02-16-000984

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November 6, 2006

Jim Ross
Waste Management Specialist – Northern Region
Wisconsin Department of Natural Resources
810 West Maple Street
Spooner, WI 54801

Subject: Koppers Superior Facility
Drip Pad Closure Investigation Work Plan

Dear Jim:

Attached please find the proposed Work Plan for a Drip Pad Closure Investigation (sampling plan) for the Koppers Inc. Superior Facility.

We believe this plan satisfies the requirements that we discussed last week as they pertain to the clean closure of the less than 90-day accumulation drip pad at the facility. As we agreed, the analyses conducted pursuant to this work plan are intended to allow the Wisconsin Department of Natural Resources to approve the clean closure of the drip pad, pending completion of Resource Conservation and Recovery Act Corrective Action activities for the entire property.

We are prepared to begin implementing this Work Plan immediately upon your approval, weather permitting. Since weather may indeed be a factor in the ability to complete this plan, your expedited approval would be appreciated.

Please feel free to call me if you have any questions.

Sincerely,

Leslie S. Hyde

Cc:
Jim Hosch, WDNR
Jane Patarcity, Beazer East, Inc.

WORK PLAN
DRIP PAD CLOSURE INVESTIGATION

KOPPERS INC.
SUPERIOR, WISCONSIN FACILITY

Prepared for:
KOPPERS INC.
436 SEVENTH AVENUE
PITTSBURGH, PENNSYLVANIA 15219-1800

NOVEMBER 2006

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DRIP PAD CLOSURE INVESTIGATION

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Prepared for:
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NOVEMBER 2006

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1.0 INTRODUCTION

This Work Plan details the activities associated with demonstrating the clean closure of the less than 90-day accumulation drip pad at the Koppers Inc. Superior, Wisconsin facility. The results of this Work Plan are intended to allow the Wisconsin Department of Natural Resources to approve the clean closure of the drip pad, pending completion of Resource Conservation and Recovery Act Corrective Action activities for the entire property. The following describes the sample collection and analysis that will be performed, and presents an anticipated schedule to complete these activities.

This scope of work covers the following:

- Collection of six surface soil samples along the drip pad;
- Installation of two temporary monitoring wells and collection of one groundwater sample from each well; and
- Laboratory analysis of the soil and groundwater samples.

Sampling and sample handling activities will follow the applicable portions of the attached Standard Operating Procedure documents, as described below.

2.0 SAMPLING AND SAMPLE HANDLING

2.1 Surface Soil Sampling

Three pairs of surface soil samples will be collected from each side of the drip pad, at points located at 150, 300, and 450 feet from the cylinder door area. The soil samples will be collected from the depth interval of zero (ground surface) to six inches.

Surface soil sampling will be performed using a new hand trowel at each sampling location. Upon sample retrieval, the field investigator will log the sample in a bound field book, and place the appropriate aliquots into laboratory-provided sample jars. Sample aliquots collected for volatile organic compound (VOC) analysis will be obtained using Method 5035 protocols. The filled jars will be placed on ice in an insulated cooler for delivery to the analytical laboratory. Information recorded in the log will include sample location, date/time of sampling, and a physical description of the soil sample. Following completion of sampling activities, the sampling locations will be backfilled with surrounding native material.

2.2 Groundwater Sampling

Two temporary groundwater monitoring wells will be installed on opposite sides along the drip pad, at points 150 and 300 feet from the cylinder door area. Based on available site information, the water table is expected to occur at a depth of less than five feet below ground surface. A temporary surface casing will be installed in order to minimize the possible infiltration of surface water. The surface casing will extend from the surface into the first several inches of native clay. The temporary wells will be installed inside the surface casing by advancing a small-diameter borehole with a decontaminated hand auger to a depth of approximately five to ten feet below grade. The final depth of the temporary monitoring well will depend on saturated conditions but will not exceed ten feet. A one-inch diameter machine-slotted PVC well screen will be inserted in the borehole to the total depth. Fine sand will fill the annular space around the installed well screen to act as a formation stabilizer.

Well development/purging will be performed following completion of monitoring well construction. Well development is performed to improve the flow of water into the well screen by removing fine particles from the formation immediately surrounding the screened well so that groundwater can enter the well more freely. Well development will be accomplished using a peristaltic pump to evacuate water from the wells. Wells will be purged until at least three casing volumes of water are removed from each well, or until the pH, conductivity, and temperature of the purge water has stabilized prior to sampling. The pH, conductivity, and temperature field measurements will be recorded in the log book. In the event that the well(s) are purged to dryness prior to meeting the above criteria, the purging will be considered complete.

After development/purging, the temporary monitoring wells will be allowed to equilibrate overnight before collection of a groundwater sample. Wells will be sampled using a peristaltic pump operating at low-flow conditions. Field measurements will be made of depth to water, pH, conductivity, and temperature during sample collection, and the appropriate aliquots will be placed in laboratory-provided sample jars. Samples for metals analysis will be field-filtered using a 0.45-micron in-line filter with the peristaltic pump. The filled sample bottles will be placed on ice in an insulated cooler for delivery to the analytical laboratory.

Following collection of the groundwater samples, the two temporary monitoring well will be abandoned by extracting the PVC casing from the ground and backfilling the borehole with bentonite powder. Soil cuttings and development/purge water will be containerized and left on site for later management pending the results of the analytical program.

2.3 Laboratory Analysis

The soil and groundwater samples will be shipped in a cooler under chain of custody protocols to the selected analytical laboratory. The analytical laboratory will be a Wisconsin Certified Commercial Laboratory.

The analytical suite for each of the soil and groundwater samples will consist of the following:

- VOCs (Method 8260B/5035)
- Polynuclear aromatic hydrocarbons (PAHs) and pentachlorophenol (Method 8270)
- Total chromium, copper, and arsenic (6000- and 7000-series Methods)

In addition, one surface soil sample from each sampling location pair (three samples total) will be analyzed for dioxins/furans (Method 8290).

2.4 Quality Control

Internal QC checks are routinely performed by the laboratory. In addition, a cooler temperature blank, and a trip (travel) blank for VOC analysis will be placed in the cooler prior to shipment to the laboratory.

3.0 ACTIVITIES SCHEDULE

Report Preparation

Following the completion of all field activities and sample analysis, KU Resources will prepare a report detailing all project activities, observations, and analytical results.

Schedule

The anticipated schedule for completion of the activities described above is as follows:

Activity	Time to Complete (business days)
Field sample collection	2
Laboratory analysis	15
Review of analytical data and report preparation	10

ATTACHMENT

Attachment A
KU Resources, Inc.
Standard Operating Procedures

1.0 PURPOSE

The objective of this SOP is to collect a soil sample that is representative of conditions as they exist at the site by selecting the appropriate sampling device(s); by taking measures to avoid introducing contamination as a result of poor sampling and/or handling technique; and by reducing the potential of cross contamination between samples.

Prior to conducting a soil sampling investigation, a sampling strategy should be developed based on the objectives of the investigation. After developing a soil sampling strategy, the appropriate equipment and techniques must be used to conduct the investigation. This section discusses the various soil sample collection methods, sample handling, and available sampling equipment which has been shown to be technically appropriate.

2.0 EQUIPMENT

Selection of equipment is usually based on the depth of the samples to be collected, but it is also controlled to a certain extent by the characteristics of the soil. Manual techniques and equipment such as hand augers are usually used for collecting surface or shallow, subsurface soil samples. Power-operated equipment is usually associated with deep sampling but can also be used for shallow sampling when the bore hole begins to collapse or when the soil is so tight that manual sampling is not practical.

2.1 Precautions for Trace Contaminant Soil Sampling

All soil sampling equipment used for sampling trace contaminants should be constructed of inert materials such as stainless steel where possible. Pans used for mixing should be made of Pyrex® (or equivalent) glass. In no case will chromium, cadmium, galvanized, or plated equipment be used for soil sampling when trace levels of inorganic contaminants are of concern. Similarly, no painted or plastic equipment (other than disposable sleeves used in Geoprobe® sampling) may be used where trace levels of organic contaminants are of concern. Paint, scaly, or heavy rust and grease must be removed before use, most often by sandblasting the equipment. Ancillary equipment such as auger flights may be constructed of other materials since this equipment does not come in direct contact with the samples.

