Soil, Tuff, and Sediment Sampling

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Approval Signatures:

Name/Title	Z#	Org	Signature	Date
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This document fully satisfies the requirements of P300, *Integrated Work Management*, in order to systematically describe the work activity, the associated hazards, and the controls that **MUST** be employed to mitigate the risks.

Classification Review: [X] Unclassified [ ] UCNI [ ] Classified: _____

Name	Z#	Signature	Date
Billy Turney	112765	/s/Billy Turney	11/5/14

REVISION HISTORY

Document No./Revision No.	Issue Date	Action	Description
ER-SOP-20069 R0	02/23/15	New Document	Consolidates and supersedes SOP-06.09, SOP-06.10, SOP-06-24, and SOP-06-26.

CONTENTS

1.0 PURPOSE

This standard operating procedure (SOP) describes the methods used to collect surface and subsurface samples, as well as sediment samples, normally encountered at Los Alamos National Laboratory (LANL).

This SOP is a mandatory document and shall be implemented by all Environmental Programs Directorate (ADEP) participants when collecting soil, tuff, and sediment samples.

These techniques are suitable for use when analyzing radiological and chemical constituents that may be encountered at a characterization site. Work performed using this procedure helps to fulfill the requirements of applicable work plans required by

- NMED/DOE signed on 3/1/2005; revised 04/20/2012, *Compliance Order on Consent*;
- AP-DIR-AP-10008, *ADEP Roles, Responsibilities, Authorities, and Accountabilities*;
- DOE Order 458.1, *Radiation Protection of the Public and the Environment*, and
- LANL P315, *Conduct of Operations Manual*.

2.0 SCOPE

This procedure applies to all personnel assigned to collect surface and subsurface soil, tuff, and sediment samples for environmental chemical and radiological constituent analyses. This procedure encompasses both disturbed and relatively undisturbed sampling methods, including

- spade and scoop sampling;
- hand and small power-auger sampling with or without thin-wall tube sampling;
- thin-wall, tube-type sampling;
- split-barrel sampling (with and without sleeved liners); and
- tuff/rock core sampling.

3.0 BACKGROUND

The objective of the environmental sampling program at LANL is to collect samples that are representative of the site that is being investigated. Sample quality can be affected by the methods used to collect and handle samples, as well as by variability within these methods as applied by different sampling personnel. Because of variability between sampling locations, no one method can be applied to all soil, tuff, and sediment sampling. Instead, site-specific considerations such as sampling objectives, equipment availability, site location, and physical constraints must be taken into account when deciding how to collect the most representative samples at a given location.

Most site investigation samples are collected using spade and scoop and hand and small power-auger equipment. Drilling methods for collecting samples at greater depths include hollow stem augers and solid-flight augers. Consideration for selection of borehole advancement should consider the media through which the borehole is being advanced, the quality of sample being collected, and the need to minimize cross-contamination between samples. Methods of inserting the sampler into the augered borehole will vary with drilling equipment and sampling needs.

Careful consideration shall be given by the team of subject matter experts (SMEs) preparing the sampling plan to achieve the data quality objectives for the site. An understanding of the general site subsurface conditions, the chemicals of potential concern (COPCs), and the available

sampling technologies will allow the field team leader (FTL) to select the most appropriate sampling techniques.

Numerous sampling techniques are suitable for unusual or special sampling conditions. These techniques may prove useful in obtaining suitable samples under special field conditions but are not covered specifically in this procedure. Such a technique, called *direct push technology*, allows for thin-wall sampling using a vibratory method to force the sampler to penetrate the soil; however, this technique has limited application at LANL because the hard subsurface soil/rock 1conditions present at most sites cannot be penetrated with this type of equipment.

In addition to sampling methods, specific procedures are provided for subsampling of samples when volatile organic compounds (VOCs) are suspected to be present and require analysis. These procedures are described in detail later in this procedure.

This procedure is not applicable to geotechnical sampling, although the equipment used to perform geotechnical sampling is the same or similar to that described in this procedure.

Personnel performing this work should be aware of hazards and recommended safety practices before setting up and operating equipment, including those represented by the site-specific health and safety plan (SSHASP) and integrated work document (IWD).

