARY

CLOSED SOUTH SETTLING LAGOON
MORAINE, OHIO

OH001102.0002

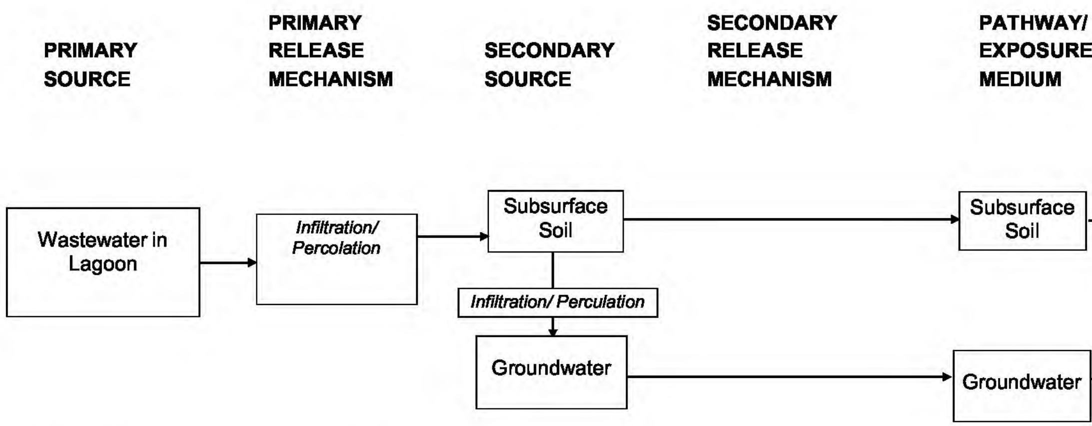
SAMPLING LOCATIONS

ARCADIS

FIGURE
3

CITY:(COLUMBUS) DIV/GROUP:(SER1) DB:(R. SMITH) LD:(Opt) PIC:(Opt) PM:(N. GILLOTTI) TM:(OPT) LYR:(Opt)ON=*;OFF=*REF* SAVED: 6/26/2012 8:59 AM ACADVER: 18.1S (LMS TECH) PAGESETUP: ---- PLOTSTYLETABLE: ACAD.CTB PLOTTED: 6/26/2012
G:\ENVCAD\Columbus-OH\ACT\OH001102 - MIAMI VALLEY SPORTS FOUNDATION\OH110212-01.dwg LAYOUT: HHRA - ALL SAMPLES IN NEIGHBORHOOD SW OF SITE
11:25 AM BY: SMITH, BOB

XREFS:



POTENTIAL FUTURE RECEPTORS

Pathway/Exposure Medium	Exposure Route	Site Worker	Construction Worker	Child and Adult Visitor
Subsurface Soil	Ingestion	NA	NA	NA
	Dermal	NA	NA	NA
	Inhalation of Dust and Vapors in Outdoor Air	NA	NA	NA
	Indoor Vapor Inhalation	NA	NA	NA
Groundwater	Ingestion	NA	NA	NA
	Dermal	NA	NA	NA
	Indoor Vapor Inhalation	X	NA	X (a)

NA Pathway not applicable - incomplete.
x Potential pathway.
(a) Risk/hazard to visitor receptor will be qualitatively assessed only.

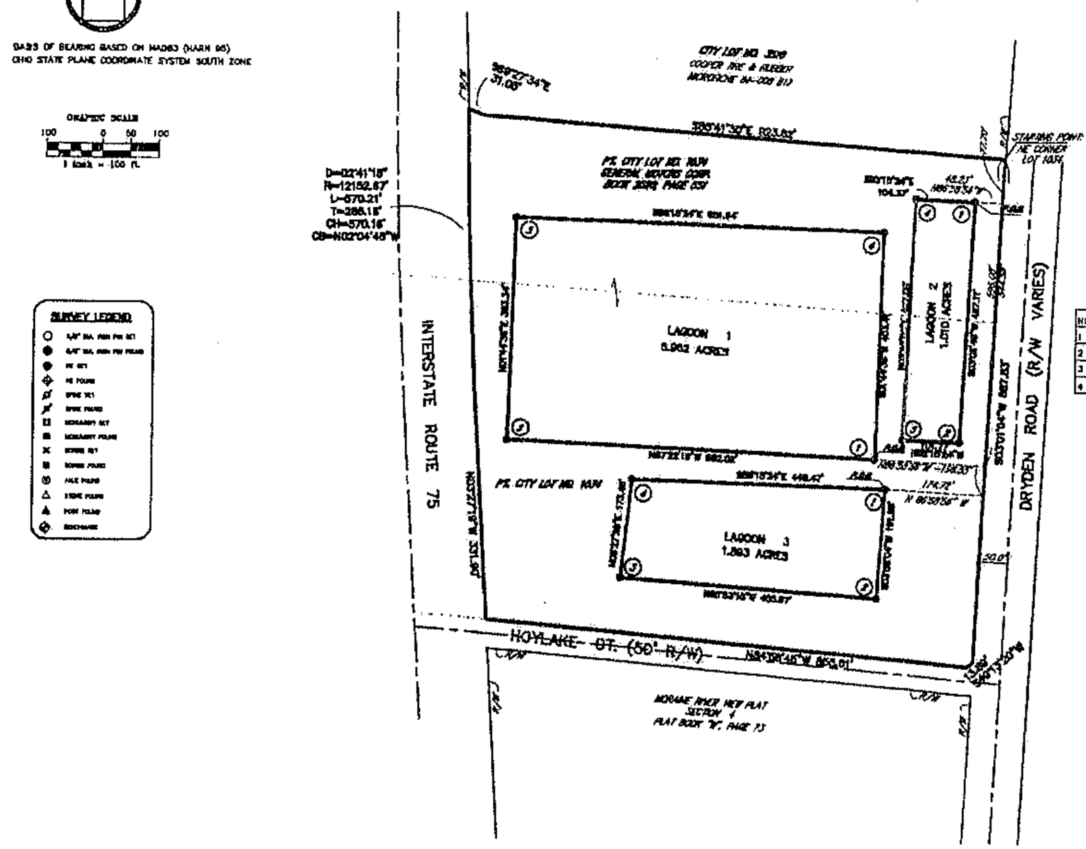
ARCADIS

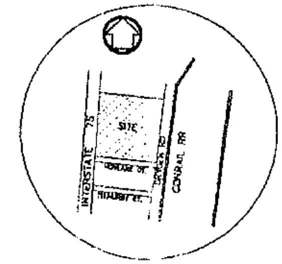
Conceptual Site Model for Potential Human Receptors
Closed South Settling Lagoon
Motors Liquidation Company, Moraine, Ohio

Figure 4

ARCADIS

Appendix A: Survey Map





VICINITY MAP
NOT TO SCALE

LAGOON NO. 1

NO.	NORTHING	EASTING
1	620647.43	1482824.74
2	620677.33	1481973.31
3	621070.49	1481980.27
4	621050.65	1482836.91

LAGOON NO. 2

NO.	NORTHING	EASTING
1	621105.84	1482797.44
2	620679.37	1482774.24
3	620682.47	1482672.52
4	621109.03	1482693.12

LAGOON NO. 3

NO.	NORTHING	EASTING
1	620594.85	1482843.83
2	620403.47	1482830.55
3	620438.14	1482178.08
4	620606.50	1482195.84

CERTIFICATION:

I HEREBY CERTIFY THAT THIS PLAT IS A CORRECT REPRESENTATION OF A FIELD SURVEY PERFORMED UNDER MY DIRECTION BY JUDGE ENGINEERING COMPANY IN AUGUST 2001. I FURTHER CERTIFY THAT ALL MONUMENTS WERE SET OR FOUND AS SHOWN.

RAYMOND B. MOTORO
OHIO REGISTERED SURVEYOR NO. 7367
AUGUST 7, 2001

STATE OF OHIO
RAYMOND B. MOTORO
NO. 7367
REGISTERED
PROFESSIONAL SURVEYOR

LAGOON 1

DESCRIPTION OF A 5.962 ACRE PARCEL
CITY OF MORAINE, MONTGOMERY COUNTY, OHIO

SITUATE IN SECTION 16, TOWN 1, RANGE 6 MRS, CITY OF MORAINE, MONTGOMERY COUNTY, OHIO, AND BEING A 5.962 ACRE PARCEL UPON LOT 1034 OF THE REVISED AND CONSECUTIVE NUMBERS OF LOTS AS SHOWN ON THE PLAT OF THE CITY OF MORAINE AS CONVEYED TO GENERAL MOTORS CORPORATION BY DEED RECORDED IN BOOK 2020, PAGE 551 OF THE DEED RECORDS OF SAID COUNTY, AND BEING MORE PARTICULARLY DESCRIBED AS FOLLOWS:

STARTING AT A POINT ON THE EAST LINE OF SAID LOT 1034, SAID POINT BEING S 3° 01' 04" W A DISTANCE OF 644.58 FEET FROM THE NORTHEAST CORNER OF SAID LOT 1034; THENCE N 86° 58' 56" W A DISTANCE OF 106.66 FEET TO A 5/8" IRON PIN SET AT THE TRUE PLACE OF BEGINNING OF THE HEREIN DESCRIBED PARCEL;

THENCE FROM SAID TRUE PLACE OF BEGINNING, N 87° 22' 16" W A DISTANCE OF 852.02 FEET TO A 5/8" IRON PIN SET; THENCE N 1°44' 36" E A DISTANCE OF 393.34 FEET TO A 5/8" IRON PIN SET; THENCE S 88° 15' 24" E A DISTANCE OF 856.64 FEET TO A 5/8" IRON PIN SET; THENCE S 1° 44' 36" W A DISTANCE OF 403.41 FEET TO THE TRUE PLACE OF BEGINNING, CONTAINING 5.962 ACRES MORE OR LESS.

LAGOON 2

DESCRIPTION OF A 1.010 ACRE PARCEL
CITY OF MORAINE, MONTGOMERY COUNTY, OHIO

SITUATE IN SECTION 16, TOWN 1, RANGE 6 MRS, CITY OF MORAINE, MONTGOMERY COUNTY, OHIO, AND BEING A 1.010 ACRE PARCEL UPON LOT 1034 OF THE REVISED AND CONSECUTIVE NUMBERS OF LOTS AS SHOWN ON THE PLAT OF THE CITY OF MORAINE AS CONVEYED TO GENERAL MOTORS CORPORATION BY DEED RECORDED IN BOOK 2020, PAGE 551 OF THE DEED RECORDS OF SAID COUNTY, AND BEING MORE PARTICULARLY DESCRIBED AS FOLLOWS:

STARTING AT A POINT ON THE EAST LINE OF SAID LOT 1034, SAID POINT BEING S 3° 01' 04" W A DISTANCE OF 77.70 FEET FROM THE NORTHEAST CORNER OF SAID LOT 1034; THENCE N 86° 58' 56" W A DISTANCE OF 40.23 FEET TO A 5/8" IRON PIN SET AT THE TRUE PLACE OF BEGINNING OF THE HEREIN DESCRIBED PARCEL;

THENCE FROM SAID TRUE PLACE OF BEGINNING, S 3° 06' 49" W A DISTANCE OF 427.10 FEET TO A 5/8" IRON PIN SET; THENCE N 88° 15' 24" W A DISTANCE OF 101.77 FEET TO A 5/8" IRON PIN SET; THENCE N 2° 45' 50" E A DISTANCE OF 427.05 FEET TO A 5/8" IRON PIN SET; THENCE S 88° 15' 24" E A DISTANCE OF 104.36 FEET TO THE TRUE PLACE OF BEGINNING, CONTAINING 1.010 ACRES MORE OR LESS.

LAGOON 3

DESCRIPTION OF A 1.893 ACRE PARCEL
CITY OF MORAINE, MONTGOMERY COUNTY, OHIO

SITUATE IN SECTION 16, TOWN 1, RANGE 6 MRS, CITY OF MORAINE, MONTGOMERY COUNTY, OHIO, AND BEING A 1.893 ACRE PARCEL UPON LOT 1034 OF THE REVISED AND CONSECUTIVE NUMBERS OF LOTS AS SHOWN ON THE PLAT OF THE CITY OF MORAINE AS CONVEYED TO GENERAL MOTORS CORPORATION BY DEED RECORDED IN BOOK 2020, PAGE 551 OF THE DEED RECORDS OF SAID COUNTY, AND BEING MORE PARTICULARLY DESCRIBED AS FOLLOWS:

STARTING AT A POINT ON THE EAST LINE OF SAID LOT 1034, SAID POINT BEING S 3° 01' 04" W A DISTANCE OF 896.08 FEET FROM THE NORTHEAST CORNER OF SAID LOT 1034; THENCE N 86° 58' 56" W A DISTANCE OF 174.72 FEET TO A 5/8" IRON PIN SET AT THE TRUE PLACE OF BEGINNING OF THE HEREIN DESCRIBED PARCEL;

THENCE FROM SAID TRUE PLACE OF BEGINNING, S 3° 50' 04" W A DISTANCE OF 191.84 FEET TO A 5/8" IRON PIN SET; THENCE N 87° 53' 15" W A DISTANCE OF 403.67 FEET TO A 5/8" IRON PIN SET; THENCE N 6° 27' 29" E A DISTANCE OF 173.45 FEET TO A 5/8" IRON PIN SET; THENCE S 88° 15' 24" E A DISTANCE OF 448.47 FEET TO THE TRUE PLACE OF BEGINNING, CONTAINING 1.893 ACRES MORE OR LESS.

HARRISON RADIATOR FACILITY
PLAT OF SURVEY OF
SOUTH LAGOON
OF THE FORMER WASTEWATER IMPOUNDMENT
PART CITY LOT NO. 1034
CITY OF MORAINE MONTGOMERY COUNTY, OHIO

Judge Engineering Company
Professional Engineers and Surveyors – Consultants
1201 East David Road
Kettering, Ohio 45429
Phone (937) 294-1441 Fax (937) 294-5498

SURVEY
DRAWING NO. C-1
SHEET 1 of 1

ARCADIS

Human Health Risk Assessment

Closed South Settling Lagoon
RACER
Moraine, Ohio
JULY 3, 2012

Appendix ~~A~~B: ProUCL Outputs

Soil ProUCL Outputs
South Settling Lagoon
Moraine, Ohio

General UCL Statistics for Data Sets with Non-Detects

User Selected Options

From File	WorkSheet.wst
Full Precision	OFF
Confidence Coefficient	95%
nber of Bootstrap Operations	2000

Result (arsenic)

General Statistics

Number of Valid Data	30	Number of Detected Data	29
Number of Distinct Detected Data	27	Number of Non-Detect Data	1
		Percent Non-Detects	3.33%

Raw Statistics		Log-transformed Statistics	
Minimum Detected	2.36	Minimum Detected	0.859
Maximum Detected	9.16	Maximum Detected	2.215
Mean of Detected	5.01	Mean of Detected	1.578
SD of Detected	1.398	SD of Detected	0.261
Minimum Non-Detect	0.808	Minimum Non-Detect	-0.213
Maximum Non-Detect	0.808	Maximum Non-Detect	-0.213

UCL Statistics

Normal Distribution Test with Detected Values Only		Lognormal Distribution Test with Detected Values Only	
Shapiro Wilk Test Statistic	0.844	Shapiro Wilk Test Statistic	0.924
5% Shapiro Wilk Critical Value	0.926	5% Shapiro Wilk Critical Value	0.926
Data not Normal at 5% Significance Level		Data not Lognormal at 5% Significance Level	
Assuming Normal Distribution		Assuming Lognormal Distribution	
DL/2 Substitution Method		DL/2 Substitution Method	
Mean	4.856	Mean	1.495
SD	1.611	SD	0.521
95% DL/2 (t) UCL	5.356	95% H-Stat (DL/2) UCL	6.18
Maximum Likelihood Estimate(MLE) Method		Log ROS Method	
Mean	4.853	Mean in Log Scale	1.557
SD	1.596	SD in Log Scale	0.281
95% MLE (t) UCL	5.348	Mean in Original Scale	4.929
95% MLE (Tiku) UCL	5.355	SD in Original Scale	1.443
		95% t UCL	5.377
		95% Percentile Bootstrap UCL	5.37
		95% BCA Bootstrap UCL	5.397
Gamma Distribution Test with Detected Values Only		Data Distribution Test with Detected Values Only	
k star (bias corrected)	13.47	Data do not follow a Discernable Distribution (0.05)	
Theta Star	0.372		

nu star	781		
A-D Test Statistic	0.991	Nonparametric Statistics	
5% A-D Critical Value	0.745	Kaplan-Meier (KM) Method	
K-S Test Statistic	0.745	Mean	4.921
5% K-S Critical Value	0.162	SD	1.432
Data not Gamma Distributed at 5% Significance Level		SE of Mean	0.266
		95% KM (t) UCL	5.373
Assuming Gamma Distribution		95% KM (z) UCL	5.359
Gamma ROS Statistics using Extrapolated Data		95% KM (jackknife) UCL	5.361
Minimum	1.752	95% KM (bootstrap t) UCL	5.473
Maximum	9.16	95% KM (BCA) UCL	5.442
Mean	4.901	95% KM (Percentile Bootstrap) UCL	5.398
Median	4.73	95% KM (Chebyshev) UCL	6.081
SD	1.497	97.5% KM (Chebyshev) UCL	6.583
k star	10.02	99% KM (Chebyshev) UCL	7.569
Theta star	0.489		
Nu star	601	Potential UCLs to Use	
AppChi2	545.1	95% KM (Chebyshev) UCL	6.081
95% Gamma Approximate UCL	5.403		
95% Adjusted Gamma UCL	5.434		

Note: DL/2 is not a recommended method.

te: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UC
hese recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006
For additional insight, the user may want to consult a statistician.