3.0 SAMPLING METHODOLOGY

This discussion of soil sampling methods reflects both the equipment used to collect the sample as well as how the sample is handled and processed after retrieval. Selection of equipment is usually based on the depth of sampling, but it is also controlled, to a certain extent, by the characteristics of the material. Simple, manual techniques and equipment, such as hand augers, are usually selected for surface or shallow, subsurface soil sampling. As the depth of the sampling interval increases, some type of powered sampling equipment is usually needed to overcome the friction induced by soil resistance and depth. The following is an overview of the various sample collection methods employed over three general depth classifications: surface, shallow subsurface, and deep subsurface. Any of the deep collection methods described may be used to collect samples from the shallower intervals.

3.1 Manual Collection Techniques and Equipment

These methods are used primarily to collect surface and shallow subsurface soil samples. Surface soils are generally classified as soils between the ground surface and 6 to 12 inches below ground surface. The shallow subsurface interval may be considered to extend from approximately 12 inches below ground surface to a site-specific depth at which sample collection using manual methods becomes impractical.

Surface Soils

Surface soils may be collected with a wide variety of equipment, if constructed of appropriate materials. Spoons or hand-augers are typically used to collect surface soil samples. If a thick, matted root zone is encountered at or near the surface, it should be removed before the sample is collected. The collected soil is placed in a pan, thoroughly mixed and placed in the appropriate sample container(s). Section 4.0 contains specific procedures for collecting and handling soil samples for volatile organic compounds (VOCs) analysis.

Shallow Subsurface Soils

Hand augers may be used to collect shallow subsurface samples. Typically, 4-inch auger-buckets with cutting heads are pushed and twisted into the ground, then removed as the buckets are filled. The auger holes are advanced one bucket at a time. The practical depth of investigation using a hand-auger depends upon the soil properties. In sand, augering is usually easily performed, but the depth of collection is limited to the depth at which the sand begins to flow. At this depth, the bore hole will usually collapse and cannot be advanced. Deeper sampling must be accomplished using power equipment. Hand augering may also be of limited use in tight clays or cemented sands. Regardless of the soil type, at depths approaching 20 feet sidewall friction may become so severe that power equipment must be used.

Power augers may be used to advance the borehole where hand augers are impractical. Power augers are a sampling aid, not a sampling device, and can be used to advance a borehole to approximately 20 feet, depending upon soil conditions.

If power augers are used to advance the borehole, care must be taken that exhaust fumes, gasoline, and\or oil do not contaminate the borehole. The soil sample may then be collected using a hand auger. After the sample has been collected, the borehole may again be advanced (if necessary), and additional samples collected. The auger bucket must be replaced between samples with a properly decontaminated auger bucket. When a new borehole is advanced, the entire hand auger assembly must be replaced with a properly decontaminated hand auger assembly.

If the borehole is advanced using a hand auger, upon reaching the desired sampling depth replace the bucket with a properly decontaminated bucket. The sample may then be collected. After the sample has been collected, the borehole may be advanced (if necessary) with the bucket that was used to collect the sample. Each sample must be collected using a properly decontaminated bucket.

Before the soil is placed in a pan, it is necessary to remove the top several inches of soil to minimize the possibility of cross contamination of the sample from fall in of material from the upper portions of the hole.

Once the soil is placed in a pan, it is thoroughly mixed and placed in the appropriate sample container(s). Section 4.0 contains specific procedures for collecting and handling soil samples for VOCs analysis.

3.2 Powered Equipment

Powered equipment may be used to acquire soil samples from any depth (surface, shallow subsurface, and deep subsurface). When power equipment is used to advance the borehole and collect the sample, care must be taken that exhaust fumes, gasoline, and\or oil do not contaminate the borehole and the sample. Among the common types of powered equipment used to collect subsurface soil samples are split-spoon samplers driven with a drill rig drive-weight assembly or pushed using drill rig hydraulics; continuous split-spoon samplers; direct-push rigs; and backhoes. The use of each of these is described below.

Drill Rigs

Drill rigs offer the capability of collecting soil samples from greater depths. For all practical purposes, the depth of investigation achievable by this method is controlled only by the depth of soil overlying bedrock, which may be in excess of 100 feet.

Split-spoon samplers are usually driven either inside a hollow-stem auger or an open borehole after the auger(s) have been temporarily removed. The spoon is driven with a 140-pound hammer through a distance of up to 24 inches and removed.

Continuous split-spoon samplers may be used to obtain 5-foot long, continuous samples approximately 3 to 5 inches in diameter. These devices are placed inside a 5-foot section of hollow-stem auger and advanced with the auger during drilling. As the auger advances, the central core of soil moves into the sampler and is retained.

Before the soil is placed in a pan, it is necessary to remove the top several inches of soil to minimize the possibility of cross contamination of the sample from fall in of material from the upper portions of the hole. Once the soil is placed in a pan, it is thoroughly mixed and placed in the appropriate sample container(s). Section 4.0 contains specific procedures for collecting and handling soil samples for VOCs analysis.

Direct-Push Rigs

This method uses a standard split-spoon modified with a locking tip which keeps the spoon closed during the sampling push. Upon arrival at the desired depth, the tip is remotely released and the push continued. During the push, the released tip moves freely inside of the spoon as the soil core displaces it. This technique is particularly beneficial at highly contaminated sites, because no cuttings are produced. The push rods are generally retrieved with very little residue resulting in minimal exposure to sampling personnel and reduced IDW.

Before the soil is placed in a pan, it is necessary to remove the top several inches of soil to minimize the possibility of cross contamination of the sample from fall-in of material from the upper portions of the hole. Once the soil is placed in a pan, it is thoroughly mixed and placed in the appropriate sample container(s). Section 4.0 contains specific procedures for collecting and handling soil samples for VOCs analysis.

Geoprobe® Large Bore Soil Sampler

Geoprobe® offers several tools for soil sample collection. Among these are the Macro-Core® Soil Sampler and the large bore and dual tube soil sampling systems. The large bore soil sampling system is utilized for collection of surface and subsurface soil samples. The selection of this system does not preclude the use of the other systems at a future time. The large bore sampler is a solid barrel, piston-sealed, direct-push device for collecting discrete interval samples of unconsolidated materials at depth. The sampler is approximately 30 inches (762 mm) long and has a 1.5-inch (38 mm) outside diameter. The large bore sampler is capable of recovering a discrete sample core 22 inches x 1.0 inches (559 mm x 25 mm) contained inside a removable liner. Sample volume measures up to 283 ml. The liner is a 24-inch long by 1.15-inch OD (610 mm x 29 mm) removable/replaceable thin-walled tube that fits inside the large bore sample tube. Liners facilitate retrieval of the sample and may be used for storage, when applicable. The large bore soil sampler is pushed with 1.25-inch diameter probe rod.

Special Considerations for Large Bore Soil Sampling

Liner Use and Material Selection

Due to the mode of operation, the Large Bore soil sampler must be used with a liner. Liners are available in the following materials: stainless steel, brass, cellulose acetate butyrate (CAB), and Teflon®. For the majority of environmental investigations, CAB liners are used.

Sample Orientation

When the liners and associated sample are removed from the sample tubes, it is important to maintain the proper orientation of the sample. This is particularly important when multiple sample depths are collected from the same push. It is also important to maintain proper orientation to define precisely what depth an aliquot was collected from. Maintaining proper orientation is typically accomplished using vinyl end caps. Convention is to place red caps on the top of liner and black caps on the bottom to maintain the proper sample orientation. Orientation can also be indicated by marking on the exterior of the liner with a permanent marker.

Backhoes

Backhoes may be utilized in the collection of shallow subsurface soil samples. Samples may be collected directly from the bucket, or the trench wall (subject to applicable safety procedures). The bucket must be free of rust, grease, and paint. Only soil which has not been in contact with the bucket may be sampled, unless the bucket has been decontaminated.

