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August 27, 2018

Ms. Carolyn Bury
Project Manager
Corrective Action Section 2
Remediation and Re-use Branch
U.S. Environmental Protection Agency, Region 5
77 West Jackson Boulevard
Chicago, IL 60604-3590

Re: **Residential Vapor Intrusion Investigation Work Plan – [redacted]**
Franklin Power Products, Inc./Amphenol Corporation
Administrative Order on Consent, Docket # R8H-5-99-002
EPA ID # IND 044 587 848
980 Hurricane Road
Franklin, Indiana 46131

Dear Ms. Bury:

Industrial Waste Management Consulting Group, LLC (IWM Consulting), on behalf of the "Performing Respondent", Amphenol Corporation (Amphenol), is submitting this Residential Vapor Intrusion Investigation Work Plan (Work Plan) to the United States Environmental Protection Agency (USEPA) in order to document the proposed work activities for [redacted] residential property [redacted] the Former Amphenol facility located at 980 Hurricane Road, Franklin, IN (Site). The address of the residential property is [redacted], Franklin, IN (Residence) and [redacted] will be sampled. The objective of the proposed work activities is as follows:

- Determine if volatile organic compounds (VOCs) are present in either the sub-slab vapor, indoor air, sewer lateral, and/or outside ambient air at the Residence; and
- Document whether or not the potential vapor intrusion (VI) exposure pathway is complete, based upon the laboratory analytical results of the samples obtained as part of this Work Plan.

Although it is understood that additional investigation sampling activities will occur at the Site and in the area immediately surrounding the Site at a future date, additional investigation sampling activities are not being proposed as part of this Work Plan. Those activities will be discussed in future Work Plan(s) submitted to the USEPA once the request from the USEPA has been received. However, IWM Consulting and Amphenol would like to complete the Residential sampling as quickly as possible and thus this Work Plan is being submitted prior to issuance of an official Work Plan Request letter from the USEPA.

This Work Plan outlines the proposed methodology and VI sampling activities that will occur in order to evaluate the potential VI exposure pathway associated with the historical release documented to have occurred at the Site. A site vicinity map is provided as **Figure 1**, which displays the location of the Site and properties in the vicinity of the Site. **Figure 2** displays the location of [redacted] Residence which will be sampled as part of the proposed work activities.

Residential Structure Characteristics & Site Access

IWM Consulting has communicated directly with the current property owner and the property owner has verbally granted access to the Residence in order to complete the proposed VI sampling activities. The following information was verbally communicated to IWM Consulting or obtained from the property card, which is publicly available online (https://beacon.schneidercorp.com/?site=JohnsonCountyIN):

- The Residence [redacted]
- [redacted]
- The basement is not finished and thus is not occupied.
- The Residence has a bathroom and kitchen on both the first floor and the upstairs.
- An exterior sewer cleanout is present near the northwest corner of the Residence.

A signed access agreement will be secured prior to completing the VI sampling activities and a scaled diagram will be created documenting the layout and dimensions of key site features at the Residence.

Proposed Sampling Activities

IWM Consulting proposes to obtain a maximum of nine (9) individual samples at the Residence, which includes one (1) duplicate sample. Six (6) of the samples will be obtained from within or beneath the Residence, one (1) will be obtained from the exterior sewer cleanout, and up to two (2) outside ambient air samples will be obtained in order to document the ambient air quality outside the Residence. The proposed VI sampling locations are further summarized in the following table:

Proposed Sample ID	Proposed Sample Location	Sampling Rationale
SVP-1 [redacted]	Sub-slab vapor sampling point installed along west central portion of the basement	Determine VOC concentration of soil gas immediately beneath the Residence
SG-1 [redacted]	Sewer gas sample obtained from the exterior sewer cleanout	Determine if VOCs are present within the sewer lateral entering into the Residence
IA-BM1 [redacted]	Indoor air sample obtained from the basement, in close proximity to sampling location SVP-1	Paired indoor air sample correlating to location of SVP-1; provides indoor air VOC concentration and assists in determining if VI is occurring in the basement area of the Residence
IA-CS1 [redacted]	Indoor air sample obtained from the central portion of crawlspace	Determine if VI is occurring in the crawlspace portion of the Residence
IA-MF1 [redacted]	Main Floor bathroom	Determine if VOCs are entering the indoor air of the Residence through the sanitary sewer
IA-SF1 [redacted]	Second Floor bathroom	Determine if VOCs are entering the indoor air of the Residence through the sanitary sewer
IA-FD1 [redacted]	Duplicate sample obtained from one of the indoor air sampling locations	Obtained for Quality Assurance/Quality Control (QA/QC) purposes
AA-1 East [redacted]	Outside ambient air, East of the Residence	Document ambient air quality between the Residence and the Site's treatment system
AA-2 Upwind [redacted]	Outside ambient air, located on the upwind side of the Residence	Document ambient air quality upwind of the Residence

Proposed Sampling Procedures and Laboratory Analytical Methods

IWM Consulting will obtain all of the VI samples in individually certified clean, laboratory provided stainless steel 6-liter summa canisters. All of the summa canisters will be equipped with 24-hour flow regulators (~4.16 milliliters per minute (mL/minute) flow rate) and the samples will be obtained over a 24-hour period of time. The intake of the outside ambient air samples will be obtained from a height of approximately 6 feet, thus the sample canisters may be placed upon a small platform or attached to a shepherd's hook (or similar apparatus). The indoor air samples obtained from the basement, main floor bathroom, and second floor bathroom will be obtained from a height corresponding to the typical breathing height (4-6 feet above the surface). The sample obtained from the crawlspace will be obtained at a height approximately 12-inches above the ground surface of the crawlspace. The soil vapor sample will be obtained directly from a newly installed sub-slab vapor sampling point (minimum installation 24-hours prior to sampling), once the sampling point has been confirmed to be tight and is properly purged. The sewer gas sample will be obtained directly from the access point of the exterior sewer lateral. The access point is reportedly a 4-inch diameter threaded PVC cap and IWM Consulting will install a temporary new PVC cap with an air tight sample port. Nyaflow tubing will extend from the bottom of the sampling port into the sewer cleanout to ensure a representative sample is obtained from the sewer lateral. The starting and ending time of each sample, along with the initial and final vacuum measurements of the summa canister will be recorded during the VI sampling activities. The VI sampling activities are deemed complete when the vacuum on the summa canister is between 3 and 5-inches of mercury or the pre-determined timeframe is reached, whichever occurs first. Care will be taken as to not allow the vacuum to reach zero.

All of the samples will be labeled in the field utilizing the sample tags attached to the summa canisters by the laboratory. Information included on the sample labels includes the sample ID, sample date, sample time, and the requested analysis. A site-specific chain-of-custody (COC) will also be completed and includes all of the pertinent sampling information (i.e. sample ID, sample date, sample start and end time, initial and final field pressure readings, summa canister ID, flow controller ID, field PID readings (if applicable), and the requested analysis). The wind speed and direction will also be recorded during the sampling event. A limited Indoor Air Survey will be completed during the sampling activities, which will primarily only focus on items within the basement, crawlspace, and bathrooms.

All of the samples collected will be submitted under chain-of-custody control to Pace Analytical Services, LLC (Pace) located in Minneapolis, Minnesota for laboratory analysis of shortlist VOCs using analytical method TO-15. The shortlist VOCs include the following compounds: vinyl chloride (VC), trans 1,2-dichloroethene (trans-1,2 DCE), 1,1-dichloroethane (1,1-DCA), cis 1,2 dichloroethene (cis 1,2-DCE), 1,2 dichloroethane (1,2 DCA), methylene chloride, 1,1,1-trichloroethane (1,1,1 TCA), trichloroethylene (TCE), and tetrachloroethylene (PCE). The samples will be analyzed using a combination of EPA Method TO-15 and EPA Method TO-15 SIM. Specifically, EPA Method TO-15 SIM will be utilized when analyzing for VC, 1,2-DCA, and TCE in order to meet the most stringent USEPA Regional Screening Levels. An expedited turnaround time will be requested from the laboratory and the results of the sampling event are anticipated to be received within 3-5 working days from the date the samples are collected in the field.

For Quality Assurance/Quality Control (QA/QC) purposes, one (1) field duplicate sample will be collected at a rate of one (1) sample per every twenty (20) confirmatory samples per sampling media and will be analyzed for the same analytical parameters. All of the summa canisters will also be individually certified clean by the laboratory using a combination of EPA Method TO-15 and TO-15 SIM. The duplicate sample will be attached to the parent sample with a brass tee fitting (ensuring only one common air intake) and Nyaflow or tygon tubing.

Both the parent sample and duplicate sample will have their own individual flow regulator set for a 24-hour sampling period but the start and end time for these samples will be the same.

A copy of all of the applicable Standard Operating Procedures (SOPs) which will be followed by IWM Consulting during the sub-slab vapor point installation and VI sampling activities is provided as **Attachment A**. A copy of the Pace COC which will be utilized during the work activities is provided as **Attachment B.** Pertinent information such as laboratory certifications and a table summarizing the corresponding method detection and reporting limits for Pace were previously submitted to the USEPA as part of the Ambient Air Investigation Work Plan submitted on July 25, 2018 and are not being resubmitted as part of this Work Plan.

Reporting

Preliminary results (copy of the laboratory report) will be supplied to representatives from the USEPA as soon as possible once the information has been received and reviewed. A brief letter report will also be generated and submitted to the USEPA within approximately 2-weeks of receiving the analytical results. The indoor air and sub-slab vapor analytical results will be compared to the USEPA Regional Residential Vapor Intrusion Screening Levels (VISLs) and/or Ambient Air Screening Levels, using both the carcinogenic target cancer risk of 10E-06 and the non-carcinogenic hazard quotient of 1. The results will also be evaluated in accordance with the Indiana Department of Environmental Management (IDEM) Vapor Remedy Selection and Implementation Guidance Document dated February 2014. The letter report will summarize the sampling activities, results, and make recommendations regarding the need for additional sampling or mitigation activities. The analytical results will be validated by a third party and the validation will be included within the letter report being submitted to the USEPA. A copy of the applicable USEPA Regional Screening Levels (shortened to be Site specific) is provided as **Attachment C** and a copy of the IDEM Vapor Remedy Selection Guidance Document is provided as **Attachment D**.

Contingency Plan

As noted, the analytical results will be evaluated against the IDEM Vapor Remedy Selection and Implementation Guidance Document, which provides guidance with respect to when additional sampling and/or mitigation activities should be implemented. If the initial sampling results indicate additional sampling is required, IWM Consulting and Amphenol will work closely with the USEPA in order to gain approval of a subsequent Work Plan (if required) and then schedule the subsequent sampling activities at an appropriate time.

If the initial sampling results confirm that the potential vapor intrusion pathway is complete, IWM Consulting and Amphenol will work closely with the USEPA in order to expeditiously develop and implement a vapor mitigation plan. The mitigation activities may include one or more the following activities: ventilating the Residence, sealing large cracks in the foundation or walls of the basement/crawlspace, installing Dranjer plugs within any floor drains, sealing any sump pits (if present), pressure testing the Residence's sewer lines and sealing any leaks (if detected), temporarily installing portable air scrubber(s), installation of an active vapor mitigation system (combination sub-slab depressurization beneath the basement and a sub-membrane depressurization system in the crawlspace), and/or temporarily evacuating the Residence.

