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Memo

To	Tauren Beggs, WDNR
From	David de Courcy-Bower and John Roberts, ERM
Date	January 23, 2020
Reference	Thermo Fisher Scientific, Inc.
Subject	Vapor Intrusion Evaluation Work Plan Addendum 1

1 Introduction

This work plan addendum has been prepared on behalf of Thermo Fisher Scientific, Inc. (Thermo Fisher) for the former Hamilton Industries facility located at 1316 18th Street in Two Rivers, Wisconsin (the "Site"). Thermo Fisher has performed site investigation work in accordance with Wisconsin Department of Natural Resources (WDNR) requirements to investigate volatile organic compounds (VOCs) detected at the Site (BRRTS Activity #02-36-578316).

The Thermo Fisher facility was demolished in 2015 and the Site is currently an approximately 13-acre vacant lot. The Site was historically used for a variety of manufacturing operations, which reportedly began in the late 1800s. Previous investigations of the Site include soil sampling, vertical aquifer sampling, and installation and sampling monitoring wells. Sample results indicate that the primary contaminants of concern are VOCs. The results of prior Site investigations were submitted to the WDNR in a series of documents, the most recent being the fifth Quarterly Groundwater Sampling Event and Additional North Investigation Summary dated July 31, 2019. WDNR reviewed the documents and communicated required additional investigation activities via August 13 and 23, 2019 e-mails from Tauren Beggs. The required additional investigation activities include:

1. Limited soil sampling be performed west and north of monitoring well MW-25S,
2. Vapor intrusion (VI) assessment activities,
    a. Off-site building occupancy assessment,
    b. Off-site sub-slab VI sampling,
3. Utility line, contaminant pathway assessment/sampling.

This document outlines the approach to conduct vapor and additional soil sampling as required based on e-mail communications with WDNR on August 13 and 23, 2019.

2 Scope of Work

Based on communication with the WDNR, the following activities are included in this work plan:

2.1 Sub-Surface Clearance

The following paragraphs summarize proposed approach to complete sub-surface clearance activities. Site-specific procedures for sub-surface clearance can be found in the project Health and Safety Plan (HASP).

In accordance with State and local regulations, ERM will contact the Wisconsin Digger's Hotline prior to performing intrusive work to mark out where public utilities enter the Thermo Fisher Site. ERM will also subcontract a private utility location company to conduct an on-site utility survey. An area of sufficient size will be cleared for utilities to allow for flexibility in point location during installation activities.

A Site walk will be conducted with the private utility location company to inspect and mark-out the proposed sampling locations. The locations will be verified, if possible, for the presence of underground utility lines and underground infrastructure based on discussions with the property owner, knowledgeable persons, and available maps. Wherever required, locations will be moved and the preliminary sampling location map will be updated. The scope of work for the utility locator will involve the use of a precision cable locator, signal generator, and/or ground penetrating radar (GPR) to locate, trace, and map out potential services in the investigation target areas. ERM will also direct the private utility contractor to utilize a hand-held GPR to identify the potential for rebar and/or reinforcing wire mesh within concrete covered areas so it may be avoided.

2.2 Task 1 – MW-25 Area Soil Sampling

ERM will advance four soil borings using a hand auger to a depth of approximately 6 feet to further investigate soil contamination in the proximity of MW-25S. Sampling will occur at the four locations proposed in Figure 1 (Proposed Sample Locations). Prior to any intrusive work, ERM will follow the Sub-Surface Clearance protocols outlined in Section 2.1.

2.2.1 Sample Collection Procedures

An ERM geologist will examine and record descriptions of the materials encountered, including visual and/ or olfactory evidence of contamination, during advancement of the hand auger borings. Soil recovered during hand auguring will be field screened for the presence of VOCs by using a photoionization detector (PID) equipped with an 11.7eV lamp and the headspace technique. The headspace technique includes:

- Placing approximately 50 – 100 grams of a representative soil sample into a clean quart-sized plastic bag;
- Sealing, agitating, and allowing the sample to equilibrate for 10 to 15 minutes; and
- Measuring the concentration of vapors in the headspace above the soil sample by inserting the probe of the PID into the bag.

The PID is capable of semi-quantitatively measuring total VOC concentrations in parts per million by volume (Vppm) compared to an equivalent standard. A headspace reading of 1 Vppm or less is used as an indication of clean soil conditions.