Trenches offer the capability of collecting samples from very specific intervals and allow visual correlation with vertically and horizontally adjacent material. The sample should be collected without entering the trench itself, if possible. To collect the sample without entering the trench, use a stainless steel scoop attached to rigid electrical conduit with a scoop bracket to "dress" (remove surface layer of soil smeared on the trench wall as the bucket passed) the wall of the trench. Replace the scoop with a decontaminated scoop. Collect the soil. The collected soil is placed in a pan, thoroughly mixed and placed in the appropriate sample container(s). Section 4.0 contains specific procedures for collecting and handling soil samples for VOCs analysis.

4.0 SOIL/SEDIMENT SAMPLING METHOD (METHOD 5035)

The following sampling protocol is recommended for site investigators assessing the extent of volatile organic compounds in soils and sediments at a project site. Because of the large number of options available, careful coordination between field and laboratory personnel is needed. The specific sampling containers and sampling tools required will depend upon the detection levels and intended data use. Once this information has been established, selection of the appropriate sampling procedure and preservation method best applicable to the investigation can be made.

4.1 Equipment

Once the soil\sediment has been obtained, the EnCore™ VOC sampler, syringes, stainless steel spatula, standard 2-oz. soil VOC container, or pre-prepared 40-mL vials may be used/required for subsampling collection. The specific sample containers and the sampling tools required will depend upon the data quality objectives established for the site or sampling investigation. The various methods are described below.

4.2 Sampling Methodology – Low Concentrations

When total VOC concentrations in the soil/sediment are expected to be less than 200 µg/kg, the samples may be collected directly with the EnCore™ sampler or syringe. If using the syringes, the sample must be placed in the sample container (40-ml pre-prepared vial) immediately to reduce volatilization losses. The 40-ml vials should contain 10 ml of organic free water for an unpreserved sample or approximately 10 ml of organic free water and a preservative. It is recommended that the 40-ml vials be prepared and weighed by the laboratory (commercial sources are available which supply preserved and tared vials). When sampling directly with the EnCore™ sampler, the vial must be immediately capped.

A soil/sediment sample for VOC analysis may also be collected with conventional sampling equipment. A sample collected in this fashion must either be placed in the final sample container (EnCore™ or 40-ml pre-prepared vial) immediately or the sample may be immediately placed into an intermediate sample container with no head space. If an intermediate container (usually 2-oz. soil jar) is used, the sample must be transferred to the final sample container (EnCore™ or 40-ml pre-prepared vial) as soon as possible not to exceed 30 minutes.

NOTE: After collection of the sample into either the EnCore™ Sampler or other container, the sample must immediately be stored in an ice chest and cooled.

Soil\sediment samples may be prepared for shipping and analysis as follows:

EnCore™ Sampler - the sample may simply be capped, locked and secured in a plastic bag.

Syringe - Add about 3.7 cc (approximately 5 grams) of sample material to 40-ml pre-prepared containers. Secure the containers in a plastic bag. Do not use a custody seals on the container, place the custody seal on the plastic bag. Note: When using the syringes, it is important that no air is allowed to become trapped behind the sample prior to extrusion, as this will adversely affect the sample.

Stainless Steel Laboratory Spatulas - Add between 4.5 and 5.5 grams (approximate) of sample material to 40-ml containers. Secure the containers in a plastic bag. Do not use a custody seal on the container, place the custody seal on the plastic bag.

4.3 Sampling Methodology – High Concentrations

Based upon the data quality objectives and the detection level requirements, this high level method may also be used. Specifically, the sample may be packed into a single 2-oz. glass container with a screw cap and septum seal. The sample container must be filled quickly and completely to eliminate head space. Soils\sediments containing high total VOC concentrations may also be collected as described in Section 4.2, and preserved using 10-ml methanol.

4.4 Special Techniques and Considerations

The following is the standard procedure for field cleaning augers, drill stems, rods, tools, and associated equipment. This procedure does not apply to well casings, well screens, or split-spoon samplers used to obtain samples for chemical analyses, which should be cleaned as outlined in Section 2.3.

Effervescence

If low concentration samples effervesce from contact with the acid preservative, then either a test for effervescence must be performed prior to sampling, or the investigators must be prepared to collect each sample both preserved or unpreserved as needed, or all samples must be collected unpreserved.

To check for effervescence, collect a test sample and add to a pre-preserved vial. If preservation (acidification) of the sample results in effervescence (rapid formation of bubbles) then preservation by acidification is not acceptable, and the sample must be collected unpreserved.

If effervescence occurs and only pre-preserved sample vials are available, the preservative solution may placed into an appropriate hazardous waste container and the vials triple rinsed with organic free water. An appropriate amount of organic free water, equal to the amount of preservative solution, should be placed into the vial. The sample may then be collected as an unpreserved sample. Note that the amount of organic free water placed into the vials will have to be accurately measured.

Sample Size

While this method is an improvement over earlier ones, field investigators must be aware of an inherent limitation. Because of the extremely small sample size, sample representativeness for VOCs may be reduced compared to samples with larger volumes collected for other constituents. The sampling design and objectives of the investigation should take this into consideration.

Holding Times

Field investigators should note that the holding time for an unpreserved VOC soil/sediment sample is 48 hours. Arrangements should be made to ship the soil/sediment VOC samples to the laboratory by overnight delivery the day they are collected so the laboratory may preserve and\or analyze the sample within 48 hours of collection.

4.5 Summary

The following summary table lists the options available for compliance with SW846 Method 5035. The advantages and disadvantages are noted for each option. SESD's goal is to minimize the use of hazardous material (methanol and sodium bisulfate) and minimize the generation of hazardous waste during sample collection.

Option	Procedure	Advantages	Disadvantages
1	Collect 2 – 40-mL vials with ~5 grams of sample and 1 – 2 oz., glass w/septum lid for screening and % moisture.	Screening conducted by lab.	Presently, a 48-hour holding time for unpreserved samples.
2	Collect 3 Encore™; and 1 – 2 oz., glass w/septum lid for screening and % moisture.	Lab conducts all preservation/preparation procedures.	Presently, a 48-hour holding time for preparation of samples
3	Collect 2 – 40-mL vials with 5 grams of sample and preserve w/methanol or sodium bisulfate and 1 – 2 oz., glass w/septum lid for screening and % moisture.	High-level VOC samples may be composited. Longer holding time.	Hazardous materials used in field.
4	Collect 1 – 2 oz., glass w/septum lid for analysis and % moisture.	Lab conducts all preservation/preparation procedures.	May have significant VOC loss.

Percent Moisture

Samplers must ensure that the laboratory has sufficient material to determine percent moisture in the VOC soil/sediment sample to correct the analytical results to dry weight. If other analyses requiring percent moisture determination are being performed upon the sample, these results may be used. If not, a separate sample (minimum of 2 oz.) for percent moisture determination will be required.

Safety

Methanol is a toxic and flammable liquid. Therefore, methanol must be handled with all required safety precautions related to toxic and flammable liquids. Inhalation of methanol vapors must be avoided. Vials should be opened and closed quickly during the sample preservation procedure. Methanol must be handled in a ventilated area. Use protective gloves when handling the methanol vials. Store methanol away from sources of ignition such as extreme heat or open flames. The vials of methanol should be stored in a cooler with ice at all times.

Shipping

Methanol and sodium bisulfate are considered dangerous goods, therefore shipment of samples preserved with these materials by common carrier is regulated by the U.S. Department of Transportation and the International Air Transport Association (IATA). The rules of shipment found in Title 49 of the Code of Federal Regulations (49 CFR parts 171 to 179) and the current edition of the IATA Dangerous Goods Regulations must be followed when shipping methanol and sodium bisulfate. Consult the above documents or the carrier for additional information. Shipment of the quantities of methanol and sodium bisulfate used for sample preservation falls under the exemption for small quantities. A summary of the requirements for shipping samples follows. Refer to the code for a complete review of the requirements.

1. The maximum volume of methanol or sodium bisulfate in a sample container is limited to 30 mls.

2. The sample container must not be full of methanol.

3. The sample container must be stored upright and have the lid held securely in place. Note that the mechanism used to hold the cap in place must be able to be completely removed so weight is not added to the sample container, as specified in Method 5035.

