

ARCADIS

**Appendix D**

Vapor Intrusion Supporting  
Information

## **Appendix D - Summary of Vapor Intrusion Assessment and Mitigation Activities**

### **Revitalizing Auto Communities Environmental Response Trust (RACER Trust)**

Former Delphi Harrison Thermal Systems Moraine Plant  
Former General Motors Powertrain Group, Moraine Engine Plant  
Former General Motors Truck Group, Moraine Assembly Plant

Moraine, Ohio

December 31, 2012

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- D-1 Vapor Intrusion Verification Report
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AOC	Administrative Order on Consent
ASTM	American Society for Testing and Materials
BTEX	benzene, toluene, ethylbenzene, and xylenes
CSDSs	crawlspace depressurization systems
GM Corporation	General Motors Corporation
MLC	Motors Liquidation Company
Ohio EPA	Ohio Environmental Protection Agency
O&M	operation and maintenance
PCE	tetrachloroethene
PIPS	post-installation proficiency sampling
PSWP	property-specific work plan
PVC	poly-vinyl chloride
RACER Trust	Revitalizing Auto Communities Environmental Response Trust
Site	Moraine Facilities
SSDSs	sub-slab depressurization systems
SMDSs	sub-membrane depressurization systems
TCE	trichloroethene
U.S. EPA	United States Environmental Protection Agency
VOCs	volatile organic compounds
1,1-DCA	1,1-dichloroethane
1,1,1-TCA	1,1,1-trichloroethane

## **1. Introduction**

This *Summary of Vapor Intrusion Assessment and Mitigation Activities* (Appendix D to the *Corrective Measures Proposal*) describes the vapor intrusion assessment and mitigation activities completed in association with the Revitalizing Auto Communities Environmental Response Trust (RACER Trust) Moraine Facilities (Site) including activities described in the *Vapor Intrusion Verification Investigation Report* (ARCADIS, Inc. 2012), the *Closed South Settling Lagoon Vapor Intrusion Verification Summary Report* (RACER Trust 2012a), and the *Landfill L1 Investigation Summary Report*. This report also summarizes on-going sub-slab and indoor air sampling activities, vapor intrusion mitigation activities, and community outreach efforts associated with the Riverview Plat neighborhood adjacent to the Site.

The vapor intrusion assessment and mitigation activities were completed with oversight from the United States Environmental Protection Agency (U.S. EPA). The Site includes the former Delphi Harrison Thermal Systems Moraine Plant (former Delphi Thermal Moraine), former General Motors Powertrain Group, Moraine Engine Plant (former Moraine Engine), former General Motors Truck Group, and Moraine Assembly Plant (former Moraine Assembly). Vapor intrusion assessment and mitigation activities are focused around the Riverview Plat neighborhood, located immediately to the southwest of the Site. The Site and location of the Riverview Plat neighborhood are shown on Figure 1.

### **1.1 Site Description and History**

The RACER Trust Moraine Facilities have been used for industrial purposes since the property was acquired in the mid-1920s by former General Motors Corporation (GM Corporation). The former Moraine Engine and Moraine Assembly facilities occupy approximately 239 acres, while the adjacent former Delphi Thermal Moraine facility occupies approximately 124 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 shows the location of each facility and site features.

Frigidaire (a former division of GM Corporation) produced appliances at the Site from the late 1920's until GM Corporation announced the shutdown 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



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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. Operations at the former Moraine Engine facility ceased in the fall of 2000. The plant building has been decommissioned and demolished, and the majority of this Site has been covered with a parking surface. GM Corporation operated a regional haulaway at the location of the former Moraine Engine Plant, which was referred to as the Vehicle Distribution Center until December 2008 when operations ceased.

Since 1981, Moraine Assembly operations included the manufacture, assembly, and painting of small trucks and later sport utility vehicles (SUVs). Operations at the former Moraine Assembly ceased in December 2008.

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.

On June 1, 2009, GM Corporation and certain subsidiaries filed voluntary petitions for relief under Chapter 11 of the Bankruptcy Code. An order was entered approving the sale of substantially all of GM Corporation's assets to a new and independent company (now known as General Motors Company, LLC) under Section 363 of the Bankruptcy Code on June 5, 2009. The sale closed on July 10, 2009. At that time, GM Corporation changed its name to Motors Liquidation Company (MLC). RACER Trust was established on March 31, 2011 by a federal bankruptcy court to own, manage, remediate and revitalize the properties from the 2009 GM Corporation bankruptcy.

On June 30, 2011, RACER Trust sold former Delphi Thermal Moraine, former Moraine Engine Plant, and former Moraine Assembly Plant to IRG Moraine, LLC. As part of the property transfer, RACER Trust retained environmental liability for these properties.

The closed South Settling Lagoon was not included in this property transaction. The closed South Settling Lagoon was retained by RACER Properties, LLC.

On September 29, 2011, the Administrative Order on Consent (AOC) for the Site was fully executed proceeding under Section 3008(h) of the Resource Conservation and

Recovery Act, as amended, 42 U.S. C. Section 6928(h), U.S. EPA Docket No: RCRA-05-2011-0016. The performance-based AOC covers corrective action for past releases of hazardous contaminants at or from the Site.

### **1.2 Vapor Intrusion Assessment and Mitigation Activity Objectives**

The objectives of the vapor intrusion assessment and mitigation activities at the Site were as follows:

- Determine if the presence of VOC-containing soil-gas in the Riverview Plat neighborhood and along the eastern boundary of the Site is considered a potential pathway for vapor intrusion.
- Determine the source of VOC-containing soil-gas in the Riverview Plat neighborhood, and determine if Landfill L1 and the closed South Settling Lagoon are a contributing source of site-specific VOCs in soil-gas.
- Complete sub-slab and indoor air sampling to determine if the vapor intrusion pathway is complete at the properties in the Riverview Plat neighborhood.
- Install mitigation system to reduce the concentrations of site-specific VOCs in indoor air at properties within the Riverview Plat neighborhood to concentrations that are below the May 2012 U.S. EPA Regional Screening Levels for indoor air (Action Levels).
- Engage the local community to provide updates on the status of the vapor intrusion assessment and mitigation activities and to provide an opportunity to respond to concerns of the local residents.

### **1.3 Document Organization**

The remainder of this document is organized into the following sections:

- Section 2 – Vapor Intrusion Verification Investigation, summarizes the investigation completed to evaluate the potential for a complete vapor intrusion pathway in the areas located to the east and southwest of the Site.
- Section 3 - Closed South Settling Lagoon Vapor Intrusion Verification Investigation, summarizes the investigation completed to further evaluate the vapor intrusion pathway for site-specific VOCs.



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- Section 4 - Landfill L1 Investigation, summarizes the investigation to characterize the landfill and its potential contribution of site-specific VOCs to the Riverview Plat neighborhood.
- Section 5 - Vapor Intrusion Source Evaluation, identifies and describes the rationale for selection of underlying shallow groundwater as the primary source of the site-specific VOCs present in soil-gas within the Riverview Plat neighborhood.
- Section 6 - Sub-Slab and Indoor Air Sampling Investigation, describes the sub-slab and indoor air investigation designed to evaluate whether vapor intrusion was occurring in the residential and commercial structures in the Riverview Plat neighborhood and the City of Moraine Municipal Building.
- Section 7 - Vapor Intrusion Mitigation Activities, details the mitigation system components, the design process, post-installation proficiency sampling (PIPS), system operation and maintenance (O&M), and system decommissioning.
- Section 8 - Vapor Intrusion Community Outreach Activities, summarizes the community outreach activities completed in association with the vapor intrusion assessment and mitigation activities in the Riverview Plat neighborhood.
- Section 9 - Conclusions of Vapor Intrusion Assessment and Mitigation Activities, presents the conclusions of the vapor intrusion assessment and mitigation activities completed to date at the Site.
- Section 10 – References.



## **2. Vapor Intrusion Verification Investigation**

As outlined in the revised *Vapor Intrusion Verification Work Plan* (ARCADIS, Inc. 2010) dated September 16, 2010 and approved by the U.S. EPA on September 29, 2010, a field investigation was completed in October and November 2010 and March 2011 to evaluate the potential for a complete vapor intrusion pathway using a phased approach. During the field investigation, soil-gas and groundwater table samples were collected near potential off-site receptors (residential and commercial structures) located in proximity to the Site. The areas of the investigation were the areas located to the east and southwest (the Riverview Plat neighborhood) of the Site. The groundwater and soil-gas data were used as part of the overall weight of evidence for evaluating the vapor intrusion pathway. The *Vapor Intrusion Verification Report* provides the specific methodologies used to collect the soil-gas and groundwater samples, details the results of the investigation, and is presented in Attachment D-1.

In October and November 2010, soil-gas points SGP-1 through SGP-12 were installed, geotechnical data were collected from various sample locations, soil-gas sampling was completed, groundwater sampling at the water table was completed, and existing monitoring wells GM-25 and GM-77S were sampled. In the Riverview Plat neighborhood, eight soil-gas sample points (SGP-1 through SGP-8) were installed within the right-of-way (between the street and the sidewalk). One soil-gas sample point was installed near the City of Moraine Municipal Building (SGP-9). Along the eastern boundary of the Site, three soil-gas sample points (SGP-10 through SGP-12) were installed near the primarily residential area along Southbound Kettering Boulevard. Monitoring wells GM-25 and GM-77S are located to the east of the Site.

Based on the results of the Vapor Intrusion Verification Investigation, the following conclusions were made:

- Tetrachloroethene (PCE) and trichloroethene (TCE) were the primary chemicals of concern identified in soil-gas.



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- Concentrations of PCE and TCE in soil-gas increased with depth which indicated that groundwater was the primary source of the PCE and TCE detected in soil-gas.
- Based on the concentrations of PCE and TCE in soil-gas, indoor air and sub-slab sampling at properties in the Riverview Plat neighborhood was completed.
- Based on the lack of a site-specific VOC source in soil or groundwater and confirmation that VOCs were not detected above the soil-gas Action Levels in the samples collected, a future phase of investigation to the east of the Site was not warranted.

### **3. Closed South Settling Lagoon Vapor Intrusion Verification Investigation**

As outlined in the *Vapor Intrusion Verification Work Plan Addendum* (RACER Trust 2011a) dated November 14, 2011 and approved by the U.S. EPA on January 10, 2012, a field investigation was completed from January 30, 2012 to February 6, 2012 to further evaluate the vapor intrusion pathway for site-specific VOCs along the southern and eastern portions of the closed South Settling Lagoon (Figure 1). Soil-gas and groundwater table samples were collected in association with this investigation. The *Closed South Settling Lagoon Vapor Intrusion Verification Summary Report* details the results of the investigation and is included as Attachment D-2.

In January and February 2012, soil-gas sample points SSL-1 through SSL-3 were installed, soil-gas sampling was completed, groundwater sampling at the water table was completed, and existing upper aquifer monitoring well GM-63 was sampled.

The site-specific VOCs detected in soil-gas at the closed South Settling Lagoon were similar to the site-specific VOCs detected in soil-gas at the Riverview Plat neighborhood. However, the concentrations at the closed South Settling Lagoon were lower. The difference in the site-specific VOC soil-gas concentrations between the closed South Settling Lagoon and the Riverview Plat neighborhood could be attributed to the lack of foundations, asphalt roads, and/or other impervious structures along the perimeter of the closed South Settling Lagoon. Conceptually, soil-gas along the perimeter of the closed South Settling Lagoon is more likely to migrate to the surface where it can dissipate into the atmosphere and not collect underneath an impervious structure (e.g., basement).

The groundwater table and soil-gas sampling results indicate that groundwater is the source of site-specific VOCs, primarily of PCE and TCE, to soil-gas along the perimeter of the closed South Settling Lagoon. Soil-gas concentrations correlated with groundwater data results and increased in concentration with depth. Concentrations of benzene, toluene, ethylbenzene, and xylenes (BTEX) and 1,1,1-trichloroethane (1,1,1-TCA) were not detected in groundwater but were detected at low concentrations in soil-gas. The BTEX and 1,1,1-TCA concentrations in soil-gas were several orders of magnitude below their respective Action Levels. Based on the review of the soil-gas data, these compounds were not risk-based drivers. Further investigation as to the source of these low concentrations was not warranted.

#### **4. Landfill L1 Investigation**

As outlined in the *Landfill L1 Investigation Work Plan* dated October 27, 2011 (ARCADIS, Inc. 2011a) (approved by the U.S. EPA with conditions on November 1, 2011) and addendums dated November 29, 2011 (RACER Trust 2011b) and July 17, 2012 (RACER Trust 2012b) (approved by the U.S. EPA on July 18, 2012), a field investigation was completed at Landfill L1 (shown on Figure 1) from November 14, 2011 to December 22, 2011 and from September 19 to 20, 2012. The specific objectives of the investigation were: 1) to determine the site-specific VOC concentrations of soil-gas along the western, eastern, and southern boundaries and within the landfill, 2) to determine if the landfill is a potential contributing source for site-specific VOCs in the soil-gas beneath the Riverview Plat neighborhood and the City of Moraine Municipal Building property, 3) to characterize the waste within the landfill, 4) to determine the relative contribution of waste containing site-specific VOCs to groundwater, 5) to confirm the vertical and horizontal extent of the waste, 6) to determine the influence the soil-gas present within the landfill has on the ambient air, and 7) to assess the potential for site-specific VOC-containing soil-gas to migrate laterally from the landfill and collect within the storm sewer dry wells.

During the investigation, waste, soil, groundwater, soil-gas, ambient air, and storm sewer dry well air samples were collected. The *Landfill L1 Investigation Summary Report* provides the specific methodologies used to collect the soil-gas and groundwater samples, details the results of the investigation, and is presented in Appendix E of the Corrective Measures Proposal.

The following is a summary of the vapor intrusion related conclusions of the investigation:

- The soil-gas VOC concentrations along on the western, eastern, and southern boundaries of the landfill were determined. Based on the results of the waste samples, the soil-gas samples, and the groundwater samples, the primary source of VOCs in landfill soil-gas appears to be the waste within the landfill. Since the soil-gas concentrations in the landfill are associated with the waste and not groundwater, offsite vapor intrusion issues associated with landfill soil-gas are not anticipated to be an issue.
- Methane was detected in landfill soil-gas at concentrations exceeding 5 % (100 % LEL). The methane concentrations detected in the landfill soil-gas are not uncommon in landfill settings. To determine if methane was migrating offsite, the dry wells near the western and southern landfill perimeter and soil-gas points on

the eastern portion of the Riverview Plat neighborhood were sampled for methane. Based on the results of the methane sampling activities, soil-gas containing methane is not migrating to the Riverview Plat neighborhood or the nearby storm sewer dry wells.

- Current dissolved methane groundwater concentrations in the landfill are comparable to the dissolved methane concentrations detected prior to initiation of interim measures. The dissolved methane concentrations at the landfill may be contributing to the methane concentrations detected in landfill soil-gas. However, as indicated above, soil-gas containing methane is not migrating to the Riverview Plat neighborhood or the nearby storm sewer dry wells.
- Based on a comparison of the chemical distribution profiles of the soil-gas samples from the landfill, the Riverview Plat neighborhood, and the City of Moraine Municipal Building property to the south of the landfill, the landfill is not a significant contributing source of site-specific VOCs to the soil-gas beneath the Riverview Plat neighborhood to the west or the City of Moraine Municipal Building property to the south.
- Based on a comparison of the chemical distribution profiles of the soil-gas samples from the landfill to the ambient air samples collected along the western perimeter of the landfill and the dry well samples collected to the west of the landfill, the impact that the landfill soil-gas has on ambient air and the dry wells, if any, is not significant.

## **5. Vapor Intrusion Source Evaluation**

Based on the results of the Vapor Intrusion Verification Investigation, the Closed South Settling Lagoon Vapor Intrusion Investigation, and the Landfill L1 Investigation, the primary source of the site-specific VOCs present in soil-gas within the Riverview Plat neighborhood is the underlying shallow groundwater. The results of the Vapor Intrusion Verification Investigation indicate that soil-gas VOC concentrations in the Riverview Plat neighborhood increase with depth and the only site-specific VOCs detected in soil-gas above the Action Levels were PCE and TCE. This attenuation indicates that the source of site-specific VOCs in soil-gas is attributable to concentrations of site-specific VOCs in groundwater. Based on the data collected from the investigations at the closed South Settling Lagoon and Landfill L1, these areas are not contributing significant sources of site-specific VOCs to the soil-gas in the Riverview Plat neighborhood. Figure 2 shows the combined PCE and TCE groundwater plume (based on total PCE and TCE concentrations from grab groundwater samples) that is located below the Riverview Plat neighborhood.

## **6. Sub-Slab and Indoor Air Sampling Investigation**

Based on the results of the Vapor Intrusion Verification Investigation and in a December 3, 2010 letter from the U.S. EPA requesting that a Sub-Slab and Indoor Air Sampling Work Plan be prepared, the *Sub-Slab and Indoor Air Sampling Work Plan* (ARCADIS, Inc. 2011b) was prepared. The U.S. EPA conditionally approved the Work Plan on February 8, 2011. The *Sub-Slab and Indoor Air Work Plan* was revised per the U.S. EPA's conditional approval and finalized on March 4, 2011. Addendums to the Work Plan, dated February 27, 2012 (RACER Trust 2012c) and March 19, 2012 (RACER Trust 2012d) were prepared and approved by the U.S. EPA on March 2, 2012 and June 1, 2012, respectively. Per the Work Plan and Work Plan Addendums, a sub-slab and indoor air investigation was initiated in March 2011 to evaluate whether vapor intrusion was occurring in the residential and commercial structures in the Riverview Plat neighborhood and the City of Moraine Municipal Building.

Sixty-three properties are located in the Riverview Plat neighborhood -- sixty residential properties and three commercial properties (i.e., church, retail petroleum station, and automotive repair facility). Fifty-eight of the residential structures are single family homes, and two of the residential structures are duplexes. Several of the properties in the Riverview Plat neighborhood were occupied by tenants. The structures in the neighborhood have a variety of foundation types (e.g., basement, crawlspace, slab-on-grade, or a combination thereof). Additionally, the City of Moraine Municipal Building located to the south of Landfill L1 was included in the sub-slab and indoor air sampling investigation (Figure 1). Sub-slab and indoor air sampling was completed at properties where access agreements signed by the property owners were received.

The following sections summarize the site reconnaissance, sample locations, sub-slab soil-gas sampling, indoor air sampling, ambient air sampling, investigation results, decision matrix, and confirmation sampling activities associated with the Sub-Slab and Indoor Air Investigation.

### **6.1 Structure Reconnaissance**

RACER Trust obtained a signed access agreement prior to entering any building. Once access was granted, a structure reconnaissance was scheduled with the property owner and/or tenant. The goal of the structure reconnaissance was to complete a building survey that identified the building and foundation condition,

building materials, heating, ventilation, and air conditioning operation, and any preferential vapor migration pathways (e.g., sump pump). In addition, a product inventory was completed to identify products that were stored or used within the structure. The field personnel requested that any products that contained VOCs be removed from the structure at least 48 hours prior to sampling and a copy of Instructions for Occupants during Indoor Air Sampling Events was provided to the building occupant. During the structure reconnaissance, the sampling activities were scheduled and/or confirmed with the property owner/tenant, and an explanation of the sampling activities was provided, if necessary.

## **6.2 Sample Locations**

The sample locations were discussed with the owner/tenant during the site reconnaissance and prior to sampling. Three foundation construction types (e.g., basement, crawlspace, slab-on-grade) or a combination of the three types were encountered in the buildings in the neighborhood. Building construction influenced the sub-slab sampling as follows:

- One sub-slab soil-gas sample was collected in buildings with basement or slab-on-grade foundations that were less than 1,000 square feet (ft.).
- Buildings with basement or slab-on-grade foundations that were between 1,000 and 1,100 square ft. had one or two sub-slab soil-gas samples collected per foundation area, based on a case-by-case analysis of the building construction.
- Two sub-slab soil-gas samples were collected in buildings with basement or slab-on-grade foundations that were greater than 1,100 square ft.

Building construction influenced indoor air sampling as follows:

- Basement (full or partial) construction: One indoor air basement and one indoor air first floor sample was collected.
- Slab-on-grade construction: One indoor air first floor sample was collected.
- Crawlspace construction: One crawlspace and one indoor air first floor sample was collected.
- Combination foundations: One indoor air sample was collected from the basement (if present), the crawlspace (if present), and the first floor.

Sub-slab soil-gas samples were collected as close as possible to the center of the foundation (slab-on-grade and basement). Indoor air first floor samples were collected as close as possible to the center of the building and within the breathing zone. Basement and crawlspace air samples were collected as close as possible to the center of the foundation and in the breathing zone. Actual sampling locations were adjusted based on information from the structure reconnaissance and input from the owner/tenant. This included sample location adjustment due to utilities beneath the structure, in a crawlspace, or underneath the slab.

### **6.3 Sub-Slab Soil-Gas Sampling**

Sub-slab soil-gas samples were collected from permanent soil-gas sample points. Prior to installation of the soil-gas sample points, the Ohio Utility Protection Service was notified to identify underground utilities. Construction of the sub-slab soil-gas sample point is illustrated in Figure 3. A helium leak test was completed prior to sampling to verify the seal of the sample point. If the seal was compromised, the sample point was re-sealed until the helium leak test passed.

Sub-slab soil-gas samples were collected using 1-liter SUMMA<sup>®</sup>-type canisters with attached pre-set flow regulators. A total of three volumes of air (open space of tubing and sample point) were purged into a Tedlar<sup>®</sup> bag prior to sampling with a flow rate not exceeding 50 milliliters per minute. Flow regulators were pre-set by the laboratory to provide uniform sample collection over a 30-minute sampling period. The valve on the SUMMA<sup>®</sup>-type canister was closed when approximately 5 inches (in.) of mercury (Hg) vacuum remained in the canister, leaving a vacuum in the canister as a means for the laboratory to verify the canister did not leak while in transit. Samples were submitted under chain-of-custody protocols to Air Toxics, Ltd. (Air Toxics) located in Folsom, California for laboratory analysis of site-specific VOCs per U.S. EPA Method TO-15 using standard detection limits.

### **6.4 Indoor Air Sampling**

One indoor air sample was collected from the breathing zone (4 to 5 ft.) in the basement (if present), the crawlspace (if present), and the first floor of each building. The locations were dependent on the structure reconnaissance. Indoor air samples were collected using 6-liter SUMMA<sup>®</sup>-type canisters with attached pre-set flow regulators. Flow regulators for indoor air sampling were pre-set by the laboratory to provide uniform sample collection over a 24-hour sampling period. Like sub-slab soil-gas sample collection, the valve on the SUMMA<sup>®</sup>-type canister was closed when

approximately 5 in. of Hg vacuum remained in the canister or when the sample duration was complete, leaving a vacuum in the canister as a means for the laboratory to verify the canister did not leak while in transit. To prevent the canisters from losing vacuum, the canisters were closed after 23 hours when possible. Samples were submitted under chain-of-custody protocols to Air Toxics for laboratory analysis of site-specific VOCs per U.S. EPA Method TO-15 using low-level detection limits.

### **6.5 Ambient Air Sampling**

Ambient air samples were collected during days that indoor air samples were collected from March to September 2011. After September 2011, access to properties for sub-slab and indoor air sampling was infrequent and sporadic; therefore, ambient air sampling was not completed.

Similar to indoor air samples, ambient air samples were collected at breathing height (4 to 5 ft.) in a location upwind of the Riverview Plat neighborhood. One ambient air sample was considered representative of the day of sampling regardless of how many properties were sampled. The wind direction was determined each day and the sample canister was placed accordingly. Ambient air samples were collected over a 23-hour sampling period.

Ambient air samples were collected and analyzed using the same methods described in Section 6.4 for indoor air samples.

### **6.6 Sub-Slab and Indoor Air Investigation Results**

Air sample results were compared to the Action Levels summarized in Table 1. Indoor air Action Levels are based on the May 2012 U.S. EPA Regional Screening Levels for air at a cancer risk of  $1 \times 10^{-5}$  or non-cancer hazard of 1. The sub-slab soil-gas Action Levels were calculated from the indoor air Action Levels using an attenuation factor of 0.1.

Concentrations of PCE and TCE in various indoor air and sub-slab samples collected from the Riverview Plat neighborhood exceeded the Action Levels. The concentration of 1,1-dichloroethane (1,1-DCA) in one sub-slab sample collected from a property in the Riverview Plat neighborhood exceeded the Action Level. No other constituent concentrations in indoor air or sub-slab samples exceeded the Action

Levels, and none of the ambient air samples exhibited concentrations of site-specific VOCs above the Action Levels.

## **6.7 Decision Matrix**

Since concentrations of PCE, TCE, and 1,1-DCA were detected in the sub-slab and indoor air samples collected from the properties in the Riverview Plat neighborhood at concentrations that were greater than or equal to the Action Levels, the *Vapor Intrusion Mitigation Work Plan* (ARCADIS, Inc. 2011c) dated September 13, 2011 was prepared. The U.S. EPA approved the Work Plan on September 14, 2011. Additionally, *Vapor Intrusion Mitigation Work Plan Addendums* dated February 23, 2012 (RACER Trust 2012e), May 18, 2012 (RACER Trust 2012f), and August 10, 2012 (RACER Trust 2012g) were submitted to the U.S. EPA. The February 23, 2012 Addendum and the May 18, 2012 Addendum were both approved by the U.S. EPA on June 1, 2012. The August 10, 2012 Addendum is currently pending approval.

Per the Work Plan and Work Plan Addendums, following receipt of the final sub-slab and indoor air laboratory analytical results and completion of data validation, a decision analysis was conducted to evaluate the vapor intrusion potential for each property that was sampled and additional evaluation, sampling, or mitigation, if necessary, was recommended. Each property was evaluated on a case-by-case basis considering the indoor air (first floor, basement, and crawlspace) and sub-slab soil-gas results, applicable Action Levels, and the results of the right-of-way groundwater and soil-gas sampling completed in the Riverview Plat neighborhood during the Vapor Intrusion Verification Investigation. The U.S. EPA identified right-of-way sample locations that were correlated with each property in the neighborhood. Table 1 presents the sub-slab and indoor air Action Levels. The right-of-way groundwater and soil-gas sampling results are summarized in the *Vapor Intrusion Verification Report*.

The following is a summary of the Decision Matrix that was provided by the U.S. EPA to determine the next phase of sampling or mitigation for each property where sampling data were available. Categories 1 through 4 applied to properties where sub-slab data were available. Categories 5 and 6 applied to properties where sub-slab data were not available.

#### 6.7.1 Decision Matrix Category 1

If sub-slab and indoor air concentrations were less than the Action Levels, one of the following two categories applied to the property:

Category 1A: If the right-of-way sample concentrations were less than the Action Levels for groundwater and soil-gas, “worst case” (see Section 6.8 for explanation of “worst case”) confirmation sampling was recommended.

Category 1B: If the right-of-way sample concentrations were greater than or equal to the Action Levels for groundwater and soil-gas, an active mitigation system was recommended.

#### 6.7.2 Decision Matrix Category 2

If indoor air concentrations were greater than or equal to the Action Levels and sub-slab concentrations were less than the Action Levels, an additional review of the product inventory was completed to determine the potential for background sources to contribute to the indoor air concentrations. Additionally, the representativeness of the sub-slab sample point was evaluated. One of the following two categories applied to the property:

Category 2A: If a potential background source for the detected VOC was identified, the potential source was removed and re-sampling of indoor air was completed. If the results of the re-sampling indicated that indoor air concentrations were less than the Action Levels, the property was considered Category 1. If the results of the re-sampling indicated that indoor air concentrations were greater than or equal to the Action Levels, the property was considered Category 2B.

Category 2B: If a background source could not be identified, an active mitigation system was recommended. In this scenario, an active mitigation system was recommended regardless of the right-of-way sample results.

#### 6.7.3 Decision Matrix Category 3

If indoor air concentrations were less than the Action Levels and sub-slab concentrations were greater than or equal to the Action Levels, an active mitigation system was recommended.

#### 6.7.4 Decision Matrix Category 4

If indoor air concentrations were greater than or equal to the Action Levels and sub-slab concentrations were greater than or equal to the Action Levels, an active mitigation system was recommended.

#### 6.7.5 Decision Matrix Category 5

If indoor air concentrations were greater than or equal to the Action Levels and sub-slab data were not available, an active mitigation system was recommended.

#### 6.7.6 Decision Matrix Category 6

If indoor air concentrations were less than the Action Levels and sub-slab data were not available, one of the following two categories applied to the property:

Category 6A: If the right-of-way sample concentrations were less than the Action Levels for groundwater and soil-gas, “worst case” confirmation sampling was recommended.

Category 6B: If the right-of-way sample concentrations were greater than or equal to the Action Levels for groundwater and soil-gas, an active mitigation system was recommended.

### **6.8 Confirmation Sampling**

In cases where “worst case” confirmation sampling was recommended, sampling is completed during the heating season which extends from November through March (aiming at high water table conditions). Confirmatory sampling biannually was recommended for two consecutive years, beginning during the up-coming heating season. Confirmatory sampling is completed during the first quarter of the year (January through March) and the fourth quarter of the year (November through December) to coincide with the “worst case” scenario. The number of samples and sample locations were based on building construction and previous sampling results. If confirmatory sampling results are less than the Action Levels for indoor air and sub-slab, no further action was required. If confirmatory sampling results were greater than or equal to the Action Levels for indoor air and/or sub-slab, the property was considered Category 2, 3, or 4, as appropriate.

## **7. Vapor Intrusion Mitigation Activities**

Per the *Vapor Intrusion Mitigation Work Plan* and associated Addendums, active mitigation systems were, and continue to be, installed in applicable properties, where access was provided. The following sections detail the mitigation system components, the design process, PIPS, system O&M, and system decommissioning.

### **7.1 VI Mitigation System Design**

For the properties that require mitigation and where access was provided, an active mitigation system was designed to prevent vapors present below the foundation of the structure from entering the indoor air within the structure. The active mitigation systems include a depressurization system that creates a negative pressure (or vacuum) below the foundation of the structure using an electric powered fan. Sub-slab depressurization systems (SSDSs), sub-membrane depressurization systems (SMDSs), crawlspace depressurization systems (CSDSs), or a combination thereof as applicable based on the foundation type(s) are used to mitigate vapor intrusion in the Riverview Plat neighborhood. The mitigation systems are designed to reverse the pre-existing pressure gradient across the foundation of the structure. The resulting vacuum below the foundation prevents soil vapor from entering the structure.

Accessible crawlspace, inaccessible crawlspace, basement, slab-on-grade, or a combination of these foundations were present in the neighborhood. The foundations are sealed to the extent possible to minimize the existing pathways for vapors to enter the building and to minimize short-circuiting of the mitigation system.

Permanent sub-slab sample points are installed in properties with basement or slab-on-grade foundation types to allow for monitoring of the pressure field extension and to verify sub-slab depressurization that exceeds negative 0.004 in. of water column (w.c.).

The active mitigation system design is based on SSDS, SMDS, and CSDS design criteria found in American Society for Testing and Materials (ASTM) Standard E2121, Standard Practice for Installing Radon Mitigation Systems in Existing Low-Rise Residential Buildings (ASTM 2003), Vapor Intrusion Guidebook (U.S. EPA 2010), Radon Reduction Techniques for Existing Detached Houses (U.S. EPA 1993), and Indoor Air Vapor Intrusion Mitigation Approaches (U.S. EPA 2008). The following subsections detail the design components for mitigations systems installed in properties with basement, slab-on-grade, and crawlspace foundation types and standard procedures for sealing the foundations of these structures.

### 7.1.1 Basement Foundations

Components of a typical active mitigation system installed in a structure with a basement foundation included the following:

- Sealing the foundation to allow vacuum influence to extend under the entire foundation.
- A suction pit(s) installed through the basement slab. The pit was created by removing approximately 1 cubic ft. of soil from below the slab, inserting the vent piping through the slab, and sealing the slab opening with polyurethane caulk.
- Vent piping [4-in., Schedule 40 poly-vinyl chloride (PVC)] installed from the suction pit through the sill plate of the building and up the exterior of the building to the rooftop discharge location.
- An in-line fan installed within the vent piping on the exterior of the building. The fan is wired through a local disconnect switch to the building's electric panel. The associated breaker on the panel is labeled to indicate it is connected to the fan.
- A manometer installed on the vent piping within the basement to confirm on-going system operation within the desired range.
- An audible alarm to notify the property owner of system malfunction.
- Roof flashing installed, as necessary, to seal the penetration of the vent piping through the roof.

An example of a typical active mitigation system installed in a building with a basement foundation is shown on Figure 4.

### 7.1.2 Slab-On-Grade Foundations

Components of a typical active mitigation system installed in a structure with a slab-on-grade foundation included the following:

- Sealing of the foundation to enable vacuum influence to extend under the entire foundation.
- A suction pit(s) installed through the slab-on-grade foundation. The pit is created by removing approximately 1 cubic ft. of soil from below the slab, inserting the

vent piping through the slab, and sealing the slab opening with polyurethane caulk.

- Vent piping (4-in., Schedule 40 PVC) installed from the suction pit(s), up through the attic of the building, and through the roof to the rooftop discharge location.
- An in-line fan installed within the vent piping inside the attic of the building. The fan is wired through a local disconnect switch to the building's electric panel. The associated breaker on the panel is labeled to indicate it is connected to the fan.
- A manometer installed on the vent piping within the building to confirm system operation within the desired range.
- An audible alarm to notify the property owner of system malfunction.
- Roof flashing installed to seal the penetration of the vent piping through the roof, if installed through the interior of the building.
- In the event that the vent piping is not able to be installed through the interior of the building, the suction pit(s) may be installed from the exterior of the building through the frost wall. In this case the vent piping would continue up the outside of the building to the discharge location above the roof line. The in-line fan and manometer would be installed in the piping on the exterior of the building.

An example of a typical active mitigation system installed in a building with a slab-on-grade foundation is shown on Figure 5.

#### 7.1.3 Crawlspace and Other Dirt Floor Type Foundations

Components of a typical active mitigation system installed within a crawlspace include the following:

- Sealing of the crawlspace or dirt floor with reinforced, polyethylene sheeting to allow vacuum influence to extend under the entire foundation of the building.
- Installation of a suction point under the crawlspace sheeting. The suction point consists of a tee connected to perforated polyethylene drain tile. The drain tile creates the necessary collection area and prevents the sheeting from being pulled into the vent pipe. These components are equivalent to a sub-membrane depressurization system.

- Vent piping (4-in., Schedule 40 PVC) is installed from the suction point through the sill plate of the building and up the exterior of the building to the rooftop discharge location.
- An in-line fan is installed within the vent piping on the exterior of the building. The fan is wired through a local disconnect switch to the building's electric panel. The associated breaker on the panel is labeled to indicate it is connected to the fan.
- A manometer is installed on the vent piping at an accessible location within the crawlspace to confirm system operation within the desired range.
- An audible alarm is installed to notify the property owner of system malfunction.
- Roof flashing is installed, as necessary, to seal the penetration of the vent piping through the roof.

An example of a typical active mitigation system installed in buildings with a crawlspace foundation is shown on Figure 6.

#### 7.1.4 Sealing

Sealing openings in the foundation is necessary to eliminate potential pathways for soil vapors to enter the building and to enhance the performance of the mitigation system. Sealing all basement floor and wall cracks, basement perimeter joints, cracks in slab-on-grade foundations, crawlspaces, open block wall cores, sump lids, and any other openings leading directly to the soil is typically completed. Sealing is conducted utilizing the following methods.

- All surfaces to be sealed are cleaned using a wet/dry vacuum prior to applying sealant. In some cases, a wire brush may be necessary to loosen dirt or debris prior to vacuuming. Surfaces must be clean, dry, and free of all dirt, debris, oil, and grease prior to sealing.
- All cracks greater than a half in. wide are filled with closed cell foam backer rod prior to applying sealant. Backer rods are approximately 25 percent larger than the width of the crack and are installed using a roller or flat sided tool to prevent puncture of the rods during installation.
- Cracks are sealed with polyurethane caulk by forcing the caulk into the crack and smoothing at or slightly below the floor/wall surface to create a complete seal to each edge of the crack.

- Open block wall cores are typically sealed by filling the top portion of the cores with expanding foam.
- Sumps are sealed by installing solid lids with air-tight seals around all protrusions through the lid. Lids are sealed to the floor using a non-permanent caulking, such as silicone, or through the use of an air-tight gasket and mechanical fasteners to allow the opening of the lid for pump maintenance. A view port may also be included in the lid to enable routine inspection of pump performance without repeated removal of the lid.
- Drains installed through sump lids, through crawlspace liners, or through basement floors (not connected to sewer) are sealed by installing a drain seal consisting of a trapped drain or a one way valve which allows water to drain, but no air to travel up through them. If a trapped drain is utilized it is capable of holding a minimum of 6 in. of standing water to minimize the potential for drying out.
- Accessible crawlspaces are sealed using reinforced, polyethylene sheeting. Adjacent sheets are overlapped by 1 ft. and sealed between with polyurethane caulking and tape. Sheeting is sealed to the perimeter of the crawlspace and around any protrusions using polyurethane caulking and tape as necessary. Sheeting is secured to the crawlspace walls using 1-in. by 2-in. wood strips (non-treated) and concrete anchors. Exterior crawlspace walls are sealed, as necessary, with polyurethane caulking or by extending the sheeting up the exterior walls and securing at the top. Crawlspace access openings are covered as necessary to prevent pets or other animals from entering and damaging the sheeting. Concrete is considered to seal dirt floor areas with significant foot traffic (i.e., daily). If the dirt floor is only periodically used (weekly or less), plastic sheeting protected with foam padding and plywood is considered. Regardless, the condition of the flooring is inspected twice during the first year after installation and annually thereafter.
- Inaccessible crawlspaces are sealed by identifying and sealing openings from the crawlspace to the first floor with appropriate materials (e.g., polyurethane caulking, expanding foam, and/or polyethylene sheeting). Cracks within the crawlspace foundation walls are sealed with polyurethane caulking. Larger openings in the foundation are sealed with expanding foam or covered with sheet metal, sealed with polyurethane caulk, and anchored to the foundation with screws.
- Other openings are evaluated and sealed using polyethylene sheeting, non-shrink grout, mortar, concrete, or expanding foam.

- Based on specific construction details of each property, other sealing methods are considered as appropriate.

## **7.2 Design Process**

A unique design for each mitigation system is completed at each property where access is provided. The process begins with a visual survey of the structure. After the necessary information is gathered, the system design is completed, a property-specific work plan (PSWP) is submitted to the U.S. EPA, the system is installed, and operation is verified.

### **7.2.1 Design Visit**

A visual survey and hand sketch of each building is completed to identify the unique characteristics of the building to be considered during the design phase. The property owner and/or tenant is consulted for input on areas that need sealing and on their preferences for system component location. The following information is recorded on an Inspection Form during the Design Visit:

- Each separate foundation and foundation type is identified. The configuration of the building is sketched and the approximate dimensions of each foundation are noted.
- The size and location of crawlspace access doors and the approximate working height within each crawlspace is noted. Obstacles that may present a problem for access and if any stored materials need to be temporarily removed are noted. It is noted whether padding and plywood or other materials are needed to protect the sheeting and whether the access door needed to be protected from pets or other small animals.
- For slab-on-grade foundations, the floor plan for the first floor is sketched, and locations such as closets or utility rooms that may be candidates for system installation is identified. If a second floor was present, locations where the system piping could be installed through both floor levels within closets or other acceptable locations is identified. Cracks or other openings in the slab that are accessible for sealing are identified.
- The basement floor plan (as applicable) including the identification of finished and unfinished areas, sumps, floor drains not connected to sewers, cracks, wall to floor joints, open block wall cores, plumbing penetrations, and other areas that require sealing are sketched. The presence of stored items that need to be temporarily relocated to access areas for sealing and system installation are

noted. Significant degradation in the integrity of the floor and/or walls that require additional sealing measures beyond the standard caulking procedures is noted.

- If a sump was present, the drains connected to the sump and the type of sump pump (pedestal or submersible) are identified.
- Gas fired appliances, such as furnaces and water heaters that need to be checked for backdrafting, are identified. If a backdraft test failure was noted at any time during the mitigation design or installation process, the contractor diagnosed the cause of the backdraft test failure. If the backdraft test failure is associated with appliance venting, the mitigation contractor corrects the problem and the appliance is re-tested. If the backdraft test failure was associated with the appliance malfunctioning, the property owner is asked to repair or replace the appliance prior to mitigation system operation.
- On the exterior of the building, the number of stories, the type and condition of the roof, and any receptors that may need to be avoided when determining the system discharge location is identified.

#### 7.2.2 Property-Specific Work Plans (PSWPs)

After completion of the Design Visit, PSWPs with the following information are prepared for each property and submitted to the U.S. EPA prior to installation. It should be noted that deviations from the PSWP may be warranted based on field conditions and are noted in the as-built diagrams provided to the residents and the U.S. EPA in the O&M Manuals for each property. The following information was included in the PSWPs:

- A description of the mitigation system design;
- A summary of areas that required sealing;
- A summary of the backdraft testing completed during the Design Visit, if applicable;
- A summary of the results of the communication test completed during the Design Visit;
- The fan model to be used and the manufacturers design specifications for the fan;
- A floor plan showing each foundation type, location of suction point(s) and piping, location of sub-slab sample points, and areas to be sealed; and

- Property owner preferences that were incorporated.

#### 7.2.3 System Installation

Mitigation system installation is completed by a State of Ohio, Department of Health licensed and insured Radon Mitigation Contractor/Specialist who performed work in compliance with local code requirements. The installations were completed at no cost to the property owner. ARCADIS completes oversight of the design and installation of each system. Systems are installed in accordance with the *Vapor Intrusion Mitigation Work Plan* and per the requirements of ASTM Standard E 2121-03 (ASTM 2003).

#### 7.2.4 System Inspection

If approved by the property owner and/or tenant, when active mitigation systems are installed in buildings with basement or slab-on-grade foundations, sub-slab sample points are installed for collection of sub-slab pressure field extension readings. A vacuum reading exceeding negative 0.004 in. w.c. below the slab indicates that the mitigation system is successfully depressurizing the sub-slab area. When possible, the sub-slab sample points are located on opposite sides of the foundation from the suction point to ensure the depressurization of the entire slab. The sub-slab sample points remain in place for future measurements to be taken during the two inspections conducted in the first year and the subsequent annual inspections. The location of the sample points and the initial sub-slab pressure field extension readings are documented and included in the O&M Manual for future reference. If the pressure field extension readings do not exceed negative 0.004 in. w.c., the Pressure Field Extension Evaluation Flow Chart shown on Figure 7 is adhered to.

As part of the system inspection, an ARCADIS team member verifies that the differential pressure measured by the manometer installed on the system piping was within the design range. The operating differential pressure on the manometer is marked and ARCADIS shows the property owner how to read the manometer. The property owner and/or tenant is encouraged to call the phone number listed on the system label if the system was not functioning within the range marked on the monitoring device or damage to the system was noted. ARCADIS also provides an O&M Manual to each property owner or tenant with contact information for troubleshooting or repairs. All repairs or system modifications are made at no cost to the property owner. Property owners or tenants sign a form stating that they received the O&M Manual.

#### 7.2.5 O&M Manual Preparation

After completion of the mitigation system installation, O&M Manuals are provided to the property owners or tenants during the 30-day PIPS event and O&M inspection. The following information is provided in each O&M Manual:

- Dates of system installation,
- A copy of the signed mitigation access agreement,
- A copy of the initial sample results letter,
- Copies of post-installation sample result letters,
- Photos of the mitigation system components,
- As-built drawings,
- Material Safety Data Sheets for the products used in the mitigation system,
- Manufacturer's instructions and warranty information for the system fan,
- A copy of the initial (30-day) O&M inspection form,
- Copies of the subsequent O&M inspection forms,
- RACER Trust and ARCADIS contact information, and
- A copy of the O&M Manual receipt form.

#### 7.2.7 Post-Installation Proficiency Sampling (PIPS)

At buildings with active mitigation systems, PIPS of indoor air (first floor, basement, and accessible crawlspaces) is completed approximately 30 days, 180 days, and 360 days after system installation to document that the indoor air concentrations are below the Action Levels. In addition, five years from completion of the 360-day PIPS, another round of indoor air sampling is completed. Upon receipt of the laboratory data and completion of the laboratory data validation, property owners are provided with a letter from the U.S. EPA to notify them of the sampling results. To date, the results of the PIPS from all properties with a vapor intrusion mitigation system indicate that the systems have effectively reduced site-specific VOCs in indoor air to concentrations that are below the Action Levels.

In the future, if the PIPS results are above the Action Levels, ARCADIS personnel will evaluate the performance of the system and complete any necessary modifications and/or sealing within 30 days of receiving validated sample results. Approximately 30 days after completion of the modifications and/or sealing, an additional PIPS event will be completed for indoor air (first floor, basement, and accessible crawlspaces).

#### 7.2.6 System Operation and Maintenance

An annual O&M inspection is completed by ARCADIS to inspect the vapor intrusion mitigation systems and verify that they are functioning properly. At least two inspections are conducted in the first year (approximately 30 days and 180 days after installation), and the systems are inspected annually thereafter. The following items are inspected and recorded on the Inspection Form.

- The manometer reading is checked to ensure the system is operating in the design range.
- Sub-slab pressure field extension readings are measured at the permanent sub-slab sample points to ensure sub-slab depressurization of negative 0.004 in. w.c. (systems with slab foundations only).
- The fan is checked for unusual noise or vibration.
- The vent piping is checked for any damage.
- The pipe supports are checked to verify they are secure.
- Accessible crawlspaces or other areas sealed with reinforced, polyethylene sheeting are inspected for damage.
- For inaccessible crawlspaces, openings from the crawlspace to the first floor, cracks within the crawlspace foundation walls, and larger openings in the foundation that required sealing are inspected for damage.
- The foundation sealing and sealing around system piping penetrations are checked for any additional areas requiring sealing.
- The presence of the padlock on the disconnect switch is checked.
- The presence of the O&M Manual at the residence is checked.

A payment is issued annually to reimburse property owners or tenants for the cost of mitigation system operation. The cost to operate the fan is calculated by Dayton Power and Light using local electric rates and the fan wattage.

#### 7.2.7 System Decommissioning

The determining criteria for discontinuing operation of individual vapor mitigation systems will be as follows:

- Evaluation of the potential for discontinuing operation of the SSDS, SMDS, or CSDS would only be completed once the final remedies outlined in the Corrective Measures Proposal are implemented.
- Groundwater data from the Riverview Plat neighborhood, the southern boundary of the closed South Settling Lagoon, and the west boundary of Landfill L1 and site-specific attenuation factors will be used to determine if the vapor intrusion pathway at the Site remains complete. If the vapor intrusion pathway is determined to be incomplete, after concurrence with the U.S. EPA, two rounds of confirmatory sampling will be completed. Indoor air samples and samples from the permanent sub-slab sample point(s), if applicable, will be collected. The sampling will be completed during the “worst case” sampling scenario, during the heating season. To accommodate this, one sampling event will be completed in November/December and one sampling event will be completed in February/March. Prior to sampling, a request will be submitted to the property owner to shutdown the SSDS, SMDS, CSDS for 48-hours prior to sampling. As soon as the first round of data is available the property owner will be notified of the results. If the results are above the sub-slab Action Levels, the property owner will be notified to restart the SSDS, SMDS, or CSDS. If the results are below the Action Levels, the property owner will be notified to keep the SSDS, SMDS, or CSDS off until the second round (February/March) of confirmatory sampling can be completed.
- After completion of the second round of confirmatory sampling, assuming the results are below the Action Levels, the property owner will be provided with the option of removing the system (at RACER Trust’s cost), operating the system at the owner’s expense for radon mitigation, or shutting the system off and leaving the components in place.

## **8. Overview of Vapor Intrusion Community Outreach Activities**

The following is a summary of the community outreach activities completed in association with the vapor intrusion assessment and mitigation activities in the Riverview Plat neighborhood:

- September 30, 2010 - A public meeting hosted by the City of Moraine was held at the Municipal Building with the U.S. EPA as a guest to discuss the *Vapor Intrusion Verification Work Plan*.
- February 3, 2011 - U.S. EPA sent a letter to the residents of the Riverview Plat neighborhood regarding the upcoming public meeting to be held on February 17, 2011.
- February 17, 2011 - The City of Moraine hosted a public meeting to discuss the results of the Vapor Intrusive Verification Investigation and the upcoming work related to the *Sub-Slab and Indoor Air Sampling Work Plan*.
- March 7, 2011 - MLC, Ohio Environmental Protection Agency (Ohio EPA), Montgomery County Department of Health, and ARCADIS, completed a door-to-door community outreach program to request additional access agreements associated with the *Sub-Slab and Indoor Air Sampling Work Plan*. On March 14 and 22, 2011, ARCADIS on behalf of MLC completed a follow-up door-to-door outreach program to request additional access agreements.
- May 3, 2011 - U.S. EPA sent out letters to property owners in the Riverview Plat neighborhood whom had not previously signed the access agreement for sub-slab and indoor air sampling requesting access to complete the sampling.
- May 24-26, 2011 - U.S. EPA, RACER Trust, and the Montgomery County Department of Health participated in meetings at the Moraine Civic Center with property owners in the Riverview Plat neighborhood. During these meetings, the property owners were provided the results of the sub-slab and indoor air sampling completed in March, April, and May 2011. RACER Trust mailed the results to those property owners that were not able to attend the meetings.
- July 15, 2011 - U.S. EPA sent sub-slab and indoor air sampling results letters to tenants in the Riverview Plat neighborhood.
- August 23, 2011 - A meeting notice prepared by the U.S. EPA for the Public Availability Meeting to be held on August 30, 2011 was mailed to the property owners and tenants in the Riverview Plat neighborhood.



## Summary of Vapor Intrusion Assessment and Mitigation Activities

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- August 24, 2011 – ARCADIS, on behalf of RACER Trust, visited the Riverview Plat neighborhood to distribute the August 30, 2011 Public Availability Meeting notice.
- August 30, 2011 - U.S. EPA held a Public Availability Meeting at the Moraine Civic Center to provide an update to the property owners and tenants on the vapor intrusion assessment and mitigation activities.
- November 9, 2011 - RACER, U.S. EPA, Ohio EPA, and Public Health – Dayton and Montgomery County held individual meetings with select Riverview Plat property owners to provide them with the sub-slab and indoor air sampling results for their properties and to discuss if mitigation was required.
- November 10, 2011 - RACER Trust distributed a letter to residents within the Riverview Plat neighborhood outlining the upcoming work associated with the Landfill L1 Investigation.
- November 16-17, 2011 - U.S. EPA and ARCADIS completed a door-to-door community outreach program in the Riverview Plat neighborhood regarding the vapor intrusion assessment and mitigation activities.
- December 6-7, 2011 – RACER Trust, U.S. EPA, and Public Health – Dayton and Montgomery County, held individual meetings with select Riverview Plat property owners to provide them with the sub-slab and indoor air sampling results for their properties and to discuss if mitigation was required.
- April 25, 2012 - Public Health – Dayton and Montgomery County and the Ohio Department of Health hosted a public meeting at the City of Moraine Municipal Building to discuss the work associated with the vapor intrusion assessment and mitigation activities. A presentation “Cancer Incidence among residents of the Riverview Plat neighborhood, Moraine, Ohio; January 1996 – January 2012” was provided and included information regarding general cancer risks and the risks specific to exposures of PCE and TCE.
- Periodic Stakeholders conference calls, typically monthly, are held to discuss the status of the vapor intrusion assessment and mitigation activities. The Stakeholders include representatives from RACER Trust, U.S. EPA, Ohio Environmental Protection Agency (Ohio EPA), Ohio Department of Health, Public Health – Dayton and Montgomery County, City of Moraine, and ARCADIS.
- RACER Trust continues to implement sub-slab and indoor air sampling for residents who submit access agreements. Additionally, RACER Trust continues efforts to obtain access agreements, updates the U.S. EPA and Stakeholders



## **Summary of Vapor Intrusion Assessment and Mitigation Activities**

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regarding the progress of the vapor intrusion assessment and mitigation activities, and provides information to the U.S. EPA to present the residents with their indoor air and sub-slab data results.

- RACER Trust continues to implement vapor intrusion mitigation activities. This work includes system installations and modifications, addressing U.S. EPA comments regarding property-specific installations, PIPS, and annual O&M of the vapor intrusion mitigation systems.

## **9. Conclusions of Vapor Intrusion Assessment and Mitigation Activities**

The following is a summary of the conclusions of the vapor intrusion assessment and mitigation activities completed to date at the Site:

- Based on the results of the Vapor Intrusion Verification Investigation, the closed South Settling Lagoon Vapor Intrusion Investigation, and the Landfill L1 Investigation, the source of VOC-containing soil-gas in the Riverview Plat neighborhood is PCE and TCE in groundwater. The results of the Vapor Intrusion Verification Investigation indicated that concentrations of site-specific VOCs in soil-gas within the Riverview Plat neighborhood increase with depth. This attenuation confirms that the source of site-specific VOCs in soil-gas is attributable to concentrations of site-specific VOCs in groundwater. Additionally, the results of the Vapor Intrusion Verification Investigation indicated that there is not a vapor intrusion exposure risk along the eastern boundary of the Site.
- The closed South Settling Lagoon and Landfill L1 are not contributing sources of site-specific VOCs to soil-gas within the Riverview Plat neighborhood.
- Sub-slab and indoor air sampling activities have been completed at the properties within the Riverview Plat neighborhood, where access has been provided. Based on the results of these activities, concentrations of site-specific VOCs, specifically PCE and TCE, exceed the sub-slab and indoor air Action Levels within most of the sampled properties.
- A Decision Matrix presented in the *Vapor Intrusion Mitigation Work Plan* was used to identify which properties with sub-slab and indoor air sampling data required vapor intrusion mitigation systems. Based on the Decision Matrix, vapor intrusion mitigation systems were recommended for most of the sampled properties within the Riverview Plat neighborhood and systems have been installed in the properties where access was provided.
- The vapor intrusion mitigation systems installed to date have effectively reduced site-specific VOCs in indoor air to concentrations that are below the Action Levels.
- Sub-slab and indoor air sampling, vapor intrusion mitigation system installation activities, and community outreach efforts are on-going.



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U.S. EPA. 2008. Indoor Air Vapor Intrusion Mitigation Approaches. Office of Research and Development, National Risk Management Research Laboratory, Cincinnati, Ohio, October, 48pp.

U.S. EPA. 2010. Vapor Intrusion Guidebook. Region 5, Superfund Division, October, 323 pp.



**Table 1. Residential and Non-Residential Action Levels for Sub-Slab Soil-Gas and Indoor Air, RACER Trust, Moraine, Ohio.**

Chemical Constituent	Residential Long-Term Action Level				Non-Residential Long-Term Action Level			
	Indoor Air <sup>(a)</sup>		Sub-Slab Soil-Gas <sup>(b)</sup>		Indoor Air <sup>(a)</sup>		Sub-Slab Soil-Gas <sup>(b)</sup>	
	(ug/m <sup>3</sup> )	(ppbv)	(ug/m <sup>3</sup> )	(ppbv)	(ug/m <sup>3</sup> )	(ppbv)	(ug/m <sup>3</sup> )	(ppbv)
1,1,1-Trichloroethane	5,210	955	52,100	9,550	21,900	4010	219,000	40,100
1,1-Dichloroethane	15.2	3.8	152	38	76.7	19.0	767	190
1,1-Dichloroethene	209	53	2,090	530	876	221	8,760	2,210
Cis-1,2-Dichloroethene	Not available	Not available	Not available	Not available	Not available	Not available	Not available	Not available
Tetrachloroethene	42	6.2	420	62	180	27	1,800	270
Trans-1,2-Dichloroethene	62.6	15.79	626	157.9	263	66	2,630	660
Trichloroethene	2.1	0.39	21	3.9	8.8	1.6	88	16
Vinyl Chloride	1.6	0.63	16	6.3	27.9	10.9	279	109

(a) Indoor Air Action Levels based on May 2012 U.S. EPA Regional Screening Levels for air at a cancer risk of  $1 \times 10^{-5}$  or noncancer hazard of 1.

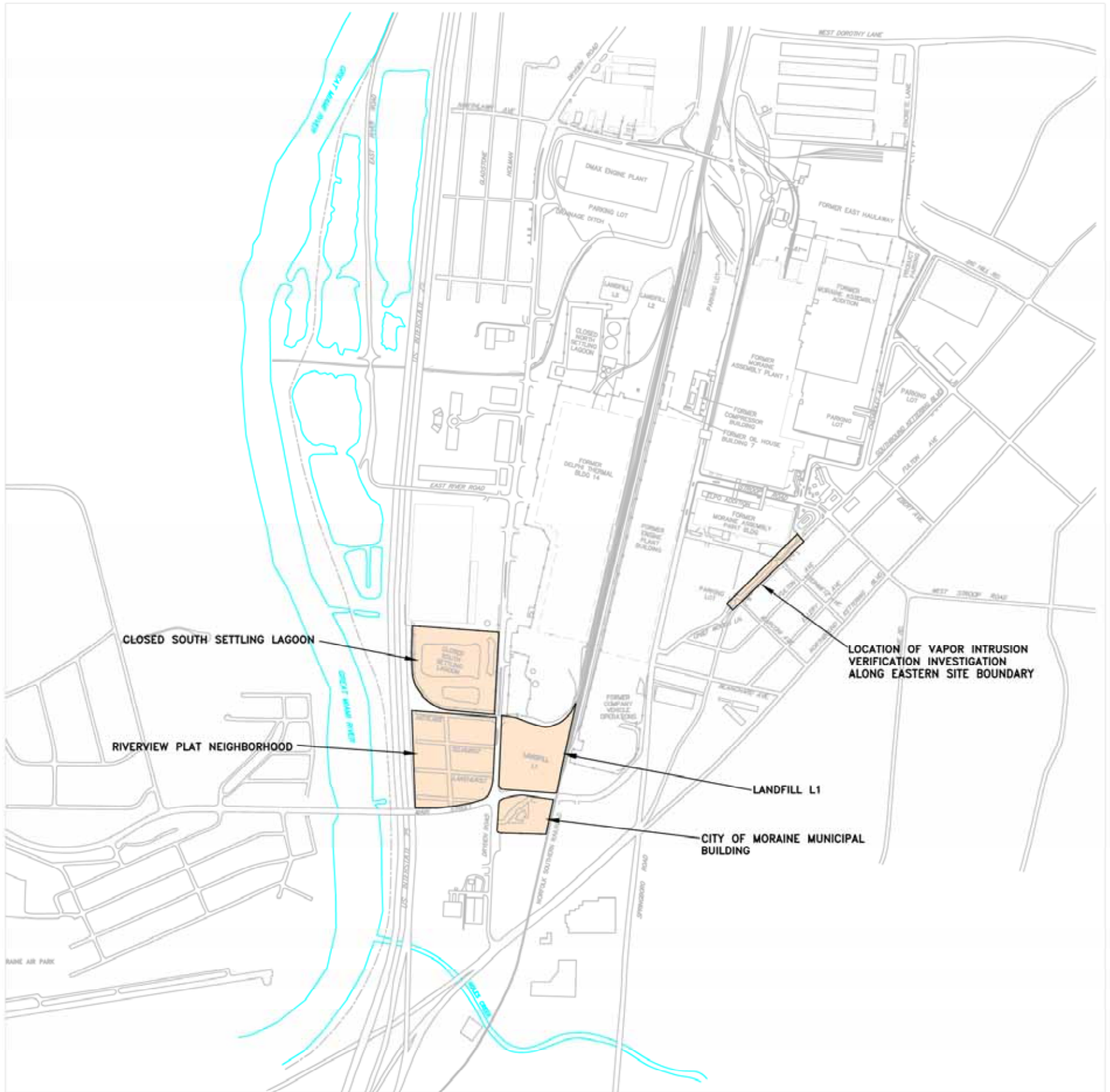
(b) The Sub-Slab Soil-Gas Action Levels are calculated from Indoor Air Action Levels using an attenuation factor of 0.1.

Note: Calculation for action levels for ppbv are based on established action levels in ug/m<sup>3</sup> utilizing the following equation:  $ppbv = ug/m^3 \times 24.45 \text{ (constant K) / molecular weight (MW)}$ .

ug/m<sup>3</sup> - Micrograms per cubic meter.

ppbv - parts per billion by volume.

XREFS: PROJECTNAME: ---  
 MLCBASE MAP 2010

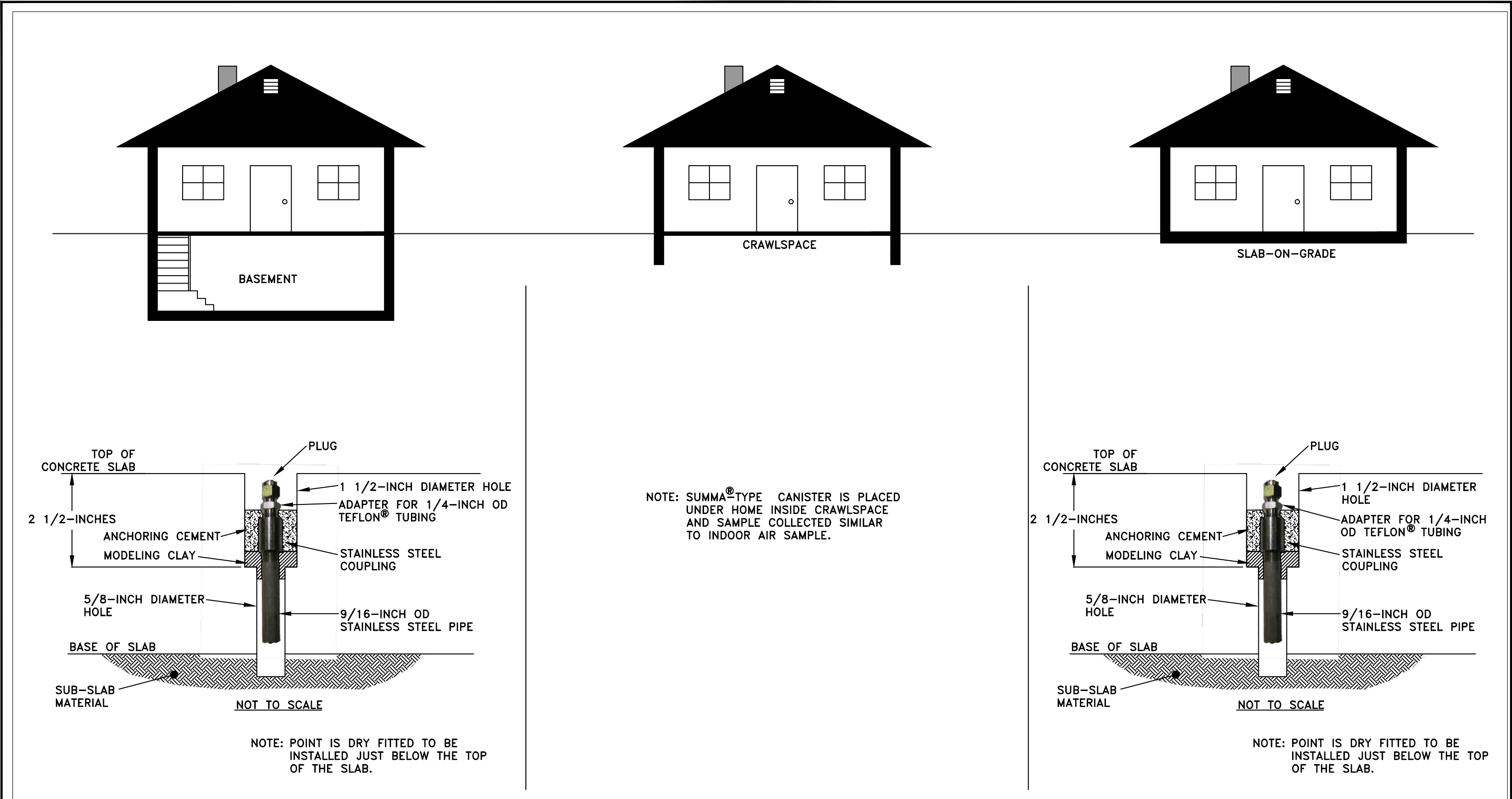


**LEGEND**  
 - - - FORMER BUILDING 14 FOOTPRINT  
 - - - RIVER LEVEL

RACER TRUST MORaine, OHIO OH000294.0012.005	
<b>VAPOR INTRUSION ASSESSMENT AND                  MITIGATION ACTIVITIES SITE MAP</b>	
	FIGURE <b>1</b>



CITY:(DUBLIN) DIV:(GROUP:(SER2) DB:(RSMITH) LD:(Opt) PIC:(Opt) PM:(N. GILLOTTI) TM:(J. MANZO) LYR:(OPHON)-OFF-REF- G:\ENV\CAD\Columbus-OH\ACT\OH000294 - RACER\KIP\KIP29412-08.dwg LAYOUT: FIG 1 PARCEL.MAP SAVED: 12/5/2012 4:39 PM ACADVER: 18.1S (LIMS TECH) PAGES: 18 PLOTSTYLETABLE: ACAD.CTB PLOTTED: 12/5/2012 4:41 PM BY: SMITH, BOB XREFS:



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OH000294.2012

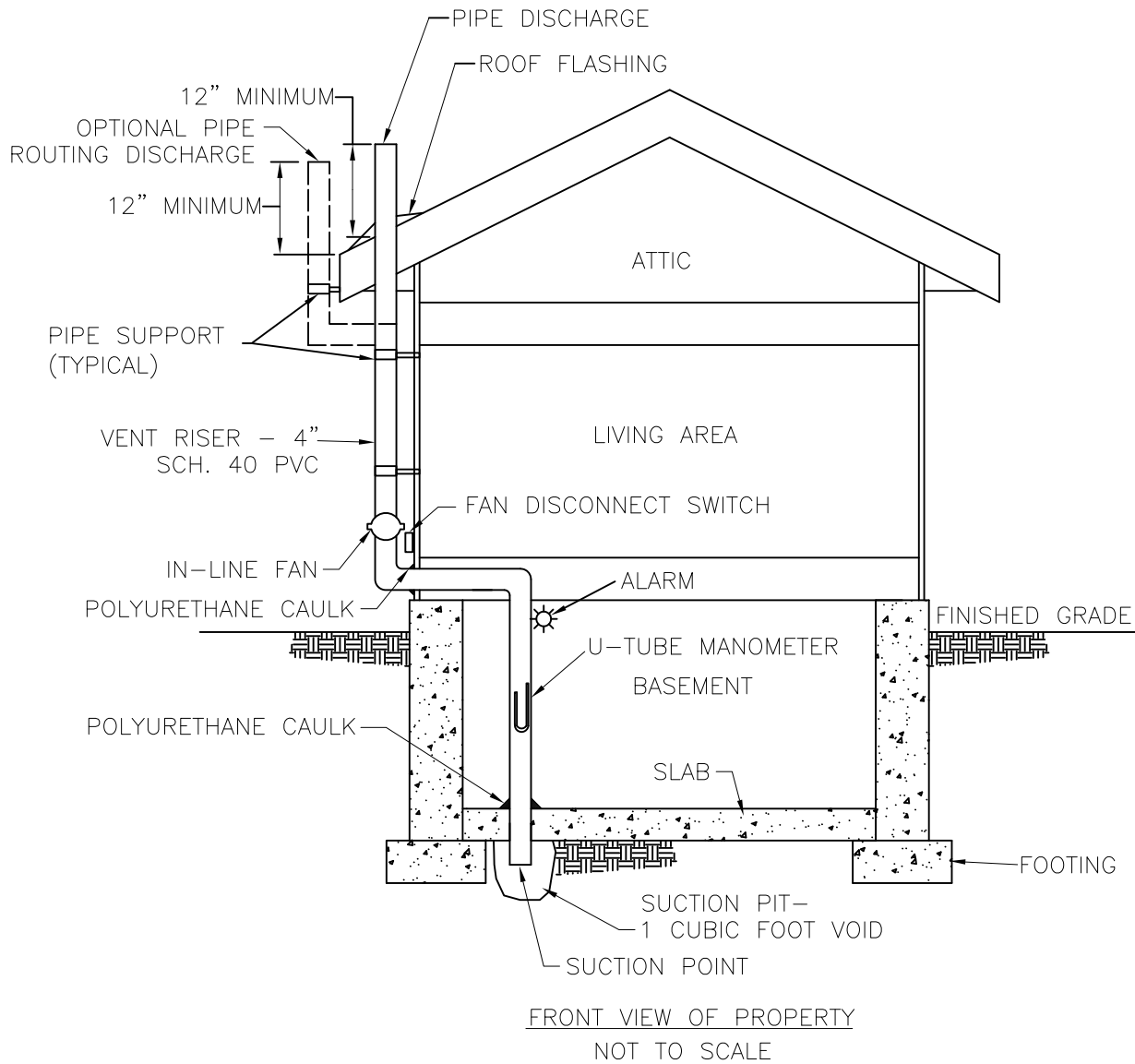
**RESIDENTIAL STRUCTURE AND  
SUB-SLAB SAMPLE POINT DETAIL**

**ARCADIS**

FIGURE  
**3**

NOTES:

1. VENT RISER TERMINATES A MINIMUM OF 12 INCHES ABOVE ROOF ELEVATION AND A MINIMUM OF 10 FEET FROM ANY AIR INTAKE LOCATED HORIZONTALLY ADJACENT TO OR ABOVE THE TERMINATION POINT.
2. HORIZONTAL PIPE RUNS ARE SLOPED BACK TOWARDS THE SUCTION POINT AT MINIMUM 1% SLOPE.
3. PIPE SUPPORTS INSTALLED NEAR DISCHARGE, EVERY 8 FEET ON VERTICAL PIPING, AND EVERY 6 FEET ON HORIZONTAL PIPING AT A MINIMUM.
4. CRACKS IN FOUNDATION SEALED.
5. DIMENSIONS ARE APPROXIMATE.



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**ACTIVE MITIGATION SYSTEM  
INSTALLATION DETAILS - BASEMENT  
FOUNDATION TYPE**



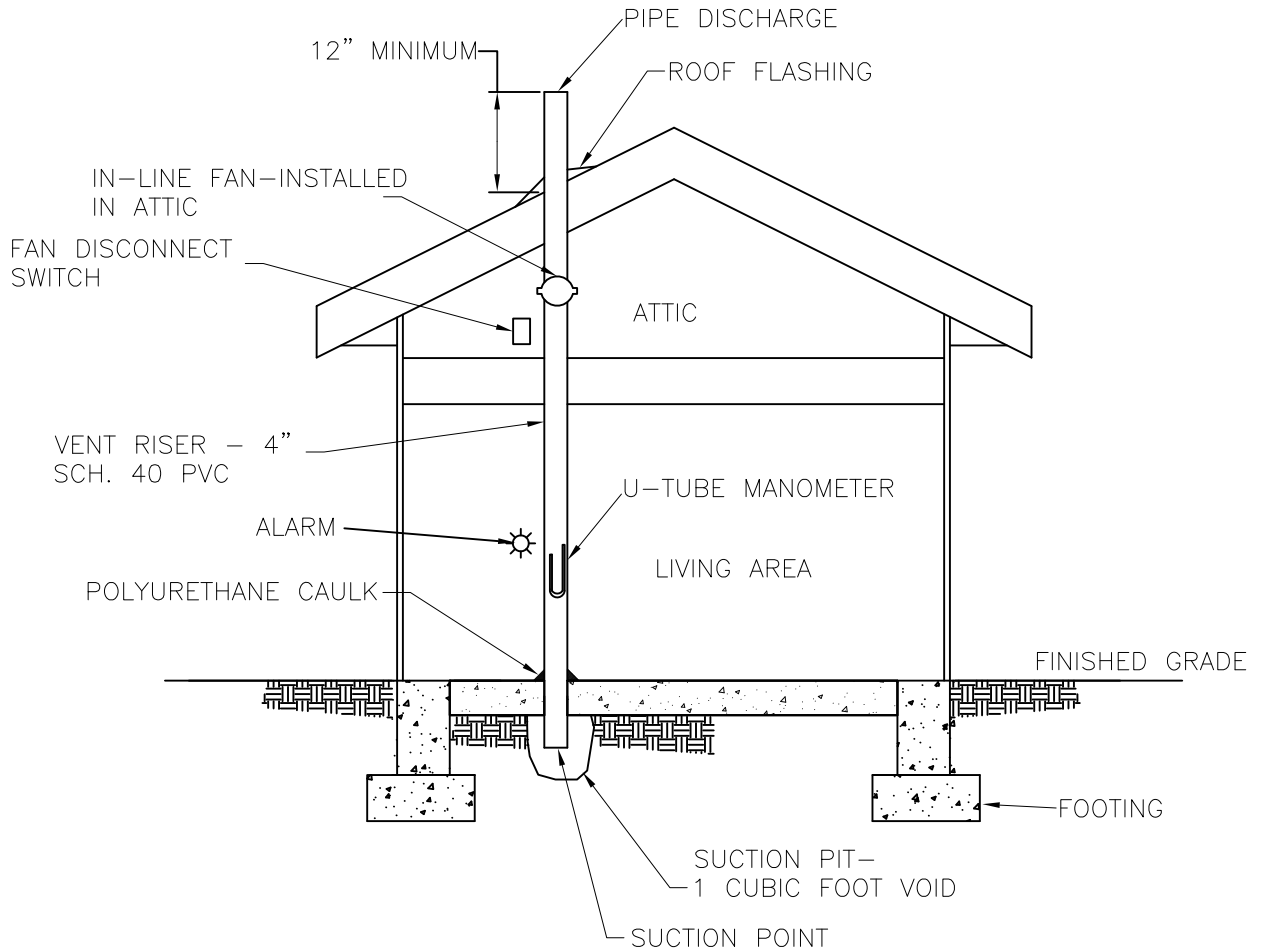
FIGURE

**4**


CITY: (Reed) DIV/GROUP: (Reed) DB: (Reed) LD: (Opt) PIC: (Opt) PM: (Reed) TM: (Opt) LY: (Opt) ON: OFF REF: G:\ENV\CAD\Columbus-OH\ACT\10\000294 - RACER\CMP\CIP\294\2-07.dwg LA\OUT: CMP - FIG 5. SAVED: 12/5/2012 12:31 PM ACADVER: 18.1S (LMS TECH) PAGESETUP: --- PLOTSTYLETABLE: ACAD.CTB PLOTTED: 12/5/2012 12:32 PM BY: SMITH, BOB

NOTES:

1. VENT RISER TERMINATES A MINIMUM OF 12 INCHES ABOVE ROOF ELEVATION AND A MINIMUM OF 10 FEET FROM ANY AIR INTAKE LOCATED HORIZONTALLY ADJACENT TO OR ABOVE THE TERMINATION POINT.
2. HORIZONTAL PIPE RUNS ARE SLOPED BACK TOWARDS THE SUCTION POINT AT MINIMUM 1% SLOPE.
3. PIPE SUPPORTS INSTALLED NEAR DISCHARGE, EVERY 8 FEET ON VERTICAL PIPING, AND EVERY 6 FEET ON HORIZONTAL PIPING AT A MINIMUM.
4. DIMENSIONS ARE APPROXIMATE.

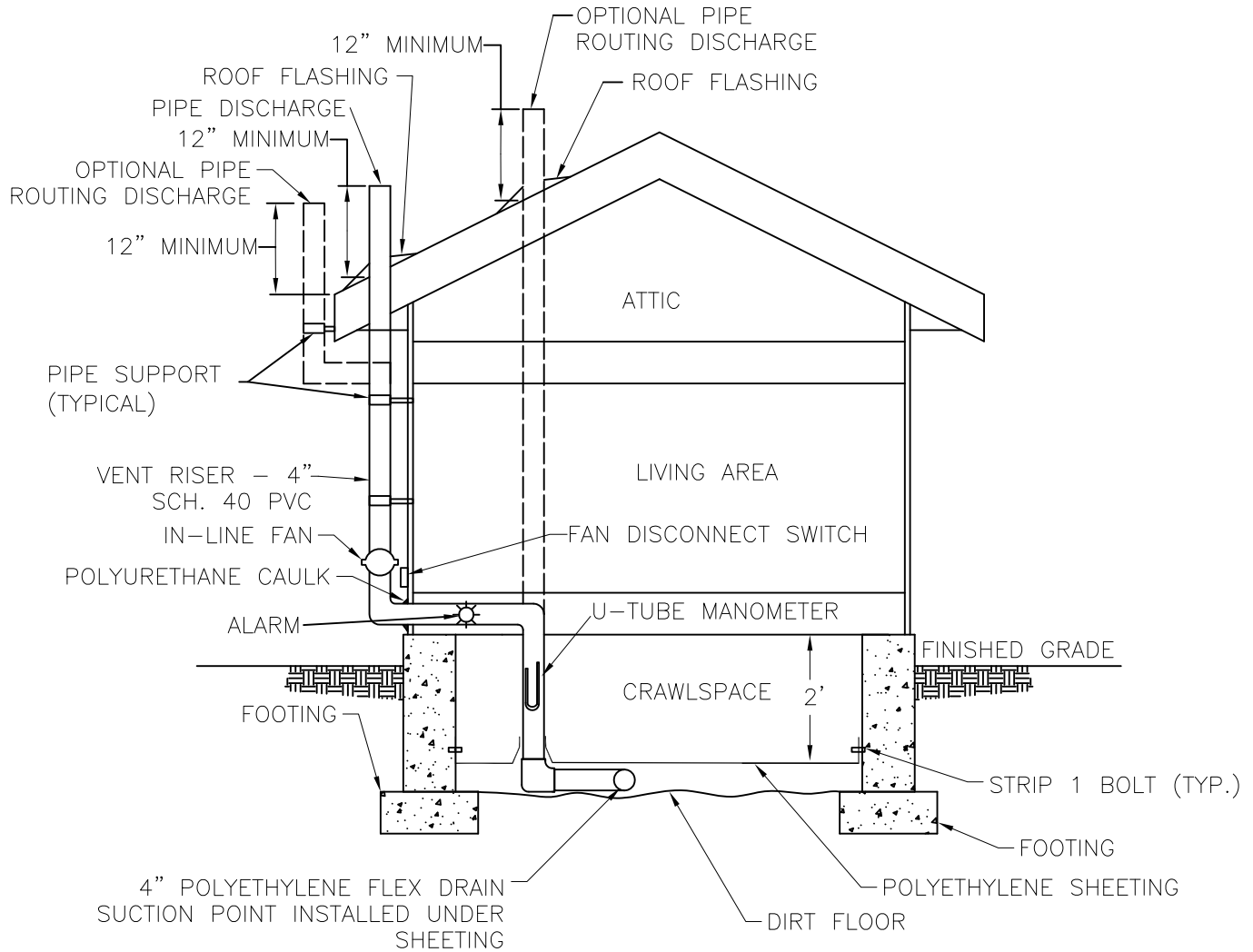


FRONT VIEW OF PROPERTY  
NOT TO SCALE

RACER TRUST MORAINE, OHIO  <b>OH000294.2012</b>	
<b>ACTIVE MITIGATION SYSTEM          INSTALLATION DETAILS - SLAB - ON -          GRADE FOUNDATION TYPE</b>	
	FIGURE <b>5</b>

NOTES:

1. VENT RISER TERMINATES A MINIMUM OF 12 INCHES ABOVE ROOF ELEVATION AND A MINIMUM OF 10 FEET FROM ANY AIR INTAKE LOCATED HORIZONTALLY ADJACENT TO OR ABOVE THE TERMINATION POINT.
2. HORIZONTAL PIPE RUNS SLOPED BACK TOWARDS THE SUCTION POINT AT A MINIMUM 1% SLOPE.
3. PIPE SUPPORTS INSTALLED NEAR DISCHARGE, EVERY 8 FEET ON VERTICAL PIPING, AND EVERY 6 FEET ON HORIZONTAL PIPING AT A MINIMUM.
4. INTERIOR CRACKS IN FOUNDATION WALLS SEALED. CRAWLSPACE SEALED WITH POLYETHYLENE SHEETING.
5. DIMENSIONS ARE APPROXIMATE.