Geological logs will be completed for each soil boring based on the recorded descriptions and observations described above.

Unsaturated zone soil samples will be collected from the 2 – 4 and 4 – 6 foot depth intervals at each soil boring location and retained for potential laboratory analysis. Prior to submittal, headspace readings will be observed. Samples will be placed in laboratory-supplied bottles of appropriate volume and preservation, stored in cooled packaging, and dispatched to the laboratory with full chain-of-custody tracking documentation.

2.2.2 Laboratory Analysis

ERM will utilize a Wisconsin-certified environmental laboratory (Pace Analytical of Green Bay, Wisconsin). Collected samples will be retained for laboratory chemical analysis of the full list of VOCs (SW 846 Method 8260B).

2.3 Task 2 –Vapor Intrusion Assessment and Soil Gas Sampling South of the Building at 1303 19th St.

The VI assessment and sampling procedures presented in this work plan addendum were developed based on the following publications:

- Wisconsin Remediation and Redevelopment Program Addressing Vapor Intrusion at Remediation & Redevelopment Sites in Wisconsin, published in January 2018 (Publication RR-800)
- Sewers and Utility Tunnels as Preferential Pathways for Volatile Organic Compound Migration Into Buildings: Risk Factors and Investigation Protocol, Department of Defense (DOD) - ESTCP, November 2018 (Publication ER-201505)

WDNR guidance includes criteria for when sub-slab vapor sampling is required to evaluate the potential for vapor intrusion of chlorinated volatile organic compounds (CVOCs) at commercial and industrial properties. The criteria involve the position of a structure relative to the lateral distance from impacted soil, the distance above impacted groundwater, and the potential for preferential migration pathways to connect CVOC vapors to a building. MW-25S is located approximately 30 feet south of the 1303 19th Street building. Laboratory analysis of unsaturated soil samples collected during installation of MW-25S detected a maximum trichloroethene (TCE) concentration of 38.4 ug/kg, exceeding the migration to groundwater pathway standard for TCE at a depth of 2-4 feet. The impacted soil encountered in the MW-25S soil boring is within WDNR's 100 foot lateral distance criteria presented in the VI guidance. Additionally, laboratory analytical results for groundwater samples collected from MW-25S indicate that TCE has been detected at concentrations exceeding the NR140 Preventive Action Limit (PAL). It is not known whether impacted groundwater extends beneath the foundation of the 1303 19th Street building or whether building support structures extend vertically downward sufficiently to intersect the groundwater table.

The City of Two Rivers has provided a map showing the approximate traces of subsurface utility lines in the vicinity of the Site. The utility map shows that the laterals that connect the 1303 19th Street building to the stormwater and sanitary sewer mains enter the property from the east, on the opposite side of the building from the MW-25S location. Therefore, the sewer laterals are currently not considered VI migration pathways for the TCE impacts detected at the MW-25 location. The results of future sewer main sampling described later in this work plan addendum will be assessed to determine whether additional utility corridor vapor sampling may be warranted.

Based on the above information, two sub-slab samples are proposed to be collected from the building at 1303 19th St. in the locations proposed on Figure 1. Locations will be field-fit to avoid footings, large cracks, and high-traffic areas. Details regarding sampling locations, methodology, and analysis are included in the following sections. The proposed sub-slab sampling is contingent the granting of access for ERM to the 1303 19th St. building by the property owner.

2.3.1 Sub-Slab Soil Gas Sampling

Prior to sub-slab sampling, the use of TCE will be evaluated by performing a building survey and collecting indoor air PID readings. The survey form is provided as Appendix A.

ERM will collect sub-slab samples from each of the approximate locations proposed in Figure 1. The locations will be set away from doors and at least five feet away from the exterior wall to minimize potential influence from outdoor air. Locations may be modified based on access, equipment locations and utilities, and reducing the impact to ongoing operations in the buildings. Locations may need to be modified to avoid sub-surface utilities, cracks in the foundation, or other features that may limit the reliability of the sampling results.

ERM will install Cox-Colvin, Inc. Vapor Pin™ (Vapor Pin) devices to facilitate collection of the sub-slab samples. The procedures used to install the sub-slab Vapor Pin sampling points and collect the soil gas samples are included in Appendix B.

