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SUB-SLAB SOIL GAS SAMPLING AND ANALYSIS PLAN

Sunoco Pipeline LP Twin Oaks-Newark 14” Diameter Pipeline Release
Upper Makefield Township, Bucks County, Pennsylvania

Prepared for:
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Verdantas Project No: 34328

June 2025

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1. Introduction and Purpose

This sub-slab soil gas sampling and analysis plan was prepared by Verdantas LLC ("Verdantas") on behalf of Sunoco Pipeline LP ("Sunoco Pipeline") in relation to the release of petroleum products from the 14-inch diameter Twin Oaks – Newark Pipeline ("pipeline"). The location of the release is in the Mt. Eyre neighborhood of Upper Makefield Township ("Township"), Bucks County, Pennsylvania (the "Project Area"). A United States Geological Survey ("USGS") Topographic Map is provided as Figure 1, and Figure 2 is a Project Area Layout Map.

This sampling and analysis plan outlines the procedures for the collection of sub-slab soil gas samples from selected residences within the Project Area. This sampling program was designed based on Section IV (Vapor Intrusion) of the Pennsylvania Department of Environmental Protection ("PADEP") Land Recycling Program Technical Guidance Manual ("TGM").

The objective of this sub-slab soil gas sampling program is to collect soil gas samples from beneath the slab (basement or slab-on-grade) of selected residences in the Project Area to use:

- As an additional line of evidence for the evaluation of sampling results from indoor air samples collected in accordance with the Indoor Air Sampling and Analysis Plan (CTEH, February 2025); and
- To evaluate potential vapor intrusion into inhabited buildings from soil and/or groundwater contamination associated with the pipeline release, including associated light non-aqueous phase liquid ("LNAPL").

2. Health and Safety

Field personnel will review and adhere to the site-specific Health and Safety Plan. Sampling and field activities will only be conducted under weather and other conditions that do not create an unsafe working environment.

3. Data Quality Objectives

The data collected during sampling and field activities will be used to evaluate potential vapor intrusion into inhabited buildings of certain volatile organic compounds ("VOCs") related to refined petroleum products, including jet fuel, under the Statewide health standard ("SHS") of Pennsylvania's Land Recycling and Environmental Remediation Standards Act (Act 2).

4. Sub-Slab Soil Gas Sampling Strategy

4.1 Sub-Slab Sampling Locations

Indoor air sampling has been conducted at six residences on Glenwood Drive, Walker Road, and Spencer Road. Sub-slab soil gas sampling may be conducted at these residences if additional

lines of evidence are necessary to evaluate the potential influence of background conditions on the indoor air sampling results.

Sub-slab soil gas sampling[1] may also be conducted to evaluate the potential for vapor intrusion into residences that are determined to be within the horizontal and vertical proximity distances of soil or groundwater with concentrations greater than the applicable SHS screening values or LNAPL (potential vapor intrusion sources) identified during investigation and characterization activities.

4.2 Target Analytes

The list of target analytes is the VOCs included in the PADEP Short Lists of Petroleum Products. The VOCs hexane and cyclohexane have been added to the list of target analytes for consistency with the prior indoor air sampling analyte list.

Target analytes are listed on **Table 1**.

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[1] Other types of sampling described in the TGM (e.g., indoor air or near-source soil gas) may also be used to evaluate the potential vapor intrusion pathway in the Project Area if warranted by site-dependent considerations.

Table 1. Target Analytes, Detection Limits, and Screening Levels

Analyte	CAS Registry Number	Method Detection Limit	Laboratory Reporting Limit	PADEP Statewide Health Standard Residential	
				Sub-Slab Screening Value ("SV_{SS}")	Indoor Air Screening Value ("SV_{IA}")
Benzene+	71-43-2	0.016	0.319	120	3.1
Toluene	108-88-3	0.196	0.754	200,000	5,200
Ethylbenzene	100-41-4	0.188	0.869	370	9.7
m&p-Xylene	1330-20-7	0.395	1.74	4,000*	100**
o-Xylene	95-47-6	0.197	0.869		
Isopropylbenzene	98-82-8	0.305	0.983	16,000	420
Methyl tert-butyl ether	1634-04-4	0.189	0.721	3,600	94
Naphthalene+	91-20-3	0.184	0.262	28	0.72
1,2,4-Trimethylbenzene	95-63-6	0.181	0.983	2,400	63
1,3,5-Trimethylbenzene	108-67-8	0.332	0.983	2,400	63
1,2-Dichloroethane+	107-06-2	0.039	0.081	36	0.94
1,2-Dibromoethane+	106-93-4	0.062	0.154	1.6	0.041
Hexane	110-54-3	0.128	0.705	28,000	730
Cyclohexane	110-82-7	0.127	0.688	240,000	6,300

All concentrations in $\mu g/m^3$ = micrograms per cubic meter

+ Analyte will be analyzed using US EPA Method TO-15 in Selective Ion Monitoring (SIM) mode.

* The PADEP Residential SV_{SS} for total xylenes (CAS Registry Number 1330-20-7) is 4,000 $\mu g/m^3$. The concentration of total xylenes will be calculated by adding the concentrations of m&p-xylene and o-xylene.

** The PADEP Residential SV_{IA} for total xylenes (CAS Registry Number 1330-20-7) is 100 $\mu g/m^3$. The concentration of total xylenes will be calculated by adding the concentrations of m&p-xylene and o-xylene

4.3 Pre-Sampling Procedures

4.3.1 Pre-Sampling Survey

To minimize potential impacts from other sources of VOCs, Sunoco Pipeline will request that the occupant remove potential sources of VOCs (e.g., fuel containers, paints, cleaning products, personal care products, candles) from the sampling location (lowest occupied level of the structure) at least 24 hours prior to sampling. Sunoco Pipeline will request that items either be removed from the area or placed in a sealed container for temporary storage throughout the duration of the air sampling event.

On the day of sample collection, a pre-sampling survey will be conducted with the occupant. The pre-sampling survey will include a short questionnaire for the occupant, a visual assessment of accessible portions of the lowest level of the residence, an air monitoring assessment of accessible portions of the lowest level and first floor of the residence, and a barometric pressure assessment both inside and outside the building. The pre-sampling survey will include information about building-specific factors that could potentially influence the concentration of VOCs in indoor air and sub-slab soil gas. Specifically, the pre-sampling survey will include:

- Property owner and building occupant information;
- Building evaluation (i.e., building use/description and summary of potential vapor entry points);
- Building construction characteristics;
- Building features (e.g., condition of the floor slab, the presence of floor penetrations or cracks, presence of radon mitigation system);
- Heating and ventilation systems;
- Items within the residence that could be potential sources of VOCs (e.g., fuel containers, paint cans, solvents, cleaning products, personal care products, candles);
- Occupant activities within the residence (e.g., smoking, painting, cleaning);
- Exterior building characteristics; and
- Items or occupant activities outside the residence that could be potential sources of VOCs (e.g., storage of fuel containers or paint cans, and use of fuel-powered equipment such as a lawnmower).