4. Sample containers must be packed in a sorbent material capable of absorbing spills from leaks or breakage of the sample containers.

5. The maximum sample shuttle weight must not exceed 64 pounds.

6. The maximum volume of methanol or sodium bisulfate per shipping container is 500 mls.

7. The shipper must mark the sample shuttle in accordance with shipping dangerous goods in acceptable quantities.

8. The package must not be opened or altered until no longer in commerce.

1.0 PURPOSE

This Standard Operating Procedure (SOP) will be used in preparing for and executing groundwater sampling from wells. The procedures describe recommended methods for obtaining representative groundwater samples for organic, inorganic, other general chemistry parameters. This SOP is based on U.S. EPA and other guidelines and is intended to provide general procedures. Any exceptions are to be documented in the Site Quality Assurance Project Plan (QAPP) and Sampling and Analysis Plan (SAP).

This SOP addresses the three major phases for the implementation of a field groundwater sampling program: pre-field or office activities; on-site purging and sampling activities; and post-sampling activities. Each phase is addressed, herein, first by briefly describing the general tasks that must be considered and then by detailing procedures to be followed in implementing each phase.

2.0 PRE-FIELD/OFFICE ACTIVITIES

2.1 Summary of Tasks to be Performed

To aid in the preparation of a field sampling event, a site-specific Pre-Field Check List for Sampling Activities and an equipment checklist are used. It is the responsibility of the Field Team Leader to ensure that all items on the checklist are completed in a timely manner before the sampling event occurs. Verifying completion of the tasks will be documented by the Field Team Leader or their designee by initialing in the space provided on the equipment checklist.

2.2 Office Activities Procedures

2.2.1 Analytical Laboratory(ies)

Notification of the analytical laboratory(ies) of the sampling event and anticipated schedule is performed by the Project Manager. However, verification should be completed by the Field Team Leader. The Project Manager will complete an analytical request that specifies the project name, schedule, laboratory, sample locations, matrix, number of samples, analytical parameters, quality assurance/quality control (QA/QC) requirements and frequency, and sample bottle delivery location. Any quality assurance samples requiring laboratory-grade water will be specified. The analytical request form will then be submitted to the laboratory and the Field Team Leader.

To ensure analyses occur within the requisite holding times, the Project Manager is to coordinate with the laboratory to schedule sample receipt, which allows scheduling of field sampling activities, sample shipment and delivery. The Project Manager should also determine the frequency of submittal of laboratory-required QA samples, such as matrix spike and matrix spike duplicate samples.

2.2.2 Notification of Facility and Regulatory Agency Personnel

Prior to each sampling event, the appropriate client contact and appropriate regulatory personnel, if any, will be notified in writing of the proposed sampling date by the Project Manager. This notification is to allow scheduling of sampling oversight and any coordination with plant operations.

2.2.3 Project-Specific Plans

Prior to initiating sampling activities, it is the responsibility of all field personnel to review the project-specific Health and Safety Plan, Work Plan, Analytical Request Form and pertinent SOPs to ensure that the objectives of the groundwater monitoring and sampling program are attained in a safe and timely manner. Groundwater sampling personnel should have access to a map showing well locations, and confirm access to well locations (i.e., access agreements, keys to well locations, etc.)

The field team leader should determine the methods for handling the investigation derived waste (IDW) generated and, as necessary, procure appropriate containers for purge water.

The project-specific work plan will dictate the QA/QC samples that are needed. The QA/QC samples most often included in groundwater sampling programs are described in Section 3.8.

2.2.4 Sample Bottles and Shipping Containers

The number, type, and size of bottles are determined based on the scope of work. The laboratory performing the analyses will provide and ship bottles to the site or other designated location. The laboratory will also provide the appropriate type and amount of preservatives for the analyses to be performed, and laboratory-grade water, as specified in the analytical request. The laboratory is to provide an extra bottle allowance for breakage or additional sampling. The appropriate QA/QC sample bottles should also be included.

2.2.5 Assemble Sampling Equipment

The appropriate quantity and type of equipment will be determined from the project work plan. The field team leader and technicians will perform the function of preparing and checking the equipment. The completed equipment checklist and Pre-Field Check List for Sampling Activities should be reviewed by the Field Team Leader.

The calibration of meters will be performed prior to use in the field. Once in the field, the meters will be recalibrated. Section 3.2 contains general information regarding instrument calibration.

3.0 ON-SITE ACTIVITIES

3.1 Summary of Tasks to be Performed

The procedures for groundwater sampling are presented herein. The tasks highlighted in this section include:

- Meter calibration,
- Water level measurement procedures,
- Well purging procedures,
- Groundwater sampling procedures,
- Filtering procedures,
- Field QA/C requirements,

- Documentation, and
- Safety precautions.

During well purging and sampling activities, there are several basic procedures which must be completed for quality assurance purposes.

- New sampling gloves should be worn at each well location;
- Wells should be sampled in the order of least impacted to most impacted, starting with upgradient wells; and
- Equipment cleanliness should be maintained and if necessary, a new sheet of plastic surrounding or to the side of the well may be used to eliminate equipment contamination from the ground surface.

3.2 Calibration of Meters

At a minimum, temperature, specific conductance, and pH will be measured during and at the completion of well purging. Since stabilization of these groundwater indicator parameters is often used to evaluate the adequacy of the purging procedure, properly calibrated equipment is essential to collect valid data.

3.2.1 Specific Conductance Meter

Conductivity is defined as the ability to conduct or transmit an electrical current. Most specific conductance meters use a conductivity bridge where a voltage is applied, and the current is measured. Conductivity units are measured in micromhos per centimeter (umhos/cm) or microsiemens per centimeter (uS/cm) at 25°C. Results are reported to the nearest ten (10) units for readings less than 1,000 umhos/cm at 25°C and to the nearest one hundreds (100) units for readings greater than 1,000 umhos/cm at 25°C. All calibration information is recorded in the site-specific field logbook. Calibration of the specific conductance (conductivity) meter is to be conducted in accordance with the owner's manual at the beginning of the day and at the end of the daily sampling.

3.2.2 pH Meter

The pH is defined as the negative logarithm of the effective hydrogen ion concentration or hydrogen ion activity in gram equivalents per liter on a scale which ranges from 0 to 14, with 7 representing neutrality. The pH meter is to be equipped with automatic temperature compensation. The meter may also have the capability of measuring ORP. All calibration information is to be recorded in the site-specific field logbooks. Units: Units of pH are Standard Units (SU) and should be read in one-hundredth (0.01) of a unit.

The calibration of the pH meter is to be conducted on a daily basis in the field. At the beginning and end of the day, the meter is to be checked against three standard buffer solutions that span the pH range (e.g., 4.0, 7.0, and 10.0). While in the field, the meter is to be periodically checked against one or more buffer solutions, as necessary. The pH meter is to be prepared and used in accordance with the owner's manual.

3.3 Water Level Measurement

Water levels in monitoring wells must be measured before the wells are purged and sampled. Several methods may be used when measuring the water levels in wells. Regardless of the method of water level measurement, the upgradient well(s) should be measured prior to the downgradient. When performed in conjunction with decontaminating the measuring device between wells, the potential for cross contamination will be further reduced. Protective gloves are to be worn during water level measurements.

All in-well measurements (depth to water, total well depth) levels are referenced from a surveyed point at the top of each well casing and measured to an accuracy of .01 feet.

The following methods will obtain accurate water level and depth measurements, and will also minimize the chance of cross contamination.

3.3.1 Electronic Water Level Indicator

This instrument consists of a spool of dual conductor wire, with a probe attached at one end of the wire, and an indicator containing a low voltage electrical source at the other end. The wire is typically sheathed with a graduated measuring tape marked on the tap cover. When the probe comes in contact with water, an electronic circuit is closed, which is indicated by a tone and/or light in the indicator. The total depth of any well measured using a water level indicator should be corrected for any length of the probe that extends below the probe's circuit bridge. All measurements should be recorded to one-hundredth (0.01) of a foot.

