COVERSHEET
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 is also applicable to all parties that may submit data that will be used by the MEDEP/DR.

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 vapor samples from the interstitial spaces immediately beneath the concrete floors of buildings.

3.0 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 procedure. MEDEP/DR staff reviewing data by outside parties are responsible for assuring that the procedure (or an equivalent) was utilized appropriately.

4.0 GUIDELINES AND PROCEDURES

4.1 SAMPLING PLAN

A well-developed Conceptual Site Model (CSM) is imperative for effective soil gas sampling. Prior to conducting any sampling event, a Sampling and Analysis Plan (SAP) should be developed (see MEDEP/DR SOP# RWM-DR-014 - Development of a Sampling and Analysis Plan). Special considerations should be made to determine the presence of preferential pathways for contamination into the building and appropriate locations and methodology to assure proper sampling locations are selected. Included in the sampling plan should be specifics regarding the anticipated substances of concern, data quality objectives, the name of the State certified laboratory conducting the analysis, sample containers and tubing for collection, and Quality Assurance/Quality Control (QA/QC).

It should be noted that sub-slab sampling will involve the drilling of a hole in the basement floor of the building. The owner of the property of the sampling must be made fully aware and approve of the sampling event and any follow-up monitoring planned. Work with the Office of Commissioner and Attorney General's Office to gain access when you cannot obtain landowner permission. 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.

If collection of soil gas will become part of a routine monitoring program, it is recommended that permanent monitoring points, such as Geoprobe® soil gas implant system, be utilized.

4.2 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 negatively affect collection of soil gas samples. For this reason, rain dates should be planned in the proposed field work schedule. The exception may be when the site is located in an area with little exposed soils and adequate stormwater drainage that restrict soil pores from becoming water filled.

4.3 EQUIPMENT

4.3.1 EQUIPMENT LIST

The Equipment used for the collection of soil gas samples when following this this SOP may include:

- Cordless hand hammer rotary drill
- Extension cord(s) (if necessary)
- Masonry drill bit, 3/8 to 5/8-inch diameter x 8-10 inches long
- Appropriate tubing (see Section 5.2.3)
- Geoprobe Soil Gas Implant system (Optional if placing a permanent monitoring point),
- Vacuum pump, such as peristaltic;
- Bentonite clay or modeling clay;
- Photo-ionization Detector (ppb level);
- Multi-gas meter for oxygen and carbon dioxide;
- Indoor air/sub-slab sampling field sheet (updated as of Effective Date or newer)
- Camera
- Hydraulic cement
- Containers and flow controllers (Summa Canister or Tedlar Bags, see Section 5.2.1 and 5.2.2)

4.3.2 SPECIFIC CONTAINER AND TUBING CONSIDERATIONS FOR SOIL VAPOR SAMPLING

Due to the nature of sub-slab soil gas sampling, additional planning must be undertaken in order to assure the appropriate sample collection/analysis methods and appropriate containers for a sampling event. Two types of sample containers are described in this SOP, Summa Canisters and Tedlar Bags. When deciding which container to use, staff should consider the data quality objectives (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.

4.3.2.1 SUMMA CANISTERS

A Summa canister is a clean metal container sealed with a vacuum. This vacuum is then used to draw in the gas sample. Summa canisters must be ordered from a laboratory in advance of the sampling event. Samples from Summa canisters are analyzed by certified labs only, and by methods which have been approved by EPA and have detection limits that generally meet the ambient air guidelines.

Summa canister samples can collect two types of samples: grab and time elapsed. Grab samples are collected utilizing the vacuum of the canister for a sample with a collection time of less than 30 minutes. Time elapsed samples are collected utilizing the vacuum of the canister over an extended period of time, up to and beyond 24 hours. Both sample types require a regulator between the tubing and canister to control the length of time the sample is collected. The regulator will be provided and calibrated by the laboratory conducting the analysis of the sample. The type and duration of sample should be indicated as part of the (SAP).

The laboratory certifies the summa canister has been appropriately cleaned prior to shipment. Laboratory certification can be done on individual canisters or from one representative can in a batch. **For sub-slab soil gas sample collection, personnel may use either individually certified clean canisters or batch certified clean canisters depending on the DQOs for the project.**

Clean Summa canisters must be obtained from the laboratory providing the analysis for each sampling event. Unused canisters will be sent back to the laboratory. 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.

4.3.2.2 TEDLAR BAG

A Tedlar bag is a bag manufactured from Tedlar (Polyvinyl fluoride) with a two-way valve. Tedlar bag samples require less time for planning because they can be ordered in advance and kept on hand until they are needed. However, the bags must be stored in a clean location. Laboratories capable of analyzing these samples are even more limited than the Summa Canisters. Holding time for Tedlar bag samples is 48 hours. However, Tedlar bags can be analyzed in the field with a mobile laboratory that is capable of providing the analysis, providing real time data. Due to detection limits for this analytical method (generally 10 times the indoor air standard for most compounds), Tedlar bag collection is most often used for screening purposes. There is no USEPA approved method; samplers using Tedlar bag collection must communicate with the laboratory conducting the analysis, prior to sampling, to be sure DQOs will be met. Due to the potential for cross-contamination, each group of Tedlar bags that are stored together for more than 1 hour should be accompanied with a zero-VOC field blank and at least one field duplicate. The field blank and duplicate should be analyzed after all the other environmental samples in the group.

4.3.2.3 TUBING SELECTION

Certain volatile chemicals (especially those found in petroleum products) may interact with certain types of tubing used for collecting samples. Tubing used for vapor sampling is usually a flexible, polyethylene-based tubing. These interactions will affect the quality of sample results and may require a contaminant specific tubing such as a 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 assure appropriate tubing is used. Type of tubing used should be noted in the field notes of the samplers.

