SAMPLING ANALYSIS AND MONITORING PLAN

BROWNFIELDS PETROLEUM CLEANUP
116 MEMORIAL DRIVE
HINESVILLE, GEORGIA

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1.0 INTRODUCTION

1.1 PURPOSE

The purpose of the Sampling Analysis and Monitoring Plan (SAMP) is to detail environmental sample collection procedures for petroleum constituents as required by the *Rules of Georgia Department of Natural Resources, Environmental Protection Division Chapter 391-3-15, Underground Storage Tank Management.* Georgia Environmental Protection Division (Georgia EPD) guidance documents identify soil, groundwater, and surface water as the types of media that require environmental sampling during implementation of Part A of a Corrective Action Plan (CAP) and, if necessary, Part B. The collected samples also will be analyzed for other volatile organic compounds (VOCs) based on the proximity to a dry cleaning facility and the analytical results from the assessment phase of the project.

1.2 OBJECTIVES AND DOCUMENT DESCRIPTION

The objectives of this SAMP are as follows:

- To provide guidance for technical support personnel performing sampling and monitoring activities at the City of Hinesville Brownfields Petroleum Cleanup Site in Hinesville, Georgia.
- To present procedures to be used that are in accordance with guidance set forth by the United States Environmental Protection Agency (EPA) Region IV *Environmental Investigations Standard Operating Procedures and Quality Assurance Manual (EISOPQAM)*.
- To fulfill the requirements of the Cooperative Agreement between the City of Hinesville and EPA Region IV.

This document discusses procedures for the following activities: general field tasks associated with sampling activities; soil, groundwater, and surface water sampling; and analytical procedures.

The general field procedure section documents how collected samples will be designated, sample shipping and handling, investigative derived waste (IDW) containerization and management, the surveying of monitoring well locations and soil borings, documentation during field activities, and in-situ permeability testing. The soil sampling section will discuss Method 5035 field preservation method to be used during soil sample collection, hand auger sampling procedures, GeoProbe™ soil sampling procedures, and split spoon sampling procedures. The groundwater sampling section discusses monitoring well installation procedures, groundwater purging and sample collection from monitoring wells, GeoProbe™ techniques for sampling groundwater, and water level measurements. The surface water sampling section discusses surface water sampling techniques. The analytical procedure section discusses analytical methodologies to be used during sample analyses.

2.0 GENERAL FIELD PROCEDURES

This section discusses the general field procedures associated with soil, groundwater, and surface water sampling. These procedures include sample designations, sample handling and shipping, investigative derived wastes, surveying, field documentation, in-situ permeability testing, and decontamination.

2.1 SAMPLE DESIGNATIONS

Sample containers will be labeled with the following information prior to collecting each sample: Date and time, sample identification, sampling personnel, preservatives, and analytical parameters. All information pertaining to a particular sample is referenced by the sample identification when it is recorded on the sample bottle, field log book, and on the chain of custody form. The sample identification will be formatted such that the designation contains specific information about the sample matrix, sample location, and depth (for soil samples). This format is discussed in the following sections.

2.1.1 Soil Sample Designations

Soil samples collected for chemical analysis will be identified with the first prefix representing boring type **SB-** (identifies it as a soil boring), followed by a sequential boring location number, then actual sampling depth and finally the sampling matrices (i.e., **S** for soil or **GW** for groundwater). Therefore, a soil sample collected from a depth of 15 feet will be identified as SB-01-15S. A soil sample collected from a depth of 10 feet during monitoring well installation will be identified as MW-01-10S. Soil samples collected at various intervals from a GeoProbe™ will be identified with the boring type **GP-** (identifies it as a GeoProbe™ sample), then actual sampling depth, and finally the sampling matrices (i.e., **S** for soil or **GW** for groundwater). Therefore, a GeoProbe soil sample collected from a depth of 15 feet will be identified as GP-01-15S. Surface soil samples collected from the surface will be identified with the boring type **SS-** (identifies it as a surface soil). Therefore, a surface soil sample collected from the surface will be identified as SS-01.

2.1.2 Groundwater Sample Designation

Groundwater samples collected for chemical analysis will be identified with the first prefix representing sample type **MW-** (identifies it as a monitoring well), followed by a sequential well location number. Therefore, a sample collected from a site monitoring well will be identified as MW-01. Groundwater samples collected at various intervals from a GeoProbe™ will be identified with the boring type **GP-** (identifies it as a GeoProbe™ sample), then actual sampling depth, and finally the sampling matrices (i.e., **S** for soil or **GW** for groundwater). Therefore, a GeoProbe groundwater sample collected taken from a depth of 15 feet will be identified as GP-01-15GW.

2.1.3 Surface Water Sample Designation

Surface water samples will be labeled with the sample type **SW-** (identifies it as a surface water sample). Therefore, a surface water sample collected from a stream will be identified as SW-01.

2.1.4 Quality Assurance and Quality Control Sample Designation

Duplicate samples for QA/QC purposes will be identified by adding the suffix letter **-D** to the identification number of the duplicated sample. Thus, the duplicate sample of MW-01 will be identified as MW-01-D. Other QA/QC samples that may be collected are listed along there suffix labels as follows:

- Equipment blank **-EB**
- Field blank **-FB**
- Split sample **-SPLT**

Trip Blanks will be identified as trip blank on the chain of custody and on the trip blank sample bottles with each shipment. The date of the trip blank shipment will be labeled on the both the trip blank sample bottles and chain of custody to designate the different trip blank shipments.

