ANNEX 4C-1

STANDARD OPERATING PROCEDURES (SOP)

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SOP-1

FIELD LOG BOOK AND FIELD SAMPLING FORMS

Pertinent field investigation and sampling information should be recorded on a daily field log book and appropriate sampling forms to provide a continual record of actions taken each day on the site. Each employee is responsible for completing a record of the day's activities in a log book and field forms of sufficient detail such that someone can reconstruct the field activities without relying on the memory of the field crew. Field Books will be bound, with consecutively numbered pages and all information must be recorded with permanent ink. If changes need to me made within the field book, a single strikethrough line will be used to mark out incorrect information. Initials of the employee making the corrections and the date of the correction must accompany the strikeout. At a minimum, daily entries on the field log book shall include, as appropriate:

Purpose

To provide guidance on how to document activities completed in the field by field personnel

Goal and Objective

To provide a record of our project work and the decisions made in the field

Equipment Needs

Sampling and Analysis Plan
Field Note Book
Field Sampling Forms
Permanent Writing Utensils
Camera

- Project and client name.
- Date, times and locations.
- Purpose of the field effort.
- Names of field crew leader and team members present on the site, and other site visitors.
- Description of site conditions and any unusual circumstances, including weather conditions.
- Details of actual work performed, particularly any deviations from the field work plan or standard operating procedures.
- Location of sample site, including map reference, if relevant.
- Field observations including documentations of conditions and procedures used when collecting, handling or treating samples.
- Field measurements made (e.g., PID readings, pH, temperature, etc.) on appropriate forms.
- Date and time of initiation and cessation of work.

Specific details for each sample collected should be recorded using standardized field forms. These field forms contain blank queries to be filled in by field personnel. Items typically recorded on field sampling forms consist of the following:

- Sample name.
- Time and date samples were collected.
- Number and type (media; natural, duplicate, QA/QC) of samples collected.
- Analysis requested.

- Sample depth.
- Sample preservative (if applicable) and volume.
- Sampling method, particularly any deviations from standard operating procedures.
- Additional field observations, including collection of field parameters.
- Decontamination procedures (if applicable).
- Photo documentation; including a photo board in the photograph with details such as date, time and location or an accompanying photo log with descriptions, dates, and times.
- Signature of sampler.

The field log book and field data sheet must be signed on a daily basis by the author of the entry. Upon completion of the field effort, the original field forms will be electronically scanned and both hard copies and electronic documents will be filed in their respective project file. Photocopies of the original field forms can be made and used as working documents.

SOP-2

EQUIPMENT DECONTAMINATION

Decontamination of field equipment is necessary to prevent cross contamination between sites to be investigated and sampling locations on a site. Decontamination should be performed on all non-dedicated and non-disposable sampling equipment that may contact potentially contaminated media.

The following should be done to decontaminate field sampling equipment:

- Set up a decontamination area, preferably upwind from your sampling area to reduce the potential for windborne contamination.
- Don disposal gloves while decontaminating equipment.
- Prior to initiating decontamination, visually inspect sampling equipment for evidence of contamination; use stiff brush to remove visible material.
- Once rough brushing is complete, decontaminate each piece of equipment following a sequential process of washing with Liquinox or an equivalent degreasing detergent; rinsing with distilled water; rinsing with 10% dilute nitric acid; and finally rinsing with distilled water three times. Best procedure is to set up wash tubs for each of the above processes.
- Rinse equipment with methanol instead of nitric acid if sampling for organic contamination.
- Decontaminated equipment that is used for sampling organics should be wrapped in aluminum foil or another inert material if not used immediately.

The following should be done for oversized equipment, such as drilling rigs:

- Determine whether rinsate generated during decontamination must be containerized. If so, establish a lined decontamination area and move equipment into this area prior to decontamination. If not, decontamination should be done far enough away from the area of sampling so that rinsate generated does not affect future anticipated samples as part of the investigation. The area should also allow for the infiltration of the rinsate into the soil.

Purpose

The purpose of this SOP is to describe general decontamination procedures for field equipment

Goal and Objective

To sufficiently clean field equipment to prevent cross contamination between sites and sample locations

Equipment Needs

Sampling and Analysis Plan

5-gallon plastic tubs/buckets

Distilled water

10% Nitric Acid rinse (if metals are COC)

10% Methanol

Liquinox Soap

Hard Bristle Brush

Garbage Bags

Disposable Gloves

Paper Towels

55-gallon drums (optional depending on need to containerize decon water)

Steam cleaning equipment/water truck

- Decontaminate tracks/wheels, drilling pipes, bits, etc. using a high pressure washer with potable water, preferably using hot potable water.

All disposable items (e.g., paper towels, latex gloves) should be deposited into a garbage bag and disposed of as Class II common refuse, unless you are investigating a site known to contain hazardous wastes. Check with the project manager before initiating investigation to confirm proper handling of disposable items. Handling and disposal procedures for the rinse and wash water will depend on the likely presence and type of contaminant in the wash water. The Sampling and Analysis Plan should be reviewed to determine the process for handling wash water.

If equipment rinse blank samples are to be collected as part of quality control procedures, they should be collected from decontaminated sampling equipment in accordance with the Sampling and Analysis Plan and documented in accordance with SOP-1.

A list of equipment for decontamination is provided above (text box). The amount of distilled water and rinse solutions needed on site will depend on the number of samples to be collected and the sampling methods. For this reason, equipment needs should be evaluated prior to going in the field.

SOP-3

SAMPLE NOMENCLATURE, DOCUMENTATION, AND CHAIN-OF CUSTODY PROCEDURES

When completing sampling it is critical that the process used to label and transport samples to the laboratory for analysis is sufficient to demonstrate with confidence that the samples were collected from the location indicated, and that during transport to the lab no actions were taken to potentially alter the integrity of the samples. Without following strict sample labeling and chain-of-custody procedures, analytical data collected at a site has little to no value.

SAMPLE NOMENCLATURE

Samples should be labeled in such a way to allow a person unfamiliar with the site to understand where the samples were collected. Samples will be named in accordance with the designation listed **Table 4C-1** in the Sampling and Analysis Plan.

Prior to initiating sampling, field personnel should familiarize themselves with the Sampling and Analysis Plan and the nomenclature to be used for the site.

Field quality assurance/quality control (QA/QC) samples for this Project include:

- *Field Duplicate* are independent samples of the same medium collected at the same time from the same location. Duplicate samples will be collected for analysis of all the same analytes as the parent sample. Duplicates are submitted for analysis "blind", meaning that they will not be identified to the laboratory as duplicate samples. The duplicate samples will be identified with a nonexistent sample location ID that is similar to, but different from the other sample location IDs at the site. All other labeling shall be identical to the investigative samples. The true identity of the duplicate samples shall be recorded in the field logbook, but not on the COC form or sample labels and tags that are sent to the laboratory.

- *Trip blanks* are required only when samples are collected for analysis of VOCs (i.e., BTEX). They are prepared from analyte-free (deionized) water by the laboratory, and are transported to the sampling site with the VOC sample bottles for the investigative sampling. They are kept with the samples throughout the sampling program and are shipped for analysis with the samples. They are not opened on site, and are designed to evaluate VOC contamination encountered within the coolers during the shipping and handling procedures. Trip blanks are prepared in 40 ml VOA vials with Teflon septum lids, and must be chilled and handled in the same manner as a water sample for VOC analysis. Two trip blank vials per each daily set of shipping containers or coolers containing VOC samples are required. Trip blanks will be analyzed for BTEX.

