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Environment

Subject:  
Plant 6 Vapor Intrusion Investigation – Revised  
RACER Lansing Plant 6  
Lansing, Michigan

Date:  
October 29, 2020

Contact:  
Patrick Curry

Dear Ms. Matlock:

Phone:  
810-225-1926

Arcadis of Michigan, LLC (Arcadis) on behalf of Revitalizing Auto Communities Environmental Response (RACER) Trust has completed additional delineation of vinyl chloride near the Plant 6 entrance (site) in Lansing, Michigan. The following revised version of this memorandum incorporates additions to the scope of work as suggested by EGLE via email correspondence from Joseph Rogers on October 20, 2020.

Email:  
patrick.curry@arcadis.com

Our ref:  
30006870

The investigation near the Plant 6 entrance was completed consistent with the revised *2019 Vapor Intrusion Evaluation and Work Plan (Arcadis 2019a)* provided to the Michigan Department of Environment, Great Lakes and Energy (EGLE) on October 1, 2019 and the *2020 Vapor Intrusion Follow Up Workplan (Arcadis 2020)* provided to EGLE on May 6, 2020. The objective of the additional work was to evaluate the off-site extent of vinyl chloride above the Site-Specific Volatilization to Indoor Air Criteria (SSVIAC) provided by the EGLE on August 15, 2018. The most restrictive SSVIAC for vinyl chloride in groundwater is 0.96 micrograms per liter ( $\mu\text{g/L}$ ) and applies to a residential house with a basement, sandy soils and groundwater at a depth of 10 feet below grade.

This report summarizes the additional groundwater data collected near the Plant 6 northeast entrance and includes proposed additional work to further evaluate the potential VI pathway at the site.

## INVESTIGATION ACTIVITIES

As recommended in the EGLE 2013 VI Guidance Document a general rule of thumb is that a source of chlorinated vapors is considered a viable exposure pathway if it is located up to 100 feet from a receptor. Based on an initial screening of soil and groundwater compared to the draft EGLE 2017 VI Criteria, several exceedances were observed near the Plant 6 property boundaries.

Near the Plant 6 entrance, the vertical aquifer profile (VAP) location VAP-A5.7-MB257 had a detection of vinyl chloride of 13 µg/L at a depth of 7-8 feet bgs during the initial investigation completed in 2012. The 7 to 8-foot interval at VAP-A5.7-MB257 was resampled on February 17, 2020 using direct push rig and a temporary well screen. Vinyl chloride was detected at a concentration of 3.0 micrograms per liter (µg/L) during the resample of VAP-A5.7-MB257, exceeding the SSVIAC of 0.96 µg/L.

Based on these results Arcadis completed additional delineation activities on July 20-24, 2020 for vinyl chloride outlined in the May 6, 2020 *RACER Lansing Vapor Intrusion Follow Up Workplan* (Arcadis 2020). Additional activities consisted of advancing five direct push VAP borings in the rights-of-way (ROW) along Stanley Street and Osborne Road located to the east of Plant 6 and VAP-A5.7-MB257. Boring locations are provided on **Figure 1**. At each location soil borings were advanced to a depth of 15 to 20 feet bgs and soils were described by an Arcadis geologist. Boring logs are included in **Attachment 1**. A groundwater sample was collected at each boring location using a PVC temporary well. Sample intervals were selected to intersect saturated zones at a similar depth to the one encountered in VAP-A5.7-MB257 (7-8 feet bgs). Samples were submitted to Merit Laboratories in East Lansing, Michigan for volatile organic compound (VOC) analysis using USEPA Method 8260.

## RESULTS AND DISCUSSION

Analytical results compared to groundwater SSVIAC are summarized on **Table 1** and on **Figure 1**. Laboratory analytical reports are included as **Attachment 2**. Vinyl chloride was detected in groundwater at concentrations of 1 to 2 µg/L at two of the five off-site boring locations. Vinyl chloride was not detected in SB-OS-LV263, SB-OS-MB263, or SB-OS-MC268, providing delineation to the north, southeast, and east respectively. SB-OS-MA266 is located approximately 100 feet from the nearest building (a garage associated with a residence including a basement) and contained a vinyl chloride at a concentration of 1 µg/L. At boring SB-A5.7-LX268 located further northeast, the geology consisted entirely of clay and groundwater was not encountered.

Cis-1,2-dichloroethene (Cis-1,2-DCE) was the only VOC other than vinyl chloride detected during this investigation. Cis-1,2-DCE was detected at a concentration of 3 µg/L in SB-OS-LY263 and at 1 µg/L at SB-OS-MA266. Both concentrations are below the SSVIAC of 48 µg/L for cis-1,2-DCE.

In general, the hydrogeologic conditions in this area are expected to limit the off-site risk of vapor intrusion. Vinyl chloride impacts exceeding SSVIAC in groundwater are encountered between ground surface and 15 ft bgs, consistent with the perched zone at the Site. The geology of the area is dominated by clay with discontinuous layers of sand, silt and some fill material that can be saturated in the upper 15 feet. A cross section of the Plant 6 entrance area is provided as **Figure 2**. SSVIAC exceedances in groundwater at soil boring location VAP-A5.7-MB257 were encountered in a sand seam from 7 to 8 feet bgs. The sand seam is present in soil boring SB-OS-MA266 located on the east side of Stanley Street at a depth of 8-9.5 feet bgs. A previous VAP boring, SB-A5.7-LX268, which is located between the

residence to the northeast and the detection at SB-OS-MA266, encountered only clay with no sampleable groundwater present.

Also, note that the presumed source of vinyl chloride was removed in 2016 during the Area 5-7 excavation of trichlorethylene (TCE) impacted soil (PM Environmental 2016). This is likely the primary reason vinyl chloride concentrations dropped from 13 ug/L to 3 µg/L at location VAP-A5.7-MB257. Based on the clay dominant geology, limited migration of groundwater to the northeast, mitigated source, and apparent decreasing concentrations, risk of vapor migration through the subsurface appears limited.

### Utility Corridor Assessment

At the request of the EGLE, Arcadis has reviewed available utility drawings for Stanley St, Osborn Rd., and Drexler Rd to determine if migration of vapors to residences via utility corridors could pose a VI risk to residents. A map summarizing the utilities present along Osborn Road, Stanley Street and Drexel Road is provided as **Figure 3**. The utility drawings provided by the City of Lansing are included as **Attachment 3**. Based on the review, the combined sanitary sewer passes through the zone where vinyl chloride was detected at 1-2 µg/L, continues north along Stanley, and may intersect with the sewer corridor that flows west to east along Drexel, before continuing north along Stanley. It is unclear, based on the city drawings, how the sewers at Stanley and Drexel connect, if at all. The residential connections to the sewer are on Drexel. Other utilities present in the area include buried electric, a high-pressure gas main and water (**Figure 3**).

The location of combined sewers (within the street) and depth (typically <6 feet to top of pipe) presents several challenges for evaluating the utility corridor pathway. Based on the vinyl chloride concentration present in groundwater (1-3 µg/L), and the sewer connections to the residential homes along Drexel (as opposed to Stanley), it seems unlikely that vapor associated with groundwater impacts could migrate 300-400 feet along the sewer corridor and impact the nearest home.

## PROPOSED INVESTIGATION ACTIVITIES

Based on the groundwater SSVIIC exceedances observed near the Plant 6 entrance Arcadis is proposing to install two monitoring wells to monitor vinyl chloride concentrations in perched groundwater, and three nested soil vapor monitoring points (SVMPs) to verify the absence of vinyl chloride vapors within 100 feet of the nearest occupied structure. One monitoring well will be co-located with VAP-A5.7-MB257 on Plant 6 and will be screened to intersect the sand seam identified at 7-8 feet bgs. A monitoring well will also be installed in the eastern Stanley Street right-of-way (ROW), north of SB-OS-MA266 and screened to intersect the sand seam observed at 9 – 10.5 feet bgs. Additionally, up to 3 soil vapor monitoring points will be installed further northeast (in the vicinity of soil boring SB-A5.7-LX268). The proposed monitoring well and SVMP locations are included on **Figure 1**.

### Borehole Clearance

Prior to initiating this scope of work, Arcadis will obtain the required permits from the City of Lansing to complete the ROW work and complete utility clearance at each proposed monitoring well location. Arcadis will subcontract a private utility locate firm to identify utilities and to clear each intrusive location utilizing ground penetrating radar and/or electromagnetic surveying. In addition, Arcadis will use the Michigan One-Call system, or Miss Dig to submit utility clearance requests for the property.

### **Monitoring Well Construction and Sampling**

Continuous soil cores will be obtained from the ground surface to the target well depth or deepest SVMP depth at each boring location using a direct push drilling approach. Arcadis will log and describe the soils in accordance with the Arcadis Soil Description Technical Guidance Instruction (TGI). Boring logs will be generated based on the field descriptions and provided as part of the follow-up reporting.

Monitoring wells will be constructed with a 5-foot stainless-steel wire-wrapped 0.010-slot screens and 2-inch PVC riser. An appropriate sand pack will be placed around the screen interval to a depth of 1 foot above the well screen followed by 1 to 2 feet of choker sand and then bentonite grout to grade. The wells will be developed using a purge and surge technique prior to sample collection.

Monitoring wells installed as part of the above described work will be integrated into the revised Interim Groundwater Monitoring Plan (Arcadis 2019b) and will be sampled for VOCs.

### **SVMP Construction and Sampling**

The proposed SVMPs will be installed at approximately 5, 10, and 15 feet bgs unless groundwater is encountered in which case SVMPs will be installed at 5-foot intervals until approximately 2 feet above the water table. **Attachment 4** includes a schematic of a completed SVMP for reference. Installation will be completed in accordance with the Arcadis Installation of Permanent Soil Vapor Probes TGI (**Attachment 5**) and will include:

- Each SVMP will consist of a 6-inch stainless-steel screen inside a 12-inch sand pack.
- Teflon, Teflon-lined, or nylon tubing will be attached to the SVMP screen and terminated with an air-tight cap at ground surface.
- Approximately 6 inches of dry granulated bentonite will be placed on top of the sand pack associated with the deeper SVMP followed by hydrated granulated bentonite to seal above the sand pack to 3 inches below the bottom of the shallow SVMP depth. This will be repeated above the shallow SVMP sand pack with the addition of hydrated bentonite to 12 inches below surface grade. A small amount of sand will be placed on top of the bentonite to ensure that the tubing does not contact the bentonite during curing.
- Each SVMP will be permanently labeled with the proper identification and depth on both the tubing associated with each SVMP and the well box cover.

A minimum of 48 hours will pass following SVMP installation before sampling will be conducted per the *Guidance Document for the Vapor Intrusion Pathway* (MDEQ 2013). Arcadis will collect soil vapor samples from the newly installed SVMPs. Prior to sampling, at least three tubing volumes will be purged from each SVMP. Additionally, a real-time helium leak test will be conducted to ensure no atmospheric air is entering the sample point or sample train. Samples will be collected using 1-liter Bottle-Vacs. The initial canister vacuum will be at least -26 inches of mercury. Samples will be collected using dedicated flow-controllers set at a 5-minute collection time (200 milliliters per minute). Canisters will be closed when 5 inches of mercury vacuum remain as measured by a field digital gauge.

Ms. Christine Matlock  
EGLE  
October 29, 2020

During the vapor sampling events, quality control samples will be collected and will include one duplicate sample per mobilization. Soil vapor samples will be submitted under chain-of-custody protocol to Fibertec in Brighton, Michigan, for analysis of VOCs by United States Environmental Protection Agency Method TO-15. Sample results will be compared to EGLE-provided Site-Specific Volatilization to Indoor Air Criteria, as appropriate.

The SVMPs will be sampled on a quarterly basis, for up to one year following installation, with results provided to EGLE after each round of sampling.

Should you have any questions regarding the proposed work, please contact David Favero at 217-741-6235 or Patrick Curry at 810-225-1926.

Sincerely,

Arcadis of Michigan, LLC



Patrick Curry, PG, CPG  
Principal Geologist

Copies:

Mr. Dave Favero – RACER

## REFERENCES:

- MDEQ. 2013. Guidance Document for the Vapor Intrusion Pathway. Remediation and Redevelopment Division. May.
- Arcadis. 2019a. Vapor Intrusion Evaluation and Work Plan -2019. RACER Trust, Lansing, Michigan, Plants 2, 3, and 6. October 1.
- Arcadis. 2019b. Revised Interim Groundwater Monitoring Plan - 2019. RACER Trust, Plants 2, 3 and 6, Lansing, Michigan. October 28.
- Arcadis. 2020. Vapor Intrusion Follow Up Workplan. RACER Trust, Plant 6, Lansing, Michigan. May 6.
- PM Environmental. 2016. Excavation Summary Report for Areas 5-7, 7, and 9. RACER Industrial Property, Plant 6, Lansing, Michigan. September.

Enclosures:

**Tables**

- 1 Summary of Groundwater Analytical Results

**Figures**

- 1 Summary of Groundwater Analytical Results – Vinyl Chloride
- 2 Plant 6 Entrance Cross-Section
- 3 Utility Summary

**Attachments**

- 1 Soil Boring Logs
- 2 Laboratory Analytical Results
- 3 Storm and Sanitary Sewer Figures
- 4 Nested SVMP Diagram
- 5 Technical Guidance Instructions – Installation of Permanent Soil Vapor Probes

# TABLES



**Table 1**  
**Summary of Groundwater Analytical Results**  
**July 2020**  
**2020 Plant 6 Vinyl Chloride Investigation Memo**  
**RACER Trust Plant 6 - Lansing, Michigan**

Location ID: Date Collected: Sample Name:	RES SSVIAC GWNIC (EGLE2018)	Units	SB-OS-MA266 07/24/20 VAP-OS-MA266_7-12	SB-OS-MB263 07/21/20 VAP-OS-MB263_5-10	SB-OS-MC268 07/24/20 VAP-OS-MC268_7-12	SB-OS-LV263 07/21/20 VAP-OS-LV263_8-13	SB-OS-LY263 07/21/20 VAP-OS-LY263_9-14
<b>Volatile Organics</b>							
Ethyl ether (diethyl ether)	--	µg/L	<10	<10	<10	<10	<10 [ $<10$ ]
Acetone	1.20E+07	µg/L	<50	<50	<50	<50	<50 [ $<50$ ]
Carbon disulfide	970	µg/L	<5	<5	<5	<5	<5 [ $<5$ ]
Methyl tert butyl ether (MTBE)	4,000	µg/L	<5	<5	<5	<5	<5 [ $<5$ ]
Acrylonitrile	--	µg/L	<2	<2	<2	<2	<2 [ $<2$ ]
2-Butanone (Methyl ethyl ketone) (MEK)	1.50E+06	µg/L	<25	<25	<25	<25	<25 [ $<25$ ]
Dichlorodifluoromethane (CFC-12)	--	µg/L	<5	<5	<5	<5	<5 [ $<5$ ]
Chloromethane (Methyl chloride)	--	µg/L	<5	<5	<5	<5	<5 [ $<5$ ]
Vinyl chloride	0.96	µg/L	<b>1</b>	<1	<1	<1	<b>2 [2]</b>
Bromomethane (Methyl bromide)	--	µg/L	<5	<5	<5	<5	<5 [ $<5$ ]
Chloroethane	--	µg/L	<5	<5	<5	<5	<5 [ $<5$ ]
Trichlorofluoromethane (CFC-11)	--	µg/L	<1	<1	<1	<1	<1 [ $<1$ ]
1,1-Dichloroethene	170	µg/L	<1	<1	<1	<1	<1 [ $<1$ ]
Methylene chloride	--	µg/L	<5	<5	<5	<5	<5 [ $<5$ ]
trans-1,2-Dichloroethene	200	µg/L	<1	<1	<1	<1	<1 [ $<1$ ]
1,1-Dichloroethane	67	µg/L	<1	<1	<1	<1	<1 [ $<1$ ]
cis-1,2-Dichloroethene	48	µg/L	<b>1</b>	<1	<1	<1	<b>3 [3]</b>
Tetrahydrofuran	--	µg/L	<90	<90	<90	<90	<90 [ $<90$ ]
Chloroform (Trichloromethane)	7.6	µg/L	<1	<1	<1	<1	<1 [ $<1$ ]
Bromochloromethane	--	µg/L	<1	<1	<1	<1	<1 [ $<1$ ]
1,1,1-Trichloroethane	8,700	µg/L	<1	<1	<1	<1	<1 [ $<1$ ]
4-Methyl-2-pentanone (Methyl isobutyl ketone) (MIBK)	--	µg/L	<50	<50	<50	<50	<50 [ $<50$ ]
2-Hexanone	--	µg/L	<50	<50	<50	<50	<50 [ $<50$ ]
Carbon tetrachloride	--	µg/L	<1	<1	<1	<1	<1 [ $<1$ ]
Benzene	14	µg/L	<1	<1	<1	<1	<1 [ $<1$ ]
1,2-Dichloroethane	21	µg/L	<1	<1	<1	<1	<1 [ $<1$ ]
Trichloroethene	6.2	µg/L	<1	<1	<1	<1	<1 [ $<1$ ]
1,2-Dichloropropane	--	µg/L	<1	<1	<1	<1	<1 [ $<1$ ]
Bromodichloromethane	--	µg/L	<1	<1	<1	<1	<1 [ $<1$ ]
Dibromomethane	--	µg/L	<5	<5	<5	<5	<5 [ $<5$ ]
cis-1,3-Dichloropropene	--	µg/L	<1	<1	<1	<1	<1 [ $<1$ ]
Toluene	23,000	µg/L	<1	<1	<1	<1	<1 [ $<1$ ]
trans-1,3-Dichloropropene	--	µg/L	<1	<1	<1	<1	<1 [ $<1$ ]
1,1,2-Trichloroethane	8.1	µg/L	<1	<1	<1	<1	<1 [ $<1$ ]
Tetrachloroethene	97	µg/L	<1	<1	<1	<1	<1 [ $<1$ ]
trans-1,4-Dichloro-2-butene	--	µg/L	<1	<1	<1	<1	<1 [ $<1$ ]
Dibromochloromethane	--	µg/L	<5	<5	<5	<5	<5 [ $<5$ ]
1,2-Dibromoethane (Ethylene dibromide)	2.9	µg/L	<1	<1	<1	<1	<1 [ $<1$ ]
Chlorobenzene	--	µg/L	<1	<1	<1	<1	<1 [ $<1$ ]

**Table 1**  
**Summary of Groundwater Analytical Results**  
**July 2020**  
**2020 Plant 6 Vinyl Chloride Investigation Memo**  
**RACER Trust Plant 6 - Lansing, Michigan**

Location ID: Date Collected: Sample Name:	RES SSVIAC GWNIC (EGLE2018)	Units	SB-OS-MA266 07/24/20 VAP-OS-MA266_7-12	SB-OS-MB263 07/21/20 VAP-OS-MB263_5-10	SB-OS-MC268 07/24/20 VAP-OS-MC268_7-12	SB-OS-LV263 07/21/20 VAP-OS-LV263_8-13	SB-OS-LY263 07/21/20 VAP-OS-LY263_9-14
1,1,1,2-Tetrachloroethane	--	µg/L	<1	<1	<1	<1	<1 [<1]
Ethylbenzene	45	µg/L	<1	<1	<1	<1	<1 [<1]
m&p-Xylene	--	µg/L	<2	<2	<2	<2	<2 [<2]
o-Xylene	--	µg/L	<1	<1	<1	<1	<1 [<1]
Xylene (total)	1,200	µg/L	NA	NA	NA	NA	NA
Styrene	--	µg/L	<1	<1	<1	<1	<1 [<1]
Isopropyl benzene	10	µg/L	<5	<5	<5	<5	<5 [<5]
Bromoform	--	µg/L	<1	<1	<1	<1	<1 [<1]
1,1,2,2-Tetrachloroethane	--	µg/L	<1	<1	<1	<1	<1 [<1]
1,2,3-Trichloropropane	--	µg/L	<1	<1	<1	<1	<1 [<1]
N-Propylbenzene	4,100	µg/L	<1	<1	<1	<1	<1 [<1]
Bromobenzene	--	µg/L	<1	<1	<1	<1	<1 [<1]
1,3,5-Trimethylbenzene	310	µg/L	<1	<1	<1	<1	<1 [<1]
tert-Butylbenzene (t-Butylbenzene)	--	µg/L	<1	<1	<1	<1	<1 [<1]
1,2,4-Trimethylbenzene	440	µg/L	<1	<1	<1	<1	<1 [<1]
2-Phenylbutane (sec-Butylbenzene)	--	µg/L	<1	<1	<1	<1	<1 [<1]
Cymene (p-Isopropyltoluene)	--	µg/L	<5	<5	<5	<5	<5 [<5]
1,3-Dichlorobenzene	--	µg/L	<1	<1	<1	<1	<1 [<1]
1,4-Dichlorobenzene	--	µg/L	<1	<1	<1	<1	<1 [<1]
1,2-Dichlorobenzene	--	µg/L	<1	<1	<1	<1	<1 [<1]
1,2,3-Trimethylbenzene	800	µg/L	<1	<1	<1	<1	<1 [<1]
N-Butylbenzene	--	µg/L	<1	<1	<1	<1	<1 [<1]
Hexachloroethane	--	µg/L	<5	<5	<5	<5	<5 [<5]
1,2-Dibromo-3-chloropropane (DBCP)	--	µg/L	<5	<5	<5	<5	<5 [<5]
1,2,4-Trichlorobenzene	--	µg/L	<5	<5	<5	<5	<5 [<5]
1,2,3-Trichlorobenzene	--	µg/L	<5	<5	<5	<5	<5 [<5]
Naphthalene	73	µg/L	<5	<5	<5	<5	<5 [<5]
2-Methylnaphthalene	1,300	µg/L	<5	<5	<5	<5	<5 [<5]

**Table Notes:**

Shading indicates a result exceeding EGLE Residential Site-specific Volatilization to Indoor Air Criteria (SSVIAC) for Groundwater Not In Contact (GWNIC), dated July 11, 2018.

**Bold** fonts represent data where detections were noted above the laboratory method detection limit.

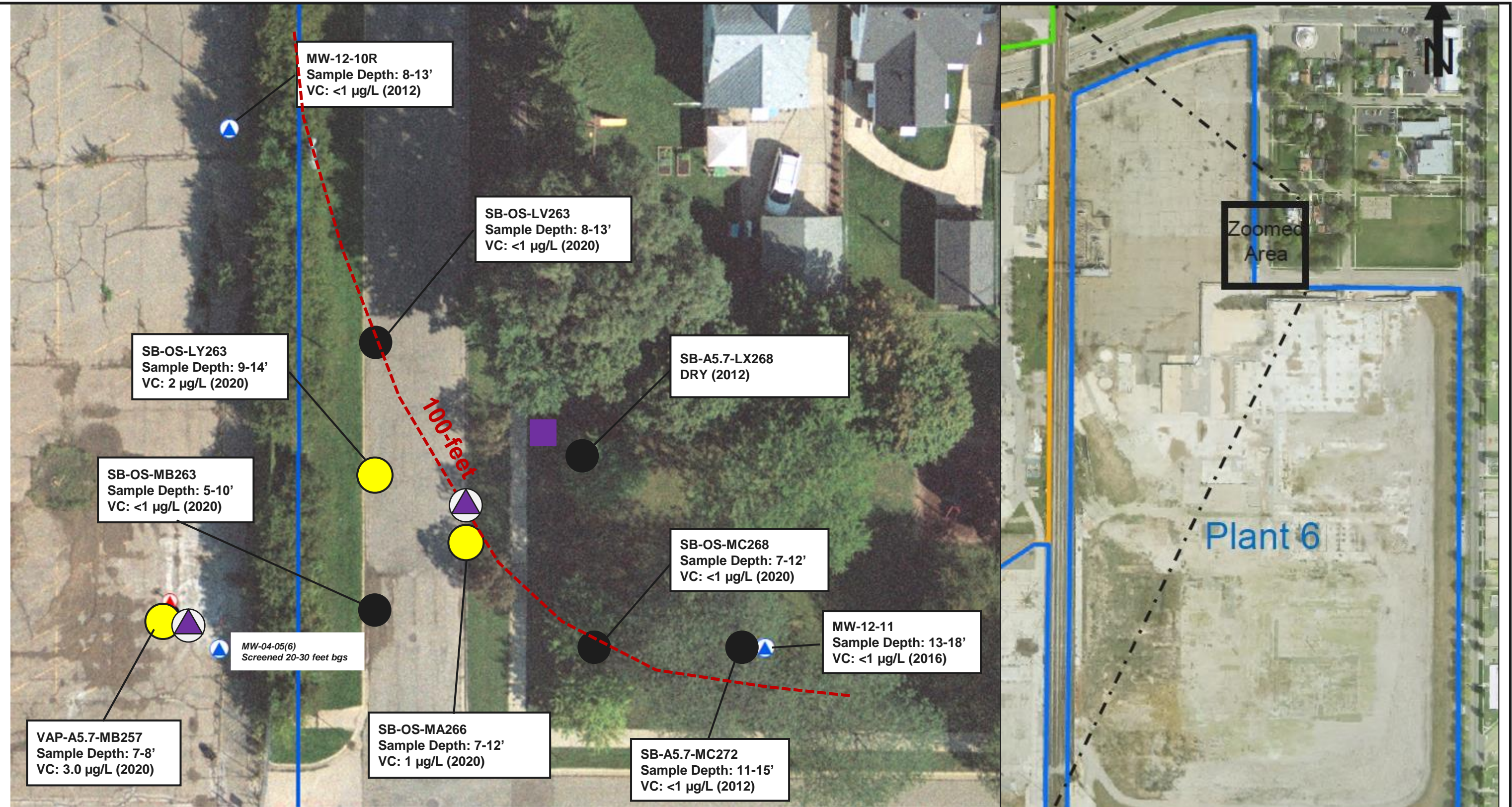
Data shown in [ ] represent duplicate sample analytical results.

