CHAIN OF CUSTODY

1.0 PURPOSE

This Standard Operating Procedure (SOP) establishes the method and responsibilities associated with the maintenance and custody of samples that are to be used to provide data that form a basis for making project related decisions. It outlines the general procedures for maintaining and documenting sample chain of custody from the time of sample collection through sample disposition.

2.0 REFERENCES

USEPA, Test Methods for Evaluating Hazardous Waste, (SW-846), current revision.

3.0 RESPONSIBILITIES

The Project Technical Manager or Technical Coordinator is responsible for ensuring that all sample collection activities are conducted in accordance with this SOP and any other appropriate procedures. This will be accomplished through staff training and by maintaining quality assurance/quality control (QA/QC).

The Project Chemist is responsible for assuring that the proper chain of custody is initiated at the time the sample(s) are collected and maintained throughout the handling and subsequent transportation of the sample(s) to the designated laboratory. Additionally, the Project Chemist is the project authority for determining the disposition and fate of sample(s) that have identified deficiencies (e.g., missed holding times, elevated temperature at receipt, etc.).

The Quality Assurance Officer is responsible for periodic review of Chain of Custody records generated and other documentation associated with this SOP. The Quality Assurance Officer is also responsible for implementation of corrective action (i.e., retraining personnel, additional review of work plans and SOPs, variances to QC sampling requirements, issuing nonconformances, etc.) if quality issues are identified.

The Sampling Team Leader is responsible for properly documenting and maintaining the Chain of Custody from the time of sample collection until the sample is delivered to the laboratory.

Laboratory Personnel are responsible for receipt and entry of samples into the laboratory that have been submitted to the laboratory under a Chain of Custody document. Additionally, samples received will be entered into the laboratory Chain of Custody procedures by properly documenting and maintaining chain of custody from the moment that they take custody of the sample at the laboratory until the sample is disposed of or returned to the client.

4.0 DEFINITIONS/MATERIALS

4.1 Chain of Custody

The Chain of Custody document sometimes called the “cradle to grave” record is the written record that traces the sample possession from the time each sample is collected until its final disposition. Chain of Custody is maintained by compliance with one of the following criteria:

- The sample is in the individual’s physical possession.
- The sample is maintained in the individual’s physical view after being in his/her possession.
- The sample is transferred to a designated secure area restricted to authorized personnel.
- The sample is sealed and maintained under lock and key to prevent tampering, after having been in physical possession.
- The sample is transferred under proper manifesting and documentation from one party to another with documentation being maintained throughout the sampling and analysis period.

4.2 Waybill

A waybill is a document that contains a list of the goods and shipping instructions relative to a shipment.

4.3 Common Carrier

For the purpose of this procedure, the common carrier is any commercial carrier utilized for the transportation of the sample(s) from the field to the laboratory.

5.0 PROCEDURE

5.1 General

The ability to demonstrate that the samples were obtained from the locations stated and that they reached the laboratory without alteration is required to maintain documented chain-of-custody. Evidence of collection, shipment, laboratory receipt, and laboratory custody until disposal must be documented to accomplish this. Documentation will be accomplished through a Chain of Custody Record that lists each sample and the individuals performing the sample collection, shipment, and receipt.

The Chain of Custody document is a preprinted form. The original will accompany the samples to the laboratory and a copy will be retained in the field project file.

5.2 Field Sample Custody

Sampling personnel, upon collection of samples for analysis, will properly complete a Chain of Custody record form. The Chain of Custody document will be the controlling document to assure that sample maintenance and custody are maintained; thereby assuring the sample(s) are representative of the environment from which they were collected. At a minimum, the following information will be recorded on the Chain of Custody document:

- The unique identification number assigned to each sample.
- A brief description of the sampling location and a physical description of the sample type.
- The date and time of the sample collection.
- The general environmental conditions (i.e. temperature, weather) at the time of sample collection.
- Container type (e.g., glass, poly, brass sleeve, etc.).
- Sample volume and number of containers (e.g., 2 x 40 ml, 3 x 1 liter)
- Sample preservation (e.g., HNO_3, H_2SO_4, 4^oC).
- Requested analyses.
- Special instructions to the laboratory including handling requirements, quality assurance / quality control, health and safety, and sample disposition.
- The project name and number.
- The date the analytical report is due.
- The names of all sampling personnel.
- The name and telephone number of the project contact.
- The name and telephone number of the laboratory contact.
- The name of the courier and the waybill number (if applicable).
- A unique document reference number.

5.3 Transferring Chain-of-Custody

The Chain of Custody document will be initiated in the field by the person collecting the sample and signed by each individual who has the samples in their possession. Each time that sample custody is transferred, the former custodian must sign over the Chain of Custody as “Relinquished By,” and the new custodian must sign on to the Chain of Custody as “Received By.” The date, time, and the name of their project or company affiliation must accompany each signature. Shipping by common carrier is addressed separately, elsewhere in this subsection.

Transferring of Chain of Custody from sampling personnel to the analytical laboratory will be performed in accordance with the requirements stated below. If the sampling personnel deliver the samples to the laboratory directly, transfer of Chain of Custody occurs as follows:

- The sample collector delivers the samples to the laboratory and relinquishes the sample directly to a laboratory representative.
- The collector signs the Chain of Custody listing his/her name, affiliation, the date, and time. Any person involved in the collection of the sample may act as the sample custodian.
- The laboratory representative must receive the samples by signing his/her name, affiliation, the date, and time of the Chain of Custody Record. The laboratory representative may decline to take receipt of the samples if the Chain of Custody Record is not properly completed or if the samples are not properly packaged. All designated laboratory personnel may act as the sample custodian.

If the sampling personnel transfer sample(s) to the laboratory utilizing a common carrier, sampling personnel will retain Chain of Custody responsibility and the common carrier is not responsible for maintaining sample custody. The sample collectors are responsible for packaging the samples in a manner that meets the Chain of Custody definition criteria, that is; the samples are sealed to prevent tampering. When transferring samples to the courier for transport, Chain of Custody procedures are maintained as follows:

- The sample collector lists the courier affiliation and waybill number on the Chain of Custody Record.
- The sample collector relinquishes custody by signing his name, affiliation, date, and time. The collector keeps a copy of the relinquished Chain of Custody Record for the project file.
- The relinquished original Chain of Custody Record is sealed in a watertight plastic bag and taped to the inside of the lid of the transport container.
- The transportation container is sealed to prevent tampering and given to the courier for delivery to the laboratory.
- The sample collector obtains a copy of the waybill from the courier for the project file.
- The laboratory representative must receive the samples by signing his/her name, affiliation, the date, and time on the Chain of Custody Record. This copy is maintained with the samples at the laboratory.
- The laboratory representative obtains a copy of the waybill from the courier for the project file.

5.4 Analytical Laboratory Custody

Upon receipt at the analytical laboratory, the field generated Chain of Custody document will be signed, dated, time marked, temperature marked, and laboratory identification will be provided in the appropriate spaces. Laboratory receipt personnel will enter the samples into the laboratory by implementing the sample custody procedures addressed within their approved Program Plan.

After completion of analytical testing, sample remnants not consumed during testing may be kept for six months beyond the completion of analysis, unless otherwise specified by a notation on the Chain of Custody record that samples are to be returned to the project site for disposal. Once this time period has elapsed, the samples will be disposed of and the disposal record number will be recorded on the laboratory record copy of the Chain of Custody Record.

6.0 REQUIRED FORMS/DOCUMENTATION

Chain of Custody Record
Shipping waybill (as applicable)

SAMPLE HANDLING, PACKING, AND SHIPPING

1.0 PURPOSE

This Standard Operating Procedure (SOP) outlines the methods and responsibilities for field personnel to use in the packaging and shipping of environmental samples for chemical and physical analysis. This SOP only applies to the packaging and shipping of limited quantity, low concentration environmental samples. This procedure does not apply to those samples considered hazardous materials, hazardous waste, mixed waste, radioactive waste, and/or dangerous goods. Those requirements are specified in the Department of Transportation (DOT) 49 CFR 114-327 and the International Air Transport Association (IATA) procedures. The details within this SOP are only applicable to the general requirements for sample packaging and shipping and should only be used as a guide for developing more job-specific work plans.

2.0 REFERENCES

EPA, September 1987, Compendium of Superfund Field Operations Methods, EPA 540/P-87/001a, OSWER 9355.0-14.

EPA, August 1988, EPA Guidelines for Conducting Remedial Investigation and Feasibility Studies under CERCLA, Interim Final OSWER directive 9355.3-01.

Code of Federal Regulations, DOT 49 CFR parts 100 to 177, revised October 1, 1992.

Dangerous Goods Regulations, IATA, January 1, 1994.

3.0 RESPONSIBILITIES

The Project Technical Manager and Technical Coordinator are responsible for ensuring that all sample collection activities are conducted in accordance with this SOP and any other appropriate procedures or related SOPs. This will be accomplished through staff training and by maintaining quality assurance/quality control (QA/QC).

The Project Chemist is responsible for the development and review of site-specific work plans that address the specific sample handling, packaging, and shipping requirements for the project. Review the project specific documentation forms to ensure they are appropriate for the field activities. The Project Chemist is also responsible for seeing that field personnel receive proper training and maintain quality assurance/quality control (QA/QC). If problems arise, the Project Chemist is responsible for swift implementation of corrective action (i.e., retraining personnel, additional review of work plans and SOPs, variances to requirements, issuing nonconformances, etc.).

The Quality Assurance Officer is responsible for periodic review of documentation generated during sample handling, packaging, and shipping and the periodic review and audit of field personnel as they perform the work.

The Sampling Team Leader(s) is responsible for ensuring that samples are handled, packed and shipped in accordance with this procedure.

4.0 DEFINITIONS/MATERIALS

4.1 Environmental Sample

A limited quantity, low concentration sample that does not require DOT or IATA hazardous waste labeling as a hazardous waste or material.

4.2 Hazardous Waste Sample

Medium or high concentration sample requiring either DOT or IATA labeling as a hazardous waste or material.

4.3 Hazardous Waste

Any substance listed in 40 CFR Subpart D (260.30 et seq.) or otherwise characterized as ignitable, corrosive, reactive, or toxic as specified in Subpart C (261.20 et seq.) and that would be subject to manifest and packaging requirements specified in 40 CFR 262. Hazardous waste is defined and regulated by the U.S. Environmental Protection Agency (USEPA).

4.4 Hazardous Material

A substance or material in a quantity or form that may pose an unreasonable risk to health, safety, and/or property when transported in commerce and as specifically defined and regulated by DOT (49 CFR 173.2 and 172.101) and IATA (Section 4.2).

4.5 Sample

Physical evidence collected from a facility or the environment that is representative of conditions at the point and time at which the sample is collected.

5.0 PROCEDURE

5.1 Sample Handling

Inspect the sampling containers (as applicable, generally obtained from the analytical laboratory prior to the sampling event) to ensure that they are appropriate for the samples being collected, correctly preserved, and undamaged.

When collecting or handling a sample, always use approved/site specific personal protective equipment (e.g., gloves, etc.) not only to prevent cross-contamination from sample to sample but also as a health and safety requirement.

5.2 Field Packaging

1. Collect the samples in accordance with the site-specific work plans and applicable SOPs.
2. As soon as possible after sample collection, tightly seal the container, and place a piece of custody tape over or around the cap. The custody tape should be placed over the cap so that any attempt to remove the cap will cause the tape to be broken. Do not place custody tape over a volatile organic analysis (VOA) vial septum.
3. Place each container in a separate, appropriately sized, airtight, seam-sealing polyethylene bag (e.g., ZiplocTM or equivalent). Seal the bag, removing any excess air.
4. Place the bagged container inside an insulating shipping container, “cooler”. This cooler should have frozen blue ice or airtight, seam-sealing polyethylene bags of ice inside to assure samples remain cool, 4°C ± 2°C, during transit from field to the packaging location.
5. Because blue ice does not maintain 4°C standard required for sample shipping, it should only be used while in the field collecting samples.
6. Maintain the samples under chain of custody in accordance with the site-specific work plans and appropriate SOPs.

5.3 Sample Packaging

1. Inspect the integrity of the shipping container. The container is generally a "cooler" constructed of heavy plastic or metal with appropriate insulating properties so that variation in temperature during shipping is minimized. Also make sure that the drain plug has been sealed with nylon reinforced strapping tape or mailing tape.
2. Place two or four inches of absorbent packaging material (e.g., Styrofoam bubbles, Vermiculite™ etc.) in the bottom of the shipping container.
3. Carefully check the chain of custody record against the collected sample labels and containers to ensure that the sample numbers, sample description, date and time of collection, container type and volume, preservative, and the required analytical methods are correct and in agreement.
4. Place the samples in the shipping container, allowing sufficient room between the samples to place ice and/or packing material.
5. Double bag and seal crushed or cubed ice in heavy-duty polyethylene bags (Ziplock™ or equivalent). Place these bags of ice on top of and between samples. Blue ice should not be used for sample shipping; it does not maintain the 4°C temperature necessary for regulatory compliance. Include a VOA vial of tap water clearly labeled "temperature blank" so that the laboratory can verify the temperature of the samples upon receipt. The remaining space will be filled with packing material.
6. All samples requiring temperature preservation stated at 4°C will be acceptable "as is" within the range of 4°C ± 2°C. The laboratory should record the temperature of receipt upon the chain of custody report. For all samples received at less than 2°C (note not frozen), or at greater than 6°C, the sample(s) and temperature (in 1°C increments) will be identified on the chain of custody and the Project Chemist notified in order to provide a determination and written authorization to proceed to analysis.

5.4 Sample Shipping

1. The laboratory will be contacted prior to sample shipments. Delivery on weekends and holidays will be confirmed in advance, and prior to shipment.
2. The person in charge of sample custody will note the time, date, and sign over relinquishment of custody on the Chain of Custody. When a common carrier is to be used for sample shipment, also record the air/waybill number (tracking number) and the name of the carrier on the Chain of Custody record.
3. Place the original copy of the Chain of Custody record and a copy of the task specific analyte list in a sealed, clear plastic envelop or bag and tape the envelope to the inside lid of the shipping container. Retain a copy of the Chain of Custody record and shipping waybill (as applicable) for tracking purposes.
4. Using nylon reinforced strapping tape or mailing tap, seal the shipping container. Place custody tape over opposite ends of the lid. Apply a label stating the name and address of the shipper and the receiving laboratory on the outside of the cooler.
5. If QA split samples are shipped the Project Chemist or Project Manager shall notify the QA Laboratory in advance of sample shipment (for large numbers of samples, greater than 20).

   NOTE: The courier or carrier is not responsible for sample custody and is not required to sign the Chain of Custody record. Contact the appropriate laboratory personnel to advise them of the sample shipment.
6. Review the Chain of Custody and sample collection forms for completeness and turn them over to site or project management.

6.0 REQUIRED FORMS/DOCUMENTATION

Chain of Custody Record

Shipping Waybill (as applicable)

Task Specific Analyte List (as applicable)

SAMPLE LABELING

1.0 PURPOSE

This Standard Operating Procedure (SOP) establishes guidelines and procedures for sample labeling. Sample labeling is required to identify, track and trace samples from the time of collection until the time of disposal. Additional specific procedures and requirements will be provided in the project work plans.

2.0 REFERENCES

EPA, September 1987, Compendium of Superfund Field Operations Methods, EPA 540/P-87/001a, OSWER 9355.0-14.

EPA, August 1988, EPA Guidelines for Conducting Remedial Investigation and Feasibility Studies under CERCLA, Interim Final OSWER directive 9355.3-01.

3.0 RESPONSIBILITIES

The Project Technical Manager and Technical Coordinator are responsible for ensuring that all sample collection and labeling activities are conducted in accordance with this SOP and any other appropriate procedures or related SOPs. This will be accomplished through staff training and by maintaining quality assurance/quality control (QA/QC).

The Quality Assurance Officer is responsible for periodic review of field generated documentation associated with this sample labeling SOP. The Quality Assurance Officer is also responsible for the implementation of corrective action (i.e., retaining personnel, additional review of work plans and SOPs, variances to sample labeling requirements, issuing nonconformances, etc.) if quality issues are identified.

The Sampling Team Leader(s) assigned to sampling and sample labeling activities are responsible for completing their tasks to specifications outlined in this SOP and other appropriate procedures. All staff members are responsible for reporting deviations from the procedures to the Project Technical Manager or Technical Coordinator.

4.0 DEFINITIONS/MATERIALS

4.1 Sample Label

Sample labels include all forms of sample identification (labels and tags) that are physically attached to samples collected and provide, at a minimum, the information required by this SOP and related project work plans.

5.0 PROCEDURE

This section contains the procedures involved with sample labeling. Sample labeling is required to identify, track and trace samples from the time of collection until the time of disposal. The details within this SOP should be used in conjunction with the project work plans and other related SOPs. The project work plans will commonly provide the following information:

- Sample collection objectives.
- Number, types and locations of samples to be collected.
- Any additional sample labeling requirements or procedures beyond those covered in this or related SOPs, as applicable.

5.1 Sample Labeling

Document all the information necessary on the sample label and ensure that the label is physically attached to each respective sample. Each sample label must contain at a minimum the following information:

- Project name
- Project number
- Date and Time of collection
- Sample location
- Sample identification number
- Collector's name
- Preservative used (if any)

Additional information may also be required per the project work plans and must accordingly be included on all sample labels. Indelible ink should be used in filling out all sample labels. Ensure that each sample collected has a sample label.

Ensure that the information documented on the sample label corresponds with the information documented on the Field Logbook and Chain of Custody Record.

6.0 REQUIRED FORMS

Sample Labels

Chain of Custody Record

SAMPLE NUMBERING

1.0 PURPOSE

This Standard Operating Procedure (SOP) establishes guidelines and procedures for sample numbering. Sample numbering is required to identify, track and trace samples from the time of collection until the time of disposal. Additional specific procedures and requirements will be provided in the project work plans and/or related SOPs.

2.0 REFERENCES

EPA, September 1987, Compendium of Superfund Field Operations Methods, EPA 540/P-87/001a, OSWER 9355.0-14.

EPA, August 1988, EPA Guidelines for Conducting Remedial Investigation and Feasibility Studies under CERCLA, Interim Final OSWER Directive 9355.3-01.