Purpose

To identify the specific requirements for labeling and documenting sample collection

Goal and Objective

To increase the confidence in sample locations and to submit samples to the laboratory without risk of integrity loss

Equipment Needs

Sampling and Analysis Plan

Indelible ink pen

Chain-of-custody forms

Field Log Book

Field Sampling Form

- *Equipment rinsate blanks* are obtained from the last rinse of analyte-free (deionized) water during decontamination of sample collection equipment. No extraordinary decontamination procedures will be followed when a rinsate blank is collected. The date and time of collection will be noted, as well as the ID number of the investigative sample collected just prior to decontamination, and the ID number of the next sample collected with the decontaminated equipment. If dedicated or disposable equipment is used, rinsate blanks need not be collected.

SAMPLE DOCUMENTATION

In addition to the chain-of-custody forms discussed below, field person must keep a list of samples collected in the field in the field log book and on appropriate field sampling forms. This allows you to go back and verify sample locations and numbers should there be any confusion at a later time. Upon returning to the office, the field log book and forms should be kept in the project file and subsequent copies sent to the laboratory, or other designated parties, as needed.

Each person in the field is responsible for putting entries into the field log and sampling forms. Designating an individual from the sampling team for record keeping is fine, provided all field personnel come to an agreement as to who this will be, and the field crew leader is certain field personnel are familiar with the record keeping requirements. All entries on the log book and field sampling forms must be made in indelible ink.

CHAIN OF CUSTODY PROCEDURES

A chain-of-custody form must be generated for all samples collected in the field for laboratory analysis. Samples from more than one project should not be included on the same chain of custody; however, multiple samples from a specific project can be included on the same custody form.

Copies of the chain-of-custody form should be maintained in the project file. The sampler may use the chain-of-custody form provided for in **Annex 4C-2** of the Sampling and Analysis Plan or a chain-of-custody form provided by the laboratory. Sample custody records must be maintained from the time of sample collection until the time of sample delivery to the analytical laboratory and should accompany the sample through analysis and final disposition. The information to be included on the chain-of-custody form will include, but is not limited to:

- Project number/site name
- Sampler's name and signature
- Date and time of sample collection
- Unique sample identification number or name
- Number of containers
- Sample media (e.g., soil, water, vapor, etc.)
- Sample preservative (if applicable)
- Requested analysis
- Comments or special instructions to the laboratory

Each sample must be assigned a unique sample identification number as described above. The information on the chain-of-custody form, including the sample identification number, must correspond to the information recorded by the sampler on the field forms and field log book and the label on the sample container.

A sample is considered under a person's control when it is in their possession. When custody of a sample is relinquished by the sampler, the sampler will sign and date the chain-of-custody form and note the time that custody was relinquished. The person receiving custody of the sample will also sign and date the form and note the time that the sample was accepted into custody. The goal is to provide a complete record of control of the samples. Should the chain be broken (signed by the relinquished but not receiver or vice versa), the integrity of the sample is lost and the resulting analytical data suspect. Samples must be shipped to the analytical laboratory following the procedures described in in SOP-4. If an overnight shipping service is used to transport the samples to the laboratory, custody of the samples must be relinquished to the shipping service. If possible, have the shipping service sign the chain-of-custody form prior to placing the chain of custody in the sample cooler. If this is not possible (i.e. form placed in the sealed cooler), a note should be included on the chain of custody that the shipping company has received the samples with the chain of custody inside the cooler.

SOP-4

SAMPLE PACKAGING AND SHIPPING

Purpose

To ensure samples are properly packaged for shipment to the analytical laboratory

Goal and Objective

To have samples received by the analytical laboratory in good condition and within EPA temperature thresholds

Equipment Needs

Sampling and Analysis Plan

Indelible ink pen

Chain-of-custody forms

Custody Seals

Sample Labels from Lab

Coolers and Ice

Field Sampling Form

Packing Tape

Bubble wrap/absorbent pads

Ziploc Bags

SAMPLE PACKAGING

Samples must be packaged to preclude breakage or damage to sample containers, and shipped under chain of custody, complying with shipper, U.S. EPA, and U.S. DOT regulations. When packaging samples:

- Chain of custody procedures must be strictly adhered to. This applies to sample collection, transportation, shipment and laboratory handling. The COC will provide documentation from collection to analysis.
- Use sample labels from the laboratory whenever possible. Place the sample label on the side of the sample container and use indelible ink when completing the label. Sample containers should be new and stored in an environment free from dust, dirt and fumes.
- Sample should never stand in the sun. After collection and preservation, place labeled sample bottles in a high quality cooler. Place the samples in an upright position inside the cooler and wrap the samples with cushioning material for protection during transport. The cooler should be able to withstand tough handling during shipment without sample breakage.
- Make sure the cooler has an adequate amount of “wet” or “blue” ice (inside sealed Ziploc bags) at all times. Make sure ice volume is sufficient and appropriate for the season in order to maintain a temperature of 6°C or less inside the cooler from the time the samples are placed in the cooler until they are received by the laboratory. When in doubt put in more ice. Ensure the cooler drain plug is taped shut.
- Fill out the appropriate chain-of-custody forms and place them in a Ziploc bag and tape it to the inside lid of the shipping container. If more than one cooler is used per chain of custody, put a photocopy in the other coolers and mark them as a copy. Commercial carriers are not required to sign the COC, but the tracking number and name of the carrier should be documented on the original cahin-of-custody.
- Close and thoroughly secure the cooler with packing tape.

- Place completed sample custody seals on the outside of the cooler such that the seals will be broken when the cooler is opened. Secure the custody seals on the cooler with clear strapping tape.
- Secure a shipping label with address, phone number, and return address on the outside of the cooler where it is clearly visible. Shipping samples should be coordinated and scheduled to prevent exceeding of hold times or temperature requirements of analytical tests. Check with the lab if there are questions regarding holding times. If Saturday delivery is necessary, confirm with the lab that they will be able to receive the sample delivery before it is shipped.

SHIPPING HAZARDOUS MATERIALS/WASTE

Transportation regulations for shipping of hazardous substances and dangerous goods are defined by the U.S. DOT in 49 CFR, Subchapter C, Part 171 (October 1, 1988); IATA and ICAO. These regulations are accepted by Federal Express and other ground and air carriers.

According to DOT regulations, environmental samples are classified as Other Regulated Substances (ORS). ORS are articles, samples, or materials that are suspected or known to contain contaminants and/or are capable of posing a risk to health, safety, or property when transported by ground or air. Samples, substances, or materials from sources other than material drums, leachate streams, or sludge, should be considered as ORS or environmental samples. Materials shipped under the classification of ORS must not meet any of the following definitions:

Class 1: Explosives; Class 2: Gases- compressed, liquefied, dissolved under pressure, or deeply refrigerated; Class 3 Flammable Liquids; Class 4: Substances susceptible to spontaneous combustion; Class 5: Oxidizing substances; Class 6: Poisonous (toxic and infectious); Class 7: Radioactive materials; Class 8: Corrosives.

If your samples might meet any of the above definitions, contact the project manager to obtain instructions on sample shipment.