4.3.2.4 SAMPLE COLLECTION DURATION/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 samples usually takes less than 30 minutes.

4.4 SAMPLE COLLECTION

If the sampling point is for one-time use, utilizing tubing inserted into the hole drilled in the slab will be sufficient. However, if the sampling is to be part of a long-term monitoring program, a more robust sampler, such as Geoprobe Systems permanent soil gas implant, can be used.

1) 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, cover the location with a towel/cloth and drill through a pre-cut hole in the cloth or use water where appropriate.

2) After drilling the hole through the concrete slab, evaluate and note the sub-slab conditions. The conditions and data quality objectives will determine the appropriate intake depth(s) for the sub-slab sample(s). Conditions to be noted include the presence of 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 or tubing can be attached to an anchor (implant) to hold the tube in place beneath the cement slab.

Note: Care should be taken to reduce cross contaminating sub-slab soil vapor and indoor air vapors. This may be done by backfilling the intake with filter sand below the slab and sealing the sample point with modeling clay or pre-mixed hydrated bentonite clay to the top of the cement slab.

3) Purge sample tubing and device with peristaltic pump for approximately 1minute per foot.

4) Record sample data on updated Soil Gas Sample Field Sheet, including ambient O_2, CO_2, PID (optional): pre-sample PID, O_2, and CO_2.

5) Connect Sample Device, record initial vacuum, start time, canister ID, and controller ID as appropriate.

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

7) When appropriate, stop sample collection with -1 to -4 in.H_20 pressure in canister and record final vacuum and sample end time.

8) Record post-sample O_2, CO_2, PID (optional).

9) Remove Sampler or secure permanent Sampler, backfill as appropriate using sand, bentonite, and seal floor using hydrated cement.

4.5 QUALITY CONTROL

Due to cross contamination and carry-over issues inherent with air collection and analysis, data quality objectives (DQOs) should be stated in the sampling and analysis plan (SAP). Quality Assurance/Quality Control (QA/QC) samples may be collected if needed to meet your data quality objectives. The following typical types of QA/QC samples should be collected as part of the QA/QC program for soil gas sample collection. For an additional discussion of QA/QC, please refer to the MEDEP/DR Quality Assurance Plan, Sections 4 and 8.

4.5.1 EQUIPMENT BLANKS

When Tedlar bags are used equipment blanks should be collected at a rate of 5%, which is equivalent to one (1) equipment blank every twenty (20) samples collected. The equipment blank will consist of purging a complete drive rod and closed point system with zero air and collecting the air for analysis in a Tedlar bag.

4.5.2 DUPLICATE SAMPLES

It is recommended that duplicate samples be collected at a rate of 10% to assess sample location variability.

4.5.3 BACKGROUND/AMBIENT AIR SAMPLES

Depending on the DQOs for the sampling event, background/ambient air samples may or may not be appropriate to assess ambient air conditions. If background/ambient air samples are determined to be necessary, the rationale should be outlined in the SAP.

4.5.4 TRIP BLANK

A trip blank should be collected when utilizing Tedlar bags as sample containers. The trip blank will consist of a Tedlar bag filled from a canister of zero air.

4.5.5 TRACER GAS DISPERSION

This SOP relies on the use of carbon dioxide, and to a lesser degree oxygen, as tracer gases for surface leakage. Under normal situations ambient air concentrations of carbon dioxide are an order of magnitude less (~500 ppm) than soil gas carbon dioxide concentrations (5,000+ ppm). 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 leakage from the surface into the soil gas.

4.6 SYSTEM DECONTAMINATION

In an effort to provide the most representative soil vapor samples possible, all tooling and materials in contact with the site soils will be cleaned with a detergent wash and potable water rinse prior to re-use, as outlined in MEDEP/DR SOP# RWM-DR-017 –Equipment Decontamination Protocol. Additional cleaning of the tooling with steam cleaning may be warranted depending on the site contamination.

New, flexible tubing (i.e. dedicated) will be used at each different sample location, regardless as to the type of tubing used.

5.0 DOCUMENTATION/CHAIN OF CUSTODY

All sampling activities must be documented as outlined in MEDEP/DR SOP# RWM-DR-013 - Documentation of Field Activities and Development of a Trip Report. The Indoor Air/Sub-slab Sampling Field Sheet (updated as of the effective date of this SOP) should be used each time a soil gas sample is collected. Sample custody must be followed as outlined in MEDEP/DR SOP# RWM-DR-012 – Chain of Custody Protocol. Samplers should contact the selected laboratory to determine the most appropriate method for avoiding carry-over of highly contaminated samples during the laboratory analyses. Due to the nature of soil gas sampling, attention should be made to the following:

- Weather conditions, particularly precipitation, within past 3 days;
- Depth of sample collection;
- Sub-slab conditions;
- Modifications to the procedure;
- Possible sources of off-site contamination (gas stations, dry cleaners, automotive body shops, etc.) in the vicinity of the investigation field work;
- Possible sources of cross contamination (fueling vehicles/equipment, etc.);
- Length of time of sample collection.

As with all sampling events, any deviations from the sampling plan or SOPs must be documented in field staff's field notes.

6.0 REFERENCES

1. USEPA, Environmental Response Team, Soil Gas Sampling, SOP #2042, 6/1/96.
2. Geoprobe Systems, Direct Push Installation of Devices for Active Soil Gas Sampling and Monitoring. Technical Bulletin NO. MK3098. Prepared May 2006.

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