4.0 PRECAUTIONS AND LIMITATIONS

4.1 General

- When a worker observes an unsafe condition or act that may pose an imminent danger or other safety concern/hazard, the worker has the authority and responsibility to inform the worker engaged in the work and request that the work activity be paused and/or stopped based on the risk posed to the individual, the employees, the environment, or the facility in accordance with P101-18, *Procedure for Pause/Stop Work*.
- The activities performed in accordance with this procedure are determined to be "moderate to high hazard" as defined by P300, *Integrated Work Management*; therefore, a hazard analysis is required to perform this procedure.
- If any issues arise in the field that would prevent sample collection as described in this SOP, the FTL shall contact the site technical lead (STL), subcontract technical representative (STR), or project manager (PM), as appropriate, to discuss these issues before continuing with sampling.
- Activities, items, and containers shall satisfy approved design specifications, regulatory requirements, process-specific parameters, and procedural requirements. Activities, items, or containers that do not conform to the approved specifications and requirements are considered nonconforming and nonconformance reports (NCRs) shall be generated in accordance with P330-6, *Nonconformance Reporting*, as required.
- The FTL shall document any deviations from the scope of work and provide the PM with such documentation.
- If unusual conditions occur at the sampling site or during the sampling that might affect the sampling results, the FTL shall discuss such conditions with the STL, STR, or PM.
- All waste generated by sampling operations will be handled in accordance with EP-DIR-SOP-10021, *Characterization and Management of Environmental Restoration Project Waste*.
- All equipment that will be used to collect samples will be decontaminated following the provisions of EP-ERSS-SOP-5061, *Field Decontamination of Equipment*.

- Before sampling, ensure that all sample collection logs and documentation have been generated by the Sample Management Office (SMO) and are available in the field.
- If sampling occurs in an area controlled by a radiological work permit (RWP), radiological scanning of equipment and core samples takes precedence over other sampling activities. The radiological field technician will survey any equipment or samples during the sampling event, in addition to those listed in the step-by-step process, at their discretion.
- To minimize the potential for cross contamination, use dedicated sampling equipment whenever possible. Equipment blanks should be taken before use of non-dedicated equipment.
- The FTL, in concurrence with the STL, shall select the appropriate sampling technique(s) that optimize(s) the quality of the samples obtained specific to the analytical and data quality objectives, keeping cost minimization of the sampling program in mind.

4.2 VOC Sampling

- Because of potential volatilization of the VOCs at such shallow depth, VOC sample collection should be from the bottom of the 0- to 1-foot sample interval. By sampling the upper foot of the site for VOCs, data will exist for assessment of the industrial and trail user risk screening scenarios, although it is unlikely to encounter VOCs within the upper foot of the LANL sites because of the legacy nature of contaminants.
- Field sampling of VOCs will be done as rapidly as possible, immediately upon removal or exposure of the sampling media. The field sample process will minimize, to the extent practical, exposure of the sediment, soil, or tuff to ambient air conditions. By minimizing this exposure time, the loss of VOCs will be kept to the minimum amount practical. Adding reagents, etc., if required, will be performed in the laboratory setting, under controlled conditions. The FTL must coordinate closely with the SMO representative to ensure proper handling and preparation of VOC samples.
- This procedure defines processes to be used when sampling sites suspected of having low concentrations of VOCs and for subsurface conditions expected at LANL. If high levels of VOCs are suspected to be present or if coarse-grained, gravelly soils are encountered when sampling for VOCs, a site-specific sampling procedure will be needed and may include field measurement of VOC concentrations.
- Undisturbed soil samples should be collected in a manner that prevents samples from “stacking up,” awaiting logging and subsampling.
- Cores should not be stored in large- or small-diameter sampling devices, or in capped liners.
- Cores should not be exposed to extreme weather conditions, such as direct sunlight, rain, or wind, and sub-sample collection should occur in an area that minimizes exposure to the elements (e.g. under covered, shady areas).
- Undisturbed soil samples cannot be transferred from the core sampler to a secondary container (empty sample bottle, Ziploc bag, aluminum foil, or sampling bowls) for future VOC sample collection.