SOP-5

FIELD MEASUREMENT OF GROUNDWATER LEVEL

Purpose

To ensure groundwater levels are accurately measured in the field

Goal and Objective

To accurately measure water levels in the field, and prevent cross contamination during water level measurement

Equipment Needs

Electric Water level Indicator

Sonic Water Level Meter (e.g., Global Water WL650)

Oil-Water Interface Probe, as necessary

Extra set of batteries

Indelible Ink Pen

Field Sampling Form

Decontamination supplies, as necessary

FIELD PROCEDURE

- Verify the water level indicator is operating correctly prior to leaving for the field by placing probe in water to test the buzzer and light. Repair as necessary. Make certain the meter and extra batteries are in the carrying case.
- Prior to collecting a measurement in any well, decontaminate the water level indicator (see SOP-2) as appropriate. Note any repairs or modifications to water level indicator measurements on field forms.
- All well measuring points should be surveyed and permanently marked. Measure and record the distance from the measuring point to ground level. If the measuring point is not marked, measure from the north side of the well and note the location on appropriate field forms. Also mark the location on the outside of the casing near the rim for future measurements.
- If free product is known or suspected to be present in a well, an oil-water interface probe or other method must be used to measure the depth to water and the thickness of free product in the well, as described in SOP-6.
- If no free product is suspected, measure the depth to water from the measuring point to the nearest hundredth of a foot using the electric water level indicator.
- For wells with depth to water of more than about 200 feet or where pump discharge tubing and electrical wires preclude the use of a water level indicator, a sonic water level meter can be used. To check the accuracy of the sonic meter, measurement in five wells with no pumps or wires, and varying depth to water intervals (e.g., 30 to 200 feet) shall be made using both devices (water level indicator and sonic level meter). The difference between the two measurements should be linear and a correction factor must be calculated and applied to the data collected using the sonic meter.
- Record depth to groundwater measurements to the nearest 0.01 foot on the appropriate field form(s) in accordance with SOP-1. Also record the presence/absence of free product.
- Replace well caps and lids, re-lock wells (if necessary).

Notes: If air-tight well caps are used and pressure or a vacuum seal is noted when removing the well cap, ensure that the well has sufficient time to equilibrate before water levels are measured and recorded. If upon opening a flush-mounted well cover, water is found in the well monument, this water must be removed prior to opening the well cap and measuring the groundwater level.

SOP-7

FIELD MEASUREMENT OF ELECTRIC OR SPECIFIC CONDUCTANCE

Purpose

To ensure measurement of specific conductance is done consistently and correctly in the field

Goal and Objective

To obtain accurate specific conductivity measurements in the field

Equipment Needs

Sampling and Analysis Plan

Specific Conductivity Meter

Calibration Standard

Decontamination Supplies

Measurement container

Extra set of batteries

Indelible Ink Pen

Field Sampling Form

INSTRUMENT CALIBRATION

The conductivity meter should be inspected and calibrated prior to each sampling event following the manufacturer's recommendations. If the instrument is a multi-parameter meter, follow the instructions for measurement of electric or specific conductance from the manual.

Prior to calibrating the field meter, the expiration date on the conductivity calibration solution should be checked. If the standard has expired, it should be discarded.

During calibration the standard value and units should be recorded on the apropriate field form, in addition to the meter reading.

Prior to conducting field measurements, verify the meter automatically corrects for temperature variations. If the meter does not, apply the appropriate temperature correction to the field measurements.

Calibration data will be recorded to maintain a record of the calibration and proof of acceptability.

Equipment used to collect field measurements will be calibrated at the start of each sampling day. More frequent calibration may be necessary, depending on the reliability and inherent stability of the instrumentation, extreme field conditions (weather/climate), continuous or heavy use, or high concentrations of monitored parameters. When field calibration is performed, calibration will be verified and documented at the end of the day.

Results of calibration will be recorded in the field log book or field form referenced in the field log book. Calibration results outside ±5% from the standard will require the calibration procedure to be repeated.

FIELD MEASUREMENT PROCEDURE

Rinse a decontaminated glass container or plastic flow-through cell with sample water.

Fill the container or flow-through cell with sample water, with enough available space to insert the probe without undesired overflow of the container.

Rinse the conductivity or multi-parameter probe with deionized water and then place it in the beaker of sample water or in the flow-through cell. Immerse the probe in sample water and move it around to

displace any air bubbles. Keep the probe tip off of the sides of the beaker or flow through cell. Record the conductivity reading. Be sure to recognize the units of the reading (i.e. microseimens/centimeter (µs/cm), micromhos/centimeter (µmhos/cm), or milliseimens/centimeter (ms/cm). Record the reading on the field sampling form and filed log book. If the reading is being taken in-situ or using a flow-through cell, record the reading at time intervals until the reading stabilizes and samples are collected.

Note any problems such as erratic readings. If previous readings are available, compare the current measurement to previous reading to check that the current reading is within reasonable limits.

Remove the probe from sample and decontaminate probe. Store the probe following the manufacturer's recommendations.

SOP-8

FIELD MEASUREMENT OF PH

Purpose

Provide guidelines for pH measurements in water samples

Goal and Objective

To obtain accurate pH measurements in the field

Equipment Needs

Sampling and Analysis Plan

pH Meter

Calibration standards

Glass container or flow-through cell

Decontamination Supplies

Extra set of batteries

Indelible Ink Pen

Field Sampling Form

INSTRUMENT CALIBRATION

The pH meter must be calibrated prior to each daily field event, or more frequently if required by the project/client. Follow the manufacturer's recommendations to calibrate. Inspect the probe daily for damages or defects. A three-point calibration should be completed (unless meter manual specifies otherwise), using pH standards 4.0, 7.0 and 10.0. If instrument is a multi-parameter meter, follow the instructions for measurement of pH from the manual.

Prior to calibrating the field meter, the expiration date of the calibration solutions should be checked. If the standard has expired, it should be discarded. During calibration the standard value and units should be recorded on the appropriate field form, in addition to the meter reading.

Periodically throughout the field day, place the probe in 7.0 pH buffer solution. If the measured value differs from the expected value by more than 0.1 pH units, recalibrate the meter according to the manufacturer's instructions.

Calibration data will be recorded to maintain a record of the calibration and proof of acceptability.

Equipment used to collect field measurements will be calibrated at the start of each sampling day. More frequent calibration may be necessary, depending on the reliability and inherent stability of the instrumentation, extreme field conditions (weather/climate), continuous or heavy use, or high concentrations of monitored parameters. When field calibration is performed, calibration will be verified and documented at the end of the day.

Results of calibration will be recorded in the field log book or field form referenced in the field log book. Calibration results outside ±5% from the standard will require the calibration procedure to be repeated.

FIELD MEASUREMENT PROCEDURE

- Rinse a decontaminated glass beaker or plastic flow-through cell sample water three times.
- Rinse the pH probe with deionized water.
- Fill the container with sample water.
- Immerse the probe in the sample and agitate it to provide thorough mixing. Continue to agitate until the reading has stabilized. Read the pH to the nearest 0.1 s.u. and record on the field

sampling form. If the reading is being taken using a flow-through cell, record the readings until they stabilize prior to sample collection. If the measurement is taken in-situ, wait until the reading has stabilized then recorded it on the field form.