FRONT VIEW OF PROPERTY  
NOT TO SCALE

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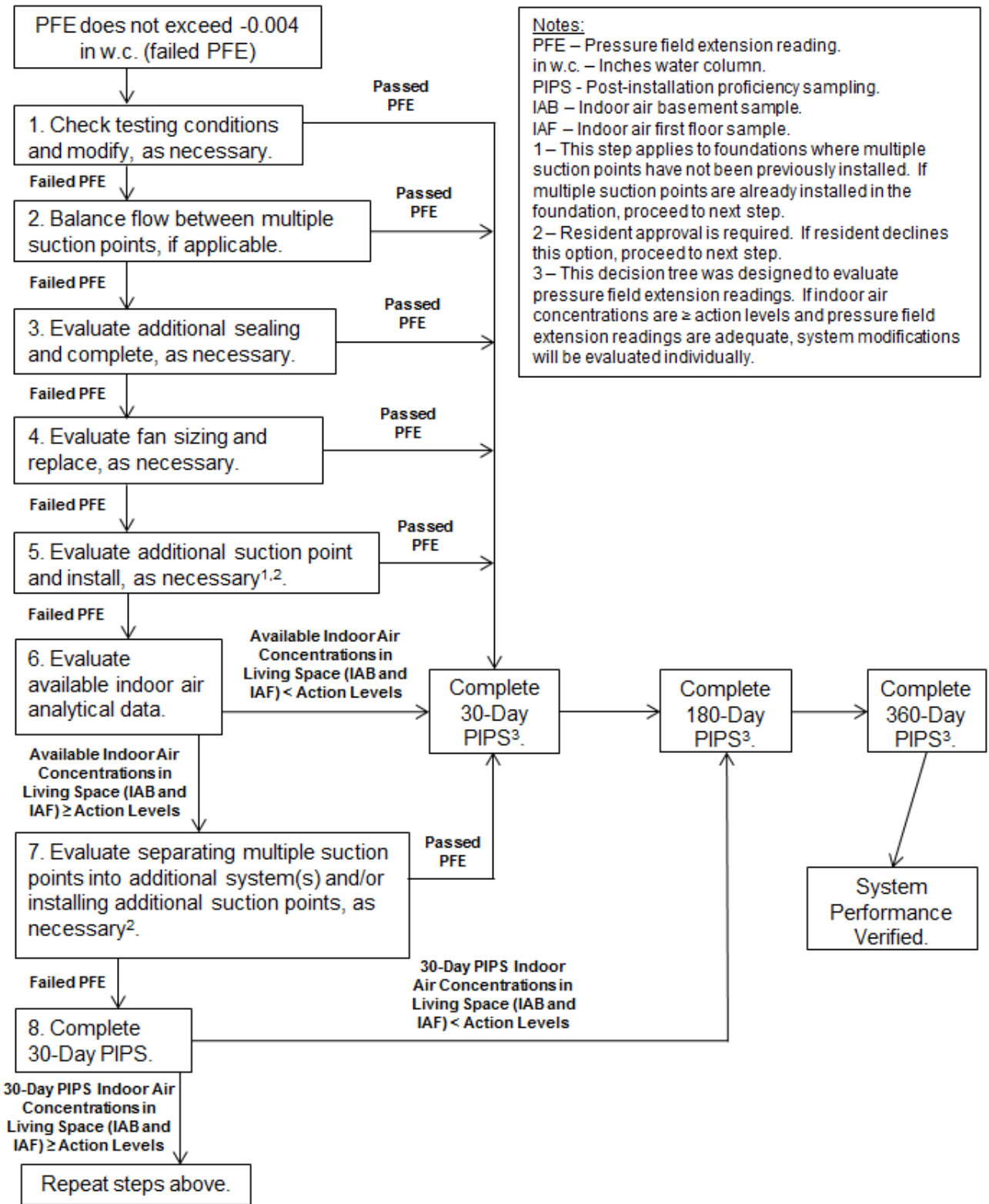
OH000294.2012

**ACTIVE MITIGATION SYSTEM  
INSTALLATION DETAILS - CRAWLSPACE  
FOUNDATION TYPE**



FIGURE

6



**Notes:**  
 PFE – Pressure field extension reading.  
 in w.c. – Inches water column.  
 PIPS - Post-installation proficiency sampling.  
 IAB – Indoor air basement sample.  
 IAF – Indoor air first floor sample.  
 1 – This step applies to foundations where multiple suction points have not been previously installed. If multiple suction points are already installed in the foundation, proceed to next step.  
 2 – Resident approval is required. If resident declines this option, proceed to next step.  
 3 – This decision tree was designed to evaluate pressure field extension readings. If indoor air concentrations are  $\geq$  action levels and pressure field extension readings are adequate, system modifications will be evaluated individually.

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 MORRAINE, OHIO  
 OH000294.2012

**PRESSURE FIELD EXTENSION  
 EVALUATION FLOW CHART**


 **ARCADIS**

FIGURE  
**7**

ARCADIS

**Attachment D-1**

Vapor Intrusion Verification Report

December 2012

## **Attachment D-1**

### **Vapor Intrusion Verification Report**

### **Revitalizing Auto Communities Environmental Response Trust (RACER Trust)**

Former Delphi Harrison Thermal Systems Moraine Plant  
Former General Motors Powertrain Group, Moraine Engine Plant  
Former General Motors Truck Group, Moraine Assembly Plant

Moraine, Ohio

December 2012

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- 2 Summary of Soil-Gas Sampling Results.
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- 1 Groundwater Table Sample Results East of Site (October through November 2010).
- 2 Groundwater Table Sample Results Southwest of Site (October through November 2010).
- 3 Soil-Gas Sampling Point Analytical Results East of Site (November 2010 and March 2011).
- 4 Soil-Gas Sampling Point Analytical Results Southwest of Site (November 2010 and March 2011).

**Appendices**

- A Soil Boring Logs
- B Soil-Gas Point Construction Diagrams
- C Soil-Gas Sampling Logs
- D Geotechnical Laboratory Reports

# Vapor Intrusion Verification Report

RACER Trust  
Moraine, Ohio

## 1. Introduction

As outlined in the revised Vapor Intrusion Verification Work Plan (Work Plan) (ARCADIS, Inc. 2010a) dated September 16, 2010 and approved by the United States Environmental Protection Agency (U.S. EPA) on September 29, 2010, a field investigation was completed to provide a line of evidence to further evaluate the potential for the vapor intrusion pathway using a phased approach. During this field investigation soil-gas and groundwater table samples were collected near potential off-site receptors (residential and commercial structures) located within proximity to the Revitalizing Auto Communities Environmental Response Trust (RACER Trust) Moraine Facilities (formerly General Motors Corporation [GM]) former Moraine Facilities located in Moraine, Ohio (Site). The areas of the investigation are the area located to the east of the Site (Figure 1) and southwest of the Site, referred to as the Riverview Plat neighborhood (Figure 2). The groundwater and soil-gas data were used as part of the overall weight of evidence for evaluating the vapor intrusion pathway. This Vapor Intrusion Verification Report presents the results of groundwater and soil-gas sampling completed in October/November 2010 and March 2011 associated with the Work Plan.

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### 2. Field Investigation

The initial field investigation was completed in October and November 2010 and involved soil boring advancement, geotechnical data collection, groundwater sampling at the water table, the installation of soil-gas points SGP-1 through SGP-12, soil-gas sampling, and the sampling of existing upper aquifer monitoring wells GM-25 and GM-77S. To the southwest of the Site, eight soil-gas sampling points (SGP-1 through SGP-8) were installed within the right-of-way (between the street and the sidewalk) in the neighborhood and one soil-gas sampling point (SGP-9) was installed across the street near the City of Moraine Municipal Building (Figures 2 and 4). Along the eastern boundary of the Site, three soil-gas sampling points (SGP-10 through SGP-12) were installed along Southbound Kettering Boulevard (Figures 1 and 3). Monitoring wells GM-25 and GM-77S are located to the east of the Site (Figures 1 and 3). Additional field work was conducted in March 2011 which involved the re-sampling of the soil-gas points SGP-9 and SGP-10 through SGP-12 located near the City of Moraine Municipal Building and along the eastern boundary of the Site, respectively. The specific methodology used to collect the groundwater and soil-gas samples is presented in Sections 2.2 and 2.3, respectively. The field methods followed standard operating procedures (SOP) outlined in the Work Plan except as noted below due to various circumstances during field implementation.

#### 2.1 Drilling Methodology

The soil-gas sampling points were drilled and installed using the direct-push drilling techniques. The drill rig was outfitted with a dual-core sampler to ensure borehole stability during advancement. Prior to drilling, all locations were cleared of underground utilities by contacting the Ohio Utility Protection Service (OUPS), coordinating with the City of Moraine and Montgomery County, and by wet-knifing to a depth of approximately 10 feet below land surface (bls) except for geotechnical borehole locations. Geotechnical boreholes were cleared to a depth of 6 feet bls.

The borings were advanced to the groundwater table. Continuous soil samples were collected for lithology observations and screened using a photo-ionization detector (PID). All non-disposable down-hole equipment was decontaminated between boring locations. Soil boring logs are included in Appendix A.

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### 2.2 Groundwater Sample Collection

A groundwater table sample was collected from a temporary well point installed in soil-gas point locations SGP-1 through SGP-9 and SGP-12 prior to soil-gas point installation. A professional surveyor measured the ground surface elevation prior to the beginning of the drilling program at each soil-gas point location so that the current depth to groundwater and the depth below ground surface to set the bottom of the deepest soil-gas point screen could be calculated. Once the boring was advanced to the depth of the water table, a stainless steel well screen was extracted from the dual casing of the direct push drilling string. A nominal amount of groundwater was purged from the well screen using a small diameter bladder pump. The groundwater removed during this development included three times the volume of water within the dual casing. After development, groundwater samples were collected using low-flow methodology. Groundwater was encountered southwest of the Site at depths ranging from 21 feet bls to 23.5 feet bls. Groundwater samples were not collected from soil-gas points SGP-10 and SGP-11 because groundwater was not encountered. At SGP-10 the borehole was advanced to the top of a confining unit (clay) at 31.5 feet bls before being terminated. At SGP-11 refusal was encountered at 19.25 feet bls and groundwater was not encountered during advancement. Multiple attempts were made at locations SGP-10 and SGP-11 to advance the drilling string past the point of refusal, but were not successful. Groundwater was encountered east of the Site at SGP-12 at 29.5 feet bls.

Groundwater samples were also collected from upper aquifer monitoring wells GM-25 and GM-77S since these wells had not been sampled since 1999 and 2007, respectively. The monitoring wells were purged and sampled using low-flow methodology. Additional samples including duplicates (1 per 20 samples) and trip blanks were collected and submitted for quality assurance and quality control (QA/QC) requirements. The groundwater samples were submitted to TestAmerica Laboratories of North Canton, Ohio for analysis of site-specific volatile organic compounds (VOCs) by U.S. EPA Method 8260B.

### 2.3 Soil-Gas Sample Point Installation and Sampling

After completion of the boring and collection of the groundwater sample, the direct-push tooling was pulled back to allow formation collapse to install the soil-gas sampling points. At each location, the formation failed to completely collapse between the water table and the installation of the first soil-gas point. In order to complete the installation at these locations, the holes were backfilled with bentonite for approximately three feet

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and then the remaining portion of the hole was filled with sand (approximately 12 inches) until the first soil-gas sampling point screen was installed. It was necessary to use bentonite to not artificially create a preferential vapor pathway between the water table and the first sample point. Since the bentonite can act as a plug, the sand pack around the first point was increased to ensure there was sufficient space for soil-gas to accumulate. A total of three nested soil-gas sampling point screens were installed within each borehole at discreet intervals. The deepest soil-gas sampling point screen was installed approximately two feet above the maximum groundwater table elevation in order to ensure that the sample point would not encounter groundwater in the future. Historic fluctuations of the groundwater table were considered for the determination of the deepest soil-gas sampling point screen depth. Specifically, soil-gas samples were collected from the following three depths: approximately 15 feet bls (2 feet above the maximum groundwater table elevation); 11 feet bls; and 6 feet bls (approximate depth of a basement). The three sample depths were selected to provide information on the vertical attenuation of soil-gas moving away (vertically) from the groundwater table.

The soil-gas sampling point screen installed approximately two feet above the maximum groundwater elevation was installed first. The soil-gas sampling points were constructed of a 6-inch stainless steel screened implant connected to Teflon® tubing extending to the surface with a clean brass needle valve. The sampling point screen (stainless steel screen implant) was surrounded by a sand pack to approximately six inches above and approximately two inches below the sampling point. One foot of dry granular bentonite was placed on top of the sand pack followed by hydrated bentonite to about two inches from the base of the next soil-gas sampling point screen. Sand was placed above the bentonite and the next soil-gas sampling point screen was installed at 11 feet bls and surrounded by sand extending six inches above the sampling point screen. The same procedure was followed for the final sampling point screen. One foot of dry granular bentonite was placed on top of the sand pack followed by hydrated bentonite to approximately two inches below the base of the shallowest screen set at six feet. Finally, sand was poured to six inches above the final screen and bentonite was added to approximately two feet from the surface, where a lockable flush-mount well vault was installed. Approximately three feet of bentonite (hydrated on top of dry) was placed above the sand above the shallowest sample point screen to ensure no short-circuiting with ambient air. After installation, sample points were allowed to equilibrate for at least 48-hours prior to sampling (CEPA 2010). Soil-gas point construction diagrams are included in Appendix B. The actual soil-gas sampling point construction details are indicated on the diagrams in Appendix B and on Figures 3 and 4.

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Prior to sampling, soil-gas sampling points were tested for leaks by administering helium gas as a tracer within a sealed manifold. Concentrations of helium were monitored inside the manifold and from the shallow-screened points as soil-gas was purged prior to sampling. All purged air was collected in a Tedlar® bag to facilitate helium testing. A total of one volume of air (tubing plus screen, sand pack, and dry granular bentonite pore space) was purged prior to sampling at a flow rate of 200 milliliters per minute (mL/min). All other soil-gas points (deepest screened interval and screened interval at 11 foot depth) were purged at a rate of 50 mL/min until three volumes were purged. All locations passed the helium leak test. Documentation of the volume of air purged from each soil-gas point is included in the soil-gas point construction diagrams in Appendix B. Results of the helium tracer test are included on the soil-gas sampling logs located in Appendix C.

After the purging was complete, the needle valve located at the termination of the tubing was closed, a sample canister was connected to the tubing, the needle valve was then reopened and then the canister was opened to commence sampling. The duration of sampling was monitored to ensure the flow controllers were working properly. The vacuum gauges provided by the analytical laboratory as part of the sample train (i.e., canister and flow controller) were used to record the initial and final vacuums in the air sampling canister. Pre-sampling vacuum in the canister was between -30 inches of mercury (in Hg) and -25 in Hg. Duplicate samples were collected at a rate of 1 per 20 samples for QA/QC purposes. A field instrument was used on-site during soil-gas sampling to measure temperature, barometric pressure, and relative humidity. Soil-gas samples were analyzed using Method TO-15 for site-specific VOCs. Each soil-gas sample was collected in a batch certified one liter (L) SUMMA®-type canister provided and analyzed by Air Toxics Ltd. in Folsom, California (Air Toxics). Flow controllers were cleaned, inspected, and set by the analytical laboratory prior to the sampling event. The soil-gas sampling logs are included in Appendix C.

### **2.4 Geotechnical Data Collection**

Geotechnical samples were collected at four discreet depth intervals from one soil boring (located near SGP-11) along the eastern boundary of the Site and from two soil borings (located near SGP-1 and SGP-8) within the Riverview Plat neighborhood between October 25, 2010 and December 14, 2010. The samples were collected in borings separate but adjacent to the borings used to install the soil-gas sampling points (Figures 1 and 2). The geotechnical samples were collected using a direct-push drill rig. Due to concerns of utilities below grade, geotechnical samples from the six to

## Vapor Intrusion Verification Report

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eight-foot interval were collected using a hand auger which limited sample volume. An attempt to collect deeper samples adjacent to SGP-1 using a Shelby tube was unsuccessful due to lithology; therefore, samples were collected in a Geoprobe® Macro-Core® acetate liner, also limiting sample volume. All other geotechnical samples were collected inside a thick-walled Shelby tube. After retrieval of the samples the geotechnical boreholes were abandoned with bentonite.

Samples were submitted to DLZ Laboratories in Columbus, Ohio (DLZ) for analysis of grain size (American Society for Testing and Materials [ASTM] Method D422/D1140), specific gravity (ASTM Method D854), permeability (ASTM Method D2434), moisture content (ASTM Method D2216), and air filled/water filled and total porosity (calculation). However, permeability was not analyzed for samples SGP-1 (8-10 ft bls), SGP-1 (10-12 ft bls), SGP-1 (12-14 ft bls), SGP-8 (6-8 ft bls), and SGP-11 (6-8 ft bls) due to the limited sample volume collected. In addition, air/water filled porosity was not analyzed for samples SGP-1 (6-7 ft bls), SGP-8 (6-8 ft bls), and SGP-11 (6-8 ft bls) because samples were collected using a hand auger and submitted as bag samples with no fixed dimensions.

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### 3. Investigation Results

Upon completion of the first round of soil-gas sampling in November 2010, the sample location figure and laboratory analytical reports for groundwater and soil-gas were submitted to the U.S. EPA via electronic mail (e-mail) on November 30, 2010. Additionally, a data package containing validated groundwater and soil-gas analytical data in tabular format, site maps showing the soil-gas sample points southwest and east of the Site, the soil-gas sample collection logs, the boring logs for the soil-gas points, and the soil-gas point construction diagrams were submitted to the U.S. EPA via e-mail on December 16, 2010. The second round of soil-gas sampling was completed in March 2011. The groundwater results, soil-gas results from both rounds of sampling, and the geotechnical results are presented below.

#### 3.1 Groundwater Results

The following paragraphs detail the results of the groundwater investigation conducted at the Riverview Plat neighborhood, at the eastern portion of the Site, and near the City of Moraine Municipal Building, between October 20, 2010 and November 11, 2010. The groundwater laboratory analytical results were validated per the Amended Quality Assurance Project Plan (QAPP) (ARCADIS, Inc. 2010b).

##### 3.1.1 Riverview Plat Neighborhood

Groundwater samples were collected from eight temporary well points installed at soil-gas sampling locations SGP-1 through SGP-8 in the right-of-way (between the sidewalk and the street) within the Riverview Plat neighborhood. A comparison of the groundwater sample results to the U.S. EPA Maximum Contaminant Levels (MCLs) indicated that all groundwater concentrations were below the MCLs with the exception of tetrachloroethene (PCE) and trichloroethene (TCE). PCE concentrations ranged from 2.1 micrograms per liter ( $\mu\text{g/L}$ ) to 100  $\mu\text{g/L}$  and exceeded the MCL (5  $\mu\text{g/L}$ ) in seven out of eight groundwater samples. TCE concentrations ranged from 1.7  $\mu\text{g/L}$  to 130  $\mu\text{g/L}$  and exceeded the MCL (5  $\mu\text{g/L}$ ) in seven out of eight groundwater samples. A comparison of the groundwater sample results to the MCLs is provided in Table 1 and shown on Figure 2.

##### 3.1.2 Eastern Site Boundary

Groundwater samples were collected from a temporary well point installed at soil-gas sampling location SGP-12 and from monitoring wells GM-25 and GM-77S, located on

## Vapor Intrusion Verification Report

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the eastern boundary of the Site. As discussed in Section 2.2, groundwater samples were not collected from SGP-10 and SGP-11. The groundwater analytical results from the samples collected along the eastern boundary of the Site were all below the MCLs. A comparison of the groundwater sample results to the MCLs is provided in Table 1 and shown on Figure 1.

### 3.1.3 City of Moraine Municipal Building Property

A groundwater sample was collected from a temporary well point installed at soil-gas sampling location SGP-9, located to the west of the City of Moraine Municipal Building along Dryden Road. The groundwater analytical results were all below the MCLs. A comparison of the groundwater sample results to the MCLs is provided in Table 1 and shown on Figure 2.

## 3.2 Soil-Gas Results

The following paragraphs detail the results of the soil-gas sampling conducted at the Riverview Plat neighborhood, at the eastern boundary of the Site, and near the City of Moraine Municipal Building, between November 9 and 11, 2010. Based on this round of data, no additional soil-gas sampling was conducted in the Riverview Plat neighborhood and indoor air and sub-slab sampling was recommended by U.S. EPA for this area. A second round of soil-gas sampling was conducted only on the eastern boundary of the Site and near the City of Moraine Municipal Building between March 30 and 31, 2011.

Soil-gas sample results were compared to the May 2012 U.S. EPA Regional Screening Levels (Action Levels). The Action Levels for soil-gas at the water table are based on a target risk level of  $1 \times 10^{-5}$  for potential carcinogenic constituents and a hazard index of 1 for non-carcinogenic constituents. An attenuation factor of 0.01 was then applied to calculate the Action Levels for soil-gas at the water table from the residential and commercial indoor air Action Levels. A comparison of the soil-gas sample results to the Action Levels is provided in Tables 2 and 3.

The soil-gas laboratory analytical results were validated per the Amended (QAPP) (ARCADIS, Inc. 2010b).

## Vapor Intrusion Verification Report

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### 3.2.1 Riverview Plat Neighborhood

Soil-gas samples were collected from eight locations in the right-of-way (between the sidewalk and the street) within the Riverview Plat neighborhood from November 9 through 11, 2010 (Figure 2). A comparison of the soil-gas sample results to the Action Levels for soil-gas near the water table indicated that all soil-gas constituent concentrations were below Action Levels with exception of PCE and TCE (Table 2 and Figure 4). Non-chlorinated compounds from the Site (benzene, ethylbenzene, toluene, and xylenes) were not found to be risk-based drivers as all detected concentrations were well below their respective Action Levels. PCE concentrations ranged from <1.2 ppbv (parts per billion by volume) to 5,600 ppbv and exceeded the generic screening level (620 ppbv) in nine out of 24 soil-gas samples (duplicate samples were not included in the count). TCE concentrations ranged from <1.1 ppbv to 2,900 ppbv and exceeded the generic screening level (39 ppbv) in 16 out of 24 samples. No additional soil-gas sampling was conducted in the Riverview Plat neighborhood as indoor air and sub-slab sampling was recommended by U.S. EPA for this area.

### 3.2.2 Eastern Site Boundary

Soil-gas samples were collected from three locations along the eastern boundary of the Site (Figure 1). Two separate rounds of sampling were conducted at these locations on November 11, 2010 and March 30-31, 2011. The second round of sampling was requested by U.S. EPA to ensure that the soil-gas results were representative of “worst case” conditions considering the potential for variability over time. A comparison of the soil-gas sample results to the generic Action Levels for soil-gas near the water table indicated that all soil-gas constituent concentrations were below Action Levels (Table 2 and Figure 3). Based on the soil-gas results, indoor air or sub-slab sampling is not warranted for the area east of the Site.

### 3.2.3 City of Moraine Municipal Building Property

Soil-gas samples were collected from one location near the City of Moraine Municipal Building. Two separate rounds of sampling were conducted at this location on November 11, 2010 and March 31, 2011. The second round of sampling was requested by U.S. EPA to ensure that the soil-gas results were representative of “worst case” conditions considering the potential for variability over time. A comparison of the soil-gas sample results to the commercial generic Action Levels for soil-gas at the water table indicated that all soil-gas constituent concentrations were below Action Levels (Table 3 and Figure 4). The U.S. EPA requested sub-slab and indoor air

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sampling be completed at the City of Moraine Municipal Building. The sub-slab and indoor air sampling was completed in April 2012 and confirmation sub-slab and indoor air sampling will be completed bi-annually for two years.

### 3.3 Geotechnical Results

Geotechnical samples were collected from four discrete depth intervals (6-8 ft bls, 8-10 ft bls, 10-12 ft bls, and 12-14 ft bls) at three separate locations including: SGP-1 and SGP-8 (located southwest of Site – Figure 2) and SGP-11 (located along the eastern boundary of Site – Figure 1). The geotechnical samples were analyzed for moisture content, permeability, specific gravity, grain size, and air/water filled porosity. Results for sample locations located southwest of the Site indicated that permeability ranged from  $3.96 \times 10^{-3}$  centimeters per second (cm/sec) to  $2.78 \times 10^{-2}$  cm/sec; air/water filled porosity ranged from 0.2253 to 0.3054; moisture content ranged from 2.8% to 6.5%; specific gravity ranged from 2.70 to 2.80; and grain size consisted mainly of gravel with varying degrees of sand and silt. Results for samples collected at SGP-11 indicated that permeability ranged from  $7.37 \times 10^{-3}$  cm/sec to  $1.12 \times 10^{-1}$  cm/sec; air/water filled porosity ranged from 0.2168 to 0.2302; moisture content ranged from 3.8% to 6.0%; specific gravity ranged from 2.70 to 2.73; and grain size consisted mainly of sand with varying degrees of gravel and silt. Table 4 summarizes the geotechnical sample results and the geotechnical laboratory report is included in Appendix D.

## Vapor Intrusion Verification Report

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### 4. Investigation Summary

Consistent with the Work Plan (ARCADIS, Inc. 2010a), a soil-gas investigation was completed in the Riverview Plat neighborhood right-of-way southwest of the Site, along the eastern boundary of the Site, and near the City of Moraine Municipal Building. The overall goal of the soil-gas investigation was to provide site-specific data to provide another line of evidence to further evaluate the vapor intrusion pathway.

As stated in the Work Plan, RACER Trust has conducted indoor air and sub-slab sampling at properties within the Riverview Plat, where access has been provided. RACER Trust is working under the direction of the U.S. EPA and with the property owners to complete this work. The U.S. EPA requested sub-slab and indoor air sampling be completed at the City of Moraine Municipal Building. The sub-slab and indoor air sampling was completed in April 2012 and confirmation sub-slab and indoor air sampling will be completed bi-annually for two years at the City of Moraine Municipal Building. Based on the lack of a volatile organic compound source in soil or groundwater and the results of this investigation, a future phase of investigation to the east of the Site is not warranted.

## Vapor Intrusion Verification Report

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### 5. References

ARCADIS, Inc., 2010a. Vapor Intrusion Verification Work Plan, Motors Liquidation Company, Moraine, Ohio. Revised September 16, 2010.

ARCADIS, Inc., 2010b. Amended Quality Assurance Project Plan, Motors Liquidation Company, Moraine, Ohio. November 19, 2010.

CEPA, 2010: California Environmental Protection Agency. 2010. "Advisory – Active Soil Investigation". March.

United States Environmental Protection Agency (U.S. EPA), 2002. OSWER Draft Guidance for Evaluating the Vapor Intrusion to Indoor Air Pathway from Groundwater and Soils (Subsurface Vapor Intrusion Guidance), EPA530-D-02-004. November 2002.

United States Environmental Protection Agency (U.S. EPA), 2010. Re: Vapor Intrusion Verification Work Plan; Motors Liquidation Company – Former Delphi Harrison Thermal Systems (OHD 000 817 577), Former Moraine Engine Plant (OHD 980 569 388), and Former Moraine Assembly Plant (OHD 041 063 074). June 1, 2010.



Table 1. Summary of Groundwater Sampling Results, RACER Trust, Moraine, Ohio.

Location			Riverview Plat Neighborhood								
Location Code	Sample Label	Sample Date	SGP-1 SGP-1/102610/GW 10/26/2010	SGP-2 SGP-2/102510/GW 10/25/2010	SGP-3 SGP-3/102010/GW 10/20/2010	SGP-3 (Duplicate) DUP-/102010/GW 10/20/2010	SGP-4 SGP-4/102210/GW 10/22/2010	SGP-5 SGP-5/102910/GW 10/29/2010	SGP-6 SGP-6/102810/GW 10/28/2010	SGP-7 SGP-7/102110/GW 10/21/2010	SGP-8 SGP-8/110110/GW 11/1/2010
Units	MCL	Laboratory Analytical Results									
<b>Volatile Organic Compounds</b>											
1,1,1-Trichloroethane	µg/L	200	< 1.4 U	1.3 J	< 1.0 U	< 1.0 U	< 3.3 U	1.2 J	1.3 J	0.73 J	0.53 J
1,1-Dichloroethane	µg/L	NA	0.92 J	0.96 J	< 1.0 U	< 1.0 U	1.2 J	2.5 J	1.2 J	3.4	2.9
1,1-Dichloroethene	µg/L	7	< 1.4 U	< 4.0 U	< 1.0 U	< 1.0 U	< 3.3 U	< 3.3 U	< 2.5 U	< 1.7 U	< 1.4 U
Benzene	µg/L	5	< 1.4 U	< 4.0 U	< 1.0 U	< 1.0 U	< 3.3 U	< 3.3 U	< 2.5 U	< 1.7 U	< 1.4 U
cis-1,2-Dichloroethene	µg/L	70	2.8	1.9 J	0.44 J	0.42 J	1.7 J	8.2 J	2.5	8.1	4.5
Ethylbenzene	µg/L	700	< 1.4 U	< 4.0 U	< 1.0 U	< 1.0 U	< 3.3 U	< 3.3 U	< 2.5 U	< 1.7 U	< 1.4 U
Tetrachloroethene	µg/L	5	<b>39 J</b>	<b>100</b>	2.1	2.3	<b>100</b>	<b>72</b>	<b>74</b>	<b>49</b>	<b>21</b>
Toluene	µg/L	1000	0.32 J	< 4.0 U	< 1.0 U	< 1.0 U	< 3.3 U	< 3.3 U	< 2.5 U	0.32 J	< 1.4 U
trans-1,2-Dichloroethene	µg/L	100	0.53 J	< 4.0 U	< 1.0 U	< 1.0 U	0.91 J	< 3.3 U	0.53 J	< 1.7 U	< 1.4 U
Trichloroethene	µg/L	5	<b>17</b>	<b>130</b>	1.7	1.9	<b>72</b>	<b>90</b>	<b>87</b>	<b>46</b>	<b>25</b>
Vinyl chloride	µg/L	2	< 1.4 U	< 4.0 U	< 1.0 U	< 1.0 U	< 3.3 U	< 3.3 U	< 2.5 U	< 1.7 U	< 1.4 U
Xylenes	µg/L	10000	< 2.9 U	< 8.0 U	< 2.0 U	< 2.0 U	< 6.7 U	< 6.7 U	< 5.0 U	< 3.3 U	< 2.9 U

City Building - Moraine Municipal City Building  
 µg/L - Micrograms per Liter.  
 MCL - United States Environmental Protection Agency,  
 Maximum Contaminant Level.  
 < - Chemical of concern not detected above laboratory  
 reporting limit shown.  
 U - Chemical of concern not detected above laboratory  
 reporting limit shown.  
 J - Value estimated.  
 NA - No action level.  
**Bold** indicates sample result is above the MCL.



Table 1. Summary of Groundwater Sampling Results, RACER Trust, Moraine, Ohio.

	Location		City Building		Eastern Site Boundary	
	Location Code		SGP-9	SGP-12	GM-25	GM-77S
	Sample Label	Sample Date	SGP-9/102710/GW 10/27/2010	SGP-12/110210/GW 11/2/2010	GM-25/102110/ 10/21/2010	GM-77S/102110/ 10/21/2010
	Units	MCL	Laboratory Analytical Results			
<b>Volatile Organic Compounds</b>						
1,1,1-Trichloroethane	µg/L	200	< 1.0 U	< 1.0 U	< 1.0	< 1.0
1,1-Dichloroethane	µg/L	NA	0.61 J	< 1.0 U	< 1.0	< 1.0
1,1-Dichloroethene	µg/L	7	< 1.0 U	< 1.0 U	< 1.0	< 1.0
Benzene	µg/L	5	< 1.0 U	< 1.0 U	< 1.0	< 1.0
cis-1,2-Dichloroethene	µg/L	70	2.0	< 1.0 U	< 1.0	< 1.0
Ethylbenzene	µg/L	700	< 1.0 U	< 1.0 U	< 1.0	< 1.0
Tetrachloroethene	µg/L	5	2.0	0.60 J	< 1.0	< 1.0
Toluene	µg/L	1000	0.25 J	0.43 J	< 1.0	< 1.0
trans-1,2-Dichloroethene	µg/L	100	< 1.0 U	< 1.0 U	< 1.0	< 1.0
Trichloroethene	µg/L	5	4.6	< 1.0 U	< 1.0	< 1.0
Vinyl chloride	µg/L	2	< 1.0 U	< 1.0 U	< 1.0	< 1.0
Xylenes	µg/L	10000	< 2.0 U	< 2.0 U	< 2.0	< 2.0

City Building - Moraine Municipal City Building

µg/L - Micrograms per Liter.

MCL - United States Environmental Protection Agency, Maximum Contaminant Level.

< - Chemical of concern not detected above laboratory reporting limit shown.

U - Chemical of concern not detected above laboratory reporting limit shown.

J - Value estimated.

NA - No action level.

**Bold** indicates sample result is above the MCL.

Table 2. Summary of Soil-Gas Sampling Results, RACER Trust, Moraine, Ohio.

Volatile Organic Compounds	Units	Location Location Code Sample Date Long-Term Screening Level Soil-Gas at Water Table*	Riverview Plat Neighborhood											
			SGP-1 11/10/2010			SGP-2 11/11/2010			SGP-3 11/9/2010			SGP-4 11/10/2010		
			6 feet bls	11 feet bls	16 feet bls	6 feet bls	11 feet bls	15.4 feet bls	6 feet bls	11 feet bls	16.26 feet bls	6 feet bls	11 feet bls	16.2 feet bls
1,1,1-Trichloroethane	ppbv	95500	1.8	2.4	4.3	14	26	47	1.0 J	3.7	5.9	2	3.3	7.3
1,1-Dichloroethane	ppbv	380	< 1.2 U	0.56 J	1.7	1.6 J	6.4 J	20	< 1.1 U	< 1.1 U	0.75 J	< 1.1 U	< 1.6 U	< 2.5 U
1,1-Dichloroethene	ppbv	5300	< 1.2 U	< 1.2 U	< 1.2 U	< 3.2 U	< 9.7 U	< 16 U	< 1.1 U	< 1.1 U	< 1.1 U	< 1.1 U	< 1.6 U	< 2.5 U
Benzene	ppbv	100	0.62 J	0.41 J	0.94 J	2.8 J	< 9.7 U	< 16 U	< 1.1 U	0.27 J	0.31 J	0.33 J	< 1.6 U	0.54 J
cis-1,2-Dichloroethene	ppbv	Not Available	< 1.2 U	< 1.2 U	2.2	0.59 J	2.5 J	14 J	< 1.1 U	< 1.1 U	< 1.1 U	< 1.1 U	< 1.6 U	< 2.5 U
Ethylbenzene	ppbv	220	0.51 J	< 1.2 U	0.44 J	< 3.2 U	< 9.7 U	< 16 U	0.65 J	< 1.1 U	< 1.1 U	< 1.1 U	< 1.6 U	< 2.5 U
Tetrachloroethene	ppbv	620	54	140	360	<b>840</b>	<b>3100</b>	<b>5600</b>	6.0	15	25	130	470	<b>830</b>
Toluene	ppbv	137990	2.2	0.49 J	0.84 J	5.7	< 9.7 U	< 16 U	0.73 J	0.28 J	< 1.1 U	1.3	< 1.6 U	< 2.5 U
trans-1,2-Dichloroethene	ppbv	1579	< 1.2 U	1.2	3.1	2.5 J	10	27	< 1.1 U	< 1.1 U	0.46 J	< 1.1 U	< 1.6 U	3.1
Trichloroethene	ppbv	39	16	<b>47</b>	<b>110</b>	<b>380</b>	<b>1200</b>	<b>2900</b>	1.6	13	23	33	<b>110</b>	<b>230</b>
Vinyl chloride	ppbv	63	< 1.2 U	< 1.2 U	< 1.2 U	< 3.2 U	< 9.7 U	< 16 U	< 1.1 U	< 1.1 U	< 1.1 U	< 1.1 U	< 1.6 U	< 2.5 U
Xylenes	ppbv	2300	2.3 J	< 1.2 U	1.2 J	0.98 J	< 9.7 U	< 16 U	4.0	< 1.1 U	< 1.1 U	< 1.1 U	< 1.6 U	< 2.5 U

bis - below land surface.

ppbv - Part per billion by volume.

< - 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 value due to associated blank contamination.

UJ - The chemical of concern was not detected above the reported sample quantitation limit. However, the reported limit is approximate and may or may not represent the actual limit of quantitation.

J - Value estimated.

**Bold** indicates chemical of concern is above the Screening Level.

\* - These values were based on the May 2012 U.S. EPA Regional Screening Levels for soil-gas in a residential area. The attenuation factor for Indoor Air to Soil-Gas at the Water Table is 0.01.

Table 2. Summary of Soil-Gas Sampling Results, RACER Trust, Moraine, Ohio.

Volatile Organic Compounds	Units	Location Location Code Sample Date	Southwest Neighborhood													
			SGP-5 11/11/2010				SGP-6 11/11/2010			SGP-7 11/10/2010			SGP-8 11/11/2010			
			Long -Term Screening Level Soil-Gas at Water Table*	6 feet bls	11 feet bls	14.8 feet bls DUPLICATE	6 feet bls	11 feet bls	15 feet bls	6 feet bls	11 feet bls	15.65 feet bls	6 feet bls	6 feet bls DUPLICATE	11 feet bls	14.25 feet bls
1,1,1-Trichloroethane	ppbv	95500	0.16 J	34	62	54	3.8	11	24	2.2	10	13	15	16	38	54
1,1-Dichloroethane	ppbv	380	< 1.1 U	8.4	31	27	< 1.2 U	< 1.2 U	0.48 J	0.48 J	5.3	9.2	1.1	1.0 J	20	51
1,1-Dichloroethene	ppbv	5300	< 1.1 U	< 6 U	< 12 U	< 9 U	< 1.2 U	< 1.2 U	< 1.2 U	< 1.2 U	< 1.5 U	< 2.3 U	< 1.1 U	< 1.1 U	< 3.1 U	< 4.4 U
Benzene	ppbv	100	0.34 J	1.8 J	< 12 U	< 9 U	< 1.2 U	< 1.2 U	1.3	2	0.56 J	0.53 J	0.35 J	0.33 J	1.5 J	1.9 J
cis-1,2-Dichloroethene	ppbv	Not Available	< 1.1 U	7.9	35	34	< 1.2 U	< 1.2 U	< 1.2 U	< 1.2 U	1.8	3.7	< 1.1 U	< 1.1 U	8.3	30
Ethylbenzene	ppbv	220	< 1.1 U	< 6 U	< 12 U	< 9 U	0.53 J	0.15 J	0.96 J	4.3	< 1.5 U	< 2.3 U	< 1.1 U	< 1.1 U	< 3.1 U	< 4.4 U
Tetrachloroethene	ppbv	620	0.31 J	<b>1800</b>	<b>3200</b>	<b>2700</b>	16	140	400	100	500	<b>700</b>	240	250	<b>850</b>	<b>1600</b>
Toluene	ppbv	137990	1.4	1.9 J	< 12 U	2.7 J	4.4	0.27 J	4.2	6.6	< 1.5 U	< 2.3 U	0.32 J	< 1.1 U	0.98 J	1.4 J
trans-1,2-Dichloroethene	ppbv	1579	< 1.1 U	< 6 U	< 12 U	< 9 U	< 1.2 U	< 1.2 U	0.49 J	< 1.2 U	< 1.5 U	< 2.3 U	< 1.1 U	< 1.1 U	< 3.1 U	< 4.4 U
Trichloroethene	ppbv	39	0.49 J	<b>600</b>	<b>1800</b>	<b>1600</b>	5.3	<b>51</b>	<b>210</b>	30	<b>200</b>	<b>310</b>	<b>49</b>	<b>52</b>	<b>300</b>	<b>680</b>
Vinyl chloride	ppbv	63	< 1.1 U	< 6 U	< 12 U	< 9 U	< 1.2 U	< 1.2 U	< 1.2 U	< 1.2 U	< 1.5 U	< 2.3 U	< 1.1 U	< 1.1 U	< 3.1 U	< 4.4 U
Xylenes	ppbv	2300	0.15 J	< 6 U	< 12 U	< 9 U	2.12 J	0.24 J	1.55 J	18.7	< 1.5 U	< 2.3 U	< 1.1 U	< 1.1 U	< 3.1 U	< 4.4 U

bis - below land surface.  
 ppbv - Part per billion by volume.  
 < - 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 value due to associated blank contamination.  
 UJ - The chemical of concern was not detected above the reported sample quantitation limit. However, the reported limit is approximate and may or may not represent the actual limit of quantitation.  
 J - Value estimated.  
**Bold** indicates chemical of concern is above the Screening Level.  
 \* - These values were based on the May 2012 U.S. EPA Regional Screening Levels for soil-gas in a residential area. The attenuation factor for Indoor Air to Soil-Gas at the Water Table is 0.01.

Table 2. Summary of Soil-Gas Sampling Results, RACER Trust, Moraine, Ohio.

Volatile Organic Compounds	Units	Location	Eastern Site Boundary						
		Location Code	SGP-10						
		Sample Date	11/11/2010			3/30/2011			28.08 feet bls DUPLICATE
Long -Term Screening Level Soil-Gas at Water Table*	6 feet bls	11 feet bls	28.08 feet bls	6 feet bls	11 feet bls	28.08 feet bls			
1,1,1-Trichloroethane	ppbv	95500	0.22 J	< 1.2 U	< 1.1 U	< 1.1 U	< 1.2 U	< 1.1 U	< 1.2 U
1,1-Dichloroethane	ppbv	380	< 1.2 U	< 1.2 U	0.26 J	< 1.1 U	< 1.2 U	< 1.1 U	< 1.2 U
1,1-Dichloroethene	ppbv	5300	< 1.2 U	< 1.2 U	< 1.1 U	< 1.1 U	< 1.2 U	< 1.1 U	< 1.2 U
Benzene	ppbv	100	0.34 J	0.34 J	2.2	< 1.1 U	0.25 J	0.45 J	0.47 J
cis-1,2-Dichloroethene	ppbv	Not Available	< 1.2 U	< 1.2 U	< 1.1 U	< 1.1 U	< 1.2 U	< 1.1 U	< 1.2 U
Ethylbenzene	ppbv	220	0.39 J	< 1.2 U	1.4	< 1.1 U	< 1.2 U	< 1.1 U	< 1.2 U
Tetrachloroethene	ppbv	620	0.3 J	1.0 J	2.5	< 1.1 U	< 1.2 U	1.6	1.7
Toluene	ppbv	137990	1.2	0.49 J	3.4	< 1.1 U	0.19 J	0.45 J	0.34 J
trans-1,2-Dichloroethene	ppbv	1579	< 1.2 U	< 1.2 U	< 1.1 U	< 1.1 U	< 1.2 U	< 1.1 U	< 1.2 U
Trichloroethene	ppbv	39	0.45 J	< 1.2 U	1.4	< 1.1 U	< 1.2 U	< 1.1 U	< 1.2 U
Vinyl chloride	ppbv	63	< 1.2 U	< 1.2 U	< 1.1 U	< 1.1 U	< 1.2 U	< 1.1 U	< 1.2 U
Xylenes	ppbv	2300	2.48 J	0.15 J	1.42 J	< 1.1 U	< 1.2 U	< 1.1 U	< 1.2 U

bis - below land surface.  
 ppbv - Part per billion by volume.  
 < - 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 value due to associated blank contamination.  
 UJ - The chemical of concern was not detected above the reported sample quantitation limit. However, the reported limit is approximate and may or may not represent the actual limit of quantitation.  
 J - Value estimated.  
**Bold** indicates chemical of concern is above the Screening Level.  
 \* - These values were based on the May 2012 U.S. EPA Regional Screening Levels for soil-gas in a residential area. The attenuation factor for Indoor Air to Soil-Gas at the Water Table is 0.01.

Table 2. Summary of Soil-Gas Sampling Results, RACER Trust, Moraine, Ohio.

Volatile Organic Compounds	Units	Location Location Code Sample Date	Eastern Site Boundary											
			SGP-11						SGP-12					
			11/11/2010			3/31/2011			11/11/2010			3/30/2011		
Long -Term Screening Level Soil-Gas at Water Table*	6 feet bls	11 feet bls	15.33 feet bls	6 feet bls	11 feet bls	15.33 feet bls	6 feet bls	11 feet bls	22.9 feet bls	6 feet bls	11 feet bls	22.9 feet bls		
1,1,1-Trichloroethane	ppbv	95500	0.18 J	0.16 J	< 1.2 U	< 1.2 U	< 1.2 U	< 1.2 U	0.25 J	0.22 J	2.7	< 1.2 U	< 1.1 U	1.6
1,1-Dichloroethane	ppbv	380	< 1.2 U	< 1.2 U	0.28 J	< 1.2 U	< 1.2 U	< 1.2 U	< 1.2 U	< 1.2 U	< 1.2 U	< 1.2 U	< 1.1 U	< 1.1 U
1,1-Dichloroethene	ppbv	5300	< 1.2 U	< 1.2 U	< 1.2 U	< 1.2 U	< 1.2 U	< 1.2 U	< 1.2 U	< 1.2 U	< 1.2 U	< 1.2 U	< 1.1 U	< 1.1 U
Benzene	ppbv	100	< 1.2 U	< 1.2 U	3.4	< 1.2 U	< 1.2 U	< 1.2 U	0.96 J	2.2	3.2	< 1.2 U	< 1.1 U	0.32 J
cis-1,2-Dichloroethene	ppbv	Not Available	< 1.2 U	< 1.2 U	0.27 J	< 1.2 U	< 1.2 U	< 1.2 U	< 1.2 U	< 1.2 U	< 1.2 U	< 1.2 U	< 1.1 U	< 1.1 U
Ethylbenzene	ppbv	220	< 1.2 U	< 1.2 U	8.0	< 1.2 U	< 1.2 U	< 1.2 U	< 1.2 U	1.2	0.78 J	< 1.2 U	< 1.1 U	< 1.1 U
Tetrachloroethene	ppbv	620	0.14 J	0.22 J	1.7	< 1.2 U	< 1.2 U	0.7 J	0.80 J	1.0 J	1.7	< 1.2 U	0.65 J	1.8
Toluene	ppbv	137990	0.24 J	0.82 J	9.8	< 1.2 U	0.99 J	1 J	1.4	3.9	2.8	< 1.2 U	1.6	1.7
trans-1,2-Dichloroethene	ppbv	1579	< 1.2 U	< 1.2 U	< 1.2 U	< 1.2 U	< 1.2 U	< 1.2 U	< 1.2 U	< 1.2 U	< 1.2 U	< 1.2 U	< 1.1 U	< 1.1 U
Trichloroethene	ppbv	39	0.32 J	0.46 J	1.7	< 1.2 U	< 1.2 U	< 1.2 U	0.60 J	0.72 J	0.55 J	< 1.2 U	< 1.1 U	< 1.1 U
Vinyl chloride	ppbv	63	< 1.2 U	< 1.2 U	< 1.2 U	< 1.2 U	< 1.2 U	< 1.2 U	< 1.2 U	< 1.2 U	< 1.2 U	< 1.2 U	< 1.1 U	< 1.1 U
Xylenes	ppbv	2300	0.16 J	0.19 J	8.1	< 1.2 U	< 1.2 U	< 1.2 U	0.22 J	1.58 J	0.89 J	< 1.2 U	< 1.1 U	< 1.1 U

bls - below land surface.  
 ppbv - Part per billion by volume.  
 < - 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 value due to associated blank contamination.  
 UJ - The chemical of concern was not detected above the reported sample quantitation limit. However, the reported limit is approximate and may or may not represent the actual limit of quantitation.  
 J - Value estimated.  
**Bold** indicates chemical of concern is above the Screening Level.  
 \* - These values were based on the May 2012 U.S. EPA Regional Screening Levels for soil-gas in a residential area. The attenuation factor for Indoor Air to Soil-Gas at the Water Table is 0.01.



Table 3. Summary of Soil-Gas Sampling Results near the City Building, RACER Trust, Moraine, Ohio.

		Location	Moraine Municipal City Building						
		Location Code	SGP-9						
		Sample Date	11/11/2010			3/31/2011			
Volatiles Organic Compounds	Units	Long -Term Screening Level Soil-Gas at Water Table*	6 feet bls	11 feet bls	14.42 feet bls	6 feet bls	11 feet bls	11 feet bls DUPLICATE	14.42 feet bls
1,1,1-Trichloroethane	ppbv	401000	2	3	4.4	1.5	1.7	< 1.2 U	2.3
1,1-Dichloroethane	ppbv	1900	< 1.1 U	0.33 J	2.5	< 1.2 U	0.38 J	< 1.2 U	4.8
1,1-Dichloroethene	ppbv	22100	< 1.1 U	< 1.1 U	< 1.2 U	< 1.2 U	< 1.2 U	< 1.2 U	< 1.2 U
Benzene	ppbv	500	0.24 J	0.45 J	0.53 J	< 1.2 U	< 1.2 U	< 1.2 U	0.46 J
cis-1,2-Dichloroethene	ppbv	Not Available	< 1.1 U	< 1.1 U	2.5	< 1.2 U	< 1.2 U	< 1.2 U	2.5
Ethylbenzene	ppbv	1130	< 1.1 U	< 1.1 U	< 1.2 U	< 1.2 U	< 1.2 U	< 1.2 U	< 1.2 U
Tetrachloroethene	ppbv	2700	6.4	12	43	5	9.9 J	< 1.2 UJ	22
Toluene	ppbv	583790	0.34 J	0.96 J	0.34 J	< 1.2 U	< 1.2 U	0.33 J	0.2 J
trans-1,2-Dichloroethene	ppbv	6600	< 1.1 U	< 1.1 U	< 1.2 U	< 1.2 U	< 1.2 U	< 1.2 U	0.47 J
Trichloroethene	ppbv	160	12	32	88	10	22 J	< 1.2 UJ	49
Vinyl chloride	ppbv	1100	< 1.1 U	< 1.1 U	< 1.2 U	< 1.2 U	< 1.2 U	< 1.2 U	< 1.2 U
Xylenes	ppbv	10130	< 1.1 U	0.3 J	< 1.2 U	< 1.2 U	< 1.2 U	< 1.2 U	< 1.2 U

bls - below land surface.

ppbv - Parts per billion by volume.

< - 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 value due to associated blank contamination.

UJ - The chemical of concern was not detected above the reported sample quantitation limit. However, the reported limit is approximate and may or may not represent the actual limit of quantitation.

J - Value estimated.

**Bold** indicates chemical of concern is above the Screening Level.

\* - These values were based on the May 2012 U.S. EPA Regional Screening Levels for soil-gas in a commercial area. The attenuation factor for Indoor Air to Soil-Gas at the Water Table is 0.01.



**Table 4. Summary of Geotechnical Sample Results, RACER Trust, Moraine, Ohio.**

Sample ID	Location	Date	Depth (feet bls)	Moisture Content (%)	Specific Gravity	Particle Size Analysis		Permeability (cm/sec)	Air/Water Filled Porosity
						Soil Description	USCS Classification		
SGP-1	Riverview Plat Neighborhood	10/25/2010	6 to 7	3.6	2.70	Poorly graded sand with silt and gravel	SP-SM	2.78E-02	NA
			8 to 10	3.2	2.79	Well-graded gravel with silt and sand	GW-GM	NT	0.2580
			10 to 12	3.1	2.75	Well-graded gravel with silt and sand	GW-GM	NT	0.2886
			12 to 14	2.8	2.79	Poorly graded gravel with sand	GP	NT	0.3017
SGP-8	Riverview Plat Neighborhood	11/1/2010	6 to 8	5.9	2.70	Poorly graded sand with silt and gravel	SP-SM	NT	NA
			8 to 10	6.5	2.77	Silty gravel with sand	GM	3.99E-03	0.3054
			10 to 12	3.6	2.80	Poorly-graded gravel with silt and sand	GP-GM	9.40E-03	0.2662
			12 to 14	3.8	2.76	Well-graded gravel with silt and sand	GW-GM	3.96E-03	0.2253
SGP-11	Eastern Site Boundary	12/14/2010	6 to 8	6.0	2.70	Poorly graded sand with silt and gravel	SP-SM	NT	NA
			8 to 10	5.8	2.71	Well-graded sand with silt and gravel	SW-SM	7.37E-03	0.2251
			10 to 12	5.8	2.71	Well-graded sand with silt and gravel	SW-SM	1.12E-01	0.2302
			12 to 14	3.8	2.73	Poorly-graded gravel with silt and sand	GP-GM	2.86E-02	0.2168

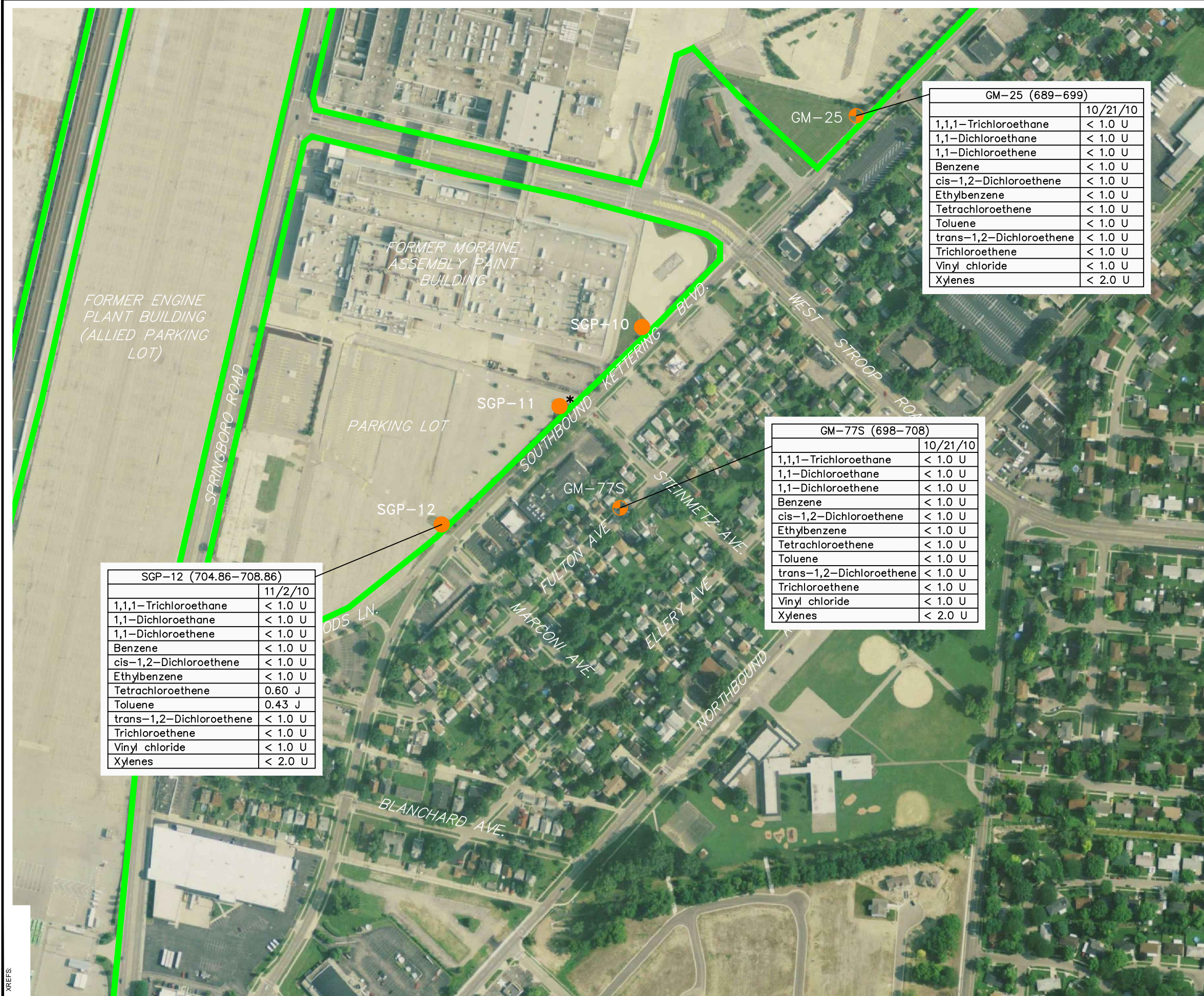
NT - not tested due to low sample volume.

NA - not applicable - bag sample.

bls - below land surface.

cm/sec - centimeters per second.

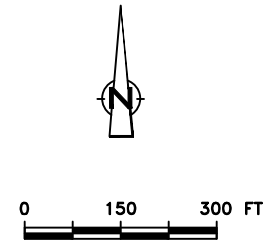
USCS - United Soil Classification System.



SGP-12 (704.86-708.86)	
	11/2/10
1,1,1-Trichloroethane	< 1.0 U
1,1-Dichloroethane	< 1.0 U
1,1-Dichloroethene	< 1.0 U
Benzene	< 1.0 U
cis-1,2-Dichloroethene	< 1.0 U
Ethylbenzene	< 1.0 U
Tetrachloroethene	0.60 J
Toluene	0.43 J
trans-1,2-Dichloroethene	< 1.0 U
Trichloroethene	< 1.0 U
Vinyl chloride	< 1.0 U
Xylenes	< 2.0 U

GM-77S (698-708)	
	10/21/10
1,1,1-Trichloroethane	< 1.0 U
1,1-Dichloroethane	< 1.0 U
1,1-Dichloroethene	< 1.0 U
Benzene	< 1.0 U
cis-1,2-Dichloroethene	< 1.0 U
Ethylbenzene	< 1.0 U
Tetrachloroethene	< 1.0 U
Toluene	< 1.0 U
trans-1,2-Dichloroethene	< 1.0 U
Trichloroethene	< 1.0 U
Vinyl chloride	< 1.0 U
Xylenes	< 2.0 U

GM-25 (689-699)	
	10/21/10
1,1,1-Trichloroethane	< 1.0 U
1,1-Dichloroethane	< 1.0 U
1,1-Dichloroethene	< 1.0 U
Benzene	< 1.0 U
cis-1,2-Dichloroethene	< 1.0 U
Ethylbenzene	< 1.0 U
Tetrachloroethene	< 1.0 U
Toluene	< 1.0 U
trans-1,2-Dichloroethene	< 1.0 U
Trichloroethene	< 1.0 U
Vinyl chloride	< 1.0 U
Xylenes	< 2.0 U



**LEGEND**

- SOIL-GAS SAMPLING POINT
- ⊕ MONITORING WELL (UPPER AQUIFER)
- RACER PROPERTY BOUNDARY
- \* GEOTECHNICAL BORING LOCATION ADJACENT TO SOIL-GAS SAMPLING POINT

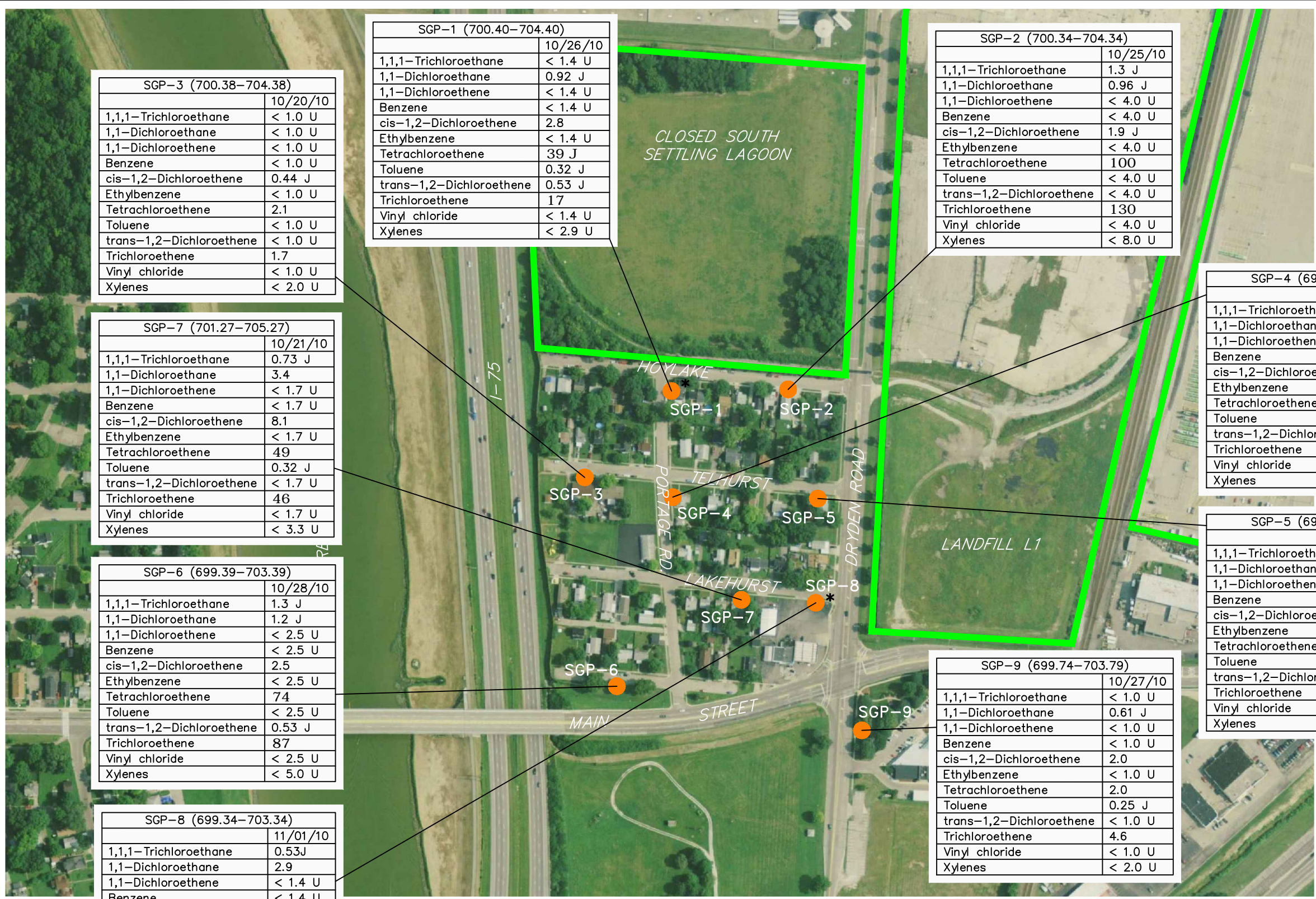
(698-708) WELL SCREEN INTERVAL ELEVATION (FEET ABOVE MEAN SEA LEVEL)

J ESTIMATED VALUE  
 < LESS THAN REPORTING LIMIT  
 U LESS THAN REPORTING LIMIT

ALL CONCENTRATIONS IN MICROGRAMS PER LITER

RACER TRUST  
 MORaine, OHIO  
 OH000294.2012

**GROUNDWATER TABLE SAMPLE RESULTS EAST OF SITE (OCTOBER THROUGH NOVEMBER 2010)**



SGP-3 (700.38-704.38)	
	10/20/10
1,1,1-Trichloroethane	< 1.0 U
1,1-Dichloroethane	< 1.0 U
1,1-Dichloroethene	< 1.0 U
Benzene	< 1.0 U
cis-1,2-Dichloroethene	0.44 J
Ethylbenzene	< 1.0 U
Tetrachloroethene	2.1
Toluene	< 1.0 U
trans-1,2-Dichloroethene	< 1.0 U
Trichloroethene	1.7
Vinyl chloride	< 1.0 U
Xylenes	< 2.0 U

SGP-1 (700.40-704.40)	
	10/26/10
1,1,1-Trichloroethane	< 1.4 U
1,1-Dichloroethane	0.92 J
1,1-Dichloroethene	< 1.4 U
Benzene	< 1.4 U
cis-1,2-Dichloroethene	2.8
Ethylbenzene	< 1.4 U
Tetrachloroethene	39 J
Toluene	0.32 J
trans-1,2-Dichloroethene	0.53 J
Trichloroethene	17
Vinyl chloride	< 1.4 U
Xylenes	< 2.9 U

SGP-2 (700.34-704.34)	
	10/25/10
1,1,1-Trichloroethane	1.3 J
1,1-Dichloroethane	0.96 J
1,1-Dichloroethene	< 4.0 U
Benzene	< 4.0 U
cis-1,2-Dichloroethene	1.9 J
Ethylbenzene	< 4.0 U
Tetrachloroethene	100
Toluene	< 4.0 U
trans-1,2-Dichloroethene	< 4.0 U
Trichloroethene	130
Vinyl chloride	< 4.0 U
Xylenes	< 8.0 U

SGP-4 (699.43-703.43)	
	10/22/10
1,1,1-Trichloroethane	< 3.3 U
1,1-Dichloroethane	1.2 J
1,1-Dichloroethene	< 3.3 U
Benzene	< 3.3 U
cis-1,2-Dichloroethene	1.7 J
Ethylbenzene	< 3.3 U
Tetrachloroethene	100
Toluene	< 3.3 U
trans-1,2-Dichloroethene	0.91 J
Trichloroethene	72
Vinyl chloride	< 3.3 U
Xylenes	< 6.7 U

SGP-7 (701.27-705.27)	
	10/21/10
1,1,1-Trichloroethane	0.73 J
1,1-Dichloroethane	3.4
1,1-Dichloroethene	< 1.7 U
Benzene	< 1.7 U
cis-1,2-Dichloroethene	8.1
Ethylbenzene	< 1.7 U
Tetrachloroethene	49
Toluene	0.32 J
trans-1,2-Dichloroethene	< 1.7 U
Trichloroethene	46
Vinyl chloride	< 1.7 U
Xylenes	< 3.3 U

SGP-5 (699.63-703.63)	
	10/29/10
1,1,1-Trichloroethane	1.2 J
1,1-Dichloroethane	2.5 J
1,1-Dichloroethene	< 3.3 U
Benzene	< 3.3 U
cis-1,2-Dichloroethene	8.2 J
Ethylbenzene	< 3.3 U
Tetrachloroethene	72
Toluene	< 3.3 U
trans-1,2-Dichloroethene	< 3.3 U
Trichloroethene	90
Vinyl chloride	< 3.3 U
Xylenes	< 6.7 U

SGP-6 (699.39-703.39)	
	10/28/10
1,1,1-Trichloroethane	1.3 J
1,1-Dichloroethane	1.2 J
1,1-Dichloroethene	< 2.5 U
Benzene	< 2.5 U
cis-1,2-Dichloroethene	2.5
Ethylbenzene	< 2.5 U
Tetrachloroethene	74
Toluene	< 2.5 U
trans-1,2-Dichloroethene	0.53 J
Trichloroethene	87
Vinyl chloride	< 2.5 U
Xylenes	< 5.0 U

SGP-9 (699.74-703.79)	
	10/27/10
1,1,1-Trichloroethane	< 1.0 U
1,1-Dichloroethane	0.61 J
1,1-Dichloroethene	< 1.0 U
Benzene	< 1.0 U
cis-1,2-Dichloroethene	2.0
Ethylbenzene	< 1.0 U
Tetrachloroethene	2.0
Toluene	0.25 J
trans-1,2-Dichloroethene	< 1.0 U
Trichloroethene	4.6
Vinyl chloride	< 1.0 U
Xylenes	< 2.0 U

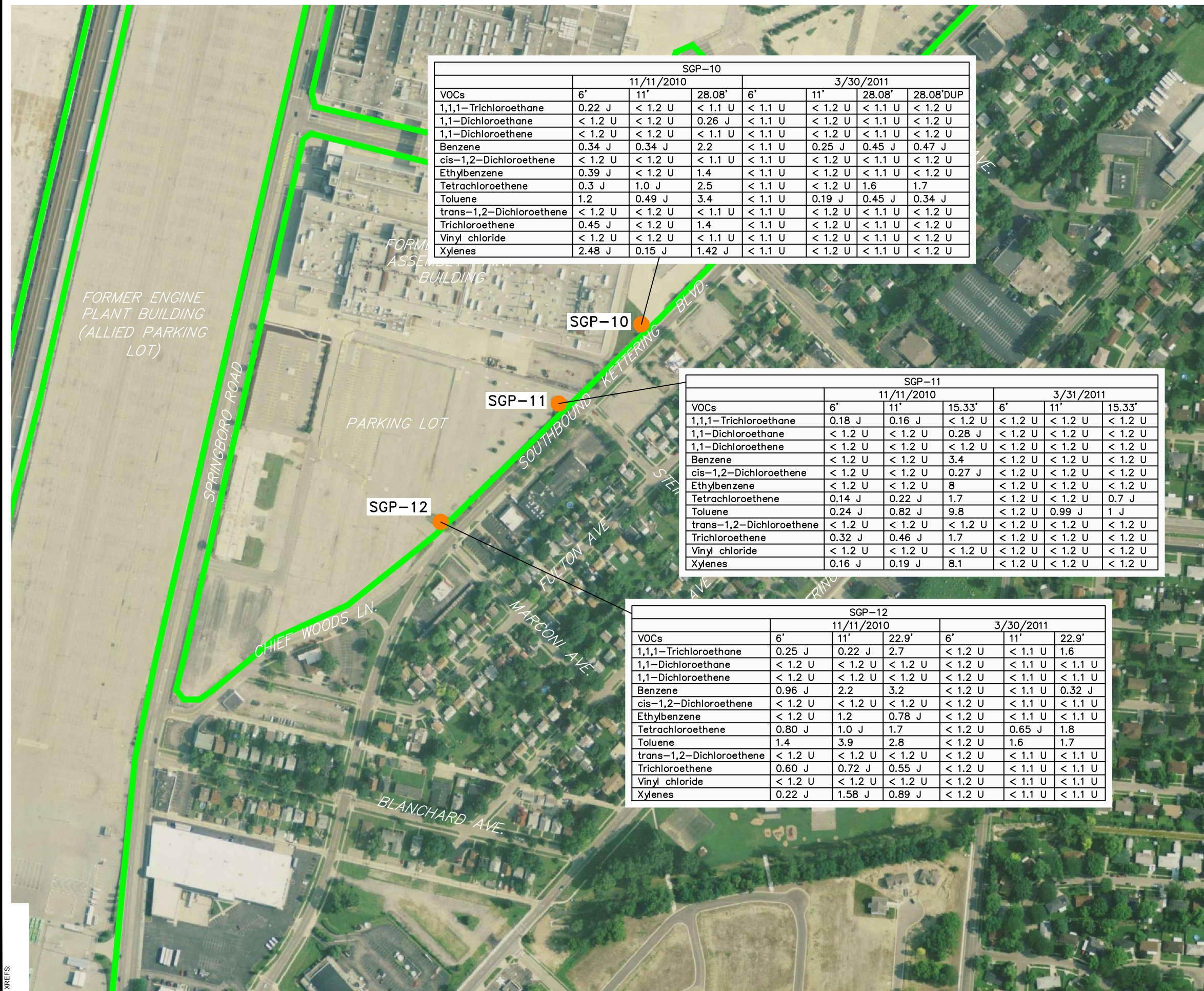
SGP-8 (699.34-703.34)	
	11/01/10
1,1,1-Trichloroethane	0.53J
1,1-Dichloroethane	2.9
1,1-Dichloroethene	< 1.4 U
Benzene	< 1.4 U
cis-1,2-Dichloroethene	4.5
Ethylbenzene	< 1.4 U
Tetrachloroethene	21
Toluene	< 1.4 U
trans-1,2-Dichloroethene	< 1.4 U
Trichloroethene	25
Vinyl chloride	< 1.4 U
Xylenes	< 2.9 U

- LEGEND**
- SOIL-GAS SAMPLING POINT LOCATIONS
  - RACER PROPERTY BOUNDARY
  - \* GEOTECHNICAL BORING LOCATION ADJACENT TO SOIL-GAS SAMPLING POINT
  - (701.93-705.93) TEMPORARY WELL SCREEN INTERVAL ELEVATION (FEET ABOVE MEAN SEA LEVEL)
  - J ESTIMATED VALUE
  - < LESS THAN REPORTING LIMIT
  - U LESS THAN REPORTING LIMIT
  - BOLD** CONCENTRATION ABOVE MAXIMUM CONTAMINANT LEVELS PRESENTED ON TABLE 1
  - ALL CONCENTRATIONS IN MICROGRAMS PER LITER

RACER TRUST  
 MORAINES, OHIO  
 OH000294.2012

**GROUNDWATER TABLE SAMPLE RESULTS  
 SOUTHWEST OF SITE  
 (OCTOBER THROUGH NOVEMBER 2010)**

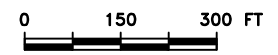
2



VOCs	11/11/2010			3/30/2011		
	6'	11'	28.08'	6'	11'	28.08'DUP
1,1,1-Trichloroethane	0.22 J	< 1.2 U	< 1.1 U	< 1.1 U	< 1.2 U	< 1.1 U
1,1-Dichloroethane	< 1.2 U	< 1.2 U	0.26 J	< 1.1 U	< 1.2 U	< 1.1 U
1,1-Dichloroethene	< 1.2 U	< 1.2 U	< 1.1 U	< 1.1 U	< 1.2 U	< 1.1 U
Benzene	0.34 J	0.34 J	2.2	< 1.1 U	0.25 J	0.45 J
cis-1,2-Dichloroethene	< 1.2 U	< 1.2 U	< 1.1 U	< 1.1 U	< 1.2 U	< 1.1 U
Ethylbenzene	0.39 J	< 1.2 U	1.4	< 1.1 U	< 1.2 U	< 1.1 U
Tetrachloroethene	0.3 J	1.0 J	2.5	< 1.1 U	< 1.2 U	1.6
Toluene	1.2	0.49 J	3.4	< 1.1 U	0.19 J	0.45 J
trans-1,2-Dichloroethene	< 1.2 U	< 1.2 U	< 1.1 U	< 1.1 U	< 1.2 U	< 1.1 U
Trichloroethene	0.45 J	< 1.2 U	1.4	< 1.1 U	< 1.2 U	< 1.1 U
Vinyl chloride	< 1.2 U	< 1.2 U	< 1.1 U	< 1.1 U	< 1.2 U	< 1.1 U
Xylenes	2.48 J	0.15 J	1.42 J	< 1.1 U	< 1.2 U	< 1.1 U

VOCs	11/11/2010			3/31/2011		
	6'	11'	15.33'	6'	11'	15.33'
1,1,1-Trichloroethane	0.18 J	0.16 J	< 1.2 U	< 1.2 U	< 1.2 U	< 1.2 U
1,1-Dichloroethane	< 1.2 U	< 1.2 U	0.28 J	< 1.2 U	< 1.2 U	< 1.2 U
1,1-Dichloroethene	< 1.2 U	< 1.2 U	< 1.2 U	< 1.2 U	< 1.2 U	< 1.2 U
Benzene	< 1.2 U	< 1.2 U	3.4	< 1.2 U	< 1.2 U	< 1.2 U
cis-1,2-Dichloroethene	< 1.2 U	< 1.2 U	0.27 J	< 1.2 U	< 1.2 U	< 1.2 U
Ethylbenzene	< 1.2 U	< 1.2 U	8	< 1.2 U	< 1.2 U	< 1.2 U
Tetrachloroethene	0.14 J	0.22 J	1.7	< 1.2 U	< 1.2 U	0.7 J
Toluene	0.24 J	0.82 J	9.8	< 1.2 U	0.99 J	1 J
trans-1,2-Dichloroethene	< 1.2 U	< 1.2 U	< 1.2 U	< 1.2 U	< 1.2 U	< 1.2 U
Trichloroethene	0.32 J	0.46 J	1.7	< 1.2 U	< 1.2 U	< 1.2 U
Vinyl chloride	< 1.2 U	< 1.2 U	< 1.2 U	< 1.2 U	< 1.2 U	< 1.2 U
Xylenes	0.16 J	0.19 J	8.1	< 1.2 U	< 1.2 U	< 1.2 U

VOCs	11/11/2010			3/30/2011		
	6'	11'	22.9'	6'	11'	22.9'
1,1,1-Trichloroethane	0.25 J	0.22 J	2.7	< 1.2 U	< 1.1 U	1.6
1,1-Dichloroethane	< 1.2 U	< 1.2 U	< 1.2 U	< 1.2 U	< 1.1 U	< 1.1 U
1,1-Dichloroethene	< 1.2 U	< 1.2 U	< 1.2 U	< 1.2 U	< 1.1 U	< 1.1 U
Benzene	0.96 J	2.2	3.2	< 1.2 U	< 1.1 U	0.32 J
cis-1,2-Dichloroethene	< 1.2 U	< 1.2 U	< 1.2 U	< 1.2 U	< 1.1 U	< 1.1 U
Ethylbenzene	< 1.2 U	1.2	0.78 J	< 1.2 U	< 1.1 U	< 1.1 U
Tetrachloroethene	0.80 J	1.0 J	1.7	< 1.2 U	0.65 J	1.8
Toluene	1.4	3.9	2.8	< 1.2 U	1.6	1.7
trans-1,2-Dichloroethene	< 1.2 U	< 1.2 U	< 1.2 U	< 1.2 U	< 1.1 U	< 1.1 U
Trichloroethene	0.60 J	0.72 J	0.55 J	< 1.2 U	< 1.1 U	< 1.1 U
Vinyl chloride	< 1.2 U	< 1.2 U	< 1.2 U	< 1.2 U	< 1.1 U	< 1.1 U
Xylenes	0.22 J	1.58 J	0.89 J	< 1.2 U	< 1.1 U	< 1.1 U