2.3.2 Analysis

Sub-slab soil gas samples will be analyzed using US EPA method TO-15. Samples will be submitted to Pace Analytical Laboratory of Minneapolis, MN, a Wisconsin-certified laboratory.

Analytical results for sub-slab, soil gas samples will be reported for TCE. However, if additional VOCs are detected above WDNR criteria in the soil samples collected to the north and west of MW-25S, additional VOCs may be analyzed.

2.4 Task 3 – City Sewer Vapor Assessment

The WDNR expressed concern regarding the potential for the proposed hotel development west of the Site and other surrounding properties to be impacted by vapors off-gassing from groundwater and/or contaminant migration through sanitary sewer lines and laterals. Testing of the sanitary sewers in the surrounding areas is proposed to determine the presence or absence of VOCs, specifically TCE, within the sewer. The investigation will follow procedures presented in DOD ESTCP Project ER-201505 as provided by the State of Wisconsin. Sampling will occur at 6 sanitary sewer manholes in the proposed locations in Figure 1 (Proposed Sanitary Sampling Locations).

2.4.1 Sample Collection Procedures

Sewer vapor sampling will be used to determine whether portions of the sanitary sewers that were either connected to the former Hamilton facility buildings, or intersect impacted groundwater represent preferential migration pathways for compounds of concern from the Site. The sewer sampling locations included for the initial testing were selected based on City of Two Rivers sewer maps that show sewer laterals from the former Hamilton facility connecting to the main pipelines in

the adjacent rights-of-way, as well as WDNR sampling recommendations from email correspondence dated August 23, 2019.

An evacuated 1-Liter Summa® canister will be used to collect the sewer vapor sample. The canister will be provided by the laboratory equipped with an in-line particulate filter and a vacuum gauge. According to the DOD guidance, no flow controller is required for sewer sample collection.

For all proposed locations, sewer vapor samples will be collected following the procedures presented in Appendix C.

2.4.2 Data Analysis

The results of the sewer sampling will be evaluated to determine whether additional sewer and/or building VI sampling are necessary. WDNR has indicated that preliminary, compound specific screening levels for comparison with the sewer vapor sample results are based on information presented in the DOD ESTCP Project ER-201505 guidance. The ESTCP guidance refers to tracer testing indicating that a factor of 0.03 (33x attenuation) is a reasonable upper-bound attenuation factor for evaluating of VOC concentrations in sewers. As a result, the WDNR has indicated that sewer screening values be developed by applying the 0.03 attenuation factor to existing ***residential*** indoor air screening concentrations.

As described above, the sewer sampling locations were selected based on City of Two Rivers sewer maps that show where sewer laterals from the former Hamilton facility connected to the main pipelines in the adjacent rights-of-way. The sample results will be used to determine the spatial distribution of Site COC (if present) in sewers between the designated manhole access points close to the lateral line connections and groundwater plume boundaries. If the VOC concentrations exceed the sewer screening concentrations, then further testing may be recommended to delineate the extent of vapors within the sewer and to evaluate potential impacts to buildings.

2.5 Investigation Derived Waste

All investigative waste (i.e., wastewater, sludge, soil cuttings, and sampling waste) will be placed in 55-gallon steel drums approved by the U.S. Department of Transportation, labeled, and temporarily stored on the site in a secured area for future management based on sample laboratory analytical results. The collected investigative waste will be stored, transported, and treated or disposed of in accordance with all applicable local, state, and federal waste handling regulations.

2.6 Reporting

The Site Investigation Report Addendum will be prepared according to ERM standard report format and WDNR requirements. The report will be submitted within 60 days after the additional site investigation activities included in this work plan addendum are completed and receipt of the laboratory data. The report will include a description of the Site investigation activities, field work methodologies, and analysis of the findings based on the regulatory framework, and a final evaluation. The final report, appendices, and photos will be provided to the WDNR in hard copy.

