COVERSHEET
STANDARD OPERATING PROCEDURE

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

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1.0 PURPOSE

The purpose of this document is to describe the Maine Department of Environmental Protection, Bureau of Remediation and Waste Management, Division of Remediation (MEDEP/DR) procedure for collecting soil samples at or near hazardous substance sites.

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 taken to determine the geographical extent, chemical characteristics, and relative levels of contamination at each site and the surrounding area. This standard operating procedure (SOP) is designed to provide guidelines for the collection of soil samples from surface and subsurface via auguring, boring, and with earth moving equipment, such as excavators.

3.0 RESPONSIBILITIES

All Uncontrolled Sites Program Staff must follow these procedures when performing field activities involving the collection of soil samples. All Managers and Supervisors are responsible for ensuring that their staff are familiar with and adhere to these procedures.

4.0 DEFINITIONS

- Soil Auger - Stainless steel in construction and consists of a t-handle, extension piece, and a screw-like cutting blade. Used to collect soil samples from various depths. Soil conditions permitting a depth of up to 10 feet can be adequately sampled using a hand auger. Power augers allow for even further depths to be sampled.
- Soil borer – A device, such as a Geoprobe® Systems Large Bore Soil Sampler or a Split Spoon Samper, which allows the collection of Soil from discrete levels below grade.
- Grab Sample - A single portion of material from a point source sample location.
- Composite Sample - Two or more portions of material mixed together to yield a single sample for analysis.
- Trench - a narrow excavation (at least four feet in depth according to OSHA standards) made below the surface of the ground in which the depth is greater than the width--the width not exceeding 15 feet.
- Excavation - is any man-made cut, cavity, trench, test pit or depression in the earth's surface formed by earth removal.
- Containerization – the act of collecting the appropriate amount of soil for a specific analysis, and placing it in the appropriate jar with any required preservation.
- Obtaining a soil sample – the act of retrieving soil from a specific sample point in order to containerize a sample.

5.0 INTRODUCTION

Soil sample collection is the most basic aspect of the investigation of hazardous and petroleum discharges into the environment. Other than the direct discharge to a surface water body, most hazardous substance and petroleum releases are into a Site's soil. Hazardous substances and petroleum can be discharged surficially, from a variety of sources such as poorly stored containers leaking into soil, or direct surficial soil discharge, or below grade, from sources such as buried drums, leaking underground storage tanks, or dry wells and other sub surface waste collection systems. This contaminated soil thereby becomes a source of contamination, from which contamination can migrate and contaminate additional soil, and can contaminate underlying groundwater. Understanding the extent and chemical characteristics of soil contamination is paramount, and can be determined through effective soil sampling.

Soil sample collection has two steps. The first is obtaining the soil from the desired spatial location. The second is containerizing the soil obtained as appropriate for the specific analysis. Shovels, trowels, borers, and excavators are all tools that can be used to obtain the soil from the desired location. Staff then utilize syringes, gloved hands, trowels and other tools to containerize the appropriate amount of soil in appropriate jars with required preservation, as specified by the analysis methodology.

6.0 PLANNING

A well developed conceptual site model (CSM) is imperative for effective soil 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, method of sample collection, and Quality Assurance/Quality Control.

A well though out conceptual site model, and a statement of specific goals for a sampling project, will make any sampling event more efficient and provide meaningful data for making sound decisions.

6.1 SPECIAL CONSIDERATIONS REGARDING CONTAINERIZATION

Many analytical procedures require more specific containerization and preservation protocols than just "jamming dirt in a jar and keeping it cold". For example, samples collected for volatile organic analysis, depending on the specific method, may require a set of three containers for conducting the complete analysis. One of these containers will require a specific amount of soil sample (5 grams), placed in a pre-weighted jar with 10 ml of methanol added, another, other containers in the set will have a different requirements. MEDEP/DR expects these requirements for soil sample containerization to change as analysis methodology and sample preservation techniques evolve. Therefore, container and preservation requirements for the specific analysis methodology must be obtained from the laboratory conducting the analysis, and outlined in the SAP. Field staff must be trained and familiar with these protocols.