- Note any problems such as erratic readings. If previous readings are available, compare the current measurement to previous reading to check that the current reading is within reasonable limits.
- Rinse probe with deionized water, decontaminate as necessary (refer to SOP-2) and store according to the manufacturer's instructions.

SOP-9

FIELD MEASUREMENT OF DISSOLVED OXYGEN

Purpose

Provide guidelines for Dissolved Oxygen measurements in water samples

Goal and Objective

To obtain accurate dissolved oxygen measurements in the field

Equipment Needs

Sampling and Analysis Plan

Dissolved Oxygen Meter

Distilled water

Decontamination Supplies

Calibration cup

Extra set of batteries

Indelible Ink Pen

Field Sampling Form

FIELD MEASUREMENT PROCEDURE

Before each use, clean and rinse the electrode tip with distilled water. Verify that the membrane cap has been filled with DO electrolyte in accordance with manufacturers required maintenance schedule and that there are no bubbles present under the membrane (does not apply if meter includes an optical DO probe). Visibly check the meter for damage or defects, and cleanliness.

Calibrate the probe and meter using the fresh water-air calibration method described in the manufacturer's manual. Correct the calibration value for temperature and altitude and adjust the meter accordingly. Record all calibration measurements and units on field forms. Note: Sensor can maintain polarization when disconnected from the meter for up to three hours.

Place probe directly into the well to be measured. If not possible, place the probe into a flow-through cell (must fill flow cell from the bottom, for accurate DO readings) receiving a continuous stream of water from the source being measured. Do not measure DO in a container of sample water extracted from a well. Allow sufficient time for the probe to stabilize to sample temperature and dissolved oxygen concentration. Record the dissolved oxygen value on the appropriate field forms. Decontaminate probe when measurement is complete in accordance with SOP-2.

If the sensor will not calibrate, becomes sluggish or erratic:

- Clean tip and refill cap with DO electrolyte in accordance with manufacturer's instructions (typically care must be taken to eliminate air bubbles from inside probe, and probe tip must be scarified using manufacturer-provided sandpaper).
- Check membrane for damage, replace if necessary.
- Check meter with test plug.
- Replace battery.

SOP-10

FIELD MEASUREMENT OF OXIDATION REDUCTION POTENTIAL (ORP)

Purpose

Provide guidelines for Redox Potential measurements in water samples

Goal and Objective

To obtain accurate Redox Potential measurements in the field

Equipment Needs

Sampling and Analysis Plan

Redox Potential Meter

Distilled water

Decontamination Supplies

Calibration solution with table of temperature adjustment information

Extra set of batteries

Indelible Ink Pen

Field Sampling Forms

FIELD MEASUREMENT PROCEDURE

- Calibrate the meter in accordance with the manufacturer's instructions prior to each daily sampling event. Inspect the meter for damage, defects and cleanliness.
- Calibration data will be recorded to maintain a record of the calibration and proof of acceptability.
- Equipment used to collect field measurements will be calibrated at the start of each sampling day. More frequent calibration may be necessary, depending on the reliability and inherent stability of the instrumentation, extreme field conditions (weather/climate), continuous or heavy use, or high concentrations of monitored parameters. When field calibration is performed, calibration will be verified and documented at the end of the day.
- Results of calibration will be recorded in the field log book or field form referenced in the field log book. Calibration results outside ±5% from the standard will require the calibration procedure to be repeated.
- Prior to calibrating the field meter, the expiration/preparation date of the calibration solution should be checked. If the standard has expired, it should be discarded. During calibration the standard value and units should be recorded on the appropriate field form, in addition to the meter reading. Make sure the calibration input is correct for the ORP solution and temperature by verifying it with the calibration solution manufacturers supplied table.
- If possible, obtain an in situ measurement of ORP in an effort to minimize agitation of the sample and limit exposure to oxygen. If not possible, use a flow-through cell that receives a constant stream of water from the well. If a flow-through cell is not available, ORP measurements can be taken of sample water placed in a glass container or beaker.
- If collecting a sample in-situ or in a flow through cell, place the ORP probe into the cell or the water.

- If using a beaker, rinse the ORP electrode with distilled water and then with sample water prior to inserting it into the sample beaker. Immerse the ORP electrode in the beaker and allow at least one minute for the probe to equilibrate with the water. Obtain a reading to the nearest ten millivolts.
- Record the reading on standardized field forms and the field book. Note any problems such as erratic or drifting readings.
- Decontaminate the probe following SOP-2, store probe in accordance with manufactures specifications.

SOP-11

FIELD SAMPLE FILTRATION

FIELD PROCEDURE

- Set up a system whereby water samples can be filtered, including a disposable filter apparatus and use of a pump (peristaltic, hand-vacuum or other suitable pump) to force water under pressure through the filter.
- To avoid the need for decontamination, use disposable tubing, filters and equipment when possible.
- When collecting a grab sample of water collect the groundwater or surface water using a decontaminated bailer or similar sampling device and place water into a decontaminated vessel that can be pressurized to force the water through a disposable 0.45 micron filter.
- If a groundwater sample is being collected using a submersible pump, the submersible pump can be used to push the water through the filter.
- Filtered effluent should be placed directly into appropriate laboratory supplied sample containers and capped. Add preservative as necessary prior to capping.
- Invert sample container several times to insure complete sample-preservative mixing.
- Place sample into cooler; package and ship accordance with SOP-4 concerning shipping.
- Decontaminate, if necessary, all equipment in accordance with SOP-2 concerning decontamination.

Note: If extremely turbid sample water is obtained, you may need to pre-filter the sample using 3.0 or 5.0 micron filter paper followed by 0.45 micron filtration.

Purpose

Provide guidelines for filtering water samples in the field

Goal and Objective

To employ a method of filtering samples in the field, thus removing sediment from the sample and allowing for analysis of dissolved components in the sample

Equipment Needs

Sampling and Analysis Plan

0.45 micron disposable filters

3.0 and 5.0 micron disposable filter paper (if necessary)

Disposable peristaltic tubing (if using a peristaltic pump)

Decontamination Supplies

Pump (peristaltic or other)

Preservatives, as required

Indelible Ink Pen

Field Sampling Form

SOP-12

GROUNDWATER SAMPLING

Prior to initiating groundwater sampling, all equipment should be inspected for damage and repaired. Check with the project manager to be sure you understand what type of pump or sampling device will be used to purge and sample groundwater. Equipment to be placed down the well must be decontaminated in accordance with SOP-2. For this project, dedicated pumps will be used for each well and will consist of electric submersible pumps or bladder pumps.

When arriving at each well site, the condition of the well shall be noted on field forms, including but not limited to: confirming the well is locked, evaluating condition of well caps and surface seal about the well, and for industrial water supply wells if backflow prevention devices are installed at the well head.

WELL PURGING

Purging must be performed on all wells prior to sample collection in order to obtain a representative groundwater sample. Two methods are specified in the Sampling and Analysis Plan:

1) Stabilization of Parameters, and
2) Low-Flow Sampling.

It is anticipated that existing industrial water supply wells and new wells installed in the North and South Zones will be sampled using Method 1; the four existing alluvial wells and new monitoring wells in the River Corridor Envelope (RCE) are anticipated to be sampled using Method 2.

Before purging each well, measure and record the depth to groundwater from the top of the well casing to the nearest 0.01 foot using a water level indicator or sonic water level meter in accordance with SOP-5. If sampling at a site where there may be free product, wells shall be checked for the presence of free product prior to purging and sampling using an oil-water interface probe in accordance with SOP-6.