IWM Consulting will implement the proposed work activities as quickly as possible upon receiving USEPA approval of this Work Plan. Please do not hesitate to contact the undersigned with questions or if you need additional information regarding this submittal.

Sincerely,

IWM CONSULTING GROUP, LLC

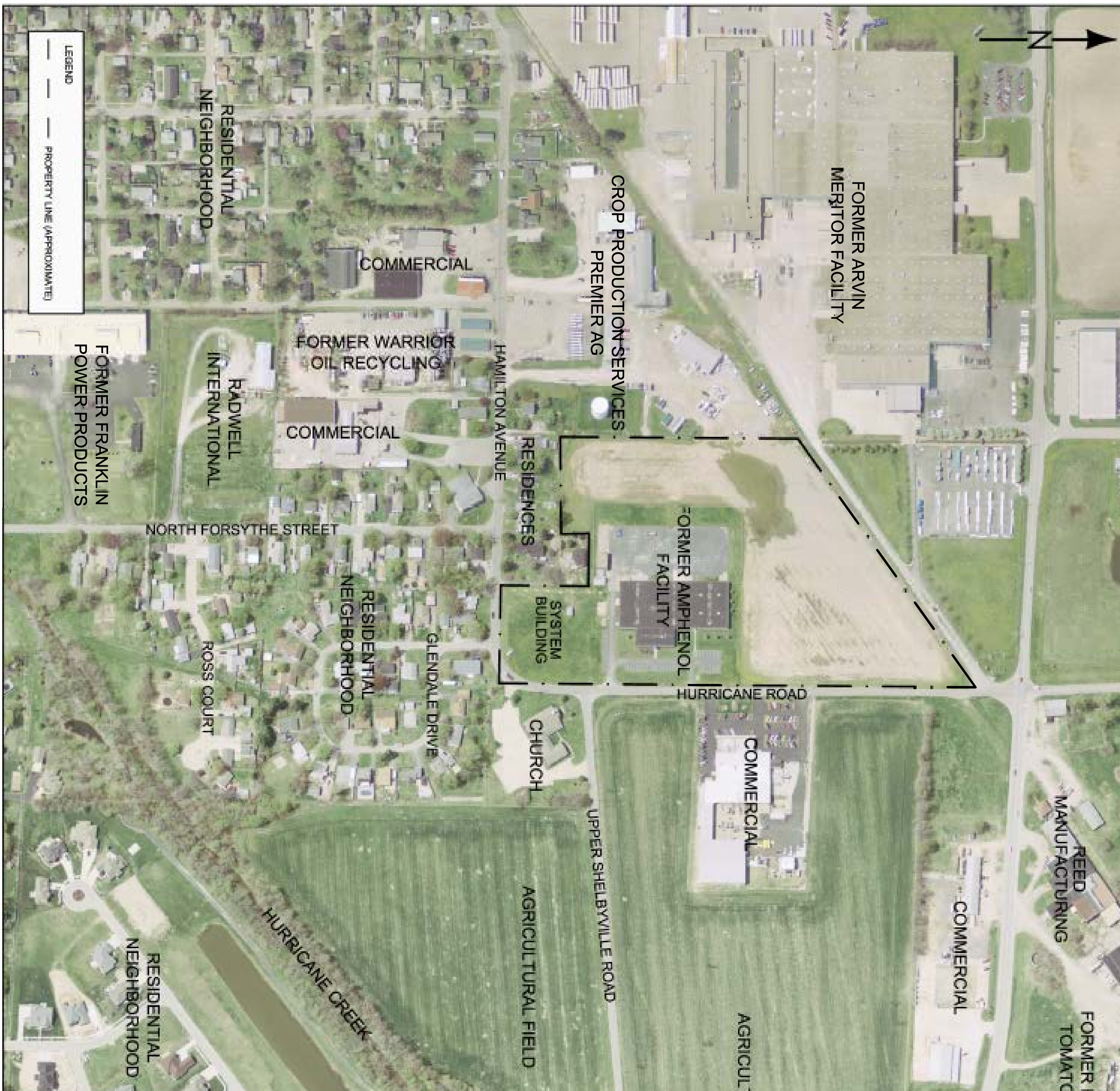
Bradley E. Gentry, LPG #2165
Vice President/Brownfield Coordinator

Gregory S. Scarpone, LPG #2030
Vice President Environmental Services

cc: Mr. Joseph Bianchi, Amphenol (electronic only)
Bhooma Sundar, U.S. EPA Region 5, RRB CAS2 (electronic only)

Attachments

Figures



0' 300' SCALE IN FEET	DRAWN BY: L. STRUM DATE: 9/27/99 REVISED: 07/24/2018 HWPA #111291-01 DWG. NO. 111291S1	FIGURE 1 SITE VICINITY MAP	FORMER AMPHENOL RFI/CMS 980 HURRICANE ROAD FRANKLIN, INDIANA	IWM CONSULTING GROUP

[redacted]

0' 50' SCALE IN FEET	DATE: 9/27/99 REVISED: 08/22/2018 HWPA #111291-01 DWG. NO. 111291S1	FIGURE 2 PROPOSED RESIDENTIAL SAMPLING MAP	FORMER AMPHENOL RFI/CMS 980 HURRICANE ROAD FRANKLIN, INDIANA

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Attachments

Attachment A

IWM Consulting SOPs

SOP Group A
Standard Operating Procedures
For Outside Ambient Air Sampling Activities

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SOP Group A
Standard Operating Procedures
For Outside Ambient Air Sampling Activities

Introduction

This standard operating procedure (SOP) sets forth the criteria and guidelines used to obtain outside ambient air samples for analysis of volatile organic compounds (VOCs). All air samples will be collected using summa canister sampling kits provided by the contract laboratory.

When evaluating the vapor intrusion exposure pathway, it is important to also obtain a minimum of one (1) outside ambient air (AA) sample within the project area being investigated if crawlspace (CS) or indoor air (IA) samples are being collected. Collection and analysis of the outside ambient air sample(s) will allow for a determination to be made regarding the potential for outside ambient air to be contributing VOC contaminants into the structure being evaluated. Outside ambient air samples will also provide information relating to identification of any potential offsite sources of airborne VOCs. The direction and speed of the wind should be recorded during the sampling event and outside ambient air samples are typically located on the upwind side of the property, if feasible.

SOP A.1 Outside Ambient Air Sampling

The AA sample(s) will be submitted to the contract laboratory for TO-15 laboratory analysis. **The recommended sample container is a 6-liter summa canister equipped with a flow regulator calibrated to a sampling rate of 4.67 or 12.5 milliliters per minute (mL/minute). This will equate to a total sampling time of 24-hours and 8 hours, respectively and the length of time for sampling should correspond with the length of sampling for the associated CS and/or IA samples, if applicable. If the sampling is not being conducted simultaneously with CS or IA samples, then review the site-specific Sampling and Analysis Plan (SAP) in order to identify the project goals and the appropriate sampling period.** The sampling and screening procedures shall include the following:

1. Placement of one (1) outside ambient air sample located in the upwind direction of the property (if feasible). Typically, one (1) sample is sufficient for evaluation purposes but for larger facilities or project areas, more than one (1) sample may be required, including areas that are downwind. Please review the site-specific SAP prior to finalizing the number and location of the outside ambient air samples.

2. The contract laboratory will provide either a batch or individually certified clean (depending upon the site-specific requirements) summa canister sampling kit for each sampling location which will include a 6-liter summa canister (or 1-liter if

the site-specific SAP specifies differently), sampling inlet line (Teflon or Teflon lined) with fittings, moisture filter, and flow regulator (set for a 24-hour or 8-hour sampling period). The summa canisters and flow regulators will be tagged with matching serial numbers provided by the laboratory.

3. Each summa canister will be placed in a predetermined location and the inlet of the summa canister will coincide with the typical breathing zone (generally 4 to 6 feet above ground surface) or the height established in the site-specific SAP. Laboratory provided stainless steel sampling canes, sample tubing, shepherd hooks, or other platforms can be utilized to assist in placing the intake of the summa canister at the appropriate sampling height.

4. Prior to initiating the sampling activities and utilizing the laboratory provided summa canisters, the vacuum of each summa canister should be checked via the "shut-in test" by opening the valve of the summa canister while the cap is still on the sampling port of the summa canister then closing the valve. The observed vacuum on the canister vacuum gauge should exhibit no change after 1 minute. If the observed vacuum changes, the cap, connection fittings, and/or regulator will be reseated, tightened, and retested. If subsequent testing exhibits further observed vacuum changes, the integrity of the summa canister is questionable, and the summa canister should not be utilized for the sampling activities. Additionally, the observed vacuum should be within 4-inches of mercury from the laboratory recorded vacuum prior to shipment from the laboratory. The laboratory will provide the user of the summa canisters the laboratory recorded vacuum for each canister and if there is >4-inches of mercury difference, the integrity of the summa canister is questionable, and the summa canister should not be utilized for the sampling activities.

5. Prior to initiating the sampling activities and utilizing the appropriate sampling train and sample tubing, a leak test of the sampling set-up should be performed. Attach the Nyaflow (or Teflon lined) tubing to the canister regulator with the provided Swagelok ferrules and attach a medium length piece of Tygon tubing to the Nyaflow tubing and to a hand-held vacuum pump with a pressure gauge and stopcock. Induce a vacuum of at least 15-inches of mercury on the sampling set-up with the stopcock open and then close the stopcock. The observed vacuum on the pressure gauge should exhibit no change after 1 minute. If the observed vacuum changes, tighten the Swagelok connection for the canister regulator and Nyaflow tubing and retest. If the observed vacuum does not change, the sampling set-up is considered tight and the Tygon tubing will be cut short for subsequent sampling. **Do not remove or adjust the remaining sampling train after the sampling train has been verified tight.**

6. Prior to sample collection, the appropriate information will be completed on the Air Sampling Field Data Sheet provided in **Appendix A**. The canister will be equipped with a pre-determined time flow regulator. The summa canister and flow regulator will be opened and the pressure differential will cause the air sample to enter the canister at the pre-determined flow rate. The sampling activities are complete when the vacuum on the summa canister is between 3 and 5-inches of mercury or the pre-determined timeframe is reached, whichever occurs first. Care should be taken as to not allow the vacuum to reach zero.

7. Upon completion of the sampling time, the flow regulator will be shut off and the appropriate information will be recorded on the Air Sampling Field Data Form. Remove the sampling train from the summa canister, tightly secure the cap on the summa canister, and ship the sampling kit back to the contract laboratory following typical chain of custody protocols. Confirm that the summa canister and flow regulator serial numbers all match prior to delivery to the laboratory.

8. Be certain to record the initial and final canister pressures, start and stop times for canister filling, and appropriate canister pressure checks during sampling.