Use of electronic water level indicators should be limited to those wells not containing hydrocarbon liquids. The electronic water level indicator can generally be used at most well locations. Groundwater at some locations may have low concentrations of dissolved ions that do not conduct the electrical current emitted by the probe.

The procedures for using an electronic water level indicator are as follows:

1. Lower the weighted probe into the well casing. When the probe contacts water, a tone will be heard. Observe the calibrated tape to determine the water level.

2. Measure and record the reading to the nearest 0.01 foot.

3. Continue to lower the probe into the well casing to determine the total depth of the well, if needed. The measurement is typically accomplished by determining the point where tension is felt on the tape when raising the probe from resting on the bottom of the well. Measure and record total depth.

4. Decontaminate the probe and submerged portion of tape between each well by rinsing with distilled water and wiping the line with a clean cloth.

3.3.2 Interface Probe

Oil/water interface probes are commonly used to detect the presence of any floating or sinking non-aqueous phase liquid (NAPL) layers as well as the water levels inside well. An interface probe typically used an optical sensor to determine when the probe is in NAPL and a conductivity sensor to determine when the probe is submerged in water. Each phase may be measured separately.

When highly volatile vapors may be present, an interface probe with a grounding clamp should be used.

The procedures for using an interface probe are listed below:

1. The probe should be lowered slowly inside each well. If water is detected, the probe will sound a tone (beeping) to signify the beginning of the water level.

   When a floating layer is encountered, a different (continuous) tone sounds. After recording the depth of the top of the floating NAPL, continue lowering the probe (observing the calibrated tape) until the steady tone stops at the LNAPL/water interface. Record this depth. The measurements on the drop line between when the steady tone began and when it stopped will determine the thickness of the NAPL layer.

2. The procedure as described above can also be used to determine the presence (and thickness) of dense (sinking) NAPL layers, except that the bottom of the well will indicate the bottom of the layer.

3. All measurements should be recorded to the nearest one hundredth (0.01) of a foot.

4. The probe is decontaminated between each well by rinsing with distilled water, or hexane if NAPL layers are present, and then wiping with a clean cloth.

3.4 Well Purging

Monitoring wells are purged of water contained in the well prior to sample collection to assure collection of groundwater samples representative of actual water-bearing zone conditions. Two methods for determining adequacy of purging are provided below.

3.4.1 Conventional Well Purging

Using conventional well purging methods, it is typically required that wells be purged of a minimum of three well volumes until a maximum of five well volumes of standing water has been removed or until the pH, conductivity, and temperature of the purge water stabilizes. A combination of these methods is typically used, where increments of well volumes are monitored for stabilization.

The flow rate of pumps used for purging should be able to be regulated and maintained at a low rate to avoid causing turbidity in samples. The rate of pumping during purging should be less than the rate used for development. Similarly, the use of a bailer during purging should not cause turbidity, and not allowed to drop to the water surface. Attempts should be made to avoid purging wells to dryness. This can be accomplished by pumping at a low flow rate. If a well is pumped dry, water than enters the well in an evacuated condition may cascade across the well screen and reduce volatile organic compound (VOC) concentrations and/or introduce fine particles into the water column.

In some situations, even with low flow rates, a well will be pumped or bailed dry (i.e., low yield bedrock wells or low permeability sediments). In these situations, this generally constitutes an adequate purge and wells can be sampled following sufficient recovery (i.e., sufficient volume to fill all sample containers). It is not necessary to purge three well volumes. The pH, temperature, and specific conductance should be measured during the collection of the sample from the recovered volume as the measurements of record for the sampling event.

To calculate the amount of water to purge from each well, the depth of standing water must be measured. In addition, the well casing diameter and screen length of each well must be known. This information, along with the following appropriate formulas, is used to determine the volume to be purged from each well.

The following formula may be used to determine the volume of any well:

$$V = 5.875 \times C^2 \times H$$

where: V = volume in gallons
C = casing diameter, in feet
H = height of water column, in feet

Using this formula, the volume per linear foot of well casing of common casing sizes is listed below:

Casing Diameter (inches)	Volume per Linear Foot (gallons)
1.5"	0.092
2.0"	0.163
4.0"	0.563
6.0"	1.469

The minimum purge volume required is three times the standing water volume in the well. Between the purging of three to five well volumes, groundwater purge parameters (pH, specific conductance, and temperature) are measured to determine whether adequate purging has occurred through stabilization of purge parameters. Stabilization monitoring should occur during purging at regular intervals of the standing water volume. As a general criteria, three successive readings should be within ±0.1 for pH and ±3% for conductivity.

To verify the removal of the required water volume during purging, a graduated bucket is used to measure flow rate during pumping or purge water volume. Purge water will be contained as IDW for proper disposal.

3.4.2 Low-Flow Purging and Sampling

The low-flow purging method is an alternative to the conventional method of purging multiple well volumes. Low-flow purging focuses on pumping a monitoring well from the well's screen interval at a flow rate that is less than the recharge capacity of the formation. The rate of pumping is generally specific to the water-bearing unit, but typically does not exceed one liter per minute (or equivalently, 0.26 gallons per minute). By purging at low flow rates, only groundwater that enters through the well screen is purged from the well. Because stagnant water located above the pump intake is not drawn down into the pump, the casing volume would not have to be purged from the well prior to sampling.

Groundwater samples are generally collected during low-flow purging as soon as formation water is determined to be flowing from the well. Therefore, it is important to recognize the difference between stagnant water from casing storage and recharged formation water. The volume of water purged from a well is solely dependent on formation water stabilization rather than predetermined well volumes. Low-flow purging can significantly reduce the volume of water removed during sampling.

Objective

The overall objective of low-flow purging is to match the purging device intake velocity with the natural groundwater velocity and thereby reduce sample disturbance. This is most easily evaluated by monitoring drawdown in the well and adjusting flow rate to minimize or eliminate that drawdown. Research has shown that purging with various types of pumps (peristaltic, low-speed submersibles, and bladder pumps) does produce low turbidity and high-quality samples (Puls and Barcelona, 1989, Puls et al., 1992; Backhus et al., 1993; Barcelona et al., 1994).

With low-flow purging, the purge volume or purge duration is evaluated through continuous monitoring of water quality parameters, such as specific conductance, oxidation-reduction (redox) potential, dissolved oxygen, pH and turbidity. Upon equilibration of these parameters, it is assumed that formation water is being accessed and sampling can be initiated.

Since the low-flow purging method is based on minimal disturbance, the total depth of the well should be measured after completion of groundwater sampling.

Procedures

All equipment cleanliness should be maintained and, if necessary, should be laid on clean plastic sheeting placed around or beside the well. The pump or tubing connected to a peristaltic pump is set with the intake at the mid-point of the screen interval, preferable in advance of the sampling event at the well.

Upon initiation of pumping, the flow rate is to be measured using an appropriate graduated container, preferably one-liter or one-quart. The flow rate should be adjusted to approximately one liter per minute. The water level should be checked periodically as a guide to flow rate adjustment. Collect the purge water as IDW.

Optimally, an in-line water quality measurement device should be used to continuously monitor groundwater quality indicator parameters. The water quality indicator parameters can include pH, ORP, specific conductance, dissolved oxygen (DO) and turbidity. The last three parameters are often most sensitive. Measurements should be taken every three to five minutes if the above suggested rate is used. Stabilization is achieved after all parameters have stabilized. Three successive readings should be within ±0.1 for pH, ±3% for conductivity, ±10 mv for ORP, and ±10% for turbidity and DO. Stabilized purge indicator parameter trends are generally obvious and follow either an asymptotic or exponential change to table valves. Dissolved oxygen and turbidity usually require the longest time for stabilization.

Upon parameter stabilization, sampling can be initiated. If an in-line device is used to monitor water quality parameters, it should be disconnected or bypassed during sample collection. Sampling flow rate may remain at the established purge rate or altered to minimize aeration, bubble formation, turbulence in sample bottles, or loss of volatile constituents due to extended residence time in tubing. Typically, flow rates less than 0.5 L/min are appropriate. The same device should be used for sampling as was used for purging. Groundwater sampling should proceed by collecting groundwater samples in appropriate containers, and preserving the samples as necessary.