5.0 REFERENCES

- EP-DIR-AP-10001, *ADEP Document Control*
- EP-DIR-AP-10003, *Records Management Procedure for ADEP Employees*
- EP-CAP-EP-20235, *Sample Containers and Preservation*
- EP-CAP-SOP-20236, *Handling, Packaging, and Transporting Field Samples*
- American Society for Testing Materials (ASTM) D1586, *Standard Test Method for Standard Penetration Test (SPT) and Split-Barrel Sampling of Soils*, 2011.
- American Society for Testing Materials (ASTM) D1587, *Standard Practice for Thin-Walled Tube Sampling of Soils for Geotechnical Purposes*, 2008.
- American Society for Testing Materials (ASTM) D2113, *Standard Practice for Rock Core Drilling and Sampling of Rock for Site Investigation*, 2008.
- American Society for Testing Materials (ASTM) D2113, *Standard Practice for Thick Wall, Ring-Lined, Split Barrel, Drive Sampling of Soils*, Reapproved 2007.
- American Society for Testing Materials (ASTM) D4547, *Standard Guide for Sampling Waste and Soil for Volatile Organic Compounds*, 2009.
- American Society for Testing Materials (ASTM) D6418, *Standard Practice for Using the Disposable En Core Sampler for Sampling and Storing Soil for Volatile Organic Analysis*, 2009.
- American Society for Testing Materials (ASTM) D6640, *Standard Practice for Collection and Handling of Soils Obtained in Core Barrel Samplers for Environmental Investigations*, Reapproved 2010.
- *Guidance Document for the Implementation of United States Environmental Protection Agency Method 5035: Methodologies for Collection, Preservation, Storage, and Preparation of Soils to be Analyzed for Volatile Organic Compounds*, Department of Toxic Substances Control California Environmental Protection Agency, 2004.
- *USACE Sample Collection and Preservation Strategies for Volatile Organic Compounds in Solids*, October 1998.

6.0 DEFINITIONS AND ACRONYMS

6.1 Definitions

hand or small power auger: A method of advancing a borehole to obtain fully disturbed samples of subsurface media using solid flight power augers (ranging from hand held to light drill rig mounted to the back of a pickup truck). Hand augers may use a “bucket” auger on the end of a pipe or steel shaft to advance the borehole.

integrated work document (IWD): Hazard control documentation that integrates work definition, hazards, and controls for work authorization and user-friendly communication to the workers. The IWD may be a subset of a larger “work package,” such as the field readiness review package, that includes other documents and information relating to an activity but does not not address hazard controls.

rock core sampling: The use of rock core drilling and sampling (see ASTM D2113) to obtain relatively undisturbed samples of tuff where the tuff is too hard or depth too great to penetrate with hollow-stem augers.

sediment: Solid fragments of inorganic or organic material that come from the weathering of rock and are carried and deposited by wind, water, or ice.

site-specific health and safety plan (SSHASP): Health and safety plan that is specific to a site or related field activity that has been approved by an Environmental Programs (EP) project health and safety representative. This document contains information specific to the project, including scope of work, relevant history, chain of command, and a map to the hospital.

soils: Normally or over-consolidated soils overlying tuff bedrock. These soils may be fill or naturally occurring material.

spade-and-scoop sampling: Sampling of subsurface media using a shovel (spade) and/or a scoop to collect a fully disturbed soil, sediment, or tuff sample. Includes sampling from spoils of a backhoe excavation. Practically, sampling is limited to approximately 10-foot depth (when using a backhoe).

split-barrel sampler: A thick-walled sampler (ASTM D1586 [unlined] and ASTM D3550 [lined]; also ASTM D6640, Section 6.1.1) usually driven or cored into the subsurface media to obtain relatively disturbed to relatively undisturbed samples. The sampler barrel between the head and cutting shoe is cut in half along its length. This type of sampler will obtain samples of material that is too hard for sampling with a thin-walled tube sampler. The sampler may be a split-barrel device, with or without stainless-steel sampling sleeves. The amount of sample disturbance depends on the ratio of the inside diameter to the wall thickness of the sampler and the method of advancement (as with a coring device inside hollow-stem augers compared with a drive head).

subsample: Smaller samples taken from a larger sample collected for targeted chemical or radiological analysis.

surface samples: Samples obtained from a depth typically ranging from 0 to12 inches below the ground surface.

thin-walled tube sampler: A thin metal tube conforming to ASTM D1587 that is usually pushed into the soil using the hydraulics of a drill rig to retrieve slightly disturbed samples of soil and sediment. This sampling method does not work well on hard and cemented soil, sediment, tuff, or coarse-grained soil.

tuff: Bedrock at LANL consisting of volcanic ash deposits from the Jemez Mountains. The tuff can range from non-welded to highly welded vitrified material. It generally has a gradation of silty to clayey sand when crushed to its elemental particle size. If weathered to a soil, tuff is always ”hard” relative to softer surface soils.

volatile organic compounds (VOCs): A class of chemical compounds, predominantly hydrocarbons and halogenated hydrocarbons, with low molecular weights and low boiling points, that are insoluble or slightly soluble in water.