Appendix A

Air Sampling Field Data Sheet

Air Sampling Data Sheet

VI Sampling Event Date: ________________________ **Weather Conditions:** ________________________

Project: ________________________ **Building HVAC Status:** ________________________

Building Site Address: ________________________ **Sampling Personnel:** ________________________

Sample ID	Sampling Location	Sampling Time		Vacuum (in Hg)		Canister Details	
		Start		Initial		Canister ID #	
		End		Final		Flow Controller #	

Canister Pressure Check

Time							
Vacuum (in Hg)							

Sample Type: Soil-Gas ____ Sub-Slab ____ Indoor ____ Ambient ____ Other ____ **Timeframe:** 24-Hr ____ 8-Hr ____ Grab ____ **Canister Type:** 6L Summa ____ 1L Summa ____ Other ____________

Notes: ________________________ **Sample Height / Depth (ft.):** ____________ **Analytical Method:** TO-15 ____ TO-15 SIM ____ Shortlist ____________

Sample ID	Sampling Location	Sampling Time		Vacuum (in Hg)		Canister Details	
		Start		Initial		Canister ID #	
		End		Final		Flow Controller #	

Canister Pressure Check

Time							
Vacuum (in Hg)							

Sample Type: Soil-Gas ____ Sub-Slab ____ Indoor ____ Ambient ____ Other ____ **Timeframe:** 24-Hr ____ 8-Hr ____ Grab ____ **Canister Type:** 6L Summa ____ 1L Summa ____ Other ____________

Notes: ________________________ **Sample Height / Depth (ft.):** ____________ **Analytical Method:** TO-15 ____ TO-15 SIM ____ Shortlist ____________

Sample ID	Sampling Location	Sampling Time		Vacuum (in Hg)		Canister Details	
		Start		Initial		Canister ID #	
		End		Final		Flow Controller #	

Canister Pressure Check

Time							
Vacuum (in Hg)							

Sample Type: Soil-Gas ____ Sub-Slab ____ Indoor ____ Ambient ____ Other ____ **Timeframe:** 24-Hr ____ 8-Hr ____ Grab ____ **Canister Type:** 6L Summa ____ 1L Summa ____ Other ____________

Notes: ________________________ **Sample Height / Depth (ft.):** ____________ **Analytical Method:** TO-15 ____ TO-15 SIM ____ Shortlist ____________

SOP Group B
Standard Operating Procedures
For Sub-slab, Crawl Space, & Indoor Air Sampling

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SOP Group B
Standard Operating Procedures
For Sub-Slab, Exterior Soil Gas, Crawl Space, & Indoor Air Sampling

Introduction

This standard operating procedure (SOP) sets forth the criteria and guidelines used to obtain volatile organic compound (VOC) vapor/air samples from the following locations: sub-slab soil gas samples from fill material directly beneath the slab of enclosed structures (sub-slab samples); air samples obtained from the crawl space (crawl space air samples); and air samples obtained from the breathing zone of enclosed structures (indoor air samples). All vapor/air samples will be collected using summa canister sampling kits provided by the contract laboratory.

When evaluating the vapor intrusion exposure pathway, potential sampling methods and locations include sub-slab soil gas sampling (SGss) and indoor air sampling (IA). These sampling activities can be completely concurrently or independently, depending upon the approved scope of work. If the structure is constructed on a crawl space instead of a slab or has a combination partial basement and crawlspace, then indoor air samples should also be obtained from the crawl space (CSA). Sewer gas samples can also be obtained directly from the structures sewer lateral if further evaluation of this potential preferential pathway is warranted. The least preferred method is exterior soil gas sampling (SGe), which is typically only done if access to the interior of the structure is not possible of if the site is classified as a “low risk” site during the initial site evaluation process. When performing these sampling activities under the direction of a regulatory agency, the sampling methods and locations should be discussed and approved by the regulatory project manager prior to implementing the work activities.

In general, 1-liter stainless steel summa canisters are utilized when obtaining grab SGss or sewer gas samples and 6-liter stainless steel summa canisters are utilized when obtained samples over extended periods of time (between 8 and 24-hours). The grab samples are typically obtained over a 5-minute period of time. Indoor air samples obtained from a commercial/industrial structure are typically obtained over an 8-hour timeframe and indoor air samples obtained from residential structures are obtained over a 24-hour timeframe.

When completing indoor air sampling, it is recommended that the Indoor Air Sampling Survey Checklist provided in **Appendix A** is completed in order to evaluate for potential background contaminant sources. The Air Sampling Field Data Sheet provided in **Appendix B** should also be completed when conducting the sampling activities.

SOP B.1 Sub-Slab Soil Gas Sampling

SGss samples will be submitted to the contract laboratory for TO-15 laboratory analysis. **If obtaining grab SGss samples, the recommended sample containers are either 1-liter or 6-liter summa canisters equipped with a flow regulator calibrated to a sampling rate ranging between 100 to 200 milliliters per minute (mL/minute). If conducting paired sampling with indoor air sampling activities, the sampling rates will need to be adjusted accordingly for 8-hour (~12.5 mL/minute) or 24-hour (4.16 mL/minute) events, assuming you are utilizing a 6-liter summa canister and that the paired SGss and IA samples need to have the same sampling duration.** The sampling and screening procedures shall include the following: The sampling and screening procedures shall include the following:

1. One (1) centrally (if feasible) located sub-slab point is typically sufficient for residential homes. Three (3) points are recommended for commercial/industrial structures with a footprint of 5,000-square feet, with one (1) additional point for every 2,000-square feet. Alternative sampling plans and points can be developed if site conditions warrant a variance from the recommended sampling plan layout. The sub-slab vapor sampling points will be installed following the protocols established in Cox-Colvin & Associates, Inc. SOP for Installation and Extraction of the Vapor Pin™. Copies of the Vapor Pin™ Installation and Extraction SOP and the IWM Consulting Sub-Slab Installation Datasheet are provided in **Appendix C**. A mechanical leak test should also be performed at each Vapor Pin™ sampling point to ensure the integrity of the sampling train and sampling point. The leak test should be performed in general accordance with the Leak Testing Vapor Pin™ Via Mechanical Means SOP, which is provided in **Appendix D**.

2. If paired SGss and IA sampling will be performed, IWM Consulting may need to complete the pre-sampling indoor air building survey with a representative of the enclosed structure to be sampled prior to initiating the paired SGss & IA sampling activities. The survey can help identify potential background contaminant sources, should be completed 48-hours prior to the sampling event (if feasible), and any identified potential background sources should be removed (if feasible) a minimum of 24-hours prior to initiating the sampling activities. A copy of each indoor air building survey checklist form is provided in **Appendix A**. Completing this checklist is not required if conducting only standalone SGss sampling activities.

3. The contract laboratory will provide certified clean summa canister sampling kits which will include a 1-liter or 6-liter summa canister, sampling inlet line with fittings, filter, and flow regulator (set for approximately five minutes for 1-liter canisters or thirty minutes for 6-liter canisters). If paired SGss and IA samples are being obtained, a 24-hour flow regulator (Residential) or 8-hour (Commercial/Industrial) flow regulator and a 6-liter summa canister can be

utilized during the sampling activities. The summa canisters and flow regulators will be tagged with matching serial numbers provided by the laboratory.

4. Prior to initiating the sampling activities and utilizing the laboratory provided summa canisters, the vacuum of each summa canister should be checked via the "shut-in test" by opening the valve of the summa canister while the cap is still on the sampling port of the summa canister then closing the valve. The observed vacuum on the canister vacuum gauge should exhibit no change after 1 minute. If the observed vacuum changes, the cap, connection fittings, and/or regulator will be reseated, tightened, and retested. If subsequent testing exhibits further observed vacuum changes, the integrity of the summa canister is questionable, and the summa canister should not be utilized for the sampling activities. Additionally, the observed vacuum should be within 4-inches of mercury from the laboratory recorded vacuum prior to shipment from the laboratory. The laboratory will provide the user of the summa canisters the laboratory recorded vacuum for each canister and if there is >4-inches of mercury difference, the integrity of the summa canister is questionable, and the summa canister should not be utilized for the sampling activities.

5. Prior to initiating the sampling activities and utilizing the appropriate sampling train and sample tubing, a leak test of the sampling set-up should be performed. Attach the Nyaflow (or Teflon lined) tubing to the canister regulator with the provided Swagelok ferrules and attach a medium length piece of Tygon tubing to the Nyaflow tubing and to a hand-held vacuum pump with a pressure gauge and stopcock. Induce a vacuum of at least 15-inches of mercury on the sampling set-up with the stopcock open and then close the stopcock. The observed vacuum on the pressure gauge should exhibit no change after 1 minute. If the observed vacuum changes, tighten the Swagelok connection for the canister regulator and Nyaflow tubing and retest. If the observed vacuum does not change, the sampling set-up is considered tight and the Tygon tubing will be cut short for subsequent sampling. **Do not remove or adjust the remaining sampling train after the sampling train has been verified tight.**

6. Prior to initiating the sample collection phase of the sampling event, approximately three (3) times the "dead volume" of air within the sampling point and sampling tubing should be slowly (equal to or less than 100 to 200 mL/minute) purged from each sampling point. The air can be purged using an SKC Aircheck sampler set at a rate of 0.1 liters per minute, an RKI GX-6000 multi-gas photo-ionization detector (PID) monitor (or equivalent), or from a graduated syringe. The purged air will be removed from each sampling point and temporarily discharged into a 1 or 2-liter tedlar bag if it is being purged with an SKC Aircheck sampling pump or RKI GX-6000 multi-gas PID monitor. The purged soil gas removed with the graduated syringe should remain containerized within the syringe until it is removed from the structure. The purged air (either from the syringe or tedlar bags) should then be released to the atmosphere once outside the structure, preferably in a downwind location from the structure.

Measure and record the purge rates and volumes. Measure and record the lower explosive limit (LEL) and O_2 if using the RKI GX-6000 multi-gas PID monitor.

7. Prior to sample collection the appropriate information will be completed on the Air Sampling Field Data Sheet provided in **Appendix B**. The canister will be equipped with a pre-determined time flow regulator and connected to the sampling point via a short piece of Tygon tubing and Nyaflow tubing. The summa canister and flow regulator will be opened and the pressure differential will cause the air sample to enter the canister at the pre-determined flow rate. The vacuum applied by the summa canister during the sampling events should be as low as possible. The sampling activities are complete when the vacuum on the summa canister is between 3 and 5-inches of mercury or the pre-determined timeframe is reached, whichever occurs first. Care should be taken as to not allow the vacuum to reach zero.

8. Upon completion of the sampling time, shut off the flow regulator and record the appropriate information on the Air Sampling Field Data Form. Remove the sampling train from the summa canister, tightly secure the cap on the summa canister, and ship the sampling kit back to the contract laboratory following typical chain of custody protocols. Confirm that the summa canister and flow regulator serial numbers all match prior to delivery to the laboratory.

9. Be certain to record the initial and final canister pressures, start and stop times for canister filling, and appropriate canister pressure checks during sampling.

