Cover Sheet
Standard Operating Procedure

Operation Title: **Protocol for Collecting Sub-Slab Soil Gas Samples**

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1.0 Applicability

This Standard Operating Procedure (SOP) applies to all programs in the Maine Department of Environmental Protection's (MEDEP) Division of Remediation (DR). It may be utilized by other Divisions within MEDEP, as determined by the respective Division Directors or their designees.

This SOP is not a rule and is not intended to have the force of law, nor does it create or affect any legal rights of any individual, all of which are determined by applicable statutes and law. This SOP does not supersede statutes or rules.

2.0 Purpose

The purpose of this document is to describe the MEDEP/DR procedure for collecting soil gas samples from the interstitial spaces immediately beneath the concrete floors of buildings.

3.0 Key Definitions

SUMMA® Canister: Stainless steel vessel with an internally passivated (inert) surface used to collect air samples for analyzing Volatile Organic Compounds (VOCs).

4.0 Responsibilities

All MEDEP/DR Staff must follow this procedure when performing this task. All Managers and Supervisors are responsible for ensuring that their staff are familiar with and adhere to this SOP. MEDEP/DR staff reviewing data by outside parties should ensure that this SOP (or an equivalent) was followed, depending on the specific Data Quality Objectives (DQOs) of the task.

Other MEDEP SOPs may also apply when performing this task, including, but not limited to MEDEP/DR SOP *RWM-DR-014 - Development of a Sampling and Analysis Plan* (SAP). The SAP should consider quality assurance and quality control (QA/QC) samples and measures, the specifics of which will depend on the DQOs for the task. Types of QA/QC samples are discussed in more detail in the DR Quality Assurance Plan (QAP). SAP development includes provisions for creating a Health and Safety Plan (HASP) associated with the activity, including compliance with Dig Safe notifications when disturbing soil with powered equipment or tools (i.e., not hand tools). Dig Safe notification does not include public utility clearance requests which must be completed separately (e.g., sewer and water lines). These utility marking requests typically do not extend onto marking private property (i.e., they may only mark lines in the public right of way), so hiring a private utility marking company may be necessary, depending on site specifics. Fieldwork and data collection tasks must be properly documented in accordance with applicable MEDEP SOPs and policies.

5.0 Guidelines and Procedures

5.1 Preparation

When evaluating vapor transport, it is important to identify preferential vapor pathways that are created by relatively permeable non-native fill associated with site development. Utility trenches are of particular importance because they can facilitate the transport of both vapor and groundwater. At a minimum, a Conceptual Site Model (CSM) should identify potential site sources (e.g., current and former underground storage tanks, petroleum dispensers, dry cleaning machines and ventilation hoods, etc.), preferential pathways (and interrelationships), surface water drainage patterns (both natural and man-made or influenced), and the closest receptors in all directions from the site.

In certain situations, sewer utilities may be secondary vapor sources as a result of chemical handling and disposal and the age of the sewer. Vapor samples from the utility corridor will provide information on the strength of the secondary source.

NOTE: Sub-slab sampling will involve the drilling of a hole in the basement floor of the building. The owner of the property where the sub-slab gas sampling occurs must be made fully aware and approve of the sampling event and any follow-up monitoring planned. Additionally, the owner/operator of the building should identify any sub-slab utilities, foundation/column footings, vapor barriers, radon sub-slab depressurization systems, and any other foundation structures that might impact the results or collection of sub-slab soil gas samples.

5.2 Sampling Plan

A thoroughly developed Conceptual Site Model (CSM) is imperative for effective sub-slab soil gas sampling. Special considerations should be made to determine the presence of preferential soil vapor pathways (e.g., utility corridors with more permeable backfill) for contamination into nearby buildings, and appropriate locations and methodology to ensure proper sampling locations are selected. Potential on-site or off-site sources of contamination or cross contamination should be noted (e.g., active or historical gas stations, dry cleaners, body shops, etc.).

5.3 Scheduling

It should be noted that sampling during times when soil pores are water-filled (spring thaw, extended rain events, or heavy short duration rain events greater than 0.25 inches over an 8-hour period) may lead to the collection of non-representative sub-slab soil gas samples, biasing results low. For this reason, rain dates should be planned in the proposed field work schedule. The exception may be when the site surrounding the building has limited exposed soils, or is covered with impervious surfaces, and has adequate stormwater drainage that restricts soil pores from becoming saturated.