6.2 Acronyms

ADEP	Environmental Programs (Associate Directorate)
DOE	Department of Energy
EP	Environmental Programs
EPA	Environmental Protection Agency
FTL	field team leader
IWD	integrated work document

LANL	Los Alamos National Laboratory
PM	project manager
RWP	radiological work permit
SMO	Sample Management Office
SOP	standard operating procedure
SSHASP	site-specific health and safety plan
STL	site technical lead
STR	subcontract technical representative
USACE	United States Army Corps of Engineers
VOC	volatile organic compound

7.0 EQUIPMENT AND TOOLS

Refer to Attachment 1, Equipment and Supplies Checklist for Soil, Sediment, and Tuff Sampling

8.0 STEP-BY-STEP PROCESS DESCRIPTION

8.1 Perform Pre-Operational Activities

8.1.1 *Field Team Members*

1. Complete sample management request paperwork, and acquire necessary documentation for sample collection.
2. Review EP-CAP-EP-20235, *Sample Containers and Preservation*, and EP-CAP-SOP-20236, *Handling, Packaging, and Transporting Field Samples* for guidance regarding appropriate sample containers and documentation, packaging, and shipping of collected samples.
3. Ensure that the required equipment and supplies are available for the particular sampling methods to be used. See Attachment 1, Equipment and Supplies Checklist for Soil, Tuff and Sediment Sampling.
4. Gather and decontaminate the needed supplies and equipment as specified in EP-ERSS-SOP-5061, *Field Decontamination of Equipment*.
5. Locate sample locations and mark with stakes that include the location identification number.
6. If applicable, photograph the location in accordance with LANL security requirements and policies.

8.1.2 *Field Team Leader*

1. Ensure that excavation permits and site-specific permissions and permits have been obtained.
2. Ensure that any measuring and test equipment needed for performing the work, such as scales, PIDs, and radiation instruments are in current calibration.

3. Discuss with the field team, understand, and fully document in field notebooks and/or daily logs as required by SOP-5181, *Notebook and Logbook Documentation for Environmental Directorate Technical and Field Activities* at a minimum, the following:
   - Location and location identification number of the sample.
   - Mark the final sampling location with a stake that includes the location identification number.
4. Monitor the proper implementation of this procedure, and ensure that the appropriate personnel complete applicable training.

8.2 Perform Sampling Activities Using a Spade and Scoop

8.2.1 *Field Team Members*

1. Using the most effective stainless-steel tool available, collect sample from the required depth, typically 0 to 6 inches for a spade and scoop. The stainless-steel scoop should be decontaminated before use.
2. Homogenize the sample in a stainless steel bowl. Samples may be broken up, as necessary, to allow for containerization, and rocks and woody material may be removed. Samples collected for tritium and semi-volatile organic compound analyses shall not be homogenized.
3. Fill the sample containers and, if collecting duplicate samples, fill the bottles as described in EP-CAP-SOP-20235, *Sample Containers, Preservation, and Field Quality Control*.
4. Label the sample containers and complete documentation according to in EP-CAP-SOP-20235, *Sample Containers, Preservation, and Field Quality Control.*
5. At this time, enter the sample information in the field notebook according to SOP-5181 and in the collection log, including sample location identification number, depth interval, etc.
6. Whenever a sample is collected for chemical analyses, initiate a custody record via the Chain of Custody/Request for Analysis Form, and affix a sample label to the sample container.
7. Whenever a sample is collected, enter a complete description in the sample collection log.

NOTE: Refer to Section 4.8 for VOC-specific sampling methods.

8. Collect field duplicates according to EP-CAP-SOP-20235, *Sample Containers, Preservation, and Field Quality Control.*

8.3 Perform Sampling Activities Using a Hand Auger

8.3.1 *Field Team Members*

1. Perform sampling.

   NOTE: Discuss, understand, and fully document in the field notebook and/or daily logs the collection strategy and rationale described in the relevant sampling and analysis plan, as well as the requirements for sample handling and decontamination between samples.

2. Dig with a bucket auger in the following manner:
   - Assemble the auger with a two-, three-, or four-foot shaft.
   - Apply 0.5-inch Teflon tape to all threads to facilitate disassembly.
   - Press down and turn the auger, digging down 6 to 12 inches.

- Lift the auger out of the hole, and remove the soil from the auger bucket.

NOTE: Experience shows how deep to dig with each bucket load without causing the auger to get stuck.

- Adding additional shaft sections, repeat this step until the required depth (usually about 6 inches above the intended collection depth) is reached.

3. Collect a sample with a bucket auger in the following manner:
   - With a clean bucket, dig out enough soil for the sample.