Determine the volume of water within the well screen interval. To do so, first determine the well screen thickness (i.e., depth of lowest screened interval minus the top of screened interval). The following equation should used to calculate well screen volume in

Purpose

Provide guidelines for sampling groundwater

Goal and Objective

To employ a method of collecting groundwater samples representative of the chemistry of the aquifer

Equipment Needs

Sampling and Analysis Plan

Graduated 5-gallon bucket

Oil-Water Interface Probe, as necessary

Water Level Indicator and Sonic Water Level Meter

Meter(s) for: pH, temperature, ORP, dissolved oxygen and specific conductance; calibration standards

Flow-Through Cell to Measure Field Parameters

Filtering apparatus and pump

Sample Containers and Preservatives, as required

Field Sampling Forms

Decontamination equipment and fluids

Tubing, as needed

Generator or power supply

Compressor for bladder pump, and/or nitrogen gas cylinders

Coolers and Ice

Stop Watch

gallons. Record all calculations on the appropriate field form(s) or in a field book in accordance with SOP-1:

$$V = 3.14 * (r^2) * d * 7.48$$

Where,

V = volume (gallons)
r = well borehole radius (feet)
d = column of water thickness in the well screen interval (feet)

The radius should be the radius of the well borehole, not the well casing radius. For example, for a 2-inch diameter PVC monitoring well installed in a 6-inch diameter borehole, the radius is 0.25 foot.

Method 1 (Stabilization of Parameters; wells located in the North and South Zones): To obtain a representative sample of groundwater, monitoring wells shall be purged of a minimum of three well screen volumes and when field water quality parameters have stabilized. Field parameters shall be measured every 5 minutes using a flow-through cell, with a minimum of six parameter measurements completed before stabilization is determined as noted below. For this method, a minimum of three well screen interval volumes will be removed prior to sample collection. If field water quality parameters fail to stabilize, a minimum of six well screen volumes should be removed. If the well purges dry, samples should be collected after the well fully recharges to pre-sampling water elevations. At no time should a monitoring well be pumped dry if the recharge rate causes formation water to cascade down the well casing causing an accelerated loss of volatiles and change in pH.

When the field parameters have stabilized for three consecutive readings, a groundwater sample can be collected for laboratory analysis in accordance with the other conditions described above. Stabilization can be demonstrated by the following conditions:

Temperature: ±10%	Specific Conductance: ±10%
Turbidity: ±10% (if >10 NTU)	Oxidation-Reduction Potential: ±10 millivolts (mV)
Dissolved Oxygen: ±10% (if >0.5 mg/L)	pH: ±0.2 standard units

Method 2 (Low-Flow Sampling Method; Wells located in the RCE)**:** When purging a well using low-flow sampling techniques (e.g., bladder pump), the goal is minimal drawdown (<0.3 foot) of the groundwater level during purging. A groundwater sample can be collected for laboratory analysis after at least two or three well screen interval volumes have been removed and field parameters have stabilized (see above). The goal is to exchange water residing in the well screen interval with water in the aquifer, and the low flow method consists of pumping water directly from the aquifer adjacent to the well screen (not entire well casing). It is assumed that the one casing volume criterion specified by WOGCC for sampling low-yield wells can be modified to that portion of the well with the screen interval. Typically, two to three well screen volumes are removed using the low-flow sampling method prior to sampling to achieve parameter stabilization as noted in the chart above.

Purge water generated for both Methods 1 and 2 must be handled in accordance with SOP-25 for investigative-derived wastes. For water that is discharged directly to the ground, attention must be

given to avoid direct recharge of shallow wells with the purge water. Purge water must be discharged down gradient and at an adequate distance from the well to avoid mounding and interference.

COLLECTING GROUNDWATER QUALITY SAMPLES

Groundwater samples should be collected after field parameters have stabilized. Label each sample container with project number, sample location, well owner, date, military time, sampler's initials, preservative, and analysis required in accordance with SOP-3. Don clean latex or nitrile gloves immediately prior to obtaining the sample, and as often as necessary to avoid any risk of contamination. Refer to Table 4C-2 in the Sampling and Analysis Plan for the parameter-specific requirements.

For wells equipped with electric submersible pumps (wells located in the North and South Zones), samples will be obtained using a slip-stream method at the well head from discharge piping connected to submersible fixed-rate pumps. If not already equipped, a brass or stainless steel quill-type sampling port will be installed in the bottom of the discharge piping at the well head. The sampling port will be equipped with a ball valve to control flow rates to approximately 100 milliliters per minute for sampling. The port will have a nipple or other type of connection to allow disposable tubing to be attached between the sample port and a flow-through cell. The flow-through cell will be equipped with various probes/sensors to measure field water quality parameters that are noted above.

For wells in the RCE equipped with bladder pumps, samples will be obtained from pump discharge tubing. If the well is pumped dry during the purge, the pumping rate shall be reduced to match well yield if possible and a note made on the sampling form.

For sampling and analysis of dissolved gases (e.g., dissolved methane), refer to the protocol described in SOP-41.

When sampling, add preservatives to the sample container prior to sample collection (this is often done by the analytical laboratory). Remove water from the well and transfer sample water directly into sample bottles or filter apparatus (should filtering be necessary see SOP-11), maintaining a slow linear flow with as little agitation as possible. For volatile analyses, fill container vials at the rate of 100 milliliters per minute (24 seconds for 40 milliliter vial) or less. Fill each sample vial completely so the water forms a convex meniscus at the top to ensure no air space exists in the vial after it has been capped. After filling, immediately cap, invert, and gently tap the vial to check for trapped air. If air bubbles are present, un-cap vial, add more sample water and repeat procedure. If air bubbles are still present, discard the vial.

Be sure to properly cap and lock the well when sampling is complete.

Complete the necessary shipping and handling paperwork in accordance with SOP-4, and record all pertinent information on appropriate field sampling forms in accordance with SOP-1. Samples should be maintained under chain-of-custody record at all time from sample collection to lab analysis.

SOP-13

FIELD MEASUREMENT OF TURBIDITY

Purpose

To ensure field measurement of turbidity is done consistently and correctly

Goal and Objective

To obtain accurate turbidity measurements in the field

Equipment Needs

Sampling and Analysis Plan

Turbidimeter

Calibration Solution

Sample bottle(s)

Extra set of batteries

Indelible Ink Pen

Field Sampling Form

Powder-free latex or nitrile gloves

INSTRUMENT CALIBRATION

The turbidimeter should be inspected and calibrated prior to each sampling event following the manufacturer's recommendations. More frequent calibration may be necessary, depending on the reliability and inherent stability of the instrumentation, extreme field conditions (weather/climate), continuous or heavy use, or high concentrations of monitored parameters. Prior to calibration, the calibration solution expiration date should be checked. If the solution has expired, it should be discarded.

During calibration the standard value and units should be recorded on the apropriate field form, in addition to the instrument reading. Calibration data will be recorded to maintain a record of the calibration and proof of acceptability. When field calibration is performed, calibration will be verified and documented at the end of the day.

FIELD MEASUREMENT PROCEDURE

Remove turbidimeter from protective case and place on a level surface.

Put on powder-free latex or nitrile gloves.