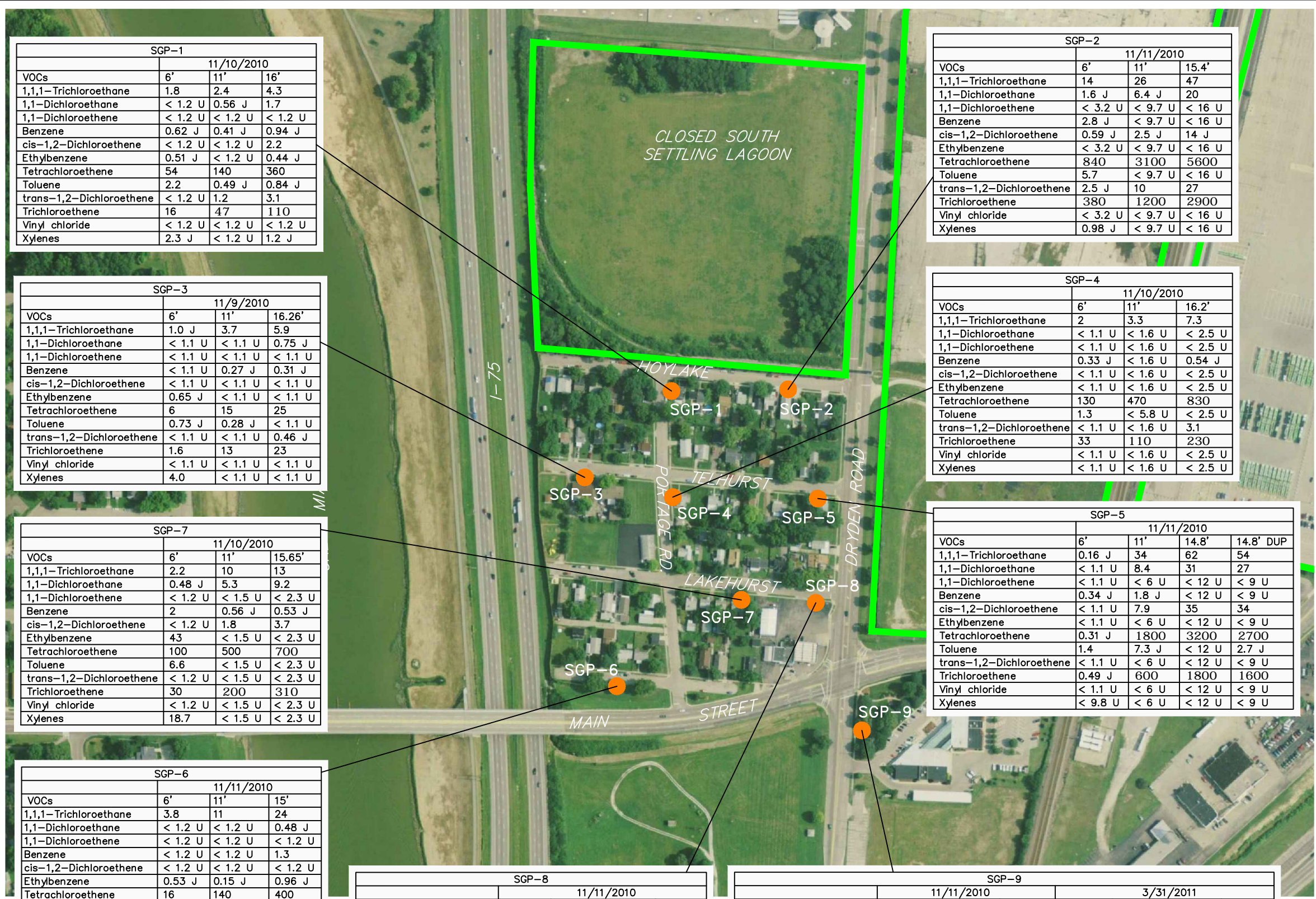


- LEGEND**
- SOIL-GAS SAMPLING POINT
  - RACER PROPERTY BOUNDARY
  - SGP-11 SAMPLE IDENTIFICATION
  - 11/11/10 DATE OF SAMPLE
  - 11' DEPTH IN FEET
  - J ESTIMATED VALUE
  - < LESS THAN REPORTING LIMIT
  - U LESS THAN REPORTING LIMIT
  - VOCs VOLATILE ORGANIC COMPOUNDS
- ALL CONCENTRATIONS IN PARTS PER BILLION BY VOLUME

RACER TRUST  
MORAIN, OHIO  
OH000294.2012

**SOIL-GAS SAMPLING POINT ANALYTICAL RESULTS EAST OF SITE (NOVEMBER 2010 AND MARCH 2011)**





SGP-1			
11/10/2010			
VOCs	6'	11'	16'
1,1,1-Trichloroethane	1.8	2.4	4.3
1,1-Dichloroethane	< 1.2 U	0.56 J	1.7
1,1-Dichloroethene	< 1.2 U	< 1.2 U	< 1.2 U
Benzene	0.62 J	0.41 J	0.94 J
cis-1,2-Dichloroethene	< 1.2 U	< 1.2 U	2.2
Ethylbenzene	0.51 J	< 1.2 U	0.44 J
Tetrachloroethene	54	140	360
Toluene	2.2	0.49 J	0.84 J
trans-1,2-Dichloroethene	< 1.2 U	1.2	3.1
Trichloroethene	16	47	110
Vinyl chloride	< 1.2 U	< 1.2 U	< 1.2 U
Xylenes	2.3 J	< 1.2 U	1.2 J

SGP-2			
11/11/2010			
VOCs	6'	11'	15.4'
1,1,1-Trichloroethane	14	26	47
1,1-Dichloroethane	1.6 J	6.4 J	20
1,1-Dichloroethene	< 3.2 U	< 9.7 U	< 16 U
Benzene	2.8 J	< 9.7 U	< 16 U
cis-1,2-Dichloroethene	0.59 J	2.5 J	14 J
Ethylbenzene	< 3.2 U	< 9.7 U	< 16 U
Tetrachloroethene	840	3100	5600
Toluene	5.7	< 9.7 U	< 16 U
trans-1,2-Dichloroethene	2.5 J	10	27
Trichloroethene	380	1200	2900
Vinyl chloride	< 3.2 U	< 9.7 U	< 16 U
Xylenes	0.98 J	< 9.7 U	< 16 U

SGP-3			
11/9/2010			
VOCs	6'	11'	16.26'
1,1,1-Trichloroethane	1.0 J	3.7	5.9
1,1-Dichloroethane	< 1.1 U	< 1.1 U	0.75 J
1,1-Dichloroethene	< 1.1 U	< 1.1 U	< 1.1 U
Benzene	< 1.1 U	0.27 J	0.31 J
cis-1,2-Dichloroethene	< 1.1 U	< 1.1 U	< 1.1 U
Ethylbenzene	0.65 J	< 1.1 U	< 1.1 U
Tetrachloroethene	6	15	25
Toluene	0.73 J	0.28 J	< 1.1 U
trans-1,2-Dichloroethene	< 1.1 U	< 1.1 U	0.46 J
Trichloroethene	1.6	13	23
Vinyl chloride	< 1.1 U	< 1.1 U	< 1.1 U
Xylenes	4.0	< 1.1 U	< 1.1 U

SGP-4			
11/10/2010			
VOCs	6'	11'	16.2'
1,1,1-Trichloroethane	2	3.3	7.3
1,1-Dichloroethane	< 1.1 U	< 1.6 U	< 2.5 U
1,1-Dichloroethene	< 1.1 U	< 1.6 U	< 2.5 U
Benzene	0.33 J	< 1.6 U	0.54 J
cis-1,2-Dichloroethene	< 1.1 U	< 1.6 U	< 2.5 U
Ethylbenzene	< 1.1 U	< 1.6 U	< 2.5 U
Tetrachloroethene	130	470	830
Toluene	1.3	< 5.8 U	< 2.5 U
trans-1,2-Dichloroethene	< 1.1 U	< 1.6 U	3.1
Trichloroethene	33	110	230
Vinyl chloride	< 1.1 U	< 1.6 U	< 2.5 U
Xylenes	< 1.1 U	< 1.6 U	< 2.5 U

SGP-7			
11/10/2010			
VOCs	6'	11'	15.65'
1,1,1-Trichloroethane	2.2	10	13
1,1-Dichloroethane	0.48 J	5.3	9.2
1,1-Dichloroethene	< 1.2 U	< 1.5 U	< 2.3 U
Benzene	2	0.56 J	0.53 J
cis-1,2-Dichloroethene	< 1.2 U	1.8	3.7
Ethylbenzene	43	< 1.5 U	< 2.3 U
Tetrachloroethene	100	500	700
Toluene	6.6	< 1.5 U	< 2.3 U
trans-1,2-Dichloroethene	< 1.2 U	< 1.5 U	< 2.3 U
Trichloroethene	30	200	310
Vinyl chloride	< 1.2 U	< 1.5 U	< 2.3 U
Xylenes	18.7	< 1.5 U	< 2.3 U

SGP-5				
11/11/2010				
VOCs	6'	11'	14.8'	14.8' DUP
1,1,1-Trichloroethane	0.16 J	34	62	54
1,1-Dichloroethane	< 1.1 U	8.4	31	27
1,1-Dichloroethene	< 1.1 U	< 6 U	< 12 U	< 9 U
Benzene	0.34 J	1.8 J	< 12 U	< 9 U
cis-1,2-Dichloroethene	< 1.1 U	7.9	35	34
Ethylbenzene	< 1.1 U	< 6 U	< 12 U	< 9 U
Tetrachloroethene	0.31 J	1800	3200	2700
Toluene	1.4	7.3 J	< 12 U	2.7 J
trans-1,2-Dichloroethene	< 1.1 U	< 6 U	< 12 U	< 9 U
Trichloroethene	0.49 J	600	1800	1600
Vinyl chloride	< 1.1 U	< 6 U	< 12 U	< 9 U
Xylenes	< 9.8 U	< 6 U	< 12 U	< 9 U

SGP-6			
11/11/2010			
VOCs	6'	11'	15'
1,1,1-Trichloroethane	3.8	11	24
1,1-Dichloroethane	< 1.2 U	< 1.2 U	0.48 J
1,1-Dichloroethene	< 1.2 U	< 1.2 U	< 1.2 U
Benzene	< 1.2 U	< 1.2 U	1.3
cis-1,2-Dichloroethene	< 1.2 U	< 1.2 U	< 1.2 U
Ethylbenzene	0.53 J	0.15 J	0.96 J
Tetrachloroethene	16	140	400
Toluene	4.4	0.27 J	4.2
trans-1,2-Dichloroethene	< 1.2 U	< 1.2 U	0.49 J
Trichloroethene	5.3	51	210
Vinyl chloride	< 1.2 U	< 1.2 U	< 1.2 U
Xylenes	2.12 J	0.24 J	1.55 J

SGP-8				
11/11/2010				
VOCs	6'	6' DUP	11'	14.25'
1,1,1-Trichloroethane	15	16	38	54
1,1-Dichloroethane	1.1	1.0 J	20	51
1,1-Dichloroethene	< 1.1 U	< 1.1 U	< 3.1 U	< 4.4 U
Benzene	0.35 J	0.33 J	1.5 J	1.9 J
cis-1,2-Dichloroethene	< 1.1 U	< 1.1 U	8.3	30
Ethylbenzene	< 1.1 U	< 1.1 U	< 3.1 U	< 4.4 U
Tetrachloroethene	240	250	850	1600
Toluene	0.32 J	< 1.1 U	0.98 J	1.4 J
trans-1,2-Dichloroethene	< 1.1 U	< 1.1 U	< 3.1 U	< 4.4 U
Trichloroethene	49	52	300	680
Vinyl chloride	< 1.1 U	< 1.1 U	< 3.1 U	< 4.4 U
Xylenes	< 1.1 U	< 1.1 U	< 3.1 U	< 4.4 U

SGP-9							
11/11/2010							
11/11/2010				3/31/2011			
VOCs	6'	11'	14.42'	6'	11'	11' DUP	14.42'
1,1,1-Trichloroethane	2	3	4.4	1.5	1.7	< 1.2 U	2.3
1,1-Dichloroethane	< 1.1 U	0.33 J	2.5	< 1.2 U	0.38 J	< 1.2 U	4.8
1,1-Dichloroethene	< 1.1 U	< 1.1 U	< 1.2 U	< 1.2 U	< 1.2 U	< 1.2 U	< 1.2 U
Benzene	0.24 J	0.45 J	0.53 J	< 1.2 U	< 1.2 U	< 1.2 U	0.46 J
cis-1,2-Dichloroethene	< 1.1 U	< 1.1 U	2.5	< 1.2 U	< 1.2 U	< 1.2 U	2.5
Ethylbenzene	< 1.1 U	< 1.1 U	< 1.2 U	< 1.2 U	< 1.2 U	< 1.2 U	< 1.2 U
Tetrachloroethene	6.4	12	43	5	9.9 J	< 1.2 U	22
Toluene	0.34 J	0.96 J	0.34 J	< 1.2 U	< 1.2 U	0.33 J	0.2 J
trans-1,2-Dichloroethene	< 1.1 U	< 1.1 U	< 1.2 U	< 1.2 U	< 1.2 U	< 1.2 U	0.47 J
Trichloroethene	12	32	88	10	22 J	< 1.2 U	49
Vinyl chloride	< 1.1 U	< 1.1 U	< 1.2 U	< 1.2 U	< 1.2 U	< 1.2 U	< 1.2 U
Xylenes	< 1.1 U	0.3 J	< 1.2 U	< 1.2 U	< 1.2 U	< 1.2 U	< 1.2 U

**LEGEND**

- SOIL-GAS SAMPLING POINT
- RACER PROPERTY BOUNDARY

SGP-4	SAMPLE IDENTIFICATION
11/10/10	DATE OF SAMPLE
11'	DEPTH IN FEET

- J ESTIMATED VALUE
- BOLD** CONCENTRATION ABOVE SCREENING LEVELS PRESENTED ON TABLES 2 AND 3
- < LESS THAN REPORTING LIMIT
- U LESS THAN REPORTING LIMIT
- UU THE CHEMICAL OF CONCERN WAS NOT DETECTED ABOVE THE REPORTED SAMPLE QUANTITATION LIMIT. HOWEVER, THE REPORTED LIMIT IS APPROXIMATE AND MAY OR MAY NOT REPRESENT THE ACTUAL LIMIT OF QUANTITATION.

VOCs VOLATILE ORGANIC COMPOUNDS

ALL CONCENTRATIONS IN PARTS PER BILLION BY VOLUME

RACER TRUST  
 MORAINE, OHIO  
 OH000294.2012

**SOIL-GAS SAMPLING POINT ANALYTICAL RESULTS SOUTHWEST OF SITE (NOVEMBER 2010 AND MARCH 2011)**

FIGURE  
**4**

ARCADIS

**Appendix A**

Soil Boring Logs



## SOIL BORING LOG

BORING NO.: **SGP-1**  
 TOTAL DEPTH: **25** feet bgs

### PROJECT INFORMATION

CLIENT: **RACER Trust**  
 PROJECT: **Vapor Intrusion Investigation**  
 CITY, STATE: **Moraine, Ohio**  
 PROJECT NUMBER: **OH000294.0018**  
 LOGGED BY: **Joe Rumschlag**

### DRILLING INFORMATION

DRILLING CO.: **EnviroCore**  
 DRILLER: **Chris Rismiller**  
 DRILLING METHOD: **Direct Push**  
 DATE STARTED: **10/26/2010**  
 DATE COMPLETED: **10/26/2010**

DEPTH (feet)	Recovery (inches)	PID (ppm)	Soil Symbols	USCS Classification	SOIL DESCRIPTION
0			// //	TOPSOIL	(0.0 - 0.3) TOPSOIL.
2					(0.3 - 9.8) Utility clearance.
4	N/A	N/A			
6					
8					
10	18	0.6	•••••	SW	(9.8 - 25.0) SAND with gravel, olive brown, well graded, medium to coarse, 15 to 25% fine to coarse gravel (2 inch), subrounded, trace silt, medium dense, moist to dry.
12		0.6	•••••		
14	28	0.6	•••••		Note: 15 to 25% fine gravel (1 inch) at 13 feet.
16		0.9	•••••		
18	18	0.6	•••••		Note: coarse sand at 17 feet.
20		0.9	•••••		Note: 2 inch layer moist to wet then cobbles (3 inch).

**Notes:**  
 bgs: below ground surface      NM: Not Measured      ppm: parts per million      Date: 8/13/2012  
 in.: inch      USCS: Unified Soil Classification System      PID: Photo-ionization Detector      Page: 1 of 2  
 \*Indicates sample submitted for laboratory analysis.      ft: feet



# SOIL BORING LOG

BORING NO.: **SGP-1**  
 TOTAL DEPTH: **25** feet bgs

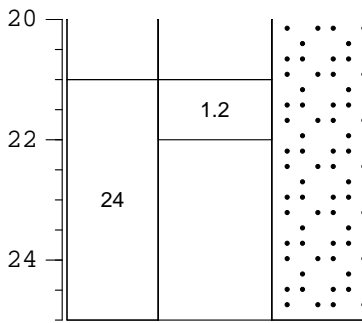
## PROJECT INFORMATION

CLIENT: **RACER Trust**  
 PROJECT: **Vapor Intrusion Investigation**  
 CITY, STATE: **Moraine, Ohio**  
 PROJECT NUMBER: **OH000294.0018**  
 LOGGED BY: **Joe Rumschlag**

## DRILLING INFORMATION

DRILLING CO.: **EnviroCore**  
 DRILLER: **Chris Rismiller**  
 DRILLING METHOD: **Direct Push**  
 DATE STARTED: **10/26/2010**  
 DATE COMPLETED: **10/26/2010**

DEPTH (feet)	Recovery (inches)	PID (ppm)	Soil Symbols	USCS Classification	SOIL DESCRIPTION
--------------	-------------------	-----------	--------------	---------------------	------------------



Note: increase silt content 10 to 20% at 22 feet.  
 Note: soil becomes saturated at 22.5 feet.

End of boring at 25 feet. \* Note: Screen set from 22.5 to 26.5 feet below land surface and groundwater sampled via low-flow methodology on 10/26/2010 at 1015.

**Notes:**

bgs: below ground surface      NM: Not Measured  
 in.: inch                              USCS: Unified Soil Classification System  
 \*Indicates sample submitted for laboratory analysis.

ppm: parts per million  
 PID: Photo-ionization Detector  
 ft: feet

Date: 8/13/2012  
 Page: 2 of 2



### SOIL BORING LOG

BORING NO.: **SGP-2**  
 TOTAL DEPTH: **25** feet bgs

#### PROJECT INFORMATION

CLIENT: **RACER Trust**  
 PROJECT: **Vapor Intrusion Investigation**  
 CITY, STATE: **Moraine, Ohio**  
 PROJECT NUMBER: **OH000294.0018**  
 LOGGED BY: **Joe Rumschlag**

#### DRILLING INFORMATION

DRILLING CO.: **EnviroCore**  
 DRILLER: **Chris Rismiller**  
 DRILLING METHOD: **Direct Push**  
 DATE STARTED: **10/25/2010**  
 DATE COMPLETED: **10/25/2010**

DEPTH (feet)	Recovery (inches)	PID (ppm)	Soil Symbols	USCS Classification	SOIL DESCRIPTION
0				TOPSOIL	(0.0 - 0.3) TOPSOIL. (0.3 - 9.0) Utility clearance.
0 - 9.0	N/A	N/A			
9.0 - 10.0	19	0.7	•••••	SW	(9.0 - 25.0) Silty SAND with gravel, olive brown, well graded, medium to coarse, 15 to 25% fine gravel (1.5 inch subrounded), 10 to 20% silt, dense, dry.  Note: coarse gravel in liner (2 inch) at 13.5 feet.
10.0 - 12.0		1.1	•••••		
12.0 - 14.0	12	1.4	•••••		
14.0 - 16.0		NM	•••••		
16.0 - 18.0		NM	•••••		
18.0 - 20.0	NM	NM	•••••		

**Notes:**  
 bgs: below ground surface      NM: Not Measured      ppm: parts per million      Date: 8/13/2012  
 in.: inch      USCS: Unified Soil Classification System      PID: Photo-ionization Detector      Page: 1 of 2  
 \*Indicates sample submitted for laboratory analysis.      ft: feet



# SOIL BORING LOG

BORING NO.: **SGP-2**  
 TOTAL DEPTH: **25** feet bgs

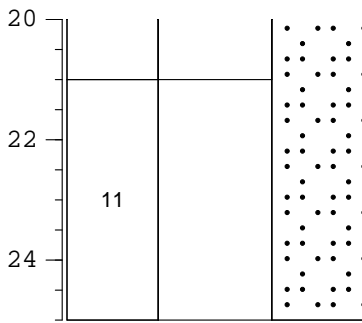
## PROJECT INFORMATION

CLIENT: **RACER Trust**  
 PROJECT: **Vapor Intrusion Investigation**  
 CITY, STATE: **Moraine, Ohio**  
 PROJECT NUMBER: **OH000294.0018**  
 LOGGED BY: **Joe Rumschlag**

## DRILLING INFORMATION

DRILLING CO.: **EnviroCore**  
 DRILLER: **Chris Rismiller**  
 DRILLING METHOD: **Direct Push**  
 DATE STARTED: **10/25/2010**  
 DATE COMPLETED: **10/25/2010**

DEPTH (feet)	Recovery (inches)	PID (ppm)	Soil Symbols	USCS Classification	SOIL DESCRIPTION
--------------	-------------------	-----------	--------------	---------------------	------------------



Note: wet at 22 feet.

End of boring at 25 feet. \* Note: Screen set from 22 to 26 feet below land surface and groundwater sampled via low-flow methodology on 10/25/2010 at 1117.

**Notes:**

bgs: below ground surface      NM: Not Measured  
 in.: inch                              USCS: Unified Soil Classification System  
 \*Indicates sample submitted for laboratory analysis.

ppm: parts per million  
 PID: Photo-ionization Detector  
 ft: feet

Date: 8/13/2012  
 Page: 2 of 2



# SOIL BORING LOG

BORING NO.: **SGP-3**  
 TOTAL DEPTH: **25** feet bgs

## PROJECT INFORMATION

CLIENT: **RACER Trust**  
 PROJECT: **Vapor Intrusion Investigation**  
 CITY, STATE: **Moraine, Ohio**  
 PROJECT NUMBER: **OH000294.0018**  
 LOGGED BY: **Joe Rumschlag**

## DRILLING INFORMATION

DRILLING CO.: **EnviroCore**  
 DRILLER: **Chris Rismiller**  
 DRILLING METHOD: **Direct Push**  
 DATE STARTED: **10/20/2010**  
 DATE COMPLETED: **10/20/2010**

DEPTH (feet)	Recovery (inches)	PID (ppm)	Soil Symbols	USCS Classification	SOIL DESCRIPTION
0				TOPSOIL	(0.0 - 0.3) TOPSOIL. (0.3 - 9.0) Utility clearance.
4	N/A	N/A			
10	22	0.5		SW	(9.0 - 25.0) SAND with gravel, olive brown, well graded, medium, 20 to 30% fine to coarse gravel (1.5 inch), trace silt, dense, dry to moist.
12		0.8			
14	27	0.5			
16		0.2			
18		0.2			
20	32	0.2			

**Notes:**  
 bgs: below ground surface      NM: Not Measured      ppm: parts per million      Date: 8/13/2012  
 in.: inch      USCS: Unified Soil Classification System      PID: Photo-ionization Detector      Page: 1 of 2  
 \*Indicates sample submitted for laboratory analysis.      ft: feet



# SOIL BORING LOG

BORING NO.: **SGP-3**  
 TOTAL DEPTH: **25** feet bgs

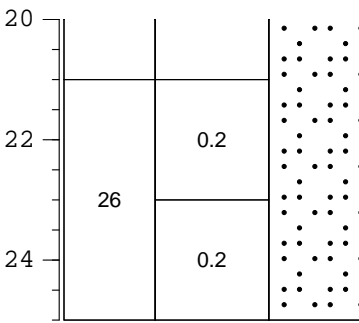
## PROJECT INFORMATION

CLIENT: **RACER Trust**  
 PROJECT: **Vapor Intrusion Investigation**  
 CITY, STATE: **Moraine, Ohio**  
 PROJECT NUMBER: **OH000294.0018**  
 LOGGED BY: **Joe Rumschlag**

## DRILLING INFORMATION

DRILLING CO.: **EnviroCore**  
 DRILLER: **Chris Rismiller**  
 DRILLING METHOD: **Direct Push**  
 DATE STARTED: **10/20/2010**  
 DATE COMPLETED: **10/20/2010**

DEPTH (feet)	Recovery (inches)	PID (ppm)	Soil Symbols	USCS Classification	SOIL DESCRIPTION
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Note: soil becomes saturated, increase in silt content to 10 to 15% at 21 feet.

End of boring at 25 feet. \* Note: Screen set from 21 to 25 feet below land surface and groundwater sampled via low-flow methodology on 10/20/10 at 1125.

**Notes:**

bgs: below ground surface      NM: Not Measured  
 in.: inch      USCS: Unified Soil Classification System  
 \*Indicates sample submitted for laboratory analysis.

ppm: parts per million  
 PID: Photo-ionization Detector  
 ft: feet

Date: 8/13/2012  
 Page: 2 of 2



# SOIL BORING LOG

BORING NO.: **SGP-4**  
 TOTAL DEPTH: **25** feet bgs

## PROJECT INFORMATION

CLIENT: **RACER Trust**  
 PROJECT: **Vapor Intrusion Investigation**  
 CITY, STATE: **Moraine, Ohio**  
 PROJECT NUMBER: **OH000294.0018**  
 LOGGED BY: **Joe Rumschlag**

## DRILLING INFORMATION

DRILLING CO.: **EnviroCore**  
 DRILLER: **Chris Rismiller**  
 DRILLING METHOD: **Direct Push**  
 DATE STARTED: **10/22/2010**  
 DATE COMPLETED: **10/22/2010**

DEPTH (feet)	Recovery (inches)	PID (ppm)	Soil Symbols	USCS Classification	SOIL DESCRIPTION
0				TOPSOIL	(0.0 - 0.3) TOPSOIL. (0.3 - 8.5) Utility clearance.
4	N/A	N/A			
8.5				SW	(8.5 - 21.0) Silty SAND with gravel, olive brown, well graded, coarse, 20 to 30% fine gravel (1 inch), subrounded, 10 to 15% silt, moist.
10	12	0.0			
12		0.1			
13		0.1			Note: trace coarse gravel (2 inch) at 13 feet.
14	22	0.1			
16		0.1			Note: 3 inch layer with 30 to 40% fine gravel (0.5 inch) at 16.5 feet.
18		0.4			Note: increase silt content to 10 to 20% at 18 feet.
20	NM	0.4			

**Notes:**  
 bgs: below ground surface      NM: Not Measured      ppm: parts per million      Date: 8/13/2012  
 in.: inch      USCS: Unified Soil Classification System      PID: Photo-ionization Detector      Page: 1 of 2  
 \*Indicates sample submitted for laboratory analysis.      ft: feet



# SOIL BORING LOG

BORING NO.: **SGP-4**  
 TOTAL DEPTH: **25** feet bgs

## PROJECT INFORMATION

CLIENT: **RACER Trust**  
 PROJECT: **Vapor Intrusion Investigation**  
 CITY, STATE: **Moraine, Ohio**  
 PROJECT NUMBER: **OH000294.0018**  
 LOGGED BY: **Joe Rumschlag**

## DRILLING INFORMATION

DRILLING CO.: **EnviroCore**  
 DRILLER: **Chris Rismiller**  
 DRILLING METHOD: **Direct Push**  
 DATE STARTED: **10/22/2010**  
 DATE COMPLETED: **10/22/2010**

DEPTH (feet)	Recovery (inches)	PID (ppm)	Soil Symbols	USCS Classification	SOIL DESCRIPTION
20					
22	20	0.8	[Soil Symbols]	SW	(21.0 - 23.5) SAND with gravel, olive brown, well graded, fine to medium, 10 to 20% fine gravel, subrounded, trace coarse gravel, subrounded, moist.
24			[Soil Symbols]	SW	(23.5 - 25.0) Silty SAND with gravel, olive brown, well graded, 30 to 40% fine gravel, 10 to 20% silt, wet.
<p>End of boring at 25 feet. *Note: Screen set from 23.5 to 27.5 feet below land surface and groundwater sampled via low-flow methodology on 10/22/2010 at 1053.</p>					



## SOIL BORING LOG

BORING NO.: **SGP-5**  
 TOTAL DEPTH: **25** feet bgs

### PROJECT INFORMATION

CLIENT: **RACER Trust**  
 PROJECT: **Vapor Intrusion Investigation**  
 CITY, STATE: **Moraine, Ohio**  
 PROJECT NUMBER: **OH000294.0018**  
 LOGGED BY: **Trey Fortner**

### DRILLING INFORMATION

DRILLING CO.: **EnviroCore**  
 DRILLER: **Chris Rismiller**  
 DRILLING METHOD: **Direct Push**  
 DATE STARTED: **10/29/2010**  
 DATE COMPLETED: **10/29/2010**

DEPTH (feet)	Recovery (inches)	PID (ppm)	Soil Symbols	USCS Classification	SOIL DESCRIPTION
0			TOPSOIL		(0.0 - 0.3) TOPSOIL.  (0.3 - 9.3) Utility clearance.
2					
4	N/A	N/A			
6					
8					
10	6	N/A			(9.3 - 13.0) Very little recovery, broken limestone cobbles, little sand, medium to coarse (subangular), dry.
12					
14	21	1.0	•••••	SW	(13.0 - 19.6) SAND with cobbles, brown, medium to coarse sand (subangular), broken up cobbles, little silt, dry, loose.
16	13		•••••		
18	24	1.0	•••••		
20	0.4		•••••	SW	(19.6 - 25.0) Gravelly SAND, brown, fine to coarse sand (subangular), 30% fine to medium

**Notes:**  
 bgs: below ground surface      NM: Not Measured      ppm: parts per million      Date: 8/13/2012  
 in.: inch      USCS: Unified Soil Classification System      PID: Photo-ionization Detector      Page: 1 of 2  
 \*Indicates sample submitted for laboratory analysis.      ft: feet



# SOIL BORING LOG

BORING NO.: **SGP-5**  
 TOTAL DEPTH: **25** feet bgs

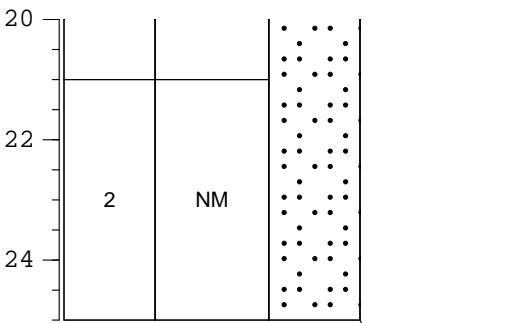
## PROJECT INFORMATION

CLIENT: **RACER Trust**  
 PROJECT: **Vapor Intrusion Investigation**  
 CITY, STATE: **Moraine, Ohio**  
 PROJECT NUMBER: **OH000294.0018**  
 LOGGED BY: **Trey Fortner**

## DRILLING INFORMATION

DRILLING CO.: **EnviroCore**  
 DRILLER: **Chris Rismiller**  
 DRILLING METHOD: **Direct Push**  
 DATE STARTED: **10/29/2010**  
 DATE COMPLETED: **10/29/2010**

DEPTH (feet)	Recovery (inches)	PID (ppm)	Soil Symbols	USCS Classification	SOIL DESCRIPTION
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gravel (subangular to subrounded), dry, loose, well graded.

Note: very little recovery, wet broken cobbles.

End of boring at 25 feet. \* Note: Screen set from 23 to 27 feet below land surface and groundwater sampled via low-flow methodology on 10/29/2010 at 1015.

**Notes:**

bgs: below ground surface  
 in.: inch  
 \*Indicates sample submitted for laboratory analysis.

ppm: parts per million  
 PID: Photo-ionization Detector  
 ft: feet

Date: 8/13/2012  
 Page: 2 of 2



# SOIL BORING LOG

BORING NO.: **SGP-6**  
 TOTAL DEPTH: **25** feet bgs

## PROJECT INFORMATION

CLIENT: **RACER Trust**  
 PROJECT: **Vapor Intrusion Investigation**  
 CITY, STATE: **Moraine, Ohio**  
 PROJECT NUMBER: **OH000294.0018**  
 LOGGED BY: **Trey Fortner**

## DRILLING INFORMATION

DRILLING CO.: **EnviroCore**  
 DRILLER: **Chris Rismiller**  
 DRILLING METHOD: **Direct Push**  
 DATE STARTED: **10/28/2010**  
 DATE COMPLETED: **10/28/2010**

DEPTH (feet)	Recovery (inches)	PID (ppm)	Soil Symbols	USCS Classification	SOIL DESCRIPTION
0				TOPSOIL	(0.0 - 0.3) TOPSOIL. (0.3 - 10.0) Utility clearance.
0 - 10	N/A	N/A			
10	10	0.0	•••••	SW	(10.0 - 13.0) SAND with gravel, brown, medium to coarse sand (subangular), fine to medium gravel (subrounded to subangular), loose, well graded, dry.
13	4	NM			(13.0 - 13.5) Hit cobble, broken limestone cobble. Refusal, return push slight offset.
14	7	0.0	•••••	SW	(13.5 - 15.0) SAND with gravel, light brown, fine to coarse sand (subangular to subrounded), 30% fine to medium gravel (subrounded to subangular), trace silt, dry, medium dense, well graded.
15 - 17	NR	NM			(15.0 - 17.0) No recovery, cobbles.
17 - 20	6	0.0	•••••	SW	(17.0 - 25.0) SAND with gravel, light brown, fine to coarse sand (subangular to subrounded), 30% fine to coarse gravel (subrounded to subangular), trace silt, dry, medium dense, well graded.
20		0.0	•••••		



# SOIL BORING LOG

BORING NO.: **SGP-6**  
 TOTAL DEPTH: **25** feet bgs

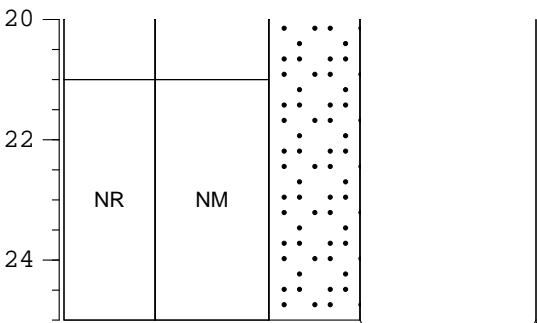
## PROJECT INFORMATION

CLIENT: **RACER Trust**  
 PROJECT: **Vapor Intrusion Investigation**  
 CITY, STATE: **Moraine, Ohio**  
 PROJECT NUMBER: **OH000294.0018**  
 LOGGED BY: **Trey Fortner**

## DRILLING INFORMATION

DRILLING CO.: **EnviroCore**  
 DRILLER: **Chris Rismiller**  
 DRILLING METHOD: **Direct Push**  
 DATE STARTED: **10/28/2010**  
 DATE COMPLETED: **10/28/2010**

DEPTH (feet)	Recovery (inches)	PID (ppm)	Soil Symbols	USCS Classification	SOIL DESCRIPTION
--------------	-------------------	-----------	--------------	---------------------	------------------



End of boring at 25 feet. \* Note: Screen set from 22 to 26 feet below land surface and groundwater sampled via low-flow methodology on 10/28/2010 at 1115.

**Notes:**

bgs: below ground surface  
 in.: inch  
 \*Indicates sample submitted for laboratory analysis.

NM: Not Measured  
 USCS: Unified Soil Classification System

ppm: parts per million  
 PID: Photo-ionization Detector  
 ft: feet

Date: 8/13/2012  
 Page: 2 of 2



# SOIL BORING LOG

BORING NO.: **SGP-7**  
 TOTAL DEPTH: **25** feet bgs

## PROJECT INFORMATION

CLIENT: **RACER Trust**  
 PROJECT: **Vapor Intrusion Investigation**  
 CITY, STATE: **Moraine, Ohio**  
 PROJECT NUMBER: **OH000294.0018**  
 LOGGED BY: **Joe Rumschlag**

## DRILLING INFORMATION

DRILLING CO.: **EnviroCore**  
 DRILLER: **Chris Rismiller**  
 DRILLING METHOD: **Direct Push**  
 DATE STARTED: **10/21/2010**  
 DATE COMPLETED: **10/21/2010**

DEPTH (feet)	Recovery (inches)	PID (ppm)	Soil Symbols	USCS Classification	SOIL DESCRIPTION
0				TOPSOIL	(0.0 - 0.3) TOPSOIL.
0.3 - 10.0					(0.3 - 10.0) Utility clearance. Note: silty sand with gravel and clay at 0.25 feet.
4					Note: silty sand with gravel at 4 feet.
6					Note: sand with gravel at 6 feet.
10 - 25.0				SW	(10.0 - 25.0) Silty SAND with gravel, olive brown, well graded, medium, 15 to 25% gravel (1.5 inch), trace coarse gravel, trace silt, moist to dry.
12	12	0.8	•••••		
14	14	1.1	•••••		
16		0.8	•••••		
18		1.1	•••••		Note: coarse gravel increases to 10 to 15% at 17 feet.
19	19	1.1	•••••		
20		1.1	•••••		

**Notes:**  
 bgs: below ground surface      NM: Not Measured      ppm: parts per million      Date: 8/13/2012  
 in.: inch      USCS: Unified Soil Classification System      PID: Photo-ionization Detector      Page: 1 of 2  
 \*Indicates sample submitted for laboratory analysis.      ft: feet



## SOIL BORING LOG

BORING NO.: **SGP-7**  
 TOTAL DEPTH: **25** feet bgs

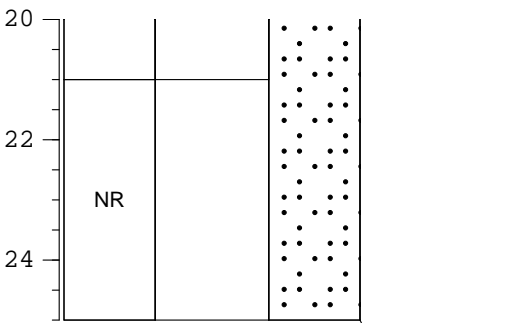
### PROJECT INFORMATION

CLIENT: **RACER Trust**  
 PROJECT: **Vapor Intrusion Investigation**  
 CITY, STATE: **Moraine, Ohio**  
 PROJECT NUMBER: **OH000294.0018**  
 LOGGED BY: **Joe Rumschlag**

### DRILLING INFORMATION

DRILLING CO.: **EnviroCore**  
 DRILLER: **Chris Rismiller**  
 DRILLING METHOD: **Direct Push**  
 DATE STARTED: **10/21/2010**  
 DATE COMPLETED: **10/21/2010**

DEPTH (feet)	Recovery (inches)	PID (ppm)	Soil Symbols	USCS Classification	SOIL DESCRIPTION
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Note: drilling changer, easier push, confirmed water at this level with water level meter.

End of boring at 25 feet. \* Note: Screen set from 21 to 25 feet below land surface and groundwater sampled via low-flow methodology on 10/21/2010 at 1122.

**Notes:**

bgs: below ground surface      NM: Not Measured  
 in.: inch                              USCS: Unified Soil Classification System  
 \*Indicates sample submitted for laboratory analysis.

ppm: parts per million  
 PID: Photo-ionization Detector  
 ft: feet

Date: 8/13/2012  
 Page: 2 of 2



# SOIL BORING LOG

BORING NO.: **SGP-8**  
 TOTAL DEPTH: **25** feet bgs

## PROJECT INFORMATION

CLIENT: **RACER Trust**  
 PROJECT: **Vapor Intrusion Investigation**  
 CITY, STATE: **Moraine, Ohio**  
 PROJECT NUMBER: **OH000294.0018**  
 LOGGED BY: **Joe Rumschlag**

## DRILLING INFORMATION

DRILLING CO.: **EnviroCore**  
 DRILLER: **Chris Rismiller**  
 DRILLING METHOD: **Direct Push**  
 DATE STARTED: **11/1/2010**  
 DATE COMPLETED: **11/1/2010**

DEPTH (feet)	Recovery (inches)	PID (ppm)	Soil Symbols	USCS Classification	SOIL DESCRIPTION
0				TOPSOIL	(0.0 - 0.3) TOPSOIL. (0.3 - 9.7) Utility clearance.
0 - 10	N/A	N/A			
10 - 13.5	19	0.6	•••••	SW-SM	(9.7 - 25.0) SILTY SAND with gravel, olive brown, well graded, medium, 20 to 30% fine coarse gravel (2 inch) subrounded, 10 to 20% silt, medium dense, moist to dry.
13.5 - 15	23	0.3	•••••		Note: silt content decrease to 10 to 15% at 13.5 feet.
15 - 17		0.6	•••••		
17 - 19	16	1.0	•••••		
19 - 20		1.3	•••••		

**Notes:**  
 bgs: below ground surface      NM: Not Measured      ppm: parts per million      Date: 8/13/2012  
 in.: inch      USCS: Unified Soil Classification System      PID: Photo-ionization Detector      Page: 1 of 2  
 \*Indicates sample submitted for laboratory analysis.      ft: feet



## SOIL BORING LOG

BORING NO.: **SGP-8**  
 TOTAL DEPTH: **25** feet bgs

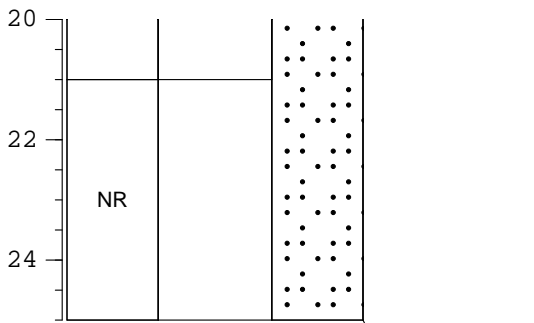
### PROJECT INFORMATION

CLIENT: **RACER Trust**  
 PROJECT: **Vapor Intrusion Investigation**  
 CITY, STATE: **Moraine, Ohio**  
 PROJECT NUMBER: **OH000294.0018**  
 LOGGED BY: **Joe Rumschlag**

### DRILLING INFORMATION

DRILLING CO.: **EnviroCore**  
 DRILLER: **Chris Rismiller**  
 DRILLING METHOD: **Direct Push**  
 DATE STARTED: **11/1/2010**  
 DATE COMPLETED: **11/1/2010**

DEPTH (feet)	Recovery (inches)	PID (ppm)	Soil Symbols	USCS Classification	SOIL DESCRIPTION
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Note: moist to wet at 21 feet.  
 Note: soil becomes wet at 21.5 feet.

End of boring at 25 feet. \* Note: Screen set from 21.5 to 25.5 feet below land surface and groundwater sampled via low-flow methodology on 11/01/2010 at 1010.



## SOIL BORING LOG

BORING NO.: **SGP-9**  
 TOTAL DEPTH: **25** feet bgs

### PROJECT INFORMATION

CLIENT: **RACER Trust**  
 PROJECT: **Vapor Intrusion Investigation**  
 CITY, STATE: **Moraine, Ohio**  
 PROJECT NUMBER: **OH000294.0018**  
 LOGGED BY: **Trey Fortner**

### DRILLING INFORMATION

DRILLING CO.: **EnviroCore**  
 DRILLER: **Chris Rismiller**  
 DRILLING METHOD: **Direct Push**  
 DATE STARTED: **10/27/2010**  
 DATE COMPLETED: **10/27/2010**

DEPTH (feet)	Recovery (inches)	PID (ppm)	Soil Symbols	USCS Classification	SOIL DESCRIPTION
0				TOPSOIL	(0.0 - 0.3) TOPSOIL.  (0.3 - 11.3) Utility clearance.
2					
4					
6	N/A	N/A			
8					
10					
12	12	0.0	•••••	SW	(11.3 - 21.0) SAND with gravel, brown, medium to coarse sand (subangular), 20% fine to medium gravel (subrounded to subangular), dry, loose.
14		0.0	•••••		
16	16	0.0	•••••		
18		0.0	•••••		
20	16	0.0	•••••		

**Notes:**  
 bgs: below ground surface      NM: Not Measured      ppm: parts per million      Date: 8/13/2012  
 in.: inch      USCS: Unified Soil Classification System      PID: Photo-ionization Detector      Page: 1 of 2  
 \*Indicates sample submitted for laboratory analysis.      ft: feet



**SOIL BORING LOG**

BORING NO.: **SGP-9**  
 TOTAL DEPTH: **25 feet bgs**

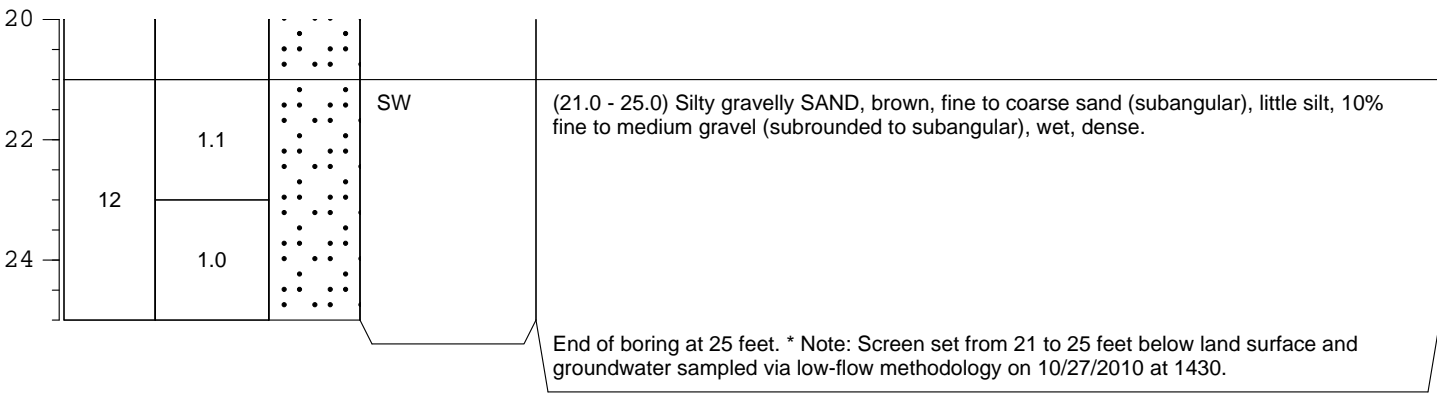
**PROJECT INFORMATION**

**DRILLING INFORMATION**

CLIENT: **RACER Trust**  
 PROJECT: **Vapor Intrusion Investigation**  
 CITY, STATE: **Moraine, Ohio**  
 PROJECT NUMBER: **OH000294.0018**  
 LOGGED BY: **Trey Fortner**

DRILLING CO.: **EnviroCore**  
 DRILLER: **Chris Rismiller**  
 DRILLING METHOD: **Direct Push**  
 DATE STARTED: **10/27/2010**  
 DATE COMPLETED: **10/27/2010**

DEPTH (feet)	Recovery (inches)	PID (ppm)	Soil Symbols	USCS Classification	SOIL DESCRIPTION
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# SOIL BORING LOG

BORING NO.: **SGP-10**  
 TOTAL DEPTH: **31.5 feet bgs**

## PROJECT INFORMATION

CLIENT: **RACER Trust**  
 PROJECT: **Vapor Intrusion Investigation**  
 CITY, STATE: **Moraine, Ohio**  
 PROJECT NUMBER: **OH000294.0018**  
 LOGGED BY: **Joe Rumschlag**

## DRILLING INFORMATION

DRILLING CO.: **EnviroCore**  
 DRILLER: **Chris Rismiller**  
 DRILLING METHOD: **Direct Push**  
 DATE STARTED: **10/26/2010**  
 DATE COMPLETED: **10/27/2010**

DEPTH (feet)	Recovery (inches)	PID (ppm)	Soil Symbols	USCS Classification	SOIL DESCRIPTION
0				TOPSOIL	(0.0 - 0.3) TOPSOIL. (0.3 - 8.5) Utility clearance.
0 - 8.5	N/A	N/A			
8.5 - 12.5	28	0.0		SW-SM	(8.5 - 12.5) SILTY SAND with gravel, olive brown, well graded, medium, 15 to 25% fine gravel (1.5 inch) subrounded, 15 to 25% silt, dense, moist.
12.5 - 13.5	12	0.0		CL-ML	(12.5 - 13.5) CLAYEY SILT with gravel, olive brown, low plasticity, stiff to very stiff, 10 to 20%, fine gravel, moist to dry.
13.5 - 20.0	48	0.0		SW-SM	(13.5 - 30.5) Limestone cobbles, then SILTY SAND with gravel, olive brown, well graded, medium, 20 to 30% fine to coarse gravel (2.5 inch), 10 to 20% silt, trace cobbles,

**Notes:**

bgs: below ground surface      NM: Not Measured  
 in.: inch                              USCS: Unified Soil Classification System  
 \*Indicates sample submitted for laboratory analysis.

ppm: parts per million  
 PID: Photo-ionization Detector  
 ft: feet

Date: 8/13/2012  
 Page: 1 of 2



# SOIL BORING LOG

BORING NO.: **SGP-10**  
 TOTAL DEPTH: **31.5 feet bgs**

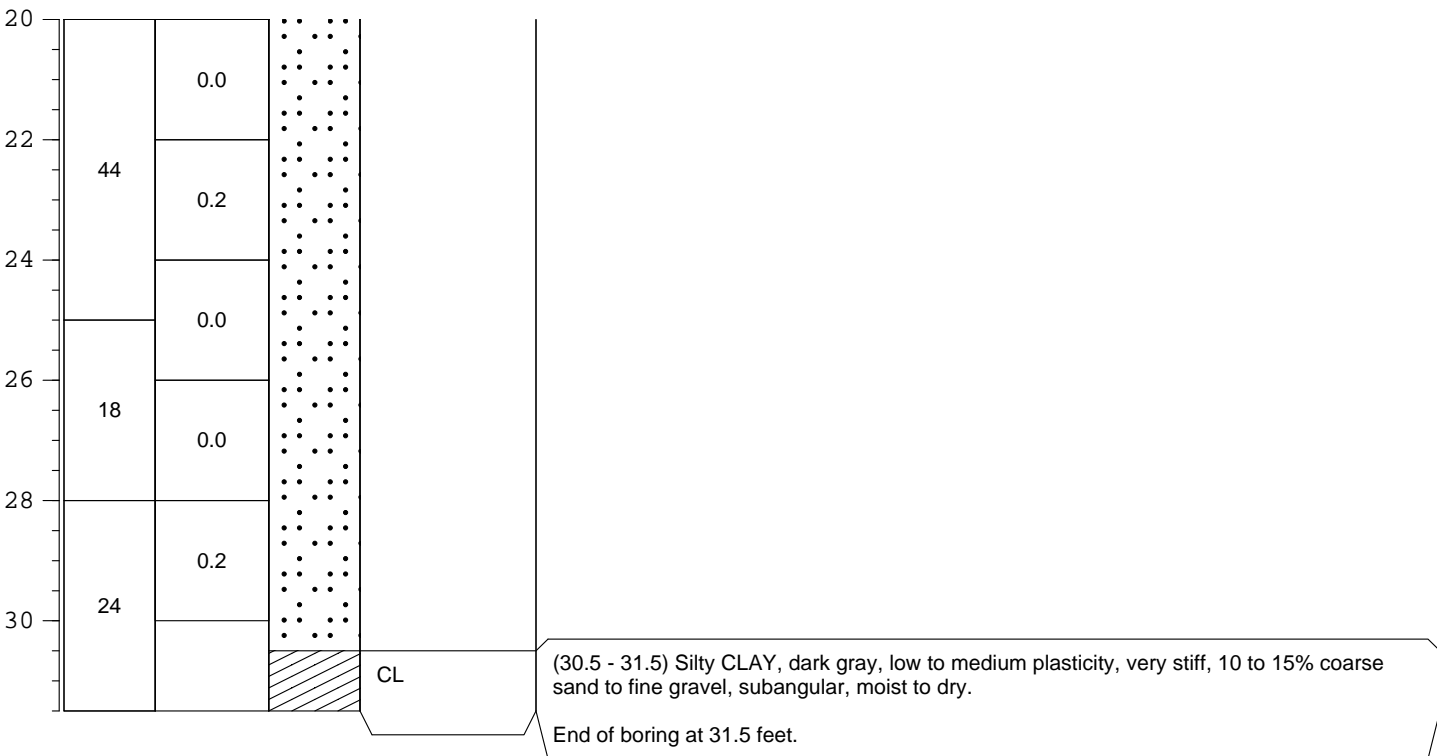
## PROJECT INFORMATION

CLIENT: **RACER Trust**  
 PROJECT: **Vapor Intrusion Investigation**  
 CITY, STATE: **Moraine, Ohio**  
 PROJECT NUMBER: **OH000294.0018**  
 LOGGED BY: **Joe Rumschlag**

## DRILLING INFORMATION

DRILLING CO.: **EnviroCore**  
 DRILLER: **Chris Rismiller**  
 DRILLING METHOD: **Direct Push**  
 DATE STARTED: **10/26/2010**  
 DATE COMPLETED: **10/27/2010**

DEPTH (feet)	Recovery (inches)	PID (ppm)	Soil Symbols	USCS Classification	SOIL DESCRIPTION
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### Notes:

bgs: below ground surface  
 in.: inch  
 \*Indicates sample submitted for laboratory analysis.

NM: Not Measured  
 USCS: Unified Soil Classification System

ppm: parts per million  
 PID: Photo-ionization Detector  
 ft: feet

Date: 8/13/2012  
 Page: 2 of 2



# SOIL BORING LOG

BORING NO.: **SGP-11**  
 TOTAL DEPTH: **19.25 feet bgs**

## PROJECT INFORMATION

CLIENT: **RACER Trust**  
 PROJECT: **Vapor Intrusion Investigation**  
 CITY, STATE: **Moraine, Ohio**  
 PROJECT NUMBER: **OH000294.0018**  
 LOGGED BY: **Joe Rumschlag**

## DRILLING INFORMATION

DRILLING CO.: **EnviroCore**  
 DRILLER: **Chris Rismiller**  
 DRILLING METHOD: **Direct Push**  
 DATE STARTED: **11/2/2010**  
 DATE COMPLETED: **11/2/2010**

DEPTH (feet)	Recovery (inches)	PID (ppm)	Soil Symbols	USCS Classification	SOIL DESCRIPTION
0				TOPSOIL	(0.0 - 0.3) TOPSOIL.
0.3 - 9.3					(0.3 - 9.3) Utility clearance.
0 - 9.3	N/A	N/A			
9.3 - 19.25				SW-SM	(9.3 - 19.3) SILTY SAND with gravel, olive brown, well graded, medium, 15 to 25% coarse sand to fine gravel, subrounded, 10 to 20% silt, trace coarse gravel (1.5 inch), loose, moist.
9.3 - 11.0	23	0.1	•••••		
11.0 - 13.0		0.8	•••••		
13.0 - 14.5	27	0.1	•••••		Note: 15 to 25% fine to coarse gravel, 15 to 25% silt at 13.5 feet.
14.5 - 16.0		0.8	•••••		
16.0 - 18.0	33	1.1	•••••		
18.0 - 19.25					Probe refusal at 19.25 feet.



## SOIL BORING LOG

BORING NO.: **SGP-12**  
 TOTAL DEPTH: **33** feet bgs

### PROJECT INFORMATION

CLIENT: **RACER Trust**  
 PROJECT: **Vapor Intrusion Investigation**  
 CITY, STATE: **Moraine, Ohio**  
 PROJECT NUMBER: **OH000294.0018**  
 LOGGED BY: **Joe Rumschlag**

### DRILLING INFORMATION

DRILLING CO.: **EnviroCore**  
 DRILLER: **Chris Rismiller**  
 DRILLING METHOD: **Direct Push**  
 DATE STARTED: **11/1/2010**  
 DATE COMPLETED: **11/2/2010**

DEPTH (feet)	Recovery (inches)	PID (ppm)	Soil Symbols	USCS Classification	SOIL DESCRIPTION
0			// //	TOPSOIL	(0.0 - 0.3) TOPSOIL.  (0.3 - 9.6) Utility clearance.
2					
4	N/A	N/A			
6					
8					
10	33	1.0	•••••	SW-SM	(9.6 - 16.0) SILTY SAND with gravel, olive brown, well graded, medium, 20 to 30% fine gravel, subrounded, 10 to 20% silt, dense, moist.
12					
14	17	0.3	•••••		Note: 10 to 20% fine gravel (0.5 inch), trace to 10% silt, loose at 13 feet.
16		0.6	•••••		
18		1.0	•••••	SP	(16.0 - 23.0) SAND, olive brown, poorly graded, medium, trace silt, trace fine gravel, subrounded, moist.
20	26	0.3	•••••		

**Notes:**  
 bgs: below ground surface      NM: Not Measured      ppm: parts per million      Date: 8/13/2012  
 in.: inch      USCS: Unified Soil Classification System      PID: Photo-ionization Detector      Page: 1 of 2  
 \*Indicates sample submitted for laboratory analysis.      ft: feet



# SOIL BORING LOG

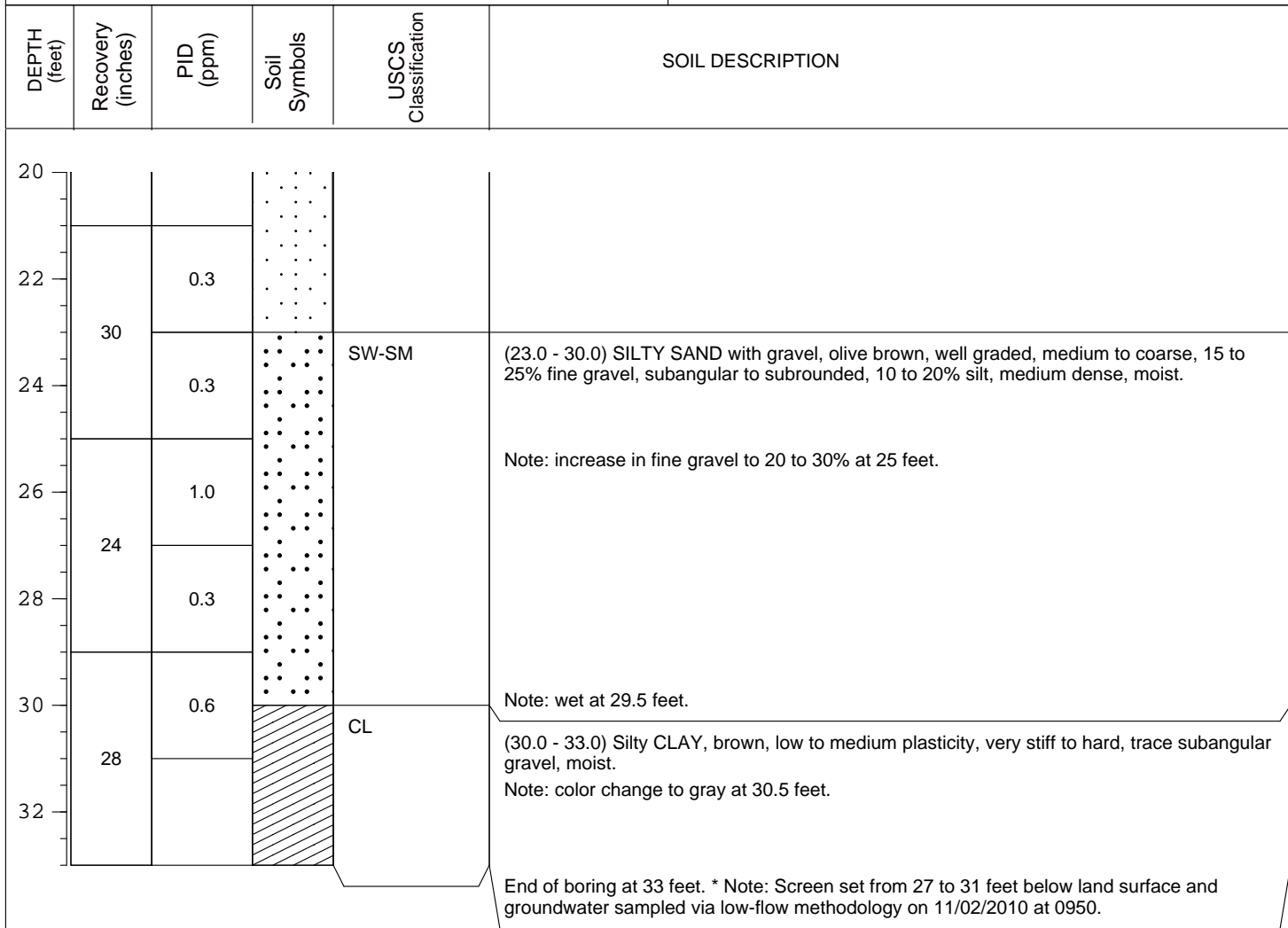
BORING NO.: **SGP-12**  
 TOTAL DEPTH: **33 feet bgs**

## PROJECT INFORMATION

CLIENT: **RACER Trust**  
 PROJECT: **Vapor Intrusion Investigation**  
 CITY, STATE: **Moraine, Ohio**  
 PROJECT NUMBER: **OH000294.0018**  
 LOGGED BY: **Joe Rumschlag**

## DRILLING INFORMATION

DRILLING CO.: **EnviroCore**  
 DRILLER: **Chris Rismiller**  
 DRILLING METHOD: **Direct Push**  
 DATE STARTED: **11/1/2010**  
 DATE COMPLETED: **11/2/2010**

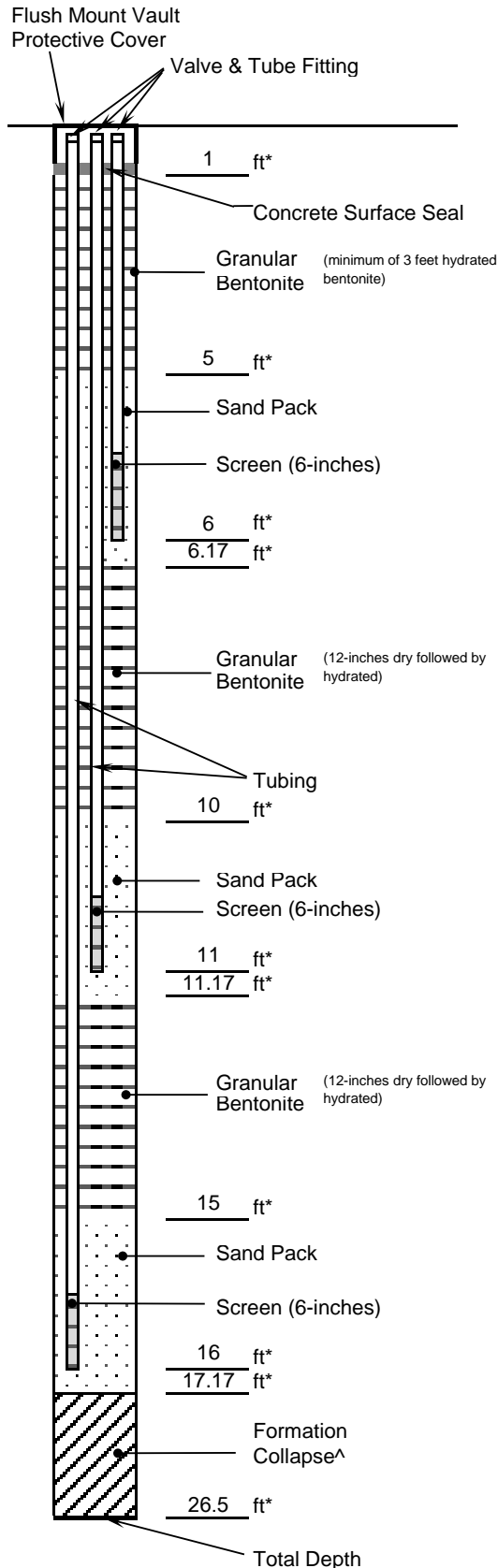


ARCADIS

## **Appendix B**

Soil-Gas Point Construction  
Diagrams

## SOIL-GAS POINT CONSTRUCTION DIAGRAM



RACER Trust Vapor Intrusion  
 Project: Verification Investigation Point: SGP-1

City: Moraine

County: Montgomery State: OH

Survey Coordinates:  
 Northing: 620247.03  
 Easting: 1482316.13

Land-Surface Elevation (surveyed): 726.90 feet  
 (above mean sea level)

Historic Maximum Groundwater Elevation: 708.93 feet  
 (above mean sea level)

Groundwater Encountered During Drilling: 22.5 feet bls

Installation Dates: 10/26/2010

Weather Conditions at Installation: Windy/Cloudy 60s

Drilling Contractor: Envirocore

Driller: Chris Rismiller

Drilling Method: Direct push

Screen Construction: Type: Stainless Steel  
 Length: 6 inches  
 Diameter: 0.4375-inch OD, 0.3125-inch ID

Tubing Construction: Type: Teflon  
 Diameter: 0.25-inch OD, 0.17-inch ID

Volume Calculation (mL):	Shallow	Middle	Deep
$V_1$	8	8	8
$V_2$	36	54	72
$V_3$	30,122	1,415	2,067
$V_t$	30,166	1,477	2,147

Remarks: 15" utility hole to 9'9", 3.25" diameter drill rods

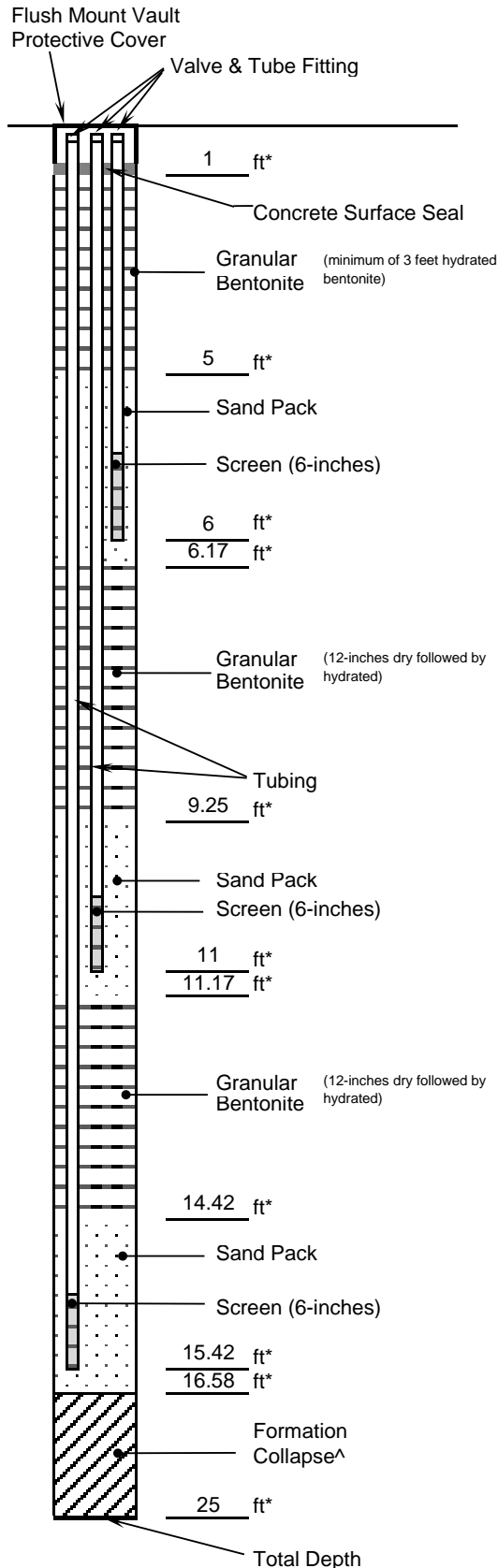
Prepared by: Rumschlag

$V_1 + V_2 + V_3 = V_t$  where:  $V_1 = \pi r^2 h$  = open space volume of soil-gas screen;  
 $V_2 = \pi r^2 h$  = open space volume of sample tubing;  $V_3 = \pi r^2 h \rho$  = estimated  
 open pore space for sand pack and dry bentonite seal;  $V_t$  = total volume;  
 $r$  = inner radius of soil-gas screen, borehole, or sample tubing;  $h$  = height of  
 soil-gas screen or height (length) of tubing or height of sand pack and dry  
 bentonite seal;  $\rho$  = porosity of sand pack and dry bentonite seal (40%).

OD - outer diameter                      12-inches = 1 foot  
 ID - inner diameter                      1 cubic inch = 16.39 mL  
 bls - below land surface                 $\pi = 3.1416$   
 mL - milliliters

\* Depth in Feet Below Land Surface  
 ^ Formation partially collapsed.  
 Bentonite was used to backfill remaining volume

# SOIL-GAS POINT CONSTRUCTION DIAGRAM



RACER Trust Vapor Intrusion  
 Project: Verification Investigation Point: SGP-2

City: Moraine

County: Montgomery State: OH

Survey Coordinates:  
 Northing: 620251.53  
 Easting: 1482642.05

Land-Surface Elevation (surveyed): 726.34 feet  
 (above mean sea level)

Historic Maximum Groundwater Elevation: 708.93 feet  
 (above mean sea level)

Groundwater Encountered During Drilling: 22.5 feet bls

Installation Dates: 10/25/2010

Weather Conditions at Installation: Cloudy 60s

Drilling Contractor: Envirocore

Driller: Chris Rismiller

Drilling Method: Direct push

Screen Construction: Typ Stainless Steel  
 Length: 6 inches  
 Diameter: 0.4375-inch OD, 0.3125-inch ID

Tubing Construction: Typ Teflon  
 Diameter: 0.25-inch OD, 0.17-inch ID

Volume Calculation (mL):	Shallow	Middle	Deep
$V_1$	8	8	8
$V_2$	36	59	78
$V_3$	30,122	1,795	1,414
$V_t$	30,166	1,862	1,500

Remarks: 15" utility hole, 3.25" diameter drill rods

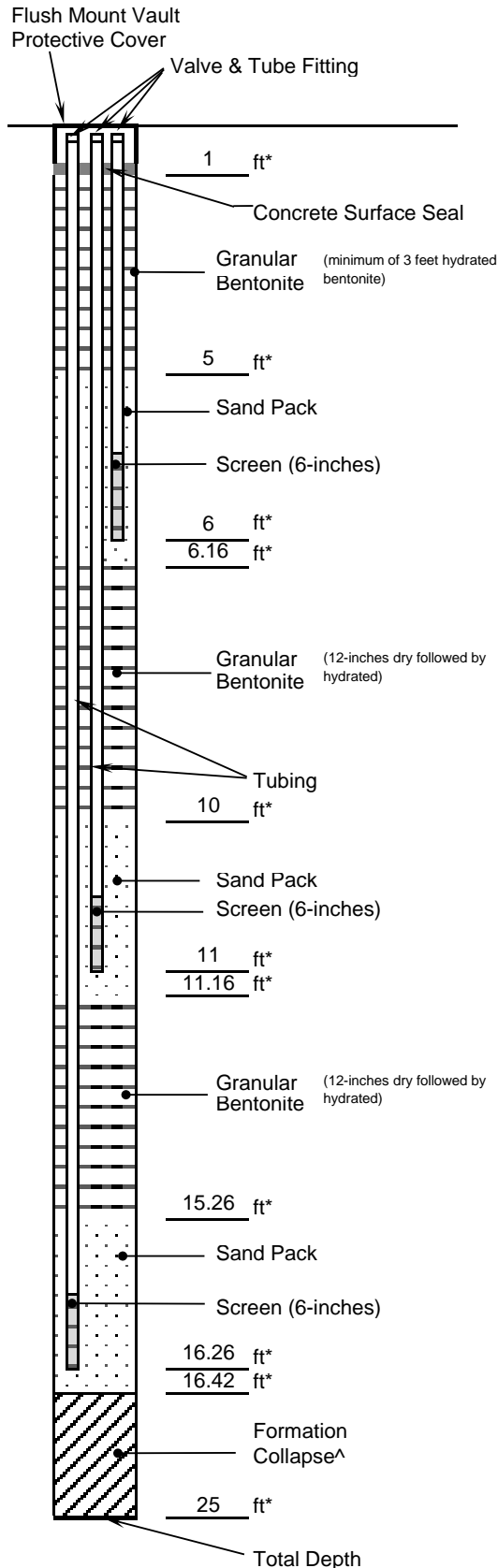
Prepared by: Rumschlag

$V_1 + V_2 + V_3 = V_t$  where:  $V_1 = \pi r^2 h$  = open space volume of soil-gas screen;  
 $V_2 = \pi r^2 h$  = open space volume of sample tubing;  $V_3 = \pi r^2 h \rho$  = estimated  
 open pore space for sand pack and dry bentonite seal;  $V_t$  = total volume;  
 $r$  = inner radius of soil-gas screen, borehole, or sample tubing;  $h$  = height  
 of soil-gas screen or height (length) of tubing or height of sand pack and  
 dry bentonite seal;  $\rho$  = porosity of sand pack and dry bentonite seal (40%).

OD - outer diameter      12-inches = 1 foot  
 ID - inner diameter      1 cubic inch = 16.39 mL  
 bls - below land surface       $\pi = 3.1416$   
 mL - milliliters

\* Depth in Feet Below Land Surface  
 ^ Formation partially collapsed.  
 Bentonite was used to backfill remaining volume

## SOIL-GAS POINT CONSTRUCTION DIAGRAM



RACER Trust Vapor Intrusion

Project: Verification Investigation Point: SGP-3

City: Moraine

County: Montgomery State: OH

Survey Coordinates:  
 Northing: 620005.77  
 Easting: 1482073.99

Land-Surface Elevation (surveyed): 725.38 feet  
 (above mean sea level)

Historic Maximum Groundwater Elevation: 708.67 feet  
 (above mean sea level)

Groundwater Encountered During Drilling: 705.93 feet bls

Installation Dates: 10/20/2010

Weather Conditions at Installation: Sunny 60s

Drilling Contractor: Envirocore

Driller: Chris Rismiller

Drilling Method: Direct push

Screen Construction: Type: Stainless Steel  
 Length: 6 inches  
 Diameter: 0.4375-inch OD, 0.3125-inch ID

Tubing Construction: Type: Teflon  
 Diameter: 0.25-inch OD, 0.17-inch ID

**Volume Calculation (mL):**

	Shallow	Middle	Deep
$V_1$	<u>8</u>	<u>8</u>	<u>8</u>
$V_2$	<u>34</u>	<u>56</u>	<u>80</u>
$V_3$	<u>30,122</u>	<u>1,414</u>	<u>1,414</u>
$V_t$	<u>30,164</u>	<u>1,478</u>	<u>1,502</u>

Remarks: 15" utility hole, 3.25" diameter drill rods

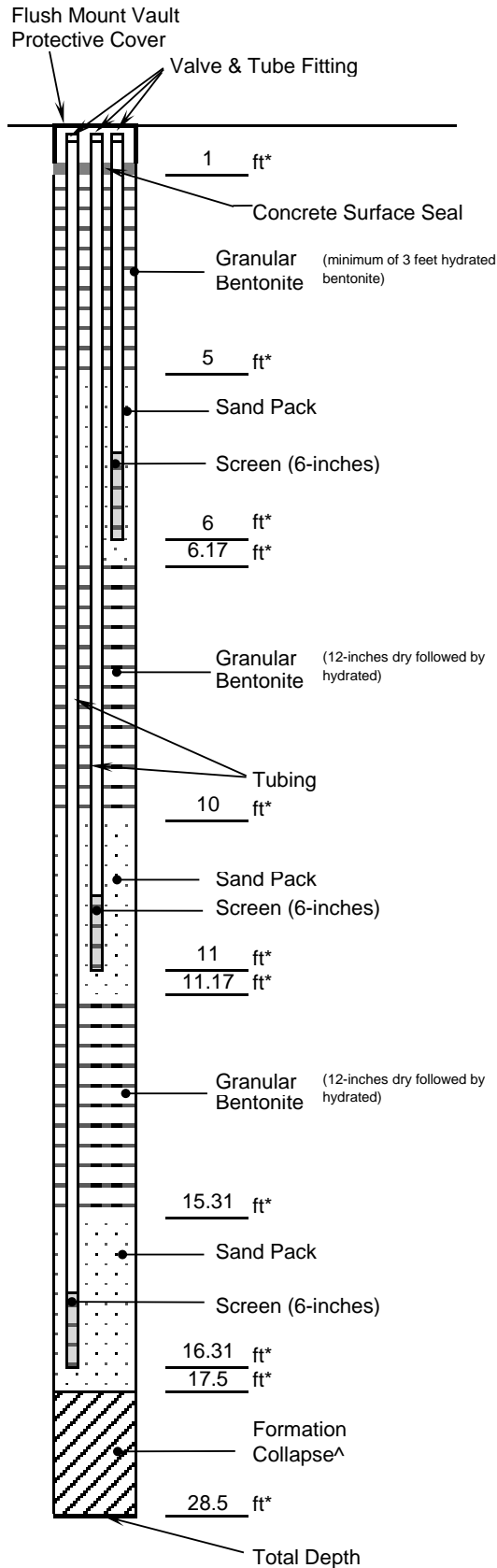
Prepared by: Rumschlag

$V_1 + V_2 + V_3 = V_t$  where:  $V_1 = \pi r^2 h$  = open space volume of soil-gas screen;  
 $V_2 = \pi r^2 h$  = open space volume of sample tubing;  $V_3 = \pi r^2 h \rho$  = estimated open pore space for sand pack and dry bentonite seal;  $V_t$  = total volume;  $r$  = inner radius of soil-gas screen, borehole, or sample tubing;  $h$  = height of soil-gas screen or height (length) of tubing or height of sand pack and dry bentonite seal;  $\rho$  = porosity of sand pack and dry bentonite seal (40%).