3.0 RESPONSIBILITIES

The Project Technical Manager and Technical Coordinator are responsible for ensuring that all sample collection and numbering activities are conducted in accordance with this SOP and any other appropriate procedures. This will be accomplished through staff training and by maintaining quality assurance/quality control (QA/QC).

The Quality Assurance Officer is responsible for periodic review of field generated documentation associated with this sample numbering SOP. The Quality Assurance Officer is also responsible for the implementation of corrective action (i.e., retaining personnel, additional review of work plans and SOPs, variances to sample numbering requirements, issuing nonconformances, etc.) if quality issues are identified.

The Sampling Team Leader(s) assigned to sampling and sample-numbering activities is responsible for completing their tasks according to specifications outlined in this SOP and other appropriate procedures. All staff members are responsible for reporting deviations from the procedures to the Project Technical Manager or Technical Coordinator.

4.0 DEFINITIONS/MATERIALS

4.1 Area

An area is a common name given to a subdivision of White Sands Missile Range (WSMR).

4.2 Composite Sample

A composite sample is one that was obtained by thoroughly mixing two or more distinct samples until the individual ones were no longer distinguishable.

4.3 Sample Number

A sample number is a unique alphanumeric identification (ID) assigned to all samples of air, soil, water and waste collected as part of any given project. It is also known as the sample ID.

4.4 Site Code

A Site Code is a unique identifier given to a specific solid waste management unit (SWMU), area of concern (AOC), or locality where an investigation is being conducted. It is generally a small area defined by the boundaries of contamination or investigation.

5.0 PROCEDURE

5.1 Introduction

The following is a site-specific sample identification system that will ensure the uniform documentation of soil borings, soil and sediment samples, monitoring wells, groundwater samples and surface water samples.

A unique identification number (ID) will be assigned to each sample. This ID is called the sample number. It references information pertaining to a particular sample including the location of the site, the type of sample, sample location number and other information contained in the suffix, such as the date, sample interval. The sample identification number is recorded on the sample container label, in the field logbook, and on the chain of custody form.

5.2 Location

Each sample collected will be designated with a prefix which identifies the site where it was taken using two identifiers. These identifiers include the area and site code. Both are a four character alphanumeric code.

An index of these identifiers is maintained in the Environmental Data Management System (EDMS), which is an online database located in WTS's Intranet. The following is an example of the identifiers for a particular site:

> The systemic diesel spill site is located at the High Energy Laser System Test Facility (HELSTF). HELSTF is identified as an area and has been given the abbreviation "HLSF". The systemic diesel spill also known as solid waste management unit (SWMU 154) is identified specifically with a site code of "0154". Therefore every sample at the HELSTF systemic diesel spill site will be identified with the prefix "HLSF-0154".

When a particular site or area is not identified in the EDMS, the Task Coordinator should contact the database administrator for directions on adding it to the online database. If the sample is being collected to determine site-wide background concentrations in a large area, the site code "BKGD" should be used.

5.3 Location Number

Each sample will be identified by a unique three digit number. The first digit is a marker to identify and improve the electronic data management of replicate and other QA/QC samples and analytical results (see Section 4.4.10). The last two digits are used to indicate different sample locations of identical sample types. An example would be that most sites have multiple monitoring wells which are numbered 01, 02, 03 etc.

5.4 Types of Samples

There are many types of samples that may be taken. The most common ones are listed in the following sections. Directions are provided for identifying them in a meaningful and consistent manner.

5.4.1 Surface Soil and Sediment Sample Identification

The sample ID for surface soil, sediment and wash sediment samples contains the area identifier, site code, and location number along with the abbreviation "SD" for sediment.

The surface soil and sediment samples are identified as follows:

ABCD-####-SD-$$$

Where:

- ABCD = Area Identifier
- #### = Site Code
- SD = Surface soil or sediment
- $$$ = Location number

5.4.2 Composite Samples

The sample ID for composite samples contains the area identifier, site code, and location number along with the abbreviation "CS" for composite.

The composite samples are identified as follows:

ABCD-####-CS-$$$

Where:

- ABCD = Area Identifier
- ## = Site Code
- CS = Composite sample
- $$$ = Location number

5.4.3 Subsurface Soil Samples

The sample ID for subsurface soil samples contains the area identifier, site code, location number, and depth interval, along with the abbreviation "SB" for soil boring.

The subsurface soil samples are identified as follows:

ABCD-####-SB-$$$-(yy.y-zz.z)

Where:

- ABCD = Area Identifier
- #### = Site Code
- SB = Soil boring
- $$$ = Location number
- (yy.y-zz.z) = Depth interval where soil sample was taken in feet

5.4.4 Surface Water Samples

The sample ID for surface water samples contains the area identifier, site code, and location number, along with the abbreviation "SW" for surface water.

The surface water samples are identified as follows:

ABCD-####-SW-$$$

Where:

- ABCD = Area Identifier
- #### = Site Code
- SW = Surface water
- $$$ = Location number
- Groundwater Samples

The sample ID for groundwater samples contains the area identifier, site code, location number (monitoring well number), and date, along with the site specific well abbreviation. Many different well abbreviations have been previously used to identify wells at a particular site. Examples include MW, B, DRW, HCF, HMW, SRW, TTF, etc. Up to four alphanumeric characters may be used to uniquely identify the wells. The existing abbreviations already in use at a given site should generally continue to be used for consistency when possible. If an existing well abbreviation exceeds four characters it must be truncated with a note in the log book indicating the new well name. In addition, inform the EDMS database administrator of the change so that it can be noted in the database. Do not confuse the well abbreviation with the well number. The specific number for the well must go after the abbreviation as designated below with $$$.

The groundwater samples are identified as follows:

ABCD-##-WXYZ-$$$-MMYY

Where:

- ABCD = Area Identifier
- ## = Site Code
- WXYZ = Monitoring well abbreviation
- $$$ = Monitoring well number
- MMYY = Sample date indicated by the month and year by four numbers.

5.4.5 Rinsate Blank Samples

The sample ID for rinsate blank water samples contains the area identifier, site code, rinsate blank number, and date, along with the abbreviation “RB” for rinsate blank.

The subsurface soil samples are identified as follows:

ABCD-####-RB-$$$-MMYY

Where:

- ABCD = Area Identifier
- #### = Site Code
- RB = Rinsate blank
- $$$ = Rinsate blank sample number
- MMYY = Sample date indicated by the month and year by four numbers.

5.4.6 Waste Samples

The sample ID for waste samples contains the area identifier, site code, sample number and date, along with the waste type abbreviation.

Investigation Derived Waste such as purge water, soil cuttings, personal protective equipment and decontamination water will be identified with the following alphanumeric abbreviation containing no more than four digits:

Purge Water	–	PW
Soil Cuttings	–	SC
Personal Protective Equipment	–	PPE
Decontamination Water	–	DCON

Generic solid and liquid waste will be designated as follows:

Solid	–	SL
Liquid	–	LQ

The waste samples are identified as follows:

ABCD-####-XXXX-$$$-MMYY

Where:

- ABCD = Area Identifier
- #### = Site Code
- XXXX = Waste type
- $$$ = sample number
- MMYY = Sample date indicated by the month and year by four numbers.

5.4.7 Trip Blank Samples

The sample ID for trip blank samples contains the area identifier, site code, year and chain of custody number, along with the abbreviation "TB" for trip blank. The chain of custody number is a sequential three digit number which starts at 001 each calendar year.

The trip blank samples are identified as follows:

ABCD-####-TB-YY-&&&

Where:

- ABCD = Area Identifier
- #### = Site Code
- TB = Trip blank
- YY = Calendar Year designated by a two digit number
- &&& = Chain of custody number

5.4.8 Replicate Samples

As previously noted, there is an "extra" digit or marker in the sample ID format. It is placed in the location number to provide a more discreet identifier of QA related samples.

For normal (non-QA related) samples the digit remains a zero. For replicate or other QA/QC-related samples co-located with the first sample, the first replicate will have this place filled with a "1", the second replicate or QA/QC sample will have this place filled with a "2", etc. For example, a duplicate sample might be collected on January 7, 2003 from DRW01 at the HELSTF systemic diesel spill site.

The identical groundwater samples would be identified as follows:

The original sample ID would be: HLSF-0154-DRW-001-0103

The duplicate sample ID would be: HLSF-0154-DRW-101-0103

5.4.9 Matrix Spike Samples

Matrix spike and matrix spike duplicate samples are provided as a courtesy to the laboratory for complying with data quality objectives. The abbreviation "-MS/MSD" is added at the end of any sample ID used for this purpose.

6.0 REQUIRED FORMS

Field Log Book

Chain of Custody Record

ON-SITE SAMPLE STORAGE

1.0 PURPOSE

This Standard Operating Procedure (SOP) establishes guidelines and procedures for on-site sample storage. On-site sample storage may be required for samples collected during a given project. Additional on-site sample storage procedures and requirements will be provided in the project work plans and/or related SOPs.

2.0 REFERENCES

EPA, September 1987, Compendium of Superfund Field Operations Methods, EPA 540/P-87/001a, OSWER 9355.0-14.

EPA, August 1988, EPA Guidelines for Conducting Remedial Investigation and Feasibility Studies under CERCLA, Interim Final OSWER directive 9355.3-01.

3.0 RESPONSIBILITIES

The Project Technical Manager and Technical Coordinator are responsible for ensuring that all on-site sample storage activities are conducted in accordance with this SOP and any other appropriate procedures or related SOPs. This will be accomplished through staff training and by maintaining quality assurance/quality control (QA/QC).

The Quality Assurance Officer is responsible for periodic review of field generated documentation associated with this SOP. The Quality Assurance Officer is also responsible for the implementation of corrective action (i.e., retaining personnel, additional review of work plans and SOPs, variances to sample numbering requirements, issuing nonconformances, etc.) if quality issues are identified.

The Sampling Team Leader(s) assigned to sample storage activities is responsible for completing their tasks according to specifications outlined in this SOP and other appropriate procedures. All staff members are responsible for reporting deviations from the procedures to the Project Technical Manager or Technical Coordinator.

4.0 DEFINITIONS/MATERIALS

4.1 Field Sample

A sample that has been collected at a project site, during the execution phase of the project, and for the purposes of the project, as defined in the project work plans.

4.2 On-site

For purposes of this SOP, “on-site” is defined as any area within the project site.

4.3 On-site sample storage

For purposes of this SOP, “on-site sample storage” applies to samples stored within the project site for a temporary period of time. Typically, samples may be stored on-site if they are in transit between the project site and a designated laboratory.

5.0 PROCEDURE

This section contains the requirements pertaining to on-site sample storage. Proper storage is essential to maintain in the quality and integrity of samples collected during a field project.

The details within this SOP should be used in conjunction with project specific work plans. At a minimum, the project work plans will provide the following information:

- Sample collection objectives.
- Number, types and locations of samples to be collected.
- Any additional sample numbering requirements or procedures beyond those covered in this SOP, as necessary.

5.1 On-Site Sample Storage

Samples of all types of media may require being stored on-site. The manner in which these samples are stored will be appropriate for individual samples and each sample type.

Samples collected for chemical analysis are typically required to be stored at approximately 4° Centigrade (°C). Therefore, such samples should either be preserved in a "cooler" using water ice, or a "Sample-Only" refrigerator until received by the assigned laboratory. Blue ice is not recommended for on-site sample storage as is does not maintain the 4°C temperature necessary for regulatory compliance. If a refrigerator is used to store samples at the project site, this refrigerator will be dedicated for the sole use of samples and will be located in an area that is access controlled; no food, drinks, or other personal items will be allowed in this refrigerator.

Samples that do not require refrigeration (e.g., air samples and samples for geotechnical or radionuclide analysis) should be stored on-site in a designated, marked area which is access controlled.

Samples that are stored on-site must be stored in appropriate containers per the project-specific work plans and be maintained under custody per SOP No. 1.1.

Samples that are stored on-site must not be stored in a manner in which they may threaten the integrity of other samples in the holding location.

All samples that are stored on-site must be labeled per SOP No. 2.1, numbered per SOP 2.2, and appropriately handled per SOP 2.0.

The Sampling Team Leader or other designee is responsible for maintaining a master sample log listing sample numbers and a brief description of samples collected. The master log should be reviewed on a daily basis for samples that are under storage on site. The samples should then be appropriately shipped, following procedures per SOP No. 2.1, to ensure that holding time is not missed.

6.0 REQUIRED FORMS

Chain of Custody Record

Master Sampling Log

SURFACE AND SHALLOW SUBSURFACE SOIL SAMPLING

1.0 PURPOSE

This Standard Operating Procedure (SOP) establishes guidelines and procedures for use by field personnel in the collection and documentation of surface (0 to 6-inch depth below ground surface (bgs)) and shallow subsurface (6-inch to 6-feet in depth bgs) soil samples for physical and chemical analysis. Proper collection procedures are necessary to assure the quality and integrity of all surface and shallow subsurface soil samples. Additional specific procedures and requirements will be provided in the project work plans.

2.0 REFERENCES

EPA, September 1987, Compendium of Superfund Field Operations Methods, EPA 540/P-87/001a, OSWER 9355.0-14.

EPA, August 1988, EPA Guidelines for Conducting Remedial Investigation and Feasibility Studies under CERCLA, Interim Final OSWER Directive 9355.3-01.

3.0 RESPONSIBILITIES

The Project Technical Manager and Technical Coordinator are responsible for ensuring that all sample collection activities are conducted in accordance with this SOP and any other appropriate procedures and/or related SOPs. This will be accomplished through staff training and by maintaining quality assurance/quality control (QA/QC).

The Quality Assurance Officer is responsible for periodic review of field generated documentation associated with this SOP. The Quality Assurance Officer is also responsible for the implementation of corrective action (i.e., retaining personnel, additional review of work plans and SOPs, variances to sample numbering requirements, issuing nonconformances, etc.) if quality issues are identified.

The Sampling Team Leader(s) assigned to surface and shallow subsurface soils sampling activities is responsible for completing their tasks according to specifications outlined in this SOP and other appropriate procedures and/or related SOPs. All staff members are responsible for reporting deviations from the procedures to the Project Technical Manager, Technical Coordinator, or Quality Assurance Officer as appropriate.

4.0 DEFINITIONS/MATERIALS

4.1 Surface Soil Sample

Soil collected form the surface to a depth of no more than 6 inches bgs.

4.2 Shallow Subsurface Soil Sample

Soil collected from a depth of 6 inches to 6 feet bgs.

4.3 Subsurface Soil Sample

Soil collected at any depth interval greater than 6 inches.

4.4 Disturbed Soil Sample

Soil sample whose in situ physical structure and fabric has been disturbed as the direct result of sample collection.

4.5 Undisturbed Soil Sample.

Soil sample whose in situ physical structure and fabric has not been disturbed as the result of sample collection.

4.6 Grab Samples

Representative disturbed soil sample that is collected by using such devices as a shovel, stainless steel spoon, etc.

5.0 PROCEDURE

This section contains both the responsibilities and procedures involved with surface and shallow subsurface soil sampling. Proper surface and shallow soil sampling procedures are necessary to insure the quality and integrity of the samples. The details within this SOP should be used in conjunction with project work plans. The project work plans will generally provide the following information:

- Sample collection objectives.
- Locations and depths of soil samples to be collected.
- Number and volumes of samples to be collected.
- Types of analyses to be conducted for the samples.
- Specific quality control (QC) procedures and sampling required.

Any additional surface or shallow subsurface soil sampling requirements or procedures beyond those covered in this SOP, as necessary.

At a minimum, the procedures outlined below for surface and shallow subsurface soil sampling will be followed unless otherwise directed within project specific work plans or SOPs.

5.1 Surface Soil Sampling Equipment

A number of devices are available for the collection of surface soil samples. These include, but are not limited to, core samplers, hand augers, spoons, scoops, trowels and, shovels. These devices are constructed of a number of materials including, but not limited to, stainless steel, brass, glass and, Teflon. The sampling and analytical requirements, as well as site characteristics, must be taken into account when determining the proper surface soil sampling equipment to use.

At present, the method commonly used for the collection of surface samples and shallow subsurface samples, both disturbed and undisturbed, is with a core sampler. The core sampler is usually a hollow, stainless steel cylinder, tapered at the leading end. A sample sleeve (brass, stainless steel, lexan, etc.) is inserted into the trailing end. The trailing end is then connected to a piston-type drive hammer. The core is driven into the soil by a hammer so that a relatively undisturbed sample is collected in the sleeve. The sample is then handled and shipped in the sample sleeve.

When a core sample is not feasible or planned, such devices as a stainless steel shovel, hand auger, trowel and, spoon, can be used to collect a sample. The soil is transferred from the collection device into decontaminated sample containers (commonly glass jars). The project work plans will specify the type of sampling equipment containers to be used; the sample to be used will be specified in the project work plans.

5.2 Surface Soil Sample Collection

Prior to sampling and between sampling locations, decontaminate the sample equipment according to WTS-SOP 6.0 and procedures outlined in the project work plans.

1. Ensure that all surface and shallow subsurface soil sampling locations have been appropriately cleared of all underground utilities and buried objects per the project work plans. Review all forms and diagrams documenting the location of the cleared sampling locations, as well as that of any underground utilities or lines, or other buried objects.
2. As required, calibrate any health and safety monitoring equipment according to the instrument manufacturer's specifications. Calibration results will be recorded on the appropriate form(s), as specified in the project work plans. Instruments that cannot be calibrated according to the manufacturer's specifications will be removed from service and tagged.
3. Don appropriate personal protection equipment as specified in the project work plans.
4. Using equipment that will not be used for sample collection, clear the area to be sampled of surface debris and vegetation.
5. If using the coring device, place the sleeve into the device and drive the assembly into the soil using the drive hammer. Drive the device into the soil until the trailing end of the sleeve is at the soil surface.
6. Retrieve the device; check to see that soil recovery is adequate in the sample sleeve. If there is sufficient recovery, mark or note the leading end of the sample sleeve.
7. If using a different sample collection device (other than the coring device), use the other device to scoop or collect soil and directly transfer the soil into the sample container (e.g., glass jar, brass sample sleeve, etc.). Fill the sample container such that little to no headspace exists.
8. If using sample sleeves, place Teflon squares over each end of the sleeve and seal each end with plastic end caps. With a permanent marker, write a "T" for top on the trailing end and a "B" for bottom on the leading end.
9. Appropriately label and number the sample containers per WTS-SOP 2.1 and 2.2, respectively, and the project work plans. The label will be filled out with waterproof ink and will contain, at a minimum, the following information:
    - Project number
    - Sample number
    - Sample location
    - Sample depth
    - Sample type
    - Date and time of collection
    - Parameters for analysis
    - Sampler's initials.
10. Document the sampling event on the Field Logbook or an equivalent form as specified in the project work plans. Note any pertinent field observations, conditions or problems on the Field Logbook. Any encountered problems or unusual conditions should also be immediately brought to the attention of the field geologist.
11. Appropriately preserve, handle, package, and ship the samples per WTS-SOP No. 2.0 and the project work plans. The samples shall also be maintained under custody per WTS-SOP No. 1.1.
12. Fill and abandon the sample hole as required by the project work plans.