2.2 SAMPLE HANDLING AND SHIPPING

The *EISOPQAM* (US EPA, 2001) requires that samples collected during field investigations be classified as either environmental or hazardous materials samples. The *EISOPQAM* identifies most groundwater, soil, drinking water, and surface water samples (potential samples types of this investigation) as typical environmental samples provided that the amount of preservative does not exceed amounts defined in 40 CFR 136.3 (4).

The *EISOPQAM* also identifies that drums; bulk storage tanks; and highly contaminated soils, sediment, or water samples as potential hazardous materials and may require shipping as dangerous goods. The site manager will be responsible for determining if samples collected during site activities are dangerous goods materials as defined by Dangerous Goods List, Section 4.2, IATA. If the site manager determines the collected sample or samples to be dangerous goods, then the sample must be identified, packaged, marked, labeled, and shipped according to the handling protocol of that particular dangerous good. In addition, if the site manager suspects that the sample is a potentially dangerous good, but does not know the composition of the collected sample; the sample may not be shipped via air transport.

Samples that are classified as environmental will be shipped using a sturdy cooler in good condition. If the cooler has a drain plug, then the plug must be sealed with fiber or duct tape. Prior to placement of the samples in the cooler, the cooler must be lined with a garbage bag followed by a layer of bubble wrap placed on the bottom of the lined cooler. Sample lids prior to packing should be checked for tightness to reduce the potential for leakage. Sample bottles should be placed in bubble wrap and then sealed in a polyethylene bag for transport. It is necessary to keep samples cooled to a temperature of less than 4^{o}C; therefore, ice will be “double bagged” in heavy duty pothyethylene bags and subsequently placed on top of or between sample bottles to be shipped. Once placement of the samples and bagged ice in the cooler has been completed, the garbage bag being used as a liner will be sealed with tape. The Chain-of-Custody (COC) form will be placed in a plastic polyethylene bag and taped to the inner side of the cooler lid.

COC forms will be completed and signed by a member of the sampling team before the samples are relinquished for shipment. The samplers will sign and date the COC. The air bill number will also be recorded on the COC. If a bonded courier is utilized, the shipping documents from the bonded courier will be used in lieu of a signature on the COC while the shipping company holds custody.

Once the COC is in place inside the cooler, the cooler is shut securely and wrapped in tape such that the cooler cannot be opened without cutting the tape. Two custody seals or custody seal tape will be affixed to the outside of each cooler when the samples are to be shipped by a bonded shipping company. Each seal will be placed over the cooler seam, signed, and dated. Clear packing tape will be placed over the seal and around the cooler to reduce the potential for accidental tearing.

Preferably, environmental samples will be shipped using a overnight shipping company. All shipping bills will be saved and will become part of the COC documentation. All shipping bills and copies of COC forms will be made a part of the project file.

2.3 INVESTIGATIVE DERIVED WASTE

The *EISOPQAM* identifies the following types of investigative derive waste (IDW):

- Personnel protective equipment (PPE) -- This includes disposable coveralls, gloves, booties, respirator canisters, splash suits, etc.
- Disposable equipment -- This includes plastic ground and equipment covers, aluminum foil, conduit pipe, composite liquid waste samplers (COLIWASAs), Teflon® tubing, broken or unused sample containers, sample container boxes, tape, etc.
- Soil cuttings from drilling or hand augering.
- Drilling mud or water used for rotary drilling.
- Ground water obtained through well development or well purging.
- Cleaning fluids such as spent solvents and washwater.
- Packing and shipping materials.

Because the Memorial Drive Site is associated with the Georgia EPD Underground Storage Tank Management Program, the IDW will be profiled as petroleum contaminated waste. According to Georgia EPD, soil contaminated from regulated UST containing petroleum products is deferred from regulation under the Hazardous Waste Management Act and may be disposed of in a Municipal Solid Waste Landfill or Soil Treatment Facility. The IDW soil generated from the site will be profiled using benzene, toluene, ethylbenzene and xylenes (BTEX) and TCLP analytical data collected during the investigation and a permit request will be submitted to the Superior Landfill located in Savannah, Georgia. If a disposal permit cannot be obtained from either this landfill or other nearby landfills, then a disposal option of taking the soil to a recovered materials processing facility such as one of the following will be considered:

- Chattahoochee Brick
- Good Earth Recycling
- SRTI

During the site investigation, all soil and groundwater collected during investigative activities will be stock piled on site and containerized. PPE (i.e., gloves, booties, and Tyvex™) will be stored in separate waste containers and disposed of in approved dumpsters.

To dispose of IDW groundwater generated at the site, a one time discharge permit request will be made at a nearby wastewater treatment facility. If a one time discharge permit cannot be obtained from a nearby waste treatment facility, then the IDW groundwater will be taken to one of the recovered materials processing facilities.

If analyses for part of or all the soil and/or groundwater IDW indicate no detections, then it may be feasible to reintroduce the clean soil back to the area where the soil was collected and reintroduce the groundwater near the potential source area.

