COVERSHEET
STANDARD OPERATING PROCEDURE

Operation Title: **PROTOCOL FOR COLLECTING SOIL GAS SAMPLES**

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1.0 PURPOSE

The purpose of this document is to describe the Maine Department of Environmental Protection (DEP) Bureau of Remediation and Waste Management, Division of Remediation's (MEDEP/DR) procedure for collecting soil vapor samples.

2.0 APPLICABILITY

MEDEP/DR is responsible for the investigation and remediation of hazardous substance, petroleum, and landfill sites throughout Maine. In the course of the investigation and subsequent remediation, samples must be collected to determine the geographical extent, chemical characteristics, and relative levels of contaminants at each site and surrounding area. For this reason soil gas samples are often collected near sites where volatile chemicals are contaminants of concern. This standard operating procedure (SOP) is designed to be a guideline for the collection of soil gas samples.

This SOP will outline the collection of soil gas samples utilizing Geoprobe Systems Post-Run Tubing (PRT) Soil Gas collection system or the Geoprobe Systems Soil Gas Sampling Implants for collection of a soil gas sample, using either tedlar bags or Suma canisters as the container for collection of the sample. The PRT and Implant system will be advanced into the ground utilizing a "direct push" probing system; direct push machines and hammers "push" tools and sensors into the ground without the use of rotary drilling to remove soil to make a path for the tool.

3.0 RESPONSIBILITIES

All Uncontrolled Sites Program Staff must follow this procedure when collecting soil gas samples. All managers and supervisors within MEDEP/DR are responsible for ensuring that their staff are familiar with and adhere to this procedure.

4.0 PREPARATION

4.1 SAMPLING PLAN

A well developed Site conceptual model is imperative for effective soil gas sampling. Prior to conducting any sampling event, a sampling plan should be developed (see SOP DR#014 - Development of a Sampling and Analysis Plan). Included in the sampling plan should be specifics regarding the anticipated substances of concern, data quality objectives, the laboratory conducting analysis, sample containers and tubing for collection, and Quality Assurance/Quality Control.

4.2 SCHEDULING

It should be noted that sampling during heavy precipitation and saturated soil conditions may negatively effect collection of soil gas samples. A provision to have alternate days for conducting field work if scheduled days are raining, or immediately proceeding heavy rains, should be made.

5.0 EQUIPMENT

5.1 EQUIPMENT LIST

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

- Direct push probing equipment and soil gas collection system:
  - Geoprobe PRT holder and Post Run Tubing system,
  - Geoprobe Soil Gas Implant system,
  - Removable or fixed drive point and rod,
  - Internal extension rods and couplings,
  - Disposable point holder and point,
  - Screened point,
  - Tubing,
  - Drive rods,
  - Drive head, and
  - Retrieval head;
- Installation device (direct push rig manual hammer);
- Vacuum pump, such as peristaltic;
- Bentonite clay or modeling clay;
- Flow meter;
- Polyethylene tubing (see Section 5.1.1)
- Teflon lined tubing (see Section 5.1.2)
- Containers (Summa Canister or Tedlar Bags, see Section 5.1.3)

5.2 Specific Container and Tubing Considerations for Soil Vapor Sampling

Due to the nature of 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, Suma Canisters and Tedlar Bags. When deciding which container to use, staff should consider the data quality objectives for the sample and the availability of a laboratory capable of analyzing the sample.

5.2.1 Suma Canisters

A Suma canister is a clean metal container sealed with a vacuum; this vacuum is then used to draw in the gas sample. Suma canisters must be ordered from a laboratory in advance of the sampling event and are available from a limited number of labs. Samples from Suma 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.

Suma 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 are samples 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 length of time of sample should be indicated as part of the sample plan.

Clean Suma 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 Suma canisters and regulators for the sampling event.

5.2.2 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 not an USEPA approved method; samplers using tedlar bag collection must be sure data quality objectives will be met prior to sampling. Samplers utilizing tedlar bags must communicate with the laboratory conducting the analysis prior to sampling to assure data quality objectives for the project are met.

5.2.3 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, PVC based tubing. These interactions will affect the quality of sample results, and may require a contaminant specific tubing, such as a Teflon lined tubing. Therefore, contaminants of concern for the site should be determined before collecting samples (refer to the Sites conceptual site model). 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.