5.3 Subsurface Soil Sample Collection

The common method to collect shallow subsurface soil samples is to use a hand auger to bore to the desired sampling depth and then retrieve the sample with a core sampler. The hand auger might also be used to recover the sample for direct transfer into glass jars. The exact methodology to be used will be specified in the project work plans.

For subsurface soil samples of less than 18 inches in depth, successive drives of the core sampler may potentially be used to recover shallow subsurface soil samples. In all methods cited above, borehole stability should be maintained to prevent the recovery of slough in the samples. If sloughing cannot be controlled, than another sampling methodology may have to be considered.

As with surface soil samples, shallow subsurface soil sampling follows the same sample collection procedures specified in Section 5.2.1 through 5.2.13.

6.0 REQUIRED FORMS

Chain of Custody

Master Sampling Log

Field Log Books

SUBSURFACE SOIL SAMPLING WHILE DRILLING

1.0 PURPOSE

This Standard Operating Procedure (SOP) establishes guidelines and procedures for subsurface soil sampling while drilling. Proper collection procedures are necessary to assure the quality and integrity of all subsurface soil samples. Additional specific procedures and requirements will be provided in the project work plans, as necessary.

2.0 REFERENCES

American Society for Testing Materials (ASTM), 1989, Standard Method for Penetration Test and Split-Barrel Sampling of Soils, Method D-1586-84, Philadelphia. PA.

American Society for Testing Materials (ASTM), 1986, Standard Practice for Thin-Walled Tube Sampling of Soils, Method D-1587-83, Philadelphia. PA, pp. 304-307.

American Society for Testing Materials (ASTM), 1986, Standard Practice for Ring-Lined Barrel Sampling of Soils, Method D-3550-84, Philadelphia. PA, pp. 560-563.

3.0 RESPONSIBILITIES

The Project Technical Manager and Technical Coordinator are responsible for ensuring that all sample collection activities are conducted in accordance with this SOP and any other appropriate procedures and/or other SOPs as applicable. This will be accomplished through staff training and by maintaining quality assurance/quality control (QA/QC).

The Quality Assurance Officer is responsible for periodic review of field generated documentation associated with this SOP. The Quality Assurance Officer is also responsible for the implementation of corrective action (i.e., retaining personnel, additional review of work plans and SOPs, variances to sample numbering requirements, issuing nonconformances, etc.) if quality issues are identified.

The Sampling Team Leader(s) assigned to subsurface soils sampling activities during drilling is responsible for completing their tasks according to specifications outlined in this SOP and other appropriate procedures and/or other SOPs as applicable. All staff members are responsible for reporting deviations from the procedures to the Project Technical Manager, Technical Coordinator, or Quality Assurance Officer as appropriate.

4.0 DEFINITIONS/MATERIALS

4.1 Borehole

Any hole drilled into the subsurface for the purpose of identifying lithology, collecting soil samples, and/or installing a monitor well.

4.2 Split-Spoon Sampler

A steel tube, split in half lengthwise, with the halves held together by threaded collars at either end of the tube. This device can be driven into resistant (semiconsolidated) materials using a drive weight or drilling jars mounted in the drilling rig. A standard split-spoon sampler (used for performing standard penetration tests) is 2 inches in outside diameter and 1 ⅜ inches in inside diameter. This standard spoon typically is available in two common lengths, providing either 20-inch or 26-inch internal longitudinal clearance for obtaining 18-inch or 24-inch long samples, respectively. Six-inch long sleeves (tubes) of brass, stainless steel, or plastic are commonly placed inside the sampler to collect and retain soil samples. A five-foot long split-spoon sampler is also available. A California modified split-spoon sampler is also commonly used. The design is similar to the standard split-spoon except the outside diameter is 2 ½ inches and the inside diameter is 2 inches.

4.3 Shelby Tube Sampler

A thin-walled metal tube used to recover relatively undisturbed samples. These tubes are available in various sizes, ranging from 2 to 5 inches in outside diameter and 18 to 54 inches in length. A stationary piston device is included in the sampler to reduce sampling disturbance and increase sample recovery.

5.0 PROCEDURE

This section contains both the responsibilities and procedures involved with subsurface soil sampling while drilling. Proper subsurface soil sampling procedures are necessary to insure the quality and integrity of the samples. The details within this SOP should be used in conjunction with project work plans. The project work plans will generally provide the following information:

- Sample collection objectives.
- Locations of soil boreholes and target horizons or depths of soil samples to be collected.
- Number and volumes of samples to be collected.
- Types of chemical analyses to be conducted for the samples.
- Specific quality control (QC) procedures and sampling required.
- Any additional subsurface soil boring sampling requirements or procedures beyond those covered in this SOP, as necessary.

There are many different methods that may be used for subsurface soil sample collection during drilling. This SOP focuses on the two most common methods of soil sample collection: split-spoon sampling and Shelby tube sampling. At a minimum, the procedure outlined below for these two subsurface soil-sampling methods will be followed unless specifically noted within project specific work plans. If other subsurface soil sampling methods are deemed necessary to meet project objectives, the procedures for these methods will be updated in this SOP or included in the project work plans.

5.1 General Sampling Considerations

The two subsurface soil sampling methods covered in this SOP, split-spoon and Shelby tube, are commonly used in conjunction with hollow stem auger, air rotary, and dual tube percussion drilling methods. Split-spoon or Shelby tube sampling may be conducted when drilling with mud rotary methods. However, when using this drilling method, the samples are not generally useful for chemical analyses. This is because the samples may become invaded or chemically altered when they are tripped through the drilling mud during sample retrieval. In addition, loose unconsolidated soils may also literally wash out of the samplers when they are tripped through the mud column.

The procedures described in the SOP must be used in conjunction with the SOP proscribed for the specific drilling method used at the site. These also include, but are not limited to, site clearance, site preparation, and health and safety requirements. Consequently, the SOP for the specific drilling method to be used at the site, the project work plans, and this SOP must be reviewed together in their entirety before the initiation of drilling and sampling.

5.2 Split-Spoon Sampling

Split-spoon samples for chemical analysis will be obtained in brass, plastic, or stainless steel sleeves. The types, dimensions and number of sleeves to be used, along with the length and type of sampler will be stated in the project work plans. The split-spoon sampler, lined with the brass, plastic, or stainless steel sleeves, is connected to the drill rod string or a wireline sampling string. The procedure for collecting samples from the split-spoon sampler will be outlined in the project work plans.

- ✓ Calibrate all field analytical and health and safety monitoring equipment according to the instrument manufacturer's specifications. Calibration results will be recorded on the appropriate form(s) as specified by the project-specific work plans. Instruments that cannot be calibrated according to the manufacturer's specifications will be removed from service and tagged.

- ✓ Wear the appropriate personal protection equipment as specified in the project work plans and the applicable drilling method SOP. Personnel protection will typically include a hard hat, safety glasses, gloves, steel-toed boots, hearing protection, and coveralls.
- ✓ Between each sampling location and prior to each sampling run, decontaminate the sampler, sleeves, and other sampling equipment as described in WTS-SOP No. 6.0.
- ✓ Advance the borehole to the desired depth or target horizon where the sampling run is to begin. During drilling, monitor vapors in the breathing zone according to the project work plans, and drilling method SOP.
- ✓ Insert the sleeves into the split-spoon sampler, connect the halves, and screw together the rear threaded collar and front drive shoe. Attach the split-spoon sampler to the bottom end of the drill rod string or wireline sampling string. Set up and attach the specified weight, if used.
- ✓ Drive the sampler into the soil at the bottom of the borehole. Record the type of sampler assembly and hammer weight on the Visual Classification of Soils form and/or other appropriate form(s), as specified in the project work plans. To minimize off gassing of the volatiles, the sampler should not be driven until the sampling team is ready to process the sample.
- ✓ When conducting penetration testing, observe and record on the Visual Classification of Soils form the number of hammer blows as described in WTS-SOP No. 10.0.
- ✓ Pull the drill rod or wireline sampling string up from the bottom of the borehole and remove the sampler.
- ✓ Remove the drive shoe and rear collar from the sampler and open the split barrel.
- ✓ Remove the sleeves one at a time, starting with the sleeve adjoining the drive shoe. Observe and record the amount of sample recovery on the Visual Classification of Soils form per WTS-SOP No. 10.0. Any observed field problems associated with the sampling attempt (e.g., refusal) or lack of recovery should be noted on the Visual Classification of Soils form within a clean area on a stand or table between samples.
- ✓ Select sleeve(s) to be submitted for laboratory analysis. Sample sleeve selection should be based on four factors: judgment that the sample represents relatively undisturbed intact material, not slough; proximity to the drive shoe; minimal exposure to air; lithology; and obvious evidence of contamination. The project work plans will specify the sample sleeve to be submitted for specific analyses and confirm the selection criteria.
- ✓ Place Teflon film over each end of sleeves to be submitted for chemical analysis and seal each end with plastic end caps. Place custody tape over each end cap so that any attempt to remove the cap will break the tape.
- ✓ Appropriately label and number each sleeve to be submitted for analysis per WTS-SOP No. 2.1 and 2.2, respectively. The label will be filled out using waterproof ink and will contain, at a minimum, the follow information:
    - Project number
    - Boring number
    - Sample number
    - Bottom depth of sleeve
    - Date and time of sample collection
    - Parameters for analysis
    - Sampler?s initials.
- ✓ Document the sampling event on the Field Logbook or an equivalent form as specified in the project work plans. At a minimum, this log will contain:
    - Project name and number
    - Date and time of the sampling event
    - Drilling and sampling methods
    - Sample number

- Sample location
- Boring number
- Sample depth
- Sample description
- Weather conditions
- Unusual events
- Signature or initials of the sampler.

✓ Appropriately preserve, package, handle, and ship the sample in accordance with the procedures outlined in WTS-SOP No. 2.0 and the project work plans. The samples shall also be maintained under custody per WTS-SOP No 1.1. Samples stored on-site will be subject to the provisions of WTS-SOP No. 2.3.

✓ One of the sample sleeves shall be utilized for lithologic logging per WTS-SOP No. 10.0. This sleeve may not then be retained for chemical analysis, as soil must be removed from the sleeve to effectively describe the soils/lithology and compile the lithologic log.

✓ When VOCs or petroleum hydrocarbons are of concern, remove the soil from one of the remaining sleeves and place in a glass mason jar (fill to one half volume of jar) and seal for organic vapor screening using either Teflon tape or aluminum foil. Place the jar in a warm water bath or in the sunlight (warm) for at least five minutes, shake vigorously for one minute, then using an organic vapor probe (e.g., portable photoionization detector, flame ionization detector, or other appropriate instrument), pierce the lid seal with the probe and monitor the soil for organic vapors. Record the reading on the Visual Classification of Soils form, the Field Logbook, and any other form(s) specified in the project work plans.

✓ Repeat this sampling procedure at the intervals specified in the project work plans until the bottom of the borehole is reached and/or last sample is collected.

5.3 Thin Walled or Shelby Tube Sampling

A thin-walled tube or Shelby tube sampler may be used to collect relatively undisturbed soil samples. The procedure for collecting soil samples using a Shelby tube sampler should be outlined in the project work plans. The standard procedure is described below.

✓ Calibrate all field analytical and health and safety monitoring equipment as discussed in Section 5.2.1.

✓ Wear the appropriate personal protective equipment as described in Section 5.2.2.

✓ Between each sampling location and prior to each sampling run, decontaminate the sampler and other sampling equipment as described in WTS-SOP No. 6.0.

✓ Advance the borehole to the desired depth or target horizon where the sampling run is to begin. While drilling, monitor the breathing zone according to the project work plans and applicable drilling method SOP.

✓ Connect the sampling tube to the drill rod string and advance the tube to the bottom of the boring. The tube is then pushed about 2 to 2.5 feet into the soil with a continuous, rapid motion without impact or twisting.

✓ Pull the drill rod strip up from the bottom of the borehole and remove the sampling tube from the string. Observe and record the amount of sample recovery and any associated problems as discussed in Section 5.2.11.

✓ Place Teflon film over each end of the tube if it is to be submitted for chemical analysis and seal the ends with plastic end caps. Place custody tape over each end cap so that any attempt to remove the cap will break the tape. With a waterproof marker, write a “T” for top on the trailing end and a “B” for bottom on the leading end of the tube.

- ✓ Appropriately label and number the tube as described in Section 5.2.14.
- ✓ Document the sampling event on the Field Logbook as discussed in Section 5.2.15.
- ✓ Appropriately preserve, package, handle, and ship the sample in accordance with the procedures outlined in WTS-SOP No. 2.0 and the project work plans. The samples shall also be maintained under custody per WTS-SOP No. 1.1. Samples stored on-site will be subject to the provisions of WTS-SOP 2.3.
- ✓ Repeat this sampling procedure at the intervals specified in the project work plans until the bottom of the borehole is reached and/or last sample is collected.

6.0 REQUIRED FORMS

Visual Classification of Soils Form

Chain of Custody

Master Sampling Log

Field Log Books

COMPOSITE SAMPLE PREPARATION

1.0 PURPOSE

This Standard Operating Procedure (SOP) describes the requirements for compositing techniques. Composite samples, regardless of the media, consist of two or more subsamples taken from a specific media and site at different depth intervals. The subsamples are collected and mixed. A single average sample is taken from the mixture.

The composite sampling will be used at sites where hand augered borings are to be performed. Composite samples are useful in estimating the overall contamination properties of a specific site. They are less expensive than non-composite samples because one sample for analysis represents many subsample locations. Composite samples do not provide detailed information of contamination variability as a function of the location.

2.0 REFERENCES

None.

3.0 DEFINITIONS/MATERIALS

The equipment required to obtain a composite sample is identical to that for primary media sampling.

4.0 RESPONSIBILITIES

The Project Technical Manager and Technical Coordinator are responsible for ensuring that all composite sample collection activities are conducted in accordance with this SOP and any other appropriate procedures and/or other SOPs as applicable. This will be accomplished through staff training and by maintaining quality assurance/quality control (QA/QC).

The Quality Assurance Officer is responsible for ensuring that this procedure is correctly implemented and that the quantity and quality of composite samples meet the requirements of the project Sample and Analysis Plan.

The Sampling Team Leader(s) assigned to composite soil sampling activities is responsible for completing their tasks according to specifications outlined in this SOP and other appropriate procedures and/or other SOPs as applicable. All staff members are responsible for reporting deviations from the procedures to the Project Technical Manager, Technical Coordinator, or Quality Assurance Officer as appropriate.

5.0 PROCEDURE

5.1 Preparation

Site preparation for the purpose of composite sampling is not different from that required for any of the media/waste sampling activities.

5.2 Surface Soil Compositing

The following steps must be followed when compositing surface soil samples in the field:

1. Determine where composite sample(s) will be obtained as indicated in the site-specific sampling plan.
2. Volatile organic compound (VOC) and, in some cases, semivolatile organic compound (SVOC) samples of solids (e.g., soils, sludge) must be collected and contained immediately as stand-alone samples and, therefore, cannot be composited.

3. Collect a minimum of three equal-volume samples from the specific sample location. The volume of each sample must be at least the amount required for a single sample.
4. Place the samples on an appropriate mixing tray. Thoroughly homogenize the pooled samples using the appropriate equipment.
5. Transfer subsamples of the composite sample into the appropriate sample containers. Seal, decontaminate, and label sample containers. Use the same care in handling these samples as that used for other samples from the site.
6. Document activities in field log book(s) as appropriate. Documentation should consist of detailed notes of locations and methods used to collect individual samples included in each composite sample.
7. Decontaminate sampling equipment between sample events.

5.3 Subsurface Soil Compositing

Compositing of subsurface soils refers to a single borehole in which several consecutively sampled depths are combined for a single sample. This is done to allow sufficient sample volume for the required analysis.

The following steps must be followed when compositing subsurface soil samples:

1. Determine where composite sample(s) will be obtained as indicated in the site-specific sampling plan.
2. Obtain samples by the methods:
3. For split-spoon or Shelby tube cores from a specified depth or range of depths:
   - Extract or extrude the sample from the split-spoon or Shelby tube onto an appropriate mixing tray, peel sample, and discard ends.
   - Continue with the four-quarters mixing method.
   - Document activities.
   - Decontaminate sampling equipment.
4. For hand auger samples:
   - The sample is acquired directly from the withdrawn auger.
   - Extract or extrude the sample from the bucket to an appropriate mixing tray.
   - Continue with the four-quarters mixing method.
   - Document activities.
   - Decontaminate sampling equipment.

5.4 Surface Water Compositing in the Field

The following steps must be followed when compositing surface water samples:

1. Determine where composite sample(s) will be obtained as detailed in the site-specific sampling plan.
2. VOC and, in some cases, SVOC samples must be collected and contained immediately as stand-alone samples and, therefore, <u>cannot</u> be composited.
3. Collect a minimum of three equal volume samples from the specified sample locations. The volume of each sample must be at least the amount required for a single sample.
4. Place the samples in the appropriate mixing container. Thoroughly homogenize the pooled samples using the appropriate equipment.
5. Transfer aliquots of the composited sample into the appropriate sample containers. Seal, wipe clean, and label sample container. Handle with the same care as that used for other samples from the site.