2.4 SURVEY REQUIREMENTS

A registered land surveyor will survey all monitoring wells, soil boring, surface water samples, GeoProbe™ borings and other important features at the completion of all site activities for mapping purposes. Surface elevations at each location will be determined to the nearest 0.01 foot. Elevations will be referenced to the North American Datum (NAD) 83. Horizontal locations will be determined to the nearest 0.1 foot and referenced to the Georgia state plane. Elevations at the top of well casings (top rim of riser pipe) will also be determined for all installed wells. The survey data will be used to complete a location map of the site. A list of the sampling locations, borings, and wells will be prepared and submitted as part of the CAP to be submitted to Georgia EPD.

2.5 FIELD DOCUMENTATION

Logbooks will be maintained by the site manager and potentially task managers assisting the site manager. Field logbooks will be dated and numbered sequentially from cover to cover, and notations of the time of day will be made at intervals appropriate to the activities being performed. Notations in field logbooks will include general field conditions, activities performed, locations of work performed, sample identifications, sample locations, monitoring well construction diagrams, boring information, decontamination procedures (if applicable), instrument calibration parameters, and instrument readings.

Entries in the logbooks will be printed in black ink. Corrections will be made by drawing a single line through the entry and initialing and dating the revision. Pages left blank in the logbook will be marked "intentionally blank." The individual responsible for documenting the day's field activities will sign the bottom of the page at the end of the day. If documentation duties are shared, then both team members shall sign the bottom of the page at the end of the day.

When recording the day's field activities, the day, date, and time the activities began; weather conditions; the activity performed; the location of the activity; and the names of personnel performing specific tasks will be entered. Names of personnel visiting the areas of the activity, and the times and duration of those visits will be recorded.

Field conditions that may affect the activity performed or the data collected during the activity will be noted in the logbooks. This includes unexpected and adverse weather conditions or events that may inhibit site activities or site personnel's ability to collect quality data. Examples of poor conditions include accidents, weather, equipment problems, and damaged wells.

2.6 IN-SITU PERMEABILITY TESTS

In-situ permeability tests (slug tests) require an instantaneous change in water head in the well by means such as displacement with a slug and measuring the well response while it approaches equilibrium. Data generated from the slug test are used to determine the hydraulic conductivity of the formation materials near the well. Slug tests will not be performed until the construction of a well is completed and the well has been developed.

The following equipment may be needed for slug testing.

- Water lever measuring equipment
  - Water level measuring tape
  - Transducer and data logger or Insitu Level Head™ (optional)

- Slug Equipment
  - Solid mechanical slug (of known volume) and nylon rope
  - Water slug
  - Bailer

Note: a variety of apparatus may be used for a slug and not all types of slugs are listed.

Procedure

1. Enter all pertinent data concerning the well on the appropriate field form (Appendix A) and/or logbook.
2. Measure the depth to water below the measuring point to an accuracy of 0.01 feet. Document the depth to water (DTW) on appropriate field forms and/or logbook.
3. Measure the total depth of the test well (sounding depth) from the top of casing to an accuracy of 0.1 feet. Document the sounding depth on appropriate field forms and/or field logbook. Compare sounding depth to as-built total depth to assure that siltation of the well has not occurred.
4. When using a transducer and data logger in the test, the transducer should be set at a sufficient depth below the water level so as not to be disturbed by the mechanical slug, but it should be no closer than 6-inches from bottom of the test well.
5. Check that all equipment is functioning properly before starting the test.
6. Cause an instantaneous change in water level by either lowering a solid slug into the water column or retrieving a fully immersed slug after the water level has equilibrated. Lowering the slug performs a falling head test and withdrawing the slug performs a rising head test.
7. Record water level response. For falling head or rising head tests, the maximum displacement should be recorded at time zero and measurements should be taken at frequent intervals until the water level has recovered to 60 to 80%. The frequency of the water level measurements is dependent on how quickly the water level recovers. A typical frequency may be every 5 to 10 seconds for the first minutes followed by 15 second intervals for the second minute, 30 second intervals for 3 to 10 minutes and every minute thereafter. Time should be recorded in seconds elapsed, minutes elapsed, or clock time. Water level measurements should be recorded in feet below top of measuring point or as displacement in feet.

8. Review the data before leaving the site to assure that the test has been conducted properly, data are properly recorded and legible, and all criteria are met.

Subsequent to collection of monitoring slug test data, the data will be evaluated and analyzed utilizing AQTESOLV 3.2 for Windows, or a similar computer program. This data will be subsequently included and summarized in the submittal for Georgia EPD.

2.7 DECONTAMINATION

All downhole drill tools, the drill rig, downhole measuring equipment, bailers, and pumps will be decontaminated upon mobilization to the site and between each borehole or monitoring well thereafter. Decontamination of the pertinent sampling equipment will be performed between each sampling event.

Decontamination will be performed in an area of the site away from the highest levels of contamination. The drill rig and tools will be steam cleaned with a steam cleaner and/or high-pressure hot water washer capable of generating at least 2500 PSI and producing greater than 200^{o} F hot water or steam. Persistent dirt and other foreign material will be removed with a scrub brush.

Reusable sampling equipment and monitoring equipment, including bailers, hand auger equipment, slug test equipment, pumps and lines, will be decontaminated upon mobilization to the site and between each borehole or monitoring well thereafter by using the following decontamination procedure:

- Rinse with tap water
- Wash with laboratory soap solution (Liquinox)
- Rinse with distilled water
- Rinse with isopropyl alcohol
- Triple rinse with distilled water
- Air dry and wrap with aluminum foil.