Result (barium)

General Statistics

Number of Valid Data	30
Number of Distinct Detected Data	28
Number of Detected Data	29
Number of Non-Detect Data	1
Percent Non-Detects	3.33%

Raw Statistics

Minimum Detected	12
Maximum Detected	77.2
Mean of Detected	39.88
SD of Detected	16.95
Minimum Non-Detect	66
Maximum Non-Detect	66

Log-transformed Statistics

Minimum Detected	2.485
Maximum Detected	4.346
Mean of Detected	3.589
SD of Detected	0.465
Minimum Non-Detect	4.19
Maximum Non-Detect	4.19

UCL Statistics

Normal Distribution Test with Detected Values Only

Shapiro Wilk Test Statistic	0.965
5% Shapiro Wilk Critical Value	0.926

Data appear Normal at 5% Significance Level

Lognormal Distribution Test with Detected Values Only

Shapiro Wilk Test Statistic	0.969
5% Shapiro Wilk Critical Value	0.926

Data appear Lognormal at 5% Significance Level

Assuming Normal Distribution

DL/2 Substitution Method

Mean	39.65
SD	16.7
95% DL/2 (t) UCL	44.83

Maximum Likelihood Estimate(MLE) Method N/A

MLE method failed to converge properly

Assuming Lognormal Distribution

DL/2 Substitution Method

Mean	3.586
SD	0.457
95% H-Stat (DL/2) UCL	47.15

Log ROS Method

Mean in Log Scale	3.589
SD in Log Scale	0.456
Mean in Original Scale	39.73
SD in Original Scale	16.67
95% t UCL	44.9
95% Percentile Bootstrap UCL	44.83
95% BCA Bootstrap UCL	44.97

Gamma Distribution Test with Detected Values Only

k star (bias corrected)	4.818
Theta Star	8.277
nu star	279.5
A-D Test Statistic	0.189
5% A-D Critical Value	0.747
K-S Test Statistic	0.747
5% K-S Critical Value	0.163

Data appear Gamma Distributed at 5% Significance Level

Assuming Gamma Distribution

Gamma ROS Statistics using Extrapolated Data

Minimum	12
Maximum	77.2

Data Distribution Test with Detected Values Only

Data appear Normal at 5% Significance Level

Nonparametric Statistics

Kaplan-Meier (KM) Method

Mean	39.83
SD	16.61
SE of Mean	3.132
95% KM (t) UCL	45.16
95% KM (z) UCL	44.99
95% KM (jackknife) UCL	45.16
95% KM (bootstrap t) UCL	45.44
95% KM (BCA) UCL	45.26

Mean	39.98	95% KM (Percentile Bootstrap) UCL	45.1
Median	38.15	95% KM (Chebyshev) UCL	53.49
SD	16.66	97.5% KM (Chebyshev) UCL	59.4
k star	4.992	99% KM (Chebyshev) UCL	71
Theta star	8.008		
Nu star	299.5	Potential UCLs to Use	
AppChi2	260.5	95% KM (t) UCL	45.16
95% Gamma Approximate UCL	45.98	95% KM (Percentile Bootstrap) UCL	45.1
95% Adjusted Gamma UCL	46.36		

Note: DL/2 is not a recommended method.

te: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UC
hese recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006
For additional insight, the user may want to consult a statistician.

Result (benzo(a)anthracene)

General Statistics

Number of Valid Data	30	Number of Detected Data	4
Number of Distinct Detected Data	4	Number of Non-Detect Data	26
		Percent Non-Detects	86.67%

Raw Statistics		Log-transformed Statistics	
Minimum Detected	550	Minimum Detected	6.31
Maximum Detected	7560	Maximum Detected	8.931
Mean of Detected	2519	Mean of Detected	7.252
SD of Detected	3368	SD of Detected	1.156
Minimum Non-Detect	330	Minimum Non-Detect	5.799
Maximum Non-Detect	3300	Maximum Non-Detect	8.102

Note: Data have multiple DLs - Use of KM Method is recommer
For all methods (except KM, DL/2, and ROS Methods),
Observations < Largest ND are treated as NDs

Number treated as Non-Detect	29
Number treated as Detected	1
Single DL Non-Detect Percentage	96.67%

Warning: There are only 4 Distinct Detected Values in this data
Note: It should be noted that even though bootstrap may be performed on this data set
the resulting calculations may not be reliable enough to draw conclusions

It is recommended to have 10-15 or more distinct observations for accurate and meaningful results.

UCL Statistics

Normal Distribution Test with Detected Values Only		Lognormal Distribution Test with Detected Values Only	
Shapiro Wilk Test Statistic	0.693	Shapiro Wilk Test Statistic	0.846
5% Shapiro Wilk Critical Value	0.748	5% Shapiro Wilk Critical Value	0.748
Data not Normal at 5% Significance Level		Data appear Lognormal at 5% Significance Level	
Assuming Normal Distribution		Assuming Lognormal Distribution	
DL/2 Substitution Method		DL/2 Substitution Method	
Mean	1139	Mean	6.436
SD	1398	SD	1.177
95% DL/2 (t) UCL	1572	95% H-Stat (DL/2) UCL	2255
Maximum Likelihood Estimate(MLE) Method	N/A	Log ROS Method	
MLE method failed to converge properly		Mean in Log Scale	4.267
		SD in Log Scale	1.922
		Mean in Original Scale	448.6
		SD in Original Scale	1379
		95% t UCL	876.2
		95% Percentile Bootstrap UCL	898.4
		95% BCA Bootstrap UCL	1185
Gamma Distribution Test with Detected Values Only		Data Distribution Test with Detected Values Only	
k star (bias corrected)	0.416	Data appear Gamma Distributed at 5% Significance Level	
Theta Star	6060		
nu star	3.325		

A-D Test Statistic	0.608	Nonparametric Statistics	
5% A-D Critical Value	0.667	Kaplan-Meier (KM) Method	
K-S Test Statistic	0.667	Mean	839.4
5% K-S Critical Value	0.402	SD	1257
Data appear Gamma Distributed at 5% Significance Level		SE of Mean	266.8
		95% KM (t) UCL	1293
Assuming Gamma Distribution		95% KM (z) UCL	1278
Gamma ROS Statistics using Extrapolated Data		95% KM (jackknife) UCL	1188
Minimum	1E-12	95% KM (bootstrap t) UCL	2365
Maximum	176631	95% KM (BCA) UCL	N/A
Mean	40504	95% KM (Percentile Bootstrap) UCL	1748
Median	22811	95% KM (Chebyshev) UCL	2002
SD	47340	97.5% KM (Chebyshev) UCL	2505
k star	0.216	99% KM (Chebyshev) UCL	3494
Theta star	187321		
Nu star	12.97	Potential UCLs to Use	
AppChi2	5.875	95% KM (t) UCL	1293
95% Gamma Approximate UCL	89444		
95% Adjusted Gamma UCL	N/A		

Note: DL/2 is not a recommended method.

te: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UC
hese recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006
For additional insight, the user may want to consult a statistician.

Result (benzo(a)pyrene)

General Statistics

Number of Valid Data	30	Number of Detected Data	9
Number of Distinct Detected Data	9	Number of Non-Detect Data	21
		Percent Non-Detects	70.00%

Raw Statistics		Log-transformed Statistics	
Minimum Detected	242	Minimum Detected	5.489
Maximum Detected	6140	Maximum Detected	8.723
Mean of Detected	1382	Mean of Detected	6.695
SD of Detected	1853	SD of Detected	1.029
Minimum Non-Detect	165	Minimum Non-Detect	5.106
Maximum Non-Detect	1650	Maximum Non-Detect	7.409

Note: Data have multiple DLs - Use of KM Method is recommer		Number treated as Non-Detect	28
For all methods (except KM, DL/2, and ROS Methods),		Number treated as Detected	2
Observations < Largest ND are treated as NDs		Single DL Non-Detect Percentage	93.33%

Warning: There are only 9 Detected Values in this data

Note: It should be noted that even though bootstrap may be performed on this data set

the resulting calculations may not be reliable enough to draw conclusions

It is recommended to have 10-15 or more distinct observations for accurate and meaningful results.

UCL Statistics

Normal Distribution Test with Detected Values Only		Lognormal Distribution Test with Detected Values Only	
Shapiro Wilk Test Statistic	0.634	Shapiro Wilk Test Statistic	0.932
5% Shapiro Wilk Critical Value	0.829	5% Shapiro Wilk Critical Value	0.829
Data not Normal at 5% Significance Level		Data appear Lognormal at 5% Significance Level	

Assuming Normal Distribution		Assuming Lognormal Distribution	
DL/2 Substitution Method		DL/2 Substitution Method	
Mean	769.4	Mean	6.019
SD	1101	SD	1.198
95% DL/2 (t) UCL	1111	95% H-Stat (DL/2) UCL	1548
Maximum Likelihood Estimate(MLE) Method	N/A	Log ROS Method	
MLE method failed to converge properly		Mean in Log Scale	5.252
		SD in Log Scale	1.465
		Mean in Original Scale	551.9
		SD in Original Scale	1140
		95% t UCL	905.6
		95% Percentile Bootstrap UCL	922.4
		95% BCA Bootstrap UCL	1155

Gamma Distribution Test with Detected Values Only		Data Distribution Test with Detected Values Only
k star (bias corrected)	0.786	Data appear Gamma Distributed at 5% Significance Level
Theta Star	1757	
nu star	14.16	

A-D Test Statistic	0.541
5% A-D Critical Value	0.742
K-S Test Statistic	0.742
5% K-S Critical Value	0.286

Data appear Gamma Distributed at 5% Significance Level

Assuming Gamma Distribution

Gamma ROS Statistics using Extrapolated Data

Minimum	1E-12
Maximum	8722
Mean	2377
Median	1431
SD	2496
k star	0.192
Theta star	12358
Nu star	11.54
AppChi2	4.927
95% Gamma Approximate UCL	5569
95% Adjusted Gamma UCL	5864

Note: DL/2 is not a recommended method.

Nonparametric Statistics

Kaplan-Meier (KM) Method

Mean	656.9
SD	1091
SE of Mean	218.1
95% KM (t) UCL	1027
95% KM (z) UCL	1016
95% KM (jackknife) UCL	988.9
95% KM (bootstrap t) UCL	1448
95% KM (BCA) UCL	1249
95% KM (Percentile Bootstrap) UCL	1059
95% KM (Chebyshev) UCL	1607
97.5% KM (Chebyshev) UCL	2019
99% KM (Chebyshev) UCL	2827

Potential UCLs to Use

95% KM (t) UCL	1027

te: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UC
hese recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006
For additional insight, the user may want to consult a statistician.

Result (benzo(b)fluoranthene)

General Statistics

Number of Valid Data	30	Number of Detected Data	7
Number of Distinct Detected Data	7	Number of Non-Detect Data	23
		Percent Non-Detects	76.67%

Raw Statistics		Log-transformed Statistics	
Minimum Detected	449	Minimum Detected	6.107
Maximum Detected	8230	Maximum Detected	9.016
Mean of Detected	2031	Mean of Detected	7.104
SD of Detected	2771	SD of Detected	0.984
Minimum Non-Detect	330	Minimum Non-Detect	5.799
Maximum Non-Detect	3300	Maximum Non-Detect	8.102

Note: Data have multiple DLs - Use of KM Method is recommer	Number treated as Non-Detect	29
For all methods (except KM, DL/2, and ROS Methods),	Number treated as Detected	1
Observations < Largest ND are treated as NDs	Single DL Non-Detect Percentage	96.67%

Warning: There are only 7 Detected Values in this data

Note: It should be noted that even though bootstrap may be performed on this data set

the resulting calculations may not be reliable enough to draw conclusions

It is recommended to have 10-15 or more distinct observations for accurate and meaningful results.

UCL Statistics

Normal Distribution Test with Detected Values Only		Lognormal Distribution Test with Detected Values Only	
Shapiro Wilk Test Statistic	0.606	Shapiro Wilk Test Statistic	0.881
5% Shapiro Wilk Critical Value	0.803	5% Shapiro Wilk Critical Value	0.803
Data not Normal at 5% Significance Level		Data appear Lognormal at 5% Significance Level	
Assuming Normal Distribution		Assuming Lognormal Distribution	
DL/2 Substitution Method		DL/2 Substitution Method	
Mean	1244	Mean	6.57
SD	1488	SD	1.15
95% DL/2 (t) UCL	1705	95% H-Stat (DL/2) UCL	2447
Maximum Likelihood Estimate(MLE) Method	N/A	Log ROS Method	
MLE method failed to converge properly		Mean in Log Scale	5.452
		SD in Log Scale	1.485
		Mean in Original Scale	697
		SD in Original Scale	1511
		95% t UCL	1166
		95% Percentile Bootstrap UCL	1218
		95% BCA Bootstrap UCL	1501
Gamma Distribution Test with Detected Values Only		Data Distribution Test with Detected Values Only	
k star (bias corrected)	0.731	ata Follow Appr. Gamma Distribution at 5% Significance Leve	
Theta Star	2778		
nu star	10.23		

A-D Test Statistic	0.717	Nonparametric Statistics	
5% A-D Critical Value	0.726	Kaplan-Meier (KM) Method	
K-S Test Statistic	0.726	Mean	907.3
5% K-S Critical Value	0.319	SD	1412
)ata follow Appr. Gamma Distribution at 5% Significance Leve		SE of Mean	286.4
		95% KM (t) UCL	1394
Assuming Gamma Distribution		95% KM (z) UCL	1378
Gamma ROS Statistics using Extrapolated Data		95% KM (jackknife) UCL	1353
Minimum	1E-12	95% KM (bootstrap t) UCL	2149
Maximum	19080	95% KM (BCA) UCL	1736
Mean	5322	95% KM (Percentile Bootstrap) UCL	1480
Median	3464	95% KM (Chebyshev) UCL	2156
SD	5392	97.5% KM (Chebyshev) UCL	2696
k star	0.24	99% KM (Chebyshev) UCL	3757
Theta star	22193		
Nu star	14.39	Potential UCLs to Use	
AppChi2	6.838	95% KM (t) UCL	1394
95% Gamma Approximate UCL	11198		
95% Adjusted Gamma UCL	11711		

Note: DL/2 is not a recommended method.

te: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UC
hese recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006
For additional insight, the user may want to consult a statistician.

Result (chromium)

General Statistics

Number of Valid Data	30	Number of Detected Data	4
Number of Distinct Detected Data	3	Number of Non-Detect Data	26
		Percent Non-Detects	86.67%

Raw Statistics		Log-transformed Statistics	
Minimum Detected	13	Minimum Detected	2.565
Maximum Detected	20	Maximum Detected	2.996
Mean of Detected	15.25	Mean of Detected	2.71
SD of Detected	3.202	SD of Detected	0.194
Minimum Non-Detect	13	Minimum Non-Detect	2.565
Maximum Non-Detect	130	Maximum Non-Detect	4.868

Note: Data have multiple DLs - Use of KM Method is recommer
For all methods (except KM, DL/2, and ROS Methods),
Observations < Largest ND are treated as NDs

Number treated as Non-Detect	30
Number treated as Detected	0
Single DL Non-Detect Percentage	100.00%

Warning: There are only 3 Distinct Detected Values in this data set
The number of detected data may not be adequate enough to perform GOF tests, bootstrap, and ROS methods.
Those methods will return a 'N/A' value on your output display!