-- = Not listed in the EGLE Criteria Tables.

µg/L - micrograms per liter

# FIGURES





**Legend**

- VAP Groundwater Analytical Results**
- <SSVIAC for vinyl Chloride (0.96 µg/L)
  - >SSVIAC for vinyl Chloride (0.96 µg/L)

- Monitoring Wells**
- ▲ Perched Monitoring Well
  - ▲ Bedrock Monitoring Well
  - ▲ Proposed Monitoring Well

- Proposed Soil Vapor Monitoring Point

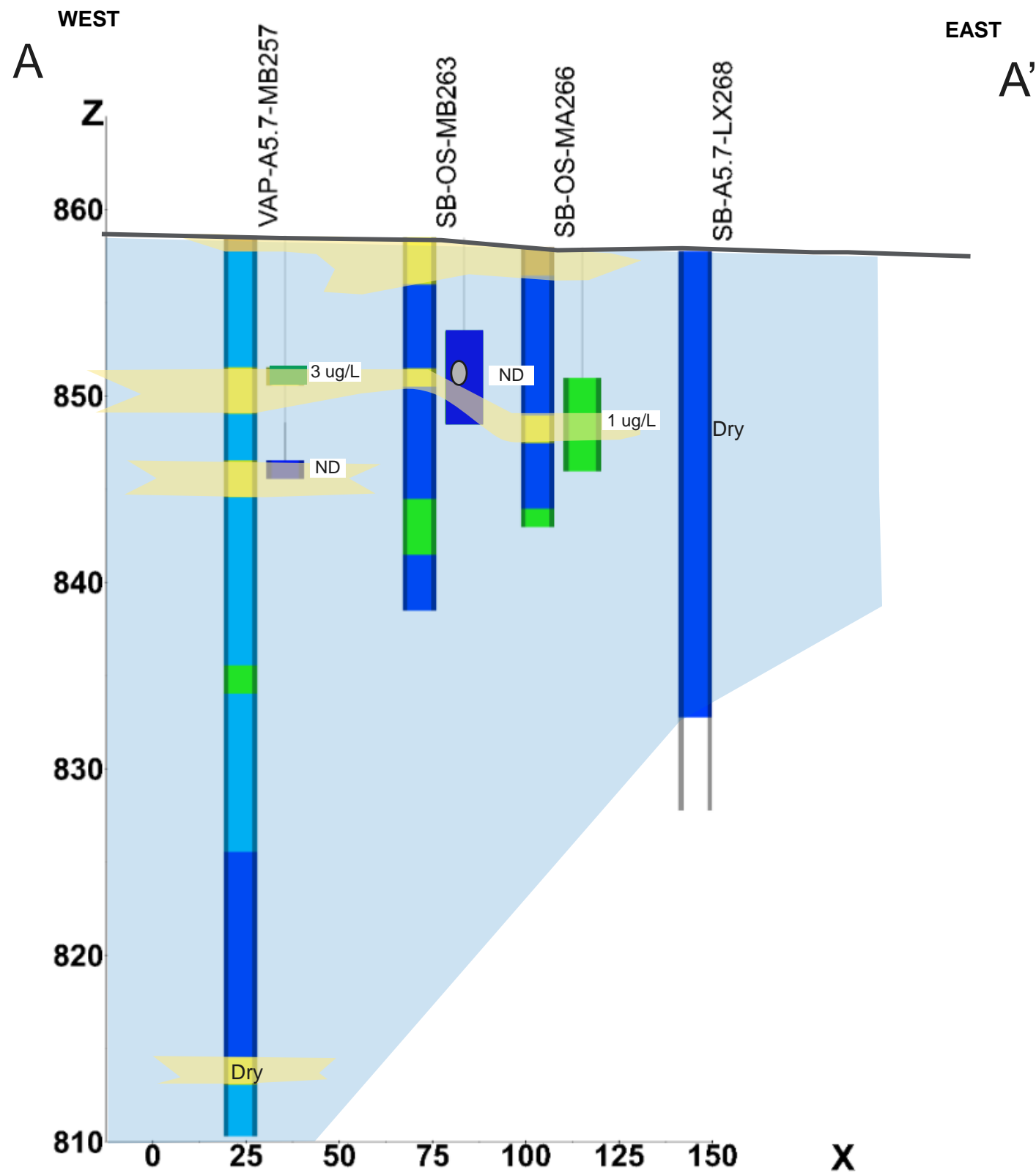
**Notes:**  
 SSVIAC – Site Specific Volatilization to Indoor Air Criteria  
 µg/l – micrograms per liter  
 VC – Vinyl Chloride



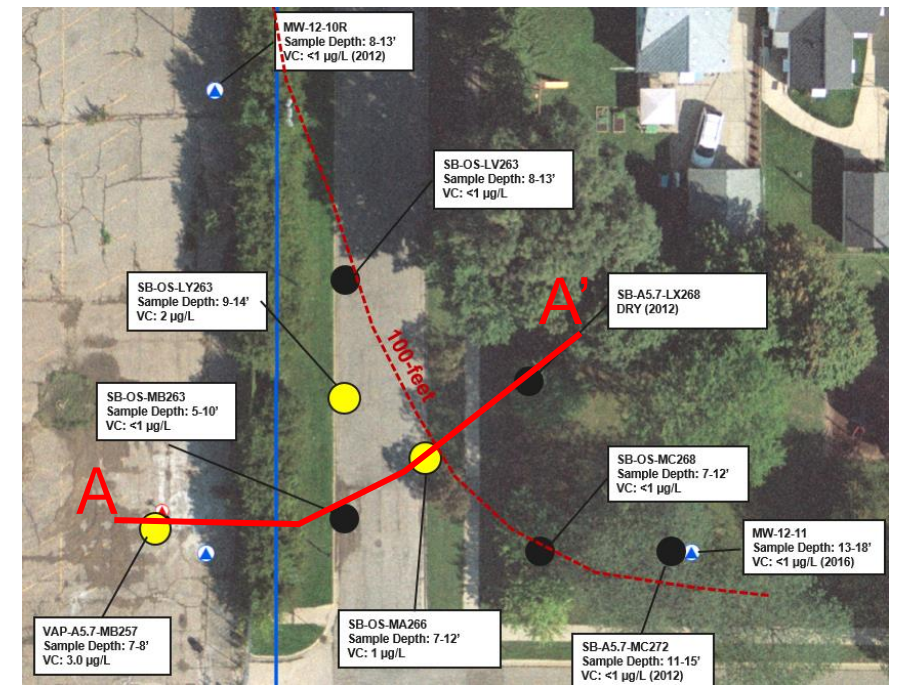
RACER TRUST PLANT 6  
LANSING, MICHIGAN

**SUMMARY OF GROUNDWATER ANALYTICAL RESULTS – VINYL CHLORIDE**





- Stratigraphy**
- Topsoil/Concrete/Asphalt
  - Fill
  - Gravelly Sand
  - Sand
  - Silty/Sandy/Gravelly Clay
  - Clay
  - Peat
  - Bedrock (Primarily Sandstone)
  - Bedrock (Primarily Shale)
  - No Recovery
- General Hydrostratigraphy**
- Lower Permeability
  - Higher Permeability
- Vinyl Chloride (µg/L)**
- >1
  - Non-detect
- Approximate Combined Sewer Location
- VE: 5:1

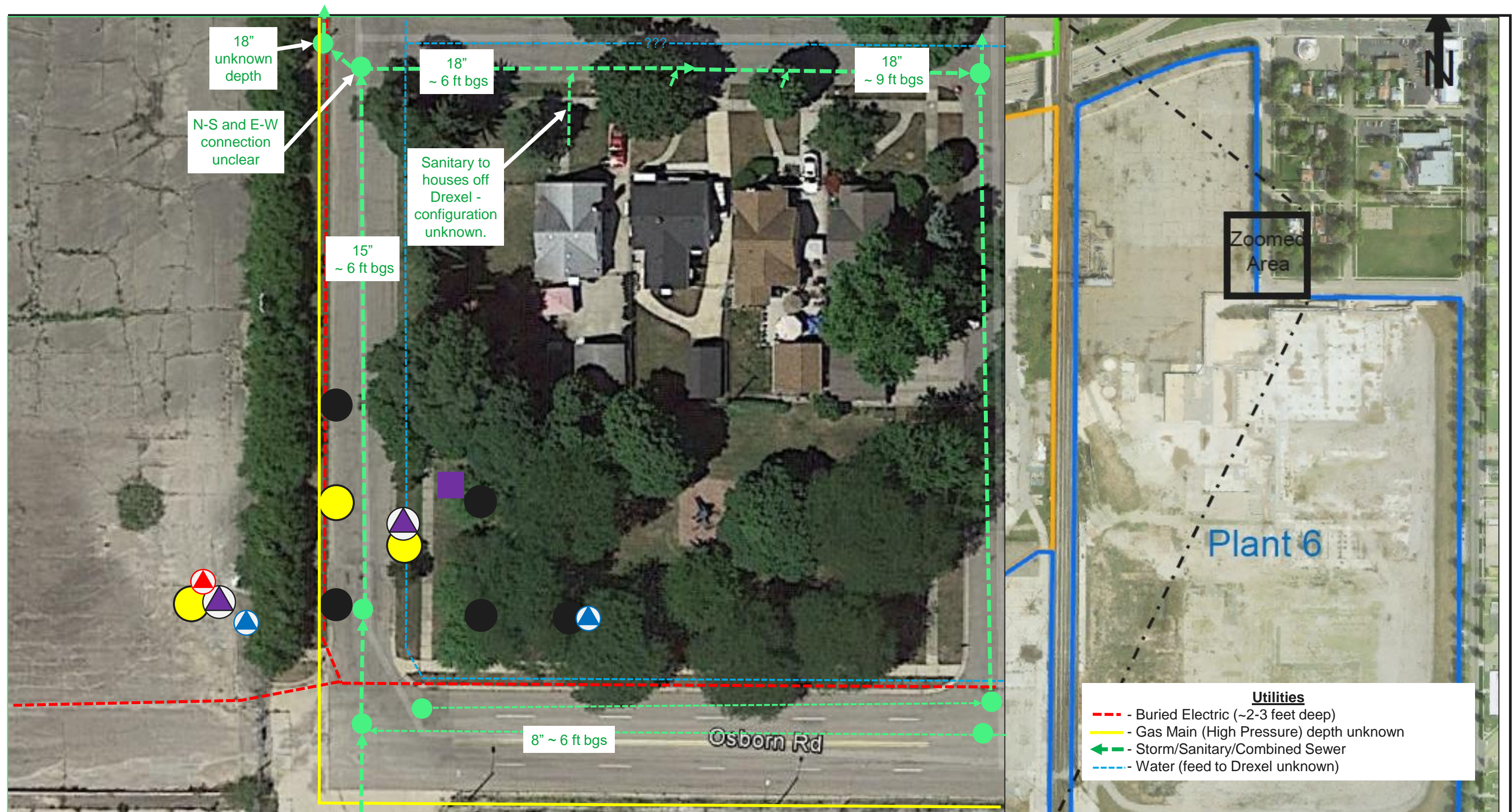


RACER TRUST PLANT 6  
LANSING, MICHIGAN

**PLANT 6 ENTRANCE CROSS-SECTION**

**ARCADIS** Design & Consultancy  
for natural and built assets

FIGURE  
**2**



**Utilities**

- - - Buried Electric (~2-3 feet deep)
- - - Gas Main (High Pressure) depth unknown
- - - Storm/Sanitary/Combined Sewer
- - - Water (feed to Drexel unknown)

**Legend**

**VAP Groundwater Analytical Results**

- <SSVIAC for vinyl Chloride (0.96 µg/L)
- >SSVIAC for vinyl Chloride (0.96 µg/L)

**Monitoring Wells**

- ▲ Perched Monitoring Well
- ▲ Bedrock Monitoring Well
- ▲ Proposed Monitoring Well

■ Proposed Soil Vapor Monitoring Point

**Notes:**  
 ft bgs – feet below ground surface (top of utility)  
 SSVIAC – Site Specific Volatilization to Indoor Air Criteria  
 µg/l – micrograms per liter  
 VC – Vinyl Chloride



RACER TRUST PLANT 6  
 LANSING, MICHIGAN

**UTILITY SUMMARY**



10/28/2020 2:06:35 PM

# ATTACHMENT 1

Soil Boring Logs



# Soil Boring Log

Project Name: RACER Lansing Date Started: 07/21/2020 Logger: K. Donahue  
 Project Number: 30042872 Date Completed: 07/21/2020 Editor: C. Cisco  
 Project Location: Lansing, MI Weather Conditions: 70° F, Cloudy

Depth (feet)	Sample Interval	Blow Counts	Recovery (in.)	Sample ID	PID (ppm)	USCS Class	Description	Construction Details	Well
1					0.0		(0.0-1.0') SAND, very fine to very coarse; and GRAVEL; some pebbles, small to very large, subrounded; poorly sorted; moist; dark yellowish brown (10YR 3/6).	(0.0-15.0') Backfilled with bentonite.	
2			60		0.0		(1.0-2.5') SAND, very fine to very coarse; and GRAVEL; some pebbles, small to large, subrounded to subangular; poorly sorted; moist; very dark brown (10YR 2/2).		
3					0.0		(2.5-3.0') CLAY, high plasticity, no dilatancy; little silt; trace sand, very fine to fine; soft; moist to wet; dark grayish brown (10YR 4/2).		
4					0.0		(3.0-5.0') CLAY, medium to high plasticity, no dilatancy; little silt; trace sand, very fine to fine; medium stiff; moist; gray (10YR 6/1) and brownish yellow (10YR 6/6).		
5					0.0		(5.0-9.0') CLAY, high plasticity, no dilatancy; little silt; trace sand, very fine to fine; medium stiff to soft; moist to wet; gray (10YR 6/1).		
6					0.0				
7					0.0				
8			53		0.0				
9					0.0				
10					0.0		(9.0-10.0') SAND, very fine to medium; and CLAY, high plasticity, no dilatancy; little silt; trace sand, very coarse, subrounded to subangular; trace granules, subrounded to subangular; well sorted; medium stiff; moist; dark yellowish brown (10YR4/6) and gray (10YR 6/1).		
11				VAP-OS-LV263_8-13 @ 12:42 on 7/21/2020	0.0		(10.0-13.0') SAND, very fine to fine; little silt; little sand, medium to coarse, subrounded to subangular; trace clay; well sorted; wet; brown (10YR 5/3).		
12			48		0.0				
13					0.0				
14					0.0		(13.0-15.0') CLAY, high plasticity, no dilatancy; little silt; trace sand, very fine to fine; medium stiff; moist to wet; dark gray (10YR 4/1).		
15					0.0		End of boring at 15.0' bgs.		
16									
17									
18									
19									
20									

Drilling Co.: Stock Drilling Sampling Method: Dual Tube  
 Driller: Jesse Stromberger Sampling Interval: Continuous  
 Drilling Method: Hand Auger / Direct Push Water Level Start (ft. bgs.): NA  
 Drilling Fluid: None Water Level Finish (ft. btoc.): NA  
 Remarks: Temporary well screen set from 8.0-13.0' bgs. Converted to Well:  Yes  No  
Located in roadway. Pavement ~5" thick. Surface Elev.: NA  
 North Coor.: \_\_\_\_\_  
 East Coor.: \_\_\_\_\_

SOIL BORING LOG - 2013 VARCADIS-US-COM-OFFICE-DATA\ANALYSIS\BORING LOGS\RACER LANSING MASTER.DAT\BASE\_081520.GPJ ARCADIS 2013 GDT 9/15/20

# Soil Boring Log

Project Name: RACER Lansing Date Started: 07/21/2020 Logger: K. Donahue  
 Project Number: 30042872 Date Completed: 07/21/2020 Editor: C. Cisco  
 Project Location: Lansing, MI Weather Conditions: 70° F, Cloudy

Depth (feet)	Sample Interval	Blow Counts	Recovery (in.)	Sample ID	PID (ppm)	USCS Class	Description	Construction Details	Well
1					0.0		(0.0-2.0') SAND, very fine to very coarse; and GRAVEL; some pebbles, small to medium, rounded to subangular; poorly sorted; moist; dark yellowish brown (10YR 3/4).		
2					0.0				
3			60		0.0		(2.0-3.0') CLAY, high plasticity, no dilatancy; little silt; trace sand, very fine to medium; soft; moist; very dark gray (10YR 3/1) and gray (10YR 5/1).		
4					0.0		(3.0-8.0') CLAY, high plasticity, no dilatancy; little silt; trace sand, very fine to fine; medium stiff; moist; gray (10YR 6/1) and brownish yellow (10YR 6/6).		
5					0.0				
6					0.0				
7					0.0				
8			48		0.0				
9					0.0		(8.0-10.0') CLAY, high plasticity, no dilatancy; some sand, very fine to fine; little silt; trace sand, very coarse, subrounded to subangular; very soft; wet; gray (10YR 5/1).		
10					0.0				
11				VAP-OS-LY263_9-14 and DUP-01 @ 13:03 on 7/21/2020	0.0		(10.0-14.5') SAND, very fine to fine; some clay, high plasticity, no dilatancy; little silt; well sorted; wet; grayish brown (10YR 5/2).		
12			42		0.0				
13					0.0				
14					0.0				
15					0.0		(14.5-15.0') CLAY, high plasticity, no dilatancy; little silt; trace sand, very fine to fine; soft; moist to wet; dark grayish brown (10YR 4/2). End of boring at 15.0' bgs.		
16									
17									
18									
19									
20									

(0.0-15.0')  
Backfilled with bentonite.

Drilling Co.: Stock Drilling Sampling Method: Dual Tube  
 Driller: Jesse Stromberger Sampling Interval: Continuous  
 Drilling Method: Hand Auger / Direct Push Water Level Start (ft. bgs.): NA  
 Drilling Fluid: None Water Level Finish (ft. btoc.): NA  
 Remarks: Temporary well screen set from 9.0-14.0' bgs. Converted to Well:  Yes  No  
Located in roadway. Pavement ~5" thick. Surface Elev.: NA  
 North Coord.: \_\_\_\_\_  
 East Coord.: \_\_\_\_\_

SOIL BORING LOG - 2013 VARCADIS-US-COM-OFFICE-DATA\ANALYSIS\BORING LOGS\RACER LANSING MASTER.DAT\BASE\_091520.GPJ ARCADIS 2013 GDT 9/15/20

# Soil Boring Log

Project Name: RACER Lansing Date Started: 07/24/2020 Logger: K. Donahue  
 Project Number: 30042872 Date Completed: 07/24/2020 Editor: C. Cisco  
 Project Location: Lansing, MI Weather Conditions: 70° F, Sunny

Depth (feet)	Sample Interval	Blow Counts	Recovery (in.)	Sample ID	PID (ppm)	USCS Class	Description	Construction Details	Well
1					0.0		(0.0-1.5') TOPSOIL.		
2			60		0.0		(1.5-8.0') CLAY, high plasticity, no dilatancy; little silt; trace sand, very fine to fine; stiff; dry to moist; gray (10YR 6/1) and yellowish brown (10YR 5/6). Note: Clay crumbles easily.		
3					0.0				
4					0.0				
5					0.0				
6					0.0				
7			56		0.0		Note: Moisture content changes to moist at 7.0' bgs.	(0.0-15.0') Backfilled with bentonite.	
8					0.0				
9				VAP-OS-MA266_7-12 @ 11:53 on 7/24/2020	0.0		(8.0-9.0') CLAY, high plasticity, no dilatancy; some sand, very fine to fine; little silt; trace sand, coarse to very coarse, subrounded to subangular; trace granules, subrounded to subangular; soft; moist to wet; grayish brown (10YR 5/2).		
10					0.0		(9.0-10.5') SAND, very fine to medium; some silt; little sand, coarse to very coarse, subrounded to subangular; little pebbles, small to medium, subrounded to subangular; trace clay; poorly sorted; wet; yellowish brown (10YR 5/4).		
11					NR				
12					NR		(10.5-13.0') CLAY, high plasticity, no dilatancy; little silt; trace sand, very fine to fine; trace sand, very coarse, rounded to subangular; trace granules, rounded to subangular; soft; moist to wet; gray (10YR 5/1).		
13			53		NR				
14					NR		(13.0-14.0') CLAY, high plasticity, no dilatancy; some silt; little sand, very fine to fine; trace granules, subrounded to subangular; soft; moist to wet; gray (10YR 5/1).		
15					NR		(14.0-15.0') SILT, nonplastic, rapid dilatancy; some sand, very fine to fine; little clay; trace granules, subrounded to subangular; trace pebbles, small to medium, subrounded to subangular; wet; gray (10YR 5/1). End of boring at 15.0' bgs.		
16									
17									
18									
19									
20									

Drilling Co.: Stock Drilling Sampling Method: Dual Tube  
 Driller: Jesse Stromberger Sampling Interval: Continuous  
 Drilling Method: Hand Auger / Direct Push Water Level Start (ft. bgs.): NA  
 Drilling Fluid: None Water Level Finish (ft. btoc.): NA  
 Remarks: Temporary well screen set from 7.0-12.0' bgs. Converted to Well:  Yes  No  
 Surface Elev.: NA  
 North Coor.: \_\_\_\_\_  
 East Coor.: \_\_\_\_\_

SOIL BORING LOG: 2013 \ARCADIS\US\COM\OFFICE\DATA\NOV\HMC\COMMON\BACER\LANSING\WORKING DATA\ANALYSIS\BORING LOGS\RACER\LANSING MASTER.DAT\BASE\_081520.GPJ ARCADIS 2013.GDT 9/15/20

# Soil Boring Log

Project Name: RACER Lansing Date Started: 07/21/2020 Logger: K. Donahue  
 Project Number: 30042872 Date Completed: 07/21/2020 Editor: C. Cisco  
 Project Location: Lansing, MI Weather Conditions: 72° F, Cloudy

Depth (feet)	Sample Interval	Blow Counts	Recovery (in.)	Sample ID	PID (ppm)	USCS Class	Description	Construction Details	Well
0.0							(0.0-0.4') ASPHALT.		
1.0							(0.4-2.5') SAND, very fine to medium; trace silt; trace gravel; trace granules; trace pebbles, small to large, subrounded to subangular; poorly sorted; moist; dark yellowish brown (10YR 4/4).		
2.0									
3.0			60				(2.5-7.0') CLAY, high plasticity, no dilatancy; little silt; trace sand, very fine to fine; soft; moist; gray (10YR 5/1) and brownish yellow (10YR 6/6).		
4.0									
5.0									
6.0									
7.0				VAP-OS-MB263_5-10					
8.0			54	and MS/MSD @ 13:37 on 7/21/2020			(7.0-8.0') SAND, very fine to fine; some silt; trace granules, subrounded to subangular; trace clay; well sorted; wet; yellowish brown (10YR 5/4).		
9.0							(8.0-14.0') CLAY, high plasticity, no dilatancy; little silt; trace sand, very fine to fine; trace pebbles, very large, subrounded to subangular; soft; moist to wet; dark gray (10YR 4/1).		
10.0								(0.0-20.0') Backfilled with bentonite.	
11.0									
12.0									
13.0			52						
14.0									
15.0							(14.0-17.0') SILT, nonplastic, rapid dilatancy; little sand, very fine to fine; trace clay; wet; gray (10YR 5/1).		
16.0									
17.0									
18.0			43				(17.0-20.0') CLAY, medium to high plasticity, no dilatancy; some silt; little sand, very fine to fine; soft; wet; gray (10YR 5/1).		
19.0									
20.0							End of boring at 20.0' bgs.		