OD - outer diameter                      12-inches = 1 foot  
 ID - inner diameter                      1 cubic inch = 16.39 mL  
 bls - below land surface                 $\pi = 3.1416$   
 mL - milliliters

\* Depth in Feet Below Land Surface  
 ^ Formation partially collapsed.  
 Bentonite was used to backfill remaining volume

## SOIL-GAS POINT CONSTRUCTION DIAGRAM



RACER Trust Vapor Intrusion  
 Project: Verification Investigation Point: SGP-4

City: Moraine

County: Montgomery State: OH

Survey Coordinates:  
 Northing: 619950.63  
 Easting: 1482319.98

Land-Surface Elevation (surveyed): 726.93 feet  
 (above mean sea level)

Historic Maximum Groundwater Elevation: 708.62 feet  
 (above mean sea level)

Groundwater Encountered During Drilling: 23.5 feet bls

Installation Dates: 10/22/2010

Weather Conditions at Installation: Sunny 50s

Drilling Contractor: Envirocore

Driller: Chris Rismiller

Drilling Method: Direct push

Screen Construction: Type: Stainless Steel  
 Length: 6 inches  
 Diameter: 0.4375-inch OD, 0.3125-inch ID

Tubing Construction: Type: Teflon  
 Diameter: 0.25-inch OD, 0.17-inch ID

Volume Calculation (mL):	Shallow	Middle	Deep
$V_1$	8	8	8
$V_2$	34	56	79
$V_3$	30,122	1,414	2,067
$V_t$	30,164	1,478	2,154

Remarks: 15" utility hole, 3.25" diameter drill rods

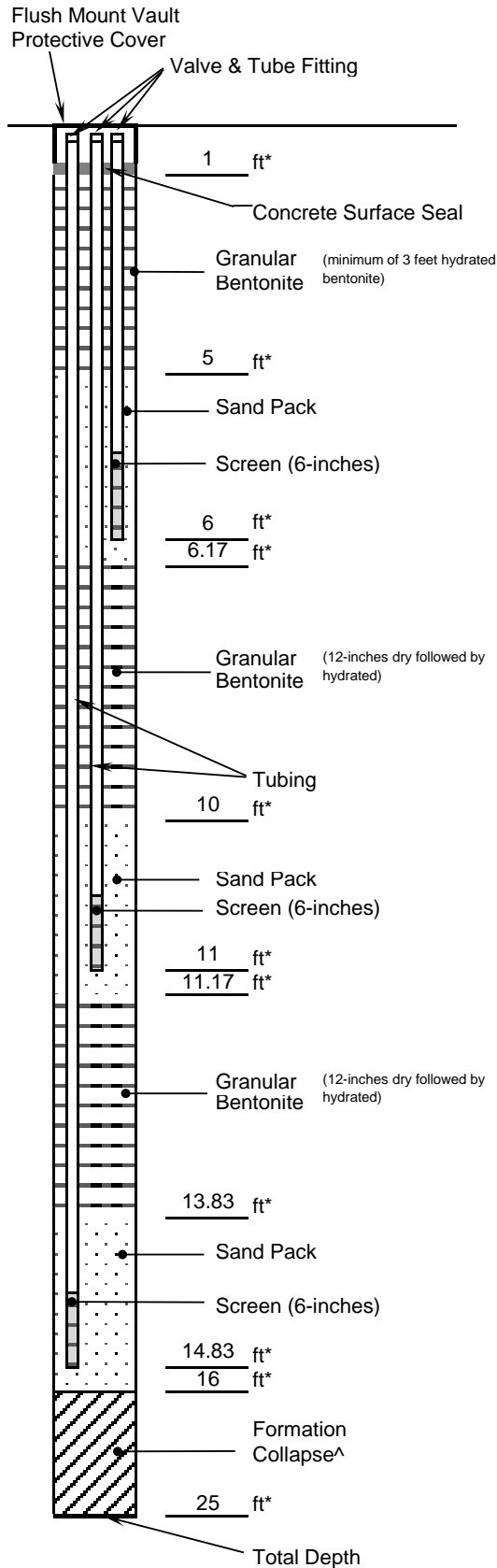
Prepared by: Rumschlag

$V_1 + V_2 + V_3 = V_t$  where:  $V_1 = \pi r^2 h$  = open space volume of soil-gas screen;  
 $V_2 = \pi r^2 h$  = open space volume of sample tubing;  $V_3 = \pi r^2 h \rho$  = estimated open pore space for sand pack and dry bentonite seal;  $V_t$  = total volume;  $r$  = inner radius of soil-gas screen, borehole, or sample tubing;  $h$  = height of soil-gas screen or height (length) of tubing or height of sand pack and dry bentonite seal;  $\rho$  = porosity of sand pack and dry bentonite seal (40%).

OD - outer diameter                      12-inches = 1 foot  
 ID - inner diameter                      1 cubic inch = 16.39 mL  
 bls - below land surface                 $\pi = 3.1416$   
 mL - milliliters

\* Depth in Feet Below Land Surface  
 ^ Formation partially collapsed.  
 Bentonite was used to backfill remaining volume

# SOIL-GAS POINT CONSTRUCTION DIAGRAM



RACER Trust Vapor Intrusion  
 Project: Verification Investigation Point: SGP-5

City: Moraine

County: Montgomery State: OH

Survey Coordinates:  
 Northing: 619946.82  
 Easting: 1482724.90

Land-Surface Elevation (surveyed): 725.39 feet  
 (above mean sea level)

Historic Maximum Groundwater Elevation: 708.62 feet  
 (above mean sea level)

Groundwater Encountered During Drilling: 21.49 feet bls

Installation Dates: 10/29/2010

Weather Conditions at Installation: Cloudy 40s

Drilling Contractor: Envirocore

Driller: Chris Rismiller

Drilling Method: Direct push

Screen Construction: Type: Stainless Steel  
 Length: 6 inches  
 Diameter: 0.4375-inch OD, 0.3125-inch ID

Tubing Construction: Type: Teflon  
 Diameter: 0.25-inch OD, 0.17-inch ID

Volume Calculation (mL):	Shallow	Middle	Deep
$V_1$	8	8	8
$V_2$	36	67	73
$V_3$	30122	1414	2066
$V_t$	30166	1489	2147

Remarks: Borehole diameter = 3.25" from 16' - 8"10"

Borehole diameter = 18" from 8'10" - 1'

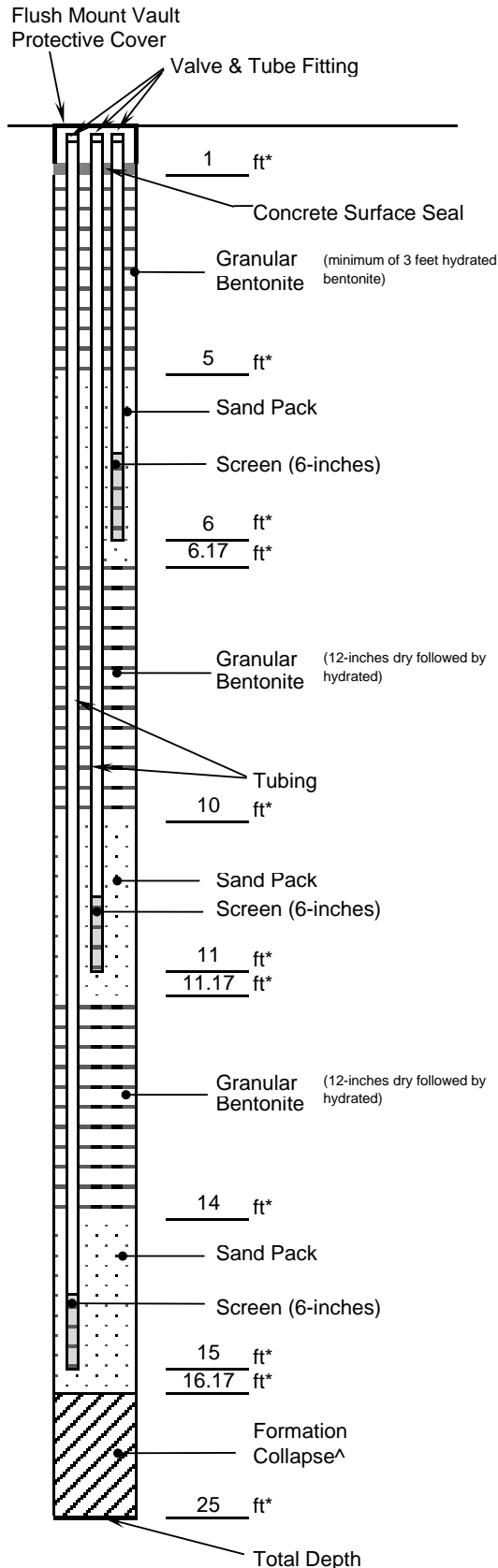
Prepared by: Fortner

$V_1 + V_2 + V_3 = V_t$  where:  $V_1 = \pi r^2 h$  = open space volume of soil-gas screen;  
 $V_2 = \pi r^2 h$  = open space volume of sample tubing;  $V_3 = \pi r^2 h \rho$  = estimated open pore space for sand pack and dry bentonite seal;  $V_t$  = total volume;  $r$  = inner radius of soil-gas screen, borehole, or sample tubing;  $h$  = height of soil-gas screen or height (length) of tubing or height of sand pack and dry bentonite seal;  $\rho$  = porosity of sand pack and dry bentonite seal (40%).

OD - outer diameter      12-inches = 1 foot  
 ID - inner diameter      1 cubic inch = 16.39 mL  
 bls - below land surface       $\pi = 3.1416$   
 mL - milliliters

\* Depth in Feet Below Land Surface  
 ^ Formation partially collapsed.  
 Bentonite was used to backfill remaining volume

## SOIL-GAS POINT CONSTRUCTION DIAGRAM



RACER Trust Vapor Intrusion  
 Project: Verification Investigation Point: SGP-6

City: Moraine

County: Montgomery State: OH

Survey Coordinates:  
 Northing: 619422.84  
 Easting: 1482163.67

Land-Surface Elevation (surveyed): 725.63 feet  
 (above mean sea level)

Historic Maximum Groundwater Elevation: 708.38 feet  
 (above mean sea level)

Groundwater Encountered During Drilling: 22.32 feet bls

Installation Dates: 10/8/2010

Weather Conditions at Installation: Cloudy 50s

Drilling Contractor: Envirocore

Driller: Chris Rismiller

Drilling Method: Direct push

Screen Construction: Type: Stainless Steel  
 Length: 6 inches  
 Diameter: 0.4375-inch OD, 0.3125-inch ID

Tubing Construction: Type: Teflon  
 Diameter: 0.25-inch OD, 0.17-inch ID

Volume Calculation (mL):	Shallow	Middle	Deep
$V_1$	8	NM	8
$V_2$	36	NM	76
$V_3$	43,376	NM	2,067
$V_t$	43,420	NM	2,151

Remarks: Borehole diameter = 18" from 7'8" to 1'

Borehole diameter = 1' from 19.4" to 7'8"

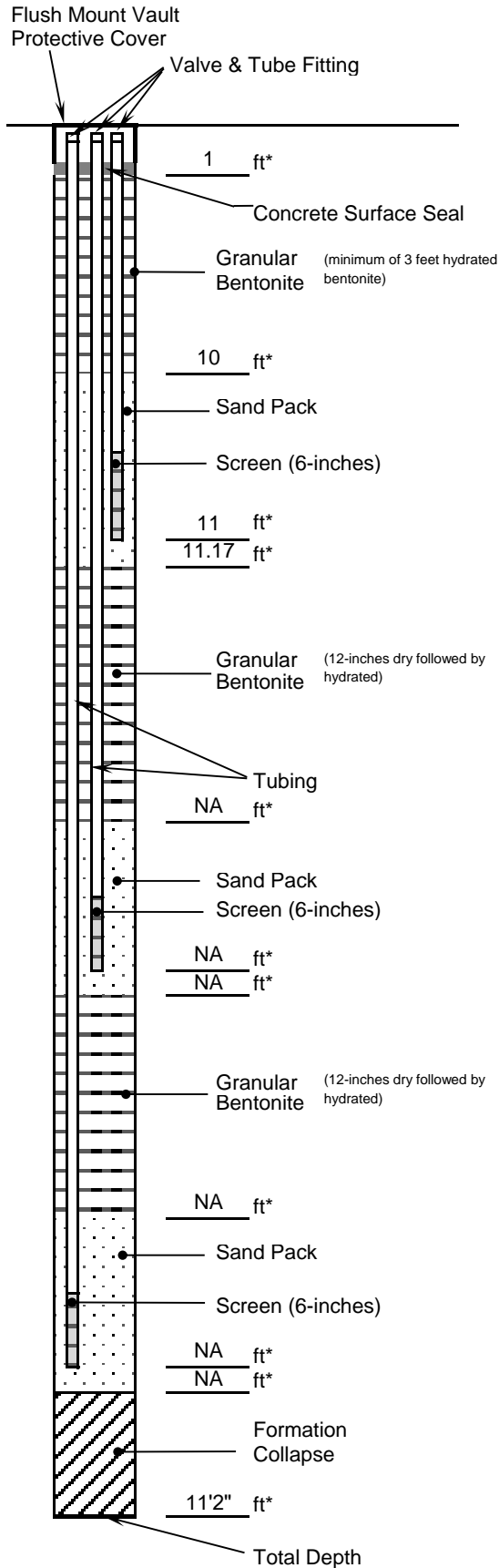
Prepared by: Fortner

$V_1 + V_2 + V_3 = V_t$  where:  $V_1 = \pi r^2 h$  = open space volume of soil-gas screen;  
 $V_2 = \pi r^2 h$  = open space volume of sample tubing;  $V_3 = \pi r^2 h \rho$  = estimated open pore space for sand pack and dry bentonite seal;  $V_t$  = total volume;  $r$  = inner radius of soil-gas screen, borehole, or sample tubing;  $h$  = height of soil-gas screen or height (length) of tubing or height of sand pack and dry bentonite seal;  $\rho$  = porosity of sand pack and dry bentonite seal (40%).

OD - outer diameter      12-inches = 1 foot  
 ID - inner diameter      1 cubic inch = 16.39 mL  
 bls - below land surface       $\pi = 3.1416$   
 mL - milliliters

\* Depth in Feet Below Land Surface  
 ^ Formation partially collapsed.  
 Bentonite was used to backfill remaining volume

# SOIL-GAS POINT CONSTRUCTION DIAGRAM



\* Depth in Feet Below Land Surface

Project: RACER Trust Vapor Intrusion Verification Investigation Point: SGP-6A  
 City: Moraine  
 County: Montgomery State: OH  
 Survey Coordinates:  
 Northing: NM  
 Easting: NM  
 Land-Surface Elevation (surveyed): NM feet (above mean sea level)  
 Historic Maximum Groundwater Elevation: NA feet (above mean sea level)  
 Groundwater Encountered During Drilling: NA feet bls  
 Installation Dates: 10/29/2010  
 Weather Conditions at Installation: Clear 50s  
 Drilling Contractor: Envirocore  
 Driller: Chris Rismiller  
 Drilling Method: Direct push  
 Screen Construction: Type: Stainless Steel  
 Length: 6 inches  
 Diameter: 0.4375-inch OD, 0.3125-inch ID  
 Tubing Construction: Type: Teflon  
 Diameter: 0.25-inch OD, 0.17-inch ID

**Volume Calculation (mL):**

	Shallow	Middle	Deep
$V_1$		<u>8</u>	
$V_2$		<u>58</u>	
$V_3$		<u>678</u>	
$V_t$		<u>744</u>	

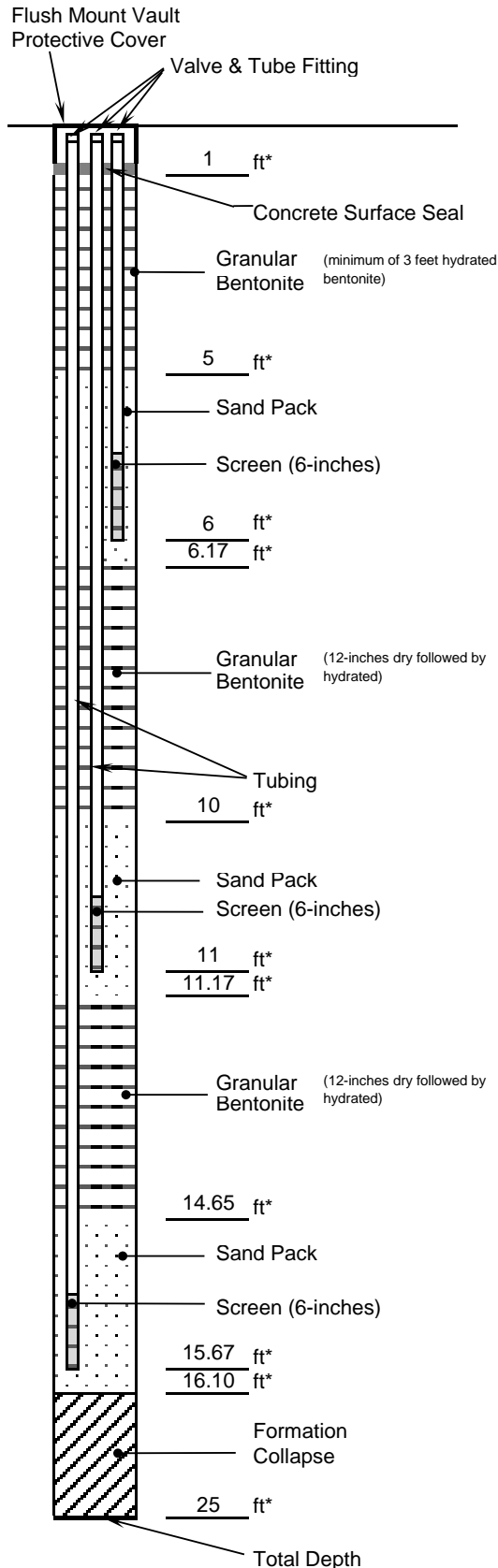
Remarks: Borehole diameter = 2.25 from 11'2" -6'2"  
Borehole diameter = 18" from 6'2" - 1', offset from SGP-6.

Prepared by: Fortner

$V_1 + V_2 + V_3 = V_t$  where:  $V_1 = \pi r^2 h$  = open space volume of soil-gas screen;  
 $V_2 = \pi r^2 h$  = open space volume of sample tubing;  $V_3 = \pi r^2 h \rho$  = estimated open pore space for sand pack and dry bentonite seal;  $V_t$  = total volume;  $r$  = inner radius of soil-gas screen, borehole, or sample tubing;  $h$  = height of soil-gas screen or height (length) of tubing or height of sand pack and dry bentonite seal;  $\rho$  = porosity of sand pack and dry bentonite seal (40%).

OD - outer diameter                      12-inches = 1 foot  
 ID - inner diameter                      1 cubic inch = 16.39 mL  
 bls - below land surface                 $\pi = 3.1416$

## SOIL-GAS POINT CONSTRUCTION DIAGRAM



\* Depth in Feet Below Land Surface  
 ^ Formation partially collapsed.  
 Bentonite was used to backfill remaining volume

RACER Trust Vapor Intrusion  
 Project: Verification Investigation Point: SGP-7

City: Moraine

County: Montgomery State: OH

Survey Coordinates:  
 Northing: 619663.88  
 Easting: 1482511.58

Land-Surface Elevation (surveyed): 726.27 feet  
 (above mean sea level)

Historic Maximum Groundwater Elevation: 708.62 feet  
 (above mean sea level)

Groundwater Encountered During Drilling: 21 feet bls

Installation Dates: 10/21/2010

Weather Conditions at Installation: Sunny 60s

Drilling Contractor: Envirocore

Driller: Chris Rismiller

Drilling Method: Direct push

Screen Construction: Type: Stainless Steel  
 Length: 6 inches  
 Diameter: 0.4375-inch OD, 0.3125-inch ID

Tubing Construction: Type: Teflon  
 Diameter: 0.25-inch OD, 0.17-inch ID

Volume Calculation (mL):	Shallow	Middle	Deep
$V_1$	8	8	8
$V_2$	36	67	82
$V_3$	30,122	1,414	2,066
$V_t$	30,166	1,489	2,156

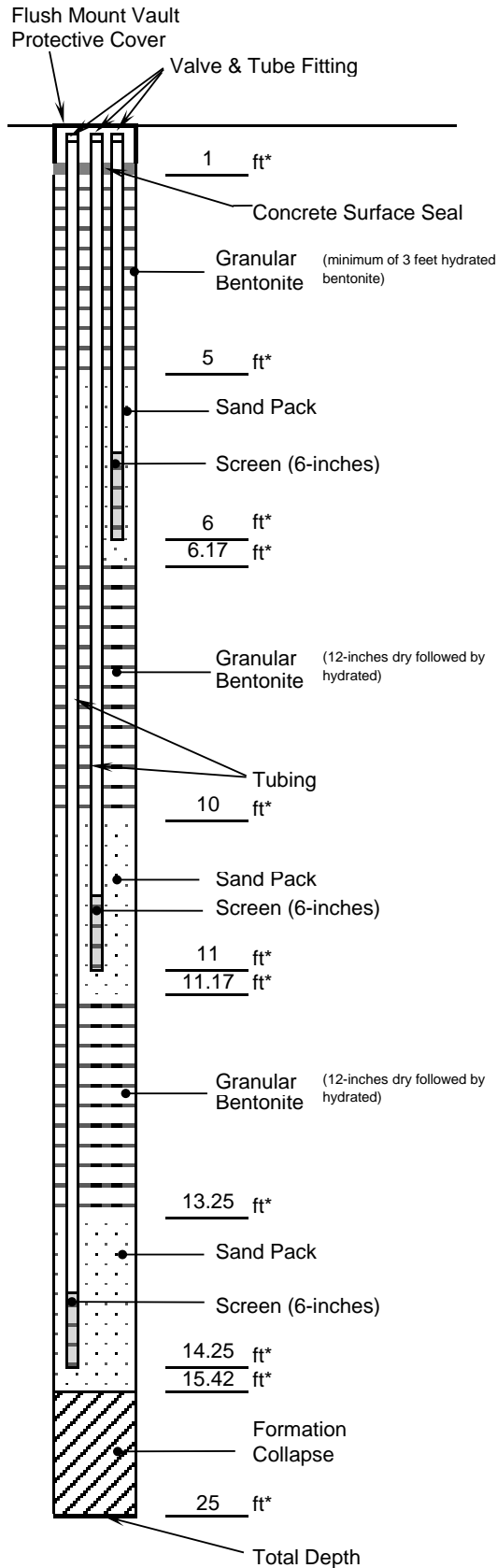
Remarks: 15" utility hole, 3.25" diameter drill rods

Prepared by: Rumschlag

$V_1 + V_2 + V_3 = V_t$  where:  $V_1 = \pi r^2 h$  = open space volume of soil-gas screen;  
 $V_2 = \pi r^2 h$  = open space volume of sample tubing;  $V_3 = \pi r^2 h \rho$  = estimated open pore space for sand pack and dry bentonite seal;  $V_t$  = total volume;  $r$  = inner radius of soil-gas screen, borehole, or sample tubing;  $h$  = height of soil-gas screen or height (length) of tubing or height of sand pack and dry bentonite seal;  $\rho$  = porosity of sand pack and dry bentonite seal (40%).

OD - outer diameter      12-inches = 1 foot  
 ID - inner diameter      1 cubic inch = 16.39 mL  
 bls - below land surface       $\pi = 3.1416$   
 mL - milliliters

# SOIL-GAS POINT CONSTRUCTION DIAGRAM



RACER Trust Vapor Intrusion  
 Project: Verification Investigation Point: SGP-8

City: Moraine

County: Montgomery State: OH

Survey Coordinates:  
 Northing: 619655.80  
 Easting: 1482719.18

Land-Surface Elevation (surveyed): 724.84 feet  
 (above mean sea level)

Historic Maximum Groundwater Elevation: 708.84 feet  
 (above mean sea level)

Groundwater Encountered During Drilling: 21.5 feet bls

Installation Dates: 11/1/2010

Weather Conditions at Installation: Clear 40s

Drilling Contractor: Envirocore

Driller: Chris Rismiller

Drilling Method: Direct push

Screen Construction: Type: Stainless Steel  
 Length: 6 inches  
 Diameter: 0.4375-inch OD, 0.3125-inch ID

Tubing Construction: Type: Teflon  
 Diameter: 0.25-inch OD, 0.17-inch ID

**Volume Calculation (mL):**

	Shallow	Middle	Deep
$V_1$	8	8	8
$V_2$	36	50	28
$V_3$	30,122	1,414	1,522
$V_t$	30,166	1,472	1,558

Remarks: Formation collapse 20.5' - Benseal to 15'5" then sand to 14'3" where 1st point is 3 1/4 inch rods

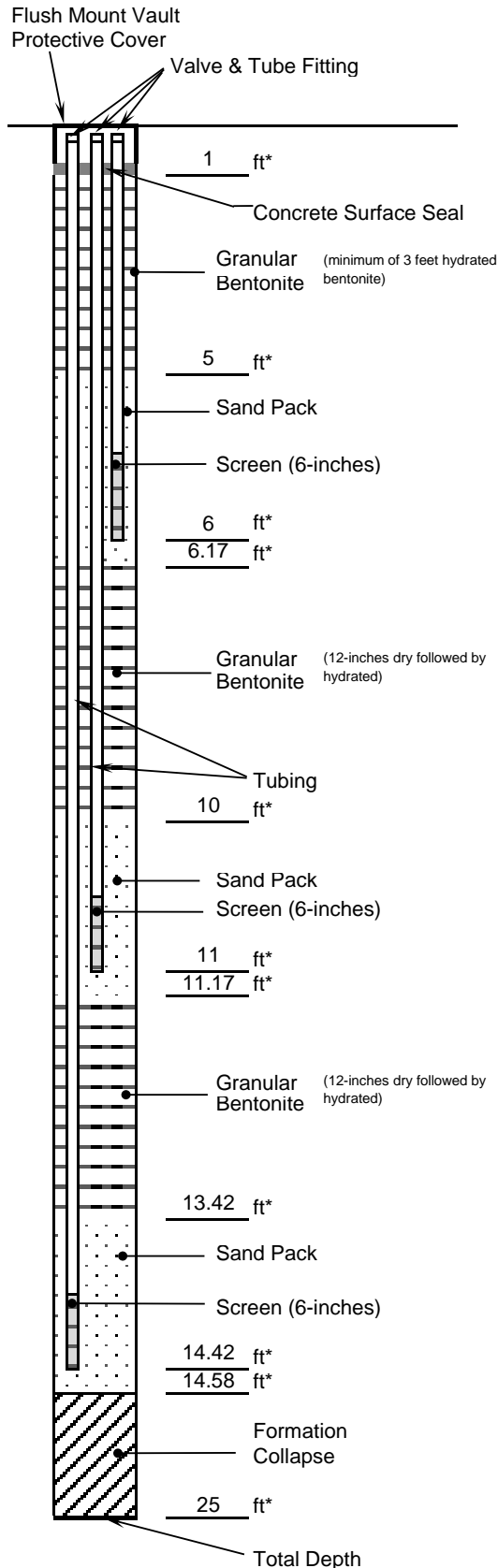
Prepared by: Rumschlag

$V_1 + V_2 + V_3 = V_t$  where:  $V_1 = \pi r^2 h$  = open space volume of soil-gas screen;  
 $V_2 = \pi r^2 h$  = open space volume of sample tubing;  $V_3 = \pi r^2 h \rho$  = estimated open pore space for sand pack and dry bentonite seal;  $V_t$  = total volume;  $r$  = inner radius of soil-gas screen, borehole, or sample tubing;  $h$  = height of soil-gas screen or height (length) of tubing or height of sand pack and dry bentonite seal;  $\rho$  = porosity of sand pack and dry bentonite seal (40%).

OD - outer diameter      12-inches = 1 foot  
 ID - inner diameter      1 cubic inch = 16.39 mL  
 bls - below land surface       $\pi = 3.1416$   
 mL - milliliters

\* Depth in Feet Below Land Surface  
 ^ Formation partially collapsed.  
 Bentonite was used to backfill remaining volume

## SOIL-GAS POINT CONSTRUCTION DIAGRAM



\* Depth in Feet Below Land Surface  
 ^ Formation partially collapsed.  
 Bentonite was used to backfill remaining volume

RACER Trust Vapor Intrusion  
 Project: Verification Investigation Point: SGP-9  
 City: Moraine  
 County: Montgomery State: OH  
 Survey Coordinates:  
 Northing: 619299.71  
 Easting: 1482848.04  
 Land-Surface Elevation (surveyed): 724.79 feet  
 (above mean sea level)  
 Historic Maximum Groundwater Elevation: 708.38 feet  
 (above mean sea level)  
 Groundwater Encountered During Drilling: 20.74 feet bls  
 Installation Dates: 10/26/2010  
 Weather Conditions at Installation: Sunny 60s  
 Drilling Contractor: Envirocore  
 Driller: Chris Rismiller  
 Drilling Method: Direct push  
 Screen Construction: Type: Stainless Steel  
 Length: 6 inches  
 Diameter: 0.4375-inch OD, 0.3125-inch ID  
 Tubing Construction: Type: Teflon  
 Diameter: 0.25-inch OD, 0.17-inch ID

**Volume Calculation (mL):**

	Shallow	Middle	Deep
$V_1$	8	8	8
$V_2$	36	59	74
$V_3$	43,375	46,712	1,414
$V_t$	43,419	46,779	1,496

Remarks: Borehole diameter = 3.25" from 14'7" - 11'4"

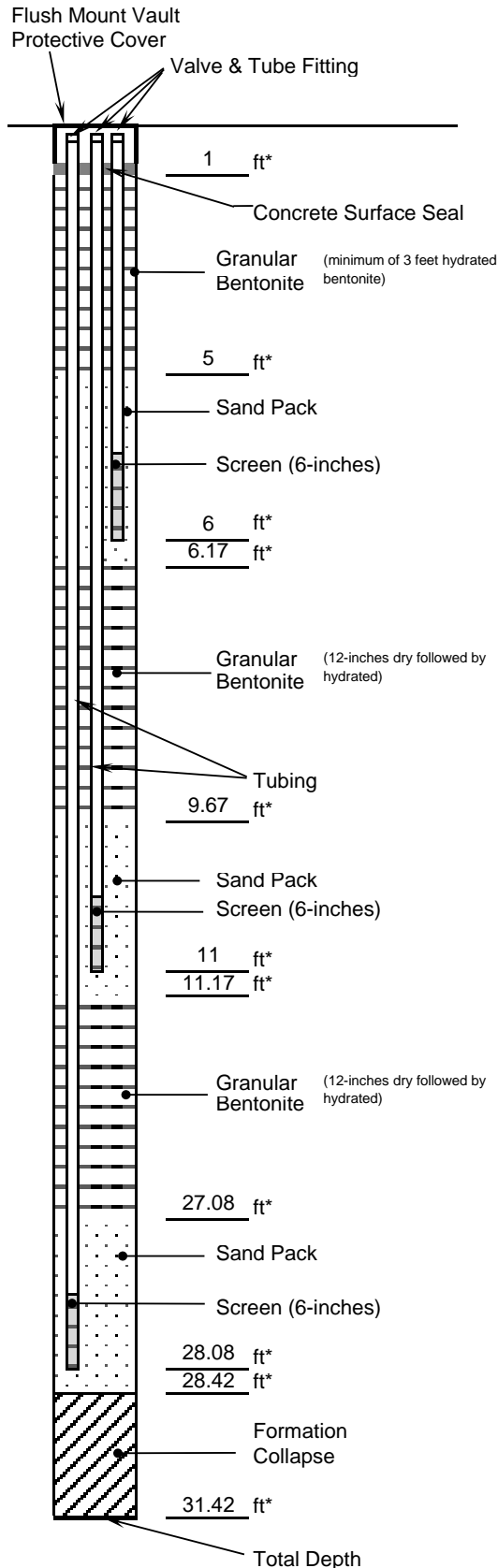
Borehole diameter = 18" from 11'4" - 1'

Prepared by: Fortner

$V_1 + V_2 + V_3 = V_t$  where:  $V_1 = \pi r^2 h$  = open space volume of soil-gas screen;  
 $V_2 = \pi r^2 h$  = open space volume of sample tubing;  $V_3 = \pi r^2 h \rho$  = estimated open pore space for sand pack and dry bentonite seal;  $V_t$  = total volume;  $r$  = inner radius of soil-gas screen, borehole, or sample tubing;  $h$  = height of soil-gas screen or height (length) of tubing or height of sand pack and dry bentonite seal;  $\rho$  = porosity of sand pack and dry bentonite seal (40%).

OD - outer diameter      12-inches = 1 foot  
 ID - inner diameter      1 cubic inch = 16.39 mL  
 bls - below land surface       $\pi = 3.1416$   
 mL - milliliters

# SOIL-GAS POINT CONSTRUCTION DIAGRAM



RACER Trust Vapor Intrusion  
 Project: Verification Investigation Point: SGP-10

City: Moraine

County: Montgomery State: OH

Survey Coordinates:  
 Northing: 622141.86  
 Easting: 1485746.29

Land-Surface Elevation (surveyed): 741.64 feet  
 (above mean sea level)

Historic Maximum Groundwater Elevation: 711.51 feet  
 (above mean sea level)

Groundwater Encountered During Drilling: NA feet bls

Installation Dates: 10/26/2010

Weather Conditions at Installation: Sunny 60s

Drilling Contractor: Envirocore

Driller: Chris Rismiller

Drilling Method: Direct push

Screen Construction: Type: Stainless Steel  
 Length: 6 inches  
 Diameter: 0.4375-inch OD, 0.3125-inch ID

Tubing Construction: Type: Teflon  
 Diameter: 0.25-inch OD, 0.17-inch ID

Volume Calculation (mL):	Shallow	Middle	Deep
$V_1$	8	8	8
$V_2$	36	58	133
$V_3$	43,375	782	729
$V_t$	43,419	848	870

Remarks: Rods 2 1/4 inch for borehole diameter 28'5" - 8'6"

Utility borehole diameter = 18" from 8'6" - 1'

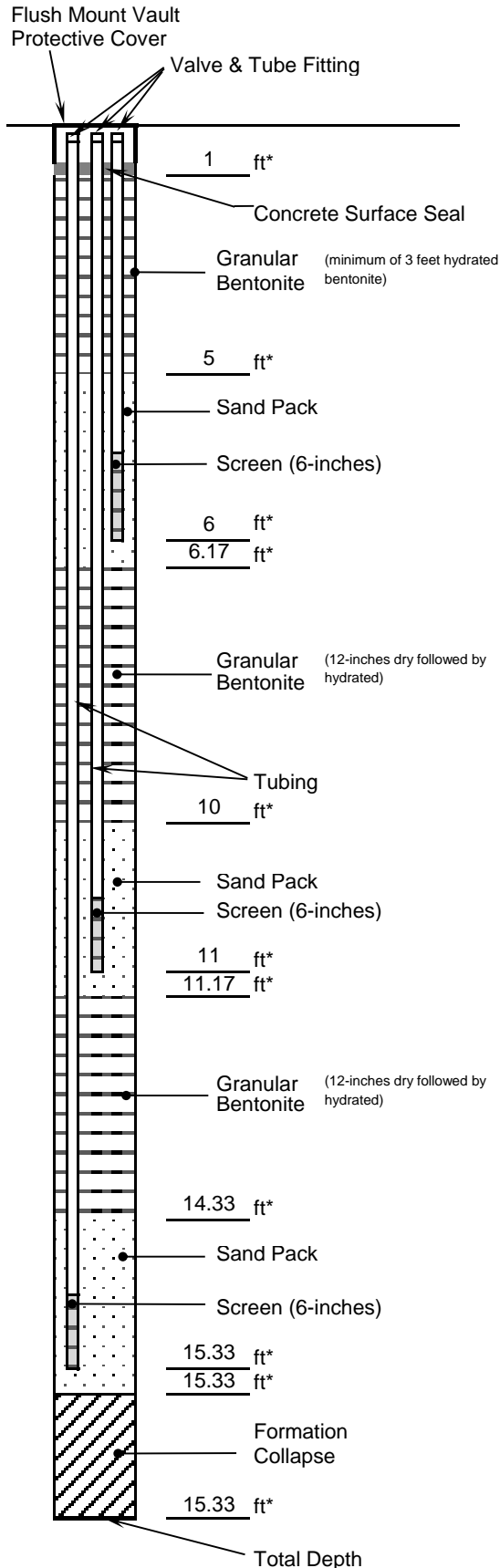
Prepared by: Fortner

$V_1 + V_2 + V_3 = V_t$  where:  $V_1 = \pi r^2 h$  = open space volume of soil-gas screen;  
 $V_2 = \pi r^2 h$  = open space volume of sample tubing;  $V_3 = \pi r^2 h \rho$  = estimated open pore space for sand pack and dry bentonite seal;  $V_t$  = total volume;  $r$  = inner radius of soil-gas screen, borehole, or sample tubing;  $h$  = height of soil-gas screen or height (length) of tubing or height of sand pack and dry bentonite seal;  $\rho$  = porosity of sand pack and dry bentonite seal (40%).

OD - outer diameter      12-inches = 1 foot  
 ID - inner diameter      1 cubic inch = 16.39 mL  
 bls - below land surface       $\pi = 3.1416$   
 mL - milliliters

\* Depth in Feet Below Land Surface  
 ^ Formation partially collapsed.  
 Bentonite was used to backfill remaining volume

# SOIL-GAS POINT CONSTRUCTION DIAGRAM



\* Depth in Feet Below Land Surface

Project: RACER Trust Vapor Intrusion Verification Investigation Point: SGP-11

City: Moraine

County: Montgomery State: OH

Survey Coordinates:  
 Northing: 621900.57  
 Easting: 1485694.31

Land-Surface Elevation (surveyed): 737.94 feet  
 (above mean sea level)

Historic Maximum Groundwater Elevation: 711.54 feet  
 (above mean sea level)

Groundwater Encountered During Drilling: NA feet bls

Installation Dates: 11/2/2010

Weather Conditions at Installation: Sunny 50s

Drilling Contractor: Envirocore

Driller: Chris Rismiller

Drilling Method: Direct push

Screen Construction: Type: Stainless Steel  
 Length: 6 inches  
 Diameter: 0.4375-inch OD, 0.3125-inch ID

Tubing Construction: Type: Teflon  
 Diameter: 0.25-inch OD, 0.17-inch ID

Volume Calculation (mL):	Shallow	Middle	Deep
$V_1$	8	8	8
$V_2$	36	58	78
$V_3$	30,122	677	625
$V_t$	30,166	743	711

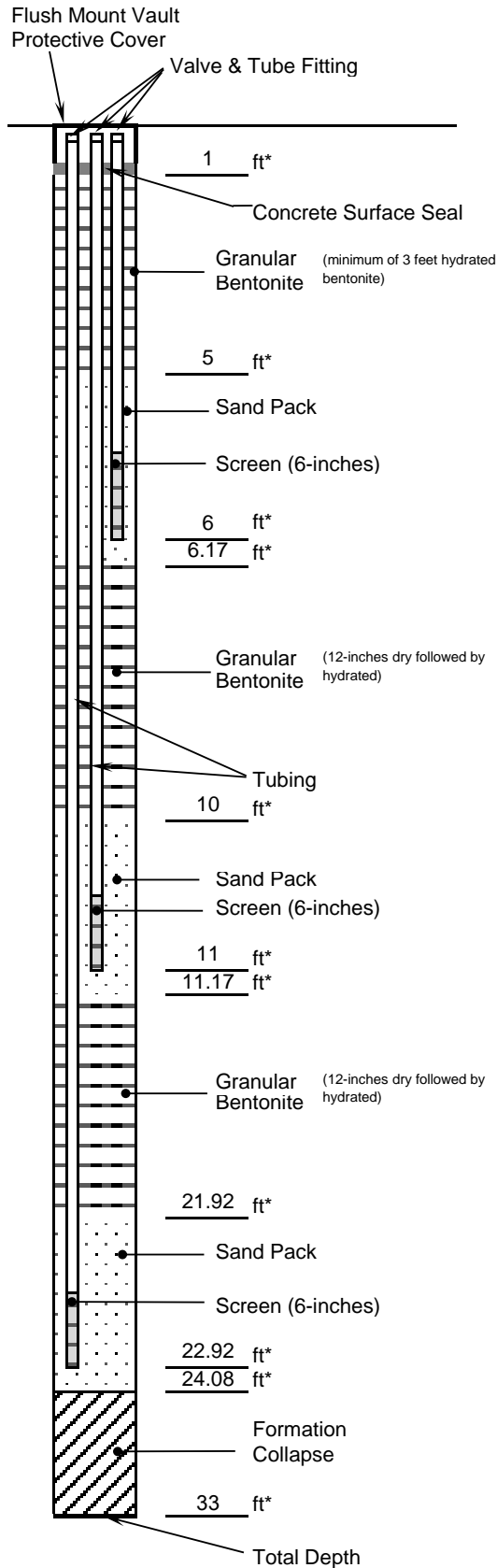
Remarks: 2 1/4 inch rods - utility holes 15" in diameter

Prepared by: Rumschlag

$V_1 + V_2 + V_3 = V_t$  where:  $V_1 = \pi r^2 h =$  open space volume of soil-gas screen;  
 $V_2 = \pi r^2 h =$  open space volume of sample tubing;  $V_3 = \pi r^2 h \rho =$  estimated open pore space for sand pack and dry bentonite seal;  $V_t =$  total volume;  $r =$  inner radius of soil-gas screen, borehole, or sample tubing;  $h =$  height of soil-gas screen or height (length) of tubing or height of sand pack and dry bentonite seal;  $\rho =$  porosity of sand pack and dry bentonite seal (40%).

OD - outer diameter                      12-inches = 1 foot  
 ID - inner diameter                      1 cubic inch = 16.39 mL  
 bls - below land surface                 $\pi = 3.1416$

# SOIL-GAS POINT CONSTRUCTION DIAGRAM



RACER Trust Vapor Intrusion  
 Project: Verification Investigation Point: SGP-12

City: Moraine

County: Montgomery State: OH

Survey Coordinates:  
 Northing: 621539.77  
 Easting: 1485334.67

Land-Surface Elevation (surveyed): 735.86 feet  
 (above mean sea level)

Historic Maximum Groundwater Elevation: 710.93 feet  
 (above mean sea level)

Groundwater Encountered During Drilling: 29.5 feet bls

Installation Dates: 11/2/2010

Weather Conditions at Installation: Sunny 40s

Drilling Contractor: Envirocore

Driller: Chris Rismiller

Drilling Method: Direct push

Screen Construction: Type: Stainless Steel  
 Length: 6 inches  
 Diameter: 0.4375-inch OD, 0.3125-inch ID

Tubing Construction: Type: Teflon  
 Diameter: 0.25-inch OD, 0.17-inch ID

Volume Calculation (mL):	Shallow	Middle	Deep
$V_1$	8	8	8
$V_2$	36	58	111
$V_3$	30,122	1,414	2,067
$V_t$	30,166	1,480	2,186

Remarks: Formation collapse to 26'1" - benseal to 24'1"

Sand to 22'11" - 3 1/4 inch rods - 15" utility hole

Prepared by: Rumschlag

$V_1 + V_2 + V_3 = V_t$  where:  $V_1 = \pi r^2 h$  = open space volume of soil-gas screen;  
 $V_2 = \pi r^2 h$  = open space volume of sample tubing;  $V_3 = \pi r^2 h \rho$  = estimated open pore space for sand pack and dry bentonite seal;  $V_t$  = total volume;  $r$  = inner radius of soil-gas screen, borehole, or sample tubing;  $h$  = height of soil-gas screen or height (length) of tubing or height of sand pack and dry bentonite seal;  $\rho$  = porosity of sand pack and dry bentonite seal (40%).

OD - outer diameter      12-inches = 1 foot  
 ID - inner diameter      1 cubic inch = 16.39 mL  
 bls - below land surface       $\pi = 3.1416$   
 mL - milliliters

\* Depth in Feet Below Land Surface  
 ^ Formation partially collapsed.  
 Bentonite was use to backfill remaining volume

ARCADIS

**Appendix C**

Soil-Gas Sample Logs

November 2010



## Sub-slab/Soil-Gas Sample Collection Log

		<b>Sample ID:</b> <b>SGP-1(6)/111010</b>
<b>Client:</b>	RACER Trust Trust	<b>Boring Equipment:</b> Direct-push drill rig
<b>Project:</b>	Vapor Intrusion Verification Investigation	<b>Sealant:</b> Benseal/Bentonite
<b>Location:</b>	Moraine, Ohio	<b>Tubing Information:</b> 0.25 inch OD; 0.17 inch ID Teflon
<b>Project #:</b>	OH000294.0018.00007	<b>Miscellaneous Equipment:</b> Dielectric MGD-2002, Thermo 580B, GEM 500
<b>Samplers:</b>	E. Epple (ARCADIS)	<b>Subcontractor:</b> Envirocore
		<b>Equipment:</b> SKC 220 air pumps, Defender 150
<b>Sampling Depth:</b>	6 feet below land surface	<b>Moisture Content of Sampling Zone):</b> Moist to dry
<b>Date of Installation:</b>	10-26-2010	<b>Approximate Purge Volume:</b> 30.2L

### Instrument Readings:

Date	Time	Canister Vacuum (a) (inches of Hg)	Temperature (°F)	Relative Humidity (%)	Air Speed (mph)	Barometric Pressure (inches of Hg)	PID (ppm)
11-10-2010	1245	-29.25	42	79	0	30.15	NM
11-10-2010	1247	-24.00*	42	79	0	30.15	NM
11-10-2010	1320	-6.00*	42	79	0	30.15	1.1
11-10-2010	1327	-5.00	42	79	0	30.15	NM

(a) Record canister information at a minimum at the beginning and end of sampling

#### SUMMA® Canister Information:

<b>Size (check one):</b>	<input type="checkbox"/> 250 mL	<input checked="" type="checkbox"/> 1L
<b>Canister ID:</b>	33720	
<b>Flow Controller ID:</b>	FC00671	
<b>Notes:</b>	Lab calibrated canister/controller	

#### Tracer Test Information (if applicable):

<b>Initial Helium Shroud:</b>	89.6%
<b>Final Helium Shroud:</b>	42.9%
<b>Tracer Test Passed:</b>	<input checked="" type="checkbox"/> Yes <input type="checkbox"/> No
<b>Notes:</b>	50 ppm helium detected in point after purge on 11-8-2010.

### General Observations/Notes:

$V_1=7.53 \text{ mL} ; V_2=35.71 \text{ mL} ; V_t=43.24 \text{ mL} ;$ purge time = 52 seconds at 50 mL/min.
Passed shut-in test.
*Flow controller pressure gauge readings.

### Approximating One-Well Volume (for purging):

$V_1 + V_2 + V_3 = V_t$  where:  $V_1 = \pi r^2 h$  = open space volume of soil-gas screen;  $V_2 = \pi r^2 h$  = open space volume of sample tubing;  $V_3 = \pi r^2 h \rho$  = estimated open pore space for sand pack and dry bentonite seal;  $V_t$  = total volume;  $r$  = inner radius of soil-gas screen, borehole, or sample tubing;  $h$  = height of soil-gas screen or height (length) of tubing or height of sand pack and dry bentonite seal;  $\rho$  = porosity of sand pack and dry bentonite seal (40%).



## Sub-slab/Soil-Gas Sample Collection Log

		<b>Sample ID:</b> <b>SGP-1(11)/111010</b>	
<b>Client:</b>	RACER Trust Trust	<b>Boring Equipment:</b>	Direct-push drill rig
<b>Project:</b>	Vapor Intrusion Verification Investigation	<b>Sealant:</b>	Benseal/Bentonite
<b>Location:</b>	Moraine, Ohio	<b>Tubing Information:</b>	0.25 inch OD; 0.17 inch ID Teflon
<b>Project #:</b>	OH000294.0018.00007	<b>Miscellaneous Equipment:</b>	Dielectric MGD-2002, Thermo 580B, GEM 500
<b>Samplers:</b>	E. Epple (ARCADIS)	<b>Subcontractor:</b>	Envirocore
		<b>Equipment:</b>	SKC 220 air pumps, Defender 150
<b>Sampling Depth:</b>	11 feet below land surface	<b>Moisture Content of Sampling Zone):</b>	Moist to dry
<b>Date of Installation:</b>	10-26-2010	<b>Approximate Purge Volume:</b>	4.5L

### Instrument Readings:

Date	Time	Canister Vacuum (a) (inches of Hg)	Temperature (°F)	Relative Humidity (%)	Air Speed (mph)	Barometric Pressure (inches of Hg)	PID (ppm)
11-10-2010	1249	-28.25	42	79	0	30.15	NM
11-10-2010	1251	-27.50*	42	79	0	30.15	NM
11-10-2010	1322	-5.0*	42	79	0	30.15	NM
11-10-2010	1331	-4.5	42	79	0	30.15	0.3

(a) Record canister information at a minimum at the beginning and end of sampling

#### SUMMA® Canister Information:

<b>Size (check one):</b>	<input type="checkbox"/> 250 mL	<input checked="" type="checkbox"/> 1L
<b>Canister ID:</b>	36529	
<b>Flow Controller ID:</b>	6863	
<b>Notes:</b>	Lab calibrated canister/controller	

#### Tracer Test Information (if applicable):

<b>Initial Helium Shroud:</b>	N/A
<b>Final Helium Shroud:</b>	N/A
<b>Tracer Test Passed:</b>	<input type="checkbox"/> Yes <input type="checkbox"/> No
<b>Notes:</b>	

### General Observations/Notes:

$V_1=7.53 \text{ mL} ; V_2=58.04 \text{ mL} ; V_t=65.6 \text{ mL} ;$ purge time = 1 minute 19 seconds at 50 mL/min
Start purge at 1237. Passed shut-in test.
*Flow controller pressure gauge readings.

### Approximating One-Well Volume (for purging):

$V_1 + V_2 + V_3 = V_t$  where:  $V_1 = \pi r^2 h$  = open space volume of soil-gas screen;  $V_2 = \pi r^2 h$  = open space volume of sample tubing;  $V_3 = \pi r^2 h \rho$  = estimated open pore space for sand pack and dry bentonite seal;  $V_t$  = total volume;  $r$  = inner radius of soil-gas screen, borehole, or sample tubing;  $h$  = height of soil-gas screen or height (length) of tubing or height of sand pack and dry bentonite seal;  $\rho$  = porosity of sand pack and dry bentonite seal (40%).



## Sub-slab/Soil-Gas Sample Collection Log

		<b>Sample ID:</b> <b>SGP-1(16)/111010</b>	
<b>Client:</b>	RACER Trust Trust	<b>Boring Equipment:</b>	Direct-push drill rig
<b>Project:</b>	Vapor Intrusion Verification Investigation	<b>Sealant:</b>	Benseal/Bentonite
<b>Location:</b>	Moraine, Ohio	<b>Tubing Information:</b>	0.25 inch OD; 0.17 inch ID Teflon
<b>Project #:</b>	OH000294.0018.00007	<b>Miscellaneous Equipment:</b>	Dielectric MGD-2002, Thermo 580B, GEM 500
<b>Samplers:</b>	E. Epple (ARCADIS)	<b>Subcontractor:</b>	Envirocore
		<b>Equipment:</b>	SKC 220 air pumps, Defender 150
<b>Sampling Depth:</b>	6 feet below land surface	<b>Moisture Content of Sampling Zone):</b>	Moist to dry
<b>Date of Installation:</b>	10-26-2010	<b>Approximate Purge Volume:</b>	6.5L

### Instrument Readings:

Date	Time	Canister Vacuum (a) (inches of Hg)	Temperature (°F)	Relative Humidity (%)	Air Speed (mph)	Barometric Pressure (inches of Hg)	PID (ppm)
11-10-2010	1254	-28.0	42	79	0	30.15	NM
11-10-2010	1257	-27.0*	42	79	0	30.15	NM
11-10-2010	1336	-4.75	42	79	0	30.15	1.1

(a) Record canister information at a minimum at the beginning and end of sampling

#### SUMMA® Canister Information:

<b>Size (check one):</b>	<input type="checkbox"/> 250 mL	<input checked="" type="checkbox"/> 1L
<b>Canister ID:</b>	34578	
<b>Flow Controller ID:</b>	6849	
<b>Notes:</b>	Lab calibrated canister/controller	

#### Tracer Test Information (if applicable):

<b>Initial Helium Shroud:</b>	N/A
<b>Final Helium Shroud:</b>	N/A
<b>Tracer Test Passed:</b>	<input type="checkbox"/> Yes <input type="checkbox"/> No
<b>Notes:</b>	

#### General Observations/Notes:

$V_1=7.53 \text{ mL} ; V_2=71.43 \text{ mL} ; V_t=78.96 \text{ mL} ;$ purge time = 1 minute 35 seconds at 50 mL/min.
Passed shut-in test; purge start at 1239.
*Flow controller pressure gauge readings.

#### Approximating One-Well Volume (for purging):

$V_1 + V_2 + V_3 = V_t$  where:  $V_1 = \pi r^2 h$  = open space volume of soil-gas screen;  $V_2 = \pi r^2 h$  = open space volume of sample tubing;  $V_3 = \pi r^2 h \rho$  = estimated open pore space for sand pack and dry bentonite seal;  $V_t$  = total volume;  $r$  = inner radius of soil-gas screen, borehole, or sample tubing;  $h$  = height of soil-gas screen or height (length) of tubing or height of sand pack and dry bentonite seal;  $\rho$  = porosity of sand pack and dry bentonite seal (40%).



# Sub-slab/Soil-Gas Sample Collection Log

		Sample ID:	<b>SGP-2(6)/111110</b>
		Boring Equipment:	Direct-push drill rig
Client:	RACER Trust Trust	Sealant:	Benseal/Bentonite
Project:	Vapor Intrusion Verification Investigation	Tubing Information:	0.25 inch OD; 0.17 inch ID Teflon
Location:	Moraine, Ohio	Miscellaneous Equipment:	Dielectric MGD-2002, Thermo 580B, GEM 500
Project #:	OH000294.0018.00007	Subcontractor:	Envirocore
Samplers:	J. Rumschlag (ARCADIS)	Equipment:	SKC 220 air pumps, Defender 150
Sampling Depth:	6 feet below land surface	Moisture Content of Sampling Zone):	Dry
Date of Installation:	10-25-2010	Approximate Purge Volume:	30.2 L

## Instrument Readings:

Date	Time	Canister Vacuum (a) (inches of Hg)	Temperature (°F)	Relative Humidity (%)	Air Speed (mph)	Barometric Pressure (inches of Hg)	PID (ppm)
11-11-2010	1002	-28.5	46	68	1	30.38	NM
11-11-2010	1013	-29.75*	46	68	1	30.38	NM
11-11-2010	1043	-4.25	46	68	1	30.38	3.4

(a) Record canister information at a minimum at the beginning and end of sampling

### SUMMA® Canister Information:

Size (check one):	<input type="checkbox"/> 250 mL	<input checked="" type="checkbox"/> 1L
Canister ID:	35632	
Flow Controller ID:	FC00172	
Notes:	Lab calibrated canister/controller	

### Tracer Test Information (if applicable):

Initial Helium Shroud:	89.9%
Final Helium Shroud:	90.2%
Tracer Test Passed:	<input checked="" type="checkbox"/> Yes <input type="checkbox"/> No
Notes:	475 ppm helium detected in point after purge on 11-8-2010.

### General Observations/Notes:

$V_1 = 7.5$ ml; $V_2 = 35.7$ ml; $V_T = 43.2$ mL at 50 ml/min for 52 seconds at 50 mL/min;
Passed shut-in test.
*Flow controller pressure gauge readings.

### Approximating One-Well Volume (for purging):

$V_1 + V_2 + V_3 = V_t$  where:  $V_1 = \pi r^2 h$  = open space volume of soil-gas screen;  $V_2 = \pi r^2 h$  = open space volume of sample tubing;  $V_3 = \pi r^2 h \rho$  = estimated open pore space for sand pack and dry bentonite seal;  $V_t$  = total volume;  $r$  = inner radius of soil-gas screen, borehole, or sample tubing;  $h$  = height of soil-gas screen or height (length) of tubing or height of sand pack and dry bentonite seal;  $\rho$  = porosity of sand pack and dry bentonite seal (40%).



# Sub-slab/Soil-Gas Sample Collection Log

Sample ID: **SGP-2(11)/111110**

<b>Client:</b>	RACER Trust Trust	<b>Boring Equipment:</b>	Direct-push drill rig
<b>Project:</b>	Vapor Intrusion Verification Investigation	<b>Sealant:</b>	Benseal/Bentonite
<b>Location:</b>	Moraine, Ohio	<b>Tubing Information:</b>	0.25 inch OD; 0.17 inch ID Teflon
<b>Project #:</b>	OH000294.0018.00007	<b>Miscellaneous Equipment:</b>	Dielectric MGD-2002, Thermo 580B, GEM 500
<b>Samplers:</b>	J. Rumschlag (ARCADIS)	<b>Subcontractor:</b>	Envirocore
		<b>Equipment:</b>	SKC 220 air pumps, Defender 150
<b>Sampling Depth:</b>	11 feet below land surface	<b>Moisture Content of Sampling Zone):</b>	Dry
<b>Date of Installation:</b>	10-25-2010	<b>Approximate Purge Volume:</b>	5.6L

## Instrument Readings:

Date	Time	Canister Vacuum (a) (inches of Hg)	Temperature (°F)	Relative Humidity (%)	Air Speed (mph)	Barometric Pressure (inches of Hg)	PID (ppm)
11-11-2010	1005	-28.75	46	68	1	30.38	NM
11-11-2010	1016	<-30*	46	68	1	30.38	NM
11-11-2010	1044	-4.5	46	68	1	30.38	8.0

(a) Record canister information at a minimum at the beginning and end of sampling

### SUMMA® Canister Information:

<b>Size (check one):</b>	<input type="checkbox"/> 250 mL	<input checked="" type="checkbox"/> 1L
<b>Canister ID:</b>	2218	
<b>Flow Controller ID:</b>	FC00454	
<b>Notes:</b>	Lab calibrated canister/controller	

### Tracer Test Information (if applicable):

<b>Initial Helium Shroud:</b>	N/A	
<b>Final Helium Shroud:</b>	N/A	
<b>Tracer Test Passed:</b>	<input type="checkbox"/> Yes	<input type="checkbox"/> No
<b>Notes:</b>		

### General Observations/Notes:

$V_1 = 7.5$ mL; $V_2 = 58$ mL; $V_T = 65.5$ ; purge for 1 min 19 sec at 50 mL/min
Passed shut-in test.
*Flow controller pressure gauge readings.

### Approximating One-Well Volume (for purging):

$V_1 + V_2 + V_3 = V_t$  where:  $V_1 = \pi r^2 h$  = open space volume of soil-gas screen;  $V_2 = \pi r^2 h$  = open space volume of sample tubing;  $V_3 = \pi r^2 h \rho$  = estimated open pore space for sand pack and dry bentonite seal;  $V_t$  = total volume;  $r$  = inner radius of soil-gas screen, borehole, or sample tubing;  $h$  = height of soil-gas screen or height (length) of tubing or height of sand pack and dry bentonite seal;  $\rho$  = porosity of sand pack and dry bentonite seal (40%).



## Sub-slab/Soil-Gas Sample Collection Log

		<b>Sample ID:</b> <b>SGP-2(15.4)/111110</b>
<b>Client:</b>	RACER Trust Trust	<b>Boring Equipment:</b> Direct-push drill rig
<b>Project:</b>	Vapor Intrusion Verification Investigation	<b>Sealant:</b> Benseal/Bentonite
<b>Location:</b>	Moraine, Ohio	<b>Tubing Information:</b> 0.25 inch OD; 0.17 inch ID Teflon
<b>Project #:</b>	OH000294.0018.00007	<b>Miscellaneous Equipment:</b> Dielectric MGD-2002, Thermo 580B, GEM 500
<b>Samplers:</b>	E. Epple (ARCADIS)	<b>Subcontractor:</b> Envirocore
		<b>Equipment:</b> SKC 220 air pumps, Defender 150
<b>Sampling Depth:</b>	15.4 feet below land surface	<b>Moisture Content of Sampling Zone):</b> Dry
<b>Date of Installation:</b>	10-25-2010	<b>Approximate Purge Volume:</b> 4.5L

### Instrument Readings:

Date	Time	Canister Vacuum (a) (inches of Hg)	Temperature (°F)	Relative Humidity (%)	Air Speed (mph)	Barometric Pressure (inches of Hg)	PID (ppm)
11-11-2010	1008	-28.25	46	68	1	30.38	NM
11-11-2010	1019	-29.5*	46	68	1	30.38	NM
11-11-2010	1047	-4.0	46	68	1	30.38	14.1

(a) Record canister information at a minimum at the beginning and end of sampling

#### SUMMA® Canister Information:

<b>Size (check one):</b>	<input type="checkbox"/> 250 mL	<input checked="" type="checkbox"/> 1L
<b>Canister ID:</b>	3053	
<b>Flow Controller ID:</b>	FC00741	
<b>Notes:</b>	Lab calibrated canister/controller	

#### Tracer Test Information (if applicable):

<b>Initial Helium Shroud:</b>	N/A
<b>Final Helium Shroud:</b>	N/A
<b>Tracer Test Passed:</b>	<input type="checkbox"/> Yes <input type="checkbox"/> No
<b>Notes:</b>	

### General Observations/Notes:

$V_1 = 7.5 \text{ mL}; V_2 = 77.8 \text{ mL}; V_T = 85.3;$ purge for 1 min 43 sec at 50 mL/min
Start purge at 0945. Passed shut-in test.
*Flow controller pressure gauge readings.

### Approximating One-Well Volume (for purging):

$V_1 + V_2 + V_3 = V_t$  where:  $V_1 = \pi r^2 h$  = open space volume of soil-gas screen;  $V_2 = \pi r^2 h$  = open space volume of sample tubing;  $V_3 = \pi r^2 h \rho$  = estimated open pore space for sand pack and dry bentonite seal;  $V_t$  = total volume;  $r$  = inner radius of soil-gas screen, borehole, or sample tubing;  $h$  = height of soil-gas screen or height (length) of tubing or height of sand pack and dry bentonite seal;  $\rho$  = porosity of sand pack and dry bentonite seal (40%).



## Sub-slab/Soil-Gas Sample Collection Log

		<b>Sample ID:</b> <b>SGP-3(6)/110910</b>
<b>Client:</b>	RACER Trust Trust	<b>Boring Equipment:</b> Direct-push drill rig
<b>Project:</b>	Vapor Intrusion Verification Investigation	<b>Sealant:</b> Benseal/Bentonite
<b>Location:</b>	Moraine, Ohio	<b>Tubing Information:</b> 0.25 inch OD; 0.17 inch ID Teflon
<b>Project #:</b>	OH000294.0018.00007	<b>Miscellaneous Equipment:</b> Dielectric MGD-2002, Thermo 580B, GEM 500
<b>Samplers:</b>	E. Epple (ARCADIS)	<b>Subcontractor:</b> Envirocore
		<b>Equipment:</b> SKC 220 air pumps, Defender 150
<b>Sampling Depth:</b>	6 feet below land surface	<b>Moisture Content of Sampling Zone):</b> Moist to Dry
<b>Date of Installation:</b>	10-20-2010	<b>Approximate Purge Volume:</b> 30.2L

### Instrument Readings:

Date	Time	Canister Vacuum (a) (inches of Hg)	Temperature (°F)	Relative Humidity (%)	Air Speed (mph)	Barometric Pressure (inches of Hg)	PID (ppm)
11-9-2010	1413	29.0	68	30	6	29.98	NM
11-9-2010	1506	28.25*	68	30	6	29.98	NM
11-9-2010	1506	NM*	68	30	6	29.98	NM
11-9-2010	1534	-3.5*	68	30	6	29.98	NM
11-9-2010	1539	-2.75	68	30	6	29.98	0.1

(a) Record canister information at a minimum at the beginning and end of sampling

#### SUMMA® Canister Information:

<b>Size (check one):</b>	<input type="checkbox"/> 250 mL	<input checked="" type="checkbox"/> 1L
<b>Canister ID:</b>	37383	
<b>Flow Controller ID:</b>	FC00200	
<b>Notes:</b>	Lab calibrated canister/controller	

#### Tracer Test Information (if applicable):

<b>Initial Helium Shroud:</b>	99%
<b>Final Helium Shroud:</b>	76%
<b>Tracer Test Passed:</b>	<input checked="" type="checkbox"/> Yes <input type="checkbox"/> No
<b>Notes:</b>	1125 ppm Helium detected at point after purge on 11-5-2010.

### General Observations/Notes:

$V_1 = 7.53 \text{ mL}; V_2 = 35.71 \text{ mL}; V_T = 43.24$ ; purge for 1 min at 50 mL/min, shut-in test passed.
*Flow controller pressure gauge readings.

### Approximating One-Well Volume (for purging):

$V_1 + V_2 + V_3 = V_t$  where:  $V_1 = \pi r^2 h$  = open space volume of soil-gas screen;  $V_2 = \pi r^2 h$  = open space volume of sample tubing;  $V_3 = \pi r^2 h \rho$  = estimated open pore space for sand pack and dry bentonite seal;  $V_t$  = total volume;  $r$  = inner radius of soil-gas screen, borehole, or sample tubing;  $h$  = height of soil-gas screen or height (length) of tubing or height of sand pack and dry bentonite seal;  $\rho$  = porosity of sand pack and dry bentonite seal (40%).



## Sub-slab/Soil-Gas Sample Collection Log

		<b>Sample ID:</b> <b>SGP-3(11)/110910</b>
<b>Client:</b>	RACER Trust Trust	<b>Boring Equipment:</b> Direct-push drill rig
<b>Project:</b>	Vapor Intrusion Verification Investigation	<b>Sealant:</b> Benseal/Bentonite
<b>Location:</b>	Moraine, Ohio	<b>Tubing Information:</b> 0.25 inch OD; 0.17 inch ID Teflon
<b>Project #:</b>	OH000294.0018.00007	<b>Miscellaneous Equipment:</b> Dielectric MGD-2002, Thermo 580B, GEM 500
<b>Samplers:</b>	J. Rumschlag (ARCADIS)	<b>Subcontractor:</b> Envirocore
		<b>Equipment:</b> SKC 220 air pumps, Defender 150
<b>Sampling Depth:</b>	11 feet below land surface	<b>Moisture Content of Sampling Zone):</b> Moist to Dry
<b>Date of Installation:</b>	10-20-2010	<b>Approximate Purge Volume:</b> 4.5L

### Instrument Readings:

Date	Time	Canister Vacuum (a) (inches of Hg)	Temperature (°F)	Relative Humidity (%)	Air Speed (mph)	Barometric Pressure (inches of Hg)	PID (ppm)
11-9-2010	1511	28.75	68	30	5	29.97	NM
11-9-2010	1527	-27.50*	68	30	5	29.97	NM
11-9-2010	1528	-27.25*	68	30	5	29.97	NM
11-9-2010	1544	-2.75	68	30	5	29.97	0.1

(a) Record canister information at a minimum at the beginning and end of sampling

#### SUMMA® Canister Information:

<b>Size (check one):</b>	<input type="checkbox"/> 250 mL	<input checked="" type="checkbox"/> 1L
<b>Canister ID:</b>	3393	
<b>Flow Controller ID:</b>	FC00213	
<b>Notes:</b>	Lab calibrated canister/controller	

#### Tracer Test Information (if applicable):

<b>Initial Helium Shroud:</b>	N/A
<b>Final Helium Shroud:</b>	N/A
<b>Tracer Test Passed:</b>	<input type="checkbox"/> Yes <input type="checkbox"/> No
<b>Notes:</b>	

#### General Observations/Notes:

$V_1 = 7.53 \text{ mL}; V_2 = 58.04 \text{ mL}; V_T = 65.57;$ purge for 1 min 19 sec at 50 mL/min
Start purge at 1521; passed shut-in test. *Flow controller pressure gauge readings.

#### Approximating One-Well Volume (for purging):

$V_1 + V_2 + V_3 = V_t$  where:  $V_1 = \pi r^2 h$  = open space volume of soil-gas screen;  $V_2 = \pi r^2 h$  = open space volume of sample tubing;  $V_3 = \pi r^2 h \rho$  = estimated open pore space for sand pack and dry bentonite seal;  $V_t$  = total volume;  $r$  = inner radius of soil-gas screen, borehole, or sample tubing;  $h$  = height of soil-gas screen or height (length) of tubing or height of sand pack and dry bentonite seal;  $\rho$  = porosity of sand pack and dry bentonite seal (40%).



## Sub-slab/Soil-Gas Sample Collection Log

		<b>Sample ID:</b> <b>SGP-3(16.26)/110910</b>
<b>Client:</b>	RACER Trust Trust	<b>Boring Equipment:</b> Direct-push drill rig
<b>Project:</b>	Vapor Intrusion Verification Investigation	<b>Sealant:</b> Benseal/Bentonite
<b>Location:</b>	Moraine, Ohio	<b>Tubing Information:</b> 0.25 inch OD; 0.17 inch ID Teflon
<b>Project #:</b>	OH000294.0018.00007	<b>Miscellaneous Equipment:</b> Dielectric MGD-2002, Thermo 580B, GEM 500
<b>Samplers:</b>	E. Epple (ARCADIS)	<b>Subcontractor:</b> Envirocore
		<b>Equipment:</b> SKC 220 air pumps, Defender 150
<b>Sampling Depth:</b>	16.25 feet below land surface	<b>Moisture Content of Sampling Zone):</b>
<b>Date of Installation:</b>	10-20-2010	<b>Approximate Purge Volume:</b> 4.6L

### Instrument Readings:

Date	Time	Canister Vacuum (a) (inches of Hg)	Temperature (°F)	Relative Humidity (%)	Air Speed (mph)	Barometric Pressure (inches of Hg)	PID (ppm)
11-9-2010	1659	-29.25	68	30	5	29.97	NM
11-9-2010	1725	-3.2	68	30	5	29.97	0.1

(a) Record canister information at a minimum at the beginning and end of sampling

#### SUMMA® Canister Information:

<b>Size (check one):</b>	<input type="checkbox"/> 250 mL	<input checked="" type="checkbox"/> 1L
<b>Canister ID:</b>	01460	
<b>Flow Controller ID:</b>	FC00658	
<b>Notes:</b>	Lab calibrated canister/controller	

#### Tracer Test Information (if applicable):

<b>Initial Helium Shroud:</b>	N/A
<b>Final Helium Shroud:</b>	N/A
<b>Tracer Test Passed:</b>	<input type="checkbox"/> Yes <input type="checkbox"/> No
<b>Notes:</b>	

### General Observations/Notes:

$V_1 = 7.53 \text{ mL}; V_2 = 72.59 \text{ mL}; V_T = 80.12;$ purge for 1 min 36 sec at 50 mL/min
Start purge at 1557, shut-in test passed. Resampled after first canister was unintentionally allowed to equilibrate with the atmosphere.

#### Approximating One-Well Volume (for purging):

$V_1 + V_2 + V_3 = V_t$  where:  $V_1 = \pi r^2 h$  = open space volume of soil-gas screen;  $V_2 = \pi r^2 h$  = open space volume of sample tubing;  $V_3 = \pi r^2 h \rho$  = estimated open pore space for sand pack and dry bentonite seal;  $V_t$  = total volume;  $r$  = inner radius of soil-gas screen, borehole, or sample tubing;  $h$  = height of soil-gas screen or height (length) of tubing or height of sand pack and dry bentonite seal;  $\rho$  = porosity of sand pack and dry bentonite seal (40%).



## Sub-slab/Soil-Gas Sample Collection Log

		<b>Sample ID:</b> <b>SGP-4(16.2)/111010</b>	
<b>Client:</b>	RACER Trust Trust	<b>Boring Equipment:</b>	Direct-push drill rig
<b>Project:</b>	Vapor Intrusion Verification Investigation	<b>Sealant:</b>	Benseal/Bentonite
<b>Location:</b>	Moraine, Ohio	<b>Tubing Information:</b>	0.25 inch OD; 0.17 inch ID Teflon
<b>Project #:</b>	OH000294.0018.00007	<b>Miscellaneous Equipment:</b>	Dielectric MGD-2002, Thermo 580B, GEM 500
<b>Samplers:</b>	E. Epple (ARCADIS)	<b>Subcontractor:</b>	Envirocore
		<b>Equipment:</b>	SKC 220 air pumps, Defender 150
<b>Sampling Depth:</b>	16.2 feet below land surface	<b>Moisture Content of Sampling Zone):</b>	Moist
<b>Date of Installation:</b>	10-22-2010	<b>Approximate Purge Volume:</b>	4.6L

### Instrument Readings:

Date	Time	Canister Vacuum (a) (inches of Hg)	Temperature (°F)	Relative Humidity (%)	Air Speed (mph)	Barometric Pressure (inches of Hg)	PID (ppm)
11-10-2010	1012	-29.25	68	30	5	29.97	NM
11-10-2010	1045	-5.0	68	30	5	29.97	1.3

(a) Record canister information at a minimum at the beginning and end of sampling

#### SUMMA® Canister Information:

<b>Size (check one):</b>	<input type="checkbox"/> 250 mL	<input checked="" type="checkbox"/> 1L
<b>Canister ID:</b>	4129	
<b>Flow Controller ID:</b>	FC00248	
<b>Notes:</b>	Lab calibrated canister/controller	

#### Tracer Test Information (if applicable):

<b>Initial Helium Shroud:</b>	N/A
<b>Final Helium Shroud:</b>	N/A
<b>Tracer Test Passed:</b>	<input type="checkbox"/> Yes <input type="checkbox"/> No
<b>Notes:</b>	

#### General Observations/Notes:

$V_1 = 7.53 \text{ mL}; V_2 = 81.25 \text{ mL}; V_T = 88.78$ ; purge for 1 min 47 sec at 50 mL/min
Start purge at 1016, shut-in test passed.
Initial controller pressure=-27.75 in Hg

#### Approximating One-Well Volume (for purging):

$V_1 + V_2 + V_3 = V_t$  where:  $V_1 = \pi r^2 h$  = open space volume of soil-gas screen;  $V_2 = \pi r^2 h$  = open space volume of sample tubing;  $V_3 = \pi r^2 h \rho$  = estimated open pore space for sand pack and dry bentonite seal;  $V_t$  = total volume;  $r$  = inner radius of soil-gas screen, borehole, or sample tubing;  $h$  = height of soil-gas screen or height (length) of tubing or height of sand pack and dry bentonite seal;  $\rho$  = porosity of sand pack and dry bentonite seal (40%).



# Sub-slab/Soil-Gas Sample Collection Log

		Sample ID:	<b>SGP-4(6)/111010</b>
		Boring Equipment:	Direct-push drill rig
Client:	RACER Trust Trust	Sealant:	Benseal/Bentonite
Project:	Vapor Intrusion Verification Investigation	Tubing Information:	0.25 inch OD; 0.17 inch ID Teflon
Location:	Moraine, Ohio	Miscellaneous Equipment:	Dielectric MGD-2002, Thermo 580B, GEM 500
Project #:	OH000294.0018.00007	Subcontractor:	Envirocore
Samplers:	E. Epple (ARCADIS)	Equipment:	SKC 220 air pumps, Defender 150
Sampling Depth:	6 feet below land surface	Moisture Content of Sampling Zone):	Moist
Date of Installation:	10-22-2010	Approximate Purge Volume:	30.2L

## Instrument Readings:

Date	Time	Canister Vacuum (a) (inches of Hg)	Temperature (°F)	Relative Humidity (%)	Air Speed (mph)	Barometric Pressure (inches of Hg)	PID (ppm)
11-10-2010	0845	-27.0	42	79	0	30.15	NM
11-10-2010	0905	-29.75*	42	79	0	30.15	NM
11-10-2010	0925	-1.25	42	79	0	30.15	0.3

(a) Record canister information at a minimum at the beginning and end of sampling

### SUMMA® Canister Information:

Size (check one):	<input type="checkbox"/> 250 mL	<input checked="" type="checkbox"/> 1L
Canister ID:	35659	
Flow Controller ID:	6488	
Notes:	Lab calibrated canister/controller	

### Tracer Test Information (if applicable):

Initial Helium Shroud:	98.8%
Final Helium Shroud:	39.3%
Tracer Test Passed:	<input checked="" type="checkbox"/> Yes <input type="checkbox"/> No
Notes:	Helium not detected in point after purge on 11-5-2010.

### General Observations/Notes:

V <sub>1</sub> = 7.53 mL; V <sub>2</sub> = 35.71 mL; V <sub>T</sub> = 43.25; purge for 52 sec at 50 mL/min
Start purge at 0901, shut-in test passed. Regulator casing loose
*Initial controller pressure

### Approximating One-Well Volume (for purging):

$V_1 + V_2 + V_3 = V_t$  where:  $V_1 = \pi r^2 h$  = open space volume of soil-gas screen;  $V_2 = \pi r^2 h$  = open space volume of sample tubing;  $V_3 = \pi r^2 h \rho$  = estimated open pore space for sand pack and dry bentonite seal;  $V_t$  = total volume;  $r$  = inner radius of soil-gas screen, borehole, or sample tubing;  $h$  = height of soil-gas screen or height (length) of tubing or height of sand pack and dry bentonite seal;  $\rho$  = porosity of sand pack and dry bentonite seal (40%).