6. Document activities in field log book(s) as appropriate. Documentation should consist of detailed notes of locations and methods used to collect individual samples included in each composite sample.
7. Decontaminate sampling equipment between sampling events.

5.5 Collection of Replicate Samples

The following steps must be followed when compositing ground water samples:

1. Determine the well that a composite sample(s) will be obtained as detailed in the site-specific sampling plan.
2. VOC and, in some cases, SVOC samples must be collected and contained immediately as stand-alone samples and, therefore, cannot be composited.
3. Collect a minimum of three equal volume samples from the specified sample locations. The volume of each sample must be at least the amount required for a single sample.
4. Place the samples in the appropriate mixing container. Thoroughly homogenize the pooled samples using the appropriate equipment.
5. Transfer aliquots of the composited sample into the appropriate sample containers. Seal, wipe clean, and label sample container. Handle with the same care as that used for other samples from the site.
6. Document activities in field log book(s) as appropriate. Documentation should consist of detailed notes of locations and methods used to collect individual samples included in each composite sample.
7. Decontaminate sampling equipment between sampling events.

6.0 REQUIRED FORMS / DOCUMENTATION

Filed Log Books

Master Sampling Log

Chain of Custody

DUPLICATE AND SPLIT SAMPLE PREPARATION

1.0 PURPOSE

This Standard Operating Procedure (SOP) describes the requirements for the collection and preparation of duplicate, split, and/or co-located samples.

Duplicate, split, and co-located samples are typically obtained for either of two purposes: (1) as a means of quality control (QC) from the point of sample collection through all analytical processes (if the initial and duplicate samples are not within specification, the reasons for the discrepancy must be found and corrected, if possible), or (2) for later laboratory analyses, if needed. For WTS projects, co-located or duplicate samples will be collected to provide information on the variability of the contaminants in the field.

Duplicate or co-located samples are samples collected from a location as close to the primary sample location as possible. They are collected to provide a means of assessing the reliability of field sampling methods and analytic data resulting from field samples.

Split samples are normally obtained for the express purpose of submitting identical samples to different laboratories for comparative analytical results. Duplicate, split, and co-located samples may be collected as composite or grab samples from most media or waste types.

The same equipment and techniques will be required when obtaining duplicate and/or split samples as for primary samples. Briefly, the sampling requirements are: (1) grab samples will be collected for surface soil, surface water, ground water, sediment, and sludge, destined for volatile organic compound (VOC) analysis, and, (2) composite or grab sampling techniques can be used for non-VOCs and for subsurface soils.

Comparative analyses between laboratories can also be obtained for semivolatile organic compounds and/or metals. Duplicate samples can also be obtained for VOC and non-VOC contaminated media by careful grab samples. For most duplicate, split, or co-locate sampling for non-VOC parameters, in all media, compositing is recommended.

2.0 REFERENCES

None.

3.0 DEFINITIONS/MATERIALS

The equipment necessary to obtain a duplicate, split, and/or co-located sample is identical to that for primary media sampling.

4.0 RESPONSIBILITIES

The Project Technical Manager and Technical Coordinator are responsible for ensuring that all duplicate, split, and co-located sample collection activities are conducted in accordance with this SOP and any other appropriate procedures or related SOPs. This will be accomplished through staff training and by maintaining quality assurance/quality control (QA/QC).

The Quality Assurance Officer is responsible for ensuring that this procedure is correctly implemented and that the quantity and quality of duplicate and split samples meet the requirements of the project Quality Assurance Project Plan.

The Sampling Team Leader(s) assigned to duplicate, split, or co-located sampling activities is responsible for completing their tasks according to specifications outlined in this SOP and other appropriate procedures. All staff members are responsible for reporting deviations from the procedures to the Project Technical Manager, Technical Coordinator, or Quality Assurance Officer as appropriate.

5.0 PROCEDURE

5.1 Duplicate or Co-located Samples

The following steps must be followed when collecting duplicate or co-located samples:

1. Determine the frequency of obtaining duplicate samples as specified in the site-specific sampling plan.
2. Proceed with site sampling to the point that a duplicate or co-located sample is required.
3. The duplicate or co-located sample is a sample taken at the same time, as close as possible, and under the exact conditions as those required for the primary sample. Note: any sample or portion of a sample that is to be analyzed for VOCs shall be collected and contained immediately. Do not stir, mix, or agitate samples for VOC analysis before containment.
4. Follow the specific media-sampling plan. The preparation and disposition of the duplicates will be the same as those for the primary samples.
5. Obtain VOC samples first (without mixing or compositing), then proceed to Step 6. Samples for VOCs must be collected and contained immediately. Agitation by mixing, stirring, or shaking will cause vaporization of the volatile fraction to a significant degree. Resample if agitation has occurred. Mix all non-VOC duplicate samples or when taking duplicates of surface water or ground water samples. Mixing may be accomplished by pouring a portion of the sample directly from the sampling device into the original container, and then pouring an equal portion into the duplicate container, alternating between the two until the sample containers are full.
6. Place the sample(s) in the appropriate sample container. Duplicate and co-located samples will be labeled or tagged according to their intended use as detailed in the site-specific sampling plan. If the sampling plan duplicates are to be held for possible later analyses, they may be labeled as “sample XXX duplicate”, where the number “XXX” refers to the primary sample. If the duplicates are intended for QC measures, they may be given discrete sample numbers. Duplicate and co-located samples must be properly identified in the field logbook.
7. Seal, pack, and transport duplicate and co-located samples in the same manner as that used for other samples from the sampling site.
8. Decontaminate all equipment. Place all disposable liquids and solids in the appropriate receptacles.
9. Remove personal protective clothing and equipment and place in the designated receptacles. Field sampling personnel must be contamination-free before leaving the sampling site.
10. Document activities.

5.2 Split Samples for Surface Soils, Sediments, and Sludges

The following steps must be followed when collecting split samples of surface soils, sediments, and sludges:

1. Determine the number and frequency of required sample splits as specified in the site-specific sampling plan.
2. Proceed with site sampling to the point of obtaining split sample(s).
3. Follow the specific media sampling procedure.

   NOTE: Split samples for VOCs are not recommended. Adequate cross-laboratory checks can be obtained by splits of non-VOC samples. If QA is required for VOC samples, obtain duplicates as outlined in Section 5.1 of the SOP. All split samples for VOC analysis for the above media are grab samples taken as specified in Step (3), Section 5.1 of this SOP.

4. For non-VOC grab samples, obtain a sufficient volume to fill all required sample containers, including those required for splits.
5. Composite these samples.
6. Split the composite sample equally and place the required volumes into the sample containers.
7. Seal and decontaminate the outside surfaces of the containers.
8. Label split samples as specified in the site-sampling plan. Record all pertinent information in the field logbook.
9. Split samples will have a separate chain of custody record.
10. Split samples will be sealed, packed, and transported in an identical manner as that specified for other samples from the site. The difference may be their destination (different laboratories) and the extent of analytical work. The site-specific sampling plan specifies the disposition of split samples.
11. Decontaminate all equipment according. Place all disposables in the appropriate receptacles.
12. Remove personal protective clothing and equipment and place in the designated receptacles. Field sampling personnel must be contamination-free before leaving the sampling site.
13. Document activities.

5.3 Split, Duplicate, or Co-located Volatile Organic Compound Sampling of Subsurface Soils with Split-Spoons or Shelby Tubes

The following steps must be followed when sampling subsurface soils with split-spoons or Shelby tubes:

1. Determine the number and frequency of required sample splits as stated in the site-specific sampling plan.
2. Proceed with site sampling to the point of obtaining split sample(s).
3. Follow the specific media-sampling plan.

   NOTE: Most split-spoon sampling in the field is accomplished with 2-inch outside diameter (OD) split-spoons. When split, duplicate, or co-located samples are required, a 2-inch OD split-spoon will usually not collect sufficient sample volume if a number of analytes are to be sampled. In such situations, it is advisable to follow the American Society for Testing Materials (ASTM) D-1584 modified method of split-spoon sampling and a 3-inch OD split-spoon. If blow counts are not required for engineering purposes, and the site soils permit, attempts may be made to drive the 3-inch split-spoon by the 140-lb. weight. This deviation will ensure collection of enough sample volume.
4. Upon retrieval of the split-spoon, the sample should be peeled and the ends discarded. Divide the sample into four sections (A, B, C, and D). Sample A should be immediately containerized and becomes the original sample for VOC analysis. Sample B is also immediately containerized and becomes the duplicate sample for VOC analyses. Section C and D can be composited for all other non-VOC analyses.
5. Decontaminate the outside of the sample container after sealing.
6. Label split samples as specified in the site-specific sampling plan. Record all pertinent information in the field logbook.
7. Split samples will have a separate chain of custody record.
8. Split samples will be sealed, packed, and transported in an identical manner as other samples from the site. The difference may be their destination (different laboratories) and the extent of analytical work. The site-specific sampling plan specifies the disposition of split samples.

9. Decontaminate all equipment. Place all disposables in the appropriate receptacles.
10. Remove personal protective clothing and equipment and place in the designated receptacles. Field sampling personnel must be contamination-free before leaving the sampling site.
11. Document activities.

5.4 Split, Duplicate, or Co-located Non-Volatile Organic Compounds Sampling of Subsurface Soils with Split-Spoon or Shelby Tubs

The following steps must be followed when sampling subsurface soils with split-spoon or Shelby tubes:

1. Determine the number and frequency of required sample splits as stated in the site-specific sampling plan.
2. Proceed with site sampling to the point of obtaining split sample(s).
3. Follow the specific media-sampling plan.
4. Peel the sample and composite the sample.

   NOTE: Most split-spoon sampling in the field is accomplished with 2-inch outside diameter (OD) split-spoons. When split, duplicate, or co-located samples are required, a 2-inch OD split-spoon will usually not collect sufficient sample volume if a number of analytes are to be sampled. In such situations, it is advisable to follow the American Society for Testing Materials (ASTM) D-1584 modified method of split-spoon sampling and to use a 3-inch OD split-spoon. If blow counts are not required for engineering purposes, and the site soils permit, attempts may be made to drive the 3-inch split-spoon by the 140-lb. weight. This deviation will ensure collection of enough sample volume.
5. Seal sample containers and wipe outside surfaces.
6. Label split samples as specified in the site-specific sampling plan. Record all pertinent information in the field logbook.
7. Split samples will have a separate chain of custody record.
8. Split samples will be sealed, packed, and transported in an identical manner as other samples from the site. The difference may be their destination (different laboratories) and the extent of analytical work. The site-specific sampling plan specifies the disposition of split samples.
9. Decontaminate all equipment. Place all disposables in the appropriate receptacles.
10. Remove personal protective clothing and equipment and place in the designated receptacles. Field sampling personnel must be contamination-free before leaving the sampling site.
11. Document activities.

5.5 Split Samples for Surface Water and Ground Water

The following steps must be followed when collecting split samples for surface water and ground water:

1. Determine the number and frequency of required sample splits as stated in the site-specific sampling plan.
2. Proceed with site sampling to the point of obtaining split sample(s).
3. Follow the specific media-sampling plan.
4. Split samples for VOCs are not recommended. Adequate cross-laboratory checks can be obtained by splits of non-VOC samples. If QA is required for VOC samples, obtain duplicates as outlined in Section 5.1 of this SOP. All split samples for VOC analysis for the above media are grab samples taken as specified in Step (3), Section 5.1 of this SOP.

5. For non-VOC grab samples, obtain a sufficient volume to fill all required sample containers, including those required for splits.
6. Obtain VOC samples first (without mixing or compositing). Samples for VOCs must be collected and contained immediately. Agitation by mixing, stirring, or shaking will cause vaporization of the volatile fraction to a significant degree. Resample if agitation has occurred. Mix all non-VOC duplicate samples or when taking duplicates of surface water of ground water samples. Pouring a portion of the sample directly from the sampling device into the original container, and then pouring an equal portion into the duplicate container, alternating between the two until the sample containers are full will accomplish mixing.
7. Split the composited sample by placing the required volumes in the sample containers, including those for split samples.
8. Seal sample containers and wipe outside surfaces.
9. Label split samples as specified in the site-specific sampling plan. Record all pertinent information in the field logbook.
10. Split samples will have a separate chain of custody record.
11. Split samples will be sealed, packed, and transported in an identical manner as other samples from the site. The difference may be their destination (different laboratories) and the extent of analytical work. The site-specific sampling plan specifies the disposition of split samples.
12. Decontaminate all equipment. Place all disposables in the appropriate receptacles.
13. Remove personal protective clothing and equipment and place in the designated receptacles. Field sampling personnel must be contamination-free before leaving the sampling site.
14. Document activities.

6.0 REQUIRED FORMS/DOCUMENTATION

Chain of Custody Record

WATER LEVEL MEASUREMENTS IN MONITORING WELLS

1.0 PURPOSE

This Standard Operating Procedure (SOP) establishes guidelines for personnel to use in determining the depth to water in monitoring wells.

2.0 REFERENCES

EPA, 1986, RCRA Groundwater Monitoring Technical Enforcement Guidance Document, OSWER-9950.1, U.S. Government Printing Office, Washington, D.C.

EPA, 1991, Environmental Compliance Branch, Standard Operating Procedures and Quality Assurance Manual, Region IV, Environmental Services Division, Athens, Georgia, U.S. Government Printing Office, Washington, D.C.

3.0 RESPONSIBILITIES

The Project Technical Manager and Technical Coordinator are responsible for ensuring that all sample collection activities are conducted in accordance with this SOP and any other appropriate procedures or related SOPs. This will be accomplished through staff training and by maintaining quality assurance/quality control (QA/QC).

The Quality Assurance Officer is responsible for the periodic review of documentation generated as a result of this SOP and the periodic review and audit of field personnel as they perform the work. If problems arise, the Quality Assurance Officer is also responsible for verifying implementation of corrective action(s) (i.e., retraining personnel, additional review of work plans and SOPs, variances to requirements, and issuing nonconformances) and assuring through monitoring the continued implementation of stated corrective actions.

The Sampling Team Leader(s) is responsible for ensuring that monitoring well water level measurements are properly collected and documented.

4.0 DEFINITIONS/MATERIALS

A number of devices are available for the determination of water level measurements in monitoring wells. Those most commonly used and covered in this SOP includes steel tapes, electric sounders, and petroleum product probes. The equipment must be capable of recording a measurement to the accuracy required by the project plans.

5.0 PROCEDURE

Water level measurements are commonly taken in each monitoring well immediately prior to, during, and following well development, and both before and after well purging and sampling. Water level measurements may also be taken where no development or purging is being conducted, strictly to monitor or generate water table or piezometric surfaces. When such measurements are made to monitor water table or piezometric surfaces, water levels in all wells at a given site should be measured within a 24-hour maximum period whenever possible. When measuring wells for water for water table or potentiometric surface analysis, and if the contaminant history is known for each of the wells, it is advisable to monitor water levels beginning with the least contaminated wells first and progressing to the most contaminated wells last.

5.1 Equipment Selection

Project data quality objectives and site characteristics must be taken into account when determining the water level measurement equipment to use. The total number of wells to be measured, weather, tidal influences, pumping, and construction can all affect water level measurements. The project-specific work plans will identify the specific equipment to be used.

5.2 Determining Water Level Measurements in Monitoring Wells

The standard procedure for determining depth to water is described below.

1. Calibrate all measuring devices according to the manufacturer's specifications. Measuring tapes should be checked a minimum of every six months against a surveyor's tape to determine if shrinking or stretching has occurred.
2. Prior to taking a water level measurement at each well, decontaminate the measuring device according to the procedures outlined in WTS-SOP 6.0. During decontamination, all measuring tapes should be inspected for kinks, cracks, or tears and, if present, repaired or replaced with undamaged equipment.
3. Visually inspect the well to ensure that it is undamaged, properly labeled and secured. Any damage or problems with the well head should be noted on the Field Logbook and the site superintendent notified for repair or replacement of the equipment.
4. Uncap the well and monitor the air space immediately above the open casing per the project-specific health and safety plan. Observe if any air is flowing into or out of the casing. In the event such conditions are observed, they should be noted on the Field Logbook. Lower the electric sounder or equivalent (product probe or steel tape) into the well until the water surface is encountered. If air is observed to be entering or flowing out of the casing, the sounder should not be placed inside the well until the air flow stops and pressure equalizes.
5. Measure the distance from the water surface to the permanent reference point. For aboveground “stickup” completions, the reference point is usually a groove cut into the north side of the casing. If no permanent reference point is available for an aboveground completion, measure from another permanently fixed structure or from ground level. The point of measurement should then be noted on the Field Logbook. For flush mount completions, such as street boxes, the water level measurement should be referenced to a steel rate placed across the rim of the street box and over the casing. Any aboveground completions without permanent reference points or marks should be brought to the attention of the appropriate supervisory personnel per the project-specific work plans.
6. Collect measurements until two consecutive measurements are identical or within the specified tolerance of the project-specific work plan (usually 0.01 ft). Record all appropriate information on the Field Logbook. At a minimum, the following information must be recorded:
   - project name and number;
   - unique well identification number;
   - date and time of measurement collection;
   - depth to water to the specified tolerance;
   - weather conditions; and
   - any problems encountered.
7. If product or other nonaqueous liquid is encountered, follow the procedures outlined in WTS-SOP 5.1.
8. Cap and relock the well.

6.0 REQUIRED FORMS/DOCUMENTATION

Field Logbook

FIELD EQUIPMENT DECONTAMINATION

1.0 PURPOSE

This Standard Operating Procedure (SOP) describes the procedures required for decontamination of field equipment. Decontamination of field equipment is necessary to ensure the quality of samples by preventing cross-contamination. Further, decontamination reduces health hazards and prevents the spread of contaminants off site.

2.0 REFERENCES

EPA, September 1987, EPA Compendium of Superfund Field Operations Methods, EPA 540/P-87/001a, OSWER 9355.0-14.

EPA, August 1988, EPA Guidelines for Conducting Remedial Investigation and Feasibility Studies under CERCLA, Interim Final OSWER Directive 9355.3-01.

3.0 RESPONSIBILITIES

The Project Technical Manager and Technical Coordinator are responsible for ensuring that all sample collection activities are conducted in accordance with this SOP and any other appropriate procedures or related SOPs. This will be accomplished through staff training and by maintaining quality assurance/quality control (QA/QC).