Pre-sampling surveys were conducted prior to the indoor air sampling performed at six residences. Prior to sub-slab soil gas sampling at these locations, the occupant will be asked whether there have been any changes since the initial survey was completed.

In addition to the visual assessment, an air monitoring assessment will also be conducted in accessible portions of the lowest level of the residence to further identify items within the residence that could be potential sources of VOCs. The air monitoring assessment will be conducted using a handheld RAE Systems by Honeywell ppbRAE 3000 instrument equipped with a photoionization detector ("PID") and a 10.6 eV lamp (detection limit = 1 part per billion [ppb]).

The PID will be calibrated daily or per manufacturer recommendations. The information collected during the pre-sampling survey will be documented digitally and/or on the Pre-Sampling Survey Form (Attachment A).

4.3.2 Sample Location Selection

Sampling locations within the lowest level of each residence will be determined based on the specific characteristics of the building. Sampling locations will be at least five feet from perimeter foundation walls and away from footers, large floor cracks, and slab penetrations (e.g., sumps, floor drains).

Two sub-slab soil gas sampling locations will be selected at each residence.

4.3.3 Sampling Point Installation Procedures

Sub-slab soil gas samples will be collected using stainless steel Vapor Pin® Sampling Devices, provided by Vapor Pin Enterprises, Inc. Information on the installation and use of Vapor Pin® Sampling Devices can be found at: https://vaporpin.com (detailed product standard operating procedures ("SOPs") are included in Attachment B). The following procedures will be followed for installation.

1) Check for buried utilities prior to proceeding (including notification of Pennsylvania One Call System).
2) Using a rotary hammer drill and a wet/dry vacuum to collect cuttings, drill a 1 1/2-inch (38-millimeter ["mm"]) diameter hole at least 1 3/4-inches (45 mm) into the slab.
3) Remove cuttings from the hole and place the Vapor Pin® drilling guide in the hole with the conical end down. The hole is sufficiently deep if the flange of the drilling guide lies flush with the surface of the slab. Deepen the hole as necessary but do not drill more than 2 inches (50.8 mm) into the slab, to ensure that the threads on the Vapor Pin® Cover engage properly with the threads on the Vapor Pin® Sampling Device.
4) When the 1 1/2-inch (38 mm) hole is drilled to the proper depth, replace the drill bit with a 5/8-inch (16 mm) bit, insert the bit through the drilling guide, and drill through the slab. The drilling guide will help to center the hole for the Vapor Pin® Sampling Device and keep the hole perpendicular to the slab.
5) Remove the bit and drilling guide, clean the hole, and install the Vapor Pin® Sampling Device.
   a) Assemble the Vapor Pin® Sampling Device and Vapor Pin® Sleeve.
   b) Place the lower end of the Vapor Pin® Sampling Device assembly into the drilled hole. Place the small hole located in the handle of the installation/extraction tool over the Vapor Pin® Sampling Device to protect the barb fitting and tap the Vapor Pin® into place using a dead blow hammer. Make sure that the installation/extraction tool is aligned parallel to the Vapor Pin® Sampling Device to avoid damaging the barb.
   c) Place the Vapor Pin® cap on the Vapor Pin® Sampling Device to prevent vapor loss prior to sampling.
6) Cover the Vapor Pin® Sampling Device with a Vapor Pin® Cover.
7) Allow at least two hours for the sub-slab soil-gas conditions to equilibrate prior to sampling.

4.4 Sampling Procedures

4.4.1 Sample Train Set Up and Testing

The PID will be used to screen the indoor air in the vicinity of each sub-slab sample throughout the sampling process as well as to scan the air beneath the slab (through the sampling device) prior to sampling. The PID provides screening-level data for the possible presence of total VOCs within a certain range of ionization potential. The PID will be calibrated daily (or per manufacturer recommendations).

1) The sub-slab soil gas samples will be collected in 2.7- or 3-, or 6-liter passivated stainless-steel canisters equipped with 30-minute flow restriction valves (flow regulators) provided by

the laboratory so that a sampling rate of less than 200 milliliters per minute and a sampling duration of at least 15 minutes is maintained. Prior to sampling, each canister will be inspected for damage, a leak test will be performed, and the initial pressure of the canister will be recorded.

2) The canister/flow regulator assembly will be connected to the sampling device with poltytetrafluroethylene ("PTFE") tubing and a short piece of silicone tubing. This length of silicone tubing exposed to the sample should be less than 1/2-inch (13 mm) total length. The canister, flow regulator, PTFE tubing, and their associated valves, fittings, and connections are referred to as the "sampling train." Figure 3 shows a diagram of the sampling train.
3) Prior to connecting the sampling train to the sampling device, a "shut-in" test will be completed to test the sampling train for leaks. The shut-in test will be performed by applying a vacuum of approximately 15 inches of mercury to the closed sampling train for at least one minute. The test will be considered successful if a vacuum loss of no more than 0.5 inches of mercury is observed.
4) Following completion of the shut-in test, the sampling train will be connected to the sampling device and a hydrostatic test will be performed to test the PTFE tubing/sampling device connection as well as the sampling device/concrete slab seal for leaks.
    a) Remove the Vapor Pin® Cap and connect sample tubing to the barb fitting of the Vapor Pin® Sampling Device using a short piece of silicone tubing to join the Vapor Pin® Sampling Device.
    b) To complete the hydrostatic test, fill the 1 1/2-inch hole with water. The hydrostatic test will be continued throughout the collection of the sub-slab soil gas samples.
    c) An observed loss of water during the hydrostatic test implies that a leak is present between the sampling device and the concrete slab and/or at the sampling device/PTFE tubing connection.
5) Prior to initiating the sampling, the fully connected sampling train will be purged of at least one sampling train volume (not including the canister volume) using a graduated syringe connected to the sampling train. The purpose of purging the sampling train is to evacuate stagnate air and test the connectivity of the sampling train to the air beneath the sub-slab for obstructions that would prevent the collection of sub-slab soil gas samples. The sub-slab soil gas sampling will commence immediately following the sampling train purge.

4.4.2 Sample Collection

Information and data, including PID readings, sample dates, times, and identifications, canister and flow regulator numbers, and canister start and stop pressures, collected during the sampling process will be recorded on the Air Sampling Field Data Sheet (Attachment C).

To ensure sample integrity, a partial vacuum will be left in each canister at the conclusion of sample collection. At the end of the air sampling period, the final pressure of the canister will be recorded. Sample collection time will be approximately 30 minutes for individual samples and up to 60 minutes for locations with duplicates. Air samples will be labeled (see Section 6.1) and sent under chain-of-custody ("COC") (see Section 6.2) to Pace Analytical in Mansfield, Massachusetts, a National Environmental Laboratory Accreditation Program-accredited laboratory.