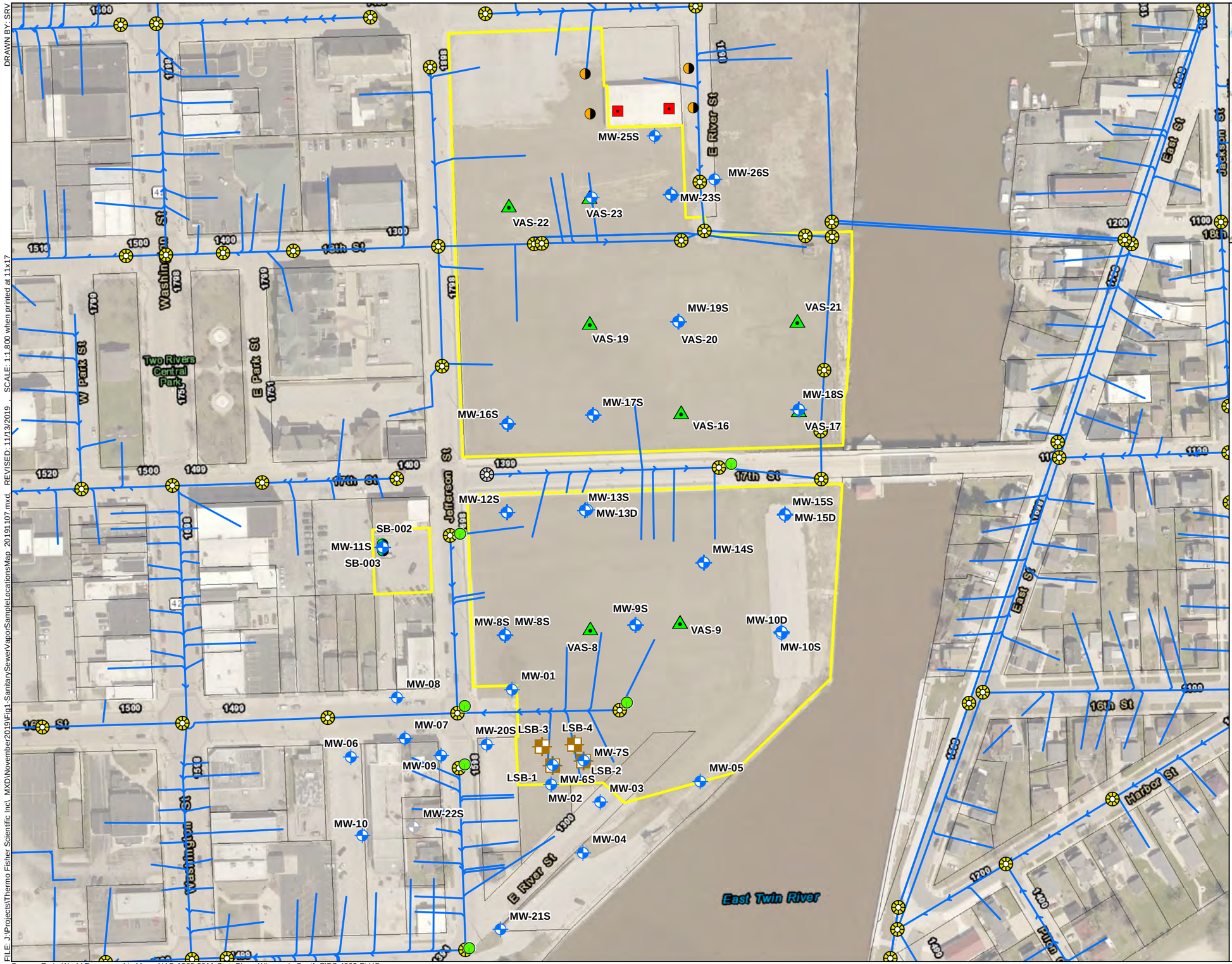
Yours Sincerely,

Environmental Resources Management

David de Courcy-Bower
Partner

John C. Roberts
Senior Project Manager, Geologist

FIGURE



Legend

- Sanitary Manhole (Removed)
- Sanitary Manhole
- Proposed Sanitary Sewer Vapor
- Proposed Soil Boring
- Proposed Sub-Slab
- Soil Boring Location
- Monitoring Well Location
- Vertical Aquifer Boring (VAS)
- LNAPL Investigation Boring
- Abandoned Monitoring Well Location
- Sanitary Sewer Line (Main/Lateral)
- Property Boundary
- Parcel Boundary

Notes:
1. Manitowoc County Imagery, 2017
2. Manitowoc County provided utilities

N

0 150 300
Feet

Figure 1
Proposed Sample Locations
Former Hamilton Industries
1316 18th Street
Two Rivers, Wisconsin