It is necessary to have 4 or more Distinct Values for bootstrap methods.
However, results obtained using 4 to 9 distinct values may not be reliable.
It is recommended to have 10 to 15 or more observations for accurate and meaningful results and estimates.

UCL Statistics

Normal Distribution Test with Detected Values Only		Lognormal Distribution Test with Detected Values Only	
Shapiro Wilk Test Statistic	0.753	Shapiro Wilk Test Statistic	0.777
5% Shapiro Wilk Critical Value	0.748	5% Shapiro Wilk Critical Value	0.748
Data appear Normal at 5% Significance Level		Data appear Lognormal at 5% Significance Level	

Assuming Normal Distribution		Assuming Lognormal Distribution	
DL/2 Substitution Method		DL/2 Substitution Method	
Mean	9.617	Mean	2.06
SD	10.94	SD	0.497
95% DL/2 (t) UCL	13.01	95% H-Stat (DL/2) UCL	10.63
Maximum Likelihood Estimate(MLE) Method	N/A	Log ROS Method	
MLE method failed to converge properly		Mean in Log Scale	1.798
		SD in Log Scale	0.551
		Mean in Original Scale	7
		SD in Original Scale	4.078
		95% t UCL	8.265
		95% Percentile Bootstrap UCL	8.258
		95% BCA Bootstrap UCL	8.418

Gamma Distribution Test with Detected Values Only		Data Distribution Test with Detected Values Only
k star (bias corrected)	8.608	Data appear Normal at 5% Significance Level
Theta Star	1.772	

nu star	68.87
A-D Test Statistic	0.661
5% A-D Critical Value	0.657
K-S Test Statistic	0.657
5% K-S Critical Value	0.394

Data not Gamma Distributed at 5% Significance Level

Assuming Gamma Distribution

Gamma ROS Statistics using Extrapolated Data

Minimum	12.05
Maximum	28.87
Mean	22.25
Median	23.52
SD	5.131
k star	15.27
Theta star	1.457
Nu star	916.2
AppChi2	846.9
95% Gamma Approximate UCL	24.07
95% Adjusted Gamma UCL	N/A

Note: DL/2 is not a recommended method.

Nonparametric Statistics

Kaplan-Meier (KM) Method

Mean	13.31
SD	1.289
SE of Mean	0.276
95% KM (t) UCL	13.78
95% KM (z) UCL	13.77
95% KM (jackknife) UCL	13.99
95% KM (bootstrap t) UCL	14.49
95% KM (BCA) UCL	N/A
95% KM (Percentile Bootstrap) UCL	14.62
95% KM (Chebyshev) UCL	14.52
97.5% KM (Chebyshev) UCL	15.04
99% KM (Chebyshev) UCL	16.06

Potential UCLs to Use

95% KM (t) UCL	13.78
95% KM (Percentile Bootstrap) UCL	14.62

te: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UC
hese recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006
For additional insight, the user may want to consult a statistician.

Result (chrysene)

General Statistics

Number of Valid Data	30	Number of Detected Data	6
Number of Distinct Detected Data	6	Number of Non-Detect Data	24
		Percent Non-Detects	80.00%

Raw Statistics		Log-transformed Statistics	
Minimum Detected	341	Minimum Detected	5.832
Maximum Detected	8240	Maximum Detected	9.017
Mean of Detected	1951	Mean of Detected	6.848
SD of Detected	3099	SD of Detected	1.179
Minimum Non-Detect	330	Minimum Non-Detect	5.799
Maximum Non-Detect	3300	Maximum Non-Detect	8.102

Note: Data have multiple DLs - Use of KM Method is recommer		Number treated as Non-Detect	29
For all methods (except KM, DL/2, and ROS Methods),		Number treated as Detected	1
Observations < Largest ND are treated as NDs		Single DL Non-Detect Percentage	96.67%

Warning: There are only 6 Detected Values in this data

Note: It should be noted that even though bootstrap may be performed on this data set

the resulting calculations may not be reliable enough to draw conclusions

It is recommended to have 10-15 or more distinct observations for accurate and meaningful results.

UCL Statistics

Normal Distribution Test with Detected Values Only		Lognormal Distribution Test with Detected Values Only	
Shapiro Wilk Test Statistic	0.595	Shapiro Wilk Test Statistic	0.849
5% Shapiro Wilk Critical Value	0.788	5% Shapiro Wilk Critical Value	0.788
Data not Normal at 5% Significance Level		Data appear Lognormal at 5% Significance Level	
Assuming Normal Distribution		Assuming Lognormal Distribution	
DL/2 Substitution Method		DL/2 Substitution Method	
Mean	1182	Mean	6.498
SD	1498	SD	1.142
95% DL/2 (t) UCL	1647	95% H-Stat (DL/2) UCL	2243
Maximum Likelihood Estimate(MLE) Method	N/A	Log ROS Method	
MLE method failed to converge properly		Mean in Log Scale	4.667
		SD in Log Scale	1.777
		Mean in Original Scale	522.5
		SD in Original Scale	1500
		95% t UCL	987.9
		95% Percentile Bootstrap UCL	1041
		95% BCA Bootstrap UCL	1400
Gamma Distribution Test with Detected Values Only		Data Distribution Test with Detected Values Only	
k star (bias corrected)	0.518	Data appear Lognormal at 5% Significance Level	
Theta Star	3768		
nu star	6.215		

A-D Test Statistic	0.768	Nonparametric Statistics	
5% A-D Critical Value	0.719	Kaplan-Meier (KM) Method	
K-S Test Statistic	0.719	Mean	717.9
5% K-S Critical Value	0.343	SD	1419
Data not Gamma Distributed at 5% Significance Level		SE of Mean	288
		95% KM (t) UCL	1207
Assuming Gamma Distribution		95% KM (z) UCL	1192
Gamma ROS Statistics using Extrapolated Data		95% KM (jackknife) UCL	1167
Minimum	1E-12	95% KM (bootstrap t) UCL	2422
Maximum	41126	95% KM (BCA) UCL	1481
Mean	9434	95% KM (Percentile Bootstrap) UCL	1395
Median	5768	95% KM (Chebyshev) UCL	1973
SD	11074	97.5% KM (Chebyshev) UCL	2516
k star	0.179	99% KM (Chebyshev) UCL	3583
Theta star	52778		
Nu star	10.72	Potential UCLs to Use	
AppChi2	4.399	95% KM (BCA) UCL	1481
95% Gamma Approximate UCL	22996		
95% Adjusted Gamma UCL	24277		

Note: DL/2 is not a recommended method.

te: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UC
hese recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006
For additional insight, the user may want to consult a statistician.

Result (copper)

General Statistics

Number of Valid Data	30	Number of Detected Data	27
Number of Distinct Detected Data	13	Number of Non-Detect Data	3
		Percent Non-Detects	10.00%

Raw Statistics		Log-transformed Statistics	
Minimum Detected	7.5	Minimum Detected	2.015
Maximum Detected	15	Maximum Detected	2.708
Mean of Detected	10.35	Mean of Detected	2.322
SD of Detected	1.885	SD of Detected	0.179
Minimum Non-Detect	6.6	Minimum Non-Detect	1.887
Maximum Non-Detect	66	Maximum Non-Detect	4.19

Note: Data have multiple DLs - Use of KM Method is recommer
For all methods (except KM, DL/2, and ROS Methods),
Observations < Largest ND are treated as NDs

Number treated as Non-Detect	30
Number treated as Detected	0
Single DL Non-Detect Percentage	100.00%

UCL Statistics

Normal Distribution Test with Detected Values Only		Lognormal Distribution Test with Detected Values Only	
Shapiro Wilk Test Statistic	0.943	Shapiro Wilk Test Statistic	0.96
5% Shapiro Wilk Critical Value	0.923	5% Shapiro Wilk Critical Value	0.923
Data appear Normal at 5% Significance Level		Data appear Lognormal at 5% Significance Level	

Assuming Normal Distribution		Assuming Lognormal Distribution	
DL/2 Substitution Method		DL/2 Substitution Method	
Mean	10.64	Mean	2.286
SD	4.921	SD	0.403
95% DL/2 (t) UCL	12.16	95% H-Stat (DL/2) UCL	12.27
Maximum Likelihood Estimate(MLE) Method	N/A	Log ROS Method	
MLE method failed to converge properly		Mean in Log Scale	2.292
		SD in Log Scale	0.201
		Mean in Original Scale	10.09
		SD in Original Scale	2.016
		95% t UCL	10.72
		95% Percentile Bootstrap UCL	10.69
		95% BCA Bootstrap UCL	10.72

Gamma Distribution Test with Detected Values Only		Data Distribution Test with Detected Values Only	
k star (bias corrected)	28.72	Data appear Normal at 5% Significance Level	
Theta Star	0.36		
nu star	1551		
A-D Test Statistic	0.456	Nonparametric Statistics	
5% A-D Critical Value	0.744	Kaplan-Meier (KM) Method	
K-S Test Statistic	0.744	Mean	10.16
5% K-S Critical Value	0.168	SD	1.926
Data appear Gamma Distributed at 5% Significance Level		SE of Mean	0.364
		95% KM (t) UCL	10.77
Assuming Gamma Distribution		95% KM (z) UCL	10.75

Gamma ROS Statistics using Extrapolated Data		95% KM (jackknife) UCL	10.76
Minimum	5.832	95% KM (bootstrap t) UCL	10.78
Maximum	15	95% KM (BCA) UCL	10.8
Mean	10.1	95% KM (Percentile Bootstrap) UCL	10.76
Median	10	95% KM (Chebyshev) UCL	11.74
SD	2.068	97.5% KM (Chebyshev) UCL	12.43
k star	21.66	99% KM (Chebyshev) UCL	13.78
Theta star	0.466		
Nu star	1300	Potential UCLs to Use	
AppChi2	1217	95% KM (t) UCL	10.77
95% Gamma Approximate UCL	10.79	95% KM (Percentile Bootstrap) UCL	10.76
95% Adjusted Gamma UCL	10.83		

Note: DL/2 is not a recommended method.

te: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UC

hese recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006

For additional insight, the user may want to consult a statistician.

Result (fluoranthene)

General Statistics

Number of Valid Data	30	Number of Detected Data	11
Number of Distinct Detected Data	11	Number of Non-Detect Data	19
		Percent Non-Detects	63.33%

Raw Statistics		Log-transformed Statistics	
Minimum Detected	337	Minimum Detected	5.82
Maximum Detected	10200	Maximum Detected	9.23
Mean of Detected	2543	Mean of Detected	7.392
SD of Detected	2816	SD of Detected	0.992
Minimum Non-Detect	330	Minimum Non-Detect	5.799
Maximum Non-Detect	3300	Maximum Non-Detect	8.102

Note: Data have multiple DLs - Use of KM Method is recommer		Number treated as Non-Detect	27
For all methods (except KM, DL/2, and ROS Methods),		Number treated as Detected	3
Observations < Largest ND are treated as NDs		Single DL Non-Detect Percentage	90.00%

UCL Statistics

Normal Distribution Test with Detected Values Only		Lognormal Distribution Test with Detected Values Only	
Shapiro Wilk Test Statistic	0.731	Shapiro Wilk Test Statistic	0.985
5% Shapiro Wilk Critical Value	0.85	5% Shapiro Wilk Critical Value	0.85
Data not Normal at 5% Significance Level		Data appear Lognormal at 5% Significance Level	

Assuming Normal Distribution		Assuming Lognormal Distribution	
DL/2 Substitution Method		DL/2 Substitution Method	
Mean	1581	Mean	6.789
SD	1908	SD	1.185
95% DL/2 (t) UCL	2173	95% H-Stat (DL/2) UCL	3258
Maximum Likelihood Estimate(MLE) Method	N/A	Log ROS Method	
MLE yields a negative mean		Mean in Log Scale	6.206
		SD in Log Scale	1.37
		Mean in Original Scale	1202
		SD in Original Scale	1992
		95% t UCL	1820
		95% Percentile Bootstrap UCL	1845
		95% BCA Bootstrap UCL	2063

Gamma Distribution Test with Detected Values Only		Data Distribution Test with Detected Values Only	
k star (bias corrected)	0.973	Data appear Gamma Distributed at 5% Significance Level	
Theta Star	2613		
nu star	21.41		
A-D Test Statistic	0.283	Nonparametric Statistics	
5% A-D Critical Value	0.747	Kaplan-Meier (KM) Method	
K-S Test Statistic	0.747	Mean	1318
5% K-S Critical Value	0.261	SD	1931
Data appear Gamma Distributed at 5% Significance Level		SE of Mean	384.9
		95% KM (t) UCL	1972
Assuming Gamma Distribution		95% KM (z) UCL	1951

Gamma ROS Statistics using Extrapolated Data		95% KM (jackknife) UCL	1894
Minimum	1E-12	95% KM (bootstrap t) UCL	2436
Maximum	10200	95% KM (BCA) UCL	2234
Mean	2931	95% KM (Percentile Bootstrap) UCL	2069
Median	2343	95% KM (Chebyshev) UCL	2995
SD	2815	97.5% KM (Chebyshev) UCL	3721
k star	0.196	99% KM (Chebyshev) UCL	5147
Theta star	14921		
Nu star	11.79	Potential UCLs to Use	
AppChi2	5.087	95% KM (t) UCL	1972
95% Gamma Approximate UCL	6792		
95% Adjusted Gamma UCL	7147		

Note: DL/2 is not a recommended method.

te: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UC

hese recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006

For additional insight, the user may want to consult a statistician.

Result (lead)

General Statistics

Number of Valid Observations	30	Number of Distinct Observations	28

Raw Statistics		Log-transformed Statistics	
Minimum	5.51	Minimum of Log Data	1.707
Maximum	23.2	Maximum of Log Data	3.144
Mean	9.176	Mean of log Data	2.154
Median	7.945	SD of log Data	0.337
SD	3.851		
Coefficient of Variation	0.42		
Skewness	2.293		

Relevant UCL Statistics

Normal Distribution Test		Lognormal Distribution Test	
Shapiro Wilk Test Statistic	0.761	Shapiro Wilk Test Statistic	0.91
Shapiro Wilk Critical Value	0.927	Shapiro Wilk Critical Value	0.927
Data not Normal at 5% Significance Level		Data not Lognormal at 5% Significance Level	

Assuming Normal Distribution		Assuming Lognormal Distribution	
95% Student's-t UCL	10.37	95% H-UCL	10.23
95% UCLs (Adjusted for Skewness)		95% Chebyshev (MVUE) UCL	11.6
95% Adjusted-CLT UCL (Chen-1995)	10.65	97.5% Chebyshev (MVUE) UCL	12.68
95% Modified-t UCL (Johnson-1978)	10.42	99% Chebyshev (MVUE) UCL	14.8

Gamma Distribution Test		Data Distribution	
k star (bias corrected)	7.372	Data do not follow a Discernable Distribution (0.05)	
Theta Star	1.245		
MLE of Mean	9.176		
MLE of Standard Deviation	3.38		
nu star	442.3		
Approximate Chi Square Value (.05)	394.6	Nonparametric Statistics	
Adjusted Level of Significance	0.041	95% CLT UCL	10.33
Adjusted Chi Square Value	392	95% Jackknife UCL	10.37
		95% Standard Bootstrap UCL	10.29
Anderson-Darling Test Statistic	1.122	95% Bootstrap-t UCL	11.11
Anderson-Darling 5% Critical Value	0.746	95% Hall's Bootstrap UCL	15.26
Kolmogorov-Smirnov Test Statistic	0.161	95% Percentile Bootstrap UCL	10.39
Kolmogorov-Smirnov 5% Critical Value	0.16	95% BCA Bootstrap UCL	10.73
Data not Gamma Distributed at 5% Significance Level		95% Chebyshev(Mean, Sd) UCL	12.24
		97.5% Chebyshev(Mean, Sd) UCL	13.57
Assuming Gamma Distribution		99% Chebyshev(Mean, Sd) UCL	16.17
95% Approximate Gamma UCL	10.29		
95% Adjusted Gamma UCL	10.36		

Potential UCL to Use		Use 95% Student's-t UCL	10.37
		or 95% Modified-t UCL	10.42

te: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UC
These recommendations are based upon the results of the simulation studies summarized in Singh, Singh, and Iaci (2002)
and Singh and Singh (2003). For additional insight, the user may want to consult a statistician.