NOTE: Granular soils may not stay in the bucket. Different styles of buckets are available for clayey versus sandy soil or sediment. These buckets vary in their degree of soil containment; choose accordingly.

   - Discard any soil that falls down the hole and, as such, did not come from the required sample depth.
   - Put an adequate amount of sample material into a decontaminated, stainless-steel bowl, and mix until the sample is homogenized.
   - Fill the sample containers (see EP-ERSS-SOP-5056).
   - When collecting a composite sample, keep the bowl of soil out of the sun and keep it covered with aluminum foil; collect all of the aliquots as quickly as possible; do not decontaminate the auger between aliquots.
4. Label the sample containers, and complete documentation according to in EP-CAP-SOP-20235, *Sample Containers, Preservation, and Field Quality Control*.
5. At this time, enter the sample information in the field notebook according to SOP-5181 and in the collection log, including sample location identification number, depth interval, etc.
6. Whenever a sample is collected for chemical analyses, initiate a custody record via the Chain of Custody/Request for Analysis Form, and affix a sample label to the sample container.
7. Whenever a sample is collected, enter a complete description of the sample collection log.

NOTE: Refer to Section 4.8 for VOC-specific sampling methods.

8. Collect field duplicates according to in EP-CAP-SOP-20235, *Sample Containers, Preservation, and Field Quality Control*.

8.4 Perform Sampling Activities Using a Thin-Wall Tube Sampler

8.4.1 *Field Team Members*

1. Collect with a thin-wall tube sampler in the following manner:
   - Dig to the required depth using the bucket auger.
   - Assemble the tube holder with the appropriate tube inside, and attach the tube holder to the auger shaft, applying Teflon tape to the threads.
   - Shove, twist, or pound the tube holder into the ground until it is full; when pounding, use a plastic hammer and take care not to damage the equipment.

NOTE: If the sample is taken from the surface, remove any rocks, sticks, or leaves before driving the sampler into the ground.

   - Place the thin-wall tube sampler on a secure bench, table, rack, or on plastic laid on the ground.

- Disassemble the tube holder, being careful not to let any soil fall out of the tube.
- Immediately cover the ends of the sample tube with 2-inch Teflon film, and then put plastic caps over the film.

NOTE: If appropriate, place tape over the caps to ensure retention before submitting the entire tube to the laboratory.

- Label the bottom end of the tube with "Open This End."

2. Label sample containers and complete documentation.
3. At this time, enter the sample information in the field notebook according to SOP-5181 and in the collection log, including sample location identification number, depth interval, etc.
4. Whenever a sample is collected for chemical analyses, initiate a custody record via the Chain of Custody/Request for Analysis Form, and affix a sample label to the sample container.
5. Whenever a sample is collected, enter a complete description in the sample collection log.

NOTE: Refer to Section 4.8 for VOC-specific sampling methods.

6. Collect field duplicates according to in EP-CAP-SOP-20235, *Sample Containers, Preservation, and Field Quality Control*.

8.5 Perform Sampling Activities Using a Small Power Auger

8.5.1 *Field Team Members*

1. Using the most effective tool available, advance a borehole to just above the required sample depth.
2. Clean the slough from the borehole with the bucket auger. Discard any soil that falls down the hole and, as such, did not come from the required sample depth.
3. Go to Section 8.3, Perform Sampling Activities Using a Hand Auger, and continue.

NOTE: Refer to Section 4.8 for VOC-specific sampling methods.

4. Collect field duplicates according to in EP-CAP-SOP-20235, *Sample Containers, Preservation, and Field Quality Control*.

8.6 Perform Sampling Activities Using a Split-Barrel

8.6.1 *Field Team Members*

1. Advance the borehole to the sample collection depth.
2. Collect and place the split-barrel sampler on a secure bench, table, or rack.
3. Separate the split-barrel sampler tube (a flat-blade screwdriver is useful), exposing either the sample or stainless steel liners.
4. For non-VOC samples, collect a subsample from the liner (or directly from the sample if the sampler is unlined) at the desired depth interval in a stainless-steel bowl in the following manner:
   - With a decontaminated spatula or knife, dig out enough soil for the subsample.
   - Discard any soil that falls down the hole and, as such, did not come from the required sample depth.
   - Put an adequate amount of sample material into a decontaminated, stainless-steel bowl, and mix until the sample is homogenized.

- Fill the sample containers (see EP-CAP-SOP-20235, *Sample Containers, Preservation, and Field Quality Control*).
- When collecting a composite sample, keep the bowl of soil out of the sun and keep it covered with aluminum foil; collect all of the aliquots as quickly as possible; do not decontaminate the auger between aliquots.