Environmental Resources Management
www.erm.com

Source: Esri - World Topographic Map; NAD 1983 2011 StatePlane Wisconsin South FIPS 4803 Ft US

FILE: J:\Projects\Thermo Fisher Scientific, Inc_MXD\November2019\Fig1-SanitarySewerVaporSampleLocationsMap_20191107.mxd REVISED: 11/13/2019 - SCALE: 1:1,800 when printed at 11x17

DRAWN BY: SRV

APPENDICES

Appendix A - Building Survey, Product Inventory, and Sampling Forms

Indoor Air Survey
Commercial/Industrial Building

Preparer's name:
Date/Time prepared:
Preparer's affiliation:
Phone #:
Purpose of investigation:

Weather Conditions
Temperature (°F):
Wind (speed/direction):
Barometric pressure (inches):
Precipitation (inches):

Occupants
Address:
Number of occupants/persons at this location:

Building Characteristics		
Building Construction		
Number of floors: ____ Building Age: _____		
	Y	N
Is the building insulated?		
How air tight (tight/average/not tight)?		
Does the building have a basement, crawl space or vaults?		
Does the building have large doors/window?		

Airflow
Outdoor air infiltration:

Infiltration into air ducts:

Construction Characteristics			
Above grade construction (wood frame/concrete/stone/brick): _____			
	Y	**N**	**NA**
Concrete Floor:			
If so, is it sealed?			
If so, what is it sealed with? _____			
Thickness: _____ (cm)			
Foundation walls (poured/block/stone/other-specify):			
Are the walls sealed?			
If so, what are they sealed with? _____			
Sump present:			
Water in sump:			
Ceiling Height: ___ (cm)			
Lowest level depth below grade: _____ (cm)			
Does the building flood at any time during the year?			
Is it possible to determine how deep water is below the floor?			
If yes, approximately how deep?			
Identify potential soil vapor entry points and indicate the approximate size (e.g., cracks, utility ports, drains). Inspect the previous soil gas sample locations and the monitoring wells for cracks and gaps. Indicate issues on the floor plan drawing.			

Heating, Venting and Air Conditioning			
Type of Heating System(s)			
Hot air circulation / Heat pump / Hot water baseboard / Space heaters / Stream radiation			
Radiant floor / Electric baseboard / Wood Stove / Outdoor wood boiler			
Other: _____ Primary: _____			
Primary Fuel			
Natural gas / Fuel oil / Kerosene / Electric / Propane / Solar / Wood / Coal			
Hot water tank fueled by:			
Location of boiler/furnace (Basement/outdoors/main floor/NA):			
Other: _____			
Air conditioning (central air/window units/open windows/none):			
Is the HVAC system operational?			
If so, when was the last time the system was operated?			
Are there air distribution ducts present?			

Describe the supply and cold air return ductwork, and its current condition where visible, including whether there is a colld air return and the tightness of duct joints. Indicate the locations on the floor pland drawing.

When is the HVAC system used (what months?):			
	Y	N	NA
When the HVAC is operational, does air enter/exit the building when a door/window is opened?			
When is mechanic ventilation used (what months)?			
When is passive ventilation used (what months)?			
If possible estimate the number of air exchanges per hour based on HVAC specifications:			

Facility Use
Describe the current and past uses of the building. If mixed use, describe use of each portion of the building.

Factors That May Influence Indoor Air Quality			
	Y	N	NA
Is there an attached garage or loading bay?			
Does the garage/loading bay area have a separate HVAC unit?			
Are petroleum-powere machines or vehicles stored in the garage/loading bay (e.g., lawnmower, atv, trucks)? If so, specify: _____			
Has the building ever had a fire? If so, when? _____			
Is a kerosene or unvented gas space heater present? If so, where? _____			
Is there a workshop or chemical storage area? If so, where? _____ Type? _____			

	Y	N	NA
Is there smoking in the building? If so, how frequently? _____			
Have cleaning products been used recently? When? _____ Type? _____			
Have cosmetic products been stored or used recently? When? _____ Type? _____			
Has painting/stain been done in the last 6 months? Where? _____ When? _____			
Is there new carpet, drapes, or other textiles? Where? _____ When? _____			
Have air fresheners been used recently? When? _____ Type? _____			
Are there exhaust fans or hoods? If yes, where vented? _____			
Is there a bathroom exhaust fan? If yes, where vented? _____			
Are there any other mechanical vents? If yes, where vented? _____			
Has there been a pesticide application in the last 6 months? When/Where? _____ Type? _____			
Has there been any recent construction? If yes, describe: _____ _____ _____			
Are there any odors in the building? If yes, describe: _____ _____ _____			
Are there any solvents used in the building? If yes, where? What types of solvents are used? _____ _____ _____			