Drilling Co.: Stock Drilling Sampling Method: Dual Tube  
 Driller: Jesse Stromberger Sampling Interval: Continuous  
 Drilling Method: Hand Auger / Direct Push Water Level Start (ft. bgs.): NA  
 Drilling Fluid: None Water Level Finish (ft. btoc.): NA  
 Remarks: Temporary well screen set from 5.0-10.0' bgs. Converted to Well:  Yes  No  
 Surface Elev.: NA  
 North Coor.: \_\_\_\_\_  
 East Coor.: \_\_\_\_\_

SOIL BORING LOG - 2013 VARCADIS-US-COM-OFFICE-DATA\NOV-11-MICOMMON\RACER\LANSING\WORKING DATA\ANALYSIS\BORING LOGS\RACER\LANSING MASTER.DAT\BASE\_091520.GPJ ARCADIS - 2013.GDT 9/15/20

# Soil Boring Log

Project Name: RACER Lansing Date Started: 07/24/2020 Logger: K. Donahue  
 Project Number: 30042872 Date Completed: 07/24/2020 Editor: C. Cisco  
 Project Location: Lansing, MI Weather Conditions: 75° F, Sunny

Depth (feet)	Sample Interval	Blow Counts	Recovery (in.)	Sample ID	PID (ppm)	USCS Class	Description	Construction Details	Well
1					0.0		(0.0-1.0') TOPSOIL.	(0.0-15.0') Backfilled with bentonite.	
2			60		0.0		(1.0-6.0') CLAY, high plasticity, no dilatancy; little silt; trace sand, very fine to fine; stiff; dry to moist; gray (10YR 6/1) and yellowish brown (10YR 5/6). Note: Clay crumbles easily.		
3					0.0				
4					0.0				
5					0.0				
6					0.0		Note: Boring appears wet at 5.5' bgs.		
7			50		0.0		(6.0-6.5') SAND, very fine to fine; some silt; trace clay; trace sand, coarse to very coarse, subrounded to subangular; well sorted; wet; brown (10YR 5/3).		
8					0.0		(6.5-7.0') CLAY, high plasticity, no dilatancy; little sand, very fine to fine; little silt; trace sand, very coarse, subrounded to subangular; trace granules, subrounded to subangular; soft; wet; gray (10YR 5/1).		
9					0.0		(7.0-7.2') SAND, very fine to medium; some sand, coarse to very coarse, subrounded to subangular; some pebbles, small to large, subrounded to subangular; little silt; poorly sorted; wet; brown (10YR 5/3).		
10					0.0		(7.2-14.0') CLAY, high plasticity, no dilatancy; little silt; trace sand, very fine to fine; trace sand, very coarse, subrounded to subangular; trace pebbles, small to large, subrounded to subangular; medium stiff; moist to wet; dark gray (10YR 4/1).		
11				VAP-OS-MC268_8-13 @ 13:15 on 7/24/2020	0.0				
12					0.0				
13			52		0.0				
14					0.0				
15					0.0		(14.0-14.3') SAND, very fine to medium; some sand, coarse, subrounded to subangular; some pebbles, small, subrounded to subangular; little silt; poorly sorted; wet; grayish brown (10YR 5/2).		
16							(14.3-15.0') CLAY, nonplastic to medium plasticity, slow to rapid dilatancy; and SILT; some sand, very fine to fine; trace granules, subrounded to subangular; medium stiff; wet; gray (10YR 5/1). End of boring at 15.0' bgs.		
17									
18									
19									
20									

Drilling Co.: Stock Drilling Sampling Method: Dual Tube  
 Driller: Jesse Stromberger Sampling Interval: Continuous  
 Drilling Method: Hand Auger / Direct Push Water Level Start (ft. bgs.): NA  
 Drilling Fluid: None Water Level Finish (ft. btoc.): NA  
 Remarks: \_\_\_\_\_ Converted to Well:  Yes  No  
 Surface Elev.: NA  
 North Coor.: \_\_\_\_\_  
 East Coor.: \_\_\_\_\_

SOIL BORING LOG - 2013 VARCADIS-US-COM-OFFICE-DATA\ANALYSIS\BORING LOGS\RACER LANSING MASTER.DAT\BASE\_091520.GPJ ARCADIS - 2013.GDT 9/15/20

# ATTACHMENT 2

Laboratory Analytical Results





# Analytical Laboratory Report

Report ID: S15872.01(01)  
Generated on 07/23/2020

Report to

Attention: Tiffany Linder  
Arcadis  
28550 Cabot Drive  
Suite 500  
Novi, MI 48377

Phone: 248-994-2272 FAX:  
Email: tiffany.linder@arcadis-us.com

Additional Contacts: Alex Villhauer, Trevor Swarhout, Marina Samp

Report produced by

Merit Laboratories, Inc.  
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Contacts for report questions:  
John Lavery (johnlavery@meritlabs.com)  
Barbara Ball (bball@meritlabs.com)

Report Summary

Lab Sample ID(s): S15872.01-S15872.07  
Project: RACER Lansing  
Collected Date(s): 07/21/2020  
Submitted Date/Time: 07/21/2020 15:47  
Sampled by: Kara Donahue  
P.O. #: 30042872.04600

Table of Contents

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- Report Narrative (Page 2)
- Laboratory Certifications (Page 3)
- Qualifier Descriptions (Page 3)
- Glossary of Abbreviations (Page 3)
- Method Summary (Page 4)
- Sample Summary (Page 5)

Maya Murshak  
Technical Director



# Analytical Laboratory Report

## General Report Notes

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Analytical results relate only to the samples tested, in the condition received by the laboratory.

Methods may be modified for improved performance.

Results reported on a dry weight basis where applicable.

'Not detected' indicates that parameter was not found at a level equal to or greater than the reporting limit (RL).

40 CFR Part 136 Table II Required Containers, Preservation Techniques and Holding Times for the Clean Water Act specify that samples for acrolein and acrylonitrile need to be preserved at a pH in the range of 4 to 5 or if not preserved, analyzed within 3 days of sampling.

QA/QC corresponding to this analytical report is a separate document with the same Merit ID reference and is available upon request.

Full accreditation certificates are available upon request. Starred (\*) analytes are not NELAP accredited.

Samples are held by the lab for 30 days from the final report date unless a written request to hold longer is provided by the client.

Report shall not be reproduced except in full, without the written approval of Merit Laboratories, Inc.

Limits for drinking water samples, are listed as the MCL Limits (Maximum Contaminant Level Concentrations)

## Report Narrative

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There is no additional narrative for this analytical report



# Analytical Laboratory Report

## Laboratory Certifications

Authority	Certification ID
Michigan DEQ	#9956
DOD ELAP/ISO 17025	#69699
WBENC	#2005110032
Ohio VAP	#CL0002
Indiana DOH	#C-MI-07
New York NELAC	#11814
North Carolina DENR	#680
North Carolina DOH	#26702
Alaska CSLAP	#17-001

## Qualifier Descriptions

Qualifier	Description
!	Result is outside of stated limit criteria
B	Compound also found in associated method blank
E	Concentration exceeds calibration range
F	Analysis run outside of holding time
G	Estimated result due to extraction run outside of holding time
H	Sample submitted and run outside of holding time
I	Matrix interference with internal standard
J	Estimated value less than reporting limit, but greater than MDL
L	Elevated reporting limit due to low sample amount
M	Result reported to MDL not RDL
O	Analysis performed by outside laboratory. See attached report.
R	Preliminary result
S	Surrogate recovery outside of control limits
T	No correction for total solids
X	Elevated reporting limit due to matrix interference
Y	Elevated reporting limit due to high target concentration
b	Value detected less than reporting limit, but greater than MDL
e	Reported value estimated due to interference
j	Analyte also found in associated method blank
p	Benzo(b)Fluoranthene and Benzo(k)Fluoranthene integrated as one peak.
x	Preserved from bulk sample

## Glossary of Abbreviations

Abbreviation	Description
RL/RDL	Reporting Limit
MDL	Method Detection Limit
MS	Matrix Spike
MSD	Matrix Spike Duplicate
SW	EPA SW 846 (Soil and Wastewater) Methods
E	EPA Methods
SM	Standard Methods
LN	Linear
BR	Branched



# Analytical Laboratory Report

## Method Summary

Method	Version
N/A	Not Applicable
SW5030C/8260C	SW 846 Method 8260C Revision 3 August 2006 / 5030C Revision 3 May 2003



# Analytical Laboratory Report

## Sample Summary (7 samples)

Sample ID	Sample Tag	Matrix	Collected Date/Time
S15872.01	VAP-OS-LV263_8-13	Groundwater	07/21/20 12:42
S15872.02	VAP-OS-LY263_9-14	Groundwater	07/21/20 13:03
S15872.03	DUP-01	Groundwater	07/21/20 00:01
S15872.04	VAP-OS-MB263_5-10	Groundwater	07/21/20 13:37
S15872.05	VAP-OS-MB263_5-10 MS	Groundwater	07/21/20 13:37
S15872.06	VAP-OS-MB263_5-10 MSD	Groundwater	07/21/20 13:37
S15872.07	Trip Blank	Water	07/21/20 00:01



# Analytical Laboratory Report

Lab Sample ID: S15872.01

Sample Tag: VAP-OS-LV263\_8-13

Collected Date/Time: 07/21/2020 12:42

Matrix: Groundwater

COC Reference: 135816

### Sample Containers

#	Type	Preservative(s)	Refrigerated?	Arrival Temp. (C)	Thermometer #
3	40ml Glass	HCL	Yes	20.2	IR

### Extraction / Prep.

Parameter	Result	Method	Run Date	Analyst	Flags
pH check for VOCs*	<2	N/A	07/23/20 13:15	JLS	

### Organics - Volatiles

Volatile Organics - DEQ List, Method: SW5030C/8260C, Run Date: 07/22/20 18:52, Analyst: KAG

Parameter	Result	RL	MDL	Units	Dilution	CAS#	Flags
Diethyl ether	Not detected	10		ug/L	1	60-29-7	
Acetone	Not detected	50		ug/L	1	67-64-1	
Methyl iodide	Not detected	1		ug/L	1	74-88-4	
Carbon disulfide	Not detected	5		ug/L	1	75-15-0	
tert-Methyl butyl ether (MTBE)	Not detected	5		ug/L	1	1634-04-4	
Acrylonitrile	Not detected	2		ug/L	1	107-13-1	
2-Butanone (MEK)	Not detected	25		ug/L	1	78-93-3	
Dichlorodifluoromethane	Not detected	5		ug/L	1	75-71-8	
Chloromethane	Not detected	5		ug/L	1	74-87-3	
Vinyl chloride	Not detected	1		ug/L	1	75-01-4	
Bromomethane	Not detected	5		ug/L	1	74-83-9	
Chloroethane	Not detected	5		ug/L	1	75-00-3	
Trichlorofluoromethane	Not detected	1		ug/L	1	75-69-4	
1,1-Dichloroethene	Not detected	1		ug/L	1	75-35-4	
Methylene chloride	Not detected	5		ug/L	1	75-09-2	
trans-1,2-Dichloroethene	Not detected	1		ug/L	1	156-60-5	
1,1-Dichloroethane	Not detected	1		ug/L	1	75-34-3	
cis-1,2-Dichloroethene	Not detected	1		ug/L	1	156-59-2	
Tetrahydrofuran*	Not detected	90		ug/L	1	109-99-9	
Chloroform	Not detected	1		ug/L	1	67-66-3	
Bromochloromethane	Not detected	1		ug/L	1	74-97-5	
1,1,1-Trichloroethane	Not detected	1		ug/L	1	71-55-6	
4-Methyl-2-pentanone (MIBK)	Not detected	50		ug/L	1	108-10-1	
2-Hexanone	Not detected	50		ug/L	1	591-78-6	
Carbon tetrachloride	Not detected	1		ug/L	1	56-23-5	
Benzene	Not detected	1		ug/L	1	71-43-2	
1,2-Dichloroethane	Not detected	1		ug/L	1	107-06-2	
Trichloroethene	Not detected	1		ug/L	1	79-01-6	
1,2-Dichloropropane	Not detected	1		ug/L	1	78-87-5	
Bromodichloromethane	Not detected	1		ug/L	1	75-27-4	
Dibromomethane	Not detected	5		ug/L	1	74-95-3	
cis-1,3-Dichloropropene	Not detected	1		ug/L	1	10061-01-5	
Toluene	Not detected	1		ug/L	1	108-88-3	
trans-1,3-Dichloropropene	Not detected	1		ug/L	1	10061-02-6	
1,1,2-Trichloroethane	Not detected	1		ug/L	1	79-00-5	
Tetrachloroethene	Not detected	1		ug/L	1	127-18-4	
trans-1,4-Dichloro-2-butene	Not detected	1		ug/L	1	110-57-6	



# Analytical Laboratory Report

Lab Sample ID: S15872.01 (continued)

Sample Tag: VAP-OS-LV263\_8-13

**Volatile Organics - DEQ List, Method: SW5030C/8260C, Run Date: 07/22/20 18:52, Analyst: KAG (continued)**

Parameter	Result	RL	MDL	Units	Dilution	CAS#	Flags
Dibromochloromethane	Not detected	5		ug/L	1	124-48-1	
1,2-Dibromoethane	Not detected	1		ug/L	1	106-93-4	
Chlorobenzene	Not detected	1		ug/L	1	108-90-7	
1,1,1,2-Tetrachloroethane	Not detected	1		ug/L	1	630-20-6	
Ethylbenzene	Not detected	1		ug/L	1	100-41-4	
p,m-Xylene*	Not detected	2		ug/L	1		
o-Xylene	Not detected	1		ug/L	1	95-47-6	
Styrene	Not detected	1		ug/L	1	100-42-5	
Isopropylbenzene	Not detected	5		ug/L	1	98-82-8	
Bromoform	Not detected	1		ug/L	1	75-25-2	
1,1,2,2-Tetrachloroethane	Not detected	1		ug/L	1	79-34-5	
1,2,3-Trichloropropane	Not detected	1		ug/L	1	96-18-4	
n-Propylbenzene	Not detected	1		ug/L	1	103-65-1	
Bromobenzene	Not detected	1		ug/L	1	108-86-1	
1,3,5-Trimethylbenzene	Not detected	1		ug/L	1	108-67-8	
tert-Butylbenzene	Not detected	1		ug/L	1	98-06-6	
1,2,4-Trimethylbenzene	Not detected	1		ug/L	1	95-63-6	
sec-Butylbenzene	Not detected	1		ug/L	1	135-98-8	
p-Isopropyltoluene	Not detected	5		ug/L	1	99-87-6	
1,3-Dichlorobenzene	Not detected	1		ug/L	1	541-73-1	
1,4-Dichlorobenzene	Not detected	1		ug/L	1	106-46-7	
1,2-Dichlorobenzene	Not detected	1		ug/L	1	95-50-1	
1,2,3-Trimethylbenzene	Not detected	1		ug/L	1	526-73-8	
n-Butylbenzene	Not detected	1		ug/L	1	104-51-8	
Hexachloroethane	Not detected	5		ug/L	1	67-72-1	
1,2-Dibromo-3-chloropropane	Not detected	5		ug/L	1	96-12-8	
1,2,4-Trichlorobenzene	Not detected	5		ug/L	1	120-82-1	
1,2,3-Trichlorobenzene	Not detected	5		ug/L	1	87-61-6	
Naphthalene	Not detected	5		ug/L	1	91-20-3	
2-Methylnaphthalene	Not detected	5		ug/L	1	91-57-6	



# Analytical Laboratory Report

Lab Sample ID: S15872.02

Sample Tag: VAP-OS-LY263\_9-14

Collected Date/Time: 07/21/2020 13:03

Matrix: Groundwater

COC Reference: 135816

Sample Containers

#	Type	Preservative(s)	Refrigerated?	Arrival Temp. (C)	Thermometer #
3	40ml Glass	HCL	Yes	20.2	IR

Extraction / Prep.

Parameter	Result	Method	Run Date	Analyst	Flags
pH check for VOCs*	<2	N/A	07/23/20 13:15	JLS	

Organics - Volatiles

Volatile Organics - DEQ List, Method: SW5030C/8260C, Run Date: 07/22/20 19:11, Analyst: KAG

Parameter	Result	RL	MDL	Units	Dilution	CAS#	Flags
Diethyl ether	Not detected	10		ug/L	1	60-29-7	
Acetone	Not detected	50		ug/L	1	67-64-1	
Methyl iodide	Not detected	1		ug/L	1	74-88-4	
Carbon disulfide	Not detected	5		ug/L	1	75-15-0	
tert-Methyl butyl ether (MTBE)	Not detected	5		ug/L	1	1634-04-4	
Acrylonitrile	Not detected	2		ug/L	1	107-13-1	
2-Butanone (MEK)	Not detected	25		ug/L	1	78-93-3	
Dichlorodifluoromethane	Not detected	5		ug/L	1	75-71-8	
Chloromethane	Not detected	5		ug/L	1	74-87-3	
Vinyl chloride	2	1		ug/L	1	75-01-4	
Bromomethane	Not detected	5		ug/L	1	74-83-9	
Chloroethane	Not detected	5		ug/L	1	75-00-3	
Trichlorofluoromethane	Not detected	1		ug/L	1	75-69-4	
1,1-Dichloroethene	Not detected	1		ug/L	1	75-35-4	
Methylene chloride	Not detected	5		ug/L	1	75-09-2	
trans-1,2-Dichloroethene	Not detected	1		ug/L	1	156-60-5	
1,1-Dichloroethane	Not detected	1		ug/L	1	75-34-3	
cis-1,2-Dichloroethene	3	1		ug/L	1	156-59-2	
Tetrahydrofuran*	Not detected	90		ug/L	1	109-99-9	
Chloroform	Not detected	1		ug/L	1	67-66-3	
Bromochloromethane	Not detected	1		ug/L	1	74-97-5	
1,1,1-Trichloroethane	Not detected	1		ug/L	1	71-55-6	
4-Methyl-2-pentanone (MIBK)	Not detected	50		ug/L	1	108-10-1	
2-Hexanone	Not detected	50		ug/L	1	591-78-6	
Carbon tetrachloride	Not detected	1		ug/L	1	56-23-5	
Benzene	Not detected	1		ug/L	1	71-43-2	
1,2-Dichloroethane	Not detected	1		ug/L	1	107-06-2	
Trichloroethene	Not detected	1		ug/L	1	79-01-6	
1,2-Dichloropropane	Not detected	1		ug/L	1	78-87-5	
Bromodichloromethane	Not detected	1		ug/L	1	75-27-4	
Dibromomethane	Not detected	5		ug/L	1	74-95-3	
cis-1,3-Dichloropropene	Not detected	1		ug/L	1	10061-01-5	
Toluene	Not detected	1		ug/L	1	108-88-3	
trans-1,3-Dichloropropene	Not detected	1		ug/L	1	10061-02-6	
1,1,2-Trichloroethane	Not detected	1		ug/L	1	79-00-5	
Tetrachloroethene	Not detected	1		ug/L	1	127-18-4	
trans-1,4-Dichloro-2-butene	Not detected	1		ug/L	1	110-57-6	



# Analytical Laboratory Report

Lab Sample ID: S15872.02 (continued)

Sample Tag: VAP-OS-LY263\_9-14

**Volatile Organics - DEQ List, Method: SW5030C/8260C, Run Date: 07/22/20 19:11, Analyst: KAG (continued)**

Parameter	Result	RL	MDL	Units	Dilution	CAS#	Flags
Dibromochloromethane	Not detected	5		ug/L	1	124-48-1	
1,2-Dibromoethane	Not detected	1		ug/L	1	106-93-4	
Chlorobenzene	Not detected	1		ug/L	1	108-90-7	
1,1,1,2-Tetrachloroethane	Not detected	1		ug/L	1	630-20-6	
Ethylbenzene	Not detected	1		ug/L	1	100-41-4	
p,m-Xylene*	Not detected	2		ug/L	1		
o-Xylene	Not detected	1		ug/L	1	95-47-6	
Styrene	Not detected	1		ug/L	1	100-42-5	
Isopropylbenzene	Not detected	5		ug/L	1	98-82-8	
Bromoform	Not detected	1		ug/L	1	75-25-2	
1,1,2,2-Tetrachloroethane	Not detected	1		ug/L	1	79-34-5	
1,2,3-Trichloropropane	Not detected	1		ug/L	1	96-18-4	
n-Propylbenzene	Not detected	1		ug/L	1	103-65-1	
Bromobenzene	Not detected	1		ug/L	1	108-86-1	
1,3,5-Trimethylbenzene	Not detected	1		ug/L	1	108-67-8	
tert-Butylbenzene	Not detected	1		ug/L	1	98-06-6	
1,2,4-Trimethylbenzene	Not detected	1		ug/L	1	95-63-6	
sec-Butylbenzene	Not detected	1		ug/L	1	135-98-8	
p-Isopropyltoluene	Not detected	5		ug/L	1	99-87-6	
1,3-Dichlorobenzene	Not detected	1		ug/L	1	541-73-1	
1,4-Dichlorobenzene	Not detected	1		ug/L	1	106-46-7	
1,2-Dichlorobenzene	Not detected	1		ug/L	1	95-50-1	
1,2,3-Trimethylbenzene	Not detected	1		ug/L	1	526-73-8	
n-Butylbenzene	Not detected	1		ug/L	1	104-51-8	
Hexachloroethane	Not detected	5		ug/L	1	67-72-1	
1,2-Dibromo-3-chloropropane	Not detected	5		ug/L	1	96-12-8	
1,2,4-Trichlorobenzene	Not detected	5		ug/L	1	120-82-1	
1,2,3-Trichlorobenzene	Not detected	5		ug/L	1	87-61-6	
Naphthalene	Not detected	5		ug/L	1	91-20-3	
2-Methylnaphthalene	Not detected	5		ug/L	1	91-57-6	



# Analytical Laboratory Report

Lab Sample ID: S15872.03

Sample Tag: DUP-01

Collected Date/Time: 07/21/2020 00:01

Matrix: Groundwater

COC Reference: 135816

### Sample Containers

#	Type	Preservative(s)	Refrigerated?	Arrival Temp. (C)	Thermometer #
3	40ml Glass	HCL	Yes	20.2	IR

### Extraction / Prep.

Parameter	Result	Method	Run Date	Analyst	Flags
pH check for VOCs*	<2	N/A	07/23/20 13:15	JLS	

### Organics - Volatiles

Volatile Organics - DEQ List, Method: SW5030C/8260C, Run Date: 07/22/20 19:31, Analyst: KAG

Parameter	Result	RL	MDL	Units	Dilution	CAS#	Flags
Diethyl ether	Not detected	10		ug/L	1	60-29-7	
Acetone	Not detected	50		ug/L	1	67-64-1	
Methyl iodide	Not detected	1		ug/L	1	74-88-4	
Carbon disulfide	Not detected	5		ug/L	1	75-15-0	
tert-Methyl butyl ether (MTBE)	Not detected	5		ug/L	1	1634-04-4	
Acrylonitrile	Not detected	2		ug/L	1	107-13-1	
2-Butanone (MEK)	Not detected	25		ug/L	1	78-93-3	
Dichlorodifluoromethane	Not detected	5		ug/L	1	75-71-8	
Chloromethane	Not detected	5		ug/L	1	74-87-3	
Vinyl chloride	2	1		ug/L	1	75-01-4	
Bromomethane	Not detected	5		ug/L	1	74-83-9	
Chloroethane	Not detected	5		ug/L	1	75-00-3	
Trichlorofluoromethane	Not detected	1		ug/L	1	75-69-4	
1,1-Dichloroethene	Not detected	1		ug/L	1	75-35-4	
Methylene chloride	Not detected	5		ug/L	1	75-09-2	
trans-1,2-Dichloroethene	Not detected	1		ug/L	1	156-60-5	
1,1-Dichloroethane	Not detected	1		ug/L	1	75-34-3	
cis-1,2-Dichloroethene	3	1		ug/L	1	156-59-2	
Tetrahydrofuran*	Not detected	90		ug/L	1	109-99-9	
Chloroform	Not detected	1		ug/L	1	67-66-3	
Bromochloromethane	Not detected	1		ug/L	1	74-97-5	
1,1,1-Trichloroethane	Not detected	1		ug/L	1	71-55-6	
4-Methyl-2-pentanone (MIBK)	Not detected	50		ug/L	1	108-10-1	
2-Hexanone	Not detected	50		ug/L	1	591-78-6	
Carbon tetrachloride	Not detected	1		ug/L	1	56-23-5	
Benzene	Not detected	1		ug/L	1	71-43-2	
1,2-Dichloroethane	Not detected	1		ug/L	1	107-06-2	
Trichloroethene	Not detected	1		ug/L	1	79-01-6	
1,2-Dichloropropane	Not detected	1		ug/L	1	78-87-5	
Bromodichloromethane	Not detected	1		ug/L	1	75-27-4	
Dibromomethane	Not detected	5		ug/L	1	74-95-3	
cis-1,3-Dichloropropene	Not detected	1		ug/L	1	10061-01-5	
Toluene	Not detected	1		ug/L	1	108-88-3	
trans-1,3-Dichloropropene	Not detected	1		ug/L	1	10061-02-6	
1,1,2-Trichloroethane	Not detected	1		ug/L	1	79-00-5	
Tetrachloroethene	Not detected	1		ug/L	1	127-18-4	
trans-1,4-Dichloro-2-butene	Not detected	1		ug/L	1	110-57-6	



# Analytical Laboratory Report

Lab Sample ID: S15872.03 (continued)

Sample Tag: DUP-01

Volatile Organics - DEQ List, Method: SW5030C/8260C, Run Date: 07/22/20 19:31, Analyst: KAG (continued)

Parameter	Result	RL	MDL	Units	Dilution	CAS#	Flags
Dibromochloromethane	Not detected	5		ug/L	1	124-48-1	
1,2-Dibromoethane	Not detected	1		ug/L	1	106-93-4	
Chlorobenzene	Not detected	1		ug/L	1	108-90-7	
1,1,1,2-Tetrachloroethane	Not detected	1		ug/L	1	630-20-6	
Ethylbenzene	Not detected	1		ug/L	1	100-41-4	
p,m-Xylene*	Not detected	2		ug/L	1		
o-Xylene	Not detected	1		ug/L	1	95-47-6	
Styrene	Not detected	1		ug/L	1	100-42-5	
Isopropylbenzene	Not detected	5		ug/L	1	98-82-8	
Bromoform	Not detected	1		ug/L	1	75-25-2	
1,1,2,2-Tetrachloroethane	Not detected	1		ug/L	1	79-34-5	
1,2,3-Trichloropropane	Not detected	1		ug/L	1	96-18-4	
n-Propylbenzene	Not detected	1		ug/L	1	103-65-1	
Bromobenzene	Not detected	1		ug/L	1	108-86-1	
1,3,5-Trimethylbenzene	Not detected	1		ug/L	1	108-67-8	
tert-Butylbenzene	Not detected	1		ug/L	1	98-06-6	
1,2,4-Trimethylbenzene	Not detected	1		ug/L	1	95-63-6	
sec-Butylbenzene	Not detected	1		ug/L	1	135-98-8	
p-Isopropyltoluene	Not detected	5		ug/L	1	99-87-6	
1,3-Dichlorobenzene	Not detected	1		ug/L	1	541-73-1	
1,4-Dichlorobenzene	Not detected	1		ug/L	1	106-46-7	
1,2-Dichlorobenzene	Not detected	1		ug/L	1	95-50-1	
1,2,3-Trimethylbenzene	Not detected	1		ug/L	1	526-73-8	
n-Butylbenzene	Not detected	1		ug/L	1	104-51-8	
Hexachloroethane	Not detected	5		ug/L	1	67-72-1	
1,2-Dibromo-3-chloropropane	Not detected	5		ug/L	1	96-12-8	
1,2,4-Trichlorobenzene	Not detected	5		ug/L	1	120-82-1	
1,2,3-Trichlorobenzene	Not detected	5		ug/L	1	87-61-6	
Naphthalene	Not detected	5		ug/L	1	91-20-3	
2-Methylnaphthalene	Not detected	5		ug/L	1	91-57-6	