Take one sample bottle included with meter and rinse three times with the sample water. Fill the sample bottle to the top or fill line and close the bottle cap. If available, squeeze one drop of silicone gel onto the sample bottle and wipe thoroughly around the bottle with black cloth included with the meter.

Following the manufacturer's instructions, place the sample bottle into the turbidimeter and take a measurement.

Record the turbidity value on field form. Discard the sample water and place the bottle and turbidimeter back in case.

When done at the end of day, leave turbidimeter case and sample bottle(s) open to dry. Store the instrument according to the manufacturer's instructions.

SOP-15

MONITORING WELL CONSTRUCTION

Monitoring well construction specifications may differ from those listed in this SOP. The Sampling and Analysis Plan should be consulted prior to any well installation to ensure objectives are met.

MONITORING WELL CONSTRUCTION

- Arrive on site with the appropriate decontaminated drilling equipment and materials for site conditions. Be sure to review the Sampling and Analysis Plan and other Project reports to determine anticipated lithology and well depth. Drilling method, filter pack, and well-screen slotting should be predetermined and based on the site lithology.
- Ensure that the driller has properly decontaminated all drilling equipment and materials prior to arrival on site, in accordance with SOP-2.
- Verify the driller is licensed in Wyoming prior to beginning fieldwork.
- Safety equipment required for drilling is mandatory. All field personnel must comply with the site-specific Health and Safety Plan (HASP) and SOP-40.
- Anticipated drilling techniques for this Project include air-rotary, mud-rotary, or air-hammer methods, with potable water foam, and/or mud used during the drilling process to facilitate removal of cuttings and maintain an open hole for casing installation. Biodegradable foam and/or bentonite mud may be required during drilling to remove cuttings if water is unsuccessful. For well locations in the South Zone where dissolved methane concentrations in groundwater in excess of 1 milligram per liter (mg/L) is anticipated, mud-rotary methods may be used to minimize the potential for explosive concentrations of methane encountered during drilling. The foam and bentonite products must be hydrocarbon-free and metal-free. Drilling compound or pipe dope used on the drill rig must be a NSF/ANSI certified biodegradable, nontoxic, metal-free, and hydrocarbon-free vegetable-based fluid.
- If unconsolidated material is encountered, it may be necessary to drive steel casing during drilling to maintain borehole integrity.
- Appropriate decontamination of drilling equipment between well installations is required and

Purpose

Provide guidelines for installing monitoring wells in the field

Goal and Objective

To employ a standard method of installing monitoring wells, which will allow for collection of representative groundwater samples

Equipment Needs

Sampling and Analysis Plan

Drilling system

Well completion material (screen, filter pack, borehole seal, and surface seal) consistent with anticipated lithology

Hand lens (10) power

USGS Soil Classification Chart and Munsel color book

Latex or Nitrile gloves

Boring Log and field book

Field forms and field book

should be completed in accordance with SOP-2. Cross contamination of water bearing zones by drilling must be avoided.

- Unless otherwise required differently by state or federal agencies, drilling fluids and water generated from new wells will be discharged to the ground surface in the vicinity of the well location for evaporation and infiltration of the water-based fluids. All surface discharge areas should be selected for infiltration capability and should not allow for migration of discharge water to a surface water body. Drill cuttings will be thin-spread on the ground surface near the well, and the drilling sites will be reclaimed to approximate pre-disturbed conditions.
- Subsurface samples shall be collected by the driller at intervals specified in the Sampling and Analysis Plan.
- A detailed lithologic boring log must be completed by field staff during drilling activities on standard lithologic field forms with additional notes detailed in the field book (SOP-1). Drill cuttings will be logged continuously for lithology while drilling. Unconsolidated materials will be described according to the Unified Soil Classification System. Once the Wasatch Formation is encountered in each borehole, lithologic descriptions of cuttings (e.g., siltstone, mudstone, shale, sandstone) will be continuously logged and recorded. Other information recorded will include: rock color; grain size; description of induration or consolidation; description of any fracture zones encountered; water-bearing intervals; estimated water yields; and an estimate of any potable water added to borehole to aid in cuttings removal. Details of monitoring well construction should be described on the well log including total depth, perforated interval, sizes, depths, and types of construction materials, etc.
- When completing the well, install factory-slotted well screen (slot size dependent on lithology; screen length is dependent on site conditions) and blank flush-threaded PVC well casing unless otherwise specified in the Sampling and Analysis Plan.
- After borehole is drilled and well is positioned in the borehole by the driller, emplace chemically inert silica sand in the annular space from well depth to 5 feet above the screened interval of the casing as specified in the Sampling and Analysis Plan. Measure placement of sand with a tag line to ensure proper placement. The silica sand or filter pack should be sized based on the screen slot size and aquifer characteristics.
- Bentonite chips or pellets will be installed into the borehole annulus above the sand filter pack to a depth of 5 feet above the top of the sand pack, and hydrated with potable water. Neat cement grout slurry mixed with potable water will be pumped into the annulus using a tremie pipe from the bottom to top of the remaining open annulus in one continuous upward operation.
- Develop the well (SOP-18) prior to collecting groundwater samples (SOP-12).
- Place locking protective well monument (stick-up or flush-mount) over well casing(s) after outer steel casing has been removed from the borehole, if required. Grout the cover in place and secure with high quality lock.
- Mark groundwater depth measuring point on north side of inner well casing with permanent marker.
- Well location and top of casing elevation should be surveyed to 0.01 ft.

BOREHOLE ABANDONMENT IN EVENT WELL CANNOT BE COMPLETED

If for some reason attempts to install a well fail, the borehole must be properly abandoned (consult state-specific requirements). In general, to abandon a borehole, bentonite pellets or bentonite grout or slurry should be introduced into the borehole as the well casing is extracted. If bentonite pellets are used, at periodic intervals of not less than every 3 feet of casing extraction, the bentonite should be hydrated with potable water if above the water table. Bentonite pellets or slurry should be placed in the borehole to ground surface.

SOP-18

MONITORING WELL DEVELOPMENT

Purpose

Provide guidelines for developing monitoring wells

Goal and Objective

To ensure wells are sufficiently developed prior to sampling

Equipment Needs

Sampling and Analysis Plan

Meter(s) for: pH, specific conductance, temperature, and turbidity; calibration standards

Decontamination equipment and fluids

Latex or Nitrile gloves

Well Development Form

Multi-parameter meters

Surge block/bailer/pump

Field Forms

FIELD PROCEDURE

After installation and prior to sampling a monitoring well, the well must be developed to remove excess formation fines and optimize the filter pack installed during well construction. Multiple techniques exist for development of a well, but the goal should be to extract enough groundwater from the well until clean (non-turbid) water is produced from the well. Care should be taken to not damage well screen or filter pack during development.

Once installed, a minimum of 10 casing volumes of water will be removed by the surge-and-bail or surge-and-pump technique to develop each new well and remove excess fines from the screened interval. The quantity of water developed from the well will include the estimated volume of any water added to the borehole during drilling. The goal is to obtain water from the aquifer adjacent to the well screen that has low turbidity (<10 nephelometric turbidity units [NTU]).