	Y	N	NA
Are uniforms dry-cleaned?			
If yes, are they stored in the building?			
Is there a vapor intrusion mitigation system for the building? If yes, what was the date of installation? _____			
Is the system active or passive? _____			

Water and Sewage
Water supply (public water/drilled well/dug well): _____
Other (specify): _____
Sewage disposal (public sewer/septic tank/leach field/dry well): _____
Other (specify): _____

Floor Plans
Draw a plan view sketch of the building. Indicate air sampling locations, possible indoor air pollution sources, and PID meter results.
First floor:

Outdoor Plot

Draw a sketch of the area surrounding the building bing sampled. If applicable, provide information on spill locations, potential air contamination sources (industries, gas stations, repair shops, landfills, etc.), outdoor air sampling location(s) and PID meter readings.

Also indidcate compass direction, wind direction and speed during sampling, the locations of well and septic systems, if applicable, and a qualifying statement to help locate the site on a topographic map.

Product Inventory Form

Make and Model of PID Field Instrument Used: ______________________________

List specific products found in the building that have the potential to affect indoor air quality. Do not open a container to determine the contents or to take a field instrument reading.

Location	Product Description	Size (units)	Chemical Ingredients	Condition	Field Instrument Reading (Units)	Photo (Y/N)

Air Sampling Discussion

Discuss what will happen the day of the indoor air sampling:
Normal operations

	Y	N	NA
Will the building be occupied during sampling?			
What hours will ERM have access to check on the samples?			
Are there any activities of note planned between the time this survey was completed and when the indoor air sampling will be conducted (i.e., interior painting)?			
If so, list/describe:			

Other Comments:

Environmental Resources Management

Project #:
Project Name:
Location:
Project Manager:

Sample Location:		**Collector Name(s):**	
Address:			
PID Meter Used: (Model, Serial #)		**Date:**	

Sample ID:

Duplicate Sample? (Y/N) **Duplicate Sample ID:**

Type of sample (circle one): INDOOR AIR AMBIENT AIR SUB-SLAB SOIL GAS EXTERIOR SOIL GAS

Photograph description:

Summa® Information							
Canister Serial Number:				Flow Controller ID Number:			
Start Date/Time:				Stop Date/Time:			
Start Pressure: (inches Hg) [1]				Stop Pressure: (inches Hg) [2]			

Other Sampling Information:

Story/Level		Ground Surface (pavement, flooring)		Depth of Vapor Probe (bgs)	
Room (if applicable)		Slab thickness (if applicable)		Distance from Building (if applicable)	
Indoor Air Temp (ºF)		Potential Vapor Pathways Observed?		Distance to nearest Roadway (ft.)	
Intake Height Above Ground Level (ft.)		Noticeable Odor?			
Outside Barometric Pressure ("Hg or mb)					

Purge Time (for exterior soil gas or sub slab if needed)							
Purge Rate:				Purge Total Time (min):			
Purge Start Time:				Purge End Time:			
Initial Vacuum:	\			Final Vacuum:	\		
	(Probe \ Purge)				(Probe \ Purge)		

Helium Purge Test	~He Shroud			ppm	% calc:		
	~He Syringe			ppm			
Field Screen PID Readings	Purge Vol.			C02		Methane	
	VOCs			O2		Time Stop	
Initial Sample Purge Vol (soil gas only):		PID Reading (ppm):					

Water Dam Completed and Passed? Time: comments

Shut-In Test Completed and Passed? Vac held time held (min)

Any Other Quality Control Checks Performed and Results? (i.e., helium shroud, liquid tracer, etc.):

Interim Monitoring (for indoor air only or if needed for soil gas)

Reading #1:	Time:	Summa Vacuum ("Hg):	Noticeable Odor? (Y/N)		
Reading #2:	Time:	Summa Vacuum ("Hg):	Noticeable Odor? (Y/N)		
Reading #3:	Time:	Summa Vacuum ("Hg):	Noticeable Odor? (Y/N)		
Reading #4:	Time:	Summa Vacuum ("Hg):	Noticeable Odor? (Y/N)		
Reading #5:	Time:	Summa Vacuum ("Hg):	Noticeable Odor? (Y/N)		

Sketch of Sample Location:

Comments:

1 - Verify pressure did not decrease noticeably from laboratory reported value.