Sampling personnel will avoid contacting bailers or pumps with the surrounding soils or unprotected hands. All bailers or pumps which have contacted any soil, unprotected hands, or anything which may contaminate the equipment will be decontaminated according to the above procedures.

Probes serving analytical instruments used in the field (e.g., pH, specific conductance meters) will be rinsed with distilled water prior to each use. The electric water level probe will be cleaned with laboratory grade soap, isopropanol, and triple rinsed with distilled water between wells.

Sample containers will be cleaned prior to delivery to the field by the laboratory. For safety reasons and to minimize contamination, preservatives shall be added to the sample bottles prior to delivery to the site.

Sampling personnel will don new, laboratory quality disposable gloves prior to sampling. These gloves will be replaced, as necessary, during the well evacuation and sampling procedure and will always be changed between wells.

3.0 SOIL SAMPLING PROCEDURES

Methods for determining the nature and extent of petroleum impact in soil may entail soil sampling techniques such as hand auger, GeoProbe™, and/or drill rig split-spoon sampling techniques. During soil sampling activities, samples collected for BTEX/VOC analyses will be collected in the field using Method 5035 field preservation techniques.

3.1 HAND AUGER SOIL SAMPLING

Hand augers may be used when collecting soil samples at shallow depths. These samples may be collected when probing for utilities prior to drilling with a GeoProbe™ or drill rig. In addition, hand augers may be used to sample in areas along stream banks that may be inaccessible to drilling equipment. Hand augers typically consist of a 4-inch auger bucket and 3-foot extensions that are added on as the depth of the boring increases. Hand auger bucket holes are advanced one bucket at a time by pushing and twisting the hand auger bucket in the ground. Hand auger buckets will be constructed of stainless steel material free of paint, scale, or heavy rust. The hand auger extensions will be constructed of stainless steel or zinc since the extensions do not come into direct contact with the samples. Hand auger equipment will be decontaminated with methods described in Section 2.7. Soil samples collected for BTEX/VOC analyses will be collected using Method 5035, which is discussed in Section 3.4.

3.2 GEOPROBE™ SOIL SAMPLING

Some soil sampling may be completed using a GeoProbe™ 5400 truck-mounted rig, a GeoProbe™ 66DT track-mounted rig, or similar device. Soil samples will be collected at discreet intervals using a piston operated sampling tube fitted with plastic sampling sleeves that range between 2 and 5 feet in length.

Prior to initiating sampling, the sample tube is pushed to the desired depth and the piston in the sampling tube is unlatched. The sampler is subsequently pushed and the piston allows the sampling tube to fill up with soil. After the tube is completely filled, the sampler is retrieved and the soil is removed from the sampling tube for logging, headspace analyses, and sample retention.

The collected samples will be logged by an on-site geologist or engineer to determine the geologic or hydrogeologic conditions underlying the site. This information will be recorded on subsurface drill log forms presented in Appendix A.

Headspace analyses will be on completed during soil sampling by inserting the probe of a photoionization detector (PID) (i.e., Photovac 2020 or similar instrument) into a plastic bag containing the soil sample and then monitoring the soil for organic vapors and logging data on the subsurface drill log form included in Appendix A. The sample interval vapor concentration will be utilized in determine the samples to be submitted for laboratory analytical work. Soil samples collected for BTEX and other VOCc will be collected using USEPA Method 5035 sampling method for field preservation.

GeoProbe™ soil sampling equipment will be decontaminated utilizing the protocol presented in Section 2.7.

3.3 SPLIT SPOON SOIL SAMPLING FROM DRILL RIGS

Soil samples will be collected during the monitoring well installation by drilling with a CME, or similar, drill rig and 4 ¼ inch inside-diameter (ID) hollow stem augers (HSA). During drilling, a split-spoon sampling device will be used to collect samples at 5-foot intervals. After achieving the desired sample depth, the sample will be collected by lowering a two foot split-spoon to the sample interval depth and driving the tool into the subsurface with a 140-pound hammer. The collected samples will be logged by an on-site geologist or engineer to determine the geologic or hydrogeologic conditions underlying the site. This information will be included on the subsurface drill log form presented in Appendix A.

A portion of the sample from each sampling interval also will be placed into a resealable plastic bag so the field geologist could screen the headspace above the sample for the presence of volatile organic compounds (VOCs) with a photoionization detector (PID). The results of the headspace screening will be recorded on the subsurface drill log form included in Appendix A and used in determining which samples from a given boring location will be retained and forwarded to the laboratory for analysis.

Soil samples collected for BTEX/VOCs will be collected using USEPA Method 5035 for field preservation. The procedures of this method are discussed in the following section.

3.4 METHOD 5035 SOIL SAMPLE PRESERVATION

Method 5035 field preservation kits will be used when collecting soil samples to be analyzed for BTEX and other VOCs and includes the following equipment:

- A syringe capable of collecting 5 grams (3.7 cc) of soil for analyses
- Two pre-weighed 40 ml vials containing 10 milliliters (ml) of organic free water and a preservative
- One pre-weighed 40 ml vial containing 10 milliliters of methanol.