5. Label the sample containers, and complete documentation according to EP-CAP-SOP-20235, *Sample Containers, Preservation, and Field Quality Control*.
6. At this time, enter the sample information in the field notebook according to SOP-5181 and in the collection log, including sample location identification number, depth interval, etc.
7. Whenever a sample is collected for chemical analyses, initiate a custody record via the Chain of Custody/Request for Analysis Form, and affix a sample label to the sample container.
8. Whenever a sample is collected, enter a complete description in the sample collection log.

NOTE: Refer to Section 4.8 for VOC-specific sampling methods.

9. Collect field duplicates according to EP-CAP-SOP-20235, *Sample Containers, Preservation, and Field Quality Control*.

8.7 Perform Sampling Activities Using a Core-Barrel

8.7.1 *Field Team Members*

1. Rock core handling and logging will be performed in accordance with *Borehole Materials Management*, EP-DIR-SOP-20019.
2. Place the core barrel on a secure bench, table, or rack.
3. If required by an RWP, field screen for radiological contamination.
4. Open the core barrel to expose the core run.
5. Collect a subsample of the exposed rock core run from the desired depth interval in a stainless-steel bowl in the following manner:
   - With a clean stainless steel knife, spatula and/or other tools, cut or break enough tuff for the sample.
   - Discard any material that falls down the hole and, as such, did not come from the required sample depth.
   - Put an adequate amount of sample material into a decontaminated, stainless-steel bucket and mix until the sample is homogenized.
   - Fill the sample containers (see in EP-CAP-SOP-20235, Sample Containers, Preservation, and Field Quality Control).
   - When collecting a composite sample, keep the pan of soil out of the sun and keep it covered with aluminum foil; collect all the aliquots as quickly as possible; do not decontaminate the auger between aliquots.
6. Label the sample containers and complete documentation according to in EP-CAP-SOP-20235, Sample Containers, Preservation, and Field Quality Control.
7. Enter the sample information in the field notebook according to SOP-5181 and in the collection log at this time, including sample location identification number, depth interval, etc.

8. Whenever a sample is collected for chemical analyses, initiate a custody record via the Chain of Custody/Request for Analysis Form and affix a sample label to the sample container.
9. Whenever a sample is collected, enter a complete description of the sample collection log.

NOTE: Refer to Section 4.8 for VOC-specific sampling methods.

10. Collect field duplicates according to in EP-CAP-SOP-20235, Sample Containers, Preservation, and Field Quality Control

8.8 Sampling for Analysis of VOCs

VOC sampling of soils, sediment, and/or tuff at LANL is aimed at assessing low levels of VOCs that might be present as a legacy of past industrial processes. Sites where high levels of VOCs may be present (such as disposal pits) are concerned with deeper migration of VOCs and are characterized using vapor-monitoring well systems.

Solid media sampling for VOCs requires use of techniques that produce the least disturbance of the media being sampled in order to provide samples in which VOCs are most representative of site conditions. Studies have also shown (United States Army Corps of Engineers [USACE], 1998) that the sample should not be exposed to air. VOCs will be lost even in the sample container if a headspace is present. VOC samples should never be composited or homogenized before sample collection. Studies have shown that aggressive homogenization can reduce VOC concentrations in laboratory samples by as much as 90%. Choice and implementation of VOC sample collection needs to consider 1) determination of target compounds and their concentration to select low- or high-concentration sampling methods, 2) selection of the preservation options that are best suited for the VOC target compounds and data quality objectives, and 3) determination of the appropriate container or sampler for the sample collection.