SOP B.3 Crawl Space Air Sampling

CSA samples will be submitted to the contract laboratory for TO-15 laboratory analysis. **The recommended sample container is a 6-liter summa canister equipped with a flow regulator calibrated to a 24-hour sampling period for residential structures and an 8-hour sampling period for commercial/industrial structures. However, alternative sampling intervals may be necessary if the commercial/industrial workers work alternative shifts (i.e. 12-hour shifts).** The sampling and screening procedures shall include the following:

1. Prior to initiating the CSA sampling activities, IWM Consulting should complete the pre-sampling indoor air building survey with a representative of the enclosed structure to be sampled prior to initiating the CSA sampling activities. The survey can help identify potential background contaminant sources, should be completed 48-hours prior to the sampling event (if feasible), and any identified potential background sources should be removed (if feasible) a minimum of 24-hours prior to initiating the sampling activities. The occupants will also be asked to refrain from opening windows, leaving doors open, running whole-house fans, etc., so that the sampling event simulates worst-case conditions. A copy of each indoor air building survey checklist form is provided in **Appendix A**.

2. One (1) centrally (if feasible) located CSA sampling point is typically sufficient for residential homes. Crawl spaces are not typically within commercial/ industrial structures but if this situation arises, additional sampling points may be required. One (1) ambient air (AA) background sample should also be obtained during the sampling event in order to determine if an AA background source is present which may bias the CSA sample results high, thus falsely suggesting that a vapor intrusion condition exists.

3. The contract laboratory will provide certified clean summa canister sampling kits which will include a 6-liter summa canister, sampling inlet line with fittings, filter, and flow regulator (set for a 24-hour or 8-hour sampling period). The summa canisters and flow regulators will be tagged with matching serial numbers provided by the laboratory.

4. The summa canister will be placed in a secured location of the crawl space and at the approximate midpoint elevation of the crawl space (generally 12 inches in height).

5. Prior to initiating the sampling activities and utilizing the laboratory provided summa canisters, the vacuum of each summa canister should be checked via the "shut-in test" by opening the valve of the summa canister while the cap is still on the sampling port of the summa canister then closing the valve. The observed vacuum on the canister vacuum gauge should exhibit no change after 1 minute. If the observed vacuum changes, the cap, connection fittings, and/or regulator will be reseated, tightened, and retested. If subsequent testing exhibits further observed vacuum changes, the integrity of the summa canister is questionable, and the summa canister should not be utilized for the sampling activities. Additionally, the observed vacuum should be within 4-inches of mercury from the laboratory recorded vacuum prior to shipment from the laboratory. The laboratory will provide the user of the summa canisters the laboratory recorded vacuum for each canister and if there is >4-inches of mercury difference, the integrity of the summa canister is questionable, and the summa canister should not be utilized for the sampling activities.

6. Prior to initiating the sampling activities and utilizing the appropriate sampling train and sample tubing (if applicable), a leak test of the sampling set-up should be performed. Attach the Nyaflow (or Teflon lined) tubing or sampling cane (if either are applicable for the sampling activities), to the canister regulator with the provided Swagelok ferrules and attach a medium length piece of Tygon tubing to the Nyaflow tubing and to a hand-held vacuum pump with a pressure gauge and stopcock. Induce a vacuum of at least 15-inches of mercury on the sampling set-up with the stopcock open and then close the stopcock. The observed vacuum on the pressure gauge should exhibit no change after 1 minute. If the observed vacuum changes, tighten the Swagelok connection for the canister regulator and

Nyaflow tubing and retest. If the observed vacuum does not change, the sampling set-up is considered tight and the Tygon tubing will be cut short for subsequent sampling. **Do not remove or adjust the remaining sampling train after the sampling train has been verified tight. This step is NOT necessary if no additional sampling train (i.e. Nyaflow or Teflon tubing or a stainless-steel sampling cane) is required to complete the CSA sampling activities.**

7. Prior to sample collection the appropriate information will be completed on the Air Sampling Field Data Sheet provided in **Appendix B**. The canister will be equipped with a pre-determined time flow regulator. The summa canister and flow regulator will be opened and the pressure differential will cause the air sample to enter the canister at the pre-determined flow rate. The sampling activities are complete when the vacuum on the summa canister is between 3 and 5-inches of mercury or the pre-determined timeframe is reached, whichever occurs first. Care should be taken as to not allow the vacuum to reach zero.

8. Upon completion of the sampling time, shut off the flow regulator and record the appropriate information on the Air Sampling Field Data Form. Remove the sampling suite/train from the summa canister, tightly secure the cap on the summa canister, and ship the sampling kit back to the contract laboratory following typical chain of custody protocols. Confirm that the summa canister and flow regulator serial numbers all match prior to delivery to the laboratory.

9. Be certain to record the initial and final canister pressures, start and stop times for canister filling, and appropriate canister pressure checks during sampling.

SOP B.3 Indoor Air Sampling

IA samples will be submitted to the contract laboratory for TO-15 laboratory analysis. **The recommended sample container is a 6-liter summa canister equipped with a flow regulator calibrated to a 24-hour sampling period for residential structures and an 8-hour sampling period for commercial/industrial structures. However, alternative sampling intervals may be necessary if the commercial/industrial workers work alternative shifts (i.e. 12-hour shifts).** The sampling and screening procedures shall include the following:

1. Prior to initiating air sampling activities, IWM Consulting will complete the pre-sampling indoor air building survey with a representative of enclosed structure to be sampled. The survey can help identify potential background contaminant sources, should be completed 48-hours prior to the sampling event (if feasible), and any identified potential background sources should be removed (if feasible) a minimum of 24-hours prior to initiating the sampling activities. The occupants will also be asked to refrain from opening windows, leaving doors open, running whole-house fans, etc., so that the sampling event simulates worst-case conditions. A copy of each indoor air building survey checklist form is provided in **Appendix A**.

2. The exact number and location of the IA samples can vary from project to project and the sampling locations for each project should be identified in the site-specific Sampling and Analysis Plan or Work Plan. However, as previously discussed, if IA samples are being obtained, outside AA samples should also be obtained in order to determine if an outside source of VOCs is present during the sampling event.

3. The contract laboratory will provide certified clean summa canister sampling kits which will include a 6-liter summa canister, sampling inlet line or sampling canes with fittings, and a flow regulator (set for a 24-hour or 8-hour sampling period). The summa canisters and flow regulators will be tagged with matching serial numbers provided by the laboratory.

4. The summa canister will be placed in a secured location of the building at the approximate height of the typical breathing zone (generally 3 to 5 feet) of a person. Laboratory provided stainless steel sampling canes or other platforms can be utilized to assist in placing the intake of the summa canister at the appropriate sampling height.

5. Prior to initiating the sampling activities and utilizing the laboratory provided summa canisters, the vacuum of each summa canister should be checked via the "shut-in test" by opening the valve of the summa canister while the cap is still on the sampling port of the summa canister then closing the valve. The observed vacuum on the canister vacuum gauge should exhibit no change after 1 minute. If the observed vacuum changes, the cap, connection fittings, and/or regulator will be reseated, tightened, and retested. If subsequent testing exhibits further observed vacuum changes, the integrity of the summa canister is questionable, and the summa canister should not be utilized for the sampling activities. Additionally, the observed vacuum should be within 4-inches of mercury from the laboratory recorded vacuum prior to shipment from the laboratory. The laboratory will provide the user of the summa canisters the laboratory recorded vacuum for each canister and if there is >4-inches of mercury difference, the integrity of the summa canister is questionable, and the summa canister should not be utilized for the sampling activities.

6. Prior to initiating the sampling activities and utilizing the appropriate sampling train and sample tubing, a leak test of the sampling set-up should be performed. Attach the Nyaflow (or Teflon lined) tubing or sampling stainless-steel cane to the canister regulator with the provided Swagelok ferrules and attach a medium length piece of Tygon tubing to the Nyaflow tubing/sampling cane and to a hand-held vacuum pump with a pressure gauge and stopcock. Induce a vacuum of at least 15-inches of mercury on the sampling set-up with the stopcock open and then close the stopcock. The observed vacuum on the pressure gauge should exhibit no change after 1 minute. If the observed vacuum changes, tighten the

Swagelok connection for the canister regulator and Nyaflow tubing/sampling cane and retest. If the observed vacuum does not change, the sampling set-up is considered tight and the Tygon tubing will be cut short for subsequent sampling. **Do not remove or adjust the remaining sampling train after the sampling train has been verified tight.**

7. Prior to sample collection the appropriate information will be completed on the Air Sampling Field Data Sheet provided in **Appendix B**. The canister will be equipped with a pre-determined time flow regulator. The summa canister and flow regulator will be opened and the pressure differential will cause the air sample to enter the canister at the pre-determined flow rate. The sampling activities are complete when the vacuum on the summa canister is between 3 and 5-inches of mercury or the pre-determined timeframe is reached, whichever occurs first. Care should be taken as to not allow the vacuum to reach zero.

8. Upon completion of the sampling time, shut off the flow regulator and record the appropriate information on the Air Sampling Field Data Form. Remove the sampling suite/train from the summa canister, tightly secure the cap on the summa canister, and ship the sampling kit back to the contract laboratory following typical chain of custody protocols. Confirm that the summa canister and flow regulator serial numbers all match prior to delivery to the laboratory.

9. Be certain to record the initial and final canister pressures, start and stop times for canister filling, and appropriate canister pressure checks during sampling.

Appendix A - Indoor Air Sampling Survey Checklist

INDOOR AIR BUILDING SURVEY CHECKLIST

Preparer's Name: ______________________ Date: __________________________

Preparer's Affiliation: __________________ Phone #: ________________________

Site Name: ____________________________ Site #: _________________________

Site Address (include city and zip): ____

Part I – Occupants

List of Current Occupants/Occupation (include children)

Name (Age)	Address: (Lot # or apt. #)	Sex (M/F)	Occupation

Person Interviewed: ____________________ Phone #: ________________________

Owner (if different): ___________________ Phone #: ________________________

Sensitive population: *day care / nursing home / hospital / school / other (specify):* ______

Number of occupied floors: _____________

Part II – Building Characteristics

Building type: *residential / commercial / industrial / other* Year constructed: ________

Describe building: ____

Describe business (if commercial/industrial): ____________________________________

Number of floors below grade: ___________ (*full basement / crawl space / slab on grade*)

Depth of basement below grade surface: _____ft. Basement size: _____ft^2

Basement floor construction: *concrete / dirt / slab / stone / other (specify):*____________

Foundation walls: *poured concrete / cinder blocks / stone / other (specify):*____________

Basement sump present? *Yes / No* Sump pump? *Yes / No* Water in sump? *Yes / No*

Significant cracks present in basement floor? *Yes / No*

Significant cracks present in basement walls? *Yes / No*

Floor drains present? *Yes / No* If so, describe: ____________________________

Pipes/utilities present? *Yes / No* If so, describe: ____________________________

Are the basement walls or floor sealed with waterproof paint or epoxy coatings? *Yes / No*

Is the basement finished? *Yes / No* Is the basement used as living space? *Yes / No*

Does the lowest floor or basement exhibit wetness during rainfall events? *Yes / No*

Does the building envelope (window and doorframes) appear airtight? *Yes / No*

If not, describe: ____

Is there a whole house fan? *Yes / No*

Septic system? *Yes / Yes (but not used) / No*

Irrigation / private well? *Yes / Yes (but not used) / No*

Type of ground cover outside of building: *grass / concrete / asphalt /*
*other (specify):*____

Sub-slab vapor/moisture barrier in place? *Yes / No / Unknown*
Type of barrier: ___________________________________

Type of heating system (circle all that apply):
hot air circulation *hot air radiation* *wood* *steam radiation*
heat pump *hot water radiation* *kerosene heater* *electric baseboard*
other (specify): ___________________________________

Type of ventilation system (circle all that apply):

central air conditioning *mechanical fans* *bathroom ventilation fans*
individual air conditioning units *kitchen range hood fan* *outside air intake*

Type of fuel utilized (circle all that apply):

Natural gas / electric / fuel oil / wood / coal / solar / kerosene /
other (specify): ___________________________________

Type of water heater (circle all that apply):

Natural gas / electric / other (specify): _________________

Part III – Outside Contaminant Sources

Other stationary sources nearby (neighboring automobile servicing, gas stations, emission stacks, etc.): ____

____

Heavy vehicular traffic nearby (or other mobile services): __________________________

Part IV – Indoor Contaminant Sources

Identify all potential indoor sources found in the building (including attached garages), the location of the source (floor & room), and whether the item was removed from the building 48 hours prior to the indoor air sampling event. Any ventilation implemented after removal of the items should be completed at least 24 hours prior to the start of the indoor air sampling event.