Method 5035 soil samples will be collected by pulling 5 grams of soil from the sample medium and immediately injecting the soil from the syringe into one of the 40 ml pre-weighed vials, repeating this process for the remaining two 40 ml vials of the sampling kit for each soil sample. One of the 40 ml vials will contain methanol and 2 of the 40 ml vials will contain Sodium bisulfate. An additional 2 to 4 ounce jar of soil will be collected for each soil sample to determine moisture content and will benefit the laboratory in analyzing the sample for either high or low range concentrations. BTEX/VOC samples may also be collected using 5 gram Encore™ samplers; however, these samplers have a holding time of 48 hours. Thus, an overnight shipping company must be available in the area to ship samples daily.

4.0 GROUNDWATER SAMPLING PROCEDURES

Groundwater sampling at the site will be achieved by the installation and sampling of permanent monitoring wells. Groundwater sampling may also utilize GeoProbe™ sampling techniques if a CAP Part B site investigation requires additional plume delineation. GeoProbe™ sampling techniques are beneficial in further defining plume boundaries and locating permanent monitoring wells along the plume fringe. However, Georgia EPD generally recognizes groundwater data collected from GeoProbe™ borings as only screening data and currently only accepts monitoring well data as definitive data in plume definition. This section describes the installation, development, and sampling of monitoring wells and the sampling techniques utilized during groundwater GeoProbe™ sampling. Procedures presented in this section are based on *EISOPQAM* and EPA Region IV methods.

4.1 MONITORING WELL INSTALLATION

Initial groundwater sampling at the site will require installation and development of permanent monitoring wells, as the previous assessment utilized temporary monitoring wells. Methodologies for monitoring well installation and development, water level measurements, and groundwater sampling are presented in the following sections. Procedures presented in this section are based on *EISOPQAM* and EPA Region IV methods.

4.1.1 Installation and Design of Monitoring Wells

Initial monitoring wells will be installed using hollow stem auger drilling methods.

Monitoring well installation objectives are to:

- Install monitoring wells that will provide high quality and representative groundwater samples;
- Install properly constructed monitoring wells that will last the duration of the project; and
- Install monitoring wells that will not serve as a conduit for surface contaminants, and will prevent the migration of contaminants between aquifers.

Decontamination of materials, drilling tools, and equipment will be conducted in accordance with the procedures detailed in Section 2.7.

Drilling Methods

The City of Hinesville Brownfields Cleanup Site is located in the Coastal Plain Physiographic Province (Coastal Plain) in Georgia. The typical drilling technique used in this province includes hollow stem auger drilling. Formation matrices in the Coastal Plain generally consist of Quaternary deposits consisting of sand and sandy clays. HSAs are the preferred method of drilling in the sedimentary deposits, and this drilling method is discussed below.

Hollow Stem Auger

4-¼ inch ID (8 inches OD) or 8-¼ inch HSA drilling methods will be used to install the monitoring wells into soil or overburden water bearing zones underlying the site. The wells will be installed inside of the HSAs to prevent caving from the soil formations during placement of well materials.

Since the augers are hollow, augering without a center plug in the lead bottom auger may require removal of a soil plug at the bottom of the augers. Removing this plug can be accomplished by washing out the plug with a side discharge rotary bit. Typical rigs used in HSA drilling include a CME-55 truck-mounted rotary drilling rig or a GeoProbe™ 66DT track-mounted rig. During HSA drilling activities, split spoon sampling will be accomplished at 5-foot centers for soil sampling purposes and is discussed in Section 3.3.

6-1/4 inch (10 inches ID) HSA drilling methods may be required if monitoring wells have to be installed into weathered or competent rock. These augers will serve as temporary casings for a 6-inch air hammer bit for drilling into rock. Monitoring wells installed into rock below a highly contaminated zone may require a permanent casing for sealing off the contaminant zone.

Once augering has been completed to the well's proposed total depth, the well material should be lowered inside the augers and the augers should be removed only during sand pack placement during well construction. During well construction, depths and borehole diameters will be recorded in the field notebook.

Well Construction Methods

This section discusses the placement of materials during well construction activities. During the placement of materials, the annular space between well material and the borehole should be 2 inches in diameter. In addition, the annular space should large enough to allow for the insertion of tremie pipe to be passed through the annular space of the borehole. The material placement will entail well material placement, filter pack material placement, bentonite seal material placement, well grouting, and surface pad completion. The Earth Tech field geologist will log the boring during drilling activities and document the well construction on the Well Construction Summary form that is included in Appendix A and in a field notebook.

Well Materials Placement

The string of well screen and riser/casing will be placed into the borehole and visually plumbed. The well screens and casing material will be constructed of 2-inch diameter, flush-thread, and schedule 40 PVC pipe. The well screen will be constructed with a 0.010-inch factory slot, well screen. Screen intervals constructed in deep wells below the water table will be 5 feet in length. The screen will be constructed as determined by the field geologist at the time of well installation.

Centralizers were not required due to the shallow depth of the borings and will not be considered in wells less than 50 feet in depth.

Filter Pack Placement

Before placing the filter pack into the borehole, approximately 6-inches of the filter pack material will be placed under the bottom of the well screen to provide a firm footing and an unrestricted flow under the screened area. The filter pack typically will be extended a minimum of 2-feet above the top of the well screen. The filter pack during installation will be placed into the annular space between the well screen/casing and borehole wall using tremie methods. The filter pack will be tremied slowly into the annular space to prevent bridging. In addition, the hollow stem augers will be removed slowly as the filter pack is placed to prevent "bridging."