Two rounds of sampling are expected to be conducted at each location. The sample rounds will be separated by at least 45 days.

4.4.3 Quality Assurance and Quality Control Samples

A field duplicate sample will be collected from one location during each sampling round. The duplicate will be collected concurrently by including a second canister in the sampling train. The flow regulator for a sample location with a duplicate will be set to 60-minute fill time to maintain a sampling rate of less than 200 milliliters per minute.

Samples of ambient outdoor air will be collected during each sampling round. The air sample collected outside the residence(s) will be located in an area that is representative of ambient conditions outside the residence (e.g., backyard). Air samples will be collected in locations that minimize potential impacts from other sources of VOCs.

4.5 Post-Sampling Procedures

After the second sampling event (more than 45 days following the first sampling event), the sampling devices will be removed, and the floor will be patched by filling the void with hydraulic cement and smoothing with a trowel. If the sample was collected from a location covered by finished flooring materials, the location will be restored in accordance with the access arrangements between the property owner and Sunoco Pipeline.

4.6 Analytical Methods

The sample canisters will be delivered to the laboratory using COC procedures. The samples will be analyzed for the target analyte list in accordance with United States Environmental Protection Agency ("USEPA") Method TO-15*,* as listed on **Table 1***.* Sunoco Pipeline and its contractors will work with the analytical laboratory to try and obtain laboratory reporting limits that are below one tenth of the published SHS indoor air screening values for residential properties.

5. Analysis of Sub-Slab Soil Gas Sampling Results

5.1 Screening Levels

The PADEP sub-slab soil gas and indoor air SHS screening values for residential properties are listed in **Table 1.**

5.2 Data Analysis

5.2.1 Locations with Indoor Air Samples

Validated sub-slab soil gas sampling results will be reviewed and compared to the validated indoor air sampling results for the residences where indoor air sampling was performed to

determine whether vapor intrusion is the likely source of any analyte detections in the indoor air samples (rather than potential influence from other sources of VOCs or outdoor air).

Prior to data validation (see Section 7.3), preliminary sub-slab soil gas sampling results issued by the laboratory will be provided to Sunoco Pipeline personnel, who will share the results verbally and in writing with individual property owners. Sharing preliminary sampling results will enable property owners to receive their sampling results sooner, rather than waiting for data validation to be completed before sharing sampling results. If any issues with data quality are identified during data validation, Sunoco Pipeline personnel will notify the individual property owner.

5.2.2 Locations without Indoor Air Samples

For samples collected at residences within proximity distances of identified potential vapor intrusion sources, but without indoor air sampling results, sub-slab soil gas sampling results will be reviewed for the presence/absence of target analytes and, if a target analyte is detected, the concentration of that analyte will be compared to applicable screening levels, as shown on **Table 1**. Note that for sub-slab soil gas samples collected from residences with identified significant foundation openings, the indoor air screening values may be applicable.

If sampling results indicate that concentrations of target analytes are below their applicable screening levels in sub-slab soil gas samples from both sampling events, no further action is required. If sampling results indicate that the concentration of a target analyte is greater than its respective applicable screening level in a sub-slab soil gas sample, the need for additional site investigation or mitigation will be evaluated.

Sub-slab soil gas sampling results issued by the laboratory will be provided to Sunoco Pipeline personnel, who will share the results with the individual property owners.

6. Sample Labeling and Handling

6.1 Labeling

Sub-slab soil gas samples will be clearly labeled with the following information:

- Unique sample identification, including UMPA (Upper Makefield, PA)
- Sample type – SS (sub-slab soil gas), IA/OA (indoor air/outdoor air)
- Start/stop date
- Start/stop time
- Start/stop pressure

The unique sample designation will include the following: four-letter site prefix, two-digit month, two- digit day, sample type (SS, IA, OA), and three-digit numerical designation.

6.2 Handling

Samples will be collected using laboratory-supplied, individually certified clean evacuated canisters, and labeled with the sample identification number and sample date. The laboratory COC will contain sample identification number, sample date, analysis and methodology requested, and time of sample collection. Custody seals will be placed on packages containing the sample containers, if necessary, and COC procedures will be maintained from the time of sample collection until arrival at the laboratory to protect sample integrity. Shipping or transporting samples to the laboratory will be done within a timeframe to meet the recommended holding times (i.e., 30 days from collection to preparation; five days from preparation to analysis).

7. Quality Assurance

This sampling program, including both air monitoring and soil gas/air sampling, will be carried out in conjunction with a well-defined quality assurance (“QA”) program. The QA program refers to the sampling, analysis, and data validation procedures for generating valid and defensible data. The types of quality control (“QC”) measures and samples that will be conducted are outlined below.

7.1 Field Calibration

Air monitoring instruments used in the field as part of this sampling program will consist of PIDs and handheld data collection devices such as tablets/smartphones. PID instruments will be maintained and calibrated daily in accordance with manufacturer recommendations and instructions. Operators of each instrument are responsible for maintaining (including proper battery charge) and operating the equipment such that it conforms to manufacturer specifications.

7.2 Laboratory Quality Assurance

Laboratory QC procedures will be conducted in a manner consistent with relevant state and federal regulatory guidance. Deliverables will contain the supporting documentation necessary for data validation. Internal laboratory QC checks will include method blanks, matrix spike/matrix spike duplicate (“MS/MSD”) samples, surrogate samples, calibration standards, and laboratory control standards (“LCS”).

Field QA/QC procedures are described in Section 4.4.3.

7.3 Data Verification/Validation

Third-party data verification/validation will be performed by Environmental Standards, Inc. Data verification/validation will include, at a minimum, sample holding times, accuracy, precision, contamination of laboratory method blanks, and surrogate compound recovery. Accuracy will be determined by evaluating LCS and MS/MSD recovery. Precision will be determined by evaluating laboratory duplicate samples.

Level 4 data validation will be performed on 100% of the samples. The components of data verification/validation are summarized in **Table 2**.

Table 2
Summary of Data Verification/Validation Levels

Data Verification/ Validation Level	Definition
Level 1	Sample data reporting only
Level 2	Complete QC, including data blanks, spikes, duplicates (including matrix spike duplicates), laboratory control samples, relative percent difference, and percent recovery
Level 3	Items listed in Level 2 plus QC limits and QA batch cross-reference table
Level 4	Items listed in Levels 2 and 3, including sample raw data and chromatograms

8. Waste Disposal

Used personal protective equipment and sampling tubing will be containerized and collected at the designated on-site waste staging area. All waste produced on-site will be managed and disposed of in a manner consistent with regulatory guidelines and requirements.