# Sub-slab/Soil-Gas Sample Collection Log

		Sample ID:	<b>SGP-4(11)/111010</b>
		Boring Equipment:	Direct-push drill rig
Client:	RACER Trust Trust	Sealant:	Benseal/Bentonite
Project:	Vapor Intrusion Verification Investigation	Tubing Information:	0.25 inch OD; 0.17 inch ID Teflon
Location:	Moraine, Ohio	Miscellaneous Equipment:	Dielectric MGD-2002, Thermo 580B, GEM 500
Project #:	OH000294.0018.00007	Subcontractor:	Envirocore
Samplers:	E. Epple (ARCADIS)	Equipment:	SKC 220 air pumps, Defender 150
Sampling Depth:	11 feet below land surface	Moisture Content of Sampling Zone):	Moist
Date of Installation:	10-22-2010	Approximate Purge Volume:	4.5L

### Instrument Readings:

Date	Time	Canister Vacuum (a) (inches of Hg)	Temperature (°F)	Relative Humidity (%)	Air Speed (mph)	Barometric Pressure (inches of Hg)	PID (ppm)
11-10-2010	0925	-28.0	42	79	0	30.15	NM
11-10-2010	0931	-29.0*	42	79	0	30.15	NM
11-10-2010	0959	-5.0*	42	79	0	30.15	1.1
11-10-2010	1002	-3.5	42	79	0	30.15	1.1

(a) Record canister information at a minimum at the beginning and end of sampling

### SUMMA® Canister Information:

Size (check one):	<input type="checkbox"/> 250 mL	<input checked="" type="checkbox"/> 1L
Canister ID:	37298	
Flow Controller ID:	FC00263	
Notes:	Lab calibrated canister/controller	

### Tracer Test Information (if applicable):

Initial Helium Shroud:	N/A	
Final Helium Shroud:	N/A	
Tracer Test Passed:	<input type="checkbox"/> Yes	<input type="checkbox"/> No
Notes:		

### General Observations/Notes:

$V_1 = 7.53$ mL; $V_2 = 58.03$ mL; $V_T = 65.57$ ; purge for 1 min 19 sec at 50 mL/min
Start purge at 0918, shut-in test passed. *Flow controller pressure gauge readings.

### Approximating One-Well Volume (for purging):

$V_1 + V_2 + V_3 = V_t$  where:  $V_1 = \pi r^2 h$  = open space volume of soil-gas screen;  $V_2 = \pi r^2 h$  = open space volume of sample tubing;  $V_3 = \pi r^2 h \rho$  = estimated open pore space for sand pack and dry bentonite seal;  $V_t$  = total volume;  $r$  = inner radius of soil-gas screen, borehole, or sample tubing;  $h$  = height of soil-gas screen or height (length) of tubing or height of sand pack and dry bentonite seal;  $\rho$  = porosity of sand pack and dry bentonite seal (40%).



# Sub-slab/Soil-Gas Sample Collection Log

Sample ID: **SGP-5(6)/111110**

<b>Client:</b>	RACER Trust Trust	<b>Boring Equipment:</b>	Direct-push drill rig
<b>Project:</b>	Vapor Intrusion Verification Investigation	<b>Sealant:</b>	Benseal/Bentonite
<b>Location:</b>	Moraine, Ohio	<b>Tubing Information:</b>	0.25 inch OD; 0.17 inch ID Teflon
<b>Project #:</b>	OH000294.0018.00007	<b>Miscellaneous Equipment:</b>	Dielectric MGD-2002, Thermo 580B, GEM 500
<b>Samplers:</b>	J. Rumschlag (ARCADIS)	<b>Subcontractor:</b>	Envirocore
		<b>Equipment:</b>	SKC 220 air pumps, Defender 150
<b>Sampling Depth:</b>	6 feet below land surface	<b>Moisture Content of Sampling Zone):</b>	Dry
<b>Date of Installation:</b>	10-29-2010	<b>Approximate Purge Volume:</b>	30.2L

## Instrument Readings:

Date	Time	Canister Vacuum (a) (inches of Hg)	Temperature (°F)	Relative Humidity (%)	Air Speed (mph)	Barometric Pressure (inches of Hg)	PID (ppm)
11-11-2010	1214	-28.5	62	48	2	30.34	NM
11-11-2010	1321	-3.25	62	48	2	30.34	1.9

(a) Record canister information at a minimum at the beginning and end of sampling

### SUMMA® Canister Information:

<b>Size (check one):</b>	<input type="checkbox"/> 250 mL	<input checked="" type="checkbox"/> 1L
<b>Canister ID:</b>	33636	
<b>Flow Controller ID:</b>	40832	
<b>Notes:</b>	Lab calibrated canister/controller	

### Tracer Test Information (if applicable):

<b>Initial Helium Shroud:</b>	<b>87.2 %</b>
<b>Final Helium Shroud:</b>	<b>75.1%</b>
<b>Tracer Test Passed:</b>	<input checked="" type="checkbox"/> <b>Yes</b> <input type="checkbox"/> <b>No</b>
<b>Notes:</b>	1250 ppm Helium detected in point after purge on 11-8-2010

### General Observations/Notes:

Start purge at 12:01 43 mL; regulator start pressure = -25.5 in Hg; note: failed initial shut-in test lost 0.5 in Hg to leak-shut valve closed and tightened all connections. Second shut-in test passed no leaks. Finished sampling after 7 minutes.

### Approximating One-Well Volume (for purging):

$V_1 + V_2 + V_3 = V_t$  where:  $V_1 = \pi r^2 h$  = open space volume of soil-gas screen;  $V_2 = \pi r^2 h$  = open space volume of sample tubing;  $V_3 = \pi r^2 h \rho$  = estimated open pore space for sand pack and dry bentonite seal;  $V_t$  = total volume;  $r$  = inner radius of soil-gas screen, borehole, or sample tubing;  $h$  = height of soil-gas screen or height (length) of tubing or height of sand pack and dry bentonite seal;  $\rho$  = porosity of sand pack and dry bentonite seal (40%).



## Sub-slab/Soil-Gas Sample Collection Log

		<b>Sample ID:</b> <b>SGP-5(11)/111110</b>
<b>Client:</b>	RACER Trust Trust	<b>Boring Equipment:</b> Direct-push drill rig
<b>Project:</b>	Vapor Intrusion Verification Investigation	<b>Sealant:</b> Benseal/Bentonite
<b>Location:</b>	Moraine, Ohio	<b>Tubing Information:</b> 0.25 inch OD; 0.17 inch ID Teflon
<b>Project #:</b>	OH000294.0018.00007	<b>Miscellaneous Equipment:</b> Dielectric MGD-2002, Thermo 580B, GEM 500
<b>Samplers:</b>	J. Rumschlag (ARCADIS)	<b>Subcontractor:</b> Envirocore
		<b>Equipment:</b> SKC 220 air pumps, Defender 150
<b>Sampling Depth:</b>	11 feet below land surface	<b>Moisture Content of Sampling Zone):</b> Dry
<b>Date of Installation:</b>	10-29-2010	<b>Approximate Purge Volume:</b> 4.5L

### Instrument Readings:

Date	Time	Canister Vacuum (a) (inches of Hg)	Temperature (°F)	Relative Humidity (%)	Air Speed (mph)	Barometric Pressure (inches of Hg)	PID (ppm)
11-11-2010	1223	-28.75	62	48	2	30.34	NM
11-11-2010	1337	-4.0	62	48	2	30.34	2.6

(a) Record canister information at a minimum at the beginning and end of sampling

#### SUMMA® Canister Information:

<b>Size (check one):</b>	<input type="checkbox"/> 250 mL	<input checked="" type="checkbox"/> 1L
<b>Canister ID:</b>	3033	
<b>Flow Controller ID:</b>	FC00933	
<b>Notes:</b>	Lab calibrated canister/controller	

#### Tracer Test Information (if applicable):

<b>Initial Helium Shroud:</b>	N/A
<b>Final Helium Shroud:</b>	N/A
<b>Tracer Test Passed:</b>	<input type="checkbox"/> Yes <input type="checkbox"/> No
<b>Notes:</b>	

#### General Observations/Notes:

$V_1 = 7.5 \text{ mL}; V_2 = 58 \text{ mL}; V_T = 65.5 \text{ mL};$ purged 1 min 19 sec at 50 mL/min
Begin purge at 1203:30; purged 65.5 mL
Regulator pressure start < -29.5 in Hg; pass shut-in test.

#### Approximating One-Well Volume (for purging):

$V_1 + V_2 + V_3 = V_t$  where:  $V_1 = \pi r^2 h$  = open space volume of soil-gas screen;  $V_2 = \pi r^2 h$  = open space volume of sample tubing;  $V_3 = \pi r^2 h \rho$  = estimated open pore space for sand pack and dry bentonite seal;  $V_t$  = total volume;  $r$  = inner radius of soil-gas screen, borehole, or sample tubing;  $h$  = height of soil-gas screen or height (length) of tubing or height of sand pack and dry bentonite seal;  $\rho$  = porosity of sand pack and dry bentonite seal (40%).



## Sub-slab/Soil-Gas Sample Collection Log

		<b>Sample ID:</b> <b>SGP-5(14.8)/111110</b>
<b>Client:</b>	RACER Trust Trust	<b>Boring Equipment:</b> Direct-push drill rig
<b>Project:</b>	Vapor Intrusion Verification Investigation	<b>Sealant:</b> Benseal/Bentonite
<b>Location:</b>	Moraine, Ohio	<b>Tubing Information:</b> 0.25 inch OD; 0.17 inch ID Teflon
<b>Project #:</b>	OH000294.0018.00007	<b>Miscellaneous Equipment:</b> Dielectric MGD-2002, Thermo 580B, GEM 500
<b>Samplers:</b>	J. Rumschlag (ARCADIS)	<b>Subcontractor:</b> Envirocore
		<b>Equipment:</b> SKC 220 air pumps, Defender 150
<b>Sampling Depth:</b>	14.8 feet below land surface	<b>Moisture Content of Sampling Zone):</b> Dry
<b>Date of Installation:</b>	10-29-2010	<b>Approximate Purge Volume:</b> 6.5L

### Instrument Readings:

Date	Time	Canister Vacuum (a) (inches of Hg)	Temperature (°F)	Relative Humidity (%)	Air Speed (mph)	Barometric Pressure (inches of Hg)	PID (ppm)
11-11-2010	1240	-28.5	62	48	2	30.34	NM
11-11-2010	1341	-3.75	62	48	2	30.34	2.6

(a) Record canister information at a minimum at the beginning and end of sampling

#### SUMMA® Canister Information:

<b>Size (check one):</b>	<input type="checkbox"/> 250 mL	<input checked="" type="checkbox"/> 1L
<b>Canister ID:</b>	34176	
<b>Flow Controller ID:</b>	FC00823	
<b>Notes:</b>	Certification label incorrectly labeled	

#### Tracer Test Information (if applicable):

<b>Initial Helium Shroud:</b>	N/A
<b>Final Helium Shroud:</b>	N/A
<b>Tracer Test Passed:</b>	<input type="checkbox"/> Yes <input type="checkbox"/> No
<b>Notes:</b>	

### General Observations/Notes:

$V_1 = 7.5$ $V_2 = (0.085)^2 \times \pi \times 202 \text{ in} \times 16.39 \text{ mL/in}^3 = 75 \text{ mL}$ ; $V_T = 82.5 \text{ mL}$ ; purged at 50 mL/min for 1 min 39 sec
Begin purge at 1207:30; purged 82.5 mL
Collected duplicate (Dup-2); Initial regulator pressure = -28 in Hg

#### Approximating One-Well Volume (for purging):

$V_1 + V_2 + V_3 = V_t$  where:  $V_1 = \pi r^2 h$  = open space volume of soil-gas screen;  $V_2 = \pi r^2 h$  = open space volume of sample tubing;  $V_3 = \pi r^2 h \rho$  = estimated open pore space for sand pack and dry bentonite seal;  $V_t$  = total volume;  $r$  = inner radius of soil-gas screen, borehole, or sample tubing;  $h$  = height of soil-gas screen or height (length) of tubing or height of sand pack and dry bentonite seal;  $\rho$  = porosity of sand pack and dry bentonite seal (40%).



## Sub-slab/Soil-Gas Sample Collection Log

		<b>Sample ID:</b> <b>SGP-6(6)/111110</b>
<b>Client:</b>	RACER Trust Trust	<b>Boring Equipment:</b> Direct-push drill rig
<b>Project:</b>	Vapor Intrusion Verification Investigation	<b>Sealant:</b> Benseal/Bentonite
<b>Location:</b>	Moraine, Ohio	<b>Tubing Information:</b> 0.25 inch OD; 0.17 inch ID Teflon
<b>Project #:</b>	OH000294.0018.00007	<b>Miscellaneous Equipment:</b> Dielectric MGD-2002, Thermo 580B, GEM 500
<b>Samplers:</b>	J. Rumschlag (ARCADIS)	<b>Subcontractor:</b> Envirocore
		<b>Equipment:</b> SKC 220 air pumps, Defender 150
<b>Sampling Depth:</b>	6 feet below land surface	<b>Moisture Content of Sampling Zone):</b> Dry
<b>Date of Installation:</b>	10-28-2010	<b>Approximate Purge Volume:</b> 43.5L

### Instrument Readings:

Date	Time	Canister Vacuum (a) (inches of Hg)	Temperature (°F)	Relative Humidity (%)	Air Speed (mph)	Barometric Pressure (inches of Hg)	PID (ppb)
11-11-2010	1653	-28.75	62	48	2	30.34	NM
11-11-2010	1728	-3.75	62	48	2	30.34	0.0

(a) Record canister information at a minimum at the beginning and end of sampling

#### SUMMA® Canister Information:

<b>Size (check one):</b>	<input type="checkbox"/> 250 mL	<input checked="" type="checkbox"/> 1L
<b>Canister ID:</b>	37325	
<b>Flow Controller ID:</b>	6862	
<b>Notes:</b>	Lab calibrated canister/controller	

#### Tracer Test Information (if applicable):

<b>Initial Helium Shroud:</b>	94.4%
<b>Final Helium Shroud:</b>	88.5%
<b>Tracer Test Passed:</b>	<input checked="" type="checkbox"/> Yes <input type="checkbox"/> No
<b>Notes:</b>	350 ppm Helium detected in point after purge on 11-10-2010.

### General Observations/Notes:

V <sub>1</sub> =7.5 mL ; V <sub>2</sub> = 35.7 mL; V <sub>T</sub> = 43.2 mL; purge 52 seconds at 50 mL/min
At 1659:10 begin purging point for 52 seconds
Initial regulator pressure = <-30 in Hg; passed shut-in test

#### Approximating One-Well Volume (for purging):

$V_1 + V_2 + V_3 = V_t$  where:  $V_1 = \pi r^2 h$  = open space volume of soil-gas screen;  $V_2 = \pi r^2 h$  = open space volume of sample tubing;  $V_3 = \pi r^2 h \rho$  = estimated open pore space for sand pack and dry bentonite seal;  $V_t$  = total volume;  $r$  = inner radius of soil-gas screen, borehole, or sample tubing;  $h$  = height of soil-gas screen or height (length) of tubing or height of sand pack and dry bentonite seal;  $\rho$  = porosity of sand pack and dry bentonite seal (40%).



## Sub-slab/Soil-Gas Sample Collection Log

		<b>Sample ID:</b> <b>SGP-6(11)/111110</b>	
<b>Client:</b>	RACER Trust Trust	<b>Boring Equipment:</b>	Direct-push drill rig
<b>Project:</b>	Vapor Intrusion Verification Investigation	<b>Sealant:</b>	Benseal/Bentonite
<b>Location:</b>	Moraine, Ohio	<b>Tubing Information:</b>	0.25 inch OD; 0.17 inch ID Teflon
<b>Project #:</b>	OH000294.0018.00007	<b>Miscellaneous Equipment:</b>	Dielectric MGD-2002, Thermo 580B, GEM 500
<b>Samplers:</b>	J. Rumschlag (ARCADIS)	<b>Subcontractor:</b>	Envirocore
		<b>Equipment:</b>	SKC 220 air pumps, Defender 150
<b>Sampling Depth:</b>	11 feet below land surface	<b>Moisture Content of Sampling Zone):</b>	Dry
<b>Date of Installation:</b>	10-28-2010	<b>Approximate Purge Volume:</b>	2.3L

### Instrument Readings:

Date	Time	Canister Vacuum (a) (inches of Hg)	Temperature (°F)	Relative Humidity (%)	Air Speed (mph)	Barometric Pressure (inches of Hg)	PID (ppm)
11-11-2010	1657	-28.5	62	48	2	30.34	NM
11-11-2010	1731	-4.5	62	48	2	30.34	0.0

(a) Record canister information at a minimum at the beginning and end of sampling

#### SUMMA® Canister Information:

<b>Size (check one):</b>	<input type="checkbox"/> 250 mL	<input checked="" type="checkbox"/> 1L
<b>Canister ID:</b>	2059	
<b>Flow Controller ID:</b>	FC00340	
<b>Notes:</b>	Lab calibrated canister/controller	

#### Tracer Test Information (if applicable):

<b>Initial Helium Shroud:</b>	95.5%
<b>Final Helium Shroud:</b>	89.4%
<b>Tracer Test Passed:</b>	<input checked="" type="checkbox"/> Yes <input type="checkbox"/> No
<b>Notes:</b>	125 ppm helium detected in point after purge on 11-10-2010.

#### General Observations/Notes:

$V_1 = 7.5 \text{ mL}; V_2 = 58 \text{ mL}; V_T = 65.5 \text{ mL};$ purge time = 1 min 19 sec at 50 mL/min .
1649 begin purge at point and tubing for 1 min 19 sec
Initial regulator pressure = < -30 in Hg; passed shut-in test

#### Approximating One-Well Volume (for purging):

$V_1 + V_2 + V_3 = V_t$  where:  $V_1 = \pi r^2 h$  = open space volume of soil-gas screen;  $V_2 = \pi r^2 h$  = open space volume of sample tubing;  $V_3 = \pi r^2 h \rho$  = estimated open pore space for sand pack and dry bentonite seal;  $V_t$  = total volume;  $r$  = inner radius of soil-gas screen, borehole, or sample tubing;  $h$  = height of soil-gas screen or height (length) of tubing or height of sand pack and dry bentonite seal;  $\rho$  = porosity of sand pack and dry bentonite seal (40%).



## Sub-slab/Soil-Gas Sample Collection Log

		<b>Sample ID:</b> <b>SGP-6(15)/111110</b>
<b>Client:</b>	RACER Trust	<b>Boring Equipment:</b> Direct-push drill rig
<b>Project:</b>	Vapor Intrusion Verification Investigation	<b>Sealant:</b> Benseal/Bentonite
<b>Location:</b>	Moraine, Ohio	<b>Tubing Information:</b> 0.25 inch OD; 0.17 inch ID Teflon
<b>Project #:</b>	OH000294.0018.00007	<b>Miscellaneous Equipment:</b> Dielectric MGD-2002, Thermo 580B, GEM 500
<b>Samplers:</b>	J. Rumschlag (ARCADIS)	<b>Subcontractor:</b> Envirocore
		<b>Equipment:</b> SKC 220 air pumps, Defender 150
<b>Sampling Depth:</b>	15 feet below land surface	<b>Moisture Content of Sampling Zone):</b> Moist
<b>Date of Installation:</b>	10-28-2010	<b>Approximate Purge Volume:</b> 6.5L

### Instrument Readings:

Date	Time	Canister Vacuum (a) (inches of Hg)	Temperature (°F)	Relative Humidity (%)	Air Speed (mph)	Barometric Pressure (inches of Hg)	PID (ppm)
11-11-2010	1703	-28.5	62	48	2	30.34	NM
11-11-2010	1729	-4.0	62	48	2	30.34	0.0

(a) Record canister information at a minimum at the beginning and end of sampling

#### SUMMA® Canister Information:

<b>Size (check one):</b>	<input type="checkbox"/> 250 mL	<input checked="" type="checkbox"/> 1L
<b>Canister ID:</b>	34646	
<b>Flow Controller ID:</b>	FC00828	
<b>Notes:</b>	Lab calibrated canister/controller	

#### Tracer Test Information (if applicable):

<b>Initial Helium Shroud:</b>	N/A
<b>Final Helium Shroud:</b>	N/A
<b>Tracer Test Passed:</b>	<input type="checkbox"/> Yes <input type="checkbox"/> No
<b>Notes:</b>	

#### General Observations/Notes:

$V_1 = 7.5 \text{ mL}; V_2 = 76 \text{ mL}; V_T = 83.5 \text{ mL};$ purge time = 1 min 41 sec at 50 mL/min.
1651 begin purge at point and tubing for 1 min 41 sec.
Initial regulator pressure = -30 in Hg; passed shut-in test

#### Approximating One-Well Volume (for purging):

$V_1 + V_2 + V_3 = V_t$  where:  $V_1 = \pi r^2 h$  = open space volume of soil-gas screen;  $V_2 = \pi r^2 h$  = open space volume of sample tubing;  $V_3 = \pi r^2 h \rho$  = estimated open pore space for sand pack and dry bentonite seal;  $V_t$  = total volume;  $r$  = inner radius of soil-gas screen, borehole, or sample tubing;  $h$  = height of soil-gas screen or height (length) of tubing or height of sand pack and dry bentonite seal;  $\rho$  = porosity of sand pack and dry bentonite seal (40%).



## Sub-slab/Soil-Gas Sample Collection Log

		<b>Sample ID:</b> <span style="font-size: 1.2em; font-weight: bold;">SGP-7(6)/111010</span>	
<b>Client:</b>	RACER Trust	<b>Boring Equipment:</b>	Direct-push drill rig
<b>Project:</b>	Vapor Intrusion Verification Investigation	<b>Sealant:</b>	Benseal/Bentonite
<b>Location:</b>	Moraine, Ohio	<b>Tubing Information:</b>	0.25 inch OD; 0.17 inch ID Teflon
<b>Project #:</b>	OH000294.0018.00007	<b>Miscellaneous Equipment:</b>	Dielectric MGD-2002, Thermo 580B, GEM 500
<b>Samplers:</b>	E. Epple (ARCADIS)	<b>Subcontractor:</b>	Envirocore
		<b>Equipment:</b>	SKC 220 air pumps, Defender 150
<b>Sampling Depth:</b>	6 feet below land surface	<b>Moisture Content of Sampling Zone):</b>	Dry
<b>Date of Installation:</b>	10-21-2010	<b>Approximate Purge Volume:</b>	30.2L

### Instrument Readings:

Date	Time	Canister Vacuum (a) (inches of Hg)	Temperature (°F)	Relative Humidity (%)	Air Speed (mph)	Barometric Pressure (inches of Hg)	PID (ppm)
11-10-2010	1447	-29.0	42	79	0	30.15	NM
11-10-2010	1451	-29.75*	42	79	0	30.15	NM
11-10-2010	1701	-4.75	42	79	0	30.15	1.1

(a) Record canister information at a minimum at the beginning and end of sampling

#### SUMMA® Canister Information:

<b>Size (check one):</b>	<input type="checkbox"/> 250 mL	<input checked="" type="checkbox"/> 1L
<b>Canister ID:</b>	34634	
<b>Flow Controller ID:</b>	FC00790	
<b>Notes:</b>	Lab calibrated canister/controller	

#### Tracer Test Information (if applicable):

<b>Initial Helium Shroud:</b>	96.7%
<b>Final Helium Shroud:</b>	66.4%
<b>Tracer Test Passed:</b>	<input checked="" type="checkbox"/> Yes <input type="checkbox"/> No
<b>Notes:</b>	52.5 ppm Helium detected in point after purge on 11-8-2010.

### General Observations/Notes:

$V_1 = 7.53 \text{ mL}; V_2 = 35.71 \text{ mL}; V_T = 43.24 \text{ mL};$ purge time = 52 sec at 50 mL/min.
1436 begin purge; passed shut-in test
*Flow controller pressure gauge readings.

#### Approximating One-Well Volume (for purging):

$V_1 + V_2 + V_3 = V_t$  where:  $V_1 = \pi r^2 h$  = open space volume of soil-gas screen;  $V_2 = \pi r^2 h$  = open space volume of sample tubing;  $V_3 = \pi r^2 h \rho$  = estimated open pore space for sand pack and dry bentonite seal;  $V_t$  = total volume;  $r$  = inner radius of soil-gas screen, borehole, or sample tubing;  $h$  = height of soil-gas screen or height (length) of tubing or height of sand pack and dry bentonite seal;  $\rho$  = porosity of sand pack and dry bentonite seal (40%).



# Sub-slab/Soil-Gas Sample Collection Log

		Sample ID:	<b>SGP-7(11)/111010</b>
		Boring Equipment:	Direct-push drill rig
Client:	RACER Trust	Sealant:	Benseal/Bentonite
Project:	Vapor Intrusion Verification Investigation	Tubing Information:	0.25 inch OD; 0.17 inch ID Teflon
Location:	Moraine, Ohio	Miscellaneous Equipment:	Dielectric MGD-2002, Thermo 580B, GEM 500
Project #:	OH000294.0018.00007	Subcontractor:	Envirocore
Samplers:	E. Epple (ARCADIS)	Equipment:	SKC 220 air pumps, Defender 150
Sampling Depth:	11 feet below land surface	Moisture Content of Sampling Zone):	Dry
Date of Installation:	10-21-2010	Approximate Purge Volume:	4.5L

### Instrument Readings:

Date	Time	Canister Vacuum (a) (inches of Hg)	Temperature (°F)	Relative Humidity (%)	Air Speed (mph)	Barometric Pressure (inches of Hg)	PID (ppm)
11-10-2010	1455	-29.25	42	79	0	30.15	NM
11-10-2010	1459	-30.00*	42	79	0	30.15	NM
11-10-2010	1536	-3.5	42	79	0	30.15	0.3

(a) Record canister information at a minimum at the beginning and end of sampling

### SUMMA® Canister Information:

Size (check one):	<input type="checkbox"/> 250 mL	<input checked="" type="checkbox"/> 1L
Canister ID:	37425	
Flow Controller ID:	FC00410	
Notes:	Lab calibrated canister/controller	

### Tracer Test Information (if applicable):

Initial Helium Shroud:	N/A	
Final Helium Shroud:	N/A	
Tracer Test Passed:	<input type="checkbox"/> Yes	<input type="checkbox"/> No
Notes:		

### General Observations/Notes:

$V_1 = 7.53$ mL; $V_2 = 58.04$ mL; $V_T = 65.6$ mL; purge time = 1 min 19 sec at 50 mL/min.
1439 begin purge; passed shut-in test
*Flow controller pressure gauge readings.

### Approximating One-Well Volume (for purging):

$V_1 + V_2 + V_3 = V_t$  where:  $V_1 = \pi r^2 h$  = open space volume of soil-gas screen;  $V_2 = \pi r^2 h$  = open space volume of sample tubing;  $V_3 = \pi r^2 h \rho$  = estimated open pore space for sand pack and dry bentonite seal;  $V_t$  = total volume;  $r$  = inner radius of soil-gas screen, borehole, or sample tubing;  $h$  = height of soil-gas screen or height (length) of tubing or height of sand pack and dry bentonite seal;  $\rho$  = porosity of sand pack and dry bentonite seal (40%).



## Sub-slab/Soil-Gas Sample Collection Log

		<b>Sample ID:</b> <b>SGP-7(15.65)/111010</b>
<b>Client:</b>	RACER Trust	<b>Boring Equipment:</b> Direct-push drill rig
<b>Project:</b>	Vapor Intrusion Verification Investigation	<b>Sealant:</b> Benseal/Bentonite
<b>Location:</b>	Moraine, Ohio	<b>Tubing Information:</b> 0.25 inch OD; 0.17 inch ID Teflon
<b>Project #:</b>	OH000294.0018.00007	<b>Miscellaneous Equipment:</b> Dielectric MGD-2002, Thermo 580B, GEM 500
<b>Samplers:</b>	E. Epple (ARCADIS)	<b>Subcontractor:</b> Envirocore
		<b>Equipment:</b> SKC 220 air pumps, Defender 150
<b>Sampling Depth:</b>	15.65 feet below land surface	<b>Moisture Content of Sampling Zone):</b> Dry
<b>Date of Installation:</b>	10-21-2010	<b>Approximate Purge Volume:</b> 6.5L

### Instrument Readings:

Date	Time	Canister Vacuum (a) (inches of Hg)	Temperature (°F)	Relative Humidity (%)	Air Speed (mph)	Barometric Pressure (inches of Hg)	PID (ppm)
11-10-2010	1508	-29.25	42	79	0	30.15	NM
11-10-2010	1510	-30.00 *	42	79	0	30.15	NM
11-10-2010	1538	-4.0	42	79	0	30.15	0.3

(a) Record canister information at a minimum at the beginning and end of sampling

#### SUMMA® Canister Information:

<b>Size (check one):</b>	<input type="checkbox"/> 250 mL	<input checked="" type="checkbox"/> 1L
<b>Canister ID:</b>	1487	
<b>Flow Controller ID:</b>	FC00788	
<b>Notes:</b>	Lab calibrated canister/controller	

#### Tracer Test Information (if applicable):

<b>Initial Helium Shroud:</b>	N/A
<b>Final Helium Shroud:</b>	N/A
<b>Tracer Test Passed:</b>	<input type="checkbox"/> Yes <input type="checkbox"/> No
<b>Notes:</b>	

### General Observations/Notes:

$V_1 = 7.53 \text{ mL}; V_2 = 69.94 \text{ mL}; V_T = 77.47 \text{ mL};$ purge time = 1 min 24 sec at 50 mL/min.
*Initial flow controller reading; passed shut-in test

### Approximating One-Well Volume (for purging):

$V_1 + V_2 + V_3 = V_t$  where:  $V_1 = \pi r^2 h$  = open space volume of soil-gas screen;  $V_2 = \pi r^2 h$  = open space volume of sample tubing;  $V_3 = \pi r^2 h \rho$  = estimated open pore space for sand pack and dry bentonite seal;  $V_t$  = total volume;  $r$  = inner radius of soil-gas screen, borehole, or sample tubing;  $h$  = height of soil-gas screen or height (length) of tubing or height of sand pack and dry bentonite seal;  $\rho$  = porosity of sand pack and dry bentonite seal (40%).



## Sub-slab/Soil-Gas Sample Collection Log

		<b>Sample ID:</b> <b>SGP-8(6)/111110</b>	
<b>Client:</b>	RACER Trust	<b>Boring Equipment:</b>	Direct-push drill rig
<b>Project:</b>	Vapor Intrusion Verification Investigation	<b>Sealant:</b>	Benseal/Bentonite
<b>Location:</b>	Moraine, Ohio	<b>Tubing Information:</b>	0.25 inch OD; 0.17 inch ID Teflon
<b>Project #:</b>	OH000294.0018.00007	<b>Miscellaneous Equipment:</b>	Dielectric MGD-2002, Thermo 580B, GEM 500
<b>Samplers:</b>	E. Epple (ARCADIS)	<b>Subcontractor:</b>	Envirocore
		<b>Equipment:</b>	SKC 220 air pumps, Defender 150
<b>Sampling Depth:</b>	6 feet below land surface	<b>Moisture Content of Sampling Zone):</b>	Moist to dry
<b>Date of Installation:</b>	11-1-2010	<b>Approximate Purge Volume:</b>	30.2L

### Instrument Readings:

Date	Time	Canister Vacuum (a) (inches of Hg)	Temperature (°F)	Relative Humidity (%)	Air Speed (mph)	Barometric Pressure (inches of Hg)	PID (ppm)
11-11-2010	0801	-29.5	37	80	0	30.35	NM
11-11-2010	0807	-29.75*	37	80	0	30.35	NM
11-11-2010	0858	-4.0	37	80	0	30.35	0.0

(a) Record canister information at a minimum at the beginning and end of sampling

#### SUMMA® Canister Information:

<b>Size (check one):</b>	<input type="checkbox"/> 250 mL	<input checked="" type="checkbox"/> 1L
<b>Canister ID:</b>	36406	
<b>Flow Controller ID:</b>	FC00935	
<b>Notes:</b>	Lab calibrated canister/controller	

#### Tracer Test Information (if applicable):

<b>Initial Helium Shroud:</b>	99.0%
<b>Final Helium Shroud:</b>	65.6%
<b>Tracer Test Passed:</b>	<input checked="" type="checkbox"/> Yes <input type="checkbox"/> No
<b>Notes:</b>	Helium not detected in point after purge on 11-8-2010.

### General Observations/Notes:

$V_1 = 7.53 \text{ mL}; V_2 = 35.71 \text{ mL}; V_T = 43.24 \text{ mL};$ purge time = 52 sec.; purge start at 0743; duplicate (DUP-1) collected.
*Initial flow controller reading; passed shut-in test

### Approximating One-Well Volume (for purging):

$V_1 + V_2 + V_3 = V_t$  where:  $V_1 = \pi r^2 h$  = open space volume of soil-gas screen;  $V_2 = \pi r^2 h$  = open space volume of sample tubing;  $V_3 = \pi r^2 h \rho$  = estimated open pore space for sand pack and dry bentonite seal;  $V_t$  = total volume;  $r$  = inner radius of soil-gas screen, borehole, or sample tubing;  $h$  = height of soil-gas screen or height (length) of tubing or height of sand pack and dry bentonite seal;  $\rho$  = porosity of sand pack and dry bentonite seal (40%).



# Sub-slab/Soil-Gas Sample Collection Log

		<b>Sample ID:</b>	<b>SGP-8(11)/111010</b>
		<b>Boring Equipment:</b>	Direct-push drill rig
<b>Client:</b>	RACER Trust	<b>Sealant:</b>	Benseal/Bentonite
<b>Project:</b>	Vapor Intrusion Verification Investigation	<b>Tubing Information:</b>	0.25 inch OD; 0.17 inch ID Teflon
<b>Location:</b>	Moraine, Ohio	<b>Miscellaneous Equipment:</b>	Dielectric MGD-2002, Thermo 580B, GEM 500
<b>Project #:</b>	OH000294.0018.00007	<b>Subcontractor:</b>	Envirocore
<b>Samplers:</b>	E. Epple (ARCADIS)	<b>Equipment:</b>	SKC 220 air pumps, Defender 150
<b>Sampling Depth:</b>	11 feet below land surface	<b>Moisture Content of Sampling Zone):</b>	Moist to dry
<b>Date of Installation:</b>	11-1-2010	<b>Approximate Purge Volume:</b>	4.5L

## Instrument Readings:

Date	Time	Canister Vacuum (a) (inches of Hg)	Temperature (°F)	Relative Humidity (%)	Air Speed (mph)	Barometric Pressure (inches of Hg)	PID (ppm)
11-11-2010	0815	-29.0	37	80	0	30.35	NM
11-11-2010	0818	-29.0*	37	80	0	30.35	NM
11-11-2010	0908	-4.75	37	80	0	30.35	0.0

(a) Record canister information at a minimum at the beginning and end of sampling

### SUMMA® Canister Information:

<b>Size (check one):</b>	<input type="checkbox"/> 250 mL	<input checked="" type="checkbox"/> 1L
<b>Canister ID:</b>	33391	
<b>Flow Controller ID:</b>	FC00887	
<b>Notes:</b>	Lab calibrated canister/controller	

### Tracer Test Information (if applicable):

<b>Initial Helium Shroud:</b>	N/A	
<b>Final Helium Shroud:</b>	N/A	
<b>Tracer Test Passed:</b>	<input type="checkbox"/> Yes	<input type="checkbox"/> No
<b>Notes:</b>		

### General Observations/Notes:

V <sub>1</sub> = 7.53 mL; V <sub>2</sub> = 58.04 mL; V <sub>T</sub> = 65.6 mL; purge time = 1 min 19 sec at 50 mL/min; purge start at 0745
*Initial flow controller reading; passed shut-in test

### Approximating One-Well Volume (for purging):

$V_1 + V_2 + V_3 = V_t$  where:  $V_1 = \pi r^2 h$  = open space volume of soil-gas screen;  $V_2 = \pi r^2 h$  = open space volume of sample tubing;  $V_3 = \pi r^2 h \rho$  = estimated open pore space for sand pack and dry bentonite seal;  $V_t$  = total volume;  $r$  = inner radius of soil-gas screen, borehole, or sample tubing;  $h$  = height of soil-gas screen or height (length) of tubing or height of sand pack and dry bentonite seal;  $\rho$  = porosity of sand pack and dry bentonite seal (40%).



## Sub-slab/Soil-Gas Sample Collection Log

		<b>Sample ID:</b> <b>SGP-8(14.25)/111110</b>	
<b>Client:</b>	RACER Trust	<b>Boring Equipment:</b>	Direct-push drill rig
<b>Project:</b>	Vapor Intrusion Verification Investigation	<b>Sealant:</b>	Benseal/Bentonite
<b>Location:</b>	Moraine, Ohio	<b>Tubing Information:</b>	0.25 inch OD; 0.17 inch ID Teflon
<b>Project #:</b>	OH000294.0018.00007	<b>Miscellaneous Equipment:</b>	Dielectric MGD-2002, Thermo 580B, GEM 500
<b>Samplers:</b>	E. Epple (ARCADIS)	<b>Subcontractor:</b>	Envirocore
		<b>Equipment:</b>	SKC 220 air pumps, Defender 150
<b>Sampling Depth:</b>	14.25 feet below land surface	<b>Moisture Content of Sampling Zone):</b>	Moist to dry
<b>Date of Installation:</b>	11-1-2010	<b>Approximate Purge Volume:</b>	5L

### Instrument Readings:

Date	Time	Canister Vacuum (a) (inches of Hg)	Temperature (°F)	Relative Humidity (%)	Air Speed (mph)	Barometric Pressure (inches of Hg)	PID (ppm)
11-11-2010	0822	-29.50	37	80	0	30.35	NM
11-11-2010	0826	-29.0*	37	80	0	30.35	NM
11-11-2010	0912	-4.0	37	80	0	30.35	0.0

(a) Record canister information at a minimum at the beginning and end of sampling

#### SUMMA® Canister Information:

<b>Size (check one):</b>	<input type="checkbox"/> 250 mL	<input checked="" type="checkbox"/> 1L
<b>Canister ID:</b>	2061	
<b>Flow Controller ID:</b>	FC00264	
<b>Notes:</b>	Lab calibrated canister/controller	

#### Tracer Test Information (if applicable):

<b>Initial Helium Shroud:</b>	N/A
<b>Final Helium Shroud:</b>	N/A
<b>Tracer Test Passed:</b>	<input type="checkbox"/> Yes <input type="checkbox"/> No
<b>Notes:</b>	

### General Observations/Notes:

$V_1 = 7.53 \text{ mL}; V_2 = 63.62 \text{ mL}; V_T = 71.15 \text{ mL};$ purge time = 1 min 26 sec at 50 mL/min; purge start at 0748
*Initial flow controller reading; passed shut-in test

### Approximating One-Well Volume (for purging):

$V_1 + V_2 + V_3 = V_t$  where:  $V_1 = \pi r^2 h$  = open space volume of soil-gas screen;  $V_2 = \pi r^2 h$  = open space volume of sample tubing;  $V_3 = \pi r^2 h \rho$  = estimated open pore space for sand pack and dry bentonite seal;  $V_t$  = total volume;  $r$  = inner radius of soil-gas screen, borehole, or sample tubing;  $h$  = height of soil-gas screen or height (length) of tubing or height of sand pack and dry bentonite seal;  $\rho$  = porosity of sand pack and dry bentonite seal (40%).



## Sub-slab/Soil-Gas Sample Collection Log

		<b>Sample ID:</b> <b>SGP-9(6)/111110</b>	
<b>Client:</b>	RACER Trust	<b>Boring Equipment:</b>	Direct-push drill rig
<b>Project:</b>	Vapor Intrusion Verification Investigation	<b>Sealant:</b>	Benseal/Bentonite
<b>Location:</b>	Moraine, Ohio	<b>Tubing Information:</b>	0.25 inch OD; 0.17 inch ID Teflon
<b>Project #:</b>	OH000294.0018.00007	<b>Miscellaneous Equipment:</b>	Dielectric MGD-2002, Thermo 580B, GEM 500
<b>Samplers:</b>	E. Epple (ARCADIS)	<b>Subcontractor:</b>	Envirocore
		<b>Equipment:</b>	SKC 220 air pumps, Defender 150
<b>Sampling Depth:</b>	6 feet below land surface	<b>Moisture Content of Sampling Zone):</b>	Dry
<b>Date of Installation:</b>	10-27-2010	<b>Approximate Purge Volume:</b>	43.5L

### Instrument Readings:

Date	Time	Canister Vacuum (a) (inches of Hg)	Temperature (°F)	Relative Humidity (%)	Air Speed (mph)	Barometric Pressure (inches of Hg)	PID (ppm)
11-11-2010	1054	-29.5	62	48	2	30.34	NM
11-11-2010	1055	-29.75*	62	48	2	30.34	NM
11-11-2010	1128	-2.50	62	48	2	30.34	0.5

(a) Record canister information at a minimum at the beginning and end of sampling

#### SUMMA® Canister Information:

<b>Size (check one):</b>	<input type="checkbox"/> 250 mL	<input checked="" type="checkbox"/> 1L
<b>Canister ID:</b>	9380	
<b>Flow Controller ID:</b>	FC00665	
<b>Notes:</b>	Lab calibrated canister/controller	

#### Tracer Test Information (if applicable):

<b>Initial Helium Shroud:</b>	89.6%
<b>Final Helium Shroud:</b>	42.9%
<b>Tracer Test Passed:</b>	<input checked="" type="checkbox"/> Yes <input type="checkbox"/> No
<b>Notes:</b>	Helium not detected in point after purge on 11-9-2010.

### General Observations/Notes:

$V_1 = 7.53 \text{ mL}; V_2 = 35.71 \text{ mL}; V_T = 43.24 \text{ mL};$ purge time = 52 sec at 50 mL/min ; purge start at 1041
*Initial flow controller reading; passed shut-in test.

### Approximating One-Well Volume (for purging):

$V_1 + V_2 + V_3 = V_t$  where:  $V_1 = \pi r^2 h$  = open space volume of soil-gas screen;  $V_2 = \pi r^2 h$  = open space volume of sample tubing;  $V_3 = \pi r^2 h \rho$  = estimated open pore space for sand pack and dry bentonite seal;  $V_t$  = total volume;  $r$  = inner radius of soil-gas screen, borehole, or sample tubing;  $h$  = height of soil-gas screen or height (length) of tubing or height of sand pack and dry bentonite seal;  $\rho$  = porosity of sand pack and dry bentonite seal (40%).



## Sub-slab/Soil-Gas Sample Collection Log

		<b>Sample ID:</b> <b>SGP-9(11)/111110</b>	
<b>Client:</b>	RACER Trust	<b>Boring Equipment:</b>	Direct-push drill rig
<b>Project:</b>	Vapor Intrusion Verification Investigation	<b>Sealant:</b>	Benseal/Bentonite
<b>Location:</b>	Moraine, Ohio	<b>Tubing Information:</b>	0.25 inch OD; 0.17 inch ID Teflon
<b>Project #:</b>	OH000294.0018.00007	<b>Miscellaneous Equipment:</b>	Dielectric MGD-2002, Thermo 580B, GEM 500
<b>Samplers:</b>	E. Epple (ARCADIS)	<b>Subcontractor:</b>	Envirocore
		<b>Equipment:</b>	SKC 220 air pumps, Defender 150
<b>Sampling Depth:</b>	11 feet below land surface	<b>Moisture Content of Sampling Zone):</b>	Dry
<b>Date of Installation:</b>	10-27-2010	<b>Approximate Purge Volume:</b>	46.8L

### Instrument Readings:

Date	Time	Canister Vacuum (a) (inches of Hg)	Temperature (°F)	Relative Humidity (%)	Air Speed (mph)	Barometric Pressure (inches of Hg)	PID (ppm)
11-11-2010	1057	-28.0	62	48	2	30.34	NM
11-11-2010	1059	-28.5*	62	48	2	30.34	NM
11-11-2010	1131	-2.25	62	48	2	30.34	0.5

(a) Record canister information at a minimum at the beginning and end of sampling

#### SUMMA® Canister Information:

<b>Size (check one):</b>	<input type="checkbox"/> 250 mL	<input checked="" type="checkbox"/> 1L
<b>Canister ID:</b>	9495	
<b>Flow Controller ID:</b>	FC00971	
<b>Notes:</b>	Lab calibrated canister/controller	

#### Tracer Test Information (if applicable):

<b>Initial Helium Shroud:</b>	N/A
<b>Final Helium Shroud:</b>	N/A
<b>Tracer Test Passed:</b>	<input type="checkbox"/> Yes <input type="checkbox"/> No
<b>Notes:</b>	

#### General Observations/Notes:

$V_1 = 7.53 \text{ mL}; V_2 = 58.04 \text{ mL}; V_T = 65.6 \text{ mL};$ purge time = 1 min 19 sec at 50 mL/min; purge start at 1044
*Initial flow controller reading; passed shut-in test

#### Approximating One-Well Volume (for purging):

$V_1 + V_2 + V_3 = V_t$  where:  $V_1 = \pi r^2 h$  = open space volume of soil-gas screen;  $V_2 = \pi r^2 h$  = open space volume of sample tubing;  $V_3 = \pi r^2 h \rho$  = estimated open pore space for sand pack and dry bentonite seal;  $V_t$  = total volume;  $r$  = inner radius of soil-gas screen, borehole, or sample tubing;  $h$  = height of soil-gas screen or height (length) of tubing or height of sand pack and dry bentonite seal;  $\rho$  = porosity of sand pack and dry bentonite seal (40%).



## Sub-slab/Soil-Gas Sample Collection Log

		<b>Sample ID:</b> <b>SGP-9(14.42)/111110</b>	
<b>Client:</b>	RACER Trust	<b>Boring Equipment:</b>	Direct-push drill rig
<b>Project:</b>	Vapor Intrusion Verification Investigation	<b>Sealant:</b>	Benseal/Bentonite
<b>Location:</b>	Moraine, Ohio	<b>Tubing Information:</b>	0.25 inch OD; 0.17 inch ID Teflon
<b>Project #:</b>	OH000294.0018.00007	<b>Miscellaneous Equipment:</b>	Dielectric MGD-2002, Thermo 580B, GEM 500
<b>Samplers:</b>	E. Epple (ARCADIS)	<b>Subcontractor:</b>	Envirocore
		<b>Equipment:</b>	SKC 220 air pumps, Defender 150
<b>Sampling Depth:</b>	14.42 feet below land surface	<b>Moisture Content of Sampling Zone):</b>	Dry
<b>Date of Installation:</b>	10-27-2010	<b>Approximate Purge Volume:</b>	4.5L

### Instrument Readings:

Date	Time	Canister Vacuum (a) (inches of Hg)	Temperature (°F)	Relative Humidity (%)	Air Speed (mph)	Barometric Pressure (inches of Hg)	PID (ppm)
11-11-2010	1101	-29.5	62	48	2	30.34	NM
11-11-2010	1104	-35.0*	62	48	2	30.34	NM
11-11-2010	1139	-4.5	62	48	2	30.34	0.5

(a) Record canister information at a minimum at the beginning and end of sampling

#### SUMMA® Canister Information:

<b>Size (check one):</b>	<input type="checkbox"/> 250 mL	<input checked="" type="checkbox"/> 1L
<b>Canister ID:</b>	36566	
<b>Flow Controller ID:</b>	FC06750	
<b>Notes:</b>	Lab calibrated canister/controller	

#### Tracer Test Information (if applicable):

<b>Initial Helium Shroud:</b>	N/A
<b>Final Helium Shroud:</b>	N/A
<b>Tracer Test Passed:</b>	<input type="checkbox"/> Yes <input type="checkbox"/> No
<b>Notes:</b>	

### General Observations/Notes:

$V_1 = 7.53 \text{ mL}; V_2 = 64.73 \text{ mL}; V_T = 72.26 \text{ mL};$ purge time = 1 min 27 sec at 50 mL/min; purge start at 1047
*Initial flow controller reading; passed shut-in test

### Approximating One-Well Volume (for purging):

$V_1 + V_2 + V_3 = V_t$  where:  $V_1 = \pi r^2 h$  = open space volume of soil-gas screen;  $V_2 = \pi r^2 h$  = open space volume of sample tubing;  $V_3 = \pi r^2 h \rho$  = estimated open pore space for sand pack and dry bentonite seal;  $V_t$  = total volume;  $r$  = inner radius of soil-gas screen, borehole, or sample tubing;  $h$  = height of soil-gas screen or height (length) of tubing or height of sand pack and dry bentonite seal;  $\rho$  = porosity of sand pack and dry bentonite seal (40%).



## Sub-slab/Soil-Gas Sample Collection Log

		<b>Sample ID:</b> <b>SGP-10(6)/111110</b>
<b>Client:</b>	RACER Trust	<b>Boring Equipment:</b> Direct-push drill rig
<b>Project:</b>	Vapor Intrusion Verification Investigation	<b>Sealant:</b> Benseal/Bentonite
<b>Location:</b>	Moraine, Ohio	<b>Tubing Information:</b> 0.25 inch OD; 0.17 inch ID Teflon
<b>Project #:</b>	OH000294.0018.00007	<b>Miscellaneous Equipment:</b> Dielectric MGD-2002, Thermo 580B, GEM 500
<b>Samplers:</b>	E. Epple (ARCADIS)	<b>Subcontractor:</b> Envirocore
		<b>Equipment:</b> SKC 220 air pumps, Defender 150
<b>Sampling Depth:</b>	6 feet below land surface	<b>Moisture Content of Sampling Zone):</b> Moist
<b>Date of Installation:</b>	10-27-2010	<b>Approximate Purge Volume:</b> 43.5L

### Instrument Readings:

Date	Time	Canister Vacuum (a) (inches of Hg)	Temperature (°F)	Relative Humidity (%)	Air Speed (mph)	Barometric Pressure (inches of Hg)	PID (ppm)
11-11-2010	1332	-29.5	62	68	2	30.34	NM
11-11-2010	1335	-28.0*	62	68	2	30.34	NM
11-11-2010	1413	-4.0	62	68	2	30.34	0.3

(a) Record canister information at a minimum at the beginning and end of sampling

#### SUMMA® Canister Information:

<b>Size (check one):</b>	<input type="checkbox"/> 250 mL	<input checked="" type="checkbox"/> 1L
<b>Canister ID:</b>	2164	
<b>Flow Controller ID:</b>	FC00676	
<b>Notes:</b>	Lab calibrated canister/controller	

#### Tracer Test Information (if applicable):

<b>Initial Helium Shroud:</b>	92.6%
<b>Final Helium Shroud:</b>	90.2%
<b>Tracer Test Passed:</b>	<input checked="" type="checkbox"/> Yes <input type="checkbox"/> No
<b>Notes:</b>	475 ppm Helium detected in point after purge on 11-9-2010.

#### General Observations/Notes:

$V_1 = 7.53 \text{ mL}; V_2 = 35.71 \text{ mL}; V_T = 43.24 \text{ mL};$ purge time = 52 sec at 50 mL/min ; purge start at 1324
*Initial flow controller reading; passed shut-in test.

#### Approximating One-Well Volume (for purging):

$V_1 + V_2 + V_3 = V_t$  where:  $V_1 = \pi r^2 h$  = open space volume of soil-gas screen;  $V_2 = \pi r^2 h$  = open space volume of sample tubing;  $V_3 = \pi r^2 h \rho$  = estimated open pore space for sand pack and dry bentonite seal;  $V_t$  = total volume;  $r$  = inner radius of soil-gas screen, borehole, or sample tubing;  $h$  = height of soil-gas screen or height (length) of tubing or height of sand pack and dry bentonite seal;  $\rho$  = porosity of sand pack and dry bentonite seal (40%).



## Sub-slab/Soil-Gas Sample Collection Log

		<b>Sample ID:</b> <b>SGP-10(11)/111110</b>	
<b>Client:</b>	RACER Trust	<b>Boring Equipment:</b>	Direct-push drill rig
<b>Project:</b>	Vapor Intrusion Verification Investigation	<b>Sealant:</b>	Benseal/Bentonite
<b>Location:</b>	Moraine, Ohio	<b>Tubing Information:</b>	0.25 inch OD; 0.17 inch ID Teflon
<b>Project #:</b>	OH000294.0018.00007	<b>Miscellaneous Equipment:</b>	Dielectric MGD-2002, Thermo 580B, GEM 500
<b>Samplers:</b>	E. Epple (ARCADIS)	<b>Subcontractor:</b>	Envirocore
		<b>Equipment:</b>	SKC 220 air pumps, Defender 150
<b>Sampling Depth:</b>	11 feet below land surface	<b>Moisture Content of Sampling Zone):</b>	Moist
<b>Date of Installation:</b>	10-27-2010	<b>Approximate Purge Volume:</b>	2.6L

### Instrument Readings:

Date	Time	Canister Vacuum (a) (inches of Hg)	Temperature (°F)	Relative Humidity (%)	Air Speed (mph)	Barometric Pressure (inches of Hg)	PID (ppm)
11-11-2010	1349	-29.5	62	48	2	30.34	NM
11-11-2010	1410	-4.5	62	48	2	30.34	0.3

(a) Record canister information at a minimum at the beginning and end of sampling

#### SUMMA® Canister Information:

<b>Size (check one):</b>	<input type="checkbox"/> 250 mL	<input checked="" type="checkbox"/> 1L
<b>Canister ID:</b>	14523	
<b>Flow Controller ID:</b>	FC00984	
<b>Notes:</b>	Lab calibrated canister/controller	

#### Tracer Test Information (if applicable):

<b>Initial Helium Shroud:</b>	N/A
<b>Final Helium Shroud:</b>	N/A
<b>Tracer Test Passed:</b>	<input type="checkbox"/> Yes <input type="checkbox"/> No
<b>Notes:</b>	

### General Observations/Notes:

$V_1 = 7.53 \text{ mL}; V_2 = 58.04 \text{ mL}; V_T = 65.6 \text{ mL};$ purge time = 1 min 19 sec at 50 mL/min ; purge start at 1325
Initial flow controller reading=-29.5 in Hg
Passed shut-in test

### Approximating One-Well Volume (for purging):

$V_1 + V_2 + V_3 = V_t$  where:  $V_1 = \pi r^2 h$  = open space volume of soil-gas screen;  $V_2 = \pi r^2 h$  = open space volume of sample tubing;  $V_3 = \pi r^2 h \rho$  = estimated open pore space for sand pack and dry bentonite seal;  $V_t$  = total volume;  $r$  = inner radius of soil-gas screen, borehole, or sample tubing;  $h$  = height of soil-gas screen or height (length) of tubing or height of sand pack and dry bentonite seal;  $\rho$  = porosity of sand pack and dry bentonite seal (40%).



## Sub-slab/Soil-Gas Sample Collection Log

		<b>Sample ID:</b> <b>SGP-10(28.08)/111110</b>	
<b>Client:</b>	RACER Trust	<b>Boring Equipment:</b>	Direct-push drill rig
<b>Project:</b>	Vapor Intrusion Verification Investigation	<b>Sealant:</b>	Benseal/Bentonite
<b>Location:</b>	Moraine, Ohio	<b>Tubing Information:</b>	0.25 inch OD; 0.17 inch ID Teflon
<b>Project #:</b>	OH000294.0018.00007	<b>Miscellaneous Equipment:</b>	Dielectric MGD-2002, Thermo 580B, GEM 500
<b>Samplers:</b>	E. Epple (ARCADIS)	<b>Subcontractor:</b>	Envirocore
		<b>Equipment:</b>	SKC 220 air pumps, Defender 150
<b>Sampling Depth:</b>	28.08 feet below land surface	<b>Moisture Content of Sampling Zone):</b>	Moist
<b>Date of Installation:</b>	10-27-2010	<b>Approximate Purge Volume:</b>	2.7L

### Instrument Readings:

Date	Time	Canister Vacuum (a) (inches of Hg)	Temperature (°F)	Relative Humidity (%)	Air Speed (mph)	Barometric Pressure (inches of Hg)	PID (ppm)
11-11-2010	1352	-29.75	62	48	2	30.34	NM
11-11-2010	1419	-4.0	62	48	2	30.34	1.1

(a) Record canister information at a minimum at the beginning and end of sampling

#### SUMMA® Canister Information:

<b>Size (check one):</b>	<input type="checkbox"/> 250 mL	<input checked="" type="checkbox"/> 1L
<b>Canister ID:</b>	13385	
<b>Flow Controller ID:</b>	FC00954	
<b>Notes:</b>	Lab calibrated canister/controller	

#### Tracer Test Information (if applicable):

<b>Initial Helium Shroud:</b>	N/A
<b>Final Helium Shroud:</b>	N/A
<b>Tracer Test Passed:</b>	<input type="checkbox"/> Yes <input type="checkbox"/> No
<b>Notes:</b>	

### General Observations/Notes:

$V_1 = 7.53 \text{ mL}; V_2 = 125.4 \text{ mL}; V_T = 132.89 \text{ mL};$ purge time = 2 min 40 sec at 50 mL/min ; purge start at 1528
Initial flow controller reading=-29.5 in Hg
Passed shut-in test

### Approximating One-Well Volume (for purging):

$V_1 + V_2 + V_3 = V_t$  where:  $V_1 = \pi r^2 h$  = open space volume of soil-gas screen;  $V_2 = \pi r^2 h$  = open space volume of sample tubing;  $V_3 = \pi r^2 h \rho$  = estimated open pore space for sand pack and dry bentonite seal;  $V_t$  = total volume;  $r$  = inner radius of soil-gas screen, borehole, or sample tubing;  $h$  = height of soil-gas screen or height (length) of tubing or height of sand pack and dry bentonite seal;  $\rho$  = porosity of sand pack and dry bentonite seal (40%).



## Sub-slab/Soil-Gas Sample Collection Log

		<b>Sample ID:</b> <b>SGP-11(6)/111110</b>
<b>Client:</b>	RACER Trust	<b>Boring Equipment:</b> Direct-push drill rig
<b>Project:</b>	Vapor Intrusion Verification Investigation	<b>Sealant:</b> Benseal/Bentonite
<b>Location:</b>	Moraine, Ohio	<b>Tubing Information:</b> 0.25 inch OD; 0.17 inch ID Teflon
<b>Project #:</b>	OH000294.0018.00007	<b>Miscellaneous Equipment:</b> Dielectric MGD-2002, Thermo 580B, GEM 500
<b>Samplers:</b>	E. Epple (ARCADIS)	<b>Subcontractor:</b> Envirocore
		<b>Equipment:</b> SKC 220 air pumps, Defender 150
<b>Sampling Depth:</b>	6 feet below land surface	<b>Moisture Content of Sampling Zone):</b> Moist
<b>Date of Installation:</b>	11-2-2010	<b>Approximate Purge Volume:</b> 30.2L

### Instrument Readings:

Date	Time	Canister Vacuum (a) (inches of Hg)	Temperature (°F)	Relative Humidity (%)	Air Speed (mph)	Barometric Pressure (inches of Hg)	PID (ppm)
11-11-2010	1529	-29.5	62	48	2	30.34	NM
11-11-2010	1552	-4.0	62	48	2	30.34	NM

(a) Record canister information at a minimum at the beginning and end of sampling

#### SUMMA® Canister Information:

<b>Size (check one):</b>	<input type="checkbox"/> 250 mL	<input checked="" type="checkbox"/> 1L
<b>Canister ID:</b>	34573	
<b>Flow Controller ID:</b>	FC00565	
<b>Notes:</b>	Lab calibrated canister/controller	

#### Tracer Test Information (if applicable):

<b>Initial Helium Shroud:</b>	93.5%
<b>Final Helium Shroud:</b>	85.5%
<b>Tracer Test Passed:</b>	<input checked="" type="checkbox"/> Yes <input type="checkbox"/> No
<b>Notes:</b>	75 ppm Helium detected in point after purging on 11-9-2010.

#### General Observations/Notes:

$V_1 = 7.53 \text{ mL}; V_2 = 35.71 \text{ mL}; V_T = 43.24 \text{ mL};$ purge time = 52 sec at 50 mL/min ; purge start at 1509
Initial pressure of controller = -29.75 in Hg; passed shut-in test.

#### Approximating One-Well Volume (for purging):

$V_1 + V_2 + V_3 = V_t$  where:  $V_1 = \pi r^2 h$  = open space volume of soil-gas screen;  $V_2 = \pi r^2 h$  = open space volume of sample tubing;  $V_3 = \pi r^2 h \rho$  = estimated open pore space for sand pack and dry bentonite seal;  $V_t$  = total volume;  $r$  = inner radius of soil-gas screen, borehole, or sample tubing;  $h$  = height of soil-gas screen or height (length) of tubing or height of sand pack and dry bentonite seal;  $\rho$  = porosity of sand pack and dry bentonite seal (40%).



## Sub-slab/Soil-Gas Sample Collection Log

		<b>Sample ID:</b> <b>SGP-11(11)/111110</b>
<b>Client:</b>	RACER Trust	<b>Boring Equipment:</b> Direct-push drill rig
<b>Project:</b>	Vapor Intrusion Verification Investigation	<b>Sealant:</b> Benseal/Bentonite
<b>Location:</b>	Moraine, Ohio	<b>Tubing Information:</b> 0.25 inch OD; 0.17 inch ID Teflon
<b>Project #:</b>	OH000294.0018.00007	<b>Miscellaneous Equipment:</b> Dielectric MGD-2002, Thermo 580B, GEM 500
<b>Samplers:</b>	E. Epple (ARCADIS)	<b>Subcontractor:</b> Envirocore
		<b>Equipment:</b> SKC 220 air pumps, Defender 150
<b>Sampling Depth:</b>	11 feet below land surface	<b>Moisture Content of Sampling Zone):</b> Moist
<b>Date of Installation:</b>	11-2-2010	<b>Approximate Purge Volume:</b> 2.3L

### Instrument Readings:

Date	Time	Canister Vacuum (a) (inches of Hg)	Temperature (°F)	Relative Humidity (%)	Air Speed (mph)	Barometric Pressure (inches of Hg)	PID (ppm)
11-11-2010	1532	-28.0	62	48	2	30.34	NM
11-11-2010	1554	-4.5	62	48	2	30.34	NM

(a) Record canister information at a minimum at the beginning and end of sampling

#### SUMMA® Canister Information:

<b>Size (check one):</b>	<input type="checkbox"/> 250 mL	<input checked="" type="checkbox"/> 1L
<b>Canister ID:</b>	37334	
<b>Flow Controller ID:</b>	40673	
<b>Notes:</b>	Lab calibrated canister/controller	

#### Tracer Test Information (if applicable):

<b>Initial Helium Shroud:</b>	N/A
<b>Final Helium Shroud:</b>	N/A
<b>Tracer Test Passed:</b>	<input type="checkbox"/> Yes <input type="checkbox"/> No
<b>Notes:</b>	

### General Observations/Notes:

$V_1 = 7.53 \text{ mL}; V_2 = 58.04 \text{ mL}; V_T = 65.60 \text{ mL};$ purge time = 1 min 19 sec at 50 mL/min ; purge start at 1511
Initial pressure of controller = -28.0 in Hg; passed shut-in test.

### Approximating One-Well Volume (for purging):

$V_1 + V_2 + V_3 = V_t$  where:  $V_1 = \pi r^2 h$  = open space volume of soil-gas screen;  $V_2 = \pi r^2 h$  = open space volume of sample tubing;  $V_3 = \pi r^2 h \rho$  = estimated open pore space for sand pack and dry bentonite seal;  $V_t$  = total volume;  $r$  = inner radius of soil-gas screen, borehole, or sample tubing;  $h$  = height of soil-gas screen or height (length) of tubing or height of sand pack and dry bentonite seal;  $\rho$  = porosity of sand pack and dry bentonite seal (40%).



## Sub-slab/Soil-Gas Sample Collection Log

		<b>Sample ID:</b> <b>SGP-11(15.33)/111110</b>	
<b>Client:</b>	RACER Trust	<b>Boring Equipment:</b>	Direct-push drill rig
<b>Project:</b>	Vapor Intrusion Verification Investigation	<b>Sealant:</b>	Benseal/Bentonite
<b>Location:</b>	Moraine, Ohio	<b>Tubing Information:</b>	0.25 inch OD; 0.17 inch ID Teflon
<b>Project #:</b>	OH000294.0018.00007	<b>Miscellaneous Equipment:</b>	Dielectric MGD-2002, Thermo 580B, GEM 500
<b>Samplers:</b>	E. Epple (ARCADIS)	<b>Subcontractor:</b>	Envirocore
		<b>Equipment:</b>	SKC 220 air pumps, Defender 150
<b>Sampling Depth:</b>	15.33 feet below land surface	<b>Moisture Content of Sampling Zone):</b>	Moist
<b>Date of Installation:</b>	11-2-2010	<b>Approximate Purge Volume:</b>	2.13L

### Instrument Readings:

Date	Time	Canister Vacuum (a) (inches of Hg)	Temperature (°F)	Relative Humidity (%)	Air Speed (mph)	Barometric Pressure (inches of Hg)	PID (ppm)
11-11-2010	1535	-29.5	62	48	2	30.34	NM
11-11-2010	1602	-4.0	62	48	2	30.34	NM

(a) Record canister information at a minimum at the beginning and end of sampling

#### SUMMA® Canister Information:

<b>Size (check one):</b>	<input type="checkbox"/> 250 mL	<input checked="" type="checkbox"/> 1L
<b>Canister ID:</b>	34621	
<b>Flow Controller ID:</b>	FC00160	
<b>Notes:</b>	Lab calibrated canister/controller	

#### Tracer Test Information (if applicable):

<b>Initial Helium Shroud:</b>	N/A
<b>Final Helium Shroud:</b>	N/A
<b>Tracer Test Passed:</b>	<input type="checkbox"/> Yes <input type="checkbox"/> No
<b>Notes:</b>	

### General Observations/Notes:

$V_1 = 7.53 \text{ mL}; V_2 = 68.45 \text{ mL}; V_T = 75.98 \text{ mL};$ purge time = 1 min 32 sec at 50 mL/min; purge start at 1514
Initial pressure of controller = -28.75 in Hg; passed shut-in test.

### Approximating One-Well Volume (for purging):

$V_1 + V_2 + V_3 = V_t$  where:  $V_1 = \pi r^2 h$  = open space volume of soil-gas screen;  $V_2 = \pi r^2 h$  = open space volume of sample tubing;  $V_3 = \pi r^2 h \rho$  = estimated open pore space for sand pack and dry bentonite seal;  $V_t$  = total volume;  $r$  = inner radius of soil-gas screen, borehole, or sample tubing;  $h$  = height of soil-gas screen or height (length) of tubing or height of sand pack and dry bentonite seal;  $\rho$  = porosity of sand pack and dry bentonite seal (40%).



## Sub-slab/Soil-Gas Sample Collection Log

		<b>Sample ID:</b> <b>SGP-12(6)/111110</b>	
<b>Client:</b>	RACER Trust	<b>Boring Equipment:</b>	Direct-push drill rig
<b>Project:</b>	Vapor Intrusion Verification Investigation	<b>Sealant:</b>	Benseal/Bentonite
<b>Location:</b>	Moraine, Ohio	<b>Tubing Information:</b>	0.25 inch OD; 0.17 inch ID Teflon
<b>Project #:</b>	OH000294.0018.00007	<b>Miscellaneous Equipment:</b>	Dielectric MGD-2002, Thermo 580B, GEM 500
<b>Samplers:</b>	E. Epple (ARCADIS)	<b>Subcontractor:</b>	Envirocore
		<b>Equipment:</b>	SKC 220 air pumps, Defender 150
<b>Sampling Depth:</b>	6 feet below land surface	<b>Moisture Content of Sampling Zone):</b>	Moist
<b>Date of Installation:</b>	11-2-2010	<b>Approximate Purge Volume:</b>	31.2L

### Instrument Readings:

Date	Time	Canister Vacuum (a) (inches of Hg)	Temperature (°F)	Relative Humidity (%)	Air Speed (mph)	Barometric Pressure (inches of Hg)	PID (ppm)
11-11-2010	1526	-28.5	62	48	2	30.34	NM
11-11-2010	1559	-4.25	62	48	2	30.34	0.3

(a) Record canister information at a minimum at the beginning and end of sampling

#### SUMMA® Canister Information:

<b>Size (check one):</b>	<input type="checkbox"/> 250 mL	<input checked="" type="checkbox"/> 1L
<b>Canister ID:</b>	35688	
<b>Flow Controller ID:</b>	FC00893	
<b>Notes:</b>	Lab calibrated canister/controller	

#### Tracer Test Information (if applicable):

<b>Initial Helium Shroud:</b>	94.9%
<b>Final Helium Shroud:</b>	81.2%
<b>Tracer Test Passed:</b>	<input checked="" type="checkbox"/> Yes <input type="checkbox"/> No
<b>Notes:</b>	325 ppm helium detected in point after purge on 11-10-2010

### General Observations/Notes:

V <sub>1</sub> = 7.5 mL; V <sub>2</sub> = 35.7 mL; V <sub>T</sub> = 43.2 mL; purge time = 52 sec at 50 mL/min.
1517 begin purge at point and tubing for 53 sec. to remove 44 mL
Initial regulator pressure = < -30 in Hg; passed shut-in test .

### Approximating One-Well Volume (for purging):

$V_1 + V_2 + V_3 = V_t$  where:  $V_1 = \pi r^2 h$  = open space volume of soil-gas screen;  $V_2 = \pi r^2 h$  = open space volume of sample tubing;  $V_3 = \pi r^2 h \rho$  = estimated open pore space for sand pack and dry bentonite seal;  $V_t$  = total volume;  $r$  = inner radius of soil-gas screen, borehole, or sample tubing;  $h$  = height of soil-gas screen or height (length) of tubing or height of sand pack and dry bentonite seal;  $\rho$  = porosity of sand pack and dry bentonite seal (40%).



## Sub-slab/Soil-Gas Sample Collection Log

		<b>Sample ID:</b> <b>SGP-12(11)/111110</b>	
<b>Client:</b>	RACER Trust	<b>Boring Equipment:</b>	Direct-push drill rig
<b>Project:</b>	Vapor Intrusion Verification Investigation	<b>Sealant:</b>	Benseal/Bentonite
<b>Location:</b>	Moraine, Ohio	<b>Tubing Information:</b>	0.25 inch OD; 0.17 inch ID Teflon
<b>Project #:</b>	OH000294.0018.00007	<b>Miscellaneous Equipment:</b>	Dielectric MGD-2002, Thermo 580B, GEM 500
<b>Samplers:</b>	J. Rumschlag (ARCADIS)	<b>Subcontractor:</b>	Envirocore
		<b>Equipment:</b>	SKC 220 air pumps, Defender 150
<b>Sampling Depth:</b>	11 feet below land surface	<b>Moisture Content of Sampling Zone):</b>	Moist
<b>Date of Installation:</b>	11-2-2010	<b>Approximate Purge Volume:</b>	4.5L

### Instrument Readings:

Date	Time	Canister Vacuum (a) (inches of Hg)	Temperature (°F)	Relative Humidity (%)	Air Speed (mph)	Barometric Pressure (inches of Hg)	PID (ppm)
11-11-2010	1530	-28.5	62	48	2	30.34	0.0
11-11-2010	1601	-4.75	62	48	2	30.34	0.0

(a) Record canister information at a minimum at the beginning and end of sampling

#### SUMMA® Canister Information:

<b>Size (check one):</b>	<input type="checkbox"/> 250 mL	<input checked="" type="checkbox"/> 1L
<b>Canister ID:</b>	3045	
<b>Flow Controller ID:</b>	FC00738	
<b>Notes:</b>	Lab calibrated canister/controller	

#### Tracer Test Information (if applicable):

<b>Initial Helium Shroud:</b>	N/A
<b>Final Helium Shroud:</b>	N/A
<b>Tracer Test Passed:</b>	<input type="checkbox"/> Yes <input type="checkbox"/> No
<b>Notes:</b>	

### General Observations/Notes:

$V_1 = 7.5 \text{ mL}; V_2 = 58 \text{ mL}; V_T = 65.5 \text{ mL};$ purge time = 1 min 19 sec at 50 mL/min.
1518:30 begin purge at point and tubing to remove 66 mL
Initial regulator pressure = -29 in Hg; passed shut-in test.

#### Approximating One-Well Volume (for purging):

$V_1 + V_2 + V_3 = V_t$  where:  $V_1 = \pi r^2 h$  = open space volume of soil-gas screen;  $V_2 = \pi r^2 h$  = open space volume of sample tubing;  $V_3 = \pi r^2 h \rho$  = estimated open pore space for sand pack and dry bentonite seal;  $V_t$  = total volume;  $r$  = inner radius of soil-gas screen, borehole, or sample tubing;  $h$  = height of soil-gas screen or height (length) of tubing or height of sand pack and dry bentonite seal;  $\rho$  = porosity of sand pack and dry bentonite seal (40%).



## Sub-slab/Soil-Gas Sample Collection Log

		<b>Sample ID:</b> <b>SGP-12(22.9)/111110</b>	
<b>Client:</b>	RACER Trust	<b>Boring Equipment:</b>	Direct-push drill rig
<b>Project:</b>	Vapor Intrusion Verification Investigation	<b>Sealant:</b>	Benseal/Bentonite
<b>Location:</b>	Moraine, Ohio	<b>Tubing Information:</b>	0.25 inch OD; 0.17 inch ID Teflon
<b>Project #:</b>	OH000294.0018.00007	<b>Miscellaneous Equipment:</b>	Dielectric MGD-2002, Thermo 580B, GEM 500
<b>Samplers:</b>	J. Rumschlag (ARCADIS)	<b>Subcontractor:</b>	Envirocore
		<b>Equipment:</b>	SKC 220 air pumps, Defender 150
<b>Sampling Depth:</b>	22.9 feet below land surface	<b>Moisture Content of Sampling Zone):</b>	Moist
<b>Date of Installation:</b>	11-2-2010	<b>Approximate Purge Volume:</b>	6.6L

### Instrument Readings:

Date	Time	Canister Vacuum (a) (inches of Hg)	Temperature (°F)	Relative Humidity (%)	Air Speed (mph)	Barometric Pressure (inches of Hg)	PID (ppm)
11-11-2010	1533	-28.0	62	48	2	30.34	NM
11-11-2010	1555	-3.5	62	48	2	30.34	0.0

(a) Record canister information at a minimum at the beginning and end of sampling

#### SUMMA® Canister Information:

<b>Size (check one):</b>	<input type="checkbox"/> 250 mL	<input checked="" type="checkbox"/> 1L
<b>Canister ID:</b>	34121	
<b>Flow Controller ID:</b>	6525	
<b>Notes:</b>	Lab calibrated canister/controller	

#### Tracer Test Information (if applicable):

<b>Initial Helium Shroud:</b>	N/A
<b>Final Helium Shroud:</b>	N/A
<b>Tracer Test Passed:</b>	<input type="checkbox"/> Yes <input type="checkbox"/> No
<b>Notes:</b>	

### General Observations/Notes:

$V_1 = 7.5 \text{ mL}; V_2 = 111.2 \text{ mL}; V_T = 118.7 \text{ mL};$ purge time = 2 min 23 sec at 50 mL/min.
1520:10 begin purge at point and tubing to remove 119 mL
Initial regulator pressure = -29.5 in Hg

#### Approximating One-Well Volume (for purging):

$V_1 + V_2 + V_3 = V_t$  where:  $V_1 = \pi r^2 h$  = open space volume of soil-gas screen;  $V_2 = \pi r^2 h$  = open space volume of sample tubing;  $V_3 = \pi r^2 h \rho$  = estimated open pore space for sand pack and dry bentonite seal;  $V_t$  = total volume;  $r$  = inner radius of soil-gas screen, borehole, or sample tubing;  $h$  = height of soil-gas screen or height (length) of tubing or height of sand pack and dry bentonite seal;  $\rho$  = porosity of sand pack and dry bentonite seal (40%).



## Sub-slab/Soil-Gas Sample Collection Log

		<b>Sample ID:</b> <span style="font-size: 1.2em;">Dup-2/111110</span>	
<b>Client:</b>	RACER Trust	<b>Boring Equipment:</b>	Direct-push drill rig
<b>Project:</b>	Vapor Intrusion Verification Investigation	<b>Sealant:</b>	Benseal/Bentonite
<b>Location:</b>	Moraine, Ohio	<b>Tubing Information:</b>	0.25 inch OD; 0.17 inch ID Teflon
<b>Project #:</b>	OH000294.0018.00007	<b>Miscellaneous Equipment:</b>	Dielectric MGD-2002, Thermo 580B, GEM 500
<b>Samplers:</b>	J. Rumschlag (ARCADIS)	<b>Subcontractor:</b>	Envirocore
		<b>Equipment:</b>	SKC 220 air pumps, Defender 150
<b>Sampling Depth:</b>	N/A	<b>Moisture Content of Sampling Zone):</b>	N/A
<b>Date of Installation:</b>	N/A	<b>Approximate Purge Volume:</b>	N/A

### Instrument Readings:

Date	Time	Canister Vacuum (a) (inches of Hg)	Temperature (°F)	Relative Humidity (%)	Air Speed (mph)	Barometric Pressure (inches of Hg)	PID (ppm)
11-11-2010	1258	-25	62	48	2	30.34	NM
11-11-2010	1342	-2.25	62	48	2	30.34	NM

(a) Record canister information at a minimum at the beginning and end of sampling

#### SUMMA® Canister Information:

<b>Size (check one):</b>	<input type="checkbox"/> 250 mL	<input checked="" type="checkbox"/> 1L
<b>Canister ID:</b>	34101	
<b>Flow Controller ID:</b>	FC06741	
<b>Notes:</b>	Lab calibrated canister/controller	

#### Tracer Test Information (if applicable):

<b>Initial Helium Shroud:</b>	N/A
<b>Final Helium Shroud:</b>	N/A
<b>Tracer Test Passed:</b>	<input type="checkbox"/> Yes <input type="checkbox"/> No
<b>Notes:</b>	

#### General Observations/Notes:

Initial regulator pressure = -28 in Hg passed shut-in test, collected from SGP-5 (14.8).

#### Approximating One-Well Volume (for purging):

$V_1 + V_2 + V_3 = V_t$  where:  $V_1 = \pi r^2 h$  = open space volume of soil-gas screen;  $V_2 = \pi r^2 h$  = open space volume of sample tubing;  $V_3 = \pi r^2 h \rho$  = estimated open pore space for sand pack and dry bentonite seal;  $V_t$  = total volume;  $r$  = inner radius of soil-gas screen, borehole, or sample tubing;  $h$  = height of soil-gas screen or height (length) of tubing or height of sand pack and dry bentonite seal;  $\rho$  = porosity of sand pack and dry bentonite seal (40%).