# Analytical Laboratory Report

Lab Sample ID: S15872.04

Sample Tag: VAP-OS-MB263\_5-10

Collected Date/Time: 07/21/2020 13:37

Matrix: Groundwater

COC Reference: 135816

### Sample Containers

#	Type	Preservative(s)	Refrigerated?	Arrival Temp. (C)	Thermometer #
3	40ml Glass	HCL	Yes	20.2	IR

### Extraction / Prep.

Parameter	Result	Method	Run Date	Analyst	Flags
pH check for VOCs*	<2	N/A	07/23/20 13:15	JLS	

### Organics - Volatiles

Volatile Organics - DEQ List, Method: SW5030C/8260C, Run Date: 07/22/20 15:20, Analyst: KAG

Parameter	Result	RL	MDL	Units	Dilution	CAS#	Flags
Diethyl ether	Not detected	10		ug/L	1	60-29-7	
Acetone	Not detected	50		ug/L	1	67-64-1	
Methyl iodide	Not detected	1		ug/L	1	74-88-4	
Carbon disulfide	Not detected	5		ug/L	1	75-15-0	
tert-Methyl butyl ether (MTBE)	Not detected	5		ug/L	1	1634-04-4	
Acrylonitrile	Not detected	2		ug/L	1	107-13-1	
2-Butanone (MEK)	Not detected	25		ug/L	1	78-93-3	
Dichlorodifluoromethane	Not detected	5		ug/L	1	75-71-8	
Chloromethane	Not detected	5		ug/L	1	74-87-3	
Vinyl chloride	Not detected	1		ug/L	1	75-01-4	
Bromomethane	Not detected	5		ug/L	1	74-83-9	
Chloroethane	Not detected	5		ug/L	1	75-00-3	
Trichlorofluoromethane	Not detected	1		ug/L	1	75-69-4	
1,1-Dichloroethene	Not detected	1		ug/L	1	75-35-4	
Methylene chloride	Not detected	5		ug/L	1	75-09-2	
trans-1,2-Dichloroethene	Not detected	1		ug/L	1	156-60-5	
1,1-Dichloroethane	Not detected	1		ug/L	1	75-34-3	
cis-1,2-Dichloroethene	Not detected	1		ug/L	1	156-59-2	
Tetrahydrofuran*	Not detected	90		ug/L	1	109-99-9	
Chloroform	Not detected	1		ug/L	1	67-66-3	
Bromochloromethane	Not detected	1		ug/L	1	74-97-5	
1,1,1-Trichloroethane	Not detected	1		ug/L	1	71-55-6	
4-Methyl-2-pentanone (MIBK)	Not detected	50		ug/L	1	108-10-1	
2-Hexanone	Not detected	50		ug/L	1	591-78-6	
Carbon tetrachloride	Not detected	1		ug/L	1	56-23-5	
Benzene	Not detected	1		ug/L	1	71-43-2	
1,2-Dichloroethane	Not detected	1		ug/L	1	107-06-2	
Trichloroethene	Not detected	1		ug/L	1	79-01-6	
1,2-Dichloropropane	Not detected	1		ug/L	1	78-87-5	
Bromodichloromethane	Not detected	1		ug/L	1	75-27-4	
Dibromomethane	Not detected	5		ug/L	1	74-95-3	
cis-1,3-Dichloropropene	Not detected	1		ug/L	1	10061-01-5	
Toluene	Not detected	1		ug/L	1	108-88-3	
trans-1,3-Dichloropropene	Not detected	1		ug/L	1	10061-02-6	
1,1,2-Trichloroethane	Not detected	1		ug/L	1	79-00-5	
Tetrachloroethene	Not detected	1		ug/L	1	127-18-4	
trans-1,4-Dichloro-2-butene	Not detected	1		ug/L	1	110-57-6	



# Analytical Laboratory Report

Lab Sample ID: S15872.04 (continued)

Sample Tag: VAP-OS-MB263\_5-10

**Volatile Organics - DEQ List, Method: SW5030C/8260C, Run Date: 07/22/20 15:20, Analyst: KAG (continued)**

Parameter	Result	RL	MDL	Units	Dilution	CAS#	Flags
Dibromochloromethane	Not detected	5		ug/L	1	124-48-1	
1,2-Dibromoethane	Not detected	1		ug/L	1	106-93-4	
Chlorobenzene	Not detected	1		ug/L	1	108-90-7	
1,1,1,2-Tetrachloroethane	Not detected	1		ug/L	1	630-20-6	
Ethylbenzene	Not detected	1		ug/L	1	100-41-4	
p,m-Xylene*	Not detected	2		ug/L	1		
o-Xylene	Not detected	1		ug/L	1	95-47-6	
Styrene	Not detected	1		ug/L	1	100-42-5	
Isopropylbenzene	Not detected	5		ug/L	1	98-82-8	
Bromoform	Not detected	1		ug/L	1	75-25-2	
1,1,2,2-Tetrachloroethane	Not detected	1		ug/L	1	79-34-5	
1,2,3-Trichloropropane	Not detected	1		ug/L	1	96-18-4	
n-Propylbenzene	Not detected	1		ug/L	1	103-65-1	
Bromobenzene	Not detected	1		ug/L	1	108-86-1	
1,3,5-Trimethylbenzene	Not detected	1		ug/L	1	108-67-8	
tert-Butylbenzene	Not detected	1		ug/L	1	98-06-6	
1,2,4-Trimethylbenzene	Not detected	1		ug/L	1	95-63-6	
sec-Butylbenzene	Not detected	1		ug/L	1	135-98-8	
p-Isopropyltoluene	Not detected	5		ug/L	1	99-87-6	
1,3-Dichlorobenzene	Not detected	1		ug/L	1	541-73-1	
1,4-Dichlorobenzene	Not detected	1		ug/L	1	106-46-7	
1,2-Dichlorobenzene	Not detected	1		ug/L	1	95-50-1	
1,2,3-Trimethylbenzene	Not detected	1		ug/L	1	526-73-8	
n-Butylbenzene	Not detected	1		ug/L	1	104-51-8	
Hexachloroethane	Not detected	5		ug/L	1	67-72-1	
1,2-Dibromo-3-chloropropane	Not detected	5		ug/L	1	96-12-8	
1,2,4-Trichlorobenzene	Not detected	5		ug/L	1	120-82-1	
1,2,3-Trichlorobenzene	Not detected	5		ug/L	1	87-61-6	
Naphthalene	Not detected	5		ug/L	1	91-20-3	
2-Methylnaphthalene	Not detected	5		ug/L	1	91-57-6	



# Analytical Laboratory Report

Lab Sample ID: S15872.05

Sample Tag: VAP-OS-MB263\_5-10 MS

Collected Date/Time: 07/21/2020 13:37

Matrix: Groundwater

COC Reference: 135816

Sample Containers

#	Type	Preservative(s)	Refrigerated?	Arrival Temp. (C)	Thermometer #
3	40ml Glass	HCL	Yes	20.2	IR

Extraction / Prep.

Parameter	Result	Method	Run Date	Analyst	Flags
pH check for VOCs*	<2	N/A	07/23/20 13:15	JLS	

Organics - Volatiles

Volatile Organics - DEQ List, Method: SW5030C/8260C, Run Date: 07/22/20 21:06, Analyst: KAG

Parameter	Result	RL	MDL	Units	Dilution	CAS#	Flags
Diethyl ether	50	10		ug/L	1	60-29-7	1
Acetone	52	50		ug/L	1	67-64-1	1
Methyl iodide	47	1		ug/L	1	74-88-4	1
Carbon disulfide	43	5		ug/L	1	75-15-0	1
tert-Methyl butyl ether (MTBE)	50	5		ug/L	1	1634-04-4	1
Acrylonitrile	52	2		ug/L	1	107-13-1	1
2-Butanone (MEK)	51	25		ug/L	1	78-93-3	1
Dichlorodifluoromethane	29	5		ug/L	1	75-71-8	1
Chloromethane	39	5		ug/L	1	74-87-3	1
Vinyl chloride	40	1		ug/L	1	75-01-4	1
Bromomethane	42	5		ug/L	1	74-83-9	1
Chloroethane	44	5		ug/L	1	75-00-3	1
Trichlorofluoromethane	44	1		ug/L	1	75-69-4	1
1,1-Dichloroethene	45	1		ug/L	1	75-35-4	1
Methylene chloride	48	5		ug/L	1	75-09-2	1
trans-1,2-Dichloroethene	48	1		ug/L	1	156-60-5	1
1,1-Dichloroethane	50	1		ug/L	1	75-34-3	1
cis-1,2-Dichloroethene	51	1		ug/L	1	156-59-2	1
Tetrahydrofuran*	Not detected	90		ug/L	1	109-99-9	1
Chloroform	51	1		ug/L	1	67-66-3	1
Bromochloromethane	51	1		ug/L	1	74-97-5	1
1,1,1-Trichloroethane	48	1		ug/L	1	71-55-6	1
4-Methyl-2-pentanone (MIBK)	53	50		ug/L	1	108-10-1	1
2-Hexanone	55	50		ug/L	1	591-78-6	1
Carbon tetrachloride	46	1		ug/L	1	56-23-5	1
Benzene	49	1		ug/L	1	71-43-2	1
1,2-Dichloroethane	49	1		ug/L	1	107-06-2	1
Trichloroethene	48	1		ug/L	1	79-01-6	1
1,2-Dichloropropane	50	1		ug/L	1	78-87-5	1
Bromodichloromethane	51	1		ug/L	1	75-27-4	1
Dibromomethane	49	5		ug/L	1	74-95-3	1
cis-1,3-Dichloropropene	51	1		ug/L	1	10061-01-5	1
Toluene	50	1		ug/L	1	108-88-3	1
trans-1,3-Dichloropropene	51	1		ug/L	1	10061-02-6	1
1,1,2-Trichloroethane	51	1		ug/L	1	79-00-5	1
Tetrachloroethene	45	1		ug/L	1	127-18-4	1

1-Spiked at 50ug/L



# Analytical Laboratory Report

Lab Sample ID: S15872.05 (continued)

Sample Tag: VAP-OS-MB263\_5-10 MS

Volatile Organics - DEQ List, Method: SW5030C/8260C, Run Date: 07/22/20 21:06, Analyst: KAG (continued)

Parameter	Result	RL	MDL	Units	Dilution	CAS#	Flags
trans-1,4-Dichloro-2-butene	44	1		ug/L	1	110-57-6	1
Dibromochloromethane	47	5		ug/L	1	124-48-1	1
1,2-Dibromoethane	47	1		ug/L	1	106-93-4	1
Chlorobenzene	46	1		ug/L	1	108-90-7	1
1,1,1,2-Tetrachloroethane	46	1		ug/L	1	630-20-6	1
Ethylbenzene	47	1		ug/L	1	100-41-4	1
p,m-Xylene*	94	2		ug/L	1		1
o-Xylene	48	1		ug/L	1	95-47-6	1
Styrene	49	1		ug/L	1	100-42-5	1
Isopropylbenzene	47	5		ug/L	1	98-82-8	1
Bromoform	45	1		ug/L	1	75-25-2	1
1,1,2,2-Tetrachloroethane	48	1		ug/L	1	79-34-5	1
1,2,3-Trichloropropane	46	1		ug/L	1	96-18-4	1
n-Propylbenzene	47	1		ug/L	1	103-65-1	1
Bromobenzene	46	1		ug/L	1	108-86-1	1
1,3,5-Trimethylbenzene	46	1		ug/L	1	108-67-8	1
tert-Butylbenzene	46	1		ug/L	1	98-06-6	1
1,2,4-Trimethylbenzene	46	1		ug/L	1	95-63-6	1
sec-Butylbenzene	50	1		ug/L	1	135-98-8	1
p-Isopropyltoluene	51	5		ug/L	1	99-87-6	1
1,3-Dichlorobenzene	49	1		ug/L	1	541-73-1	1
1,4-Dichlorobenzene	49	1		ug/L	1	106-46-7	1
1,2-Dichlorobenzene	50	1		ug/L	1	95-50-1	1
1,2,3-Trimethylbenzene	51	1		ug/L	1	526-73-8	1
n-Butylbenzene	48	1		ug/L	1	104-51-8	1
Hexachloroethane	46	5		ug/L	1	67-72-1	1
1,2-Dibromo-3-chloropropane	52	5		ug/L	1	96-12-8	1
1,2,4-Trichlorobenzene	48	5		ug/L	1	120-82-1	1
1,2,3-Trichlorobenzene	47	5		ug/L	1	87-61-6	1
Naphthalene	54	5		ug/L	1	91-20-3	1
2-Methylnaphthalene	57	5		ug/L	1	91-57-6	1

1-Spiked at 50ug/L



# Analytical Laboratory Report

Lab Sample ID: S15872.06

Sample Tag: VAP-OS-MB263\_5-10 MSD

Collected Date/Time: 07/21/2020 13:37

Matrix: Groundwater

COC Reference: 135816

Sample Containers

#	Type	Preservative(s)	Refrigerated?	Arrival Temp. (C)	Thermometer #
3	40ml Glass	HCL	Yes	20.2	IR

Extraction / Prep.

Parameter	Result	Method	Run Date	Analyst	Flags
pH check for VOCs*	<2	N/A	07/23/20 13:15	JLS	

Organics - Volatiles

Volatile Organics - DEQ List, Method: SW5030C/8260C, Run Date: 07/22/20 21:25, Analyst: KAG

Parameter	Result	RL	MDL	Units	Dilution	CAS#	Flags
Diethyl ether	59	10		ug/L	1	60-29-7	1
Acetone	60	50		ug/L	1	67-64-1	1
Methyl iodide	60	1		ug/L	1	74-88-4	1
Carbon disulfide	59	5		ug/L	1	75-15-0	1
tert-Methyl butyl ether (MTBE)	63	5		ug/L	1	1634-04-4	1
Acrylonitrile	62	2		ug/L	1	107-13-1	1
2-Butanone (MEK)	60	25		ug/L	1	78-93-3	1
Dichlorodifluoromethane	40	5		ug/L	1	75-71-8	1
Chloromethane	51	5		ug/L	1	74-87-3	1
Vinyl chloride	54	1		ug/L	1	75-01-4	1
Bromomethane	54	5		ug/L	1	74-83-9	1
Chloroethane	57	5		ug/L	1	75-00-3	1
Trichlorofluoromethane	58	1		ug/L	1	75-69-4	1
1,1-Dichloroethene	60	1		ug/L	1	75-35-4	1
Methylene chloride	58	5		ug/L	1	75-09-2	1
trans-1,2-Dichloroethene	61	1		ug/L	1	156-60-5	1
1,1-Dichloroethane	62	1		ug/L	1	75-34-3	1
cis-1,2-Dichloroethene	62	1		ug/L	1	156-59-2	1
Tetrahydrofuran*	Not detected	90		ug/L	1	109-99-9	1
Chloroform	63	1		ug/L	1	67-66-3	1
Bromochloromethane	62	1		ug/L	1	74-97-5	1
1,1,1-Trichloroethane	63	1		ug/L	1	71-55-6	1
4-Methyl-2-pentanone (MIBK)	63	50		ug/L	1	108-10-1	1
2-Hexanone	63	50		ug/L	1	591-78-6	1
Carbon tetrachloride	63	1		ug/L	1	56-23-5	1
Benzene	61	1		ug/L	1	71-43-2	1
1,2-Dichloroethane	60	1		ug/L	1	107-06-2	1
Trichloroethene	61	1		ug/L	1	79-01-6	1
1,2-Dichloropropane	63	1		ug/L	1	78-87-5	1
Bromodichloromethane	64	1		ug/L	1	75-27-4	1
Dibromomethane	60	5		ug/L	1	74-95-3	1
cis-1,3-Dichloropropene	63	1		ug/L	1	10061-01-5	1
Toluene	62	1		ug/L	1	108-88-3	1
trans-1,3-Dichloropropene	64	1		ug/L	1	10061-02-6	1
1,1,2-Trichloroethane	62	1		ug/L	1	79-00-5	1
Tetrachloroethene	58	1		ug/L	1	127-18-4	1

1-Spiked at 50ug/L



# Analytical Laboratory Report

Lab Sample ID: S15872.06 (continued)

Sample Tag: VAP-OS-MB263\_5-10 MSD

Volatile Organics - DEQ List, Method: SW5030C/8260C, Run Date: 07/22/20 21:25, Analyst: KAG (continued)

Parameter	Result	RL	MDL	Units	Dilution	CAS#	Flags
trans-1,4-Dichloro-2-butene	58	1		ug/L	1	110-57-6	1
Dibromochloromethane	64	5		ug/L	1	124-48-1	1
1,2-Dibromoethane	61	1		ug/L	1	106-93-4	1
Chlorobenzene	61	1		ug/L	1	108-90-7	1
1,1,1,2-Tetrachloroethane	64	1		ug/L	1	630-20-6	1
Ethylbenzene	64	1		ug/L	1	100-41-4	1
p,m-Xylene*	127	2		ug/L	1		1
o-Xylene	65	1		ug/L	1	95-47-6	1
Styrene	65	1		ug/L	1	100-42-5	1
Isopropylbenzene	65	5		ug/L	1	98-82-8	1
Bromoform	63	1		ug/L	1	75-25-2	1
1,1,2,2-Tetrachloroethane	62	1		ug/L	1	79-34-5	1
1,2,3-Trichloropropane	61	1		ug/L	1	96-18-4	1
n-Propylbenzene	63	1		ug/L	1	103-65-1	1
Bromobenzene	61	1		ug/L	1	108-86-1	1
1,3,5-Trimethylbenzene	62	1		ug/L	1	108-67-8	1
tert-Butylbenzene	63	1		ug/L	1	98-06-6	1
1,2,4-Trimethylbenzene	62	1		ug/L	1	95-63-6	1
sec-Butylbenzene	65	1		ug/L	1	135-98-8	1
p-Isopropyltoluene	66	5		ug/L	1	99-87-6	1
1,3-Dichlorobenzene	64	1		ug/L	1	541-73-1	1
1,4-Dichlorobenzene	63	1		ug/L	1	106-46-7	1
1,2-Dichlorobenzene	64	1		ug/L	1	95-50-1	1
1,2,3-Trimethylbenzene	65	1		ug/L	1	526-73-8	1
n-Butylbenzene	62	1		ug/L	1	104-51-8	1
Hexachloroethane	64	5		ug/L	1	67-72-1	1
1,2-Dibromo-3-chloropropane	66	5		ug/L	1	96-12-8	1
1,2,4-Trichlorobenzene	61	5		ug/L	1	120-82-1	1
1,2,3-Trichlorobenzene	59	5		ug/L	1	87-61-6	1
Naphthalene	68	5		ug/L	1	91-20-3	1
2-Methylnaphthalene	70	5		ug/L	1	91-57-6	1

1-Spiked at 50ug/L



# Analytical Laboratory Report

Lab Sample ID: S15872.07

Sample Tag: Trip Blank

Collected Date/Time: 07/21/2020 00:01

Matrix: Water

COC Reference: 135816

Sample Containers

#	Type	Preservative(s)	Refrigerated?	Arrival Temp. (C)	Thermometer #
1	40ml Glass	HCL	Yes	20.2	IR

Extraction / Prep.

Parameter	Result	Method	Run Date	Analyst	Flags
pH check for VOCs*	<2	N/A	07/23/20 13:15	JLS	

Organics - Volatiles

Volatile Organics - DEQ List, Method: SW5030C/8260C, Run Date: 07/22/20 14:04, Analyst: KAG

Parameter	Result	RL	MDL	Units	Dilution	CAS#	Flags
Diethyl ether	Not detected	10		ug/L	1	60-29-7	
Acetone	Not detected	50		ug/L	1	67-64-1	
Methyl iodide	Not detected	1		ug/L	1	74-88-4	
Carbon disulfide	Not detected	5		ug/L	1	75-15-0	
tert-Methyl butyl ether (MTBE)	Not detected	5		ug/L	1	1634-04-4	
Acrylonitrile	Not detected	2		ug/L	1	107-13-1	
2-Butanone (MEK)	Not detected	25		ug/L	1	78-93-3	
Dichlorodifluoromethane	Not detected	5		ug/L	1	75-71-8	
Chloromethane	Not detected	5		ug/L	1	74-87-3	
Vinyl chloride	Not detected	1		ug/L	1	75-01-4	
Bromomethane	Not detected	5		ug/L	1	74-83-9	
Chloroethane	Not detected	5		ug/L	1	75-00-3	
Trichlorofluoromethane	Not detected	1		ug/L	1	75-69-4	
1,1-Dichloroethene	Not detected	1		ug/L	1	75-35-4	
Methylene chloride	Not detected	5		ug/L	1	75-09-2	
trans-1,2-Dichloroethene	Not detected	1		ug/L	1	156-60-5	
1,1-Dichloroethane	Not detected	1		ug/L	1	75-34-3	
cis-1,2-Dichloroethene	Not detected	1		ug/L	1	156-59-2	
Tetrahydrofuran*	Not detected	90		ug/L	1	109-99-9	
Chloroform	Not detected	1		ug/L	1	67-66-3	
Bromochloromethane	Not detected	1		ug/L	1	74-97-5	
1,1,1-Trichloroethane	Not detected	1		ug/L	1	71-55-6	
4-Methyl-2-pentanone (MIBK)	Not detected	50		ug/L	1	108-10-1	
2-Hexanone	Not detected	50		ug/L	1	591-78-6	
Carbon tetrachloride	Not detected	1		ug/L	1	56-23-5	
Benzene	Not detected	1		ug/L	1	71-43-2	
1,2-Dichloroethane	Not detected	1		ug/L	1	107-06-2	
Trichloroethene	Not detected	1		ug/L	1	79-01-6	
1,2-Dichloropropane	Not detected	1		ug/L	1	78-87-5	
Bromodichloromethane	Not detected	1		ug/L	1	75-27-4	
Dibromomethane	Not detected	5		ug/L	1	74-95-3	
cis-1,3-Dichloropropene	Not detected	1		ug/L	1	10061-01-5	
Toluene	Not detected	1		ug/L	1	108-88-3	
trans-1,3-Dichloropropene	Not detected	1		ug/L	1	10061-02-6	
1,1,2-Trichloroethane	Not detected	1		ug/L	1	79-00-5	
Tetrachloroethene	Not detected	1		ug/L	1	127-18-4	
trans-1,4-Dichloro-2-butene	Not detected	1		ug/L	1	110-57-6	



# Analytical Laboratory Report

Lab Sample ID: S15872.07 (continued)

Sample Tag: Trip Blank

Volatile Organics - DEQ List, Method: SW5030C/8260C, Run Date: 07/22/20 14:04, Analyst: KAG (continued)

Parameter	Result	RL	MDL	Units	Dilution	CAS#	Flags
Dibromochloromethane	Not detected	5		ug/L	1	124-48-1	
1,2-Dibromoethane	Not detected	1		ug/L	1	106-93-4	
Chlorobenzene	Not detected	1		ug/L	1	108-90-7	
1,1,1,2-Tetrachloroethane	Not detected	1		ug/L	1	630-20-6	
Ethylbenzene	Not detected	1		ug/L	1	100-41-4	
p,m-Xylene*	Not detected	2		ug/L	1		
o-Xylene	Not detected	1		ug/L	1	95-47-6	
Styrene	Not detected	1		ug/L	1	100-42-5	
Isopropylbenzene	Not detected	5		ug/L	1	98-82-8	
Bromoform	Not detected	1		ug/L	1	75-25-2	
1,1,2,2-Tetrachloroethane	Not detected	1		ug/L	1	79-34-5	
1,2,3-Trichloropropane	Not detected	1		ug/L	1	96-18-4	
n-Propylbenzene	Not detected	1		ug/L	1	103-65-1	
Bromobenzene	Not detected	1		ug/L	1	108-86-1	
1,3,5-Trimethylbenzene	Not detected	1		ug/L	1	108-67-8	
tert-Butylbenzene	Not detected	1		ug/L	1	98-06-6	
1,2,4-Trimethylbenzene	Not detected	1		ug/L	1	95-63-6	
sec-Butylbenzene	Not detected	1		ug/L	1	135-98-8	
p-Isopropyltoluene	Not detected	5		ug/L	1	99-87-6	
1,3-Dichlorobenzene	Not detected	1		ug/L	1	541-73-1	
1,4-Dichlorobenzene	Not detected	1		ug/L	1	106-46-7	
1,2-Dichlorobenzene	Not detected	1		ug/L	1	95-50-1	
1,2,3-Trimethylbenzene	Not detected	1		ug/L	1	526-73-8	
n-Butylbenzene	Not detected	1		ug/L	1	104-51-8	
Hexachloroethane	Not detected	5		ug/L	1	67-72-1	
1,2-Dibromo-3-chloropropane	Not detected	5		ug/L	1	96-12-8	
1,2,4-Trichlorobenzene	Not detected	5		ug/L	1	120-82-1	
1,2,3-Trichlorobenzene	Not detected	5		ug/L	1	87-61-6	
Naphthalene	Not detected	5		ug/L	1	91-20-3	
2-Methylnaphthalene	Not detected	5		ug/L	1	91-57-6	

# Merit Laboratories Login Checklist

Lab Set ID:S15872

Client:ARCADIS\_NOVI (ARCADIS U.S., Inc.)