3.5 Conventional Purging and Sampling Methods

Wells may be purged and sampled by either hand bailing or pumping. When possible, all samples are collected using laboratory cleaned bailers. Hand bailing for sample collection is preferred because bailers may be decontaminated more effectively than pumps. Also, degassing of volatile organic compounds may occur through the use of some types of pumps.

If NAPLs are present in the well, pumping with a peristaltic pump will be the preferred purge method. This method should reduce mixing of the NAPL within the water column. The effectiveness of peristaltic pumps is generally limited to wells with water levels less than 25 feet below the top of the casing.

3.5.1 Bailing

The following procedures describe the techniques to be used when wells are purged and samples are extracted using hand bailers.

1. If necessary to maintain equipment cleanliness, place plastic sheeting (or garbage bags) around the well casing to create a clean surface for the placement of sampling cord and equipment.

2. Use a disposable, dedicated, or new/decontaminated bailer on each well for the required purging and sampling. Each bailer will be constructed of stainless steel, Teflon, polyvinyl chloride (PVC) or high density polyethylene (HDPE)

3. Use new surgical or nitrile gloves when working at each well.

4. Use new nylon or polypropylene cord to tie to the top of the bailer. Make sure the knotted cord is securely tied.

5. After attaching the cord to the bailer, lower it into the well until it touches the bottom. It is critical that the bailer be slowly and gently immersed into the top of the water column, allowed to fill and removed.

Then remove an additional length of cord and tie it securely to the well head to serve as a safety line for the bailer.

If an NAPL layer is present, either remove the LNAPL with a bailer or see Section 3.5.2 for purging with a pump. If a sinking NAPL layer exists and pumping is not feasible, lower the bailer so as to avoid mixing of this layer within the well water column; i.e., the bailer will not be lowered into the sinking NAPL layer. If the dense NAPL is to be removed, it should be conducted after groundwater sampling is completed.

6. When raising the bailer, collect the cord on the plastic sheeting or in a plastic-lined, five-gallon bucket. Collect the purge water as IDW.

7. When Sampling for VOCs, the sample aliquot is to be removed from the bottom of the bailer through the use of a dedicated or decontaminated bottom emptying device.

8. A separate laboratory-cleaned stainless steel or Teflon bailer may be used to collect samples from each monitoring well.

   - Samples are collected when the well recharges after purging.
   - All samples are collected according to their order of volatilization.
   - All volatile organic samples will be collected with a laboratory cleaned, bottom-filling bailer in a manner which will prevent degassification of volatile organic constituents that may be present in the groundwater.

9. Preserve the samples as necessary and place them in ice chests and cool to a temperature of 4°C.

10. Before the cooler is sealed, a chain-of-custody sheet is completed for each cooler containing samples.

11. Each cooler is sealed, with chain-of-custody tape or a tag, and shipped or delivered to the laboratory for analysis.

3.5.2 Pumping

There are circumstances when pumps are more effective purging devices than bailers. It is preferable to purge wells containing NAPL layer(s) with a pump to help reduce the mixing of this material in the water column. Also, in some instances, pumps are the only means by which samples can be extracted from monitoring wells.

Several pumps which are frequently used to purge and sample wells are discussed below.

Peristaltic Pump

Peristaltic pumps must be operated above ground, next to the well being purged, and are limited to purging depths of 20 to 30 feet below ground surface. The flow rate of peristaltic pumps is typically ariable by altering the pump head speed, and may achieve flow rates of 140 to 1,700 ml/min. The following procedures are used in operating a peristaltic pump.

1. New suction line is used on each well being purged. New medical grade silicon pump head tubing will also be used if the pump is utilized for sampling.

2. If the sample is collected directly from the pump discharge, the choice of tubing used to collect the sample will be contingent on the parameters of interest.

   - Standard polyethylene tubing is sufficient to collect the sample for conventional and inorganic parameters.
   - Teflon tubing may be used to collect samples to be analyzed for volatile and/or semi-volatile parameters.

3. Lower the suction line to a depth in the water column that assures continued collection. The intake of the suction line should be placed to avoid disturbing any NAPL layer. If a floating NAPL layer is encountered, this should be either suctioned off with a pump or removed with a bailer, during purging. If a sinking NAPL layer is encountered, the suction line should be placed to avoid this layer regardless of well water drawdown. The suction-line assembly is dedicated for use on one well only. After use, the tubing is wrapped, marked, and stored for future use in the well to which it is dedicated. Otherwise, the tubing is discarded as IDW.

4. Monitor the pumping to ensure proper pump operation and assure continuous discharge. If drawdown occurs, lower the tubing deeper into the water column.

5. When the required amount of water is purged from each well, allow for sufficient recovery before sampling. If a floating NAPL was removed during purging, the suction line should be changed for sample collection.

Bladder Pumps

The bladder pump is a gas-operated positive displacement submersible well pump that uses inert compressed gas, e.g., nitrogen, to inflate an internal bladder which pumps water up to the discharge line. These pumps can be used when large volumes of water must be purged from monitoring wells or when slow purge rates are desired. Usually these pumps are used on wells with depths up to 150 feet.

The line assembly is dedicated for use on one well only. After use, the tubing is wrapped, marked, and stored for future use in the well to which it is dedicated. Otherwise, the tubing is discarded as IDW.

Bladder pumps are primarily used to remove the required amount of water from the monitoring well prior to sampling. When this is accomplished, groundwater may be sampled using the bladder pump or using a laboratory-cleaned stainless steel bailer.

1. Connect the line assembly to the pump by first attaching the cable and then connecting the water and pneumatic lines.

2. Lower the pump down the well by unrolling the line off the spool. Lower the pump to the desired position inside the well, allowing sufficient room for drawdown of the water column.

3. Secure the cable to hold the pump at the desired depth.

4. Connect the gas line to the control box. The discharge line should be placed in a container (e.g., 55-gallon drum) to collect the purged water as IDW.

5. Connect the gas supply to the control box and adjust the pressure according to the manufacturer's manual.

6. Turn on the control box and adjust the inflate delay to obtain the optimal pumping cycle.

7. The pumping rate should be calculated to determine the length of time the pump should run to purge the well. Field measurements of pH and specific conductance, or the calculation of three casing volumes may be used to determine when a sufficient amount of water has been purged.

8. When the sufficient amount of water has been purged, the well may be sampled using the bladder pump at a low flow rate or using a laboratory-cleaned stainless steel bailer.

9. As noted, the tubing is used on one well only and after each sampling it is packed, sealed, and stored for future use on that well.

Submersible Pumps

For large diameter wells or wells with depths greater than 150 feet, submersible pumps are used to purge the required amount groundwater. The submersible pumping apparatus may be removed to allow for sampling with a bailer, or the submersible pump assembly will remain intact and will be used to collect the sample. The flow rate of submersible pumps may be changed using a pump controller.

When possible, the submersible pumps will be dedicated to each well. However, this may not be economically feasible and the same pump must be used in several wells. In this instance, the pump must be decontaminated with a non-phosphate soap and water wash between each well. The pumps may be steam cleaned between well if the equipment is available.

1. Connect the pump to the discharge tubing. The discharge tubing used may be constructed of polyethylene or Teflon, depending on the analytes of interest. The submerged portion of tubing may need to be of Teflon construction.

2. The submersible pump should be lowered to a depth of approximately the middle of the screened portion of each monitoring well. The safety line should be secured to the well casing.

3. Connect the power cord to the power source (generator) and turn on the pump.

4. Monitor the pumping rate and lower the line if drawdown of the water column occurs.

5. If the well is pumped dry, allow sufficient time for the well to recover prior to sample collection.

3.6 Sample Collection

Groundwater samples should be decanted from the sample collection device (bailer or tubing) directly into the appropriate sample container. Samples are to be collected in order of volatilization and preserved. New surgical gloves, or the equivalent, must be worn for each well location.

3.7 Sample Filtration

Filtering will not be performed on samples to be analyzed for organics. Specific project filtering requirements will be outlined in the project work plan.