7.0 EQUIPMENT

Depending on the objectives of the sampling event and site characteristics, there is a great range of equipment available for sample collection purposes. Equipment choice will generally be dictated by the depth of the soil samples to be taken:

- Surficial soil 0 – 6 inches in depth;
- Shallow soil samples - 6 - 2 feet in depth; and
- Deep soils or greater than 2 feet in depth.

In addition to the tool(s) and its associated paraphernalia for obtaining the soil sample, additional required equipment for a soil sampling event would include:

- Containers – As indicated by the laboratory conducting the analysis, including sample preservative;
- Personal Protective Equipment – As required for expected contamination, and stated in the SAP/ HASP; and
- Decontamination Equipment – As outlined in MEDEP/DR SOP RWM-DR-017, and specified in the HASP.
- Sample Containerization tools – Certain analytical methods have specific sample size and preservation requirements. A number of tools can be utilized for meeting these requirements. A sample collection syringe, such as a disposable open barrel (without Luer - tip end) plastic syringe for sampling, or a Terra Core™ sampler is useful for collecting a specific amount of soil, and extruding it into the containers. As sample requirements are based on mass, a field scale is useful to assure the appropriate amount of soil is collected. To make containerization easier and minimize soil disturbance, syringes used for collection should be smaller than the mouth of the jar. Syringes having rubber or other elastomer seals are not acceptable, and must have the rubber seal removed prior to use. . A stated earlier, specific tools for sample containerization must be outlined in the SAP.

The sampling equipment's composition may vary with analytical needs. For instance, stainless steel is preferred for organic analysis whereas Teflon and/or plastics are preferred for inorganic sample collection.

7.1 Equipment for Surficial Soil Sample Collection

Shallow soil sampling is generally conducted utilizing hand common hand tools, such as shovels, trowels, etc. An appropriately gloved hand can also be used.

7.2 Equipment for Shallow Soil Sample Collection

Shallow soil sampling can be conducted utilizing common hand tools, such as shovels, trowels, etc. Additionally, augers and borers may also be useful for sampling below a depth of one foot. Soil characteristics, such as coarseness, rocks, etc will also dictate tool selection. For example, a collapsing soil, such as sand or gravel, may not be suitable to collect with a shovel at depth, making a borer a better option. Below is a list of tools and equipment available to MEDEP/DR staff for shallow soil sampling:

- Shovels

- trowels
- Lab spatulas, scoops
- Soil Augers - bucket, screw and push
- Geoprobe® soil borer

This is list is in no means complete, as any type of tool capable of "digging" can be used for soil sampling, as long as it is clean. Use of shovels, trowels, and augers are for the most part intuitive. For use of the Geoprobe® soil borer or other boring device, please refer to manufacterers operation manual.

7.3 Equipment for Deep Soil Sample Collection

Tools for deep soil sample collection are used to obtain the soil from the depth desired and bring it to the surface upon which it is containerized. Sampling equipment for obtaining deep soil samples includes augers, direct push boring machinery, such as Geoprobe Systems manual boring equipment and rigs, rotary auger rigs with split spoon samplers, and earthmoving equipment, such as backhoes and excavators. A standard shovel can also be used. Use of Augers and shovels is intuitive, boring and drilling rigs, and earthmoving equipment should only be used by staff trained specifically in the use of that piece of equipment.