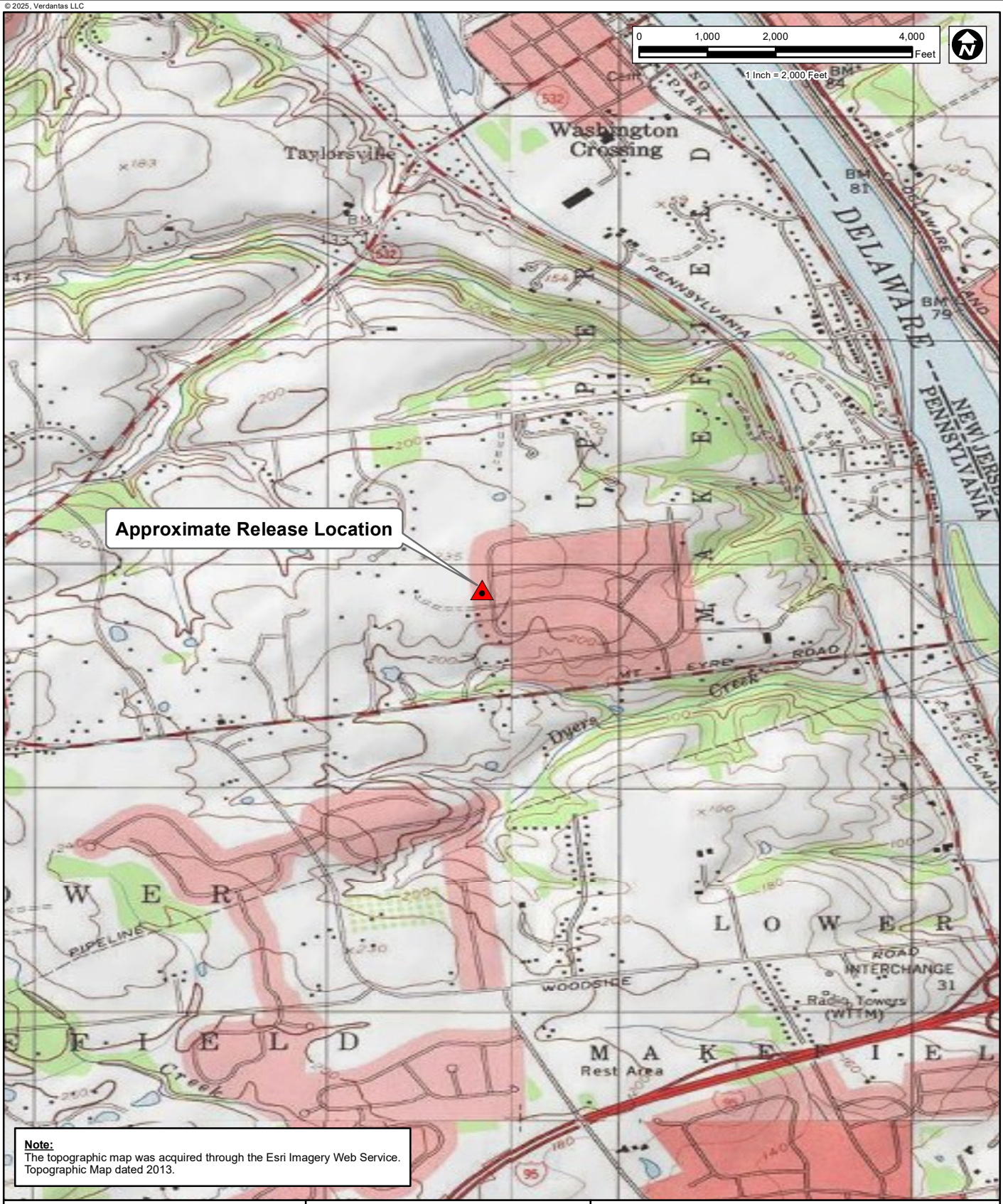
9. Records Management

Records management refers to the procedures for generating, controlling, and archiving project-specific records and records of field activities. Project records, particularly those that are anticipated to be used as evidentiary data, directly support current or ongoing technical studies and activities, and provide historical evidence needed for later reviews and analyses, will be legible, identifiable, retrievable, and protected against damage, deterioration, and loss on a centralized electronic database. Handwritten records will be written in indelible ink. Records may include, but are not limited to, the following: bound field notebooks on pre-numbered pages, sample collection forms, personnel qualification and training forms, sample location maps, equipment maintenance and calibration forms, COC forms, maps and drawings, transportation and disposal documents, reports issued as a result of the work, procedures used, correspondences, and any deviations from the procedural records. Documentation errors will be corrected by drawing a single line through the error so that it remains legible and writing the correction adjacent to the error; the change will be initialed by the responsible individual, along with the date of change.

10. Interim Site Characterization Report

The results of the sub-slab soil gas sampling will be integrated into the Interim Site Characterization Report that provides the results of the completed interim remedial and characterization activities.

Figures



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April 2025

Twin Oaks – Newark 14"-Diameter Pipeline-
LNAPL Incident : Site Characterization Work Plan