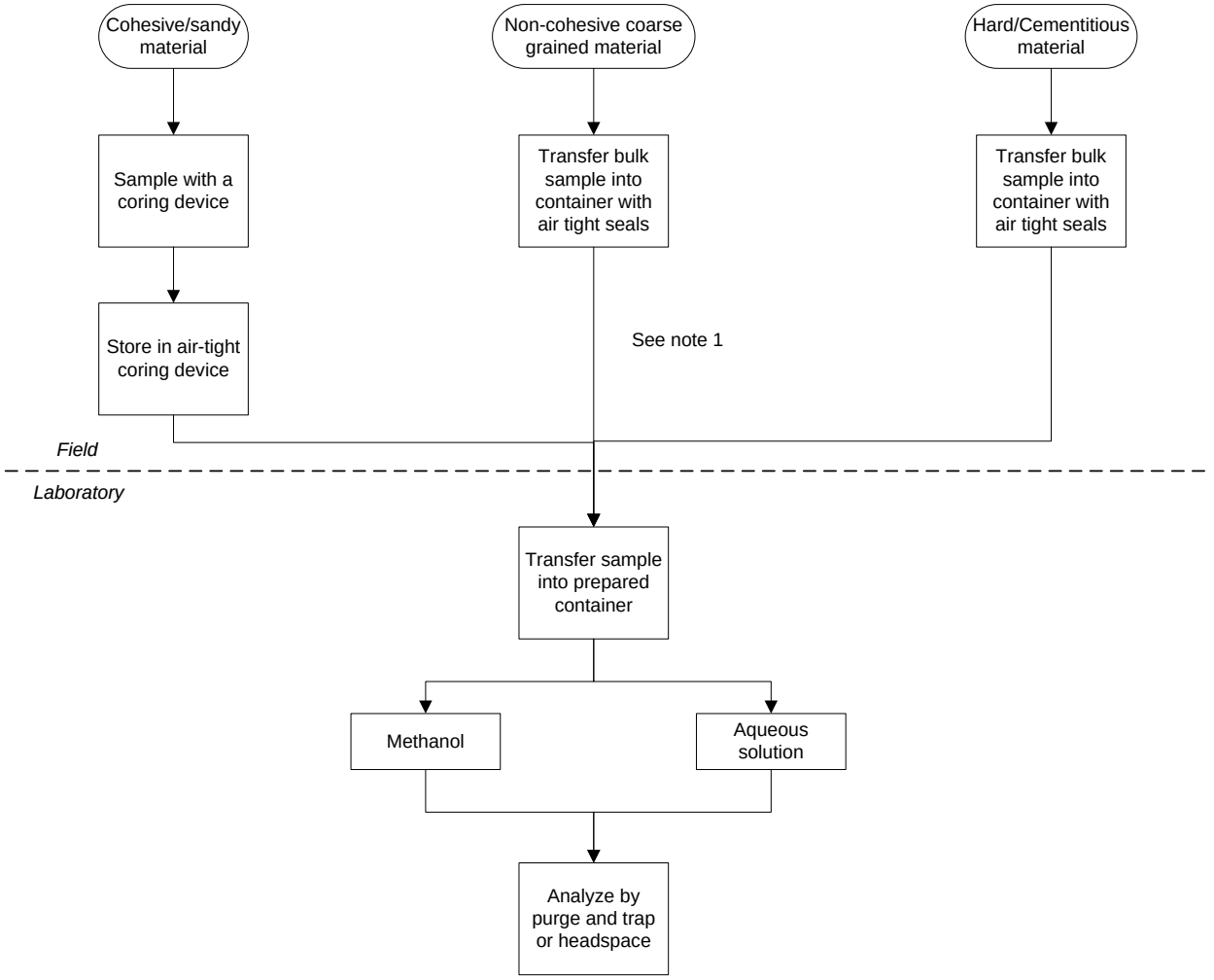
When sampling conditions allow, coring devices specifically developed for sampling VOCs (such as the En Core-type sampler) should be used to preserve the sample structure. ASTM D6418 should be followed when using this sampling device. However, such coring devices are limited to sampling of softer and finer-grained soils and soil-like sediments. At LANL, these particular soil conditions rarely exist because the soils and soil-like sediment is usually very dry and desiccated, or the sediment is so liquid that it cannot be cored.

Gravelly, coarse-grained soils are not present at LANL except in canyon-bottom arroyos where VOC contamination is unlikely; an exception is for the occasional presence of paleochannel material, which is present in soil profiles on some mesa tops. According to ASTM D4547, coarse-grained soils require immediate preservation of the sample in the field, thus requiring a site-specific sampling procedure.

The VOC sampling program must therefore account for the practicality of sampling. To facilitate sampling the predominant soil, sediment, and tuff present at LANL, a variety of sampling methods are available. These include tube and drive samplers, and soil- and rock-coring devices capable of obtaining larger-diameter cores, but these result in more soil disturbance than is desired. As a result, some VOC loss will be experienced in the sampling effort. In addition, subsampling of these larger samples will be required, and VOC coring or sampling devices will not work because of the “cemented” nature (hard) of the sampled material. To minimize the amount of time a sample is exposed to air, VOCs are sampled as soon and quickly as practical upon opening the sample-collection device. A chisel or spatula should be used to fragment a larger portion of material for placement into the tared sample vial (ASTM D4547). Sample bottles are filled as completely as possible to eliminate headspace. Samples should not be

collected from auger cuttings or homogenized samples because the amount of disturbance is too great and most, if not all, VOCs will be lost via volatilization from the sample before placement into the sample container. This procedure follows standard guidance given in ASTM D4547, Figures 1 and 2 as modified for LANL operational conditions (see Figure 1 in this SOP).