8.0 SAMPLING PROCEDURE

8.1 SITE MOBILIZATION/ RECONNAISSANCE

Upon arrival at the work area, note conditions around the sample site. If sampling pre-determined locations stated in the SAP, reconnoiter each location to determine whether in fact the sample location is appropriate to meet the goals of the activity stated in the SAP, if this has not been done previously. If sampling based on field conditions, conduct a walkover of the entire area in question and observe the conditions of the site. Look for visual indicators such as stained soil and stressed vegetation resulting from some occurrence other than natural conditions. For instance, pooling liquids are a quick indication of a low area where liquid contaminants are likely to have concentrated. Note the general condition of the landscape (i.e., has it been disturbed or does it appear to be in a natural condition). Designate site boundaries and work zones and establish a secure perimeter to keep out unauthorized persons.

8.2 SAMPLING PROCEDURE

8.2.1 Sampling Procedure for Surficial Soil Sampling

1) Don appropriate PPE for sampling.

2) Use a Scoop, Spatula, Trowel, or other appropriate tool to collect sample. The goal of the sample collection is to collect the soil with minimal disturbance and limit the amount of handling and tooling contact. . For those soils more densely packed or rocky, a more robust tool, such as a shovel can be used. Remove Debris, twigs, rocks, vegetation, and organisms (such as bugs and worms) from the sample point to gain a representative sample material.

An attempt should be made to keep the samples collected as similar with each other as possible. Choose sample locations that have same soil type, organic matter content, and depth if such locations are available and still allow collection of the data that is consistent with the goals of the SAP, and the DQOs of the project.

Depending on the containerization requirements, the tool will be used to expose the soil desired, and the soil will then be containerized directly from the soil formation. *Or*, the tool will be used to remove the soil from the formation and the soil containerized directly from the tool. Either method will work; chose the specific procedure that allows sample collection with the minimal amount disturbance of the actual soil to be submitted to the lab.

An example:

As stated earlier, samples for volatile organic compound (VOC) analysis are generally collected utilizing a plastic syringe pushed into the soil to collect a specific amount (approximately 5 grams). This "plug" of soil is then extruded from the syringe into the container, with preservation fluid added. Metals are generally collected by placing approximately 250 grams of the soil in a plastic "whirlpak" style bag. So, an appropriate procedure to collect a surficial sample for VOC and metals analysis would be to: a) use trowel to scrape off vegetation, duff, and the top 1 - 2 inches of soil; b) use appropriately gloved hands to pick out large rocks, stones, sticks and bugs; c) push the syringe directly into the soil to collect the sample for VOC analysis, thereby minimizing the soils' handling, and then extrude into the container; d) use the trowel, or gloved fingers, to remove soil from the sample location, and place soil into whirlpak container.

Pushing the syringe directly into the formation minimizes the disturbance of the soil collected for VOC analysis. If it is not possible to push the syringe directly into the soil formation, it is acceptable to collect the soil with a tool, and push the syringe into the soil collected by tool. Containers for VOC analysis should be filled first.

3) Add preservative (if necessary) and tightly close containers. Be sure to remove any dirt from the threads of the jar to assure a tight fit. Wipe or wash off any large soil particles adhering to the jar lab.

8.2.2 Sampling Procedure for Shallow Soil Sampling

1) Don appropriate PPE for sampling

2) Using appropriate tool, expose the soil to be sampled. As stated earlier, the goal of the sample collection is to collect the soil with as minimal disturbance of the soil and limiting the amount of handling and tooling contact to the sample collected. If using a shovel, the shovel can be used to dig a hole to the specific depth, and the sample then collected from the side wall using a trowel, gloved hand, syringe, or even the container itself. If using an auger or borer, the soil to be sampled is brought up to the surface, and soil is removed from the tool and placed in the container(s). If utilizing a syringe to

collect a specific amount of soil, the syringe should be pushed into the soil in the tool as soon as possible to minimize handling of soil.

3) Collect and containerize sample. Care should be taken to make sure that the soil sample containerized is from the specific depth to be sampled, not from soil smeared from the surface by tools, or soil having fallen into the excavated hole from the surface.