Figure 1
Site Location Map

Upper Makefield Township
Bucks County, Pennsylvania

Figure
1

Produced Using Esri's ArcGIS Software

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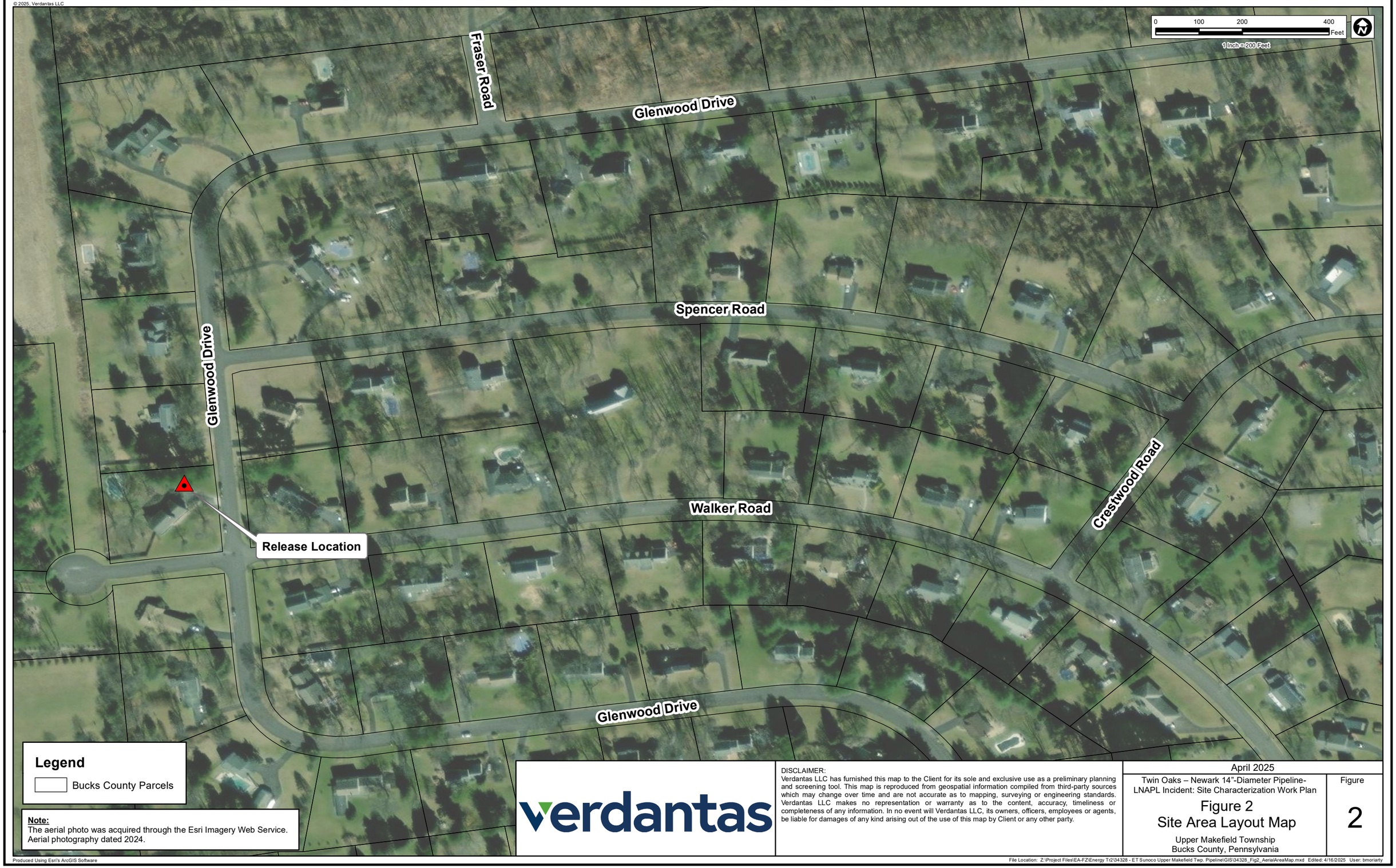

Legend

Bucks County Parcels

Note:
The aerial photo was acquired through the Esri Imagery Web Service. Aerial photography dated 2024.

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April 2025

Twin Oaks – Newark 14"-Diameter Pipeline-
LNAPL Incident: Site Characterization Work Plan

Figure 2
Site Area Layout Map

Upper Makefield Township
Bucks County, Pennsylvania

Figure
2

Produced Using Esri's ArcGIS Software

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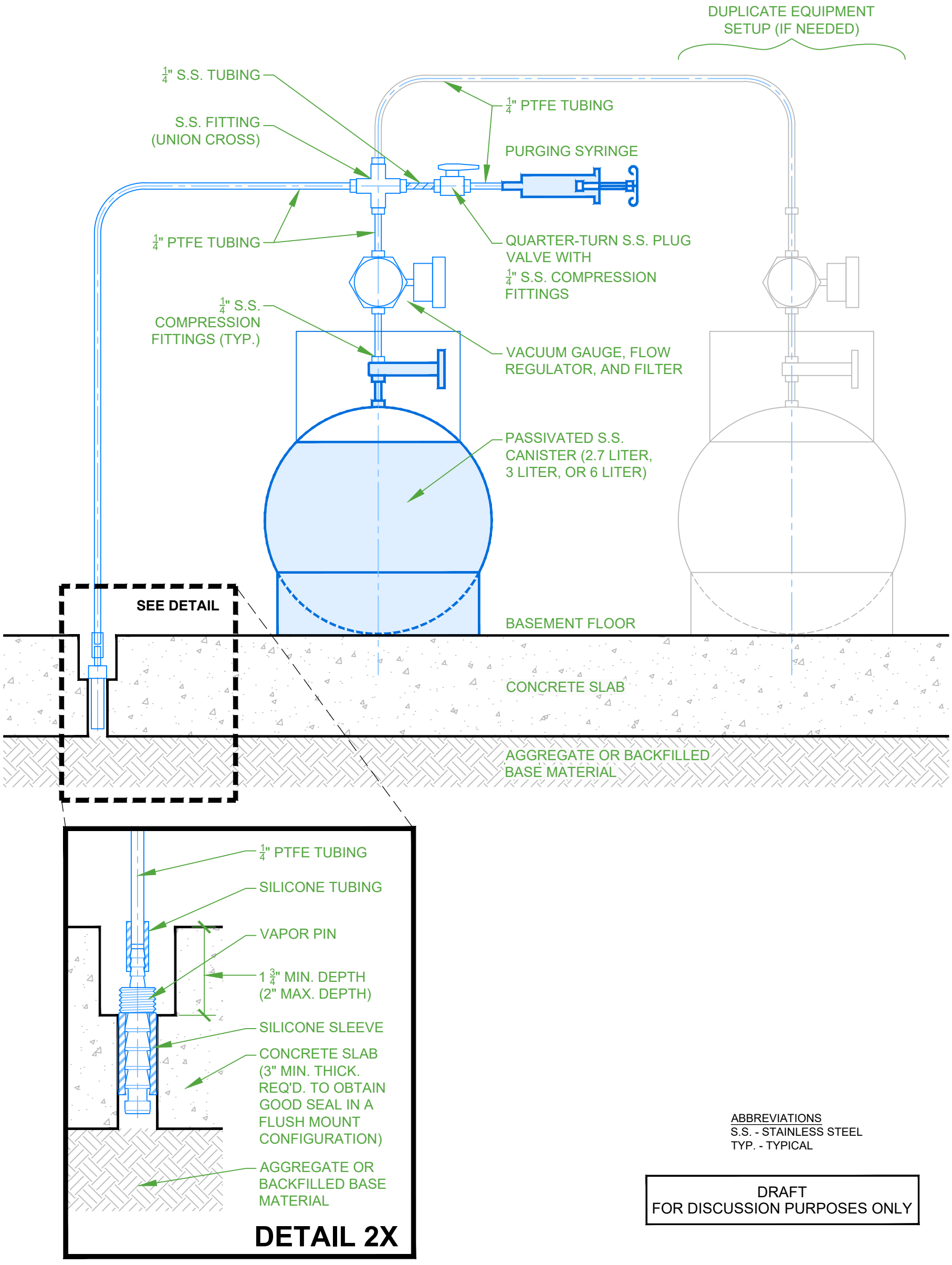

ABBREVIATIONS
S.S. - STAINLESS STEEL
TYP. - TYPICAL

DRAFT
FOR DISCUSSION PURPOSES ONLY

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Bucks County, Pennsylvania
Upper Makefield Township