Project: RACER Lansing

Submitted:07/21/2020 15:47 Login User: MMC

Attention: Tiffany Linder

Address: Arcadis  
28550 Cabot Drive  
Suite 500  
Novi, MI 48377

Phone: 248-994-2272 FAX:  
Email: tiffany.linder@arcadis-us.com

Selection	Description	Note
<b>Sample Receiving</b>		
01.	<input type="checkbox"/> Yes <input checked="" type="checkbox"/> No <input type="checkbox"/> N/A	Samples are received at 4C +/- 2C Thermometer # IR 20.2
02.	<input checked="" type="checkbox"/> Yes <input type="checkbox"/> No <input type="checkbox"/> N/A	Received on ice/ cooling process begun
03.	<input type="checkbox"/> Yes <input checked="" type="checkbox"/> No <input type="checkbox"/> N/A	Samples shipped
04.	<input type="checkbox"/> Yes <input checked="" type="checkbox"/> No <input type="checkbox"/> N/A	Samples left in 24 hr. drop box
05.	<input type="checkbox"/> Yes <input type="checkbox"/> No <input checked="" type="checkbox"/> N/A	Are there custody seals/tape or is the drop box locked
<b>Chain of Custody</b>		
06.	<input checked="" type="checkbox"/> Yes <input type="checkbox"/> No <input type="checkbox"/> N/A	COC adequately filled out
07.	<input checked="" type="checkbox"/> Yes <input type="checkbox"/> No <input type="checkbox"/> N/A	COC signed and relinquished to the lab
08.	<input checked="" type="checkbox"/> Yes <input type="checkbox"/> No <input type="checkbox"/> N/A	Sample tag on bottles match COC
09.	<input type="checkbox"/> Yes <input checked="" type="checkbox"/> No <input type="checkbox"/> N/A	Subcontracting needed? Subcontracted to:
<b>Preservation</b>		
10.	<input checked="" type="checkbox"/> Yes <input type="checkbox"/> No <input type="checkbox"/> N/A	Do sample have correct chemical preservation
11.	<input type="checkbox"/> Yes <input type="checkbox"/> No <input checked="" type="checkbox"/> N/A	Completed pH checks on preserved samples? (no VOAs)
12.	<input type="checkbox"/> Yes <input checked="" type="checkbox"/> No <input type="checkbox"/> N/A	Did any samples need to be preserved in the lab?
<b>Bottle Conditions</b>		
13.	<input checked="" type="checkbox"/> Yes <input type="checkbox"/> No <input type="checkbox"/> N/A	All bottles intact
14.	<input checked="" type="checkbox"/> Yes <input type="checkbox"/> No <input type="checkbox"/> N/A	Appropriate analytical bottles are used
15.	<input checked="" type="checkbox"/> Yes <input type="checkbox"/> No <input type="checkbox"/> N/A	Merit bottles used
16.	<input checked="" type="checkbox"/> Yes <input type="checkbox"/> No <input type="checkbox"/> N/A	Sufficient sample volume received
17.	<input type="checkbox"/> Yes <input checked="" type="checkbox"/> No <input type="checkbox"/> N/A	Samples require laboratory filtration
18.	<input checked="" type="checkbox"/> Yes <input type="checkbox"/> No <input type="checkbox"/> N/A	Samples submitted within holding time
19.	<input type="checkbox"/> Yes <input type="checkbox"/> No <input checked="" type="checkbox"/> N/A	Do water VOC or TOX bottles contain headspace

Corrective action for all exceptions is to call the client and to notify the project manager.

Client Review By: \_\_\_\_\_ Date: \_\_\_\_\_



2680 East Lansing Dr., East Lansing, MI 48823  
 Phone (517) 332-0167 Fax (517) 332-4034  
 www.meritlabs.com

C.O.C. PAGE # 1 OF 1

135816

**REPORT TO**

**CHAIN OF CUSTODY RECORD**

**INVOICE TO**

CONTACT NAME *Tiffany Linder*  
 COMPANY *Arcadis*  
 ADDRESS *28550 Cabot Dr. #500*  
 CITY *Novi* STATE *MI* ZIP CODE *48377*  
 PHONE NO. FAX NO. P.O. NO.  
 E-MAIL ADDRESS *Tiffany.Linder@arcadis.com* QUOTE NO.

CONTACT NAME  SAME  
 COMPANY  
 ADDRESS  
 CITY STATE ZIP CODE  
 PHONE NO. E-MAIL ADDRESS

**ANALYSIS (ATTACH LIST IF MORE SPACE IS REQUIRED)**

PROJECT NO./NAME *RACER Lansing* SAMPLER(S) - PLEASE PRINT/SIGN NAME *Kara Donahue Km John*  
 TURNAROUND TIME REQUIRED  1 DAY  2 DAYS  3 DAYS  STANDARD  OTHER  
 DELIVERABLES REQUIRED  STD  LEVEL II  LEVEL III  LEVEL IV  EDD  OTHER

MATRIX GW=GROUNDWATER WW=WASTEWATER S=SOIL L=LIQUID SD=SOLID  
 CODE: SL=SLUDGE DW=DRINKING WATER O=OIL WP=WIFE A=AIR W=WASTE

# Containers & Preservatives

*VOLs sm5030c 2810c*

MATRIX	# OF BOTTLES	NONE	HCl	HNO <sub>3</sub>	H <sub>2</sub> SO <sub>4</sub>	NaOH	MeOH	OTHER
GW	3		3					X
GW	3		3					X
GW	3		3					X
GW	9		9					X
	1							X

Certifications  
 OHIO VAP  Drinking Water  
 DoD  NPDES  
 Project Locations  
 Detroit  New York  
 Other  
 Special Instructions

MERIT LAB NO. <small>FOR LAB USE ONLY</small>	YEAR		SAMPLE TAG IDENTIFICATION-DESCRIPTION	MATRIX	# OF BOTTLES	NONE	HCl	HNO <sub>3</sub>	H <sub>2</sub> SO <sub>4</sub>	NaOH	MeOH	OTHER
	DATE	TIME										
<i>15872.01</i>	<i>7/21/20</i>	<i>12:42</i>	<i>VAP-OS-LV263</i>	<i>GW</i>	<i>3</i>		<i>3</i>					<i>X</i>
<i>.02</i>	<i>7/21/20</i>	<i>13:03</i>	<i>VAP-OS-LY263</i>	<i>GW</i>	<i>3</i>		<i>3</i>					<i>X</i>
<i>.03</i>			<i>DUP-01</i>	<i>GW</i>	<i>3</i>		<i>3</i>					<i>X</i>
<i>04/05/06</i>	<i>7/21/20</i>	<i>13:37</i>	<i>VAP-OS-MB263</i>	<i>GW</i>	<i>9</i>		<i>9</i>					<i>X</i>
<i>.07</i>	<i>7/21/20</i>		<i>Trip Blank</i>		<i>1</i>							<i>X</i>

*3 for MS and 3 for MSD*

RELINQUISHED BY: *Km John/Arcadis*  Sampler DATE *7/21/20* TIME *1547*  
 SIGNATURE/ORGANIZATION  
 RECEIVED BY: *M Orlowski* DATE *7/21/2020* TIME *1347*  
 SIGNATURE/ORGANIZATION  
 RELINQUISHED BY: DATE TIME  
 SIGNATURE/ORGANIZATION  
 RECEIVED BY: DATE TIME  
 SIGNATURE/ORGANIZATION

RELINQUISHED BY: DATE TIME  
 SIGNATURE/ORGANIZATION  
 RECEIVED BY: DATE TIME  
 SIGNATURE/ORGANIZATION  
 SEAL NO. SEAL INTACT YES  NO  INITIALS  
 SEAL NO. SEAL INTACT YES  NO  INITIALS  
 NOTES: TEMP. ON ARRIVAL *20.2*

PLEASE NOTE: SIGNING ACKNOWLEDGES ADHERENCE TO MERIT'S SAMPLE ACCEPTANCE POLICY ON REVERSE SIDE



# Analytical Laboratory Report

Report ID: S16026.01(01)  
Generated on 07/28/2020

## Report to

---

Attention: Tiffany Linder  
Arcadis  
28550 Cabot Drive  
Suite 500  
Novi, MI 48377

Phone: 248-994-2272 FAX:  
Email: [tiffany.linder@arcadis-us.com](mailto:tiffany.linder@arcadis-us.com)

Additional Contacts: Alex Villhauer, Trevor Swarhout, Marina Samp

## Report produced by

---

Merit Laboratories, Inc.  
2680 East Lansing Drive  
East Lansing, MI 48823

Phone: (517) 332-0167 FAX: (517) 332-6333

Contacts for report questions:  
John Lavery ([johnlavery@meritlabs.com](mailto:johnlavery@meritlabs.com))  
Barbara Ball ([bball@meritlabs.com](mailto:bball@meritlabs.com))

## Report Summary

---

Lab Sample ID(s): S16026.01-S16026.03  
Project: RACER Lansing  
Collected Date(s): 07/24/2020  
Submitted Date/Time: 07/24/2020 19:00  
Sampled by: Kara Donahue  
P.O. #: 30042872.04600

## Table of Contents

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Maya Murshak  
Technical Director



# Analytical Laboratory Report

## General Report Notes

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Analytical results relate only to the samples tested, in the condition received by the laboratory.

Methods may be modified for improved performance.

Results reported on a dry weight basis where applicable.

'Not detected' indicates that parameter was not found at a level equal to or greater than the reporting limit (RL).

40 CFR Part 136 Table II Required Containers, Preservation Techniques and Holding Times for the Clean Water Act specify that samples for acrolein and acrylonitrile need to be preserved at a pH in the range of 4 to 5 or if not preserved, analyzed within 3 days of sampling.

QA/QC corresponding to this analytical report is a separate document with the same Merit ID reference and is available upon request.

Full accreditation certificates are available upon request. Starred (\*) analytes are not NELAP accredited.

Samples are held by the lab for 30 days from the final report date unless a written request to hold longer is provided by the client.

Report shall not be reproduced except in full, without the written approval of Merit Laboratories, Inc.

Limits for drinking water samples, are listed as the MCL Limits (Maximum Contaminant Level Concentrations)

## Report Narrative

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There is no additional narrative for this analytical report



# Analytical Laboratory Report

## Laboratory Certifications

Authority	Certification ID
Michigan DEQ	#9956
DOD ELAP/ISO 17025	#69699
WBENC	#2005110032
Ohio VAP	#CL0002
Indiana DOH	#C-MI-07
New York NELAC	#11814
North Carolina DENR	#680
North Carolina DOH	#26702
Alaska CSLAP	#17-001

## Qualifier Descriptions

Qualifier	Description
!	Result is outside of stated limit criteria
B	Compound also found in associated method blank
E	Concentration exceeds calibration range
F	Analysis run outside of holding time
G	Estimated result due to extraction run outside of holding time
H	Sample submitted and run outside of holding time
I	Matrix interference with internal standard
J	Estimated value less than reporting limit, but greater than MDL
L	Elevated reporting limit due to low sample amount
M	Result reported to MDL not RDL
O	Analysis performed by outside laboratory. See attached report.
R	Preliminary result
S	Surrogate recovery outside of control limits
T	No correction for total solids
X	Elevated reporting limit due to matrix interference
Y	Elevated reporting limit due to high target concentration
b	Value detected less than reporting limit, but greater than MDL
e	Reported value estimated due to interference
j	Analyte also found in associated method blank
p	Benzo(b)Fluoranthene and Benzo(k)Fluoranthene integrated as one peak.
x	Preserved from bulk sample

## Glossary of Abbreviations

Abbreviation	Description
RL/RDL	Reporting Limit
MDL	Method Detection Limit
MS	Matrix Spike
MSD	Matrix Spike Duplicate
SW	EPA SW 846 (Soil and Wastewater) Methods
E	EPA Methods
SM	Standard Methods
LN	Linear
BR	Branched



# Analytical Laboratory Report

## Method Summary

Method	Version
N/A	Not Applicable
SW5030C/8260C	SW 846 Method 8260C Revision 3 August 2006 / 5030C Revision 3 May 2003



# Analytical Laboratory Report

## Sample Summary (3 samples)

Sample ID	Sample Tag	Matrix	Collected Date/Time
S16026.01	VAP-OS-MA266_7-12	Groundwater	07/24/20 11:53
S16026.02	VAP-OS-MC268_7-12	Groundwater	07/24/20 13:15
S16026.03	Trip Blank	Water	07/24/20 00:01



# Analytical Laboratory Report

Lab Sample ID: S16026.01

Sample Tag: VAP-OS-MA266\_7-12

Collected Date/Time: 07/24/2020 11:53

Matrix: Groundwater

COC Reference: 135926

Sample Containers

#	Type	Preservative(s)	Refrigerated?	Arrival Temp. (C)	Thermometer #
3	40ml Glass	HCL	Yes	18.0	IR

Extraction / Prep.

Parameter	Result	Method	Run Date	Analyst	Flags
pH check for VOCs*	<2	N/A	07/28/20 09:36	JLS	

Organics - Volatiles

Volatile Organics - DEQ List, Method: SW5030C/8260C, Run Date: 07/28/20 00:56, Analyst: KAG

Parameter	Result	RL	MDL	Units	Dilution	CAS#	Flags
Diethyl ether	Not detected	10		ug/L	1	60-29-7	
Acetone	Not detected	50		ug/L	1	67-64-1	
Methyl iodide	Not detected	1		ug/L	1	74-88-4	
Carbon disulfide	Not detected	5		ug/L	1	75-15-0	
tert-Methyl butyl ether (MTBE)	Not detected	5		ug/L	1	1634-04-4	
Acrylonitrile	Not detected	2		ug/L	1	107-13-1	
2-Butanone (MEK)	Not detected	25		ug/L	1	78-93-3	
Dichlorodifluoromethane	Not detected	5		ug/L	1	75-71-8	
Chloromethane	Not detected	5		ug/L	1	74-87-3	
Vinyl chloride	1	1		ug/L	1	75-01-4	
Bromomethane	Not detected	5		ug/L	1	74-83-9	
Chloroethane	Not detected	5		ug/L	1	75-00-3	
Trichlorofluoromethane	Not detected	1		ug/L	1	75-69-4	
1,1-Dichloroethene	Not detected	1		ug/L	1	75-35-4	
Methylene chloride	Not detected	5		ug/L	1	75-09-2	
trans-1,2-Dichloroethene	Not detected	1		ug/L	1	156-60-5	
1,1-Dichloroethane	Not detected	1		ug/L	1	75-34-3	
cis-1,2-Dichloroethene	1	1		ug/L	1	156-59-2	
Tetrahydrofuran*	Not detected	90		ug/L	1	109-99-9	
Chloroform	Not detected	1		ug/L	1	67-66-3	
Bromochloromethane	Not detected	1		ug/L	1	74-97-5	
1,1,1-Trichloroethane	Not detected	1		ug/L	1	71-55-6	
4-Methyl-2-pentanone (MIBK)	Not detected	50		ug/L	1	108-10-1	
2-Hexanone	Not detected	50		ug/L	1	591-78-6	
Carbon tetrachloride	Not detected	1		ug/L	1	56-23-5	
Benzene	Not detected	1		ug/L	1	71-43-2	
1,2-Dichloroethane	Not detected	1		ug/L	1	107-06-2	
Trichloroethene	Not detected	1		ug/L	1	79-01-6	
1,2-Dichloropropane	Not detected	1		ug/L	1	78-87-5	
Bromodichloromethane	Not detected	1		ug/L	1	75-27-4	
Dibromomethane	Not detected	5		ug/L	1	74-95-3	
cis-1,3-Dichloropropene	Not detected	1		ug/L	1	10061-01-5	
Toluene	Not detected	1		ug/L	1	108-88-3	
trans-1,3-Dichloropropene	Not detected	1		ug/L	1	10061-02-6	
1,1,2-Trichloroethane	Not detected	1		ug/L	1	79-00-5	
Tetrachloroethene	Not detected	1		ug/L	1	127-18-4	
trans-1,4-Dichloro-2-butene	Not detected	1		ug/L	1	110-57-6	



# Analytical Laboratory Report

Lab Sample ID: S16026.01 (continued)

Sample Tag: VAP-OS-MA266\_7-12

Volatile Organics - DEQ List, Method: SW5030C/8260C, Run Date: 07/28/20 00:56, Analyst: KAG (continued)

Parameter	Result	RL	MDL	Units	Dilution	CAS#	Flags
Dibromochloromethane	Not detected	5		ug/L	1	124-48-1	
1,2-Dibromoethane	Not detected	1		ug/L	1	106-93-4	
Chlorobenzene	Not detected	1		ug/L	1	108-90-7	
1,1,1,2-Tetrachloroethane	Not detected	1		ug/L	1	630-20-6	
Ethylbenzene	Not detected	1		ug/L	1	100-41-4	
p,m-Xylene*	Not detected	2		ug/L	1		
o-Xylene	Not detected	1		ug/L	1	95-47-6	
Styrene	Not detected	1		ug/L	1	100-42-5	
Isopropylbenzene	Not detected	5		ug/L	1	98-82-8	
Bromoform	Not detected	1		ug/L	1	75-25-2	
1,1,2,2-Tetrachloroethane	Not detected	1		ug/L	1	79-34-5	
1,2,3-Trichloropropane	Not detected	1		ug/L	1	96-18-4	
n-Propylbenzene	Not detected	1		ug/L	1	103-65-1	
Bromobenzene	Not detected	1		ug/L	1	108-86-1	
1,3,5-Trimethylbenzene	Not detected	1		ug/L	1	108-67-8	
tert-Butylbenzene	Not detected	1		ug/L	1	98-06-6	
1,2,4-Trimethylbenzene	Not detected	1		ug/L	1	95-63-6	
sec-Butylbenzene	Not detected	1		ug/L	1	135-98-8	
p-Isopropyltoluene	Not detected	5		ug/L	1	99-87-6	
1,3-Dichlorobenzene	Not detected	1		ug/L	1	541-73-1	
1,4-Dichlorobenzene	Not detected	1		ug/L	1	106-46-7	
1,2-Dichlorobenzene	Not detected	1		ug/L	1	95-50-1	
1,2,3-Trimethylbenzene	Not detected	1		ug/L	1	526-73-8	
n-Butylbenzene	Not detected	1		ug/L	1	104-51-8	
Hexachloroethane	Not detected	5		ug/L	1	67-72-1	
1,2-Dibromo-3-chloropropane	Not detected	5		ug/L	1	96-12-8	
1,2,4-Trichlorobenzene	Not detected	5		ug/L	1	120-82-1	
1,2,3-Trichlorobenzene	Not detected	5		ug/L	1	87-61-6	
Naphthalene	Not detected	5		ug/L	1	91-20-3	
2-Methylnaphthalene	Not detected	5		ug/L	1	91-57-6	



# Analytical Laboratory Report

Lab Sample ID: S16026.02

Sample Tag: VAP-OS-MC268\_7-12

Collected Date/Time: 07/24/2020 13:15

Matrix: Groundwater

COC Reference: 135926

Sample Containers

#	Type	Preservative(s)	Refrigerated?	Arrival Temp. (C)	Thermometer #
3	40ml Glass	HCL	Yes	18.0	IR

Extraction / Prep.

Parameter	Result	Method	Run Date	Analyst	Flags
pH check for VOCs*	<2	N/A	07/28/20 09:36	JLS	

Organics - Volatiles

Volatile Organics - DEQ List, Method: SW5030C/8260C, Run Date: 07/28/20 01:15, Analyst: KAG

Parameter	Result	RL	MDL	Units	Dilution	CAS#	Flags
Diethyl ether	Not detected	10		ug/L	1	60-29-7	
Acetone	Not detected	50		ug/L	1	67-64-1	
Methyl iodide	Not detected	1		ug/L	1	74-88-4	
Carbon disulfide	Not detected	5		ug/L	1	75-15-0	
tert-Methyl butyl ether (MTBE)	Not detected	5		ug/L	1	1634-04-4	
Acrylonitrile	Not detected	2		ug/L	1	107-13-1	
2-Butanone (MEK)	Not detected	25		ug/L	1	78-93-3	
Dichlorodifluoromethane	Not detected	5		ug/L	1	75-71-8	
Chloromethane	Not detected	5		ug/L	1	74-87-3	
Vinyl chloride	Not detected	1		ug/L	1	75-01-4	
Bromomethane	Not detected	5		ug/L	1	74-83-9	
Chloroethane	Not detected	5		ug/L	1	75-00-3	
Trichlorofluoromethane	Not detected	1		ug/L	1	75-69-4	
1,1-Dichloroethene	Not detected	1		ug/L	1	75-35-4	
Methylene chloride	Not detected	5		ug/L	1	75-09-2	
trans-1,2-Dichloroethene	Not detected	1		ug/L	1	156-60-5	
1,1-Dichloroethane	Not detected	1		ug/L	1	75-34-3	
cis-1,2-Dichloroethene	Not detected	1		ug/L	1	156-59-2	
Tetrahydrofuran*	Not detected	90		ug/L	1	109-99-9	
Chloroform	Not detected	1		ug/L	1	67-66-3	
Bromochloromethane	Not detected	1		ug/L	1	74-97-5	
1,1,1-Trichloroethane	Not detected	1		ug/L	1	71-55-6	
4-Methyl-2-pentanone (MIBK)	Not detected	50		ug/L	1	108-10-1	
2-Hexanone	Not detected	50		ug/L	1	591-78-6	
Carbon tetrachloride	Not detected	1		ug/L	1	56-23-5	
Benzene	Not detected	1		ug/L	1	71-43-2	
1,2-Dichloroethane	Not detected	1		ug/L	1	107-06-2	
Trichloroethene	Not detected	1		ug/L	1	79-01-6	
1,2-Dichloropropane	Not detected	1		ug/L	1	78-87-5	
Bromodichloromethane	Not detected	1		ug/L	1	75-27-4	
Dibromomethane	Not detected	5		ug/L	1	74-95-3	
cis-1,3-Dichloropropene	Not detected	1		ug/L	1	10061-01-5	
Toluene	Not detected	1		ug/L	1	108-88-3	
trans-1,3-Dichloropropene	Not detected	1		ug/L	1	10061-02-6	
1,1,2-Trichloroethane	Not detected	1		ug/L	1	79-00-5	
Tetrachloroethene	Not detected	1		ug/L	1	127-18-4	
trans-1,4-Dichloro-2-butene	Not detected	1		ug/L	1	110-57-6	



# Analytical Laboratory Report

Lab Sample ID: S16026.02 (continued)

Sample Tag: VAP-OS-MC268\_7-12

Volatile Organics - DEQ List, Method: SW5030C/8260C, Run Date: 07/28/20 01:15, Analyst: KAG (continued)

Parameter	Result	RL	MDL	Units	Dilution	CAS#	Flags
Dibromochloromethane	Not detected	5		ug/L	1	124-48-1	
1,2-Dibromoethane	Not detected	1		ug/L	1	106-93-4	
Chlorobenzene	Not detected	1		ug/L	1	108-90-7	
1,1,1,2-Tetrachloroethane	Not detected	1		ug/L	1	630-20-6	
Ethylbenzene	Not detected	1		ug/L	1	100-41-4	
p,m-Xylene*	Not detected	2		ug/L	1		
o-Xylene	Not detected	1		ug/L	1	95-47-6	
Styrene	Not detected	1		ug/L	1	100-42-5	
Isopropylbenzene	Not detected	5		ug/L	1	98-82-8	
Bromoform	Not detected	1		ug/L	1	75-25-2	
1,1,2,2-Tetrachloroethane	Not detected	1		ug/L	1	79-34-5	
1,2,3-Trichloropropane	Not detected	1		ug/L	1	96-18-4	
n-Propylbenzene	Not detected	1		ug/L	1	103-65-1	
Bromobenzene	Not detected	1		ug/L	1	108-86-1	
1,3,5-Trimethylbenzene	Not detected	1		ug/L	1	108-67-8	
tert-Butylbenzene	Not detected	1		ug/L	1	98-06-6	
1,2,4-Trimethylbenzene	Not detected	1		ug/L	1	95-63-6	
sec-Butylbenzene	Not detected	1		ug/L	1	135-98-8	
p-Isopropyltoluene	Not detected	5		ug/L	1	99-87-6	
1,3-Dichlorobenzene	Not detected	1		ug/L	1	541-73-1	
1,4-Dichlorobenzene	Not detected	1		ug/L	1	106-46-7	
1,2-Dichlorobenzene	Not detected	1		ug/L	1	95-50-1	
1,2,3-Trimethylbenzene	Not detected	1		ug/L	1	526-73-8	
n-Butylbenzene	Not detected	1		ug/L	1	104-51-8	
Hexachloroethane	Not detected	5		ug/L	1	67-72-1	
1,2-Dibromo-3-chloropropane	Not detected	5		ug/L	1	96-12-8	
1,2,4-Trichlorobenzene	Not detected	5		ug/L	1	120-82-1	
1,2,3-Trichlorobenzene	Not detected	5		ug/L	1	87-61-6	
Naphthalene	Not detected	5		ug/L	1	91-20-3	
2-Methylnaphthalene	Not detected	5		ug/L	1	91-57-6	



# Analytical Laboratory Report

Lab Sample ID: S16026.03

Sample Tag: Trip Blank

Collected Date/Time: 07/24/2020 00:01

Matrix: Water

COC Reference: 135926

Sample Containers

#	Type	Preservative(s)	Refrigerated?	Arrival Temp. (C)	Thermometer #
1	40ml Glass	HCL	Yes	18.0	IR

Extraction / Prep.