An Example:
Using a shovel, dig a hole to a little beyond the desired sample depth. Then, using a trowel or gloved hand, scrape the sidewall at the desired depth to remove the any possible smeared soil from the shovel. For VOC analysis, push a syringe directly into the sidewall, and then extrude the soil into the container. Then, for metals analysis, use the trowel to obtain the appropriate amount of soil from the desired sample depth and containerize, removing any large roots, stones, worms, etc.

Another Example
Using a bucket auger, advance the auger to the desired sample depth. Upon reaching an inch or two above the desired depth, removed the bucket auger and empty out soil. Remove any soil that might have collapsed into the hole with bucket auger after removing the first time. Reinsert auger, and advance to desired depth. Remove bucket auger, and containerize soil samples from soil at end of bucket auger, trying to minimize handling as much as possible. If syringes are used, push syringe directly into soil in auger.

3) Add preservative (if necessary) and tightly close containers. Be sure to remove any dirt from the threads of the jar to assure a tight fit. . Wipe or wash off any large soil particles adhering to the jar lab.

8.2.2 Sampling Procedure for Deep Soil Sampling

1) Don appropriate PPE for sampling.

2) Using appropriate tool or machinery, obtain soil for containerization. With the exception of very large excavations, sampling tools will be used to bring the soil up to the surface for containerization. This will be with the use of an auger, borer, or excavation equipment, such as an excavator or backhoe. Soil boring/drilling equipment should be operated per manufacturers' instructions. Heavy machinery is to be used by trained operators.

For samples requiring the use of heavy equipment (i.e. back-hoe, loader) to excavate, samplers should not enter the pit/trench. All observations and samples can generally be taken from the excavation from the ground surface. "Trenching and excavation work presents serious risks to all workers involved. Strict compliance, however, with all sections of the standard will prevent or greatly reduce the risk of cave-ins as well as other excavation-related accidents."(OSHA Subpart P-Excavation, Trenching, and Shoring-1926.650 et seq.). Particularly with excavators and backhoes, be careful to obtain the sample from depth of the formation, and not from slough or caved in material from a shallower depth. As with shallow sampling, it may be appropriate to have the excavator dig to the desired depth, scrape the side or bottom wall of the pit to remove

slough and smeared material, and then obtain soil for sampling. When collecting from the excavator bucket, try to watch to bucket as it collects the soil, and obtain the soil for the sample from an area of the bucket that did not touch the bucket itself. For example, the interior soil of clods would not have touched the bucket, so remove the clod, break in half, and collect a sample from the freshly broken face of the clod.

It may be possible to use a remote sampling device to collect samples at the desired depth from the sidewall or bottom of the pit. The face of the pit/trench should first be scraped to remove the smeared zone that has contacted the backhoe bucket by the remote sampler. Then utilize the remote sampler to obtain soil for containerization.

If the excavation is large enough to allow entry (see the MEDEP BRW SOP entitled "Confined Space and Excavations Entry" dated July 9, 1999), an attachment to the MEDEP/DR Quality Assurance Plan), obtain sample using the protocol for surface or shallow soil samples.

3) Containerize the sample. After using the borer, excavator or remote sampler to obtain the soil from the appropriate depth, containerize the sample, following laboratory protocol. Soil sample should be collected and containerized with as minimal handling and disturbance as possible. Wipe or wash off any large soil particles adhering to the jar lab.

4) Add preservative (if necessary) and tightly close containers. Be sure to remove any dirt from the threads of the jar to assure a tight fit. . Wipe or wash off any large soil particles adhering to the jar lab.

8.3 GENERAL CONSIDERATIONS

The sampler should remove gloves after completion of sample collection, and don new, clean gloves for each sampling point. All sampling equipment must be decontaminated before use at each sampling point, or new, dedicated equipment for each point must be used.

If re sampling is expected, mark the sample location by placing a marker in the hole such as a stake with flagging. After completing sampling activities, close (fill in) the excavation to ground level to reduce the chance of a tripping hazard, being sure to mark the site for future reference. Even if sampling is not expected to be repeated in future the future, sample locations should also located using global positioning to assure location can be identified replicated in the future..