Result (manganese)

General Statistics

Number of Valid Observations	30	Number of Distinct Observations	28

Raw Statistics		Log-transformed Statistics	
Minimum	181	Minimum of Log Data	5.198
Maximum	680	Maximum of Log Data	6.522
Mean	341.3	Mean of log Data	5.799
Median	339.5	SD of log Data	0.261
SD	93.53		
Coefficient of Variation	0.274		
Skewness	1.423		

Relevant UCL Statistics

Normal Distribution Test		Lognormal Distribution Test	
Shapiro Wilk Test Statistic	0.901	Shapiro Wilk Test Statistic	0.971
Shapiro Wilk Critical Value	0.927	Shapiro Wilk Critical Value	0.927
Data not Normal at 5% Significance Level		Data appear Lognormal at 5% Significance Level	

Assuming Normal Distribution		Assuming Lognormal Distribution	
95% Student's-t UCL	370.3	95% H-UCL	372.5
95% UCLs (Adjusted for Skewness)		95% Chebyshev (MVUE) UCL	413
95% Adjusted-CLT UCL (Chen-1995)	374.2	97.5% Chebyshev (MVUE) UCL	444
95% Modified-t UCL (Johnson-1978)	371.1	99% Chebyshev (MVUE) UCL	505

Gamma Distribution Test		Data Distribution	
k star (bias corrected)	13.65	Data appear Gamma Distributed at 5% Significance Level	
Theta Star	25.01		
MLE of Mean	341.3		
MLE of Standard Deviation	92.4		
nu star	818.7		
Approximate Chi Square Value (.05)	753.3	**Nonparametric Statistics**	
Adjusted Level of Significance	0.041	95% CLT UCL	369.4
Adjusted Chi Square Value	749.7	95% Jackknife UCL	370.3
		95% Standard Bootstrap UCL	368.4
Anderson-Darling Test Statistic	0.361	95% Bootstrap-t UCL	374.7
Anderson-Darling 5% Critical Value	0.745	95% Hall's Bootstrap UCL	384.5
Kolmogorov-Smirnov Test Statistic	0.106	95% Percentile Bootstrap UCL	371.3
Kolmogorov-Smirnov 5% Critical Value	0.16	95% BCA Bootstrap UCL	373.8
Data appear Gamma Distributed at 5% Significance Level		95% Chebyshev(Mean, Sd) UCL	415.8
		97.5% Chebyshev(Mean, Sd) UCL	448
Assuming Gamma Distribution		99% Chebyshev(Mean, Sd) UCL	511.2
95% Approximate Gamma UCL	371		
95% Adjusted Gamma UCL	372.8		

Potential UCL to Use		Use 95% Approximate Gamma UCL	371

te: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UC

These recommendations are based upon the results of the simulation studies summarized in Singh, Singh, and Iaci (2002)

and Singh and Singh (2003). For additional insight, the user may want to consult a statistician.

Result (mercury)

General Statistics

Number of Valid Observations	30	Number of Distinct Observations	18

Raw Statistics		Log-transformed Statistics	
Minimum	0.009	Minimum of Log Data	-4.711
Maximum	0.041	Maximum of Log Data	-3.194
Mean	0.0201	Mean of log Data	-3.968
Median	0.019	SD of log Data	0.358
SD	0.00721		
Coefficient of Variation	0.359		
Skewness	0.801		

Relevant UCL Statistics

Normal Distribution Test		Lognormal Distribution Test	
Shapiro Wilk Test Statistic	0.949	Shapiro Wilk Test Statistic	0.982
Shapiro Wilk Critical Value	0.927	Shapiro Wilk Critical Value	0.927
Data appear Normal at 5% Significance Level		Data appear Lognormal at 5% Significance Level	
Assuming Normal Distribution		Assuming Lognormal Distribution	
95% Student's-t UCL	0.0223	95% H-UCL	0.0228
95% UCLs (Adjusted for Skewness)		95% Chebyshev (MVUE) UCL	0.026
95% Adjusted-CLT UCL (Chen-1995)	0.0225	97.5% Chebyshev (MVUE) UCL	0.0285
95% Modified-t UCL (Johnson-1978)	0.0224	99% Chebyshev (MVUE) UCL	0.0335
Gamma Distribution Test		Data Distribution	
k star (bias corrected)	7.526	Data appear Normal at 5% Significance Level	
Theta Star	0.00267		
MLE of Mean	0.0201		
MLE of Standard Deviation	0.00733		
nu star	451.6		
Approximate Chi Square Value (.05)	403.3	Nonparametric Statistics	
Adjusted Level of Significance	0.041	95% CLT UCL	0.0223
Adjusted Chi Square Value	400.7	95% Jackknife UCL	0.0223
		95% Standard Bootstrap UCL	0.0223
Anderson-Darling Test Statistic	0.265	95% Bootstrap-t UCL	0.0225
Anderson-Darling 5% Critical Value	0.746	95% Hall's Bootstrap UCL	0.0227
Kolmogorov-Smirnov Test Statistic	0.106	95% Percentile Bootstrap UCL	0.0222
Kolmogorov-Smirnov 5% Critical Value	0.16	95% BCA Bootstrap UCL	0.0226
Data appear Gamma Distributed at 5% Significance Level		95% Chebyshev(Mean, Sd) UCL	0.0258
		97.5% Chebyshev(Mean, Sd) UCL	0.0283
Assuming Gamma Distribution		99% Chebyshev(Mean, Sd) UCL	0.0332
95% Approximate Gamma UCL	0.0225		
95% Adjusted Gamma UCL	0.0227		
Potential UCL to Use		Use 95% Student's-t UCL	0.0223

te: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UC

These recommendations are based upon the results of the simulation studies summarized in Singh, Singh, and Iaci (2002) and Singh and Singh (2003). For additional insight, the user may want to consult a statistician.

Result (nickel)

General Statistics

Number of Valid Data	30	Number of Detected Data	29
Number of Distinct Detected Data	18	Number of Non-Detect Data	1
		Percent Non-Detects	3.33%

Raw Statistics		Log-transformed Statistics	
Minimum Detected	5	Minimum Detected	1.609
Maximum Detected	15	Maximum Detected	2.708
Mean of Detected	9.679	Mean of Detected	2.237
SD of Detected	2.524	SD of Detected	0.265
Minimum Non-Detect	33	Minimum Non-Detect	3.497
Maximum Non-Detect	33	Maximum Non-Detect	3.497

UCL Statistics

Normal Distribution Test with Detected Values Only		Lognormal Distribution Test with Detected Values Only	
Shapiro Wilk Test Statistic	0.955	Shapiro Wilk Test Statistic	0.969
5% Shapiro Wilk Critical Value	0.926	5% Shapiro Wilk Critical Value	0.926
Data appear Normal at 5% Significance Level		Data appear Lognormal at 5% Significance Level	
Assuming Normal Distribution		Assuming Lognormal Distribution	
DL/2 Substitution Method		DL/2 Substitution Method	
Mean	9.907	Mean	2.256
SD	2.775	SD	0.281
95% DL/2 (t) UCL	10.77	95% H-Stat (DL/2) UCL	10.9
Maximum Likelihood Estimate(MLE) Method	N/A	Log ROS Method	
MLE method failed to converge properly		Mean in Log Scale	2.237
		SD in Log Scale	0.261
		Mean in Original Scale	9.669
		SD in Original Scale	2.48
		95% t UCL	10.44
		95% Percentile Bootstrap UCL	10.39
		95% BCA Bootstrap UCL	10.47
Gamma Distribution Test with Detected Values Only		Data Distribution Test with Detected Values Only	
k star (bias corrected)	13.63	Data appear Normal at 5% Significance Level	
Theta Star	0.71		
nu star	790.6		
A-D Test Statistic	0.383	Nonparametric Statistics	
5% A-D Critical Value	0.745	Kaplan-Meier (KM) Method	
K-S Test Statistic	0.745	Mean	9.679
5% K-S Critical Value	0.162	SD	2.48
Data appear Gamma Distributed at 5% Significance Level		SE of Mean	0.469
		95% KM (t) UCL	10.48

Assuming Gamma Distribution		95% KM (z) UCL	10.45
Gamma ROS Statistics using Extrapolated Data		95% KM (jackknife) UCL	10.48
Minimum	5	95% KM (bootstrap t) UCL	10.52
Maximum	15	95% KM (BCA) UCL	10.47
Mean	9.698	95% KM (Percentile Bootstrap) UCL	10.47
Median	10	95% KM (Chebyshev) UCL	11.72
SD	2.482	97.5% KM (Chebyshev) UCL	12.61
k star	14.13	99% KM (Chebyshev) UCL	14.34
Theta star	0.686		
Nu star	847.6	Potential UCLs to Use	
AppChi2	781.1	95% KM (t) UCL	10.48
95% Gamma Approximate UCL	10.52	95% KM (Percentile Bootstrap) UCL	10.47
95% Adjusted Gamma UCL	10.57		

Note: DL/2 is not a recommended method.

te: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UC

hese recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006

For additional insight, the user may want to consult a statistician.

Result (phenanthrene)

General Statistics

Number of Valid Data	30	Number of Detected Data	6
Number of Distinct Detected Data	6	Number of Non-Detect Data	24
		Percent Non-Detects	80.00%

Raw Statistics		Log-transformed Statistics	
Minimum Detected	544	Minimum Detected	6.299
Maximum Detected	3480	Maximum Detected	8.155
Mean of Detected	1401	Mean of Detected	6.985
SD of Detected	1157	SD of Detected	0.772
Minimum Non-Detect	330	Minimum Non-Detect	5.799
Maximum Non-Detect	3300	Maximum Non-Detect	8.102

Note: Data have multiple DLs - Use of KM Method is recommer	Number treated as Non-Detect	29
For all methods (except KM, DL/2, and ROS Methods),	Number treated as Detected	1
Observations < Largest ND are treated as NDs	Single DL Non-Detect Percentage	96.67%

Warning: There are only 6 Detected Values in this data

Note: It should be noted that even though bootstrap may be performed on this data set

the resulting calculations may not be reliable enough to draw conclusions

It is recommended to have 10-15 or more distinct observations for accurate and meaningful results.

UCL Statistics

Normal Distribution Test with Detected Values Only		Lognormal Distribution Test with Detected Values Only	
Shapiro Wilk Test Statistic	0.813	Shapiro Wilk Test Statistic	0.867
5% Shapiro Wilk Critical Value	0.788	5% Shapiro Wilk Critical Value	0.788
Data appear Normal at 5% Significance Level		Data appear Lognormal at 5% Significance Level	

Assuming Normal Distribution		Assuming Lognormal Distribution	
DL/2 Substitution Method		DL/2 Substitution Method	
Mean	1072	Mean	6.526
SD	832.2	SD	1.091
95% DL/2 (t) UCL	1330	95% H-Stat (DL/2) UCL	2094
Maximum Likelihood Estimate(MLE) Method	N/A	Log ROS Method	
MLE method failed to converge properly		Mean in Log Scale	5.601
		SD in Log Scale	1.119
		Mean in Original Scale	507.9
		SD in Original Scale	710.3
		95% t UCL	728.3
		95% Percentile Bootstrap UCL	739.1
		95% BCA Bootstrap UCL	822.1
Gamma Distribution Test with Detected Values Only		Data Distribution Test with Detected Values Only	
k star (bias corrected)	1.149	Data appear Normal at 5% Significance Level	
Theta Star	1219		
nu star	13.79		
A-D Test Statistic	0.485	Nonparametric Statistics	
5% A-D Critical Value	0.704	Kaplan-Meier (KM) Method	
K-S Test Statistic	0.704	Mean	778.7
5% K-S Critical Value	0.336	SD	620.1
Data appear Gamma Distributed at 5% Significance Level		SE of Mean	141
		95% KM (t) UCL	1018
Assuming Gamma Distribution		95% KM (z) UCL	1011
Gamma ROS Statistics using Extrapolated Data		95% KM (jackknife) UCL	995.4
Minimum	1E-12	95% KM (bootstrap t) UCL	1205
Maximum	7201	95% KM (BCA) UCL	1402
Mean	2849	95% KM (Percentile Bootstrap) UCL	1258
Median	2707	95% KM (Chebyshev) UCL	1393
SD	2017	97.5% KM (Chebyshev) UCL	1659
k star	0.418	99% KM (Chebyshev) UCL	2181
Theta star	6816		
Nu star	25.08	Potential UCLs to Use	
AppChi2	14.67	95% KM (t) UCL	1018
95% Gamma Approximate UCL	4870	95% KM (Percentile Bootstrap) UCL	1258
95% Adjusted Gamma UCL	5028		

Note: DL/2 is not a recommended method.

te: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UC
hese recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006
For additional insight, the user may want to consult a statistician.

Result (pyrene)

General Statistics			
Number of Valid Data	30	Number of Detected Data	10
Number of Distinct Detected Data	10	Number of Non-Detect Data	20
		Percent Non-Detects	66.67%

Raw Statistics		Log-transformed Statistics	
Minimum Detected	342	Minimum Detected	5.835
Maximum Detected	12200	Maximum Detected	9.409
Mean of Detected	2513	Mean of Detected	7.279
SD of Detected	3535	SD of Detected	1.021
Minimum Non-Detect	330	Minimum Non-Detect	5.799
Maximum Non-Detect	3300	Maximum Non-Detect	8.102

Note: Data have multiple DLs - Use of KM Method is recommer
For all methods (except KM, DL/2, and ROS Methods),
Observations < Largest ND are treated as NDs

Number treated as Non-Detect	28
Number treated as Detected	2
Single DL Non-Detect Percentage	93.33%

UCL Statistics

Normal Distribution Test with Detected Values Only		Lognormal Distribution Test with Detected Values Only	
Shapiro Wilk Test Statistic	0.605	Shapiro Wilk Test Statistic	0.96
5% Shapiro Wilk Critical Value	0.842	5% Shapiro Wilk Critical Value	0.842
Data not Normal at 5% Significance Level		Data appear Lognormal at 5% Significance Level	

Assuming Normal Distribution		Assuming Lognormal Distribution	
DL/2 Substitution Method		DL/2 Substitution Method	
Mean	1542	Mean	6.751
SD	2175	SD	1.16
95% DL/2 (t) UCL	2216	95% H-Stat (DL/2) UCL	2987
Maximum Likelihood Estimate(MLE) Method	N/A	Log ROS Method	
MLE method failed to converge properly		Mean in Log Scale	6.045
		SD in Log Scale	1.398
		Mean in Original Scale	1120
		SD in Original Scale	2253
		95% t UCL	1819
		95% Percentile Bootstrap UCL	1874
		95% BCA Bootstrap UCL	2208

Gamma Distribution Test with Detected Values Only		Data Distribution Test with Detected Values Only	
k star (bias corrected)	0.797	Data appear Gamma Distributed at 5% Significance Level	
Theta Star	3152		
nu star	15.95		
A-D Test Statistic	0.595	Nonparametric Statistics	
5% A-D Critical Value	0.747	Kaplan-Meier (KM) Method	
K-S Test Statistic	0.747	Mean	1233
5% K-S Critical Value	0.274	SD	2180
Data appear Gamma Distributed at 5% Significance Level		SE of Mean	431.4
		95% KM (t) UCL	1966
Assuming Gamma Distribution		95% KM (z) UCL	1943
Gamma ROS Statistics using Extrapolated Data		95% KM (jackknife) UCL	1872
Minimum	1E-12	95% KM (bootstrap t) UCL	3002
Maximum	13048	95% KM (BCA) UCL	2248
Mean	3537	95% KM (Percentile Bootstrap) UCL	2057
Median	2151	95% KM (Chebyshev) UCL	3114
SD	3923	97.5% KM (Chebyshev) UCL	3927

k star	0.188	99% KM (Chebyshev) UCL	5526
Theta star	18768		
Nu star	11.31	Potential UCLs to Use	
AppChi2	4.774	95% KM (t) UCL	1966
95% Gamma Approximate UCL	8376		
95% Adjusted Gamma UCL	8827		

Note: DL/2 is not a recommended method.

te: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UC
hese recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006
For additional insight, the user may want to consult a statistician.