Schematic of Sub-Slab Soil Gas Sampling Train

ET - Sunoco Twin Oaks
Newark Pipeline Incident

Project Number	34328
Date	05/14/2025
Author	JPB
Scale	1:4 SCALE
Figure	3

Attachment A

Pre-Sampling Survey Form

INDOOR AIR QUALITY QUESTIONNAIRE AND BUILDING SURVEY

Date/Time: _____ Collector(s)_____

Location (Address): _____
_____

1. Access Contact

Name: _____
Address: _____
_____
Home Phone: _____ Work Phone: _____

2. **Access Agreement Signed? ____ (DO NOT PROCEED WITHOUT SIGNED AGREEMENT)**

3. Are you the Owner □ Renter □ Other □ (please specify) _____
of this Property/Structure?

4. Mail Results to:

Name	Address	Phone	Owner/Renter/Other

5. Number of current occupants at this location ? _____

6. How long have you owned/rented/leased at this location? _____

7. Building Characteristics

7.1. Type of Building (check only one):

Single Family Home □ School □ Commercial/Multi-Use □ Industrial □ Church □
Other □ _____

If this is a residential property, specify form:

Ranch	□	2-Family	□	3-Family	□
Raised Ranch	□	Split Level	□	Colonial	□
Cape Cod	□	Contemporary	□	Mobile Home	□
Duplex	□	Apartment	□	Condominium	□
Modular	□	Log Home	□	Other (specify) _____	□

7.2. If Multiple Units, How Many? _____

7.3. If the property is commercial, type?

Business Type(s)_____
Does it include residences (i.e.multi-use)? Y / N If yes, how many?_____

7.4. Number of floors _____

Floor Level	General Use Description
Basement	
First Floor	
Second Floor	
Third Floor	

7.5. Approximate age of building _____years, Not sure/Unknown □

7.6. Has the building been weatherized with the following (check all that apply):

Insulation □ Storm Windows □ Energy Efficient Windows □

Other □ (specify) _____

8. Building Construction Characteristics (check all that apply)

8.1. Above grade construction:

Wood frame □ Brick □ Concrete □ Cement Block □ Other □ _____

8.2. Basement/lowest-level type:

Full □ Crawlspace □ Concrete Slab-on-Grade □ Other □ _____

8.3. Basement/lowest-level depth below grade (estimate in feet):

front _____ rear _____ side 1 _____ side 2 _____

8.4. Basement/lowest-level floor:

Concrete Slab □ Earthen (dirt) □ Fieldstone □ Other □ _____

8.5. Basement/lowest-level floor covering:

None □ Paint □ Linoleum □ Vinyl □

Ceramic Tile □ Wood □ Carpet □ Other □ _____

8.6. Basement/lowest-level floor sealed?:

unsealed □ sealed □ sealed with? _____

8.7. Foundation walls:

Poured concrete □ Concrete Block □ Fieldstone □ Other □ _____

8.8. Foundation walls sealed?:

unsealed □ sealed □ sealed with? _____

8.9. The basement/lowest-level is:

unfinished □ finished □ partially finished □

9. Basement/lowest-level use:

Playroom/den □ Bedroom □ Workshop □ Laundry □

Storage □ Office □ Retail □ Other □ _____

10. Basement/lowest-level occupancy

Full time □ Occasionally □ Seldom □ Almost Never □

11. Does the basement/lowest-level have any of the following?

Wall cracks □	Floor cracks □	Pipes/utility conduits through wall □	Pipes/utility conduits through floor □
Floor drain(s) □ If yes, unsealed or sealed, connected to sewer/storm, or dry well (circle all that apply if known)		Sump □ If yes, is water present, connected to sewer/storm, or dry well (circle all that apply if known)	Other floor or wall penetration □ (describe)_____ _____ _____

12. Building Heating and Ventilation Systems (check all that apply)

12.1. Type of Heating system(s)

Forced hot air □ Forced hot water □ Steam radiation □ Electric baseboard □

Radiant floor □ Wood stove □ Kerosene heater □ Other □ _____

12.2. Type of fuel

Natural gas □ Fuel oil □ Kerosene □ Electric □

Propane □ Wood □ Coal □ Other □ _____

12.3. Location of boiler/furnace

Basement/lowest-level □ First floor or higher □ Other □ _____

12.4. Air Conditioning

Central Air □ Window Units □ Open Windows □ None □

12.5. Air ducts present in basement/lowest-level? Yes / No
If yes, is duct work sealed? Yes / No
If yes, is there a cold air return (air intake) in the basement/lowest-level? Yes / No

12.6. What type of cooking appliance do you have**?** Electric □ Gas □ Other □ _____
Is there a stove exhaust hood present? Yes □ No □
Does it vent to the outdoors? Yes □ No □

12.7. Are there other ventilation systems present in the building?

Mechanical fans □ Bathroom fans □ Other □ _____

13. Other Building Characteristics

13.1. Does the home have an attached garage? Yes □ No □ Type _____
If so, is a car usually parked in the garage? Yes □ No □

13.2. Water Heater Type: Gas □ Electric □ By furnace □ Other □ _____
Water heater location: Basement □ Upstairs utility room □ Garage □ Other □ (please describe)
_____

14. What is the source of drinking water (check all that apply)?

Public water supply □ Private well □ Bottled water □ Other, please specify _____

15. Do you have a private well for purposes other than drinking? Yes □ No □
If yes, please describe what you use the well for: _____

16. Do you have a septic system? Yes □ No □ Not used □ Unknown □

17. Do you have standing water outside your home (pond, ditch, swale)? Yes □ No □

18. Does the basement have a moisture problem (check one only)?

Wet - Yes, frequently (3 or more times/yr) □

Damp - Yes, occasionally (1-2 times/yr) □

Yes, rarely (less than 1 time/yr) □

Dry - No □

19. Does the basement ever flood (check one only)?

Yes, frequently (3 or more times/yr) □

Yes, occasionally (1-2 times/yr) □

Yes, rarely (less than 1 time/yr) □

No □

20. Are any of the following present in the basement/lowest-level of the building? (Check all that apply)

Potential VOC Source	Location of source	Removed 24 hours prior to sampling (Yes/No/NA)
Paints or paint thinners		
Gas-powered equipment		
Gasoline storage cans		
Cleaning solvents		
Air fresheners		
Oven cleaners		
Carpet/upholstery cleaners		
Hair spray		
Nail polish/polish remover		
Bathroom cleaner		
Appliance cleaner		
Furniture/floor polish		
Moth balls		
Fuel tank		
Wood stove		
Fireplace		
Perfume/colognes		
Hobby supplies (e.g., solvents, paints, lacquers, glues, photographic darkroom chemicals)		
Scented trees, wreaths, potpourri, etc.		
Other		
Other		