2- If conducting a purge of soil gas inside a building, release purged air outside or capture purged air in tedlar bag and then release outside.

3 - If conducting both indoor air and soil gas sampling, all indoor air sampling must be completed and canisters closed before soil gas sampling can be started. Call VI team lead for more information.

Appendix B - PIN Install Sub-Slab Sampling Procedures

Appendix B

Sub-Slab Vapor Sampling Procedure

Vapor Pin Installation

- Drill a pilot 1.5-inch-diameter hole to approximately 1.75 inches deep into the concrete slab using an electric hammer drill.
- Drill a 5/8-inch-diameter hole through the remaining thickness of the slab and approximately 1-inch into the sub-slab material to form a void.
- Clean the hole of concrete cuttings and dust using a pipe brush and vacuum cleaner equipped with a high-energy air (HEPA) filter.
- Place a Vapor Pin with a silicone sleeve over the hole and tap into place using a dead blow hammer (the silicone sleeve will form a water- and air-tight seal with the concrete).
- Screw a stainless steel cover in place with the Vapor Pin to secure the pin and prevent its damage.
- A syringe will be used to conduct a purge check of the sample point (soil gas should be relatively easy to extract without generation of a significant vacuum).
- Allow sub-slab sampling points to equilibrate for at least 2 hours prior to sampling.
- Following the equilibration period, ERM will proceed with the quality assurance (QA) checks and soil gas sampling discussed in the following sections.

A typical installation of a soil vapor sampling point is shown below.

Typical Vapor Pin sub-slab sampling point

Sample Collection Procedures

The following sections describe the sub-slab, soil gas sample collection procedures that will be employed. In addition, field documentation, analytical needs, and sample identification methods are described. Scheduling and planning of sampling activities will be completed after approval of this Work Plan.

Scheduling will take into consideration weather conditions at the time of sampling, as sampling will not be performed during or immediately following (i.e., within 24 hours) a very high wind or a rain/storm event with an accumulation greater than or equal to 0.1 inch. Sampling events may need to be postponed or rescheduled to accommodate these weather conditions.

Leak Check and Vacuum Leak Check

After installation of a sampling point, a water dam will be placed around the point and filled with water. The water dam will consist of a Schedule 40 PVC coupler secured to the ground around the Vapor Pin location using non-VOC compliant material such as plumbers' putty. ERM field staff will monitor the water for five minutes to check for leaks in the seal between the concrete and the Vapor Pin. If leaks are observed based on water draining into the sampling point, the sampling point will be extracted and reset.

Typical water dam setup 1

Nylaflow (or Teflon) tubing will be attached from the sampling port to a 1-liter Summa® canister and a vacuum leak check will be completed to determine the security of the sampling train between the sampling port and the sampling canister. The vacuum leak check is performed by generating a vacuum inside the sample tubing while keeping the sampling port and the sampling canister closed. A vacuum is generated using a plastic syringe and the vacuum is monitored using a vacuum gauge for one minute. If vacuum is maintained for the observed period, then the sampling train is deemed adequate and sampling will begin. If vacuum is lost during the observation period, then tubing connections will be tightened/altered until there is no observable loss in vacuum during the test. After the shut-in test is validated, the sampling train will not be altered.

Typical Vacuum leak check and sampling configuration

After completion of quality control (QC) activities, the valve to the plastic syringe will be closed and the sampling port will be opened. The sampling canister is equipped with a regulator limiting flow to a maximum of 100 to 200 milliliters per minute (i.e., approximately 5 to 10-minute sampling time into a 1-liter canister). The sampling canister is opened and the vacuum in the canister is monitored during sample collection using a calibrated vacuum gauge. Sampling is complete when vacuum measurements indicate a residual vacuum in the canister of approximately -5 in. of Hg. Residual vacuum will be actively monitored by field personnel during sampling (i.e., a witnessed sample); residual vacuum in the canister will be used as a general check of integrity during shipping. Residual vacuum will be confirmed and recorded by the laboratory after receipt of the canisters.