The Project Chemist is responsible for ensuring that field personnel are trained in the use of this procedure and that decontamination is conducted in accordance with this procedure.

The Quality Assurance Officer has the responsibility for periodic review of procedures and documentation associated with the decontamination of drilling and heavy equipment. If perceived variances occur, the Quality Assurance Officer is also responsible for issuing notices of nonconformances and requesting corrective actions. Additionally, he/she will perform the three phases of inspections and continuous monitoring of the decontamination activities.

The Sampling Team Leader(s) is responsible for verifying that this procedure is correctly implemented. The Sampling Team Leader may also be required to collect and document rinsate samples to provide quantitative verification that these procedures have been correctly implemented. This SOP and the project work plans should be reviewed before implementing decontamination procedures at the project field area.

4.0 DEFINITIONS/MATERIALS

4.1 Deionized Analyte-Free Water

Ion-free, analyte-free water produced on site or purchased from a supplier with a deionization chamber equipped with a carbon filter.

4.2 Potable Water

Treated municipal water.

4.3 Laboratory Grade Detergent

A standard brand of laboratory-grade detergent, such as “Liquinox.”

4.4 Methanol

Laboratory-grade methanol alcohol, CAS #67-56-1

4.5 Hexane

Laboratory-grade hexane, CAS #110-54-3

4.6 HPLC Water

High purity laboratory-grade water.

4.7 Non-sampling Equipment

Non-sampling equipment includes:

- Field logbook.
- Drilling rigs, backhoes, augers, drill pipe, bits, casing, and screen.
- High-pressure pump soap dispenser or steam-spray unit.
- 2- to 5-gal manual-pump sprayer (pump sprayer material must be compatible with the solution used).
- Stiff-bristle brushes.
- Gloves, goggles, boots, and other protective clothing as specified in the site-specific health and safety plan.

4.8 Small Equipment

Small equipment includes:

- Split spoons, bailers, bowls, and filtration equipment
- 5-gal plastic buckets
- Laboratory-grade detergent (phosphate free)
- Stiff-bristle brushes
- Nalgene or Teflon, sprayers or wash bottles or 2- to 5-gal manual-pump sprayer (pump sprayer material must be compatible with the solution used)
- Plastic sheeting
- Disposable wipes or rags
- Potable water
- Appropriate decontamination solutions
- Gloves, goggles, and other protective clothing as specified in the site-specific health and safety plan

4.9 Pumps and Pump Assemblies

The required pumps and pump assemblies include:

- Three or more empty 30-40 gallon containers
- Plastic sheeting
- 5-gal (or larger) containers of potable water and other required decontamination solutions
- Disposable wipes or rags
- Gloves, goggles, and other protective clothing as specified in the site-specific health and safety plan.

5.0 PROCEDURES

This section contains responsibilities, requirements, and procedures for sampling equipment and well material decontamination. The decontamination is required in order to maintain proper quality and integrity of collected samples.

The details within this SOP should be used in conjunction with the project work plans. The project work plans will provide the following information:

- Types of equipment requiring decontamination under this SOP;
- Specific materials to be used for the decontamination; and
- Additional decontamination requirements and procedures beyond those covered in this SOP, as necessary.

All field personnel associated with decontamination of sampling equipment or well materials must read both this SOP and the project work plans prior to implementation of related decontamination activities. Information and requirements for the decontamination of any and all drilling and heavy equipment is provided in MSOP No. 6.1.

5.1 Decontamination Facility

If possible, sampling equipment decontamination will take place in an area designed exclusively for decontamination. This area will ideally be located within the contamination reduction zone on the project site. Well materials may be decontaminated at the facility set up for decontamination of drilling and heavy equipment (see MSOP No. 6.1).

Each decontamination facility will be constructed so that the equipment, as well as all wastes generated during decontamination (e.g.: soil, rinsate, liquid spray, debris, etc.), is fully contained. In addition, chemical products used in the decontamination process must be properly containerized and labeled.

5.2 Decontamination of Non-dedicated Sampling Equipment

Each piece of reusable, small or non-dedicated sampling equipment will be decontaminated before mobilization to each site and before each sampling event. The standard procedure will be performed as described below.

1. All personnel involved with the task must wear suitable personal protective equipment to reduce personal exposure (specified by the project work plans).

2. Heavily caked soil and/or other material will be scraped or brushed from equipment. The scrapings will be placed into an appropriate container for disposal. Steam cleaning of equipment may be required to remove material from samplers.

3. Equipment that will not be damaged by water should be placed into a wash tub containing a laboratory-grade detergent solution and scrubbed with a brush or clean cloth. Rinsing will then be conducted with fresh, potable water, followed by deionized water.

4. Methanol, hexane, and HPLC water rinses may then follow for some sampler components when specified by the project work plans.

5. Any equipment that may be damaged by submersion into water will be wiped clean using a sponge and detergent solution. Wiping the equipment with deionized water will follow cleaning.

6. Air-dry the rinsed equipment. Soil organic vapor sampling equipment should be flushed dry with bottled air of known quality and/or as per the project work plans.

7. Place decontaminated equipment on clean plastic sheeting to prevent contact with contaminated soil. If equipment is not used immediately, cover or wrap the equipment in clean plastic sheeting to minimize airborne contamination.

8. Decontamination activities shall be documented on the Field Logbook.

5.3 Decontamination of Dedicated Sampling Equipment

Dedicated sampling equipment, such as submersible pumps, will be decontaminated prior to installation inside monitoring wells. At a minimum, the procedure outlined below must be performed. If factory-cleaned, hermetically sealed materials are used, no decontamination will be necessary provided that laboratory certification of decontamination is submitted with the equipment.

1. All personnel involved in the task will wear suitable personal protective equipment in accordance with the project work plans.

2. Foot vale and pumping lines will be washed with a laboratory-grade detergent solution.

3. The equipment will then be rinsed twice with tap water, followed by a rinse with deionized water.

4. Air dry.

5. Place decontaminated equipment on clean plastic sheeting to prevent contact with contaminated soil. If equipment is not used immediately, cover or wrap the equipment in clean plastic sheeting to minimize airborne contamination.

6. Decontamination activities will be documented on the Field Logbook.

5.4 Decontamination of Well Materials

Well materials including well casing, well screens, centralizers, and end caps will be decontaminated prior to use in constructing monitoring wells. (If factory-cleaned, hermetically sealed materials are used, no decontamination will be necessary provided that laboratory decontamination certification is submitted with the equipment.) The standard procedure outlined below must be performed when decontaminating well materials.

1. All personnel involved in the task will wear appropriate personal protective equipment in accordance with the project work plans.

2. Materials will be thoroughly sprayed and washed with water using a high-pressure steam cleaner.

3. Air dry.

4. Decontaminated materials will be placed on clean metal racks or clean plastic sheeting. If equipment is not used immediately, cover or wrap the equipment in clean plastic sheeting to minimize airborne contamination.

5. Decontamination activities will be documented on the Facility Logbook.

5.5 Pump Decontamination

The following steps must be followed when decontaminating pumps:

1. Set up decontamination area and separate clean storage area using plastic sheeting to cover the ground, tables, and other porous surfaces. Set up three 30-40 gallon containers in a triangle. The two containers at the base of the triangle will be used to contain dilute (non-foaming) soapy

water and potable water. The drum at the apex will receive wastewater. Place 5-gal cans of potable water adjacent to the water container on the same side as the potable water container.

2. Pump should be set up in the same configuration as for sampling. Submerge pump intake (or pump if submersible) and all downhole wetted parts (tubing, piping, foot valve) in soapy water of the first container. Place the discharge outlet in the waste container above the level of wastewater.

3. Pump soapy water through the pump assembly until it discharges to the waste container.

4. Move pump assembly to the potable water container while leaving discharge outlet in the waste container. All downhole-wetted parts must be immersed in the potable water rinse. Pump potable water through the pump assembly until it runs clear.

5. Decontaminate the discharge outlet by hand following the steps outlined in Section 5.2. Part 2 of this SOP.

6. Remove the decontaminated pump assembly to the clean area and allow to air dry. Intake and outlet orifices should be covered with aluminum foil to prevent the entry of airborne contaminants and particles.

7. Record the equipment type and identification, and the date, time, and method of decontamination in the appropriate logbook.

5.6 Waste Disposal

The following steps must be followed when disposing of wastes:

1. All wash water and rinse water that have come in contact with contaminated equipment are to be handled, packaged, labeled, marked, stored, and disposed of as investigation-derived waste unless other arrangements are approved in advance. Waste disposal will be in accordance with the project-specific Investigation-Derived Waste Management Plan.

2. Small quantities of decontamination solutions may be allowed to evaporate to dryness.

3. If large quantities of used decontamination solutions are generated, segregate each type of waste in separate containers. This may permit the disposal of wash water and rinse water in a sanitary sewage treatment plant rather than as a hazardous waste.

4. Unless required, plastic sheeting and disposable protective clothing may be treated as a solid non-hazardous waste.

6.0 REQUIRED FORMS/DOCUMENTATION

Field Logbook

MONITORING WELL INSTALLATION

1.0 PURPOSE

This Standard Operating Procedure (SOP) provides procedures and requirements for the installation of monitoring wells using rotary, dual-tube percussion, or hollow-stem auger drilling techniques. Monitoring wells are installed to provide access to groundwater for collecting samples, as well as for obtaining water level and other data. Because monitoring wells are used to collect samples, it is important that construction materials not interfere with sample quality either by contributing contaminants or by sorbing contaminants already present. Further, construction materials must be compatible with (i.e., not degraded by) contaminants present in soils or groundwater.

Monitoring wells are potential contaminant migration routes between aquifers or from the surface to the subsurface. Construction procedures and standards must ensure that neither passive nor active introduction of contaminants can occur. Properly installed hydraulic seals and locking well covers reduce the potential for cross-contamination of monitoring wells. The details within this SOP should be used in conjunction with specific project work plans and/or related SOPs.

2.0 REFERENCES

U.S. Environmental Protection Agency (EPA), Manual of Water Well Construction Practices, U.S. Environmental Protection Agency, Office of Water Supply, U.S. Government Printing Office, Washington D.C.

U.S. Environmental Protection Agency (EPA), 1986, Resource Conservation and Recovery Act (RCRA) Ground Monitoring Technical Enforcement Guidance Document, OSWER-9950.1, U.S. Environmental Protection Agency, Office of Solid Waste and Emergency Response, U.S. Government Printing Office, Washington D.C.

U.S. Environmental Protection Agency (EPA), 1987, A Compendium of Superfund Field Operations Methods, EPA-500/P-87/001, U.S. Government Printing Office, Washington D.C.

3.0 RESPONSIBILITIES

The Project Technical Manager and Technical Coordinator are responsible for ensuring that all monitoring well installation activities are conducted and documented in accordance with this and any other appropriate procedures or related SOPs. This will be accomplished through staff training and by quality assurance/quality control (QA/QC) monitoring activities.

The Quality Assurance Officer is responsible for periodic review of well installation activities to assure implementation of this SOP. The Quality Assurance Officer is also responsible for the review and approval of corrective action (i.e., retraining personnel, additional review of work plans and SOPs, variances to monitoring well installation requirements, issuing nonconformances, etc.) identified during the performance of these activities.

The Sampling Team Leader(s) assigned to monitoring well installation activities is responsible for completing their tasks according to specifications outlined in this SOP and other appropriate procedures. All staff members are responsible for reporting deviations from the procedures to the Project Technical Manager or Technical Coordinator.

4.0 DEFINITIONS/MATERIALS

4.1 Cuttings

Pieces of soil, sediment, or rock cut by a bit in the process of drilling borings.

4.2 Borehole

Any hole drilled into the subsurface for the purpose of identifying lithology, collecting soil samples, and/or installing groundwater wells.

4.3 Grout

For the purposes of this SOP, the term "grout" consists of a neat cement grout generally containing three to five percent bentonite powder to water by weight. The grout is emplaced as a slurry, and once properly set and cured, is capable of restricting movement of water.

4.4 Hollow-Stem Auger Drilling

A drilling method using augers with open centers. The augers are advanced with a screwing or rotating motion into the ground. Cuttings are brought to the surface by the rotating action of the augers, thereby clearing the borehole.

4.5 Air Rotary Casing Hammer Drilling

A drilling method using a non-rotating drive casing that is advanced simultaneously with a slightly smaller diameter rotary bit attached to a string of drill pipe. The drive casing is a heavy-walled, threaded pipe that allows for pass-through of the rotary drill bit inside the center of the casing. Air is forced down through the center drill pipe to the bit, and then upward through the space between the drive casing and the drill pipe. The upward return stream removes cuttings from the bottom of the borehole.

4.6 Mud Rotary Drilling

For the purposes of this monitoring well installation SOP, the term "mud rotary drilling" refers to direct circulation (as opposed to reverse circulation) mud rotary drilling. Mud rotary drilling uses a rotating drill bit that is attached to the lower end of a string of drill pipe. Drilling mud is pumped down through the inside of the drill pipe and out through the bit. The mud then flows upward in the annular space between the borehole and the drill pipe, carrying the cuttings in suspension to the surface.

4.7 Dual-tube Percussion Drilling

A drilling method using non-rotating drive casing with a bit on the bottom of the casing string. A smaller diameter tube or drill pipe is positioned inside the drive casing. The drive casing is advanced by the use of a percussion hammer, thereby causing the bit to cut or break up the sediment or soil at the bottom of the boring. Air is forced down the annular space between the drive casing and inner drill pipe and cuttings are forced up the center of the inner drill pipe.

4.8 Monitoring Well

A well that provides for the collection of representative groundwater samples, the detection and collection of representative light and dense nonaqueous phase organic liquids, and the measurement of fluid levels.

4.9 Annular Space

The space between:

- Concentric drill pipes;
- An inner drill pipe and outer drive casing;
- Drill pipe or drive casing and the borehole wall; or
- Well screen or casing and the borehole wall.

4.10 Filter Pack

Granular filter material (sand, gravel, etc.) placed in the annular space between the well screen and the borehole to increase the effective diameter of the well and prevent fine-grained material from entering the well.

4.11 Well Screen

A perforated, wire wound, continuous wrap or slotted casing segment used in a well to maximize the entry of water from the producing zone and to minimize the entrance of sand.

4.12 Tremie

A tubular device or pipe used to place grout, bentonite, or filter pack in the annular space.

5.0 PROCEDURES

5.1 Well Installation Procedures

This section contains the procedures for monitoring well installation activities. The procedures described herein are applicable as requirements for monitoring well installations using mud rotary, air rotary, air rotary casing hammer, dual tube percussion, or hollow-stem auger drilling techniques. Site-specific factors need to be considered in the selection of well construction and completion materials, specification of well designs, and choosing well drilling methods. These factors will be incorporated in project planning activities and the compilation of specific project work plans. The project work plans will contain the following information related to monitoring well installation:

- Objectives of the monitoring well
- Specific location of the well to be installed
- Zone or depth well is to be installed
- Drilling method(s) to be used
- Well construction materials to be used
- Specification of well design(s) including Well Construction Diagrams.
- Additional procedures or requirements beyond this SOP.

1. Before mobilization of a rig to the well site, ensure that the monitoring well location has been appropriately cleared of all underground utilities, buried objects, and that drill permits have been issued per the project work plans.
2. Review all forms and diagrams documenting the location of the cleared monitoring well site and the location of any identified underground utility lines or other buried objects.
3. Decontaminate all downhole equipment and well construction materials before monitoring well installation, as described in WTS-SOP 6.0.
4. Decontaminate the drilling rig and all drilling equipment before monitoring well installation per WTS-SOP 6.1.
5. Clear the work site of all brush and minor obstructions and then mobilize the rig to the monitoring well location.
6. The rig geologist or engineer should then review with the driller the proposed well design and details of the well installation including any anticipated potential drilling or completion problems.
7. Calibrate health and safety monitoring equipment according to the instrument manufacturer's specifications.
8. Document the calibration results on the appropriate form(s). Instruments that cannot be calibrated according to the manufacturer's specifications will be removed from service and tagged.

9. Workers will be provided with, and don, the appropriate personal protective equipment as specified by the project work plans. Typically, the minimum personal protection will include a hard hat, safety glasses, gloves, steel-toed boots, hearing protection, and coveralls.
10. Commence drilling and advance the borehole while conducting health and safety monitoring according to the project work plans.
11. Perform readings as often as necessary to ensure the safety of workers.
12. Record all measurements on the Field Logbook.
13. Record all other pertinent information (date, site, well or boring number, and location) on the Field Logbook. Also note and record observed field conditions, any unusual circumstances, and weather conditions.
14. Drilling of the borehole should be conducted in conformance with applicable SOPs, as appropriate.
15. During drilling, collect representative cutting and soil samples as required by the project work plans.
16. Compile a boring or lithologic log from the cuttings and samples per WTS-SOP 10.0.
17. At total depth, remove soil cuttings through circulation or rapidly spinning the augers prior to constructing the well.
18. Review logs and notes with the driller for any zones or depths exhibiting drilling problems that may affect the well installation.
19. Condition the hole or take other actions mutually agreed upon by the rig geologist (or engineer), lead technical personnel, and the driller to ensure or aid in the well development.
20. Remove the drill pipe and bit if using rotary techniques, or remove the center bit boring if using the hollow-stem auger technique. The well construction materials will then be installed inside the open borehole or through the center of the drive casing or augers.
21. Measure the total depth of the completed boring using a weighted sounding line. The borehole depth is checked to assure that formation material has not heaved to fill the borehole. If heaving has taken place, options for cleaning, re-drilling, or installation in the open section of the boring should be discussed with lead technical personnel.
22. In the event that the hole was over-drilled, grout, bentonite pellets, or bentonite chips (as specified in the project work plans) may be added to the bottom of the boring to raise the bottom of the hole to the desired depth. The grout should be pumped through a tremie pipe and fill from the bottom of the boring upward. During grouting, the tremie pipe should be submerged below the top of the grout column in the borehole to prevent free-fall and bridging. If bentonite is used, it should be added gradually to prevent bridging. Grout or bentonite addition will stop when its level has reached approximately one foot below the desired base of the well string (casing, screen, end plug or sump, etc.). The bentonite plug will be hydrated for at least one hour before installation of a filter pack.
23. Calculate volumes of filter pack, bentonite pellets/slurry, and grout required, based on borehole and well casing dimensions. If required by the project work plans, determine the filter pack and well screen slot size for the monitoring well.
24. Place a layer of filter pack (one to two feet, unless otherwise specified in the project-specific work plans) at the bottom of the borehole. The filter pack will be installed through the center of the drive casing/augers. Filter pack will be added slowly while withdrawing the drive casing/augers.
25. Inspect the casing, screen, and any other well construction materials prior to installation to assure that no damage has occurred during shipment and decontamination activities.
26. Connect and carefully lower the well string through the open borehole, drive casing, or inside of the augers until the well string is at the desired depth. The well string should be suspended by the installation rig and should not rest on the bottom of the boring. In the event the well string was dropped, lowered abruptly, or for any other reason suspected of being damaged during placement,

the string should be removed from the boring and inspected. In certain instances, the well string may rise after being placed in the borehole due to heaving sands. If this occurs, the driller must not place any drilling equipment (drill pipe, hammers, etc.) to prevent the casing from rising. The rig geologist or engineer shall note the amount of rise and then shall consult the lead technical personnel for an appropriate course of action.