Result (selenium)

General Statistics

Number of Valid Data	30	Number of Detected Data	9
Number of Distinct Detected Data	9	Number of Non-Detect Data	21
		Percent Non-Detects	70.00%

Raw Statistics		Log-transformed Statistics	
Minimum Detected	0.189	Minimum Detected	-1.666
Maximum Detected	0.518	Maximum Detected	-0.658
Mean of Detected	0.322	Mean of Detected	-1.18
SD of Detected	0.107	SD of Detected	0.319
Minimum Non-Detect	0.159	Minimum Non-Detect	-1.839
Maximum Non-Detect	0.323	Maximum Non-Detect	-1.13

Note: Data have multiple DLs - Use of KM Method is recommer	Number treated as Non-Detect	27
For all methods (except KM, DL/2, and ROS Methods),	Number treated as Detected	3
Observations < Largest ND are treated as NDs	Single DL Non-Detect Percentage	90.00%

Warning: There are only 9 Detected Values in this data
Note: It should be noted that even though bootstrap may be performed on this data set
the resulting calculations may not be reliable enough to draw conclusions

It is recommended to have 10-15 or more distinct observations for accurate and meaningful results.

UCL Statistics

Normal Distribution Test with Detected Values Only		Lognormal Distribution Test with Detected Values Only	
Shapiro Wilk Test Statistic	0.906	Shapiro Wilk Test Statistic	0.957
5% Shapiro Wilk Critical Value	0.829	5% Shapiro Wilk Critical Value	0.829
Data appear Normal at 5% Significance Level		Data appear Lognormal at 5% Significance Level	
Assuming Normal Distribution		Assuming Lognormal Distribution	
DL/2 Substitution Method		DL/2 Substitution Method	
Mean	0.156	Mean	-2.088
SD	0.125	SD	0.64
95% DL/2 (t) UCL	0.195	95% H-Stat (DL/2) UCL	0.195
Maximum Likelihood Estimate(MLE) Method		Log ROS Method	

Mean	0.0177	Mean in Log Scale	-1.897
SD	0.241	SD in Log Scale	0.55
95% MLE (t) UCL	0.0923	Mean in Original Scale	0.176
95% MLE (Tiku) UCL	0.331	SD in Original Scale	0.115
		95% t UCL	0.212
		95% Percentile Bootstrap UCL	0.212
		95% BCA Bootstrap UCL	0.217

Gamma Distribution Test with Detected Values Only		Data Distribution Test with Detected Values Only	
k star (bias corrected)	7.358	Data appear Normal at 5% Significance Level	
Theta Star	0.0437		
nu star	132.4		
A-D Test Statistic	0.341	Nonparametric Statistics	
5% A-D Critical Value	0.722	Kaplan-Meier (KM) Method	
K-S Test Statistic	0.722	Mean	0.229
5% K-S Critical Value	0.279	SD	0.0824
Data appear Gamma Distributed at 5% Significance Level		SE of Mean	0.016
		95% KM (t) UCL	0.257
Assuming Gamma Distribution		95% KM (z) UCL	0.256
Gamma ROS Statistics using Extrapolated Data		95% KM (jackknife) UCL	0.259
Minimum	0.189	95% KM (bootstrap t) UCL	0.267
Maximum	0.518	95% KM (BCA) UCL	0.306
Mean	0.318	95% KM (Percentile Bootstrap) UCL	0.294
Median	0.306	95% KM (Chebyshev) UCL	0.299
SD	0.0585	97.5% KM (Chebyshev) UCL	0.329
k star	29.97	99% KM (Chebyshev) UCL	0.389
Theta star	0.0106		
Nu star	1798	Potential UCLs to Use	
AppChi2	1701	95% KM (t) UCL	0.257
95% Gamma Approximate UCL	0.336	95% KM (Percentile Bootstrap) UCL	0.294
95% Adjusted Gamma UCL	0.338		

Note: DL/2 is not a recommended method.

te: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UC
hese recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006
For additional insight, the user may want to consult a statistician.

Result (thallium)

General Statistics

Number of Valid Data	30	Number of Detected Data	15
Number of Distinct Detected Data	13	Number of Non-Detect Data	15
		Percent Non-Detects	50.00%

Raw Statistics		Log-transformed Statistics	
Minimum Detected	0.34	Minimum Detected	-1.079
Maximum Detected	0.565	Maximum Detected	-0.571
Mean of Detected	0.423	Mean of Detected	-0.875
SD of Detected	0.0755	SD of Detected	0.175
Minimum Non-Detect	0.318	Minimum Non-Detect	-1.146

Maximum Non-Detect	0.333	Maximum Non-Detect	-1.1
Note: Data have multiple DLs - Use of KM Method is recommer		Number treated as Non-Detect	15
For all methods (except KM, DL/2, and ROS Methods),		Number treated as Detected	15
Observations < Largest ND are treated as NDs		Single DL Non-Detect Percentage	50.00%

UCL Statistics

Normal Distribution Test with Detected Values Only		Lognormal Distribution Test with Detected Values Only	
Shapiro Wilk Test Statistic	0.898	Shapiro Wilk Test Statistic	0.901
5% Shapiro Wilk Critical Value	0.881	5% Shapiro Wilk Critical Value	0.881
Data appear Normal at 5% Significance Level		Data appear Lognormal at 5% Significance Level	
Assuming Normal Distribution		Assuming Lognormal Distribution	
DL/2 Substitution Method		DL/2 Substitution Method	
Mean	0.292	Mean	-1.348
SD	0.143	SD	0.496
95% DL/2 (t) UCL	0.337	95% H-Stat (DL/2) UCL	0.352
Maximum Likelihood Estimate(MLE) Method		Log ROS Method	
Mean	0.331	Mean in Log Scale	-1.111
SD	0.117	SD in Log Scale	0.273
95% MLE (t) UCL	0.367	Mean in Original Scale	0.342
95% MLE (Tiku) UCL	0.376	SD in Original Scale	0.0986
		95% t UCL	0.372
		95% Percentile Bootstrap UCL	0.373
		95% BCA Bootstrap UCL	0.373
Gamma Distribution Test with Detected Values Only		Data Distribution Test with Detected Values Only	
k star (bias corrected)	27.8	Data appear Normal at 5% Significance Level	
Theta Star	0.0152		
nu star	833.9		
A-D Test Statistic	0.598	Nonparametric Statistics	
5% A-D Critical Value	0.735	Kaplan-Meier (KM) Method	
K-S Test Statistic	0.735	Mean	0.381
5% K-S Critical Value	0.221	SD	0.0662
)ata follow Appr. Gamma Distribution at 5% Significance Leve		SE of Mean	0.0125
		95% KM (t) UCL	0.403
Assuming Gamma Distribution		95% KM (z) UCL	0.402
Gamma ROS Statistics using Extrapolated Data		95% KM (jackknife) UCL	0.402
Minimum	0.34	95% KM (bootstrap t) UCL	0.409
Maximum	0.565	95% KM (BCA) UCL	0.406
Mean	0.423	95% KM (Percentile Bootstrap) UCL	0.404
Median	0.424	95% KM (Chebyshev) UCL	0.436
SD	0.0526	97.5% KM (Chebyshev) UCL	0.46
k star	61.9	99% KM (Chebyshev) UCL	0.506
Theta star	0.00683		
Nu star	3714	Potential UCLs to Use	
AppChi2	3573	95% KM (t) UCL	0.403
95% Gamma Approximate UCL	0.44	95% KM (Percentile Bootstrap) UCL	0.404
95% Adjusted Gamma UCL	0.441		

Note: DL/2 is not a recommended method.

te: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UC

hese recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006

For additional insight, the user may want to consult a statistician.

Result (zinc)

General Statistics

Number of Valid Data	30	Number of Detected Data	29
Number of Distinct Detected Data	24	Number of Non-Detect Data	1
		Percent Non-Detects	3.33%

Raw Statistics		Log-transformed Statistics	
Minimum Detected	19	Minimum Detected	2.944
Maximum Detected	64	Maximum Detected	4.159
Mean of Detected	34.1	Mean of Detected	3.493
SD of Detected	9.663	SD of Detected	0.272
Minimum Non-Detect	170	Minimum Non-Detect	5.136
Maximum Non-Detect	170	Maximum Non-Detect	5.136

UCL Statistics

Normal Distribution Test with Detected Values Only		Lognormal Distribution Test with Detected Values Only	
Shapiro Wilk Test Statistic	0.944	Shapiro Wilk Test Statistic	0.992
5% Shapiro Wilk Critical Value	0.926	5% Shapiro Wilk Critical Value	0.926
Data appear Normal at 5% Significance Level		Data appear Lognormal at 5% Significance Level	
Assuming Normal Distribution		Assuming Lognormal Distribution	
DL/2 Substitution Method		DL/2 Substitution Method	
Mean	35.8	Mean	3.525
SD	13.29	SD	0.319
95% DL/2 (t) UCL	39.92	95% H-Stat (DL/2) UCL	39.77
Maximum Likelihood Estimate(MLE) Method	N/A	Log ROS Method	
MLE method failed to converge properly		Mean in Log Scale	3.493
		SD in Log Scale	0.267
		Mean in Original Scale	34.06
		SD in Original Scale	9.498
		95% t UCL	37.01
		95% Percentile Bootstrap UCL	36.96
		95% BCA Bootstrap UCL	36.93
Gamma Distribution Test with Detected Values Only		Data Distribution Test with Detected Values Only	
k star (bias corrected)	12.51	Data appear Normal at 5% Significance Level	
Theta Star	2.727		
nu star	725.4		
A-D Test Statistic	0.151	Nonparametric Statistics	
5% A-D Critical Value	0.745	Kaplan-Meier (KM) Method	
K-S Test Statistic	0.745	Mean	34.1
5% K-S Critical Value	0.162	SD	9.495

Data appear Gamma Distributed at 5% Significance Level

Assuming Gamma Distribution

Gamma ROS Statistics using Extrapolated Data

Minimum	19
Maximum	64
Mean	34.17
Median	33.5
SD	9.502
k star	12.96
Theta star	2.636
Nu star	777.7
AppChi2	714
95% Gamma Approximate UCL	37.22
95% Adjusted Gamma UCL	37.4

Note: DL/2 is not a recommended method.

SE of Mean	1.794
95% KM (t) UCL	37.15
95% KM (z) UCL	37.06
95% KM (jackknife) UCL	37.15
95% KM (bootstrap t) UCL	37.73
95% KM (BCA) UCL	37
95% KM (Percentile Bootstrap) UCL	37.1
95% KM (Chebyshev) UCL	41.93
97.5% KM (Chebyshev) UCL	45.31
99% KM (Chebyshev) UCL	51.96

Potential UCLs to Use

95% KM (t) UCL	37.15
95% KM (Percentile Bootstrap) UCL	37.1

te: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UC

hese recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006

For additional insight, the user may want to consult a statistician.

Deep Groundwater ProUCL Outputs
South Settling Lagoon
Moraine, Ohio

General UCL Statistics for Data Sets with Non-Detects

User Selected Options

From File	WorkSheet.wst
Full Precision	OFF
Confidence Coefficient	95%
mber of Bootstrap Operations	2000

Result (tetrachloroethene)

General Statistics

Number of Valid Data	19	Number of Detected Data	13
Number of Distinct Detected Data	13	Number of Non-Detect Data	6
		Percent Non-Detects	31.58%

Raw Statistics		Log-transformed Statistics	
Minimum Detected	0.35	Minimum Detected	-1.05
Maximum Detected	120	Maximum Detected	4.787
Mean of Detected	32.37	Mean of Detected	2.205
SD of Detected	36.43	SD of Detected	2.166
Minimum Non-Detect	1	Minimum Non-Detect	0
Maximum Non-Detect	1	Maximum Non-Detect	0

UCL Statistics

Normal Distribution Test with Detected Values Only		Lognormal Distribution Test with Detected Values Only	
Shapiro Wilk Test Statistic	0.834	Shapiro Wilk Test Statistic	0.832
5% Shapiro Wilk Critical Value	0.866	5% Shapiro Wilk Critical Value	0.866
Data not Normal at 5% Significance Level		Data not Lognormal at 5% Significance Level	

Assuming Normal Distribution		Assuming Lognormal Distribution	
DL/2 Substitution Method		DL/2 Substitution Method	
Mean	22.31	Mean	1.29
SD	33.42	SD	2.246
95% DL/2 (t) UCL	35.6	95% H-Stat (DL/2) UCL	541.6
Maximum Likelihood Estimate(MLE) Method	N/A	Log ROS Method	
MLE yields a negative mean		Mean in Log Scale	1.421
		SD in Log Scale	2.215
		Mean in Original Scale	22.53
		SD in Original Scale	33.27
		95% t UCL	35.76
		95% Percentile Bootstrap UCL	35.65
		95% BCA Bootstrap UCL	38.76

Deep Groundwater ProUCL Outputs
South Settling Lagoon
Moraine, Ohio

Gamma Distribution Test with Detected Values Only		Data Distribution Test with Detected Values Only	
k star (bias corrected)	0.435	Data appear Gamma Distributed at 5% Significance Level	
Theta Star	74.36		
nu star	11.32		
A-D Test Statistic	0.79	Nonparametric Statistics	
5% A-D Critical Value	0.79	Kaplan-Meier (KM) Method	
K-S Test Statistic	0.79	Mean	22.35
5% K-S Critical Value	0.25	SD	32.5
Data appear Gamma Distributed at 5% Significance Level		SE of Mean	7.76
		95% KM (t) UCL	35.81
Assuming Gamma Distribution		95% KM (z) UCL	35.11
Gamma ROS Statistics using Extrapolated Data		95% KM (jackknife) UCL	35.63
Minimum	0.35	95% KM (bootstrap t) UCL	41.9
Maximum	120	95% KM (BCA) UCL	34.68
Mean	27.57	95% KM (Percentile Bootstrap) UCL	35.93
Median	22	95% KM (Chebyshev) UCL	56.17
SD	31.6	97.5% KM (Chebyshev) UCL	70.81
k star	0.537	99% KM (Chebyshev) UCL	99.56
Theta star	51.32		
Nu star	20.41	Potential UCLs to Use	
AppChi2	11.16	95% KM (BCA) UCL	34.68
95% Gamma Approximate UCL	50.44		
95% Adjusted Gamma UCL	53.29		

Note: DL/2 is not a recommended method.

ote: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UC
These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006)
For additional insight, the user may want to consult a statistician.

Deep Groundwater ProUCL Outputs
South Settling Lagoon
Moraine, Ohio

Result (trichloroethene)

General Statistics

Number of Valid Observations	19	Number of Distinct Observations	18

Raw Statistics		Log-transformed Statistics	
Minimum	1.3	Minimum of Log Data	0.262
Maximum	31	Maximum of Log Data	3.434
Mean	9.568	Mean of log Data	1.812
Median	5.3	SD of log Data	1.006
SD	8.839		
Coefficient of Variation	0.924		
Skewness	1.06		

Relevant UCL Statistics

Normal Distribution Test		Lognormal Distribution Test	
Shapiro Wilk Test Statistic	0.839	Shapiro Wilk Test Statistic	0.936
Shapiro Wilk Critical Value	0.901	Shapiro Wilk Critical Value	0.901
Data not Normal at 5% Significance Level		Data appear Lognormal at 5% Significance Level	

Assuming Normal Distribution		Assuming Lognormal Distribution	
95% Student's-t UCL	13.08	95% H-UCL	18.92
95% UCLs (Adjusted for Skewness)		95% Chebyshev (MVUE) UCL	20.78
95% Adjusted-CLT UCL (Chen-1995)	13.43	97.5% Chebyshev (MVUE) UCL	25.53
95% Modified-t UCL (Johnson-1978)	13.17	99% Chebyshev (MVUE) UCL	34.87

Gamma Distribution Test		Data Distribution	
k star (bias corrected)	1.097	Data appear Gamma Distributed at 5% Significance Level	
Theta Star	8.719		
MLE of Mean	9.568		
MLE of Standard Deviation	9.134		
nu star	41.7		
Approximate Chi Square Value (.05)	27.9	Nonparametric Statistics	
Adjusted Level of Significance	0.0369	95% CLT UCL	12.9
Adjusted Chi Square Value	26.92	95% Jackknife UCL	13.08
		95% Standard Bootstrap UCL	12.86
Anderson-Darling Test Statistic	0.646	95% Bootstrap-t UCL	14.08
Anderson-Darling 5% Critical Value	0.763	95% Hall's Bootstrap UCL	13.39
Kolmogorov-Smirnov Test Statistic	0.175	95% Percentile Bootstrap UCL	12.86
Kolmogorov-Smirnov 5% Critical Value	0.203	95% BCA Bootstrap UCL	13.26
Data appear Gamma Distributed at 5% Significance Level		95% Chebyshev(Mean, Sd) UCL	18.41
		97.5% Chebyshev(Mean, Sd) UCL	22.23
Assuming Gamma Distribution		99% Chebyshev(Mean, Sd) UCL	29.74
95% Approximate Gamma UCL	14.3		
95% Adjusted Gamma UCL	14.83		

Potential UCL to Use		Use 95% Approximate Gamma UCL	14.3

ote: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UC
These recommendations are based upon the results of the simulation studies summarized in Singh, Singh, and Iaci (2002)
and Singh and Singh (2003). For additional insight, the user may want to consult a statistician.