Sub-slab, soil gas canisters will be batch-certified clean by the laboratory prior to use. Sampling information, including starting and ending vacuum reading of each canister will be recorded on the appropriate sampling data sheet. A copy of a template sampling data sheet is included in Appendix A of the Work Plan Addendum. A typical sampling configuration (including vacuum leak check set-up) is shown above.

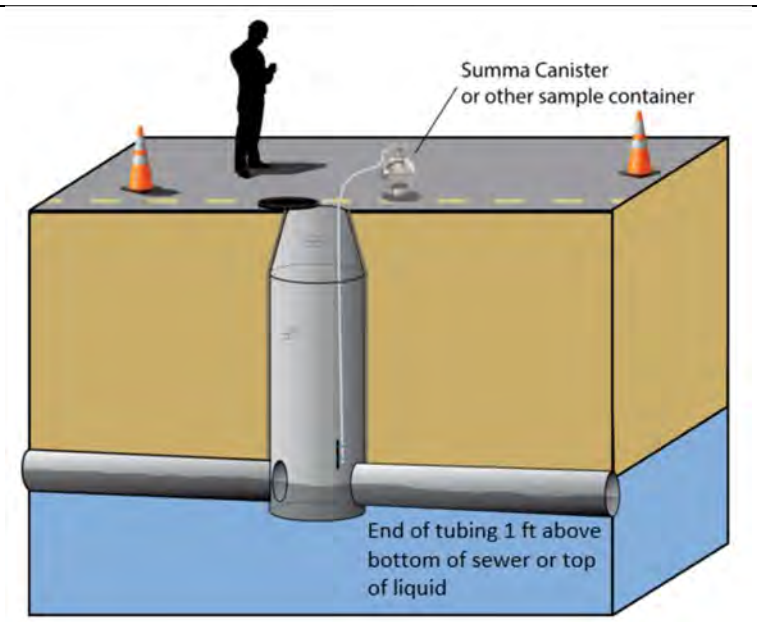
Upon completion of sample collection, sub-slab sampling ports will be capped and left in place with a metal, flush-mounted cover until the investigation is complete. When the sub-slab investigation is complete, the Vapor Pin will be removed and the hole grouted with construction grout flush with the surrounding finished floor. Vapor Pin removal will occur at a later date.

Appendix C - Sewer Sample Collection Procedures

Appendix C

Sewer Sample Collection Procedure

- Samples will be collected between 9 am and 3 pm, when baseline flow in sanitary sewers is relatively low. Samples will not be collected within 48 hours of a rainfall event of more than 0.1 inches.
- Opening of manhole covers will be minimized prior to sampling by threading measurement or sampling equipment through vent holes, or opening covers just enough to insert the equipment into the manhole.
- A water level meter or weighted string will be used to measure the distance from the access point to the bottom of the sewer/utility tunnel or the depth to any liquid (whichever is shallower).
- A grab vapor sample will be collected from a depth of one foot above the bottom or liquid level using nylon or Teflon tubing extended through the access point.
- Using a gas-tight syringe (-60cc), purge three tubing volumes prior to sample collection at a rate of approximately 0.1 liter per minute. 1/4- inch diameter tubing (3/16-inch inside diameter) has a volume of 5.43 ml/ft).
- Record the identification numbers for the canister along with the initial canister pressure on the vacuum in the field notebook or field sampling form. A canister with a significantly different pressure than originally recorded by the testing laboratory will not be used for sampling.
- Connect the tubing from the sampling port to the canister using Swagelok® compression fittings.
- Open the canister valve. Record the time (beginning of sampling) and the canister pressure on the vacuum gauge.
- Take a photograph of the canister and the area surrounding the canister.
- Stop sample collection after the scheduled duration of sampling (approximately 8 minutes at a flow setting of 1 lpm), but when the canister still has at least -3 inches Hg vacuum. Record the final vacuum pressure.
- Disconnect the tubing from the canister and replace the protective brass plug.
- Attach identification tags (sample name, time/date of sampling, etc.) to the canister as directed by the laboratory.
- Place the canister and other laboratory supplied equipment in the packaging provided by the laboratory.
- Complete the chain of custody form, making sure to include the identification number for each canister, and the initial and final canister pressures.
- Ship samples to the laboratory within one business day of sample collection via overnight delivery.



Vapor Sample Collection from Sewer