General steps to well development are discussed below:

- Visually inspect all well development equipment for damage and repair, as necessary.
- Decontaminate all equipment that will be placed downhole following SOP-2.
- Generally, a minimum of 10 casing volumes is needed to properly develop a well, including the estimated volume of any water added during drilling. A well is considered developed when field parameters (pH, temperature and conductivity) have stabilized and the turbidity has dropped below 10 NTU.
- Turbidity readings and field parameters should be recorded periodically throughout the development process on well development form (SOP-1). Clarity of water (turbidity and color) after development, and volume of water removed during development of the well, should be included the on well development form.
- Report field observations on well development form including:
    1. Volume of water removed during purge
    2. Date and time (duration) of development
    3. Depth to water, pre- and post-development

4. Pumping and/or bailing depth
5. Yield and field parameters collected at set time intervals.

Evacuated water shall be disposed following the process defined in the Sampling and Analysis Plan for derived wastes, and may need to be treated as investigation derived wastes (SOP-25). Unless otherwise required differently by state or federal agencies, development water will be discharged onto the ground at least 20 feet from and down-gradient of the water source, and in a location designated by the landowner or land manager (e.g., BLM). Development water, if disposed of onto the surface, shall be discharged in a location to allow for infiltration of the water, and the water should not enter a stream or other water body.

SURGING AND PUMP TECHNIQUES

Monitoring wells can be effectively developed using surging and pump techniques. A surge block or bailer is commonly used to remove entrained sediment and set the well casing followed by evacuation of water and sediment using a pump or bailer. To employ this method, place the surge block or bailer in the well and lower to bottom. Move the surge block or bailer up and down over the entire length of the well screen several times. Remove the surge block and bailer and evacuate water from the well. Repeat this procedure until evacuated water is visibly clean and free of sediment.

SOP-24

QUALITY CONTROL SAMPLING

Quality Control (QC) samples must be submitted along with natural samples to provide supporting laboratory data to validate field methods and laboratory results. In general, field equipment rinsate blanks and field duplicate samples should be collected for every sampling event. Always check the Sampling and Analysis Plan (SAP) before going to the field to understand what QC samples are required for the sampling event, and at what frequency samples should be collected.

With the exception of the trip blank, QC samples will be collected in the field following sample collection procedures (SOP-3, SOP-4). Trip blanks are supplied by the laboratory and will accompany each sample cooler containing samples for analysis of volatile organic compounds (VOCs). Trip blanks provide data to evaluate whether the samples were affected by organic compounds during transport from the field to the laboratory.

Field quality assurance/quality control (QA/QC) samples for this Project include:

- *Field Duplicate Samples* are independent samples of the same medium collected at the same time from the same location. Duplicate samples will be collected for analysis of all the same analytes as the parent sample. Duplicates are submitted for analysis "blind", meaning that they will not be identified to the laboratory as duplicate samples. The duplicate samples will be identified with a nonexistent sample location ID that is similar to, but different from the other sample location IDs at the site. All other labeling shall be identical to the investigative samples. The true identity of the duplicate samples shall be recorded in the field logbook, but not on the chain-of-custody (COC) form or sample labels and tags that are sent to the laboratory.

- *Trip Blanks* are required only when samples are collected for analysis of VOCs (i.e., BTEX). They are prepared from analyte-free (deionized) water by the laboratory, and are transported to the sampling site with the VOC sample bottles for the investigative sampling. They are kept with the samples throughout the sampling program and are shipped back to the laboratory for analysis with the samples. They are not opened on site, and are designed to evaluate VOC contamination encountered within the coolers during the shipping and handling procedures. Trip blanks are prepared in 40 ml VOA vials with Teflon septum lids, and must be chilled and handled in the same manner as a water sample for VOC analysis. Two trip blank vials per each daily set of shipping containers or coolers containing VOC samples are required. Trip blanks will be analyzed for BTEX.

Purpose

To outline the quality control samples to be collected in the field

Goal and Objective

To ensure quality control samples are collected along with natural samples to validate field methods and laboratory results

Equipment Needs

Sampling and Analysis Plan

Field forms and field book

Chain-of-custody forms

- *Equipment Rinsate Blanks* are obtained from the last rinse of analyte-free (deionized) water during decontamination of non-disposable sample collection equipment. No extraordinary decontamination procedures will be followed when a rinsate blank is collected. The date and time of collection will be noted, as well as the ID number of the investigative sample collected just prior to decontamination, and the ID number of the next sample collected with the decontaminated equipment. If dedicated or disposable equipment is used, rinsate blanks are not required.

QC samples for this investigation will be collected in accordance with the Project's SAP and Quality Assurance Project Plan (QAPP). QC samples include field duplicates, trip blanks, and equipment rinsate blanks, as noted above. A temperature blank also will be placed in each cooler by the laboratory when the sample coolers are shipped to the Project site.

The following chart summarizes the minimum rate at which QC samples must be collected for the Project.

Medium	Field Duplicates[1]	Trip Blanks[2]	Equipment Rinsate Blanks[1]
Groundwater	1 duplicate in 20 natural samples	One trip blank bottle set per daily set of sample shipment containers containing VOC samples	1 per 20 decontamination procedures

[1] Duplicate and rinsate blank samples are collected at the minimum rate of 1 per 20 samples. If fewer than 20 samples are collected, one duplicate sample and one rinsate blank sample (if decontamination procedures are performed) must be collected.
[2] Trip blanks are prepared in the laboratory or at another off-site location from distilled or deionized water. They are never prepared on-site, or from soils or other solid material.

SOP-25

MANAGEMENT OF INVESTIGATIVE-DERIVED WASTE

Prior to the field sampling event, review the Sampling and Analysis Plan to understand how wastes generated during the investigation should be handled. This standard operating procedure is applicable to non-hazardous wastes. If hazardous wastes may be generated, please consult with the project manager and the project specific SAP.

Subsurface contamination is not anticipated to be encountered based on the current lack of evidence of known contamination at any drilling site for this Project.

Purpose

To outline the procedure for handling wastes generated during site investigation

Goal and Objective

To employ a method for appropriate handling investigative-derived wastes that limits contamination of the environment

Equipment Needs

Sampling and Analysis Plan

PID and Calibration Gas

Field Forms and field book

DOT approved 55-gallon drums

Drum wrench

DRILL CUTTINGS

To determine appropriate methods for handing of drill cuttings from monitoring well installation, cuttings removed from the borehole should be monitored for staining and field screened for volatile organic vapors using a photoionization device (PID) in accordance with standard operating procedures. Based on the PID screening, cuttings with organic vapor concentrations greater than 100 parts per million (ppm) should be containerized in labeled 55-gallon drums (or roll-off containers if large volumes of cuttings are anticipated) pending further characterization. Containerized soil must be properly labeled, documented and disposed of in accordance with state and federal regulations based on of soil analytical results.

Cuttings that do not appear to be contaminated based on observations by field personnel and PID screening may be thin-spread on the ground near the point of origin.

GROUNDWATER

Although not anticipated, groundwater purged from a well during development or sampling that has a sheen or contains non-aqueous phase liquids must be containerized in an appropriately labeled 55-gallon drum or tank pending receipt of analytical results. A drum should be dedicated to each well sampled so that the analytical results of the groundwater sample from the well can be used to characterize the water in the drum. If groundwater from several wells is placed in a drum, the water in the drum should be sampled for adequate characterization. The containerized water must be disposed of in accordance with state and federal regulations based on the analytical results. Groundwater that does not have a sheen or contain non-aqueous phase liquids or other know contamination may be discharged to the ground surface in the vicinity of the well location for evaporation and infiltration. All

surface discharge areas should not allow for migration of discharge water to a surface water body.