Potential Sources	**Location(s)**	**Removed** (*Yes / No / N/A*)
Gasoline storage cans		
Gas-powered equipment (mowers, etc.)		
Kerosene storage cans		
Paints / thinners / strippers		
Cleaning solvents		
Oven cleaners		
Carpet / upholstery cleaners		
Other house cleaning products		
Moth balls		

Potential Sources	Location(s)	Removed (*Yes / No / N/A*)
Polishes / waxes		
Insecticides		
Furniture / floor remover		
Nail polish / polish remover		
Hairspray		
Cologne / perfume		
Air fresheners		
Fuel tank (inside building)		*N/A*
Wood stove or fireplace		*N/A*
New furniture / upholstery		
New carpeting / flooring		*N/A*
Hobbies–glues, paints, lacquers, photographic darkroom chemicals, etc.		
Scented trees, wreaths, potpourri, etc.		
Other (specify):		

Part V – Miscellaneous Items

Typical thermostat temperature (Winter): ________° F (Summer): ________° F

Are windows typically open? *Yes / No*

Are outside doors (or service bays) typically open? *Yes / No*

Have there been reports of odors? *Yes / No*

If yes, describe: ____

Has radon been detected in the structure? *Yes / No / N/A (not tested)*

Is a vapor/radon mitigation system installed? *Yes / No*

If so, is it operational? *Yes / No*

Do any occupants of the building smoke? *Yes / No* If so, how often? __________

Last time someone smoked in the building? ____________ *hours / days* ago

Does the building have an attached garage directly connected to the living space? *Yes / No*

If so, is a car usually parked in the garage? *Yes / No*

Are gas-powered equipment or cans of gasoline/fuels stored in the garage? *Yes / No*
Are automobile repair/service activities performed onsite? *Yes / No*

Do the occupants of the building have their clothes dry cleaned? *Yes / No*

If yes, how often? *weekly / monthly / 3-4 times a year*

When was the last dry cleaned garment brought home? ______________________

Do any of the occupants use solvents in work? *Yes / No*

If yes, what types of solvents are used? ___________________________________

If yes, are their clothes washed at work? *Yes / No*

Have any pesticides/herbicides been applied around the building or in the yard? *Yes / No*

If so, when and which chemicals? _______________________________________

Has there ever been a fire in the building? *Yes / No* If yes, when?__________

Has painting or staining been done in the building in the last 6 months? *Yes / No*

If yes, when? __________________ And where? _________________________

Part VI – Sampling Information

Company/Consultant: ________________________ Phone number: ( ) _____-_____

Sampling Source: *Indoor Air / Sub-Slab / Near Slab Soil Gas / Exterior Soil Gas*

Laboratory:____________________

Were occupants notified to keep the windows closed, not to leave exterior doors open, not to run the whole house fan, etc. during the sampling event? *Yes / No / N/A*

Were “Instructions for Occupants” followed? *Yes / No / N/A*

If not, describe modifications: ____

Part VII – Metrological Conditions

Was there significant precipitation within 12 hours prior to (or during) the sampling event?

Yes / No

Describe the general weather conditions: ____

____

____

Part VIII – General Observations

Provide any information that may be pertinent to the sampling event and may assist in the data interpretation process:

____

____

____

____

____

____

____

____

____

____

Provide Drawing of Sample Location(s) in Building

Appendix B - Air Sampling Field Data Sheet

Air Sampling Data Sheet

VI Sampling Event Date: ______________________________ **Weather Conditions:** ______________________________

Project: ______________________________ **Building HVAC Status:** ______________________________

Building Site Address: ______________________________ **Sampling Personnel:** ______________________________

Sample ID	Sampling Location	Sampling Time		Vacuum (in Hg)		Canister Details	
		Start		Initial		Canister ID #	
		End		Final		Flow Controller #	

Canister Pressure Check

Time							
Vacuum (in Hg)							

Sample Type: Soil-Gas ____ Sub-Slab ____ Indoor ____ Ambient ____ Other ____ **Timeframe:** 24-Hr ____ 8-Hr ____ Grab ____ **Canister Type:** 6L Summa ____ 1L Summa ____ Other ______________

Notes: ______________________________ **Sample Height / Depth (ft.):** ______________ **Analytical Method:** TO-15 ____ TO-15 SIM ____ Shortlist ______________________

Sample ID	Sampling Location	Sampling Time		Vacuum (in Hg)		Canister Details	
		Start		Initial		Canister ID #	
		End		Final		Flow Controller #	

Canister Pressure Check

Time							
Vacuum (in Hg)							

Sample Type: Soil-Gas ____ Sub-Slab ____ Indoor ____ Ambient ____ Other ____ **Timeframe:** 24-Hr ____ 8-Hr ____ Grab ____ **Canister Type:** 6L Summa ____ 1L Summa ____ Other ______________

Notes: ______________________________ **Sample Height / Depth (ft.):** ______________ **Analytical Method:** TO-15 ____ TO-15 SIM ____ Shortlist ______________________

Sample ID	Sampling Location	Sampling Time		Vacuum (in Hg)		Canister Details	
		Start		Initial		Canister ID #	
		End		Final		Flow Controller #	

Canister Pressure Check

Time							
Vacuum (in Hg)							

Sample Type: Soil-Gas ____ Sub-Slab ____ Indoor ____ Ambient ____ Other ____ **Timeframe:** 24-Hr ____ 8-Hr ____ Grab ____ **Canister Type:** 6L Summa ____ 1L Summa ____ Other ______________

Notes: ______________________________ **Sample Height / Depth (ft.):** ______________ **Analytical Method:** TO-15 ____ TO-15 SIM ____ Shortlist ______________________

Appendix C - Vapor Pin™ Installation and Extraction SOP &
IWM Consulting Sub-Slab Installation Datasheet

Standard Operating Procedure
Installation and Extraction of the Vapor Pin™

Updated April 3, 2015

Scope:

This standard operating procedure describes the installation and extraction of the Vapor Pin™ for use in sub-slab soil-gas sampling.

Purpose:

The purpose of this procedure is to assure good quality control in field operations and uniformity between field personnel in the use of the Vapor Pin™ for the collection of sub-slab soil-gas samples or pressure readings.

Equipment Needed:

- Assembled Vapor Pin™ [Vapor Pin™ and silicone sleeve(Figure 1)]; Because of sharp edges, gloves are recommended for sleeve installation;
- Hammer drill;
- 5/8-inch (16mm) diameter hammer bit (hole **must** be 5/8-inch (16mm) diameter to ensure seal. It is recommended that you use the drill guide). (Hilti™ TE-YX 5/8” x 22” (400 mm) #00206514 or equivalent);
- 1½-inch (38mm) diameter hammer bit (Hilti™ TE-YX 1½” x 23” #00293032 or equivalent) for flush mount applications;
- ¾-inch (19mm) diameter bottle brush;
- Wet/Dry vacuum with HEPA filter (optional);
- Vapor Pin™ installation/extraction tool;
- Dead blow hammer;
- Vapor Pin™ flush mount cover, if desired;
- Vapor Pin™ drilling guide, if desired;
- Vapor Pin™ protective cap; and
- VOC-free hole patching material (hydraulic cement) and putty knife or trowel for repairing the hole following the extraction of the Vapor Pin™.

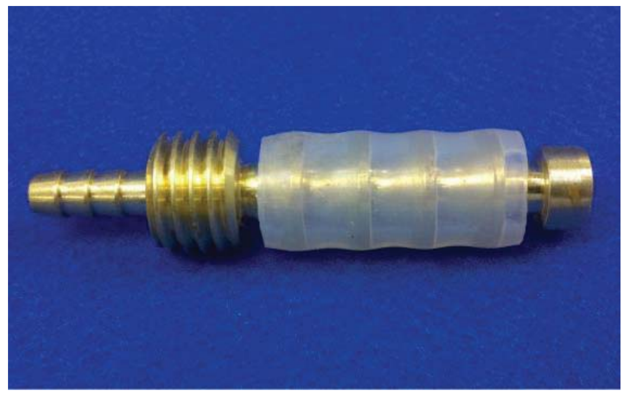

Figure 1. Assembled Vapor Pin™

Installation Procedure:

1) Check for buried obstacles (pipes, electrical lines, etc.) prior to proceeding.

2) Set up wet/dry vacuum to collect drill cuttings.

3) If a flush mount installation is required, drill a 1½-inch (38mm) diameter hole at least 1¾-inches (45mm) into the slab. Use of a Vapor Pin™ drilling guide is recommended.

4) Drill a 5/8-inch (16mm) diameter hole through the slab and approximately 1-inch (25mm) into the underlying soil to form a void. Hole **must** be 5/8-inch (16mm) in diameter to ensure seal. It is recommended that you use the drill guide.

5) Remove the drill bit, brush the hole with the bottle brush, and remove the loose cuttings with the vacuum.

6) Place the lower end of Vapor Pin™ assembly into the drilled hole. Place the small hole located in the handle of the installation/extraction tool over the Vapor Pin™ to protect the barb fitting, and tap the Vapor Pin™ into place using a dead blow hammer (Figure 2). Make sure the installation/extraction tool is aligned parallel to the Vapor Pin™ to avoid damaging the barb fitting.

Figure 2. Installing the Vapor Pin™.

During installation, the silicone sleeve will form a slight bulge between the slab and the Vapor Pin™ shoulder. Place the protective cap on Vapor Pin™ to prevent vapor loss prior to sampling (Figure 3).

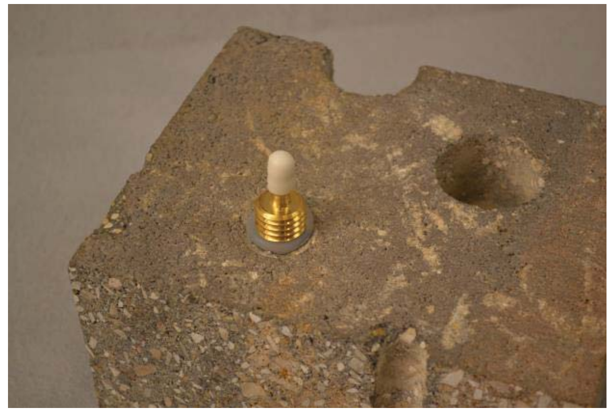

Figure 3. Installed Vapor Pin™

7) For flush mount installations, cover the Vapor Pin™ with a flush mount cover, using either the plastic cover or the optional stainless-steel Secure Cover (Figure 4).