Filtering will be performed using peristaltic pumps with disposable 0.45 micron filters and disposable tubing. After filtering, samples requiring preservation are preserved and all containers are securely placed in coolers and chilled to a temperature of 4 ±2 degrees Celsius (^{o}C).

3.8 Quality Assurance/Quality Control Samples

Field Quality Assurance samples are an integral part of a groundwater sampling event. Sample integrity is verified by collecting duplicate analysis and blank samples (trip and equipment). The following samples will be addressed as required by the associated QAPP:

Trip Blanks:

A trip blank consists of sample bottles (40-ml vials) filled with laboratory-grade water. Trip blanks are transported to and returned from the sampling location and delivered to the lab in the same manner as containers used for the field samples. At no time are trip blanks to be opened.

Trip blanks are generally analyzed for volatile organic constituents only; however, the project work plan should be reviewed to ensure trip blanks are not required for other analyses. Constituents found in the trip blank could be attributed to:

1. Interaction between the sample and the container,
2. Contamination in the laboratory water, or
3. Handling procedures that alter the sample analysis results.

Equipment Blanks:

Equipment blanks are intended to ensure that the sampling devices have been appropriately cleaned (in the lab or field). To prepare an equipment blank, the sampling device should be filled with distilled water (or water poured through or over), then poured (or transferred) into the containers and delivered to the laboratory for analysis. The project-specific work plan or field sampling plan will dictate the frequency of equipment blank samples and the analyses to be performed.

Field Duplicates:

Field Duplicates are intended to ensure that the sampling procedures result in consistent and repeatable laboratory analysis results. A field duplicate is a sample collected by the same team or by another sampler or team at the same place, at the same time, using the same equipment, the same type of bottles, the same preservatives, and the same shipping protocol. It is used to estimate sampling and laboratory analysis precision. The project-specific work plan or field sampling plan will dictate the frequency of duplicate samples and the analyses to be performed.

3.9 Documentation

A number of documents must be completed before, during, and after each sampling project. These documents include: field logbooks, site data sheet forms, chain-of-custody sheets, field data sheets, and any project notes pertaining to the sampling work. Additional documents are used as reference information during each phase of a project and they include: holding time sheets, and sample preservation and containment sheets.

Site Data Sheets

The site data sheet is completed by the project manager or project engineer/scientist and submitted to the sampling team when requesting sampling work. These sheets contain the specific parameters of interest for which the collected samples will be analyzed. The project manager or field team coordinator must send the site data sheet to the laboratory to obtain the appropriate sample containers.

Field Logbook

A site-specific logbook will be used for documentation while in the field for all notes. It is recommended that each page of the logbook be numbered and dated. The entries should be legible and contain accurate and inclusive and should include, at a minimum, the following information:

- Identification of logbook ownership on the inside front cover, and telephone number.
- Site name and location .
- Names of field personnel at the site, including daily safety meeting.
- Weather information (general).
- Sample locations and activities.
- Sample collection equipment;
- Calculations, results, and calibration data from field sampling equipment, field analytical equipment, and field physical parameters.
- Date, time, and method of monitoring well purging.
- Date, time, and method of groundwater sampling.
- Diameter of wells.
- Total depth of wells (to 0.01 feet).
- Distance to water in each well (to 0.01 feet) and volume of standing water in each well.
- Detection/amount of product in each well, if any.
- Water quality measurements (field) measured in increments during well volume purging, including, but not limited to: pH, specific conductance, and water temperature.
- Visual observations of the purge/sample water (i.e., turbidity, color).

- Observations of well integrity (i.e., conditions of casing, lid, pad, or lock).
- Collection of field quality assurance samples (i.e., blanks, split samples, or duplicates).
- Maps or sketches of sample locations.
- Regulatory agency personnel observing sampling or obtaining split samples.
- Documentation of sample shipment dates, time, and carrier tracking (air bill) number.
- Photograph information, including date and time, and brief description of what the photograph is intended to show.

Chain-of-Custody Forms

Chain-of-custody forms will accompany all samples shipped to the laboratory. This form contains information pertaining to the samples, such as: the project name; the signature of the people collecting the samples; the site of collection; the date and time of collection; the parameters of interest for each sample; remarks or observations of samples, if appropriate; the signature of the person relinquishing control of the samples; and the name of the carrier shipping the samples to the laboratory (e.g., Federal Express, UPS, etc.). The original chain-of-custody sheet is sent with the samples, and at least one copy is retained for the project files.

4.0 POST-SAMPLING ACTIVITIES

4.1 Summary of Post-Sampling Activities

The post-sampling activities involve:

- Completion of Field Data Sheets from the Field Notes,
- Completing the Trip Report, and
- Updating the Site-Specific Field Sampling Manual (as necessary).

4.1.1 Trip Report

The Field Team Leader is responsible for a brief summary of the sampling event, prepared to serve as a cover page for all project-specific data, such as:

- Field notes,
- Chain-of-custody sheets, and
- Other pertinent information, as necessary.

The Field Team Leader is responsible for submitting the Trip Report to the Project Manager, Geologist/Engineer, and other pertinent team members upon completion of the sampling event.

4.1.2 Site-Specific Field Sampling Manual

Any new site-specific considerations that need to be updated, to account for equipment/bottle/procedures changes (i.e., a well is damaged and must be sampled with a pump, etc.), will be adjusted in the site-specific manual.

1.0 PURPOSE AND APPLICABILITY

This Standard Operating Procedure (SOP) details the procedures associated with the packaging and shipping of groundwater, surface water, soil, and waste samples. The purpose of this SOP is to identify general procedures to minimize sample loss through breakage, spillage, or leakage.

Based on EPA regulations 40 CFR Sec. 261.4(d), samples collected for the sole purpose of testing are exempt from RCRA regulations when one of the following conditions are applicable:

- Samples are being transported to a laboratory for analysis;
- Samples are being transported to the collector from the laboratory after analysis; or,
- Samples are being stored (I) by the collector prior to shipment for analysis, (ii) by the analytical laboratory prior to analysis, or (iii) by the analytical laboratory after testing but prior to return of sample to the collector or pending the conclusion of a court case.

Samples collected during field investigations or in response to a hazardous materials incident must be classified prior to shipment, as either environmental or hazardous materials samples. In general, environmental samples include drinking water, most groundwater and ambient surface water, soil, sediment, treated municipal and industrial wastewater effluent, biological specimens, or any samples not expected to be contaminated with high levels of hazardous materials.

Samples collected from process wastewater streams, drums, bulk storage tanks, soil, sediment, or water samples from areas suspected of being highly contaminated may require shipment as dangerous goods. Regulations for packing, marking, labeling, and shipping of dangerous goods by air transport are promulgated by the International Air Transport Authority (IATA).

2.0 RESPONSIBILITIES

It is the responsibility of the field team leader or his designee to assure that the proper sample packaging and shipping procedures are implemented.

3.0 REQUIRED MATERIALS

- Shipping containers; e.g., cardboard boxes, ice chests;
- Shipping labels and chain-of-custody forms;
- Packing tape;
- Chain-of-custody tape or tags;
- Packing material; e.g., styrofoam, vermiculite;
- Ice, cold packs or other suitable cooling agents; and
- Marking pens.

4.0 SAFETY PRECAUTIONS

No specific safety precautions are necessary; however, all personnel must recognize and adhere to health and safety policies governing the handling of potentially hazardous materials and when lifting sample packages.

5.0 PROCEDURE

5.1 Shipment of Environmental Laboratory Samples

Guidance for the shipment of environmental laboratory samples is provided in a memorandum dated March 6, 1981, subject "Final National Guidance Package for Compliance with Department of Transportation Regulations in the Shipment of Laboratory Samples" (3). By this memorandum, the shipment of the following unpreserved samples is not regulated:

- Drinking water
- Treated effluent
- Biological specimens
- Sediment
- Water treatment plant sludge
- POTW sludge

In addition, the shipment of the following preserved samples is not regulated, provided the amount of preservative used does not exceed the amounts found in 40 CFR 136.3(4). It is the shipper's (individual signing the air waybill) responsibility to ensure that proper amounts of preservative are used:

- Drinking water
- Ambient water
- Treated effluent
- Biological specimens
- Sediment
- Wastewater treatment plant sludge
- Water treatment plant sludge

Samples determined by the project leader to be in these categories are to be shipped using the following protocol, developed jointly between U.S. EPA, OSHA, and DOT. This procedure is documented in the "Final National Guidance Package for Compliance with Department of Transportation Regulations in the Shipment of Environmental Laboratory Samples."