RINSEATE WATER ORIGINATING FROM DECONTAMINATION

All source water for sampling equipment decontamination purposes will be distilled water. For larger equipment when power washing procedures are used for decontamination, potable water will be used. Decontamination will be conducted in a specified area that limits the spread of decontamination water. Decontamination water will be discharged to the ground in the vicinity of the source of dirt and mud to evaporate and infiltrate.

SOP-40

WORKER RESPONSIBILITY TO SAFETY

This SOP establishes general guidelines for field personnel to follow to complete field investigations in a safe manner. All field personnel involved in field work must:

1. Review and sign the site-specific Health and Safety Plan (HASP). In addition to this SOP, there are numerous other SOPs that identify specific requirements for maintaining a safe work environment, appropriate safety communication and reporting of a safety incident. Field personnel must become familiar with these SOPs prior to initiation of field work and follow them during field work.

2. Prevent visitor access to a site unless they have reviewed the HASP and signed site entry form in the HASP. Visitors should never be allowed access to a work zone, as defined in the HASP.

3. Take personal responsibility for maintaining a safe working environment throughout the entirety of the field work. While field personnel are not responsible for the safety of other contractors on the site, field personnel that witness unsafe conditions should immediately report this to the company's Health & Safety Officer (HSO) and Project Manager (PM). If while working on a site you feel something is being done in an unsafe manner, do not continue to participate in the activity and call the HSO and PM.

4. Maintain and wear appropriate personal protective equipment (PPE), as described in the HASP.

5. Facilitate or participate in daily health and safety meetings, preferably at the beginning of each work day. The meeting should be facilitated by the Project field lead. At these meetings, safety issues anticipated for the upcoming work day including potential contaminant exposure, appropriate PPE, traffic safety, and any potential on site hazards should be discussed with all workers. If drilling or excavation is planned, applicable safety issues such as utility clearance, creation of work zones, heavy equipment hazards, adequate sloping of excavations, excavation setbacks, potential shoring requirements, and means of communications in a noisy environment should be discussed. In addition, protocols to follow in the event of a hazardous incident should be discussed at daily safety meetings, including what defines and incident and where personnel should congregate in the event of an incident.

6. Report all safety incidents, in accordance with the HASP.

7. Confirm prior to the start of each work day that field personnel and drilling and excavation contractors have appropriate safety equipment and PPE on site. At a minimum, this shall include a hardhat, safety glasses, steel toed boots, gloves, first aid kit, fire extinguisher and a copy of the HASP.

SOP-41

GROUNDWATER SAMPLING FOR DISSOLVED GASES

Prior to initiating groundwater sampling, all equipment should be inspected for damage and repaired. Check with the project manager to be sure you understand what type of pump or sampling device will be used to purge and sample groundwater. Equipment to be placed down hole must be decontaminated. Always sequence groundwater sampling by beginning with the well containing the lowest level of dissolved gases, sample wells in succession based on anticipated increasing concentrations. For this project, lowest dissolved gases are expected in the North Zone and highest in the South Zone.

Purpose

Provide guidelines for sampling dissolved gases in groundwater

Goal and Objective

To employ a method of collecting dissolved gases in groundwater samples representative of the underlying aquifer

Equipment Needs

Sampling and Analysis Plan

Five gallon bucket

Sample Containers

Preservatives, as required

Field Sampling Forms

Tubing, disposable

Step-down valves

Coolers and Ice

See SOP-12 for additional equipment for collecting groundwater samples.

COLLECT SAMPLE FOR DISSOLVED GASES

Refer to SOP-12 for procedures to be used to collect groundwater samples. To collect a sample for dissolved gases, fill a clean container (5-gallon bucket) with groundwater from the well. Connect a section of disposable tubing to the discharge point, and using a step-down valve, connect a short length of ¼-inch diameter disposable tubing to the valve. Adjust flow through the tubing so that the rate is low.

Submerge the closed sample container for dissolved gas provided by the laboratory to the bottom of the 5-gallon bucket. While under water, open the sample container and place the sampling tubing with a slow flow rate into the bottom of the sample container. Monitor the time to allow enough water volume to flow through the sample container to flush the container for at least twice its volume.

Slowly remove the sample tubing while maintaining the sample bottle beneath the surface of the water, then quickly place the cap on the sample container while submerged in order to maintain the pressure head of the water. If collecting the sample for compositional analysis, quickly insert the benzalkonium tablet into the container prior to capping.

Remove the sample container from the bucket of water and check to be sure there are no air bubbles in the sample. If air bubbles are visible, collect another sample. If the water is effervescent, a gas headspace bubble in the VOA vial is acceptable, but the laboratory must be notified to analyze the gas headspace. Dissolved gas samples shall be stored and packed upside down.

New sampling tubing and step-down valves shall be used at each sampling location.

All pumps and purging equipment will be examined for damage and cleanliness prior to use. Ensure all pumping equipment is new or properly decontaminated in accordance with SOP-2 prior to putting it down a well. If wells are sampled on a regular basis, dedicated sampling equipment may be used. Use extra care when using dedicated equipment to ensure it remains correctly labeled and is not exposed to cross contamination.

Purge water must be handled in accordance with SOP-25 for investigative-derived wastes. For water that is discharged directly to the ground, attention must be given to avoid direct recharge of shallow wells with the purge water. Purge water must be discharged down gradient and at an adequate distance from the well to avoid mounding and interference.

Label each sample container with project number, sample location, well owner, date, military time, sampler's initials, preservative, and analysis required in accordance with SOP-3.

Wear clean latex or nitrile gloves during the sample collection procedure.

Be sure to properly cap and lock the well when sampling is complete.

Be sure to complete the necessary shipping and handling paperwork in accordance SOP-4, and record all pertinent information on Field Sampling Forms per SOP-1. Samples should be maintained under Chain of Custody record at all time from sample collection to lab analysis.

SOP-42

MONITORING COMBUSTIBLE GAS DURING GROUNDWATER SAMPLING

At some locations, especially in oil and gas production fields, combustible gas may be present in wells that are subject to groundwater sampling. If such gas concentrations are >20% of the lower explosive limit (LEL), then sampling should be avoided until mitigation measures are implemented and the gas concentrations are reduced to safe levels.

PROCEDURE

Calibrate the combustible gas indicator (CGI) at the start of the work day in accordance with manufacturer's directions (calibrated for both flammable gas and oxygen concentrations). Document calibration on appropriate field form.

Survey workspace in and around the well-head with a CGI for potentially explosive conditions. While it is safe to proceed if CGI readings are <20% LEL, the source of CGI readings in the 1-20% range should be investigated and mitigated, if possible. If readings are >20% of the LEL, additional sampling activities should not be performed until the combustible gases are mitigated.

Monitor the work space around the well casing and well head continuously with the CGI during groundwater sample collection to ensure combustible gas readings remain <20% LEL.

Purpose

Provide guidelines for safely sampling groundwater in wells potentially influenced by combustible gases

Goal and Objective

To employ a method of monitoring the work space around the well head for combustible gases

Equipment Needs

Sampling and Analysis Plan

Combustible Gas Indicator (CGI)

Calibration Gas

Field Forms