5.4 Equipment

- Cordless or corded hand hammer rotary drill Peristaltic pump
- Masonry drill bit, 3/8 to 5/8-inch diameter x 8-10 inches long
- Extension cord(s) (if necessary)
- Peristaltic Pump
- Hydraulic cement or equivalent for patching concrete
- Differential Pressure Gage (optional)
- Appropriate tubing, typically LDPE, see section regarding tubing selection below
- Hydrated bentonite clay for sealing around tubing
- Photo-ionization Detector (ppb level recommended)
- Multi-gas meter for oxygen and carbon dioxide
- Sub-Slab Soil gas sampling field sheet (updated as of effective date or newer, see Attachment A)
- Sample containers and flow controllers supplied by laboratory (e.g., SUMMA® Canister)
- Adjustable wrenches for connecting flow controller to SUMMA® Canister

Only SUMMA® Canisters are discussed in this SOP as they are currently used for most sub slab soil vapor applications at MEDEP, however other types of sample containers or technologies can be considered (e.g., sorbent tubes, tedlar bags, etc.). When deciding which container to use, staff should consider the DQOs for the sample and the availability of a laboratory capable of analyzing the sample that is both state certified and capable of reaching required detection limits. Additional container types will be considered on a case-by-case basis.

SUMMA® Canisters must be ordered from a laboratory in advance of the sampling event. The canisters are received sealed and under vacuum pressure. Once opened, air is drawn in through the laboratory supplied regulator.

The laboratory must certify that the canister has been appropriately cleaned prior to shipment. Laboratory certification can be done on individual canisters or from one representative can in a batch, depending on project DQOs. The laboratory will need to be informed as to the sample collection method used and the duration of collection time prior to shipping the SUMMA® Canisters and regulators for the sampling event. Unused canisters will be sent back to the laboratory.

With the advancement of technology, it may be possible to utilize alternative analytical methods (field laboratory methods) that are not Maine certified. Such alternatives will be considered on a case-by-case basis and will likely require confirmation with SUMMA® Canister sampling. Such alternative methods will likely be considered screening within the context of a vapor intrusion investigation and are dependent on DQOs.

5.5 Tubing Considerations

Tubing used for vapor sampling is usually a flexible, low-density polyethylene plastic tubing (LDPE). Certain volatile chemicals (especially those found in petroleum products) may interact with certain types of tubing used for collecting samples. These interactions will affect the quality of sample results and may require contaminant specific tubing, such as Teflon-lined tubing (e.g., when sampling for petroleum vapors). Therefore, contaminants of concern for the site should be determined before collecting samples (refer to the Site's CSM). If tubing interaction is a concern, the laboratory and /or the DEP Chemist in the DEP's Division of Technical Services should be consulted prior to sample collection to ensure appropriate tubing is used. The type of tubing used should be documented in field notes or on sample collection forms. **Disposable tubing should be used at each sample location.**

5.6 Sample Collection Duration and Rate

The sample collection duration and rate will depend on the DQO for the project. Sub-slab soil gas sample rates should not exceed 200 mL/min. In general, the collection of sub-slab soil gas samples usually takes less than 30 minutes.

Together, the sample duration, list of analytes, laboratory methods, DQOs, QA/QC measures), and desired reporting limits will determine the appropriate sample type and volume.

6.0 Sample Collection Procedure

NOTE: This SOP relies on the use of carbon dioxide (CO_2), and to a lesser degree, oxygen (O_2), as tracer gases for surface leakage, as described above. The contrast between ambient air concentrations and soil gas concentrations in addition to pre-sample and post-sample soil gas concentrations provides sufficient information on whether ambient air is mixing with soil gas, which can bias results low. Other methods of determining ambient air influence may also be used, such as a helium shroud, however those methods are not covered in this SOP.

6.1 If a permanent monitoring point is in place already (e.g., permanent implant such as a Vapor Pin®), inspect the pin and connect tubing directly to it and proceed to the purging sample tubing step below. If no permanent monitoring point is present, proceed to the next step to create a temporary monitoring hole.

6.2 Using the hammer rotary drill and 3/8 to 5/8-inch diameter drill bit, drill a hole through the cement floor slab of the building. If dust prevention is necessary, use water or vacuum, as appropriate.