21. Have you recently (within the last six months) done any painting or remodeling in your home?

Yes □ No □
If yes, please specify what was done, where in the home, and what month:
_____

22. Are there any pressed wood products in the building (ex., hardwood, plywood, wall paneling, particle board, fiber board)? Please specify_____

23. Have you installed new carpeting in your home within the last year? Yes □ No □
If yes, when and where? _____

24. Do you regularly use or work in a dry cleaning service (check only one box)?

Yes, use dry-cleaning regularly (at least weekly) □

Yes, use dry-cleaning infrequently (monthly or less) □

Yes, work at a dry cleaning service □

No □

25. Does anyone in your home use solvents at work?

Yes □ If yes, how many persons?_____

No □ If no, go to question 27

26. If yes for question 25 above, are the work clothes washed at home? Yes □ No □

27. Where is the washer/dryer located?

Basement □

Upstairs utility room □

Kitchen □

Garage □

Use a Laundromat □

Other, please specify □ _____

28. If you have a dryer, is it vented to the outdoors? Yes □ No □

29. Has your home had termite or other pesticide treatment? Yes □ No □ Unknown □
If yes, please specify type of pest controlled, _____
and approximate date of service _____

30. Smoking in Home:
None □, Rare (only guests) □, Moderate (residents light smokers) □,
Heavy (at least one heavy smoker in household) □
Has anyone smoked in the building in the last 48 hours? Yes □ No □

31. Do you regularly use air fresheners? Yes □ No □

32. Does anyone in the home have indoor home hobbies of crafts involving: None □
Heating □ Soldering □ Welding □ Model glues □ Paint □ Spray paint □
Wood finishing □ Other □ (Please specify what type of hobby):_____
_____

33. General family/home use of consumer products (please circle appropriate): Assume that:
Never = never used, **Hardly ever** = less than once/month, **Occasionally** = about once/month, **Regularly** = about once/week, and **Often** = more than once/week.

Product	Frequency of Use				
Spray-on deodorant	Never	Hardly ever	Occasionally	Regularly	Often
Aerosol deodorizers	Never	Hardly ever	Occasionally	Regularly	Often
Insecticides	Never	Hardly ever	Occasionally	Regularly	Often
Disinfectants	Never	Hardly ever	Occasionally	Regularly	Often
Window cleaners	Never	Hardly ever	Occasionally	Regularly	Often
Spray-on oven cleaners	Never	Hardly ever	Occasionally	Regularly	Often
Nail polish remover	Never	Hardly ever	Occasionally	Regularly	Often
Hair sprays	Never	Hardly ever	Occasionally	Regularly	Often

34. Please check weekly household cleaning practices:

Dusting □

Dry sweeping □

Vacuuming □

Polishing (furniture, etc.) □

Washing/waxing floors □

Other □ _____

35. Are any pesticides/herbicides applied in the yard or to the garden? If so, what chemicals are used and how often are they applied?

_____
_____

36. Are there any mobile emission sources in the vicinity of the building (ex., highway, bus stop, high traffic area)?

_____

37. Comments: Is there any other information about the building, the habits of its occupants or potential sources for chemical contaminants to the indoor air that may be of importance in facilitating the evaluation of the indoor air?

_____
_____
_____
_____
_____
_____
_____

Attachment B

Detailed Vapor Pin® Product Documentation

Standard Operating Procedure

Installation and Extraction
Vapor Pin® Sampling Device

Scope & Purpose

Scope

This standard operating procedure describes the installation and extraction of the Vapor Pin® Sampling Device 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® Sampling Device.

Equipment Needed

- Vapor Pin® Sampling Device
- Vapor Pin® Sleeves
- Vapor Pin® Cap
- Installation/Extraction Tool
- Rotary Hammer Drill
  - ⅝-Inch (16mm) diameter hammer bit
  - 1½-Inch (38mm) diameter hammer bit for flush mount applications
- ¾-Inch (19mm) diameter bottle brush
- Wet/Dry Vacuum with HEPA filter (optional)
- Dead Blow Hammer
- VOC-free hole patching material (hydraulic cement) and a putty knife or trowel
  - This is for repairing the hole following the extraction of the Vapor Pin® Sampling Device

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. For a temporary installation, drill a ⅝-inch (16mm) diameter hole through the slab and approximately 1-inch (25mm) into the underlying soil to form a void. The hole must be ⅝-inch (16mm) in diameter to ensure a seal.
   - If a flush mount installation is required, drill a 1½-inch (38mm) diameter hole at least 1¾-inches (45mm) into the slab. We highly recommend using the Stainless Steel Drilling Guide and to reference the Standard Operating Procedure Drilling Guide & Secure Cover.
4. Remove the drill bit, brush the hole with the bottle brush and remove the loose cuttings with the vacuum.
5. Assemble the Vapor Pin® Sampling Device and Vapor Pin® Sleeve (Figure 1).
6. Place the lower end of the Vapor Pin® Sampling Device 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.
   - During installation, the Vapor Pin® Sleeve may form a slight bulge between the slab and the Vapor Pin® Sampling Device shoulder.
7. Place the Vapor Pin® Cap on the Vapor Pin® to prevent vapor loss prior to sampling (Figure 3).
8. 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).
9. Allow 20 minutes or more (consult applicable guidance for your situation) for the sub-slab soil-gas conditions to re-equilibrate prior to sampling.

Figure 1.

Figure 2.

Figure 3.

Figure 4.

Sampling

1. Remove the Vapor Pin® Cap and connect your sample tubing to the barb fitting of the Vapor Pin® Sampling Device.
2. Create a connection by using a short piece of Tygon™ tubing to join the Vapor Pin® Sampling Device with the Nylaflow tubing (Figure 5). Put the Nylaflow tubing as close to the Vapor Pin® Sampling Device as possible to minimize contact between soil gas and Tygon™ tubing. You do not **have** to use Nyflaflow tubing, any stiff tubing will suffice.
3. Prior to sampling, conduct a leak test in accordance with applicable guidance. If a leak test is not specified, refer to the SOP Leak Testing the Vapor Pin® Sampling Device, via Mechanical Means (Figure 6). For flush-mount installations, distilled water can be poured directly into the 1½ inch (38mm) hole.

Figure 5.

Figure 6.

Figure 7.

Extraction Procedure & Reuse Notes

1. Remove the protective cap, and thread the Installation/Extraction Tool onto the Vapor Pin® Sampling Device (Figure 7). Turn the tool clockwise continuously, don't stop turning, the Vapor Pin® Sampling Device will feed into the bottom of the Installation/Extraction Tool and will extract from the hole like a wine cork, **DO NOT PULL!**
2. Fill the void with hydraulic cement and smooth with a trowel or putty knife.
3. Prior to reuse, remove the silicon Vapor Pin® Sleeve and Vapor Pin® Cap and discard. Decontaminate the Vapor Pin® Sampling Device in a Alconox® solution, then heat in an oven to a temperature of 265° F (130°C). For Stainless – ½ hour, Brass 8 minutes.