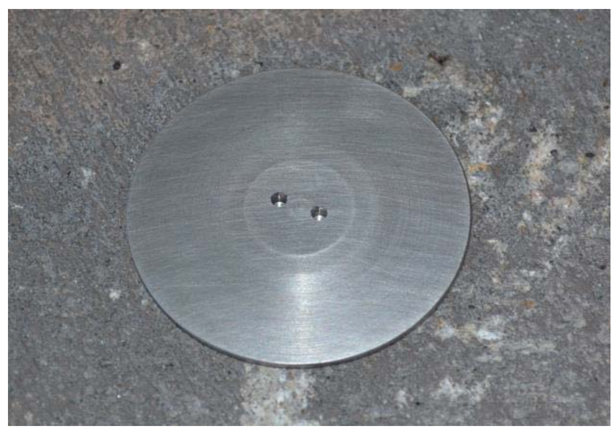

Figure 4. Secure Cover Installed

8) Allow 20 minutes or more (consult applicable guidance for your situation) for the sub-slab soil-gas conditions to re-equilibrate prior to sampling.

9) Remove protective cap and connect sample tubing to the barb fitting of the Vapor Pin™. This connection can be made using a short piece of Tygon™ tubing to join the Vapor Pin™ with the Nylaflow

tubing (Figure 5). Put the Nylaflow tubing as close to the Vapor Pin as possible to minimize contact between soil gas and Tygon™ tubing.

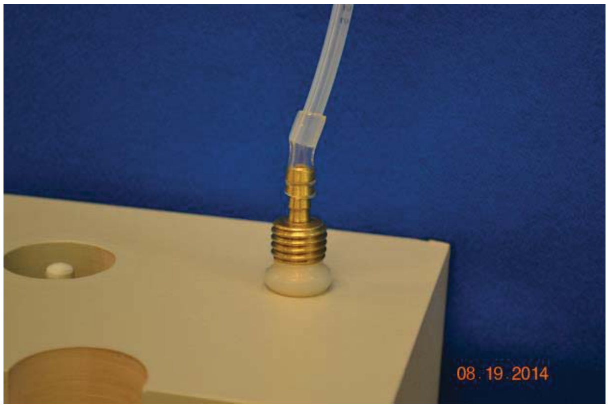

Figure 5. Vapor Pin™ sample connection.

10) Conduct leak tests in accordance with applicable guidance. If the method of leak testing is not specified, an alternative can be the use of a water dam and vacuum pump, as described in SOP Leak Testing the Vapor Pin™ via Mechanical Means (Figure 6). For flush-mount installations, distilled water can be poured directly into the 1 1/2 inch (38mm) hole.

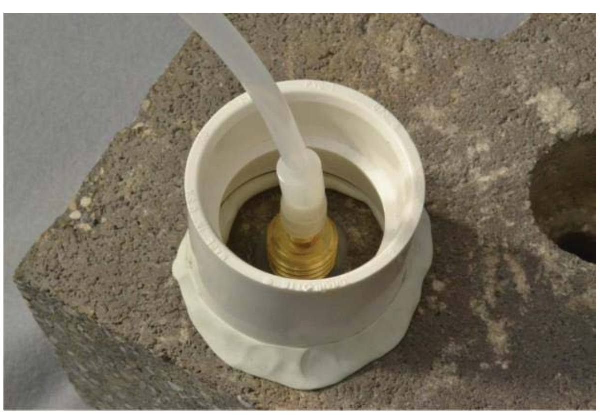

Figure 6. Water dam used for leak detection

11) Collect sub-slab soil gas sample or pressure reading. When finished, replace the protective cap and flush mount cover until the next event. If the sampling is complete, extract the Vapor Pin™.

<u>Extraction Procedure:</u>

1) Remove the protective cap, and thread the installation/extraction tool onto the barrel of the Vapor Pin™ (Figure 7). Continue turning the tool clockwise to pull the Vapor Pin™ from the hole into the installation/extraction tool.

2) Fill the void with hydraulic cement and smooth with a trowel or putty knife.

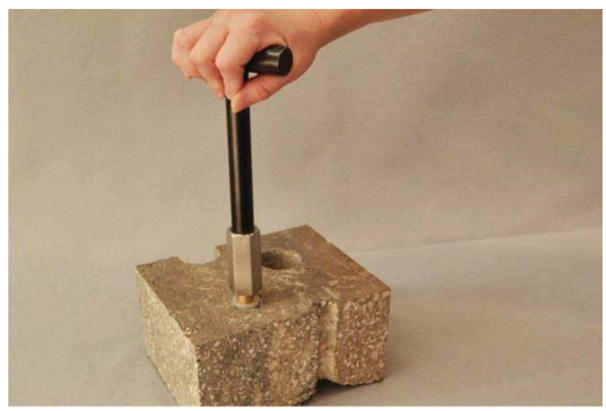

Figure 7. Removing the Vapor Pin™.

3) Prior to reuse, remove the silicone sleeve and protective cap and discard. Decontaminate the Vapor Pin™ in a hot water and Alconox® wash, then heat in an oven to a temperature of 265° F (130° C) for 15 to 30 minutes.

The Vapor Pin™ to designed be used repeatedly, however, replacement parts and supplies will be required periodically. These parts are available on-line at VaporPin.CoxColvin.com.

Sub-Slab Installation Data Sheet

Sub-slab Vapor Point Installation Date: ______________________

Project: ______________________

Building Site Address: ______________________

Weather Conditions: ______________________

Building HVAC Status: ______________________

Install Personnel: ______________________

Sample Point ID	Sample Point Location	Water Leak Test						Pass ____ Fail ____	
		Test Time		Purge Method ______					
		Start		Purge Amount (mL)		Vacuum Induced (in Hg)		LEL (%)	
		End		Purge Rate (mL/min)		O_2 (%)		PID (ppm)	

Circle One: Stick-Up Vapor Pin™ or Flush-Mount Vapor Pin™ or Exterior Soil-Gas Point **Slab Thickness:** ______ **Subslab Material:** ______

Notes: ______________________ **Subslab-to-Air Pressure (in $H_2$0):** ______

Sample Point ID	Sample Point Location	Water Leak Test						Pass ____ Fail ____	
		Test Time		Purge Method ______					
		Start		Purge Amount (mL)		Vacuum Induced (in Hg)		LEL (%)	
		End		Purge Rate (mL/min)		O_2 (%)		PID (ppm)	

Circle One: Stick-Up Vapor Pin™ or Flush-Mount Vapor Pin™ or Exterior Soil-Gas Point **Slab Thickness:** ______ **Subslab Material:** ______

Notes: ______________________ **Subslab-to-Air Pressure (in $H_2$0):** ______

Sample Point ID	Sample Point Location	Water Leak Test						Pass ____ Fail ____	
		Test Time		Purge Method ______					
		Start		Purge Amount (mL)		Vacuum Induced (in Hg)		LEL (%)	
		End		Purge Rate (mL/min)		O_2 (%)		PID (ppm)	

Circle One: Stick-Up Vapor Pin™ or Flush-Mount Vapor Pin™ or Exterior Soil-Gas Point **Slab Thickness:** ______ **Subslab Material:** ______

Notes: ______________________ **Subslab-to-Air Pressure (in $H_2$0):** ______

Sample Point ID	Sample Point Location	Water Leak Test						Pass ____ Fail ____	
		Test Time		Purge Method ______					
		Start		Purge Amount (mL)		Vacuum Induced (in Hg)		LEL (%)	
		End		Purge Rate (mL/min)		O_2 (%)		PID (ppm)	

Circle One: Stick-Up Vapor Pin™ or Flush-Mount Vapor Pin™ or Exterior Soil-Gas Point **Slab Thickness:** ______ **Subslab Material:** ______

Notes: ______________________ **Subslab-to-Air Pressure (in $H_2$0):** ______

Appendix D – Leak Testing Vapor Pin™ Via Mechanical Means SOP

Standard Operating Procedure
Leak Testing VAPOR PIN®
Via Mechanical Means

Updated March 29, 2016

Scope:

The operating procedure describes the methodology to test a VAPOR PIN® or equivalent sub-slab sampling device and sample train for leakage of indoor air. Mechanical leak testing is generally simpler and less costly than testing with tracer gases such as helium, but relevant state, program, or other guidance documents should be consulted to determine if a specific type of leak test is needed.

Purpose:

The purpose of this procedure is to ensure that indoor air does not leak past the VAPOR PIN® or associated tubing and hardware, and dilute the sub-slab soil gas sample with indoor air.

Equipment Needed:

- VAPOR PIN®;
- 3 stopcocks
- 2 Tee fittings
- Vacuum pump or peristaltic pump
- Photo-Ionization Detector (PID) or other pump for purging soil gas
- Sample container
- Vacuum gauge
- 0.25-inch Outer Diameter sample tubing (Nylaflow LM shown)
- Tubing or fittings to connect sample tubing to equipment (Tygon™ R-3803 tubing shown)
- Distilled Water

For stick-up configuration only:

- Play-Doh or VOC-free modeling clay
- 2-inch diameter plastic pipe couple;

Procedure:

1) Drill a 5/8" diameter hole in the concrete slab and install the VAPOR PIN® as per the Standard Operating Procedure (SOP). For a flush-mount installation, drill the 1-1/2" diameter hole first, and follow the SOP Use of the VAPOR PIN® Drilling Guide and Secure Cover. Testing evacuated ("Summa") canisters and regulators in accordance with ASTM standard D7663-11 or Restek Corporation's A Guide to Whole Air Canister Sampling prior to starting field work eliminates most risk of leakage when sampling with the VAPOR PIN®. Leave the canister closed until leak testing is completed.

2) Install the VAPOR PIN® as described in the SOP Installation and Extraction of the VAPOR PIN®.

3) Clean the slab within a 2-inch radius of the VAPOR PIN® to remove all dust. Avoid wetting the concrete or wait until the concrete is dry before proceeding, and avoid cleaning with VOC-containing substances. A whisk broom or shop vacuum is recommended. Remaining dust can be picked up with a scrap of clay.

4) For a flush-mount installation, water is poured directly into the 1-1/2” depression without the PVC couple or modeling clay-proceed to the next step. For a stick-up installation, roll a 1-inch diameter ball of clay between your palms to form a “snake” approximately 7 inches long and press it against the end of the 2” pipe couple. Push the couple against the slab to form a seal between the pipe and the concrete. Notice that water soluble clays such as Play-Doh may absorb enough water to be unsuitable for tests lasting more than one hour.

5) Assemble the sample train as shown in Figure 1. Notice that the figure shows Photo-Ionization Detector (PID) at the end of the sample train, which should be replaced with the hand-held vacuum pump next to it, or a peristaltic pump, during shut-in testing. The shut-in test is conducted by closing stopcock 1, opening stopcocks 2 and 3, and imposing a vacuum of 15” mercury equivalent (in Hg) with the vacuum pump or peristaltic pump. Close stopcock 3, and observe the vacuum gauge for one to five minutes to verify that pressure in the sample train increases no more than 0.5 in Hg. Tighten or replace leaking components, if needed. The compression fitting connecting sample tubing to the sample canister is a common leak point.