If possible, samples should be collected from areas of lower expected concentrations or background and progresses to areas of increasing levels of contamination.

Preservation for most samples, even if preservative is used, includes the cooling of samples to 4° Celsius. All samples should be placed in iced cooler for storage and transport immediately after collection.

8.4 COMPOSITE SAMPLES

Depending on the DQOs of the project, it may be necessary to collect composite samples. Composite samples are most likely collected for disposal characterization. The SAP will outline any specific composite requirements. The same procedure for obtaining soil from surficial, shallow or deep locations would be followed. However, instead of directly containerizing the sample, the soil is placed in a dish, bucket, or other suitable bowl for mixing. This mixed sample material is then transferred into the final sample containers, following laboratory protocol for containerization and preservation. Use an equal amount of soil from each sample location.

If a composite sample is desired from a test pit, several depths or locations within the pit/trench are selected and a bucket is filled from each area. The SAP will outline composite sample requirements. Material from each bucket is then placed into an appropriate container where the material Is mixed.

Unless specifically stated in the SAP, samples for compounds considered volatile, such as volatile organic compound analysis (VOC) and gasoline range organic (GRO) analysis, should not be composited in the field.

9.0 DECONTAMINATION

All equipment should be decontaminated between sampling points, and at the end of the day, following the procedure outlined in MEDEP/DR SOP RWM-DR-017 – Decontamination procedures, and as outlined in the project specific SAP.

10.0 QUALITY ASSURANCE/QUALITY CONTROL

Data quality objectives should be stated in the sampling plan. Quality Assurance/Quality Control (QA/QC) samples may be required to meet your data quality objectives. The following typical types of QA/QC samples may be collected as part of the QA/QC program for soil sample collection. For an additional discussion of QA/QC, please refer to the MEDEP/DR Quality Assurance Plan, Section 5.

10.1 EQUIPMENT BLANKS

Equipment blanks may be collected at a rate of 5%, one equipment blank every twenty samples collected.

10.2 DUPLICATE SAMPLES

It is recommended that duplicate samples be collected at a rate of 5% to assess sample location variability.

10.3 BACKGROUND SAMPLES

Background samples may be collected as part of the soil evaluation, depending on the goals of the sampling event, and the DQOs of the project. Background sample requirements should be outlined in the SAP.

10.4 TRIP BLANK

When collecting samples for volatile organic compound analysis, trip blanks may be collected.

11. DOCUMENTATION

Documentation is the most important aspect of any sampling event, but even particularly so with a soil sampling event. Documentation should be completed with the idea that someone not present during the actual event may need to repeat the event exactly as was conducted originally. During the sampling event or immediately upon the completion of the event, create a map of the area and locate the sampling points on the map. Refer to the MEDEP/DR SOP RWM-DR-013 - Documentation of Field Notes and Development of a Sampling Event Trip report. It is very important that all information regarding a sampling event (or any events/activities) be accurately recorded. A trip report package should also be completed for the event, as outlined in MEDEP/DR SOP RWM-DR-013.

Sample custody must be followed as outlined in MEDEP/DR SOP#012 – Chain of Custody Protocol.

12.0 HEALTH AND SAFETY

As part of the SAP, a Health and Safety Plan (HASP) must be developed for site work. Additional safety considerations are required for working with heavy equipment. Note the conditions of the sample area, be aware of the potential physical hazards (i.e., trench, open excavation, loose uneven footing). With each of these unique situations take a common sense approach, that will yield a representative sample in the safest manner possible. Establish alternative means of communication other than verbal for situations when hearing is hampered or impaired.

For information on buried utilities that may be impacted by the excavations occurring on site call the DIG SAFE HOTLINE, toll free at 1-800-225-4977. This is required by law!

Samplers must read the HASP and acknowledge that they have read it and understand it.