During filter pack installation, the top of the sand will be measured with a weighted tape measure to ensure that bridging did not occur and to install the filter pack to the desired interval.

Bentonite Seal Placement

A two-foot thick bentonite seal will be placed on top of the filter pack. This seal consists of a 30% solids bentonite pellet. The top of the bentonite seal will be measured with a weighted tape measure to determine that the pellets are placed at the proper interval. The bentonite seal will be constructed with a minimum thickness of 2 feet above the filter pack. The depth of the bentonite interval will be documented in the field notebook.

Well Grouting

Subsequent to bentonite seal placement, the annular space will be tremie grouted from the top of the bentonite seal to the within 2 feet of ground surface with a grout mixture that is 7 gallons of water per 94 pound bag of Type 1 portland cement, with approximately 3 to 5 percent bentonite added to the mixture. The well grout will be allowed to cure a minimum of 24 hours before the concrete surface pad can be installed. Initially, the well was grouted to within 2 feet of the ground surface. If the grout settles for more than 1-foot, the annular space grout will be topped off before well completion.

Concrete Surface Pad

Subsequent to allowing the well grout to cure for 24 hours, a carbon steel flush mounted well vault will be installed by pouring 2 feet of wet concrete around the remaining annual space of the well borehole. Subsequently, the flush mounted vault will be pushed into concrete until the top vault sticks up approximately 1 inch above the ground surface. A concrete pad will be installed around the wells by placing a pad form around the borehole with the vault placed in the center of the pad form. The concrete pad will be constructed approximately 3 feet square by 6-inches thick. The finished pad will be sloped so that drainage will occur away from the well and off the pad. In addition, a minimum of 1-inch of the finished pad will be below grade to prevent washing and undermining of the pad.

4.1.2 Monitoring Well Development

Well development will only begin after allowing the concrete of the newly installed surface pad to cure for 24 hours. The purpose of well development is to remove residual fines remaining in wells after well installation was completed and to establish natural flow conditions in the well that may have been disturbed during well construction. Wells at the site will be developed with one or a combination of the following techniques:

- Pumping and overpumping
- Surging
- Bailers.

Well development at the site will generally consist of a combination of surging and pumping to remove fines from the well. The development pump that is down the well will be surged suspending the residual fines in the well and filter pack. Subsequently, pumping will begin while the fines are suspended in the water column. A bailer will be used, if necessary, to remove the fines if they are too thick to remove with a submersible pump. Bailing will continue until an adequate amount of fines have been removed that will allow use of a submersible pump to resume. Typically, suspended fines during development tend settle if periodic surging is not continued. Therefore, downhole pumps should be periodically surged to keep fines in the well suspended in the water column. During development, pH, specific conductance, temperature, and turbidity will be monitored and documented in the field notebook and field forms included in Appendix A. Development will be continued until the water column has become visibly free of sediment and the indicator parameters pH, specific conductance, temperature, and turbidity have stabilized.

Since wells with low recharge may be pumped dry if a submersible pump is used for development, a bailer may be used for surging and removing groundwater. Low recharge wells will be surged and bailed until the well is purged dry. Subsequently, the well will be allowed to recharge before the next development period is initiated. Once the well has recharged, the well will be surged and bailed until the well has purged dry. During this process, pH, specific conductance, temperature, and turbidity will be monitored from the purged groundwater. The development periods will continue until the well is visibly free of sediment and the indicator parameters have stabilized. Upon development completion on a well, the well should be allowed to stabilize 24 hours before groundwater sampling begins.

4.1.3 Water Level Measurements

Groundwater levels will be measured in wells to be sampled. The water levels will be measured from the mark on the top of the well to the nearest 0.01 foot. If there is not a mark on the well casing, a mark will be placed on the casing on the side of the well casing nearest the lock hasp, or if there is not a lock hasp (i.e., flush-mount well), on the north side of the casing. Measurements will be recorded in the field logbook. If a well is not accessible, damaged, or covered, it will be documented in the field notebook.

4.1.4 Monitoring Well Purging and Groundwater Sampling Procedures

All monitoring wells will be purged before sampling. According to the *EISOPQAM*, purging is the process of removing stagnant water from a monitoring well prior to sampling, causing recharge to occur from the adjacent formation.

A clean sheet of plastic will be placed on the ground around the well prior to purging or sampling. Sampling team members will change gloves after purging and before sampling and at any other time when there is potential contaminated gloves being worn. Before initiating groundwater purging, the volume of standing water inside the well casing needs to be calculated. This volume can be calculated using the following equation:

$$V=0.041d^2h$$

Where: h=water column in casing in feet
d=diameter of well in inches
V=volume of water in gallons.

To calculate the water column, collect a groundwater measurement prior to sampling and review documentation for the recorded total depth. The total depth can be validated by remeasuring the depth of the well. The water column height can be determined by subtracting the measured water level depth from the total depth. The well diameter can be found in field documentation.

Purging and sampling will be completed using on or a combination of the following purging techniques:

- Polyethylene or Teflon™ bailers
- Peristaltic pumps using Teflon™ or polyethylene tubing
- Grundfos™ submersible pumps.

All reusable equipment will be deconned using protocol detailed in Section 2.7.