Parameter	Result	Method	Run Date	Analyst	Flags
pH check for VOCs*	<2	N/A	07/28/20 09:36	JLS	

Organics - Volatiles

Volatile Organics - DEQ List, Method: SW5030C/8260C, Run Date: 07/27/20 22:01, Analyst: KAG

Parameter	Result	RL	MDL	Units	Dilution	CAS#	Flags
Diethyl ether	Not detected	10		ug/L	1	60-29-7	
Acetone	Not detected	50		ug/L	1	67-64-1	
Methyl iodide	Not detected	1		ug/L	1	74-88-4	
Carbon disulfide	Not detected	5		ug/L	1	75-15-0	
tert-Methyl butyl ether (MTBE)	Not detected	5		ug/L	1	1634-04-4	
Acrylonitrile	Not detected	2		ug/L	1	107-13-1	
2-Butanone (MEK)	Not detected	25		ug/L	1	78-93-3	
Dichlorodifluoromethane	Not detected	5		ug/L	1	75-71-8	
Chloromethane	Not detected	5		ug/L	1	74-87-3	
Vinyl chloride	Not detected	1		ug/L	1	75-01-4	
Bromomethane	Not detected	5		ug/L	1	74-83-9	
Chloroethane	Not detected	5		ug/L	1	75-00-3	
Trichlorofluoromethane	Not detected	1		ug/L	1	75-69-4	
1,1-Dichloroethene	Not detected	1		ug/L	1	75-35-4	
Methylene chloride	Not detected	5		ug/L	1	75-09-2	
trans-1,2-Dichloroethene	Not detected	1		ug/L	1	156-60-5	
1,1-Dichloroethane	Not detected	1		ug/L	1	75-34-3	
cis-1,2-Dichloroethene	Not detected	1		ug/L	1	156-59-2	
Tetrahydrofuran*	Not detected	90		ug/L	1	109-99-9	
Chloroform	Not detected	1		ug/L	1	67-66-3	
Bromochloromethane	Not detected	1		ug/L	1	74-97-5	
1,1,1-Trichloroethane	Not detected	1		ug/L	1	71-55-6	
4-Methyl-2-pentanone (MIBK)	Not detected	50		ug/L	1	108-10-1	
2-Hexanone	Not detected	50		ug/L	1	591-78-6	
Carbon tetrachloride	Not detected	1		ug/L	1	56-23-5	
Benzene	Not detected	1		ug/L	1	71-43-2	
1,2-Dichloroethane	Not detected	1		ug/L	1	107-06-2	
Trichloroethene	Not detected	1		ug/L	1	79-01-6	
1,2-Dichloropropane	Not detected	1		ug/L	1	78-87-5	
Bromodichloromethane	Not detected	1		ug/L	1	75-27-4	
Dibromomethane	Not detected	5		ug/L	1	74-95-3	
cis-1,3-Dichloropropene	Not detected	1		ug/L	1	10061-01-5	
Toluene	Not detected	1		ug/L	1	108-88-3	
trans-1,3-Dichloropropene	Not detected	1		ug/L	1	10061-02-6	
1,1,2-Trichloroethane	Not detected	1		ug/L	1	79-00-5	
Tetrachloroethene	Not detected	1		ug/L	1	127-18-4	
trans-1,4-Dichloro-2-butene	Not detected	1		ug/L	1	110-57-6	



# Analytical Laboratory Report

Lab Sample ID: S16026.03 (continued)

Sample Tag: Trip Blank

Volatile Organics - DEQ List, Method: SW5030C/8260C, Run Date: 07/27/20 22:01, Analyst: KAG (continued)

Parameter	Result	RL	MDL	Units	Dilution	CAS#	Flags
Dibromochloromethane	Not detected	5		ug/L	1	124-48-1	
1,2-Dibromoethane	Not detected	1		ug/L	1	106-93-4	
Chlorobenzene	Not detected	1		ug/L	1	108-90-7	
1,1,1,2-Tetrachloroethane	Not detected	1		ug/L	1	630-20-6	
Ethylbenzene	Not detected	1		ug/L	1	100-41-4	
p,m-Xylene*	Not detected	2		ug/L	1		
o-Xylene	Not detected	1		ug/L	1	95-47-6	
Styrene	Not detected	1		ug/L	1	100-42-5	
Isopropylbenzene	Not detected	5		ug/L	1	98-82-8	
Bromoform	Not detected	1		ug/L	1	75-25-2	
1,1,2,2-Tetrachloroethane	Not detected	1		ug/L	1	79-34-5	
1,2,3-Trichloropropane	Not detected	1		ug/L	1	96-18-4	
n-Propylbenzene	Not detected	1		ug/L	1	103-65-1	
Bromobenzene	Not detected	1		ug/L	1	108-86-1	
1,3,5-Trimethylbenzene	Not detected	1		ug/L	1	108-67-8	
tert-Butylbenzene	Not detected	1		ug/L	1	98-06-6	
1,2,4-Trimethylbenzene	Not detected	1		ug/L	1	95-63-6	
sec-Butylbenzene	Not detected	1		ug/L	1	135-98-8	
p-Isopropyltoluene	Not detected	5		ug/L	1	99-87-6	
1,3-Dichlorobenzene	Not detected	1		ug/L	1	541-73-1	
1,4-Dichlorobenzene	Not detected	1		ug/L	1	106-46-7	
1,2-Dichlorobenzene	Not detected	1		ug/L	1	95-50-1	
1,2,3-Trimethylbenzene	Not detected	1		ug/L	1	526-73-8	
n-Butylbenzene	Not detected	1		ug/L	1	104-51-8	
Hexachloroethane	Not detected	5		ug/L	1	67-72-1	
1,2-Dibromo-3-chloropropane	Not detected	5		ug/L	1	96-12-8	
1,2,4-Trichlorobenzene	Not detected	5		ug/L	1	120-82-1	
1,2,3-Trichlorobenzene	Not detected	5		ug/L	1	87-61-6	
Naphthalene	Not detected	5		ug/L	1	91-20-3	
2-Methylnaphthalene	Not detected	5		ug/L	1	91-57-6	

# Merit Laboratories Login Checklist

Lab Set ID:S16026

Client:ARCADIS\_NOVI (ARCADIS U.S., Inc.)

Project: RACER Lansing

Submitted:07/24/2020 19:00 Login User: REJ

Attention: Tiffany Linder

Address: Arcadis  
28550 Cabot Drive  
Suite 500  
Novi, MI 48377

Phone: 248-994-2272 FAX:  
Email: tiffany.linder@arcadis-us.com

Selection	Description	Note
-----------	-------------	------

### Sample Receiving

- |     |  |   |
|-----|--|---|
| 01. | <input type="checkbox"/> Yes <input checked="" type="checkbox"/> No <input type="checkbox"/> N/A | Samples are received at 4C +/- 2C Thermometer # IR 18.0 |
| 02. | <input checked="" type="checkbox"/> Yes <input type="checkbox"/> No <input type="checkbox"/> N/A | Received on ice/ cooling process begun                  |
| 03. | <input type="checkbox"/> Yes <input checked="" type="checkbox"/> No <input type="checkbox"/> N/A | Samples shipped   |
| 04. | <input checked="" type="checkbox"/> Yes <input type="checkbox"/> No <input type="checkbox"/> N/A | Samples left in 24 hr. drop box                         |
| 05. | <input type="checkbox"/> Yes <input type="checkbox"/> No <input checked="" type="checkbox"/> N/A | Are there custody seals/tape or is the drop box locked  |

### Chain of Custody

- |     |  |  |
|-----|--|--|
| 06. | <input checked="" type="checkbox"/> Yes <input type="checkbox"/> No <input type="checkbox"/> N/A | COC adequately filled out                |
| 07. | <input checked="" type="checkbox"/> Yes <input type="checkbox"/> No <input type="checkbox"/> N/A | COC signed and relinquished to the lab   |
| 08. | <input checked="" type="checkbox"/> Yes <input type="checkbox"/> No <input type="checkbox"/> N/A | Sample tag on bottles match COC          |
| 09. | <input type="checkbox"/> Yes <input checked="" type="checkbox"/> No <input type="checkbox"/> N/A | Subcontracting needed? Subcontracted to: |

### Preservation

- |     |  |   |
|-----|--|---|
| 10. | <input checked="" type="checkbox"/> Yes <input type="checkbox"/> No <input type="checkbox"/> N/A | Do sample have correct chemical preservation        |
| 11. | <input type="checkbox"/> Yes <input type="checkbox"/> No <input checked="" type="checkbox"/> N/A | Completed pH checks on preserved samples? (no VOAs) |
| 12. | <input type="checkbox"/> Yes <input checked="" type="checkbox"/> No <input type="checkbox"/> N/A | Did any samples need to be preserved in the lab?    |

### Bottle Conditions

- |     |  |   |
|-----|--|---|
| 13. | <input checked="" type="checkbox"/> Yes <input type="checkbox"/> No <input type="checkbox"/> N/A | All bottles intact                            |
| 14. | <input checked="" type="checkbox"/> Yes <input type="checkbox"/> No <input type="checkbox"/> N/A | Appropriate analytical bottles are used       |
| 15. | <input checked="" type="checkbox"/> Yes <input type="checkbox"/> No <input type="checkbox"/> N/A | Merit bottles used                            |
| 16. | <input checked="" type="checkbox"/> Yes <input type="checkbox"/> No <input type="checkbox"/> N/A | Sufficient sample volume received             |
| 17. | <input type="checkbox"/> Yes <input checked="" type="checkbox"/> No <input type="checkbox"/> N/A | Samples require laboratory filtration         |
| 18. | <input checked="" type="checkbox"/> Yes <input type="checkbox"/> No <input type="checkbox"/> N/A | Samples submitted within holding time         |
| 19. | <input type="checkbox"/> Yes <input checked="" type="checkbox"/> No <input type="checkbox"/> N/A | Do water VOC or TOX bottles contain headspace |

Corrective action for all exceptions is to call the client and to notify the project manager.

Client Review By: \_\_\_\_\_ Date: \_\_\_\_\_



2680 East Lansing Dr., East Lansing, MI 48823  
 Phone (517) 332-0167 Fax (517) 332-4034  
 www.meritlabs.com

C.O.C. PAGE # 1 OF 1

135926

**REPORT TO**

**CHAIN OF CUSTODY RECORD**

**INVOICE TO**

CONTACT NAME *Tiffany Linder*  
 COMPANY *Arcadis*  
 ADDRESS *28550 Cabot Dr., Suite 500*  
 CITY *Novi* STATE *MI* ZIP CODE *48377*  
 PHONE NO. *810-225-1929* FAX NO. \_\_\_\_\_ P.O. NO. \_\_\_\_\_  
 E-MAIL ADDRESS *Tiffany.Linder@arcadis.com* QUOTE NO. \_\_\_\_\_

CONTACT NAME \_\_\_\_\_  SAME  
 COMPANY \_\_\_\_\_  
 ADDRESS \_\_\_\_\_  
 CITY \_\_\_\_\_ STATE \_\_\_\_\_ ZIP CODE \_\_\_\_\_  
 PHONE NO. \_\_\_\_\_ E-MAIL ADDRESS \_\_\_\_\_

ANALYSIS (ATTACH LIST IF MORE SPACE IS REQUIRED)

PROJECT NO./NAME *RACER Lansing* SAMPLER(S) - PLEASE PRINT/SIGN NAME *Kara Donahue*  
 TURNAROUND TIME REQUIRED  1 DAY  2 DAYS  3 DAYS  STANDARD  OTHER \_\_\_\_\_  
 DELIVERABLES REQUIRED  STD  LEVEL II  LEVEL III  LEVEL IV  EDD  OTHER \_\_\_\_\_

Certifications  
 OHIO VAP  Drinking Water  
 DoD  NPDES  
 Project Locations  
 Detroit  New York  
 Other \_\_\_\_\_  
 Special Instructions

MATRIX GW=GROUNDWATER WW=WASTEWATER S=SOIL L=LIQUID SD=SOLID  
 CODE: SL=SLUDGE DW=DRINKING WATER O=OIL WP=WIPE A=AIR W=WASTE

# Containers & Preservatives

MERIT LAB NO. <small>FOR LAB USE ONLY</small>	YEAR		SAMPLE TAG IDENTIFICATION-DESCRIPTION	MATRIX	# OF BOTTLES	NONE	HCl	HNO <sub>3</sub>	H <sub>2</sub> SO <sub>4</sub>	NaOH	MeOH	OTHER	VOCs	SM 5030	8260C
	DATE	TIME													
<i>1602601</i>	<i>7/24/20</i>	<i>11:53</i>	<i>VAP-OS-MA266-7-12</i>	<i>GW</i>	<i>3</i>		<i>X</i>						<i>XX</i>		
<i>.02</i>	<i>7/24/20</i>	<i>13:15</i>	<i>VAP-OS-MC268-8-13</i>	<i>GW</i>	<i>3</i>		<i>X</i>						<i>XX</i>		
<i>.03</i>	<i>7/24/20</i>	<i>-</i>	<i>Trip Blank</i>	<i>L</i>	<i>1</i>								<i>X</i>		

RELINQUISHED BY: *Kara Donahue*  Sampler DATE *7/24/20* TIME *18:20*  
 SIGNATURE/ORGANIZATION \_\_\_\_\_  
 RECEIVED BY: *Merit Lab* DATE *7/24/20* TIME *18:20*  
 SIGNATURE/ORGANIZATION \_\_\_\_\_  
 RELINQUISHED BY: *Ment* DATE *7/24/20* TIME *19:00*  
 SIGNATURE/ORGANIZATION \_\_\_\_\_  
 RECEIVED BY: *Miley* DATE *7/24/20* TIME *19:00*  
 SIGNATURE/ORGANIZATION \_\_\_\_\_

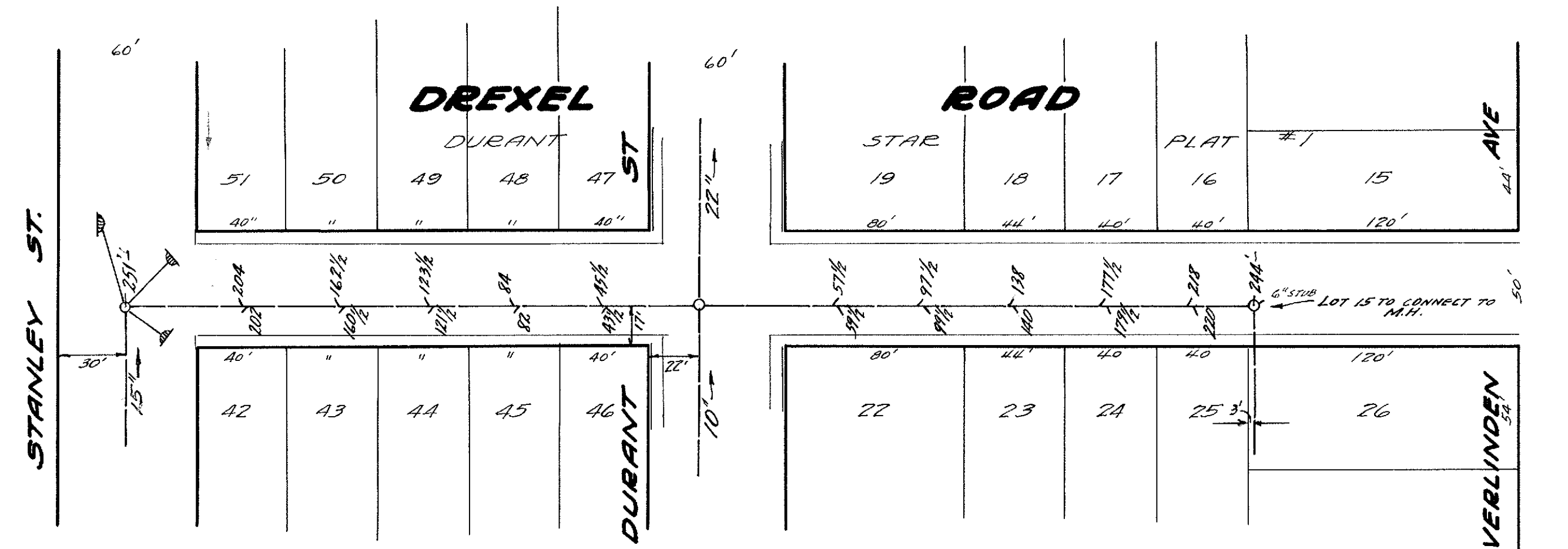
RELINQUISHED BY: \_\_\_\_\_ DATE \_\_\_\_\_ TIME \_\_\_\_\_  
 SIGNATURE/ORGANIZATION \_\_\_\_\_  
 RECEIVED BY: \_\_\_\_\_ DATE \_\_\_\_\_ TIME \_\_\_\_\_  
 SIGNATURE/ORGANIZATION \_\_\_\_\_  
 SEAL NO. SEAL INTACT YES  NO  INITIALS \_\_\_\_\_  
 SEAL NO. SEAL INTACT YES  NO  INITIALS \_\_\_\_\_  
 NOTES: TEMP. ON ARRIVAL *18.0*

PLEASE NOTE: SIGNING ACKNOWLEDGES ADHERENCE TO MERIT'S SAMPLE ACCEPTANCE POLICY ON REVERSE SIDE

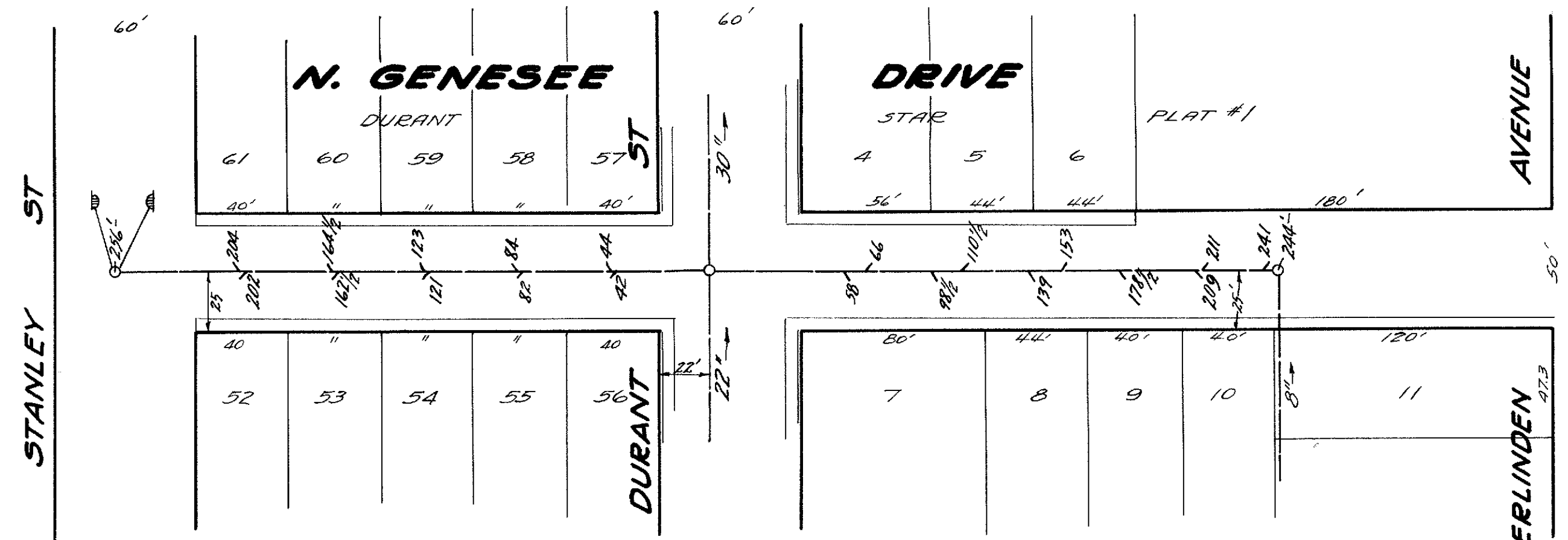
# ATTACHMENT 3

Storm and Sanitary Sewer Figures

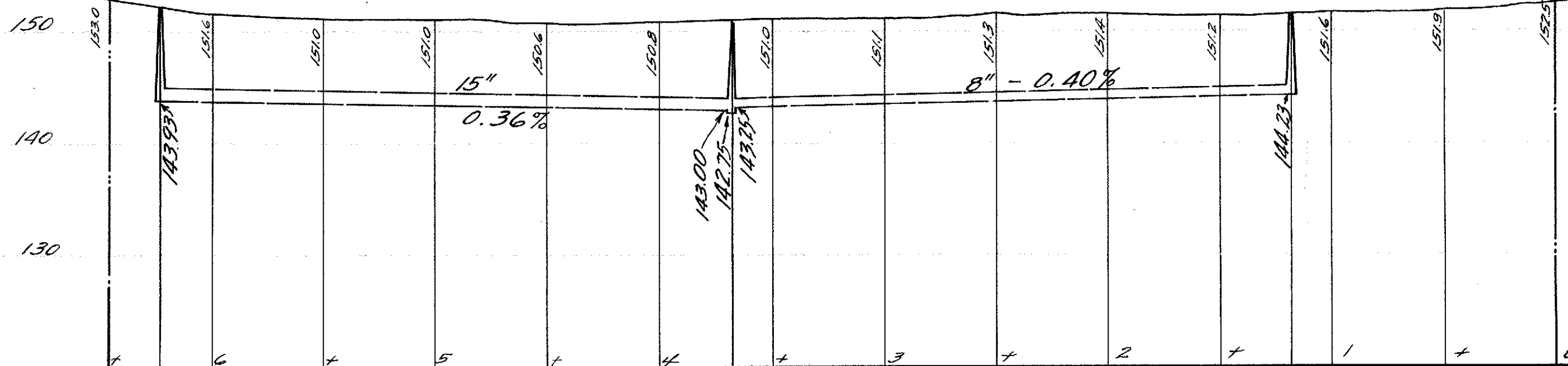
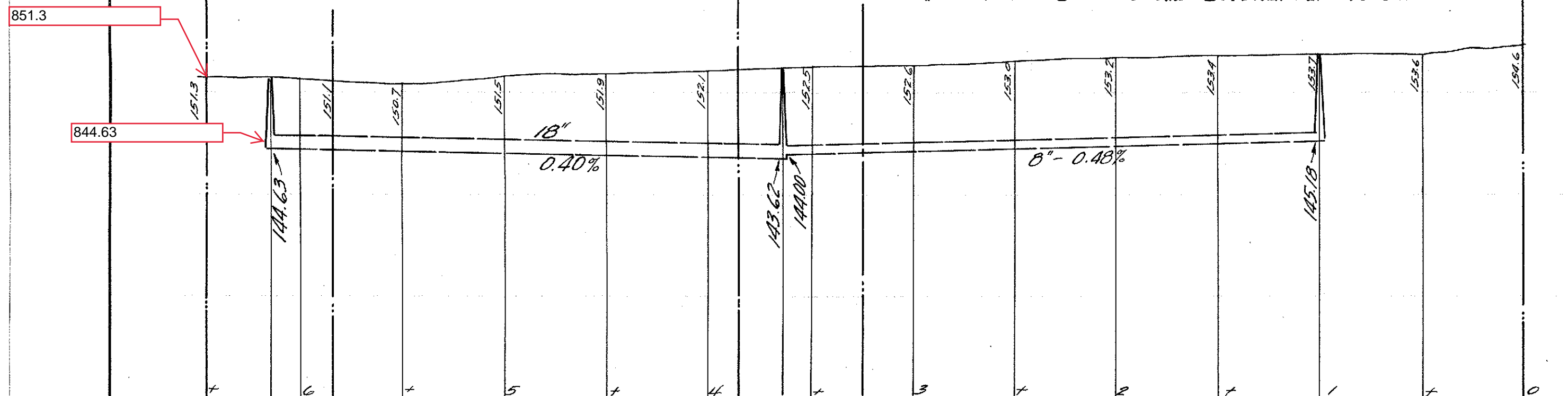




B.M. HYD. S.E. COR. DREXEL & VERLINDEN 156.54



B.M. HYD. - GEN. DRIVE & VERLINDEN 154.77



CITY OF LANSING ENGINEERING DEPT.  
 O. E. ECKERT CITY ENGINEER  
 PLAN AND PROFILE OF SEWER IN  
**DREXEL RD. VERLINDEN-STANLEY**  
**N. GENESEE DR. " TO "**  
 SCALES: HORIZONTAL, 1"=50'. VERTICAL, 1"=10'  
 DRAWN BY *SAB* DATE 4-14-26  
 CHECKED BY *CE* DATE  
 SHEET 2 OF 6 BOOK 144 PAGE



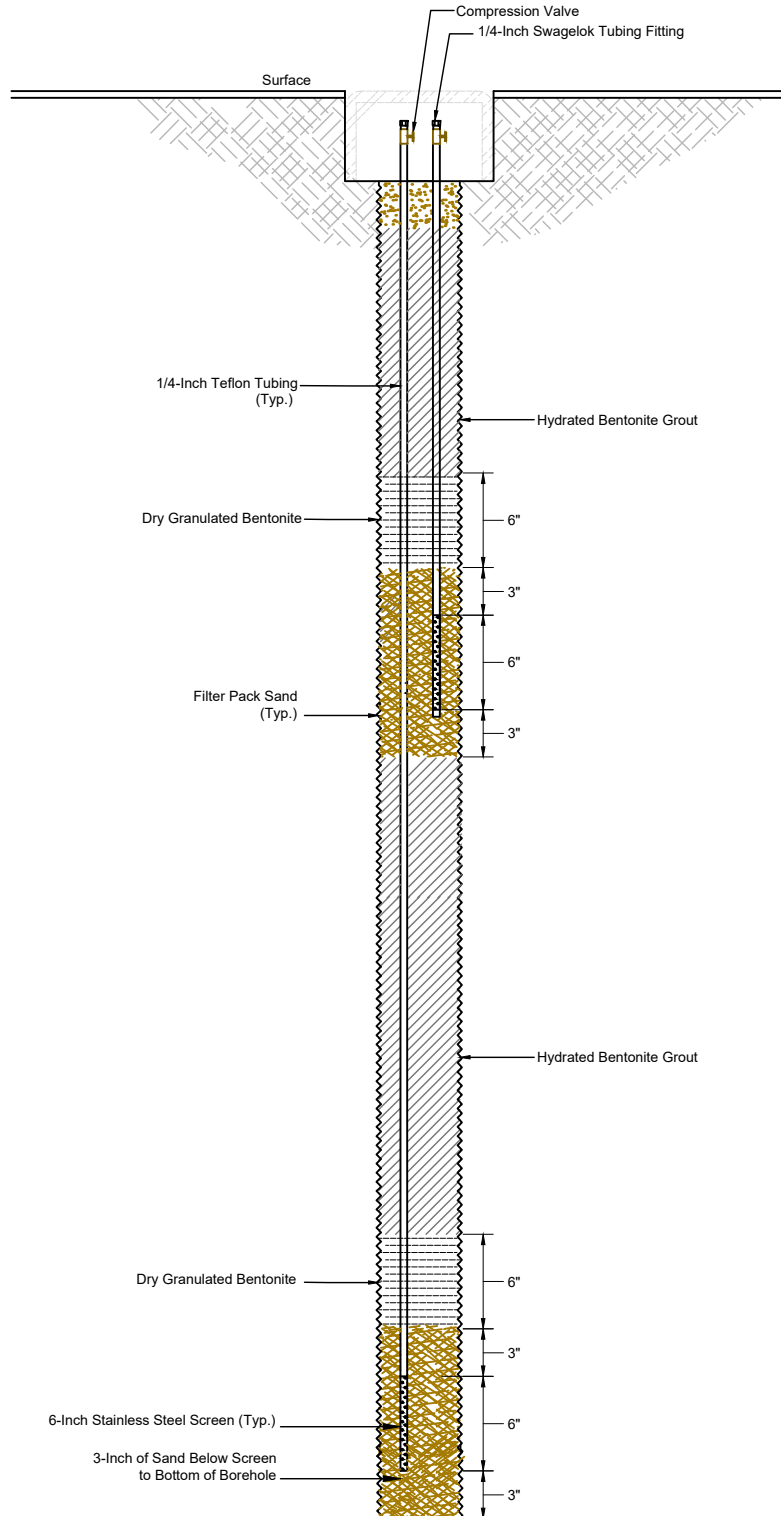


# ATTACHMENT 4

Nested SVM Diagram



# SOIL VAPOR MONITORING POINT CONSTRUCTION



# ATTACHMENT 5


Technical Guidance Instructions – Installation of Permanent Soil Vapor Probes



# TECHNICAL GUIDANCE INSTRUCTIONS: INSTALLATION OF PERMANENT SOIL VAPOR PROBES

Rev: 0


Rev Date: 12/12/2017




## VERSION CONTROL

Revision No	Revision Date	Page No(s)	Description	Reviewed by
0	12/12/2017			Technical Expert Name Procedure Librarian Name

## APPROVAL SIGNATURES

Prepared by:   
Eric Epple 12/12/2017  
Date:

Technical Expert Reviewed by:   
Daniel Zuck, CPG 12/12/2017  
Date:

Technical Expert Reviewed by:   
Mitch Wacksman 12/12/2017  
Date:

## 1 INTRODUCTION

This document describes general and/or specific procedures, methods, actions, steps, and considerations to be used and observed by Arcadis staff when performing work, tasks, or actions under the scope and relevancy of this document. This document may describe expectations, requirements, guidance, recommendations, and/or instructions pertinent to the service, work task, or activity it covers.