6) Attach the peristaltic pump or PID and pour enough distilled water into the pipe couple or flush-mount depression to immerse the tubing connection to the VAPOR PIN®.

7) Open all stopcocks and purge and sample the sample point as required by the data quality objectives. Water level might drop slightly due to absorption into the concrete, but if there is a sudden drop in water level, the appearance of water in sample tubing, or other indication of water entering the sub-slab, remove the distilled water from the couple or depression, and reposition the VAPOR PIN® to stop the leakage before resuming the leak test and sampling.

8) If long-term sampling is conducted (e.g. 8-hour or 24-hour), the vacuum gauge, stopcock 3, PID and pumps can be removed immediately after closing stopcock 2, for use at subsequent sample locations.

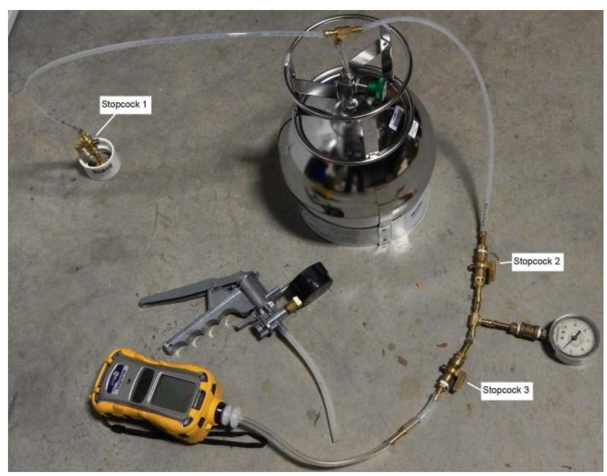

Figure 1. Example of Sub-Slab Sampling and Leak-Test Setup

Attachment B

Pace Analytical Services, LLC – Chain of Custody

Pace Analytical™
www.pacelabs.com

AIR: CHAIN-OF-CUSTODY / Analytical Request Document

The Chain-of-Custody is a LEGAL DOCUMENT. All relevant fields must be completed accurately.

Page: of

Section A Required Client Information:	**Section B** Required Project Information:	**Section C** Invoice Information:
Company:	Report To:	Attention:
Address:	Copy To:	Company Name:
		Address:
Email To:	Purchase Order No.:	Pace Quote Reference:
Phone: Fax:	Project Name:	Pace Project Manager/Sales Rep.
Requested Due Date/TAT:	Project Number:	Pace Profile #:

Program

☐ UST ☐ Superfund ☐ Emissions ☐ Clean Air Act

☐ Voluntary Clean Up ☐ Dry Clean ☐ RCRA ☐ Other______

Location of Sampling by State ___________

Reporting Units
ug/m³___ mg/m³ ____
PPBV ___ PPMV ____
Other ___

Report Level II.___ III.___ IV.___ Other_____

Section D Required Client Information

AIR SAMPLE ID

Sample IDs MUST BE UNIQUE

Valid Media Codes MEDIA	CODE
Tedlar Bag	TB
1 Liter Summa Can	1LC
6 Liter Summa Can	6LC
Low Volume Puff	LVP
High Volume Puff	HVP
Other	PM10

ITEM #	AIR SAMPLE ID	MEDIA CODE	PID Reading (Client only)	COLLECTED COMPOSITE START DATE	COLLECTED COMPOSITE START TIME	COLLECTED COMPOSITE - END/GRAB DATE	COLLECTED COMPOSITE - END/GRAB TIME	Initial Field reading (-inches of Hg)	Final Field reading (-inches of Hg)	Summa Can Number	Flow Control Number	Method: PM10	3C- Fixed Gas (%)	TO-3	TO-3M (Methane)	TO-4 (PCBs)	TO-13 (PAH)	TO-14	TO-15	TO15 Short List*		Pace Lab ID
1																						
2																						
3																						
4																						
5																						
6																						
7																						
8																						
9																						
10																						
11																						
12																						

Comments :

RELINQUISHED BY / AFFILIATION	DATE	TIME	ACCEPTED BY / AFFILIATION	DATE	TIME

SAMPLE CONDITIONS

Temp in °C	Received on Ice	Custody Sealed Cooler	Samples Intact
	Y/N	Y/N	Y/N
	Y/N	Y/N	Y/N
	Y/N	Y/N	Y/N
	Y/N	Y/N	Y/N

SAMPLER NAME AND SIGNATURE

PRINT Name of SAMPLER:

SIGNATURE of SAMPLER: DATE Signed (MM / DD / YY)

Attachment C

Applicable USEPA Regional Screening Levels
(Site specific shortlist only)

Resident Vapor Intrusion Screening Levels (VISL) - May 2018

Chemical	CAS Number	Does the chemical meet the definition for volatility? (HLC>1E-5 or VP>1)	Does the chemical have inhalation toxicity data? (IUR and/or RfC)	Is Chemical Sufficiently Volatile and Toxic to Pose Inhalation Risk Via Vapor Intrusion from Soil Source? (C_{vp} > $C_{i,a}$,Target?)	Is Chemical Sufficiently Volatile and Toxic to Pose Inhalation Risk Via Vapor Intrusion from Groundwater Source? (C_{hc} > $C_{i,a}$,Target?)	Target Indoor Air Concentration (TCR=1E-06 or THQ=1) MIN($C_{ia,c}$,$C_{ia,nc}$) (µg/m^3)	Toxicity Basis	Target Sub-Slab and Near-Source Soil Gas Concentration (TCR=1E-06 or THQ=1) C_{sg},Target (µg/m^3)	Target Groundwater Concentration (TCR=1E-06 or THQ=1) C_{gw},Target (µg/L)
Dichloroethane, 1,1-	75-34-3	Yes	Yes	Yes	Yes	1.8E+00	CA	5.9E+01	7.6E+00
Dichloroethane, 1,2-	107-06-2	Yes	Yes	Yes	Yes	1.1E-01	CA	3.6E+00	2.2E+00
Dichloroethylene, 1,2-trans-	156-60-5	Yes	No	No Inhal. Tox. Info	No Inhal. Tox. Info	-		-	-
Methylene Chloride	75-09-2	Yes	Yes	Yes	Yes	1.0E+02	CA	3.4E+03	7.6E+02
Tetrachloroethylene	127-18-4	Yes	Yes	Yes	Yes	1.1E+01	CA	3.6E+02	1.5E+01
Trichloroethane, 1,1,1-	71-55-6	Yes	Yes	Yes	Yes	5.2E+03	NC	1.7E+05	7.4E+03
Trichloroethylene	79-01-6	Yes	Yes	Yes	Yes	4.8E-01	CA	1.6E+01	1.2E+00
Vinyl Chloride	75-01-4	Yes	Yes	Yes	Yes	1.7E-01	CA	5.6E+00	1.5E-01

Key: I = IRIS; P = PPRTV; D = DWSHA; O = OPP; A = ATSDR; C = Cal EPA; X = APPENDIX PPRTV SCREEN (See FAQ #29); H = HEAST; F = See FAQ; E = see user guide Section 2.3.5; W = see user guide Section 2.3.6; L = see user guide on lead; M = mutagen; S = see user guide Section 5; V = volatile; R = RBA applied (See User Guide for Arsenic notice) ; c = cancer; n = noncancer; * = where: n SL < 100X c SL; ** = where n SL < 10X c SL; SSL values are based on DAF=1; m = Concentration may exceed ceiling limit (See User Guide); s = Concentration may exceed Csat (See User Guide); U = User-provided

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Key: I = IRIS; P = PPRTV; D = DWSHA; O = OPP; A = ATSDR; C = Cal EPA; X = APPENDIX PPRTV SCREEN (See FAQ #29); H = HEAST; F = See FAQ; E = see user guide Section 2.3.5; W = see user guide Section 2.3.6; L = see user guide on lead; M = mutagen; S = see user guide Section 5; V = volatile; R = RBA applied (See User Guide for Arsenic notice) ; c = cancer; n = noncancer; * = where: n SL < 100X c SL; ** = where n SL < 10X c SL; SSL values are based on DAF=1; m = Concentration may exceed ceiling limit (See User Guide); s = Concentration may exceed Csat (See User Guide)

Toxicity and Chemical-specific Information						Contaminant		Carcinogenic Target Risk (TR) = 1E-06	Noncancer Hazard Index (HI) = 1
IUR $(ug/m^3)^{-1}$	key	RfC_i (mg/m^3)	key	vol	mutagen	Analyte	CAS No.	Carcinogenic SL TR=1E-06 (ug/m^3)	Noncarcinogenic SL THI=1 (ug/m^3)
1.6E-06	C			V		Dichloroethane, 1,1-	75-34-3	1.8E+00	
2.6E-05	I	7.0E-03	P	V		Dichloroethane, 1,2-	107-06-2	1.1E-01	7.3E+00
				V		Dichloroethylene, 1,2-cis-	156-59-2		
				V		Dichloroethylene, 1,2-trans-	156-60-5		
1.0E-08	I	6.0E-01	I	V	M	Methylene Chloride	75-09-2	1.0E+02	6.3E+02
2.6E-07	I	4.0E-02	I	V		Tetrachloroethylene	127-18-4	1.1E+01	4.2E+01
		5.0E+00	I	V		Trichloroethane, 1,1,1-	71-55-6		5.2E+03
4.1E-06	I	2.0E-03	I	V	M	Trichloroethylene	79-01-6	4.8E-01	2.1E+00
4.4E-06	I	1.0E-01	I	V	M	Vinyl Chloride	75-01-4	1.7E-01	1.0E+02

TR=1E-06

THQ=1.0

Attachment D

IDEM Vapor Remedy Selection and Implementation Guidance Document – February 2014

DRAFT INTERIM GUIDANCE DOCUMENT

INDIANA DEPARTMENT OF ENVIRONMENTAL MANAGEMENT

Vapor Remedy Selection and Implementation

Office of Land Quality

(317) 232-8941 • (800) 451-6027 www.idem.IN.gov 100 N. Senate Ave., Indianapolis, IN 46204

Guidance Created: February 2014

1.0 INTRODUCTION

IDEM's Remediation Closure Guide (RCG) significantly updated the vapor intrusion (VI) guidance applicable to remediation projects in Indiana. The RCG focuses on investigation and interpretation of sampling results and provides guidance on institutional control remedies. The RCG does not provide guidance on operation and maintenance of long-term engineered remedies.

The U.S. Environmental Protection Agency (EPA) stated its intention to release final VI guidance by the end of November 2013. EPA has not yet issued their guidance and IDEM does not know when EPA will do so. The following draft interim guidance supplements RCG Section 5 (Conceptual Site Model (CSM) Development: Vapor), Section 10 (Risk Evaluation: Vapor) and Section 12 (Remedy Selection and Implementation) and provides additional guidance for evaluation and implementation of remedies at potential vapor intrusion sites. IDEM may review and update the RCG when EPA releases new science and policy.