6.3 After drilling the hole through the concrete slab, evaluate and note the sub-slab conditions, if possible. The conditions and DQOs will determine the appropriate intake depth(s) for the sub-slab sample(s). Conditions to be noted include the presence of a vapor barrier, bedrock, groundwater, pipes, underdrain, void spaces, soil conditions (native, backfill), and general soil type (silt, clay, sand, gravel). Sample tubing can be placed directly into the sub-slab environment, generally extending to the bottom of the concrete slab or just below as there is often a small void space below the slab. New tubing should be used at each sample location.

6.4 Note: Care should be taken to reduce cross-contaminating sub-slab soil vapor and indoor air vapors. This should be done by sealing the sample point with pre-mixed hydrated bentonite clay, or equivalent, around the tubing where it penetrates the top of the concrete slab.

6.5 Purge sample tubing and device with a peristaltic pump for approximately 1-minute per foot of sampling depth. This clears stagnant air from the tubing and ensures that groundwater is not present. If groundwater is present, a different location or sample depth must be selected.

6.6 Record sample data on Sub-slab Soil Gas Field Sheet (see Attachment A), including ambient O_2, CO_2, PID. An elevated CO_2 reading compared to ambient conditions is an indication that representative sub slab vapors are being collected. CO_2 will typically be as much as 10 times the ambient concentration compared to subsurface. Sometimes O_2 levels will be below ambient values, but elevated CO_2 is the best indicator of a good seal with no ambient air being short circuited into the sampling train. If elevated CO_2 concentrations are not observed, try resealing around the penetration or try a new location. New tubing should be used at each sample location. If duplicate samples are being collected, a “t” fitting should be used to simultaneously collect two samples at once. If using pore water rods, bring multiple rods so that you do not need to decontaminate them in the field

6.7 Connect flow control regulator assembly to canister. Using the appropriate fittings (Swagelok® or similar) connect the controller assembly to the canister and tighten using two adjustable wrenches. Tighten snugly but do not overtighten. Note that some laboratories supply “quick connect” fittings that connect and release, which substitute threaded fittings with tightening nuts. Open canister and record initial vacuum, start time, canister ID, and controller ID as appropriate.

6.8 Sketch accurate sample location using available landmarks and site features so others not present can find the sample location with ease.

6.9 Efforts should be made to shut off the canister valve while there is still a negative pressure vacuum in the canister (between -1 and -4 inches of mercury) to prevent sample loss. It is important not to allow the canister to equilibrate to atmospheric pressure during the sampling period. Allowing the canister to reach an ambient pressure may invalidate the data since the lab cannot confirm whether the canister is faulty. If the lab receives the canister with a vacuum on it, it confirms the canister has not leaked after the sample was collected, indicating the canister has not leaked.

6.10 Record post-sample O_2, CO_2, PID from the tubing after disconnecting the sample container. A significant change in concentrations can indicate that the tubing seal was disturbed during sampling and should be noted on field forms and in report QA/QC summary since the sample may not be representative.

6.11 Remove sampler or secure permanent sampler and patch concrete penetration with hydraulic cement or equivalent.

7.0 References

- **EPA's Technical Guide for Assessing and Mitigating the Vapor Intrusion Pathway from Subsurface Vapor Sources to Indoor Air (EPA, June 2015)**
- **DEP's Supplemental Guidance for Vapor Intrusion of Chlorinated Solvents and other Persistent Chemicals (February 5, 2016)**

ATTACHMENT A

Sub-Slab Soil Gas Field Sheet

		Sample Location Sketch
Site Name:		
Town:		
Date:		
Sample I.D.:		
Project Manager:		
Sampling Personnel:		
Collection Device:	(Summa Can) (Other)	
Sample Type:	(Subslab) (Other)	
Sampling Location:		
Foundation Floor Type:	(Dirt) (Concrete)	
Foundation Wall Type:	(Concrete) (Block) (Stone) (Brick) (Slab on Grade)	
Sump Hole:	(Yes) (No)	
Penetrations in Floor:	(Sewer) (Water) (Gas) (Cracks) (Drains)	
Penetrations in Wall:	(Sewer) (Water) (Gas) (Electric) (Cracks)	
Suspected COCs:	(Petroleum) (Solvents)	
Cannister I.D.:		
Flow Control I.D.:		
Flow control rate:		
O_2 Ambient		
CO_2 Ambient		
PID Ambient		
Pre-Sample: O_2		
Pre-Sample CO_2:		
Pre-Sample PID:		
Sample Initiation Time:		
Initial Vacuum:		
Sample End Time:		
Final Vaccum:		
Post Sample O_2:		
Post Sample CO_2:		
Post Sample PID:		
Notes/Observations:		