## Sub-slab/Soil-Gas Sample Collection Log

<b>Sample ID:</b>		<b>Dup-1/111110</b>	
<b>Client:</b>	RACER Trust	<b>Boring Equipment:</b>	Direct-push drill rig
<b>Project:</b>	Vapor Intrusion Verification Investigation	<b>Sealant:</b>	Benseal/Bentonite
<b>Location:</b>	Moraine, Ohio	<b>Tubing Information:</b>	0.25 inch OD; 0.17 inch ID Teflon
<b>Project #:</b>	OH000294.0018.00007	<b>Miscellaneous Equipment:</b>	Dielectric MGD-2002, Thermo 580B, GEM 500
<b>Samplers:</b>	E. Epple (ARCADIS)	<b>Subcontractor:</b>	Envirocore
		<b>Equipment:</b>	SKC 220 air pumps, Defender 150
<b>Sampling Depth:</b>	N/A	<b>Moisture Content of Sampling Zone):</b>	N/A
<b>Date of Installation:</b>	N/A	<b>Approximate Purge Volume:</b>	N/A

### Instrument Readings:

Date	Time	Canister Vacuum (a) (inches of Hg)	Temperature (°F)	Relative Humidity (%)	Air Speed (mph)	Barometric Pressure (inches of Hg)	PID (ppm)
11-11-2010	0753	-29.0	37	80	0	30.35	NM
11-11-2010	0903	-4.25	37	80	0	30.35	0.0

(a) Record canister information at a minimum at the beginning and end of sampling

#### SUMMA® Canister Information:

<b>Size (check one):</b>	<input type="checkbox"/> 250 mL	<input checked="" type="checkbox"/> 1L
<b>Canister ID:</b>	37433	
<b>Flow Controller ID:</b>	40779	
<b>Notes:</b>	Lab calibrated canister/controller	

#### Tracer Test Information (if applicable):

<b>Initial Helium Shroud:</b>	N/A	
<b>Final Helium Shroud:</b>	N/A	
<b>Tracer Test Passed:</b>	<input type="checkbox"/> Yes	<input type="checkbox"/> No
<b>Notes:</b>		

#### General Observations/Notes:

Initial regulator pressure = -28.0 in Hg; passed shut-in test, collected from SGP-8 (6).

#### Approximating One-Well Volume (for purging):

$V_1 + V_2 + V_3 = V_t$  where:  $V_1 = \pi r^2 h$  = open space volume of soil-gas screen;  $V_2 = \pi r^2 h$  = open space volume of sample tubing;  $V_3 = \pi r^2 h \rho$  = estimated open pore space for sand pack and dry bentonite seal;  $V_t$  = total volume;  $r$  = inner radius of soil-gas screen, borehole, or sample tubing;  $h$  = height of soil-gas screen or height (length) of tubing or height of sand pack and dry bentonite seal;  $\rho$  = porosity of sand pack and dry bentonite seal (40%).

March 2011



## Sub-slab/Soil-Gas Sample Collection Log

Sample ID: <b>SGP-9 (6')</b>	
<b>Client:</b> RACER Trust	<b>Boring Equipment:</b> Direct-push Drilling Rig
<b>Project:</b> Vapor Intrusion Verification Investigation	<b>Sealant:</b> Benseal/Bentonite
<b>Location:</b> Moraine, Ohio	<b>Tubing Information:</b> 0.25 inch OD; 0.17 inch ID Teflon
<b>Project #:</b> OH000294.2011.00007	<b>Miscellaneous Equipment:</b> Dielectric MGD-2002, MiniRae 2000 PID, GEM 500
<b>Samplers:</b> Abby Caporuscio	<b>Subcontractor:</b> None
	<b>Equipment:</b> SKC 220 air pumps, Defender 150
<b>Sampling Depth:</b> 6 feet below land surface	<b>Moisture Content of Sampling Zone:</b> Dry
<b>Date of Installation:</b> 10/27/2010	<b>Approximate Purge Volume:</b> 43.24 mL before sampling

**Instrument Readings:**

Date	Time	Canister Vacuum (a) (inches of Hg)	Temperature (°F)	Relative Humidity (%)	Air Speed (mph)	Barometric Pressure (inches of Hg)	PID (ppb)
3/31/2011	1438	<-30	52.0	100	1.2	29.03	NM
3/31/2011	1515	-5	52.0	100	1.2	29.03	NM

(a) Record canister information at a minimum at the beginning and end of sampling

**SUMMA® Canister Information:**

<b>Size (circle one):</b>	<input checked="" type="radio"/> 1 L <input type="radio"/> 6 L
<b>Canister ID:</b>	35634
<b>Flow Controller ID:</b>	6352
<b>Notes:</b>	

**Tracer Test Information (if applicable):**

<b>Initial Helium Shroud:</b>	100%
<b>Final Helium Shroud:</b>	67.10%
<b>Tracer Test Passed:</b>	<input checked="" type="radio"/> Yes <input type="radio"/> No
<b>Notes:</b>	He in tedlar bag =0 ppm

**General Observations/Notes:**

Purge start time: 0930, pump calibrated 0830: 150mL/min. Purge end time: 1435.

**Approximating One-Well Volume (for purging):**

$V_1 + V_2 = V_t$  where:  $V_1 = \pi r^2 h$  = open space volume of sample tubing;  $V_2 = \pi r^2 h$  = open space volume of sample point;  $V_t$  = total volume;  $r$  = inner radius of sample point, or sample tubing;  $h$  = height of sample point or length of tubing.



## Sub-slab/Soil-Gas Sample Collection Log

<b>Sample ID:</b> SGP-9 (11')	
<b>Client:</b> RACER Trust	<b>Boring Equipment:</b> Direct-push Drilling Rig
<b>Project:</b> Vapor Intrusion Verification Investigation	<b>Sealant:</b> Benseal/Bentonite
<b>Location:</b> Moraine, Ohio	<b>Tubing Information:</b> 0.25 inch OD; 0.17 inch ID Teflon
<b>Project #:</b> OH000294.2011.00007	<b>Miscellaneous Equipment:</b> Dielectric MGD-2002, MiniRae 2000 PID, GEM 500
<b>Samplers:</b> Abby Caporuscio	<b>Subcontractor:</b> None
	<b>Equipment:</b> SKC 220 air pumps, Defender 150
<b>Sampling Depth:</b> 11 feet below land surface	<b>Moisture Content of Sampling Zone:</b> Dry
<b>Date of Installation:</b> 10/27/2010	<b>Approximate Purge Volume:</b> 65 mL

### Instrument Readings:

Date	Time	Canister Vacuum (a) (inches of Hg)	Temperature (°F)	Relative Humidity (%)	Air Speed (mph)	Barometric Pressure (inches of Hg)	PID (ppb)
3/31/2011	1434	-28.25	52.0	100	1.2	29.03	NM
3/31/2011	1508	-5	52.0	100	1.2	29.03	NM

(a) Record canister information at a minimum at the beginning and end of sampling

### SUMMA® Canister Information:

<b>Size (circle one):</b>	<input checked="" type="radio"/> 1 L <input type="radio"/> 6 L
<b>Canister ID:</b>	36457
<b>Flow Controller ID:</b>	6843
<b>Notes:</b>	

### Tracer Test Information (if applicable):

<b>Initial Helium Shroud:</b>	Not Applicable
<b>Final Helium Shroud:</b>	Not Applicable
<b>Tracer Test Passed:</b>	Yes                  No
<b>Notes:</b>	

### General Observations/Notes:

Passed shut in test.
<b>Approximating One-Well Volume (for purging):</b> $V_1 + V_2 = V_t$ where: $V_1 = \pi r^2 h$ = open space volume of sample tubing; $V_2 = \pi r^2 h$ = open space volume of sample point; $V_t$ = total volume; $r$ = inner radius of sample point, or sample tubing; $h$ = height of sample point or length of tubing.



## Sub-slab/Soil-Gas Sample Collection Log

Sample ID: <b>DUP-3/03312011/</b>	
<b>Client:</b> RACER Trust	<b>Boring Equipment:</b> Direct-push Drilling Rig
<b>Project:</b> Vapor Intrusion Verification Investigation	<b>Sealant:</b> Benseal/Bentonite
<b>Location:</b> Moraine, Ohio	<b>Tubing Information:</b> 0.25 inch OD; 0.17 inch ID Teflon
<b>Project #:</b> OH000294.2011.00007	<b>Miscellaneous Equipment:</b> Dielectric MGD-2002, MiniRae 2000 PID, GEM 500
<b>Samplers:</b> Abby Caporuscio	<b>Subcontractor:</b> None
	<b>Equipment:</b> SKC 220 air pumps, Defender 150
<b>Sampling Depth:</b> 11 feet below land surface	<b>Moisture Content of Sampling Zone:</b> Dry
<b>Date of Installation:</b> 10/27/2010	<b>Approximate Purge Volume:</b> 65 mL

**Instrument Readings:**

Date	Time	Canister Vacuum (a) (inches of Hg)	Temperature (°F)	Relative Humidity (%)	Air Speed (mph)	Barometric Pressure (inches of Hg)	PID (ppb)
3/31/2011	1434	-29.25	52.0	100	1.2	29.03	NM
3/31/2011	1512	-5	52.0	100	1.2	29.03	NM

(a) Record canister information at a minimum at the beginning and end of sampling

**SUMMA® Canister Information:**

<b>Size (circle one):</b>	<input checked="" type="radio"/> 1 L <input type="radio"/> 6 L
<b>Canister ID:</b>	34615
<b>Flow Controller ID:</b>	FC00999
<b>Notes:</b>	

**Tracer Test Information (if applicable):**

<b>Initial Helium Shroud:</b>	Not Applicable
<b>Final Helium Shroud:</b>	Not Applicable
<b>Tracer Test Passed:</b>	Yes                  No
<b>Notes:</b>	

**General Observations/Notes:**

Passed shut in test.
<b>Approximating One-Well Volume (for purging):</b> $V_1 + V_2 = V_t$ where: $V_1 = \pi r^2 h$ = open space volume of sample tubing; $V_2 = \pi r^2 h$ = open space volume of sample point; $V_t$ = total volume; $r$ = inner radius of sample point, or sample tubing; $h$ = height of sample point or length of tubing.



## Sub-slab/Soil-Gas Sample Collection Log

<b>Sample ID:</b> SPG-9 (14' 5")	
<b>Client:</b> RACER Trust	<b>Boring Equipment:</b> Direct-push Drilling Rig
<b>Project:</b> Vapor Intrusion Verification Investigation	<b>Sealant:</b> Benseal/Bentonite
<b>Location:</b> Moraine, Ohio	<b>Tubing Information:</b> 0.25 inch OD; 0.17 inch ID Teflon
<b>Project #:</b> OH000294.2011.00007	<b>Miscellaneous Equipment:</b> Dielectric MGD-2002, MiniRae 2000 PID, GEM 500
<b>Samplers:</b> Abby Caporuscio	<b>Subcontractor:</b> None
	<b>Equipment:</b> SKC 220 air pumps, Defender 150
<b>Sampling Depth:</b> 14' 5" feet below land surface	<b>Moisture Content of Sampling Zone:</b> Dry
<b>Date of Installation:</b> 10/27/2010	<b>Approximate Purge Volume:</b> 81 mL

**Instrument Readings:**

Date	Time	Canister Vacuum (a) (inches of Hg)	Temperature (°F)	Relative Humidity (%)	Air Speed (mph)	Barometric Pressure (inches of Hg)	PID (ppb)
3/31/2011	1436	-30	52.0	100	1.2	29.07	NM
3/31/2011	1517	-5	52.0	100	1.2	29.07	NM

(a) Record canister information at a minimum at the beginning and end of sampling

**SUMMA® Canister Information:**

<b>Size (circle one):</b>	<input checked="" type="radio"/> 1 L <input type="radio"/> 6 L
<b>Canister ID:</b>	35668
<b>Flow Controller ID:</b>	FC00969
<b>Notes:</b>	

**Tracer Test Information (if applicable):**

<b>Initial Helium Shroud:</b>	Not Applicable
<b>Final Helium Shroud:</b>	Not Applicable
<b>Tracer Test Passed:</b>	Yes                  No
<b>Notes:</b>	

**General Observations/Notes:**

Passed shut in test.

**Approximating One-Well Volume (for purging):**

$V_1 + V_2 = V_t$  where:  $V_1 = \pi r^2 h$  = open space volume of sample tubing;  $V_2 = \pi r^2 h$  = open space volume of sample point;  $V_t$  = total volume;  $r$  = inner radius of sample point, or sample tubing;  $h$  = height of sample point or length of tubing.



## Sub-slab/Soil-Gas Sample Collection Log

Sample ID: <b>SGP-10 (6')</b>	
<b>Client:</b> RACER Trust	<b>Boring Equipment:</b> Direct-push Drilling Rig
<b>Project:</b> Vapor Intrusion Verification Investigation	<b>Sealant:</b> Benseal/Bentonite
<b>Location:</b> Moraine, Ohio	<b>Tubing Information:</b> 0.25 inch OD; 0.17 inch ID Teflon
<b>Project #:</b> OH000294.2011.00007	<b>Miscellaneous Equipment:</b> Dielectric MGD-2002, MiniRae 2000 PID, GEM 500
<b>Samplers:</b> Abby Caporuscio	<b>Subcontractor:</b> None
	<b>Equipment:</b> SKC 220 air pumps, Defender 150
<b>Sampling Depth:</b> 6 feet below land surface	<b>Moisture Content of Sampling Zone:</b> Moist
<b>Date of Installation:</b> 10/27/2010	<b>Approximate Purge Volume:</b> 43.24 mL before sampling

### Instrument Readings:

Date	Time	Canister Vacuum (a) (inches of Hg)	Temperature (°F)	Relative Humidity (%)	Air Speed (mph)	Barometric Pressure (inches of Hg)	PID (ppb)
3/30/2011	0910	-30	38.1	49.3	2.4	29.24	NM
3/30/2011	0945	-5	38.1	49.3	2.4	29.24	NM

(a) Record canister information at a minimum at the beginning and end of sampling

### SUMMA® Canister Information:

<b>Size (circle one):</b>	(1 L)      6 L
<b>Canister ID:</b>	13385
<b>Flow Controller ID:</b>	FC00778
<b>Notes:</b>	

### Tracer Test Information (if applicable):

<b>Initial Helium Shroud:</b>	89.6%
<b>Final Helium Shroud:</b>	83.2%
<b>Tracer Test Passed:</b>	(Yes)      No
<b>Notes:</b>	He- in Tedlar bag = 0 ppm

### General Observations/Notes:

On 3-28-11 He leak test. Begin purge at 1452 at 200 mL/mi. 3 hrs 36 mins. At 1531 He= 82%.

### Approximating One-Well Volume (for purging):

$V_1 + V_2 = V_t$  where:  $V_1 = \pi r^2 h$  = open space volume of sample tubing;  $V_2 = \pi r^2 h$  = open space volume of sample point;  $V_t$  = total volume;  $r$  = inner radius of sample point, or sample tubing;  $h$  = height of sample point or length of tubing.



## Sub-slab/Soil-Gas Sample Collection Log

<b>Sample ID:</b> SGP-10 (11')	
<b>Client:</b> RACER Trust	<b>Boring Equipment:</b> Direct-push Drilling Rig
<b>Project:</b> Vapor Intrusion Verification Investigation	<b>Sealant:</b> Benseal/Bentonite
<b>Location:</b> Moraine, Ohio	<b>Tubing Information:</b> 0.25 inch OD; 0.17 inch ID Teflon
<b>Project #:</b> OH000294.2011.00007	<b>Miscellaneous Equipment:</b> Dielectric MGD-2002, MiniRae 2000 PID, GEM 500
<b>Samplers:</b> Abby Caporuscio	<b>Subcontractor:</b> None
	<b>Equipment:</b> SKC 220 air pumps, Defender 150
<b>Sampling Depth:</b> 11 feet below land surface	<b>Moisture Content of Sampling Zone:</b> Moist
<b>Date of Installation:</b> 10/27/2010	<b>Approximate Purge Volume:</b> 65 mL

**Instrument Readings:**

Date	Time	Canister Vacuum (a) (inches of Hg)	Temperature (°F)	Relative Humidity (%)	Air Speed (mph)	Barometric Pressure (inches of Hg)	PID (ppb)
3/30/2011	906	-29.5	38.1	49.3	2.4	29.24	NM
3/30/2011	942	-5	38.1	49.3	2.4	29.24	NM

(a) Record canister information at a minimum at the beginning and end of sampling

**SUMMA® Canister Information:**

<b>Size (circle one):</b>	<input checked="" type="radio"/> 1 L <input type="radio"/> 6 L
<b>Canister ID:</b>	2176
<b>Flow Controller ID:</b>	FC00506
<b>Notes:</b>	

**Tracer Test Information (if applicable):**

<b>Initial Helium Shroud:</b>	Not Applicable
<b>Final Helium Shroud:</b>	Not Applicable
<b>Tracer Test Passed:</b>	Yes                  No
<b>Notes:</b>	

**General Observations/Notes:**


**Approximating One-Well Volume (for purging):**

$V_1 + V_2 = V_t$  where:  $V_1 = \pi r^2 h$  = open space volume of sample tubing;  $V_2 = \pi r^2 h$  = open space volume of sample point;  $V_t$  = total volume;  $r$  = inner radius of sample point, or sample tubing;  $h$  = height of sample point or length of tubing.



## Sub-slab/Soil-Gas Sample Collection Log

<b>Sample ID:</b> SGP-10 (28'11")	
<b>Client:</b> RACER Trust	<b>Boring Equipment:</b> Direct-push Drilling Rig
<b>Project:</b> Vapor Intrusion Verification Investigation	<b>Sealant:</b> Benseal/Bentonite
<b>Location:</b> Moraine, Ohio	<b>Tubing Information:</b> 0.25 inch OD; 0.17 inch ID Teflon
<b>Project #:</b> OH000294.2011.00007	<b>Miscellaneous Equipment:</b> Dielectric MGD-2002, MiniRae 2000 PID, GEM 500
<b>Samplers:</b> Abby Caporuscio	<b>Subcontractor:</b> None
	<b>Equipment:</b> SKC 220 air pumps, Defender 150
<b>Sampling Depth:</b> 28' 11" feet below land surface	<b>Moisture Content of Sampling Zone:</b> Moist
<b>Date of Installation:</b> 10/27/2010	<b>Approximate Purge Volume:</b> 140 mL

**Instrument Readings:**

Date	Time	Canister Vacuum (a) (inches of Hg)	Temperature (°F)	Relative Humidity (%)	Air Speed (mph)	Barometric Pressure (inches of Hg)	PID (ppb)
3/30/2011	0904	-28.75	38.1	49.3	2.4	29.24	NM
3/30/2011	0946	-5	38.1	49.3	2.4	29.24	NM

(a) Record canister information at a minimum at the beginning and end of sampling

**SUMMA® Canister Information:**

<b>Size (circle one):</b>	<input checked="" type="radio"/> 1 L <input type="radio"/> 6 L
<b>Canister ID:</b>	36516
<b>Flow Controller ID:</b>	FC00124
<b>Notes:</b>	

**Tracer Test Information (if applicable):**

<b>Initial Helium Shroud:</b>	Not Applicable
<b>Final Helium Shroud:</b>	Not Applicable
<b>Tracer Test Passed:</b>	Yes                  No
<b>Notes:</b>	

**General Observations/Notes:**

Collected duplicate DUP-1/03302011/

**Approximating One-Well Volume (for purging):**

$V_1 + V_2 = V_t$  where:  $V_1 = \pi r^2 h$  = open space volume of sample tubing;  $V_2 = \pi r^2 h$  = open space volume of sample point;  $V_t$  = total volume;  $r$  = inner radius of sample point, or sample tubing;  $h$  = height of sample point or length of tubing.



## Sub-slab/Soil-Gas Sample Collection Log

<b>Sample ID:</b> DUP-1/03302011/	
<b>Client:</b> RACER Trust	<b>Boring Equipment:</b> Direct-push Drilling Rig
<b>Project:</b> Vapor Intrusion Verification Investigation	<b>Sealant:</b> Benseal/Bentonite
<b>Location:</b> Moraine, Ohio	<b>Tubing Information:</b> 0.25 inch OD; 0.17 inch ID Teflon
<b>Project #:</b> OH000294.2011.00007	<b>Miscellaneous Equipment:</b> Dielectric MGD-2002, MiniRae 2000 PID, GEM 500
<b>Samplers:</b> Abby Caporuscio	<b>Subcontractor:</b> None
	<b>Equipment:</b> SKC 220 air pumps, Defender 150
<b>Sampling Depth:</b> 28' 11" feet below land surface	<b>Moisture Content of Sampling Zone:</b> Moist
<b>Date of Installation:</b> 10/27/2010	<b>Approximate Purge Volume:</b> 140 mL

**Instrument Readings:**

Date	Time	Canister Vacuum (a) (inches of Hg)	Temperature (°F)	Relative Humidity (%)	Air Speed (mph)	Barometric Pressure (inches of Hg)	PID (ppb)
3/30/2011	0904	-28.5	38.1	49.3	2.4	29.24	NM
3/30/2011	0937	-5	38.1	49.3	2.4	29.24	NM

(a) Record canister information at a minimum at the beginning and end of sampling

**SUMMA® Canister Information:**

<b>Size (circle one):</b>	<input checked="" type="radio"/> 1 L <input type="radio"/> 6 L
<b>Canister ID:</b>	35561
<b>Flow Controller ID:</b>	FC00214
<b>Notes:</b>	

**Tracer Test Information (if applicable):**

<b>Initial Helium Shroud:</b>	Not Applicable
<b>Final Helium Shroud:</b>	Not Applicable
<b>Tracer Test Passed:</b>	Yes                  No
<b>Notes:</b>	

**General Observations/Notes:**

Parent sample is SGP-10(28'11")

**Approximating One-Well Volume (for purging):**

$V_1 + V_2 = V_t$  where:  $V_1 = \pi r^2 h$  = open space volume of sample tubing;  $V_2 = \pi r^2 h$  = open space volume of sample point;  $V_t$  = total volume;  $r$  = inner radius of sample point, or sample tubing;  $h$  = height of sample point or length of tubing.



## Sub-slab/Soil-Gas Sample Collection Log

<b>Sample ID: SGP-11 (6')</b>	
<b>Client:</b> RACER Trust	<b>Boring Equipment:</b> Direct-push Drilling Rig
<b>Project:</b> Vapor Intrusion Verification Investigation	<b>Sealant:</b> Benseal/Bentonite
<b>Location:</b> Moraine, Ohio	<b>Tubing Information:</b> 0.25 inch OD; 0.17 inch ID Teflon
<b>Project #:</b> OH000294.2011.00007	<b>Miscellaneous Equipment:</b> Dielectric MGD-2002, MiniRae 2000 PID, GEM 500
<b>Samplers:</b> Abby Caporuscio	<b>Subcontractor:</b> None
	<b>Equipment:</b> SKC 220 air pumps, Defender 150
<b>Sampling Depth:</b> 6 feet below land surface	<b>Moisture Content of Sampling Zone:</b> Moist
<b>Date of Installation:</b> 11/2/2010	<b>Approximate Purge Volume:</b> 43 mL before sampling

**Instrument Readings:**

Date	Time	Canister Vacuum (a) (inches of Hg)	Temperature (°F)	Relative Humidity (%)	Air Speed (mph)	Barometric Pressure (inches of Hg)	PID (ppb)
3/31/2011	1543	-30	52.7	75.8	1.2	29.00	NM
3/31/2011	1620	-5	52.0	75.8	1.2	29.00	NM

(a) Record canister information at a minimum at the beginning and end of sampling

**SUMMA® Canister Information:**

<b>Size (circle one):</b>	<input checked="" type="radio"/> 1 L <input type="radio"/> 6 L
<b>Canister ID:</b>	37406
<b>Flow Controller ID:</b>	FC00464
<b>Notes:</b>	

**Tracer Test Information (if applicable):**

<b>Initial Helium Shroud:</b>	95.0%
<b>Final Helium Shroud:</b>	69.6%
<b>Tracer Test Passed:</b>	<input checked="" type="radio"/> Yes <input type="radio"/> No
<b>Notes:</b>	He in Tedlar bag = 0 ppm

**General Observations/Notes:**

Purge start time: 1640. 1720 pump would not pump at 150 mL/min (30mL/min measured value). 1740 pump shut off. 1745 replaced pump with new pump (s/n #1-304-09): 195 mL/min. Passed shut-in test.

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**Approximating One-Well Volume (for purging):**

$V_1 + V_2 = V_t$  where:  $V_1 = \pi r^2 h$  = open space volume of sample tubing;  $V_2 = \pi r^2 h$  = open space volume of sample point;  $V_t$  = total volume;  $r$  = inner radius of sample point, or sample tubing;  $h$  = height of sample point or length of tubing.



## Sub-slab/Soil-Gas Sample Collection Log

<b>Sample ID:</b> SGP-11 (11')	
<b>Client:</b> RACER Trust	<b>Boring Equipment:</b> Direct-push Drilling Rig
<b>Project:</b> Vapor Intrusion Verification Investigation	<b>Sealant:</b> Benseal/Bentonite
<b>Location:</b> Moraine, Ohio	<b>Tubing Information:</b> 0.25 inch OD; 0.17 inch ID Teflon
<b>Project #:</b> OH000294.2011.00007	<b>Miscellaneous Equipment:</b> Dielectric MGD-2002, MiniRae 2000 PID, GEM 500
<b>Samplers:</b> Abby Caporuscio	<b>Subcontractor:</b> None
	<b>Equipment:</b> SKC 220 air pumps, Defender 150
<b>Sampling Depth:</b> 11 feet below land surface	<b>Moisture Content of Sampling Zone:</b> Moist
<b>Date of Installation:</b> 11/2/2010	<b>Approximate Purge Volume:</b> 65 mL

**Instrument Readings:**

Date	Time	Canister Vacuum (a) (inches of Hg)	Temperature (°F)	Relative Humidity (%)	Air Speed (mph)	Barometric Pressure (inches of Hg)	PID (ppb)
3/31/2011	1542	<-30	52.7	75.8	1.2	29.00	NM
3/31/2011	1623	-5	52.7	75.8	1.2	29.00	NM

(a) Record canister information at a minimum at the beginning and end of sampling

**SUMMA® Canister Information:**

<b>Size (circle one):</b>	<input checked="" type="radio"/> 1 L <input type="radio"/> 6 L
<b>Canister ID:</b>	37345
<b>Flow Controller ID:</b>	FC00875
<b>Notes:</b>	

**Tracer Test Information (if applicable):**

<b>Initial Helium Shroud:</b>	Not Applicable
<b>Final Helium Shroud:</b>	Not Applicable
<b>Tracer Test Passed:</b>	Yes                  No
<b>Notes:</b>	

**General Observations/Notes:**

Passed shut in test.

**Approximating One-Well Volume (for purging):**

$V_1 + V_2 = V_t$  where:  $V_1 = \pi r^2 h$  = open space volume of sample tubing;  $V_2 = \pi r^2 h$  = open space volume of sample point;  $V_t$  = total volume;  $r$  = inner radius of sample point, or sample tubing;  $h$  = height of sample point or length of tubing.



## Sub-slab/Soil-Gas Sample Collection Log

<b>Sample ID: SGP-11 (15' 4")</b>	
<b>Client:</b> RACER Trust	<b>Boring Equipment:</b> Direct-push Drilling Rig
<b>Project:</b> Vapor Intrusion Verification Investigation	<b>Sealant:</b> Benseal/Bentonite
<b>Location:</b> Moraine, Ohio	<b>Tubing Information:</b> 0.25 inch OD; 0.17 inch ID Teflon
<b>Project #:</b> OH000294.2011.00007	<b>Miscellaneous Equipment:</b> Dielectric MGD-2002, MiniRae 2000 PID, GEM 500
<b>Samplers:</b> Abby Caporuscio	<b>Subcontractor:</b> None
	<b>Equipment:</b> SKC 220 air pumps, Defender 150
<b>Sampling Depth:</b> 15' 4" feet below land surface	<b>Moisture Content of Sampling Zone:</b> Moist
<b>Date of Installation:</b> 11/2/2010	<b>Approximate Purge Volume:</b> 85 mL

**Instrument Readings:**

Date	Time	Canister Vacuum (a) (inches of Hg)	Temperature (°F)	Relative Humidity (%)	Air Speed (mph)	Barometric Pressure (inches of Hg)	PID (ppb)
3/31/2011	1541	<-30	52.7	75.8	1.2	29	NM
3/31/2011	1617	-5	52.7	75.8	1.2	29	NM

(a) Record canister information at a minimum at the beginning and end of sampling

**SUMMA® Canister Information:**

<b>Size (circle one):</b>	<input checked="" type="radio"/> 1 L <input type="radio"/> 6 L
<b>Canister ID:</b>	34572
<b>Flow Controller ID:</b>	FC00374
<b>Notes:</b>	

**Tracer Test Information (if applicable):**

<b>Initial Helium Shroud:</b>	Not Applicable
<b>Final Helium Shroud:</b>	Not Applicable
<b>Tracer Test Passed:</b>	Yes                  No
<b>Notes:</b>	

**General Observations/Notes:**

Passed shut in test.

**Approximating One-Well Volume (for purging):**

$V_1 + V_2 = V_t$  where:  $V_1 = \pi r^2 h$  = open space volume of sample tubing;  $V_2 = \pi r^2 h$  = open space volume of sample point;  $V_t$  = total volume;  $r$  = inner radius of sample point, or sample tubing;  $h$  = height of sample point or length of tubing.



## Sub-slab/Soil-Gas Sample Collection Log

Sample ID: <b>SGP-12 (6')</b>	
<b>Client:</b> RACER Trust	<b>Boring Equipment:</b> Direct-push Drilling Rig
<b>Project:</b> Vapor Intrusion Verification Investigation	<b>Sealant:</b> Benseal/Bentonite
<b>Location:</b> Moraine, Ohio	<b>Tubing Information:</b> 0.25 inch OD; 0.17 inch ID Teflon
<b>Project #:</b> OH000294.2011.00007	<b>Miscellaneous Equipment:</b> Dielectric MGD-2002, MiniRae 2000 PID, GEM 500
<b>Samplers:</b> Abby Caporuscio	<b>Subcontractor:</b> None
AFC (Sampling 3/30/11)	<b>Equipment:</b> SKC 220 air pumps, Defender 150
<b>Sampling Depth:</b> 6 feet below land surface	<b>Moisture Content of Sampling Zone:</b> Moist
<b>Date of Installation:</b> 11/2/2010	<b>Approximate Purge Volume:</b> 43.24 mL before sampling

**Instrument Readings:**

Date	Time	Canister Vacuum (a) (inches of Hg)	Temperature (°F)	Relative Humidity (%)	Air Speed (mph)	Barometric Pressure (inches of Hg)	PID (ppb)
3/30/2011	0753	-28	44.3	36.2	2.1	29.26	NM
3/30/2011	0844	-5	44.3	36.2	2.1	29.26	NM

(a) Record canister information at a minimum at the beginning and end of sampling

**SUMMA® Canister Information:**

<b>Size (circle one):</b>	(1 L)      6 L
<b>Canister ID:</b>	33408
<b>Flow Controller ID:</b>	FC00348
<b>Notes:</b>	

**Tracer Test Information (if applicable):**

<b>Initial Helium Shroud:</b>	91.6%
<b>Final Helium Shroud:</b>	69.5%
<b>Tracer Test Passed:</b>	(Yes)      No
<b>Notes:</b>	He in Tedlar bag =0 ppm

**General Observations/Notes:**

On 3/28/11 He leak test. Purge at 200 mL/min Begin pure at 1018. Purge start time 0740.
Photos 0001 and 007
<b>Approximating One-Well Volume (for purging):</b> $V_1 + V_2 = V_t$ where: $V_1 = \pi r^2 h$ = open space volume of sample tubing; $V_2 = \pi r^2 h$ = open space volume of sample point; $V_t$ = total volume; $r$ = inner radius of sample point, or sample tubing; $h$ = height of sample point or length of tubing.



## Sub-slab/Soil-Gas Sample Collection Log

<b>Sample ID: SGP-12 (11')</b>	
<b>Client:</b> RACER Trust	<b>Boring Equipment:</b> Direct-push Drilling Rig
<b>Project:</b> Vapor Intrusion Verification Investigation	<b>Sealant:</b> Benseal/Bentonite
<b>Location:</b> Moraine, Ohio	<b>Tubing Information:</b> 0.25 inch OD; 0.17 inch ID Teflon
<b>Project #:</b> OH000294.2011.00007	<b>Miscellaneous Equipment:</b> Dielectric MGD-2002, MiniRae 2000 PID, GEM 500
<b>Samplers:</b> Abby Caporuscio	<b>Subcontractor:</b> None
	<b>Equipment:</b> SKC 220 air pumps, Defender 150
<b>Sampling Depth:</b> 11 feet below land surface	<b>Moisture Content of Sampling Zone:</b> Moist
<b>Date of Installation:</b> 11/2/2010	<b>Approximate Purge Volume:</b> 65 mL

**Instrument Readings:**

Date	Time	Canister Vacuum (a) (inches of Hg)	Temperature (°F)	Relative Humidity (%)	Air Speed (mph)	Barometric Pressure (inches of Hg)	PID (ppb)
3/30/2011	0741	-28	44.3	36.2	2.1	29.26	NM
3/30/2011	0812	-5	44.3	36.2	2.1	29.26	NM

(a) Record canister information at a minimum at the beginning and end of sampling

**SUMMA® Canister Information:**

<b>Size (circle one):</b>	<input checked="" type="radio"/> 1 L <input type="radio"/> 6 L
<b>Canister ID:</b>	33723
<b>Flow Controller ID:</b>	6668
<b>Notes:</b>	

**Tracer Test Information (if applicable):**

<b>Initial Helium Shroud:</b>	Not Applicable
<b>Final Helium Shroud:</b>	Not Applicable
<b>Tracer Test Passed:</b>	Yes                  No
<b>Notes:</b>	

**General Observations/Notes:**

<b>Purge time: 1.5 min. Purge Start time: 0739</b>  <hr/> <hr/> <hr/>
<b>Photo 007</b> <b>Approximating One-Well Volume (for purging):</b> $V_1 + V_2 = V_t$ where: $V_1 = \pi r^2 h$ = open space volume of sample tubing; $V_2 = \pi r^2 h$ = open space volume of sample point; $V_t$ = total volume; $r$ = inner radius of sample point, or sample tubing; $h$ = height of sample point or length of tubing.



## Sub-slab/Soil-Gas Sample Collection Log

<b>Sample ID: SGP-12 (22'11")</b>	
<b>Client:</b> RACER Trust	<b>Boring Equipment:</b> Direct-push Drilling Rig
<b>Project:</b> Vapor Intrusion Verification Investigation	<b>Sealant:</b> Benseal/Bentonite
<b>Location:</b> Moraine, Ohio	<b>Tubing Information:</b> 0.25 inch OD; 0.17 inch ID Teflon
<b>Project #:</b> OH000294.2011.00007	<b>Miscellaneous Equipment:</b> Dielectric MGD-2002, MiniRae 2000 PID, GEM 500
<b>Samplers:</b> Abby Caporuscio	<b>Subcontractor:</b> None
	<b>Equipment:</b> SKC 220 air pumps, Defender 150
<b>Sampling Depth:</b> 22' 11" feet below land surface	<b>Moisture Content of Sampling Zone:</b> Moist
<b>Date of Installation:</b> 11/2/2010	<b>Approximate Purge Volume:</b> 118 mL

### Instrument Readings:

Date	Time	Canister Vacuum (a) (inches of Hg)	Temperature (°F)	Relative Humidity (%)	Air Speed (mph)	Barometric Pressure (inches of Hg)	PID (ppb)
3/30/2011	0741	-28	44.3	36.2	2.1	29.26	NM
3/30/2011	0813	-5	44.3	36.2	2.1	29.26	NM

(a) Record canister information at a minimum at the beginning and end of sampling

### SUMMA® Canister Information:

<b>Size (circle one):</b>	<input checked="" type="radio"/> 1 L <input type="radio"/> 6 L
<b>Canister ID:</b>	36572
<b>Flow Controller ID:</b>	FC00695
<b>Notes:</b>	

### Tracer Test Information (if applicable):

<b>Initial Helium Shroud:</b>	Not Applicable
<b>Final Helium Shroud:</b>	Not Applicable
<b>Tracer Test Passed:</b>	Yes                  No
<b>Notes:</b>	

### General Observations/Notes:

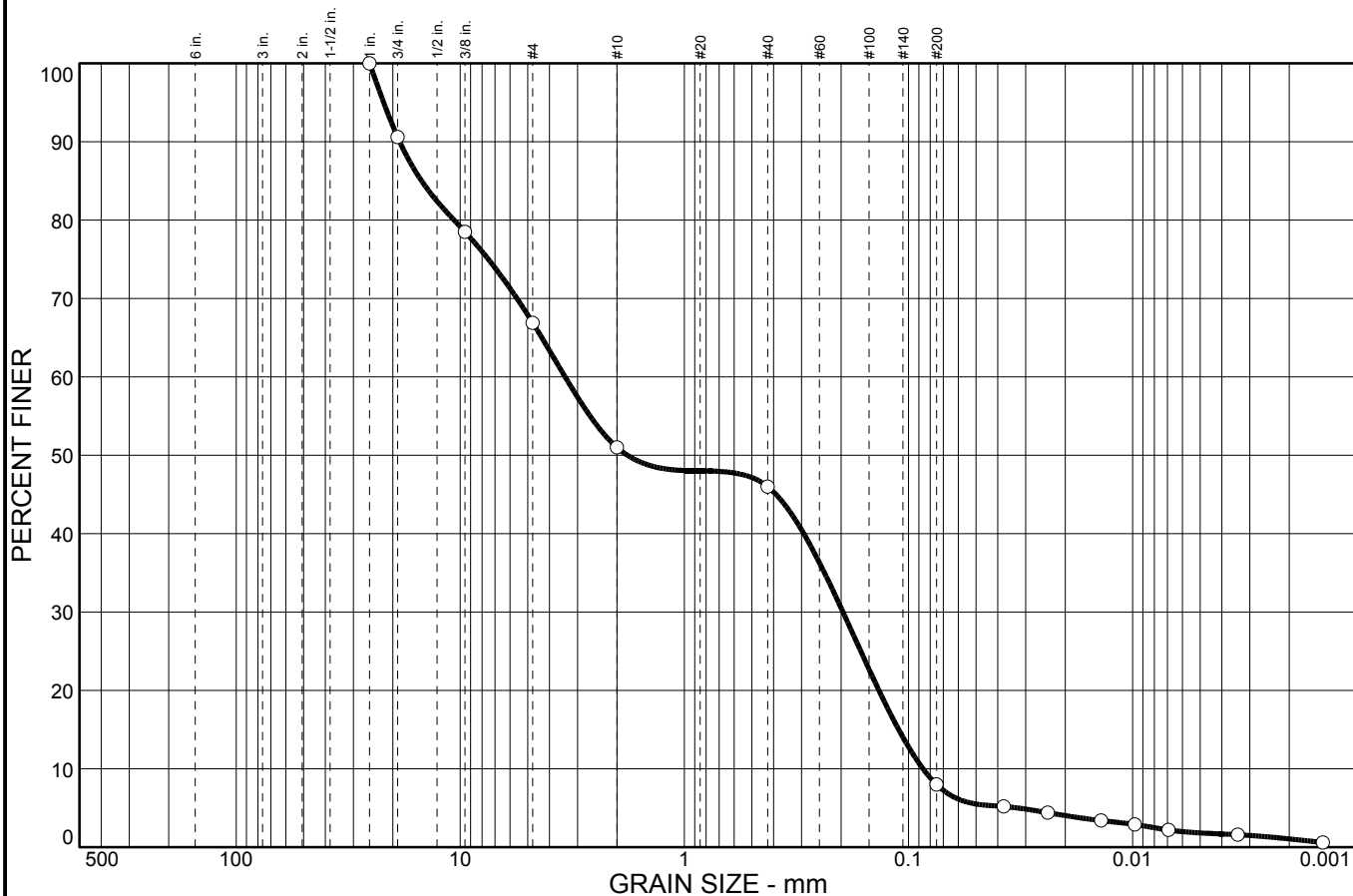
<b>Purge time: 2.5 min. Purge Start time: 0739</b>
<b>Photo 007</b>
<b>Approximating One-Well Volume (for purging):</b> $V_1 + V_2 = V_t$ where: $V_1 = \pi r^2 h$ = open space volume of sample tubing; $V_2 = \pi r^2 h$ = open space volume of sample point; $V_t$ = total volume; $r$ = inner radius of sample point, or sample tubing; $h$ = height of sample point or length of tubing.

ARCADIS

**Appendix D**

Geotechnical Laboratory Report

# PARTICLE SIZE DISTRIBUTION TEST REPORT



% COBBLES	% GRAVEL		% SAND			% FINES	
	CRS.	FINE	CRS.	MEDIUM	FINE	SILT	CLAY
0.0	9.4	23.7	15.9	5.0	38.0	6.2	1.8

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
1.00 in.	100.0		
0.75 in.	90.6		
0.375 in.	78.5		
#4	66.9		
#10	51.0		
#40	46.0		
#200	8.0		

**Soil Description**

Poorly graded sand with silt and gravel

**Atterberg Limits**

PL= NP      LL= NP      PI= NP

**Coefficients**

D<sub>85</sub>= 14.9      D<sub>60</sub>= 3.41      D<sub>50</sub>= 1.80  
D<sub>30</sub>= 0.196      D<sub>15</sub>= 0.111      D<sub>10</sub>= 0.0862  
C<sub>u</sub>= 39.52      C<sub>c</sub>= 0.13

**Classification**

USCS= SP-SM      AASHTO= A-1-b

**Remarks**

Moisture Content= 3.6%

\* (no specification provided)

**Sample No.:** SPG-1 (bag)  
**Location:**

**Source of Sample:** SPG-1

**Date:** 4/7/2011  
**Elev./Depth:** 6.0'-7.0'



**Client:** Arcadis  
**Project:** MLC Moraine (OH000294.0018.00007)  
 Test Methods: ASTM D-421, D-422, D-854, D-2216, D-4318  
**Project No.:** 1021-4505.18      **Figure**

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**GRAIN SIZE DISTRIBUTION TEST DATA**

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**Client:** Arcadis  
**Project:** MLC Moraine (OH000294.0018.00007)  
Test Methods: ASTM D-421, D-422, D-854, D-2216, D-4318  
**Project Number:** 1021-4505.18

---

**Sample Data**

---

**Source:** SPG-1  
**Sample No.:** SPG-1 (bag)  
**Elev. or Depth:** 6.0'-7.0' **Sample Length(in./cm.):**  
**Location:**  
**Description:** Poorly graded sand with silt and gravel  
**Date:** 4/7/2011 **PL:** NP **LL:** NP **PI:** NP  
**USCS Classification:** SP-SM **AASHTO Classification:** A-1-b  
**Testing Remarks:** Moisture Content= 3.6%

---

**Mechanical Analysis Data**

---

**Initial**

**Dry sample and tare=** 247.78  
**Tare =** 62.04  
**Dry sample weight =** 185.74  
**Sample split on number 10 sieve**  
**Split sample data:**  
Sample and tare = 30.77 Tare = .00 Sample weight = 30.77

**Sieve tare method**

Sieve	Weight retained	Sieve tare	Percent finer
1.00 inch	0.00	0.00	100.0
0.75 inch	17.42	0.00	90.6
0.375 inch	22.51	0.00	78.5
# 4	21.49	0.00	66.9
# 10	29.56	0.00	51.0
# 40	3.03	0.00	46.0
# 200	22.93	0.00	8.0

---

**Hydrometer Analysis Data**

---

**Separation sieve is #10**  
**Percent -#10 based upon complete sample=** 51.0  
**Weight of hydrometer sample:** 30.77  
**Calculated biased weight=** 60.33  
**Automatic temperature correction**  
Composite correction at 20 deg C = -3.4

**Meniscus correction only=**  
**Specific gravity of solids=** 2.70  
**Hydrometer type:** 151H  
Effective depth L= 16.294964 - 0.2645 x Rm

Elapsed time, min	Temp, deg C	Actual reading	Corrected reading	K	Rm	Eff. depth	Diameter mm	Percent finer
2.00	17.8	1.0057	1.0020	0.0138	5.7	14.8	0.0376	5.2
5.00	17.6	1.0054	1.0017	0.0139	5.4	14.9	0.0239	4.4
15.00	17.8	1.0050	1.0013	0.0138	5.0	15.0	0.0138	3.4
30.00	17.8	1.0048	1.0011	0.0138	4.8	15.0	0.0098	2.9
60.00	18.0	1.0045	1.0008	0.0138	4.5	15.1	0.0069	2.2

Elapsed time, min	Temp, deg C	Actual reading	Corrected reading	K	Rm	Eff. depth	Diameter mm	Percent finer
250.00	18.0	1.0043	1.0006	0.0138	4.3	15.2	0.0034	1.6
1440.00	18.2	1.0039	1.0002	0.0138	3.9	15.3	0.0014	0.6

---

**Fractional Components**

---

Gravel/Sand based on #4

Sand/Fines based on #200

% COBBLES =                    % GRAVEL = 33.1    (% coarse = 9.4        % fine = 23.7)

% SAND = 58.9    (% coarse = 15.9    % medium = 5.0        % fine = 38.0)

% SILT = 6.2            % CLAY = 1.8

D<sub>85</sub>= 14.88    D<sub>60</sub>= 3.41    D<sub>50</sub>= 1.80

D<sub>30</sub>= 0.20    D<sub>15</sub>= 0.11    D<sub>10</sub>= 0.09

C<sub>c</sub>= 0.131    C<sub>u</sub>= 39.5237

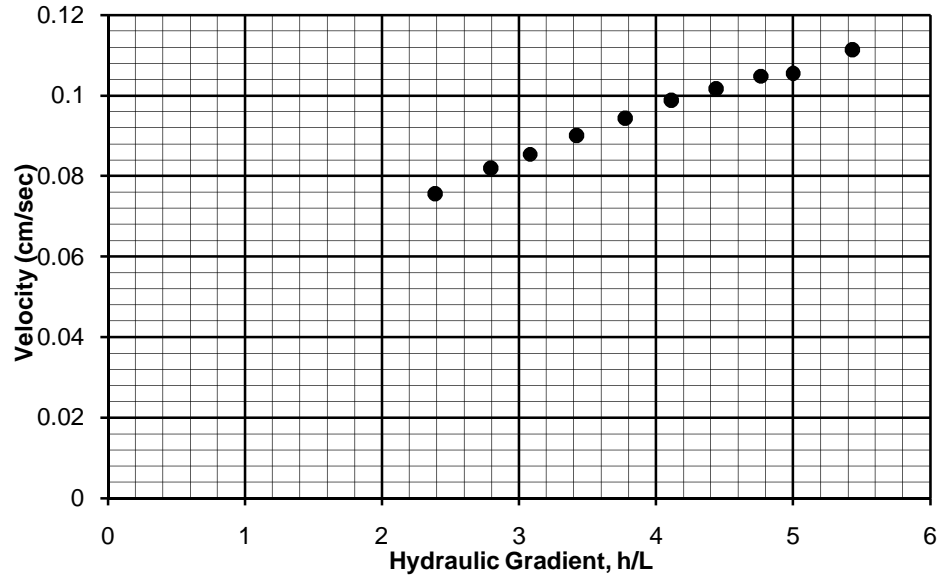
# Constant Head Permeability Test Report

ASTM D 2434

Boring: SPG-1  
 Sample:  
 Depth: 6.0'-7.0'

Grain Size Distribution	%
Aggregate:	33.1
Coarse Sand:	15.9
Med. Sand:	5.0
Fine Sand:	38.0
Silt:	6.2
Clay: (5 Micron)	1.8

Permeant Liquid  
 De-aired, deionized water



Diameter (cm)	Area, A (cm <sup>2</sup> )	Length (cm)	Moisture (%)	Dry Density (pcf)	Void Ratio	Specific Gravity
7.610	45.48	14.930	0.0	117.7	0.46	2.75

Trial	Manometers		Head h (cm)	Flow Q (cm <sup>3</sup> )	Time t (sec)	Temp. (°C)	Velocity Q/At	Gradient h/L	Permeability k <sub>20°C</sub> (cm/sec)
	H <sub>1</sub>	H <sub>2</sub>							
1	27.4	9.1	18.3	206.5	60	18.2	7.57E-02	2.39E+00	3.32E-02
2	32.2	10.8	21.4	223.8	60	17.4	8.20E-02	2.79E+00	3.14E-02
3	35.7	12.1	23.6	233.0	60	16.6	8.54E-02	3.08E+00	3.02E-02
4	39.7	13.5	26.2	245.9	60	16.0	9.01E-02	3.42E+00	2.90E-02
5	44.2	15.3	28.9	257.6	60	15.6	9.44E-02	3.77E+00	2.78E-02
6	48.2	16.7	31.5	269.8	60	15.1	9.89E-02	4.11E+00	2.70E-02
7	52.1	18.1	34.0	277.3	60	14.6	1.02E-01	4.44E+00	2.60E-02
8	56.1	19.6	36.5	285.9	60	14.2	1.05E-01	4.77E+00	2.52E-02
9	58.9	20.6	38.3	288.0	60	14.0	1.06E-01	5.00E+00	2.43E-02
10	64.5	22.9	41.6	303.9	60	13.8	1.11E-01	5.43E+00	2.37E-02

$k_{20°C} = R_T \times QL/At h = 2.78E-02 \text{ cm/sec}$

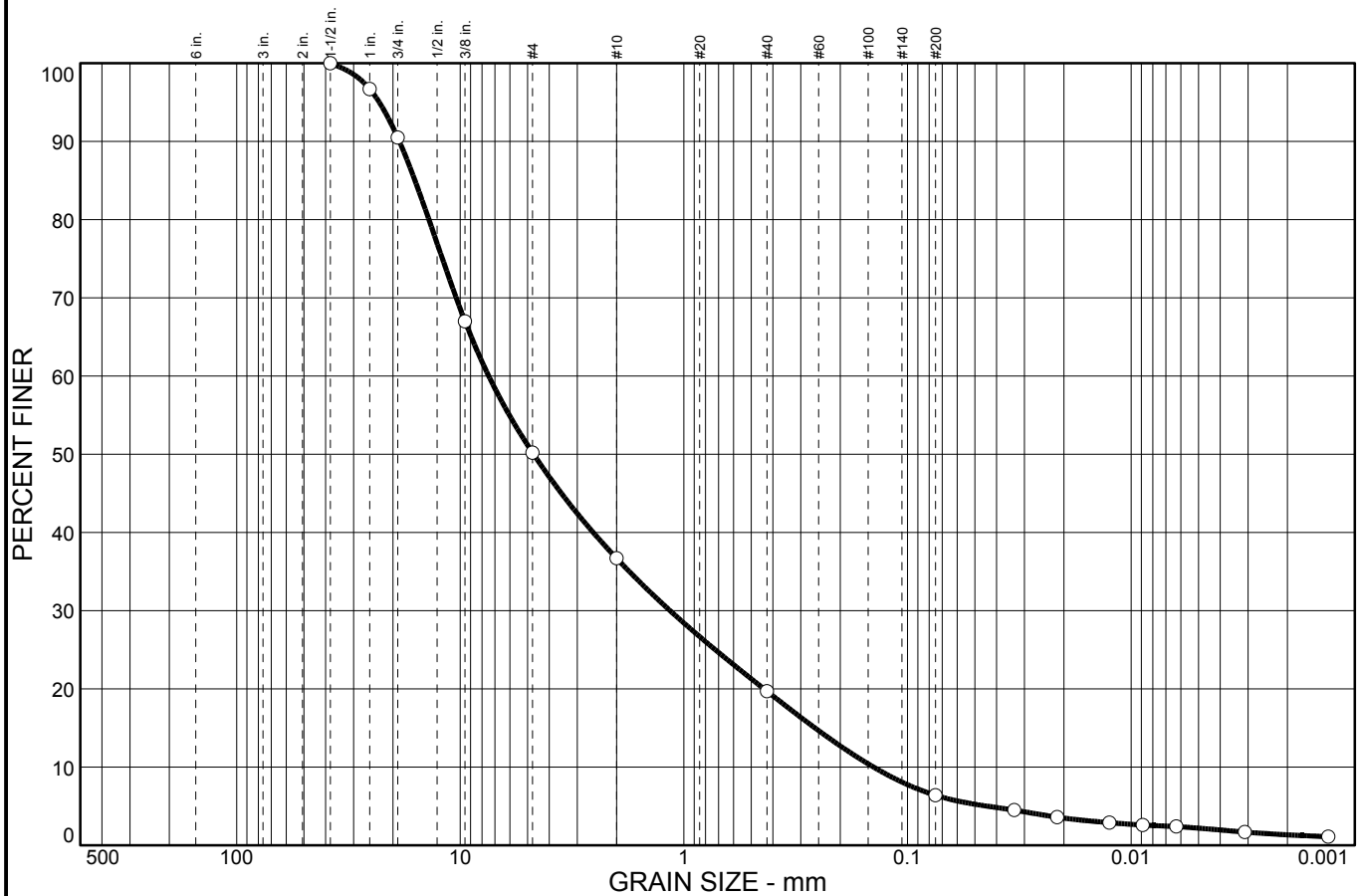
L - Distance between manometers = 7.66 cm  
 R<sub>T</sub> - Temperature correction factor

Remarks:  
 Sample was passed over a 3/4 inch sieve to remove oversized particles. Clay is considered to be 5 micron. **In this case the specific gravity is assumed to be 2.75**



Client: Arcadis  
 Project: MLC Moraine (OH000924-0018.00007)  
 Job No: 1021-4505.18

# PARTICLE SIZE DISTRIBUTION TEST REPORT



% COBBLES	% GRAVEL		% SAND			% FINES	
	CRS.	FINE	CRS.	MEDIUM	FINE	SILT	CLAY
0.0	9.5	40.3	13.5	17.0	13.3	4.2	2.2

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
1.50 in.	100.0		
1.00 in.	96.7		
0.75 in.	90.5		
0.375 in.	67.0		
#4	50.2		
#10	36.7		
#40	19.7		
#200	6.4		

**Soil Description**

Well-graded gravel with silt and sand

**Atterberg Limits**

PL= NP      LL= NP      PI= NP

**Coefficients**

D<sub>85</sub>= 15.9      D<sub>60</sub>= 7.46      D<sub>50</sub>= 4.70  
D<sub>30</sub>= 1.15      D<sub>15</sub>= 0.259      D<sub>10</sub>= 0.142  
C<sub>u</sub>= 52.61      C<sub>c</sub>= 1.26

**Classification**

USCS= GW-GM      AASHTO= A-1-a

**Remarks**

Moisture Content= 3.2%  
Specific Gravity= 2.79

\* (no specification provided)

**Sample No.:** SPG-1 (2" Liner)  
**Location:**

**Source of Sample:** SPG-1

**Date:** 4/11/2011  
**Elev./Depth:** 8.0'-10.0'



**Client:** Arcadis  
**Project:** MLC Moraine (OH000294.0018.00007)  
Test Methods: ASTM D-421, D-422, D-854, D-2216, D-4318  
**Project No.:** 1021-4505.18      **Figure**

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**GRAIN SIZE DISTRIBUTION TEST DATA**

---

**Client:** Arcadis  
**Project:** MLC Moraine (OH000294.0018.00007)  
Test Methods: ASTM D-421, D-422, D-854, D-2216, D-4318  
**Project Number:** 1021-4505.18

---

**Sample Data**

---

**Source:** SPG-1  
**Sample No.:** SPG-1 (2" Liner)  
**Elev. or Depth:** 8.0'-10.0' **Sample Length(in./cm.):**  
**Location:**  
**Description:** Well-graded gravel with silt and sand  
**Date:** 4/11/2011 **PL:** NP **LL:** NP **PI:** NP  
**USCS Classification:** GW-GM **AASHTO Classification:** A-1-a  
**Testing Remarks:** Moisture Content= 3.2%  
Specific Gravity= 2.79

---

**Mechanical Analysis Data**

---

**Initial**

**Dry sample and tare=** 1050.00  
**Tare** = 121.04  
**Dry sample weight** = 928.96  
**Sample split on number 10 sieve**  
**Split sample data:**  
Sample and tare = 103.92 Tare = .00 Sample weight = 103.92

**Sieve tare method**

Sieve	Weight retained	Sieve tare	Percent finer
1.50 inch	0.00	0.00	100.0
1.00 inch	30.96	0.00	96.7
0.75 inch	57.24	0.00	90.5
0.375 inch	218.36	0.00	67.0
# 4	156.27	0.00	50.2
# 10	125.22	0.00	36.7
# 40	48.18	0.00	19.7
# 200	37.48	0.00	6.4

---

**Hydrometer Analysis Data**

---

**Separation sieve is #10**  
**Percent -#10 based upon complete sample=** 36.7  
**Weight of hydrometer sample:** 103.92  
**Calculated biased weight=** 283.16  
**Automatic temperature correction**  
Composite correction at 20 deg C = -3.4

**Meniscus correction only=**  
**Specific gravity of solids=** 2.79  
**Hydrometer type:** 151H

Effective depth L= 16.294964 - 0.2645 x Rm

Elapsed time, min	Temp, deg C	Actual reading	Corrected reading	K	Rm	Eff. depth	Diameter mm	Percent finer
2.00	21.0	1.0115	1.0082	0.0129	11.5	13.3	0.0333	4.5
5.00	21.0	1.0099	1.0066	0.0129	9.9	13.7	0.0214	3.6
15.00	21.1	1.0086	1.0053	0.0129	8.6	14.0	0.0125	2.9

Elapsed time, min	Temp, Actual deg C	Actual reading	Corrected reading	K	Rm	Eff. depth	Diameter mm	Percent finer
30.00	21.2	1.0080	1.0047	0.0129	8.0	14.2	0.0089	2.6
60.00	21.4	1.0076	1.0044	0.0129	7.6	14.3	0.0063	2.4
250.00	21.8	1.0062	1.0030	0.0128	6.2	14.7	0.0031	1.7
1440.00	21.3	1.0052	1.0019	0.0129	5.2	14.9	0.0013	1.1

---

**Fractional Components**

---

Gravel/Sand based on #4

Sand/Fines based on #200

% COBBLES =                    % GRAVEL = 49.8    (% coarse = 9.5    % fine = 40.3)

% SAND = 43.8    (% coarse = 13.5    % medium = 17.0    % fine = 13.3)

% SILT = 4.2            % CLAY = 2.2

D<sub>85</sub>= 15.95    D<sub>60</sub>= 7.46    D<sub>50</sub>= 4.70

D<sub>30</sub>= 1.15    D<sub>15</sub>= 0.26    D<sub>10</sub>= 0.14

C<sub>c</sub>= 1.2573    C<sub>u</sub>= 52.6123

# Data Input for Index Properties

(Maximum Unit Weight / Minimum Porosity)

Project Name: MLC Moraine      Sample ID: SPG-1  
 DLZ Project Number: 1021-4505.18      Depth: 8.0'-10.0'  
 Client: Arcadis      Date: 4/8/2011  
 Client Project ID: OH000294.0018.00007

Moisture Content Data	
Wet Wt. & Cont (g)	1079.90
Dry Wt. & Cont (g)	1050.00
Wt. Cont (g)	121.04
Wt. Water (g)	29.90
Dry Wt. Soil (g)	928.96
Moisture Content (%)	3.2

Specific Gravity (G)= 2.79  
 Total Weight of Sample (Wt) wet = 958.86

Diameters			
D <sub>1</sub>	<u>1.958</u>	D <sub>4</sub>	<u>1.956</u>
D <sub>2</sub>	<u>1.958</u>	D <sub>5</sub>	<u>1.955</u>
D <sub>3</sub>	<u>1.963</u>	D <sub>6</sub>	<u>1.961</u>

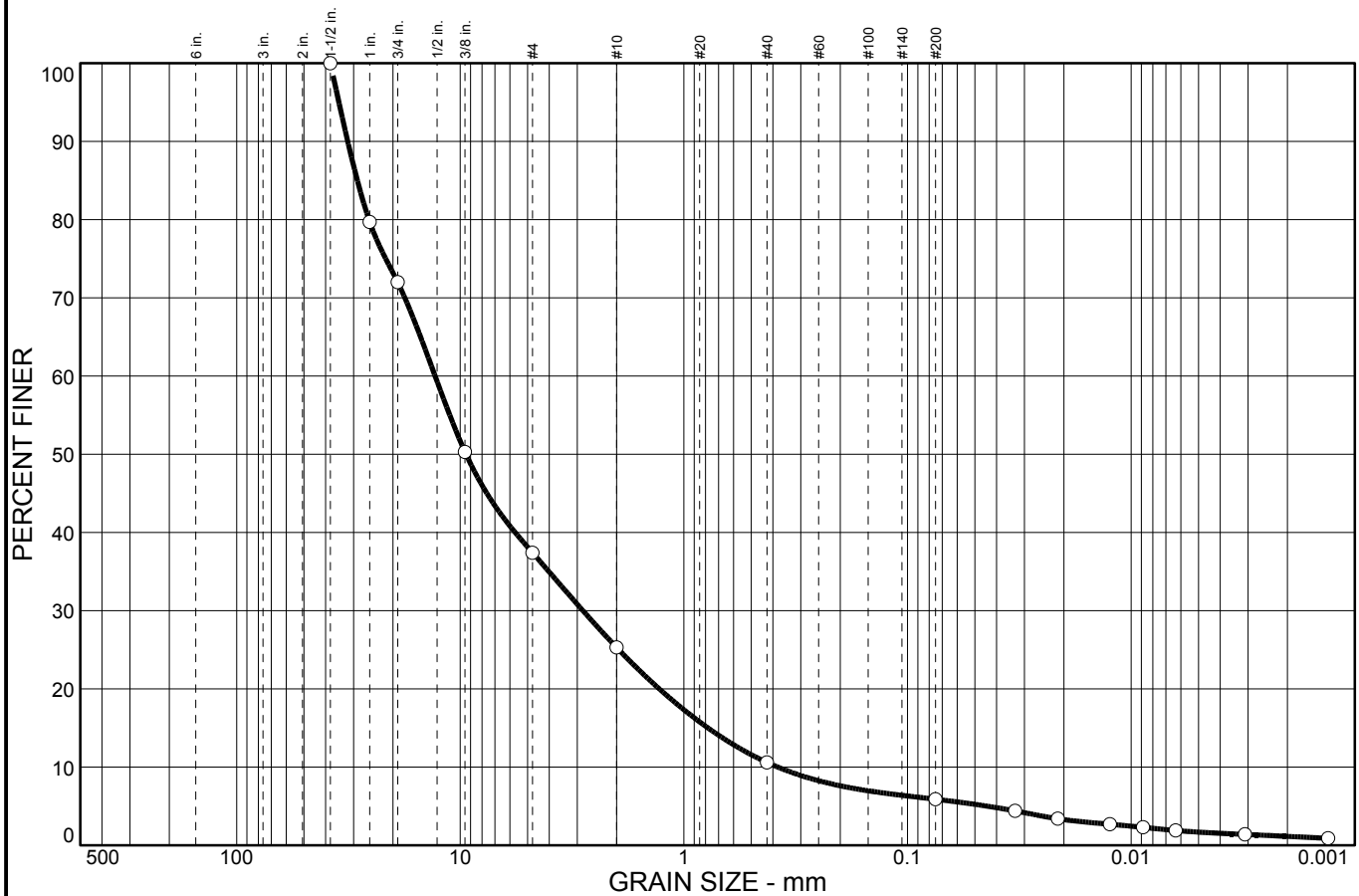
Avg. Diameter 1.959 in.

Lengths			
L <sub>1</sub>	<u>9.094</u>	L <sub>4</sub>	
L <sub>2</sub>	<u>9.125</u>	L <sub>5</sub>	
L <sub>3</sub>	<u>9.063</u>	L <sub>6</sub>	

Avg. Length 9.094 in.

Volume & Weights	Densities & Unit Weights
Volume of Sample <u>0.0158543</u> ft <sup>3</sup>	Wet Unit Weight ( $\gamma_T$ ) = <u>133.33</u> lb/ft <sup>3</sup>
Moisture <u>3.2</u> %	Bulk Density (dry)( $\gamma_d$ )= <u>129.18</u> lb/ft <sup>3</sup>
Mass of Dry Soil <u>929.0</u> g	Saturated unit Weight ( $\gamma_{SAT}$ )= <u>145.28</u> lb/ft <sup>3</sup>
Mass of Water <u>29.90</u> g	Submerged Unit Wt ( $\gamma_{SUB}$ )= <u>82.88</u> lb/ft <sup>3</sup>
Volume of Water <u>0.0010564</u> ft <sup>3</sup>	Degree of Saturation (S)= <u>25.825</u> %
Volume of Solids <u>0.0117637</u> ft <sup>3</sup>	
Volume of air <u>0.00303422</u> ft <sup>3</sup>	
Volume of Voids <u>0.0040906</u> ft <sup>3</sup>	
Porosity (n)= <u>0.2580120</u>	
Void Ratio (e)= <u>0.3477307</u>	
Volumetric Water <u>6.7</u> %	
Volumetric Air <u>19.1381183</u> %	

# PARTICLE SIZE DISTRIBUTION TEST REPORT



% COBBLES	% GRAVEL		% SAND			% FINES	
	CRS.	FINE	CRS.	MEDIUM	FINE	SILT	CLAY
0.0	28.0	34.6	12.1	14.7	4.7	4.2	1.7

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
1.50 in.	100.0		
1.00 in.	79.7		
0.75 in.	72.0		
0.375 in.	50.3		
#4	37.4		
#10	25.3		
#40	10.6		
#200	5.9		

**Soil Description**

Well-graded gravel with silt and sand

**Atterberg Limits**

PL= NP      LL= NP      PI= NP

**Coefficients**

D<sub>85</sub>= 28.9      D<sub>60</sub>= 13.0      D<sub>50</sub>= 9.42  
 D<sub>30</sub>= 2.83      D<sub>15</sub>= 0.780      D<sub>10</sub>= 0.380  
 C<sub>u</sub>= 34.10      C<sub>c</sub>= 1.62

**Classification**

USCS= GW-GM      AASHTO= A-1-a

**Remarks**

Moisture Content= 3.1%  
 Specific Gravity= 2.75

\* (no specification provided)

**Sample No.:** SPG-1 (2" liner)  
**Location:**

**Source of Sample:** SPG-1

**Date:** 4/11/2011  
**Elev./Depth:** 10.0'-12.0'



**Client:** Arcadis  
**Project:** MLC Moraine (OH000294.0018.00007)  
 Test Methods: ASTM D-421, D-422, D-854, D-2216, D-4318  
**Project No.:** 1021-4505.18      **Figure**

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**GRAIN SIZE DISTRIBUTION TEST DATA**

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**Client:** Arcadis  
**Project:** MLC Moraine (OH000294.0018.00007)  
Test Methods: ASTM D-421, D-422, D-854, D-2216, D-4318  
**Project Number:** 1021-4505.18

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**Sample Data**

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**Source:** SPG-1  
**Sample No.:** SPG-1 (2" liner)  
**Elev. or Depth:** 10.0'-12.0' **Sample Length(in./cm.):**  
**Location:**  
**Description:** Well-graded gravel with silt and sand  
**Date:** 4/11/2011 **PL:** NP **LL:** NP **PI:** NP  
**USCS Classification:** GW-GM **AASHTO Classification:** A-1-a  
**Testing Remarks:** Moisture Content= 3.1%  
Specific Gravity= 2.75

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**Mechanical Analysis Data**

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**Initial**

**Dry sample and tare=** 920.00  
**Tare** = 281.61  
**Dry sample weight** = 638.39  
**Sample split on number 10 sieve**  
**Split sample data:**  
Sample and tare = 80.01 Tare = .00 Sample weight = 80.01

**Sieve tare method**

Sieve	Weight retained	Sieve tare	Percent finer
1.50 inch	0.00	0.00	100.0
1.00 inch	129.43	0.00	79.7
0.75 inch	49.30	0.00	72.0
0.375 inch	138.78	0.00	50.3
# 4	82.43	0.00	37.4
# 10	76.91	0.00	25.3
# 40	46.45	0.00	10.6
# 200	14.83	0.00	5.9

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**Hydrometer Analysis Data**

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**Separation sieve is #10**  
**Percent -#10 based upon complete sample=** 25.3  
**Weight of hydrometer sample:** 80.01  
**Calculated biased weight=** 316.25  
**Automatic temperature correction**  
Composite correction at 20 deg C = -3.4

**Meniscus correction only=**  
**Specific gravity of solids=** 2.75  
**Hydrometer type:** 151H

Effective depth L= 16.294964 - 0.2645 x Rm

Elapsed time, min	Temp, deg C	Actual reading	Corrected reading	K	Rm	Eff. depth	Diameter mm	Percent finer
2.00	22.4	1.0119	1.0088	0.0129	11.9	13.1	0.0330	4.4
5.00	22.4	1.0099	1.0068	0.0129	9.9	13.7	0.0213	3.4
15.00	22.5	1.0085	1.0054	0.0128	8.5	14.0	0.0124	2.7

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Elapsed time, min	Temp, deg C	Actual reading	Corrected reading	K	Rm	Eff. depth	Diameter mm	Percent finer
30.00	22.6	1.0077	1.0046	0.0128	7.7	14.3	0.0088	2.3
60.00	22.5	1.0068	1.0037	0.0128	6.8	14.5	0.0063	1.9
250.00	23.3	1.0057	1.0028	0.0127	5.7	14.8	0.0031	1.4
1440.00	22.3	1.0049	1.0018	0.0129	4.9	15.0	0.0013	0.9

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**Fractional Components**

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Gravel/Sand based on #4

Sand/Fines based on #200

% COBBLES =                    % GRAVEL = 62.6    (% coarse = 28.0    % fine = 34.6)

% SAND = 31.5    (% coarse = 12.1    % medium = 14.7    % fine = 4.7)

% SILT = 4.2            % CLAY = 1.7

D<sub>85</sub>= 28.86    D<sub>60</sub>= 12.96    D<sub>50</sub>= 9.42

D<sub>30</sub>= 2.83    D<sub>15</sub>= 0.78    D<sub>10</sub>= 0.38

C<sub>c</sub>= 1.6247    C<sub>u</sub>= 34.0998

# Data Input for Index Properties

(Maximum Unit Weight / Minimum Porosity)

Project Name: MLC Moraine      Sample ID: SPG-1  
 DLZ Project Number: 1021-4505.18      Depth: 10.0'-12.0'  
 Client: Arcadis      Date: 4/8/2011  
 Client Project ID: OH000294.0018.00007

Moisture Content Data	
Wet Wt. & Cont (g)	939.60
Dry Wt. & Cont (g)	920.00
Wt. Cont (g)	281.61
Wt. Water (g)	19.60
Dry Wt. Soil (g)	638.39
Moisture Content (%)	3.1

Specific Gravity (G)= 2.75  
 Total Weight of Sample (Wt) wet = 657.99

Diameters			
D <sub>1</sub>	1.990	D <sub>4</sub>	1.968
D <sub>2</sub>	2.002	D <sub>5</sub>	1.963
D <sub>3</sub>	1.992	D <sub>6</sub>	1.985

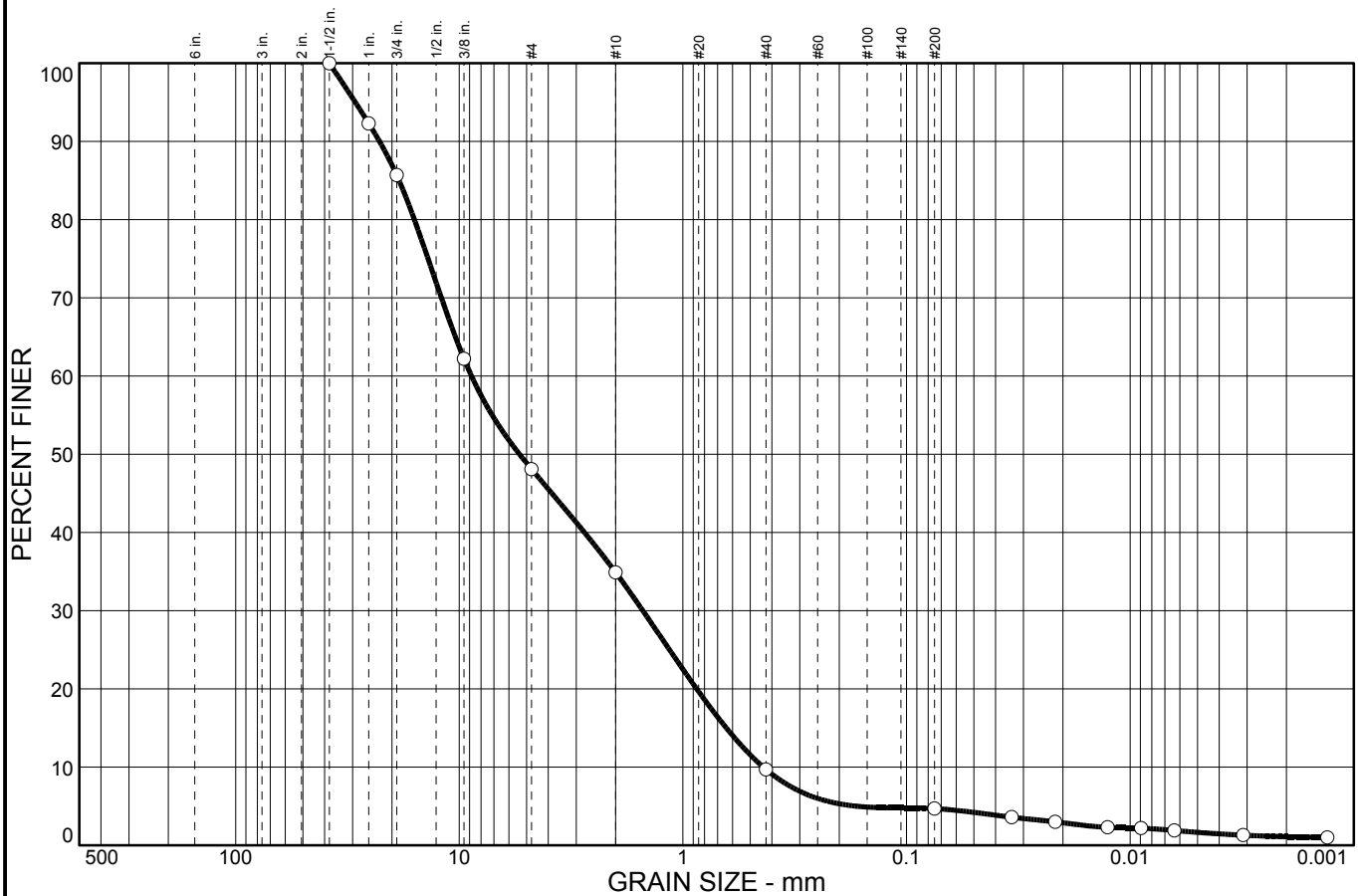
Avg. Diameter 1.983 in.

Lengths			
L <sub>1</sub>	6.493	L <sub>4</sub>	
L <sub>2</sub>	6.454	L <sub>5</sub>	
L <sub>3</sub>	6.397	L <sub>6</sub>	

Avg. Length 6.448 in.