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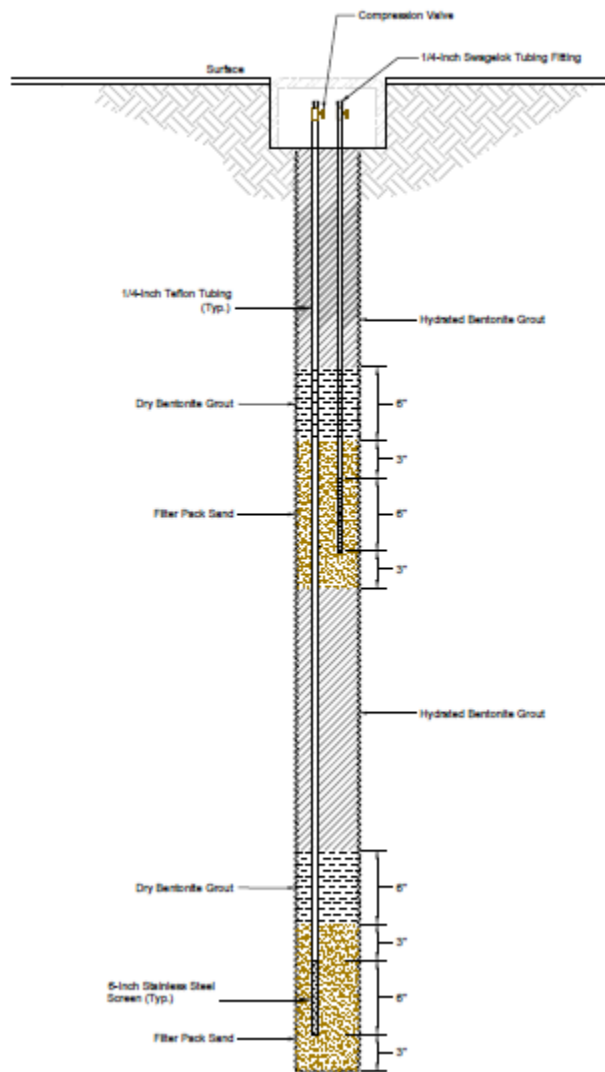
## 2 SCOPE AND APPLICATION

This technical guidance instructions (TGI) is recommended as a practical approach for the installation of permanent soil vapor sampling probes where the intent is to collect soil vapor samples over one or more sampling events. Nested sample soil vapor probes (i.e., multiple sample depths inside a single boring) can also be installed using these methods. Methods that can be used to advance the soil vapor probes installation include: hand auger, direct push, and auger. Rotary sonic drilling should be avoided. Soil vapor samples are often used during vapor intrusion investigations associated with subsurface impacts. Methods for soil vapor sample collection are described in Arcadis documents *TGI: Sub-Slab Soil Vapor or Soil Vapor Sampling Using Whole Air Canisters Analyzed Via USEPA Method TO-15* and *SOP: Soil-Gas Sampling and Analysis Using Sorbent Tubes*. The project team is responsible for ensuring this procedure meets all applicable guidance or regulations in the jurisdiction where work is performed. Receiving approval/concurrence from the leading regulatory agency for the project is suggested prior to implementation.

Water level gauging, geotechnical sampling, soil sampling, and soil logging are often executed during soil vapor sampling or as part of a vapor intrusion investigation. These activities are outside the scope of this TGI.

The depth of each soil vapor probe should be discussed and determined by the project team prior to beginning installation procedures. Under normal circumstances soil vapor probe should not be shallower than 5' below ground surface. Soil vapor probe placement is project specific and based on site objectives, however as a general consideration soil vapor probe are often placed approximately 2.5' above the highest known groundwater elevation.

An example of a finished soil vapor probe is presented in the schematic below.



### 3 PERSONNEL QUALIFICATIONS

Soil vapor probe installation activities will be performed by persons who have been trained in proper installation procedures. If geotechnical sampling, soil sampling, or soil logging are required as part of the scope of work it is critical that field personnel are appropriately trained for these additional tasks as described in the appropriate Standard Operating Procedures (SOPs) and/or Technical Guidance Instructions(TGI)s for those activities.

### 4 EQUIPMENT LIST

The following materials will be available during soil vapor probe installation and soil logging activities, as required:

- Site Plan figure presenting proposed soil boring/well locations
- Work Plan (or equivalent)
- Site-specific Health and Safety Plan (HASP) with task specific Job Safety Analysis (JSA(s))
- Personal protective equipment (PPE), as required by the HASP and JSA
- Traffic cones, delineators, caution tape, and/or fencing, as appropriate
- Probe tubing – new 1/4-inch or 3/8-inch outer diameter (OD) Teflon, Teflon-lined, or Nylon tubing
- Probe cap (to seal the tubing during equilibration) – Swagelok® part number SS-400-;
- Probe screen and anchor point – ½-inch OD stainless steel screen, such as the Geoprobe Systems® implant, or similar. Several screen lengths are available (1-inch, 6-inch, 14-inch, 21-inch), for discrete intervals required in Vapor Intrusion investigations, a 6-inch screen is typically recommended. Make sure the diameter of the tubing connection (i.e. barbed, Swagelok®) on the top side of the screen matches the diameter of the sample tubing used for the installation.
- Hand tools including appropriate-sized open-end wrenches (typically 9/16-inch, 1/2-inch, and 3/4-inch), tubing cutters, etc.
- Drum labels as required for investigation derived waste handling
- Labels for sample soil vapor probe tubing. Stamped metal tags affixed with zip ties are recommended
- MultiRae® four or five-gas meter for health and safety monitoring during drilling. A photoionization detector (PID) capable of parts per billion (ppb) readings (e.g., ppbRAE); and/or Landtec® GEM 2000 landfill gas meter (or equivalent) may be used instead of the five-gas meter when only VOC hazards exist
- Particulate Dust Meter (PDR-1000) as required by HASP
- Decontamination equipment (bucket, distilled or deionized water, cleansers (Alconox® or similar) appropriate for removing expected chemicals of concern, paper towels)
- Engineer's tape/measuring wheel
- Weighted tape
- Digital camera or phone with camera (confirm client approval)
- Field notebook or Personal Digital Assistant (PDA)
- Appropriate field forms

If soil sampling or soil logging is required by the project additional materials may be required per the appropriate TGIs for these tasks.

Prior to mobilizing to the site, Arcadis personnel will contact the drilling subcontractor to confirm that appropriate equipment will be provided. Specifications of the installation equipment are expected to vary by project, and so communication with the driller is necessary to ensure that the materials provided will meet the project objectives. It is strongly recommended that Arcadis personnel provide sample tubing and not drillers.

Equipment/materials typically provided by the driller could include:

- Disposable plastic liners (when drilling with direct-push equipment);
- Drums for investigation derived waste;
- Drilling decontamination materials;
- Decontamination pad materials, if required;
- Boring equipment: hand auger, air knife with vac-truck, and/or drill rig equipped with direct push or rotary auger capability;
- Clean filter silica sand (#2 or larger);
- Granular bentonite and bentonite powder;
- Hydraulic or non-shrink cement grout;
- Tremie pipe with funnel or manual grout pump (1-inch OD PVC Pipe);
- Applicable materials to install water tight protective casing (flush or stand-pipe) to be discussed with drilling contractor prior to mobilization.

## 5 PRECAUTIONS

### Pre-installation considerations:

- Underground utilities in the vicinity of the drilling areas must be delineated by the drilling contractor or an independent underground utility locator service prior to soil vapor probe installation. See AUS Utility Clearance HS Standard and HASP for detail. An AUS Utility Clearance Checklist must be completed and discussed with the project manager and team. There should be a clear understanding of subsurface conditions at the site, with a minimum of 3 good lines of evidence used.
- A field mobilization memo, work plan or scope of work should be reviewed and discussed with team members (office, field, and subcontractors) prior to implementation to ensure that all field logistics (e.g., access issues, health and safety issues, communication network, schedules, etc.) and task objectives are clearly understood by all.
- Soil vapor probe installation should not be performed within 48 hours after a significant rain event (defined as >1 inch of rainfall), as saturated soils could present a false saturated soil interval which could lead to inaccurate screen settings.
- Field personnel should not handle substances that could contain VOCs and lead to cross-contamination. These include marking paint, fuels and solvents or oils prior to handling soil vapor construction materials. Clean nitrile gloves should be used when handling any probe components (this include the drilling contractor). Field personnel should not use sharpie markers during installation or note taking.

- Gravel or dense clay may make direct push installation impracticable. Site geology should be discussed with the project technical lead and drilling contractor prior to field work.
- Ensure all soil vapor sampling probes are decontaminated and compatible with sample tubing prior to field mobilization. A two-stage decontamination process is preferred consisting of a soap wash that consists of distilled water and a non-phosphate detergent (Alconox® or similar), then a final rinse with distilled water. The equipment should be allowed to air dry before use.

#### **Installation Considerations:**

- Depth to Groundwater – soil vapor samples must be collected in the vadose zone (and above the capillary fringe). The bottom of the soil vapor probe must be above the capillary fringe. Depths of perched water zones should also be considered.
- If using an air knife for utility clearing, soils should be removed via hand auger or direct push beginning a minimum of 1 foot above the top of the sampling interval.
- Vapor probes can be finished at the ground surface with a flush mount road box (preferred) or with a stand pipe protective casing, similar to groundwater monitoring wells.
- Soil permeability - It may not be feasible to collect soil vapor from finer-grained or tight soils with little pore volume, such as clays or dense dry silts; if there are known clay layers present in the subsurface, these intervals should be avoided when setting vapor probes. During the installation process, it is advisable to collect a soil core from the proposed sampling interval prior to installing the soil vapor probe to identify the exact depth of the capillary fringe and/or determine where the most permeable soil layers are located. For sampling in tighter soils, it is recommended that permanent soil vapor implants be installed with a wider borehole diameter.

## **6 HEALTH AND SAFETY CONSIDERATIONS**

Field activities associated with soil vapor probe installation will be performed in accordance with a site-specific HASP and applicable JSA, a copy of which will be present on site during such activities.

## **7 PROCEDURE**

All drilling equipment must be decontaminated prior to use. Handle and store decontaminated soil vapor probes in a manner that prevents contamination, such as in a Ziploc® bag prior to use.

Inspect vapor probe parts and drilling equipment for wear and faulty parts. Have the driller replace probe tips, o-rings, adapters, and probe rods as appropriate.

The procedures below allow the installation of a soil vapor probe similar to that presented in the figure below. If multiple depths are to be installed, steps 3-6 are repeated, starting with the deepest sample interval.

1. Hand clear boring location as specified in HASP. If an air knife is used, discontinue use 1-foot above the top of the sample interval and finish boring using a hand auger or drill rig.

2. Record in the field log the soil type and any PID readings that were collected from soil cuttings removed during installation. If saturated soils are encountered, plug the interval(s) with granulated bentonite up through the last dry interval.
3. After reaching the desired depth, install sample screen and tubing. Place the screen and tubing into the open borehole or have the driller place inside the direct push drill pipe along with the push tip.
4. Once in place, install the required amount of clean silica sand (as specified in Step 3 based on soil type). Add clean silica sand to create an appropriate sand pack. Typically, there are 3 inches of clean silica sand both above and below a 6-inch sample screen, along with the clean silica sand surrounding the screen, creating a 12 inches total sampling interval.
5. Withdraw the drill pipe 6-inches and place 6 inches of dry granulated bentonite on top of the clean sand layer.
6. Add hydrated bentonite to 12-inches below the ground surface, or bottom of next sample interval (for nested installations). Install appropriate surface finish (i.e., bolting water tight road box, stick-up). If nested ports are not installed and the depth is greater than 10-feet below grade, a bentonite slurry grout may be placed above the granulated bentonite to 1-foot below grade.
7. Fill the remaining annulus within the road box with non-shrink grout cement to approximately 0.5-foot below ground surface, or enough to seal the tubing to the protective casing. A small amount of sand may need to be placed on top of the cement to ensure that the tubing does not make contact with the cement during curing.
8. Cut sample tubing long enough to allow enough length to reach a sample container or sorbent tube in the future. For flush mounted casings, 2-3 feet of tubing is recommended. For stand-pipe casing, make sure there is at least 6-7-feet of tubing extending above grade. Terminate sample tubing using an air tight plug or valve. Swagelok® or similar stainless-steel fittings are recommended.
9. Clearly label sample probe and protective casing with ID and depth. Stamped metal tags affixed with stainless zip ties are recommended.
10. Allow at least 24-hours for soil vapor probe equilibration and cement curing prior to leak testing and sampling. See applicable TGIs for these procedures.

## 8 WASTE MANAGEMENT

Investigation-derived wastes (IDW), including soil cuttings, decontamination liquids, and disposable materials (material packages, PPE, etc.), will be placed in clearly labeled, appropriate containers, or managed as otherwise specified in the Work Plan (or equivalent), field sampling plan (FSP), and/or IDW management guidance document.

## 9 DATA RECORDING AND MANAGEMENT

Drilling activities should be documented on appropriate field/log forms (see Attachment A) as well as in a proper field notebook and/or PDA. Additionally, all documents (and photographs) should be scanned and electronically filed in the appropriate project directory for easy access. Pertinent information will include personnel present on site, times of arrival and departure, significant weather conditions, timing of installation activities, soil descriptions, construction specifications (backfill material and borehole diameter,

tubing length, screen details, seal type), and quantities of materials used. In addition, the locations of newly-installed soil vapor probes will be documented photographically or in a site sketch. If appropriate, a measuring wheel or engineer's tape will be used to determine approximate distances between important site features. The well location will be surveyed using the method specified in the site Work Plan (or equivalent).

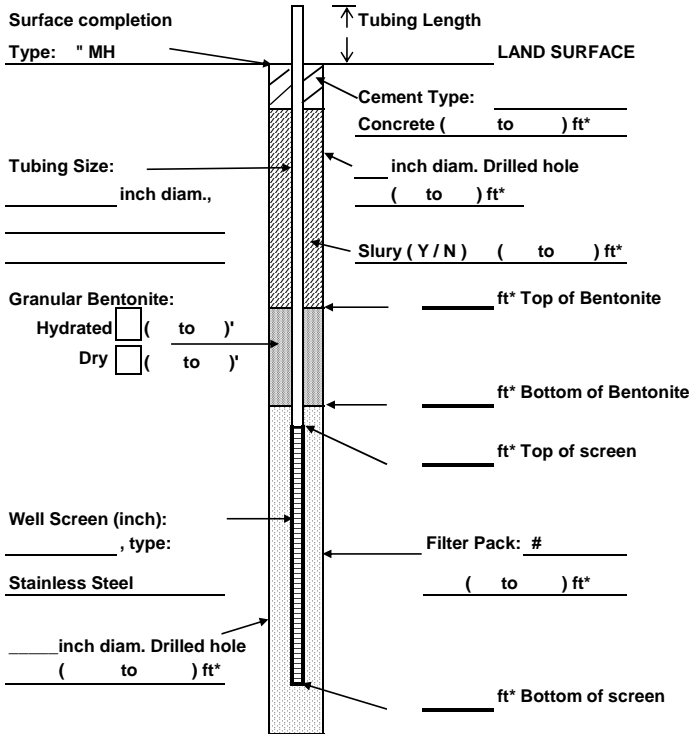
## 10 QUALITY ASSURANCE

All drilling equipment and associated tools (including augers, drill rods, sampling equipment, wrenches, and any other equipment or tools) that may have come in contact with soil will be cleaned in accordance with the procedures outlined in the appropriate SOP. Soil vapor probe materials will also be cleaned prior to well installation.

## 11 REFERENCES

- California Environmental Protection Agency (CalEPA) – Department of Toxic Substances Control (DTSC). 2012. Advisory – Active Soil Gas Investigations ([https://www.dtsc.ca.gov/SiteCleanup/upload/VI\\_ActiveSoilGasAdvisory\\_FINAL\\_043012.pdf](https://www.dtsc.ca.gov/SiteCleanup/upload/VI_ActiveSoilGasAdvisory_FINAL_043012.pdf)). April.
- Interstate Technology Regulatory Council (ITRC). 2007. Technical and Regulatory Guidance. Vapor Intrusion Pathway: A Practical Guideline (<http://www.itrcweb.org/documents/VI-1.pdf>). January.
- New Jersey Department of Environmental Protection (NJDEP) – Site Remediation and Waste Management Program. 2016. Vapor Intrusion Technical Guidance ([http://www.nj.gov/dep/srp/guidance/vaporintrusion/vig\\_main.pdf?version\\_4](http://www.nj.gov/dep/srp/guidance/vaporintrusion/vig_main.pdf?version_4)). August.
- United States Environmental Protection Agency (USEPA) – Office of Solid Waste and Emergency Response (OSWER). 2015. Technical Guide for Assessing and Mitigating the Vapor Intrusion Pathway from Subsurface Vapor Sources to Indoor Air (<https://www.epa.gov/sites/production/files/2015-09/documents/oswer-vapor-intrusion-technical-guide-final.pdf>). June.

## Permanent Soil Vapor Probe Construction Log



Project Name and No.: \_\_\_\_\_

SV Probe ID: \_\_\_\_\_ Address: \_\_\_\_\_

Town/City: \_\_\_\_\_ State: \_\_\_\_\_

Land-Surface Elevation and Datum:  
 \_\_\_\_\_ feet  Surveyed  Estimated

Coordinates- Northing: \_\_\_\_\_ Easting: \_\_\_\_\_

Installation Date(s): \_\_\_\_\_

Drilling Contractor:  
(Diller/Helper) \_\_\_\_\_

Installation Method: \_\_\_\_\_

Equipment Used: \_\_\_\_\_

**Groundwater Information:**

Well ID: \_\_\_\_\_

Well Screen Setting: \_\_\_\_\_

Static Depth to Water: \_\_\_\_\_

SV Probe Purpose: \_\_\_\_\_

Remarks: Soils: \_\_\_\_\_

**\*\*Measuring Point is Top of Well Casing Unless Otherwise Noted.**

Prepared by \_\_\_\_\_



# **TGI - SUB-SLAB SOIL VAPOR OR SOIL VAPOR SAMPLING USING WHOLE AIR CANISTERS ANALYZED VIA USEPA METHOD TO-15**

Rev #: 1


Date: September 18, 2016



## SOP VERSION CONTROL

Revision No	Revision Date	Page No(s)	Description	Reviewed by
1	9/18/2016	All	Updated Rev0	Mitch Wacksman

## APPROVAL SIGNATURES

Prepared by:   
Eric Cathcart

Date: 9/18/2016

Reviewed by:   
Mitch Wacksman (Technical Expert)

Date: 9/18/2016

## I. INTRODUCTION

This Technical Guidance Instruction (TGI) document describes the procedures to conduct a building survey prior to indoor air sampling.

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## II. SCOPE AND APPLICATION

This document describes the procedures for collecting exterior soil vapor or sub-slab soil vapor (herein referred to as "soil vapor") samples using whole air canisters for the analysis of volatile organic compounds (VOCs) by United States Environmental Protection Agency (USEPA) Method TO-15 (TO-15). This document assumes a sample port – either sub-slab or exterior soil vapor – has already been installed. This document covers the above ground assembly and sampling methods.

Method TO-15 uses a 1-liter 3-liter or 6-liter SUMMA® passivated stainless steel canister to collect a whole-air sample. The whole-air sample is then analyzed for VOCs using a quadrupole or ion-trap gas chromatograph/mass spectrometer (GS/MS) system to provide typical compound detection limits of 0.5 parts per billion volume (ppbv).

The following sections list the necessary equipment and detailed instructions for collecting soil vapor samples for VOC analysis.

### III. PERSONNEL QUALIFICATIONS

Arcadis field sampling personnel will have current health and safety training, including 40-hour HAZWOPER training, site supervisor training, site-specific training, first-aid, and cardiopulmonary resuscitation (CPR), as needed. Arcadis field sampling personnel will be well versed in the relevant technical guidance instructions (TGIs) and possess the required skills and experience necessary to successfully complete the desired field work. Arcadis personnel responsible for leading soil vapor sample collection activities must have previous soil vapor sampling experience.

### IV. EQUIPMENT LIST

The equipment required for soil vapor sample collection is presented below:

- 1,3, or 6 – liter stainless steel SUMMA® canisters (order at least one extra, if feasible) (batch certified canisters or individual certified canisters as required by the project);
- Flow controllers with in-line particulate filters and vacuum gauges; flow controllers are pre-calibrated to specified sample duration (e.g., 5-, 10, or 30- minutes) or flow rate (e.g., < 200 milliliters per minute [mL/min]); confirm with the laboratory that the flow controller comes with an in-line particulate filter and pressure gauge (order at least one extra, if feasible);
- 1/4-inch OD tubing (Teflon®, or similar);
- Extra 1/4-inch Swagelok front and back compression sleeves
- Decontaminated stainless steel Swagelok or comparable “T” fitting and ball or needle valve for isolation of purge leg of sample train;
- Stainless steel duplicate “T” fitting provided by the laboratory (if collecting duplicate [i.e., split] samples);
- 60-mL syringe equipped with a three-way leuc lock valve;
- Appropriate equipment and materials for quality assurance testing as laid out in the respective quality assurance TGIs (i.e., helium leak testing, water dam testing, methane testing);
- Appropriate-sized open-end wrench (typically 9/16-inch and 1/2”);
- Tedlar® bag to collect purge air for venting outside a structure if working inside;
- Portable weather meter, if appropriate;

- Chain-of-custody (COC) form;
- Sample collection log (attached);
- Nitrile gloves;
- Work gloves; and
- Field notebook

## V. CAUTIONS

The following cautions and field tips should be reviewed and considered prior to installing or collecting a soil vapor sample.