Standard Operating Procedure

Drilling Guide & Secure Cover

Scope & Purpose

Scope

This standard operating procedure (SOP) describes the methodology to use the Vapor Pin® Sampling Device Drilling Guide and Secure Cover to install and secure a Vapor Pin® Sampling Device in a flush mount configuration.

Purpose

The purpose of this SOP is to detail the methodology for installing a Vapor Pin® Sampling Device and Secure Cover in a flush mount configuration. The flush mount configuration reduces the risk of damage to the Vapor Pin® Sampling Device by foot and vehicular traffic, keeps dust and debris from falling into the flush mount hole, and reduces the opportunity for tampering.

Equipment Needed

- Vapor Pin® Sampling Device Secure Cover (Figure 1)
- Vapor Pin® Sampling Device Drilling Guide (Figure 2)
- Rotary Hammer Drill
  - ⅝-Inch (16mm) diameter hammer bit
  - 1½-Inch (38mm) diameter hammer bit for flush mount applications
- Assembled Vapor Pin® Sampling Device
- #14 Spanner Wrench
- Wet/Dry vacuum with HEPA filter (optional)
- Personal Protective Equipment (PPE)

Figure 1

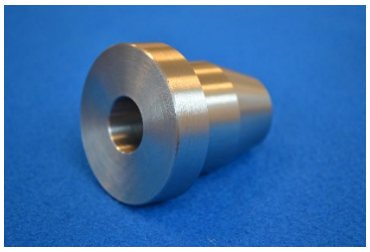

Figure 2

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. While wearing PPE, drill a 1½-inch (38mm) diameter hole into the concrete slab to a depth of approximately 1¾-inches (45mm). Pre-marking the desired depth on the drill bit with tape will assist in this process.
4. Remove cuttings from the hole and place the Drilling Guide in the hole with the conical end down (Figure 3). The hole is sufficiently deep if the flange of the Drilling Guide lies flush with the surface of the slab. Deepen the hole as necessary but avoid drilling more than 2 inches (50.8mm) into the slab, as the threads on the Secure Cover may not engage properly with the threads on the Vapor Pin® Sampling Device.
5. When the 1½-inch (38mm) hole is drilled to the proper depth, replace the drill bit with a ⅝-inch (16mm) bit, insert the bit through the Drilling Guide (Figure 4), and drill through the slab. The Drilling Guide will help to center the hole for the Vapor Pin® Sampling Device and keep the hole perpendicular to the slab.
6. Remove the bit and drilling guide, clean the hole, and install the Vapor Pin® Sampling Device in accordance with the SOP “Installation and Extraction of the Vapor Pin® Sampling Device.”
7. Screw the Secure Cover onto the Vapor Pin® Sampling Device and tighten using a #14 Spanner Wrench by rotating it clockwise (Figure 5). Rotate the cover counterclockwise to remove it for subsequent access.

Standard Operating Procedure

Leak Testing the Vapor Pin® Sampling Device Via Water Dam

Scope & Purpose

Scope

The operating procedure describes the methodology to test a Vapor Pin® Sampling Device or equivalent sub-slab sampling device for leakage of indoor air.

Purpose

The purpose of this procedure is to assess the potential for indoor air to leak past the Vapor Pin® Sampling Device.

Equipment Needed

- Water Dam
- Distilled water
- VOC free modeling clay or equivalent
- Vapor Pin® Sampling Device and associated sample tubing

Procedure

1. Drill a ⅝-inch (16mm) hole in the concrete slab and install the Vapor Pin® Sampling Device as per the Standard Operating Procedure (SOP).
2. Clean the slab within a 2-inch radius of the Vapor Pin® Sampling Device to remove 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 piece of scrap modeling clay.
3. Roll a 1-inch diameter ball of modeling clay between your palms to form a “snake” approximately 7 inches long and press it against the end of the water dam. Push the water dam gently against the slab to form a seal with the concrete.
4. Attach the sample tubing to the top of the Vapor Pin® Sampling Device and pour enough distilled water into the water dam to immerse the base of the Vapor Pin® and the tubing connection at the top of the Vapor Pin® Sampling Device.
5. Purge the sample point as required by the data quality objectives. Concrete will absorb some of the water, which is normal; however, if water is lost to the sub-slab, stop, remove the water from the water dam, and reposition the Vapor Pin® Sampling Device to stop the leakage. Reseat the leak test equipment, if needed.
6. If the Vapor Pin® Sampling Device is installed in the flush-mount configuration, the larger hole can be filled with water in place of the water dam modeling clay.

Figure 1. Water dam used for leak detection

Attachment C

Air Sampling Field Data Sheet

GROUNDWATER SCIENCES CORPORATION

Soil Vapor Field Data Sheet

GENERAL INFORMATION

Project Number:_____

Sample Location/SV Point ID:_____ Site:_____

Vapor Point Completion: Permanent / Temporary / Other:_____ (circle one)

Physical Point/Sample Location Condition:_____

PURGING

Date: _____ Personnel: _____ Air Temp: _____ Skies: _____ Wnd Spd/Drctn: _____

TD: _____ (ft) Required Purge Vol: (TD x C F (below)) _____ (ml)

Method: _____ Start Time: _____ Stop Time: _____ Volume Purged: _____ (ml)

Comments: _____

Conversion Factors *(point diameter (ID) – milliliters per foot of well):(r^2 π) x 196.65= ml/ft (r = radius of point in inches)*

3/16" – 5.43 ml/ft **1/4" – 9.65 ml/ft** **3/8" – 21.7 ml/ft**

SAMPLING

Sample ID: | | | | | | | | | | | | |

Sample Type: Vapor Point
(circle one) Substructure

Personnel: _____ Air Temp: _____ Skies: _____ Wnd Spd/Drctn: _____

CANISTER NUMBER:_____ **REGULATOR NUMBER**:_____ Canister Size:_____

Noticeable Odor: YES / NO Description of Odor:_____

Field Screening: PID / FID / Other / NA Reading: _____ (ppmv) Duplicate Sample Collected: YES / NO

START DATE: _____ START TIME: _____ START VACUUM: _____ (in/Hg)

STOP DATE: _____ STOP TIME: _____ STOP VACUUM: _____ (in/Hg)

Sampler's Signature: _____

LABORATORY INFORMATION

Laboratory: _____ Turnaround Time (TAT): _____ Number of Containers: _____

Date Shipped or Delivered: _____ Method of Delivery to Laboratory: _____

Analyses Requested: _____

_____

ADDITIONAL NOTES