27. Record the following information on the As-Built Well Completion Form and/or other appropriate forms per the project work plans:
    - Length of well screen
    - Total depth of well boring
    - Depth from ground surface to top of grout or bentonite plug in bottom of borehole (if present)
    - Depth to base of well string
    - Depth to top and bottom of well screen.

28. When using the mud rotary drilling technique, tremie the filter pack into the annular space around the screen. Clean, potable water may be used to assist with the filter pack tremie operation. For all other drilling techniques, the filter pack may be allowed to free-fall or be tremied per the project work plans. If using drive casing or augers, the drive casing or augers should be pulled slowly during filter pack installation in increments no greater than five feet.

29. Filter pack settlement should be monitored by initially measuring the sand level (before beginning to withdraw the drive casing/augers). In addition, depth soundings using a weighted tape shall be taken repeatedly to continually monitor the level of the sand. The top of the well casing shall also be monitored to detect any movement due to settlement or from drive casing/auger removal. If the top of the well casing moves upwards at any time during the well installation process, the driller should not be allowed to set drilling equipment (downhole hammers, drill pipe, etc.) on the top of the casing to prevent further movement.

30. Filter pack should be added until its height is approximately two feet above the top of the screen (unless otherwise specified in the project work plans), and verification of its placement (by sounding) should be conducted. The filter pack should then be gently surged using a surge block or swab in order to settle the pack material and reduce the possibility of bridging.

31. The height of the filter pack will then be re-sounded and additional filter pack placed as necessary. Once the placement of the filter pack is completed, the depth to the top of the pack is measured and recorded on the As-Built Well Completion Form or other appropriate forms per the project work plans.

32. A three-foot thick (unless otherwise specified in the project work plans) bentonite seal is then installed on top of the filter pack. If pellets or chips are used, they should be added gradually to avoid bridging. Repeated depth soundings will be taken using a weighted tape to ascertain the top of the bentonite seal. The seal should be allowed to hydrate for at least one hour before proceeding with the grouting operation.

33. After hydration of the bentonite seal, grout is then pumped through a tremie pipe and filled from the top of the bentonite seal upward. The bottom of the tremie pipe should be maintained below the top of the grout to prevent free fall and bridging. When using drive casing or hollow-stem auger techniques, the drive casing/augers should be raised in incremental intervals, keeping the bottom of the drive casing/augers below the top of the grout. Grouting will cease when the grout level has risen to within approximately one to two feet of the ground surface, depending on the surface completion type (flush mount versus aboveground). Grout levels should be monitored to assure that grout taken into the formation is replaced by additional grout. If settling of the grout occurs, additional topping off of the grout may be necessary.

34. For aboveground completions, the protective steel casing will be centered on the well casing and inserted into the grouted annulus. Prior to installation, a 2-inch deep temporary spacer shall be placed between the PVC well cap and the bottom of the protective casing cover to keep the protective casing from settling onto the well cap.

35. After the protective casing has set, a drainage hole may be drilled into the protective casing if required by the project work plans. The drainage hole is positioned approximately two inches above ground surface. The protective casing will be painted with a rust-preventive colored paint.

36. The well head will be labeled to identify, at a minimum, the well number.

37. A minimum of 24 hours after grouting should elapse before installation of the concrete pad and steel guard posts for aboveground completions, or street boxes or vaults for flush mount completions.

    - For aboveground completions, a concrete pad, usually 3-foot by 3-foot by 4-inch thick, is constructed at ground surface around the protective steel casing. The concrete is sloped away from the protective casing to promote surface drainage from the well.

    - For aboveground completions, where traffic conditions warrant extra protection, three steel bucking posts will be embedded to a depth approximately 1.5 feet below the top of the concrete pad. The posts will be installed in concrete filled postholes spaced equally around the well at a distance of approximately 1.5 feet from the protective steel casing. Where removal of bucking posts is required for well access, mounting sleeves should be imbedded into the concrete.

    - For flush mount (or subgrade) completions, a street box or vault is set and cemented in position. The top of the street box or vault will be raised slightly above grade and the cement sloped to grade to promote surface drainage away from the well.

    - Following well completion and demobilization of the rig, the well site should be cleared of all debris and trash and restored to a neat and clean appearance per the project work plans. All investigation-derived waste generated at the well site should be appropriately contained and managed per the project work plans.

6.0 REQUIRED FORMS/DOCUMENTATION

Well Construction Diagram

Field Logbook

Lithologic/Soil Boring Log

As-Built Well Completion Form

MONITORING WELL DEVELOPMENT

1.0 PURPOSE

This Standard Operating Procedure (SOP) establishes guidelines for specifying, assessing and documenting the well development process. Additional specific well development procedures and requirements will be provided in the project work plans and/or related SOPs. Monitoring wells are developed to remove skin (i.e., near-well-bore formation damage), well drilling fluids, sediments, and to settle and remove fines from the filter pack. Wells should not be developed for 48 hours after completion when a cement bentonite grout is used to seal the annular space, or after 7 calendar days beyond internal mortar collar placement.

2.0 REFERENCES

U.S. Environmental Protection Agency (EPA), August 1988, *Guidance for Conducting Remedial Investigation and Feasibility Studies under CERCLA*, Interim Final OSWER Directive 9355.3-01.

U.S. Environmental Protection Agency (EPA), 1987, *A Compendium of Superfund Field Operations Methods*, EPA-540/P-87/001a, U.S. Government Printing Office, Washington D.C.

ASTM, 1988, *Standards Technology Training Program - Groundwater and Vadose Zone Monitoring*, Nielsen, et al.

3.0 RESPONSIBILITIES

The Project Technical Manager and Technical Coordinator are responsible for ensuring that monitoring wells are properly developed and that the development process is properly documented. This will be accomplished by staff training and by maintaining quality assurance/quality control (QA/QC).

The Quality Assurance Officer is responsible for periodic review of field generated documentation associated with well development. If deviations from project requirements occur, the Quality Assurance Officer is also responsible for issuing notices of nonconformances and requests for corrective action.

The Sampling Team Leader(s) is responsible for conducting monitoring well development and documentation in accordance with the specifications outlined in this SOP and by the project work plans.

4.0 DEFINITIONS/MATERIALS

4.1 Well Development

The act of removing fine grained sediment and drilling fluids from the sand pack and formation in the immediate vicinity of the well, thus increasing the porosity and permeability of the materials surrounding the intake portion of the well.

4.2 Eductor Pipe

The pipe used to transport well discharge water to the surface.

4.3 Materials

- Submersible pump or bailer.
- Power source (e.g., generator), if required.
- Electronic water level indicator and/or oil/water interface probe.
- Temperature, conductivity, pH, and turbidity meters.
- Personal protective equipment as specified in the project health and safety plan.

- Organic vapor meter (MicroTip, OVM, HNU, etc.).
- Teflon-coated stainless steel cable or acceptable material.
- Well development logs.

5.0 PROCEDURE

5.1 General

The most common methods used to develop monitoring wells consist of surging and bailing, surging and pumping, or combinations of all these.

The project work plans will identify the specific well development procedure to be followed. The standard procedure for field personnel to use in assessing and documenting well development is described below and is intended only for development methods listed above.

5.2 Well Development

Decontaminate the rig and development equipment in accordance with WTS-SOPs 6.0 and 6.1, respectively.

Calibrate all field analytical test equipment (pH, temperature, conductivity, and turbidity) according to the instrument manufacturer's specifications and WTS-SOP No. 4.0. Specific test equipment to be used should be identified in the project-specific work plans. Instruments that cannot be calibrated according to the manufacturer's specifications will be removed from service, tagged with an out of calibration label, and segregated (when possible) from the calibrated equipment area. An exception to the daily calibration requirements will be made in the case of the water level meters. The tape of these instruments will be checked prior to the beginning of the project and each succeeding six months using a steel surveyor's tape.

Visually inspect the well to ensure that it is undamaged, properly labeled and secured. Any observed problems with the well head should be noted in the Field Activity Daily Log and reported to the Sampling Team Leader(s). Unlock the well and obtain a depth to water level measurement according to the procedures outlined in WTS-SOP No. 5.0. Calculate the volume of water in the well (cased well volume) as follows:

$$\pi \times (d/2)^2 \times (h_1 - h_2) \times 7.48 = \text{cased well volume (in gallons)}$$

Where

d = inside diameter of well casing (in feet)
h_1 = depth of well from top of casing (in feet)
h_2 = depth to water from top of casing (in feet)

The depth to the bottom of the well should be sounded and then compared to the completion form or diagram for the well. If sand or sediment is present inside the well, it should first be removed by bailing. Do not insert bailers, pumps, or surge blocks into the well if obstructions, parting of the casing, or other damage to the well is suspected. Instead report the conditions to the Site Superintendent and obtain approval to continue or cease well development activities.

Begin development by first gently surging followed by bailing or pumping. This is then continued with alternate surging and bailing or pumping. At no time should the surge block be forced down the well if excessive resistance is encountered. During development, the bailer should not be allowed to free-fall or descend rapidly such that it becomes lodged in the casing or damages the end cap or sediment trap at the bottom of the well.

While developing, take periodic water level measurements (at least one every five minutes) to determine if drawdown is occurring and record the measurements on the Well Development Record.

While developing, calculate the rate at which water is being removed from the well. Record the volume on the Well Development Record.

While developing, water is also periodically collected directly from the eductor pipe or bailer discharge and readings taken of the indicator parameters: pH, specific conductance, and temperature. Development is considered complete when the indicator parameters have stabilized (i.e., three consecutive pH, specific conductance, and temperature readings are within tolerances specified in the project work plans) and a minimum of three well volumes of water have been removed. In certain instances, for slow recharging wells, the parameters may not stabilize. In this case, well development is considered complete upon removal of the minimum of three well volumes. In some cases, the project work plans may also specify a maximum turbidity requirement for completion of development.

Obtain a water level and turbidity measurement at the completion of development.

Complete documentation of the well development event on the Well Development Record form. At a minimum this record must contain:

- Project name and number
- Well identification number
- Well depth, casing size, and completion date
- Method of development
- Volume of water removed
- Water levels (including the time of measurement)
- Physical description of the water (e.g., discoloration, turbidity, odor, etc.) and solids removed from the well
- Test equipment readings for pH, conductivity, temperature and turbidity (including the time of collection)
- Signature of the well development observer.

Collect and appropriately transport and dispose of water removed from the well in accordance with criteria listed in the project-specific work plans and regulatory requirements.

Allow the well to recover for at least 24 hours prior to sampling.

6.0 REQUIRED FORMS/DOCUMENTATION

Well Development Record Form

GROUND WATER SAMPLING

1.0 PURPOSE

This Standard Operating Procedure (SOP) establishes guidelines and procedures for use by field personnel in the collection and documentation of ground water samples for chemical analysis. Proper collection procedures are necessary to assure the quality and integrity of all ground water samples. Additional specific procedures and requirements will be provided in the project work plans, as necessary and/or related SOPs. Work plans may range in complexity and formality from fully published, reviewed, and approved plans (typically provided for single events) down to WAO responses with notes (typically provided for routine, ongoing monitoring programs).

2.0 REFERENCES

EPA, September 1987, *Compendium of Superfund Field Operations Methods*, EPA 540/P-87/001a, OSWER 9355.0-14.

EPA, August 1988, *EPA Guidance for Conducting Remedial Investigation and Feasibility Studies Under CERCLA*, Interim Final OSWER Directive 9355.3-01.

ASTM, 1988, *Standards Technology Training Program - Groundwater and Vadose Zone Monitoring*, Nielsen, et al.

3.0 RESPONSIBILITIES

The Project Technical Manager and Technical Coordinator are responsible for ensuring that all sample collection activities are conducted in accordance with this SOP and any other appropriate procedures or related SOPs. This will be accomplished through staff training and by maintaining quality assurance/quality control (QC/QC).

The Quality Assurance Officer is responsible for periodic review of field generated documentation associated with this SOP. The Quality Assurance Officer is also responsible for implementation of corrective action (i.e., retraining personnel, additional review of work plans and SOPs, variances to QC sampling requirements, issuing nonconformances, etc.) if quality issues are identified.

The Sampling Team Leader(s) assigned to ground water sampling activities is responsible for completing their tasks according to specifications outlined in this SOP and other appropriate procedures. All staff members are responsible for reporting deviations from procedures to the Project Technical Coordinator.

4.0 DEFINITIONS/MATERIALS

4.1 Bladder Pump

A bladder pump is an enclosed cylindrical tube containing a flexible membrane bladder. Well water enters the bladder through a one-way check-valve at the bottom. Gas is forced into the annular space (positive displacement) surrounding the bladder through a gas supply line. The gas displaces the well water through a one-way check-value at the top. The water is brought to the surface through a water discharge line. Compressors or cylinders provide gas (air or nitrogen).

4.2 Peristaltic Pump

A peristaltic pump is a self-priming, low volume pump consisting of a rotor and a ball bearing roller. The rotor squeezes tubing placed around the rotor as they revolve. The squeezing produces a wavelike contractual movement that causes water to be drawn through the tubing. The peristaltic pump is limited to sampling at depths of less than 25 feet.

4.3 Electric Submersible Pump

An electric submersible pump is an enclosed cylindrical tube containing a motor with rotary attachments. Well water enters the cylinder through a one-way check valve. Electrical power to the motor causes rotors or impellers to turn and displace the groundwater.

4.4 Bailer

A bailer is an enclosed cylindrical tube containing a floating ball check-valve at the bottom. Lowering the bailer into water causes the ball to float allowing water to enter the cylinder. Raising the bailer through the water causes the ball to settle, creating a seal to trap the water so that it can be brought to the surface.

4.5 Dedicated Ground Water Monitoring Equipment

Dedicated ground water monitoring equipment is used to purge and sample only one well. The equipment is installed and remains in the well for the duration of the monitoring program. Dedicated equipment does not need to be decontaminated between sampling events.

4.6 Materials:

- Clean rope or wire line of sufficient length for conditions.
- Appropriate sample containers with labels and preservatives, as required.
- Hard plastic or steel cooler with cold packs (or ice) for samples.
- Temperature, pH, conductivity, and turbidity meters.
- Equipment calibration standards.
- Electronic water level indicator.
- Organic vapor meters.
- Plastic sheeting, if needed.
- 55-gallon drums for purge water.
- Decontamination supplies, as required.
- Personal protective clothing and equipment, if required by the project health and safety plan.
- Field logbook and monitoring well purge and sample forms

5.0 PROCEDURE

This section contains the procedures involved with groundwater sampling. Proper ground water sampling procedures are necessary to insure the quality and integrity of the samples. The details within this SOP should be used in conjunction with project work plans. The project work plans will generally provide the following information:

- Sample collection objectives
- Locations of ground water samples to be collected
- Numbers and volumes of samples to be collected
- Types of chemical analyses to be conducted for the samples
- Specific quality control (QC) procedures and sampling required
- Any additional groundwater sampling requirements or procedures beyond those covered in this SOP, as necessary.

At a minimum, the procedures outlined in this SOP for ground water sampling will be followed.

5.1 Ground Water Sampling Requirements – Equipment Selection and Sampling Considerations

Purging and sampling equipment is constructed from a variety of materials. The most inert material (e.g., Teflon, stainless steel), with respect to known or anticipated contaminants in the well(s), should be used whenever possible. The project work plans will describe the type of equipment to be used.

If non-dedicated sampling is to be used and the contaminant histories of the wells are known, it is advisable to establish a sampling order starting with the least contaminated well and progressing to the most contaminated last.

5.2 Ground Water Purging and Sampling

Pre-sample purging and sampling should be conducted in accordance with the project work plans. The standard procedure for purging and sampling will be conducted as described below.

1. Inspect the equipment to ensure that it is in good working order.

2. Calibrate all field analytical test equipment (e.g., pH, temperature, and conductivity) according to the instrument manufacturer's specifications. Calibration results will be recorded on the appropriate form(s) as specified by the project work plans. Instruments that cannot be calibrated according to the manufacturer's specifications will be removed from service and tagged.

   NOTE: An exception to the daily calibration requirements will be made in the case of the water level meters. These instruments will be calibrated at the beginning of the project and then every six months using a steel surveyors tape.

3. If non-dedicated equipment is being used, decontaminate according to WTS-SOP No. 6.0. During decontamination, the equipment should again be inspected for damage and, if present, repaired or replaced with undamaged equipment.

4. Visually inspect the well to ensure that it is undamaged, properly labeled and secured. Damage or other conditions that may affect the integrity of the well will be recorded on the Field Activity Daily Log and brought to the attention of the Sampling Team Leader.

5. Uncap the well and monitor the air space immediately above the open casing per the health and safety plan. Observe if any air is flowing into or out of the casing. In the event such conditions are observed, they should be noted on the Sampling Information Form.