ATTACHMENT 3

Appendix to the Lagoon Post-Closure Plan

MEMO

ARCADIS Design & Consultancy for natural and built assets

To:

Laurie Stevenson, Ohio EPA

Copies:

Pam Barnett, RACER Trust
Brian Gitzinger, Ohio EPA
Randall Kirkland, Ohio EPA
Brad Mitchell, Ohio EPA
Mirtha Capiro, U.S. EPA

Arcadis U.S., Inc.
100 E Campus View Boulevard
Suite 200
Columbus
Ohio 43235-1447
Tel 614 985 9100
Fax 614 985 9170

From:

Carolyn Grogan, Arcadis

Date:

February 6, 2019

Arcadis Project No.:

OH000294.2018.0003E

Subject:

Appendix to the Lagoon Post-Closure Plan – Revision 1
Site: RACER Trust Moraine Facilities, Moraine, Ohio

On behalf of Revitalizing Auto Communities Environmental Response Trust (RACER Trust), Arcadis U.S., Inc. (Arcadis) prepared this Appendix to the approved Lagoon Post-Closure Plan (Conestoga-Rovers & Associates [CRA], 2002) for the RACER Trust Moraine Facilities in Moraine, Ohio (Site). This Appendix is being provided per August 29, 2018, October 1, 2018, and October 19, 2018 emails from the Ohio Environmental Protection Agency (Ohio EPA) and since RACER Trust plans to implement an interim measure called Phase 1 Dynamic Groundwater Recirculation (DGR™). This Appendix also accounts for comments received from the Ohio EPA in the Notice of Deficiency – Amended Post-Closure Plan letter (Ohio EPA 2019). The objective of the Phase 1 DGR™ interim measure is to reduce site-specific volatile organic compounds (VOCs) in groundwater within the Riverview Plat neighborhood (neighborhood) to concentrations below the United States Environmental Protection Agency (U.S. EPA) Maximum Contaminant Levels (MCLs), within 5 years of initiating full-scale operation. Once concentrations of VOCs have been adequately reduced, vapor intrusion mitigation systems in the neighborhood will no longer be necessary.

Phase 1 DGR™ includes installation of two injection wells and three extraction wells; installation of three Conex boxes containing groundwater treatment systems; and subgrade trenching/piping to convey water to and from the treatment system at the closed South Settling Lagoon (SSL) property at the Site. Two existing injection wells at the property will be incorporated into the system. The activities planned at the closed SSL will be completed in accordance with the approved Phase 1 DGR™ Interim Measure Design Report and Work Plan (Arcadis, 2018; Report). Figure 1 shows the general project layout, Figure 2 shows an example cross section, and Figures 3 and 4 include design details associated with the project.

The SSL was closed per Ohio Administrative Code (OAC) 3745-66-11 by solidifying sludge in-situ, backfilling the basins with material from existing on-site soil stockpiles or imported material, and constructing a vegetated soil cover as documented in the Certification of Lagoon Closure Report (CRA, 2001). Three extraction wells and portions of the subgrade piping will be installed in the cover at the SSL. The injection wells, the Conex boxes containing the treatment systems, and portions of the subgrade piping will not be installed through the cover. None of the work will be within the limits of the waste units. The cover will be restored around the extraction wells and applicable portions of the piping. Based on the criteria set forth in OAC 3745-50-51 (K.3 of the Appendix) and per the Ohio EPA's recommendation, the modification of the cover at the proposed three extraction well points and portions of subgrade piping constitute a Class 3 Modification.

The following information is being provided as an appendix to the Lagoon Closure Report.

1. Name of the facility, if any, and type of facility

Name: RACER Trust Moraine Facilities – The work will be completed on the SSL portion of the Site.
Type: The Site is a former automotive manufacturing facility with current mixed industrial/commercial use. The SSL portion of the Site is vacant.

2. Address of the Site

3600 Dryden Road
Moraine, Ohio 45439

3. County and township in which the Site is located

County: Montgomery
Township: Moraine

4. Name, address, and telephone number of a person to contact for additional information regarding the activities at the Site

Pamela Barnett
Cleanup Manager (DE, LA, MA, OH, PA, VA)
RACER Trust
500 Woodward Avenue, Suite 2650
Detroit, Michigan 48226
937-751-8635

5. Size of the Site

The Site is approximately 423 acres and consists of 12 parcels. The parcel that the SSL is located on is owned by RACER Properties, LLC and is 18.174 acres.

6. Identification of type and amount of waste present at the Site, including a description of the process that created the waste and time period of waste disposal

Based on the Lagoon Closure Plan (CRA, 2000), approximately 60,700 cubic yards of sludge was present in the SSL. The June 13, 1988 Resource Conservation and Recovery Act (RCRA) Part A Permit Application indicated that the sludges within the SSL were generated by a mixed wastewater stream from the following processes:

- Wastewater treatment sludges from electroplating operations (Waste Code F006)
- Spent cyanide plating bath solutions from electroplating operations (Waste Code F007)
- Spent stripping and cleaning bath solutions from electroplating operations (Waste Code F009)
- Quenching wastewater treatment sludges from metal heat treating operations (F012)
- Wastewater treatment sludges from the chemical conversion coating of aluminum (F019)

Per the Lagoon Closure Plan, the SSL received waste from 1965 to November 1985.

7. Description of activities proposed at the Site

The following is a summary of the planned activities. It should be noted that all the work will be completed outside the limits of the waste that was present at the Site.

- Drilling will be completed within the lagoon cover area (between the boundaries of the former basins) for the three proposed extraction wells at the Site. The two proposed injection wells will be installed outside the extent of the cover. To avoid the former waste units during construction activities (i.e., drilling and piping installation), measurements from the historic construction drawings included in the Lagoon Closure Plan (CRA, 2000) and the Certification of Lagoon Closure Report (CRA, 2001) will be used to survey and flag the limits of the former waste units. Additionally, the extent of the cover system will be flagged to verify the only work that completed through the cover is the three extraction wells and a portion of the subgrade piping. The work proposed to be completed through the cover will be completed approximately 50 feet from the limits of the former waste units. While it is not anticipated that waste will be encountered during the planned activities, if observations of waste are noted during construction, work will be stopped to ensure compliance with OAC-3745-27-13, the Ohio EPA will be notified, and alternate locations for the system components will be evaluated.
- Initial soil borings will be advanced at each of the two injection well and three extraction well locations, to the regional clay till (approximately 60 feet below ground surface [bgs]), to confirm lithology.
- At the two injection well locations, the boreholes will be completed with an 8-inch steel drive casing and stainless-steel screens. The target depth of 62 feet bgs is approximately 2 to 3 feet into the regional clay till horizon, which has a known thickness of 11 feet or more in the area, to accommodate injection well sumps.
    - The injection well screens will be installed with a stainless-steel basal sump with a length of 3 feet. The injection well screen lengths are expected to be 40 feet long, from approximately 20 feet bgs to 60 feet bgs. A natural formation pack screen design will be used based on grain size analyses.
    - The annular seal in each injection well will be installed to the surface using neat cement.
    - The injection wells will be completed with pitless adapters that will be connected to a treatment system through underground piping (see below), and a lockable stickup cover with a concrete pad.
- At the three extraction well locations, the boreholes will be completed with an 8-inch steel drive casing and stainless-steel screen. The target depth of 62 feet bgs is approximately 2 to 3 feet into the regional clay till horizon, which has a known thickness of 11 feet or more in the area, to accommodate extraction well sumps.

  - The extraction well screens will be installed with a stainless-steel basal sump with a length of 3 feet. The extraction well screen lengths are expected to be 20 to 30 feet long, from approximately 30 or 40 feet bgs to 60 feet bgs. A natural formation pack screen design will be used based on grain size analyses.
  - The annular seal in each extraction well will be installed to the surface using neat cement.
  - The extraction wells will be completed with pitless adapters that will be connected to a treatment system through underground piping, and a lockable stickup cover with a concrete pad.
- Well development will be completed on each of the two injection and three extraction wells:
  - Pre-development – performed after screen installation to allow for the natural formation pack to settle and to avoid bridging.
    - Stages of well development: 1). Initial pumping or air-lift to remove fines, 2). Surge entire screen utilizing a double surge block in 2-feet screen increments, 3). Using pumps and backwash techniques to aggressively remove fines from well between rounds of surging.
  - Final well development – performed once the wells have been completed, utilizing the same three stage development process.
  - To gauge the development process, a baseline specific capacity test will be performed, and water quality parameters will be collected prior to engaging in well development procedures.
  - Once the stages of development are complete, a second round of water quality parameters will be collected along with an additional specific capacity test. A comparison between the baseline values will be assessed to identify if additional rounds of surging, backwashing, or jetting need to be performed. This process will be repeated until specific capacity shows an improvement of less than approximately 10% and measured parameters have stabilized against predetermined criteria.
  - After development is determined to be complete, an injection and/or extraction step test will be completed to document well-specific capacity and performance.
- Subgrade/underground piping will be installed within trenches to connect the extraction wells to the aboveground treatment system. Subgrade/underground piping will also be installed within trenches to connect the centralized above ground treatment system to the injection wells.
  - Trenches for the underground piping will be constructed to a depth of 42 inches bgs and a width of 24 inches across. Where encountered, the cover will be properly restored once piping has been installed.
  - Extracted groundwater will be conveyed by way of 3-inch diameter, high-density polyethylene (HDPE) pipe to the above ground treatment system.
  - Flows from extraction wells will move through parallel bag filters and two granular activated carbon (GAC) vessels in series to remove particulates and contaminates, before being redistributed to the injection well network through the 3-inch diameter HDPE underground piping.
- Cover restoration activities will be completed consistent with the methods summarized in the Lagoon Closure Plan (CRA, 2000). Sand bedding will be used to backfill 4-inches below and 6-inches above the conveyance pipe. Spoils generated during the excavation for the subgrade pipe will be used to backfill to 1.5-feet bgs. The spoils will be placed in lifts and a smooth drum roller will be used to achieve 95% modified proctor density compaction. Clay with a permeability of 1 X 10-7 centimeters per second will be used to backfill from 1.5 to 0.5-feet bgs. The clay will be placed in multiple lifts and compacted using a pad foot roller. The clay lifts will not exceed the total depth of the compactor foot depth and compacted to achieve 95% modified proctor density compaction. ~~Once the clay is placed, it will be compacted using a pad foot roller to achieve 95% modified proctor density compaction.~~ Approximately 6-inches of topsoil will be used to backfill from the ground surface to 0.5 feet bgs. Backfill will be placed continuously in lifts not exceeding 12 inches. ~~Compaction testing will be completed at a minimum frequency of one test per 2,500 cubic yards of backfill material for documentation.~~ One compaction test will be conducted for each 100 linear feet of trench that disturbs the cover. The compaction testing will be conducted at each lift. Compaction testing of backfill material will be conducted using a radioactive Troxler moisture density gauge operated by an independent geotechnical firm. The compaction testing results and locations will be documented in the

Construction Completion Report. The backfill will be completed to the grade specified in the Lagoon Closure Plan. It is to be noted that the disturbed areas will be graded so the cover promotes drainage and does not pond water. The disturbed areas will be seeded.

Since the extraction wells will replace the cover, restoration of the cover in these three locations will not be necessary. Well construction details are shown on Figure 2. Disturbed areas will be seeded.

The Report should be referenced for additional details regarding DGR™ and the proposed scope of work. The Work Plan was provided to the Ohio EPA, and additional copies can be made available upon request. The Ohio EPA will be provided with a construction schedule and 7-day notice prior to reconstruction of the cover. Once construction is complete, the location of the treatment systems, the associated infrastructure location, and the cover reconstruction will be documented in a post-closure plan amendment and submitted to the Ohio EPA.

8. Description of any institutional control that applies to the Site

Property deed and land use restrictions are in place for the SSL. The SSL property is restricted to activities that will not disturb the integrity of the final cover in a manner that is inconsistent with the risk assessment for the Site. Since the cover will be restored around the proposed wells and piping, the cover will be maintained in a manner that is consistent with the risk assessment and compliance with the deed and land use restrictions will be maintained.

9. Description of the manner in which the control of air emissions, control of leachate, surface water run-on and runoff, explosive and toxic gas migration, and protection of groundwater will be performed.

- Control of Air Emissions – While unacceptable air emissions are not anticipated, air monitoring will be completed during monitoring well and extraction well installation activities for worker safety and the safety of others near the SSL. Air in the work area will be monitored for VOCs, lower explosive limit, and oxygen per the site-specific health and safety plan. If unacceptable concentrations of these parameters are encountered, work will stop and measures to control the emissions will implemented. GAC will be used to treat the impacted groundwater extracted from the SSL property. Groundwater treatment using GAC does not result in emissions of VOCs.
- Control of Leachate – Per the November 3, 1989 Draft North Settling Lagoon Revised Closure/Post-Closure Plan, sludge within the SSL and the soil underlying the sludge were sampled. The sludge was determined to be characteristically non-hazardous, and concentrations of constituents of concern in the underlying soils were below site-specific background levels or non-detect. Given the nature of the waste, subsequent solidification, and location of the extraction and monitoring wells outside of the waste units, measures to control leachate are not necessary.
- Surface Water Run-on and Runoff – Sediment and erosion control measures (e.g., silt fencing) will be implemented during drilling and construction activities. Containers used to store water during drilling and development and as part of the treatment system will have secondary containment. Water generated as part of the system operation will be treated and re-injected to the subsurface.
- Explosive and Toxic Gas Migration – Given the nature of the waste as described in the Control of Leachate section above, explosive and toxic gas migration is not anticipated. However, air monitoring will be completed during drilling activities to ensure worker safety and the safety of others near the SSL.
- Protection of Groundwater – The monitoring and extraction wells will be installed within a fenced area with a lock, and the wells will be installed with a proper seal and locked covers to prevent impacts to groundwater from a surficial source, if any. The planned activities are being completed in support of a remedy to improve groundwater quality.

REFERENCES

Arcadis U.S., Inc., 2018. Phase 1 Dynamic Groundwater Recirculation Interim Measure Design Report and Work Plan, Revision No. 1, RACER Trust, RACER Trust Moraine Facilities, Moraine, Ohio. July 2018.

Conestoga-Rovers & Associates, 2000. Lagoon Closure Plan, General Motors, Harrison Radiator Division Facility, Moraine, Ohio. June 2000.

Conestoga-Rovers & Associates, 2001. Closure Certification Report, General Motors, Harrison Radiator Division Facility, Moraine, Ohio. August 2001.

Conestoga-Rovers & Associates, 2002. Lagoon Post-Closure Plan, General Motors, Harrison Radiator Division Facility, Moraine, Ohio. December 2002.

Ohio Environmental Protection Agency, 2019. Notice of Deficiency Amended Post-Closure Plan, Closed South Settling Lagoon, Moraine, Ohio. February 2019.