For most wells, purging will be considered complete after a minimum of three, and no more than five, well casing volumes have been evacuated and the aforementioned parameters have stabilized within 10 percent on two consecutive readings. Additional care should be taken to reduce turbidity to levels at or lower than the previous data provided on the purge forms. Field monitoring parameters, purged volume, depth to water, and time will be recorded for the initial discharge and after each successive well volume is evacuated. Water temperature, pH, turbidity, and specific conductance will be monitored during purging. Well purging and monitoring data will be recorded on the Well Purging & Sample Collection form included in Appendix A.

If a monitoring well is purged dry prior to purging the minimum of three volumes due to a low recharge rate, purging will be considered complete. Every effort will be made to sustain a yield from all low flow wells during purging, rather than purging wells dry at higher pumping rates. Sampling will be performed after the water level in the well has recovered to provide an adequate volume of water to fill the required sample bottles. If the water level is slow to recover in the well, the sampling team will monitor the rate of recovery until an approximate recovery rate can be determined. Using the estimated recovery rate, the sampling team will periodically check the well and perform sampling of the well when the volume of water in the well casing is adequate to fill the required sample bottles. It will be the responsibility of the field sampling team leader to ensure that a well which has purged dry is sampled at the earliest possible opportunity following recovery of an adequate volume of water to fill the sample bottles. Field monitoring parameters will be measured and recorded at least once prior to sampling wells which have purged dry.

Groundwater samples collected from the monitoring wells will be analyzed for BTEX/VOCs (Method SW-846 8260B) and polynuclear aromatic compounds (PAHs) (Method SW-846 8270C). Samples will immediately be placed in a cooler with ice for sample preservation purposes. Containers for collected samples will be labeled with the following information: Date and time, sample identification, sampling personnel, preservatives, and analytical parameters. All information pertaining to a particular sample is referenced by the sample identification when it is recorded on the sample bottle, field log book, and on the chain of custody form.

4.2 GEOPROBE™ GROUNDWATER SAMPLING PROCEDURES

GeoProbe™ groundwater sampling may be utilized if Georgia EPD requires a Part B CAP for the site. GeoProbe™ groundwater sampling will be used as a screening tool for defining the groundwater plume fringe and minimize unnecessary monitoring well installation by identifying suitable locations for wells downgradient of the plume. The objective of the GeoProbe™ groundwater sampling is to evaluate the horizontal and vertical extents of the petroleum hydrocarbon contamination in groundwater. During GeoProbe™ groundwater sampling, the field geologist will document the sample collection in a field notebook. GeoProbe™ groundwater samples will be collected approximately 5 feet below the groundwater surface, and samples will be collected through the GeoProbe™ rods using small-diameter, stainless steel bailers.

Before initiating GeoProbe™ installation, the following items will be completed:

- Each location will be field checked for accessibility
- All proposed sampling locations will be staked or marked
- Utility clearance will be completed on each location.

Groundwater samples will be collected using a GeoProbe™ screen-point sampler. The screen-point groundwater sampler consists of a screen encased in a stainless steel sleeve. The screen section remains enclosed in a sheath until it is pushed out into the formation at the desired depth. Groundwater samples will be collected approximately 5 feet below the groundwater surface. To minimize disturbance to the water column, the GeoProbe™groundwater samples will be collected using a peristaltic pump and/or small-diameter, stainless steel bailers, as described below:

- Attach and secure the flexible tubing and the polyethylene tubing to the pump.
- The tubing will be lowered SLOWLY into the well to the appropriate depth.
- Start the pump and set at the lowest pumping rate that will maintain a constant flow being careful to avoid surging. Precautions will be taken to avoid pump suction loss or air entrainment.
- Reduce the pumping rate, if needed, to avoid pumping the well dry.
- If practical, allow the well to purge before sampling. The duration of the purge will depend on aquifer conditions and will be determined by the field geologist.
- After purging, samples will be collected directly into pre-preserved sample containers. Volatile organic compound (VOC) samples will be collected first followed in polynuclear aromatic hydrocarbons (PAHs).
- Sample containers will be filled by allowing the pump discharge to flow gently down the inside of the container with minimal turbulence.
- After sample collection, dispose of the pump tubing and secure the well.

The samples will be labeled and placed into a cooler on ice and logged onto the chain-of-custody form. Groundwater sampling will be documented in the field logbook for each sampling location including, at a minimum, sampling ID, a descriptive site location, sample time, sample analytes, number of bottles collected, problems encountered during sample collection, and any modifications to the sampling procedures, with justification. Field equipment will be decontaminated in accordance with the procedures provided in Section 2.7 and will be decontaminated between each GeoProbe™ location. Disposable equipment will be discarded after one use.

5.0 SURFACEWATER SAMPLING PROCEDURES

Surface water sampling may be conducted if a surface water receptor is identified during the CAP Part A to be downgradient of the site and/or within 500 feet of the plume fringe. Surface water samples will be collected by dipping the Method 8270C PAH container into the stream using the sample container to fill the Method 8260B 40ml BTEX/VOC vials and subsequently filling the PAH containers. During sample collection, the sampler should face upstream to collect the sample and avoid inducing turbidity by disturbing the stream bottom. Samples will immediately be placed in a cooler with ice for sample preservation purposes. Containers for collected samples will be labeled with the following information: Date and time, sample identification, sampling personnel, preservatives, and analytical parameters. All information pertaining to a particular sample is referenced by the sample identification when it is recorded on the sample bottle, field log book, and on the chain-of-custody form.