6. Obtain a depth to water level measurement according to the procedures outlined in WTS-SOP 5.0. Calculate the volume of water in the well (cased well volume) as follows:

   $$\pi \times (d/2)^2 \times (h_1 - h_2) \times 7.48 = \text{cased well volume (in gallons)}$$

   Where

   d = inside diameter of well casing (in feet)
   h_1 = depth of well from top of casing (in feet)
   h_2 = depth to water from top of casing (in feet)

   Record static water level measurement and calculations on the Field Logbook.

5.3 Purging with various devices

If using non-dedicated equipment, lower the pump and associated tubing and/or lines into the well.

For a bladder pump, attach the compressor or cylinder to the controller and the controller to the gas supply line, making sure that the compressor is downwind of the monitoring well. Attach the sampling tube to the discharge supply line. Adjust the pressure/discharge cycle on the controller.

For a peristaltic pump, conduct equipment decontamination as described in Section 5.2.3. However, the old Tygon™ tubing should not be decontaminated. New tubing should be used for each well. Connect new Tygon™ tubing to the rotor head of the pump motor and tighten until snug. Run a short section of the tubing from the discharge side of the pump head to a collection vessel. Insert the free end of the influent tubing into the well and lower it to the middle of the well screen.

For an electric submersible pump, place the generator downwind of the well. Start the generator and then plug the pump into the generator.

For a bailer, Secure the bailer to a five foot length of Teflon™ coated stainless bailer wire with a bowline knot or clip. Attach the bailer wire to bailing line or chain. Begin purging by slowly lowering the bailer into the groundwater. Allow the floating ball valve to seat, and slowly retrieve the bailer. Repeat this procedure to purge the well. During purging, the descent of the bailer should be controlled to prevent free fall inside the well. In the event the bailer encounters an obstruction inside the well, no attempts may be made to push the bailer beyond the obstruction. If the bailer becomes lodged in the well, the line should not be pulled with such force that it would part from the bailer. Such conditions should also be noted in the Field Logbook and brought to the immediate attention of the field geologist or engineer.

Begin purging. Collect, transport, and dispose of purge water in accordance with the criteria specified by the project work plans.

Physical parameters (pH, specific conductance, and temperature) of the purge water will be measured when purging begins and then periodically throughout the purging procedure. These measurements will be recorded on Sampling Information Form. Purging is considered complete when a minimum of three casing volumes have been removed and pH, specific conductivity, and temperature measurements have stabilized (i.e., three consecutive pH, specific conductance, and temperature readings are within tolerances specified in the project work plans). Standard tolerances for successive readings are as follows:

- pH within 0.1 standard unit;
- Specific conductance within 10%;
- Temperature within 0.5^{o} C; and
- No trends among the successive readings.

If stability is not reached within the removal of three well volumes then purging is continued until a maximum of five cased well volumes have been removed. If stability is not reached within removal of five well volumes, the Sampling Team Leader will, at their discretion, elect to collect the sample or discontinue the effort.

For slowly recharging wells (i.e., wells that are purged to dryness at the lowest practicable purge rate), the well will be purged to dryness, allowed to recover, and sampled without further purging. Allow the well to recover to at least 80 percent of the initial cased well volume prior to sampling.

Inspect the sampling bottles (obtained from the analytical laboratory prior to the sampling event) to be used to ensure that they are appropriate for the samples being collected, are undamaged, and have had the appropriate types and volumes of preservatives added. The types of sample containers to be used and sample preservation requirements will be provided in the project work plans.

5.4 Sampling with various devices

For a bladder pump, turn on the pump and adjust the pressure/discharge cycle on the pump controller so that the water will flow smoothly and without agitation into the sample containers.

For a peristaltic pump, turn on and adjust the rotor speed of the pump so that the water will flow smoothly and without agitation into the sample bottles.
For an electric submersible pump, turn on and adjust the flow rate of the pump by using the check-valve on the discharge line so that the water will flow smoothly and without agitation into the sample bottles.

For a bailer, lower the sample collection bailer and submerge into the water column as above. Retrieve the bailer and insert a bottom-emptying device into the bailer so that the water will flow smoothly and without agitation into the sample bottles.

Collect the sample directly into the provided sample bottle (container), allowing the discharge to flow gently down the inside of the bottle, minimizing aeration of the sample. Completely fill the bottle. Samples collected for metals and general water chemistry analysis should be filled to the base of the bottleneck.

The samples should be collected in the order of volatility, collecting the most volatile samples first, followed by the least volatile samples. The volatile samples should be collected during one full discharge cycle. Do not partially fill a volatile sample during one cycle and complete the filling during the next cycle. VOC samples should not be collected with a peristaltic pump.

Samples that require filtering should be collected last. The samples should preferably be filtered using a disposable vacuum filterization unit. The required filter mesh should be stipulated in the project work plans. The standard filter size is 0.45 microns.

Cap the bottle and attach custody tape across the cap so that any attempt to remove the sample or open the sample bottle will be evident. Fill out and attach the sample label to the bottle per WTS-SOP No. 2.1. The sample will be assigned a sample number per WTS-SOP No. 2.2.

Document the sampling event on the Field Logbook.

As soon as possible after sample collection, place the sample in a separate, appropriately sized, airtight, seam sealing, polyethylene bag (i.e., Ziplock™ or equivalent). Seal the bag, removing any excess air. Place the bagged sample inside the shipping container.

Handle and ship the sample according to the procedures outlined in WTS-SOP No. 2.1, following appropriate custody procedures described in WTS-SOP No. 1.1. Samples stored temporarily on site will be maintained per WTS-SOP No. 2.3.

6.0 REQUIRED FORMS/DOCUMENTATION

Field Logbook

LITHOLOGIC LOGGING

1.0 PURPOSE

The purpose of this procedure is to define the requirements necessary for borehole and sample logging. The major objective of this procedure is to provide a uniform set of guidelines that will aid in developing consistency among sample descriptions and sample techniques. The importance of accurate, complete, clear, and concise logs cannot be overemphasized.

2.0 BACKGROUND

Borehole logging is used to determine the geologic relationships of subsurface soil and rock formations. The relationship of geologic formations and features is important in describing groundwater flow and in determining probable contaminant migration pathways.

3.0 RESPONSIBILITIES

The Field Geologist is responsible for on-site monitoring of drilling and soil sampling operations, for recording (logging) pertinent information regarding the geologic materials penetrated during the operations, and for ensuring that the well and sample numbering system is consistent with the site specific sampling and analysis plan.

4.0 EQUIPMENT

4.1 Required Equipment

- Clipboard
- Drilling record forms
- Portable organic vapor detector
- Field logbook, straight edge and black permanent ink
- Weighted engineer's tape
- Folding rule or tape measure
- Sand gauge
- Color chart
- Acid bottle
- Water level indicator
- Site map
- Copy of drilling contract
- Waterproof marking pen
- Sample jars or bags

4.2 Optional Equipment

- Hand lens
- Brunton or equivalent compass
- Pocket penetrometer
- Equipment pouch
- Flagging tape
- Cooler and water bottles
- Flashlight
- Rock hammer

5.0 PROCEDURE FOR FILLING OUT SOIL BORING/WELL LOG

This form is intended for use in the field during the drilling, sampling, and logging process for soil borings and wells. Most of the items can be neatly and legibly included in the field; however, some items, such as the graphic log column, may be reserved for completion in the office. The purpose of the log is to clearly document the events and findings of the drilling activity. All pertinent data related to boring/drilling operations must be concisely recorded as objectively as possible. The geologist or engineer has the option to resubmit this form in a deliverable as a completely redrafted/typed form, or as a combination of information applied in the field and in the office. Regardless, the original field log should be retained in the permanent file. Any alterations or changes between the office copy and the original should be justified. To complete the boring or well logs:

- Fill out information on header of the log noting either boring or well number, if well is to be installed. Use the sampling site identification number.
- Note number under "Location".
- Note start and end date of boring or well installation under "Date", use MM/DD/YY format.
- Briefly describe wind direction, speed, and temperature under "Weather".
- The logging geologist or engineer should include his name under "Logged by", include three initials.
- The driller's name and drilling company should be included under "Drilled by", include three initials for the driller’s name.
- "Drilling method" should contain information such as hollow-stem auger and auger inside diameter. If using rotary methods, include size of bit and rotary method used.
- "Sampling method" should be described as length of sampler and type, i.e., 2.5´ split spoon. The sampling method should be described such that it is easily translatable to one of the following codes at time of data entry:

B	Bail
C	Composite grab
G	Single grab
P	Pump
S	Split-spoon core sampling
T	Shelby tube core sampling
U	Soil auger
X	Composite core sample
Z	Scraping from physical surface
1	Magnetometer (UXO survey)
2	Well sampler
9	Trip and rinse blanks

- "Gravel pack" should include the depth interval of gravel pack installation, sieve filter size, and type, e.g., 50´-39´, 20-40 Colorado silica.
- "Seal" The seal should describe the depth interval of seal above the gravel pack and type. The seal should also describe the depth interval of grout slurry, e.g., 39´ - 34´ - Bentonite pellets, 34´ - 0´ - Bentonite/grout slurry

5.1 Under the header of casing, the casing description will require the following:

- "Type" Schedule 40 polyvinyl chloride (PVC), stainless steel etc.
- "Diameter" The information supplied here will be reported in inches (usually 4 inch).
- "Length" The length of casing or riser should include stick-up at the surface.

5.2 Under the heading of screen, the well screen will require the following information:

- "Type" Schedule 40 polyvinyl chloride (PVC), stainless steel etc.
- "Slot" The screen slot size. For silts and fine-grained sands, the slot size will be 0.01 inch. For sands medium to coarse grained, the slot size will be 0.02 inch.
- "Diameter" The diameter for well screens reported in inches (usually will be 4 inch).
- "Length" The length of the well screen in reported feet.
- "Hole Diameter" The diameter of hole cut by either a rotating bit or auger cutting head. Reported in inches.
- "Total Depth" The total depth drilled (in feet). If sampled deeper than depth drilled, this should be noted at the bottom of the log.
- "Location Map" A sketch of the boring location should be constructed in this corner.

5.3 Topographical setting will be one of the following:

DEPR	Local depression
DTCH	Drainage ditch
DUNE	Dunes (mound, ridge, or hill of windblown sand; bare or covered with vegetation)
FLAT	Flat surface
HLSD	Hillside slope
HLTP	Hilltop
PDMT	Pediment (broad, gently sloping erosion surface)
TRCH	Trench (a long, narrow excavation, natural or artificial)
VALY	Valley - flat valleys of all sizes

- "Surface cover" will be bare, wooded, or grassy.
- Below the header are lithology/remarks and sample classifications. The following sample classifications should be described as follows:
- "Moisture Content" (Clays and Sands)
- Dry
- Damp
- Moist (compactable)
- Wet (not compactable)
- Saturated
- "Sorting" (Sands only)
- Very well
- Well
- Moderately
- Poorly
- Very poorly
- "Density" or consistency (CONSS) (Sands and Clay) Density is described by the number of drops required by a 140 lb. hammer over 30 inches to drive a 2-inch outside diameter, 1 3/8 inch inside diameter, split-spoon 6 inches. The following is a description of soil consistency (density):

Sand or Gravel	Blows per Foot	Silt or Clay	Blows per Foot	Thumb Penetration
VL (Very Loose)	0-4	VSO (Very Soft)	0-2	Very easy-inches
L (Loose)	4-10	SO (Soft)	2-4	Easily inches
MD (Medium Dense)	10-30	M (Medium Soft)	4-8	Moderate effort-inches
D (Dense)	30-50	ST (Stiff)	8-15	Indented easily
VD (Very Dense	> 50	VST (Very Stiff)	15-30	Indented by nail
		H (Hard)	> 30	Difficult by nail

5.4 Other descriptions may include:

- NC (Non-cemented)
- PC (Poorly cemented)
- "Plasticity" Plasticity refers to the case in which cohesive soils are molded. The following describes the plasticity terms.
- EXTREMELY HARD, resistant to pressure, not broken by hand
- NONPLASTIC, not wire formable
- SLIGHTLY PLASTIC, wire formable but soil remains easily deformed
- PLASTIC, wire formable, moderate pressure required
- VERY PLASTIC, wire formable, much pressure required
- "Sample Number" In this column, record the number order that the sample was taken.
- "TIP Reading" Refers to "Total Ionizables Present". Record the headspace reading here and the type of instrument used, i.e., HNU, OVM, etc.
- "Sample Recovery" After obtaining a split-spoon sample or Shelby sample, measure the length of recovered sample to the nearest 0.01´ and record level.
- "Penetration Resistance" The blow counts for every 6 inches of driving the sample are to be recorded under this heading.
- "Color" The Munsell soil color or Geological Society of America soil color codes (COLOR) are a combination of the hues, values, and colors listed below:
- Hue: 2Y, 2YR, 5B, 5BG, 5G, 5GY, 5P, 5PB, 5R, 5RP, 5Y, 5YR, 7R, 7YR, 10G, 10GY, 10R, 10Y, 10YR, N
- Value: 0 - 9
- Color: 0 - 8 (not used when hue is "N"). A Munsell color chart will be available for color determination.

"USCS Classification/Lithology/Grain Size, Modifications/Remarks". The predominant lithology or lithologies should be identified first in capital letters, followed by qualifying adjectives that define grain size, color (using a Munsell chart), mineralogy, structural/textural features, bedding and laminations. For mixed lithologies within a common interval, provide relative percentages of the two or more lithologies within parenthesis following the lithologic name. For example, Sand (fine-medium [60%]) brownish yellow (10 yr. 6/6), and Gravel coarse (40%) very pale brown (10 yr. 7/3). Any obvious features related to evidence for contamination, such as odor or staining, should be documented. Drilling comments and occurrences should also be noted under this section. The acceptable codes, based on Unified Soil Classification System (USCS) augmented by lithology and special codes, are identified in Table 1. Codes for grain size (soil) are listed on the following page:

Action or Measurement		Acceptable Entries	
Code	**Description**	**Code**	**Description**
GRAIN	Grain size (soil)	For soils:	
		C	Coarse
		CF	Coarse to fine
		F	Fine
		FM	Fine to medium
		LG	Large
		vM	Medium
		MC	Medium to coarse
		SMALL	Small
		VC	Very coarse
		VF	Very fine

Rock texture codes are available, but have not been included here since they are not expected.

5.5 Soil Classification and Lithology.

Action or Measurement		Acceptable Entries	
Code	**Description**	**Code**	**Description**
USCS	Unified Soil Classification System augmented by lithology and special codes		Separate dual USCS codes by a hyphen.
		USCS Codes:	
		CH	Fat clay, inorganic clay of high plasticity
		CL	Lean clay, sandy clay, silty clay, or low to medium plasticity
		GC	Clayey gravel, gravel-sand-clay mixtures
		GM	Silty gravel, gravel-sand-silt mixtures
		GP	Gravel, poorly graded, gravel-sand mixtures, little or no fines
		GW	Well graded gravel-sand mixture, little or no fines
		MH	Silt, fine sandy or silty soil with high plasticity
		ML	Silty and very fine sand, silty or clayey fine sand or clayey silt with slight plasticity
		OH	Organic clays of medium to high plasticity, organic silts
		OL	Organic silts and organic silty clays of low plasticity
		PT	Peat or other highly organic soil
		SC	Clayey sand, sand-clay mixtures
		SI	Shells
		SM	Silty-sand, sand-silt mixtures
		SP	Sand, poorly-graded, gravelly sands
		SW	Sand, well-graded, gravelly sands
		WD	Wood
USCS	Unified Soil Classification System augmented by lithology and special codes		Separate dual USCS codes by a hyphen.
		Special:	
		ASH	Ash
		ASPHLT	Asphalt (road material
		CONC	Concrete
		CRLMSN	Crushed limestone
		FILL	Unknown man-made landfill material
		LC	LC Lost core
		NR	NR No recovery
		NTLOGD	Not logged
		RUBBLE	Construction debris rubble or demolition fill
		VOID	Void or cavity
WSTAT	Final status of the well	CB	Well filled with grout: cement-bentonite
		FB	Well filled with bentonite
		FC	Well filled with concrete
		FG	Well filled with gravel
		FS	Well filled with soil
		NC	Well filled with grout: neat cement
		O	Open well
		OP	Open well with piezometer or observation well installed
		WD	Well damaged

Action or Measurement		Acceptable Entries	
Code	**Description**	**Code**	**Description**
MODIF	Lithology modifications	B	Boulders
		BDWX	Badly weathered
		CAL	Calcareous
		CARB	Carbonaceous
		CC	Concretions
		CEM	Cemented
		CHE	With chemicals (based on headspace reading)
		CL	Clayey
		CS	Clay strata or lenses
		DCOLOR	Discolored
		FAULT	Faulted
		FECC	Iron concentrations
		FILL	Disturbed soil
		FRACT	Fractured
		FRIA	Friable
		G	Gravelly
		HPL	Highly plastic
		IRNST	Ironstained
		LIG	Lignite fragments
		MICA	Micaceous
		ML	Silty
		MOT	Mottled
		O	Organic matter
		ODOR	Odiferous
		OX	Oxidized
MODIF	Lithology modifications	PL	Plastic
		ROUND	Rounded
		RT	Rootlets
		S	Sandy
		SDL	Sandstone lenses
		SDS	Sandstone fragments
		SH	Shale fragments
		SHLN	Shale lenses
		SHLY	Shaly
		SIS	Silt strata or lenses
		SL	Slickensides
		SLF	Shell fragments
		SLWX	Slightly weathered
		SO	Solid
		THSK	Thin streaks
		TR	Trace
		TRCL	Trace of clay
		TRG	Trace of gravel
		TRML	Trace of silt
		TRMN	Trace of manganese
		TRS	Trace of sand
		WCL	With clay
		WFE	With iron oxide
		WG	With gravel
		WGML	With gravel and silt
		WLAM	With laminations
		WML	With silt
		WS	With sand
		WX	Weathered

6.0 REQUIRED FORMS/DOCUMENTATION

Soil Boring Log Forms

MANAGEMENT OF INVESTIGATION-DERIVED WASTE

1.0 PURPOSE

This Standard Operating Procedure (SOP) establishes guidelines and procedures for the proper management of investigation-derived waste (IDW) generated during environmental activities under contract number DAAD07-95-C-0125. Management includes waste minimization, hazardous waste determination, storage, labeling and transportation to the White Sands Missile Range Hazardous Waste Minimization Center.