Volume & Weights	Densities & Unit Weights
Volume of Sample <u>0.0115282</u> ft <sup>3</sup>	Wet Unit Weight ( $\gamma_T$ ) = <u>125.83</u> lb/ft <sup>3</sup>
Moisture <u>3.1</u> %	Bulk Density (dry)( $\gamma_d$ )= <u>122.08</u> lb/ft <sup>3</sup>
Mass of Dry Soil <u>638.4</u> g	Saturated unit Weight ( $\gamma_{SAT}$ )= <u>140.09</u> lb/ft <sup>3</sup>
Mass of Water <u>19.60</u> g	Submerged Unit Wt ( $\gamma_{SUB}$ )= <u>77.69</u> lb/ft <sup>3</sup>
Volume of Water <u>0.0006925</u> ft <sup>3</sup>	Degree of Saturation (S)= <u>20.817</u> %
Volume of Solids <u>0.0082017</u> ft <sup>3</sup>	
Volume of air <u>0.00263401</u> ft <sup>3</sup>	
Volume of Voids <u>0.0033265</u> ft <sup>3</sup>	
Porosity (n)= <u>0.2885521</u>	
Void Ratio (e)= <u>0.4055843</u>	
Volumetric Water <u>6.0</u> %	
Volumetric Air <u>22.8483753</u> %	

# PARTICLE SIZE DISTRIBUTION TEST REPORT



% COBBLES	% GRAVEL		% SAND			% FINES	
	CRS.	FINE	CRS.	MEDIUM	FINE	SILT	CLAY
0.0	14.3	37.6	13.2	25.2	5.0	3.0	1.7

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
1.50 in.	100.0		
1.00 in.	92.3		
0.75 in.	85.7		
0.375 in.	62.2		
#4	48.1		
#10	34.9		
#40	9.7		
#200	4.7		

**Soil Description**

Poorly graded gravel with sand

**Atterberg Limits**

PL= NP      LL= NP      PI= NP

**Coefficients**

D<sub>85</sub>= 18.6      D<sub>60</sub>= 8.82      D<sub>50</sub>= 5.38  
D<sub>30</sub>= 1.51      D<sub>15</sub>= 0.640      D<sub>10</sub>= 0.437  
C<sub>u</sub>= 20.16      C<sub>c</sub>= 0.59

**Classification**

USCS= GP      AASHTO= A-1-a

**Remarks**

Moisture Content= 2.8%  
Specific Gravity= 2.79

\* (no specification provided)

**Sample No.:** SPG-1 (2" Liner)  
**Location:**

**Source of Sample:** SPG-1

**Date:** 4/11/2011  
**Elev./Depth:** 12.0'-14.0'



**Client:** Arcadis  
**Project:** MLC Moraine (OH000294.0018.00007)  
Test Methods: ASTM D-421, D-422, D-854, D-2216, D-4318  
**Project No.:** 1021-4505.18      **Figure**

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**GRAIN SIZE DISTRIBUTION TEST DATA**

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**Client:** Arcadis  
**Project:** MLC Moraine (OH000294.0018.00007)  
Test Methods: ASTM D-421, D-422, D-854, D-2216, D-4318  
**Project Number:** 1021-4505.18

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**Sample Data**

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**Source:** SPG-1  
**Sample No.:** SPG-1 (2" Liner)  
**Elev. or Depth:** 12.0'-14.0' **Sample Length(in./cm.):**  
**Location:**  
**Description:** Poorly graded gravel with sand  
**Date:** 4/11/2011 **PL:** NP **LL:** NP **PI:** NP  
**USCS Classification:** GP **AASHTO Classification:** A-1-a  
**Testing Remarks:** Moisture Content= 2.8%  
Specific Gravity= 2.79

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**Mechanical Analysis Data**

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**Initial**

**Dry sample and tare=** 1274.20  
**Tare** = 279.79  
**Dry sample weight** = 994.41  
**Sample split on number 10 sieve**  
**Split sample data:**  
Sample and tare = 101.72 Tare = .00 Sample weight = 101.72

**Sieve tare method**

Sieve	Weight retained	Sieve tare	Percent finer
1.50 inch	0.00	0.00	100.0
1.00 inch	76.93	0.00	92.3
0.75 inch	65.52	0.00	85.7
0.375 inch	233.71	0.00	62.2
# 4	140.17	0.00	48.1
# 10	130.55	0.00	34.9
# 40	73.41	0.00	9.7
# 200	14.56	0.00	4.7

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**Hydrometer Analysis Data**

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**Separation sieve is #10**  
**Percent -#10 based upon complete sample=** 34.9  
**Weight of hydrometer sample:** 101.72  
**Calculated biased weight=** 291.46  
**Automatic temperature correction**  
Composite correction at 20 deg C = -3.4

**Meniscus correction only=**  
**Specific gravity of solids=** 2.79  
**Hydrometer type:** 151H  
Effective depth L= 16.294964 - 0.2645 x Rm

Elapsed time, min	Temp, deg C	Actual reading	Corrected reading	K	Rm	Eff. depth	Diameter mm	Percent finer
2.00	20.9	1.0101	1.0068	0.0130	10.1	13.6	0.0338	3.6
5.00	20.9	1.0090	1.0057	0.0130	9.0	13.9	0.0216	3.0
15.00	21.1	1.0076	1.0043	0.0129	7.6	14.3	0.0126	2.3

Elapsed time, min	Temp, Actual deg C	Actual reading	Corrected reading	K	Rm	Eff. depth	Diameter mm	Percent finer
30.00	21.2	1.0073	1.0040	0.0129	7.3	14.4	0.0089	2.2
60.00	21.4	1.0067	1.0035	0.0129	6.7	14.5	0.0063	1.9
250.00	21.8	1.0056	1.0024	0.0128	5.6	14.8	0.0031	1.3
1440.00	21.2	1.0052	1.0019	0.0129	5.2	14.9	0.0013	1.0

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**Fractional Components**

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Gravel/Sand based on #4

Sand/Fines based on #200

% COBBLES =                    % GRAVEL = 51.9    (% coarse = 14.3    % fine = 37.6)

% SAND = 43.4    (% coarse = 13.2    % medium = 25.2    % fine = 5.0)

% SILT = 3.0            % CLAY = 1.7

D<sub>85</sub>= 18.59    D<sub>60</sub>= 8.82    D<sub>50</sub>= 5.38

D<sub>30</sub>= 1.51    D<sub>15</sub>= 0.64    D<sub>10</sub>= 0.44

C<sub>c</sub>= 0.5923    C<sub>u</sub>= 20.1615

# Data Input for Index Properties

(Maximum Unit Weight / Minimum Porosity)

Project Name: MLC Moraine      Sample ID: SPG-1  
 DLZ Project Number: 1021-4505.18      Depth: 12.0'-14.0'  
 Client: Arcadis      Date: 4/8/2011  
 Client Project ID: OH000294.0018.00007

Moisture Content Data	
Wet Wt. & Cont (g)	1301.70
Dry Wt. & Cont (g)	1274.20
Wt. Cont (g)	279.79
Wt. Water (g)	27.50
Dry Wt. Soil (g)	994.41
Moisture Content (%)	2.8

Specific Gravity (G)= 2.79  
 Total Weight of Sample (Wt) wet = 1021.91

Diameters	
D <sub>1</sub>	1.972
D <sub>2</sub>	1.986
D <sub>3</sub>	1.973
D <sub>4</sub>	1.956
D <sub>5</sub>	1.967
D <sub>6</sub>	1.982

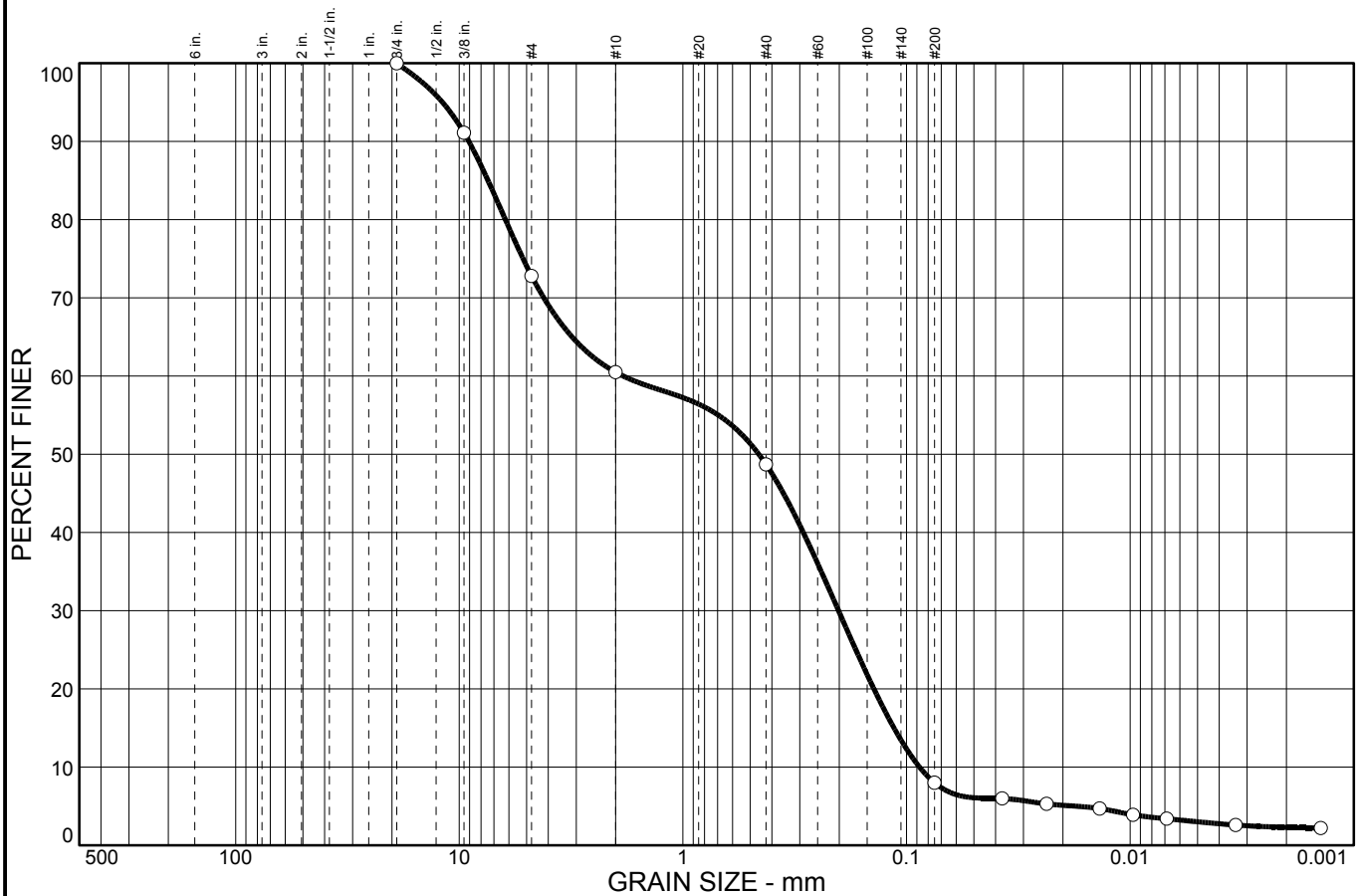
Avg. Diameter 1.973 in.

Lengths	
L <sub>1</sub>	10.092
L <sub>2</sub>	10.156
L <sub>3</sub>	10.338
L <sub>4</sub>	
L <sub>5</sub>	
L <sub>6</sub>	

Avg. Length 10.195 in.

Volume & Weights	Densities & Unit Weights
Volume of Sample <u>0.0180324</u> ft <sup>3</sup>	Wet Unit Weight ( $\gamma_T$ ) = <u>124.94</u> lb/ft <sup>3</sup>
Moisture <u>2.8</u> %	Bulk Density (dry)( $\gamma_d$ )= <u>121.58</u> lb/ft <sup>3</sup>
Mass of Dry Soil <u>994.4</u> g	Saturated unit Weight ( $\gamma_{SAT}$ )= <u>140.40</u> lb/ft <sup>3</sup>
Mass of Water <u>27.50</u> g	Submerged Unit Wt ( $\gamma_{SUB}$ )= <u>78.00</u> lb/ft <sup>3</sup>
Volume of Water <u>0.0009716</u> ft <sup>3</sup>	Degree of Saturation (S)= <u>17.860</u> %
Volume of Solids <u>0.0125925</u> ft <sup>3</sup>	
Volume of air <u>0.00446831</u> ft <sup>3</sup>	
Volume of Voids <u>0.0054399</u> ft <sup>3</sup>	
Porosity (n)= <u>0.3016734</u>	
Void Ratio (e)= <u>0.4319947</u>	
Volumetric Water <u>5.4</u> %	
Volumetric Air <u>24.7793074</u> %	

# PARTICLE SIZE DISTRIBUTION TEST REPORT



% COBBLES	% GRAVEL		% SAND			% FINES	
	CRS.	FINE	CRS.	MEDIUM	FINE	SILT	CLAY
0.0	0.0	27.2	12.3	11.8	40.7	5.0	3.0

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
0.75 in.	100.0		
0.375 in.	91.1		
#4	72.8		
#10	60.5		
#40	48.7		
#200	8.0		

**Soil Description**

Poorly graded sand with silt and gravel

**Atterberg Limits**

PL= NP      LL= NP      PI= NP

**Coefficients**

D<sub>85</sub>= 7.44      D<sub>60</sub>= 1.85      D<sub>50</sub>= 0.458  
D<sub>30</sub>= 0.201      D<sub>15</sub>= 0.114      D<sub>10</sub>= 0.0875  
C<sub>u</sub>= 21.12      C<sub>c</sub>= 0.25

**Classification**

USCS= SP-SM      AASHTO= A-1-b

**Remarks**

Moisture Content= 5.9%

\* (no specification provided)

**Sample No.:** SPG-8 (bag)  
**Location:**

**Source of Sample:** SPG-8

**Date:** 4/8/2011  
**Elev./Depth:** 6.0'-8.0'



**Client:** Arcadis  
**Project:** MLC Moraine (OH000294.0018.00007)  
Test Methods: ASTM D-421, D-422, D-854, D-2216, D-4318  
**Project No.:** 1021-4505.18      **Figure**



Elapsed time, min	Temp, deg C	Actual reading	Corrected reading	K	Rm	Eff. depth	Diameter mm	Percent finer
1440.00	18.2	1.0048	1.0011	0.0138	4.8	15.0	0.0014	2.2

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**Fractional Components**

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Gravel/Sand based on #4

Sand/Fines based on #200

% COBBLES =                    % GRAVEL = 27.2    (% coarse =                    % fine = 27.2)

% SAND = 64.8    (% coarse = 12.3    % medium = 11.8    % fine = 40.7)

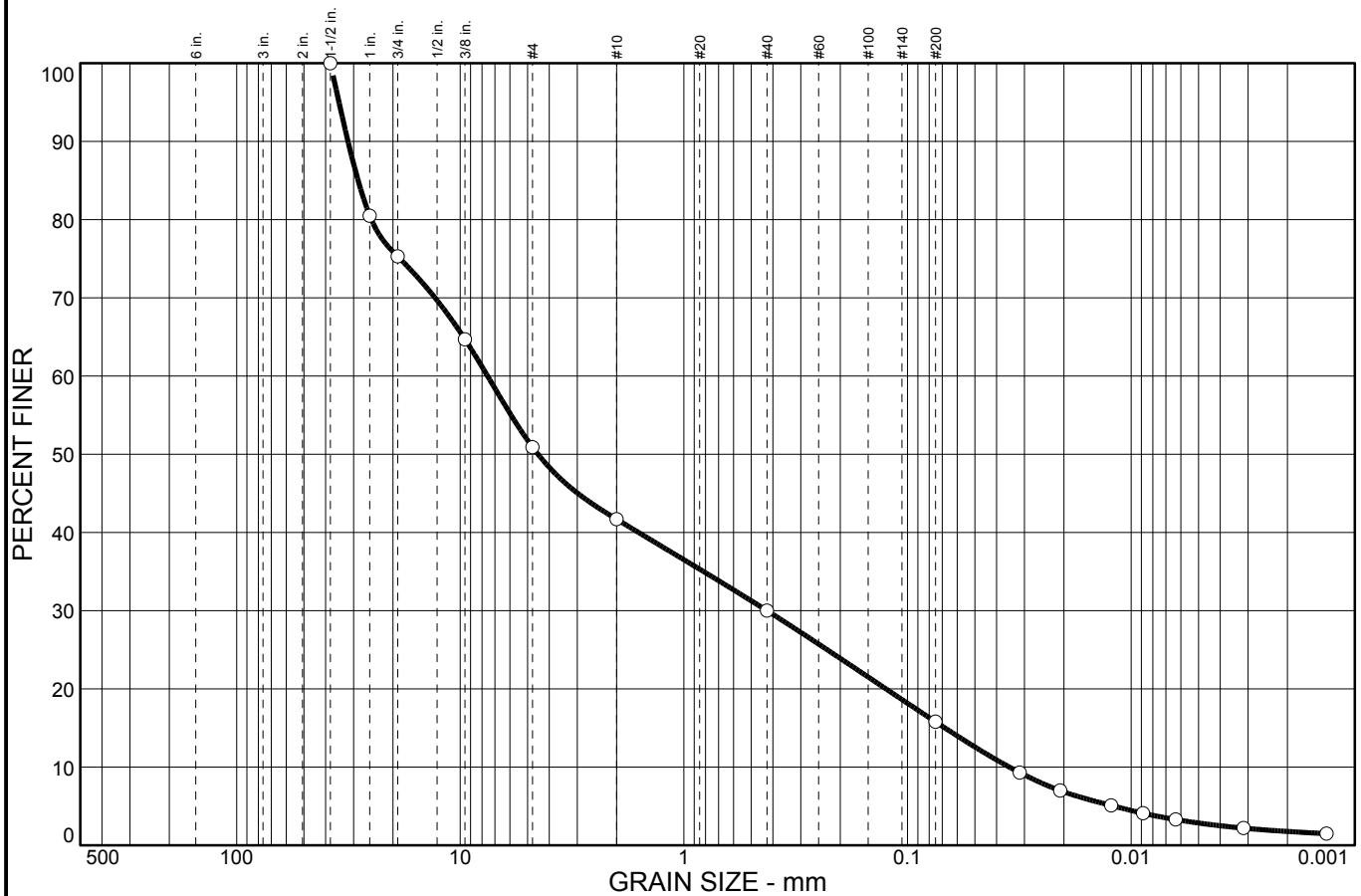
% SILT = 5.0            % CLAY = 3.0

D<sub>85</sub>= 7.44    D<sub>60</sub>= 1.85    D<sub>50</sub>= 0.46

D<sub>30</sub>= 0.20    D<sub>15</sub>= 0.11    D<sub>10</sub>= 0.09

C<sub>c</sub>= 0.2509    C<sub>u</sub>= 21.1184

# PARTICLE SIZE DISTRIBUTION TEST REPORT



% COBBLES	% GRAVEL		% SAND			% FINES	
	CRS.	FINE	CRS.	MEDIUM	FINE	SILT	CLAY
0.0	24.7	24.4	9.2	11.7	14.2	12.9	2.9

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
1.50 in.	100.0		
1.00 in.	80.5		
0.75 in.	75.3		
0.375 in.	64.7		
#4	50.9		
#10	41.7		
#40	30.0		
#200	15.8		

**Soil Description**

Silty gravel with sand

**Atterberg Limits**

PL= NP      LL= NP      PI= NP

**Coefficients**

D<sub>85</sub>= 28.6      D<sub>60</sub>= 7.55      D<sub>50</sub>= 4.49  
D<sub>30</sub>= 0.425      D<sub>15</sub>= 0.0680      D<sub>10</sub>= 0.0350  
C<sub>u</sub>= 215.49      C<sub>c</sub>= 0.68

**Classification**

USCS= GM      AASHTO= A-1-b

**Remarks**

Moisture Content= 6.5%  
Specific Gravity= 2.77

\* (no specification provided)

**Sample No.:** SPG-8 (3" tube)  
**Location:**

**Source of Sample:** SPG-8

**Date:** 4/10/2011  
**Elev./Depth:** 8.0'-10.0'



**Client:** Arcadis  
**Project:** MLC Moraine (OH000294.0018.00007)  
Test Methods: ASTM D-421, D-422, D-854, D-2216, D-4318  
**Project No.:** 1021-4505.18      **Figure**



Elapsed time, min	Temp, deg C	Actual reading	Corrected reading	K	Rm	Eff. depth	Diameter mm	Percent finer
30.00	20.5	1.0099	1.0065	0.0131	9.9	13.7	0.0088	4.1
60.00	20.6	1.0087	1.0054	0.0131	8.7	14.0	0.0063	3.3
250.00	20.8	1.0068	1.0035	0.0130	6.8	14.5	0.0031	2.2
1440.00	19.8	1.0058	1.0023	0.0132	5.8	14.8	0.0013	1.5

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**Fractional Components**

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Gravel/Sand based on #4

Sand/Fines based on #200

% COBBLES =                    % GRAVEL = 49.1    (% coarse = 24.7    % fine = 24.4)

% SAND = 35.1    (% coarse = 9.2        % medium = 11.7    % fine = 14.2)

% SILT = 12.9        % CLAY = 2.9

D<sub>85</sub>= 28.64    D<sub>60</sub>= 7.55    D<sub>50</sub>= 4.49

D<sub>30</sub>= 0.43    D<sub>15</sub>= 0.07    D<sub>10</sub>= 0.04

C<sub>c</sub>= 0.6829    C<sub>u</sub>= 215.4892

# Data Input for Index Properties

(Maximum Unit Weight / Minimum Porosity)

Project Name: MLC Moraine      Sample ID: SPG-8  
 DLZ Project Number: 1021-4505.18      Depth: 8.0'-10.0'  
 Client: Arcadis      Date: 4/8/2011  
 Client Project ID: OH000294.0018.00007

Moisture Content Data	
Wet Wt. & Cont (g)	8017.20
Dry Wt. & Cont (g)	7740.50
Wt. Cont (g)	3454.10
Wt. Water (g)	276.70
Dry Wt. Soil (g)	4286.40
Moisture Content (%)	6.5

Specific Gravity (G)= 2.77  
 Total Weight of Sample (Wt) wet = 5567.82

Diameters	
D <sub>1</sub>	<u>2.832</u>
D <sub>2</sub>	<u>2.848</u>
D <sub>3</sub>	<u>2.849</u>
D <sub>4</sub>	<u>2.867</u>
D <sub>5</sub>	<u>2.869</u>
D <sub>6</sub>	<u>2.857</u>

Avg. Diameter 2.854 in.

Lengths	
L <sub>1</sub>	<u>25.938</u>
L <sub>2</sub>	<u>25.937</u>
L <sub>3</sub>	<u>25.969</u>
L <sub>4</sub>	<u> </u>
L <sub>5</sub>	<u> </u>
L <sub>6</sub>	<u> </u>

Avg. Length 25.948 in.

Volume & Weights
Volume of Sample <u>0.0960409</u> ft <sup>3</sup>
Moisture <u>6.5</u> %
Mass of Dry Soil <u>5230.2</u> g
Mass of Water <u>337.62</u> g
Volume of Water <u>0.0119285</u> ft <sup>3</sup>
Volume of Solids <u>0.0667099</u> ft <sup>3</sup>
Volume of air <u>0.01740251</u> ft <sup>3</sup>
Volume of Voids <u>0.0293310</u> ft <sup>3</sup>
Porosity (n)= <u>0.3054014</u>
Void Ratio (e)= <u>0.4396804</u>
Volumetric Water <u>12.4</u> %
Volumetric Air <u>18.1198934</u> %

Densities & Unit Weights
Wet Unit Weight (γ <sub>T</sub> ) = <u>127.81</u> lb/ft <sup>3</sup>
Bulk Density (dry)(γ <sub>d</sub> )= <u>120.06</u> lb/ft <sup>3</sup>
Saturated unit Weight (γ <sub>SAT</sub> )= <u>139.12</u> lb/ft <sup>3</sup>
Submerged Unit Wt (γ <sub>SUB</sub> )= <u>76.72</u> lb/ft <sup>3</sup>
Degree of Saturation (S)= <u>40.669</u> %

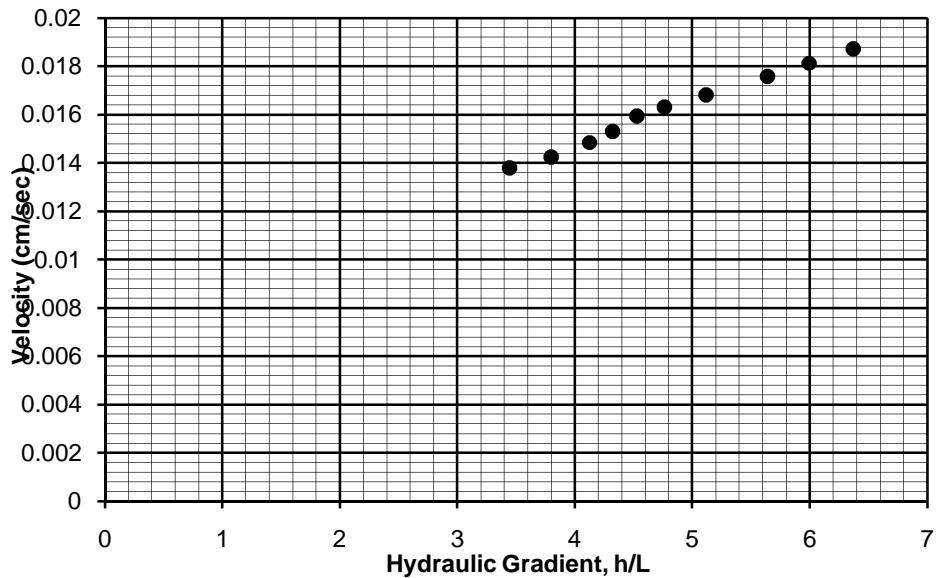
# Constant Head Permeability Test Report

ASTM D 2434

Boring: SPG-8  
 Sample:  
 Depth: 8.0'-10.0'

Grain Size Distribution	%
Aggregate:	49.1
Coarse Sand:	9.2
Med. Sand:	11.7
Fine Sand:	14.2
Silt:	12.9
Clay: (5 micron)	2.9

Permeant Liquid  
 De-aired, deionized water



Diameter (cm)	Area, A (cm <sup>2</sup> )	Length (cm)	Moisture (%)	Dry Density (pcf)	Void Ratio	Specific Gravity
7.610	45.48	15.900	0.0	112.1	0.54	2.77

Trial	Manometers		Head h (cm)	Flow Q (cm <sup>3</sup> )	Time t (sec)	Temp. (°C)	Velocity Q/At	Gradient h/L	Permeability k <sub>20°C</sub> (cm/sec)
	H <sub>1</sub>	H <sub>2</sub>							
1	33.4	7.0	26.4	112.9	180	15.4	1.38E-02	3.45E+00	4.47E-03
2	37.3	8.2	29.1	116.6	180	14.6	1.42E-02	3.80E+00	4.26E-03
3	41.1	9.5	31.6	121.5	180	14.6	1.48E-02	4.13E+00	4.09E-03
4	43.6	10.5	33.1	125.3	180	13.8	1.53E-02	4.32E+00	4.10E-03
5	47.0	12.3	34.7	130.5	180	13.0	1.59E-02	4.53E+00	4.14E-03
6	50.9	14.4	36.5	133.6	180	12.2	1.63E-02	4.77E+00	4.10E-03
7	54.2	15.0	39.2	137.7	180	12.2	1.68E-02	5.12E+00	3.93E-03
8	61.9	18.7	43.2	144.0	180	12.2	1.76E-02	5.64E+00	3.73E-03
9	65.3	19.4	45.9	148.4	180	12.2	1.81E-02	5.99E+00	3.62E-03
10	70.4	21.6	48.8	153.3	180	12.2	1.87E-02	6.37E+00	3.51E-03

$k_{20°C} = R_T \times QL/At = 3.99E-03 \text{ cm/sec}$

L - Distance between manometers = 7.66 cm  
 R<sub>T</sub> - Temperature correction factor

Remarks:  
 Sample was passed over a 3/4 inch sieve to remove oversized particles. Clay is considered to be 5 micron.



Client: Arcadis  
 Project: MLC Moraine (OH000924-0018.00007)  
 Job No: 1021-4505.18





Elapsed time, min	Temp, Actual deg C	Actual reading	Corrected reading	K	Rm	Eff. depth	Diameter mm	Percent finer
30.00	20.4	1.0078	1.0044	0.0130	7.8	14.2	0.0090	2.7
60.00	20.7	1.0070	1.0037	0.0130	7.0	14.4	0.0064	2.3
250.00	21.8	1.0056	1.0024	0.0128	5.6	14.8	0.0031	1.5
1440.00	21.4	1.0049	1.0017	0.0128	4.9	15.0	0.0013	1.0

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**Fractional Components**

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Gravel/Sand based on #4

Sand/Fines based on #200

% COBBLES =                    % GRAVEL = 55.7    (% coarse = 25.6    % fine = 30.1)

% SAND = 37.3    (% coarse = 7.9    % medium = 20.7    % fine = 8.7)

% SILT = 5.0            % CLAY = 2.0

D<sub>85</sub>= 27.30    D<sub>60</sub>= 11.75    D<sub>50</sub>= 7.63

D<sub>30</sub>= 1.22    D<sub>15</sub>= 0.40    D<sub>10</sub>= 0.20

C<sub>c</sub>= 0.639    C<sub>u</sub>= 59.4144

# Data Input for Index Properties

(Maximum Unit Weight / Minimum Porosity)

Project Name: MLC Moraine      Sample ID: SPG-8  
 DLZ Project Number: 1021-4505.18      Depth: 10.0'-12.0'  
 Client: Arcadis      Date: 4/8/2011  
 Client Project ID: OH000294.0018.00007

Moisture Content Data	
Wet Wt. & Cont (g)	1142.40
Dry Wt. & Cont (g)	1114.00
Wt. Cont (g)	320.21
Wt. Water (g)	28.40
Dry Wt. Soil (g)	793.79
Moisture Content (%)	3.6

Specific Gravity (G)= 2.80

Total Weight of Sample (Wt) wet = 5570.10

### Diameters

D <sub>1</sub>	2.865	D <sub>4</sub>	2.858
D <sub>2</sub>	2.842	D <sub>5</sub>	2.852
D <sub>3</sub>	2.758	D <sub>6</sub>	2.862

Avg. Diameter 2.840 in.

### Lengths

L <sub>1</sub>	25.269	L <sub>4</sub>	
L <sub>2</sub>	25.404	L <sub>5</sub>	
L <sub>3</sub>	25.033	L <sub>6</sub>	

Avg. Length 25.235 in.

### Volume & Weights

Volume of Sample 0.0924780 ft<sup>3</sup>  
 Moisture 3.6 %  
 Mass of Dry Soil 5377.7 g  
 Mass of Water 192.40 g  
 Volume of Water 0.0067977 ft<sup>3</sup>  
 Volume of Solids 0.0678563 ft<sup>3</sup>  
 Volume of air 0.01782402 ft<sup>3</sup>  
 Volume of Voids 0.0246217 ft<sup>3</sup>  
 Porosity (n)= 0.2662438  
 Void Ratio (e)= 0.3628506  
 Volumetric Water 7.4 %  
 Volumetric Air 19.2737879 %

### Densities & Unit Weights

Wet Unit Weight ( $\gamma_T$ ) = 132.79 lb/ft<sup>3</sup>  
 Bulk Density (dry)( $\gamma_d$ )= 128.20 lb/ft<sup>3</sup>  
 Saturated unit Weight ( $\gamma_{SAT}$ )= 144.82 lb/ft<sup>3</sup>  
 Submerged Unit Wt ( $\gamma_{SUB}$ )= 82.42 lb/ft<sup>3</sup>  
 Degree of Saturation (S)= 27.609 %

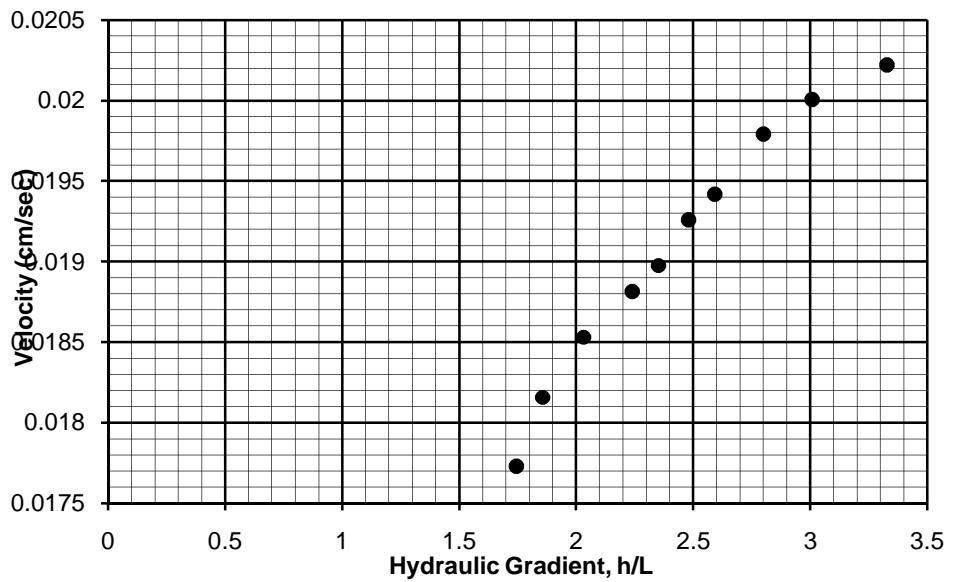
# Constant Head Permeability Test Report

ASTM D 2434

**Boring:** SPG-8  
**Sample:**  
**Depth:** 10.0'-12.0'

Grain Size Distribution	%
Aggregate:	55.7
Coarse Sand:	7.9
Med. Sand:	20.7
Fine Sand:	8.7
Silt:	5.0
Clay: (5 Micron)	2.0

**Permeant Liquid**  
De-aired, deionized water



Diameter (cm)	Area, A (cm <sup>2</sup> )	Length (cm)	Moisture (%)	Dry Density (pcf)	Void Ratio	Specific Gravity
6.307	31.24	15.682	0.0	116.5	0.50	2.80

Trial	Manometers		Head h (cm)	Flow Q (cm <sup>3</sup> )	Time t (sec)	Temp. (°C)	Velocity Q/At	Gradient h/L	Permeability k <sub>20°C</sub> (cm/sec)
	H <sub>1</sub>	H <sub>2</sub>							
1	27.6	16.7	10.9	99.7	180	14.8	1.77E-02	1.74E+00	1.15E-02
2	30.5	18.9	11.6	102.1	180	14.2	1.82E-02	1.86E+00	1.12E-02
3	34.2	21.5	12.7	104.2	180	14.0	1.85E-02	2.03E+00	1.05E-02
4	37.8	23.8	14.0	105.8	180	14.0	1.88E-02	2.24E+00	9.67E-03
5	41.0	26.3	14.7	106.7	180	13.6	1.90E-02	2.35E+00	9.37E-03
6	43.5	28.0	15.5	108.3	180	13.3	1.93E-02	2.48E+00	9.08E-03
7	46.4	30.2	16.2	109.2	180	12.8	1.94E-02	2.59E+00	8.85E-03
8	49.4	31.9	17.5	111.3	180	12.2	1.98E-02	2.80E+00	8.45E-03
9	52.1	33.3	18.8	112.5	180	12.0	2.00E-02	3.01E+00	7.99E-03
10	55.3	34.5	20.8	113.7	180	11.6	2.02E-02	3.33E+00	7.36E-03

$k_{20°C} = R_T \times QL/At = 9.40E-03 \text{ cm/sec}$

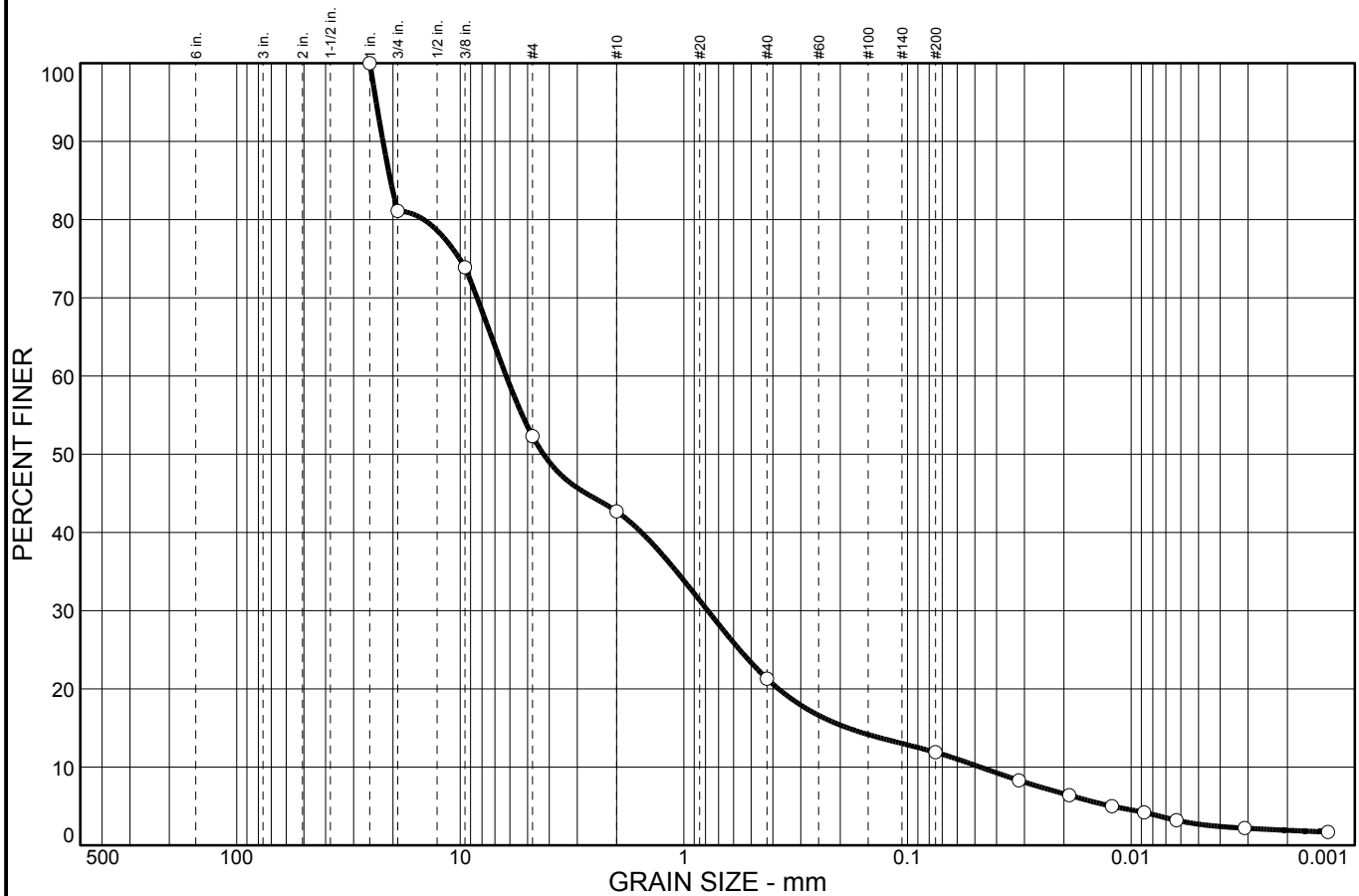
L - Distance between manometers = 6.25 cm  
R<sub>T</sub> - Temperature correction factor

**Remarks:**  
Sample was passed over a 3/4 inch sieve to remove oversized particles. Clay is considered to be 5 micron.



**Client:** Arcadis  
**Project:** MLC Moraine (OH000924-0018.00007)  
**Job No:** 1021-4505.18

# PARTICLE SIZE DISTRIBUTION TEST REPORT



% COBBLES	% GRAVEL		% SAND			% FINES	
	CRS.	FINE	CRS.	MEDIUM	FINE	SILT	CLAY
0.0	18.9	28.8	9.6	21.4	9.4	9.2	2.7

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
1.00 in.	100.0		
0.75 in.	81.1		
0.375 in.	73.9		
#4	52.3		
#10	42.7		
#40	21.3		
#200	11.9		

**Soil Description**

Well-graded gravel with silt and sand

**Atterberg Limits**

PL= NP      LL= NP      PI= NP

**Coefficients**

D<sub>85</sub>= 20.5      D<sub>60</sub>= 6.23      D<sub>50</sub>= 4.24  
D<sub>30</sub>= 0.782      D<sub>15</sub>= 0.184      D<sub>10</sub>= 0.0473  
C<sub>u</sub>= 131.91      C<sub>c</sub>= 2.08

**Classification**

USCS= GW-GM      AASHTO= A-1-a

**Remarks**

Moisture Content= 3.8%  
Specific Gravity= 2.76

\* (no specification provided)

**Sample No.:** SPG-8 (3" tube)  
**Location:**

**Source of Sample:** SPG-8

**Date:** 4/14/2011  
**Elev./Depth:** 12.0'-14.0'



**Client:** Arcadis  
**Project:** MLC Moraine (OH000294.0018.00007)  
Test Methods: ASTM D-421, D-422, D-854, D-2216, D-4318  
**Project No.:** 1021-4505.18      **Figure**



Elapsed time, min	Temp, Actual deg C	Actual reading	Corrected reading	K	Rm	Eff. depth	Diameter mm	Percent finer
60.00	22.0	1.0080	1.0049	0.0129	8.0	14.2	0.0063	3.2
250.00	22.2	1.0065	1.0034	0.0129	6.5	14.6	0.0031	2.2
1443.00	21.1	1.0059	1.0026	0.0130	5.9	14.7	0.0013	1.7

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**Fractional Components**

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Gravel/Sand based on #4

Sand/Fines based on #200

% COBBLES =                    % GRAVEL = 47.7    (% coarse = 18.9    % fine = 28.8)

% SAND = 40.4    (% coarse = 9.6        % medium = 21.4    % fine = 9.4)

% SILT = 9.2            % CLAY = 2.7

D<sub>85</sub> = 20.51    D<sub>60</sub> = 6.23    D<sub>50</sub> = 4.24

D<sub>30</sub> = 0.78    D<sub>15</sub> = 0.18    D<sub>10</sub> = 0.05

C<sub>c</sub> = 2.0783    C<sub>u</sub> = 131.9114

# Data Input for Index Properties

(Maximum Unit Weight / Minimum Porosity)

Project Name: MLC Moraine      Sample ID: SPG-8  
 DLZ Project Number: 1021-4505.18      Depth: 12.0'-14.0'  
 Client: Arcadis      Date: 4/8/2011  
 Client Project ID: OH000294.0018.00007

Moisture Content Data	
Wet Wt. & Cont (g)	5992.00
Dry Wt. & Cont (g)	5818.00
Wt. Cont (g)	1230.00
Wt. Water (g)	174.00
Dry Wt. Soil (g)	4588.00
Moisture Content (%)	3.8

Specific Gravity (G)= 2.76  
 Total Weight of Sample (Wt) wet = 4762.00

Diameters	
D <sub>1</sub> <u>2.864</u>	D <sub>4</sub> <u>2.862</u>
D <sub>2</sub> <u>2.843</u>	D <sub>5</sub> <u>2.868</u>
D <sub>3</sub> <u>2.866</u>	D <sub>6</sub> <u>2.863</u>

Avg. Diameter 2.861 in.

Lengths	
L <sub>1</sub> <u>19.832</u>	L <sub>4</sub> <u>          </u>
L <sub>2</sub> <u>20.621</u>	L <sub>5</sub> <u>          </u>
L <sub>3</sub> <u>20.679</u>	L <sub>6</sub> <u>          </u>

Avg. Length 20.377 in.

Volume & Weights
Volume of Sample <u>0.0758104</u> ft <sup>3</sup>
Moisture <u>3.8</u> %
Mass of Dry Soil <u>4588.0</u> g
Mass of Water <u>174.00</u> g
Volume of Water <u>0.0061475</u> ft <sup>3</sup>
Volume of Solids <u>0.0587308</u> ft <sup>3</sup>
Volume of air <u>0.01093202</u> ft <sup>3</sup>
Volume of Voids <u>0.0170796</u> ft <sup>3</sup>
Porosity (n)= <u>0.2252931</u>
Void Ratio (e)= <u>0.2908108</u>
Volumetric Water <u>8.1</u> %
Volumetric Air <u>14.4202157</u> %

Densities & Unit Weights
Wet Unit Weight (γ <sub>T</sub> ) = <u>138.48</u> lb/ft <sup>3</sup>
Bulk Density (dry)(γ <sub>d</sub> )= <u>133.42</u> lb/ft <sup>3</sup>
Saturated unit Weight (γ <sub>SAT</sub> )= <u>147.48</u> lb/ft <sup>3</sup>
Submerged Unit Wt (γ <sub>SUB</sub> )= <u>85.08</u> lb/ft <sup>3</sup>
Degree of Saturation (S)= <u>35.994</u> %

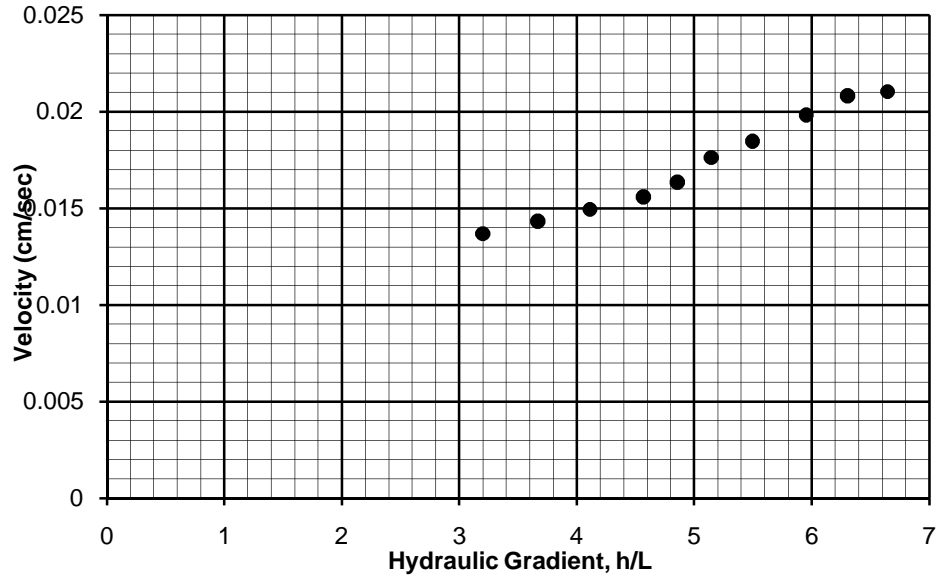
# Constant Head Permeability Test Report

ASTM D 2434

Boring: SPG-8  
 Sample:  
 Depth: 12.0'-14.0'

Grain Size Distribution	%
Aggregate:	47.7
Coarse Sand:	9.6
Med. Sand:	21.4
Fine Sand:	9.4
Silt:	9.2
Clay: (5 Micron)	2.7

Permeant Liquid  
 De-aired, deionized water



Diameter (cm)	Area, A (cm <sup>2</sup> )	Length (cm)	Moisture (%)	Dry Density (pcf)	Void Ratio	Specific Gravity
7.610	45.48	15.598	0.0	105.6	0.63	2.76

Trial	Manometers		Head h (cm)	Flow Q (cm <sup>3</sup> )	Time t (sec)	Temp. (°C)	Velocity Q/At	Gradient h/L	Permeability k <sub>20°C</sub> (cm/sec)
	H <sub>1</sub>	H <sub>2</sub>							
1	34.1	9.6	24.5	149.4	240	19.0	1.37E-02	3.20E+00	4.40E-03
2	38.6	10.5	28.1	156.3	240	17.8	1.43E-02	3.67E+00	4.13E-03
3	43.0	11.5	31.5	163.1	240	17.0	1.49E-02	4.11E+00	3.92E-03
4	47.4	12.4	35.0	170.1	240	16.0	1.56E-02	4.57E+00	3.76E-03
5	50.5	13.3	37.2	178.6	240	14.6	1.64E-02	4.86E+00	3.83E-03
6	53.4	14.0	39.4	144.3	180	13.6	1.76E-02	5.14E+00	3.98E-03
7	57.6	15.5	42.1	151.2	180	13.6	1.85E-02	5.50E+00	3.90E-03
8	62.0	16.4	45.6	162.3	180	12.6	1.98E-02	5.95E+00	3.95E-03
9	65.3	17.0	48.3	170.5	180	12.6	2.08E-02	6.31E+00	3.92E-03
10	69.3	18.4	50.9	172.2	180	12.4	2.10E-02	6.64E+00	3.77E-03

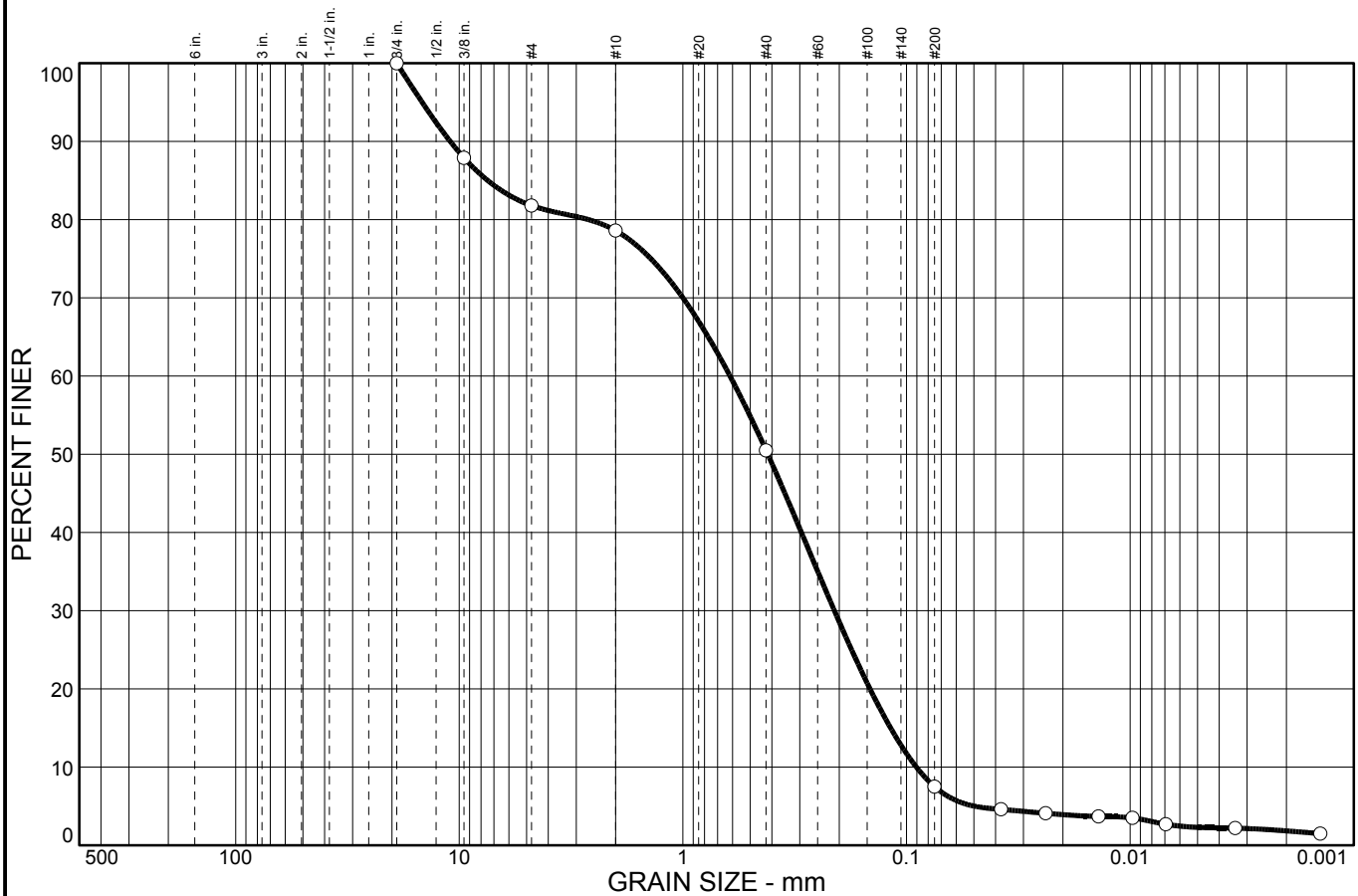
$k_{20°C} = R_T \times QL/At = 3.96E-03 \text{ cm/sec}$   
 L - Distance between manometers = 7.66 cm  
 R<sub>T</sub> - Temperature correction factor

Remarks:  
 Sample was passed over a 3/4 inch sieve to remove oversized particles. Clay is considered to be 5 micron.



Client: Arcadis  
 Project: MLC Moraine (OH000924-0018.00007)  
 Job No: 1021-4505.18

# PARTICLE SIZE DISTRIBUTION TEST REPORT



% COBBLES	% GRAVEL		% SAND			% FINES	
	CRS.	FINE	CRS.	MEDIUM	FINE	SILT	CLAY
0.0	0.0	18.2	3.2	28.1	43.0	5.2	2.3

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
0.75 in.	100.0		
0.375 in.	87.9		
#4	81.8		
#10	78.6		
#40	50.5		
#200	7.5		

**Soil Description**

Poorly graded sand with silt and gravel

**Atterberg Limits**

PL= NP      LL= NP      PI= NP

**Coefficients**

D<sub>85</sub>= 7.46      D<sub>60</sub>= 0.616      D<sub>50</sub>= 0.417  
D<sub>30</sub>= 0.210      D<sub>15</sub>= 0.118      D<sub>10</sub>= 0.0904  
C<sub>u</sub>= 6.81      C<sub>c</sub>= 0.79

**Classification**

USCS= SP-SM      AASHTO= A-1-b

**Remarks**

Moisture Content= 6.0%

\* (no specification provided)

**Sample No.:** SPG-11 (bag)  
**Location:**

**Source of Sample:** SPG-11

**Date:** 4/8/2011  
**Elev./Depth:** 6.0'-8.0'



**Client:** Arcadis  
**Project:** MLC Moraine (OH000294.0018.00007)  
 Test Methods: ASTM D-421, D-422, D-854, D-2216, D-4318  
**Project No.:** 1021-4505.18      **Figure**



Elapsed time, min	Temp, deg C	Actual reading	Corrected reading	K	Rm	Eff. depth	Diameter mm	Percent finer
1440.00	18.2	1.0042	1.0005	0.0138	4.2	15.2	0.0014	1.5

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**Fractional Components**

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Gravel/Sand based on #4

Sand/Fines based on #200

% COBBLES =                      % GRAVEL = 18.2    (% coarse =                      % fine = 18.2)

% SAND = 74.3    (% coarse = 3.2            % medium = 28.1            % fine = 43.0)

% SILT = 5.2            % CLAY = 2.3

D<sub>85</sub>= 7.46    D<sub>60</sub>= 0.62    D<sub>50</sub>= 0.42

D<sub>30</sub>= 0.21    D<sub>15</sub>= 0.12    D<sub>10</sub>= 0.09

C<sub>c</sub>= 0.794    C<sub>u</sub>= 6.8138



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**GRAIN SIZE DISTRIBUTION TEST DATA**

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**Client:** Arcadis  
**Project:** MLC Moraine (OH000294.0018.00007)  
Test Methods: ASTM D-421, D-422, D-854, D-2216, D-4318  
**Project Number:** 1021-4505.18

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**Sample Data**

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**Source:** SPG-11  
**Sample No.:** SPG-11 (3" tube)  
**Elev. or Depth:** 8.0'-10.0' **Sample Length(in./cm.):**  
**Location:**  
**Description:** Well-graded sand with silt and gravel  
**Date:** 4/10/2011 **PL:** NP **LL:** NP **PI:** NP  
**USCS Classification:** SW-SM **AASHTO Classification:** A-1-b  
**Testing Remarks:** Moisture Content= 5.8%

---

**Mechanical Analysis Data**

---

**Initial**

**Dry sample and tare=** 1273.70  
**Tare** = 327.52  
**Dry sample weight** = 946.18  
**Sample split on number 10 sieve**  
**Split sample data:**  
Sample and tare = 85.82 Tare = .00 Sample weight = 85.82

**Sieve tare method**

Sieve	Weight retained	Sieve tare	Percent finer
1.00 inch	0.00	0.00	100.0
0.75 inch	61.08	0.00	93.5
0.375 inch	129.27	0.00	79.9
# 4	67.05	0.00	72.8
# 10	43.55	0.00	68.2
# 40	43.64	0.00	33.5
# 200	32.81	0.00	7.4

---

**Hydrometer Analysis Data**

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**Separation sieve is** #10  
**Percent -#10 based upon complete sample=** 68.2  
**Weight of hydrometer sample:** 85.82  
**Calculated biased weight=** 125.84  
**Automatic temperature correction**  
Composite correction at 20 deg C = -3.4

**Meniscus correction only=**  
**Specific gravity of solids=** 2.71  
**Hydrometer type:** 151H  
Effective depth L= 16.294964 - 0.2645 x Rm

Elapsed time, min	Temp, deg C	Actual reading	Corrected reading	K	Rm	Eff. depth	Diameter mm	Percent finer
2.00	20.2	1.0068	1.0034	0.0134	6.8	14.5	0.0360	4.3
5.00	20.2	1.0060	1.0026	0.0134	6.0	14.7	0.0229	3.3
15.00	20.2	1.0055	1.0021	0.0134	5.5	14.8	0.0133	2.6
30.00	20.2	1.0053	1.0019	0.0134	5.3	14.9	0.0094	2.4
60.00	20.3	1.0050	1.0016	0.0134	5.0	15.0	0.0067	2.0

Elapsed time, min	Temp, deg C	Actual reading	Corrected reading	K	Rm	Eff. depth	Diameter mm	Percent finer
250.00	20.7	1.0048	1.0015	0.0133	4.8	15.0	0.0033	1.8
1440.00	19.6	1.0045	1.0010	0.0135	4.5	15.1	0.0014	1.3

---

**Fractional Components**

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Gravel/Sand based on #4

Sand/Fines based on #200

% COBBLES =                    % GRAVEL = 27.2    (% coarse = 6.5        % fine = 20.7)

% SAND = 65.4    (% coarse = 4.6        % medium = 34.7    % fine = 26.1)

% SILT = 5.6            % CLAY = 1.8

D<sub>85</sub>= 12.73    D<sub>60</sub>= 1.23    D<sub>50</sub>= 0.81

D<sub>30</sub>= 0.37    D<sub>15</sub>= 0.16    D<sub>10</sub>= 0.10

C<sub>c</sub>= 1.052    C<sub>u</sub>= 11.9094

# Data Input for Index Properties

(Maximum Unit Weight / Minimum Porosity)

Project Name: MLC Moraine      Sample ID: SPG-11  
 DLZ Project Number: 1021-4505.18      Depth: 8.0'-10.0'  
 Client: Arcadis      Date: 4/8/2011  
 Client Project ID: OH000294.0018.00007

Moisture Content Data	
Wet Wt. & Cont (g)	7872.10
Dry Wt. & Cont (g)	7717.80
Wt. Cont (g)	3497.20
Wt. Water (g)	154.30
Dry Wt. Soil (g)	4220.60
Moisture Content (%)	3.7

Specific Gravity (G)= 2.71

Total Weight of Sample (Wt) wet = 5384.10

### Diameters

D <sub>1</sub>	<u>2.853</u>	D <sub>4</sub>	<u>2.850</u>
D <sub>2</sub>	<u>2.850</u>	D <sub>5</sub>	<u>2.838</u>
D <sub>3</sub>	<u>2.829</u>	D <sub>6</sub>	<u>2.848</u>

Avg. Diameter 2.845 in.

### Lengths

L <sub>1</sub>	<u>23.851</u>	L <sub>4</sub>	
L <sub>2</sub>	<u>23.810</u>	L <sub>5</sub>	
L <sub>3</sub>	<u>23.618</u>	L <sub>6</sub>	

Avg. Length 23.760 in.

### Volume & Weights

Volume of Sample 0.0873874 ft<sup>3</sup>  
 Moisture 3.7 %  
 Mass of Dry Soil 5194.2 g  
 Mass of Water 189.89 g  
 Volume of Water 0.0067091 ft<sup>3</sup>  
 Volume of Solids 0.0677176 ft<sup>3</sup>  
 Volume of air 0.01296069 ft<sup>3</sup>  
 Volume of Voids 0.0196698 ft<sup>3</sup>  
 Porosity (n)= 0.2250870  
 Void Ratio (e)= 0.2904675  
 Volumetric Water 7.7 %  
 Volumetric Air 14.8313044 %

### Densities & Unit Weights

Wet Unit Weight ( $\gamma_T$ ) = 135.83 lb/ft<sup>3</sup>  
 Bulk Density (dry)( $\gamma_d$ )= 131.04 lb/ft<sup>3</sup>  
 Saturated unit Weight ( $\gamma_{SAT}$ )= 145.09 lb/ft<sup>3</sup>  
 Submerged Unit Wt ( $\gamma_{SUB}$ )= 82.69 lb/ft<sup>3</sup>  
 Degree of Saturation (S)= 34.109 %

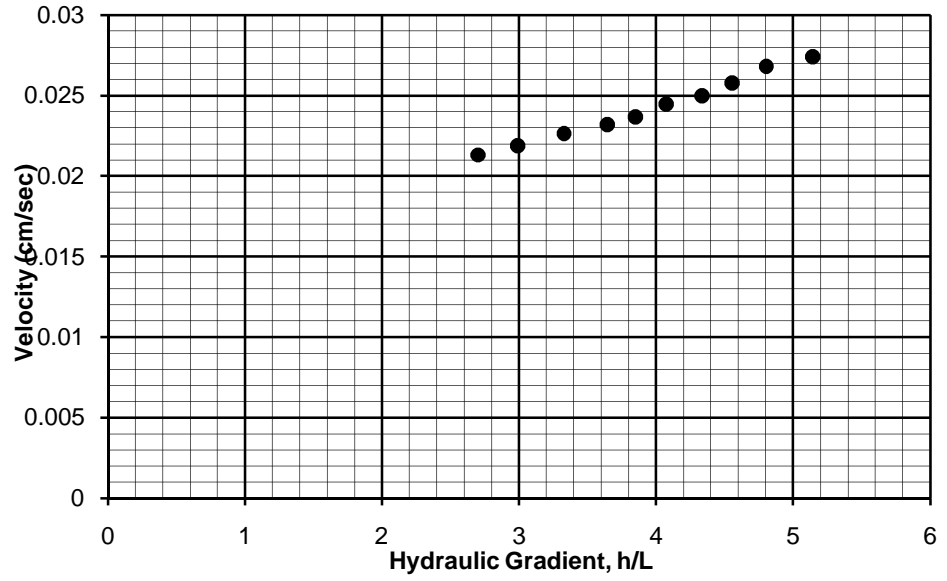
# Constant Head Permeability Test Report

ASTM D 2434

**Boring:** SPG-11  
**Sample:**  
**Depth:** 8.0'-10.0'

Grain Size Distribution	%
Aggregate:	27.2
Coarse Sand:	4.6
Med. Sand:	34.7
Fine Sand:	26.1
Silt:	5.6
Clay: (5 Micron)	1.8

**Permeant Liquid**  
De-aired, deionized water



Diameter (cm)	Area, A (cm <sup>2</sup> )	Length (cm)	Moisture (%)	Dry Density (pcf)	Void Ratio	Specific Gravity
7.610	45.48	15.923	0.0	99.0	0.75	2.77

Trial	Manometers		Head h (cm)	Flow Q (cm <sup>3</sup> )	Time t (sec)	Temp. (°C)	Velocity Q/At	Gradient h/L	Permeability k <sub>20°C</sub> (cm/sec)
	H <sub>1</sub>	H <sub>2</sub>							
1	25.9	5.2	20.7	116.3	120	17.2	2.13E-02	2.70E+00	8.46E-03
2	28.8	5.9	22.9	119.4	120	15.4	2.19E-02	2.99E+00	8.18E-03
3	32.3	6.8	25.5	123.6	120	14.0	2.26E-02	3.33E+00	7.83E-03
4	35.6	7.7	27.9	126.6	120	14.0	2.32E-02	3.64E+00	7.33E-03
5	37.7	8.2	29.5	129.2	120	12.6	2.37E-02	3.85E+00	7.29E-03
6	40.2	9.0	31.2	133.5	120	11.6	2.45E-02	4.07E+00	7.27E-03
7	42.8	9.6	33.2	136.3	120	11.0	2.50E-02	4.33E+00	7.06E-03
8	45.1	10.2	34.9	140.6	120	11.0	2.58E-02	4.56E+00	6.93E-03
9	47.9	11.1	36.8	146.3	120	11.0	2.68E-02	4.80E+00	6.84E-03
10	51.1	11.7	39.4	149.5	120	11.0	2.74E-02	5.14E+00	6.53E-03

**$k_{20°C} = R_T \times QL/At = 7.37E-03 \text{ cm/sec}$**

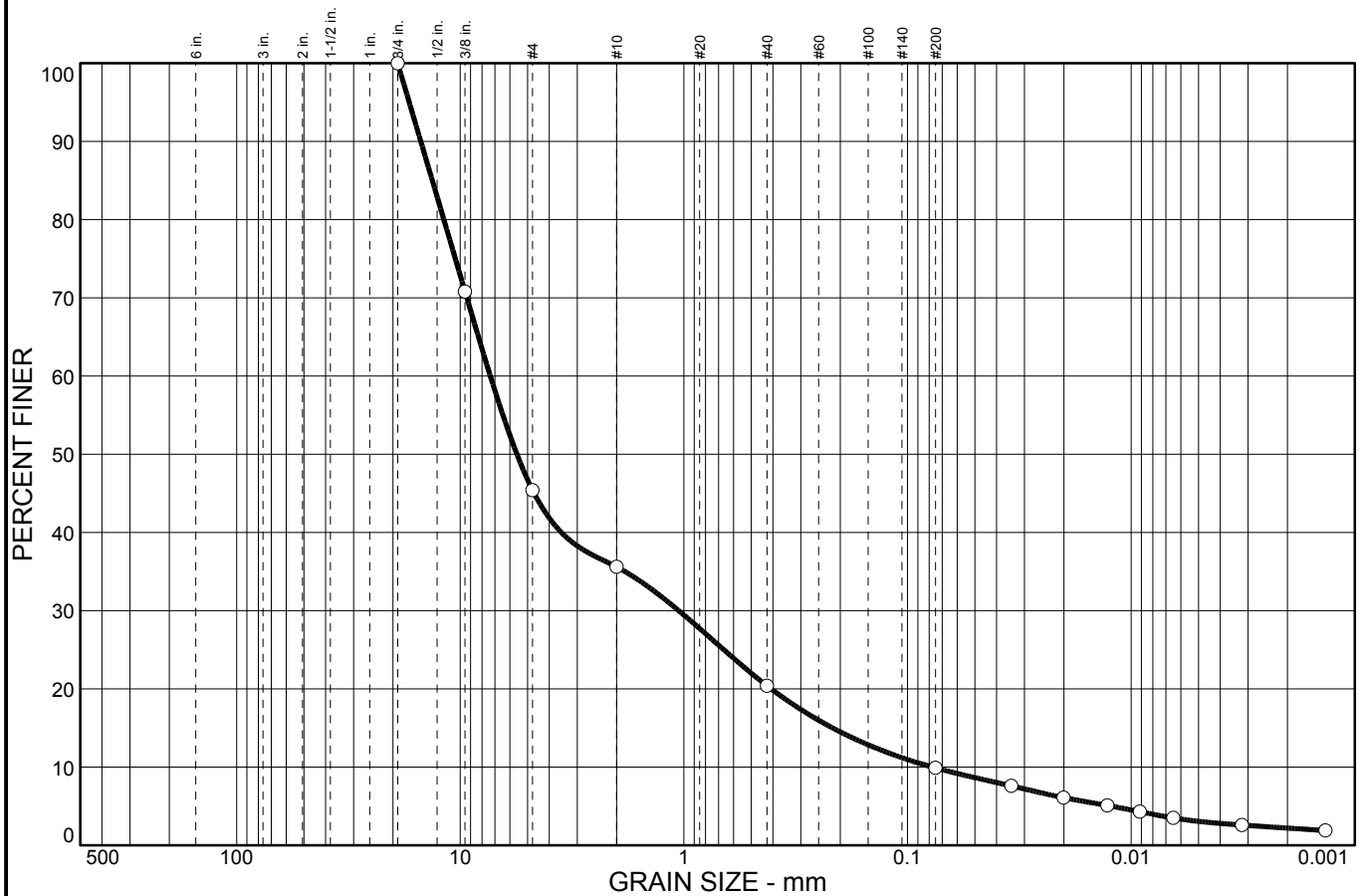
*L* - Distance between manometers = 7.66 cm  
*R<sub>T</sub>* - Temperature correction factor

**Remarks:**  
Sample was passed over a 3/4 inch sieve to remove oversized particles. Clay is considered to be 5 micron.



**Client:** Arcadis  
**Project:** MLC Moraine (OH000924-0018.00007)  
**Job No:** 1021-4505.18

# PARTICLE SIZE DISTRIBUTION TEST REPORT



% COBBLES	% GRAVEL		% SAND			% FINES	
	CRS.	FINE	CRS.	MEDIUM	FINE	SILT	CLAY
0.0	0.0	54.6	9.8	15.2	10.5	6.8	3.1

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
0.75 in.	100.0		
0.375 in.	70.8		
#4	45.4		
#10	35.6		
#40	20.4		
#200	9.9		

**Soil Description**

Well-graded sand with silt and gravel

**Atterberg Limits**

PL= NP      LL= NP      PI= NP

**Coefficients**

D<sub>85</sub>= 13.3      D<sub>60</sub>= 7.34      D<sub>50</sub>= 5.58  
 D<sub>30</sub>= 1.05      D<sub>15</sub>= 0.216      D<sub>10</sub>= 0.0772  
 C<sub>u</sub>= 95.10      C<sub>c</sub>= 1.96

**Classification**

USCS= SW-SM      AASHTO= A-1-b

**Remarks**

Moisture Content= 5.8%  
 Specific Gravity= 2.71

\* (no specification provided)

**Sample No.:** SPG-11 (3" tube)  
**Location:**

**Source of Sample:** SPG-11

**Date:** 4/15/2011  
**Elev./Depth:** 10.0'-12.0'



**Client:** Arcadis  
**Project:** MLC Moraine (OH000294.0018.00007)  
 Test Methods: ASTM D-421, D-422, D-854, D-2216, D-4318  
**Project No.:** 1021-4505.18      **Figure**

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**GRAIN SIZE DISTRIBUTION TEST DATA**

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**Client:** Arcadis  
**Project:** MLC Moraine (OH000294.0018.00007)  
Test Methods: ASTM D-421, D-422, D-854, D-2216, D-4318  
**Project Number:** 1021-4505.18

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**Sample Data**

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**Source:** SPG-11  
**Sample No.:** SPG-11 (3" tube)  
**Elev. or Depth:** 10.0'-12.0' **Sample Length(in./cm.):**  
**Location:**  
**Description:** Well-graded sand with silt and gravel  
**Date:** 4/15/2011 **PL:** NP **LL:** NP **PI:** NP  
**USCS Classification:** SW-SM **AASHTO Classification:** A-1-b  
**Testing Remarks:** Moisture Content= 5.8%  
Specific Gravity= 2.71

---

**Mechanical Analysis Data**

---

**Initial**

**Dry sample and tare=** 333.56  
**Tare =** 56.77  
**Dry sample weight =** 276.79  
**Sample split on number 10 sieve**  
**Split sample data:**  
Sample and tare = 47.76 Tare = .00 Sample weight = 47.76

**Sieve tare method**

Sieve	Weight retained	Sieve tare	Percent finer
0.75 inch	0.00	0.00	100.0
0.375 inch	80.71	0.00	70.8
# 4	70.41	0.00	45.4
# 10	27.25	0.00	35.6
# 40	20.33	0.00	20.4
# 200	14.14	0.00	9.9

---

**Hydrometer Analysis Data**

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**Separation sieve is #10**  
**Percent -#10 based upon complete sample=** 35.6  
**Weight of hydrometer sample:** 47.76  
**Calculated biased weight=** 134.16  
**Automatic temperature correction**  
Composite correction at 20 deg C = -3.4

**Meniscus correction only=**  
**Specific gravity of solids=** 2.70  
**Hydrometer type:** 151H  
Effective depth L= 16.294964 - 0.2645 x Rm

Elapsed time, min	Temp, deg C	Actual reading	Corrected reading	K	Rm	Eff. depth	Diameter mm	Percent finer
2.00	22.2	1.0095	1.0064	0.0131	9.5	13.8	0.0343	7.6
6.00	22.2	1.0083	1.0052	0.0131	8.3	14.1	0.0201	6.1
15.00	22.3	1.0074	1.0043	0.0131	7.4	14.3	0.0128	5.1
30.00	21.8	1.0068	1.0036	0.0131	6.8	14.5	0.0091	4.3
60.00	22.1	1.0061	1.0030	0.0131	6.1	14.7	0.0065	3.5

Elapsed time, min	Temp, deg C	Actual reading	Corrected reading	K	Rm	Eff. depth	Diameter mm	Percent finer
250.00	22.2	1.0053	1.0022	0.0131	5.3	14.9	0.0032	2.6
1440.00	21.2	1.0049	1.0016	0.0132	4.9	15.0	0.0014	1.9

---

**Fractional Components**

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Gravel/Sand based on #4

Sand/Fines based on #200

% COBBLES =                      % GRAVEL = 54.6    (% coarse =                      % fine = 54.6)

% SAND = 35.5    (% coarse = 9.8            % medium = 15.2            % fine = 10.5)

% SILT = 6.8            % CLAY = 3.1

D<sub>85</sub>= 13.34    D<sub>60</sub>= 7.34    D<sub>50</sub>= 5.58

D<sub>30</sub>= 1.05    D<sub>15</sub>= 0.22    D<sub>10</sub>= 0.08

C<sub>c</sub>= 1.9616    C<sub>u</sub>= 95.098

# Data Input for Index Properties

(Maximum Unit Weight / Minimum Porosity)

Project Name: MLC Moraine      Sample ID: SPG-11  
 DLZ Project Number: 1021-4505.18      Depth: 10.0'-12.0'  
 Client: Arcadis      Date: 4/8/2011  
 Client Project ID: OH000294.0018.00007

Moisture Content Data	
Wet Wt. & Cont (g)	5064.30
Dry Wt. & Cont (g)	5025.80
Wt. Cont (g)	3488.10
Wt. Water (g)	38.50
Dry Wt. Soil (g)	1537.70
Moisture Content (%)	2.5

Specific Gravity (G)= 2.77

Total Weight of Sample (Wt) wet = 2474.30

### Diameters

D <sub>1</sub>	<u>2.800</u>	D <sub>4</sub>	<u>2.856</u>
D <sub>2</sub>	<u>2.854</u>	D <sub>5</sub>	<u>2.896</u>
D <sub>3</sub>	<u>2.858</u>	D <sub>6</sub>	<u>2.857</u>

Avg. Diameter 2.854 in.

### Lengths

L <sub>1</sub>	<u>11.204</u>	L <sub>4</sub>	
L <sub>2</sub>	<u>10.463</u>	L <sub>5</sub>	
L <sub>3</sub>	<u>10.756</u>	L <sub>6</sub>	

Avg. Length 10.808 in.

### Volume & Weights

Volume of Sample 0.0399976 ft<sup>3</sup>  
 Moisture 2.5 %  
 Mass of Dry Soil 2413.9 g  
 Mass of Water 60.44 g  
 Volume of Water 0.0021353 ft<sup>3</sup>  
 Volume of Solids 0.0307882 ft<sup>3</sup>  
 Volume of air 0.00707405 ft<sup>3</sup>  
 Volume of Voids 0.0092093 ft<sup>3</sup>  
 Porosity (n)= 0.2302471  
 Void Ratio (e)= 0.2991182  
 Volumetric Water 5.3 %  
 Volumetric Air 17.6861960 %

### Densities & Unit Weights

Wet Unit Weight ( $\gamma_T$ ) = 136.38 lb/ft<sup>3</sup>  
 Bulk Density (dry)( $\gamma_d$ )= 133.05 lb/ft<sup>3</sup>  
 Saturated unit Weight ( $\gamma_{SAT}$ )= 147.42 lb/ft<sup>3</sup>  
 Submerged Unit Wt ( $\gamma_{SUB}$ )= 85.02 lb/ft<sup>3</sup>  
 Degree of Saturation (S)= 23.186 %

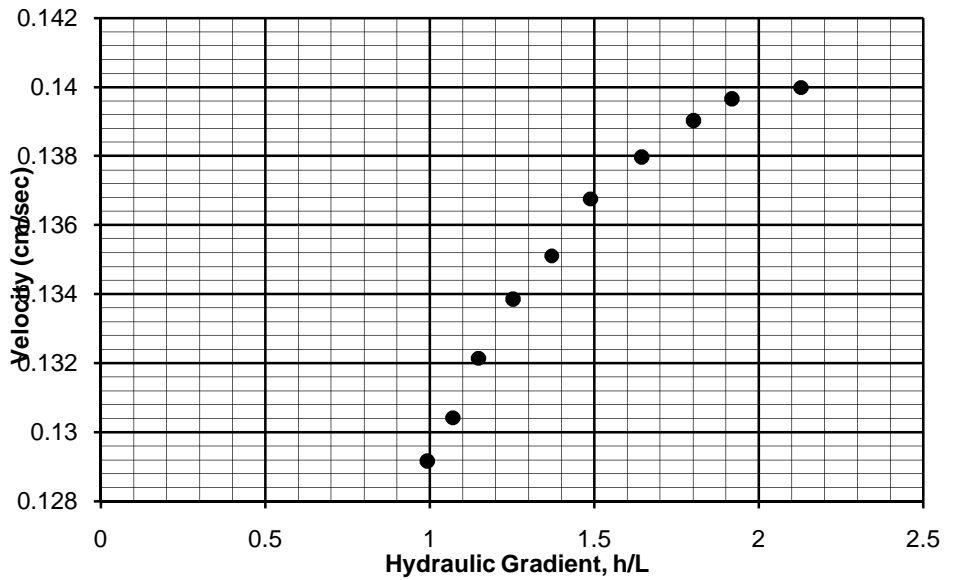
# Constant Head Permeability Test Report

ASTM D 2434

Boring: SPG-11  
 Sample:  
 Depth: 10.0'-12.0'

Grain Size Distribution	%
Aggregate:	54.6
Coarse Sand:	9.8
Med. Sand:	15.2
Fine Sand:	10.5
Silt:	6.8
Clay: (5 Micron)	3.1

Permeant Liquid  
 De-aired, deionized water



Diameter (cm)	Area, A (cm <sup>2</sup> )	Length (cm)	Moisture (%)	Dry Density (pcf)	Void Ratio	Specific Gravity
7.610	45.48	15.880	0.0	109.2	0.55	2.71

Trial	Manometers		Head h (cm)	Flow Q (cm <sup>3</sup> )	Time t (sec)	Temp. (°C)	Velocity Q/At	Gradient h/L	Permeability k <sub>20°C</sub> (cm/sec)
	H <sub>1</sub>	H <sub>2</sub>							
1	23.5	15.9	7.6	352.5	60	15.6	1.29E-01	9.92E-01	1.45E-01
2	25.2	17.0	8.2	355.9	60	14.8	1.30E-01	1.07E+00	1.38E-01
3	27.5	18.7	8.8	360.6	60	14.0	1.32E-01	1.15E+00	1.32E-01
4	29.8	20.2	9.6	365.3	60	13.6	1.34E-01	1.25E+00	1.24E-01
5	32.6	22.1	10.5	368.7	60	13.4	1.35E-01	1.37E+00	1.15E-01
6	35.9	24.5	11.4	373.2	60	12.8	1.37E-01	1.49E+00	1.09E-01
7	39.3	26.7	12.6	376.5	60	12.8	1.38E-01	1.64E+00	9.91E-02
8	40.9	27.1	13.8	379.4	60	12.4	1.39E-01	1.80E+00	9.19E-02
9	45.2	30.5	14.7	381.1	60	12.0	1.40E-01	1.92E+00	8.74E-02
10	48.3	32.0	16.3	382.0	60	11.6	1.40E-01	2.13E+00	7.96E-02

$k_{20°C} = R_T \times QL/At h = 1.12E-01 \text{ cm/sec}$

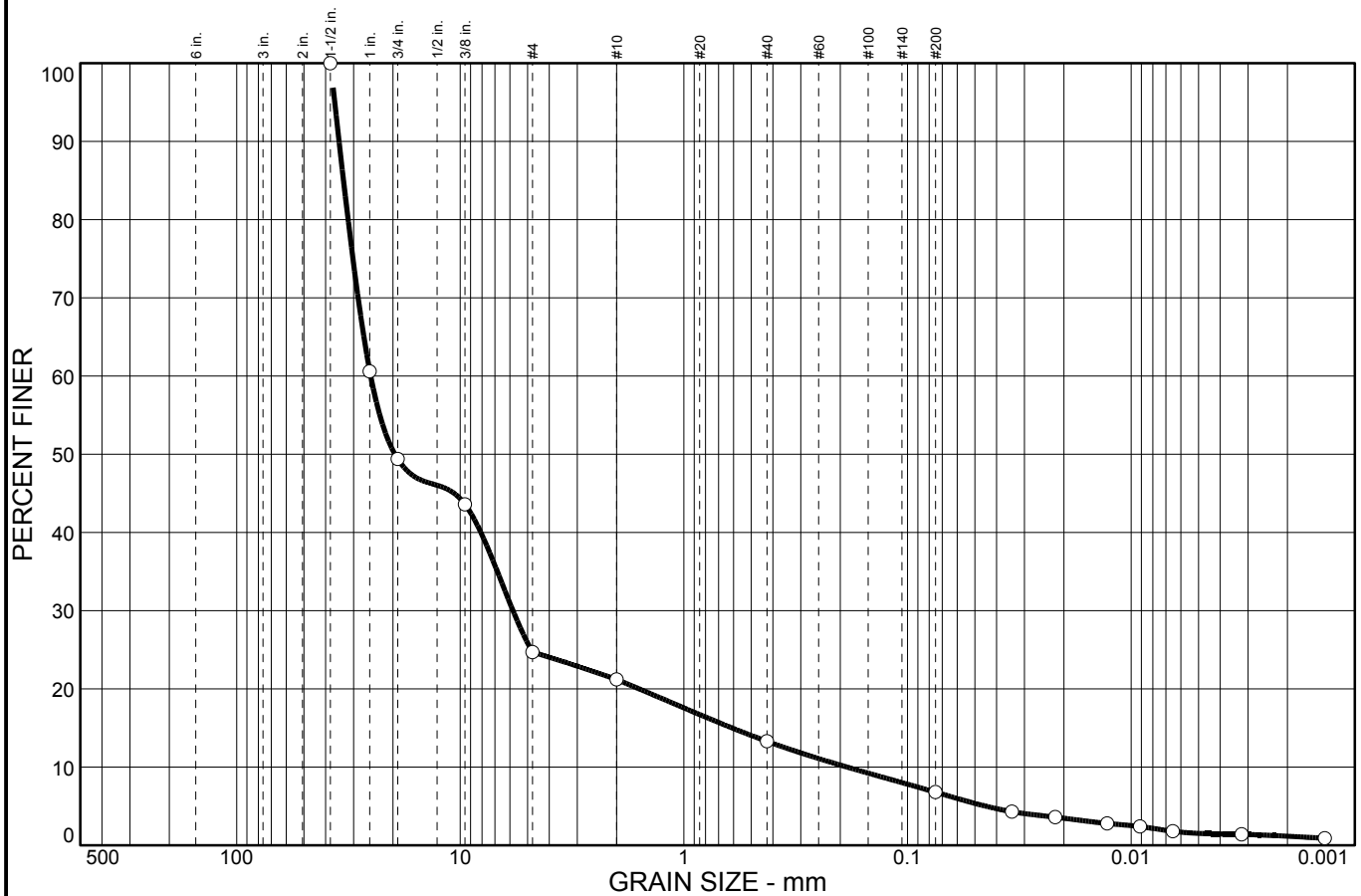
L - Distance between manometers = 7.66 cm  
 R<sub>T</sub> - Temperature correction factor

Remarks:  
 Sample was passed over a 3/4 inch sieve to remove oversized particles. Clay is considered to be 5 micron.