6.0 ANALYTICAL PROCEDURES

Georgia EPD analytical requirements are based on the type of substance stored in the UST. Since the information on the site is somewhat dated, and the USTs were to store gasoline and there may have been dieselor waste oil storage on site, Table 1 details the type of analyses to be completed during investigative activities. Because groundwater impact is known to have occurred based on results of previous assessment, soil analyses for total petroleum hydrocarbons during soil characterization activities will not be necessary. In addition, a full VOC (Method 8260B) analysis also is warranted, as a previous assessment revealed the presence of chlorinated solvents in groundwater samples, and there are two dry cleaning establishments in the vicinity of the Site,

Table1

Laboratory Methods and Quantitative Limits for Soil and Groundwater Sampling

UST Substance	Constituent	Analytical Method	Matrix	Estimated Quantitation Limits
Gasoline	BTEX	8260B	Soil	5 ug/kg
	BTEX/VOCs	8260B	Groundwater	5 ug/L
Diesel	PAH	8270C	Soil	660 ug/L
	PAH	8270C	Groundwater	10 ug/L

All analyses for samples collected during site investigation activities will be performed by a qualified laboratory, using EPA-approved SW-846 methods (Test Methods for Evaluating Solid Waste, EPA, Office of Solid Waste and Emergency Response, SW-846, Third Edition, as revised). Laboratories must meet the estimated quantitative (detection) limits required by SW846 or provide a brief explanation of elevated levels. In addition, if interfering constituents are present, then the laboratory must include a tentative identification and estimated quantification must be reported.

Laboratory QA/QC begins with the receipt of samples from the field. The laboratory will follow proper procedures for sample handling, chain of custody, sample preparation, use of quality control samples, instrument calibration, sample analysis, laboratory validation, reporting documentation, and record keeping. A summary of the groundwater sample analytical methods, holding times, sample preservation, and sample volume for each of the required laboratory methods is presented as Table 2. Holding times recommended by the EPA are not to be exceeded. A detailed laboratory quality assurance plan is presented under a separate cover and is kept on file. Submittals will be made in both hard copy and electronic data delivery (EDD) form. In addition, the laboratory is required to fully document the QA/QC process. This includes such items as sample log-in procedures, internal chain-of-custody, instrument logs, and raw data.

Table 2

Sample Containers, Preservation Techniques, and Holding Times for Sampling

Sample Parameter	Container	Preservation Technique	Maximum Holding Time	Minimum Volume (mL)
BTEX Soil	3x40ml pre-preserved vials plus 125-ml bulk or 3 5g encores plus 125 ml bulk	2-5% sodium bisulfate vials 1-5% methanol vial	14 days or 48 hours if using Encore sample kits	3x40ml pre-preserved vials plus 125-ml bulk or 3 5g encores plus 125 ml bulk
PAH Soil	250 or 500 ml	None	14 days	30 g
BTEX/VOC Groundwater	3-40ml vials glass	0.3 1:1 HCL	14 days	40 ml
PAH Groundwater	2x1 amber L	None	14 days	1 L

7.0 QUALITY CONTROL (QC) SAMPLING PROCEDURES

Quality control (QC) samples will include trip blanks, field blanks, equipment blanks, and duplicates. Duplicates and equipment blanks will be collected at a rate of 5% of the total sample volume. Field blanks will be collected at a rate of approximately 2% of the total sample volume. A trip blank will be submitted with every shipment to the laboratory that includes VOCs.

QC samples are defined as follows:

Trip Blank - This is a QC sample that is prepared in the laboratory and will be analyzed for VOCs only. It is used to test for cross-contamination of the samples in the sample storage and shipping environment. The trip blank is never opened in the field. One trip blank will accompany volatile organic samples shipped to the laboratory in a single cooler which contains all of the volatile organic samples collected that day.

Equipment Rinsate Blank - This is a QC sample, which is made in the field from laboratory-supplied organic free water, which has come in contact with the sampling equipment (Grundfos™ pump) after the equipment has been used and then decontaminated. This sample is used to test for adequacy of decontamination practices and the presence of contaminants in the sampling equipment. The VOC sample will be collected by running deionized water across the equipment and filling the VOC vials from the bottom of a sampling device.

Field Blank - This is a QC sample that is made in the field from source water used for decontamination. It is used to test potable tap water, deionized source water, and laboratory supplied organic free water for contamination. One field blank will be collected from the water source used for decontamination.

Field Duplicate - This is a sample taken in duplicate with a normal sample and given a field duplicate designation to check sample collection replication. Duplicates will be collected at a rate of one for every 20 samples collected.

8.0 REFERENCES

Georgia Environmental Protection Division, 1996, Rules of Georgia Department of Natural Resources, Environmental Protection Division, Chapter 391-3-15, Underground Storage Tank Management.

Georgia Environmental Protection Division, 1995, *Petroleum Contaminated Soil Disposal/Treatment Guidance Document.*

Georgia Environmental Protection Division, 1995, *Underground Storage Tank Release: Corrective Action Plan (CAP) Part A.*

Georgia Environmental Protection Division, 1995, *Underground Storage Tank Release: Corrective Action Plan (CAP) Part B.*

United States Environmental Protection Agency, 2001, *Environmental Investigations Standard Operating Procedures and Quality Assurance Manual.*

APPENDIX A

FIELD FORMS