Untreated wastewater and sludge from POTWs are considered to be "diagnostic specimens" (not environmental laboratory samples). However, because they are not considered to be etiologic agents (infectious), they are not restricted and may be shipped using the procedures outlined below.

Environmental samples should be packed prior to shipment by air using the following procedures:

1. Allow sufficient headspace (ullage) in all bottles (except VOC containers with a septum seal) to compensate for any pressure and temperature changes (approximately 10 percent of the volume of the container).

2. Be sure the lids on all bottles are tight (will not leak).

3. Place bottles in separate and appropriately sized polyethylene bags and seal the bags with tape (preferably plastic electrical tape), or separate each sample container with plastic-bubble wrap matting or other suitable material.

4. Select a sturdy cooler in good repair. Place plastic-bubble wrap matting or other suitable material on bottom and in corners.

5. Place sample containers upright in ice chest and, if necessary, complete chain-of-custody form(s) for samples contained in each packaged cooler.

6. Place suitable packaging material throughout the voids in the ice chest to restrict sample container movement.

7. Secure and tape the drain plug with fiber or duct tape.

8. Place "blue ice" or ice that has been "double bagged" in heavy duty polyethylene bags and properly sealed on top of and/or between the samples. The purpose of this is to reduce free water in the ice chests. Fill all remaining space between the bottles with vermiculite or other suitable material to completely fill the ice chest.

9. Place the Chain-of-Custody Record into a plastic bag, and tape the bag to the inner side of the cooler lid.

10. Close the cooler and securely tape (preferably with fiber tape) the top of the cooler shut. Chain-of-custody seals should be affixed to the top and sides of the cooler within the securing tape so that the cooler cannot be opened without breaking the seal.

11. Shipping containers must be marked "THIS END UP," and arrow labels which indicate the proper upward position of the container should be affixed to the container. A label containing the name and address of the shipper should be placed on the outside of the container. Labels used in the shipment of hazardous materials (e.g., Cargo Only Aircraft, Flammable Solids, etc.) are not permitted to be on the outside of containers used to transport environmental samples.

12. Use air-express overnight delivery service if immediate sample delivery to the laboratory is required and samples cannot be hand delivered to the laboratory.

5.2 Shipment of Dangerous Goods

The field team leader is responsible for determining if samples collected during a specific field investigation meet the definitions for dangerous goods. If a sample is collected of a material that is listed in the Dangerous Goods List, Section 4.2, IATA, then that sample must be identified, packaged, marked, labeled, and shipped according to the instructions given for that material. If the composition of the collected sample(s) is unknown, and the project leader knows or suspects that it is a regulated material (dangerous goods), the sample may not be offered for air transport. If the composition and properties of the waste sample or highly contaminated soil, sediment, or water sample are unknown, or only partially known, the sample may not be offered for air transport.

In addition, the shipment of pre-preserved sample containers or bottles of preservatives (e.g., NaOH pellets, HCL, etc.) which are designated as dangerous goods by IATA is regulated.

6.0 DOCUMENTATION

Completed chain-of-custody records should contain shipping information, including the carrier airbill number. Obtain copies of shipment records from all handlers/couriers of sample packages. This documentation will be maintained in the project file.

7.0 REFERENCES

IATA, 1995. Dangerous Goods Regulations, International Air Transport Authority (IATA). 31st Edition, Effective January 1, 1995.

U.S. EPA, 1984. Characterization of Hazardous Waste Sites, a Methods Manual. Volume 2. 2nd ed. EPA-600/4-84-076.

U.S. EPA, 1981. "Final Regulation Package for Compliance with DOT Regulations in the Shipment of Environmental Laboratory Samples." Memo from David Weitzman, Work Group Chairman, Office of Occupational Health and Safety (PM-273), U.S. EPA, April 13, 1981.

40 CFR 136.3. July 1, 1994. Table 11, Footnote 3.

1.0 PURPOSE AND APPLICABILITY

This Standard Operating Procedure (SOP) details the specific procedures to be employed to document possession/custody of samples, (i.e., groundwater, surface water, stormwater runoff, plant discharge water, soils, etc.) from the time of collection through arrival at the receiving laboratory for analysis. At this point, internal laboratory records should document sample custody until its final disposition. This SOP also discusses sample identification and the use of chain-of-custody forms.

Chain-of-custody procedures are comprised of the following elements: 1) maintaining sample custody and 2) documentation of samples for evidence. To document chain-of-custody, an accurate record must be maintained to trace the possession of each sample from the moment of collection to its introduction into evidence.

A sample or other physical evidence is in custody if:

- it is in the actual possession of an investigator;
- it is in the view of an investigator, after being in their physical possession;
- it was in the physical possession of an investigator and then they secured it to prevent tampering; and/or
- it is placed in a designated secure area.

2.0 RESPONSIBILITIES

The site coordinator (field team leader) or his/her designee is responsible for ensuring that sample labeling is completed in accordance with this SOP and that chain-of-custody forms are completed for sample shipments. All individuals relinquishing and receiving samples shall sign, date, and record the time on the chain-of-custody forms.

3.0 REQUIRED MATERIALS

- Chain-of-custody, and
- Field logbook.

4.0 SAFETY PRECAUTIONS

No specific safety precautions are needed for this procedure. All sample jars should be handled using gloves.

5.0 PROCEDURE

5.1 Sample Identification

A label will be affixed to each sample container. Each sample will be identified with a label which is waterproof. The label shall contain the following information:

1. Site name.

2. Sample designation, as indicated in site-specific field sampling and analysis plan or work plan.

3. Date – six digit number; e.g., 06/12/05.

4. Time – four digit number; e.g., 0954 for 9:54 a.m.; 1629 for 4:29 p.m.

5. Sample analyses to be completed.

6. Preservatives.

5.2 Chain-of-Custody Forms

Once the samples have been properly labeled, they will be readied for shipment to the receiving laboratory. Boxes, coolers, etc. containing samples will be accomplished by a chain-of-custody form. The following procedures shall then be used:

1. The field team leader or his/her designee shall complete a chain-of-custody form for each packages lot of samples (e.g., box, cooler). The following information should be recorded on the form:

    - Sample site/location;
    - Sampling date and time;
    - Sampler's name;
    - Sample identification;
    - Sample description, e.g., surface water, solid waste;
    - Analyses to be performed on sample(s);
    - Total number of sample containers per sample location;
    - Number of sample containers per each analysis; and
    - Name(s) and signature(s) of personnel collecting sample(s).

2. The person transporting samples to the shipment courier (e.g., airline, Federal Express, bus line) shall indicate on the chain-of-custody form (remarks box) the courier's name, date and time. Also note in the remarks box if split samples are being shipped and to what laboratory/organization. Have the courier sign the form, if possible.

3. Forward the original chain-of-custody form with each packaged lot of samples. The field team leader shall retain a copy of each form and forward them to the Project Manager or project scientist/engineer.

4. Upon receipt of the samples by the laboratory, the original chain-of-custody form should be signed and dated by the laboratory person assigned to log-in samples. In addition, the receiving laboratory should inspect each sample, particularly tape sealing of the sample and indicate condition on the form. The receiving laboratory should retain a copy of each chain-of-custody form along with the shipper's airbill.

5. Internal laboratory documentation should take control of the sample once it is logged in by the receiving laboratory.

6.0 QUALITY CONTROL

Properly executed and maintained chain-of-custody records are needed to document the validity of the sample and its analytical results, and to ensure that the sample has not been tampered with.

7.0 DOCUMENTATION

The original chain-of-custody form must be shipped with the samples and retained by the receiving laboratory. The field team leader will retain a copy of the form and provide the project scientist/engineer with a copy for central filing. The field logbook should also be used to record similar information concerning chain-of-custody and other quality assurance information.