Because samples for organic analyses at LANL are shipped to an off-site laboratory, the addition of the aqueous solution will be performed in the laboratory, regardless of the sampling method used to collect VOCs. This practice reduces the health and safety risk to the sampling team because of the toxic and flammable nature of the liquid and eliminates the need to ship the sample as a hazardous waste; however it will result in a biased low analytical result for coarse-grained cohesionless soils.



Note 1: ASTM requires field use of methanol or aqueous solution, which is not done at LANL due to safety concerns during shipment of sample. This is a rare soil condition at LANL.

Reference: Taken from ASTM D4547 and modified as noted for LANL site conditions.

Figure 1. VOC sample-handling operations for LANL.

It is also important to use consistent sampling techniques so as not to introduce sampling bias into the sampling program. The same sampling technique is recommended throughout a site-sampling program and at all depths, although a site can be subdivided (such as augers and hand drive samples for hillsides and drill rig core sampling for level ground where deeper sampling is required) to allow the optimized use of appropriate sample methods. Using a single sampling method in a given area will reduce the potential for the sampling method to influence the VOC nature and extent determination of a site.

This process complies with ASTM D4547 for the hard soil, tuff, and sediment typically encountered at LANL (considered "cementitious") but does not strictly conform to the United States Environmental Protection Agency (EPA) Method 5035 because EPA Method 5035 does not accommodate hard materials. The process does meet EPA Method 5035 for softer soil or sediment by incorporating the use of the En Core-type sampler according to ASTM D6418.

8.9 Perform Post-Sampling Activities

8.9.1 *Field Team Members*

1. Ensure that all sample containers are completely filled.
2. Decontaminate the outside of sample containers.
   - Seal the lid of every sample container with a chain-of-custody seal (i.e., custody tape) to ensure that samples are not tampered with. Do not place the custody seal over a volatile organic analysis vial septum.
   - Apply correct pre-made sample labels to each container.
   - Bag samples in a Ziploc bag and label the bag with the sample information.
3. Pack samples in a cooler at the sampling site, ensuring that the cooler contains ice as specified by the site-specific sampling plan.
4. Transport the cooler full of samples to the SMO (see EP-CAP-SOP-20236, *Handling, Packaging, and Shipping of Samples*).
5. Complete the field chain-of-custody form for each sample set collected.
6. Decontaminate equipment according to EP-ERSS-SOP-5061, *Field Decontamination of Equipment*.
7. Fill all hand-augered holes as directed by the work plan and or waste characterization strategy form; leave any open holes in a safe and secure manner by appropriately covering or barricading before demobilization from the site.
8. Check that all sampling locations are properly staked and that location identifications are readily visible on the location stakes.
9. Survey all sample locations, and upload the survey data into the Sample Management Database.

9.0 RECORDS PROCESSING

Field Team Member

1. Maintain and submit records and/or documents generated to the Records Processing Facility according to EP-DIR-AP-10003, *Records Management Procedure for ADEP Employees*.

10.0 ATTACHMENTS

Attachment 1, Equipment and Supplies Checklist

ATTACHMENT 1

Equipment and Supplies Checklist

	Field Logbook, Sampling Logs/Field Chain of Custody Forms, Plan of the Day, relevant IWDs, SSHASP, and SOP
	Roll-up tables, chairs, shade shelter, paperwork, investigation work plan, and detailed sampling summary
	Radio, cell phones, pagers, appropriate keys
	First aid kit, eyewash, fire extinguisher, appropriate personal protective equipment
	Tool box with pipe wrenches, crescent wrenches, socket wrenches, assorted other tools
	Waste drums and containers
	Extension cord, computer with appropriate connections, inverter
	Manual depth-sounding tape if necessary
	Field screening instruments (see EP-DIR-SOP-20025, *Headspace Vapor Screening with a Photoionization Detector*)
	Action packer fully stocked with nitrile gloves, Wypalls, polyethylene flexible tubing, chain-of-custody tape, deionized water squirt bottle, pH test strips, Ziploc bags, duct tape, and Teflon tape
	Assorted preservatives (acids & bases)
	Cooler with blue ice
	Drilling/coring apparatus
	Sampling apparatus
	Power auger system (as needed)