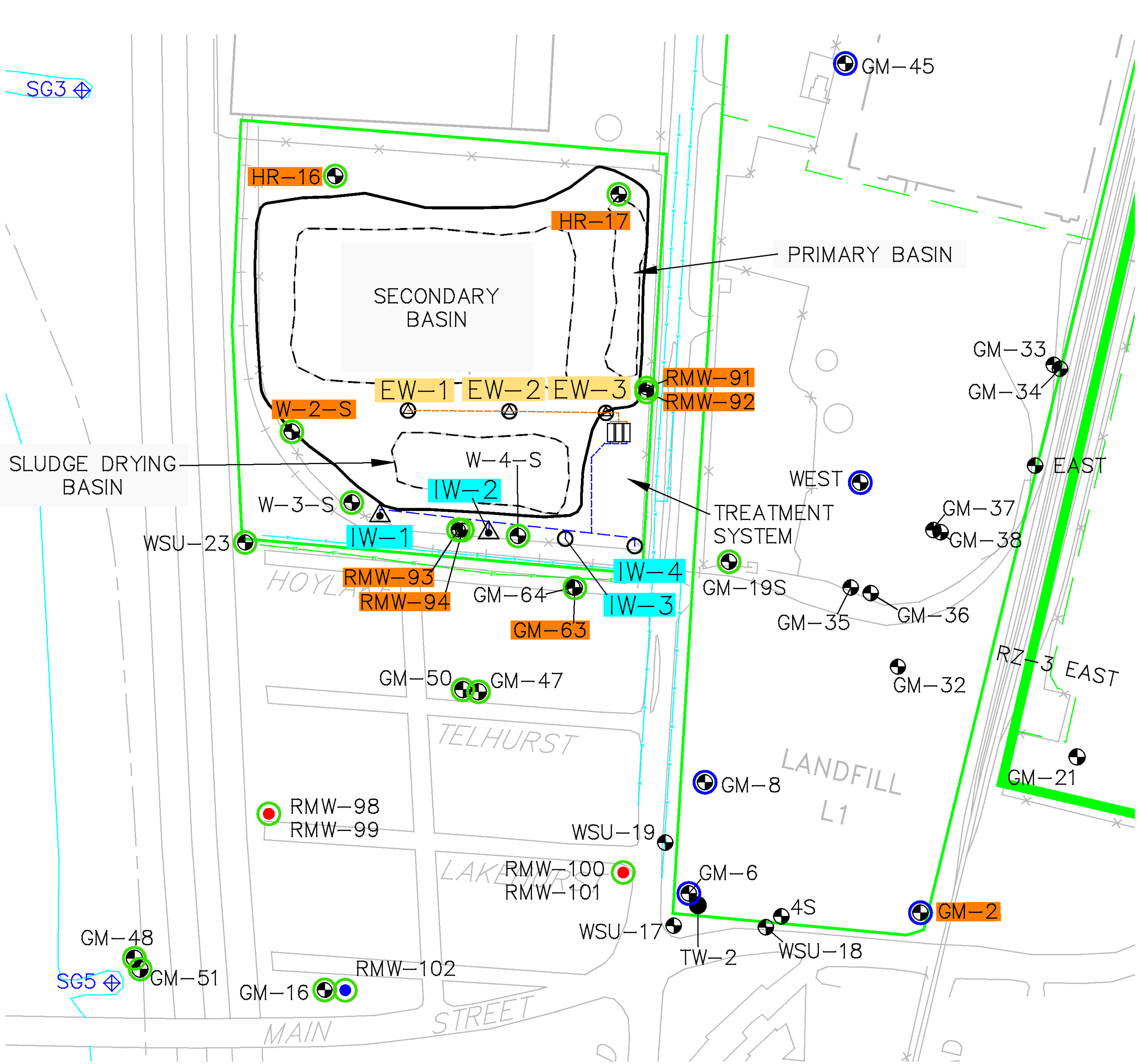
ENCLOSURES

Figure 1 – Site Plan

Figure 2 – Cross Section

Figure 3 – Phase 1 DGR Site Plan and Monitoring Well Network Treatment System

Figure 4 – Pipe and Conduit Sections



LEGEND

- MONITORING WELL (UPPER AQUIFER)
- INACTIVE RECOVERY WELL (TW-2) (UPPER AQUIFER)
- STREAM GAUGE
- EXISTING INJECTION WELL (UPPER AQUIFER)
- PROPOSED INJECTION WELL (UPPER AQUIFER)
- PROPOSED EXTRACTION WELL (UPPER AQUIFER)
- MONTGOMERY COUNTY WELL (USED BY RACER TRUST AS A LOWER AQUIFER RECOVERY WELL)
- PROPOSED HYDRAULIC MONITORING WELLS(UPPER AQUIFER)
- PROPOSED WATER QUALITY AND HYDRAULIC MONITORING WELLS (UPPER AQUIFER)
- PROPOSED MONITORING WELL PAIR (SHALLOW/DEEP UPPER AQUIFER)
- PROPOSED WATER TABLE WELL (SHALLOW UPPER AQUIFER)
- PROPOSED PRESSURE TRANSDUCER LOCATION
- PROPOSED VENTED PRESSURE TRANSDUCER LOCATION
- PROPOSED VENTED/SET POINT PRESSURE TRANSDUCER LOCATION
- PROPOSED SYSTEM INFLUENT PIPING
- PROPOSED SYSTEM EFFLUENT PIPING
- RIVER LEVEE
- FORMER BUILDING FOOTPRINT
- SURFACE WATER FEATURE
- PROPERTY BOUNDARY
- PARCEL BOUNDARY
- EXTENT OF LAGOON COVER
- FORMER LIMITS OF LAND-BASED UNITS

RACER TRUST
MORAINE, OHIO

OH000294.2018

SITE PLAN

ARCADIS Design & Consultancy for natural and built assets

FIGURE
1

CITY:(COLUMBUS, OHIO) DIV/GROUP:(IM/DV) DB:(R. SMITH) LD:(Opt) PIC:(Opt) PM:(T. FORTNER) TM:(Opt) LYR:(Opt)ON=*;OFF=*REF*
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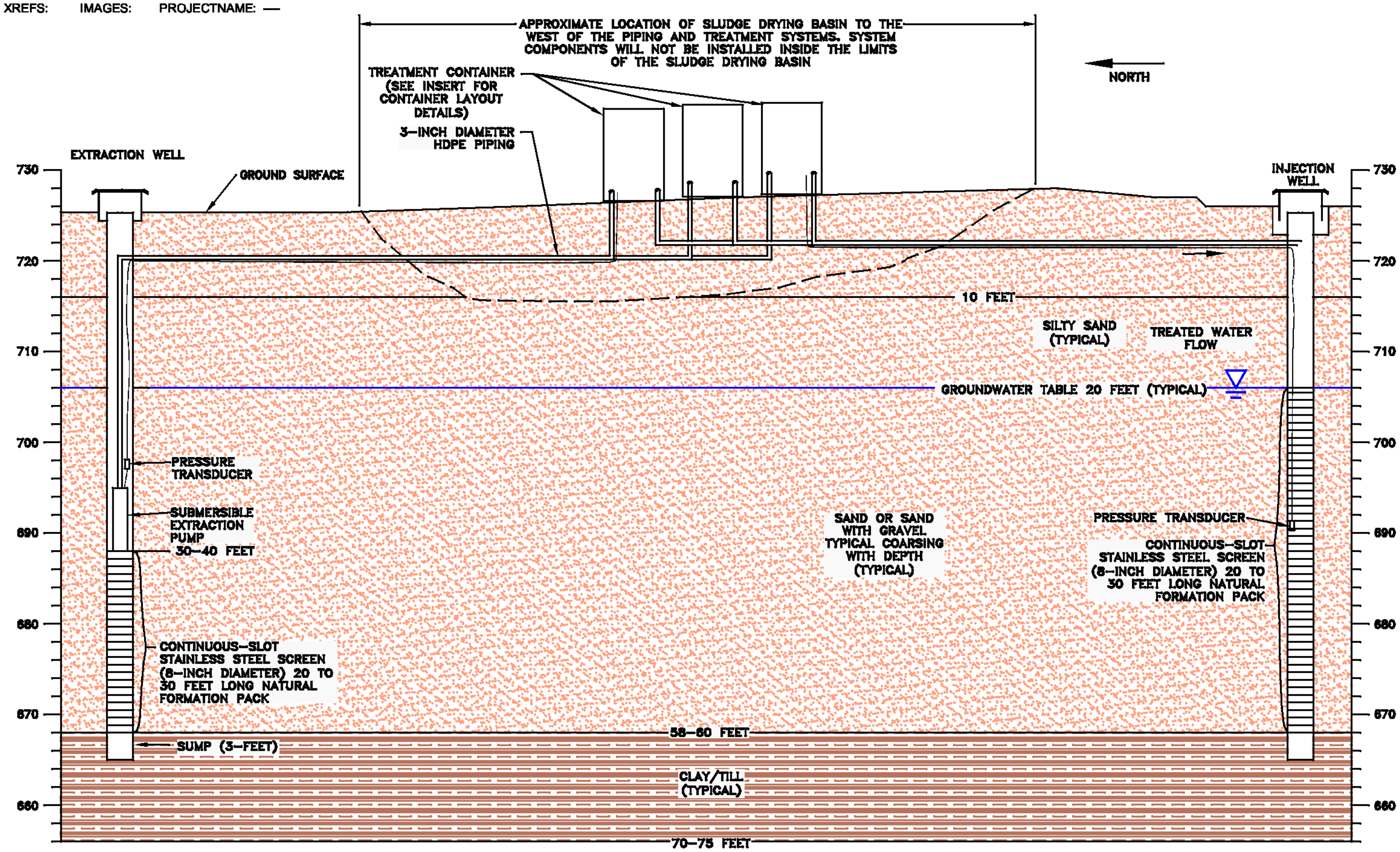
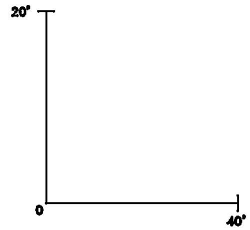


NOTES:

1. SLUDGE WAS REMOVED FROM THE SLUDGE DRYING BASIN AND TRANSFEERED TO THE SECONDARY BASIN DURING CLOSURE ACTIVITIES.
2. SOLIDIFIED SLUDGE IN THE PRIMARY BASIN IS LOCATED FROM APPROXIMATELY 702.5 TO 711.5 FEET ABOVE MEAN SEA LEVEL (AMSL).
3. SOLIDIFIED SLUDGE IN THE SECONDARY BASIN IS LOCATED FROM APPROXIMATELY 698.5 TO 711.5 FEET ABOVE MEAN SEA LEVEL (AMSL).
4. THE DEPTHS OF THE SLUDGE NOTED ABOVE ARE APPROXIMATE AND BASED ON INFORMATION CONTAINED IN THE JUNE 5, 2000 LAGOON CLOSURE PLAN PREPARED BY CONESTOGA-ROVERS & ASSOCIATES (CRA) AND THE AUGUST 10, 2001 CERTIFICATION OF LAGOON CLOSURE PREPARED BY CRA.



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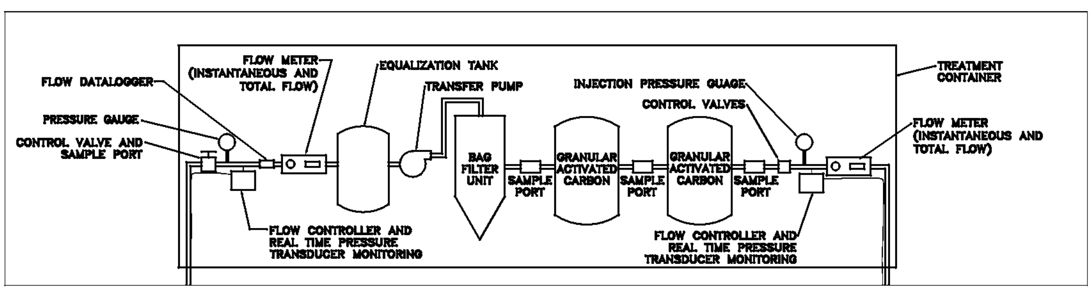
HORIZONTAL SCALE: 1" = 40'



EXAMPLE TREATMENT SYSTEM DETAILS

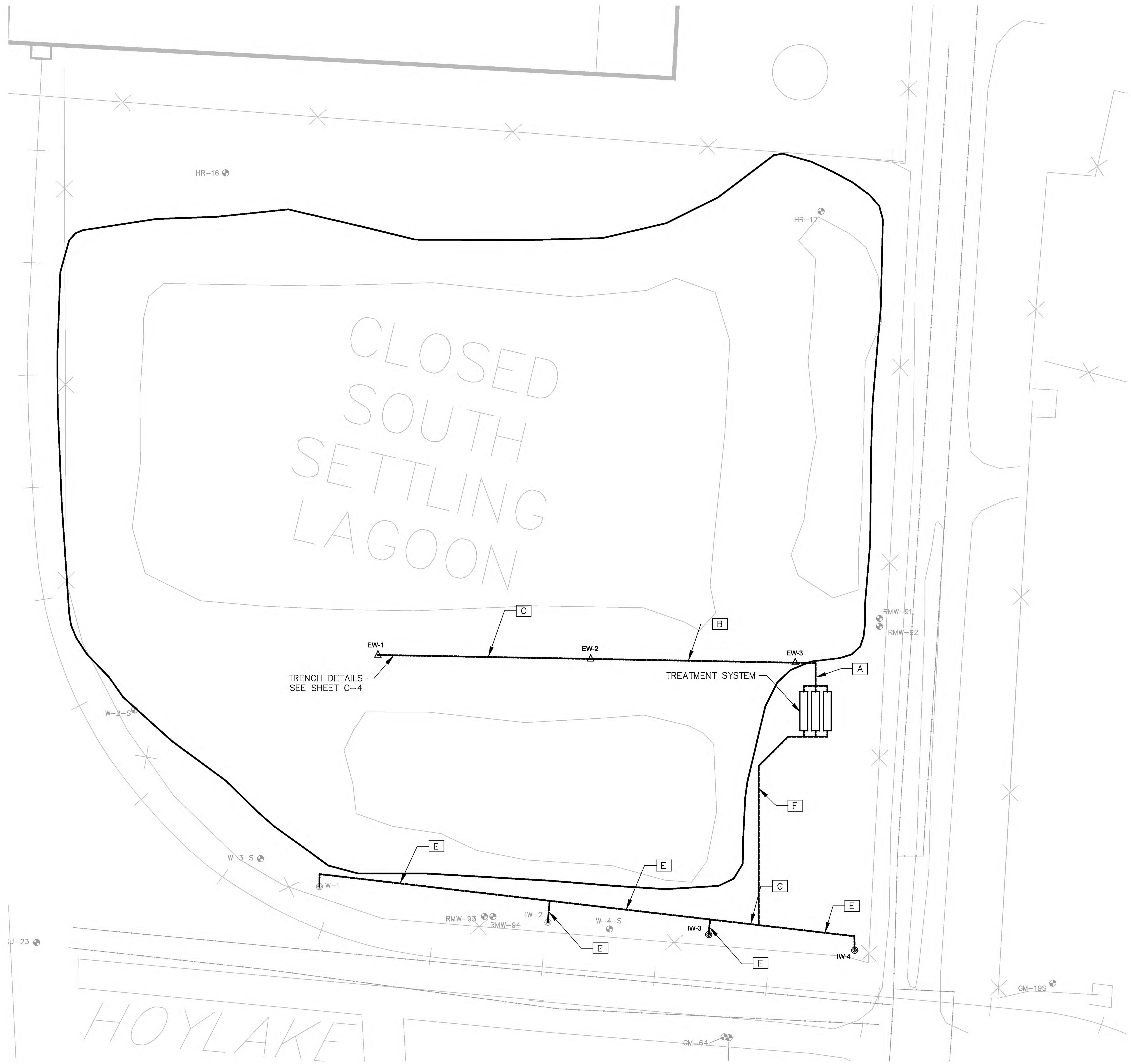
RACER TRUST
MORAINE, OHIO

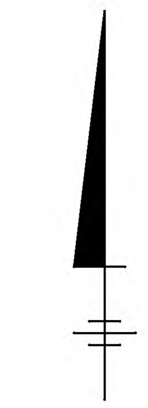
OH000294.2018

CROSS SECTION

ARCADIS Design & Consultancy for natural and built assets

FIGURE
2





LEGEND

- NEW INJECTION WELL (UPPER AQUIFER)
- NEW EXTRACTION WELL (UPPER AQUIFER)
- NEW MONITORING WELL PAIR (SHALLOW/DEEP UPPER AQUIFER)
- NEW WATER TABLE WELL (SHALLOW UPPER AQUIFER)
- EXISTING MONITORING WELL (UPPER AQUIFER)
- EXISTING INJECTION WELL (UPPER AQUIFER)
- EXISTING INACTIVE RECOVERY WELL (TW-2) (UPPER AQUIFER)
- EXISTING STREAM GAUGE
- EXISTING MONTGOMERY COUNTY WELL (USED BY RACER TRUST AS A LOWER AQUIFER RECOVERY WELL)
- SYSTEM CONVEYANCE TRENCH
- RIVER LEVEE
- FORMER BUILDING FOOTPRINT
- SURFACE WATER FEATURE
- PROPERTY BOUNDARY
- PARCEL BOUNDARY
- CAP BOUNDARY

NOTE:

PRELIMINARY DESIGN. SOME SITE FEATURES MAY CHANGE AS FINAL DESIGN PROGRESSES.