2.0 VI PATHWAY EVALUATION

If a volatile chemical is detected in ground water at concentrations above its vapor intrusion ground water screening level (VIGWSL) within specified distance criteria of a building, the RCG recommends evaluation of the VI pathway at that building to determine if the exposure pathway is complete.[1] This typically involves collection of indoor air (IA) and sub-slab soil gas (SGss) or exterior soil gas (SGe) samples.

Note that VIGWSLs are modeled numbers intended for use as triggers that prompt VI investigations. They are not intended as stand-alone remediation objectives that must be met in addition to ground water direct contact and indoor air remediation objectives.

Table 1 below summarizes IDEM's draft interim guidance based on observed concentrations of volatile chemicals in IA and SGss/SGe after the first round of worst case sampling. Text providing additional detail on the various scenarios follows the table.

[1] At the present time IDEM has no VI SLs for soil.

Use of the table and text assumes an adequate CSM and preferential pathway analysis and that the subsurface source of contamination is stable or decreasing - that is, that ground water concentrations of volatile chemicals underlying or near the building, including degradation products, are not increasing or likely to increase with time.

Neither the table nor the text is a substitute for critical thinking or best professional judgment. They are only general guides. Site-specific decisions regarding mitigation options and urgency/timing of action should be based on site conditions. The conditions at any given site may lead to different decisions than the simple suggestions provided in the table and text below.

Table 1: Evaluation of Paired SGss/SGe-IA Sample Results

	IA Concentration			
SGss/SGe Concentration	IA < SL	SL < IA < 2x SL	2x SL < IA < 10x SL	IA > 10x SL
SGss/SGe <SL	Scenario 1 (Mitigation not necessary)	Scenario 4 (Indoor air source likely)	Scenario 4 (Indoor air source likely)	Scenario 4 (Indoor air source likely)
SL < SGss/SGe < 2x SL	Scenario 2 (Mitigation typically not necessary)	Scenario 5 (Mitigate or demonstrate through additional sampling and lines of evidence that a remedy is not needed)	Scenario 6 (Remedy)	Scenario 7 (Mitigate promptly)
2x SL < SGss/SGe < 10x SL	Scenario 3 (Remedy or indefinite sampling)	Scenario 6 (Remedy)	Scenario 6 (Remedy)	Scenario 7 (Mitigate promptly)
SGss/SGe >10x SL	Scenario 3 (Remedy or indefinite sampling)	Scenario 6 (Remedy)	Scenario 6 (Remedy)	Scenario 7 (Mitigate promptly)

Instructions for Use of Table 1

Note that IDEM has a preference for paired SGss and IA measurements taken under worst case conditions over paired exterior soil gas (SGe) and IA measurements unless the structure is considered low risk (see RCG). If the structure is not low risk, SGe samples should be paired with IA samples only when SGss samples cannot be obtained.

Table 1 applies after the *first* round of worst case sampling. Some of the scenarios described in Table 1 and the text below call for additional sampling. If those additional sample results suggest a scenario different from that indicated after initial sampling, responsible parties should implement the more protective scenario, or demonstrate through additional sampling and other lines of evidence (LOEs) that another approach is appropriate and protective.

Scenario 1: SGss/SGe < SL and IA < SL
Resample under worst case conditions. If both rounds of paired worst case sampling show that the SGss and IA concentrations are below their applicable SLs, no complete VI pathway exists, and no additional sampling is necessary.

Scenario 2: SL < SGss/SGe < 2x SL and IA < SL
Detections of VOCs in SGss indicate potential VI and additional evaluation is required. If three paired worst case sampling events (winter season, summer season, repeat of winter/summer season) show that SGss is less than 2x the SL, and do not detect IA concentrations above SLs, there is no evidence that VI is occurring above the SL and VI does not pose an unacceptable risk. Generally, no additional sampling is necessary. Note that responsible parties always have the option of performing pre-emptive mitigation as an alternative to collecting additional SGss/IA samples.

Scenario 3. 2x SL < SGss/SGe and IA < SL
In this scenario there is a significant potential for future VI. Responsible parties should either implement a remedy or undertake long term paired sampling.

Scenario 4: SGss/SGe < SL and IA > SL
This scenario typically occurs when there is an IA source of the observed chemical(s). Investigate and if possible remove the IA source, then resample. If paired re-sampling shows that SGss/SGe < SL and IA < SL after removal of an indoor air source, no further sampling is necessary. If re-sampling shows that SGss/SGe < SL and IA > SL, then the indoor air problem is not likely due to vapor intrusion. Corrective action may be advisable, but a vapor intrusion remedy is likely not necessary.

Scenario 5: SL < SGss/SGe < 2x SL and SL < IA < 2x SL
In this scenario, VI is occurring. Responsible parties should either implement a remedy or demonstrate through additional sampling and lines of evidence that a remedy is not needed.

Scenario 6: Applies to various combinations of SGss/SGe and IA results
In this scenario, there is stronger evidence that VI is occurring and responsible parties should interrupt the vapor pathway and/or remove source material to reduce contamination to achieve acceptable levels.

Scenario 7: Applies to SGss/SGe > SL and IA > 10x SL
In this scenario, the indoor air action level has been exceeded and responsible parties should act promptly to interrupt the VI pathway.

3.0 VI REMEDIES

VI remedy options include source reduction or use of vapor mitigation technologies until IA SLs are no longer exceeded. Source reduction is the most effective way to eliminate the long-term risks of VI from sources such as contaminated soils, groundwater, and/or non-aqueous phase liquids. Vapor mitigation technologies are approaches to interrupt the VI pathway based on the characteristics and construction of a building (e.g., existing building, slab-on-grade, basement, or crawl space foundation).

3.1 Vapor Mitigation Options

There are two types of vapor mitigation technologies: active vapor mitigation and passive vapor mitigation. If a vapor mitigation system is needed, the type of system chosen should take into consideration factors such as the use, construction and design of the building, the sub-slab soils, and whether the building exists or is proposed for construction.

3.2 Mitigation System Diagnostic Testing and Verification Sampling

Once a vapor mitigation system is installed, responsible parties should perform diagnostic testing and verification sampling. Diagnostic testing is needed to verify that the system meets its performance specifications and to establish an operational baseline. Diagnostic testing should include:

- visual inspection of the mitigation system;
- documentation of baseline system performance measurements, e.g. manometer, gauge, or other appropriate measurement and documentation of the measurements; and
- determining whether alterations or augmentations to the system are needed.

It takes time for the sub-slab or crawl space area to reach steady state conditions after the installation of the vapor mitigation system. For this reason, baseline mitigation system performance measurements should be collected no sooner than 30 days after the system is activated. The 30 day timeframe also allows the building time to reach steady state conditions prior to collecting verification IA samples.

Once a vapor mitigation system has been installed inside a building, verification sampling should be conducted to show that the system is operating effectively and reducing IA contaminant concentrations to below the IA SLs. Verification IA sampling is only necessary for previously detected chemicals and their breakdown products. Verification sampling should include both IA sampling and pressure testing. The IA sample(s) should be collected in a location biased towards worst case conditions identified during previous sampling events and/or based on professional judgment. Following installation of a vapor mitigation system, IDEM recommends the following:

1. IA sampling
   - One round of IA sampling 30 days after system installation.
   - If the sampling event conducted 30 days after system installation does not occur during winter worst case conditions, an additional IA sampling event should be conducted during winter worst case conditions.
2. Pressure testing
   - Demonstrate that a negative pressure differential exists between the sub-slab and indoor air.

Regardless of the vapor mitigation technique selected, IA sampling is a necessary LOE to confirm the mitigation system is performing as expected. Pressure testing will verify that a negative pressure gradient is being sustained between the sub-slab and indoor air. Visual documentation of a sub-slab vacuum pressure differential may be used under certain conditions during the operation, maintenance, and monitoring phase of the project to confirm steady state operational conditions and provide a LOE that the mitigation system continues to prevent VI in lieu of continued IA testing.

3.3 Vapor Mitigation System Operation, Maintenance, and Monitoring (OMM)

Routine long-term OMM of the vapor mitigation system will be necessary for as long as it is used to interrupt the VI pathway. A site-specific OMM plan should be developed that specifies the requirements for and frequency of vapor mitigation system inspection based on the risk level involved with each building. The risk level can be evaluated using the following LOEs:

- SGss and IA contaminant concentrations
- source contaminant concentrations
- source remedy selection
- estimated time that will be required before areas of highest contamination decrease to acceptable levels

For example, an OMM plan for a building overlying or near a source that is actively being remediated may only need visual inspection and pressure tests on a reduced frequency. In contrast, a building overlying or near a source that is being left in place will need inspection and air monitoring on an increased frequency. Generally, an OMM plan should include:

- Routine visual inspections of the buildings to ensure there are no significant changes such as remodeled areas, or additions to the building.
- Routine visual inspections of the vapor mitigation system, in particular the pressure gauge or the manometer to ensure that the system is functioning appropriately.
- Periodic monitoring of IA on the lowest routinely occupied floor to ensure that IA concentrations are below the SLs and that VI does not present a health risk.

3.4 Long-Term Monitoring(LTM)

Table 2 (below) provides general guidance on appropriate inspection and sampling intervals. Note that development of a long-term VI monitoring plan should use site-specific data and professional judgment to determine the frequency of mitigation system monitoring. The conditions at any given site may lead to different decisions than the approaches described below.

Table 2: Inspection and Sampling Intervals

	Premitigation IA Concentration			
SGss/SGe Concentration	IA < SL	SL < IA < 2x SL	2SL < IA < 10x SL	IA > 10x SL
SGss/SGe < SL	None anticipated	None anticipated	None anticipated	None anticipated
SL < SGss/SGe < 2x SL	None anticipated	Schedule 1	Schedule 2	Schedule 2
2x SL < SGss/SGe < 10x SL	Schedule 1 OR conduct on-going sampling	Schedule1	Schedule 2	Schedule 2
SGss/SGe > 10x SL	Schedule 2	Schedule 2	Schedule 2	Schedule 2

Table 3. Mitigation System Monitoring Schedule

Schedule 1.	**Schedule 2.**
1. Perform activities specified in Section 3.3, generally on an annual basis. 2. Annual sampling of IA during the winter worst case season during the first, second, and fifth year, and every fifth year thereafter.	1. Perform activities specified in Section 3.3, generally on an annual basis. 2. Annual sampling of IA during the winter worst case season during the first, second, and fourth year, and every other year thereafter.

4.0 Mitigation System Termination Guidelines

Site cleanup efforts may reduce contaminant levels in ground water, soil, soil gas, etc. to levels no longer resulting in VI. If so, it may be possible to terminate operation of VI mitigation systems.

System termination sampling is based on the results of IA and SGss sampling. Prior to sampling for system termination, shut down the mitigation system for a period of at least 30 days to allow re-development of pre-mitigation subsurface conditions. Where possible, collect samples from the same locations initially used to evaluate VI. Collect a round of paired samples during the winter heating season and compare the results to Table 1. Use the procedures in Table 1 to determine whether it is appropriate to terminate system operation or pursue some other course of action.

Upon system termination, some home owners may prefer to keep the system in place (e.g. for radon mitigation) instead of removing it. This is acceptable. Otherwise, arrangements should be made with the building owner to remove any equipment and/or monitoring devices associated with the mitigation system or long term monitoring operations and perform repairs to the building resulting from system removal.