- Sampling personnel should not handle hazardous substances (such as gasoline), permanent marking pens (sharpies), wear/apply fragrances, or smoke cigarettes/cigars before and/or during the sampling event.
- Ensure that the flow controller is pre-calibrated to the proper sample collection duration (confirm with laboratory). Sample integrity can be compromised if sample collection is extended to the point that the canister reaches atmospheric pressure. Sample integrity is maintained if sample collection is terminated prior to the target duration and a measurable vacuum (e.g., -6 or greater inches Hg) remains in the canister when sample collection is terminated.
- The integrity of the sample train will be tested in accordance with the project specific requirements. These procedures are contained in their own TGI documents and include helium leak testing, water dam testing, and methane screening.
- It is important to record the canister pressure, start and stop times, and sample identification on a proper field sampling form. You should observe and record the time/pressure at the start, and then again one or two hours after starting the sample collection. It is a good practice to lightly tap the pressure gauge with your finger before reading it to make sure it is not stuck. If the canister is running correctly for a 24-hour period, the vacuum will have decreased slightly after one or two hours (for example from 29 inches to 27 inches). Consult your project manager, risk assessor or air sampling expert by phone if the SUMMA canister does not appear to be working properly.
- Ensure that there is still measurable vacuum in the SUMMA® after sampling. Sometimes the gauges sent from labs have offset errors, or they stick.
- When sampling carefully consider elevation. If your site is over 2,000' above sea level or the difference in elevation between your site and your lab is more than 2,000' then pressure effects will be significant. If you take your samples at a high elevation they will contain less air for a given ending pressure reading. High elevation samples analyzed at low elevation

will result in more dilution at the lab, which could affect reporting limits. Conversely low elevation samples when received at high elevation may appear to not have much vacuum left in them. [http://www.uiqi.com/Atmos\\_pressure.html](http://www.uiqi.com/Atmos_pressure.html).

- If possible, have equipment shipped a two to three days before the scheduled start of the sampling event so that all materials can be checked. Order replacements if needed.
- Requesting extra canisters and flow controllers from the laboratory should also be considered to ensure that you have enough equipment on site in case of an equipment failure.
- Check the seal around the soil vapor sampling port by using a tracer gas (e.g., helium) or other method established in the appropriate guidance document. See TGI library and project specific instructions for appropriate TGIs.

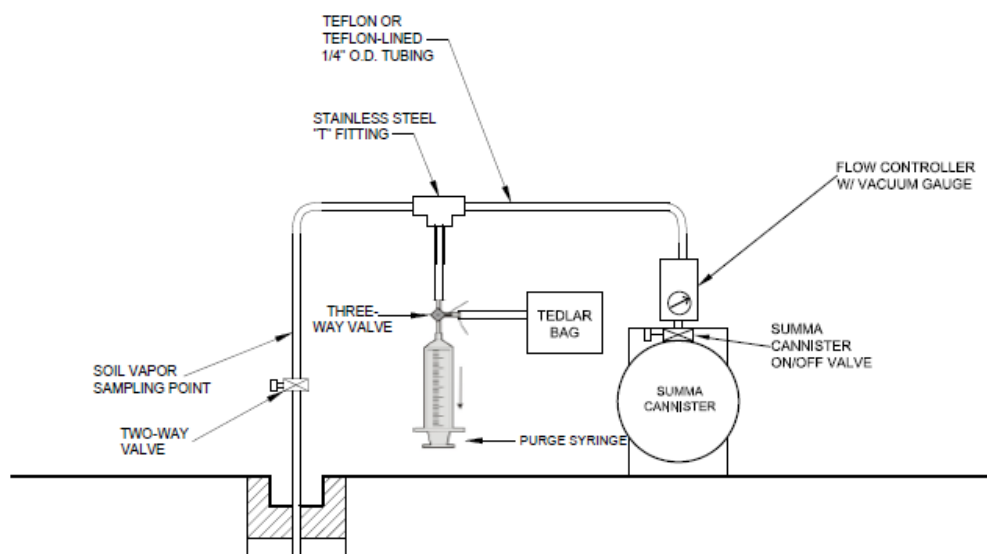
## VI. HEALTH AND SAFETY CONSIDERATIONS

All sampling personnel should review the appropriate health and safety plan (HASP) and job safety analysis (JSA) prior to beginning work to be aware of all potential hazards associated with the job site and the specific task. Field sampling must be carefully performed to minimize the potential for injury and the spread of hazardous substances.

## VII. SOIL VAPOR SAMPLE COLLECTION

### Sample Train Assembly

The following procedures should be used to collect a soil vapor sample using a whole air canister (i.e., SUMMA canister). These methods can be used for both exterior soil vapor samples and interior sub-slab soil vapor samples collected from both permanent or temporary sample points installations. A schematic of the suggested sample train set up is included below. See the attached vapor sampling form for required sample train tubing length.



1. Assemble the sample train by removing the cap from the SUMMA canister and connecting the flow controller with in-line particulate filter and vacuum gauge. The flow controller attaches directly to the canister and dictates the sample duration. This piece will come preset from the laboratory.
2. Attach the canister and flow controller assembly to a stainless steel T-fitting using a short length of 1/4-inch OD Teflon tubing. This T-fitting adds a leg to the sample train that will be used to purge “dead” air from the sample train in order to collect a more representative sample.
3. Connect the purge syringe with three-way valve to one of the free ends of the T-fitting using a length of Teflon sample tubing, Swagelok compression fittings, and silicon tubing.
4. Attach the Swagelok two-way valve to the remaining free end of the T-fitting using a short length of 1/4-inch OD Teflon tubing. The two-way valve will be immediately adjacent to the sample point in the train assembly. This valve is used to isolate the sample train from the sample point prior to sampling in order to test the sample train’s integrity.
5. When collecting duplicate or other quality assurance/quality control (QA/QC) samples as required by applicable regulations and guidance, couple two SUMMA canisters using stainless steel Swagelok duplicate sample T-fitting supplied by the laboratory. Attach flow controller with in-line particulate filter and vacuum gauge to duplicate sample T-fitting provided by the laboratory.
6. Attach the terminal end of the two-way Swagelok valve to the sample port as appropriate. This may be done using the options below:

- a. Use a section of silicon tube to connect the Teflon sample tubing to the barbed fitting of a Vapor Pin™ port.
- b. Use Swagelok compression fittings to connect Teflon tubing to sampling port. Teflon tape should never be used on Swagelok compression fitting connections.
- c. Wrap the Teflon tubing with Teflon tape to seal around the slab then use VOC free clay to further seal around the slab if using temporary points.

## Sample Documentation

1. Record on the sample log and COC form the flow controller number with the appropriate SUMMA® canister number.
2. Record the following information on the sample log, if appropriate, using the [www.weather.com](http://www.weather.com) application to obtain the information:
  - a. wind speed and direction;
  - b. ambient temperature;
  - c. barometric pressure; and
  - d. relative humidity.
3. Take a photograph of the SUMMA® canister and surrounding area.

## Sample Collection

1. Perform a leak-down-test by closing the two-way valve to the sample port. Open the three-way valve to the syringe and pull a vacuum. Quickly close the three-way valve and record the pressure indicated on the gauge connected to the canister. If there are no leaks in the system this vacuum should be held. If vacuum holds proceed with sample collection; if not attempt to rectify the situation by tightening fittings.
2. Open the two-way valve and purge the soil vapor sampling port and tubing with the portable sampling pump. Purge approximately three volumes of air from the soil vapor sampling port and sampling line using a flow rate of 100 mL/min. Purge volume is calculated by the following equation "purge volume = 3 x Pi x inner radius of tubing<sup>2</sup> x length of tubing. Purge air will be collected into a Tedlar bag to provide that VOCs are not released into interior spaces. Perform quality control method tests concurrently, as appropriate
3. Close the three-way valve to the syringe in order to isolate this leg of the sample train.

4. Open the SUMMA® canister valve to initiate sample collection. Record on the sample log (attached) the time sampling began and the canister pressure.

If the initial vacuum pressure registers less than -26 inches of Hg (as registered on a digital gauge only) prior to sample collection, then the SUMMA® canister is not appropriate for use and another canister should be used.

5. Check the SUMMA canister approximately half way through the sample duration and note progress on sample logs.

## Termination of Sample Collection

1. Arrive at the SUMMA® canister prior to the end of sample collection.
2. Record the final vacuum pressure using a digital gauge only. Stop collecting the sample by closing the SUMMA® canister valves. The canister should have a minimum amount of pressure at the end of sampling (i.e., -6" Hg). However, ending pressures between -2" Hg and -10" Hg (measured at lab) are considered acceptable.
3. Record the date and local time (24-hour basis) of valve closing on the sample collection log and COC form.
4. Disconnect sample tubing from the sample port; replace any coverings or abandon as appropriate to mitigate tripping hazards.
5. Remove the particulate filter and flow controller from the SUMMA® canister, re-install the brass plug on the canister fitting, and tighten with the appropriate wrench.
6. Package the canister and flow controller per Department of Transportation regulations for return shipment to the laboratory. These regulations can be found at the Transportation Safety Program's Team Site on the Source. The SUMMA® canister does not require preservation with ice or refrigeration during shipment.
7. Complete the appropriate forms and sample labels as directed by the laboratory (e.g., affix card with a string) onsite at time of sampling.
8. Complete the COC form (including signature) and place the requisite copies in a shipping container. Close the shipping container and affix a custody seal to the container closure. Ship the container to the laboratory via overnight carrier (e.g., Federal Express) for analysis.

## VIII. WASTE MANAGEMENT

No specific waste management procedures are required.

## IX. DATA RECORDING AND MANAGEMENT

Measurements will be recorded on the sample log at the time of measurement with notations of the project name, sample date, sample start and finish time, sample location (e.g., GPS

coordinates, distance from permanent structure [e.g., two walls, corner of room]), canister serial number, flow controller serial number, initial vacuum reading, and final pressure reading. Field sampling logs and COC records will be transmitted to the Project Manager.

## **X. QUALITY ASSURANCE**

Duplicate samples should be collected in the field as a quality assurance step per project requirements. Generally, duplicates are taken from 10% of samples, but project specific requirements should take precedence.

## **XI. REFERENCES**

- DiGiulio et. al. 2003. Draft Standard Operating Procedure (SOP) for Installation of Sub-Slab Vapor Probes and Sampling Using EPA TO-15 to Support Vapor Intrusion Investigations. <http://www.cdphe.state.co.us/hm/indoorair.pdf> (Attachment C)
- Di Giulio et. Al. 2006. Assessment of Vapor intrusion in Homes Near the Raymark Superfund Site Using Basement and Sub-Slab Air Samples. USEPA. EPA/600/R-05/147.
- New York State Department of Health (NYSDOH). 2005. DRAFT "Guidance for Evaluating Soil Vapor Intrusion in the State of New York" February 23, 2005.



# TGI - ADMINISTERING HELIUM TRACER GAS LEAK TEST

Rev: 2

Rev Date: December 5, 2018



## VERSION CONTROL

Revision No	Revision Date	Page No(s)	Description	Reviewed by
1	October 14, 2016			Mitch Wacksman
2	December 5, 2018		<ul style="list-style-type: none"><li>Revised purge rate to be consistent with other vapor intrusion TGIs</li><li>Add Health and Safety Considerations section</li></ul>	Mitch Wacksman

## APPROVAL SIGNATURES

Prepared by:   
Eric Cathcart 12/5/2018  
Date:

Technical Expert Reviewed by:   
Mitch Wacksman (Technical Expert) 12/5/2018  
Date:

## 1 INTRODUCTION

This document describes general and/or specific procedures, methods, actions, steps, and considerations to be used and observed by Arcadis staff when performing work, tasks, or actions under the scope and relevancy of this document. This document may describe expectations, requirements, guidance, recommendations, and/or instructions pertinent to the service, work task, or activity it covers.

It is the responsibility of the Arcadis Certified Project Manager (CPM) to provide this document to the persons conducting services that fall under the scope and purpose of this procedure, instruction, and/or guidance. The Arcadis CPM will also ensure that the persons conducting the work falling under this document are appropriately trained and familiar with its content. The persons conducting the work under this document are required to meet the minimum competency requirements outlined herein, and inquire to the CPM regarding any questions, misunderstanding, or discrepancy related to the work under this document.

This document is not considered to be all inclusive nor does it apply to all projects. It is the CPM's responsibility to determine the proper scope and personnel required for each project. There may be project- and/or client- and/or state-specific requirements that may be more or less stringent than what is described herein. The CPM is responsible for informing Arcadis and/or Subcontractor personnel of omissions and/or deviations from this document that may be required for the project. In turn, project staff are required to inform the CPM if or when there is a deviation or omission from work performed as compared to what is described herein.

In following this document to execute the scope of work for a project, it may be necessary for staff to make professional judgment decisions to meet the project's scope of work based upon site conditions, staffing expertise, regulation-specific requirements, health and safety concerns, etc. Staff are required to consult with the CPM when or if a deviation or omission from this document is required that has not already been previously approved by the CPM. Upon approval by the CPM, the staff can perform the deviation or omission as confirmed by the CPM.

## 2 SCOPE AND APPLICATION

When collecting subsurface vapor samples as part of a vapor intrusion evaluation, a tracer gas serves as a quality assurance/quality control method to verify the integrity of the vapor port seal and the numerous connections comprising the sample train. Without the use of a tracer, verification that a soil vapor sample has not been diluted by ambient or indoor air is difficult.

This Technical Guidance Instruction (TGI) focuses on using helium as a tracer gas. It should be noted that a field helium meter could register a false positive if methane is present in the subsurface. In this case an alternative method should be employed (i.e., water dam test), The protocol for using a tracer gas includes the following basic steps: (1) enrich the atmosphere in the immediate vicinity of the sample port where ambient air could enter the sampling train during sampling with the tracer gas; and (2) measure a vapor sample from the sample tubing for the presence of elevated concentrations (> 2%) of the tracer. A plastic pail, bucket, garbage can or even a plastic bag can serve as a shroud to keep the tracer gas in contact with the port during the testing.

There are two basic approaches to testing for the tracer gas:

1. Include the tracer gas in the list of target analytes reported by the laboratory; and/or
2. Use a portable monitoring device to analyze a sample of soil vapor for the tracer prior to sampling for the compounds of concern. (Note that tracer gas samples can be collected via syringe, Tedlar bag, etc. They need not be collected in SUMMA® canisters or minicans)

This TGI focuses on monitoring helium using a portable sampling device, although helium can also be analyzed by the laboratory along with other volatile organic compounds (VOCs). Real-time tracer sampling allows the investigator to confirm the integrity of the port seals prior to formal sample collection.

During the initial stages of a subsurface vapor sampling program, tracer gas samples should be collected at each of the sampling points. If the results of the initial samples indicate that the port seals are adequate, the Project Manager can consider reducing the number of locations at which tracer gas samples are used in future monitoring rounds. At a minimum, at least 10% of the subsequent samples should be supported with tracer gas analyses. When using permanent soil vapor points as part of a long-term monitoring program, the port should be tested prior to the first sampling event. Tracer gas testing of subsequent sampling events may often be reduced or eliminated unless conditions have changed at the site. Soil gas port integrity should certainly be rechecked with Tracer gas if land clearing/grading activities, freeze thaw cycles, or soil desiccation may have occurred. Points should also be rechecked if more than 2 years have elapsed since the last check of that port.

### 3 PERSONNEL QUALIFICATIONS

Arcadis field sampling personnel will have current health and safety training, including 40-hour HAZWOPER training, site supervisor training, site-specific training, first aid, and cardiopulmonary resuscitation (CPR), as needed. Arcadis field sampling personnel will be competent in the relevant procedures and possess the required skills and experience necessary to successfully complete the desired field work. Arcadis personnel responsible for directing tracer gas testing must have previous experience conducting similar tests without direct supervision.

### 4 EQUIPMENT LIST

The equipment required to conduct a helium tracer gas test is presented below:

- Appropriate PPE for site (as required by the Health and Safety Plan)
- Helium (laboratory grade)
- Regulator for helium tank
- Shroud (plastic bucket, garbage can, plastic bag, etc.)
  - The size of the shroud should be sufficient to fit over the sample port. It is worth noting that using the smallest shroud possible will minimize the volume of helium needed; this may be important when projects require a large number of helium tracer tests.

- The shroud will need to have three small holes in it. These holes will include one on the top (to accommodate the sample tubing), and two on the side (one for the helium detector probe, and one for the helium line).
- The shroud should ideally enclose the sample port and as much as possible of the sampling train.
- Helium detector capable of measuring from 1 - 100% (Dielectric MGD-2002, Mark Model 9522, or equivalent)
- Tedlar bag
- Seal material for shroud (rubber gasket, VOC-free modeling clay, bentonite, etc.) to keep helium levels in shroud high in windy conditions. Although the sealing material is not in direct contact with the sample if leakage does not occur, sealing materials with high levels of VOC emissions should be avoided, since they could contaminate a sample if a leak occurs.
- Sample logs
- Field notebook

## 5 CAUTIONS

Helium is an asphyxiant! Be cautious with its use indoors! Never release large volumes of helium within a closed room!

Field sampling equipment must be carefully handled to minimize the potential for injury and the spread of hazardous substances. All sampling personnel should review the appropriate health and safety plan (HASP) and job safety analysis (JSA) prior to beginning work to be aware of all potential hazards associated with the job site and the specific task. Field staff should review the attachment on safely handling compressed gas cylinders prior to commencing field work.

Compressed gas cylinders should be handled with caution; see attachment on the use and storage of compressed gasses before beginning field work.

Care should be taken not to pressurize the shroud while introducing helium. If the shroud is completely air tight and the helium is introduced quickly, the shroud can be over-pressurized and helium can be pushed into the ground. Provide a relief valve or small gap where the helium can escape.

Because minor leakage around the port seal should not materially affect the usability of the soil vapor sampling results, the mere presence of the tracer gas in the sample should not be a cause for alarm. Consequently, portable field monitoring devices with detection limits in the low ppm range are more than adequate for screening samples for the tracer. If high concentrations (> 2%) of tracer gas are observed in a sample, the port seal should be enhanced and fittings within the sampling train should be checked and/or tightened to reduce the infiltration of ambient air and the tracer test readministered. If the problem cannot be rectified, a new sample point should be installed or an alternate sampling train used.

## 6 HEALTH AND SAFETY CONSIDERATIONS

All sampling personnel should review the appropriate health and safety plan (HASP) and job safety analysis (JSA) prior to beginning work to be aware of all potential hazards associated with the job site and the specific task. Field sampling must be carefully performed to minimize the potential for injury and the spread of hazardous substances.

Soil Vapor sampling is often done on the ground with workers on their knees. Knee pads or a large pad can be used under the entire sample area (i.e. a large folded box). This will protect the worker's knees and the sampling equipment from touching the potentially impacted ground (i.e. asphalt parking lot with car oil stains).

The metal on metal fittings often create small metal splinters, so always used gloves when handling the canisters, fittings, valves, etc. Do not blow the splinters off towards other workers

## 7 PROCEDURE

The helium tracer test can be conducted when using temporary or permanent sampling points and inside or outside a facility. A visual of an example helium tracer gas test equipment set up is included as Figure 1.

1. Attach Teflon or nylon (Nylaflo) sample tubing to the sample point. This can be accomplished utilizing a number of different methods depending on the sample install (i.e., Swage-Lok or comparable fittings).
2. Place the shroud over the sample point and tubing.
3. Pull the tubing through hole in top of shroud. Seal opening at top of shroud with VOC free modeling clay.
4. Place weight on top of shroud to help maintain a good seal with the ground.
5. Insert helium tubing and helium detector probe into side of shroud. Seal both with modeling clay to prevent leaks.
6. Fill shroud with helium. Fill shroud slowly, allowing atmospheric air to escape either by leaving a gap where the shroud meets the ground surface or by providing a release valve on the side of the shroud. Do not pressurize the shroud!
7. Use the helium detector to monitor helium concentration within the shroud from the lowest hole drilled in the shroud (bottom of the shroud nearest where the sample tubing intersects the ground). Helium should be added until the environment inside the shroud has > 40% helium.
8. Purge 100 ml of air from the sample point through the sample tubing into a Tedlar bag using a syringe equipped with a three-way leur lock valve. The purge rate should at least match the sample collection rate but not exceed 100 ml/min. Test the air in the Tedlar bag for helium using portable helium detector. If the point is free of leaks there should be very low helium in the purge air from the soil. The natural concentration of helium in the atmosphere is 0.00052% by volume and there are few if any natural sources of helium to soil gas.

9. If > 10% of the amount of helium present in the shroud is noted in purge air, rectify issues with the seal at the sample port and repeat the testing procedure. If the seal cannot be fixed, reinstall sample point.
10. Monitor the helium level in shroud before, during and after tracer test.
11. Monitor and record helium level in purge exhaust.
12. At successful completion of tracer test and sample point purging, the soil vapor sample can be collected (if the helium shroud must be removed prior to sample collection be mindful not disturb the sample tubing and any established seals).

## **8 WASTE MANAGEMENT**

No specific waste management procedures are required.

## **9 DATA RECORDING AND MANAGEMENT**

Measurements will be recorded on the sample logs at the time of measurement with notations of the project name, sample date, sample start and finish time, sample location, and the helium concentrations in both the shroud and the purge air before, during, and after tracer testing. Any problems encountered should also be recorded in the field notes.

## **10 QUALITY ASSURANCE**

Conduct quality assurance as required by the project-specific work plan and/or Quality Assurance Project Plan (QAPP).

## **11 REFERENCES**

New Jersey Department of Environmental Protection (NJDEP). 2018. Vapor Intrusion Technical Guidance. January.

New York Department of Health. 2006. Guidance for Evaluating Soil Vapor Intrusion in the State of New York. October.

United States Environmental Protection Agency (USEPA). 2015. OSWER Technical Guide for Assessing and Mitigating the Vapor Intrusion Pathway from Subsurface Vapor Sources to Indoor Air. June

## ATTACHMENT

### Compressed Gases – Use and Storage

In general, a compressed gas is any material contained under pressure that is dissolved or liquefied by compression or refrigeration. Compressed gas cylinders should be handled as high- energy sources and therefore as potential explosives and projectiles. Prudent safety practices should be followed when handling compressed gases since they expose workers to both chemical and physical hazards.

#### Handling

- Safety glasses with side shields (or safety goggles) and other appropriate personal protective equipment should be worn when working with compressed gases.
- Cylinders should be marked with a label that clearly identifies the contents.
- All cylinders should be checked for damage prior to use. Do not repair damaged cylinders or valves. Damaged or defective cylinders, valves, etc., should be taken out of use immediately and returned to the manufacturer/distributor for repair.
- All gas cylinders (full or empty) should be rigidly secured to a substantial structure at 2/3 height. Only two cylinders per restraint are allowed in the laboratory and only soldered link chains or belts with buckles are acceptable. Cylinder stands are also acceptable but not preferred.
- Handcarts shall be used when moving gas cylinders. Cylinders must be chained to the carts.
- All cylinders must be fitted with safety valve covers before they are moved.
- Only three-wheeled or four-wheeled carts should be used to move cylinders.
- A pressure-regulating device shall be used at all times to control the flow of gas from the cylinder.
- The main cylinder valve shall be the only means by which gas flow is to be shut off. The correct position for the main valve is all the way on or all the way off.
- Cylinder valves should never be lubricated, modified, forced, or tampered with.
- After connecting a cylinder, check for leaks at connections. Periodically check for leaks while the cylinder is in use.
- Regulators and valves should be tightened firmly with the proper size wrench. Do not use adjustable wrenches or pliers because they may damage the nuts.
- Cylinders should not be placed near heat or where they can become part of an electrical circuit.
- Cylinders should not be exposed to temperatures above 50 °C (122 °F). Some rupture devices on cylinders will release at about 65 °C (149 °F). Some small cylinders, such as lecture bottles, are not fitted with rupture devices and may explode if exposed to high temperatures.
- Rapid release of a compressed gas should be avoided because it will cause an unsecured gas hose to whip dangerously and also may build up enough static charge to ignite a flammable gas.

- Appropriate regulators should be used on each gas cylinder. Threads and the configuration of valve outlets are different for each family of gases to avoid improper use. Adaptors and homemade modifications are prohibited.
- Cylinders should never be bled completely empty. Leave a slight pressure to keep contaminants out.

### **Storage**

- When not in use, cylinders should be stored with their main valve closed and the valve safety cap in place.
- Cylinders must be stored upright and not on their side. All cylinders should be secured.
- Cylinders awaiting use should be stored according to their hazard classes.
- Cylinders should not be located where objects may strike or fall on them.
- Cylinders should not be stored in damp areas or near salt, corrosive chemicals, chemical vapors, heat, or direct sunlight. Cylinders stored outside should be protected from the weather.

### **Special Precautions**

#### Flammable Gases

- No more than two cylinders should be manifolded together; however, several instruments or outlets are permitted for a single cylinder.
- Valves on flammable gas cylinders should be shut off when the laboratory is unattended and no experimental process is in progress.
- Flames involving a highly flammable gas should not be extinguished until the source of the gas has been safely shut off; otherwise it can reignite causing an explosion.

#### Acetylene Gas Cylinders

- Acetylene cylinders must always be stored upright. They contain acetone, which can discharge instead of or along with acetylene. Do not use an acetylene cylinder that has been stored or handled in a nonupright position until it has remained in an upright position for at least 30 minutes.
- A flame arrestor must protect the outlet line of an acetylene cylinder.
- Compatible tubing should be used to transport gaseous acetylene. Some tubing like copper forms explosive acetylides.

#### Lecture Bottles

- All lecture bottles should be marked with a label that clearly identifies the contents.
- Lecture bottles should be stored according to their hazard classes.
- Lecture bottles that contain toxic gases should be stored in a ventilated cabinet.
- Lecture bottles should be stored in a secure place to eliminate them from rolling or falling.
- Lecture bottles should not be stored near corrosives, heat, direct sunlight, or in damp areas.

- To avoid costly disposal fees, lecture bottles should only be purchased from suppliers that will accept returned bottles (full or empty). Contact the supplier before purchasing lecture bottles to ensure that they have a return policy.
- Lecture bottles should be dated upon initial use. It is advised that bottles be sent back to the supplier after one year to avoid accumulation of old bottles.