During environmental investigations at the White Sands Missile Range (WSMR), WTS sampling crews may generate potentially contaminated IDW, including but not limited to the following types of materials:

- Saturated and unsaturated soil
- Groundwater
- Non-aqueous phase liquid (NAPL)
- Decontamination water
- Personal Protective Equipment (PPE) and miscellaneous refuse

Deviations from this procedure should be detailed in site-specific waste management plans approved by the New Mexico Environment Department (NMED).

2.0 REGULATORY AUTHORITY

The NMED has consolidated authority for all remedial investigations and corrective actions at the WSMR under the Hazardous Waste Bureau (HWB). The bureau regulates these activities under the **New Mexico Hazardous Waste Act** (NMSA 1978, sections 74-4-1 through 14), the corresponding regulations (Title 20 of the New Mexico Administrative Code, Chapter 4.1), and the **New Mexico Solid Waste Act** (NMSA 1978, sections 74-9-1 through 74-9-42) and its corresponding regulations (Title 20 of the New Mexico Administrative Code, Chapter 9.1). The federal regulations governing hazardous waste, 40 CFR 260-273 (also known as RCRA) have been adopted by New Mexico almost in their entirety and are referred to in this document.

The transportation of hazardous waste (and some non-hazardous waste) is regulated under the DOT **Hazardous Material Regulations** (49 CFR 171-178). **The New Mexico Hazardous Waste Act** and the corresponding regulations refer the reader to the DOT Hazardous Material Regulations when addressing transportation of hazardous waste beyond manifesting requirements. The transportation of other non-hazardous waste is regulated under the **New Mexico Solid Waste Act** (NMSA 1978, sections 74-9-1 through 74-9-42) and its corresponding regulations (Title 20 of the New Mexico Administrative Code, Chapter 9.1).

3.0 REFERENCES

State of New Mexico, 1983. *Hazardous Waste Act (NMSA 1978, sections 74-4-1 through 14)*. Santa Fe, New Mexico.

New Mexico Environment Improvement Board, June 2000. *New Mexico Hazardous Waste Management Regulations (20 NMAC 4.1)*. Santa Fe, New Mexico.

State of New Mexico, 1991. Solid *Waste Act (NMSA 1978, sections 74-9-1 through 42)*. Santa Fe, New Mexico.

New Mexico Environment Improvement Board, November 1995. *New Mexico Solid Waste Management Regulations (20 NMAC 9.1)*. Santa Fe, New Mexico.

U.S. Department of Environmental Protection, 1999. *Hazardous Waste Regulations (40 CFR Parts 260-273).* Washington D.C.

U.S. Department of Transportation, 2001. *Hazardous Materials Regulations (49 CFR Parts 171-178).* Washington D.C.

EPA, 1991. Memo from S. Lawrence (Director of Office of Solid Waste) to John Ely addressing the EPA's "Contained-In Policy".

EPA, 1998, Management of Remediation Waste Under RCRA, EPA Publication Number 530-F-98-026.

Forsythe, G. (Environmental Compliance Division, WSMR), July 10, 2002. Email to Don Emig: Transporting items across U.S. 70.

4.0 RESPONSIBILITIES

The project Task Manager and Task Coordinator are responsible for ensuring that all investigation-derived waste is managed in accordance with this SOP and any other appropriate procedures or related SOPs. This will be accomplished through staff training and by maintaining quality assurance/quality control (QA/QC).

The Quality Assurance Officer is responsible for periodic review of field-generated documentation associated with this SOP. The Quality Assurance Officer is also responsible for implementation of corrective action (i.e., retraining personnel, additional review of work plans and SOPs, variances to QC sampling requirements, issuing nonconformance memorandums, etc.) if quality issues are identified.

The project Sampling Team Leader assigned to environmental and QC sampling activities is responsible for completing tasks according to specifications outlined in this SOP and other appropriate procedures.

All staff members are responsible for reporting deviations from procedures to the Project Task Coordinator.

5.0 REQUIRED MATERIALS

- Field logbook: surveyor's book or field book, bound and ruled/gridded, record book with sequentially numbered and waterproof pages.
- Indelible black ink pens.
- Paint pens for marking drums
- Drum Labels

6.0 PROCEDURES

6.1 Waste Management Procedures Overview

These procedures are conservative in their approach to waste management so that they may ensure the protection of human health and the environment and comply with regulatory requirements that are applicable or relevant and appropriate requirements (ARARs). They include the management of waste from the point of generation to the transfer of responsibility at the WSMR Hazardous Waste Minimization Center (HWMC).

The HWMC is responsible for the transportation and disposal of all wastes from the WSMR. The center makes the final waste determination for all waste streams using information provided by their customers. The center is the repository for all of the waste determination analytical data, waste profiles, manifests and certificates of disposal for the WSMR.

6.2 Waste Minimization

To the extent that it is practical, environmental investigations will follow waste minimization procedures.

Guidelines for waste minimization are:

- Minimize materials that are introduced into any exclusion zone in an investigation area.
- Combine similar wastes throughout an investigation area in a single container wherever possible.
- Combine decontamination water from multiple sites in one container.
- Use a container of the appropriate size (e.g., use a 5-gallon drum for small amounts of waste unless a 55-gallon drum is needed to hold all the waste).
- Decontaminate and reuse material and equipment whenever practical.
- Minimize the volume of decontamination water generated.
- With solid environmental media and materials, ensure that waste is tightly packed to minimize the number of containers.
- Use less hazardous substances whenever possible.

6.3 Waste Determinations

The initial waste determination may be established using the guidelines outlined below. This determination should be used to properly manage the waste until the final waste determination is made by the HWMC. A copy of the analytical data and supporting documentation shall be provided to the HWMC upon completion of the initial waste determination. The center will notify the project Task Coordinator if they do not concur with the initial waste determination. If there is a discrepancy, the two parties shall meet and review the conclusions and supporting data. Appropriate corrective actions shall be subsequently taken to ensure that the waste is being properly managed.

6.3.1 Background

Investigation derived waste (IDW) originates from solid waste or environmental media. Solid waste as defined in 40 CFR 261.2 is <u>any discarded material</u> that is not excluded by 261.4(a) or that is not excluded by variance granted under 260.30 and 260.31. The reader should familiarize himself or herself with the exclusions, but it is not expected that they will apply. Examples of IDW that is solid waste are personal protective equipment, disposable equipment, non-aqueous phase liquid and decontamination water.

The EPA describes environmental media as being soil, groundwater or sediment (EPA, 1991). The presumption is that they were not discarded and therefore do not meet the definition of solid waste. The EPA has established and upheld in court of law, a policy, which addresses the applicability of RCRA to contaminated environmental media. This policy is known as the “contained-in-policy”. Simply put, the environmental media will be considered a solid waste, if it “contains” a solid waste. Examples of IDW that is environmental media are soil cuttings and purge water.

6.3.2 Regulatory Requirement

RCRA compels the solid waste generator under 40 CFR 262.11, to determine if that waste is a hazardous waste using the following method:

- He should first determine if the waste is excluded from regulation under 40 CFR 261.4.
- He must then determine if the waste is listed as a hazardous waste in subpart D of 40 CFR part 261.

NOTE: Even if the waste is listed, the generator still has an opportunity under 40 CFR 260.22 to demonstrate to the Administrator that the waste from his particular facility or operation is not a hazardous waste.

- For purposes of compliance with 40 CFR part 268, or if the waste is not listed in subpart D of 40 CFR part 261, the generator must then determine whether the waste is identified in subpart C of 40 CFR part 261 by either:
    - Testing the waste according to the methods set forth in subpart C of 40 CFR part 261, or according to an equivalent method approved by the Administrator under 40 CFR 260.21; or

- o Applying knowledge of the hazard characteristic of the waste in light of the materials or the processes used.

- If the waste is determined to be hazardous, the generator must refer to parts 261, 264, 265, 266, 268, and 273 of this chapter for possible exclusions or restrictions pertaining to management of the specific waste.

6.3.3 Waste Analysis

It is the policy of the HWMC to make waste determinations based on analytical data and supported by generator knowledge. They also require that the analytical data be no older than one year.

The sample collected for waste analysis should be representative of the material being evaluated. Acquiring a representative sample can include compositing and statistical analysis.

Waste analysis should be performed for those analytes that are suspected to be present based on site information and/or generator knowledge. The approved testing methods are indicated in 40 CFR 261 Subpart C. When generator knowledge is absent a full waste characterization should be performed. This would include running the toxicity characteristic leaching procedure for the entire Table 1 constituents listed in 40 CFR 261.24 and ignitability, corrosivity and reactivity.

6.3.4 Methodology

Waste determinations will be established as soon as practical after the waste is generated.
The determination is made using the three-step process outlined below. Sites that have not been previously investigated are inherently problematic. It often requires substantial individual judgment in making waste management decisions. It is recommended that the person responsible for waste management handle the material as though it were hazardous waste, if sufficient information is not available at the time of generation. This would include labeling the drums as hazardous waste and managing them accordingly. Refer to section 6.5.1 of this procedure for further instruction on proper labeling of containers lacking adequate waste determination.

Step 1: <u>Is the waste a solid waste</u>?

The EPA's "contained-in policy" should be referred to for direction in determining whether environmental media is a solid waste. The policy provides that environmental media will be considered a solid waste if it contains a listed waste or exhibits the characteristics of a hazardous waste.

The EPA has not defined what volume or concentration of a listed waste constitutes "contained-in". They have advised that the determination be made in consultation with the regulatory authority and be based on conservative risk-based screening levels.

This document advises the use of the universal treatment standards (UTS) provided in 40 CFR 268.48 for determination as to whether the media contains the chemical(s), which gave origin to the listing. These standards are utilized to determine whether underlying hazardous constituents require further treatment as required by the Land Disposal Restrictions in 40 CFR Part 268 prior to disposal. This document presumes that the UTS would provide adequate screening for waste disposal purposes. Any material left onsite at a concentration below the UTS, would still be subject to risk based cleanup criteria for corrective action. Therefore this procedure presumes that the environmental media contains a listed waste if the UTS are exceeded for the chemical that gave origin to the listing.

If the environmental media does not contain a listed waste or exhibit the characteristic of a hazardous waste, it shall be considered to contain a solid waste when any constituent exceeds the appropriate detection limit or established background level for organic and inorganic naturally occurring compounds. Other investigation-derived waste is a solid waste at the point at which it is discarded.

Step 2: Is the solid waste a hazardous waste?

Once the waste has been declared a solid waste, it is necessary to determine whether it is hazardous. The process is the same whether or not it is environmental media. The only difference being whether the "mixture rule" or the "contained-in" policy applies.

Review the site history and interview current and former employees to determine whether a listed (F, K, P or U) waste caused the contamination. The EPA has stated that one may assume a listed waste did not cause the contamination if the documentation for making such as determination is unavailable or inconclusive and the facility owner/operator has made a good faith effort to do so (EPA, 1998). If a listed waste caused the contamination, then the (non-environmental media) solid waste will be considered a hazardous waste, based on the "mixture rule". Environmental media containing by a listed waste is considered a hazardous waste based on the "contained in policy".

Analyze the waste for the Subpart C hazardous waste characteristics (ignitability, corrosivity, reactivity and toxicity). If the levels exceed the values provided in 40 CFR 261.21 thru 261.24 the material exhibits a characteristic of a hazardous waste and shall be managed as such.

Step 3: Does the waste contain an underlying hazardous constituent?

Identification of underlying hazardous constituents (UHC) is an important part of waste profiling in order to satisfy the land disposal restrictions. Although the management activities covered in this procedure does not address disposal options, gathering this information up front is an important step.

Sufficient laboratory analysis should be performed to determine whether other contaminants are present in the waste. The analysis should be based on generator knowledge of the waste and include those contaminants that may reasonably be expected. The results should be provided to the HWMC for evaluation as UHCs when considering disposal options.

6.3.5 Storage of IDW

Waste may be stored in a variety of portable containers, such as 5-gallon buckets, 55-gallon drums, rolloff boxes, and baker tanks. The specifications of each device will depend on the hazardous waste determination.

Containers used to store hazardous waste must meet the requirements of 40 CFR 262.34 (c) (1) (Accumulation), by being in good condition, being compatible with the waste and being closed except when adding or removing waste. Containers must also satisfy the DOT shipping requirements appropriate for the hazard classification. Refer to column 8 of the Hazardous Materials Table in 49 CFR 172.101. The containers will be marked with appropriate hazardous waste labels as prescribed in 40 CFR 262.34 (c)(1)(ii) and will be transported within 3 days of generation to the HWMC.

Non-hazardous solid waste must meet the requirements of 20 NMAC 9.1, Section 106 by being covered, reasonably clean and leak proof. The containers will be labeled, indicating the contents and potential health, safety, and environmental hazards associated with the waste (20 NMAC 9.1 Section 703) and will be shipped to the HWMC for disposal within 45 days of generation in accordance with Section 712 of 20 NMAC 9.1.

IDW that has been classified as hazardous waste "pending analysis" must be moved to a permitted 90-day storage facility within three days of generation and stored until analytical results have been received and reviewed. It is imperative that analytical results be received sufficiently in advance of the 90-day limit to allow for disposal within that time period.

Drums used for storage of liquid waste will not be completely filled. At least 6 inches of space will be left at the top of each drum to allow for expansion of waste due to freezing. All containers must be covered and sealed daily before field personnel leave the site.

6.4 Container Labeling and Marking

All containers used to store investigation-derived waste at the White Sands Missile Range will be labeled by the end of each workday. Containers will be assigned numbers sequentially. Duplicate numbers will be avoided by reviewing the Field Logbook before assigning a number to an IDW drum. Containers will be marked on the side and lid using a paint marker. Marking will include the following:

- Container number
- Dates of first use and last use
- Site Identification (include SWMU #, sample type, sample No.)
- Level of PPE worn when IDW was generated

Non-hazardous waste containers will be labeled using the green label (figure 1). The contents will be written in the space provided at the bottom.

Hazardous waste containers will be labeled using the yellow label (figure 2). The proper shipping name will be filled in the space provided at the bottom of the label. The contents of the container (ie. decontamination water, soil cuttings) will be marked on the side and top of the container, as practical, with the other information listed above.

Containers of IDW that do not have a hazardous waste determination will be labeled as Hazardous Waste using the label in Figure 2 and a Pending Analysis label shown in Figure 3.

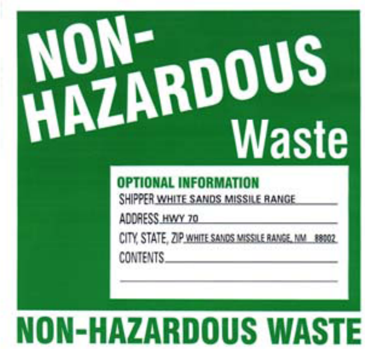

Figure 1

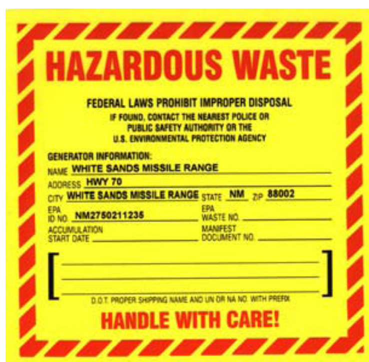

Figure 2

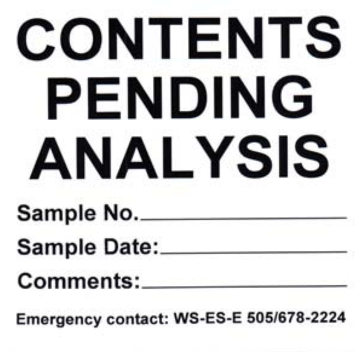

Figure 3

6.5 Field Logbook

The field operations leader will keep all container inventory information in the Field Logbook. The Field Logbook will contain the following information

1. Unique container ID number
2. Site ID
3. Container contents
4. Dates:
    - Container filled
    - Sample collected
    - Container transfer to HWMC
    - Analytical results received
5. Hazardous waste determination
6. Date the containers were turned over to the Hazardous Waste Minimization Center

6.6 Alternate Disposal of Environmental Media

Environmental media determined to be non-hazardous waste may be placed back within the area of investigation provided that the concentration of contaminants are below (in order of preference):

- Established naturally occurring organic and inorganic background levels.
- Human Health Standards for groundwater (20 NMAC 6.2 Section 3103).
- NMED Residential and/or DAF 20 Soil Screening Levels (whichever is lower).
- EPA Region IX Preliminary Remediation Goals and DAF 20 Soil Screening Levels.

Environmental media will not be placed within the area of investigation even if the above criteria are met, if it is known to exceed established ecological risk criteria.

6.7 Record keeping

The Investigation Contractor will maintain completed Field Logbooks and waste characterization data packages that they generate.

6.8 Transportation

WTS may transport hazardous and non-hazardous waste within the boundaries of the White Sands Missile Range without a manifest, bill of lading, placarding, DOT container marking or Hazardous Material Transporter registration. WTS may also cross non-range roads to transport hazardous and non-hazardous waste between contiguous properties of WSMR, without being subject to the DOT Hazardous Materials Regulations or the Uniform Hazardous Waste Manifest (the manifest) requirements of RCRA (G. Forsythe, 2002).

WTS will not transport the waste along non-range roads, even within the boundaries of the WSMR. If this is necessary, WTS shall require these transportation services be provided by the HWMC.

If the waste will be transported offsite, a manifest must be prepared. The manifest is a form used to track the movement of hazardous or non-hazardous waste from the point of generation to the point of ultimate disposition ("cradle to grave") (40 CFR Part 262, Subpart B). The manifest generally requires the following information;

- Name, address and US EPA ID No. of the generator, transporter, and the destination facility
- U.S. DOT description of the waste being transported and any associated hazards
- waste quantity
- name and phone number of a contact in case of an emergency
- special handling or hazard information
- Generators Certification (Signature required by authorized Gov't POC)
- other information required either by EPA or the state

In all cases the “Generator” shall be White Sands Missile Range and the manifest should be signed by the authorized Government point of contact. **UNDER NO CONDITION SHOULD A WTS EMPLOYEE SIGN AS OR FOR THE GENERATOR ON A MANIFEST.**