6.0 SAMPLE COLLECTION

6.1 PRT SYSTEM

6.1.1 Overview

The PRT System discrete soil vapor sampler system consists of a steel drive tube, approximately 1- 1.5 inches in diameter, which allows for an inner post run tubing system to be inserted. The drive end is closed to the soil formation through the use of an expendable drive tip. At the ground surface the sample rod should be packed with a material that will prevent air from entering the formation during sampling.

6.1.2 Procedure for Sample Collection

1) Assemble PRT drive end. Thread the PRT expendable point holder to the end of a solid drive rod. Insert an expendable drive point into the expendable point holder, and place the rod

on the ground, expendable point first, making sure the expendable point stays attached to the holder.

2) Drive the PRT to the desired depth into the ground. There are two methods available for driving the PRT; a direct push drill rig, and a manual slide hammer. Currently the MEDEP/DR has a Concord Environmental Little White Wagon (Modified) as a direct push drill rig; however other direct push rigs as provided by outside contractors can also be used. Operation of the LWW can be found in MEDEP/DR SOP# 007 – Soil Sampling With the Geoprobe® Large Bore Soil Sampler, Attachment B - Concord Environmental Equipment Little White Wagon Operator's Manual. Operation of the manual slide hammer is intuitive. As the drive rods will need to be retracted 3 – 6 inches to remove the expendable point, the PRT should be driven approximately 2 - 4 inches beyond the desired sample collection depth. Be sure to indicate depth on field notes.

3) Retract the drive rods. Upon reaching the desired depth, assemble the PRT Point Popper with the appropriate number of extension rods, and insert the Popper into the drive rod until it reaches the expendable drive point. While applying downward pressure on the PRT Point Popper, extract the drive rods 3 - 6 utilizing the drilling rig or a manual jack. Retracting the drive rods while applying downward pressure will remove the drive point (it will be held by the formation by friction) creating a soil cavity from which the soil vapors will be removed.

4) Attach specified flexible tubing to the non threaded (i.e., the barbed) end of the PRT Adapter. Be sure to attach completely so no air leaks between tubing and adapter.

5) Seal drive rod. Place bentonite or model clay seal around drive rods at surface to prevent air from entering formation through spaces created during the advancement of the sampler.

5) Insert the PRT Adapter into the drive rod. Remove the PRT point popper, and feed the PRT Adapter and tubing until it hits the end of the PRT expendable point holder. Cut the tubing to desired length to allow connection of tubing to pump. While applying downward pressure to tubing, thread PRT Adapter into the PRT expendable point holder by turning counterclockwise.

6) Check connection of PRT Adapter. Pull up on tubing to make sure the PRT adapter has engaged into the PRT Expendable point holder. Failure of adapter to thread could indicate the intrusion of soil during driving of the probe rods or disengagement of drive point. The PRT adapter must be engaged into expendable point holder to assure collection of a viable sample.

7) Connect tubing to a vacuum or peristaltic pump and purge tubing. Start pump and expel at least one tube volume prior to connection to sample container. The typical tubing system, ¼" OD x 3/16" ID, contains approximately 5.5 mL per ft. of dead volume. A minimum of 1 tube volume of gas should be removed prior to sampling.

9) Collect sample in Tedlar Bag or Suma Canister. If using a tedlar bag for sample collection, connect the exhaust end of the tube from the vacuum or peristaltic pump and directly fill the tedlar bag. Tedlar bags should be filled at a rate of approximately 5 minutes per liter, or 15 minutes for a three liter bag. If using Suma canisters for sample collection, remove pump from tubing, and attach canister/ regulator to end of tubing, and allow the canister to fill using the vacuum of the canister.

6.2 SOIL GAS IMPLANT SYSTEM

6.2.1 Overview

Geoprobe implants are stainless steel screens that can be inserted down the bore of a drive rod and anchored at depth, providing a permanent soil gas sampling point. Once set, a gas sample can be obtained the same way as the PRT system

6.2.2 Procedure for Sample Collection

1) Assemble Implant drive end to drive rod. Thread the implant expendable point holder to the end of a solid drive rod. Insert an implant anchor/ drive point into the expendable point holder and place the rod on the ground, expendable point first, making sure the expendable point stays attached to the holder.