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60' 0 60' 120'
1"=60'

THIS BAR REPRESENTS ONE INCH ON THE ORIGINAL DRAWING: USE TO VERIFY FIGURE REPRODUCTION SCALE

No.	Date	Revisions	By	Ckd

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Professional Engineer's Name		
Professional Engineer's No.		
State: OH	Date Signed	Project Mgr.
Designed by: AR	Drawn by	Checked by

ARCADIS Design & Consultancy for natural and built assets

ARCADIS U.S., INC.

RACER TRUST • MORAINE, OHIO
PHASE I DGR IM SYSTEM 50% DESIGN

PHASE I DGR™ SITE PLAN AND MONITORING WELL NETWORK TREATMENT SYSTEM

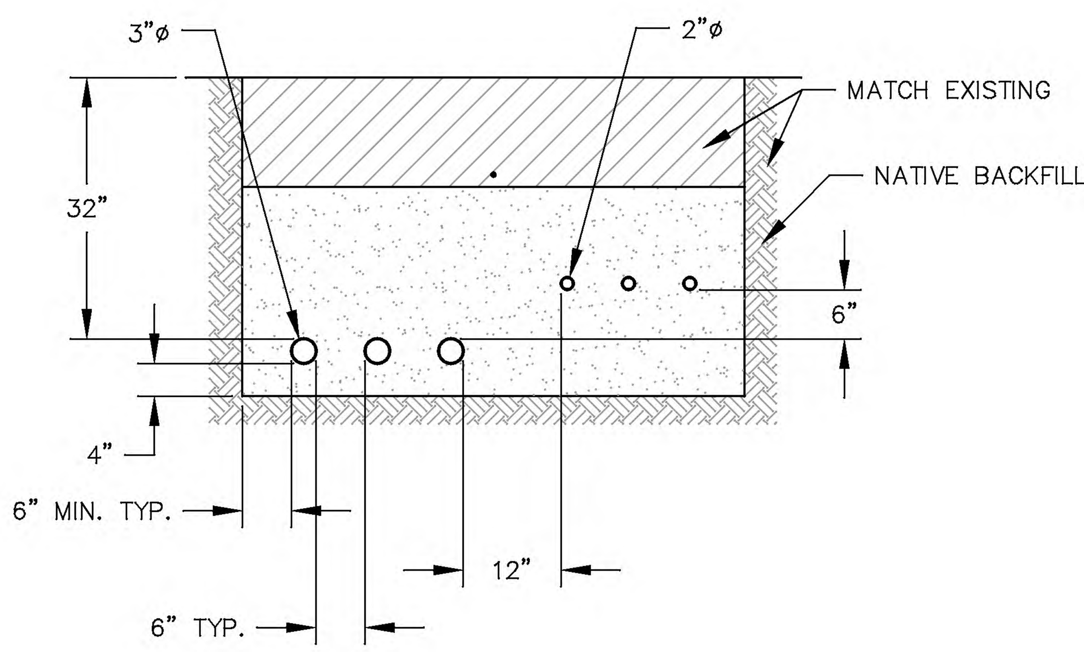
PROCESS

ARCADIS Project No. OH000294.2018.0003E

Date AUGUST 2018

ARCADIS
110 WEST FAYETTE ST.
SUITE 300
SYRACUSE, NY 13202
TEL. 315.446.9120

3



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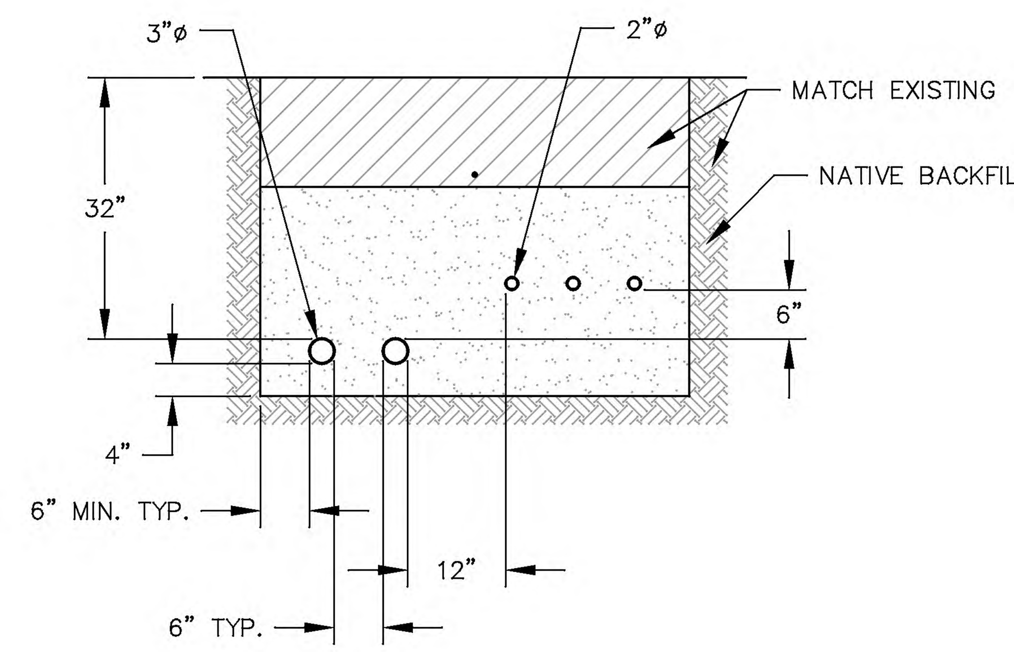

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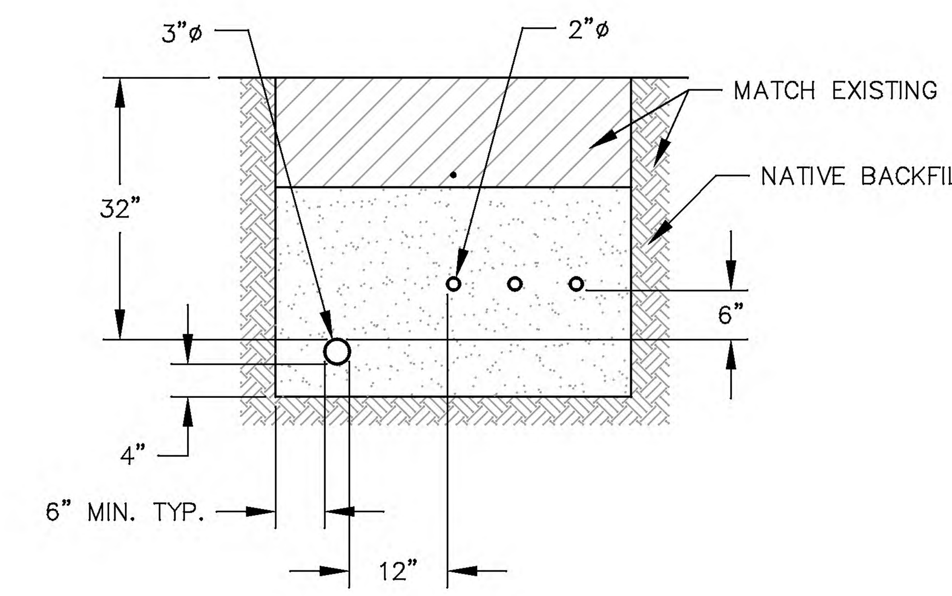

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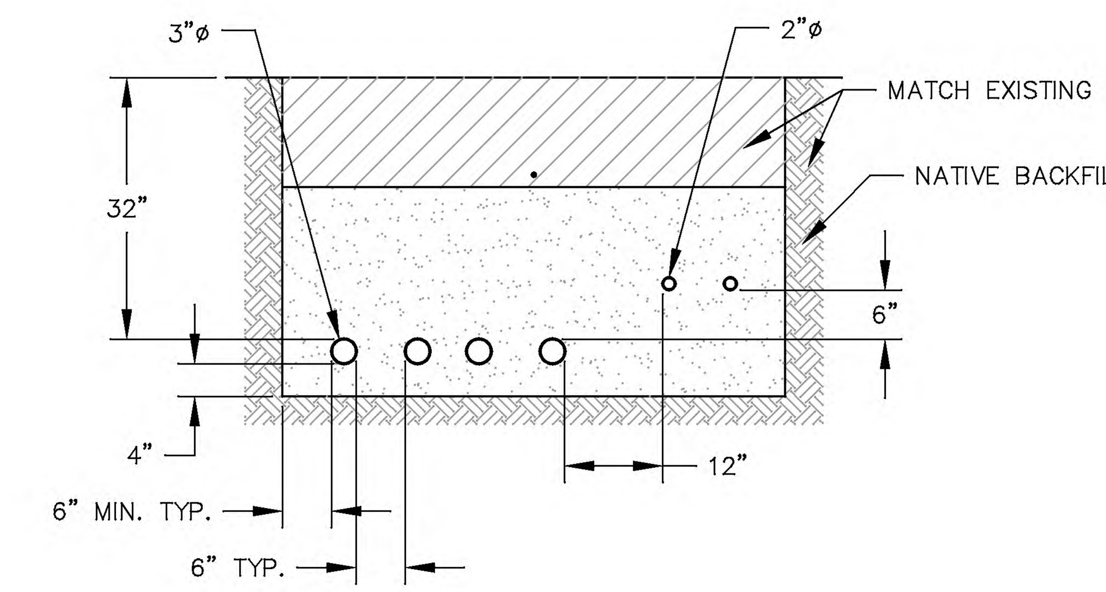

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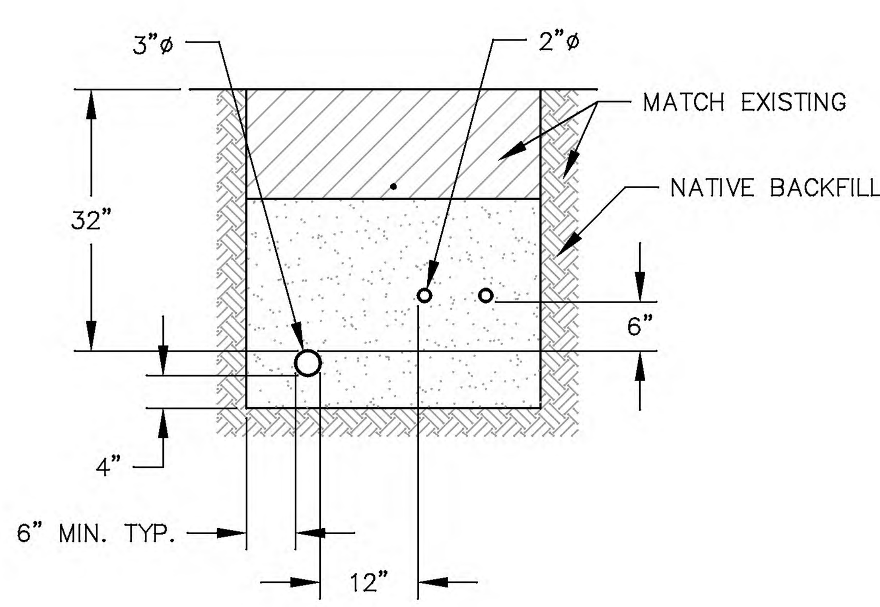

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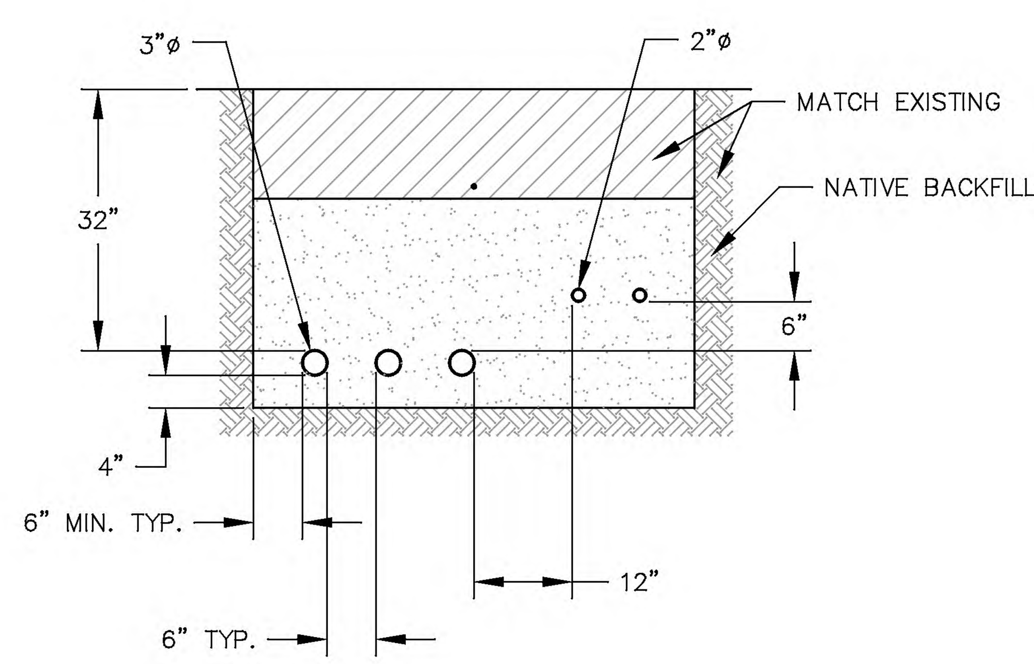

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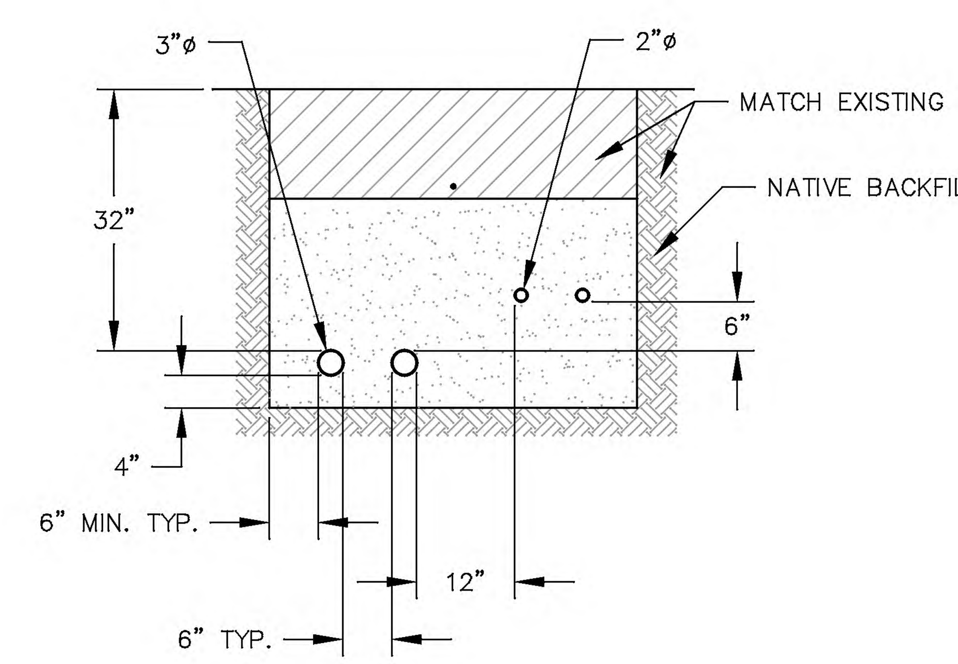

TRENCH SECTION (G)
NOT TO SCALE

LEGEND

- 2–IN ELECTRICAL OR SIGNAL CONDUIT SEE SCHEDULE FOR MORE INFORMATION
- 3–IN WATER CONVEYANCE PIPE SEE SCHEDULE FOR MORE INFORMATION
- NATIVE MATERIAL BACKFILL
- SAND BACKFILL/FILL MATERIAL
- UNDISTURBED NATIVE MATERIAL

SCALE(S) AS INDICATED

THIS BAR REPRESENTS ONE INCH ON THE ORIGINAL DRAWING: USE TO VERIFY FIGURE REPRODUCTION SCALE

No.	Date	Revisions	By	Ckd

Professional Engineer's Name
Professional Engineer's No.

State	Date Signed	Project Mgr.
OH		
Designed by	Drawn by	Checked by
AR		

ARCADIS Design & Consultancy for natural and built assets

ARCADIS U.S., INC.

RACER TRUST • MORAINE, OHIO
PHASE I DGR IM SYSTEM 50% DESIGN

PIPE AND CONDUIT SECTIONS

PROCESS

ARCADIS Project No.
OH000294.2018.0003E

Date
AUGUST 2018

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4