Client: Arcadis  
 Project: MLC Moraine (OH000924-0018.00007)  
 Job No: 1021-4505.18

# PARTICLE SIZE DISTRIBUTION TEST REPORT



% COBBLES	% GRAVEL		% SAND			% FINES	
	CRS.	FINE	CRS.	MEDIUM	FINE	SILT	CLAY
0.0	50.6	24.7	3.5	7.9	6.5	5.3	1.5

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
1.50 in.	100.0		
1.00 in.	60.6		
0.75 in.	49.4		
0.375 in.	43.6		
#4	24.7		
#10	21.2		
#40	13.3		
#200	6.8		

**Soil Description**

Poorly graded gravel with silt and sand

**Atterberg Limits**

PL= NP      LL= NP      PI= NP

**Coefficients**

D<sub>85</sub>= 33.3      D<sub>60</sub>= 25.2      D<sub>50</sub>= 19.6  
 D<sub>30</sub>= 5.81      D<sub>15</sub>= 0.608      D<sub>10</sub>= 0.186  
 C<sub>u</sub>= 135.30      C<sub>c</sub>= 7.22

**Classification**

USCS= GP-GM      AASHTO= A-1-a

**Remarks**

Moisture Content= 3.8%  
 Specific Gravity= 2.73

\* (no specification provided)

**Sample No.:** SPG-11 (3" tube)  
**Location:**

**Source of Sample:** SPG-11

**Date:** 4/11/2011  
**Elev./Depth:** 12.0'-14.0'



**Client:** Arcadis  
**Project:** MLC Moraine (OH000294.0018.00007)  
 Test Methods: ASTM D-421, D-422, D-854, D-2216, D-4318  
**Project No.:** 1021-4505.18      **Figure**

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**GRAIN SIZE DISTRIBUTION TEST DATA**

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**Client:** Arcadis  
**Project:** MLC Moraine (OH000294.0018.00007)  
Test Methods: ASTM D-421, D-422, D-854, D-2216, D-4318  
**Project Number:** 1021-4505.18

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**Sample Data**

---

**Source:** SPG-11  
**Sample No.:** SPG-11 (3" tube)  
**Elev. or Depth:** 12.0'-14.0' **Sample Length(in./cm.):**  
**Location:**  
**Description:** Poorly graded gravel with silt and sand  
**Date:** 4/11/2011 **PL:** NP **LL:** NP **PI:** NP  
**USCS Classification:** GP-GM **AASHTO Classification:** A-1-a  
**Testing Remarks:** Moisture Content= 3.8%  
Specific Gravity= 2.73

---

**Mechanical Analysis Data**

---

**Initial**

**Dry sample and tare=** 900.40  
**Tare =** 429.37  
**Dry sample weight =** 471.03  
**Sample split on number 10 sieve**  
**Split sample data:**  
**Sample and tare = 64.02 Tare = .00 Sample weight = 64.02**

**Sieve tare method**

<b>Sieve</b>	<b>Weight retained</b>	<b>Sieve tare</b>	<b>Percent finer</b>
1.50 inch	0.00	0.00	100.0
1.00 inch	185.73	0.00	60.6
0.75 inch	52.62	0.00	49.4
0.375 inch	27.51	0.00	43.6
# 4	88.84	0.00	24.7
# 10	16.54	0.00	21.2
# 40	23.95	0.00	13.3
# 200	19.62	0.00	6.8

---

**Hydrometer Analysis Data**

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**Separation sieve is #10**  
**Percent -#10 based upon complete sample= 21.2**  
**Weight of hydrometer sample: 64.02**  
**Calculated biased weight= 301.98**  
**Automatic temperature correction**  
**Composite correction at 20 deg C = -3.4**

**Meniscus correction only=**  
**Specific gravity of solids= 2.73**  
**Hydrometer type: 151H**  
**Effective depth L= 16.294964 - 0.2645 x Rm**

<b>Elapsed time, min</b>	<b>Temp, deg C</b>	<b>Actual reading</b>	<b>Corrected reading</b>	<b>K</b>	<b>Rm</b>	<b>Eff. depth</b>	<b>Diameter mm</b>	<b>Percent finer</b>
2.00	20.5	1.0115	1.0081	0.0132	11.5	13.3	0.0341	4.3
5.00	20.5	1.0103	1.0069	0.0132	10.3	13.6	0.0218	3.6
15.00	20.4	1.0088	1.0054	0.0133	8.8	14.0	0.0128	2.8

Elapsed time, min	Temp, deg C	Actual reading	Corrected reading	K	Rm	Eff. depth	Diameter mm	Percent finer
30.00	20.4	1.0079	1.0045	0.0133	7.9	14.2	0.0091	2.4
60.00	20.4	1.0069	1.0035	0.0133	6.9	14.5	0.0065	1.8
250.00	20.7	1.0060	1.0027	0.0132	6.0	14.7	0.0032	1.4
1440.00	19.7	1.0052	1.0017	0.0134	5.2	14.9	0.0014	0.9

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**Fractional Components**

---

Gravel/Sand based on #4

Sand/Fines based on #200

% COBBLES =                    % GRAVEL = 75.3    (% coarse = 50.6    % fine = 24.7)

% SAND = 17.9    (% coarse = 3.5    % medium = 7.9    % fine = 6.5)

% SILT = 5.3            % CLAY = 1.5

D<sub>85</sub>= 33.29    D<sub>60</sub>= 25.16    D<sub>50</sub>= 19.61

D<sub>30</sub>= 5.81    D<sub>15</sub>= 0.61    D<sub>10</sub>= 0.19

C<sub>c</sub>= 7.2208    C<sub>u</sub>= 135.3049

# Data Input for Index Properties

(Maximum Unit Weight / Minimum Porosity)

Project Name: MLC Moraine                      Sample ID: SPG-11  
 DLZ Project Number: 1021-4505.18                      Depth: 12.0'-14.0'  
 Client: Arcadis                      Date: 4/8/2011  
 Client Project ID: OH000294.0018.00007

Moisture Content Data	
Wet Wt. & Cont (g)	5992.00
Dry Wt. & Cont (g)	5818.00
Wt. Cont (g)	1230.00
Wt. Water (g)	174.00
Dry Wt. Soil (g)	4588.00
Moisture Content (%)	3.8

Specific Gravity (G)= 2.73  
 Total Weight of Sample (Wt) wet = 4762.00

Diameters			
D <sub>1</sub>	<u>2.864</u>	D <sub>4</sub>	<u>2.862</u>
D <sub>2</sub>	<u>2.843</u>	D <sub>5</sub>	<u>2.868</u>
D <sub>3</sub>	<u>2.866</u>	D <sub>6</sub>	<u>2.863</u>

Avg. Diameter 2.861 in.

Lengths			
L <sub>1</sub>	<u>19.832</u>	L <sub>4</sub>	
L <sub>2</sub>	<u>20.621</u>	L <sub>5</sub>	
L <sub>3</sub>	<u>20.679</u>	L <sub>6</sub>	

Avg. Length 20.377 in.

Volume & Weights	Densities & Unit Weights
Volume of Sample <u>0.0758104</u> ft <sup>3</sup>	Wet Unit Weight (γ <sub>T</sub> ) = <u>138.48</u> lb/ft <sup>3</sup>
Moisture <u>3.8</u> %	Bulk Density (dry)(γ <sub>d</sub> ) = <u>133.42</u> lb/ft <sup>3</sup>
Mass of Dry Soil <u>4588.0</u> g	Saturated unit Weight (γ <sub>SAT</sub> ) = <u>146.95</u> lb/ft <sup>3</sup>
Mass of Water <u>174.00</u> g	Submerged Unit Wt (γ <sub>SUB</sub> ) = <u>84.55</u> lb/ft <sup>3</sup>
Volume of Water <u>0.0061475</u> ft <sup>3</sup>	Degree of Saturation (S) = <u>37.407</u> %
Volume of Solids <u>0.0593762</u> ft <sup>3</sup>	
Volume of air <u>0.01028663</u> ft <sup>3</sup>	
Volume of Voids <u>0.0164342</u> ft <sup>3</sup>	
Porosity (n) = <u>0.2167798</u>	
Void Ratio (e) = <u>0.2767802</u>	
Volumetric Water <u>8.1</u> %	
Volumetric Air <u>13.5688895</u> %	

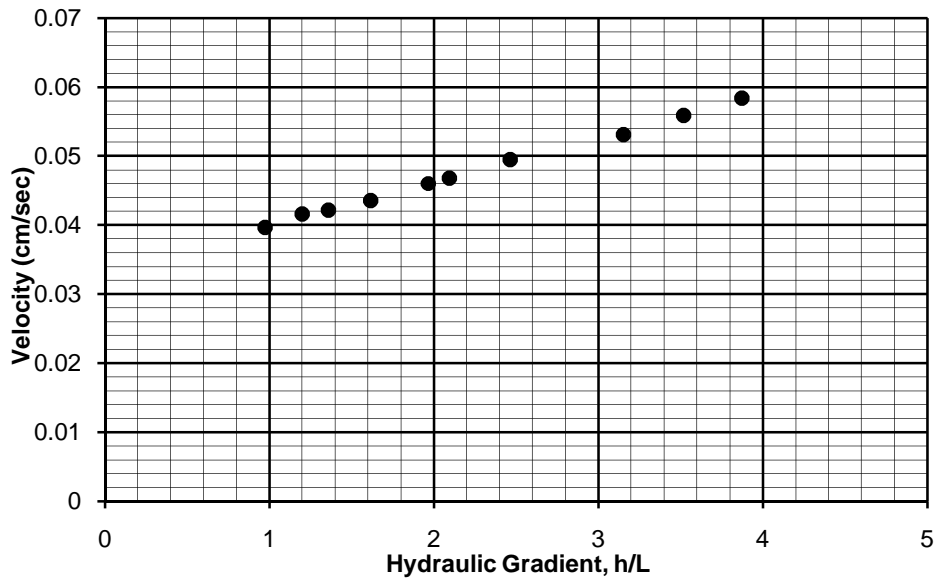
# Constant Head Permeability Test Report

ASTM D 2434

**Boring:** SPG-11  
**Sample:**  
**Depth:** 12.0'-14.0'

Grain Size Distribution	%
Aggregate:	75.3
Coarse Sand:	3.5
Med. Sand:	7.9
Fine Sand:	6.5
Silt:	5.3
Clay: (5 Micron)	1.5

**Permeant Liquid**  
De-aired, deionized water



Diameter (cm)	Area, A (cm <sup>2</sup> )	Length (cm)	Moisture (%)	Dry Density (pcf)	Void Ratio	Specific Gravity
6.307	31.24	15.733	0.0	104.4	0.63	2.73

Trial	Manometers		Head h (cm)	Flow Q (cm <sup>3</sup> )	Time t (sec)	Temp. (°C)	Velocity Q/At	Gradient h/L	Permeability k <sub>20°C</sub> (cm/sec)
	H <sub>1</sub>	H <sub>2</sub>							
1	33.5	27.4	6.1	148.6	120	15.8	3.96E-02	9.76E-01	4.50E-02
2	37.5	30.0	7.5	155.9	120	14.4	4.16E-02	1.20E+00	3.96E-02
3	41.4	32.9	8.5	158.1	120	14.0	4.22E-02	1.36E+00	3.57E-02
4	46.6	36.5	10.1	163.2	120	13.6	4.35E-02	1.62E+00	3.13E-02
5	52.3	40.0	12.3	172.5	120	13.2	4.60E-02	1.97E+00	2.74E-02
6	56.9	43.8	13.1	175.5	120	13.1	4.68E-02	2.10E+00	2.62E-02
7	63.3	47.9	15.4	185.6	120	12.8	4.95E-02	2.46E+00	2.37E-02
8	74.9	55.2	19.7	199.1	120	12.6	5.31E-02	3.15E+00	2.00E-02
9	80.0	58.0	22.0	209.4	120	12.6	5.59E-02	3.52E+00	1.88E-02
10	86.1	61.9	24.2	218.9	120	12.6	5.84E-02	3.87E+00	1.79E-02

$k_{20°C} = R_T \times QL/At = 2.86E-02 \text{ cm/sec}$

L - Distance between manometers = 6.25 cm  
R<sub>T</sub> - Temperature correction factor

**Remarks:**  
Sample was passed over a 3/4 inch sieve to remove oversized particles. Clay is considered to be 5 micron.



**Client:** Arcadis  
**Project:** MLC Moraine (OH000924-0018.00007)  
**Job No:** 1021-4505.18

ARCADIS

**Attachment D-2**

Closed South Settling Lagoon Vapor  
Intrusion Verification Summary  
Report

March 30, 2012



Revitalizing Auto Communities  
Environmental Response Trust

March 30, 2012

U.S.EPA Region 5  
Remediation and Reuse Branch  
Land and Chemicals Division, LU-9J  
77 West Jackson Blvd.  
Chicago, IL 60604-3590  
Attn: Mirtha Cápiro

RE: Closed South Settling Lagoon Vapor Intrusion Verification Summary Report  
RACER Trust Moraine Facilities, Moraine, Ohio

Dear Ms. Cápiro:

The Revitalizing Auto Communities Environmental Response Trust (RACER Trust) is providing this Closed South Settling Lagoon Vapor Intrusion Verification Summary Report for investigation activities completed as proposed in the Vapor Intrusion Verification Work Plan Addendum (Addendum) submitted to the United States Environmental Protection Agency (U.S. EPA) on November 14, 2011, for the RACER Trust Moraine Facilities in Moraine, Ohio. The Addendum was approved by U.S. EPA on January 10, 2012, and focused on collecting groundwater table and soil-gas samples along the eastern and southern boundaries of the closed South Settling Lagoon (Figures 1 and 2). The groundwater and soil-gas data were used as part of the overall weight of evidence for evaluating the vapor intrusion pathway along the southern and eastern boundaries of the closed South Settling Lagoon. This summary report presents the results of groundwater and soil-gas sampling completed in January and February 2012 associated with the approved Addendum.

Field activities for the closed South Settling Lagoon vapor intrusion verification investigation began on January 30, 2012, and were completed by February 6, 2012. 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. All activities were completed in accordance with procedures outlined in the Vapor Intrusion Verification Work Plan approved by U.S. EPA on September 29, 2010. Soil boring logs, soil-gas point construction logs, and soil-gas point sampling logs are included in Attachments 1, 2, and 3, respectively.

Groundwater table sampling results indicate tetrachloroethene (PCE) and trichloroethene (TCE) exceeded their respective Maximum Contaminant Level (MCL) at all three locations in the closed South Settling Lagoon (Table 1 and Figure 1). Concentrations of PCE ranged from 15 micrograms per liter ( $\mu\text{g/L}$ ) at SSL-1 to 130  $\mu\text{g/L}$  at SSL-3. TCE concentrations ranged from 11  $\mu\text{g/L}$  at SSL-1 to 120  $\mu\text{g/L}$  at SSL-3. Other site-specific volatile organic compounds (VOCs) were detected but all were below their respective MCL including 1,1-dichloroethane (1,1-DCA), cis-1,2-dichloroethene (cis-1,2-DCE), and trans-1,2-dichloroethene (trans-1,2-DCE) (Table 1). All other site-specific compounds at the three locations were not detected. Detected concentrations of site-specific VOCs at SSL-2 and SSL-3 were similar to VOC concentrations detected at GM-63. Existing groundwater monitoring well GM-63 is located along the northern boundary of the Riverview Plat neighborhood and screened in the shallow portion of the upper aquifer similar to SSL-1 through SSL-3 (Table 1). In addition, the VOC concentrations in groundwater at the closed South Settling Lagoon are consistent with groundwater concentrations observed at the Riverview Plat neighborhood and the site-wide groundwater monitoring program.

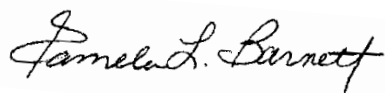
Soil-gas sample point results indicate all site-specific VOCs are below their respective non-residential Action Levels at each location except for TCE (Table 2 and Figure 2). At location SSL-2 at 14.2 feet below land surface (bls), TCE exceeded the Action Level for soil-gas at the water table (880 micrograms per cubic meter [ $\mu\text{g/m}^3$ ]) with a concentration of 3,100  $\mu\text{g/m}^3$ . All other site-specific VOCs were detected below their respective Action Level including 1,1,1-trichloroethane (1,1,1-TCA), 1,1-DCA, benzene, cis-1,2-DCE, ethylbenzene, PCE, toluene, trans-1,2-DCE, and xylenes. The VOCs detected in soil-gas at the closed South Settling Lagoon are the same VOCs detected in soil-gas at the Riverview Plat neighborhood, but the concentrations at the closed South Settling Lagoon are lower. The geology along the perimeter of the closed South Settling Lagoon consisted primarily of sand with gravel and is similar to the geology encountered in the Riverview Plat neighborhood. Depth to groundwater was encountered approximately 3 to 3.5 feet shallower in the closed South Settling Lagoon than in the Riverview Plat neighborhood. The difference in VOC soil-gas concentration between the closed South Settling Lagoon and the Riverview Plat neighborhood could be attributed to the lack of foundations, asphalt roads, and/or other impervious structures along the perimeter of the closed South Settling Lagoon. Conceptually, soil-gas along the perimeter of the closed South Settling Lagoon is freer to migrate to the surface where it can dissipate into the atmosphere and not collect underneath an impervious structure.

The groundwater table and soil-gas sampling results indicate groundwater is the single most significant contributor of VOCs, primarily of PCE and TCE, to soil-gas along the perimeter of the closed South Settling Lagoon. This is demonstrated in two different but supporting factors. First, soil-gas concentrations correlate with groundwater data results. Where concentrations of PCE and TCE are the highest in groundwater (SSL-2 and SSL-3), higher concentrations of PCE and TCE in soil-gas are also present. For example, at SSL-1, relatively lower concentrations of PCE and TCE were detected in groundwater and thus soil-gas concentrations of PCE and TCE were also relatively

lower. Second, PCE and TCE concentrations are highest at depth, closest to the groundwater table. Moving away from the water table (shallower depths) VOC concentrations decrease significantly. At locations SSL-2 and SSL-3 soil-gas concentrations of PCE and TCE significantly attenuate from directly above the water table to the shallowest point (6 feet bls). Attenuation of PCE and TCE through the soil demonstrates that groundwater is the only source of VOCs to soil gas. It also is worth noting that benzene, ethylbenzene, toluene, xylenes, and 1,1,1-trichloroethane were not detected in groundwater but were detected in soil-gas at low concentrations. The concentrations of benzene, ethylbenzene, toluene, xylenes, and 1,1,1-TCA in soil-gas are several orders of magnitude below their respective Action Levels indicating these compounds are not risked based drivers and further investigation as to the source of these low concentrations is not warranted. Information presented in this summary report will also be included in the site conceptual model presented in the Corrective Measures Proposal.

If you have any questions, please contact me at (937) 751-8635.

Sincerely,



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

cc: J. Stark, Ohio EPA

Attachments:

- Table 1 Closed South Settling Lagoon Groundwater Table and Historic GM-63 Sampling Results
- Table 2 Closed South Settling Lagoon Soil-Gas Point Sampling Results
- Figure 1 Groundwater Table Sample Results, Closed South Settling Lagoon, January through February 2012
- Figure 2 Soil-Gas Sample Point Analytical Results, Closed South Settling Lagoon, February 6, 2012
- Attachment 1 Soil Boring Logs
- Attachment 2 Soil-Gas Point Construction Logs
- Attachment 3 Soil-Gas Point Sampling Logs



Table 1. Closed South Settling Lagoon Groundwater Table and Historic GM-63 Sampling Results, RACER Trust, Moraine, Ohio.

	Location Code		SSL-1	SSL-2	SSL-3	SSL-3	GM-63
	Sample Label	Sample Date	SSL-1-GW/02012012/ 2/1/2012	SSL-2-GW/01312012/ 1/31/2012	SSL-3-GW/01302012/ 1/30/2012	DUP-01/01302012/ 1/30/2012	GM-63/01282010/ 1/28/2010
	Units	MCL	Laboratory Analytical Results				
<b>Volatile Organic Compounds</b>							
1,1,1-Trichloroethane	µg/L	200	< 1.0 U	< 3.3 U	< 5.0 U	< 5.0 U	2.0 J
1,1-Dichloroethane	µg/L	NA	0.76 J	< 3.3 U	< 5.0 U	< 5.0 U	< 5.7 U
1,1-Dichloroethene	µg/L	7	< 1.0 U	< 3.3 U	< 5.0 U	< 5.0 U	< 5.7 U
Benzene	µg/L	5	< 1.0 U	< 3.3 U	< 5.0 U	< 5.0 U	< 5.7 U
cis-1,2-Dichloroethene	µg/L	70	5.4	0.95 J	1.4 J	1.6 J	3.2 J
Ethylbenzene	µg/L	700	< 1.0 U	< 3.3 U	< 5.0 U	< 5.0 U	< 5.7 U
Tetrachloroethene	µg/L	5	<b>15</b>	<b>86</b>	<b>130</b>	<b>130</b>	<b>150</b>
Toluene	µg/L	1000	< 1.0 UB	< 3.3 UB	< 5.0 U	< 5.0 U	< 5.7 U
trans-1,2-Dichloroethene	µg/L	100	0.41 J	< 3.3 U	< 5.0 U	< 5.0 U	< 5.7 U
Trichloroethene	µg/L	5	<b>11</b>	<b>74</b>	<b>120</b>	<b>130</b>	<b>140</b>
Vinyl chloride	µg/L	2	< 1.0 U	< 3.3 U	< 5.0 U	< 5.0 U	< 5.7 U
Xylenes	µg/L	10000	< 2.0 U	< 6.7 U	< 10 U	< 10 U	< 11 U

µg/L - Micrograms per Liter.

MCL - United States Environmental Protection Agency, Maximum Contaminant Level.

< - 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 2. Closed South Settling Lagoon Soil-Gas Point Sampling Results, RACER Trust, Moraine, Ohio.

Volatile Organic Compounds	Units	Location Code Sample Date	SSL-1 2/6/2012				SSL-2 2/6/2012			SSL-3 2/6/2012		
		Action Level Soil-Gas at Water Table	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 <sup>3</sup>	2190000	< 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 <sup>3</sup>	7670	< 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 <sup>3</sup>	87600	< 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 <sup>3</sup>	16000	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 <sup>3</sup>	NA	< 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 <sup>3</sup>	4900	28	3.0 J	1.0 J	1.8 J	< 4.1 U	3.7 J	16 J	16	15	37
Tetrachloroethene	µg/m <sup>3</sup>	18000	86	94	96	200	52	1400	9600	360	2700	4500
Toluene	µg/m <sup>3</sup>	2200000	130	7.4	2.9 J	5.6	< 3.5 UB	12	55	80	38	100
trans-1,2-Dichloroethene	µg/m <sup>3</sup>	26300	< 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 <sup>3</sup>	880	8.3	45	47	96	7.0	320	<b>3100</b>	13	270	530
Vinyl chloride	µg/m <sup>3</sup>	2790	< 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 <sup>3</sup>	44000	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<sup>3</sup> - 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.

Note: The "Action Levels" for soil-gas at the water table are derived from the updated May 2010 United States Environmental Protection Agency (U.S. EPA) Regional Screening Levels (RSLs) for non-residential indoor air by applying an attenuation factor of 0.01. The RSL for trichloroethene was revised by the U.S. EPA in September 2011, and the RSL for tetrachloroethene was revised by the U.S. EPA in February 2012. Trichloroethene and tetrachloroethene toxicity values are based on U.S. EPA's Integrated Risk Information System Database (<http://www.epa.gov/iris/subst/0199.htm> and <http://www.epa.gov/iris/subst/0106.htm>). "Action levels" are protective for an individual exposed to the chemical for 8 hours per day; 5 days per week; for 30 years.

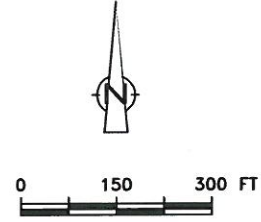
CITY(COLUMBUS) DIV(GROUP/SER1) DR(R, SMITH) LD:(Opt) PIC:(Opt) PM(N, GILLOTTI) TM:(OPT) LVR(OPTION) OFF=REF  
 G:\ENVCAD\Columbus-CHACTON\00294 - RACER\South Settling Lagoon\SS1\2-01.dwg LAYOUT: FIG 1 WATER TABLE DATA\0012 - RACER\South Settling Lagoon\SS1\2-01.dwg LAYOUT: FIG 1 WATER TABLE DATA\0012 - RACER\South Settling Lagoon\SS1\2-01.dwg LAYOUT: FIG 1 WATER TABLE DATA\0012 - RACER\South Settling Lagoon\SS1\2-01.dwg  
 XREFS:



SSL-1 (700.99 - 702.99)	
	2/1/12
1,1,1-Trichloroethane	< 1.0 U
1,1-Dichloroethane	0.76 J
1,1-Dichloroethene	< 1.0 U
Benzene	< 1.0 U
cis-1,2-Dichloroethene	5.4
Ethylbenzene	< 1.0 U
Tetrachloroethene	<b>15</b>
Toluene	< 1.0 UB
trans-1,2-Dichloroethene	0.41 J
Trichloroethene	<b>11</b>
Vinyl chloride	< 1.0 U
Xylenes	< 2.0 U

SSL-3 (699.66 - 701.66)		
	1/30/12	1/30/12 DUP
1,1,1-Trichloroethane	< 5.0 U	< 5.0 U
1,1-Dichloroethane	< 5.0 U	< 5.0 U
1,1-Dichloroethene	< 5.0 U	< 5.0 U
Benzene	< 5.0 U	< 5.0 U
cis-1,2-Dichloroethene	1.4 J	1.6 J
Ethylbenzene	< 5.0 U	< 5.0 U
Tetrachloroethene	<b>130</b>	<b>130</b>
Toluene	< 5.0 U	< 5.0 U
trans-1,2-Dichloroethene	< 5.0 U	< 5.0 U
Trichloroethene	<b>120</b>	<b>130</b>
Vinyl chloride	< 5.0 U	< 5.0 U
Xylenes	< 10 U	< 10 U

SSL-2 (701.49 - 703.49)	
	1/31/12
1,1,1-Trichloroethane	< 3.3 U
1,1-Dichloroethane	< 3.3 U
1,1-Dichloroethene	< 3.3 U
Benzene	< 3.3 U
cis-1,2-Dichloroethene	0.95 J
Ethylbenzene	< 3.3 U
Tetrachloroethene	<b>86</b>
Toluene	< 3.3 UB
trans-1,2-Dichloroethene	< 3.3 U
Trichloroethene	<b>74</b>
Vinyl chloride	< 3.3 U
Xylenes	< 6.7 U



- LEGEND**
- TEMPORARY SOIL-GAS SAMPLING POINT
  - RACER TRUST PROPERTY BOUNDARY (700.99-702.99)
  - J ESTIMATED VALUE
  - < LESS THAN REPORTING LIMIT
  - U LESS THAN REPORTING LIMIT
  - UB THE CHEMICAL OF CONCERN CONSIDERED NON-DETECT AT THE LISTED REPORTING LIMIT DUE TO ASSOCIATED BLANK CONTAMINATION.
  - BOLD** CONCENTRATION ABOVE MAXIMUM CONTAMINANT LEVELS PRESENTED ON TABLE 1
- ALL CONCENTRATIONS IN MICROGRAMS PER LITER

RACER TRUST  
MORAIN, OHIO  
OH000294.2012

**GROUNDWATER TABLE SAMPLE RESULTS  
CLOSED SOUTH SETTLING LAGOON  
JANUARY THROUGH FEBRUARY 2012**

**ARCADIS**

FIGURE  
**1**





**Attachment 1**

Soil Boring Logs



# SOIL BORING LOG

**BORING NO.:** SSL-1

**TOTAL DEPTH:** 24 feet bls

## PROJECT INFORMATION

**CLIENT:** RACER Trust  
**PROJECT:** V.I. Investigation: South Settling Lagoon  
**SITE LOCATION:** Moraine, Ohio  
**PROJECT NUMBER:** OH000294.2012.0007A  
**LOGGED BY:** Lauren Baumgartner  
**DATE STARTED:** 1/31/2012  
**DATE COMPLETED:** 2/1/2012

## DRILLING INFORMATION

**DRILLING CO.:** EnviroCore  
**DRILLER:** Adam Whitt/Jeremy Amick  
**DRILLING METHOD:** Direct Push  
**GROUND ELEVATION:** 724.99 (ft. AMSL)  
**COORDINATES, STATE PLANE:**  
**NORTHING:** 620394.287960  
**EASTING:** 1482266.010987

DEPTH (feet)	Recovery (inches)	PID (ppm)	Soil Symbols	USCS Classification	SOIL DESCRIPTION
0				SW	(0.0 - 10.0) Sand, medium to coarse grain, some medium to large round pebbles, trace clay, few small cobbles, brown, moist. Note: utility clearance using air/hydro knife to 8.5 feet.
2			•••••		
4	102	NM	•••••		
6			•••••		
8		0.2	•••••		
10			•••••	SW	(10.0 - 16.0) Sand, medium to coarse grain, trace silt, some small to medium round pebbles, pulverized rock, dry, brown.
12	18	1.2	•••••		
14	22	1.3	•••••		
16		1.3	•••••		
18		1.4	•••••	SW	(16.0 - 24.0) Sand, medium to coarse grain, small to large rounded pebbles, trace silt, wet at 18 feet, brown.  Note: more pebbles at 20 feet.  End of boring at 24 feet.
20	16	1.4	•••••		
22	8	1.9	•••••		
24			•••••		

Soil-gas sampling point SSL-1 installed with a 6-inch screen at: 5 feet 6 inches to 6 feet; 10 feet 6 inches to 11 feet; and 13 feet 8 inches to 14 feet 2 inches; groundwater table sample collected from 22-24 feet.

**Notes:** \*Sample submitted for laboratory analysis. ppm: parts per million Date: 3/23/2012  
 \*\*Sample submitted for laboratory analysis in addition with duplicate and/or MS/MSD. PID: Photo-ionization Detector Page: 1 of 1  
 NM: Not Measured NR: No Recovery ft: feet  
 USCS: Unified Soil Classification System bls: below land surface AMSL: Above Mean Sea Level



# SOIL BORING LOG

**BORING NO.:** SSL-2

**TOTAL DEPTH:** 24 feet bls

## PROJECT INFORMATION

**CLIENT:** RACER Trust  
**PROJECT:** V.I. Investigation: South Settling Lagoon  
**SITE LOCATION:** Moraine, Ohio  
**PROJECT NUMBER:** OH000294.2012.0007A  
**LOGGED BY:** Lauren Baumgartner  
**DATE STARTED:** 1/31/2012  
**DATE COMPLETED:** 1/31/2012

## DRILLING INFORMATION

**DRILLING CO.:** EnviroCore  
**DRILLER:** Adam Whitt/Jeremy Amick  
**DRILLING METHOD:** Direct Push  
**GROUND ELEVATION:** 725.49 (ft. AMSL)  
**COORDINATES, STATE PLANE:**  
**NORTHING:** 620359.287484  
**EASTING:** 1482560.679116

DEPTH (feet)	Recovery (inches)	PID (ppm)	Soil Symbols	USCS Classification	SOIL DESCRIPTION
0				SW	(0.0 - 10.0) Sand, medium to coarse grain, some medium to large pebbles, few cobbles up to 8" diameter, trace clay, dark brown, dry.  Note: utility clearance using air/hydro vac truck from 0 to 9.6 feet.
2					
4	115	NM			
6					
8					
10		0.2			
10	20	0.5		SW	(10.0 - 20.0) Sand, medium to coarse grain, medium round pebbles, pulverized rock, dry, tan/white.
12					
14	23	0.5			
16		0.5			
18	11	0.6			
20					Note: wet at 19.5 feet.
20		1.0		SW	(20.0 - 24.0) Sand, fine to coarse grain, poorly sorted, trace small round pebbles, brown, wet.
22	40	1.0			
24					End of boring at 24 feet.  Soil-gas sampling point SSL-2 installed with a 6-inch screen at: 5 feet 6 inches to 6 feet; 10 feet 6 inches to 11 feet; and 13 feet 8 inches to 14 feet 2 inches; groundwater table sample collected from 22-24 feet.

**Notes:** \*Sample submitted for laboratory analysis. ppm: parts per million Date: 3/21/2012  
 \*\*Sample submitted for laboratory analysis in addition with duplicate and/or MS/MSD. PID: Photo-ionization Detector Page: 1 of 1  
 NM: Not Measured NR: No Recovery ft: feet  
 USCS: Unified Soil Classification System bls: below land surface AMSL: Above Mean Sea Level



# SOIL BORING LOG

**BORING NO.:** SSL-3

**TOTAL DEPTH:** 24 feet bls

## PROJECT INFORMATION

**CLIENT:** RACER Trust  
**PROJECT:** V.I. Investigation: South Settling Lagoon  
**SITE LOCATION:** Moraine, Ohio  
**PROJECT NUMBER:** OH000294.2012.0007A  
**LOGGED BY:** Lauren Baumgartner  
**DATE STARTED:** 1/30/2012  
**DATE COMPLETED:** 1/30/2012

## DRILLING INFORMATION

**DRILLING CO.:** EnviroCore  
**DRILLER:** Adam Whitt/Jeremy Amick  
**DRILLING METHOD:** Direct Push  
**GROUND ELEVATION:** 723.66 (ft. AMSL)  
**COORDINATES, STATE PLANE:**  
**NORTHING:** 620653.732267  
**EASTING:** 1482809.284825

DEPTH (feet)	Recovery (inches)	PID (ppm)	Soil Symbols	USCS Classification	SOIL DESCRIPTION	
0			•••••	SW	(0.0 - 9.0) Sand, medium to coarse grain, some medium to large pebbles, few cobbles up to 3" diameter, trace clay, dark brown.  Note: utility clearance using air/hydro vac truck from 0 to 9 feet.	
2			•••••			
4	108	NM	•••••			
6			•••••			
8			•••••			
10		0.1	•••••	SW		(9.0 - 24.0) Sand, medium to coarse grain; some medium round pebbles, dry, tan, pulverized rock.  Note: moist from 12 to 20 feet.  Note: wet at 20 feet.
12	16	0.2	•••••			
14		0.4	•••••			
16	38	0.7	•••••			
18		1.0	•••••			
20	22	1.2	•••••			
22		1.5	•••••			
24	22	1.6	•••••			
					End of boring at 24 feet.  Soil-gas sampling point SSL-3 installed with a 6-inch screen at: 5 feet 6 inches to 6 feet; 10 feet 6 inches to 11 feet; and 13 feet 8 inches to 14 feet 2 inches; groundwater table sample collected from 22-24 feet.	

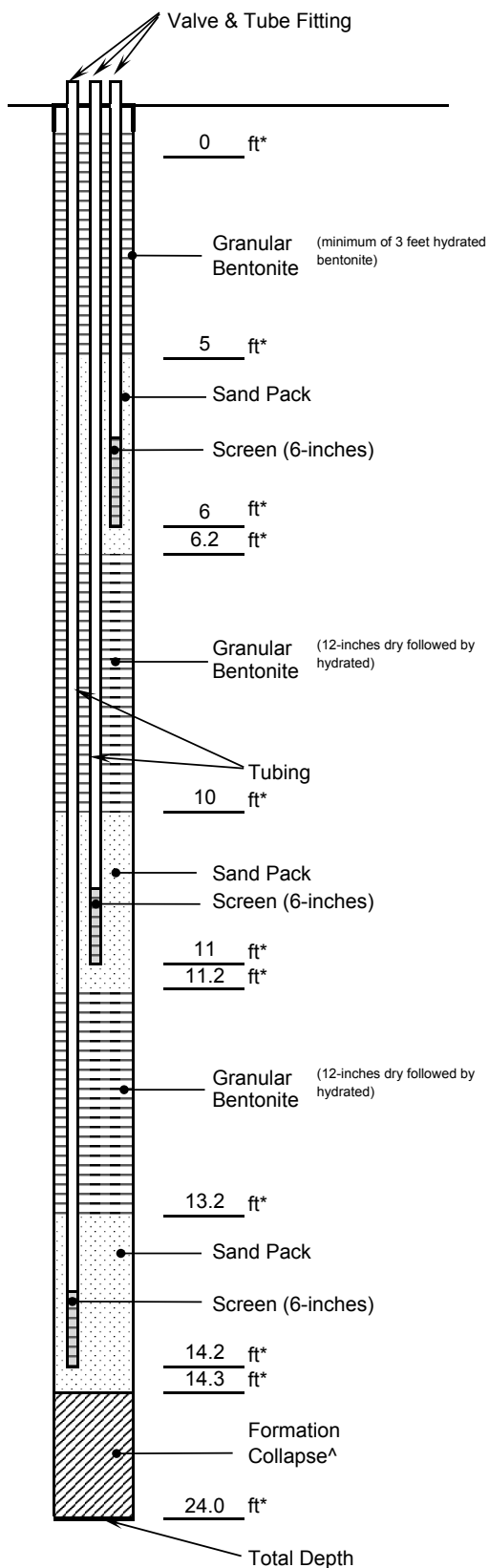
**Notes:** \*Sample submitted for laboratory analysis. ppm: parts per million Date: 3/21/2012  
 \*\*Sample submitted for laboratory analysis in addition with duplicate and/or MS/MSD. PID: Photo-ionization Detector Page: 1 of 1  
 NM: Not Measured NR: No Recovery ft: feet  
 USCS: Unified Soil Classification System bls: below land surface AMSL: Above Mean Sea Level



**Attachment 2**

Soil-Gas Point Construction Logs

## SOIL-GAS POINT CONSTRUCTION DIAGRAM



RACER Trust SSL VI  
 Project: Verification Investigation Point: SSL-1

City: Moraine

County: Montgomery State: OH

Survey Coordinates:  
 Northing: 620394.288  
 Easting: 1482266.011

Land-Surface Elevation (surveyed): 724.99 feet  
 (above mean sea level)

Historic Maximum Groundwater Elevation: 708.81 feet  
 (above mean sea level)

Groundwater Encountered During Drilling: 18 feet bls

Installation Dates: 2/1/2012

Weather Conditions at Installation: Clear 50s

Drilling Contractor: Envirocore

Driller: Adam Whitt/Jeremy Amick

Drilling Method: Direct push

Screen Construction: Type: Stainless Steel  
 Length: 6 inches  
 Diameter: 0.4375-inch OD, 0.3125-inch ID

Tubing Construction: Type: Teflon  
 Diameter: 0.25-inch OD, 0.17-inch ID

Volume Calculation (mL):	Shallow	Middle	Deep
$V_1$	8	8	8
$V_2$	36	54	72
$V_3$	16,198	1,415	1,415
$V_t$	16,242	1,477	1,495

Remarks: 11" utility hole to 8.5 feet, 3.25" diameter drill rods

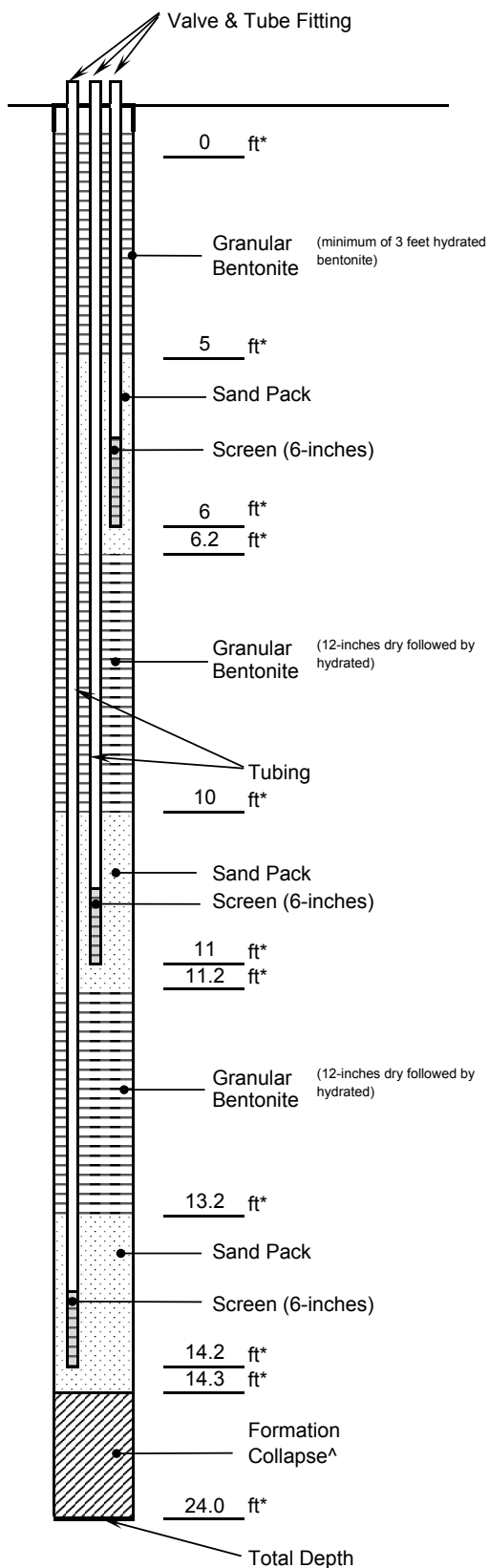
Prepared by: Rumschlag

$V_1 + V_2 + V_3 = V_t$  where:  $V_1 = \pi r^2 h$  = open space volume of soil-gas screen;  
 $V_2 = \pi r^2 h$  = open space volume of sample tubing;  $V_3 = \pi r^2 h \rho$  = estimated open pore space for sand pack and dry bentonite seal;  $V_t$  = total volume;  
 $r$  = inner radius of soil-gas screen, borehole, or sample tubing;  $h$  = height of soil-gas screen or height (length) of tubing or height of sand pack and dry bentonite seal;  $\rho$  = porosity of sand pack and dry bentonite seal (40%).

OD - outer diameter                      12-inches = 1 foot  
 ID - inner diameter                      1 cubic inch = 16.39 mL  
 bls - below land surface                 $\pi = 3.1416$   
 mL - milliliters

\* Depth in Feet Below Land Surface  
 ^ Formation partially collapsed.  
 Bentonite was used to backfill remaining volume

## SOIL-GAS POINT CONSTRUCTION DIAGRAM



RACER Trust SSL VI  
 Project: Verification Investigation Point: SSL-2

City: Moraine

County: Montgomery State: OH

Survey Coordinates:  
 Northing: 620359.2875  
 Easting: 1482560.679

Land-Surface Elevation (surveyed): 725.49 feet  
 (above mean sea level)

Historic Maximum Groundwater Elevation: 709.16 feet  
 (above mean sea level)

Groundwater Encountered During Drilling: 19.5 feet bls

Installation Dates: 1/31/2012

Weather Conditions at Installation: Clear 50s

Drilling Contractor: Envirocore

Driller: Adam Whitt/Jeremy Amick

Drilling Method: Direct push

Screen Construction: Type: Stainless Steel  
 Length: 6 inches  
 Diameter: 0.4375-inch OD, 0.3125-inch ID

Tubing Construction: Type: Teflon  
 Diameter: 0.25-inch OD, 0.17-inch ID

Volume Calculation (mL):	Shallow	Middle	Deep
$V_1$	8	8	8
$V_2$	36	54	72
$V_3$	16,198	1,415	1,415
$V_t$	16,242	1,477	1,495

Remarks: 11" utility hole to 9.6 feet, 3.25" diameter drill rods

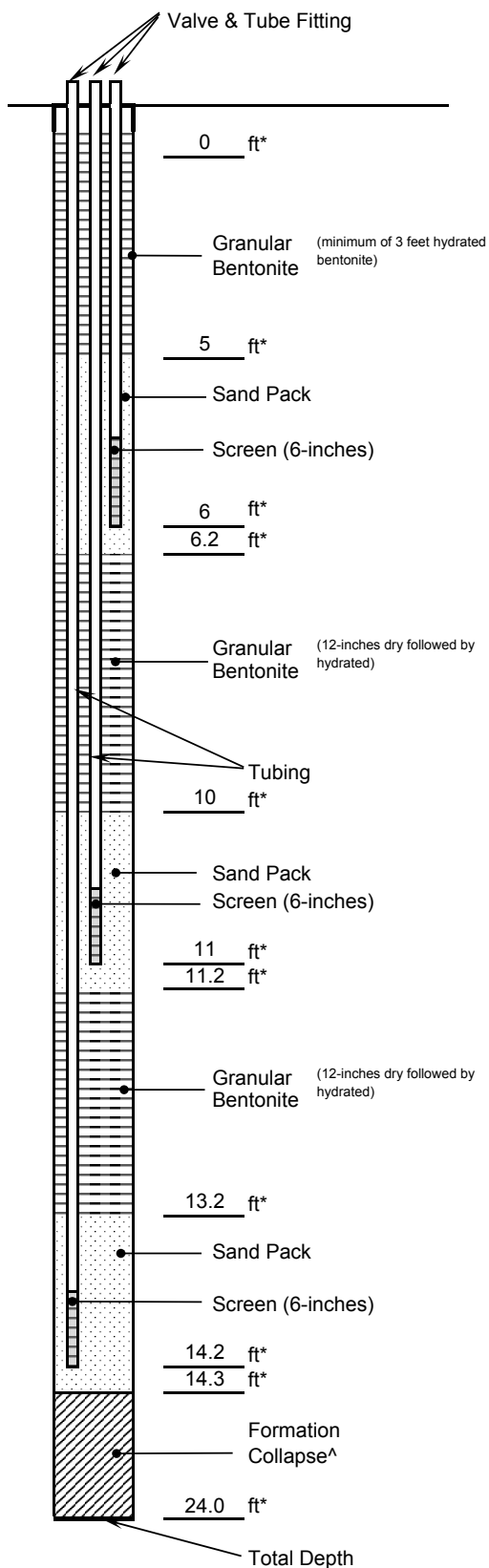
Prepared by: Rumschlag

$V_1 + V_2 + V_3 = V_t$  where:  $V_1 = \pi r^2 h$  = open space volume of soil-gas screen;  
 $V_2 = \pi r^2 h$  = open space volume of sample tubing;  $V_3 = \pi r^2 h \rho$  = estimated open pore space for sand pack and dry bentonite seal;  $V_t$  = total volume;  
 $r$  = inner radius of soil-gas screen, borehole, or sample tubing;  $h$  = height of soil-gas screen or height (length) of tubing or height of sand pack and dry bentonite seal;  $\rho$  = porosity of sand pack and dry bentonite seal (40%).

OD - outer diameter                      12-inches = 1 foot  
 ID - inner diameter                      1 cubic inch = 16.39 mL  
 bls - below land surface                 $\pi = 3.1416$   
 mL - milliliters

\* Depth in Feet Below Land Surface  
 ^ Formation partially collapsed.  
 Bentonite was used to backfill remaining volume

## SOIL-GAS POINT CONSTRUCTION DIAGRAM



RACER Trust SSL VI  
 Project: Verification Investigation Point: SSL-3

City: Moraine

County: Montgomery State: OH

Survey Coordinates:  
 Northing: 620653.7323  
 Easting: 1482809.285

Land-Surface Elevation (surveyed): 723.66 feet  
 (above mean sea level)

Historic Maximum Groundwater Elevation: 709.16 feet  
 (above mean sea level)

Groundwater Encountered During Drilling: 20 feet bls

Installation Dates: 1/30/2012

Weather Conditions at Installation: Clear 45

Drilling Contractor: Envirocore

Driller: Adam Whitt/Jeremy Amick

Drilling Method: Direct push

Screen Construction: Type: Stainless Steel  
 Length: 6 inches  
 Diameter: 0.4375-inch OD, 0.3125-inch ID

Tubing Construction: Type: Teflon  
 Diameter: 0.25-inch OD, 0.17-inch ID

Volume Calculation (mL):	Shallow	Middle	Deep
$V_1$	8	8	8
$V_2$	36	54	72
$V_3$	16,198	1,415	1,415
$V_t$	16,242	1,477	1,495

Remarks: 11" utility hole to 9 feet, 3.25" diameter drill rods

Prepared by: Rumschlag

$V_1 + V_2 + V_3 = V_t$  where:  $V_1 = \pi r^2 h$  = open space volume of soil-gas screen;  
 $V_2 = \pi r^2 h$  = open space volume of sample tubing;  $V_3 = \pi r^2 h \rho$  = estimated open pore space for sand pack and dry bentonite seal;  $V_t$  = total volume;  
 $r$  = inner radius of soil-gas screen, borehole, or sample tubing;  $h$  = height of soil-gas screen or height (length) of tubing or height of sand pack and dry bentonite seal;  $\rho$  = porosity of sand pack and dry bentonite seal (40%).

OD - outer diameter                      12-inches = 1 foot  
 ID - inner diameter                      1 cubic inch = 16.39 mL  
 bls - below land surface                 $\pi = 3.1416$   
 mL - milliliters

\* Depth in Feet Below Land Surface  
 ^ Formation partially collapsed.  
 Bentonite was used to backfill remaining volume



**Attachment 3**

Soil-Gas Point Sampling Logs



## Sub-slab/Soil-Gas Sample Collection Log

		<b>Sample ID:</b> SSL-1(6)/02062012/	
		<b>Client:</b> RACER Trust	<b>Boring Equipment:</b> Direct push drilling rig with 3.25-inch rods
<b>Project:</b> Closed South Settling Lagoon VI Investigation	<b>Sealant:</b> Cement Grout/Bentonite	<b>Location:</b> Moraine, Ohio	<b>Tubing Information:</b> 0.25-inch OD; 0.17-inch ID Teflon
<b>Project #:</b> OH000294.2012.0007A	<b>Miscellaneous Equipment:</b> PID and Dielectric MGD-2002 He detector	<b>Samplers:</b> L. Baumgartner	<b>Subcontractor:</b> None
		<b>Equipment:</b> SKC 220 Air Pumps, Defender 150	
<b>Sampling Depth:</b> 6 feet below land surface	<b>Moisture Content of Sampling Zone:</b> Moist		
<b>Date of Installation:</b> 2/1/2012	<b>Approximate Purge Volume:</b> 500 mL		

**Instrument Readings:**

Date	Time	Canister Vacuum (a) (inches of Hg)	Temperature (°F)	Relative Humidity (%)	Air Speed (mph)	Barometric Pressure (inches of Hg)	PID (ppm)
2/6/2012	13:45	-29.25	49.5	41.7	6	29.39	0.0
2/6/2012	14:16	-9.75	49.5	41.7	6	29.39	0.0

(a) Record canister information at a minimum at the beginning and end of sampling

**SUMMA® Canister Information:**

Size (circle one):	<input checked="" type="radio"/> 1 L <input type="radio"/> 6 L
Canister ID:	37360
Flow Controller ID:	6514
Notes:	

**Tracer Test Information (if applicable):**

Initial Helium Shroud:	98.3%
Final Helium Shroud:	61.8%
Tracer Test Passed:	<input checked="" type="radio"/> Yes <input type="radio"/> No
Notes:	0 ppm He in Tedlar bag following test

**General Observations/Notes:**

Purged for 10 minutes at 50 mL/minute before sampling, canister and flow control passed shut-in test.

$V_1 + V_2 + V_3 = V_t$  where:  $V_1 = \pi r^2 h$  = open space volume of soil-gas screen;  $V_2 = \pi r^2 h$  = open space volume of sample tubing;  $V_3 = \pi r^2 h p$  = estimated open pore space for sand pack and dry bentonite seal;  $V_t$  = total volume;  $r$  = inner radius of soil-gas screen, borehole, or sample tubing;  $h$  = height of soil-gas screen or height (length) of tubing or height of sand pack and dry bentonite seal;  $p$  = porosity of sand pack and dry bentonite seal (40%).



## Sub-slab/Soil-Gas Sample Collection Log

<b>Sample ID:</b> SSL-1(11)/02062012/	
<b>Client:</b> RACER Trust	<b>Boring Equipment:</b> Direct push drilling rig with 3.25-inch rods
<b>Project:</b> Closed South Settling Lagoon VI Investigation	<b>Sealant:</b> Cement Grout/Bentonite
<b>Location:</b> Moraine, Ohio	<b>Tubing Information:</b> 0.25-inch OD; 0.17-inch ID Teflon
<b>Project #:</b> OH000294.2012.0007A	<b>Miscellaneous Equipment:</b> PID and Dielectric MGD-2002 He detector
<b>Samplers:</b> L. Baumgartner	<b>Subcontractor:</b> None
	<b>Equipment:</b> SKC 220 Air Pumps, Defender 150
<b>Sampling Depth:</b> 11 feet below land surface	<b>Moisture Content of Sampling Zone:</b> Dry
<b>Date of Installation:</b> 2/1/2012	<b>Approximate Purge Volume:</b> 500 mL

**Instrument Readings:**

Date	Time	Canister Vacuum (a) (inches of Hg)	Temperature (°F)	Relative Humidity (%)	Air Speed (mph)	Barometric Pressure (inches of Hg)	PID (ppm)
2/6/2012	13:45	-28.25	49.5	41.7	6	29.39	NM
2/6/2012	14:15	-9.5	49.5	41.7	6	29.39	NM

(a) Record canister information at a minimum at the beginning and end of sampling

**SUMMA® Canister Information:**

<b>Size (circle one):</b>	① L      6 L
<b>Canister ID:</b>	36424
<b>Flow Controller ID:</b>	FC00518
<b>Notes:</b>	

**Tracer Test Information (if applicable):**

<b>Initial Helium Shroud:</b>	NA
<b>Final Helium Shroud:</b>	NA
<b>Tracer Test Passed:</b>	Yes      No
<b>Notes:</b>	

**General Observations/Notes:**

Purged for 10 minutes at 50 mL/minute before sampling, canister and flow control passed shut-in test.

$V_1 + V_2 + V_3 = V_t$  where:  $V_1 = \pi r^2 h$  = open space volume of soil-gas screen;  $V_2 = \pi r^2 h$  = open space volume of sample tubing;  $V_3 = \pi r^2 h p$  = estimated open pore space for sand pack and dry bentonite seal;  $V_t$  = total volume;  $r$  = inner radius of soil-gas screen, borehole, or sample tubing;  $h$  = height of soil-gas screen or height (length) of tubing or height of sand pack and dry bentonite seal;  $p$  = porosity of sand pack and dry bentonite seal (40%).



## Sub-slab/Soil-Gas Sample Collection Log

<b>Sample ID:</b> SSL-1(14.2)/02062012/	
<b>Client:</b> RACER Trust	<b>Boring Equipment:</b> Direct push drilling rig with 3.25-inch rods
<b>Project:</b> Closed South Settling Lagoon VI Investigation	<b>Sealant:</b> Cement Grout/Bentonite
<b>Location:</b> Moraine, Ohio	<b>Tubing Information:</b> 0.25-inch OD; 0.17-inch ID Teflon
<b>Project #:</b> OH000294.2012.0007A	<b>Miscellaneous Equipment:</b> PID and Dielectric MGD-2002 He detector
<b>Samplers:</b> L. Baumgartner	<b>Subcontractor:</b> None
	<b>Equipment:</b> SKC 220 Air Pumps, Defender 150
<b>Sampling Depth:</b> 14.2 feet below land surface	<b>Moisture Content of Sampling Zone:</b> Dry
<b>Date of Installation:</b> 2/1/2012	<b>Approximate Purge Volume:</b> 500 mL

**Instrument Readings:**

Date	Time	Canister Vacuum (a) (inches of Hg)	Temperature (°F)	Relative Humidity (%)	Air Speed (mph)	Barometric Pressure (inches of Hg)	PID (ppm)
2/6/2012	13:48	-29	49.5	41.7	6	29.39	NM
2/6/2012	14:08	-5	49.5	41.7	6	29.39	NM

(a) Record canister information at a minimum at the beginning and end of sampling

**SUMMA® Canister Information:**

<b>Size (circle one):</b>	① L      6 L
<b>Canister ID:</b>	37716
<b>Flow Controller ID:</b>	FC00861
<b>Notes:</b>	

**Tracer Test Information (if applicable):**

<b>Initial Helium Shroud:</b>	NA
<b>Final Helium Shroud:</b>	NA
<b>Tracer Test Passed:</b>	Yes      No
<b>Notes:</b>	

**General Observations/Notes:**

Purged for 10 minutes at 50 mL/minute before sampling, canister and flow control passed shut-in test.
Duplicate collected - SSL-DUP-1/02062012/

$V_1 + V_2 + V_3 = V_t$  where:  $V_1 = \pi r^2 h$  = open space volume of soil-gas screen;  $V_2 = \pi r^2 h$  = open space volume of sample tubing;  $V_3 = \pi r^2 h p$  = estimated open pore space for sand pack and dry bentonite seal;  $V_t$  = total volume;  $r$  = inner radius of soil-gas screen, borehole, or sample tubing;  $h$  = height of soil-gas screen or height (length) of tubing or height of sand pack and dry bentonite seal;  $p$  = porosity of sand pack and dry bentonite seal (40%).



## Sub-slab/Soil-Gas Sample Collection Log

		<b>Sample ID:</b> SSL-DUP-1/02062012/	
		<b>Client:</b> RACER Trust	<b>Boring Equipment:</b> Direct push drilling rig with 3.25-inch rods
<b>Project:</b> Closed South Settling Lagoon VI Investigation	<b>Sealant:</b> Cement Grout/Bentonite	<b>Location:</b> Moraine, Ohio	<b>Tubing Information:</b> 0.25-inch OD; 0.17-inch ID Teflon
<b>Project #:</b> OH000294.2012.0007A	<b>Miscellaneous Equipment:</b> PID and Dielectric MGD-2002 He detector	<b>Samplers:</b> L. Baumgartner	<b>Subcontractor:</b> None
		<b>Equipment:</b> SKC 220 Air Pumps, Defender 150	
<b>Sampling Depth:</b> 14.2 feet below land surface	<b>Moisture Content of Sampling Zone:</b> Dry		
<b>Date of Installation:</b> 2/1/2012	<b>Approximate Purge Volume:</b> 500 mL		

**Instrument Readings:**

Date	Time	Canister Vacuum (a) (inches of Hg)	Temperature (°F)	Relative Humidity (%)	Air Speed (mph)	Barometric Pressure (inches of Hg)	PID (ppm)
2/6/2012	13:48	-28.25	49.5	41.7	6	29.39	NM
2/6/2012	14:19	-8	49.5	41.7	6	29.39	NM

(a) Record canister information at a minimum at the beginning and end of sampling

**SUMMA® Canister Information:**

Size (circle one):	<input checked="" type="radio"/> 1 L <input type="radio"/> 6 L
Canister ID:	100188
Flow Controller ID:	FC00115
Notes:	

**Tracer Test Information (if applicable):**

Initial Helium Shroud:	NA	
Final Helium Shroud:	NA	
Tracer Test Passed:	Yes	No
Notes:		

**General Observations/Notes:**

Purged for 10 minutes at 50 mL/minute before sampling, canister and flow control passed shut-in test.
Parent sample - SSL-1(14.2)/02062012/

$V_1 + V_2 + V_3 = V_t$  where:  $V_1 = \pi r^2 h$  = open space volume of soil-gas screen;  $V_2 = \pi r^2 h$  = open space volume of sample tubing;  $V_3 = \pi r^2 h p$  = estimated open pore space for sand pack and dry bentonite seal;  $V_t$  = total volume;  $r$  = inner radius of soil-gas screen, borehole, or sample tubing;  $h$  = height of soil-gas screen or height (length) of tubing or height of sand pack and dry bentonite seal;  $p$  = porosity of sand pack and dry bentonite seal (40%).



## Sub-slab/Soil-Gas Sample Collection Log

<b>Sample ID:</b> SSL-2(6)/02062012/	
<b>Client:</b> RACER Trust	<b>Boring Equipment:</b> Direct push drilling rig with 3.25-inch rods
<b>Project:</b> Closed South Settling Lagoon VI Investigation	<b>Sealant:</b> Cement Grout/Bentonite
<b>Location:</b> Moraine, Ohio	<b>Tubing Information:</b> 0.25-inch OD; 0.17-inch ID Teflon
<b>Project #:</b> OH000294.2012.0007A	<b>Miscellaneous Equipment:</b> PID and Dielectric MGD-2002 He detector
<b>Samplers:</b> L. Baumgartner	<b>Subcontractor:</b> None
	<b>Equipment:</b> SKC 220 Air Pumps, Defender 150
<b>Sampling Depth:</b> 6 feet below land surface	<b>Moisture Content of Sampling Zone:</b> Dry
<b>Date of Installation:</b> 1/31/2012	<b>Approximate Purge Volume:</b> 500 mL

**Instrument Readings:**

Date	Time	Canister Vacuum (a) (inches of Hg)	Temperature (°F)	Relative Humidity (%)	Air Speed (mph)	Barometric Pressure (inches of Hg)	PID (ppm)
2/6/2012	15:02	-28.75	53.7	41.8	1.4	29.37	0.0
2/6/2012	15:32	-8	53.7	41.8	1.4	29.37	0.0

(a) Record canister information at a minimum at the beginning and end of sampling

**SUMMA® Canister Information:**

<b>Size (circle one):</b>	(1 L)      6 L
<b>Canister ID:</b>	34090
<b>Flow Controller ID:</b>	FC00649
<b>Notes:</b>	

**Tracer Test Information (if applicable):**

<b>Initial Helium Shroud:</b>	91.0%
<b>Final Helium Shroud:</b>	66.6%
<b>Tracer Test Passed:</b>	(Yes)      No
<b>Notes:</b>	0 ppm He in Tedlar bag following test

**General Observations/Notes:**

Purged for 10 minutes at 50 mL/minute before sampling, canister and flow control passed shut-in test.

$V_1 + V_2 + V_3 = V_t$  where:  $V_1 = \pi r^2 h$  = open space volume of soil-gas screen;  $V_2 = \pi r^2 h$  = open space volume of sample tubing;  $V_3 = \pi r^2 h p$  = estimated open pore space for sand pack and dry bentonite seal;  $V_t$  = total volume;  $r$  = inner radius of soil-gas screen, borehole, or sample tubing;  $h$  = height of soil-gas screen or height (length) of tubing or height of sand pack and dry bentonite seal;  $p$  = porosity of sand pack and dry bentonite seal (40%).



## Sub-slab/Soil-Gas Sample Collection Log

<b>Sample ID:</b> SSL-2(11)/02062012/	
<b>Client:</b> RACER Trust	<b>Boring Equipment:</b> Direct push drilling rig with 3.25-inch rods
<b>Project:</b> Closed South Settling Lagoon VI Investigation	<b>Sealant:</b> Cement Grout/Bentonite
<b>Location:</b> Moraine, Ohio	<b>Tubing Information:</b> 0.25-inch OD; 0.17-inch ID Teflon
<b>Project #:</b> OH000294.2012.0007A	<b>Miscellaneous Equipment:</b> PID and Dielectric MGD-2002 He detector
<b>Samplers:</b> L. Baumgartner	<b>Subcontractor:</b> None
	<b>Equipment:</b> SKC 220 Air Pumps, Defender 150
<b>Sampling Depth:</b> 11 feet below land surface	<b>Moisture Content of Sampling Zone:</b> Dry
<b>Date of Installation:</b> 1/31/2012	<b>Approximate Purge Volume:</b> 500 mL

**Instrument Readings:**

Date	Time	Canister Vacuum (a) (inches of Hg)	Temperature (°F)	Relative Humidity (%)	Air Speed (mph)	Barometric Pressure (inches of Hg)	PID (ppm)
2/6/2012	15:02	-30	53.7	41.8	1.4	29.37	0.0
2/6/2012	15:36	-8.5	53.7	41.8	1.4	29.37	0.0

(a) Record canister information at a minimum at the beginning and end of sampling

**SUMMA® Canister Information:**

<b>Size (circle one):</b>	① L      6 L
<b>Canister ID:</b>	2101
<b>Flow Controller ID:</b>	FC00828
<b>Notes:</b>	

**Tracer Test Information (if applicable):**

<b>Initial Helium Shroud:</b>	NA
<b>Final Helium Shroud:</b>	NA
<b>Tracer Test Passed:</b>	Yes      No
<b>Notes:</b>	

**General Observations/Notes:**

Purged for 10 minutes at 50 mL/minute before sampling, canister and flow control passed shut-in test.

$V_1 + V_2 + V_3 = V_t$  where:  $V_1 = \pi r^2 h$  = open space volume of soil-gas screen;  $V_2 = \pi r^2 h$  = open space volume of sample tubing;  $V_3 = \pi r^2 h p$  = estimated open pore space for sand pack and dry bentonite seal;  $V_t$  = total volume;  $r$  = inner radius of soil-gas screen, borehole, or sample tubing;  $h$  = height of soil-gas screen or height (length) of tubing or height of sand pack and dry bentonite seal;  $p$  = porosity of sand pack and dry bentonite seal (40%).



## Sub-slab/Soil-Gas Sample Collection Log

<b>Sample ID:</b> SSL-2(14.2)/02062012/	
<b>Client:</b> RACER Trust	<b>Boring Equipment:</b> Direct push drilling rig with 3.25-inch rods
<b>Project:</b> Closed South Settling Lagoon VI Investigation	<b>Sealant:</b> Cement Grout/Bentonite
<b>Location:</b> Moraine, Ohio	<b>Tubing Information:</b> 0.25-inch OD; 0.17-inch ID Teflon
<b>Project #:</b> OH000294.2012.0007A	<b>Miscellaneous Equipment:</b> PID and Dielectric MGD-2002 He detector
<b>Samplers:</b> L. Baumgartner	<b>Subcontractor:</b> None
	<b>Equipment:</b> SKC 220 Air Pumps, Defender 150
<b>Sampling Depth:</b> 14.2 feet below land surface	<b>Moisture Content of Sampling Zone:</b> Dry
<b>Date of Installation:</b> 1/31/2012	<b>Approximate Purge Volume:</b> 500 mL

**Instrument Readings:**

Date	Time	Canister Vacuum (a) (inches of Hg)	Temperature (°F)	Relative Humidity (%)	Air Speed (mph)	Barometric Pressure (inches of Hg)	PID (ppm)
2/6/2012	15:03	-30	53.7	41.8	1.4	29.37	0.0
2/6/2012	19:39	-8.5	53.7	41.8	1.4	29.37	0.0

(a) Record canister information at a minimum at the beginning and end of sampling

**SUMMA® Canister Information:**

<b>Size (circle one):</b>	① L      6 L
<b>Canister ID:</b>	35610
<b>Flow Controller ID:</b>	FC00737
<b>Notes:</b>	

**Tracer Test Information (if applicable):**

<b>Initial Helium Shroud:</b>	NA
<b>Final Helium Shroud:</b>	NA
<b>Tracer Test Passed:</b>	Yes      No
<b>Notes:</b>	

**General Observations/Notes:**

Purged for 10 minutes at 50 mL/minute before sampling, canister and flow control passed shut-in test.

$V_1 + V_2 + V_3 = V_t$  where:  $V_1 = \pi r^2 h$  = open space volume of soil-gas screen;  $V_2 = \pi r^2 h$  = open space volume of sample tubing;  $V_3 = \pi r^2 h p$  = estimated open pore space for sand pack and dry bentonite seal;  $V_t$  = total volume;  $r$  = inner radius of soil-gas screen, borehole, or sample tubing;  $h$  = height of soil-gas screen or height (length) of tubing or height of sand pack and dry bentonite seal;  $p$  = porosity of sand pack and dry bentonite seal (40%).



## Sub-slab/Soil-Gas Sample Collection Log

<b>Sample ID:</b> SSL-3(6)/02062012/	
<b>Client:</b> RACER Trust	<b>Boring Equipment:</b> Direct push drilling rig with 3.25-inch rods
<b>Project:</b> Closed South Settling Lagoon VI Investigation	<b>Sealant:</b> Cement Grout/Bentonite
<b>Location:</b> Moraine, Ohio	<b>Tubing Information:</b> 0.25-inch OD; 0.17-inch ID Teflon
<b>Project #:</b> OH000294.2012.0007A	<b>Miscellaneous Equipment:</b> PID and Dielectric MGD-2002 He detector
<b>Samplers:</b> L. Baumgartner	<b>Subcontractor:</b> None
	<b>Equipment:</b> SKC 220 Air Pumps, Defender 150
<b>Sampling Depth:</b> 6 feet below land surface	<b>Moisture Content of Sampling Zone:</b> Moist
<b>Date of Installation:</b> 1/30/2012	<b>Approximate Purge Volume:</b> 500 mL

**Instrument Readings:**

Date	Time	Canister Vacuum (a) (inches of Hg)	Temperature (°F)	Relative Humidity (%)	Air Speed (mph)	Barometric Pressure (inches of Hg)	PID (ppm)
2/6/2012	11:28	> -30	47.3	62.9	1.8	29.45	0.0
2/6/2012	12:01	-11.75	47.3	62.9	1.8	29.45	0.0

(a) Record canister information at a minimum at the beginning and end of sampling

**SUMMA® Canister Information:**

<b>Size (circle one):</b>	(1 L)      6 L
<b>Canister ID:</b>	35637
<b>Flow Controller ID:</b>	6706
<b>Notes:</b>	

**Tracer Test Information (if applicable):**

<b>Initial Helium Shroud:</b>	96.3%
<b>Final Helium Shroud:</b>	55.0%
<b>Tracer Test Passed:</b>	(Yes)      No
<b>Notes:</b>	0 ppm He in Tedlar bag following test

**General Observations/Notes:**

Purged for 10 minutes at 50 mL/minute before sampling, canister and flow control passed shut-in test.
Helium inside shroud at 11:15 was at 85%.

$V_1 + V_2 + V_3 = V_t$  where:  $V_1 = \pi r^2 h$  = open space volume of soil-gas screen;  $V_2 = \pi r^2 h$  = open space volume of sample tubing;  $V_3 = \pi r^2 h p$  = estimated open pore space for sand pack and dry bentonite seal;  $V_t$  = total volume;  $r$  = inner radius of soil-gas screen, borehole, or sample tubing;  $h$  = height of soil-gas screen or height (length) of tubing or height of sand pack and dry bentonite seal;  $p$  = porosity of sand pack and dry bentonite seal (40%).



## Sub-slab/Soil-Gas Sample Collection Log

<b>Sample ID:</b> SSL-3(11)/02062012/	
<b>Client:</b> RACER Trust	<b>Boring Equipment:</b> Direct push drilling rig with 3.25-inch rods
<b>Project:</b> Closed South Settling Lagoon VI Investigation	<b>Sealant:</b> Cement Grout/Bentonite
<b>Location:</b> Moraine, Ohio	<b>Tubing Information:</b> 0.25-inch OD; 0.17-inch ID Teflon
<b>Project #:</b> OH000294.2012.0007A	<b>Miscellaneous Equipment:</b> PID and Dielectric MGD-2002 He detector
<b>Samplers:</b> L. Baumgartner	<b>Subcontractor:</b> None
	<b>Equipment:</b> SKC 220 Air Pumps, Defender 150
<b>Sampling Depth:</b> 11 feet below land surface	<b>Moisture Content of Sampling Zone:</b> Moist
<b>Date of Installation:</b> 1/30/2012	<b>Approximate Purge Volume:</b> 500 mL

**Instrument Readings:**

Date	Time	Canister Vacuum (a) (inches of Hg)	Temperature (°F)	Relative Humidity (%)	Air Speed (mph)	Barometric Pressure (inches of Hg)	PID (ppm)
2/6/2012	11:29	-30	47.3	62.9	1.8	29.45	NM
2/6/2012	12:03	-7.5	47.3	62.9	1.8	29.45	NM

(a) Record canister information at a minimum at the beginning and end of sampling

**SUMMA® Canister Information:**

<b>Size (circle one):</b>	① L      6 L
<b>Canister ID:</b>	20777
<b>Flow Controller ID:</b>	FC00732
<b>Notes:</b>	

**Tracer Test Information (if applicable):**

<b>Initial Helium Shroud:</b>	NA
<b>Final Helium Shroud:</b>	NA
<b>Tracer Test Passed:</b>	Yes      No
<b>Notes:</b>	

**General Observations/Notes:**

Purged for 10 minutes at 50 mL/minute before sampling, canister and flow control passed shut-in test.

$V_1 + V_2 + V_3 = V_t$  where:  $V_1 = \pi r^2 h$  = open space volume of soil-gas screen;  $V_2 = \pi r^2 h$  = open space volume of sample tubing;  $V_3 = \pi r^2 h p$  = estimated open pore space for sand pack and dry bentonite seal;  $V_t$  = total volume;  $r$  = inner radius of soil-gas screen, borehole, or sample tubing;  $h$  = height of soil-gas screen or height (length) of tubing or height of sand pack and dry bentonite seal;  $p$  = porosity of sand pack and dry bentonite seal (40%).



## Sub-slab/Soil-Gas Sample Collection Log

<b>Sample ID:</b> SSL-3(14.2)/02062012/	
<b>Client:</b> RACER Trust	<b>Boring Equipment:</b> Direct push drilling rig with 3.25-inch rods
<b>Project:</b> Closed South Settling Lagoon VI Investigation	<b>Sealant:</b> Cement Grout/Bentonite
<b>Location:</b> Moraine, Ohio	<b>Tubing Information:</b> 0.25-inch OD; 0.17-inch ID Teflon
<b>Project #:</b> OH000294.2012.0007A	<b>Miscellaneous Equipment:</b> PID and Dielectric MGD-2002 He detector
<b>Samplers:</b> L. Baumgartner	<b>Subcontractor:</b> None
	<b>Equipment:</b> SKC 220 Air Pumps, Defender 150
<b>Sampling Depth:</b> 14.2 feet below land surface	<b>Moisture Content of Sampling Zone:</b> Moist
<b>Date of Installation:</b> 1/30/2012	<b>Approximate Purge Volume:</b> 500 mL

**Instrument Readings:**

Date	Time	Canister Vacuum (a) (inches of Hg)	Temperature (°F)	Relative Humidity (%)	Air Speed (mph)	Barometric Pressure (inches of Hg)	PID (ppm)
2/6/2012	11:28	-29.75	47.3	62.9	1.8	29.45	NM
2/6/2012	11:59	-9	47.3	62.9	1.8	29.45	NM

(a) Record canister information at a minimum at the beginning and end of sampling

**SUMMA® Canister Information:**

<b>Size (circle one):</b>	<input checked="" type="radio"/> 1 L <input type="radio"/> 6 L
<b>Canister ID:</b>	36402
<b>Flow Controller ID:</b>	FC00956
<b>Notes:</b>	

**Tracer Test Information (if applicable):**

<b>Initial Helium Shroud:</b>	NA	
<b>Final Helium Shroud:</b>	NA	
<b>Tracer Test Passed:</b>	Yes	No
<b>Notes:</b>		

**General Observations/Notes:**

Purged for 10 minutes at 50 mL/minute before sampling, canister and flow control passed shut-in test.

$V_1 + V_2 + V_3 = V_t$  where:  $V_1 = \pi r^2 h$  = open space volume of soil-gas screen;  $V_2 = \pi r^2 h$  = open space volume of sample tubing;  $V_3 = \pi r^2 h p$  = estimated open pore space for sand pack and dry bentonite seal;  $V_t$  = total volume;  $r$  = inner radius of soil-gas screen, borehole, or sample tubing;  $h$  = height of soil-gas screen or height (length) of tubing or height of sand pack and dry bentonite seal;  $p$  = porosity of sand pack and dry bentonite seal (40%).