2) Drive the PRT to the desired depth into the ground. There are two methods available for driving the PRT; a direct push drill rig, and a manual slide hammer. Currently the MEDEP/DR has a Concord Environmental Little White Wagon (Modified) as a direct push drill rig; however other direct push rigs as provided by outside contractors can also be used. Operation of the LWW can be found in MEDEP/DR SOP# 007 – Soil Sampling With the Geoprobe® Large Bore Soil Sampler, Attachment B - Concord Environmental Equipment Little White Wagon Operator's Manual. Operation of the manual slide hammer is intuitive, even a caveman can do it. Be sure to indicate depth on field notes.

3) Assemble implant screen and tubing. Attach the appropriate tubing to the barbed (i.e. non threaded) end of the implant. As this is intended to be a permanent sample point, apply appropriate amounts of MFP to assure connection is secure.

4) Deploy implant. Remove pull cap and lower the implant and tubing inside drive rods until the implant hits the top of the anchor/ drive point. Rotate tubing/ implant counterclockwise while exerting downward force to engage threads on implant to anchor point. Pull upward once stops rotating to assure connection.

5) Remove drive rod Remove drive rod utilizing drill rig or manual jack, while applying downward pressure on tubing.

6) Seal probe annulus. Using bentonite water mixture or modeling clay, seal the annulus around the tubing to prevent ambient air from entering borehole.

7) connect tubing to a vacuum or peristaltic pump, and purge tube. Start pump and expel at least one tube volume prior to connection to sample The typical tubing system, ¼" OD x 3/16" ID, contains approximately 5.5 mL/ft. of dead volume. A minimum of 1 volume of gas should be removed prior to sampling.

9) Collect sample in Tedlar Bag or Suma Canister. If using tedlar bag for sample collection, connect the exhaust end of the tube from the vacuum or peristaltic pump and directly fill tedlar bag. Tedlar bags should be filled at a rate of approximately 5 minutes per liter, or 15 minutes for a three liter bag. If using Suma canisters for sample collection, remove pump from tubing, and attach canister to end of tubing, and allow the canister to fill using the vacuum of the

canister, or if a time collected sample, attach tubing to regulator and Suma canister.

10 Set up protection for sampler. As the implant is designed for long term monitoring, placement and/or construction of some type of protective device, such as a road box, is recommended. Be sure to provide some means of marking/locating the implant for future monitoring.

7.0 QUALITY CONTROL

Due to cross contamination issues inherent with soil gas sample collection, more rigorous quality control sampling may be required then the sampling of other media. Data quality objectives should be stated in the sampling plan. 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, Section 5.

7.1 EQUIPMENT BLANKS

Equipment blanks should be collected at a rate of 5%, one equipment blank every twenty samples collected. The equipment blank will consist of purging a complete drive rod and closed point system with zero air.

7.2 DUPLICATE SAMPLES

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

7.3 BACKGROUND/AMBIENT AIR SAMPLES

One to two ambient air samples per day should be collected at the sampling locations to assess ambient air conditions.

7.4 TRIP BLANK

A trip blank should be collected particularly when utilizing tedlar bags as sample containers. The trip blank will consist of a tedlar bag filled at the Site area from a canister of zero air.

7.5 TRACER GAS DISPERSION

Difficult ground or weather conditions, such as frost or cold weather, may make sealing of the direct push rods from ambient air difficult. This will allow ambient air to intrude into the soil formation, and not provide a true sample of the gas within the soils spaces. In these situations, a tracer gas such as sulfur hexafluoride (SF^6) can be dispersed around the ground penetration point during sample collection to determine if ambient air contamination of the sample is present. If the immediate analysis indicates SF^6 detection in the sample, re-sampling of the location may be warranted.

8.0 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# 017, Decontamination Procedures. 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.

9.0 DOCUMENTATION/CHAIN OF CUSTODY

All sampling activities must be documented as outlined in MEDEP/DR SOP DR#013 - Documentation of Field Notes and Development of a Sampling Event Trip Report. Sample custody must be followed as outlined in MEDEP/DR SOP#012 – Chain of Custody Protocol. Due to the nature of soil gas sampling, attention should be made to the following:

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

10.0 REFERENCES

1. Geoprobe Soil Vapor Sampling, Standard Operating Procedure, Technical Bulletin No. 93-660, 9/21/93.
2. USEPA, Environmental Response Team, Soil Gas Sampling, SOP #2042, 6/1/96.
3. Geoprobe Systems, Direct Push Installation of Devices for Active Soil Gas Sampling and Monitoring. Technical Bulletin NO. MK3098. Prepared May, 2006.